

# SERVICE MANUAL

## **N843H / N843L / N843 / N844LT / N844L / N844T / N844 ISM Tier 3 Engine**

**Part number 47632248**

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# INTRODUCTION

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## INTRODUCTION

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### Foreword

This publication contains data, features instructions and methods for performing repair operations on the assembly and its components and is addressed to qualified, specialized personnel.

Check to make sure you have the right publication related to the component you are about to work on before you start. Make sure that you have all the necessary safety equipment: safety glasses, helmet, gloves, footwear, etc. Check that the working lifting and transport equipment is available and in working order. Make sure that vehicle is secured. Proceed by carefully observing the instructions contained in this publication and use the indicated specific tools to ensure correct repair procedures and safety of operators.

**NOTE:** *This manual applies to multiple applications, therefore images may not all be accurate.*

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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 information in this manual is up-to-date at the date of the publication. It is the policy of the manufacturer for continuous improvement. Some information could not be updated due to modifications of a technical or commercial type, or changes to the laws and regulations of different countries.

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

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## Safety rules

### Personal safety



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

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

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

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

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

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

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

### Machine safety

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

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

### Information

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

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

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## Safety rules - Ecology and the environment

Soil, air, and water are vital factors of agriculture and life in general. When legislation does not yet rule the treatment of some of the substances required by advanced technology, sound judgment should govern the use and disposal of products of a chemical and petrochemical nature.

**NOTE:** *The following are recommendations that may be of assistance:*

- Become acquainted with and ensure that you understand the relative legislation applicable to your country.
- Where no legislation exists, obtain information from suppliers of oils, filters, batteries, fuels, antifreeze, cleaning agents, etc., with regard to their effect on man and nature and how to safely store, use, and dispose of these substances.
- Agricultural consultants will, in many cases, be able to help you as well.

### Helpful hints

- Avoid filling tanks using cans or inappropriate pressurized fuel delivery systems that may cause considerable spillage.
- In general, avoid skin contact with all fuels, oils, acids, solvents, etc. Most of them 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 draining off used engine coolant mixtures, engine, gearbox and hydraulic oils, brake fluids, etc. Do not mix drained brake fluids or fuels with lubricants. Store them safely until they can be disposed of in a proper way to comply with local legislation and available resources.
- Modern coolant mixtures, i.e. antifreeze and other additives, should be replaced every two years. They should not be allowed to get into the soil, but should be collected and disposed of properly.
- Do not open the air-conditioning system yourself. It contains gases that should not be released into the atmosphere. Your CNH dealer or air conditioning specialist has a special extractor for this purpose and will have to recharge the system properly.
- Repair any leaks or defects in the engine cooling 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 as penetrating weld splatter may burn a hole or weaken them, allowing the loss of oils, coolant, etc.



# **SERVICE MANUAL**

## **Engine**

**N843H , N843L , N843 , N844LT , N844L , N844T , N844**

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## **Engine - 10**

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

**N843H , N843L , N843 , N844LT , N844L , N844T , N844**

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## Engine - 10

### Engine and crankcase - 001

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## Engine - General specification

| Engine model                                               | N843                                             | N843L                                             |
|------------------------------------------------------------|--------------------------------------------------|---------------------------------------------------|
| Number of cylinders                                        | 3                                                | 3                                                 |
| Bore x stroke                                              | <b>84 mm x 90 mm ( 3.31 in x 3.54 in)</b>        | <b>84 mm x 100 mm ( 3.31 in x 3.94 in)</b>        |
| Displacement                                               | <b>1496 cm<sup>3</sup> (91.3 in<sup>3</sup>)</b> | <b>1662 cm<sup>3</sup> (101.4 in<sup>3</sup>)</b> |
| Compression ratio                                          | 22:1                                             | 22.4:1                                            |
| Engine speed (Low idle no load)                            | <b>950 - 1050 RPM</b>                            | <b>950 - 1050 RPM</b>                             |
| Engine speed (High idle no load)                           | <b>3130 - 3180 RPM</b>                           | <b>3420 - 3500 RPM</b>                            |
| PTO engine horsepower                                      | <b>28.3 kW (38.5 Hp)</b>                         | <b>26.1 kW (35.5 Hp)</b>                          |
| Firing order                                               | 1-2-3                                            | 1-2-3                                             |
| Cylinder arrangement                                       | In-Line vertical                                 | In-Line vertical                                  |
| Valve arrangement                                          | Overhead                                         | Overhead                                          |
| Compression pressure at <b>200 RPM</b><br>(cylinder speed) | <b>2944 ± 345 kPa (427 ± 50 psi)</b>             | <b>2944 ± 345 kPa (427 ± 50 psi)</b>              |
| Variation between cylinders                                | <b>345 kPa (50 psi)</b>                          | <b>345 kPa (50 psi)</b>                           |

**NOTE:** If bore size exceeds **85.2 mm (3.3543 in)** replace with long block.

## Engine - General specification

| Engine model                                               | N844                                              | N844T                                             | N844L                                              | N844LT                                             |
|------------------------------------------------------------|---------------------------------------------------|---------------------------------------------------|----------------------------------------------------|----------------------------------------------------|
| Number of cylinders                                        | 4                                                 | 4                                                 | 4                                                  | 4                                                  |
| Bore x stroke                                              | <b>84 mm x 90 mm ( 3.31 in x 3.54 in)</b>         | <b>84 mm x 90 mm ( 3.31 in x 3.54 in)</b>         | <b>84 mm x 100 mm ( 3.31 in x 3.94 in)</b>         | <b>84 mm x 100 mm ( 3.31 in x 3.94 in)</b>         |
| Displacement                                               | <b>1995 cm<sup>3</sup> (121.7 in<sup>3</sup>)</b> | <b>1995 cm<sup>3</sup> (121.7 in<sup>3</sup>)</b> | <b>2216 cm<sup>3</sup> ( 135.2 in<sup>3</sup>)</b> | <b>2216 cm<sup>3</sup> ( 135.2 in<sup>3</sup>)</b> |
| Compression ratio                                          | 22:1                                              | 22:1                                              | 22.4:1                                             | 22.4:1                                             |
| Aspiration                                                 |                                                   |                                                   | Indirect naturally aspirated                       | Indirect turbocharged with waste gate              |
| Emissions control                                          |                                                   |                                                   | N/A                                                | Internal Exhaust Gas Recirculation (EGR)           |
| Engine speed (Low idle no load)                            | <b>900 - 1000 RPM</b>                             | <b>900 - 1000 RPM</b>                             | <b>1200 RPM +/- 50</b>                             | <b>1050 - 1150 RPM</b>                             |
| Engine speed (Rated - full load)                           |                                                   |                                                   | <b>2800 RPM</b>                                    |                                                    |
| Engine speed (High idle no load)                           | <b>3090 - 3190 RPM</b>                            | <b>3090 - 3190 RPM</b>                            | <b>3000 RPM +/- 40</b>                             | <b>3090 - 3190 RPM</b>                             |
| Horsepower @ <b>2800 RPM</b>                               | <b>29.8 kW (40.5 Hp)</b>                          | <b>38.8 kW (52.8 Hp)</b>                          | <b>35.9 kW (48.8 Hp)</b>                           | <b>44.1 kW (60.0 Hp)</b>                           |
| Peak torque @ <b>1800 RPM</b>                              |                                                   |                                                   | <b>143 N·m (105.5 lb ft)</b>                       | <b>171 N·m (126 lb ft)</b>                         |
| Firing order                                               | 1-3-4-2                                           | 1-3-4-2                                           | 1-3-4-2                                            | 1-3-4-2                                            |
| Cylinder arrangement                                       | In-Line vertical                                  | In-Line vertical                                  | In-Line vertical                                   | In-Line vertical                                   |
| Valve arrangement                                          | Overhead                                          | Overhead                                          | Overhead                                           | Overhead                                           |
| Compression pressure at <b>200 RPM</b><br>(cylinder speed) | <b>2944 ± 345 kPa (427 ± 50 psi)</b>              | <b>2944 ± 345 kPa (427 ± 50 psi)</b>              | <b>2944 ± 345 kPa (427 ± 50 psi)</b>               | <b>2944 ± 345 kPa (427 ± 50 psi)</b>               |
| Variation between cylinders                                | <b>345 kPa (50 psi)</b>                           | <b>345 kPa (50 psi)</b>                           | <b>345 kPa (50 psi)</b>                            | <b>345 kPa (50 psi)</b>                            |
| Oil filtration                                             | Replaceable full flow spin on cartridge           |                                                   |                                                    |                                                    |
| Oil capacity with filter                                   |                                                   |                                                   | <b>10.4 L (11 US qt)</b>                           |                                                    |
| Water pump (Style)                                         |                                                   |                                                   | Centrifugal                                        |                                                    |
| Water pump (Flow @ rated RPM)                              |                                                   |                                                   | <b>57.5 L/min (15.2 US gpm)</b>                    |                                                    |
| Injection pump                                             |                                                   |                                                   | Bosch In-Line mechanical injection                 |                                                    |

**NOTE:** If bore size exceeds **85.2 mm (3.3543 in)** replace with long block.

## Engine - Torque

|                                                      |                                 |
|------------------------------------------------------|---------------------------------|
| Connecting rod cap bolts                             | 49 - 54 N·m (36 - 40 lb ft)     |
| Main bearing retaining bolts                         | 49 - 54 N·m (36 - 40 lb ft)     |
| Relief valve assembly                                | 59 - 69 N·m (43 - 51 lb ft)     |
| Crankshaft rear main bearing bolts                   | 25 - 29 N·m (18 - 22 lb ft)     |
| Crankshaft center main bearing bolts                 | 49 - 54 N·m (36 - 40 lb ft)     |
| Engine rear mounting plate                           | 12 - 17 N·m (9 - 12 lb ft)      |
| Flywheel retaining bolts                             | 68 - 78 N·m (51 - 58 lb ft)     |
| Engine front plate                                   | 9 - 12 N·m (6 - 9 lb ft)        |
| Crankshaft pulley nut                                | 274 - 333 N·m (202 - 246 lb ft) |
| Cylinder head bolts                                  | 98 - 103 N·m (72.3 - 76 lb ft)  |
| Rocker arm assembly                                  | 27 - 39 N·m (20 - 29 lb ft)     |
| Rocker arm locknut                                   | 11 - 16 N·m (8 - 12 lb ft)      |
| Oil tube banjo bolt                                  | 9 - 13 N·m (7 - 9 lb ft)        |
| Oil pressure switch                                  | 14 - 20 N·m (10 - 14 lb ft)     |
| Rocker cover bolts                                   | 7 - 12 N·m (6 - 9 lb ft)        |
| Glow plugs                                           | 14 - 20 N·m (10 - 14 lb ft)     |
| Cooling fan bolts                                    | 9 - 13 N·m (7 - 9 lb ft)        |
| Balancer retaining bolts<br>(4 cylinder models only) | 49 - 53.9 N·m (36 - 39 lb ft)   |

## Engine - Torque - Minimum tightening torques for normal assembly

### METRIC NON-FLANGED HARDWARE

| NOM.<br>SIZE | CLASS 8.8 BOLT and<br>CLASS 8 NUT |                     | CLASS 10.9 BOLT and<br>CLASS 10 NUT |                      | LOCKNUT<br>CL.8<br>W/CL8.8<br>BOLT | LOCKNUT<br>CL.10<br>W/CL10.9<br>BOLT |
|--------------|-----------------------------------|---------------------|-------------------------------------|----------------------|------------------------------------|--------------------------------------|
|              | UNPLATED                          | PLATED<br>W/ZnCr    | UNPLATED                            | PLATED<br>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)                  |

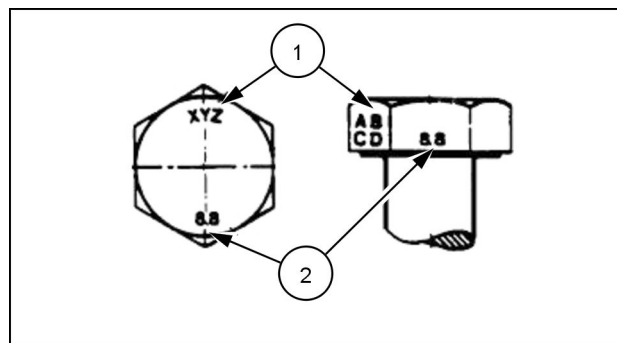
**NOTE:** M4 through M8 hardware torque specifications are shown in pound-inches. M10 through M24 hardware torque specifications are shown in pound-feet.

## METRIC FLANGED HARDWARE

| NOM.<br>SIZE | CLASS 8.8 BOLT and<br>CLASS 8 NUT |                        | CLASS 10.9 BOLT and<br>CLASS 10 NUT |                         | LOCKNUT<br>CL.8<br>W/CL8.8<br>BOLT | LOCKNUT<br>CL.10<br>W/CL10.9<br>BOLT |
|--------------|-----------------------------------|------------------------|-------------------------------------|-------------------------|------------------------------------|--------------------------------------|
|              | UNPLATED                          | PLATED<br>W/ZnCr       | UNPLATED                            | PLATED<br>W/ZnCr        |                                    |                                      |
| M4           | 2.4 N·m (21 lb<br>in)             | 3.2 N·m (28 lb<br>in)  | 3.5 N·m (31 lb<br>in)               | 4.6 N·m (41 lb<br>in)   | 2.2 N·m (19 lb<br>in)              | 3.1 N·m (27 lb<br>in)                |
| M5           | 4.9 N·m (43 lb<br>in)             | 6.5 N·m (58 lb<br>in)  | 7.0 N·m (62 lb<br>in)               | 9.4 N·m (83 lb<br>in)   | 4.4 N·m (39 lb<br>in)              | 6.4 N·m (57 lb<br>in)                |
| M6           | 8.3 N·m (73 lb<br>in)             | 11 N·m (96 lb<br>in)   | 12 N·m (105 lb<br>in)               | 16 N·m (141 lb<br>in)   | 7.5 N·m (66 lb<br>in)              | 11 N·m (96 lb<br>in)                 |
| M8           | 20 N·m (179 lb<br>in)             | 27 N·m (240 lb<br>in)  | 29 N·m (257 lb<br>in)               | 39 N·m (343 lb<br>in)   | 18 N·m (163 lb<br>in)              | 27 N·m (240 lb<br>in)                |
| M10          | 40 N·m (30 lb ft)                 | 54 N·m (40 lb<br>ft)   | 57 N·m (42 lb ft)                   | 77 N·m (56 lb<br>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<br>ft)   | 100 N·m (74 lb<br>ft)               | 134 N·m (98 lb<br>ft)   | 63 N·m (47 lb ft)                  | 91 N·m (67 lb ft)                    |
| M16          | 174 N·m (128 lb<br>ft)            | 231 N·m (171 lb<br>ft) | 248 N·m (183 lb<br>ft)              | 331 N·m (244 lb<br>ft)  | 158 N·m (116 lb<br>ft)             | 226 N·m (167 lb<br>ft)               |
| M20          | 350 N·m (259 lb<br>ft)            | 467 N·m (345 lb<br>ft) | 484 N·m (357 lb<br>ft)              | 645 N·m (476 lb<br>ft)  | 318 N·m (235 lb<br>ft)             | 440 N·m (325 lb<br>ft)               |
| M24          | 607 N·m (447 lb<br>ft)            | 809 N·m (597 lb<br>ft) | 838 N·m (618 lb<br>ft)              | 1118 N·m (824 lb<br>ft) | 552 N·m (407 lb<br>ft)             |                                      |

## IDENTIFICATION

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

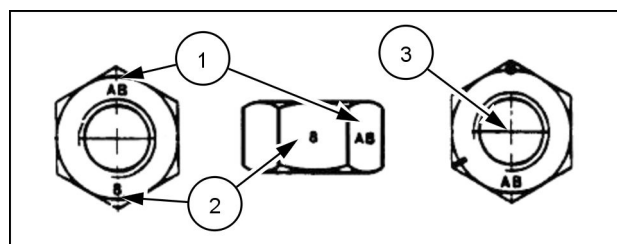


20083680 1

(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

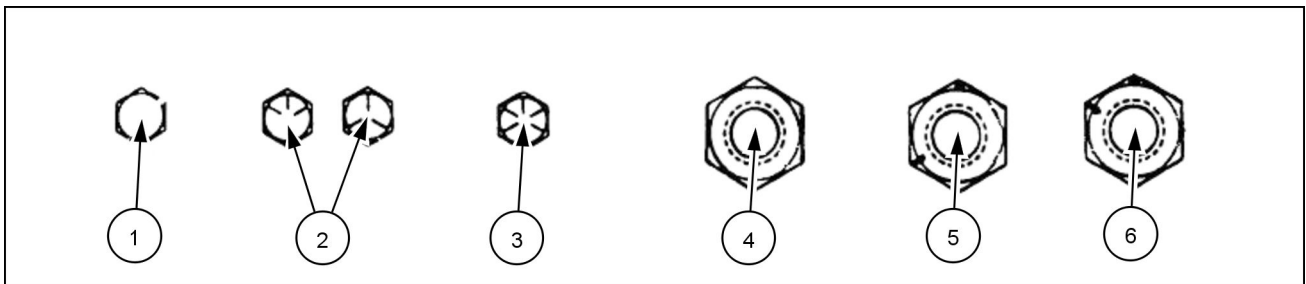
| NOMINAL SIZE | SAE GRADE 5 BOLT and NUT   |                     | SAE GRADE 8 BOLT and NUT   |                      | LOCKNUT GrB W/ Gr5 BOLT | LOCKNUT GrC W/ Gr8 BOLT |
|--------------|----------------------------|---------------------|----------------------------|----------------------|-------------------------|-------------------------|
|              | 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-<br>INAL<br>SIZE | SAE GRADE 5 BOLT and<br>NUT     |                          | SAE GRADE 8 BOLT and<br>NUT     |                          | LOCKNUT<br>GrF W/ Gr5<br>BOLT | LOCKNUT<br>GrG W/ Gr8<br>BOLT |
|----------------------|---------------------------------|--------------------------|---------------------------------|--------------------------|-------------------------------|-------------------------------|
|                      | UNPLATED<br>or PLATED<br>SILVER | PLATED<br>W/ZnCr<br>GOLD | UNPLATED<br>or PLATED<br>SILVER | PLATED<br>W/ZnCr<br>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)           |

## Inch Bolts and free-spinning nuts

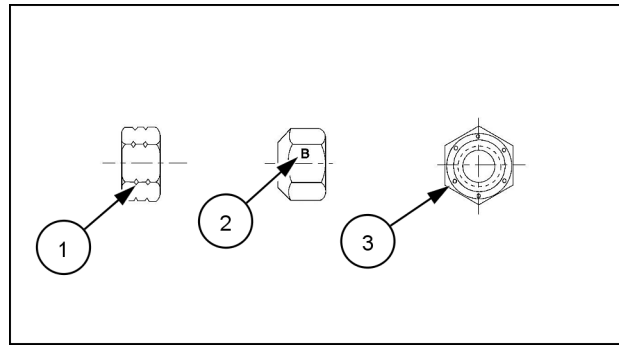


20083682 3

### 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 <b>120 °</b> Apart |
| 3                        | Grade 8 - Five Marks  | 6 | Grade 8 Nut - Marks <b>60 °</b> 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                |

## Engine - Special tools

| Tool number         | Description                       |
|---------------------|-----------------------------------|
| <b>FNH01728</b>     | Injector tester                   |
| <b>FNH00120</b>     | Adapter - Compression tester      |
| <b>FNH01728</b>     | Injector adapter set              |
| <b>OEM1074</b>      | Compression test gauge assembly   |
| <b>FNH01720</b>     | Injector cleaning kit             |
| <b>380002887</b>    | Port block installer              |
| <b>FNH11044</b>     | Port block installer pins         |
| <b>380002888</b>    | Port block remover                |
| <b>FNH00011</b>     | Oil pressure test fitting         |
| Micrometer, outside | <b>0 - 25 mm (0 - 1 in)</b>       |
| Micrometer, outside | <b>25 - 51 mm (1 - 2 in)</b>      |
| Micrometer, outside | <b>76.2 - 101.6 mm (3 - 4 in)</b> |
| Small hole gauge    | <b>19 - 25 mm (0.75 - 1 in)</b>   |
| Cylinder bore gauge | <b>76.2 - 101.6 mm (3 - 4 in)</b> |
| Cylinder bore gauge | <b>25 - 51 mm (1 - 2 in)</b>      |

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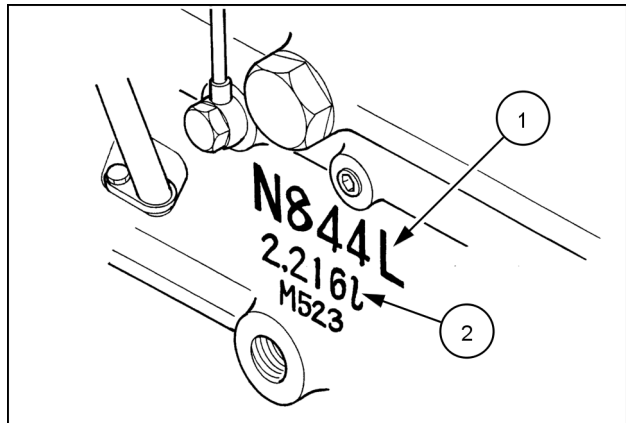
## Crankcase - Dimension

|                   |          |                                            |
|-------------------|----------|--------------------------------------------|
| Bore              |          |                                            |
|                   | Standard | <b>84 - 84.019 mm (3.3071 - 3.3078 in)</b> |
| Head surface warp |          |                                            |
|                   | Standard | <b>0.05 mm (0.002 in)</b>                  |
|                   | Maximum  | <b>0.12 mm (0.005 in)</b>                  |

## Engine - Identification

This section describes the engine overhaul and repair procedures. Repair procedures are essentially the same for all models except as noted in the repair procedures.

Numeric value **(2)** under the engine code **(1)** indicates displacement of the engine in liters.

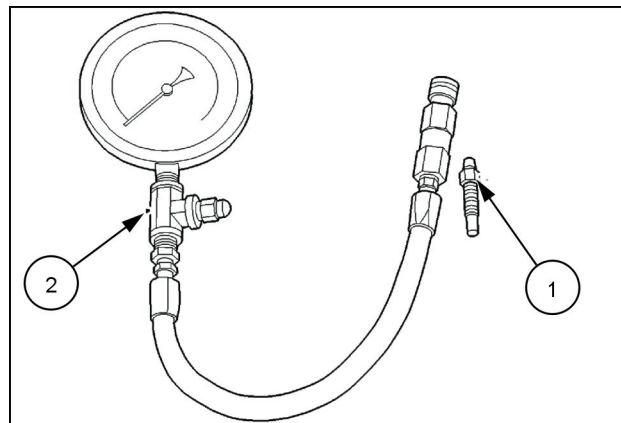


20002360 1

## Engine - Compression test

Compression test is performed through the glow plug ports. The test adapter tool (1), is equipped with quick coupler ends for easy installation of the hose and gauge.

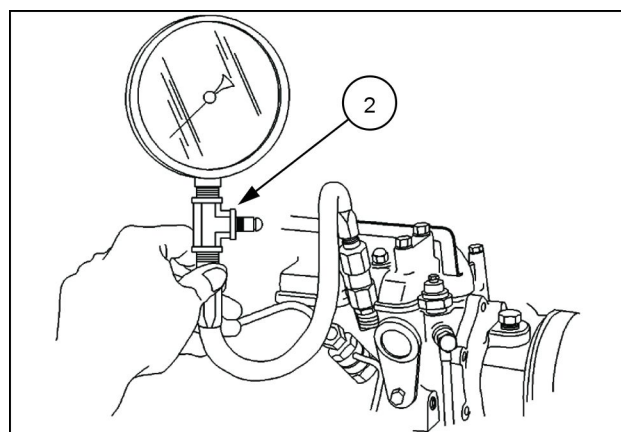
1. Remove the two pin connector from the fuel injection pump solenoid.
2. Remove the glow plug electrical wire and wire connector from top of the glow plugs. Refer to **Cold start aid - Remove - Glow plug (55.202)**.
3. Remove all of the glow plugs.



SECT10C01PG17\_1 1

**NOTE:** Be sure all the glow plugs are removed before starting the compression tests.

4. Install the adapter Tool No. **FNH00120**, hose and gauge assembly **OEM1074 (2)**, in each port and crank the engine until pressure stabilizes. The gauge should read **2944.1 kPa (427 psi)** plus or minus **344.7 kPa (50 psi)**.



SECT10C01PG17\_2 2

**NOTE:** It may be necessary to remove some injector fuel lines to install the adapter tool.

**NOTE:** There should not be more than **344.7 kPa (50 psi)** variation between the cylinders.

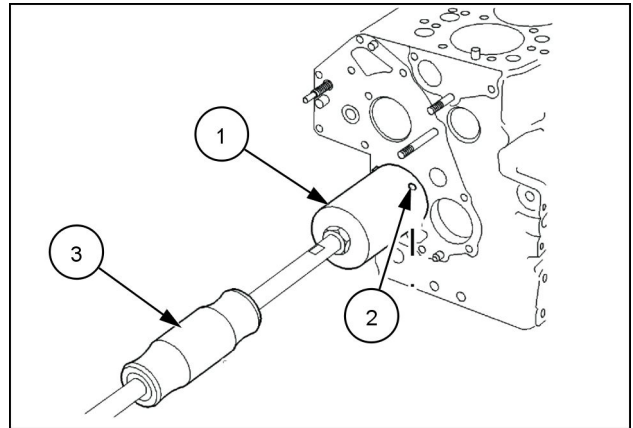
5. Install the glow plugs and electrical connections. Refer to **Cold start aid - Install - Glow plug (55.202)**.

## Crankcase - Remove - Port block

1. Use **380002888 (1)** to place the collars in the grooves of the port block assembly.
2. Align the set screws **(2)** of the puller **(1)** with the counter bores in the collars and tighten.
3. Use a slide hammer **(3)** to remove the port block.

**NOTE:** The oil pump shaft and port block assembly is a press fit in the block.

**NOTE:** The camshaft gear and the back plate have to be removed from the engine, to provide clearance for the port block removal tool installation.

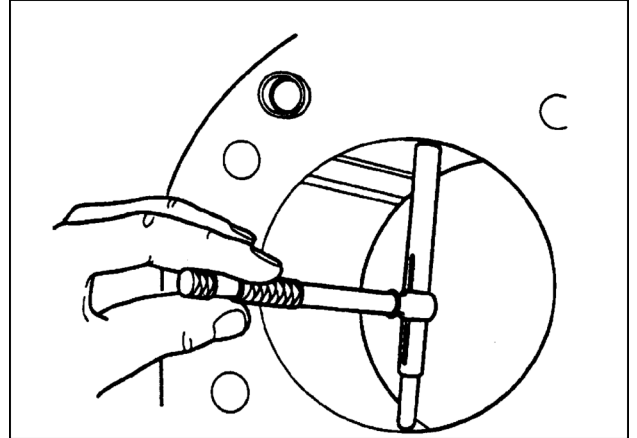


SECT10C01PG65\_2 1

## Crankcase - Inspect

1. Inspect the cylinder block top face for cracks, damage, and warping in the same way as for the cylinder head. Replace the cylinder block if warp is greater than **0.12 mm (0.005 in)**.
2. Visually inspect the cylinder bore. There should be no scoring, rust, or corrosion.
3. Use a telescoping gauge in line with the crankshaft to measure the inside diameter of the top of the bore (approximately **15 mm (0.59 in)** below the top of the block) on the N844L and N844LT. For all other models, measure **10 mm (0.39 in)**.
4. Repeat this measurement at right angles to the crankshaft at the same distance.
5. In line with the crankshaft at the bottom of the bore, measure (approximately **117 mm (4.6 in)** N844L, and **127 mm (5 in)** N844LT) from the top of the cylinder. For all other models, measure **100 mm (3.9 in)**.
6. Repeat this measurement at right angles to the crankshaft at the same distance.
7. If any of the measurements taken indicate worn or damaged cylinder bores, replace engine block with a long block assembly.

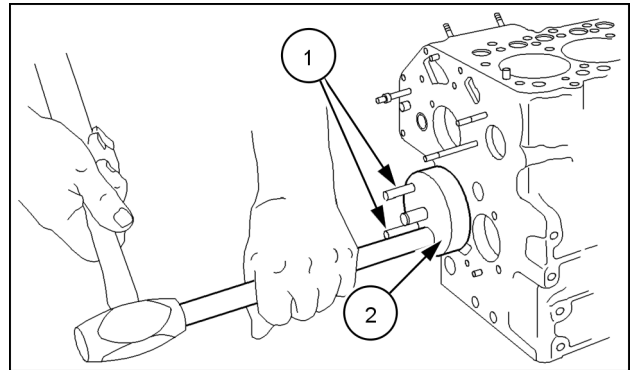
**NOTE:** If the cylinder bore measures **84.2 mm (3.315 in)**, replace the block assembly.



20093380 1

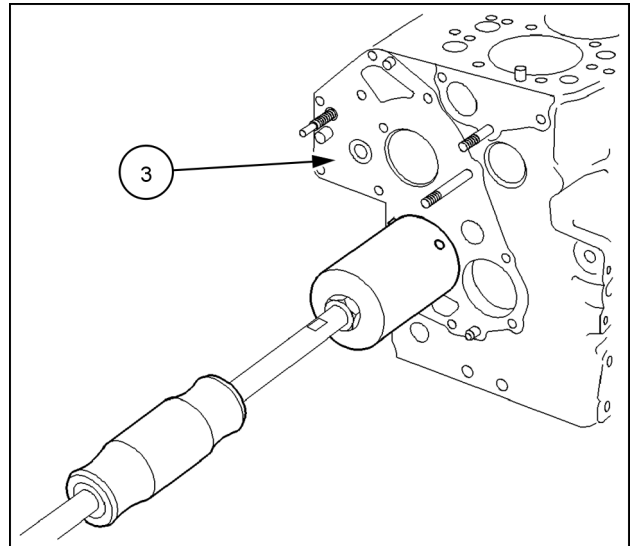
## Crankcase - Install - Port block

1. Use **380002887 (2)** to insert the threaded guide pins **(1)** into the cylinder block.
2. Assemble the oil pump shaft to the port block using nut and washer.
3. Insert the port block assembly into the installer and place on the guide pins.
4. Use a suitable driver to install the port block assembly. The installer must bottom against the engine block when fully positioned.



20093399 1

**NOTE:** Plate **(3)** must be removed from engine block for proper installation of the port block.



20093398 2

## Engine - Troubleshooting

| Problem                                            | Possible Cause                                      | Correction                                                              |
|----------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------|
| <b>Engine does not develop full power</b>          | Clogged air cleaner                                 | Inspect and replace air cleaner if necessary                            |
|                                                    | Fuel line obstructed                                | Check for crimped fuel line. Inspect fuel lifter for cleanliness        |
|                                                    | Improper injection timing                           | Repair/replace components as required                                   |
|                                                    | Improper nozzle injection pressure and angle        | Check injection timing, inspect for proper injection pressure and angle |
|                                                    | Low cylinder compression                            | Check engine compression                                                |
|                                                    | Insufficient fuel injection                         | Repair at authorized shop                                               |
|                                                    | Improper valve lash adjustment                      | Adjust valves to correct tolerances                                     |
|                                                    | Burned, worn or sticking valves                     | Inspect and replace as necessary                                        |
|                                                    | Blown head gasket                                   | Replace head gasket                                                     |
|                                                    | Worn or sticking piston rings                       | Overhaul as necessary                                                   |
|                                                    | Faulty engine stop solenoid                         | Replace stop solenoid                                                   |
| <b>Low oil pressure</b>                            | Engine oil level low                                | Fill to proper level                                                    |
|                                                    | Wrong grade of oil                                  | Replace with correct grade oil                                          |
|                                                    | Clogged oil pump filter                             | Change oil and filter                                                   |
|                                                    | Faulty oil pressure relief valve                    | Replace relief valve                                                    |
|                                                    | Worn oil pump drive shaft gears, or broken oil pipe | Inspect oil system and components. Replace defective components         |
|                                                    | Excessive main or connecting rod bearing clearances | Replace bearings or shaft if necessary                                  |
|                                                    | Oil pump axial clearance not properly set           | Check pump clearance and shim as needed to proper tolerance.            |
| <b>Engine will not stop</b>                        | Faulty engine stop solenoid                         | Replace the stop solenoid                                               |
|                                                    | Faulty starter switch                               | Replace starter switch                                                  |
| <b>Low cylinder compression</b>                    | Burned, worn or sticking valves                     | Replace valves                                                          |
|                                                    | Bent valve stem                                     | Replace valves                                                          |
|                                                    | Broken or weak valve spring                         | Replace valve spring                                                    |
|                                                    | Blown cylinder head gasket                          | Replace head gasket                                                     |
|                                                    | Worn or sticking piston rings                       | Replace piston rings                                                    |
|                                                    | Scored piston                                       | Replace piston                                                          |
| <b>Poor engine idling</b>                          | Improper injection timing                           | Correct the injection timing                                            |
|                                                    | Air in injection pump                               | Purge air from the system                                               |
|                                                    | Improper governor adjustment                        | Adjust the governor                                                     |
| <b>Oil pressure warning light fails to operate</b> | Bulb burnt out                                      | Replace the bulb                                                        |
|                                                    | Oil pressure sensor is faulty                       | Replace oil pressure sensor                                             |
|                                                    | Warning light circuit faulty                        | Replace warning light circuit                                           |
| <b>Engine knocks</b>                               | Diluted or thin oil                                 | Change engine oil and filter                                            |
|                                                    | Insufficient oil supply                             | Check engine oil level                                                  |
|                                                    | Low oil pressure                                    | Inspect lube system for restrictions                                    |
|                                                    | Worn crankshaft thrust bearing                      | Replace thrust bearing                                                  |
|                                                    | Excessive flywheel runout                           | Replace flywheel                                                        |
|                                                    | Excessive connecting rod or main bearing clearance  | Replace bearings                                                        |
|                                                    | Seized bearing                                      | Replace bearing and affected component if necessary                     |
|                                                    | Clogged oil passage                                 | Clean out oil passages                                                  |
|                                                    | Bent or twisted connecting rod                      | Replace connecting rod                                                  |
|                                                    | Crankshaft journals out of round                    | Rework or replace crankshaft                                            |
|                                                    | Excessive piston to cylinder bore clearance         | Replace piston with correct oversized piston                            |
|                                                    | Excessive piston ring side clearance                | Replace piston rings                                                    |
|                                                    | Broken or damaged ring                              | Replace piston ring                                                     |
|                                                    | Excessive piston pin clearance                      | Replace piston pin or bushing                                           |

| Problem                                                              | Possible Cause                                         | Correction                                     |
|----------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------|
|                                                                      | Seized piston                                          | Replace piston and, if necessary, engine block |
|                                                                      | Piston pin retainer loose or missing                   | Replace retainer                               |
|                                                                      | Improper valve lash adjustment                         | Adjust valve lash to specification             |
|                                                                      | Worn valve lifter                                      | Replace valve lifter                           |
|                                                                      | Excessive timing gear backlash                         | Replace all timing gears                       |
| <b>Excessive oil consumption</b>                                     | Engine oil level too high                              | Remove excess oil                              |
|                                                                      | Leakage in cylinder head gasket                        | Replace head gasket                            |
|                                                                      | Oil loss past the pistons and rings                    | Replace piston rings                           |
|                                                                      | Worn, broken, or sticking piston rings                 | Replace piston rings                           |
|                                                                      | Clogged return hole of oil ring                        | Unclog return oil hole and replace rings       |
|                                                                      | Worn valves, guides, or seals                          | Replace valves, guides, or seals               |
|                                                                      | Leakage past oil seals and gaskets                     | Replace leaking seals and gaskets              |
|                                                                      | External oil leaks from engine                         | Locate leaks and repair                        |
| <b>Engine overheats</b>                                              | Insufficient amount of coolant in the radiator         | Fill coolant to proper level                   |
|                                                                      | Hose connection leaking or collapsed hose              | Tighten hose connection or replace hose        |
|                                                                      | Radiator leakage                                       | Locate leak and repair or replace radiator     |
|                                                                      | Loose, worn, or broken V-belt                          | Adjust V-belt tension or replace belt          |
|                                                                      | Radiator fins bent or clogged                          | Straighten out and clean fins                  |
|                                                                      | Radiator cap not sealing                               | Replace radiator cap                           |
|                                                                      | Thermostat operating improperly                        | Replace thermostat cap                         |
|                                                                      | Insufficient amount of oil                             | Fill to proper level                           |
|                                                                      | Water pump operating improperly                        | Replace water pump                             |
|                                                                      | Improper valve clearance                               | Adjust valve clearance to specification        |
|                                                                      | Restriction in exhaust system                          | Remove restriction                             |
|                                                                      | Improperly installed cylinder head gasket              | Reinstall head gasket in proper position       |
|                                                                      | Rust and/or scale clogged water ports                  | Backflush cooling system                       |
|                                                                      | Extended engine idling                                 | Shutdown engine during extended idling periods |
| <b>Temperature gauge fails to reach normal operating temperature</b> | Faulty temperature sender                              | Replace temperature switch                     |
|                                                                      | Faulty thermostat                                      | Replace thermostat                             |
|                                                                      | Faulty temperature gauge                               | Replace temperature gauge                      |
| <b>Engine does not start</b>                                         | Faulty starter switch                                  | Replace switch                                 |
|                                                                      | Insufficient charging or complete discharge of battery | Check battery and charging system              |
|                                                                      | Lack of fuel                                           | Fill fuel tank                                 |
|                                                                      | Air mixed in fuel system                               | Inspect fuel system for tightness              |
|                                                                      | Clogged fuel filter                                    | Replace fuel filter                            |
|                                                                      | Irregular or faulty fuel supply                        | Replace fuel supply                            |
|                                                                      | Glow plug not heating                                  | Replace glow plug                              |
|                                                                      | Improper lubricating oil viscosity                     | Replace lube oil                               |
|                                                                      | Clogged air cleaner                                    | Replace air cleaner                            |
|                                                                      | Faulty engine stop solenoid                            | Replace solenoid                               |
| <b>Excessive Exhaust Smoke</b>                                       | Burned out fuse                                        | Replace fuse                                   |
|                                                                      | Air cleaner dirty or restricted                        | Replace air cleaner                            |
| <b>Engine stops while operating</b>                                  | Excessive fuel delivery                                | Adjust fuel delivery                           |
|                                                                      | Lack of fuel in fuel tank                              | Fill fuel tank                                 |
|                                                                      | Clogged fuel filter                                    | Replace filter                                 |
|                                                                      | Air mixed in fuel system                               | Inspect for air leaks                          |
|                                                                      | Faulty engine stop solenoid                            | Replace solenoid                               |
| <b>Undesirable exhaust color (black or light grey)</b>               | Burned out fuse                                        | Replace fuse                                   |
|                                                                      | Unsuitable fuel                                        | Replace fuel                                   |
|                                                                      | Excess injection                                       | Replace injection pump                         |
|                                                                      | Faulty engine component                                | Replace as required                            |

| Problem                                   | Possible Cause                     | Correction                           |
|-------------------------------------------|------------------------------------|--------------------------------------|
| Undesirable exhaust smoke (white or pale) | Over loading                       | Decrease load                        |
|                                           | Clogged air filter                 | Replace filter                       |
|                                           | Excess engine oil                  | Drain oil to proper oil level        |
|                                           | Improper lubricating oil viscosity | Replace oil with specified viscosity |
|                                           | Faulty injection timing            | Replace injection pump               |

## Engine - 10

### Engine and crankcase - 001

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