SERVICE MANUAL

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VM Motori
R 753 IE4
Tier 4B (final) and Stage IV
Engine

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Safety rules

Personal safety



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible death or injury.

Throughout this manual you will find the signal words DANGER, WARNING, and CAUTION followed by special instructions. These precautions are intended for the personal safety of you and those working with you.

Read and understand all the safety messages in this manual before you operate or service the machine.

DANGER indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

FAILURE TO FOLLOW DANGER, WARNING, AND CAUTION MESSAGES COULD RESULT IN DEATH OR SERIOUS INJURY.

Machine safety

NOTICE: *Notice indicates a situation that, if not avoided, could result in machine or property damage.*

Throughout this manual you will find the signal word Notice followed by special instructions to prevent machine or property damage. The word Notice is used to address practices not related to personal safety.

Information

NOTE: *Note indicates additional information that clarifies steps, procedures, or other information in this manual.*

Throughout this manual you will find the word Note followed by additional information about a step, procedure, or other information in the manual. The word Note is not intended to address personal safety or property damage.

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Torque – Minimum tightening torques for normal assembly

NOTE: *In the metric tables, nominal sizes M4 through M8 hardware torque specifications are shown as a Newton meters (pound-inches) numerical value.*
Nominal sizes M10 through M24 hardware torque specifications are shown as a Newton meters (pound-feet) numerical value.

Metric non-flanged hardware

Plain (PLN) an unplated hardware finish with residual manufacturing oils
Zinc-dichromate (ZND) – a yellow colored chemical plating formula yellow applied to the hardware

Nominal size	Class (CL) 8.8 bolt and Class (CL) 8 nut	Class (CL) 10.9 bolt and Class (CL) 10 nut	Locknut CL 8 w/CL 8.8 bolt	Locknut CL 10 w/CL 10.9 bolt
	PLN and ZND	PLN and ZND	ZND	ZND
	N·m (lb in)	N·m (lb in)	N·m (lb in)	N·m (lb in)
M4	2.9 (26)	4.2 (37)	2 (18)	2.9 (26)
M5	5.9 (52)	8.5 (75)	4 (36)	5.8 (51)
M6	10.1 (89)	14.5 (128)	6.8 (60)	10 (89)
M8	24.5 (217)	35.1 (311)	17 (151)	24 (212)
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
M10	48.7 (36)	69.5 (90)	33 (25)	48 (35)
M12	85 (63)	121 (67)	58 (43)	83 (61)
M14	135 (100)	193 (142)	92 (68)	132 (97)
M16	210 (155)	301 (222)	143 (106)	205 (151)
M18	299 (221)	414 (305)	203 (150)	281 (207)
M20	425 (313)	587 (433)	290 (214)	400 (295)
M24	735 (542)	1016 (749)	501 (370)	693 (510)

Metric flanged hardware

Plain (PLN) – an unplated hardware finish with residual manufacturing oils
Zinc-dichromate (ZND) – a yellow colored chemical plating formula yellow applied to the hardware

Nominal size	Class (CL) 8.8 bolt and Class (CL) 8 nut	Class (CL) 10.9 bolt and Class (CL) 10 nut	Locknut CL 8 w/CL 8.8 bolt	Locknut CL 10 w/CL 10.9 bolt
	PLN and ZND	PLN and ZND	ZND	ZND
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
M4	3.2 (28)	4.6 (41)	2.2 (19)	3.1 (27)
M5	6.5 (58)	9.4 (83)	4.4 (39)	6.4 (57)
M6	11.1 (98)	15.9 (141)	7.5 (66)	11 (96)
M8	27 (239)	39 (345)	18 (163)	27 (240)
	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)	N·m (lb ft)
M10	53.6 (40)	76.5 (56)	37 (27)	53 (39)
M12	93 (69)	134 (98)	63 (47)	91 (67)
M14	148 (109)	213 (157)	101 (75)	145 (107)
M16	231 (171)	331 (244)	158 116)	226 (167)
M18	329 (243)	455 (336)	223 (165)	309 (228)
M20	467 (345)	645 (476)	318 (235)	440 (325)
M24	809 (597)	1118 (824)	552 (407)	

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Engine - Technical Data

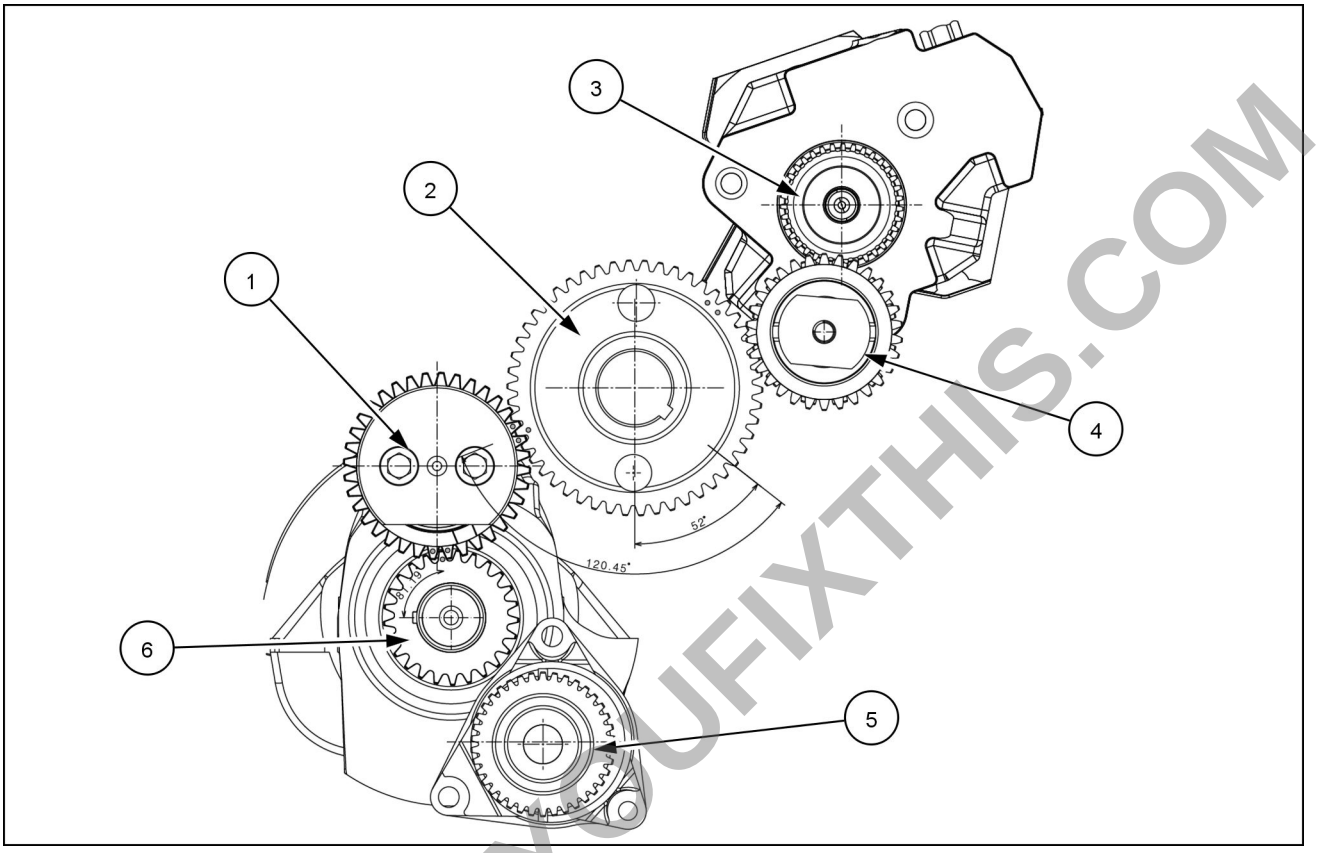
Engine specifications	
Cycle	Four stroke diesel
Total displacement	**2.228 L** (**2.354 US qt**)
Number of cylinders	3
Bore and stroke	94 x 107
Compression ratio	17.5 : 1
Intake	Turbocharged and inter-cooled circuit
Cooling	Liquid cooled
Water pump control	Belt driven
Cooler	Water / Oil
Crankshaft rotation	Counter-clockwise
Firing order	1 - 3 - 2
Timing	Pushrods and rocker arms
	With hydraulic tappets and camshaft
	Gear cascade control and camshaft fitted on the crankcase
Minimum idling speed (RPM)	**800 - 1000 RPM**
Maximum operating speed (RPM)	**3000 RPM**
Rated operating speed	**2600 RPM**
Rated power	**48.5 kW** (**65 Hp**) @ **2600 RPM**
Maximum torque	**220 N·m** (**162 lb ft**) @ **1800 RPM**
Injection	Common rail direct injection
Fuel supply	Gear pump
Injector supply	High pressure injection pump
Circuit fuel supply	Rotor pump
Type of lubrication	Forced lubrication
Oil change including filter	**6.3 L** (**6.7 US qt**)
Oil pressure at minimum speed	**2.5 bar** (**36.2 psi**)
Total capacity of cooling circuit (excluding radiator and relevant pipes)	**3.6 L** (**3.8 US qt**)
Expansion tank cap pressure setting	**1.1 bar** (**16.0 psi**)
Coolant	50/50 mix
Coolant maximum temperature alarm	**105 °C** (**221 °F**)
Nominal voltage	**12 V**
Alternating current generator (nominal voltage)	**14 V**
Alternating current generator (nominal current)	**75 A**
Starter motor output	**2 kW** (**3 Hp**)

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Engine - Timing adjust

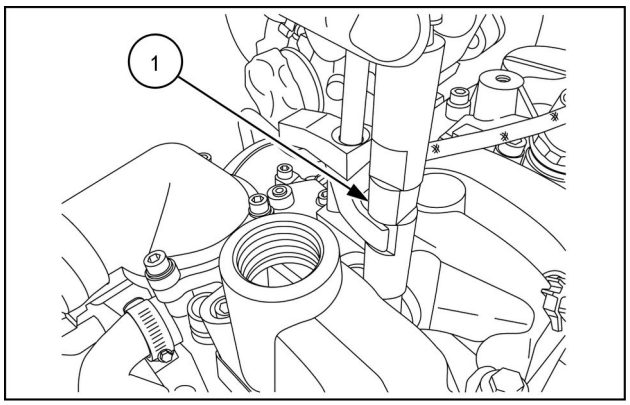
Prior operation:
Timing gear housing - Remove (10.102)



NHIL14ENG1257FA 1

(1) Idler gear	**(4)** Idler gear
(2) Camshaft gear	**(5)** Oil pump gear
(3) High pressure injection pump gear	**(6)** Crankshaft gear

1. Remove the cylinder one fuel injector. See **Fuel injectors - Remove (10.218)**.
2. Install the Top Dead Center (TDC) tool **380003392 (1)** into the cylinder one fuel injector hole.



NHIL14ENG1286AA 2

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Engine - Troubleshooting

Problem	Possible Cause	Correction
Engine will not start	An engine no start is defined as an engine that will crank but will not start. The most likely causes of this failure are issues related to the battery, fuel system or low engine compression.	1. Faulty battery, voltage too low 2. Insufficient fuel level 3. Contaminated fuel (water or air) 4. Clogged fuel filter 5. Faulty fuel injectors 6. Faulty glow plugs (if equipped) 7. Faulty fuel lift pump (if equipped) 8. Faulty high pressure pump, (if equipped) 9. Faulty mechanical pump, (if equipped) 10. Low engine compression 11. Engine timing incorrect
The engine starts then stalls	This symptom is usually caused by fuel leakage or a clogged fuel filter.	Visually inspect the fuel system for external leakage. If leakage is found, repair as necessary. Check fuel system pressure for adequate pressure. If fuel pressure is lower than expected, repair as necessary.
Engine will not crank	An engine no-crank condition is defined as an engine that will not crank. Possible failures include a dead or weak battery, an open battery disconnect switch (if equipped) or a starting system failure.	1. Check battery voltage. Charge or replace the battery as necessary. 2. Verify the status of the battery disconnect switch (if equipped). The switch must be closed. 3. Check the starting system for possible failures. Check the starter relay and battery voltage at the starter. Perform a voltage drop test between the battery and the engine starter to check the starter wiring. Repair as necessary.
The engine is difficult to start	The cause of an engine hard start condition is similar to those of an engine no start condition. Failures can include inadequate fuel pressure, air supply, engine compression, faulty glow plugs or incorrect injection timing during start up.	1. Faulty battery, voltage too low. 2. Insufficient fuel level 3. Contaminated fuel (water or air) 4. Clogged fuel filter 5. Faulty fuel injectors 6. Faulty glow plugs (if equipped) 7. Faulty fuel lift pump (if equipped) 8. Faulty high pressure pump 9. Restricted air induction system 10. Low engine compression 11. Engine timing incorrect
Engine has a slow cranking condition	A slow engine crank condition can be caused by a weak battery, worn starter internal engine resistance. Extremely cold operating temperatures can also be a factor in a slow engine crank condition.	1. Load test the battery. Charge or replace the battery as necessary. 2. Perform a voltage drop test on the starting circuit. There should be a drop less than **0.5 V** on both the positive and negative circuits. If the drop is greater than **0.5 V**, repair as necessary. 3. Bench test the starter. If the starter operates slower than expected, replace the starter.

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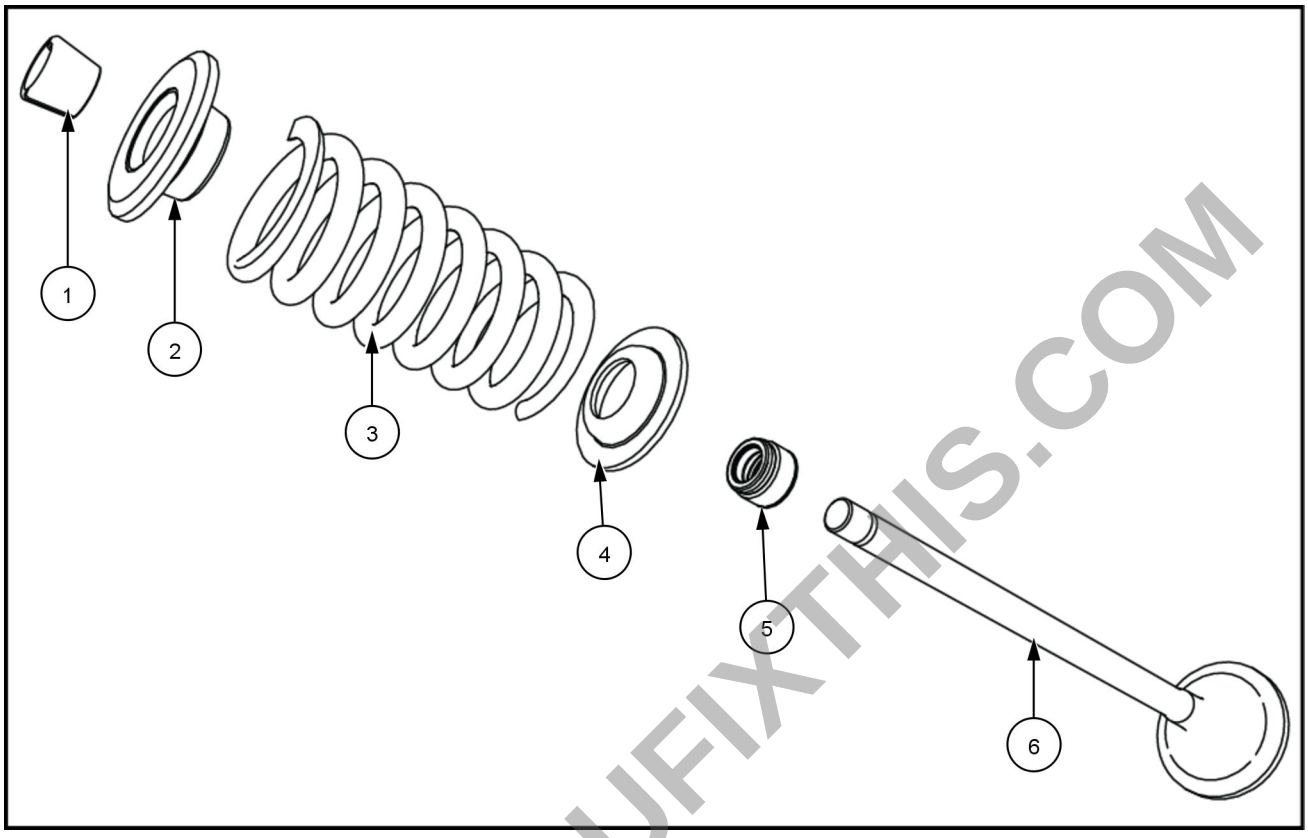
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Valves - Exploded view



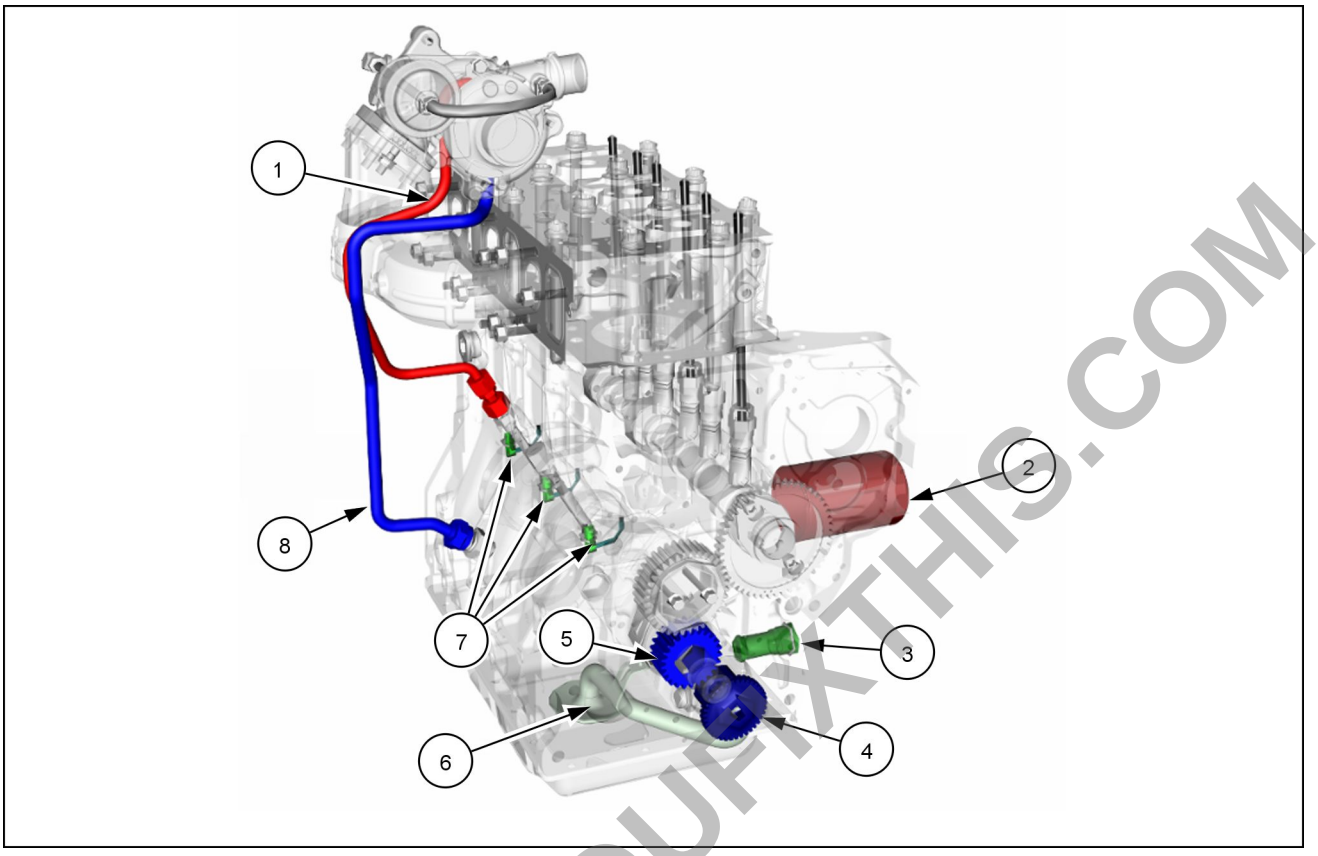
NHIL14ENG1171AA 1

(1) Valve keepers	**(4)** Spring plate washer
(2) Spring retainer	**(5)** Valve stem seal
(3) Valve spring	**(6)** Valve

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Engine lubrication system - Dynamic description



NHIL15ENG0230JA 1

The lubrication system is a pressurized type system. The engine lubrication is provided by means of an oil pump **(4)**. The oil pump is fastened to the rear section of the crankcase. The oil pump is driven by a gear **(5)** mounted on the crankshaft. The pump draws oil from the sump pick up tube **(6)**. The oil then goes to the oil filter assembly **(2)**. The oil will then distribute through the oil galleys in the crankcase. The oil pressure is controlled by the oil pressure relief valve **(3)** near the oil pump.

The pressure relief valve controls the oil pressure in the system. The valve will open if the oil pressure exceeds **7.5 bar** (**108.8 psi**).

The oil is directed from oil distribution galleys positioned lengthwise in the crankcase. The function of these galleys is to direct the oil to the camshaft and crankshaft bearings. The lower galleys supply oil to cool the pistons via piston cooling nozzles **(7)**.

The upper galleys direct oil to each of the engine cylinder heads and timing components.

The engine has a turbocharger. The turbocharger shafts receive lubrication via a supply line **(1)** connected to the lower galleys. The return oil is drained back to the engine oil sump through a drain line **(8)**.

The lubrication system provides oil to lubricate the following gears:

- High pressure pump gear
- Accessory drive gear
- Idler gears
- Camshaft gear
- Crankshaft gear
- Oil pump gear

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INTRODUCTION

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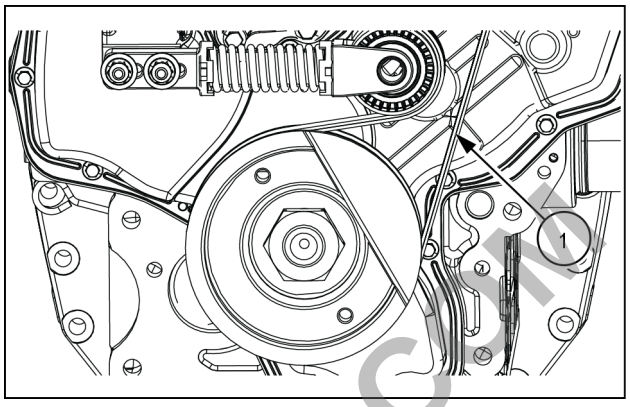
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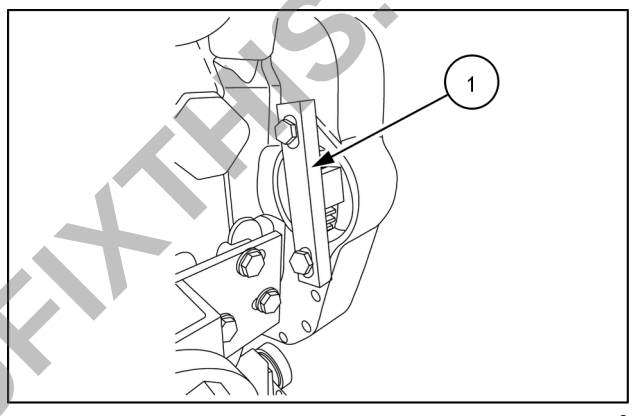
Crankshaft pulley - Remove

1. Remove the alternator belt **(1)**.



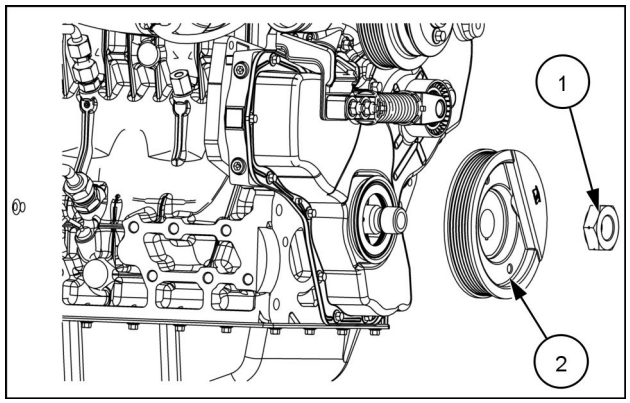
NHIL14ENG1179AA 1

2. Install the crankshaft rotation block tool **380003387 (1)** in place of starter.



NHIL14ENG1284AA 2

3. Use a 46mm socket to remove the left-hand thread crankshaft nut **(1)**.
4. Remove the crankshaft pulley **(2)**.



NHIL14ENG1180AA 3

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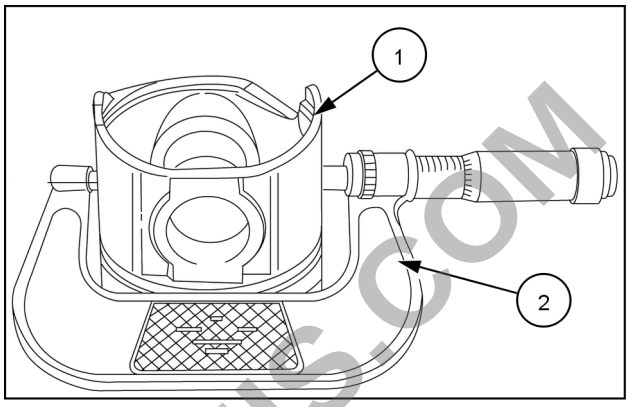
Piston - Measure

Prior operation:
Connecting rod and piston - Disassemble (10.105)

1. Use a micrometer **(2)** to measure the diameter of the piston **(1)**.

NOTE: *The diameter of the piston must be measured* ***17 mm*** *(****0.7 in****) from the bottom and* ***90 °*** *to the piston pin.*

2. The diameter should be between **93.930 - 93.950 mm** (**3.698 - 3.699 in**). Replace the piston if necessary.



NHIL13ENG1205AA 1

Next operation:
Connecting rod and piston - Assemble (10.105)

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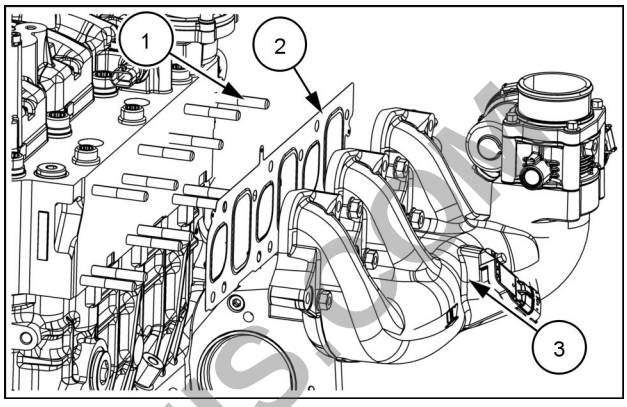
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Intake manifold - Install

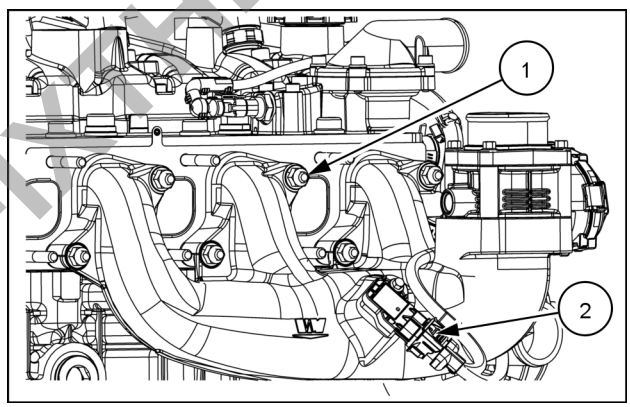
Prior operation:
Intake manifold - Remove (10.254)

1. Install a new intake/exhaust manifold gasket **(2)** onto the mounting studs **(1)**.
2. Install the exhaust manifold **(3)** onto the studs.



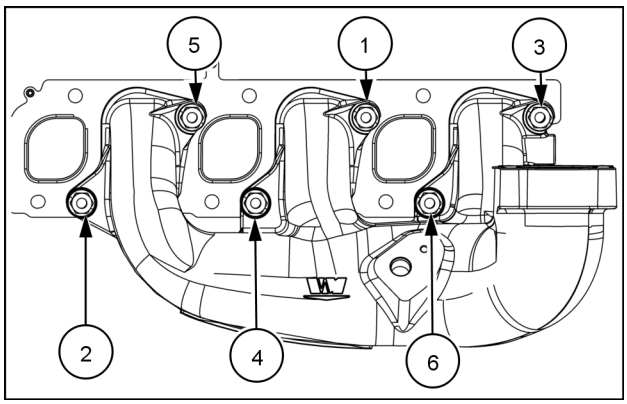
NHIL14ENG1220AA 1

3. Install the exhaust manifold nuts **(1)**.
4. Connect the wire harness to the intake manifold pressure/temperature sensor **(2)**.



NHIL14ENG1219AA 2

5. Follow the sequence shown and torque the intake manifold nuts to **27.5 N·m** (**20.3 lb ft**).



NHIL14ENG1221AA 3

Next operation:
Exhaust manifold - Install (10.254)

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Problem	Possible Cause	Correction
Engine coolant temperature too high	The most likely failures that can lead to too high coolant temperature are : - Low engine coolant level - A clogged radiator or other blockage in the cooling system - Insufficient air flow to the radiator - A failed water pump - A broken or loose engine drive belt - A failed thermostat - A failed radiator cap - Extreme operating conditions	**⚠ 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. Inspect the engine coolant level and fill, if necessary. 2. Perform an engine coolant pressure test to check for blockage within the system and repair as necessary. 3. Check for obstructions to the air flow of the radiator. A dirty or restricted radiator grille may be causing the overheating condition. 4. With the engine running at operation temperature, squeeze the top radiator hose, then release the hose. You should feel a surge of coolant indicating that the water pump is functioning properly. If no surge is felt, the water pump has failed. 5. Verify that the engine drive belt is not broken and check the belt tightness. Repair or replace as necessary. 6. Remove the thermostat and test the opening temperature using the appropriate testing equipment. The thermostat should open at approximately **87.8 °C** (**190.0 °F**). Replace the thermostat, if necessary. 7. Pressure test the radiator cap. If the radiator cap fails the test, replace the radiator cap. 8. Verify that the engine has not been operating in extreme working conditions. These conditions may include extremely high temperatures or overworking the engine.

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