

# SERVICE MANUAL

## Cursor<sup>®</sup> I3 Two Stage Turbocharger Tier 4B (final) and Stage IV Engine

*See the following page for engine model numbers*



## **SERVICE MANUAL**

**F3DFE613F\*B001 , F3DFE613F\*B002 , F3DFE613G\*B001 , F3DFE613G\*B002 ,  
F3DFE613J\*B001 , F3DFE613J\*B002**

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## INTRODUCTION

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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.



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## 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

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## Basic instructions - Shop and assembly

### Shimming

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

### Rotating shaft seals

For correct rotating shaft seal installation, proceed as follows:

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

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

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

### O-ring seals

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

### Sealing compounds

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

### Spare parts

Only use CNH Original Parts or CNH Original Parts.

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

When ordering spare parts, always provide the following information:

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

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## 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.**

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## 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

## 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)

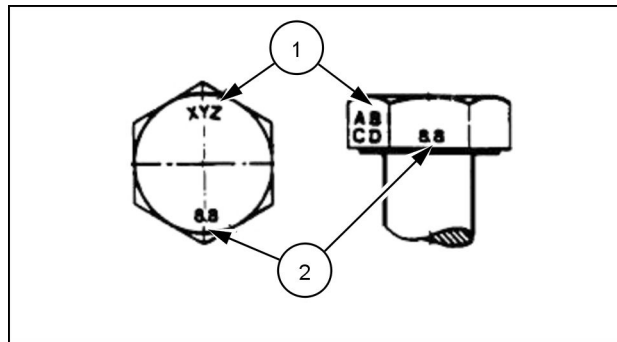
**NOTE:** M4 through M8 hardware torque specifications are shown in pound-inches. M10 through M24 hardware torque specifications are shown in pound-feet.

**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**

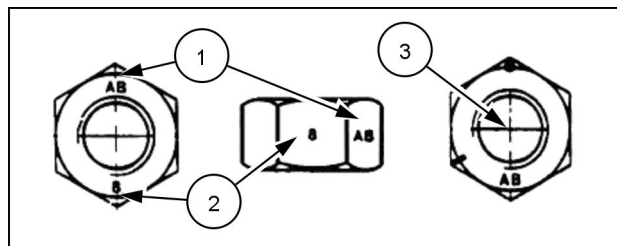
**Metric Hex head and carriage bolts, classes 5.6 and up**



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)

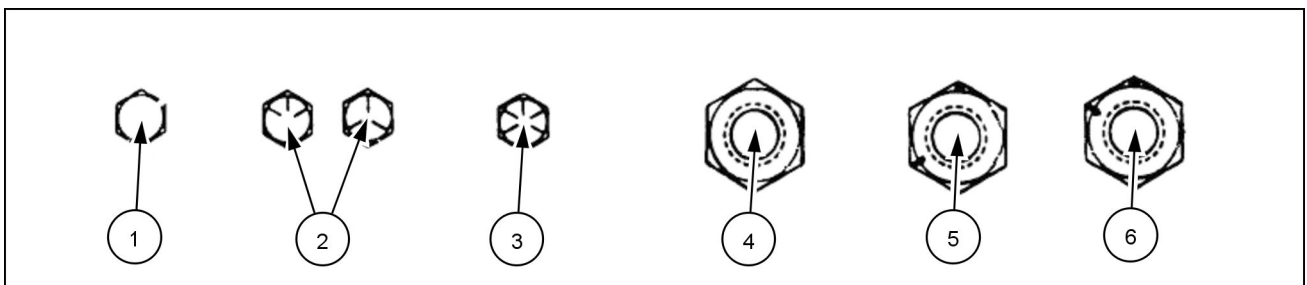
**NOTE:** For Imperial Units, *1/4 in* and *5/16 in* hardware torque specifications are shown in pound-inches. *3/8 in* through *1 in* hardware torque specifications are shown in pound-feet.

**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**

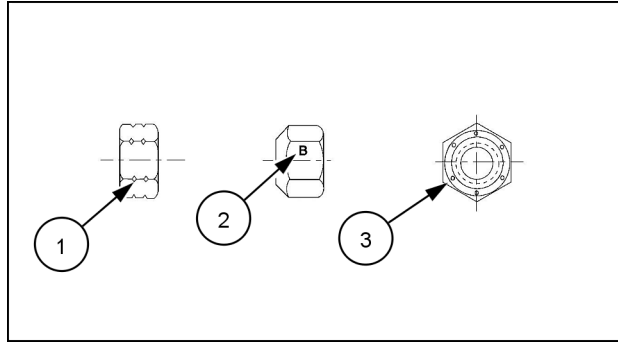


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**Grade Marking Examples**

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





## **SERVICE MANUAL**

### **Engine**

**F3DFE613F\*B001 , F3DFE613F\*B002 , F3DFE613G\*B001 , F3DFE613G\*B002 ,  
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## **Engine - 10**

### **Engine and crankcase - 001**

**F3DFE613F\*B001 , F3DFE613F\*B002 , F3DFE613G\*B001 , F3DFE613G\*B002 ,  
F3DFE613J\*B001 , F3DFE613J\*B002**

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## Engine - Service limits

<b>Engine specifications</b>	
Compression Ratio	15.5 : 1
Bore	<b>135 mm (5.3 in)</b>
Stroke	<b>150 mm (5.9 in)</b>
Displacement	<b>12880 cm<sup>3</sup></b>
Turbocharging	Inter-cooled, Direct injection
Turbocharger type	HONEYWELL HP Twin Stage Turbo (TST) T4
Lubrication	Forced by gear pump, relief valve single action
Oil Pressure (Warm engine)	
- Idling	<b>3 bar (43.5 psi)</b>
- Peak RPM	<b>4.5 bar (65.3 psi)</b>
Cooling	Liquid cooled
Water pump control	Belt driven
Thermostat (Start of opening)	<b>82 - 86 °C (180 - 187 °F)</b>
Intake valve timing	
- Opens before TDC	<b>17 °</b>
- Closes after BDC	<b>6 °</b>
Exhaust valve timing	
- Opens before BDC	<b>50 °</b>
- Closes after TDC	<b>9 °</b>
Valve lash setting (when engine is cold)	
- Intake	<b>0.4 mm (0.016 in)</b>
- Exhaust	<b>0.6 mm (0.024 in)</b>
Firing Order	1 - 4 - 2 - 6 - 3 - 5
Injection pressure	-
Injector calibration	<b>290 - 302 bar (4205 - 4379 psi)</b>
<b>Cylinder block and piston</b>	
Bores for cylinder liners:	
- Upper	<b>153.500 - 153.525 mm (6.043 - 6.044 in)</b>
- Lower	<b>152.000 - 152.025 mm (5.984 - 5.985 in)</b>
Cylinder liners external diameter:	
- Upper	<b>153.461 - 153.486 mm (6.042 - 6.043 in)</b>
- Lower	<b>151.890 - 151.915 mm (5.980 - 5.981 in)</b>
Cylinder liner length	<b>252.2 mm (9.9 in)</b>
Clearance between the OD of liners and ID of bores	
- Upper	<b>0.014 - 0.064 mm (0.001 - 0.003 in)</b>
- Lower	<b>0.085 - 0.135 mm (0.003 - 0.005 in)</b>
Cylinder liner	
- inside diameter	<b>135.000 - 135.020 mm (5.315 - 5.316 in)</b>
- Protrusion	<b>0.045 - 0.075 mm (0.002 - 0.003 in)</b>
Pistons	
- Measuring dimension	<b>50 mm (2.0 in)</b>
- External diameter	<b>134.903 - 134.933 mm (5.311 - 5.312 in)</b>
- Pin bore	<b>59.063 - 59.093 mm (2.325 - 2.326 in)</b>
Piston - cylinder liner	<b>0.0675 - 0.117 mm (0.003 - 0.005 in)</b>
Piston pin diameter	<b>58.993 - 59.000 mm (2.323 - 2.323 in)</b>
Piston pin - pin housing	<b>0.063 - 0.100 mm (0.002 - 0.004 in)</b>
Piston ring grooves	
- Top	<b>2.480 - 2.510 mm (0.098 - 0.099 in)</b>
- Middle	<b>2.580 - 2.610 mm (0.102 - 0.103 in)</b>
- Bottom	<b>4.050 - 4.080 mm (0.159 - 0.161 in)</b>
Piston rings	
- Combustion ring	<b>2.296 - 2.330 mm (0.090 - 0.092 in)</b>

- Intermediate ring	2.470 - 2.500 mm (0.097 - 0.098 in)
- Oil control ring	3.970 - 3.990 mm (0.156 - 0.157 in)
Clearance between piston rings and grooves	
- Combustion ring	0.150 - 0.214 mm (0.006 - 0.008 in)
- Intermediate ring	0.080 - 0.140 mm (0.003 - 0.006 in)
- Oil control ring	0.060 - 0.110 mm (0.002 - 0.004 in)
Piston ring end gap in cylinder liners	
- Combustion ring	0.35 - 0.45 mm (0.014 - 0.018 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)
<b>Connecting rod</b>	
Small end bush housing	
- Nominal	63.000 - 63.030 mm (2.480 - 2.481 in)
Big end bearing housing	
- Nominal	100.000 - 100.030 mm (3.937 - 3.938 in)
- Class 1	100.000 - 100.010 mm (3.937 - 3.937 in)
- Class 2	100.011 - 100.020 mm (3.937 - 3.938 in)
- Class 3	100.021 - 100.030 mm (3.938 - 3.938 in)
Small end bush diameter	
- Outside	63.120 - 63.160 mm (2.485 - 2.487 in)
- Inside	59.060 - 59.076 mm (2.325 - 2.326 in)
Big end bearing shell thickness	
- Red	1.960 - 1.970 mm (0.077 - 0.078 in)
- Green	1.971 - 1.980 mm (0.078 - 0.078 in)
- Yellow	1.981 - 1.990 mm (0.078 - 0.078 in)
Interference between small end bushing and housing	0.090 - 0.160 mm (0.004 - 0.006 in)
Clearance between piston pin and bushing	0.060 - 0.073 mm (0.002 - 0.003 in)
Connecting rod weight	
- Class A	5537 - 5570 g (195.3 - 196.5 oz)
- Class B	5571 - 5604 g (196.5 - 197.7 oz)
- Class C	5605 - 5637 g (197.7 - 198.8 oz)
Maximum connecting rod axis misalignment tolerance at 125 mm (4.9 in) distance from connecting rod	0.08 mm (0.003 in)
<b>Crankshaft</b>	
Main journals	
- Rated value	109.970 - 110.000 mm (4.330 - 4.331 in)
- Class 1	109.970 - 109.930 mm (4.330 - 4.328 in)
- Class 2	109.981 - 109.990 mm (4.330 - 4.330 in)
- Class 3	109.991 - 110.000 mm (4.330 - 4.331 in)
Crank pins	
- Rated value	95.970 - 96.000 mm (3.778 - 3.780 in)
- Class 1	95.970 - 95.980 mm (3.778 - 3.779 in)
- Class 2	95.981 - 95.990 mm (3.779 - 3.779 in)
- Class 3	95.991 - 96.000 mm (3.779 - 3.780 in)
Main bearing shells	
- Red	2.960 - 2.970 mm (0.117 - 0.117 in)
- Green	2.971 - 2.980 mm (0.117 - 0.117 in)
- Yellow	2.981 - 2.990 mm (0.117 - 0.118 in)
Main bearing housings	
- Rated value	116.000 - 116.030 mm (4.567 - 4.568 in)
- Class 1	116.000 - 116.010 mm (4.567 - 4.567 in)
- Class 2	116.011 - 116.020 mm (4.567 - 4.568 in)
- Class 3	116.021 - 116.030 mm (4.568 - 4.568 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	0.060 - 0.100 mm (0.002 - 0.004 in)

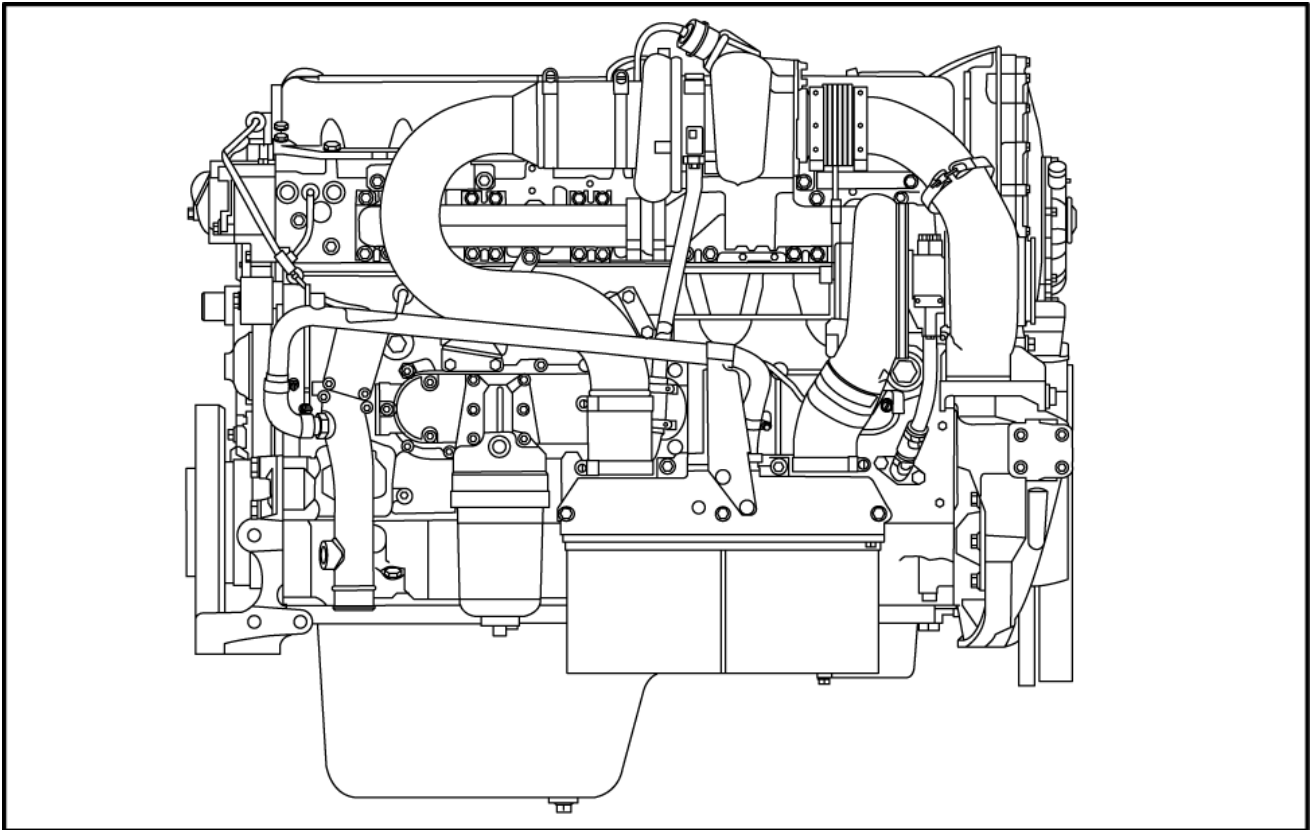
Width of thrust bearing main journal	47.95 - 48.00 mm (1.888 - 1.890 in)
Width of thrust bearing housing	40.94 - 40.99 mm (1.612 - 1.614 in)
Thrust bearing thickness	3.38 - 3.43 mm (0.133 - 0.135 in)
Crankshaft end play	0.10 - 0.30 mm (0.0039 - 0.0118 in)
Main journals and crankpins	
- Alignment	0.04 mm (0.0016 in)
- Ovalization	0.010 mm (0.0004 in)
- Taper	0.025 mm (0.0010 in)
<b>Cylinder head and valve train</b>	
Valve guide housing in cylinder head	15.980 - 15.997 mm (0.629 - 0.630 in)
Valve guide	
- Inside diameter	10.015 - 10.030 mm (0.394 - 0.395 in)
- Outside diameter	16.012 - 16.025 mm (0.630 - 0.631 in)
Interference between valve guides and 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	49.185 - 49.220 mm (1.936 - 1.938 in)
- Exhaust	46.985 - 47.020 mm (1.850 - 1.851 in)
Outside diameter of valve seat	
- Intake	49.260 - 49.275 mm (1.939 - 1.940 in)
- Exhaust	47.060 - 47.075 mm (1.8528 - 1.8533 in)
Valve seat angle	
- Intake	60 °
- Exhaust	60 °
Recessing of the valves	
- Intake	0.45 - 0.75 mm (0.018 - 0.030 in)
- Exhaust	1.65 - 1.95 mm (0.065 - 0.077 in)
Interference 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 mm (2.992 in)
- 775 N (174.2 lb +/-) 39 N (8.8 lb) load	59 mm (2.323 in)
- 1366 N (307.1 lb +/-) 68 N (15.3 lb) load	46 mm (1.811 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)
Interference between bushings and housings in the cylinder head	0.103 - 0.163 mm (0.004 - 0.006 in)
Clearance between bushings and bearing journals	0.050 - 0.135 mm (0.0020 - 0.0053 in)
Cam lift	
- Intake lobe	7.8441 mm (0.3088 in)
- Exhaust lobe	9.4196 mm (0.3709 in)
Diameter of the rocker shaft	41.984 - 42.000 mm (1.6529 - 1.6535 in)
Bushing 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	-

Engine - Engine and crankcase

- Exhaust Bushing inside diameter for rocker arms	<b>59.070 - 59.110 mm (2.326 - 2.327 in)</b>
- Intake	-
- Exhaust	<b>56.030 - 56.049 mm (2.2059 - 2.2067 in)</b>
Clearance between bushings and housings	-
- Intake	-
- Exhaust	<b>0.051 - 0.110 mm (0.002 - 0.004 in)</b>
Clearance between bushings of rocker arms and shaft	-
- Intake	-
- Exhaust	<b>0.030 - 0.068 mm (0.001 - 0.003 in)</b>
Engine brake control lever	
- Eccentric pin outer diameter	<b>55.981 - 56.000 mm (2.204 - 2.205 in)</b>
- Rocker arms shaft seat	<b>42.025 - 42.041 mm (1.655 - 1.655 in)</b>
- Interference between rocker arms and engine brake control lever pin	<b>0.030 - 0.068 mm (0.0012 - 0.0027 in)</b>
- Clearance between rocker arm and engine brake control lever	<b>0.025 - 0.057 mm (0.0010 - 0.0022 in)</b>

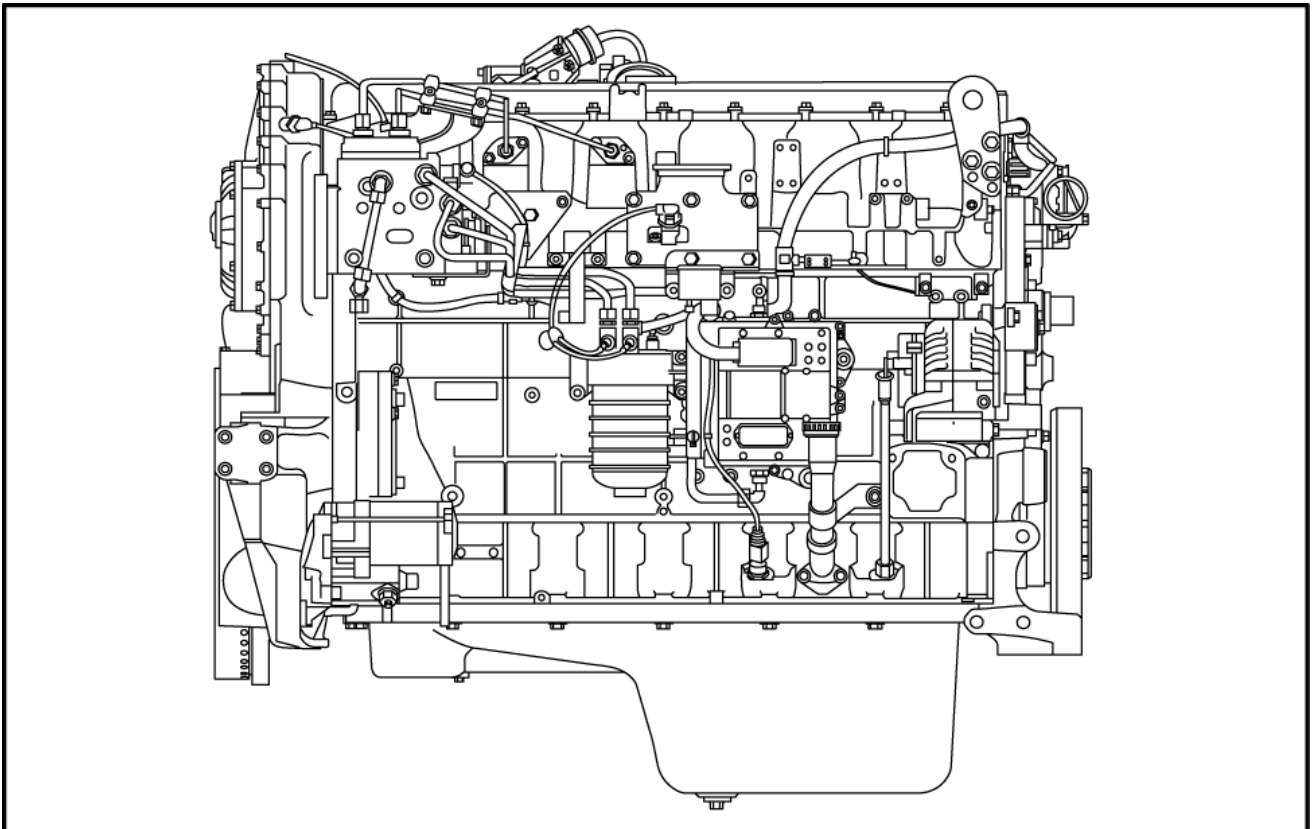


## Engine - Overview



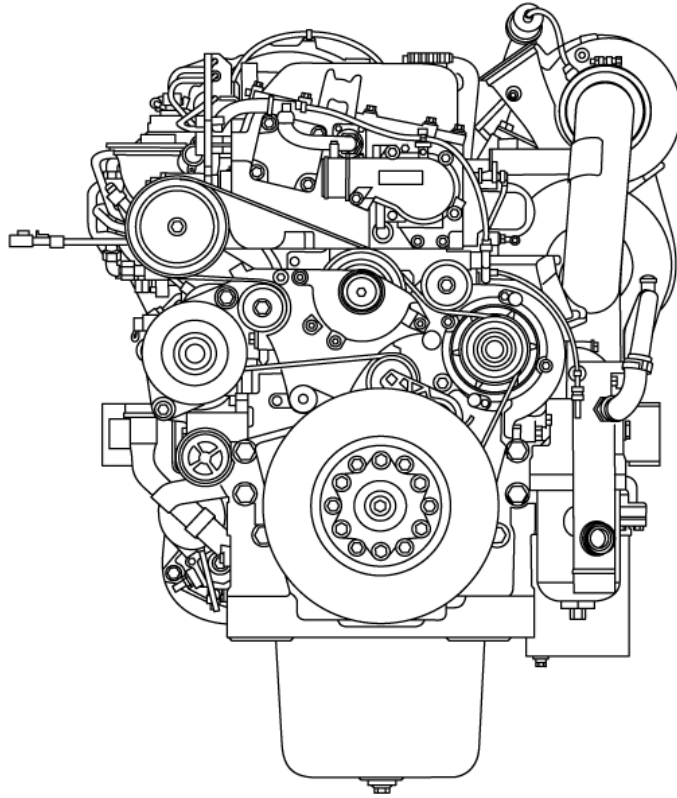
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**Left hand side view**



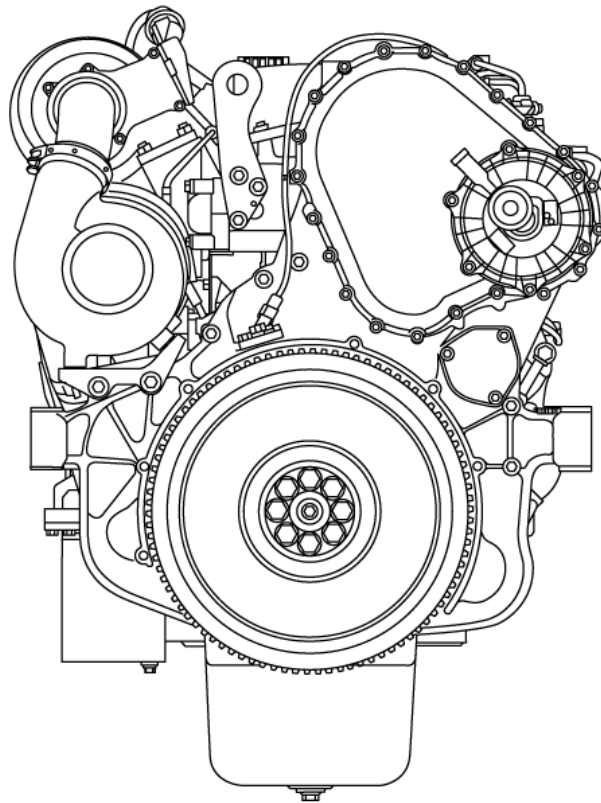
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**Right hand side view**



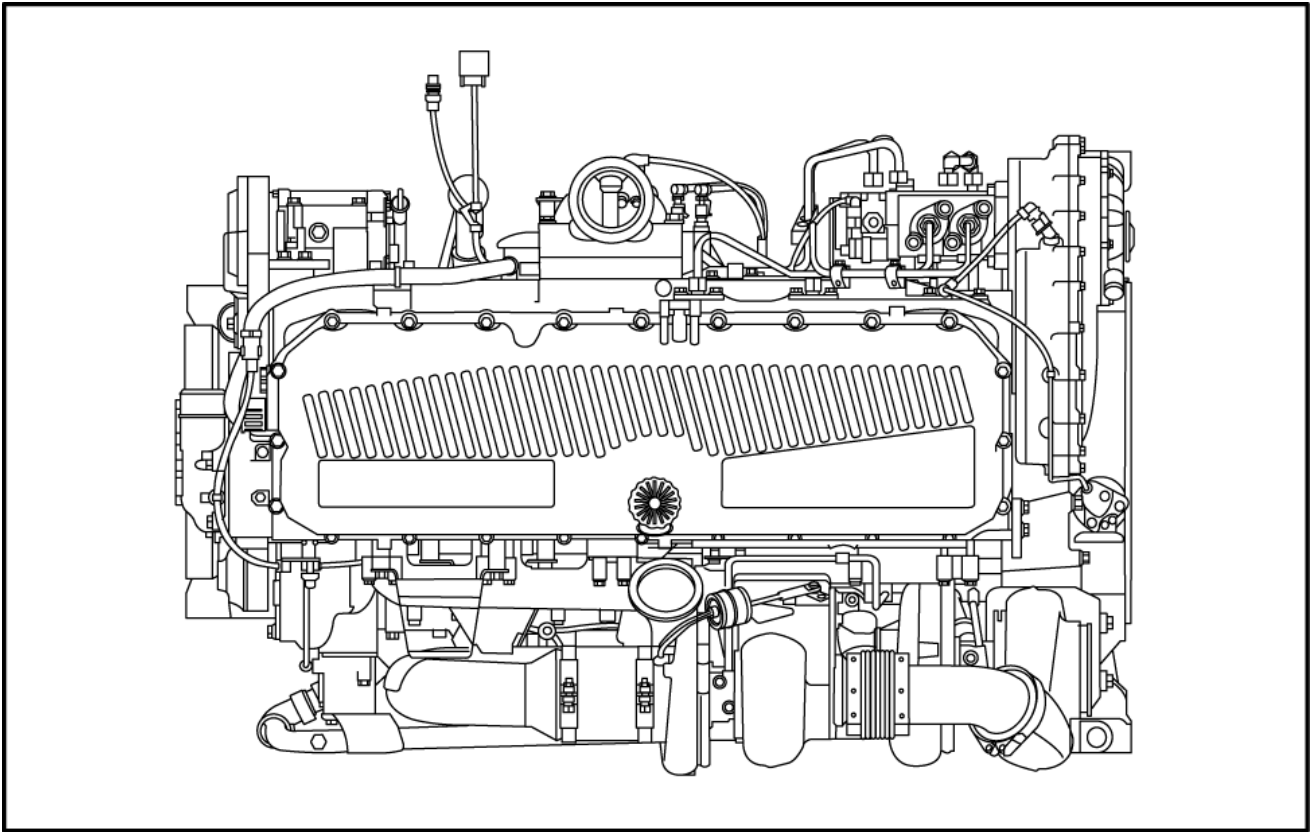
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**Front view**



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**Rear view**



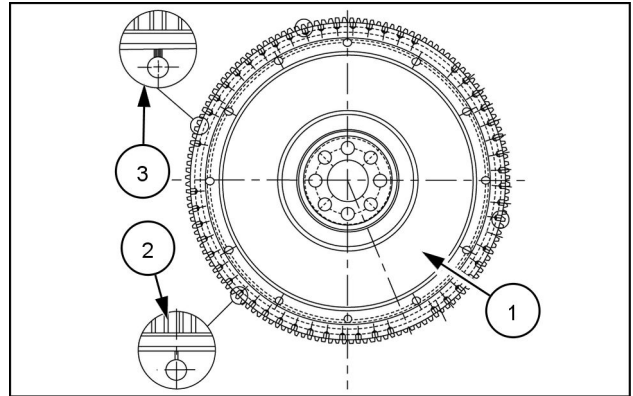
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**Top view**

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

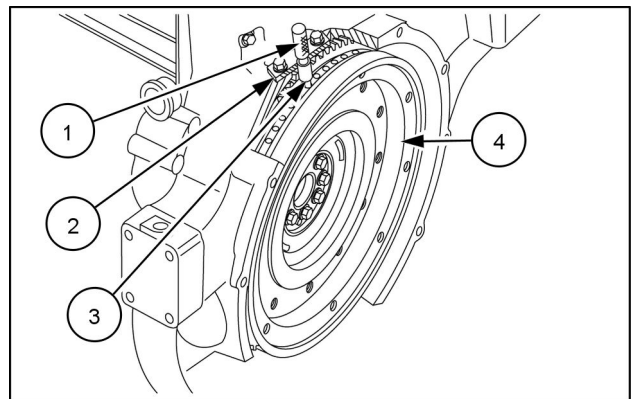
### For engines with a full flywheel housing

1. Use the tool **380000137** to 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 flywheel housing.
2. Continue to turn the flywheel until the following hole with one reference mark **(2)** can be seen. This marks Top Dead Center (TDC) of the number one cylinder.



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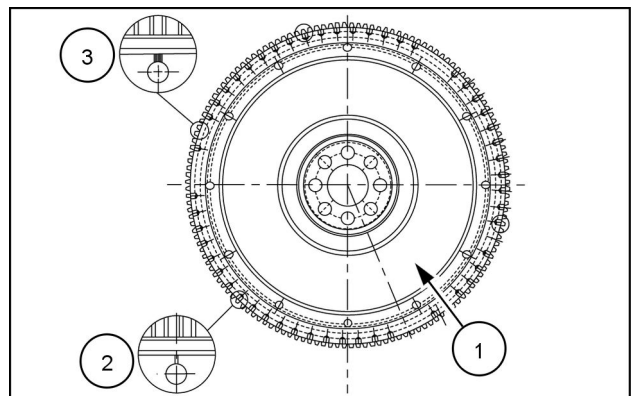
3. The exact position of piston number one at TDC is obtained when the tool **380000150** **(1)** can be inserted through the hole **(2)** of the flywheel speed sensor and engage the hole **(3)** in the engine flywheel **(4)**.
4. Remove the tool **380000150** **(1)**.



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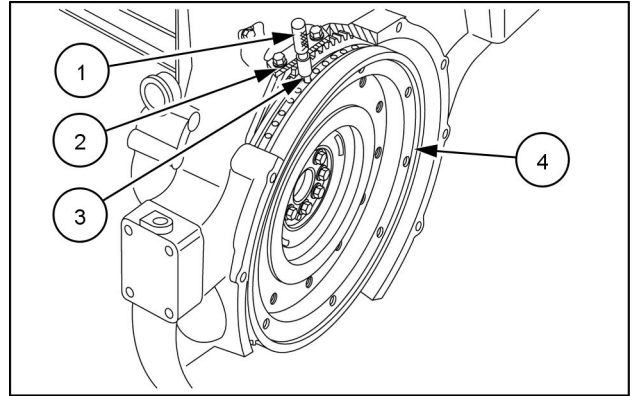
### For engines with a partial flywheel housing

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.



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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

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