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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 and on machine decals, 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 which, if not avoided, will result in death or serious injury. The color associated with DANGER is RED.

WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury. The color associated with WARNING is ORANGE.

CAUTION, used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury. The color associated with CAUTION is YELLOW.

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

Machine safety

NOTICE: *Notice indicates a situation which, if not avoided, could result in machine or property damage. The color associated with Notice is BLUE.*

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 which 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

METRIC NON-FLANGED HARDWARE

NOM. SIZE	CLASS 8.8 BOLT and CLASS 8 NUT		CLASS 10.9 BOLT and CLASS 10 NUT		LOCKNUT CL.8 W/CL8.8 BOLT	LOCKNUT CL.10 W/CL10.9 BOLT
	UNPLATED	PLATED W/ZnCr	UNPLATED	PLATED W/ZnCr		
M4	2.2 N·m (19 lb in)	2.9 N·m (26 lb in)	3.2 N·m (28 lb in)	4.2 N·m (37 lb in)	2 N·m (18 lb in)	2.9 N·m (26 lb in)
M5	4.5 N·m (40 lb in)	5.9 N·m (52 lb in)	6.4 N·m (57 lb in)	8.5 N·m (75 lb in)	4 N·m (36 lb in)	5.8 N·m (51 lb in)
M6	7.5 N·m (66 lb in)	10 N·m (89 lb in)	11 N·m (96 lb in)	15 N·m (128 lb in)	6.8 N·m (60 lb in)	10 N·m (89 lb in)
M8	18 N·m (163 lb in)	25 N·m (217 lb in)	26 N·m (234 lb in)	35 N·m (311 lb in)	17 N·m (151 lb in)	24 N·m (212 lb in)
M10	37 N·m (27 lb ft)	49 N·m (36 lb ft)	52 N·m (38 lb ft)	70 N·m (51 lb ft)	33 N·m (25 lb ft)	48 N·m (35 lb ft)
M12	64 N·m (47 lb ft)	85 N·m (63 lb ft)	91 N·m (67 lb ft)	121 N·m (90 lb ft)	58 N·m (43 lb ft)	83 N·m (61 lb ft)
M16	158 N·m (116 lb ft)	210 N·m (155 lb ft)	225 N·m (166 lb ft)	301 N·m (222 lb ft)	143 N·m (106 lb ft)	205 N·m (151 lb ft)
M20	319 N·m (235 lb ft)	425 N·m (313 lb ft)	440 N·m (325 lb ft)	587 N·m (433 lb ft)	290 N·m (214 lb ft)	400 N·m (295 lb ft)
M24	551 N·m (410 lb ft)	735 N·m (500 lb ft)	762 N·m (560 lb ft)	1016 N·m (750 lb ft)	501 N·m (370 lb ft)	693 N·m (510 lb ft)

NOTE: *M4 through M8 hardware torque specifications are shown in pound-inches. M10 through M24 hardware torque specifications are shown in pound-feet.*

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Engine - General specification

8035.25C.313T	

Specifications	
Engine type	4–stroke diesel
Fuel injection	Direct
Number of cylinders	3
Orientation of cylinders	In-line
Bore	**104 mm** (**4.094 in**)
Stroke	**115 mm** (**4.528 in**)
Displacement	**2931 cm³** (**178.9 in³**)
Compression ratio	18 : 1
Maximum power at **2300 RPM**	**48 kW** (**65 Hp**)
Maximum torque at **1400 RPM**	**261 N·m** (**192.5 lb ft**)
Number of main bearings	4
Oil pan construction	Structural, Cast iron

Engine - General specification

8035.25D.313T	

Specifications	
Engine type	4–stroke diesel
Fuel injection	Direct
Number of cylinders	3
Orientation of cylinders	In-line
Bore	**104 mm** (**4.094 in**)
Stroke	**115 mm** (**4.528 in**)
Displacement	**2931 cm³** (**178.9 in³**)
Compression ratio	18 : 1
Maximum power at **2300 RPM**	**53 kW** (**72 Hp**)
Maximum torque at **1400 RPM**	**295 N·m** (**217.6 lb ft**)
Number of main bearings	4
Oil pan construction	Structural, Cast iron

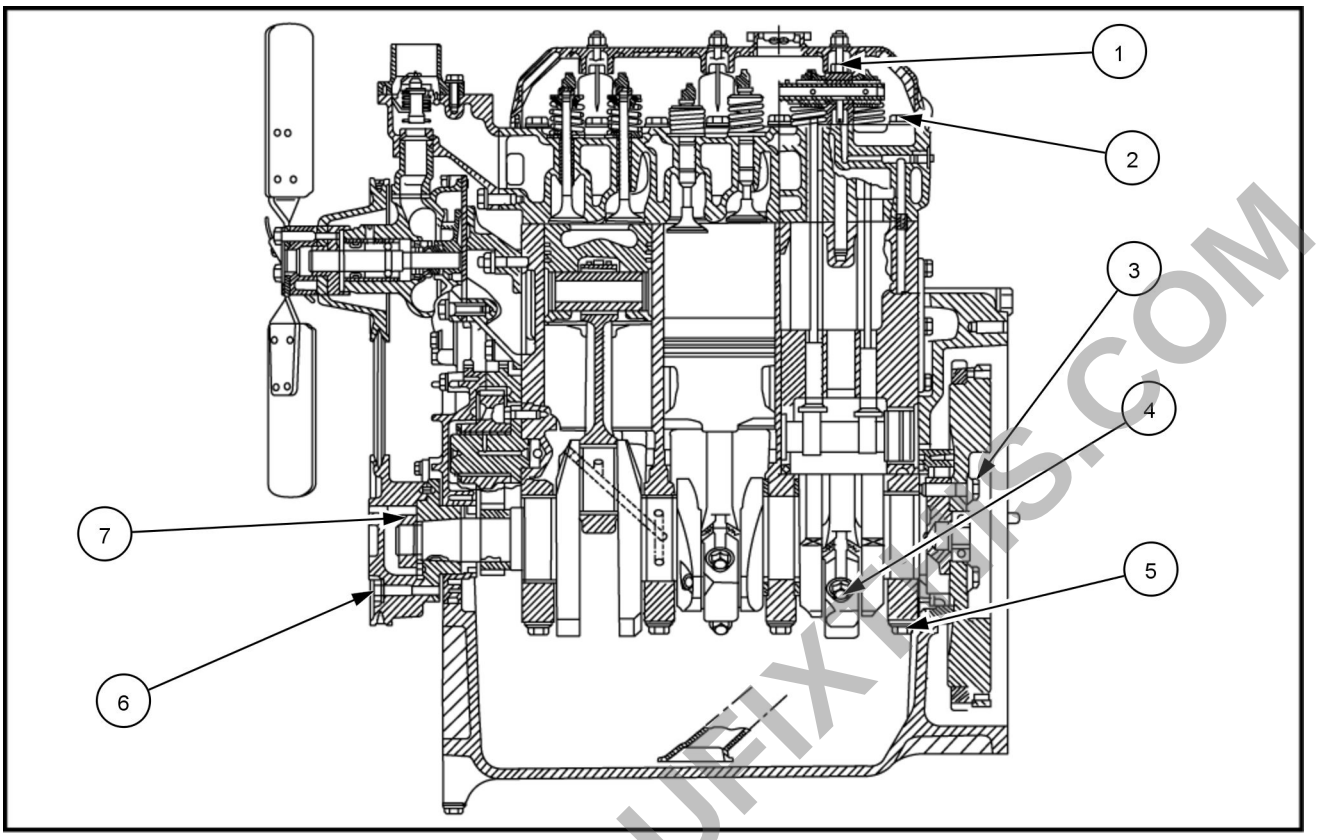
Engine - Service limits

Specifications	
Inside diameter of cylinder liners	**104.000 - 104.024 mm** (**4.094 - 4.095 in**)
Outside diameter of cylinder liners	**107.020 - 107.050 mm** (**4.213 - 4.215 in**)
Diameter of cylinder bores	**106.850 - 106.900 mm** (**4.207 - 4.209 in**)
Interference fit between cylinder liners and bores	**0.120 - 0.200 mm** (**0.005 - 0.008 in**)
Liner internal diameter oversizes	**0.4 - 0.8 mm** (**0.016 - 0.031 in**)
Liner external diameter oversizes	**0.2 mm** (**0.008 in**)
Maximum permissible liner ovality or taper due to wear	**0.12 mm** (**0.005 in**)
Diameter of crankshaft bore	**84.200 - 84.230 mm** (**3.315 - 3.316 in**)
Diameter of camshaft bore - Front - Middle - Rear	 **54.780 - 54.805 mm** (**2.157 - 2.158 in**) **54.280 - 54.305 mm** (**2.137 - 2.138 in**) **53.780 - 53.805 mm** (**2.117 - 2.118 in**)
Diameter of tappet bore	**15.000 - 15.018 mm** (**0.591 - 0.591 in**)
Spare tappet oversizes	**0.1 mm** (**0.004 in**) **0.2 mm** (**0.008 in**) **0.3 mm** (**0.012 in**)

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Engine - Sectional view



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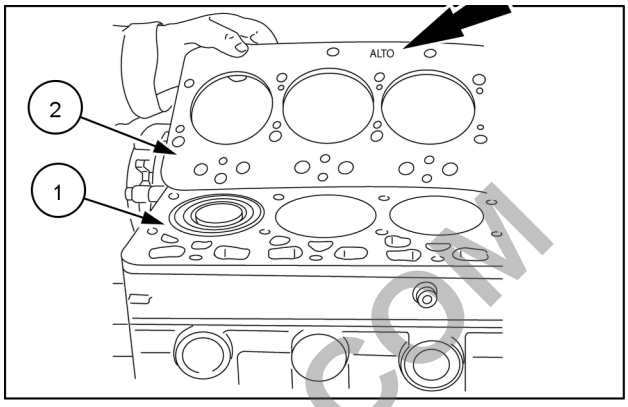
(1) Rocker shaft pedestal bolts
(2) Cylinder head bolts
(3) Flywheel bolts
(4) Big-end cap bolts
(5) Main bearing cap bolts
(6) Fan and alternator pulley bolts
(7) Crankshaft hub bolts

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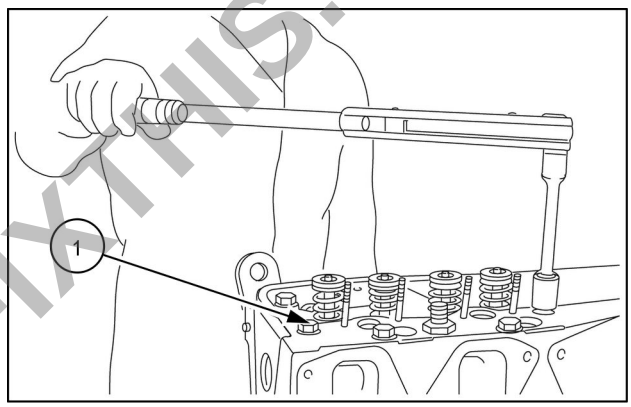
Cylinder head - Install

1. Clean the surface of the crankcase **(1)**.
2. Install the head gasket with the word TOP (ALTO) facing up.

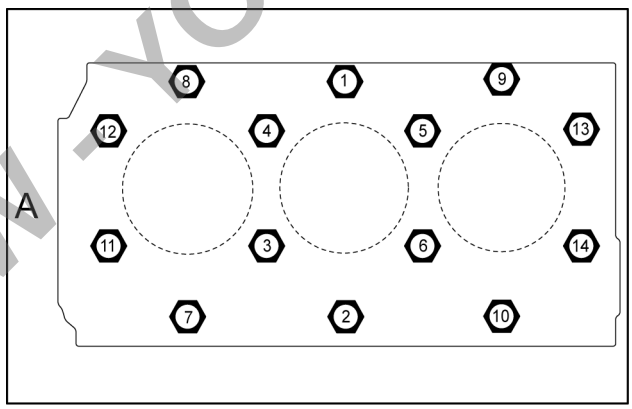


NHIL12ENG0313AA 1

3. Install the cylinder head.
4. Install the cylinder head bolts **(1)**.
5. Torque the bolts in the following phases using the torque order diagram in figure **3**.
   1. Torque the bolts to **70 N·m** (**52 lb ft**).
   2. Check the bolts to ensure an even torque of **70 N·m** (**52 lb ft**).
   3. Use the angular torque gauge tool **DM370(3/4)** to turn the bolts **90 °**.
   4. Turn the bolts an additional **90 °**.



NHIL12ENG0315AA 2



NHIL12ENG0314AA 3

(A) = front

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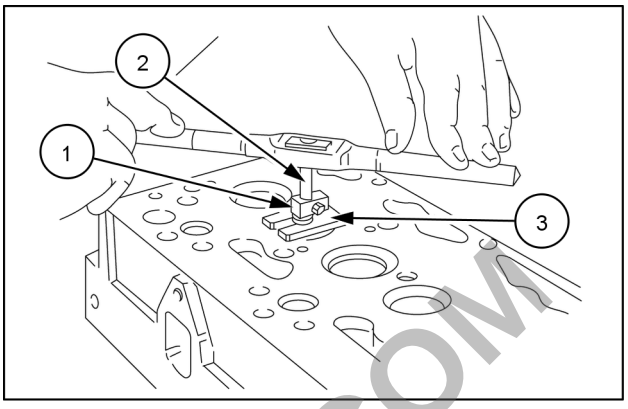
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15. Turn the cutter **(2)** until the depth stop **(1)** comes in contact with the plate **(3)**.

NOTICE: *Thoroughly clean the cylinder head after all the valve guides have been milled.*



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Connecting rods and pistons - Service limits

Specifications	
Diameter of small end bushing seat	**41.846 - 41.884 mm** (**1.647 - 1.649 in**)
Outside diameter of small end bushing	**41.979 - 42.017 mm** (**1.653 - 1.654 in**)
Interference between small end bushing and seat	**0.095 - 0.171 mm** (**0.004 - 0.007 in**)
Inside diameter of small end bushing (installed)	**38.004 - 38.014 mm** (**1.496 - 1.497 in**)
Diameter of big end shell bearing seats	**67.407 - 67.422 mm** (**2.654 - 2.654 in**)
Maximum tolerance for bend between the small end and big end axes measured at **25 mm** (**0.984 in**)	**0.07 mm** (**0.003 in**)
Maximum weight difference between connecting rods	**25 g** (**0.882 oz**)
Piston diameter	**103.852 - 103.870 mm** (**4.089 - 4.089 in**)
Piston clearance in cylinder liner	**0.130 - 0.172 mm** (**0.005 - 0.007 in**)
Maximum permitted clearance	**0.30 mm** (**0.012 in**)
Piston oversizes	**0.6 mm** (**0.024 in**)
Piston protrusion at Top Dead Center (TDC) from cylinder block face	**0.355 - 0.761 mm** (**0.014 - 0.03 in**)
Piston pin Diameter	**37.983 - 37.990 mm** (**1.495 - 1.5 in**)
Diameter of piston pin bore	**37.994 - 38.000 mm** (**1.4958 - 1.4961 in**)
Piston pin to pin bore clearance	**0.004 - 0.017 mm** (**0.0002 - 0.0007 in**)
Piston pin to small end bearing clearance	**0.014 - 0.031 mm** (**0.0006 - 0.0012 in**)
Maximum permitted wear clearance	**0.06 mm** (**0.002 in**)
Maximum weight difference between pistons	**20 g** (**0.705 oz**)
Piston ring groove clearance - Combustion ring - Intermediate ring - Oil control ring	 **0.090 - 0.122 mm** (**0.0035 - 0.0048 in**) **0.060 - 0.092 mm** (**0.0024 - 0.0036 in**) **0.040 - 0.075 mm** (**0.0016 - 0.003 in**)
Maximum permissible clearance - Combustion ring - Intermediate ring - Oil control ring	 **0.50 mm** (**0.02 in**) **0.20 mm** (**0.008 in**) **0.20 mm** (**0.008 in**)
Piston ring end gap (Installed) - Combustion ring - Intermediate ring - Oil control ring	 **0.40 - 0.65 mm** (**0.016 - 0.026 in**) **0.30 - 0.55 mm** (**0.012 - 0.022 in**) **0.30 - 0.55 mm** (**0.012 - 0.022 in**)
Maximum permissible gap	**1.20 mm** (**0.047 in**)

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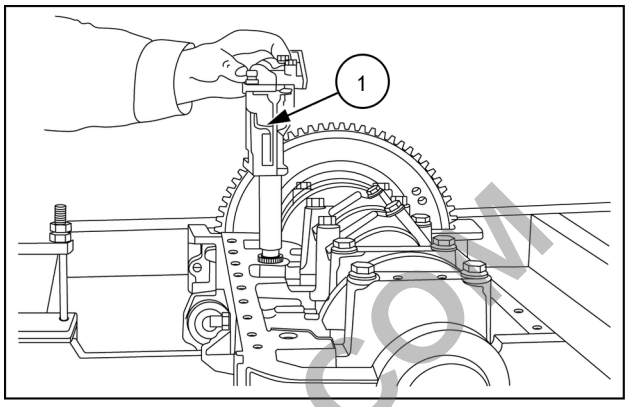
Fuel filters - Install 4
Fuel filters - Remove 3

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Engine oil pump - Install

1. Install the oil pump **(1)** assembly.
2. Torque the bolts to **20 - 30 N·m** (**15 - 22 lb ft**).



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