2011 ENGINE

2.8L Diesel - Service Information - Wrangler

DESCRIPTION

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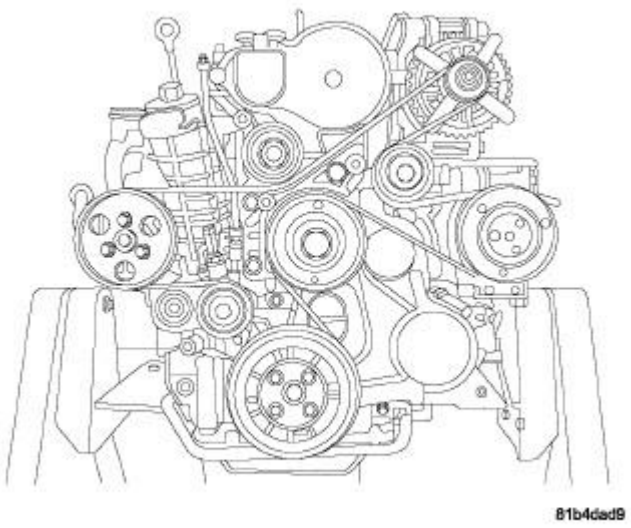

Fig. 1: 2.8L Engine
Courtesy of CHRYSLER GROUP, LLC

The 2.8L (2777cc) four-cylinder "common rail" direct injection engine is an in-line overhead valve design. The engine utilize a cast iron cylinder block. The engine has a one piece aluminum cylinder head with four valves per cylinder and dual overhead cam shafts. The 2.8L is turbocharged, intercooled and also equipped with a EGR cooler.

The identification stamp for the 2.8L is located on the left side of the engine block, above the starter. The engine code label is located on the front timing cover and is the same as the engine I.D. and serial number. There is also a fuel system label on the front timing cover used for fuel system identification during ECM programming.

STANDARD PROCEDURE

DUST COVERS AND CAPS

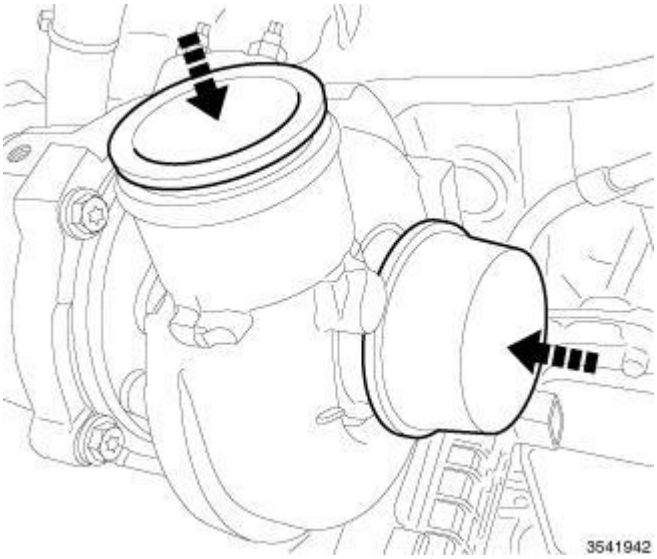

Fig. 2: Covers/Caps
Courtesy of CHRYSLER GROUP, LLC

Due to the high amounts of failures cased by dust, dirt, moisture and other foreign debris being introduced to the engine during service. Covers or caps are needed to reduce the possible damage that can be caused or created.

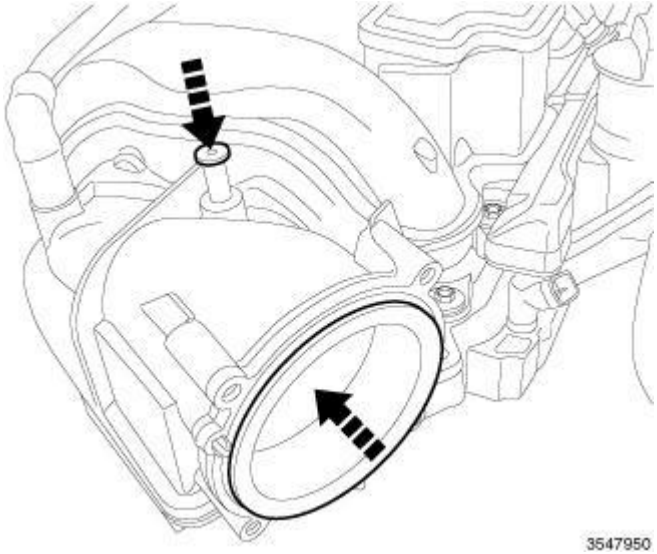

Fig. 3: Opening Cover
Courtesy of CHRYSLER GROUP, LLC

Covers over openings will reduce any possibilities for foreign materials to enter the engine systems. Using miller tool (special tool #10368, Set, Universal Protective Cap), Select the appropriated cover needed to the procedure.

ENGINE GASKET SURFACE PREPARATION

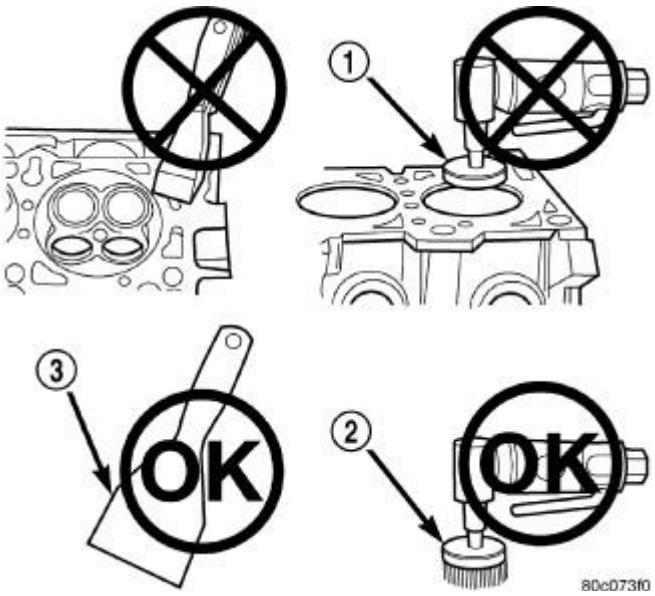

Fig. 4: Proper Tool Usage For Surface Preparation
Courtesy of CHRYSLER GROUP, LLC

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

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 (1), 3M Roloc™ Bristle Disc (2), or a wire brush (3)

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

Only use the following for cleaning gasket surfaces:

- Solvent or a commercially available gasket remover
- Plastic scraper
- Sealing surfaces must be free of grease or oil residue. Clean surfaces with Mopar® brake parts cleaner (or equivalent)

COMPRESSION TEST

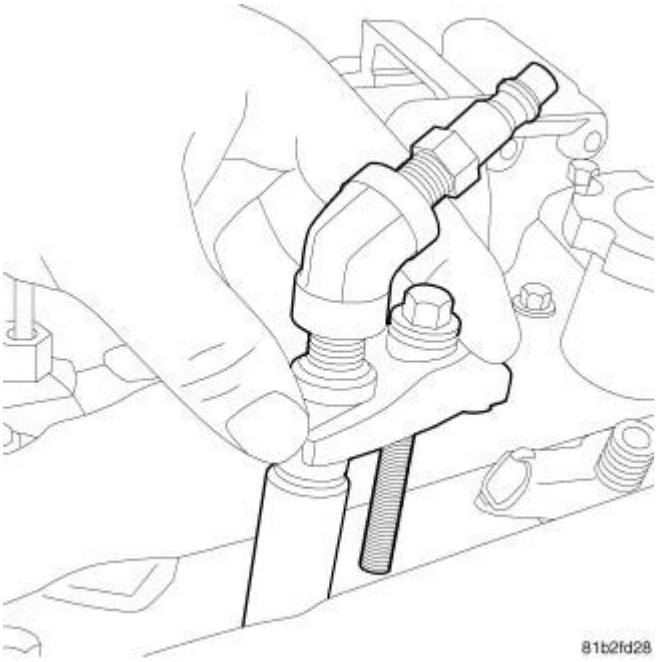

Fig. 5: Compression Tester
Courtesy of CHRYSLER GROUP, LLC

1. Warm up engine to operating temperature (approximately 80 °C, 176 °F).
2. Shut off the engine.
3. Disable the low pressure fuel pump.
4. Remove the fuel injectors. Refer to **INJECTOR(S), FUEL, REMOVAL** .
5. Crank engine several times with the starter to eliminate combustion residues in the cylinders.
6. Insert the (special tool #VM.10010, Adapter, Compression Test) into injector hole of cylinder to be tested. Install injector retainer bolts and tighten.
7. Test compression pressure by cranking engine with starter for at least 8 revolutions.

Cylinder compression Difference Between Cylinders	**10 Bar (145 psi)**

8. Carry out test procedure at the remaining cylinders in the same way.
9. Remove the (special tool #VM.10010, Adapter, Compression Test) from cylinder head.
10. Install injectors. Refer to **INJECTOR(S), FUEL, INSTALLATION** .

SPECIFICATIONS

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2.8L Engine Specifications	
Engine	2.8L JK/KK
Engine Type	2.8L - 16 Valves
Displacement	2777 cc

Bore	94.00
Stroke	100.05
Power (VGT) JK - KK	147 kW (200CV) @ 3600 RPM
Torque (ATX) JK - KK	460 N.m @ 1600 - 2600 RPM
Torque (MTX) JK - KK	410 N.m @ 2000 - 3200 RPM
Cylinders	4 In line
Injection Order	1-3-4-2
Compression Ratio	16.5:1
Vacuum at idle	600 mm/HG (27.5 In/HG) @ 800 RPM
Idle Speed (ATX) JK	760 +/- 50 RPM
Idle Speed (ATX) KK	730 +/- 50 RPM
Idle Speed (MTX) JK - KK	875 +/- 50 RPM
Maximum RPM in Gear	6600 RPM
Maximum RPM in neutral	ATX 3000 MTX 3000
Belt tension	Automatic Belt Tensioner
Thermostat opening	90°C +/- 2°C
Generator Rating	Denso 12V-180A; JK MTX 12V-220A
Emissions Level	EU5
Block configuration/Material	Open/Cast Iron
Cylinder Head	Dual Overhead Cam
Timing System	Belt
Fuel System	CP1H HP pump, 1800 bar, Piezo Injectors CRI 13.2
Fuel Supply	Electric Fuel Pump In the Fuel Tank
Electronic Control Unit	EDC 17
Timing System	Belt Driven DOHC Overhead Camshaft
Air Intake	Dry Filter With turbocharger and Charge Air Cooler
Fuel System	Direct Fuel Injection Common Rail System
Emission Devices	Cooled EGR (electric DC motor) Electric Intake Throttle Fast Metallic Glow plugs
Combustion Cycle	4 Stroke
Cylinder Compression Difference Between Cylinders	10 bar (145 psi)
Cooling System	Water Cooling
Turbocharging:	Single VGT with REA
Intake Ports	Aluminum heads with traditional dual side intake and exhaust ports. One intake port is helical and the other has a directed entry.
Crankshaft	8 Counterweights with an incorporated balance shaft gear.
Camshafts	2 overhead camshafts with axial front bearings and identical camshaft caps, finger followers, and hydraulic lifters.
Intake AND Exhaust Valves	Flat with fire deck face.
Intake Manifold	Plastic, with integrated swirl control flap and actuator

Lubrication	Pressure Lubricated By Rotary Pump
Minimum Oil Pressure (warm)	0.7 BAR at idle / 2.5 BAR at 3800 rpm
Engine Rotation	Clockwise Viewed From Front Cover
Engine Oil Capacity With Filter	6.6L (7 Quarts)

2.8L Engine Specifications	
Cylinder Head	
Cylinder head height	135.5 mm (5.334 in.)
Cylinder head flatness deformation tolerance	0.075 mm (0.003 in.)
Cylinder head gasket thickness	
0 Hole	1.10 mm (0.043 in)
1 Hole	1.20 mm (0.047 in)
2 Holes	1.30 mm (0.051 in)
Intake Manifold	
Intake manifold flatness deformation tolerance	0.075 mm (0.003 in.)
Exhaust Manifold	
Exhaust manifold flatness deformation tolerance	0.075 mm (0.003 in.)
Tappets	
Hydraulic tappet outside diameters	11.994 mm +/- 0.06 mm (0.472 in +/- 0.002)
Valves	
Intake valve face angle	45°30'
Exhaust valve face angle	45°30'
Intake Valve Head Diameter	32 mm (1.25 in.)
Exhaust Valve Head Diameter	29.4 mm (1.15 in.)
Intake Valve Stem Diameter	5.97 mm (0.235 in.)
Exhaust Valve Stem Diameter	5.96 mm (0.235 in.)
Intake Valve Guide Stem Clearance	
Min	0.030 mm (0.0012 in.)
Max	0.060 mm (0.0024 in.)
Exhaust Valve Guide Stem Clearance	
Min	0.040 mm (0.0016 in.)
Max	0.070 mm (0.0028 in.)
Valve Springs	
Free Length	50.8 mm (2 in.)
Closed Valve	38 mm (1.49 in.)
Opened Valve	29 mm (1.14 in.)
Camshafts	
Camshaft End Play	
Max	0.350 mm (0.014 in.)
Min	0.150 mm (0.006 in.)

Outer Journal Diameter (at crankshaft)	25.95 mm +/- 0.01 mm (1.021 mm +/- .0004 in)
Inner Journal Diameter (at cylinder head)	26.00 mm + 0.015 mm (1.027 mm +.0006 in)
Crankshaft Journal Clearance.	
Max	0.075 mm (0.003 in.)
Min	0.030 mm (0.0012 in)
Connecting Rods	
Connecting Rod Diameter (Small End)	32 mm (1.26 in.)
Connecting Rod Diameter (Large End)	57.563 mm (2.266 in.)
Piston Pin	
Diameter	32 mm (1.26 in.)
Length	70.7 mm - 71.00 mm (2.78 in - 2.79 in.)
Crankshaft	
End Play	0.1 mm - 0.33 mm (0.004 in. - 0.013 in.)
Bearing Selection. Refer to **Engine/Engine Block - Standard Procedure**.	
Engine Block	
Cylinder Bore Internal Diameter	94 mm (3.700 in.)
Cylinder Bore Out-Of-Round	0.007 mm (0.0003 in.)
Oversized Piston	+0.40 mm (+0.015 in.)
Fuel System	
Injection Pressure	1800 Bar
High Pressure Pump	CP1H
ECU	EDC17
Injectors	Piezo CRI 3.2
Glow Plugs	
Make/Type	Bosch / GLP2 HS
Voltage	4.4V
Lubrication System	
Oil Pump Outer Rotor End Play	
Min	0.01 (0.0004 in.)
Max	0.09 (0.0036 in.)
Oil Pump Inner Rotor End Play	
Max	0.01 mm (0.0004 in.)
Min	0.09 mm (0.0036 in.)
Oil Pump Outer Rotor to Body Diameter Clearance	
Max	0.130 mm (0.052 in.)
Min	0.230 mm (0.0091 in)
Oil Pressure Relief Valve	
Opening Pressure	5 Bar
Oil Pressure Valve Spring Free Length	46.8 mm (1.84 in)

Minimum Oil Pressure (Warm)	
at Idle	0.7 Bar
at 3800 RPM	2.5 Bar
Cooling System	
Thermostat Opening Temperature	90°C +/- 2 (194°F +/-2)
Pressure Cap Setting	1.2 Bar
Engine Oil	
Specification. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, DESCRIPTION** .	
Coolant	
Specification. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, DESCRIPTION** .	

Cylinder Head Gasket Selection		
	Millimeters	Inches
DISTANCE FROM PISTON AT TDC TO CYLINDER BLOCK	0.300 - 0.399	0.0119 - 0.0158
CYLINDER HEAD GASKET THICKNESS	1.10	0.0434
PISTON CLEARANCE	0.700-0.800	0.0276 -0.0315
DISTANCE FROM PISTON AT TDC TO CYLINDER BLOCK	0.400 - 0.499	0.0158 - 0.0197
CYLINDER HEAD GASKET THICKNESS	1.20	0.0473
PISTON CLEARANCE	0.701-0.800	0.0276 -0.0315
DISTANCE FROM PISTON AT TDC TO CYLINDER	0.500 - 0.600	0.0197 - 0.0237

BLOCK		
CYLINDER HEAD GASKET THICKNESS	1.30	0.0512
PISTON CLEARANCE	0.700-0.800	0.0276 -0.0315

TORQUE SPECIFICATIONS

ENGINE BLOCK

DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
Air Temp/Pressure Sensor	12	-	106
Balance Shaft Bolts	33	24	-
Connecting Rod Bearing Cap Bolts	Refer to **ROD, PISTON AND CONNECTING, INSTALLATION**.		
Dipstick Tube Bolt (block)	33	24	-
Dipstick Tube Bolt (sump)	11	-	97
Engine Block Plug	30	22	-
Engine Mount Bolts	54	40	-
Lower Oil Pan Bolts	Refer to **PAN, OIL, INSTALLATION**.		
Main Bearing Cap Bolts	Refer to **CRANKSHAFT, INSTALLATION**.		
Oil Cooler Bolts	12	-	106
Oil Cooler Coolant Adapter Tube at Oil Filter Housing Bolt	11	-	97
Oil Cooler Coolant Tube Bolts	15	-	133
Oil Drain Plug	54	40	-
Oil Filter Cap	25	18	-
Oil Filter			

Housing Bolts	33	24	-
Oil Jet Bolt	11	-	97
Oil Pickup Tube Bolt	15	-	133
Oil Pressure Sensor	14	-	124
Oil Temperature Sensor	20	-	177
Upper Oil Pan (M6 bolt)	15	-	133
Upper Oil Pan (M8 bolt)	32	24	-
Wire Harness Support Bracket Bolt	45	33	-

CYLINDER HEAD

DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
Camshaft Bearing Cap Bolts	11	-	97
Camshaft Position Sensor Bolt	11	-	97
Camshaft Sprocket Bolt	80	59	-
Cylinder Head Bolts	Refer to **CYLINDER HEAD, INSTALLATION**.		
Cylinder Head Cover Bolts	11	-	97
EGR Air Flow Control Valve Bolts	11	-	97
EGR Cooler Manifold Nuts	25	18	-
EGR Cooler Manifold Elbow Bolt	11	-	97
EGR Cooler Manifold Support Bracket Bolts	45	33	-
EGR Cooler Support Bracket Bolts	25	18	-
Exhaust Manifold Nuts	36	27	-
Front Camshaft Journal Bolts	11	-	97
Fuel injector Bolt	33	24	-
Fuel Rail Nuts	24	18	-
Fuel Tubes at Fuel Injector	28	20	-
Fuel Tubes at Fuel Rail	5 + 75°	-	44 + 75°
Glow Plugs	14	-	124
High Pressure Fuel Line Bracket Bolt	15	-	133
High Pressure Fuel Feed Line at Fuel Rail	5 + 75°	-	44 + 75°
High Pressure Fuel Feed Line at the High Pressure Pump	28	20	-
Intake Manifold Nuts	Refer to **MANIFOLD, INTAKE, INSTALLATION**.		
Turbocharger Nuts	25	18	-
Turbocharger Adapter (oil feed line to engine	54	40	-

block connection)			
Turbocharger Brace Bolts	32	24	-
Turbocharger Oil Feed Line at Engine Block	32	24	-
Turbocharger Oil Feed Line Nipple at Engine Block	54	40	-
Turbocharger Oil Feed Line Banjo Bolt at the Turbocharger	25	18	-
Turbocharger Oil Return Line Bolts	15	-	133
Vacuum Tube Nut	11	-	97

FRONT ENGINE

DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
Crankshaft Pulley Bolt	32	24	-
Crankshaft Sprocket Bolt	100 + 120°	74 + 120°	-
Front Cover Bolts	33	24	-
Front Engine Lifting Bracket Bolts	45	33	-
Fuel Quantity Solenoid Bolts	7	-	62
High Pressure Fuel Pump Blocker Nuts	25	18	-
High Pressure Fuel Pump Nuts	25	18	-
High Pressure Fuel Pump Sprocket Nut	88	65	-
Inner Front Cover Bolts	11	-	97
Outer Front Cover Bolts (lower)	8	-	71
Outer Front Cover Bolts (upper)	8	-	71
Timing Belt Tensioner Bolt	28	21	-
Water Pump Bolts	32	24	-

REAR ENGINE

DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
Crankshaft Sensor Bolt	11	-	97
CKP Cover Plate Bolts	15	-	133
Flex Plate (ATX)	Refer to **FLEXPLATE, INSTALLATION**.		
Rear Seal Cover Bolts	15	-	133
Trans Adapter Plate (allen bolts)	79	58	-
Trans Adapter Plate (hex bolt)	69	51	-

ACCESSORY DRIVE

DESCRIPTION	N.m	Ft. Lbs.	In. Lbs.
A/C Compressor Bolts	28	21	-
A/C Compressor Nuts	28	21	-
A/C Compressor/Generator Bracket Bolts	45	33	-
Accessory Drive Belt Tensioner Bolt	45	33	-
Accessory Drive Idler Pulley Bolt	45	33	-

Generator Bolts	33	24	-
Power Steering Pump Bolts	33	24	-
Power Steering Pump Pulley Bolts	33	24	-

REMOVAL

REMOVAL

1. Disconnect the negative and positive battery cables.
2. Remove the battery.
3. Recover the refrigerant. Refer to **PLUMBING, STANDARD PROCEDURE** .
4. On manual transmission models, remove the shiftier level. Refer to **LEVER, SHIFT, REMOVAL** .
5. Remove the air cleaner body. Refer to **BODY, AIR CLEANER, REMOVAL**.

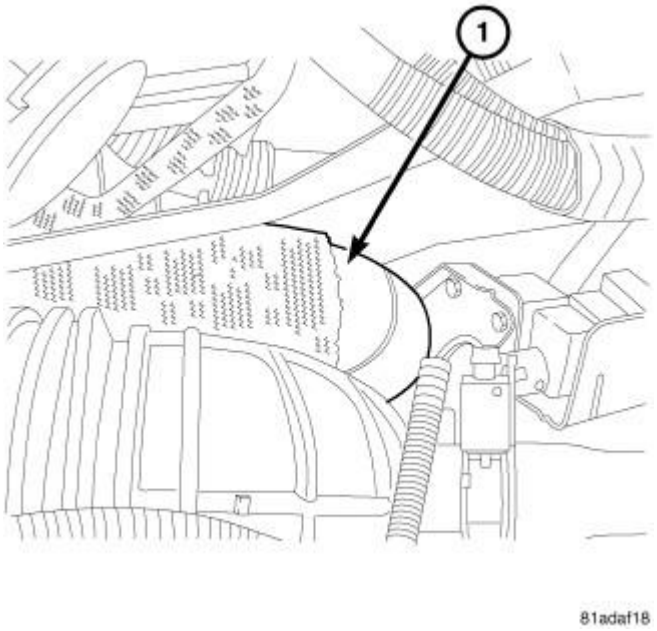

Fig. 6: Charge Air Cooler (CAC) Hose
Courtesy of CHRYSLER GROUP, LLC

6. Remove the turbocharger air inlet tube at turbo.
7. Remove the right side Charge Air Cooler (CAC) hose (1).
8. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
9. Remove the front lower splash shield.
10. Drain the coolant. Refer to **STANDARD PROCEDURE** .
11. Drain the engine oil.
12. Using a new copper sealing washer, tighten oil drain plug to 54 N.m (40 ft. lbs.).
13. Remove the transmission skid plate.

14. Remove the catalytic converter. Refer to **CONVERTER, CATALYTIC, REMOVAL** .

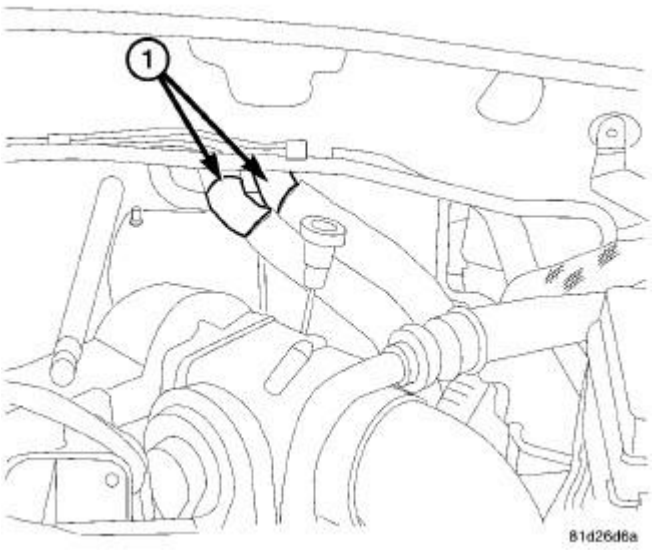

Fig. 7: Heater Core Coolant Hoses
Courtesy of CHRYSLER GROUP, LLC

15. Remove the coolant recovery bottle. Refer to **BOTTLE, COOLANT RECOVERY, REMOVAL** .
16. Disconnect the engine harness connectors at right side firewall.
17. Disconnect the coolant hoses (1) from the heater core.
18. Disconnect the upper radiator hose at radiator.
19. Remove the fan assembly. Refer to **FAN, COOLING, REMOVAL** .
20. Remove the serpentine belt. Refer to **BELT, SERPENTINE, REMOVAL** .

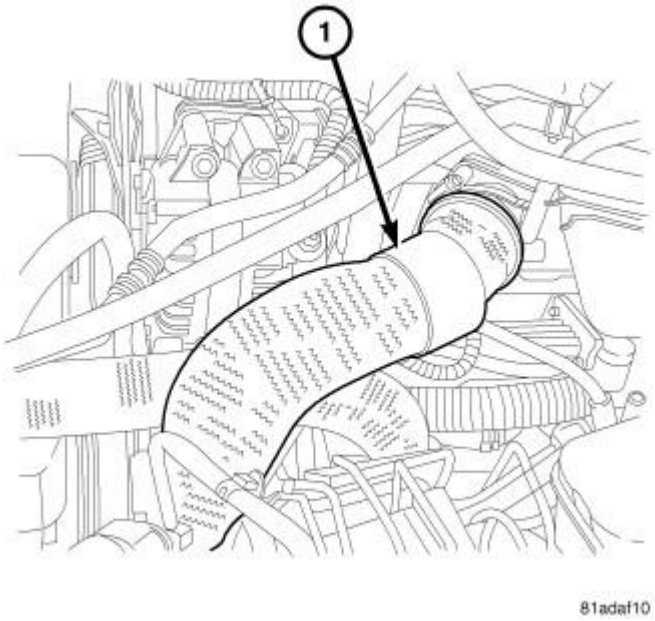

Fig. 8: Charge Air Cooler (CAC) Hose
Courtesy of CHRYSLER GROUP, LLC

21. Remove the left side Charge Air Cooler (CAC) hose (1) at EGR air flow control valve.
22. Remove the left side charge air cooler hose at cooler.

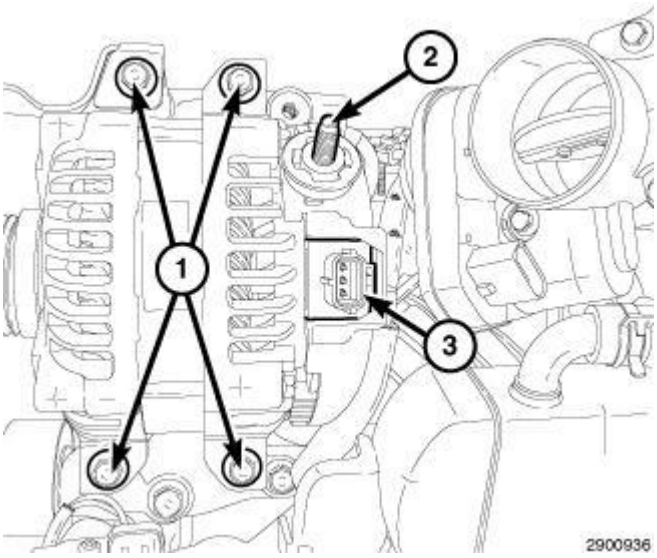

Fig. 9: Generator Bolts & Connector
Courtesy of CHRYSLER GROUP, LLC

23. Remove the generator. Refer to **GENERATOR, REMOVAL** .
24. Remove the A/C compressor. Refer to **COMPRESSOR, A/C, REMOVAL** .

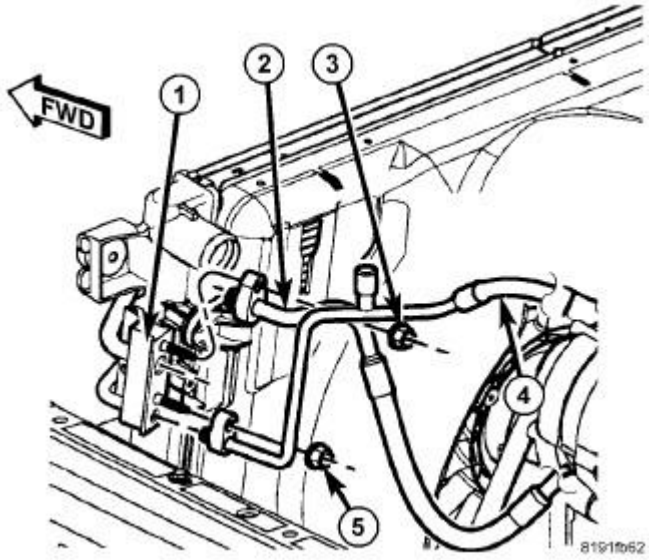

Fig. 10: A/C Condenser, Discharge Line, Liquid Line & Nuts
Courtesy of CHRYSLER GROUP, LLC

25. Remove the A/C suction and liquid line from the condenser.
26. Remove the A/C suction and liquid lines from the evaporator.
27. Remove and discard gasket/O-ring seals and install protective caps over openings.

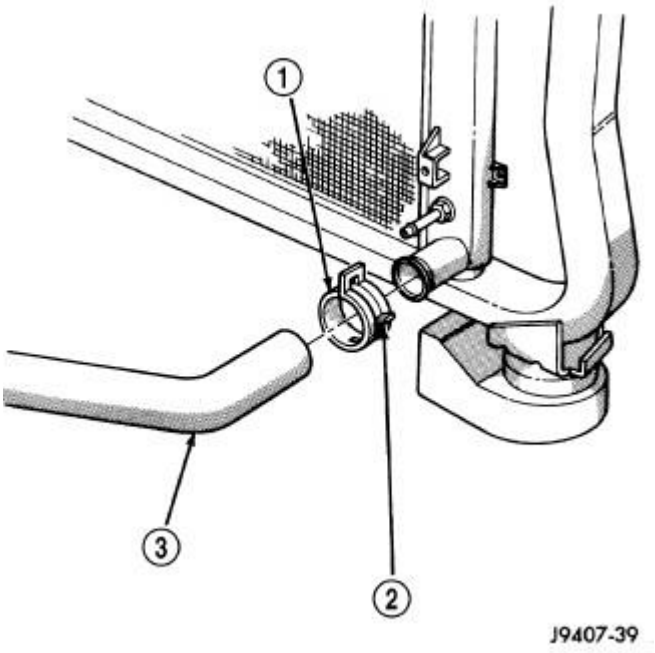

Fig. 11: Removing/Installing Lower Radiator Hose
Courtesy of CHRYSLER GROUP, LLC

28. Remove the lower radiator hose (3) at radiator.

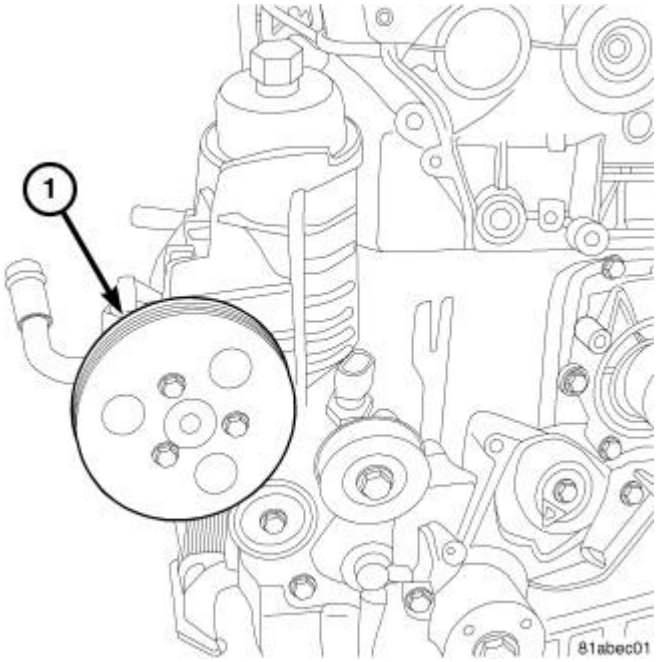

Fig. 12: Power Steering Pump Pulley
Courtesy of CHRYSLER GROUP, LLC

29. Remove the power steering pump pulley (1).

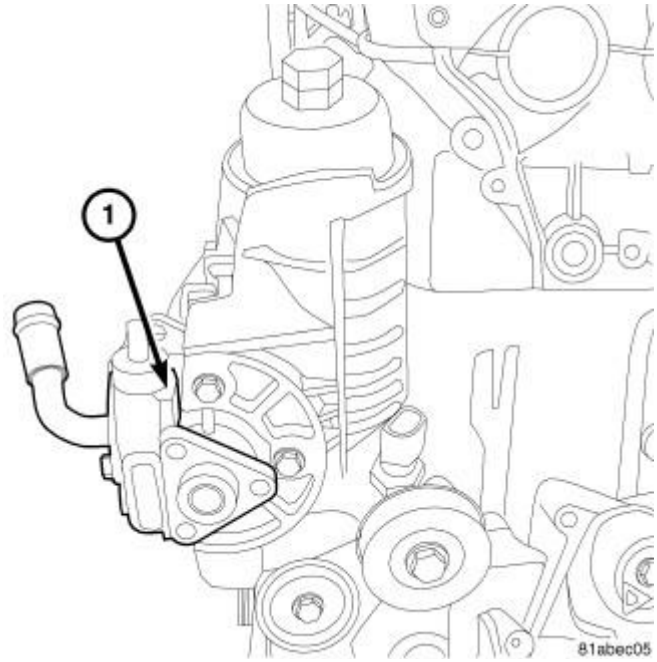

Fig. 13: Power Steering Pump
Courtesy of CHRYSLER GROUP, LLC

30. Remove the power steering pump (1) and position aside.

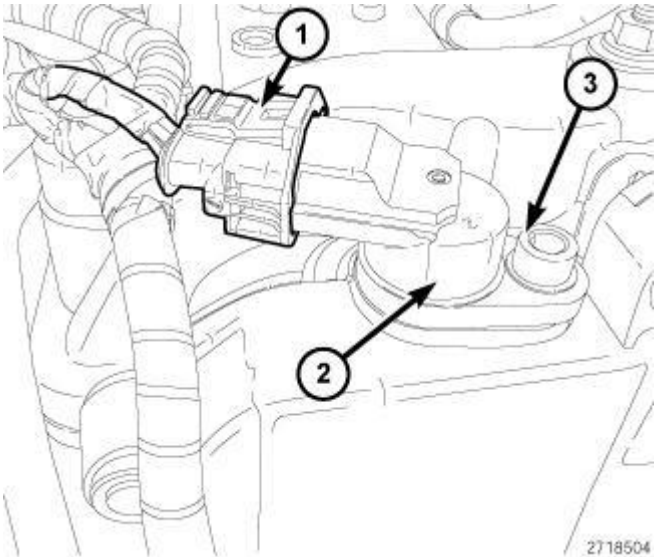

Fig. 14: Camshaft Position Sensor Harness Connector, Sensor & Bolt
Courtesy of CHRYSLER GROUP, LLC

31. Disconnect the Camshaft Position Sensor (CMP) harness connector (1).

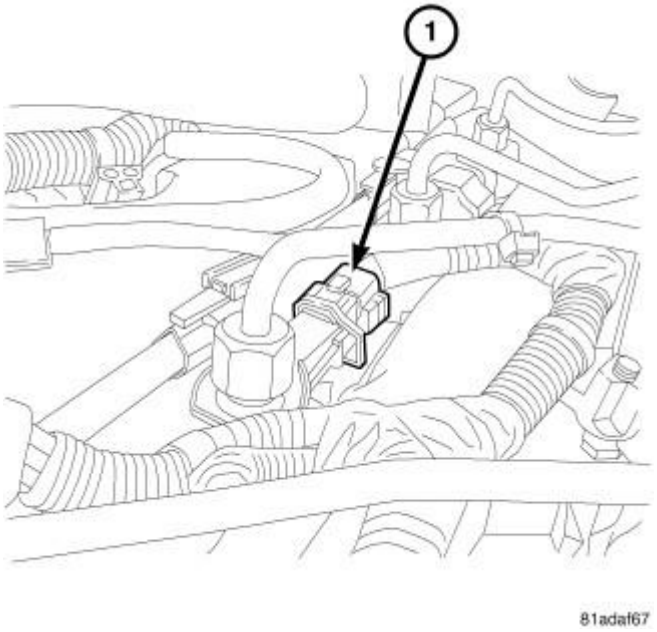

Fig. 15: Fuel Injector Connector
Courtesy of CHRYSLER GROUP, LLC

32. Disconnect the fuel injector harness connectors.

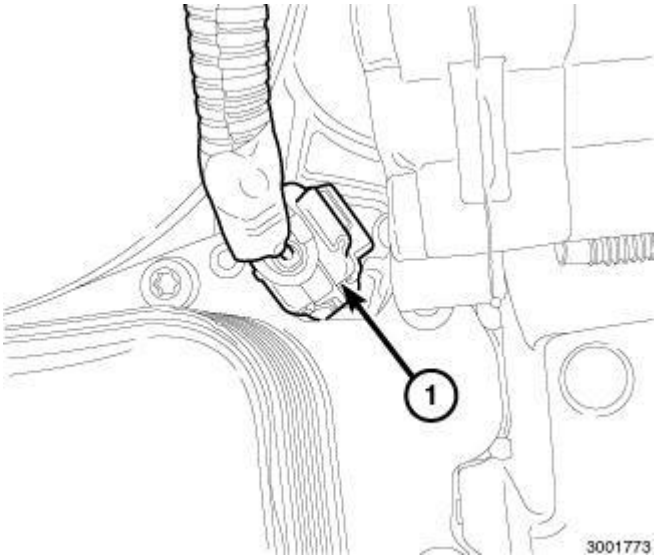

Fig. 16: Oil Temperature Sensor Harness Connector
Courtesy of CHRYSLER GROUP, LLC

33. Disconnect the oil temperature sensor harness connector (1).

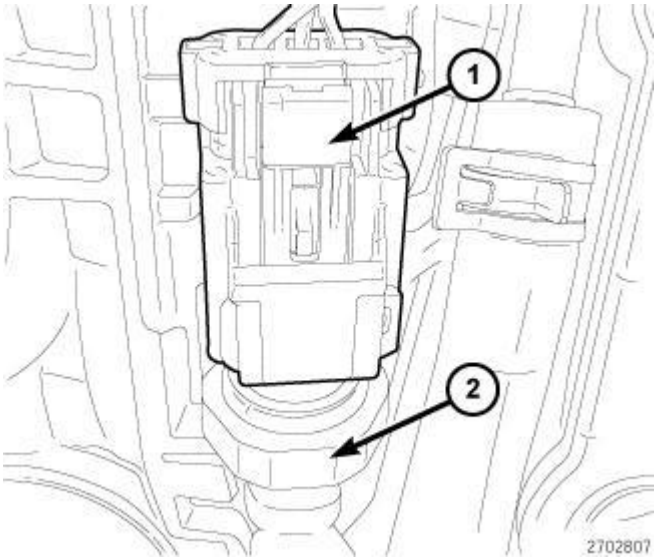

Fig. 17: Oil Pressure Switch & Harness Connector
Courtesy of CHRYSLER GROUP, LLC

34. Disconnect the oil pressure switch harness connector (1).

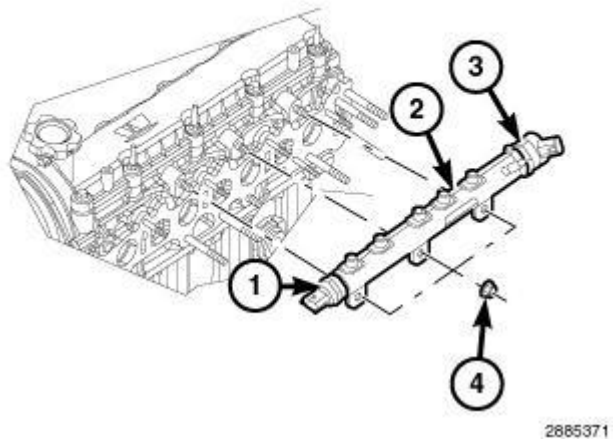

Fig. 18: Fuel Rail Pressure Sensor, Fuel Rail, Pressure Solenoid & Nuts
Courtesy of CHRYSLER GROUP, LLC

35. Disconnect the fuel pressure sensor harness connector (1).
36. Disconnect the fuel pressure regulator harness connector (3).

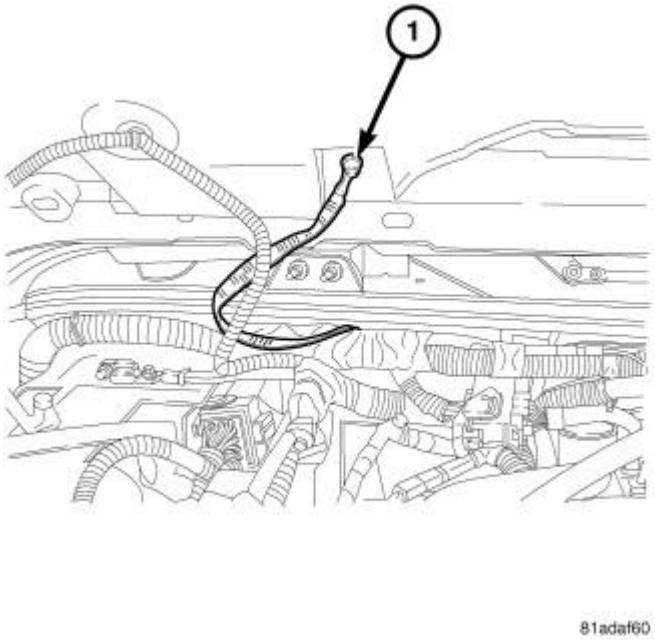

Fig. 19: Hood Ground Strap
Courtesy of CHRYSLER GROUP, LLC

37. Disconnect the turbocharger actuator connector.
38. Disconnect the EGR airflow control valve harness connector.
39. Disconnect the IAT/BPS harness connector.
40. Disconnect the ground strap between the cowl and hood.

41. Disconnect the glow plug harness connectors.
42. Position aside the upper engine harness.
43. Disconnect the brake booster vacuum hose.

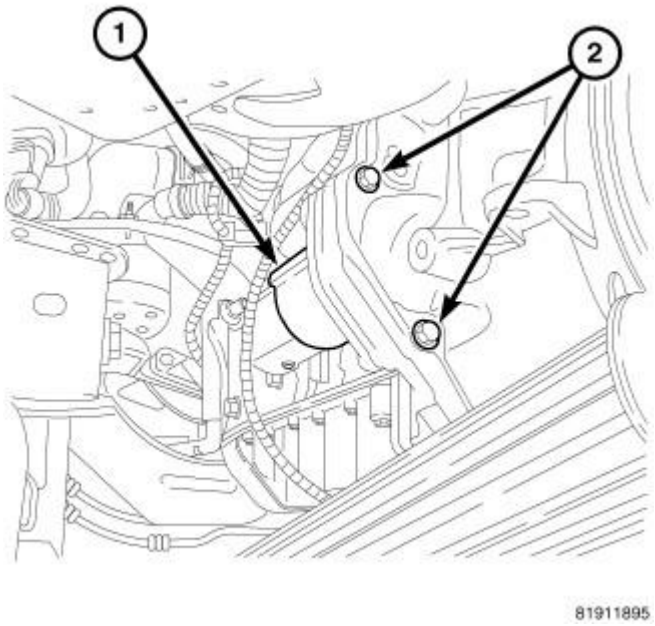

Fig. 20: Starter Mounting 2.8L Diesel
Courtesy of CHRYSLER GROUP, LLC

NOTE: Starter shown in illustration for a manual transmission.

44. Remove the starter. Refer to **STARTER, REMOVAL** .

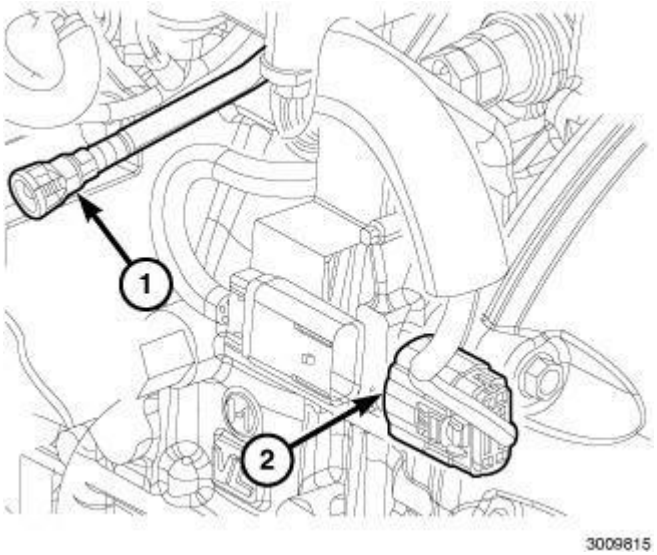

Fig. 21: Fuel Rail Fuel Return Line & Multi-Sensor Jumper Harness Connector

Courtesy of CHRYSLER GROUP, LLC

45. Disconnect the fuel supply and return tubes to high pressure pump.
46. Disconnect the fuel rail return line (1).
47. Disconnect the multi-sensor jumper harness connector (2).
48. Remove bolt, and the engine ground cable at engine block.
49. Remove the crankshaft position sensor. Refer to **SENSOR, CRANKSHAFT POSITION, REMOVAL** .

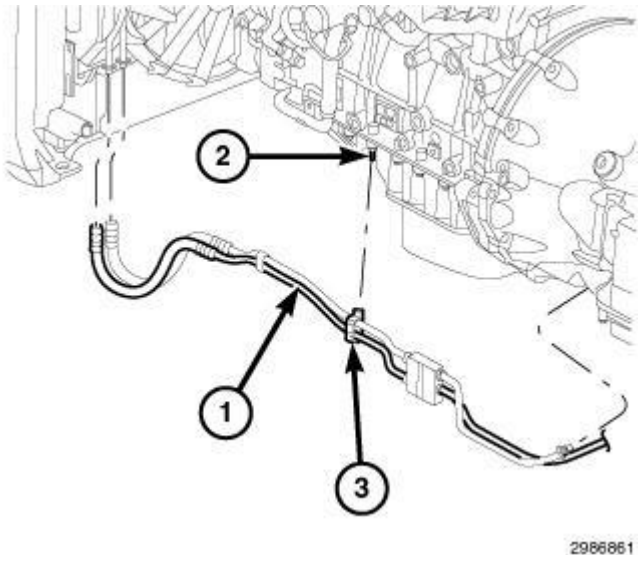

Fig. 22: Transmission Cooler Line, Oil Pan Stud & Clip
Courtesy of CHRYSLER GROUP, LLC

NOTE: The plastic clip that secures the transmission oil cooler lines to oil pan stud/bolt is a one time use clip that need to be replace each time the line is removed.

50. On automatic transmission models, remove the transmission cooler line (1) from oil pan stud (2) and discard clip (3).

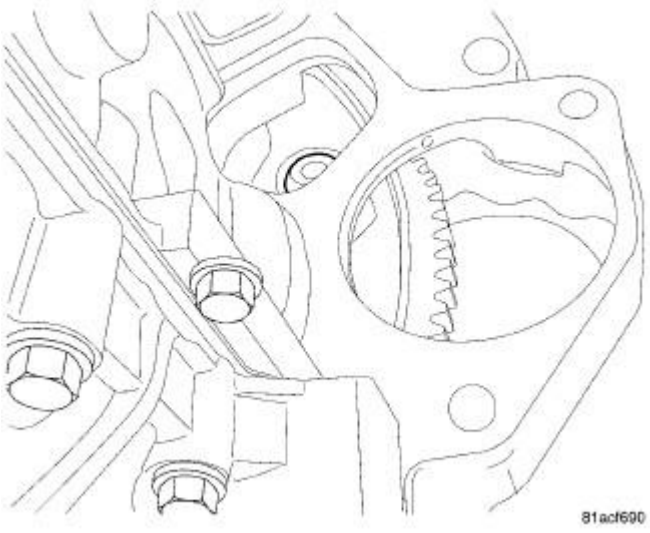

Fig. 23: Flex Plate Bolts
Courtesy of CHRYSLER GROUP, LLC

51. Remove the torque converter to flex plate bolts.
52. On manual transmission models, remove the transfer skid plate.
53. On manual transmission models, remove the manual transmission. Refer to **REMOVAL** .

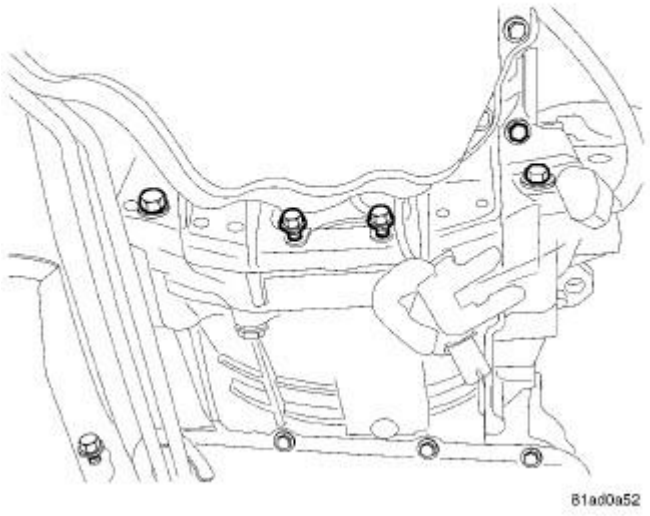

Fig. 24: Bell Housing Bolts
Courtesy of CHRYSLER GROUP, LLC

54. Remove the bell housing bolts.

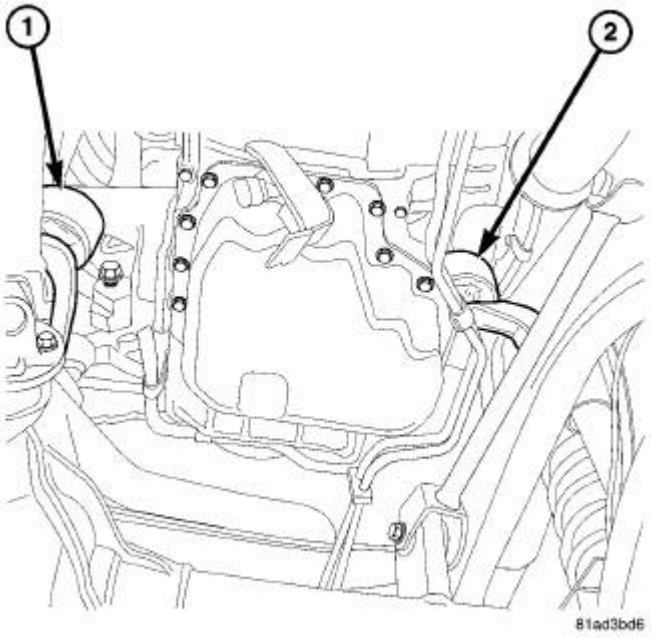

Fig. 25: Engine Mounts
Courtesy of CHRYSLER GROUP, LLC

55. Remove the nut from the left engine mount.
56. Remove the nut from the right engine mount.
57. Install a suitable engine lifting device.
58. Remove the engine.

INSTALLATION

INSTALLATION

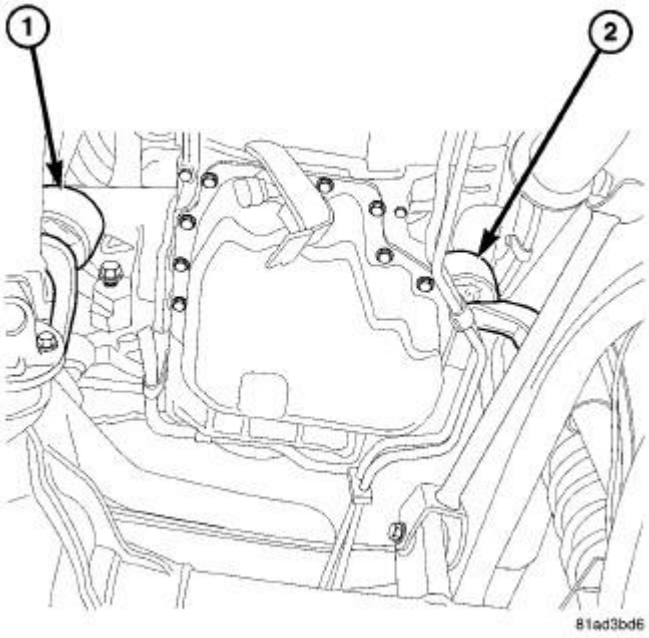

Fig. 26: Engine Mounts
Courtesy of CHRYSLER GROUP, LLC

1. Install the engine.
2. Remove the engine lift.
3. Install the right engine mount nut. Tighten nut to 54 N.m (40 ft. lbs.).
4. Install the left engine mount nut. Tighten nut to 54 N.m (40 ft. lbs.).

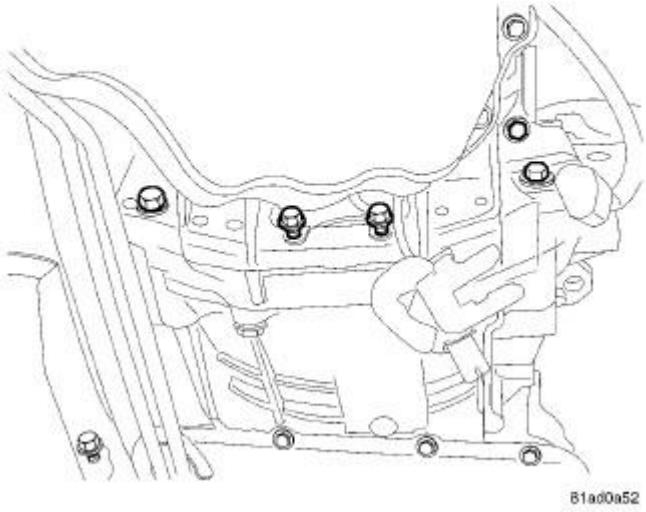

Fig. 27: Bell Housing Bolts
Courtesy of CHRYSLER GROUP, LLC

5. Install the bell housing bolts:
   - Tighten upper bolts to 41 N.m (30 ft. lbs.).
   - Tighten lower bolts to 54 N.m (40 ft. lbs.).
   - Tighten collar bolts to 68 N.m (50 ft. lbs.).
6. Install the transmission oil line bracket at the oil pan.

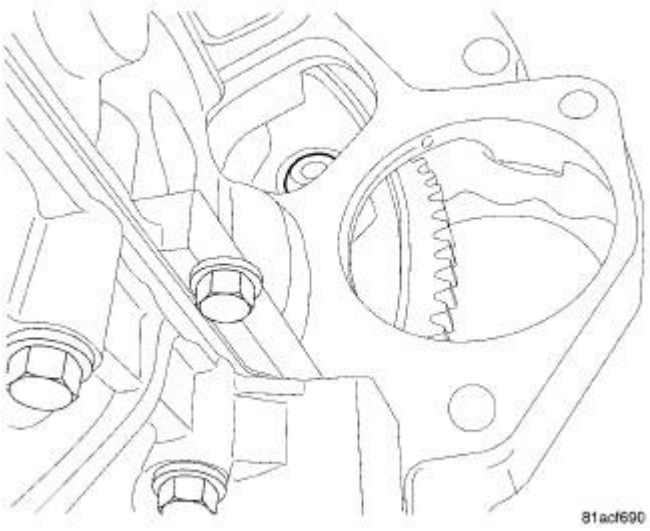

Fig. 28: Flex Plate Bolts
Courtesy of CHRYSLER GROUP, LLC

7. On manual transmission models, install the manual transmission. Refer to **INSTALLATION** .
8. On manual transmission models, install the water and fuel separator. Refer to **SEPARATOR AND FILTER, FUEL AND WATER, INSTALLATION** .
9. On manual transmission models, install the transfer skid plate.
10. Install the torque converter to flex plate bolts. Tighten bolts to 31 N.m (23 ft. lbs.).

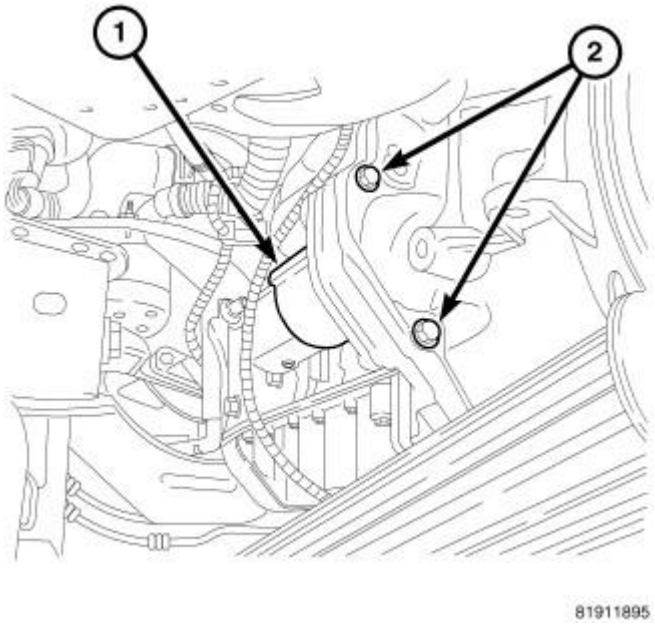

Fig. 29: Starter Mounting 2.8L Diesel
Courtesy of CHRYSLER GROUP, LLC

11. Install the crankshaft position sensor. Refer to **SENSOR, CRANKSHAFT POSITION, INSTALLATION** .
12. Install the engine ground cable at engine block.
13. Connect the fuel rail return line.
14. Connect the fuel supply and return lines to high pressure pump.
15. Install the starter. Refer to **STARTER, INSTALLATION** .

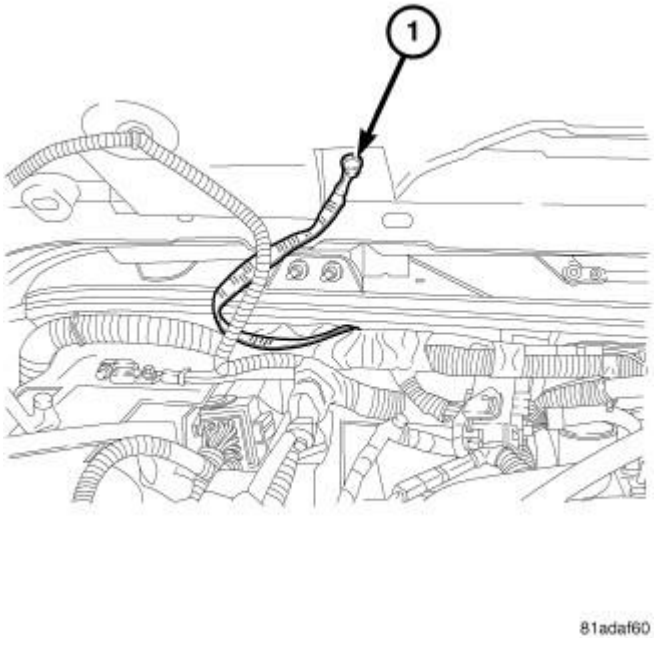

Fig. 30: Hood Ground Strap
Courtesy of CHRYSLER GROUP, LLC

16. Connect the brake booster vacuum hose.
17. Position the engine wiring harness.
18. Connect the glow plug harness connectors.
19. Connect the ground strap between the cowl and hood.

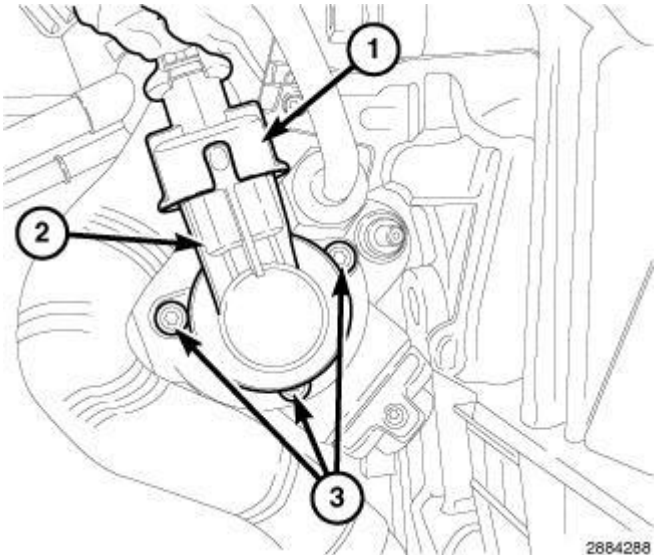

Fig. 31: Fuel Quantity Solenoid, Connector & Bolts
Courtesy of CHRYSLER GROUP, LLC

20. Connect the fuel quantity solenoid.
21. Connect the IAT/BPS harness connector (1).
22. Connect the EGR airflow control valve harness connector.
23. Connect the turbocharger actuator connector.

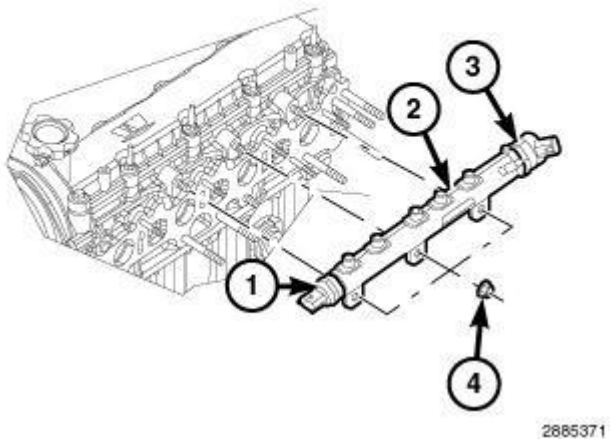

Fig. 32: Fuel Rail Pressure Sensor, Fuel Rail, Pressure Solenoid & Nuts
Courtesy of CHRYSLER GROUP, LLC

24. Connect the fuel pressure regulator harness connector (3).
25. Connect the fuel pressure sensor harness connector (1).

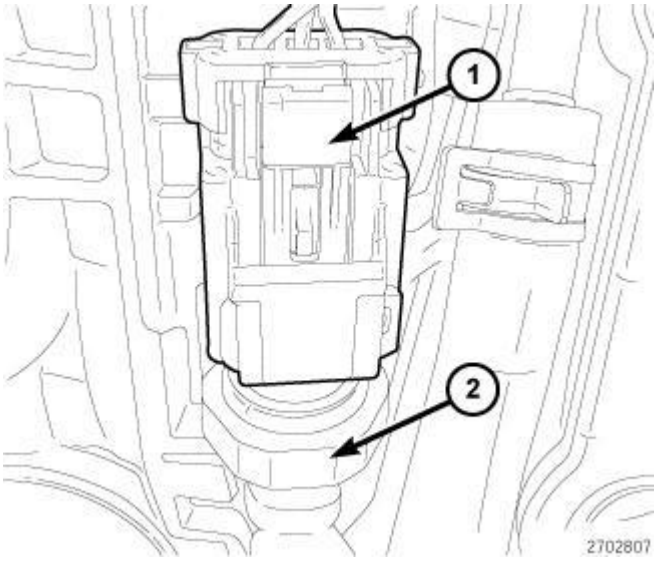

Fig. 33: Oil Pressure Switch & Harness Connector
Courtesy of CHRYSLER GROUP, LLC

26. Connect the oil pressure switch harness connector (1).

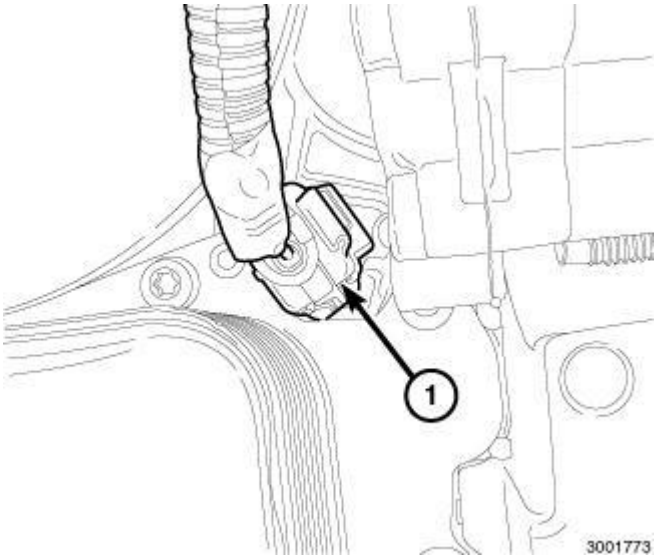

Fig. 34: Oil Temperature Sensor Harness Connector
Courtesy of CHRYSLER GROUP, LLC

27. Connect the oil temperature sensor harness connector (1).
28. Connect the coolant temperature sensor harness connector.
29. Connect the EGR bypass valve harness connector.

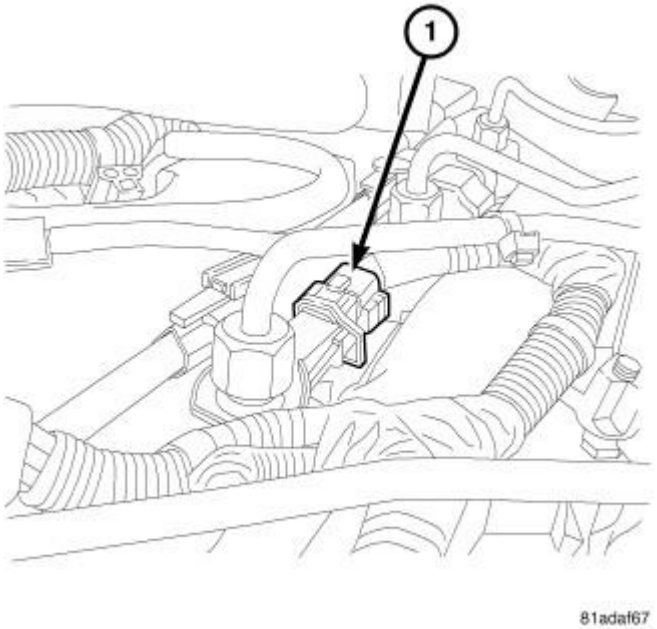

Fig. 35: Fuel Injector Connector
Courtesy of CHRYSLER GROUP, LLC

30. Connect the fuel injector harness connectors.

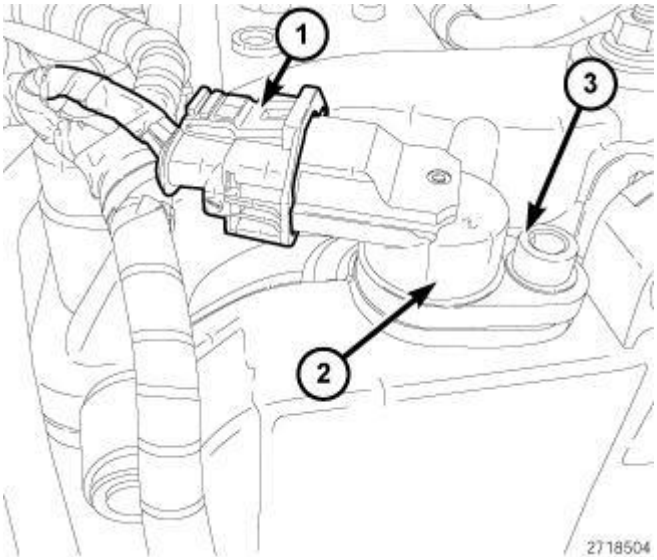

Fig. 36: Camshaft Position Sensor Harness Connector, Sensor & Bolt
Courtesy of CHRYSLER GROUP, LLC

31. Connect the Camshaft Position Sensor (CMP) harness connector (1).
32. Connect the EGR valve harness connector.

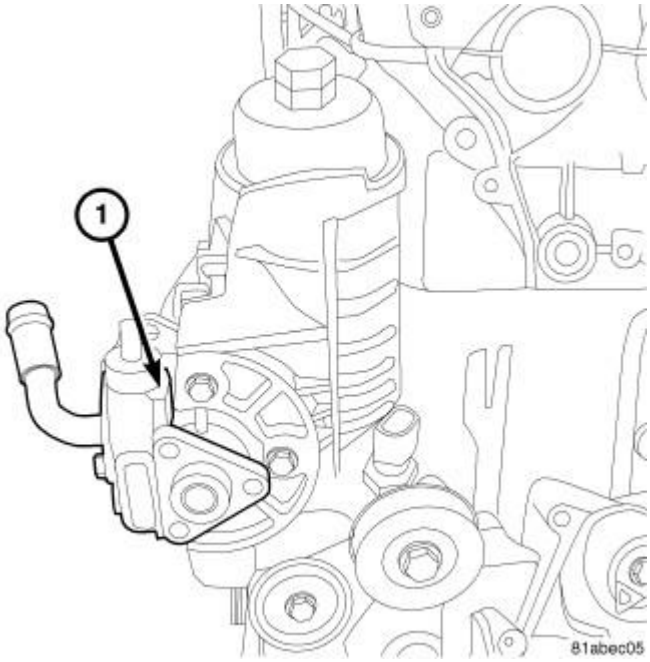

Fig. 37: Power Steering Pump
Courtesy of CHRYSLER GROUP, LLC

33. Install the power steering pump (1). Tighten the bolts to 33 N.m (24 ft. lbs.).

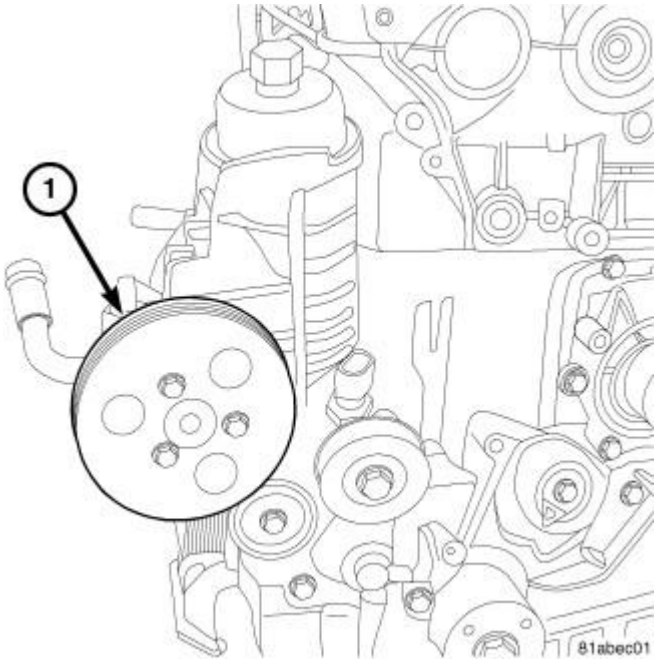

Fig. 38: Power Steering Pump Pulley
Courtesy of CHRYSLER GROUP, LLC

34. Install the power steering pump pulley (1). Tighten bolts to 33 N.m (24 ft. lbs.).

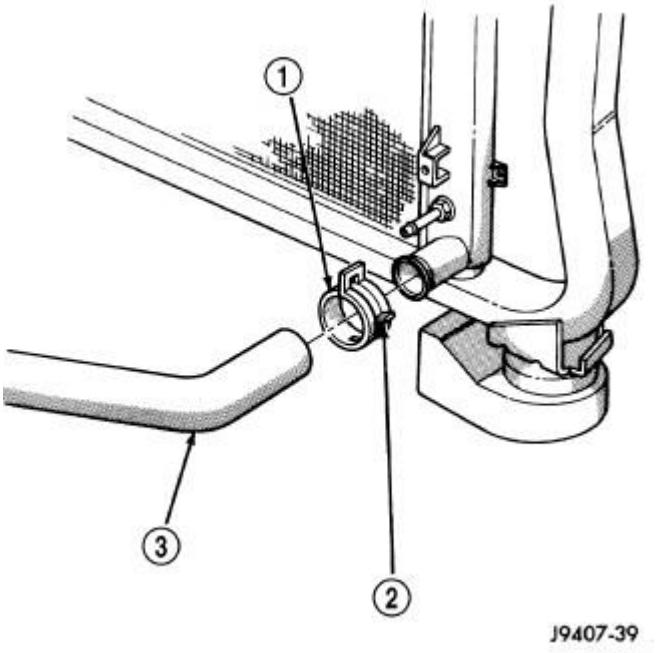

Fig. 39: Removing/Installing Lower Radiator Hose
Courtesy of CHRYSLER GROUP, LLC

35. Install the lower radiator hose at radiator.

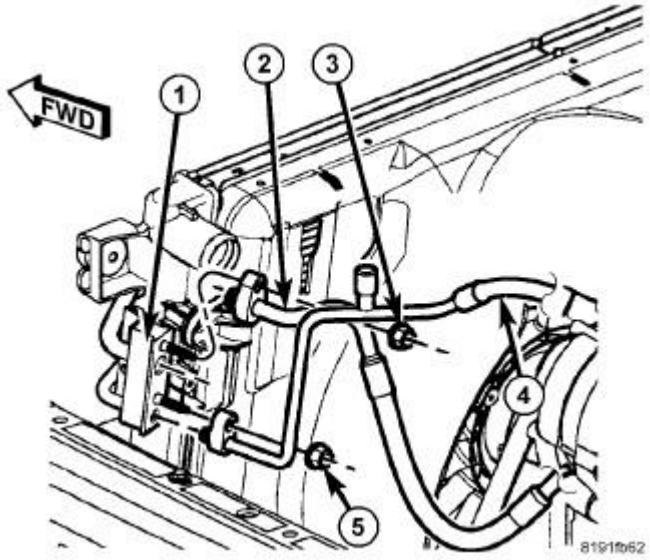

Fig. 40: A/C Condenser, Discharge Line, Liquid Line & Nuts
Courtesy of CHRYSLER GROUP, LLC

36. Remove protective caps and lubricate install new gasket/O-ring seals.
37. Install the A/C suction and liquid lines to the expansion valve. Tighten the nut to 8 N.m (70 in. lbs.).
38. Install the A/C suction and liquid line from the condenser. Tighten the nuts to 23 N.m (17 ft. lbs.).

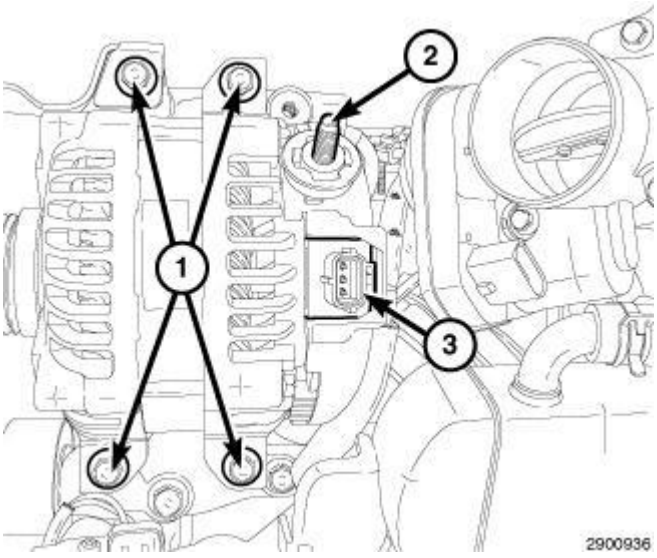

Fig. 41: Generator Bolts & Connector
Courtesy of CHRYSLER GROUP, LLC

39. Install the A/C compressor. Refer to **COMPRESSOR, A/C, INSTALLATION** .
40. Install the generator. Refer to **GENERATOR, INSTALLATION** .

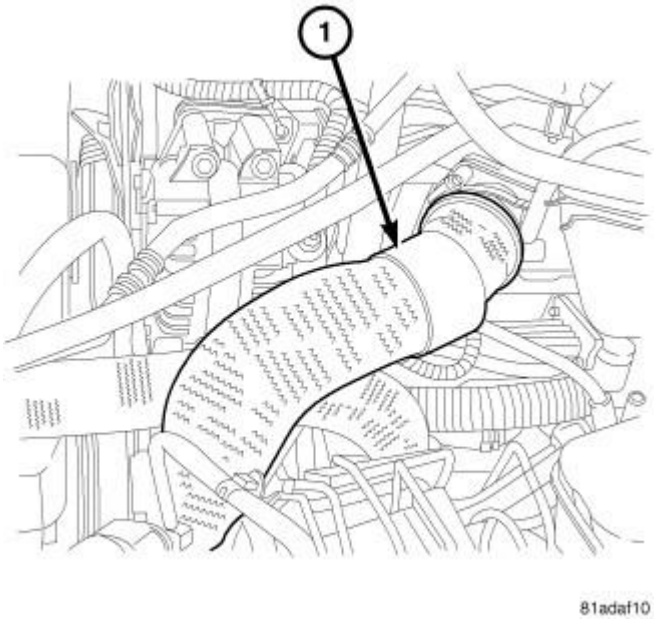

Fig. 42: Charge Air Cooler (CAC) Hose
Courtesy of CHRYSLER GROUP, LLC

41. Install the left side charge air cooler hose at cooler.
42. Install the left side charge air cooler hose at EGR air flow control valve.

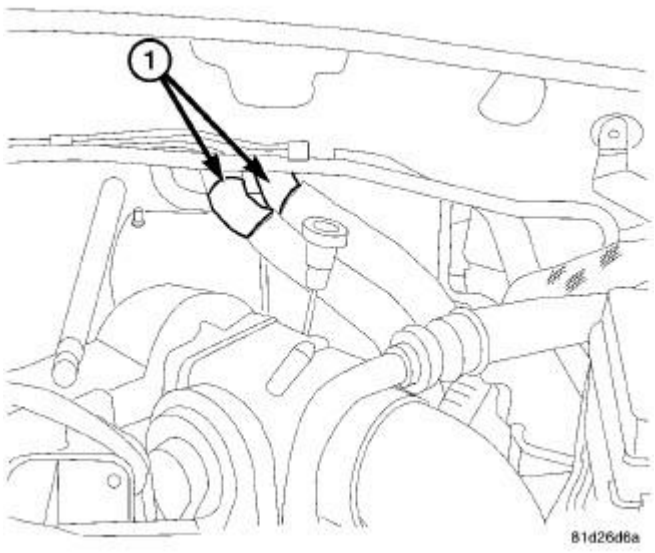

Fig. 43: Heater Core Coolant Hoses
Courtesy of CHRYSLER GROUP, LLC

43. Install the serpentine belt. Refer to **BELT, SERPENTINE, INSTALLATION** .
44. Install the fan assembly. Refer to **FAN, COOLING, INSTALLATION** .
45. Connect the upper radiator hose at radiator.

46. Install the coolant hoses (1) to the heater core.
47. Connect the engine harness connectors at right side firewall.
48. Install the coolant recovery bottle. Refer to **BOTTLE, COOLANT RECOVERY, INSTALLATION** .

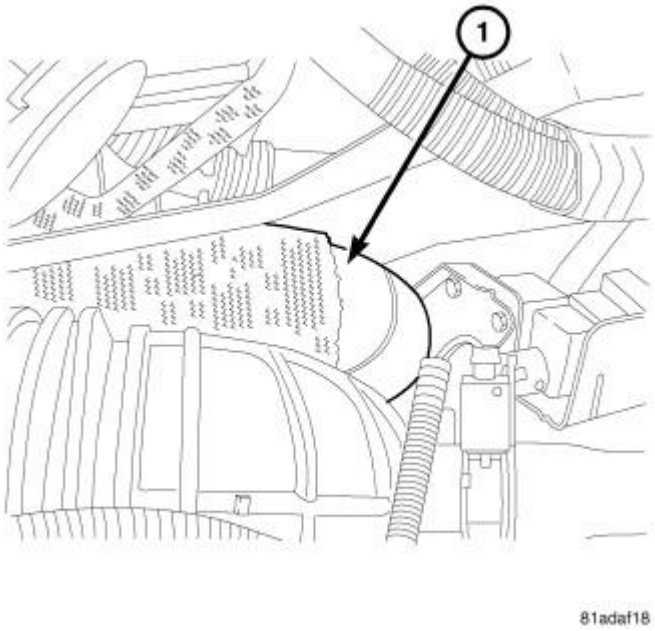

Fig. 44: Charge Air Cooler (CAC) Hose
Courtesy of CHRYSLER GROUP, LLC

49. Install the left front wheel house splash shield. Refer to **SHIELD, SPLASH, WHEELHOUSE, INSTALLATION** .
50. Install the catalytic converter. Refer to **CONVERTER, CATALYTIC, INSTALLATION** .
51. Install the transmission skid plate.
52. Install the front lower splash shield.
53. Install the right side charge air cooler hose.
54. Install the turbocharger air inlet tube at turbocharger.
55. Install the air cleaner body. Refer to **BODY, AIR CLEANER, INSTALLATION**.
56. On manual transmission models, install the shiftier lever. Refer to **LEVER, SHIFT, INSTALLATION** .
57. Fill the coolant. Refer to **STANDARD PROCEDURE** .
58. Fill the with recommended engine oil.
59. Charge the A/C system. Refer to **PLUMBING, STANDARD PROCEDURE** .
60. Install the battery.
61. Connect the positive and negative battery cables.
62. Start the engine and check for leaks.

SPECIAL TOOLS

SPECIAL TOOLS

	1023 - Puller (Originally Shipped In Kit Number(s) 8678.) 10368 - Set, Universal Protective Cap 8534B - Fixture, Driveline Support (Originally Shipped In Kit Number(s) 8534, 8534B, 8849, 9565.) 9937-1 - Installer, Seal (Originally Shipped In Kit Number(s) 9937.) 9937-2 - Guide, Seal (Originally Shipped In Kit Number(s) 9937.) C-3339A - Set, Dial Indicator (Originally Shipped In Kit Number(s) 9202.) MD998772A - Compressor, Valve Spring (Originally Shipped In Kit Number(s) 8678, 8853, 8854.) MD998772A-15 - Adapter (Originally Shipped In Kit Number(s) 8678, 8853, 8854.) VM.10010 - Adapter, Compression Test VM.10012 - Balance Shaft Split Gear Align VM.10334 - Tool, Exhaust Manifold Alignment VM.10335 - Installer, Front Crankshaft Oil Seal VM.1055 - Locking Tool (Originally Shipped In Kit Number(s) 9599.) VM.1057 - Installer, Seal (Originally Shipped In Kit Number(s) 9599.) VM.1058 - Remover, Seal (Originally Shipped In Kit Number(s) 9599.) VM.9990 - Tool, Front And Rear Seal VM.9991 - Alignment Tool, Camshaft Sprocket VM.9992 - Adapter, 90 Degree ATDC VM.9993 - Installer, Crankshaft Rear Oil Seal

COVER, ENGINE

REMOVAL

REMOVAL

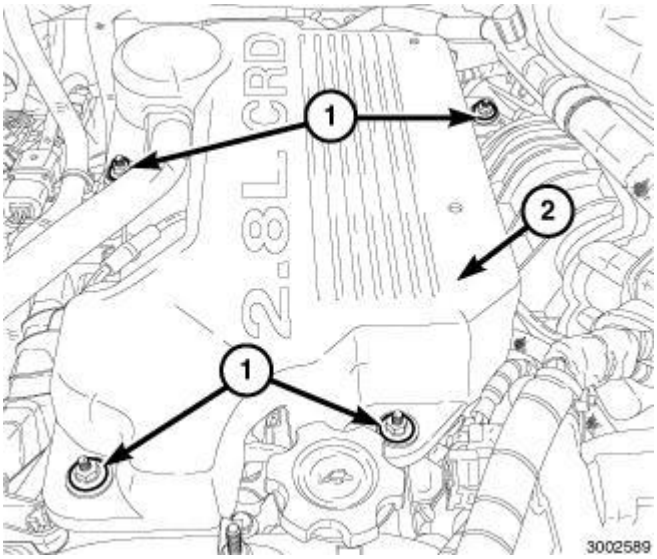

Fig. 45: Engine Cover & Nuts
Courtesy of CHRYSLER GROUP, LLC

1. Remove the four nuts (1).

NOTE: Use care when removing the engine cover as some of the insulation could get damaged upon removal.

2. Carefully lift up and remove the engine cover (2).

INSTALLATION

INSTALLATION

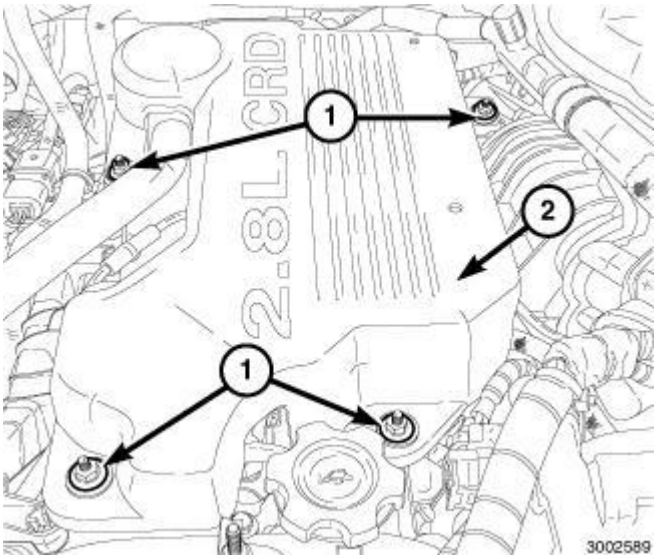

Fig. 46: Engine Cover & Nuts
Courtesy of CHRYSLER GROUP, LLC

1. Carefully position and install the engine cover (2).
2. Install and securely tighten the four retaining nuts (1).

CYLINDER HEAD

DESCRIPTION

DESCRIPTION

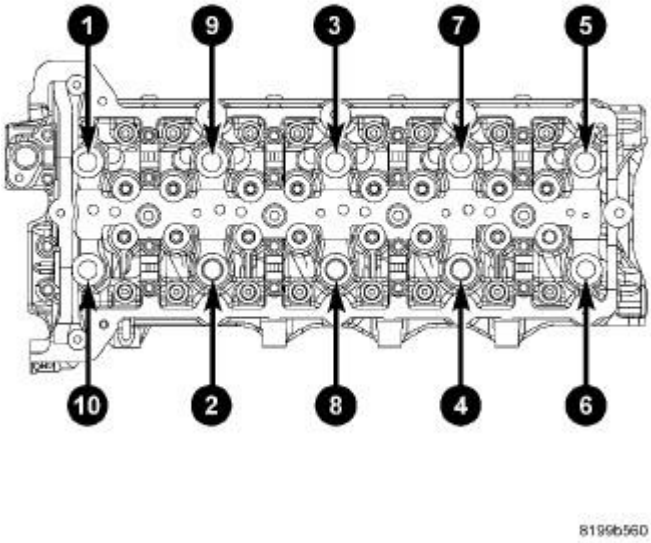

Fig. 47: Cylinder Head Bolt Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

The 2.8L aluminum, overhead valve cylinder head is torqued in a cross pattern. The cylinder head itself is not resurfacable.

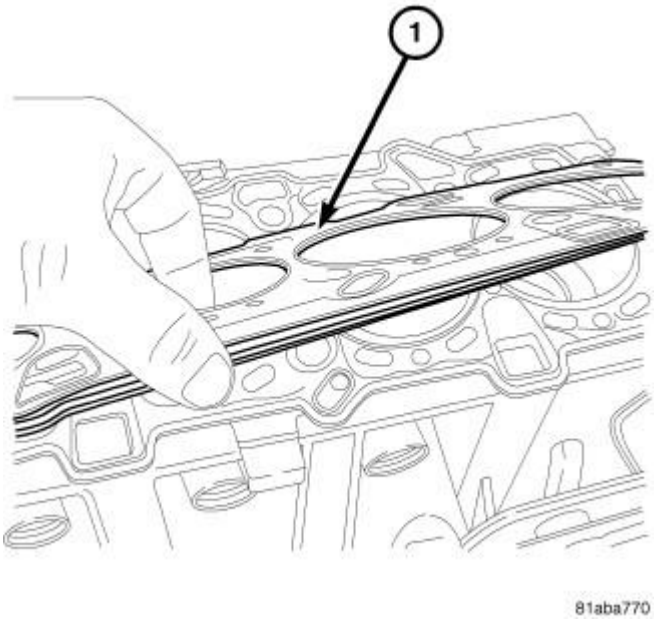

Fig. 48: MLS Head Gasket
Courtesy of CHRYSLER GROUP, LLC

1. The cylinder head uses a selectable Multi-layered Steel gasket that is available in three sizes.

STANDARD PROCEDURE

VALVE SEALS - IN VEHICLE

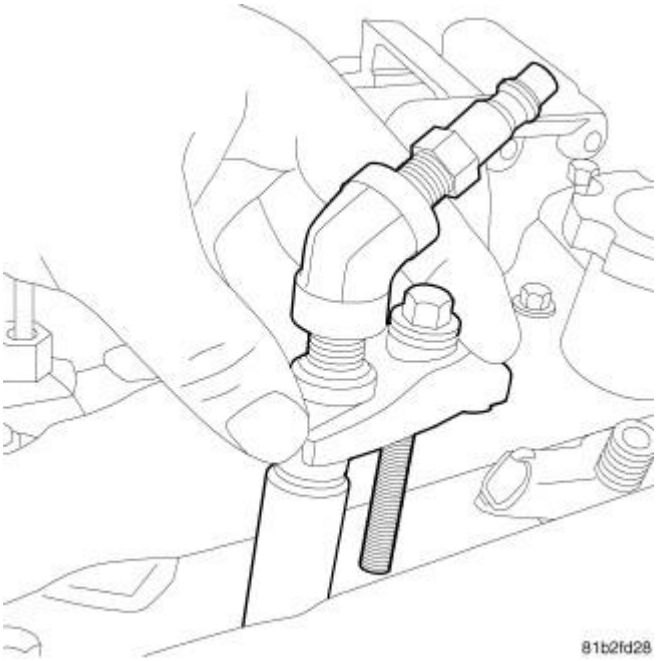

Fig. 49: Compression Tester
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.

NOTE: Rocker arms and lifters must be kept in order of removal and stored in the up right position.

2. Remove the rocker arms. Refer to **ROCKER ARM, VALVE, REMOVAL**.
3. Install the Compression Tester Adaptor Tool VM.10010, into the injector hole and retain with an injector hold down (2) bolt.
4. Prepare the (special tool #MD998772A, Compressor, Valve Spring) for usage by inverting the tool to cylinder head holding screws so that the thread size matches the cylinder head.
5. Install the (special tool #MD998772A, Compressor, Valve Spring) onto cylinder head and using (special tool #MD998772A-15, Adapter), place the adaptor over the valve spring.
6. Connect a regulated air supply (3) to Compression Test Adapter Tool VM.10010 and pressurize the cylinder.
7. Place shop towels around the working area of the cylinder head to prevent valve locks from accidently entering the engine.

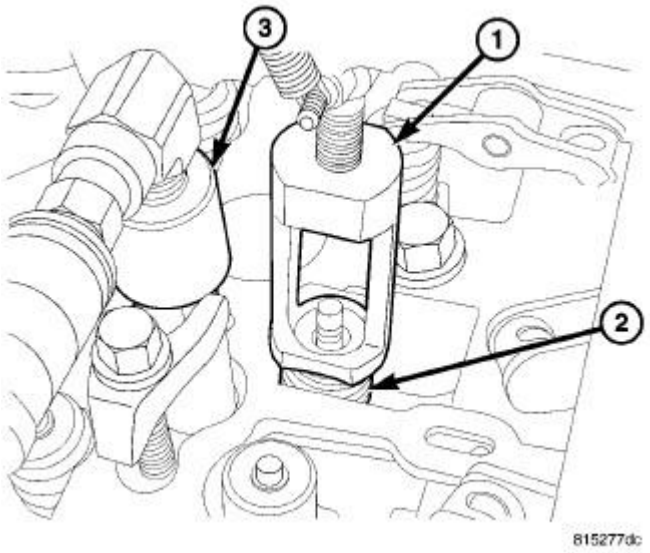

Fig. 50: Adaptors & Valve Spring
Courtesy of CHRYSLER GROUP, LLC

8. Using the (special tool #MD998772A-15, Adapter) (1), collapse the valve spring (2) and remove the locks.
9. Remove the valve spring (2) assembly.

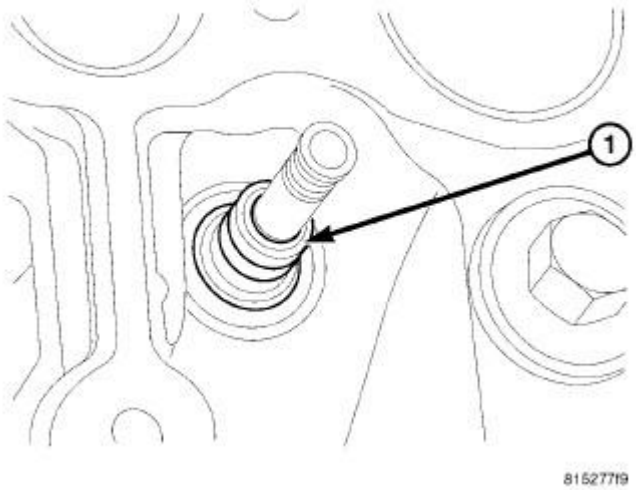

Fig. 51: Valve Seal
Courtesy of CHRYSLER GROUP, LLC

1 - VALVE SEAL

10. Remove the valve seal (1).
11. Repeat this procedure for all cylinders.
12. Install the rocker arms. Refer to **ROCKER ARM, VALVE, INSTALLATION**.
13. Connect the negative battery cable.

VALVE SERVICE

This procedure is done with the engine cylinder head removed from the block.

DISASSEMBLY

1. Remove the engine cylinder head from the cylinder block. Refer to **CYLINDER HEAD, REMOVAL**.
2. Use Valve Spring Compressor Tool and compress each valve spring.
3. Remove the valve locks, retainers, and springs.
4. Use a smooth stone or a jewelers file to remove any burrs on the top of the valve stem, especially around the groove for the locks.
5. Remove the valves, and place them in a rack in the same order as removed.

VALVE CLEANING

1. Clean all carbon deposits from the combustion chambers, valve ports, valve stems, valve stem guides and head.
2. Clean all residue and gasket material from the engine cylinder head machined gasket surface.

INSPECTION

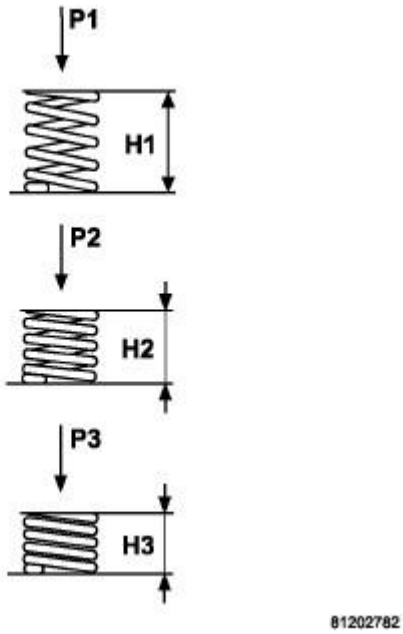

Fig. 52: Valve Spring Load Heights
Courtesy of CHRYSLER GROUP, LLC

LOAD Kg		HEIGHT mm		STATE
P1	0.00	H1	50.8	FREE LENGTH
P2	182-5 +10%	H2	38.0	VALVE CLOSED
P3	395±5%	H3	29.0	VALVE OPEN

1. Inspect for cracks in the combustion chambers and valve ports.
2. Inspect for cracks on the exhaust seat.
3. Inspect for cracks in the gasket surface at each coolant passage.
4. Inspect valves for burned, cracked or warped heads.
5. Inspect for scuffed or bent valve stems.
6. Replace valves displaying any damage.
7. Check valve spring height. Refer to **Fig. 52**.

VALVE SEAT REFACING

1. Install a pilot of the correct size in the valve guide bore. Reface the valve seat to the specified angle with a good dressing stone. Remove only enough metal to provide a smooth finish.
2. Use tapered stones to obtain the specified seat width when required.

VALVE GUIDES

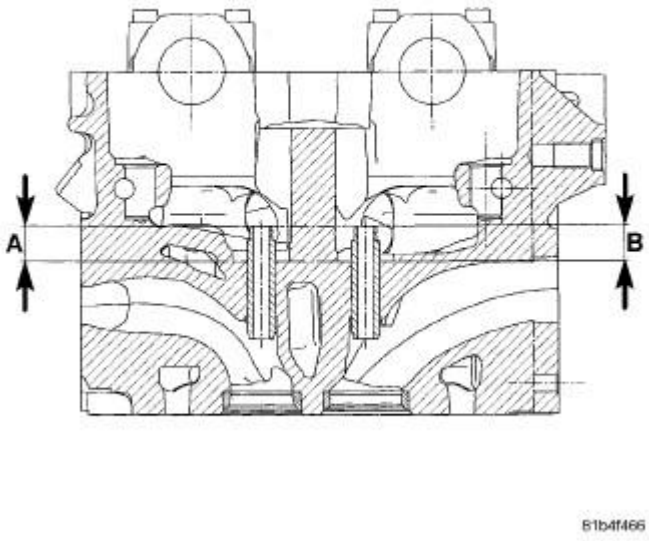

Fig. 53: Valve Height
Courtesy of CHRYSLER GROUP, LLC

1. Valve Guides height requirement.
2. Measurement A and B: 13.50 mm - 14.00 mm. (0.570 in - 0.590 in)

VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

1. Measure and record internal diameter of valve guides. Valve guide internal diameter is 6.0 to 6.012 mm (0.2362 to 0.2366 in.).
2. Measure valve stems and record diameters. Intake valve stem diameter 5.952 to 5.97 mm (0.2343 to 0.2350 in). Exhaust valve stem diameter 5.942 to 5.96 mm (0.2339 to 0.2346 in).
3. Subtract diameter of valve stem from internal diameter of its respective valve guide to obtain valve stem clearance in valve guide. Clearance of inlet valve stem in valve guide is 0.03 to 0.06 mm (.0011 to.0023 in). Clearance of exhaust valve stem in valve guide is 0.04 to 0.07 mm (.0015 to.0027 in).
4. If valve stem clearance in valve guide exceeds tolerances, new valve guides must be installed.

REMOVAL

REMOVAL

1. Disconnect the battery cables.
2. Remove the battery.
3. Remove the intake manifold. Refer to **MANIFOLD, INTAKE, REMOVAL**.
4. Remove the exhaust manifold. Refer to **MANIFOLD, EXHAUST, REMOVAL**.
5. Remove the camshafts. Refer to **CAMSHAFT, ENGINE, REMOVAL**.

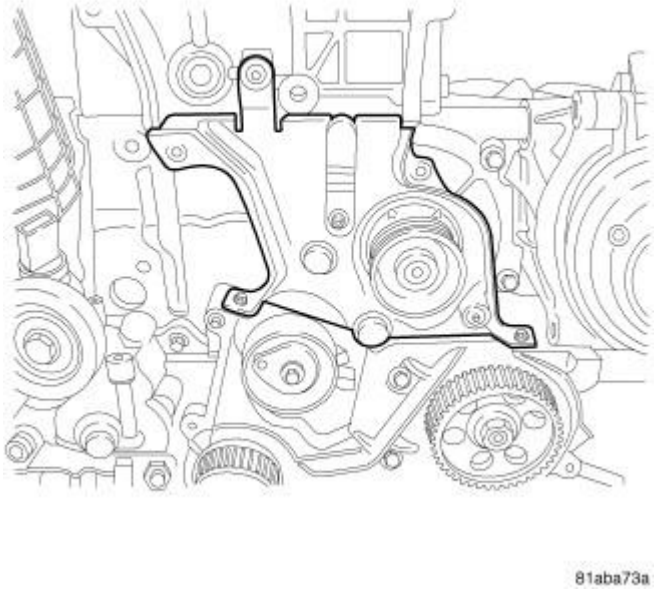

Fig. 54: Inner Front Cover
Courtesy of CHRYSLER GROUP, LLC

6. Remove the inner timing belt cover.

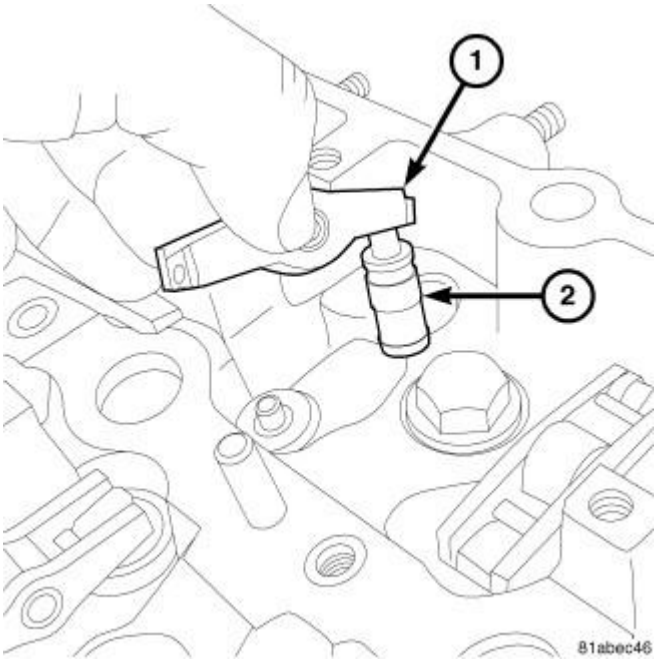

Fig. 55: Rocker Arms & Hydraulic Lifters
Courtesy of CHRYSLER GROUP, LLC

NOTE: Observe the position of the rocker arms and lifters. Always return the rocker arms and lifters to their original location.

7. Remove the rocker arms (1) and hydraulic lifters (2).
8. Remove the cylinder head bolts.
9. Remove the cylinder head.

CLEANING

CLEANING

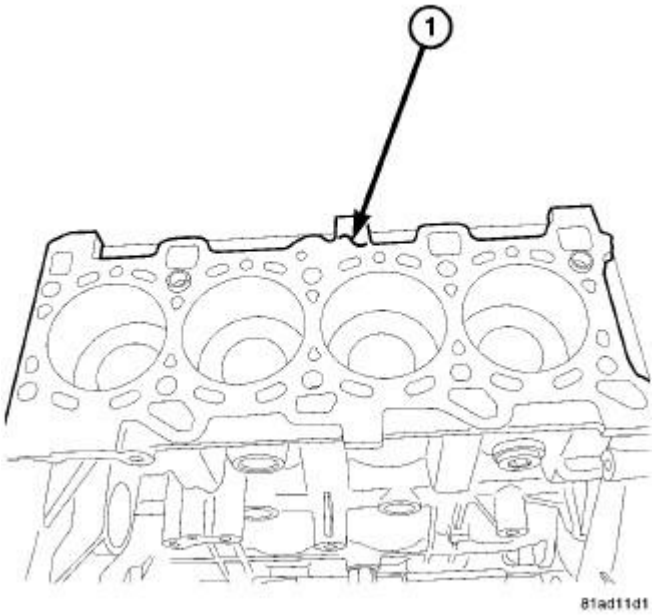

Fig. 56: Engine Block
Courtesy of CHRYSLER GROUP, LLC

Thoroughly clean the engine cylinder head and cylinder block mating surfaces. Clean the intake and exhaust manifold and engine cylinder head mating surfaces. Remove all gasket material and carbon. Refer to **Engine - Standard Procedure**.

Check to ensure that no coolant or foreign material has fallen into the tappet bore area.

Remove the carbon deposits from the combustion chambers and top of the pistons.

INSPECTION

INSPECTION

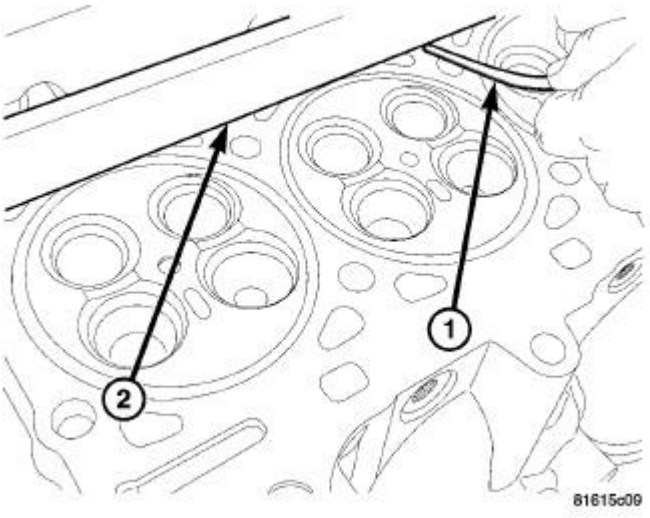

Fig. 57: Measuring Cylinder Head Flatness (1 Of 2)
Courtesy of CHRYSLER GROUP, LLC

1 - FEELER GAUGE
2 - STEEL STRAIGHT EDGE

CAUTION: The cylinder head surface and straight edge must be absolutely clean before the flatness measurement is taken. DO NOT check flatness across the combustion chamber area or on the marks left by the gasket stopper.

Use a cleaned straight edge (2) and feeler (1) gauge to check the flatness. Lie the straight edge (2) parallel across the cooling ports. Measure before each combustion chamber toward the outer edge of the cylinder head, above and below each combustion chamber, between each combustion chamber, top and bottom, on the cylinder head and block mating surfaces. The **maximum** allowed warpage is 0.075 mm (0.003 in.).

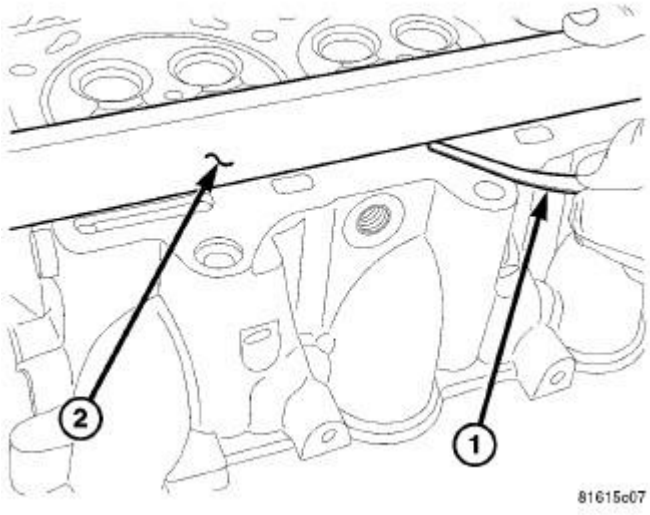

Fig. 58: Measuring Cylinder Head Flatness (2 Of 2)
Courtesy of CHRYSLER GROUP, LLC

1 - Item_1
2 - Item _2

The minimum cylinder head thickness is 135.5 mm (5.33 in.).

INSTALLATION

INSTALLATION

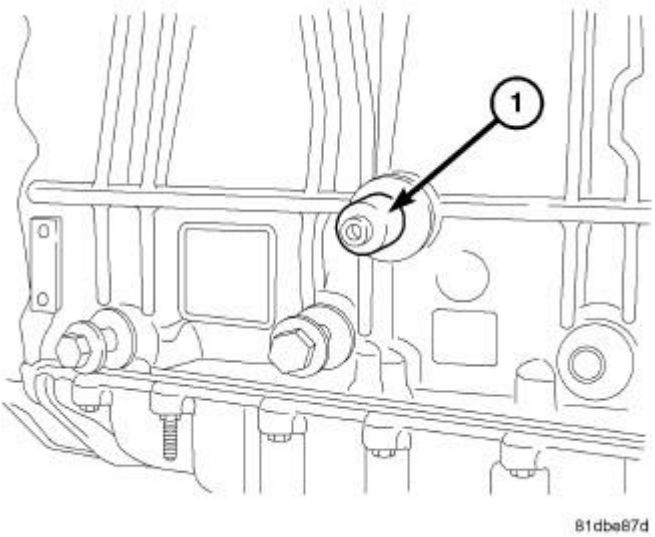

Fig. 59: Crankshaft Locking Tool
Courtesy of CHRYSLER GROUP, LLC

1. Remove the (special tool #VM.9992, Adapter, 90 Degree ATDC) tool (1).

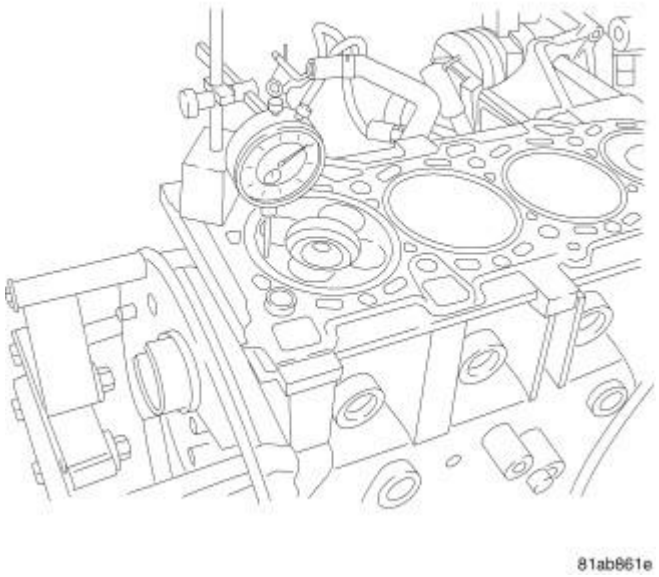

Fig. 60: Measuring Height Of Piston At Top Dead Center Using Suitable Dial Indicator
Courtesy of CHRYSLER GROUP, LLC

2. Set the number one piston to top dead center (TDC).

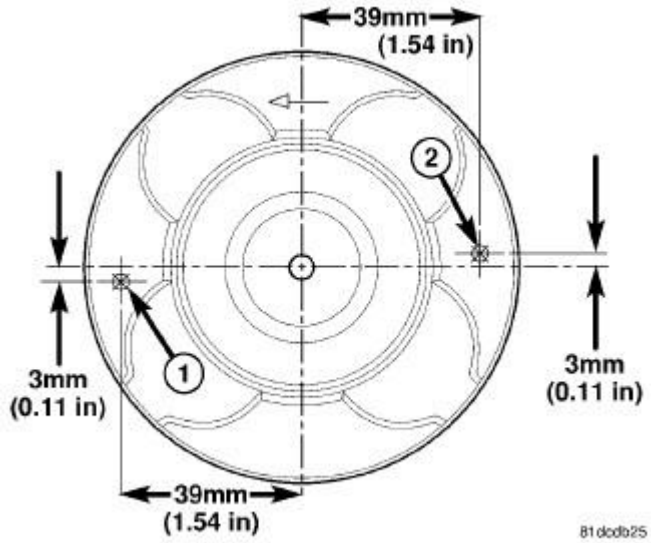

Fig. 61: Piston Protrusion Measurement
Courtesy of CHRYSLER GROUP, LLC

3. Zero the dial indicator on the top of the piston at location shown in illustration (1).
4. Use the dial indicator to measure the height of the piston at top dead center.

5. Zero the dial indicator on the top of the piston at location shown in illustration (2).
6. Use the dial indicator to measure the height of the piston at top dead center.
7. Repeat the procedure for each cylinder.
8. Average the 4 piston protrusion readings to determine the required gasket thickness.

Cylinder Head Gasket Selection		
	Millimeters	Inches
DISTANCE FROM PISTON AT TDC TO CYLINDER BLOCK	0.300 - 0.399	0.0119 - 0.0158
CYLINDER HEAD GASKET THICKNESS	1.10	0.0434
PISTON CLEARANCE	0.701 - 0.800	0.0276 - 0.0315
DISTANCE FROM PISTON AT TDC TO CYLINDER BLOCK	0.400 - 0.499	0.0158 - 0.0197
CYLINDER HEAD GASKET THICKNESS	1.20	0.0473
PISTON CLEARANCE	0.701 - 0.800	0.0276 - 0.0315
DISTANCE FROM PISTON AT TDC TO CYLINDER BLOCK	0.500 - 0.600	0.0197 - 0.0237
CYLINDER HEAD GASKET THICKNESS	1.30	0.0512
PISTON CLEARANCE	0.700 - 0.800	0.0276 - 0.0315

9. Select the appropriate cylinder head gasket from the cylinder head gasket chart.

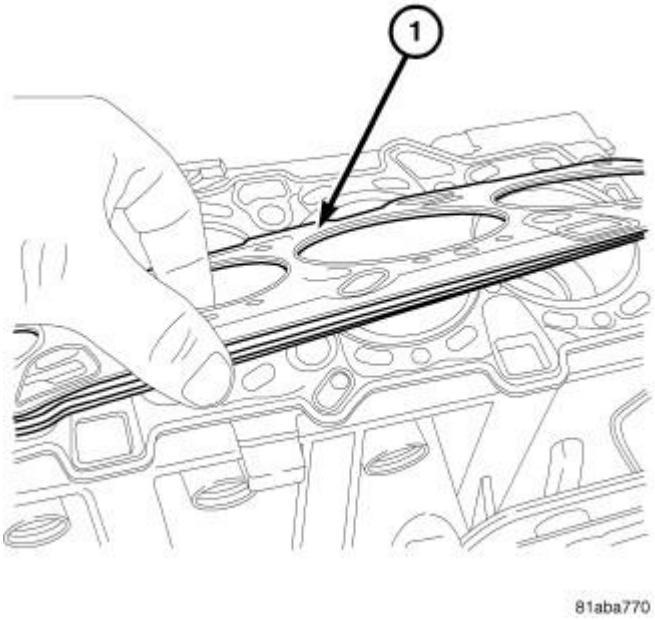

Fig. 62: MLS Head Gasket
Courtesy of CHRYSLER GROUP, LLC

10. Install the head gasket (1).

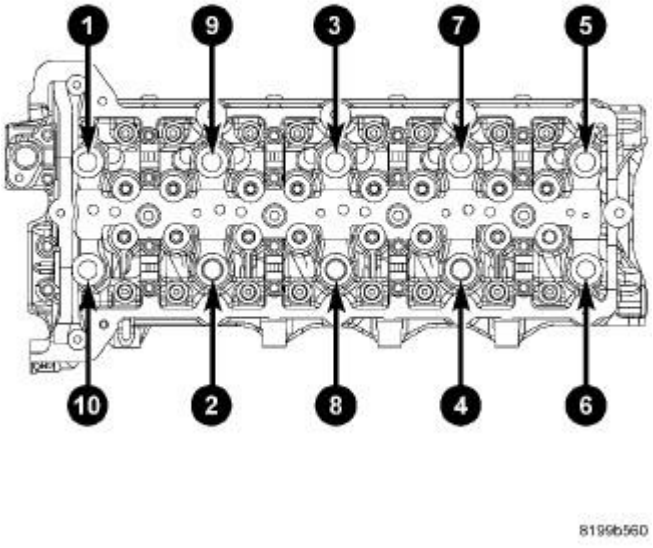

Fig. 63: Cylinder Head Bolt Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

11. Install the cylinder head.

NOTE: Always use new cylinder head bolts whenever the existing bolts have been removed.

12. Install the cylinder head bolts. Using the illustrated pattern, tighten bolts to 30 N.m (22 ft. lbs.).
    - Repeat the illustrated pattern, turning the bolts an additional 85 degrees.
    - Repeat the illustrated pattern, turning the bolts an additional 85 degrees.
    - Repeat the illustrated pattern, turning the bolts an additional 85 degrees for a total of 255 degrees.

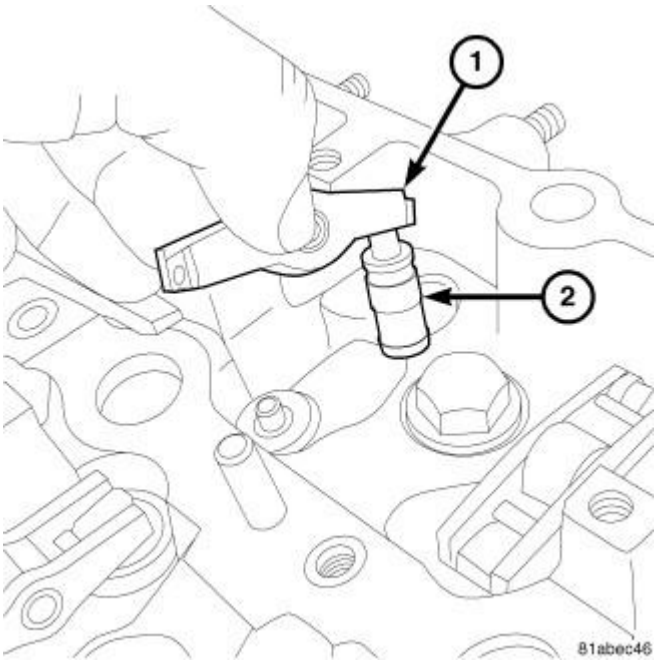

Fig. 64: Rocker Arms & Hydraulic Lifters
Courtesy of CHRYSLER GROUP, LLC

13. Install the hydraulic lifters (2) and rocker arms (1). Make sure to return the lifters and arms to their original position.

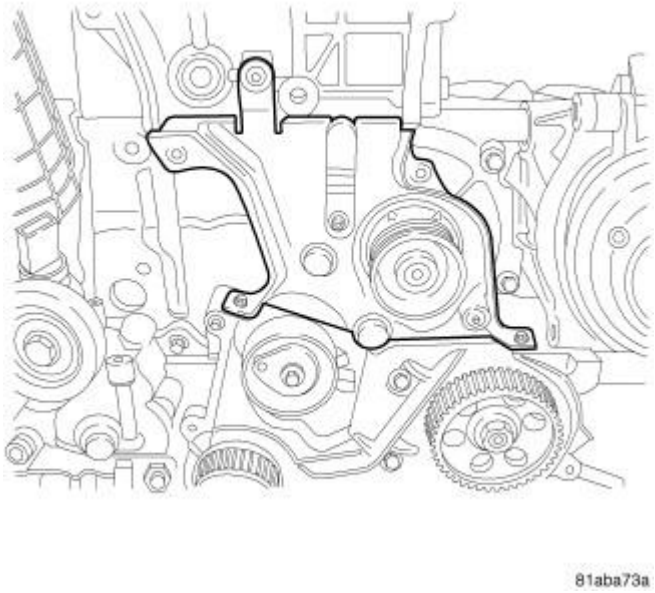

Fig. 65: Inner Front Cover
Courtesy of CHRYSLER GROUP, LLC

14. Install the inner front cover. Tighten the bolts to 11 N.m (97 in. lbs.).
15. Install the camshafts. Refer to **CAMSHAFT, ENGINE, INSTALLATION**.
16. Install the exhaust manifold. Refer to **MANIFOLD, EXHAUST, INSTALLATION**.
17. Install the intake manifold. Refer to **MANIFOLD, INTAKE, INSTALLATION**.
18. Connect the battery.

CAMSHAFT, ENGINE

DESCRIPTION

DESCRIPTION

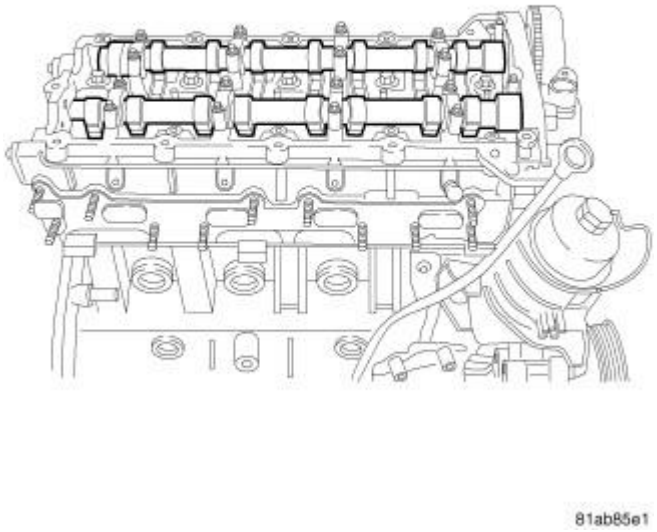

Fig. 66: Camshafts
Courtesy of CHRYSLER GROUP, LLC

The camshafts are made of cast iron with eight machined lobes and four bearing journals.

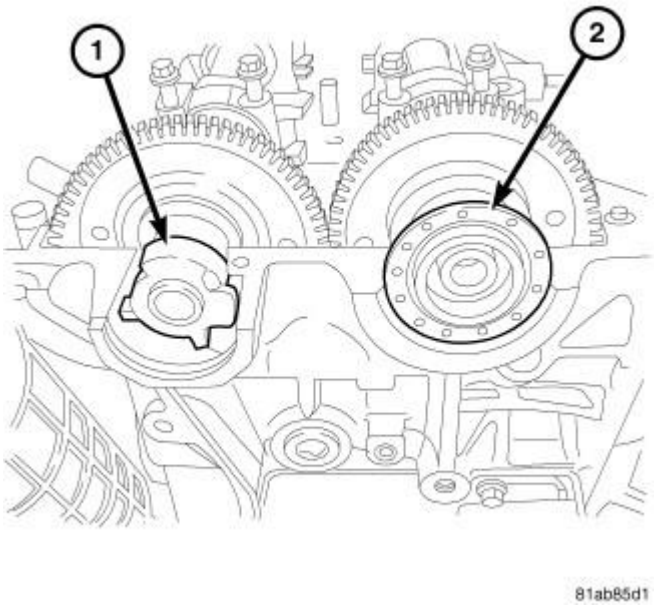

Fig. 67: Exhaust Camshaft & Intake Camshaft Oil Seal
Courtesy of CHRYSLER GROUP, LLC

1. The exhaust camshaft (1) incorporates the CMP sensor reluctor wheel. The intake camshaft uses a camshaft seal (2).

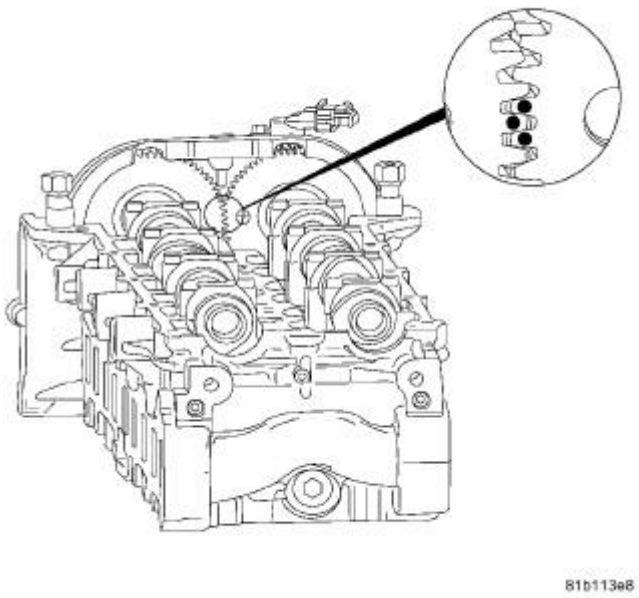

Fig. 68: Camshaft Timing Dots
Courtesy of CHRYSLER GROUP, LLC

2. The dots on the back of the camshaft gears are for initial timing only. These dots are for timing the camshafts to each other. To correctly set engine timing, the camshafts must be set to 90° ATDC. The Camshaft Locking Tool (special tool #VM.9991, Alignment Tool, Camshaft Sprocket) is used to correctly set the camshafts to their proper location.

REMOVAL

REMOVAL

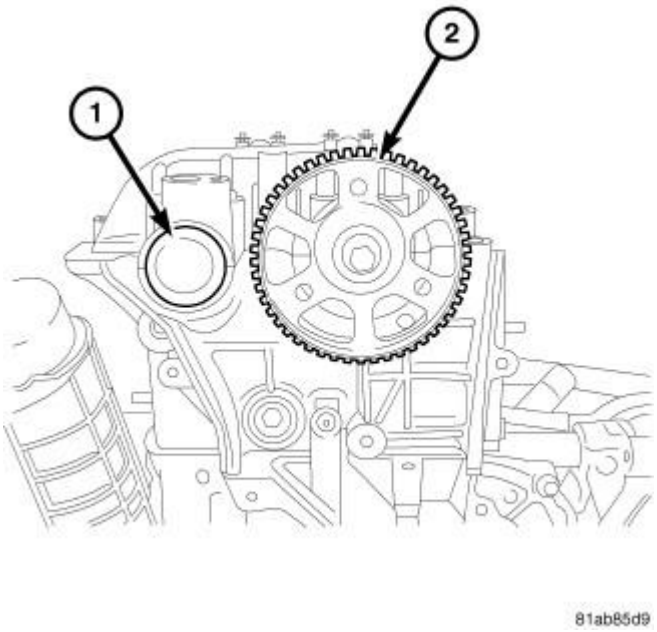

Fig. 69: Intake Camshaft Sprocket
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the intake camshaft sprocket (2). Refer to **SPROCKET(S), TIMING BELT AND CHAIN, REMOVAL**.

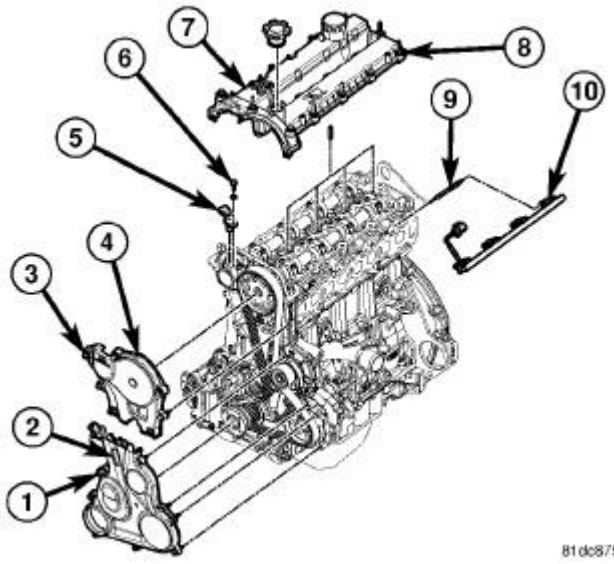

Fig. 70: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

3. Remove the cylinder head cover (7). Refer to **COVER(S), CYLINDER HEAD, REMOVAL**.

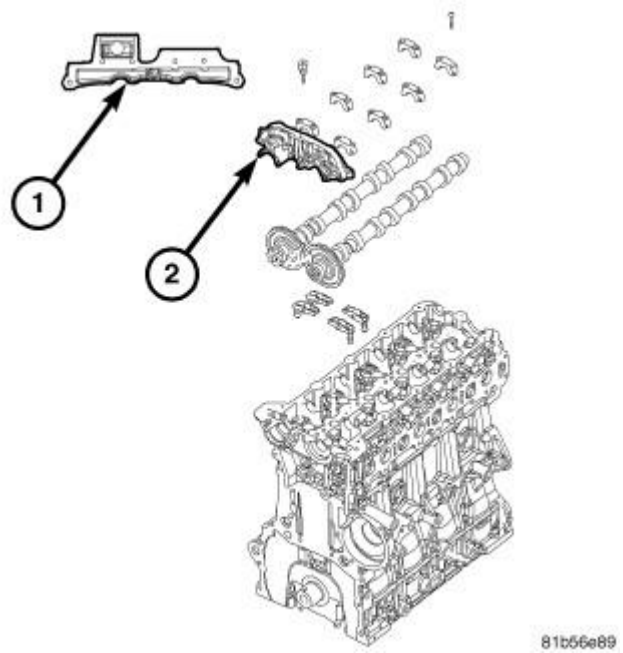

Fig. 71: Camshaft Cap RTV Location
Courtesy of CHRYSLER GROUP, LLC

4. Remove the front cam bearing journal (2).

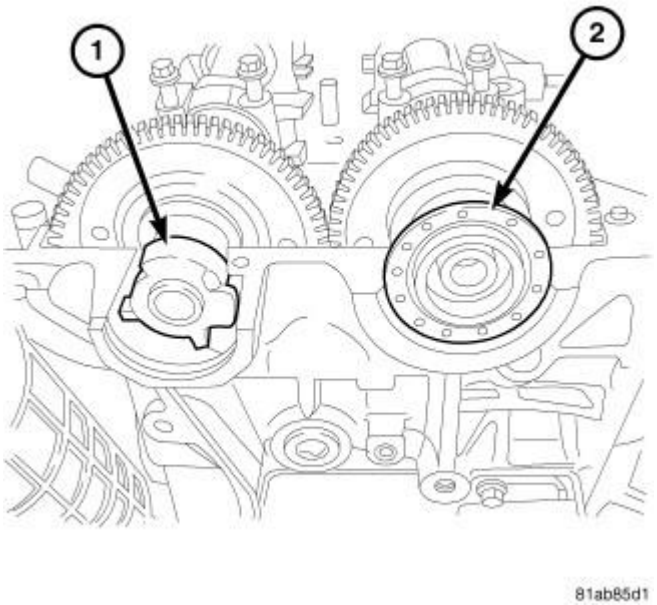

Fig. 72: Exhaust Camshaft & Intake Camshaft Oil Seal
Courtesy of CHRYSLER GROUP, LLC

5. Remove the intake camshaft oil seal (2).

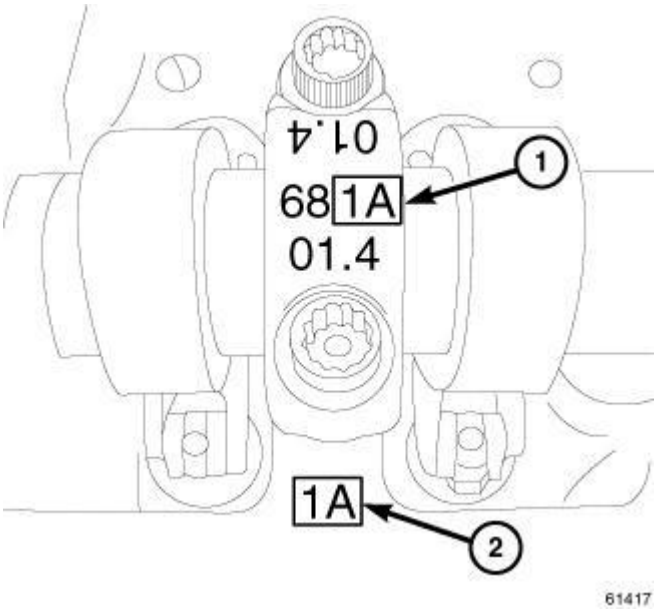

Fig. 73: Identifying Camshaft Cap & Cylinder Head (Intake Side) Markings
Courtesy of CHRYSLER GROUP, LLC

NOTE: Observe the position marks on the cylinder head and camshaft cap as a reference to its original location. The illustration is an example of the camshaft markings.

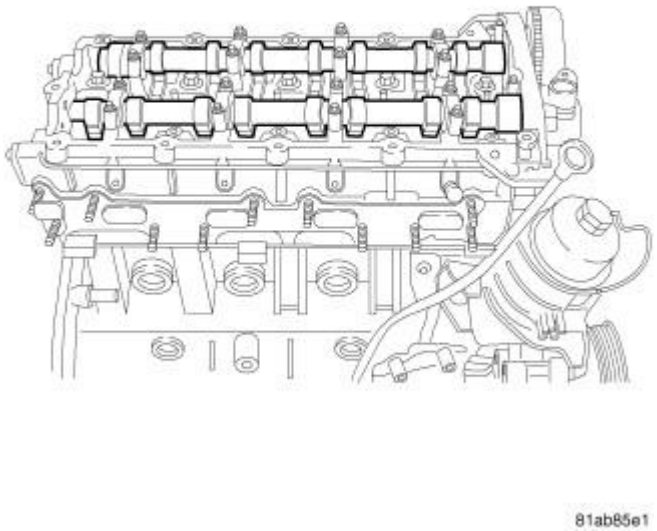

Fig. 74: Camshafts
Courtesy of CHRYSLER GROUP, LLC

NOTE: Intake and exhaust manifolds removed for clarity.

6. Using a circular pattern, remove bolts and the camshaft bearing caps.
7. Remove the camshafts.

INSTALLATION

INSTALLATION

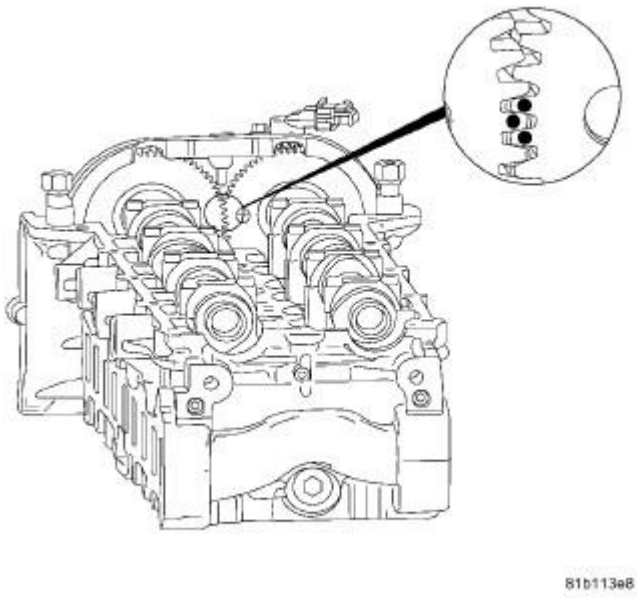

Fig. 75: Camshaft Timing Dots
Courtesy of CHRYSLER GROUP, LLC

1. Lubricate the camshaft journals with Mopar® Engine Oil Supplement, or equivalent.

NOTE: The dots on the back of the camshaft gears are for initial timing only. These dots are for timing the camshafts to each other. To correctly set engine timing, the camshafts must be set to 90° ATDC. The camshaft locking tool is used to correctly set the camshafts to their proper location.

2. Make sure that the three small orientation dots marks on the back side of the camshaft gears are horizontal and facing each other.
3. Carefully install camshafts onto the camshaft journals.

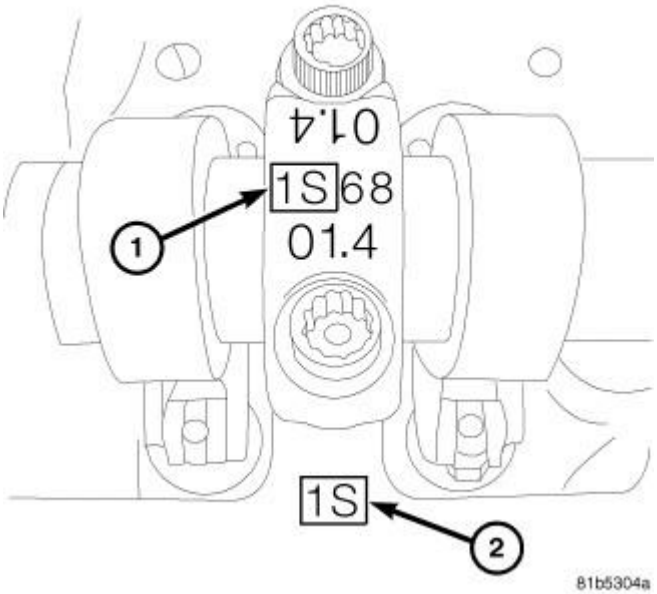

Fig. 76: Identifying Camshaft Cap & Cylinder Head (Exhaust Side) Markings
Courtesy of CHRYSLER GROUP, LLC

4. The cylinder head and camshaft caps have markings to identify each cap to its correct location. In the illustration, 1S (1) is marked on the exhaust side camshaft cap and 1S (2) is the mark on the exhaust side of the cylinder head. It is critical that all of the camshaft caps are returned to their correct locations.

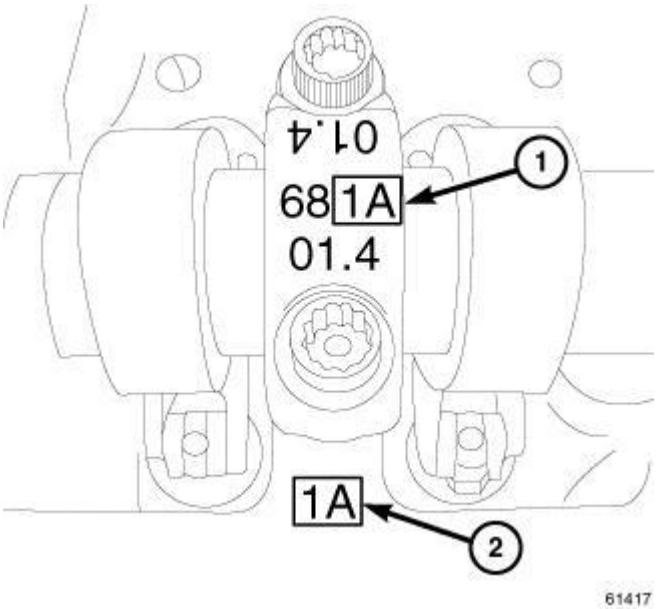

Fig. 77: Identifying Camshaft Cap & Cylinder Head (Intake Side) Markings
Courtesy of CHRYSLER GROUP, LLC

5. The cylinder head and camshaft caps have markings to identify each cap to its correct location. In the illustration, 1A (1) is marked on the intake side camshaft cap and 1A (2) is the mark on the intake side of

the cylinder head. It is critical that all of the camshaft caps are returned to their correct locations.

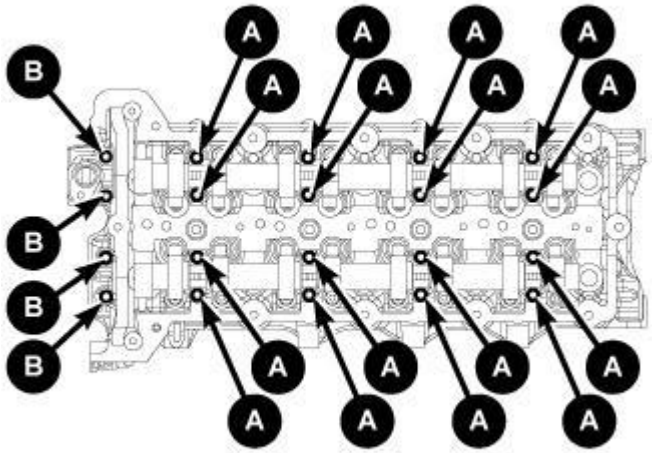

Fig. 78: Identifying Camshaft Bolts
Courtesy of CHRYSLER GROUP, LLC

NOTE: Whenever the camshaft caps are removed, always replace the bolts.

6. The camshaft bolts have 2 different bolt sizes.
   - Bolts A are M6 35 mm.
   - Bolts B are M6 45 mm.

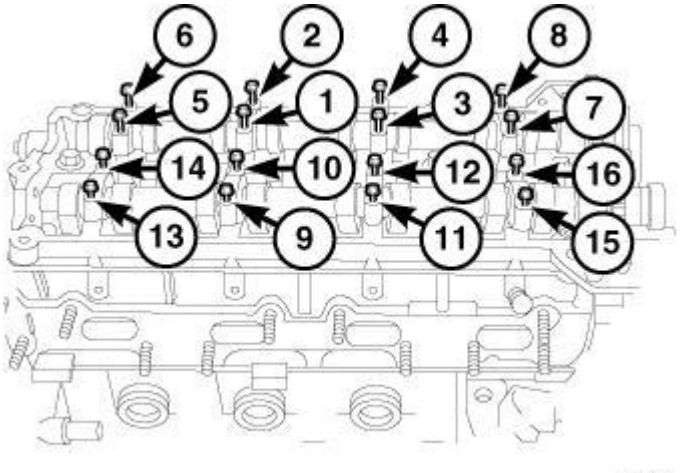

Fig. 79: Camshaft Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

7. Using new bolts and the tightening sequence shown in illustration, install the camshaft bolts and tighten

bolts in one turn increments until finger tight.

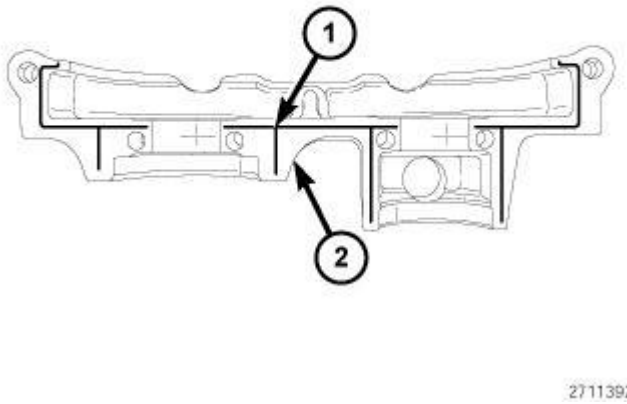

Fig. 80: Camshaft Cap RTV Location
Courtesy of CHRYSLER GROUP, LLC

NOTE: Be careful not to get ant Loctite® 510 onto the camshaft journal.

8. Apply a thin bead of Loctite® 510 to the front camshaft bearing journal (2) in the location illustrated (1).
9. Install the front camshaft bearing journal and tighten the new bolts finger tight.

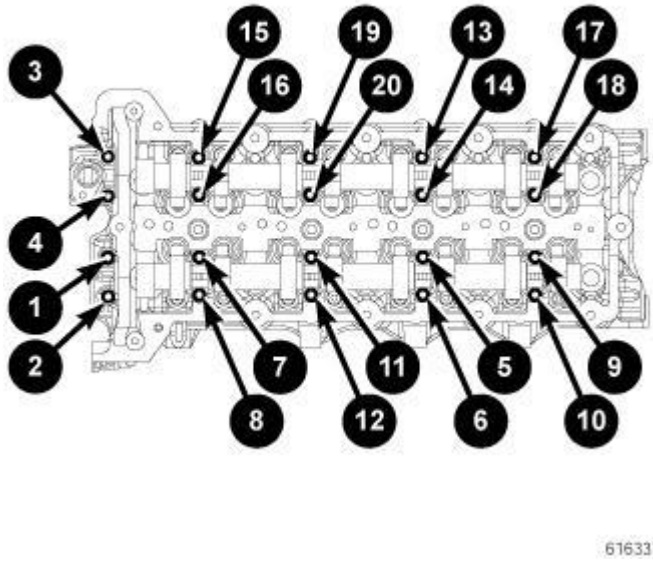

Fig. 81: Camshaft Cap Bolt Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

10. Using the sequence shown in illustration, tighten the camshaft cap bolts to 11 N.m (97 in. lbs.).

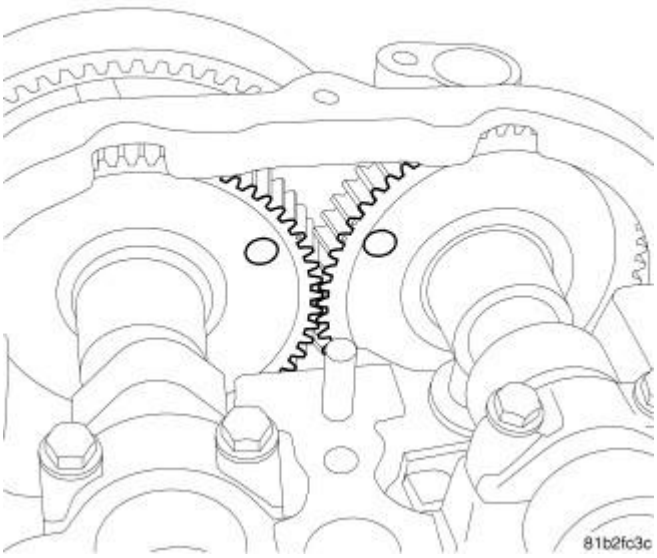

Fig. 82: Camshaft Marks At 90 Degrees ATDC
Courtesy of CHRYSLER GROUP, LLC

11. Rotate the camshafts so that the (special tool #VM.9991, Alignment Tool, Camshaft Sprocket) fits into place.

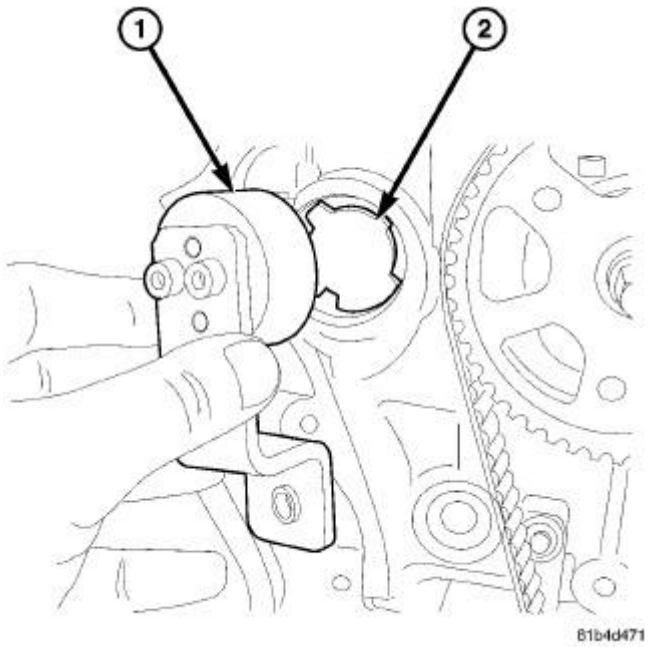

Fig. 83: Removing/Installing Camshaft Lock Tool

Courtesy of CHRYSLER GROUP, LLC

12. Install the (special tool #VM.9991, Alignment Tool, Camshaft Sprocket) (1) onto the camshaft position sensor tone wheel (2).

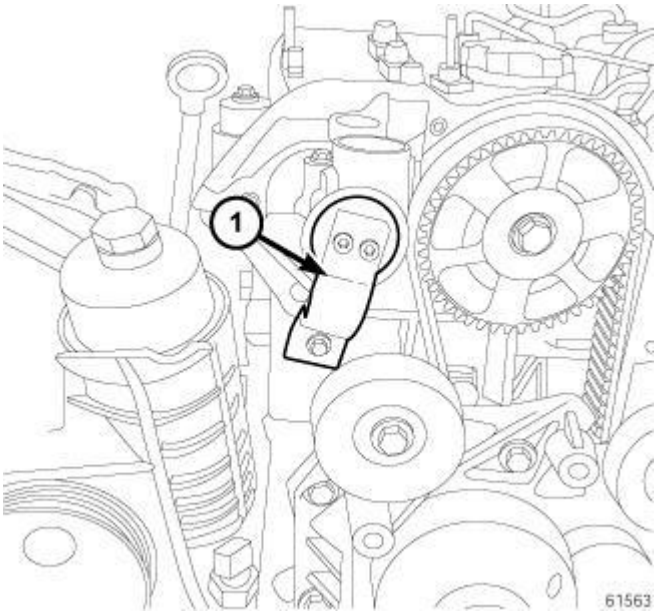

Fig. 84: Camshaft Locking Tool Installed
Courtesy of CHRYSLER GROUP, LLC

13. When the (special tool #VM.9991, Alignment Tool, Camshaft Sprocket) is bolted in place, the camshafts are locked at 90 degrees ATDC.

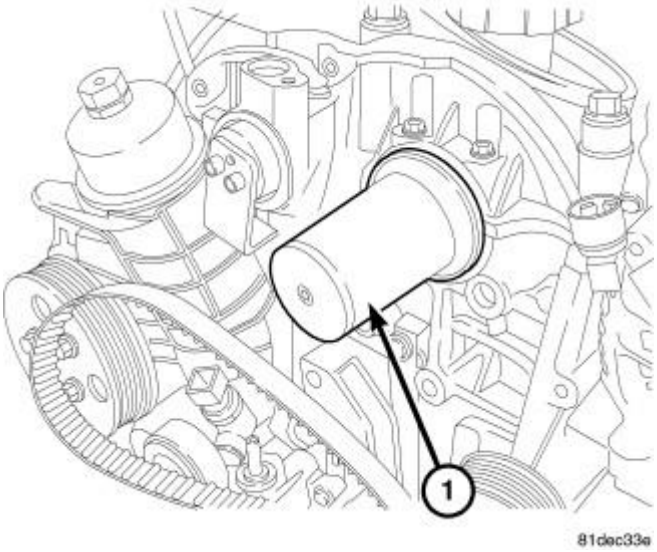

Fig. 85: Camshaft Oil Seal Installer
Courtesy of CHRYSLER GROUP, LLC

14. Using the (special tool #9937-1, Installer, Seal) and (special tool #9937-2, Guide, Seal) (1), install the

intake camshaft oil seal.

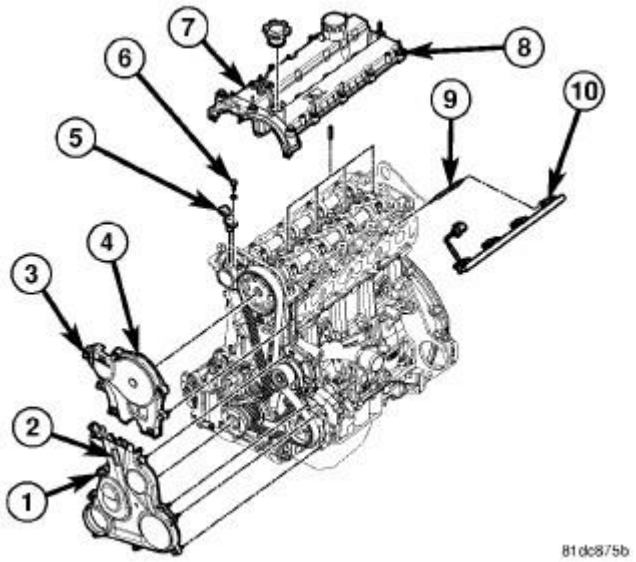

Fig. 86: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

15. Install the cylinder head cover (7). Refer to **COVER(S), CYLINDER HEAD, INSTALLATION**.

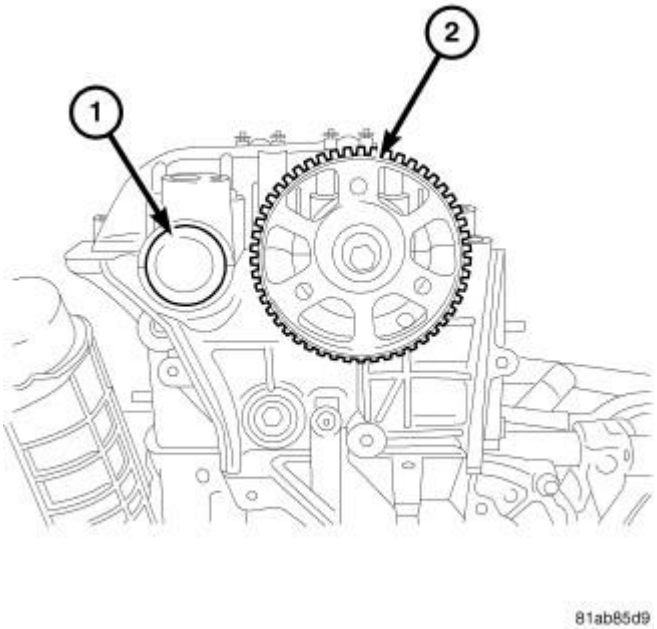

Fig. 87: Intake Camshaft Sprocket
Courtesy of CHRYSLER GROUP, LLC

16. Install the camshaft sprocket (2). Refer to **SPROCKET(S), TIMING BELT AND CHAIN, INSTALLATION**.

17. Connect the negative battery cable.

CHECKING CAMSHAFT ENDPLAY

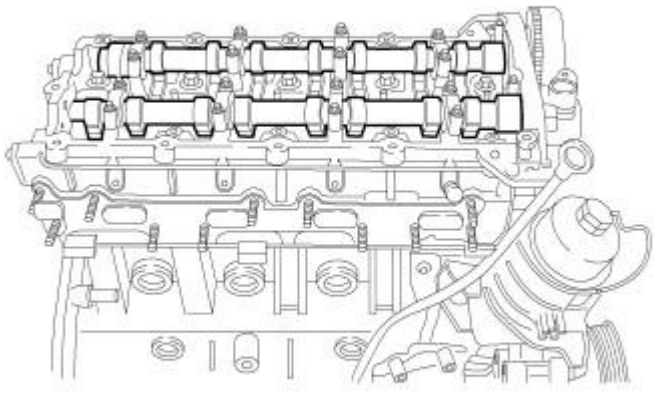

Fig. 88: Camshafts
Courtesy of CHRYSLER GROUP, LLC

1. After camshafts are properly installed in cylinder head cover check end play of camshafts with a (special tool #C-3339A, Set, Dial Indicator). The end play should be between 0.10 mm - 0.55 mm.

   NOTE: If the camshaft endplay is not within specification, replace the cylinder head.

2. Measure the camshaft end play with a (special tool #C-3339A, Set, Dial Indicator). The end play should be between 0.15 mm 0.35 mm (0.006 in - 0.014 in.).

COVER(S), CYLINDER HEAD

DESCRIPTION

DESCRIPTION

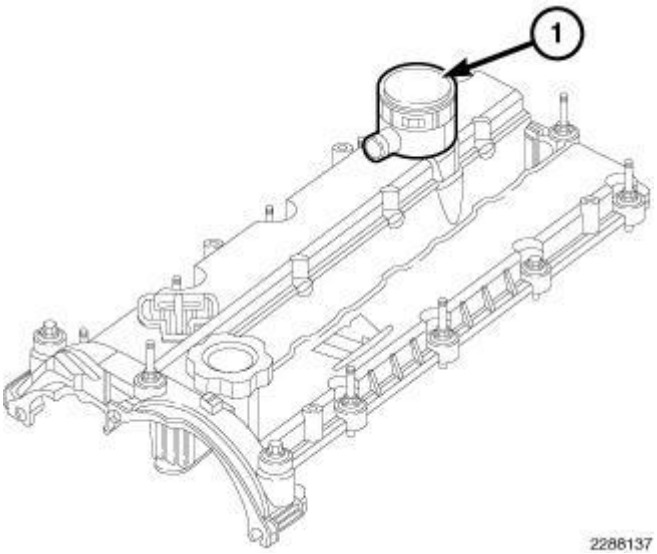

Fig. 89: Crankcase Ventilation (CCV) System
Courtesy of CHRYSLER GROUP, LLC

The cylinder head cover is made of an injection molded composite. The cylinder head cover also incorporates a oil drain back hole for the crankcase ventilation (CCV) system (1).

The cylinder head cover gasket is not a serviceable item, if the gasket is found to be defective then a **new** cylinder head cover must be installed.

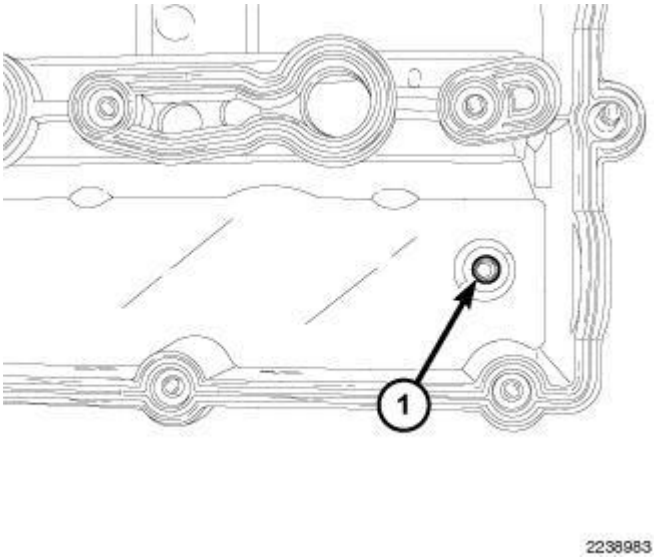

Fig. 90: Oil Drain Back Access Hole
Courtesy of CHRYSLER GROUP, LLC

The cylinder head cover also incorporates a oil drain back hole (1) for the crankcase ventilation (CCV) system.

REMOVAL

REMOVAL

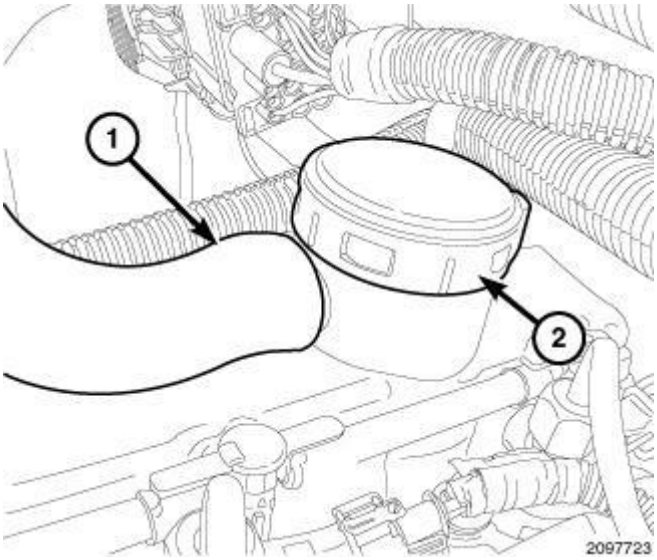

Fig. 91: Crankcase Vent Hose & Oil Separator
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Disconnect the crankcase vent hose (1) from the oil separator (2).
3. Remove the fuel injectors. Refer to **INJECTOR(S), FUEL, REMOVAL** .

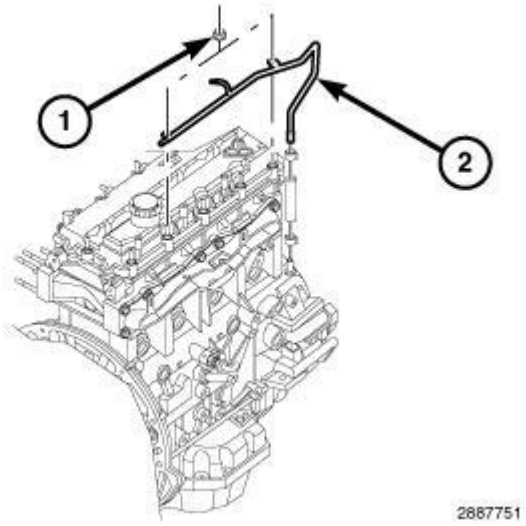

Fig. 92: Retaining Nuts & Vacuum Line
Courtesy of CHRYSLER GROUP, LLC

4. Remove the retaining nuts (1) and the vacuum supply line (2).

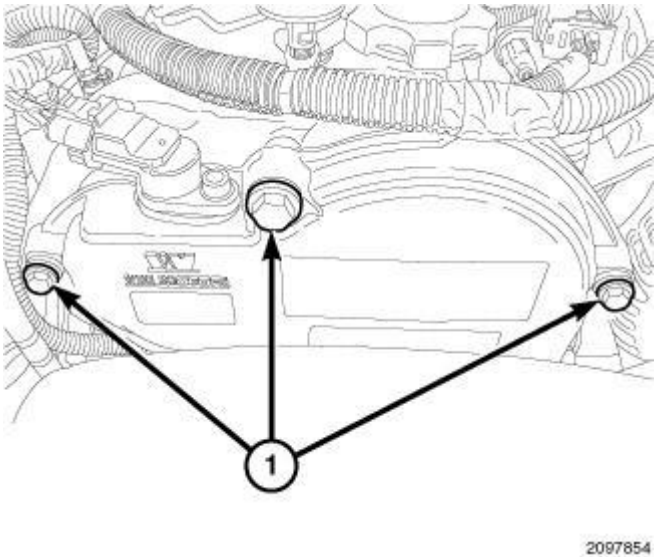

Fig. 93: Upper Front Timing Cover Bolts
Courtesy of CHRYSLER GROUP, LLC

NOTE: The upper cover bolts are encased in a collar which does not permit them to be removed.

5. Loosen the upper front timing cover bolts (1).

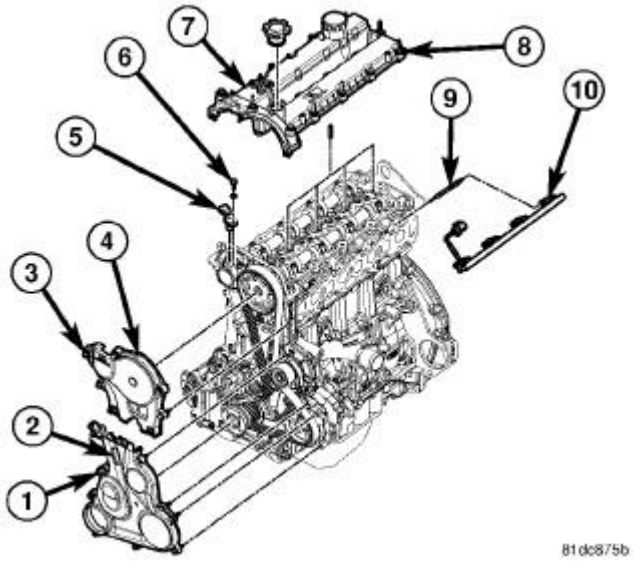

Fig. 94: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

6. Loosen the fasteners (8) and the cylinder head cover (7).

INSTALLATION

INSTALLATION

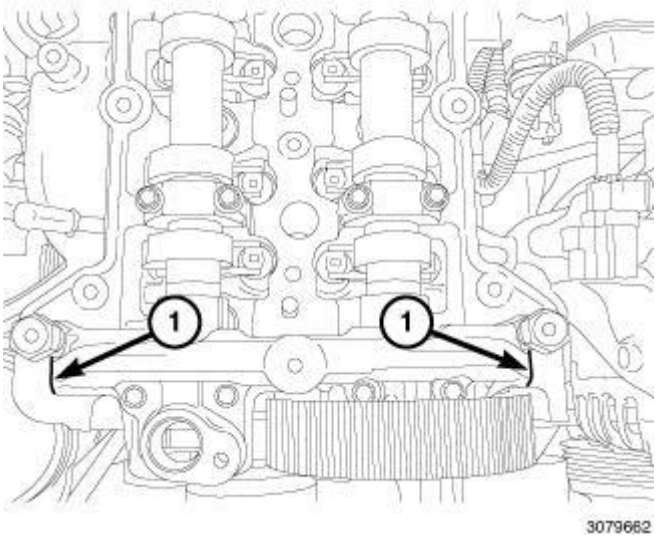

Fig. 95: Locating Application Marks Of Bead Of Mopar® Engine Sealant RTV
Courtesy of CHRYSLER GROUP, LLC

NOTE: The cylinder head cover gasket is not serviceable, if the gasket is found to be defective then a new cylinder head cover must be installed.

1. Clean the sealing surfaces and inspect the gasket for damage and replace the cylinder head cover with a new one if the gasket is found to be defective.
2. Apply a 3 mm bead of Mopar® Engine Sealant RTV to the camshaft bearing cap (1).

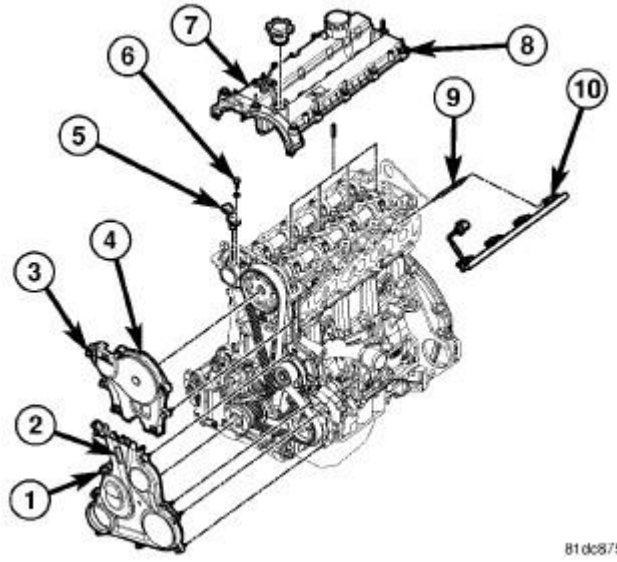

Fig. 96: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

3. Install the cylinder head cover (7). Tighten to 11 N.m (97 in. lbs.).

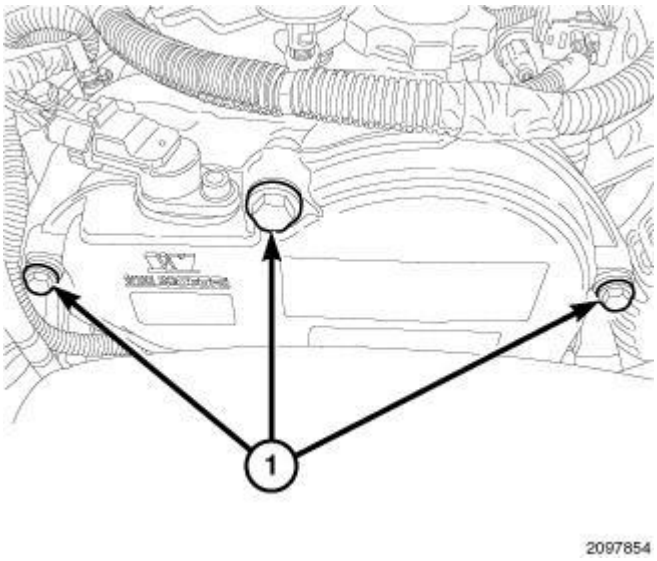

Fig. 97: Upper Front Timing Cover Bolts
Courtesy of CHRYSLER GROUP, LLC

4. Tighten the upper front timing cover bolts (1) to 11 N.m (97 in. lbs.).

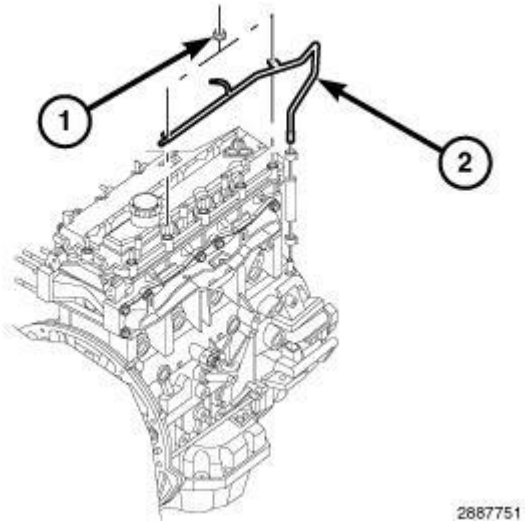

Fig. 98: Retaining Nuts & Vacuum Line
Courtesy of CHRYSLER GROUP, LLC

5. Install the vacuum supply line (2). Tighten nuts (1) to 11 N.m (97 in. lbs.).

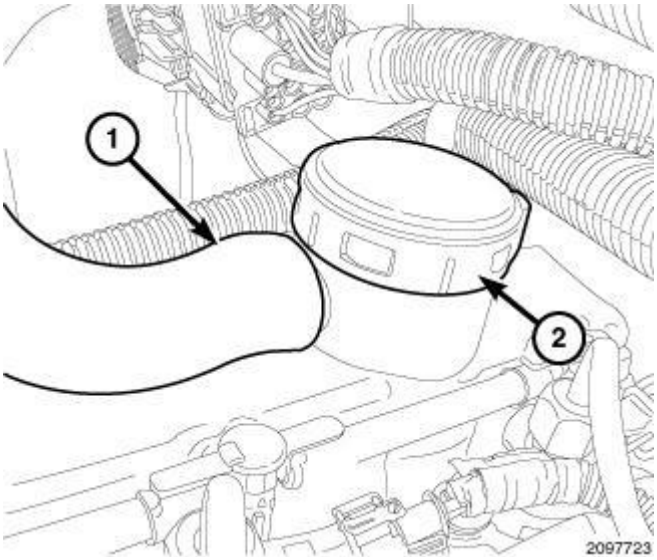

Fig. 99: Crankcase Vent Hose & Oil Separator
Courtesy of CHRYSLER GROUP, LLC

6. Install the fuel injector. Refer to **INJECTOR(S), FUEL, INSTALLATION** .
7. Connect the crankcase vent hose (1) to the oil separator (2).
8. Connect the negative battery cable.

LIFTER(S), HYDRAULIC

DESCRIPTION

DESCRIPTION

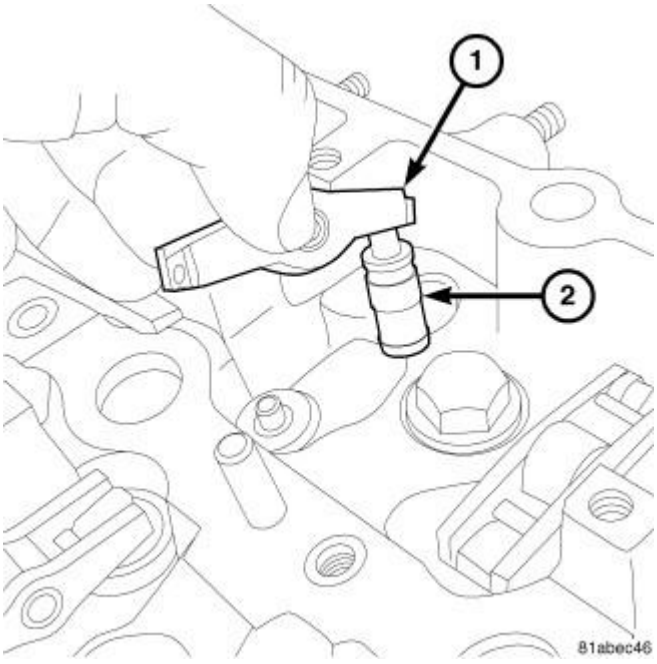

Fig. 100: Rocker Arms & Hydraulic Lifters
Courtesy of CHRYSLER GROUP, LLC

Valve lash is controlled by hydraulic tappets (2) located inside the cylinder head, in tappet bores below the camshafts.

REMOVAL

REMOVAL

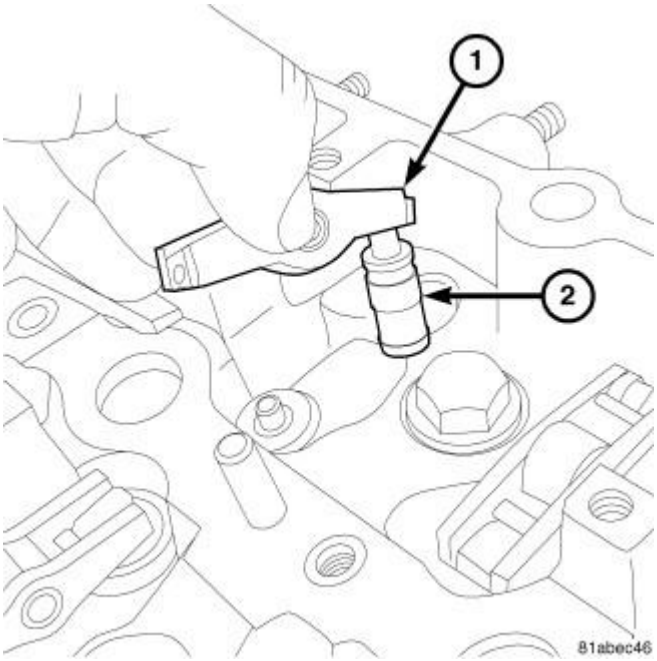

Fig. 101: Rocker Arms & Hydraulic Lifters
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the camshafts. Refer to **CAMSHAFT, ENGINE, REMOVAL**.

NOTE: Always return the hydraulic lifters to their original location in the cylinder head.

3. Remove the rocker arms (1) and hydraulic lifters (2).

INSPECTION

INSPECTION

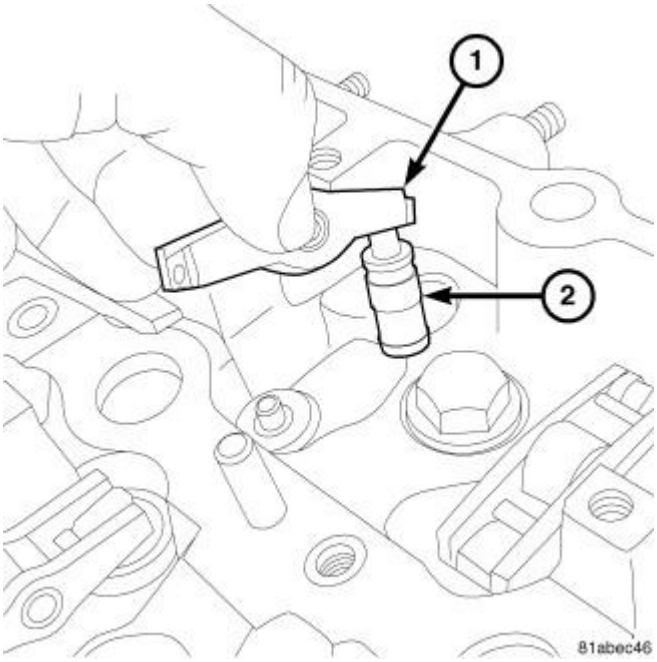

Fig. 102: Rocker Arms & Hydraulic Lifters
Courtesy of CHRYSLER GROUP, LLC

Clean each lifter assembly (1) in cleaning solvent to remove all varnish and sludge deposits. Inspect for indications of scuffing on the side and base of each lifter body.

INSTALLATION

INSTALLATION

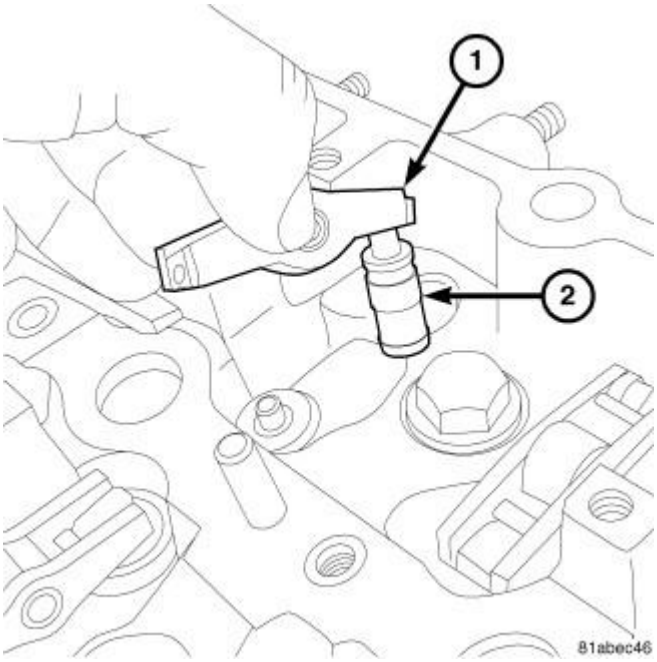

Fig. 103: Rocker Arms & Hydraulic Lifters

Courtesy of CHRYSLER GROUP, LLC

1. Install the rocker arms (1) and hydraulic lifters (2) into their original locations.
2. Install the camshafts. Refer to **CAMSHAFT, ENGINE, INSTALLATION**.
3. Connect the negative battery cable.

ROCKER ARM, VALVE

DESCRIPTION

DESCRIPTION

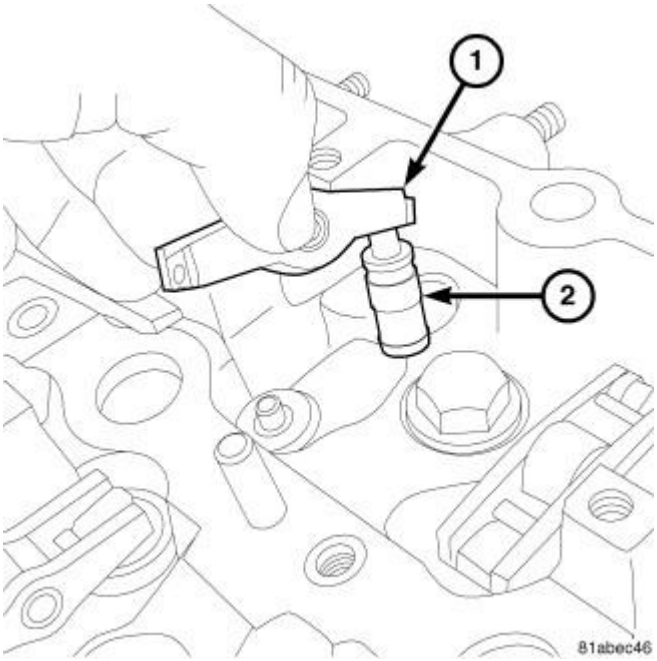

Fig. 104: Rocker Arms & Hydraulic Lifters
Courtesy of CHRYSLER GROUP, LLC

The rocker arms (1) are made of stamped steel and serviced as an assembly along with the lifter.

The rocker arms (1) are used as a link between the camshaft and valves. As the camshaft rotates, the lobes of the camshafts apply downward pressure on the rocker arms (1). This pressure is then applied to the hydraulic lifter (2) which opens the valve.

REMOVAL

REMOVAL

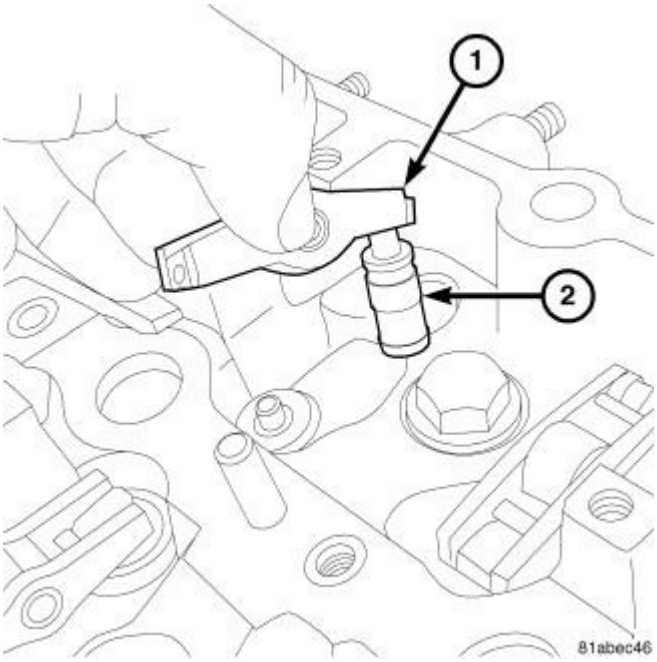

Fig. 105: Rocker Arms & Hydraulic Lifters
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the camshafts. Refer to **CAMSHAFT, ENGINE, REMOVAL**.
3. Remove rocker arms (1) and lifters (2).

INSTALLATION

INSTALLATION

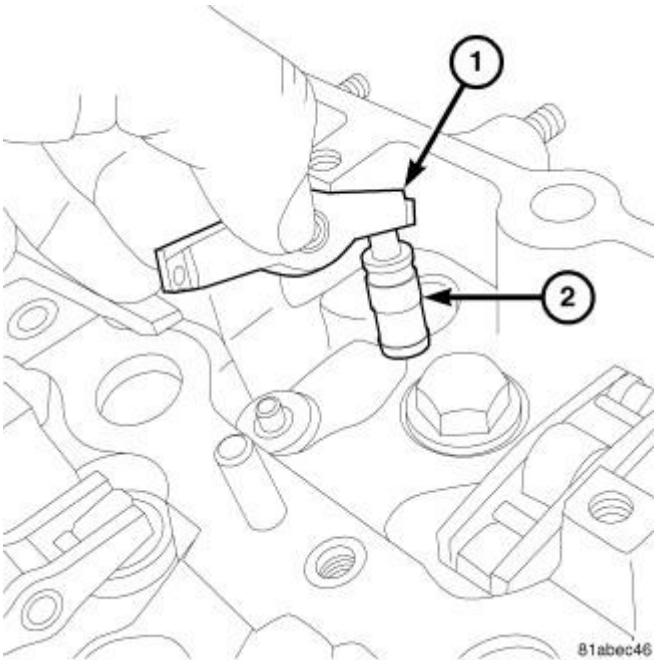

Fig. 106: Rocker Arms & Hydraulic Lifters
Courtesy of CHRYSLER GROUP, LLC

1. Clean and inspect gasket sealing surfaces.
2. Lubricate lifter ball end of lifter(s), valve(s), and rocker arm roller(s) with Mopar® Engine Oil Supplement or equivalent.
3. Connect rocker arm(s) to lifter and reposition on valve(s).
4. Install the camshafts. Refer to **CAMSHAFT, ENGINE, INSTALLATION**.
5. Connect the negative battery cable.

SEAL(S), CAMSHAFT

REMOVAL

REMOVAL

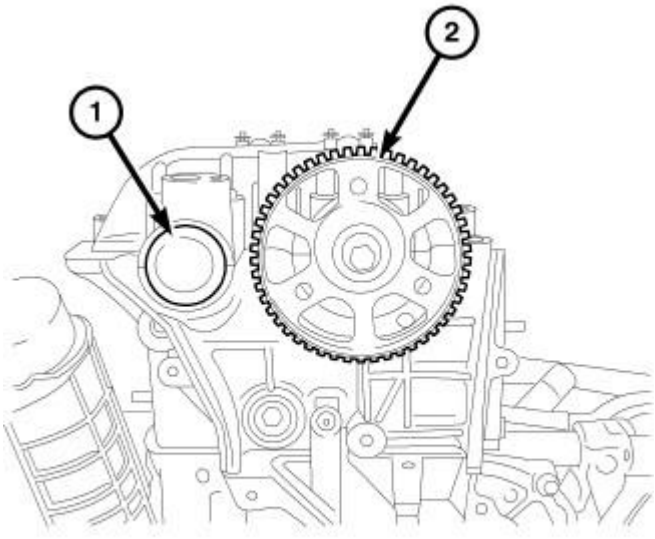

Fig. 107: Intake Camshaft Sprocket
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the intake camshaft sprocket (2). Refer to **SPROCKET(S), TIMING BELT AND CHAIN, REMOVAL**.

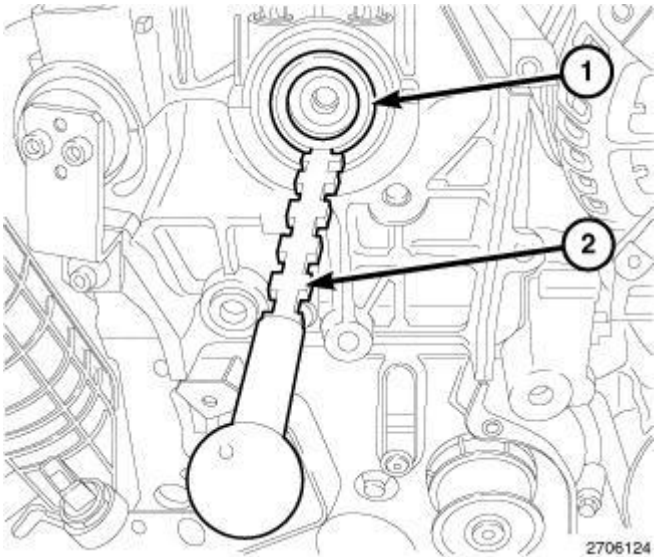

Fig. 108: Seal Remover & Seal
Courtesy of CHRYSLER GROUP, LLC

3. Install the Seal Remover (special tool #VM.1058, Remover, Seal) (2) into seal (1) as illustrated.

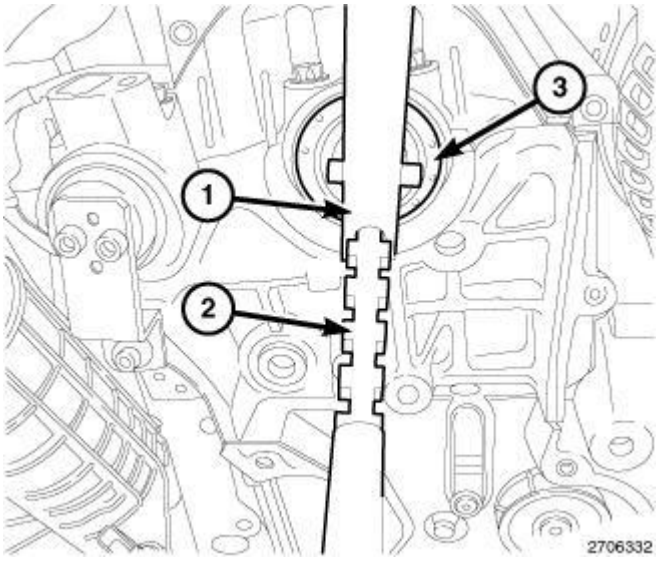

Fig. 109: Seal Remover Handle, Seal Remover & Intake Camshaft Oil Seal
Courtesy of CHRYSLER GROUP, LLC

4. Position the Seal Remover Handle (special tool #VM.1058, Remover, Seal) (1) onto Seal Remover (special tool #VM.1058, Remover, Seal) (2) and remove the intake camshaft oil seal (3).

INSTALLATION

INSTALLATION

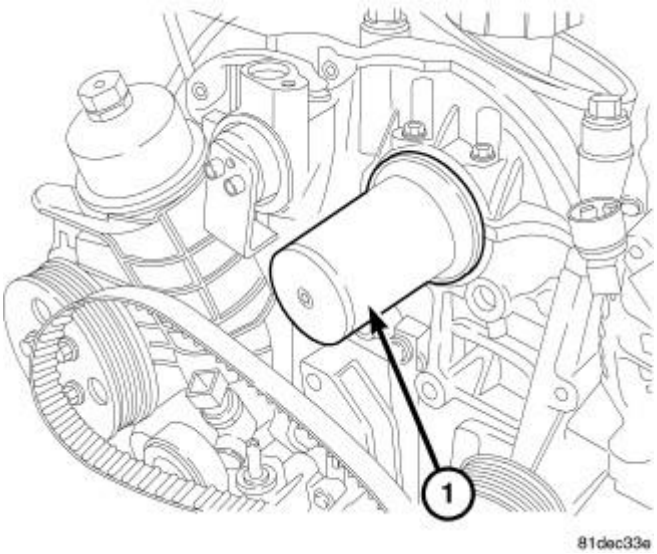

Fig. 110: Camshaft Oil Seal Installer
Courtesy of CHRYSLER GROUP, LLC

1. Use the Seal Installer (special tool #9937-1, Installer, Seal) and (special tool #9937-2, Guide, Seal) (1) to install the intake camshaft oil seal.

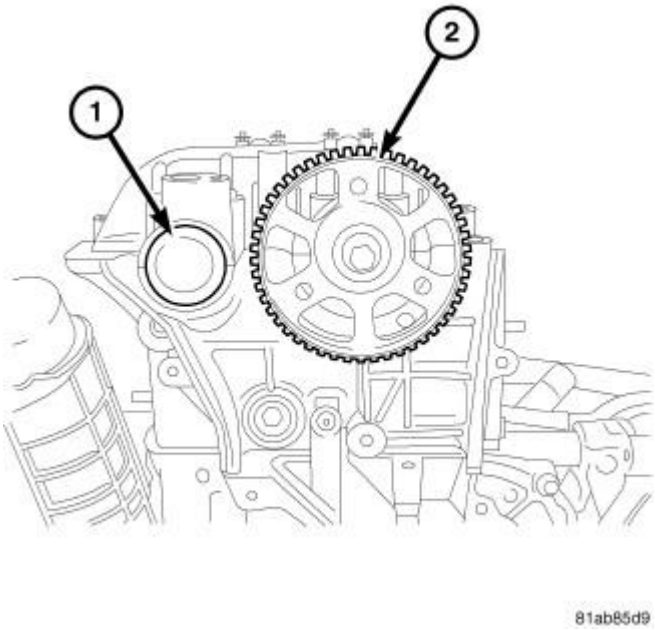

Fig. 111: Intake Camshaft Sprocket
Courtesy of CHRYSLER GROUP, LLC

2. Install the camshaft sprocket (2). Refer to **SPROCKET(S), TIMING BELT AND CHAIN, INSTALLATION**.
3. Connect the negative battery cable.

ENGINE BLOCK

DESCRIPTION

DESCRIPTION

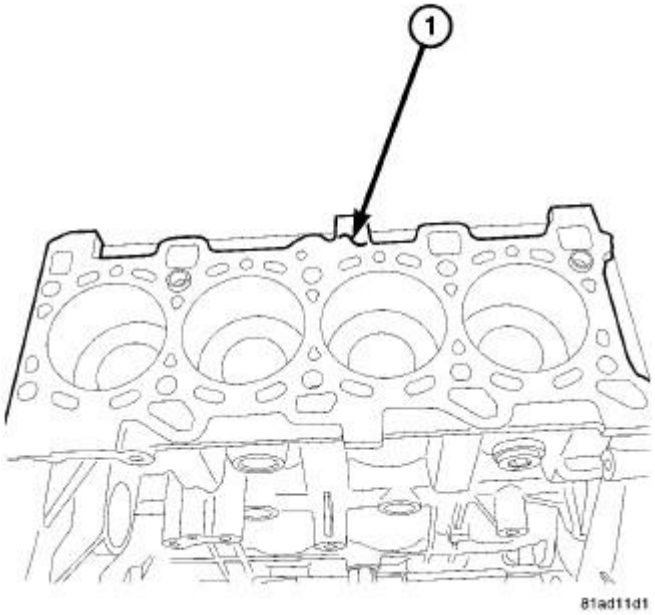

Fig. 112: Engine Block
Courtesy of CHRYSLER GROUP, LLC

The 2.8L CRD Diesel engine uses a cast iron engine block. The cylinder block has increased stiffness that reduces structural flexing and a fractured connecting rod cap design that can not distort connecting rod cap fit.

STANDARD PROCEDURE

BEARING SELECTION CHARTS

CONNECTING ROD BEARINGS - LARGE END

Connecting Rod Journal Diameter - Connecting Rod Large End	Bearing Half	Connecting Rod Journal Diameter - Crankshaft			
		D	C	B	A
		53.929 - 53.936	53.936 - 53.942	53.942 - 53.948	53.948 - 53.955
A 57.563 - 57.568	Upper Bearing Shell	Blue	Blue	Red	Red
	Lower Bearing				

	Shell	Yellow	Blue	Blue	Red
B 57.568 - 57.573	Upper Bearing Shell	Yellow	Blue	Blue	Red
	Lower Bearing Shell	Yellow	Yellow	Blue	Blue
C 57.573 - 57.578	Upper Bearing Shell	Yellow	Yellow	Blue	Blue
	Lower Bearing Shell	Green	Yellow	Yellow	Blue
D 57.578 - 57.583	Upper Bearing Shell	Green	Yellow	Yellow	Blue
	Lower Bearing Shell	Green	Green	Yellow	Yellow

CRANKSHAFT BEARINGS

Cylinder Block Seat Diameter	Bearing Half	Crankshaft Main Journal Diameter			
		D	C	B	A
		64.974 - 64.981	64.981 - 64.987	64.987 - 64.993	64.993 - 65.000
A 69.000 - 69.005	Upper Bearing Shell	Blue	Blue	Red	Red
	Lower Bearing Shell	Yellow	Blue	Blue	Red
B 69.005 - 69.010	Upper Bearing Shell	Yellow	Blue	Blue	Red
	Lower Bearing Shell	Yellow	Yellow	Blue	Blue
C 69.010 - 69.015	Upper Bearing Shell	Yellow	Yellow	Blue	Blue
	Lower Bearing Shell	Green	Yellow	Yellow	Blue

D **69.015 - 69.020**	Upper Bearing Shell	Green	Yellow	Yellow	Blue
	Lower Bearing Shell	Green	Green	Yellow	Yellow

BEARING(S), CONNECTING ROD

REMOVAL

REMOVAL

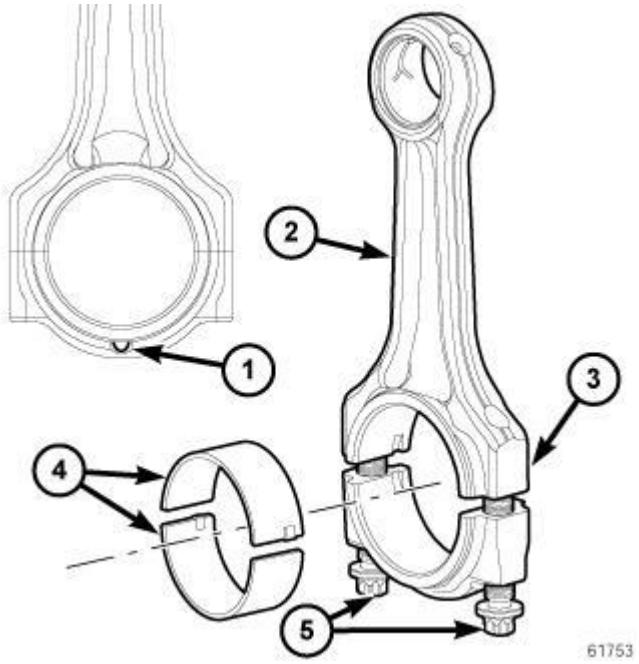

Fig. 113: Connecting Rod Identification
Courtesy of CHRYSLER GROUP, LLC

1 - CONNECTING ROD PAWL
2 - CONNECTING ROD
3 - PAINTED CYLINDER IDENTIFIER
4 - CONNECTING ROD BEARINGS

1. Remove the balance shaft module. Refer to **MODULE, BALANCE SHAFT, REMOVAL**.
2. Remove the connecting rod bearing caps (1) one at a time and discard bolts (5).
3. Carefully remove the upper half and lower half of bearing (4) from the connecting rod (2).

INSTALLATION

INSTALLATION

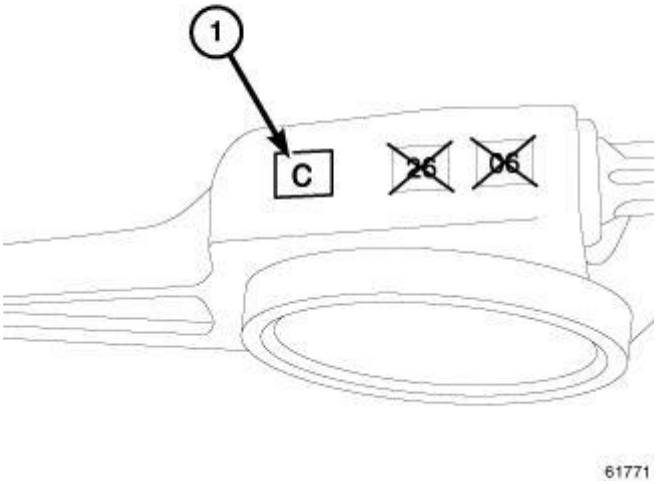

Fig. 114: Connecting Rod Size
Courtesy of CHRYSLER GROUP, LLC

1. Each connecting rod has its own letter class (1) to a specific connecting rod journal diameter.

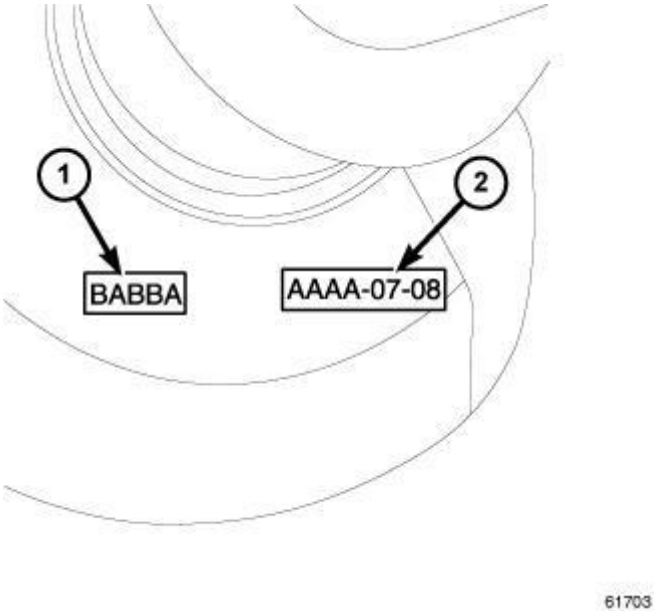

Fig. 115: Crankshaft Connecting Rod Journal Diameter
Courtesy of CHRYSLER GROUP, LLC

2. To determine the correct bearing size for each cylinder. Each connecting rod letter class must be matched with the crankshaft letter class (2) with the bearing selection chart to determine the correct bearing color for each cylinder. The letters stamped into the crankshaft (2) are in the same order as the cylinders. The first letter corresponds to the first cylinder, the second to the second, etc. See bearing selection chart.

Refer to **Engine/Engine Block - Standard Procedure**.

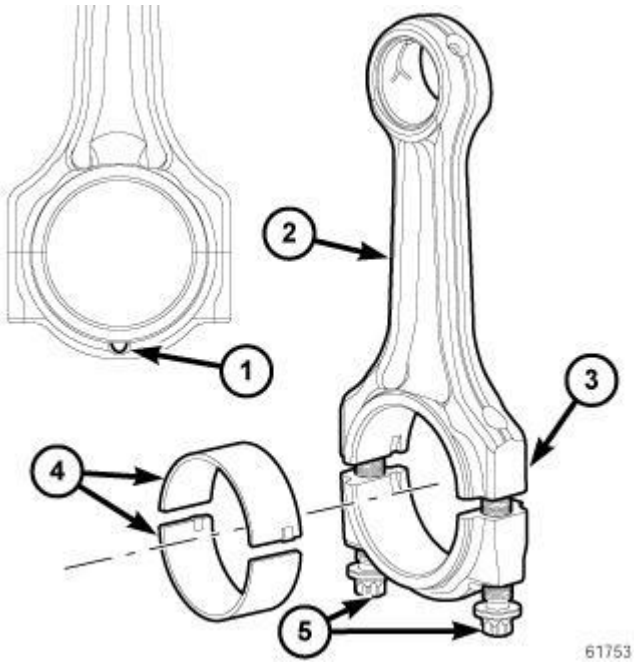

Fig. 116: Connecting Rod Identification
Courtesy of CHRYSLER GROUP, LLC

1 - CONNECTING ROD PAWL
2 - CONNECTING ROD
3 - PAINTED CYLINDER IDENTIFIER
4 - CONNECTING ROD BEARINGS

CAUTION: Connecting rod bolts must be replaced when disassembled. When assembling the connecting rod (2), be sure that the connecting rod pawl (1) on each of the connecting rod caps is facing the rear (fly wheel) side of the engine.

NOTE: Do Not lubricate the new connecting rod bolts. They are already coated with a anti scuff treatment.

3. Assemble connecting rod bearings (4) and bearing caps to their respective connecting rods (2) ensuring that the serrations on the cap and reference marks are aligned.
4. Using new connecting rod bolts, tighten the connecting rod cap bolts to 10 N.m (88 in. lbs.).
5. Without loosening connecting rod bolts, tighten all bolts to 30 N.m (22 ft. lbs.).
6. Using a torque angle gauge, tighten each bolt an additional 40 degrees.
7. Using a torque wrench, recheck all rod bolt tightening to 88 N.m (65 ft. lbs).
8. Install the balance shaft module. Refer to **MODULE, BALANCE SHAFT, INSTALLATION**.

BEARING(S), CRANKSHAFT, MAIN

REMOVAL

REMOVAL

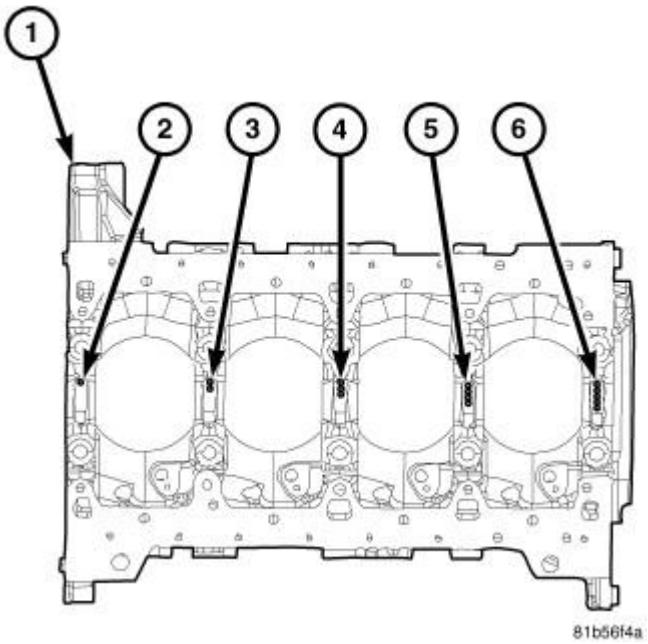

Fig. 117: Crankshaft Cap Location Marks
Courtesy of CHRYSLER GROUP, LLC

1. Remove the balance shaft assembly. Refer to **MODULE, BALANCE SHAFT, REMOVAL**.

NOTE: Bearing caps (2-6) are not interchangeable and are marked to ensure according to their locations (2-6) in the block (1). Upper and lower bearing halves are NOT interchangeable, and must be installed facing in the correct direction.

2. Identify bearing cap locations (2-6) before removal.

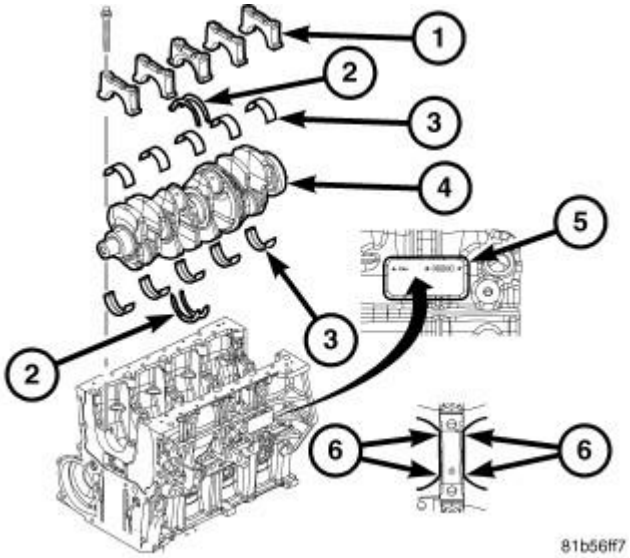

Fig. 118: Crankshaft Bearing Size Mark & Crankshaft Bearing Assembly
Courtesy of CHRYSLER GROUP, LLC

3. Remove the bearing caps (1) one at a time, and if possible, replace the crankshaft bearings (3) one at a time. Carefully rotate upper half of bearing from between the carrier and the crankshaft (4). If the upper half of the bearing does not easily slide out of position, the crankshaft must be removed for further inspection. Refer to **CRANKSHAFT, REMOVAL**.

INSTALLATION

INSTALLATION

NOTE: The crankshaft cannot be machined, if badly worn or scored it must be replaced.

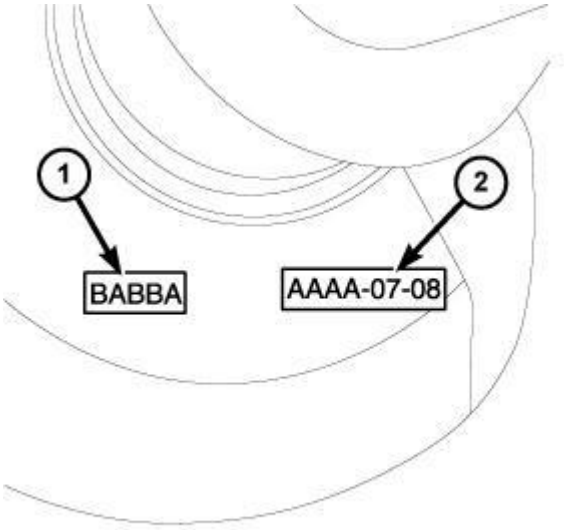

Fig. 119: Crankshaft Connecting Rod Journal Diameter
Courtesy of CHRYSLER GROUP, LLC

1. Locate the crankshaft journal letter class (1) stamp on the crankshaft weight.

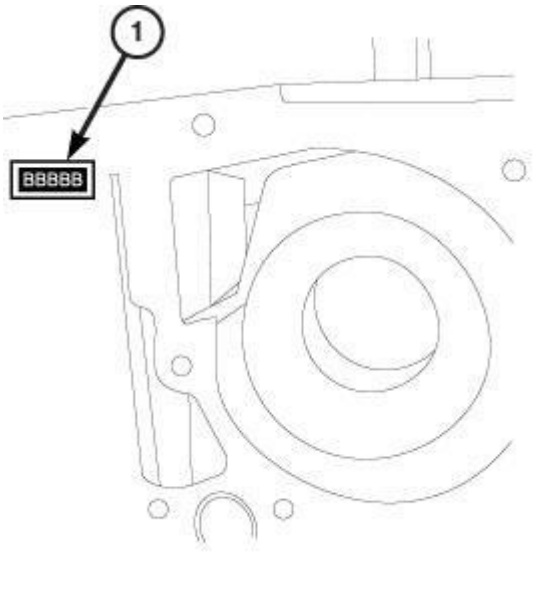

Fig. 120: Engine Block Crankshaft Journal Size Stamp
Courtesy of CHRYSLER GROUP, LLC

2. Locate the engine block crankshaft journal letter class stamp on the engine block (1) besides the water pump seat.

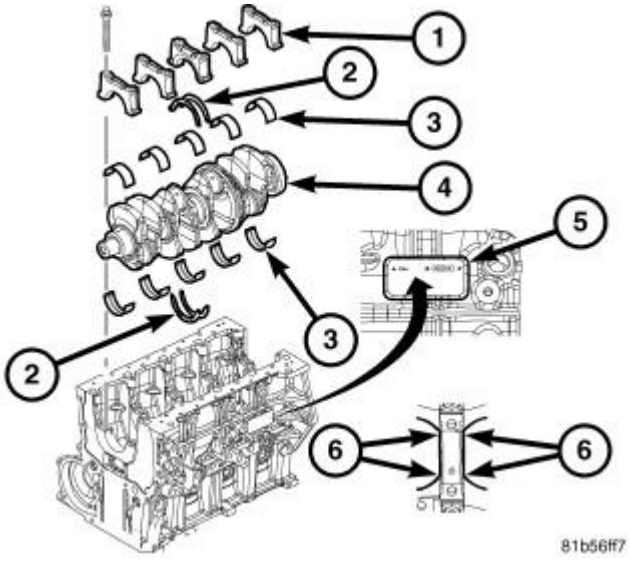

Fig. 121: Crankshaft Bearing Size Mark & Crankshaft Bearing Assembly
Courtesy of CHRYSLER GROUP, LLC

3. To determine the correct crankshaft journal size, each cylinder block seat diameter letter class must be matched with the crankshaft main journal diameter letter class. Both letter classes stamped on the cylinder

block as well as on the crankshaft weight are in a progressive order starting from the front of the engine. The first letter corresponds to the first cylinder, the second to the second, etc. Use the crankshaft bearing selection chart to determine the half shell color. Refer to **Engine/Engine Block - Standard Procedure**.

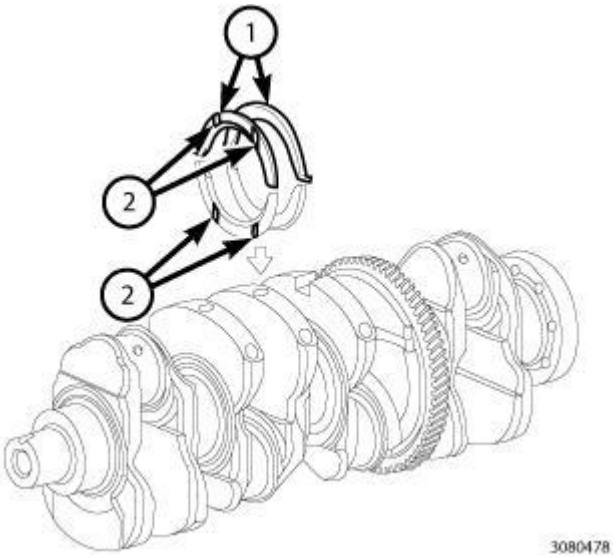

Fig. 122: Thrust Bearings & Oil Discharge Grooves Facing Toward Crankshaft
Courtesy of CHRYSLER GROUP, LLC

4. When installing the thrust bearings (1) make sure the oil discharge groves (2) face towards the crankshaft.
5. If the crankshaft was removed to install the bearings, install the crankshaft. Refer to **CRANKSHAFT, INSTALLATION**.
6. Install the balance shaft assembly. Refer to **MODULE, BALANCE SHAFT, INSTALLATION**.

COVER, ENGINE, FRONT

DESCRIPTION

DESCRIPTION

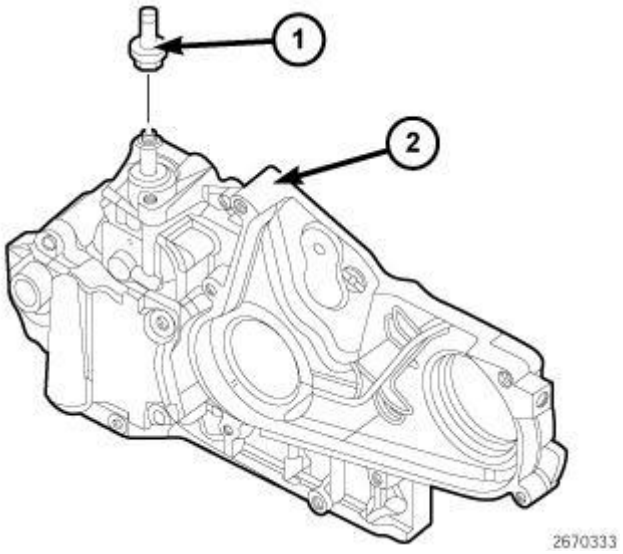

Fig. 123: Vacuum Pump Check Valve & Front Engine Cover
Courtesy of CHRYSLER GROUP, LLC

The front engine cover (2) incorporates the engine oil pump and vacuum pump. Neither of these components are serviceable, but only as a whole assembly.

REMOVAL

REMOVAL

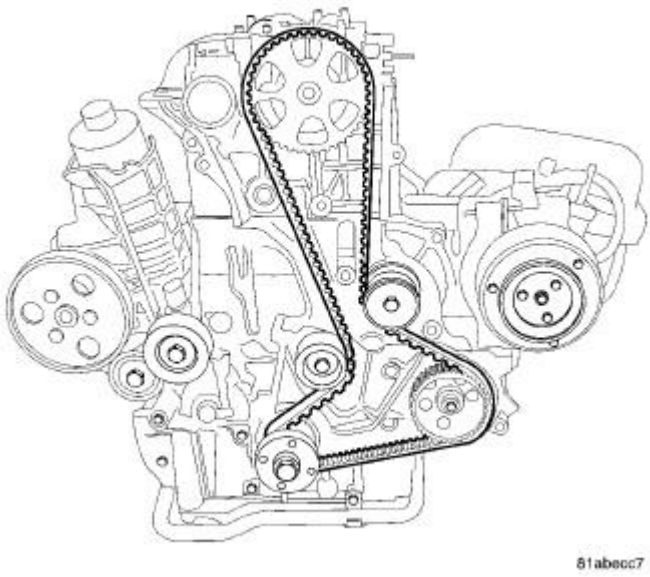

Fig. 124: Timing Belt
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Drain the cooling system. Refer to **STANDARD PROCEDURE** .
3. Remove the timing belt. Refer to **BELT, TIMING, REMOVAL**.

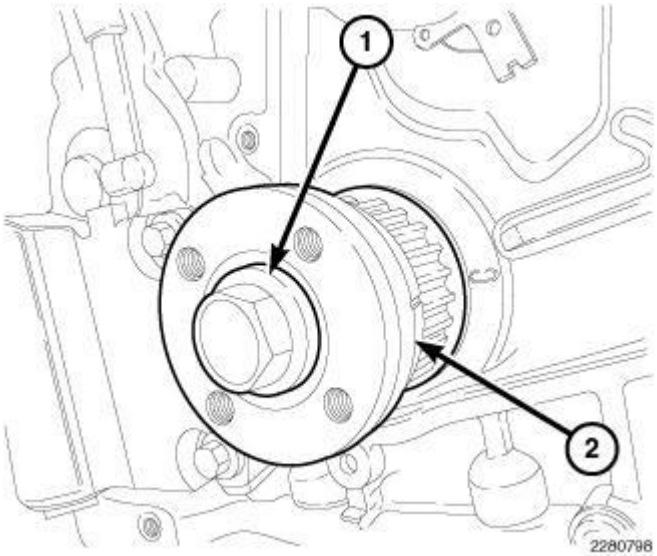

Fig. 125: Crankshaft Timing Belt Sprocket & Bolt
Courtesy of CHRYSLER GROUP, LLC

NOTE: The crankshaft sprocket bolt is a left handed thread.

4. Remove bolt (1), and the crankshaft sprocket (2).

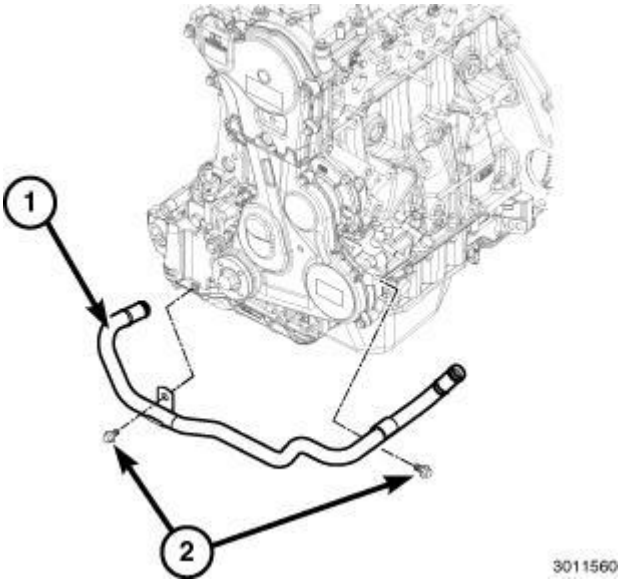

Fig. 126: Coolant Tube & Bolts
Courtesy of CHRYSLER GROUP, LLC

5. Disconnect the coolant tube hose at oil cooler and by fuel injection pump.

6. Remove bolts (2), and the coolant tube (1).

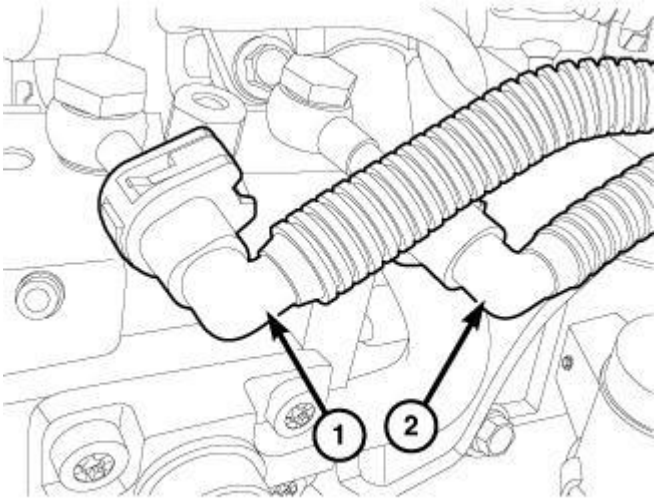

Fig. 127: Low Pressure Supply Line & Return Line
Courtesy of CHRYSLER GROUP, LLC

7. Disconnect the low pressure supply (1) and return (2) lines at injection pump.

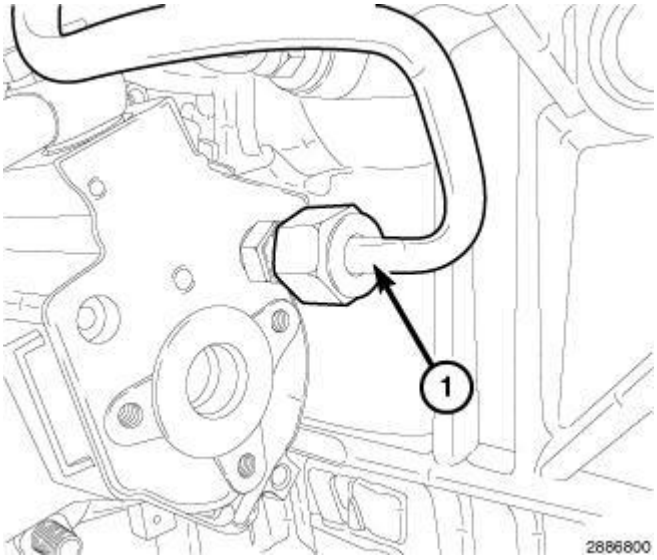

Fig. 128: High-Pressure Fuel Line
Courtesy of CHRYSLER GROUP, LLC

8. Remove the fuel quantity solenoid. Refer to **SOLENOID, FUEL QUANTITY, REMOVAL** .
9. Remove the high-pressure fuel tube (1) at rear of pump and fuel rail.

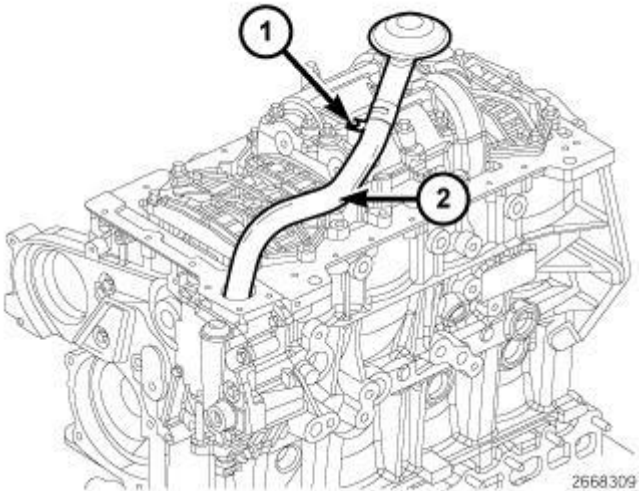

Fig. 129: Oil Pump Pickup Tube & Bolt
Courtesy of CHRYSLER GROUP, LLC

10. Remove the oil pump pickup tube. Refer to **PICK-UP, OIL PUMP, REMOVAL**.

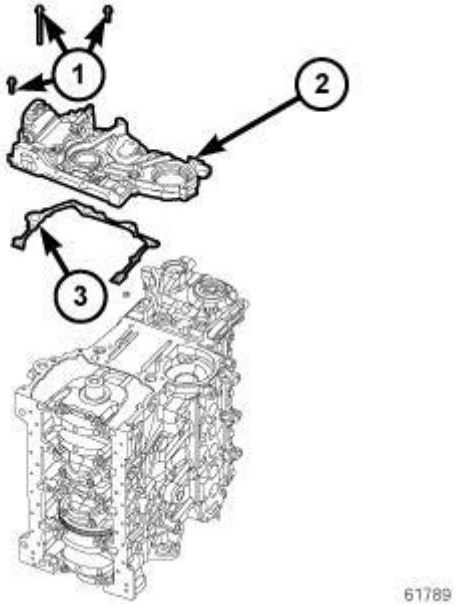

Fig. 130: Front Cover, Gasket & Bolts
Courtesy of CHRYSLER GROUP, LLC

11. Disconnect the vacuum hose at vacuum pump.
12. Remove the eight bolts (1), and the front cover assembly (2).

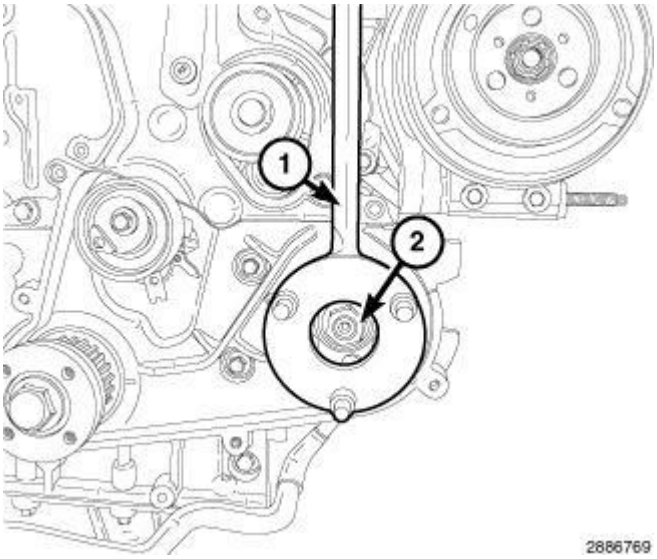

Fig. 131: Locking Tool & Injection Pump Sprocket Mounting Nut
Courtesy of CHRYSLER GROUP, LLC

13. If necessary, using (special tool #VM.1055, Locking Tool) (1) remove the injection pump sprocket nut (2).
14. If necessary, attach a (special tool #1023, Puller) and remove sprocket from pump.
15. If necessary, remove nuts and the injection fuel pump.

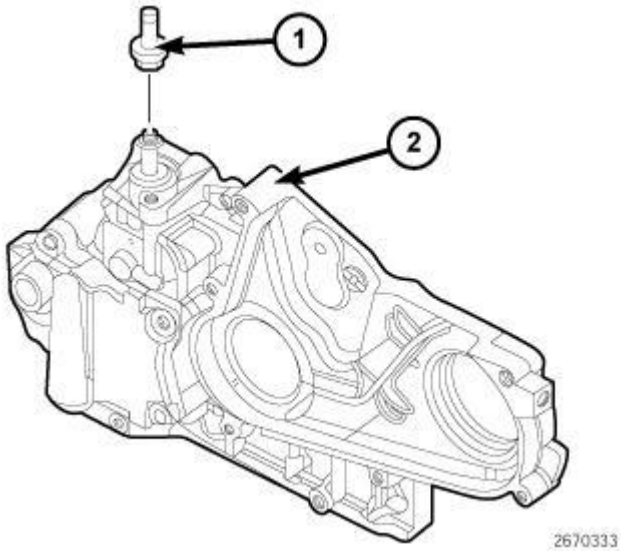

Fig. 132: Vacuum Pump Check Valve & Front Engine Cover
Courtesy of CHRYSLER GROUP, LLC

16. If necessary, remove the vacuum pump check valve.

INSTALLATION

INSTALLATION

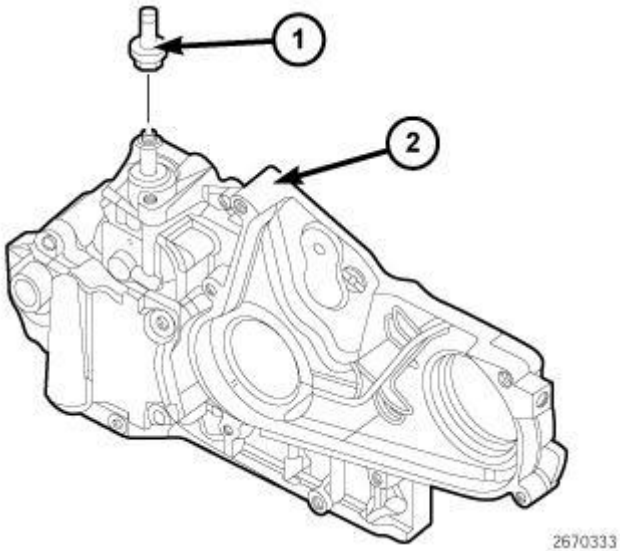

Fig. 133: Vacuum Pump Check Valve & Front Engine Cover
Courtesy of CHRYSLER GROUP, LLC

1. Clean all gasket mating surfaces.
2. If necessary, install the front crankshaft oil seal. Refer to **SEAL, CRANKSHAFT OIL, FRONT, INSTALLATION**.
3. If necessary, transfer the vacuum pump check valve (1) and securely tighten.

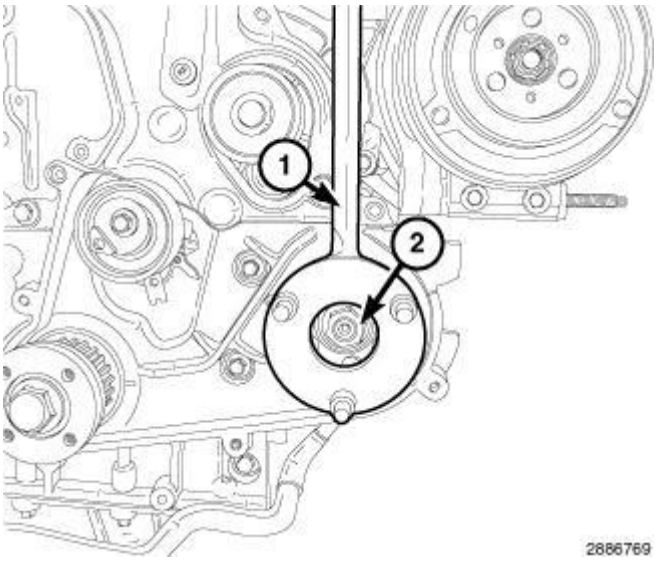

Fig. 134: Locking Tool & Injection Pump Sprocket Mounting Nut
Courtesy of CHRYSLER GROUP, LLC

4. If necessary, install the high pressure fuel pump. Tighten nuts to 24 N.m (18 ft. lbs.).
5. If necessary, using (special tool #VM.1055, Locking Tool), install the high pressure fuel pump sprocket. Tighten nut (2) to 88 N.m (65 ft. lbs.).

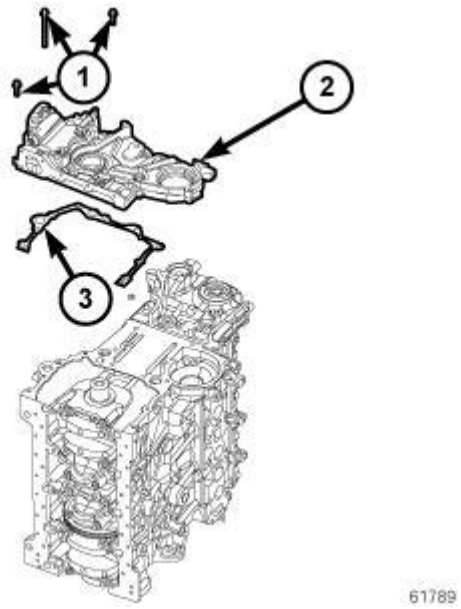

Fig. 135: Front Cover, Gasket & Bolts
Courtesy of CHRYSLER GROUP, LLC

6. Install the front cover gasket (3).
7. Install the front cover assembly (2) and tighten the eight bolts (1) finger tight.

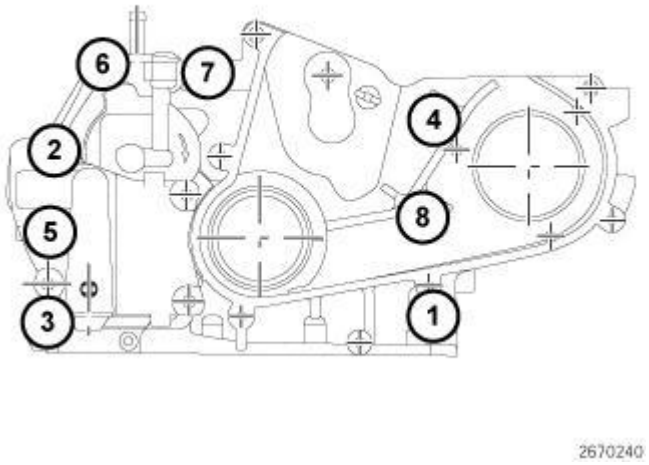

Fig. 136: Front Cover Assembly Bolt Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

8. Using the tightening sequence shown in illustration, tighten bolts to 33 N.m (24 ft. lbs.).

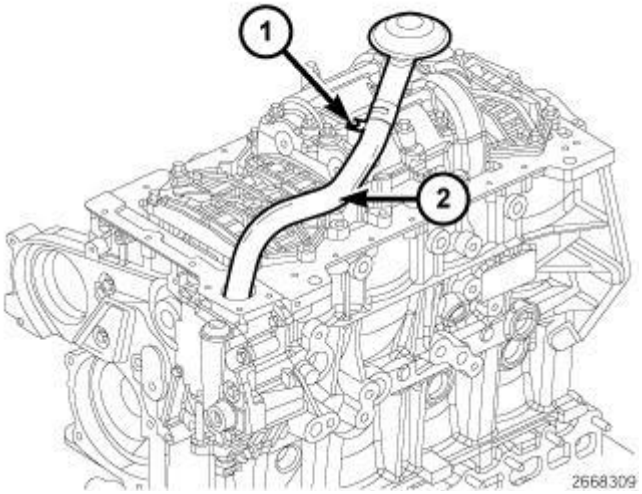

Fig. 137: Oil Pump Pickup Tube & Bolt
Courtesy of CHRYSLER GROUP, LLC

9. Install the oil pump pickup tube. Refer to **PICK-UP, OIL PUMP, INSTALLATION**.

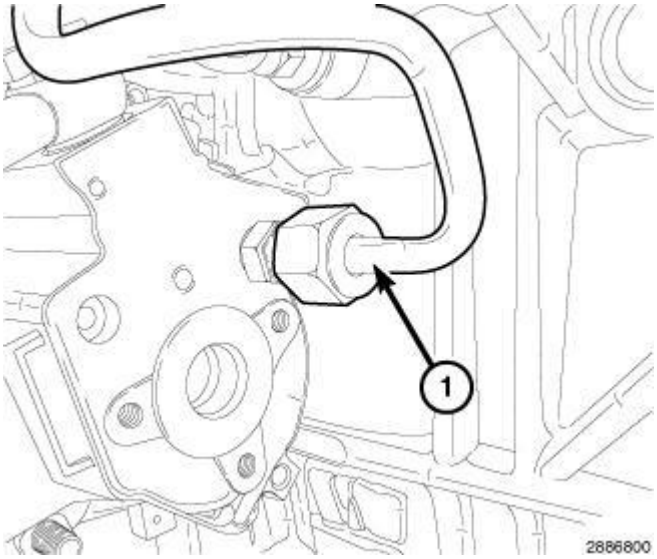

Fig. 138: High-Pressure Fuel Line
Courtesy of CHRYSLER GROUP, LLC

10. Install the new high-pressure fuel tube (1) at rear of pump and fuel rail.
    - Tighten fuel tube nut at pump to 28 N.m (21 ft. lbs.).
    - Tighten fuel tube nut at fuel rail to 5 N.m (44 in. lbs) plus an additional 75 degrees turn.
11. Install the fuel quantity solenoid. Refer to **SOLENOID, FUEL QUANTITY, INSTALLATION** .

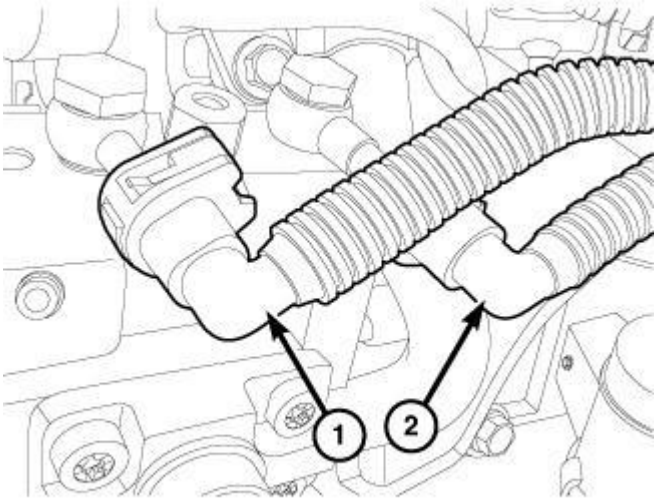

Fig. 139: Low Pressure Supply Line & Return Line
Courtesy of CHRYSLER GROUP, LLC

12. Connect the low pressure supply (1) and return (2) lines at injection pump.

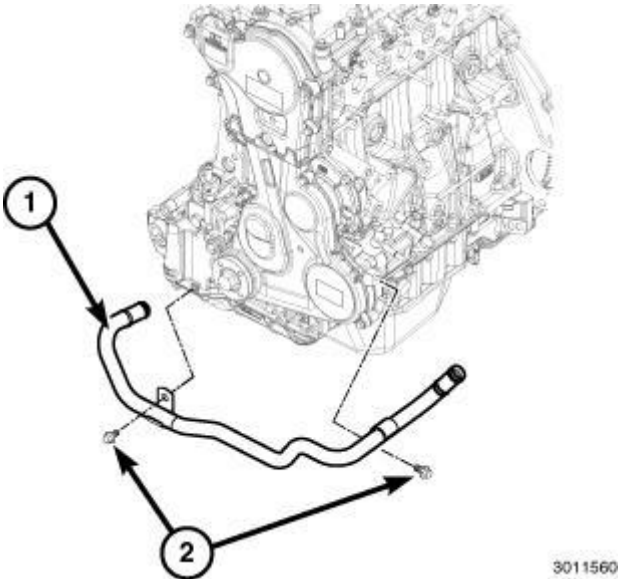

Fig. 140: Coolant Tube & Bolts
Courtesy of CHRYSLER GROUP, LLC

13. Install the coolant tube (1). Tighten bolts (2) to 15 N.m (133 in. lbs.).
14. Connect the coolant tube hose at oil cooler and by fuel injection pump.

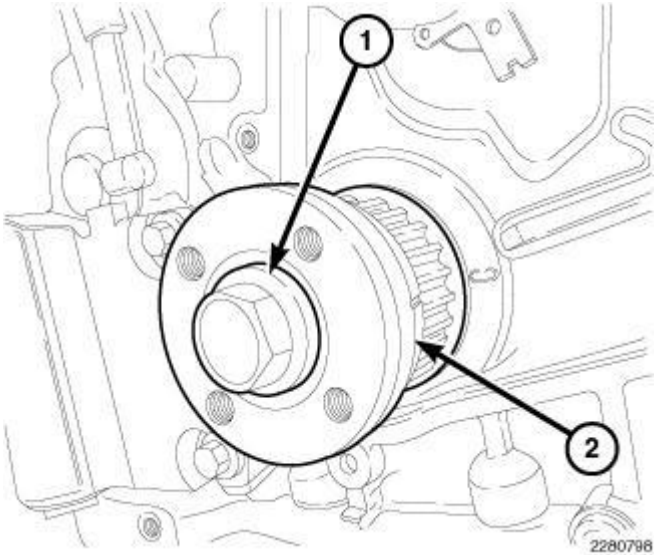

Fig. 141: Crankshaft Timing Belt Sprocket & Bolt
Courtesy of CHRYSLER GROUP, LLC

NOTE: The crankshaft sprocket bolt is a left handed thread.

15. Install the crankshaft sprocket (2). Tighten bolt to 100 N.m (74 ft. lbs.) plus an additional 120 degrees.

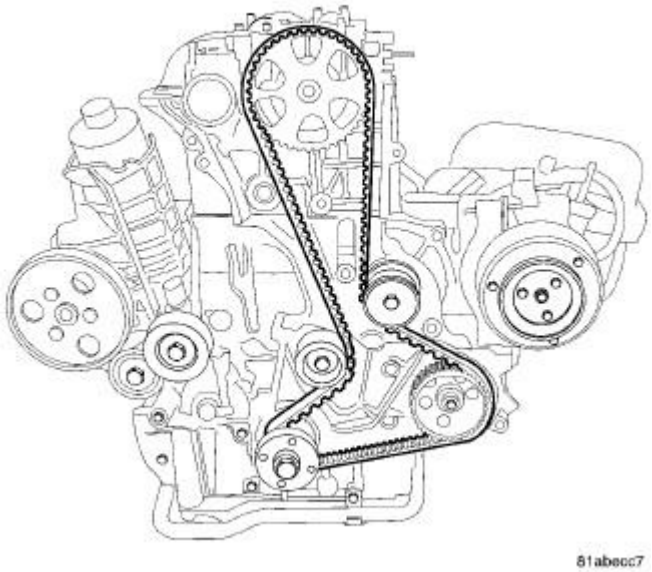

Fig. 142: Timing Belt
Courtesy of CHRYSLER GROUP, LLC

16. Install the timing belt. Refer to **BELT, TIMING, INSTALLATION**.
17. Fill the cooling system. Refer to **STANDARD PROCEDURE** .

18. Connect the negative battery cable.

CRANKSHAFT

DESCRIPTION

DESCRIPTION

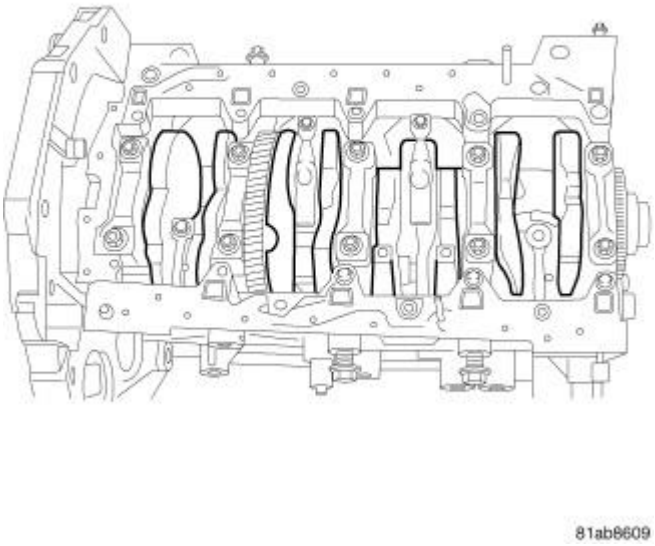

Fig. 143: Crankshaft
Courtesy of CHRYSLER GROUP, LLC

The crankshaft for the 2.8L is a forged steel type design with five main bearing journals. The crankshaft is located at the bottom of the engine block.

STANDARD PROCEDURE

STANDARD PROCEDURE

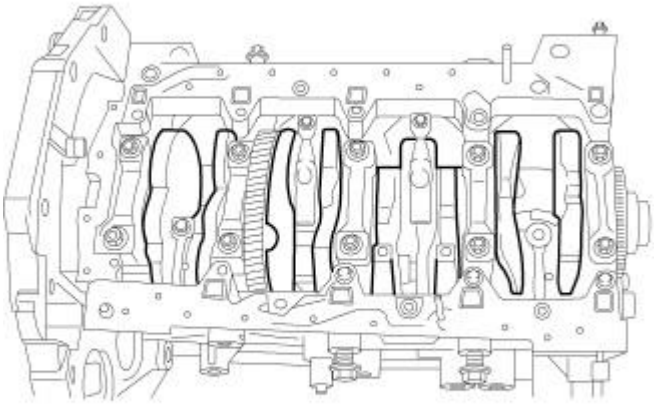

Fig. 144: Crankshaft
Courtesy of CHRYSLER GROUP, LLC

1. Mount a (special tool #C-3339A, Set, Dial Indicator) to a stationary point at rear of engine. Locate the probe perpendicular against the flywheel.
2. Move the crankshaft all the way to the front of its travel.
3. Zero the dial indicator.
4. Move the crankshaft all the way to the rear and read dial indicator. For crankshaft end play clearances. Refer to **Engine - Specifications**.

REMOVAL

REMOVAL

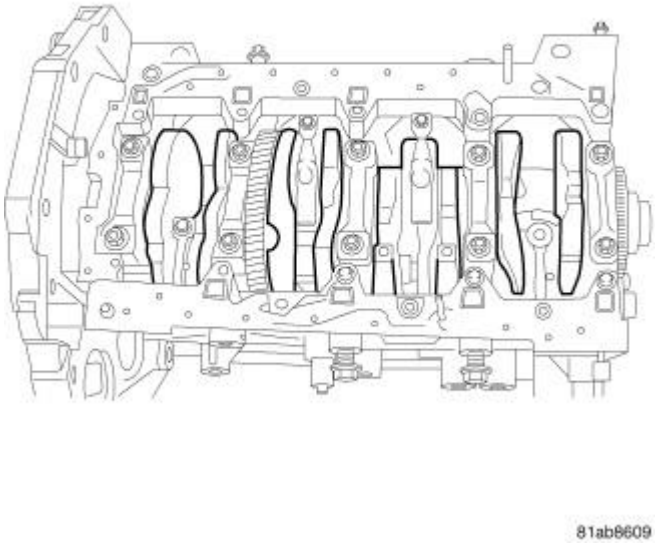

Fig. 145: Crankshaft
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the engine from vehicle. Refer to **REMOVAL**.
3. On manual transmission models, remove the clutch.
4. On manual transmission models, remove the flywheel.
5. Remove the flex plate.

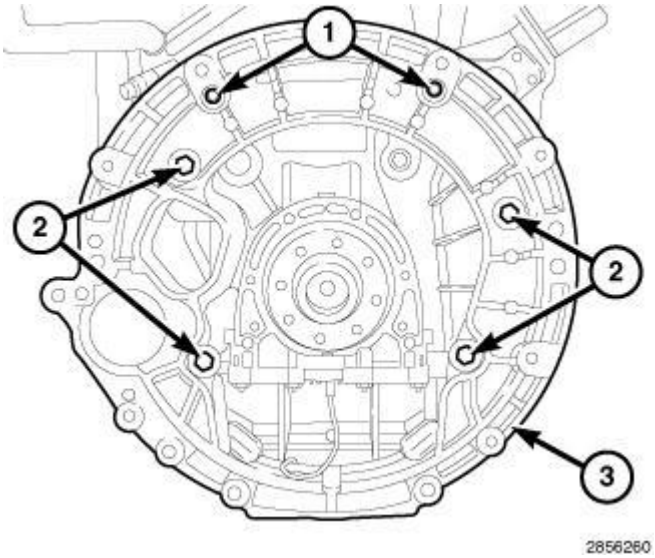

Fig. 146: Transmission Adapter Plate & Bolts
Courtesy of CHRYSLER GROUP, LLC

6. Remove bolts (1 and 2), and the transmission adapter plate (3).

7. Using a suitable engine stand, mount engine to engine stand.
8. Remove the high pressure fuel tube from high pressure pump and fuel rail.
9. Remove the vacuum line from vacuum pump.
10. Remove the inner timing belt cover. Refer to **COVER(S), ENGINE TIMING, REMOVAL**.
11. Remove the balance shaft module. Refer to **MODULE, BALANCE SHAFT, REMOVAL**.
12. Remove the rear crankshaft oil seal carrier. Refer to **SEAL, CRANKSHAFT OIL, REAR, REMOVAL**.
13. Remove the front cover and front crank oil seal. Refer to **COVER, ENGINE, FRONT, REMOVAL**.
14. Remove the (special tool #VM.9992, Adapter, 90 Degree ATDC).
15. Remove the bearing caps from the piston rods.
16. Remove the bearing caps from the crankshaft journals.
17. Remove the crankshaft.

INSTALLATION

INSTALLATION

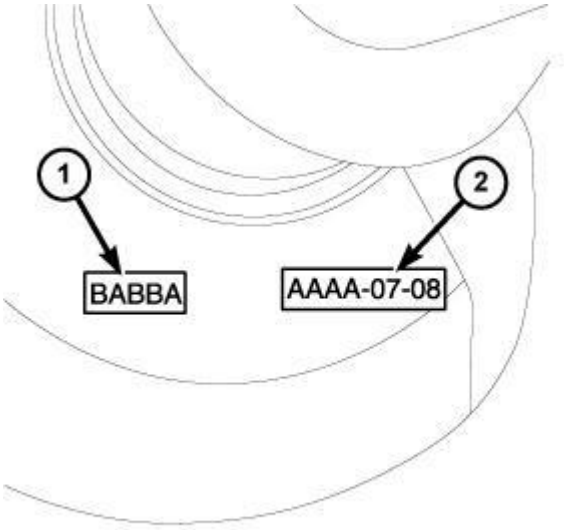

Fig. 147: Crankshaft Connecting Rod Journal Diameter
Courtesy of CHRYSLER GROUP, LLC

1. Clean and inspect the new crankshaft.
2. Locate the crankshaft journal size (1) stamp on the crankshaft weight.

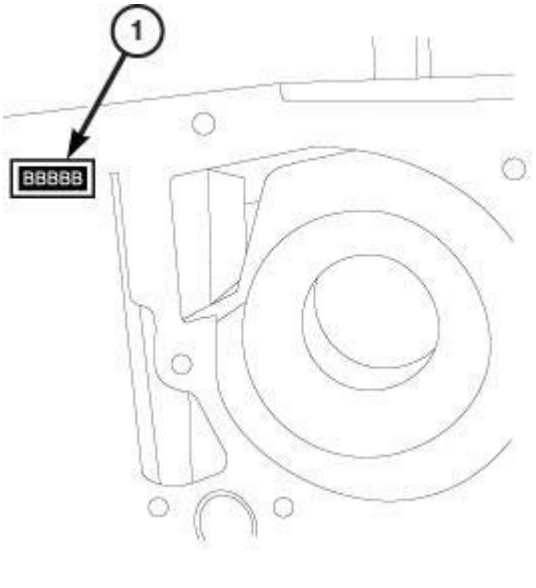

Fig. 148: Engine Block Crankshaft Journal Size Stamp
Courtesy of CHRYSLER GROUP, LLC

3. Locate the engine block crankshaft journal size stamp on the engine block (1).
4. Use the crankshaft bearing selection chart for main bearing selection. Refer to **Engine/Engine Block - Standard Procedure**.
5. Lubricate and install the crankshaft bearings. Make sure the thrust washer is not touching the engine block.
6. Install the crankshaft.

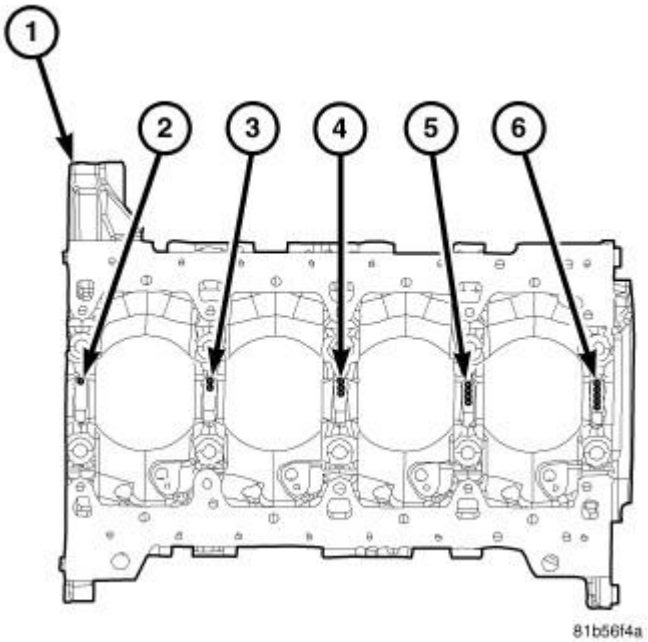

Fig. 149: Crankshaft Cap Location Marks
Courtesy of CHRYSLER GROUP, LLC

7. Using new bolts, install the main bearing caps in the same location as they were removed. The notches on the top of the bearing caps indicate their proper position. The front cap has one notch, the next cap two, etc.

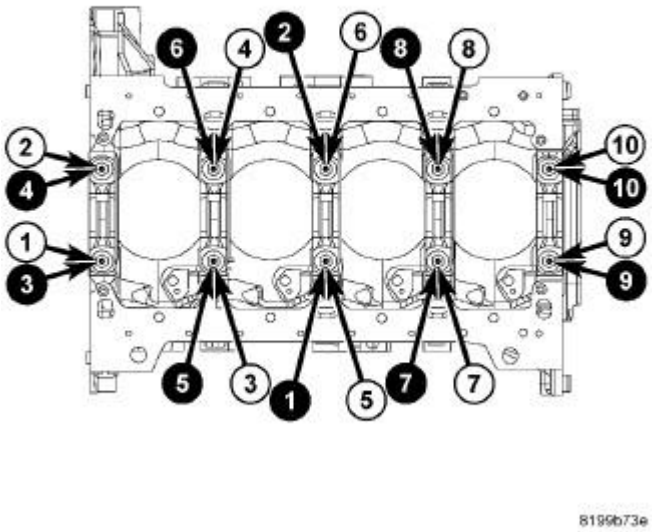

Fig. 150: Crankshaft Bolt Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

8. Using the black number bubbles in the torque pattern, tighten the crankshaft bolts to 50 N.m (37 ft. lbs.).
9. Using the white number bubbles in the tightening pattern, turn bolts an additional 90 degrees.
10. Using a (special tool #C-3339A, Set, Dial Indicator), measure the crankshaft end play. Crankshaft end play must be between 0.1 mm and 0.33 mm (0.004 in - 0.13 in).
11. Use the connecting rod bearing selection chart for connecting rod bearing selection. Refer to **Engine/Engine Block - Standard Procedure**.
12. Install the connecting rod bearing caps. Refer to **ROD, PISTON AND CONNECTING, INSTALLATION**.
13. Install the front cover and front crankshaft oil seal. Refer to **SEAL, CRANKSHAFT OIL, FRONT, INSTALLATION**.
14. Install the rear crankshaft oil seal carrier. Refer to **SEAL, CRANKSHAFT OIL, REAR, INSTALLATION**.
15. Install the balance shaft module. Refer to **MODULE, BALANCE SHAFT, INSTALLATION**.
16. Install the inner timing belt cover. Refer to **COVER(S), ENGINE TIMING, INSTALLATION**.
17. Install the vacuum line onto vacuum pump.
18. Install the high pressure fuel tube to high pressure pump and fuel rail and tighten to:
    - Tighten the high pressure fuel feed tube at the high pressure pump to 28 N.m (20 ft. lbs.).
    - Tighten the high pressure fuel feed line at the fuel rail to 5 N.m (44 in. lbs) plus an additional 75

degrees.

19. Install fuel line clamp bolt. Tighten bolt to 15 N.m (133 in. lbs.).
20. Remove the engine from engine stand.

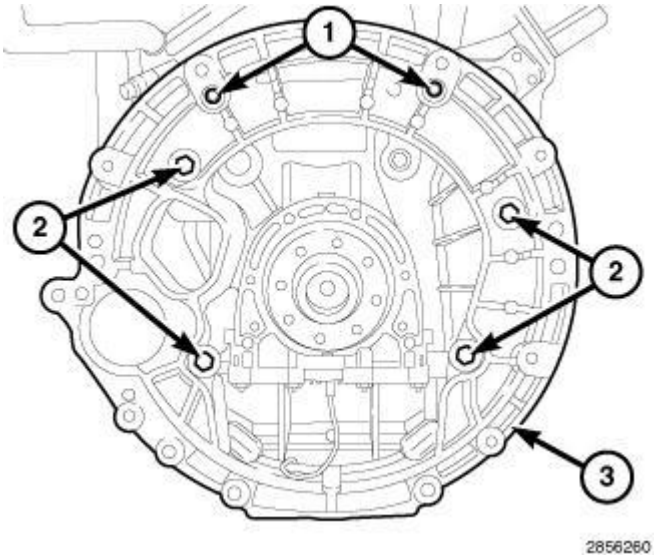

Fig. 151: Transmission Adapter Plate & Bolts
Courtesy of CHRYSLER GROUP, LLC

21. Install the transmission adapter plate (3). Tighten bolts:
    - Tighten bolts (2) to 69 N.m (51 ft. lbs.).
    - Tighten bolts (1) to 79 N.m (58 ft. lbs.).
22. Install the flex plate and tighten bolts finger tight.
23. Use a cross pattern to tighten bolts to 50 N.m (37 ft. lbs.).
24. Using a torque wrench fitted with a Torque Angle Gauge, (Goniometer), loosen one flex plate bolt at a time and tighten to 25 N.m (18 ft. lbs.) plus angle in relation to bolt length.

Bolt Length	Torque Angle
40 mm	60°
50 mm	75°
60 mm	90°

25. On manual transmission models, Using new bolts, install the flywheel. Tighten bolts to 25 N.m (18 ft. lbs.) plus angle in relation to bolt length.
26. On manual transmission models, Install the clutch. Refer to **DISC, CLUTCH, INSTALLATION** .
27. Install the engine into vehicle. Refer to **INSTALLATION**.
28. Connect the negative battery cable.

DAMPER, VIBRATION

REMOVAL

REMOVAL

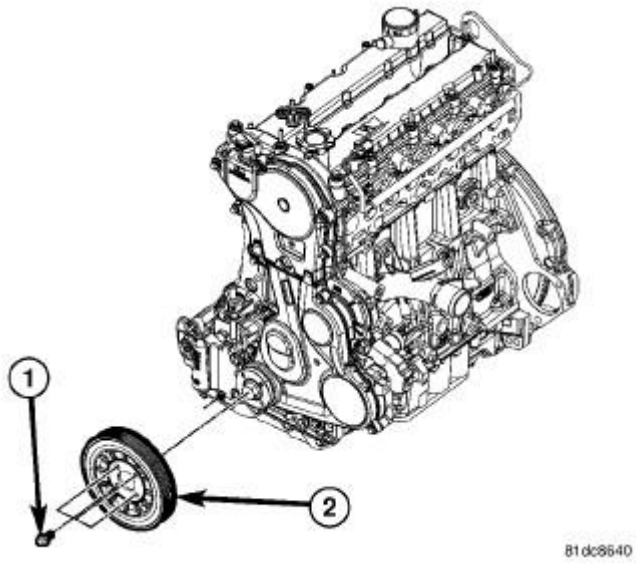

Fig. 152: Crankshaft Damper & Bolts
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the accessory drive belt. Refer to **BELT, SERPENTINE, REMOVAL** .
3. Remove the bolts (1) and the vibration damper (2).

INSTALLATION

INSTALLATION

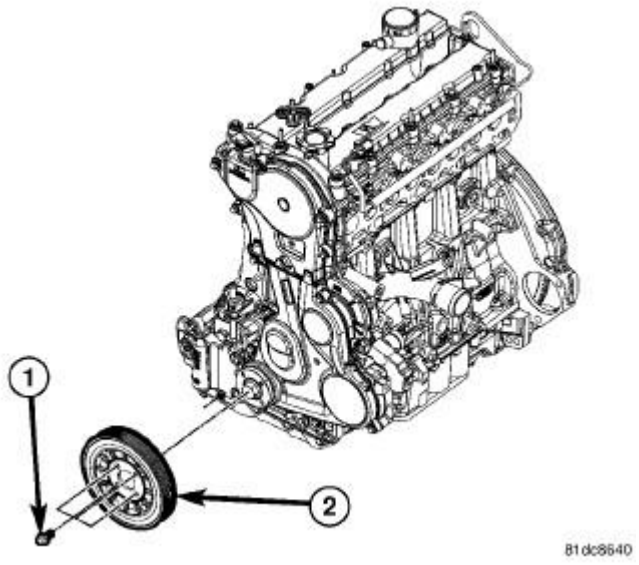

Fig. 153: Crankshaft Damper & Bolts

Courtesy of CHRYSLER GROUP, LLC

1. Install the vibration damper (2) and retaining bolts (1). Tighten the bolts to 32 N.m. (24 ft. lbs.).
2. Install the accessory drive belt. Refer to **BELT, SERPENTINE, INSTALLATION** .
3. Reconnect the negative battery cable.

FLEXPLATE

REMOVAL

REMOVAL

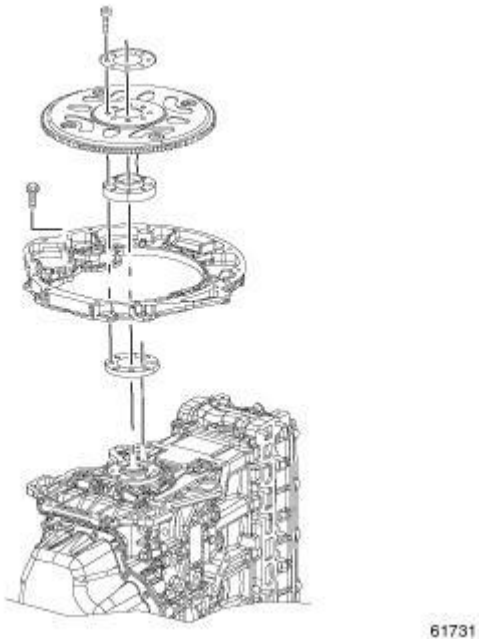

Fig. 154: Flywheel/Flex Plate Assembly
Courtesy of CHRYSLER GROUP, LLC

1. Remove the transmission. Refer to **REMOVAL** .
2. Paint mark the flex plate hub to flex plate relation.
3. Remove the 40 mm bolts (1) and flex plate (2).
4. Inspect flex plate for damage.

INSTALLATION

INSTALLATION

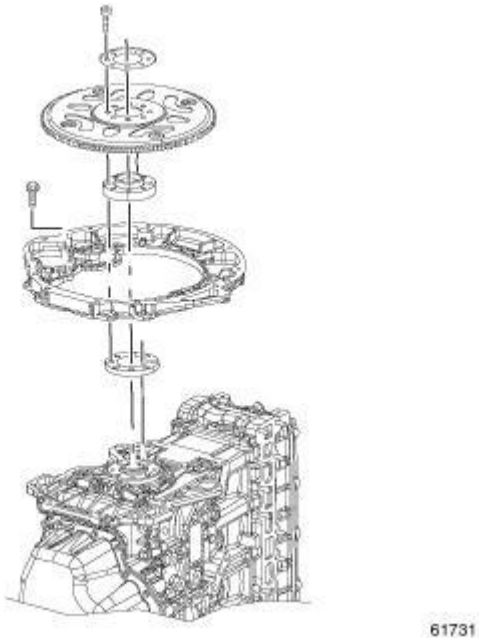

Fig. 155: Flywheel/Flex Plate Assembly
Courtesy of CHRYSLER GROUP, LLC

NOTE: Always use new bolts when installing the flex plate and do not lubricate new bolts as they are already coated with an anti-scuff treatment.

NOTE: Align the flex plate to hub paint marks, where applicable.

1. Install the flex plate and tighten bolts finger tight.
2. Use a crisscross pattern to tighten bolts to 50 N.m (37 ft. lbs.).
3. Using a torque wrench fitted with a Torque Angle Gauge, (Goniometer), loosen one flex plate bolt at a time and tighten to 25 N.m (19 ft. lbs.) plus angle in relation to bolt length.

Bolt Length	Torque Angle
40 mm	60°
50 mm	75°
60 mm	90°

4. Install the transmission. Refer to **INSTALLATION** .

MODULE, BALANCE SHAFT

DESCRIPTION

DESCRIPTION

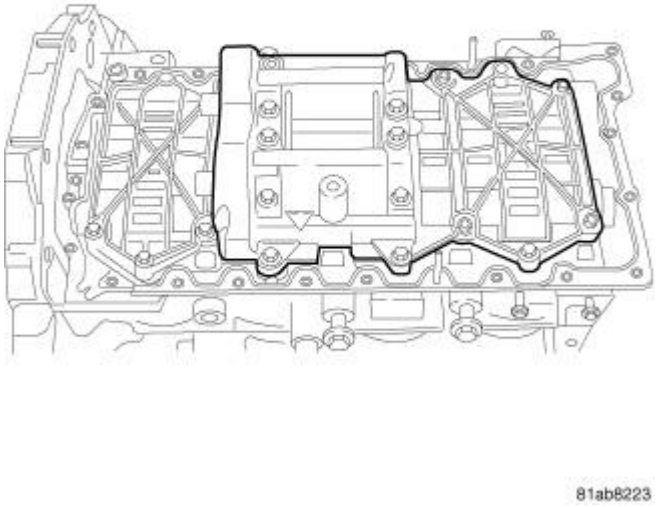

Fig. 156: Balance Shaft Module
Courtesy of CHRYSLER GROUP, LLC

The balance shaft is gear-driven and is used to counteract engine vibration and roughness. The balance shaft assembly includes balancers on two shafts. It is only serviced as an assembly. Balance shafts must be timed to the crankshaft.

REMOVAL

REMOVAL

1. Disconnect the negative battery cable.
2. Lock the engine 90 degrees ATDC. Refer to **Engine/Valve Timing - Standard Procedure**.
3. Remove the oil pump pick-up tube. Refer to **PICK-UP, OIL PUMP, REMOVAL**.

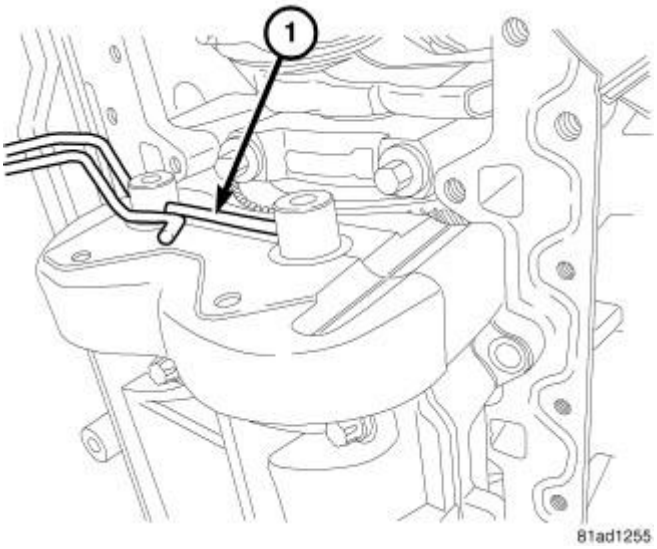

Fig. 157: Balance Shaft Timing Tool
Courtesy of CHRYSLER GROUP, LLC

4. Place a dowel rod (1) through the holes in the balance shaft axles to keep the balance shafts in the correct position for reassembly.

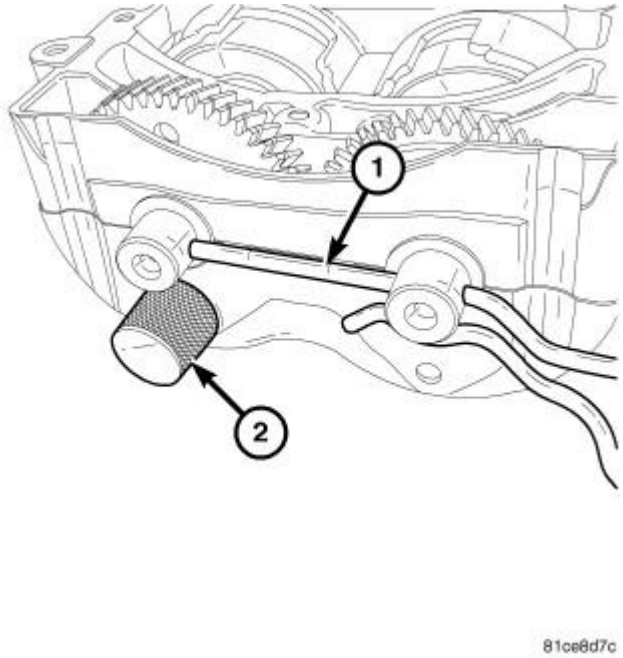

Fig. 158: Balance Shaft Tool Installed
Courtesy of CHRYSLER GROUP, LLC

WARNING: The balance shaft pin must be installed before the balance shaft assembly is remove from the engine. The balance shaft pin must always remain in the balance shaft assembly while the assembly is removed from the engine. Do not remove the balance shaft pin until

the balance shaft assembly is completely installed on the engine.

NOTE: The crankshaft must be positioned at 90° after TDC in order to install the Balance Shaft Locking Pin (special tool #VM.10012, Balance Shaft Split Gear Align) (2).

5. Insert the Balance Shaft Locking Pin (special tool #VM.10012, Balance Shaft Split Gear Align) (2) into the balance shaft assembly to lock the split gears together.

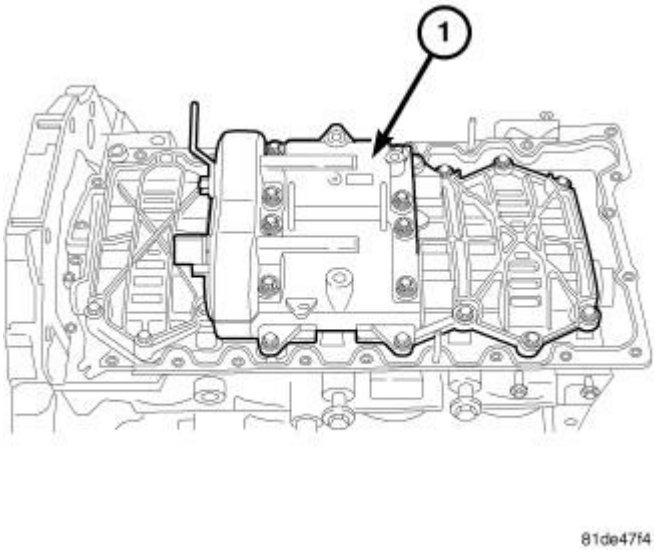

Fig. 159: Balance Shaft Housing
Courtesy of CHRYSLER GROUP, LLC

6. Remove bolts and the balance shaft housing (1).

INSTALLATION

INSTALLATION

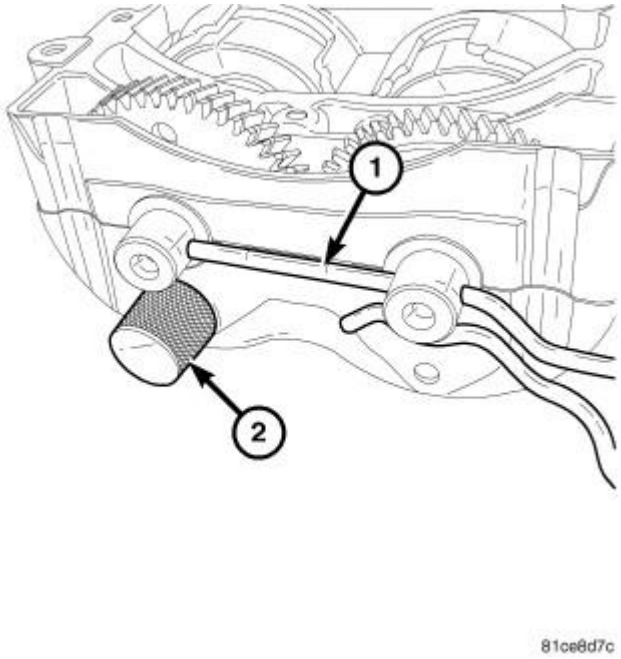

Fig. 160: Balance Shaft Tool Installed
Courtesy of CHRYSLER GROUP, LLC

1. The balance shafts must remain aligned by the alignment dowel rod (1) and the Balance Shaft Locking Pin (special tool #VM.10012, Balance Shaft Split Gear Align) (2) must remain in the balance shaft assembly until the assembly is completely installed to the engine.

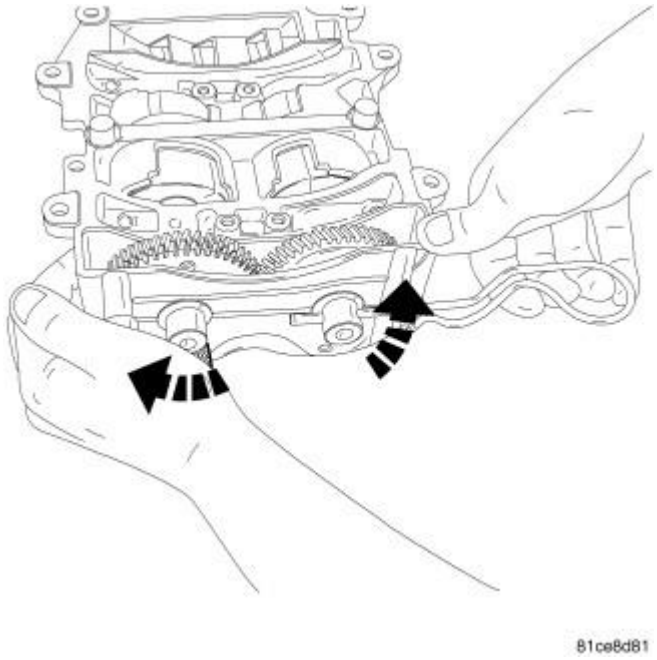

Fig. 161: Balance Shaft Tool Installation
Courtesy of CHRYSLER GROUP, LLC

2. The balance shaft pin should never be removed from the balance shaft assembly when the balance shaft

assembly is not installed in the engine. If the balance shaft was removed from the vehicle without the pin, or the pin was removed, use the dowel to load the spring while pressing the tool into place as shown in illustration.

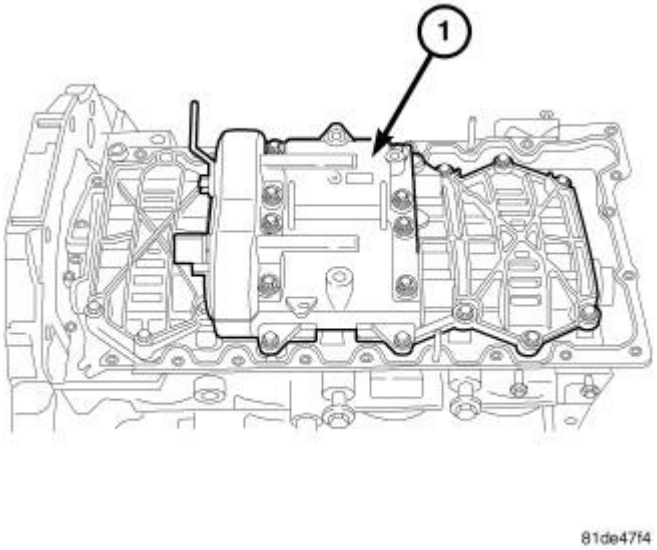

Fig. 162: Balance Shaft Housing
Courtesy of CHRYSLER GROUP, LLC

3. Install the balance shaft housing (1) to the engine and tighten bolts finger tight.

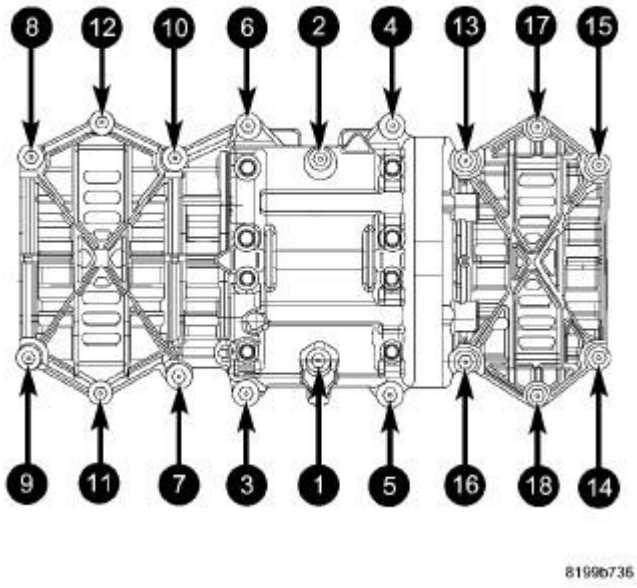

Fig. 163: Balance Shaft Bolt Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

4. Using the sequence shown in illustration, tighten balance shaft bolts to 33 N.m (24 ft. lbs.).

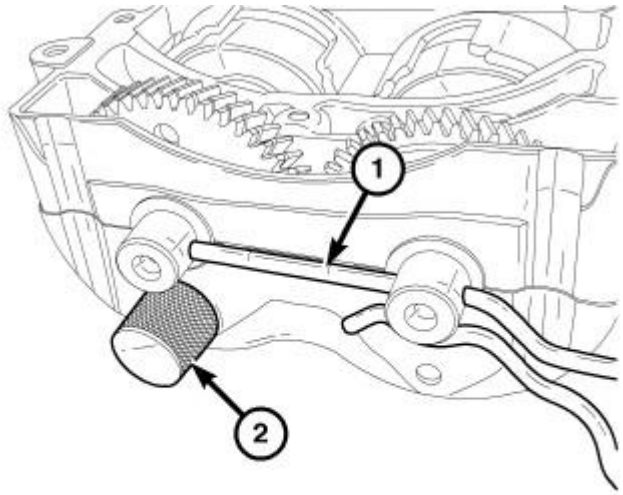

Fig. 164: Balance Shaft Tool Installed
Courtesy of CHRYSLER GROUP, LLC

5. Remove Balance Shaft Locking Pin (special tool #VM.10012, Balance Shaft Split Gear Align) (2).
6. Remove the balance shaft assembly dowel rod (1).

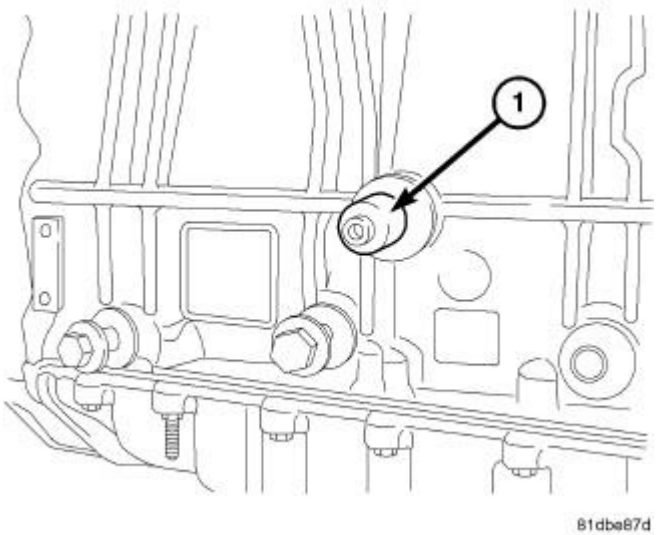

Fig. 165: Crankshaft Locking Tool
Courtesy of CHRYSLER GROUP, LLC

7. Remove the Crankshaft Locking Tool (special tool #VM.9992, Adapter, 90 Degree ATDC) (1).

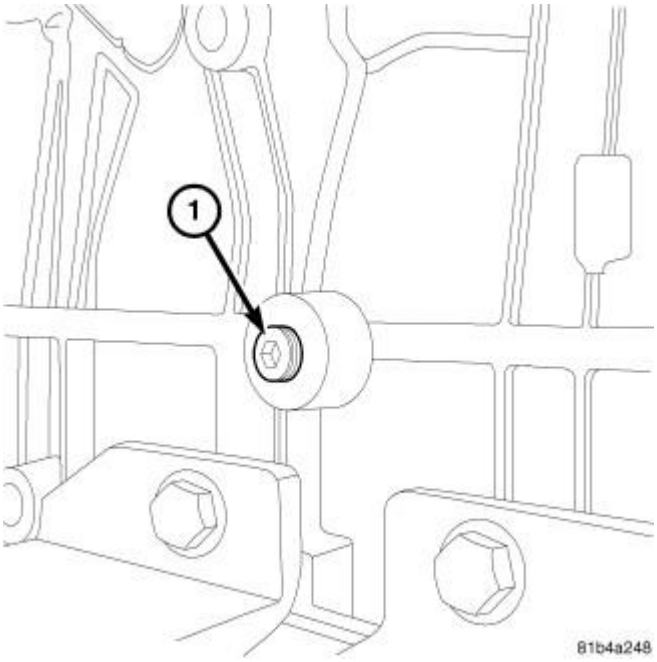

Fig. 166: Engine Block Plug
Courtesy of CHRYSLER GROUP, LLC

8. Install the engine block plug (1). Tighten the engine block plug to 30 N.m (22 ft. lbs.).
9. Install the upper and lower timing cover. Refer to **COVER(S), ENGINE TIMING, INSTALLATION**.
10. Install the oil pump pickup tube. Refer to **PICK-UP, OIL PUMP, INSTALLATION**.
11. Fill the engine oil.
12. Connect the negative battery cable.

PLATE, TRANSMISSION ADAPTER

DESCRIPTION

DESCRIPTION

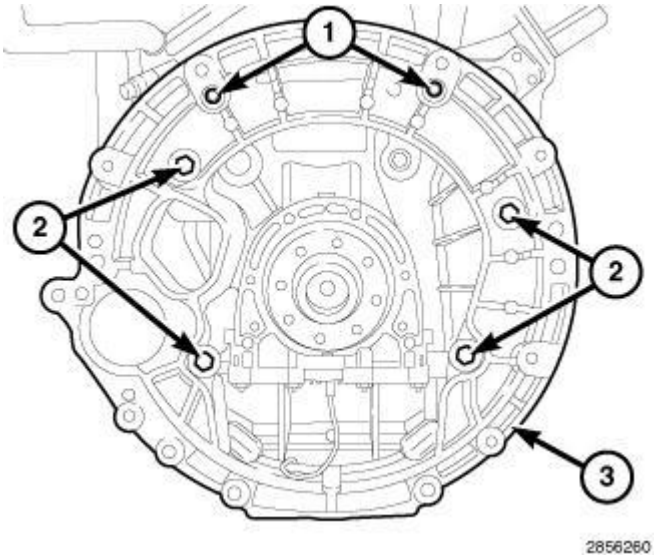

Fig. 167: Transmission Adapter Plate & Bolts
Courtesy of CHRYSLER GROUP, LLC

The transmission plate adapter (3) is the component that allows the transmission to be bolted to the engine.

REMOVAL

REMOVAL

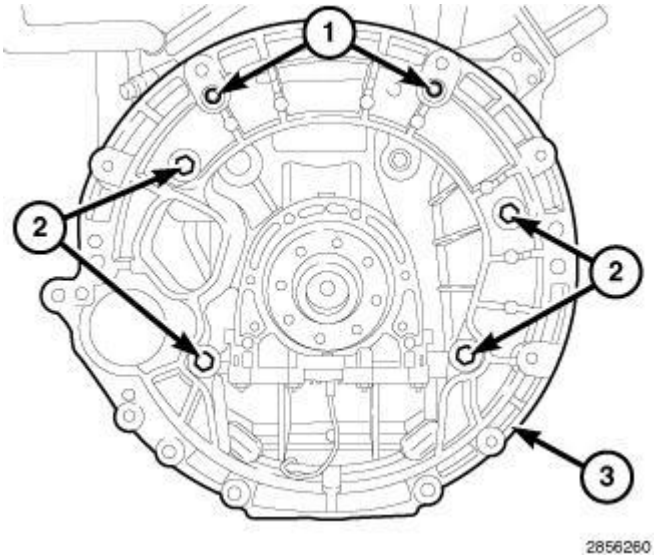

Fig. 168: Transmission Adapter Plate & Bolts
Courtesy of CHRYSLER GROUP, LLC

1. Remove the flex plate. Refer to **FLEXPLATE, REMOVAL**.
2. On manual transmission models, remove the flywheel. Refer to **FLYWHEEL, REMOVAL** .

NOTE: Do not use any magnetic tools near the crankshaft sensor tone ring.

3. Remove bolts (1 and 2) and the transmission adapter plate (3).

INSTALLATION

INSTALLATION

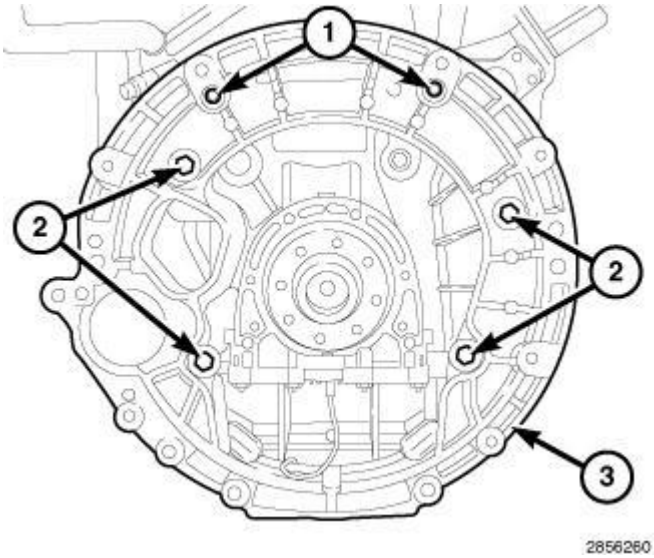

Fig. 169: Transmission Adapter Plate & Bolts
Courtesy of CHRYSLER GROUP, LLC

NOTE: Do not use any magnetic tools near the crankshaft tone ring.

1. Install the transmission adapter plate (3). Tighten bolts (1 and 2) finger tight.
   - Tighten bolts (2) to 69 N.m (51 ft. lbs.).
   - Tighten bolts (1) to 79 N.m (58 ft. lbs.).

NOTE: If equipped, manual transmission models with start/stop, there is a special tone wheel for this option that needs to be installed, refer to Clutch/Flywheel Installation .

2. On manual transmission models, install the flywheel. Refer to **FLYWHEEL, INSTALLATION** .
3. Install the flex plate. Refer to **FLEXPLATE, INSTALLATION**.

PUMP, INTERNAL VACUUM

DESCRIPTION

DESCRIPTION

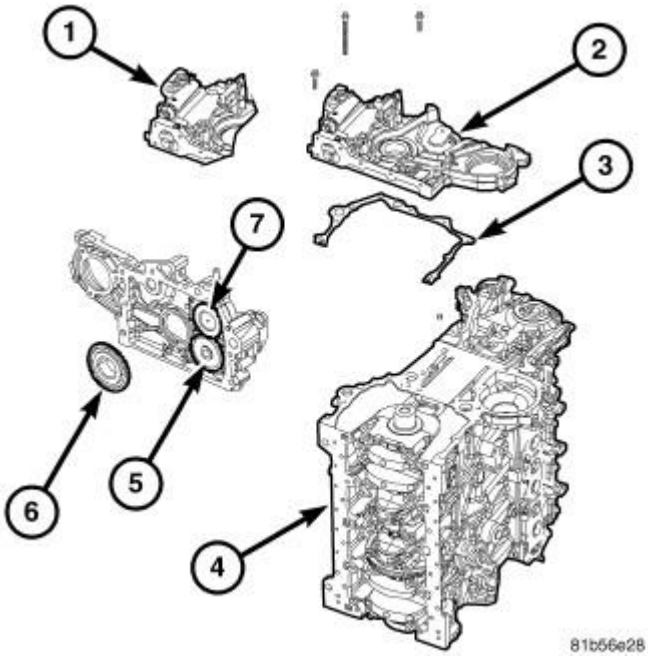

Fig. 170: Vacuum Pump And Oil Pump Assembly
Courtesy of CHRYSLER GROUP, LLC

The diesel engine uses a internal vacuum pump (7). This vacuum pump (7) is mounted in the engine front cover (2). The vacuum pump is driven by a sprocket (6) on the crankshaft.

DIAGNOSIS AND TESTING

VACUUM PUMP

1. Connect a vacuum gauge to the booster check valve with a short length of hose and T-fitting.
2. Start the engine allowing the engine to run for 30 seconds. Vacuum should be 18 inches HG (609 millibars). Verify the vacuum line is not leaking. If no leak is present replace vacuum pump. Refer to **PUMP, INTERNAL VACUUM, REMOVAL**.

REMOVAL

REMOVAL

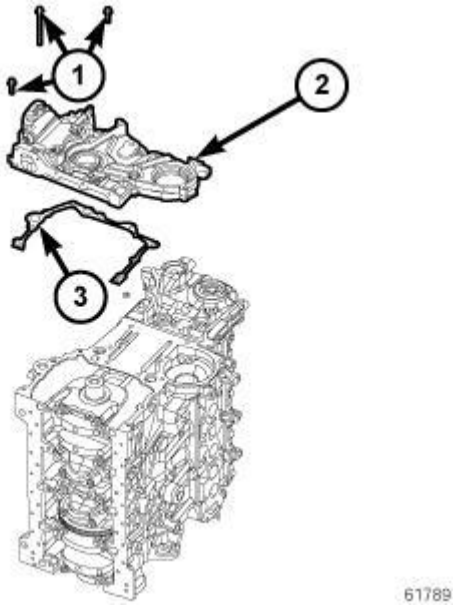

Fig. 171: Front Cover, Gasket & Bolts
Courtesy of CHRYSLER GROUP, LLC

NOTE: The vacuum pump is not a serviceable item as it is part of the front cover. If diagnosis has directed you to replace the vacuum pump, then the front cover needs to be replaced.

1. Remove the front cover. Refer to **COVER, ENGINE, FRONT, REMOVAL**.

INSTALLATION

INSTALLATION

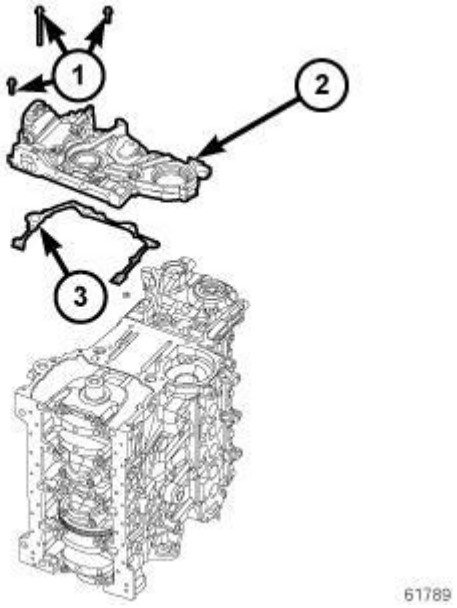

Fig. 172: Front Cover, Gasket & Bolts
Courtesy of CHRYSLER GROUP, LLC

1. Install the front cover. Refer to **COVER, ENGINE, FRONT, INSTALLATION**.

ROD, PISTON AND CONNECTING

DESCRIPTION

DESCRIPTION

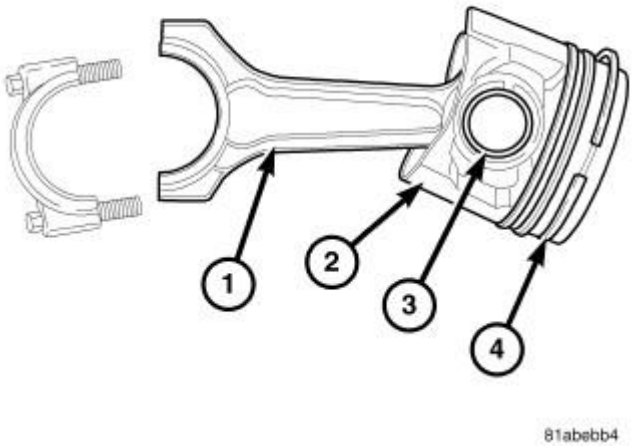

Fig. 173: Piston & Connecting Rod Assembly
Courtesy of CHRYSLER GROUP, LLC

The pistons (2) are of a free floating design. Oil jets in the engine block lubricate and cool the piston and piston pin (3) assembly. The connecting rods (1) have a pressed in place wrist pin bushing which is lubricated by the oil jets. Connecting rod (7) and bearing caps have cracked mating surfaces and are not interchangeable.

STANDARD PROCEDURE

STANDARD PROCEDURE - OVERSIZED CYLINDER BORE DIMENSIONS

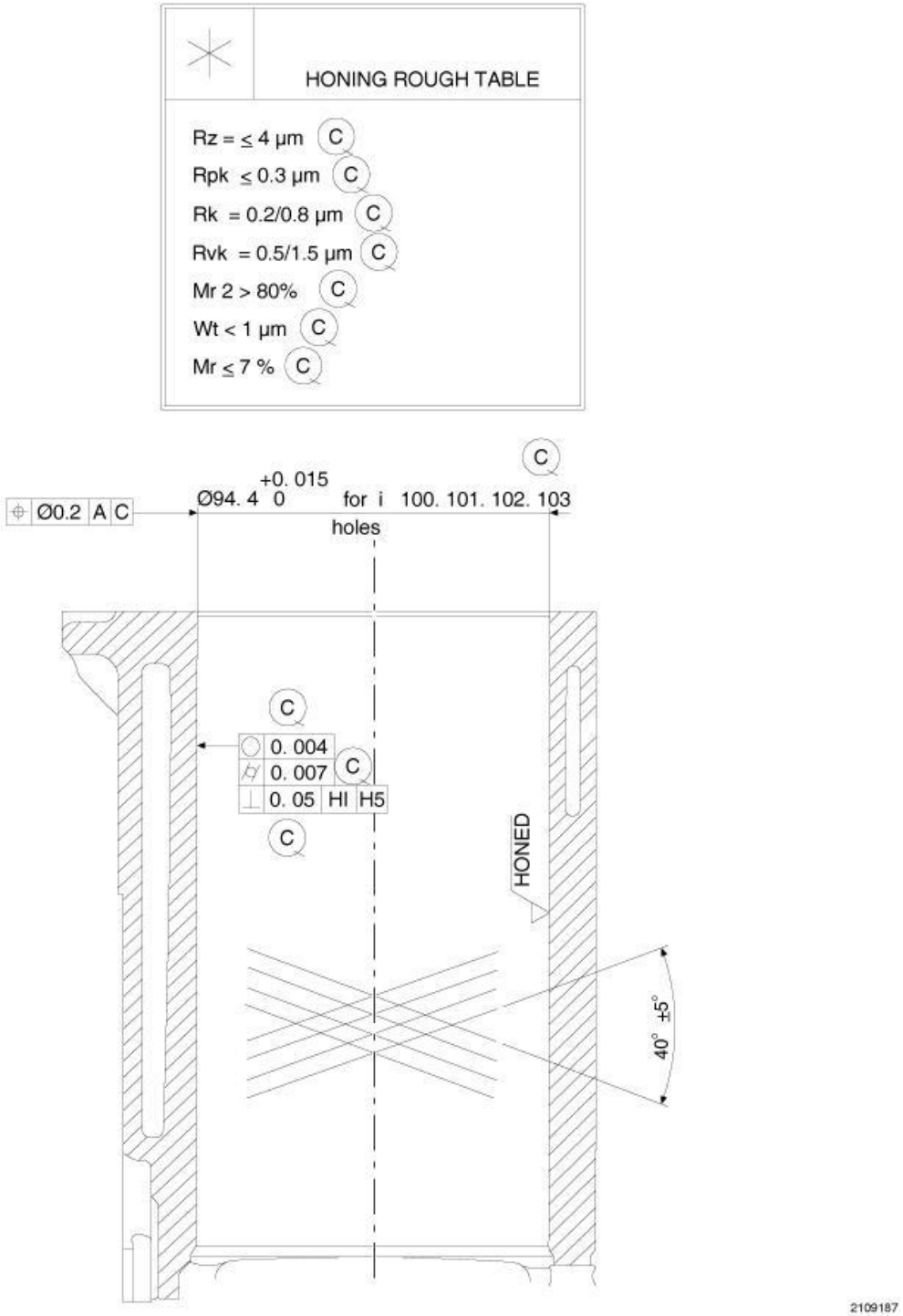

Fig. 174: Honing Rough Table
Courtesy of CHRYSLER GROUP, LLC

REMOVAL

REMOVAL

NOTE: Both the connecting rod and the connecting rod cap are paint marked to aid during assembly. Paint marks disappear after time. If the rod and the cap are not marked with paint, paint mark or scribe them before disassembly.

1. Disconnect negative battery cable.
2. Remove cylinder head. Refer to **CYLINDER HEAD, REMOVAL**.
3. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
4. Remove the oil jets. Refer to **JET, PISTON OIL COOLER, REMOVAL**.
5. Remove top ridge of cylinder bores with a ridge reamer before removing pistons from cylinder block. **Be sure to keep top of pistons covered during this operation.**
6. Piston and connecting rods must be removed from top of cylinder block. Rotate crankshaft so that each connecting rod is centered in cylinder bore.

NOTE: Be careful not to nick or scratch crankshaft journals

7. After removal, install bearing cap on the mating rod and mark pistons with matching cylinder number when removed from engine block.

PISTON PIN - REMOVAL

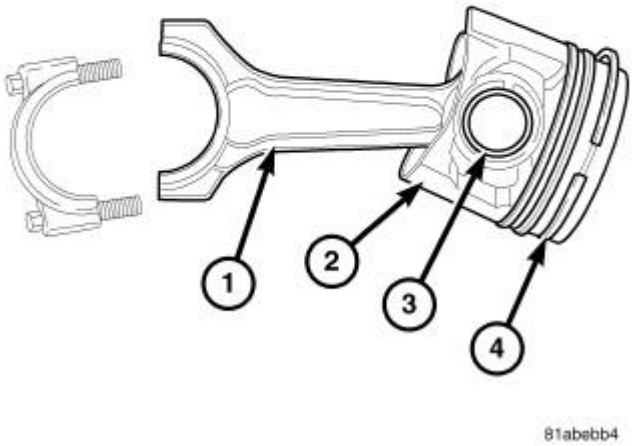

Fig. 175: Piston & Connecting Rod Assembly
Courtesy of CHRYSLER GROUP, LLC

1. Secure connecting rod (1) in a soft jawed vice.
2. Remove the snap rings securing piston pin (3).
3. Push piston pin (3) out of piston (2) and connecting rod (1).

PISTON RING - REMOVAL

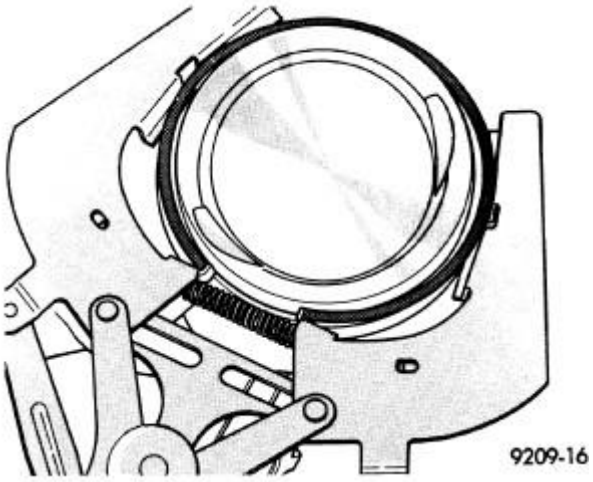

Fig. 176: Piston Rings - Removal/Installation
Courtesy of CHRYSLER GROUP, LLC

1. Reference the ID mark on top of first and second piston rings must be facing up.
2. Using a suitable ring expander, remove top and second piston rings.
3. Remove upper oil ring side rail, lower oil ring side rail and then the oil expander from piston.
4. Carefully clean carbon from piston crowns, skirts and ring grooves ensuring the 4 oil holes in the oil control ring groove are clear.

INSPECTION

INSPECTION

PISTONS

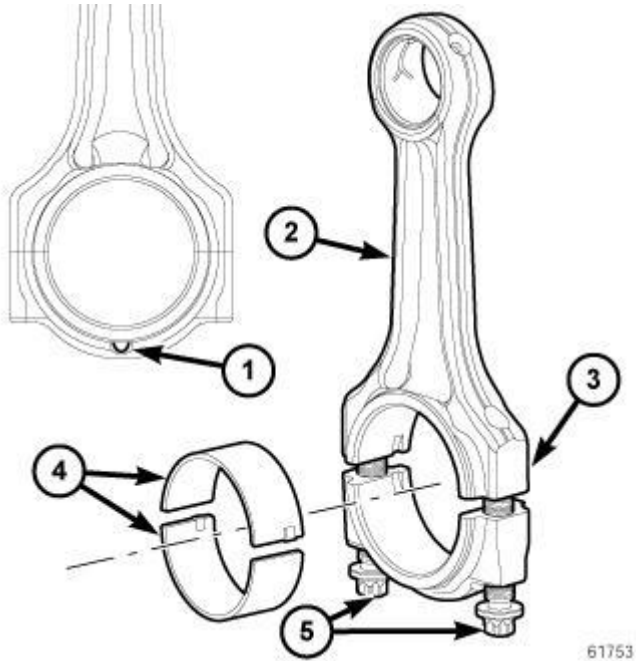

Fig. 177: Connecting Rod Identification
Courtesy of CHRYSLER GROUP, LLC

1 - CONNECTING ROD PAWL
2 - CONNECTING ROD
3 - PAINTED CYLINDER IDENTIFIER
4 - CONNECTING ROD BEARINGS

1. Piston Diameter: Size: 91.912 - 91.928 mm (3.6185 - 3.6192 in.) Maximum wear limit.05 mm (.0019 in.).
2. Check piston pin bores in piston for roundness. Make 3 checks at 120° intervals. Maximum out of roundness.05 mm (.0019 in.).
3. The piston diameter should be measured approximately 15 mm (.590 in.) up from the base.
4. Skirt wear should not exceed 0.1 mm (.00039 in.).
5. The clearance between the cylinder liner and piston should not exceed 0.065-0.083 mm (.0025-.0032 in.).

CONNECTING RODS

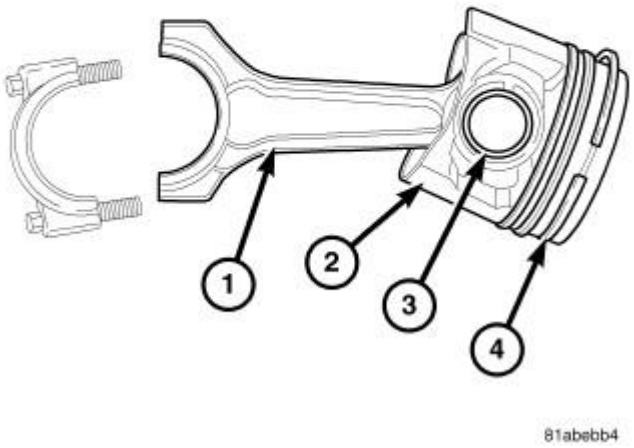

Fig. 178: Piston & Connecting Rod Assembly
Courtesy of CHRYSLER GROUP, LLC

CAUTION: Connecting rod bolts must be replaced when disassembled. When assembling the connecting rod (2), be sure that the connecting rod pawl (1) on each of the connecting rod caps is facing the rear (fly wheel) side of the engine.

NOTE: Do Not lubricate the new connecting rod bolts. They are already coated with a anti scuff treatment.

1. Assemble connecting rod bearings (4) and bearing caps to their respective connecting rods (2) ensuring that the serrations on the cap and reference marks are aligned.
2. Tighten connecting cap bolts to 10 N.m (89 in. lbs.).
3. Without loosening connecting rod bolts, tighten all bolts to 30 N.m (22 ft. lbs.).
4. Using a torque angle gauge, tighten each bolt an additional 40°.
5. Recheck all bolt tightening with a torque wrench set to 88 N.m (65 ft. lbs.).
6. Check and record internal diameter of crank end of connecting rod (2).

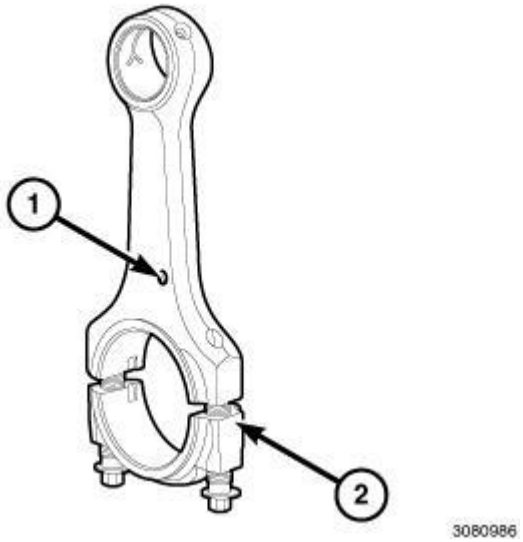

Fig. 179: Connecting Rod & Cap
Courtesy of CHRYSLER GROUP, LLC

CAUTION: When changing connecting rods (2), DO NOT use a stamp to mark the cylinder location. Identify the connecting rods (2) and caps location using a paint marker. All four must have the same weight. Replacement connecting rods (2) will only be supplied in sets of four.

Connecting rods (2) are supplied in sets of four since they all must be of the same weight category. The weight of the connecting rod is identified by a paint mark (1) on the connecting rod.

PISTON PINS

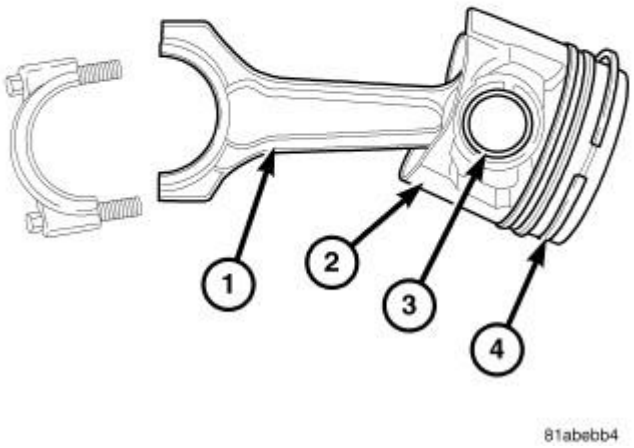

Fig. 180: Piston & Connecting Rod Assembly
Courtesy of CHRYSLER GROUP, LLC

1. Measure the diameter of piston pin in the center and both ends. For specification, refer to **Engine - Specifications**.

INSTALLATION

INSTALLATION

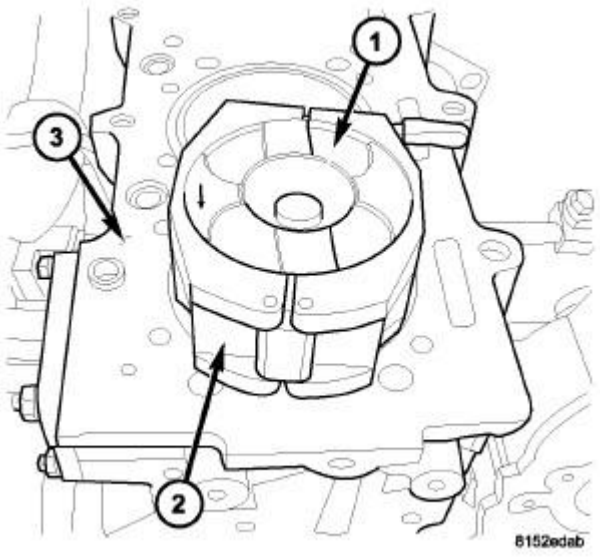

Fig. 181: Piston, Ring Compressor & Engine Block
Courtesy of CHRYSLER GROUP, LLC

1 - PISTON
2 - PISTON RING COMPRESSOR
3 - ENGINE BLOCK

1. Before installing pistons, and connecting rod assemblies into the bore, be sure that compression ring gaps are staggered so that neither is in line with oil ring rail gap.
2. Before installing the ring compressor, make sure the oil ring expander ends are butted together.
3. Immerse the piston head and rings in clean engine oil, slide the piston ring compressor, over the piston and tighten. **Ensure position of rings does not change during this operation** .
4. Face arrow on piston towards front of engine.

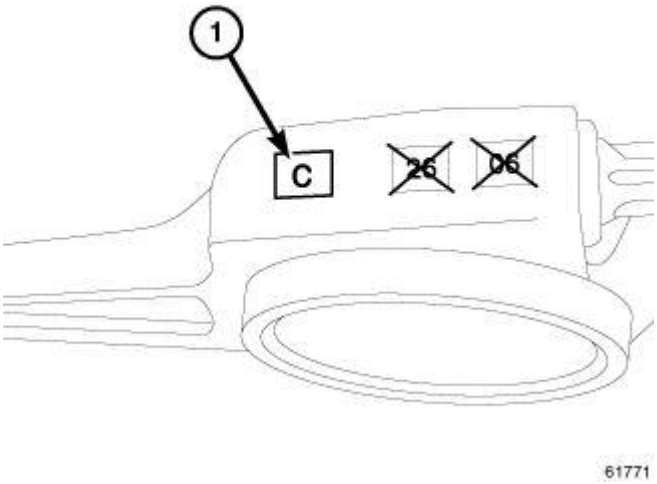

Fig. 182: Connecting Rod Size
Courtesy of CHRYSLER GROUP, LLC

5. Each connecting rod has its own letter class (1) to a specific connecting rod journal diameter.

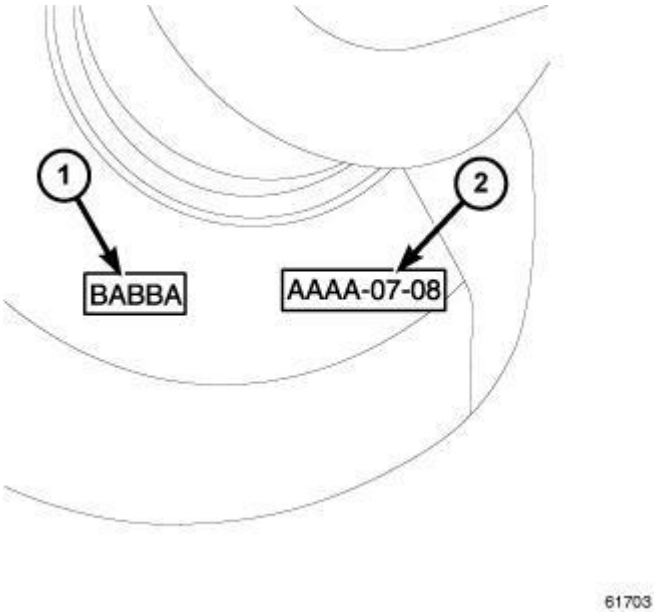

Fig. 183: Crankshaft Connecting Rod Journal Diameter
Courtesy of CHRYSLER GROUP, LLC

6. To determine the correct bearing size for each cylinder. Each connecting rod letter class must be matched with the crankshaft letter class (2) with the bearing selection chart to determine the correct bearing color for each cylinder. The letters stamped into the crankshaft (2) are in the same order as the cylinders. The first letter corresponds to the first cylinder, the second to the second, etc. See bearing selection chart. Refer to **Engine/Engine Block - Standard Procedure**.

CAUTION: Care must be taken not to nick the crankshaft journal or cylinder bore when installing the pistons.

7. Rotate crankshaft so that the connecting rod journal is on the center of the cylinder bore. Insert rod and piston into cylinder bore and guide rod over the crankshaft journal.
8. Guide the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal.

NOTE: The connecting rod bolts must be replaced every time they are loosened or removed.

9. Using new bolts, install connecting rod caps. Tighten bolts to 10 N.m (88 in. lbs.).
   - Next tighten bolts to 30 N.m (22 ft. lbs.) plus an additional 40 degrees.
   - Next tighten bolts to 88 N.m (65 ft. lbs.).
10. Install the oil jets. Refer to **JET, PISTON OIL COOLER, INSTALLATION**.
11. Install cylinder head. Refer to **CYLINDER HEAD, INSTALLATION**.
12. Connect negative battery cable.

PISTON PIN INSTALLATION

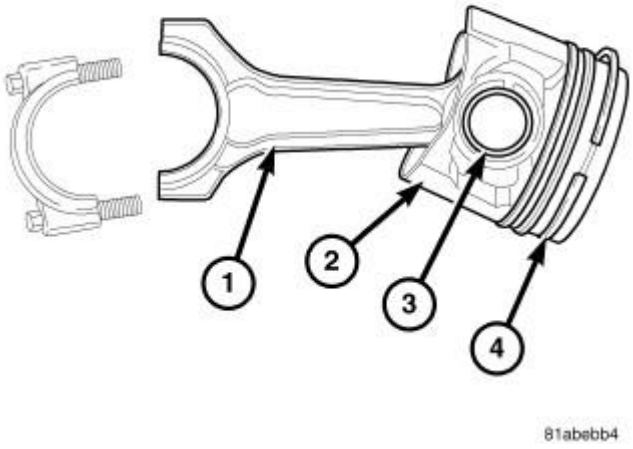

Fig. 184: Piston & Connecting Rod Assembly
Courtesy of CHRYSLER GROUP, LLC

1. Secure connecting rod (1) in soft jawed vice.
2. Lubricate piston pin (3) and piston (2) with clean engine oil.
3. Position piston (2) on connecting rod (1).

CAUTION: Ensure arrow on piston crown and the bearing cap numbers on the connecting rod are on the opposite side.

4. Install piston pin.
5. Install snap ring in piston (2) to retain piston pin (3) and visually inspect that the snap ring is seated correctly in piston seat.
6. Remove connecting rod (1) from vice.

PISTON RINGS - INSTALLATION

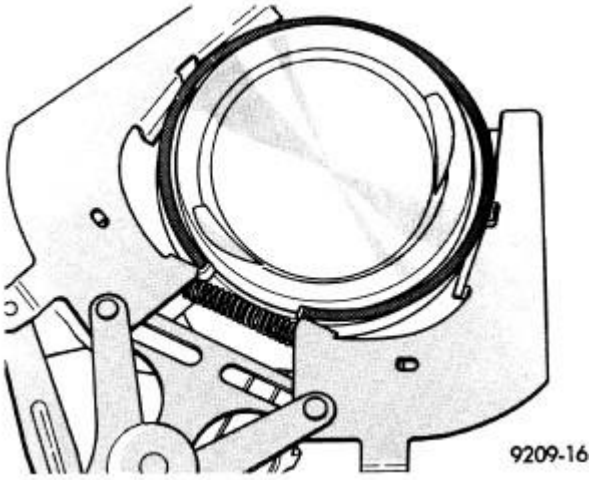

Fig. 185: Piston Rings - Removal/Installation
Courtesy of CHRYSLER GROUP, LLC

1. Install rings on the pistons using a suitable ring expander.

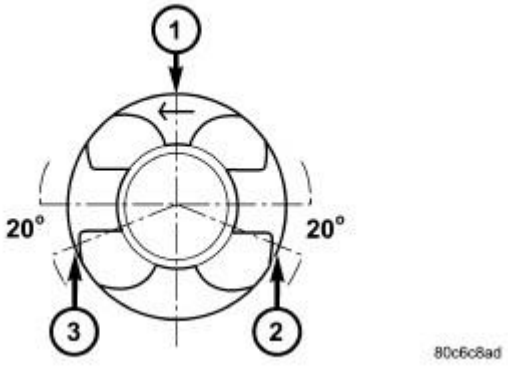

Fig. 186: Piston Ring Gap Location
Courtesy of CHRYSLER GROUP, LLC

1 - SECOND COMPRESSION RING GAP POSITION
2 - OIL CONTROL RING GAP POSITION
3 - TOP COMPRESSION RING GAP POSITION

2. Top compression ring is tapered and chromium plated. The second ring is of the scraper type and must be installed with scraping edge facing bottom of the piston. The third is an oil control ring. Ring gaps must be positioned, before inserting piston into the liners, as follows.
3. Top ring gap must be positioned at the No. 3 position (looking at the piston crown from above).
4. Second piston ring gap should be positioned at the No. 1 position.
5. Oil control ring gap should be positioned at the No. 2 position.

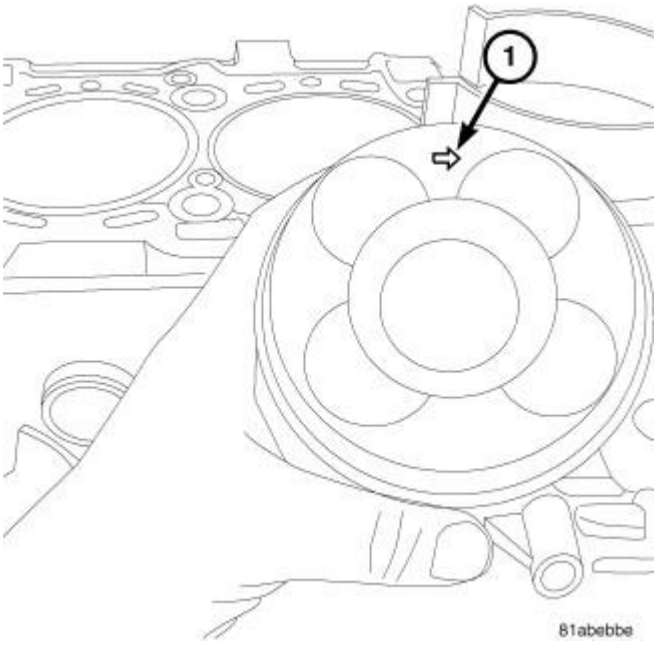

Fig. 187: Piston Direction
Courtesy of CHRYSLER GROUP, LLC

6. When assembling pistons check that components are installed in the same position as before disassembly, determined by the numbers stamped on the crown of individual pistons. Engine cylinders are numbered starting from gear train end of the engine. **Face arrow on top of piston toward front of engine** . Therefore, the numbers stamped on connecting rod big end should face toward the injection pump side of engine. To insert piston into cylinder use a ring compressor.

SEAL, CRANKSHAFT OIL, FRONT

REMOVAL

REMOVAL

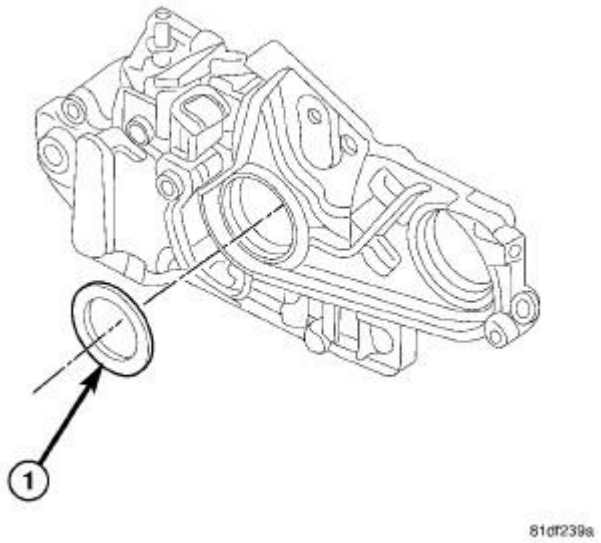

Fig. 188: Front Crankshaft Oil Seal
Courtesy of CHRYSLER GROUP, LLC

1. Remove the crankshaft sprocket. Refer to **SPROCKET(S), TIMING BELT AND CHAIN, REMOVAL**.

NOTE: Do not gouge or scratch the surface of the crankshaft when removing the front crankshaft oil seal.

2. Remove the front crankshaft oil seal (1).

INSTALLATION

INSTALLATION

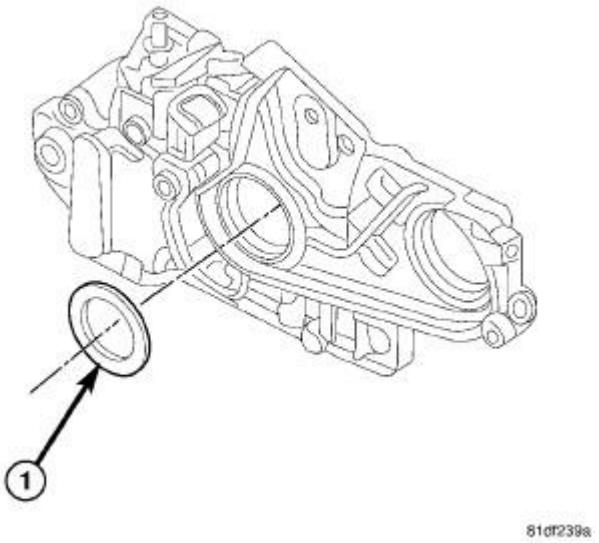

Fig. 189: Front Crankshaft Oil Seal
Courtesy of CHRYSLER GROUP, LLC

NOTE: The lip of the front oil seal faces away from the engine on installation.

1. Position the front crankshaft oil seal (1) into the front cover.

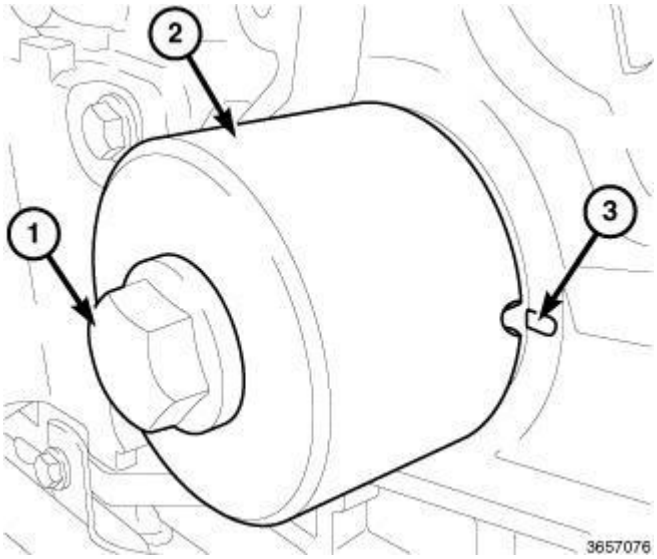

Fig. 190: Front Crankshaft Oil Seal Installer & Bolt
Courtesy of CHRYSLER GROUP, LLC

NOTE: The crankshaft sprocket bolt is a left handed thread.

2. Using (special tool #VM.10335, Installer, Front Crankshaft Oil Seal) (2), install the front crankshaft oil seal using the vibration damper bolt (1) to draw the seal in place.

3. Remove bolt (1) and the (special tool #VM.10335, Installer, Front Crankshaft Oil Seal) (2).
4. Install the crankshaft sprocket. Refer to **SPROCKET(S), TIMING BELT AND CHAIN, INSTALLATION**.

SEAL, CRANKSHAFT OIL, REAR

DESCRIPTION

DESCRIPTION

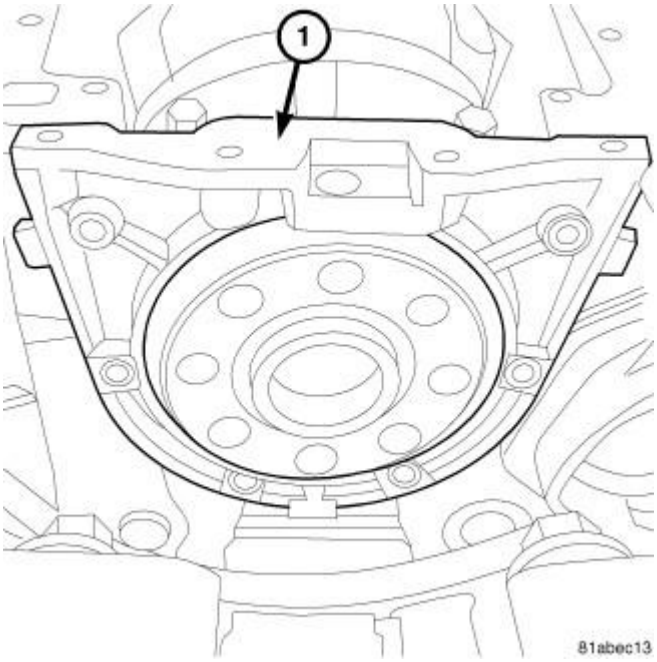

Fig. 191: Rear Crankshaft Seal & Rear Main Oil Seal Carrier
Courtesy of CHRYSLER GROUP, LLC

The rear crankshaft seal consists of a seal and a seal carrier (1). The rear seal is inserted into the carrier. Once assembled the rear main seal assembly should not be separated to reduce the possibility of damage to the internal rear seal lip.

REMOVAL

REMOVAL

NOTE: This must be done with either the engine or transmission removed from vehicle.

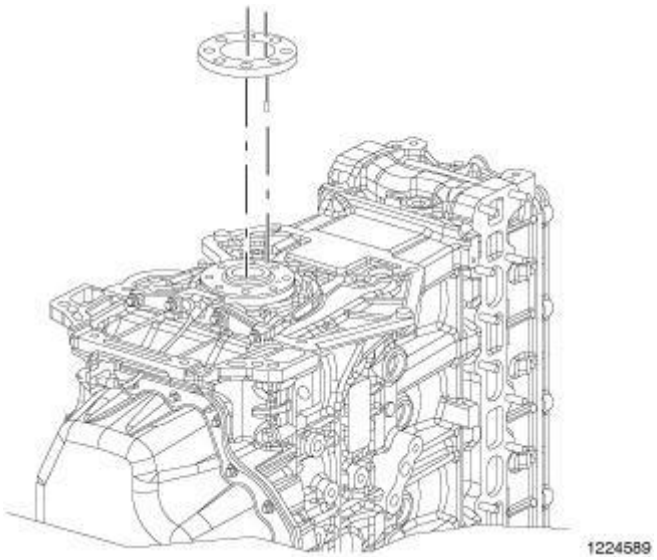

Fig. 192: Crankshaft Sensor Tone Wheel
Courtesy of CHRYSLER GROUP, LLC

1. On automatic transmission vehicles, remove the flex plate. Refer to **FLEXPLATE, REMOVAL**.
2. On manual transmission vehicles, remove the flywheel. Refer to **FLYWHEEL, REMOVAL** .
3. Remove the Crankshaft Position (CKP) sensor. Refer to **SENSOR, CRANKSHAFT POSITION, REMOVAL** .
4. Remove the upper oil pan. Refer to **PAN, OIL, REMOVAL**.
5. Remove the crankshaft sensor tone wheel before removing the rear main oil seal.

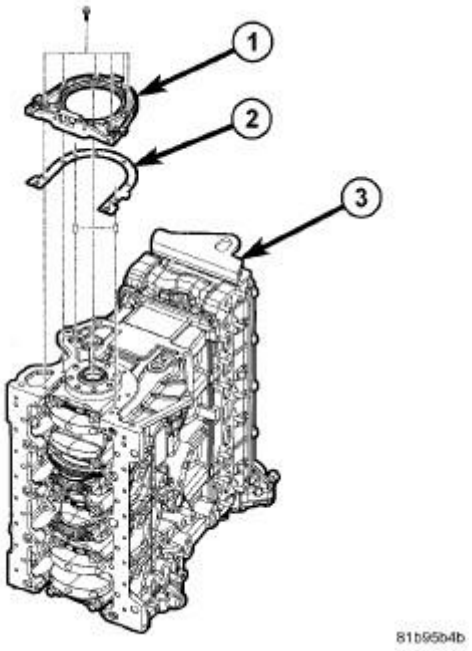

Fig. 193: Rear Main Seal Carrier, Gasket & Engine Block

Courtesy of CHRYSLER GROUP, LLC

6. Remove the bolts that secure the rear oil seal carrier (1) to the engine block (3).
7. Remove the rear oil seal carrier and gasket (2).
8. Remove the rear crankshaft oil seal from the rear oil seal carrier (1).

INSTALLATION

INSTALLATION

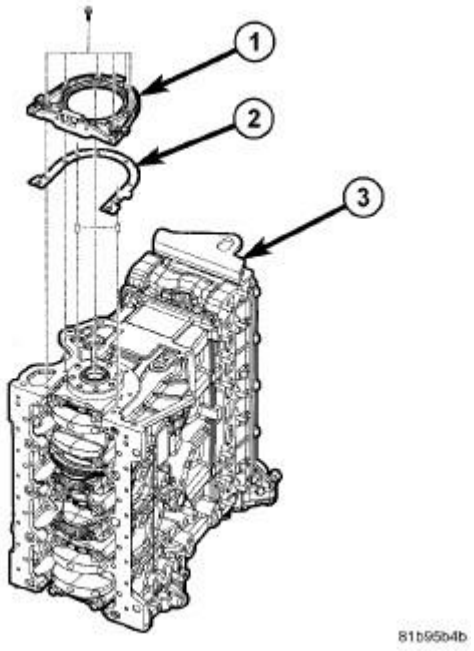

Fig. 194: Rear Main Seal Carrier, Gasket & Engine Block
Courtesy of CHRYSLER GROUP, LLC

1. Clean the rear crankshaft oil seal and seal carrier sealing surfaces.
2. Position the rear main seal carrier gasket (2) onto the rear of the engine block.
3. Using Crankshaft Seal Installer (special tool #VM.9993, Installer, Crankshaft Rear Oil Seal), install rear crankshaft oil seal into the rear main seal carrier (1).
4. Install the rear main seal carrier onto the engine block (3).

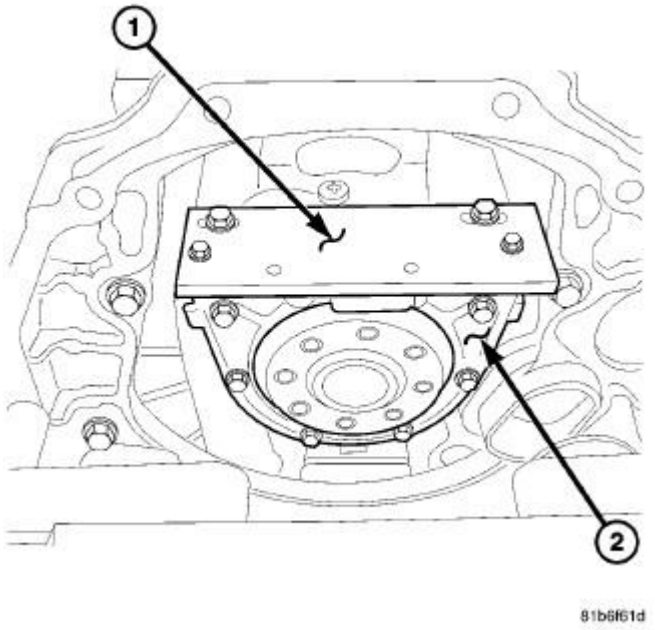

Fig. 195: Front And Rear Seal Tool Installed Onto Rear Oil Seal Carrier
Courtesy of CHRYSLER GROUP, LLC

5. Loosely install the bolts that secure the rear oil seal carrier (2) to the engine block.
6. Using the Front and Rear Seal Tool (special tool #VM.9990, Tool, Front And Rear Seal) (1) to set the depth of the rear main seal (2).

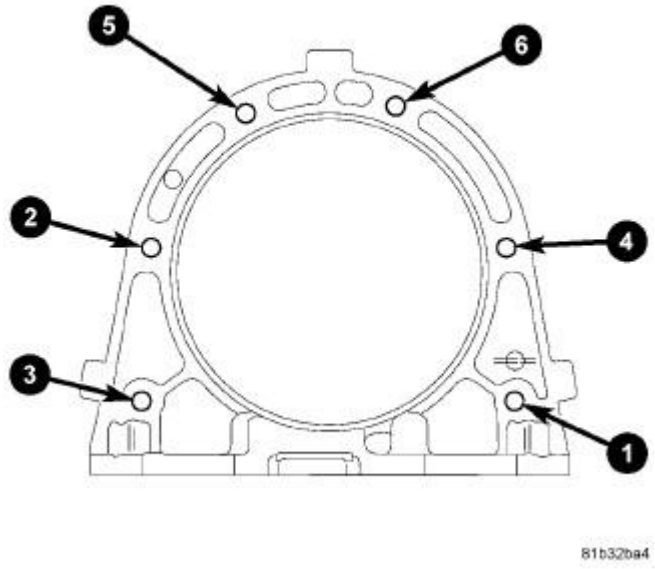

Fig. 196: Rear Cover Tightening Sequence

Courtesy of CHRYSLER GROUP, LLC

7. Using the illustration shown in illustration, tighten the rear cover bolts to 15 N.m (133 in. lbs.).
8. Install the upper oil pan. Refer to **PAN, OIL, INSTALLATION**.

NOTE: Make sure the crankshaft sensor tone wheel is positioned correctly on the crankshaft.

9. Install the Crankshaft Position Sensor (CKP). Refer to **SENSOR, CRANKSHAFT POSITION, INSTALLATION** .

NOTE: If equipped, manual transmission models with start/stop, there is a special tone wheel for this option that needs to be installed. Refer to Clutch/Flywheel Installation .

10. Install the crankshaft sensor tone wheel to the rear of the crankshaft.
11. On manual transmission models, install the flywheel. Refer to **FLYWHEEL, INSTALLATION** .
12. On automatic transmission vehicles, Install the flex plate. Refer to **FLEXPLATE, INSTALLATION**.

ENGINE MOUNTING

INSULATOR, ENGINE MOUNT, LEFT

REMOVAL

REMOVAL

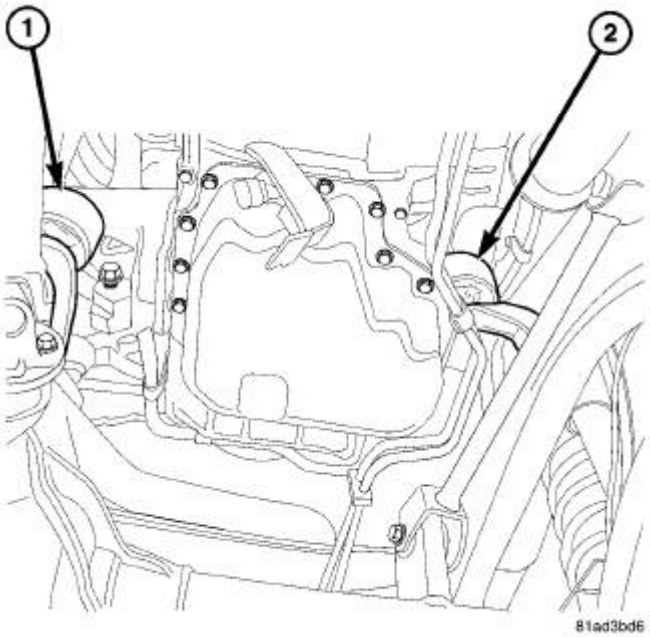

Fig. 197: Engine Mounts
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.

NOTE: The viscus fan does not need to be totally removed from vehicle only from the mounting drive.

2. Remove the viscus fan and position aside. Refer to **DRIVE, FAN, REMOVAL** .
3. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
4. Remove the right side and left side lower engine mount nuts.
5. Install the (special tool #8534B, Fixture, Driveline Support).
6. Raise the engine.
7. Remove the left front tire.
8. Remove the inner fender. Refer to **SHIELD, SPLASH, WHEELHOUSE, REMOVAL** .
9. Remove upper nut, and the left engine mount (1).

INSTALLATION

INSTALLATION

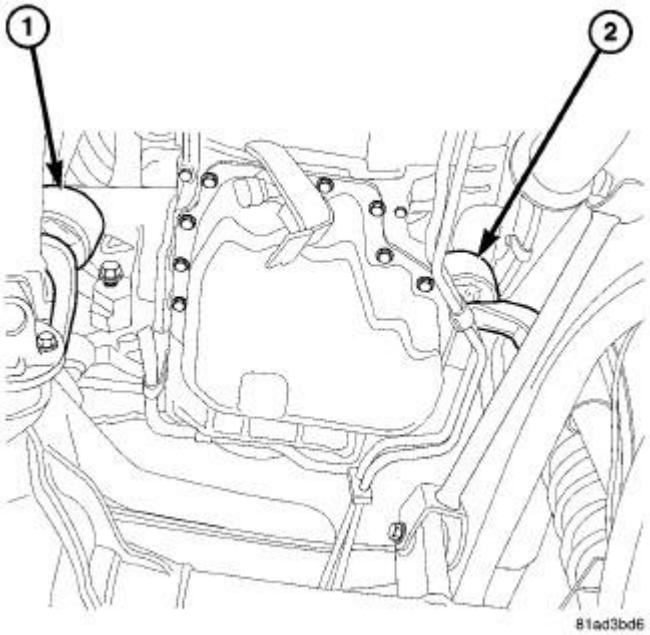

Fig. 198: Engine Mounts
Courtesy of CHRYSLER GROUP, LLC

1. Position the left engine mount (1) and install the left upper retaining nut tight.
2. Lower the vehicle.

3. Lower the engine.
4. Remove the Engine Support Fixture (special tool #8534B, Fixture, Driveline Support).
5. Install the viscus fan. Refer to **DRIVE, FAN, INSTALLATION** .
6. Tighten the left upper engine mount nut to 54 N.m (40 ft. lbs.).
7. Raise and support the vehicle.
8. Install the left and right lower engine mount nut. Tighten nut to 54 N.m (40 ft. lbs.).
9. Lower the vehicle.
10. Install the left inner splash shield. Refer to **SHIELD, SPLASH, WHEELHOUSE, INSTALLATION** .
11. Install the left front tire.
12. Connect the negative battery cable.

INSULATOR, ENGINE MOUNT, RIGHT

REMOVAL

REMOVAL

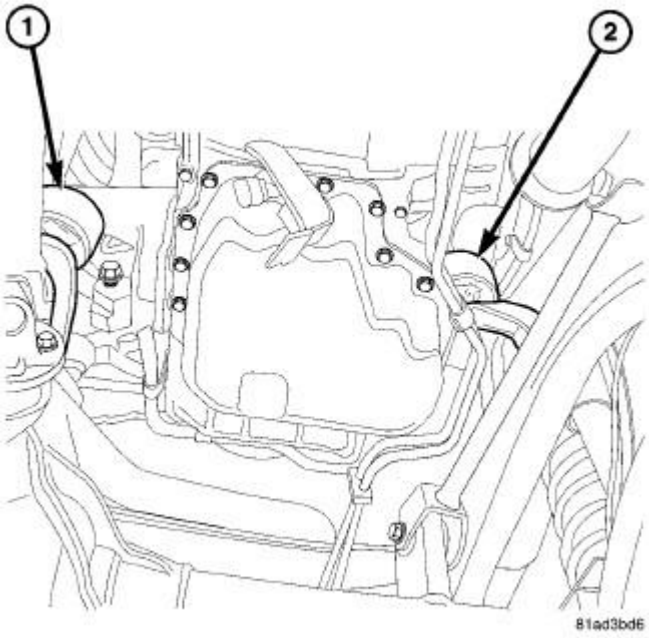

Fig. 199: Engine Mounts
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.

NOTE: The viscus fan does not need to be totally removed from vehicle only from the mounting drive.

2. Remove the viscus fan and position aside. Refer to **DRIVE, FAN, REMOVAL** .
3. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
4. Remove the right side and left side lower engine mount nuts.
5. Install the (special tool #8534B, Fixture, Driveline Support).
6. Raise the engine.
7. Remove the inner fender. Refer to **SHIELD, SPLASH, WHEELHOUSE, REMOVAL** .
8. Remove upper nut, and the right engine mount (2).

INSTALLATION

INSTALLATION

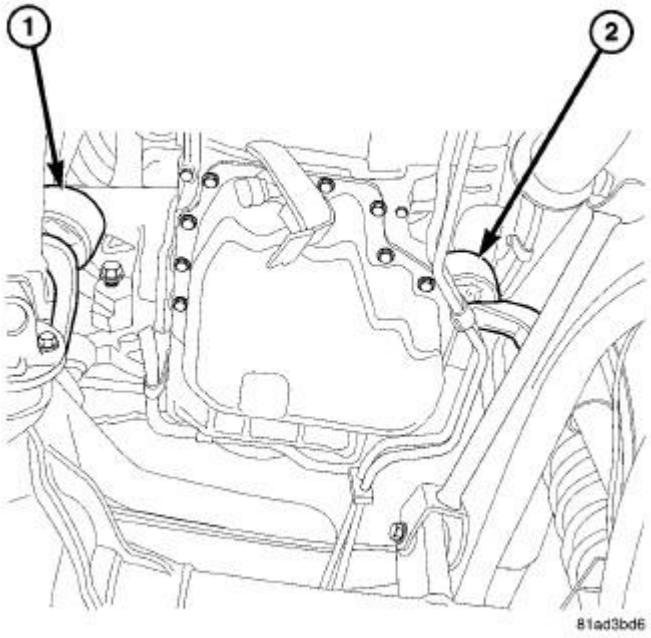

Fig. 200: Engine Mounts
Courtesy of CHRYSLER GROUP, LLC

1. Position the right engine mount (2) and install the retaining nut finger tight.
2. Lower the vehicle.
3. Lower the engine.
4. Remove the (special tool #8534B, Fixture, Driveline Support).
5. Install the viscus fan. Refer to **DRIVE, FAN, INSTALLATION** .
6. Tighten the right upper engine mount through bolts to 54 N.m (40 ft. lbs.).
7. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
8. Install the left and right lower engine mount nut. Tighten nut to 54 N.m (40 ft. lbs.).
9. Lower the vehicle.

10. Install the right inner splash shield. Refer to **SHIELD, SPLASH, WHEELHOUSE, INSTALLATION** .
11. Connect the negative battery cable.

LUBRICATION

COOLER, OIL

DESCRIPTION

DESCRIPTION

Engine coolant is used to cool the engine oil. A plate-style external heat exchanger is located on the oil filter housing which is on the right side of the engine. A gasket seals the oil cooler to the oil filter housing. Replace the gasket whenever the oil cooler is removed or replaced. The oil is fed to the oil cooler through the oil filter housing.

REMOVAL

REMOVAL

1. Disconnect the negative battery cable.
2. Remove the belly pan.
3. Drain the engine oil.
4. Drain the cooling system. Refer to **STANDARD PROCEDURE** .

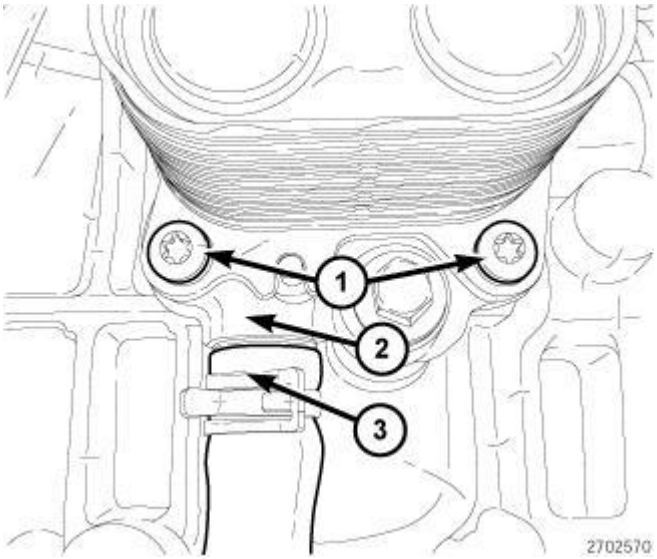

Fig. 201: Coolant Hose, Oil Cooler Housing & Bolts
Courtesy of CHRYSLER GROUP, LLC

5. Remove the two lower oil cooler bolts (1).

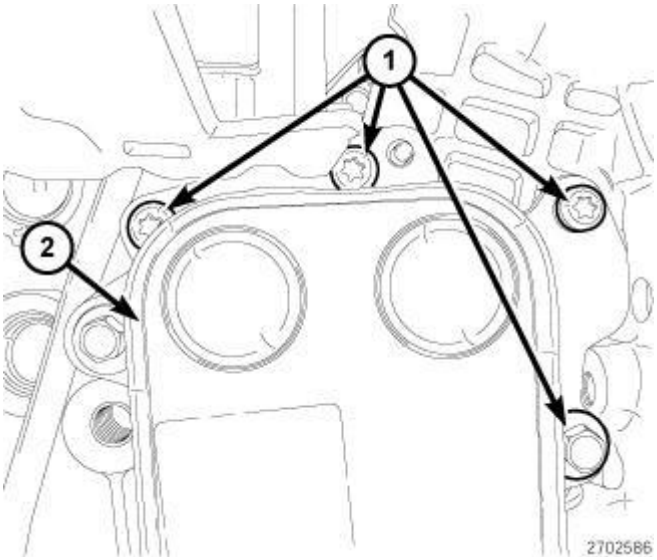

Fig. 202: Engine Oil Cooler & Bolts
Courtesy of CHRYSLER GROUP, LLC

6. Remove the air cleaner body and turbocharger air inlet tube. Refer to **BODY, AIR CLEANER, REMOVAL**.
7. Remove the Charge Air Cooler (CAC) hose from (CAC).
8. Remove the (CAC) hose from turbocharger.
9. Remove the four upper bolts (1) and the engine oil cooler (2).
10. Remove and discard the O-ring gasket.

INSTALLATION

INSTALLATION

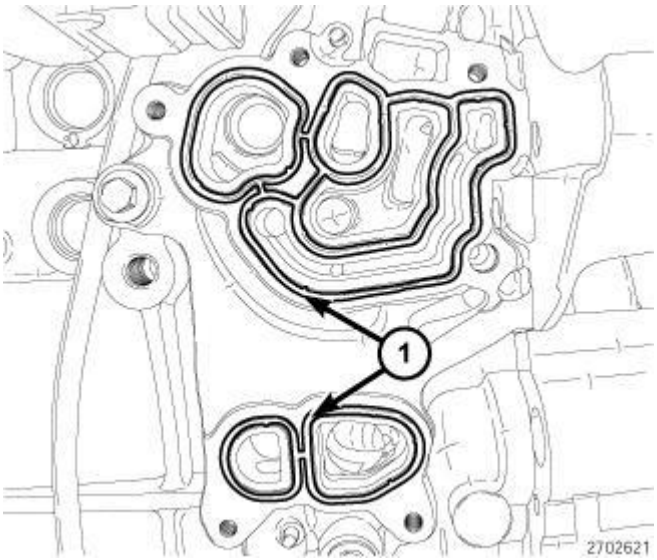

Fig. 203: O-Ring Gaskets
Courtesy of CHRYSLER GROUP, LLC

1. Clean all gasket mating surfaces.
2. Install a new O-ring gaskets (1).

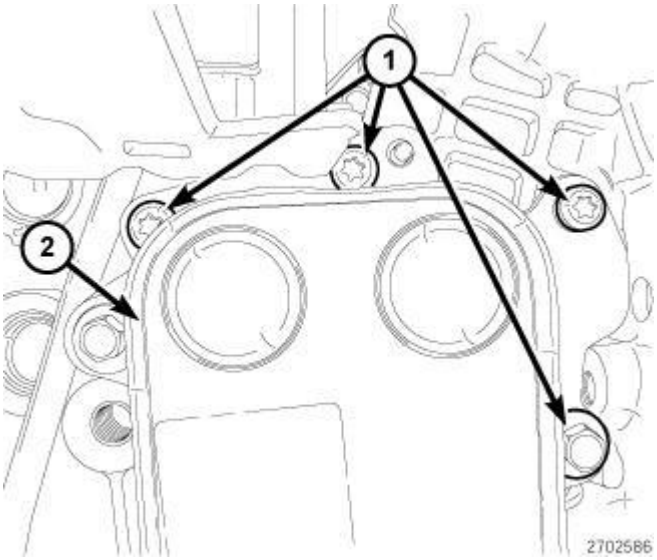

Fig. 204: Engine Oil Cooler & Bolts
Courtesy of CHRYSLER GROUP, LLC

3. Install the oil cooler (2). Tighten bolts (1) to 12 N.m (106 in. lbs.).
4. Install the (CAC) hose from turbocharger.
5. Install the Charge Air Cooler (CAC) hose from (CAC).
6. Install the air cleaner body and turbocharger air inlet tube. Refer to **BODY, AIR CLEANER, INSTALLATION**.

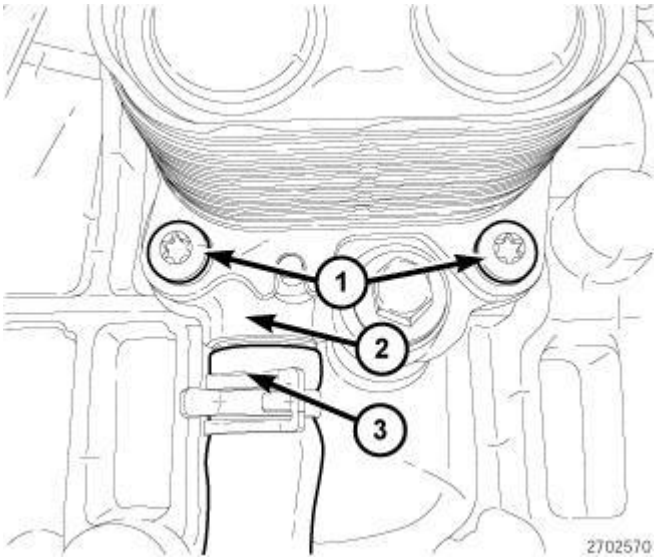

Fig. 205: Coolant Hose, Oil Cooler Housing & Bolts
Courtesy of CHRYSLER GROUP, LLC

7. Install the two lower oil cooler bolts (1). Tighten to 12 N.m (106 in. lbs.).
8. Install the belly pan.
9. Fill the cooling system. Refer to **STANDARD PROCEDURE** .
10. Fill the engine with recommended oil.
11. Connect the negative battery cable.
12. Start the engine and check for leaks.

FILTER, ENGINE OIL

REMOVAL

REMOVAL

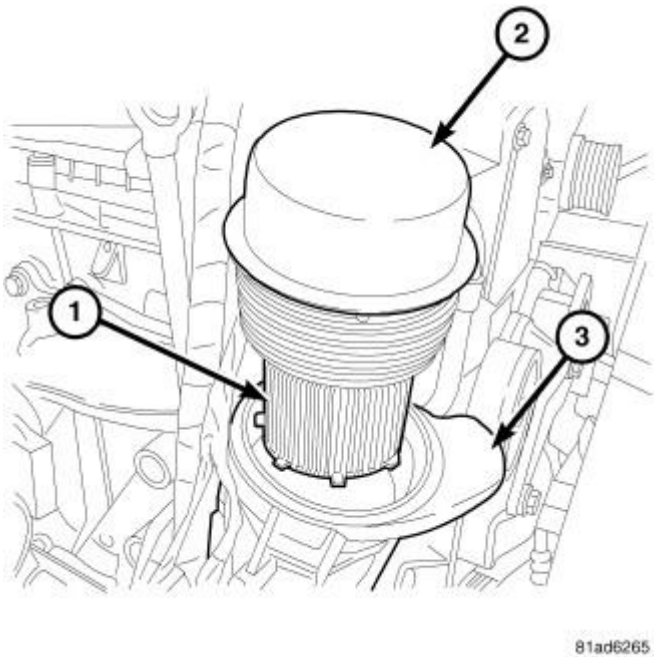

Fig. 206: Oil Filter, Oil Filter Housing Cap & Oil Filter Housing
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the air inlet tube from air cleaner housing and position aside.
3. Remove the oil filter housing cap (2) and the oil filter (1).

INSTALLATION

INSTALLATION

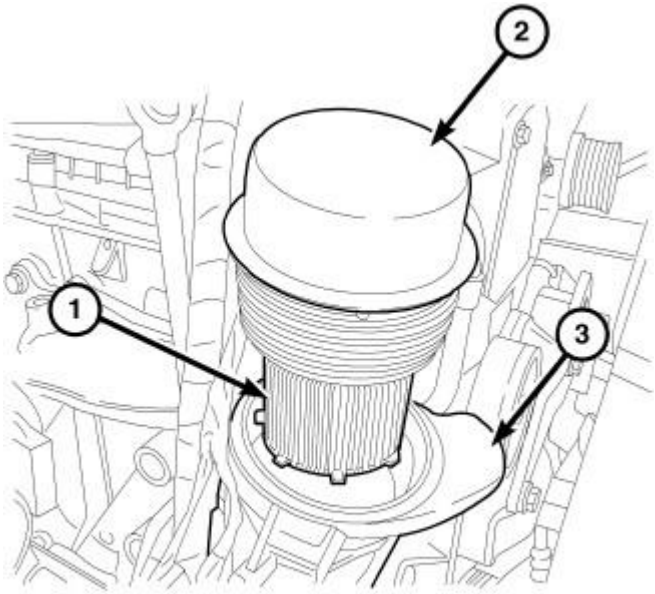

Fig. 207: Oil Filter, Oil Filter Housing Cap & Oil Filter Housing
Courtesy of CHRYSLER GROUP, LLC

1. Install oil filter (1) and the oil filter housing cap (2). Tighten cap to 25 N.m (18 ft. lbs.).
2. Install the air inlet tube to air cleaner housing and securely tighten clamp.
3. Fill engine with the recommended engine oil.
4. Connect the negative battery cable.

HOUSING, OIL FILTER

DESCRIPTION

DESCRIPTION

The oil filter housing is mounted on the right side of the engine. The engine oil cooler is bolted to the oil filter housing.

REMOVAL

REMOVAL

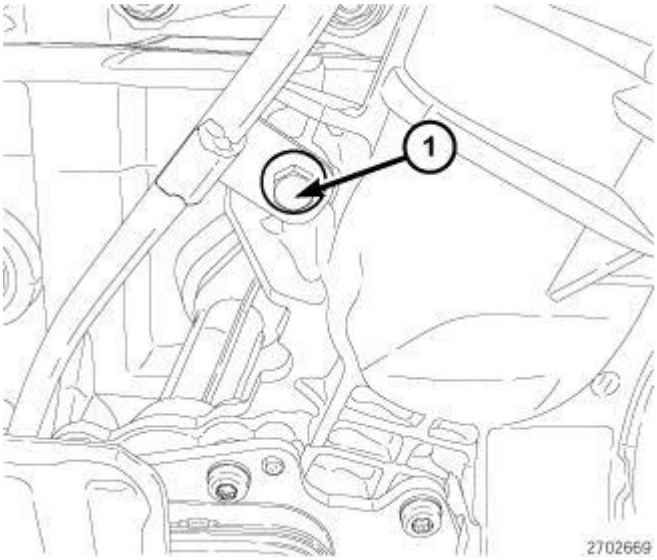

Fig. 208: Upper Oil Dipstick Bolt
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Raise and support the vehicle.
3. Remove the underbody skid plate.
4. Drain the cooling system. Refer to **STANDARD PROCEDURE** .
5. Drain the engine oil.
6. Remove the air cleaner body and turbocharger air inlet tube. Refer to **BODY, AIR CLEANER, REMOVAL**.
7. Remove the upper oil dipstick bolt (1).

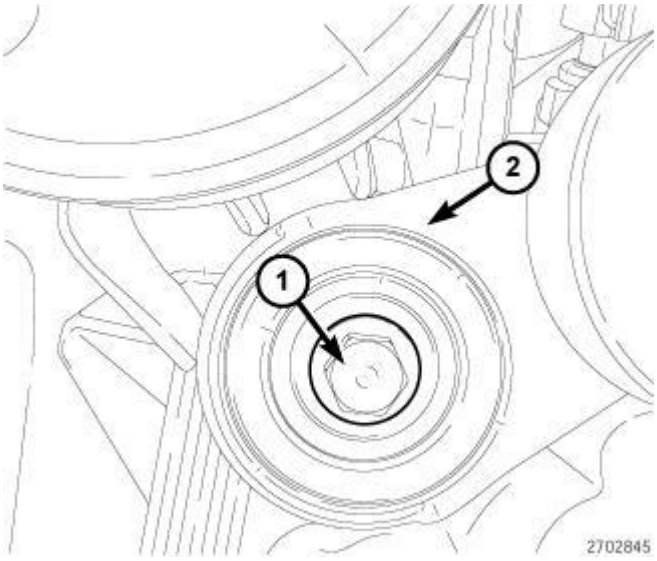

Fig. 209: Serpentine Belt Tensioner & Bolt
Courtesy of CHRYSLER GROUP, LLC

8. Remove the serpentine belt. Refer to **BELT, SERPENTINE, REMOVAL** .
9. Remove the power steering pump and position aside.
10. Remove bolt (1) and the serpentine belt tensioner (2).

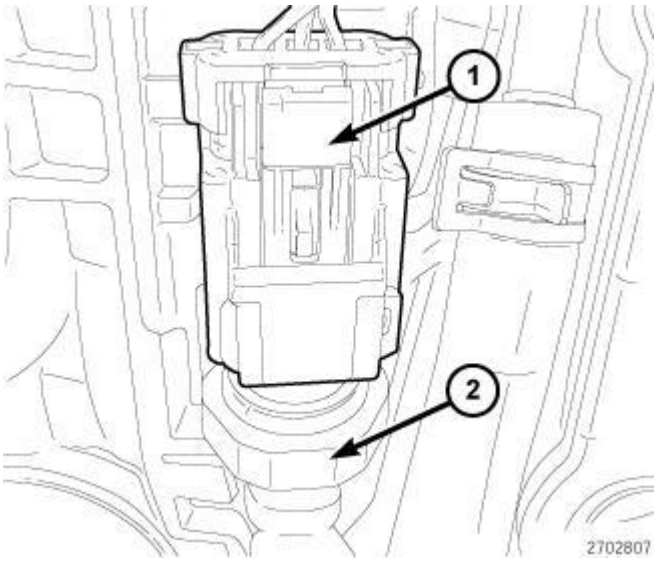

Fig. 210: Oil Pressure Switch & Harness Connector
Courtesy of CHRYSLER GROUP, LLC

11. Disconnect the oil pressure switch harness connector (1).

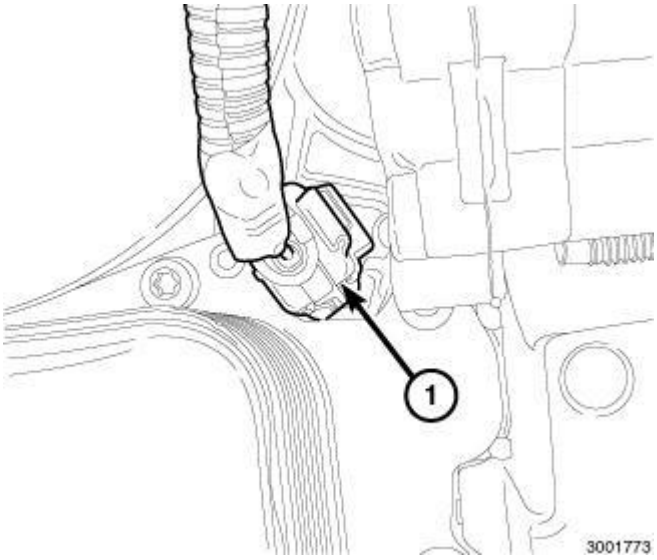

Fig. 211: Oil Temperature Sensor Harness Connector
Courtesy of CHRYSLER GROUP, LLC

12. Disconnect the oil temperature sensor harness connector (1).

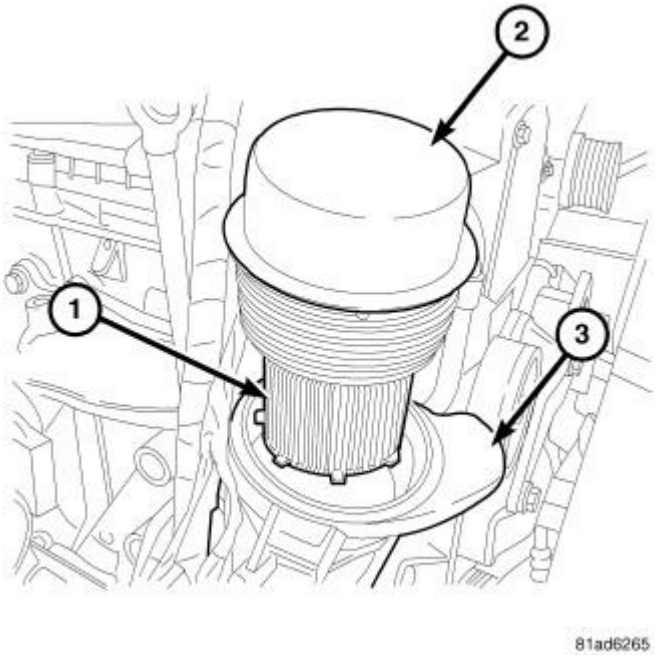

Fig. 212: Oil Filter, Oil Filter Housing Cap & Oil Filter Housing
Courtesy of CHRYSLER GROUP, LLC

13. Remove the oil filter housing cap (2) and the oil filter (1).

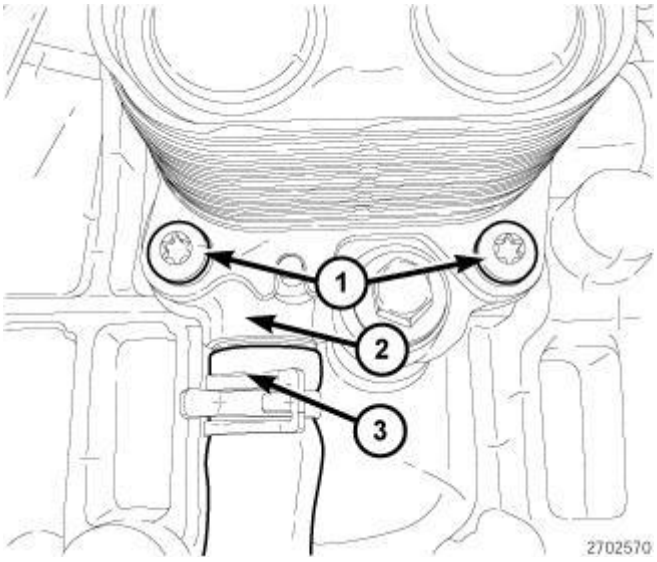

Fig. 213: Coolant Hose, Oil Cooler Housing & Bolts
Courtesy of CHRYSLER GROUP, LLC

14. Remove the coolant hose (3) from oil filter housing adapter (2).

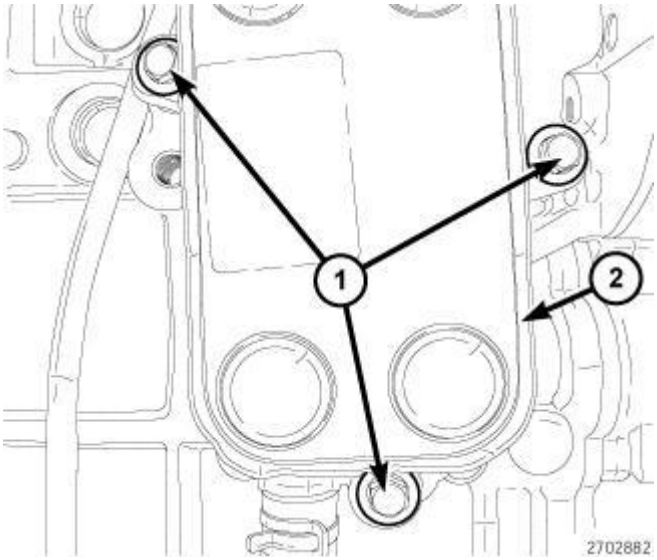

Fig. 214: Oil Filter Housing Adapter & Bolts
Courtesy of CHRYSLER GROUP, LLC

15. Remove bolts (1) and the oil filter housing adapter (2).

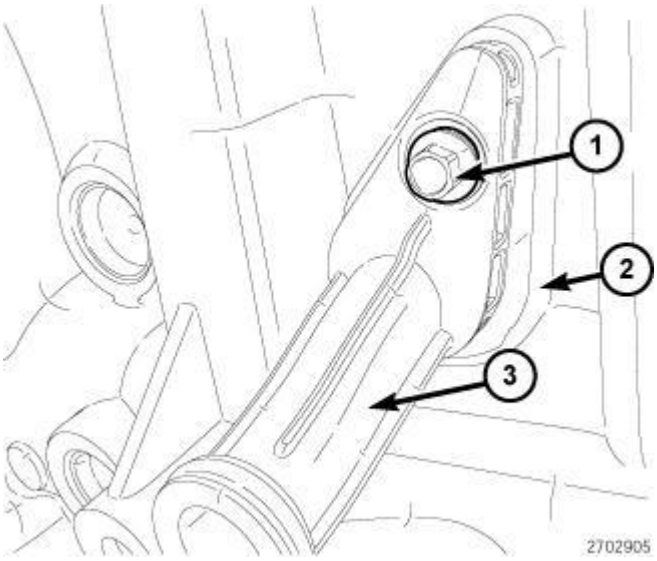

Fig. 215: Coolant Tube, Engine Block & Bolt
Courtesy of CHRYSLER GROUP, LLC

16. Remove bolt (1) and the oil cooler coolant adapter tube (3) and discard O-ring gasket.

INSTALLATION

INSTALLATION

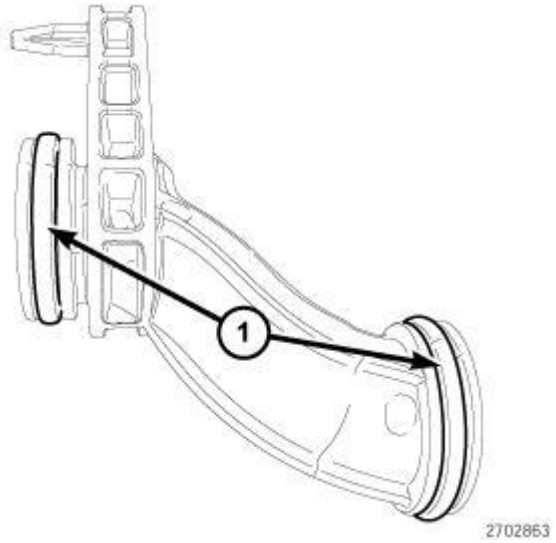

Fig. 216: Coolant Tube O-Ring Seals
Courtesy of CHRYSLER GROUP, LLC

1. Install new O-ring seals (1) onto oil cooler coolant tube adapter.

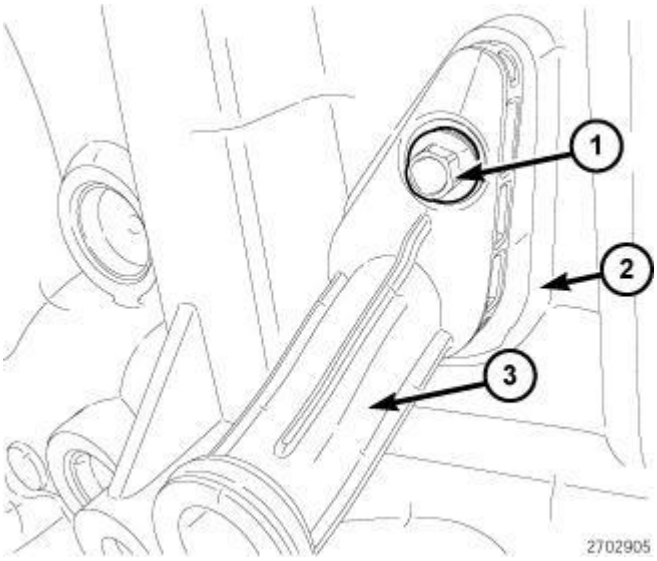

Fig. 217: Coolant Tube, Engine Block & Bolt
Courtesy of CHRYSLER GROUP, LLC

2. Install oil cooler coolant tube adapter (3) into engine block (2). Tighten bolt (1) to 11 N.m (97 in. lbs.).

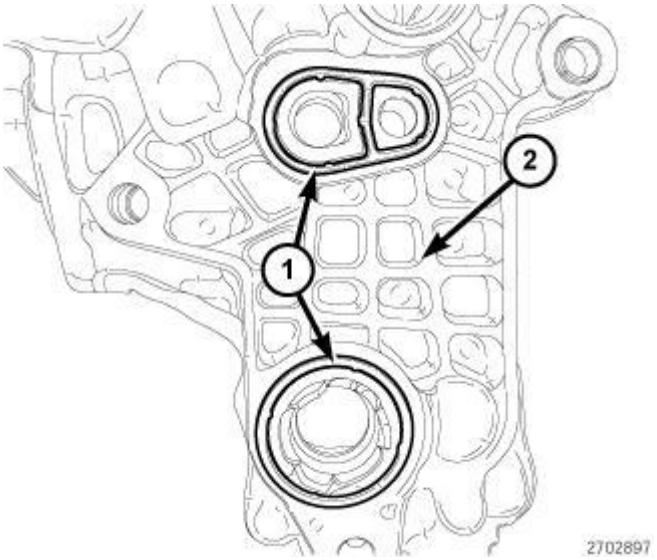

Fig. 218: O-Ring Seals & Oil Filter Housing
Courtesy of CHRYSLER GROUP, LLC

3. Install new O-ring seals (1) to the oil filter housing (2) adapter.

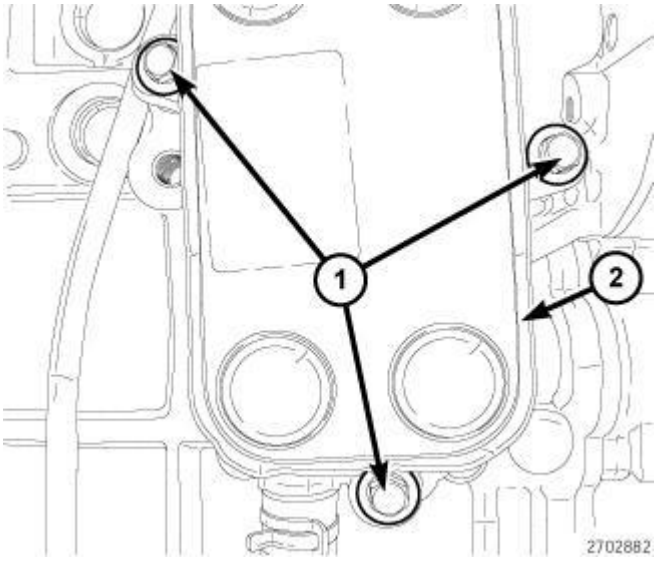

Fig. 219: Oil Filter Housing Adapter & Bolts
Courtesy of CHRYSLER GROUP, LLC

4. Install the oil filter housing adapter (2). Tighten bolts (1) to 33 N.m (24 ft. lbs.).

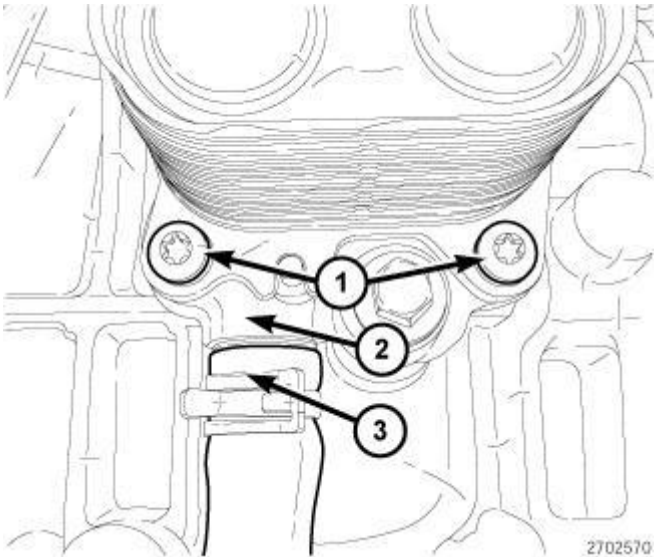

Fig. 220: Coolant Hose, Oil Cooler Housing & Bolts
Courtesy of CHRYSLER GROUP, LLC

5. Install the coolant hose (3) to the oil filter housing adapter (2).

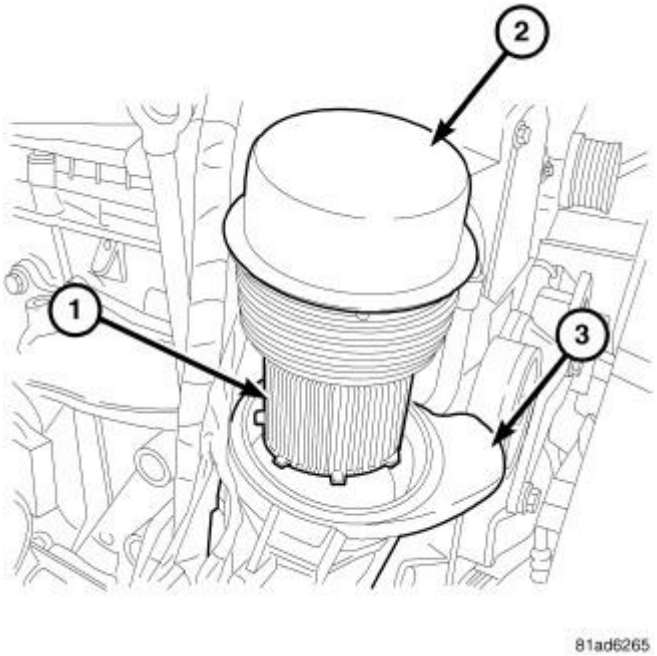

Fig. 221: Oil Filter, Oil Filter Housing Cap & Oil Filter Housing
Courtesy of CHRYSLER GROUP, LLC

6. Install the oil filter (1) and the oil filter housing cap (2). Tighten to 25 N.m (18 ft. lbs.).

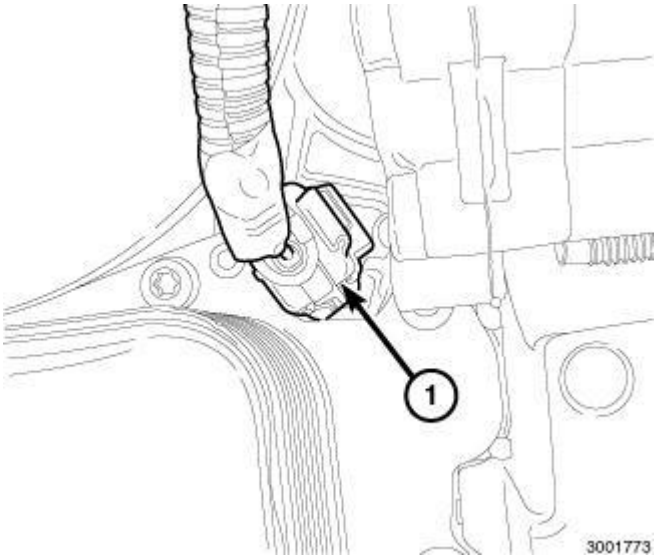

Fig. 222: Oil Temperature Sensor Harness Connector
Courtesy of CHRYSLER GROUP, LLC

7. Connect the oil temperature sensor harness connector (1).

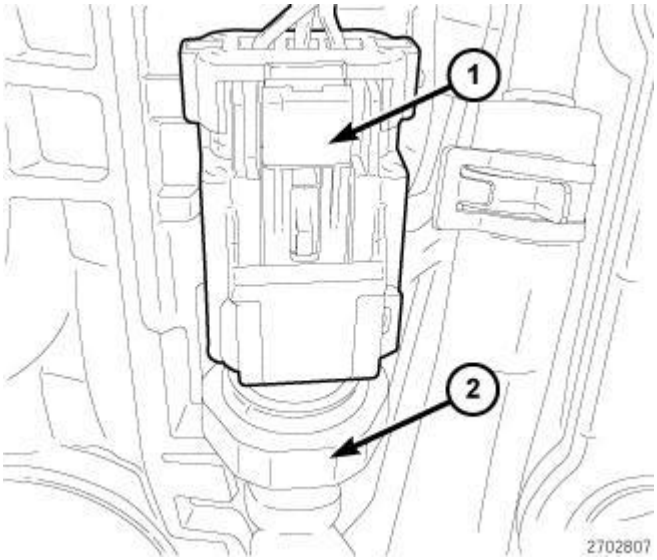

Fig. 223: Oil Pressure Switch & Harness Connector
Courtesy of CHRYSLER GROUP, LLC

8. Connect the oil pressure switch harness connector (1).

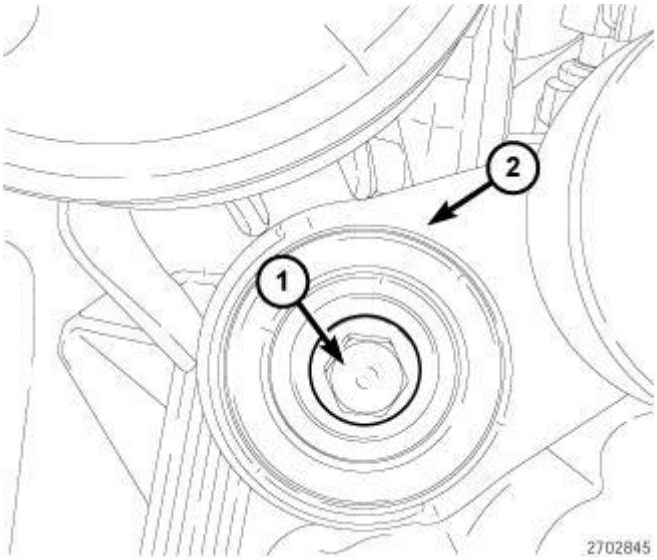

Fig. 224: Serpentine Belt Tensioner & Bolt
Courtesy of CHRYSLER GROUP, LLC

9. Install the serpentine belt tensioner (2). Tighten bolt (1) to 45 N.m (33 ft. lbs.).
10. Install the power steering pump. Tighten bolts to 33 N.m (24 (ft. lbs.).
11. Install the serpentine belt. Refer to **BELT, SERPENTINE, INSTALLATION** .

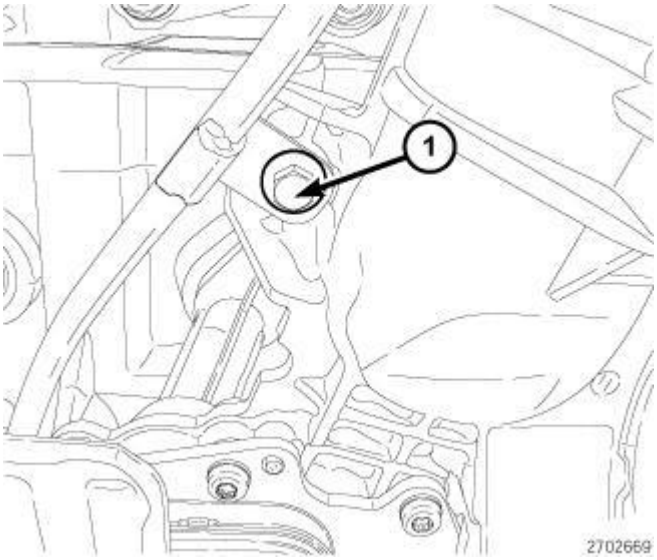

Fig. 225: Upper Oil Dipstick Bolt
Courtesy of CHRYSLER GROUP, LLC

12. Install the upper oil dipstick bolt (1). Tighten bolt (1) to 33 N.m (24 ft. lbs.).
13. Install the turbocharger air inlet tube and air cleaner body. Refer to **BODY, AIR CLEANER, INSTALLATION**.
14. Install the underbody skid plate.
15. Lower the vehicle.

16. Fill the engine with recommended oil.
17. Fill the cooling system. Refer to **STANDARD PROCEDURE** .
18. Connect the negative battery cable.
19. Start the engine and check for leaks.

JET, PISTON OIL COOLER

DESCRIPTION

DESCRIPTION

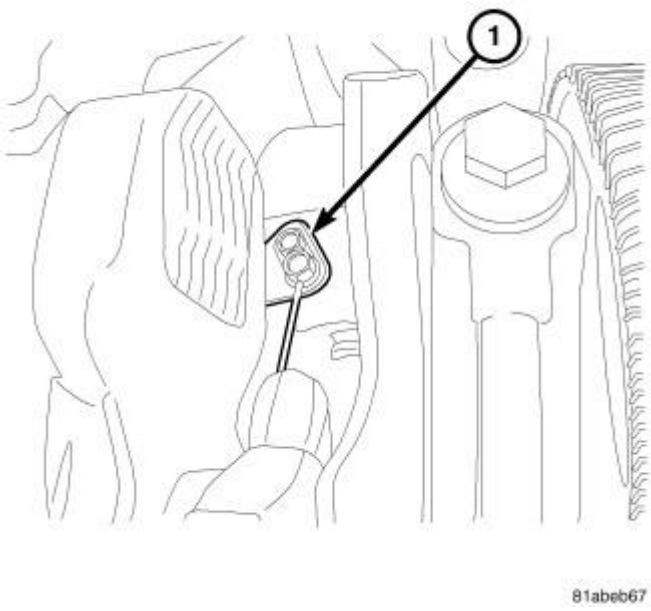

Fig. 226: Oil Jet
Courtesy of CHRYSLER GROUP, LLC

There are four oil jets installed in the engine block. These oil jets are used to cool and lubricate the piston assemblies.

REMOVAL

REMOVAL

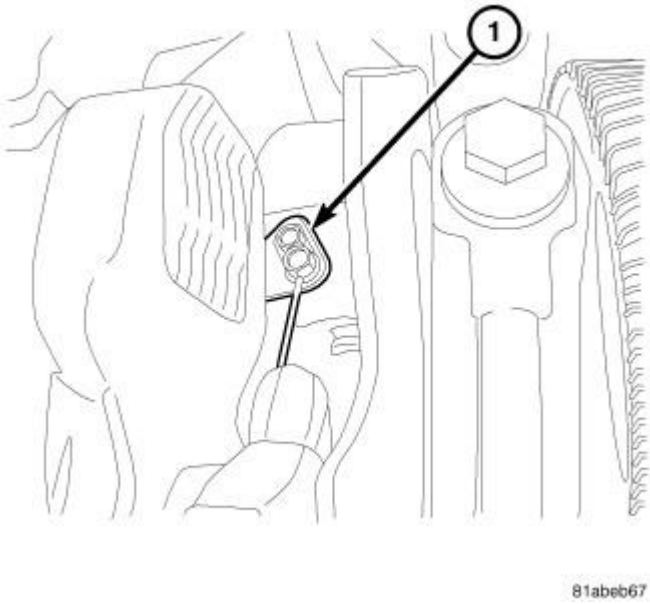

Fig. 227: Oil Jet
Courtesy of CHRYSLER GROUP, LLC

CAUTION: Use caution when removing and installing oil jets. Damage to oil jet nozzle could cause severe engine damage. Care must be taken not to damage the crankshaft tone ring when removing cylinder number four oil jet.

NOTE: To prevent damage to the oil jets, remove the oil jets before removing the pistons.

1. Disconnect negative battery cable.
2. Raise vehicle on hoist.
3. Remove the balance shaft assembly. Refer to **MODULE, BALANCE SHAFT, REMOVAL**.
4. Remove bolt and the oil jet (1).

INSTALLATION

INSTALLATION

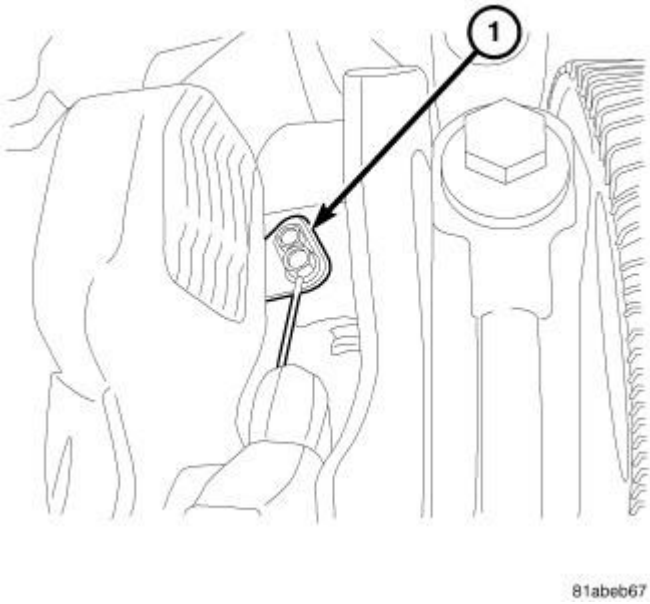

Fig. 228: Oil Jet
Courtesy of CHRYSLER GROUP, LLC

CAUTION: Use caution when removing and installing oil jets. Damage to oil jet nozzle could cause severe engine damage.

1. Lubricate oil jet O-ring seal.
2. Install oil jet (1). Tighten bolt to 11 N.m (97 in. lbs.).
3. Install the balance shaft assembly. Refer to **MODULE, BALANCE SHAFT, INSTALLATION**.
4. Connect the negative battery cable.

OIL

DESCRIPTION

DESCRIPTION

Refer to the Lube and Maintenance information for oil specifications. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS** .

PAN, OIL

REMOVAL

UPPER OIL PAN

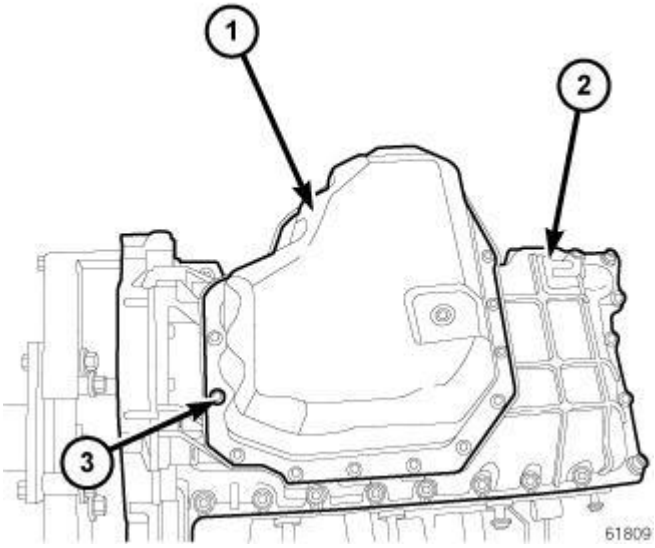

Fig. 229: Lower Oil Pan, Upper Oil Pan & Bolts
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the air cleaner body. Refer to **BODY, AIR CLEANER, REMOVAL**.
3. Remove the upper dip stick bolt.
4. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
5. Remove four bolts securing upper oil pan to transmission adapter plate.
6. Remove the lower oil pan. Refer to **PAN, OIL, REMOVAL**.
7. Remove the Crankshaft Position (CKP) sensor. Refer to **SENSOR, CRANKSHAFT POSITION, REMOVAL** .
8. Remove lower dipstick bolt and the oil dipstick.

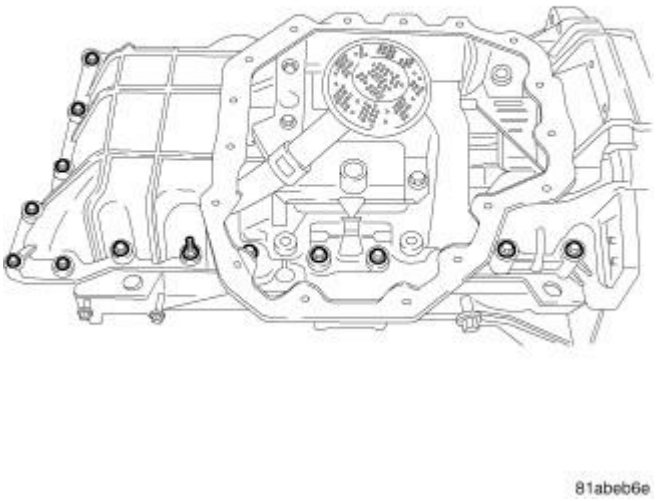

Fig. 230: Upper Oil Pan Bolts
Courtesy of CHRYSLER GROUP, LLC

9. Remove bolts and the upper oil pan.

LOWER OIL PAN

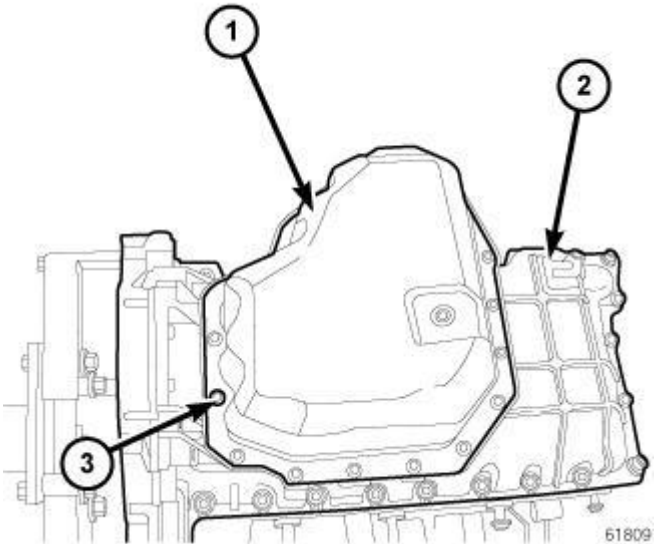

Fig. 231: Lower Oil Pan, Upper Oil Pan & Bolts
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .

3. Drain the engine oil.
4. Using a new copper sealing washer, install and tighten oil drain plug to 54 N.m (40 ft. lbs.).
5. Remove bolts (3) and the lower oil pan (1).
6. Remove and discard the oil pan gasket.

INSTALLATION

UPPER OIL PAN

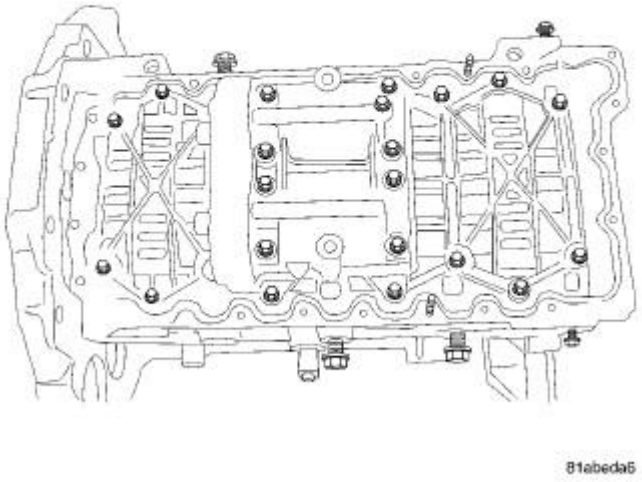

Fig. 232: Engine Block Gasket Surface
Courtesy of CHRYSLER GROUP, LLC

1. Clean oil pan and engine block gasket surfaces.

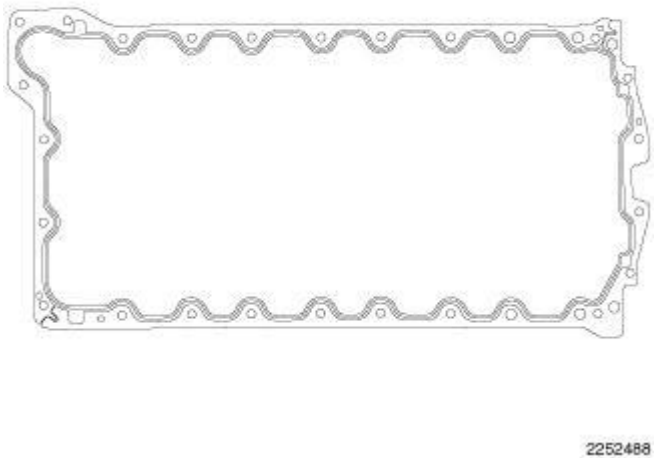

Fig. 233: Upper Oil Pan Gasket
Courtesy of CHRYSLER GROUP, LLC

2. Install the upper oil pan gasket.

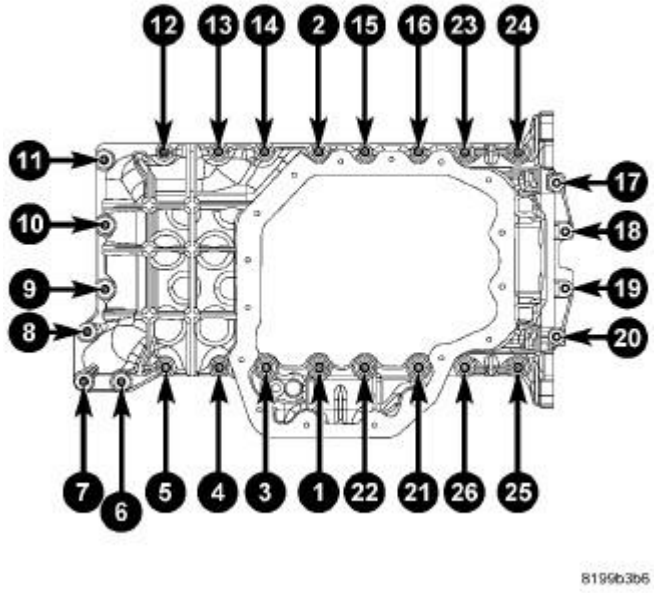

Fig. 234: Upper Oil Pan Bolts Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

3. Install the upper oil pan bolts in positions one and two, then follow the sequence illustrated for the remaining bolts. Once all of the bolts are installed, tighten the M6 bolts to 15 N.m (133 in. lbs.) and M8 bolts to 32 N.m (23 ft. lbs.).
4. Loosen all of the upper oil pan bolts and studs by 90 degrees and retighten the M6 bolts to 15 N.m (133

in. lbs.) and M8 bolts to 32 N.m (23 ft. lbs.).

5. Install the oil dip stick. Tighten lower bolt to 11 N.m (97 in. lbs.).
6. Install the lower oil pan. Refer to **PAN, OIL, INSTALLATION**.
7. Install the Crankshaft Position (CKP) sensor. Refer to **SENSOR, CRANKSHAFT POSITION, INSTALLATION** .
8. Install four bolts securing oil pan to transmission adapter plate and tighten to 69 N.m (51 ft. lbs.).
9. Lower the vehicle.
10. Install the upper dip stick bolt. Tighten upper bolt to 11 N.m (97 in. lbs.).
11. Install the air cleaner body. Refer to **BODY, AIR CLEANER, INSTALLATION**.
12. Refill engine with recommended engine oil. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS** .
13. Connect the negative battery cable.

LOWER OIL PAN

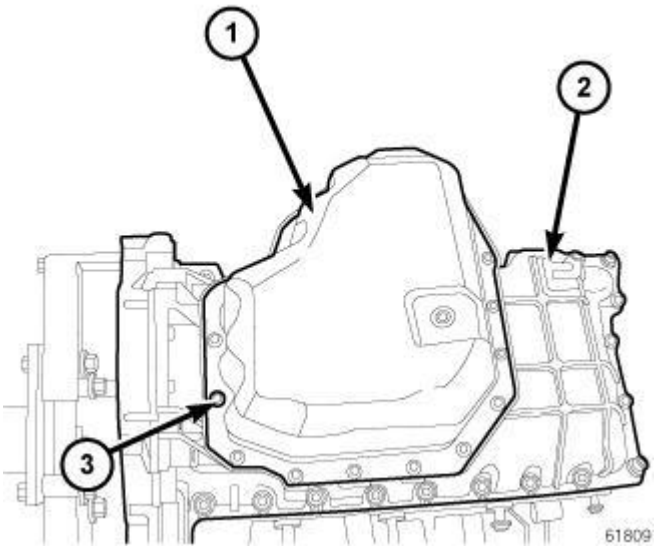

Fig. 235: Lower Oil Pan, Upper Oil Pan & Bolts
Courtesy of CHRYSLER GROUP, LLC

1. Make sure that the lower oil pan sealing surface is free of oil, debris and silicone.
2. Install the new lower oil pan gasket onto the oil pan.

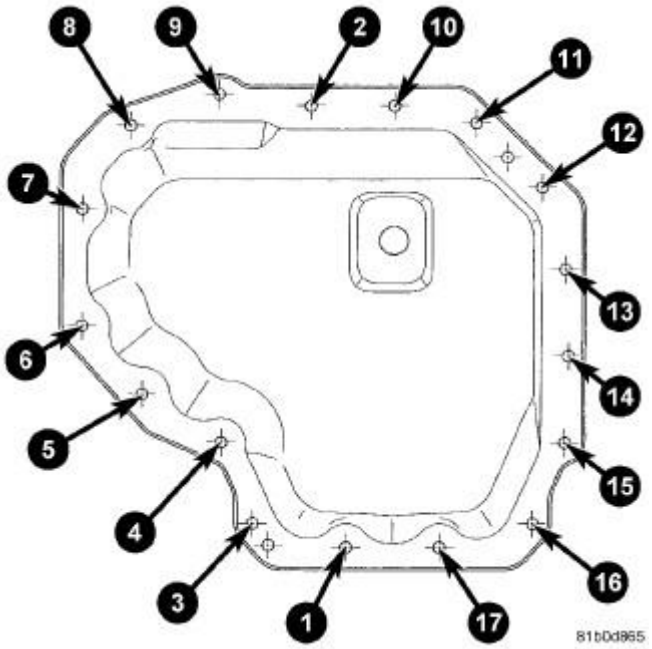

Fig. 236: Lower Oil Pan Bolts Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

3. Install bolts one and two into the lower oil pan and tighten to 15 N.m (133 in. lbs.).
4. Install the remaining bolts in the sequence shown in illustration.
5. Tighten the oil pan bolts in sequence to 15 N.m (133 in. lbs.).
6. Loosen each bolt 90 degrees and retighten bolts to 15 N.m (133 in. lbs.) using the sequence shown in illustration.
7. Fill the engine with recommended oil to proper level. Refer to **CAPACITIES AND RECOMMENDED FLUIDS, SPECIFICATIONS** .
8. Lower the vehicle.

PICK-UP, OIL PUMP

REMOVAL

REMOVAL

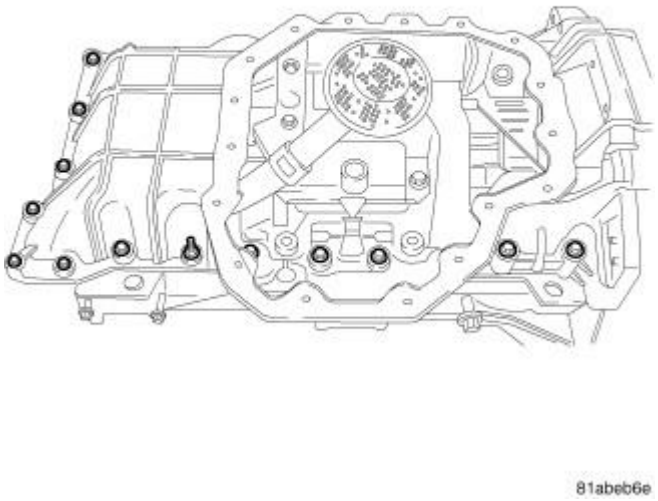

Fig. 237: Upper Oil Pan Bolts
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Raise and support the vehicle. Refer to **HOISTING, STANDARD PROCEDURE** .
3. Remove the upper oil pan. Refer to **PAN, OIL, REMOVAL**.

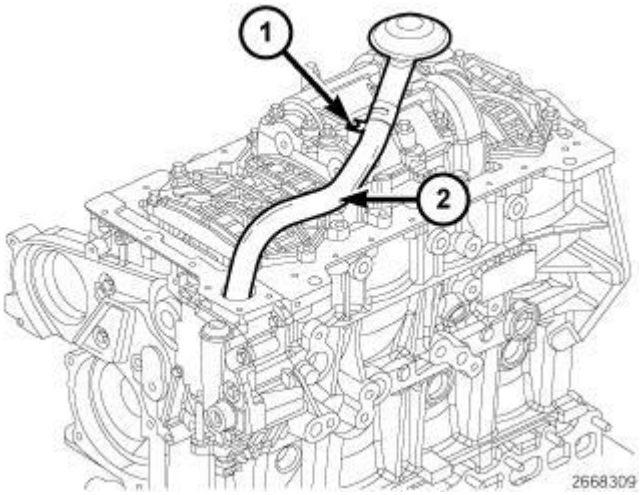

Fig. 238: Oil Pump Pickup Tube & Bolt
Courtesy of CHRYSLER GROUP, LLC

4. Remove bolt (1) and the oil pump pickup tube (2) and discard O-rings.

INSTALLATION

INSTALLATION

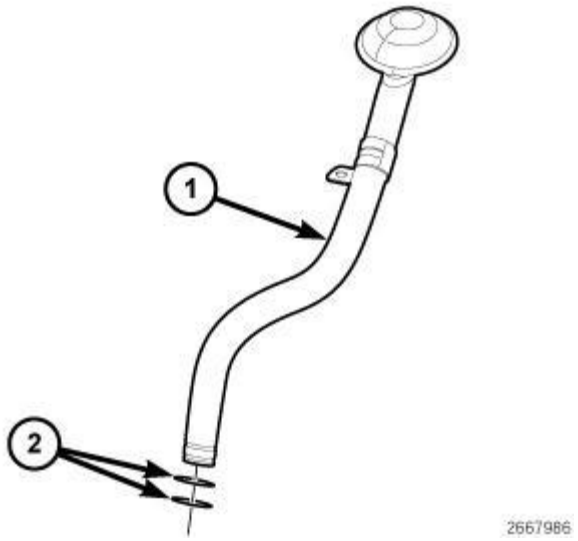

Fig. 239: Oil Pickup Tube & O-Rings
Courtesy of CHRYSLER GROUP, LLC

1. Lubricate and install two new O-rings (2) on oil pickup tube (1).

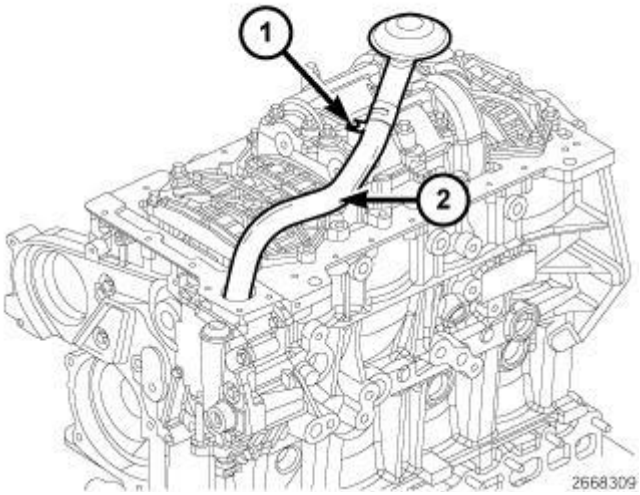

Fig. 240: Oil Pump Pickup Tube & Bolt
Courtesy of CHRYSLER GROUP, LLC

2. Install the oil pickup tube (2). Tighten bolt (1) to 15 N.m. (133 in. lbs.).

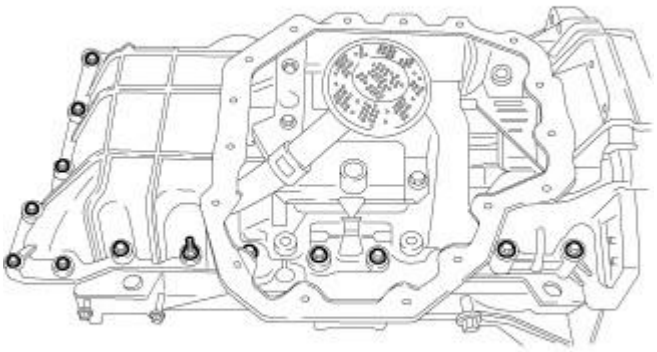

Fig. 241: Upper Oil Pan Bolts
Courtesy of CHRYSLER GROUP, LLC

3. Install the upper oil pan. Refer to **PAN, OIL, INSTALLATION**.
4. Refill engine with recommended oil to proper level.
5. Connect the negative battery cable.

PUMP, ENGINE OIL

REMOVAL

REMOVAL

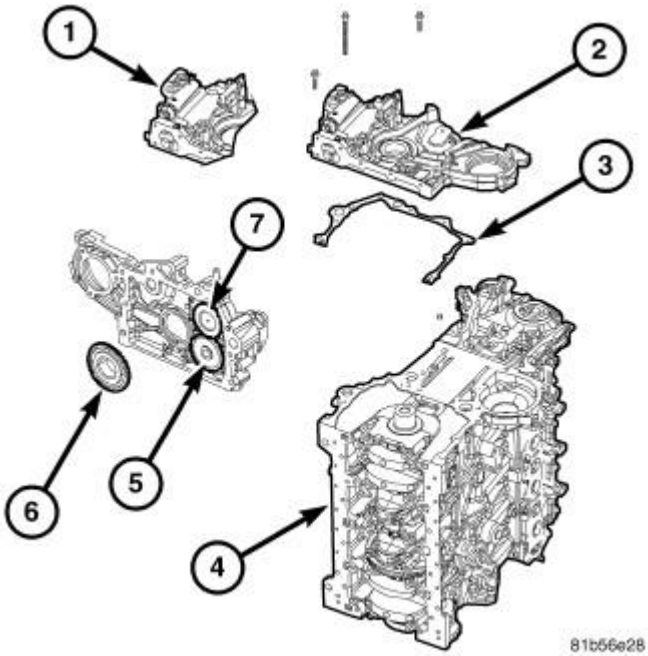

Fig. 242: Vacuum Pump And Oil Pump Assembly
Courtesy of CHRYSLER GROUP, LLC

NOTE: The oil pump is not a serviceable part. If oil pump failure has occurred or diagnosis has led you to replace the oil pump, then the front cover will have to be replaced.

1. Disconnect the negative battery cable.
2. Remove the front cover. Refer to **COVER, ENGINE, FRONT, REMOVAL**.

INSTALLATION

INSTALLATION

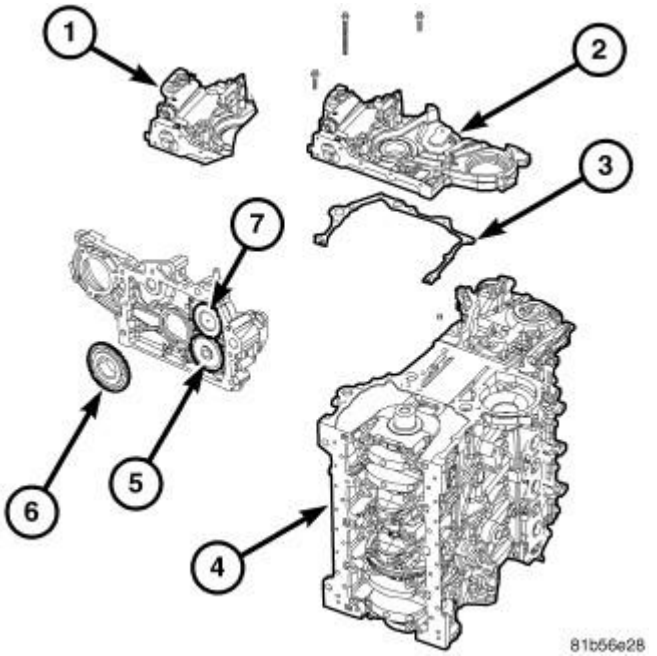

Fig. 243: Vacuum Pump And Oil Pump Assembly
Courtesy of CHRYSLER GROUP, LLC

1. Clean the gasket surfaces and sealing areas.
2. Lubricate oil pump rotor with engine oil.
3. Install front cover assembly. Refer to **COVER, ENGINE, FRONT, INSTALLATION**.
4. Connect the negative battery cable.

SENSOR, OIL PRESSURE

DESCRIPTION

DESCRIPTION

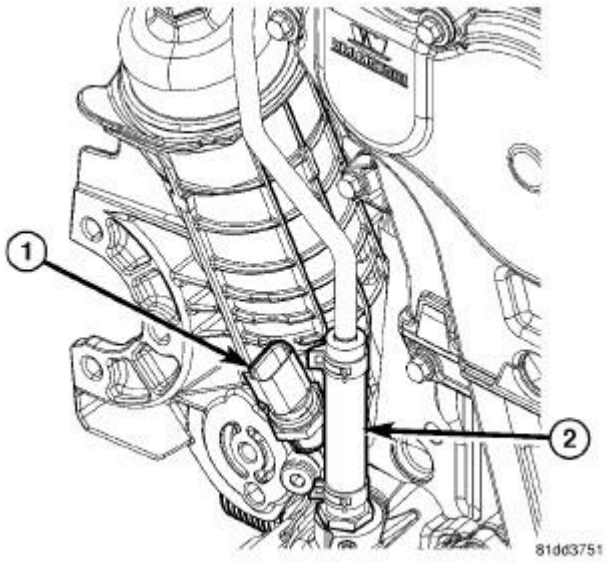

Fig. 244: Oil Pressure Sending Unit
Courtesy of CHRYSLER GROUP, LLC

The oil pressure sending unit uses three circuits. They are:

- A signal circuit to the ECM.
- A sensor ground circuit through the ECM.
- A 5 volt reference circuit from the ECM.

The oil pressure sending unit returns a voltage signal back to the ECM relating oil pressure. Ground for the sensor is supplied by the ECM.

The oil pressure switch (1) is located on the right side of the engine block. The switch screws into the engines main oil gallery.

REMOVAL

REMOVAL

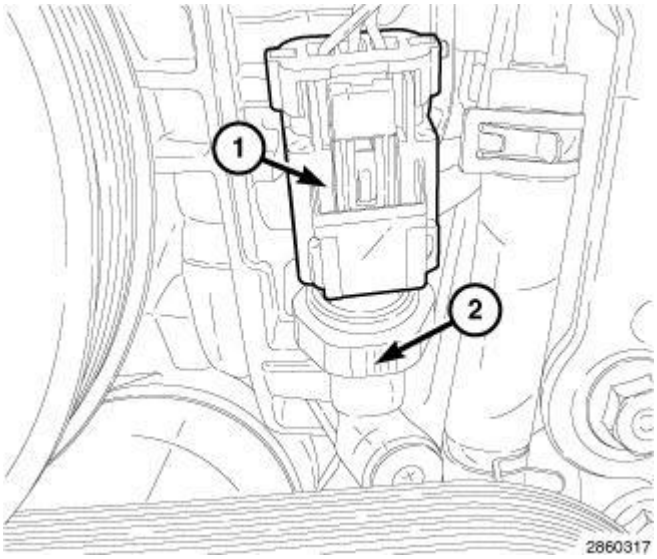

Fig. 245: Oil Pressure Switch Harness Connector & Oil Pressure Switch
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Disconnect the oil pressure switch harness connector (1).
3. Remove the oil pressure switch (2).

INSTALLATION

INSTALLATION

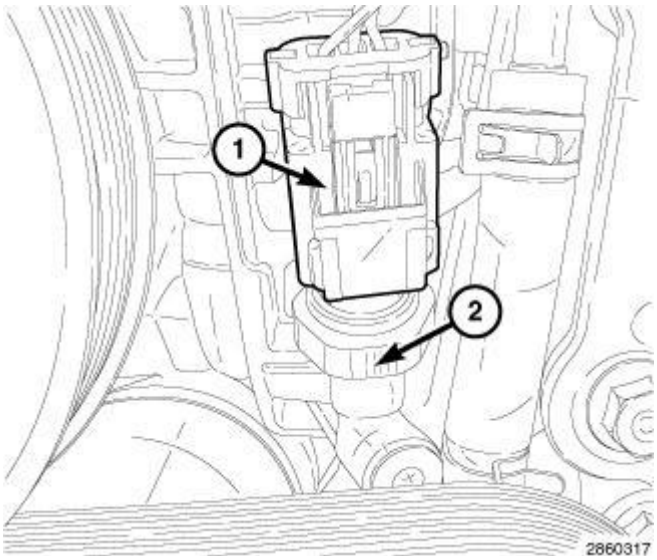

Fig. 246: Oil Pressure Switch Harness Connector & Oil Pressure Switch
Courtesy of CHRYSLER GROUP, LLC

1. Install the oil pressure switch (2). Tighten to 14 N.m (124 in. lbs.).
2. Connect the oil pressure switch harness connector (1).

3. Connect the negative battery cable.
4. Start engine and check for oil leaks.

SENSOR, OIL TEMPERATURE

DESCRIPTION

DESCRIPTION

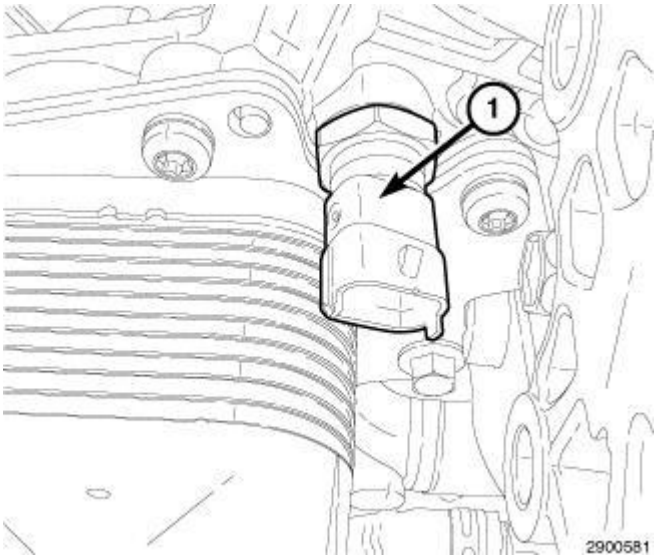

Fig. 247: Oil Temperature Sensor
Courtesy of CHRYSLER GROUP, LLC

The oil temperature sensor (1) is located on the oil filter housing next to the engine oil cooler.

REMOVAL

REMOVAL

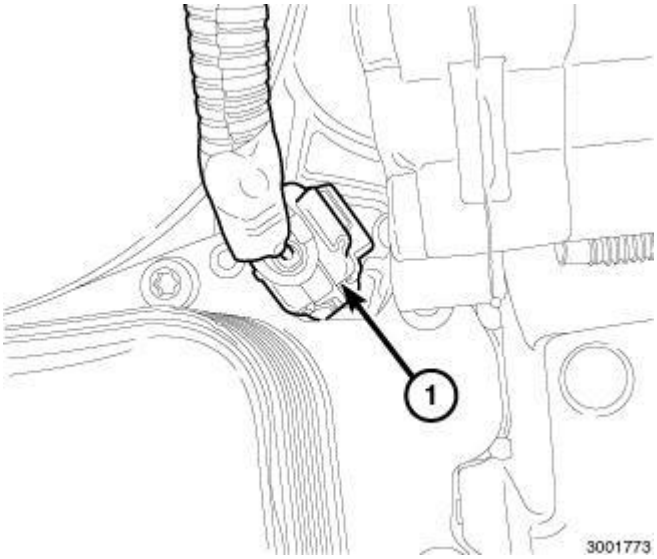

Fig. 248: Oil Temperature Sensor Harness Connector
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the air cleaner body. Refer to **BODY, AIR CLEANER, REMOVAL**.
3. Partially remove the serpentine belt. Refer to **BELT, SERPENTINE, REMOVAL** .
4. Disconnect the oil temperature sensor wire harness connector (1).

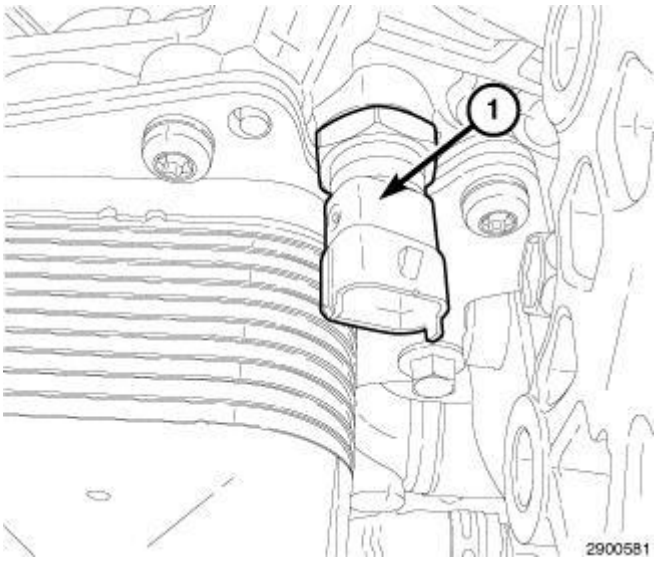

Fig. 249: Oil Temperature Sensor
Courtesy of CHRYSLER GROUP, LLC

5. Remove the oil temperature sensor (1).

INSTALLATION

INSTALLATION

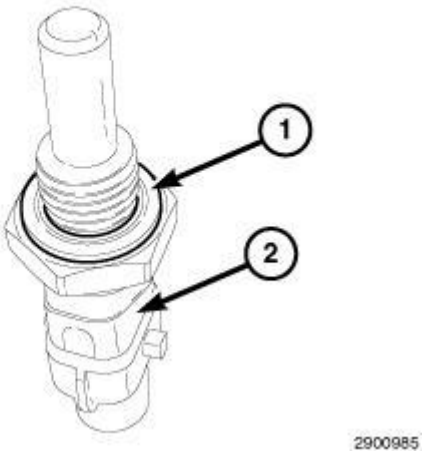

Fig. 250: Temperature Sensor & Sealing Washer
Courtesy of CHRYSLER GROUP, LLC

1. Using a new sealing washer (1), install the temperature sensor (2). Tighten to 14 N.m (124 in. lbs.).

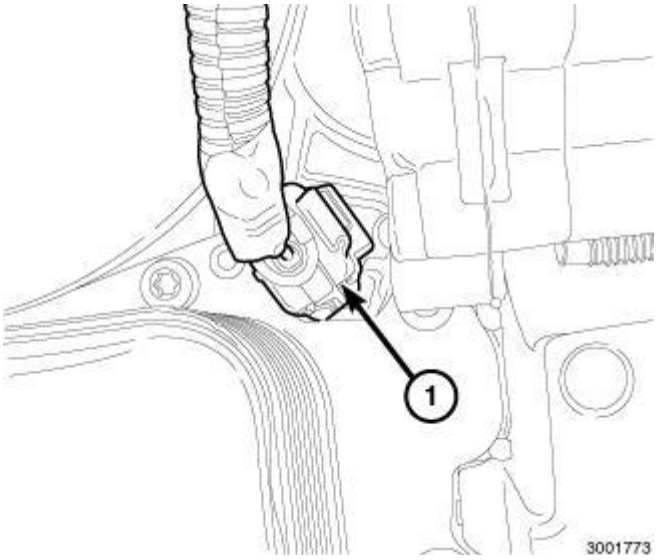

Fig. 251: Oil Temperature Sensor Harness Connector
Courtesy of CHRYSLER GROUP, LLC

2. Connect the oil temperature sensor wire harness connector (1).
3. Install the serpentine belt. Refer to **BELT, SERPENTINE, INSTALLATION** .
4. Install the air cleaner body. Refer to **BODY, AIR CLEANER, INSTALLATION**.
5. Connect the negative battery cable.
6. Start engine and check for oil leaks.

SEPARATOR, OIL

REMOVAL

REMOVAL

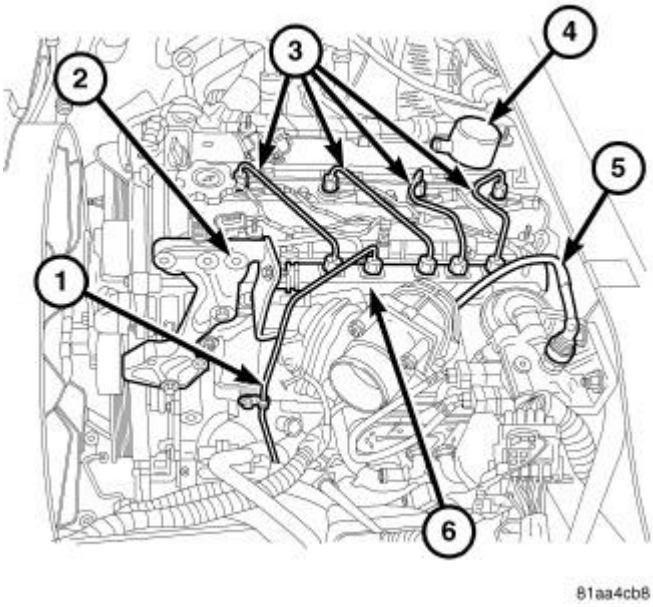

Fig. 252: High Pressure Fuel Line & Injector Fuel Lines
Courtesy of CHRYSLER GROUP, LLC

1. Remove the engine cover. Refer to **COVER(S), CYLINDER HEAD, REMOVAL**.

NOTE: Inspect the oil drain back access hole in the intake manifold/cylinder head cover to assure that it is free of obstruction.

2. Remove the oil separator fasteners and oil separator (4).

INSTALLATION

INSTALLATION

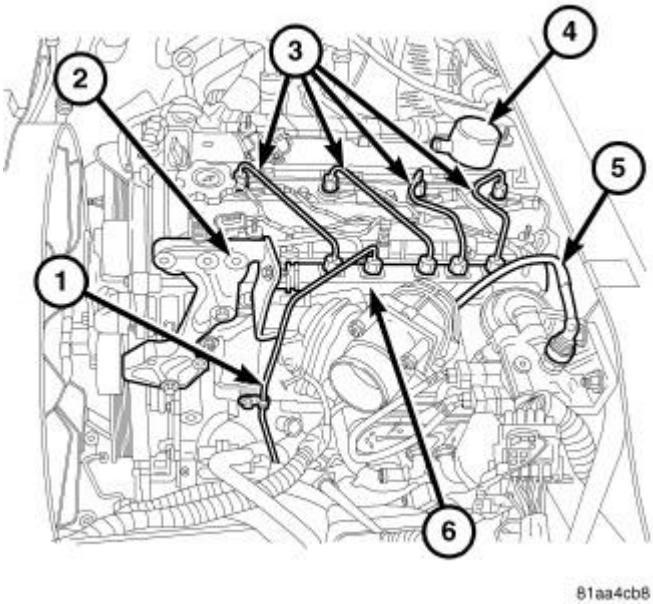

Fig. 253: High Pressure Fuel Line & Injector Fuel Lines
Courtesy of CHRYSLER GROUP, LLC

NOTE: Inspect the oil drain back access hole in the intake manifold/cylinder head cover to assure that it is free of obstruction.

1. Lubricate the oil separator o-rings with clean engine oil.
2. Carefully position and push down on the oil separator to seat.
3. Install the oil separator retaining fasteners. Tighten fasteners to 10.8 N.m (96 lbs. in.).
4. Install the camshaft cover. Refer to **COVER(S), CYLINDER HEAD, INSTALLATION**.

VALVE, OIL PRESSURE RELIEF

DESCRIPTION

DESCRIPTION

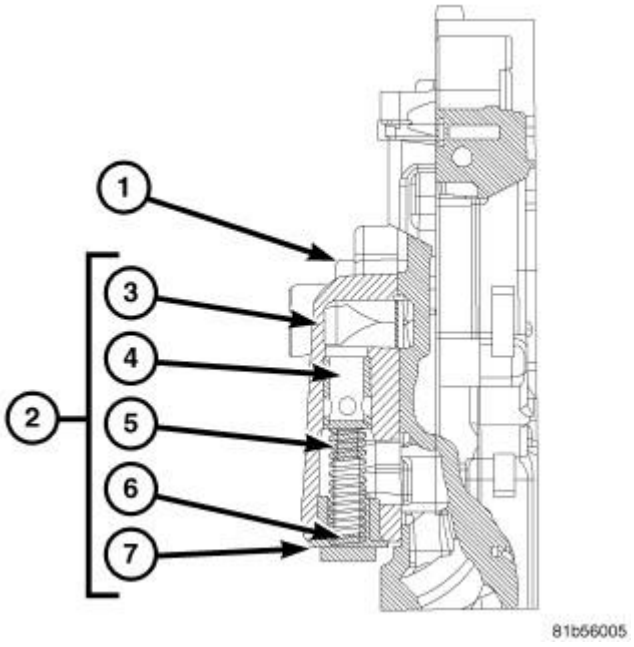

Fig. 254: Oil Pressure Relief Valve Components
Courtesy of CHRYSLER GROUP, LLC

The oil pressure relief valve is build into the front cover (1). The oil pressure relief valve assembly (2) consists of several components. The plunger (4) is held in place by the spring (5). The plug (6) keeps the plug and spring in place, and the o-ring (7) prevents oil from leaking past the plug (6).

In the case of excessively high oil pressure, the oil pressure on the piston (4) overcomes the spring (5) pressure and the piston is forced off its seat. When the piston is forced off its seat, a drain back passage is opened and the excess oil pressure is vented back into the crankcase.

MANIFOLDS

MANIFOLD, EXHAUST

REMOVAL

REMOVAL

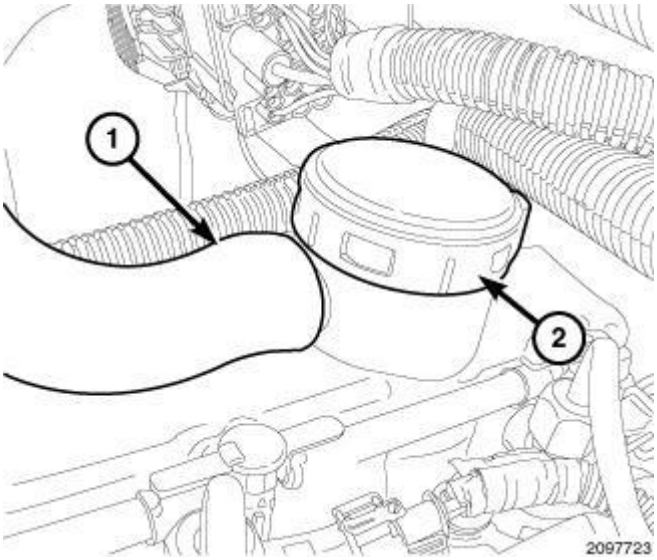

Fig. 255: Crankcase Vent Hose & Oil Separator
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the air cleaner body. Refer to **BODY, AIR CLEANER, REMOVAL**.
3. Disconnect the crankcase vent hose (1) from the oil separator (2).
4. Remove the air cleaner outlet tube.

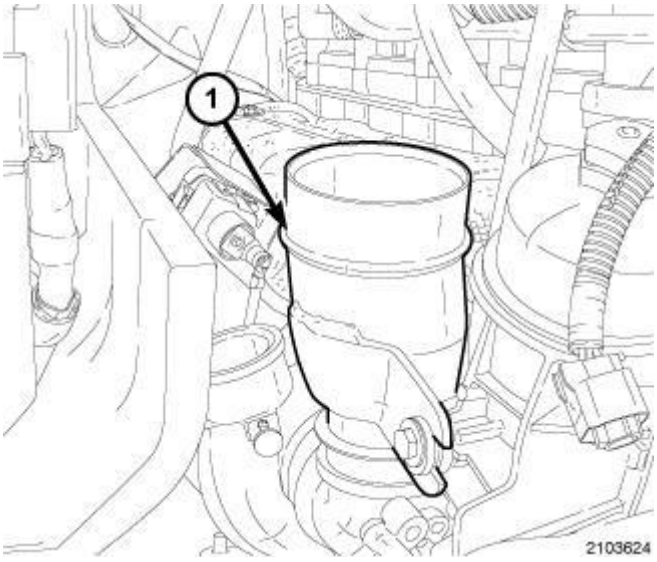

Fig. 256: Turbocharger Inlet Elbow
Courtesy of CHRYSLER GROUP, LLC

5. Remove the air cleaner outlet tube from turbocharger inlet elbow.
6. Remove the turbo charger outlet hose from CAC inlet.

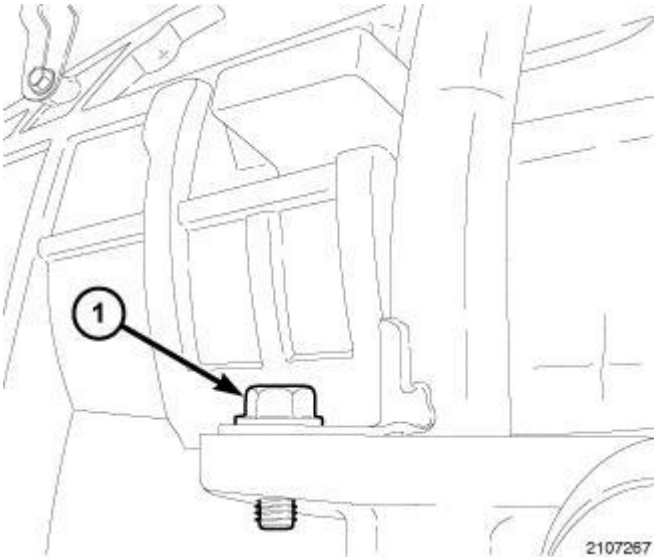

Fig. 257: Lower Transmission Fill Tube Bolt
Courtesy of CHRYSLER GROUP, LLC

7. If equipped, remove the lower transmission fill tube bolt (1).

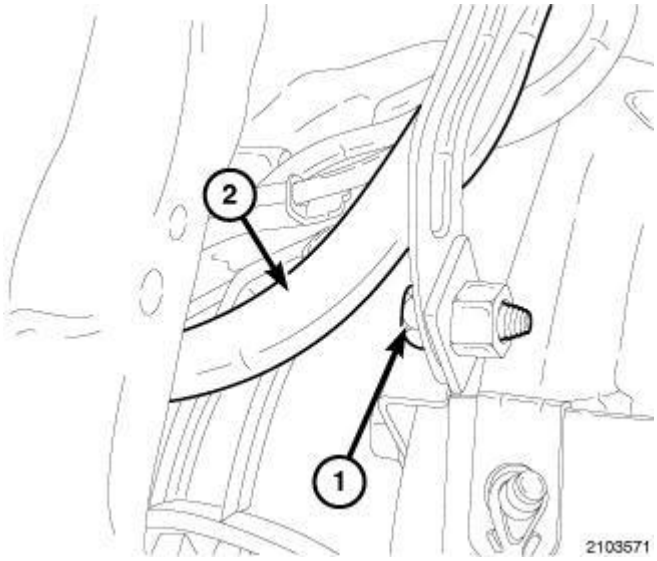

Fig. 258: Transmission Fill Tube & Bolt
Courtesy of CHRYSLER GROUP, LLC

8. If equipped, remove the bolt (1) and the transmission fill tube (2).
9. Remove the catalytic converter. Refer to **CONVERTER, CATALYTIC, REMOVAL** .

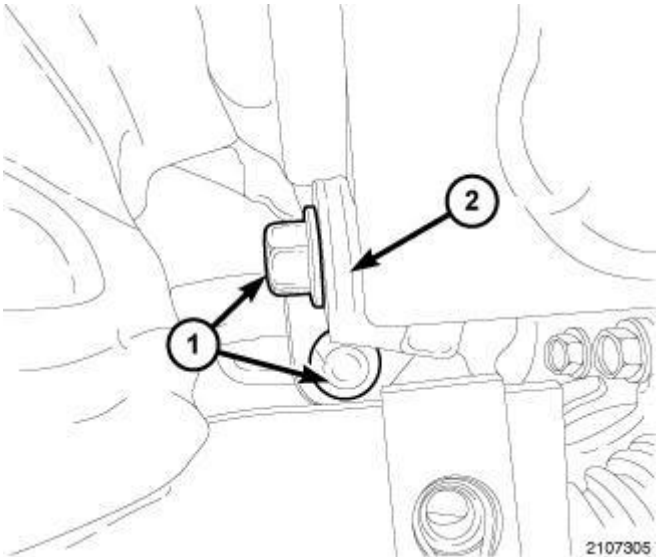

Fig. 259: Turbocharger Support Bracket & Bolts
Courtesy of CHRYSLER GROUP, LLC

10. Remove the bolts (1) from the turbocharger to engine support bracket and remove the bracket.

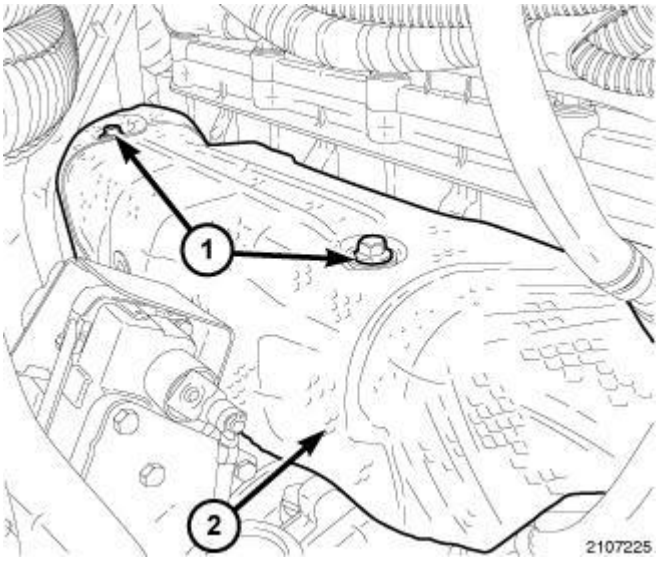

Fig. 260: Exhaust Manifold Heat Shield & Bolts
Courtesy of CHRYSLER GROUP, LLC

11. Remove the bolts (1) and exhaust manifold heat shield (2).

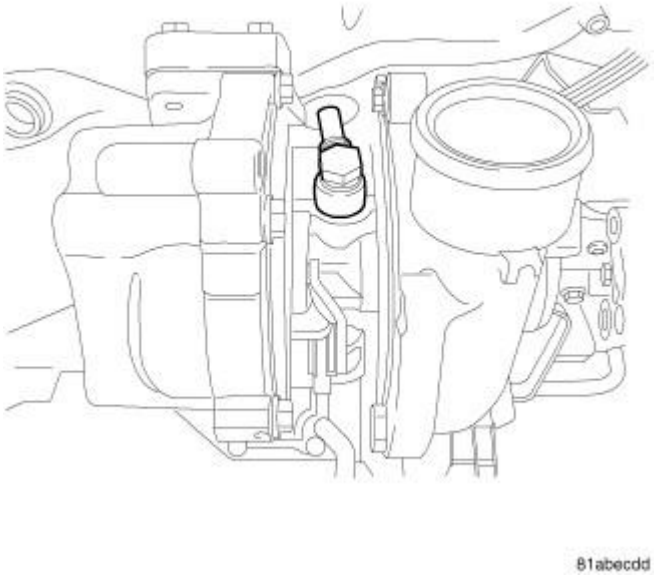

Fig. 261: Turbocharger Feed Line
Courtesy of CHRYSLER GROUP, LLC

12. Remove the turbocharger oil feed line.

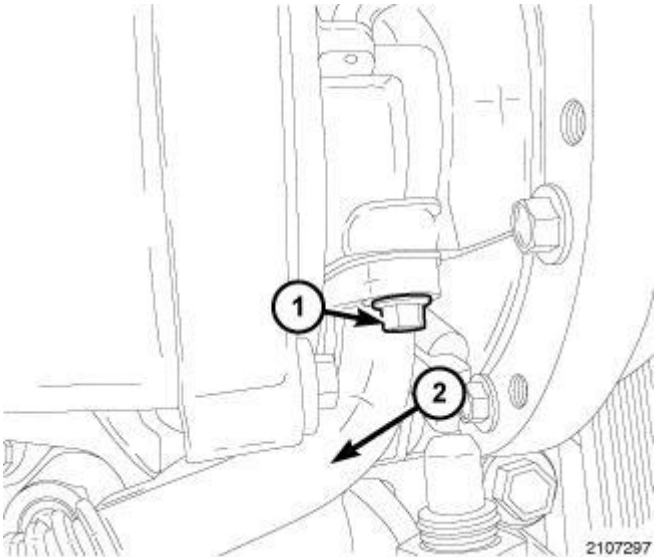

Fig. 262: Turbocharger Oil Return Line & Bolt
Courtesy of CHRYSLER GROUP, LLC

13. Remove the bolt (1) and turbocharger oil return line (2).

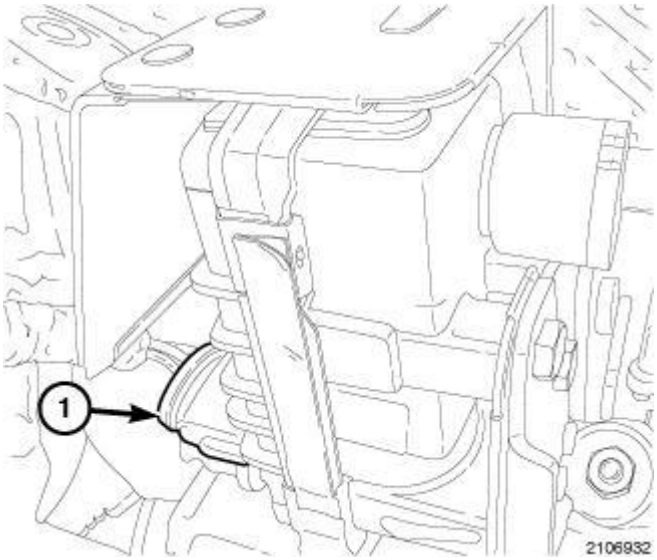

Fig. 263: Turbocharger Module Connector
Courtesy of CHRYSLER GROUP, LLC

14. Disconnect the turbocharger module connector (1).

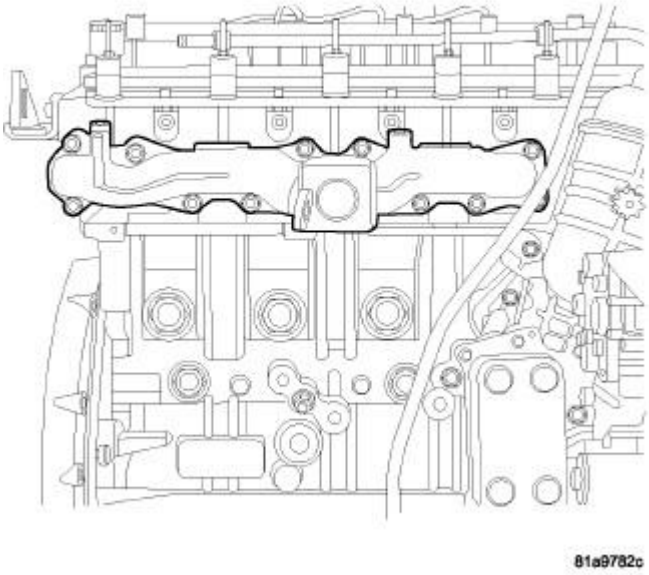

Fig. 264: Exhaust Manifold
Courtesy of CHRYSLER GROUP, LLC

NOTE: Turbocharger removed for clarity.

15. Remove the nuts and the exhaust manifold and turbocharger as an assembly.
16. If necessary, remove the turbocharger from exhaust manifold.

INSTALLATION

INSTALLATION

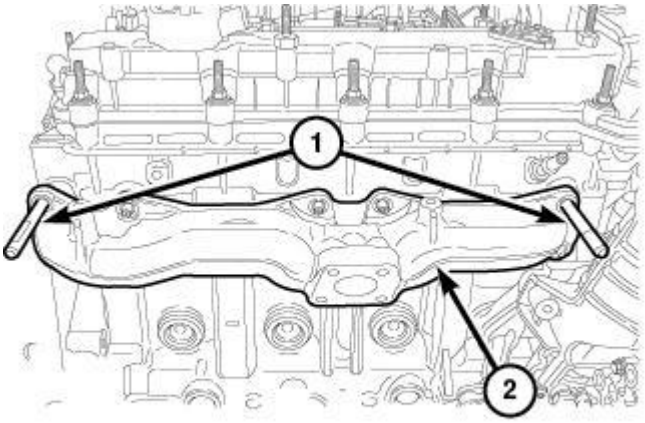

Fig. 265: Exhaust Manifold Alignment Tools & Exhaust Manifold
Courtesy of CHRYSLER GROUP, LLC

1. Clean and inspect the gasket surface of the exhaust manifold and cylinder head.
2. If necessary, clean and inspect the gasket surface of the exhaust manifold and turbocharger.
3. If necessary, using a new gasket install the turbocharger to the exhaust manifold. Tighten nuts to 32 N.m (23 ft. lbs.).
4. Install a new exhaust manifold gasket.
5. Install the (special tool #VM.10334, Tool, Exhaust Manifold Alignment) (1) onto studs.
6. Install the exhaust manifold (2) and tighten nuts finger tight.
7. Remove the (special tool #VM.10334, Tool, Exhaust Manifold Alignment) (1). Install and tighten nuts finger tight.

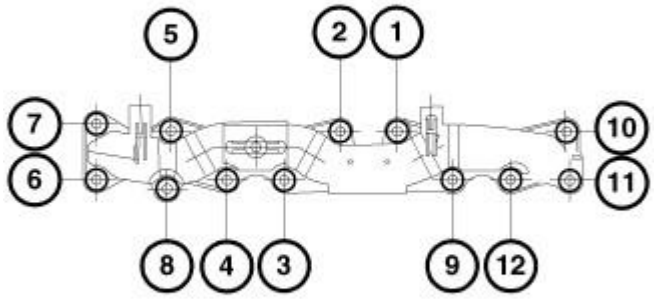

Fig. 266: Exhaust Manifold Bolt Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

8. Using the tightening sequence shown in illustration, tighten the exhaust manifold nuts to 36 N.m (27 ft. lbs.).
9. Repeat the same tightening procedure again.

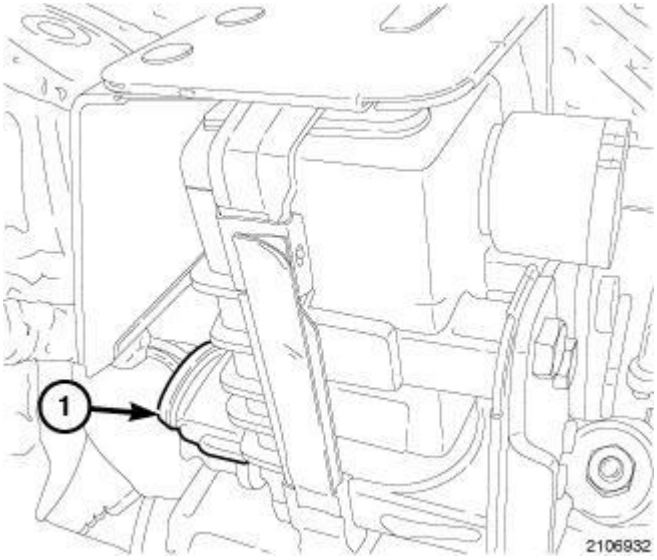

Fig. 267: Turbocharger Module Connector
Courtesy of CHRYSLER GROUP, LLC

10. Connect the turbocharger module harness connector (1).

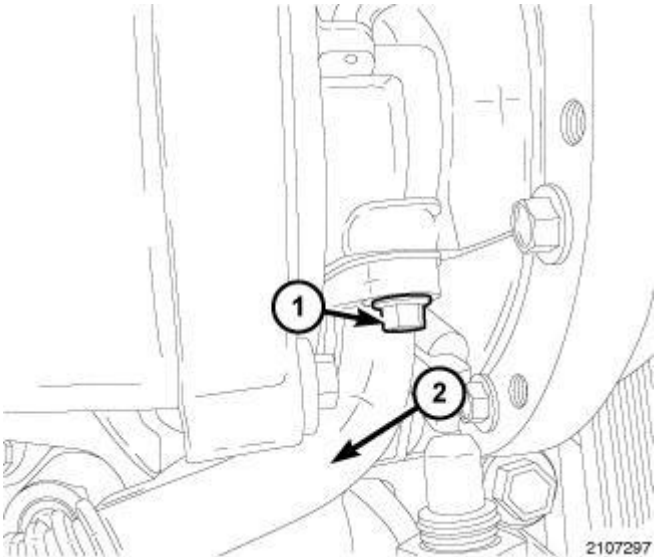

Fig. 268: Turbocharger Oil Return Line & Bolt
Courtesy of CHRYSLER GROUP, LLC

11. Install the turbocharger oil return line (2) and bolt (1). Tighten to 15 N.m (133 in. lbs.).

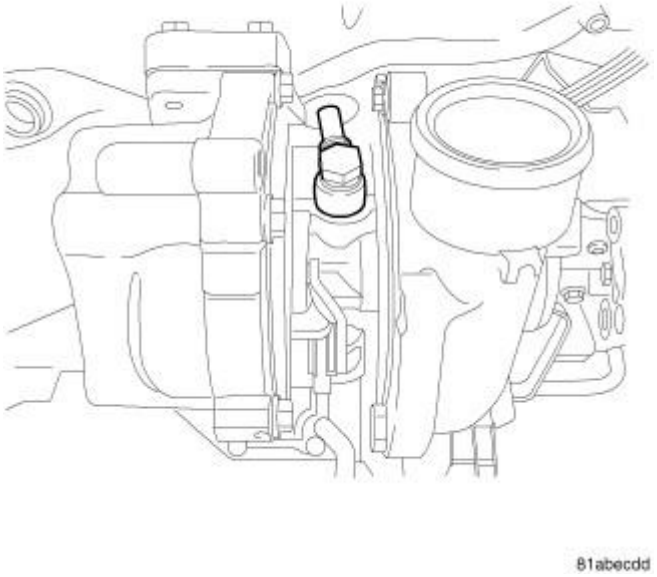

Fig. 269: Turbocharger Feed Line
Courtesy of CHRYSLER GROUP, LLC

12. Install the turbocharger oil feed line. Tighten to 24 N.m (18 ft. lbs).

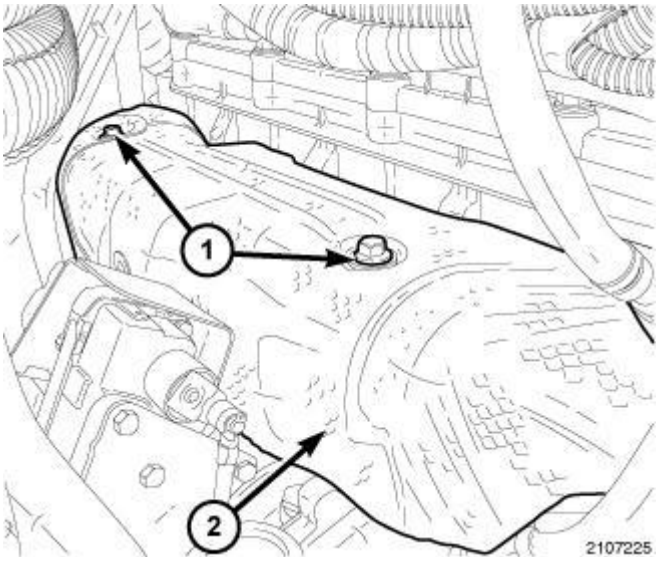

Fig. 270: Exhaust Manifold Heat Shield & Bolts
Courtesy of CHRYSLER GROUP, LLC

13. Install the exhaust manifold heat shield (2) and the heat shield bolts (1).

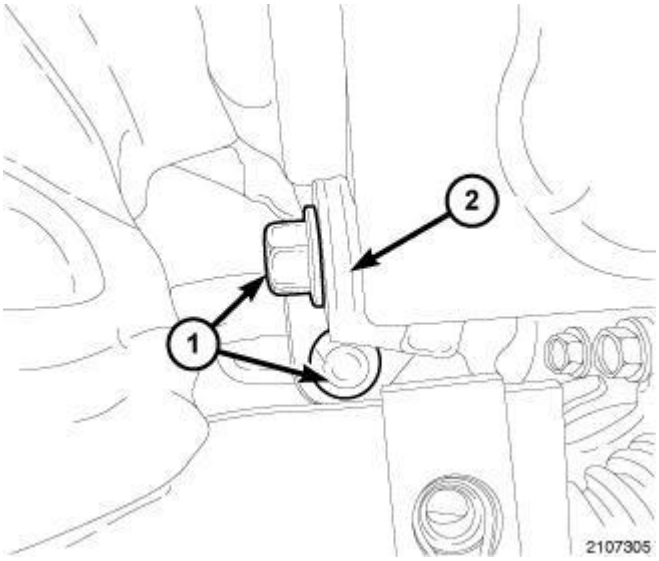

Fig. 271: Turbocharger Support Bracket & Bolts
Courtesy of CHRYSLER GROUP, LLC

14. Position the turbocharger to engine support brace and install the bolts. Tighten to 32 N.m (23 ft. lbs).

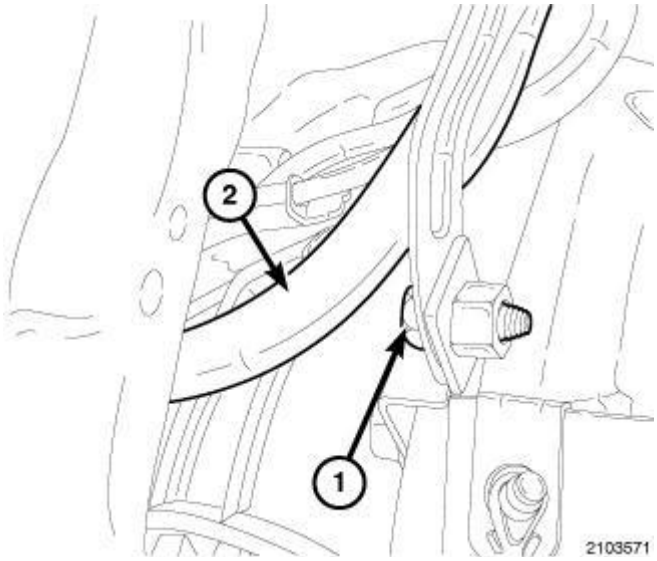

Fig. 272: Transmission Fill Tube & Bolt
Courtesy of CHRYSLER GROUP, LLC

15. Install the catalytic converter. Refer to **CONVERTER, CATALYTIC, INSTALLATION** .
16. If equipped, install the transmission fill tube (2) and the bolt (1). Tighten to 11 N.m 97 in. lbs.).

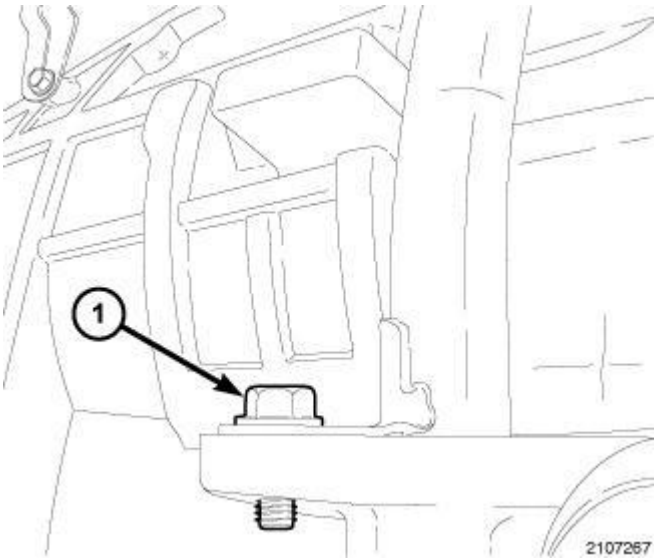

Fig. 273: Lower Transmission Fill Tube Bolt
Courtesy of CHRYSLER GROUP, LLC

17. If equipped, install the lower transmission fill tube bolt (1). Tighten to 11 N.m 97 in. lbs.).

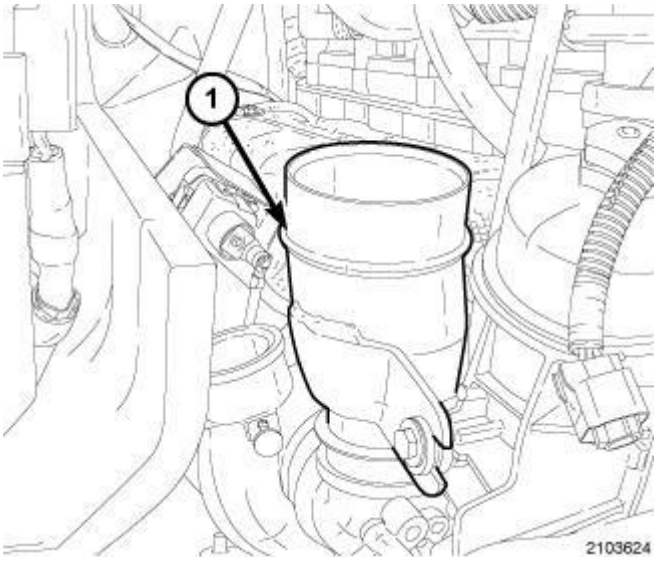

Fig. 274: Turbocharger Inlet Elbow
Courtesy of CHRYSLER GROUP, LLC

18. Install the turbo charger outlet hose to CAC inlet.
19. Install the air cleaner outlet tube to turbocharger inlet elbow (1).

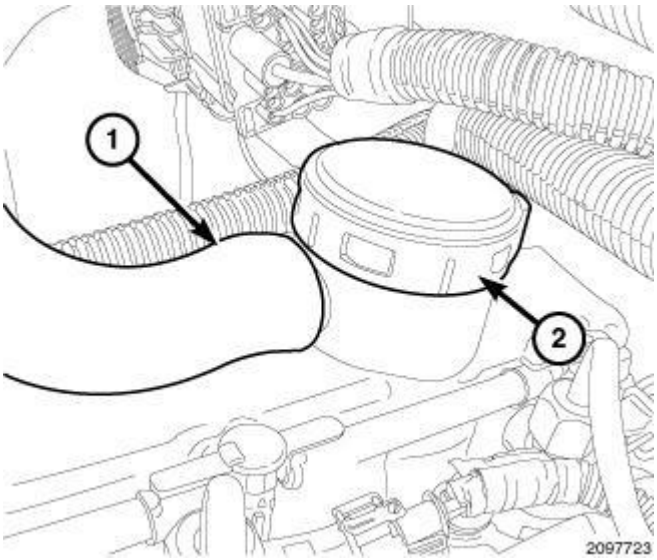

Fig. 275: Crankcase Vent Hose & Oil Separator
Courtesy of CHRYSLER GROUP, LLC

20. Install the air cleaner outlet tube.
21. Connect the crankcase vent hose (1) to the oil separator (2).
22. Install the air cleaner body. Refer to **BODY, AIR CLEANER, INSTALLATION**.
23. Connect the negative battery cable.

MANIFOLD, INTAKE

REMOVAL

REMOVAL

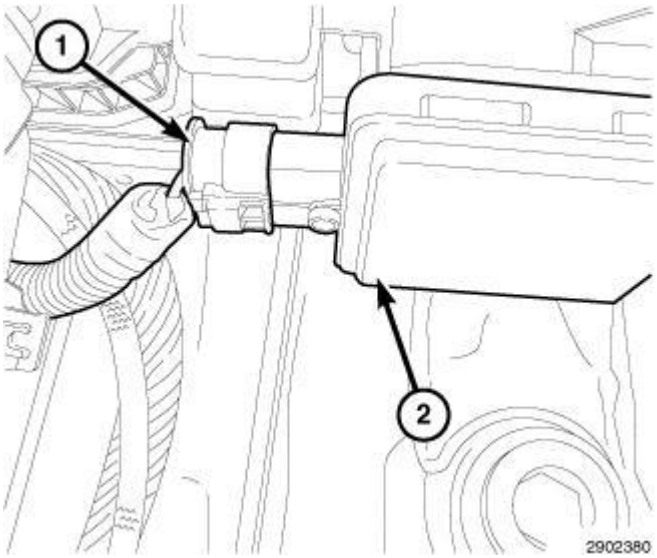

Fig. 276: Tuning Valve Harness Connector
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the EGR cooler. Refer to **COOLER, EGR, REMOVAL** .
3. Remove the coolant recovery bottle. Refer to **BOTTLE, COOLANT RECOVERY, REMOVAL** .
4. Disconnect the tuning valve harness connector (1).

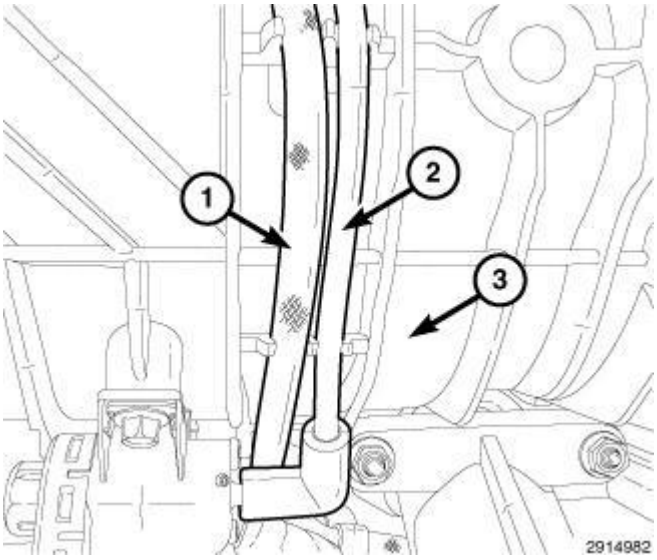

Fig. 277: Fuel Injector Return Line, Vacuum Line & Intake Manifold
Courtesy of CHRYSLER GROUP, LLC

5. Disconnect the fuel injector return line (1) from intake manifold (3).

6. Disconnect the vacuum line (2) from vacuum solenoid and intake manifold (3).

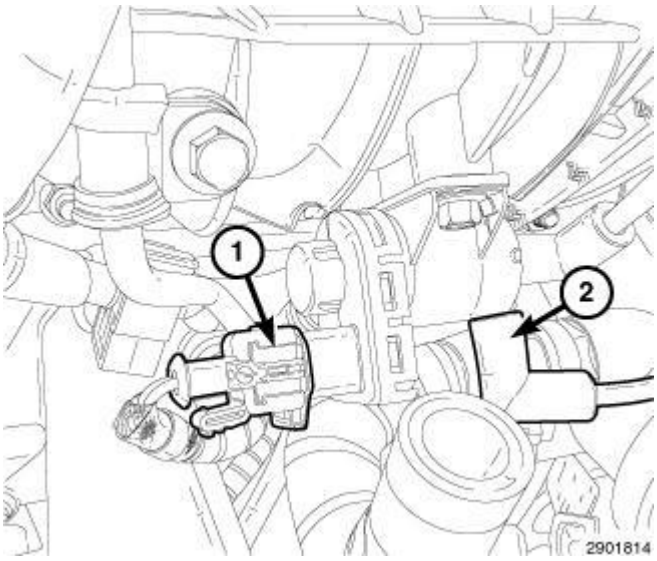

Fig. 278: Vacuum Solenoid Harness Connector
Courtesy of CHRYSLER GROUP, LLC

7. Disconnect the vacuum solenoid harness connector (1).

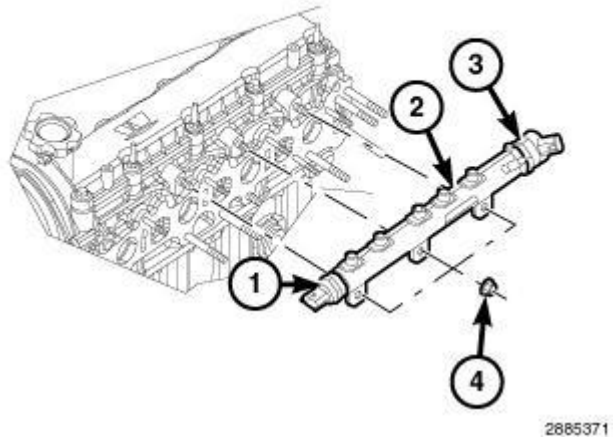

Fig. 279: Fuel Rail Pressure Sensor, Fuel Rail, Pressure Solenoid & Nuts
Courtesy of CHRYSLER GROUP, LLC

8. Remove the fuel rail (2). Refer to **RAIL, FUEL, REMOVAL** .

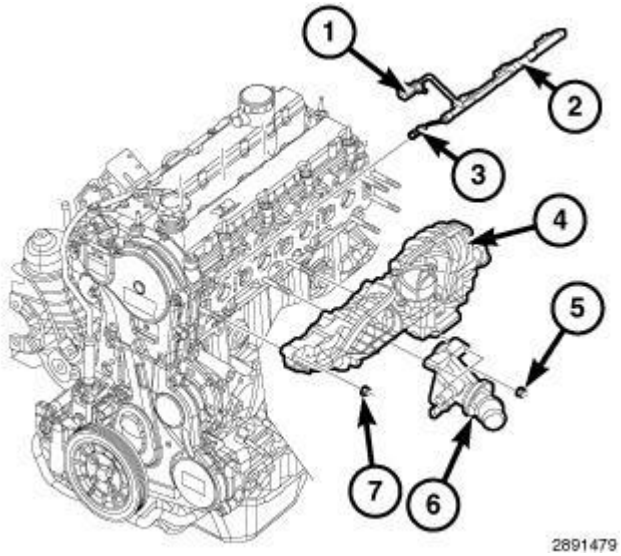

Fig. 280: Glow Plug Wire Harness Clip, Wire Harness, Glow Plugs, Intake Manifold, Thermostat Housing & Bolts
Courtesy of CHRYSLER GROUP, LLC

9. Remove the glow plug wire harness clip (1) from generator mounting bracket.
10. Disconnect glow plug (3) and remove the wire harness (2).
11. Remove nuts (7) and the intake manifold (4).
12. Remove the intake manifold gasket.

INSTALLATION

INSTALLATION

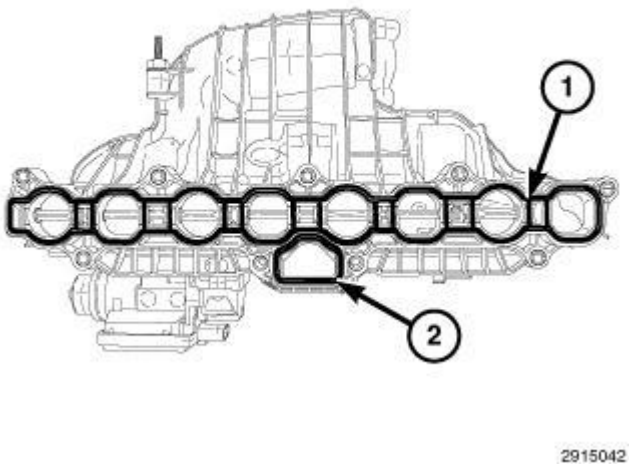

Fig. 281: Intake Manifold Gasket & Water Jacket Gasket
Courtesy of CHRYSLER GROUP, LLC

1. Clean and inspect the gasket surface of the intake manifold and the cylinder head.
2. Install the intake manifold gasket (1) and water jacket gasket (2).

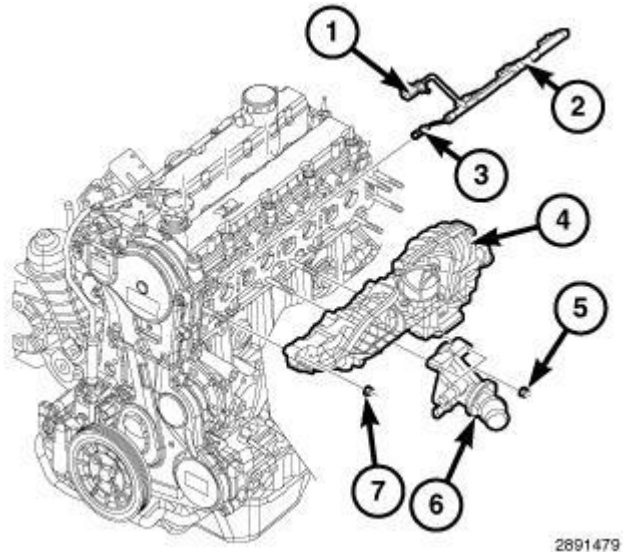

Fig. 282: Glow Plug Wire Harness Clip, Wire Harness, Glow Plugs, Intake Manifold, Thermostat Housing & Bolts
Courtesy of CHRYSLER GROUP, LLC

NOTE: The thermostat housing will be installed after the fuel rail is installed.

3. Install the intake manifold (4) and tighten nuts finger tight.
4. Connect glow plug (3) and remove the wire harness (2).
5. Install glow plug wire harness clip (1) to the generator mounting bracket.

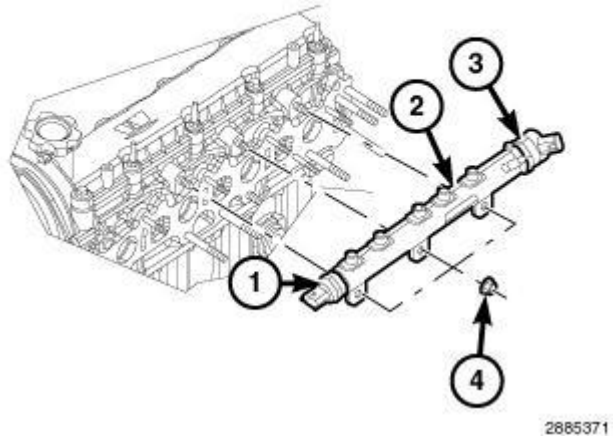

Fig. 283: Fuel Rail Pressure Sensor, Fuel Rail, Pressure Solenoid & Nuts
Courtesy of CHRYSLER GROUP, LLC

6. Install the fuel rail (2). Refer to **RAIL, FUEL, INSTALLATION** .

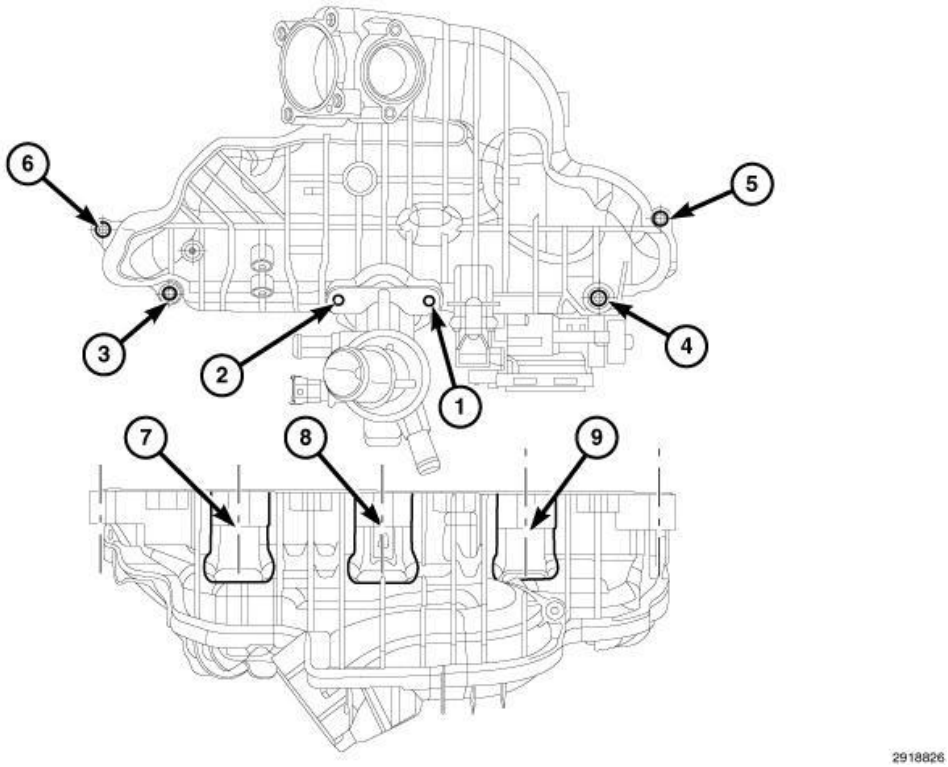

Fig. 284: Intake Manifold Retaining Nuts Tightening Sequence
Courtesy of CHRYSLER GROUP, LLC

7. Using the tightening sequence shown in illustration, tighten nuts 5, 1, 2, 6 to 5 N.m (44 in. lbs.).
8. Using the tightening sequence shown in illustration, tighten nuts 1 through 9 to 12 N.m (106 in. lbs.).

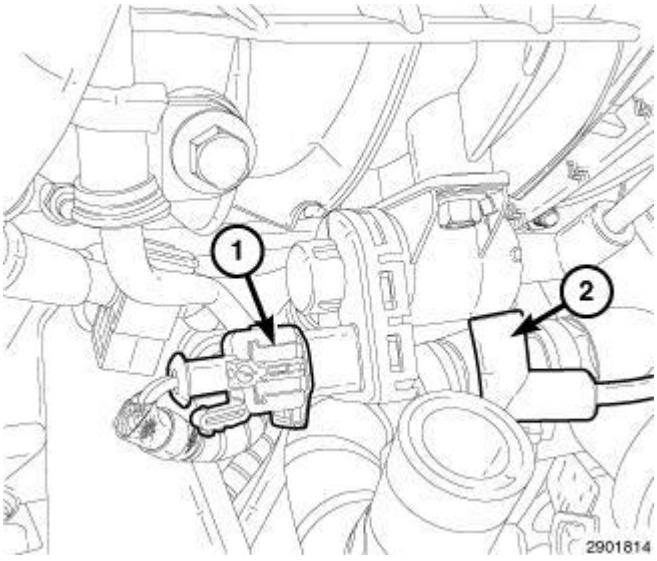

Fig. 285: Vacuum Solenoid Harness Connector
Courtesy of CHRYSLER GROUP, LLC

9. Connect the vacuum solenoid harness connector (1).

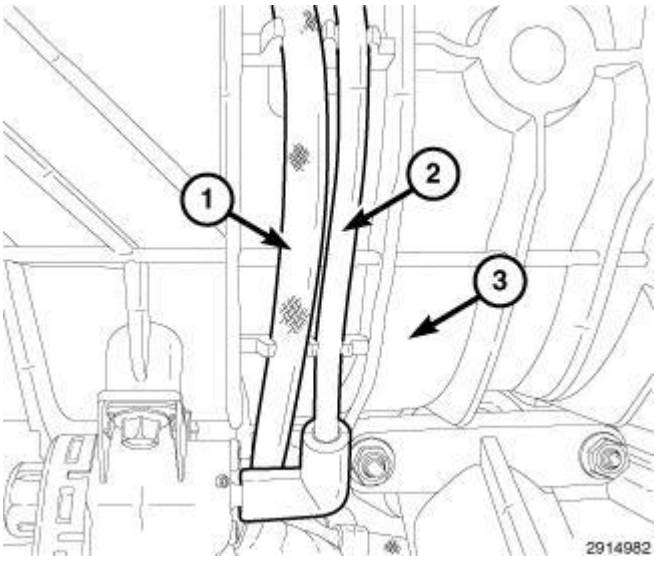

Fig. 286: Fuel Injector Return Line, Vacuum Line & Intake Manifold
Courtesy of CHRYSLER GROUP, LLC

10. Connect the vacuum line (2) to the vacuum solenoid and intake manifold (3)
11. Connect the fuel injector return line (1) to the intake manifold (3).

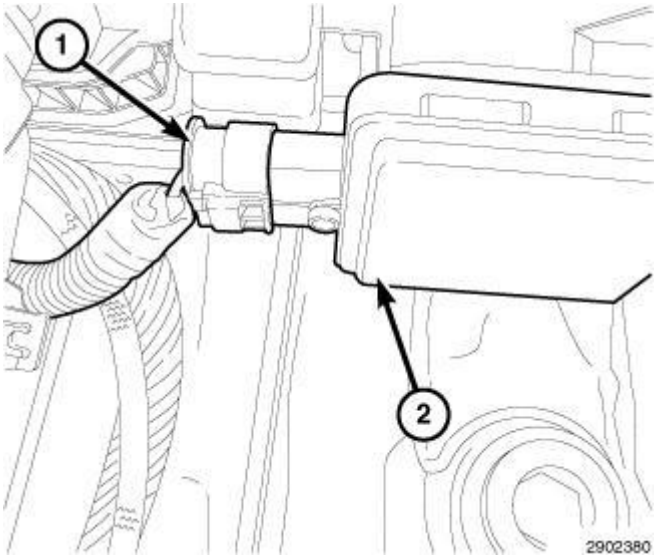

Fig. 287: Tuning Valve Harness Connector
Courtesy of CHRYSLER GROUP, LLC

12. Connect the tuning valve harness connector (1).
13. Install the coolant recovery bottle. Refer to **BOTTLE, COOLANT RECOVERY, INSTALLATION** .
14. Install the EGR cooler. Refer to **COOLER, EGR, INSTALLATION** .
15. Connect the negative battery cable.

16. Start the engine and check for leaks.

TURBOCHARGER SYSTEM

COOLER AND HOSES, CHARGE AIR

REMOVAL

REMOVAL

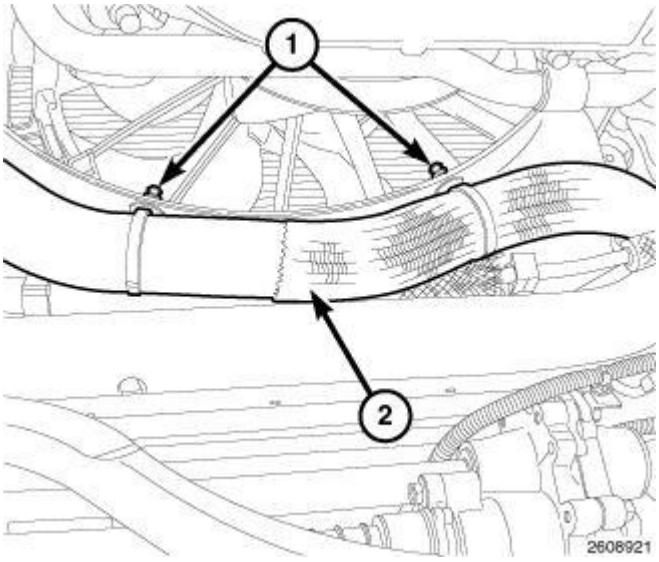

Fig. 288: Radiator Hose & Fan Shroud Retainers
Courtesy of CHRYSLER GROUP, LLC

WARNING: If the engine was just turned off, the air intake system tubes may be hot.

NOTE: When servicing the Air Charge Cooler and/or Turbocharger, the Air Charger Hose (orange) seal located between the Air Charge Hose and Turbocharger must be replaced.

NOTE: Note the location of the rubber charge air cooler to A/C condenser and air charger cooler to radiator air seals. The seals are use to prevent overheating and improve charge air and A/C efficiency.

WARNING: Refer to the applicable Warnings and Cautions for this system before performing the following operation and. Refer to PLUMBING, WARNING . Refer to PLUMBING, CAUTION . Failure to follow these instructions may result in possible serious or fatal injury.

1. Disconnect the battery negative cable.

2. Raise and support the vehicle.
3. Remove the wheelhouse splash shield. Refer to **SHIELD, SPLASH, WHEELHOUSE, REMOVAL** .
4. Remove the lower radiator seal push pins.
5. Remove the lower radiator hose to fan shroud retainers (1).
6. Remove the lower electric cooling fan mounting bolts.
7. Drain the coolant from the radiator. Refer to **STANDARD PROCEDURE** .
8. Remove the lower radiator hose (2).
9. Lower the vehicle.

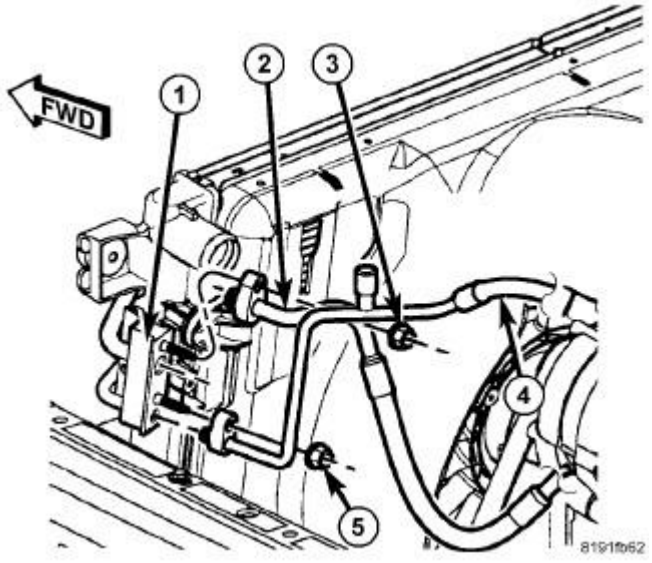

Fig. 289: A/C Condenser, Discharge Line, Liquid Line & Nuts
Courtesy of CHRYSLER GROUP, LLC

10. Remove the grille. Refer to **GRILLE, REMOVAL** .
11. Recover the refrigerant from the refrigerant system. Refer to **PLUMBING, STANDARD PROCEDURE** .
12. Remove the air filter housing assembly. Refer to **BODY, AIR CLEANER, REMOVAL**.
13. Remove the viscous fan, cooling fan and fan shroud as an assembly. Refer to **FAN, COOLING, REMOVAL** .
14. Remove the upper radiator hose.
15. Remove the nuts (3 and 5) that secure the A/C discharge line (2) and A/C liquid line (4) to the A/C condenser (1).
16. Disconnect the A/C discharge and liquid lines from the A/C condenser and remove and discard the O-ring seals and gaskets.
17. Install plugs into, or tape over the opened refrigerant line fittings and condenser ports.

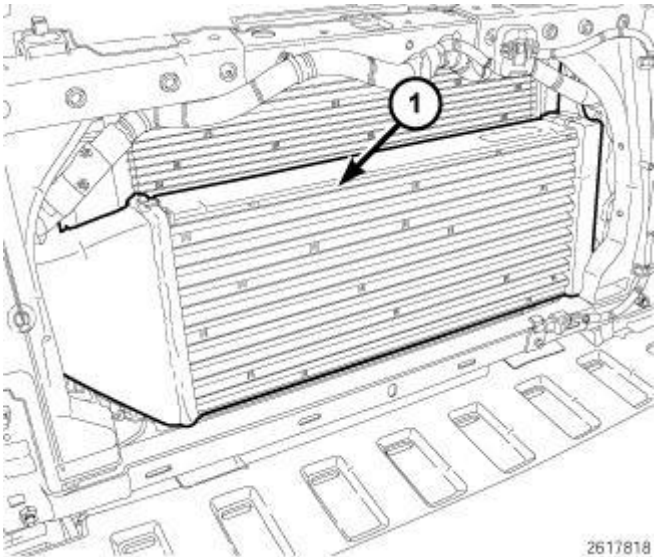

Fig. 290: Charge Air Cooler
Courtesy of CHRYSLER GROUP, LLC

18. Remove the hoses from the charge air cooler (1).
19. Remove the radiator mounting bolts.

NOTE: Care must be taken not to damage the charge air cooler fins and the fins of other ancillary cooler components.

20. Remove the radiator, A/C condenser and charge air cooler as an assembly.
21. Remove the charge air cooler to condenser bolts and separate the charge air cooler (1).

INSTALLATION

INSTALLATION

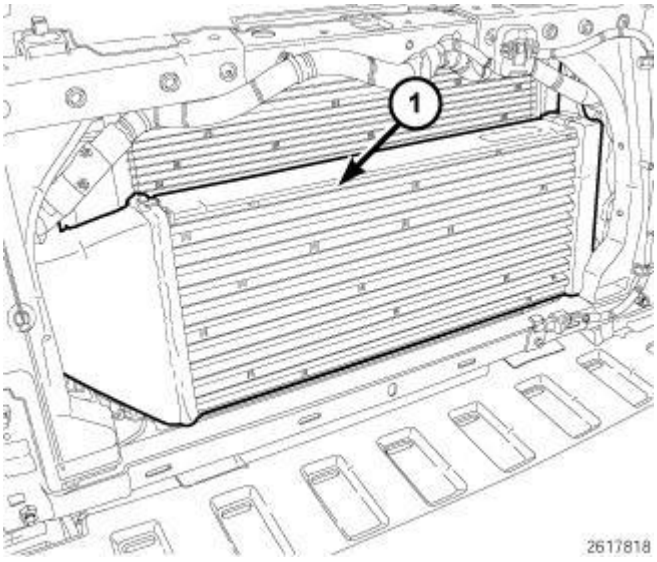

Fig. 291: Charge Air Cooler
Courtesy of CHRYSLER GROUP, LLC

NOTE: When servicing the Air Charge Cooler and/or Turbocharger, the Air Charger Hose (orange) seal located between the Air Charge Hose and Turbocharger must be replaced.

1. Install the charge air cooler to the A/C condenser/radiator assembly. Tighten the bolts to 10 N.m (89 in. lbs.).

NOTE: Care must be taken not to damage the charge air cooler fins and the fins of other ancillary cooler components.

2. Position the radiator, A/C condenser and charge air cooler into the vehicle as an assembly.
3. Install the radiator mounting bolts. Tighten the bolts to 9 N.m (81 in. lbs.).
4. Install the hoses to the charge air cooler (1). Tighten the clamps to 11 N.m (95 in. lbs.).

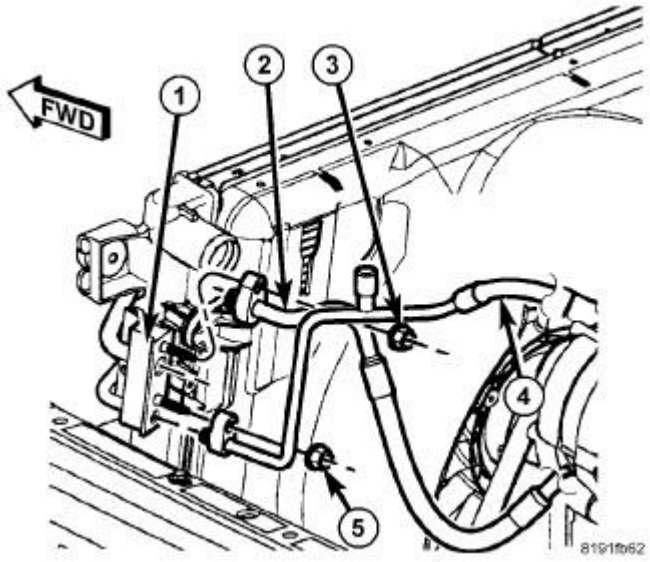

Fig. 292: A/C Condenser, Discharge Line, Liquid Line & Nuts
Courtesy of CHRYSLER GROUP, LLC

5. Remove the tape or plugs from the opened refrigerant line fittings and condenser ports.
6. Lubricate a new rubber O-ring seals with clean refrigerant oil and install them and new gaskets onto the refrigerant line fittings. Use only the specified O-ring seals as they are made of a special material for the R-134a system. Use only refrigerant oil of the type recommended for the A/C compressor in the vehicle.
7. Connect the A/C discharge line (2) and the A/C liquid line (4) to the A/C condenser (1). Install the retaining nuts (3 and 5). Tighten the nuts to 23 N.m (17 ft. lbs.).
8. Install the upper radiator hose.
9. Install the viscous fan, cooling fan and fan shroud as an assembly. Refer to **FAN, COOLING,**

INSTALLATION .

10. Install the air filter housing assembly. Refer to **BODY, AIR CLEANER, INSTALLATION**.
11. Charge the refrigerant system. Refer to **PLUMBING, STANDARD PROCEDURE** .
12. Install the grille. Refer to **GRILLE, INSTALLATION** .

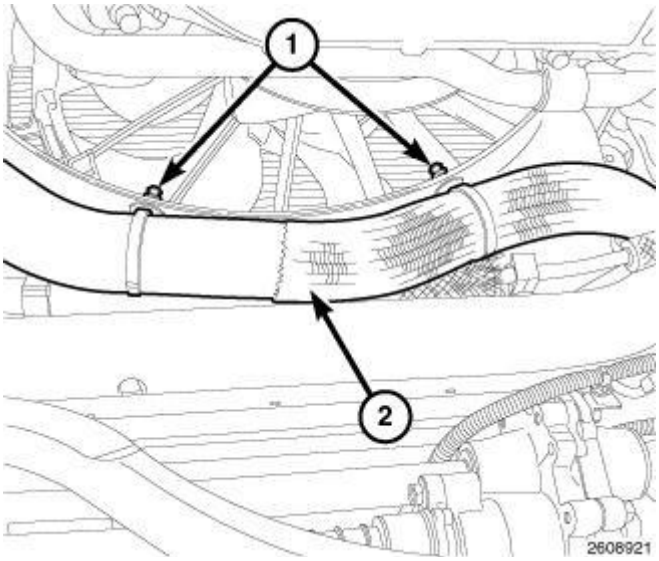

Fig. 293: Radiator Hose & Fan Shroud Retainers
Courtesy of CHRYSLER GROUP, LLC

13. Raise and support the vehicle.
14. Install the lower radiator hose (2).
15. Install the lower electric cooling fan bolts. Tighten the bolts to 6 N.m (53 in. lbs.).
16. Install the lower radiator hose to fan shroud retainers (1).
17. Install the lower radiator seal push pins.
18. Install the wheelhouse splash shield, Refer to **SHIELD, SPLASH, WHEELHOUSE, INSTALLATION** .
19. Lower the vehicle.
20. Fill the cooling system. Refer to **STANDARD PROCEDURE** .
21. Connect the battery negative cable.
22. Start engine and check for leaks.

TURBOCHARGER

REMOVAL

REMOVAL

To remove the turbocharger. Refer to **MANIFOLD, EXHAUST, REMOVAL**.

INSTALLATION

INSTALLATION

To install the turbocharger. Refer to **MANIFOLD, EXHAUST, INSTALLATION**.

VALVE TIMING

STANDARD PROCEDURE

LOCKING ENGINE 90 DEGREES AFTER TDC

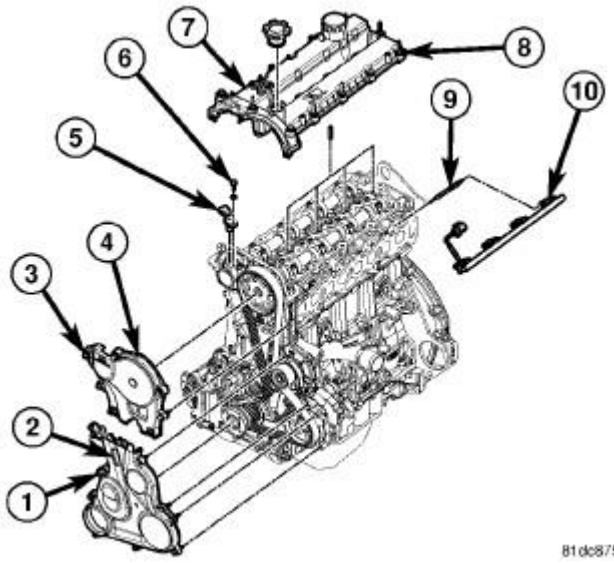

Fig. 294: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect negative battery cable.
2. Remove the upper (4) and lower (2) front covers. Refer to **COVER(S), ENGINE TIMING, REMOVAL**.

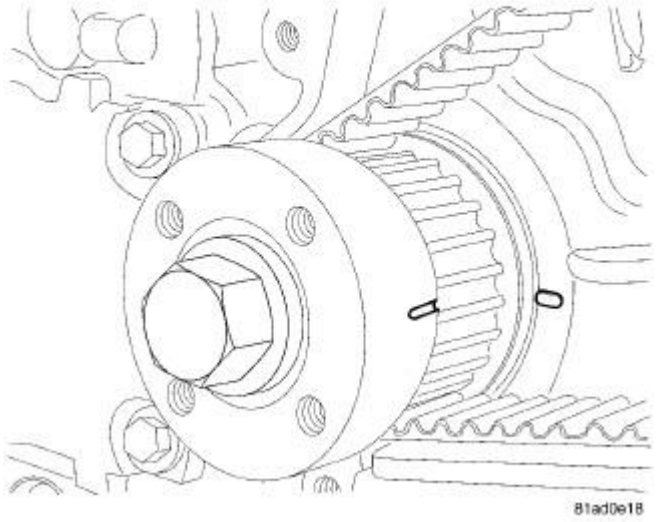

Fig. 295: Crankshaft Timing Marks
Courtesy of CHRYSLER GROUP, LLC

3. Rotate the engine until the 90° ATDC marks on the crankshaft timing belt drive sprocket and timing belt cover are aligned.

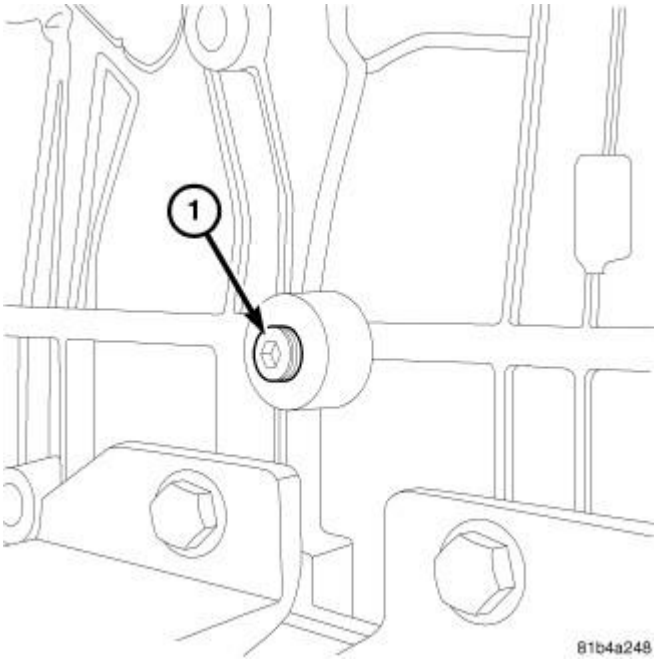

Fig. 296: Engine Block Plug
Courtesy of CHRYSLER GROUP, LLC

4. Remove the engine block plug (1) for the crankshaft locking tool. The crankshaft locking tool is installed

in the high pressure injection pump side of the engine slightly rearward of the engine mount.

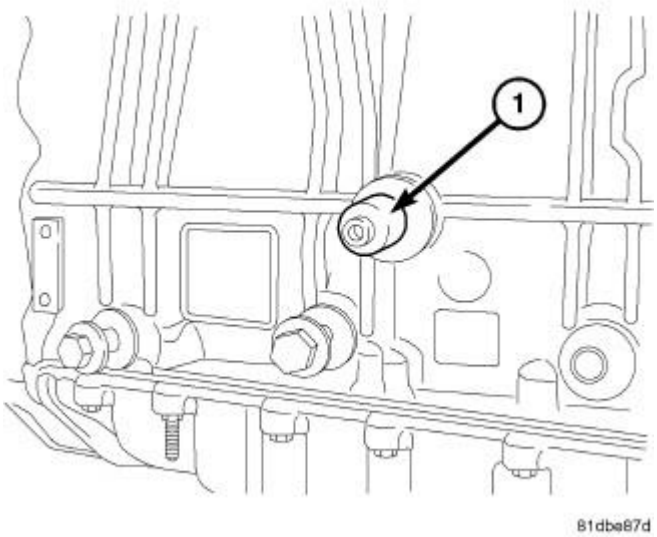

Fig. 297: Crankshaft Locking Tool
Courtesy of CHRYSLER GROUP, LLC

5. Install the Crankshaft Locking Tool (special tool #VM.9992, Adapter, 90 Degree ATDC) into the high pressure pump side of the engine block. Make sure that the outer portion of the tool threads into the block and the bolt threads into the crankshaft. If the bolt does not thread into the crankshaft, the crankshaft is not at 90° ATDC. If necessary, realign the 90° ATDC marks on the crankshaft timing belt drive sprocket and timing belt cover.

CAMSHAFT TIMING PROCEDURE

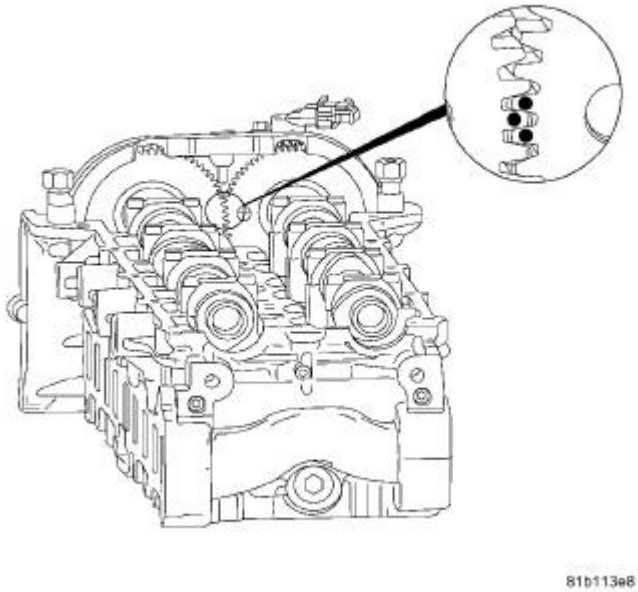

Fig. 298: Camshaft Timing Dots
Courtesy of CHRYSLER GROUP, LLC

NOTE: In order to validate camshaft timing, the cylinder head cover and timing belt should already have been removed.

CAUTION: The camshaft dots time the camshafts to each other. Later in the procedure we will rotate the camshafts so they are timed to the crankshaft.

1. Line up the camshaft gear dots.

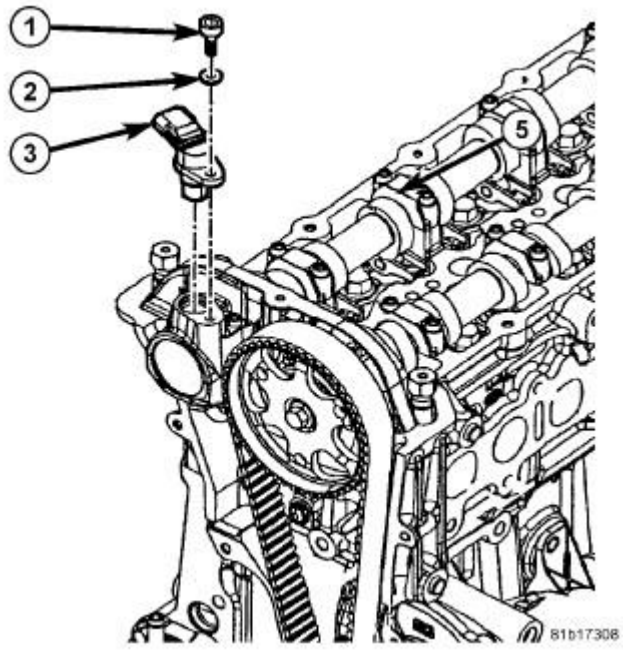

Fig. 299: Camshaft Position Sensor, Bolt & Washer
Courtesy of CHRYSLER GROUP, LLC

2. Disconnect the camshaft position sensor harness connector.
3. Remove bolt (1) and the camshaft position sensor (3).

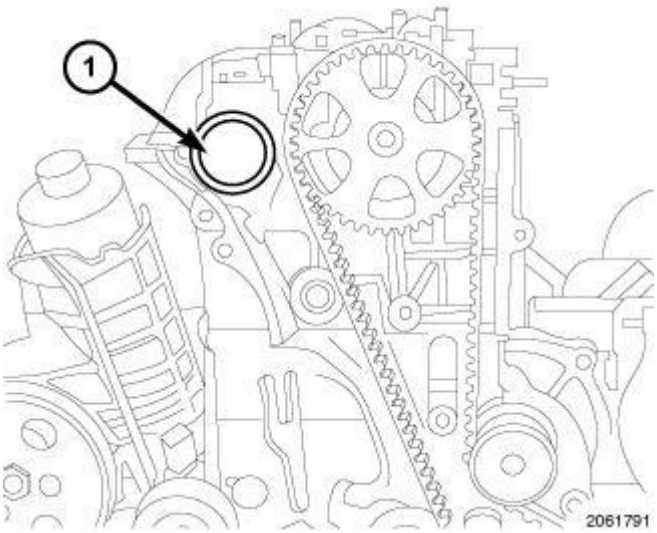

Fig. 300: Exhaust Camshaft Oil Seal
Courtesy of CHRYSLER GROUP, LLC

4. Remove the exhaust camshaft oil seal (1) to expose the camshaft reluctor.

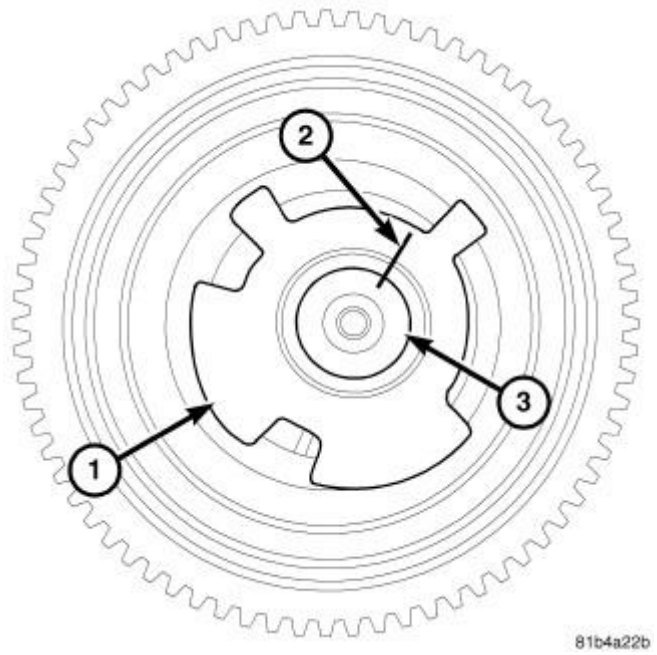

Fig. 301: Marking CMP Sensor Reluctor Wheel & Exhaust Camshaft
Courtesy of CHRYSLER GROUP, LLC

5. Mark the camshaft tone wheel with a paint marker.

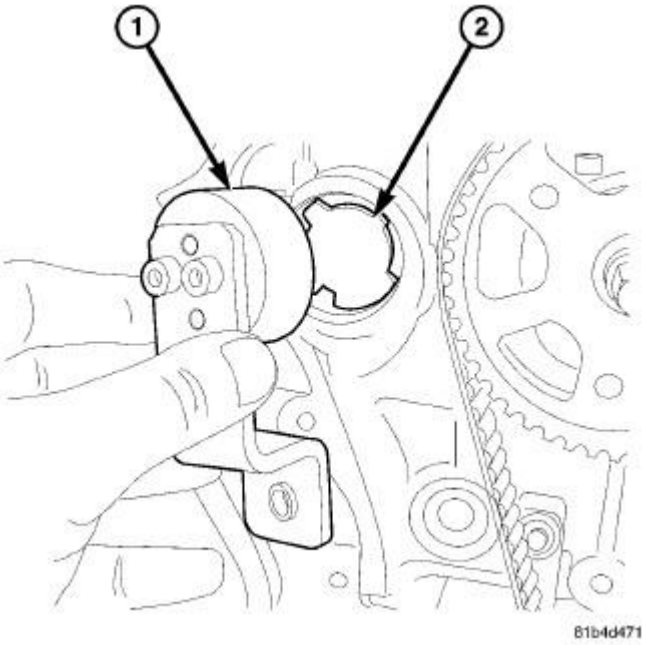

Fig. 302: Removing/Installing Camshaft Lock Tool
Courtesy of CHRYSLER GROUP, LLC

CAUTION: Do not rotate the camshaft using the Camshaft Locking Tool (special tool #VM.9991, Alignment Tool, Camshaft Sprocket). The tone wheel may spin on the camshaft. If the tone wheel is rotated on the camshaft, the camshaft must be replaced.

6. Rotate the camshafts until the Camshaft Locking Tool (special tool #VM.9991, Alignment Tool, Camshaft Sprocket) can be installed.
7. Install the Camshaft Locking Tool (special tool #VM.9991, Alignment Tool, Camshaft Sprocket).

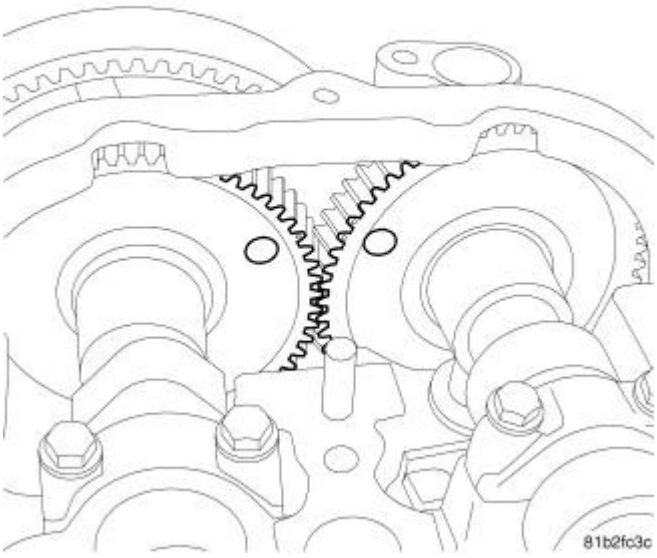

Fig. 303: Camshaft Marks At 90 Degrees ATDC
Courtesy of CHRYSLER GROUP, LLC

8. Verify the camshafts are set correctly at 90° ATDC as illustrated.

BELT, TIMING

REMOVAL

REMOVAL

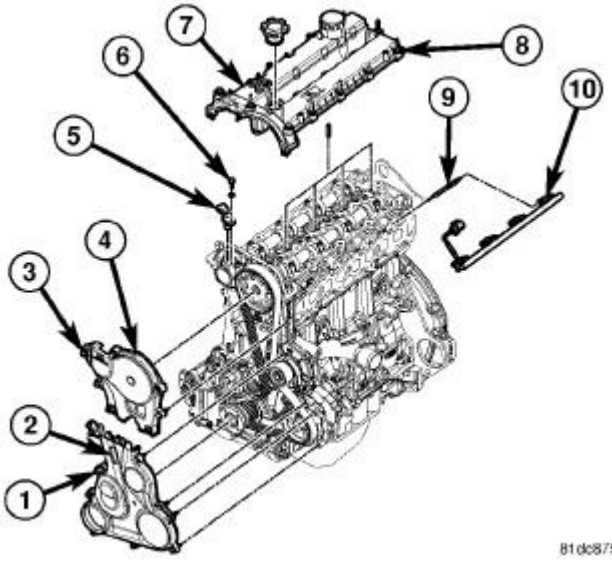

Fig. 304: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the air cleaner body. Refer to **BODY, AIR CLEANER, REMOVAL**.
3. Remove the upper and lower timing belt covers. Refer to **COVER(S), ENGINE TIMING, REMOVAL**.

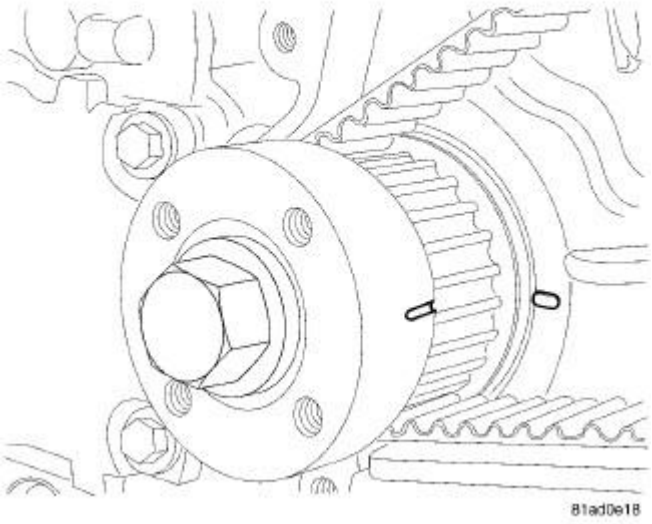

Fig. 305: Crankshaft Timing Marks
Courtesy of CHRYSLER GROUP, LLC

4. Rotate the engine until the crankshaft 90° ATDC marks on the crankshaft timing belt drive sprocket and timing cover are aligned.

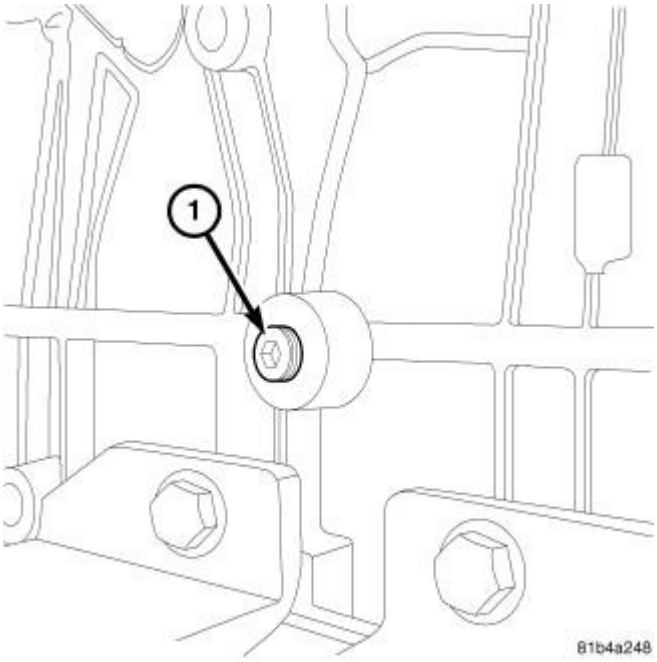

Fig. 306: Engine Block Plug
Courtesy of CHRYSLER GROUP, LLC

5. Remove the engine block plug (1).

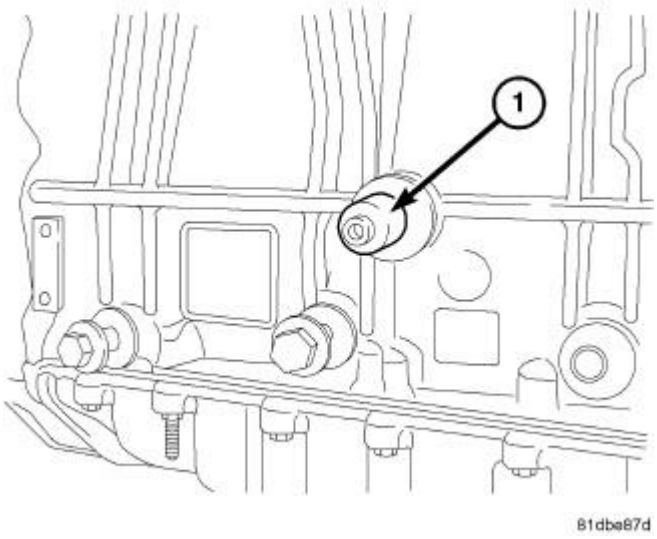

Fig. 307: Crankshaft Locking Tool
Courtesy of CHRYSLER GROUP, LLC

6. Install the (special tool #VM.9992, Adapter, 90 Degree ATDC) (1).

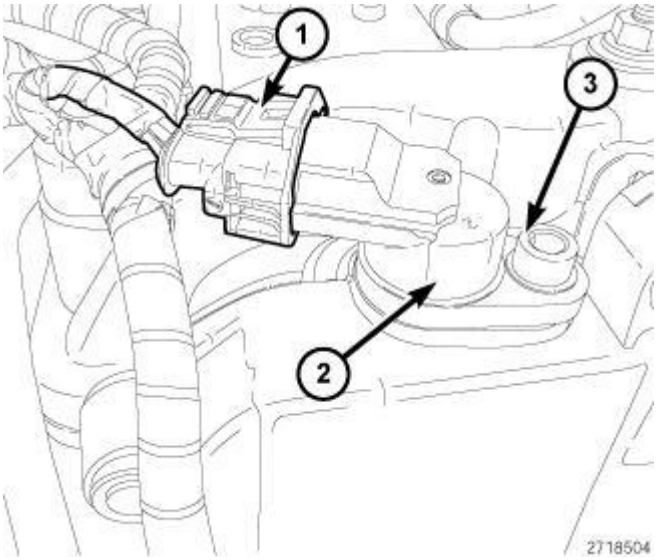

Fig. 308: Camshaft Position Sensor Harness Connector, Sensor & Bolt
Courtesy of CHRYSLER GROUP, LLC

7. Disconnect the Camshaft Position Sensor (CMP) harness connector (1).
8. Remove bolt (3) the CMP sensor (2).

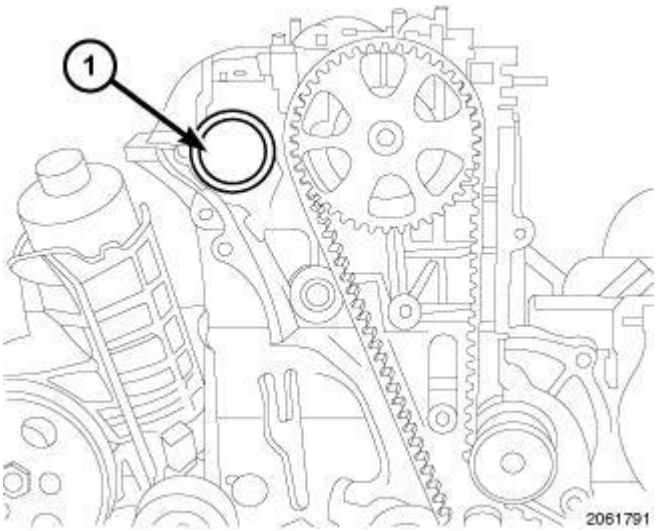

Fig. 309: Exhaust Camshaft Oil Seal
Courtesy of CHRYSLER GROUP, LLC

9. Remove the exhaust camshaft oil seal (1) to expose the camshaft reluctor.

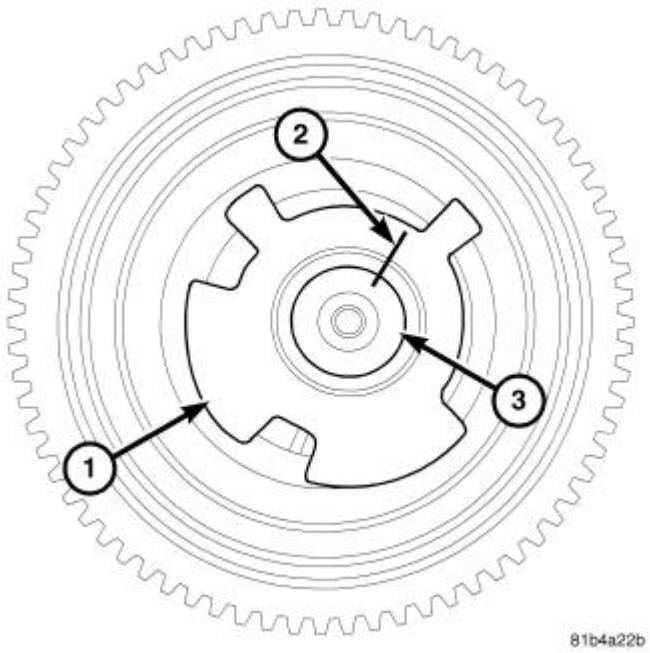

Fig. 310: Marking CMP Sensor Reluctor Wheel & Exhaust Camshaft
Courtesy of CHRYSLER GROUP, LLC

10. Use a paint pen to mark the location of the reluctor wheel (1) on the camshaft (2).

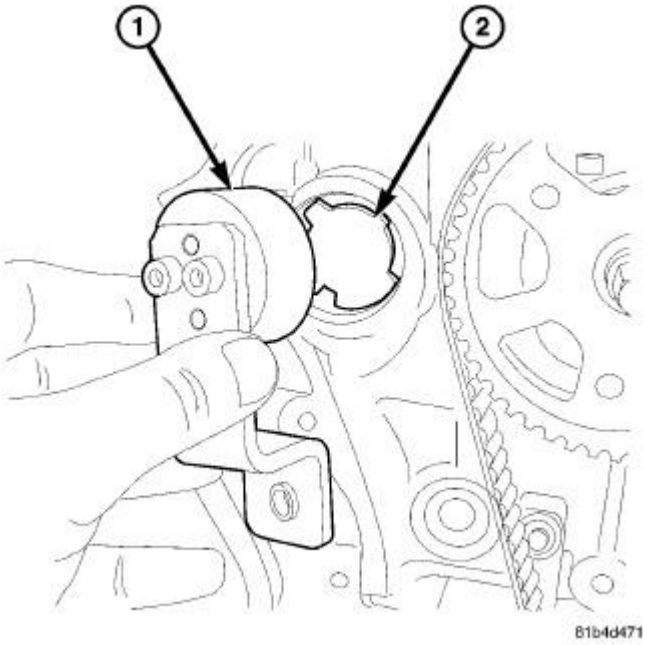

Fig. 311: Removing/Installing Camshaft Lock Tool
Courtesy of CHRYSLER GROUP, LLC

11. Install the (special tool #VM.9991, Alignment Tool, Camshaft Sprocket) (1).

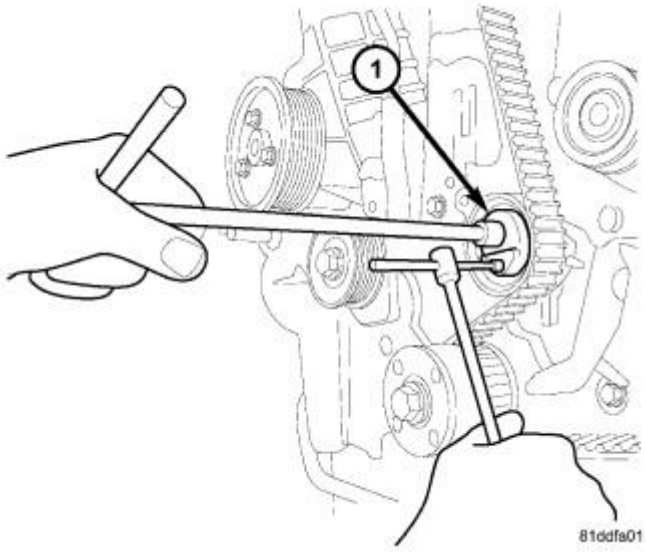

Fig. 312: Tighten/Loosen Timing Belt Tensioner Bolt
Courtesy of CHRYSLER GROUP, LLC

12. Loosen the timing belt tensioner bolt (1), and remove the timing belt.

INSTALLATION

INSTALLATION

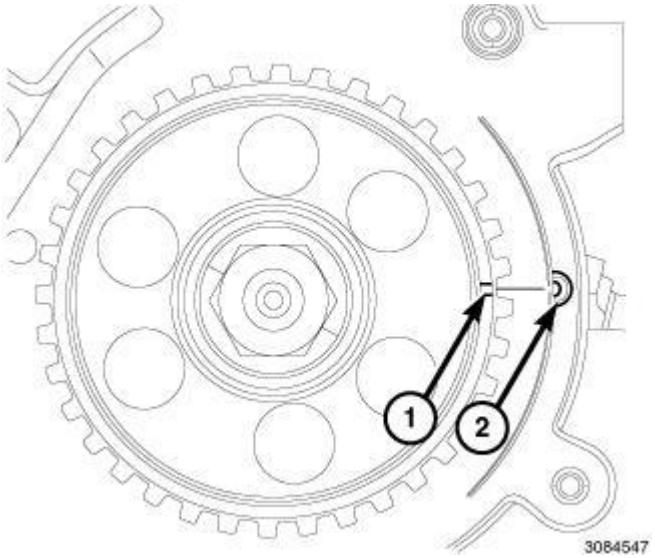

Fig. 313: Fuel Injection Pump Timing Marks
Courtesy of CHRYSLER GROUP, LLC

1. Align the high pressure fuel pump sprocket timing mark (1) with the timing mark (2) on the block.

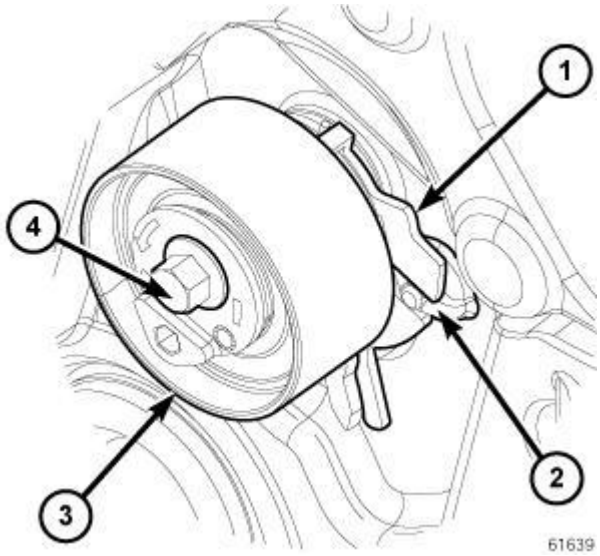

Fig. 314: Timing Belt Tensioner, Alignment Plate, Engine Cover Boss & Bolt
Courtesy of CHRYSLER GROUP, LLC

2. Verify that the bolt (4) is finger tight and tensioner alignment plate (1) is aligned with the boss (2) on the engine cover.

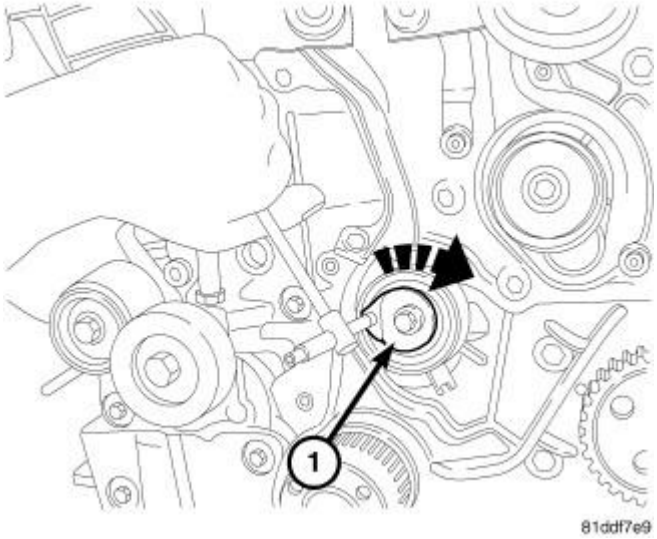

Fig. 315: Timing Belt Tensioner Adjustment
Courtesy of CHRYSLER GROUP, LLC

3. Turn the timing belt tensioner (1) clockwise to unload the tensioner enough for the timing belt to be installed.

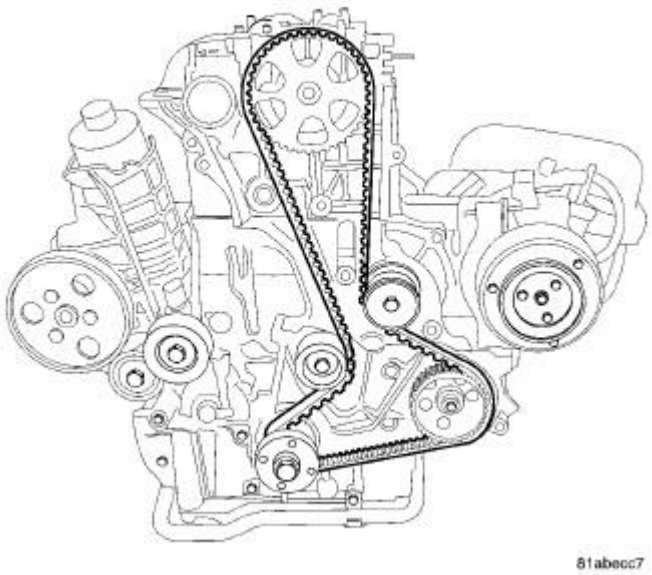

Fig. 316: Timing Belt
Courtesy of CHRYSLER GROUP, LLC

NOTE: DO NOT remove the timing belt from the package until it is going to be installed. DO NOT expose timing belt to oil, grease or water contamination. DO NOT crimp belt at a sharp angle. DO NOT clean belt, pulleys or tensioner with solvent. Check that pulleys and bearings are not seized or damaged before installing belt.

4. Install the timing belt on the components in the following order.
   - Crankshaft sprocket (1).
   - High pressure fuel pump (2).
   - Water pump pulley (3).
   - Intake camshaft pulley (4).
   - Timing belt tensioner (5).

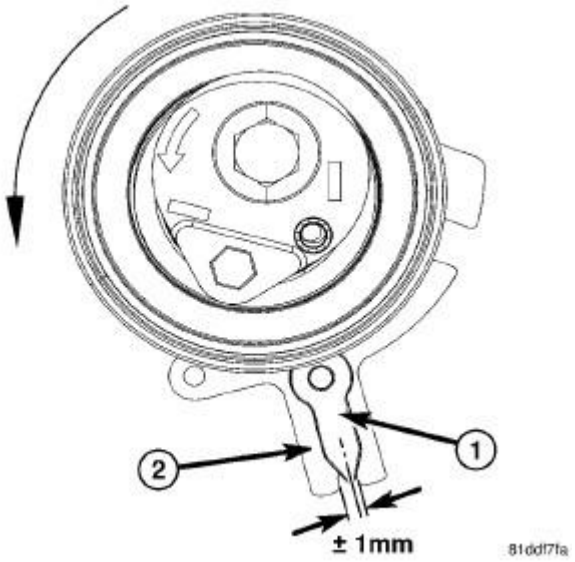

Fig. 317: Tensioner Indicator & Tensioner Gage Slot
Courtesy of CHRYSLER GROUP, LLC

NOTE: Turning the belt tensioner counter clockwise moves the pointer in a clockwise direction. Also, if the tensioner bolt is too loose this will cause the tensioner alignment slot to jump off the alignment boss on timing cover.

5. Adjust timing belt tensioner by lining up the load indicator arrow (1) to the center of the tensioner load gage (2) as illustrated.

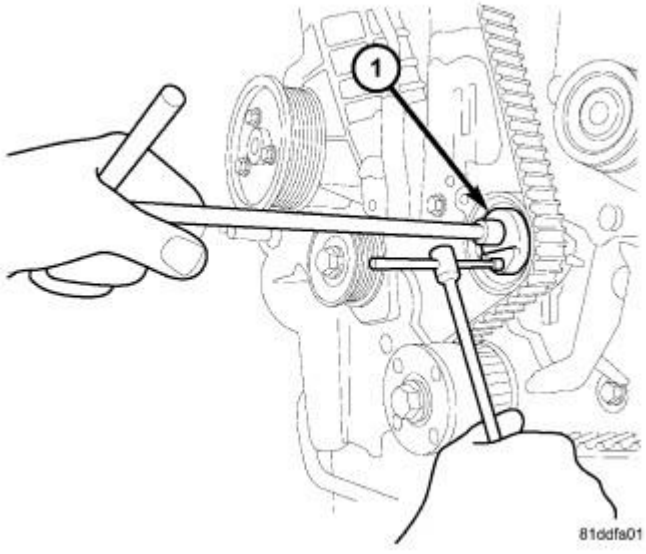

Fig. 318: Tighten/Loosen Timing Belt Tensioner Bolt
Courtesy of CHRYSLER GROUP, LLC

6. Tighten the timing belt tensioner bolt (1) to 28 N.m (21 ft. lbs.).

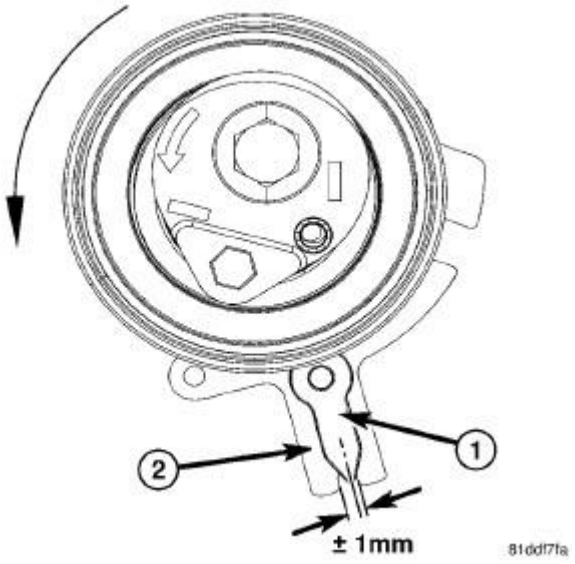

Fig. 319: Tensioner Indicator & Tensioner Gage Slot
Courtesy of CHRYSLER GROUP, LLC

7. Verify the tensioner load indicator (1) is still centered in the tensioner load gage (2). If the indicator is not centered in the gage as shown in illustration. Refer to **TENSIONER, ENGINE TIMING, ADJUSTMENTS**.

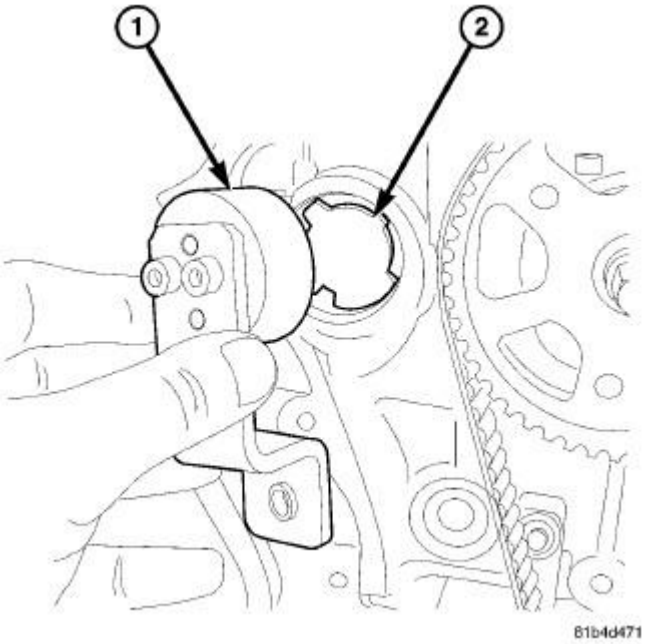

Fig. 320: Removing/Installing Camshaft Lock Tool
Courtesy of CHRYSLER GROUP, LLC

8. Remove the (special tool #VM.9991, Alignment Tool, Camshaft Sprocket) (1).

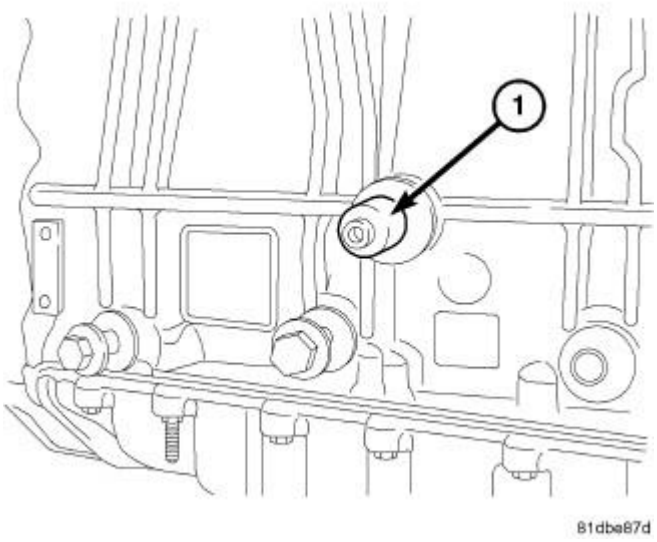

Fig. 321: Crankshaft Locking Tool
Courtesy of CHRYSLER GROUP, LLC

9. Remove the (special tool #VM.9992, Adapter, 90 Degree ATDC) (1).

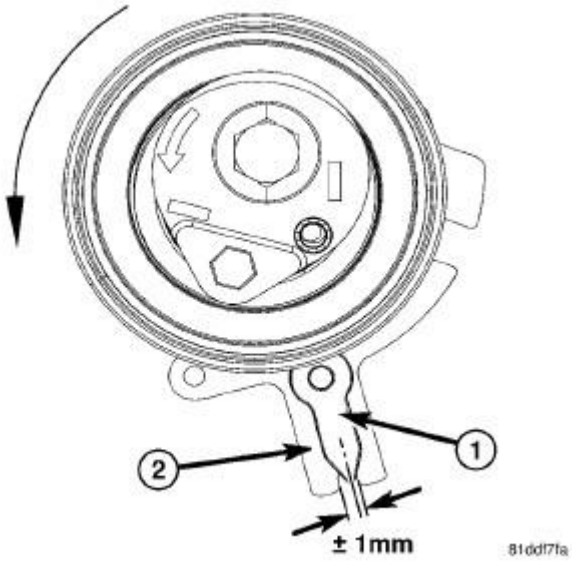

Fig. 322: Tensioner Indicator & Tensioner Gage Slot
Courtesy of CHRYSLER GROUP, LLC

NOTE: In order to rotate the engine, the (special tool #VM.9991, Alignment Tool, Camshaft Sprocket) and the (special tool #VM.9992, Adapter, 90 Degree ATDC) needs to be removed.

10. Rotate engine 2 complete revolutions and then recheck tensioner alignment. Verify that the tension indicator (1) is centered in the slot on the tensioner gage (2) slot as shown in illustration. Readjust tensioner alignment is necessary.

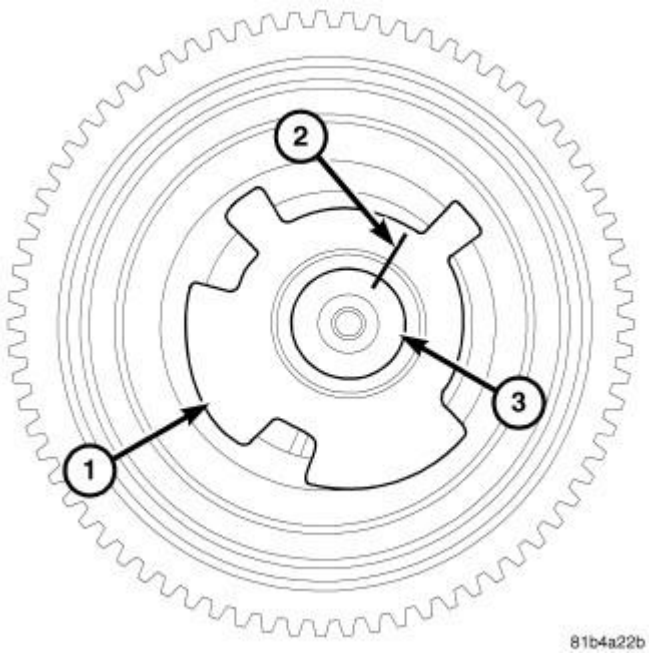

Fig. 323: Marking CMP Sensor Reluctor Wheel & Exhaust Camshaft
Courtesy of CHRYSLER GROUP, LLC

11. Verify that the reluctor wheel (1) has not moved on the camshaft. If the witness marks are not aligned, the reluctor wheel (1) has spun on the camshaft (3) during the assembly process, and the exhaust camshaft must be replaced.

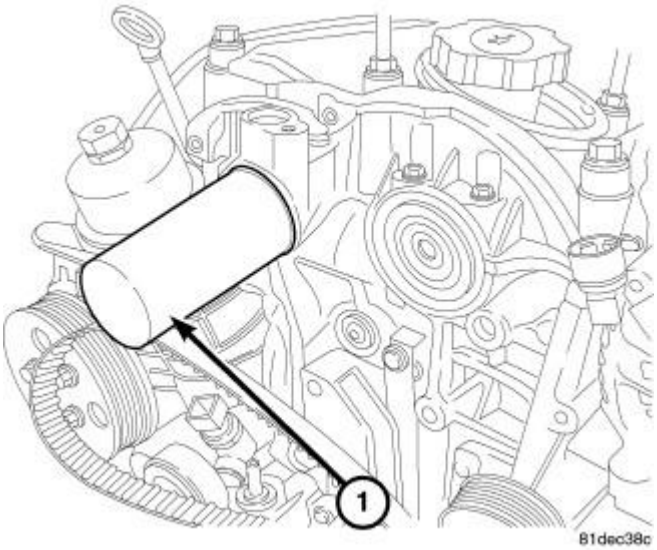

Fig. 324: Exhaust Camshaft Cap Installer
Courtesy of CHRYSLER GROUP, LLC

12. Use (special tool #VM.1057, Installer, Seal) (1) to install the exhaust camshaft seal.

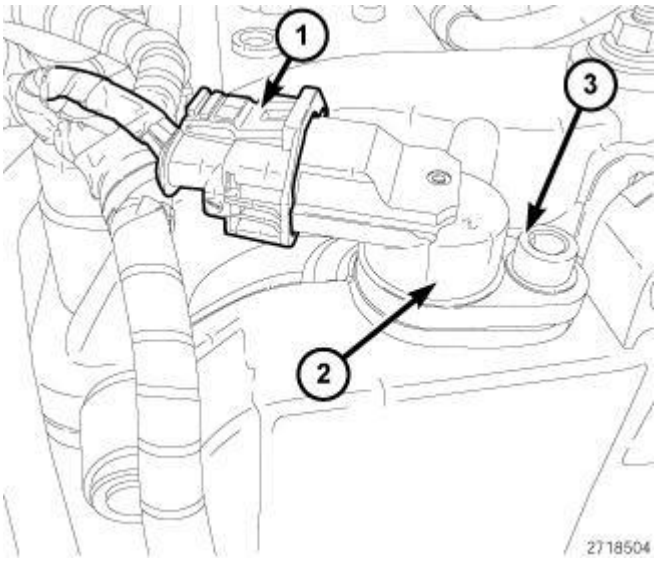

Fig. 325: Camshaft Position Sensor Harness Connector, Sensor & Bolt
Courtesy of CHRYSLER GROUP, LLC

13. Install the Camshaft Position Sensor CMP sensor (2). Tighten bolt (3) to 11 N.m (97 in. lbs.).
14. Connect the (CMP) wire harness connector (1).

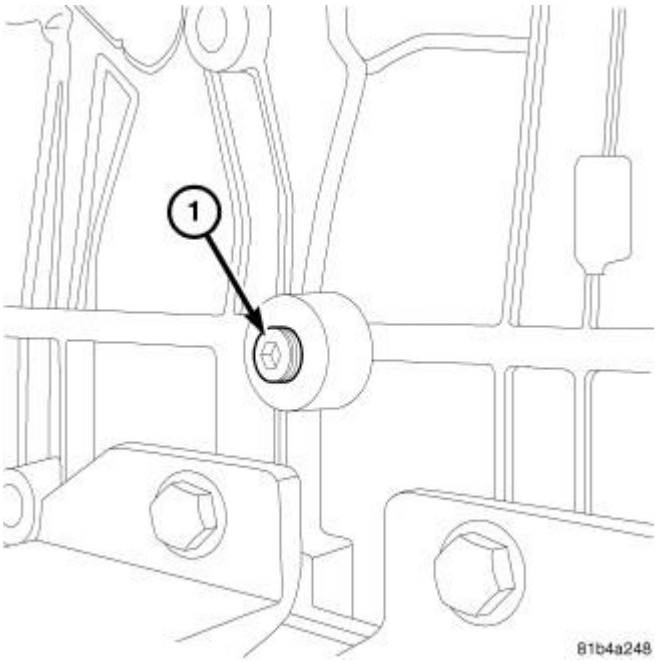

Fig. 326: Engine Block Plug
Courtesy of CHRYSLER GROUP, LLC

15. Install the engine block plug (1). Tighten the engine block plug to 30 N.m (22 ft. lbs.).

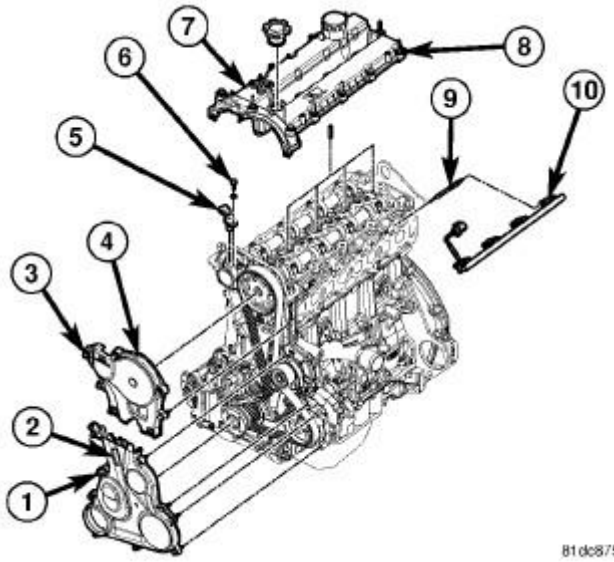

Fig. 327: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

16. Install the upper and lower outer timing belt covers. Refer to **COVER(S), ENGINE TIMING, INSTALLATION**.
17. Install the air cleaner body. Refer to **BODY, AIR CLEANER, INSTALLATION**.
18. Connect the negative battery cable.

COVER(S), ENGINE TIMING

REMOVAL

INNER TIMING BELT COVER

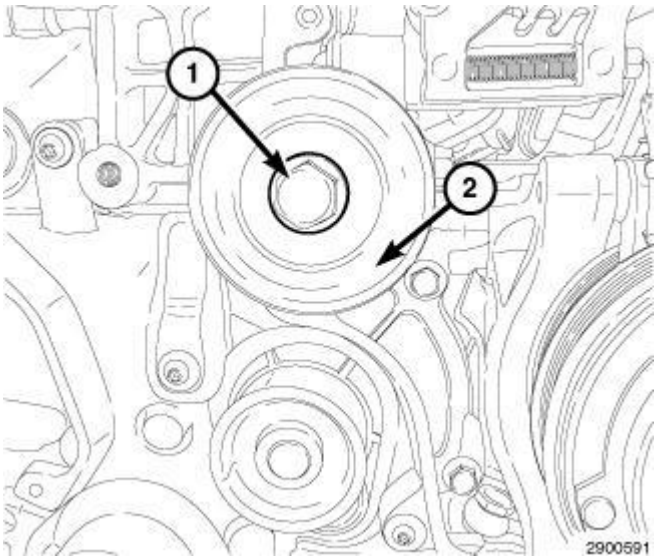

Fig. 328: Idler Pulley & Bolt

Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to **BELT, TIMING, REMOVAL**.
3. Remove bolt (1) and the Idler pulley (2).

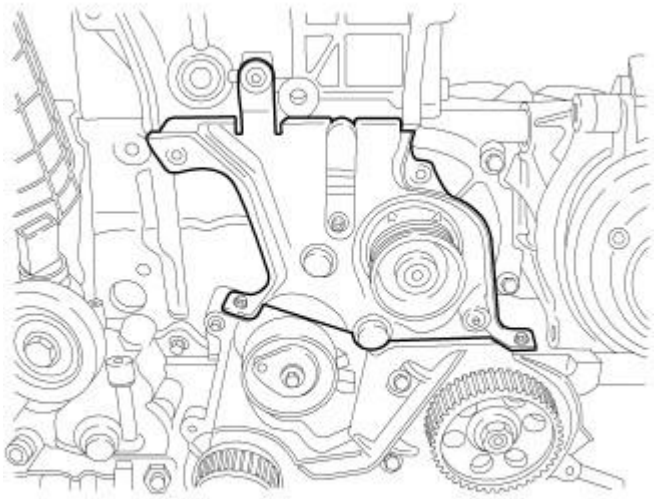

Fig. 329: Inner Front Cover
Courtesy of CHRYSLER GROUP, LLC

4. Remove bolts and the inner timing belt cover.

UPPER AND LOWER TIMING BELT OUTER COVERS

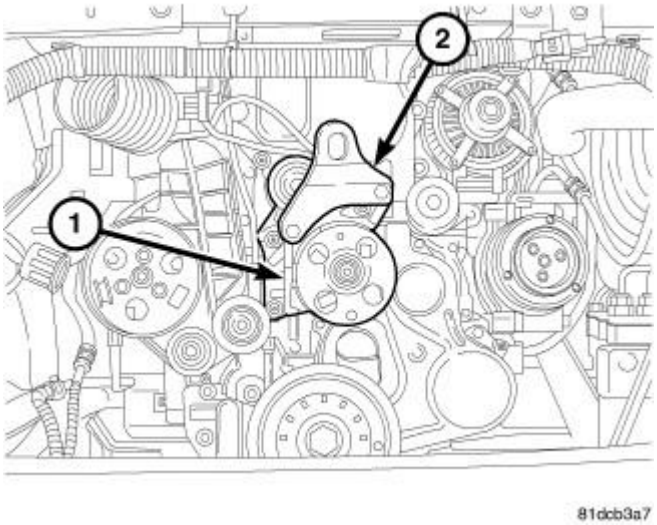

Fig. 330: Idler Pulley Assembly & Front Engine Lifting Bracket
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the fan blade/viscous fan drive assembly from water pump. Refer to **DRIVE, FAN, REMOVAL** .
3. Remove the front engine lift bracket (2).
4. Remove the accessory drive idler pulley bracket (1).

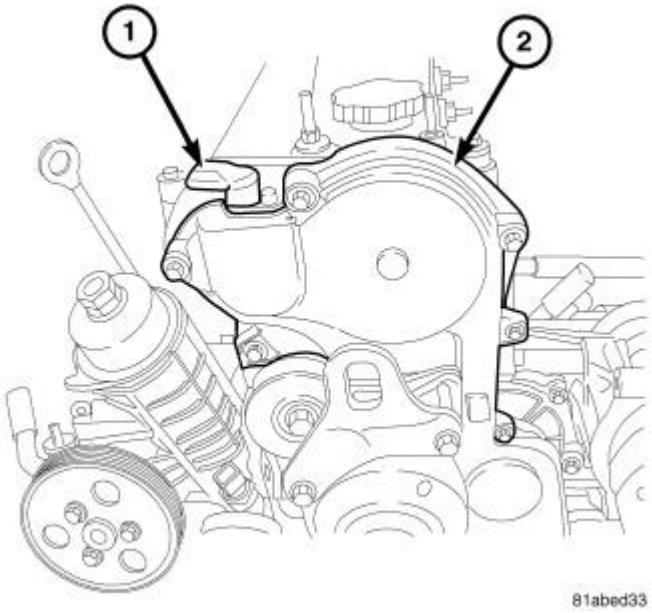

Fig. 331: Upper Front Cover & Lifting Bracket
Courtesy of CHRYSLER GROUP, LLC

5. Remove the upper front cover (2).

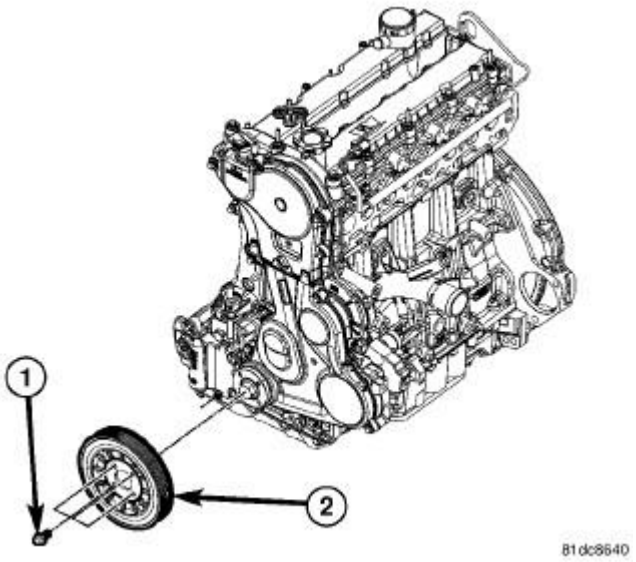

Fig. 332: Crankshaft Damper & Bolt
Courtesy of CHRYSLER GROUP, LLC

6. Remove the bolts (1) and the crankshaft damper (2).

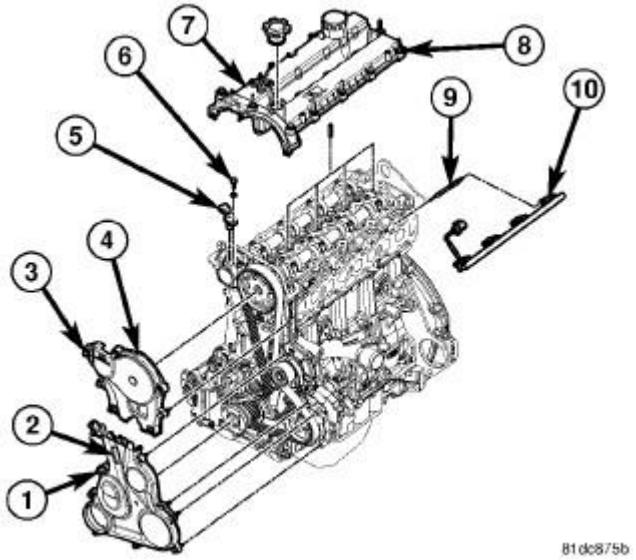

Fig. 333: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

7. Remove the lower front cover (2).

INSTALLATION

INNER TIMING BELT COVER

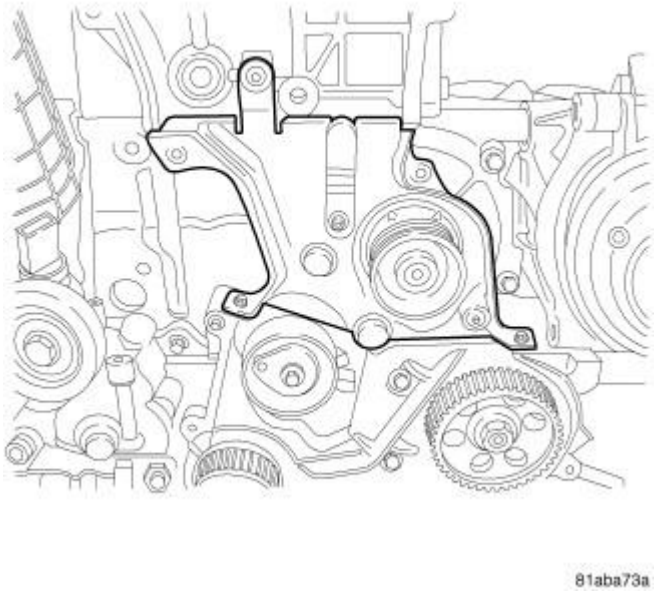

Fig. 334: Inner Front Cover
Courtesy of CHRYSLER GROUP, LLC

1. Install the inner timing belt cover. Tighten the bolts to 8 N.m (71 in. lbs.).

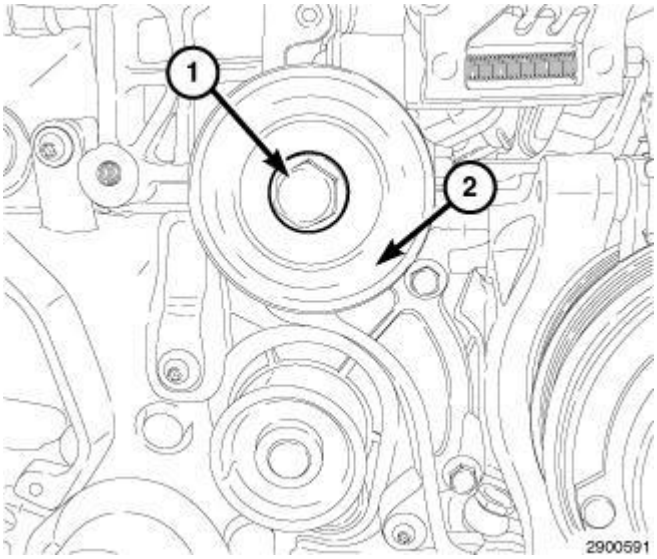

Fig. 335: Idler Pulley & Bolt
Courtesy of CHRYSLER GROUP, LLC

2. Install the idler pulley (2). Tighten bolt (1) to 45 N.m (33 ft. lbs.).
3. Install the timing belt. Refer to **BELT, TIMING, INSTALLATION**.
4. Connect the negative battery cable.

UPPER AND LOWER OUTER TIMING BELT COVERS

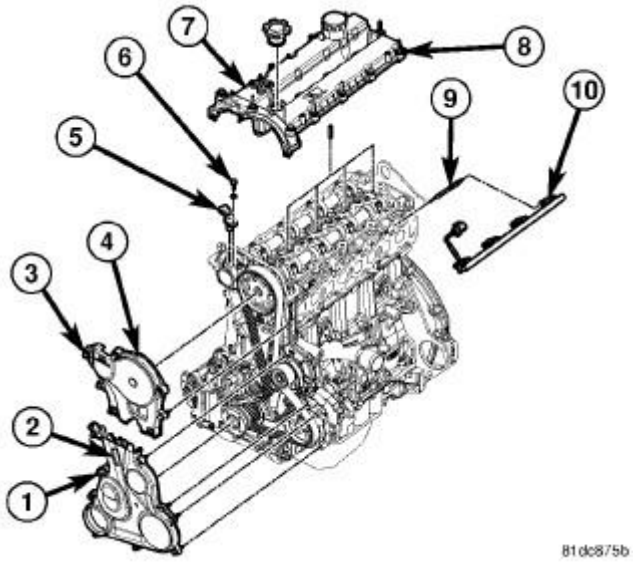

Fig. 336: Upper And Lower Front Covers With Fasteners
Courtesy of CHRYSLER GROUP, LLC

1. Install the lower timing belt cover (2). Tighten the bolts to 8 N.m (71 in. lbs.).

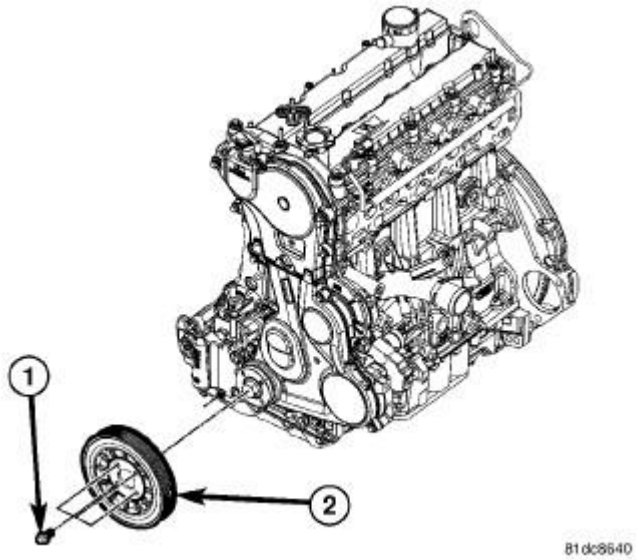

Fig. 337: Crankshaft Damper & Bolt
Courtesy of CHRYSLER GROUP, LLC

2. Install the crankshaft damper (2). Tighten the bolts (1) to 32 N.m (23 in. lbs.).

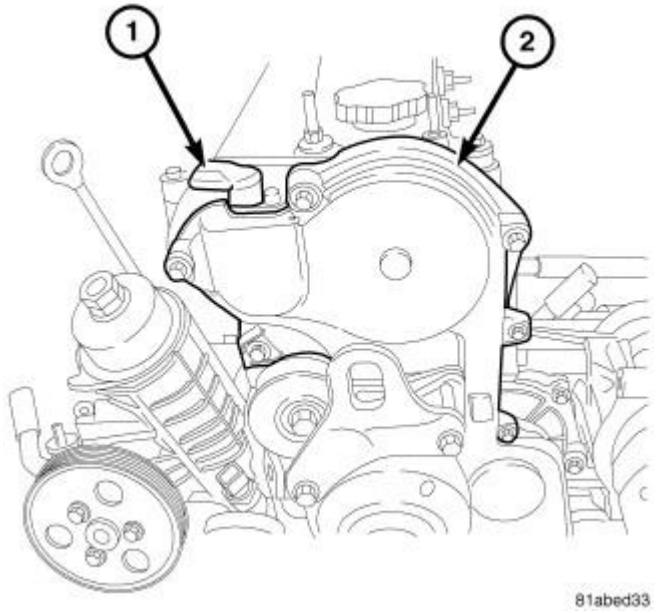

Fig. 338: Upper Front Cover & Lifting Bracket
Courtesy of CHRYSLER GROUP, LLC

3. Install the upper timing belt cover (2). Tighten the bolts to 8 N.m (71 in. lbs.).

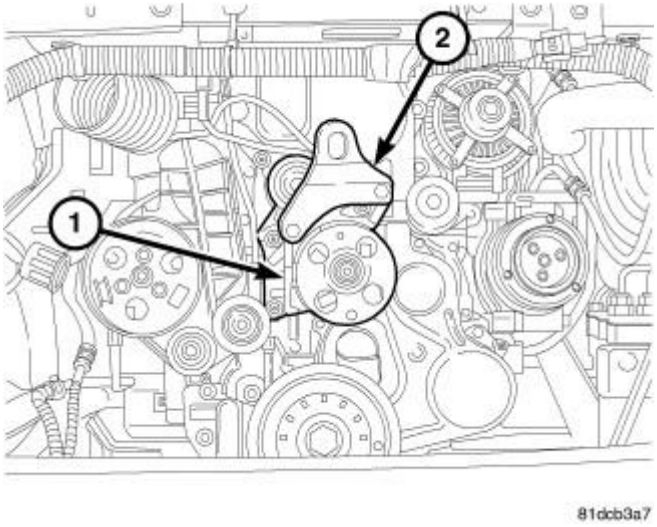

Fig. 339: Idler Pulley Assembly & Front Engine Lifting Bracket
Courtesy of CHRYSLER GROUP, LLC

4. Install the accessory drive idler pulley bracket. Tighten the bolts to 45 N.m (33 ft. lbs.).
5. Install the front engine lift bracket (2). Tighten the bolts to 45 N.m (33 ft. lbs.).
6. Install the fan blade/viscous fan drive assembly onto the water pump. Refer to **DRIVE, FAN, INSTALLATION** .
7. Connect the negative battery cable.

SPROCKET(S), TIMING BELT AND CHAIN

REMOVAL

CRANKSHAFT SPROCKET

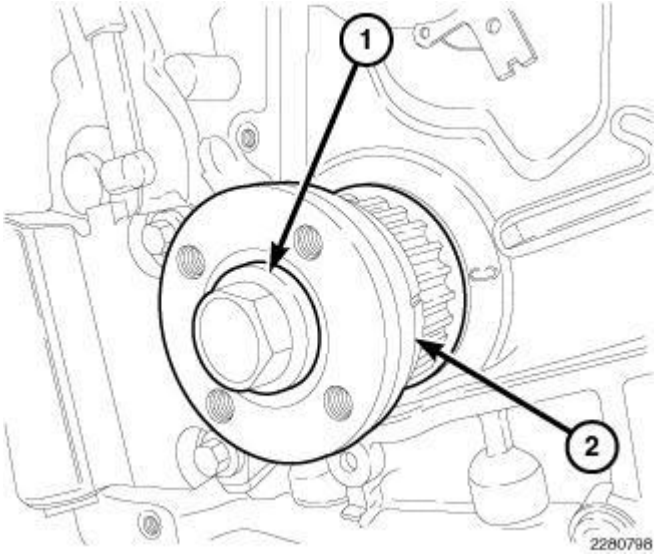

Fig. 340: Crankshaft Timing Belt Sprocket & Bolt
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to **BELT, TIMING, REMOVAL**.

NOTE: The crankshaft sprocket bolt is a left handed thread.

3. Remove bolt (1), and the crankshaft sprocket (2).

CAMSHAFT SPROCKET

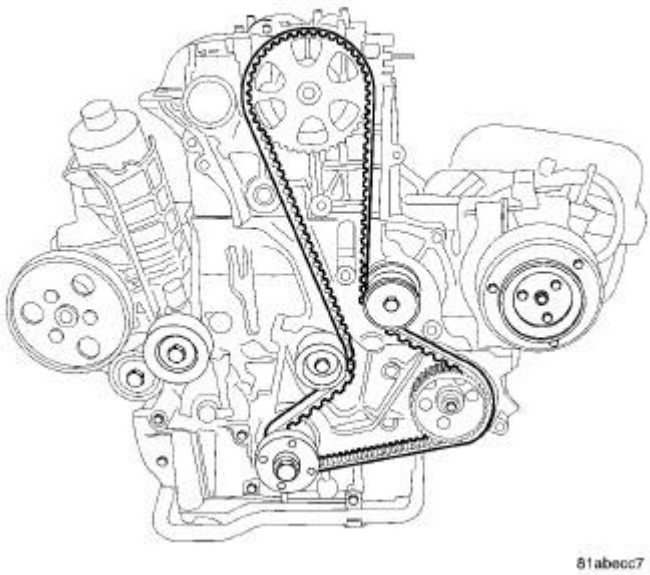

Fig. 341: Timing Belt
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove timing belt. Refer to **BELT, TIMING, REMOVAL**.

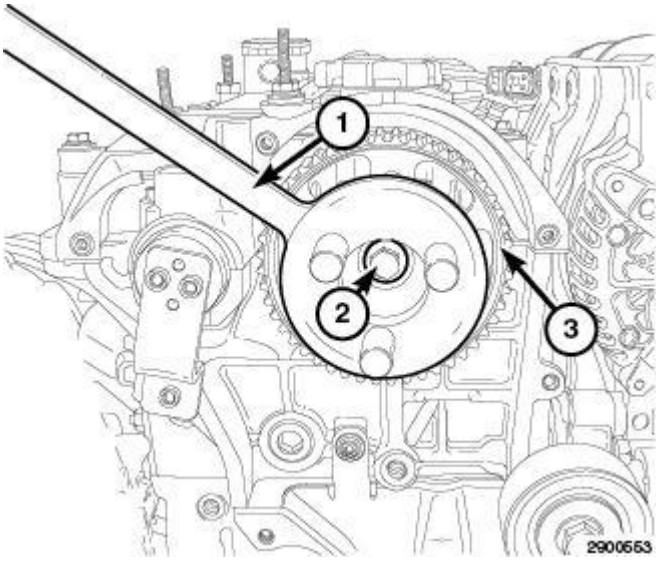

Fig. 342: Locking Tool, Camshaft Sprocket & Bolt
Courtesy of CHRYSLER GROUP, LLC

3. Using (special tool #VM.1055, Locking Tool) (1) to hold the intake camshaft sprocket, remove the bolt.

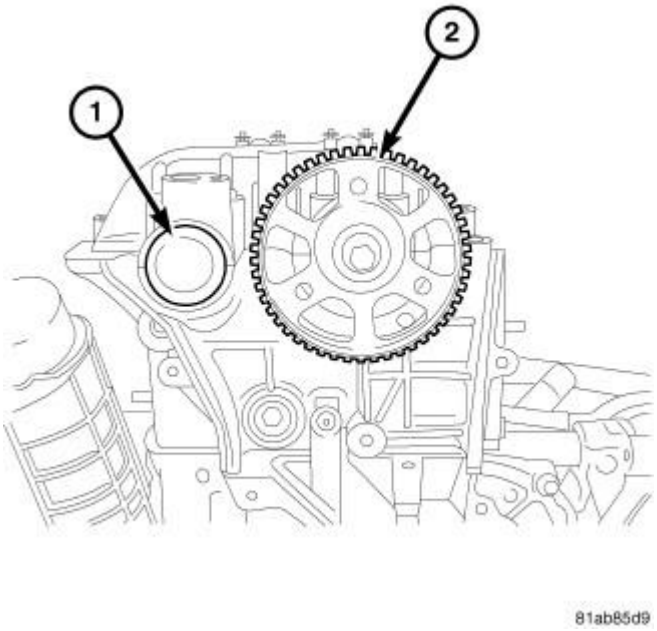

Fig. 343: Intake Camshaft Sprocket
Courtesy of CHRYSLER GROUP, LLC

4. Remove the camshaft sprocket (2).

INSTALLATION

CRANKSHAFT SPROCKET

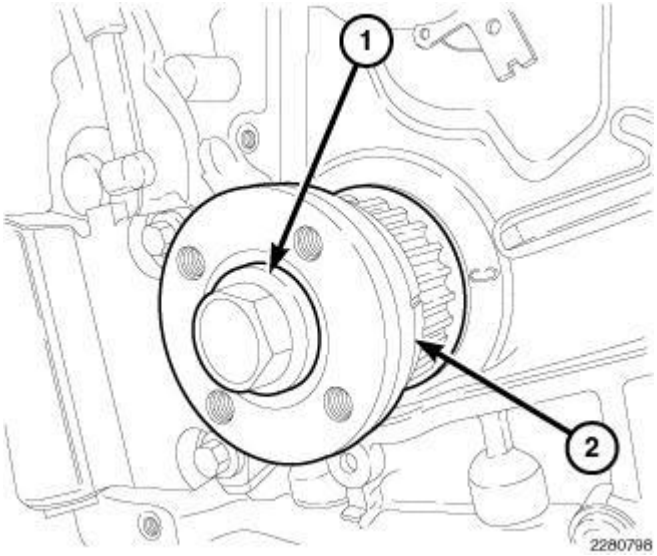

Fig. 344: Crankshaft Timing Belt Sprocket & Bolt
Courtesy of CHRYSLER GROUP, LLC

NOTE: The crankshaft sprocket bolt is a left handed thread.

1. Install the crankshaft sprocket (2). Tighten bolt to 100 N.m (74 ft. lbs.) plus an additional 120 degrees.
2. Install the timing belt. Refer to **BELT, TIMING, INSTALLATION**.
3. Connect the negative battery cable.

CAMSHAFT SPROCKET

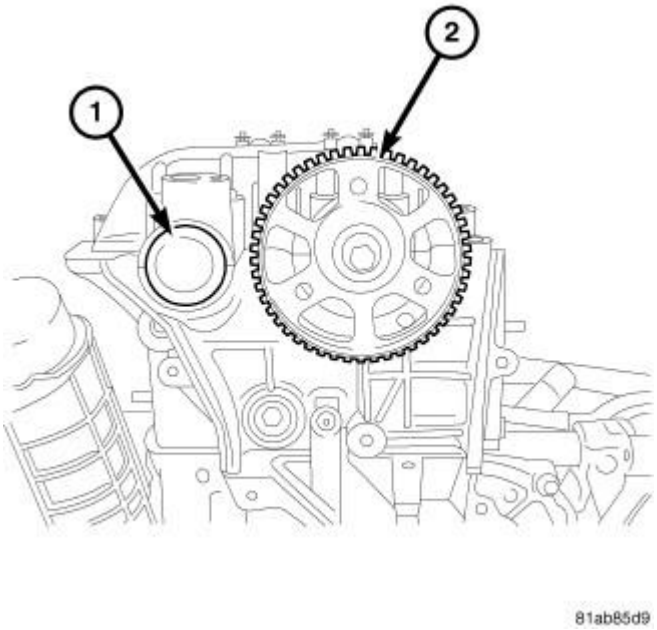

Fig. 345: Intake Camshaft Sprocket
Courtesy of CHRYSLER GROUP, LLC

1. Install the camshaft sprocket (2) and tighten bolt finger tight.

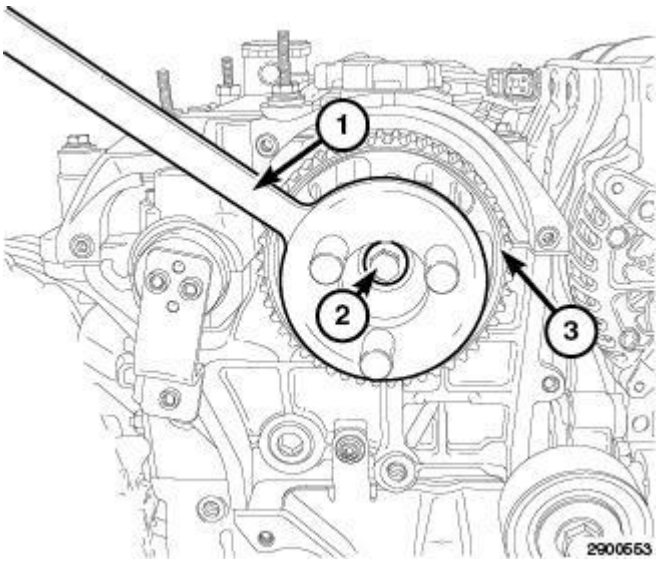

Fig. 346: Locking Tool, Camshaft Sprocket & Bolt
Courtesy of CHRYSLER GROUP, LLC

2. Using (special tool #VM.1055, Locking Tool) to hold the camshaft sprocket, tighten the camshaft sprocket (2) bolt to 64 N.m (47 ft. lbs.).
3. Install the timing belt. Refer to **SPROCKET(S), TIMING BELT AND CHAIN, INSTALLATION**.
4. Connect the negative battery cable.

TENSIONER, ENGINE TIMING

ADJUSTMENTS

ADJUSTMENTS

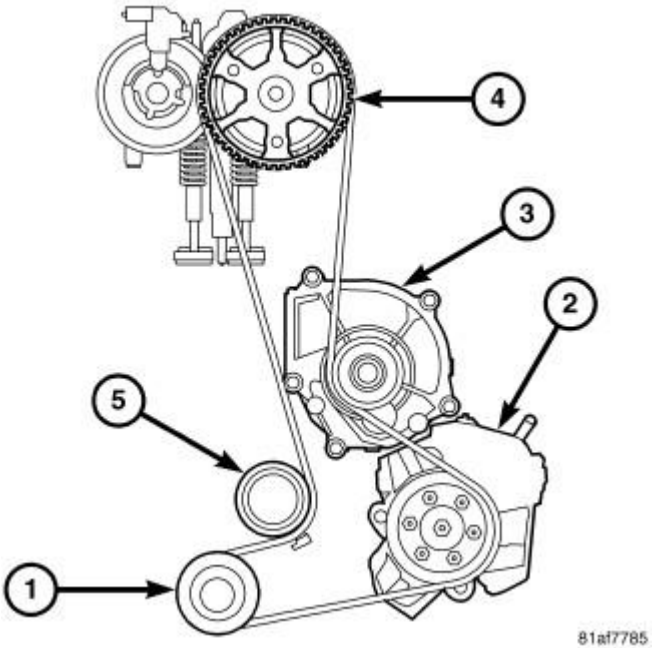

Fig. 347: Timing Belt Routing
Courtesy of CHRYSLER GROUP, LLC

1. With the upper and lower front covers removed and the timing belt installed, loosen timing belt tensioner.

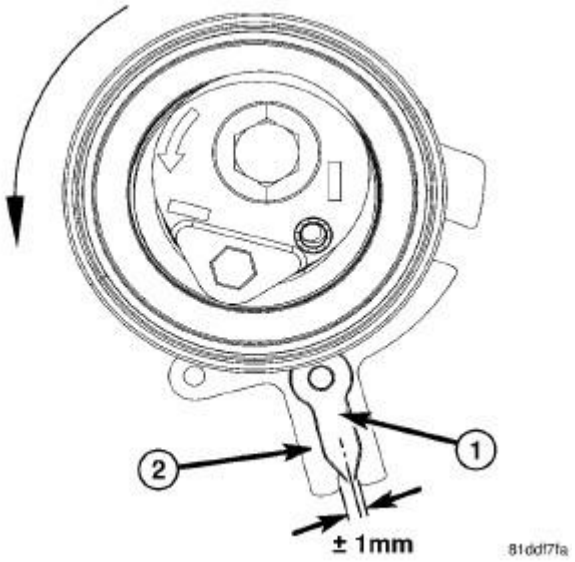

Fig. 348: Tensioner Indicator & Tensioner Gage Slot
Courtesy of CHRYSLER GROUP, LLC

NOTE: Turning the belt tensioner counter clockwise moves the pointer in a clockwise direction. Also, if the tensioner bolt is too loose this will cause the tensioner alignment slot to jump off the alignment boss on timing cover.

2. Adjust timing belt tensioner by lining up the load indicator arrow (1) to the center of the tensioner load gage (2) as illustrated. Tighten the timing belt tensioner bolt to 28 N.m (21 ft. lbs.).

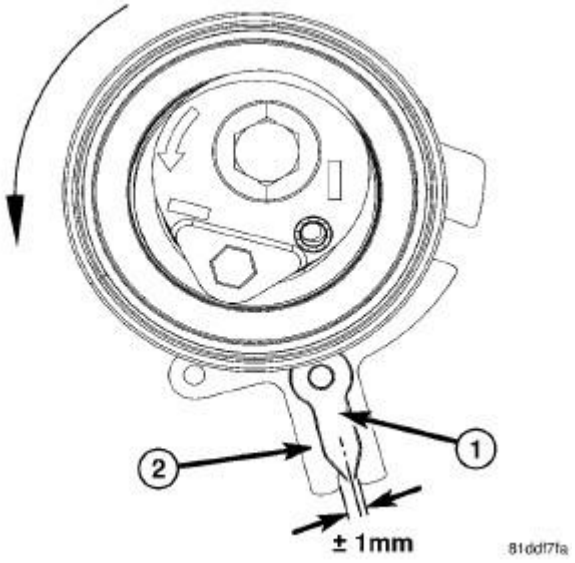

Fig. 349: Tensioner Indicator & Tensioner Gage Slot
Courtesy of CHRYSLER GROUP, LLC

3. Rotate engine 2 complete revolutions and then recheck tensioner alignment. Verify that the tension indicator (1) is centered in the slot on the tensioner gage (2) slot as shown in illustration. Readjust tensioner alignment as necessary.

REMOVAL

REMOVAL

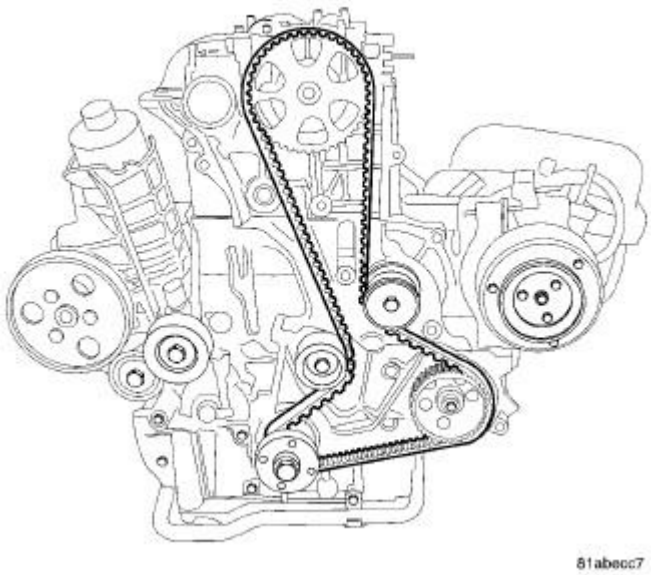

Fig. 350: Timing Belt
Courtesy of CHRYSLER GROUP, LLC

1. Disconnect the negative battery cable.
2. Remove the timing belt. Refer to **BELT, TIMING, REMOVAL**.

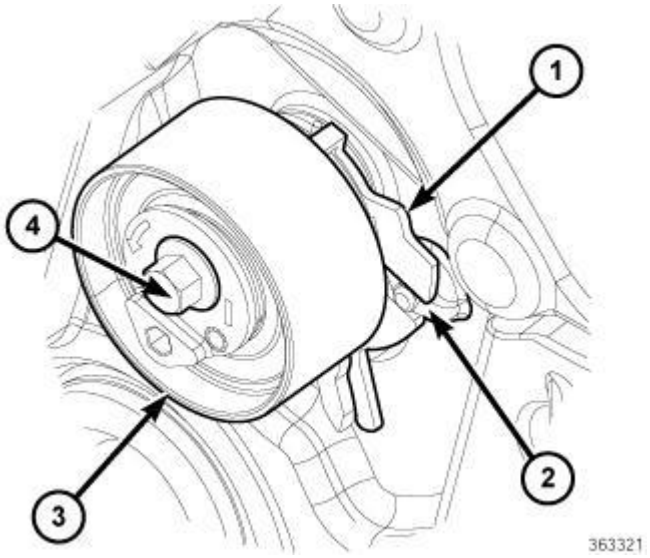

Fig. 351: Tensioner Alignment Plate, Boss, Timing Belt Tensioner & Bolt
Courtesy of CHRYSLER GROUP, LLC

3. Remove bolt (4), and timing belt tensioner (3).

INSTALLATION

INSTALLATION

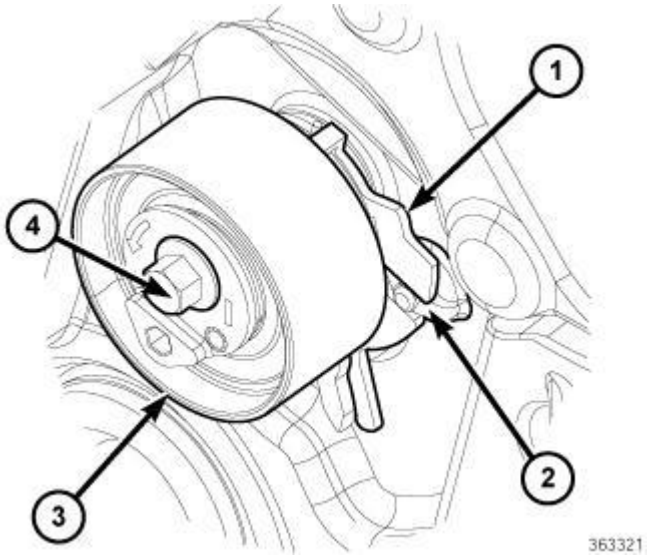

Fig. 352: Tensioner Alignment Plate, Boss, Timing Belt Tensioner & Bolt
Courtesy of CHRYSLER GROUP, LLC

1. Install the timing belt tensioner (3). Do not tighten bolt (4) at this time. Verify that the slot in the tensioner alignment plate (1) is aligned with the boss (2) in the rear timing belt cover.

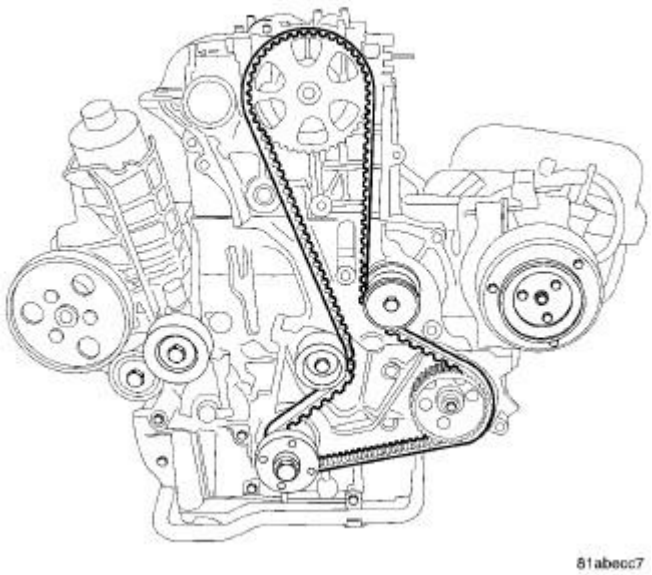

Fig. 353: Timing Belt
Courtesy of CHRYSLER GROUP, LLC

NOTE: DO NOT remove the timing belt from the package until it is going to be installed. DO NOT expose timing belt to oil, grease or water contamination. DO NOT crimp belt at a sharp angle. DO NOT clean belt, pulleys or tensioner with solvent. Check that pulleys and bearings are not seized or damaged before installing belt.

2. Install the timing belt. Refer to **BELT, TIMING, INSTALLATION**.
3. Connect the negative battery cable.

AIR INTAKE SYSTEM

AIR CLEANER

REMOVAL

REMOVAL

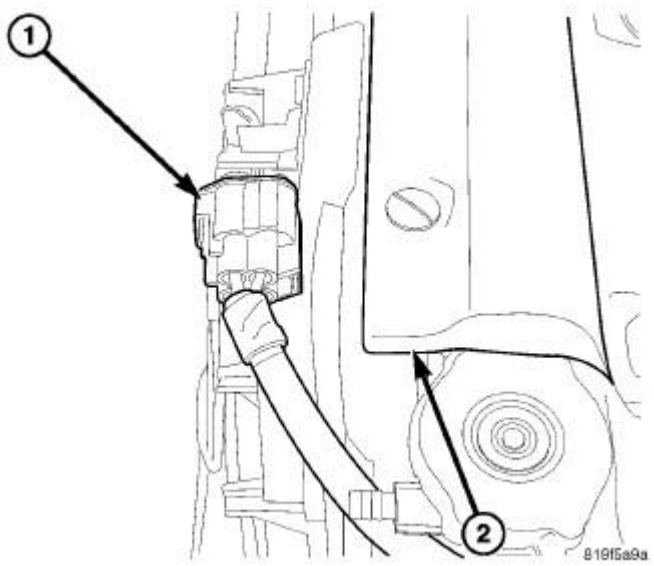

Fig. 354: Radiator Fan Electrical Connector & Upper Radiator Seal
Courtesy of CHRYSLER GROUP, LLC

1 - ELECTRICAL CONNECTOR
2 - UPPER RADIATOR SEAL

1. Disconnect the cooling fan harness connector (1).

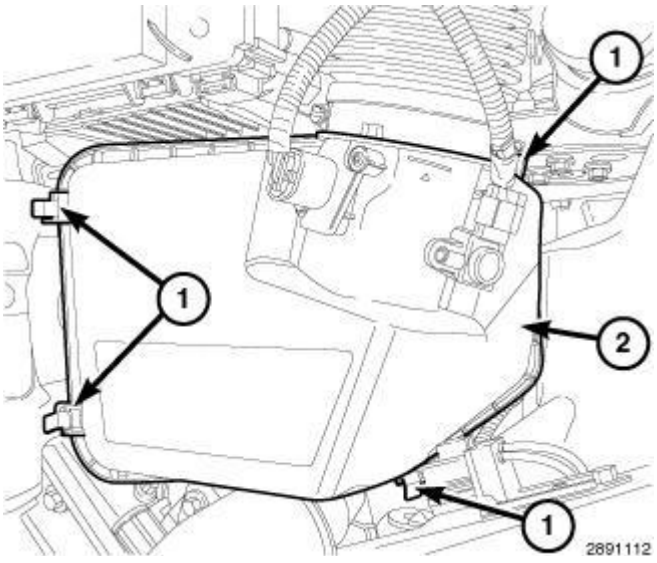

Fig. 355: Lock Tabs & Housing Cover
Courtesy of CHRYSLER GROUP, LLC

2. Release the four lock tabs (1) and remove the housing cover (2).

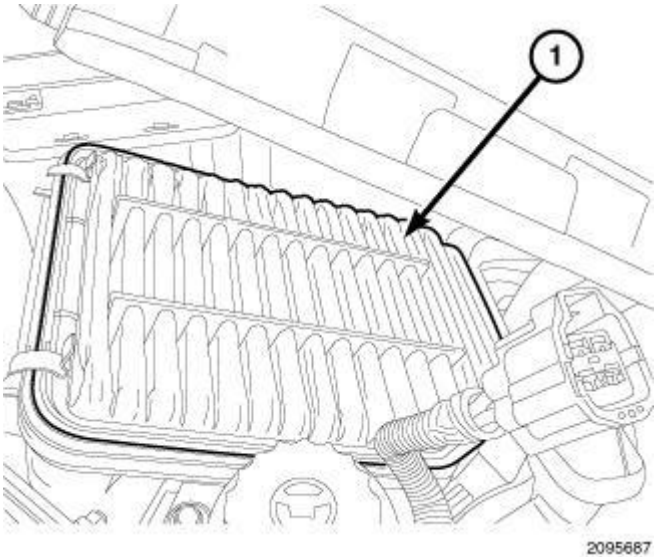

Fig. 356: Housing Cover For Filter Element
Courtesy of CHRYSLER GROUP, LLC

3. Remove the air filter element.
4. If necessary, clean the inside of the air cleaner housing.

INSTALLATION

INSTALLATION

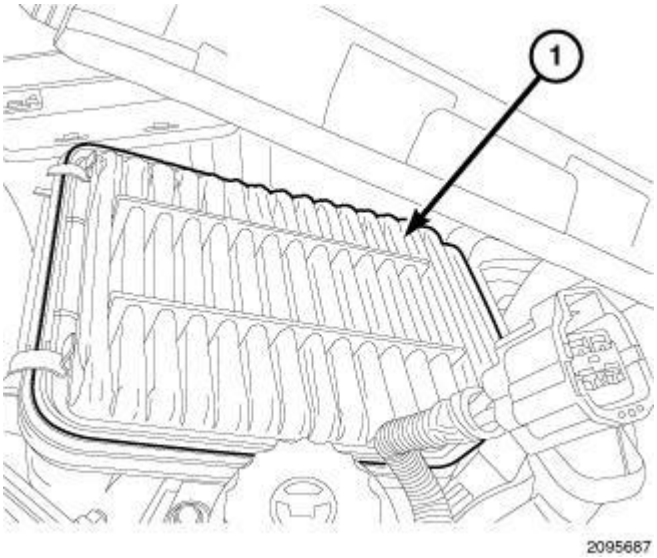

Fig. 357: Housing Cover For Filter Element
Courtesy of CHRYSLER GROUP, LLC

1. Install new air filter element (1).

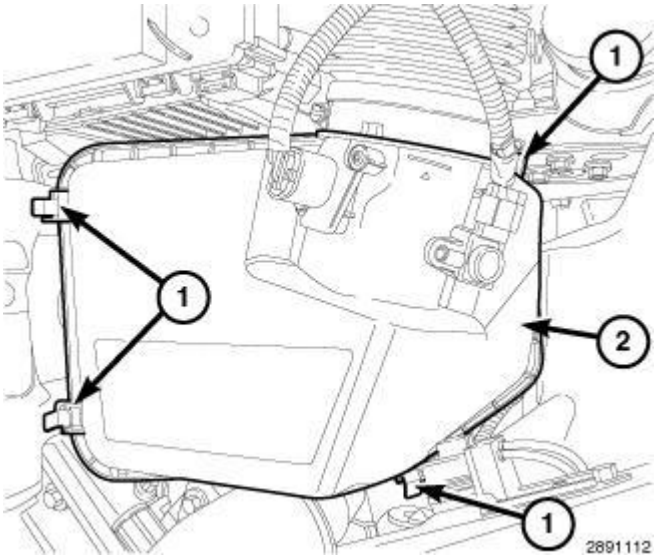

Fig. 358: Lock Tabs & Housing Cover
Courtesy of CHRYSLER GROUP, LLC

2. Install housing cover (2) and the four snap lock tabs (1) in place.

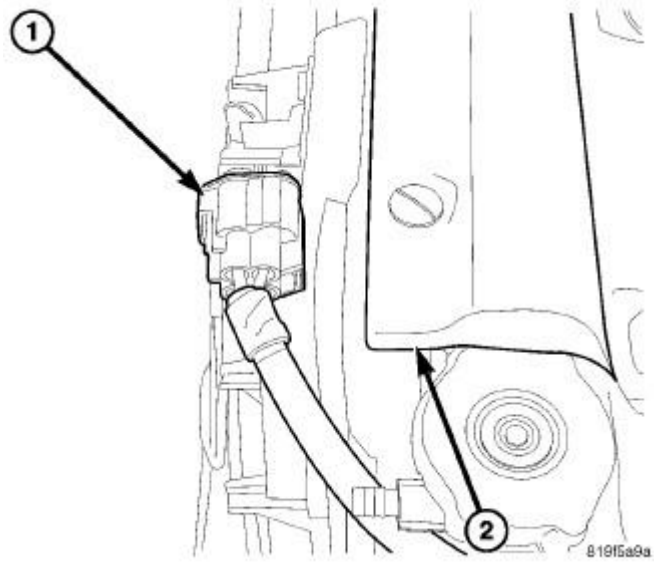

Fig. 359: Radiator Fan Electrical Connector & Upper Radiator Seal
Courtesy of CHRYSLER GROUP, LLC

1 - ELECTRICAL CONNECTOR
2 - UPPER RADIATOR SEAL

3. Connect the cooling fan electrical connector (1).

BODY, AIR CLEANER

REMOVAL

REMOVAL

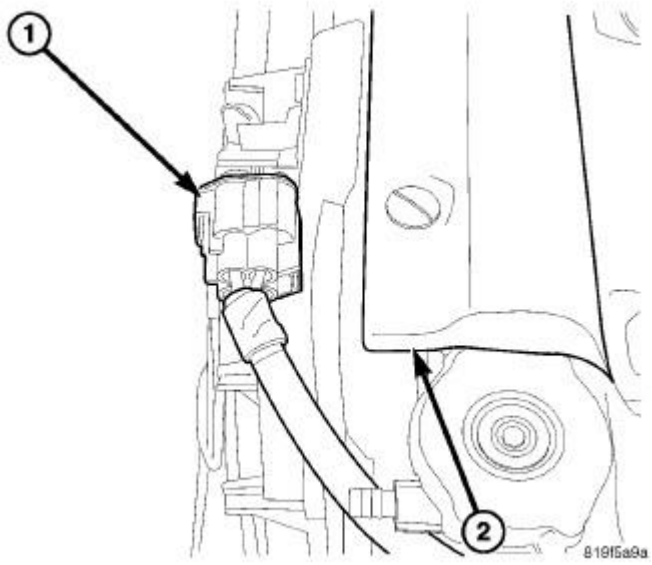

Fig. 360: Radiator Fan Electrical Connector & Upper Radiator Seal
Courtesy of CHRYSLER GROUP, LLC

1 - ELECTRICAL CONNECTOR
2 - UPPER RADIATOR SEAL

1. Disconnect the cooling fan electrical connector (1).

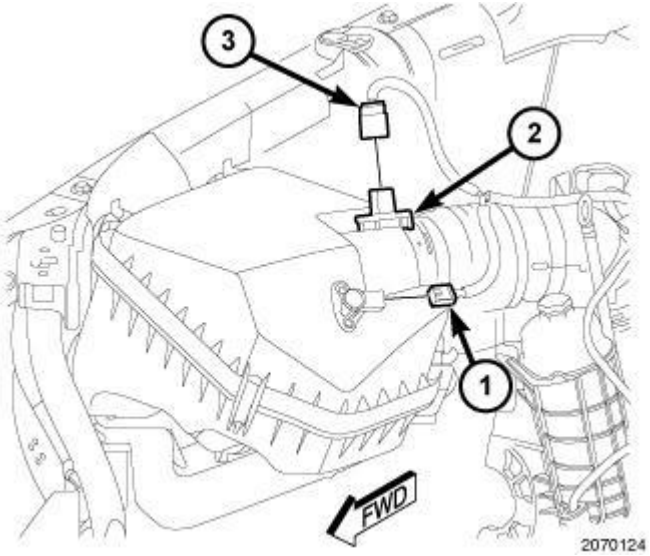

Fig. 361: Cooling Fan Electrical Connector, Air Cleaner Housing & MAF Sensor
Courtesy of CHRYSLER GROUP, LLC

2. Loosen worm clamp and remove the air cleaner outlet tube from air cleaner housing (2).
3. Disconnect the IAT sensor (1).
4. Release the lock tab and disconnect the MAF sensor (3).

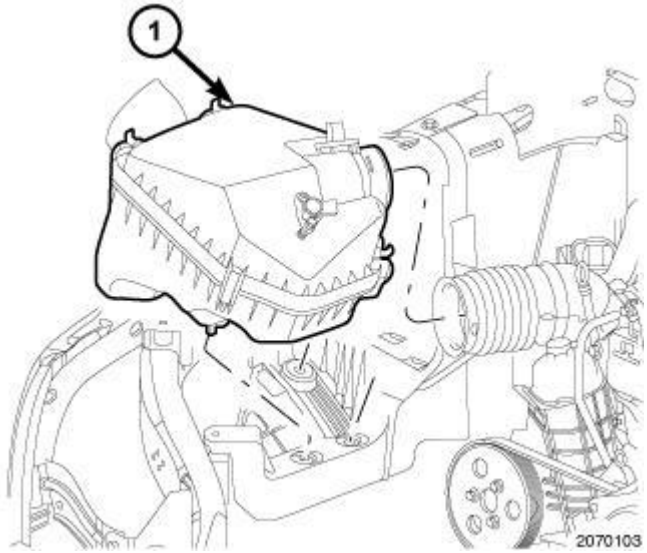

Fig. 362: Air Cleaner Assembly
Courtesy of CHRYSLER GROUP, LLC

5. To remove the air cleaner assembly, first lift up on air cleaner body to release the three tabs; then disconnect the inlet tube from housing and remove the air cleaner assembly.

INSTALLATION

INSTALLATION

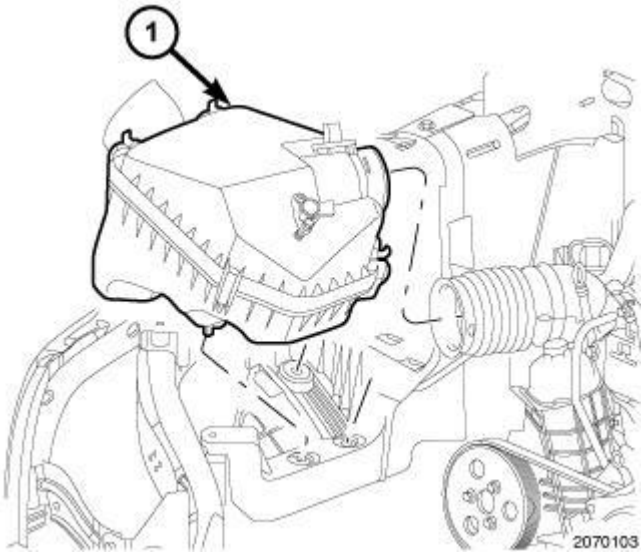

Fig. 363: Air Cleaner Assembly
Courtesy of CHRYSLER GROUP, LLC

1. Install the air cleaner assembly (1) and connect the inlet tube.

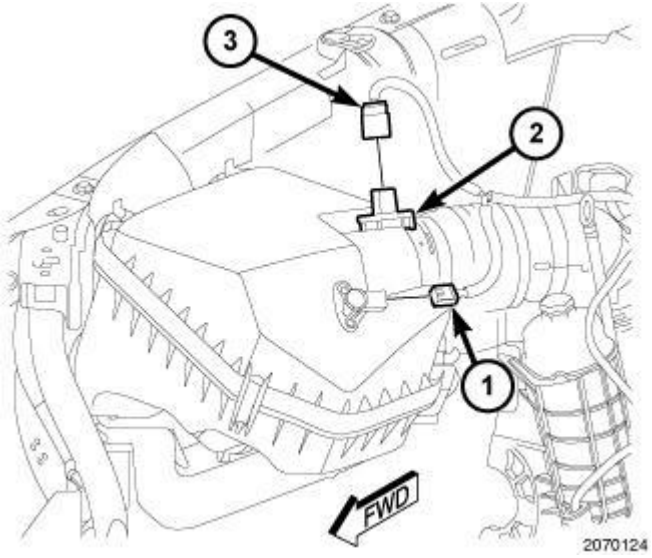

Fig. 364: Cooling Fan Electrical Connector, Air Cleaner Housing & MAF Sensor
Courtesy of CHRYSLER GROUP, LLC

2. Connect the MAF sensor (3).
3. Connect the IAT sensor (1).
4. Install the air cleaner outlet tube and tighten the worm clamp (2).

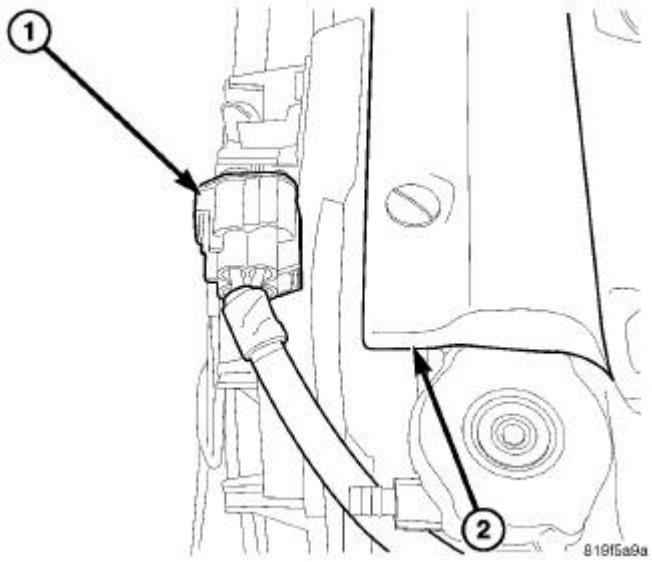

Fig. 365: Radiator Fan Electrical Connector & Upper Radiator Seal
Courtesy of CHRYSLER GROUP, LLC

1 - ELECTRICAL CONNECTOR
2 - UPPER RADIATOR SEAL

5. Connect the cooling fan electrical connector (1).

