

SERVICE MANUAL

F5 **Tier 4B (final) and Stage IV** **Engine**

See the following page for engine model numbers

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Basic instructions - Shop and assembly

Shimming

For each adjustment operation, select adjusting shims and measure the adjusting shims individually using a micrometer, then add up the recorded values. Do not rely on measuring the entire shimming set, which may be incorrect, or the rated value shown on each shim.

Rotating shaft seals

For correct rotating shaft seal installation, proceed as follows:

1. Before assembly, allow the seal to soak in the oil it will be sealing for at least thirty minutes.
2. Thoroughly clean the shaft and check that the working surface on the shaft is not damaged.
3. Position the sealing lip facing the fluid.

NOTE: *With hydrodynamic lips, take into consideration the shaft rotation direction and position the grooves so that they will move the fluid towards the inner side of the seal.*

4. Coat the sealing lip with a thin layer of lubricant (use oil rather than grease). Fill the gap between the sealing lip and the dust lip on double lip seals with grease.
5. Insert the seal in its seat and press down using a flat punch or seal installation tool. Do not tap the seal with a hammer or mallet.
6. While you insert the seal, check that the seal is perpendicular to the seat. When the seal settles, make sure that the seal makes contact with the thrust element, if required.
7. To prevent damage to the seal lip on the shaft, position a protective guard during installation operations.

O-ring seals

Lubricate the O-ring seals before you insert them in the seats. This will prevent the O-ring seals from overturning and twisting, which would jeopardize sealing efficiency.

Sealing compounds

Apply a sealing compound on the mating surfaces when specified by the procedure. Before you apply the sealing compound, prepare the surfaces as directed by the product container.

Spare parts

Only use CNH Original Parts or CNH Original Parts.

Only genuine spare parts guarantee the same quality, duration, and safety as original parts, as they are the same parts that are assembled during standard production. Only CNH Original Parts or CNH Original Parts can offer this guarantee.

When ordering spare parts, always provide the following information:

- Machine model (commercial name) and Product Identification Number (PIN)
- Part number of the ordered part, which can be found in the parts catalog

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(*) See content for specific models

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FUNCTIONAL DATA

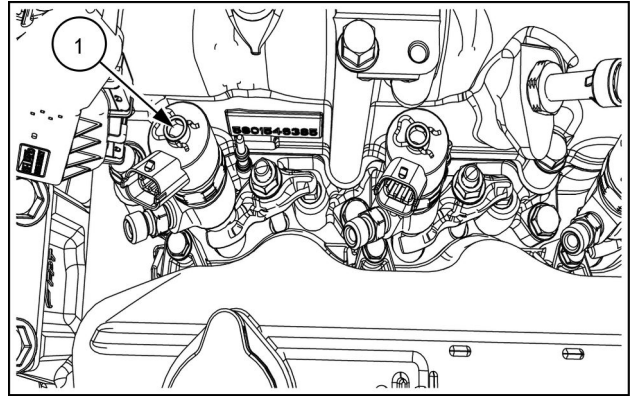
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(*) See content for specific models

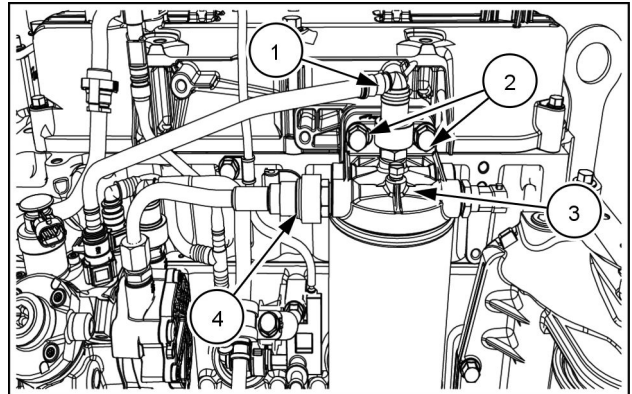
5. Install the fuel injectors (1). Refer to **Fuel injectors - Install (10.218)** for the proper procedure.



NHIL14ENG0591AA 3

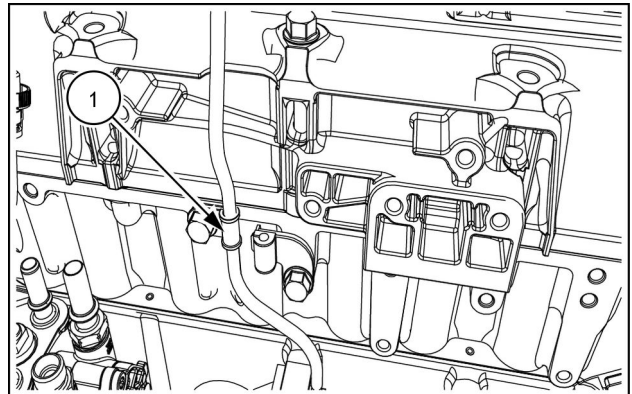
NOTE: If your machine uses a remote mounted fuel filter base, skip steps 6 through 9.

6. Install the fuel filter base (3).
7. Install the two M8 x 45 bolts (2) to secure the filter base.
8. Connect the fuel supply line (4) to the filter base.
9. Connect the fuel return line (1) to the filter base.



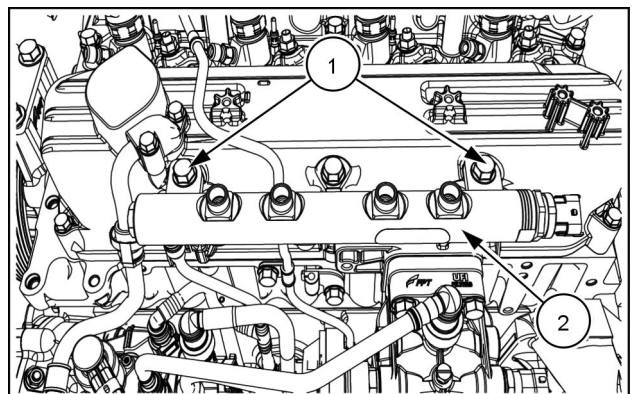
NHIL14ENG0585AA 4

10. Install the clamp (1) to secure the fuel injector return line.



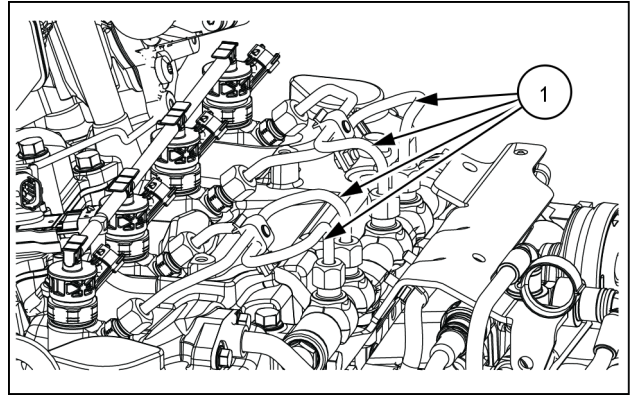
NHIL14ENG0586AA 5

11. Use the M8 x 100 bolts (1) to install the common rail (2) on the valve cover.
12. Torque the M8 x 100 bolts to **20 - 30 N·m (15 - 22 lb ft)**.



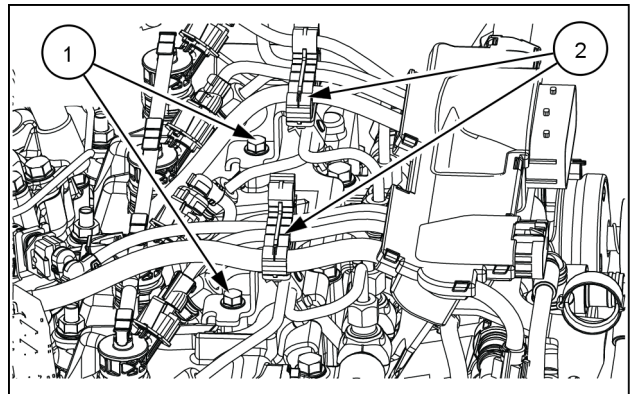
NHIL14ENG0584AA 6

23. Install the high pressure fuel lines **(1)** from the common rail to the fuel injectors.



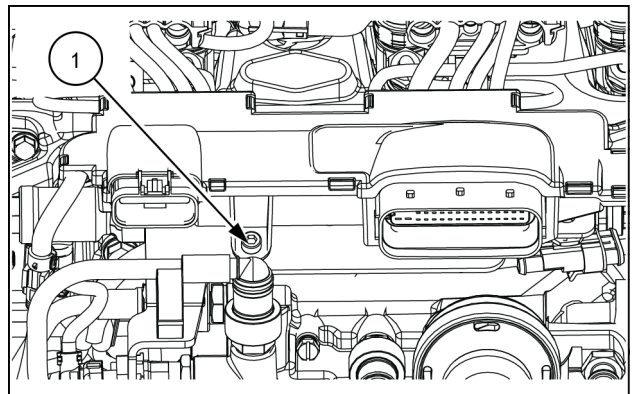
NHIL14ENG1065AA 11

24. Position the wire harness over the valve cover.
25. Install the bolts **(1)** to secure the wire stands to the valve cover.
26. Install the wire harness clamps **(2)**.



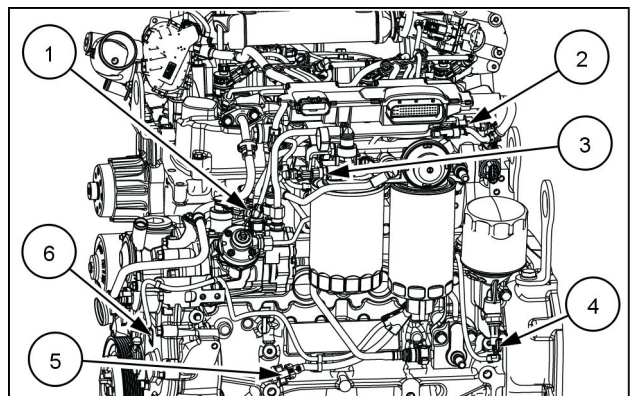
NHIL14ENG1064BA 12

27. Install the Allen head bolt **(1)** to secure the main connector harness.



NHIL14ENG1063AA 13

28. Connect the electrical connections and wire ties to the following components:
- High pressure pump metering unit **(1)**
 - Fuel pressure sensor **(2)**
 - Oil pressure sensor **(3)**
 - Fuel temperature sensor **(4)**
 - Crankshaft speed sensor **(5)**
 - Camshaft speed sensor **(6)**
 - Fuel heater (if equipped)



NHIL14ENG1062FA 14

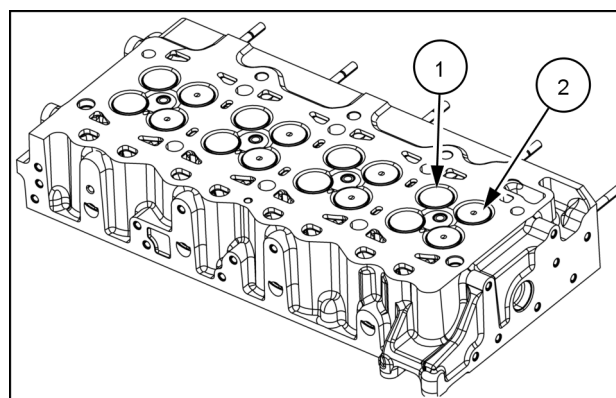
Cylinder head - Disassemble

F5BFL413A*B001	
F5BFL413A*B003	
F5BFL413A*B007	
F5BFL413A*B009	
F5BFL413D*B002	
F5BFL413D*B003	
F5BFL413F*B002	
F5BFL413F*B003	
F5GFL413A*B003	
F5GFL413A*B004	
F5GFL413A*B006	
F5GFL413A*B007	
F5GFL413A*B012	
F5GFL413A*B013	

Prior operation:

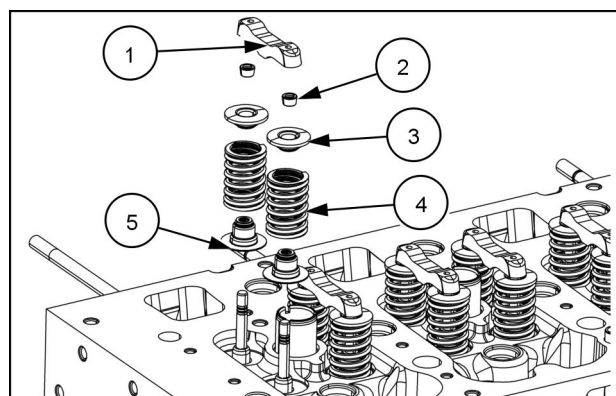
Cylinder head - Remove (10.101)

1. Number the intake valves **(1)** and the exhaust valves **(2)** before removal to ensure the correct orientation during assembly.



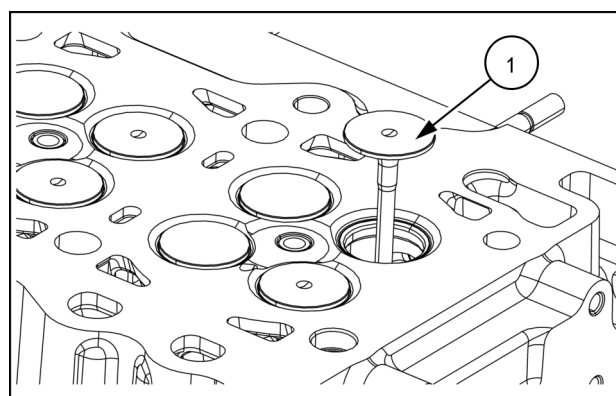
NHIL14ENG1080AA 1

2. Remove the valve bridge **(1)**.
3. Use the spring compressor tool **380000302** to compress the valve spring **(4)**.
4. Remove the keepers **(2)**.
5. Remove the spring compressor tool.
6. Remove the spring retainer **(3)**, spring **(4)** and spring cup **(5)**.
7. Repeat steps **1** through **6** for each valve.



NHIL14ENG1081AA 2

8. Turn the cylinder head upside down and remove the valves **(1)**.



NHIL14ENG1082AA 3

Next operation:

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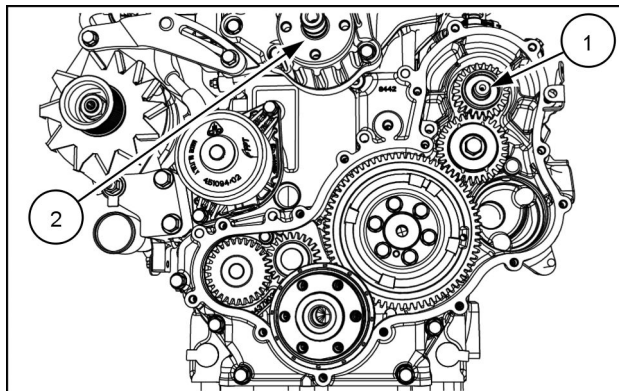
(*) See content for specific models

Timing gear housing - Remove

Prior operation:

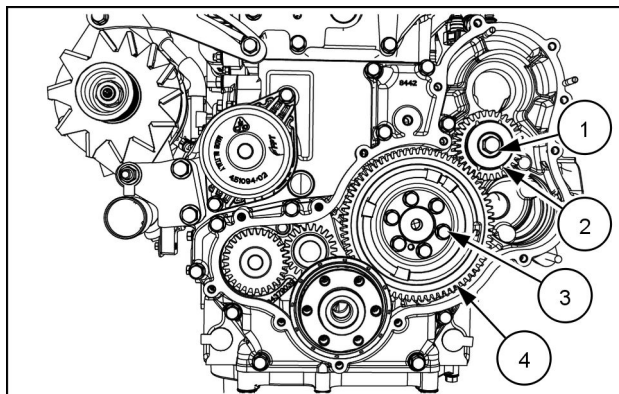
Engine block cover Front - Remove (10.102)

1. Remove the fuel injection pump (1). Refer to **Injection pump - Remove (10.218)** for the proper procedure.
2. Remove the fan pulley bolts.
3. Remove the fan pulley (2).



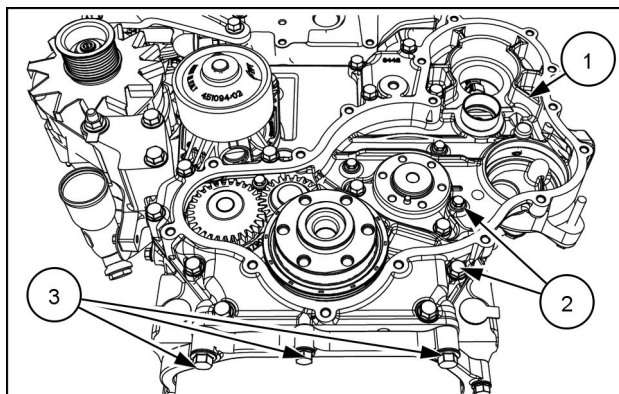
NHIL14ENG0613AA 1

4. Remove the idler gear bolt (1).
5. Remove the idler gear (2).
6. Remove the camshaft gear bolts (3).
7. Remove the camshaft gear (4).



NHIL14ENG0617AA 2

8. Remove the three bolts (3) from the front of the oil pan.
9. Remove the bolts (2) from the timing gear housing.
10. Remove the timing gear housing (1) from the engine block.



NHIL14ENG0618AA 3

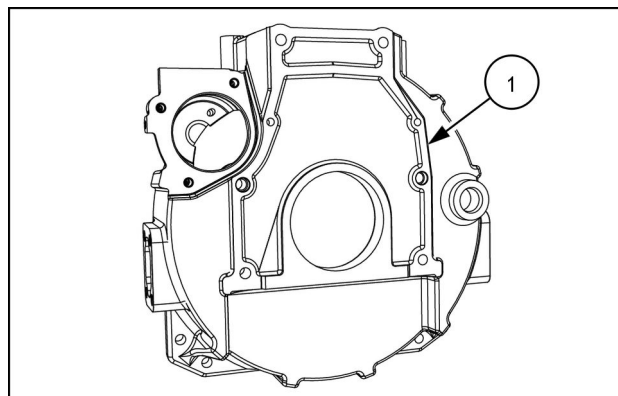
Flywheel housing - Install

F5B	
F5DFL463A*F007	
F5DFL463A*F013	
F5DFL463A*F014	
F5DFL463A*F019	
F5DFL463A*F020	
F5DFL463B*F003	
F5DFL463B*F004	
F5DFL463B*F006	
F5DFL463C*F001	
F5DFL463C*F002	
F5DFL463C*F004	
F5HFL463A*F001	
F5HFL463A*F002	
F5HFL463A*F003	
F5HFL463A*F004	
F5HFL463A*F005	
F5HFL463A*F006	
F5HFL463A*F007	
F5HFL463A*F008	
F5HFL463B*F001	
F5HFL463B*F002	
F5HFL463C*F001	
F5HFL463C*F002	
F5HFL463D*F001	
F5HFL463D*F004	
F5HFL463D*F005	
F5HFL463D*F006	

Prior operation:

Flywheel housing - Remove (10.103)

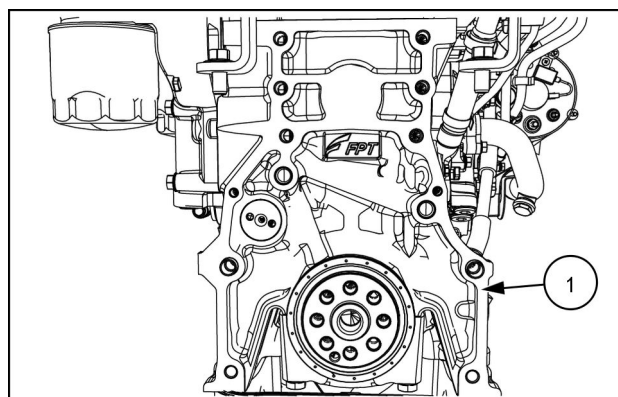
1. Clean the sealing surfaces **(1)** of the flywheel housing.



NHIL14ENG0626AA 1

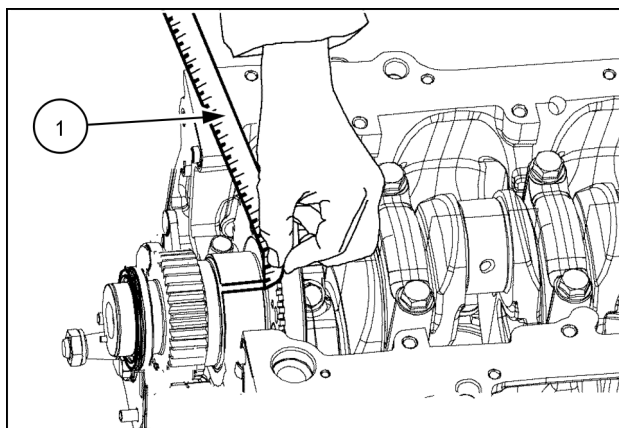
2. Clean the sealing surface **(1)** of the engine block.
3. Apply **LOCTITE® 5970™** sealant in a consistent **1.5 mm (0.059 in)** bead around the sealing surface of the flywheel housing.

NOTICE: Be sure there are no lumps, air bubbles or gaps. Do not use too much sealer as it could squeeze from the surface and obstruct lubrication passages.



NHIL14ENG0627AA 2

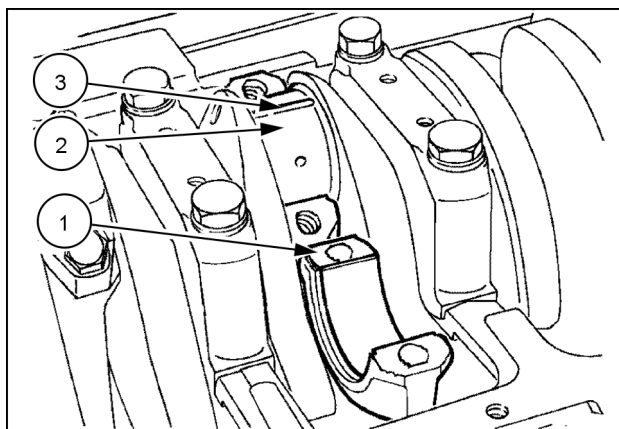
7. Remove the main bearing caps.
8. Compare the widest point of the plastic gauge to the scale on the package **(1)**.
9. The width of the wire should be between:
 - **0.064 - 0.095 mm (0.0025 - 0.0037 in)** for journals 1, 2, 3, 4
 - **0.059 - 0.100 mm (0.0023 - 0.0039 in)** for journal 5
10. Replace the bearings if the values above cannot be obtained and perform the procedure again.



73092846A 4

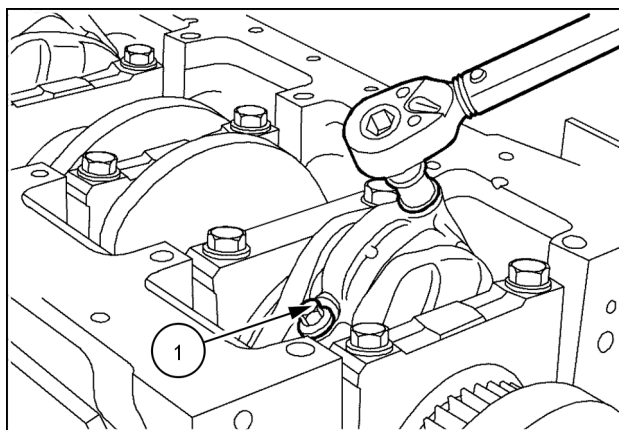
Connecting rod journals

1. Clean the crankshaft journals and connecting rod bearings.
2. Place a piece of plastic gauge **(3)** on the surface of the journal **(2)** as shown.
3. Install the connecting rod caps **(1)**.



73092867 5

4. Lubricate the rod cap bolts **(1)** with clean engine oil.
5. Install the rod cap bolts **(1)**.
6. Torque the bolts to **45 - 55 N·m (33 - 41 lb ft)**.



73092868 6

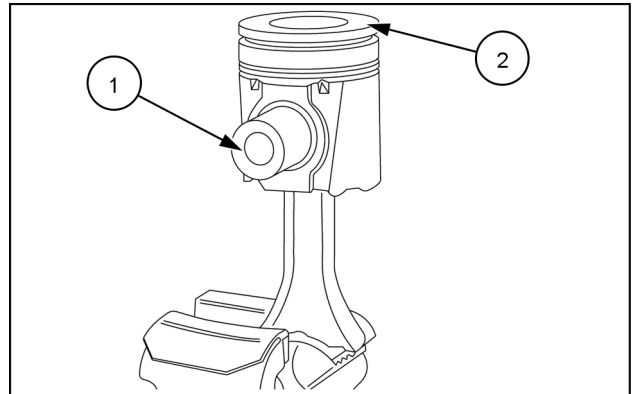
Connecting rod and piston - Assemble

Prior operation:

Connecting rod and piston - Disassemble (10.105)

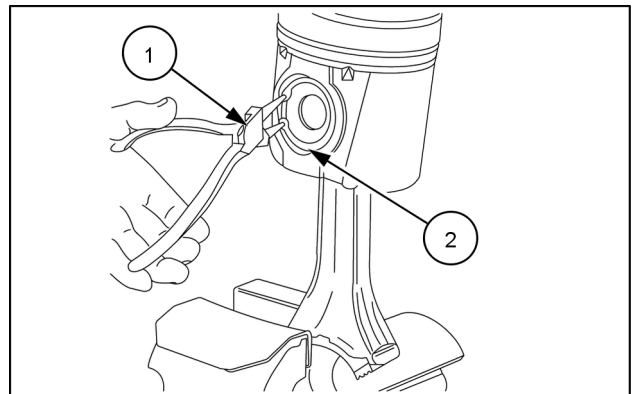
1. Install the piston pin (1) through the piston and the connecting rod.

NOTE: Use the markings on the piston (2) to correctly orient the piston on the connecting rod. The (→) marks the front of the engine as viewed from the top.



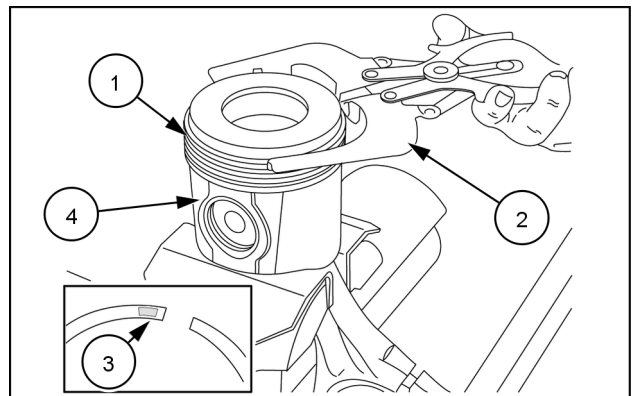
NHIL13ENG1209AA 1

2. Use snap ring pliers (1) to install the snap rings (2) that secure the assembly together.



NHIL13ENG1208AA 2

3. Use the pliers 380000324 (2) to install the piston rings (1) on the piston (4).
4. The rings need to be mounted with the marking (3) facing upwards.
5. Direct the ring openings so they are staggered 120° apart.

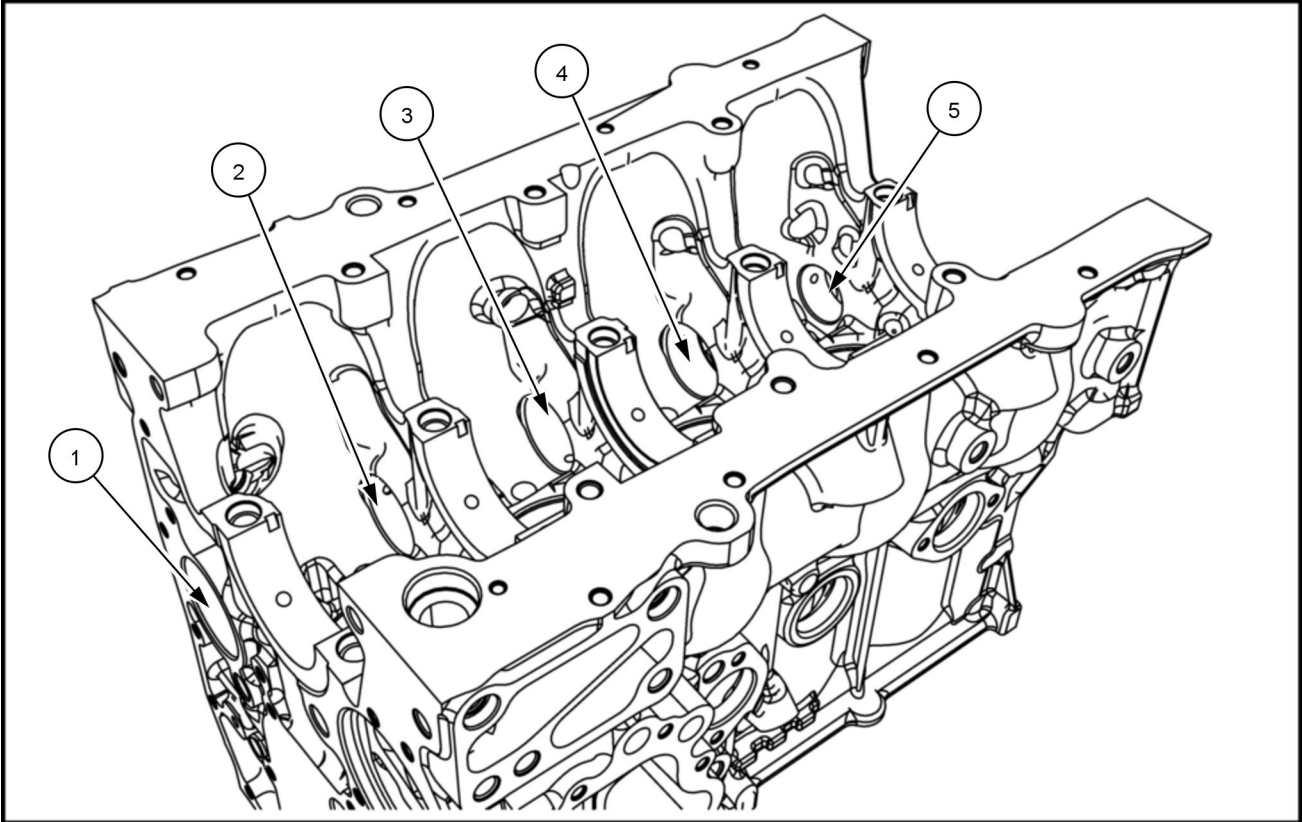


NHIL14ENG0636AA 3

Next operation:

Connecting rod and piston - Install (10.105)

Camshaft bushings - General specification



NHIL14ENG0650AA 1

Camshaft bore inside diameter	
(1)	59.222 - 59.248 mm (2.3316 - 2.3326 in)
(2), (3), (4)	50.069 - 50.119 mm (1.9712 - 1.9732 in)
(5)	40.069 - 40.119 mm (1.5775 - 1.5795 in)

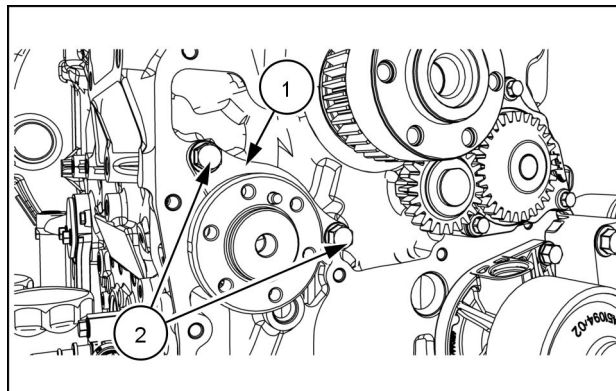
Camshaft - Remove

Prior operation:

Timing gear housing - Remove (10.102)

NOTE: This procedure is best performed with the engine block rotated upside down to keep the tappets from interfering with removal of the camshaft.

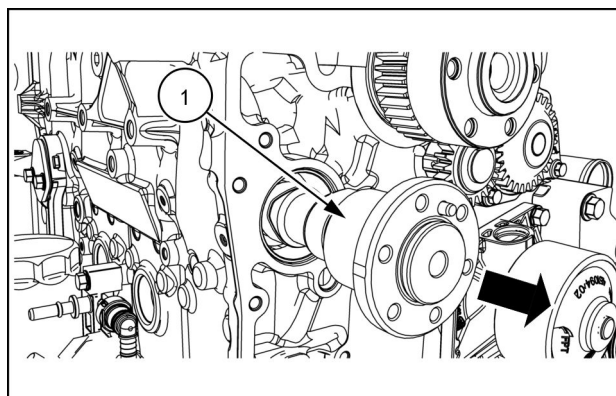
1. Remove the camshaft retainer plate bolts (2).
2. Remove the camshaft retainer plate (1).



NHIL14ENG0643AA 1

3. Slide the camshaft (1) out of the engine block.

NOTICE: Be sure not to damage the bushings during removal.



NHIL14ENG0644AA 2

Next operation:

Camshaft - Install (10.106)

Next operation:

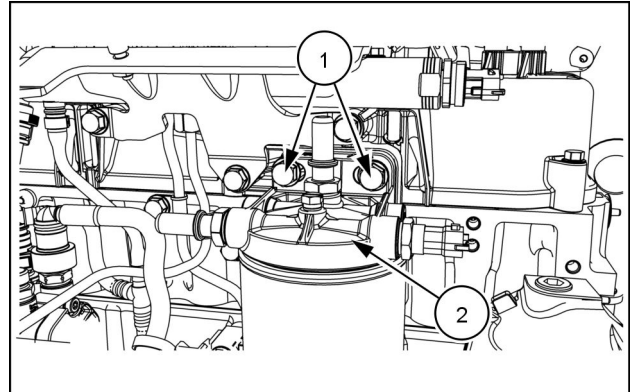
Engine block cover Front - Install (10.102)

Fuel filters - Install

Prior operation:

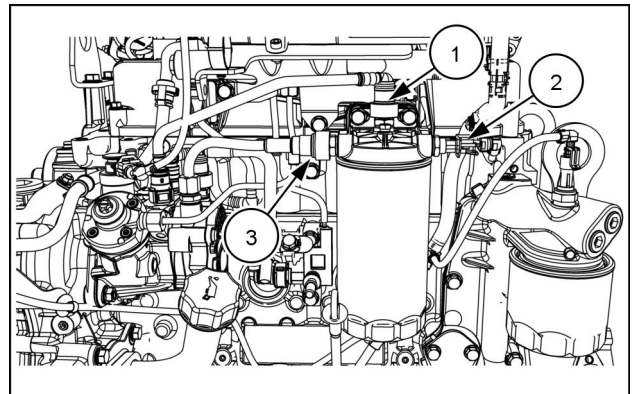
Fuel filters - Remove (10.206)

1. Install the fuel filter base (2) onto the valve cover.
2. Install the M8 x 45 bolts (1) to secure the fuel filter base.
3. Torque the M8 x 45 bolts to **25 N·m (18 lb ft)**.



NHIL14ENG0659AA 1

4. Connect the fuel filter inlet line (3).
5. Connect the fuel filter outlet line (1).
6. Connect the electrical connector (2).



NHIL14ENG0658AA 2

Fuel injection system - Bleed

⚠ WARNING

Pressurized system!

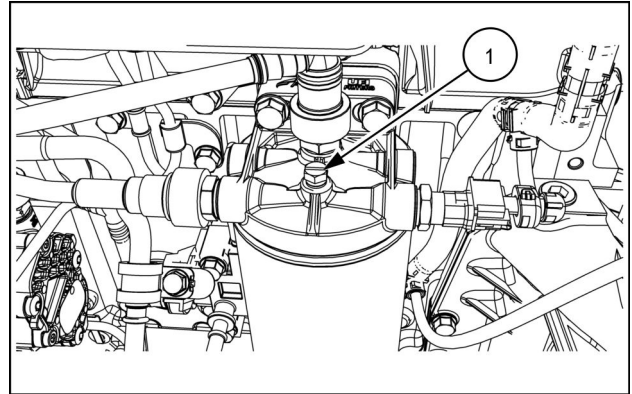
Only use the bleed screw to bleed air from the fuel system. **DO NOT** loosen the fuel or injector lines to bleed air. Injury or damage can occur. Fuel or injector lines are under very high pressure. Failure to comply could result in death or serious injury.

W0285A

Machines with a primer button.

1. Remove the fuel bleed screw (1) from the top of the fuel filter housing.
2. Press the primer button on the machine.
3. Install the bleed screw (1) when fuel is present at the top of the filter.
4. Crank the engine.

NOTICE: Only crank the engine for **20 s** at a time. Allow the starter to cool for **30 s** before cranking again.



NHIL14ENG0660AA 1

Machines without a primer button.

5. Turn the key to the ON position.
 6. Allow the pump to run approximately **30 s**.
 7. Turn the key to the OFF position.
 8. Loosen the bleed screw (1) on top of the filter base to purge the air from the system.
 9. Tighten the bleed screw (1).
 10. Crank the engine.
- NOTICE:** Only crank the engine for **20 s** at a time. Allow the starter to cool for **30 s** before cranking again.
11. Repeat steps **5** through **10** if the engine will not start.

Fuel injection system - Troubleshooting

NOTE: If the rail pressure sensor B-9004 is replaced, it is necessary to perform the Replacement of the Rail Pressure sensor - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See **Common rail pressure sensor - Configure - Reset ECU data (Rail pressure sensor) (55.010)**, if necessary.

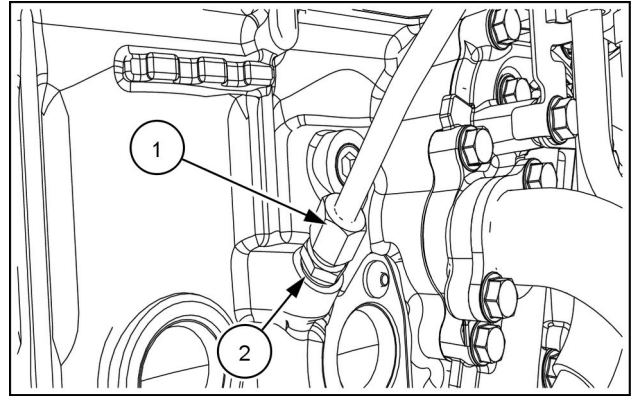
NOTE: If the Pressure Relief Valve (PRV) is replaced, it is necessary to perform the Replacement of the Rail Pressure Relief Valve (PRV) - Reset ECU Data with the Electronic Service Tool (EST) before you return the machine to service. See **Common rail Relief valve - Configure - Reset ECU data (10.218)**, if necessary.

NOTE: If a fuel injector is replaced, a new IMA code must be programmed. The IMA code may be hidden under the paint on the fuel injector. For more information regarding programming IMA codes, see **Fuel injectors - Configure - IMA codes (10.218)**.

Problem	Possible Cause	Correction
Dark, hazy fuel color	Poor fuel quality or contamination. Hazy looking fuel typically is a sign of water contamination. Dark fuel is usually indicative of oxidation, possibly from being stored for too long, and is a far more severe stage of diesel fuel contamination.	1. Drain the fuel tank and replace with new diesel fuel.
Diesel fuel leakage	Loose or improperly connected fittings, damaged seals or damaged fuel lines. Leakage from fuel filters.	1. Inspect all hoses, clamps and fittings. If any fittings or clamps are loose or improperly installed, repair as necessary. 2. Inspect all fuel filters for leakage. If the filter is damaged or there is leakage from the seal, replace the failed fuel filter. 3. Inspect all fuel lines for leakage or damage. If there is any leakage or damage present, repair as necessary. 4. Inspect the fuel tank for damage or corrosion. If there is any failures found, repair or replace as necessary. 5. Inspect all fuel system components for diesel fuel leakage. If any leakages are present, repair or replace as necessary.
Low fuel system pressure	Low fuel system pressure can be caused by clogged fuel filters, a faulty electric lift pump (if applicable), a faulty mechanical fuel pump, a faulty fuel metering unit, or leakages present in the system.	1. Perform a fuel system pressure test to verify the low pressure condition. The fuel pressure at the main fuel filter, after the mechanical gear pump, should be approximately 5.0 bar (72.5 psi). If the pressure is too low, continue to troubleshoot the low pressure side of the fuel system to isolate the failed component. If the pressure is not too low, continue to Step 2. 2. Use the Electronic Service Tool (EST) to check for active fault codes related to the fuel metering unit. If any faults are active, diagnose them first and then continue troubleshooting the fuel system.
Fuel system pressure too high	Too high fuel pressure can be caused by a faulty fuel metering unit, a stuck closed pressure relief valve, or a faulty rail pressure sensor.	1. Check the operation of the fuel metering, pressure relief valve and the rail pressure sensor. Use the appropriate section of the engine service manual, if necessary. Repair or replace as necessary.

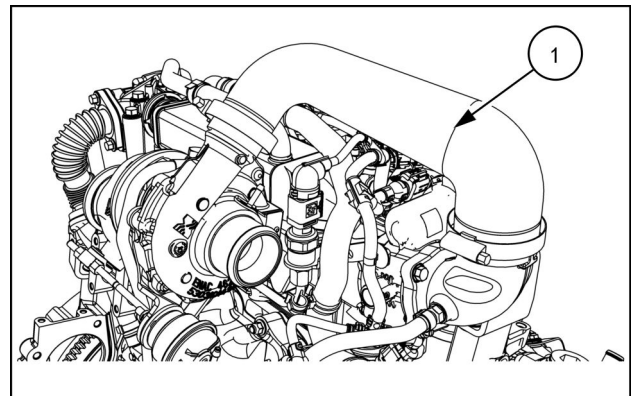
10. Connect the bottom fitting of the oil supply line (1) to the engine block.

NOTE: If the fitting (2) was removed, install the fitting and torque to **40 N·m (30 lb ft)**.



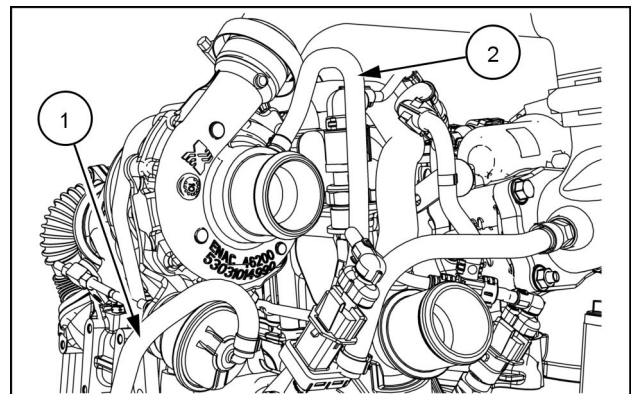
NHIL14ENG0702AA 5

11. Install the hose (1) from the turbocharger to the Throttle Valve Actuator (TVA).



NHIL14ENG0697AA 6

12. Install the hose (2) that runs from the turbocharger to the boost pressure modulator valve.
13. Install the hose (1) that runs from the wastegate actuator to the boost pressure accumulator.



NHIL14ENG0696AA 7

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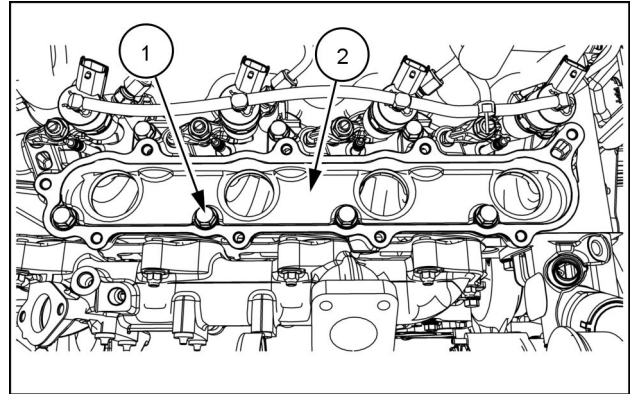
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Intake manifold - Remove - Spacer

Prior operation:

Intake manifold - Remove (10.254)

1. Remove the intake manifold spacer bolts (1).
2. Remove the air intake manifold spacer (2).
3. Remove the intake manifold spacer gaskets.

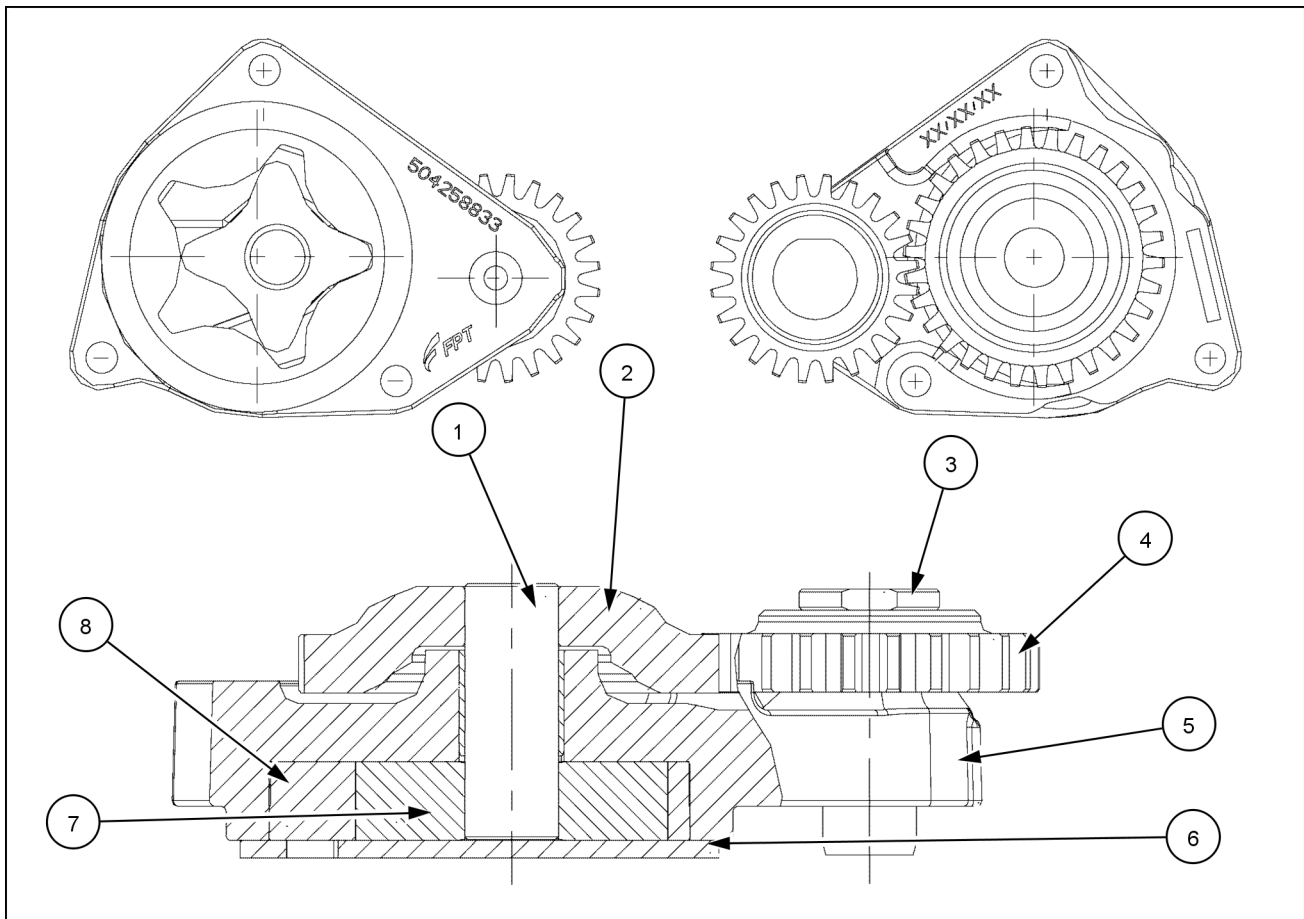


NHIL14ENG0712AA 1

Next operation:

Intake manifold - Install - Spacer (10.254)

Engine oil pump - Overview



73092739 1

- | | |
|---------------------|--------------------|
| (1) Drive shaft | (5) Housing |
| (2) Main gear | (6) Cover |
| (3) Secondary shaft | (7) Internal rotor |
| (4) Secondary gear | (8) External rotor |

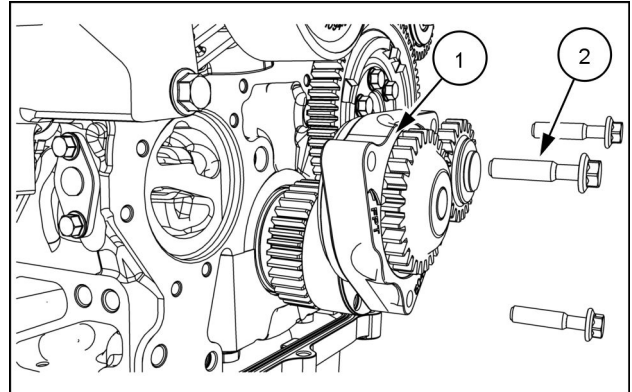
Engine oil pump - Install

Prior operation:

Engine oil pump - Remove (10.304)

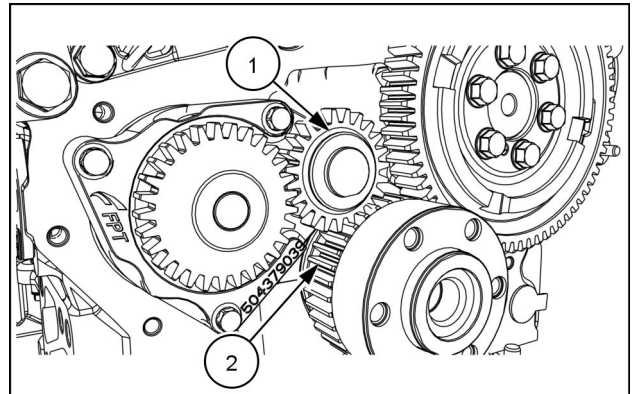
1. Install the oil pump (1) into the engine block.
2. Install the three M8 x 36 bolts (2) to snug the oil pump.

NOTE: Do not fully tighten the bolts at this time.



NHIL14ENG0722AA 1

3. Use a dial gauge with magnetic base to check the backlash between the crankshaft gear (2) and the oil pump secondary gear (1).
4. Set the backlash between **0.068 - 0.168 mm (0.003 - 0.007 in)**.
5. Torque the M8 x 36 bolts in two stages:
 1. Stage 1: **10 - 20 N·m (7 - 15 lb ft)**
 2. Stage 2: **20 - 30 N·m (15 - 22 lb ft)**



NHIL14ENG0724AA 2

Next operation:

Timing gear housing - Install (10.102)

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Engine cooling system - 400

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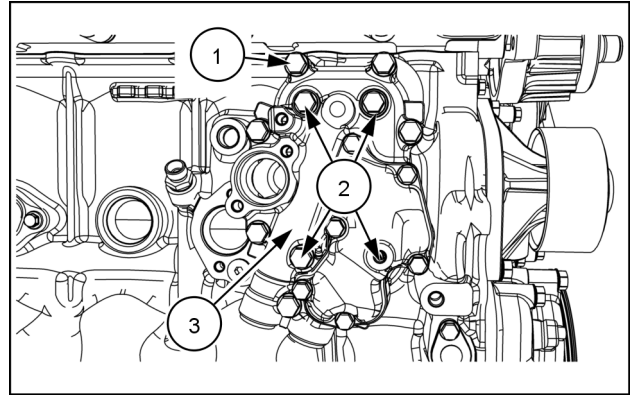
Engine cooling system - Troubleshooting

Problem	Possible Cause	Correction
External coolant leakage	Leakage is most commonly found from : - Loose, deteriorated, or damaged hoses - A fault water pump seal - A damaged radiator - Leakage from the heater core, if applicable - Cracked thermostat housing or faulty gasket - A leaking radiator cap - Leaking coolant drain plug or engine core plugs	⚠ WARNING Hot liquid under pressure! Scalding can result from fast removal of the radiator cap. Check and service the engine cooling system according to the maintenance instructions in this manual. Failure to comply could result in death or serious injury. W0163A 1. Check all hoses for damage or deterioration. Verify that all hose clamps are adequately tight. 2. Inspect the water pump and water pump housing for leakage. Gently pull up and down on the water pump to ensure it is tight. 3. Inspect the radiator and radiator cap for leakage. The leakage may be caused from cracks or other damage to the radiator. The radiator cap may be leaking from a faulty seal or may not be adequately tightened. 4. Inspect the heater core area for leakage. Leakage may be from damage to the heater radiator, faulty coolant lines or fittings. 5. Inspect the thermostat housing for leakage. A faulty thermostat gasket may be the cause of the leak. The thermostat housing may also be cracked or inadequately tightened. 6. Inspect the engine block for coolant leakage from the coolant drain plug (if applicable) or the engine core plugs.

9. Remove the bolts (1) from the heat exchanger body (3).

NOTE: The four bolts (2) that fasten the oil cooler to the heat exchanger body, do not need to be removed. To disassemble, refer to **Engine oil cooler - Disassemble (10.408)**.

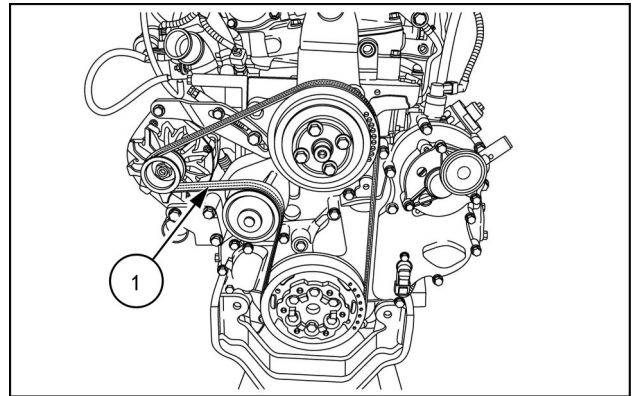
10. Remove the heat exchanger assembly with the gasket.



NHIL14ENG0746AA 4

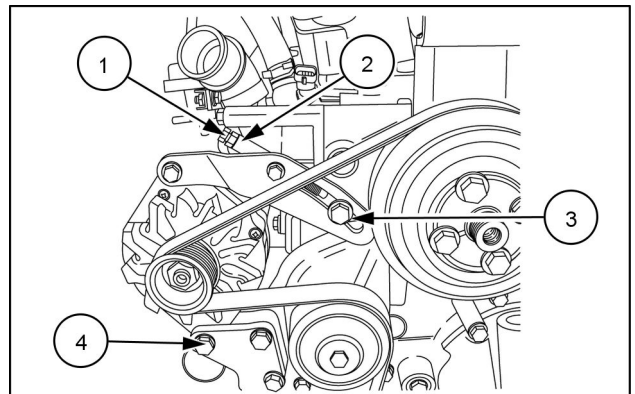
Belt - Install

1. Route the drive belt (1) on the pulleys as shown.



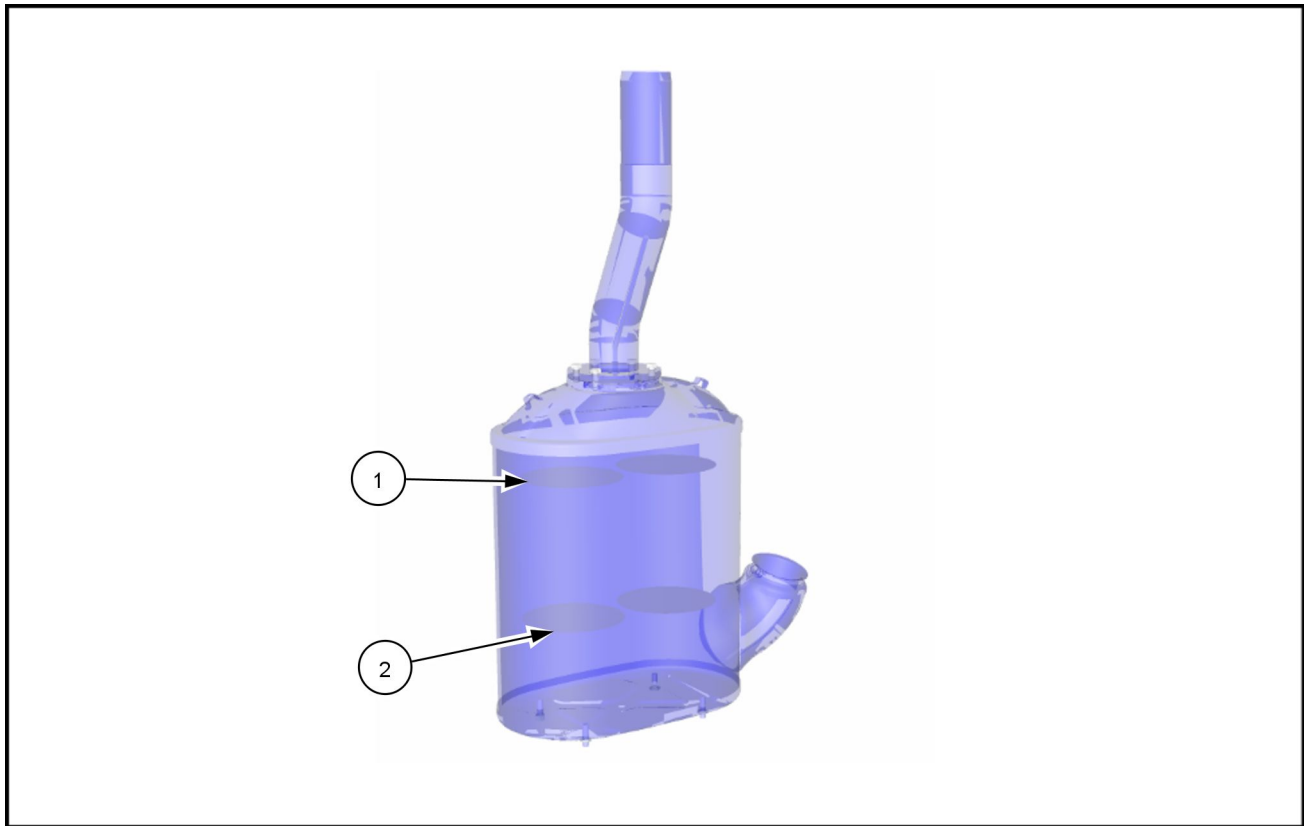
83118087 1

2. Turn the adjusting bolt (1) clockwise to apply tension to the belt, until the bracket reaches the end of its slot.
3. Tighten the jam nut (2) on the adjusting bolt.
4. Torque the tensioner retaining bolt (3) to **45 - 55 N·m (33 - 41 lb ft)**.
5. Torque the lower alternator bolt (4) to **45 - 55 N·m (33 - 41 lb ft)**.



83118121 2

Selective Catalytic Reduction (SCR) muffler and catalyst - Dynamic description - Clean Up Catalyst (CUC)



NHIL15ENG0161AA 1

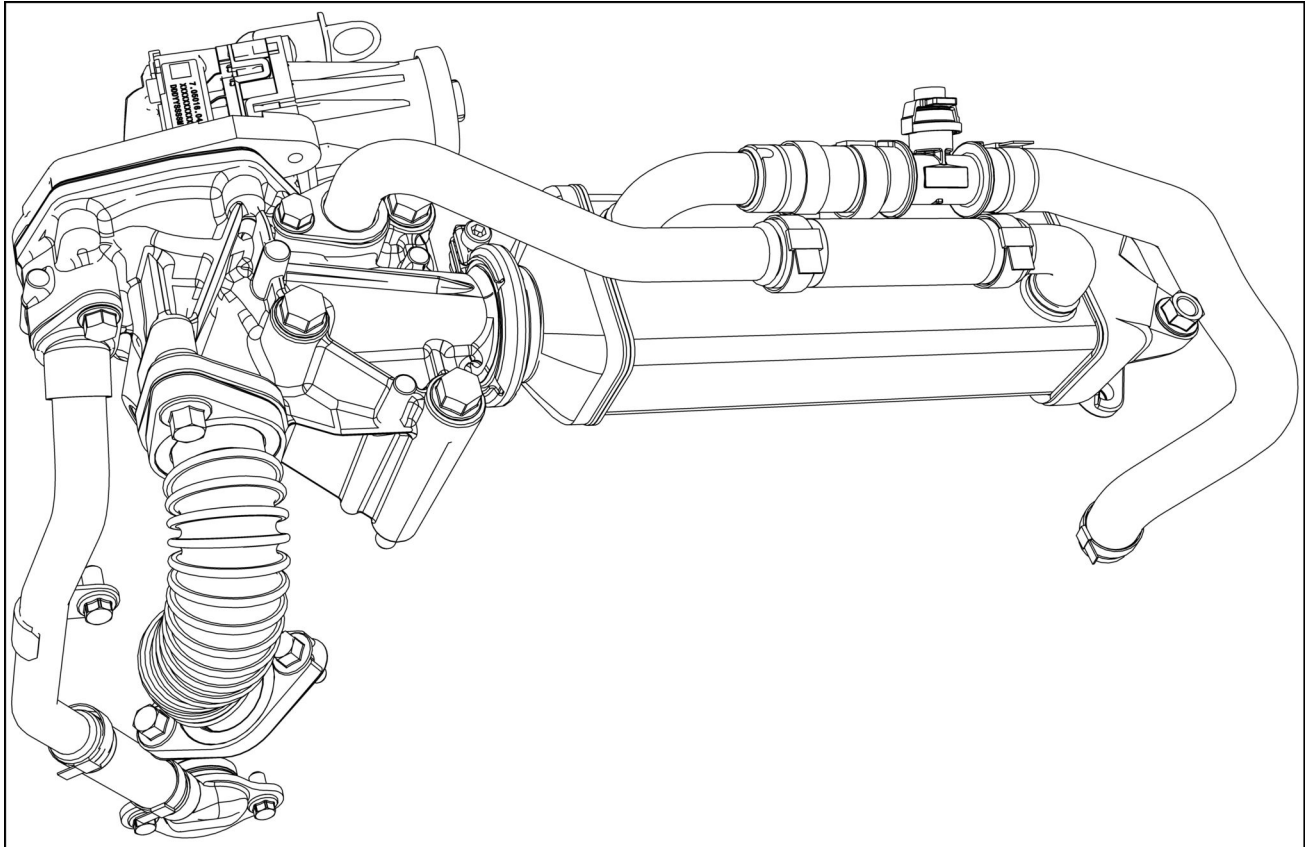
The Clean Up Catalyst (CUC) (1) is located inside the Selective Catalytic Reduction (SCR) muffler (2).

The CUC is required to eliminate residual ammonia (NH₃) for legislation implications.

It is possible to have too much ammonia in the SCR catalyst. In this case we lose ammonia through the exhaust pipe. The target to lose is less than **10 ppm** out of the exhaust pipe.

The excess ammonia reacts with the CUC and oxygen, and then is converted to nitrogen and water vapors out of the exhaust.

Exhaust Gas Recirculation (EGR) exhaust treatment - Dynamic description



NHIL14ENG0778FA 1

Exhaust Gas Recirculation (EGR) is an effective way to control NO_x emissions from diesel engines. The EGR reduces NO_x through lowering the oxygen concentration in the combustion chamber, as well as through heat absorption.

The EGR works by recirculating a portion of an engine's exhaust gas back to the engine combustion chamber. By routing the exhaust gas into the combustion chamber, the air/fuel mix does not have to do as much work to heat up the cylinder, resulting in reduced temperature. Reducing the temperature reduces the amount of NO_x produced in the chamber. This prevents the engines cylinders from reaching damaging temperatures and protects the environment from NO_x.

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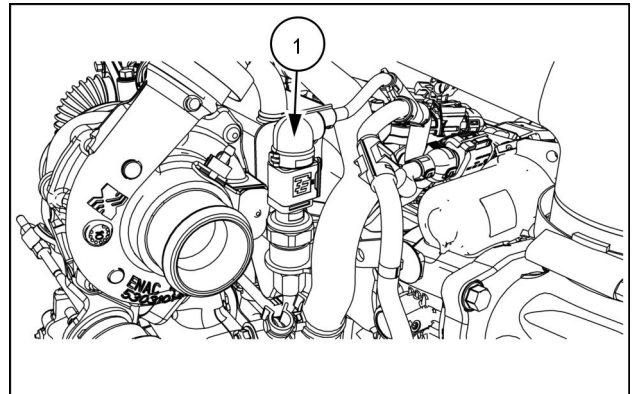
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(*) See content for specific models

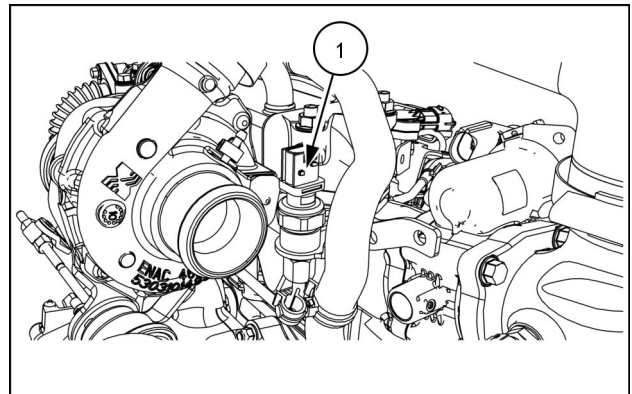
Exhaust manifold pressure sensor - Remove

1. Disconnect the electrical connector **(1)** from the exhaust pressure sensor.



NHIL14ENG0771AA 1

2. Remove the exhaust pressure sensor **(1)** from the bracket.



NHIL14ENG0772AA 2

Next operation:

Exhaust manifold pressure sensor - Install (55.014)

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Electrical systems - 55

Engine starting system - 201

FUNCTIONAL DATA

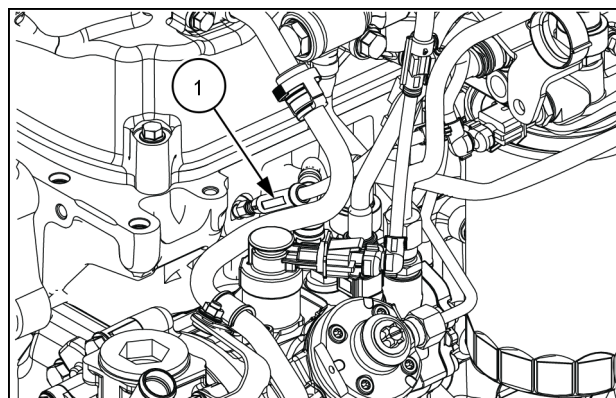
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Glow plug system - Remove

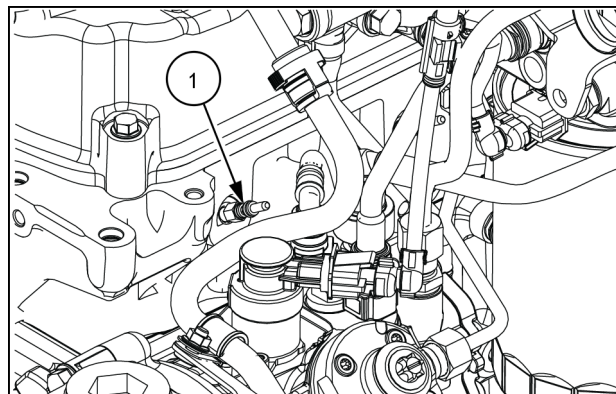
F5BFL413A*B001	
F5BFL413A*B003	
F5BFL413A*B007	
F5BFL413A*B009	
F5BFL413D*B002	
F5BFL413D*B003	
F5BFL413F*B002	
F5BFL413F*B003	
F5GFL413A*B003	
F5GFL413A*B004	
F5GFL413A*B006	
F5GFL413A*B007	
F5GFL413A*B012	
F5GFL413A*B013	

1. Disconnect the electrical connection **(1)** from the glow plug.



NHIL15ENG0143AA 1

2. Remove the glow plugs **(1)**.



NHIL15ENG0144AA 2

Next operation:

Glow plug system - Install (55.202)

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Selective Catalytic Reduction (SCR) electrical system - 988

TECHNICAL DATA

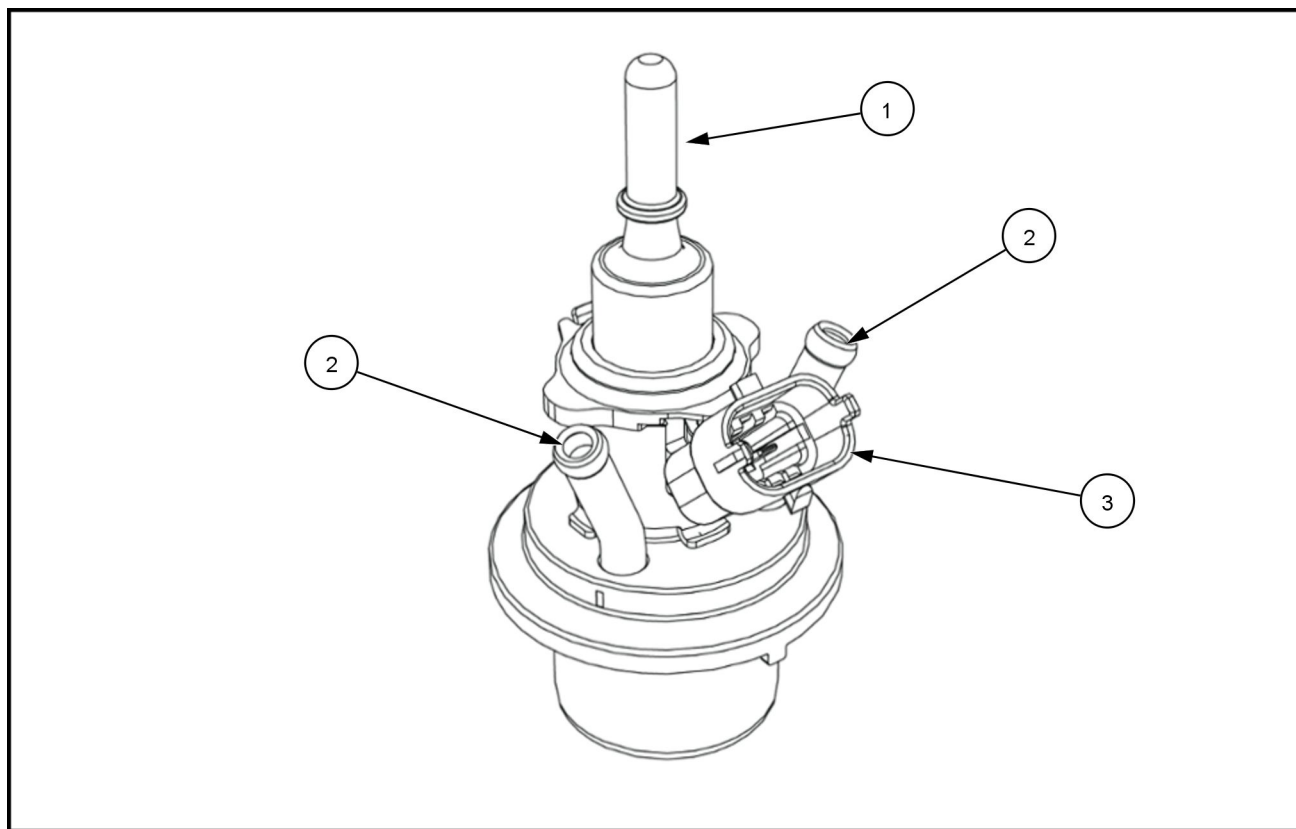
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(*) See content for specific models

Diesel Exhaust Fluid (DEF)/AdBlue® dosing module - Overview



NHVM15ENG0061AA 1

(1) DEF/AdBlue® connection

(2) Coolant connections

(3) Electrical connector

The dosing module injector is mounted in the exhaust stream near the outlet of the Diesel Oxidation Catalyst (DOC). The dosing module injector injects a metered amount of Diesel Exhaust Fluid (DEF)/AdBlue® to reduce NO_x levels. It consists of the following components:

- The dosing valve regulates the delivery of DEF/AdBlue® fluid to the exhaust stream. The Engine Control Unit (ECU) controls this electric solenoid type valve.
- The dosing injection module is cooled by engine coolant circulating through the valve. Hot DEF/AdBlue® fluid can cause deposits to build up causing blockages in the system.

Excessive carbon or oil deposits

- Excessive carbon and oil deposits can damage the sensor. Carbon deposits can clog the sensor, and effect the response time. The cause can be a rich mixture, exhaust air leaks, or high oil consumption due to worn piston rings or valve seals.



NHPH15ENG0160AA 3

The sensor is very sensitive to water. The ceramic part could crack and/or damage could occur to the sensor cell. Any contact with water before heating has to be avoided.

The connector on the module cannot be separated and the length of the cable may not be modified.

Do not add compound to the threads of the sensor when installing. Do not use penetrating oil to loosen the sensor when removing, as foreign substances could enter the sensor ports in the tip and cause damage.

Lambda sensor - Technical Data

F5DFL463A*F007	
F5DFL463A*F013	
F5DFL463A*F014	
F5DFL463A*F019	
F5DFL463A*F020	
F5DFL463B*F003	
F5DFL463B*F004	
F5DFL463B*F006	
F5DFL463C*F001	
F5DFL463C*F002	
F5DFL463C*F004	
F5HFL463A*F001	
F5HFL463A*F002	
F5HFL463A*F003	
F5HFL463A*F004	
F5HFL463A*F005	
F5HFL463A*F006	
F5HFL463A*F007	
F5HFL463A*F008	
F5HFL463B*F001	
F5HFL463B*F002	
F5HFL463C*F001	
F5HFL463C*F002	
F5HFL463D*F001	
F5HFL463D*F004	
F5HFL463D*F005	
F5HFL463D*F006	

Mechanical data	
Weight without wire	120.0 g (4.2 oz)
Thread	M18 x 1.5
Wrench size	22 mm
Tightening torque	40 - 60 N·m (30 - 44 lb ft)

Electrical data	
Power supply H+ nominal	7.5 V
System supply voltage	10.8 - 16.5 V
Heater power ready state	7.5 V
Heater control frequency	100 Hz

Characteristics		
Current of the pump circuit	Voltage (V)	Lambda (λ)
-1.243 A	0.192 V	0.750
-0.927 A	0.525 V	0.800
-0.800 A	0.658 V	0.822
-0.652 A	0.814 V	0.850
-0.4.5 A	1.074 V	0.900
-0.183 A	1.307 V	0.950
-0.106 A	1.388 V	0.970
-0.040 A	1.458 V	0.990
0 A	1.500 V	1.003
0.015 A	1.515 V	1.010
0.097 A	1.602 V	1.050
0.193 A	1.703 V	1.100
0.250 A	1.763 V	1.132
0.329 A	1.846 V	1.179
0.671 A	2.206 V	1.429
0.938 A	2.487 V	1.701
1.150 A	2.710 V	1.990
1.385 A	2.958 V	2.434
1.700 A	3.289 V	3.413
2.000 A	3.605 V	5.391
2.150 A	3.762 V	7.506

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