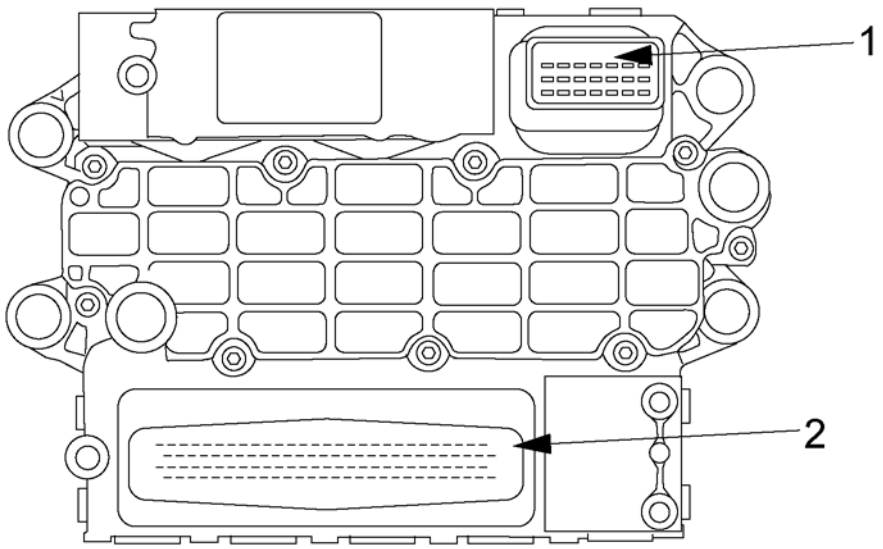
Motor Control Module

The engine mounted MCM includes control logic to provide overall engine management. See Figure 1. The MCM processes the data received from the CPC, for example the position of the accelerator pedal, engine brake, etc. These data are evaluated together with the data from the sensors on the engine, such as, charge and oil pressure and coolant and fuel temperature. The data is then compared to the characteristic maps or lines stored in the MCM. From these data, quantity and timing of injection are calculated and the unit pumps are actuated accordingly through the solenoid valves.



1. 21–Pin Connector
2. 120–Pin Connector

Figure 1 Motor Control Module

NOTE:
Do NOT ground the MCM. This can result in false codes being logged.

Engine Harness

The MCM has a 120–pin connector Engine Harness which is factory installed. It also has a 21–pin connector and 31–pin connector which are the responsibility of the OEM.

Common Powertrain Controller

The CPC has three 18–pin connectors and one 21–pin connector. The following sections contain the connector pin-outs for truck, vocational, transit bus, fire truck, and crane applications.

CPC VEHICLE INTERFACE HARNESS

The OEM supplied Vehicle Interface Harness (VIH) connects the CPC to the MCM and other vehicle systems. See Figure 4.

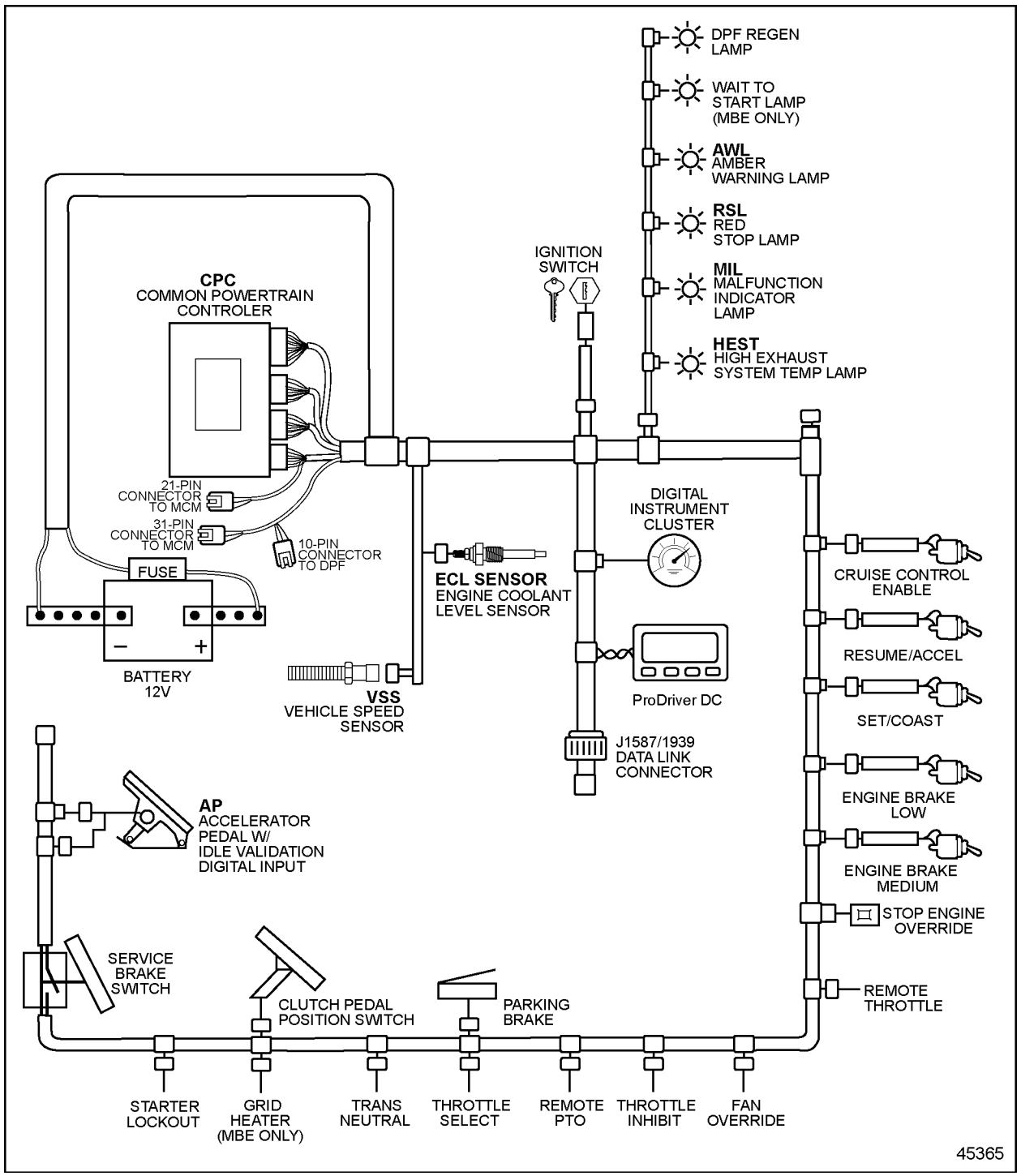


Figure 4 Vehicle Interface Harness

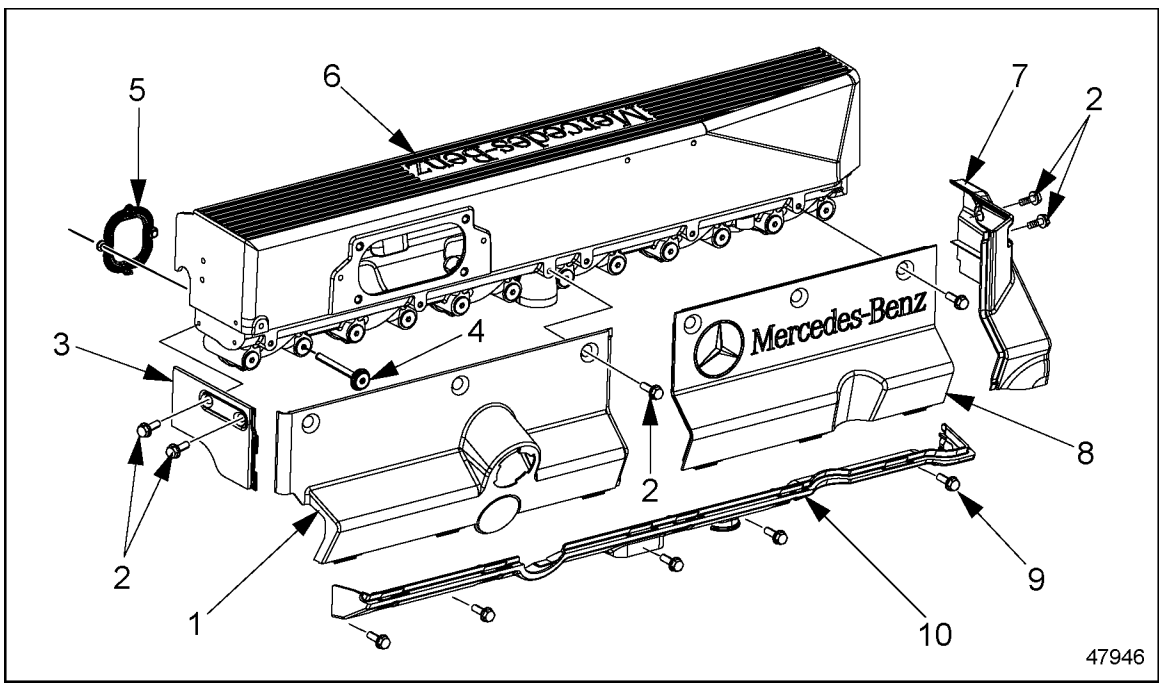
1.1 ENGINE TRIM COVERS AND FRAMES

The engine trim covers enclose the unit pumps and high pressure fuel lines on the left side of the engine.

1.1.1 Removal of Engine Trim Covers

removal steps are as follows:

1. Loosen the hose clamp at the air inlet hose at the air compressor and move hose out of the way.
2. Disconnect the 31–pin vehicle harness connector at the front trim cover by pushing on tab of 31–pin connector and rotating the connector counterclockwise.
3. Remove the two engine side trim covers by removing six bolts securing the cover to the air intake manifold. See Figure 1-1.



1. Front Side Trim Cover
2. Bolts
3. Front Trim Cover
4. Air Intake Manifold Bolts (qty 12)
5. Gaskets (qty 6)
6. Air Intake Manifold
7. Rear Trim Cover
8. Rear Side Trim Cover
9. Bolts (qty 5)
10. Trim Cover Frame

Figure 1-1 Engine Trim Covers and Frame

4. Remove the rear engine trim cover by removing the two bolts securing it to the rear of the air intake manifold. See Figure 1-1.

1.4 CYLINDER BLOCK

The cylinder block has integrated oil and water channels. The upper section of the cylinder bore is induction-hardened. The cylinder block has additional ribs for strength and an improved casting design in the area of the high pressure unit pumps. A flange was added to the left side of the cylinder block for the pre-separator crankcase breather. The purpose of the cylinder liner with an additional sealing ring is to prevent high mileage coolant leakage due to wear in the balcony area of the cylinder block. The ring will keep the coolant away from the balcony area. This service procedure applies to all models of the MBE 4000 engine.

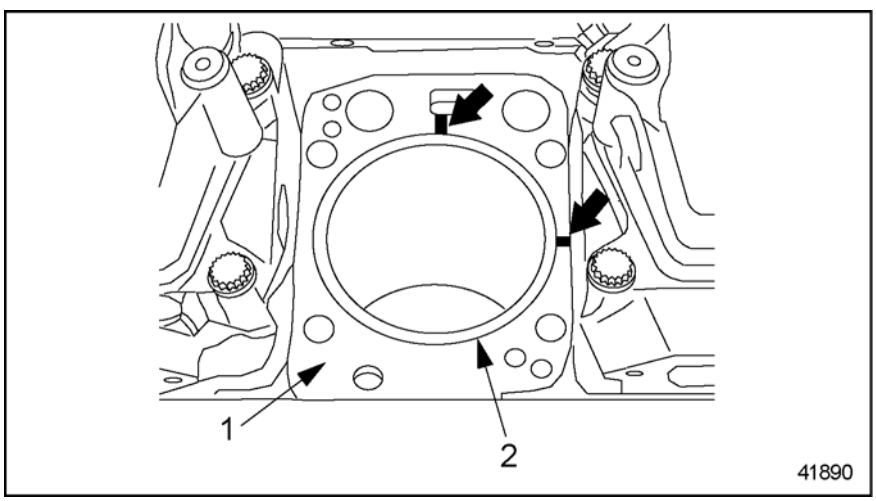
This procedure describes the steps needed to service the engine with the installation of the new design liner with the D-ring seal.

1.4.1 Removal of Cylinder Liner

Removal steps are as follows:

1. Remove the piston. Refer to section 1.19.1.
2. Using a paint pen, mark the position of the cylinder liner in the cylinder block. Mark both the cylinder liner and the block. Then make another set of marks 90 degrees from the first set, in a clockwise direction. See Figure 1-13.

NOTE:
If the same cylinder liner is used again, it must be installed at an offset of 90 degrees from its last position. This reference will not be needed if the cylinder liner is being replaced.



1. Cylinder Block
2. Cylinder Liner

Figure 1-13 Mark the Cylinder Liner

8. Install the assembled tool J–45989 into place by sliding from the bottom up along the rear of the wear sleeve. See Figure 1-51.

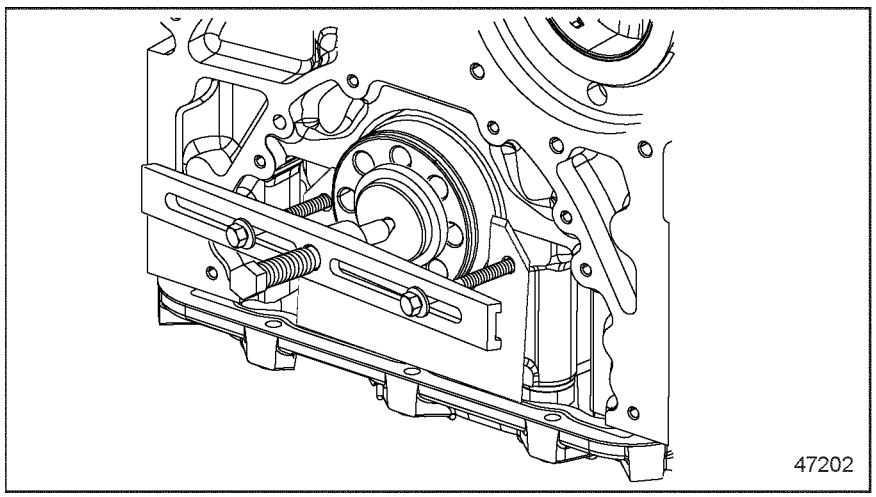


Figure 1-51 Front Seal Wear Sleeve

9. Turn the forcing screw in a slow and continuous motion until the wear sleeve is removed.

NOTE:
Once the wear sleeve is fully removed the tool will drop. Use care to support the tool during the removal procedure.

1.9.2 Installation of Front Crankshaft Wear Sleeve

Installation steps are as follows:

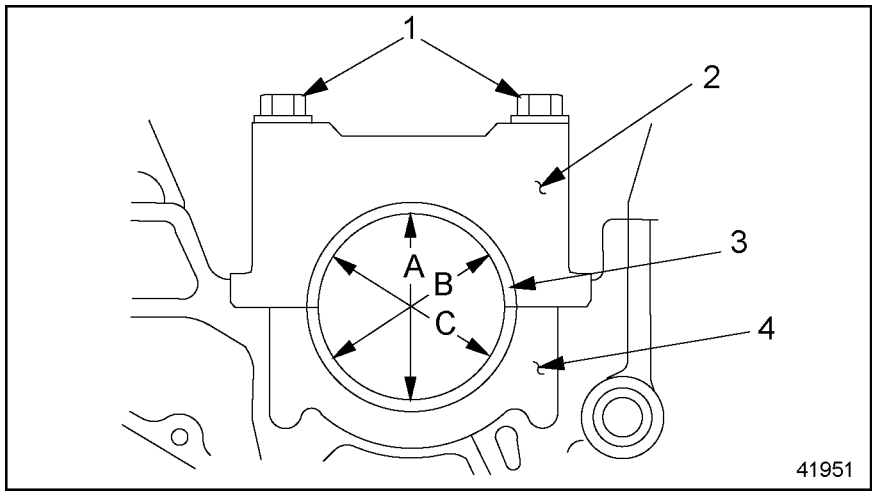
1. Clean the wear sleeve seat area on the crankshaft.

WARNING:
BURNS
To avoid injury from burning, use lifting tools and heat-resistant gloves when handling heated components.

NOTICE:
Be sure to heat the new wear sleeve as evenly as possible. If available, an oven should be used. Uneven heating of the wear sleeve can weaken the material and reduce the service life.

2. Install the wear sleeve with the rounded edge toward the inside of the wear sleeve installer tool (J–47271, part of toolset J-47273). Heat the tool and sleeve together in an oven to a maximum of 150° C (302°F).

[c] Measure 30 degrees clockwise from the separation point of the bearing shells. (see Figure 1-67, C.)



1. Bearing Cap Bolts
2. Main Bearing Cap
3. Main Bearing Shell
4. Crankcase Race

Figure 1-67 Inside Diameter of the Main Bearing Shells

7. If any one of the readings is not within tolerances listed in Table 1-17, then replace the main bearing shells as applicable.

Size: mm (in.)	Main Bearing Inside Diameter mm (in.)	Main Journal Outside Diameter mm (in.)
Standard	104.060-104.106 (4.0968-4.0987)	103.980-104.000 (4.0937-4.0945)
Undersize - 0.10 (0.004)	103.960-104.006 (4.0929-4.0947)	103.880-103.900 (4.0898-4.0905)
Undersize - 0.25 (0.010)	103.810-103.856 (4.0870-4.0888)	103.730-103.750 (4.0839-4.0846)
Undersize - 0.50 (0.020)	103.560-103.606 (4.0772-4.0790)	103.480-103.500 (4.0740-4.0748)
Undersize - 0.75 (0.030)	103.310-103.356 (4.0673-4.0691)	103.230-103.250 (4.0642-4.0650)
Undersize - 1.00 (0.040)	103.060-103.106 (4.0575-4.0593)	102.980-103.000 (4.0543-4.0551)

Table 1-17 Bearing Shell and Bearing Journal Diameter

NOTE:
New bearing shells are supplied ready for installation. Do not machine them or remove any material from them. Refer to section 1.10.2.

8. Remove the bearing caps.

NOTE:
If the bolts are going to be used again, check their length.

1.16 PILOT BEARING

The special tools listed below are required for this procedure:

- □ Engine Barring Tool (J–46392)
- □ 19mm Flywheel and Main Pulley Socket (J–45390)
- □ Flywheel Pilot Bearing Remover J-46170
- □ Flywheel Pilot Bearing Installer J-46169
- □ Slide Hammer J-6471–02
- □ Driver Handle J-8092

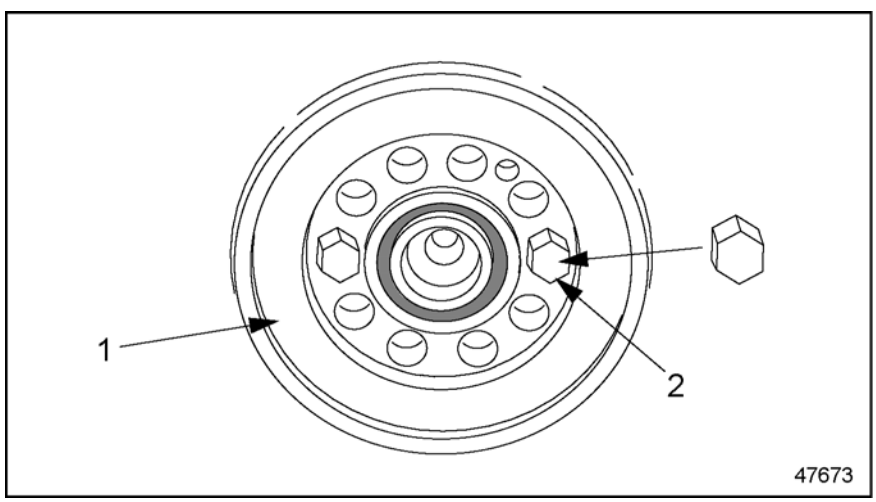
Perform the following procedures for removal and installation of the pilot bearing.

1.16.1 Removal of Pilot Bearing

Removal steps are as follows:

1. Remove the transmission. Refer to the appropriate vehicle service manual.
2. Remove the clutch from the flywheel. Refer to the appropriate vehicle service manual.
3. Install the engine barring tool (J–46392). Refer to section1.17.1.
4. Using the 19mm socket (J–45390), remove eight flywheel socket-head bolts from the flywheel leaving one bolt across from each other on the bolt circle.
5. Install and finger tighten two M16 x 1.5 x 70 mm hex-head bolts (locally procured) across from each other in the flywheel. Position the two bolts with the flats of the bolt head parallel to the pilot bearing bore. See Figure 1-91.

NOTE:
The flats on the hex-head bolts must be parallel to the pilot bearing bore in order to have sufficient clearance to remove the pilot bearing.



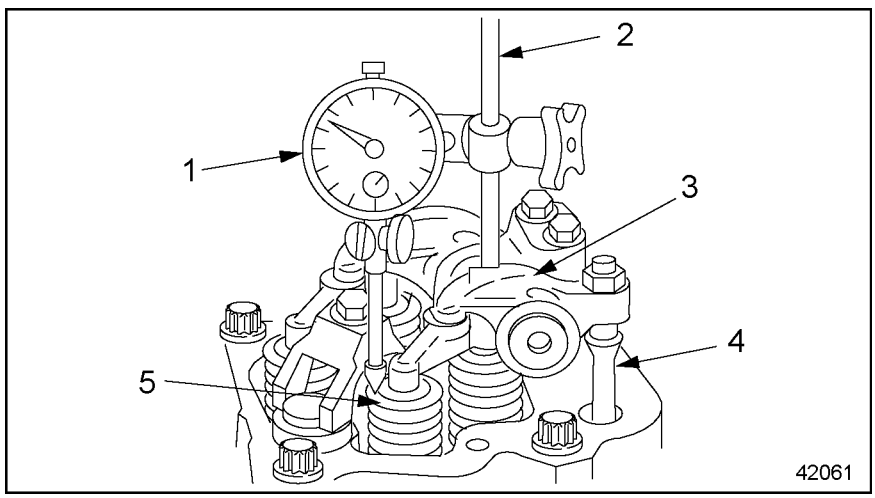
1. Flywheel
2. M16 x 1.5 x 70mm Hex-Head Bolt

Figure 1-91 Flywheel Bolt Positioning

[d] When the intake valves are completely open, read off the value on the dial gauge. If the intake valve lift reaches at least 11.546 mm (0.4546 in.) at its highest point, the intake valves are lifting correctly. If the intake valve lift fails to reach 11.546 mm (0.4546 in.) at its highest point, remove the camshaft and inspect the cams for wear. Refer to section 1.22.1.

NOTE:
If the gauge reading fails to reach 11.546 mm (0.4546 inch), be sure the valves were completely open. The dial gauge will show the highest reading when the valve is completely open.

6. Check the lift on the exhaust valves. See Figure 1-125.



1. Dial Gauge
2. Gauge Holder
3. Exhaust Rocker Arm
4. Pushrod
5. Exhaust Valve

Figure 1-125 Checking Exhaust Valve Lift

[a] Turn the flywheel in a counterclockwise direction until both exhaust valves are closed.

[b] Move the dial gauge and gauge holder to the spring retainer on the exhaust valve. Make sure the dial gauge still has a preload of approximately 15 mm (0.60 in.) to provide adequate travel for checking the exhaust valve lift.

[c] Set the scale on the dial gauge to "0" (zero).

[d] Using the engine barring tool, (J–46392) turn the flywheel in a counterclockwise direction (as viewed from the flywheel end).

NOTE:
The dial gauge will show the highest reading when the valve is completely open.

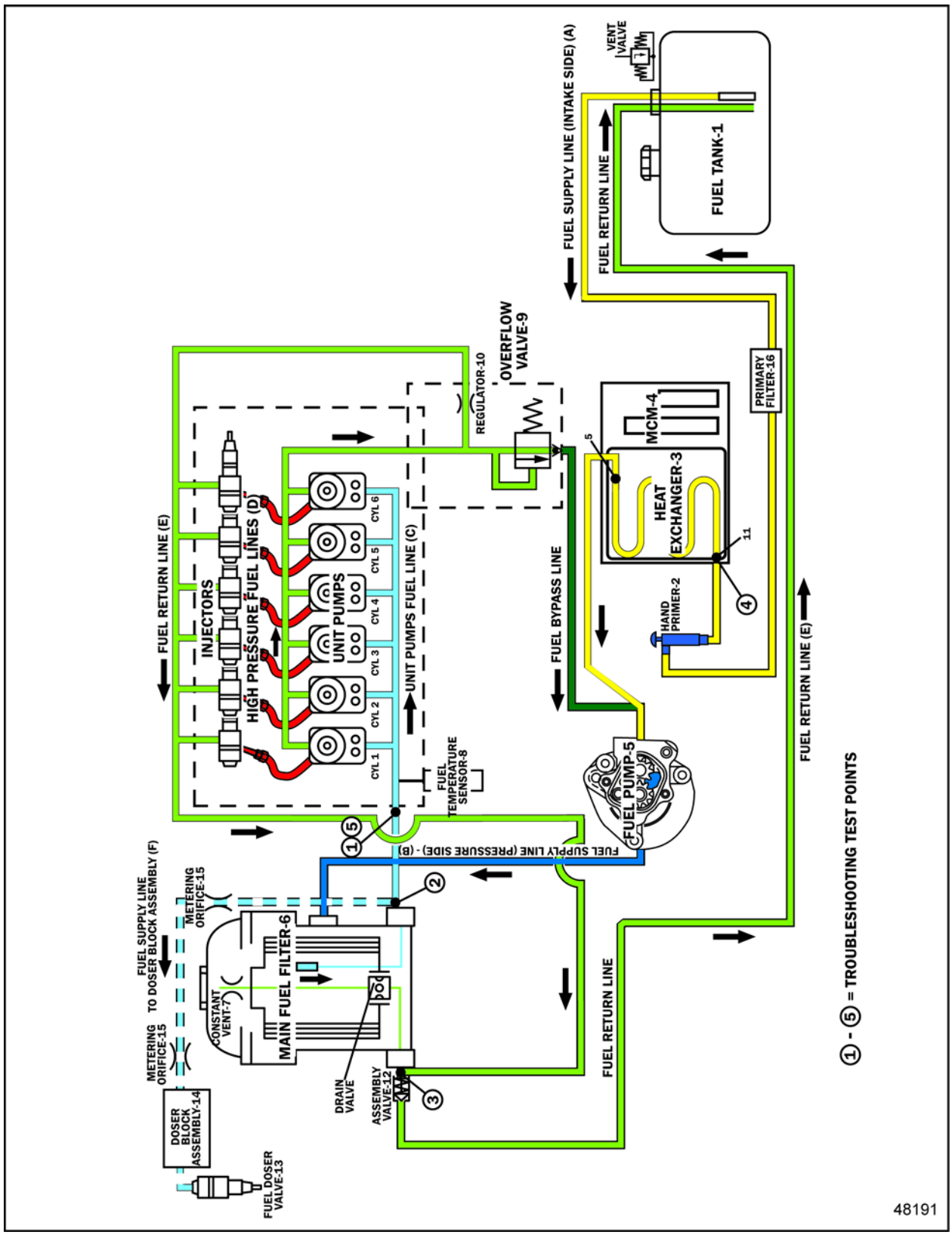


Figure 2-1 Fuel System Schematic

2.7 PROTECTIVE SLEEVE

The following sections support the repair of the protective sleeve.

2.7.1 Removal of Protective Sleeve

Removal steps are as follows:

⚠ WARNING:

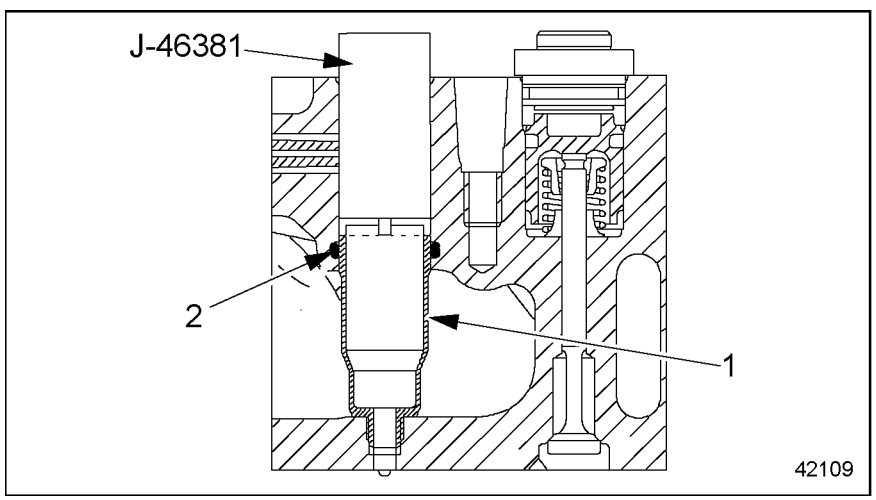
HOT COOLANT

To avoid scalding from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Wear adequate protective clothing (face shield, rubber gloves, apron, and boots). Remove the cap slowly to relieve pressure.

1. Drain the engine coolant into a clean container. If the coolant is clean, save it for later use.
2. Remove the fuel injector. Refer to section 2.6.1.

NOTE:
The injector sleeve puller kit (J–46381) comes with two sockets; a 4-toothed and a rubber-ended socket.

3. Using the injector sleeve puller (J–46381), remove the protective sleeve from the cylinder head. See Figure 2-28.



1. Protective Sleeve
2. O-ring

Figure 2-28 Protective Sleeve

3. Install the oil cooler/filter housing on the cylinder block. Install the housing bolts and tighten them in the order shown in see Figure 3-24. Tighten each bolt to 60 N·m (44 lb·ft).

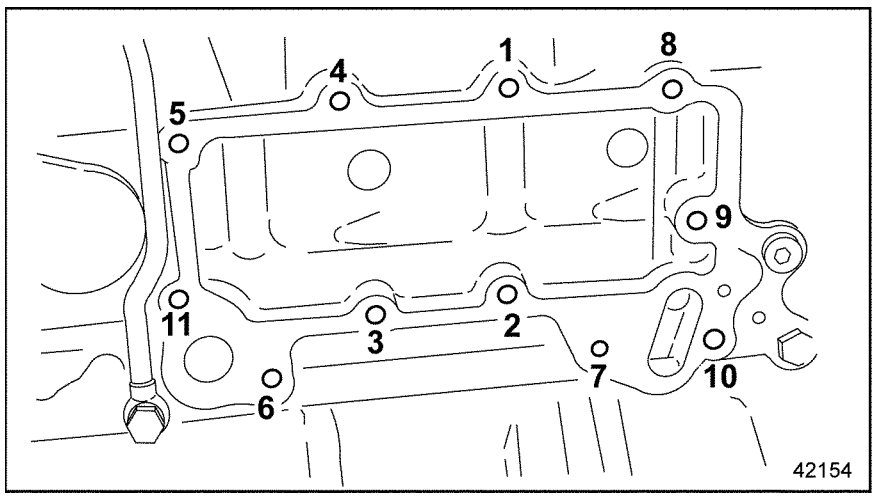
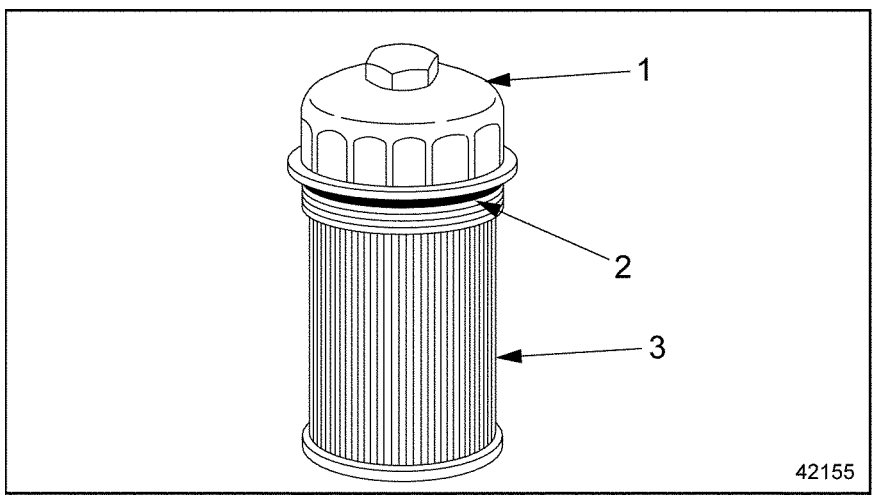


Figure 3-24 Oil Cooler Housing Bolts

[a] Clean the mating surfaces of the oil cooler/filter housing and the cylinder block. Remove any bits of adhering gasket material.

[b] Replace the oil cooler/filter housing gasket.

4. Install a new filter element and O-ring in the oil filter housing. See Figure 3-25.



1. Oil Filter Cap
2. O-ring
3. Oil Filter Element

Figure 3-25 Oil Filter Element

5. Install the oil filter cap. Tighten the cap nut to 25 N·m (18 lb·ft).

4.6 CYLINDER HEAD COOLANT VENT LINE

Perform the following procedures for removal and installation of the cylinder head coolant vent line.

4.6.1 Removal of Cylinder Head Coolant Vent Line

Remove as follows:

1. Drain the cooling system.
2. Remove air cleaner assembly.
3. Remove the radiator support bracket from the top of the EGR cooler bracket and radiator.
4. Disconnect the coolant vent line located on top of the EGR cooler by removing the banjo bolt and seal rings. Discard the seal rings.
5. Remove the bolt securing the air compressor suction supply bracket to the EGR cooler bracket. See Figure 4-14.

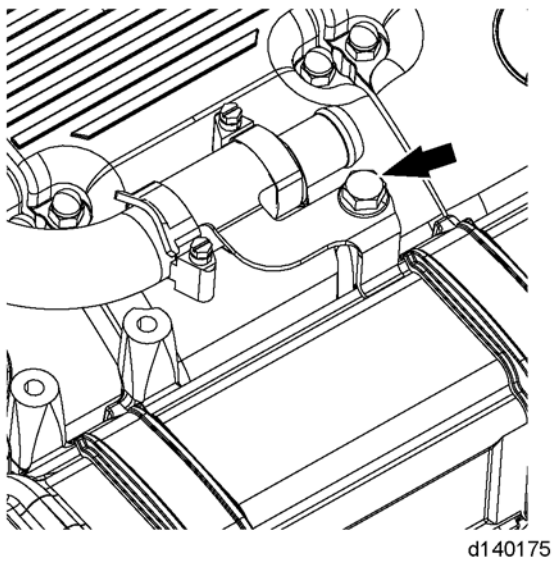


Figure 4-14 Air Compressor Suction Supply Bracket

6. Remove the two bolts securing the turbocharger inlet elbow to the EGR cooler bracket. Rotate the turbocharger inlet elbow away from the engine.

NOTE:
Do not remove the turbocharger air inlet elbow.

7. Remove the clamp halves securing the exhaust gas inlet pipe to the EGR cooler and to the center pipe of the exhaust manifold. Remove the exhaust gas inlet pipe.

10. Install the adjusting rod on the wastegate swing-arm pin. With the wastegate swing-arm in the fully closed position and the adjusting rod length properly set, the adjusting rod should be perfectly aligned with the swing-arm pin, see Figure 6-22. The adjusting rod should slip over the wastegate swing-arm pin nearly effortlessly when properly adjusted.

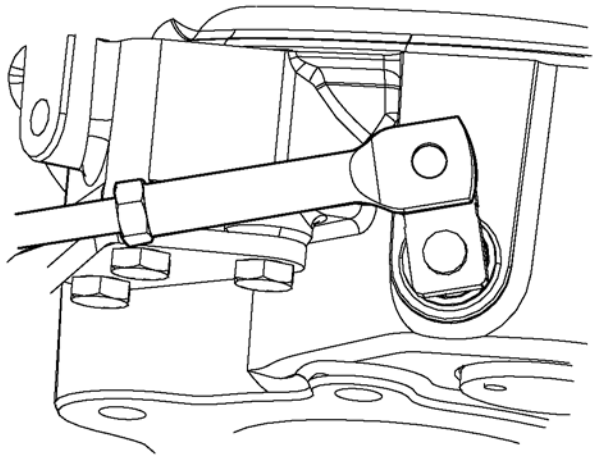
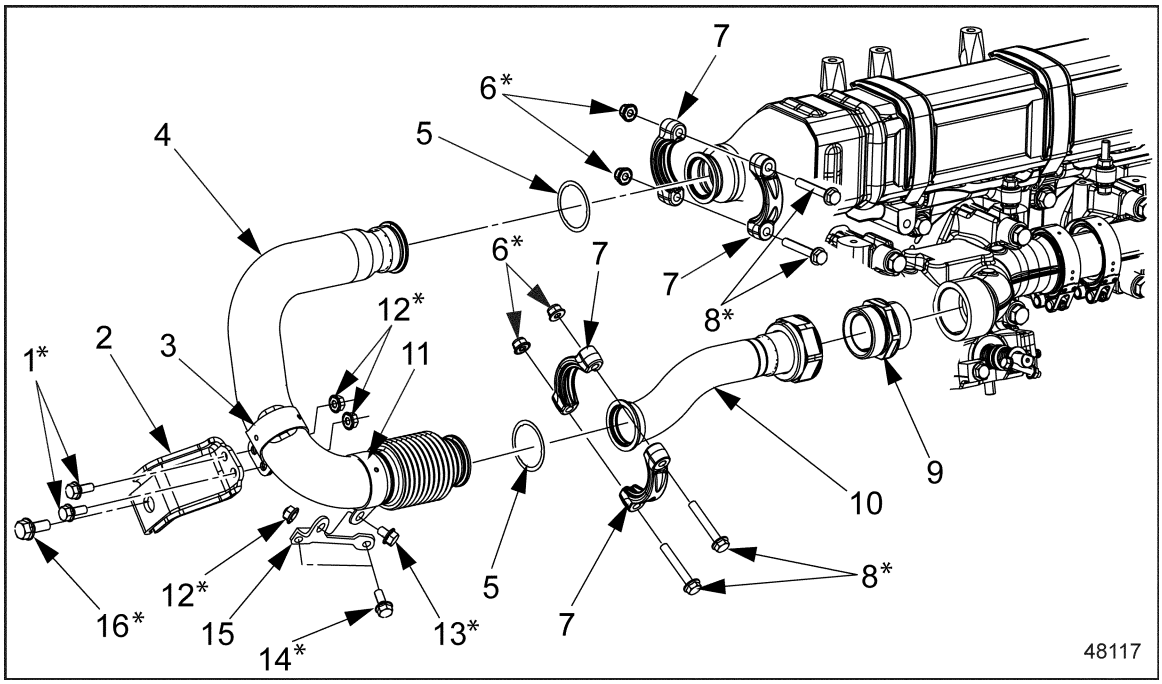


Figure 6-22 Proper Adjusting Rod Length

1. If removed, install rear mounting bracket. See Figure 8-2.

NOTE:
Do not torque bolt.



1. Bolts
2. Rear Mounting Bracket
3. Clamp
4. EGR Gas Inlet Pipe to EGR Cooler
5. Seal
6. Flanged Nut *
7. Clamp Halves
8. Bolts
9. Insert
10. EGR Gas Inlet Pipe from Exhaust Manifold
11. Clamp
12. Flanged Nut *
13. Bolt
14. Bolt
15. Bracket
16. Bolt

* Use high temperature resistant hardware only

Figure 8-2 EGR Gas Inlet Pipe and Related Components

2. If removed, install exhaust mounting bracket. See Figure 8-2

NOTE:
Do not torque bolts.

3. Install EGR gas inlet pipe to the EGR cooler and secure using clamp halves, bolts, and flanged nuts. See Figure 8-2.

NOTE:
Do not torque bolts.

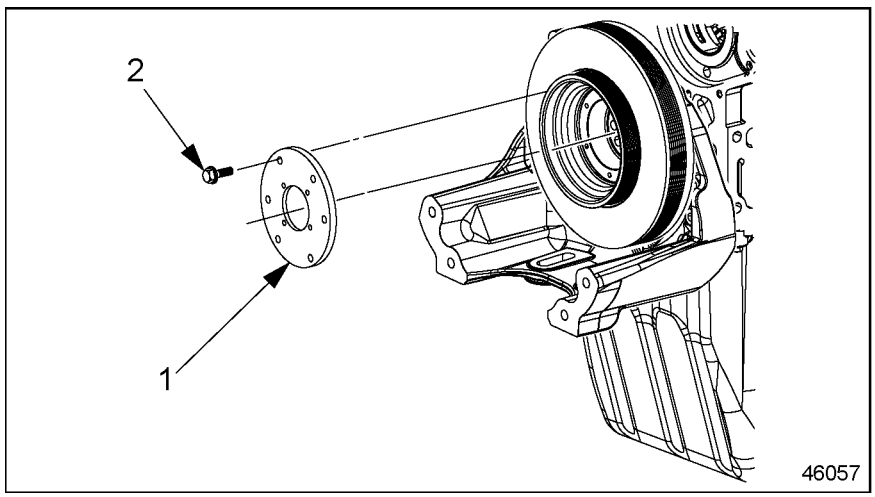
10.1 FRONT POWER TAKE-OFF

A Front Power Take-Off (FEPTO) accessory drive is an available engine option. The drive provides continuous live power anytime the engine is operating. The FEPTO is adaptable to a Spicer 1350/1410 drive shaft.

10.1.1 Removal of FEPTO Components

Removal steps are as follows:

1. Remove the bolts securing the drive shaft to the FEPTO and remove the shaft.
2. Remove the drive belts from their pulleys as installed.
3. To gain access to the vibration damper, remove the lower mounting bolts from the bottom of the front fairing/bumper.



1. Bolts
2. Plate (Hub)

Figure 10-1 FEPTO Hub Plate