

PART NO. EWDDN50-EN-01

HITACHI

Reliable solutions

Engine Manual Workshop Manual

6HK1 Tier 4 Compatible

6HK1 TIER 4 COMPATIBLE ENGINE MANUAL WORKSHOP MANUAL

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

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

PRINTED IN JAPAN (K) 2016, 02

EWDDN50-EN-01

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 6HK1 diesel engine (Tier 4/Stage 4 compatible).

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.

This manual consists of the following sub-sections.

Publication No.	Publication Name	Sub-sections	
IDE-2710	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
		1G	Exhaust
		1H	Aux. Emission Control Devices
		1J	Electrical
		38B	Maintenance Information (Urea SCR System)
		38C	Functional Inspection (Urea SCR System)
		38D	Symptom (Urea SCR System)
		38E	DTC Information (Urea SCR System)
		10M	Emission Control (Urea SCR System)
-	Wiring Diagram		

Introduction

Introduction

(All models)

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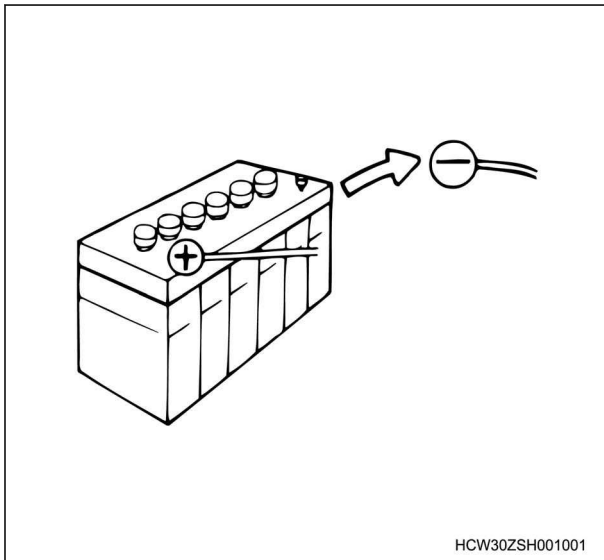
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Introduction

safety information

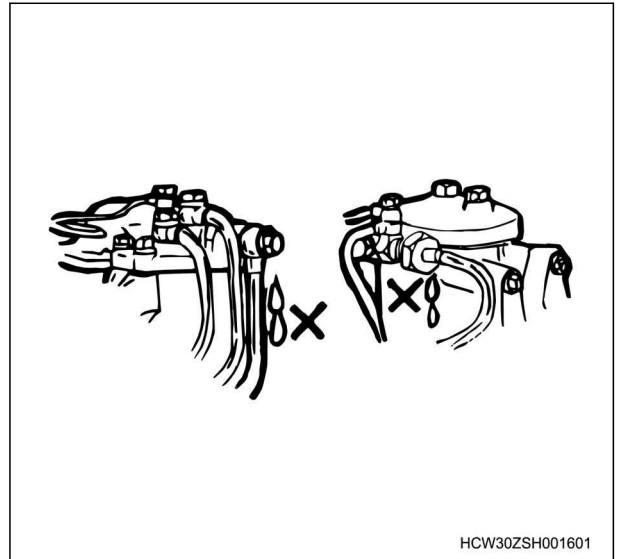
1. Repair work safety information

1. Use an engine stand when demounting the engine from the equipment.
Be sure not to place the engine directly on the ground or allow the oil pan to come into contact with the ground.
2. When performing a procedure with two or more people, make sure to ensure each other's safety.
3. Do not disconnect the battery cable for 3 minutes after turning OFF the ignition switch.
4. When repairing the electrical system, make sure to disconnect the cable from the negative (-) battery terminal before working. Keep fire away when removing the battery cover.



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 only the special tools if the procedure requires them for the work. Performing the procedure using other tools may cause damage to parts or personal injury.
7. Inspect the tools, instruments, and special tools regularly, and prepare them before working. Do not use tools such as a wrench that has lost its edges, a hammer with frayed edges, or a chipped chisel.
8. When performing work using a device such as a grinder, crane or welder, make sure to pay sufficient attention to the handling precautions.
Wear work clothes and safety equipments in the other operations as well.

9. Be sure to check that there is no fuel leaks when performing maintenance on fuel systems.



10. When handling volatile materials, be extremely careful to not let them catch fire.
Also 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 plate, and split pins, etc., with new ones.
 2. Since the part numbers indicated in this manual may differ from the supply system and are subject to change, make sure to check the supply system and part numbers in the parts catalog.

Description General Information

Service Information Guide

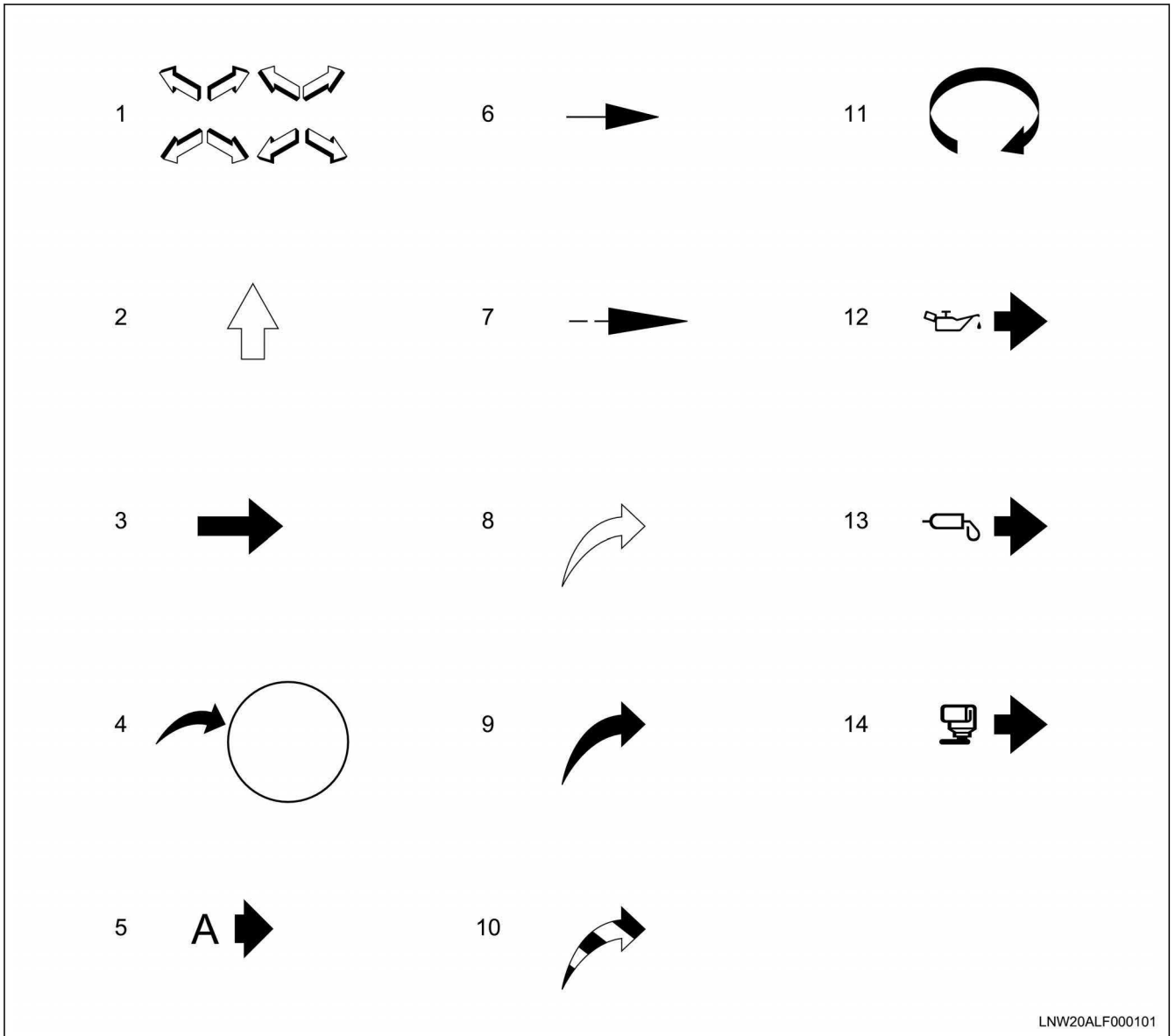
(All models)

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Contents included in service information

1. Contents included in service information
 - Removal
Includes the removal procedure for repairing parts and devices, etc.
 - Installation
Includes the installation procedure for repairing parts and devices, etc.
 - Disassembly
Includes the disassembly procedure for performing an overhaul of a unit or assembly part, etc.
 - Assembly
Includes the assembly procedure for performing an overhaul of a unit or assembly part, etc.
 - Inspection
Includes the inspection items for the parts that particularly require inspection to ensure continued performance of parts and devices.
The standard values, set values, and limits for use of parts are included if they have these specifications set.
 - Cleaning
Includes the cleaning procedure for parts and devices, etc.
 - Preparation
Includes the preparatory procedure necessary before removing parts and devices, etc.
 - Adjustment
Includes the adjustment procedure when parts have to be adjusted to set values or standard values when performing assembly or installation.
 - Measurement
Includes the measurement procedure to judge if parts are installed correctly, etc.
 - Drain
Includes the draining procedure of oil, etc.
 - Refill
Includes the refilling procedure of oil, etc.
 - Air removal
Includes the air removal procedure when air removal is necessary after replacing oil, etc.
 - Writing
Includes the writing procedure necessary after replacing the ECM or supply pump.
 - Precaution
Includes the maintenance precautions specific to each item.
 - Disconnection
Includes the disconnection procedures of wiring, piping, etc.
 - Connection
Includes the connection procedures for wiring, piping, etc.
 - Setting
Includes the setting procedure necessary after replacing the ECM, etc.
 - Replacement
Includes the replacement procedure for parts and oils, etc.
 - Prioritized DTC
Includes DTCs that need to be diagnosed and resolved before the relevant DTC when multiple DTCs are detected.
 - Diagnosis
Includes the diagnosis procedure for troubleshooting symptoms.
DTCs are listed in the descending order of priority.
 - Confirmation of problem resolution
Includes procedures to clear the DTC and any necessary confirmation steps using numeric values, etc.
 - Functional description
Includes detailed functional description related to functional inspection.
 - Symptom description
Includes detailed symptom descriptions related to diagnosis by symptom.
 - DTC description
Includes circuit description related to DTCs.
 - Setting conditions
Includes the preconditions and judgment conditions required for the ECU to detect a DTC.
 - Action upon setting
Includes information related to control actions taken by the ECU when DTCs are set.
 - Items related to ETM
Items related to the ETM are included in "Using the Wiring Diagram".
2. Arrows and symbols



LNW20ALF000101

- | | |
|---|--|
| <ul style="list-style-type: none"> 1. Vehicle front 2. Upper 3. Operating section or operating direction 4. Detail on a section 5. Detailed view from the direction of A 6. Arrow indicates measurement 7. Arrow indicates cross-section 8. Outside air or cold air | <ul style="list-style-type: none"> 9. Gas or warm air 10. Mixing of outside air and gas, or cold air and warm air 11. Rotation direction 12. Oil feeding 13. Lubrication 14. Application area of liquid gasket |
|---|--|

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 }

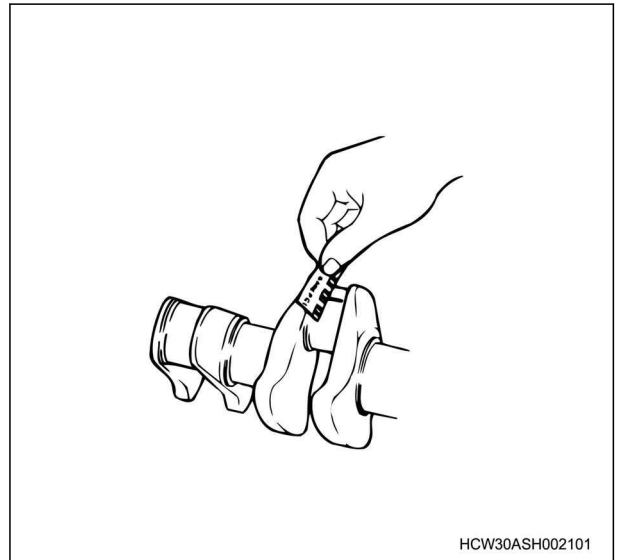
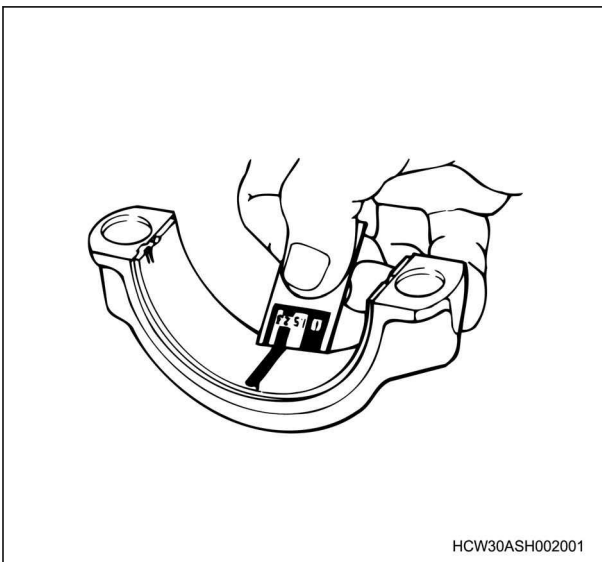
Method for measuring the gap between the connecting rod bearing and crank pin

Clean the connecting rod and bearing, and assemble them on the connecting rod. Cut the plasti-gauge 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 on the cap to assemble it on the crank pin. Apply molybdenum disulfide to the threaded portion and seat surface of the tightening bolts. Alternately tighten them so that the cap is at the specified torque.

Caution :

- Never move the connecting rod when the plasti-gauge is in use.

Gently remove the cap and connecting rod and use a scale printed on the packaging of the plasti-gauge to measure the flattened plasti-gauge.



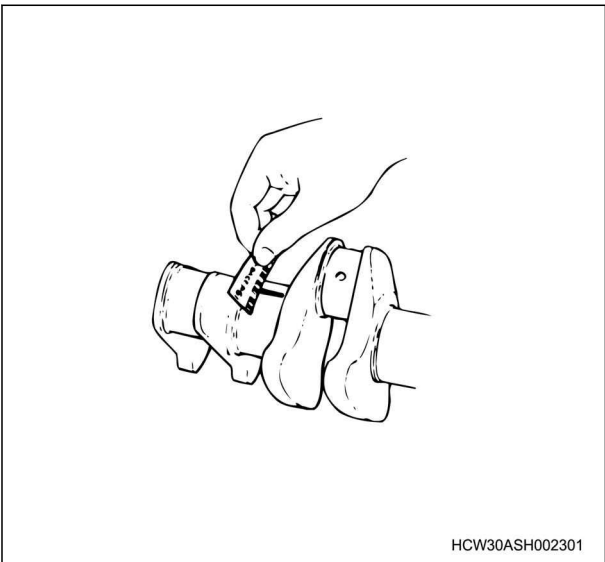
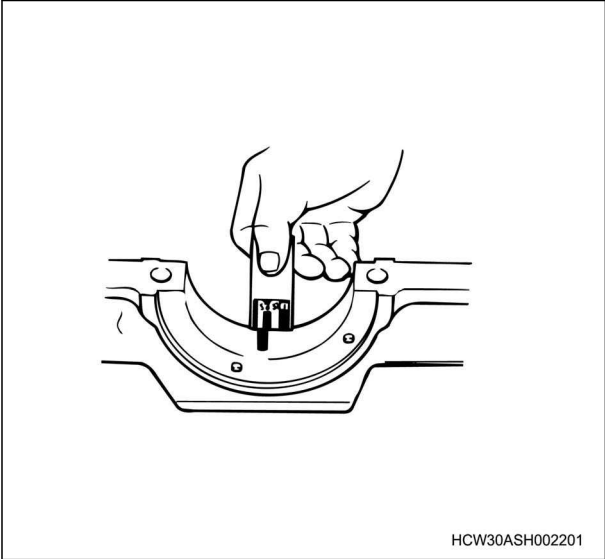
Method for measuring the gap between the crank bearing and crank journal

Clean the installation surfaces of the cylinder block and crankcase bearing, and assemble them on the cylinder block and crankcase. Gently place the crankshaft on the cylinder block, and lock it into place by turning it approximately 30 degrees. Cut the plasti-gauge 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 seat surface of the tightening bolts. Tighten in the specified order at the specified torques.

Caution :

- Never move the connecting rod when the plasti-gauge is in use.

Gently remove the crankcase and use a scale printed on the packaging of the plasti-gauge to measure the flattened plastic gauge.



Recommended liquid gasket

1. Using the thread liquid gasket

Type	Product name	Manufacturer name	Area used (reference)
Silicon type (room temperature vulcanization process)	ThreeBond 1207B	ThreeBond	Engine oil seal retainer Engine oil pan Timing gear case Flywheel housing Cylinder head cover Fuel pump Water pump etc.
	ThreeBond 1207C	ThreeBond	
Water-soluble	ThreeBond 1201	ThreeBond	
Solvent type	ThreeBond 1215	ThreeBond	
	ThreeBond 1216	ThreeBond	
	ThreeBond 1141	ThreeBond	
	ThreeBond 1104	ThreeBond	Engine oil seal retainer Water pump Plug etc.
	ThreeBond 1194	ThreeBond	
Anaerobic	Loctite 515 Loctite 518 FMD127 (Loctite 5127) Loctite 271	Loctite Loctite Loctite Loctite Loctite	

Caution :

- Make sure to use a liquid gasket with the above product name 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 when there is a gap larger than 0.25 mm {0.0098 in} between the contact surfaces of metals.

Whenever disassembling, completely remove old liquid gasket using a scraper, and clean by removing any oil, moisture, filth, etc. from the locations of parts and the mating parts where liquid gasket was used by using a rag, etc. After cleaning, apply the specified liquid gasket to each location and assemble them.

Note :

- It is better to start the removal operation approximately 10 minutes after applying when using gasket remover to make the operation easier while cleaning.

Caution :

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

Apply liquid gasket of the specified bead width to one side of the contact surface thoroughly.

Caution :

- Be careful to apply a proper amount of the liquid gasket to avoid an excess or lack in application.
- Be sure to overlap the beginning and ending of the liquid gasket application.
- Be careful not to misalign the applied part with the mating part when assembling.

Note :

- When there is a misalignment, apply again.
- Use the same size studs as a guide when using with a section which has no positioning such as a knock pin.

Caution :

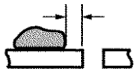

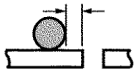
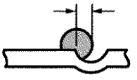


- After applying the liquid gasket, assemble within 15 minutes.

Note :

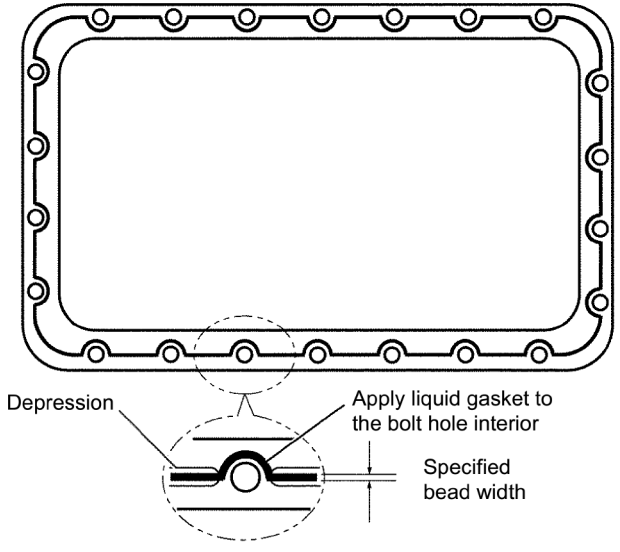
- When more than 15 minutes have passed after applying liquid gasket, remove the liquid gasket and apply it again.

Caution :

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

SCREW HOLE	DEPRESSION	JUDGEMENT
1-3 (0.04-0.12) 		OK
1-3 (0.04-0.12) 	More than 2 (0.08) 	OK
		NG

mm (in)



Depression

Apply liquid gasket to the bolt hole interior

Specified bead width

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 :

- Remove grime, fluid, oil, and grease off thoroughly from the bolts, bolt holes, and screw thread section of nuts to which thread locking adhesive agent will be applied.

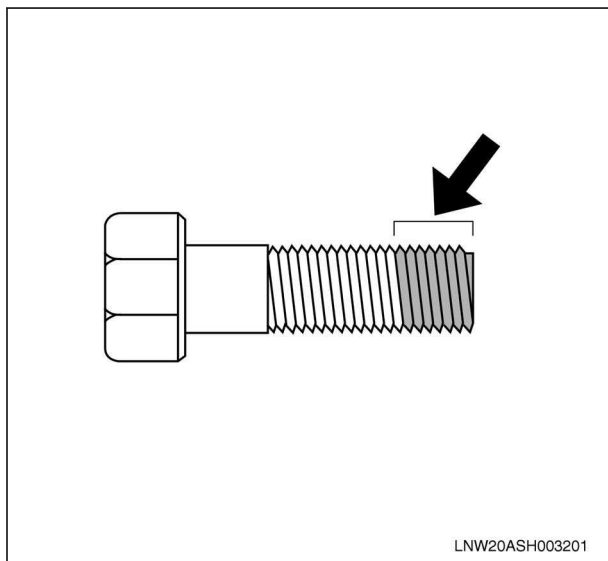
Note :

- Check if the cleaned sections are dry.

Caution :

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

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



Term

1. Term

Nominal dimensions

Refers to standard values for production.

Specified value

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

Limit

Refers to a maximum or minimum value that should not be exceeded during maintenance. If this value is exceeded, replacement or repair must be made.

Warning Refers to something which may cause serious injuries if it is not performed properly.

CAUTION

Refers to something which may cause physical loss or damage if it is not performed properly.

NOTE

Instruction, guidance, and usage conditions regarding usage, operation, and repair in the additional information.

Abbreviations

1. Abbreviations

Abbreviation	Description
A/D	Analog/Digital
ABDC	After bottom dead center
AC	Alternating current
ACC	Accessory
ACG	Alternating current generator
ACT	Actuator
API	American Petroleum Industry
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 the top dead center
C/B	Circuit breaker
C/U	Control unit
CAN	A control unit communication method (Control area network)
CKP	Crankshaft position
CMP	Camshaft position
CO	Carbon monoxide
CPU	CPU (Central processing unit)
DC	Direct current
DI	Direct injection type
DLC	Data link connector
DPD	Diesel particulate diffuser
DTC	Self-diagnosis code
DMM	Digital multi-meter
ECM	Engine control module
ECT	Engine coolant temperature
ECU	Electronic control unit
EEPROM	Electrically erasable/programmable ROM
EGR	EGR (Exhaust gas recirculation)
EMI	Electromagnetic interference
EVRV	Electric vacuum regulating valve
EXH	Exhaust
F/B	Feedback
F/C	Fuel cut
F/L	Fusible link
FLW	Fusible link wire
FRT	Front
FT	Fuel temperature
FWD	Front

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GEN	Generator
GND	Ground
HC	Hydrocarbon
HO2S	Superheat O2 sensor
IAC	Idle air control
IAT	Intake air temperature
IC	Integrated circuit
ID Plate	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	Electromagnetic valve
MAF	Mass air flow
MAP	Manifold air pressure
Max	Maximum
MIL	Warning light (Diagnostic light)
Min	Minimum
MPU	Micro processing unit
NC	Normally closed
NC	Normally closed
NO	Normally open
NOx	Nitrogen oxide
N-TDC	Top dead center revolution speed
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	Particle material
PTO	Power take-off
PWM	Pulse width modulation wave
QOS	QOS (Quick on start system)
QWS	QWS (Quick warming up system)

RH	Right side
R/L	Relay
RAM	RAM (Random access memory)
REF	Reference
ROM	ROM (Read only memory)
RP	Rail pressure
Rr	Rear
Rr	Rear
RWD	Rear
SAE	Society of Automotive Engineers
SBF	Slow blow fuse
SCV	Suction control valve
SIG	Signal
SLD	Shield
ST	Starter/start
STD	Standards
SW	Switch
TDC	Top dead center
TEMP	Temperature
TP	Throttle position
VB	Battery voltage
VGS Turbo	Variable geometry system turbo, VGS turbo
W/H	Wire/harness
W/L	Warning light (Warning light)
W/S	Weld splice
WOT	Wide open throttle

Standard bolts

1. List of standard bolt and nut tightening torques

Note :

- The tightening torque values in the following table apply to locations where tightening torques are not specified.

Strength category	4.8 4T		7T	
Bolt head shape	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 }
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 }	-

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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 }	-

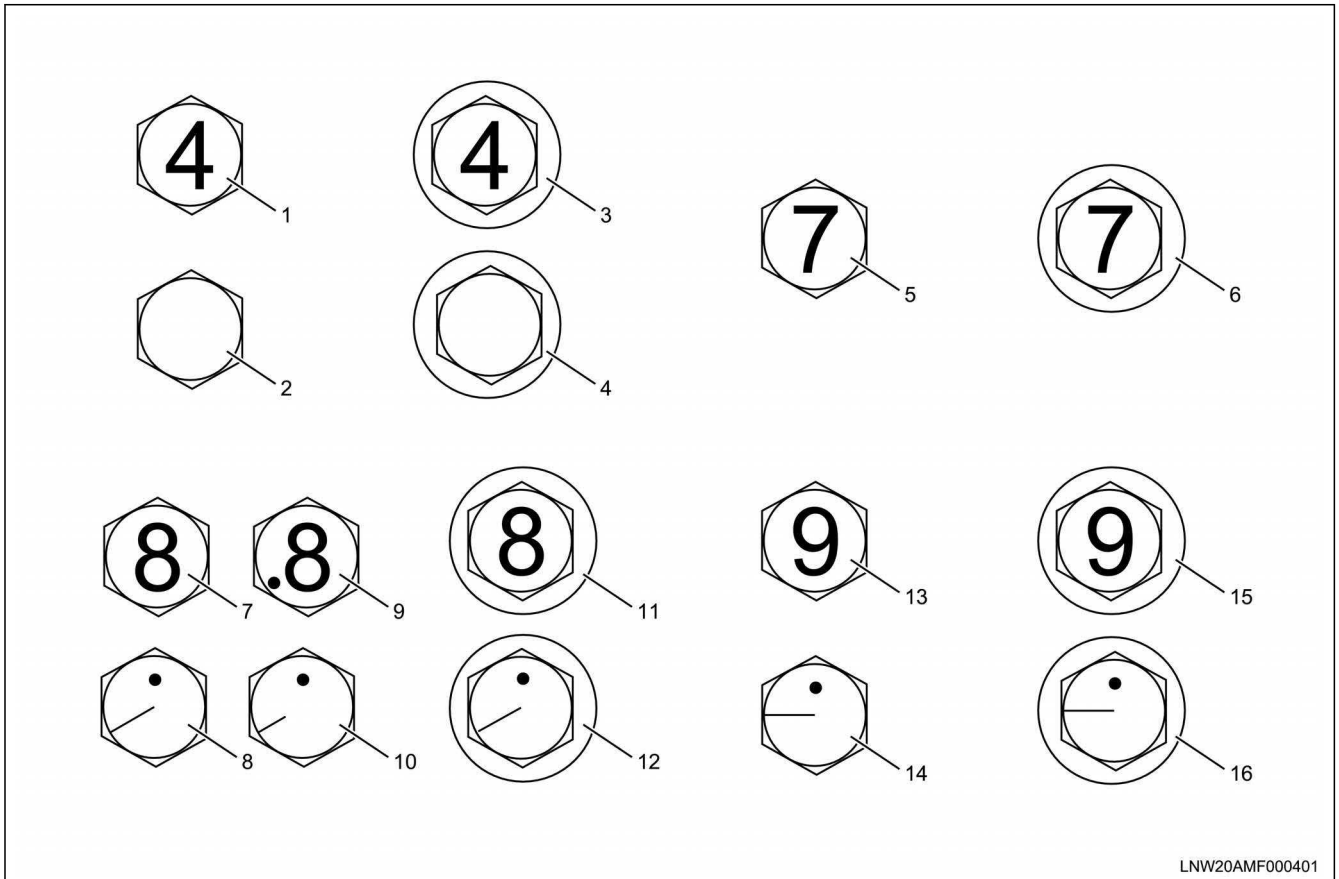
Strength category	8.8		9.8 9T	
Bolt head shape	Hex bolt	Flange bolt	Hex bolt	Flange bolt
M6 x 1	: 5.6 to 11.2 N · m { 0.6 to 1.1 kgf · m / 50 to 99 lb · in }	: 6.6 to 12.2 N · m { 0.7 to 1.2 kgf · m / 58 to 108 lb · in }	-	-
M8 x 1.25	: 13.4 to 25.7 N · m { 1.4 to 2.6 kgf · m / 10 to 19 lb · ft }	: 15.3 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 }
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 }	-

14A-18 Service Information Guide (All models)

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 :

- Those indicated with an asterisk (*) are used for the female threaded portion of soft materials such as castings.
- Refer to the following diagram regarding the marking on the top of standard bolts.



LNW20AMF000401

- Hex bolt, 4.8, 4 T
- Hex bolt, 4.8, 4 T
- Flange bolt, 4.8, 4 T
- Flange bolt, 4.8, 4 T
- Hex bolt, 7 T
- Flange bolt, 7 T
- Hex bolt, thermal refining 8.8
- Hex bolt, thermal refining 8.8
- Hex bolt, non-thermal refining 8.8
- Hex bolt, non-thermal refining 8.8
- Flange bolt 8.8
- Flange bolt 8.8
- Hex bolt, 9.8, 9 T
- Hex bolt, 9.8, 9 T
- Flange bolt, 9.8, 9 T
- Flange bolt, 9.8, 9 T

	Pipe diameter	Tightening torque for large/medium size vehicles	Flare nut width across flat	
			Previous	New
Tightening torque of 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 }

Tapered thread for connectors and brass products

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 }

Tapered thread for products other than connectors and brass products

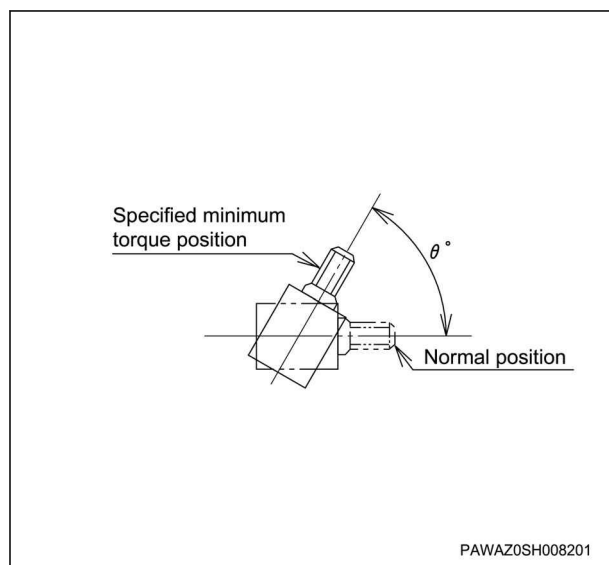
Screw size	PT (R) 1/8	PT (R) 1/4	PT (R) 3/8	PT (R) 1/2	PT (R) 3/4
-	: 5.9 to 11.8 N · m { 0.6 to 1.2 kgf · m / 52 to 104 lb · in }	: 14.7 to 29.4 N · m { 1.5 to 3.0 kgf · m / 11 to 22 lb · ft }	: 29.4 to 39.2 N · m { 3.0 to 4.0 kgf · m / 22 to 29 lb · ft }	: 29.4 to 58.8 N · m { 3.0 to 6.0 kgf · m / 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 of the tapered thread for products other than connectors and brass products is only applied when the opposite 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 then let air in after tightening.
- Do not use seal tape, etc.



Engine Mechanical (6HK1)

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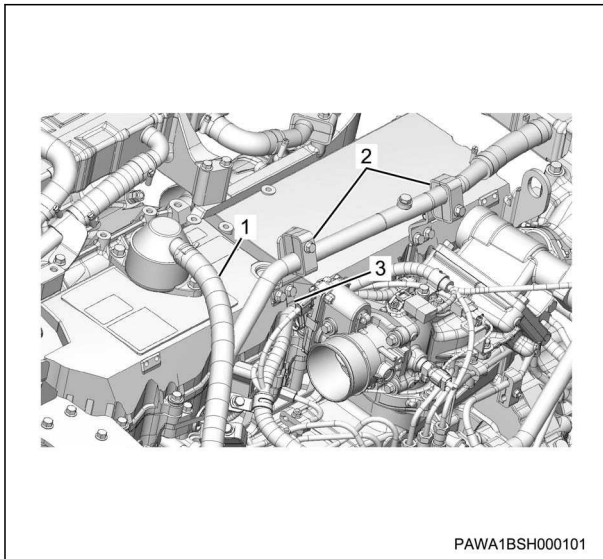
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installation.....	1B-3	removal.....	1B-308
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Cylinder head cover

removal

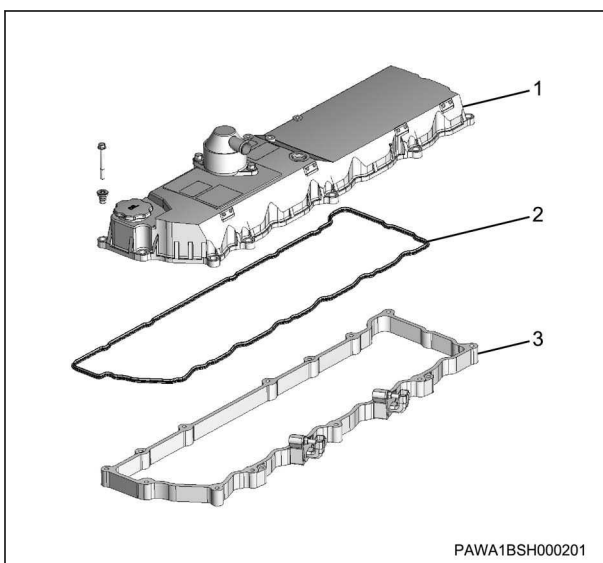
3. Lower cover

1. Cylinder head cover removal
 1. Disconnect the water pipe bracket from the cylinder head cover.
 2. Disconnect the ventilation hose from the air breather.



1. Ventilation hose
2. Water pipe bracket
3. Clip

3. Remove the cylinder head cover from the lower cover.
4. Remove the head cover gasket from the cylinder head cover.



1. Cylinder head cover
2. Head cover gasket

installation

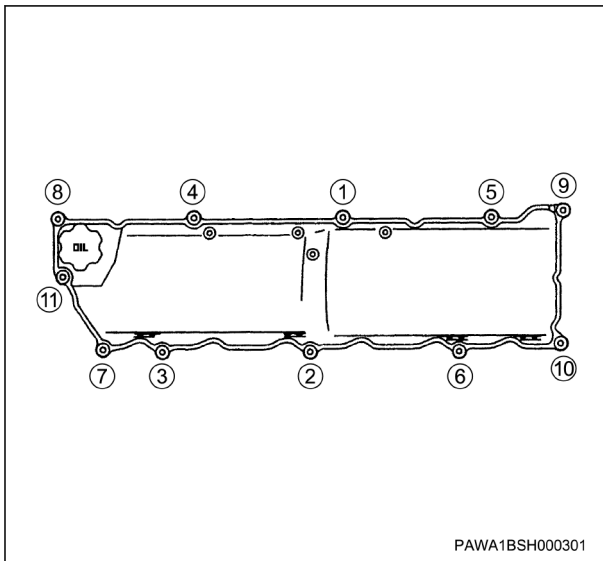
1. Cylinder head cover installation

1. Align the head cover gasket to the cylinder head cover.
2. Install the cylinder head cover to the lower cover.

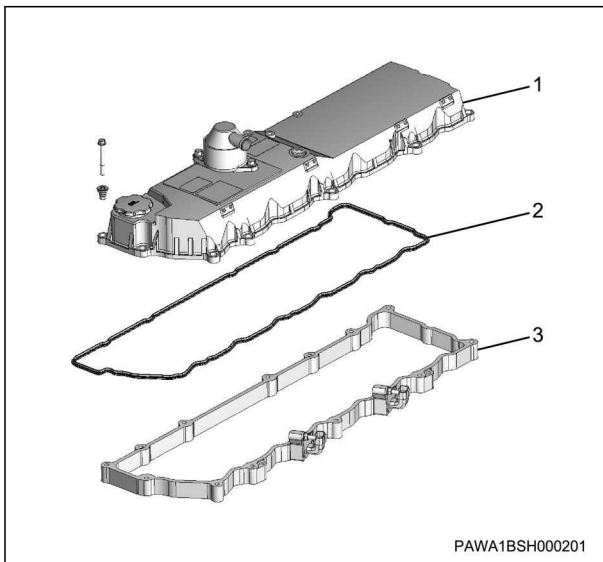
tightening torque : 13 N · m { 1.3 kgf · m / 115 lb · in }

Note :

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



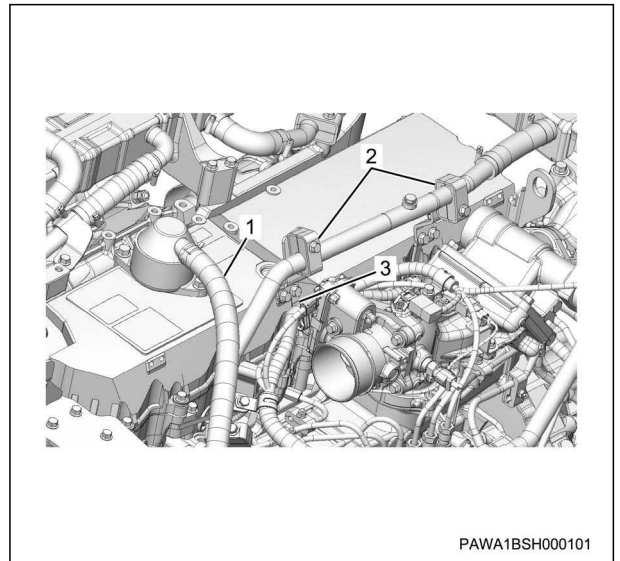
PAWA1BSH000301



PAWA1BSH000201

1. Cylinder head cover
2. Head cover gasket
3. Lower cover

tightening torque : 20 N · m { 2.0 kgf · m / 14 lb · ft }



PAWA1BSH000101

1. Ventilation hose
2. Water pipe bracket
3. Clip

3. Connect the ventilation hose to the air breather.
4. Connect the water pipe bracket to the cylinder head cover.

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 3 minutes after turning OFF the ignition switch.

2. Coolant drain

1. Remove the radiator cap from the radiator.

Caution :

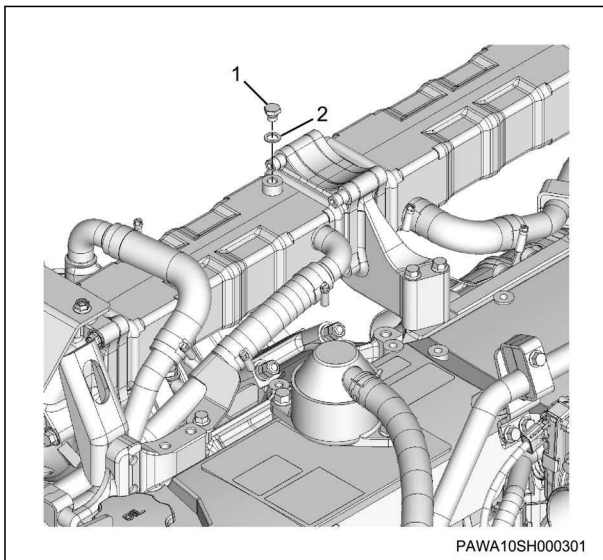
- Do not loosen the radiator cap or sub-tank cap when the coolant temperature is high.
- Because steam and boiling water can burst out from the radiator and possibly cause burns, check that the engine has cooled.

2. Remove the drain plug from the radiator.

3. Drain coolant from the radiator.

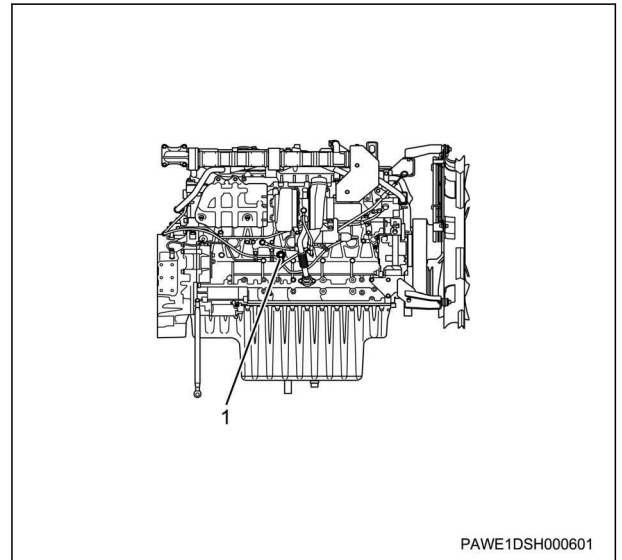
Note :

- If the EGR cooler has an air bleeding plug, loosen the plug and remove it.
- With the pressurized reserve tank specification, it is not necessary to bleed the air.



1. Air bleeding plug
2. Gasket

4. Remove the drain plug from the cylinder block.



1. Drain plug

5. Discharge coolant from the engine.
6. Install the drain plug to the cylinder block.
7. Install the drain plug to the radiator.

3. Engine harness disconnect

1. Disconnect the engine harness from the engine assembly.

Note :

- Disconnect each connector.

4. Turbocharger assembly removal

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

Note :

- Remove the clip.

5. Remove the oil feed pipe from the pipe bracket.

Note :

- Remove the clip.

6. Disconnect the oil return pipe from the turbocharger assembly.
7. Remove the oil return pipe from the cylinder block.
8. Disconnect the water return pipe from the turbocharger assembly.

9. Remove the water return pipe from the cylinder head assembly.
10. Disconnect the water feed pipe from the turbocharger assembly.

Note :

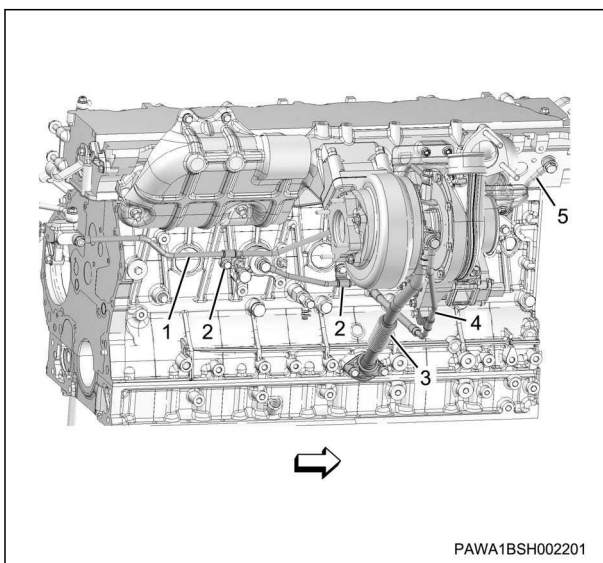
- Remove the clip.

11. Remove the water feed pipe from the cylinder block.

Note :

- Remove the clip.

12. Disconnect the harness connector from the turbocharger assembly.
13. Remove the turbocharger assembly from the exhaust manifold.

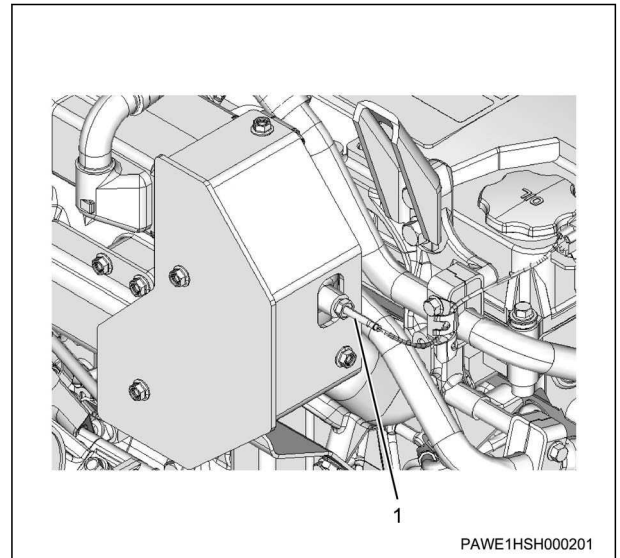


PAWA1BSH002201

1. Oil feed pipe
2. Clip
3. Oil return pipe
4. Water feed pipe
5. Water return pipe

5. EGR gas temperature sensor 1 removal

1. Disconnect the harness connector from EGR gas temperature sensor 1.
2. Remove the harness bracket from the fan guide stay.
3. Remove EGR gas temperature sensor 1 from EGR pipe A.

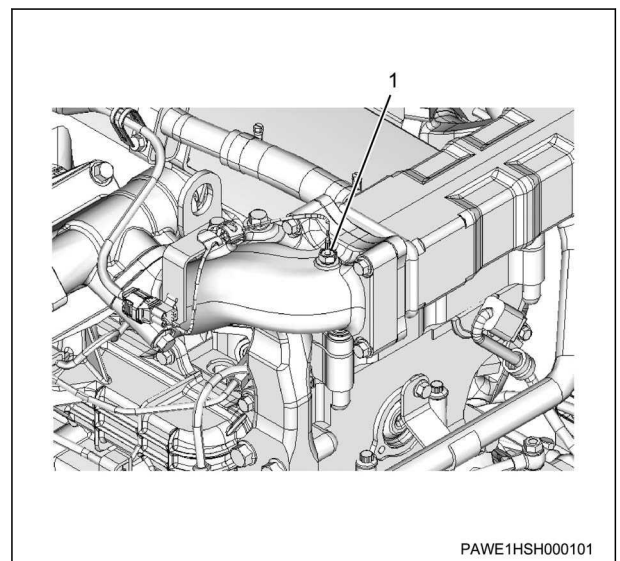


PAWE1HSH000201

1. EGR gas temperature sensor 1

6. EGR gas temperature sensor 2 removal

1. Disconnect the harness connector from EGR gas temperature sensor 2.
2. Remove the harness bracket from EGR pipe B.
3. Remove EGR gas temperature sensor 2 from EGR pipe B.



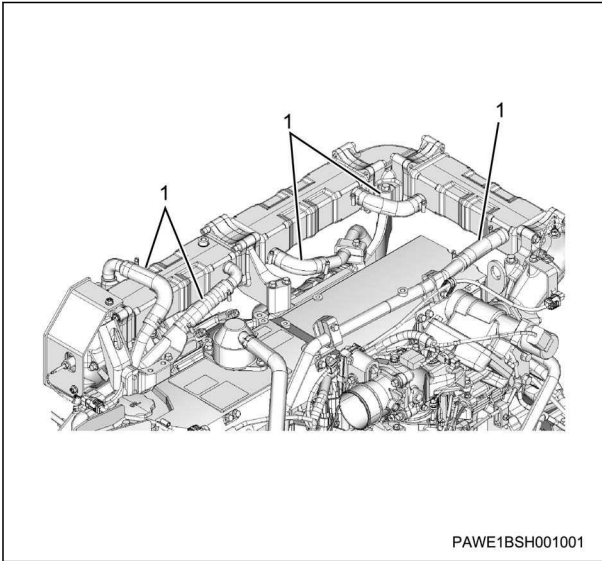
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1. EGR gas temperature sensor 2

7. EGR cooler removal

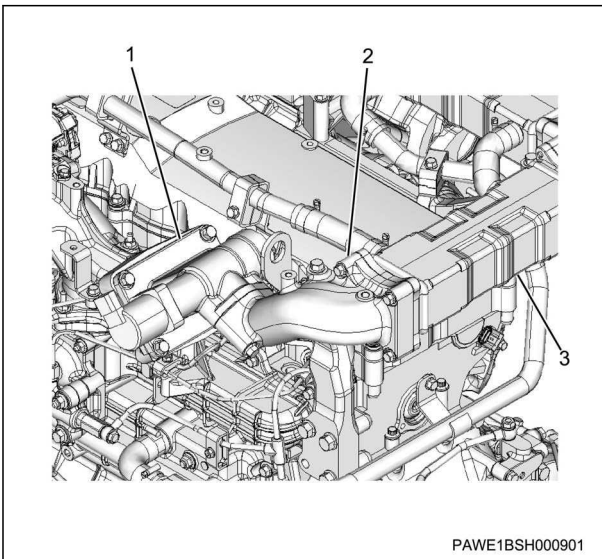
1. Disconnect the water rubber hose from the EGR cooler.

1B-6 Mechanical (6HK1)



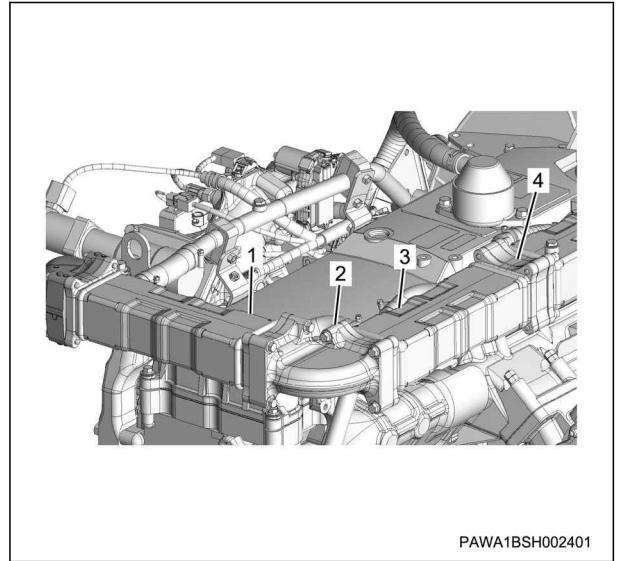
1. Water rubber hose

2. Remove the EGR pipe B from the EGR valve and the EGR cooler C.



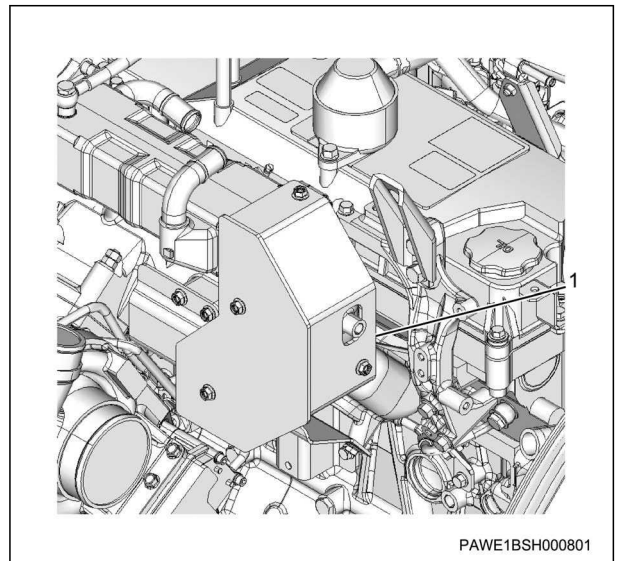
1. EGR valve
2. EGR pipe B
3. EGR cooler C

3. Remove the EGR cooler C from the EGR bracket C.
4. Remove the EGR bracket C from the EGR cooler B.
5. Remove the EGR cooler B from the EGR cooler bracket A.
6. Remove the EGR cooler bracket A from the EGR cooler A.



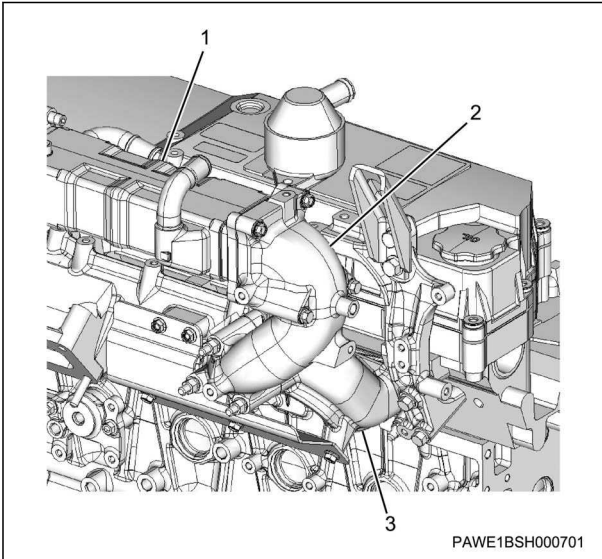
1. EGR cooler C
2. EGR bracket C
3. EGR cooler B
4. EGR cooler bracket A

7. Remove the EGR heat protector from the EGR pipe A.



1. EGR heat protector

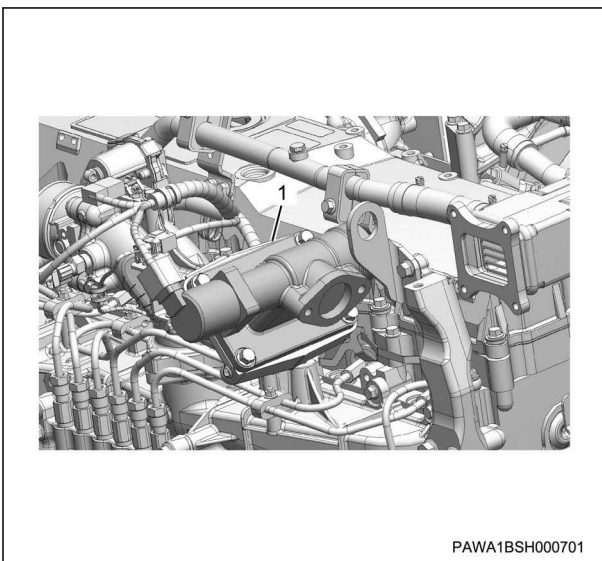
8. Remove the EGR cooler A from the EGR pipe A.
9. Remove the EGR pipe A from the exhaust manifold.



1. EGR cooler A
2. EGR pipe A
3. Exhaust manifold

8. EGR valve removal

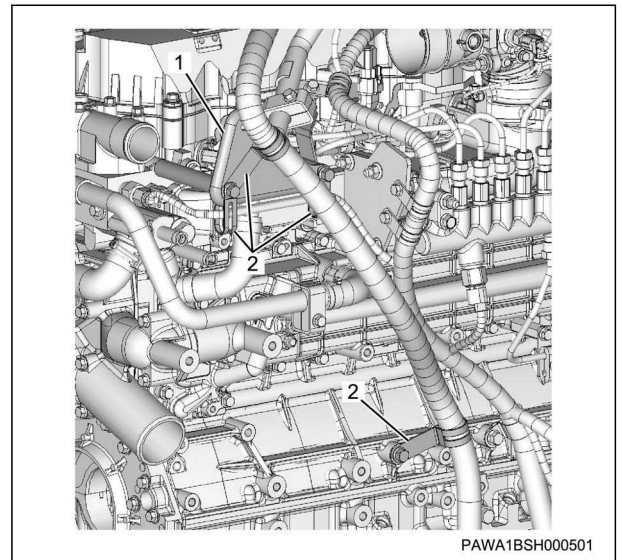
1. Disconnect the harness connector from the EGR valve.
2. Remove the EGR valve from the inlet pipe.



1. EGR valve

9. Oil separator bracket removal

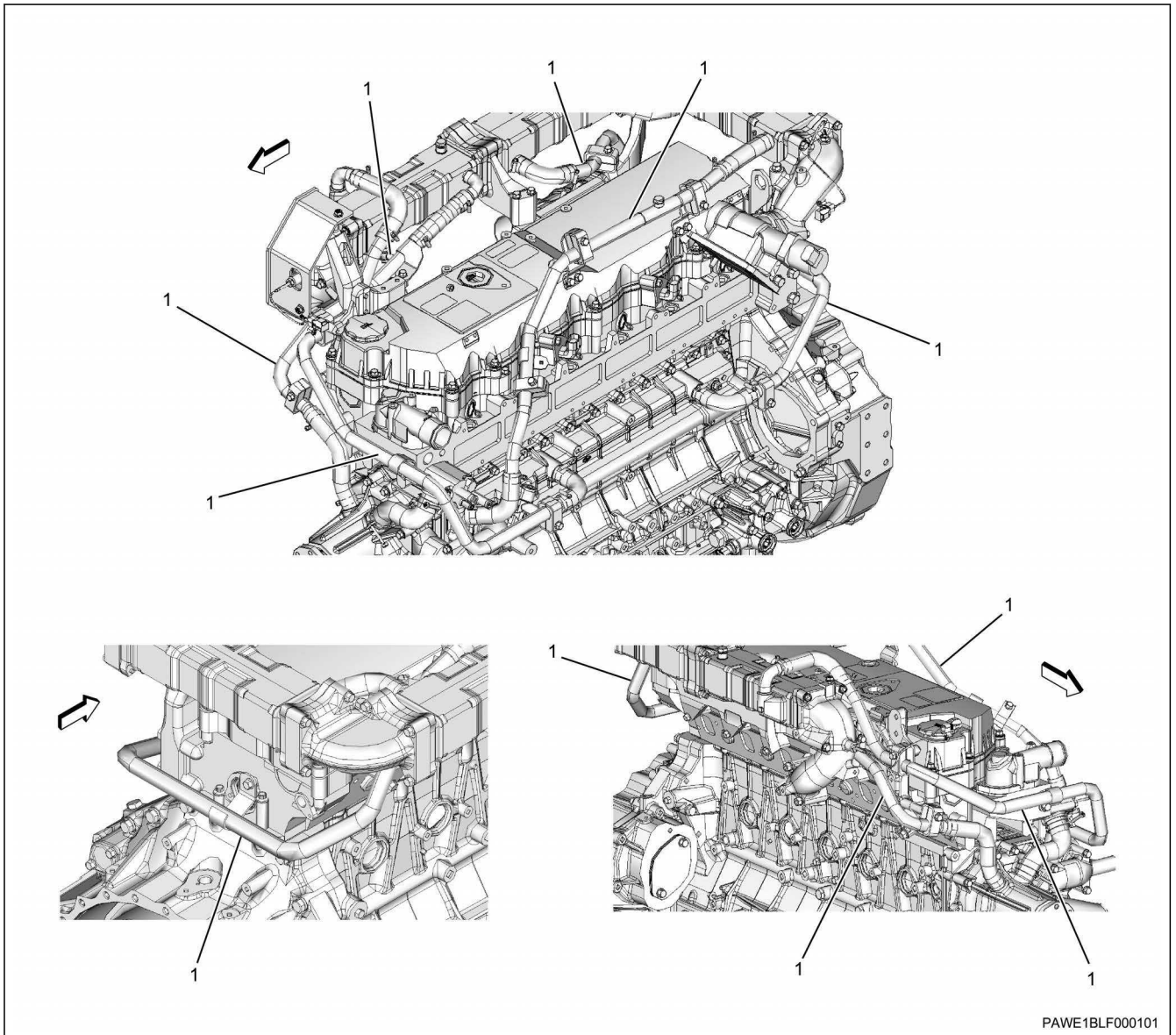
1. Remove the clip from the cylinder block.
2. Remove the ventilation hose from the air breather.
3. Remove the oil separator bracket from the cylinder head assembly.



1. Oil separator bracket
2. Clip

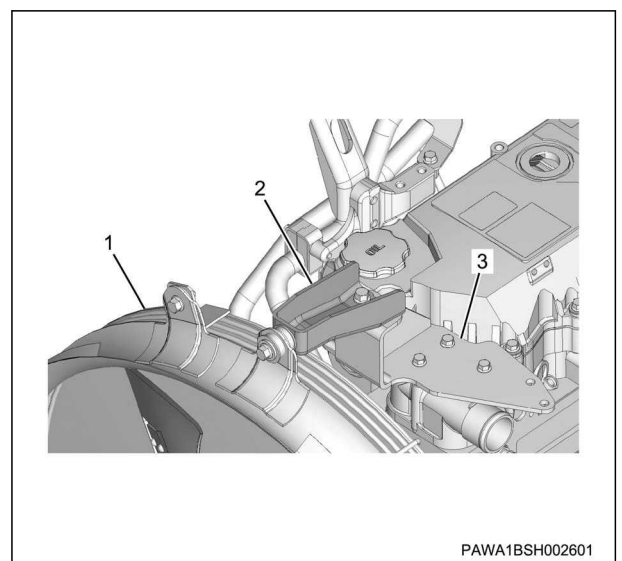
10. EGR cooler water pipe removal

1. Remove the EGR cooler water pipe from the engine assembly.



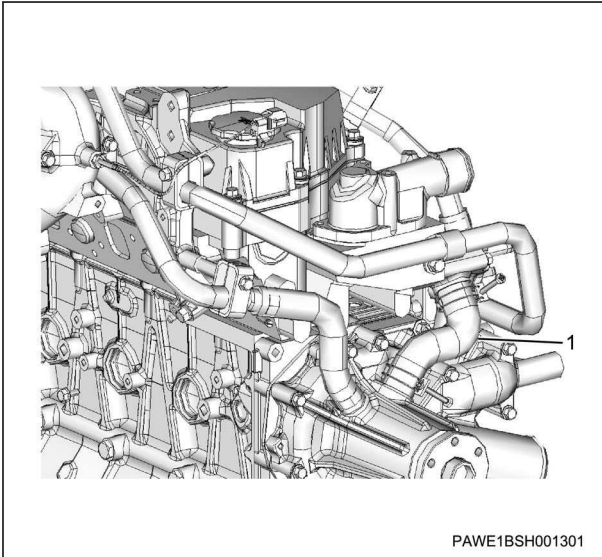
1. EGR cooler water pipe

2. Remove the fan guide stay from the fan guide and the fan guide bracket.



1. Fan guide
2. Fan guide stay
3. Fan guide bracket

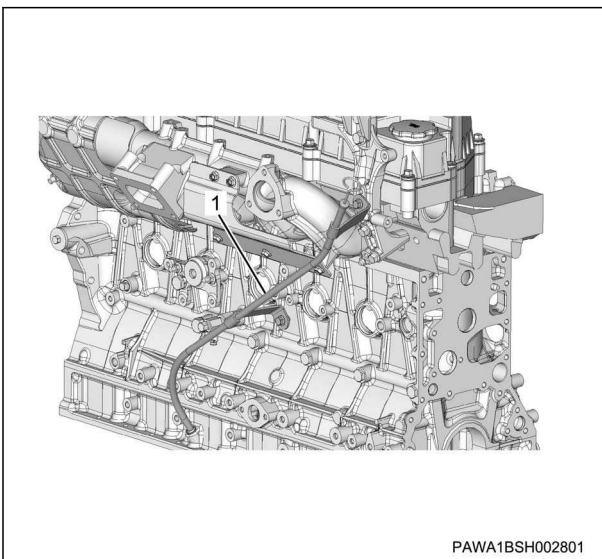
3. Disconnect the radiator upper hose from the water outlet pipe.
4. Remove the water bypass hose from the water pump assembly and the water duct.



1. Water bypass hose

11. 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 front engine hanger bracket.
3. Remove the oil level gauge guide tube from the cylinder block.



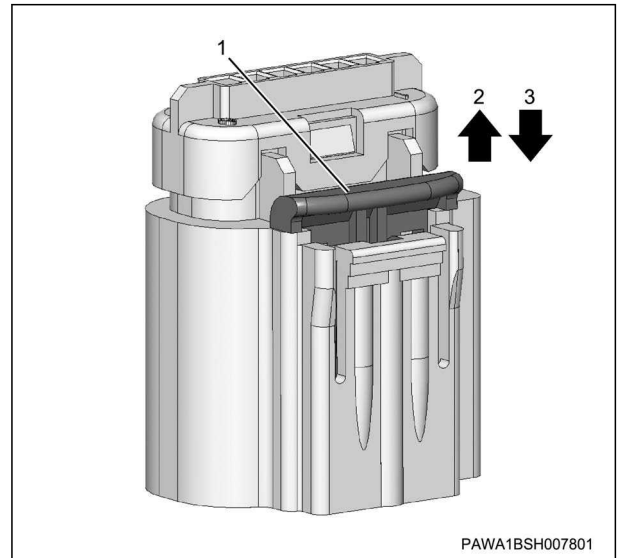
1. Oil level gauge guide tube

12. Intake throttle valve removal

1. Remove the air duct from the intake throttle valve.
2. Disconnect the harness connector from the intake throttle valve.

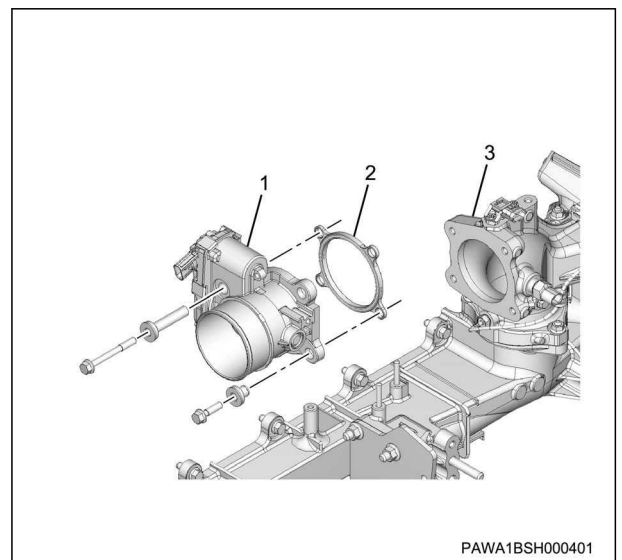
Note :

- Pull the lock operation portion to release the lock.



1. Lock operation section
2. Lock release
3. Lock

3. Remove the intake throttle valve from the inlet pipe.

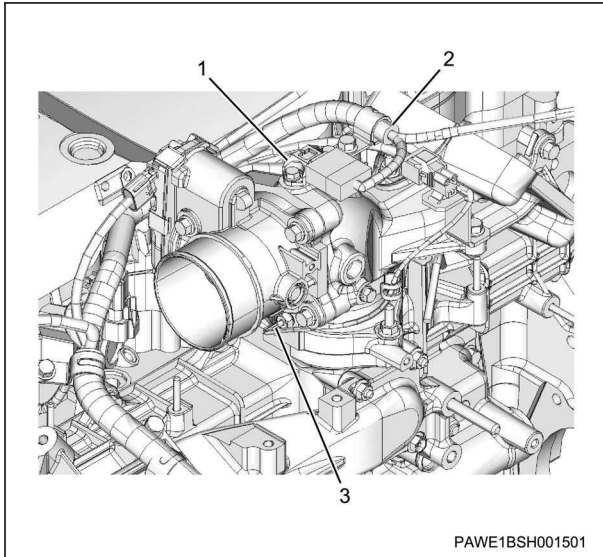


1. Intake throttle valve
2. Gasket
3. Inlet pipe

13. Inlet pipe removal

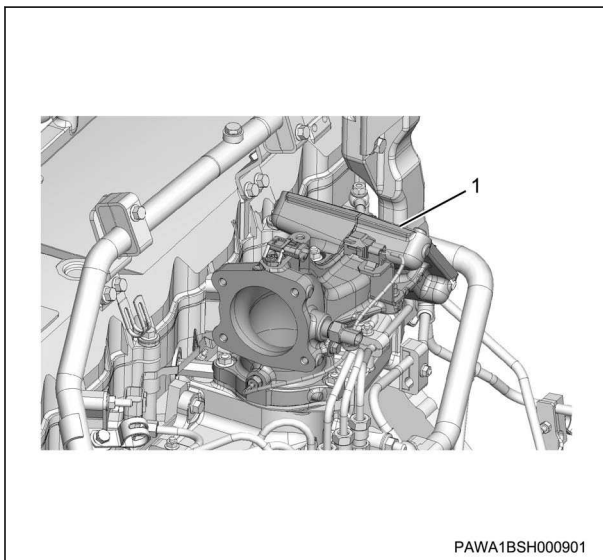
1B-10 Mechanical (6HK1)

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



1. Boost pressure sensor/boost temperature sensor
2. Harness clip
3. IMT sensor

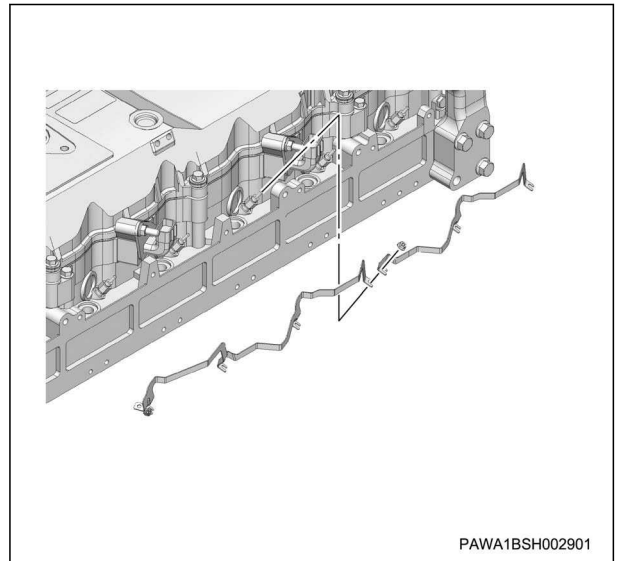
4. Remove the inlet pipe from the inlet cover.



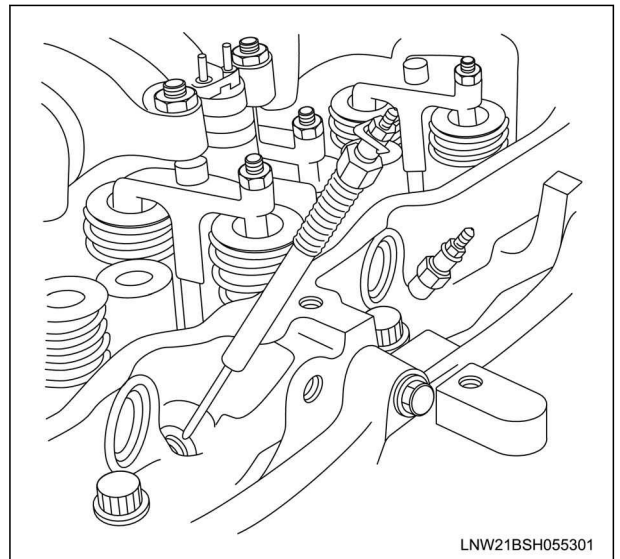
1. Inlet pipe

14. Glow plug removal

1. Remove the glow plug connector from the glow plug.



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

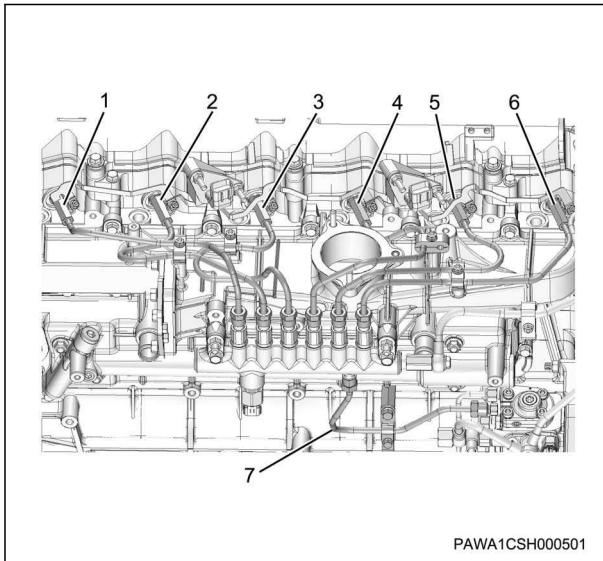


15. Injection pipe removal

1. Remove the clip from the inlet pipe.
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. No.5 injection pipe
6. No.6 injection pipe
7. Fuel pipe

16. 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 removed gasket.

17. Fuel leak off pipe assembly removal

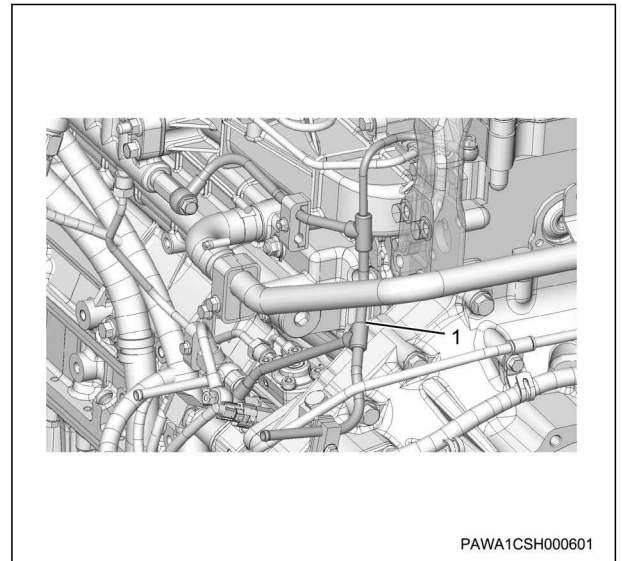
1. Disconnect the fuel leak-off pipe from the cylinder head.
2. Remove the fuel leak-off pipe from the fuel supply pump.

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 inlet pipe.

Note :

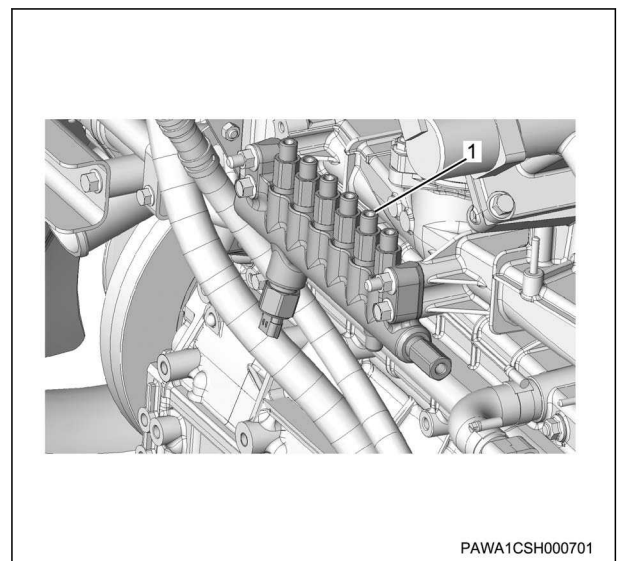
- Remove the clip.



1. Fuel leak-off pipe

18. Common rail assembly removal

1. Disconnect the harness connector from the fuel pressure sensor.
2. Remove the common rail assembly from the inlet cover.

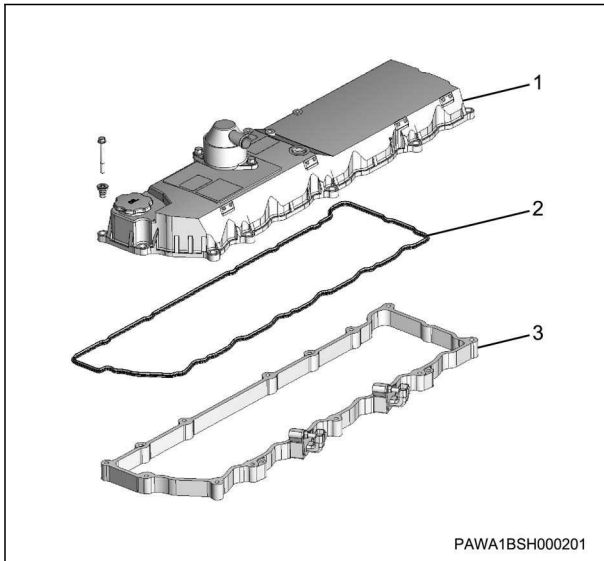


1. Common rail assembly

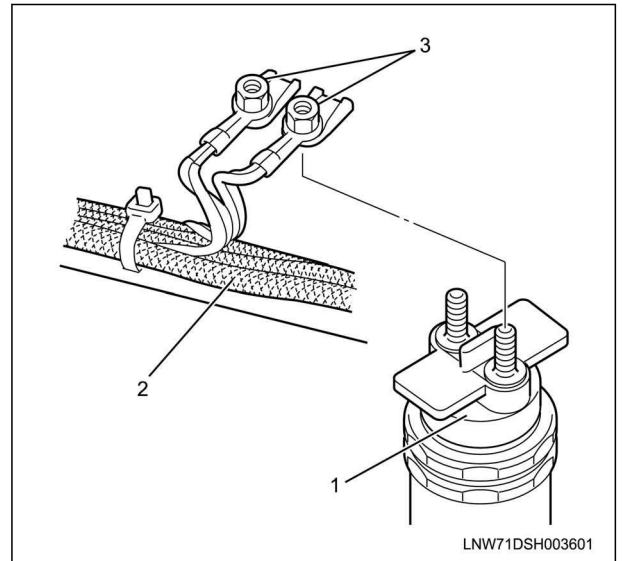
19. Cylinder head cover removal

1. Disconnect the ventilation hose from the air breather.
2. Remove the cylinder head cover from the lower cover.
3. Remove the head cover gasket from the cylinder head cover.

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1. Cylinder head cover
2. Head cover gasket
3. Lower cover



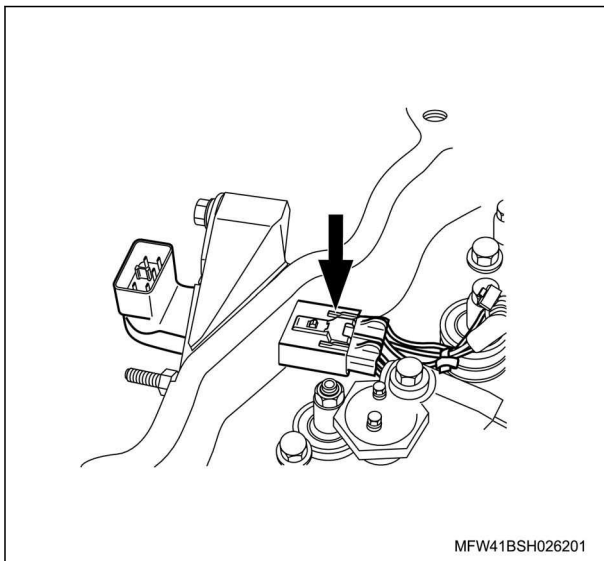
1. Injector
2. Injector harness
3. Terminal nut

20. Injector harness 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.

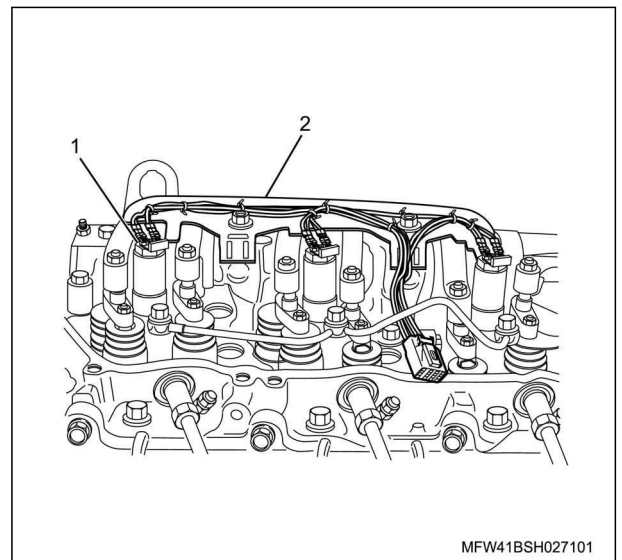
Caution :

- 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.



1. Injector harness terminal
2. Injector harness bracket

21. Lower cover removal

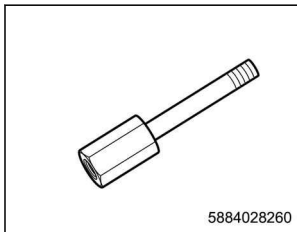
1. Remove the lower cover from the cylinder head assembly.
2. Remove the rubber plug from the cylinder head assembly.

22. Injector removal

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

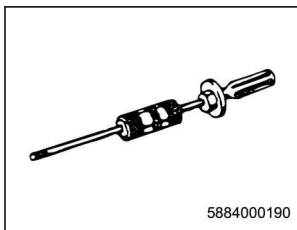
Note :

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



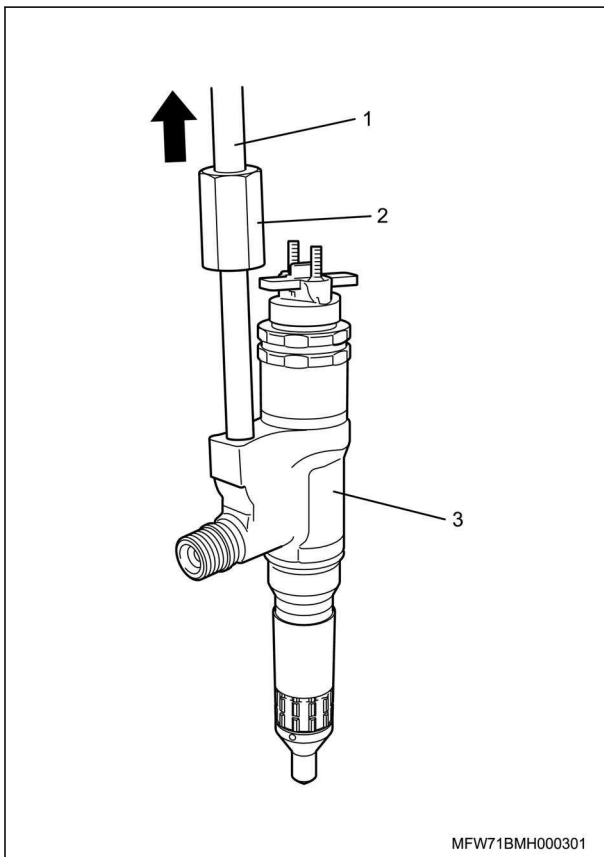
5884028260

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



5884000190

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

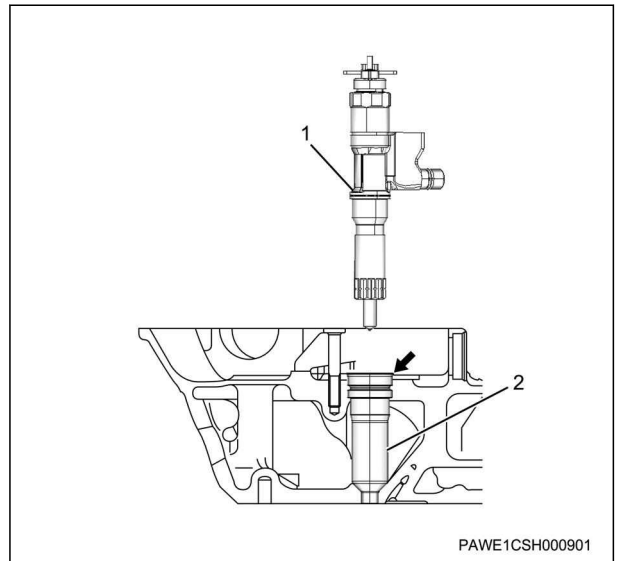


MFW71BMH000301

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.

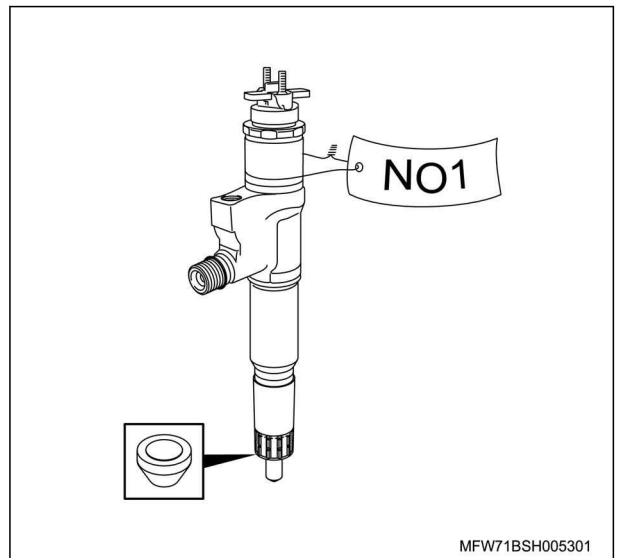


PAWE1CSH000901

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

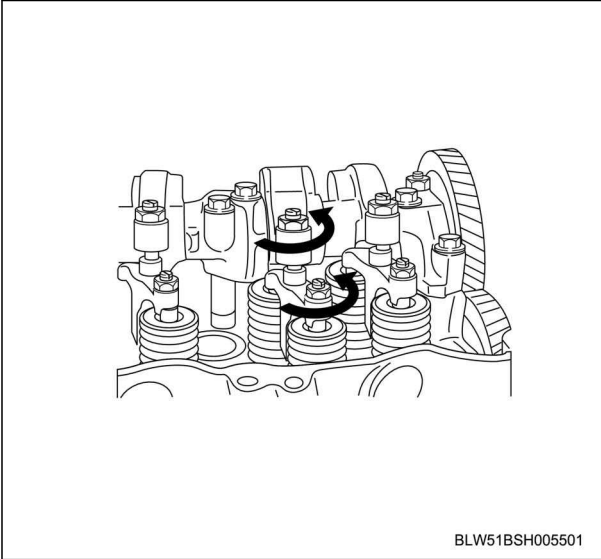
23. Rocker arm shaft removal

1. Loosen the adjust screw using a wrench.

Note :

- Loosen all valve clearance adjustment screws.

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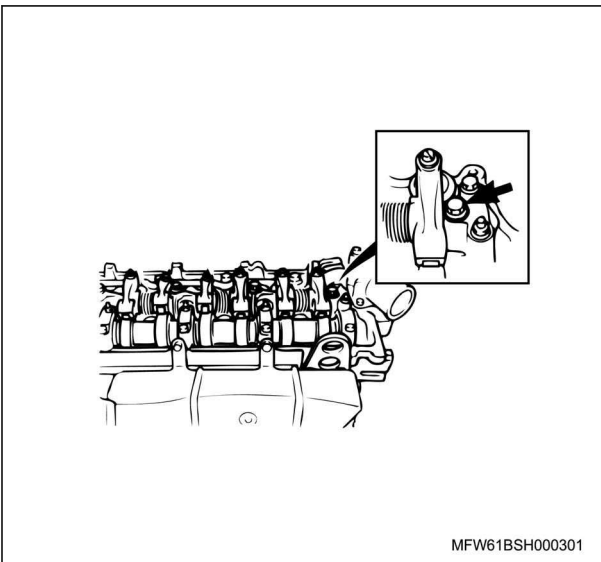
2. Remove the rocker arm shaft from the cylinder head assembly.

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.



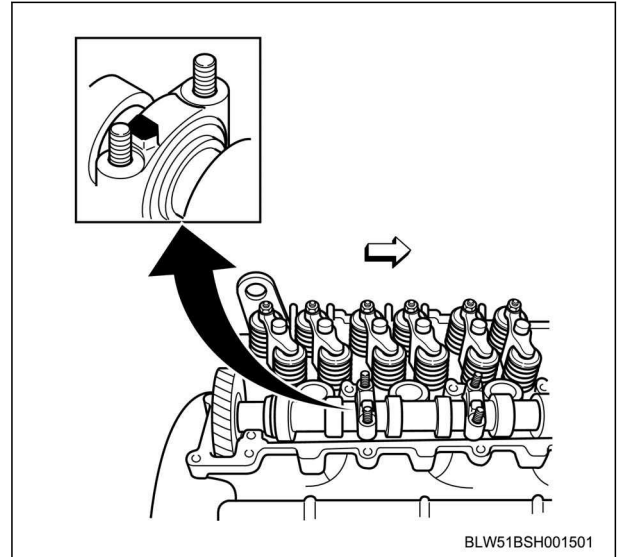
24. Camshaft removal

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.



25. Bridge removal

1. Remove the bridge cap from the bridge.

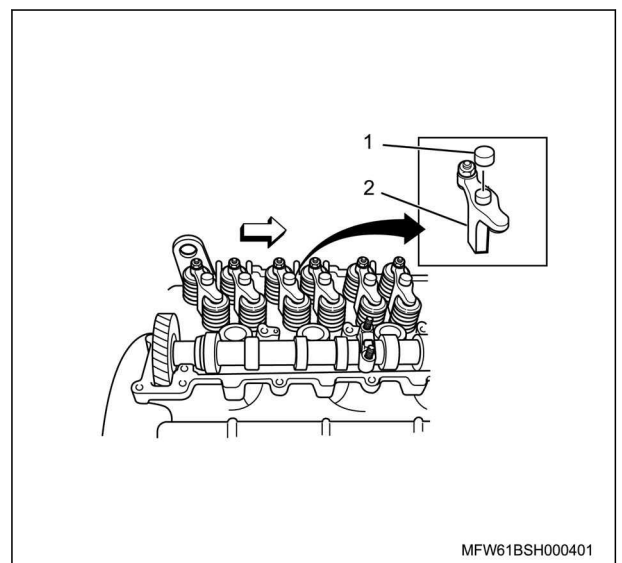
Caution :

- 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