

Engine Manual Workshop Manual

4HK1

GB3 EXHAUST EMISSION STANDARDS

4HK1 GB3 EXHAUST EMISSION STANDARDS ENGINE MANUAL WORKSHOP MANUAL

 **Hitachi Construction Machinery Co., Ltd.**

URL:<http://www.hitachi-c-m.com>

Service Manual consists of the following sections.
Technical Manual (Operational Principle)
Technical Manual (Troubleshooting)
Workshop Manual
Engine Manual

FOREWORD

This manual describes the service procedures for the 4HK1 diesel engine (GB 3).

The contents of this manual are current at the date of issue, but may differ slightly from your engine due to specification changes or other modifications made thereafter.

The engine specification and description, which is not installed in the machine, may be explained on this manual.

This manual consists of the following sub-sections.

Publication No.	Publication Name	Sub-sections	
IDE-2820	ENGINE	0	Introduction
		14A	Service Information Guide
		15B	Maintenance Information
		15C	Functional Inspection
		15D	Symptom
		15E	DTC Information
		1A	Engine Control
		1B	Mechanical
		1C	Fuel System
		1D	Cooling
		1E	Lubrication
		1F	Induction
		1H	Aux. Emission Control Devices
		1J	Electrical
-	Wiring Diagram		

Introduction

Introduction

(All)

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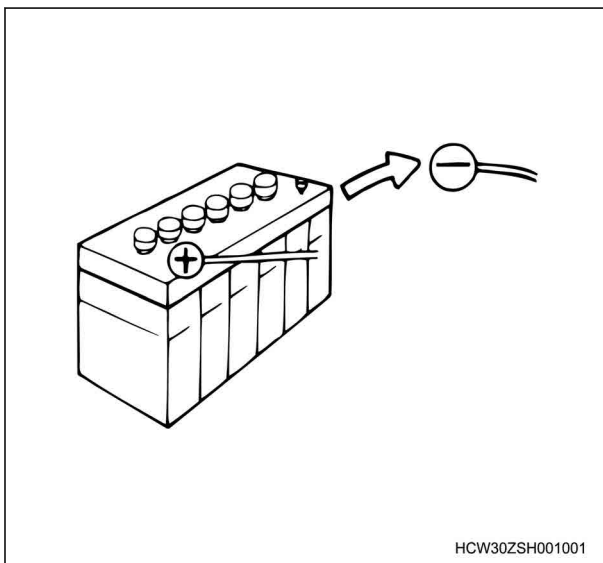
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Introduction

safety information

1. Repair work safety information

1. When the engine is unloaded from the machine, use the engine stand.
When placing the engine, place it in a way that the oil pan does not interfere.
2. When performing a work with two or more people, perform while ensuring each other's safety.
3. Do not disconnect the battery cable for approx. 1 minute after turning OFF the ignition switch. If the power supply to the ECM is cut within approx. 1 minute after turning OFF the ignition switch, failures to the ECM may be caused.
4. When repairing the electrical system, make sure to disconnect the negative cable from the battery terminal before performing the work. When removing the battery cover, do so away from fire.

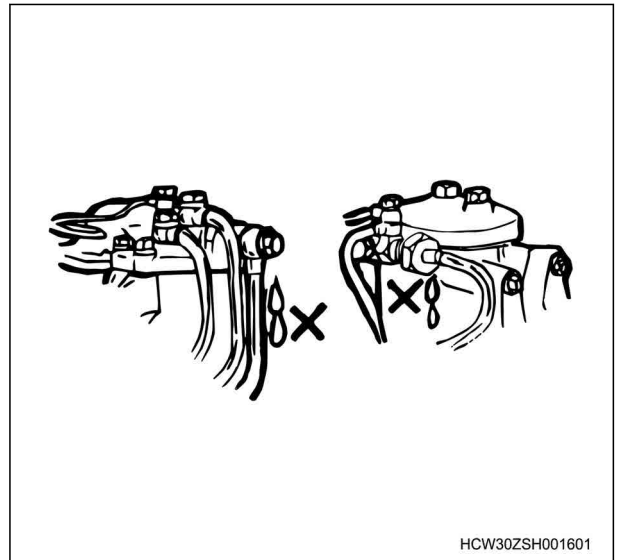


5. Do not leave the engine running for an extended period of time or perform painting in a poorly ventilated working environment.
6. Make sure to use the special tools if the procedure requires them for the work. If the procedure is performed with other tools, the parts may be damaged or injuries may occur.
7. Always inspect and prepare in advance the instruments, special tools, and the tools to be used. Also, do not use tools such as wrenches that have lost their edge, hammers with frayed edges, or chipped chisels.
8. When performing work using a device such as a grinder, crane, or welder, perform the procedure

while paying sufficient attention to the handling precautions.

Furthermore, for work besides this, carry out work while wearing safety clothes and equipment.

9. When performing maintenance on the fuel system, make sure to check that there is no fuel leakage.



10. When handling volatile materials, take care that they do not catch fire.
Make sure to wipe away any oil that sticks to rubber parts, as it can cause deterioration.
2. Replacement parts and parts number safety information
 1. Whenever disassembly is performed, make sure to replace the packing, oil seals, O-rings, crimping lock nuts, bending lock plates, cotter pins, etc., with new ones.
 2. Make sure to check the supply system and part numbers in the parts catalog because the part numbers indicated in this manual may differ from the supply system and are subject to change.

Description General Information

Service Information Guide

(All)

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Contents included in service information

1. Contents included in service information

Removal

Includes the removal procedure when repairing parts, devices, etc.

Installation

Includes the installation procedure when repairing parts, devices, etc.

Disassembly

Includes the disassembly procedure when overhauling a unit, assembly part, etc.

Assembly

Includes the assembly procedure when overhauling a unit, assembly part, etc.

Inspection

Includes inspection items for parts requiring inspection to ensure continued performance of parts, devices, etc. Values are listed for parts whose specified values, setting values, and use conditions have been determined.

Cleaning

Includes the cleaning procedure for parts, devices, etc.

Preparation

Includes the preparatory procedure necessary before removing parts, devices, etc.

Adjustment

Includes the adjustment procedure if adjustment to the set or specified values is necessary when performing assembly or installation.

Measurement

Includes the measurement procedure for determining if the installation position of parts is correct, etc.

Drain

Includes the draining procedure for oil, etc.

Refill

Includes the refilling procedure for oil, etc.

Air removal

Includes the air removal procedure when air removal is necessary after changing oil, etc.

Precaution

Includes the maintenance precautions specific to each item.

Disconnection

Includes the disconnection procedures for wiring, piping, etc.

Connection

Includes the connection procedures for wiring, piping, etc.

Writing

Includes the writing procedure necessary when replacing the ECM or supply pump.

Setting

Includes the setting procedure necessary when replacing the ECM, etc.

Replacement

Includes the procedure for replacing parts, changing oil, etc.

Prioritized DTC

Includes DTCs that need to be diagnosed and resolved before the relevant DTC when multiple DTCs are set.

Diagnosis

Includes the diagnostic procedure for troubleshooting symptoms. DTCs are listed in order of priority.

Repair verification

Includes the procedure for verifying resolution of the symptom by using numerical values, etc., other than the verification that DTCs are cleared.

Functional description

Includes the detailed functional description related to the functional inspection.

Symptom description

Includes the detailed symptom descriptions related to a diagnosis by symptom.

DTC description

Includes the circuit description related to DTCs.

Setting conditions

Includes the conditions and the judgment conditions for the ECM, etc. to set DTCs.

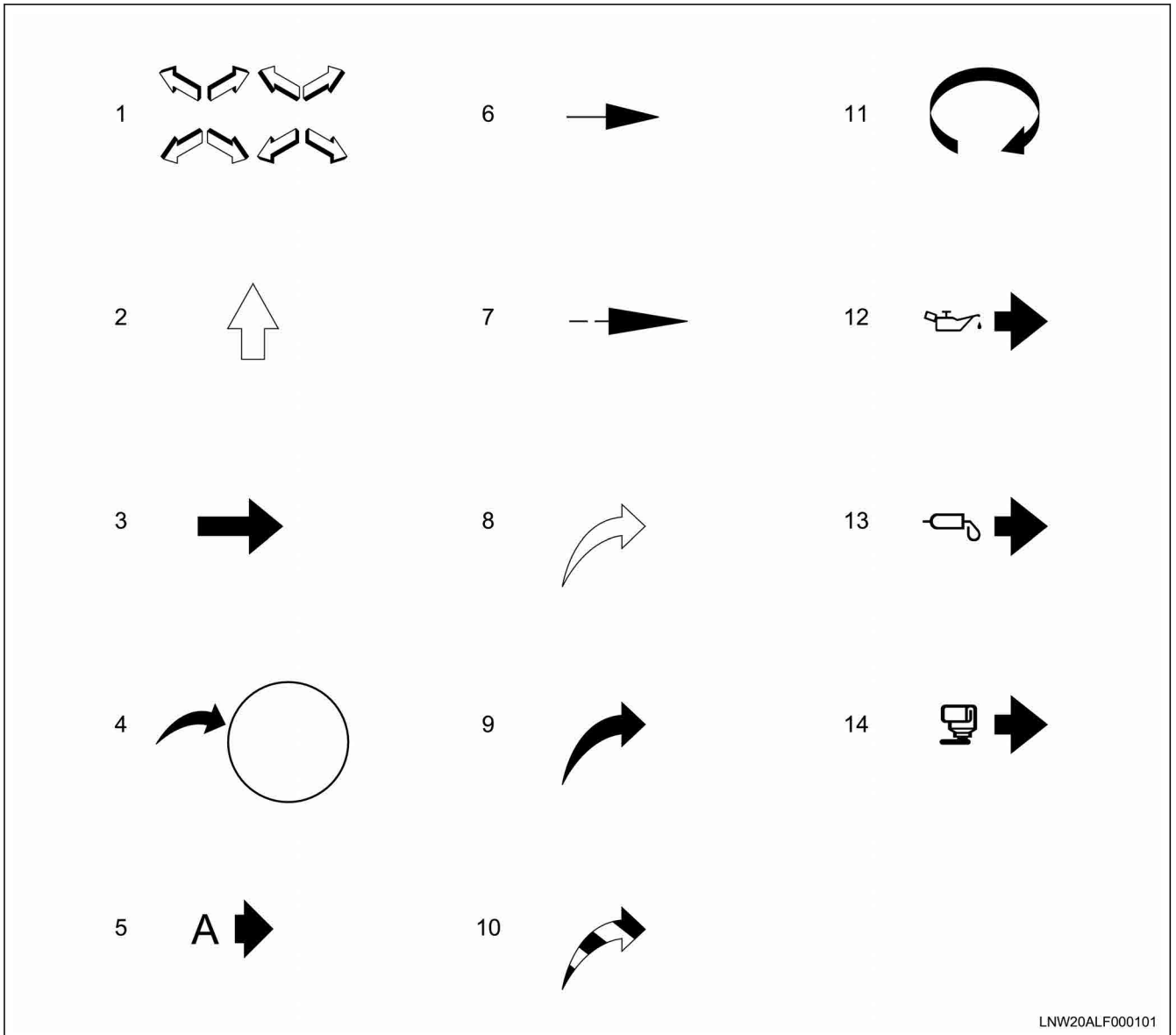
Action taken when set

Includes the information related to the control actions taken by the ECM, etc., when DTCs are set.

Items related to ETM

Items related to the ETM are described in the instructions on how to view the wiring diagram.

2. Arrows and symbols



LNW20ALF000101

- | | |
|---|--|
| 1. Forward | 9. Gas or warm air |
| 2. Upward | 10. Mixing of outside air and gas or mixing of cold air and warm air |
| 3. Operating section or operating direction | 11. Rotational direction |
| 4. Detail of a particular part | 12. Apply oil |
| 5. Detailed view from A | 13. Apply grease |
| 6. Arrow indicating a dimension | 14. Apply liquid gasket |
| 7. Arrow indicating a cross-section | |
| 8. Outside air or cold air | |

Plastic gauge

1. Using the plasti-gauge

Type	Measurable range
PG-1 (Green)	: 0.025 to 0.076 mm { 0.00098 to 0.00299 in }
PR-1 (Red)	: 0.051 to 0.152 mm { 0.00201 to 0.00598 in }
PB-1 (Blue)	: 0.102 to 0.229 mm { 0.00402 to 0.00902 in }

Method for measuring clearance between the connecting rod bearing and the crank pin

Clean the connecting rod and bearing, and assemble the bearing to the connecting rod.

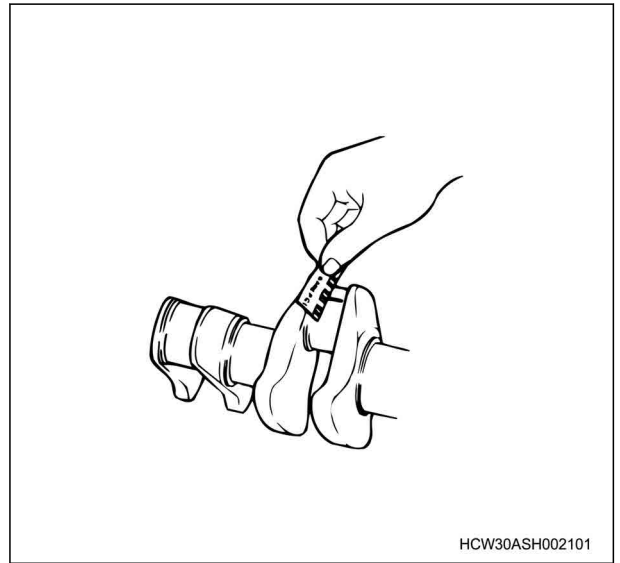
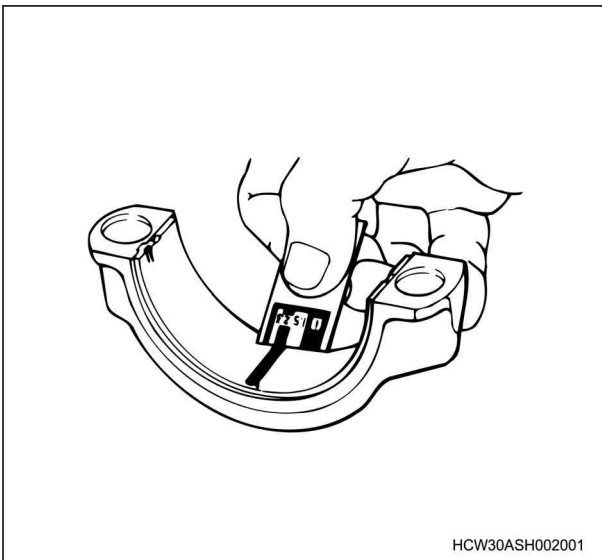
Cut the PLASTIGAUGE to the width of the crank pin and lay it parallel avoiding the crank pin oil hole.

Align the markings on the connecting rod and cap, and assemble them on the crank pin. Apply molybdenum disulfide to the threaded portion and the seating surface of the tightening bolts, and tighten the caps alternately to the specified torque.

Caution :

- Never move the connecting rod when using PLASTIGAUGE.

Gently remove the cap and the connecting rod, and measure the width of the flattened PLASTIGAUGE using the scale printed on the packaging.



Method for measuring clearance between the crank bearing and the crank journal

Clean the bearing, as well as the cylinder block and crankcase bearing mounting surfaces, and assemble to the cylinder block and crankcase.

Gently place the crankshaft on the cylinder block, and settle it by turning it approximately 30 degrees.

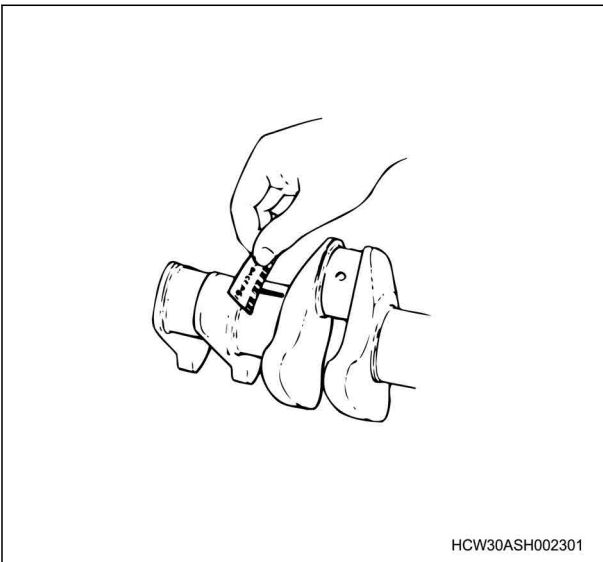
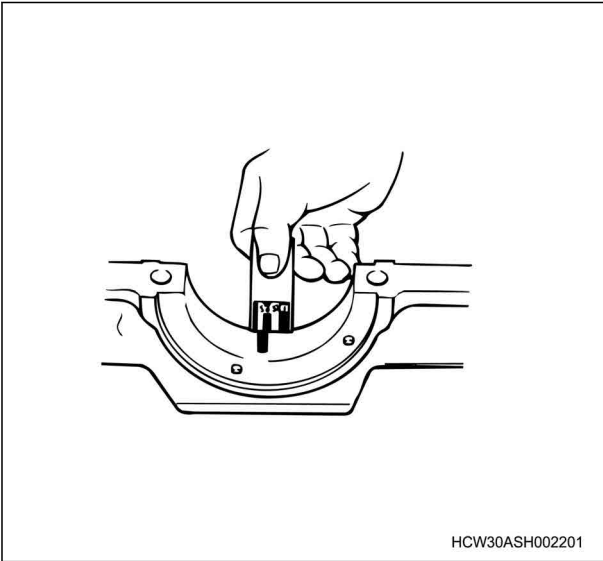
Cut the PLASTIGAUGE to the width of the crank journal and lay it parallel avoiding the journal oil hole.

Gently place the crankcase on the cylinder block, and apply molybdenum disulfide to the threaded portion and the seating surface of the tightening bolts. Tighten to the specified torque in the specified order .

Caution :

- Never move the connecting rod when using PLASTIGAUGE.

Gently remove the crankcase, and measure the width of the flattened PLASTIGAUGE using the scale printed on the packaging.



Recommended liquid gasket

1. Using the thread liquid gasket

Type	Product name	Manufacturer	Location of use (Reference)
Silicon type (Room-temperature vulcanized)	ThreeBond 1207B	ThreeBond	Engine oil seal retainer Engine oil pan Timing gear case Cylinder head cover Fuel pump Water pump etc.
	ThreeBond 1207C	ThreeBond	
	ThreeBond 1215	ThreeBond	
	ThreeBond 1216	ThreeBond	
Water soluble	ThreeBond 1141	ThreeBond	
Solvent based	ThreeBond 1104	ThreeBond	
	ThreeBond 1194	ThreeBond	
Anaerobic	Loctite 515	Loctite	Engine oil seal retainer Water pump Plug etc.
	Loctite 518	Loctite	
	FMD127 (Loctite 5127)	Loctite	
	Loctite 271	Loctite	
		Loctite	

Caution :

- Make sure to use a liquid gasket with the product name above or equivalent.
- Use an appropriate amount of liquid gasket.
- Follow the handling precautions for the product.
- Do not use LOCTITE 515, 518, or FMD 127 (Loctite 5127) as they are anaerobic and do not provide sufficient effect if there is a gap larger than 0.25 mm {0.0098 in} between the contact surfaces of metals.

Whenever disassembling, completely remove the old liquid gasket on the parts and the mating parts where the liquid gasket was used using a scraper, and clean using a waste cloth, etc., so that any oil, moisture, dirt, etc., is removed. After cleaning, apply the specified liquid gasket to each location and assemble.

Note :

- If a gasket remover is used to make the operation during cleaning easier, it is better to wait approximately 10 minutes after applying before starting the removal operation.

Caution :

- Do not apply a gasket remover to the plastic parts and the painted parts.

Thoroughly apply a liquid gasket with the specified bead width to one side of the contact surface.

Caution :

- Be careful not to excessively or insufficiently apply liquid gasket.
- Be sure to overlap the start and end of the liquid gasket application.
- Be careful not to misalign the part with the mating part when assembling applied parts.

Note :

- Apply again if there is a misalignment.
- Use the same size studs as a guide when using for a section which has no positioning such as a dowel pin.

Caution :

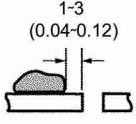

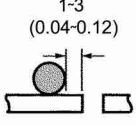
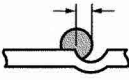


- After applying a liquid gasket, assemble within 15 minutes.

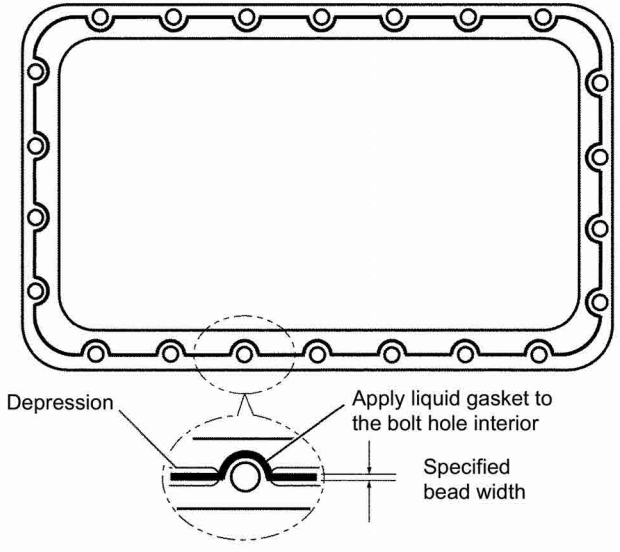
Note :

- When more than 15 minutes have passed after applying a liquid gasket, remove the liquid gasket and apply it again.

Caution :

- Wait at least 30 minutes before starting the engine after assembling each part.

		mm (in)
<p>SCREW HOLE</p> 	<p>DEPRESSION</p> 	<p>JUDGEMENT</p> <p>OK</p>
<p>1-3 (0.04-0.12)</p> 	<p>More than 2 (0.08)</p> 	<p>OK</p>
		<p>NG</p>



Example
 Anaerobic Type :2-3 mm (0.08-0.12 in)
 Others :2-6 mm (0.08-0.24 in)

PAWAZ0MF002001

Caution :

- If the workshop manual specifies an application method, follow that method.

Thread locking adhesive agent

1. Using the thread locking adhesive agent

Type	Color
Loctite 242	Blue
Loctite 262	Red
Loctite 271	Red

Caution :

- Thoroughly remove grime, moisture, oil, and grease from the bolts, bolt holes, and screw thread portion of the nuts to which thread locking adhesive agent will be applied.

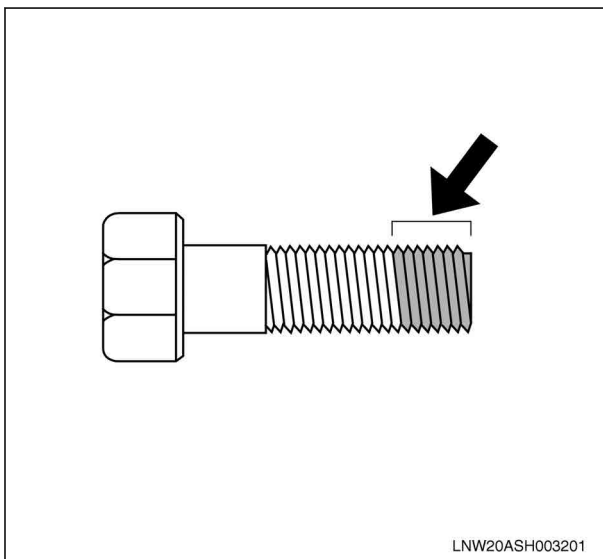
Note :

- Verify that the cleaned sections are dry.

Caution :

- After tightening, do not apply excessive torque or vibration for at least 1 hour until the thread locking adhesive agent hardens.

Apply the thread locking adhesive agent to the end 1/3 of the bolt and tighten to the specified torque.



Term

1. Term

Nominal dimension

Refers to standard values during production.

Specified value

Refers to specified values for inspection, adjustment, assembly, and installation.

Limit

Refers to maximum or minimum values that should not be exceeded during maintenance.

Parts exceeding these values must be repaired or replaced.

Warning

Refers to a precaution which may lead to injury if not observed.

Caution

Refers to a precaution which may lead to equipment damage if not observed.

Note

Refers to special notes that give instruction, guidance, or use conditions related to use, operation, repair, etc.

Abbreviations

1. Abbreviations

Abbreviation A- E	Description
A/D	Analog/Digital
ABDC	After bottom dead center
AC	Alternating current
ACC	Accessory
ACG	Alternating current generator
ACT	Actuator
API	American Petroleum Institute
ASM	Assembly
ATDC	After top dead center
ATF	Automatic transmission fluid
B+	Battery + terminal
BAT	Battery
BBDC	Before bottom dead center
BKT	Bracket
BRG	Bearing
BTDC	Before top dead center
C/B	Circuit breaker
C/U	Control unit
CAN	Control unit communication method (Controller area network)
CKP	Crankshaft position
CMP	Camshaft position
CO	Carbon monoxide
CPU	Central processing unit
DC	Direct current
DI	Direct injection type
DLC	Data link connector
DPD	Diesel particulate defuser
DTC	Diagnostic trouble code
DMM	Digital multimeter
ECM	Engine control module
ECT	Engine coolant temperature
ECU	Electronic control unit
EEPROM	Electrically erasable/programmable ROM
EGR	Exhaust gas recirculation
EMI	Electromagnetic interference
ETM	Wiring diagram (Electrical trouble shooting manual)
EVRV	Electric vacuum regulating valve
EXH	Exhaust

Abbreviation F - N	Description
F/B	Feedback
F/C	Fuel cut
F/L	Fusible link
FLW	Fusible link wire
FRT	Front
FT	Fuel temperature
FWD	Forward
GEN	Generator
GND	Ground
HC	Hydrocarbon
HO2S	Superheat O2 sensor
IAC	Idle air control
IAT	Intake air temperature
IC	Integrated circuit
ID Plate	Name plate
IDSS	ISUZU Diagnostic Service System
IMT	Intake manifold temperature
INL	Intake
INJ	Injection
ISO	International Organization for Standardization
ISP	Intake shutter position
ITP	Intake throttle position
J/C	Joint connector
JIS	Japan Industrial Standard
KW	A communication method (Keyword)
LH	Left side
LLC	Long life coolant
M/V	Magnetic valve
MAF	Mass air flow
MAP	Manifold air pressure
Max	Maximum
MIL	Malfunction indicator light (Diagnostic light)
Min	Minimum
MPU	Microprocessing unit
NC	Normally closed
NC	Normally closed
NO	Normally open
NOx	Nitrogen oxide
N-TDC	Top dead center revolution speed

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Abbreviation O - W	Description
O2S	O2 sensor
OBD	On-board diagnosis
OEM	Original equipment manufacturer
OPT	Option
OT	Oil temperature
P/L	Pilot light
PCV	Pump control valve / Positive crankcase ventilation
P-I	Proportion-integration
PM	Particulate matter
PTO	Power take-off
PWM	Pulse width modulation wave
QOS	Quick on start system
QWS	Quick warming up system
RH	Right side
R/L	Relay
RAM	Random access memory
REF	Reference
ROM	Read-only memory
RP	Rail pressure
RR	Rear
Rr	Rear
RWD	Rearward
SAE	Society of Automotive Engineers
SBF	Slow blow fuse
SCV	FRP regulator
SIG	Signal
SLD	Shield
ST	Starter/Start
STD	Standard
SW	Switch
TDC	Top dead center
TEMP	Temperature
TP	Throttle position
VB	Battery voltage
VGS Turbo	Variable geometry system turbo
W/H	Wire/Harness
W/L	Warning light
W/S	Weld splice
WOT	Wide open throttle

Standard bolts

1. List of standard bolt and nut tightening torques

The tightening torque values in the following table apply to locations where no tightening torque is specified.

Note :

- Those indicated with an asterisk (*) are used for the internal threaded portion of soft materials such as castings.

Strength category	4.8 4T		7T	
	Hex bolt	Flange bolt	Hex bolt	Flange bolt
M6 x 1	: 3.9 to 7.8 N · m { 0.4 to 0.8 kgf · m / 35 to 69 lb · in }	: 4.6 to 8.5 N · m { 0.5 to 0.9 kgf · m / 41 to 75 lb · in }	: 4.9 to 9.8 N · m { 0.5 to 1.0 kgf · m / 43 to 87 lb · in }	: 5.7 to 10.6 N · m { 0.6 to 1.1 kgf · m / 50 to 94 lb · in }
M8 x 1.25	: 7.8 to 17.7 N · m { 0.8 to 1.8 kgf · m / 69 to 157 lb · in }	: 10.5 to 19.6 N · m { 1.1 to 2.0 kgf · m / 93 to 173 lb · in }	: 11.8 to 22.6 N · m { 1.2 to 2.3 kgf · m / 9 to 17 lb · ft }	: 13.5 to 25.0 N · m { 1.4 to 2.5 kgf · m / 10 to 18 lb · ft }
M10 x 1.25	: 20.6 to 34.3 N · m { 2.1 to 3.5 kgf · m / 15 to 25 lb · ft }	: 23.1 to 38.5 N · m { 2.4 to 3.9 kgf · m / 17 to 28 lb · ft }	: 27.5 to 46.1 N · m { 2.8 to 4.7 kgf · m / 20 to 34 lb · ft }	: 31.0 to 51.7 N · m { 3.2 to 5.3 kgf · m / 23 to 38 lb · ft }
*M10 x 1.5	: 19.6 to 33.3 N · m { 2.0 to 3.4 kgf · m / 14 to 25 lb · ft }	: 22.3 to 37.2 N · m { 2.3 to 3.8 kgf · m / 16 to 27 lb · ft }	: 27.5 to 45.1 N · m { 2.8 to 4.6 kgf · m / 20 to 33 lb · ft }	: 30.3 to 50.4 N · m { 3.1 to 5.1 kgf · m / 22 to 37 lb · ft }
M12 x 1.25	: 49.0 to 73.5 N · m { 5.0 to 7.5 kgf · m / 36 to 54 lb · ft }	: 54.9 to 82.3 N · m { 5.6 to 8.4 kgf · m / 40 to 61 lb · ft }	: 60.8 to 91.2 N · m { 6.2 to 9.3 kgf · m / 45 to 67 lb · ft }	: 68.1 to 102.1 N · m { 6.9 to 10.4 kgf · m / 50 to 75 lb · ft }
*M12 x 1.75	: 45.1 to 68.6 N · m { 4.6 to 7.0 kgf · m / 33 to 51 lb · ft }	: 51.0 to 76.5 N · m { 5.2 to 7.8 kgf · m / 38 to 56 lb · ft }	: 56.9 to 84.3 N · m { 5.8 to 8.6 kgf · m / 42 to 62 lb · ft }	: 62.7 to 94.0 N · m { 6.4 to 9.6 kgf · m / 46 to 69 lb · ft }
M14 x 1.5	: 76.5 to 114.7 N · m { 7.8 to 11.7 kgf · m / 56 to 85 lb · ft }	: 83.0 to 124.5 N · m { 8.5 to 12.7 kgf · m / 61 to 92 lb · ft }	: 93.2 to 139.3 N · m { 9.5 to 14.2 kgf · m / 69 to 103 lb · ft }	: 100.8 to 151.1 N · m { 10.3 to 15.4 kgf · m / 74 to 111 lb · ft }
*M14 x 2	: 71.6 to 106.9 N · m { 7.3 to 10.9 kgf · m / 53 to 79 lb · ft }	: 77.2 to 115.8 N · m { 7.9 to 11.8 kgf · m / 57 to 85 lb · ft }	: 88.3 to 131.4 N · m { 9.0 to 13.4 kgf · m / 65 to 97 lb · ft }	: 94.9 to 142.3 N · m { 9.7 to 14.5 kgf · m / 70 to 105 lb · ft }
M16 x 1.5	: 104.0 to 157.0 N · m { 10.6 to 16.0 kgf · m / 77 to 116 lb · ft }	: 115.6 to 173.3 N · m { 11.8 to 17.7 kgf · m / 85 to 128 lb · ft }	: 135.3 to 204.0 N · m { 13.8 to 20.8 kgf · m / 100 to 150 lb · ft }	: 150.1 to 225.2 N · m { 15.3 to 23.0 kgf · m / 111 to 166 lb · ft }
*M16 x 2	: 100.0 to 149.1 N · m { 10.2 to 15.2 kgf · m / 74 to 110 lb · ft }	: 109.4 to 164.2 N · m { 11.2 to 16.7 kgf · m / 81 to 121 lb · ft }	: 129.4 to 194.2 N · m { 13.2 to 19.8 kgf · m / 95 to 143 lb · ft }	: 142.5 to 213.8 N · m { 14.5 to 21.8 kgf · m / 105 to 158 lb · ft }

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Strength category	4.8 4T		7T	
	Hex bolt	Flange bolt	Hex bolt	Flange bolt
Bolt head shape M18 - M24				
M18 x 1.5	: 151.0 to 225.6 N · m { 15.4 to 23.0 kgf · m / 111 to 166 lb · ft }	—	: 195.2 to 293.2 N · m { 19.9 to 29.9 kgf · m / 144 to 216 lb · ft }	—
*M18 x 2.5	: 151.0 to 225.6 N · m { 15.4 to 23.0 kgf · m / 111 to 166 lb · ft }	—	: 196.1 to 294.2 N · m { 20.0 to 30.0 kgf · m / 145 to 217 lb · ft }	—
M20 x 1.5	: 206.0 to 310.0 N · m { 21.0 to 31.6 kgf · m / 152 to 229 lb · ft }	—	: 269.7 to 405.0 N · m { 27.5 to 41.3 kgf · m / 199 to 299 lb · ft }	—
*M20 x 2.5	: 190.2 to 286.4 N · m { 19.4 to 29.2 kgf · m / 140 to 211 lb · ft }	—	: 249.1 to 374.6 N · m { 25.4 to 38.2 kgf · m / 184 to 276 lb · ft }	—
M22 x 1.5	: 251.1 to 413.8 N · m { 25.6 to 42.2 kgf · m / 185 to 305 lb · ft }	—	: 362.8 to 544.3 N · m { 37.0 to 55.5 kgf · m / 268 to 401 lb · ft }	—
*M22 x 2.5	: 217.7 to 327.5 N · m { 22.2 to 33.4 kgf · m / 161 to 242 lb · ft }	—	: 338.3 to 507.0 N · m { 34.5 to 51.7 kgf · m / 250 to 374 lb · ft }	—
M24 x 2	: 358.9 to 539.4 N · m { 36.6 to 55.0 kgf · m / 265 to 398 lb · ft }	—	: 430.5 to 711.0 N · m { 43.9 to 72.5 kgf · m / 318 to 524 lb · ft }	—
*M24 x 3	: 338.3 to 507.0 N · m { 34.5 to 51.7 kgf · m / 250 to 374 lb · ft }	—	: 406.0 to 608.0 N · m { 41.4 to 62.0 kgf · m / 299 to 448 lb · ft }	—

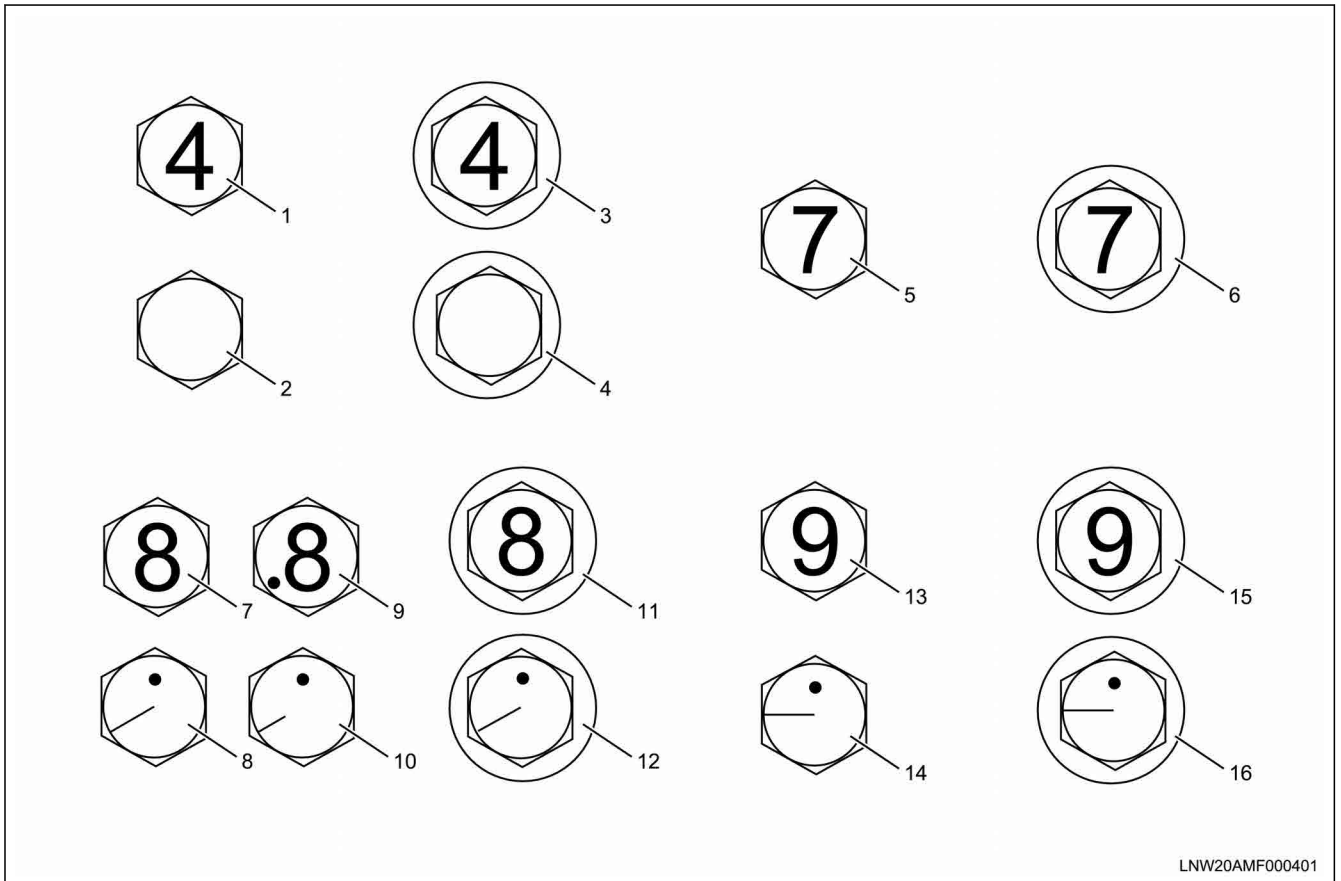
Strength category	8.8		9.8 9T	
Bolt head shape M6 - M16	Hex bolt	Flange bolt	Hex bolt	Flange bolt
M6 x 1	: 5.6 to 11.2 N · m { 0.6 to 1.1 kgf · m / 50 to 99 lb · ft }	: 6.6 to 12.2 N · m { 0.7 to 1.2 kgf · m / 58 to 108 lb · ft }	—	—
M8 x 1.25	: 13.4 to 25.7 N · m { 1.4 to 2.6 kgf · m / 10 to 19 lb · ft }	: 15.3 to 28.4 N · m { 1.6 to 2.9 kgf · m / 11 to 21 lb · ft }	: 16.7 to 30.4 N · m { 1.7 to 3.1 kgf · m / 12 to 22 lb · ft }	: 18.1 to 33.6 N · m { 1.8 to 3.4 kgf · m / 13 to 25 lb · ft }
M10 x 1.25	: 31.3 to 52.5 N · m { 3.2 to 5.4 kgf · m / 23 to 39 lb · ft }	: 35.4 to 58.9 N · m { 3.6 to 6.0 kgf · m / 26 to 43 lb · ft }	: 37.3 to 62.8 N · m { 3.8 to 6.4 kgf · m / 28 to 46 lb · ft }	: 42.3 to 70.5 N · m { 4.3 to 7.2 kgf · m / 31 to 52 lb · ft }
*M10 x 1.5	: 31.3 to 51.4 N · m { 3.2 to 5.2 kgf · m / 23 to 38 lb · ft }	: 34.5 to 57.5 N · m { 3.5 to 5.9 kgf · m / 25 to 42 lb · ft }	: 36.3 to 59.8 N · m { 3.7 to 6.1 kgf · m / 27 to 44 lb · ft }	: 40.1 to 66.9 N · m { 4.1 to 6.8 kgf · m / 30 to 49 lb · ft }
M12 x 1.25	: 69.3 to 104.0 N · m { 7.1 to 10.6 kgf · m / 51 to 77 lb · ft }	: 77.7 to 116.5 N · m { 7.9 to 11.9 kgf · m / 57 to 86 lb · ft }	: 75.5 to 113.8 N · m { 7.7 to 11.6 kgf · m / 56 to 84 lb · ft }	: 85.0 to 127.5 N · m { 8.7 to 13.0 kgf · m / 63 to 94 lb · ft }
*M12 x 1.75	: 64.8 to 96.1 N · m { 6.6 to 9.8 kgf · m / 48 to 71 lb · ft }	: 71.4 to 107.2 N · m { 7.3 to 10.9 kgf · m / 53 to 79 lb · ft }	: 71.6 to 106.9 N · m { 7.3 to 10.9 kgf · m / 53 to 79 lb · ft }	: 79.5 to 119.2 N · m { 8.1 to 12.2 kgf · m / 59 to 88 lb · ft }
M14 x 1.5	: 106.2 to 158.8 N · m { 10.8 to 16.2 kgf · m / 78 to 117 lb · ft }	: 114.9 to 172.3 N · m { 11.7 to 17.6 kgf · m / 85 to 127 lb · ft }	: 113.8 to 170.6 N · m { 11.6 to 17.4 kgf · m / 84 to 126 lb · ft }	: 123.4 to 185.1 N · m { 12.6 to 18.9 kgf · m / 91 to 137 lb · ft }
*M14 x 2	: 100.6 to 149.8 N · m { 10.3 to 15.3 kgf · m / 74 to 110 lb · ft }	: 108.2 to 162.2 N · m { 11.0 to 16.5 kgf · m / 80 to 120 lb · ft }	: 106.9 to 160.0 N · m { 10.9 to 16.3 kgf · m / 79 to 118 lb · ft }	: 115.5 to 173.3 N · m { 11.8 to 17.7 kgf · m / 85 to 128 lb · ft }
M16 x 1.5	: 154.3 to 232.5 N · m { 15.7 to 23.7 kgf · m / 114 to 171 lb · ft }	: 171.1 to 256.7 N · m { 17.4 to 26.2 kgf · m / 126 to 189 lb · ft }	: 160.0 to 240.3 N · m { 16.3 to 24.5 kgf · m / 118 to 177 lb · ft }	: 176.9 to 265.3 N · m { 18.0 to 27.1 kgf · m / 130 to 196 lb · ft }
*M16 x 2	: 147.6 to 221.4 N · m { 15.1 to 22.6 kgf · m / 109 to 163 lb · ft }	: 162.5 to 243.8 N · m { 16.6 to 24.9 kgf · m / 120 to 180 lb · ft }	: 153.0 to 229.5 N · m { 15.6 to 23.4 kgf · m / 113 to 169 lb · ft }	: 168.5 to 252.7 N · m { 17.2 to 25.8 kgf · m / 124 to 186 lb · ft }

14A-16 Service Information Guide (All)

Strength category	8.8		9.8 9T	
Bolt head shape M18 - M24	Hex bolt	Flange bolt	Hex bolt	Flange bolt
M18 x 1.5	: 222.5 to 334.3 N · m { 22.7 to 34.1 kgf · m / 164 to 247 lb · ft }	—	: 229.5 to 345.2 N · m { 23.4 to 35.2 kgf · m / 169 to 255 lb · ft }	—
*M18 x 2.5	: 223.6 to 335.4 N · m { 22.8 to 34.2 kgf · m / 165 to 247 lb · ft }	—	: 230.5 to 346.2 N · m { 23.5 to 35.3 kgf · m / 170 to 255 lb · ft }	—
M20 x 1.5	: 307.4 to 461.7 N · m { 31.3 to 47.1 kgf · m / 227 to 341 lb · ft }	—	: 293.2 to 440.3 N · m { 29.9 to 44.9 kgf · m / 216 to 325 lb · ft }	—
*M20 x 2.5	: 284.0 to 472.1 N · m { 29.0 to 48.1 kgf · m / 209 to 348 lb · ft }	—	: 293.2 to 440.3 N · m { 29.9 to 44.9 kgf · m / 216 to 325 lb · ft }	—
M22 x 1.5	: 413.6 to 620.5 N · m { 42.2 to 63.3 kgf · m / 305 to 458 lb · ft }	—	: 424.6 to 636.5 N · m { 43.3 to 64.9 kgf · m / 313 to 469 lb · ft }	—
*M22 x 2.5	: 385.7 to 578.0 N · m { 39.3 to 58.9 kgf · m / 284 to 426 lb · ft }	—	: 394.2 to 592.3 N · m { 40.2 to 60.4 kgf · m / 291 to 437 lb · ft }	—
M24 x 2	: 490.8 to 810.5 N · m { 50.0 to 82.6 kgf · m / 362 to 598 lb · ft }	—	: 554.1 to 830.6 N · m { 56.5 to 84.7 kgf · m / 409 to 613 lb · ft }	—
*M24 x 3	: 462.8 to 693.1 N · m { 47.2 to 70.7 kgf · m / 341 to 511 lb · ft }	—	: 520.7 to 781.6 N · m { 53.1 to 79.7 kgf · m / 384 to 576 lb · ft }	—

Note :

- Refer to the following list for the indicators used on standard bolt heads.



LNW20AMF000401

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

	Pipe diameter	Tightening torque for medium and heavy duty vehicles	Flare nut width across flats	
			Old	New
Tightening torque for the flare nut Service standard value	: 4.6 mm { 0.181 in }	: 12.8 to 18.6 N · m { 1.3 to 1.9 kgf · m / 9 to 14 lb · ft }	: 14 mm { 0.55 in }	: 14 mm { 0.55 in }
	: 6.35 mm { 0.25 in }	: 23.5 to 49.0 N · m { 2.4 to 5.0 kgf · m / 17 to 36 lb · ft }	: 17 mm { 0.67 in }	: 17 mm { 0.67 in }
	: 8.0 mm { 0.31 in }	: 23.5 to 49.0 N · m { 2.4 to 5.0 kgf · m / 17 to 36 lb · ft }	: 19 mm { 0.75 in }	: 17 mm { 0.67 in }
	: 10.0 mm { 0.39 in }	: 44.1 to 93.2 N · m { 4.5 to 9.5 kgf · m / 33 to 69 lb · ft }	: 22 mm { 0.87 in }	: 19 mm { 0.75 in }
	: 12.0 mm { 0.47 in }	: 58.8 to 137.3 N · m { 6.0 to 14.0 kgf · m / 43 to 101 lb · ft }	: 27 mm { 1.06 in }	: 24 mm { 0.94 in }
	: 15.0 mm { 0.59 in }	: 78.5 to 156.9 N · m { 8.0 to 16.0 kgf · m / 58 to 116 lb · ft }	: 30 mm { 1.18 in }	: 30 mm { 1.18 in }

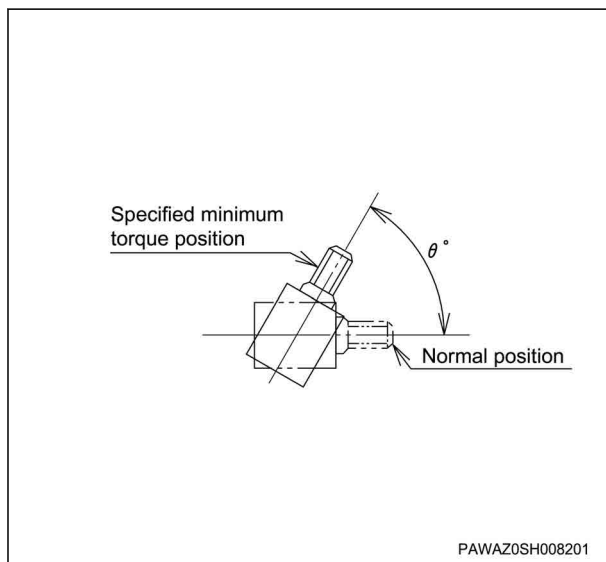
14A-18 Service Information Guide (All)

Connector (Brass tapered screws)				
Screw size	PT (R) 1/8	PT (R) 1/4	PT (R) 3/8	PT (R) 1/2
—	: 2.0 to 14.7 N · m { 0.20 to 1.50 kgf · m / 18 to 130 lb · in }	: 4.9 to 15.7 N · m { 0.5 to 1.6 kgf · m / 43 to 139 lb · in }	: 9.8 to 16.7 N · m { 1.0 to 1.7 kgf · m / 87 to 148 lb · in }	: 9.8 to 17.7 N · m { 1.0 to 1.8 kgf · m / 87 to 157 lb · in }

Connectors (Except brass tapered screws)					
Screw size	PT (R) 1/8	PT (R) 1/4	PT (R) 3/8	PT (R) 1/2	PT (R) 3/4
—	: 5.9 to 11.8 N · m { 0.6 to 1.2 kgf · m / 52 to 104 lb · in }	: 14.7 to 29.4 N · m { 1.5 to 3.0 kgf · m / 11 to 22 lb · ft }	: 29.4 to 39.2 N · m { 3.0 to 4.0 kgf · m / 22 to 29 lb · ft }	: 29.4 to 58.8 N · m { 3.0 to 6.0 kgf · m / 22 to 43 lb · ft }	: 58.8 to 98.0 N · m { 6.0 to 10.0 kgf · m / 43 to 72 lb · ft }

Note :

- The tightening torque for connectors (except brass tapered screws) is only applied when the mating side is not made of aluminum.



Note :

- For the elbow-type connector, tighten it with the minimum torque shown above and then tighten it further until the angle matches.
- Apply Loctite 575 to the threaded portion and tighten. Completely dry and then let air in after tightening.
- Do not use seal tape, etc.

Engine Mechanical (4HK1)

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Cylinder head cover

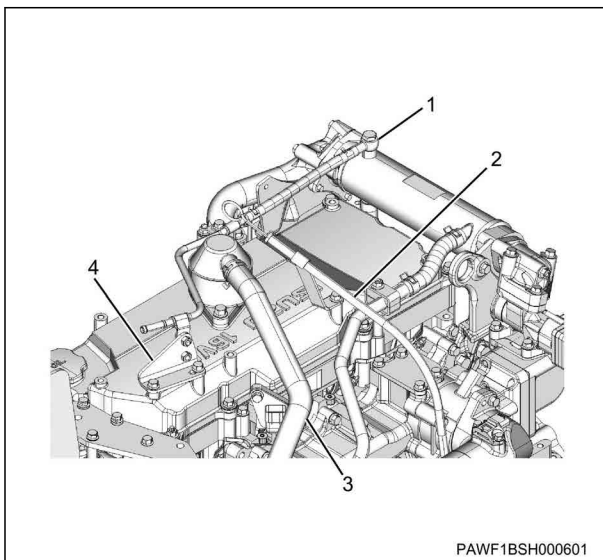
removal

1. Ventilation hose disconnect

1. Remove the air leak pipe from the EGR cooler and bracket.

Note :

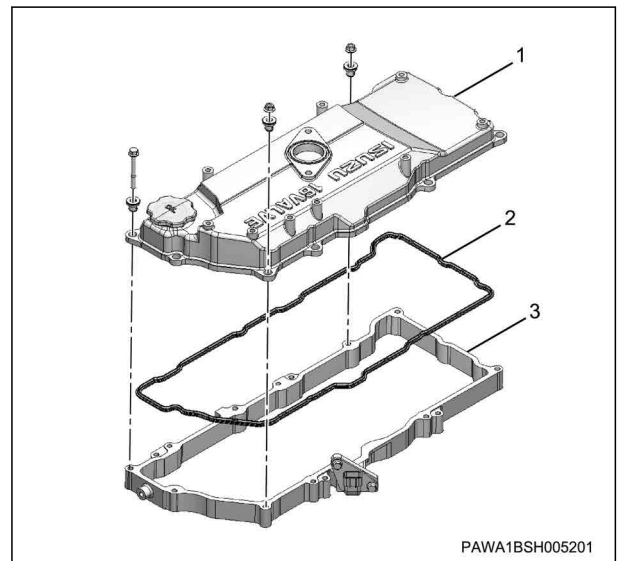
- The existence or nonexistence of the equipment varies depending on the machine manufacturer.
2. Remove the bracket from the cylinder head cover.
 3. Disconnect the oil level gauge guide tube from the cylinder head cover.
 4. Disconnect the ventilation hose from the air breather.



1. Air leak pipe
2. Oil level gauge guide tube
3. Ventilation hose
4. Bracket

2. Cylinder head cover removal

1. Remove the cylinder head cover from the lower cover.
2. Remove the head cover gasket from the cylinder head cover.



1. Cylinder head cover
2. Gasket
3. Lower cover

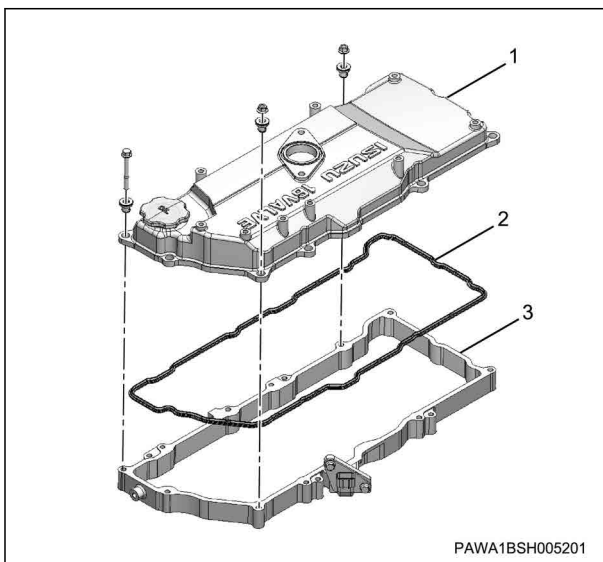
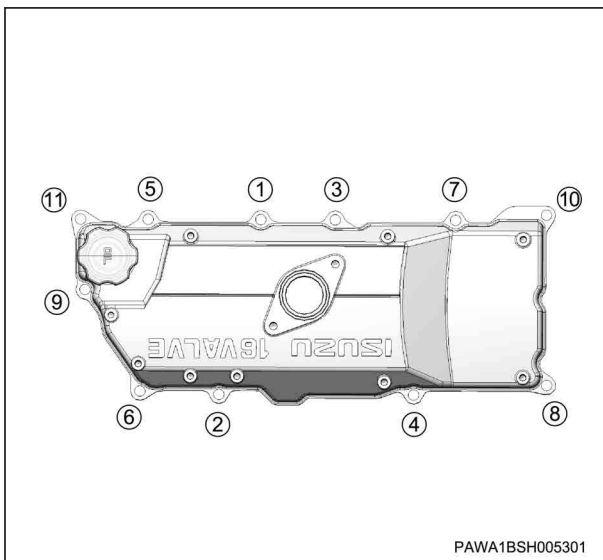
installation

1. Cylinder head cover installation

1. Align the head cover gasket to the cylinder head cover.
2. Install the cylinder head cover to the lower cover.
tightening torque : 18 N · m { 1.8 kgf · m / 13 lb · ft }

Note :

- Referring to the tightening order in the diagram, temporarily tighten all bolts and then completely tighten them.



1. Cylinder head cover
2. Gasket
3. Lower cover

2. Ventilation hose connect

1. Connect the ventilation hose to the air breather.

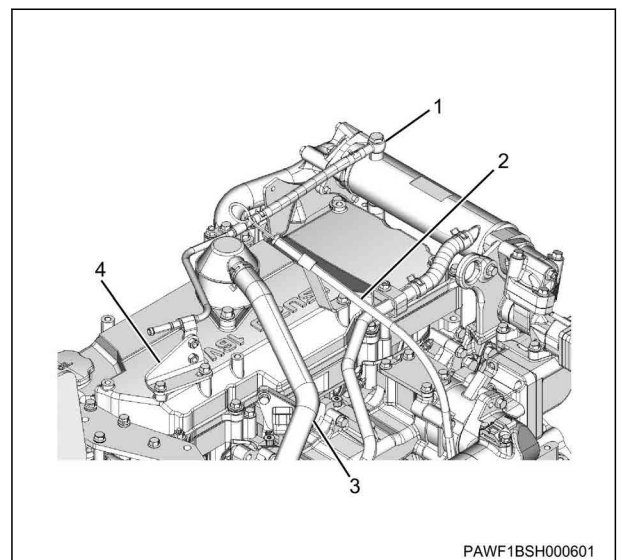
2. Connect the oil level gauge guide tube to the cylinder head cover.
tightening torque : 19 N · m { 1.9 kgf · m / 14 lb · ft }
3. Install the bracket to the cylinder head cover.
tightening torque : 24 N · m { 2.4 kgf · m / 18 lb · ft }
4. Install the air leak pipe to the bracket and EGR cooler.

Note :

- The existence or nonexistence of the equipment varies depending on the machine manufacturer.

tightening torque : 24 N · m { 2.4 kgf · m / 18 lb · ft }
Bracket

tightening torque : 22 N · m { 2.2 kgf · m / 16 lb · ft }
EGR cooler



1. Air leak pipe
2. Oil level gauge guide tube
3. Ventilation hose
4. Bracket

Cylinder head assembly

removal

1. Battery ground cable disconnect
 1. Disconnect the battery ground cable from the battery.

Caution :

- Do not disconnect the battery cable for 1 minute after turning OFF the ignition switch.

2. Coolant drain

1. Drain coolant from the radiator.

Caution :

- After draining the coolant, do not forget to tighten the drain plug.

3. Engine harness disconnect

1. Disconnect the engine harness from the engine assembly.

Note :

- Disconnect each connector.

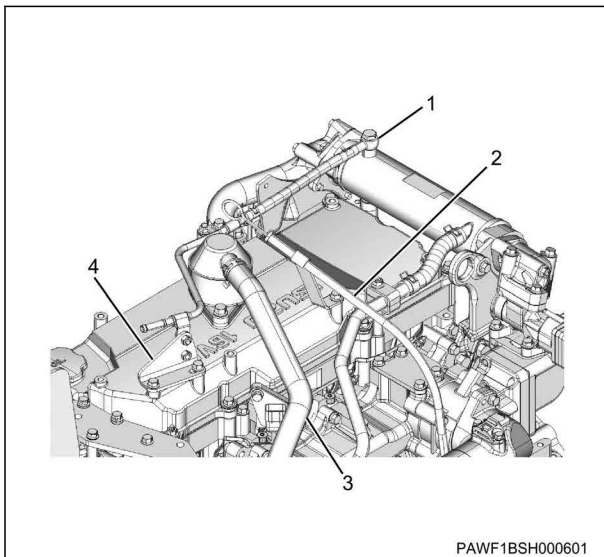
4. Ventilation hose disconnect

1. Remove the air leak pipe from the EGR cooler and bracket.

Note :

- The existence or nonexistence of the equipment varies depending on the machine manufacturer.

2. Disconnect the ventilation hose from the air breather.



1. Air leak pipe
2. Oil level gauge guide tube
3. Ventilation hose
4. Bracket

5. Turbocharger assembly removal

1. Remove the exhaust pipe from the turbocharger assembly.
2. Remove the air cleaner duct from the air cleaner assembly and turbocharger assembly.
3. Remove the air intake duct from the turbocharger assembly and intercooler.
4. Disconnect the oil feed pipe from the turbocharger assembly.

Note :

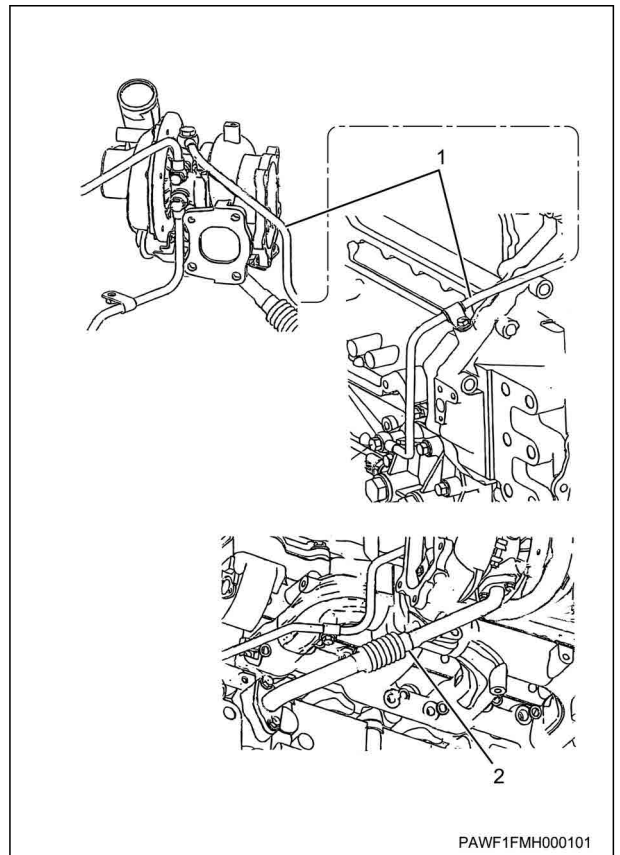
- Remove the clip.

5. Remove the oil feed pipe from the oil port cover.

Note :

- Remove the clip.

6. Disconnect the oil return pipe from the turbocharger assembly.
7. Remove the oil return pipe from the flywheel housing.

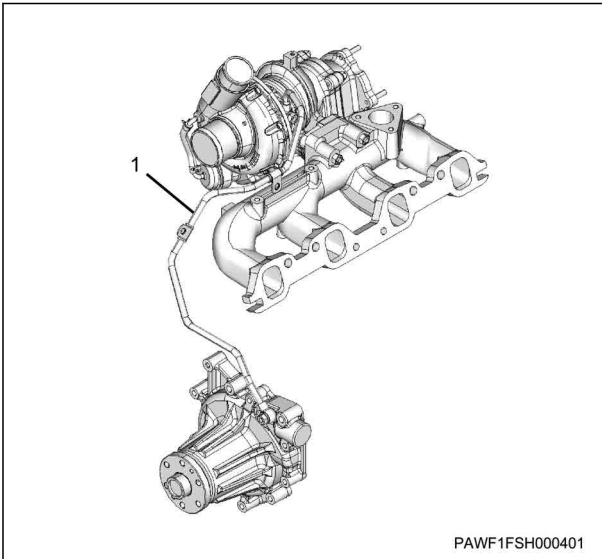


1. Oil feed pipe
2. Oil return pipe

8. Disconnect the water return pipe from the turbocharger assembly.
9. Remove the water return pipe from the water pump.

Note :

- Remove the clip.

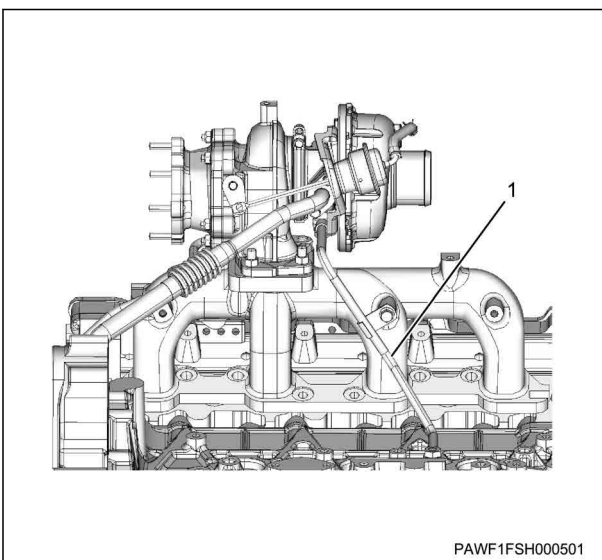


1. Water return pipe

10. Disconnect the water feed pipe from the turbocharger assembly.
11. Remove the water feed pipe from the cylinder block.

Note :

- Remove the clip.



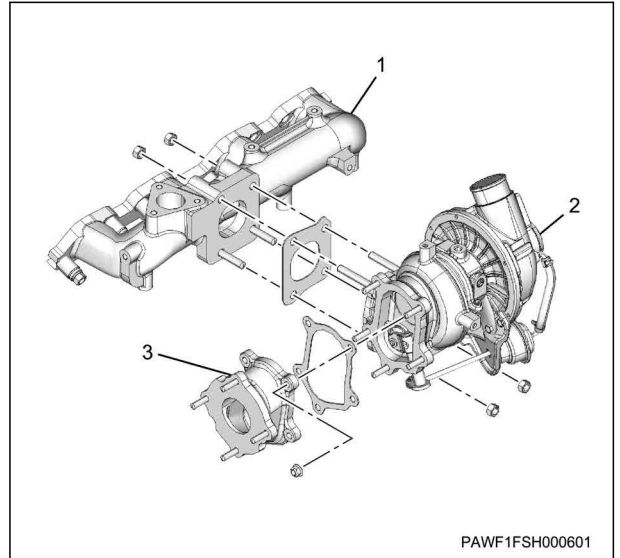
1. Water feed pipe

12. Remove the exhaust pipe adapter from the turbocharger assembly.

13. Remove the turbocharger assembly from the exhaust manifold.

Note :

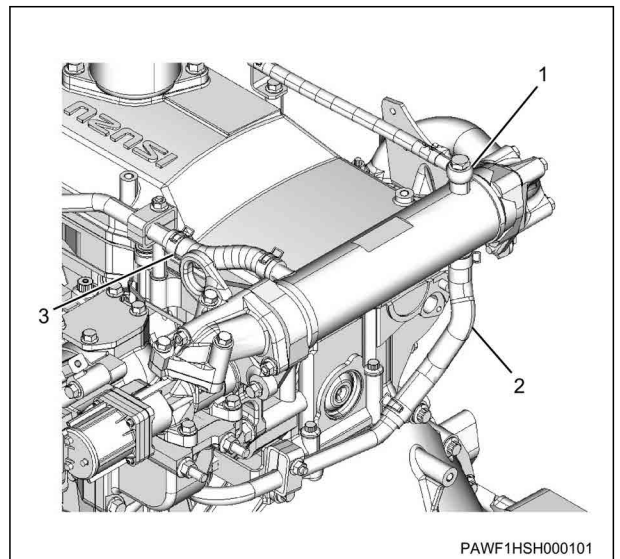
- The turbocharger specification varies depending on the machine manufacturer.



1. Exhaust manifold
2. Turbocharger assembly
3. Exhaust pipe adapter

6. EGR cooler assembly removal

1. Disconnect the water rubber hose from the EGR cooler assembly.



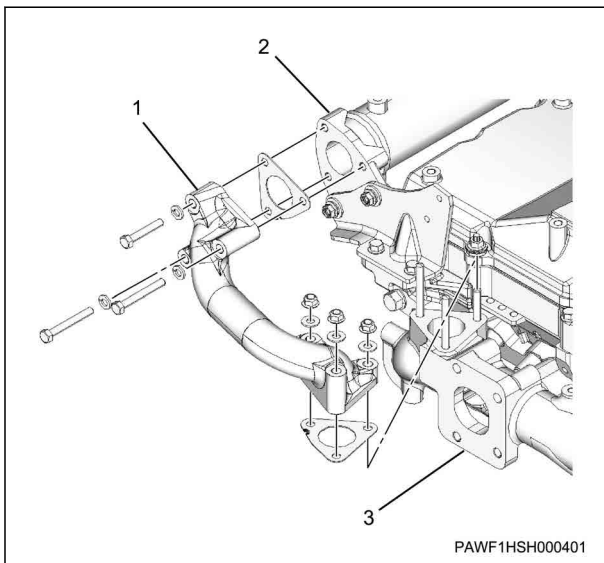
1. Air leak pipe
2. Water rubber hose
3. Water rubber hose

2. Remove EGR pipe A from the exhaust manifold and EGR cooler.

1B-6 Mechanical (4HK1)

Caution :

- After removing the EGR pipe, seal to prevent intrusions of foreign material.

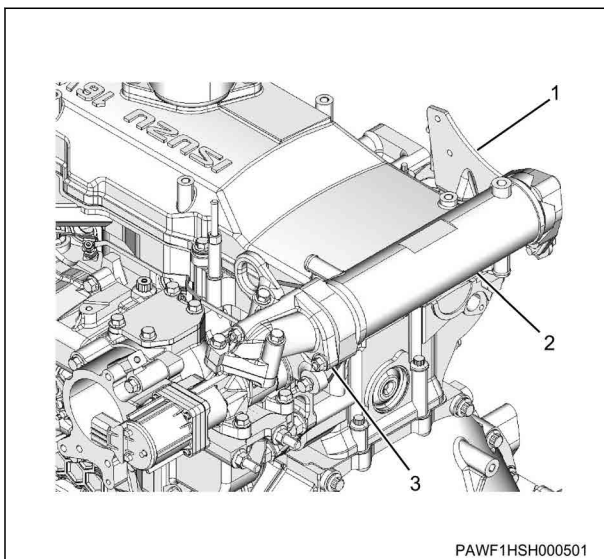


- EGR pipe A
- EGR cooler
- Exhaust manifold

- Remove the EGR cooler from EGR pipe B and the EGR cooler bracket.
- Remove EGR pipe B from the EGR valve.

Caution :

- After removing the EGR pipe, seal to prevent intrusions of foreign material.



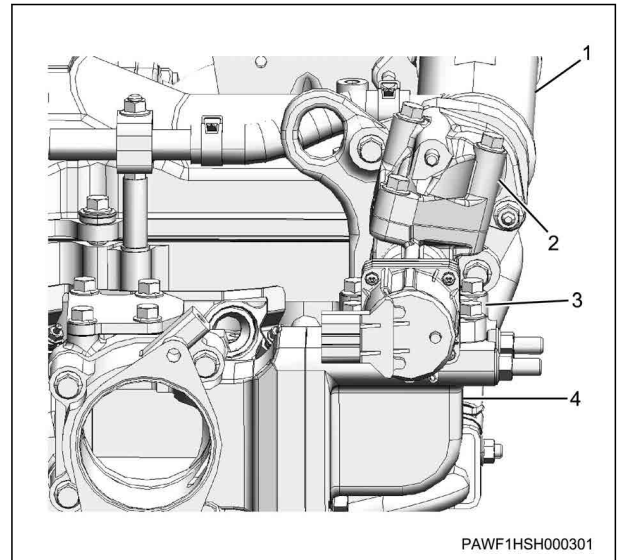
- EGR cooler bracket
- EGR cooler
- EGR pipe B

- EGR valve removal

- Disconnect the harness connector from the EGR valve.
- Remove the EGR valve from EGR pipe C.

Caution :

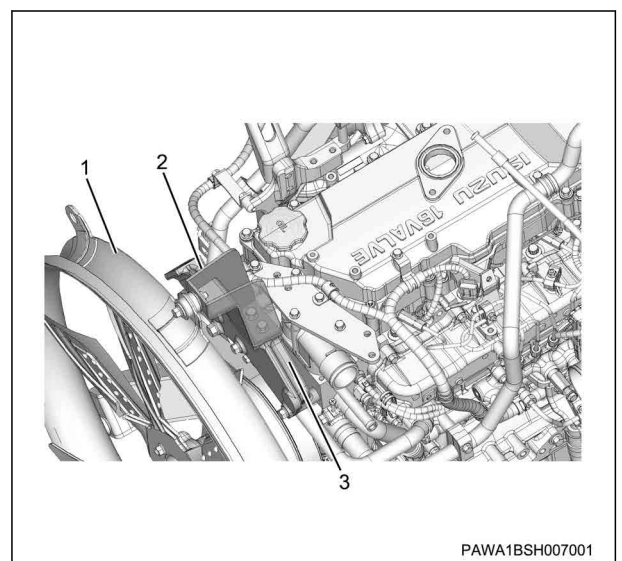
- After removing the EGR valve, seal to prevent intrusions of foreign material.



- EGR cooler
- EGR pipe B
- EGR valve
- EGR pipe C

- EGR cooler water pipe removal

- Remove the fan guide stay from the fan guide and the fan guide bracket.
- Remove the fan guide bracket from the cylinder head assembly.



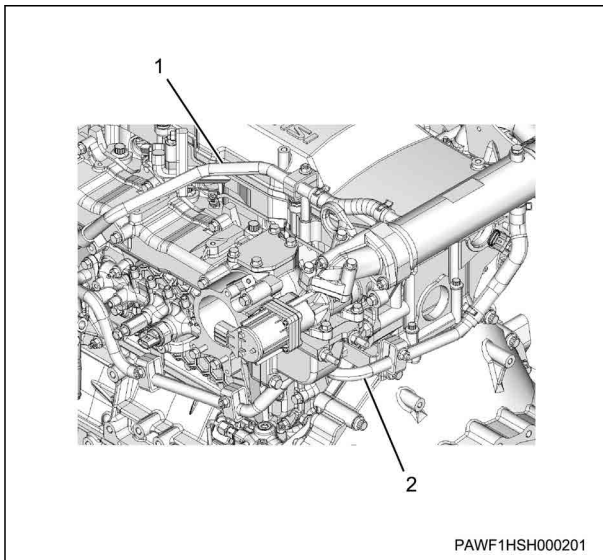
- Fan guide
- Fan guide stay

3. Fan guide bracket

3. Disconnect the radiator upper hose from the water outlet pipe.
4. Remove the EGR cooler water pipe from the engine assembly.

Note :

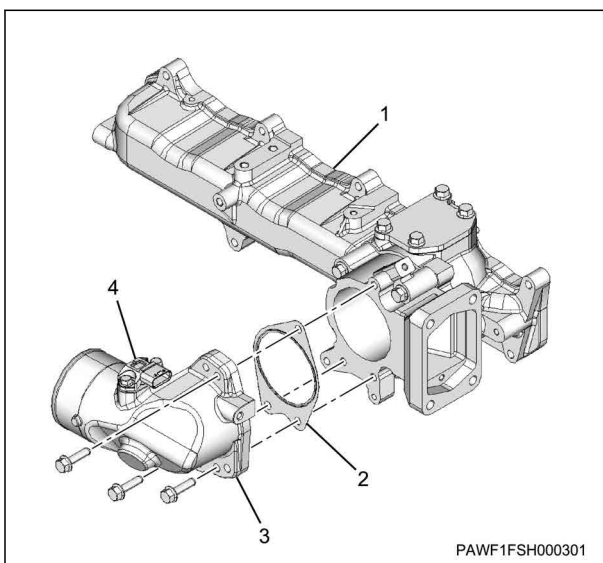
- Remove the EGR cooler water feed pipe and EGR cooler water return pipe.



1. EGR cooler water return pipe
2. EGR cooler water feed pipe

9. Inlet pipe removal

1. Disconnect the harness connector from the boost pressure/boost temperature sensor.
2. Remove the harness clip from the inlet pipe.
3. Remove the inlet pipe from the case.

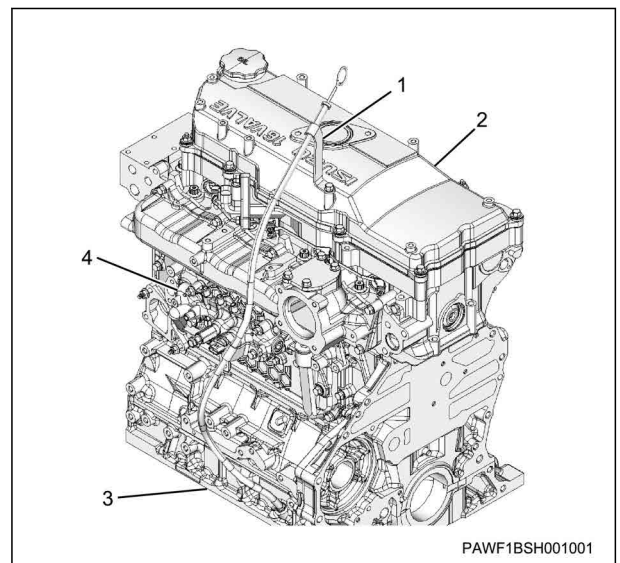


1. Inlet cover

2. Gasket
3. Inlet pipe
4. Boost pressure/boost temperature sensor

10. Oil level gauge guide tube removal

1. Remove the oil level gauge from the oil level gauge guide tube.
2. Disconnect the oil level gauge guide tube from the cylinder head cover.
3. Disconnect the oil level gauge guide tube from the common rail (fuel rail) assembly.
4. Remove the oil level gauge guide tube from the crankcase.

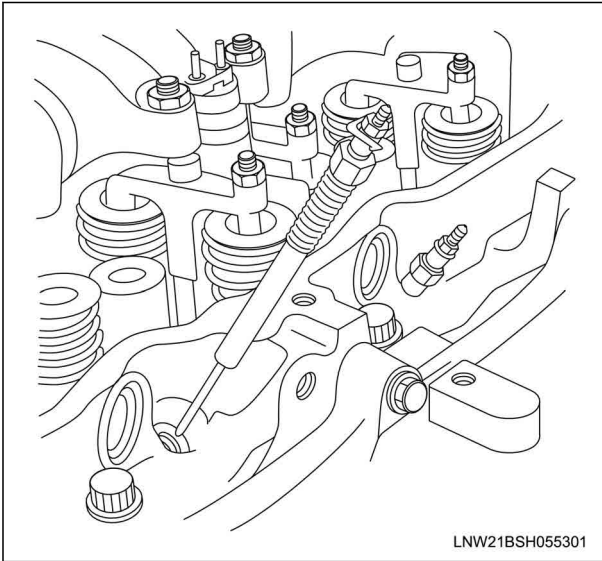


1. Oil level gauge guide tube
2. Cylinder head cover
3. Crankcase
4. Common rail (fuel rail) assembly

11. Glow plug removal

1. Remove the glow plug connector from the glow plug.
2. Remove the glow plug from the cylinder head assembly.

1B-8 Mechanical (4HK1)

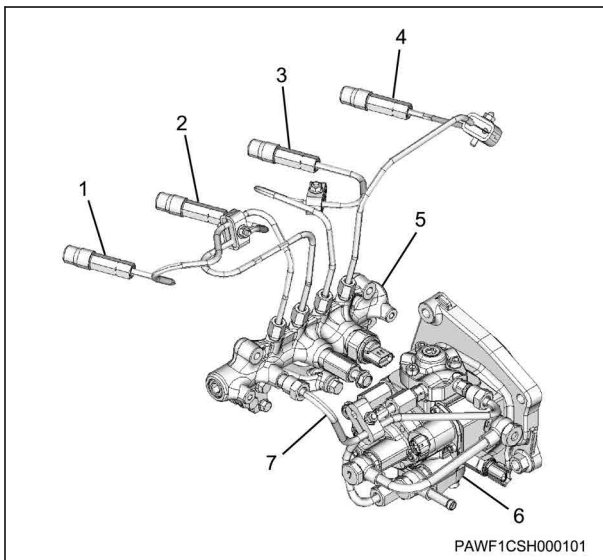


12. Injection pipe removal

1. Remove the clip from the bracket.
2. Remove the injection pipe from the injector and the common rail assembly.

Caution :

- Do not reuse the removed injection pipe.
- Seal the common rail and injector to prevent foreign material from entering.



1. No. 1 injection pipe
2. No. 2 injection pipe
3. No. 3 injection pipe
4. No. 4 injection pipe
5. Common rail (fuel rail) assembly
6. Fuel supply pump
7. Fuel pipe

13. Fuel pipe removal

1. Remove the fuel pipe from the fuel supply pump and the common rail assembly.

Note :

- Remove the clip.

Caution :

- Do not reuse the gasket.

14. Fuel leak off pipe assembly removal

1. Disconnect the fuel leak-off pipe from the cylinder head assembly.
2. Remove the fuel leak-off pipe from the fuel supply pump.

Note :

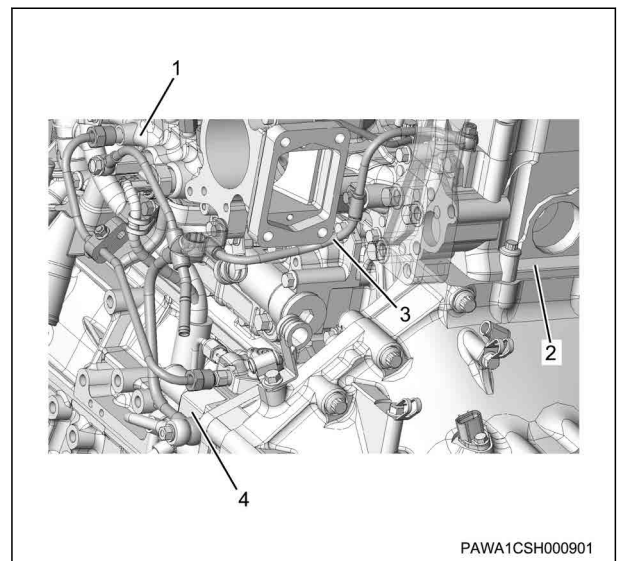
- Remove the eyebolt tightened together with the fuel feed pipe.

3. Disconnect the fuel leak-off pipe from the common rail assembly.

4. Remove the fuel leak-off pipe from the case.

Note :

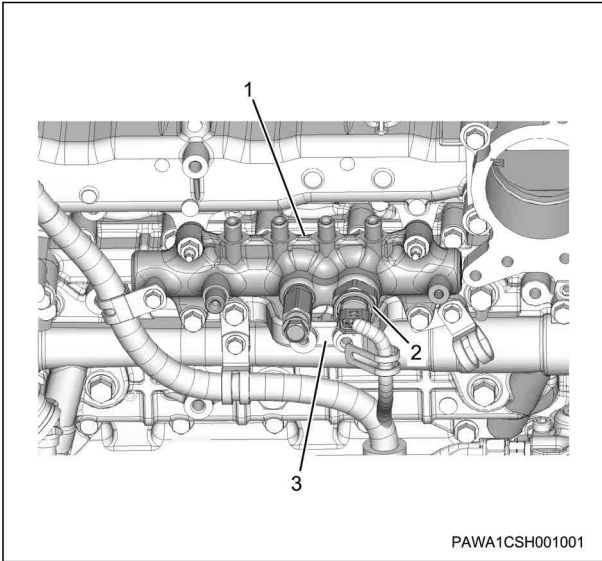
- Remove the clip.



1. Common rail assembly
2. Cylinder head assembly
3. Fuel leak-off pipe
4. Fuel supply pump

15. Common rail assembly removal

1. Disconnect the harness connector from the fuel pressure sensor.
2. Remove the common rail assembly from the inlet cover and the common rail bracket.
3. Remove the common rail bracket from the oil cooler assembly.

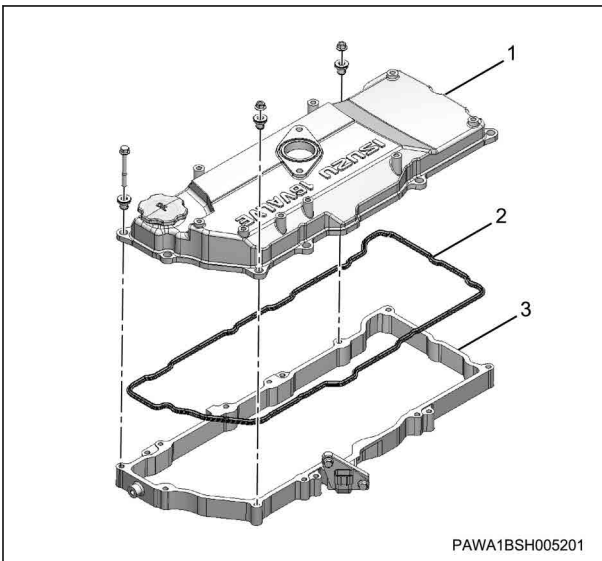


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1. Common rail assembly
2. Fuel pressure sensor
3. Common rail bracket

16. Cylinder head cover removal

1. Remove the cylinder head cover from the lower cover.
2. Remove the head cover gasket from the cylinder head cover.



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1. Cylinder head cover
2. Gasket
3. Lower cover

17. Lower cover removal

1. Remove the connector from the lower cover.

Caution :

- Do not pull the wire, or pry the connector with a screwdriver.

2. Disconnect the injector harness from the injector.

Caution :

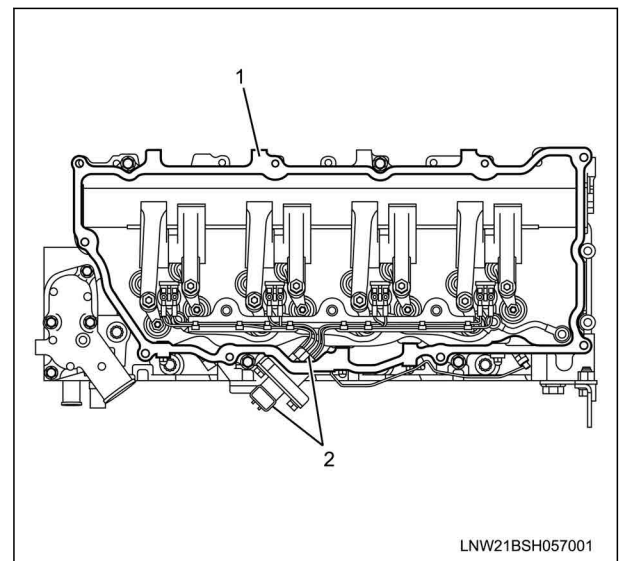
- Be careful not to damage the injector side stud bolts.

3. Remove the injector harness from the cylinder head assembly.

Note :

- Remove the bracket tightening bolts and then remove the injector harness together with the bracket.

4. Remove the lower cover from the cylinder head assembly.



LNW21BSH057001

1. Lower cover
2. Connector

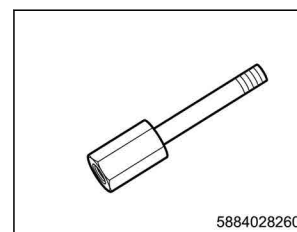
5. Remove the gasket from the lower cover.
6. Remove the rubber plug from the cylinder head assembly.

18. Injector removal

1. Remove the injector leak-off pipe from the injector.
2. Remove the injector from the cylinder head assembly.

Note :

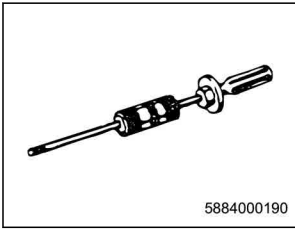
- When it is difficult to remove the injector, use a special tool.



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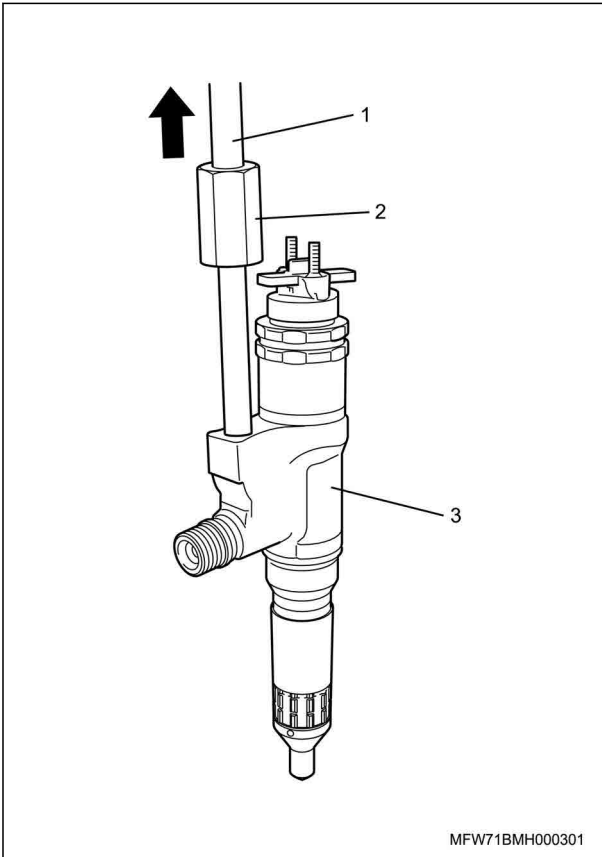
SST: 5-8840-2826-0 - injector remover

1B-10 Mechanical (4HK1)



5884000190

SST: 5-8840-0019-0 - sliding hammer

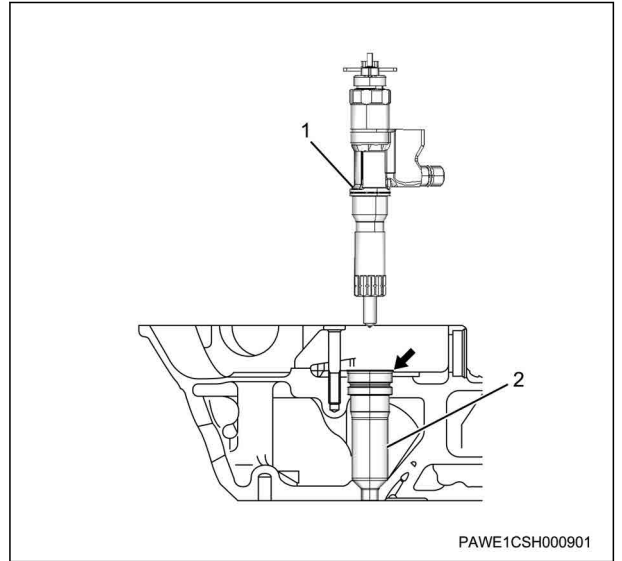


MFW71BMH000301

1. Sliding hammer
2. Fuel injector remover
3. Injector

Caution :

- When removing the injector using the special tool, check that the injector sleeve has not been removed as well.

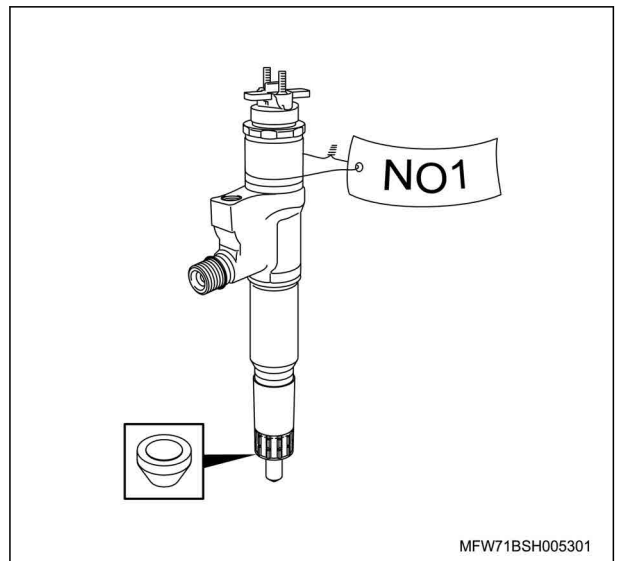


PAWE1CSH000901

1. Injector
2. Injector sleeve

Caution :

- Store each ID code plate on the injector head with the cylinder number tag attached to avoid a mix-up.
- Be extremely careful not to damage the injector nozzle.



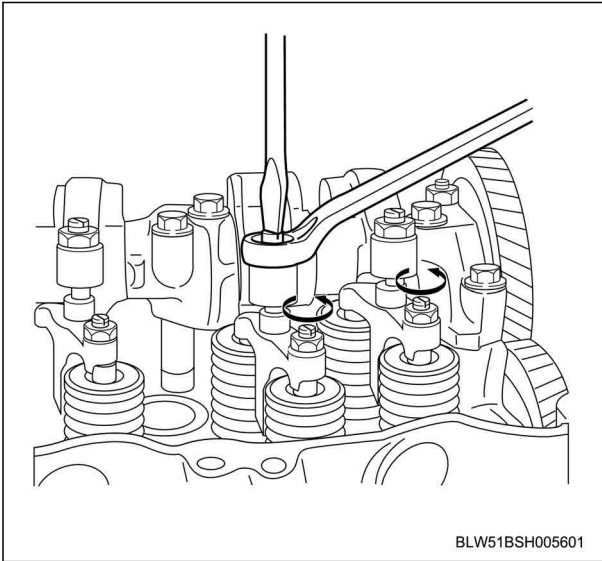
MFW71BSH005301

19. Rocker arm shaft removal

1. Loosen the adjust screw using the wrench.

Note :

- Loosen all valve clearance adjustment screws.



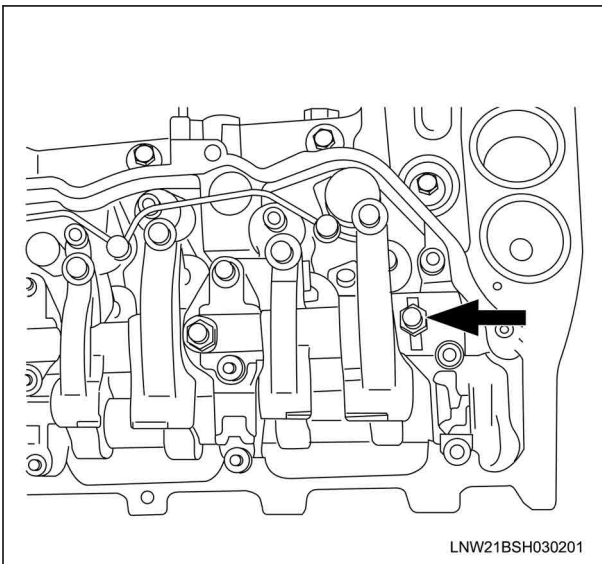
2. Remove the rocker arm shaft from the cylinder head assembly.

Note :

- Evenly loosen the rocker arm shaft bracket and the rocker arm assembly bracket tightening bolts from both ends and remove them.

Caution :

- Be careful not to remove the bolt shown in the diagram.



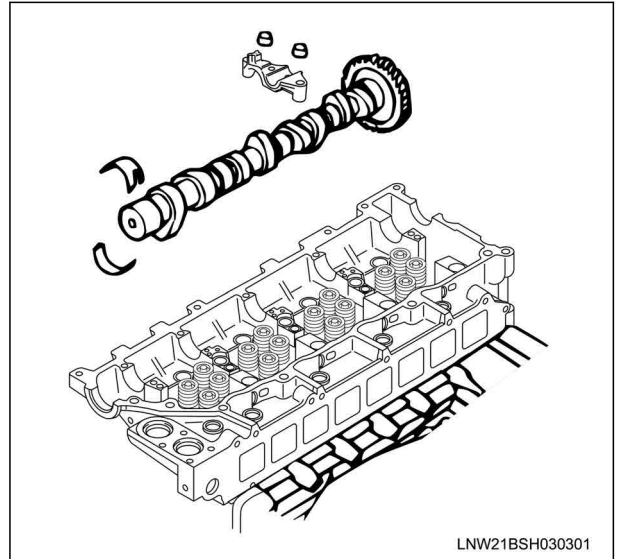
20. Camshaft removal

1. Remove the camshaft bearing cap from the cylinder head assembly.
2. Remove the camshaft bearing from the camshaft bearing cap.
3. Remove the camshaft from the cylinder head.

4. Remove the camshaft bearing from the cylinder head assembly.

Note :

- Temporarily assemble the removed caps and bearings in the original position to avoid a mix-up after the bearings have been inspected.



21. Bridge removal

1. Remove the bridge cap from the bridge.

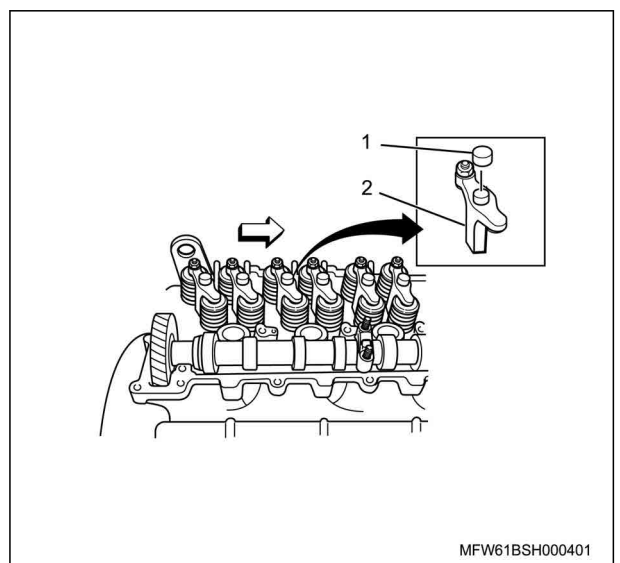
Caution :

- Be careful not to drop the bridge cap into the engine.

2. Remove the bridge from the bridge guide.

Note :

- After removing, organize to avoid a mix-up with other installation locations.



1. Bridge cap
2. Bridge

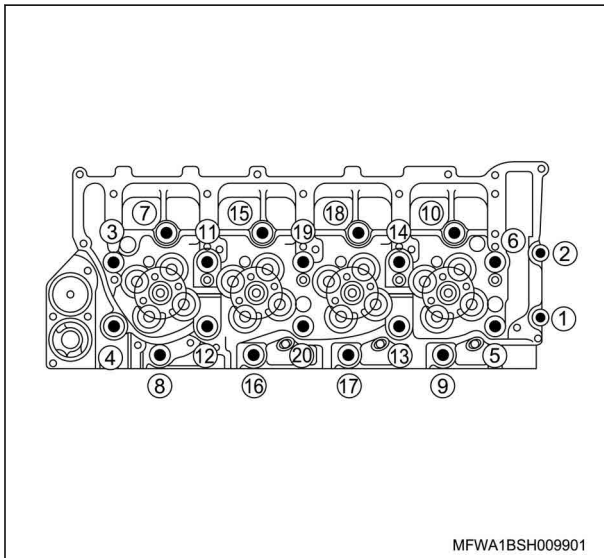
1B-12 Mechanical (4HK1)

22. Cylinder head assembly removal

1. Remove the cylinder head assembly from the cylinder block.

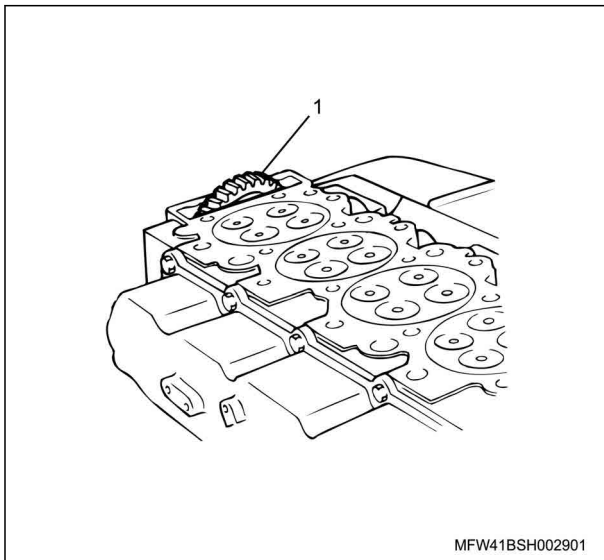
Note :

- Loosening order of the head bolts



Caution :

- Since the idle gear C protrudes from the bottom surface of the cylinder head, be careful not to damage the gear.



1. Idle gear C

2. Remove the cylinder head gasket from the cylinder block.

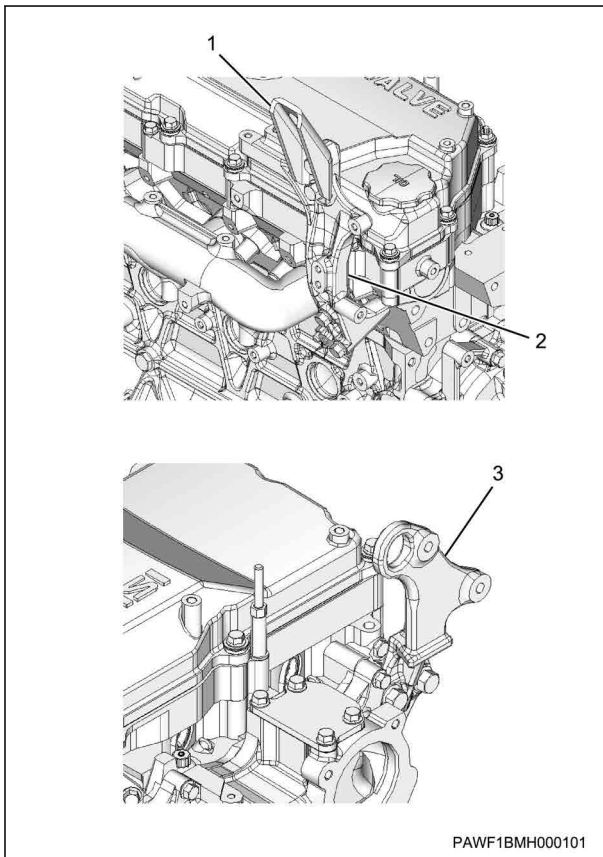
Caution :

- Do not reuse the cylinder head gasket.

disassembly

1. Engine hanger bracket removal

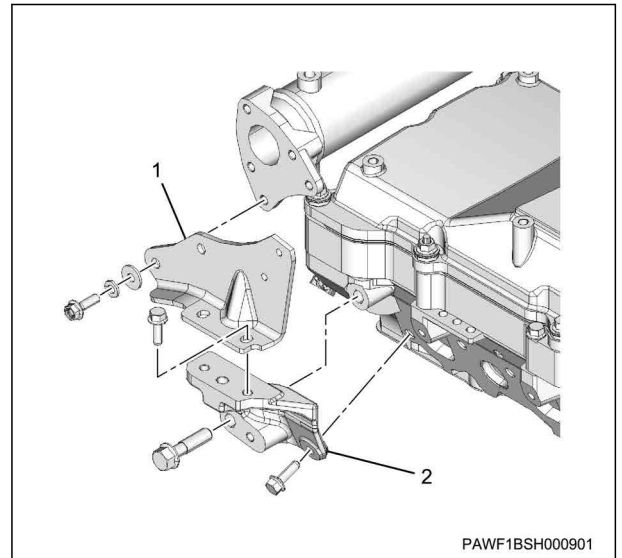
1. Remove the front engine hanger bracket from the cylinder head assembly.
2. Remove the rear engine hanger bracket from the cylinder head assembly.



1. Front engine hanger
2. Front engine hanger bracket
3. Rear engine hanger

2. Bracket removal

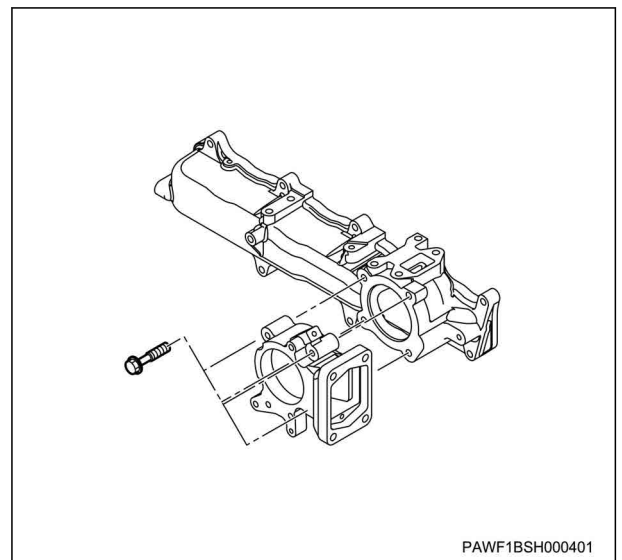
1. Remove the EGR cooler bracket from the bracket.
2. Remove the bracket from the cylinder head assembly.



1. EGR cooler bracket
2. Bracket

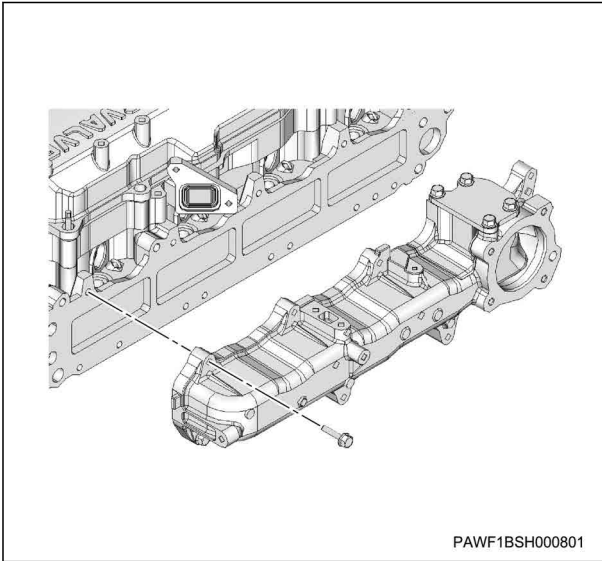
3. Inlet cover removal

1. Remove EGR pipe C from the case.
2. Remove the case from the inlet cover.



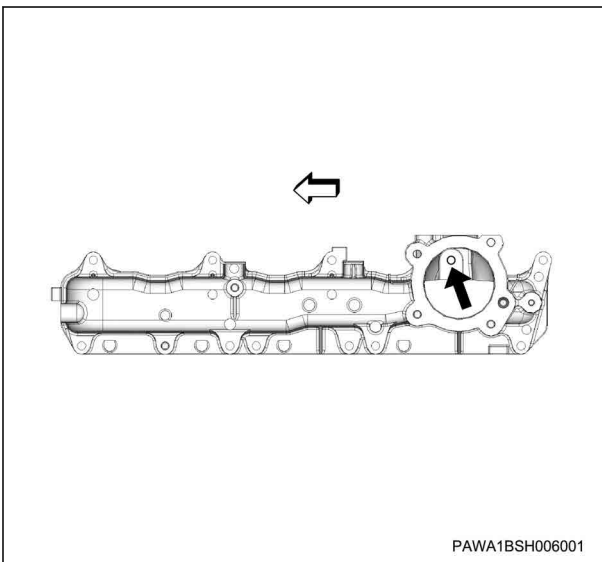
3. Remove the inlet cover from the cylinder head assembly.

1B-14 Mechanical (4HK1)



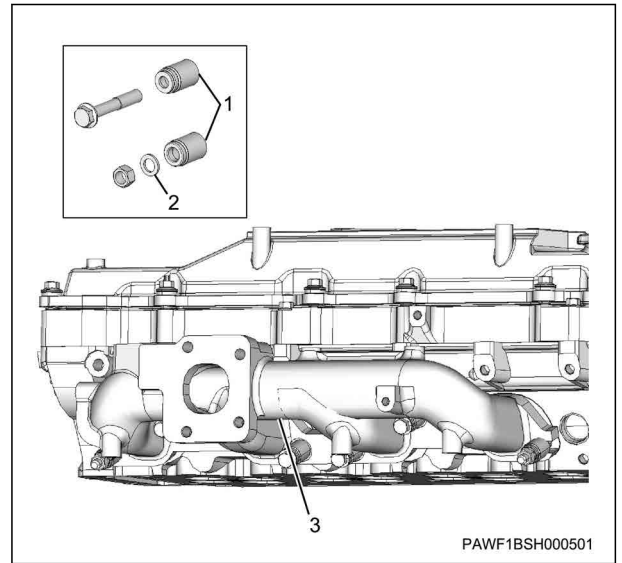
Caution :

- Do not forget to remove the bolts indicated by the arrow in the diagram.



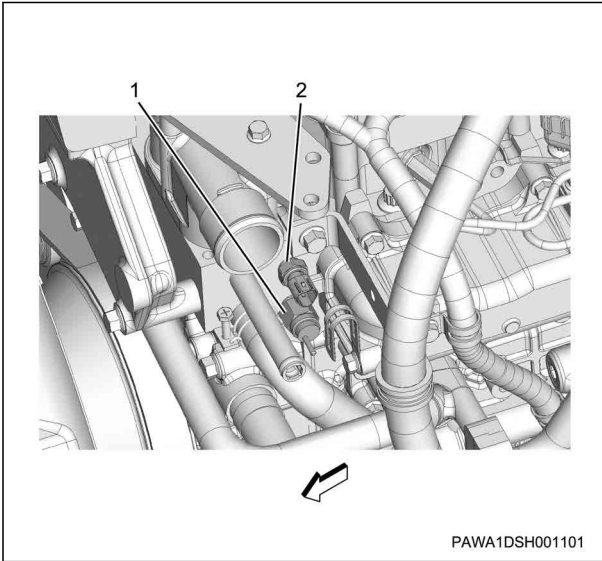
4. Exhaust manifold removal

- Remove the exhaust manifold from the cylinder head assembly.



- Distance tube
- Washer
- Exhaust manifold

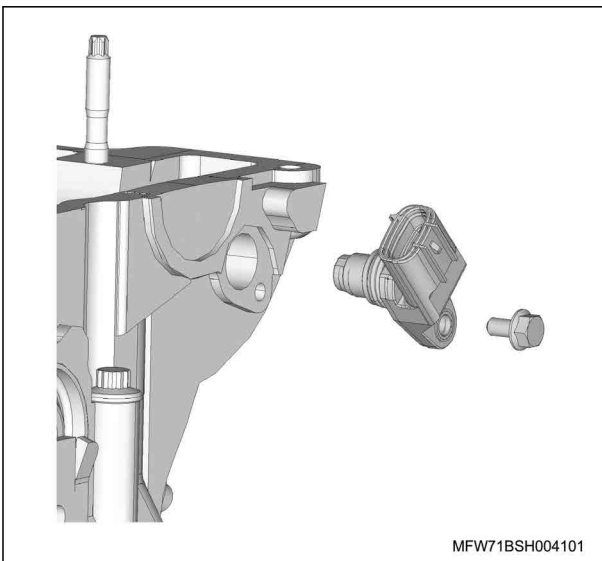
- Remove the gasket from the cylinder head assembly.
- Thermostat removal
 - Remove the fan guide bracket from the water outlet pipe.
 - Remove the water outlet pipe from the cylinder head assembly.
 - Remove the thermostat from the cylinder head assembly.
 - Remove the gasket from the thermostat.
- Overheat switch removal
 - Remove the overheat switch from the cylinder head assembly.
- Engine coolant temperature sensor removal
 - Remove the engine coolant temperature sensor from the cylinder head assembly.



1. Overheat switch
2. Engine coolant temperature sensor

8. CMP sensor removal

1. Remove the CMP sensor from the cylinder head assembly.



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Caution :

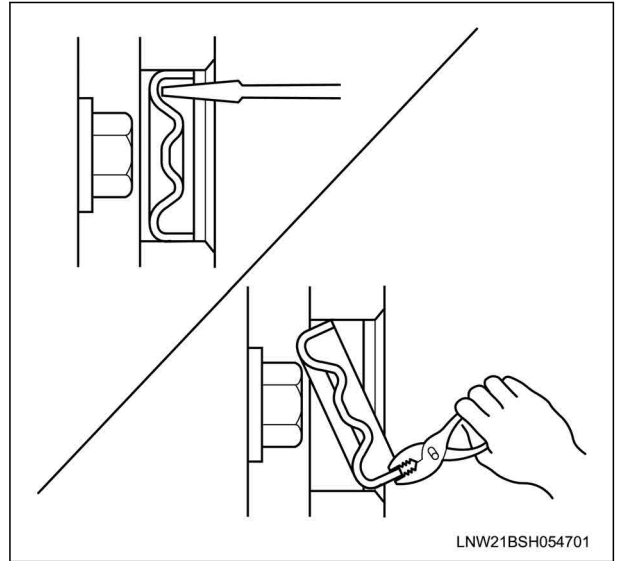
- Be careful not to subject the sensor to shock.

9. Idle gear C removal

1. Press the idle gear C cover using the driver.

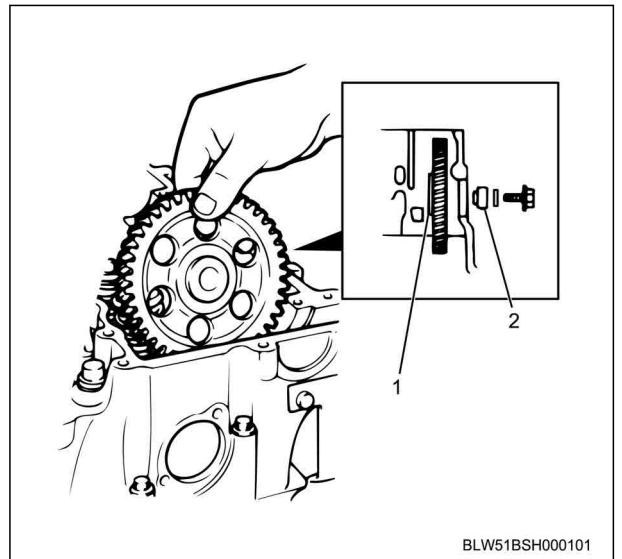
Note :

- Lightly tap the outer perimeter of the cover using a screwdriver and tilt the cover.
2. Remove the idle gear C cover from the cylinder head assembly using the pliers.



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3. Remove the idle gear C from the cylinder head assembly.

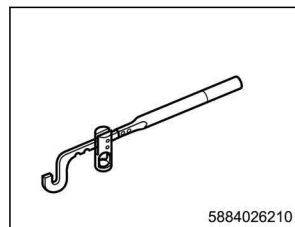


BLW51BSH000101

1. Idle gear C
2. Idle gear shaft

10. Valve spring removal

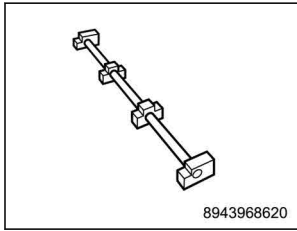
1. Press the valve spring using the special tool.



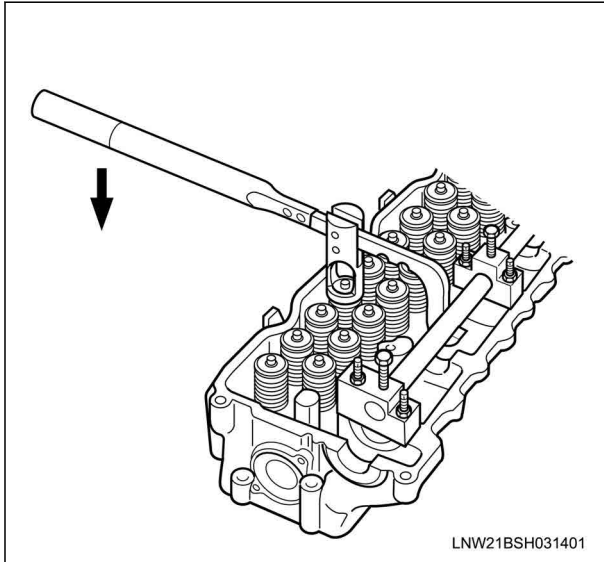
5884026210

SST: 5-8840-2621-0 - valve spring replacer

1B-16 Mechanical (4HK1)



SST: 8-9439-6862-0 - pivot ASM



2. Remove the split collar from the spring seat.
3. Remove the special tool from the cylinder head assembly.
4. Remove the valve spring seat from the valve spring.
5. Remove the valve spring from the cylinder head assembly.

Note :

- Store the removed valve springs according to the cylinders.

11. Inlet valve removal

1. Remove the inlet valve from the cylinder head assembly.

Note :

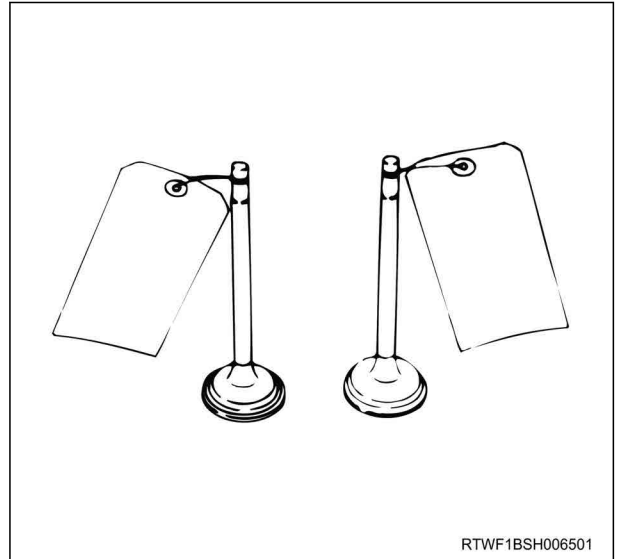
- Organize the removed valve according to the cylinders.

12. Exhaust valve removal

1. Remove the exhaust valve from the cylinder head assembly.

Note :

- Organize the removed valve according to the cylinders.



13. Valve stem oil seal removal

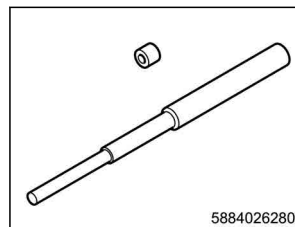
1. Remove the valve stem oil seal from the valve guide using the pliers.

Caution :

- Do not reuse the valve stem oil seal.
2. Remove the valve spring seat from the cylinder head assembly.

14. Valve guide removal

1. Remove the valve guide from the cylinder head assembly using the special tool.



SST: 5-8840-2628-0 - valve guide replacer

Note :

- Tap the valve guides out from the bottom surface of the cylinder head.