NEW HOLLAND

E385

NEW HOLLAND KOBELCO

# WORKSHOP MANUAL ISUZU ENGINE

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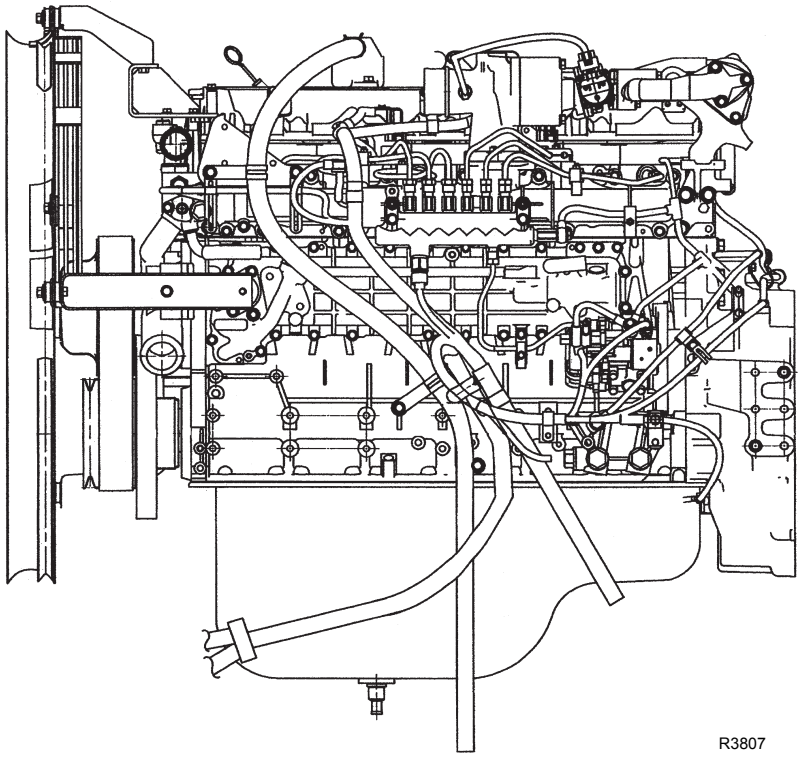
E385

# WORKSHOP MANUAL
# 4HK1-6HK1 ISUZU ENGINE

## Workshop manual integration of the following models:

## E385 (Tier 3)




*All information, illustrations and specifications in this manual are based on the latest product information available at the time of publication.*
*The right is reserved to make changes at any time without notice.*

**NEW HOLLAND KOBELCO CONSTRUCTION MACHINERY S.p.A. - PRODUCT SUPPORT**
**FORM No. 604.13.649 - Edition - January 2006**

## TO THE READER

- This manual was written for a skilled technician and contains all the technical information needed to repair this engine.
- Read this manual carefully for the information concerning repairing operations.
- For any question or comment, or should you notice any mistake concerning the contents of this manual, please contact:

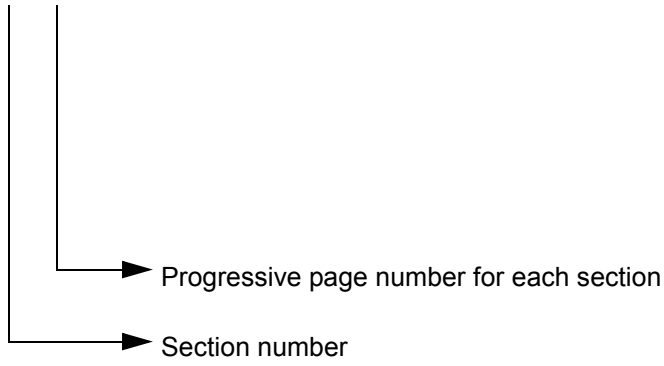
NEW HOLLAND KOBELCO CONSTRUCTION
MACHINERY S.p.A.
Strada Settimo, 323
San Mauro Torinese (TO)
10099 ITALY
PRODUCT SUPPORT
Fax. ++39 011 6877357

## FURTHER REFERENCES

## PAGE NUMBER

- Every page carries a number on the top right corner. Every page contains the following information:

**Example: 1A - 1**



## UNITS OF MEASURE

This manual adopts the units of measure based on International System.
The MKSA system units of measure are indicated within brackets after the units of measure of the International System.

Example: 24.5 MPa (250 kgf/cm$^2$)

The following table converts the International System units of measure in some of the main units belonging to other system.

| Quantity | To convert from (IS) | Into (Others) | Multiply by |
|---|---|---|---|
| Lenght | mm | in | 0.03937 |
| | mm | ft | 0.003281 |
| Volume | L | US gal | 0.2642 |
| | L | US qt | 1.057 |
| | m$^3$ | yd$^3$ | 1.308 |
| Mass | kg | lb | 2.205 |
| Force | N | kgf | 0.10197 |
| | N | lbf | 0.2248 |
| Torque | N.m | kgf.m | 0.10197 |
| | N.m | lbf.ft | 0.7375 |

| Quantity | To convert from (IS) | Into (Others) | Multiply by |
|---|---|---|---|
| Pressure | MPa | kgf/cm$^2$ | 10.197 |
| | MPa | psi | 145.0 |
| Power | kW | CV-PS | 1.360 |
| | kW | HP | 1.341 |
| Temperature | °C | °F | °C x 1.8 + 32 |
| Speed | km/h | mph | 0.6214 |
| | min$^{-1}$ | rpm | 1.0 |
| Capacity | L/min | US gpm | 0.2642 |
| | mL/rev | cc/rev | 1.0 |
| | | | |

# GENERAL INFORMATION

## General Information

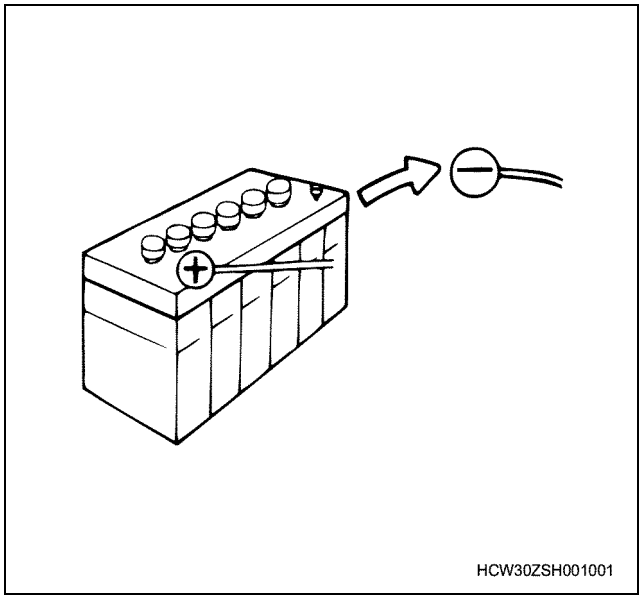
## Contents

# General Information

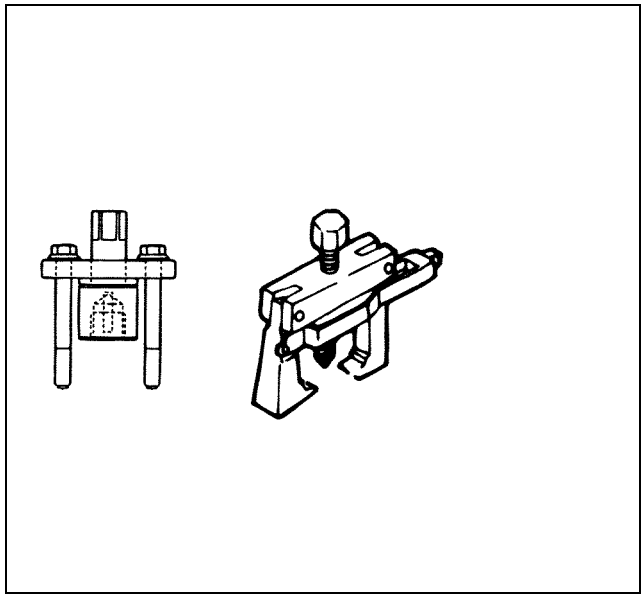
## Service Precautions

**In order to carry out work safely**

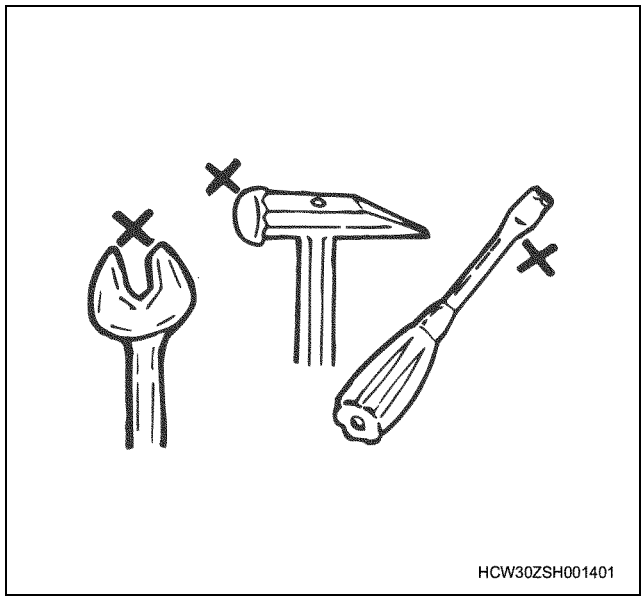
1. Always use an engine stand when taking the engine down from the vehicle.
   Do not place the engine directly onto the ground, or place in a manner that interferes with the oil pan.
2. If you are working together with others, always pay attention to each other's safety.
3. If you are repairing any part of the electrical system, always remove the minus side cable from the battery terminal before starting work. If you are removing the battery cover, always remove the cover in a place that is away from sources of fire/ heat.



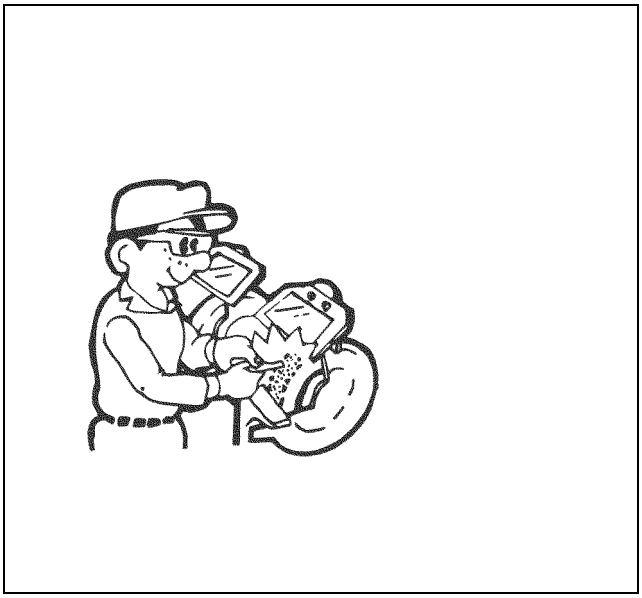

4. Do not perform painting work or leave the engine running for long periods of time in an enclosed or badly ventilated indoor workshop.
5. Always use the correct specialized tool indicated in the instructions. Using the incorrect tool may cause damage to the parts or injury to the person using the tool.



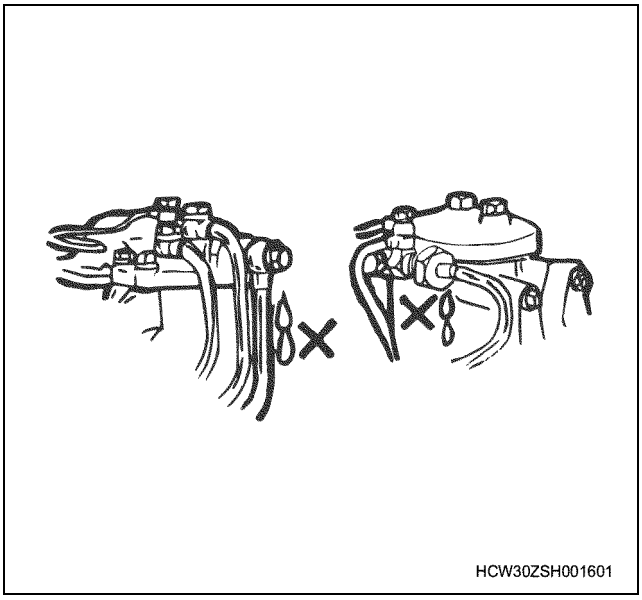
6. All regular tools, gauges and special tools should be regularly inspected, and prepared before starting work. Do not use bent spanners, hammers with damaged edges, chipped chisels, or any other faulty or damaged tools.



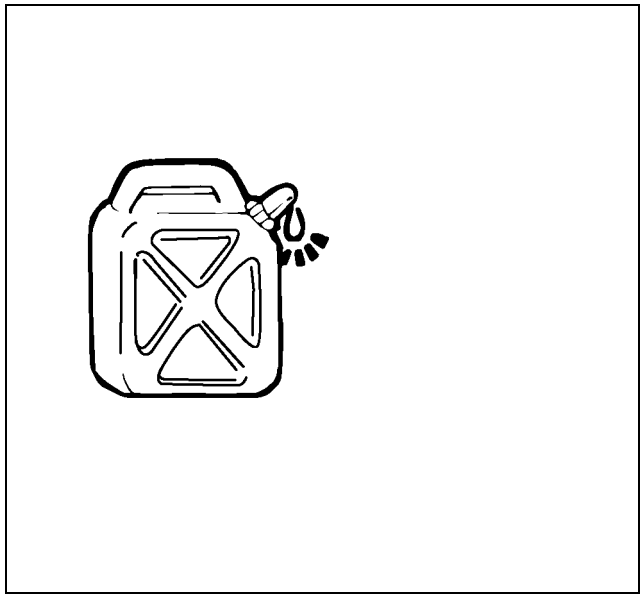

7. Always pay close attention to safety and handling requirements when using grinders, cranes, welders, and other such equipment.
   Moreover, always wear the correct protective garments and use the necessary safety tools for the job in hand.



8. Always check that there are no fuel leaks when performing maintenance work on the fuel system. (It may cause a fire.)




9. Pay close attention to the risk of ignition if you are handling parts that carry a high voltage.
   Furthermore, any oil or fat spilt onto rubber parts must be wiped off immediately, as it will cause deterioration of the rubber.



**Replacement parts and part numbers.**

1. Always replace packing, oil seals, o-rings, caulking lock nuts, folding lock plates, split pins and other such parts with brand new parts.
2. The parts numbers contained in this manual may not represent the supply condition of the parts, and the part numbers may be changed due to revisions. Therefore, parts should always be checked against a parts catalogue before use.

**Liquid gasket**

1. Each time you disassemble parts that use liquid gasket, completely remove the old gasket residue from each of the parts and matching sections using a scraper, then clean each of the parts to completely remove oil, water, and dirt etc. from the various surfaces. Using the specified type of liquid gasket, apply new liquid gasket to each of the surfaces before reassembling the parts.
2. In order to make it easier to clean liquid gasket surfaces, apply gasket remover liquid (Pando-391D made by Three Bond Co., Ltd.) and leave the part to stand for approximately 10 minutes, after which the old liquid gasket residue will be easier to remove.
   However, this should not be used on resin components or painted components.
3. Please take care not to apply too much or too little liquid gasket.
   Also, you should always re-apply the liquid gasket upon itself when you start and finish application.
4. Make sure that there are no gaps when re-installing the liquid gasket parts to each other. If there are gaps between the two parts, re-apply the liquid gasket. Some parts, especially the oil pan, use the same size studs as a guide to eliminate the need for knock pin positioning etc.
5. Re-install these parts within 7 minutes of applying the liquid gasket.

If more than 7 minutes passes, remove the previous liquid gasket and re-apply it.

6. Please wait for at least 30 minutes since the last part is installed before starting the engine.

**Liquid gasket**

| Seal section | Product name | Manufacturer's name |
|---|---|---|
| Between cylinder block and – Flywheel housing | 1207B | Three Bond |
| Between cylinder block and – Flywheel housing and – Crankcase | 1207B | Three Bond |
| Between cylinder block and – Crank case | 1207B | Three Bond |
| Between cylinder block and – Front cover | 1207B | Three Bond |
| Cylinder block, head plug nipple, unit, switches | 262 | Loctite |

- Always use the liquid gasket products listed above, or a liquid gasket identical to the ones listed above.
- Use the correct quantity of liquid gasket. Always follow the handling instructions for each product.

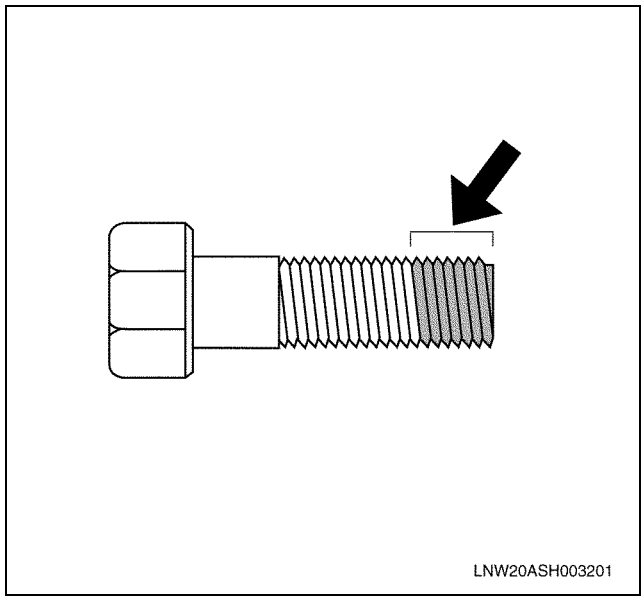
**Application procedure**

1. Wipe the contact surfaces clean of all water, fat or oil. The contact surfaces should be dry.
2. Apply a regular bead width of liquid gasket to one of the contact surfaces. Make sure that the bead does not break at this point.

**Notes:**
If there are special regulations concerning the application procedure in the repair document, please follow those regulations.

**Work procedure**

1. Wipe the joint surfaces of the bolt, bolt hole, and screw thread section clean of water, fat, and oil. The contact surfaces should be dry.
2. Apply Loctite to the top 1/3 of the screw.
3. Tighten the bolt to the correct tightening torque.




**Important:**
After tightening the bolt, do not apply excessive torque or try to rotate the bolt until at least one hour has passed, and the Loctite has hardened.

**Procedure for using the Plastiguage**

| Type | Measurable range mm (in) |
|---|---|
| PG-1 (Green) | 0.025 – 0.076 (0.001 – 0.003) |
| PR-1 (Red) | 0.051 – 0.152 (0.002 – 0.006) |
| PB-1 (Blue) | 0.102 – 0.229 (0.004 – 0.009) |

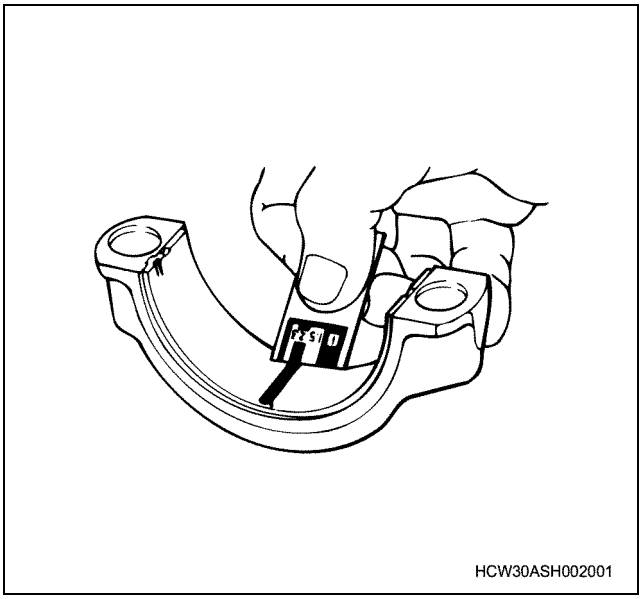
Example: Procedure for measuring the clearance between the connecting rod bearing and crank pin.

- Clean the connecting rod and bearing, and install the bearing to the rod.
- Cut the plastiguage to the same width as the crank pin, and while avoiding the oil pore of the crank pin lay the gauge parallel to the pin.

- Line up the marks on the connecting rod and cap and install the crank pin, apply molybdenum disulphide to the thread section and bearing surface of the fastening bolt, and rotate both cap and bolt to the correct torque.

**Important:**
Do not move the connecting rod while using the plastiguage.

- Gently remove the cap and connecting rod, and measure the crushed width of the plastiguage (clearance between rod and pin) using the scale printed on the bag.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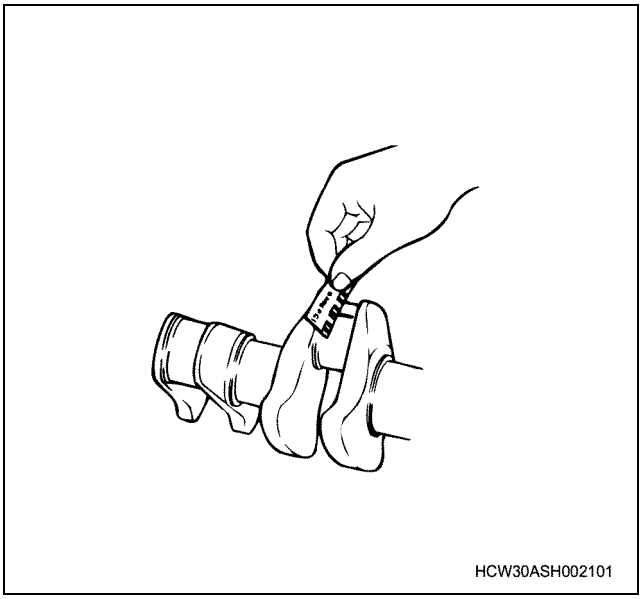
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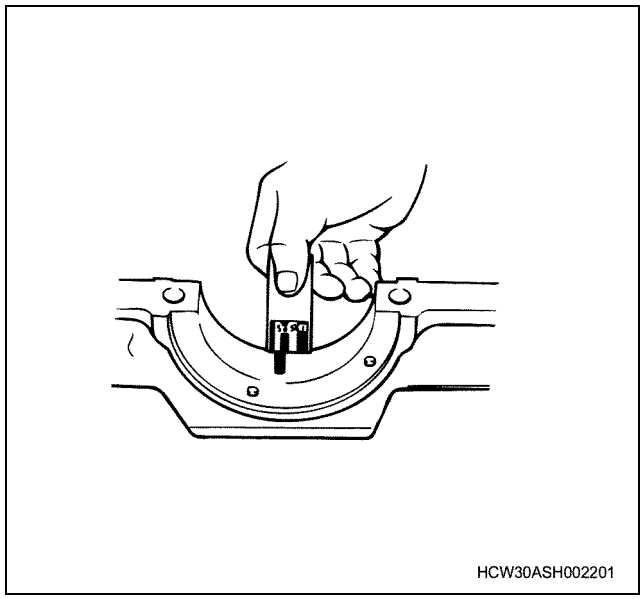
Example: Measuring the clearance between the crank bearing and crank journal

- Clean the clamp face of the cylinder block and crankcase bearing, and also the bearing, and install the cylinder block to the crankcase.
- Gently rest the crankshaft on the cylinder block, and rotate it approximately 30 degree to stabilize it.
- Cut the plastiguage to the same size as the journal width, and while avoiding the oil pore of the journal lay the gauge parallel to the journal.
- Gently rest the crank case on the cylinder block, apply molybdenum disulphide to the thread section and bearing surface of the fastening bolt, and tighten in sequence to the correct torque.

**Important:**
Do not rotate the crankshaft while using the plastiguage.

- Gently remove the crankcase, and measure the crushed width of the plastiguage (clearance between bearing and journal) using the scale printed on the bag.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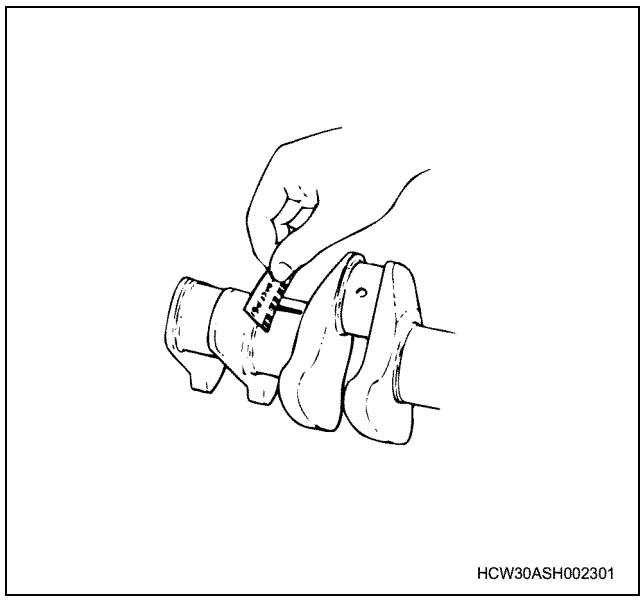
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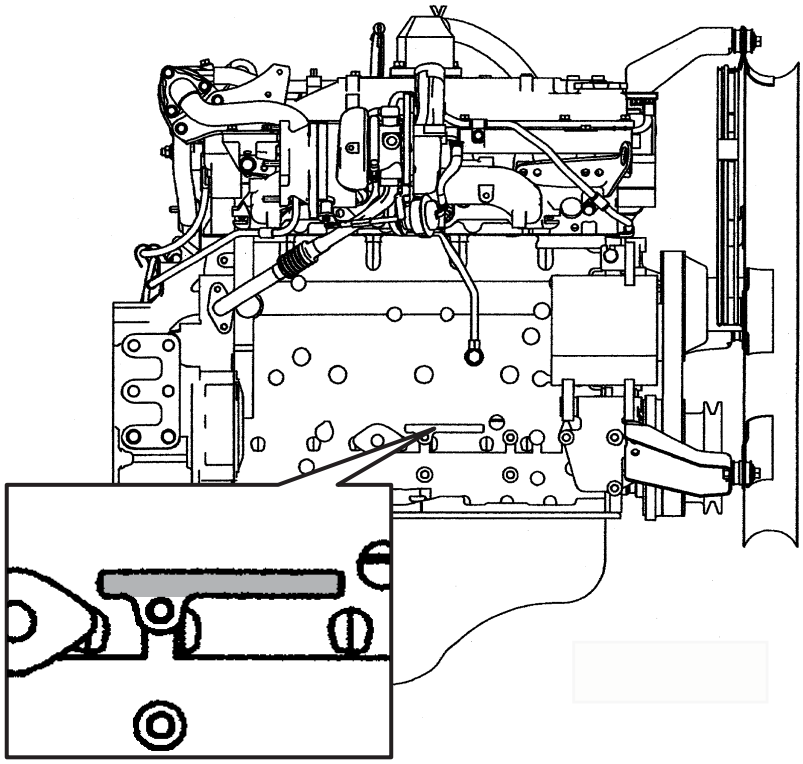
## Reading the model

### Engine number stamping position

**4HK1**



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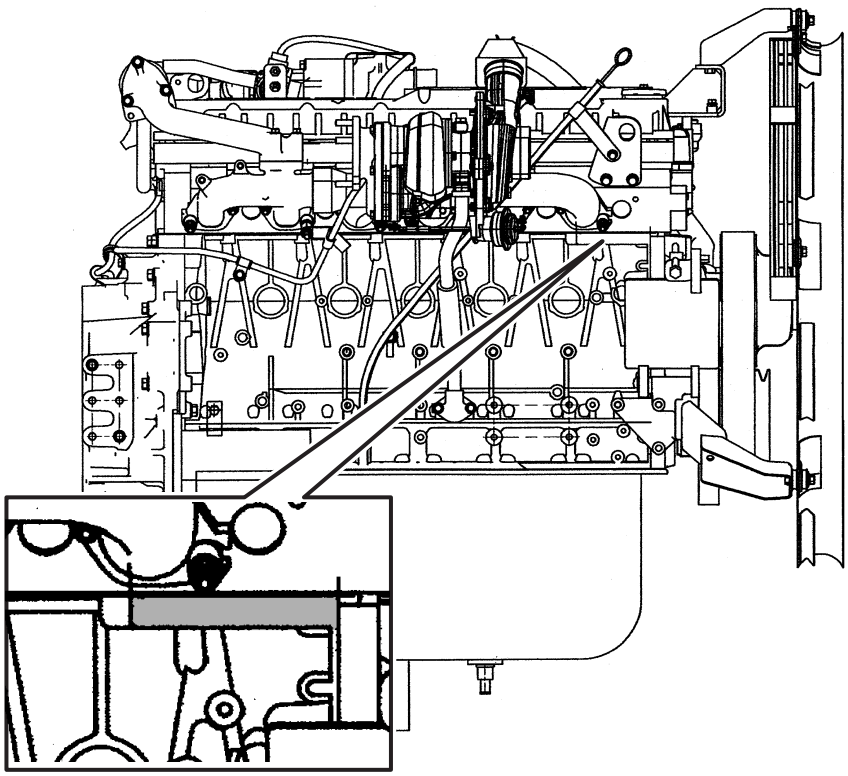
**6HK1**



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## General information

### Terminology, description of abbreviations

### Terminology definitions

| Term | Explanation |
|---|---|
| Maintenance standard | The generic name for reference values required for maintenance, such as nominal dimension, selection of a reference point, and limit. |
| Nominal dimension | Shows the standard value at the point of manufacture that does not include the common difference. |
| Selection of a reference point | Shows the standard value after assembling, repairing, or adjusting. |
| Limit | When this value (dimensions) is reached, it shows that the part has reached its full limit and must be replaced or repaired. |
| Front · rear, left · right, upper · lower | These show each orientations of parts installed to the vehicle when looking from the vehicle's forward direction. |
| Unit | Units written to SI conventions (mainly torque, pressure, force)<br>[Example] Length: mm, Torque: N·m {kgf·m} |
| Warning | Items that carry the warning mark pose a danger to life or threat of serious injury if not strictly observed. |
| Caution | Items that carry the caution mark may cause injury or lead to accidents if not strictly observed. |
| Important | Items that carry the important mark may cause the vehicle to break down, or may prevent the guaranteed normal operation of the system or related parts if not strictly observed. |

| Term | Explanation |
|---|---|
| Notes | Items that should receive special mention within a work procedure. |

**Description of abbreviations**

| Abbreviation | Description |
|---|---|
| AC | Alternating Current<br>Alternating Current |
| ACC | Accessory<br>Accessory |
| ACG | Alternating Current Generator<br>Alternating current generator |
| API | American Petrol Institute<br>American Petroleum Institute |
| ASM (Assy) | Assembly<br>Assembly |
| ATDC | After Top Dead Center<br>After Top Dead Center |
| BAT, BATT | Battery<br>Battery |
| BRG, Brg | Bearing<br>Bearing |
| BKT, BRKT | Bracket<br>Bracket |
| BTDC | Before Top Dead Center<br>Before Top Dead Center |
| CO | Carbon Oxide<br>Carbon Monoxide |
| CONN | Connector<br>Connector |
| CPU | Central Processing Unit<br>Central processing unit |
| C/U | Control Unit<br>Control unit |
| DC | Direct Current<br>Direct current |
| DI | Direct Injection<br>Direct injection |
| ECU | Engine Control Unit / Electronic Control Unit<br>Engine control unit / control unit |
| ECM | Engine Control Module<br>Engine control module |
| EGR | Exhaust Gas Recirculation<br>Exhaust gas recirculation |
| Exh, EXH | Exhaust<br>Exhaust |
| Ft, FRT | Front<br>Front |

| Abbreviation | Description |
|---|---|
| FWD | Forward<br>Forward |
| F/C | Fuel Cut<br>Fuel Cut |
| GND | Ground<br>Earth |
| IC | Integrated Circuit<br>Integrated circuit |
| ID Plate | Identification plate<br>Identification plate, ID plate |
| IN | Intake, Intake<br>Intake |
| ISO | International Organization for Standardization<br>International Organization for Standardization |
| I/PUMP | Injection Pump<br>Injection Pump |
| JIS | Japanese Industrial Standard<br>Japanese Industrial Standard |
| L/H, LH | Left Hand<br>Left hand side |
| M/V | Magnetic Valve<br>Magnetic valve |
| NOx | Nitrogen Oxide<br>Nitrogen Oxide |
| N-TDC | Number - Top Dead Center<br>Top dead center rotational frequency |
| OPT | Option<br>Option |
| P | Pole(S)<br>Pole |
| PCV | Pump Control Valve/ Positive Crankcase Ventilation<br>Pump control valve/ Positive crankcase ventilation |
| PM | Particulate Matter<br>Particulate matter |
| PS | Pre-Stroke<br>Pre-stroke |
| PTO | Power Take Off<br>Power take off |
| QOS | Quick On System<br>Rapid preheating system |
| Rr, RR | Rear<br>Rear |

| Abbreviation | Description |
|---|---|
| R/H, RH | Right Hand<br>Right hand side |
| R/L | Relay<br>Relay |
| STD | Standard<br>Standard |
| SW | Switch<br>Switch |
| TICS | Timing & Injection rate Control System<br>A type of injection system |
| VGS Turbo | Variable Geometry turbocharger System<br>Adjustable turbo, VGS turbo |
| W/L | Warning Lamp<br>Warning lamp |

**SI (International System of Units)**

**With regards the conversion to SI (International System of Units)**

The introduction of the SI systems aims to internationally unify the metric system and the various units used by different countries (traditional weights and measures, the foot pound method etc.), and to curb the confusion that occurs between the different units (conversion calculations etc.).
The new calculating method which adopted SI units was completely adopted in Japan in 1992, and is standardized by JIS-Z-8203.
All of the units in this manual are written in line with the International System of Units SI units, and conventional units are written in { } brackets.

**SI**

French) Abbreviated name of Le Systeme International d'Unites

**Connection between main SI units and conventional units**

| | SI | Conventional Unit | Item, unit conversion |
|---|---|---|---|
| Length | m | m | Same as the conventional unit |
| Weight (Mass) | kg | kg | Same as the conventional unit |
| Force | N | * kg, kgf | 1 kgf = 9.80665 N |
| Torque | N·m | * kg·m, gf·m | 1 kgf·m = 9.80665 N·m |
| Pressure | Pa | *kg/cm$^2$, mmHg | 1 kgf/cm$^2$ = 9.80665 kPa, 1 mmHg = 133.3 Pa |
| Dynamic force, horsepower | W | PS | 1 PS = 0.74 kW |
| Capacity, air volume displacement | m$^3$ | Litle, L, cc | 1 Litle = 1 dm$^3$, 1 cc = 1mLitle = 1cm$^3$ |
| Fuel consumption | g/(kW·h) | g/(PS·h) | 1 g/(PS·h) = 1.360 g/(kW·h) |

*1 Published service data may conveniently use kg for force and mass (weight) instead of kgf.
*2 Some conversion results may be rounded off to 1 or 2 decimal places.

**Converting expressions of quantity**

When converting, prefixes such as k (kilo) or m (mili) are used.

| | | | |
|---|---|---|---|
| M | Mega | $10^6$ | 1,000,000 |
| k | Kilo | $10^3$ | 1,000 |
| h | Hecto | $10^2$ | 100 |
| d | Deci | $10^{-1}$ | 0.1 |
| c | Centi | $10^{-2}$ | 0.01 |
| m | Milli | $10^{-3}$ | 0.001 |
| μ | Micro | $10^{-6}$ | 0.000001 |

- 200 kgf/cm$^2$ = 19,620 kPa = 19.6 MPa
- 40 mmHg = 5,332 Pa = 5.3 kPa

**Table of standard Isuzu tightening torque**

The tightening torque values in the table below apply to all situations unless a special tightening torque is specified.

**Isuzu standard bolts, nuts**

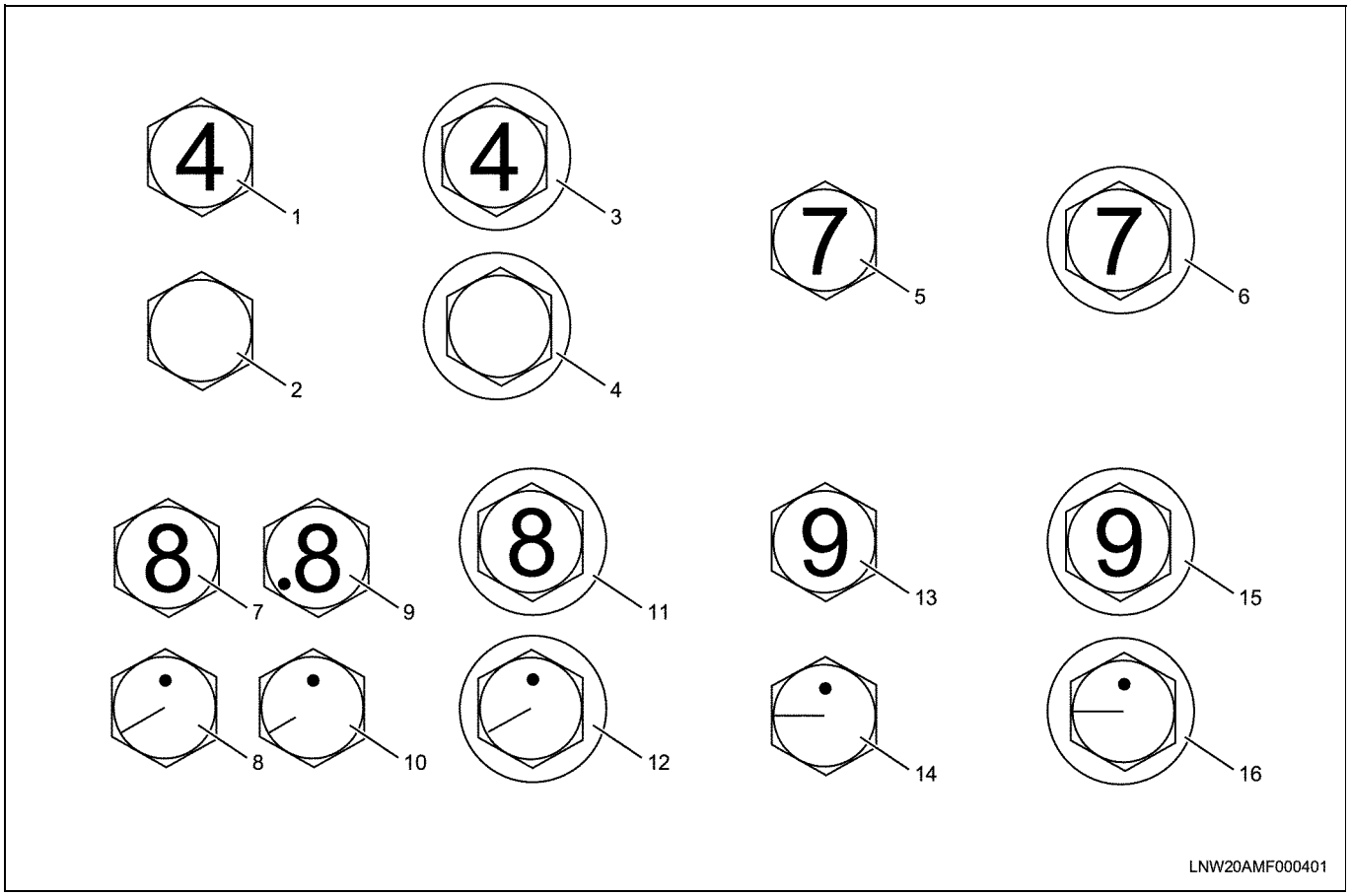
| | | | | | N·m {kgf·m} |
|---|---|---|---|---|---|
| | Strength classification | 4.8<br>4T | | 7T | |
| | Bolt head section shape | Hexagon head bolt | Flange bolt | Hexagon head bolt | Flange bolt |
| * | M10 × 1.5 | 19.6 ~ 33.3 {2.0 ~ 3.4} | 22.3 ~ 37.2 {2.3 ~ 3.8} | 27.5 ~ 45.1 {2.8 ~ 4.6} | 30.3 ~ 50.4 {3.1 ~ 5.1} |
| | M12 × 1.25 | 49.0 ~ 73.5 {5.0 ~ 7.5} | 54.9 ~ 82.3 {5.6 ~ 8.4} | 60.8 ~ 91.2 {6.2 ~ 9.3} | 68.1 ~ 102.1 {6.9 ~ 10.4} |
| * | M12 × 1.75 | 45.1 ~ 68.6 {4.6 ~ 7.0} | 51.0 ~ 76.5 {5.2 ~ 7.8} | 56.9 ~ 84.3 {5.8 ~ 8.6} | 62.7 ~ 94.0 {6.4 ~ 9.6} |
| | M14 × 1.5 | 76.5 ~ 114.7 {7.8 ~ 11.7} | 83.0 ~ 124.5 {8.5 ~ 12.7} | 93.2 ~ 139.3 {9.5 ~ 14.2} | 100.8 ~ 151.1 {10.3 ~ 15.4} |
| * | M14 × 2 | 71.6 ~ 106.9 {7.3 ~ 10.9} | 77.2 ~ 115.8 {7.9 ~ 11.8} | 88.3 ~ 131.4 {9.0 ~ 13.4} | 94.9 ~ 142.3 {9.7 ~ 14.5} |
| | M16 × 1.5 | 104.0 ~ 157.0 {10.6 ~ 16.0} | 115.6 ~ 173.3 {11.8 ~ 17.7} | 135.3 ~ 204.0 {13.8 ~ 20.8} | 150.1 ~ 225.2 {15.3 ~ 23.0} |
| * | M16 × 2 | 100.0 ~ 149.1 {10.2 ~ 15.2} | 109.4 ~ 164.2 {11.2 ~ 16.7} | 129.4 ~ 194.2 {13.2 ~ 19.8} | 142.5 ~ 213.8 {14.5 ~ 21.8} |
| | M18 × 1.5 | 151.0 ~ 225.6 {15.4 ~ 23.0} | — | 195.2 ~ 293.2 {19.9 ~ 29.9} | — |
| * | M18 × 2.5 | 151.0 ~ 225.6 {15.4 ~ 23.0} | — | 196.1 ~ 294.2 {20.0 ~ 30.0} | — |
| | M20 × 1.5 | 206.0 – 310.0 {21.0 ~ 31.6} | — | 269.7 ~ 405.0 {27.5 ~ 41.3} | — |
| * | M20 × 2.5 | 190.2 ~ 286.4 {19.4 – 29.2} | — | 249.1 ~ 374.6 {25.4 ~ 38.2} | — |
| | M22 × 1.5 | 251.1 – 413.8 {25.6 ~ 42.2} | — | 362.8 ~ 544.3 {37.0 ~ 55.5} | — |
| * | M22 × 2.5 | 217.7 ~ 327.5 {22.2 ~ 33.4} | — | 338.3 ~ 507.0 {34.5 ~ 51.7} | — |
| | M24 × 2 | 358.9 ~ 539.4 {36.6 ~ 55.0} | — | 430.5 ~ 711.0 {43.9 ~ 72.5} | — |
| * | M24 × 3 | 338.3 ~ 507.0 {34.5 ~ 51.7} | — | 406.0 ~ 608.0 {41.4 ~ 62.0} | — |

The * mark indicates where soft materials have been used for internal thread sections, such as castings.

| N·m {kgf·m} | | | | |
|---|---|---|---|---|
| Strength classification | 8.8 | | 9.8<br>9T | |
| Bolt head section shape | Hexagon head bolt | Flange bolt | Hexagon head bolt | Flange bolt |
| M6 × 1 | 5.6 ~ 11.2 {0.6 ~ 1.1} | 6.6 ~ 12.2 {0.6 ~ 1.2} | — | — |
| M8 × 1.25 | 13.4 ~ 25.7 {1.4 ~ 2.6} | 15.3 ~ 28.4 {1.6 ~ 2.9} | 16.7 ~ 30.4 {1.7 ~ 3.1} | 18.1 ~ 33.6 {1.9 ~ 3.4} |
| M10 × 1.25 | 31.3 ~ 52.5 {3.2 ~ 5.4} | 35.4 ~ 58.9 {3.6 ~ 6.1} | 37.3 ~ 62.8 {3.8 ~ 6.4} | 42.3 ~ 70.5 {4.3 ~ 7.2} |
| * M10 × 1.5 | 31.3 ~ 51.4 {3.2 ~ 5.2} | 34.5 ~ 57.5 {3.5 ~ 5.8} | 36.3 ~ 59.8 {3.7 ~ 6.1} | 40.1 ~ 66.9 {4.1 ~ 6.8} |
| M12 × 1.25 | 69.3 ~ 104.0 {7.1 ~ 10.6} | 77.7 ~ 116.5 {7.9 ~ 11.9} | 75.5 ~ 113.8 {7.7 ~ 11.6} | 85.0 ~ 127.5 {8.7 ~ 13.0} |
| * M12 × 1.75 | 64.8 ~ 96.1 {6.6 ~ 9.8} | 71.4 ~ 107.2 {7.3 ~ 10.9} | 71.6 ~ 106.9 {7.3 ~ 10.9} | 79.5 ~ 119.2 {8.1 ~ 12.2} |
| M14 × 1.5 | 106.2 ~ 158.8 {10.8 ~ 16.2} | 114.9 ~ 172.3 {11.7 ~ 17.6} | 113.8 ~ 170.6 {11.6 ~ 17.4} | 123.4 ~ 185.1 {12.6 ~ 18.9} |
| * M14 × 2 | 100.6 ~ 149.8 {10.3 ~ 15.3} | 108.2 ~ 162.2 {11.1 ~ 16.6} | 106.9 ~ 160.0 {10.9 ~ 16.3} | 115.5 ~ 173.3 {11.8 ~ 17.7} |
| M16 × 1.5 | 154.3 ~ 232.5 {15.7 ~ 23.7} | 171.1 ~ 256.7 {17.4 ~ 26.2} | 160.0 ~ 240.3 {16.3 ~ 24.5} | 176.9 ~ 265.3 {18.0 ~ 27.1} |
| * M16 × 2 | 147.6 ~ 221.4 {15.0 ~ 22.6} | 162.5 ~ 243.8 {16.6 ~ 24.9} | 153.0 ~ 229.5 {15.6 ~ 23.4} | 168.5 ~ 252.7 {17.2 ~ 25.8} |
| M18 × 1.5 | 222.5 ~ 334.3 {22.7 ~ 34.1} | — | 229.5 ~ 345.2 {23.4 ~ 35.2} | — |
| * M18 × 2.5 | 223.6 ~ 335.4 {22.8 ~ 34.2} | — | 230.5 ~ 346.2 {23.6 ~ 35.3} | — |
| M20 × 1.5 | 307.4 ~ 461.7 {31.4 ~ 47.1} | — | 316.8 ~ 475.6 {32.3 ~ 48.5} | — |
| * M20 × 2.5 | 284.0 ~ 472.1 {29.0 ~ 43.5} | — | 293.2 ~ 440.3 {29.2 ~ 44.9} | — |
| M22 × 1.5 | 413.6 ~ 620.5 {42.2 ~ 63.3} | — | 424.6 ~ 636.5 {43.3 ~ 64.9} | — |
| * M22 × 2.5 | 385.7 ~ 578.0 {39.3 ~ 58.9} | — | 394.2 ~ 592.3 {40.0 ~ 60.4} | — |
| M24 × 2 | 490.8 ~ 810.5 {50.0 ~ 82.7} | — | 554.1 ~ 830.6 {56.5 ~ 84.7} | — |
| * M24 × 3 | 462.8 ~ 693.1 {47.2 ~ 70.7} | — | 520.7 ~ 781.6 {53.1 ~ 79.7} | — |

The * mark indicates where soft materials have been used for internal thread sections, such as castings.

**Designations for Isuzu standard bolt heads**




**Legend**

1. Hexagon head bolt(4.8, 4T)
2. Hexagon head bolt(4.8, 4T)
3. Flange bolt(4.8, 4T)
4. Flange bolt(4.8, 4T)
5. Hexagon head bolt(7T)
6. Flange bolt(7T)
7. Hexagon head bolt (refined 8.8)
8. Hexagon head bolt (refined 8.8)
9. Hexagon head bolt(Un-refined 8.8)
10. Hexagon head bolt(Un-refined 8.8)
11. Flange bolt(8.8)
12. Flange bolt(8.8)
13. Hexagon head bolt(9.8, 9T)
14. Hexagon head bolt(9.8, 9T)
15. Flange bolt(9.8, 9T)
16. Flange bolt(9.8, 9T)

**Flare nut**

| | Pipe diameter | tightening torque (for medium and large size vehicles) | Flare nut 2 side width (mm) | |
|---|---|---|---|---|
| | | | Old | New |
| Flare nut tightening torque (service standard value) N·m {kgf·m} | ϕ4.76 mm | 12.8 ~ 18.6 {1.3 ~ 1.9} | 14 | 14 |
| | ϕ6.35 mm | 23.5 ~ 49 {2.4 ~ 5.0} | 17 | 17 |
| | ϕ8.0 mm | 23.5 ~ 49 {2.4 ~ 5.0} | 19 | 17 |
| | ϕ10.0 mm | 44.1 ~ 93.2 {4.5 ~ 9.5} | 22 | 19 |
| | ϕ12.0 mm | 58.8 ~ 137.3 {6.0 ~ 14.0} | 27 | 24 |
| | ϕ15.0 mm | 78.5 ~ 156.9 {8.0 ~ 16.0} | 30 | 30 |

**Taper screw from connectors (brass)**

| | | | | N·m {kgf·m} |
|---|---|---|---|---|
| Screw size | PT(R) 1/8 | PT(R) 1/4 | PT(R) 3/8 | PT(R) 1/12 |
| — | 2.0 ~ 14.7<br>(0.2 ~ 1.5) | 4.9 ~ 15.7<br>(0.5 ~ 1.6) | 9.8 ~ 16.7<br>(1.0 ~ 1.7) | 9.8 ~ 17.7<br>(1.0 ~ 1.8) |

# ENGINE

## ENGINE MECHANICAL (4HK1, 6HK1)

## TABLE OF CONTENTS

# ISUZU DIESEL ENGINE (4HK1, 6HK1)

## Precautions on Service Work

**Matters that require attention in terms of maintenance**

To prevent damage to the engine and ensure reliability of its performance, pay attention to the following in maintaining the engine: When taking down the engine on the ground, do not make the bearing surface of the oil pan touch directly the ground. Use a wood frame, for example, to support the engine with the engine foot and the flywheel housing.

Because there is only a small clearance between the oil pan and the oil pump strainer, it can damage the oil pan and the oil strainer.

- When the air duct or air cleaner is removed, cover the air intake opening to prevent foreign matter from getting into the cylinder. If it gets into it, it can considerably damage the cylinder and others while the engine is operating.
- When maintaining the engine, never fail to remove the battery ground cable. If not, it may damage the wire harness or electrical parts. If you need electricity on for the purpose of inspection, for instance, watch out for short circuits and others.
- Apply engine oil to the sliding contact surfaces of the engine before reassembling it. This ensures adequate lubrication when the engine is first started.
- When valve train parts, pistons, piston rings, connecting rods, connecting rod bearings or crankshaft journal bearings are removed, put them in order and keep them.
- When installing them, put them back to the same location as they were removed.
- Gaskets, oil seals, O-rings, etc. must be replaced with new ones when the engine is reassembled.
- As for parts where a liquid gasket is used, remove an old liquid gasket completely and clean it up thoroughly so that no oil, water or dust may be clung to them. Then, apply the designated liquid gasket to each place anew before assembly.
- Surfaces covered with liquid gasket must be assembled within 7 minutes of gasket application. If more than 7 minutes have elapsed, remove the existing liquid gasket and apply new liquid gasket.
- When assembling or installing parts, fasten them with the specified tightening torque so that they may be installed properly.

**Matters that require attention in specifically dealing with this engine.**

Holes or clearances in the fuel system, which serve as a passage of fuel, including the inside of the injector, are made with extreme precision. For this reason, they are highly sensitive to foreign matter and if it gets in, it can lead to an accident on the road, for instance; thus, make sure that foreign matter will be prevented from getting in.

When servicing the fuel system, every precaution must be taken to prevent the entry of foreign material into the system.

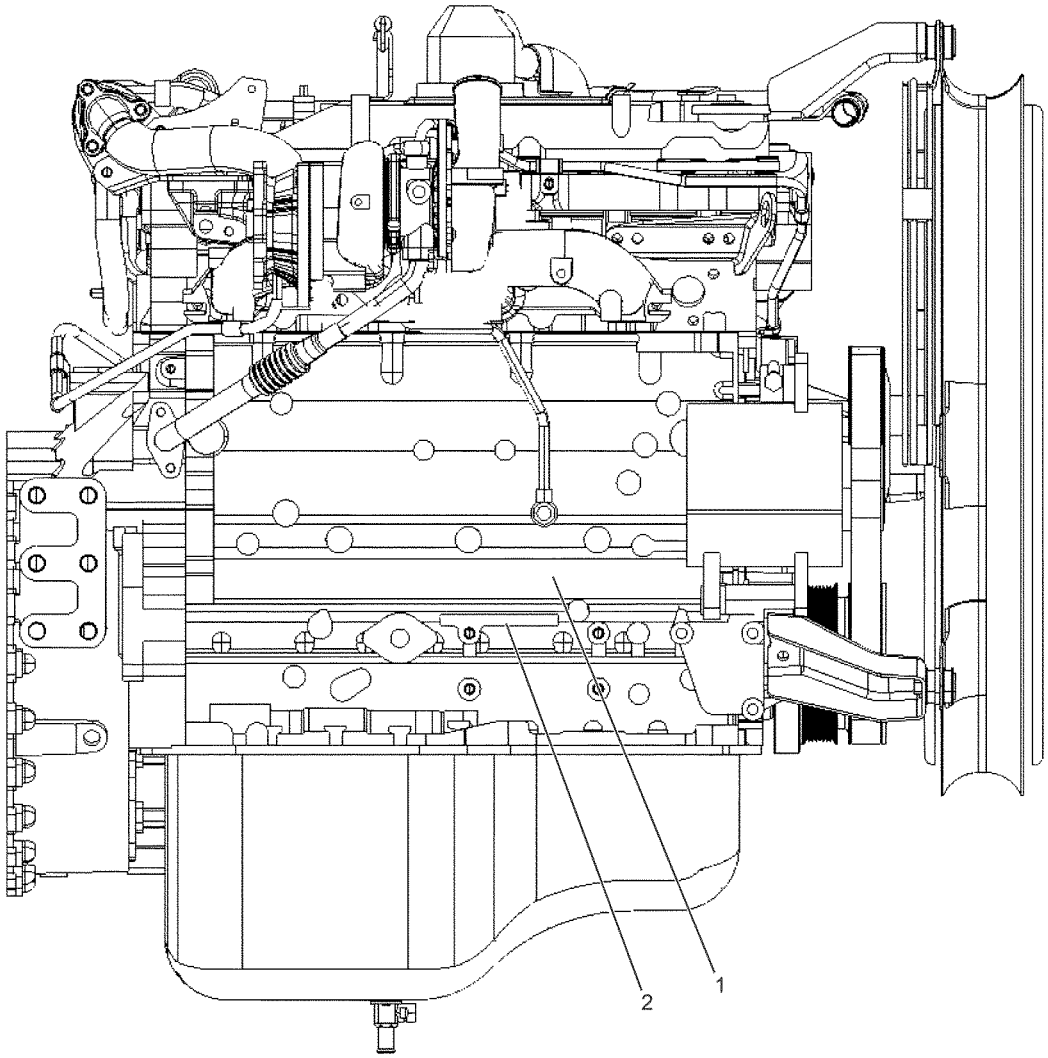
- Before beginning the service procedure, wash the fuel line and the surrounding area.
- Perform the service procedures with clean hands. Do not wear work gloves.
- Immediately after removing the fuel hose and/or fuel pipe, carefully tape vinyl bags over the exposed ends of the hose or pipe.
- If parts are to be replaced (fuel hose, fuel pipe, etc.) do not open the new part packaging until installation.

**Work procedure**

- The fuel opening must be quickly sealed when removing the fuel pipe, injection pipe, fuel injector, fuel supply pump, and common rail.
- The eyebolts and gasket must be stored in a clean parts box with a lid to prevent adhesion of foreign matter.
- Fuel leakage could cause fires. Therefore, after finishing the work, wipe off the fuel that has leaked out and make sure there is no fuel leakage after starting the engine.

**How to read the model**

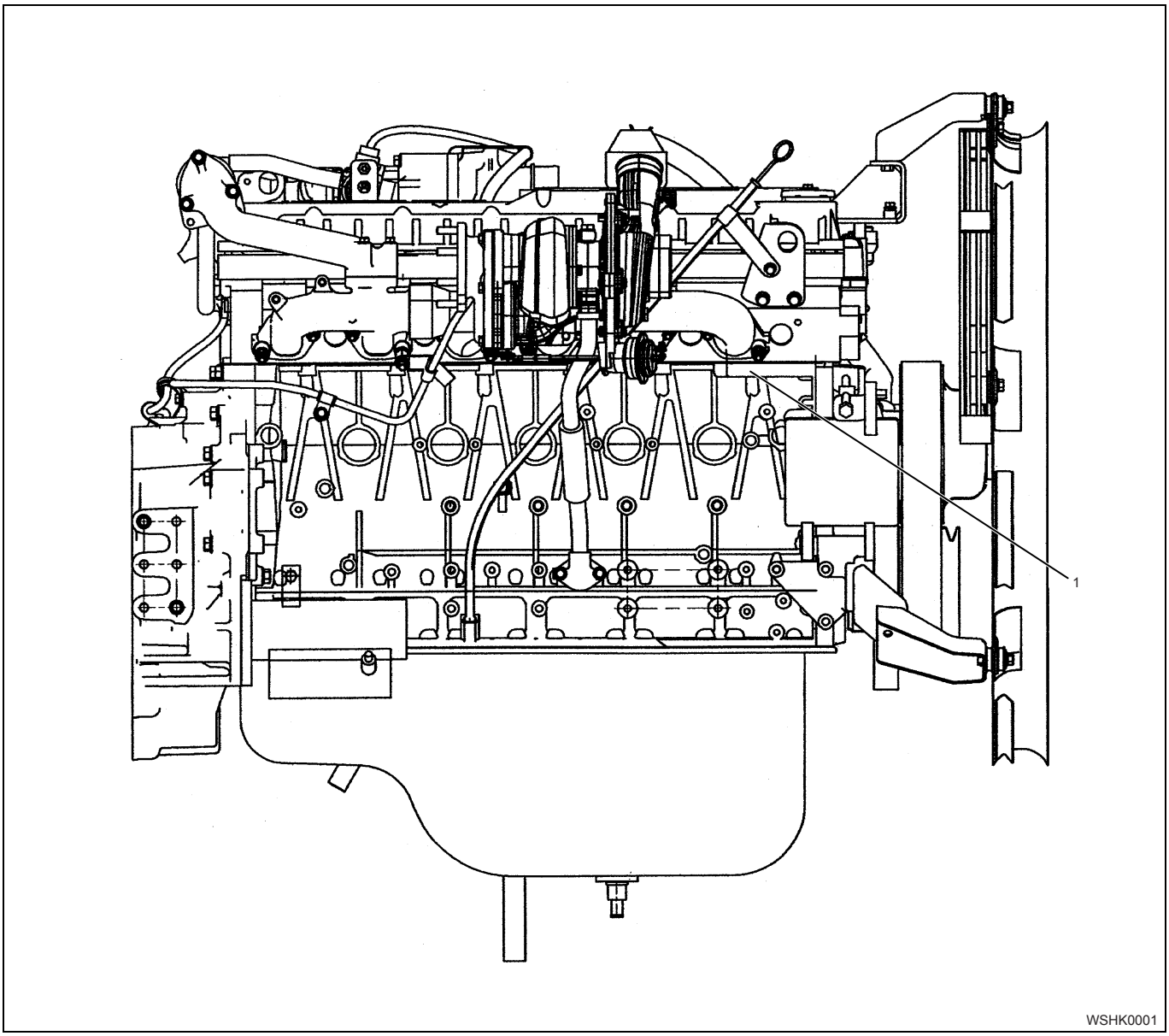
**4HK1**




**Name**

1. Cast The Engine Model
2. Stamp An Engine Number

**6HK1**




**Name**

1. Stamp An Engine Number

**Explanations on functions and operation**

**Electronic engine control**
With the control unit, the range from injection to air intake/exhaust, including fuel injection quantity, injection timing, intake air restriction, EGR, and idling rpm, is controlled.

**Cylinder block**
The cylinder block is cast-iron with the center distance of each bore being equal and is of the highly rigid, symmetrical structure with the crankshaft center being the center. The bearing cap is of the ladder frame structure and tightened up under the plastic range rotation angle method.

**Crankshaft**
Tuftriding is given, while on the No. 1 balance weight

**Cylinder liner**
The cylinder liner is selected to match an internal diameter of a bore of the cylinder block and built, which is imprinted on the left side of the cylinder.

**Piston**
The piston is aluminum-alloy and an autothermatic piston with a strut cast, while the combustion chamber is a round reentrant type.

**Cylinder head**
The cylinder head is cast-iron and there are 4 valves per cylinder. The angular tightening method of the cylinder head bolt further increases reliability and durability.

imprinted is the grade of each journal diameter.

**EGR system**
Based upon data, including water temperature, engine speeds or engine loads, it is controlled via Engine Control Module (ECM) to purify exhaust by recycling part of it.
Its main components include an EGR valve, an EGR cooler and various sensors.

**Connecting rod cap bolt**
The angular tightening method of the connecting rod cap bolt further increases reliability and durability.

**Common rail-type electronic control injection system**
The common rail-type electronic control injection system is composed of a fuel supply pump that sets the target pressure of high-pressure fuel and supply it, a common rail that measures such high-pressure fuel and a fuel injector that turns it into a fine spray and injects it. Each is controlled via ECM based upon various signals, while injection timing or fuel injection quantity is controlled under every possible driving condition.

**Fuel injector**
The fuel injector is a 7-hole nozzle that adjusts fuel injection quantity or injection timing by opening or closing an electromagnetic valve on the head of the fuel injector.
ECM corrects the dispersion of fuel injection quantity between fuel injectors according to ID code data in memory. At the replacement of fuel injectors, ID code data should be stored in ECM.

**Fuel filter with sedimenter**
It is a fuel filter with sedimenter that gets rid of water by making use of the difference in specific gravity between light oil and water, which comes with an indicator that notifies you that it is filled with water.

**Preheating system**
The preheating system consists the ECM, the glow relay, glow plugs and the glow indicator lamp. The preheating system is operated when the engine coolant temperature is low, and make the engine easy to start.

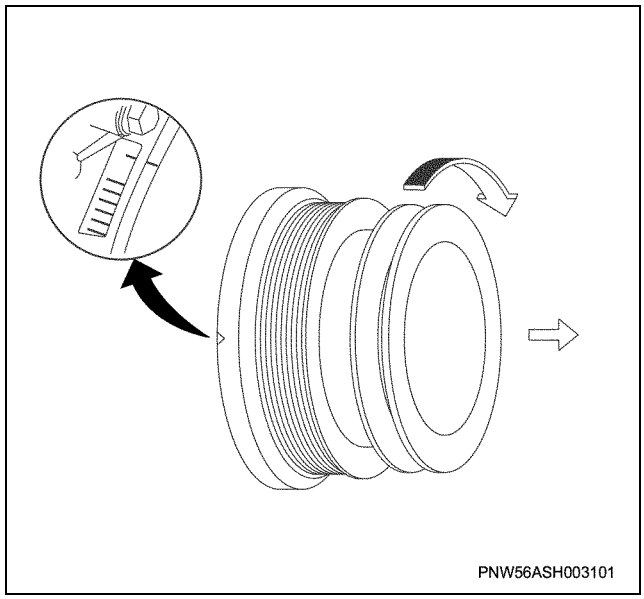
**Lubrication system**
It is an oil filter with full-flow bypass, which uses a water-cool oil cooler and oil jet to cool the piston.

**Function check**

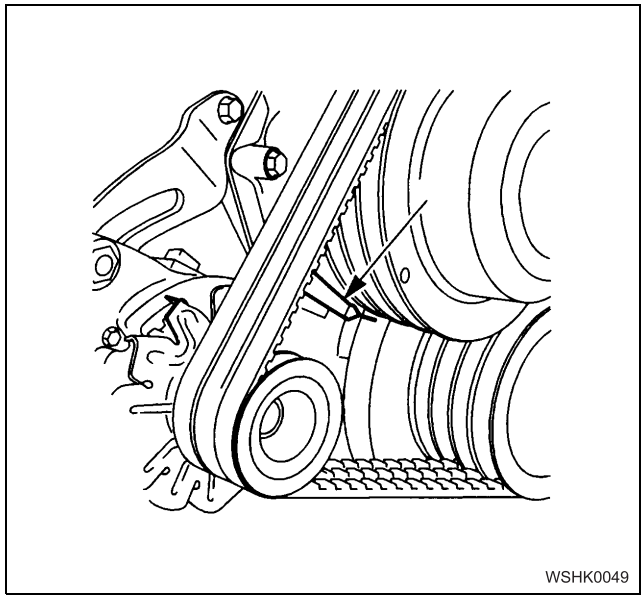
**Inspection/adjustment of valve clearance**

1. Inspection of valve clearance
   - Remove the cylinder head cover.
   - Remove the fuel injector harness ASM.
   - Loosen the terminal nuts alternately to remove.
   - Remove the leak off pipe.
   - Rotate the crankshaft to make the No.1 cylinder meet the compression top dead center (TDC).

**4HK1**




**6HK1**




   - Insert a 0.4 mm (0.016 in) thickness gauge into a clearance between the rocker arm and the bridge to check it and adjust it if needed.

| Valve clearance | mm (in) |
|---|---|
| Intake valve | 0.4 (0.016) |
| Exhaust valve | 0.4 (0.016) |

**Caution:**
Adjust while being cold.

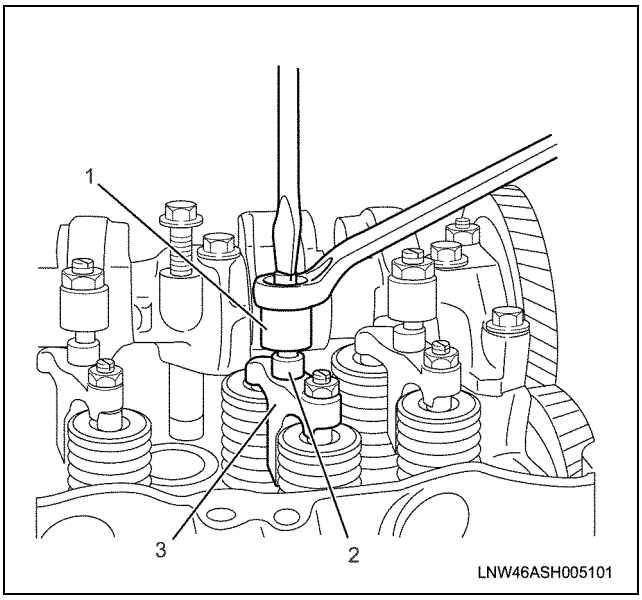
2. Adjustment of valve clearance

**Caution:**
Adjust valve clearance carefully so that the bridge may become level (hit the end of the 2 valve axes).

   a. Completely loosen all of the bridge and rocker arm adjusting nuts and adjusting screws (4HK1: 8 nuts and 8 screws, 6HK1: 12 nuts and 12 screws).

b. Place a 0.4 mm (0.016 in) thickness gauge between the No. 1 cylinder rocker arm end and the bridge cap.
c. Tighten the rocker arm adjusting screw until the thickness gauge is snug (not tight) between the rocker arm end and the bridge cap.
d. Tighten the rocker arm lock nut.
e. Tighten the bridge adjusting screw until the bridge contacts the valve head.
f. Tighten the bridge lock nut.
g. Check that the thickness gauge is still held snugly between the rocker arm end and the bridge cap. If it is too tight, slightly loosen the bridge adjusting screw and lock nut to restore snugness.
h. Remove the thickness gauge.
i. Repeat Steps 2 through 5 for the remaining cylinders.

Tightening torque: 22 N·m (2.2 kg·m/16 lb ft)



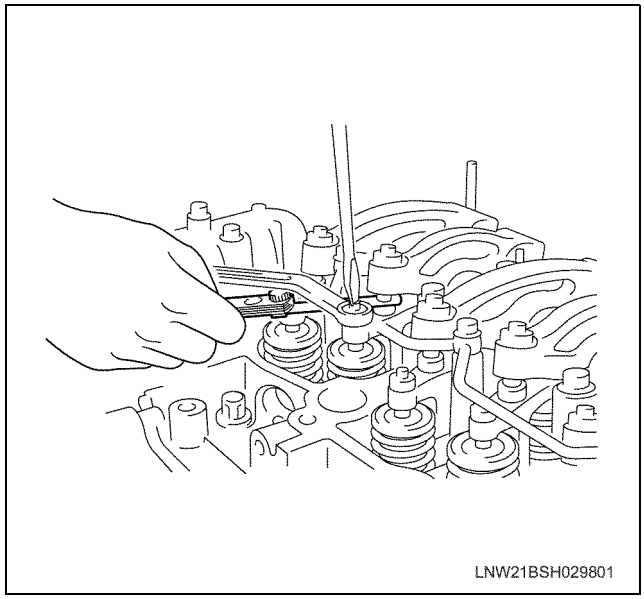

**Name**

1. Rocker Arm
2. Bridge Cap
3. Bridge

- With a thickness gauge kept inserted, tighten an adjusting screw of the bridge lightly and make sure that the tip of the adjusting screw touches the end of valve axis and the movement of the thickness gauge has become tight.
- Then, check if the end of the valve axis on the opposite side is unstable or hits diagonally. If so, loosen the bridge adjusting screw a little so that the end of the valves on both sides may touch properly.
  Valve bridge clearance: ± 0.1 mm (0.0039 in) or less
- After making an adjustment so that the end of the valves on both sides may touch properly, tighten up an adjusting screw nut of the bridge with a flathead screwdriver so that the bridge adjusting screw may not rotate.

Tightening torque: 22 N·m (2.2 kg·m/16 lb ft)

**Caution:**
If the adjusting screw of the bridge is poorly adjusted, the bridge would tilt and be pushed down and seized, which may damage the bridge guide, for example. Thus, adjust it accurately.




Tightening torque:
Rocker arm adjustment screw nut 22 N·m (2.2 kg·m/16 lb ft)
Bridge adjustment screw nut 22 N·m (2.2 kg·m/16 lb ft)

**Adjustment table (4HK1)**

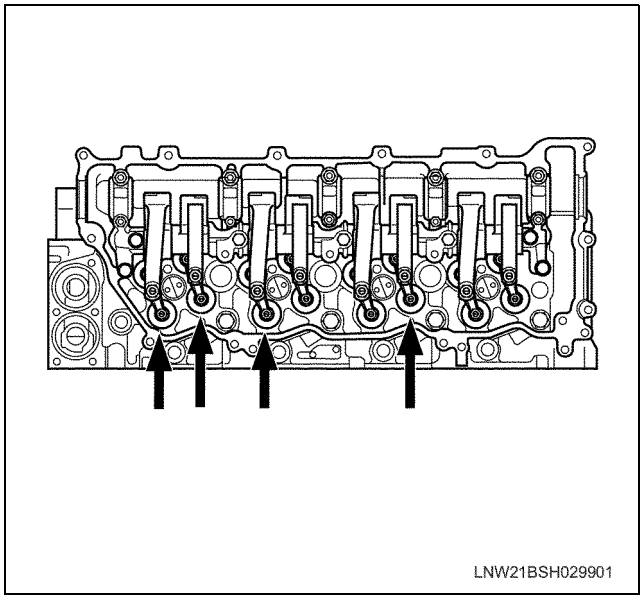
| Cylinder No. | 1 | | 2 | | 3 | | 4 | |
|---|---|---|---|---|---|---|---|---|
| Valve arrangement | IN | EX | IN | EX | IN | EX | IN | EX |
| No. 1 cylinder Compression top dead center position | ○ | ○ | ○ | | | ○ | | |
| No. 4 cylinder Compression top dead center position | | | | × | × | | × | × |

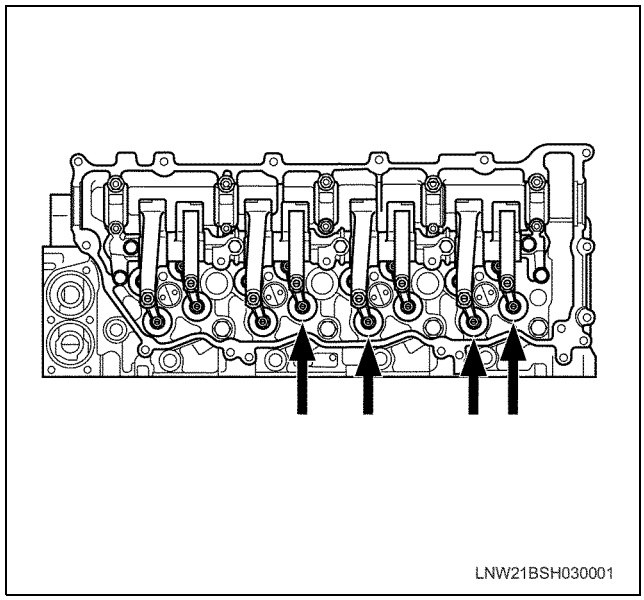
**Adjustment table (6HK1)**

| Cylinder No. | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Valve arrangement | IN | EX | IN | EX | IN | EX | IN | EX | IN | EX | IN | EX |
| No. 1 cylinder Compression top dead center position | ○ | ○ | ○ | | | ○ | ○ | | | ○ | | |
| No. 6 cylinder Compression top dead center position | | | | × | × | | | × | × | | × | × |

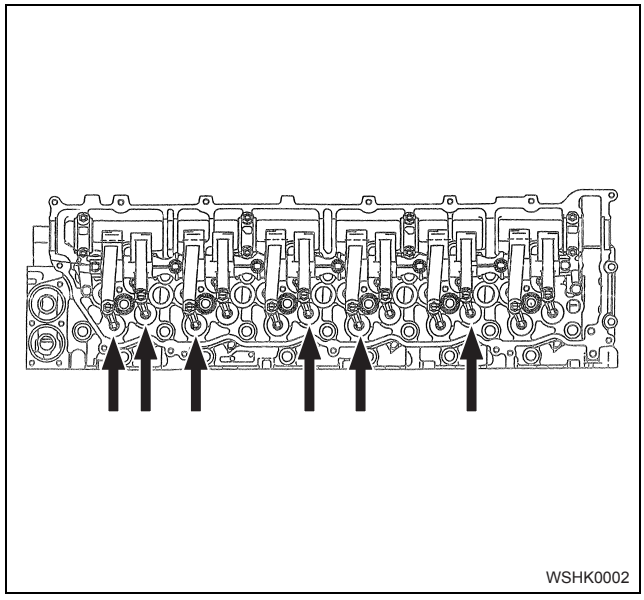
- If the No. 1 cylinder is the compression TDC, adjust a valve clearance with ○ mark given on the table and if the No. 4 (4HK1) or No. 6 (6HK1) cylinder is the compression TDC, that with × mark.

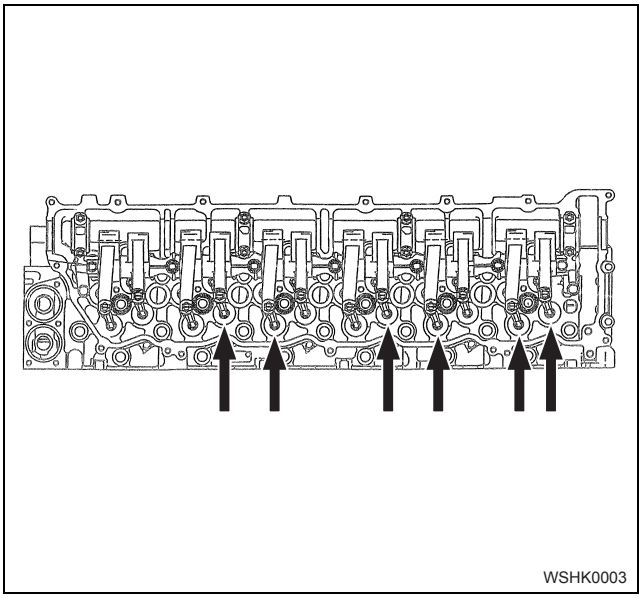
**4HK1**




**6HK1**






- Attach the harness ASM to the fuel injector. Tighten the harness bracket with the designated torque.

Tightening torque: 48 N·m (4.9 kg·m/35 lb ft)

- Install the terminal nuts on the fuel injector.

Tightening torque: 2 N·m (0.2 kg·m/18 lb in)

**Note:**

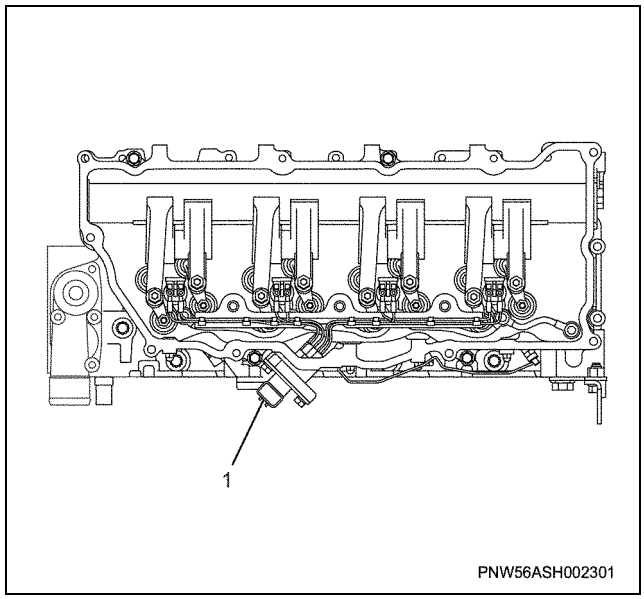
- Tighten the terminal nuts alternately in order to prevent imbalance in tightening because they are unified.
- Do not tighten the nuts too tightly because it leads to damage to the terminal stud.
  - Install the cylinder head cover. Refer to the “Cylinder Head Cover”.

**Compression pressure inspection**

- Warm-up the engine.
- Remove a negative terminal of the battery and remove all the glow plugs.
- Remove the harness connector for the fuel injector built on the lower head cover (no fuel will be injected).

**Caution:**
When the harness connector is removed, ECM judges that it broke down and DTC is recorded. Upon completion of measurement, never fail to clear memory of ECM.
(For how to clear memory of ECM, refer to the Engine Control System Section)

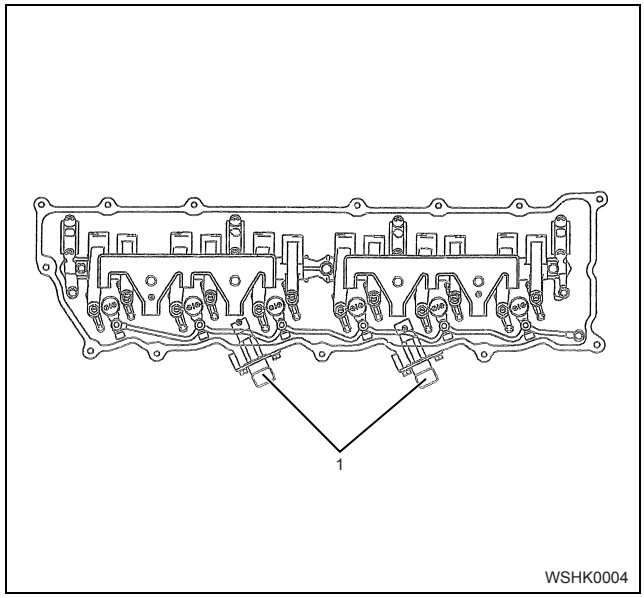
**4HK1**




**Name**

1. Fuel Injector Harness Connector

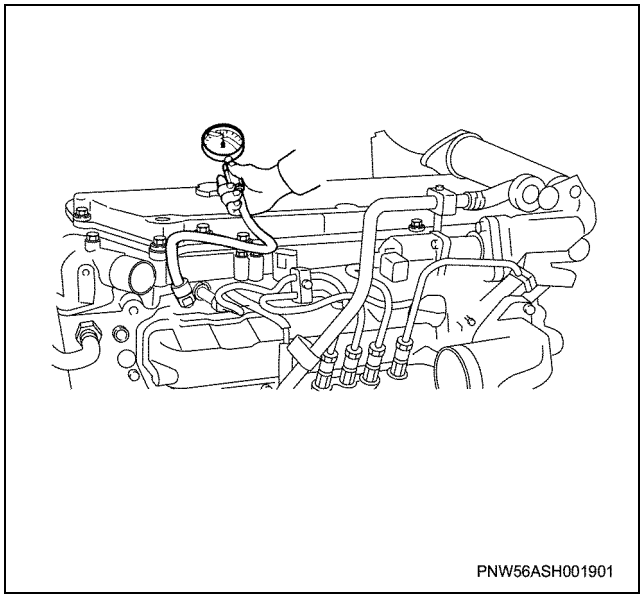
**6HK1**




**Name**

1. Fuel Injection Harness Connector

- Install the negative terminal of the battery.
- Turn on the starter to emit foreign matter within the cylinders.
- Install an adapter and a gauge of a compression gauge of the special tool.




Compression gauge: 5-8840-2675-0 (J-26999-12)
Compression gauge adapter
4HK1: EN-46722
6HK1: 380.002.627

- Turn on the starter to inspect compression pressure.

**4HK1**

| Compression pressure | MPa (psi) / 200 rpm |
|---|---|
| Standard | 2.84 – 3.24 (412 – 469) |
| Limit | 1.96 (284) |
| Differences among the cylinders | 294 kPa (43) |

**6HK1**

| Compression pressure | MPa (psi) / 200 rpm |
|---|---|
| Standard | 3.24 (469) |
| Limit | 2.26 (327) |
| Differences among the cylinders | 294 kPa (43) |

- Measure each cylinder one by one.

**Caution:**
To keep engine speed at 200 rpm or more, use fully charged batteries.

- Remove a compression gauge of the special tool.
- Remove a negative terminal of the batteries.
- Install a harness connector for the fuel injector built on the lower head cover.
- Install all the glow plugs.

Tightening torque: 20 N·m (2.0 kg·m/15 lb ft)

- Install the negative terminal of the battery.

## Main Data and Specifications

| Item | | Engine model 4HK1 |
|---|---|---|
| Type | | Diesel/4-cycle/water cooled-type, inline four-cylinder OHC |
| Combustion chamber form | | Direct injection type |
| Cylinder liner type | | Dry type |
| Number of cylinders - cylinder bore × strokes mm (in) | | 4-115 (4.53) × 125 (4.92) |
| Displacement cc (cu.in) | | 5193 (317) |
| Compression ratio | | 17.5 |
| Compression pressure MPa (psi)/rpm | | 3.23 (468)/200 |
| Idle speed rpm | | 800 |
| Valve clearance mm (in) | Intake | 0.4 (0.016) (cold) |
| | Exhaust | 0.4 (0.016) (cold) |
| Ignition type | | Compressed ignition |
| Injection order | | 1 - 3 - 4 - 2 |
| Lubricating system | | |
| Lubricating type | | Pressure type |
| Oil pump type | | Gear type |
| Volume of lubricating oil L (qts) | | 13.0 (13.7) — 20.5 (21.7) |
| Oil filter type | | Full flow filter (cartridge type) |
| Oil cooling type | | Built-in, water-cooling |
| Cooling system | | |
| Cooling type | | Water cooling type |
| Radiator type | | Corrugated fin (pressure type) |
| Water pump type | | Centrifugal, belt type |
| Thermostat type | | 2 wax-type units |
| Thermostat valve-opening temperature °C (°F) | | 85 (185) |
| Volume of coolant L (qts) | | 14 (14.8) (incl. radiator) |
| Fuel system | | |
| Injection pump type | | Electronic control common rail type |
| Governor type | | Electronic type |
| Timer type | | Electronic type |
| Injection nozzle type | | Multi-hole type<br>7-hole and ϕ 0.16 mm (0.0063 in) inside diameter |
| Charging system | | |
| Generator type | | AC type |
| Power output V/A | | 24 - 50 |
| Regulator type | | IC |