

Product: Case Cursor 13 Single Stage Turbocharger ENGINE Service Manual
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SERVICE MANUAL

Cursor[®] 13 Single Stage Turbocharger Tier 4B (final) and Stage IV Engine

See the following page for engine model numbers



Sample of manual. Download All 355 pages at:
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Part number 47869981

English

May 2015

*Replaces part numbers 47607266, 47607276,
47607286, 47607296*

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SERVICE MANUAL

**F3HFE613A*B003 , F3HFE613B*B001 , F3HFE613B*B002 , F3HFE613D*B001 ,
F3HFE613D*B002 , F3HFE613G*B001 , F3HFE613G*B002**

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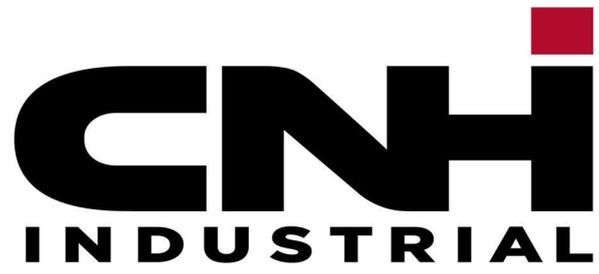
47869981 01/05/2015

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INTRODUCTION

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Foreword - Important notice regarding equipment servicing

All repair and maintenance work listed in this manual must be carried out only by qualified dealership personnel, strictly complying with the instructions given, and using, whenever possible, the special tools.

Anyone who performs repair and maintenance operations without complying with the procedures provided herein shall be responsible for any subsequent damages.

The manufacturer and all the organizations of its distribution chain, including - without limitation - national, regional, or local dealers, reject any responsibility for damages caused by parts and/or components not approved by the manufacturer, including those used for the servicing or repair of the product manufactured or marketed by the manufacturer. In any case, no warranty is given or attributed on the product manufactured or marketed by the manufacturer in case of damages caused by parts and/or components not approved by the manufacturer.

The manufacturer reserves the right to make improvements in design and changes in specifications at any time without notice and without incurring any obligation to install them on units previously sold. Specifications, descriptions, and illustrative material herein are as accurate as known at time of publication but are subject to change without notice.

In case of questions, refer to your CNH Sales and Service Networks.

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.

Safety rules - Ecology and the environment

Soil, air, and water quality is important for all industries and life in general. When legislation does not yet rule the treatment of some of the substances that advanced technology requires, sound judgment should govern the use and disposal of products of a chemical and petrochemical nature.

Familiarize yourself with the relative legislation applicable to your country, and make sure that you understand this legislation. Where no legislation exists, obtain information from suppliers of oils, filters, batteries, fuels, anti-freeze, cleaning agents, etc., with regard to the effect of these substances on man and nature and how to safely store, use, and dispose of these substances.

Helpful hints

- Avoid the use of cans or other inappropriate pressurized fuel delivery systems to fill tanks. Such delivery systems may cause considerable spillage.
- In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of these products contain substances that may be harmful to your health.
- Modern oils contain additives. Do not burn contaminated fuels and or waste oils in ordinary heating systems.
- Avoid spillage when you drain fluids such as used engine coolant mixtures, engine oil, hydraulic fluid, brake fluid, etc. Do not mix drained brake fluids or fuels with lubricants. Store all drained fluids safely until you can dispose of the fluids in a proper way that complies with all local legislation and available resources.
- Do not allow coolant mixtures to get into the soil. Collect and dispose of coolant mixtures properly.
- The air-conditioning system contains gases that should not be released into the atmosphere. Consult an air-conditioning specialist or use a special extractor to recharge the system properly.
- Repair any leaks or defects in the engine cooling system or hydraulic system immediately.
- Do not increase the pressure in a pressurized circuit as this may lead to a component failure.
- Protect hoses during welding. Penetrating weld splatter may burn a hole or weaken hoses, allowing the loss of oils, coolant, etc.

Battery recycling

Batteries and electric accumulators contain several substances that can have a harmful effect on the environment if the batteries are not properly recycled after use. Improper disposal of batteries can contaminate the soil, groundwater, and waterways. CNH strongly recommends that you return all used batteries to a CNH dealer, who will dispose of the used batteries or recycle the used batteries properly. In some countries, this is a legal requirement.



Mandatory battery recycling

NOTE: The following requirements are mandatory in Brazil.

Batteries are made of lead plates and a sulfuric acid solution. Because batteries contain heavy metals such as lead, CONAMA Resolution 401/2008 requires you to return all used batteries to the battery dealer when you replace any batteries. Do not dispose of batteries in your household garbage.

Points of sale are obliged to:

- Accept the return of your used batteries
- Store the returned batteries in a suitable location
- Send the returned batteries to the battery manufacturer for recycling

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)

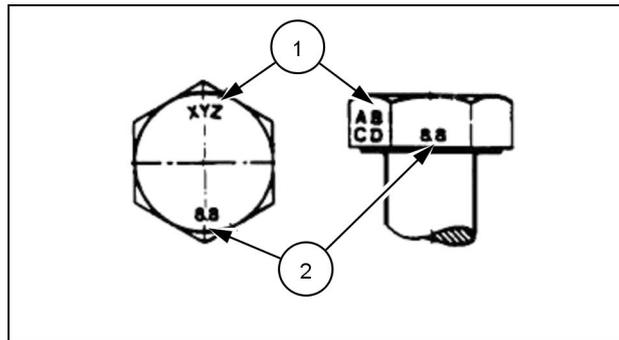
NOTE: M4 through M8 hardware torque specifications are shown in pound-inches. M10 through M24 hardware torque specifications are shown in pound-feet.

METRIC 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	2.4 N·m (21 lb in)	3.2 N·m (28 lb in)	3.5 N·m (31 lb in)	4.6 N·m (41 lb in)	2.2 N·m (19 lb in)	3.1 N·m (27 lb in)
M5	4.9 N·m (43 lb in)	6.5 N·m (58 lb in)	7.0 N·m (62 lb in)	9.4 N·m (83 lb in)	4.4 N·m (39 lb in)	6.4 N·m (57 lb in)
M6	8.3 N·m (73 lb in)	11 N·m (96 lb in)	12 N·m (105 lb in)	16 N·m (141 lb in)	7.5 N·m (66 lb in)	11 N·m (96 lb in)
M8	20 N·m (179 lb in)	27 N·m (240 lb in)	29 N·m (257 lb in)	39 N·m (343 lb in)	18 N·m (163 lb in)	27 N·m (240 lb in)
M10	40 N·m (30 lb ft)	54 N·m (40 lb ft)	57 N·m (42 lb ft)	77 N·m (56 lb ft)	37 N·m (27 lb ft)	53 N·m (39 lb ft)
M12	70 N·m (52 lb ft)	93 N·m (69 lb ft)	100 N·m (74 lb ft)	134 N·m (98 lb ft)	63 N·m (47 lb ft)	91 N·m (67 lb ft)
M16	174 N·m (128 lb ft)	231 N·m (171 lb ft)	248 N·m (183 lb ft)	331 N·m (244 lb ft)	158 N·m (116 lb ft)	226 N·m (167 lb ft)
M20	350 N·m (259 lb ft)	467 N·m (345 lb ft)	484 N·m (357 lb ft)	645 N·m (476 lb ft)	318 N·m (235 lb ft)	440 N·m (325 lb ft)
M24	607 N·m (447 lb ft)	809 N·m (597 lb ft)	838 N·m (618 lb ft)	1118 N·m (824 lb ft)	552 N·m (407 lb ft)	

IDENTIFICATION

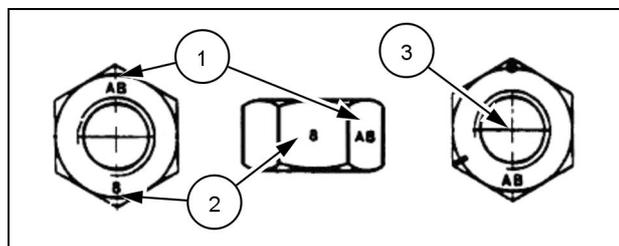
Metric Hex head and carriage bolts, classes 5.6 and up



20083680 1

1. Manufacturer's Identification
2. Property Class

Metric Hex nuts and locknuts, classes 05 and up



20083681 2

1. Manufacturer's Identification
2. Property Class
3. Clock Marking of Property Class and Manufacturer's Identification (Optional), i.e. marks **60 °** apart indicate Class 10 properties, and marks **120 °** apart indicate Class 8.

INCH NON-FLANGED HARDWARE

NOMINAL SIZE	SAE GRADE 5 BOLT and NUT		SAE GRADE 8 BOLT and NUT		LOCKNUT GrB W/ Gr5 BOLT	LOCKNUT GrC W/ Gr8 BOLT
	UN-PLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UN-PLATED or PLATED SILVER	PLATED W/ZnCr GOLD		
1/4	8 N·m (71 lb in)	11 N·m (97 lb in)	12 N·m (106 lb in)	16 N·m (142 lb in)	8.5 N·m (75 lb in)	12.2 N·m (109 lb in)
5/16	17 N·m (150 lb in)	23 N·m (204 lb in)	24 N·m (212 lb in)	32 N·m (283 lb in)	17.5 N·m (155 lb in)	25 N·m (220 lb in)
3/8	30 N·m (22 lb ft)	40 N·m (30 lb ft)	43 N·m (31 lb ft)	57 N·m (42 lb ft)	31 N·m (23 lb ft)	44 N·m (33 lb ft)
7/16	48 N·m (36 lb ft)	65 N·m (48 lb ft)	68 N·m (50 lb ft)	91 N·m (67 lb ft)	50 N·m (37 lb ft)	71 N·m (53 lb ft)
1/2	74 N·m (54 lb ft)	98 N·m (73 lb ft)	104 N·m (77 lb ft)	139 N·m (103 lb ft)	76 N·m (56 lb ft)	108 N·m (80 lb ft)
9/16	107 N·m (79 lb ft)	142 N·m (105 lb ft)	150 N·m (111 lb ft)	201 N·m (148 lb ft)	111 N·m (82 lb ft)	156 N·m (115 lb ft)
5/8	147 N·m (108 lb ft)	196 N·m (145 lb ft)	208 N·m (153 lb ft)	277 N·m (204 lb ft)	153 N·m (113 lb ft)	215 N·m (159 lb ft)
3/4	261 N·m (193 lb ft)	348 N·m (257 lb ft)	369 N·m (272 lb ft)	491 N·m (362 lb ft)	271 N·m (200 lb ft)	383 N·m (282 lb ft)
7/8	420 N·m (310 lb ft)	561 N·m (413 lb ft)	594 N·m (438 lb ft)	791 N·m (584 lb ft)	437 N·m (323 lb ft)	617 N·m (455 lb ft)
1	630 N·m (465 lb ft)	841 N·m (620 lb ft)	890 N·m (656 lb ft)	1187 N·m (875 lb ft)	654 N·m (483 lb ft)	924 N·m (681 lb ft)

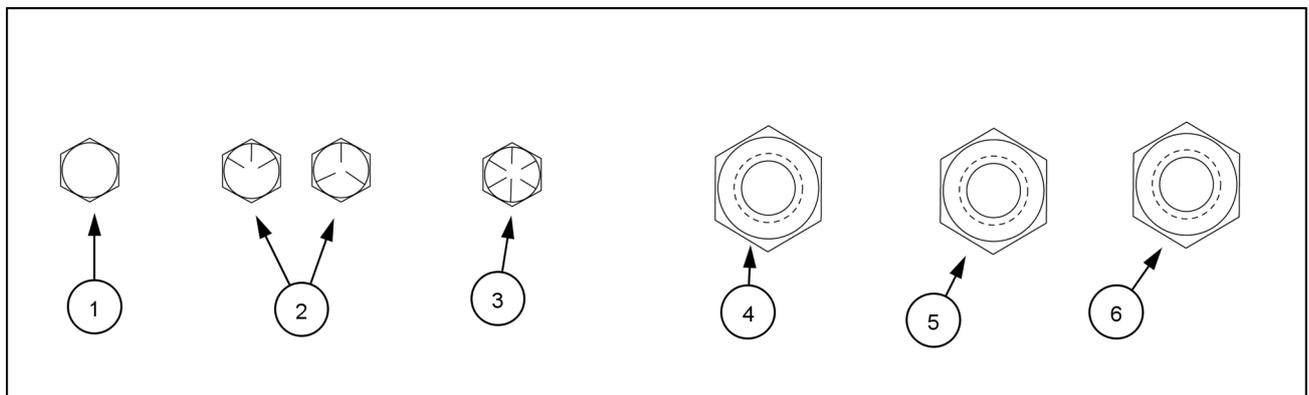
NOTE: For Imperial Units, *1/4 in* and *5/16 in* hardware torque specifications are shown in pound-inches. *3/8 in* through *1 in* hardware torque specifications are shown in pound-feet.

INCH FLANGED HARDWARE

NOM- INAL SIZE	SAE GRADE 5 BOLT and NUT		SAE GRADE 8 BOLT and NUT		LOCKNUT GrF W/ Gr5 BOLT	LOCKNUT GrG W/ Gr8 BOLT
	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD	UNPLATED or PLATED SILVER	PLATED W/ZnCr GOLD		
1/4	9 N·m (80 lb in)	12 N·m (106 lb in)	13 N·m (115 lb in)	17 N·m (150 lb in)	8 N·m (71 lb in)	12 N·m (106 lb in)
5/16	19 N·m (168 lb in)	25 N·m (221 lb in)	26 N·m (230 lb in)	35 N·m (310 lb in)	17 N·m (150 lb in)	24 N·m (212 lb in)
3/8	33 N·m (25 lb ft)	44 N·m (33 lb ft)	47 N·m (35 lb ft)	63 N·m (46 lb ft)	30 N·m (22 lb ft)	43 N·m (32 lb ft)
7/16	53 N·m (39 lb ft)	71 N·m (52 lb ft)	75 N·m (55 lb ft)	100 N·m (74 lb ft)	48 N·m (35 lb ft)	68 N·m (50 lb ft)
1/2	81 N·m (60 lb ft)	108 N·m (80 lb ft)	115 N·m (85 lb ft)	153 N·m (113 lb ft)	74 N·m (55 lb ft)	104 N·m (77 lb ft)
9/16	117 N·m (86 lb ft)	156 N·m (115 lb ft)	165 N·m (122 lb ft)	221 N·m (163 lb ft)	106 N·m (78 lb ft)	157 N·m (116 lb ft)
5/8	162 N·m (119 lb ft)	216 N·m (159 lb ft)	228 N·m (168 lb ft)	304 N·m (225 lb ft)	147 N·m (108 lb ft)	207 N·m (153 lb ft)
3/4	287 N·m (212 lb ft)	383 N·m (282 lb ft)	405 N·m (299 lb ft)	541 N·m (399 lb ft)	261 N·m (193 lb ft)	369 N·m (272 lb ft)
7/8	462 N·m (341 lb ft)	617 N·m (455 lb ft)	653 N·m (482 lb ft)	871 N·m (642 lb ft)	421 N·m (311 lb ft)	594 N·m (438 lb ft)
1	693 N·m (512 lb ft)	925 N·m (682 lb ft)	979 N·m (722 lb ft)	1305 N·m (963 lb ft)	631 N·m (465 lb ft)	890 N·m (656 lb ft)

IDENTIFICATION

Inch Bolts and free-spinning nuts

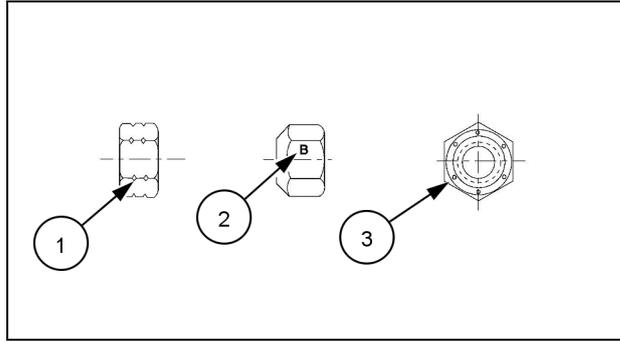


NHIL13ENG1271EA 3

Grade Marking Examples

SAE Grade Identification			
1	Grade 2 - No Marks	4	Grade 2 Nut - No Marks
2	Grade 5 - Three Marks	5	Grade 5 Nut - Marks 120 ° Apart
3	Grade 8 - Five Marks	6	Grade 8 Nut - Marks 60 ° Apart

Inch Lock Nuts, All Metal (Three optional methods)



20090268 4

Grade Identification

Grade	Corner Marking Method (1)	Flats Marking Method (2)	Clock Marking Method (3)
Grade A	No Notches	No Mark	No Marks
Grade B	One Circumferential Notch	Letter B	Three Marks
Grade C	Two Circumferential Notches	Letter C	Six Marks

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

Protecting the electronic and/or electrical systems during charging and welding

To avoid damage to the electronic and/or electrical systems, always observe the following practices:

1. Never make or break any of the charging circuit connections when the engine is running, including the battery connections.
2. Never short any of the charging components to ground.
3. Always disconnect the ground cable from the battery before arc welding on the machine or on any machine attachment.
 - Position the welder ground clamp as close to the welding area as possible.
 - If you weld in close proximity to a computer module, then you should remove the module from the machine.
 - Never allow welding cables to lie on, near, or across any electrical wiring or electronic component while you weld.
4. Always disconnect the negative cable from the battery when charging the battery in the machine with a battery charger.

NOTICE: *If you must weld on the unit, you must disconnect the battery ground cable from the machine battery. The electronic monitoring system and charging system will be damaged if this is not done.*

5. Remove the battery ground cable. Reconnect the cable when you complete welding.

⚠ WARNING

Battery acid causes burns. Batteries contain sulfuric acid.

Avoid contact with skin, eyes or clothing. Antidote (external): Flush with water. Antidote (eyes): flush with water for 15 minutes and seek medical attention immediately. Antidote (internal): Drink large quantities of water or milk. Do not induce vomiting. Seek medical attention immediately.

Failure to comply could result in death or serious injury.

W0111A

Special tools

The special tools that CNH suggests and illustrate in this manual have been specifically researched and designed for use with CNH machines. The special tools are essential for reliable repair operations. The special tools are accurately built and rigorously tested to offer efficient and long-lasting operation.

By using these tools, repair personnel will benefit from:

- Operating in optimal technical conditions
- Obtaining the best results
- Saving time and effort
- Working in safe conditions



SERVICE MANUAL

Engine

**F3HFE613A*B003 , F3HFE613B*B001 , F3HFE613B*B002 , F3HFE613D*B001 ,
F3HFE613D*B002 , F3HFE613G*B001 , F3HFE613G*B002**

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[10.500] Selective Catalytic Reduction (SCR) exhaust treatment.....	10.17



Engine - 10

Engine and crankcase - 001

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F3HFE613D*B002 , F3HFE613G*B001 , F3HFE613G*B002**

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Engine - Service limits

Engine specifications	
Compression Ratio	16.5 : 1
Bore	135 mm (5.3 in)
Stroke	150 mm (5.9 in)
Displacement	12880 cm³
Turbocharging	Inter-cooled, Direct injection
Turbocharger type	Holset HE551
Lubrication	Forced by gear pump, relief valve single action
Oil Pressure (Warm engine)	
- Idling	3 bar (43.5 psi)
- Peak RPM	4.5 bar (65.3 psi)
Cooling	Liquid cooled
Water pump control	Belt driven
Thermostat (Start of opening)	81 °C (177.8 °F)
Intake valve timing	
- Opens before TDC	17 °
- Closes after BDC	30 °
Exhaust valve timing	
- Opens before BDC	50 °
- Closes after TDC	9 °
Valve lash setting (when engine is cold)	
- Intake	0.4 mm (0.016 in)
- Exhaust	0.6 mm (0.024 in)
Firing Order	1 - 4 - 2 - 6 - 3 - 5
Cylinder block and piston	
Bores for cylinder liners:	
- Upper	153.500 - 153.525 mm (6.043 - 6.044 in)
- Lower	152.000 - 152.025 mm (5.984 - 5.985 in)
Cylinder liners external diameter:	
- Upper	153.461 - 153.486 mm (6.042 - 6.043 in)
- Lower	151.890 - 151.915 mm (5.980 - 5.981 in)
Clearance between the OD of liners and ID of bores	
- Upper	0.014 - 0.039 mm (0.001 - 0.002 in)
- Lower	0.085 - 0.135 mm (0.003 - 0.005 in)
Cylinder liner	
- ID	135.000 - 135.013 mm (5.315 - 5.315 in)
- ID under a load of 800 N (179.8 lb)	135.011 - 135.024 mm (5.315 - 5.316 in)
- Protrusion	0.045 - 0.075 mm (0.002 - 0.003 in)
Pistons	
- Measuring dimension	18 mm (0.709 in)
- External diameter (supplied as spares)	134.861 - 134.873 mm (5.309 - 5.310 in)
- External diameter (production only)	134.872 - 134.884 mm (5.310 - 5.310 in)
- Pin bore	54.010 - 54.018 mm (2.126 - 2.127 in)
OD of piston - ID of cylinder liner	0.127 - 0.151 mm (0.005 - 0.006 in)
Piston protrusion	0.12 - 0.42 mm (0.005 - 0.017 in)
Piston pin diameter	53.994 - 54.000 mm (2.126 - 2.126 in)
Piston pin OD - pin bore	0.010 - 0.024 mm (0.0004 - 0.0009 in)
Piston ring grooves	
- Top	3.100 - 3.120 mm (0.122 - 0.123 in)
- Middle	1.550 - 1.570 mm (0.061 - 0.062 in)
- Bottom	5.020 - 5.040 mm (0.198 - 0.198 in)
Piston rings	
- Combustion ring	3.000 mm (0.118 in)

- Intermediate ring	1.470 - 1.500 mm (0.058 - 0.059 in)
- Oil control ring	4.970 - 4.990 mm (0.196 - 0.196 in)
Clearance between piston rings and grooves	
- Combustion ring	0.100 - 0.120 mm (0.004 - 0.005 in)
- Intermediate ring	0.050 - 0.100 mm (0.002 - 0.004 in)
- Oil control ring	0.030 - 0.070 mm (0.001 - 0.003 in)
Piston ring end gap in cylinder liners	
- Combustion ring	0.40 - 0.50 mm (0.016 - 0.020 in)
- Intermediate ring	0.65 - 0.80 mm (0.026 - 0.031 in)
- Oil control ring	0.40 - 0.75 mm (0.016 - 0.030 in)
Connecting rod	
Small end bush housing	
- Nominal	59.000 - 59.030 mm (2.323 - 2.324 in)
Big end bearing housing	
- Nominal	94.000 - 94.030 mm (3.701 - 3.702 in)
- Class 1	94.000 - 94.010 mm (3.701 - 3.701 in)
- Class 2	94.011 - 94.020 mm (3.701 - 3.702 in)
- Class 3	94.021 - 94.030 mm (3.702 - 3.702 in)
Small end bush diameter	
- Outside	59.085 - 59.110 mm (2.326 - 2.327 in)
- Inside	54.019 - 54.035 mm (2.127 - 2.127 in)
Big end bearing shell thickness	
- Red	1.965 - 1.975 mm (0.077 - 0.078 in)
- Green	1.976 - 1.985 mm (0.078 - 0.078 in)
- Yellow	1.986 - 1.995 mm (0.078 - 0.079 in)
Clearance between small end bush and housing	0.055 - 0.110 mm (0.002 - 0.004 in)
Clearance between piston pin and bush	0.019 - 0.041 mm (0.001 - 0.002 in)
Connecting rod weight	
- Class A	4753 - 4795 g (167.7 - 169.1 oz)
- Class B	4796 - 4835 g (169.2 - 170.5 oz)
- Class C	4836 - 4875 g (170.6 - 172.0 oz)
Maximum connecting rod axis misalignment tolerance	0.08 mm (0.003 in)
Crankshaft	
Main journals	
- Rated value	99.970 - 100.000 mm (3.9358 - 3.9370 in)
- Class 1	99.970 - 99.979 mm (3.9358 - 3.9362 in)
- Class 2	99.980 - 99.989 mm (3.9362 - 3.9366 in)
- Class 3	99.990 - 100.000 mm (3.9366 - 3.9370 in)
Crankpins	
- Rated value	89.970 - 90.000 mm (3.5421 - 3.5433 in)
- Class 1	89.970 - 89.979 mm (3.5421 - 3.5425 in)
- Class 2	89.980 - 89.989 mm (3.5425 - 3.5429 in)
- Class 3	89.990 - 90.000 mm (3.5429 - 3.5433 in)
Main bearing shells	
- Red	3.110 - 3.120 mm (0.1224 - 0.1228 in)
- Green	3.121 - 3.130 mm (0.1229 - 0.1232 in)
- Yellow	3.131 - 3.140 mm (0.1233 - 0.1236 in)
Main bearing housings	
- Rated value	106.300 - 106.330 mm (4.1850 - 4.1862 in)
- Class 1	106.300 - 106.309 mm (4.1850 - 4.1854 in)
- Class 2	106.310 - 106.319 mm (4.1854 - 4.1858 in)
- Class 3	106.320 - 106.330 mm (4.1858 - 4.1862 in)
Clearance between bearing shells and main journals	0.060 - 0.100 mm (0.0024 - 0.0039 in)
Clearance between bearing shells and big ends	0.050 - 0.090 mm (0.0020 - 0.0035 in)

Main journal, thrust bearing	47.95 - 48.00 mm (1.888 - 1.890 in)
Main bearing housing, thrust bearing	40.94 - 40.99 mm (1.612 - 1.614 in)
Thrust bearing thickness	3.38 - 3.43 mm (0.133 - 0.135 in)
Crankshaft end play	0.10 - 0.30 mm (0.0039 - 0.0118 in)
Main journals and crankpins - Alignment - Ovalization - Taper	Less than or equal to 0.025 mm (0.0010 in) 0.010 mm (0.0004 in) 0.010 mm (0.0004 in)
Cylinder head and valve train	
Valve guide housing in cylinder head	15.980 - 15.997 mm (0.629 - 0.630 in)
Valve guide - Inside diameter - Outside diameter	10.015 - 10.030 mm (0.394 - 0.395 in) 16.012 - 16.025 mm (0.630 - 0.631 in)
Valve guides - housings in the cylinder head	0.015 - 0.045 mm (0.0006 - 0.0018 in)
Intake valves - Valve stem diameter - Valve face angle	9.960 - 9.975 mm (0.392 - 0.393 in) 60 °
Exhaust valves - Valve stem diameter - Valve face angle	9.960 - 9.975 mm (0.392 - 0.393 in) 45 °
Clearance between valve guide and valve stem	0.040 - 0.070 mm (0.0016 - 0.0028 in)
Valve seat in cylinder head. Intake Exhaust	49.185 - 49.220 mm (1.936 - 1.938 in) 46.985 - 47.020 mm (1.850 - 1.851 in)
Outside diameter of valve seat - Intake - Exhaust	49.260 - 49.275 mm (1.939 - 1.940 in) 47.060 - 47.075 mm (1.8528 - 1.8533 in)
Valve seat angle - Intake - Exhaust	60 ° 45 °
Recessing of the valves - Intake - Exhaust	0.54 - 0.85 mm (0.021 - 0.033 in) 1.75 - 2.05 mm (0.069 - 0.081 in)
Clearance between valve seat and cylinder head - Intake - Exhaust	0.040 - 0.090 mm (0.0016 - 0.0035 in) 0.040 - 0.090 mm (0.0016 - 0.0035 in)
Valve spring height No load 547 - 603 N (123.0 - 135.6 lb) load 1041 - 1149 N (234.0 - 258.3 lb) load	73.40 mm (2.890 in) 59 mm (2.323 in) 45 mm (1.772 in)
Camshaft bushing housing in the cylinder head	88.000 - 88.030 mm (3.465 - 3.466 in)
Camshaft bearing journals	82.950 - 82.968 mm (3.2657 - 3.2665 in)
O.D. of the camshaft bushings	88.153 - 88.183 mm (3.4706 - 3.4718 in)
I.D. of the camshaft bushings	83.018 - 83.085 mm (3.2684 - 3.2711 in)
Clearance between bushings and housings in the cylinder head	0.123 - 0.183 mm (0.0048 - 0.0072 in)
Clearance between bushings and bearing journals	0.050 - 0.135 mm (0.0020 - 0.0053 in)
Cam lift - Intake lobe - Exhaust lobe - Injector lobe	9.30 mm (0.366 in) 9.30 mm (0.366 in) 11.216 mm (0.442 in)
Diameter of the rocker shaft	41.984 - 42.000 mm (1.6529 - 1.6535 in)
Bushing housing in the rocker arms - Intake - Exhaust	45.000 - 45.016 mm (1.7717 - 1.7723 in) 59.000 - 59.019 mm (2.3228 - 2.3236 in)

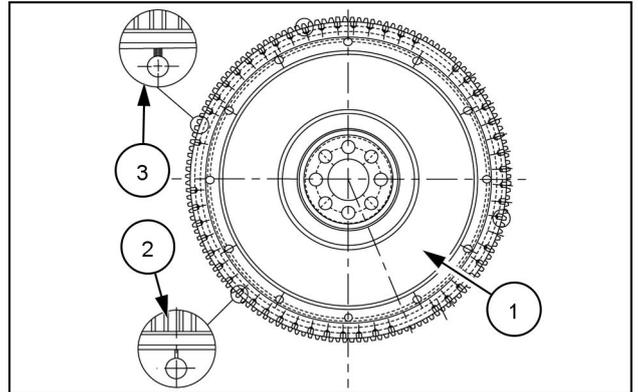
Engine - Engine and crankcase

- Injector	46.000 - 46.016 mm (1.8110 - 1.8117 in)
Bushing outside diameter for rocker arms	
- Intake	45.090 - 45.130 mm (1.7752 - 1.7768 in)
- Exhaust	59.100 - 59.140 mm (2.3268 - 2.3283 in)
- Injector	46.066 - 46.091 mm (1.8136 - 1.8146 in)
Bushing inside diameter for rocker arms	
- Intake	42.025 - 42.041 mm (1.6545 - 1.6552 in)
- Exhaust	56.030 - 56.049 mm (2.2059 - 2.2067 in)
- Injector	42.015 - 42.071 mm (1.6541 - 1.6563 in)
Clearance between bushings and housings	
- Intake	0.074 - 0.130 mm (0.0029 - 0.0051 in)
- Exhaust	0.081 - 0.140 mm (0.0032 - 0.0055 in)
- Injector	0.050 - 0.091 mm (0.0020 - 0.0036 in)
Clearance between bushings of rocker arms and shaft	
- Intake	0.025 - 0.057 mm (0.0010 - 0.0022 in)
- Exhaust	0.025 - 0.057 mm (0.0010 - 0.0022 in)
- Injector	0.015 - 0.087 mm (0.0006 - 0.0034 in)

Engine - Service instruction - Finding Top Dead Center (TDC)

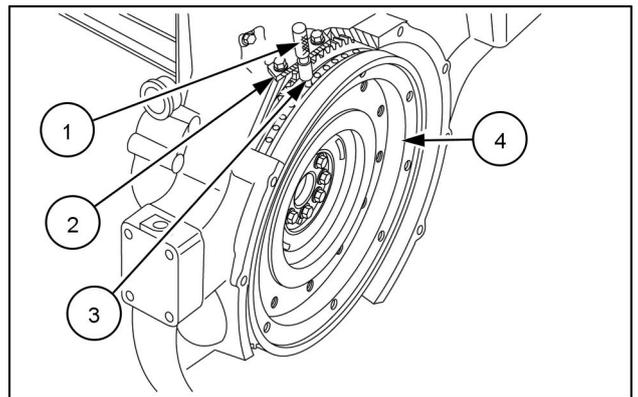
For engines with a full flywheel housing

1. Using the tool **380000137**, turn the engine flywheel (**1**) in the direction of normal rotation until you see the hole with two reference marks (**3**) through the inspection window at the bottom of the housing.
2. Continue to turn the flywheel until the following hole with one reference mark (**2**) can be seen. This marks TDC of the number one cylinder.



NHIL13ENG1171AA 1

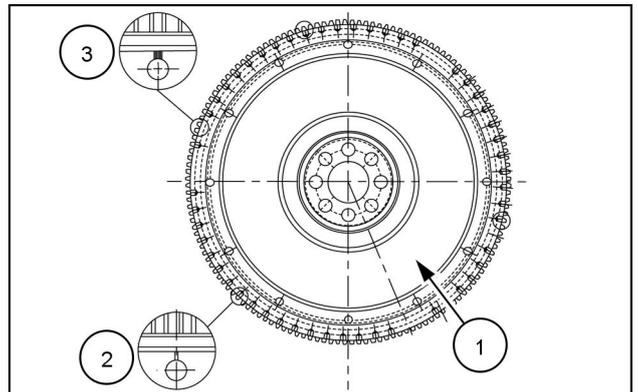
3. The exact position of piston number one at TDC is obtained when the tool **380000150** (**1**) can be inserted through the hole (**2**) of the flywheel speed sensor and engage the hole (**3**) in the engine flywheel (**4**).
4. Remove the tool **380000150** (**1**).



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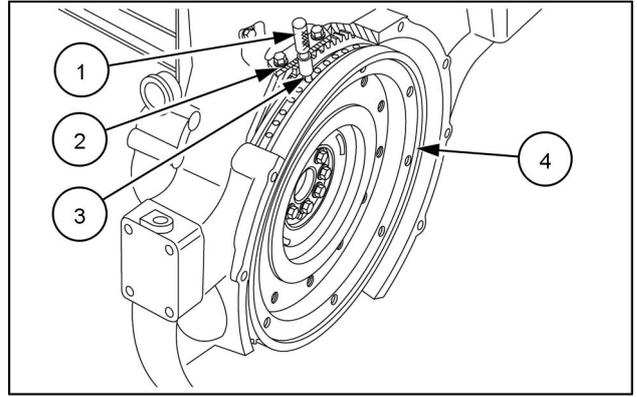
For engines with a partial flywheel housing

1. Remove the flywheel speed sensor.
2. Use the tool **380002958** to rotate the engine flywheel (**1**) in the direction of normal rotation until you see the hole with two reference marks (**3**) through the hole for the flywheel speed sensor.
3. Continue to turn the flywheel until the following hole with one reference mark (**2**) can be seen. This marks TDC of the number one cylinder.



NHIL13ENG1171AA 3

4. The exact position of piston number one at TDC is obtained when the tool **380000150 (1)** can be inserted through the hole **(2)** of the flywheel speed sensor and engage the hole **(3)** in the engine flywheel **(4)**.
5. Remove the tool **380000150 (1)**.



NHIL13ENG1231AA 4

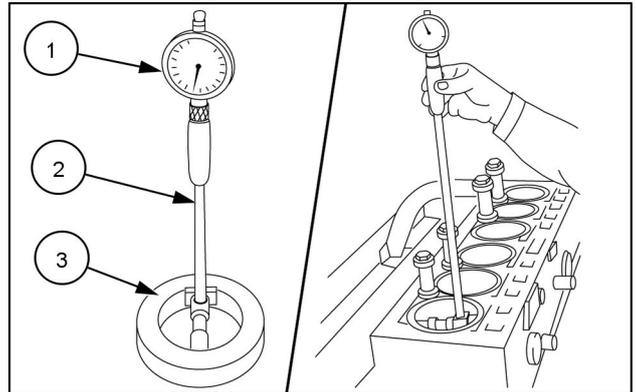
Crankcase Liner - Measure

Prior operation:

Crankcase Liner - Remove (10.001)

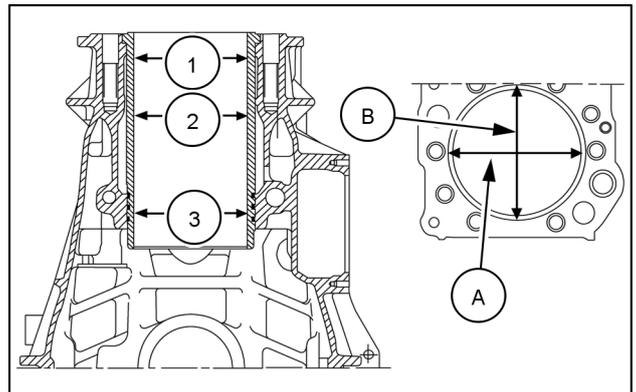
1. The internal diameter of the cylinder liner is checked for ovalization, taper, and wear, using a bore dial (1) centesimal gauge (2) previously set to ring gauge (3), which has a diameter of 135 mm (5.315 in).

NOTE: If a 135 mm (5.315 in) is not available, it is acceptable to use a micrometer.



NHIL13ENG1188AA 1

2. The measurements have to be made on each single cylinder liner at three different heights and in two different positions perpendicular to each other as shown in the figure.



NHIL13ENG1189AA 2

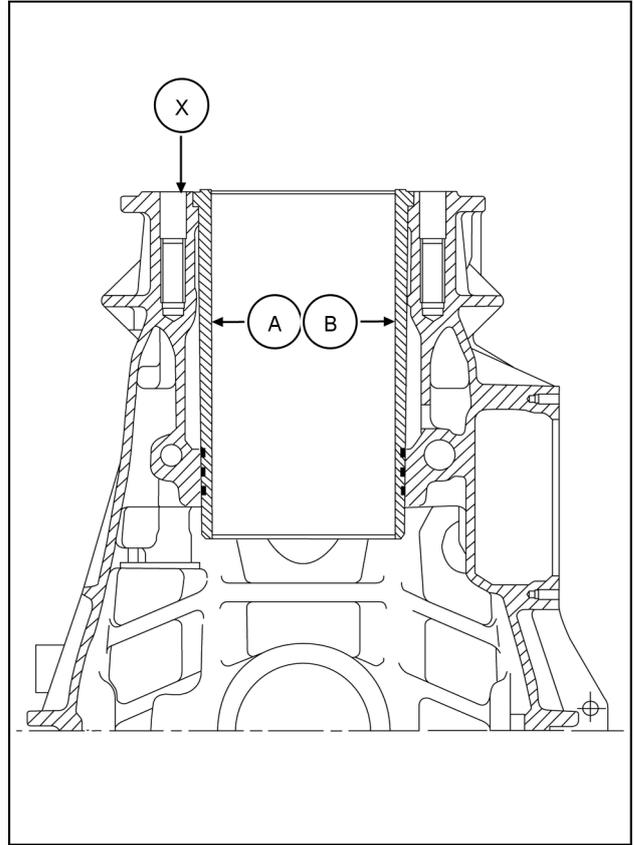
3. Upon finding a maximum wear value greater than **0.150 mm (0.006 in)** or maximum ovalization value greater than **0.100 mm (0.004 in)** as compared to the values in the following table, you need to replace the cylinder liner. No grinding, facing, or reconditioning is permitted.

4. Selection Class

- A = **135.000 - 135.012 mm (5.3150 - 5.3154 in)**.
- B = **135.011 - 135.023 mm (5.3154 - 5.3159 in)**.

NOTE: The cylinder liners are supplied as spare parts with selection class "A".

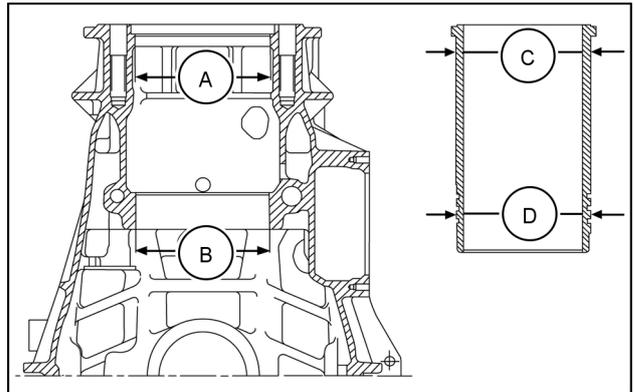
"X" - Indicates the location of the marking that designates the selection class.



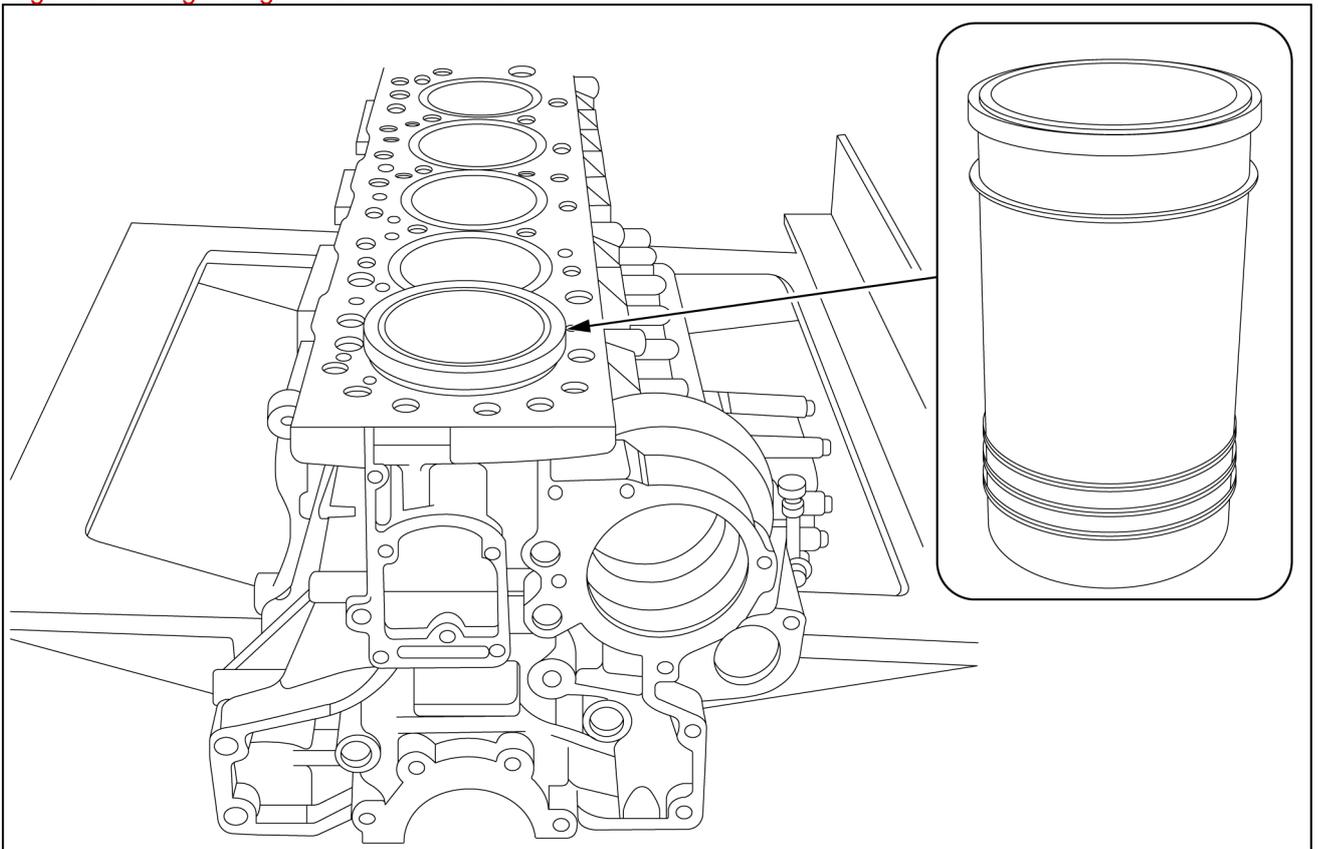
NHIL13ENG1261BA 3

5. The diagram shown in the figure gives the outside diameter of the cylinder liner and the inside diameter of its seat. The cylinder liners can, if necessary, be extracted and installed several times in different seats.

- A = **153.500 - 153.525 mm (6.0433 - 6.0443 in)**.
- B = **152.000 - 152.025 mm (5.9843 - 5.9852 in)**.
- C = **153.461 - 153.486 mm (6.0418 - 6.0428 in)**.
- D = **151.890 - 151.915 mm (5.9799 - 5.9809 in)**.

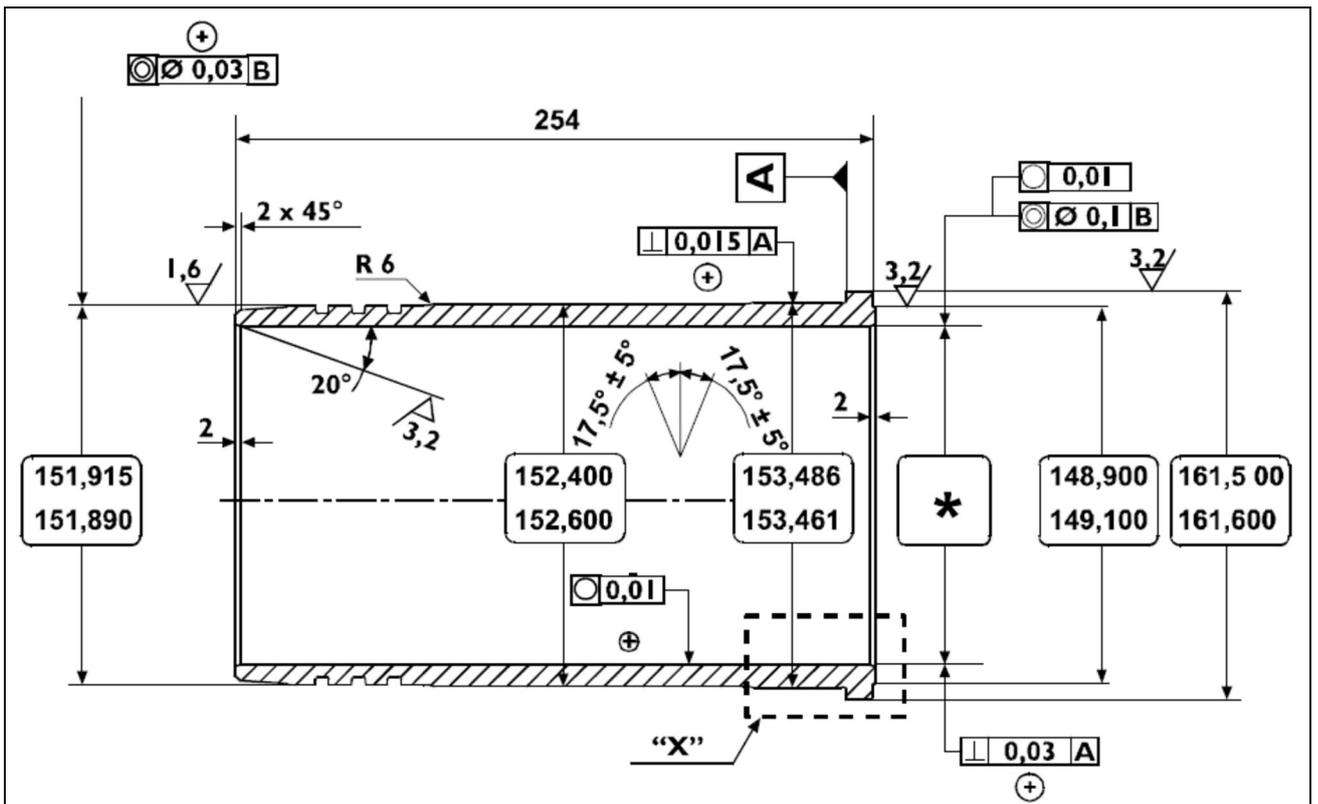


NHIL13ENG1190AA 4



NHIL13ENG1312FA 5

Crankcase Assembly With Cylinder Liners



LINERDATA 6

Main Cylinder Liner Data