

Product: CNH Cursor? 16 SST Tier 4B (final) and Stage IV Engine Service Repair Manual

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SERVICE MANUAL

Cursor® 16 SST Tier 4B (final) and Stage IV Engine

See the following page for engine model numbers



Part number 47609713

1st edition English

September 2015

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SERVICE MANUAL

**F3JFE613A*B001 , F3JFE613A*B002 , F3JFE613A*B003 , F3JFE613A*B004 ,
F3JFE613A*B005 , F3JFE613B*B006 , F3JFE613C*B001 , F3JFE613C*B002**

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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 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.

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

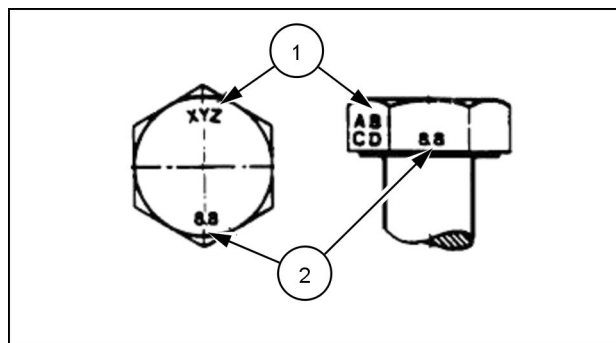
METRIC NON-FLANGED HARDWARE

| 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.

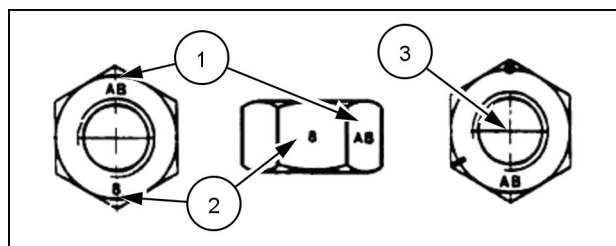
METRIC FLANGED HARDWARE

| 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.

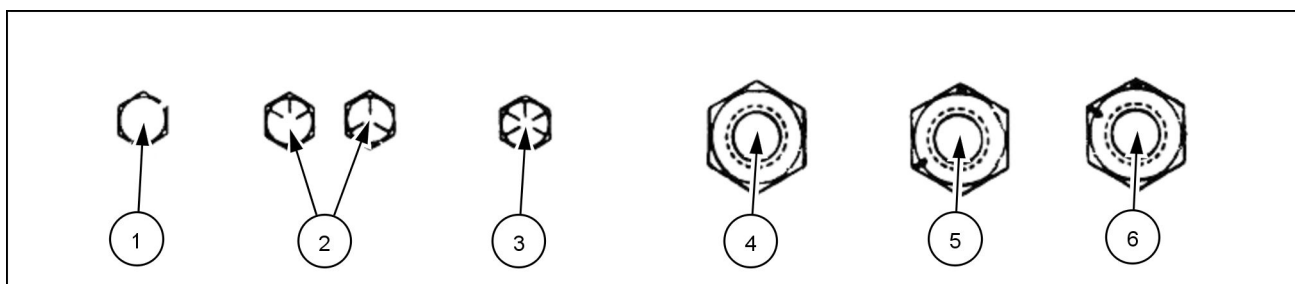
INCH NON-FLANGED HARDWARE

| 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

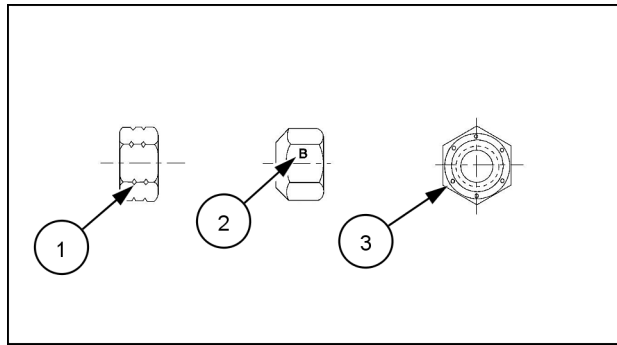
| NOM- INAL SIZE | SAE GRADE 5 BOLT and NUT | | SAE GRADE 8 BOLT and NUT | | LOCKNUT GrF W/ Gr5 BOLT | LOCKNUT GrG W/ Gr8 BOLT |
|----------------------|---------------------------------|--------------------------|---------------------------------|--------------------------|-------------------------------|-------------------------------|
| | 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**

20083682 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

**F3JFE613A*B001 , F3JFE613A*B002 , F3JFE613A*B003 , F3JFE613A*B004 ,
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Engine - 10

Engine and crankcase - 001

**F3JFE613A*B001 , F3JFE613A*B002 , F3JFE613A*B003 , F3JFE613A*B004 ,
F3JFE613A*B005 , F3JFE613B*B006 , F3JFE613C*B001 , F3JFE613C*B002**

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Engine and crankcase - 001

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DIAGNOSTIC

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Engine - Service limits

| Engine specifications | |
|--|---|
| Compression ratio | 16.5 : 1 |
| Bore | 141 mm (5.55 in) |
| Stroke | 170 mm (6.69 in) |
| Displacement | 15927 cm³ |
| Turbocharging | Inter-cooled, Direct injection |
| Turbocharger type | HTT GT 50 |
| Lubrication | Forced by gear pump, relief valve single action |
| Oil pressure (Warm engine) | |
| - Idling | 2 bar (29 psi) |
| - Peak RPM | 4.5 bar (65.3 psi) |
| Cooling | Liquid cooled |
| Water pump control | Belt driven |
| Thermostat (Start of opening) | 83 °C (181 °F) |
| Intake valve timing | |
| - Opens before TDC | 17 ° |
| - Closes after BDC | 6 ° |
| Exhaust valve timing | |
| - Opens before BDC | 50 ° |
| - Closes after TDC | 9 ° |
| Valve lash setting (when engine is cold) | |
| - Intake | 0.35 mm (0.014 in) |
| - Exhaust | 0.55 mm (0.022 in) |
| Valve lash setting (when engine is warm) | |
| - Intake | 0.45 mm (0.018 in) |
| - Exhaust | 0.65 mm (0.026 in) |
| Firing order | 1 - 4 - 2 - 6 - 3 - 5 |
| Injection pressure | 2000 bar (29000 psi) |
| Injector calibration | 290 - 302 bar (4205 - 4379 psi) |
| Cylinder block and piston | |
| Bores for cylinder liners: | |
| - Upper | 155.85 - 156.15 mm (6.14 - 6.15 in) |
| - Lower | 154.48 - 154.50 mm (6.08 - 6.08 in) |
| Cylinder liners external diameter: | |
| - Upper | 156 mm (6.142 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 | 141 mm (5.551 in) |
| - Protrusion | 0.080 - 0.140 mm (0.003 - 0.006 in) |
| Pistons | |
| - Measuring dimension | 58 mm (2 in) |
| - External diameter (supplied as spares) | 136.800 - 138.800 mm (5.386 - 5.465 in) |
| - External diameter (production only) | 136.800 - 138.800 mm (5.386 - 5.465 in) |
| - Pin bore | 62 - 62.008 mm (2.44094 - 2.44126 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 | 62 mm (2.441 in) |
| Piston pin OD - pin bore | 0.010 - 0.024 mm (0.0004 - 0.0009 in) |
| Piston ring grooves | |
| - Top | 2.480 - 2.510 mm (0.098 - 0.099 in) |

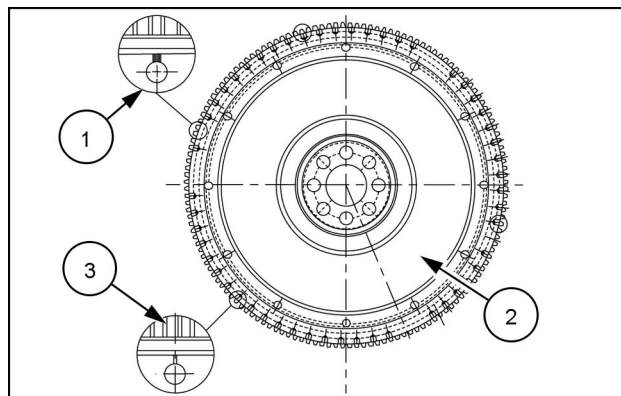
| | |
|--|---|
| - Middle | 2.50 mm (0.10 in) |
| - Bottom | 3.50 mm (0.14 in) |
| Piston rings | |
| - Combustion ring | 2.030 - 2.410 mm (0.080 - 0.095 in) |
| - Intermediate ring | 2.50 mm (0.10 in) |
| - Oil control ring | 3.50 mm (0.14 in) |
| Clearance between piston rings and grooves | |
| - Combustion 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 | 0.35 - 0.45 mm (0.01 - 0.02 in) |
| - Intermediate ring | 0.70 - 0.85 mm (0.03 - 0.03 in) |
| - Oil control ring | 0.40 - 0.60 mm (0.016 - 0.02 in) |
| Connecting rod | |
| Small end bush housing | |
| - Nominal | 67 mm (2.638 in) |
| Big end bearing housing | |
| - Nominal | 109.987 - 110.013 mm (4.330 - 4.331 in) |
| - Class 1 | 109.987 - 109.996 mm (4.330 - 4.331 in) |
| - Class 2 | 109.997 - 110.005 mm (4.331 - 4.331 in) |
| - Class 3 | 110.006 - 110.013 mm (4.331 - 4.331 in) |
| Small end bush diameter | |
| - Outside | 67.120 - 67.160 mm (2.643 - 2.644 in) |
| - Inside | 62.072 - 62.087 mm (2.444 - 2.444 in) |
| Big end bearing shell thickness | |
| - Red | 2.453 - 2.463 mm (0.097 - 0.097 in) |
| - Green | 2.463 - 2.473 mm (0.097 - 0.097 in) |
| - Yellow | 2.473 - 2.483 mm (0.097 - 0.098 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 | 6763 - 6839 g (239 - 241 oz) |
| - Class B | 6840 - 6915 g (241 - 244 oz) |
| - Class C | 6916 - 6991 g (244 - 247 oz) |
| Maximum connecting rod axis misalignment tolerance | 0.08 mm (0.003 in) |
| Crankshaft | |
| Main journals | |
| - Rated value | 119.970 - 120.000 mm (4.723 - 4.724 in) |
| - Class 1 | 119.970 - 119.979 mm (4.724 - 4.724 in) |
| - Class 2 | 119.980 - 119.989 mm (4.724 - 4.724 in) |
| - Class 3 | 119.990 - 120.000 mm (4.724 - 4.724 in) |
| Crankpins | |
| - Class 1 | 104.970 - 104.979 mm (4.133 - 4.133 in) |
| - Class 2 | 104.980 - 104.989 mm (4.133 - 4.133 in) |
| - Class 3 | 104.990 - 105.000 mm (4.133 - 4.134 in) |
| Main bearing shells | |
| - Red | 2.955 - 2.965 mm (0.116 - 0.117 in) |
| - Green | 2.965 - 2.975 mm (0.117 - 0.117 in) |
| - Yellow | 2.975 - 2.985 mm (0.117 - 0.118 in) |
| Main bearing housings | |
| - Rated value | 119.970 - 120.000 mm (4.723 - 4.724 in) |
| - Class 1 | 119.970 - 119.979 mm (4.724 - 4.724 in) |
| - Class 2 | 119.980 - 119.989 mm (4.724 - 4.724 in) |

| | |
|--|--|
| - Class 3 | 119.990 - 120.000 mm (4.724 - 4.724 in) |
| Clearance between bearing shells and main journals | 0.070 - 0.110 mm (0.003 - 0.004 in) |
| Clearance between bearing shells and big ends | 0.060 - 0.100 mm (0.002 - 0.004 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 | 3.350 - 3.400 mm (0.132 - 0.134 in) |
| Crankshaft end play | 0.10 - 0.30 mm (0.0039 - 0.0118 in) |
| Main journals and crankpins | |
| - Alignment | Less than or equal to 0.025 mm (0.0010 in) |
| - Ovalization | 0.012 mm (0.00047 in) |
| - Taper | 0.011 mm (0.00043 in) |
| Cylinder head and valve train | |
| Valve guide housing in cylinder head | 16.000 - 16.020 mm (0.630 - 0.631 in) |
| Valve guide | |
| - Inside diameter | 9.100 - 9.300 mm (0.358 - 0.366 in) |
| - Outside diameter | 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 | 9.960 - 9.975 mm (0.392 - 0.393 in) |
| - Valve face angle | 60 ° |
| Exhaust valves | |
| - Valve stem diameter | 9.960 - 9.975 mm (0.392 - 0.393 in) |
| - Valve face angle | 60 ° |
| Clearance between valve guide and valve stem | 0.040 - 0.070 mm (0.0016 - 0.0028 in) |
| Valve seat in cylinder head. | |
| Intake | 49.18 - 49.22 mm (1.94 - 1.94 in) |
| Exhaust | 47.01 - 47.02 mm (1.85 - 1.85 in) |
| Outside diameter of valve seat | |
| - Intake | 49.260 - 49.275 mm (1.939 - 1.940 in) |
| - Exhaust | 47.060 - 47.075 mm (1.853 - 1.853 in) |
| Valve seat angle | |
| - Intake | 60 ° |
| - Exhaust | 60 ° |
| Recessing of the valves | |
| - Intake | 0.54 - 0.86 mm (0.021 - 0.034 in) |
| - Exhaust | 1.65 - 1.95 mm (0.065 - 0.077 in) |
| Clearance between valve seat and cylinder head | |
| - Intake | 0.040 - 0.090 mm (0.0016 - 0.0035 in) |
| - Exhaust | 0.040 - 0.090 mm (0.0016 - 0.0035 in) |
| Valve spring height | |
| No load | 76.00 mm (2.99 in) |
| 736 - 814 N (165 - 183 lb) load | 59 mm (2.323 in) |
| 1298 - 1434 N (292 - 322 lb) load | 45 mm (1.772 in) |
| Injector protrusion | 1.6 mm (0.1 in) |
| Camshaft bushing housing in the cylinder head | 88.020 - 88.050 mm (3.465 - 3.467 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 | 7.844 mm (0.309 in) |
| - Exhaust lobe | 9.419 mm (0.371 in) |
| Diameter of the rocker shaft | 41.984 - 42.000 mm (1.6529 - 1.6535 in) |

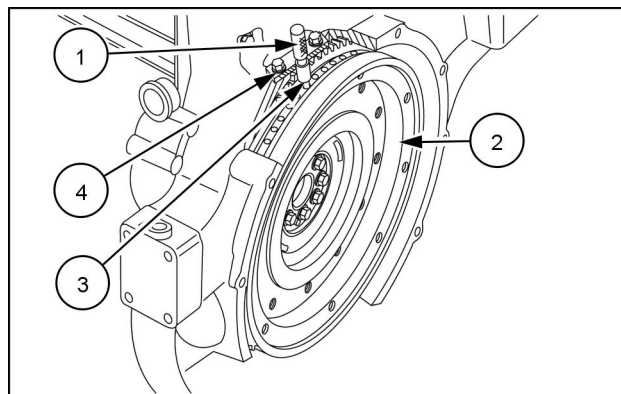
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| Housing in the rocker arms | |
| - Intake | 42.045 - 42.061 mm (1.655 - 1.656 in) |
| - Exhaust | 59.000 - 59.019 mm (2.3228 - 2.3236 in) |
| Bushing outside diameter for rocker arms | |
| - Intake | — |
| - Exhaust | 59.070 - 59.140 mm (2.326 - 2.3283 in) |
| Bushing inside diameter for rocker arms | |
| - Intake | — |
| - Exhaust | 56.030 - 56.049 mm (2.2059 - 2.2067 in) |
| Clearance between bushings and housings | |
| - Intake | — |
| - Exhaust | 0.051 - 0.110 mm (0.002 - 0.004 in) |
| Clearance between bushings of rocker arms and shaft | |
| - Intake | — |
| - Exhaust | 0.030 - 0.068 mm (0.001 - 0.003 in) |

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

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



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

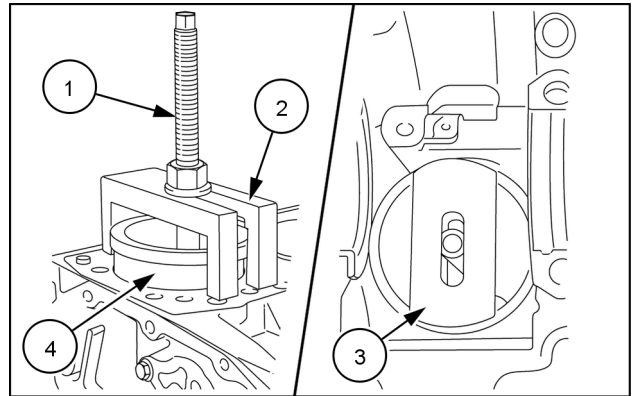


Crankcase Liner - Remove

Prior operation:

Connecting rod and piston - Remove (10.105)

1. Use tool **380000366** (2) in conjunction with tool **380000116** (3) as shown in the figure.
2. Check to make sure the plate (3) rests on the cylinder liner correctly.
3. Tighten the nut of the screw (1) to extract the cylinder liner (4) from the crankcase.



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Next operation:

Crankcase Liner - Measure (10.001)

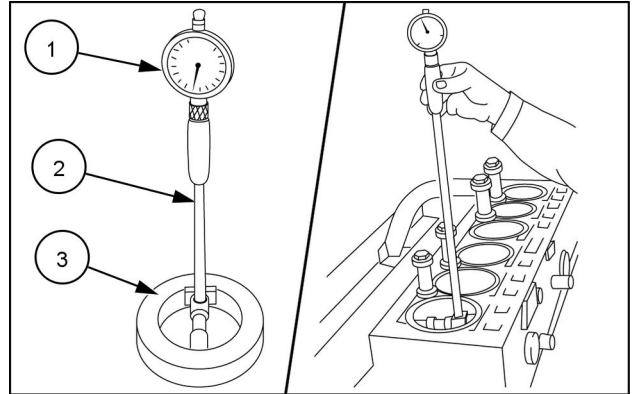
Crankcase Liner - Measure

Prior operation:

Crankcase Liner - Remove (10.001)

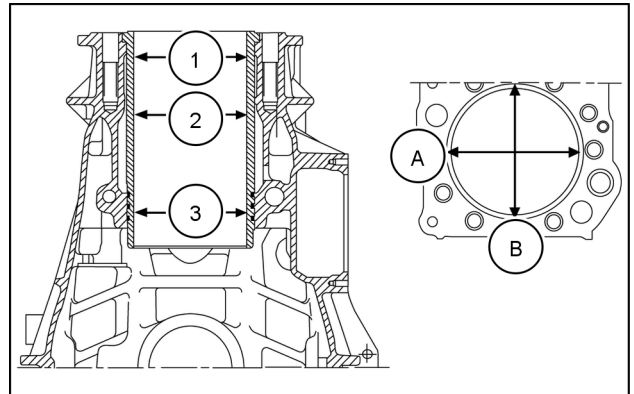
1. The internal diameter of the cylinder liner is checked for ovalization, taper, and wear, with a bore dial (1) centesimal gauge (2) previously set to ring gauge (3), which has a diameter of **141 mm (5.551 in)**.

NOTE: If a **141 mm (5.551 in)** is not available, it is acceptable to use a micrometer.



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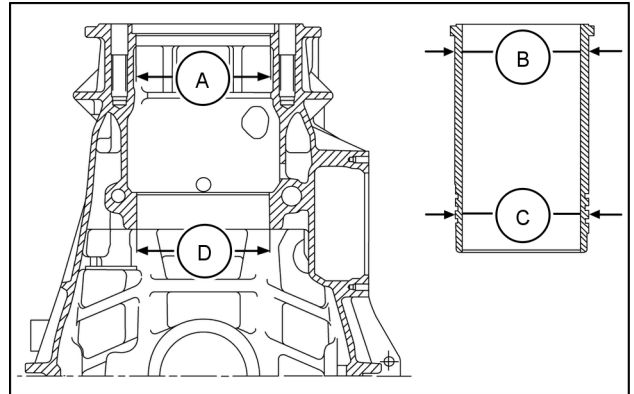
2. The measurements have to be made on each single cylinder liner at three different heights and in two different positions perpendicular to each other as shown in the figure.
3. Upon finding a maximum wear value greater than **0.150 mm (0.006 in)** or maximum ovalization value greater than **0.100 mm (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.



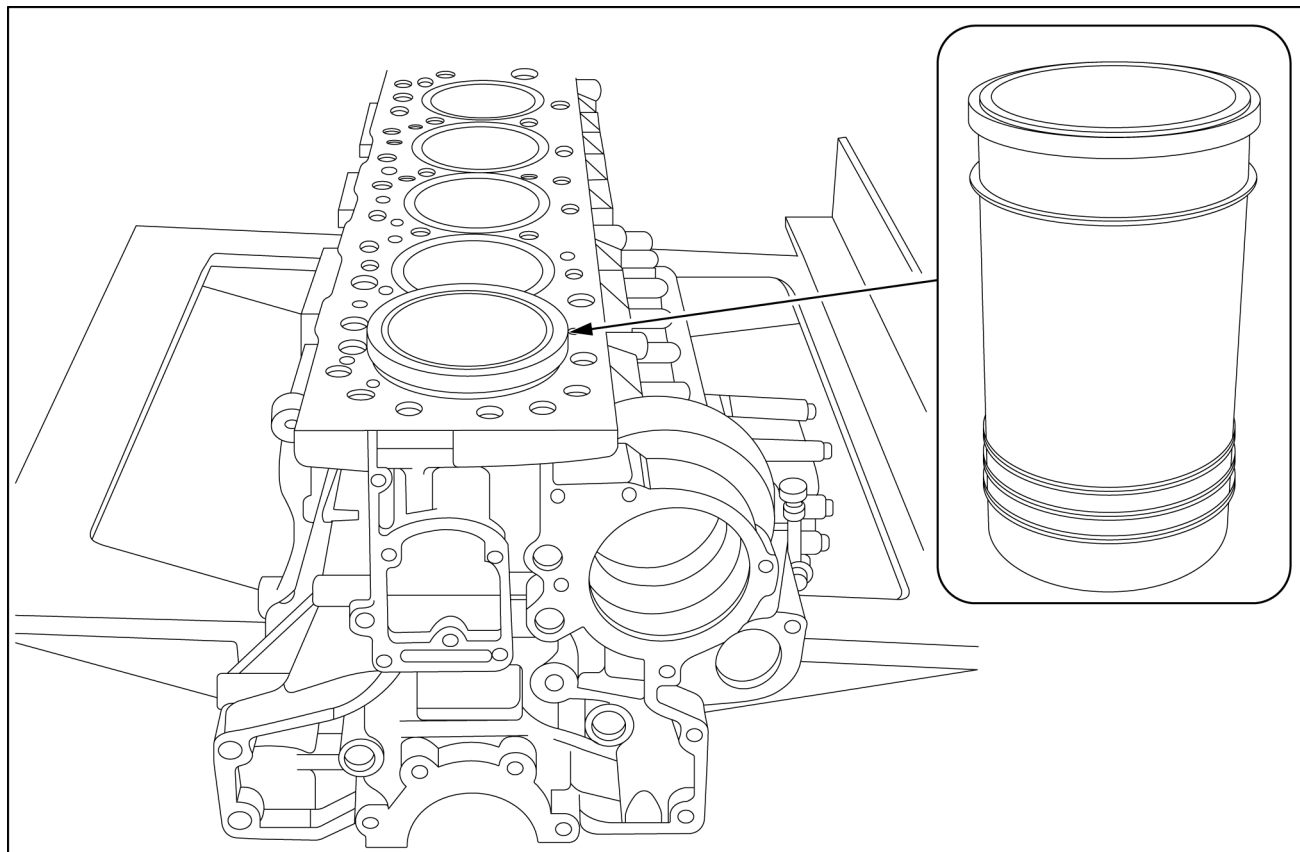
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4. The diagram shown in the figure gives the outside diameter of the cylinder liner and the inside diameter of its seat. The cylinder liners can, if necessary, be extracted and installed several times in different seats.

- (A) = **155.85 - 156.15 mm (6.14 - 6.15 in)**
- (B) = **154.85 - 155.15 mm (6.10 - 6.11 in)**
- (C) = **153.85 - 154.15 mm (6.06 - 6.07 in)**
- (D) = **154.48 - 154.50 mm (6.08 - 6.08 in)**



NHIL13ENG1190AA 3



NHIL13ENG1312FA 4

Crankcase Assembly With Cylinder Liners



Main Cylinder Liner Data