# ENGINE

## TABLE OF CONTENTS

# ENGINE 2.5L/2.8 TURBO DIESEL

## DESCRIPTION

### DESCRIPTION - 2.5L/2.8L COMMON RAIL DIESEL ENGINE

The 2.5 Liter (2499cc) and 2.8L (2776cc) four-cylinder “common rail” direct injection engines are very similar in design and operability with a few differences. The 2.5L is the engine of choice for the manual transmission and the 2.8L for the automatic transmission. Both 4 cylinder “common rail” direct injection engines are an in-line overhead valve design. The engines utilize a cast iron cylinder block and an aluminum cylinder head with four valves per cylinder and dual overhead cam shafts. Both engines are turbocharged and intercooled. Differences include a longer crankshaft gear, larger cylinder bore and larger intake ducts in the cylinder head of the 2.8L. (Fig. 1).

| DESCRIPTION | SPECIFICATION |
|---|---|
| Displacement 2.5L | 2.5L (2499 cc) |
| Displacement 2.8L | 2.8L (2776cc) |
| Bore - 2.5L | 92.00 mm |
| Bore - 2.8L | 94.00 mm |
| Stroke 2.5L | 94.00 mm |
| Stroke 2.8L | 100.00 mm |
| Compression Ratio | 17.5:1 |
| Vacuum at Idle | 700 mm/Hg (27.5 In/Hg) |
| Belt Tension | Automatic Belt Tensioner |
| Thermostat Opening | 80°C ± 2°C |
| Generator Rating | Denso 12V-95A |
| Cooling System Capacity | 13.8 Liters W/O Auxiliary Heater<br>16.6 Liters With Auxiliary Heater |
| Engine Oil Capacity | 6.0L W/Filter Change |
| Timing System | Belt Driven Overhead Camshafts |
| Air Intake | Dry Filter With Turbocharger and Charge Air Cooler |
| Fuel Supply | Vane Pump Incorporated In Injection Pump |
| Fuel System | Direct Fuel Injection Common Rail System |

| DESCRIPTION | SPECIFICATION |
|---|---|
| Combustion Cycle | 4 Stroke |
| Cylinder Compression Difference Between Cylinders | 5 Bar |
| Cooling System | Water Cooling |
| Injection Pump | Common Rail System |
| Lubrication | Pressure Lubricated By Rotary Pump |
| Minimum Oil Pressure (Warm) | 0.7 Bar at Idle<br>2 Bar at 3800 rpm |
| Engine Rotation | Clockwise Viewed From Front Cover |
| Transmission 2.5L | MTX |
| Transmission 2.8L | ATX |

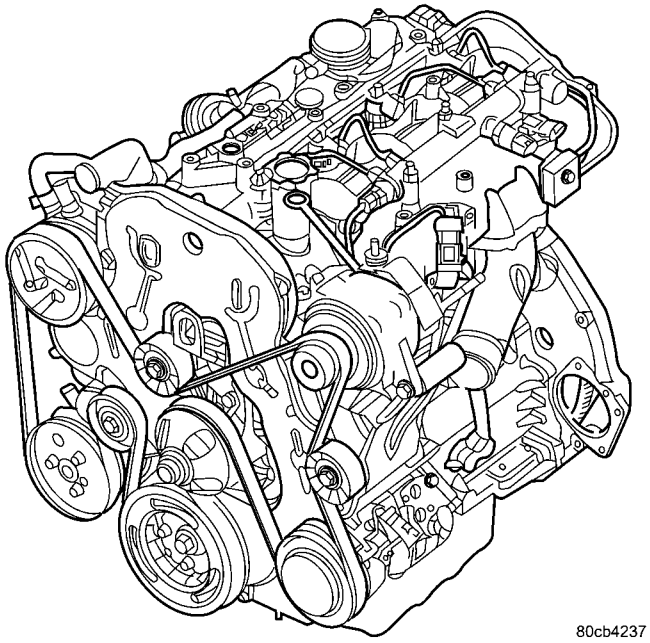



***Fig. 1 2.5L/2.8L COMMON RAIL DIESEL ENGINE***

### DESCRIPTION - ENGINE COVER

The engine cover is a black plastic cover used to cover the top of the engine (Fig. 10). It is used to isolate engine noises.

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

## REMOVAL

### REMOVAL - 2.5L/2.8L DIESEL ENGINE

(1) Disconnect negative battery cable.

(2) Remove engine cover (Fig. 2). (Refer to 9 - ENGINE - REMOVAL)

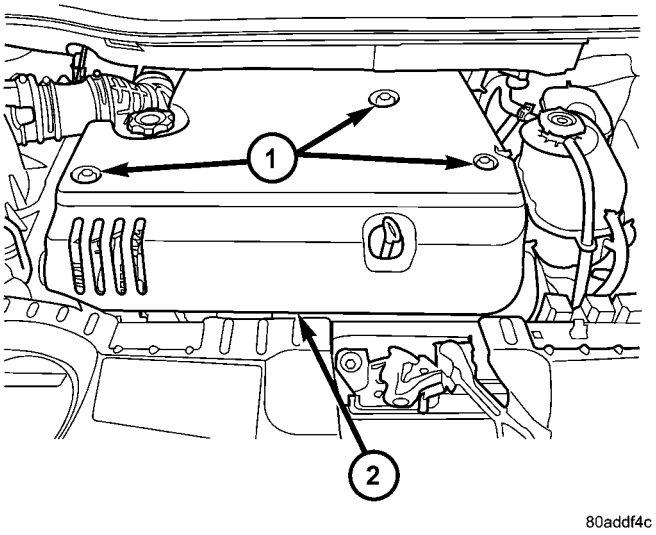



***Fig. 2 ENGINE COVER***

1 - ENGINE COVER MOUNTING BOLTS
2 - ENGINE COVER

(3) Remove air cleaner housing, MAF sensor, and air intake tube assembly (Fig. 3).

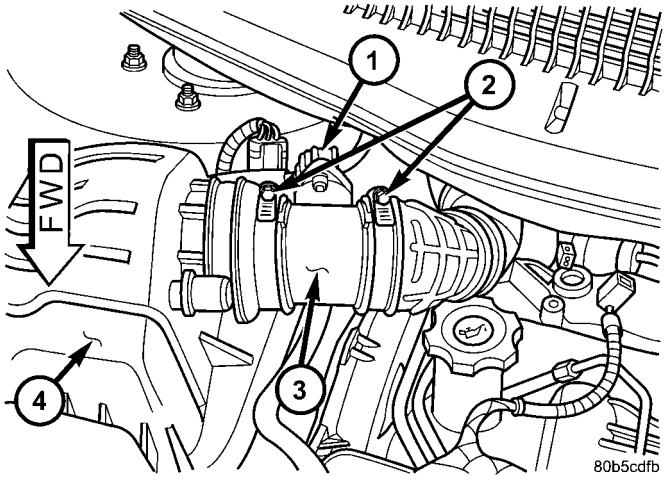



***Fig. 3 MASS AIR FLOW (MAF) SENSOR LOCATION***

1 - MAF SENSOR ELECTRICAL CONNECTOR
2 - RETAINING CLAMPS
3 - MASS AIR FLOW (MAF) SENSOR
4 - AIR CLEANER HOUSING

(4) Remove coolant pressure tank pressure cap.

(5) Raise vehicle on hoist.

(6) Drain cooling system (Refer to 7 - COOLING/ ENGINE/COOLANT - STANDARD PROCEDURE).

(7) Remove lower splash shield.

(8) Remove splash shield side panels.

(9) Remove power steering reservoir hose from power steering pump and drain power steering fluid (Fig. 4).

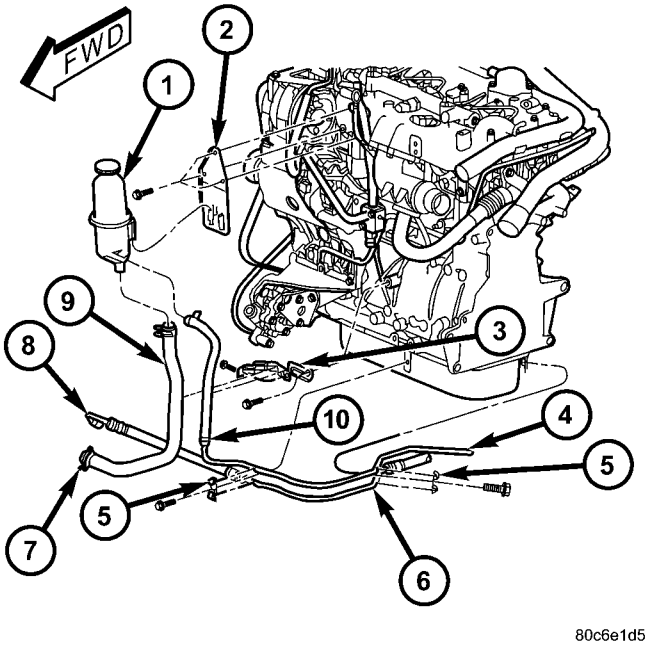



***Fig. 4 RESERVOIR AND HOSES - 2.5L DIESEL***

1 - POWER STEERING FLUID RESERVOIR
2 - RESERVOIR BRACKET
3 - SUPPLY HOSE BRACKET
4 - RETURN HOSE FROM GEAR
5 - ROUTING CLIP
6 - PRESSURE HOSE TO GEAR
7 - SUPPLY HOSE (PUMP END)
8 - PRESSURE HOSE (PUMP END)
9 - SUPPLY HOSE
10 - RETURN HOSE

(10) Disconnect high pressure power steering line at pump (Fig. 4).

(11) Disconnect power steering pump return hose clamp (Fig. 4).

(12) Remove power steering return line retaining clamp (Fig. 4).

(13) Remove power steering line clamps from oil pan (Fig. 4).

(14) Remove power steering pump reservoir and bracket (Fig. 4).

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

(15) Drain coolant system (Refer to 7 - COOLING/ ENGINE/COOLANT - STANDARD PROCEDURE).

(16) Remove coolant pressure tank (Fig. 5).

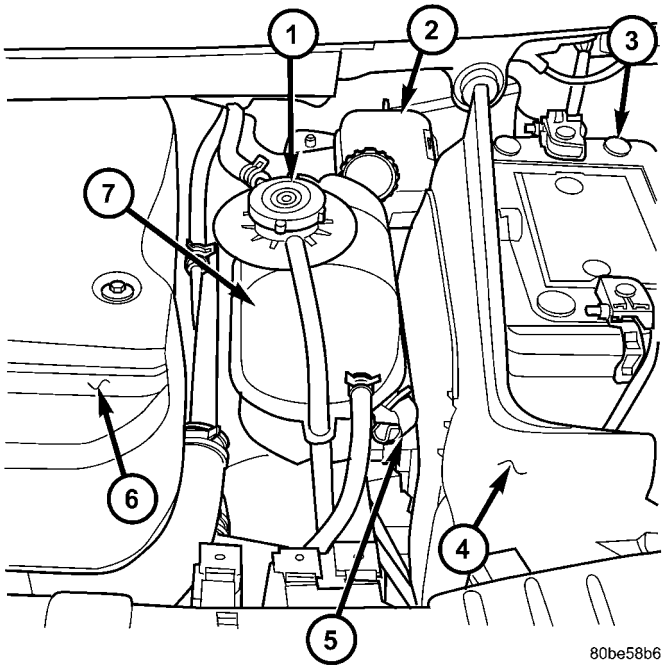



***Fig. 5 COOLANT RECOVERY PRESSURE CONTAINER LOCATION***

1 - PRESSURE/VENT CAP
2 - BRAKE MASTER CYLINDER
3 - BATTERY
4 - BATTERY SHIELD
5 - COOLANT RECOVERY PRESSURE CONTAINER RETAING CLIP
6 - ENGINE COVER
7 - COOLANT RECOVERY PRESSURE CONTAINER

(17) Remove battery shield.

(18) Remove charge air cooler outlet hose.

(19) Remove charge air cooler inlet hose (Fig. 6).

(20) Disconnect upper radiator hose at engine (Fig. 7).

(21) Disconnect lower radiator hose at engine (Fig. 7).

(22) Disconnect brake booster vacuum supply hose.

(23) Disconnect heater core return hose at engine.

(24) Disconnect EGR solenoid vacuum line at brake booster check valve.

(25) Disconnect fuel injector, cam sensor, boost pressure/intake air temperature sensor, fuel rail high pressure, and EGR solenoid connectors (Fig. 8).

(26) Disconnect generator electrical connectors.

(27) Disconnect coolant temperature sensor and glow plug electrical connectors.

(28) Disconnect high pressure injection pump and A/C compressor electrical connectors.

(29) Disconnect starter electrical connectors.

(30) Disconnect ground wires at engine block.

(31) Raise vehicle on hoist.

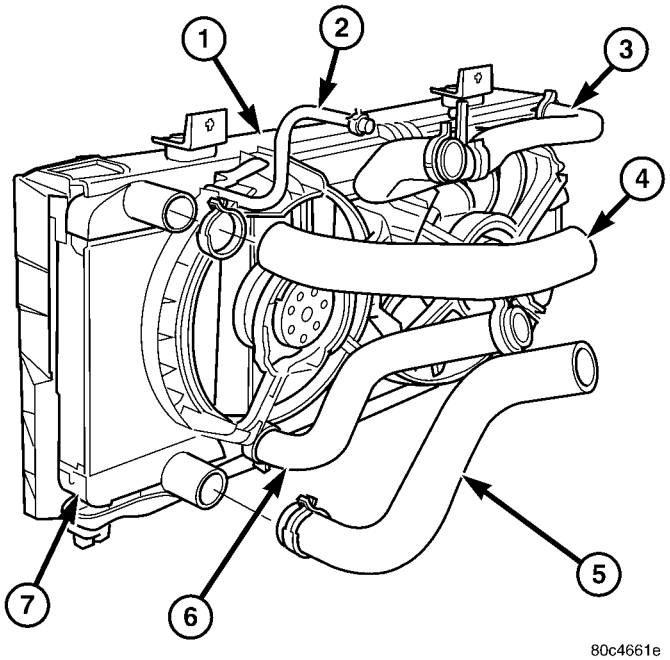



***Fig. 6 CHARGE AIR COOLER HOSES***

1 - COOLING MODULE
2 - BYPASS HOSE
3 - UPPER RADIATOR HOSE
4 - CHARGE AIR COOLER OULET HOSE
5 - CHARGE AIR COOLER INLET HOSE
6 - LOWER RADIATOR HOSE
7 - CHARGE AIR COOLER

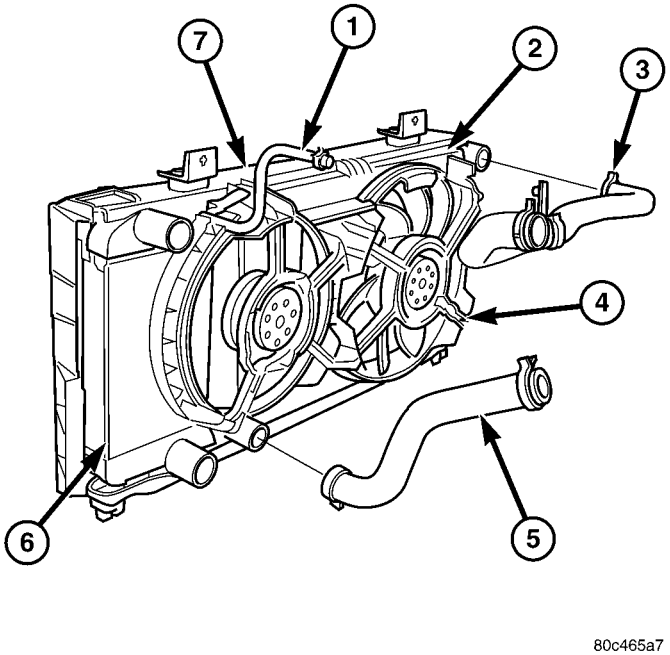



***Fig. 7 UPPER AND LOWER RADIATOR HOSES***

1 - COOLANT BYPASS HOSE
2 - RADIATOR ASSEMBLY
3 - UPPER RADIATOR HOSE
4 - COOLING FAN
5 - LOWER RADIATOR HOSE
6 - CHARGE AIR COOLER
7 - RADIATOR BRACKET

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

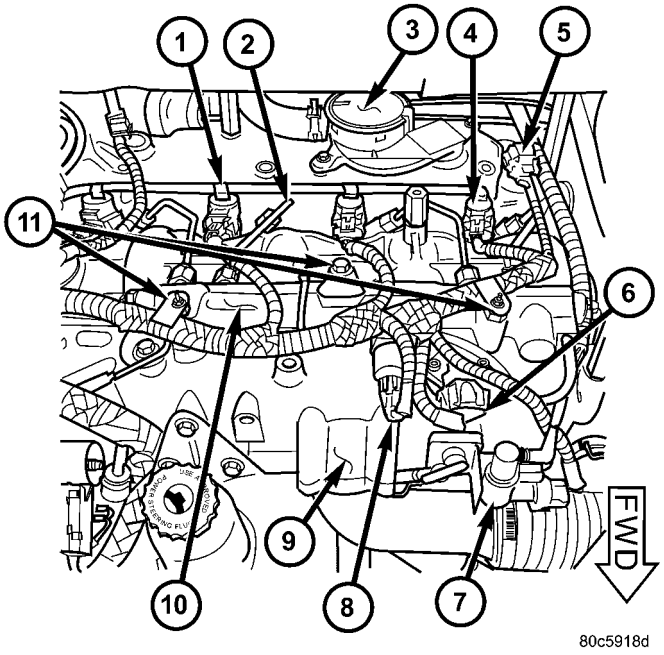



***Fig. 8 ENGINE COMPONENT LOCATIONS***

1 - FUEL INJECTOR RETURN LINE
2 - FUEL INJECTOR SUPPLY LINE
3 - OIL SEPARATOR
4 - FUEL INJECTOR
5 - CAMSHAFT POSITION SENSOR
6 - BOOST PRESSURE/INTAKE AIR TEMPERATURE SENSOR
7 - EGR SOLENOID
8 - FUEL PRESSURE SENSOR
9 - CYLINDER HEAD COVER/INTAKE MANIFOL
10 - FUEL RAIL
11 - WIRING HARNESS RETAINING CLIPS

(32) Disconnect oil pressure switch, engine speed sensor, and vehicle speed sensor electrical connector (Fig. 9).

(33) Raise and support vehicle.

(34) Remove front wheels.

(35) Remove the suspension cradle assembly (Refer to 13 - FRAME & BUMPERS/FRAME/ENGINE CRADLE CROSSMEMBER - REMOVAL).

(36) Remove both axle shaft assemblies (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT - REMOVAL).

(37) Disconnect the clutch slave cylinder quick disconnect line (RHD only)(Refer to 6 - CLUTCH/SLAVE CYLINDER - REMOVAL).

(38) Disconnect reverse lamp connector.

(39) Disconnect shifter cables at the transmission (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL/GEAR SHIFT CABLE - REMOVAL).

(40) Disconnect exhaust pipe from the turbocharger downpipe and reposition to right side of vehicle.

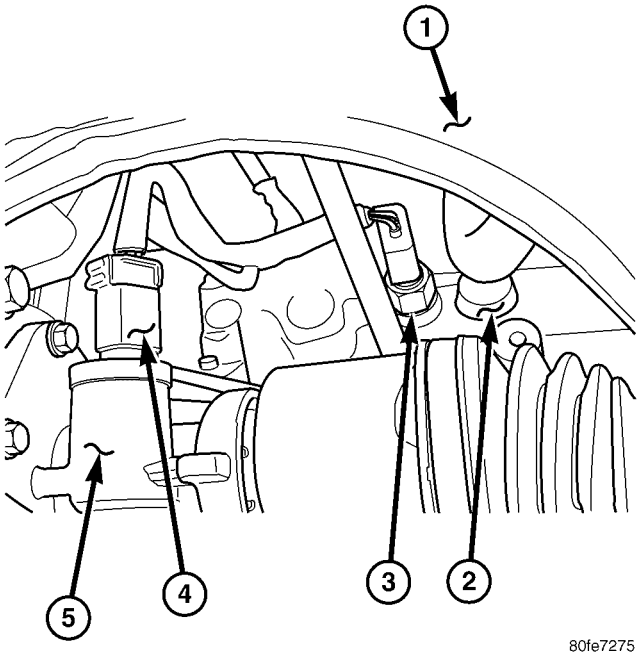



***Fig. 9 VIEW-REAR ENGINE***

1 - SUSPENSION CRADLE
2 - ENGINE BLOCK
3 - OIL PRESSURE SWITCH
4 - VEHICLE SPEED SENSOR
5 - TRANSMISSION

(41) Disconnect cabin heater coolant line (Refer to 24 - HEATING & AIR CONDITIONING/CABIN HEATER/HEATER UNIT - REMOVAL).

(42) Remove front engine mount bracket retaining bolts from lower radiator support

(43) Lower vehicle. Evacuate the A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).

(44) Disconnect the A/C lines at the A/C compressor.

(45) Raise and support vehicle.

(46) Disconnect the fuel supply and return lines.

(47) Position engine cradle under engine and lower vehicle over cradle.

(48) Remove right engine mount bolts.

(49) Remove left engine mount through bolt.

(50) Carefully raise vehicle, leaving engine and transmission on engine cradle.

(51) Lift engine from engine cradle and dissemble as necessary.

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

## REMOVAL - ENGINE COVER

(1) Remove engine cover retaining bolts.
(2) Remove engine cover from engine (Fig. 10).

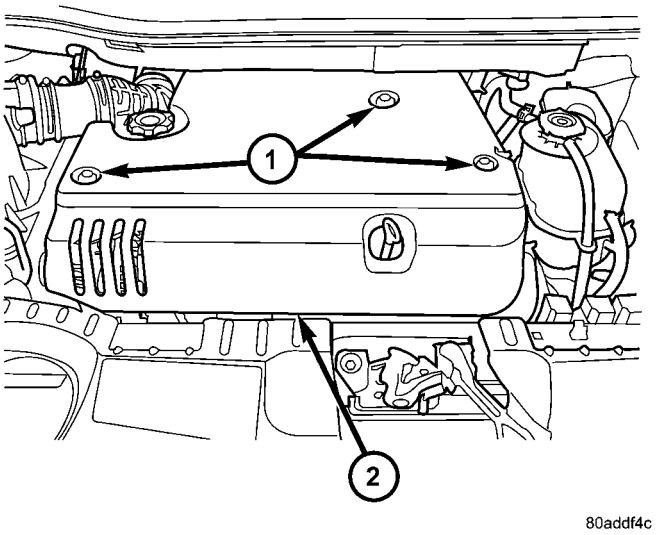



***Fig. 10 ENGINE COVER***

1 - ENGINE COVER MOUNTING BOLTS
2 - ENGINE COVER

# INSTALLATION

## INSTALLATION - 2.5L TURBO DIESEL ENGINE

(1) Reassembly engine and transmission assembly and install on engine cradle.
(2) Position engine and cradle assembly under vehicle.
(3) Slowly lower the vehicle down over the engine and cradle assembly.
(4) Install right engine mount bolts. Torque to 54N·m (40 ft. lbs.)
(5) Install left engine mount through bolt. Torque to 75N·m (55 ft. lbs.)
(6) Raise vehicle and engine from engine cradle.
(7) Attach front engine mount bracket to lower radiator support. Torque to 54N·m (40 ft. lbs.)
(8) Connect cabin heater coolant hose.
(9) Connect exhaust pipe to the turbocharger downpipe flange. Torque to 28 N·m (250 in. lbs.)
(10) Connect reverse lamp electrical connector at transmission.
(11) Connect both shifter cables (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL/GEAR SHIFT CABLE - INSTALLATION).
(12) Connect the clutch slave cylinder quick disconnect connector (RHD only)(Refer to 6 - CLUTCH/ SLAVE CYLINDER - INSTALLATION).
(13) Install engine harness into bracket on transmission.
(14) Lower vehicle.
(15) Connect fuel supply and return lines.
(16) Connect A/C lines to A/C compressor. Torque to 23N·m (17 ft. lbs.)
(17) Route engine wiring harnes to proper location.
(18) Connect engine harness ground cables to engine block
(19) Connect starter solenoid electrical connector and battery positive wire to starter. Torque to 10N·m (90 in. lbs.)
(20) Connect A/C compressor, injection pump, glow plugs, and coolant temperature sensor electrical connectors.
(21) Connect generator electrical connector. Torque to 9N·m (75 in. lbs.)
(22) Connect the fuel injector, fuel pressure sensor, boost pressure/intake air temp sensor, cam sensor, and EGR solenoid electrical connectors (Fig. 8).
(23) Connect EGR solenoid vacuum supply line to brake boost vacuum supply line.
(24) Connect brake booster vacuum supply line.
(25) Connect heater core return hose to coolant pipe.
(26) Connect lower radiator hose to engine (Fig. 7).
(27) Install charger air cooler inlet hose (Fig. 6).
(28) Install charge air cooler outlet hose (Fig. 6).
(29) Connect upper radiator hose to engine (Fig. 7).
(30) Install battery shield.
(31) Install coolant reserve pressure container (Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY PRESS CONTAINER - INSTALLATION).
(32) Install power steering reservoir and bracket (Fig. 4).
(33) Raise vehicle
(34) Connect oil pressure sensor, oil temperature sensor, engine speed sensor, and vehicle speed sensor electrical connector (Fig. 9).
(35) Install suspension cradle in vehicle (Refer to 13 - FRAME & BUMPERS/FRAME/ENGINE CRADLE CROSSMEMBER - INSTALLATION).
(36) Install both axle shaft assemblies (Refer to 3 - DIFFERENTIAL & DRIVELINE/HALF SHAFT - INSTALLATION).
(37) Connect the power steering supply, pressure, and return lines to power steering pump (Fig. 4).
(38) Install the power steering line brackets on oil pan (Fig. 4).

(39) Install lower splash shield and side panels.
(40) Install both front wheel and tire assemblies.
(41) Lower vehicle.
(42) Install air cleaner housing, MAF sensor, and air intake tube assembly (Fig. 3).
(43) Refill transmission to proper level (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL/FLUID - STANDARD PROCEDURE).
(44) Refill engine coolant (Refer to 7 - COOLING/ENGINE/COOLANT - STANDARD PROCEDURE).
(45) Fill engine crankcase to proper level, with correct viscosity engine oil.
(46) Connect negative battery cable.
(47) Recharge A/C system (Refer to 24 - HEATING & AIR CONDITIONING/PLUMBING/REFRIGERANT - STANDARD PROCEDURE).
Perform fuel system air purge procedure (Refer to 14 - FUEL SYSTEM - STANDARD PROCEDURE).
(48) Install engine cover (Refer to 9 - ENGINE - INSTALLATION) (Fig. 2).

## INSTALLATION - ENGINE COVER

(1) Install engine cover on engine.
(2) Install the engine cover mounting bolts (Fig. 10).

# SPECIFICATIONS

## SPECIFICATIONS - 2.5L COMMON RAIL DIESEL ENGINE

*GENERAL DESCRIPTION*

| DESCRIPTION | SPECIFICATION |
|---|---|
| Engine Type | R2516C5 |
| Transmission | MTX |
| Number of Cylinders | 4 |
| Bore | 92 mm |
| Stroke | 94 mm |
| Displacement | 2499.5cc |
| Injection Order | 1-3-4-2 |
| Compression Ratio | 17.5:1 (± 0.5) |
| Maximum Power | 105kW (143 HP) @ 4000 RPM |
| Peak Torque | 340N·m @ 2000 RPM |
| Cylinder Compression (Max. Difference Between Cylinders | 5 Bar |
| Minimum Oil Pressure (Warm) | .7 Bar @ Idle<br>2 Bar @ 3800 RPM |

*CRANKSHAFT*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Front Journal Diameter-Nominal | 62.985-63.005 mm | 2.479-2.480 in |
| Front Journal Diameter- minus 0.25 | 62.735-63.074 mm | 2.469-2.471 in. |
| Front Bearing Diameter-Nominal | 63.005-63.034 mm | 2.480-2.481 in. |
| Front Bearing Diameter-minus 0.25 | 62.775-62.784 mm | 2.470-2.471 in |
| Clearance Between the Journal and Bearing | 0.000-0.049 mm | 0.000-0.001 in. |
| Center Journal Diameter-Nominal | 63.005-63.020 mm | 0.001-0.003 in. |
| Center Journal Diameter-minus 0.25 | 62.775-62.770 mm | 2.470-2.471 |
| Center Bearing Diameter-Nominal | 63.005-63.020 mm | 2.480-2.481 in. |
| Center Bearing Diameter-minus 0.25 | 62.775-62.770 mm | 2.470-2.471 in. |
| Clearance Between Journal and Bearing | 0.008-0.051 mm | 0.0003-0.0002 in |
| Rear Journal Diameter-Nominal | 89.980-90.000 mm | 3.542-3.543 in |
| Rear Journal Diameter- minus 0.25 | 89.730-99.750 mm | 3.532-3.927 in. |
| Rear Bearing Diameter-Nominal | 90.045-90.065 mm | 3.545-3.546 in. |
| Rear Bearing Diameter- minus 0.25 | 89.795-89.815 mm | 3.535-3.536 in. |

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Clearance Between Journal and Bearing | 0.045-0.080 mm | 0.001-0.003 in. |
| Connecting Rod Journal-Nominal | 53.940-53.955 mm | 2.123-2.124 in. |
| Connecting Rod Journal- minus 0.25 | 53.690-53.705 mm | 2.113-2.114 in. |
| Connecting Rod Bearing-Nominal | 53.997-54.016 mm | 2.125-2.126 in. |
| Connecting Rod Bearing- minus 0.25 | 53.727-53.766 mm | 2.115-2.116 in. |
| Clearance Between Journal and Bearing | 0.022-0.076 mm | 0.0008-0.0029 in. |
| Crankshaft End Play | 0.080-0.280 mm | 0.003-0.011 in. |
| Adjustment | Thrust Washers | Thrust Washers |
| Thrust Washers Available | 2.31-2.36 mm | 0.090-0.092 in. |
| | 2.41-2.46 mm | 0.094-0.096 in. |
| | 2.51-2.56 mm | 0.098-0.100 |
| Carrier with Thrush Washers Installed | 27.670-27.820 mm | 1.089-1.095 in. |

*MAIL BEARING CARRIERS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Internal Diameter-Front | 67.025-67.050 mm | 2.638-2.639 in. |
| Internal Diameter-Center | 66.670-66.690 mm | 2.624-2.624 in. |
| Internal Diameter-Rear | 85.985-86.005 mm | 3.385-3.386 in. |

*LINERS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Internal Diameter | 091.997-92.015 mm. | 3.621-3.622 in. |
| Protrusion | 0.00-0.05 mm | 0.00-0.001 in. |

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Available Adjustment Shims | 0.15 mm | 0.005 in. |
| | 0.17 mm | 0.006 in. |
| | 0.20 mm | 0.007 in. |
| | 0.23 mm | 0.009 |
| | 0.25 mm | 0.0098 |

*CYLINDER HEAD*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Minimum Thickness | 94.95-95.05 mm. | 3.738-3.742 in. |
| Gasket Thickness | 1.32 mm ± 0.08, 0 notches | 0.0051 in. ± 0.003, 0 notches |
| | 1.42 mm ± 0.08, 1 notch | 0.051 in. ± 0.003, 1 notch |
| | 1.52 mm ± 0.08, 2 notches | 0.059 in. ± 0.003, 1 notches |

*CONNECTING RODS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Small end Bearing Internal Diameter | 32.035-32.050 mm | 1.2612-1.2618 in. |
| Large End Internal Diameter | 53.997-54.016 mm | 2.125-2.126 in. |

*PISTONS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Skirt Diameter (measured at approximately 10 mm above the bottom of the skirt) | 91.912-91.928 mm. | 3.618-3.619 in. |
| Piston Clearance | 0.065-0.83 mm | 0.002-0.003 in. |
| Top of Piston to Cylinder Head | 0.69-0.83 mm | 0.027-0.032 in. |

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Piston Protrusion | 0.460-0.609 mm Fit Gasket, Number (1.32mm), 0 notches or holes | 0.018-0.023 in. Fit Gasket, Number (0.051 in.), 0 notches |
| | 0.610-0.709 mm Fit Gasket, Number (1.42 mm) 1 notch or hole | 0.024-0.027 in. Fit Gasket, Number (0.055 in.) 1 notch or hole |
| | 0.710-0.810 mm Fit Gasket, Number (1.52 mm), 2 notches or holes | 0.027-0.031 in. Number (0.059 in) 2 notches or holes |

*PISTON PINS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Type | Full Floating | |
| Pin Diameter | 32.004-32.008 mm<br>32.004-32.010 mm | 1.2599-1.2601 in.<br>1.2599-1.2602 in. |
| Clearance | 0.010-0.020 mm<br>0.004-0.012 mm | 0.0001-0.0004 in.<br>0.0001-0.0004 in. |

*PISTON RINGS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| **Clearance in Groove** | | |
| Top Compression Ring | 0.078-0.137 mm | 0.003-0.005 in. |
| Second Compression Ring | 0.070-0.110 mm | 0.002-0.004 in. |
| Oil Control (Steel Rails) | 0.40-0.080 mm | 0.001 - 0.003 in. |
| **Fitted Gap** | | |
| Top Compression Ring | .030-0.45 mm | 0.011-0.017 in. |
| Second Compression Ring | 0.035 - 0.050 mm | 0.0013 - 0.0019 in. |
| Oil Ring (Steel Ring) | .025 - 0.50 mm | .0009 - .0019 in. |

*CAMSHAFT*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Journal Diameter-Front | 29.960-29.980 mm | 1.179-1.180 in. |
| Bearing Clearance | 0.03-0.08 mm | 0.0011-0.0031 in. |
| Journal Diameter-Center | 39.250-39.270 mm | 1.545-1.546 in. |
| Bearing Clearance | 0.03-0.08 mm | 0.001-0.003 in |
| Journal Diameter-Rear | 39.250-39.270 mm | 1.545-1.546 in. |
| Bearing Clearance | 0.03-0.08 mm | 0.001-0.003 in. |

*HYDRAULIC LIFTER*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Outside Diameter | 11.994 ± 0.006 mm | 0.472 ± 0.0002 in. |

*VALVES*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Face Angle-Intake | 45° 25'-55° 35' mm | - |
| Face Angle-Exhaust | 45° 25'-45° 35' mm | - |
| Intake Valve Opens | 15.6° ± 2° A.T.D.C. | - |
| Intake Valve Closes | 64.4° ± 2° A.B.D.C. | - |

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Exhaust Valve Opens | 66° ± 2° B.B.D.C. | - |
| Exhaust Valve Closes | 32° ± 2° A.T.D.C. | - |
| Head Diameter-Intake | 32.30-32.50 mm | 1.271-1.279 in. |
| Head Diameter-Exhaust | 30.80-31.00 mm | 1.212-1.220 in. |
| Head Stand Down-Intake | 1.08-1.34 mm | 0.042-0.052 in. |
| Head Stand Down-Exhaust | 0.99-1.25 mm | 0.038-0.049 in. |
| Stem Diameter-Intake | 5.952-5.970 mm | 0.234-0.235 in. |
| Stem Diameter-Exhaust | 5.942-5.960 mm | 0.233-0.234 in. |
| Clearance in Guide-Intake | 0.030-0.060 mm | 0.001-0.002 in. |
| Clearance in Guide-Exhaust | 0.040-0.070 mm | 0.001-0.002 in. |

*VALVE GUIDE*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Inside Diameter | 6.00-6.012 mm | 0.2362-0.2366 in. |
| Fitted Height-Intake | 14.5-15.0 mm | 0.570-0.590 in. |
| Fitted Height-Exhaust | 16.5-17.0 mm | 0.649-0.669 in. |

*VALVE SPRING*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Free Length | 45.26 mm | 1.781 in. |
| Fitted Length | 38.0 mm | 1.496 in. |
| Load at Fitted Length | 182 ± 5-10% Kg | - |
| Load at Top of Lift | 395 ± 5% Kg | - |
| Number of Coils | 8 | - |

*LUBRICATION*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Pressure Relief Valve Opens | 6.50 bar | 94 psi |
| Pressure Relief Valve Spring-Free Length | 51.5 mm | 2.02 in. |

*OIL PUMP*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Outer Rotor End Float | 0.060-0.160 mm | 0.002-0.006 in. |
| Inner Rotor End Float | 0.060-0.160 | 0.002-0.006 in. |
| Outer Rotor to Body Diameter Clearance | 0.130-0.240 mm | 0.005-0.009 in. |
| Rotor Body to Drive Gear Clearance (pump not fitted) | 0.90-1.50 mm | 0.035-0.059 in. |

## SPECIFICATIONS - 2.8L COMMON RAIL DIESEL ENGINE

*GENERAL DESCRIPTION*

| DESCRIPTION | SPECIFICATION |
|---|---|
| Engine Type | R2816C5.05A |
| Transmission | ATX |
| Number of Cylinders | 4 |
| Bore | 94 mm |
| Stroke | 100 mm |
| Displacement | 2776cc |
| Injection Order | 1-3-4-2 |
| Compression Ratio | 17.5:1 (± 0.5) |
| Maximum Power | 110kW (150 CV) @ 3800 RPM |
| Peak Torque | 360 N·m @ 1800 RPM |
| Cylinder Compression (Max. Difference Between Cylinders | 5 Bar |
| Minimum Oil Pressure (Warm) | .7 Bar @ Idle<br>2 Bar @ 3800 RPM |

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

*CRANKSHAFT*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Front Journal Diameter-Nominal | 62.985-63.005 mm | 2.479-2.480 in |
| Front Journal Diameter- minus 0.25 | 62.735-62.755 mm | 2.469-2.470 in. |
| Front Bearing Diameter-Nominal | 63.005-63.034 mm | 2.480-2.481 in. |
| Front Bearing Diameter-minus 0.25 | 62.755-62.784 mm | 2.471-2.478 in |
| Clearance Between the Journal and Bearing | 0.00-0.049 mm | 0.000-0.001 in. |
| Center Journal Diameter-Nominal | 63.005-63.020 mm | 0.001-0.003 in. |
| Center Journal Diameter-minus 0.25 | 62.775-62.770 mm | 2.470-2.471 |
| Center Bearing Diameter-Nominal | 63.005-63.020 mm | 2.480-2.481 in. |
| Center Bearing Diameter-minus 0.25 | 62.775-62.770 mm | 2.470-2.471 in. |
| Clearance Between Journal and Bearing | 0.008-0.051 mm | 0.0003-0.0002 in |
| Rear Journal Diameter-Nominal | 89.980-90.000 mm | 3.542-3.543 in |
| Rear Journal Diameter- minus 0.25 | 89.730-99.750 mm | 3.532-3.927 in. |
| Rear Bearing Diameter-Nominal | 90.045-90.065 mm | 3.545-3.546 in. |
| Rear Bearing Diameter- minus 0.25 | 89.795-89.815 mm | 3.535-3.536 in. |
| Clearance Between Journal and Bearing | 0.045-0.080 mm | 0.001-0.003 in. |
| Connecting Rod Journal-Nominal | 53.940-53.955 mm | 2.123-2.124 in. |
| Connecting Rod Journal- minus 0.25 | 53.690-53.705 mm | 2.113-2.114 in. |
| Connecting Rod Bearing-Nominal | 53.997-54.016 mm | 2.125-2.126 in. |
| Connecting Rod Bearing- minus 0.25 | 53.727-53.766 mm | 2.115-2.116 in. |
| Clearance Between Journal and Bearing | 0.022-0.076 mm | 0.0008-0.0029 in. |
| Crankshaft End Play | 0.080-0.280 mm | 0.003-0.011 in. |
| Adjustment | Thrust Washers | Thrust Washers |
| Thrust Washers Available | 2.31-2.36 mm | 0.090-0.092 in. |
| | 2.41-2.46 mm | 0.094-0.096 in. |
| | 2.51-2.56 mm | 0.098-0.100 |
| Carrier with Thrush Washers Installed | 27.670-27.820 mm | 1.089-1.095 in. |

*MAIL BEARING CARRIERS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Internal Diameter-Front | 67.025-67.050 mm | 2.638-2.639 in. |
| Internal Diameter-Center | 66.670-66.690 mm | 2.624-2.624 in. |
| Internal Diameter-Rear | 85.985-86.005 mm | 3.385-3.386 in. |

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

*LINERS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Internal Diameter | 091.997-92.015 mm. | 3.621-3.622 in. |
| Protrusion | 0.00-0.05 mm | 0.00-0.001 in. |
| Available Adjustment Shims | 0.15 mm | 0.005 in. |
| | 0.17 mm | 0.006 in. |
| | 0.20 mm | 0.007 in. |
| | 0.23 mm | 0.009 |
| | 0.25 mm | 0.0098 |

*CYLINDER HEAD*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Minimum Thickness | 94.95-95.05 mm. | 3.738-3.742 in. |
| Gasket Thickness | 1.32 mm ± 0.08, 0 notches | 0.0051 in. ± 0.003, 0 notches |
| | 1.42 mm ± 0.08, 1 notch | 0.051 in. ± 0.003, 1 notch |
| | 1.52 mm ± 0.08, 2 notches | 0.059 in. ± 0.003, 1 notches |

*CONNECTING RODS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Small end Bearing Internal Diameter | 32.035-32.050 mm | 1.2612-1.2618 in. |
| Large End Internal Diameter | 53.997-54.016 mm | 2.125-2.126 in. |

*PISTONS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Skirt Diameter (measured at approximately 10 mm above the bottom of the skirt) | 93.912-93.928 mm. | 3.6973-3.6979 in. |
| Piston Clearance | 0.010-0.22 mm | 0.0003-0.0008 in. |
| Top of Piston to Cylinder Head | 0.69-0.83 mm | 0.027-0.032 in. |
| Piston Protrusion | 0.460-0.609 mm Fit Gasket, Number (1.32mm), 0 notches or holes | 0.018-0.023 in. Fit Gasket, Number (0.051 in.), 0 notches |
| | 0.610-0.709 Fit Gasket, Number (1.42 mm) 1 notch or hole | 0.024-0.027 in. Fit Gasket, Number (0.055 in.) 1 notch or hole |
| | 0.710-0.810 Fit Gasket, Number (1.52 mm), 2 notches or holes | 0.027-0.031 in. Number (0.059 in) 2 notches or holes |

*PISTON PINS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Type | Full Floating | |
| Pin Diameter | 32.004-32.010 mm | 1.259-1.260 in. |
| Clearance | 0.010-0.020 mm | 0.0003-0.0007 in. |

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

*PISTON RINGS*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| **Clearance in Groove** | | |
| Top Compression Ring | 0.078-0.137 mm | 0.003-0.005 in. |
| Second Compression Ring | 0.070-0.110 mm | 0.002-0.004 in. |
| Oil Control (Steel Rails) | 0.40-0.080 mm | 0.001 - 0.003 in. |
| **Fitted Gap** | | |
| Top Compression Ring | .030-0.45 mm | 0.011-0.017 in. |
| Second Compression Ring | 0.030 - 0.050 mm | 0.0011 - 0.0019 in. |
| Oil Ring (Steel Ring) | .025 - 0.50 mm | .0009 - .0019 in. |

*CAMSHAFT*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Journal Diameter-Front | 29.960-29.980 mm | 1.179-1.180 in. |
| Bearing Clearance | 0.03-0.08 mm | 0.001-0.003 in. |
| Journal Diameter-Center | 39.250-39.270 mm | 1.545-1.546 in. |
| Bearing Clearance | 0.03-0.08 mm | 0.001-0.003 in |
| Journal Diameter-Rear | 39.250-39.270 mm | 1.545-1.546 in. |
| Bearing Clearance | 0.03-0.08 mm | 0.001-0.003 in. |
| Camshaft End Play | 0.10-0.55mm | 0.004-0.021 in. |

*HYDRAULIC LIFTER*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Outside Diameter | 11.994 ± 0.006 mm | 0.472 ± 0.0002 in. |

*VALVES*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Face Angle-Intake | 45° 25'-55° 35' mm | - |
| Face Angle-Exhaust | 45° 25'-45° 35' mm | - |
| Intake Valve Opens | 15.6° ± 2° A.T.D.C. | - |
| Intake Valve Closes | 64.4° ± 2° A.B.D.C. | - |
| Exhaust Valve Opens | 66° ± 2° B.B.D.C. | - |
| Exhaust Valve Closes | 32° ± 2° A.T.D.C. | - |
| Head Diameter-Intake | 32.30-32.50 mm | 1.271-1.279 in. |
| Head Diameter-Exhaust | 30.80-31.00 mm | 1.212-1.220 in. |
| Head Stand Down-Intake | 1.08-1.34 mm | 0.042-0.052 in. |
| Head Stand Down-Exhaust | 0.99-1.25 mm | 0.038-0.049 in. |
| Stem Diameter-Intake | 5.952-5.970 mm | 0.234-0.235 in. |
| Stem Diameter-Exhaust | 5.942-5.960 mm | 0.233-0.234 in. |
| Clearance in Guide-Intake | 0.030-0.060 mm | 0.001-0.002 in. |
| Clearance in Guide-Exhaust | 0.040-0.070 mm | 0.001-0.002 in. |

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

*VALVE GUIDE*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Inside Diameter | 6.00-6.012 mm | 0.2362-0.2366 in. |
| Fitted Height-Intake | 14.5-15.0 mm | 0.570-0.590 in. |
| Fitted Height-Exhaust | 16.5-17.0 mm | 0.649-0.669 in. |

*VALVE SPRING*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Free Length | 45.26 mm | 1.781 in. |
| Fitted Length | 38.0 mm | 1.496 in. |
| Load at Fitted Length | 182 ± 5-10% Kg | - |
| Load at Top of Lift | 395 ± 5% Kg | - |
| Number of Coils | 8 | - |

*LUBRICATION*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Pressure Relief Valve Opens | 6.50 bar | 94 psi |
| Pressure Relief Valve Spring-Free Length | 51.5 mm | 2.02 in. |

*OIL PUMP*

| DESCRIPTION | SPECIFICATION | |
|---|---|---|
| | Metric | Standard |
| Outer Rotor End Float | 0.060-0.160 mm | 0.002-0.006 in. |
| Inner Rotor End Float | 0.060-0.160 | 0.002-0.006 in. |
| Outer Rotor to Body Diameter Clearance | 0.130-0.240 mm | 0.005-0.009 in. |
| Rotor Body to Drive Gear Clearance (pump not fitted) | 0.90-1.50 mm | 0.035-0.059 in. |

## SPECIFICATIONS - TORQUE

*2.5L/2.8L DIESEL TORQUE SPECIFICATIONS*

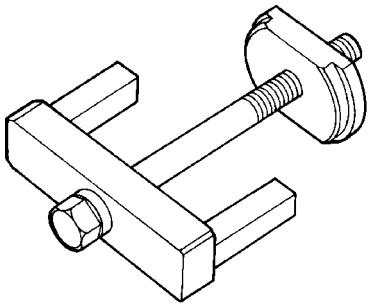
| DESCRIPTION | N·m | Ft. Lbs. | In. Lbs. |
|---|---|---|---|
| Oil Pump Bolts | 10.8 | 8 | 96 |
| Vacuum Pump Bolts | 10.8 | 8 | 96 |
| Crankshaft Gear Bolts | 10.8 | 8 | 96 |
| Crankshaft Position Sensor Bolts | 10.8 | 8 | 96 |
| Flywheel Bolts - 2.5L, Refer to the Service Procedure | | | |
| Flex Plate Bolts - 2.8L, Refer to the Service Procedure | | | |
| Cylinder Head Bolts - Refer to the Service Procedure | | | |
| Reluctor Wheel Bolts | 14.6 | 11 | 130 |
| Rear Main Bearing Support Bolts | 27.5 | 21 | 240 |
| Oil Cooler to Engine Block Bolt | 38 | 28 | — |
| Water Pump Housing Nuts | 24.4 | 18 | 212 |
| Connecting Rod Bolts - Refer to the Service Procedure | | | |
| Balance Shaft Bolts | 32.4 | 24 | — |
| Oil Jet Bolts | 10.8 | 8 | 96 |
| Oil Pan Bolts | 11.8 | 8 | 96 |
| Crankshaft Hub Bolt | 275 | 202 | — |

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

| DESCRIPTION | N·m | Ft. Lbs. | In. Lbs. |
|---|---|---|---|
| Front Engine Cover Bolts | 11.8 | 8 | 96 |
| Transmission to Engine Bolts | 83.4 | 62 | — |
| Cylinder Head Cover / Intake Manifold Bolts | 27.5 | 20 | — |
| Camshaft Access Plugs | 80 | 59 | — |
| Oil Separator Bolts | 10.8 | 8 | 96 |
| Camshaft Position Sensor Bolt | 10.8 | 8 | 96 |
| Boost Pressure / Intake Air Temp. Sensor Bolts | 5.4 | — | 48 |
| Accessory Drive Bracket Bolts | 47.1 | 35 | — |
| Vacuum Line Fitting Bolt | 56.9 | 42 | — |
| Rail Pressure Sensor | 35 | 26 | — |
| Fuel Pump Nuts | 27.5 | 21 | — |
| Fuel Line Fittings at Pump | 27.5 | 21 | — |
| Inner Timing Belt Cover Bolts | | | |
| 8mm | 10.8 | 8 | 96 |
| 10mm | 47.1 | 35 | — |
| Outer Timing Belt Cover Bolts | | | |
| 3mm | 6 | — | 54 |
| 8mm | 10.8 | 8 | 96 |
| Engine Mount Bracket to Cylinder Head Bolts | 47.1 | 35 | — |
| Intake Inlet Tube Bolts | 10.1 | 8 | 89 |
| Camshaft Sprocket Bolts | 108 | 80 | — |
| Timing Belt Idler Pulley Bolt | 47.1 | 35 | — |
| Timing Belt Tensioner Bolt | 34.7 | 26 | — |
| Fuel Pump Nut | 88.3 | 65 | — |
| Engine Lift Hook Bolts | 32.4 | 24 | — |
| Thermostat Housing Bolts | 27.5 | 21 | — |
| Turbocharger Oil Feed Line Fitting | 24.5 | 18 | 217 |
| Exhaust Manifold Nuts (Must recheck each nut after tightening sequence is completed) | 36 | 26.5 | — |
| Exhaust Manifold Heatshield Bolts | 27.5 | 21 | — |
| EGR Valve Nuts | 32.4 | 24 | — |
| EGR Pipe to EGR Bolts | 32.4 | 24 | — |
| Turbocharger Downpipe Nuts | 32.4 | 24 | — |
| Turbocharger Bracket Bolts | 47.1 | 35 | — |
| Vibration Damper to Crankshaft Hub Bolts | 27.5 | 21 | — |
| Crankshaft Support Bolts | 44.1 | 33 | — |
| Turbocharger to Exhaust Manifold Nuts | 32.4 | 24 | — |

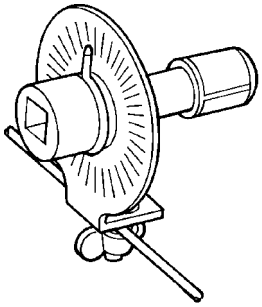
ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

## SPECIAL TOOLS



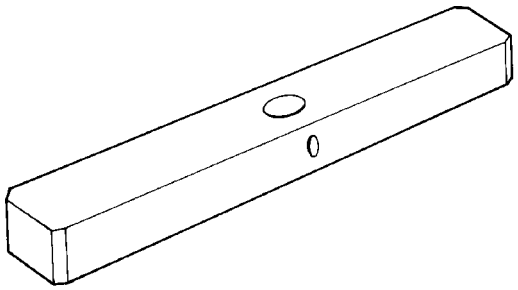
803fd6a2

***VM.1001 CYLINDER LINER PULLER***



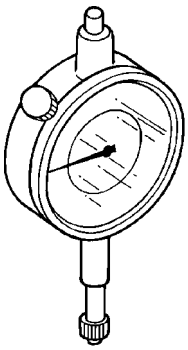
803fd6a6

***VM.1005 TORQUE ANGLE GAUGE***



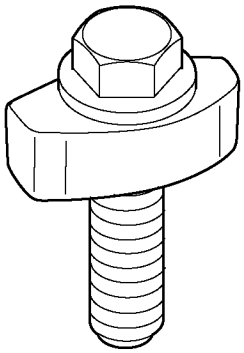
80a1aa43

***VM.1010 CYLINDER LINER PROTRUSION TOOL***



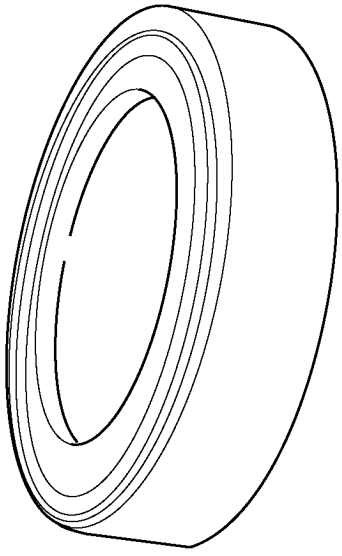
80a1aa46

***VM.1013 DIAL INDICATOR***



808bb90a

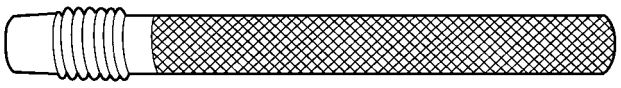
***VM.1076 CYLINDER RETAINER***



8120d646

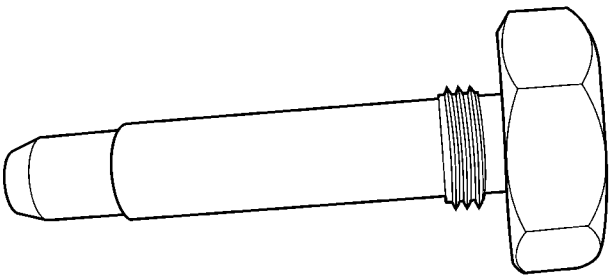
***VM.1050 CRANKSHAFT REAR SEAL INSTALLER***

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)



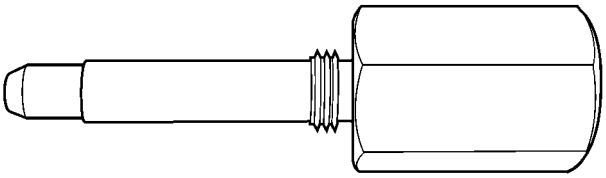
80c1426c

***VM.1051 2.5L-TDC ALIGNMENT PIN***



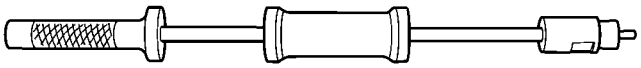
80c1449e

***VM.1053 EXHAUST CAMSHAFT ALIGNMENT PIN***



80c143ba

***VM.1052 INTAKE CAMSHAFT ALIGNMENT PIN***



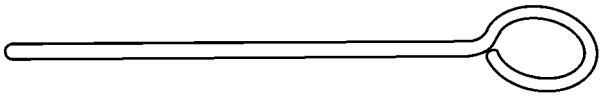
80c14546

***VM.1054 RELIEF VALVE REMOVER/CENTRAL CARRIER PIN REMOVER/INSTALLER***

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)

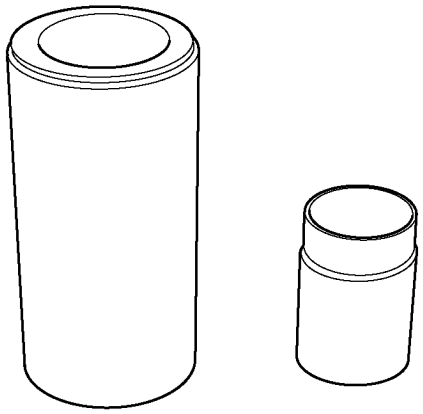
80c13cec

***VM.1055 CAMSHAFT/HIGH PRESSURE INJECTION PUMP GEAR HOLDER***



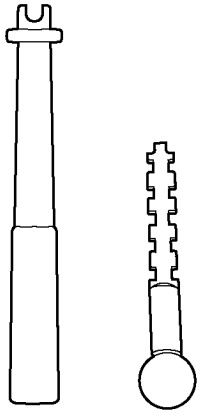
80c17320

***VM.1056 BALANCE SHAFT LOCKING PIN***



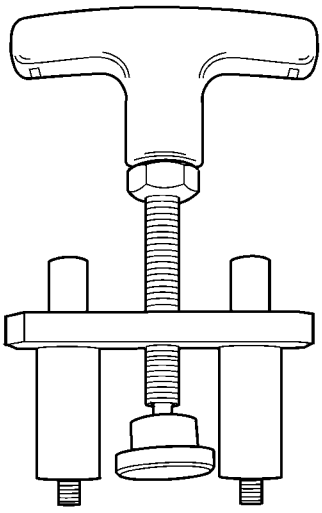
8121483c

***VM.1057 CAMSHAFT OIL SEAL INSTALLER***



81214825

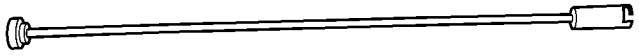
***VM.1058 CAMSHAFT OIL SEAL REMOVER***



80c1570a

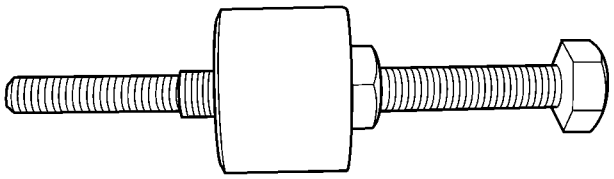
***VM.1059 OIL PRESSURE RELIEF VALVE INSTALLER***

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)



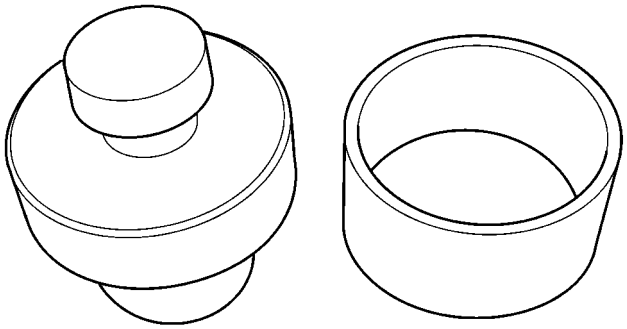
80c17f19

***VM.1060 OIL JET REMOVER /INSTALLER***



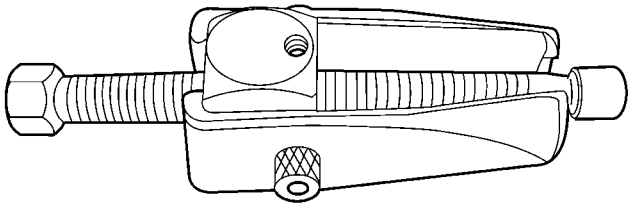
80c17ba4

***VM.1062 POWER STEERING PUMP INSTALLER***



80c17810

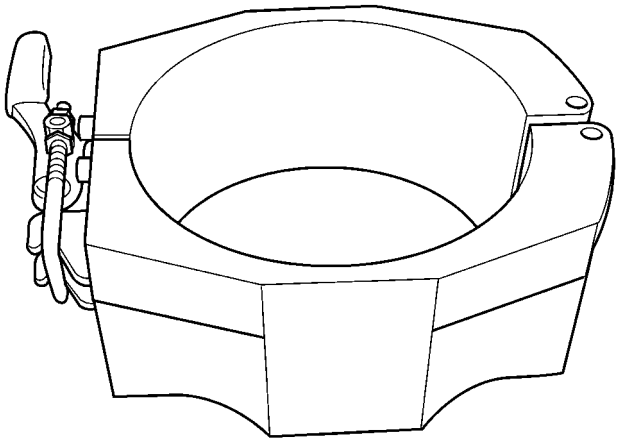
***VM.1061 FRONT COVER AND FRONT OIL SEAL INSTALLER***



80c17fce

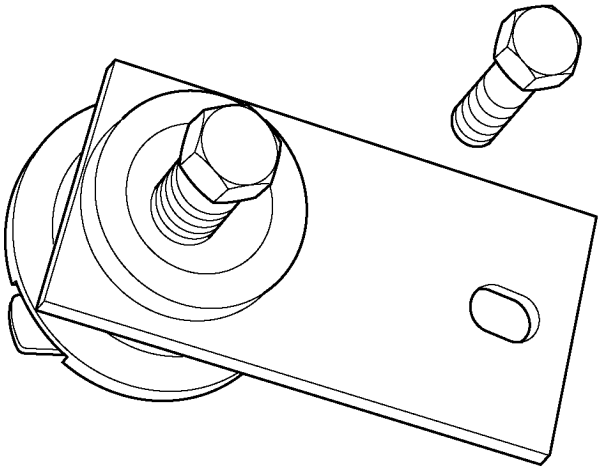
***VM.1064 POWER STEERING PUMP GEAR REMOVER***

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)



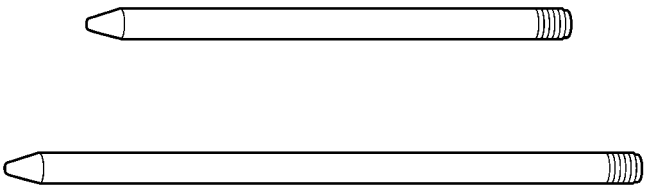
80c17f56

***VM.1065 2.5L PISTON RING COMPRESSOR***



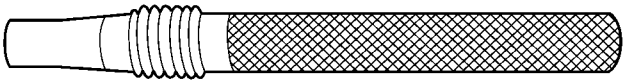
8120d627

***VM.1067 HIGH PRESSURE PUMP REMOVER***



80c177d0

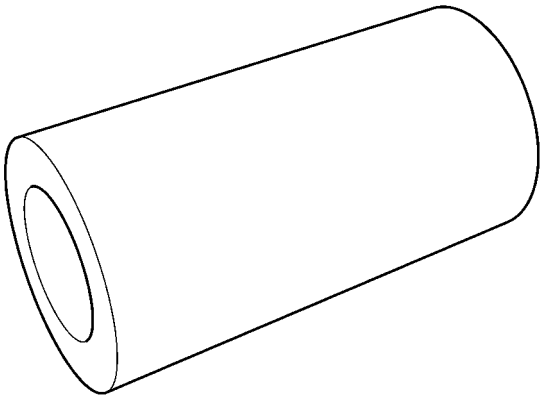
***VM.1066 VALVE COVER ALIGNMENT PINS***



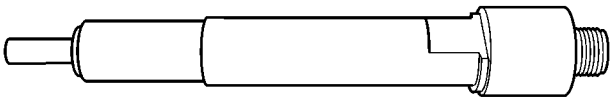
80c141ef

***VM.1068 90 DEGREES AFTER TDC ALIGNMENT PIN***

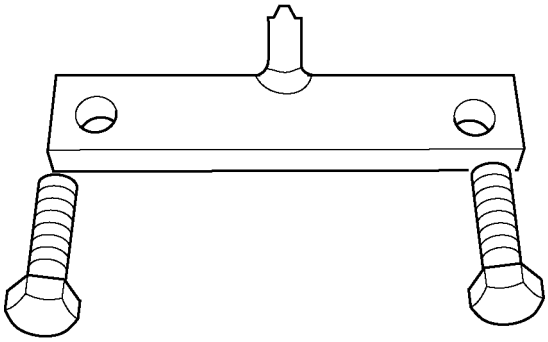
ENGINE 2.5L/2.8 TURBO DIESEL (Continued)



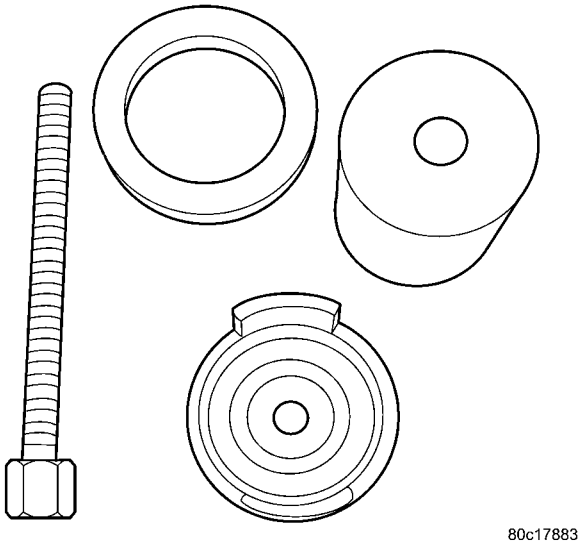

***VM.1069 CRANKSHAFT REM/INSTALL SLEEVE***




***VM.1072 COMPRESSION TESTER ADAPTER***

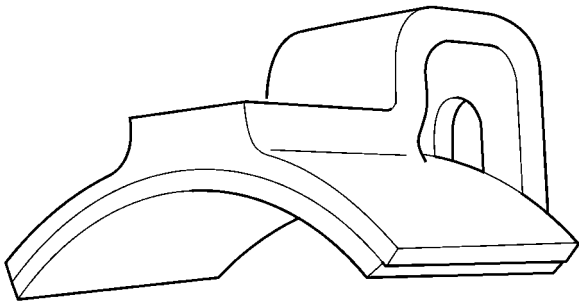



***VM.1070 FLYWHEEL LOCKING TOOL***



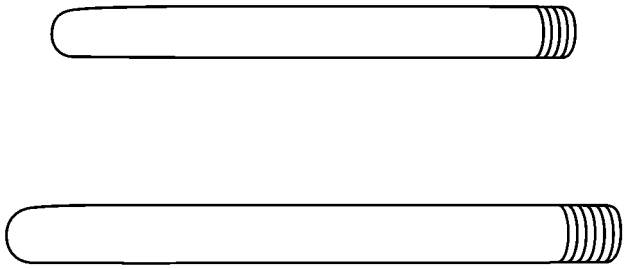

***VM.1073 CRANKSHAFT FRONT BEARING REMOVER/INSTALLER***

ENGINE 2.5L/2.8 TURBO DIESEL (Continued)



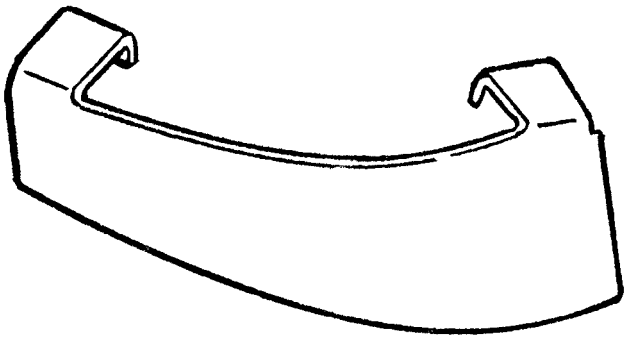
80c1727c

***VM.1074 TIMING BELT RETAINER***



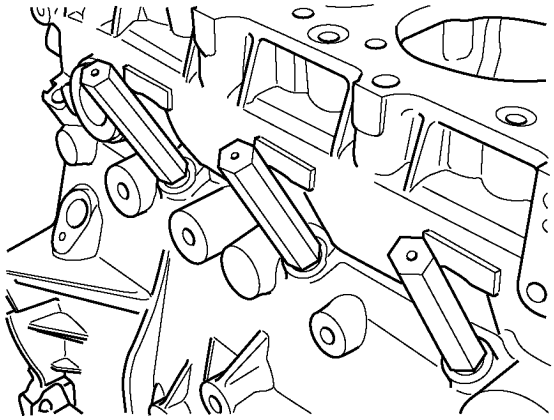
80c17b55

***VM.1075 FLYWHEEL ALIGNMENT PINS***



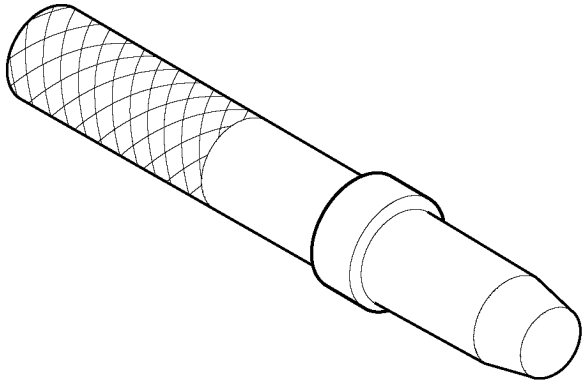
80c499af

***VM.1077 POWER STEERING BELT REMOVER***



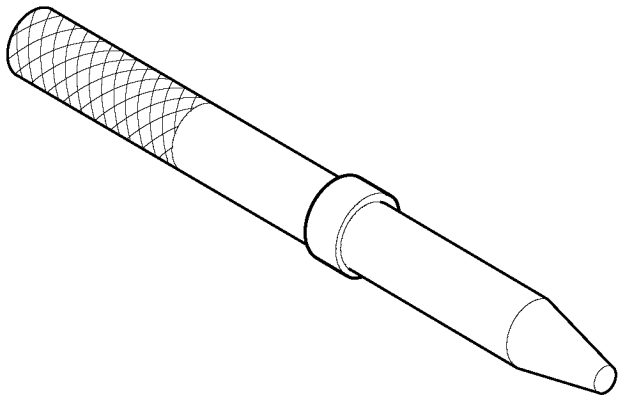
8121485c

***VM.1079 CENTRAL CARRIER ALIGNMENT PINS***

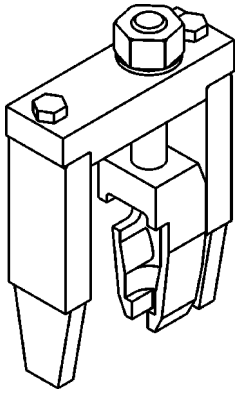


8121521d

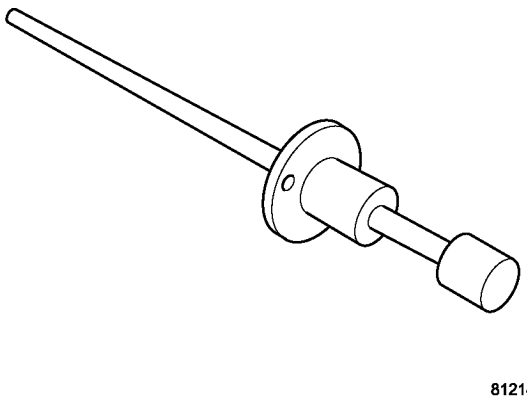
***VM.1083 2.8L-TDC LOCATING PIN***




***VM.1084 2.8L 90 DEGREES AFTER TDC LOCATING PIN***



***VM.9075 FUEL INJECTOR EXTRACTOR***




***VM.9095 CRANKSHAFT SUPPORT RETAINER***

# AIR CLEANER HOUSING

## REMOVAL

(1) Disconnect the negative battery cable.
(2) Disconnect the air inlet hose from the air cleaner housing cover (Fig. 11).

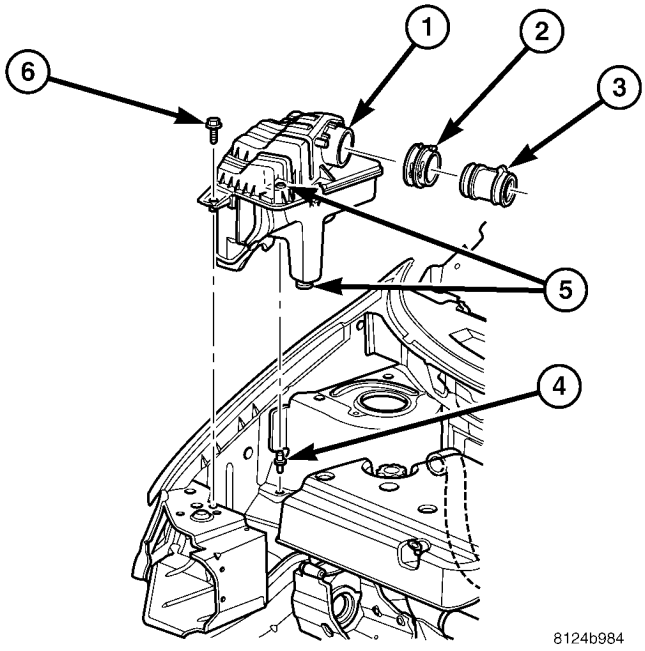



***Fig. 11 AIR CLEANER HOUSING***

1 - AIR CLEANER HOUSING
2 - AIR DUCT
3 - MASS AIR FLOW SENSOR
4 - LOCATING PIN
5 - LOCATING RINGS
6 - BOLT

(3) Remove the air duct from the air cleaner housing cover.
(4) Remove the bolt for air cleaner housing at upper radiator cross member.
(5) Pull air cleaner housing up and off over the locating pins.
(6) Remove housing from vehicle.

## INSTALLATION

(1) Install air cleaner housing into vehicle and onto the locating pins (Fig. 11).
(2) Install bolt to hold housing to the upper radiator cross member.
(3) Install the air inlet duct to the housing.
(4) Connect the air inlet hose to the housing.
(5) Connect the negative battery cable.

# CYLINDER HEAD

## STANDARD PROCEDURE

### STANDARD PROCEDURE - 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 and installation in this section.

(2) Use Valve Spring Compressor Tool and compress each valve spring.

(3) Remove the valve locks, retainers, and springs.

(4) Inspect and 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 build-up and gasket material from the engine cylinder head machined gasket surface.

### INSPECTION

(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.

### VALVE REFACING

(1) Use a valve refacing machine to reface the intake and exhaust valves to the specified angle.

(2) After refacing, a margin of at least 4.52-4.49 mm (.178-.177 inch) must remain (Fig. 12). If the margin is less than 4.49 mm (.177 inch), the valve must be replaced.

### 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.

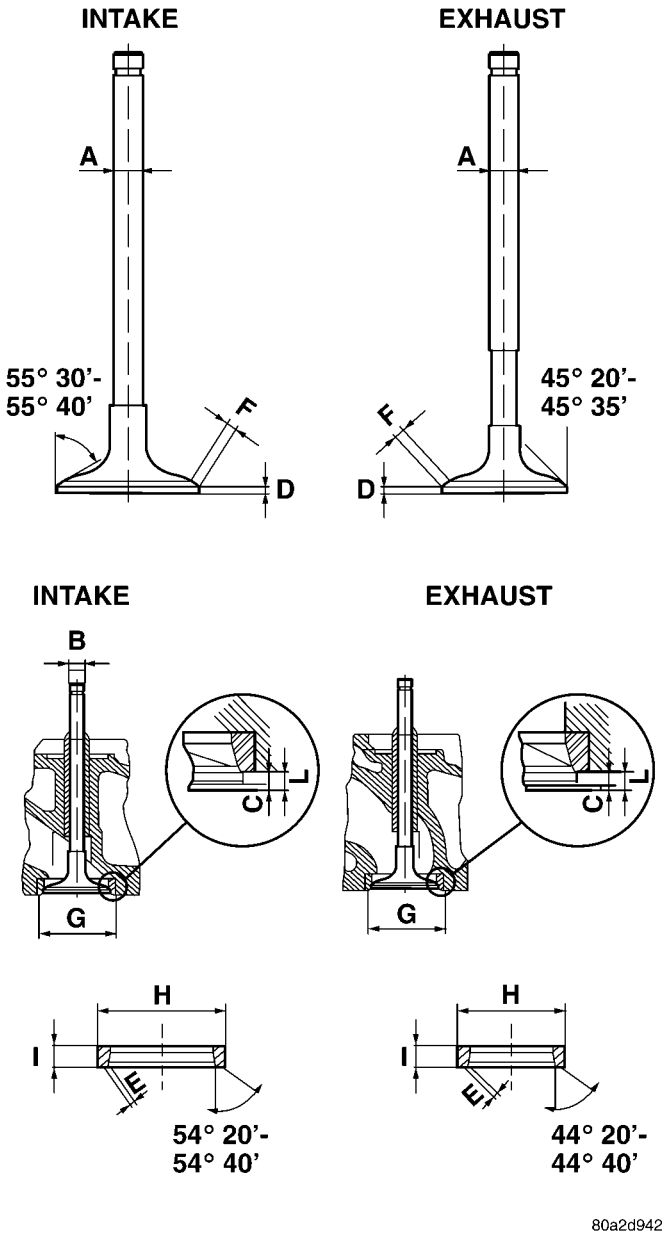



*Fig. 12 VALVE SPECS.*

| MEASUREMENT | INTAKE | EXHAUST |
|---|---|---|
| A | 7.940-7.960 | 7.922-7.940 |
| B | 8.00-8.015 | 8.000-8.015 |
| C | 1.08-1.34 | 0.990-1.250 |
| D | 2.2 ± 0.08 | 2.09 +0.07 −0.09 |
| E | 1.80-2.20 | 1.65-2.05 |
| F | 2.73-3.44 | 2.45-3.02 |
| G | 41.962-41.985 | 35.964-35.987 |
| H | 42.070-42.086 | 36.050-36.066 |
| I | 7.14-7.19 | 7.00-7.05 |
| L | 3.11-3.26 | 3.10-3.25 |

CYLINDER HEAD (Continued)

## VALVE STAND DOWN

Valve stand down is to maintain the adequate compression ratio.

(1) Invert cylinder head.

(2) Fit each valve to its respective valve guide.

(3) Using a straight edge and feeler gauge, check valve head stand down: Inlet valve head stand down 1.08 to 1.34 mm (.042 to .052 ins.) and exhaust valve stand down .99 to 1.25 mm (.035 to .049 ins.).

(4) If valve head stand down is not in accordance with above, discard original valves, check stand down with new valves and recut valve seat inserts to obtain correct stand down.

## VALVE GUIDES

(1) Valve Guides height requirement.

(2) Measurement A (Fig. 13): 16.50 - 17.00 mm. Measurment B : 14.50 - 15.00 mm.

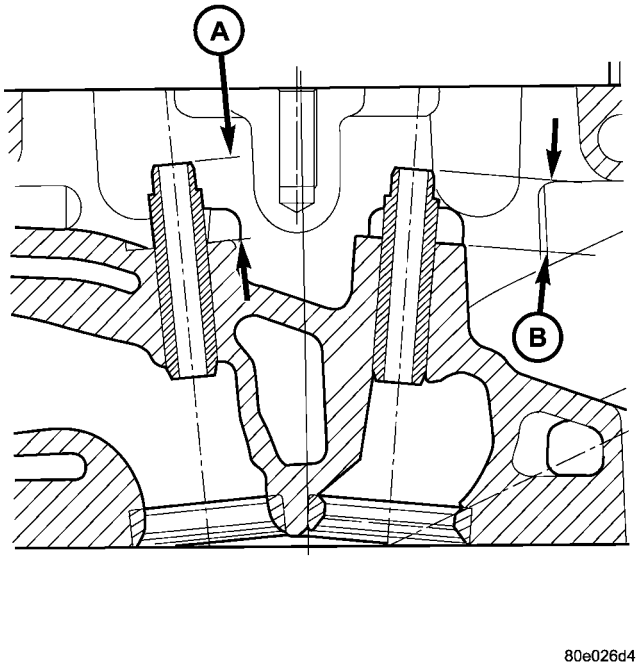



*Fig. 13 VALVE GUIDE HEIGHT*

## VALVE STEM-TO-GUIDE CLEARANCE MEASUREMENT

(1) Measure and record internal diameter of valve guides. Valve guide internal diameter is 8.0 to 8.015 mm (.3149 to .3155 ins.).

(2) Measure valve stems and record diameters. Intake valve stem diameter 7.94 to 7.96 mm (.3125 to .3133 in). Exhaust valve stem diameter 7.92 to 7.94 mm (.3118 to .31215 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 .040 to .075 mm (.0015 to .0029 in). Clearance of exhaust valve stem in valve guide is .060 to .093 mm (.0023 to .0036 in).

(4) If valve stem clearance in valve guide exceeds tolerances, new valve guides must be installed.

## STANDARD PROCEDURE - MEASURING PISTON PROTRUSION

(1) Use special tool VM.1010 with dial indicator special tool VM.1013 (Fig. 14).

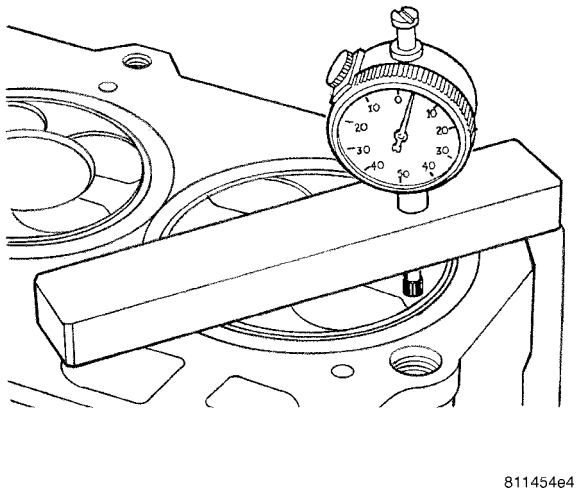



*Fig. 14 PISTON PROTRUSION*

(2) Bring the piston of cylinder no. 1 exactly to top dead center.

(3) Zero the dial indicator on the cylinder block mating surface.

(4) Setup the dial indicator on the piston crown (above the center of the piston pin) 5mm (1/8 in.) from the edge of the piston and note the measurement (Fig. 14).

(5) Repeat the procedure with the rest of the cylinders.

(6) Establish the thickness of the steel gasket by averaging the four piston potrusion readings.

CYLINDER HEAD (Continued)

| | |
|---|---|
| Measure Dimension (mm) | 0.460-0.609 |
| Cylinder Head Gasket Thickness (mm) | 1.32<br>No Holes or Notches |
| Piston Clearance (mm) | 0.71-0.86 |
| | |
| Measure Dimension (mm) | 0.610-0.709 |
| Cylinder Head Gasket Thickness (mm) | 1.42<br>1 Hole or Notch |
| Piston Clearance (mm) | 0.711-0.81 |
| | |
| Measure Dimension (mm) | 0.710-0.810 |
| Cylinder Head Gasket Thickness (mm) | 1.52<br>2 Holes or Notches |
| Piston Clearance (mm) | 0.71-0.81 |

## REMOVAL

(1) Disconnect negative battery cable.

(2) Remove front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).

(3) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).

(4) Drain cooling system (Refer to 7 - COOLING/ENGINE/COOLANT - STANDARD PROCEDURE).

(5) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(6) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(7) Remove generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

(8) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL).

**CAUTION: Before removing the cylinder head cover/intake manifold or timing belt the engine must put at 90° after TDC. Failure to do so could result in valve and/or piston damage during reassembly. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)**

(9) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(10) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(11) Remove timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(12) Remove cylinder head cover/intake manifold (Fig. 15)(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

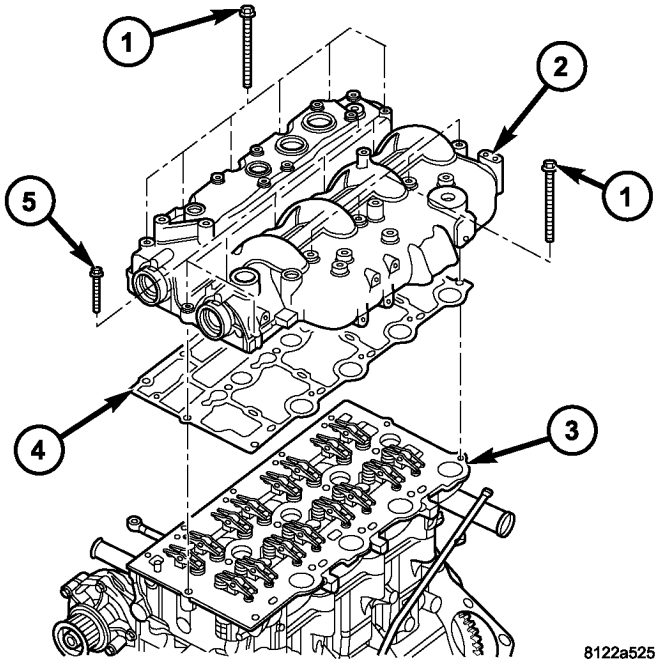



***Fig. 15 CYLINDER HEADCOVER/INTAKE MANIFOLD ASSEMBLY***

1 - CYLINDER HEAD COVER/INTAKE MANIFOLD BOLTS(LONG)
2 - CYLINDER HEAD COVER/INTAKE MANIFOLD
3 - CYLINDER HEAD
4 - CYLINDER HEAD COVER/INTAKE MANIFOLD GASKET
5 - CYLINDER HEAD COVER/INTAKE MANIFOLD BOLTS(SHORT)

(13) Remove rocker arm and lifter assemblies from cylinder head.

(14) Remove cylinder head cover/intake manifold gasket from cylinder head (Fig. 15).

(15) Disconnect glow plug and engine coolant temperature electrical connectors.

CYLINDER HEAD (Continued)

(16) Remove coolant recovery pressure container (Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY PRESS CONTAINER - REMOVAL).

(17) Remove thermostat housing to upper radiator hose pipe (Fig. 16).

(18) Remove turbocharger outlet to charge air cooler pipe (Fig. 16).

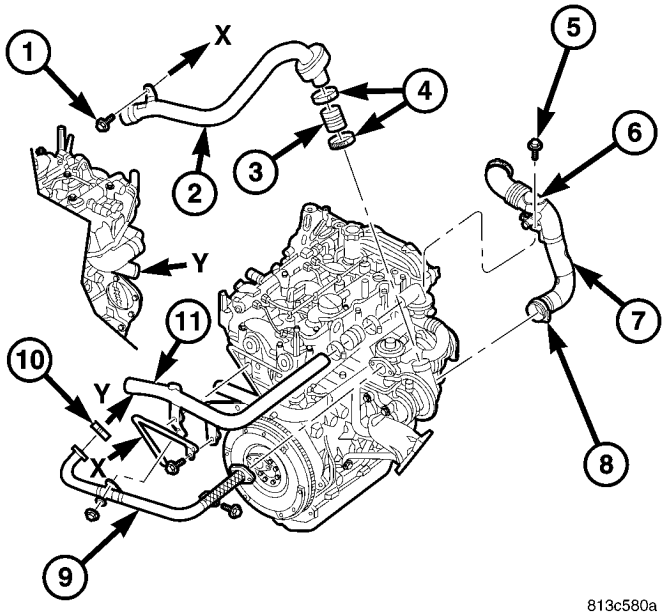



*Fig. 16 TURBOCHARGER AND COOLANT PIPES*

1 - TURBOCHARGER OUTLET PIPE RETAINING BOLT
2 - TURBOCHARGER OUTLET PIPE
3 - ADAPTOR HOSE
4 - HOSE CLAMPS
5 - TURBOCHARGER INLET PIPE RETAINING BOLT
6 - TURBOCHARGER INLET PIPE
7 - ADAPTOR HOSE
8 - HOSE CLAMPS
9 - EGR VALVE TO INTAKE AIR INLET PIPE
10 - CLAMP
11 - THERMOSTAT HOUSING TO UPPER RADIATOR HOSE PIPE

(19) Remove exhaust manifold heat shield (Fig. 17).

(20) Remove exhaust manifold retaining nuts (Fig. 17).

(21) Slide exhaust manifold and turbocharger off of exhaust manifold studs (Fig. 17).

(22) Remove cylinder head bolts.

(23) Remove cylinder head assembly from engine block (Fig. 18).

## CLEANING

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.

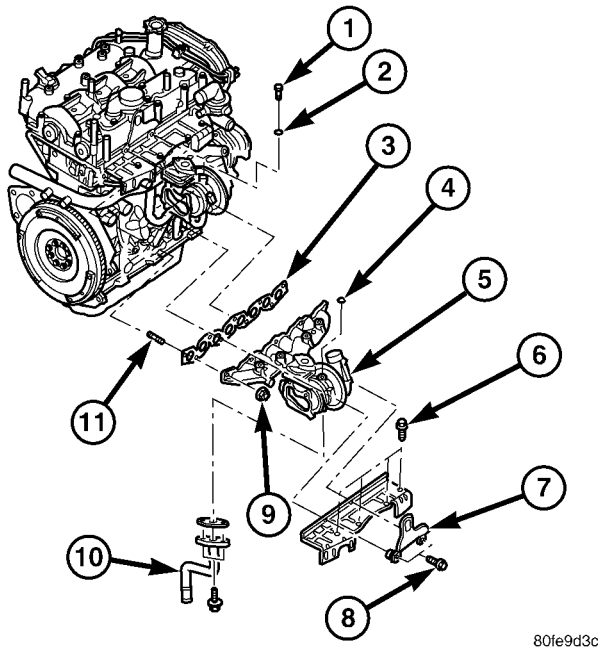



*Fig. 17 EXHAUST MANIFOLD AND TURBOCHARGER*

1 - TURBOCHARGER OIL SUPPLY BANJO BOLT
2 - COPPER WASHER
3 - EXHAUST MANIFOLD GASKET
4 - COPPER WASHER
5 - TURBOCHARGER
6 - HEAT SHIELD RETAINING BOLT
7 - ENGINE LIFT HOOK
8 - LIFT HOOK RETAINING BOLT
9 - EXHAUST MANIFOLD RETAINING NUT
10 - TURBOCHARGER RETURN HOSE
11 - EXHAUST MANIFOLD STUD

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

Use a straightedge and feeler gauge to check the flatness of the engine cylinder head and block mating surfaces.

The minimum cylinder head thickness is 89.95mm (3.541 in.).

## INSTALLATION

**CAUTION: Piston protrusion must be measured to determine cylinder head gasket thickness if one or more cylinder liners have been replaced (Refer to 9 - ENGINE/CYLINDER HEAD - STANDARD PROCEDURE).**

CYLINDER HEAD (Continued)

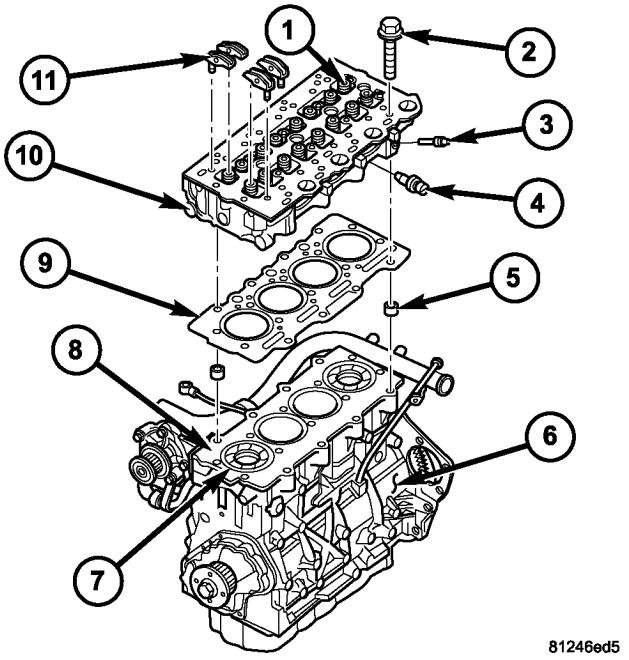



*Fig. 18 CYLINDER HEAD ASSEMBLY*

1 - VALVE SPRING
2 - CYLINDER HEAD BOLT
3 - GLOW PLUG
4 - COOLANT TEMPERATURE SENSOR
5 - CYLINDER HEAD ALIGNMENT DOWEL
6 - CYLINDER BLOCK
7 - CYLINDER LINER
8 - ENGINE BLOCK DECK
9 - CYLINDER HEAD GASKET
10 - CYLINDER HEAD
11 - ROCKER ARM AND LIFTER ASSEMBLY

**NOTE: If cylinder liner(s) have not been removed, the same thickness head gasket that was removed can be used.**

(1) Clean and inspect gasket mating surfaces.
(2) Position correct head gasket on engine block.
(3) Place cylinder head on engine block (Fig. 18).

**CAUTION: New cylinder head bolts must be used.**

(4) Tighten cylinder head bolts following procedure below:

- Lubricate the new cylinder head bolts with engine oil.
- Torque bolts to 30N·m in numerical starting with bolt #1 (Fig. 19).
- Tighten all bolts an additional 75°, starting with bolt #4 then 5-6-7-8-9-10-1-2-3 (Fig. 19).
- Tighten all bolts an additional 50° in numerical order starting with bolt #11 then 12-13-14-15-16-17-18 (Fig. 19).
- Without loosening any bolts tighten all bolts an additional 75° in the following sequence: 4-5-6-7-8-9-10-1-2-3-11-12-13-14-15-16-17-18.

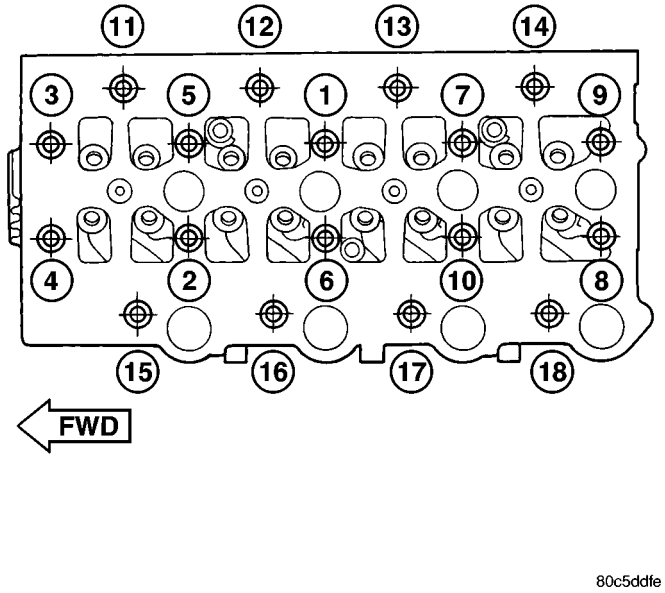



*Fig. 19 CYLINDER HEAD TORQUE SEQUENCE*

(5) Slide exhaust manifold and turbocharger on exhaust manifold studs (Fig. 20).
(6) Install exhaust manifold retaining nuts. Torque nuts to 32.4N·m.
(7) Install exhaust manifold heat shield (Fig. 20). Torque bolts to 27.5N·m.
(8) Install turbocharger outlet to charge air cooler pipe (Fig. 21).
(9) Install thermostat housing to upper radiator hose pipe (Fig. 21). Install retaining bolt and torque to 47.1N·m.
(10) Install coolant recovery pressure container (Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY PRESS CONTAINER - INSTALLATION).
(11) Connect glow plug and coolant temperature sensor electrical connectors.
(12) Install new cylinder head cover/intake manifold gasket.
(13) Install rocker arm and lifter assemblies.**Be sure to put rocker arm and lifter assemblies in same location as removed.**
(14) Install cylinder head cover/intake manifold (Fig. 15)(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
(15) Install timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
(16) Install timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
(17) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

CYLINDER HEAD (Continued)

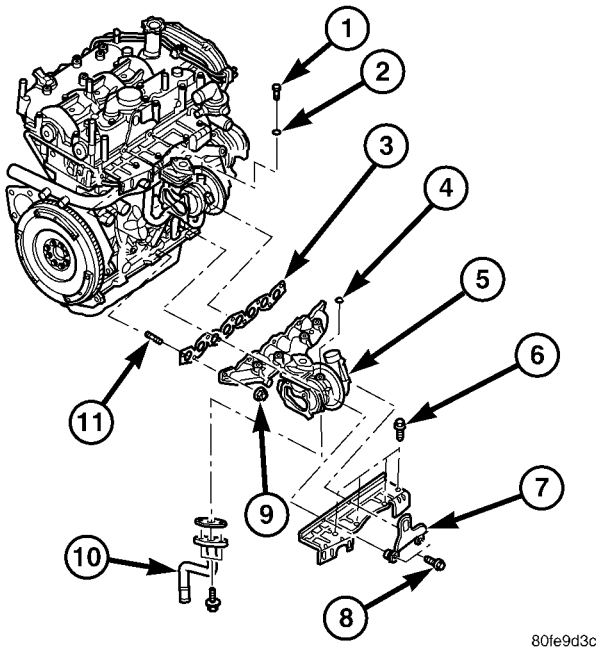



***Fig. 20 EXHAUST MANIFOLD AND TURBOCHARGER***

1 - TURBOCHARGER OIL SUPPLY BANJO BOLT
2 - COPPER WASHER
3 - EXHAUST MANIFOLD GASKET
4 - COPPER WASHER
5 - TURBOCHARGER
6 - HEAT SHIELD RETAINING BOLT
7 - ENGINE LIFT HOOK
8 - LIFT HOOK RETAINING BOLT
9 - EXHAUST MANIFOLD RETAINING NUT
10 - TURBOCHARGER RETURN HOSE
11 - EXHAUST MANIFOLD STUD

(18) **Remove crankshaft and both camshaft locking pins at this time** (Refer to 9 - ENGINE/ VALVE TIMING - STANDARD PROCEDURE) .

(19) Install generator (Refer to 8 - ELECTRICAL/ CHARGING/GENERATOR - INSTALLATION).

(20) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(21) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(22) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).

(23) Install air cleaner housing assembly.

(24) Refill cooling system (Refer to 7 - COOLING/ ENGINE/COOLANT - STANDARD PROCEDURE).

(25) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).

(26) Install front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).

(27) Connect negative battery cable.

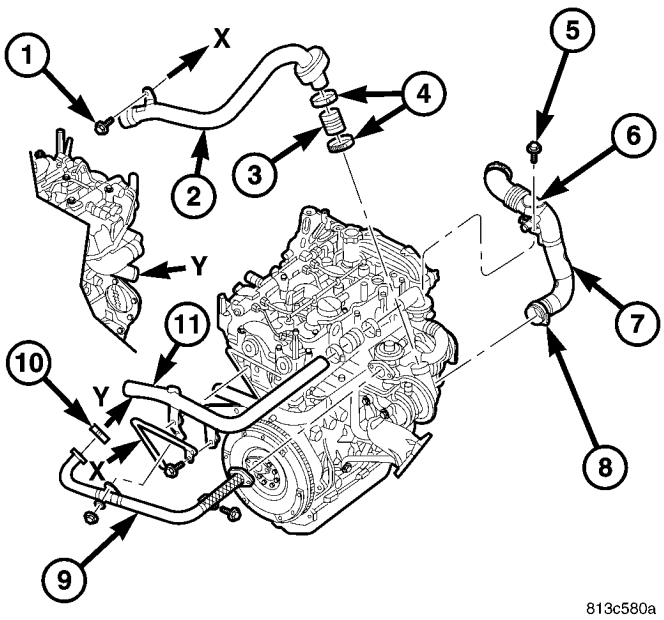



***Fig. 21 TURBOCHARGER AND COOLANT PIPES***

1 - TURBOCHARGER OUTLET PIPE RETAINING BOLT
2 - TURBOCHARGER OUTLET PIPE
3 - ADAPTOR HOSE
4 - HOSE CLAMPS
5 - TURBOCHARGER INLET PIPE RETAINING BOLT
6 - TURBOCHARGER INLET PIPE
7 - ADAPTOR HOSE
8 - HOSE CLAMPS
9 - EGR VALVE TO INTAKE AIR INLET PIPE
10 - CLAMP
11 - THERMOSTAT HOUSING TO UPPER RADIATOR HOSE PIPE

# CAMSHAFT(S)

## DESCRIPTION

The camshafts are made of gray cast iron with eight machined lobes and four bearing journals (Fig. 22).

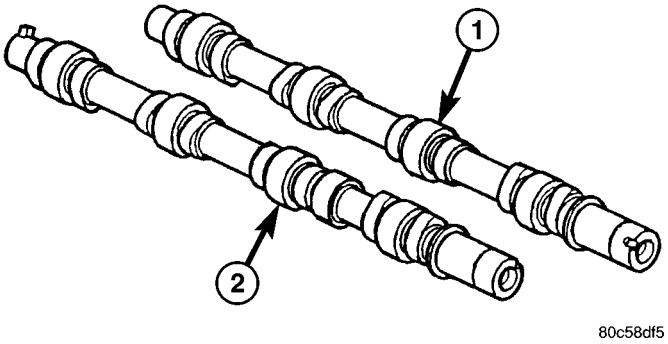



***Fig. 22 CAMSHAFTS***

1 - INTAKE CAMSHAFT
2 - EXHAUST CAMSHAFT

CAMSHAFT(S) (Continued)

## OPERATION

When the camshaft rotates the lobes actuate the hydraulic lifters and rocker arms, forcing downward on the rocker arms which opens the valves.

## REMOVAL

(1) Disconnect negative battery cable.
(2) Remove front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).
(3) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).
(4) Drain cooling system (Refer to 7 - COOLING/ENGINE/COOLANT - STANDARD PROCEDURE).
(5) Remove air cleaner housing.
(6) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(7) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(8) Remove generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).
(9) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL).

**CAUTION: Before removing the cylinder head cover/intake manifold or timing belt the engine must put at 90° after TDC. Failure to do so could result in valve and/or piston damage during reassembly. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)**

(10) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(11) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(12) Remove timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(13) Remove cylinder head cover/intake manifold (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(14) With cylinder head cover/intake manifold on work bench, remove plugs at rear of cylinder head cover/intake manifold.
(15) Remove camshaft oil seals (Fig. 23).
(16) Remove snapring and thrust washer from camshaft (Fig. 23).
(17) Slide camshaft through access hole at rear of cylinder head cover/intake manifold.

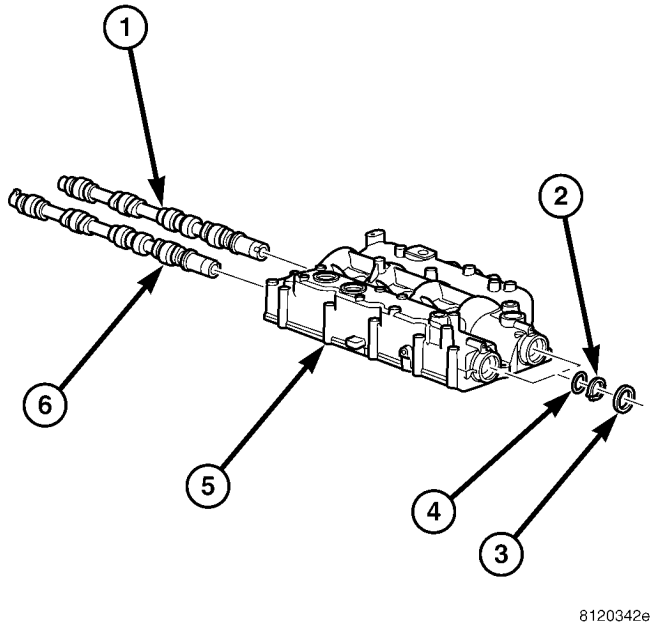



***Fig. 23 CAMSHAFT ASSEMBLY***

1 - INTAKE CAMSHAFT
2 - SNAPRING
3 - CAMSHAFT OIL SEAL
4 - THRUST WASHER
5 - CYLINDER HEAD COVER/INTAKE MANIFOLD
6 - EXHAUST MANIFOLD

## INSTALLATION

(1) Lubricate the camshafts with Mopar® Engine Oil Supplement, or equivalent.
(2) Carefully install camshafts into access holes in rear of cylinder head cover/intake manifold.
(3) Install thrust washer, snap ring, and camshaft oil seal (Fig. 23).
(4) After camshafts are properly installed in cylinder head cover check end play of camshafts with a dial indicator. The end play should be between .10 mm – .55 mm.

**NOTE: If the camshaft end play is not within specification, measure thickness of the camshaft spacer. Camshaft spacer thickness should be 2.8 ± .02mm.**

(5) Install access hole plugs and gaskets at rear of cylinder head cover/intake manifold. Torque plugs to 80N·m.
(6) Install cylinder head cover/intake manifold on engine block (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
(7) Install timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

CAMSHAFT(S) (Continued)

(8) Install timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(9) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(10) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).

(11) Install generator (Refer to 8 - ELECTRICAL/ CHARGING/GENERATOR - INSTALLATION).

(12) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(13) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(14) Install air cleaner housing.

(15) Refill cooling system (Refer to 7 - COOLING/ ENGINE/COOLANT - STANDARD PROCEDURE).

(16) Install front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).

(17) Connect negative battery cable.

# CYLINDER HEAD COVER(S)

## DESCRIPTION

The cylinder head cover is made of cast aluminum and is also the intake manifold on this engine. The cylinder head cover is equipped with a double breather port and an internal oil return pipe (Fig. 24).

## REMOVAL

## REMOVAL

**CAUTION: Before removing the cylinder head cover/ intake manifold the engine must put at 90° after TDC. Failure to do so could result in valve and/or piston damage during reassembly. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)**

(1) Disconnect negative battery cable.

(2) Remove front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).

(3) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).

(4) Drain cooling system (Refer to 7 - COOLING/ ENGINE/COOLANT - STANDARD PROCEDURE).

(5) Rotate engine until 90° after TDC is reached. Install both camshaft locking pins and the crankshaft locking pin. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)

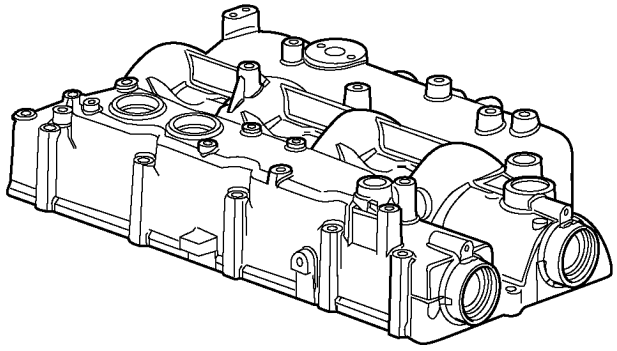



***Fig. 24 CYLINDER HEAD COVER/INTAKE MANIFOLD***

(6) Remove air cleaner housing assembly.

(7) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(8) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(9) Remove generator (Refer to 8 - ELECTRICAL/ CHARGING/GENERATOR - REMOVAL).

(10) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/ RIGHT MOUNT - REMOVAL).

(11) Remove outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(12) Remove timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(13) Remove inner timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(14) Disconnect camshaft position sensor, boost pressure/intake air temperature sensor, EGR solenoid, and fuel pressure sensor electrical connectors (Fig. 25).

(15) Disconnect vacuum lines at EGR solenoid.

(16) Position electrical harness out of way.

(17) Remove fuel injectors (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - REMOVAL).

(18) Remove fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - REMOVAL).

CYLINDER HEAD COVER(S) (Continued)

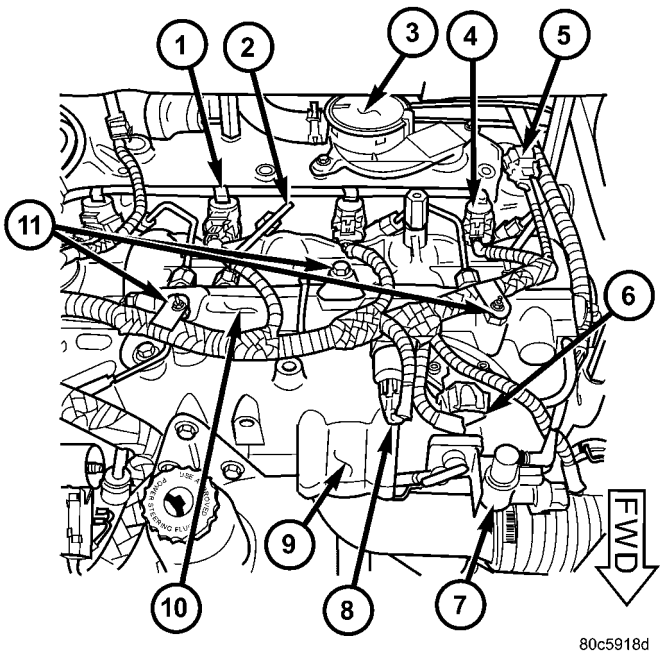



***Fig. 25 ENGINE COMPONENT LOCATIONS***

1 - FUEL INJECTOR RETURN LINE
2 - FUEL INJECTOR SUPPLY LINE
3 - OIL SEPARATOR
4 - FUEL INJECTOR
5 - CAMSHAFT POSITION SENSOR
6 - BOOST PRESSURE/INTAKE AIR TEMPERATURE SENSOR
7 - EGR SOLENOID
8 - FUEL PRESSURE SENSOR
9 - CYLINDER HEAD COVER/INTAKE MANIFOL
10 - FUEL RAIL
11 - WIRING HARNESS RETAINING CLIPS

(19) Remove power steering pump reservoir from bracket.

(20) Remove oil dipstick tube retaining bolt at intake manifold inlet.

(21) Disconnect oil separator outlet hose at separator.

(22) Remove turbo inlet tube retaining bolt at intake manifold.

(23) Disconnect EGR tube at intake manifold inlet tube.

(24) Remove cylinder head cover/intake manifold retaining bolts (Fig. 26).

(25) Lift cylinder head cover/intake manifold from cylinder head (Fig. 26).

**NOTE: While cleaning the oil return passage in the cylinder head cover, be sure to clean the drain back tube in the cylinder head as well.**

(26) Clean the oil return hole in the oil separator access hole with compressed air (Fig. 27).

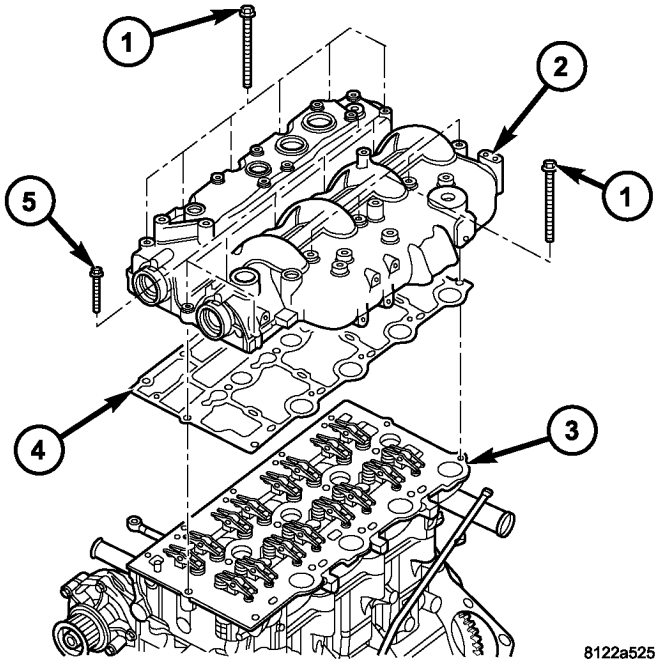



***Fig. 26 CYLINDER HEAD COVER/INTAKE MANIFOLD ASSEMBLY***

1 - CYLINDER HEAD COVER/INTAKE MANIFOLD BOLTS(LONG)
2 - CYLINDER HEAD COVER/INTAKE MANIFOLD
3 - CYLINDER HEAD
4 - CYLINDER HEAD COVER/INTAKE MANIFOLD GASKET
5 - CYLINDER HEAD COVER/INTAKE MANIFOLD BOLTS(SHORT)

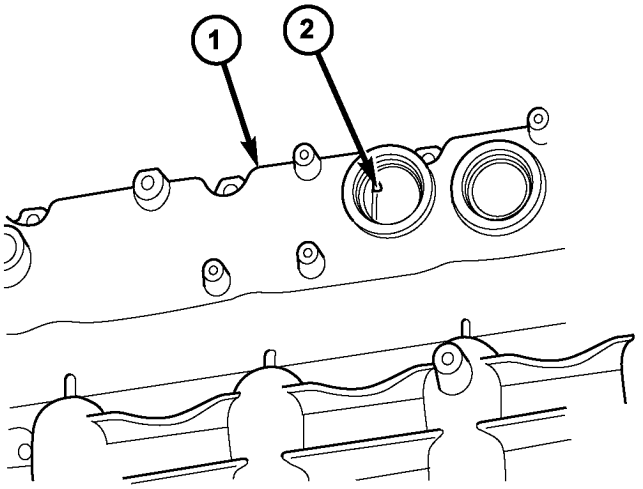



***Fig. 27 OIL RETURN PASSAGE***

1 - CYLINDER HEAD COVER/INTAKE MANIFOLD
2 - OIL RETURN PASSAGE

CYLINDER HEAD COVER(S) (Continued)

**NOTE: When removing rocker arm and lifter assemblies, be sure to keep them in order as they were removed from the cylinder head. Always keep lifters in an upright position when removed from cylinder head.**

(27) Remove rocker arm and lifter assemblies from cylinder head (Fig. 28).

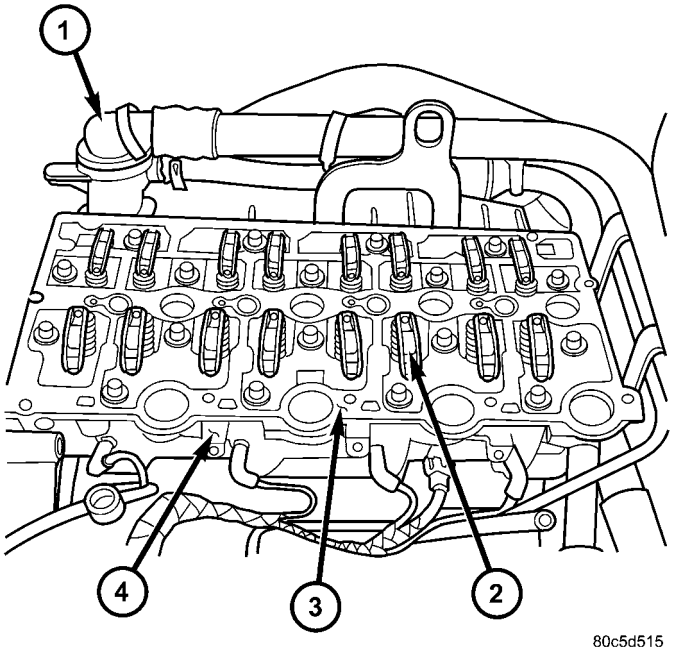



***Fig. 28 CYLINDER HEAD COVER/INTAKE MANIFOLD GASKET LOCATION***

1 - THERMOSTAT HOUSING
2 - ROCKER ARM AND LIFTER ASSEMBLY
3 - CYLINDER HEAD COVER/INTAKE MANIFOLD
4 - CYLINDER HEAD

(28) Remove cylinder head cover/intake manifold gasket from cylinder head.

## REMOVAL

(1) Disconnect the negative battery cable.
(2) Remove the engine cover (Refer to 9 - ENGINE - REMOVAL).
(3) Remove the engine oil separator fastener and remove the separator (Fig. 29).
(4) Using compressed air, blow out the oil drain back passage in the cylinder head cover/intake manifold assembly.

**NOTE: If the cylinder head cover/intake manifold is removed, be sure to clean the oil drain back tube as well.**

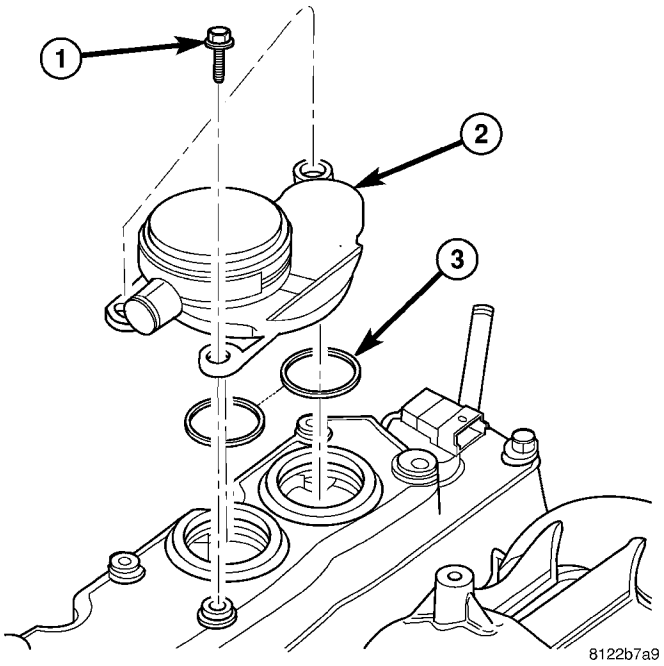



***Fig. 29 ENGINE OIL SEPARATOR***

1 - SCREW
2 - ENGINE OIL SEPARATOR
3 - O-RINGS

## INSTALLATION

## INSTALLATION

(1) Clean and inspect sealing surfaces.
(2) Clean and inspect the breather oil return passage in the cylinder head/intake manifold cover (Fig. 27).
(3) Install new gasket on cylinder head.

**NOTE: Apply a small amount of grease on each valve stem. This will help hold the rocker arm in position during the cylinder head cover installation.**

(4) Install rocker arm and lifter assemblies in cylinder head (Fig. 28).**Be sure to put rocker arm and lifter assemblies in same location as removed.**
(5) Install cylinder head cover/intake manifold alignment studs in cylinder head (Fig. 30).
(6) Install cylinder head cover/intake manifold over alignment stud.

**NOTE: Be sure to lubricate cylinder head cover/intake manifold retaining bolts with engine oil before assembly. If new bolts are being installed, DO NOT lubricate before assembly.**

(7) Install two cylinder head cover/intake manifold retaining bolts and tighten finger tight.

CYLINDER HEAD COVER(S) (Continued)

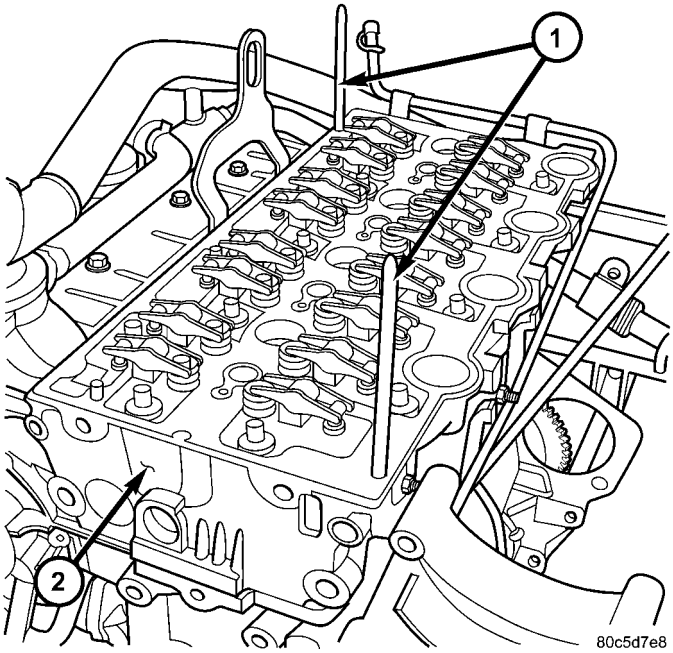



***Fig. 30 CYLINDER HEAD COVER/INTAKE MANIFOLD ALIGNMENT STUDS VM.1066***

1 - CYLINDER HEAD COVER/INTAKE MANIFOLD ALIGNMENT STUDS VM.1066
2 - CYLINDER HEAD

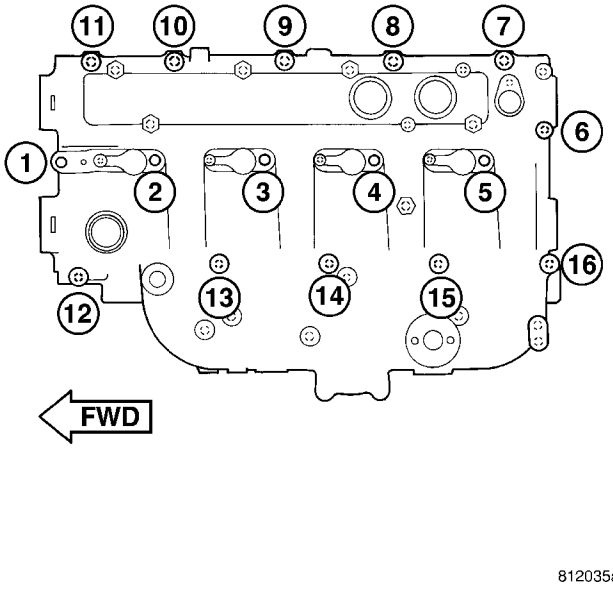



***Fig. 31 CYLINDER HEAD COVER/INTAKE MANIFOLD TIGHTENING SEQUENCE***

(8) Remove alignment studs and install remaining retaining bolts (Fig. 26). Tighten retaining bolts finger tight.

(9) Torque cylinder head cover/intake manifold retaining bolts following procedure below.

***CYLINDER HEAD COVER/INTAKE MANIFOLD TIGHTENING PROCEDURE***

- Coat all bolts being reused with clean engine oil.
- Install the M8x35 bolts into holes 1,2,3,4,5, and 12. Install the M8x85 bolts into holes 6,7,8,9,10,11,13,14,15, and 16. Tighten all bolt **hand tight**.
- Alternate between bolts #11 and #16 to seat cylinder head cover/intake manifold on cylinder head (Fig. 31). Torque bolts to 7 N·m.
- Torque all cylinder head cover/intake manifold retaining bolts to 25 N·m in numerical order starting with #1 and ending with #16 (Fig. 31).

(10) Connect EGR tube at intake manifold inlet tube. Torque clamp to 10.8 N·m.

(11) Install turbo inlet tube retaining bolt at intake manifold. Torque bolt to 27.5 N·m.

(12) Connect oil separator outlet hose at separator.

(13) Install oil dipstick tube retaining bolt at intake manifold inlet. Torque bolt to 10 N·m.

(14) Install power steering pump reservoir in bracket.

(15) Install fuel rail (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL RAIL - INSTALLATION).

(16) Install fuel injectors and fuel injector supply lines (Refer to 14 - FUEL SYSTEM/FUEL INJECTION/FUEL INJECTOR - INSTALLATION).

(17) Connect vacuum lines at EGR solenoid.

(18) Clip wiring harness retainers on studs on fuel rail (Fig. 25).

(19) Connect camshaft position sensor, boost pressure/intake air temperature sensor, EGR solenoid, and fuel pressure sensor electrical connectors (Fig. 25).

(20) Install inner timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(21) Install timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(22) Install outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(23) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).

(24) Install generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(25) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(26) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

CYLINDER HEAD COVER(S) (Continued)

(27) Install air cleaner housing assembly.
(28) Remove crankshaft and both camshaft locking pins (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE).
(29) Refill cooling system (Refer to 7 - COOLING/ENGINE/COOLANT - STANDARD PROCEDURE).
(30) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).
(31) Install front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).
(32) Connect negative battery cable.

## INSTALLATION

**NOTE: Using compressed air, blow out the oil return passage in the cylinder head cover/ intake manifold assembly. If the cylinder head cover/intake manifold has been removed, be sure to clean the oil drain back tube as well.**

(1) Lubricate the O-rings with clean engine oil and position in the cover (Fig. 29).
(2) Seat the oil separator, being careful not to damage the O-rings (Fig. 29).
(3) Install the retaining fastener and torque the bolt to 10.8 N·m (8 lbs. ft.).
(4) Install the engine cover (Refer to 9 - ENGINE - INSTALLATION).
(5) Connect the negative battery cable.

# CAMSHAFT OIL SEAL(S)

## REMOVAL

(1) Disconnect negative battery cable.
(2) Remove air cleaner housing assembly.
(3) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL).
(4) Remove outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

**WARNING: Before removing the timing belt the engine must put at 90° after TDC. Failure to do so could result in valve and/or piston damage during reassembly. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)**

(5) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(6) Using VM.1055, remove both camshaft gears (Fig. 32).
(7) Remove both camshaft oil seals.

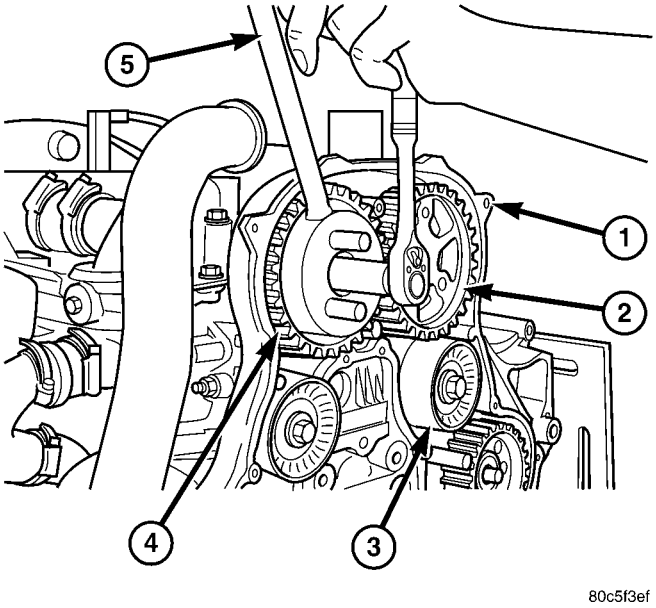



***Fig. 32 CAMSHAFT GEAR REMOVAL/INSTALLATION***

1 - TIMING BELT INNER COVER
2 - CAMSHAFT SPROCKET
3 - IDLER PULLEYS
4 - CAMSHAFT SPROCKET
5 - VM.1055

## INSTALLATION

(1) Install new camshaft oil seal using VM.1057 (Fig. 33).

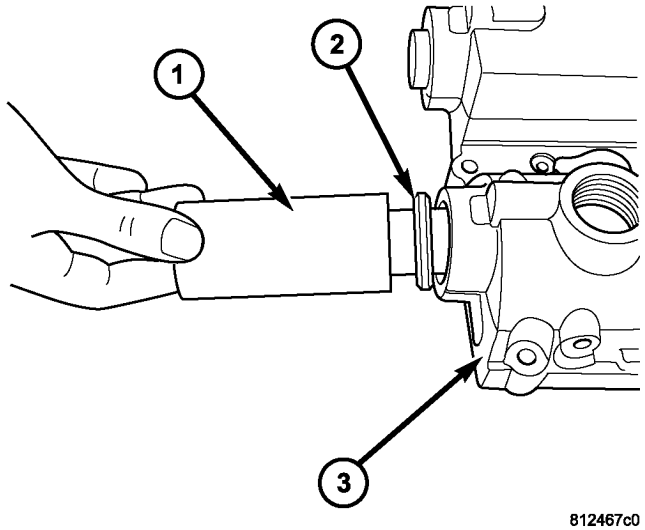



***Fig. 33 CAMSHAFT OIL SEAL INSTALLER***

1 - VM.1057
2 - CAMSHAFT SEAL
3 - CYLINDER HEAD COVER/INTAKE MANIFOLD

CAMSHAFT OIL SEAL(S) (Continued)

(2) Install camshaft sprockets and tighten retaining bolts finger tight.

(3) Install timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(4) Torque camshaft sprockets to 108 N·m using VM.1055 (Fig. 32).

(5) Install outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(6) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).

(7) Install air cleaner housing assembly.

(8) Connect negative battery cable.

# ROCKER ARMS

## DESCRIPTION

The rocker arms are made of stamped steel (Fig. 34).

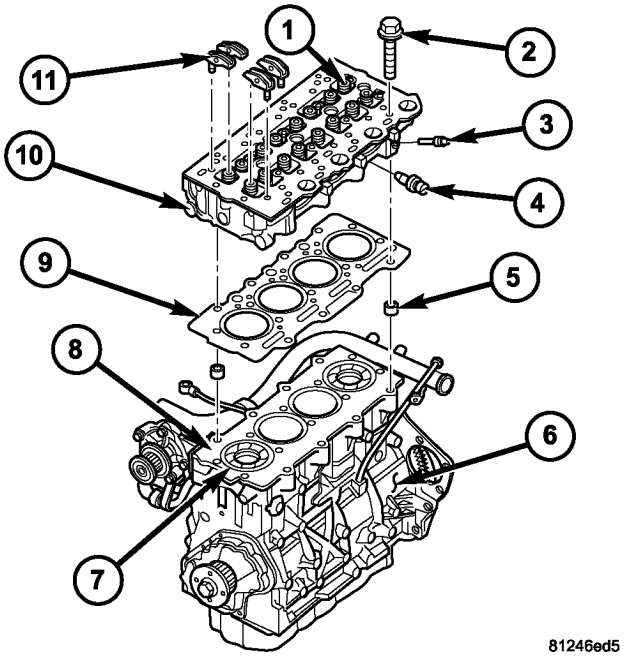



***Fig. 34 CYLINDER HEAD ASSEMBLY***

1 - VALVE SPRING
2 - CYLINDER HEAD BOLT
3 - GLOW PLUG
4 - COOLANT TEMPERATURE SENSOR
5 - CYLINDER HEAD ALIGNMENT DOWEL
6 - CYLINDER BLOCK
7 - CYLINDER LINER
8 - ENGINE BLOCK DECK
9 - CYLINDER HEAD GASKET
10 - CYLINDER HEAD
11 - ROCKER ARM AND LIFTER ASSEMBLY

## OPERATION

The rocker arms 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. This pressure is then transmitted to the valves which causes the valves to open.

## REMOVAL

(1) Disconnect negative battery cable.

(2) Remove front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).

(3) Remove air cleaner housing assembly.

(4) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL).

(5) Remove outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(6) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(7) Remove inner timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(8) Remove cylinder head cover/intake manifold (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(9) Remove rocker arm abd lifter (Fig. 35).

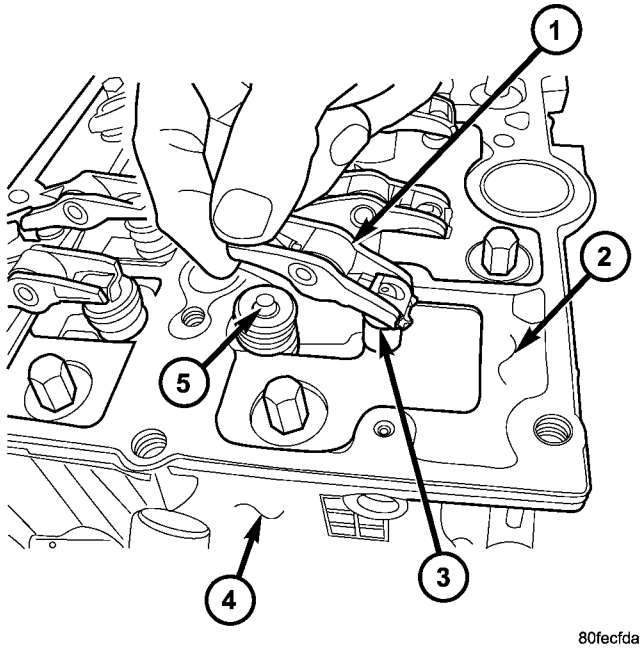



***Fig. 35 ROCKER ARM ASSEMBLY***

1 - ROCKER ARM ASSEMBLY
2 - CYLINDER HEAD COVER/INTAKE MANIFOLD
3 - HYDRAULIC LIFTER
4 - CYLINDER HEAD
5 - VALVE

ROCKER ARMS (Continued)

## INSTALLATION

(1) Clean and inspect gasket sealing surfaces.
(2) Install new gasket on cylinder head.
(3) Lubricate lifter ball end of lifter(s), valve(s), and rocker arm roller(s) with Mopar® Engine Oil Supplement or equivlalent.
(4) Connect rocker arm(s) to lifter and reposition on valve(s) (Fig. 35).
(5) Install cylinder head cover/intake manifold (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).
(6) Install inner timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
(7) Install timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
(8) Install outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
(9) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).
(10) Install air cleaner housing assembly.
(11) Install front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).
(12) Connect negative battery cable.

# HYDRAULIC LIFTERS

## DESCRIPTION

Valve lash is controlled by hydraulic tappets located inside the cylinder head, in tappet bores below the camshafts (Fig. 36).

## REMOVAL

(1) Disconnect negative battery cable.
(2) Remove front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).
(3) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).
(4) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL).
(5) Remove outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

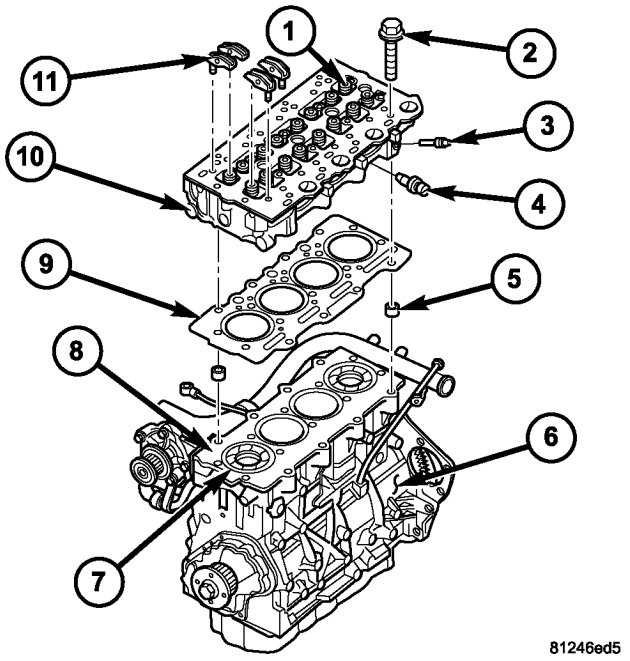



*Fig. 36 CYLINDER HEAD ASSEMBLY*

1 - VALVE SPRING
2 - CYLINDER HEAD BOLT
3 - GLOW PLUG
4 - COOLANT TEMPERATURE SENSOR
5 - CYLINDER HEAD ALIGNMENT DOWEL
6 - CYLINDER BLOCK
7 - CYLINDER LINER
8 - ENGINE BLOCK DECK
9 - CYLINDER HEAD GASKET
10 - CYLINDER HEAD
11 - ROCKER ARM AND LIFTER ASSEMBLY

**CAUTION: Before removing the cylinder head cover/intake manifold or the timing belt the engine must put at 90° after TDC. Failure to do so could result in valve and/or piston damage during reassembly. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)**

(6) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(7) Remove inner timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(8) Remove cylinder head cover/intake manifold (Fig. 37)(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).
(9) Remove rocker arm and lifter assemblies from lifter bores.

HYDRAULIC LIFTERS (Continued)

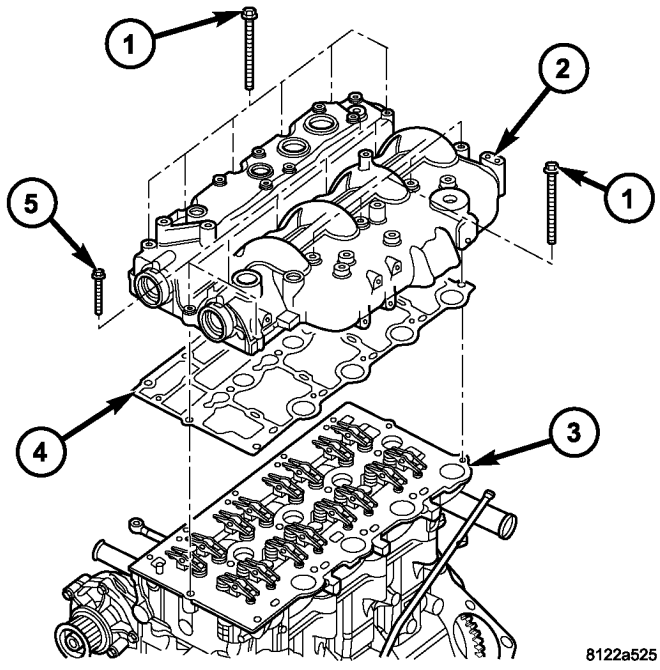



***Fig. 37 CYLINDER HEADCOVER/INTAKE MANIFOLD ASSEMBLY***

1 - CYLINDER HEAD COVER/INTAKE MANIFOLD BOLTS(LONG)
2 - CYLINDER HEAD COVER/INTAKE MANIFOLD
3 - CYLINDER HEAD
4 - CYLINDER HEAD COVER/INTAKE MANIFOLD GASKET
5 - CYLINDER HEAD COVER/INTAKE MANIFOLD BOLTS(SHORT)

## INSPECTION

Clean each lifter assembly 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

(1) Install rocker arm and lifter assemblies in lifter bores.

(2) Install cylinder head cover/intake manifold (Fig. 37) (Refer to 9 - ENGINE/CYLINDER HEAD/ CYLINDER HEAD COVER(S) - INSTALLATION).

(3) Install timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(4) Install timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(5) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(6) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).

(7) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).

(8) Install front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).

(9) Connect negative battery cable.

# ENGINE BLOCK

## DESCRIPTION

The 2.5L/2.8L CRD Diesel engine uses a cast iron engine block with wet cast iron cylinder liners (Fig. 38), (Fig. 39).

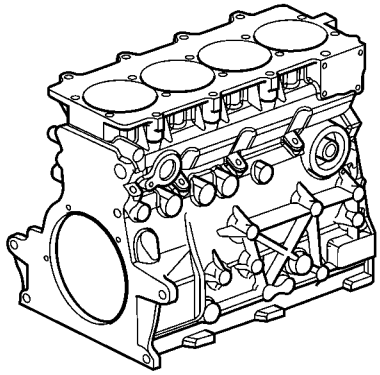



***Fig. 38 ENGINE BLOCK 2.5L***

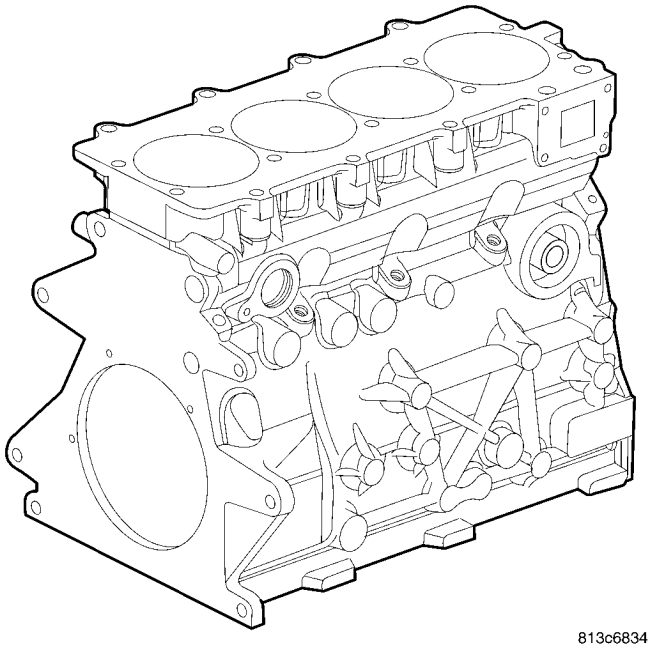



***Fig. 39 ENGINE BLOCK 2.8L***

# CRANKSHAFT

## DESCRIPTION

The crankshaft used for the 2.5L is a forged steel design with five main bearing journals (Fig. 40). The crankshaft used for the 2.8L is of the same basic construction and design except the rear alignment pin is shorter (0.12mm) and the rear crankshaft diameter is slightly larger (0.33mm) (Fig. 41). These crankshafts ARE NOT interchangable. The crankshaft is located at the bottom of the engine block and is held in place with three main bearing supports

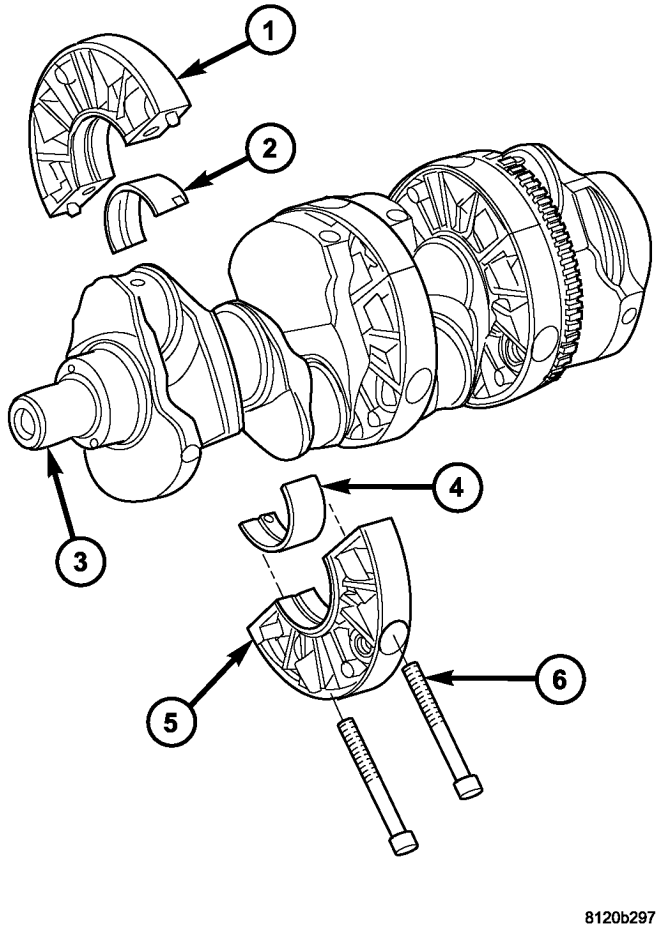



***Fig. 40 CRANKSHAFT***

1 - CRANKSHAFT SUPPORT HALVE
2 - MAIN BEARING HALVE
3 - CRANKSHAFT
4 - MAIN BEARING HALVE
5 - CRANKSHAFT SUPPORT HALVE
6 - MAIN BEARING SUPPORT BOLTS

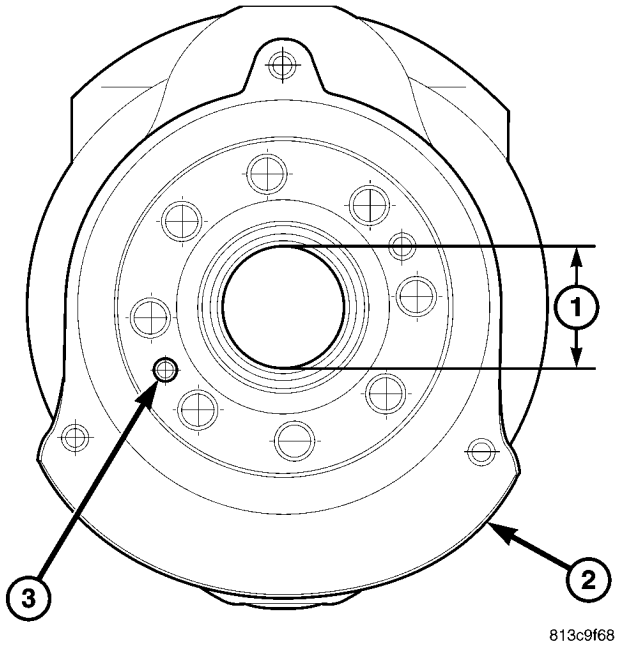



***Fig. 41 2.8L CRANKSHAFT END VIEW***

1 - DIAMETER
2 - CRANKSHAFT
3 - REAR ALIGNMENT PIN

## OPERATION

The crankshaft transfers force generated by combustion within the cylinder bores to the flywheel or flexplate.

## STANDARD PROCEDURE - CHECKING CRANKSHAFT END PLAY

**NOTE: Checking crankshaft end play is similar for both the 2.5L and the 2.8L.**

(1) Mount a dial indicator to a stationary point at rear of engine. Locate the probe perpendicular against the flywheel or flex plate (Fig. 42).

(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 9 - ENGINE - SPECIFICATIONS) .

CRANKSHAFT (Continued)

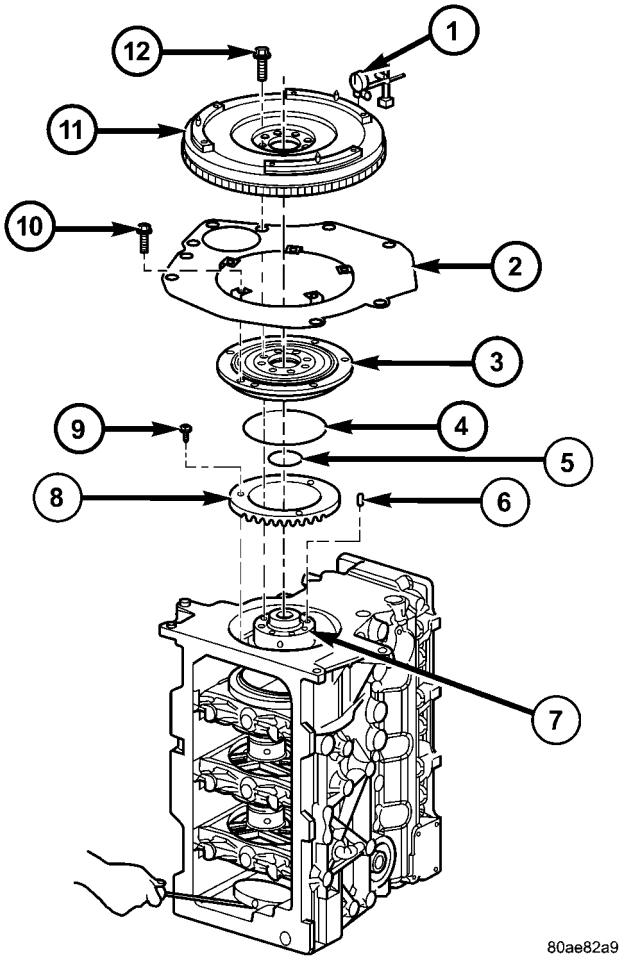



*Fig. 42 CHECKING CRANKSHAFT END PLAY*

1 - DIAL INDICATOR
2 - ADAPTER PLATE
3 - REAR MAIN BEARING SUPPORT
4 - SEALING RING
5 - SEALING RING
6 - ALIGNMENT PIN
7 - CRANKSHAFT
8 - RELUCTOR WHEEL
9 - RELUCTOR WHEEL RETAINING BOLT
10 - REAR MAIN BEARING SUPPORT RETAINING BOLTS
11 - FLYWHEEL
12 - FLYWHEEL BOLTS

## REMOVAL

(1) Remove engine from vehicle (Refer to 9 - ENGINE - REMOVAL).

(2) Mount engine on an engine stand.

(3) Drain engine oil and remove oil filter.

(4) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(5) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(6) Remove timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(7) Remove cylinder head cover/intake manifold (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL).

(8) Remove cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - REMOVAL).

(9) Remove flywheel (2.5L), Remove flex plate (2.8L).

(10) Remove rear main bearing support/adapter plate retaining bolts and remove adapter plate (Fig. 43).

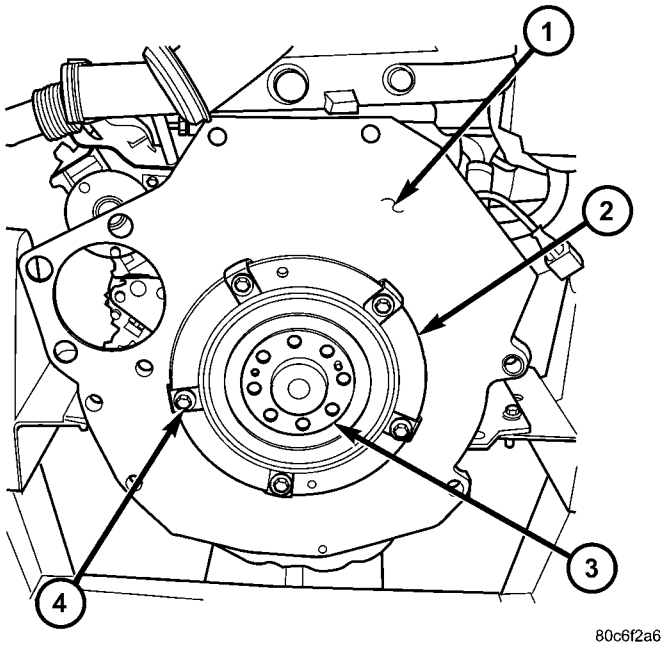



*Fig. 43 2.5L REAR MAIN BEARING SUPPORT*

1 - ADAPTER PLATE
2 - REAR MAIN BEARING SUPPORT
3 - CRANKSHAFT
4 - REAR MAIN BEARING SUPPORT RETAINING BOLTS

(11) Remove rear main bearing support by threading two retaining bolts in holes provided. Tighten bolts equally to push main bearing support out of block (Fig. 44), (Fig. 45).

CRANKSHAFT (Continued)

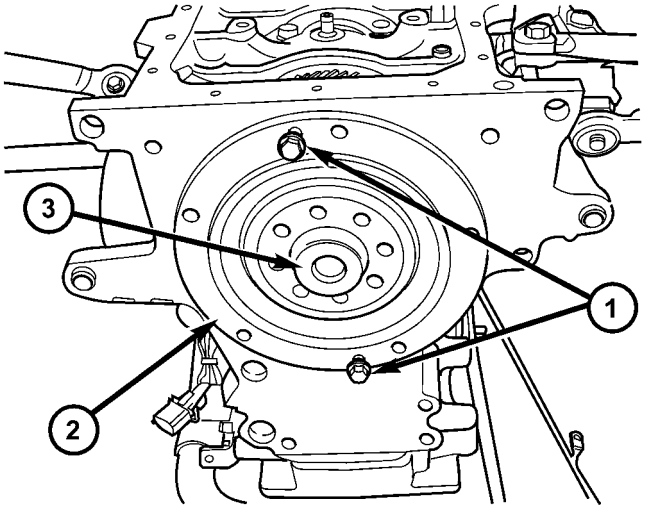



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***Fig. 44 2.5L REAR MAIN BEARING SUPPORT REMOVAL***

1 - BOLTS
2 - REAR MAIN BEARING SUPPORT
3 - CRANKSHAFT

(12) Remove front engine cover (Refer to 9 - ENGINE/ENGINE BLOCK/ENGINE COVER - REMOVAL).

(13) Remove crankshaft sprocket.

(14) Remove oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(15) Remove oil pump pickup tube (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL).

(16) Remove balance shaft assembly (Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - REMOVAL).

(17) Remove oil jets (Refer to 9 - ENGINE/LUBRICATION/OIL JET - REMOVAL).

(18) Remove piston and connecting rod assemblies (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - REMOVAL).

(19) Slide special tool VM.1069 on crankshaft (Fig. 46).

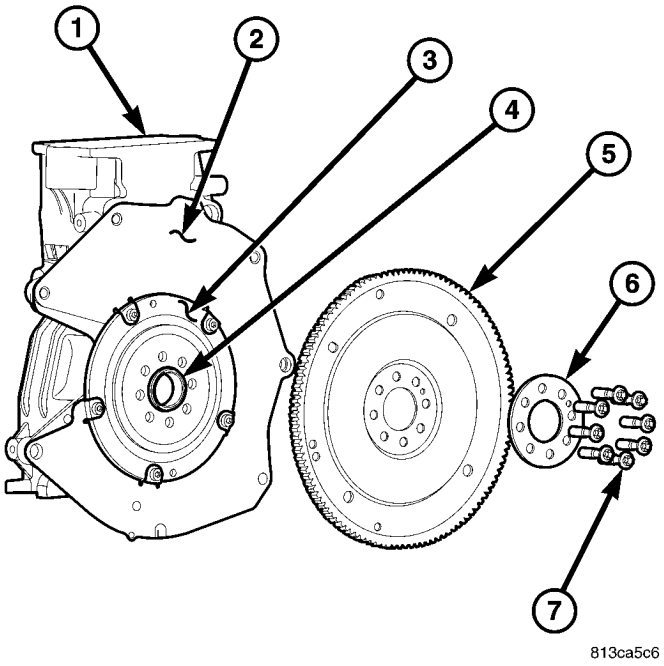


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***Fig. 45 2.8L REAR MAIN BEARING SUPPORT REMOVAL***

1 - ENGINE BLOCK
2 - PLATE
3 - REAR MAIN BEARING SUPPORT
4 - CRANKSHAFT
5 - FLEX PLATE
6 - BACKING PLATE
7 - BOLTS

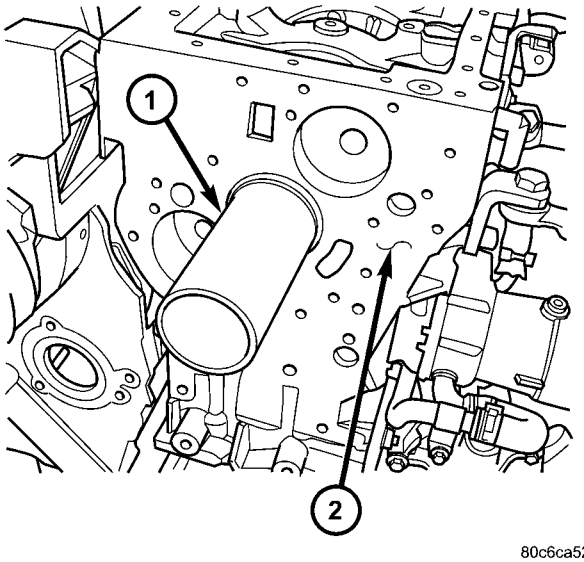


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***Fig. 46 CRANKSHAFT SLEEVE VM.1069***

1 - CRANKSHAFT SLEEVE VM.1069
2 - ENGINE BLOCK

CRANKSHAFT (Continued)

(20) Using special tool VM.1054, remove crankshaft support retainers (Fig. 47).

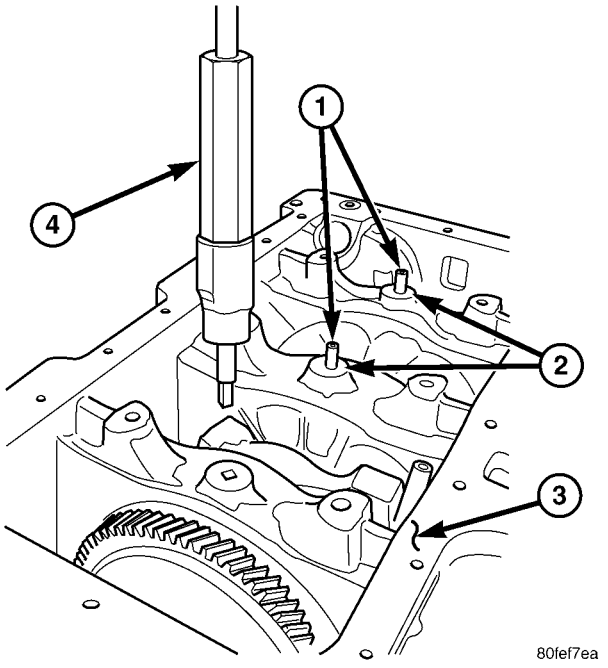


***Fig. 47 CRANKSHAFT SUPPORT RETAINERS/ BALANCE SHAFT OIL FEED***

1 - CRANKSHAFT SUPPORT RETAINERS/BALANCE SHAFT OIL FEED
2 - O-RINGS (3)
3 - ENGINE BLOCK
4 - CRANKSHAFT SUPPORT RETAINER/BALANCE SHAFT OIL FEED REMOVER - INSTALLER VM.1054

(21) Slide crankshaft out rear of engine block.

## INSTALLATION

**CAUTION: IT IS CRITICAL THAT BOTH HALVES OF THE CRANKSHAFT SUPPORT ARE ALIGNED PROPERLY WITH THE ENGINE TO SUPPORT ENGINE OIL MANAGEMENT.**

**NOTE: Before installing crankshaft in engine block, be sure the notches in the crankshaft supports are facing towards the front of the engine.**

(1) Install crankshaft in engine block. **Be sure to align oil holes in crankshaft supports and engine block.**

**NOTE: There are two identical holes in the crankshaft support. Care must be take to insert the special tool into the correct hole (Fig. 48).**

(2) Insert crankshaft alignment dowel into the vacuum pump access hole, through the proper crankshaft support holes, then slide the tool guide flush against the engine block and retain with a vacuum pump retaining bolt (Fig. 48).

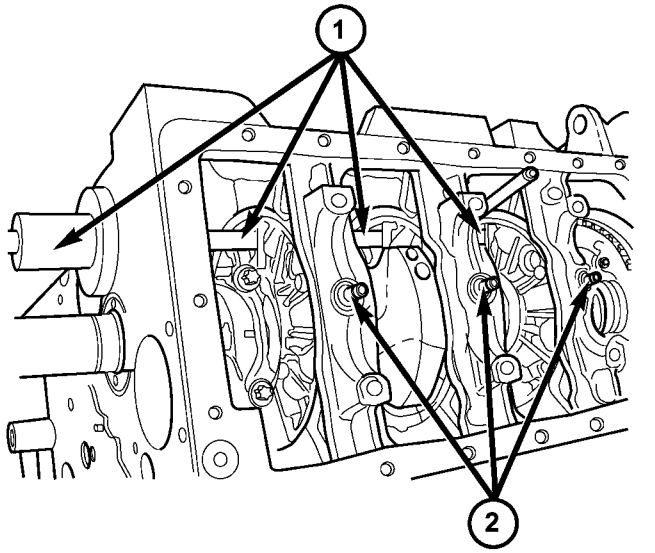


***Fig. 48 CRANKSHAFT SUPPORT ALIGNMENT***

1 - CRANKSHAFT ALIGNMENT TOOL VM9095
2 - BALANCE SHAFT OIL SUPPLY

**NOTE: Before installing the crankshaft support retainers/balance shaft oil supply be sure that special tool VM 1079, alignment pins, and VM 9095 are installed (Fig. 49).**

(3) Install crankshaft support retainers using special tool VM 1054. (Fig. 47).

(4) Install crankshaft support retainers O-rings.

(5) Remove special tool VM.1069 from crankshaft (Fig. 46).

(6) Remove special tool VM 9095 from the engine block.

(7) Install crankshaft sprocket.

(8) Install front engine cover (Refer to 9 - ENGINE/ENGINE BLOCK/ENGINE COVER - INSTALLATION).

(9) Install rear main bearing support in engine block. **Be sure to align oil hole in rear main bearing support with hole in block.**

(10) Install adapter plate and retaining bolts (Fig. 43). Torque bolts to 27.5N·m.

CRANKSHAFT (Continued)

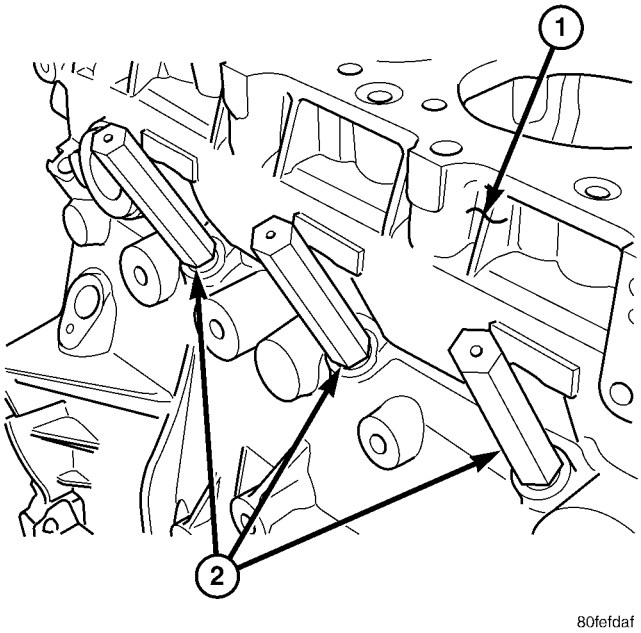


***Fig. 49 CRANKSHAFT SUPPORT RETAINERS/ BALANCE SHAFT OIL SUPPLY ALIGNMENT PINS***

1 - ENGINE BLOCK
2 - ALIGNMENT PINS VM 1079

(11) Install flywheel (2.5L), Install flex plate (2.8L).

(12) Install piston and connecting rod assemblies (Refer to 9 - ENGINE/ENGINE BLOCK/PISTON & CONNECTING ROD - INSTALLATION).

(13) Install oil jets (Refer to 9 - ENGINE/LUBRICATION/OIL JET - INSTALLATION).

(14) Install balance shaft assembly (Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - INSTALLATION).

(15) Install oil pump pickup tube (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(16) Install oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(17) Install cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(18) Install cylinder head cover/intake manifold (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION).

(19) Install timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(20) Install timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(21) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(22) Install engine in vehicle.

(23) Fill engine oil with proper oil to correct level.

# FLEX PLATE

## REMOVAL

(1) Remove the transmission (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL - REMOVAL).

(2) Paint mark the flex plate to crankshaft relationship.

(3) Remove the flex plate fasteners and fly wheel (Fig. 50).

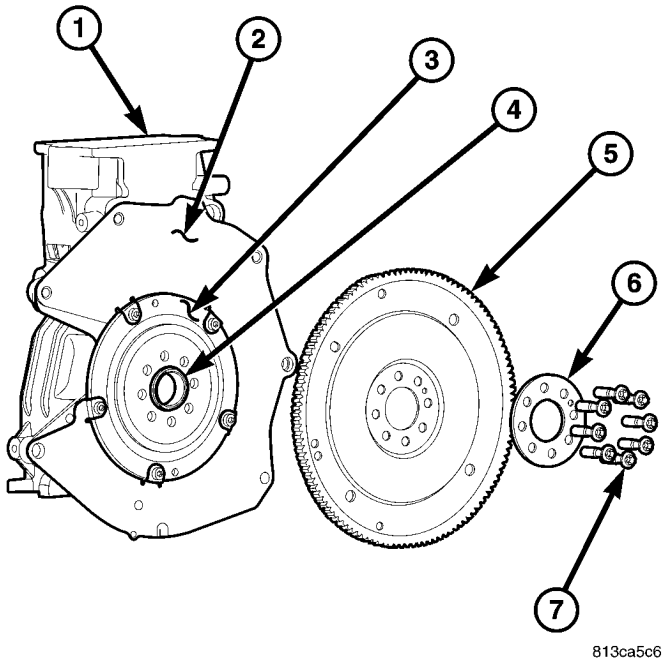


***Fig. 50 2.8L REAR MAIN BEARING SUPPORT REMOVAL***

1 - ENGINE BLOCK
2 - PLATE
3 - REAR MAIN BEARING SUPPORT
4 - CRANKSHAFT
5 - FLEX PLATE
6 - BACKING PLATE
7 - BOLTS

## INSTALLATION

**NOTE: Do Not Lubricate new bolts because they are already coated with an anti scuff treatment.**

(1) Position the flex plate and install the fasteners hand tight (Fig. 50).

(2) Tighten each fastener to 50 N·m (37 lbs. ft.) following a clockwise cross sequence.

(3) At this point, loosen only one fastener at a time and with a torque wrench set to 25 N·m (19 lbs. ft.) tighten the bolt, then with a torque angle gauge tighten that bolt an additional 60 degrees.

(4) Perform the above procedure for each fastener in a cross sequence.

# FLY WHEEL

## REMOVAL

(1) Remove the transmission (Refer to 21 - TRANSMISSION/TRANSAXLE/MANUAL - REMOVAL).

(2) Paint mark the fly wheel to crankshaft relationship.

(3) Remove the fly wheel fasteners and fly wheel (Fig. 51).

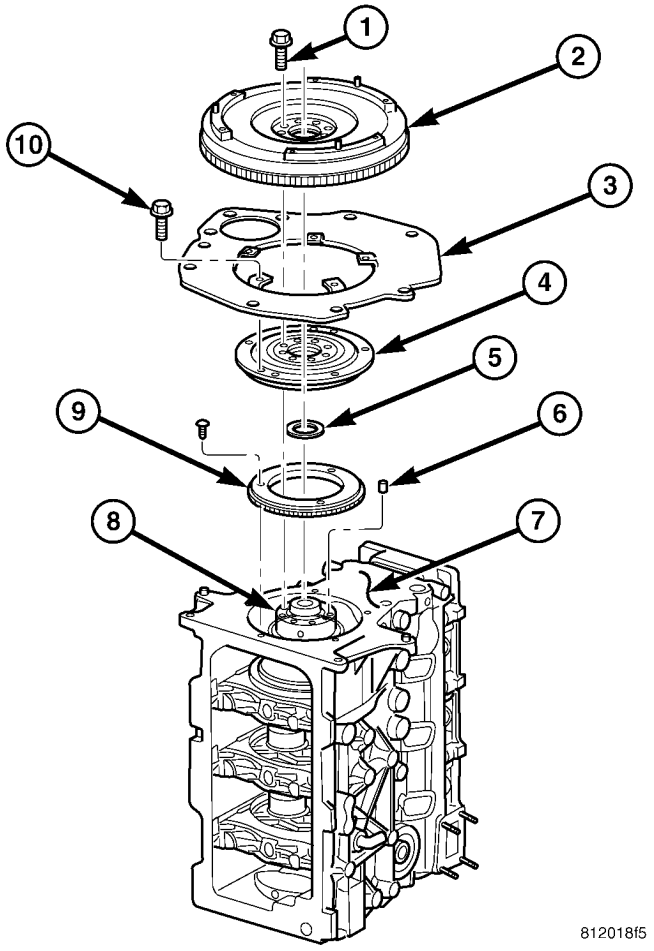


*Fig. 51 FLY WHEEL*

1 - 60 MM FLY WHEEL BOLTS
2 - FLY WHEEL
3 - TRANSMISSION ADAPTOR PLATE
4 - REAR MAIN BEARING SUPPORT
5 - O-RING
6 - DOWL
7 - ENGINE BLOCK
8 - CRANKSHAFT
9 - RELUCTOR WHEEL
10 - ADAPTOR PLATE BOLT

## INSTALLATION

**NOTE: Do Not Lubricate new bolts because they are already coated with an anti scuff treatment.**

(1) Position the fly wheel and install the fasteners hand tight (Fig. 51).

(2) Tighten each fastener to 50 N·m (37 lbs. ft.) following a clockwise cross sequence.

(3) At this point, loosen only one fastener at a time and with a torque wrench set to 25 N·m (19 lbs. ft.) tighten the bolt, then with a torque angle gauge tighten that bolt an additional 60 degrees.

(4) Perform the above procedure for each fastener in a cross sequence.

# CYLINDER LINERS

## DESCRIPTION

The cylinder wall liner used on this engine is of the wet design. O-rings are used to seal the liner to the engine block.

## REMOVAL

(1) Remove engine from vehicle.

(2) With engine completely disassembled, use special tool VM.1001 to remove liner assembly (Fig. 52).

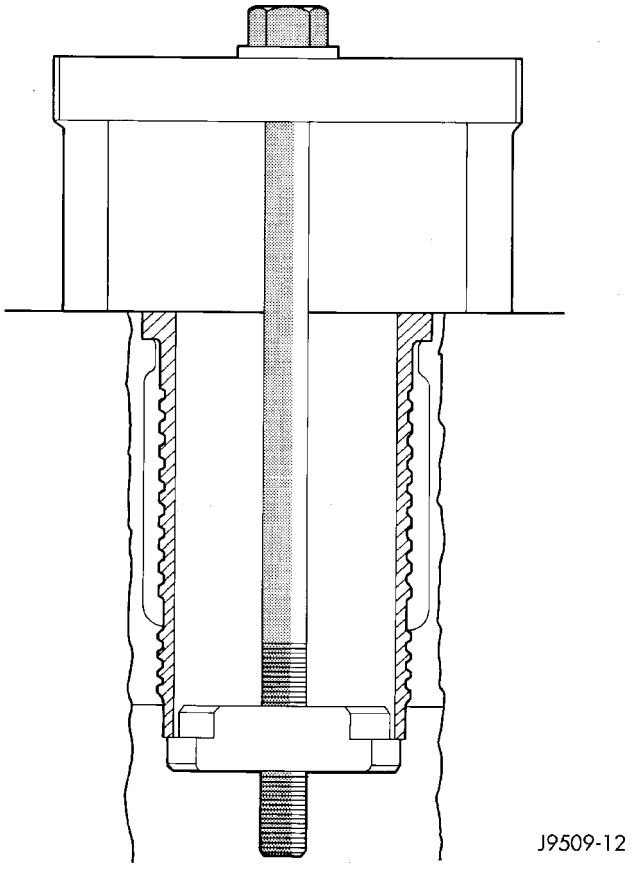


*Fig. 52 CYLINDER LINER REMOVER*

(3) Tighten bolt on VM.1001 to remove liner from block (Fig. 53).

(4) Remove shims from cylinder liner or cylinder block recess. Keep shims with each cylinder liner.

CYLINDER LINERS (Continued)

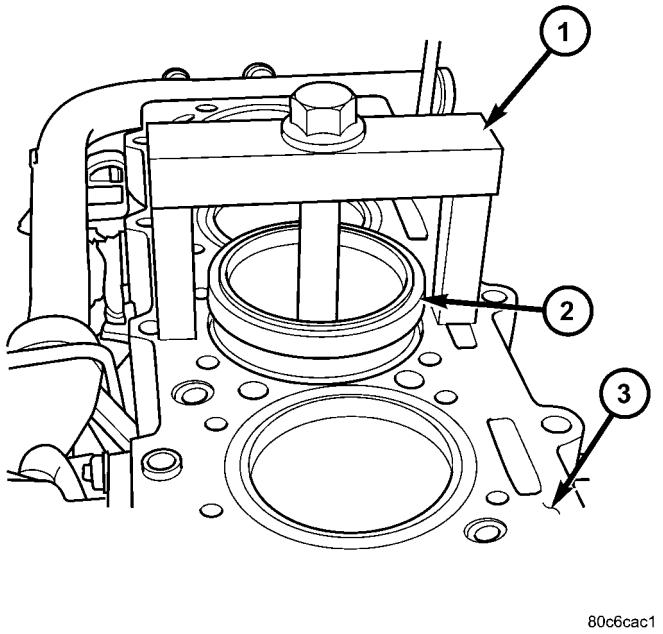


*Fig. 53 CYLINDER LINER REMOVAL*

1 - SPECIAL TOOL VM.1001
2 - CYLINDER LINER
3 - ENGINE BLOCK

## INSPECTION

The cylinder walls should be checked for out-of-round and taper with a dial bore gauge. The cylinder bore out-of-round is 0.100 mm (.0039 in.) maximum and cylinder bore taper is 0.100 mm (.0039 in.) maximum. If the cylinder walls are badly scuffed or scored, new liners should be installed and honed, and new pistons and rings fitted.

Measure the cylinder bore at three levels in directions A and B (Fig. 54). Top measurement should be 10 mm (3/8 in.) down and bottom measurement should be 10 mm (3/8 in.) up from the bottom bore.

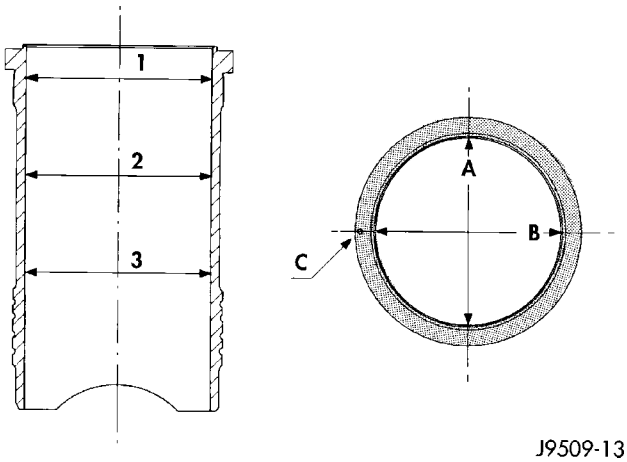


*Fig. 54 LINER INSPECTION*

## INSTALLATION

**CAUTION: Cylinder liner O-rings have different diameters. Care should be taken when installing replacement O-rings because they are engine specific.**

(1) Carefully clean liner and engine block, and degrease the engine block where it comes into contact with the liners. Install the liners in the engine block as shown, rotating them back and forth by 45° in order to guarantee correct positioning (Fig. 55).

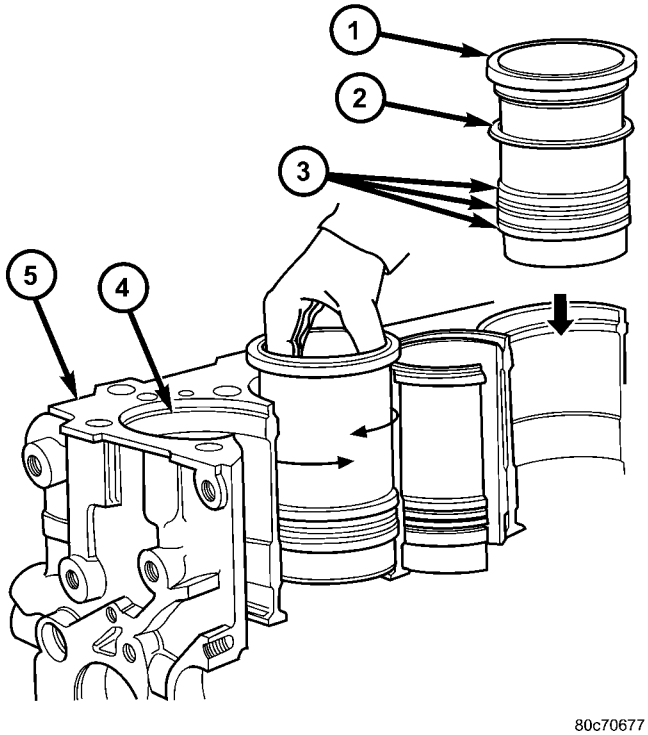


*Fig. 55 LINER INSTALLATION*

1 - CYLINDER LINER
2 - SHIMS
3 - O-RINGS
4 - BLOCK LEDGE
5 - ENGINE BLOCK

(2) Measure the liner recess relative to block deck with a dial indicator mounted on a special tool VM-1010 A. **All the measurements must be taken on high pressure pump side of engine block.** . Zero dial gauge on block deck.

(3) Move dial gauge to cylinder liner record reading on dial gauge.

(4) Remove liner and special tool.

(5) Then select the correct shim thickness to give proper protrusion (0.00 - 0.05 mm).

(6) Fit the shim and the O-rings onto the liner.

(7) Lubricate the lower liner location in the block.

CYLINDER LINERS (Continued)

(8) Fit the liners in the crankcase making sure that the shim is positioned correctly in the seat. Lock the liners in position using special tool (VM.1076) and bolts (Fig. 56).

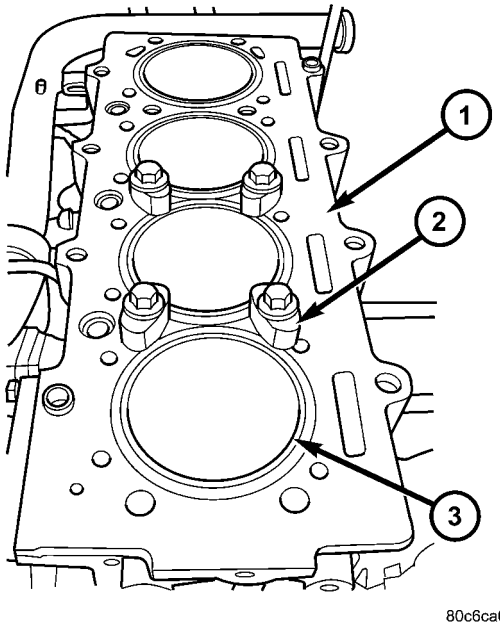


***Fig. 56 LINER CLAMP LOCATION***

1 - ENGINE BLOCK
2 - LINER RETAINER VM.1076
3 - CYLINDER LINER

(9) Recheck the liner protrusion. It should be 0.00 - 0.05 mm.

(10) Reassemble engine.

(11) Install engine in vehicle.

# INTERNAL VACUUM PUMP

## DESCRIPTION

The diesel engine uses a internal vacuum pump. This vacuum pump is mounted in the front of the engine block under the engine front cover (Fig. 57). The vacuum pump is driven by a sprocket on the crankshaft.

## REMOVAL

(1) Disconnect negative battery cable.

(2) Remove air cleaner housing.

(3) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(4) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

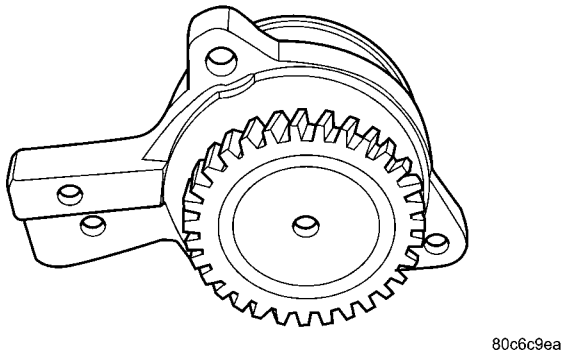


***Fig. 57 VACUUM PUMP***

(5) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL).

(6) Remove vibration damper/crankshaft pulley (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(7) Remove outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(8) Remove timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(9) Remove timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

**NOTE: Crankshaft hub has LHD thread.**

(10) Remove crankshaft hub.

(11) Remove front engine cover (Refer to 9 - ENGINE/ENGINE BLOCK/ENGINE COVER - REMOVAL).

(12) Remove crankshaft sprocket (Fig. 58).

(13) Remove vacuum pump (Fig. 58).

## INSTALLATION

**NOTE: Verify the 3 blades on the vacuum pump are in place and correctly assembled. The tapered edge should be on the outer side. Make sure the pump rotates before installation.**

(1) Lubricate vacuum pump blades and install in vacuum pump body as shown (Fig. 59).

(2) Install vacuum pump in engine block (Fig. 58). Torque bolts to 10.8N·m.

(3) Install crankshaft sprocket (Fig. 58). Torque bolts to 10.8N·m.

(4) Install front engine cover (Refer to 9 - ENGINE/ENGINE BLOCK/ENGINE COVER - INSTALLATION).

(5) Install front crankshaft hub. Torque bolt to 304N·m.

INTERNAL VACUUM PUMP (Continued)

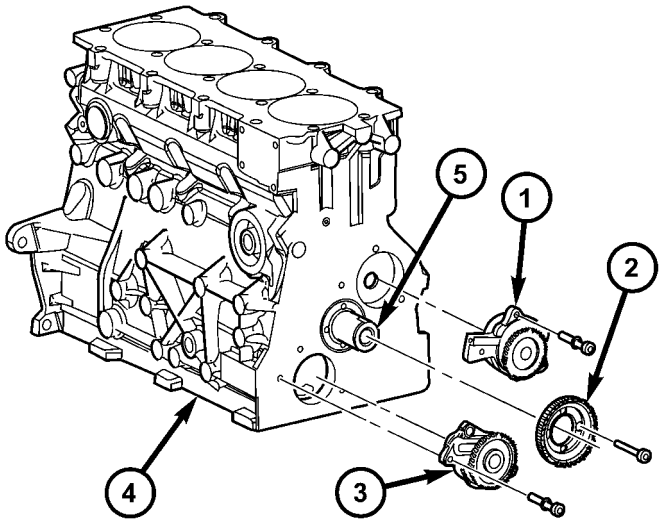


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***Fig. 58 OIL PUMP AND VACUUM PUMP***

1 - VACUUM PUMP
2 - CRANKSHAFT SPROCKET
3 - OIL PUMP
4 - ENGINE BLOCK
5 - CRANKSHAFT

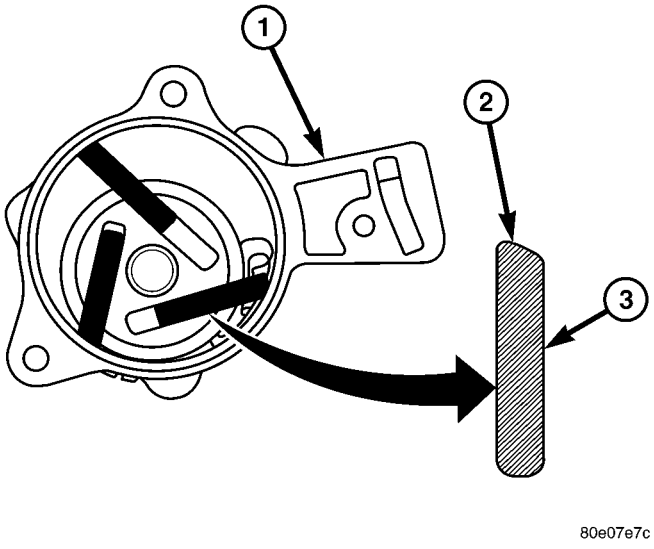


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***Fig. 59 VACUUM PUMP COMPONENTS***

1 - VACUUM PUMP BODY
2 - VACUUM PUMP BLADE TAPERED EDGE
3 - VACUUM PUMP BLADE

(6) Install timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(7) Install timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(8) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(9) Install vibration damper/crankshaft pulley.

(10) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).

(11) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(12) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(13) Install air cleaner housing.

(14) Connect negative battery cable.

# PISTON & CONNECTING ROD

## DESCRIPTION

The pistons are of a free floating design. Oil jets in the engine block lubricate and cool the piston and pin assembly. The connecting rods have a pressed in place wrist pin bushing which is lubricated by the oil jets (Fig. 60).

## STANDARD PROCEDURE - PISTON RING FITTING

(1) Wipe cylinder bore clean. Insert ring and push down with piston to ensure it is square in bore. The ring gap measurement must be made with the ring positioning at least 12 mm (0.50 in.) from bottom of cylinder bore (Fig. 61). Check gap with feeler gauge. Top compression ring gap .30 to .45mm (.0118 to .0177 in.). Second compression ring gap .30 to .45mm (.0118 to .0177 in.). Oil control ring gap .25 to .50mm (.0098 to .0196 in.).

(2) If ring gaps exceed dimension given, new rings or cylinder liners must be fitted. Keep piston rings in piston sets.

(3) Check piston ring to groove clearance (Fig. 62). Top compression ring gap .080 to .130mm (.0031 to .0051 in.). Second compression ring gap .070 to .110mm (.0027 to .0043 in.). Oil control ring gap .040 to .080mm (.0015 to .0031 in.).

## REMOVAL

(1) Disconnect negative battery cable.

(2) Remove cylinder head (Refer to 9 - ENGINE/ CYLINDER HEAD - REMOVAL).

PISTON & CONNECTING ROD (Continued)

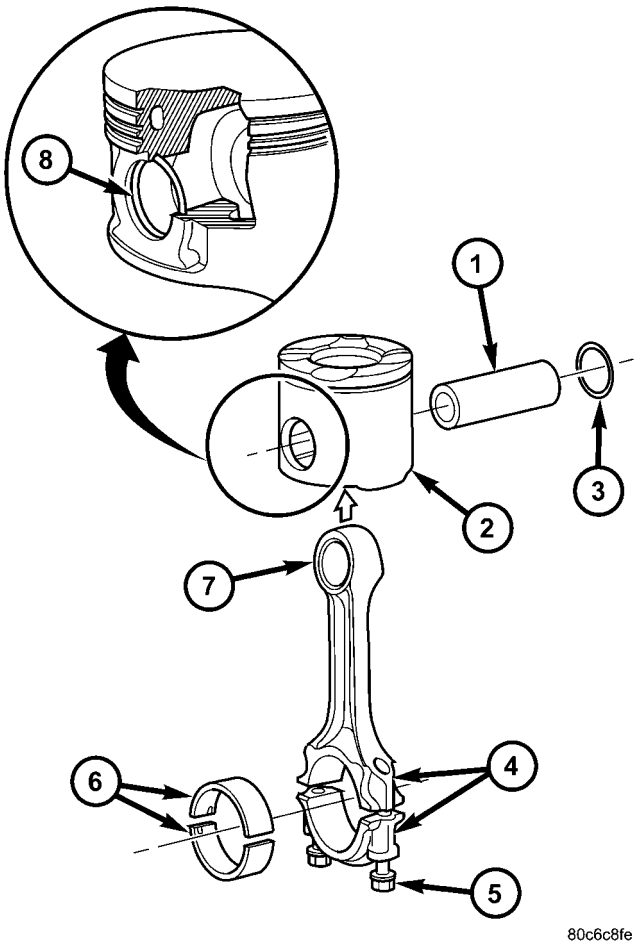


***Fig. 60 PISTON AND CONNECTING ROD ASSEMBLY***

1 - PISTON PIN
2 - PISTON
3 - SNAP RING
4 - PAINTED CONNECTING ROD ALIGNMENT NUMBERS
5 - CONNECTING ROD BOLT
6 - CONNECTING ROD BEARING
7 - CONNECTING ROD
8 - SNAP RING

(3) Raise vehicle on hoist.

(4) Remove oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(5) Remove oil pump pickup tube.(Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - REMOVAL)

(6) Remove balance shaft assembly (Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - REMOVAL).

(7) 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.**

(8) Piston and connecting rods must be removed from top of cylinder block. Rotate crankshaft so that each connecting rod is centered in cylinder bore.

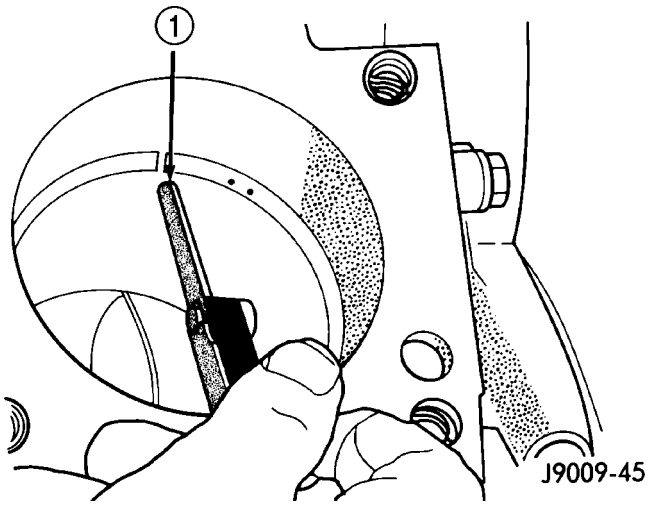


***Fig. 61 RING END GAP MEASUREMENT***

1 - FEELER GAUGE

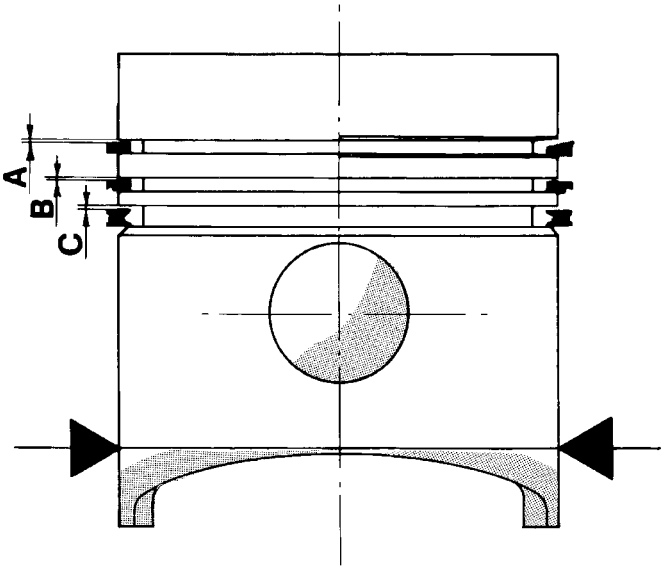


***Fig. 62 PISTON RING TO GROOVE CLEARANCE***

**NOTE: Be careful not to nick or scratch crankshaft journals, connecting rod cap can be separated by tapping with a plastic hammer on a clean surface.**

(9) After removal, install bearing cap on the mating rod and mark piston and connecting rod with painted matching cylinder number when removed from engine block.

PISTON & CONNECTING ROD (Continued)

## PISTON PIN - REMOVAL

(1) Secure connecting rods in a soft jawed vice.

(2) Remove 2 snap rings securing piston pin (Fig. 63).

(3) Push piston pin out of piston and connecting rod (Fig. 63).

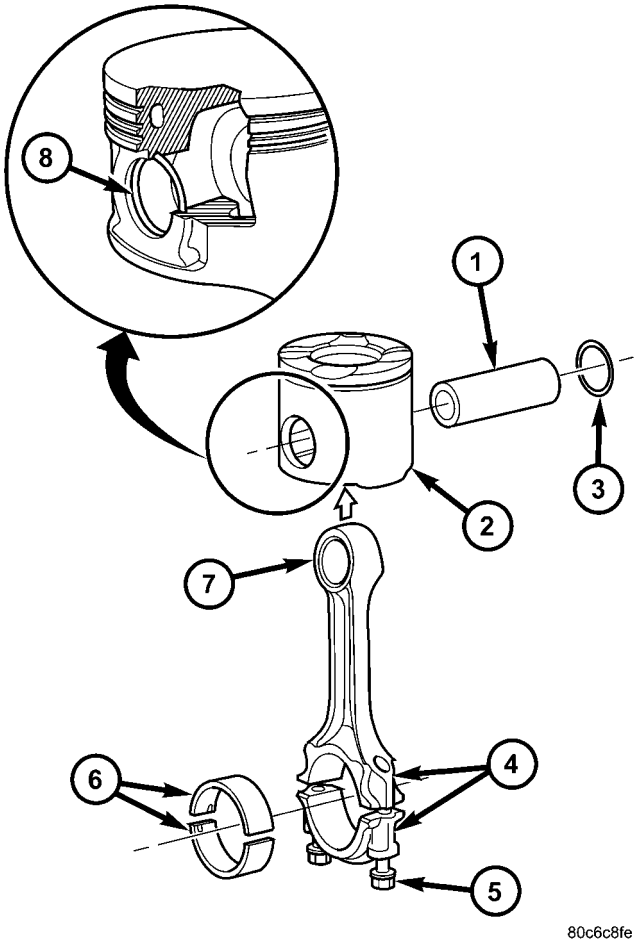


*Fig. 63 PISTON AND CONNECTING ROD ASSEMBLY*

1 - PISTON PIN
2 - PISTON
3 - SNAP RING
4 - PAINTED CONNECTING ROD ALIGNMENT NUMBERS
5 - CONNECTING ROD BOLT
6 - CONNECTING ROD BEARING
7 - CONNECTING ROD
8 - SNAP RING

## PISTON RING - REMOVAL

(1) ID mark on face of top and second piston rings must point toward piston crown.

(2) Using a suitable ring expander, remove top and second piston rings (Fig. 64).

(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.

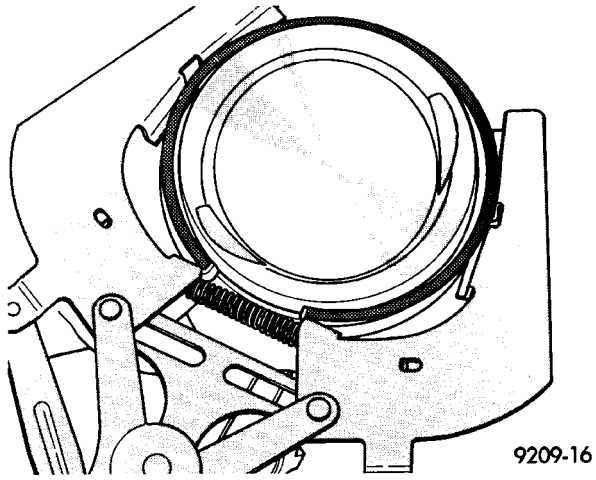


*Fig. 64 PISTON RINGS - REMOVAL/INSTALLATION*

## INSPECTION

### PISTONS

(1) Piston Diameter: Size: 91.912-91.928mm (3.6185-3.6192 in.) Maximum wear limit .05mm (.0019 in.).

(2) Check piston pin bores in piston for roundness. Make 3 checks at 120° intervals. Maximum out of roundness .05mm (.0019in.).

(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

**CAUTION: Connecting rod bolts must be replaced when disassembled. When assembling the connecting rod, be sure that the pawl on each of the connecting rod caps is facing the rear (fly wheel) side of the engine (Fig. 65).**

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

(1) Assemble bearing shells and bearing caps to their respective connecting rods ensuring that the serrations on the cap and reference marks are aligned (Fig. 65).

(2) Tighten connecting cap bolts to 10 N·m (88 in. lbs.).

(3) Without loosening connecting rod bolts, tighten all bolts to 30N·m (22 ft.lbs.).

(4) Using a torque angle gauge, tighten each bolt an additional 40°.

PISTON & CONNECTING ROD (Continued)

(5) Recheck all bolt tightening with a torque wrench set to 88N·m (65 ft.lbs.).

(6) Check and record internal diameter of crank end of connecting rod.

**CAUTION: When changing connecting rods, DO NOT use a stamp to mark the cylinder location. Identify the connecting rods and caps location using a paint marker. All four must have the same weight and the same number. Replacement connecting rods will only be supplied in sets of four (Fig. 65).**

Connecting rods are supplied in sets of four since they all must be of the same weight category. Max allowable weight difference is 5 gr.

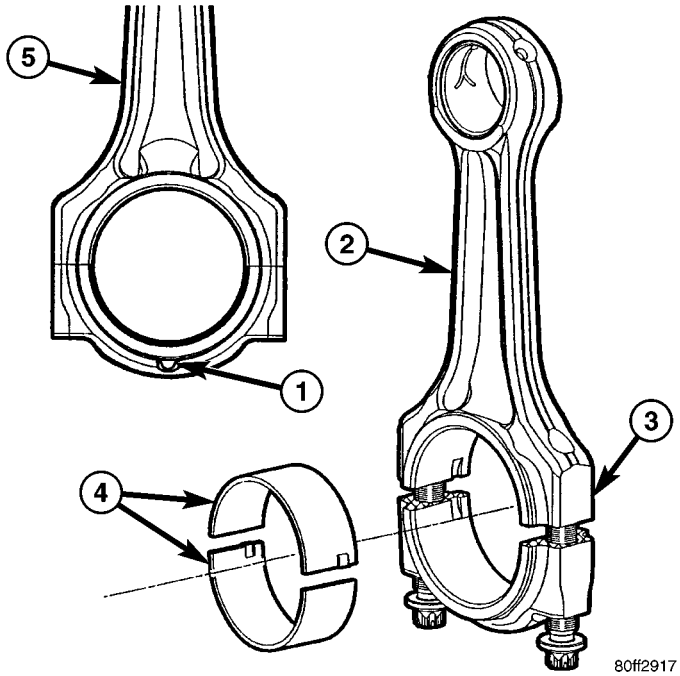


*Fig. 65 CONNECTING ROD IDENTIFICATION*

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

## PISTON PINS

(1) Measure the diameter of piston pin in the center and both ends.For specification,(Refer to 9 - ENGINE - SPECIFICATIONS), (Refer to 9 - ENGINE - SPECIFICATIONS)

# INSTALLATION

## PISTON PIN INSTALLATION

(1) Secure connecting rod in soft jawed vice.

(2) Lubricate piston pin and piston with clean engine oil.

(3) Position piston on connecting rod (Fig. 66).

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

(4) Install piston pin (Fig. 66).

(5) Install clips in piston to retain piston pin (Fig. 66).

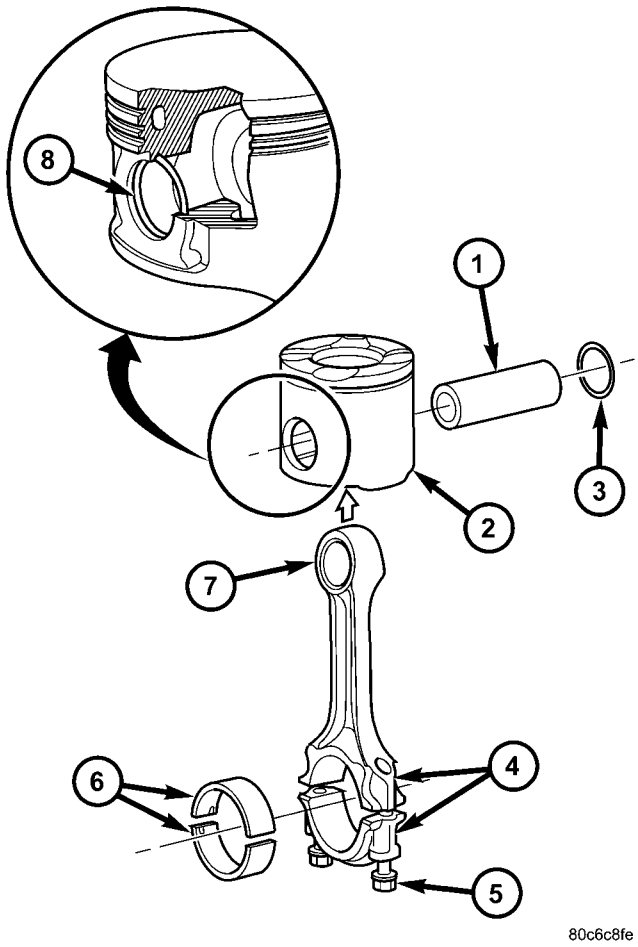


*Fig. 66 PISTON AND CONNECTING ROD ASSEMBLY*

1 - PISTON PIN
2 - PISTON
3 - SNAP RING
4 - PAINTED CONNECTING ROD ALIGNMENT NUMBERS
5 - CONNECTING ROD BOLT
6 - CONNECTING ROD BEARING
7 - CONNECTING ROD
8 - SNAP RING

(6) Remove connecting rod from vice.

## PISTON RINGS - INSTALLATION

(1) Install rings on the pistons using a suitable ring expander (Fig. 67).

(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.

PISTON & CONNECTING ROD (Continued)

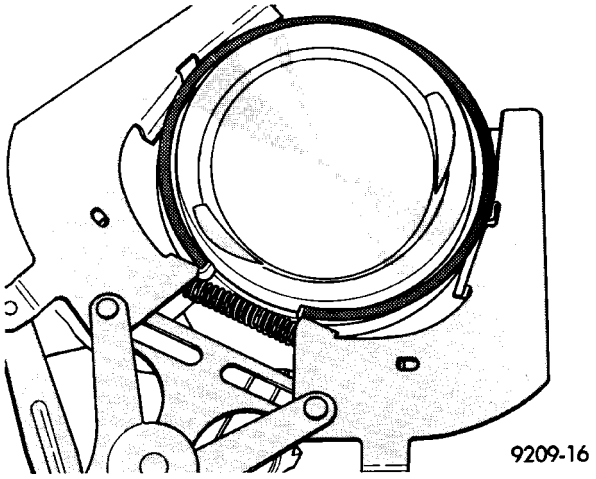


*Fig. 67 PISTON RINGS-INSTALLATION*

(3) Top ring gap must be positioned at the #3 position (looking at the piston crown from above) (Fig. 68).

(4) Second piston ring gap should be positioned at the #1 position (Fig. 68).

(5) Oil control ring gap should be positioned at the #2 position (Fig. 68).

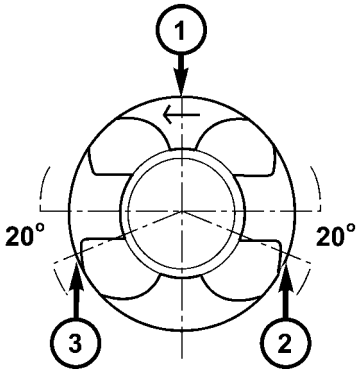


*Fig. 68 PISTON RING GAP LOCATION*

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

(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 (VM.1065) as shown in (Fig. 69).

## INSTALLATION

(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 (Fig. 68).

(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 ring compressor, over the piston and tighten (Fig. 69). **Ensure position of rings does not change during this operation**.

**NOTE: Be sure arrow on top of piston faces towards front of engine and the connecting rod pawl faces the rear (flywheel) side of the engine.**

**NOTE: Be careful not to nick crankshaft journals.**

(4) 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.

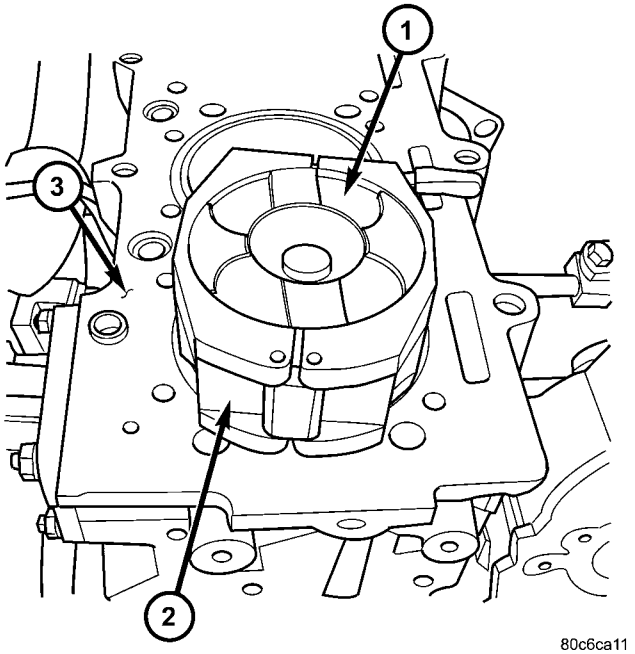


*Fig. 69 PISTON INSTALLATION USING VM.1065*

1 - PISTON
2 - PISTON RING COMPRESSOR VM.1065
3 - ENGINE BLOCK

(5) Tap the piston down in cylinder bore, using a hammer handle. At the same time, guide connecting rod into position on connecting rod journal.

PISTON & CONNECTING ROD (Continued)

**NOTE: Connecting rod bolts must be replaced when disassembled. DO NOT lubricate new connecting rod bolts as they are already coated.**

(6) Install connecting rod caps (Fig. 70). Install rod bolts and tighten each bolt to 10N·m (89 lbs. in..). Tighten each bolt again to 30N·m (22 lbs. ft.) plus 40°. Then torque to 88N·m (65 ft.lb).

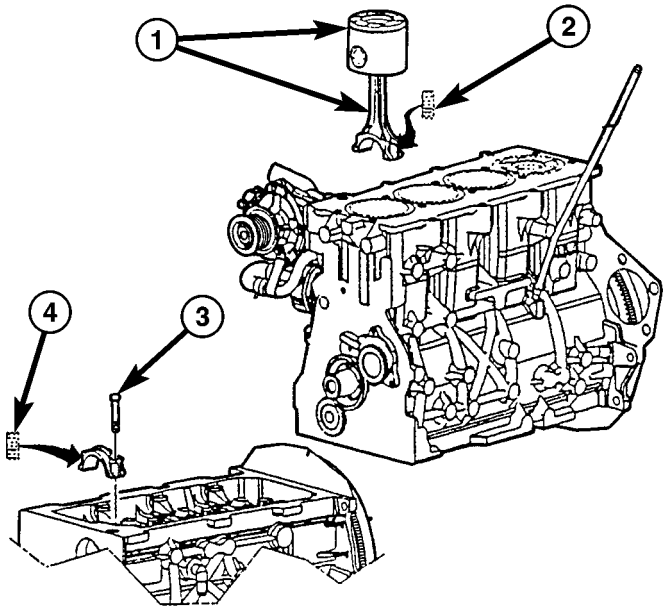


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***Fig. 70 PISTON AND CONNECTING ROD INSTALLATION***

1 - PISTON AND CONNECTING ROD ASSEMBLY
2 - PAINTED CYLINDER IDENTIFIER
3 - CONNECTING ROD BOLT
4 - PAINTED CYLINDER IDENTIFIER

(7) Install cylinder head (Refer to 9 - ENGINE/CYLINDER HEAD - INSTALLATION).

(8) Install balance shaft assembly (Refer to 9 - ENGINE/VALVE TIMING/BALANCE SHAFT - INSTALLATION).

(9) Install oil pump pickup tube (Refer to 9 - ENGINE/LUBRICATION/OIL PUMP - INSTALLATION).

(10) Install oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(11) Connect negative battery cable.

# CRANKSHAFT OIL SEAL - FRONT

## REMOVAL

(1) Disconnect negative battery cable.

(2) Remove air cleaner housing.

(3) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL).

(4) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(5) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(6) Remove vibration damper/crankshaft pulley (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(7) Remove outer timing belt cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(8) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(9) Remove timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

**NOTE: Crankshaft hub retaining bolt has LHD thread.**

(10) Remove crankshaft hub (Fig. 71).

(11) Remove front engine cover (Fig. 71) (Refer to 9 - ENGINE/ENGINE BLOCK/ENGINE COVER - REMOVAL) .

(12) With cover on work bench, pry out old seal.

## INSTALLATION

**CAUTION: Do Not use a hammer to install the crankshaft oil seal.**

**NOTE: To prevent potential oil leaks, DO NOT touch the front crankshaft inner seal. Always handle the seal from the outer diameter.**

(1) Clean engine block and front engine cover sealing surfaces.

(2) Install crankshaft oil seal on VM.1061 (Fig. 72).

(3) Place sleeve for VM.1061 on press bench as shown (Fig. 72).

CRANKSHAFT OIL SEAL - FRONT (Continued)

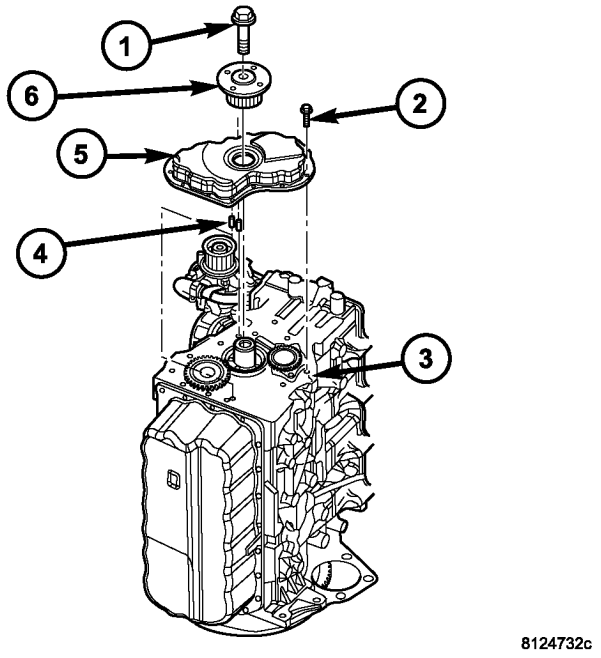


***Fig. 71 ENGINE COVER - FRONT***

1 - CRANKSHAFT HUB RETAINING BOLT
2 - FRONT ENGINE COVER RETAINING BOLTS
3 - ENGINE BLOCK
4 - FRONT ENGINE COVER ALIGNMENT DOWELS
5 - FRONT ENGINE COVER
6 - CRANKSHAFT HUB

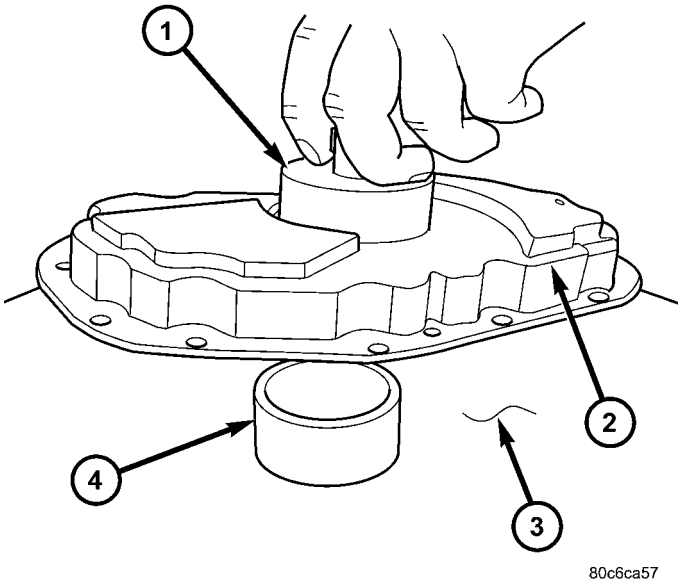


***Fig. 72 VM.1061 PLACEMENT***

1 - VM.1061
2 - FRONT ENGINE COVER
3 - PRESS BENCH
4 - SLEEVE FROM VM.1061

(4) Press the new seal into front engine cover.

(5) Install front engine cover using VM 1061 as a guide, care must be taken not to damage the seal (Fig. 73).

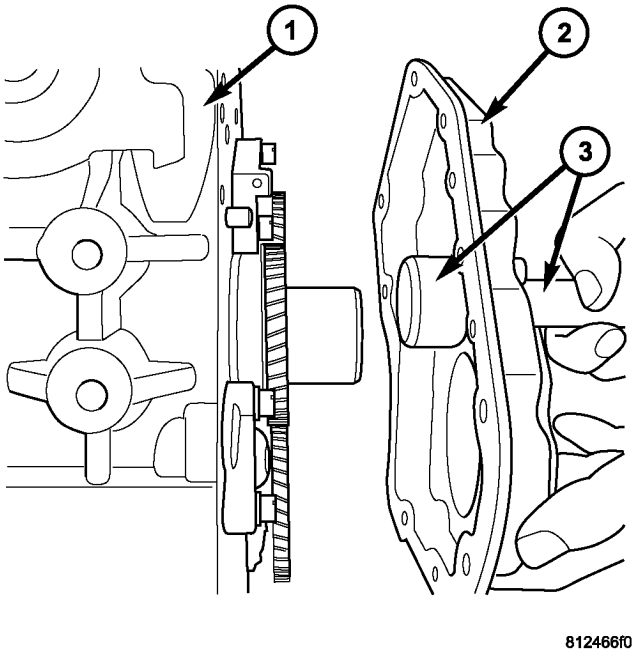


***Fig. 73 ENGINE FRONT COVER***

1 - ENGINE BLOCK
2 - FRONT ENGINE COVER
3 - VM.1061

(6) Install crankshaft hub and retaining bolt. Torque bolt to 304N·m (224 lbs. ft.).

(7) Install timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(8) Install timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(9) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(10) Install vibration damper/crankshaft pulley (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(11) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(12) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(13) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).

(14) Install air cleaner housing.

(15) Connect negative battery cable.

# VIBRATION DAMPER

## REMOVAL

(1) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(2) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(3) Remove vibration damper retaining bolts and damper (Fig. 74).

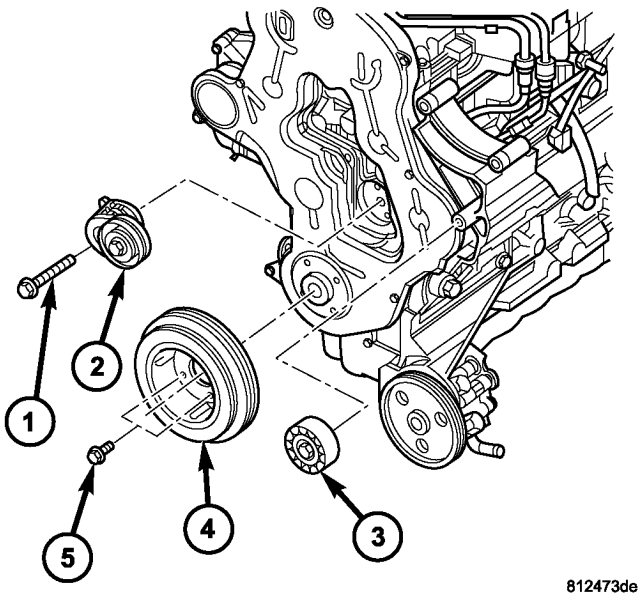


***Fig. 74 VIBRATION DAMPER***

1 - BELT TENSIONER RETAINING BOLT
2 - BELT TENSIONER
3 - IDLER PULLEY
4 - VIBRATION DAMPER/CRANKSHAFT PULLEY
5 - VIBRATION DAMPER/CRANKSHAFT PULLEY RETAINING BOLTS

## INSTALLATION

(1) Install vibration damper and retaining bolts (Fig. 74). Torque bolts to 27.5N·m.

(2) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(3) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

# ENGINE COVER - FRONT

## DESCRIPTION

The front engine cover on this engine is a stamped steel cover which covers the oil pump and vacuum pump.

## REMOVAL

(1) Disconnect negative battery cable.

(2) Remove air cleaner housing.

(3) Support engine and remove right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - REMOVAL).

(4) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(5) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(6) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(7) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

**CAUTION: Before removing the cylinder head cover/ intake manifold or timing belt the engine must put at 90° after TDC. Failure to do so could result in valve and/or piston damage during reassembly. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)**

(8) Remove timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(9) Remove timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

**NOTE: Crankshaft hub has LHD thread.**

(10) Remove crankshaft hub.

(11) Remove front engine cover (Fig. 75).

## INSTALLATION

(1) Clean engine block and front engine cover sealing surfaces.

(2) Apply a continous 3mm bead of Silicone Sealer to cover, install within 10 minutes (Fig. 75). Torque bolts to 11.8N·m.

ENGINE COVER - FRONT (Continued)

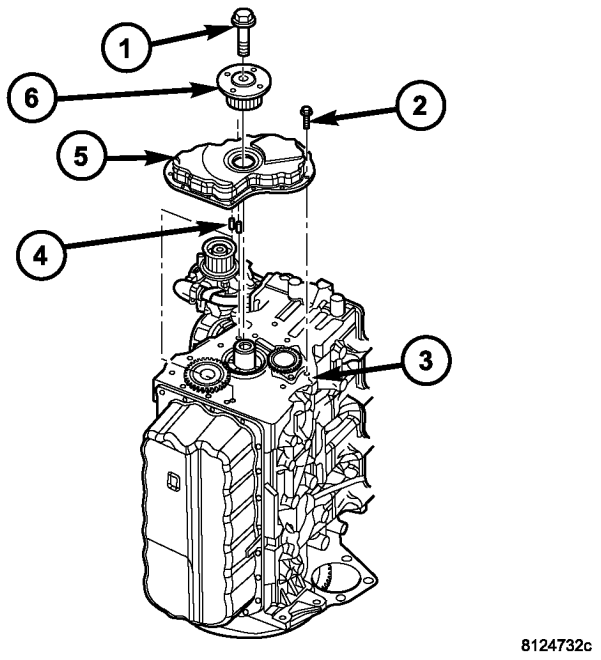


*Fig. 75 ENGINE COVER - FRONT*

1 - CRANKSHAFT HUB RETAINING BOLT
2 - FRONT ENGINE COVER RETAINING BOLTS
3 - ENGINE BLOCK
4 - FRONT ENGINE COVER ALIGNMENT DOWELS
5 - FRONT ENGINE COVER
6 - CRANKSHAFT HUB

(3) Install crankshaft hub (Fig. 75). Torque bolt to 304N·m.

(4) Install timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(5) Install timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(6) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(7) Install vibration damper (Refer to 9 - ENGINE/ ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(8) Install right engine mount (Refer to 9 - ENGINE/ENGINE MOUNTING/RIGHT MOUNT - INSTALLATION).

(9) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(10) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(11) Install air cleaner housing.

(12) Connect negative battery cable.

# CRANKSHAFT MAIN BEARINGS

## REMOVAL

**NOTE: Refer to crankshaft description for proper identification of the crankshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - DESCRIPTION).**

The engine must be removed from vehicle and completely disassembled to replace the front main bearing.

## CRANKSHAFT MAIN BEARINGS

(1) With crankshaft assembly removed from engine.

(2) Remove crankshaft supports from crankshaft and remove bearing halves from supports (Fig. 76).

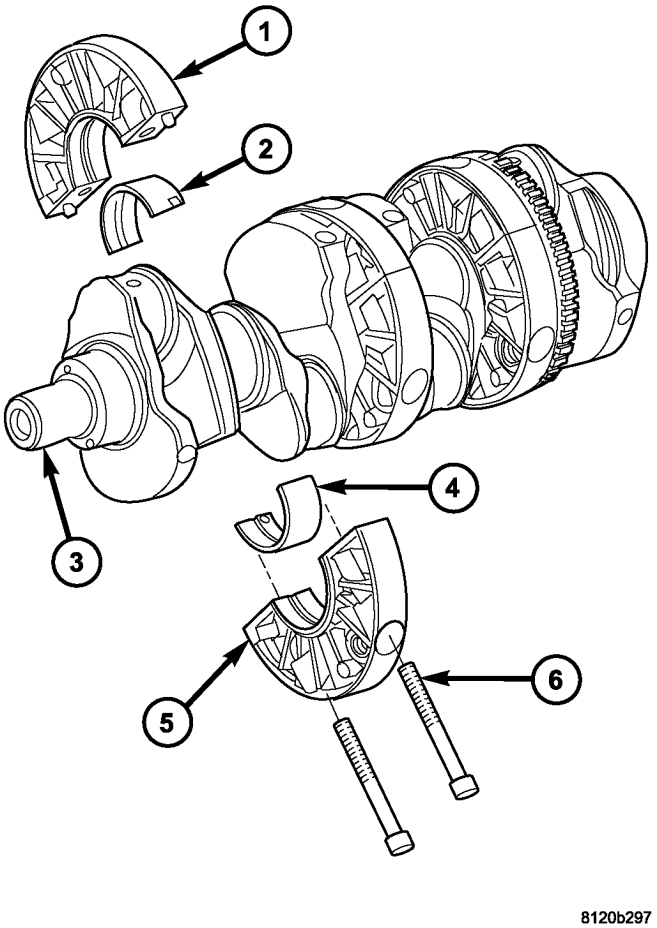


*Fig. 76 2.5L CRANKSHAFT*

1 - CRANKSHAFT SUPPORT HALVE
2 - MAIN BEARING HALVE
3 - CRANKSHAFT
4 - MAIN BEARING HALVE
5 - CRANKSHAFT SUPPORT HALVE
6 - MAIN BEARING SUPPORT BOLTS

### CRANKSHAFT FRONT MAIN BEARING

(1) Using special tool VM.1073 push front main bearing out of front of engine block (Fig. 77).

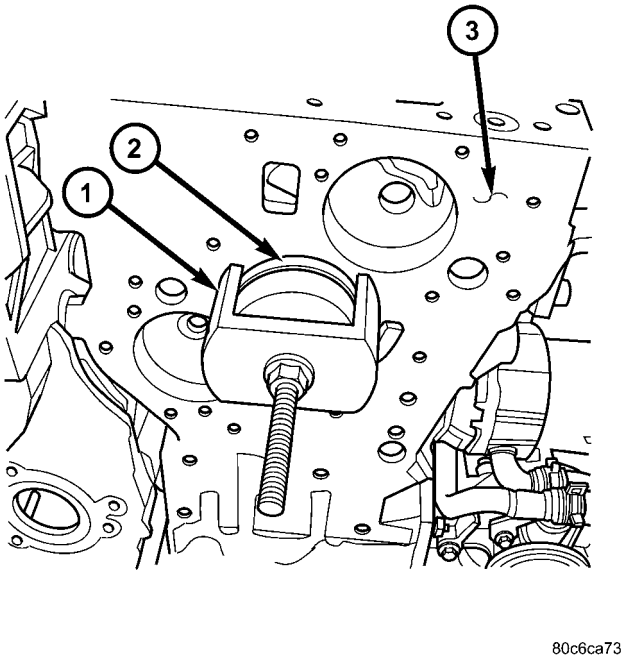


*Fig. 77 FRONT MAIN BEARING REMOVAL*

1 - VM.1073
2 - FRONT CRANKSHAFT MAIN BEARING
3 - ENGINE BLOCK

## INSTALLATION

### CRANKSHAFT MAIN BEARINGS

**NOTE: Refer to crankshaft description for proper identification of the crankshaft (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT - DESCRIPTION).**

(1) Install bearing halves in crankshaft supports.

(2) Lubricate crankshaft and main bearings with clean engine oil.

(3) Install crankshaft supports on crankshaft (Fig. 78). Torque bolts to 44.1N·m.

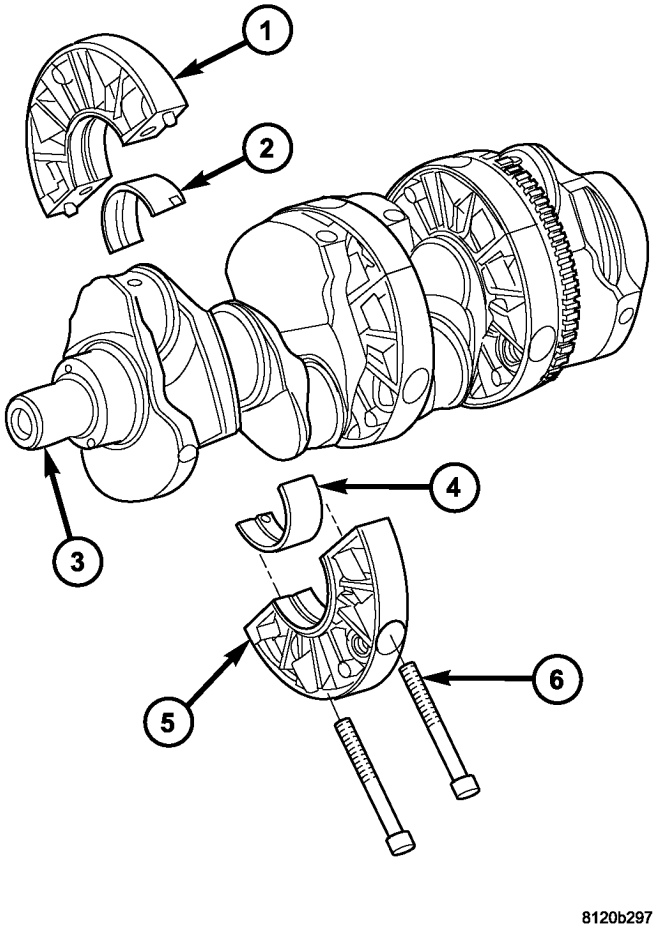


*Fig. 78 2.5L CRANKSHAFT*

1 - CRANKSHAFT SUPPORT HALVE
2 - MAIN BEARING HALVE
3 - CRANKSHAFT
4 - MAIN BEARING HALVE
5 - CRANKSHAFT SUPPORT HALVE
6 - MAIN BEARING SUPPORT BOLTS

CRANKSHAFT MAIN BEARINGS (Continued)

### FRONT CRANKSHAFT MAIN BEARING

(1) Using special tool VM.1073, push front crankshaft main bearing in engine block (Fig. 79).

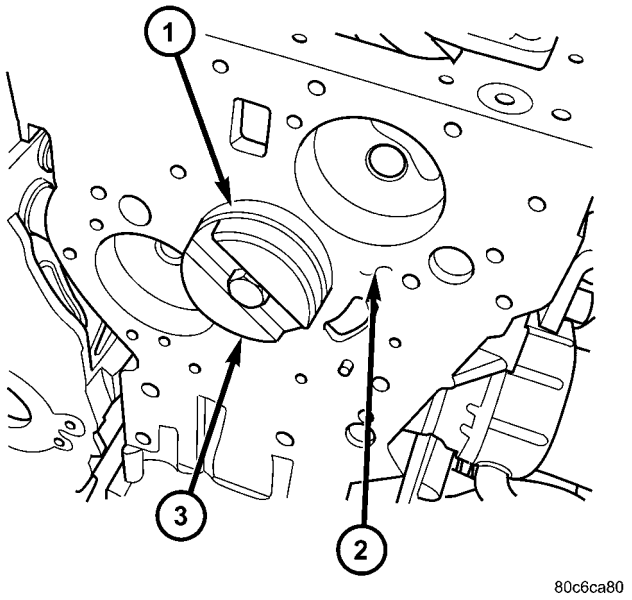


*Fig. 79 FRONT MAIN BEARING INSTALLATION*

1 - FRONT CRANKSHAFT MAIN BEARING
2 - ENGINE BLOCK
3 - SPECIAL TOOL VM.1073

(2) Be sure oil hole in bearing lines up with oil gallery in engine block (Fig. 80).

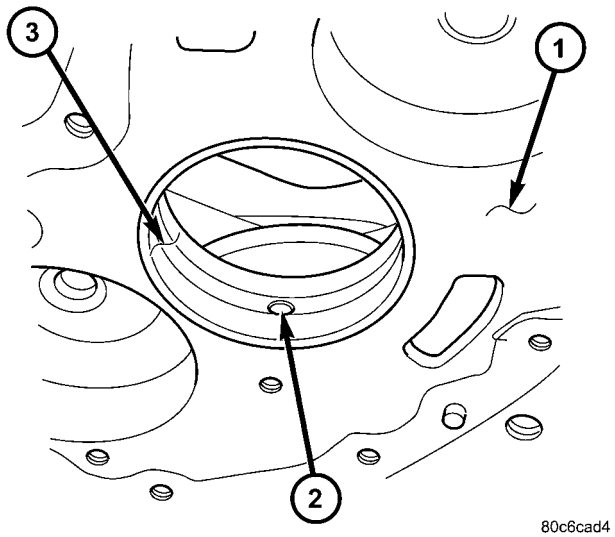


*Fig. 80 FRONT MAIN BEARING ALIGNMENT*

1 - ENGINE BLOCK
2 - OIL HOLE IN BEARING
3 - FRONT CRANKSHAFT MAIN BEARING

(3) Reassemble engine and install in vehicle.

## CRANKSHAFT OIL SEAL - REAR

### DESCRIPTION

The rear crankshaft seal consists of two parts that reside in a third part, the rear support assembly. The rear seal is inserted into the rear cup (Fig. 81). These pieces should be assembled WITH OUT removing one from the other. The rear support assembly, once assembled, should not be separated as well, to reduced possibility of damage to the internal rear seal lip (Fig. 82).

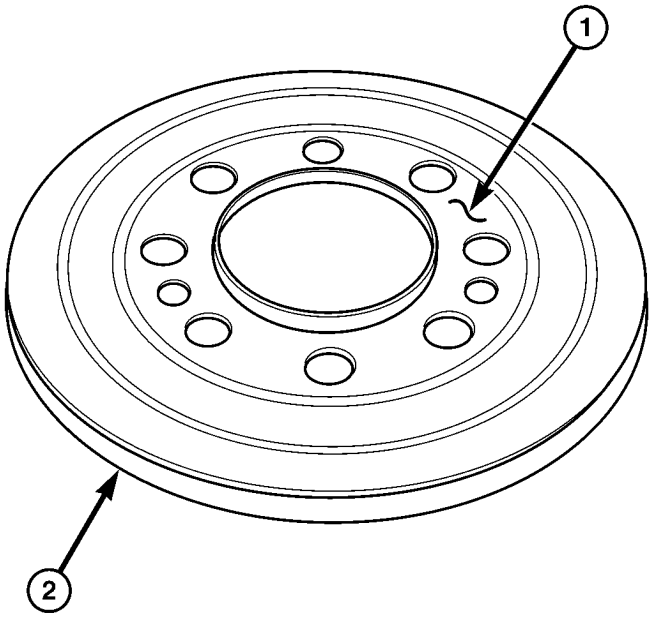


*Fig. 81 REAR CRANKSHAFT SEAL ASSEMBLY*

1 - REAR SEAL
2 - REAR CUP

### REMOVAL

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

(1) Remove flywheel assembly.
(2) Pry out old crankshaft oil seal.

### INSTALLATION

**NOTE: To prevent potential oil leaks, DO NOT touch or separate the rear crankshaft inner seal. Always handle the seal from the outer diameter (Refer to 9 - ENGINE/ENGINE BLOCK/CRANKSHAFT OIL SEAL - REAR - DESCRIPTION).**

CRANKSHAFT OIL SEAL - REAR (Continued)

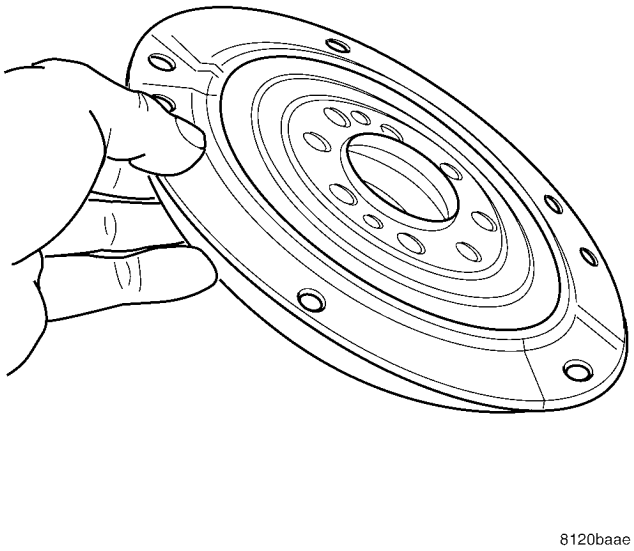


***Fig. 82 REAR SUPPORT ASSEMBLY***

(1) Using special tool VM.1050, install rear crankshaft oil seal in rear main bearing support (Fig. 83).

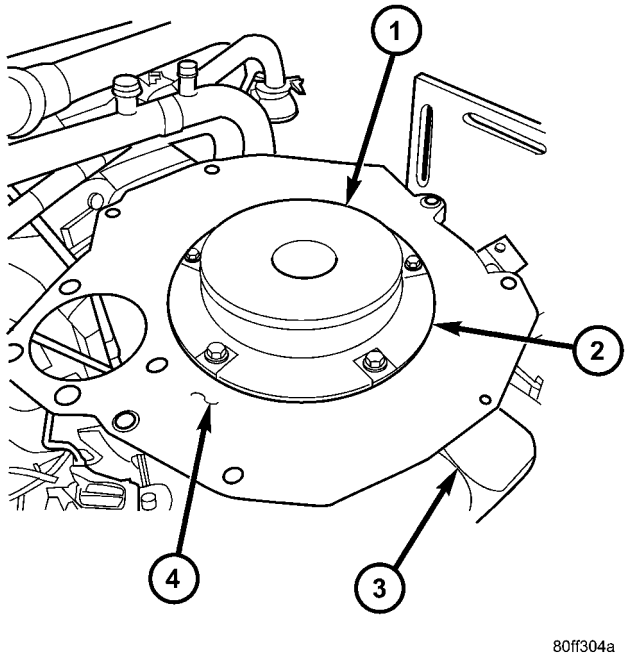


***Fig. 83 2.5L REAR CRANKSHAFT OIL SEAL INSTALLATION USING VM.1050***

1 - SPECIAL TOOL VM.1050
2 - REAR MAIN BEARING SUPPORT
3 - OIL PAN
4 - ENGINE TO TRANSMISSION ADAPTER PLATE

(2) Install engine or transmission in vehicle.

# OIL PAN

## REMOVAL

(1) Disconnect negative battery cable.
(2) Raise vehicle on hoist.
(3) Drain engine oil from engine.
(4) Remove all oil pan retaining bolts and oil pan (Fig. 84).

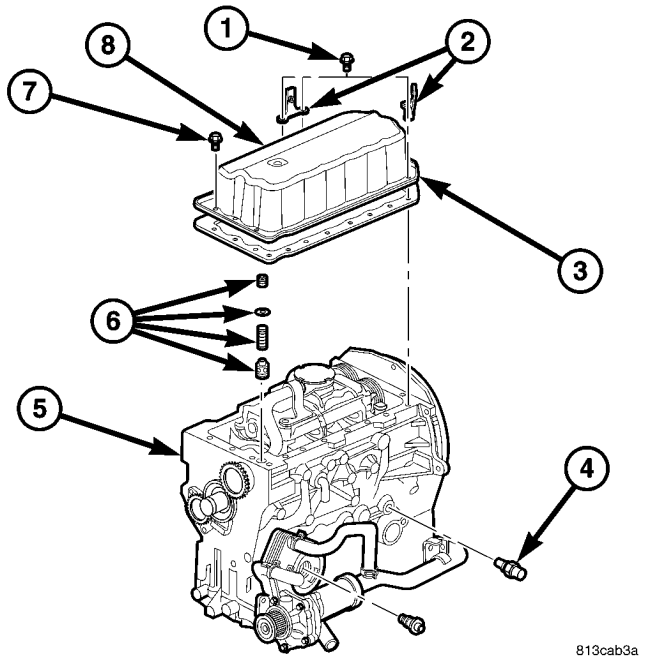


***Fig. 84 OIL PAN***

1 - OIL PAN RETAINING BOLTS
2 - POWER STEERING LINE BRACKETS
3 - OIL PAN GASKET
4 - OIL PRESSURE SENSOR
5 - ENGINE BLOCK
6 - OIL PRESSURE RELIEF VALVE
7 - OIL PAN RETAINING BOLTS
8 - OIL PAN

## INSTALLATION

(1) Clean oil pan and sealing surfaces. Inspect oil pan and engine block.
(2) Install oil pan, gasket, and retaining bolts (Fig. 84).
(3) Be sure power steering line brackets are in proper location (Fig. 84).
(4) Torque oil pan bolts to 11.8N·m.
(5) Lower vehicle.
(6) Refill engine oil to proper level.
(7) Connect negative battery cable.

# OIL PUMP

## REMOVAL

### REMOVAL

(1) Disconnect negative battery cable.
(2) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(3) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(4) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(5) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).
(6) Remove timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(7) Remove front engine cover (Refer to 9 - ENGINE/ENGINE BLOCK/ENGINE COVER - REMOVAL).
(8) Remove crankshaft sprocket (Fig. 85).
(9) Remove oil pump retaining bolts and remove pump from engine block (Fig. 85).

### REMOVAL

(1) Disconnect negative battery cable.
(2) Raise vehicle on hoist.
(3) Remove oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(4) Remove oil pump pickup tube retaining bolt and pull pickup tube from engine block (Fig. 86).

## INSTALLATION

### INSTALLATION

(1) Lubricate oil pump rotor with engine oil.
(2) Install oil pump in bore in engine block (Fig. 85).
(3) Install oil pump retaining bolts (Fig. 85). Torque bolts to 10.8N·m.
(4) Install crankshaft sprocket (Fig. 85). Torque bolts to 10.8N·m.
(5) Install front engine cover (Refer to 9 - ENGINE/ENGINE BLOCK/ENGINE COVER - INSTALLATION).

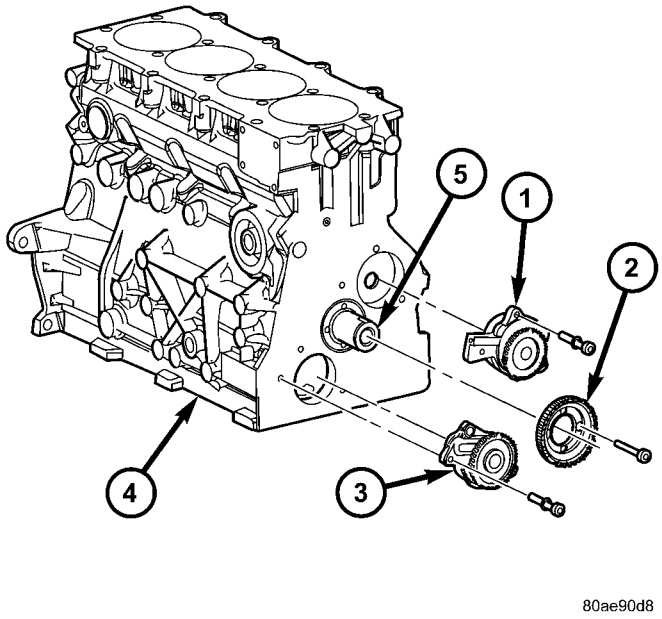


***Fig. 85 OIL PUMP AND VACUUM PUMP***

1 - VACUUM PUMP
2 - CRANKSHAFT SPROCKET
3 - OIL PUMP
4 - ENGINE BLOCK
5 - CRANKSHAFT

(6) Install timing belt inner cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
(7) Install timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
(8) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
(9) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(10) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(11) Connect negative battery cable.

OIL PUMP (Continued)

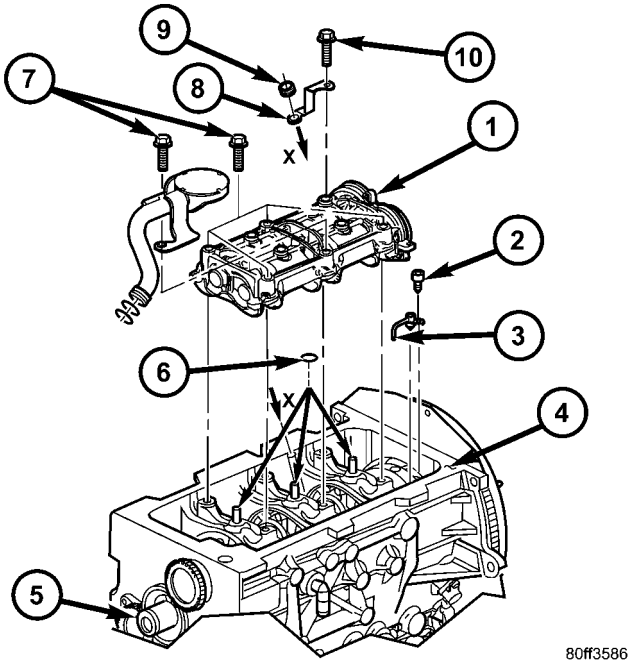


*Fig. 86 OIL PUMP PICKUP TUBE ASSEMBLY*

1 - BALANCE SHAFT
2 - OIL JET RETAINING BOLT
3 - OIL JET
4 - ENGINE BLOCK
5 - CRANKSHAFT
6 - O- RING(S)
7 - BALANCE SHAFT RETAINING BOLTS
8 - OIL DIPSTICK TUBE RETAINER
9 - RUBBER BUSHING
10 - RETAINING BOLT

## INSTALLATION

(1) Lubricate o-ring on oil pump pickup tube with engine oil.

(2) Install pickup tube in engine block and install retaining bolt (Fig. 86). Torque bolt to 32.4N·m.

(3) Install oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(4) Refill engine oil to proper level.

(5) Connect negative battery cable.

**NOTE: If a slight oil witness mark is present, retighten the oil pan bolts to 12N·m (106 in.lbs.).**

(6) Start engine and inspect for leaks.

# OIL PRESSURE SENSOR/ SWITCH

## DESCRIPTION

The oil pressure switch is located on the right side of the engine block. The switch screws into the engines main oil gallery (Fig. 87).

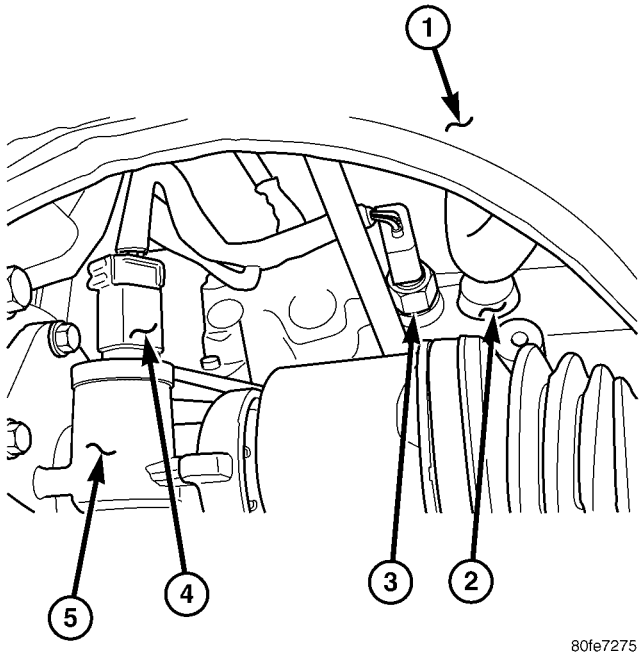


*Fig. 87 VIEW-REAR ENGINE*

1 - SUSPENSION CRADLE
2 - ENGINE BLOCK
3 - OIL PRESSURE SWITCH
4 - VEHICLE SPEED SENSOR
5 - TRANSMISSION

## REMOVAL

(1) Disconnect negative battery cable.

(2) Raise vehicle on hoist.

(3) Disconnect oil pressure switch electrical connector (Fig. 87).

(4) Remove oil pressure switch from engine block.

## INSTALLATION

(1) Apply Mopar® Thread Sealant to the switch threads.

(2) Install oil pressure switch in engine block.

(3) Connect oil pressure switch electrical connector (Fig. 87).

(4) Lower vehicle.

(5) Start engine and check for leaks.

(6) Check and adjust oil level as necessary.

# OIL PRESSURE RELIEF VALVE

## DESCRIPTION

The oil pressure relief valve mounts in the front of the engine block and is used to control oil flow through the engines lubrication system (Fig. 88).

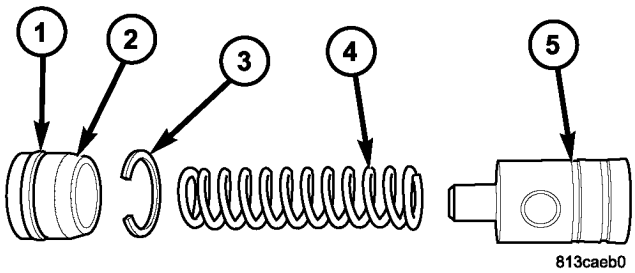


*Fig. 88 OIL PRESSURE RELIEF VALVE*

1 - O-RING
2 - OIL PRESSURE RELIEF VALVE CAP
3 - CLIP
4 - OIL PRESSURE RELIEF VALVE SPRING
5 - OIL PRESSURE RELIEF VALVE PLUNGER

## REMOVAL

(1) Remove engine oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(2) Using special tool VM.1054, remove oil pressure relief valve from engine block (Fig. 89).

## INSTALLATION

(1) Thoroughly clean all components and relief valve pocket in cylinder block.

(2) Lubricate all oil pressure relief valve components with engine oil.

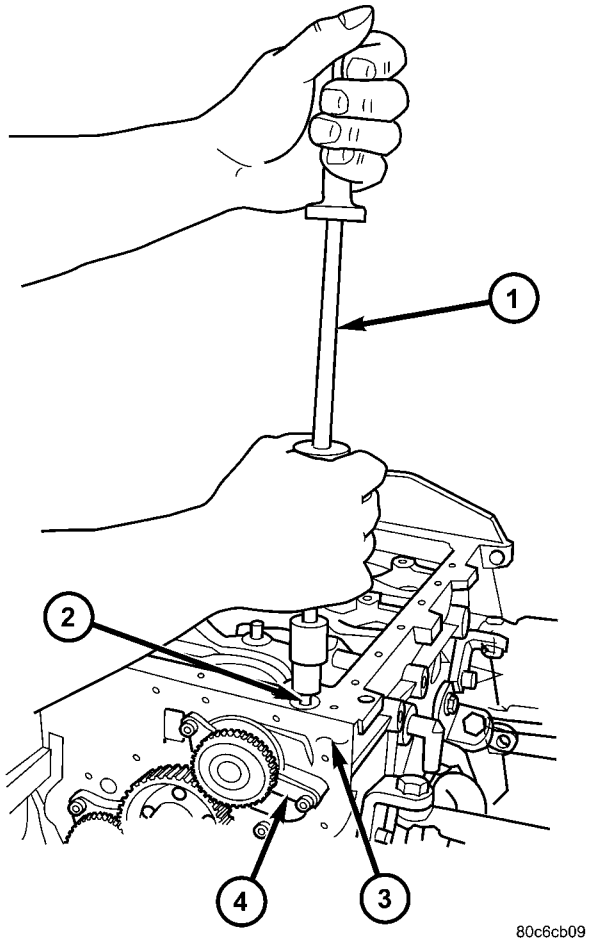


*Fig. 89 OIL PRESSURE RELIEF VALVE REMOVAL*

1 - VM.1054
2 - OIL PRESSURE RELIEF VALVE
3 - ENGINE BLOCK
4 - OIL PUMP

(3) Install oil pressure relief valve plunger, spring, and cap.

(4) Using special tool VM.1059, push oil pressure relief valve cap in untill flush with engine block (Fig. 90).

(5) Install oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

OIL PRESSURE RELIEF VALVE (Continued)

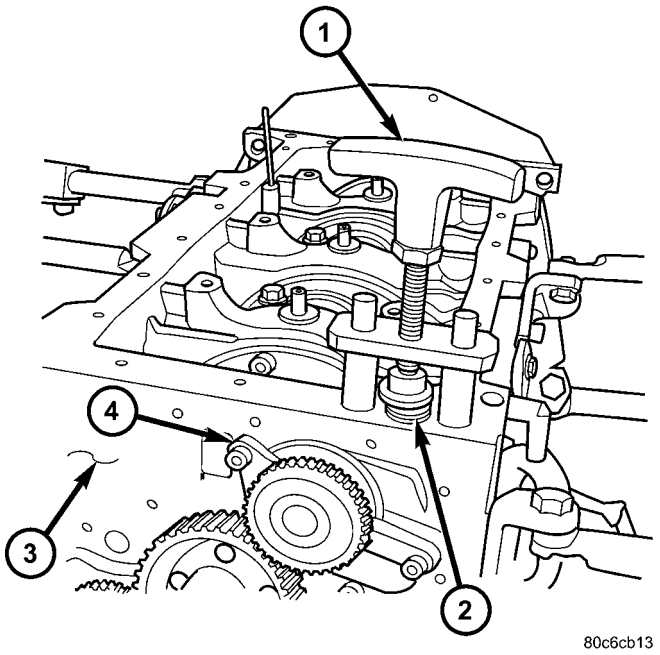


***Fig. 90 OIL PRESSURE RELIEF VALVE INSTALLATION***

1 - VM.1059
2 - OIL PRESSURE RELIEF VALVE
3 - ENGINE BLOCK
4 - OIL PUMP

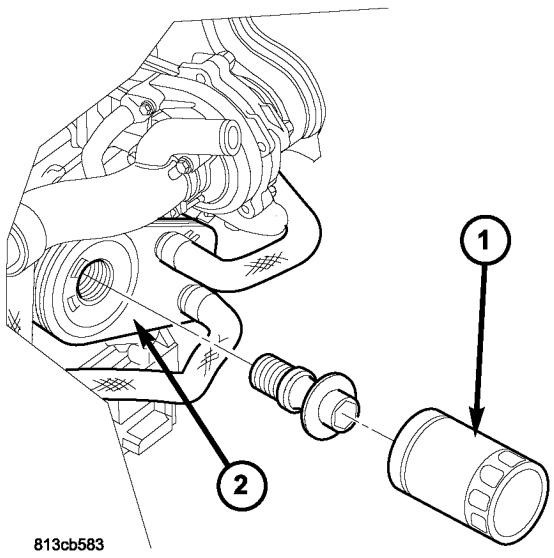


***Fig. 91 OIL FILTER***

1 - OIL FILTER
2 - ENGINE OIL COOLER

# OIL COOLER & LINES

## REMOVAL

(1) Drain cooling system (Refer to 7 - COOLING/ ENGINE/COOLANT - STANDARD PROCEDURE).
(2) Raise vehicle on hoist.
(3) Remove oil filter (Refer to 9 - ENGINE/LUBRICATION/OIL FILTER - REMOVAL).
(4) Disconnect coolant hoses at cooler (Fig. 92).
(5) Remove oil cooler retaining bolt at engine block (Fig. 92).
(6) Remove oil cooler retaining stud and remove oil cooler from engine block (Fig. 92).

## INSTALLATION

(1) Clean oil cooler and engine block sealing surfaces.
(2) Install oil cooler, retaining bolt, and stud (Fig. 92). Torque retaining bolt to 47.1N·m (35 lbs.ft.) and stud to 37.2 N·m (28 lbs.ft.)..
(3) Connect coolant hoses at cooler (Fig. 92).
(4) Install oil filter (Fig. 91)
(5) Lower vehicle.
(6) Refill cooling system (Refer to 7 - COOLING/ ENGINE/COOLANT - STANDARD PROCEDURE).
(7) Start engine and check for leaks.
(8) Check and adjust oil level as necessary.

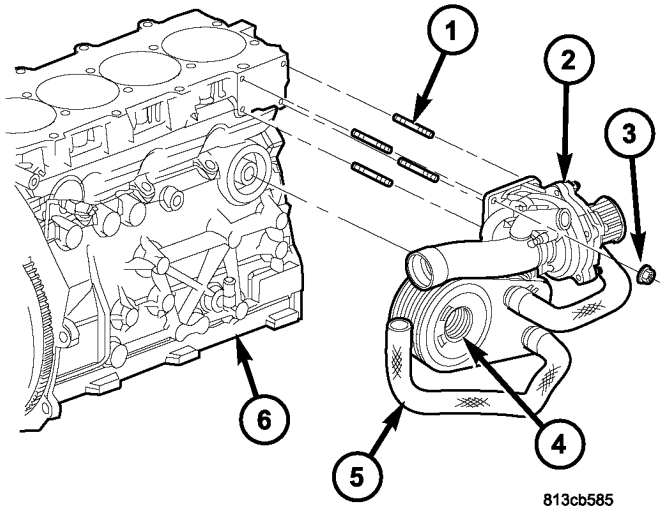


***Fig. 92 WATER PUMP AND OIL COOLER ASSEMBLIES***

1 - WATER PUMP HOUSING STUDS
2 - WATER PUMP
3 - RETAINING NUTS
4 - OIL COOLER RETAINING STUD
5 - COOLANT HOSE
6 - ENGINE BLOCK

# OIL FILTER

## DESCRIPTION

The oil filter is a high quality, full flow, disposable style. (Fig. 93).

## REMOVAL

**NOTE: Capture any residual oil spill while removing filter and wipe any oil that comes in contact with other components**

(1) Raise vehicle on hoist.
(2) Twist oil filter counterclockwise with a suitable oil filter wrench to remove. (Fig. 93)

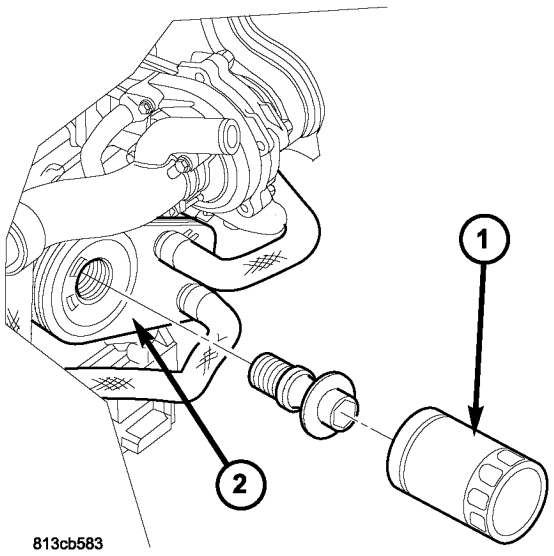


***Fig. 93 OIL FILTER***

1 - OIL FILTER
2 - ENGINE OIL COOLER

## INSTALLATION

(1) Lubracate oil filter seal with clean engine oil.
(2) Turning clockwise, seat the oil filter then tighten the oil filter 1/2 turn more (Fig. 93).
(3) Lower vehicle from hoist.
(4) Start engine and check for leaks.
(5) Check and adjust oil level as necessary.

# OIL JET

## DESCRIPTION

There are four oil jets installed in the engine block. These oil jets are used to cool and lubricate the piston assemblies (Fig. 94).

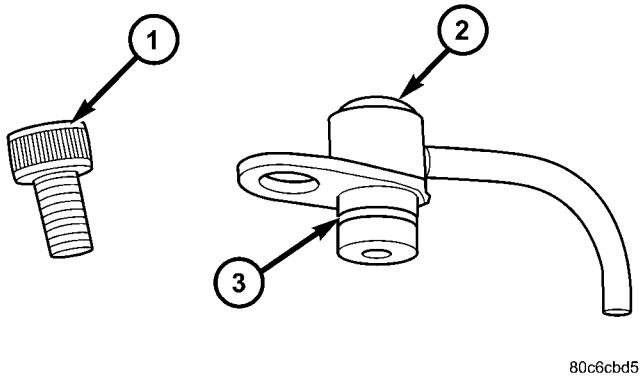


***Fig. 94 OIL JET ASSEMBLY***

1 - RETAINING BOLT
2 - OIL JET
3 - O-RING

## REMOVAL

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

**NOTE: Remove oil jets Before removing pistons, crankshaft or liners**

(1) Disconnect negative battery cable.
(2) Raise vehicle on hoist.
(3) Remove oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).
(4) Using special tool VM.1060 to hold oil jet. Remove oil jet retaining bolt and remove oil jet from engine block (Fig. 95).

## INSTALLATION

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

**NOTE: Carefully install the oil jets After assembling the engine liners, crankshaft and pistons.**

(1) Lubricate o-ring on oil jet.
(2) Using special tool VM.1060, install oil jet in engine block (Fig. 95).
(3) Install oil jet retaining bolt. Torque bolt to 10.8N·m.

OIL JET (Continued)

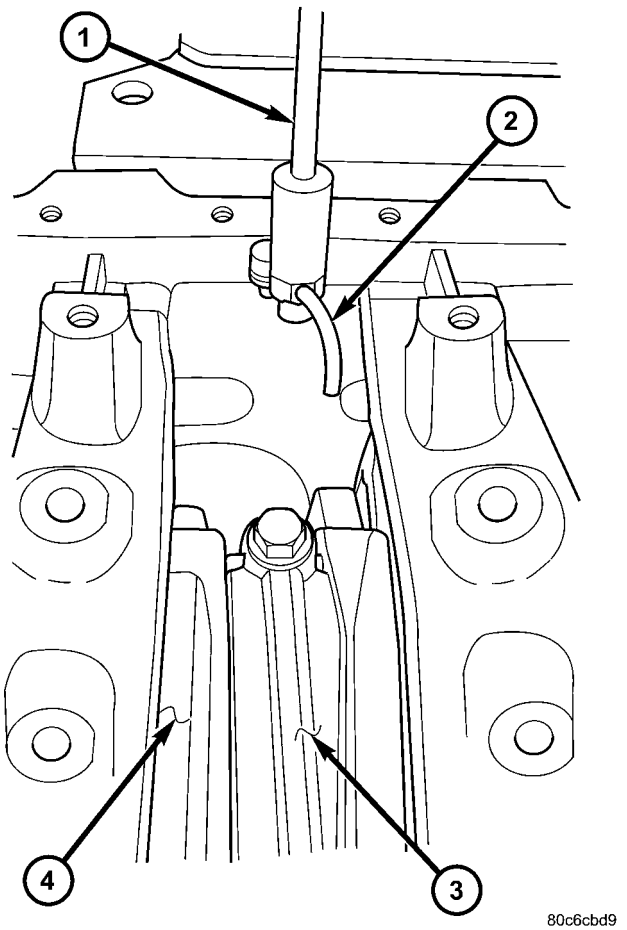


***Fig. 95 OIL JET REMOVAL/INSTALLATION***

1 - SPECIAL TOOL VM.1060
2 - OIL JET
3 - CONNECTING ROD
4 - CRANKSHAFT

(4) Install oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).
(5) Refill engine oil to proper level.
(6) Connect negative battery cable.

# INTAKE MANIFOLD

## DESCRIPTION

(Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - DESCRIPTION)

## REMOVAL

(1) (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - REMOVAL)

## INSTALLATION

(1) (Refer to 9 - ENGINE/CYLINDER HEAD/CYLINDER HEAD COVER(S) - INSTALLATION)

# EXHAUST MANIFOLD

## REMOVAL

(1) Remove the battery and tray assembly (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - REMOVAL).
(2) Remove the wiper cowl assembly (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - REMOVAL).
(3) Raise and support the vehicle.
(4) Drain the cooling system (Refer to 7 - COOLING/ENGINE/COOLANT - STANDARD PROCEDURE).
(5) Loosen the clamp retaining the upper charge air tube to the turbocharger (Fig. 96).

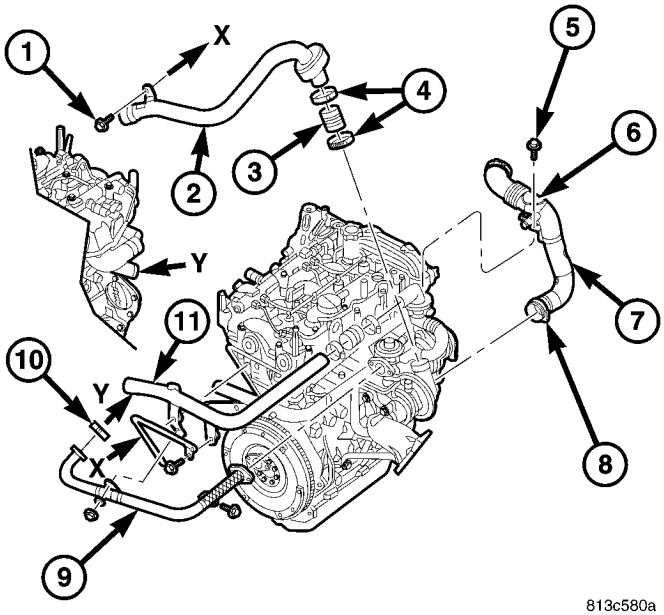


***Fig. 96 TURBOCHARGER AND COOLANT PIPES***

1 - TURBOCHARGER OUTLET PIPE RETAINING BOLT
2 - TURBOCHARGER OUTLET PIPE
3 - ADAPTOR HOSE
4 - HOSE CLAMPS
5 - TURBOCHARGER INLET PIPE RETAINING BOLT
6 - TURBOCHARGER INLET PIPE
7 - ADAPTOR HOSE
8 - HOSE CLAMPS
9 - EGR VALVE TO INTAKE AIR INLET PIPE
10 - CLAMP
11 - THERMOSTAT HOUSING TO UPPER RADIATOR HOSE PIPE

(6) Lower the vehicle.
(7) Remove the auxiliary heater coolant pipe upper retaining nut.
(8) Remove the coolant recovery pressure container(Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY PRESS CONTAINER - REMOVAL).
(9) Disconnect the upper radiator hose from the coolant tube.
(10) Remove the coolant tube fasteners and tube.

EXHAUST MANIFOLD (Continued)

(11) Disconnect the charger air inlet at the tube and remove the tube.
(12) Disconnect the EGR cooler coolant hoses.
(13) Disconnect the EGR cooler tube clamp.
(14) Disconnect the EGR vacuum hose.
(15) Remove the engine lift bracket (Fig. 97).

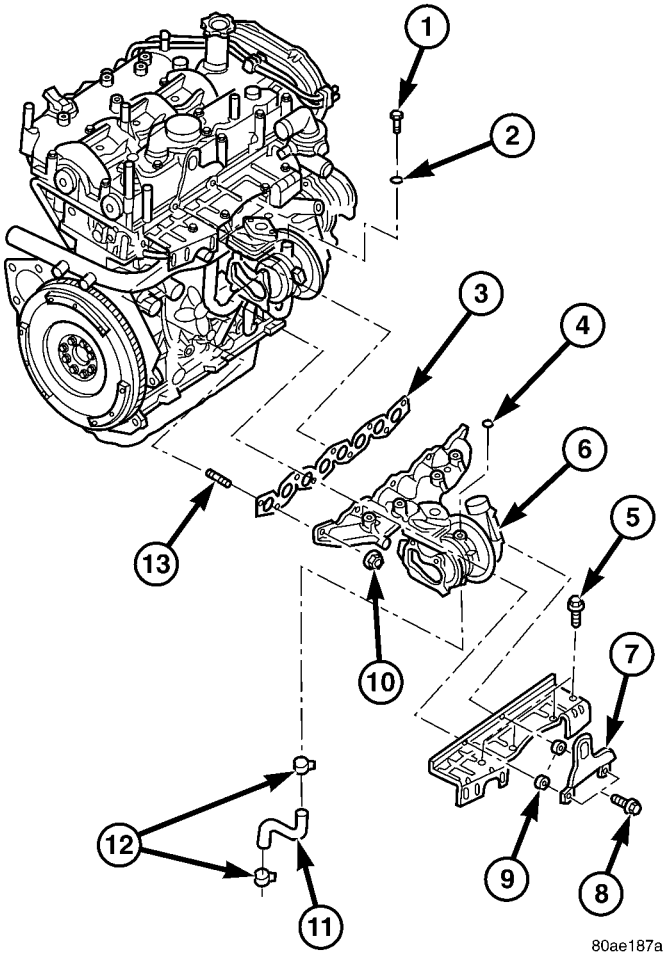


***Fig. 97 EXHAUST MANIFOLD AND TURBOCHARGER***

1 - TURBOCHARGER OIL SUPPLY BANJO BOLT
2 - COPPER WASHER
3 - EXHAUST MANIFOLD GASKET
4 - COPPER WASHER
5 - EXHAUST MANIFOLD HEAT SHIELD RETAINING BOLT
6 - TURBOCHARGER
7 - ENGINE LIFT HOOK
8 - ENGINE LIFT HOOK RETAINING BOLT
9 - SPACER
10 - EXHAUST MANIFOLD RETAINING NUT
11 - TURBOCHARGER OIL RETURN HOSE
12 - HOSE CLAMPS
13 - EXHAUST MANIFOLD STUDS

(16) Remove the exhaust manifold shields (Fig. 97).
(17) Remove the exhaust manifold upper fasteners (Fig. 97).
(18) Raise and support the vehicle.
(19) Remove the turbocharger (Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/ TURBOCHARGER - REMOVAL).
(20) Remove the lower exhaust manifold fasteners and exhaust manifold (Fig. 97).

## INSTALLATION

(1) Clean exhaust manifold mating surfaces.

**NOTE: The exhaust manifold tightening sequence must be repeated after the original sequence is completed.**

(2) Install the exhaust manifold gasket and carefully position the exhaust manifold onto the cylinder head. Tighten the fasteners in a cross pattern working from the inside out to 36 N·m (26.5 lbs. ft.) (Fig. 97).
(3) Install the turbocharger(Refer to 11 - EXHAUST SYSTEM/TURBOCHARGER SYSTEM/ TURBOCHARGER - INSTALLATION).
(4) Lower the vehicle
(5) Install the exhaust manifold heat shields. Tighten shield fasteners to 27.5 N·m (21 lbs. ft.) (Fig. 97).
(6) Connect the EGR vacuum hose and cooler hoses.
(7) Connect the EGR Cooler tube.
(8) Install the engine lift bracket (Fig. 97).
(9) Install the charge air tube (Fig. 96).
(10) Install the coolant tube and fasteners (Fig. 96).
(11) Connect the upper radiator to the coolant tube.
(12) Install the coolant reservoir (Refer to 7 - COOLING/ENGINE/COOLANT RECOVERY PRESS CONTAINER - INSTALLATION).
(13) Install the auxiliary heater tube fastener. Tighten fastener to 27.5 N·m (21 lbs. ft.).
(14) Raise and support the vehicle.
(15) Connect and tighten the charge air hose to the turbocharger (Fig. 96).
(16) Lower the vehicle.
(17) Install the wiper cowl assembly (Refer to 23 - BODY/EXTERIOR/COWL GRILLE - INSTALLATION).
(18) Install the battery and tray assembly (Refer to 8 - ELECTRICAL/BATTERY SYSTEM/TRAY - INSTALLATION).
(19) Start engine and inspect for leaks.

# VALVE TIMING

## STANDARD PROCEDURE - LOCKING ENGINE 90° AFTER TDC

(1) Disconnect negative battery cable.

(2) Remove starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - REMOVAL).

**NOTE: Crankshaft hub retaining bolt is left hand thread.**

(3) Rotate engine untill notch in hub is in the following position (Fig. 98).

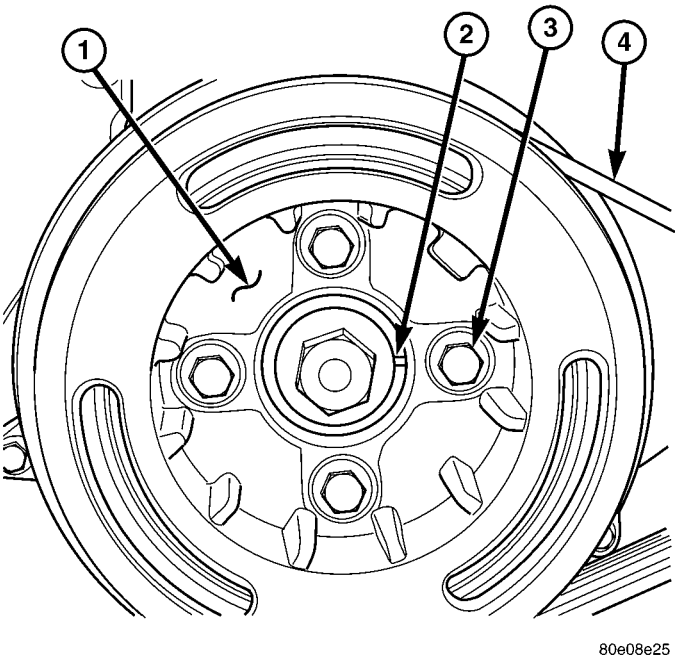


***Fig. 98 CRANKSHAFT HUB ALIGNMENT***

1 - VIBRATION DAMPER/CRANKSHAFT PULLEY
2 - CRANKSHAFT HUB NOTCH
3 - VIBRATION DAMPER/CRANKSHAFT PULLEY TO CRANKSHAFT HUB BOLTS
4 - ACCESSORY DRIVE BELT

(4) Remove the yellow plastic plug and install special tool VM.1068 in the engine block as shown at this time (Fig. 99). This will lock the engine at 90° after TDC.

(5) Remove front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - REMOVAL).

(6) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).

(7) Remove plug in cylinder head cover/intake manifold and insert VM.1053 to lock exhaust camshaft in position (Fig. 100).

(8) Remove generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - REMOVAL).

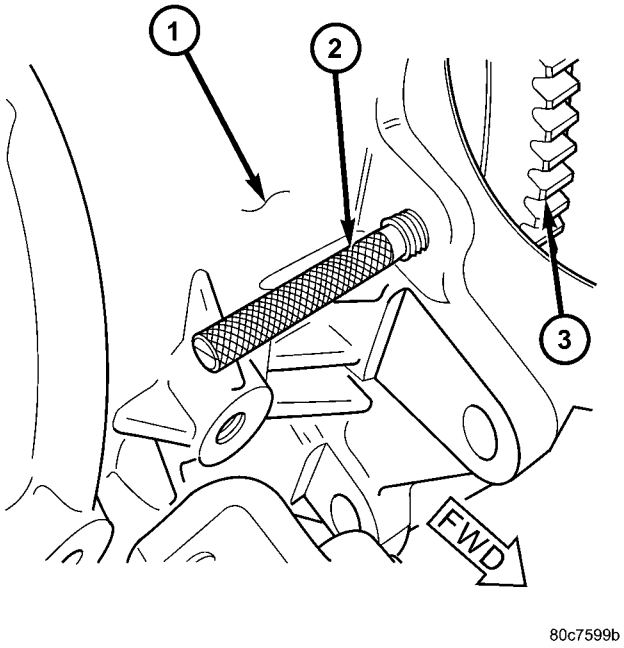


***Fig. 99 90 DEGREES AFTER TDC ALIGNMENT PIN LOCATION***

1 - ENGINE BLOCK
2 - VM.1051 TDC PIN OR VM.1068 90 DEGREES ATDC PIN
3 - FLYWHEEL

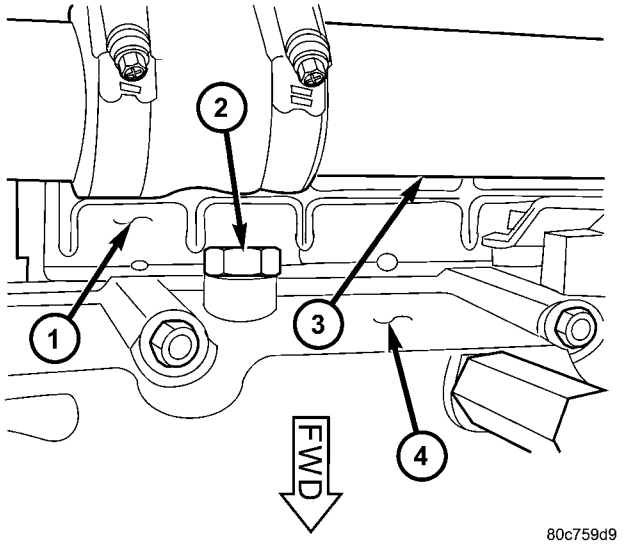


***Fig. 100 EXHAUST CAMSHAFT LOCKING PIN VM.1053***

1 - EXHAUST MANIFOLD HEAT SHIELD
2 - EXHAUST CAMSHAFT LOCKING PIN VM.1053
3 - COOLANT TUBE FROM THERMOSTAT HOUSING TO UPPER RADIATOR HOSE
4 - CYLINDER HEAD COVER/INTAKE MANIFOLD

VALVE TIMING (Continued)

(9) Remove plug in cylinder head cover/intake manifold and insert VM.1052 to lock intake camshaft in position (Fig. 101).

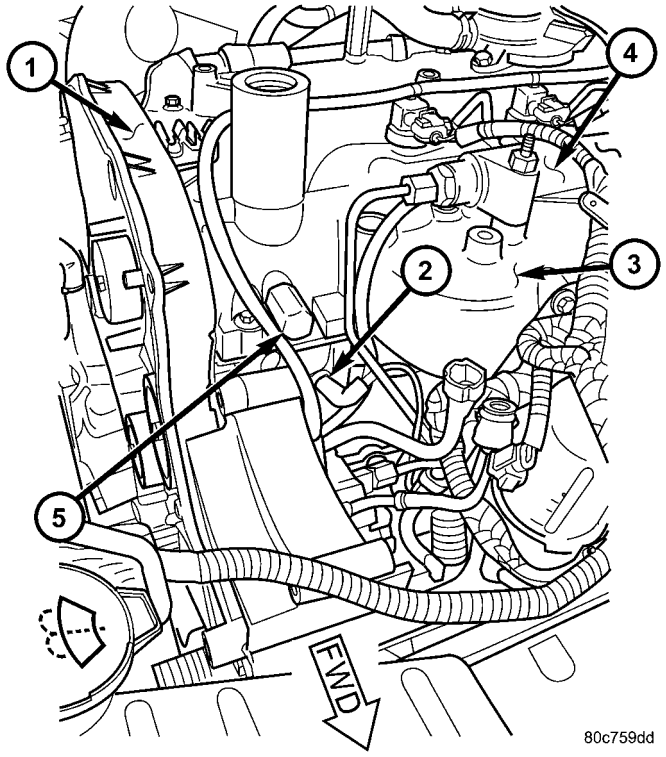


***Fig. 101 INTAKE CAMSHAFT LOCKING PIN VM.1052***

1 - TIMING BELT INNER COVER
2 - GLOW PLUG ELECTRICAL CONNECTOR
3 - CYLINDER HEAD COVER/INTAKE MANIFOLD
4 - FUEL RAIL
5 - INTAKE CAMSHAFT LOCKING PIN VM.1052

(10) At this point the timing belt can be removed for service.

(11) After engine service is completed and timing belt reinstalled, remove both camshaft locking pins from cylinder head cover/intake manifold.

(12) Install both camshaft access plugs.

(13) Remove 90° after TDC engine locking pin and install the plastic cover.

(14) Install starter motor (Refer to 8 - ELECTRICAL/STARTING/STARTER MOTOR - INSTALLATION).

(15) Install generator (Refer to 8 - ELECTRICAL/CHARGING/GENERATOR - INSTALLATION).

(16) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).

(17) Install front wiper unit (Refer to 8 - ELECTRICAL/WIPERS/WASHERS/WIPER MODULE - INSTALLATION).

(18) Connect negative battery cable.

# BALANCE SHAFT

## DESCRIPTION

The 2.5L/2.8L Common Rail Diesel engine is equipped with two nodular cast iron balance shafts in a cast aluminum carrier. The balance shaft assembly is mounted to the engine block (Fig. 102).

## OPERATION

The balance shaft is driven by the crankshaft. The balance shafts are connected by heelical gears. The dual-counter rotating shafts decrease second order vertical shaking forces caused by component movement.

## REMOVAL

(1) Disconnect negative battery cable.

(2) Raise vehicle on hoist.

(3) Before installation of the balance shaft assembly, the # 1 cylinder must be brought to TDC. Using special tool VM.1051, roll engine over by hand until tool can be inserted into engine block locking flywheel from turning.

(4) Remove oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - REMOVAL).

(5) Remove balance shaft assembly (Fig. 102).

## INSTALLATION

(1) Before installation of the balance shaft assembly, the # 1 cylinder must be brought to TDC. Using special tool VM.1051, roll engine over by hand until tool can be inserted into engine block locking flywheel from turning (Fig. 103). Once the # 1 cylinder is brought to TDC, the balance shaft assembly can be installed.

(2) With balance shaft assembly on work bench. Insert special tool VM.1056 into balance shaft assembly (Fig. 104). This will ensure proper balance shaft and crankshaft timing after assembly.

(3) Install balance shaft assembly and retaining bolts (Fig. 102). Torque bolts to 32.4N·m.

(4) Install oil pan (Refer to 9 - ENGINE/LUBRICATION/OIL PAN - INSTALLATION).

(5) Refill engine oil to proper level.

(6) Connect negative battery cable.

BALANCE SHAFT (Continued)

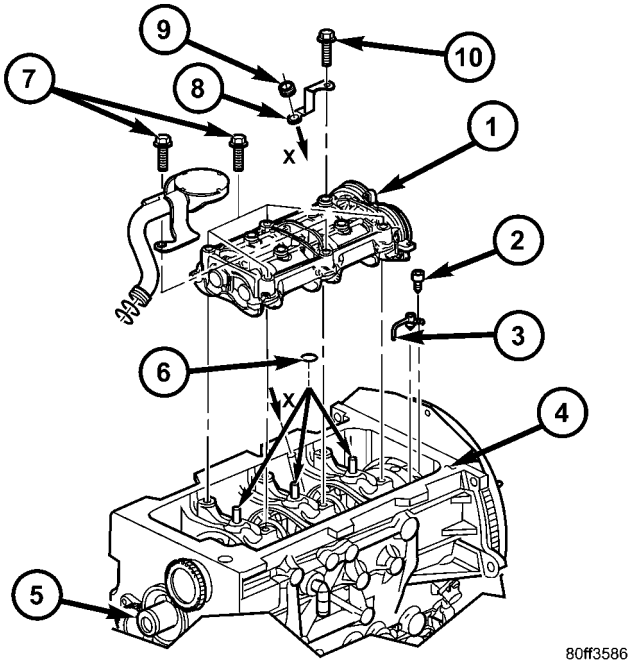


***Fig. 102 OIL PUMP PICKUP TUBE ASSEMBLY***

1 - BALANCE SHAFT
2 - OIL JET RETAINING BOLT
3 - OIL JET
4 - ENGINE BLOCK
5 - CRANKSHAFT
6 - O- RING(S)
7 - BALANCE SHAFT RETAINING BOLTS
8 - OIL DIPSTICK TUBE RETAINER
9 - RUBBER BUSHING
10 - RETAINING BOLT

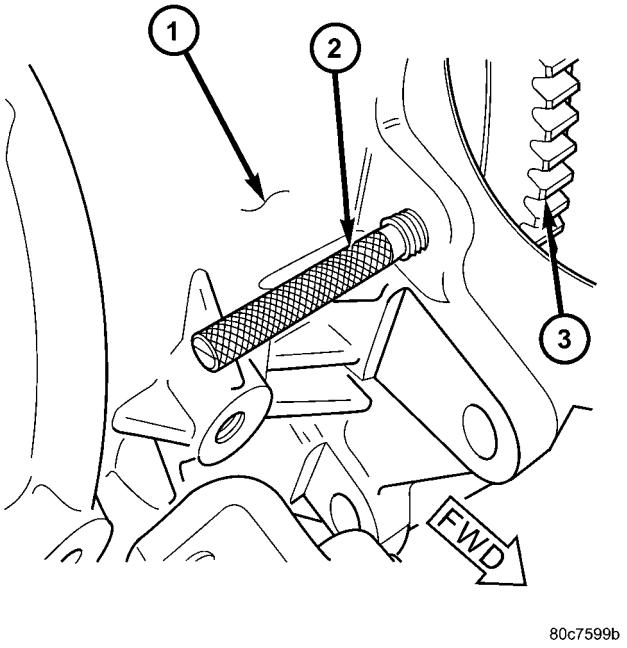


***Fig. 103 TDC ALIGNMENT PIN LOCATION***

1 - ENGINE BLOCK
2 - VM.1051 TDC PIN OR VM.1068 90 DEGREES ATDC PIN
3 - FLYWHEEL

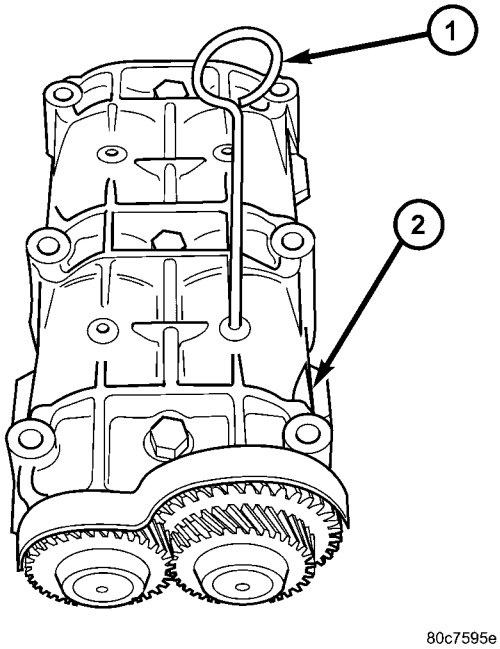


***Fig. 104 BALANCE SHAFT ALIGNMENT PIN VM.1056***

1 - VM.1056
2 - BALANCE SHAFT ASSEMBLY

# TIMING BELT COVER

## REMOVAL

### REMOVAL - TIMING BELT OUTER COVER

(1) Disconnect negative battery cable.
(2) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).
(3) Remove air cleaner housing.
(4) Support engine and remove right engine mount and bracket.
(5) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(6) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(7) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(8) Remove timing belt outer cover retaining bolts and remove cover (Fig. 105).

### REMOVAL - TIMING BELT INNER COVER

(1) Disconnect negative battery cable.
(2) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).
(3) Remove air cleaner housing.

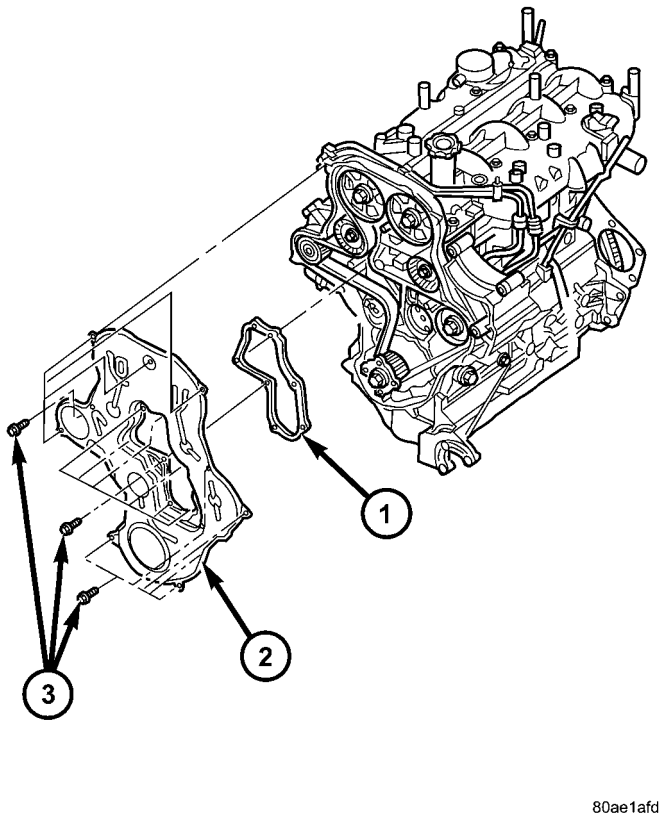


***Fig. 105 TIMING BELT COVER (OUTER)***

1 - SEAL
2 - TIMING BELT OUTER COVER
3 - RETAINING BOLTS

(4) Support engine and remove right engine mount and bracket.

(5) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(6) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(7) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(8) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(9) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

(10) Remove timing belt idler pulleys (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT IDLER PULLEY - REMOVAL).

(11) Using special tool VM.1055, remove camshaft sprockets (Fig. 106).

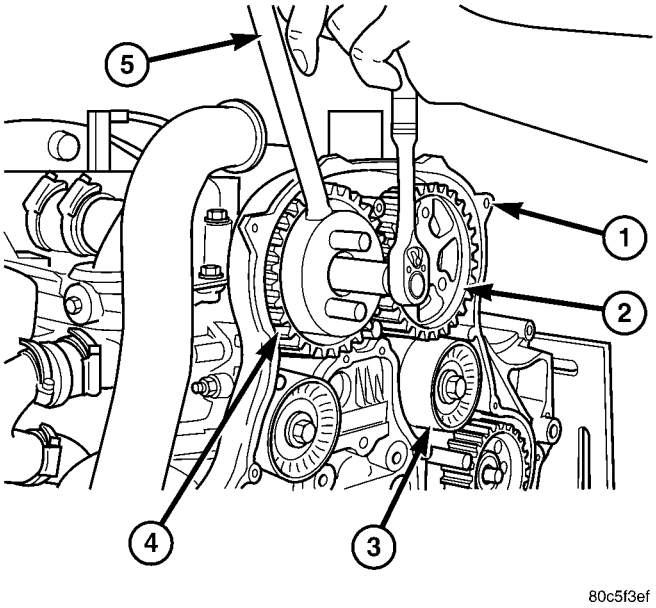


***Fig. 106 CAMSHAFT SPROCKET REMOVAL/ INSTALLATION***

1 - TIMING BELT INNER COVER
2 - CAMSHAFT SPROCKET
3 - IDLER PULLEYS
4 - CAMSHAFT SPROCKET
5 - VM.1055

(12) Remove timing belt tensioner (Refer to 9 - ENGINE/VALVE TIMING/TMNG BELT/CHAIN TENSIONER&PULLEY - REMOVAL).

(13) Remove injection pump sprocket (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL INJECTION PUMP - REMOVAL).

(14) Remove timing belt inner cover retaining bolts and remove cover (Fig. 107).

## INSTALLATION

### INSTALLATION - TIMING BELT OUTER COVER

(1) Install timing belt outer cover seal and cover (Fig. 105). Torque 3mm bolts to 10.8N·m and 8mm bolts to 10.8N·m.

(2) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(3) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(4) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

TIMING BELT COVER (Continued)

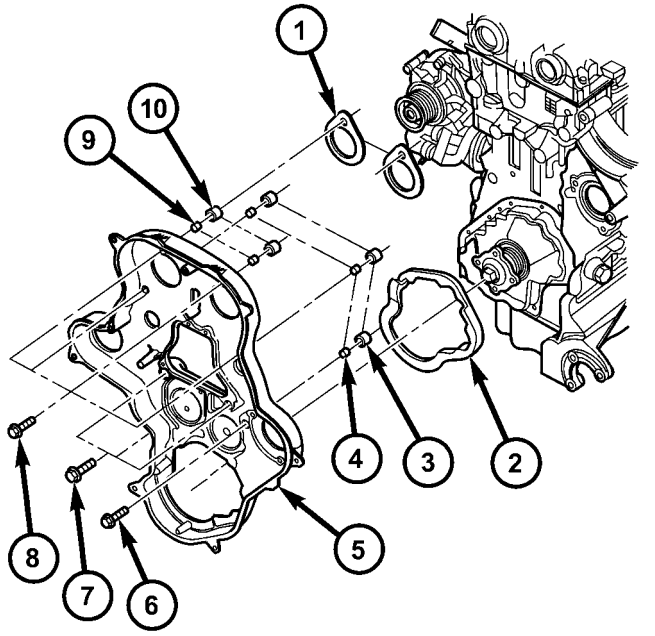


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***Fig. 107 TIMING BELT COVER - INNER***

1 - TIMING BELT COVER TO CYLINDER HEAD COVER GASKET
2 - TIMING BELT COVER TO FRONT ENGINE COVER SEAL
3 - RUBBER GROMMET
4 - BUSHING
5 - TIMING BELT COVER - INNER
6 - RETAINING BOLT
7 - RETAINING BOLT
8 - RETAINING BOLT
9 - BUSHING
10 - RUBBER GROMMET

(5) Install right engine mount.
(6) Install air cleaner housing.
(7) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).
(8) Connect negative battery cable.

## INSTALLATION - TIMING BELT INNER COVER

(1) Install timing belt inner cover to engine front cover seal (Fig. 107).
(2) Install timing belt inner cover to cylinder head cover gaskets (Fig. 107).
(3) Install timing belt inner cover and retaining bolts (Fig. 107). Torque 10mm bolts to 47.1N·m and 8mm bolts to 10.8N·m.
(4) Install injection pump sprocket (Refer to 14 - FUEL SYSTEM/FUEL DELIVERY/FUEL INJECTION PUMP - INSTALLATION).
(5) Install camshaft sprockets (Fig. 106). Torque bolts to 108N·m.
(6) Install timing belt idler pulleys (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT IDLER PULLEY - INSTALLATION).
(7) Install timing belt and tensioner (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).
(8) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).
(9) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).
(10) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(11) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).
(12) Install right engine mount assembly.
(13) Install air cleaner housing.
(14) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).
(15) Connect negative battery cable.

# TIMING BELT IDLER PULLEY

## REMOVAL

(1) Disconnect negative battery cable.
(2) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).
(3) Remove air cleaner housing.
(4) Support engine and remove right engine mount.
(5) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(6) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(7) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(8) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(9) Remove timing belt (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - REMOVAL).

**NOTE: Idler pulley retaining bolts are LHD thread.**

(10) Remove timing belt idler pulleys (Fig. 108).

TIMING BELT IDLER PULLEY (Continued)

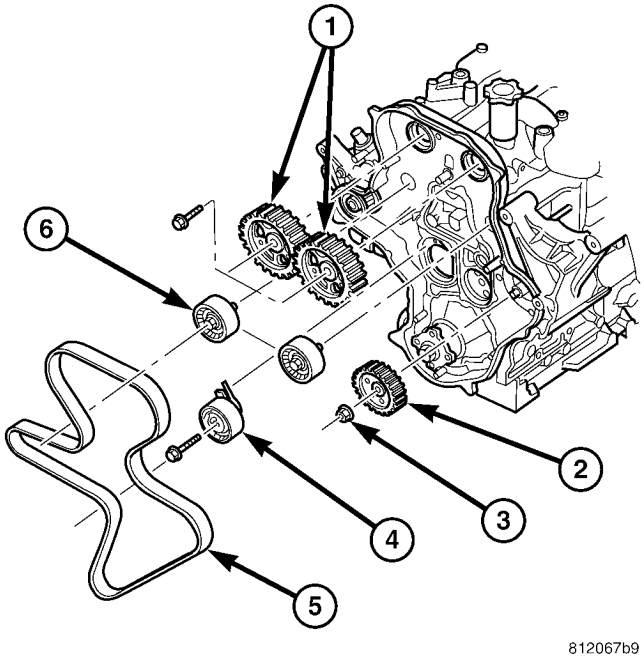


***Fig. 108 TIMING BELT AND SPROCKETS***

1 - CAMSHAFT SPROCKETS
2 - INJECTION PUMP SPROCKET
3 - INJECTION PUMP SPROCKET RETAINING NUT
4 - TIMING BELT TENSIONER
5 - TIMING BELT
6 - IDLER PULLEY

## INSTALLATION

(1) Install timing belt idler pulleys (Fig. 108). Torque bolts to 47.1N·m.

(2) Install timing belt (Refer to 9 - ENGINE/ VALVE TIMING/TIMING BELT/CHAIN AND SPROCKETS - INSTALLATION).

(3) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(4) Install vibration damper (Refer to 9 - ENGINE/ ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(5) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Install right engine mount.

(8) Install air cleaner housing.

(9) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).

(10) Connect negative battery cable.

# TIMING BELT TENSIONER & PULLEY

## REMOVAL

**CAUTION: INSPECT THE TOOTHED BELT, PULLEYS AND BEARINGS FOR DAMAGE, SEIZURE AND LEAKS.**

**NOTE: DO NOT expose the toothed belt to oil, grease or water contamination. DO NOT clean belt, pulleys or tensioner with solvent. DO NOT crimp the timing belt at a sharp angle. DO NOT install belt with levered tools forcing the belt onto the pulleys.**

(1) Disconnect negative battery cable.

(2) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).

(3) Remove air cleaner housing.

(4) Support engine and remove right engine mount.

(5) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(6) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).

(7) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).

(8) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).

(9) Loosen and remove timing belt tensioner (Fig. 109).

## INSTALLATION

**CAUTION: INSPECT THE TOOTHED BELT, PULLEYS AND BEARINGS FOR DAMAGE, SEIZURE AND LEAKS.**

**NOTE: DO NOT expose the toothed belt to oil, grease or water contamination. DO NOT clean belt, pulleys or tensioner with solvent. DO NOT crimp the timing belt at a sharp angle. DO NOT install belt with levered tools forcing the belt onto the pulleys.**

(1) Install timing belt tensioner and retaining bolt (Fig. 109).

(2) Adjust timing belt tensioner (Refer to 9 - ENGINE/VALVE TIMING/TMNG BELT/CHAIN TENSIONER&PULLEY - ADJUSTMENTS).

TIMING BELT TENSIONER & PULLEY (Continued)

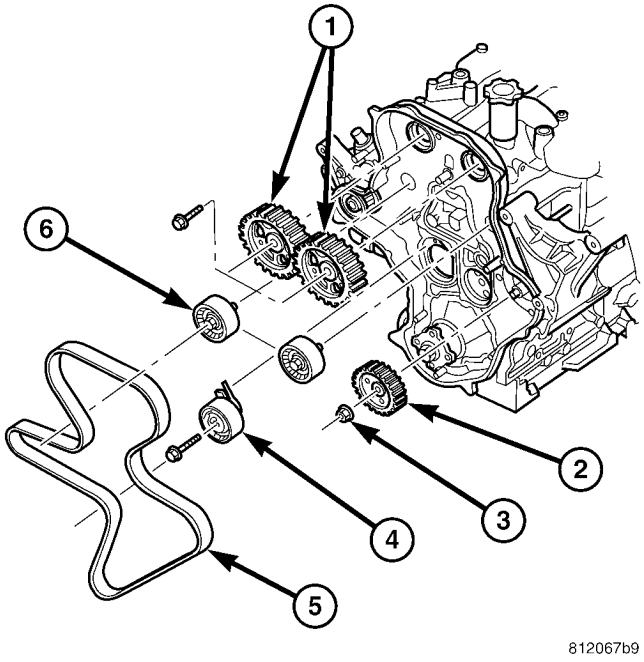


***Fig. 109 TIMING BELT AND SPROCKETS***

1 - CAMSHAFT SPROCKETS
2 - INJECTION PUMP SPROCKET
3 - INJECTION PUMP SPROCKET RETAINING NUT
4 - TIMING BELT TENSIONER
5 - TIMING BELT
6 - IDLER PULLEY

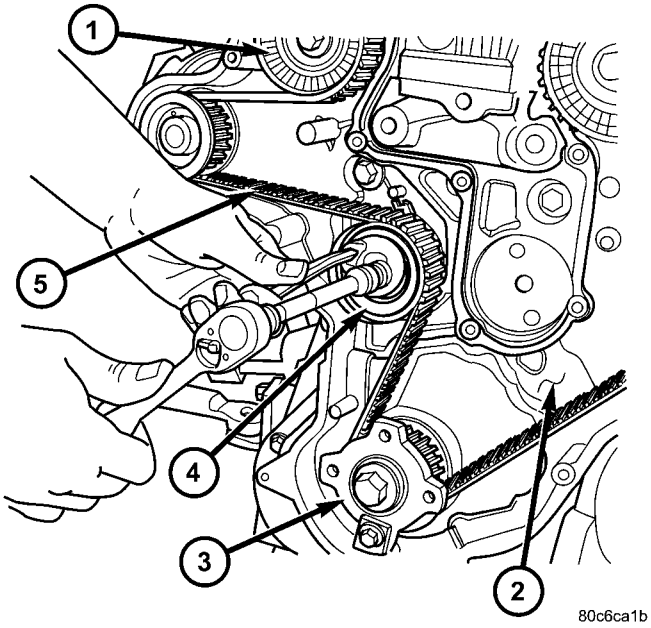


***Fig. 110 TIMING BELT TENSIONER ADJUSTMENT***

1 - TIMING BELT IDLER PULLEY
2 - ENGINE FRONT COVER
3 - CRANKSHAFT HUB
4 - TIMING BELT TENSIONER
5 - TIMING BELT

(3) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(4) Install vibration damper (Refer to 9 - ENGINE/ ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(5) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(6) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(7) Install right engine mount.

(8) Install air cleaner housing.

(9) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).

(10) Connect negative battery cable.

## ADJUSTMENTS

### ADJUSTMENT - TIMING BELT TENSIONER

(1) With timing belt outer cover removed and timing belt installed.

(2) Loosen timing belt tensioner (Fig. 110).

(3) Align timing belt tensioner spring stop with tensioner as shown (Fig. 111) and torque timing belt tensioner retaining bolt to 34.7N·m.

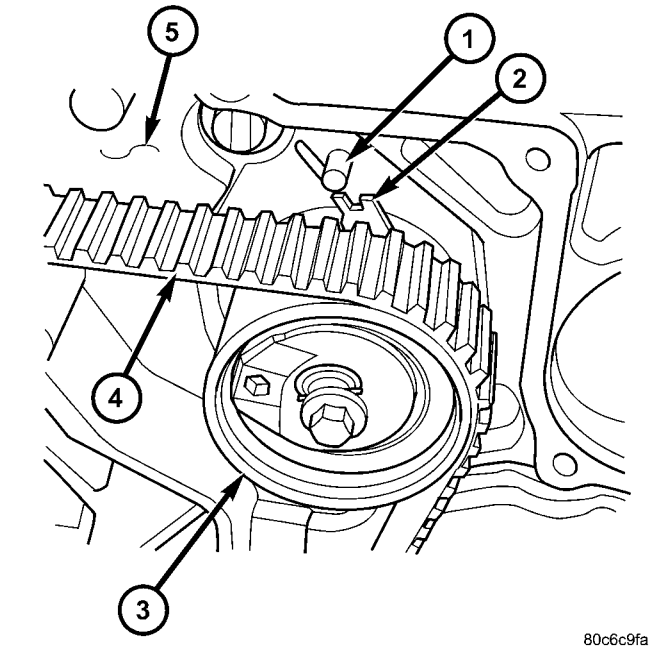


***Fig. 111 TIMING BELT TENSIONER ALIGNMENT***

1 - TENSIONER SPRING STOP
2 - TIMING BELT TENSIONER
3 - TIMING BELT TENSIONER
4 - TIMING BELT
5 - TIMING BELT INNER COVER

TIMING BELT TENSIONER & PULLEY (Continued)

(4) Rotate engine 2 complete revolution and then recheck tensioner alignment. Readjust tensioner alignment as necessary.

# TIMING BELT AND SPROCKETS

## REMOVAL

**CAUTION: BEFORE REMOVING THE TIMING BELT, THE ENGINE MUST BE PLACED AT 90° ATDC. FAILURE TO DO SO COULD RESULT IN VALVE AND/OR PISTON DAMAGE DURING REASSEMBLY. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE)**

**CAUTION: INSPECT THE TOOTHED BELT, PULLEYS AND BEARINGS FOR DAMAGE, SEIZURE AND LEAKS.**

**NOTE: DO NOT expose the toothed belt to oil, grease or water contamination. DO NOT clean belt, pulleys or tensioner with solvent. DO NOT crimp the timing belt at a sharp angle. DO NOT install belt with levered tools forcing the belt onto the pulleys.**

(1) Disconnect negative battery cable.
(2) Remove engine cover (Refer to 9 - ENGINE - REMOVAL).
(3) Remove air cleaner housing assembly.
(4) Support engine and remove right engine mount.
(5) Remove power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(6) Remove accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - REMOVAL).
(7) Remove the generator.
(8) Rotate engine until #1 piston is at TDC, crankshaft notch on the crankshaft hub will be at 12 o'clock.
(9) Looking at the engine from the belt side, rotate the crankshaft 90° clockwise.
(10) Install the 90° alignment pin, VM 1068 into the crankcase threaded hole to lock crankshaft (make sure the crankshaft will not rotate).
(11) Paint mark the crankshaft hub and the oil pump cover. This will assist during assembly.
(12) Remove vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - REMOVAL).
(13) Remove timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - REMOVAL).
(14) Remove the intake and exhaust camshaft plugs from the camshaft cover to introduce the camshaft timing pins.

**NOTE: If the engine is already timed, install the camshaft alignment pins (intake cam alignment pin, VM 1052, exhaust cam alignment pin, VM 1053).**

(15) Loosen timing belt tensioner and remove timing belt (Fig. 112).
(16) Using intake camshaft gear bolt, rotate intake camshaft until the intake alignment hole lines up with the hole in the camshaft cover. Install the intake cam alignment pin VM 1052. Repeat the operation for the exhaust camshaft with alignment pin VM 1053 (Fig. 112).
(17) Using VM 1055 hold the cam gears to remove the bolts.

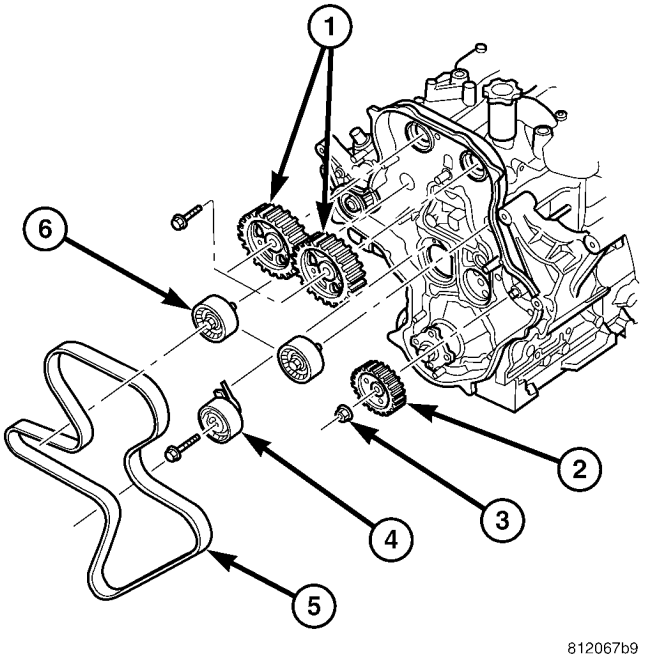


***Fig. 112 TIMING BELT AND SPROCKETS***

1 - CAMSHAFT SPROCKETS
2 - INJECTION PUMP SPROCKET
3 - INJECTION PUMP SPROCKET RETAINING NUT
4 - TIMING BELT TENSIONER
5 - TIMING BELT
6 - IDLER PULLEY

## INSTALLATION

(1) With both camshaft alignment pins still installed and the engine locked at 90° after TDC, install the timing gears finger tight.
(2) Align timing mark on high pressure injection pump sprocket with timing mark on cover (Fig. 113).

TIMING BELT AND SPROCKETS (Continued)

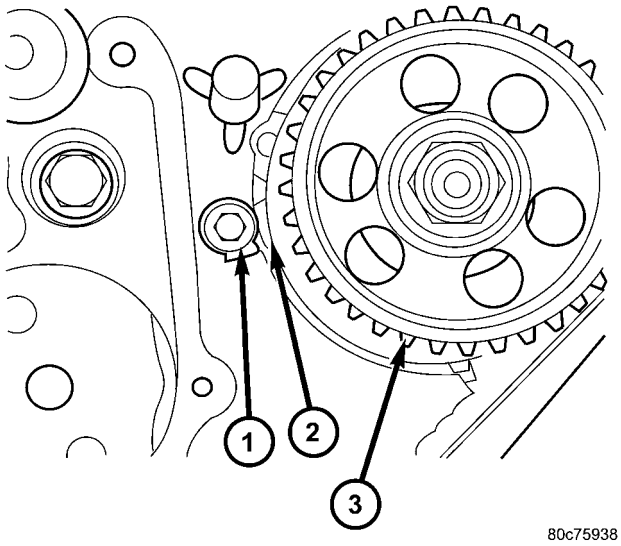


*Fig. 113 INJECTION PUMP GEAR TIMING MARKS*

1 - TIMING MARK ON COVER
2 - TIMING MARK ON INJECTION PUMP SPROCKET
3 - INJECTION PUMP SPROCKET

(3) Install timing belt on crankshaft hub, fix it with VM1074, then around high pressure injection pump, idler pulley, intake camshaft gear, exhaust camshaft gear, idler pulley and water pump gear.

**NOTE: To uniform the belt tension, slightly rotate the intake camshaft pulley counterclockwise with VM 1055.**

(4) Adjust the timing belt tensioner (turn it clockwise), lining up the tensioner center notch with aluminum cover dowel pin (Fig. 114). Tighten the tensioner bolt to 28N·m (20.5 lbs. ft.).

(5) Torque camshaft gear bolts to 60 N·m (44 lbs.ft.) (pre setting) holding gears with VM 1055.

(6) Remove both camshaft alignment pins from cylinder head cover/intake manifold. (Refer to 9 - ENGINE/VALVE TIMING - STANDARD PROCEDURE) .

(7) Torque camshaft gear bolts to 108 N·m (80 lbs.ft.) while holding gears with VM 1055.

(8) Remove 90° ATDC engine locking pin from engine block.

**CAUTION: Wait 30 minutes before rotating crankshaft after installing camshaft cover.**

(9) Rotate crankshaft 2 times (looking at it from the belt side)

(10) Carefully line up the painted mark on the crankshaft hub and oil pump cover.

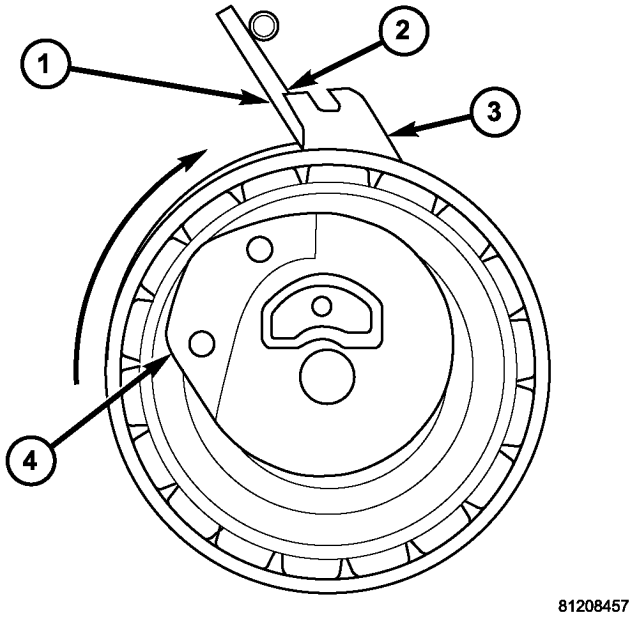


*Fig. 114 TIMING BELT TENSIONER ALIGNMENT*

1 - TENSIONER SPRING
2 - 1MM ALIGNMENT POINTER OVERLAP
3 - TENSIONER ALIGNMENT POINTER
4 - TENSIONER ASSEMBLY

**CAUTION: IF THE CAMSHAFT ALIGNMENT PINS CAN NOT BE INSTALLED, REPEAT THIS PROCEDURE.**

(11) Check that the intake and exhaust cam alignment pins CAN be installed, if so remove them.

(12) Install the intake and exhaust camshaft plugs.

(13) Install timing belt outer cover (Refer to 9 - ENGINE/VALVE TIMING/TIMING BELT / CHAIN COVER(S) - INSTALLATION).

(14) Install vibration damper (Refer to 9 - ENGINE/ENGINE BLOCK/VIBRATION DAMPER - INSTALLATION).

(15) Install the alternator.

(16) Install accessory drive belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(17) Install power steering belt (Refer to 7 - COOLING/ACCESSORY DRIVE/DRIVE BELTS - INSTALLATION).

(18) Install right engine mount.

(19) Install air cleaner housing.

(20) Install engine cover (Refer to 9 - ENGINE - INSTALLATION).

(21) Connect negative battery cable.