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Service Information Bulletin

SUBJECT	DATE
Cylinder Liner - Testing of the Cylinder Liner Upper O-Ring	June 2017

Additions, Revisions, or Updates

Publication Number / Title	Platform	Section Title	Change
DDC-SVC-MAN-0081	Heavy Duty - All	Testing of the Cylinder Liner Upper O-Ring	This is a new section. Test procedure with DKI470E16024 - Heavy Duty Cylinder Liner Seal Leak Tester.
DDC-SVC-MAN-0190		Testing of the Cylinder Liner Upper O-Ring	

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2 Testing of the Cylinder Liner Upper O-Ring

Table 1.

Service Tools Used in the Procedure				
DKI470E16024 - Heavy Duty Cylinder Liner Seal Leak Tester				
 d580226				
Kit Contents:				
Part #	**Description**	**QTY**	**Serviceable (Yes/No)**	**Tool Images**
DKI470E16024-1	Cylinder 1 Top Plate (left)	1	Yes	 d580241
DKI470E16024-2	Cylinder Top Plate	11	Yes	 d580240

Service Tools Used in the Procedure				
DKI470E16024-3	Oil Coolant Module Plate	1	Yes	 d580242
DKI470E16024-4	Bolt (Oil Coolant Module Plate) *M10-1.5 x 35mm*	10	No	 d580243
DKI470E16024-5	Washer (Oil Coolant Module Plate) *M10 Flat Washer*	10	No	 d580244
DKI470E16024-6	Spacer	32	Yes	 d580245
DKI470E16024-7	Washer (Spacer Bottom)	32	Yes	 d580246
DKI470E16024-8	Washer (Spacer Top) *M16 Flat Washer*	32	No	 d580247
DKI470E16024-9	Fuel Filter Module (FFM) Coolant Line Plate	1	Yes	 d580248

Service Tools Used in the Procedure				
DKI470E16024-10	Bolt (FFM Coolant Line Plate) *M5-0.8 x 20mm*	2	No	 d580249
DKI470E16024-11	Fuel Filter Module (FFM) Plug	1	Yes	 d580251
DKI470E16024-12	Bolt (FFM Plug) *M10-1.5 X 20mm*	2	No	 d580243
DKI470E16024-13	Threaded plug (M18)	4	Yes	 d580252
DKI470E16024-14	Threaded plug (M14)	4	Yes	 d580253
DKI470E16024-15	Cap - Coolant Line Fitting	2	Yes	 d580254
DKI470E16024-16	Cap - Coolant Crossover (EPA07-GHG14)	1	Yes	 d580255

Service Tools Used in the Procedure				
DKI470E16024-17	Cap - Coolant Crossover (GHG17)	1	Yes	 d580256
DKI470E16024-18	Cap - Coolant Inlet Elbow (Port A)	1	Yes	 d580257
DKI470E16024-19	Cap - Coolant Inlet Elbow (Port B)	1	Yes	 d580258
DKI470E16024-20	Cap - Coolant Inlet (lower radiator hose)	1	Yes	 d580259
DKI470E16024-21	Kit Case (Foam & Case Included)	1	Yes	d580260 

An external coolant leak found between the cylinder head and cylinder block could be misdiagnosed or over-repaired. The use of the Heavy Duty Cylinder Liner Upper Seal Leak Tester will enable technicians to verify if just the head gasket is leaking or if the upper cylinder liner seal(s) are leaking.

Cylinder block corrosion on the fire deck surface, as well as the counter bore area, is often misdiagnosed as a non-repairable cylinder block. Corrosion is only a concern if the sealing surface of the cooling passage(s) is compromised.

The following test procedure is performed with the cylinder head removed.

The test procedure can be performed with or without the following components installed:

- Oil Coolant Module
- Fuel Filter Module (FFM)
- Air Compressor Coolant Supply Line
- Air Compressor Coolant Return Line
- Air Compressor
- Coolant Drain Plug

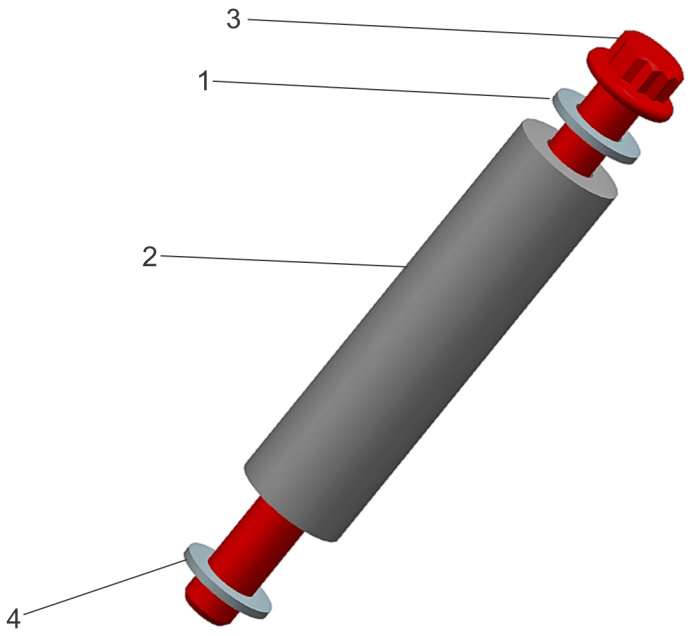
Set up as follows:

1. Clean the cylinder block fire deck, making sure there are no grommets stuck in the counter bores of the coolant passages.
2. Clean 32 of the original cylinder head bolts.

WARNING: EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

3. Using compressed air, clean all cylinder head bolt bores.
4. On each of the 32 cylinder head bolts (3), slide one small washer (1), one spacer (2), and one large flat washer (4). This will be referred to as the "cylinder head bolt assembly" throughout the rest of the procedure.

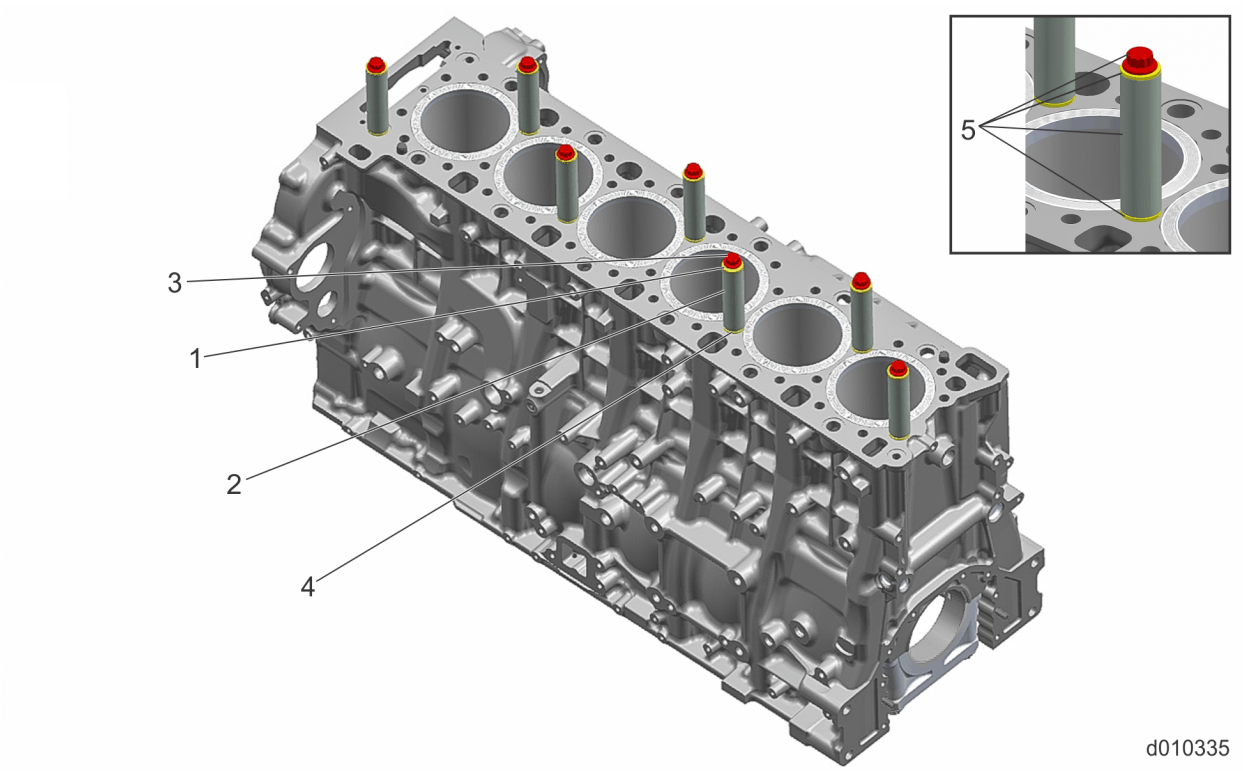


d010334

1. DKI470E16024-8 - Washer (Spacer Top)
2. DKI470E16024-6 - Spacer
3. Cylinder Head Bolt
4. DKI470E16024-7 - Washer (Spacer Bottom)

NOTE: Each cylinder liner should come into contact with a portion of the bottom washer of a cylinder head bolt assembly in two locations. Reference image below.

5. Install seven cylinder head bolt assemblies (5) into the center cylinder head bolt bores using a crisscross pattern. Hand-tighten.



1. DKI470E16024-8 - Washer (Spacer Top)
2. DKI470E16024-6 - Spacer
3. Cylinder Head Bolt
4. DKI470E16024-7 - Washer (Spacer Bottom)
5. Cylinder Head Bolt Assembly

6. Install the cylinder #1 top plate (1) using three cylinder head bolt assemblies. Hand-tighten.

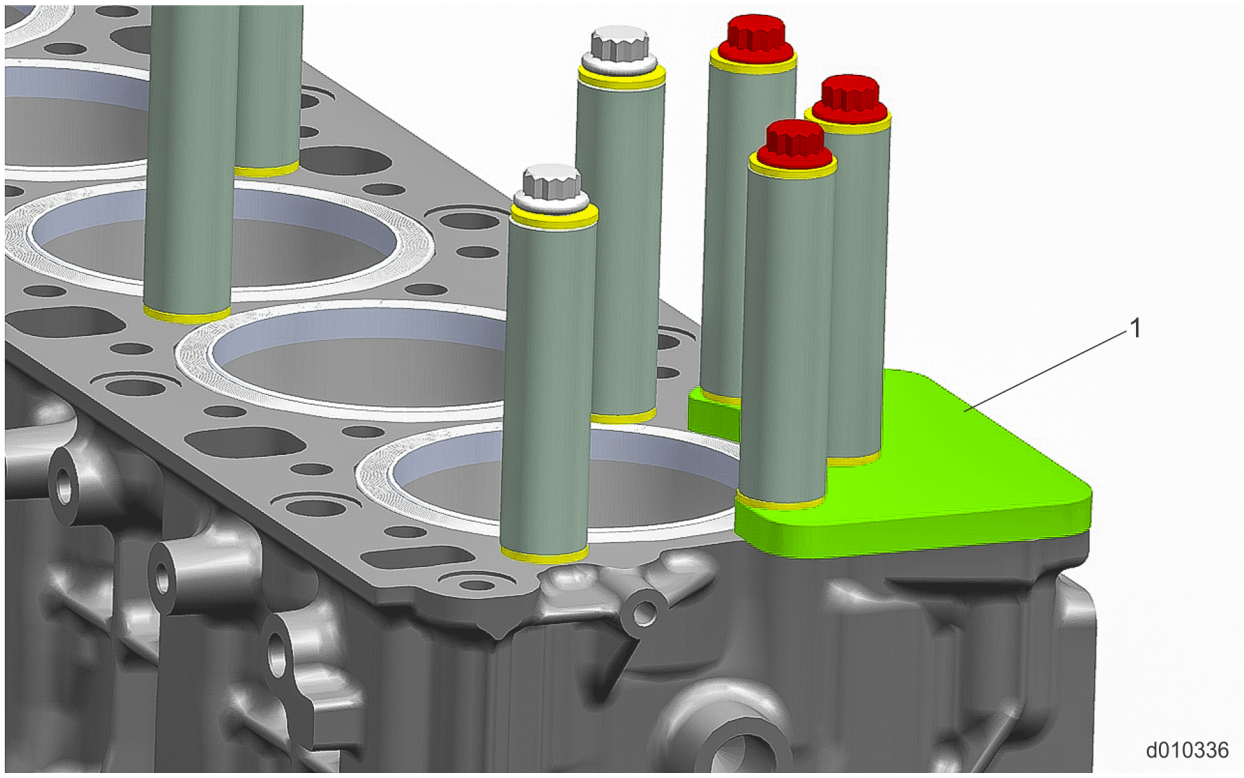


Figure 3. DKI470E16024-1 - Cylinder 1 Top Plate (left)

7. Install the remaining 11 cylinder top plates (1) using the remaining cylinder head bolt assemblies.

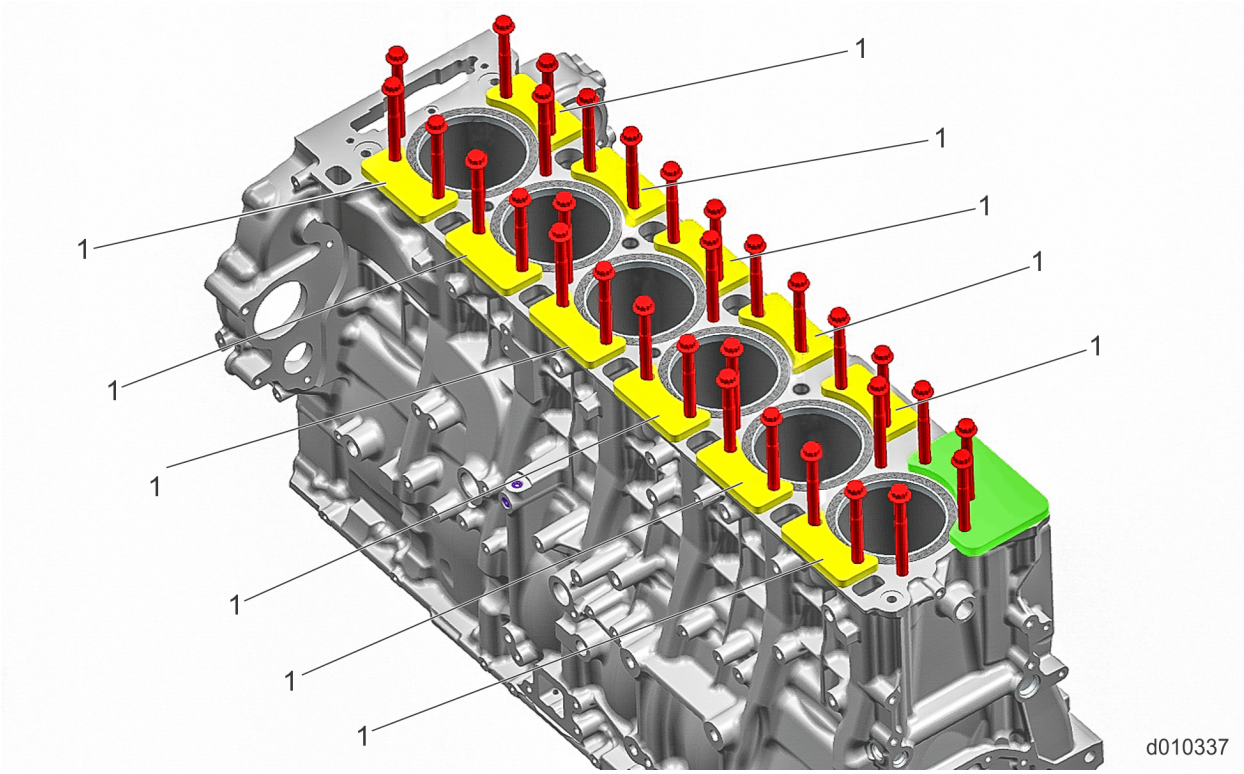


Figure 4. DKI470E16024-2 - Cylinder Top Plate

8. Torque all 32 cylinder head bolt assemblies to 25 N·m (18 lb·ft).

9. If still attached to cylinder block, remove the Exhaust Gas Recirculation (EGR) actuator coolant supply line.
10. Install threaded plug (1) into the cylinder block. Hand-tighten.

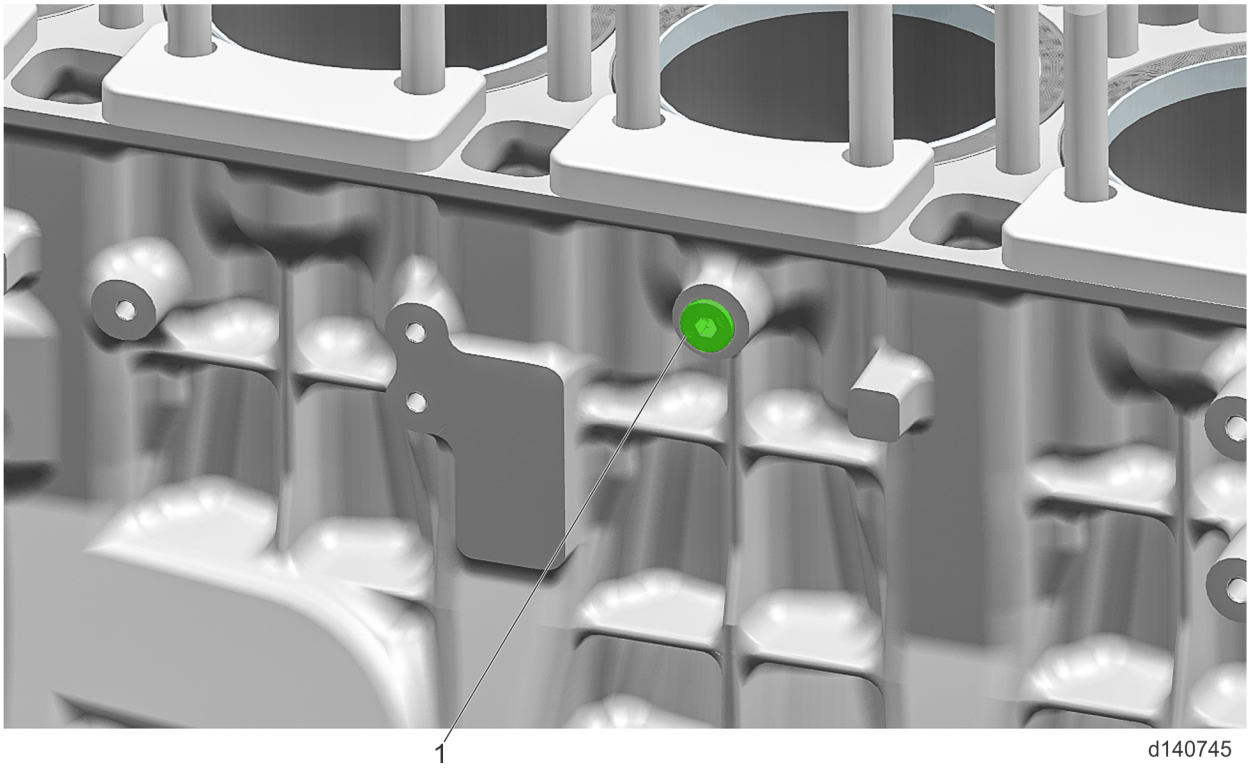
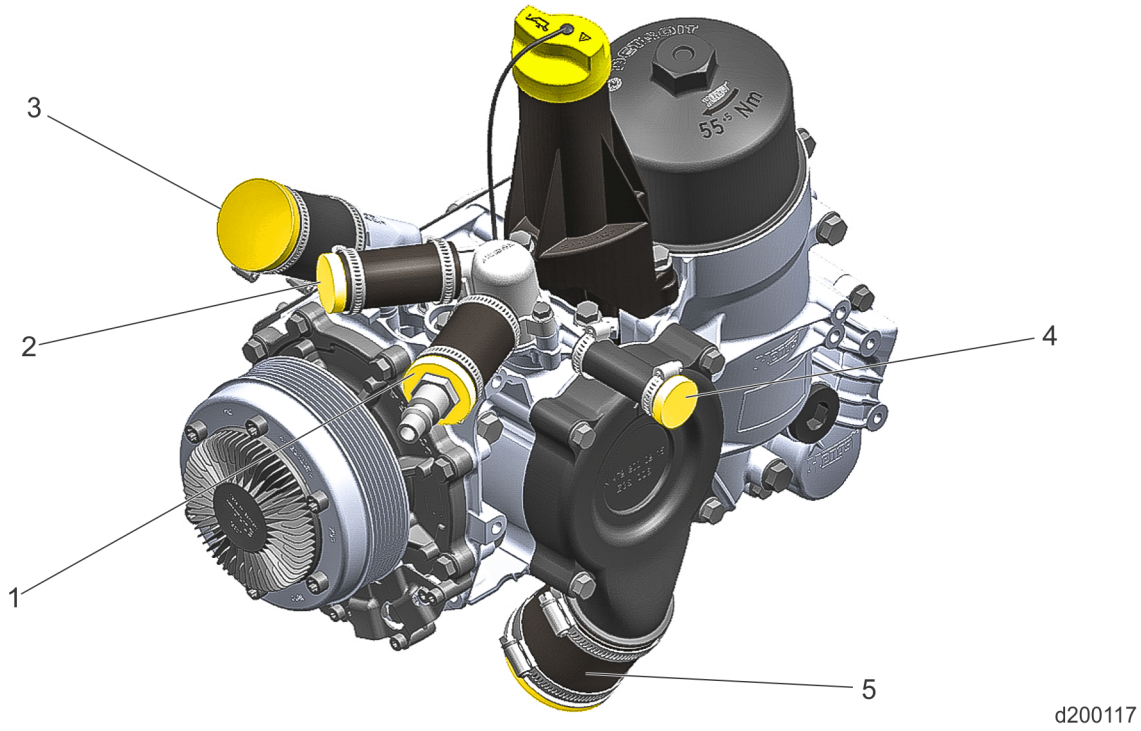


Figure 5. DKI470E16024-14 - Threaded Plug (M14)

11. Torque threaded plug to 25 N·m (18 lb·ft).
12. Install the associated caps on each coolant port of the oil coolant module. Hand-tighten. See figure below.



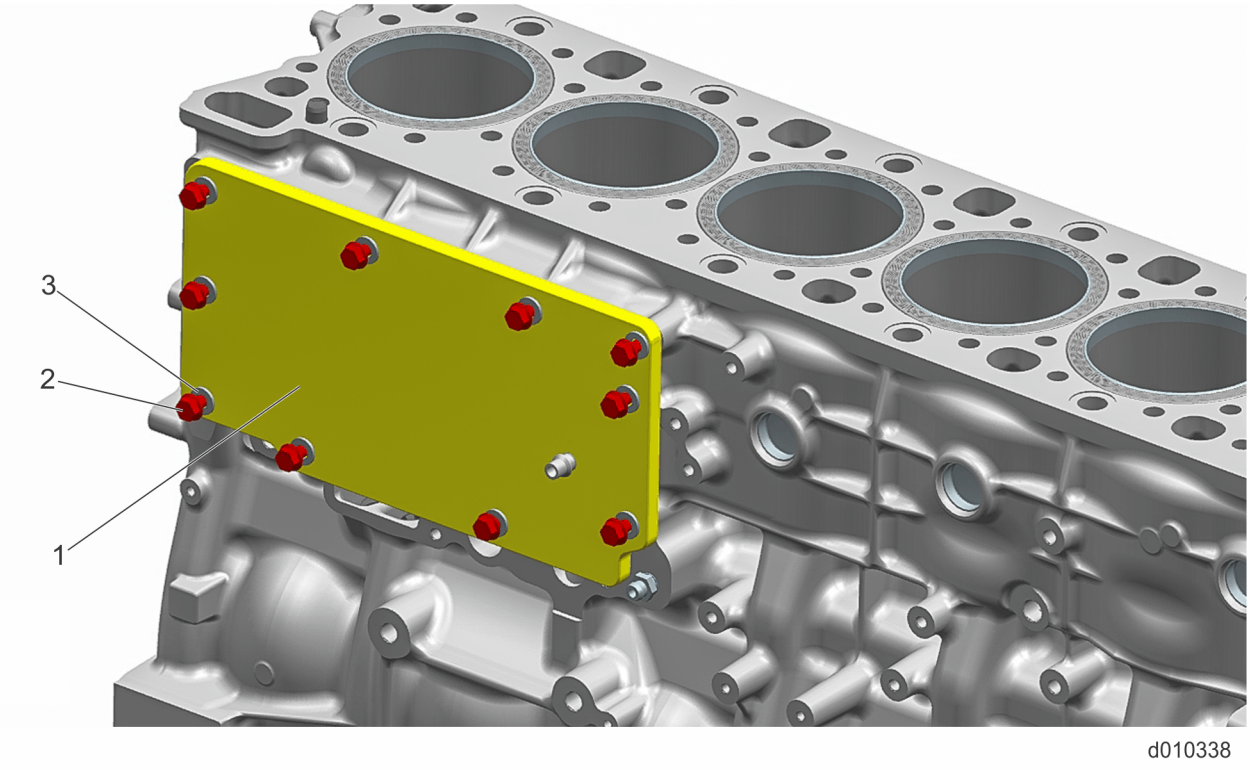
1. DKI470E16024-19 - Cap - Coolant Inlet Elbow (Port B)
2. DKI470E16024-18 - Cap - Coolant Inlet Elbow (Port A)
3. DKI470E16024-16 - Cap - Coolant Crossover (EPA07-GHG14)
4. DKI470E16024-15 - Cap - Coolant Line Fitting
5. DKI470E16024-20 - Cap - Coolant Inlet (lower radiator hose)

Figure 6. EPA07-GHG14 Oil Coolant Module

13. Torque all worm clamps to 6 N·m (4 lb·ft).

NOTE: Steps 14-16 are only required if the oil coolant module is removed from the engine.

14. Remove alignment dowel(s) if still in the engine block. Save dowels for reassembly.



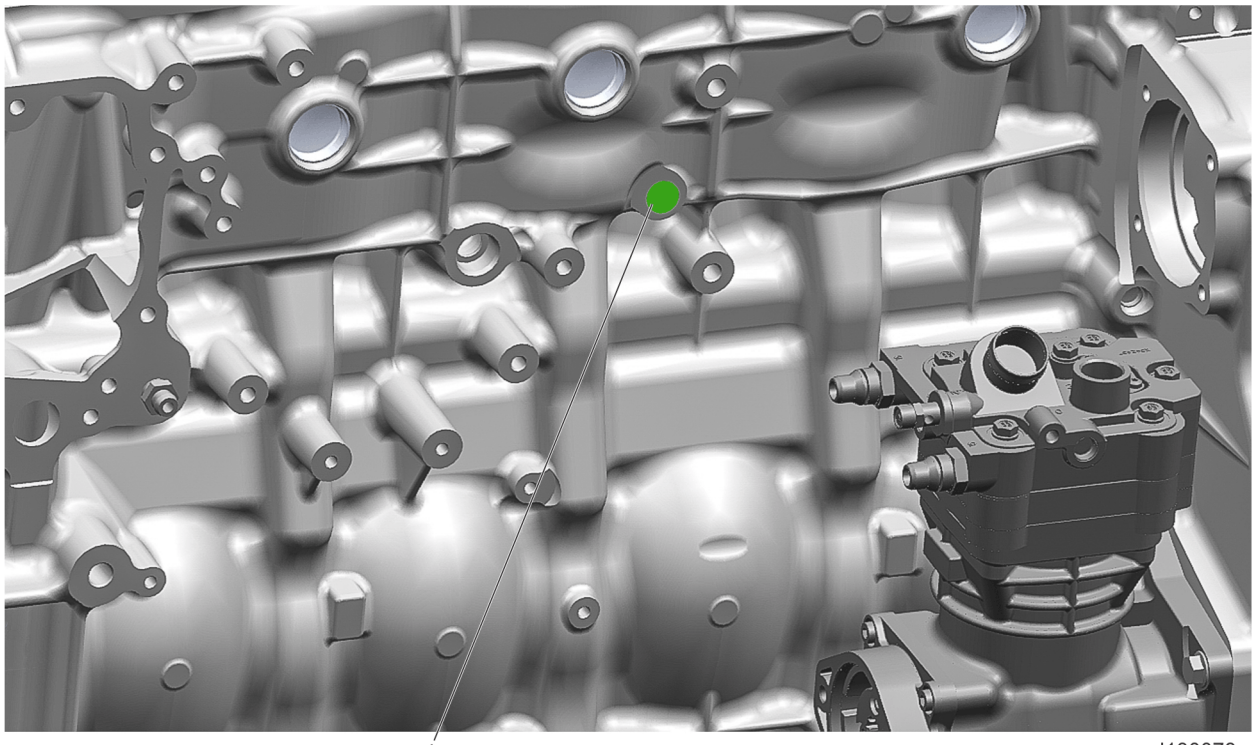
1. DKI470E16024-3 - Oil Coolant Module Plate
2. DKI470E16024-4 - Bolt (Oil Coolant Module Plate)
3. DKI470E16024-5 - Washer (Coolant Module Plate)

Figure 7. Oil Coolant Module Removed

15. If needed, install oil coolant module plate (1) with supplied bolts (2) and washers (3). Hand-tighten.
16. In a crisscross pattern, torque mounting bolts to 25 N·m (18 lb·ft).

NOTE: Steps 17-22 are only required if the air compressor coolant supply and/or return line(s) are removed from the engine.

17. Install threaded plug (1) on the coolant supply port for the air compressor on the cylinder block.



1. DKI470E16024-13 - Threaded Plug (M18)

Figure 8. Both Lines Disconnected

18. Torque threaded plug to 30 N·m (22 lb·ft).
19. Install Cap - Coolant Line Fitting (2) over the air compressor coolant outlet line fitting.

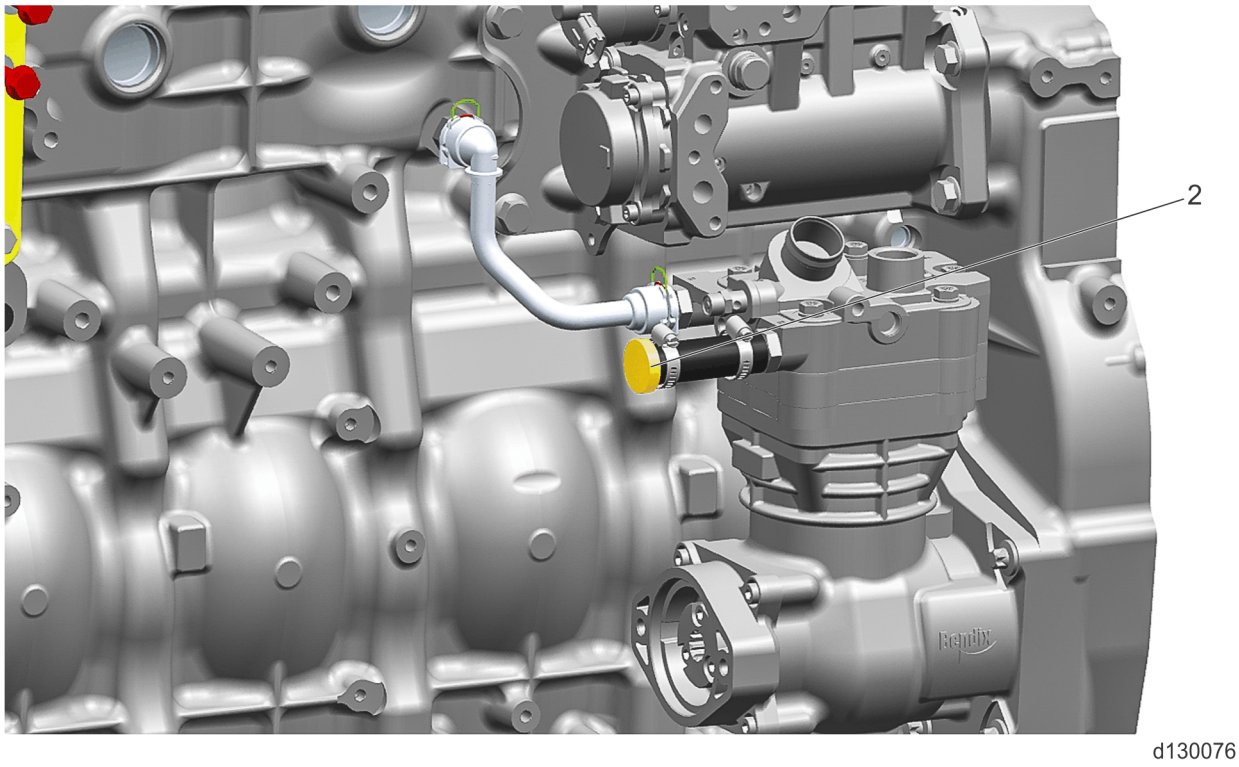
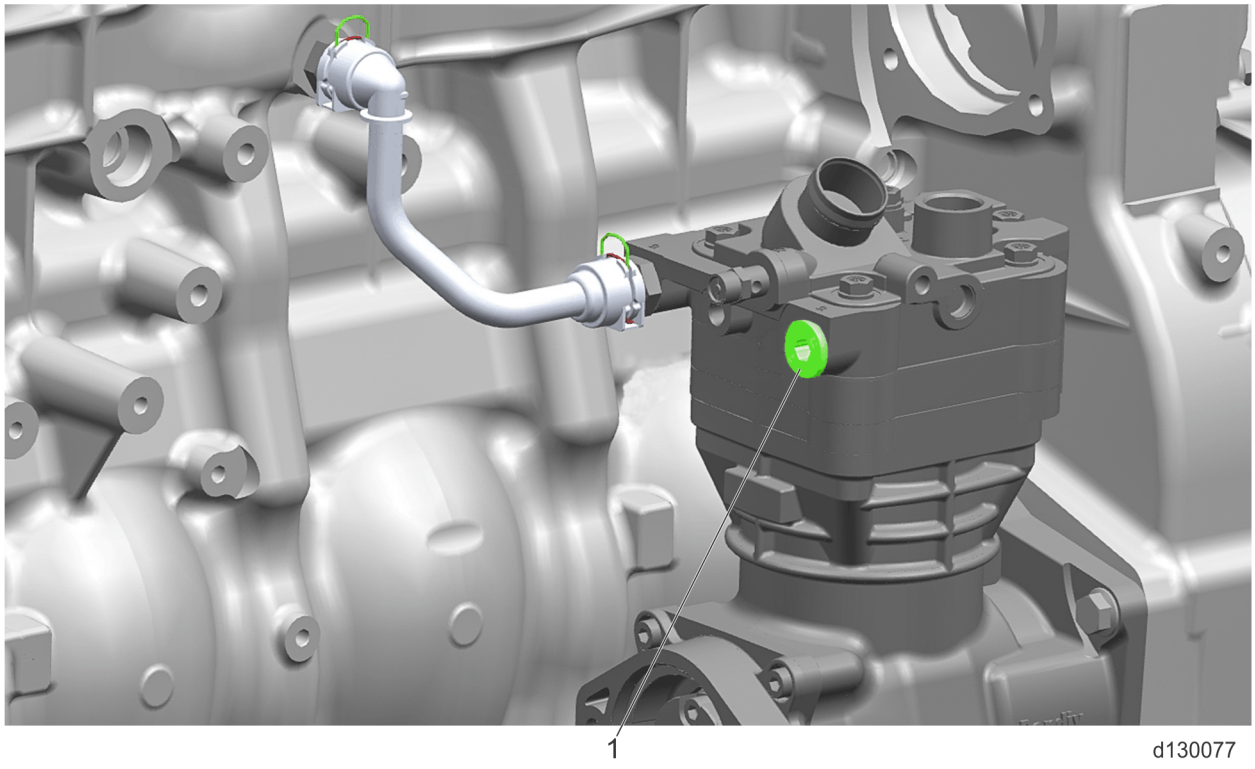


Figure 9. One Line Disconnected - Use Cap with Coolant Fitting

20. Torque worm clamp on cap to 6 N·m (4 lb·ft).
21. Install threaded plug (1) into the coolant outlet line port of the air compressor.



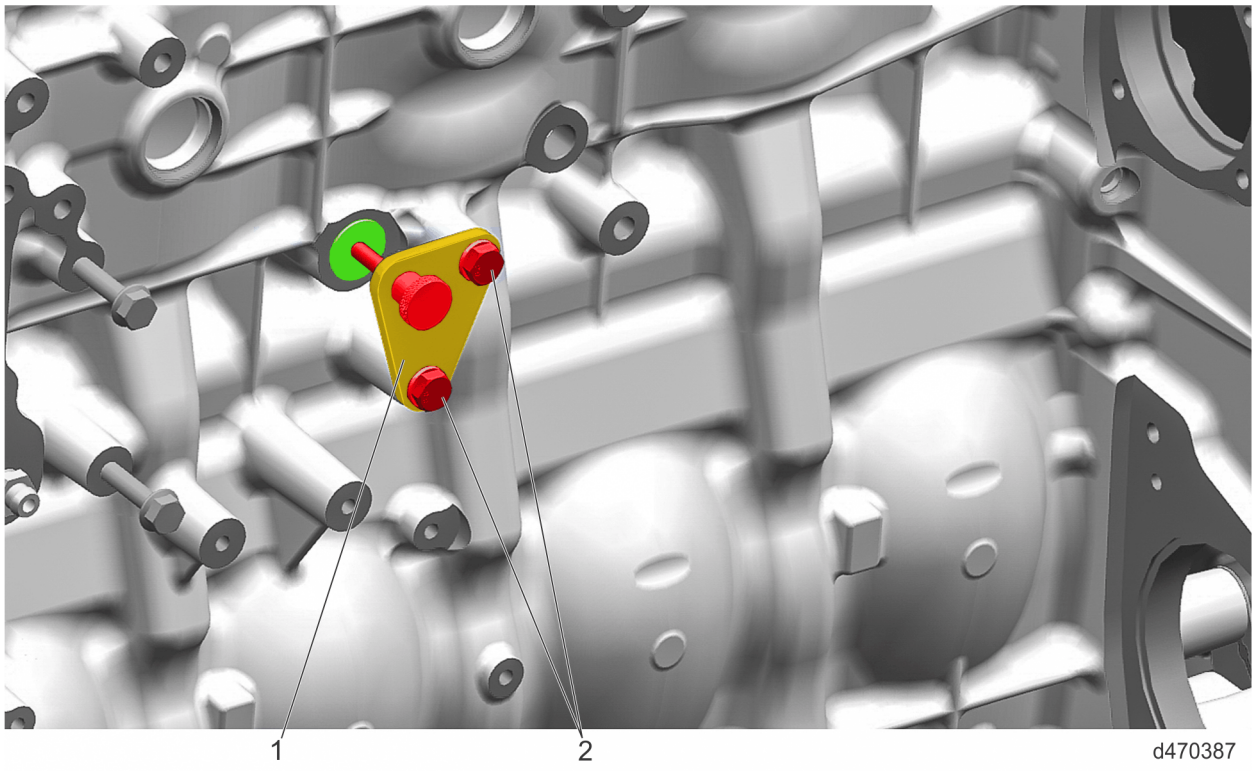
1. DKI470E16024-13 - Threaded Plug (M18)

Figure 10. One Line Disconnected - Use Threaded Cap

22. Torque threaded plug to 30 N·m (22 lb·ft).

NOTE: Steps 23-25 are only required if the Fuel Filter Module (FFM) is removed from the engine. This coolant port may be phased out depending on the vintage of the cylinder block.

23. If needed, install Fuel Filter Module (FFM) Plug (1). Hand-tighten the two captured bolts (2) making sure the rubber stop is not coming in contact with the cylinder block.



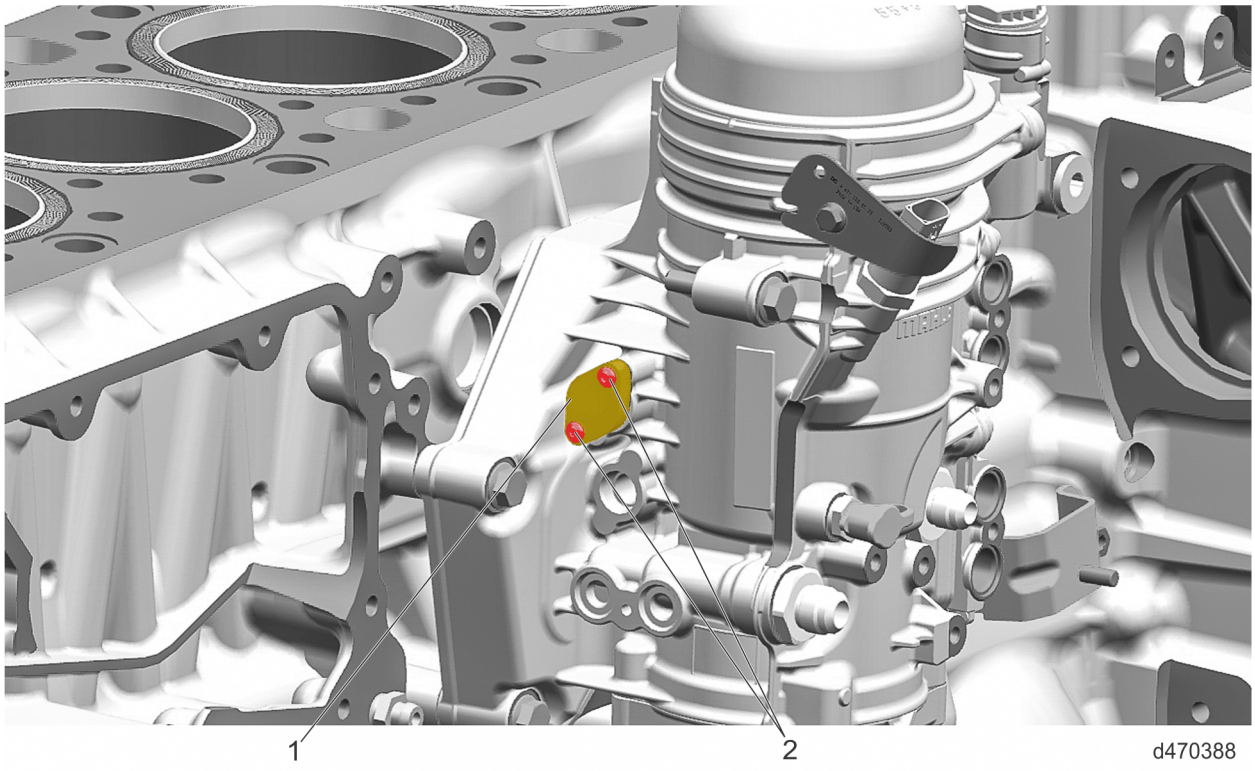
1. DKI470E16024-11 - Fuel Filter Module (FFM) Plug
2. DKI470E16024-12 - Bolt (FFM Plug)

Figure 11. Fuel Filter Module (FFM) Removed

24. Torque captured bolts to 25 N·m (18 lb·ft).
25. By hand, thread the rubber stop into the coolant port on the cylinder block. Once the rubber stop has made contact use only as much force as needed to achieve a seal between the cylinder block and rubber stop.

NOTE: Steps 26-27 are only used on units equipped with an air compressor coolant return line that connects the air compressor, fuel filter module, and oil/coolant module and is removed from the engine.

26. If needed, install the Fuel Filter Module (FFM) Line Plate (1). Hand-tighten the two captured bolts (2).



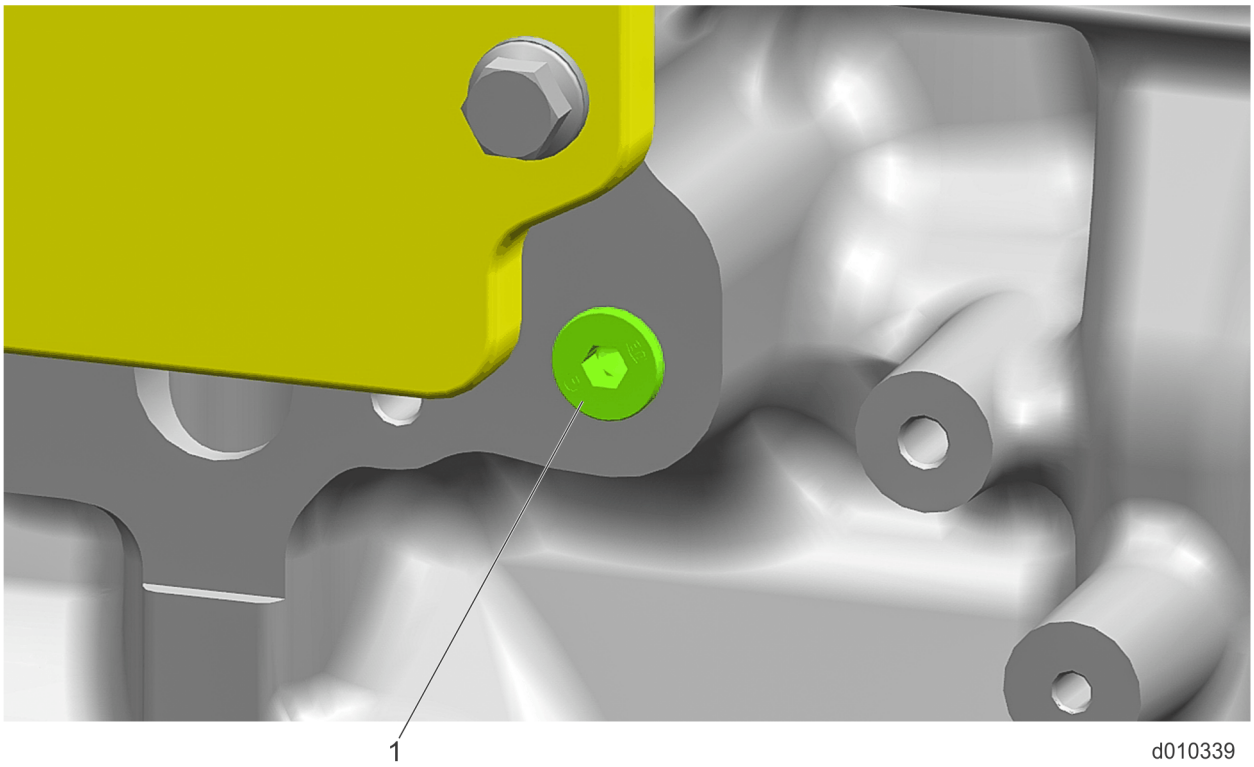
1. DKI470E16024-9 - Fuel Filter Module (FFM) Coolant Line Plate
2. DKI470E16024-10 - Bolt (FFM Coolant Line Plate)

Figure 12. Fuel Filter Module (FFM) Coolant Line Port

27. Torque captured bolts to 15 N·m (11 lb·ft).

NOTE: Steps 28-29 are only required if the coolant drain fitting is removed from the engine.

28. If needed, install threaded plug (1) into the cylinder block coolant port for the coolant drain plug.



1. DKI470E16024-13 - Threaded plug (M18)

Figure 13. Coolant Drain Plug Removed

29. Torque threaded plug to 30 N·m (22 lb·ft).
30. **Perform the test as follows;** using a regulated air source, supply 20 psi to the system, let stabilize for five minutes.
31. Shut off the air supply to the regulator.
32. Spray down all plates/plugs/regulator, etc. with soapy water and verify no leaks are present. Address any tool leaks.
33. Spray soapy water around the cylinder liners and cylinder block.
34. Observe the gap where the liner and fire deck meet. Apply more soapy water as needed until the visual inspection for bubbles (air leak) has been completed 360° around all six cylinders.

Table 2.

Example A - Multiple Upper Liner Seals Leaking
 d010358

Table 3.

Example B - Single Upper Liner Seal Leaking
 d010359

35. If system pressure drops below 20 psi in 10 minutes after the initial five-minute stabilization period, identify the leak. A failed upper cylinder liner seal can only be confirmed by a soapy water mix bubbling. A drop in pressure only indicates a gross leak. A poor tooling seal can cause a gross leak.
36. Perform the repair as follows; if one or more upper cylinder liner seals are found to be leaking, remove the cylinder head bolt assemblies and cylinder top plates. Replace the following components.
    - 6 - Liner Kits (liner, upper/lower seal ring, carbon scraper ring if equipped). Refer to section "Removal of the Cylinder Liner". Clean rust and scale from the cylinder block.
    - 6 - Piston Ring Kits (piston rings). Refer to section "Removal of the Piston and Connecting Rod Assembly". Do not reinstall piston and connecting rod assemblies until verification of the repair is completed.
    - 6 - Piston Cooling Nozzles
    - 6 - Upper and Lower Rod Bearing Shells
37. **Verify the repair as follows;** with new cylinder liners installed, reinstall the top plates and cylinder head bolt assemblies. Refer to “Set Up” section as needed.
38. Perform the test steps above again. Are leaks detected between the upper cylinder liner seal and cylinder block after new parts are installed?
    a. Yes; the cylinder block needs to be replaced.
    b. No; remove all tooling and continue with the installation of the piston and connecting rod assemblies.
39. Complete the repair process.

3 Testing of the Cylinder Liner Upper O-Ring

Table 4.

Service Tools Used in the Procedure				
DKI470E16024 - Heavy Duty Cylinder Liner Seal Leak Tester				
 d580226				
Kit Contents:				
Part #	**Description**	**QTY**	**Serviceable (Yes/No)**	**Tool Images**
DKI470E16024-1	Cylinder 1 Top Plate (left)	1	Yes	 d580241
DKI470E16024-2	Cylinder Top Plate	11	Yes	 d580240

Service Tools Used in the Procedure				
DKI470E16024-3	Oil Coolant Module Plate	1	Yes	 d580242
DKI470E16024-4	Bolt (Oil Coolant Module Plate) *M10-1.5 x 35mm*	10	No	 d580243
DKI470E16024-5	Washer (Oil Coolant Module Plate) *M10 Flat Washer*	10	No	 d580244
DKI470E16024-6	Spacer	32	Yes	 d580245
DKI470E16024-7	Washer (Spacer Bottom)	32	Yes	 d580246
DKI470E16024-8	Washer (Spacer Top) *M16 Flat Washer*	32	No	 d580247
DKI470E16024-9	Fuel Filter Module (FFM) Coolant Line Plate	1	Yes	 d580248

Service Tools Used in the Procedure				
DKI470E16024-10	Bolt (FFM Coolant Line Plate) *M5-0.8 x 20mm*	2	No	 d580249
DKI470E16024-11	Fuel Filter Module (FFM) Plug	1	Yes	 d580251
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DKI470E16024-14	Threaded plug (M14)	4	Yes	 d580253
DKI470E16024-15	Cap - Coolant Line Fitting	2	Yes	 d580254
DKI470E16024-16	Cap - Coolant Crossover (EPA07-GHG14)	1	Yes	 d580255

Service Tools Used in the Procedure				
DKI470E16024-17	Cap - Coolant Crossover (GHG17)	1	Yes	 d580256
DKI470E16024-18	Cap - Coolant Inlet Elbow (Port A)	1	Yes	 d580257
DKI470E16024-19	Cap - Coolant Inlet Elbow (Port B)	1	Yes	 d580258
DKI470E16024-20	Cap - Coolant Inlet (lower radiator hose)	1	Yes	 d580259
DKI470E16024-21	Kit Case (Foam & Case Included)	1	Yes	d580260 

An external coolant leak found between the cylinder head and cylinder block could be misdiagnosed or over-repaired. The use of the Heavy Duty Cylinder Liner Upper Seal Leak Tester will enable technicians to verify if just the head gasket is leaking or if the upper cylinder liner seal(s) are leaking.

Cylinder block corrosion on the fire deck surface, as well as the counter bore area, is often misdiagnosed as a non-repairable cylinder block. Corrosion is only a concern if the sealing surface of the cooling passage(s) is compromised.

The following test procedure is performed with the cylinder head removed.

The test procedure can be performed with or without the following components installed:

- Oil Coolant Module
- Fuel Filter Module (FFM)
- Air Compressor Coolant Supply Line
- Air Compressor Coolant Return Line
- Air Compressor
- Coolant Drain Plug

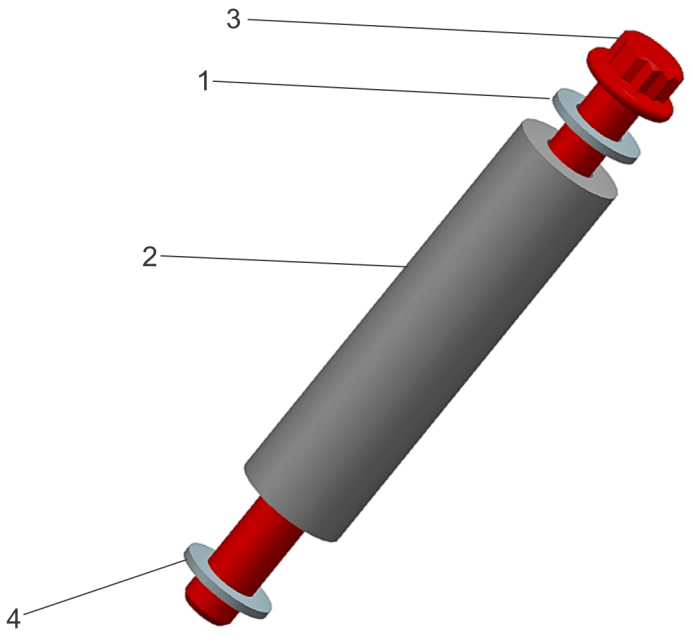
Set up as follows:

1. Clean the cylinder block fire deck, making sure there are no grommets stuck in the counter bores of the coolant passages.
2. Clean 32 of the original cylinder head bolts.

WARNING: EYE INJURY

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 276 kPa (40 psi) air pressure.

3. Using compressed air, clean all cylinder head bolt bores.
4. On each of the 32 cylinder head bolts (3), slide one small washer (1), one spacer (2), and one large flat washer (4). This will be referred to as the "cylinder head bolt assembly" throughout the rest of the procedure.

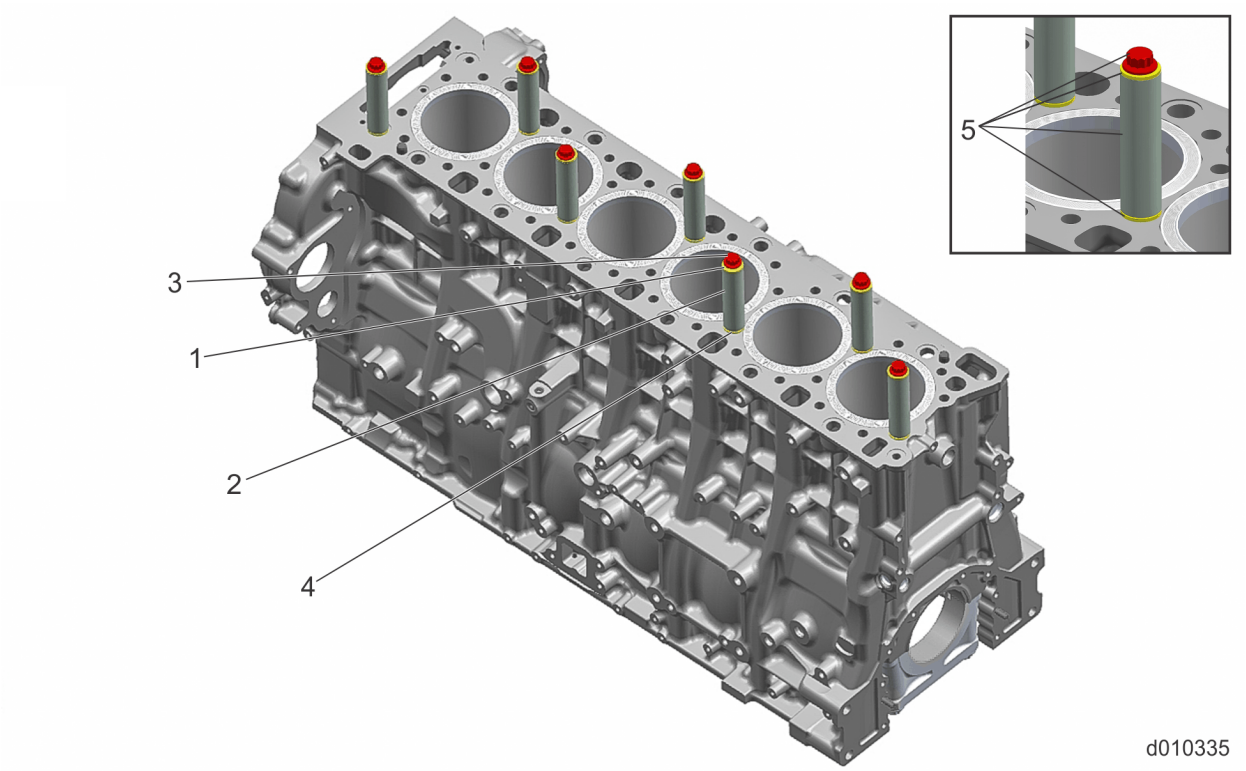


d010334

1. DKI470E16024-8 - Washer (Spacer Top)
2. DKI470E16024-6 - Spacer
3. Cylinder Head Bolt
4. DKI470E16024-7 - Washer (Spacer Bottom)

NOTE: Each cylinder liner should come into contact with a portion of the bottom washer of a cylinder head bolt assembly in two locations. Reference image below.

5. Install seven cylinder head bolt assemblies (5) into the center cylinder head bolt bores using a crisscross pattern. Hand-tighten.



1. DKI470E16024-8 - Washer (Spacer Top)
2. DKI470E16024-6 - Spacer
3. Cylinder Head Bolt
4. DKI470E16024-7 - Washer (Spacer Bottom)
5. Cylinder Head Bolt Assembly

6. Install the cylinder #1 top plate (1) using three cylinder head bolt assemblies. Hand-tighten.

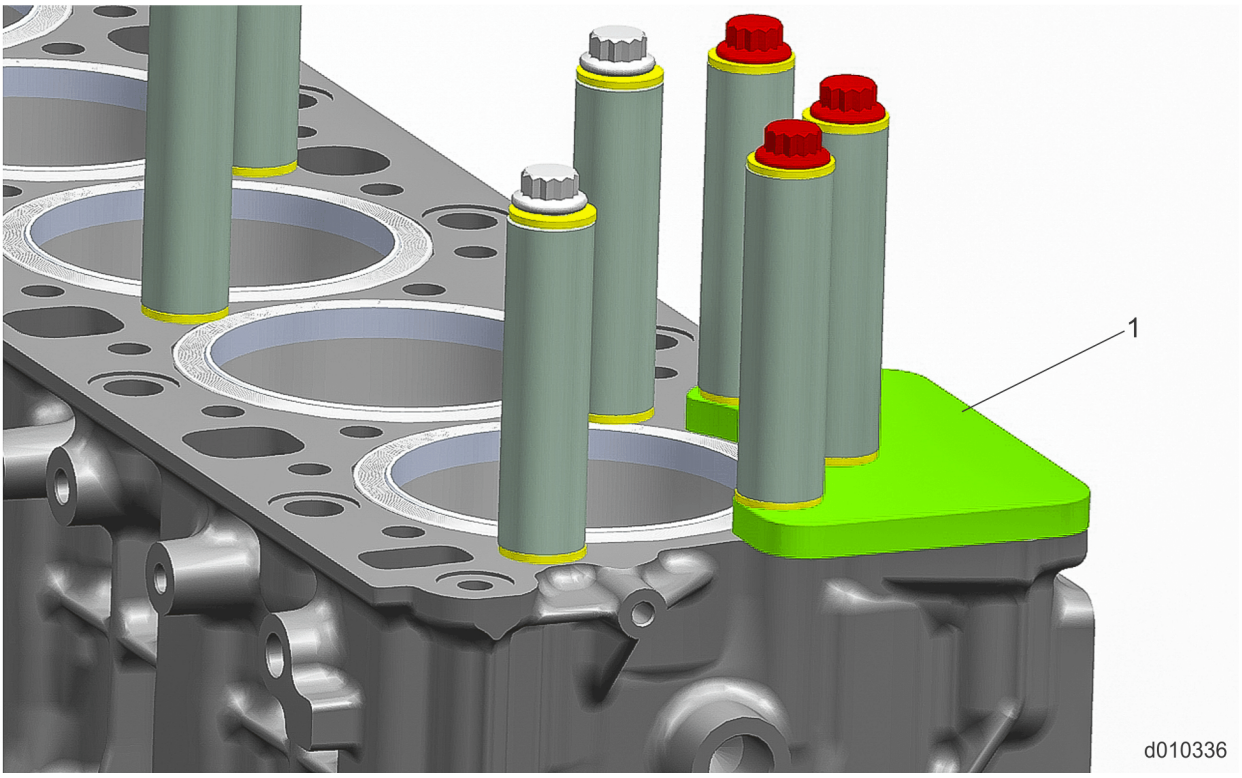


Figure 16. DKI470E16024-1 - Cylinder 1 Top Plate (left)

7. Install the remaining 11 cylinder top plates (1) using the remaining cylinder head bolt assemblies.

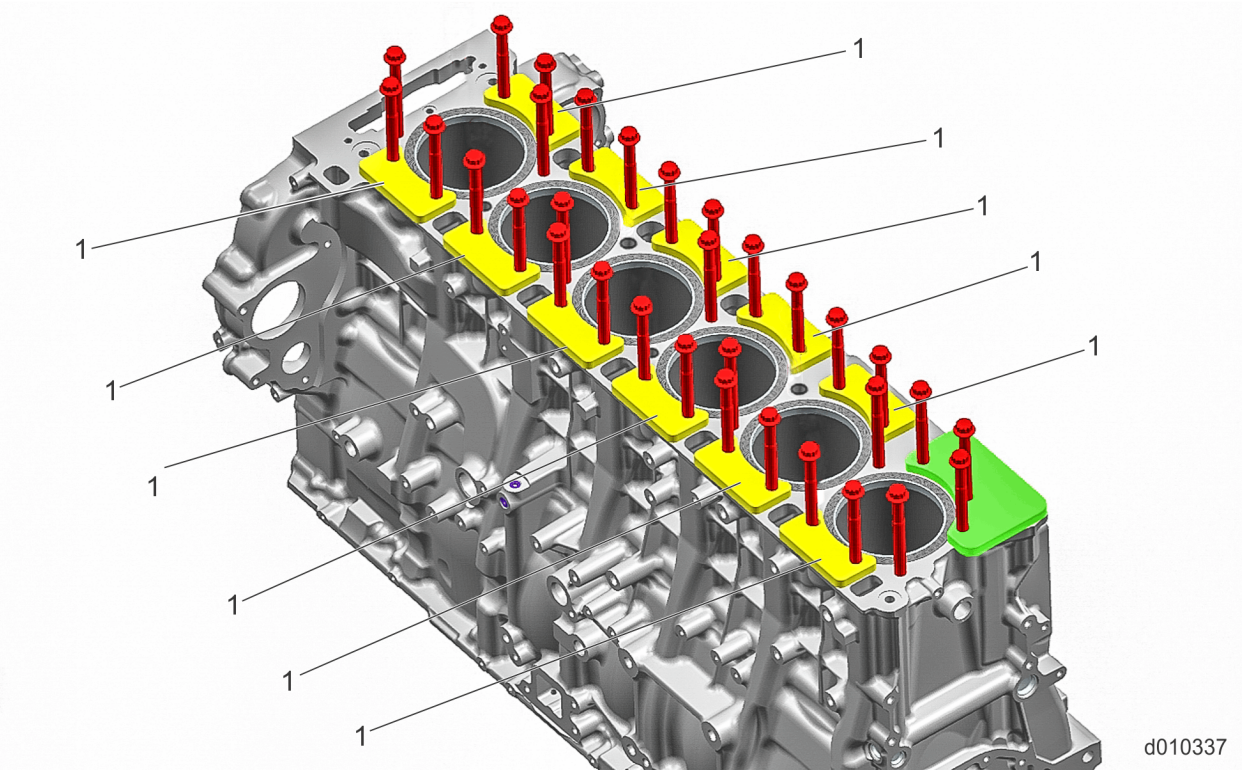


Figure 17. DKI470E16024-2 - Cylinder Top Plate

8. Torque all 32 cylinder head bolt assemblies to 25 N·m (18 lb·ft).

9. If still attached to cylinder block, remove the Exhaust Gas Recirculation (EGR) actuator coolant supply line.
10. Install threaded plug (1) into the cylinder block. Hand-tighten.

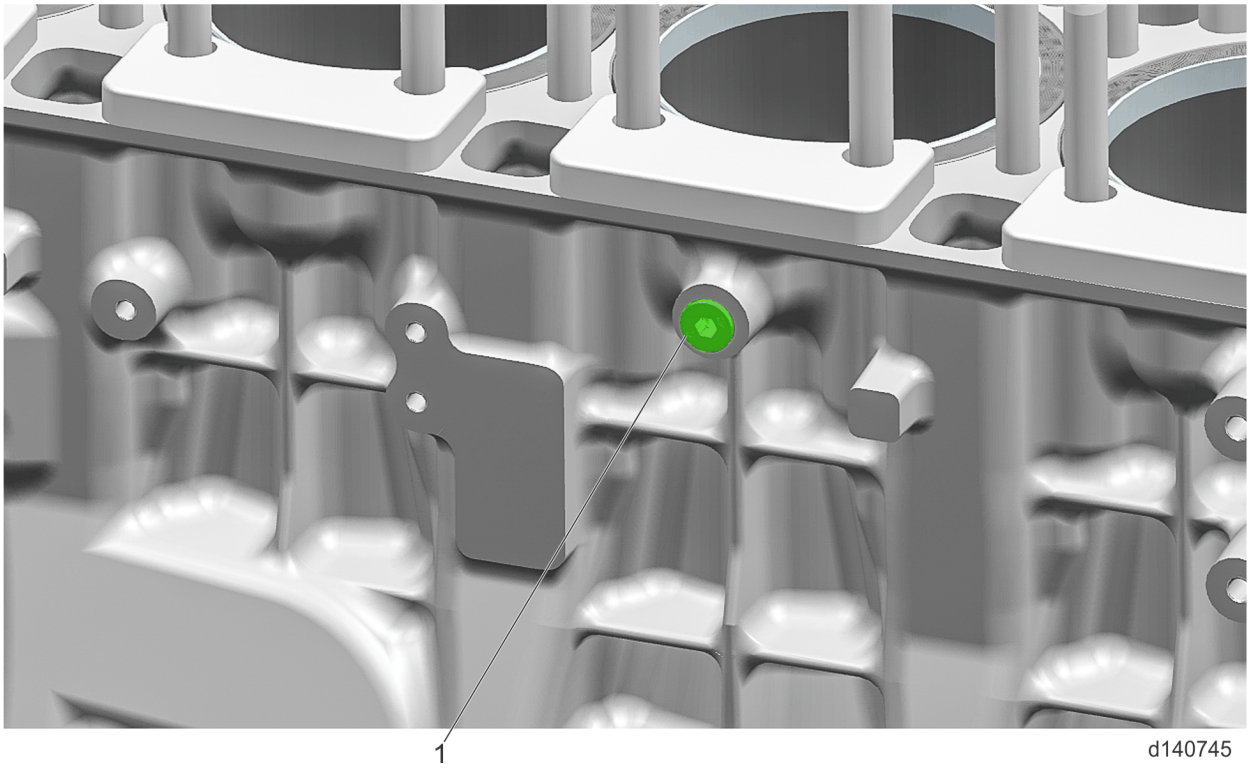
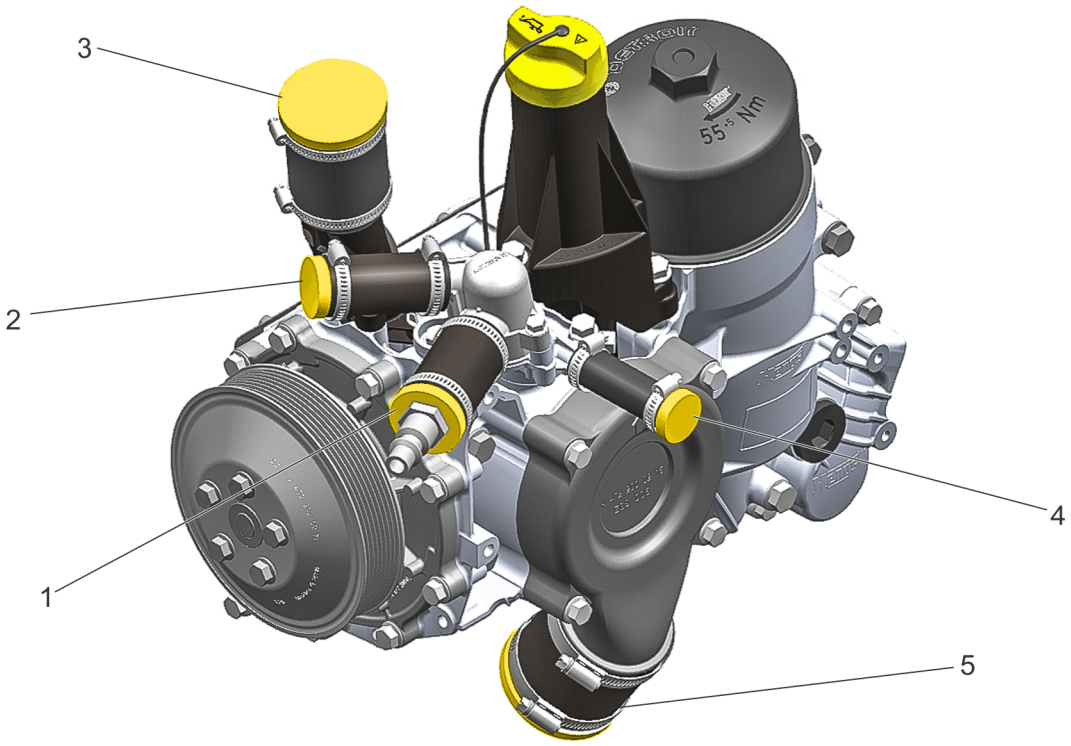


Figure 18. DKI470E16024-14 - Threaded Plug (M14)

11. Torque threaded plug to 25 N·m (18 lb·ft).
12. Install the associated caps on each coolant port of the oil coolant module. Hand-tighten. See figure below.



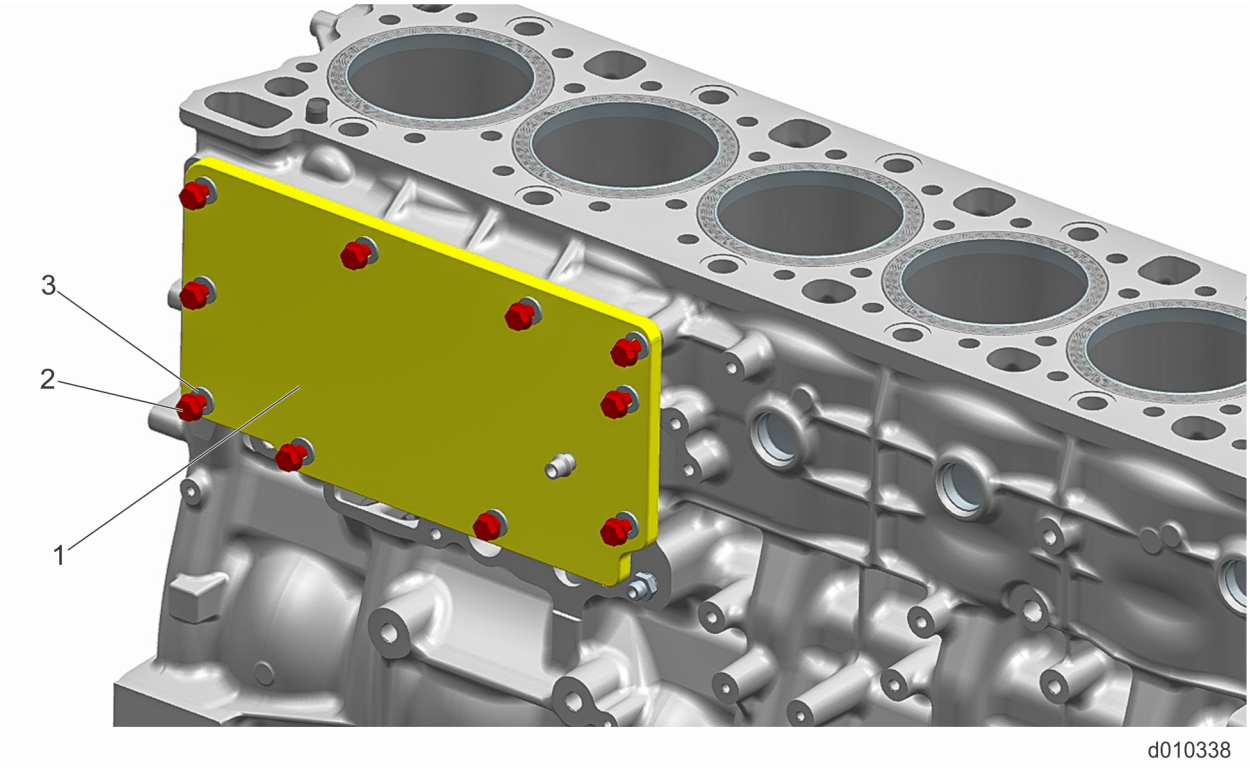
1. DKI470E16024-19 - Cap - Coolant Inlet Elbow (Port B)
2. DKI470E16024-18 - Cap - Coolant Inlet Elbow (Port A)
3. DKI470E16024-17 - Cap - Coolant Crossover (GHG17)
4. DKI470E16024-15 - Cap - Coolant Line Fitting
5. DKI470E16024-20 - Cap - Coolant Inlet (lower radiator hose)

Figure 19. GHG17 Oil Coolant Module

13. Torque all worm clamps to 6 N·m (4 lb·ft).

NOTE: Steps 14-16 are only required if the oil coolant module is removed from the engine.

14. Remove alignment dowel(s) if still in the engine block. Save dowels for reassembly.



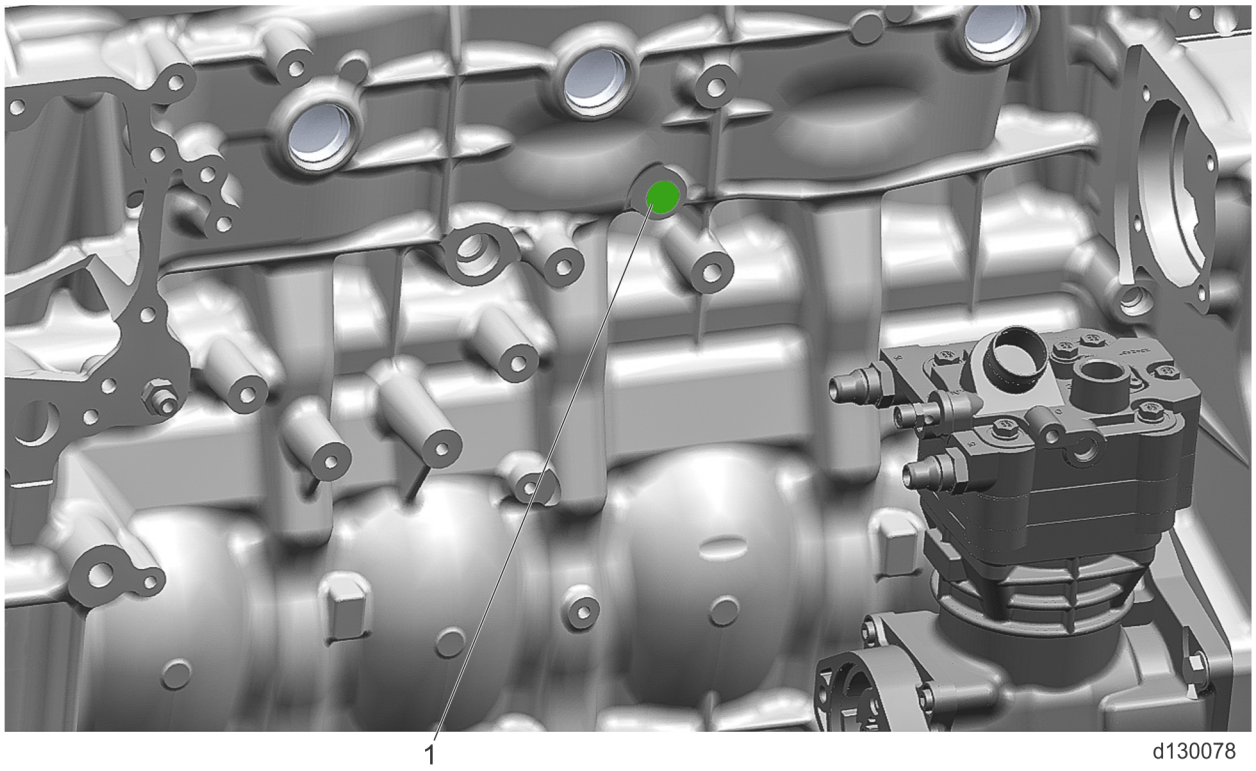
1. DKI470E16024-3 - Oil Coolant Module Plate
2. DKI470E16024-4 - Bolt (Oil Coolant Module Plate)
3. DKI470E16024-5 - Washer (Coolant Module Plate)

Figure 20. Oil Coolant Module Removed

15. If needed, install oil coolant module plate (1) with supplied bolts (2) and washers (3). Hand-tighten.
16. In a crisscross pattern, torque mounting bolts to 25 N·m (18 lb·ft).

NOTE: Steps 17-22 are only required if the air compressor coolant supply and/or return line(s) are removed from the engine.

17. Install threaded plug (1) on the coolant supply port for the air compressor on the cylinder block.



1. DKI470E16024-13 - Threaded Plug (M18)

Figure 21. Both Lines Disconnected

18. Torque threaded plug to 30 N·m (22 lb·ft).
19. Install Cap - Coolant Line Fitting (2) over the air compressor coolant outlet line fitting.

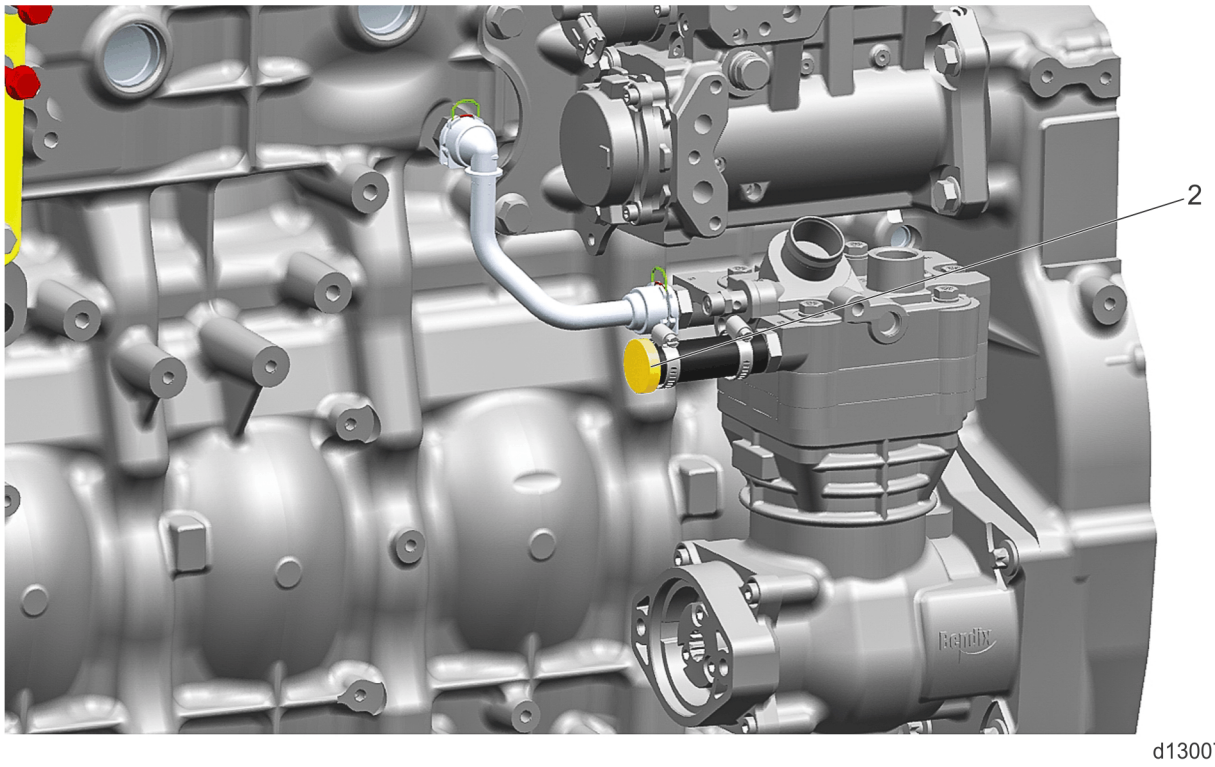
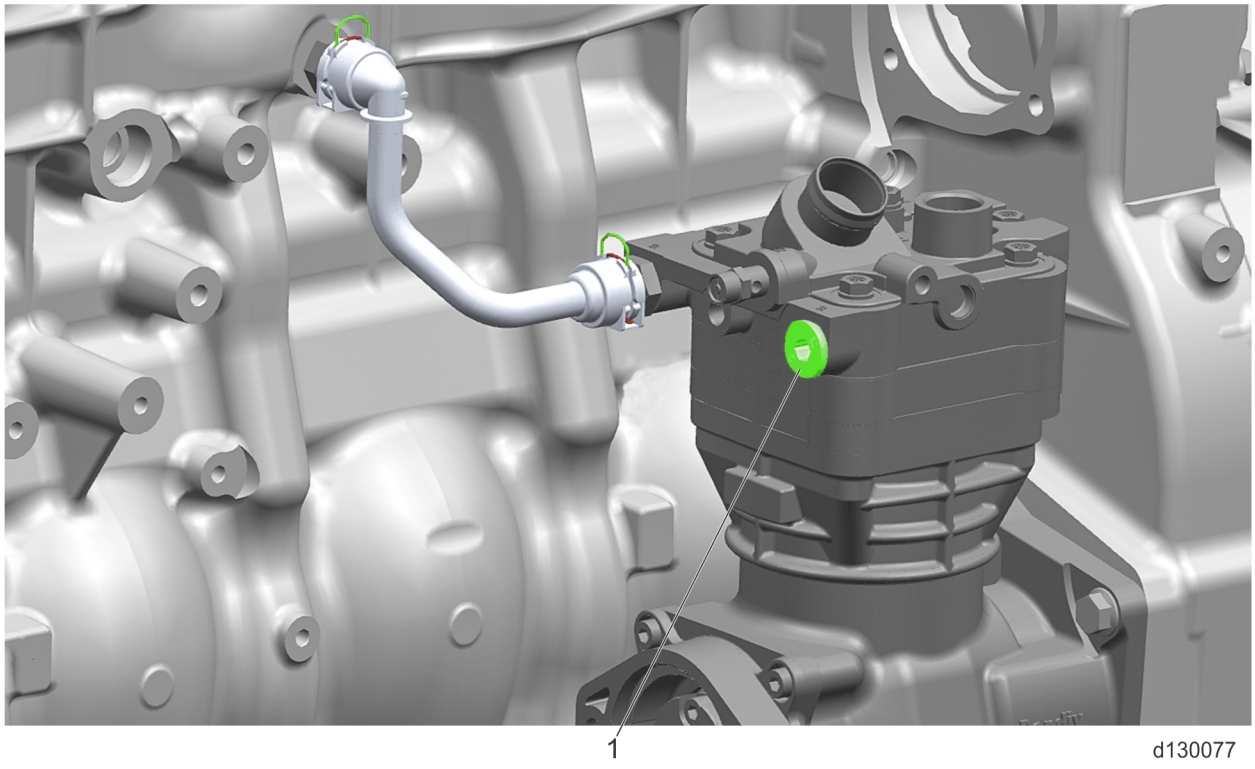


Figure 22. One Line Disconnected - Use Cap with Coolant Fitting

20. Torque worm clamp on cap to 6 N·m (4 lb·ft).
21. Install threaded plug (1) into the coolant outlet line port of the air compressor.



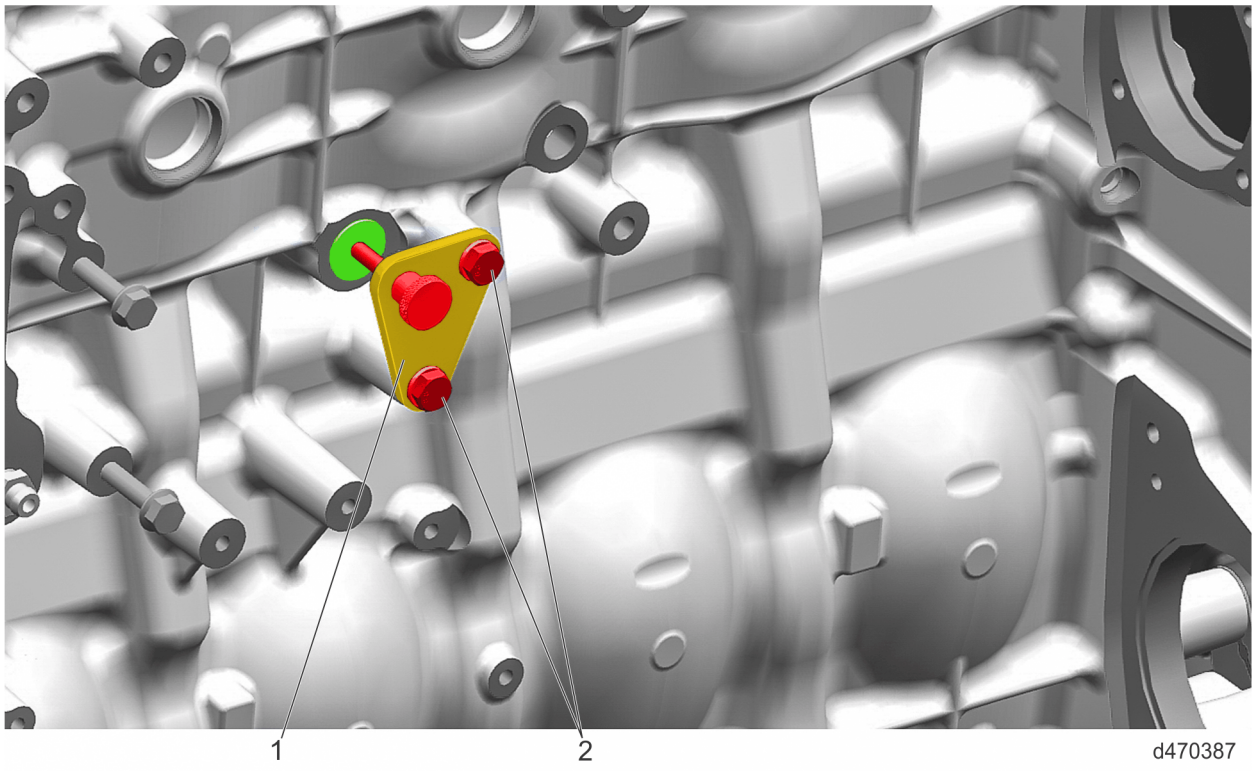
1. DKI470E16024-13 - Threaded Plug (M18)

Figure 23. One Line Disconnected - Use Threaded Cap

22. Torque threaded plug to 30 N·m (22 lb·ft).

NOTE: Steps 23-25 are only required if the Fuel Filter Module (FFM) is removed from the engine. This coolant port may be phased out depending on the vintage of the cylinder block.

23. If needed, install Fuel Filter Module (FFM) Plug (1). Hand-tighten the two captured bolts (2) making sure the rubber stop is not coming in contact with the cylinder block.



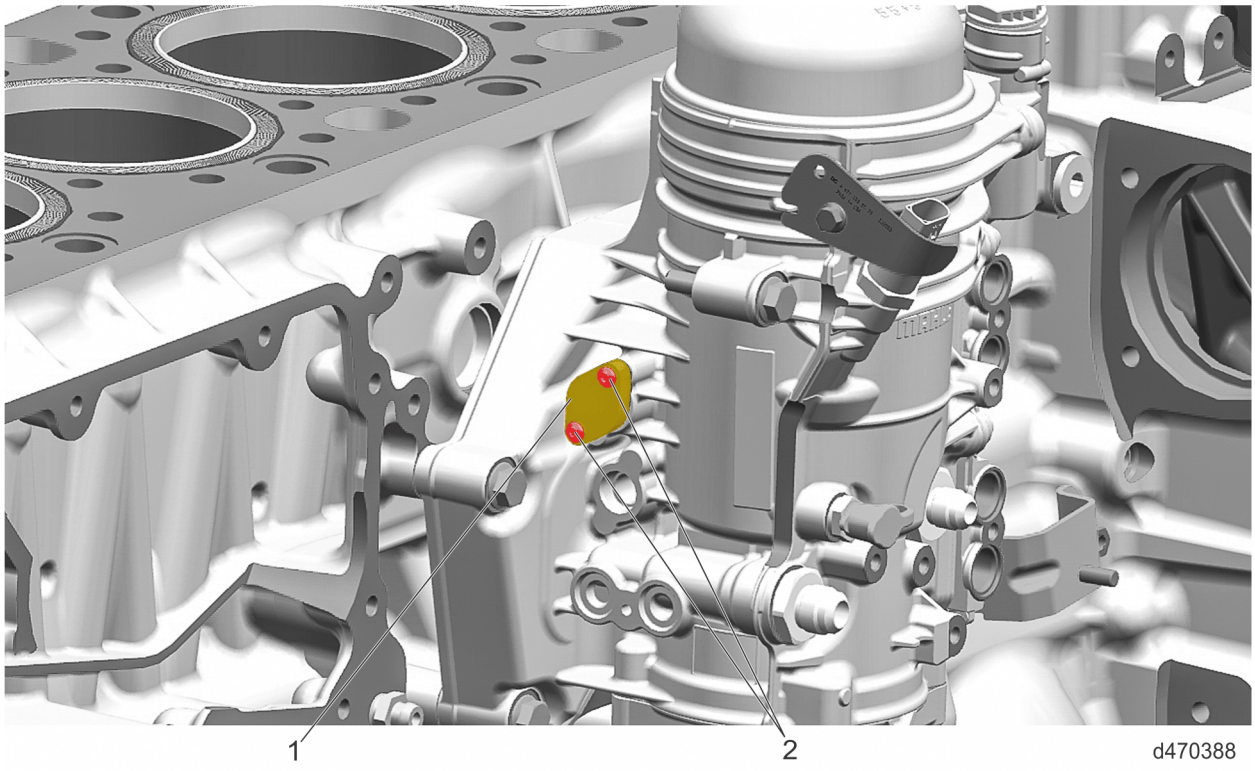
1. DKI470E16024-11 - Fuel Filter Module (FFM) Plug
2. DKI470E16024-12 - Bolt (FFM Plug)

Figure 24. Fuel Filter Module (FFM) Removed

24. Torque captured bolts to 25 N·m (18 lb·ft).
25. By hand, thread the rubber stop into the coolant port on the cylinder block. Once the rubber stop has made contact use only as much force as needed to achieve a seal between the cylinder block and rubber stop.

NOTE: Steps 26-27 are only used on units equipped with an air compressor coolant return line that connects the air compressor, fuel filter module, and oil/coolant module and is removed from the engine.

26. If needed, install the Fuel Filter Module (FFM) Line Plate (1). Hand-tighten the two captured bolts (2).



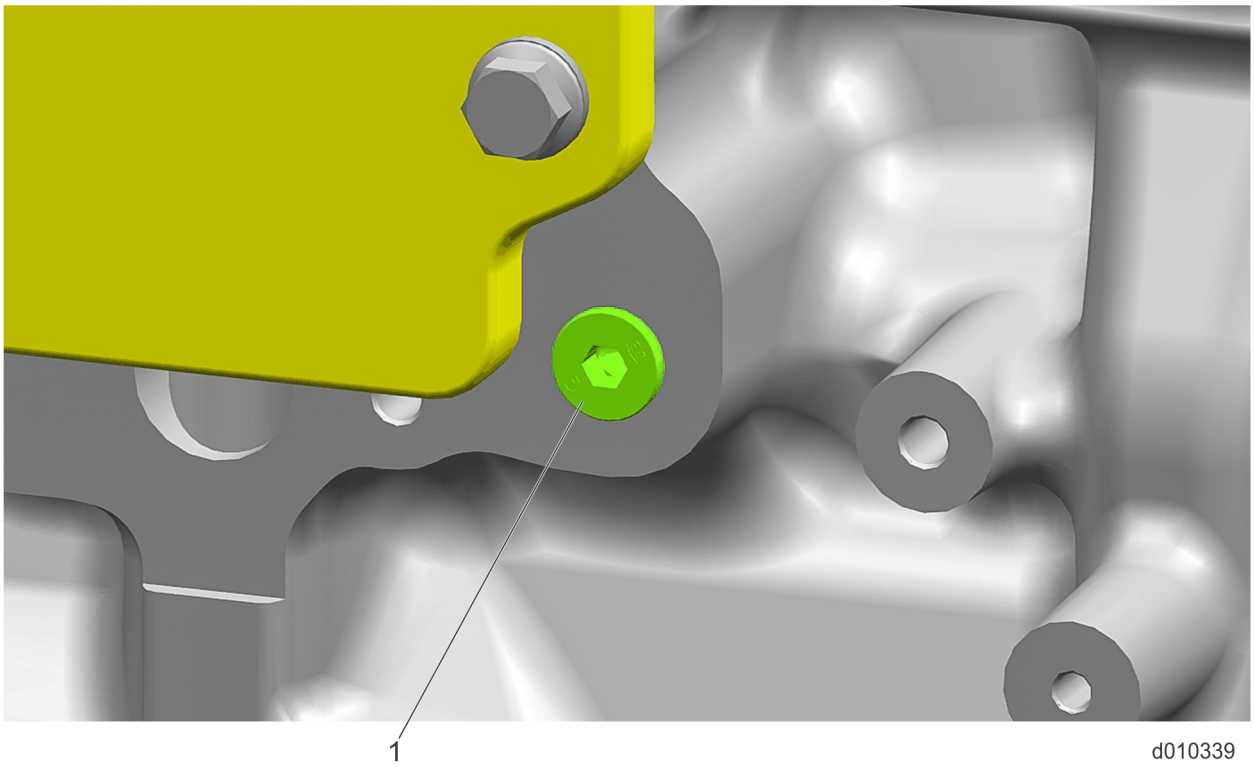
1. DKI470E16024-9 - Fuel Filter Module (FFM) Coolant Line Plate
2. DKI470E16024-10 - Bolt (FFM Coolant Line Plate)

Figure 25. Fuel Filter Module (FFM) Coolant Line Port

27. Torque captured bolts to 15 N·m (11 lb·ft).

NOTE: Steps 28-29 are only required if the coolant drain fitting is removed from the engine.

28. If needed, install threaded plug (1) into the cylinder block coolant port for the coolant drain plug.



1. DKI470E16024-13 - Threaded plug (M18)

Figure 26. Coolant Drain Plug Removed

29. Torque threaded plug to 30 N·m (22 lb·ft).
30. **Perform the test as follows;** using a regulated air source, supply 20 psi to the system, let stabilize for five minutes.
31. Shut off the air supply to the regulator.
32. Spray down all plates/plugs/regulator, etc. with soapy water and verify no leaks are present. Address any tool leaks.
33. Spray soapy water around the cylinder liners and cylinder block.
34. Observe the gap where the liner and fire deck meet. Apply more soapy water as needed until the visual inspection for bubbles (air leak) has been completed 360° around all six cylinders.

Table 5.

Example A - Multiple Upper Liner Seals Leaking
 d010358

Table 6.

Example B - Single Upper Liner Seal Leaking
 d010359

35. If system pressure drops below 20 psi in 10 minutes after the initial five-minute stabilization period, identify the leak. A failed upper cylinder liner seal can only be confirmed by a soapy water mix bubbling. A drop in pressure only indicates a gross leak. A poor tooling seal can cause a gross leak.
36. Perform the repair as follows; if one or more upper cylinder liner seals are found to be leaking, remove the cylinder head bolt assemblies and cylinder top plates. Replace the following components.
    - 6 - Liner Kits (liner, upper/lower seal ring, carbon scraper ring if equipped). Refer to section "Removal of the Cylinder Liner". Clean rust and scale from the cylinder block.
    - 6 - Piston Ring Kits (piston rings). Refer to section "Removal of the Piston and Connecting Rod Assembly". Do not reinstall piston and connecting rod assemblies until verification of the repair is completed.
    - 6 - Piston Cooling Nozzles
    - 6 - Upper and Lower Rod Bearing Shells
37. **Verify the repair as follows;** with new cylinder liners installed, reinstall the top plates and cylinder head bolt assemblies. Refer to “Set Up” section as needed.
38. Perform the test steps above again. Are leaks detected between the upper cylinder liner seal and cylinder block after new parts are installed?
    a. Yes; the cylinder block needs to be replaced.
    b. No; remove all tooling and continue with the installation of the piston and connecting rod assemblies.
39. Complete the repair process.

