

General Information

General Information

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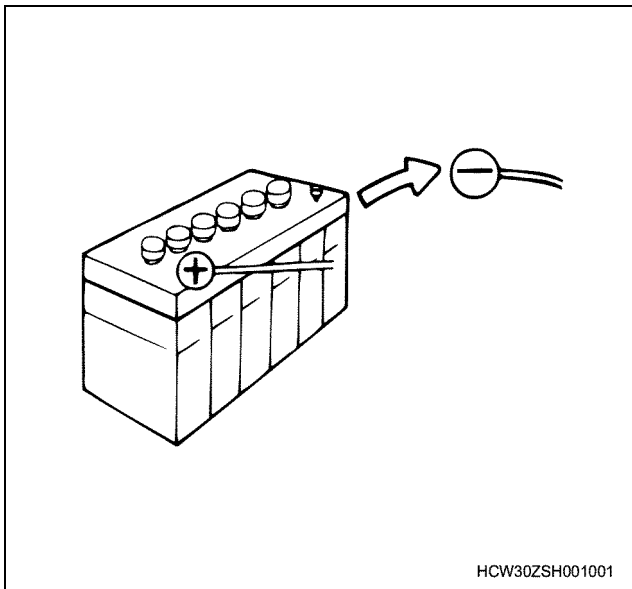
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General Information

Service Precautions

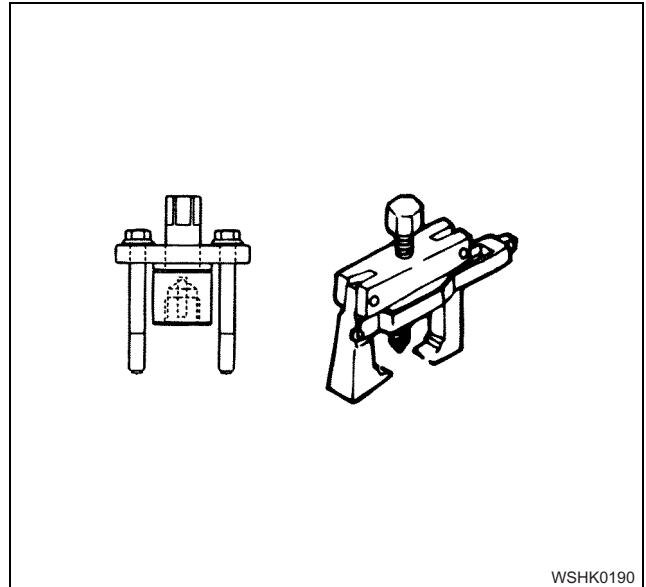
In order to carry out work safely

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

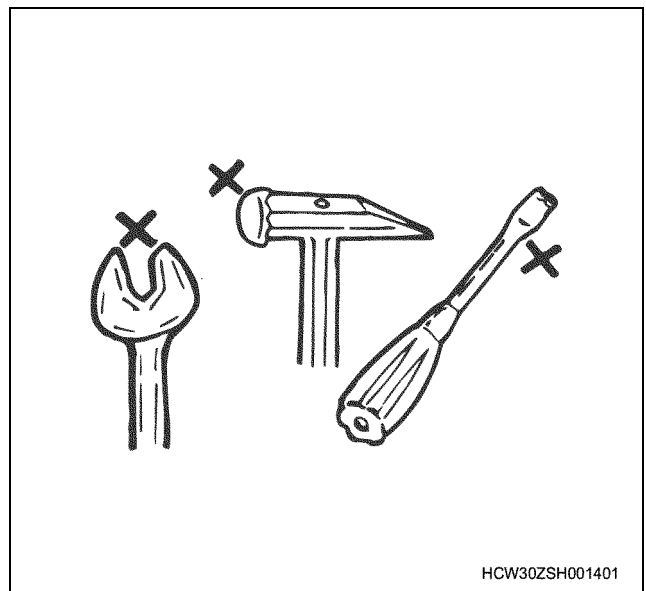


4. Do not perform painting work or leave the engine running for long periods of time in an enclosed or badly ventilated indoor workshop.

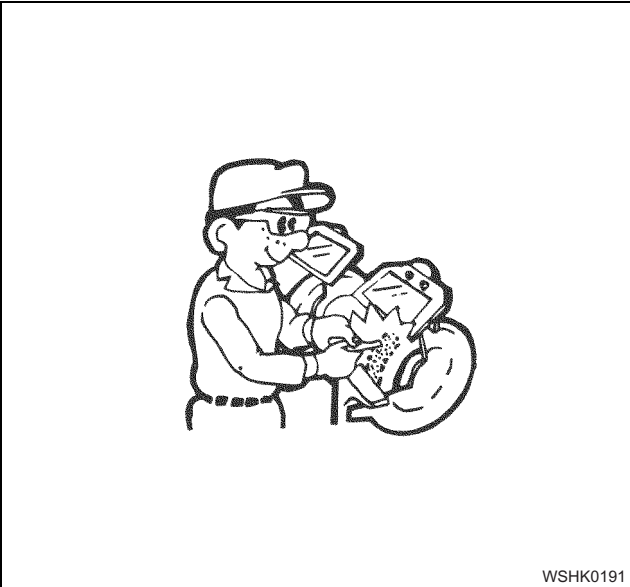
5. Always use the correct specialized tool indicated in the instructions. Using the incorrect tool may cause damage to the parts or injury to the person using the tool.



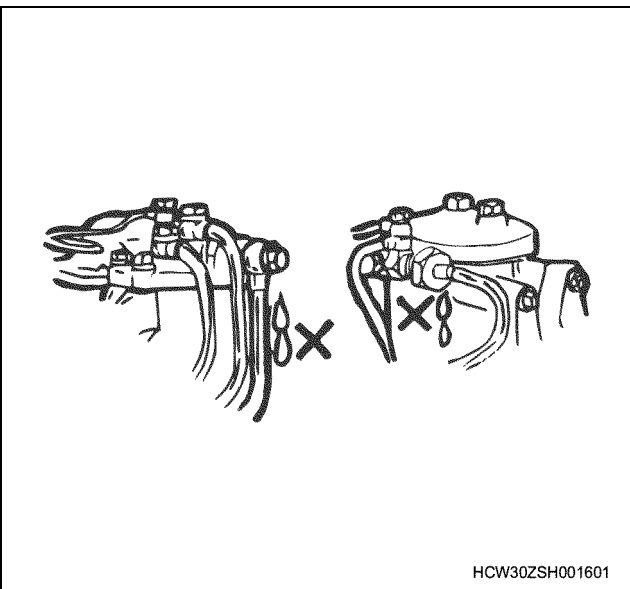
6. All regular tools, gauges and special tools should be regularly inspected, and prepared before starting work. Do not use bent spanners, hammers with damaged edges, chipped chisels, or any other faulty or damaged tools.



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



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



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



Replacement parts and part numbers

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

0A-4 General Information

Liquid gasket

- Each time you disassemble parts that use liquid gasket, completely remove the old gasket residue from each of the parts and matching sections using a scraper, then clean each of the parts to completely remove oil, water, and dirt etc. from the various surfaces by a cloth. Using the specified type of liquid gasket, apply new liquid gasket to each of the surfaces before reassembling the parts.
- In order to make it easier to clean liquid gasket surfaces, apply gasket remover liquid (Pando- 391D made by ThreeBond Co., Ltd.) and leave the part to stand for approximately 10 minutes, after which the old liquid gasket residue will be easier to remove.
However, this should not be used on resin components or painted components.

- Please take care not to apply too much or too little liquid gasket.
Also, you should always re-apply the liquid gasket upon itself when you start and finish application.
- Make sure that there are no gaps when reinstalling the liquid gasket parts to each other. If there are gaps between the two parts, re-apply the liquid gasket. Some parts, especially the oil pan, use the same size studs as a guide to eliminate the need for knock pin positioning etc.
- Re-install these parts within 5 minutes of applying the liquid gasket.
If more than 5 minutes passes, remove the previous liquid gasket and re-apply it.
- Please wait for at least 30 minutes since the last part is installed before starting the engine.

Liquid gasket

	Applied area		Use conditions		Liquid gasket name
	Parts	Matching parts	Seal object	Application groove	
1	Rocker bracket	Cylinder head	Engine oil (10W — 30)	Equipped	TB 1207B
2	Air inlet pipe	Cylinder head cover	Air	Equipped	TB 1207C
3	Timing case	Cylinder block	Engine oil (10W — 30)	Equipped	TB 1207B
4	Housing cover; injection pump	Cylinder block	Engine oil (10W — 30)	None	TB 1207C
5	Solenoid; fuel cut	Cylinder block	Engine oil (10W — 30)	Equipped	TB 1207C
6	Retainer; oil seal	Cylinder block	Engine oil (10W — 30)	Equipped	TB 1207B
7	Housing ASM; PCV	Cylinder head cover	Blow-by gas	None	TB 1207C
8	Indicator; air cleaner	Air cleaner	Air	None	(Seal tape)

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

Application procedure

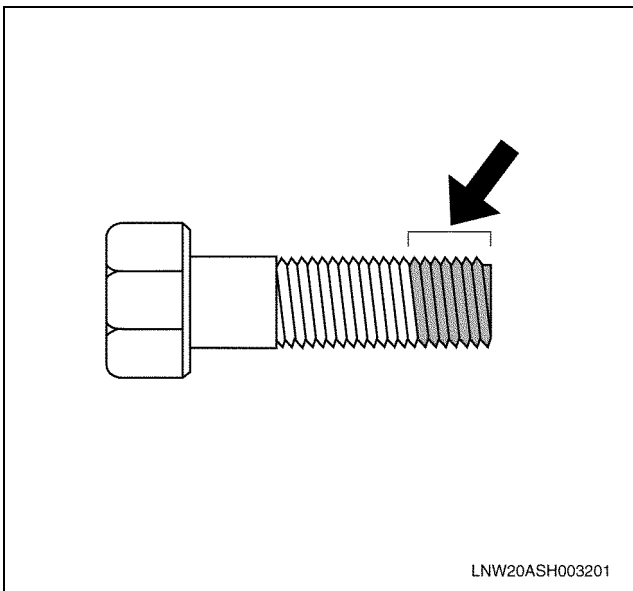
1. Wipe the contact surfaces clean of all water, oil or grease. The contact surfaces should be dry.
2. Apply a regular bead width of liquid gasket to one of the contact surfaces. Make sure that the bead does not break at this point.

Note:

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

Work procedure

1. Wipe the joint surfaces of the bolt, bolt hole, and threads clean of water, grease, and oil. The contact surfaces should be dry.
2. Apply Loctite to the top 1/3 of the screw.
3. Tighten the bolt to the specified torque.



Important:

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

Procedure for using the plastigauge

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

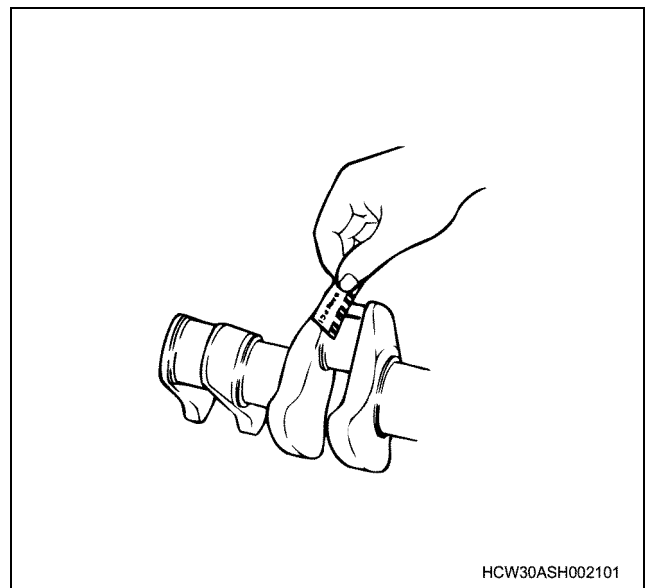
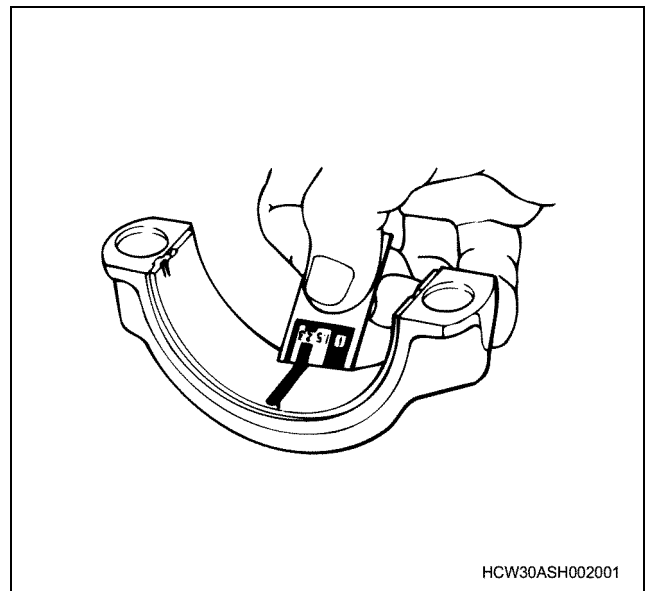
Example: Procedure for measuring the clearance between the connecting rod bearing and crank pin.

- Clean the connecting rod and bearing, and install the bearing to the rod.
- Cut the plastigauge to the same width as the crank pin, and while avoiding the oil hole of the crank pin lay the gauge parallel to the pin.
- Line up the marks on the connecting rod and cap, and install the crank pin. Apply molybdenum disulfide to the thread section and seating surface of the tightening bolt, and rotate both cap and bolt to the correct torque.

Important:

Do not move the connecting rod while using the plastigauge.

- Gently remove the cap and connecting rod, and measure the crushed width of the plastigauge (clearance between rod and pin) using the scale printed on the bag.



0A-6 General Information

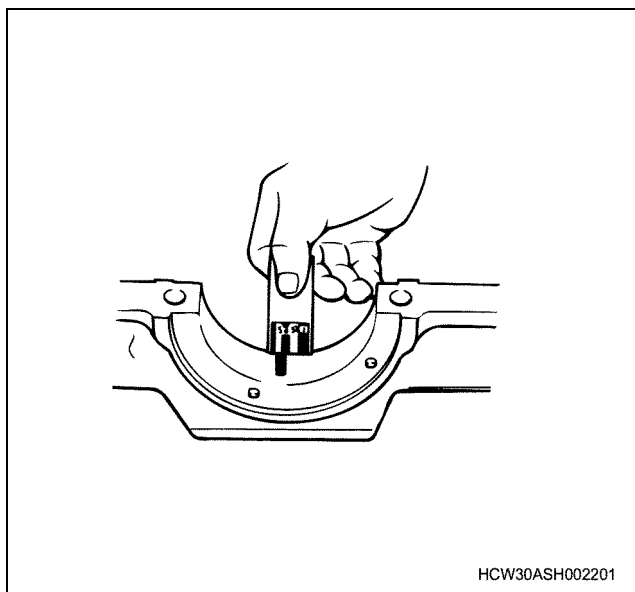
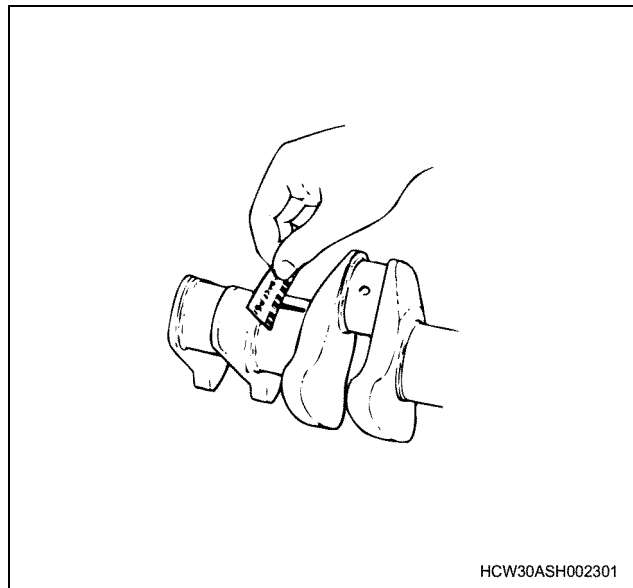
Example: Measuring the clearance between the crank bearing and crank journal

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

Important:

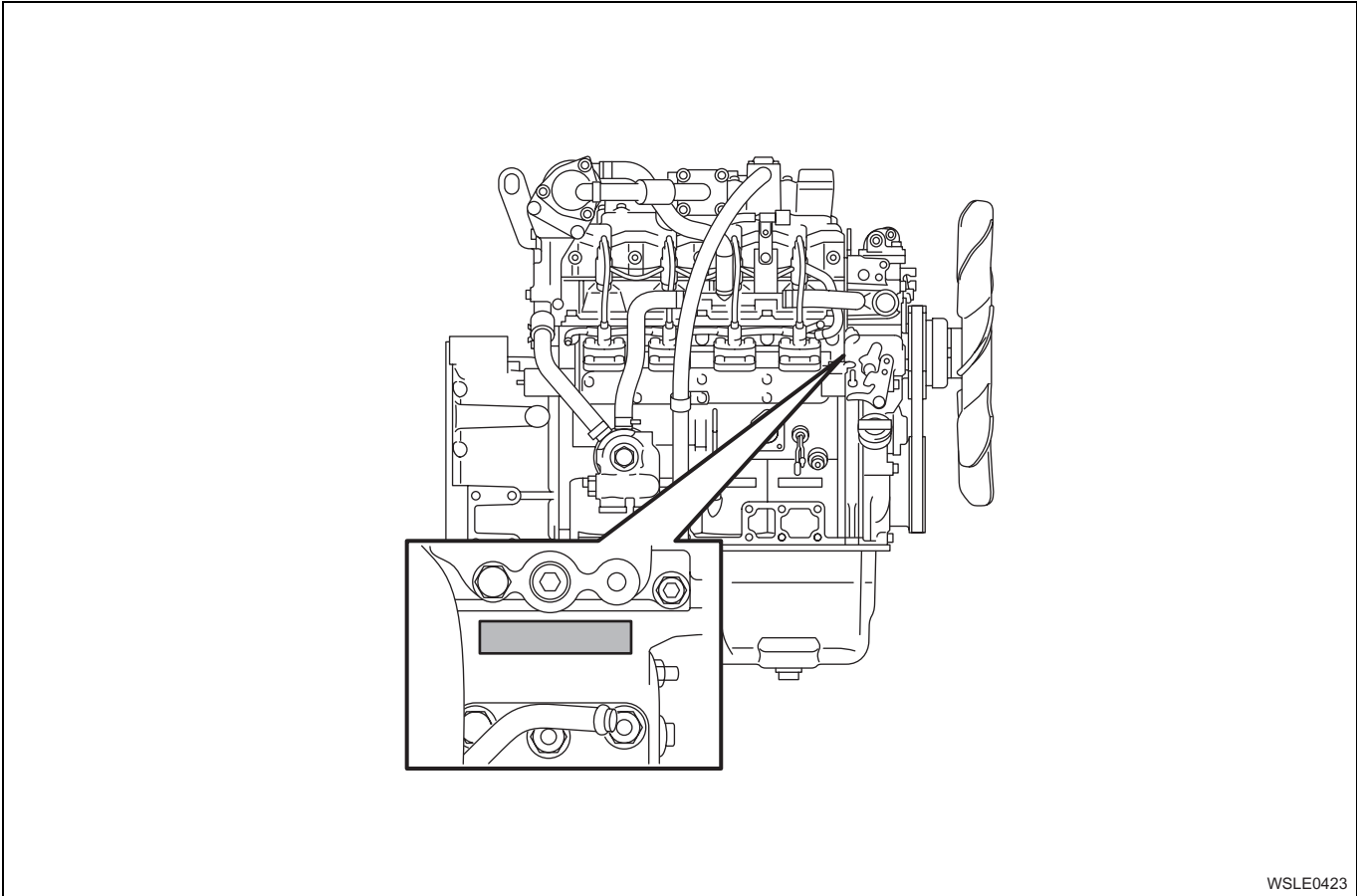
Do not rotate the crankshaft while using the plastigauge.

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



Reading the Model

Engine number stamping position



General Information

Terminology, description of abbreviations

Terminology definitions

Maintenance standard

The generic name for reference values required for maintenance, such as nominal dimension, assembly specification, and limit.

Nominal dimension

Shows the standard value at the point of manufacture that does not include the common difference.

Assembly specification

Shows the standard value after assembling, repairing, or adjusting.

Service limit

When this value (dimensions) is reached, it shows that the part has reached its full limit and must be replaced or repaired.

Wear

Shows the difference between the dimension of non-worn part (nominal dimension unless there is such part) and that of the most worn part (the dimension of worn part).

Uneven wear

Shows the difference between the maximum and the minimum wear amount.

Front/Rear, Right/Left, Top/Bottom

These show each orientations of parts installed to the vehicle when looking from the vehicle's forward direction.

Unit

Units written to SI conventions (mainly torque, pressure, force)

[Example] Length: mm, Torque: N·m {kgf·m}

Warning

Items that carry the warning mark pose a danger to life or threat of serious injury if not strictly observed.

Caution

Items that carry the caution mark may cause injury or lead to accidents if not strictly observed.

Important

Items that carry the important mark may cause the vehicle to break down, or may prevent the guaranteed normal operation of the system or related parts if not strictly observed.

Note

Items that should receive special mention within a work procedure.

Description of abbreviations

Abbreviation	Description
AC	Alternating Current
ACC	Accessory
ACG	Alternating Current Generator
API	American Petrol Institute
ASM (Assy)	Assembly
ATDC	After Top Dead Center
BAT, BATT	Battery
BRG, Brg	Bearing
BKT, BRKT	Bracket
BTDC	Before Top Dead Center
CO	Carbon Oxide
CONN	Connector
CPU	Central Processing Unit
C/U	Control Unit
DC	Direct Current
DI	Direct Injection
ECU	Engine Control Unit/Electronic Control Unit
ECM	Engine Control Module
EGR	Exhaust Gas Recirculation
Exh, EXH	Exhaust
Ft, FRT	Front
FWD	Forward
F/C	Fuel Cut
GND	Ground
IC	Integrated Circuit
ID Plate	Identification Plate
IN	Intake, Inlet
ISO	International Organization for Standardization
I/PUMP	Injection Pump
JIS	Japanese Industrial Standard
L/H, LH	Left Hand
M/V	Magnetic Valve
NOx	Nitrogen Oxide
N-TDC	Number - Top Dead Center
OPT	Option
P	Pole(S)
PCV	Pump Control Valve/Positive Crankcase Ventilation

Abbreviation	Description
PM	Particulate Matter
PS	Pre-Stroke
PTO	Power Take Off
QOS	Quick On System
Rr, RR	Rear
R/H, RH	Right Hand
R/L	Relay
STD	Standard
SW	Switch
TICS	Timing & Injection rate Control System
VGS Turbo	Variable Geometry turbocharger System
W/L	Warning Lamp

SI (International System of Units)

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

The introduction of the SI systems aims to internationally unify the metric system and the various units used by different countries (traditional weights and measures, the foot pound method etc.), and to curb the confusion that occurs between the different units (conversion calculations etc.).

The new calculating method which adopted SI units was completely adopted in Japan in 1992, and is standardized by JIS-Z-8203.

All of the units in this manual are written in line with the International System of Units SI units, and conventional units are written in { } brackets.

SI

Abbreviation of French word “Le Systeme International d’Unites”

Connection between main SI units and conventional units

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

*1 Published service data may conveniently use kg for force and mass (weight) instead of kgf.

*2 Some conversion results may be rounded off to 1 or 2 decimal places.

Converting expressions of quantity

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

M	Mega	10 ⁶	1,000,000
k	Kilo	10 ³	1,000
h	Hecto	10 ²	100
d	Deci	10 ⁻¹	0.1
c	Centi	10 ⁻²	0.01
m	Milli	10 ⁻³	0.001
μ	Micro	10 ⁻⁶	0.000001

- 200 kgf/cm² = 19,620 kPa = 19.6 MPa
- 40 mmHg = 5,332 Pa = 5.3 kPa

Conversion formula

Length

- km × 0.6214 = mile
- m × 3.281 = ft
- mm × 0.03937 = in

Pressure

- kPa × 0.0101972 = kg/cm²
- kPa × 0.145038 = psi
- MPa × 10.197162 = kg/cm²
- MPa × 145.03774 = psi

Tightening torque

- N·m × 0.101972 = kg·m
- N·m × 0.737562 = lb·ft

Speed

- km/h × 0.6214 = MPH

Temperature

- °C × 1.8 + 32 = °F

0A-10 General Information

Table of Isuzu standard tightening torque

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

Isuzu standard bolts, nuts

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

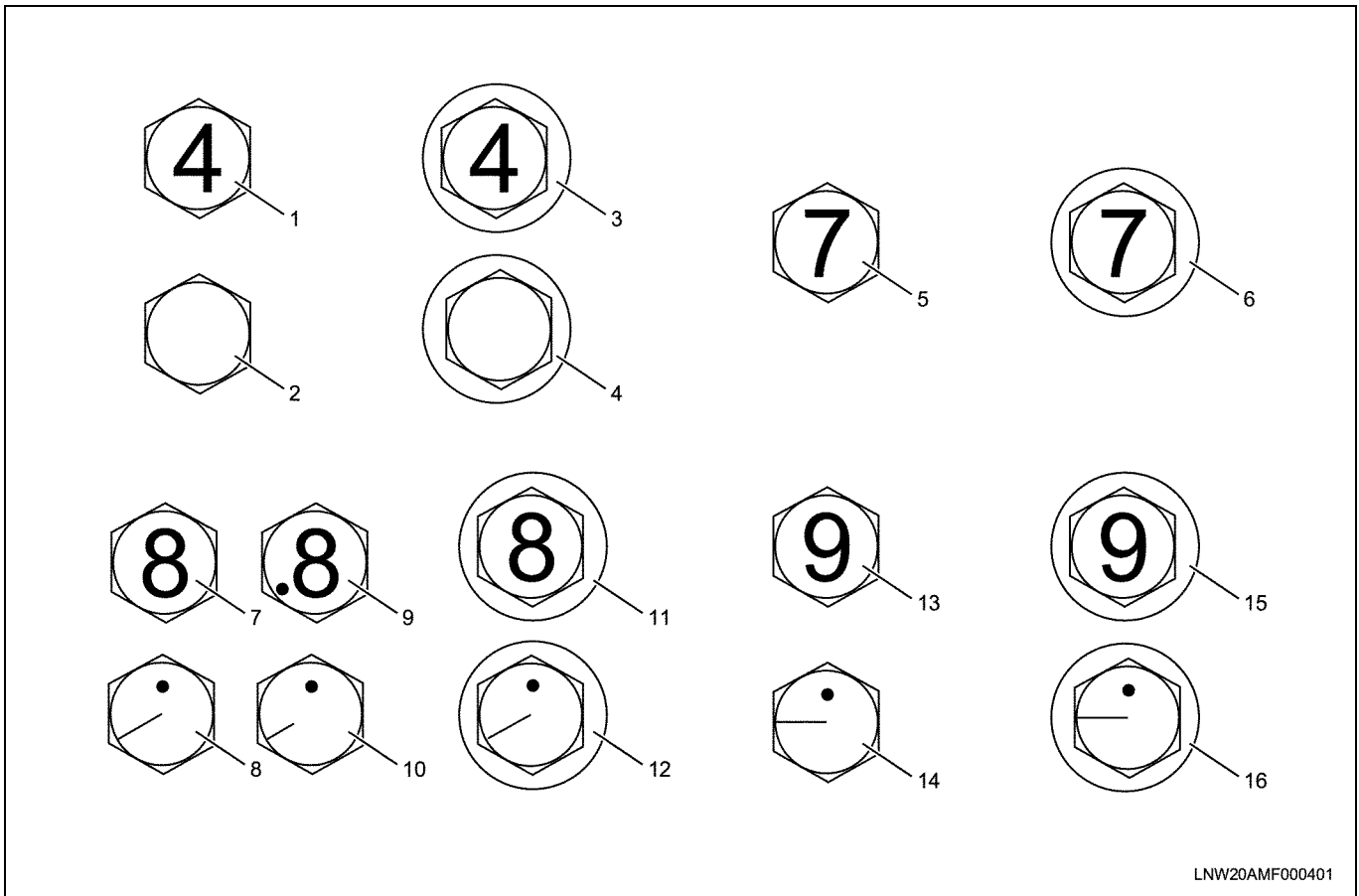
The * mark indicates where soft materials have been used for internal thread sections, such as castings.

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

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

0A-12 General Information

Designations for Isuzu standard bolt heads



LNW20AMF000401

Name

- | | |
|--|--|
| 1. Hexagon Head Bolt (4.8, 4T) | 9. Hexagon Head Bolt (Nonthermal Refined 8.8) |
| 2. Hexagon Head Bolt (4.8, 4T) | 10. Hexagon Head Bolt (Nonthermal Refined 8.8) |
| 3. Flange Bolt (4.8, 4T) | 11. Flange Bolt (8.8) |
| 4. Flange Bolt (4.8, 4T) | 12. Flange Bolt (8.8) |
| 5. Hexagon Head Bolt (7T) | 13. Hexagon Head Bolt (9.8, 9T) |
| 6. Flange Bolt (7T) | 14. Hexagon Head Bolt (9.8, 9T) |
| 7. Hexagon Head Bolt (Thermal Refined 8.8) | 15. Flange Bolt (9.8, 9T) |
| 8. Hexagon Head Bolt (Thermal Refined 8.8) | 16. Flange Bolt (9.8, 9T) |

Flare nut

	Pipe diameter	Tightening torque (for medium and large size vehicles)	Width across flats of flare nut (mm)	
			Old	New
Flare nut tightening torque (service standard value) N·m {kgf·m}	φ 4.76 mm	12.8 — 18.6 {1.3 — 1.9}	14	14
	φ 6.35 mm	23.5 — 49 {2.4 — 5.0}	17	17
	φ 8.0 mm	23.5 — 49 {2.4 — 5.0}	19	17
	φ 10.0 mm	44.1 — 93.2 {4.5 — 9.5}	22	19
	φ 12.0 mm	58.8 — 137.3 {6.0 — 14.0}	27	24
	φ 15.0 mm	78.5 — 156.9 {8.0 — 16.0}	30	30

Taper screw from connectors (brass)

N·m {kgf·m}				
Screw size	PT (R) 1/8	PT (R) 1/4	PT (R) 3/8	PT (R) 1/2
—	2.0 — 14.7 {0.2 — 1.5}	4.9 — 15.7 {0.5 — 1.6}	9.8 — 16.7 {1.0 — 1.7}	9.8 — 17.7 {1.0 — 1.8}

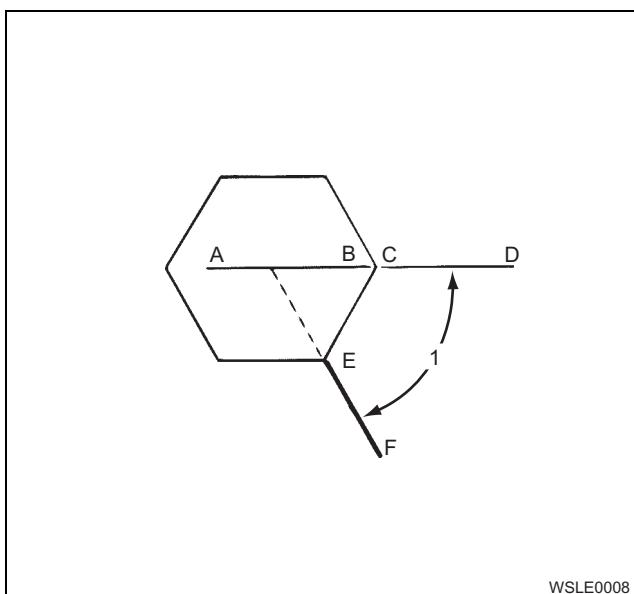
About angle method tightening

Though the general and current way to tighten bolts and nuts is torque indication, using this way results in large unevenness of shaft power to indicated torque. Therefore, bolts may be damaged at upper limit when you try to ensure minimal shaft power.

To ensure shaft power with small unevenness, it is necessary to tighten bolts measuring stretch amount of bolts, but this is actually impossible. So the angle method focuses on screw pitch as equivalent to bolt stretch, and controls using the screw rotation amount. The method can reduce the unevenness of shaft power by tightening to plastic range.

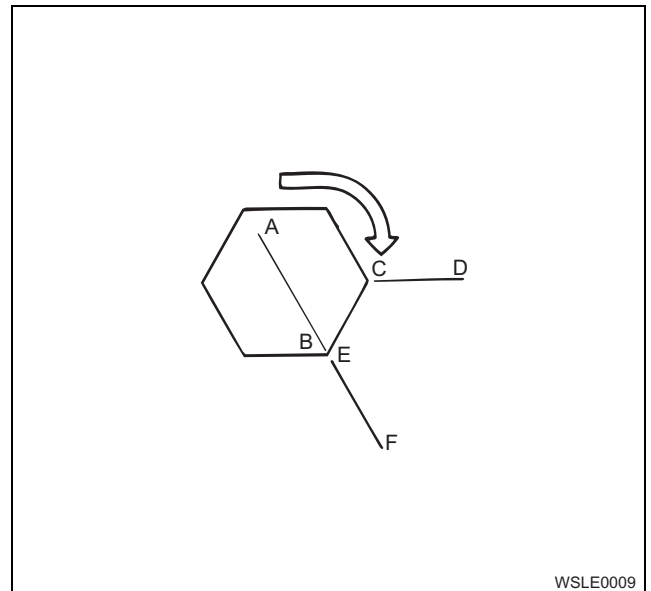
How to tighten

1. Apply molybdenum disulfide or engine oil to the threads and the seating surface of the bolt following the instruction.
2. Tighten all bolts to the pre-indicated tightening torque.
3. Draw lines on the surface of the parts you tighten: the lines which pass through the bolt's center (A — B: bolt side) (C — D: parts side) and the line at the specified tightening angle from the bolt's center (E — F).

**Name**

1. Specified Tightening Torque

4. Tighten the bolt with wrench until the line on the bolt (A — B) aligns with the specified angle line (E — F) on the surface of the parts).



Be sure to check the mark to see whether you tighten the bolt to the specified angle or not.

If you fail this, you may tighten the bolt by the angle method again by accident and damage the bolt. Take extreme care.

Important:

- Follow the instructed order to tighten bolts.
- Do not retighten if you tighten by the angle method.

Bolt angle gauge (5-8840-0266-0), the tool for tightening bolts by the angle method, is set.

Special tool classification**A; Essential tool**

Servicing operation cannot be done with any other tools than the essential tool.

B; Recommend tool

Servicing work can be done with a general-purpose tool commercially available. However, it is advisable to use the recommended tool as much as possible for a reduced work time and an improved safety in work operations.

C; Available tool

Although it takes a more working time, servicing operations can be made with a tool commercially available as substitute for the available tool.

0A-14 General Information

Recommended Lubricant

Engine oil

Use the engine oil below.

Engine oil grade

Engine classification	Engine oil grade (API service category)
With turbocharger	CD or CF-4 * (CE, CF, CH-4, CI-4 or CI-4 Plus)

* mark may vary depending on each machine. Refer to the machine manufacturer specification.

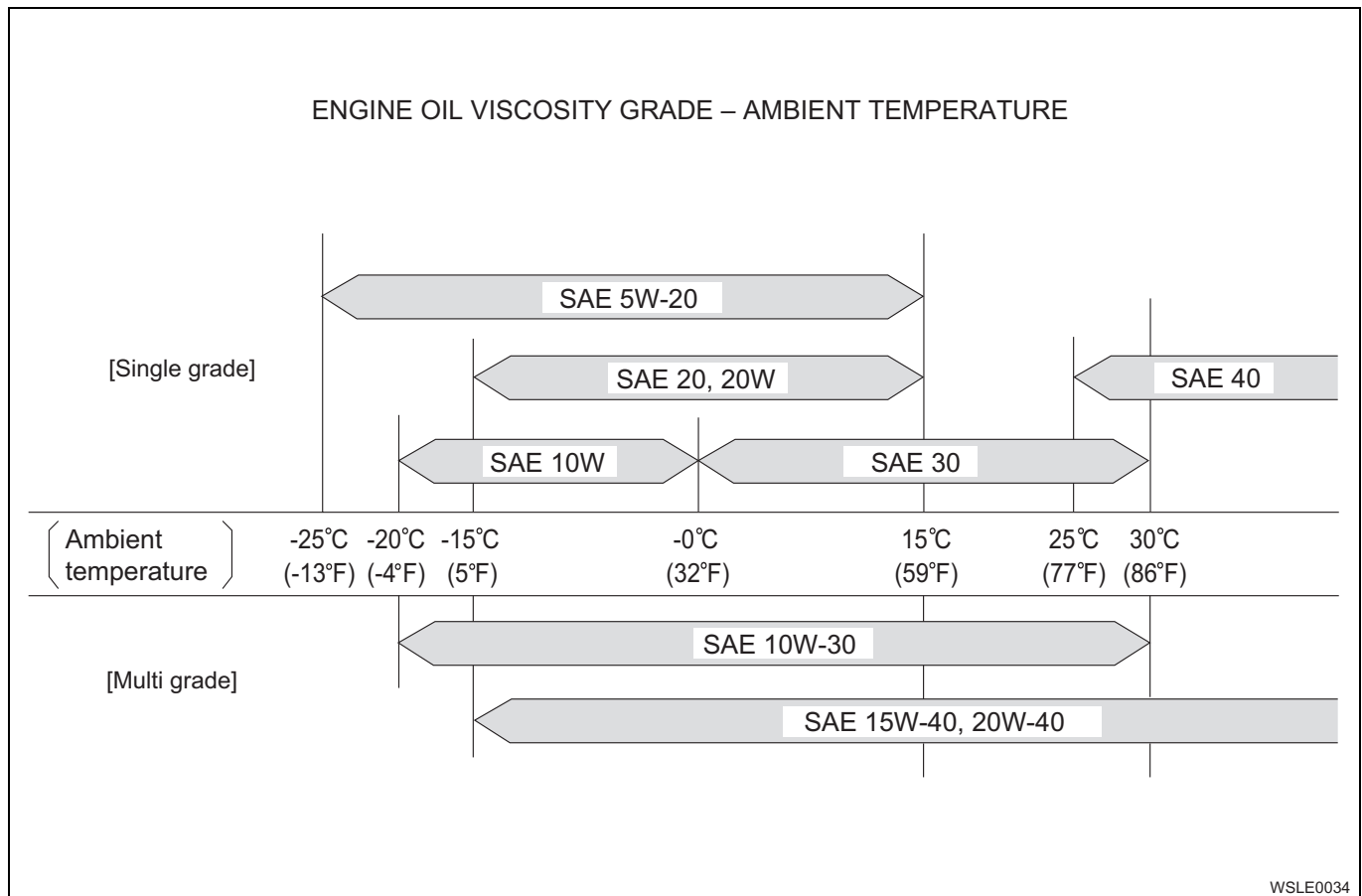
ISUZU genuine engine oil

Besco Super: CC

Besco S — 3: CD

Besco Multi Z: CD

Engine oil viscosity chart



The engine oil affects the startability, driving performance, oil consumption, wear of the sliding part, and seizure, depending on the viscosity. You should select the engine oil depending to a temperature and the chart above.

Engine oil level

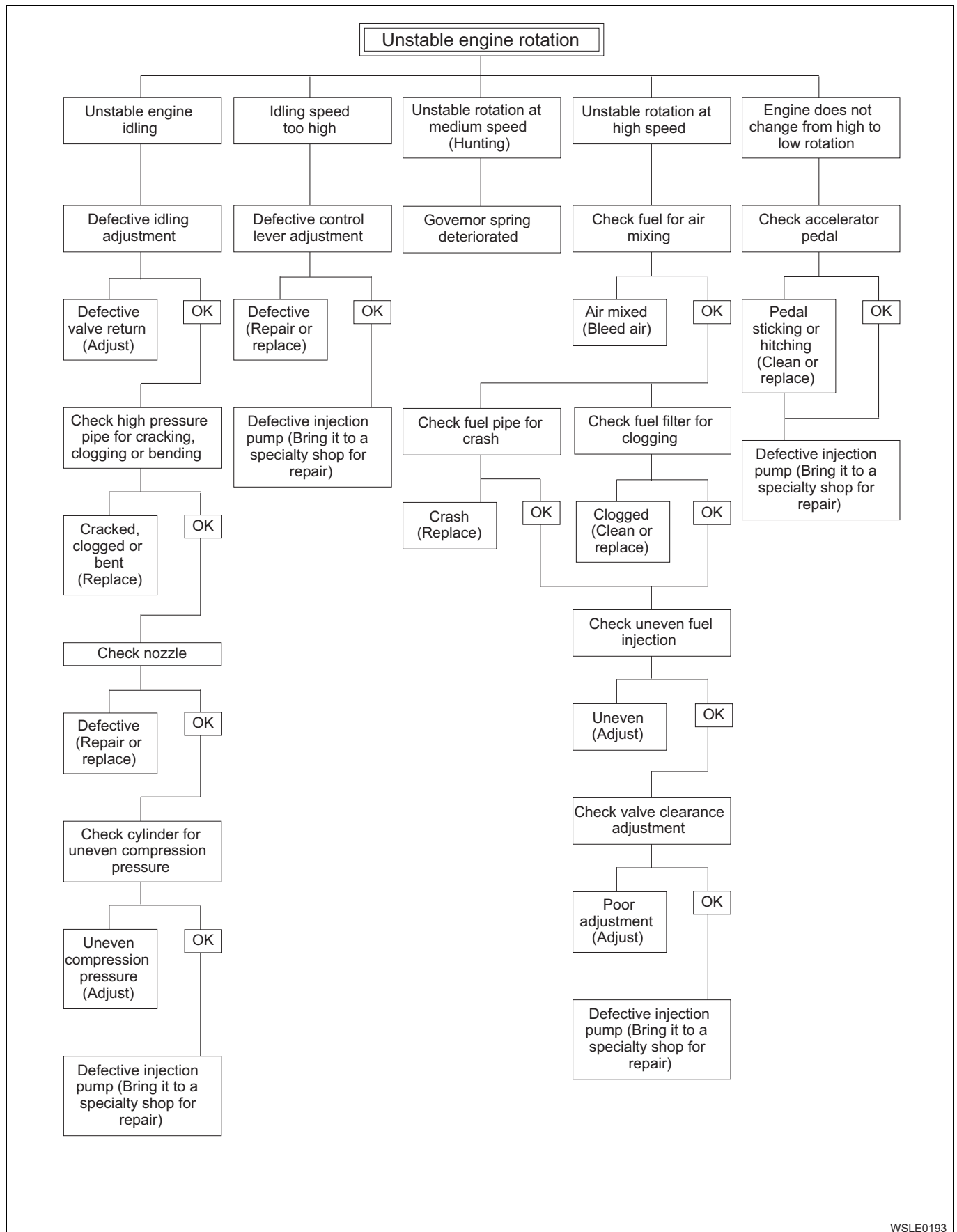
4LE1T model: Approx. 7.6 — 10.3 L {8.0 — 10.9 qts}

4LE1N model: Approx. 5.9 — 8.4 L {6.2 — 8.9 qts}

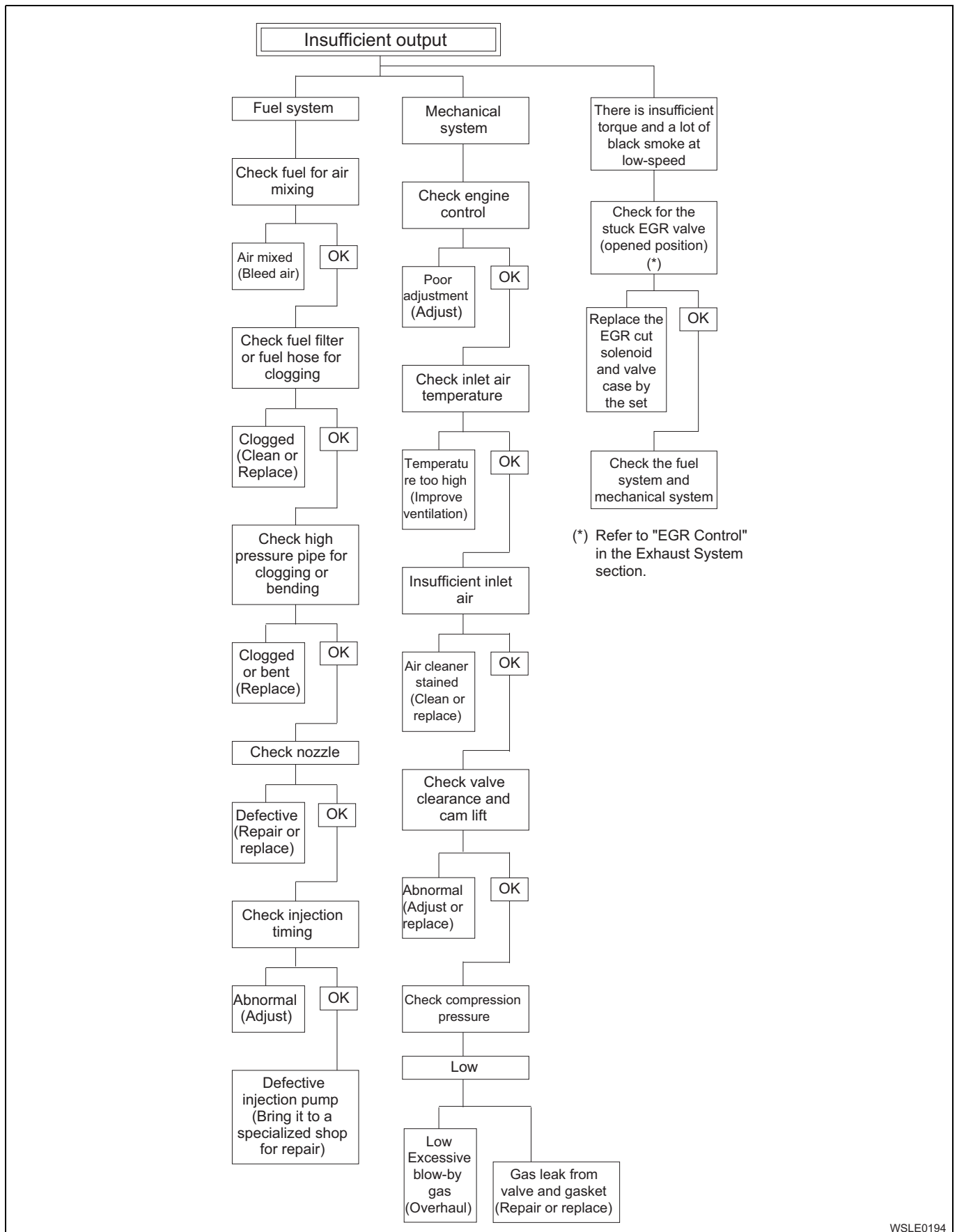
Note:

Engine oil level may vary depending on the machine specification.

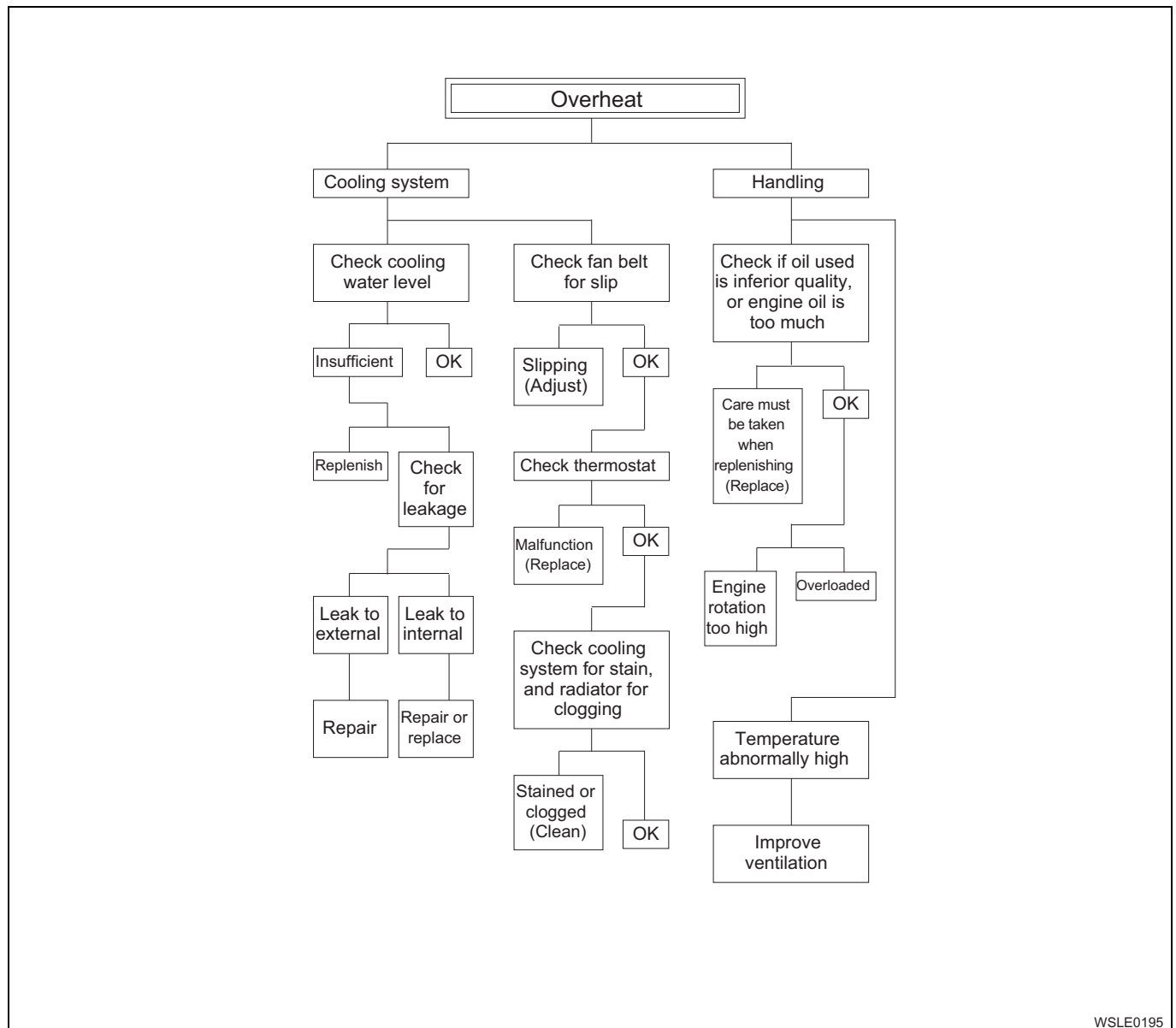
Engine speed lacks smoothness



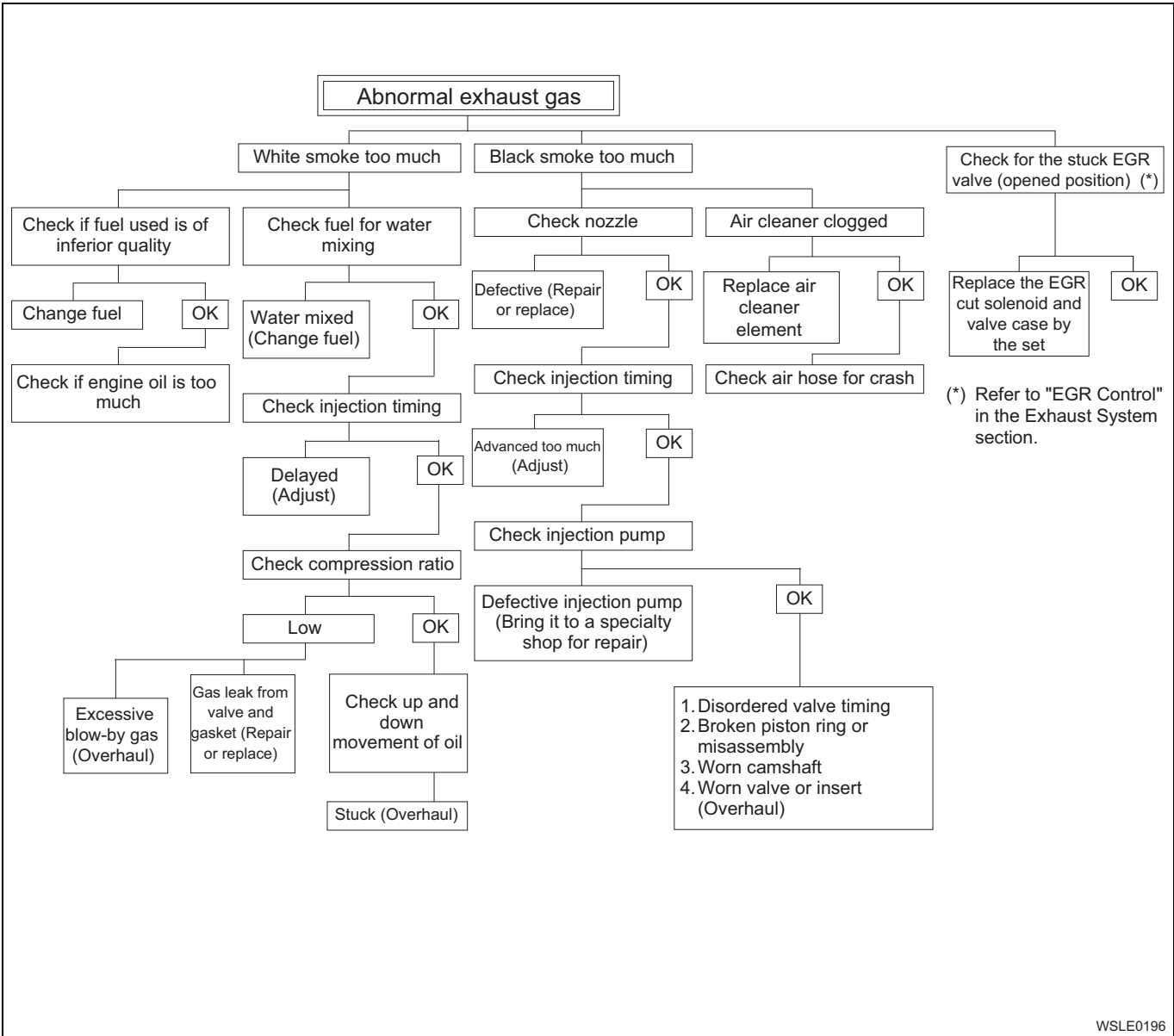
Output shortage



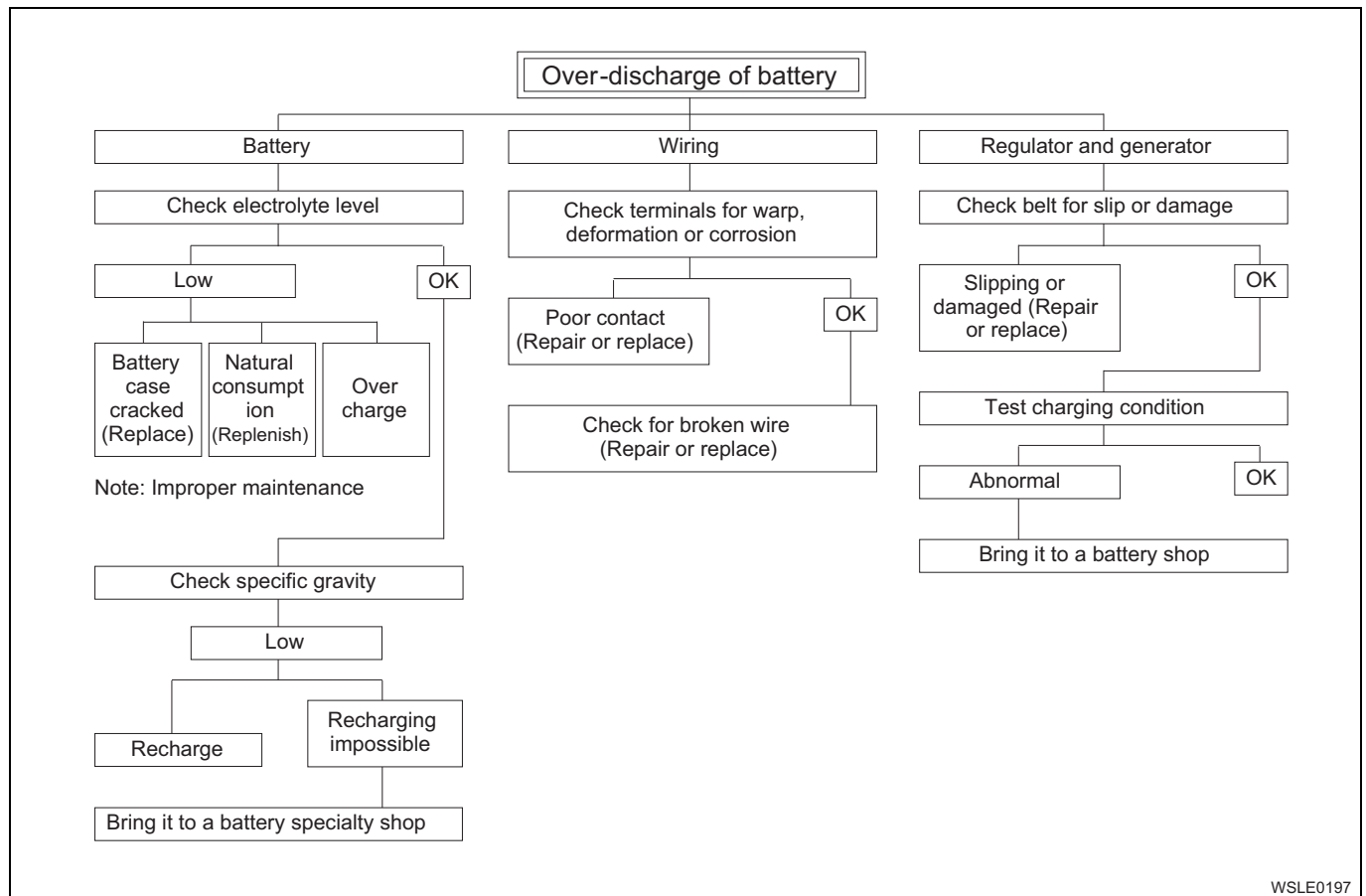
Overheat



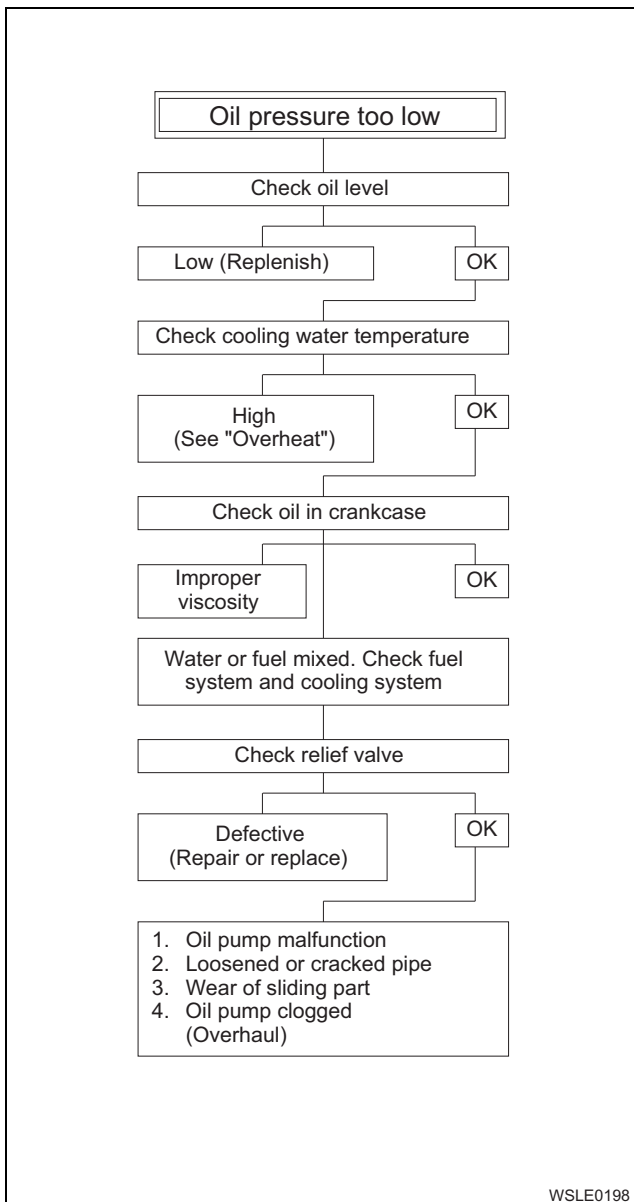
Exhaust fault



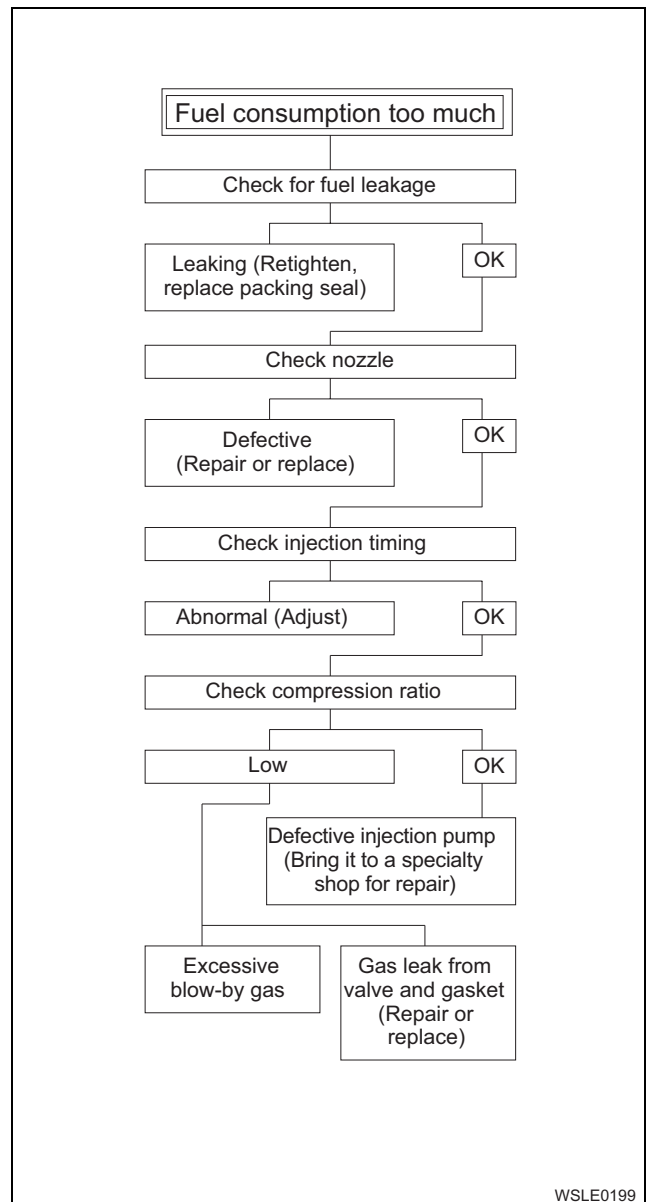
Battery over discharge



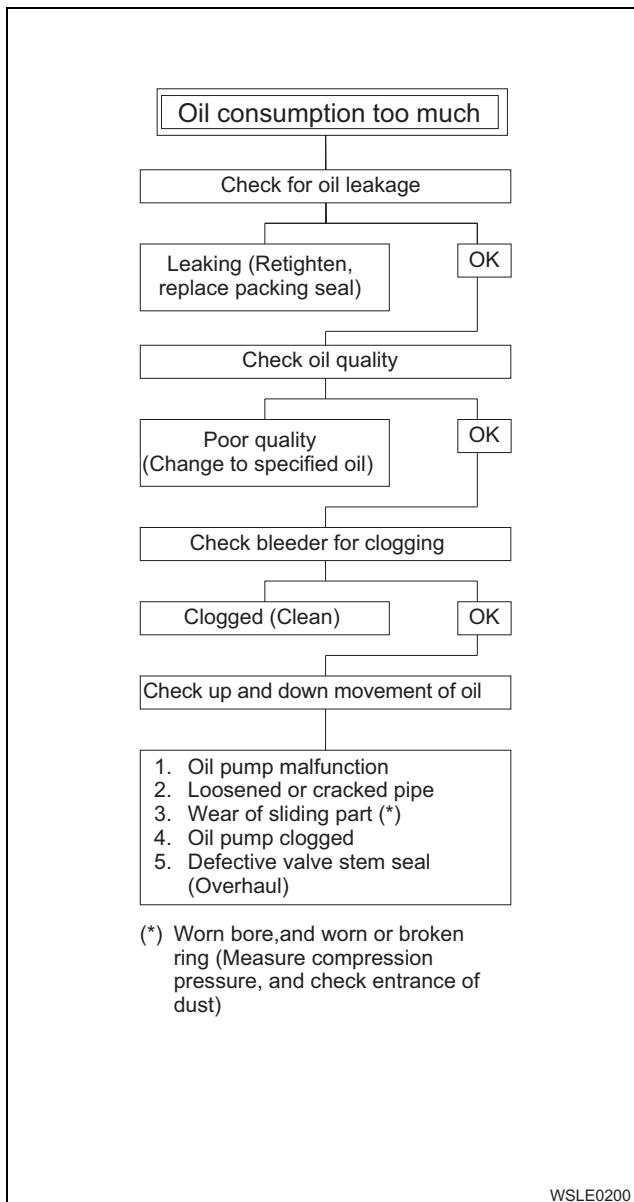
Oil pressure is too low



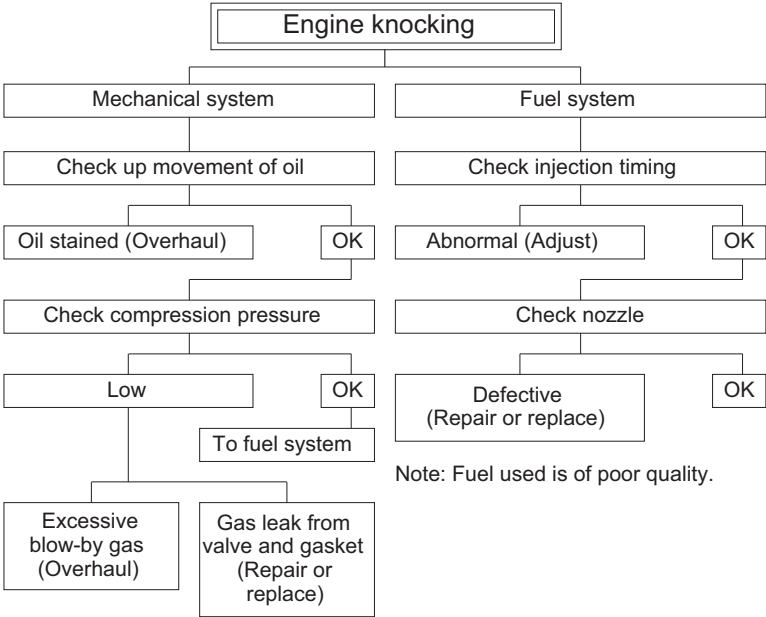
Fuel consumption deteriorates



Oil consumption deteriorates



Engine knocking



0A-24 General Information

Repair Standard

1. This table specifies the repair standard for **4LE1 model** "ISUZU diesel engine".
2. This repair standard consists of items to be checked, nominal dimension, assembly specifications, service limit, and repairing procedure.
 - "Nominal dimension" is the standard value at the time of manufacture.
 - "Assembly specification" is the target value after repairing (at assembling). It may differ in some degree from "assembly dimension" of the new engine.
 - "Service limit" is the limit value of wear, etc. which must not be exceeded. When it is reached, the part should be repaired or replaced.
 - "Repairing procedure" indicates general methods to repair.
 - The unit for the numbers in the table are all "**millimeter {inch}**" if not otherwise specified.
3. If the whole engine is requested for repair, "check the locations which need to be repaired" first by "the bench test" or something. Then perform the minimum overhaul. If a part of engine is requested for repair, perform repairing based on this "repair standard".
4. This repair standard may be changed in the value, specification, and others without notice due to "design change" of the engine.

Time to overhaul the engine

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Compression pressure of the cylinder (MPa {psi})	3.04 {441}	2.5 {363}	Overhaul the engine.	Coolant temperature: 70 — 85°C {158 — 185°F} Engine speed: approx. 250 rpm Vary depending on altitude.
Fuel consumption rate (L/h)	100%	140%		
Lubricant consumption rate (L/h)	100%	200%		

Cylinder block

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Wear of the cylinder bore Measurement position: 13 {0.512} lower from the top surface of the cylinder block	φ85 {3.3465}	φ85.2 {3.354}	Perform boring along the oversize piston, then perform honing.	
Distortion of upper surface of the cylinder block	0.075 {0.00295} or less	0.15 {0.006}	Repair with a surface grinder.	Maximum amount of repaired value; 0.3 {0.012} The total amount of repaired values of the cylinder head and of the cylinder block.
Water pressure test (three minutes) (kPa {psi})	490 {71}		Repair or replace the one with water leakage.	

Cylinder head

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Valve seat depression	IN	0.7 {0.028}	1.2 {0.047}	Replace the valve and insert.	Valve seat angle is 45°
	EX	0.9 {0.035}	1.5 {0.059}		
Contact width of the valve seat		2.0 {0.079}	2.5 {0.098}	Repair with the valve seat cutter.	Wrap the contact surface sufficiently after repair.
Distortion (flatness) of the under surface (installation surface) of the cylinder head		0.075 {0.00295} or less	0.15 {0.006}	Repair with a surface grinder.	Maximum amount of repaired value; 0.3 {0.012} The total amount of repaired values of the cylinder block and of the cylinder head.
Distortion of exhaust manifold installation surface		0.05 {0.002} or less	0.2 {0.008}	Repair.	
Water pressure test (three minutes) (kPa {psi})		490 {71}		Repair or replace the one with water leakage.	
Tightening torque of the cylinder head bolt: (N·m {kgf·m/lb·ft}) (Angle method)	M12 × 1.5	83.4 — 93.2 {8.5 — 9.5/61.5 — 68.7} ↓ 60° — 90°		- Clean the seating surface and thread of the bolt. - Apply engine oil to the seating surface and thread of the bolt. - Never retighten after angle method tightening.	
	M8 × 1.25	24.5 — 34.3 {2.5 — 3.5/18.1 — 25.3}			

Piston**Connecting rod small end diameter (φ25 mm {0.9843 in})**

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Clearance with the cylinder Grade position from the top surface: 54.85 {2.159}		0.040 — 0.085 {0.0016 — 0.0033}			
Clearance between piston pins and piston pin holes		0.004 — 0.017 {0.00016 — 0.0007}		If significant knocking sound occurs, replace the piston pin or the piston.	
Wear of the pin		φ25 {0.9843}	φ24.970 {0.9449}		
Piston ring end gap	Top ring	0.20 — 0.35 {0.008 — 0.014}	1.5 {0.059}	Replace piston ring. When overhauling the engine, replace the piston ring.	
	Second ring	0.35 — 0.50 {0.014 — 0.020}			
	Oil ring	0.20 — 0.40 {0.008 — 0.016}	1.0 {0.039}		

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Connecting rod small end diameter ($\phi 27$ mm {1.063 in})

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Clearance with the cylinder Grade position from the top surface: 54.85 {2.159}		0.040 — 0.085 {0.0016 — 0.0033}			
Clearance between piston pins and piston pin holes		0.004 — 0.017 {0.00016 — 0.0007}		If significant knocking sound occurs, replace the piston pin or the piston.	
Wear of the pin		$\phi 27$ {1.063}	$\phi 26.970$ {1.0618}		
Piston ring end gap	Top ring	0.20 — 0.35 {0.008 — 0.014}	1.5 {0.059}	Replace piston ring. When overhauling the engine, replace the piston ring.	
	Second ring	0.20 — 0.40 {0.008 — 0.016}			
	Oil ring	0.20 — 0.40 {0.008 — 0.016}	1.0 {0.039}		

Piston ring

Connecting rod small end diameter ($\phi 25$ mm {0.9843 in})

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Clearance between the piston ring groove and the ring	Top ring	0.085 — 0.120 {0.0033 — 0.0047}	0.2 {0.008}	Replace the ring or the piston.	When assembling the ring to the piston, be sure to assemble with the mark of the ring facing upward. Inverse assembly makes oil consumption deteriorate. The oil ring is independent of top or bottom.
	Second ring	0.050 — 0.085 {0.0020 — 0.0033}	0.15 {0.006}		
	Oil ring	0.030 — 0.065 {0.00120 — 0.00256}	0.15 {0.006}		
The ring end direction				180° alternate	

Connecting rod small end diameter ($\phi 27$ mm {1.063 in})

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Clearance between the piston ring groove and the ring	Top ring	It cannot be measured due to the taper type ring.	—	Replace the ring or the piston.	When assembling the ring to the piston, be sure to assemble with the mark of the ring facing upward. Inverse assembly makes oil consumption deteriorate. The oil ring is independent of top or bottom.
	Second ring	0.070 — 0.110 {0.0028 — 0.0043}	0.15 {0.006}		
	Oil ring	0.030 — 0.070 {0.00120 — 0.00276}	0.15 {0.006}		
The ring end direction				180° alternate	

Connecting rod**Connecting rod small end diameter ($\phi 25$ mm {0.9843 in})**

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Play of the small end and the piston boss between front and back direction (one side)	1.0 {0.039}			Reference value
Tension of the connecting rod bearing	Extrusion 0.04 — 0.08 {0.00157 — 0.00315}		Use the one with extrusion and tension, and be careful about sticking of rear side.	
Clearance between the connecting rod bearing and crank pin	0.035 — 0.073 {0.0014 — 0.0029}	0.1 {0.0039}	Replace the bearing.	Be careful with the precision of the crank pin.
Contact surface of the connecting rod bearing and crank pin			Replace the one with defective contact or abrasion.	
Clearance between the small end bushing and the piston pin	0.008 — 0.020 {0.00031 — 0.00079}	0.05 {0.002}	Replace the bushing or the pin.	Clearance should be wide enough to turn smoothly with its big end held.
Axial play of the connecting rod and the crank pin	0.20 — 0.33 {0.008 — 0.013}	0.35 {0.014}		
Center distance between the big end and small end	133.5 {5.256}			Reference value
Torsion of holes on the big end and small end (L = per 100 mm {3.937 in})	0.08 {0.003} or less	0.2 {0.008}	Repair or replace.	
Parallelism of holes on the big end and small end (L = per 100 mm {3.937 in})	0.05 {0.002} or less	0.15 {0.006}	Repair or replace.	
Tightening torque of the bearing cap bolt (N·m {kgf·m/lb·ft})	73.5 — 83.4 {7.5 — 8.5/ 54.2 — 61.5}		Apply engine oil to the thread of the bolt and the seating surface of the nut, and tighten.	

Connecting rod small end diameter ($\phi 27$ mm {1.063 in})

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Play of the small end and the piston boss between front and back direction (one side)	1.0 {0.039}			Reference value
Tension of the connecting rod bearing	Extrusion 0.055 — 0.085 {0.00217 — 0.00330}		Use the one with extrusion and tension, and be careful about sticking of rear side.	
Clearance between the connecting rod bearing and crank pin	0.026 — 0.067 {0.0010 — 0.0026}	0.1 {0.0039}	Replace the bearing.	Be careful with the precision of the crank pin.
Contact surface of the connecting rod bearing and crank pin			Replace the one with defective contact or abrasion.	
Clearance between the small end bushing and the piston pin	0.008 — 0.020 {0.00031 — 0.00079}	0.05 {0.002}	Replace the bushing or the pin.	Clearance should be wide enough to turn smoothly with its big end held.

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Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Axial play of the connecting rod and the crank pin	0.20 — 0.33 {0.008 — 0.013}	0.35 {0.014}		
Center distance between the big end and small end	133.5 {5.256}			Reference value
Torsion of holes on the big end and small end (L = per 24 mm {0.945 in})	0.05 {0.002} or less	0.2 {0.008}	Repair or replace.	
Parallelism of holes on the big end and small end (L = per 100 mm {3.937 in})	0.075 {0.003} or less	0.15 {0.006}	Repair or replace.	
Tightening torque of the bearing cap bolt (N·m {kgf·m/lb·ft})	23 — 26 {2.3 — 2.7/17.0 — 19.2} → 100° — 115°		Apply engine oil to the thread of the bolt and the seating surface of the nut, and tighten.	

Crankshaft

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Uneven wear of the journal and the pin		0.05 {0.002}	Replace the crankshaft.	
Wear of the journal	φ60 {2.362}	0.14 {0.0055}	Replace the crankshaft.	
Wear of the pin	φ46 {1.811}	0.13 {0.005}	Replace the crankshaft.	Connecting rod small end diameter (φ27 {1.063})
	φ49 {1.929}	0.13 {0.005}	Replace the crankshaft.	Connecting rod small end diameter (φ25 {0.9843})
Finishing precision of the journal and the pin (taper and ellipse)	Both ellipse and taper: 0.007 {0.00028}			
Tension of the journal bearing	Extrusion 0.02 — 0.06 {0.0008 — 0.00236}		Use the one with extrusion and tension, and be careful about sticking of rear side.	
Clearance between the journal and the bearing	0.029 — 0.072 {0.0011 — 0.0028}	0.11 {0.0043}	Replace the bearing.	
Axial play of the crankshaft	0.058 — 0.208 {0.0023 — 0.0082}	0.3 {0.012}	Replace the thrust bearing.	Measure at the front of the thrust in No.2 journal portion of the crankshaft.
Crankshaft runout	0.025 {0.00098} or less	0.05 {0.002}	Replace.	
Ring gear			Chamfer the warped ones and replace the remarkably damaged ones.	
Balance of the crankshaft (N·cm {gf·cm/on-in})	0.20 {20/ 0.2778} or less		Check the dynamic balance.	(Reference value) At both ends of the journal

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Tightening torque of the crank bearing cap bolt (N·m {kgf·m/lb·ft})	83.4 — 93.2 {8.5 — 9.5/61.5 — 68.7}		Apply engine oil to the thread and the seating surface of the bolt, and tighten.	Be sure that there is no scratch or foreign object pinched on the bearing cap match surface.
Wear of the oil seal in the crankshaft rear part			Replace the oil seal when there is oil leakage.	Be careful with the oil seal collapsed. (Apply oil sufficiently before assembly.)

Camshaft

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Uneven wear of the center journal		0.05 {0.002}	Repair or replace the camshaft.	
Wear of the center journal	$\phi 52$ {2.047}	$\phi 51.92$ {2.044}	Replace the camshaft.	
Camshaft runout	0.02 {0.0008} or less	0.1 {0.0039}	Replace the camshaft.	
Height of the cam	Inlet	6.13 {0.241}	Replace the camshaft.	Repair light stepped wear of the cam.
	Exhaust	6.43 {0.253}		

Timing gear

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Backlash of the timing gear	Crank gear/Idle gear	0.04 {0.0016}	Replace the gear.	
	Idle gear/Camshaft gear	0.03 {0.0012}		
Clearance between the crank gear and the crankshaft	-0.004 — +0.050 {-0.00016 — +0.0020}			
Clearance between the camshaft gear and camshaft	0 — 0.042 {0 — 0.0017}			
Clearance between the idle gear bushing and shaft	0.025 — 0.085 {0.00098 — 0.00330}	0.2 {0.008}	Replace the idle gear or the shaft.	
Uneven wear of the idle gear shaft		0.1 {0.0039}	Replace the gear shaft.	
Play between front and back direction of the idle gear	0.058 — 0.115 {0.0023 — 0.0045}	0.2 {0.008}	Replace the thrust collar.	

Valve

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Wear of the inlet valve stem	$\phi 7$ {0.276}	$\phi 6.85$ {0.270}	Replace the valve.	If the valve should be replaced due to wear of the valve seat, also replace the valve guide.
Wear of the exhaust valve stem	$\phi 7$ {0.276}	$\phi 6.80$ {0.268}		

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Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Clearance between the inlet valve stem and valve guide		0.023 — 0.056 {0.0009 — 0.0022}	0.2 {0.008}	Replace the valve or valve guide.	
Clearance between the exhaust valve stem and valve guide		0.030 — 0.063 {0.0012 — 0.0025}	0.25 {0.0098}		
Interference of the valve guide and cylinder head		0.023 {0.0009}			Apply oil to the valve guide and press-fit.
Thickness of valve	IN	1 {0.039}	0.7 {0.028}	Replace the valve.	
	EX	0.8 {0.031}	0.5 {0.020}		
Height of the valve guide from the cylinder head		9.5 {0.374}			Reference value
Lip of the valve stem oil seal		ϕ 6.5 {0.256}	ϕ 6.8 {0.268}	Replace oil seal	Be careful not to damage the lip.
Valve spring	Tension (N {lb}) (When compressed to installing length 29.9 mm {1.177 in})	167 {38}	147 {33}	Replace the valve spring.	
	Free height	42.1 {1.657}	40.0 {1.575}		
	Squareness	1.8 {0.071} or less	2.5 {0.098}		
Valve clearance; inlet and exhaust (at cold condition):		0.40 {0.016}	0.35 — 0.45 {0.014 — 0.018}	Adjust.	
Contact surface of the valve stem end and the rocker arm				Repair light stepped wear and damage with the oil stone.	Replace if there is excessive wear or damage.
Clearance between the rocker arm and the rocker arm shaft		0.005 — 0.045 {0.0002 — 0.0018}	0.2 {0.008}	Replace the rocker arm or the shaft.	
Wear of the rocker arm shaft		ϕ 12 {0.472}	ϕ 11.85 {0.467}	Replace.	
Bend of the push rod			0.3 {0.012} or less	Replace.	

Tappet

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Clearance between the tappet and the cylinder block		0.020 — 0.054 {0.0008 — 0.0021}	0.1 {0.0039}	Replace the tappet.	
Wear of the tappet		ϕ 20.97 — 20.98 {0.8256 — 0.8260}	ϕ 20.92 {0.824}	Replace the tappet.	
Contact surface of the tappet and the cam				Replace if there is excessive wear or deformation.	Repair light damage with the oil stone.

Air cleaner

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Condition of the air cleaner element				Machine manufacturer arrangement parts

Water pump

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Play of the water pump ball bearing (radius direction)	0.008 — 0.010 {0.00031 — 0.00040}	0.2 {0.008}	Replace.	
Discharge amount (L/min)	Pump speed: 2,800 rpm Coolant temperature is normal. Full pressure: 0.035 MPa {3.5 m·Aq}	70		4LE1N
	Pump speed: 1,900 rpm Coolant temperature is normal. Full pressure: 0.045 MPa {4.5 m·Aq}	61		4LE1T
Deflection of the fan belt (approx. 98 N {22 lb})	Approx. 8.0 — 10.0 mm {0.315 — 0.394 in}			
Thermostat working start temperature (at barometric pressure)	82°C {180°F}			Replace the thermostat if its working is incomplete.
Thermostat full-open temperature (at barometric pressure)	95°C {203°F}		The temperature when thermostat lift amount is 8.0 mm {0.315 in} or more	Without jiggle valve:
			The temperature when thermostat lift amount is 9.5 mm {0.374 in} or more	With jiggle valve:

Fuel feed pump

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Discharge amount (L/min)	At 28.4 kPa {4.1 psi}	1.35 or more	Repair or replace.	
	At 17.7 kPa {2.6 psi}	0.70 or more		
	At 13.7 kPa {2.0 psi}	1.41 or more		
Airtight (98.1 kPa {14.2 psi})	Be sure that there is no leakage.		Repair or replace when there is leakage.	

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Injection pump

Adjustment conditions

Pump part number	897147-5801 898098-8750 898074-7740	
Revolution direction	Counterclockwise (viewed from drive-end)	
Nozzle	897129-6440	
Nozzle holder ASM	897360-7860	
Nozzle opening pressure (MPa {psi})	15.2 — 16.2 {2205 — 2350}	
Pipe Outside diameter × inside diameter × length (mm {in})	φ6 {0.236} × φ2 {0.079} × 450 {17.717}	
Inspecting oil	JIS No.2 diesel fuel	
Oil temperature °C {°F}	35 — 40 {95 — 104}	

Injection amount adjustment

Pump part number	Rack position (adjustment point: A) (mm {in})	Pump speed (rpm)	Average injection amount (mm ³ /stroke)	Remarks
898098-8750	10.3 {0.406} ± 0.05 {0.002}	900	46.0 ± 0.3	Standard
898074-7740	10.8 {0.425} ± 0.05 {0.002}	1,250	47.5 ± 0.3	Standard
897147-5801	A = *	1,300	12.0 ± 0.3	Standard
	*	400	* (8.3)	

*: For pump part number "897147-5801, injection amount is adjusted while the pump speed is 1,300 rpm according to the the rack position value that is beforehand measured while the pump speed is 400 rpm.

Generator

12V50A Hitachi, Ltd.

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Wear of the shaft (front)		17.0 {0.669}		Replace the rotor.	
Wear of the shaft (rear)		10.0 {0.393}		Replace the rotor.	
Play of bearing				Replace the bearing.	Turn it by hand and check that it rotates smoothly and has no noise or play.
Outside diameter of the slip ring		27.0 {1.063}	26.0 {1.024}	Replace the rotor.	
Slip ring surface dirty				Repair with a sand paper or the like if there is dirt or damage.	
Brush and brush spring	Brush length	22 {0.866}	6.0 {0.236}	Repair when the following occurs: the spring contact surface of the brush is incomplete, the brush spring pressure is not even or not appropriate, the brush is excessively worn or chipping, supporting degree of the brush holder is not appropriate.	
	Tension N {lb}	3.4 {0.76}	2.5 {0.56}		

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Output current (13.5 V 5,000 r/min)	47 A or more	47 A or less	Replace.	
Regulated voltage by regulator (V)	14.1 — 14.7	14.1 or less, or 14.7 or more	Replace the regulator.	

12V35A Hitachi, Ltd.

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Wear of the shaft (front)	15 {0.591}		Replace the rotor.	
Wear of the shaft (rear)	12 {0.472}		Replace the rotor.	
Play of bearing			Replace the bearing.	Turn it by hand and check that it rotates smoothly and has no noise or play.
Outside diameter of the slip ring	31.6 {1.244}	30.6 {1.205}	Replace the rotor.	
Slip ring surface dirty			Repair with a sand paper or the like if there is dirt or damage.	
Brush and brush spring	Brush length	16 {0.630}	7 {0.276}	Repair when the following occurs: the spring contact surface of the brush is incomplete, the brush spring pressure is not even or not appropriate, the brush is excessively worn or chipping, supporting degree of the brush holder is not appropriate.
	Tension N {lb}	3.4 {0.76}	2.5 {0.56}	
Output current (13.5 V 5,000 r/min)	33 A or more	33 A or less	Replace.	
Regulated voltage by regulator (V)	14.2 — 14.8	14.2 or less, or 14.8 or more	Replace the regulator.	

12V20A Hitachi, Ltd.

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Shaft bend			Replace the rotor.	
Play of bearing			Replace the bearing.	Turn it by hand and check that it rotates smoothly and has no noise or play.
Output current (12 V 5,000 r/min)	20 A or more	20 A or less	Replace.	
Regulated voltage by regulator (V)	13.3 — 14.3	13.3 or less, or 14.3 or more	Replace the regulator.	

12V35A DENSO

Item to be checked	Standard value	Service limit	Repairing procedure	Remarks
Shaft bend			Replace the rotor.	
Play of bearing			Replace the bearing.	Turn it by hand and check that it rotates smoothly and has no noise or play.

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Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Outside diameter of the slip ring		14.4 {0.567}	14.0 {0.551}	Replace the rotor.	
Slip ring surface dirty				Repair with a sand paper or the like if there is dirt or damage.	
Brush and brush spring	Brush length	10.5 {0.413}	8.4 {0.331}	Repair when the following occurs: the spring contact surface of the brush is incomplete, the brush spring pressure is not even or not appropriate, the brush is excessively worn or chipping, supporting degree of the brush holder is not appropriate.	
Output current (13.5 V 5,000 r/min)		38 A or more	38 A or less	Replace.	
Regulated voltage by regulator (V)		14.2 — 14.8	14.2 or less, or 14.8 or more	Replace the regulator.	

Starter

24V2.2kW Mitsubishi Electric

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Wear of the outside diameter of commutator		32 {1.26}	31.4 {1.236}	Replace.	
Uneven wear of the outside diameter of commutator		—	0.1 {0.0039} or more	Replace.	
Depth of mica between commutator segments		0.5 {0.020}	0.2 {0.008} or less	Repair or replace.	
Brush length		17.5 {0.689}	11 {0.433}	Replace.	
Pinion (gap)		0.5 — 2.0 {0.020 — 0.079}	2.0 {0.079} or more	Repair or replace if there is excessive wear or chipping.	
Clutch action		—	—	—	Rotates smoothly when the pinion is turned to the drive direction, and locks when turned to the inverse direction.
No load test Revolution speed (23 V/80 A or less)		3,800 r/min or more	3,800 r/min or less	Repair or replace.	
Load test 18.6 V/250 A or less	Torque	10.4 N·m {1.1 kgf·m}	10.4 N·m {1.1 kgf·m} or less	Repair or replace.	
	Revolution speed	1,380 r/min or more	1,380 r/min or less	Repair or replace.	
Restraint test Load 8 V/760 A or less	Torque	31.38 N·m {3.2 kgf·m} or more	31.38 N·m {3.2 kgf·m} or less	Repair or replace.	

12V2.0kW DENSO

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Wear of the outside diameter of commutator		35 {1.378}	34 {1.339}	Replace.	
Uneven wear of the outside diameter of commutator		—	0.1 {0.0039} or more	Replace.	
Depth of mica between commutator segments		0.55 — 0.85 {0.021 — 0.033}	0.2 {0.008} or less	Repair or replace.	
Brush length		15 {0.591}	12 {0.472}	Replace.	
Pinion (gap)				Repair or replace if there is excessive wear or chipping.	
Clutch action		—	—	—	Rotates smoothly when the pinion is turned to the drive direction, and locks when turned to the inverse direction.
No load test Revolution speed (11.5 V/100 A or less)		4,000 r/min or more	4,000 r/min or less	Repair or replace.	
Load test 7.6 V/400 A or less	Torque	8.83 N·m {0.9 kgf·m}	8.83 N·m {0.9 kgf·m} or less	Repair or replace.	
	Revolution speed	1,380 r/min or more	1,380 r/min or less	Repair or replace.	
Restraint test Load 2.4 V/800 A or less	Torque	16.67 N·m {1.7 kgf·m} or more	16.67 N·m {1.7 kgf·m} or less	Repair or replace.	

Preheating device

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Glow plug				Replace when there is an open circuit or a short circuit.	

Oil pressure

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Lubrication oil pressure (kPa {psi})	At 1,000 rpm:	147 {21}			
	At 1,800 rpm:	294 {43}			
	At 2,200 rpm:	343 — 686 {50 — 100}			

0A-36 General Information

Oil pump and relief valve

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
Clearance between the pump body and outer circle of the outer rotor		0.28 — 0.41 {0.0110 — 0.0161}	0.4 {0.016}	Replace the bushing, rotor, or body.	
Discharge amount (L/min) (engine speed 2,700 rpm SAE#30 discharge pressure 392 kPa {57 psi} oil temperature 50°C {122°F})		26.8			
Axial clearance between the pump cover and the rotor		0.040 — 0.085 {0.0016 — 0.0033}	0.15 {0.006}	Replace the rotor or the cover.	4LE1N
		0.040 — 0.087 {0.0016 — 0.0034}	0.15 {0.006}	Replace the rotor or the cover.	4LE1T
Tip clearance between the inner rotor and the outer rotor		0.15 {0.0059} or less	0.2 {0.008}	Replace the rotor.	
Clearance between the drive shaft and the pump cover		0.032 — 0.072 {0.0013 — 0.0028}	0.15 {0.006}		
Diameter of the drive shaft		φ16 {0.629}	φ21.9 {0.862}	Replace the shaft.	
Relief valve starting pressure kPa {psi}	Oil pump	391 — 489 {56.7 — 70.9}			4LE1N
		490 — 588 {71.1 — 85.3}			4LE1T

Complete inspection

Item to be checked		Standard value	Service limit	Repairing procedure	Remarks
“Grinding” drive of the engine				Perform for 30 minutes or more	
Compression pressure of the cylinder (MPa {psi}) (approx. 250 rpm)		3.04 {441}	2.5 {363}	Repair.	Coolant temperature: 70 — 85°C {158 — 185°F}
Difference between the compression pressure of the cylinders (approx. 250 rpm)		±5% or less to the average value		Repair.	Coolant temperature: 70 — 85°C {158 — 185°F}
Lubrication oil pressure (kPa {psi})	At 1,000 rpm:	147 {21}			
	At 1,800 rpm:	294 {43}			
	At 2,200 rpm:	343 — 686 {50 — 100}			
Output inspection		90% or more			Assume that the actual performance of the new engine is 100%.
Fuel consumption inspection		110% or less			

Engine

4LE1 Engine Mechanical

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ISUZU Diesel Engine

Service Precautions

Service precautions about maintenance

To prevent damage to the engine and ensure reliability of its performance, pay attention to the following in maintaining the engine:

- When taking down the engine on the ground, do not make the bearing surface of the oil pan touch directly the ground. Use a wood frame, for example, to support the engine with the engine foot and the flywheel housing.
Because there is only a small clearance between the oil pan and the oil pump strainer, it can damage the oil pan and the oil strainer.
- When the air duct or air cleaner is removed, cover the air intake port to prevent foreign matter from getting into the cylinder. If foreign matter gets in, it can considerably damage the cylinder and others while the engine is operating.
- When maintaining the engine, never fail to remove the battery ground cable. Otherwise, this may damage the wire harness or electrical parts. If you need electricity on for the purpose of inspection, for instance, watch out for short circuits and others.
- Apply engine oil to the sliding contact surfaces of the engine before reassembling it. This ensures adequate lubrication when the engine is first started.
- When valve train parts, pistons, piston rings, connecting rods, connecting rod bearings or crankshaft journal bearings are removed, put them in order and keep them.
- When installing them, put them back to the same location as they were removed.
- Gaskets, oil seals, O-rings, etc. must be replaced with new ones when the engine is reassembled.
- As for parts where a liquid gasket is used, remove an old liquid gasket completely and clean it up thoroughly so that no oil, water or dust may be clung to them. Then, apply the designated liquid gasket to each place anew before assembly.
- Surfaces covered with liquid gasket must be assembled within 5 minutes of gasket application. If more than 5 minutes have elapsed, remove the existing liquid gasket and apply new liquid gasket.
- When assembling or installing parts, fasten them with the specified tightening torque so that they may be installed properly.

Service precautions specific to this engine

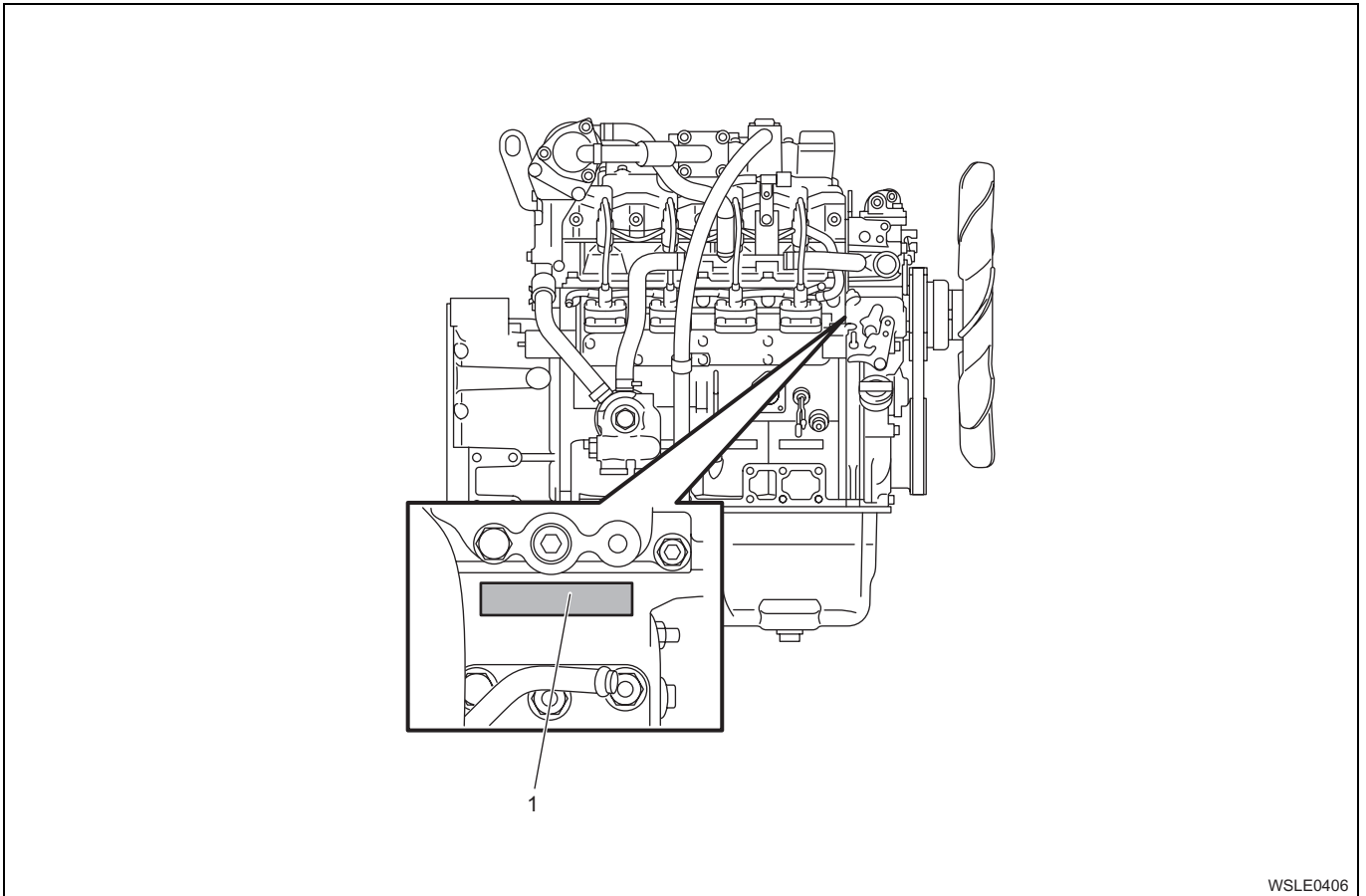
Holes or clearances in the fuel system, which serve as a passage of fuel, including the inside of the nozzle holder, are made with extreme precision. They are therefore highly sensitive to foreign matter and the entry of foreign matter could cause serious damage. Take extreme care not to allow foreign matter to enter. When servicing the fuel system, every precaution must be taken to prevent the entry of foreign material into the system.

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

Work procedure

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

How to Read the Model



WSLE0406

Name

1. Stamped Engine Number

Explanations on Functions and Operation

Cylinder block

The cylinder block is cast-iron with the center distance of each bore being equal and is of the highly rigid, symmetrical structure with the crankshaft center being the center.

Piston

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

Cylinder head

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

Crankshaft

The crankshaft which is stamped "N" on the front end surface is made of tufftride.

EGR system

Based on coolant temperature and engine speed, it is controlled by EGR cut controller to purify exhaust by recycling part of it.

Its main components include an EGR cut solenoid, an EGR cooler and various sensors.

Connecting rod cap bolt

Do not pull out the connecting rod cap bolt from the connecting rod except when you need to replace it.

Nozzle holder

Multi-hole type nozzle is used for the nozzle holder.

Sedimenter

Sedimenter gets rid of water by making use of the difference in specific gravity between diesel oil and water.

Preheating system

The preheating system consists of the glow plug timer, the glow plugs and the glow indicator lamp. The preheating system is operated when the engine coolant temperature is low, and makes the engine easy to start.

1A-4 4LE1 Engine Mechanical

Lubrication system

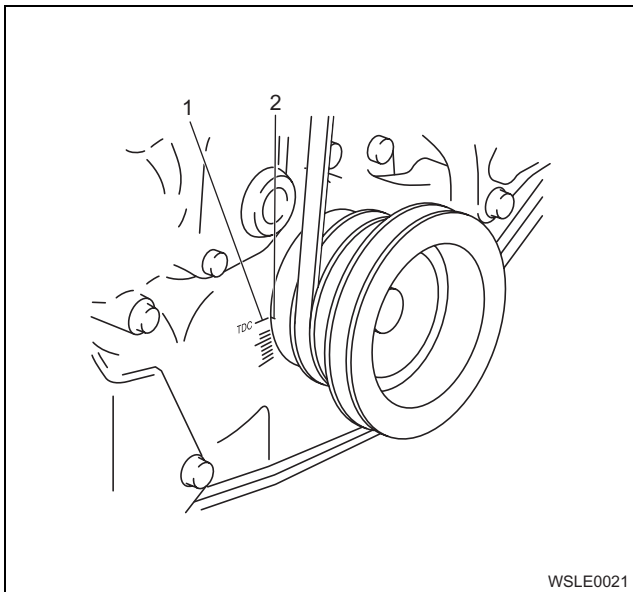
It is an oil filter with full-flow bypass, which uses a water-cooled oil cooler and oil jet to cool the piston.

Function Check

Inspection/adjustment of valve clearance

To do this work, use the thickness gauge when the engine is cold.

1. Rotate the crankshaft over 360 degrees into a proper direction (clockwise), and set the mark groove of the crank pulley to the TDC mark (cast) of the timing gear case cover.



Name

1. TDC Mark
2. Mark Groove

2. Remove the cylinder head cover and check whether the No.1 cylinder is in the compression top dead center position or in the exhaust top dead center position.

The cylinder is in the compression top dead center position if both intake and exhaust valves are closed. The cylinder is in the exhaust top dead center position if both intake and exhaust valves are open.



Name

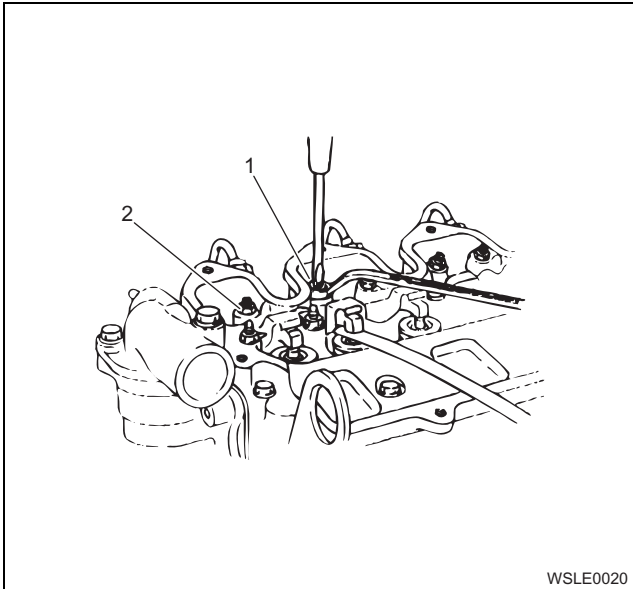
1. Intake of No.1 Cylinder
2. Exhaust of No.1 Cylinder

3. Measure the clearance of the valve with ○ mark or × mark in the table, depending on the status of the No.1 cylinder. If the clearance is not the standard value, adjust it to the standard value using the adjusting screw.

CAUTION:

To measure the clearance, use the thickness gauge when the engine is cold.

Valve clearance standard value	mm {in}
Inlet valve	0.40 ± 0.05 {0.016 ± 0.002} (at cold condition)
Exhaust valve	



WSLE0020

Name

- 1. Adjusting Screw
- 2. Lock Nut

4. Rotate the crankshaft again into a proper direction, and set the mark in the same way as 1. after 3. is completed. Then measure and adjust the clearances of the remaining valves.

CAUTION:

- **Rocker arm is die-cast aluminum. So do not over-tighten the rocker arm when tightening the adjusting screw.**
- **The load of the used valve spring is low. So do not push down the spring when measuring or adjusting the clearance.**

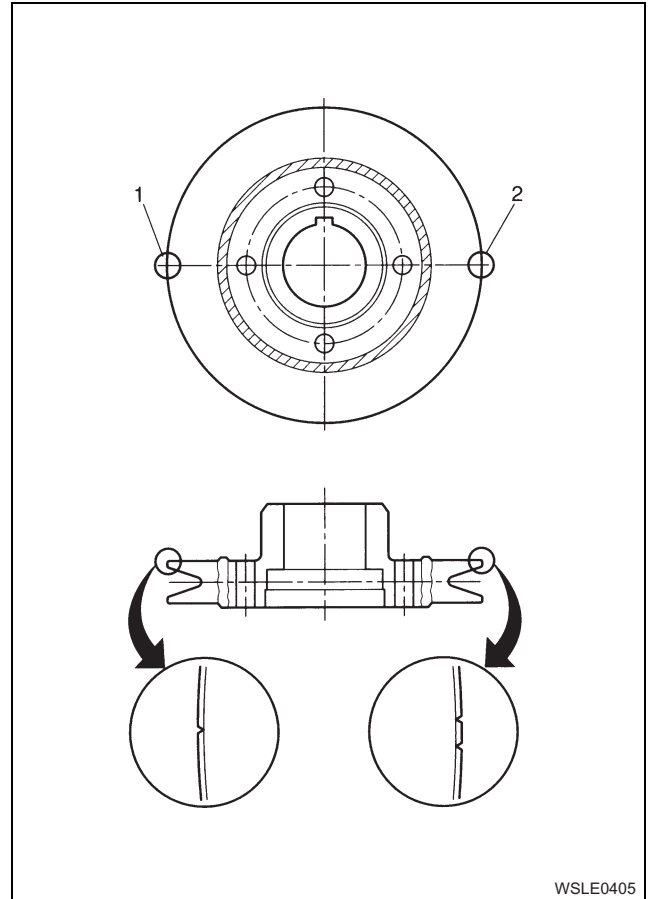
Adjustment table

Cylinder No.	1		2		3		4	
	IN	EX	IN	EX	IN	EX	IN	EX
No.1 cylinder compression top dead center position	○	○	○			○		
No.1 cylinder exhaust top dead center position				×	×		×	×

Type of the crank pulley that has two mark grooves on outer circumference

Adjustment procedure

1. Rotate the crankshaft to a proper direction (clockwise) of the engine, and set the mark groove (1) of the crank pulley to the TDC mark of the timing gear case cover.



WSLE0405

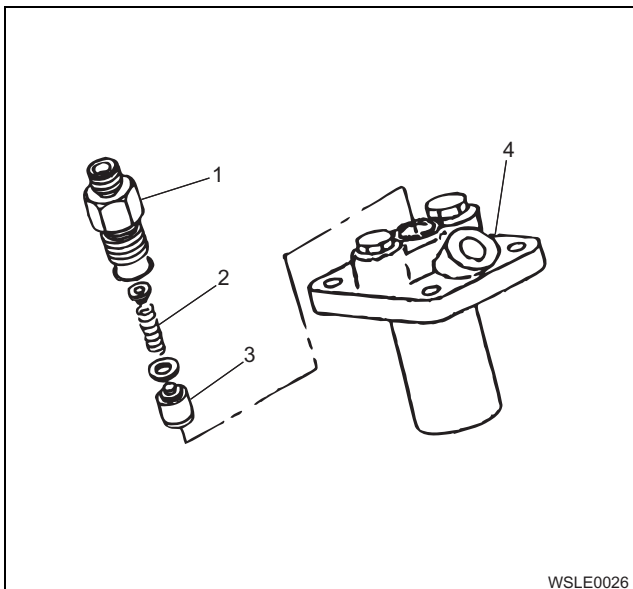
2. Remove the cylinder head cover and check whether the No.1 cylinder is in the compression top dead center position or in the exhaust top dead center position. The cylinder is in the compression top dead center position if both intake and exhaust valves are closed. The cylinder is in the exhaust top dead center position if both intake and exhaust valves are open. Make the No.1 cylinder to the compression top dead center position.
3. Measure and adjust the valve clearance of the No.1 cylinder.
4. Rotate the crank 180 degrees clockwise from the position in step 3, and align the mark groove (2) with the TDC mark of the timing gear case cover. Measure and adjust the valve clearance of the No.3 cylinder.
5. Rotate the crank 180 degrees clockwise from the position in step 4, and align the mark groove (1) with the TDC mark of the timing gear case cover. Measure and adjust the valve clearance of the No.4 cylinder.
6. Rotate the crank 180 degrees clockwise from the position in step 5, and align the mark groove (2) with the TDC mark of the timing gear case cover. Measure and adjust the valve clearance of the No.2 cylinder.

1A-6 4LE1 Engine Mechanical

Cylinder No.	1		2		3		4	
	IN	EX	IN	EX	IN	EX	IN	EX
Step 3: Crank pulley alignment groove posi- tion (1)	○	○						
Step 4: Crank pulley alignment groove posi- tion (2)					○	○		
Step 5: Crank pulley alignment groove posi- tion (1)							○	○
Step 6: Crank pulley alignment groove posi- tion (2)			○	○				

Inspection and adjustment of injection timing

1. Remove the No.1 cylinder injection pipe.
2. Then remove the delivery valve holder of the No.1 cylinder injection pump, and pull out the delivery valve and the delivery spring.



Name

1. Delivery Valve Holder
2. Delivery Spring
3. Delivery Valve
4. Injection Pump

3. Install the delivery valve holder and tighten it, leaving the delivery valve and spring removed.

Tightening torque:

39.2 — 44.1 N·m {4.0 — 4.5 kgf·m/28.9 — 32.5 lb·ft}

4. Turn the starter switch to the drive position with the lever of the sedimenter in the open position. Then rotate the crankshaft slowly feeding fuel by the electromagnetic pump, the gap with the fuel tank, the feed pump lever, etc. And when the fuel stops flowing from the delivery holder and bulging at the dent on top, stop the crankshaft rotating.

Note:

Take extreme care to rotate the crankshaft as slowly as possible and not to miss the position where the fuel stops bulging.

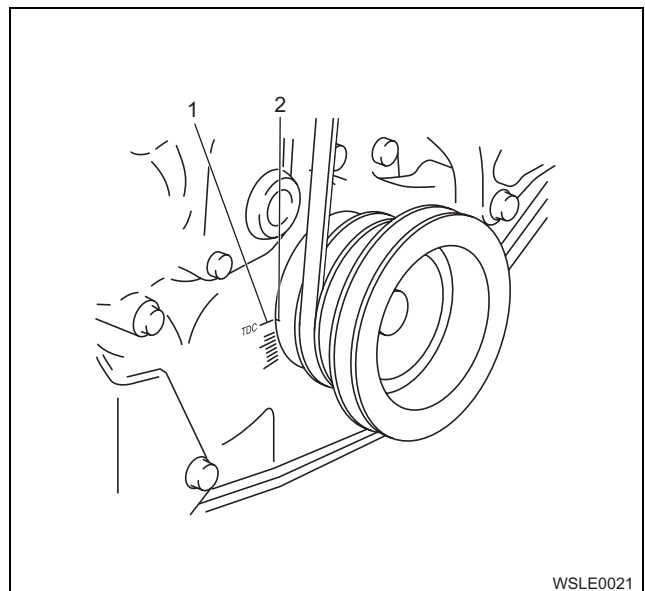
5. Check the degree in the timing mark on the timing gear case where the mark groove of the crank pulley is positioned in above 4. status. Adjust if the value is out of the standard value of the injection timing.

* Injection timing

BTDC 2°

Note:

Injection timing varies depending on the machine specification.



Name

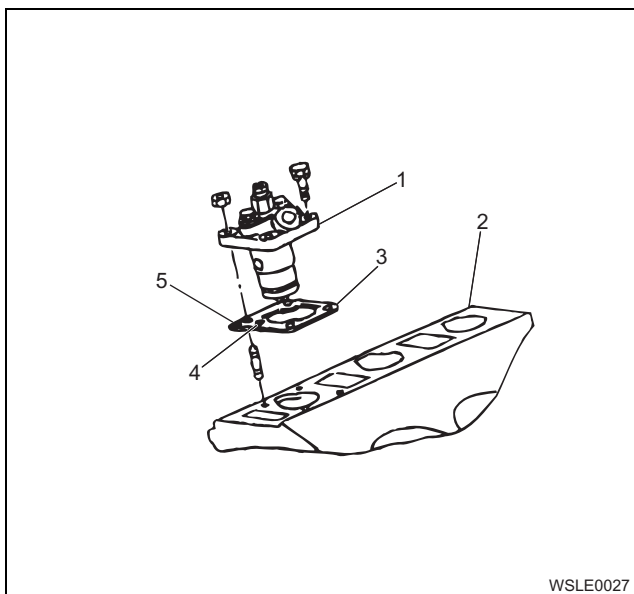
1. TDC Mark
2. Mark Groove

6. Adjust injection timing by the shim between the injection pump and the cylinder block.
The following nine types of identifying symbols are stamped (or sealed) on the shim.

The identifying symbols and thickness of the shim					
Symbol	Thick-ness	Symbol	Thick-ness	Symbol	Thick-ness
2	0.2 {0.008}	5	0.5 {0.020}	8	0.8 {0.031}
3	0.3 {0.012}	6	0.6 {0.024}	10	1.0 {0.039}
4	0.4 {0.016}	7	0.7 {0.028}	12	1.2 {0.047}

CAUTION:
Adjust the shims for each injection pump of four cylinders at the same time.

Note:
If the shim is thickened by 0.1 mm {0.0039 in}, the injection timing is delayed for approx. 0.6 degree, and if thinned by 0.1 mm {0.0039 in}, put forward for approx. 0.6 degree.



- Name**
1. Injection Pump
 2. Cylinder Block
 3. Shim
 4. Knock Hole
 5. Identifying Symbol

7. Assemble removed delivery valve to the injection pump after cleaning, and tighten the delivery holder to the specified torque.

Tightening torque:

39.2 — 44.1 N·m {4.0 — 4.5 kgf·m/28.9 — 32.5 lb·ft}

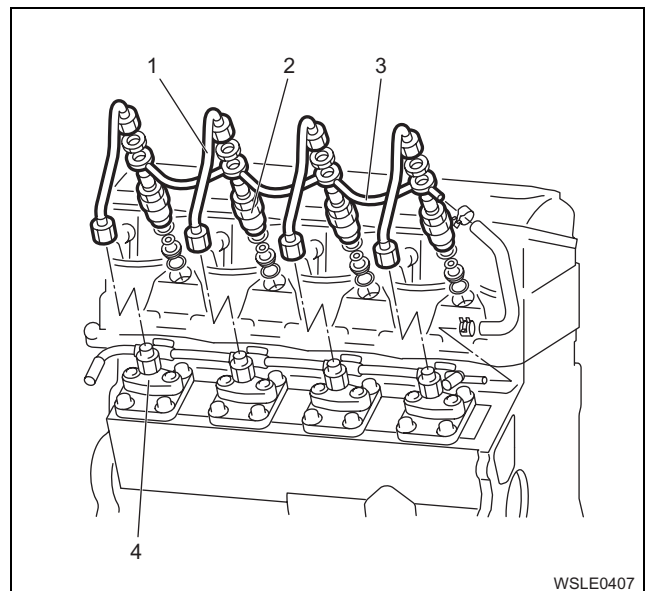
CAUTION:
Be careful with dirt getting inside when removing and installing the delivery valve or spring.

8. Install the injection pipe to the injection pump and the nozzle holder, and tighten it with the sleeve nut.
- Screw the thread portion of the sleeve nut two or three turns by your hand.
 - Hold the delivery valve holder of the injection pump with a wrench and tighten the sleeve nut securely.

Tightening torque:

14.7 — 24.5 N·m {1.5 — 2.5 kgf·m/10.8 — 18.1 lb·ft}

Important:
If over-tightening the delivery valve holder, the rack cannot move smoothly as the plunger and the housing are compressed. Therefore, when tightening the sleeve nuts of the injection pipe, hold the delivery valve holder with a wrench to prevent corotation.



- Name**
1. Injection Pipe
 2. Nozzle Holder
 3. Leak-off Pipe
 4. Injection Pump

1A-8 4LE1 Engine Mechanical

Inspection of compression pressure

1. Warm-up the engine.
2. Disconnect the battery cable from the negative terminal and remove all the glow plugs.
3. Disconnect the wire connector of the solenoid for engine stopping.
4. Install the battery cable to the negative terminal.
5. Install an adapter and a gauge of a compression gauge (special tool).

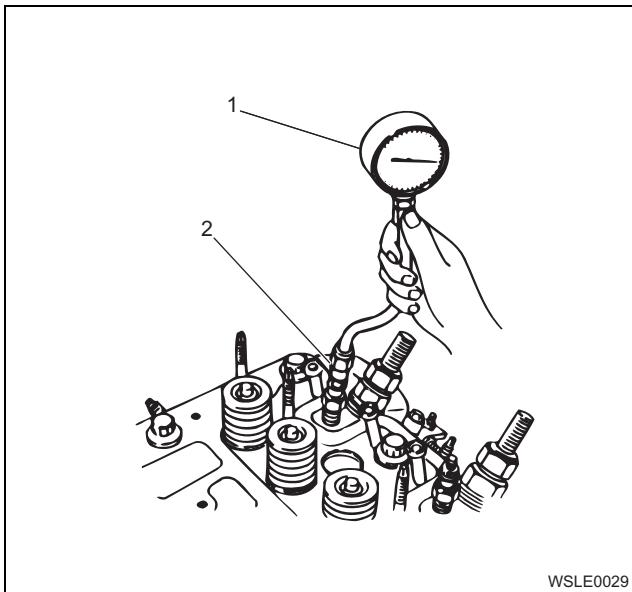
Special tool

Compression gauge (with adapter)

5-8840-2675-0

Adapter

5-8840-9029-0



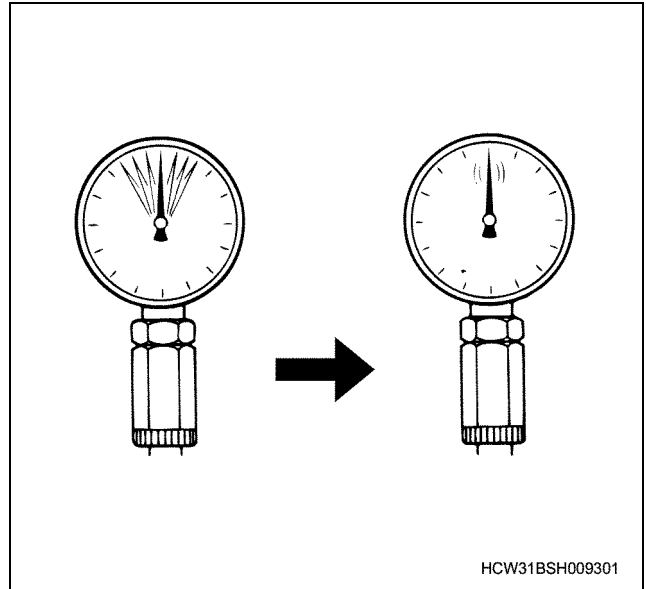
WSLE0029

Name

1. Compression Gauge
2. Adapter

6. Turn the starter until the indicator of compression gauge becomes stable and measure the compression pressure.

Compression pressure (250 rpm)		MPa {psi}
Standard value	Service limit	Difference between cylinders
3.04 {441}	2.5 {363}	±5 % or less to the average value



HCW31BSH009301

Perform the measurement described above for all cylinders. If the compression pressure is the service limit or less, overhaul the engine.

CAUTION:

- Be sure to measure for all cylinders.
- Be sure to use the full-charged battery to maintain the engine speed of 250 rpm or more.

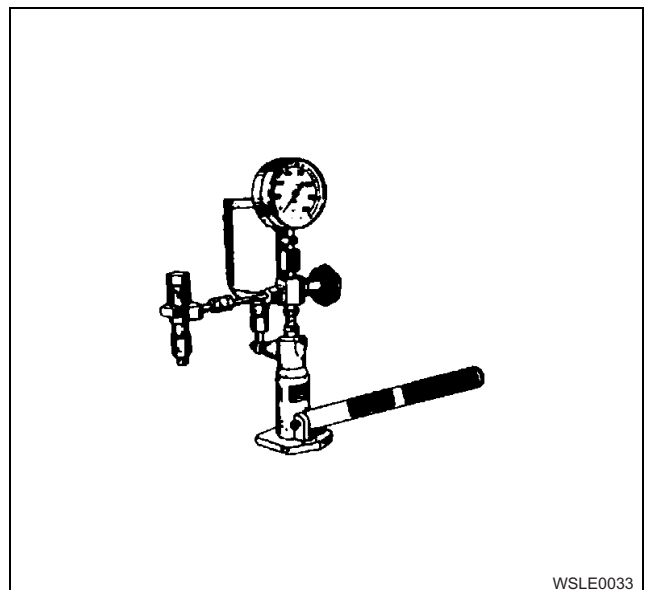
Injection nozzle

Use the nozzle tester to check the injecting condition.

WARNING:

Do not put hands close to the nozzle hole area when checking.

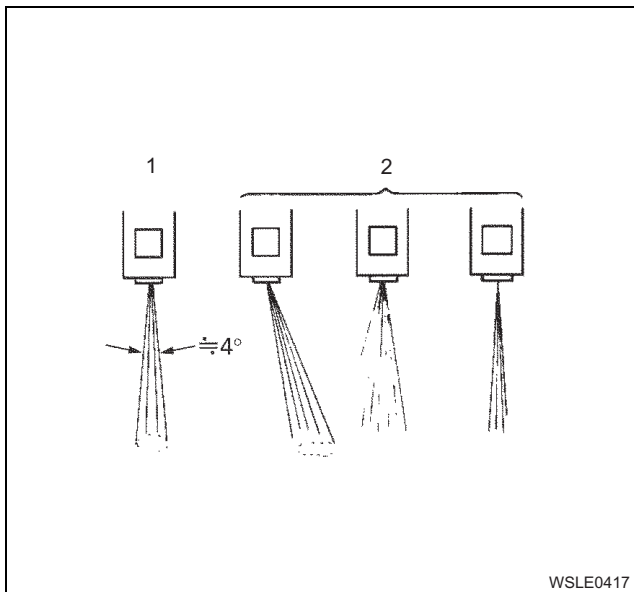
Diesel oil may permeate to your body and cause blood poisoning due to high pressure injection.



WSLE0033

Injecting condition

Judge the nozzle condition by injecting condition.



Name

1. Good
2. Defective (fine or clogged)
3. Defective (dropping)

Note:

- Do not overhaul the engine as a two-step valve pressure nozzle is adapted to this engine.
- If a overhaul of the nozzle and inspection and adjustment of the injection pressure are required, contact a BOSCH service center.

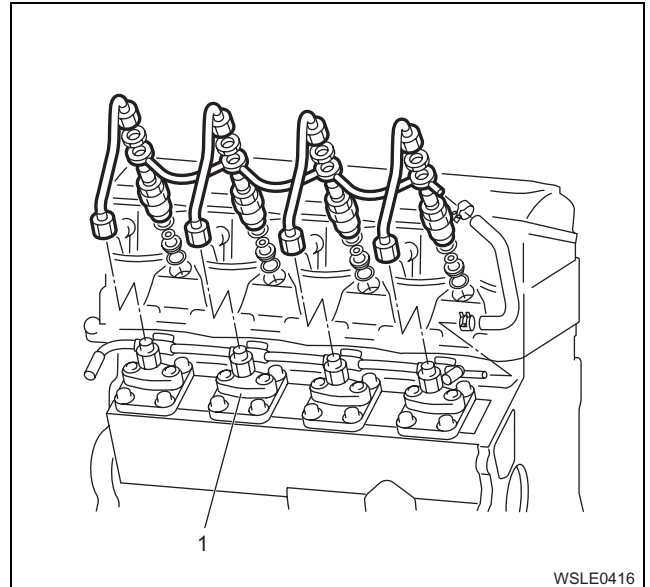
Bleeding air from fuel system

In case of automatic air bleed system

Turn the starter switch to the drive position. The electromagnetic pump operates, the fuel is pressure-fed to the fuel pipe and the leak-off pipe, and the air in the fuel system is automatically bled out.

In case of other than automatic air bleed system

Bleed air from the fuel pipe eyebolt of the No.1 cylinder injection pump, the leak-off pipe eyebolt of the injection nozzle, and the air bleed plug of the fuel filter in the order from the part installed to lower portion, feeding the fuel by the electromagnetic pump, the gap with the fuel tank, the feed pump lever, etc.

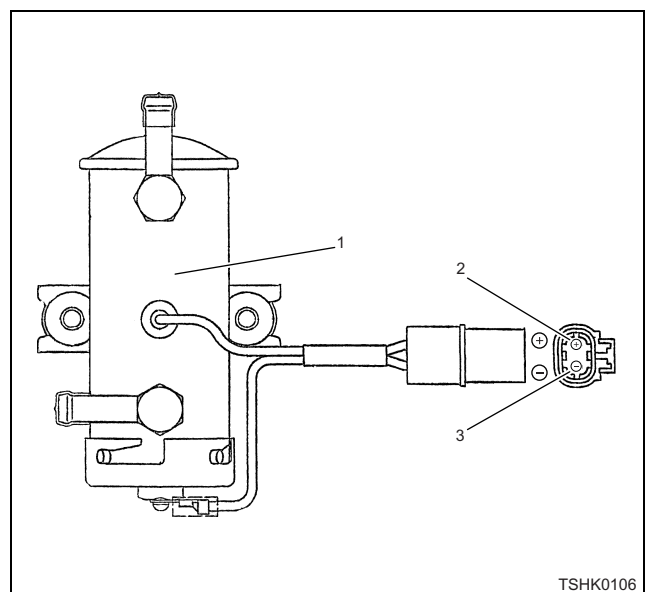


Name

1. Injection pump

Electromagnetic pump inspection procedure

1. Turn the key switch to ON, and check for pulsation in the fuel hose.
 - It is normal if pulsation exists.
2. Disconnect the electromagnetic pump connector, and connect 24 V power supply to the electromagnetic pump side to check if the pump operates.
 - If it operates properly, there may be open circuit, short circuit or poor contact in the machine-side harness. Repair the faulty part, and check again from Step 1.
 - If the electromagnetic pump does not operate, replace the pump.

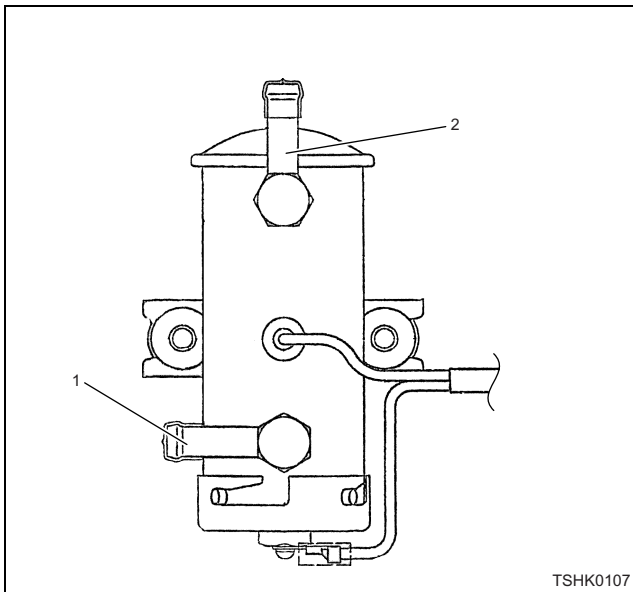


Name

1. Electromagnetic Pump
2. + Terminal
3. - Terminal

1A-10 4LE1 Engine Mechanical

- Blow air into the inlet of the electromagnetic pump with your mouth.
 - The internal seal may be stuck. Blow air to eliminate sticking.



TSHK0107

Name

- Fuel Inlet Port
- Fuel Outlet Port

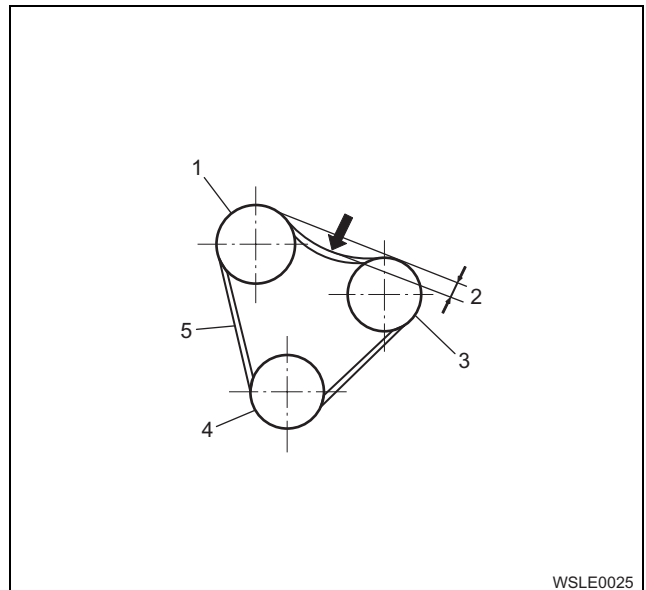
- Install the removed parts, and check again from Step 1.

Fan belt

Tension inspection

Push between the fan pulley and the generator pulley with your finger (about 98 N {22 lb}). If the deflection is out of the standard value, adjust the belt tension.

Deflection	mm {in}
Standard value	Approx. 8 — 10 {0.315 — 0.394}



WSLE0025

Name

- Fan Pulley
- Deflection
- Generator Pulley
- Crank Pulley
- Fan Belt

Adjustment procedure

- Loosen the adjusting plate which fixes the generator, and the mounting bolt of the generator.
- Adjust the adjusting bolt to the standard value and fix the generator at this position.
Be sure to tighten the mounting bolts which you have loosened.

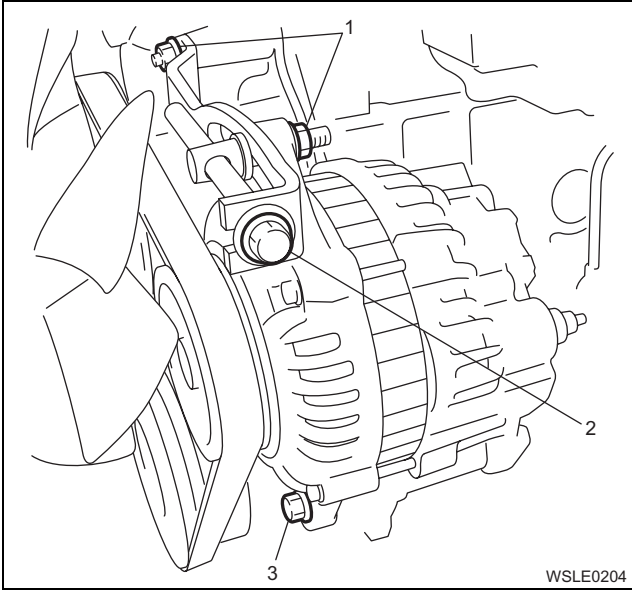
Note:

Recheck the tension of the belt after fixing the generator since the tension varies in some degree when the generator gets fixed.

Tightening torque:

M8 bolt or nut: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/
13.7 — 20.9 lb·ft}

M10 bolt or nut: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/
30.4 — 40.6 lb·ft}



Name

1. Nut
2. Adjusting Bolt
3. Mounting Bolt

1A-12 4LE1 Engine Mechanical

Specifications

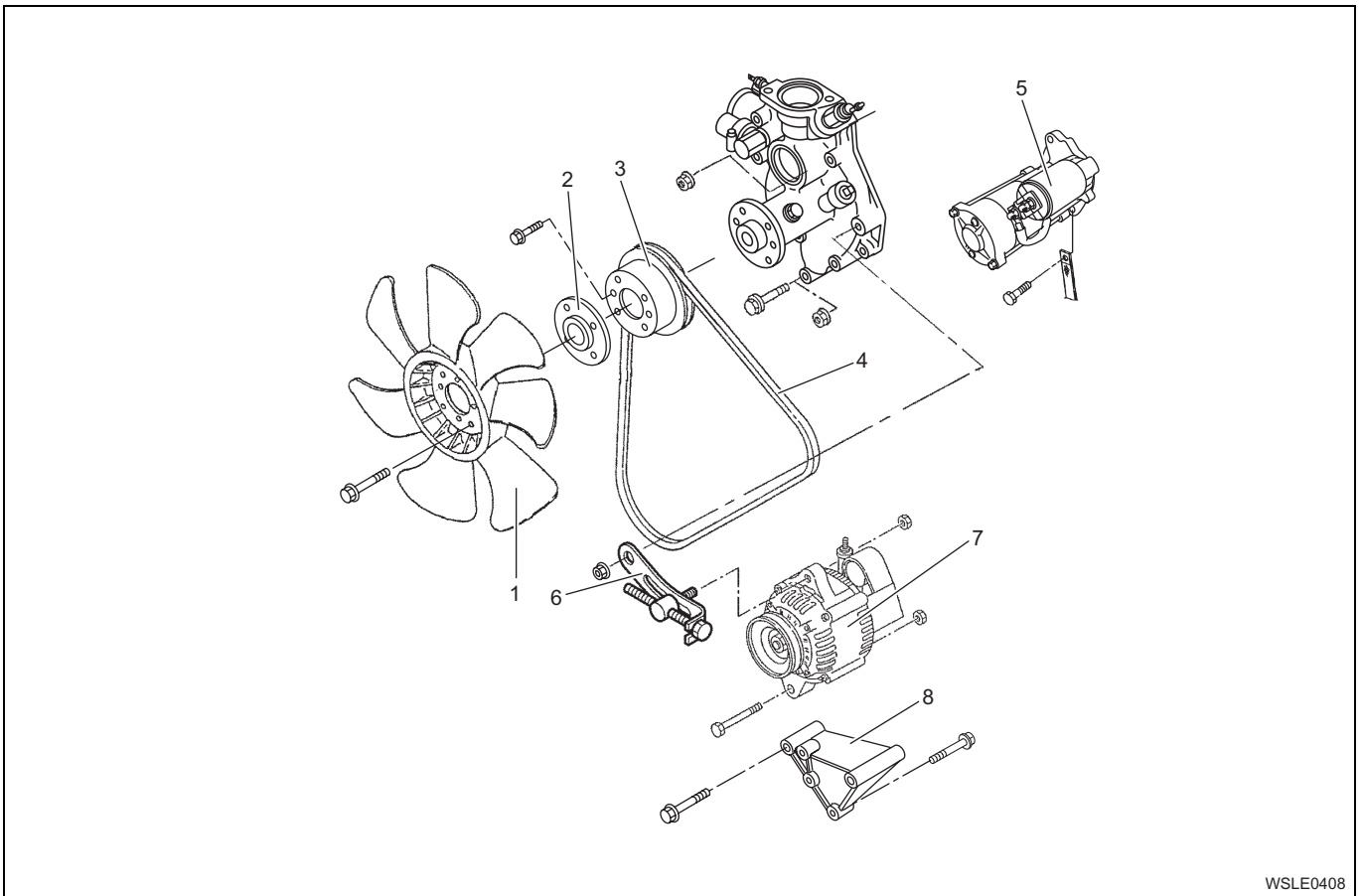
Engine name		4LE1T	4LE1N
Item			
Engine structure type		4-cycle, water cooled-type, inline four-cylinder, OHV type	
Cylinder number – bore × stroke (mm {in})		4 – 85{3.35} × 96{3.78}	
Total displacement (L {cu-in})		2.179 {133}	
Compression ratio		21.5:1	
Combustion chamber type		Three vortex combustion system	
Overall length × overall width × overall height (mm {in})		* 647.5{25.5} × 523.6{20.6} × 720.8{28.4}	695{27.4} × 486.2{19.1} × 601.8{23.7}
Dry weight (kg {lb})		* 190 {419}	* 170 {375}
Firing order		1 — 3 — 4 — 2	
Fuel injection timing (BTDC) (at stop)		* 12°	
Compression pressure (MPa {psi})		3.04 {441} / 250 rpm	
Valve clearance (at cold condition) (mm {in})		Intake air	0.40 {0.016}
		Exhaust	0.40 {0.016}
Opening/closing period of valve	Intake valve	Open (before top dead center)	15°
		Closed (after bottom dead center)	29°
	Exhaust valve	Open (before bottom dead center)	40°
		Closed (after top dead center)	16°
Injection pump type		Bosch type, PFR1KX model, four	
Governor type		Centrifugal type, all speeds controlled	
Nozzle type		Throttle type	
Injection pressure (MPa {psi})		* 14.7 {2,132}	
Fuel type		Diesel (JIS K2204)	
Cooling method		Forced circulation, water cooling pressurization type	
Cooling fan		* φ430 × 8 pieces	
Coolant amount (L {qts})		With EGR: Approx. 4.2 {3.7} (Engine only) Without EGR: Approx. 2.8 {3.0} (Engine only)	
Lubrication oil amount: total (L {qts})		* Approx. 10.3 {10.9} at MAX, 7.6 {8.0} at MIN	* Approx. 8.4 {8.9} at MAX, 5.9 {6.2} at MIN
Lubricant type (API service category)		CD or CF-4 * (CE, CF, CH-4, CI-4 or CI-4 Plus)	
Generator output (V — A)		* 12 — 30 (Hitachi) * 12 — 50 (Hitachi)	* 12 — 20 (Hitachi) * 12 — 35 (DENSO)
Starter output (V — kW)		* 12 — 2.2 (Mitsubishi) * 12 — 2.0 (DENSO)	* 12 — 2.0 (DENSO)

Caution: This specification may be changed partially without notice.

* mark may vary depending on each machine. Refer to the machine manufacturer specification.

Engine Accessories

Components



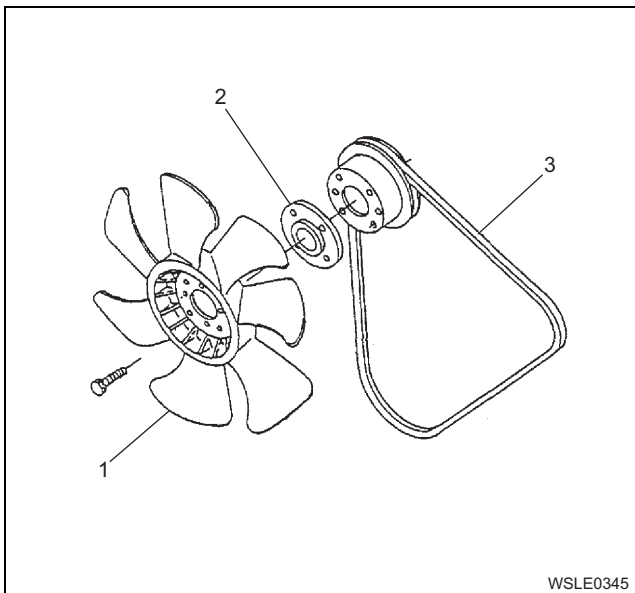
WSLE0408

Name

- | | |
|----------------|----------------------|
| 1. Cooling Fan | 5. Starter |
| 2. Spacer | 6. Adjusting Plate |
| 3. Fan Pulley | 7. Generator |
| 4. Fan Belt | 8. Generator Bracket |

Removal

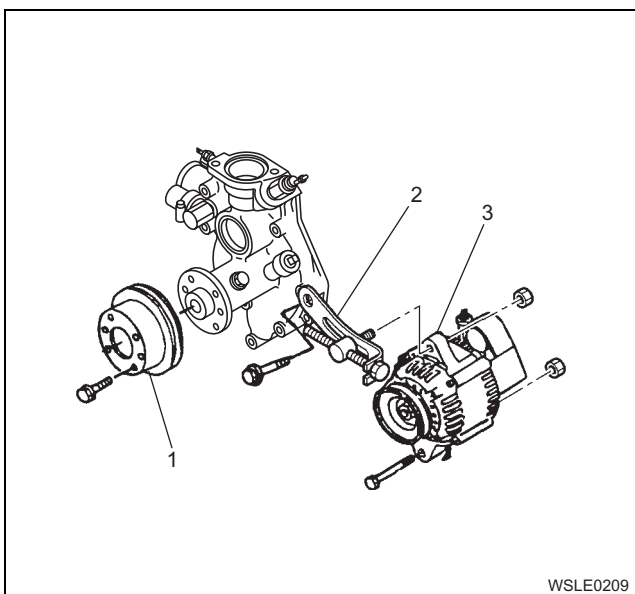
1. Remove the cooling fan.
 - Remove the bolts, and remove the cooling fan and the spacer.



Name

1. Cooling Fan
2. Spacer
3. Fan Belt

2. Loosen the mounting bolts of the generator and of the adjusting plate, loosen the belt tension, and remove the fan belt.
3. Remove the mounting bolts of the fan pulley, and remove the fan pulley from the water pump.
4. Remove the generator together with the adjusting plate.



Name

1. Fan Pulley
2. Adjusting Plate
3. Generator

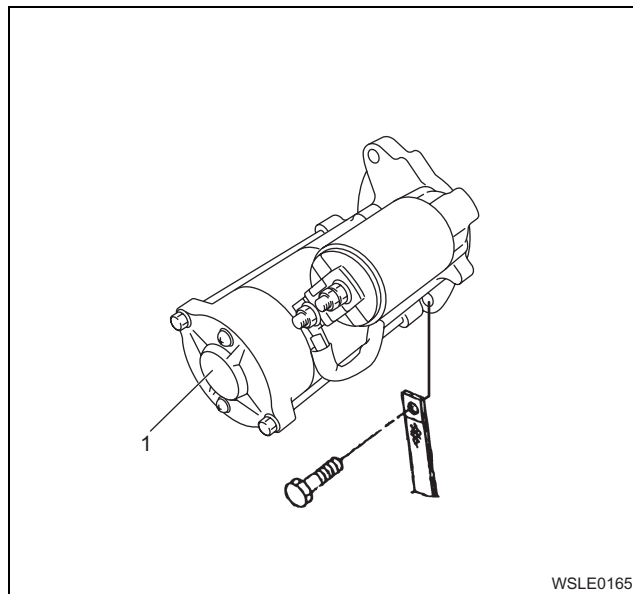
5. Remove the generator bracket.
6. Remove the starter.

Installation

1. Install the starter to the flywheel housing and tighten to the specified torque.

Tightening torque:

93.2 — 113 N·m {9.5 — 11.5 kgf·m/68.7 — 83.3 lb·ft}



Name

1. Starter

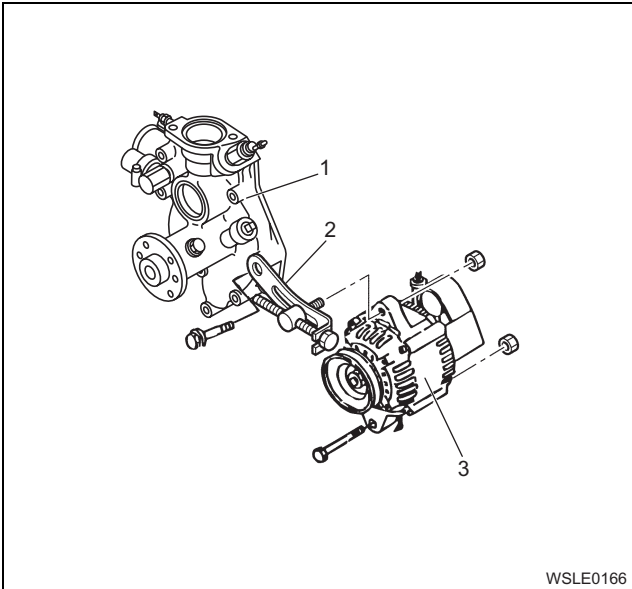
2. Install the generator bracket.

Tightening torque:

M8 bolt: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 bolt: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

3. Install the generator.
 - a. Temporarily install and tighten the adjusting plate with the water pump.
 - b. Install the lower side of the generator to the generator bracket and temporarily tighten the bolts and nuts.
 - c. Install the mounting bolt to the upper part of the generator through the adjusting plate. (Temporarily tighten)



WSLE0166

Name

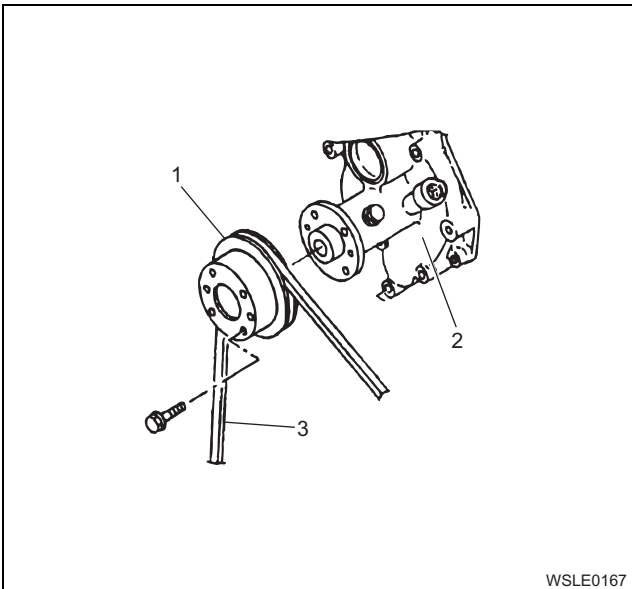
1. Water Pump
2. Adjusting Plate
3. Generator

4. Install the fan pulley to the water pump and tighten two positions.

Tightening torque:

7.8 — 11.8 N·m {0.8 — 1.2 kgf·m/5.8 — 8.7 lb·ft}

5. Install the fan belt to each pulley.



WSLE0167

Name

1. Fan Pulley
2. Water Pump
3. Fan Belt

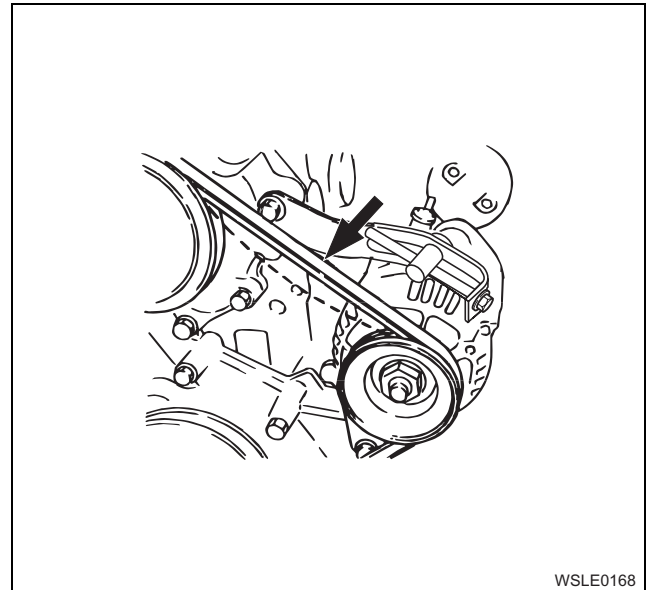
6. Adjust the tension of the fan belt.
Move the generator installation position outside, adjust the belt deflection to the specified value, and tighten the generator and the adjusting plate.

mm {in}	
Deflection (Push between the pulleys by 98 N {22 lb})	Approx. 8 — 10 {0.315 — 0.394}

Tightening torque:

M8 bolt or nut: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/
13.7 — 20.9 lb·ft}

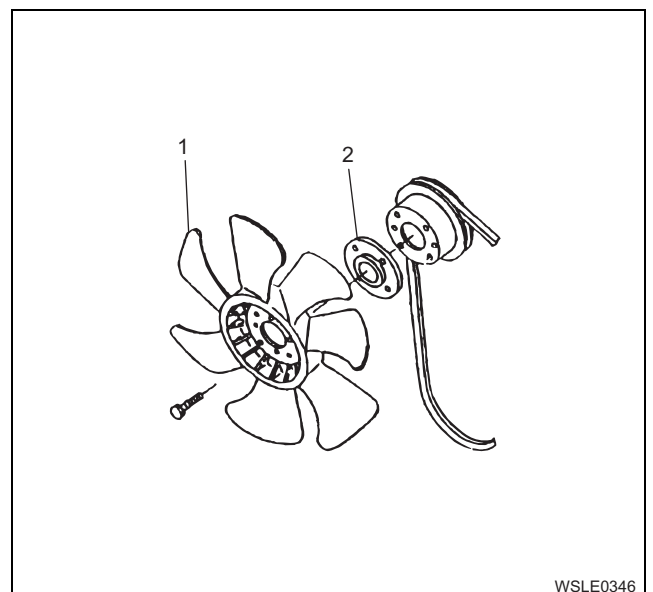
M10 bolt or nut: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/
30.4 — 40.6 lb·ft}



WSLE0168

7. Install the cooling fan.

- Assemble the spacer and install the cooling fan. Tighten this part to the torque according to the tightening torque specification table in this workshop manual. (Find the torque value {medium value — upper limit} depending on a screw size against the symbols on the bolt head.)

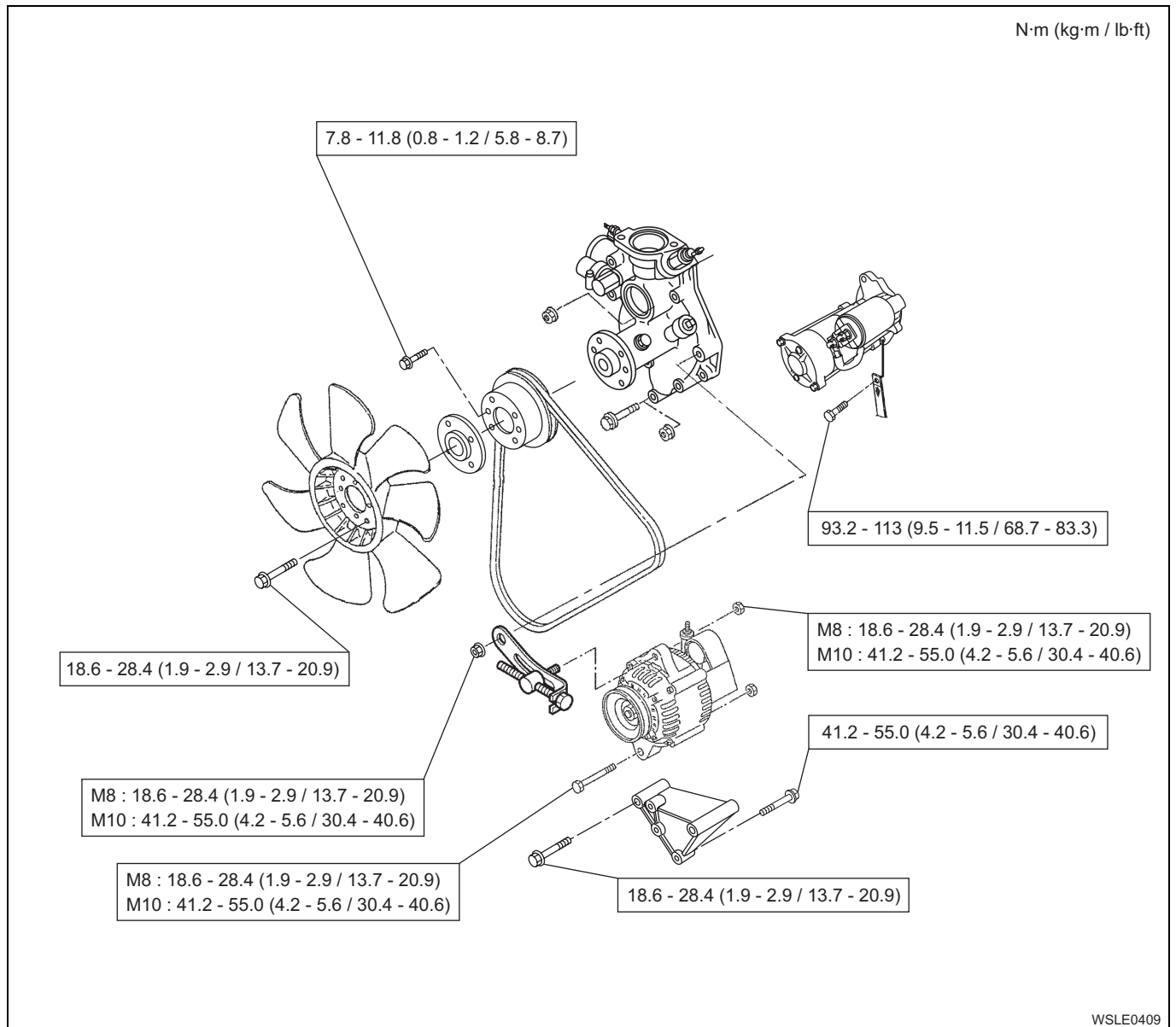


WSLE0346

Name

1. Cooling Fan
2. Spacer

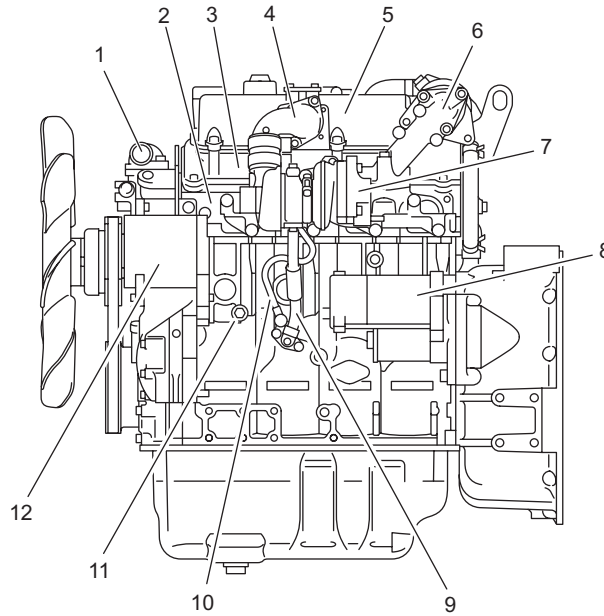
Torque Specifications



Engine Exterior Equipment

Components

4LE1T

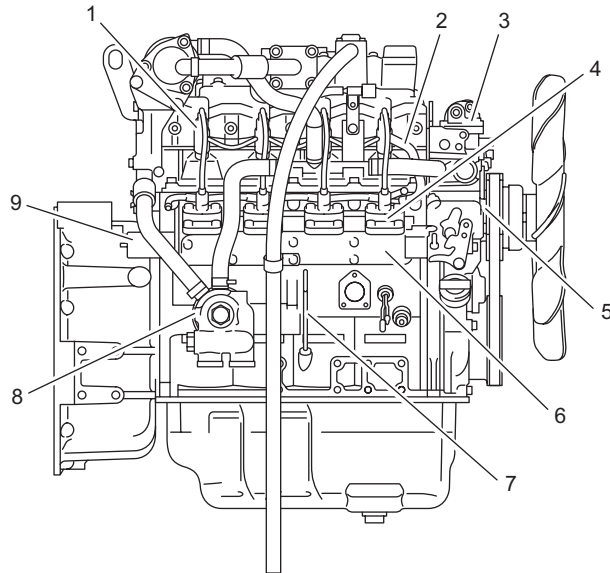


WSLE0410

Name

- | | |
|--|---------------------------------|
| 1. Water Pump Outlet Pipe (Thermostat) | 7. Turbocharger |
| 2. Exhaust Manifold | 8. Starter |
| 3. Cylinder Head Cover | 9. Turbocharger Oil Return Pipe |
| 4. Air Inlet Pipe | 10. Turbocharger Oil Feed Pipe |
| 5. Intake Chamber | 11. Water Drain Plug |
| 6. EGR Cooler Inlet Pipe | 12. Generator |

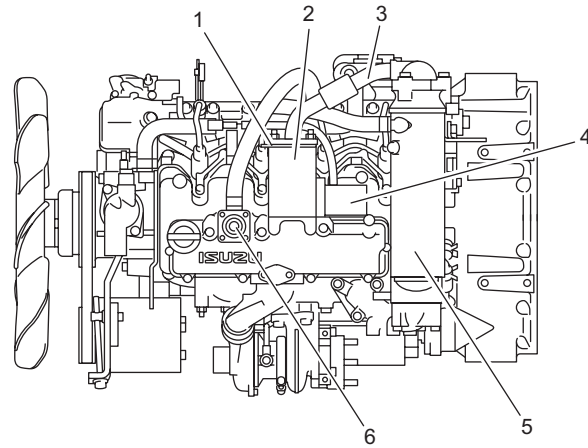
1A-18 4LE1 Engine Mechanical



WSLE0411

Name

- | | |
|-----------------------|---------------------------------|
| 1. Nozzle Holder | 6. Injection Pump Housing Cover |
| 2. Leak-off Pipe | 7. Oil Level Gauge |
| 3. Thermostat Housing | 8. Oil Cooler |
| 4. Injection Pump | 9. Solenoid ASM |
| 5. Water Pump | |
-

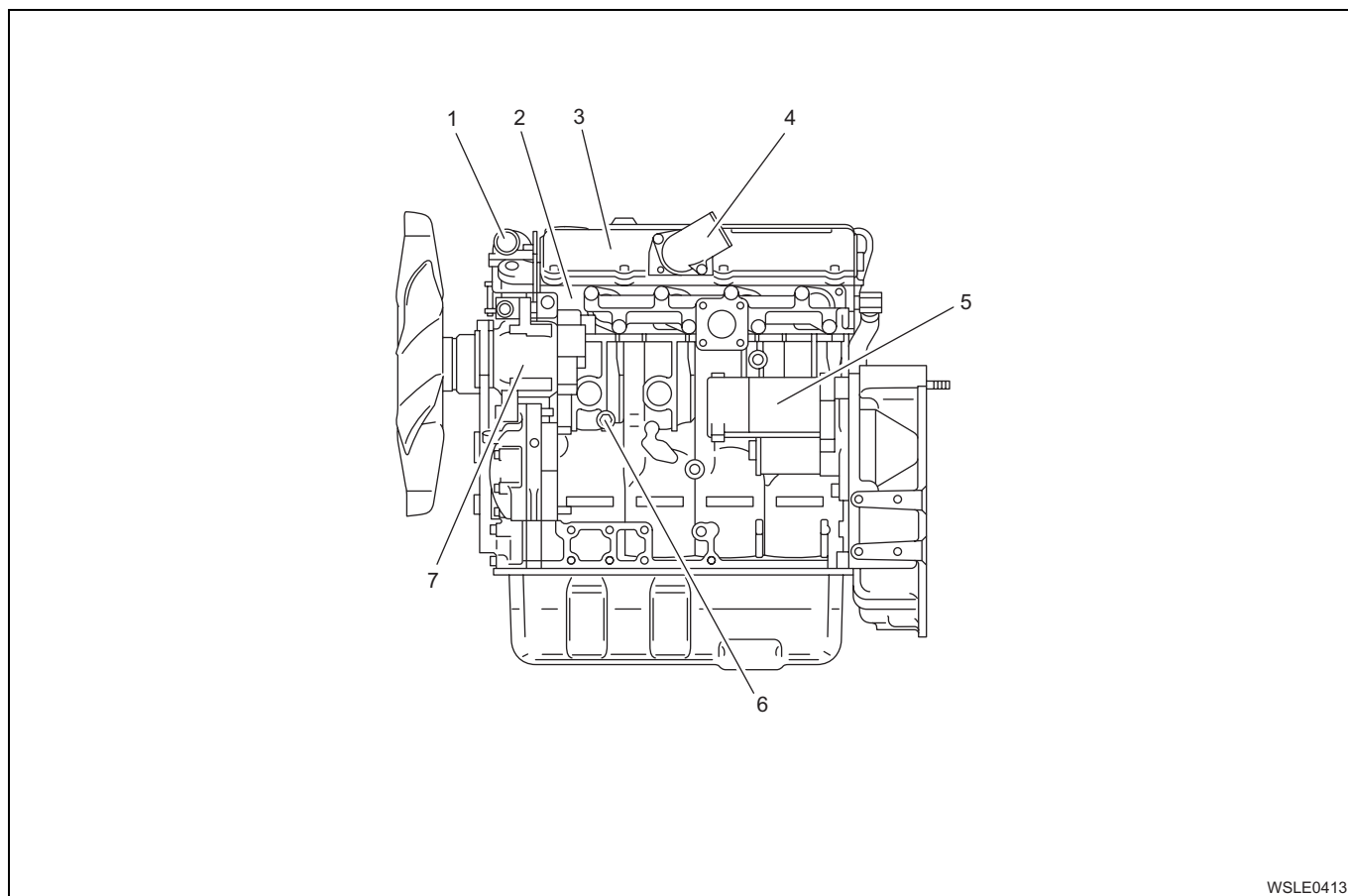


WSLE0412

Name

- | | |
|---------------------------|---------------------|
| 1. Orifice Plate | 4. EGR Cut Solenoid |
| 2. Valve Case | 5. EGR Cooler |
| 3. EGR Cooler Outlet Pipe | 6. PCV Valve |

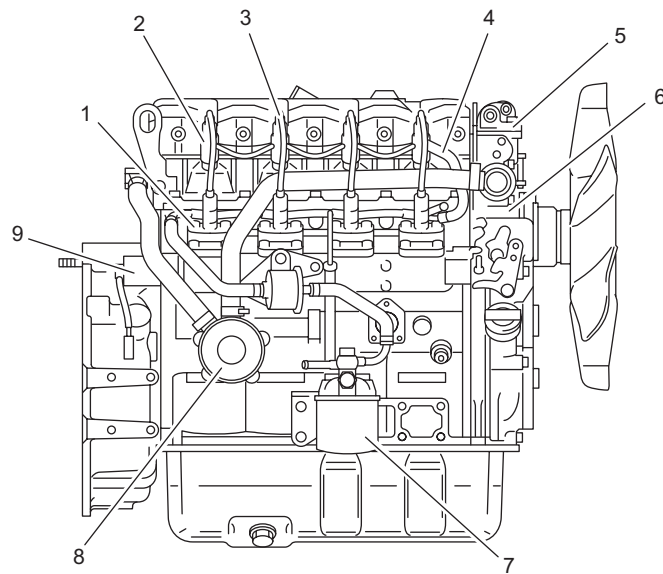
4LE1N



WSLE0413

Name

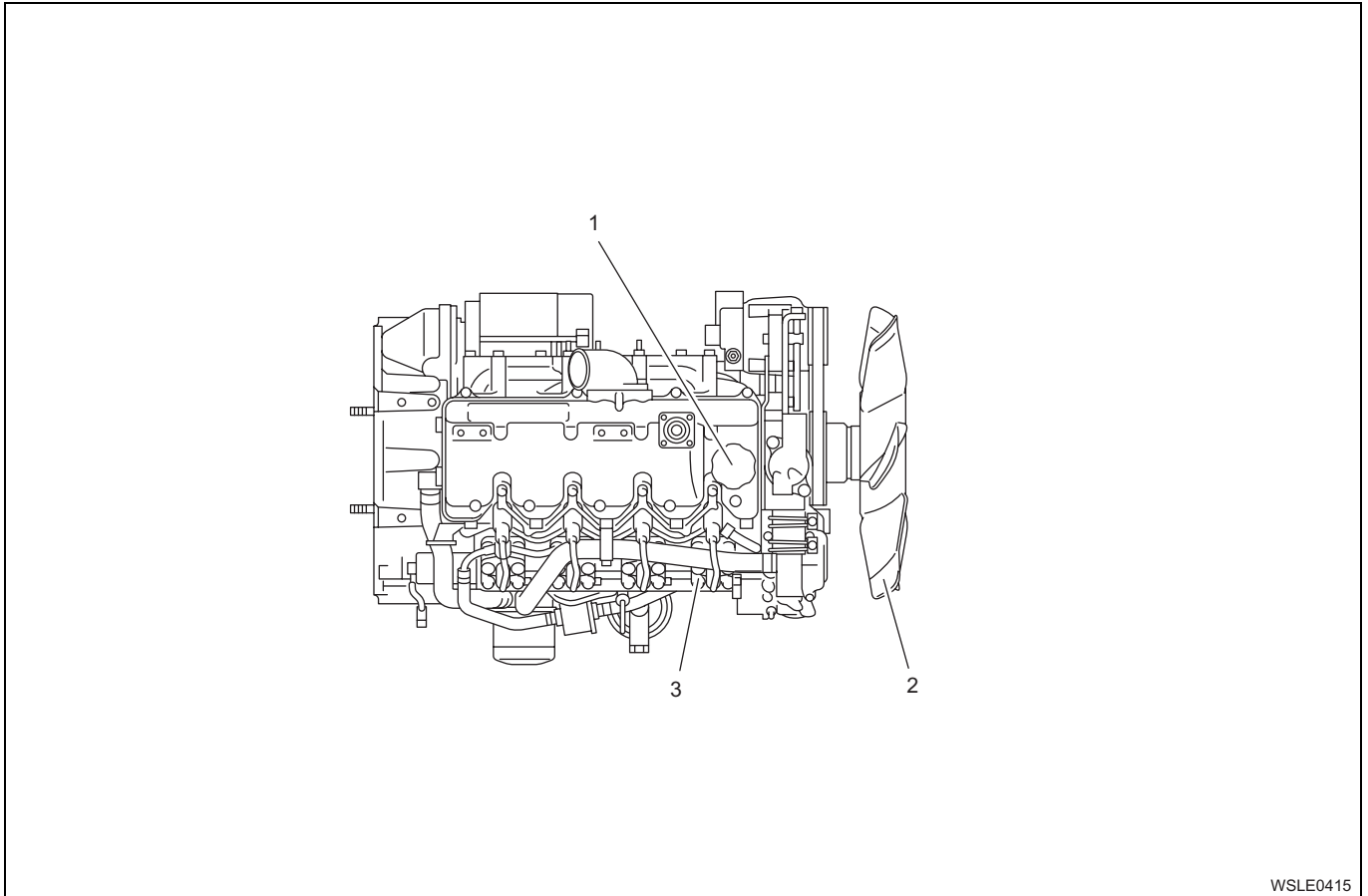
- | | |
|--|---------------------|
| 1. Water Pump Outlet Pipe (Thermostat) | 5. Starter |
| 2. Exhaust Manifold | 6. Water Drain Plug |
| 3. Cylinder Head Cover | 7. Generator |
| 4. Air Inlet Pipe | |



WSLE0414

Name

- | | |
|-----------------------|-----------------|
| 1. Injection Pump | 6. Water Pump |
| 2. Nozzle Holder | 7. Fuel Filter |
| 3. Injection Pipe | 8. Oil Filter |
| 4. Fuel Hose | 9. Solenoid ASM |
| 5. Thermostat Housing | |



WSLE0415

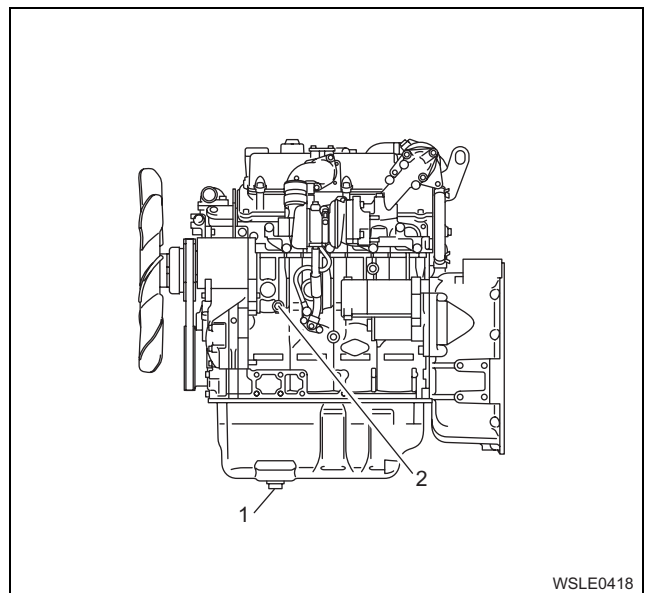
Name

- 1. Oil Filler Cap
- 2. Cooling Fan

- 3. Injection Pump

Removal

- 1. Disconnect the drain plug of the oil pan and drain the engine oil.
- 2. Loosen the water drain cock on the cylinder block to drain the coolant remaining in the engine.



WSLE0418

Name

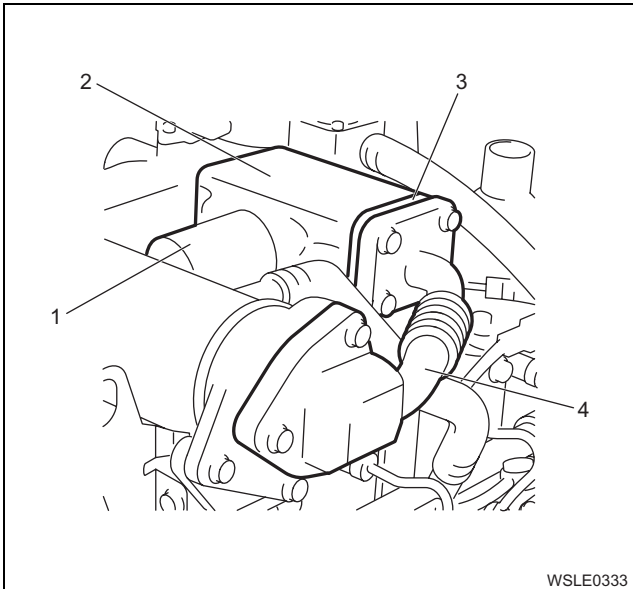
- 1. Drain Plug (Oil)
- 2. Drain Cock (Coolant)

3. Remove the EGR cooler outlet pipe.

Note:

After removing the pipe, seal so that foreign matter does not enter.

4. Remove the connector of the EGR cut solenoid, and remove the orifice plate, the valve case and the EGR cut solenoid.



Name

1. EGR Cut Solenoid
2. Valve Case
3. Orifice Plate
4. EGR Cooler Outlet Pipe

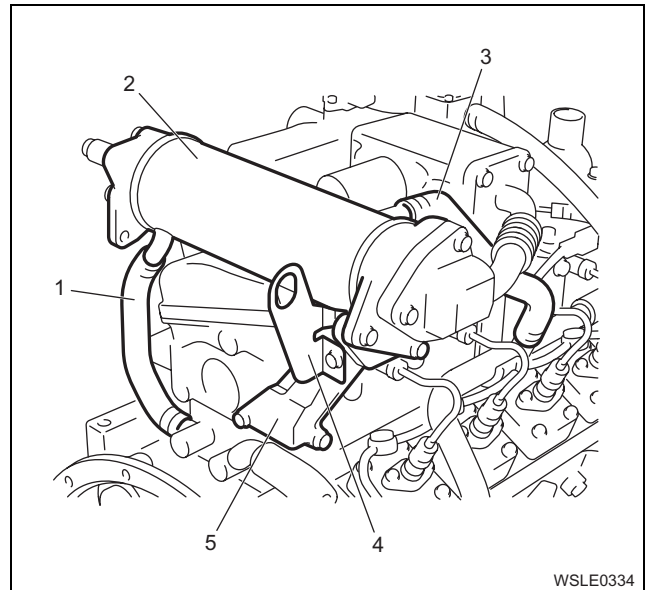
5. Remove the EGR cooler water inlet hose and the outlet hose.
6. Remove the EGR cooler.

Note:

After removing the EGR cooler, seal so that foreign matter does not enter.

7. Remove the EGR cooler bracket from the cylinder head.

8. Remove the rear hanger from the EGR cooler bracket.



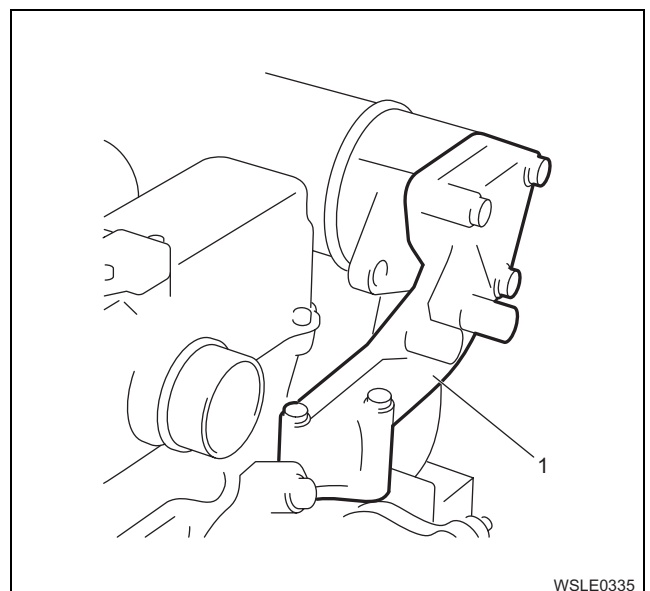
Name

1. EGR Cooler Water Inlet Hose
2. EGR Cooler
3. EGR Cooler Water Outlet Hose
4. Rear Hanger
5. EGR Cooler Bracket

9. Remove the EGR cooler inlet pipe.

Note:

After removing the pipe, seal so that foreign matter does not enter.



Name

1. EGR Cooler Inlet Pipe

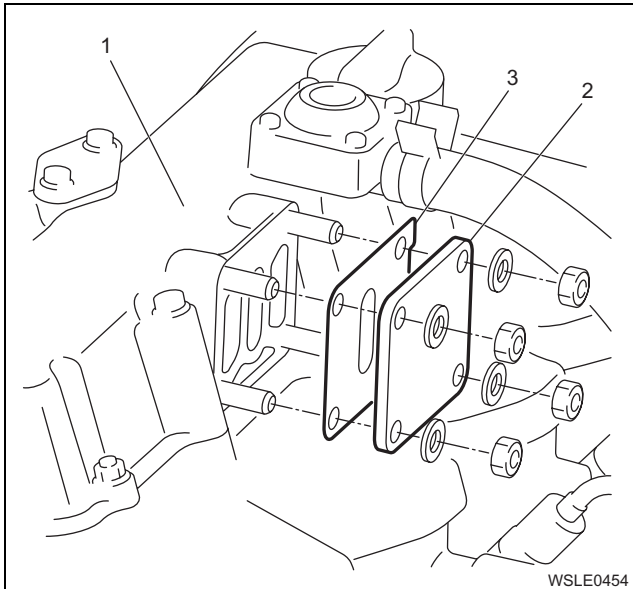
10. Remove the PCV valve from the intake chamber.
11. Loosen the rubber hose and remove the rubber hose and the air inlet pipe from the intake chamber.

1A-24 4LE1 Engine Mechanical

12. Remove the intake chamber from the cylinder head.

Note:

The model without EGR valve and the EGR cooler has a cover installed with the intake chamber. After removing the cover, seal the hole so that foreign matter does not enter.

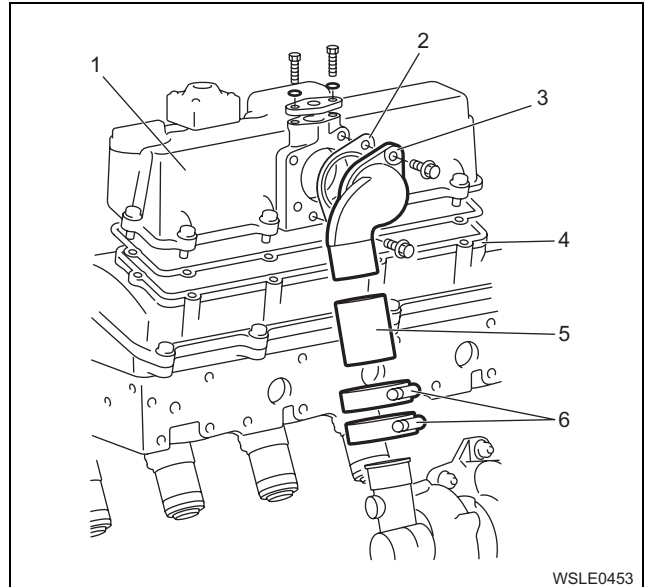


Name

1. Intake Chamber
2. Cover
3. Gasket

13. Remove the mounting bolts (M6×1.0, 15 bolts) of the head cover, and remove the head cover together with the gasket from the cylinder head.

- Remove the baffle plate from the cylinder head cover.



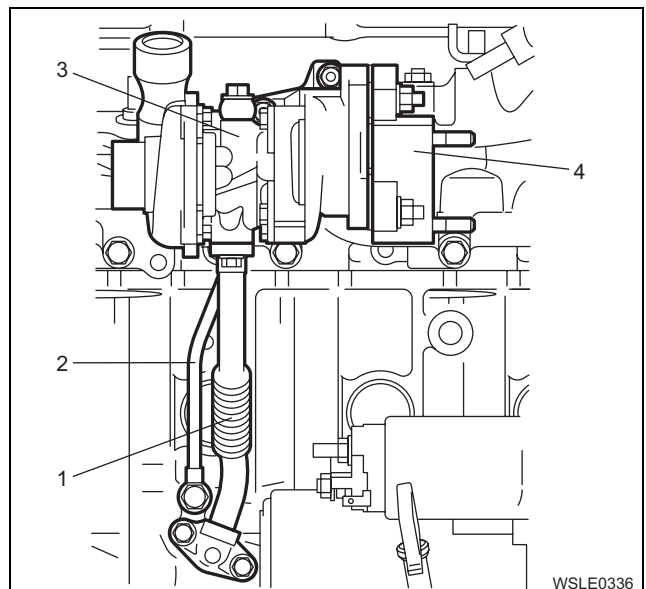
Name

1. Intake Chamber
2. Gasket
3. Air Inlet Pipe
4. Cylinder Head Cover
5. Rubber Hose
6. Rubber Hose Clip

14. Remove the turbocharger oil feed pipe and the return pipe.

15. Remove the exhaust adapter from the turbocharger.

16. Remove the turbocharger ASM from the exhaust manifold.



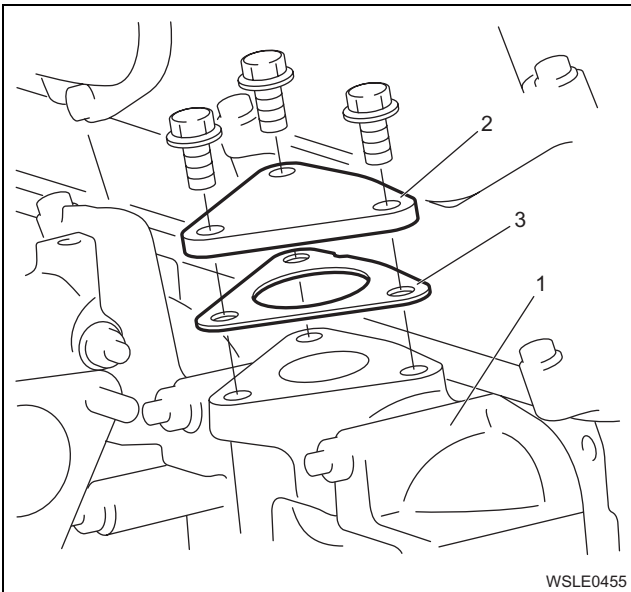
Name

1. Turbocharger Oil Return Pipe
2. Turbocharger Oil Feed Pipe
3. Turbocharger
4. Exhaust Adapter

17. Remove the mounting bolts and nuts of the exhaust manifold, and remove the manifold and the gaskets.

Note:

The model without EGR valve and the EGR cooler has a cover installed with the exhaust manifold. After removing the cover, seal the hole so that foreign matter does not enter.

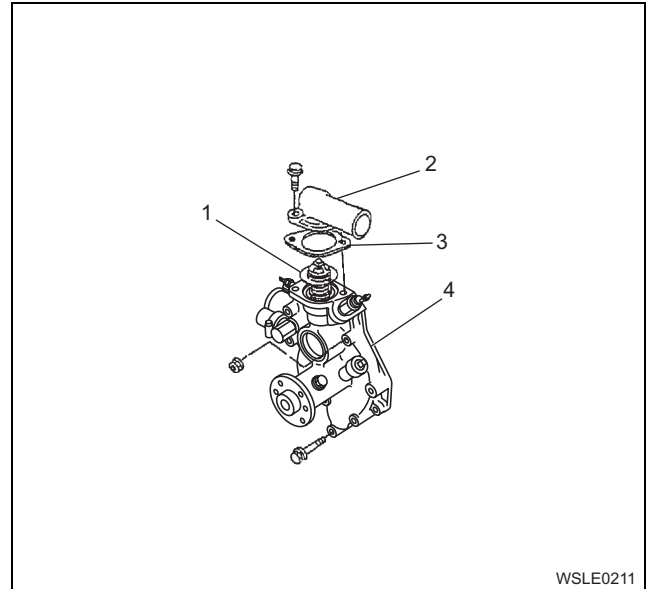
**Name**

1. Exhaust Manifold
2. Cover
3. Gasket

18. Disconnect the water outlet pipe and pull out the thermostat.
19. Remove the water pump from the cylinder head and the cylinder block. (M8: 5 bolts, 2 nuts)

Note:

The water pump is installed to both the cylinder head and the cylinder block.

**Name**

1. Thermostat
2. Water Outlet Pipe
3. Packing
4. Water Pump

20. Loosen the sleeve nuts on the nozzle holder side and on the injection pump side and remove the injection pipe.

Important:

If over-tightening the delivery valve holder, the rack cannot move smoothly as the plunger and the housing are compressed. Therefore, when loosening the sleeve nuts of the injection pipe, hold the delivery valve holder with a wrench to prevent corotation.

CAUTION:

Always put a cap to prevent dust from getting in the delivery valve holder and the nozzle holder.

21. Disconnect the leak-off pipe and remove the packing.

CAUTION:

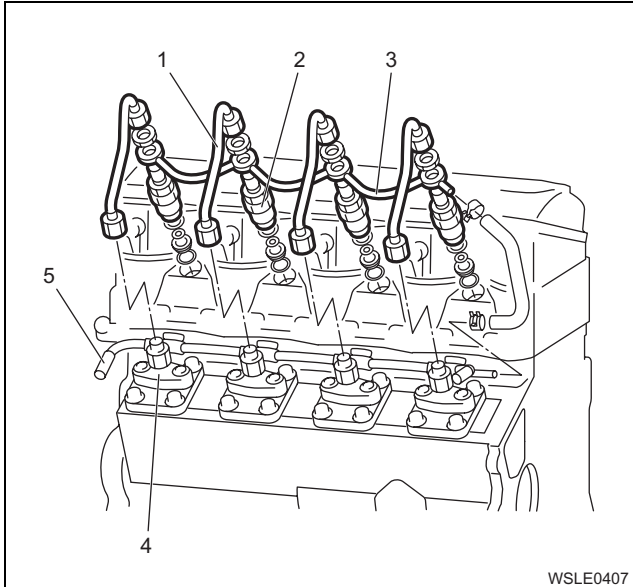
Always put a cap to prevent dust from getting in the delivery valve holder and the nozzle holder.

1A-26 4LE1 Engine Mechanical

22. Remove the eyebolt and disconnect the fuel pipe.

CAUTION:

Always put a cap to prevent dust from getting in the delivery valve holder and the nozzle holder.



WSLE0407

Name

1. Injection Pipe
2. Nozzle Holder
3. Leak-off Pipe
4. Injection Pump
5. Fuel Pipe

23. Remove the solenoid ASM inserted in the back of the injection pump installation part of the cylinder block.

Note:

Take care when removing it since liquid gasket is used.

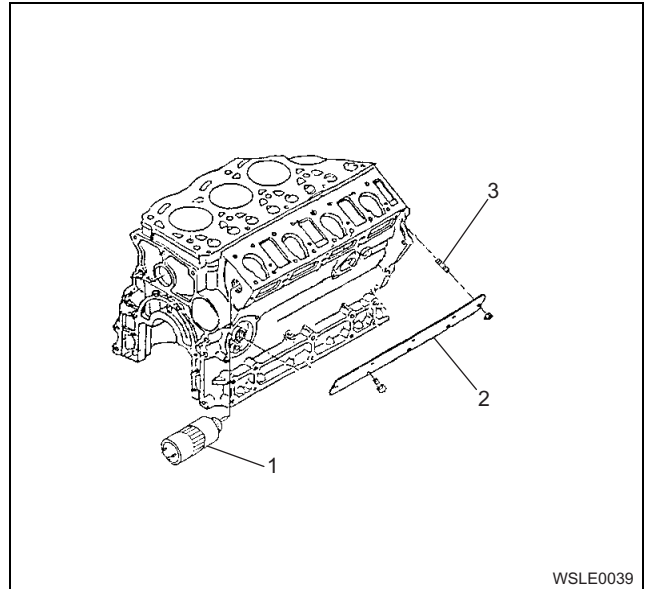
24. Remove the housing cover of the injection pump installation part.

Since the liquid gasket is applied to the mating surface of the cylinder body, insert a bolt to the hole for M8 × 1.25 thread on the cover to remove the housing cover.

Do not extract the two stud bolts since the sealant is attached to them.

Note:

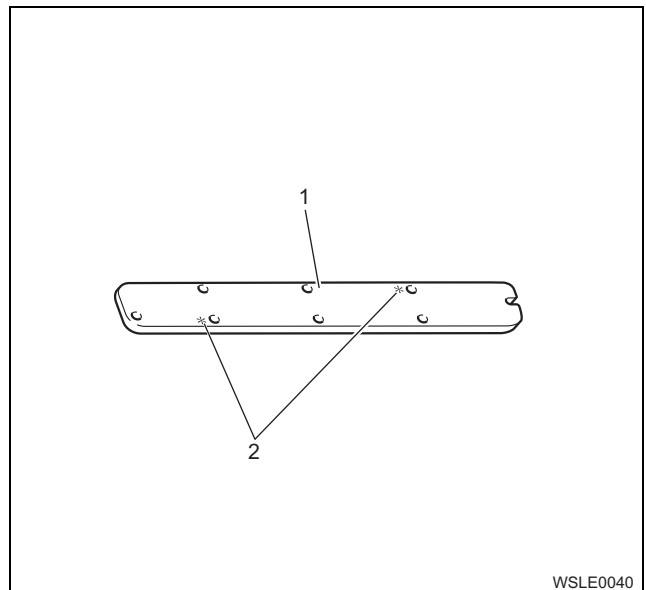
Take care when removing it since liquid gasket is used.



WSLE0039

Name

1. Solenoid ASM
2. Housing Cover
3. Stud Bolt



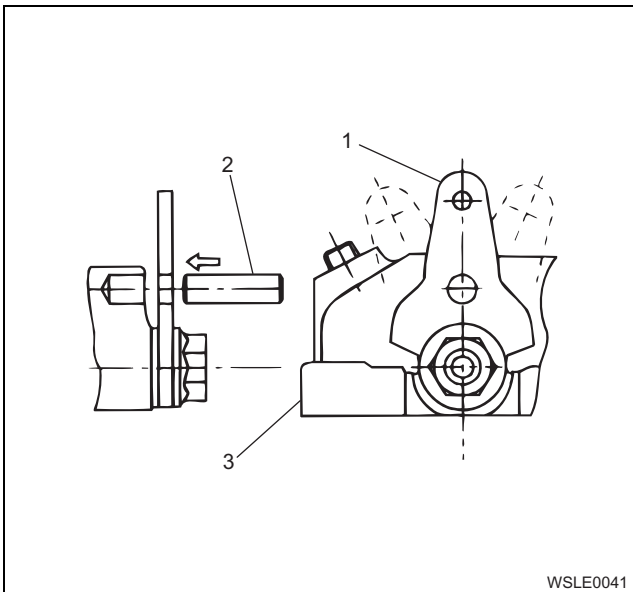
WSLE0040

Name

1. Housing Cover
2. M8 × 1.25 for Replacer

25. Remove the injection pump.

- a. Align the hole of the fuel cut lever with the hole of the governor cover, and then insert a pin ($\phi 6$ mm {0.236 in}) to the hole to hold the fuel cut lever.



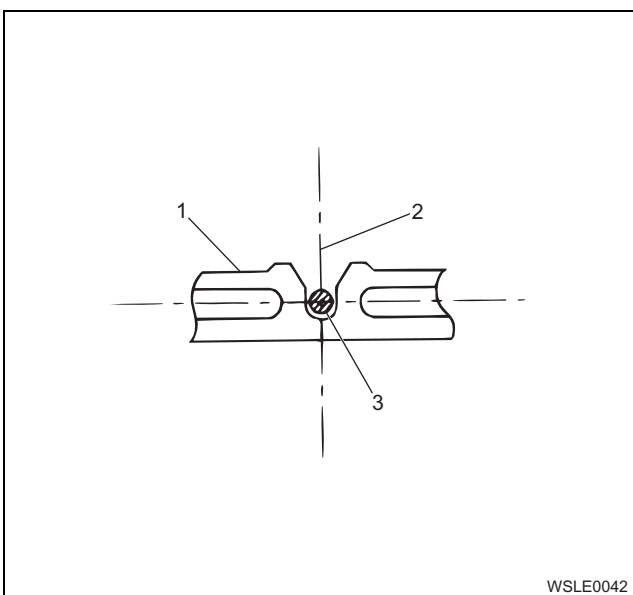
Name

1. Fuel Cut Lever
2. Pin ($\phi 6$ mm {0.236 in})
3. Governor Cover

- b. Make sure that the pin groove of the control link is aligned with the center of the injection pump.

CAUTION:

If the pin groove of the control link is not aligned with the center of the injection pump, you may not remove the injection pump because the rack pin of the injection pump is stuck to the cylinder block.



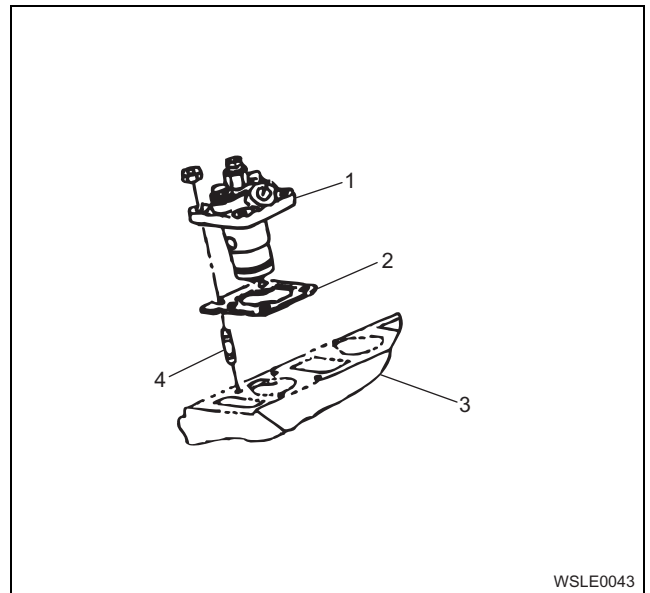
Name

1. Control Link
2. Center Position of Injection Pump
3. Rack Pin of Injection Pump

- c. Remove the injection pump, and remove the shim inserted in the pump installation part.

CAUTION:

- Put the removed shim and the injection pump together, attach a tag with cylinder number, and check the thickness. The removed shim cannot be reused.
- Do not extract the eight studs since the sealant is attached to them.



Name

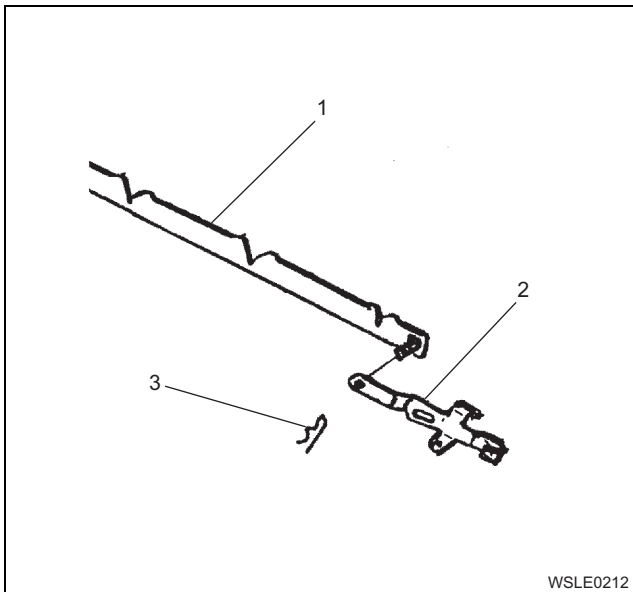
1. Injection Pump ASM
2. Shim
3. Cylinder Block
4. Stud

1A-28 4LE1 Engine Mechanical

26. Remove the control link.
Pull out the snap pin on the connecting part to the link plate of the governor assembled in the timing gear case.

Note:

Take care not to lose the snap pin.

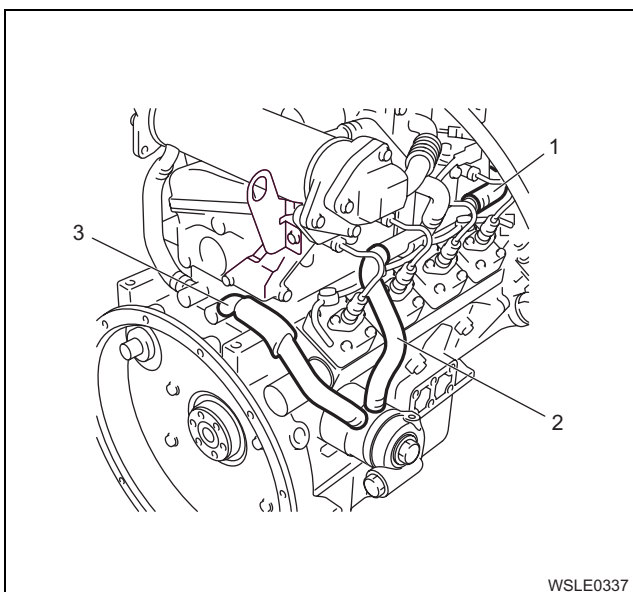


Name

1. Control Link
2. Link Plate (Governor)
3. Snap Pin

27. Disconnect the oil cooler water outlet hose and the inlet hose.

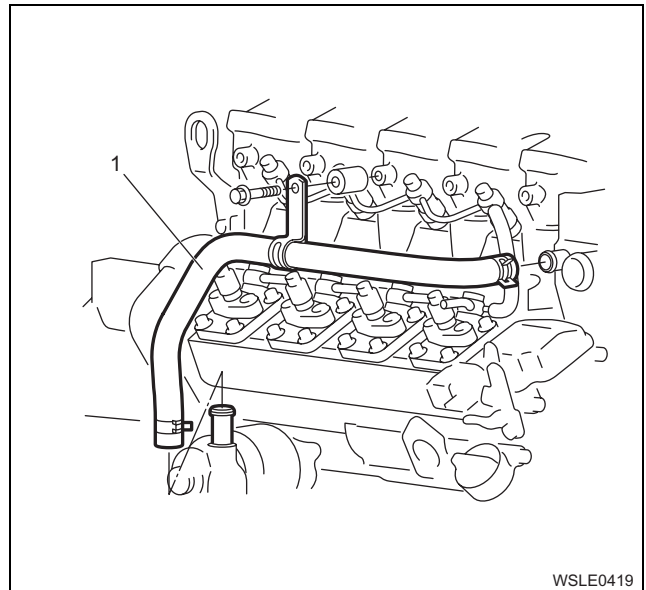
28. Disconnect the water hose (between water pipe and water pump).



Name

1. Water Hose
2. Oil Cooler Water Outlet Hose
3. Oil Cooler Water Inlet Hose

29. Remove the water pipe from the rocker arm bracket.

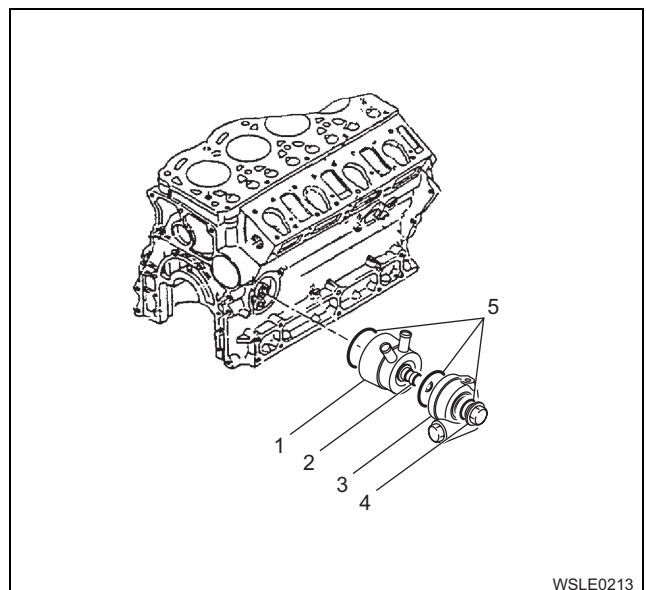


Name

1. Water Pipe

30. Remove the plug, and remove the oil cooler cover from the oil cooler.

31. Remove the center bolt, and remove the oil cooler ASM from the cylinder block.



Name

1. Oil Cooler ASM
2. Center Bolt
3. Oil Cooler Cover
4. Plug
5. Packing

32. Pull out the oil level gauge.

Installation

1. Insert the oil level gauge.
2. Install the oil cooler ASM to the cylinder block.
 - Install the packing to the oil cooler ASM and the center bolt.

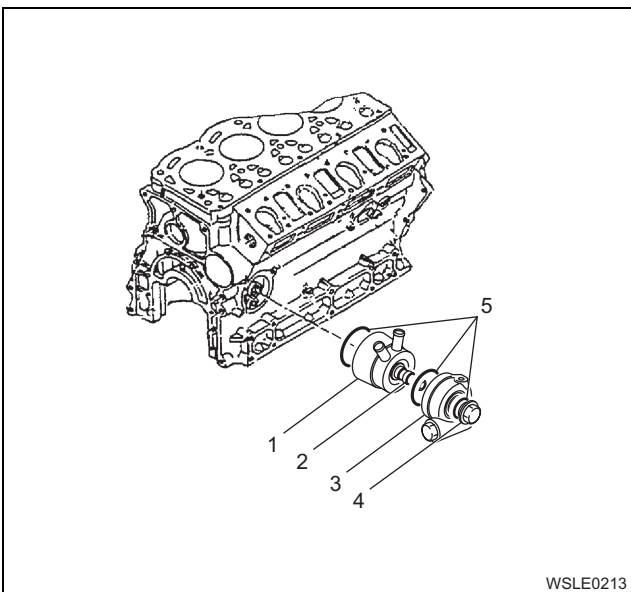
Tightening torque:

Center bolt: 24.5 — 34.3 N·m {2.5 — 3.5 kgf·m/
18.1 — 25.3 lb·ft}

3. Install the oil cooler cover to the oil cooler.
 - Install the O-ring to the oil cooler cover.

Tightening torque:

24.5 — 34.3 N·m {2.5 — 3.5 kgf·m/18.1 — 25.3
lb·ft}



WSLE0213

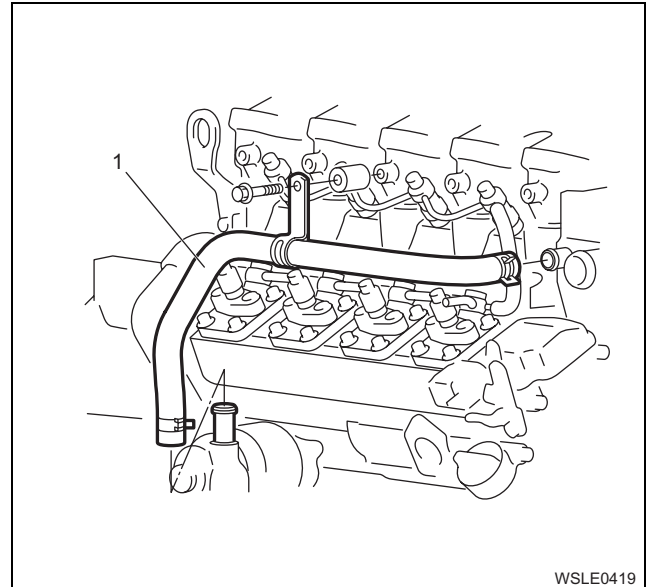
Name

1. Oil Cooler ASM
2. Center Bolt
3. Oil Cooler Cover
4. Plug
5. Packing

4. Install the water pipe to the rocker arm bracket.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9
lb·ft}

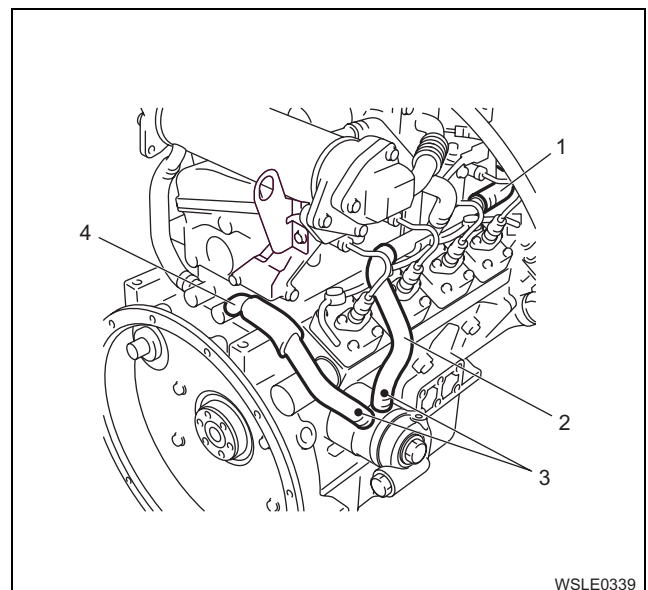


WSLE0419

Name

1. Water Pipe

5. Install the water hose (between water pipe and water pump).
6. Install the oil cooler water outlet hose and the inlet hose with a white paint applied area in the oil cooler side.

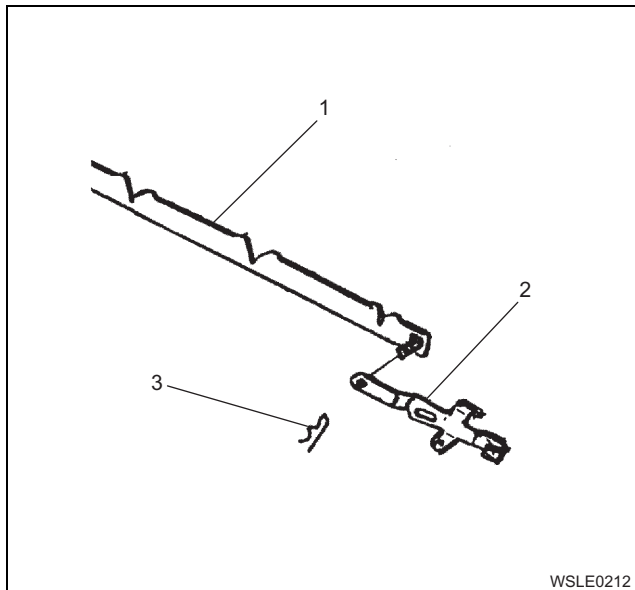


WSLE0339

Name

1. Water Hose
2. Oil Cooler Water Outlet Hose
3. White Paint Applied Area
4. Oil Cooler Water Inlet Hose

7. Install the control link.
 - a. Insert the control link from the back to the connecting hole of the injection pump of the cylinder block, align it with the guide pin in the connecting hole and assemble.
 - b. Assemble the pin part of the control link to the link plate hole of the governor assembled in the timing gear case, and fix it with the snap pin.



Name

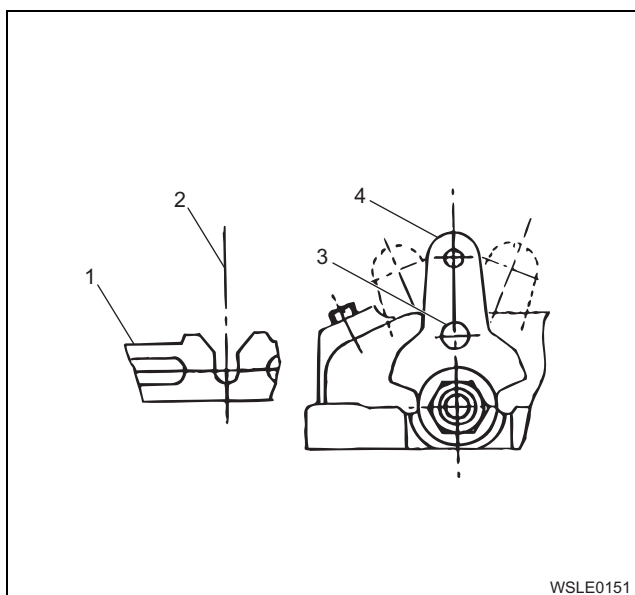
1. Control Link
2. Link Plate (Governor)
3. Snap Pin

8. Install the injection pump.

- a. Align the hole of the fuel cut lever with the hole of the governor cover, insert a pin ($\phi 6$ mm {0.236 in}) to the hole and get the lever upright. (Control link is positioned on the center.)

CAUTION:

If the control link is not positioned on the center, you may fold the link when installing the injection pump.



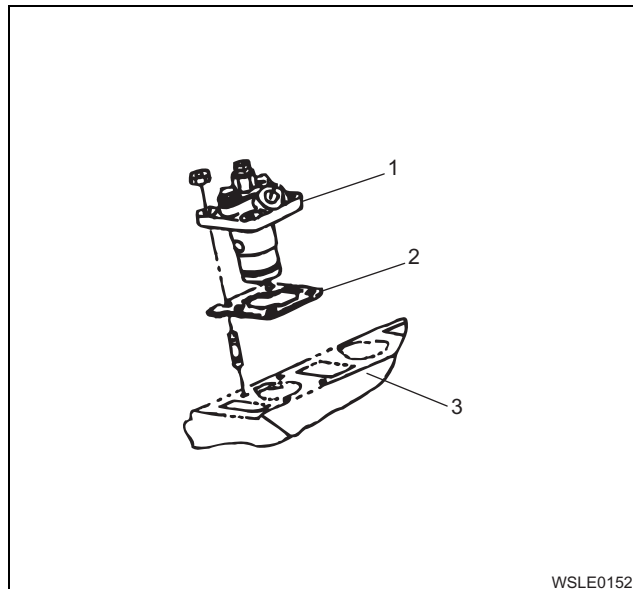
Name

1. Control Link
2. Center Position of Injection Pump
3. Pin ($\phi 6$ mm {0.236 in})
4. Fuel Cut Lever

- b. Align the shim with each stud and the knock pin, check the thickness of the shim and install it. (Shim thickness; Refer to 1A-4, "Function Check, ISUZU Diesel Engine")

CAUTION:

Install a new shim whose thickness is the same as one being removed when disassembling.



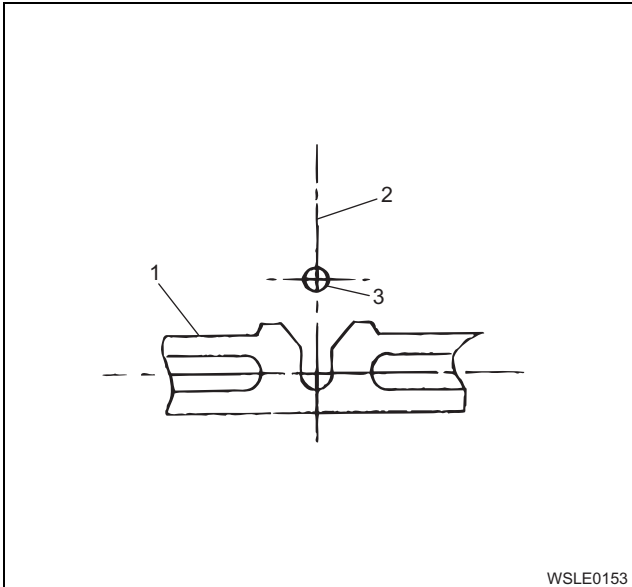
Name

1. Injection Pump ASM
2. Shim
3. Cylinder Block

- c. Align the rack pin of the injection pump with the center position of the pump.
- d. Insert the injection pump along with the two studs, align the knock hole with the knock pin of the cylinder block, and assemble them.
- e. Make sure that the rack pin and the groove of the control link are aligned from the housing cover installation part of the cylinder block side, and tighten the injection pump.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}



WSLE0153

Name

1. Control Link
2. Center Position of Injection Pump
3. Rack Pin

f. Remove the pin ($\phi 6$ mm {0.236 in}) inserted into the fuel cut lever, and make sure that the fuel cut lever moves smoothly.

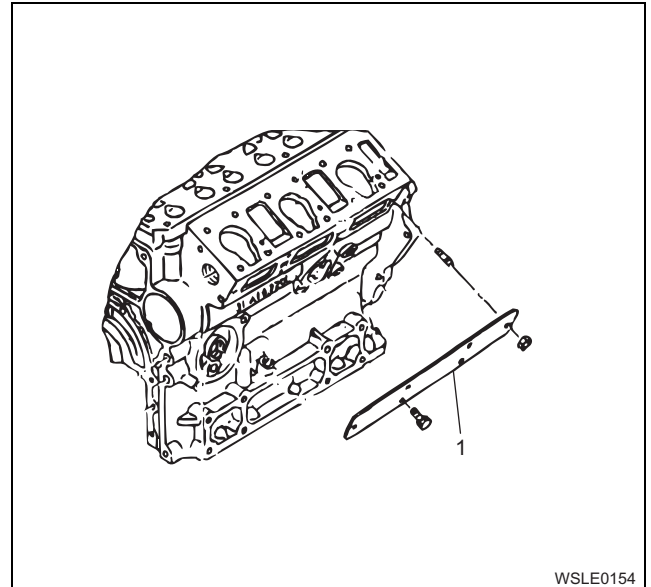
9. Install the injection pump housing cover.
Apply the liquid gasket (TB1207C) to the housing cover and install it to the cylinder block on the injection pump side.

Tightening torque:

7.8 — 11.8 N·m {0.8 — 1.2 kgf·m/5.8 — 8.7 lb·ft}

Note:

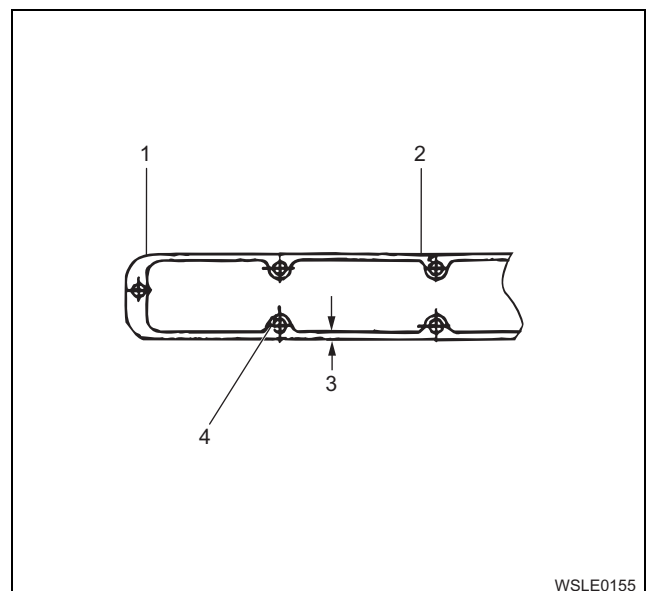
- Remove the sealant attached to the housing cover installation part of the cylinder block with a packing scraper completely and degrease sufficiently.
- Apply approx. 4 mm {0.157 in} width of liquid gasket to the cover edge and approx. 2 mm {0.079 in} width of liquid gasket to the circumference of the bolt in the housing cover.



WSLE0154

Name

1. Housing Cover



WSLE0155

Name

1. Housing Cover
2. Liquid Gasket Applied Area
3. Approx. 4 mm {0.157 in} width of the cover edge
4. Approx. 2 mm {0.079 in} of the circumference of the bolt

10. Install the solenoid ASM.

- a. Apply liquid gasket (TB1207C) to the installation surface (bit groove) of the solenoid for the engine stopping.

Note:

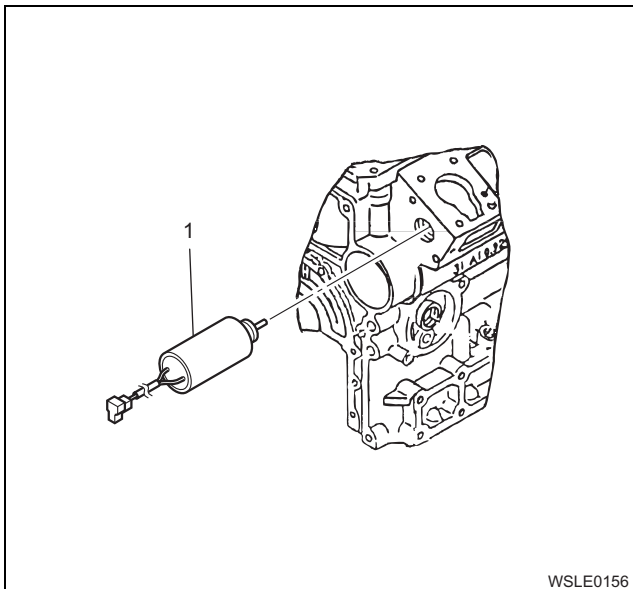
- Remove the sealant attached to the installation part of the solenoid and of the cylinder block with a packing scraper completely and degrease.
- Do not apply the liquid packing to the thread portion.

1A-32 4LE1 Engine Mechanical

- b. Insert the solenoid ASM from the back of the cylinder block (back of the No.4 injection pump rack) and tighten to the specified torque.

Tightening torque:

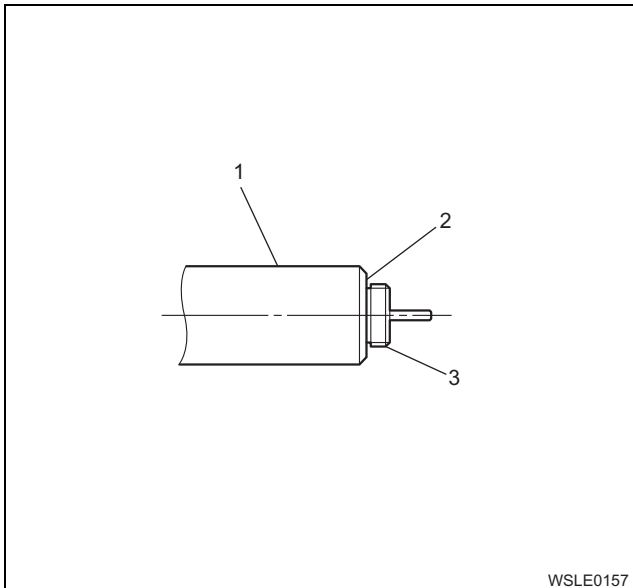
14.7 — 24.5 N·m {1.5 — 2.5 kgf·m/10.8 — 18.1 lb·ft}



WSLE0156

Name

1. Solenoid ASM



WSLE0157

Name

1. Solenoid ASM
2. Installation Surface (Liquid Gasket Applied Area)
3. Thread Portion (Do not apply the liquid gasket.)

11. Install the fuel pipe to the injection pump and tighten to the specified torque.

Tightening torque:

19.6 — 24.5 N·m {2.0 — 2.5 kgf·m/14.5 — 18.1 lb·ft}

12. Install the leak-off pipe to the nozzle holder and tighten to the specified torque.

CAUTION:

Hold the pipe by your hand to prevent it from rotating when tightening.

Tightening torque:

24.5 — 34.3 N·m {2.5 — 3.5 kgf·m/18.1 — 25.3 lb·ft}

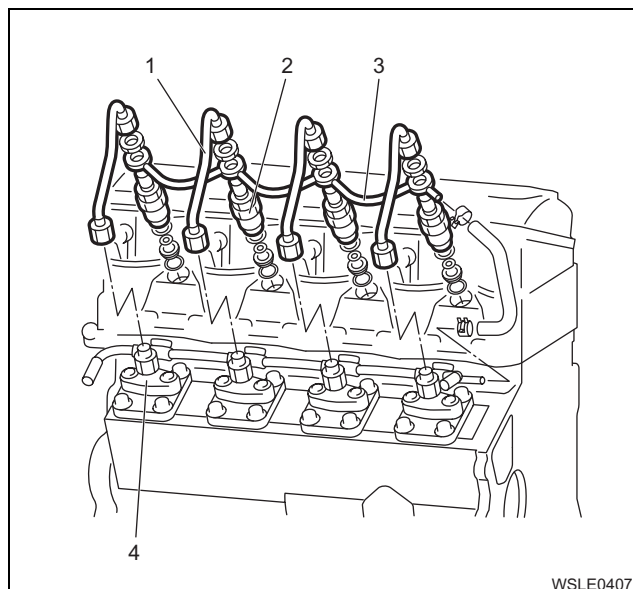
13. Connect the fuel pipe and the leak-off pipe with the fuel hose and fix it with a clip.
14. Install the injection pipe to the injection pump and the nozzle holder, and tighten it with the sleeve nut.
- a. Screw the thread portion of the sleeve nut two or three turns by your hand.
- b. Hold the delivery valve holder of the injection pump with a wrench and tighten the sleeve nut securely.

Tightening torque:

14.7 — 24.5 N·m {1.5 — 2.5 kgf·m/10.8 — 18.1 lb·ft}

Important:

If over-tightening the delivery valve holder, the rack cannot move smoothly as the plunger and the housing are compressed. Therefore, when tightening the sleeve nuts of the injection pipe, hold the delivery valve holder with a wrench to prevent corotation.



WSLE0407

Name

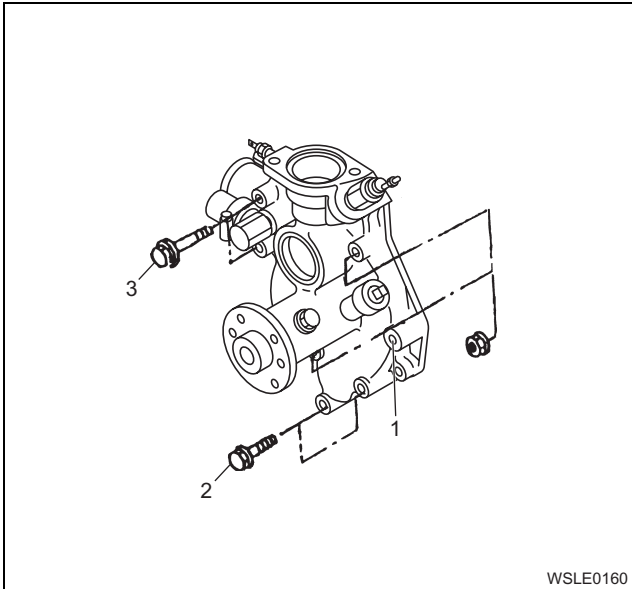
1. Injection Pipe
2. Nozzle Holder
3. Leak-off Pipe
4. Injection Pump

15. Install the water pump ASM.

- Install the water pump ASM and the gasket to the cylinder block and the cylinder head, and tighten it to the specified torque.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

**Name**

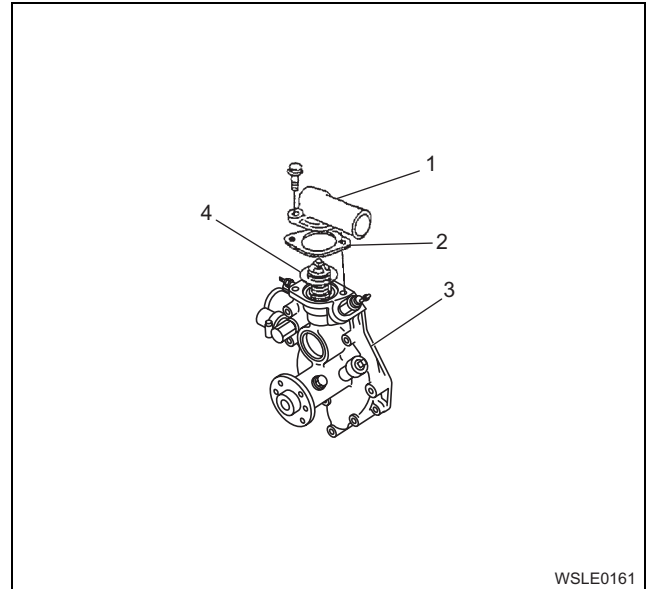
1. Tighten adjusting plate together.
2. Bolt: L = 40
3. Bolt: L = 60

16. Connect the water outlet pipe.

- Assemble the thermostat, install the packing and the water outlet pipe, and tighten it to the specified torque.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

**Name**

1. Water Outlet Pipe
2. Packing
3. Water Pump
4. Thermostat

17. Install the exhaust manifold to the cylinder head.

- Insert the gasket and tighten to the specified torque.

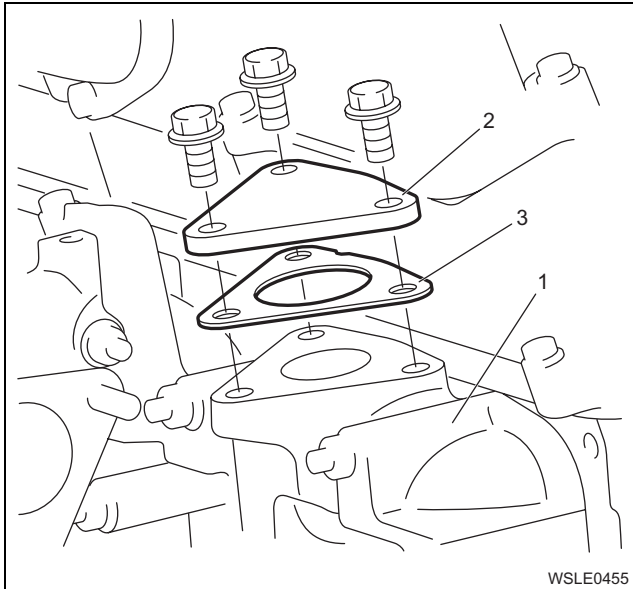
Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

- When removing the exhaust manifold cover, insert the gasket and tighten to the specified torque.

Tightening torque:

21.6 — 31.4 N·m {2.2 — 2.3 kgf·m/15.9 — 23.2 lb·ft}

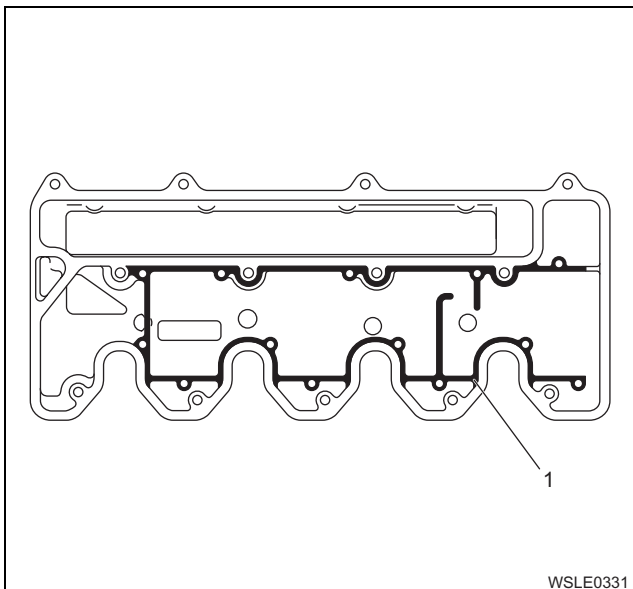


Name

1. Exhaust Manifold
2. Cover
3. Gasket

18. Install the cylinder head cover.

- a. Apply the liquid gasket (TB1207B) to the position in the cylinder head cover shown in the figure, and install the baffle plate to the cylinder head cover.



Name

1. Liquid Gasket Applied Area

- b. Install the gasket to the cylinder head cover.

Note:

Take care not to slide or distort the gasket when installing.

- c. Install the cylinder head cover to the rocker arm bracket and tighten it to the specified torque.

Tightening torque:

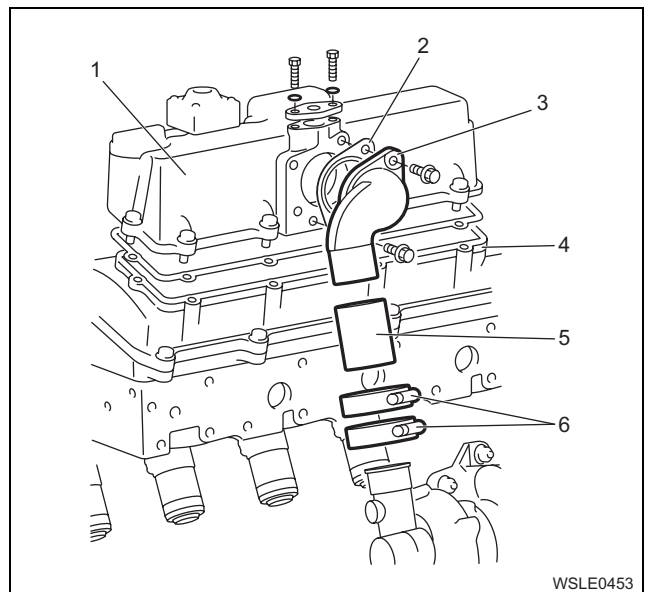
7.8 — 11.8 N·m {0.8 — 1.2 kgf-m/5.8 — 8.7 lb-ft}

19. Install the intake chamber to the cylinder head cover.

- Insert the gasket and tighten to the specified torque.

Tightening torque:

7.8 — 11.8 N·m {0.8 — 1.2 kgf-m/5.8 — 8.7 lb-ft}



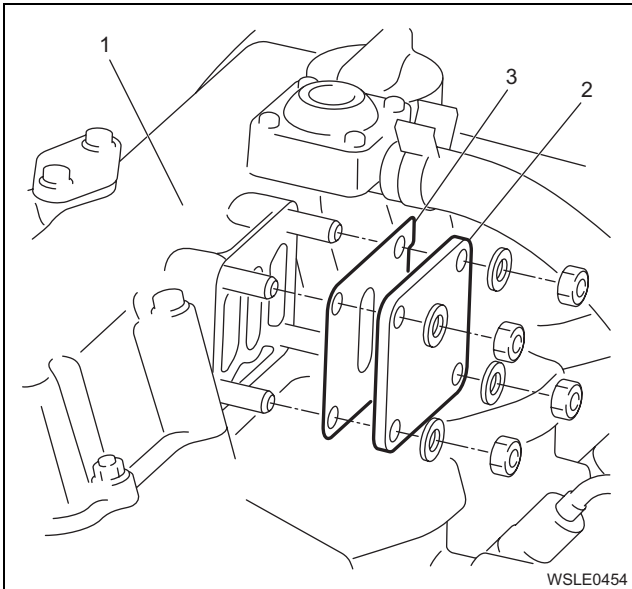
Name

1. Intake Chamber
2. Gasket
3. Air Inlet Pipe
4. Cylinder Head Cover
5. Rubber Hose
6. Rubber Hose Clip

- When removing the intake chamber cover, insert the gasket and tighten to the specified torque.

Tightening torque:

21.6 — 31.4 N·m {2.2 — 2.3 kgf·m/15.9 — 23.2 lb·ft}

**Name**

- Intake Chamber
- Cover
- Gasket

- Install the PCV valve.
- Install the turbocharger ASM to the exhaust manifold.
 - Insert the gasket and tighten to the specified torque.

Tightening torque:

21.6 — 31.4 N·m {2.2 — 3.2 kgf·m/15.9 — 23.2 lb·ft}

- Install the exhaust adapter to the turbocharger.
 - Insert the gasket and tighten to the specified torque.

Tightening torque:

21.6 — 31.4 N·m {2.2 — 3.2 kgf·m/15.9 — 23.2 lb·ft}

- Install the turbocharger oil feed pipe.

Tightening torque:

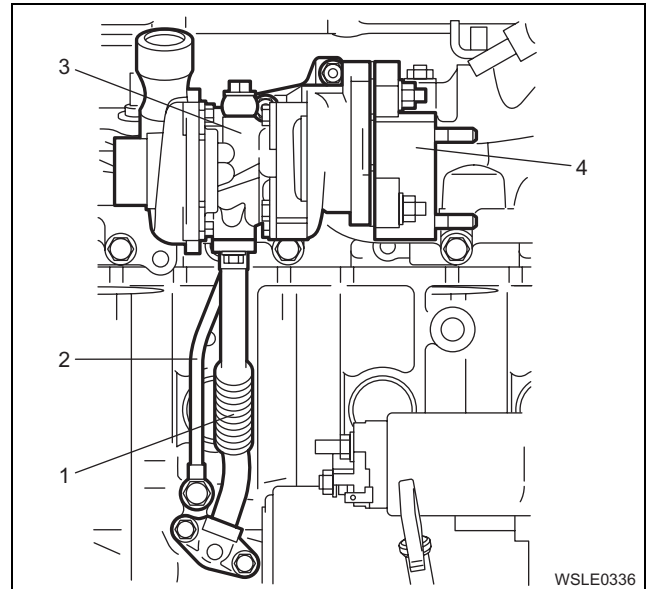
Turbocharger side: 9.8 — 14.7 N·m {1.0 — 1.5 kgf·m/7.2 — 10.8 lb·ft}

Cylinder block side: 22.0 — 27.0 N·m {2.2 — 2.8 kgf·m/16.2 — 19.9 lb·ft}

- Install the turbocharger oil return pipe.
 - Insert the gasket and tighten to the specified torque.

Tightening torque:

7.8 — 11.8 N·m {0.8 — 1.2 kgf·m/5.8 — 8.7 lb·ft}

**Name**

- Turbocharger Oil Return Pipe
- Turbocharger Oil Feed Pipe
- Turbocharger
- Exhaust Adapter

- Connect the air intake pipe to the intake chamber.

Tightening torque:

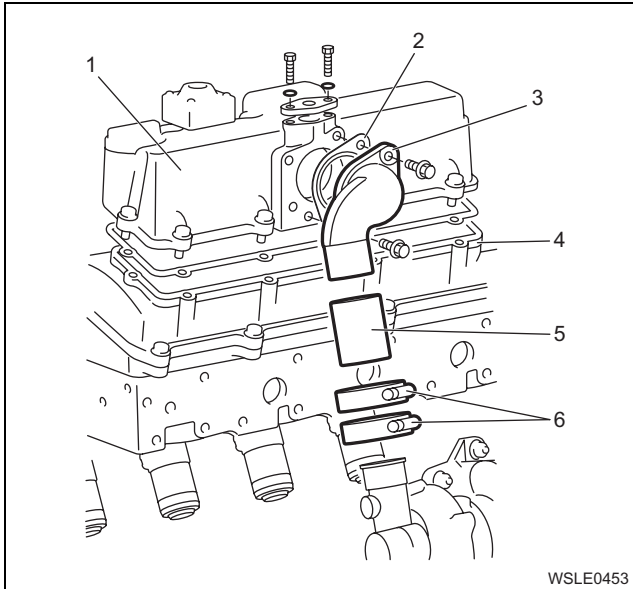
11.0 — 13.0 N·m {1.1 — 1.3 kgf·m/8.1 — 9.6 lb·ft}

- Install the sensor cover to the intake chamber with a white paint applied area facing upward.

Tightening torque:

3.0 — 5.0 N·m {0.31 — 0.51 kgf·cm/26.6 — 44.3 lb·in}

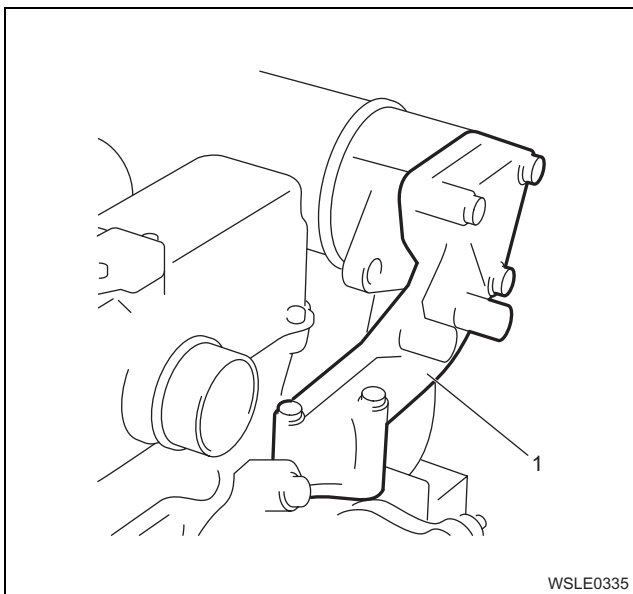
- Install the rubber hose, and tighten and fix the hose with rubber hose clips.



Name

1. Intake Chamber
2. Gasket
3. Air Inlet Pipe
4. Cylinder Head Cover
5. Rubber Hose
6. Rubber Hose Clip

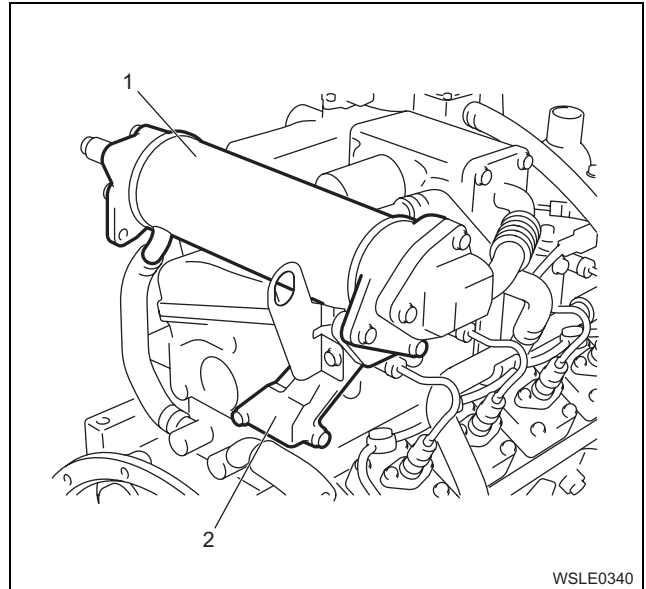
28. Install the EGR cooler inlet pipe to the exhaust manifold.
- Insert the gasket and temporarily tighten the bolts and nuts.



Name

1. EGR Cooler Inlet Pipe

29. Install the EGR cooler bracket to the cylinder head and temporarily tighten the bolts.
30. Install the EGR cooler.
- Insert the gasket and temporarily tighten the bolts.



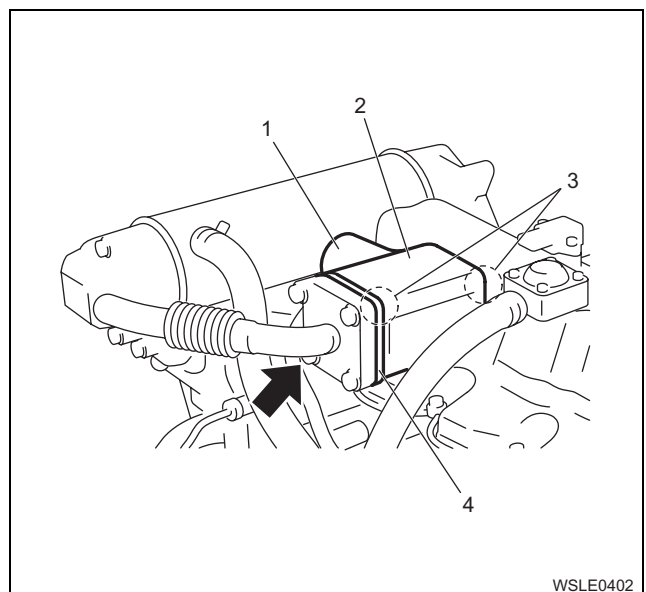
Name

1. EGR Cooler
2. EGR Cooler Bracket

31. Install the orifice plate, the valve case and the EGR cut solenoid to the intake chamber.
- Install the orifice plate and the gasket with protruding section in the position shown in the figure.
 - Install the connector of the EGR cut solenoid.

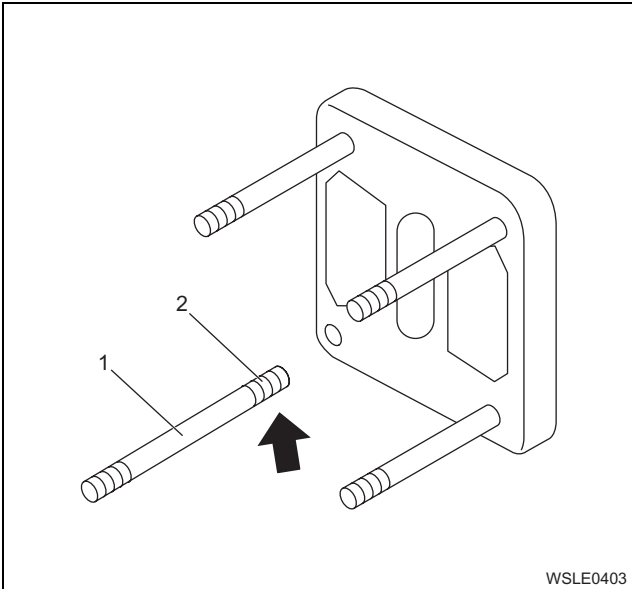
Note:

Always apply Loctite (#262) to the stud bolt tap end when removing (loosening) the stud bolt indicated with an arrow in the illustration or replacing the stud bolts.



Name

1. EGR Cut Solenoid
2. Valve Case
3. Protruding Section
4. Orifice Plate



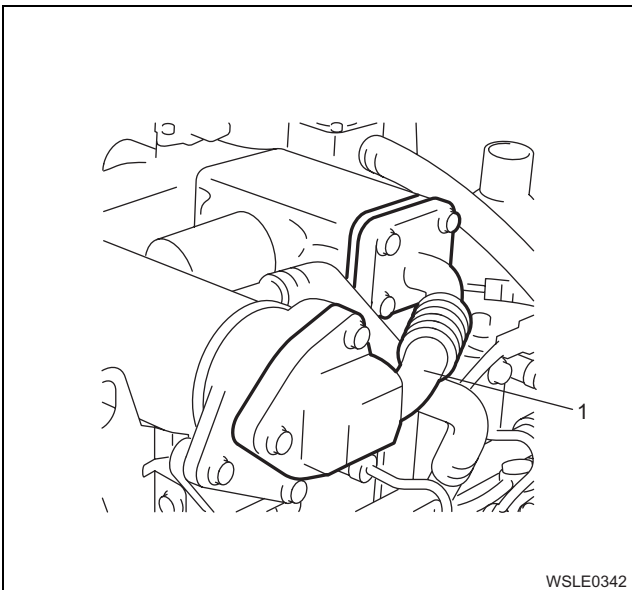
WSLE0403

Name

1. Stud Bolt
2. Tap End

32. Install the EGR cooler outlet pipe.

- Insert the gasket and temporarily tighten the bolts and nuts.

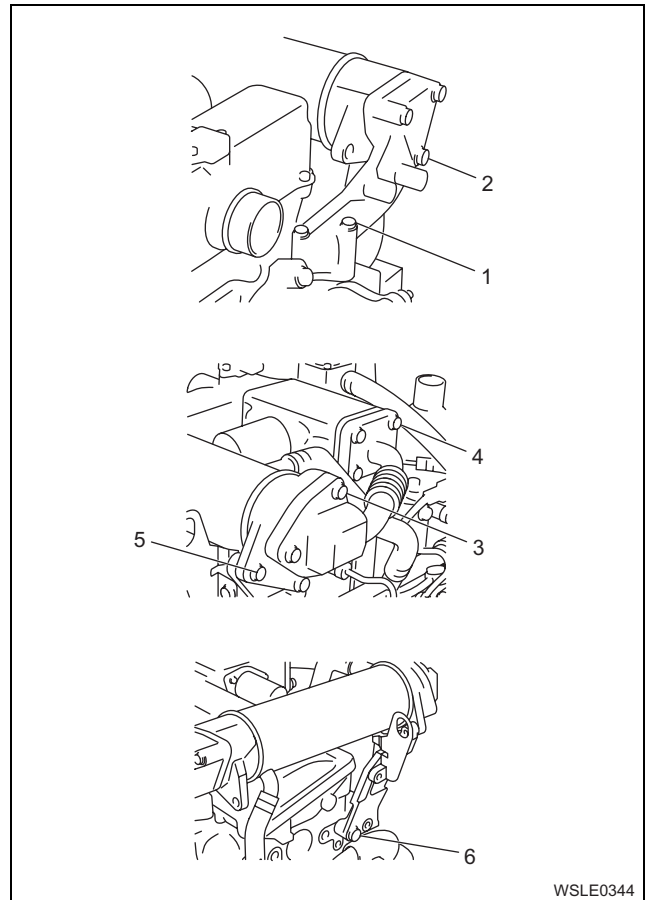


WSLE0342

Name

1. EGR Cooler Outlet Pipe

33. Temporarily tighten the bolts and nuts to the specified torque according to the order given on the figure.



WSLE0344

Name

1-6. Show the order to tighten bolts and nuts.

Tightening torque:

1,2,3,4,5: 21.6 — 31.4 N·m {2.2 — 3.2 kgf·m/15.9 — 23.2 lb·ft}

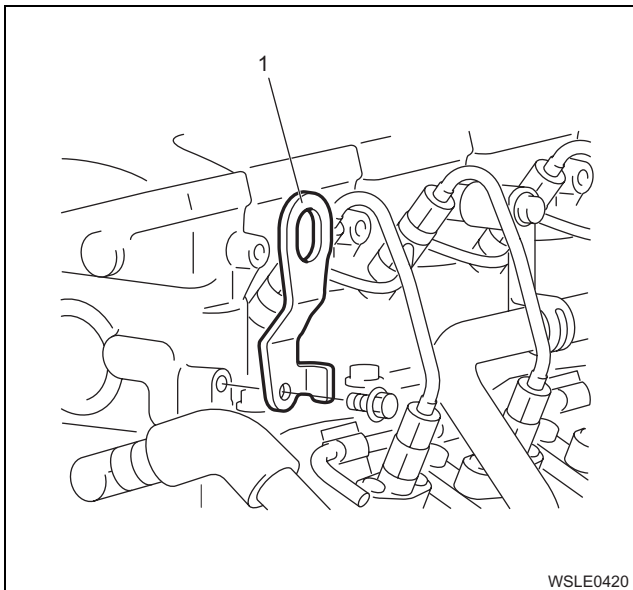
6: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

1A-38 4LE1 Engine Mechanical

34. Install the rear hanger.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

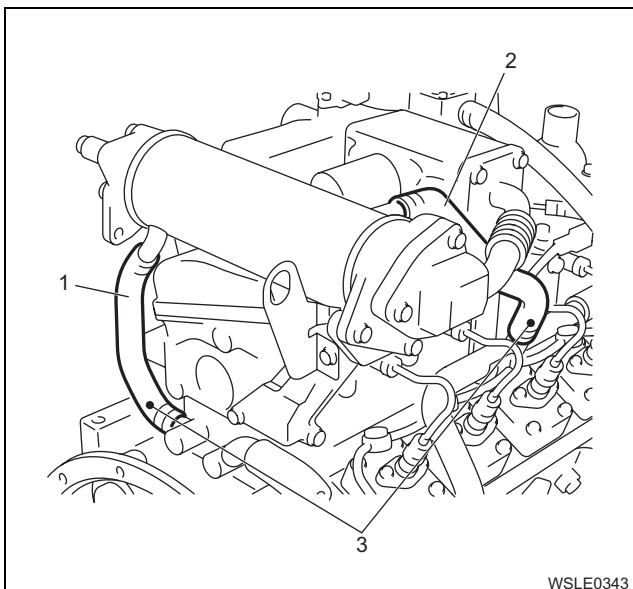


Name

1. Rear Hanger

35. Install the EGR cooler water inlet hose with a white paint applied area in the cylinder block side.

36. Install the EGR cooler water outlet hose with a white paint applied area in the water return pipe side.



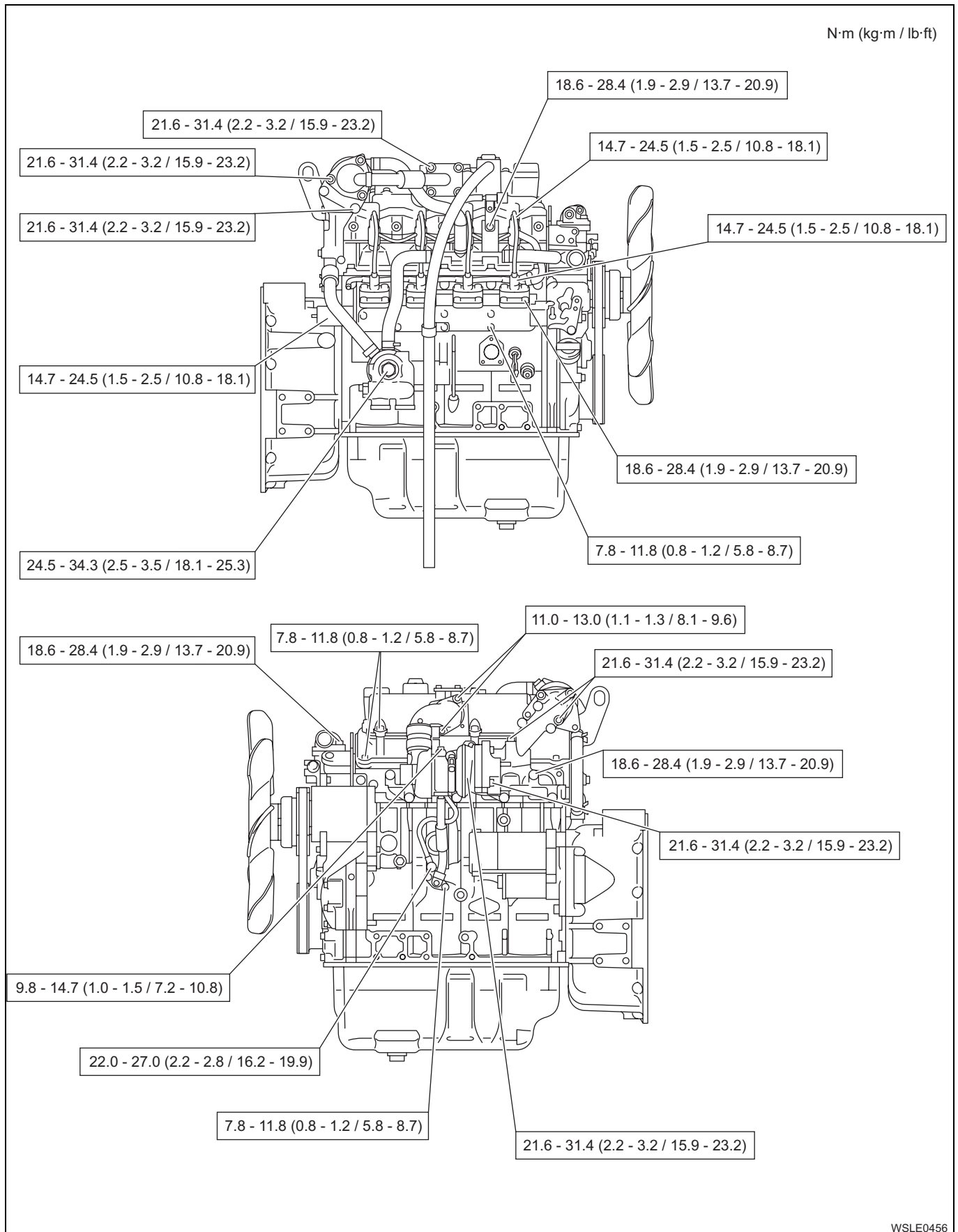
Name

1. EGR Cooler Water Inlet Hose
2. EGR Cooler Water Outlet Hose
3. White Paint Applied Area

37. Add coolant.

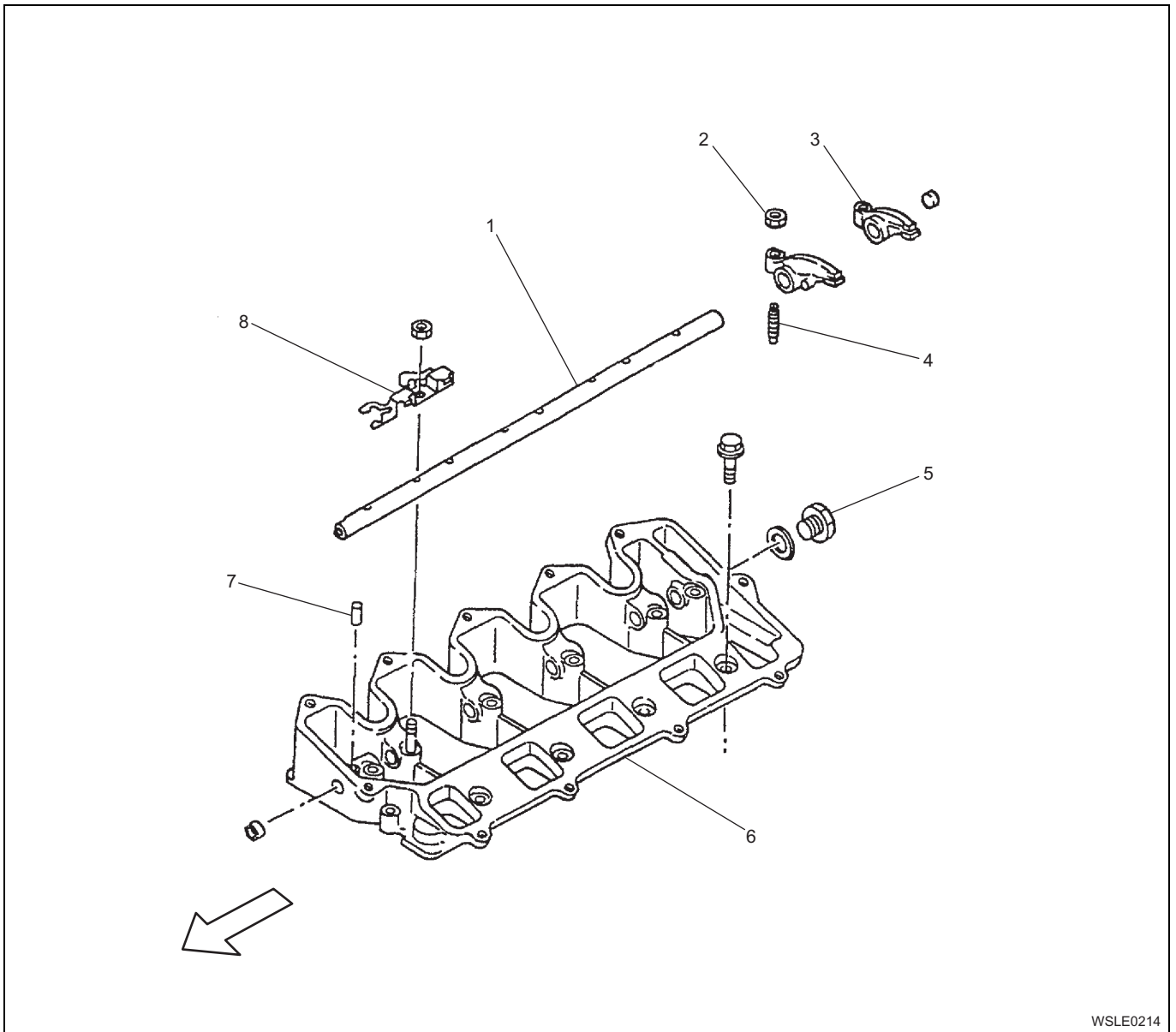
38. Add engine oil.

Torque Specifications



Rocker Arm Shaft

Components



WSLE0214

Name

- | | |
|---------------------|--------------------------|
| 1. Rocker Arm Shaft | 5. Rocker Arm Shaft Plug |
| 2. Lock Nut | 6. Rocker Arm Bracket |
| 3. Rocker Arm | 7. Rocker Arm Shaft Pin |
| 4. Adjusting Screw | 8. Rocker Arm Spring |

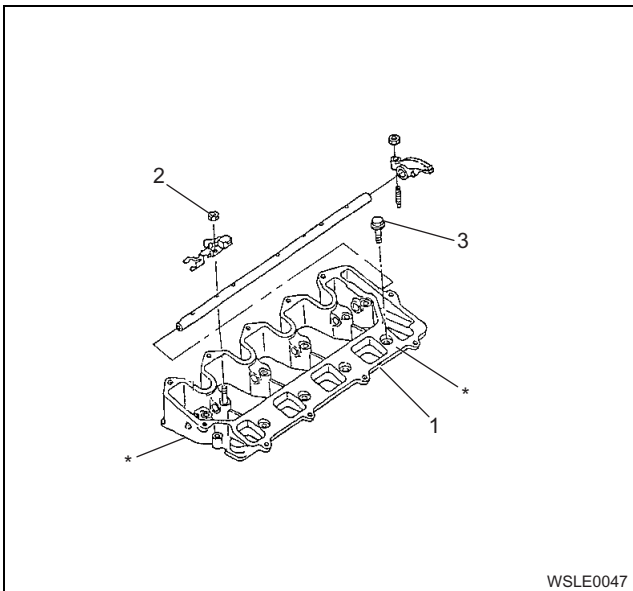
Removal

1. Remove the EGR cooler.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
2. Remove the cylinder head cover.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
3. Remove the water pipe.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
4. Remove the rocker arm bracket ASM.
(M6 × 1.0: 5 bolts, 6 nuts)

Note:

Since liquid gasket is used on the mating surface to the cylinder head, be careful not to damage the rocker arm bracket when removing it.

* With screws for replacer (M8 × 1.25)



WSLE0047

Name

1. Rocker Arm Bracket
2. Nut
3. Bolt

5. Pull out the eight push rods.

Disassembly

1. Remove plug of the rocker arm shaft.
2. Pull out the rocker arm shaft backward.

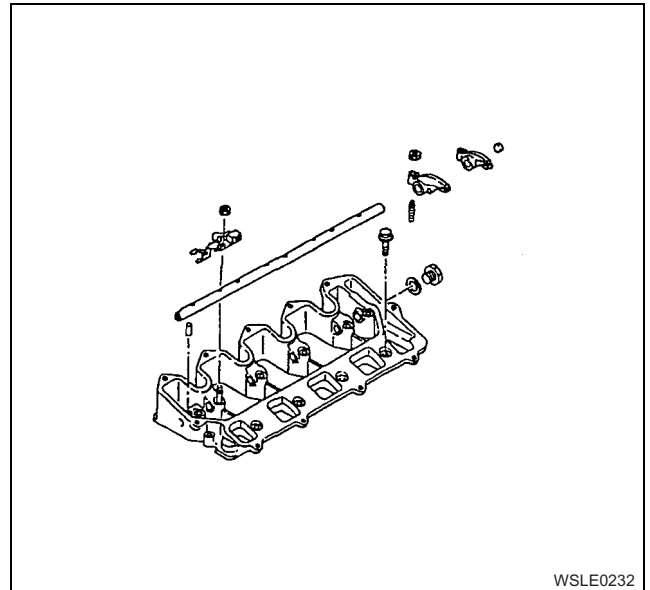
CAUTION:

When reinstalling the rocker arm, prepare tags written down the cylinder numbers and symbols to distinguish "intake" and "exhaust", to avoid installing the improper position.

Inspection

Inspection of rocker arm and rocker arm shaft

Check for wear, damage, clogging of oil port and other abnormality.

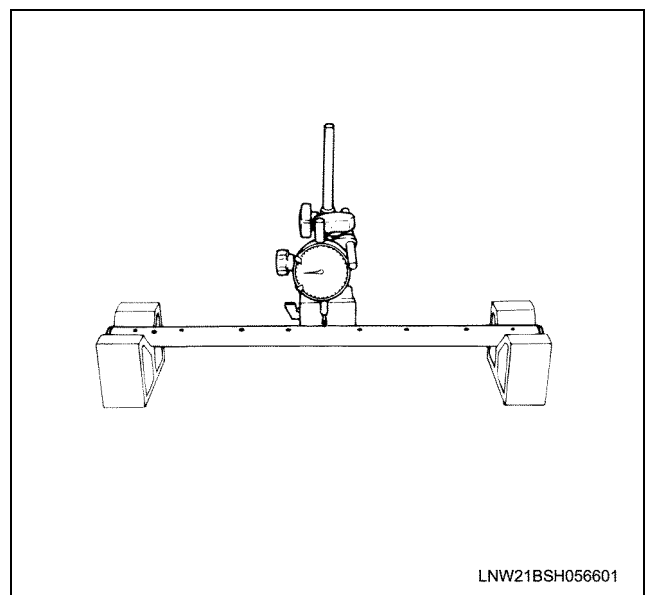


WSLE0232

Inspection for a bend of the rocker arm shaft

Hold the shaft on both ends with V block, and measure the runout of the center by the dial gauge. (The bend value should be a half of the runout.)

		mm {in}
Standard value	Service limit	Repairing procedure
0.2 {0.008} or less	0.3 {0.012}	Replace.

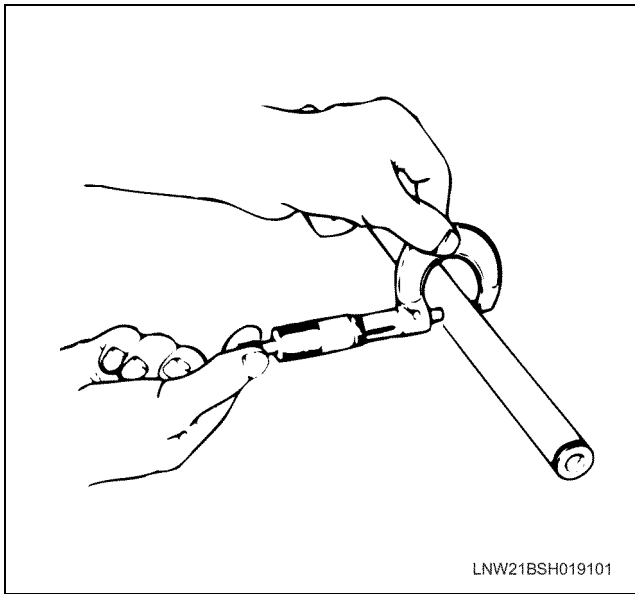


LNW21BSH056601

Inspection for wear of the rocker arm shaft

Measure the outside diameter of the shaft at sliding portions (eight points) in the rocker arm.

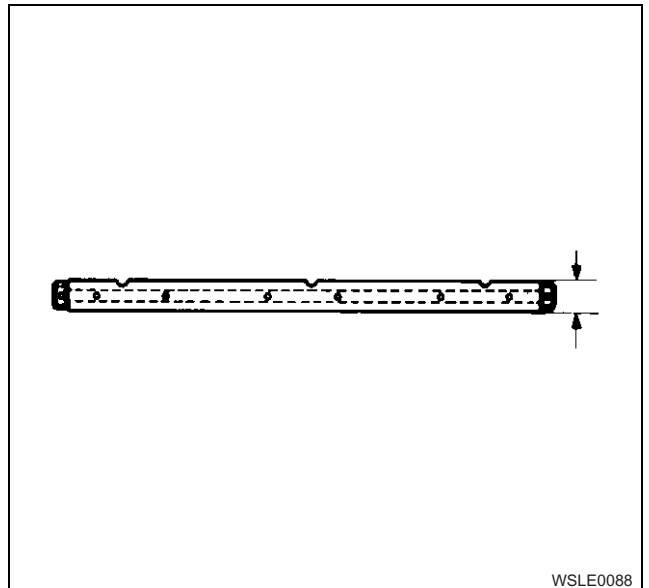
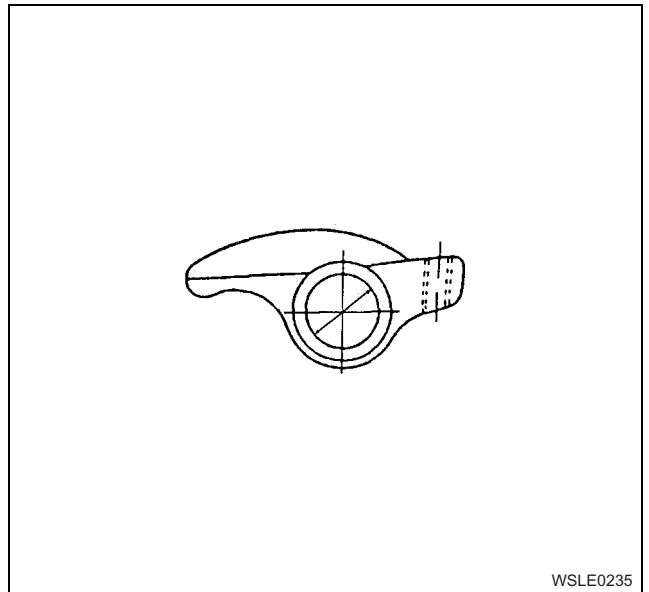
mm {in}		
Nominal dimension	Service limit	Repairing procedure
$\phi 12$ {0.472}	$\phi 11.85$ {0.467}	Replace.



Inspection of clearance between the rocker arm and the rocker arm shaft

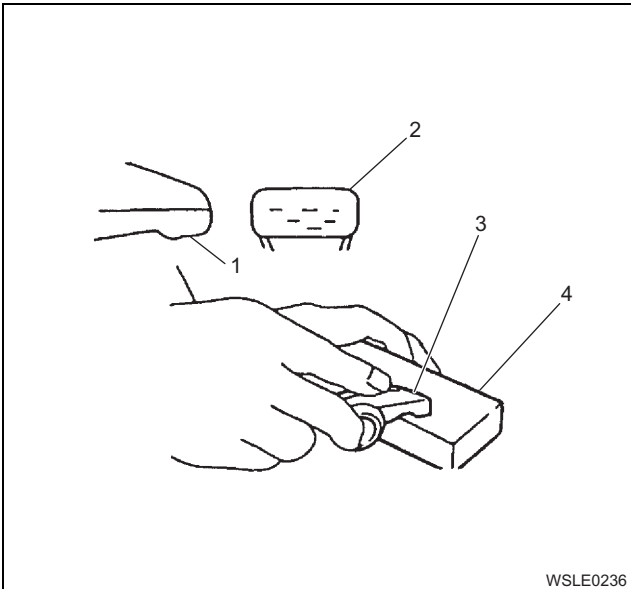
Measure the bushing bore and calculate the clearance between the arm and the outside diameter of the shaft.

mm {in}		
Clearance between the arm and the shaft		Repairing procedure
Standard value	Service limit	
0.005 — 0.045 {0.0002 — 0.0018}	0.2 {0.008}	Replace the rocker arm or the shaft.



Inspection of rocker arm

Check the contact surface of the valve stem of the rocker arm for stepped wear or damage. If the stepped wear (1) and damage (2) of the contact surface are slight, repair with the oil stone. If the stepped wear and damage are extreme, replace the rocker arm.



Name

1. Stepped Wear of the Contact Surface
2. Damage of the Contact Surface
3. Rocker Arm
4. Oil Stone

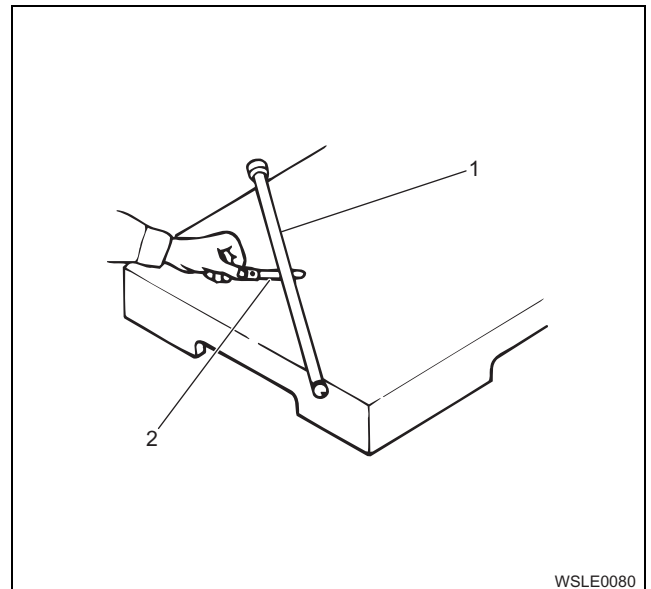
Visual check of push rod

Replace with new one if there is excessive wear or damage.

Inspection for a bend of the push rod

Rotating the push rod on a surface plate, measure the bend with the thickness gauge. If the measured value exceeds the limit, replace with new one.

Push rod bend	mm {in}
Service limit	0.3 {0.012} or less



Name

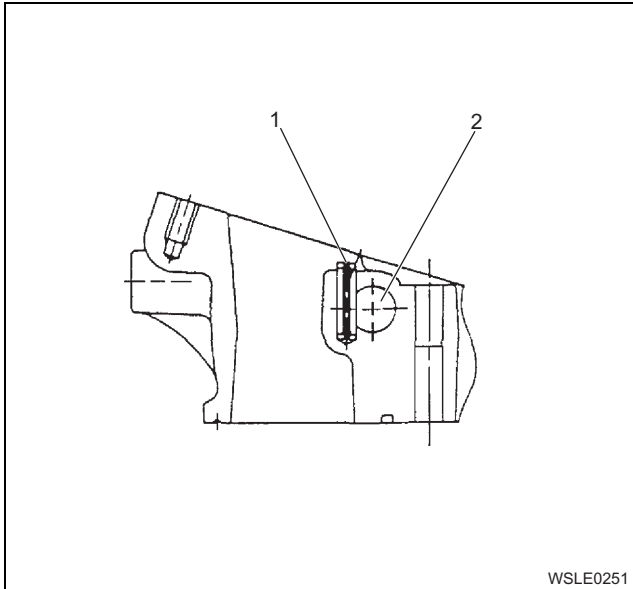
1. Push Rod
2. Thickness Gauge

Reassembly

1. Clean the rocker arm shaft and the oil port of the rocker arm by air.
2. Apply the engine oil to the rocker arm shaft and the rocker arm sliding portion.
3. Install the rocker arm shaft and the rocker arm. When positioning the rocker arm shaft, align the rocker shaft pin inserted to the rocker arm bracket with the cutout of the rocker arm shaft.

Note:

When reinstalling the rocker arm, be sure to check the tag and install to the original position.



WSLE0251

Name

1. Pin
2. Rocker Arm Shaft

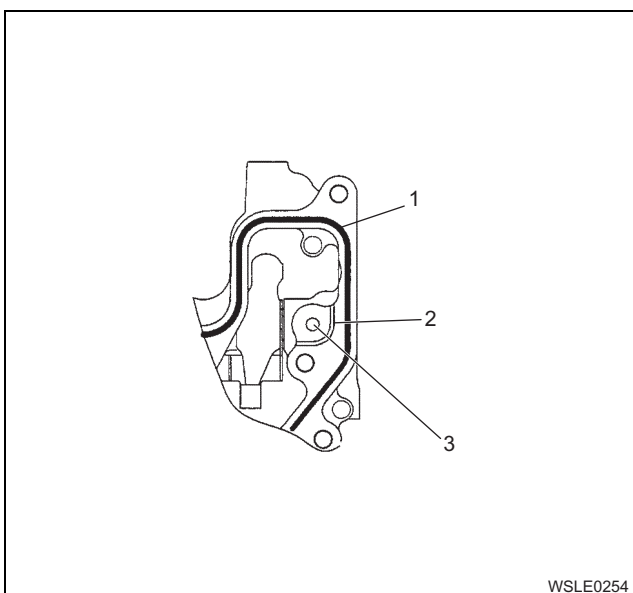
4. Install the plug of the rocker arm.

Installation

1. Put the push rod through the cylinder block and insert it to the tappet.
2. Align it with a groove on the bottom of the rocker arm bracket and apply liquid gasket (TB1207B).

Note:

Do not apply the liquid gasket to a groove around the oil gallery.

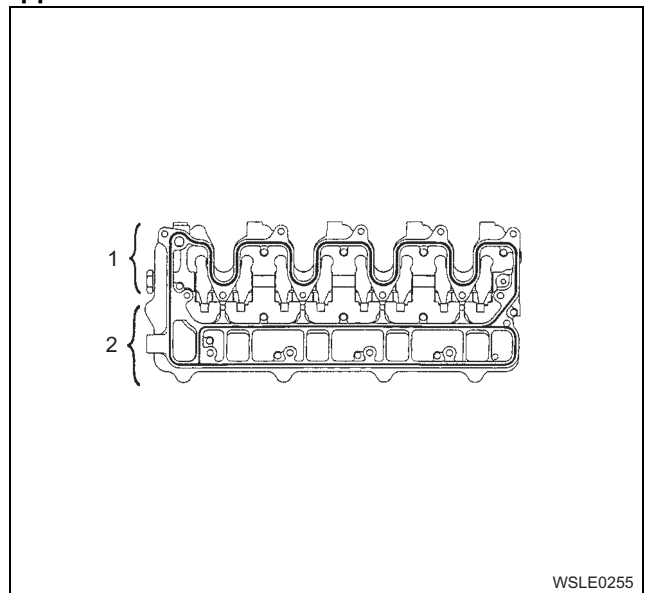


WSLE0254

Name

1. Liquid Gasket Applied Area
2. Do not apply the liquid gasket to the groove. (important)
3. Oil Gallery

Applied width of sealant



WSLE0255

Name

1. Approx. 4 mm {0.157 in}
2. Approx. 2 mm {0.079 in}

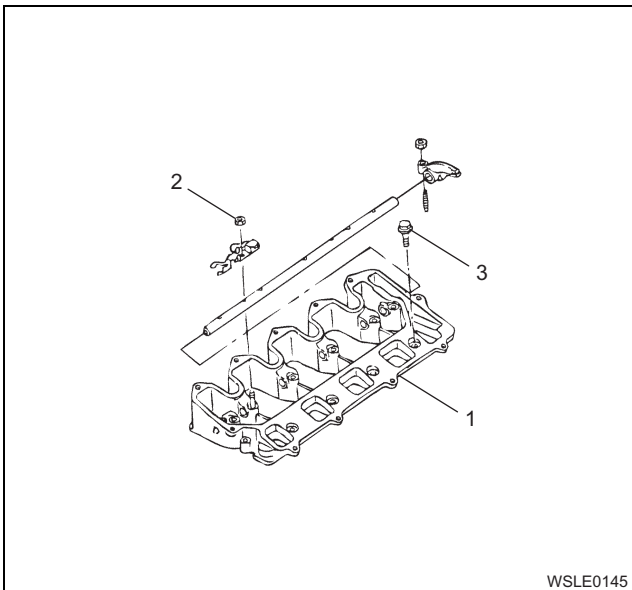
3. Contact the rocker arm to the rocker spring, rotate the crank, and set the No.1 cylinder to the exhaust top dead center.
4. Install the rocker arm bracket ASM along with the stud bolt of the cylinder head, and tighten it to the specified torque.

Tightening torque:

7.8 — 11.8 N·m {0.8 — 1.2 kgf·m/5.8 — 8.7 lb·ft}

Note:

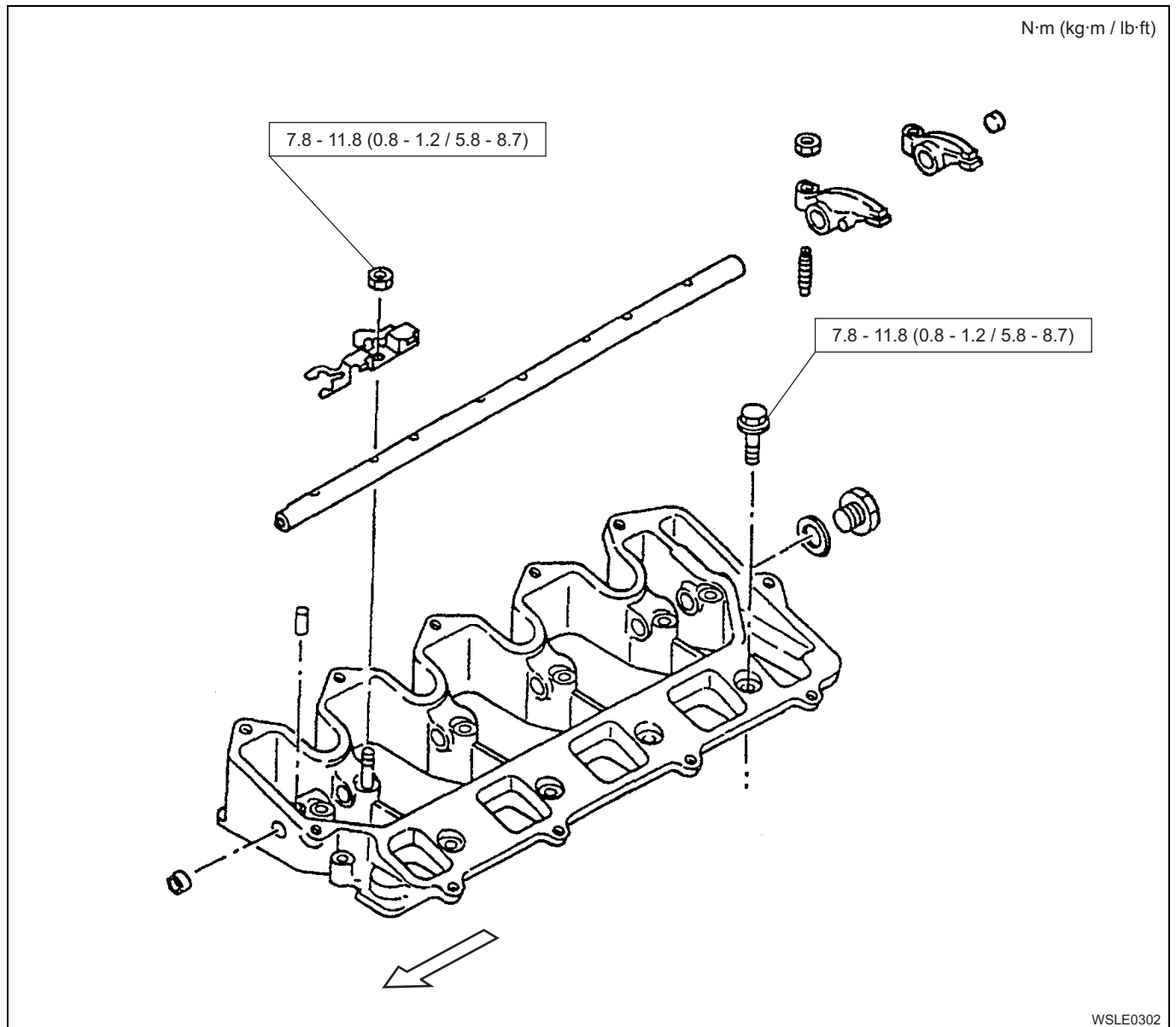
- Remove paint and sealant attached to the top of the cylinder head and the bottom of the rocker arm bracket with a PKG scraper etc., and degrease sufficiently.
- Assemble it to the cylinder head within 5 minutes after applying the sealant.
- When assembling, align the saucer part of the push rod and the rocker arm adjusting screw.

**Name**

1. Rocker Arm Bracket
2. Nut
3. Bolt

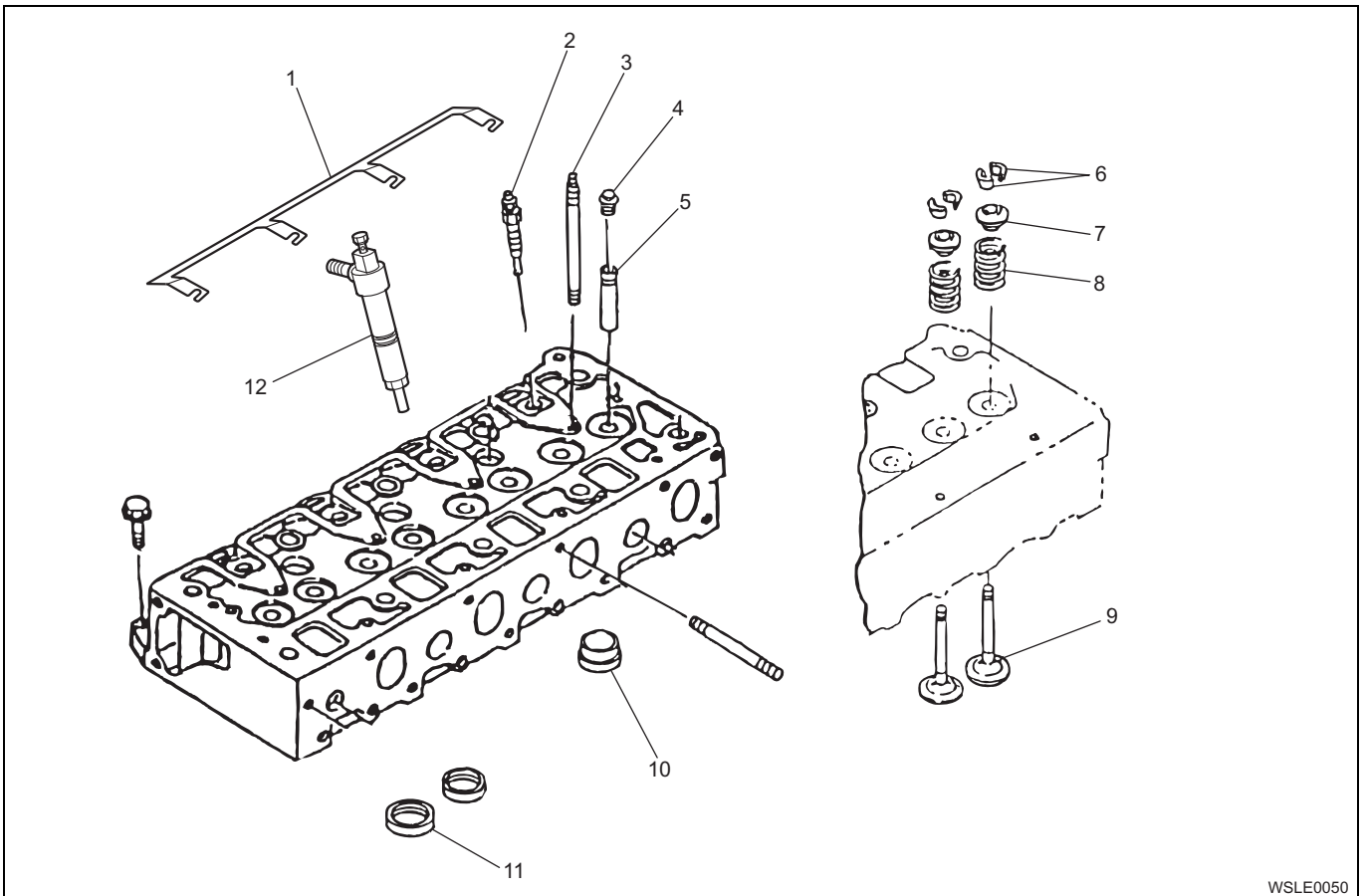
5. Adjustment of valve clearance
Refer to 1A-4, "Function Check, ISUZU Diesel Engine".
6. Install the water pipe.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
7. Install the cylinder head cover.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
8. Install the EGR cooler.
Refer to 1A-29, "Installation, Engine Exterior Equipment".

Torque Specifications



Cylinder Head

Components



WSLE0050

Name

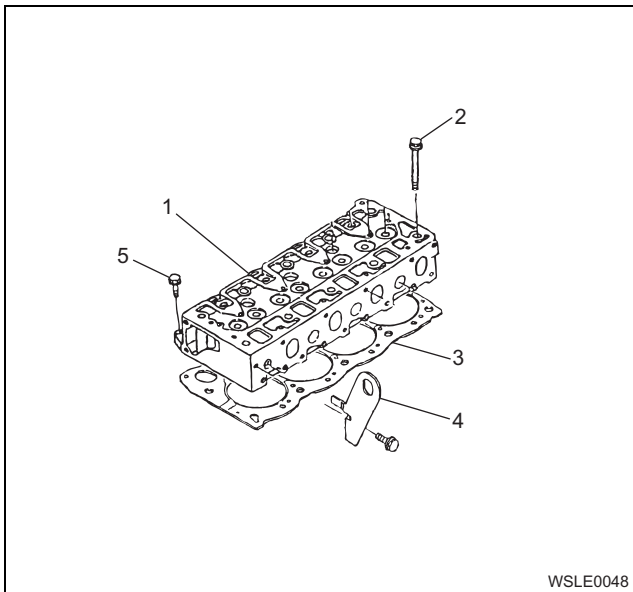
- | | |
|--|-----------------------|
| 1. Connector | 7. Spring Seat |
| 2. Glow Plug | 8. Valve Spring |
| 3. Do not extract the five stud bolts since the sealant is attached to them. | 9. Valve |
| 4. Valve Seal | 10. Hot Plug |
| 5. Valve Guide | 11. Valve Seat Insert |
| 6. Split Collar | 12. Nozzle Holder |

Removal

- Remove the cooling fan.
Refer to 1A-14, "Removal, Engine Accessories".
- Remove the fan belt.
Refer to 1A-14, "Removal, Engine Accessories".
- Remove the fan pulley.
Refer to 1A-14, "Removal, Engine Accessories".
- Remove the generator.
Refer to 1A-14, "Removal, Engine Accessories".
- Remove the EGR cooler and the bracket.
Refer to 1A-14, "Removal, Engine Accessories".
- Remove the cylinder head cover.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
- Remove the turbocharger.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
- Remove the water pump.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
- Remove the injection pipe.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
- Remove the leak-off pipe.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
- Remove the rocker arm bracket.
Refer to 1A-41, "Removal, Rocker Arm Shaft".

1A-48 4LE1 Engine Mechanical

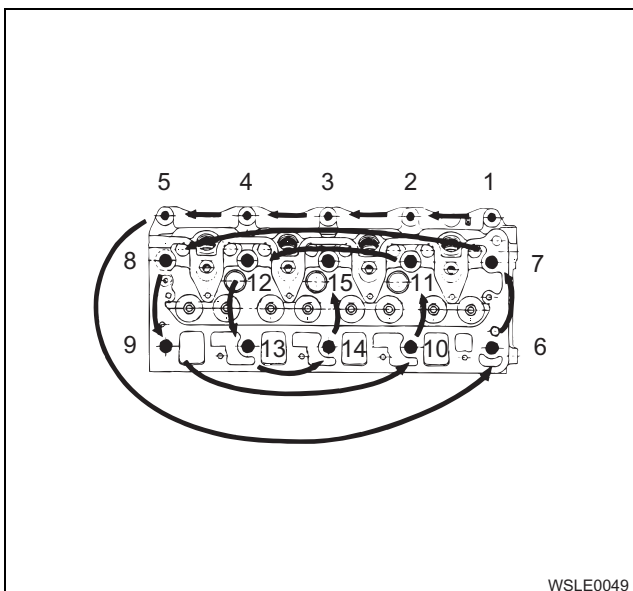
12. Remove the front hanger.



Name

1. Cylinder Head ASM
2. Head Bolt (M12)
3. Head Gasket
4. Front Hanger
5. Head Bolt (M8)

13. Gradually loosen the cylinder head bolts at an equal balanced rate from outside toward the center as the order indicated in the diagram. (M12: 10 bolts, M8: 5 bolts)



14. Remove the cylinder head ASM and the head gasket.

15. Pull out the tappet from the cylinder block.

Disassembly

1. Remove the exhaust manifold.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
2. Remove the connector, glow plug and nozzle holder ASM before disassembling the valve system.
3. Compress the valve spring to remove the split collar, spring seat, valve spring and valve.

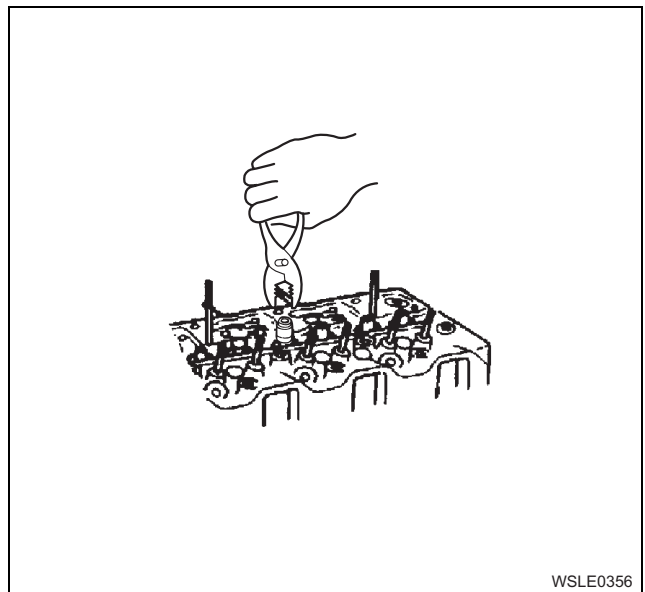
Special tool

Valve spring remover
5-8840-9030-0

CAUTION:

- Disassemble the cylinder head ASM on the flat wood to prevent part damage.
- When removing the nozzle holder ASM, take great care not to damage the nozzle tip.

4. Remove the valve seal.
 - Use pliers to remove the valve seal.

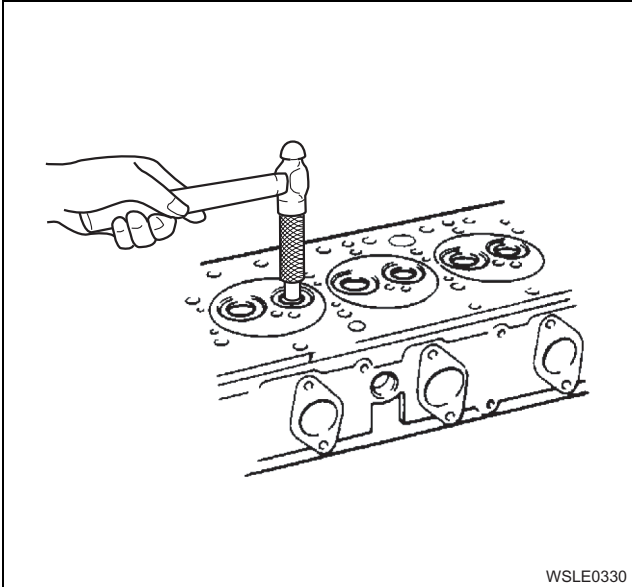


5. Remove the valve guide.

- Use a valve guide installer to pull out the valve guides from the bottom of the cylinder head.

Special tool

Valve guide installer
5-8840-9035-0

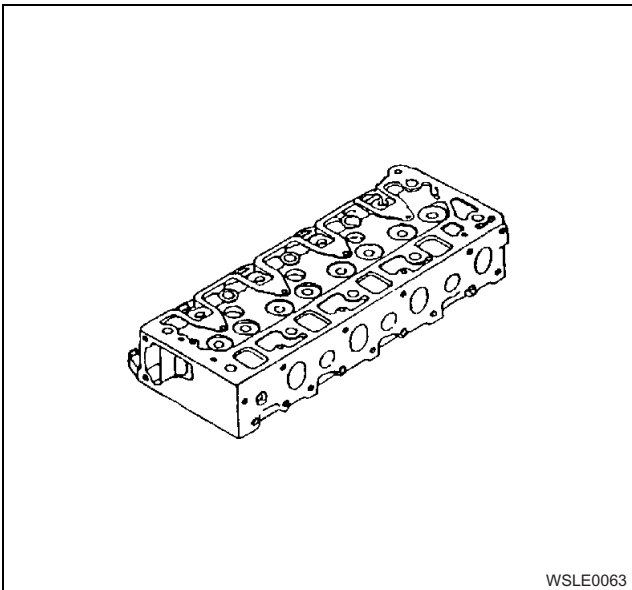


Inspection

Inspection of cylinder head

Remove any carbon attached to the bottom of the head, taking care not to damage the valve seat surface. Check each part for damage and perform the color check as required.

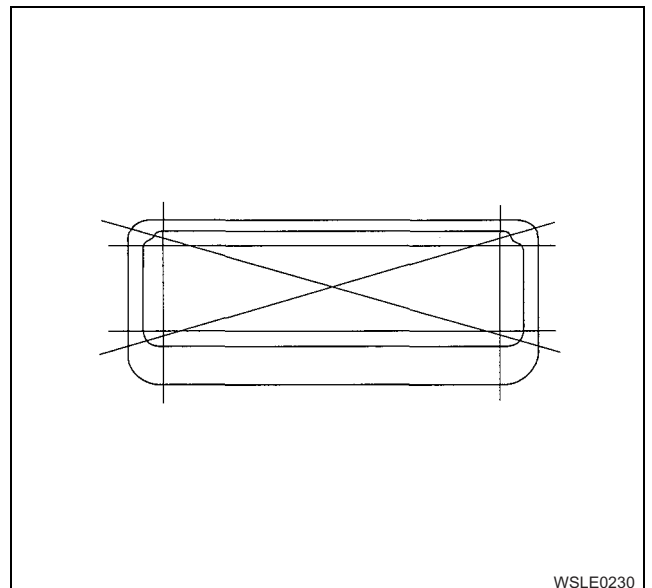
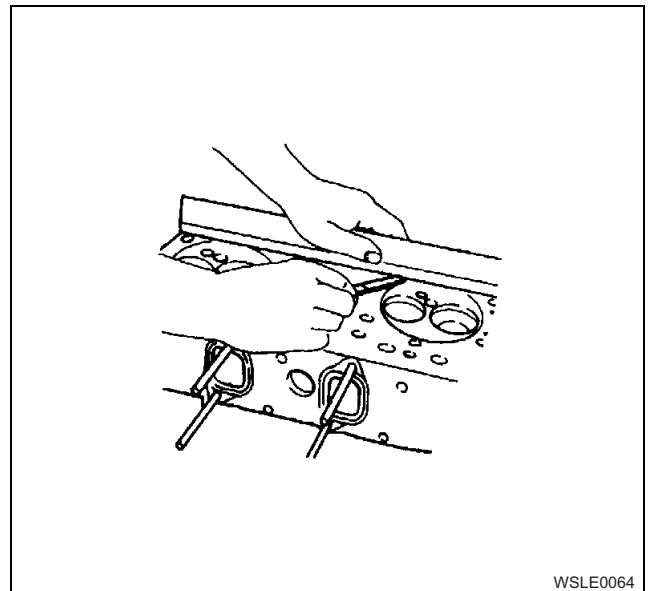
Water leakage: Water pressure test 490 kPa {71 psi} (for three minutes)



Inspection of bottom distortion

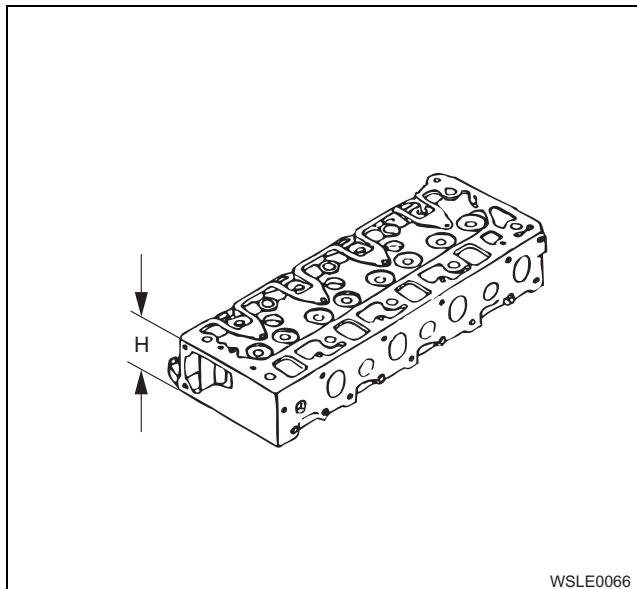
Place a straightedge on the four side-directions and the two diagonal directions, and measure the distortion with the thickness gauge. (Refer to the diagram.)

mm {in}		
Standard value	Abnormal value (need repair)	Repairing procedure
0.075 {0.00295} or less	0.15 {0.006}	Repair it with a surface grinder. The total amount of repaired values of the cylinder block and of the cylinder head should not exceed 0.3 {0.012}. If the measured value exceeds the maximum repaired value, replace the cylinder head.



1A-50 4LE1 Engine Mechanical

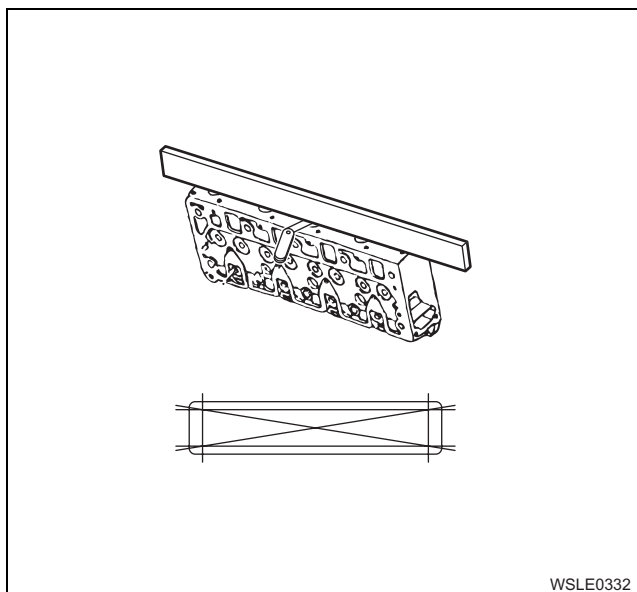
(Reference) Cylinder head height		mm {in}
Engine model	Standard value	
4LE1T	63.90 — 64.10 {2.516 — 2.524}	



Distortion of exhaust manifold installation surface

Place a straightedge on the four side-directions and the two diagonal directions, and measure the distortion with the thickness gauge.

mm {in}		
Standard value	Service limit	Repairing procedure
0.05 {0.002} or less	0.2 {0.008}	Repair.



Inspection of valve seat

Contact width: A

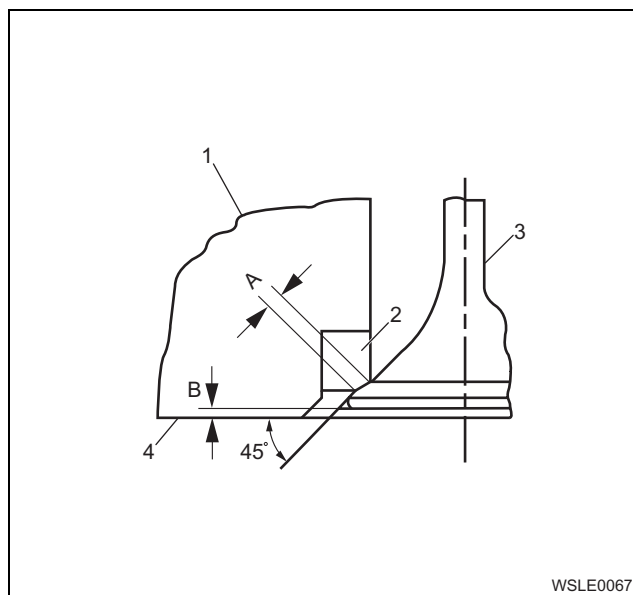
Check the contact surface of the valve seat. If any scratches and hollows exist or measured contact width exceeds the limit, repair it.

Depression level: B

Install the valve to the cylinder head. Measure the depression level of the seat with a depth gauge or with a straightedge and a scale.

If the measured value exceeds the limit, replace the valve seat insert.

mm {in}				
		Standard value	Service limit	Repairing procedure
Contact width (A)		2.0 {0.079}	2.5 {0.098}	Repair or replace.
Depression level (B)	IN	0.7 {0.028}	1.2 {0.047}	
	EX	0.9 {0.035}	1.5 {0.059}	

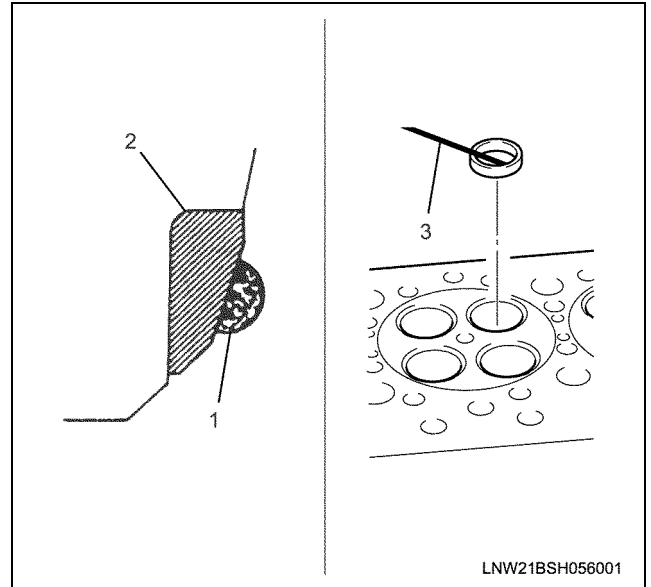
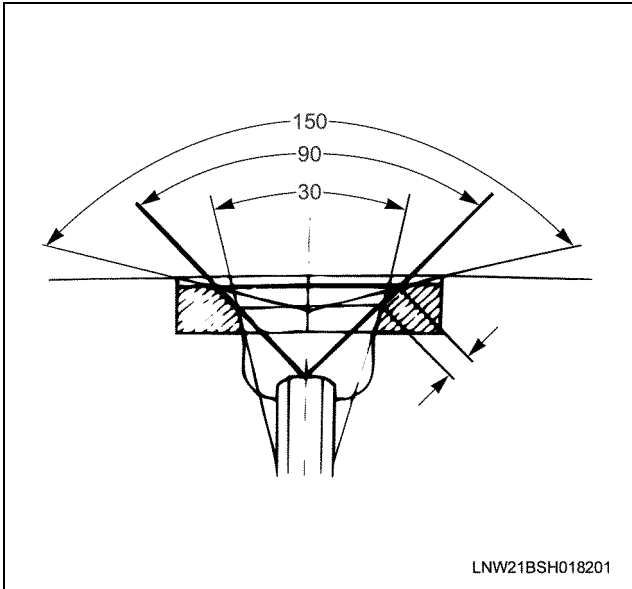


Name

1. Cylinder Head
2. Valve Seat Insert
3. Valve
4. Cylinder Head Lower Surface

Repair of valve seat

1. Remove any carbon attached to the valve seat surface. Use a seat cutter (15°, 45°, 75°) to cut off scratches and hollows at minimum until they disappear, and adjust the contact width to the standard value.
2. Grind them after repair.



Name

1. Arc-weld
2. Valve Seat Insert
3. Screwdriver

4. Clean off carbon and metallic oxides on the insert bore of the cylinder head.
5. Use a smooth pad and press-fit with a press. (9.8 — 14.7 kN {2,203 — 3,305 lb})
6. Apply compound to the valve seat surface, grind them while rotating the valve, and make sure that it contacts evenly over the circumference.

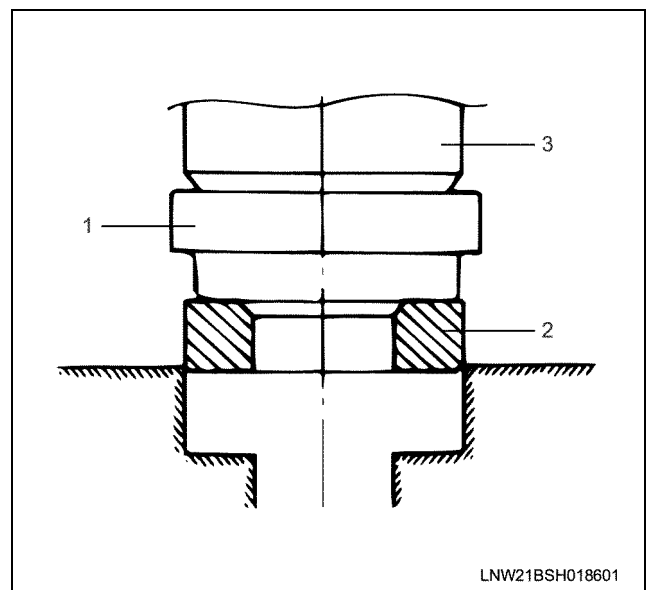
CAUTION:

After grinding, remove compound completely.

Replacement of valve seat insert

If the depression level of the seat exceeds the limit, replace the valve seat insert.

1. Arc-weld the entire inside diameter of the valve seat insert.
2. Cool the valve seat insert for two to three minutes. It contracts as it cools down, making it easier to remove the valve seat insert.
3. Remove the valve seat insert, using a screwdriver. Be sure not to hurt the cylinder head.



Name

1. Pad
2. Valve Seat Insert
3. Press

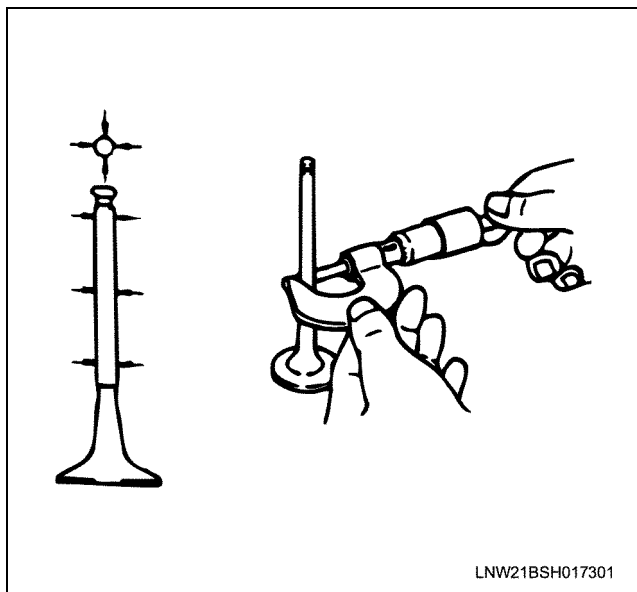
Inspection for wear of the valve stem

Measure the outside diameter at position as shown in the figure.

Repair light stepped wear with the oil stone.

If the measured value is below the service limit, replace the valve guide and the valve as a set.

mm {in}			
	Nominal dimension	Service limit	Repairing procedure
Inlet	$\phi 7$ {0.276}	$\phi 6.85$ {0.270}	Replace.
Exhaust	$\phi 7$ {0.276}	$\phi 6.80$ {0.268}	



LNW21BSH017301

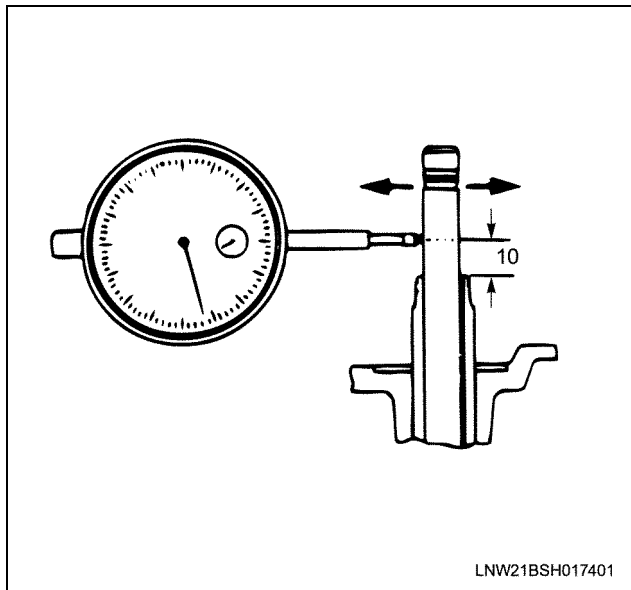
Inspection of valve guide

Note:

If there is a scratch or abnormal abrasion on the valve stem and the inside diameter part of the valve guide, replace the valve and valve guide together.

1. Measure the valve guide clearance.
 - Measure the clearance between the valve guide and valve stem within 10 mm {0.39 in} from the valve guide, using a dial gauge.
 - If the measured value exceeds the limit, replace the valve guide and valve altogether.

Clearance between the valve guide and valve stem			mm {in}
	Standard	Limit	
Inlet valve	0.023 — 0.056 {0.0009 — 0.0022}	0.2 {0.008}	
Exhaust valve	0.030 — 0.063 {0.0012 — 0.0025}	0.25 {0.0098}	

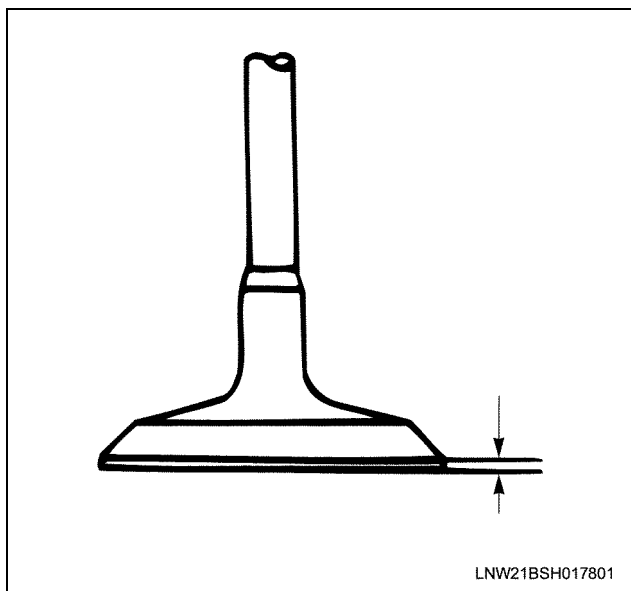


LNW21BSH017401

Inspection of thickness of the valve

If the measured value is below the service limit, replace the valve guide and the valve as a set.

mm {in}			
	Nominal dimension	Service limit	Repairing procedure
IN	1 {0.039}	0.7 {0.028}	Replace.
EX	0.8 {0.031}	0.5 {0.020}	

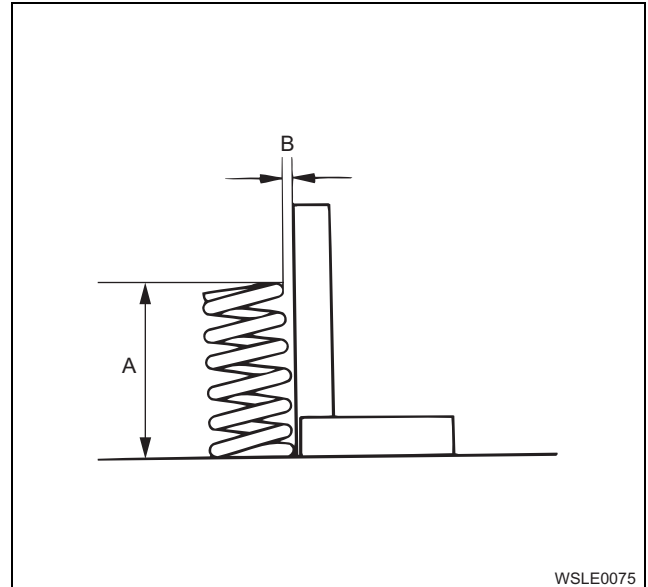
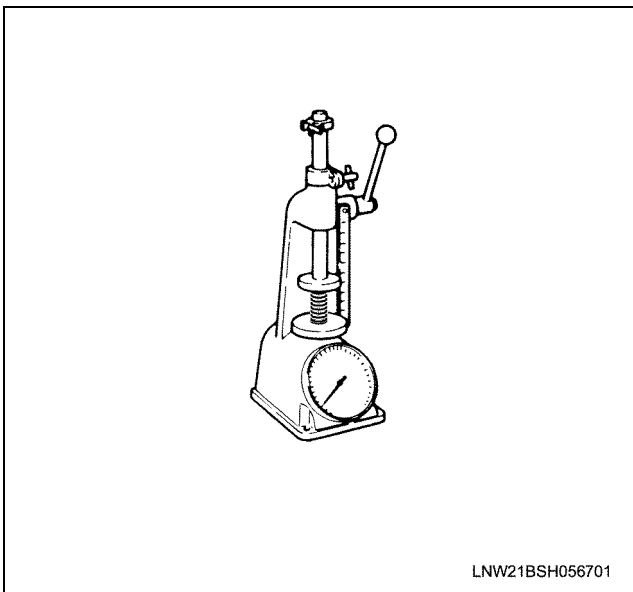


LNW21BSH017801

Inspection of force (tension) of the valve spring

Use a spring tester and read the scale when the spring is compressed to the specified dimension.

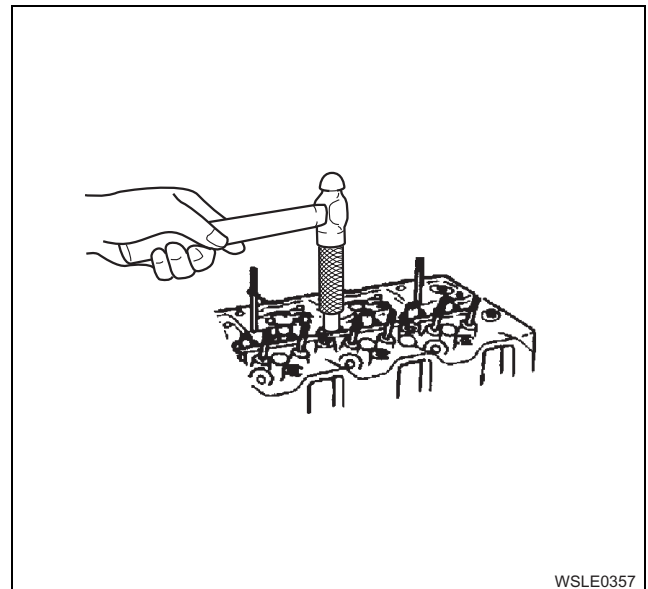
			N {lb}
	Standard value	Service limit	Repairing procedure
When compressed to 29.9 mm {1.177 in}	167 {38}	147 {33}	Replace.



Reassembly

1. Install the valve guide.
 - a. Hammer in the valve guide from the upper surface of the cylinder head, using the valve guide installer.

Special tool
Valve guide installer
5-8840-9035-0



Inspection of free height and squareness of the valve spring

Free height (free length) ; A

Measure free length of the valve spring and if it is shorter than the limit, replace the valve spring.

			mm {in}
Standard value	Service limit	Repairing procedure	
42.1 {1.657}	40 {1.575}	Replace.	

Squareness; B

Use a surface plate and a square to measure the valve spring squareness.

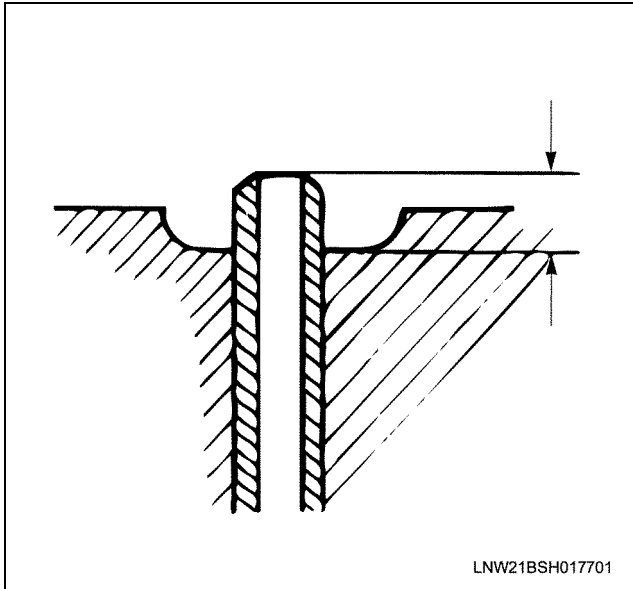
If the measurement exceeds the limit, replace the valve spring.

			mm {in}
Standard value	Service limit	Repairing procedure	
1.8 {0.071} or less	2.5 {0.098}	Replace.	

Height from the upper surface of the cylinder head to the edge surface of the valve guide: 9.5 mm {0.374 in}

Note:

When replacing the valve guide, it must be replaced together with the valve.



2. Install the valve seal.

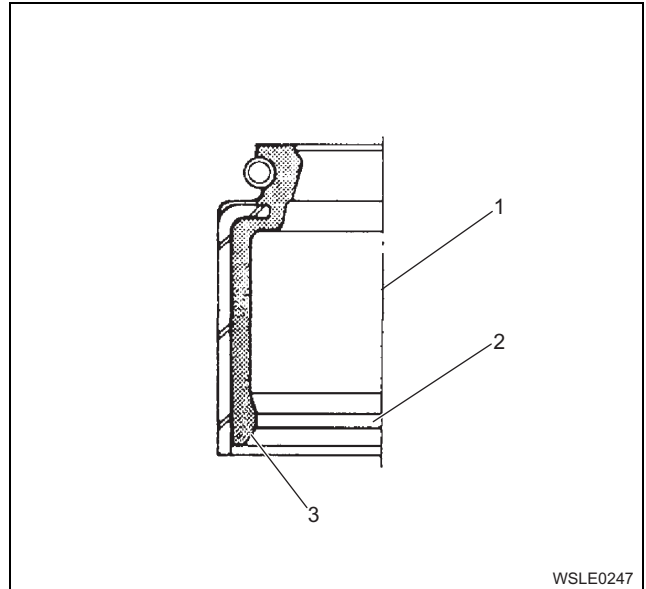
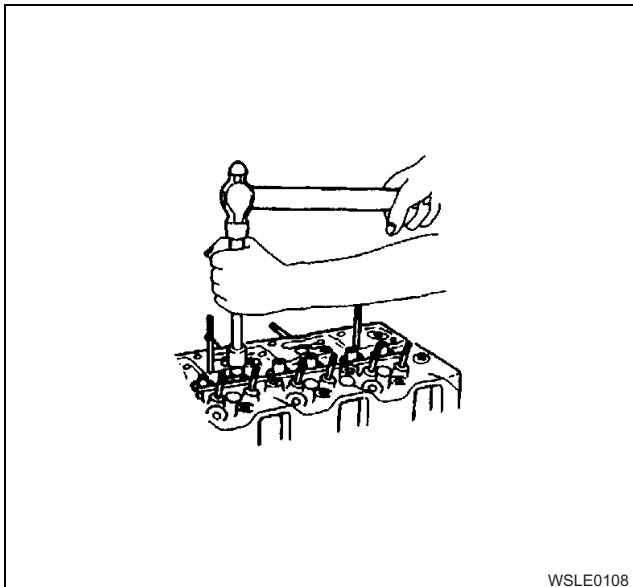
- a. When press-fitting, apply engine oil sufficiently over the outer circle of the valve guide.
- b. Beat until the oil seal protruding section is securely held to the valve guide groove. Also, check that the spring does not come off.

Special tool

Valve seal setting tool
5-8840-9033-0

CAUTION:

Take care to avoid damaging the lip of the seal.



Name

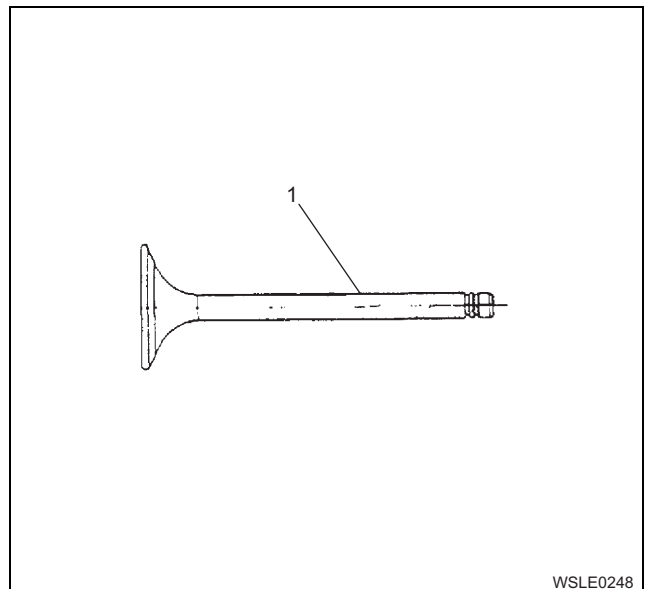
1. Valve Guide
2. Groove
3. Protruding Section

3. Install the valve.

Apply the mixture of the oil and Bellmoly Paste (molybdenum disulfide) to the valve stem part.
Engine oil : molybdenum = 1:1

CAUTION:

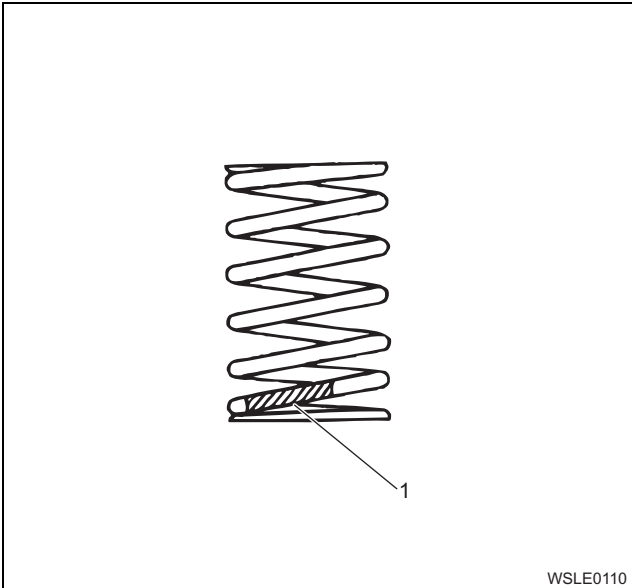
Be sure to prevent the valve from coming off and causing dents after installing the valve.



Name

1. Valve Stem

4. Install the valve spring and the spring seat.
Install the valve spring with its narrow pitched side (white paint side) facing downward.



WSLE0110

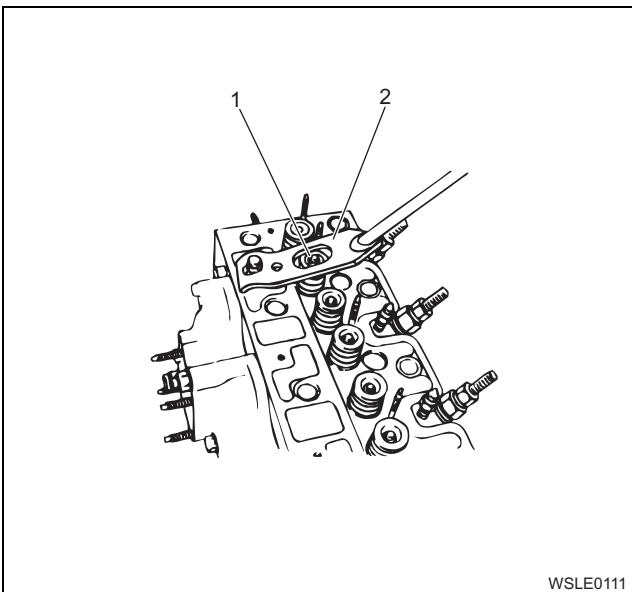
Name

1. White Paint

5. Install the split collar.
Use the tool (remover) to compress the spring and insert the split collar securely.

Special tool

Valve spring remover
5-8840-9030-0



WSLE0111

Name

1. Split Collar
2. Remover

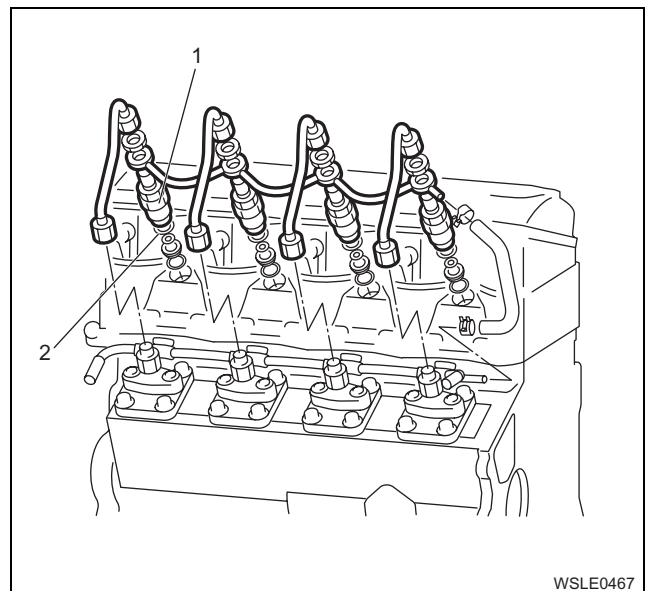
6. Install the nozzle holder ASM.
- Check the injection condition and injection pressure of the injection nozzle, and perform service before assembly. (Refer to 1A-4, "Function Check, ISUZU Diesel Engine".)
 - Install the gasket to the cylinder head.
 - Install the nozzle holder ASM and tighten to the specified torque.

Tightening torque:

39.2 — 49.0 N·m {4.0 — 5.0 kgf·m/28.9 — 36.1 lb·ft}

CAUTION:

- Be sure to prevent the nozzle holder tip from adhering of dirt and from damaging.
- Use new gasket.



WSLE0467

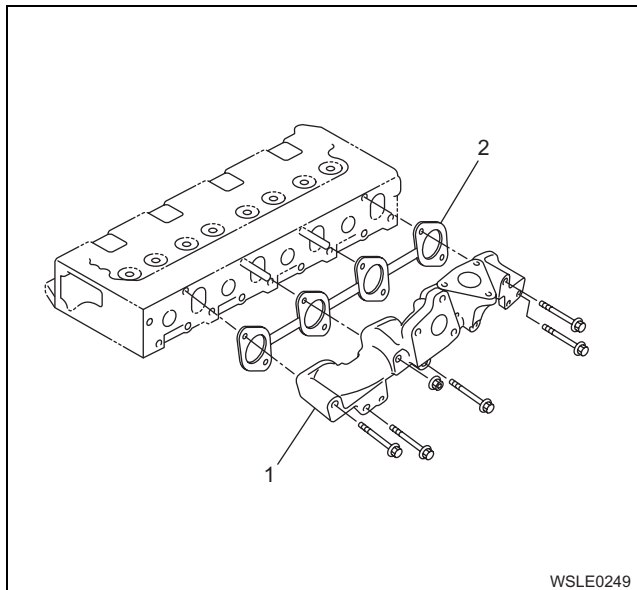
Name

1. Nozzle ASM
2. Gasket

7. Install the exhaust manifold.
Assemble the stamp mark (or seal) side of the gasket facing the manifold.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}



WSLE0249

Name

- 1. Exhaust Manifold
- 2. Gasket

- 8. Assemble the glow plug to the cylinder head and tighten to the specified torque.

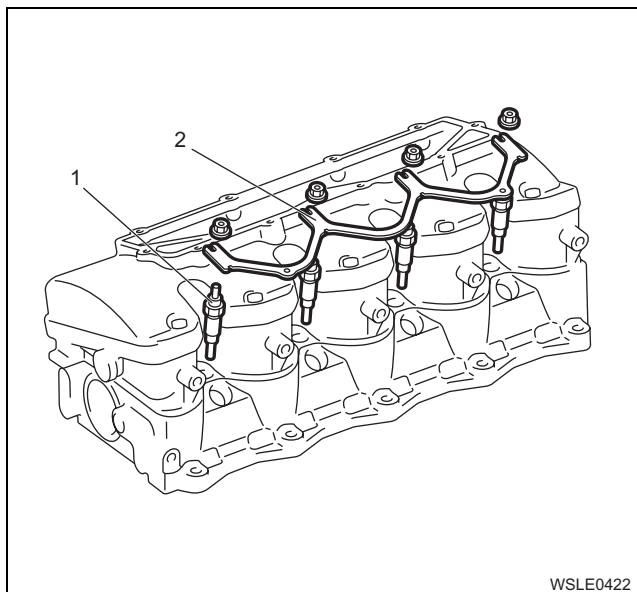
Tightening torque:

20.0 — 25.0 N·m {2.0 — 2.5 kgf·m/14.8 — 18.4 lb·ft}

- 9. Install the connector to the glow plug and tighten to the specified torque.

Tightening torque:

0.9 — 1.1 N·m {0.09 — 0.11 kgf·m/0.7 — 0.8 lb·ft}



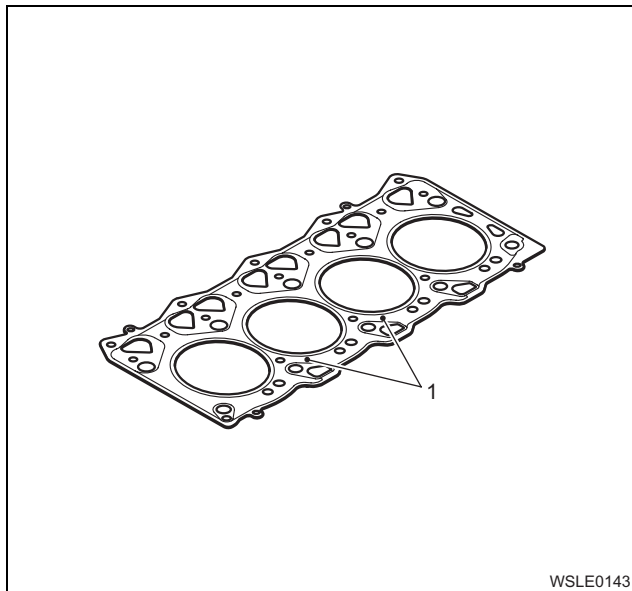
WSLE0422

Name

- 1. Glow Plug
- 2. Connector

Installation

- 1. Assemble the tappet to the cylinder block. (Check the assemble position marked at the disassembling.)
- 2. Install the head gasket.
Install the head gasket with the stamped mark facing upward.



WSLE0143

Name

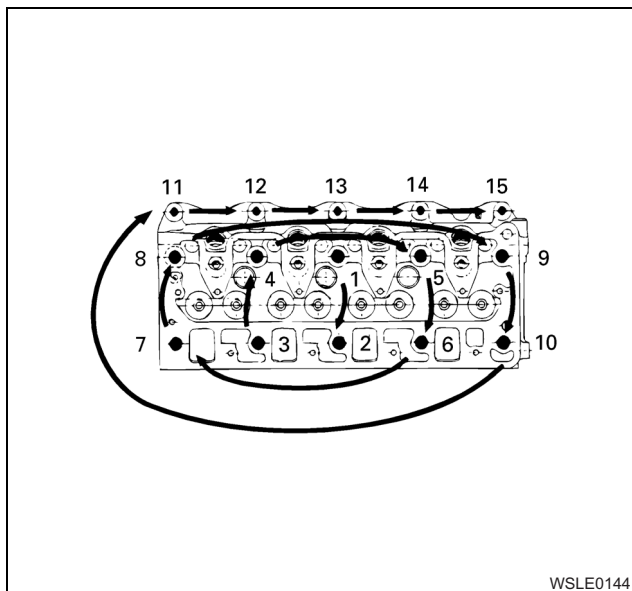
- 1. Stamped Mark

- 3. Install the cylinder head ASM gently on the gasket.
- 4. Apply engine oil to the threads and the seating surfaces of the head bolts, and tighten them from the center part to the outside bolts symmetrically in the numerical order shown in the illustration.

Tightening torque:

M12: 83.4 — 93.2 N·m {8.5 — 9.5 kgf·m/61.5 — 68.7 lb·ft} → 60° — 90°

M8: 24.5 — 34.3 N·m {2.5 — 3.5 kgf·m/18.1 — 25.3 lb·ft}

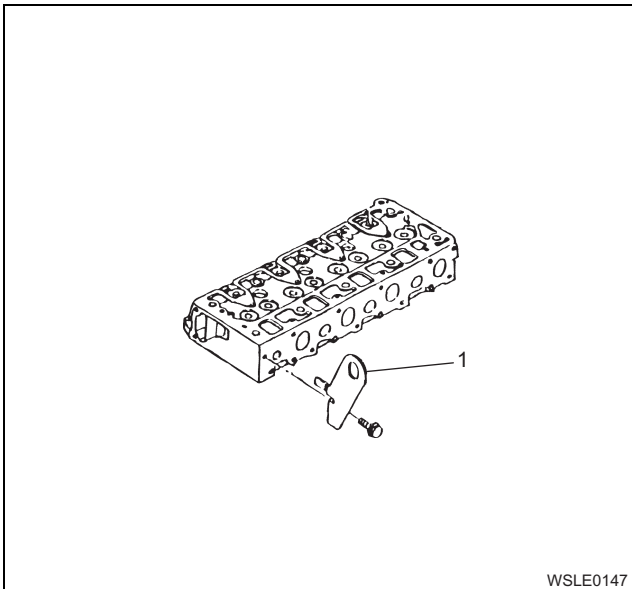


WSLE0144

5. Install the rocker arm bracket.
Refer to 1A-44, "Installation, Rocker Arm Shaft".
6. Install the front hanger and tighten to the specified torque.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}



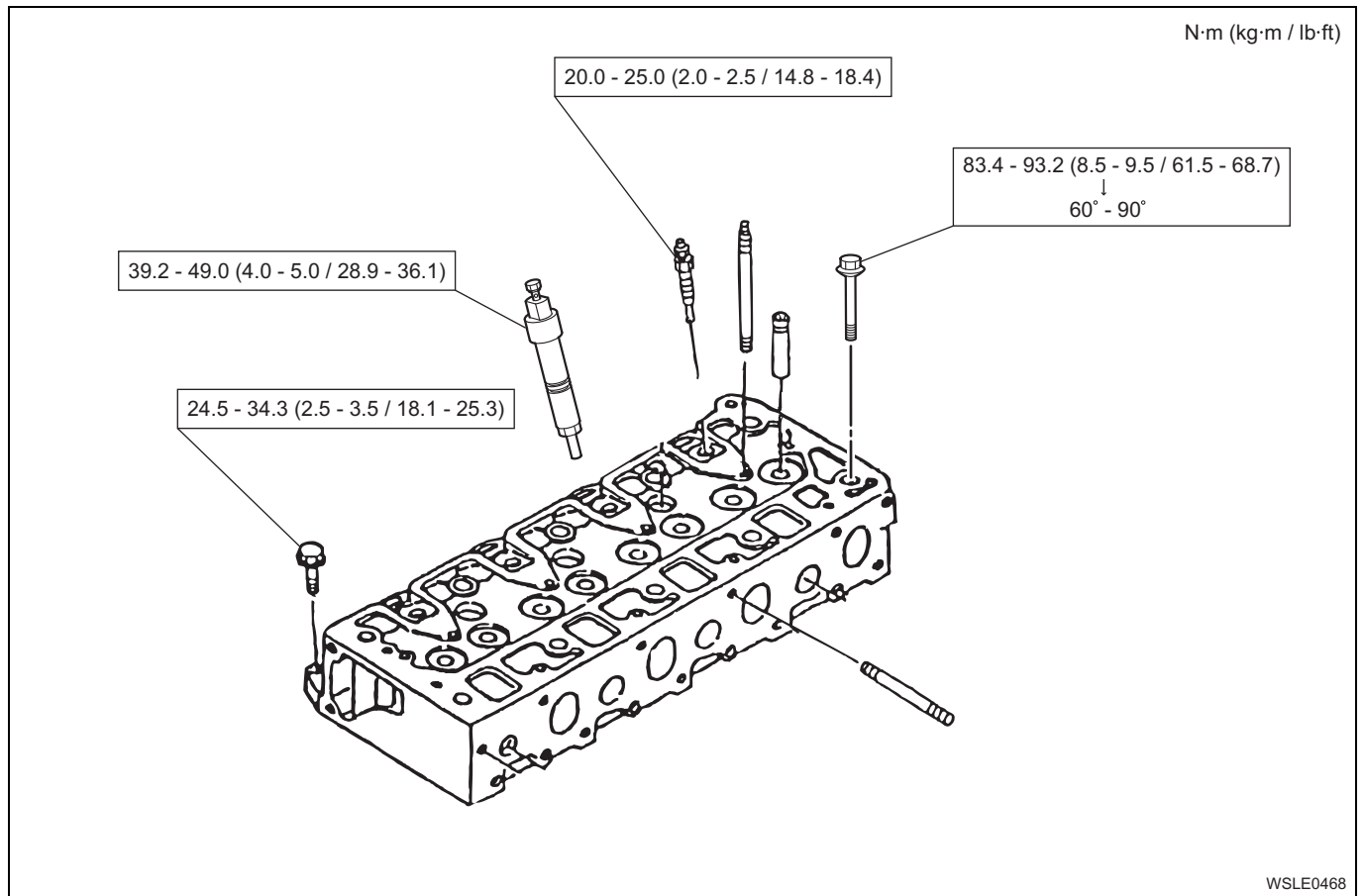
WSLE0147

Name

1. Front Hanger

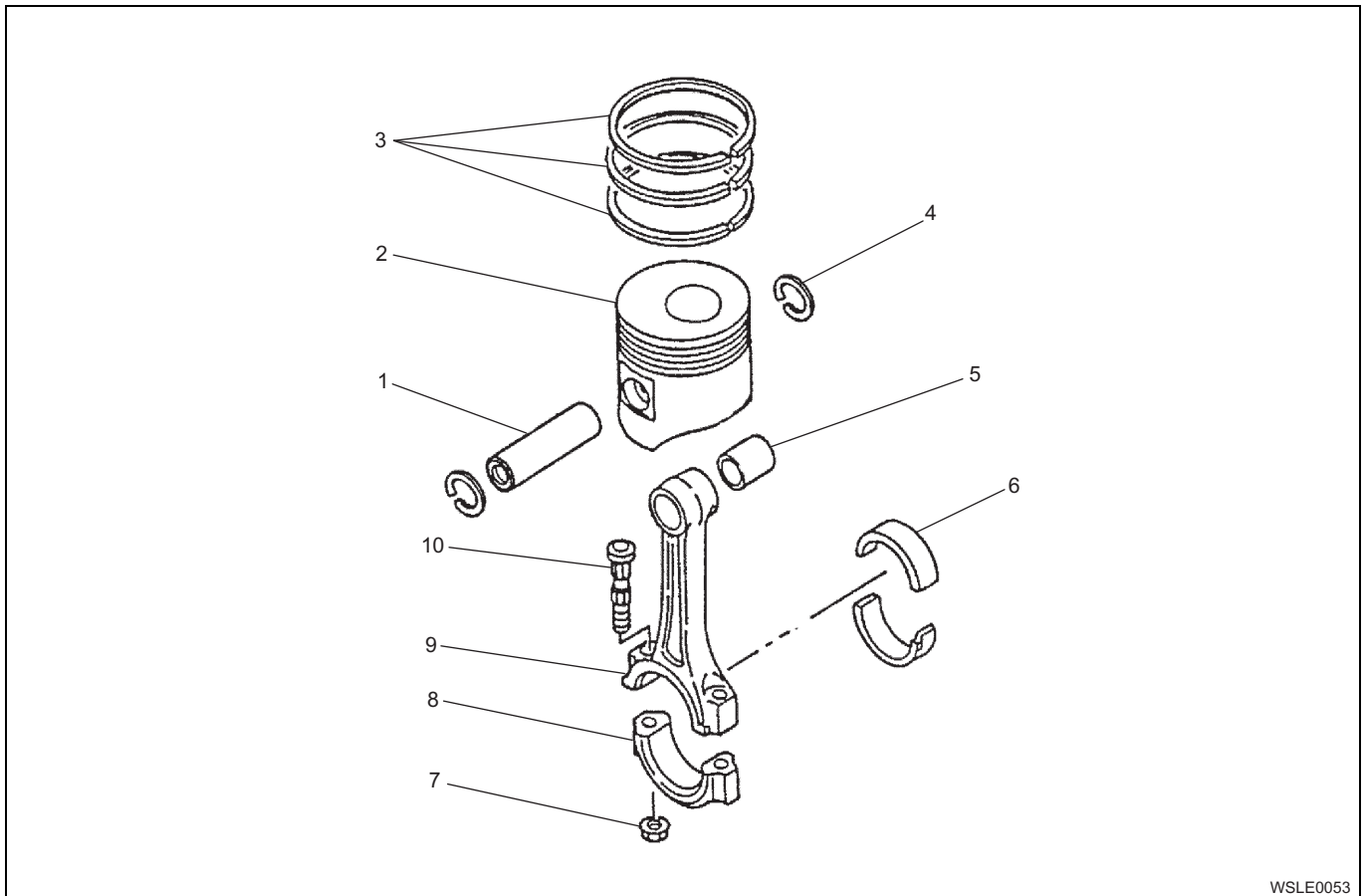
7. Install the leak-off pipe.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
8. Install the injection pipe.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
9. Install the water pump.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
10. Install the turbocharger.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
11. Install the cylinder head cover.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
12. Install the EGR cooler and the bracket.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
13. Install the generator.
Refer to 1A-14, "Installation, Engine Accessories".
14. Install the fan pulley.
Refer to 1A-14, "Installation, Engine Accessories".
15. Install the fan belt.
Refer to 1A-14, "Installation, Engine Accessories".
16. Install the cooling fan.
Refer to 1A-14, "Installation, Engine Accessories".

Torque Specifications



Piston, Connecting Rod

Components



WSLE0053

Name

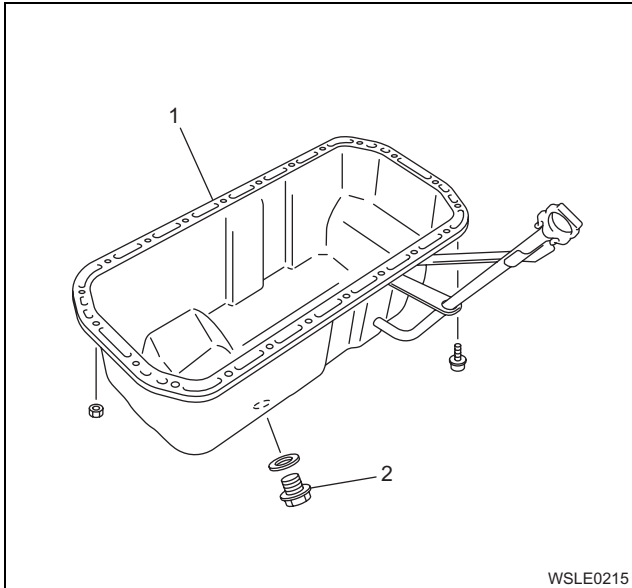
- | | |
|----------------|-------------------------|
| 1. Piston Pin | 6. Bearing |
| 2. Piston | 7. Cap Nut |
| 3. Piston Ring | 8. Cap |
| 4. Snap Ring | 9. Connecting Rod |
| 5. Bushing | 10. Connecting Rod Bolt |

Removal

1. Remove the cylinder head cover.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
2. Remove the rocker arm bracket.
Refer to 1A-41, "Removal, Rocker Arm Shaft".
3. Remove the cylinder head ASM.
Refer to 1A-47, "Removal, Cylinder Head".

1A-60 4LE1 Engine Mechanical

4. Remove the mounting bolts and nuts of the oil pan, and then remove the oil pan from the cylinder block. (M6: 18 bolts, 4 nuts)

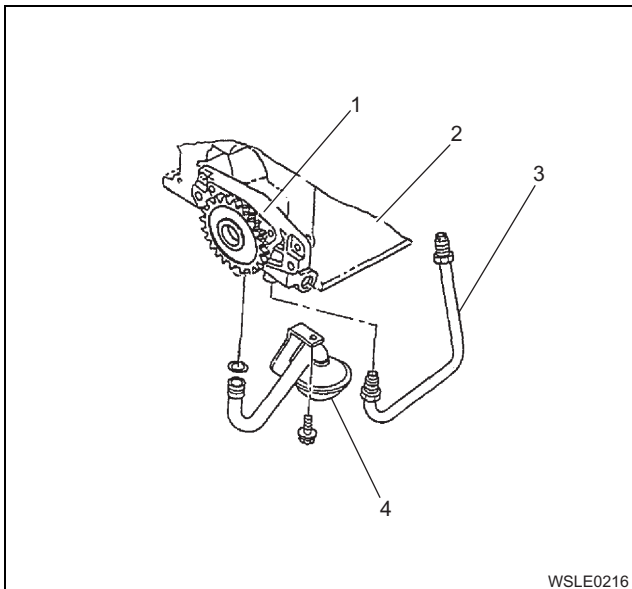


WSLE0215

Name

1. Oil Pan
2. Drain Plug

5. Remove the oil strainer mounting bolts from the bearing cap, and remove the oil strainer from the oil pump.
6. Loosen the sleeve nut and remove the oil pipe (between the oil pump and the cylinder block).



WSLE0216

Name

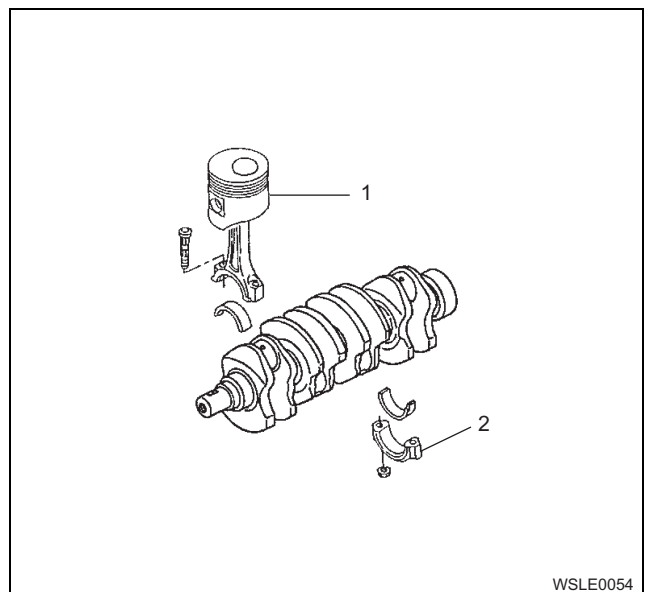
1. Oil Pump
2. Cylinder Block
3. Oil Pipe
4. Oil Strainer

7. Remove the piston and the connecting rod.
 - a. Rotate the crank and bring the removed piston to the bottom dead center.

- b. Loosen the cap nut of the connecting rod and remove the cap.
- c. Further rotate the crank and bring the piston to the top dead center.
- d. Put a handle of a hammer or something on the bottom of the connecting rod, and push the piston ASM upward from the inside of the cylinder block.

CAUTION:

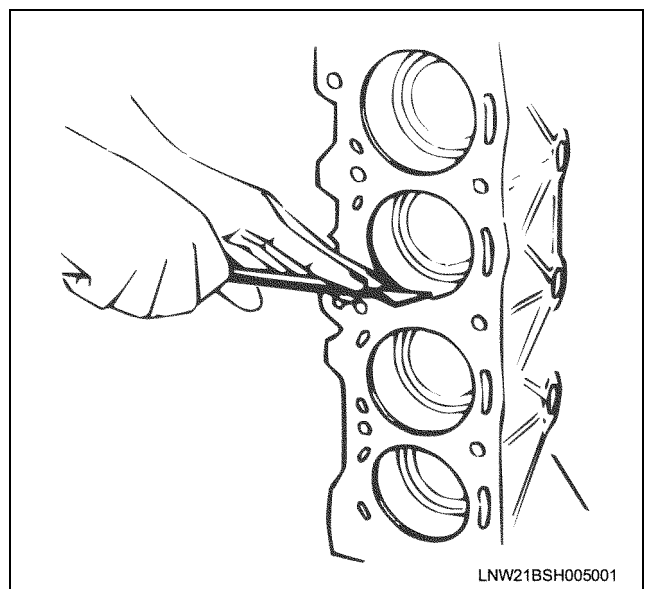
- Remove any carbon attached to the inner wall of the cylinder using a scraper before removing the piston.
- Be careful not to damage the inner wall of the cylinder when pushing out the piston ASM.
- Attach tags with each cylinder number to the removed cap and the bearing and arrange them.



WSLE0054

Name

1. Piston
2. Connecting Rod Cap



LNW21BSH005001

Disassembly

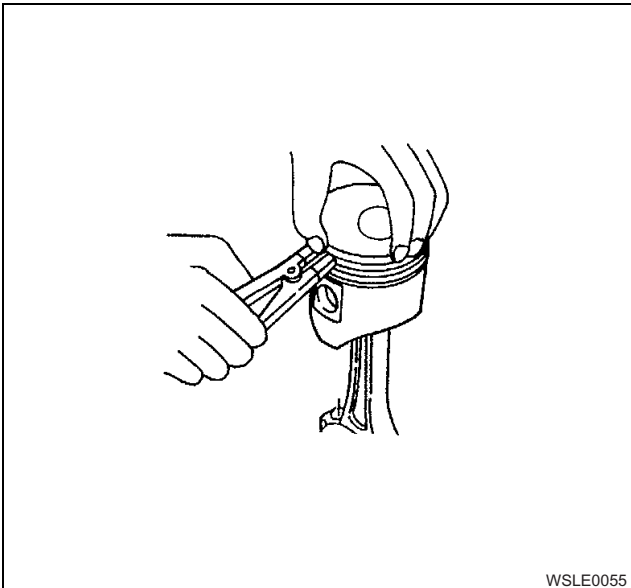
1. Use the piston ring setting tool (tool commercially available is also acceptable) to remove the piston ring.

Special tool

Piston ring setting tool
1-8522-1029-0

CAUTION:

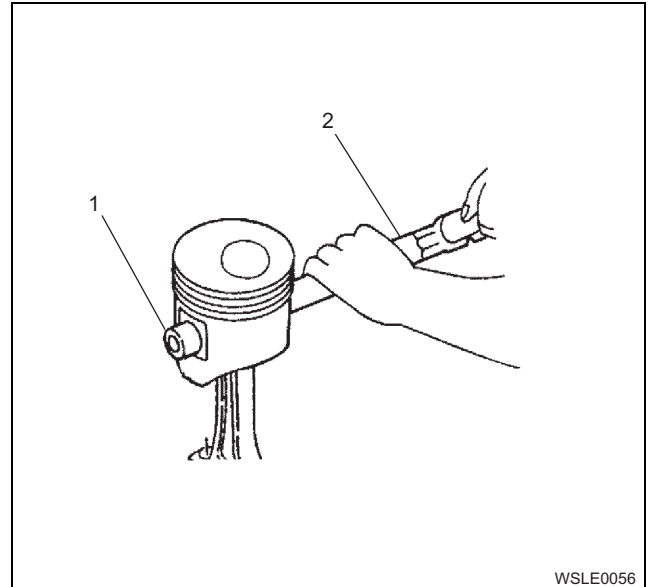
Piston ring deforms if it is expanded beyond the limit.



2. Remove the piston pin.
 - a. Use a commercial tool to remove the snap ring.
 - b. Put a brass stick on the piston pin and gently tap by a hammer to knock it out.

CAUTION:

Put the piston, piston ring, piston pin, connecting rod, and so on in order according to the cylinder number.



Name

1. Piston Pin
2. Brass Stick

Inspection

Axial play of the connecting rod and the crank pin

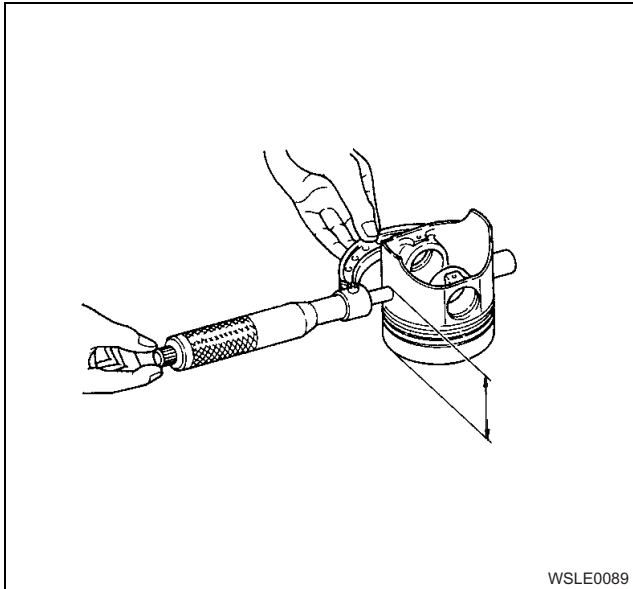
Measure an axial play before removing the connecting rod.

1. Pull the connecting rod all the way to the front.
2. Insert a thickness gauge to the clearance between the connecting rod cap and the crankshaft, and then measure a play.

		mm {in}
Standard value	Service limit	
0.20 — 0.33 {0.008 — 0.013}	0.35 {0.014}	

Inspection of clearance with the cylinder bore

1. Measure the outside diameter of the piston at the specified distance from top surface in the right-angle direction to the piston pin.
Measurement position of outside diameter: 54.85 mm {2.159 in} from the top surface.



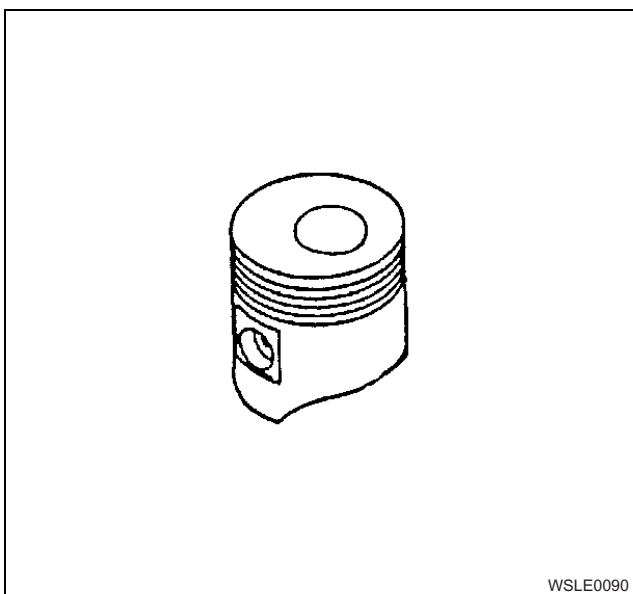
WSLE0089

2. Calculate the clearance by the dimension of the cylinder bore and the outside diameter dimension of the piston.

mm {in}	
Clearance with major axis	0.040 — 0.085 {0.0016 — 0.0033}

Outside diameter of the piston for service

mm {in}	
Piston outside diameter	Grade
$\phi 84.945$ — 84.960 {3.3443 — 3.3449}	NON
$\phi 85.195$ — 85.210 {3.3541 — 3.3547}	025

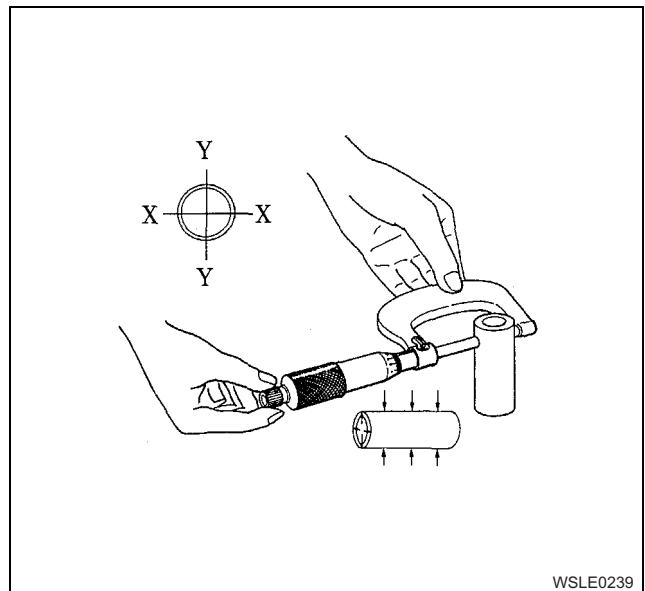


WSLE0090

Inspection for wear of the piston pin (outside diameter)

Use a micrometer to measure the outside diameter of the piston pin.
If the measured value exceeds the limit, replace the piston pin.

			mm {in}
	Nominal dimension	Service limit	Repairing procedure
Connecting rod small end diameter ($\phi 27$ mm {1.063 in})	$\phi 27$ {1.063}	$\phi 26.970$ {1.0618}	Replace.
Connecting rod small end diameter ($\phi 25$ mm {0.9843 in})	$\phi 25$ {0.9843}	$\phi 24.970$ {0.9449}	



WSLE0239

Inspection of clearance between the piston pins and piston pin holes

Measure the inner diameter of the piston pin hole and calculate the clearance with the outside diameter of the piston pin.

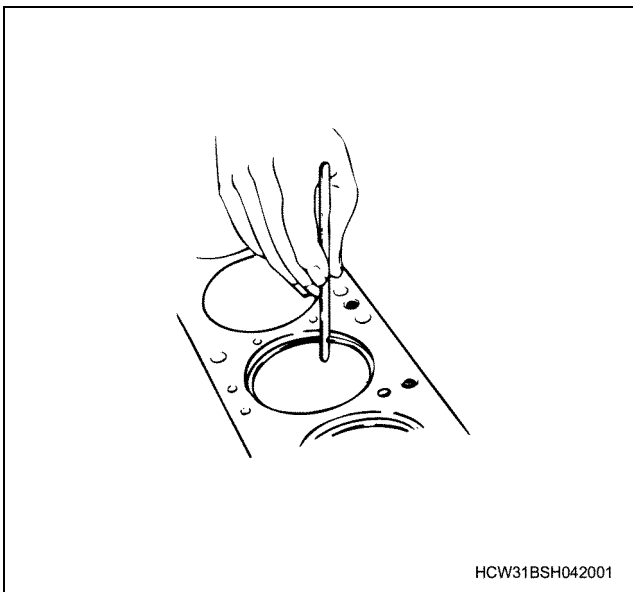
mm {in}	
Standard value	
0.004 — 0.017 {0.00016 — 0.00070}	

Inspection of piston ring end gap

Insert the ring to the cylinder bore and push it with the piston head so that the ring makes a right angle with the cylinder, then measure.

Connecting rod small end diameter ($\phi 27$ mm mm {in} {1.063 in})			
	Standard value	Service limit	Repairing procedure
Top ring	0.20 — 0.35 {0.008 — 0.014}	1.5 {0.059}	Replace.
Second ring	0.20 — 0.40 {0.008 — 0.016}		
Oil ring	0.20 — 0.40 {0.008 — 0.016}	1.0 {0.039}	

Connecting rod small end diameter ($\phi 25$ mm mm {in} {0.9843 in})			
	Standard value	Service limit	Repairing procedure
Top ring	0.20 — 0.35 {0.008 — 0.014}	1.5 {0.059}	Replace.
Second ring	0.35 — 0.50 {0.014 — 0.020}		
Oil ring	0.20 — 0.40 {0.008 — 0.016}	1.0 {0.039}	



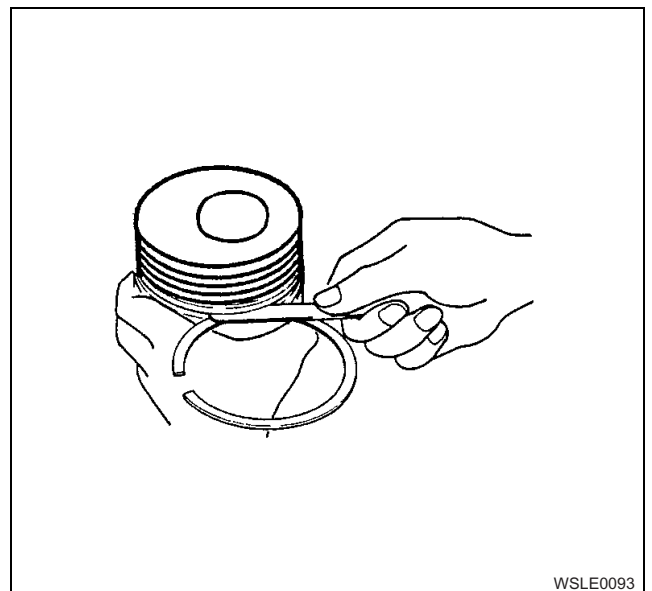
Inspection of clearance between the piston ring groove and the ring

1. Remove any carbon sludge from the piston ring groove.
Using the old piston ring helps you to remove the carbon easily.
2. Measure the clearance between the piston ring and the ring groove using a thickness gauge at several points.
If the measured value exceeds the limit, replace the piston ring or the piston.

CAUTION:
When replacing the piston, replace the piston ring also at the same time.

Connecting rod small end diameter ($\phi 27$ mm mm {in} {1.063 in})			
	Standard value	Service limit	Repairing procedure
Top ring	It cannot be measured due to the taper type ring.	—	Replace the ring or the piston.
Second ring	0.070 — 0.110 {0.0028 — 0.0043}	0.15 {0.006}	
Oil ring	0.030 — 0.070 {0.00120 — 0.00276}		

Connecting rod small end diameter ($\phi 25$ mm mm {in} {0.9843 in})			
	Standard value	Service limit	Repairing procedure
Top ring	0.085 — 0.120 {0.0033 — 0.0047}	0.2 {0.008}	Replace the ring or the piston.
Second ring	0.050 — 0.085 {0.0020 — 0.0033}	0.15 {0.006}	
Oil ring	0.030 — 0.065 {0.00120 — 0.00256}		



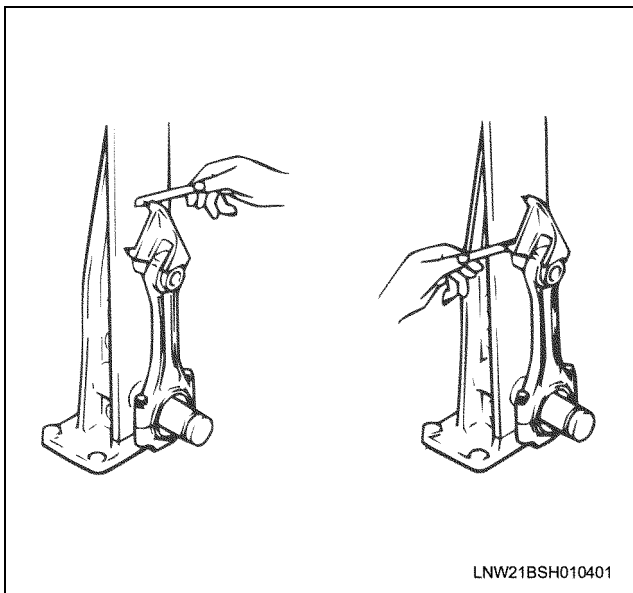
Inspection of distortion and parallelism of the connecting rod

Use a connecting rod aligner to measure it.

1A-64 4LE1 Engine Mechanical

Connecting rod small end diameter ($\phi 27$ mm mm {in} {1.063 in})			
	Standard value	Service limit	Repairing procedure
Distortion (L = per 24 mm {0.945 in})	0.05 {0.002} or less	0.2 {0.008}	Repair or replace.
Parallelism (L = per 100 mm {3.937 in})	0.075 {0.003} or less	0.15 {0.006}	

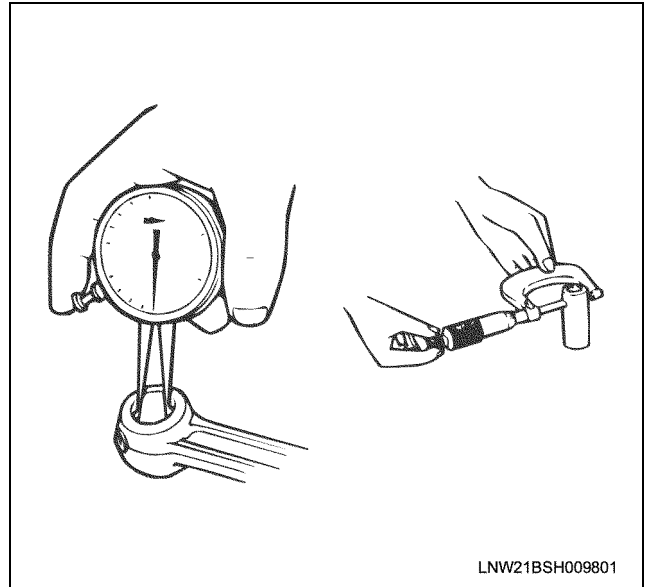
Connecting rod small end diameter ($\phi 25$ mm mm {in} {0.9843 in})			
	Standard value	Service limit	Repairing procedure
Distortion (L = per 100 mm {3.937 in})	0.08 {0.003} or less	0.2 {0.008}	Repair or replace.
Parallelism (L = per 100 mm {3.937 in})	0.05 {0.002} or less	0.15 {0.006}	



Inspection of clearance between the connecting rod small end pin holes and the piston pins

Measure the bushing bore and the piston pin outside diameter and calculate the clearance.

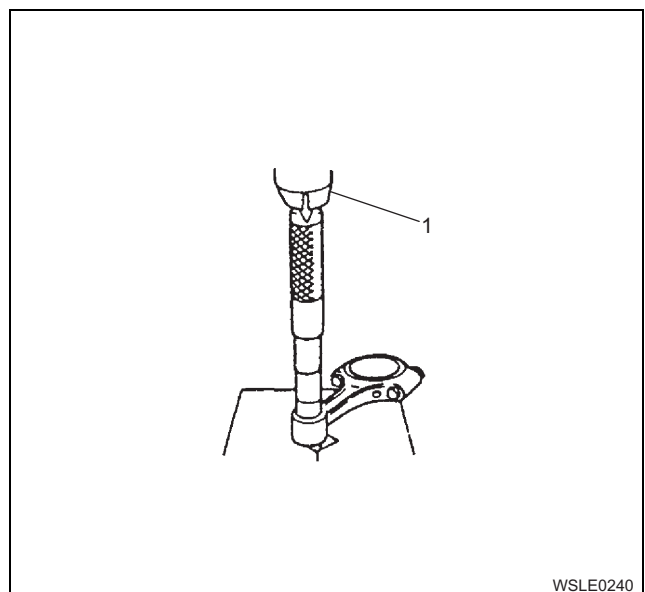
mm {in}		
Standard value	Service limit	Repairing procedure
0.008 — 0.020 {0.00031 — 0.00079}	0.05 {0.002}	Replace the bushing or the piston pin.



Replacement of bushing

Use the bench press to press-fit the bushing to the connecting rod.

Finished size of the bore after the bushing is press-fitted	
	Standard value
Connecting rod small end diameter ($\phi 27$ mm {1.063 in})	$\phi 27.00$ {1.063} (+0.008 — 0.015 {+0.00031 — 0.00060})
Connecting rod small end diameter ($\phi 25$ mm {0.9843 in})	$\phi 25.00$ {0.9843} (+0.008 — 0.015 {+0.00031 — 0.00060})



Name

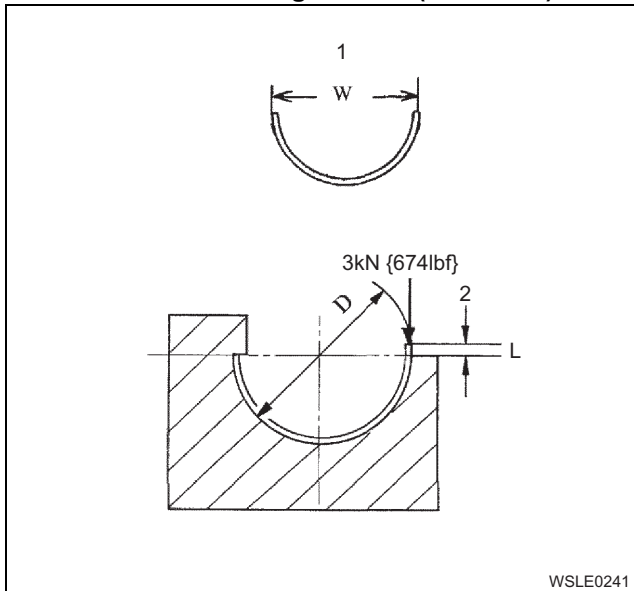
1. Press

Inspection of tension of the connecting rod bearing

Check whether the tension of the bearing is sufficient.

mm {in}		
	Standard value	Repairing procedure
Connecting rod small end diameter ($\phi 27$ mm {1.063 in})	W = 49.5 {1.949} or more D = $\phi 49$ {1.929} L = 0.055 — 0.085 {0.00217 — 0.00330}	Use the one with extrusion and tension, and be careful about sticking of rear side.
Connecting rod small end diameter ($\phi 25$ mm {0.9843 in})	W = 52.5 {2.067} or more D = $\phi 52$ {2.047} L = 0.04 — 0.08 {0.00157 — 0.00315}	

Standard for the bearing tension (reference)



Name

1. Tension (Free Condition)
2. Extrusion

Clearance between the bearing and the crank pin

1. Tighten the bearing cap to the specified torque. Then measure the inside diameter.

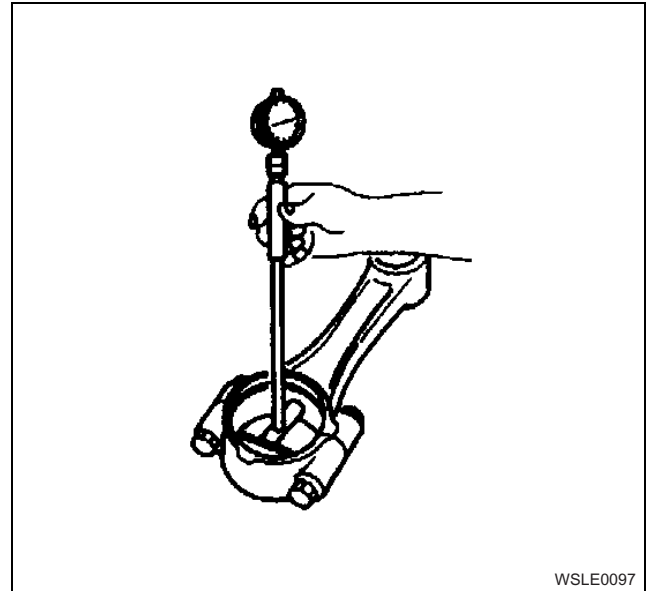
Tightening torque:

Connecting rod small end diameter ($\phi 27$ mm {1.063 in}): 23 — 26 N·m {2.3 — 2.7 kgf·m/17.0 — 19.2 lb·ft} → 100° — 115°

Connecting rod small end diameter ($\phi 25$ mm {0.9843 in}): 73.5 — 83.4 N·m {7.5 — 8.5 kgf·m/54.2 — 61.5 lb·ft}

2. Measure the outside diameter of the after-mentioned crankshaft pin, and calculate the clearance.

mm {in}		
Standard value	Service limit	Repairing procedure
0.035 — 0.073 {0.0014 — 0.0029}	0.1 {0.0039}	Replace the bearing.



Inspection of outside diameter of the crankshaft pin

Measure the outside diameter of the crankshaft pin, and calculate the wear and the uneven wear. If it exceeds the limit, replace the crankshaft.

1. Nominal dimension

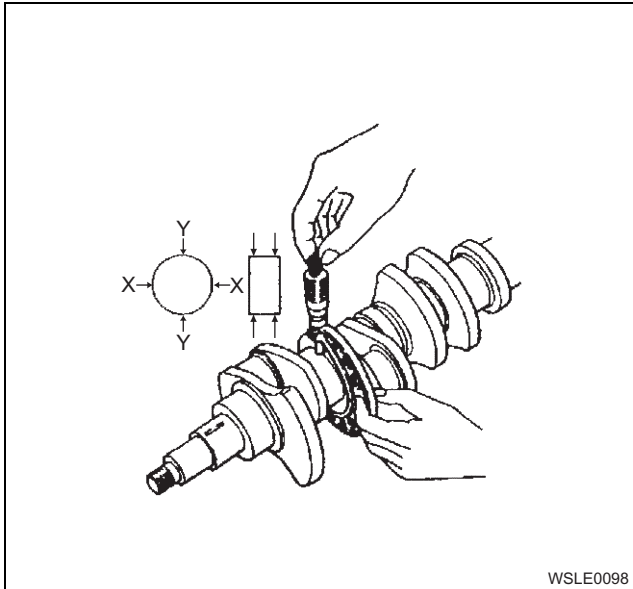
mm {in}		
Pin	Connecting rod small end diameter ($\phi 27$ mm {1.063 in})	$\phi 46$ {1.811}
	Connecting rod small end diameter ($\phi 25$ mm {0.9843 in})	$\phi 49$ {1.929}

2. Uneven wear (the difference between the measurements in X — X, Y — Y directions)

mm {in}		
	Service limit	Repairing procedure
Pin	0.05 {0.002}	Replace the crankshaft.

3. Amount of wear

mm {in}		
	Service limit	Repairing procedure
Pin	0.13 {0.005}	Replace the crankshaft.



WSLE0098

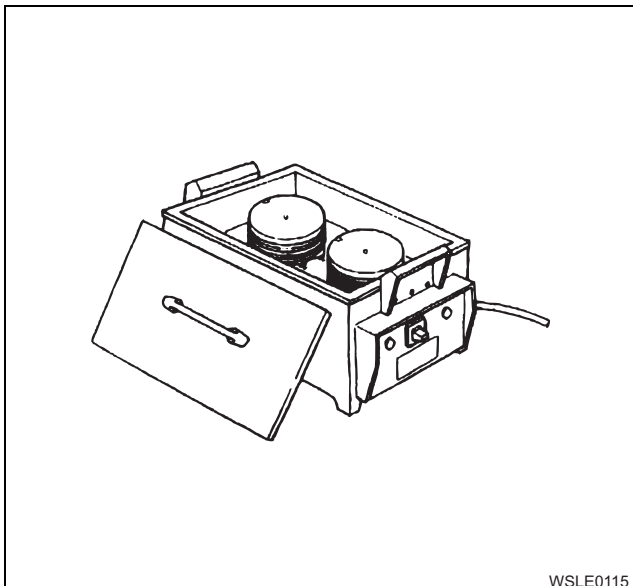
Cylinder and piston combination

The pistons are selected by the grade when assembled at the factory. However, the grades are not set to the standard pistons for service.

Cylinder bore grade	Piston grade	
	At the ISUZU factory	When servicing
A	A	NON-Grade
B	B	
C	C	

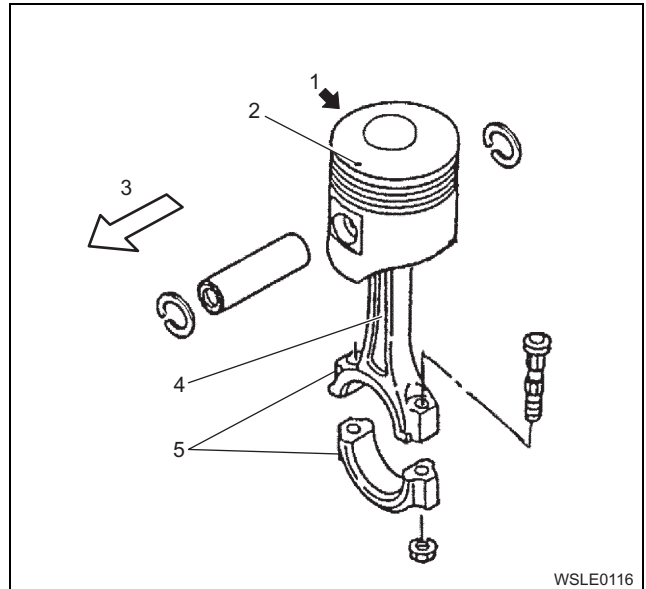
Reassembly

1. Assemble pistons and connecting rods.
 - a. It is advisable to warm the piston at a temperature of approx. 100°C {212°F} with a piston heater. However, the piston is able to be assembled when it is cold.



WSLE0115

- b. Apply engine oil sufficiently to the piston pin.
 - c. Assemble the connecting rod with the cylinder number stamped side facing the piston combustion chamber direction, and push in the piston pin.
- At this time, check that the front mark on the piston head and the casting mark (ISUZU) on the connecting rod are in the same direction.



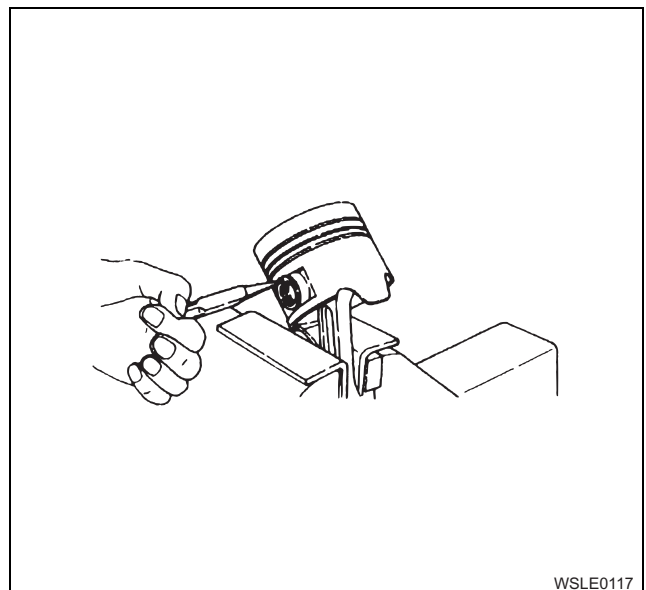
WSLE0116

Name

1. Combustion Receiver Side
2. Front Mark
3. Engine Forward Direction
4. ISUZU Mark
5. Cylinder Number Stamped Side

2. Install the snap ring.

Insert the snap ring and fix it with the piston pin. Check to see the piston and connecting rod move smoothly.



WSLE0117

3. Install the piston ring.
Use the piston ring setting tool to install the piston ring.

Special tool

Piston ring setting tool
1-8522-1029-0

- a. Install the oil ring so that the end of the ring is in the opposite direction of 180° to that of the coil expander.

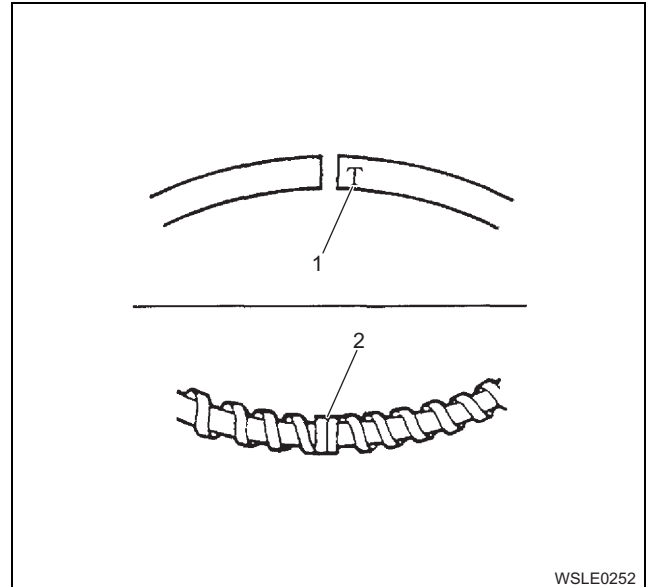
Note:

For the coil expander, make sure that there is no gap in the joint.

- b. Install the compression rings with T, 1T or 2T mark facing upward in the order of the second and top compression rings.

CAUTION:

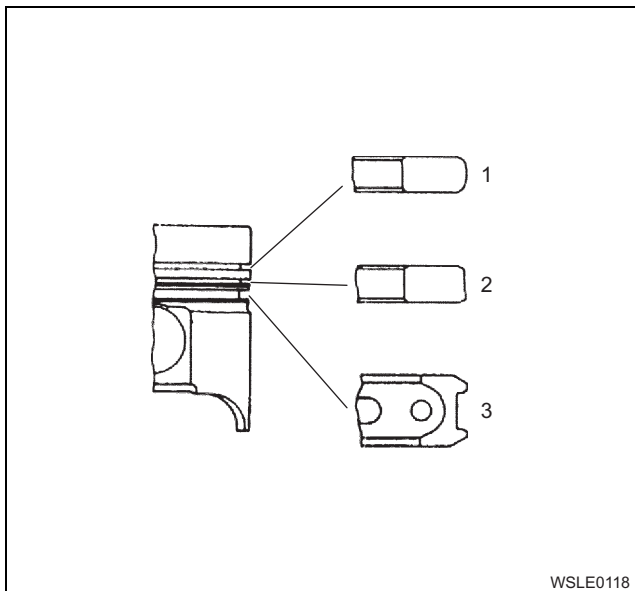
The shapes of the top and second compression rings are different.



WSLE0252

Name

1. T, 1T or 2T
2. Joint



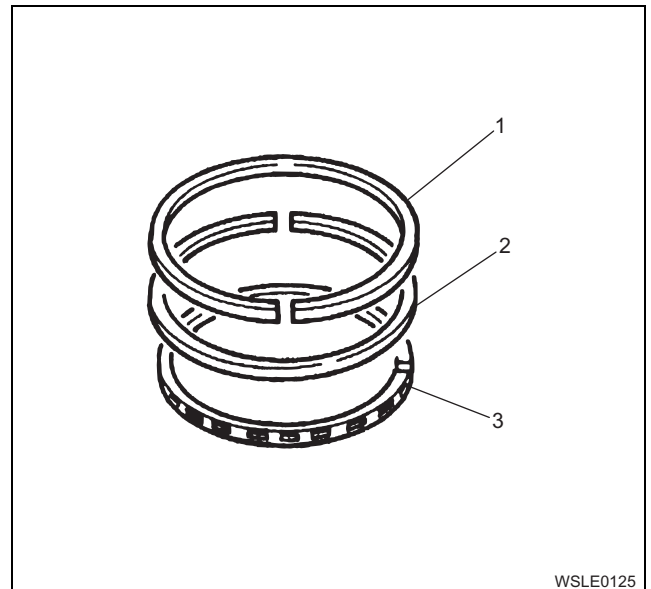
WSLE0118

Name

1. Top Ring
2. Second Ring
3. Oil Ring

Installation

1. Before inserting the piston ASM to the cylinder, set the piston ring end as shown in the illustration, avoiding the side-pressure direction (the right-angle direction to the piston pin).



WSLE0125

Name

1. Top Ring
2. Second Ring
3. Oil Ring

2. Bring the crankshaft to the top dead center position.
3. Install the bearing to the connecting rod and the bearing cap.

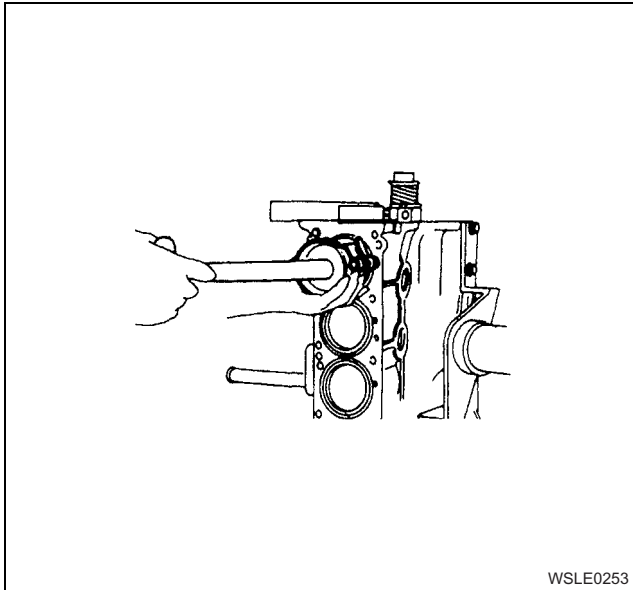
1A-68 4LE1 Engine Mechanical

4. Apply engine oil to the inside of the bearing, the piston ring, the ring groove and the side surface of the piston, and the inside of the cylinder. Then push the piston in the cylinder bore with the front mark on it facing forward.

Also, check that the connecting rod alignment number (cylinder number) is facing to the injection pump side.

Special tool

Piston ring compressor
5-8840-9018-0



5. Install the connecting rod cap.
 - a. Rotate the crank slowly to the bottom dead center position.
At this time, push in the piston ASM as it follows the crank.
 - b. Apply engine oil to the bearing and crank pin, and install aligning the marking numbers of the connecting rod and the bearing cap.
 - c. Apply engine oil to the threads and the seating surface of the connecting rod.

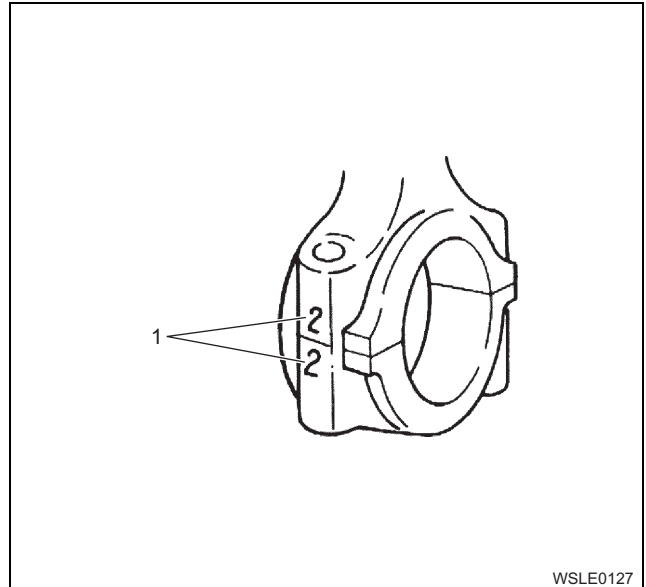
Tightening torque:

Connecting rod small end diameter ($\phi 27$ mm {1.063 in}): 23 — 26 N·m {2.3 — 2.7 kgf·m/17.0 — 19.2 lb·ft} → 100° — 115°

Connecting rod small end diameter ($\phi 25$ mm {0.9843 in}): 73.5 — 83.4 N·m {7.5 — 8.5 kgf·m/54.2 — 61.5 lb·ft}

Note:

Check that the crankshaft turns smoothly after assembly of the connecting rod.



Name

1. Cylinder Number

6. Install the oil pipe (between the oil pump and the cylinder block) and tighten the sleeve nut.

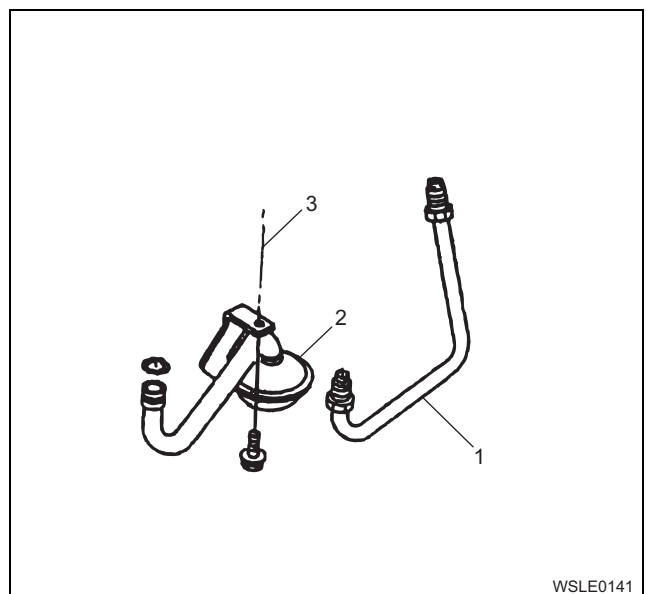
Tightening torque:

24.5 — 34.3 N·m {2.5 — 3.5 kgf·m/18.1 — 25.3 lb·ft}

7. Install the oil strainer to the oil pump and tighten the strainer bracket to No.2 bearing cap.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}



Name

1. Oil Pipe
2. Oil Strainer
3. To No.2 Bearing Cap

8. Install the oil pan.
 - a. Install the oil pan and the packing to the cylinder block and tighten the bolts evenly.

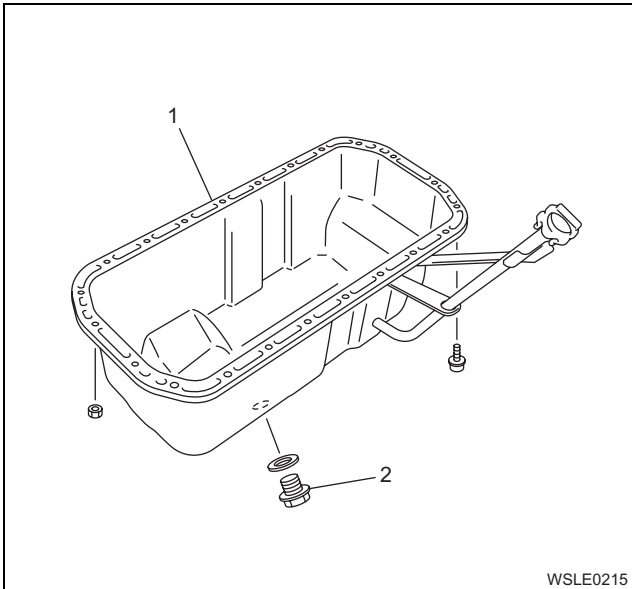
Tightening torque:

7.8 — 11.8 N·m {0.8 — 1.2 kgf·m/5.8 — 8.7 lb·ft}

- b. Install the drain plug.

Tightening torque:

68.6 — 88.2 N·m {7.0 — 9.0 kgf·m/50.6 — 65.1 lb·ft}

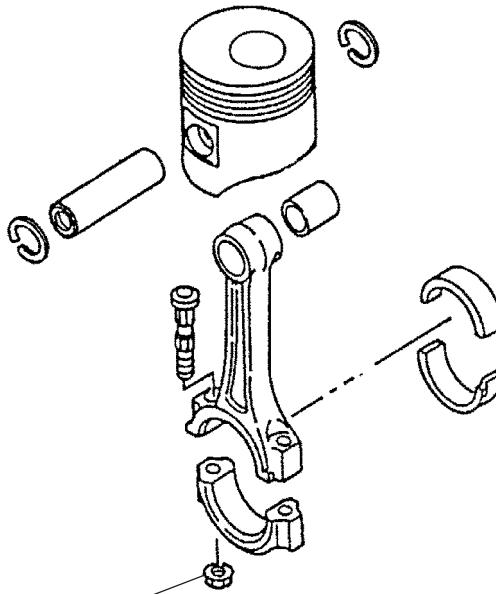
**Name**

1. Oil Pan
2. Drain Plug

9. Install the cylinder head ASM.
Refer to 1A-56, "Installation, Cylinder Head".
10. Install the rocker arm bracket.
Refer to 1A-44, "Installation, Rocker Arm Shaft".
11. Install the cylinder head cover.
Refer to 1A-29, "Installation, Engine Exterior Equipment".

Torque Specifications

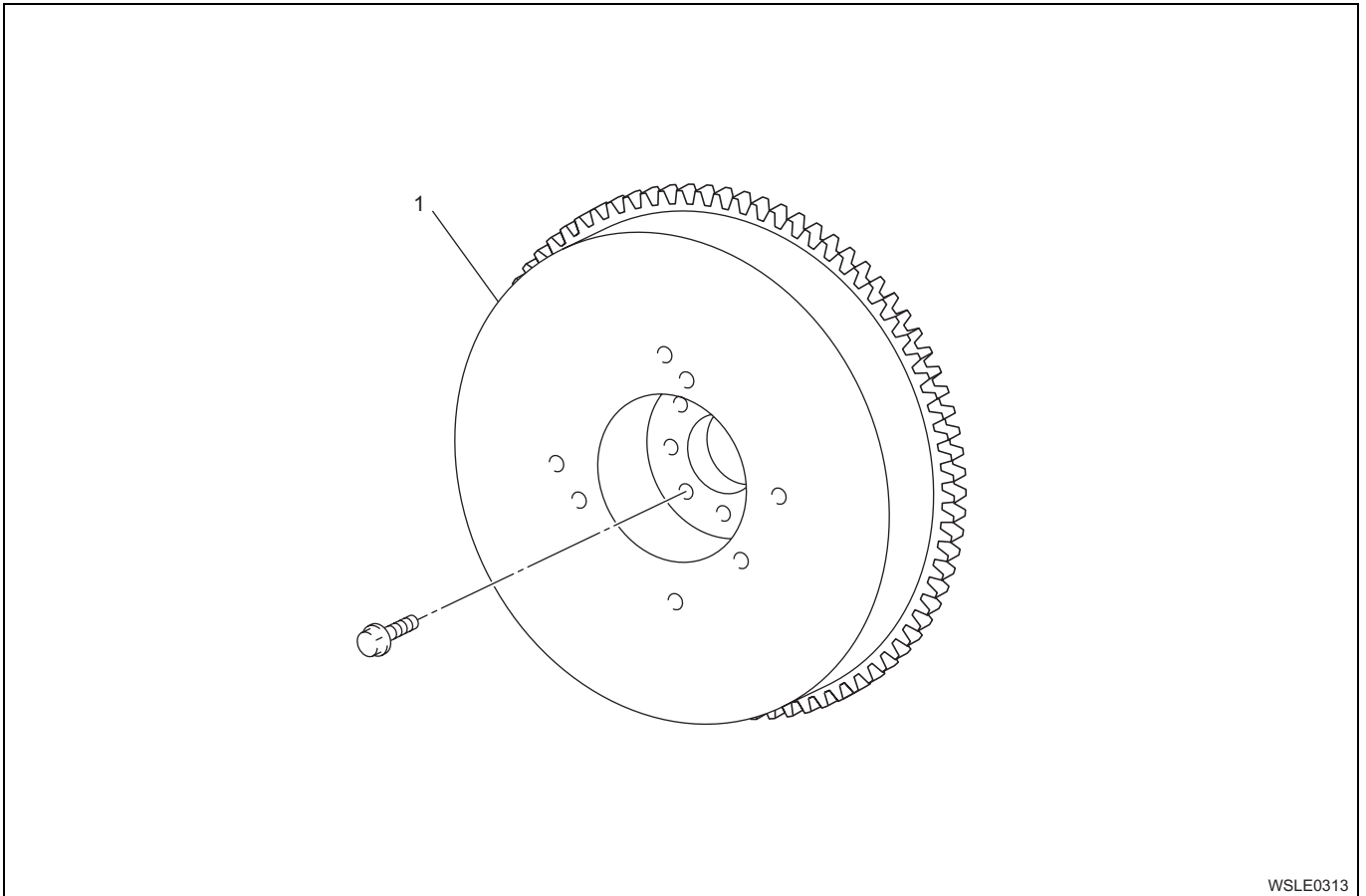
N·m (kg·m / lb·ft)



Connecting rod small end ($\phi 27\text{mm}$ {1.063in})
: 23 - 26 (2.3 - 2.7 / 17.0 - 19.2) \rightarrow 100° - 115°
Connecting rod small end ($\phi 25\text{mm}$ {0.9843in})
: 73.5 - 83.4 (7.5 - 8.5 / 54.2 - 61.5)

Flywheel

Components



WSLE0313

Name

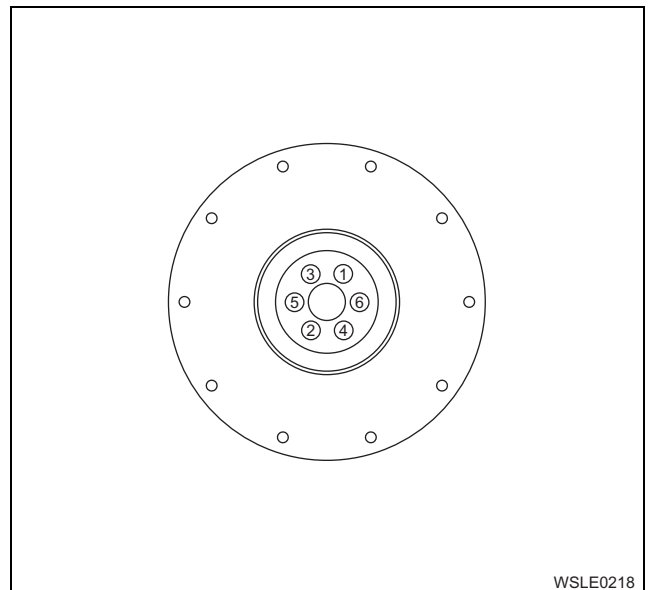
1. Flywheel

Removal

1. Remove the flywheel.
 - a. Block the crankshaft from rotating, and loosen the mounting bolts in the order indicated in the diagram to remove the flywheel.
 - b. Put alignment marks before removing the flywheel from the crankshaft. (Doing so makes installing easy because the positions of the mounting bolts are fixed even if pitch of them is not equal.)
 - c. Gently tap the flywheel by a plastic hammer or similar tool to remove it.

CAUTION:

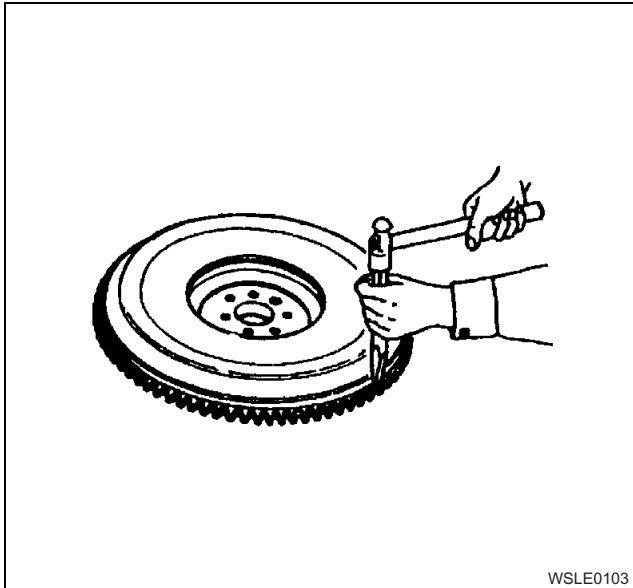
Be careful not to damage the ring gear.



WSLE0218

1A-72 4LE1 Engine Mechanical

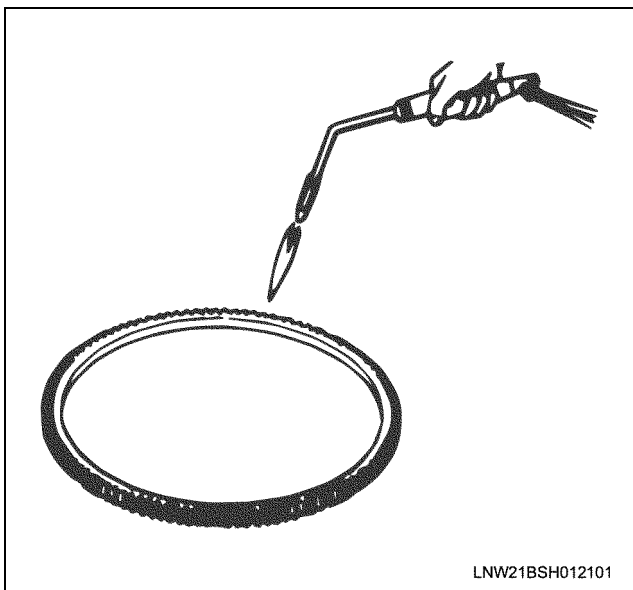
2. Take out the ring gear.
Put a brass stick on the ring gear and strike with a hammer to remove it.



Installation

1. Install the ring gear.
Heat the ring gear evenly using a gas burner and strike with a hammer to install it.
After shrinkage fit, make sure that the ring gear is stuck to the flywheel.

CAUTION:
Do not heat the ring gear at a temperatures above 200°C {392°F}.



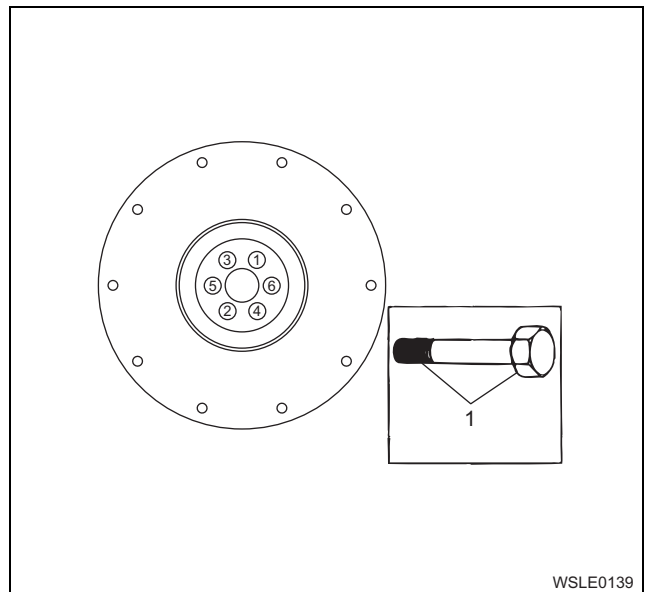
2. Install the flywheel.
Apply engine oil to the threads and the seating surface of the mounting bolts, and then install the flywheel to the crankshaft.
Tighten the mounting bolts in a balanced way in the numerical order shown in the illustration.

Tightening torque:

88.3 — 108 N·m {9.0 — 11.0 kgf·m/65.1 — 79.7 lb·ft}

Note:

Install the flywheel checking the installation position since the bolt hole pitch is not equal.

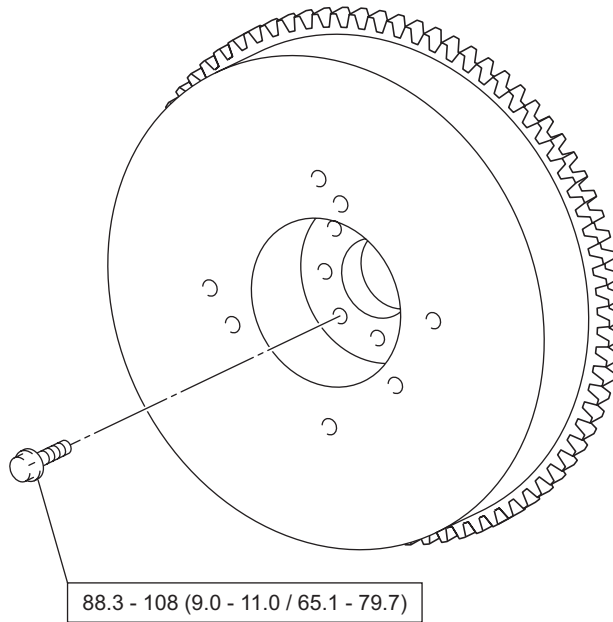


Name

1. Engine Oil Application

Torque Specifications

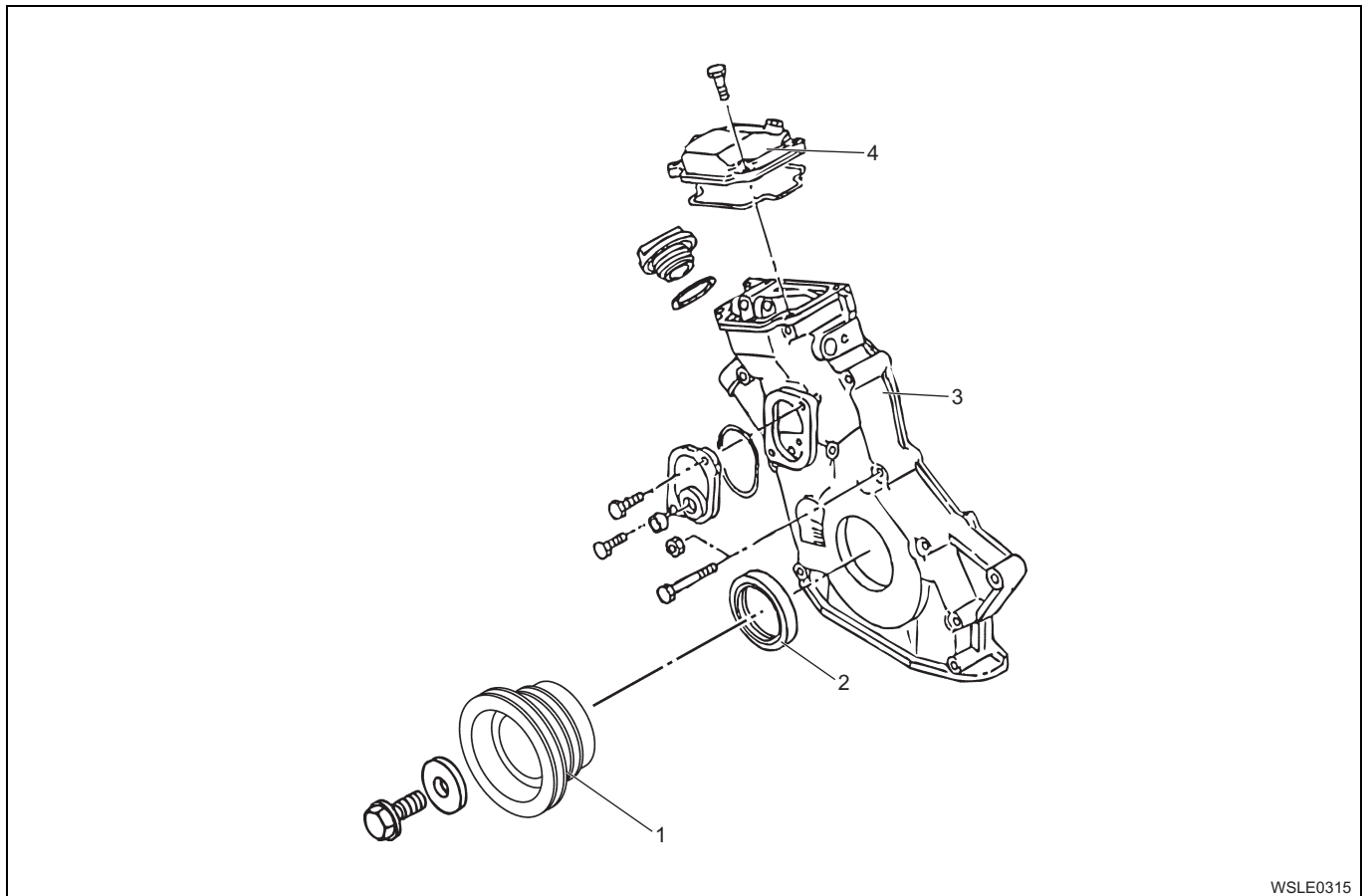
N·m (kg·m / lb·ft)



WSLE0314

Crankshaft Front Oil Seal

Components



WSLE0315

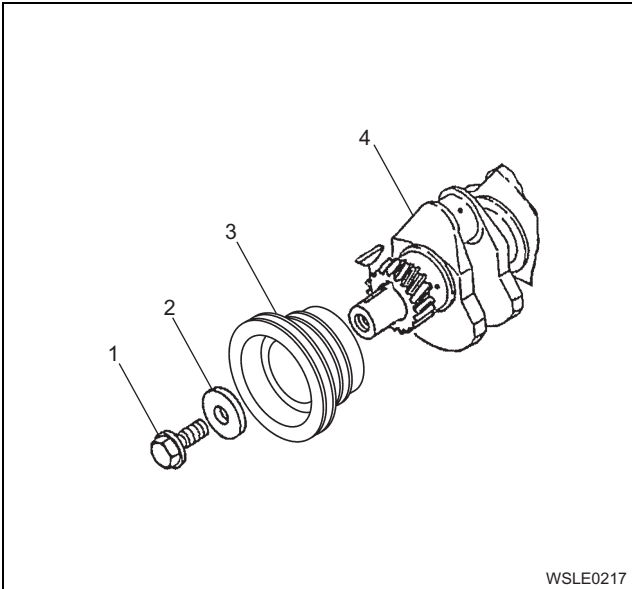
Name

- | | |
|----------------------|---------------------|
| 1. Crankshaft Pulley | 3. Timing Gear Case |
| 2. Front Oil Seal | 4. Governor Cover |

Removal

1. Remove the cooling fan and the fan belt.
Refer to 1A-14, "Removal, Engine Accessories".
2. Remove the fan pulley.
Refer to 1A-14, "Removal, Engine Accessories".
3. Remove the generator.
Refer to 1A-14, "Removal, Engine Accessories".
4. Remove the generator bracket.
Refer to 1A-14, "Removal, Engine Accessories".
5. Remove the injection pipe.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
6. Remove the fuel pipe.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
7. Remove the solenoid ASM.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
8. Remove the injection pump housing cover.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
9. Remove the injection pump.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
10. Remove the control link.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
11. Remove the oil pan.
Refer to 1A-59, "Removal, Piston, Connecting Rod".
12. Remove the crank pulley.
 - a. Block the crankshaft from rotating, and loosen the mounting bolts of the pulley to remove it.
 - b. Remove the washer and the pulley.

CAUTION:
Do not reuse the bolt and washer.



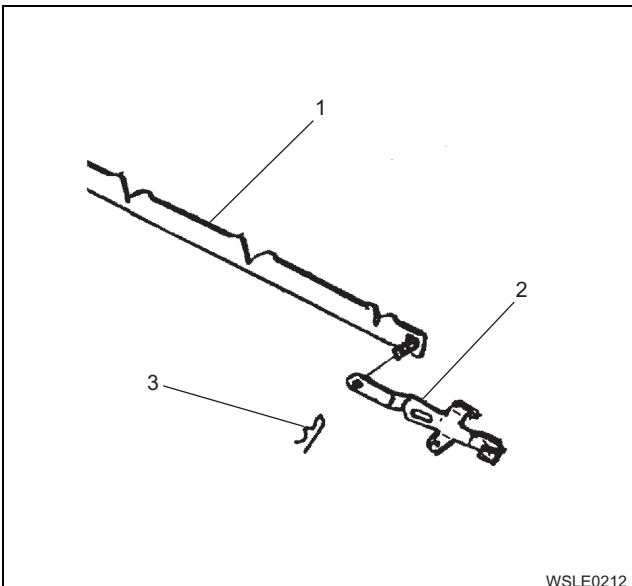
WSLE0217

Name

1. Mounting Bolt
2. Washer
3. Crank Pulley
4. Crankshaft

13. Remove the timing gear case.

- a. Before removing the timing gear case, make sure that control link supported by the cylinder block and the link plate of the governor are separated.
If they are connected, remove the snap pin and separate them.



WSLE0212

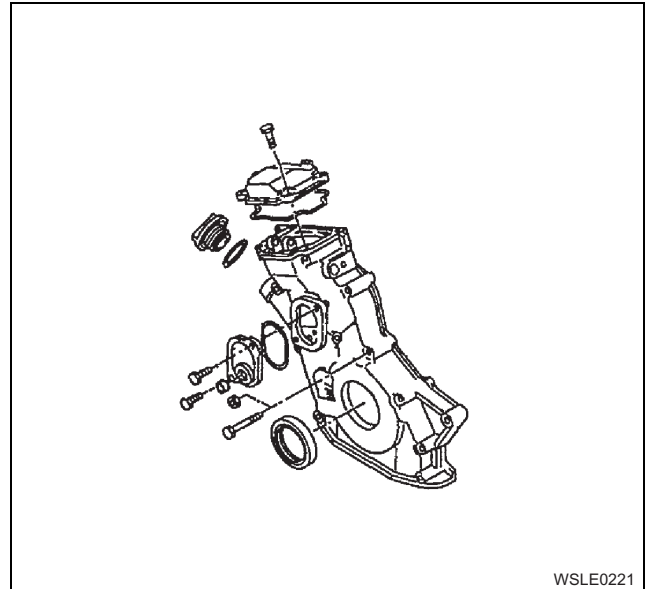
Name

1. Control Link
2. Link Plate (Governor)
3. Snap Pin

- b. The timing gear case should be removed with the governor and the front oil seal.

Note:

Since liquid gasket is applied to the mating surface to the cylinder block, take great care not to remove them forcedly to damage or deform them.



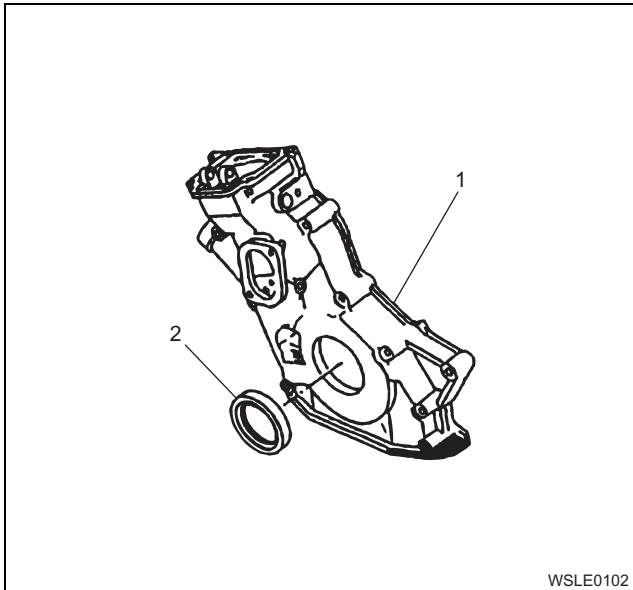
WSLE0221

14. Remove the front oil seal from the timing gear case.
 - Remove the oil seal with a screwdriver avoiding damage to the oil seal contact surface on the timing gear case.

Inspection

Inspection of oil seal

If fault is found in the lip section of the oil seal, replace it with the new one.



WSLE0102

Name

1. Timing Gear Case
2. Front Oil Seal

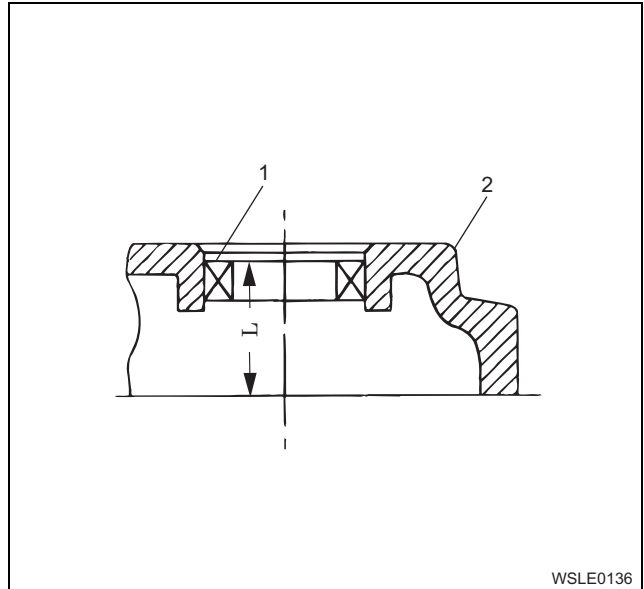
Installation

1. Install the front oil seal.
 - a. Apply enough engine oil to the felt section of the oil seal.
 - b. Install the front oil seal to the timing gear case with a front oil seal installer. Install it at the position due to the L dimension shown in the illustration.

Special tool

Front oil seal installer
5-8840-9031-0

	mm {in}
L dimension	60.5±0.1 {2.382±0.0039}



WSLE0136

Name

1. Front Oil Seal
2. Timing Gear Case

2. Install the timing gear case (with governor) to the cylinder block.
 - a. Let the link plate of the governor which is assembled in the gear case through the connection hole of the injection pump.
 - b. Apply engine oil to the both ends of the bushing section of the governor main spring lever.
 - c. Apply the liquid gasket (TB1207B) to the gear case and install to the cylinder block.

Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

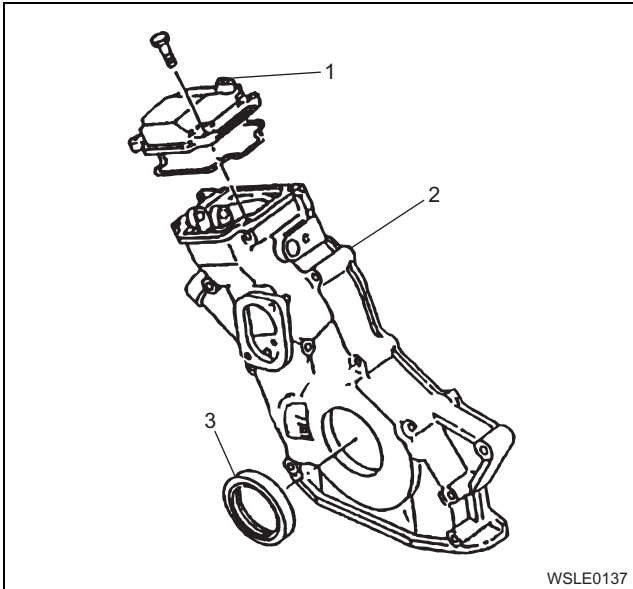
- d. Assemble the packing and the governor cover to the top of the gear case and tighten them to the specified torque.

Tightening torque:

7.8 — 11.8 N·m {0.8 — 1.2 kgf·m/5.8 — 8.7 lb·ft}

Note:

Apply enough engine oil to the main and dust lip section of the front oil seal before installing.



WSLE0137

Name

1. Governor Cover
2. Timing Gear Case
3. Front Oil Seal

3. Install the crank pulley.
 - a. Install the crank pulley to the crankshaft.
 - b. Block the crankshaft from rotating, assemble the washer, and tighten it with the mounting bolts.

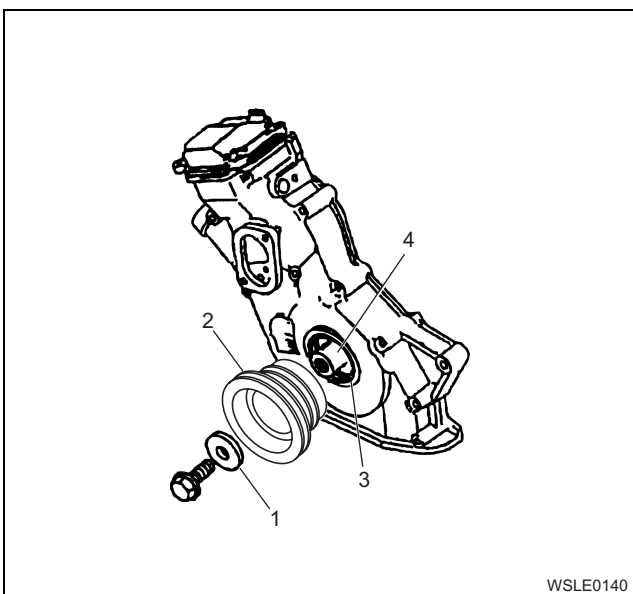
CAUTION:

Replace the bolt and washer with new ones.

Tightening torque:

167 — 186 N·m {17.0 — 19.0 kgf·m/123.2 — 137.2 lb·ft}

4. Install the oil pan.
Refer to 1A-67, "Installation, Piston, Connecting Rod".
5. Install the control link.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
6. Install the injection pump.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
7. Install the injection pump housing cover.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
8. Install the solenoid ASM.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
9. Install the fuel pipe.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
10. Install the injection pipe.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
11. Install the generator bracket.
Refer to 1A-14, "Installation, Engine Accessories".
12. Install the generator.
Refer to 1A-14, "Installation, Engine Accessories".
13. Install the fan pulley.
Refer to 1A-14, "Installation, Engine Accessories".
14. Install the cooling fan and the fan belt.
Refer to 1A-14, "Installation, Engine Accessories".

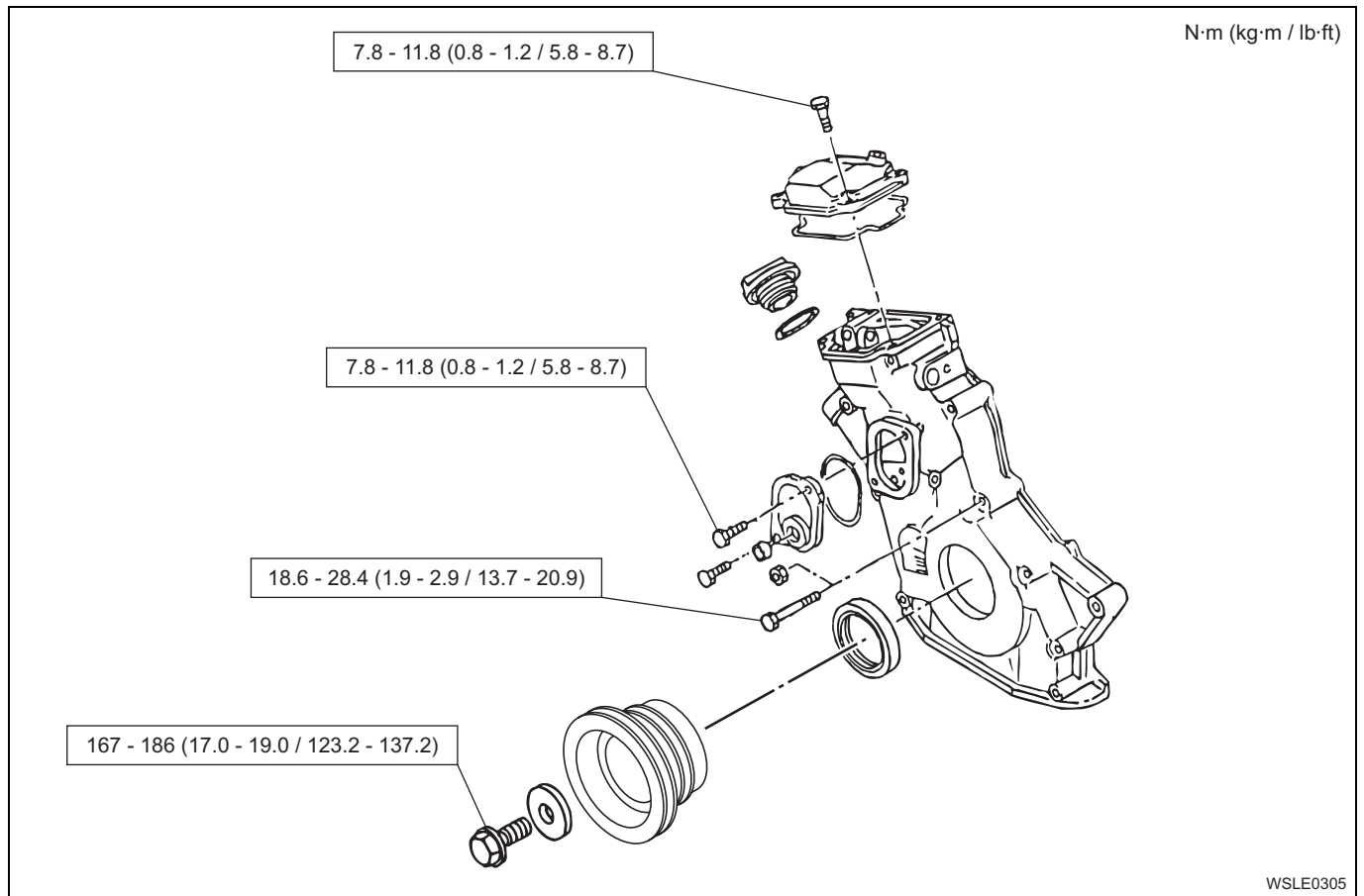


WSLE0140

Name

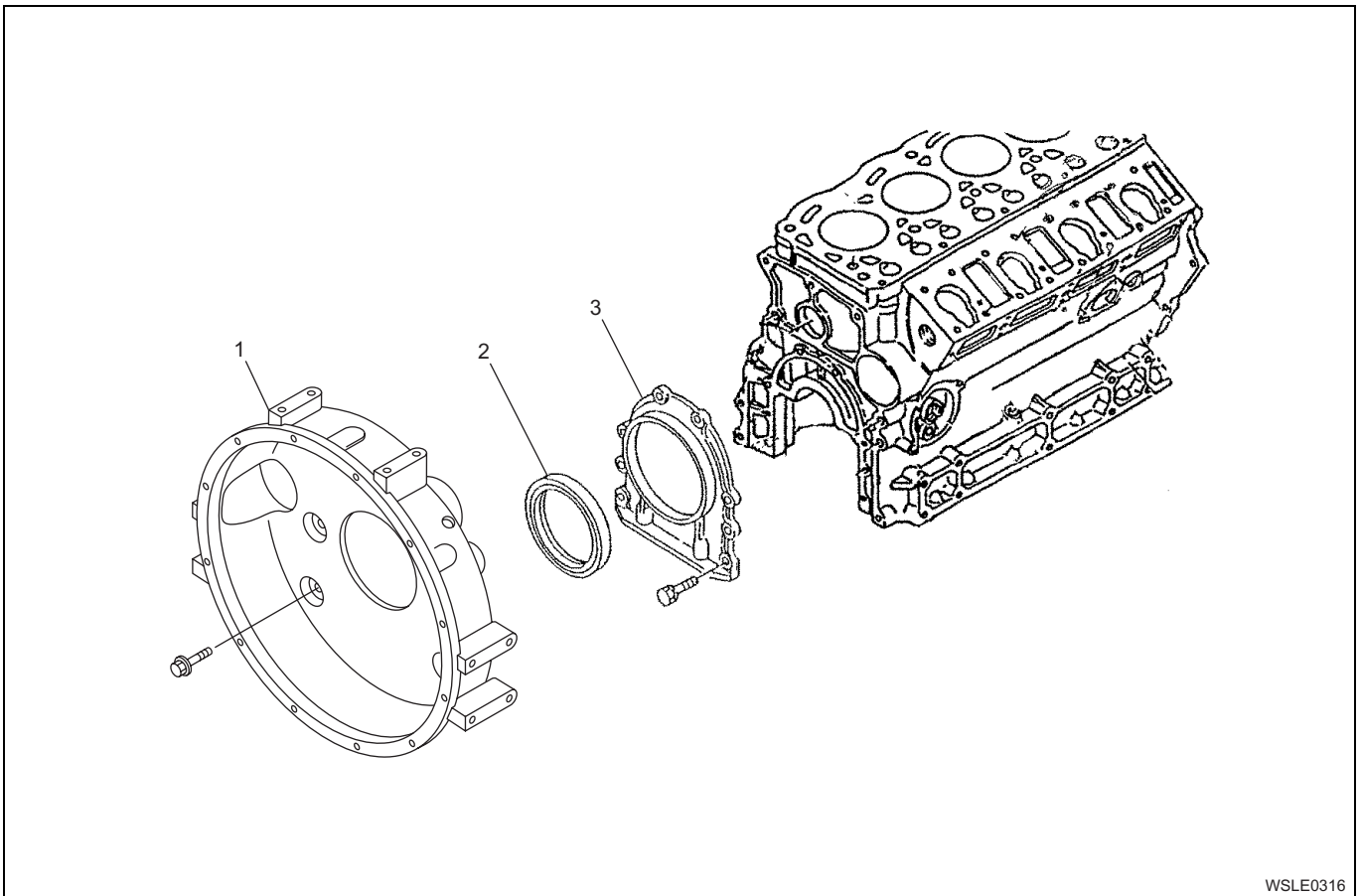
1. Washer
2. Crank Pulley
3. Front Oil Seal
4. Crankshaft

Torque Specifications



Crankshaft Rear Oil Seal

Components



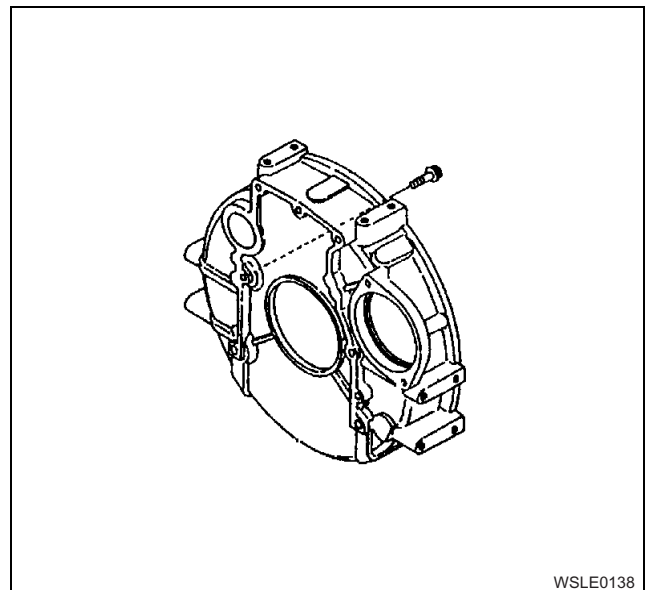
Name

1. Flywheel Housing
2. Rear Oil Seal

3. Retainer

Removal

1. Remove the starter.
Refer to 1A-14, "Removal, Engine Accessories".
2. Remove the flywheel.
Refer to 1A-71, "Removal, Flywheel".
3. Remove the flywheel housing.
 - a. Remove the mounting bolt to the cylinder block.
 - b. Gently tap the housing by a plastic hammer or similar tool to remove it from the cylinder block.

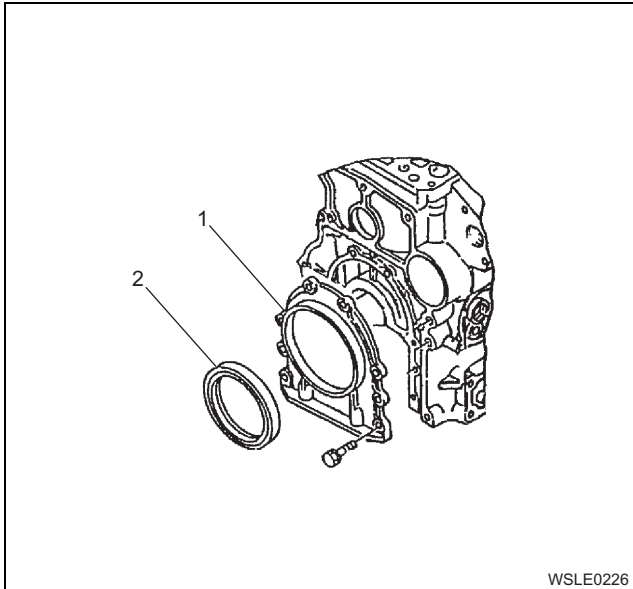


1A-80 4LE1 Engine Mechanical

- Remove the retainer.
Remove the retainer with the rear oil seal from the back of the cylinder block.

CAUTION:

Since liquid gasket is applied, be careful not to remove it forcibly to damage or deform it.



Name

- Retainer
- Rear Oil Seal

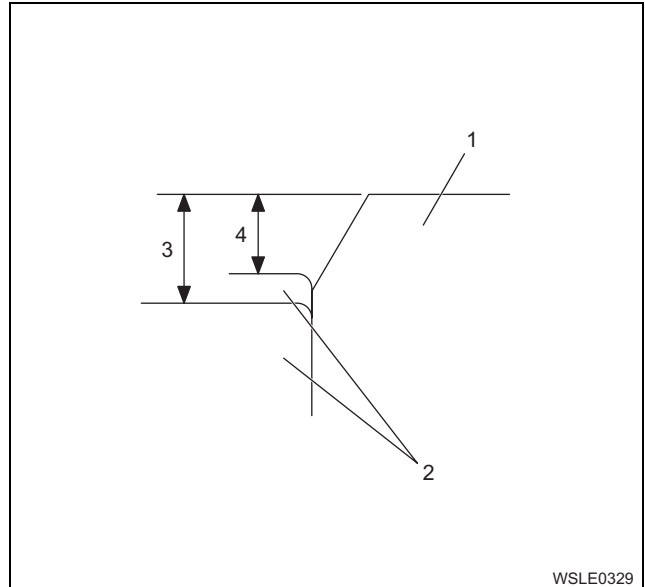
- Remove the rear oil seal from the retainer.
 - Remove the oil seal with a screwdriver avoiding damage to the oil seal contact surface on the retainer.

Installation

- Install the rear oil seal to the retainer with a rear oil seal installer.

Special tool

Rear oil seal installer
5-8840-9032-0



Name

- Retainer
- Rear Oil Seal
- 1.75 mm {0.069 in}
- 1.25 mm {0.049 in}

- Install the retainer.
Apply a thin coat of engine oil to the lip section of the oil seal and install the retainer. (Apply the liquid gasket TB1207B)

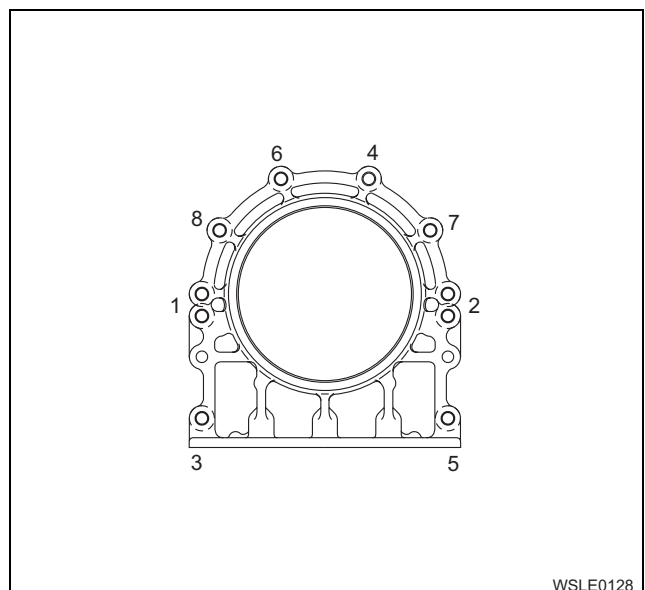
CAUTION:

Be sure to prevent the big end of the crankshaft from adhering of dust or foreign materials.

The tightening order of the retainer is as shown in the illustration and you should tighten it to the following torque.

Tightening torque:

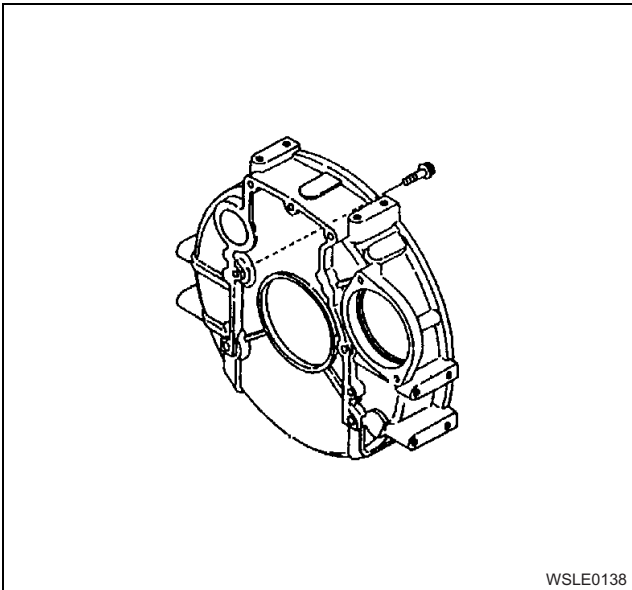
7.8 — 11.8 N·m {0.8 — 1.2 kgf·m/5.8 — 8.7 lb·ft}



3. Install the flywheel housing to the cylinder block.

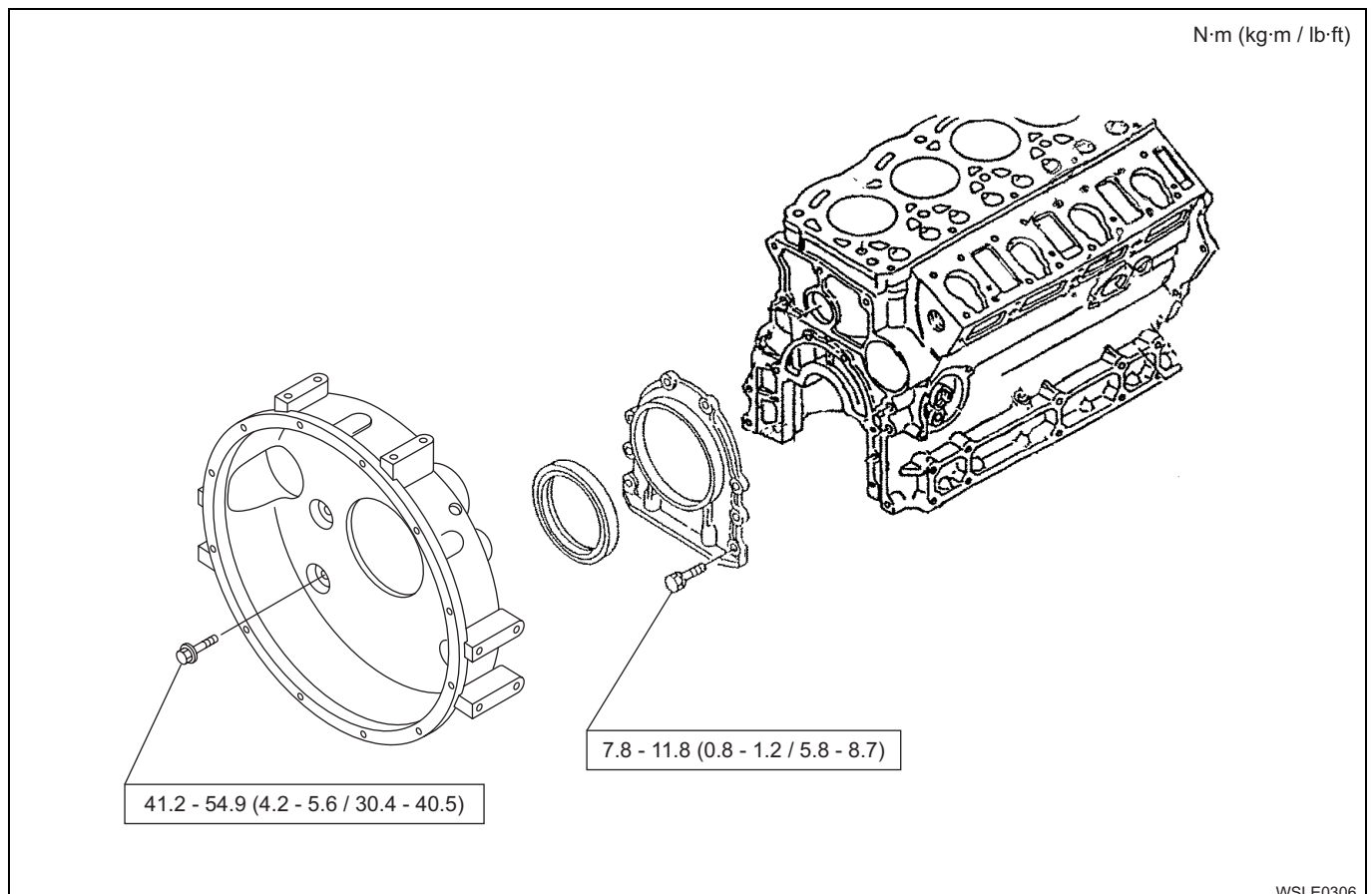
Tightening torque:

41.2 — 54.9 N·m {4.2 — 5.6 kgf·m/30.4 — 40.5 lb·ft}



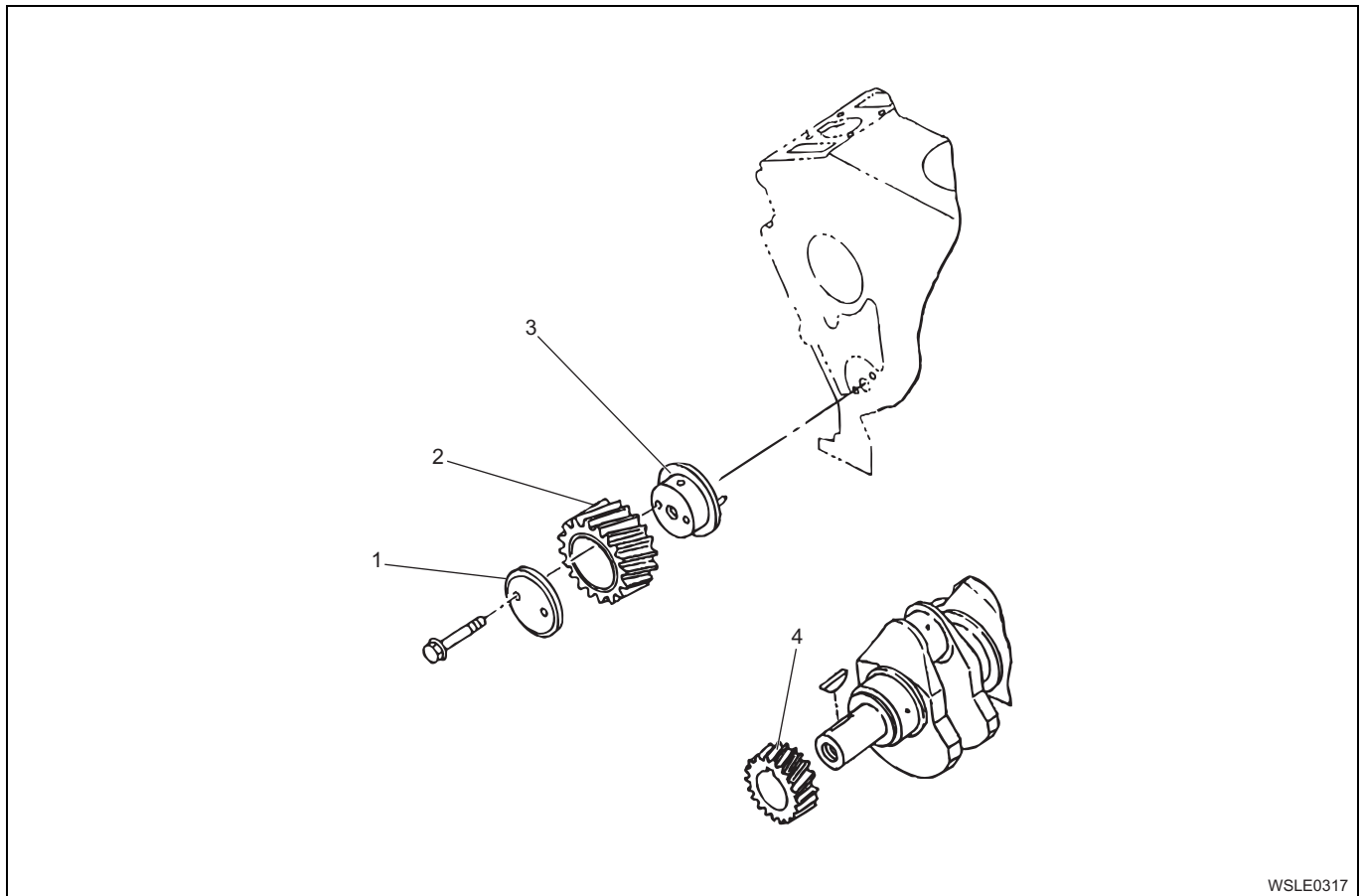
4. Install the flywheel.
Refer to 1A-72, "Installation, Flywheel".
5. Install the starter.
Refer to 1A-14, "Installation, Engine Accessories".

Torque Specifications



Timing Gear Train

Components



WSLE0317

Name

- | | |
|------------------|--------------------|
| 1. Thrust Collar | 3. Idle Gear Shaft |
| 2. Idle Gear | 4. Crankshaft Gear |

Removal

1. Remove the cooling fan and the fan belt.
Refer to 1A-14, "Removal, Engine Accessories".
2. Remove the fan pulley.
Refer to 1A-14, "Removal, Engine Accessories".
3. Remove the generator.
Refer to 1A-14, "Removal, Engine Accessories".
4. Remove the generator bracket.
Refer to 1A-14, "Removal, Engine Accessories".
5. Remove the injection pipe.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
6. Remove the fuel pipe.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
7. Remove the solenoid ASM.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
8. Remove the injection pump housing cover.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
9. Remove the injection pump.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
10. Remove the control link.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
11. Remove the oil pan.
Refer to 1A-59, "Removal, Piston, Connecting Rod".
12. Remove the crank pulley.
Refer to 1A-74, "Removal, Crankshaft Front Oil Seal".
13. Remove the timing gear case.
Refer to 1A-74, "Removal, Crankshaft Front Oil Seal".
14. Remove the idle gear and the idle gear shaft.

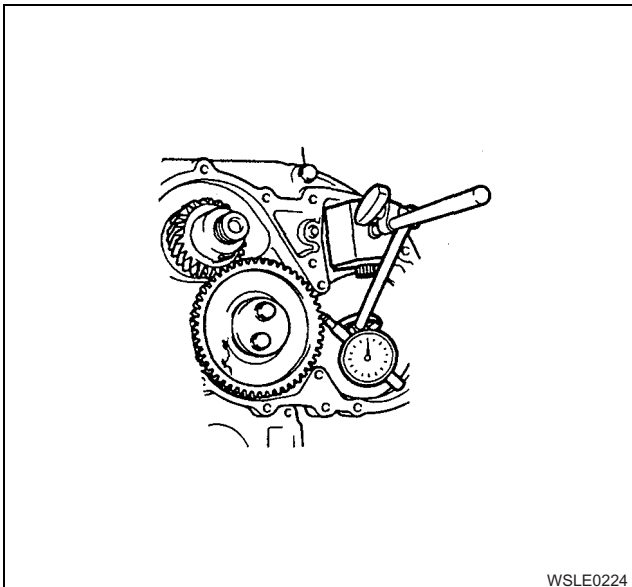
Inspection

Inspection of backlash of the timing gear

Before removing the timing gear, measure backlash of it.

1. Put a dial gauge on the tooth of the measured gear.
2. Move the gear right and left lightly, and read the deflection of the dial gauge.
If it exceeds the limit, replace the timing gear.

Backlash of the timing gear		mm {in}
Location	Standard value	Service limit
Crank gear/Idle gear	0.04 {0.0016}	0.2 {0.008}
Idle gear/Camshaft gear	0.03 {0.0012}	0.2 {0.008}

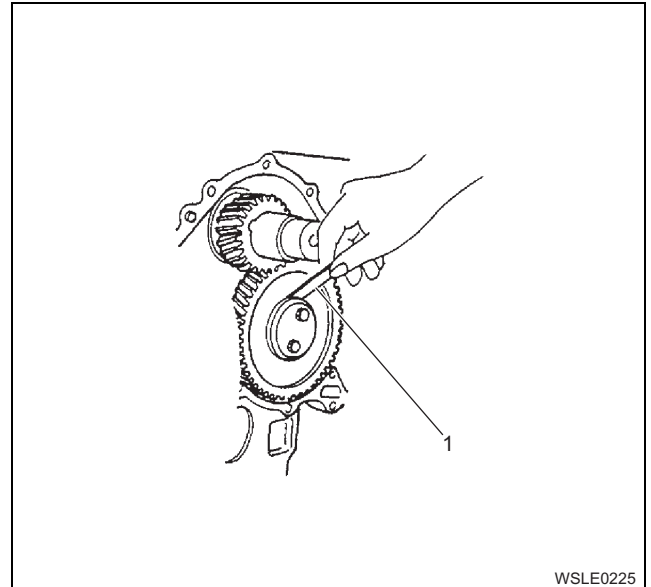


Inspection of axial play of the idle gear

Measure an axial play of the gear before removing the idle gear.

1. Insert a thickness gauge between the idle gear and the thrust collar to measure a clearance.
2. If the measurement exceeds the limit, replace either the thrust collar or the idle gear.

Axial play of idle gear		mm {in}
Standard value	Service limit	
0.058 — 0.115 {0.0023 — 0.0045}	0.2 {0.008}	

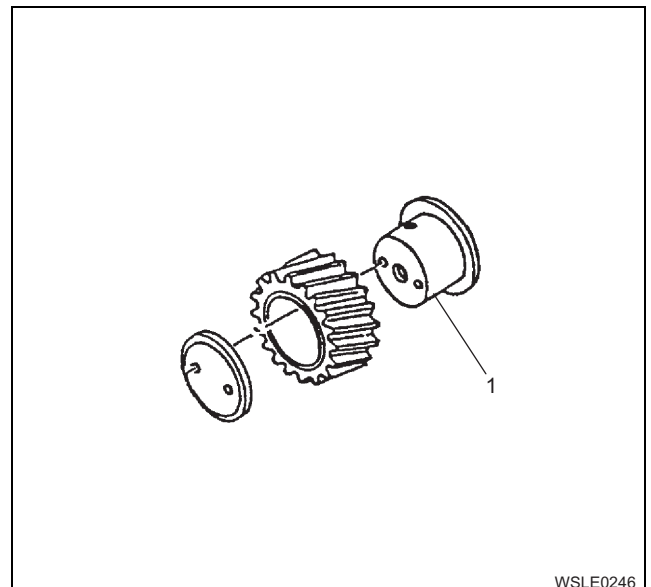


Name

1. Thickness Gauge

Inspection of idle gear and gear shaft

1. If there is excessive wear or damage on the sliding surface of the idle gear and the gear shaft, and on the inside of the idle gear bushing, replace either the shaft or the gear.
2. If there is stepped wear or something on the idle gear and the thrust collar, replace either the idle gear or the thrust collar.



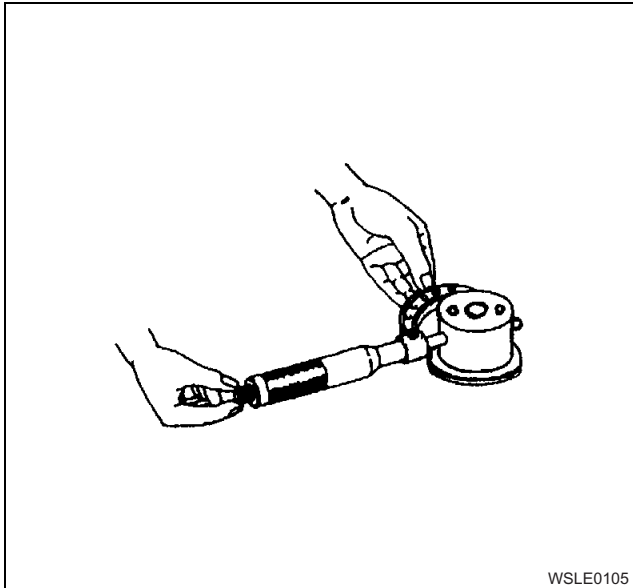
Name

1. Idle Gear Shaft

Inspection of uneven wear of the idle gear shaft

Measure the outside diameter of the idle gear shaft using a micrometer, and calculate the amount of uneven wear.

mm {in}		
Nominal dimension	Service limit	Repairing procedure
φ45 {1.772}	0.1 {0.0039}	Replace.

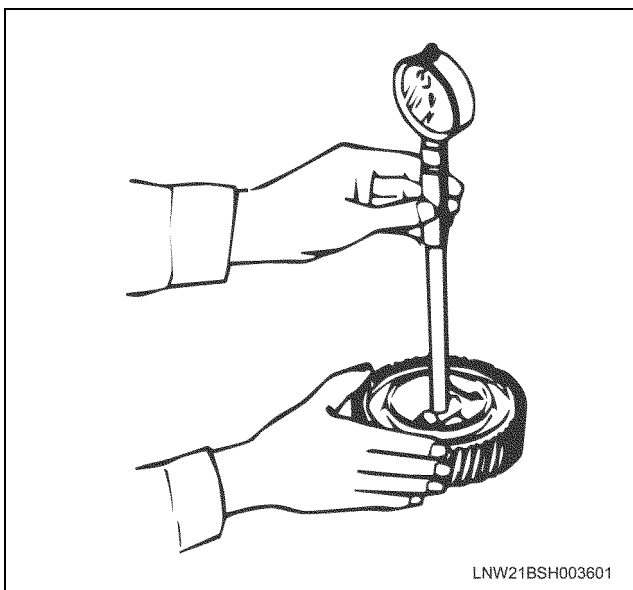


WSLE0105

Inspection of clearance between the idle gear bushing and the shaft

Measure the idle gear bushing bore and calculate the clearance between the bushing and the outside diameter of the idle gear shaft.

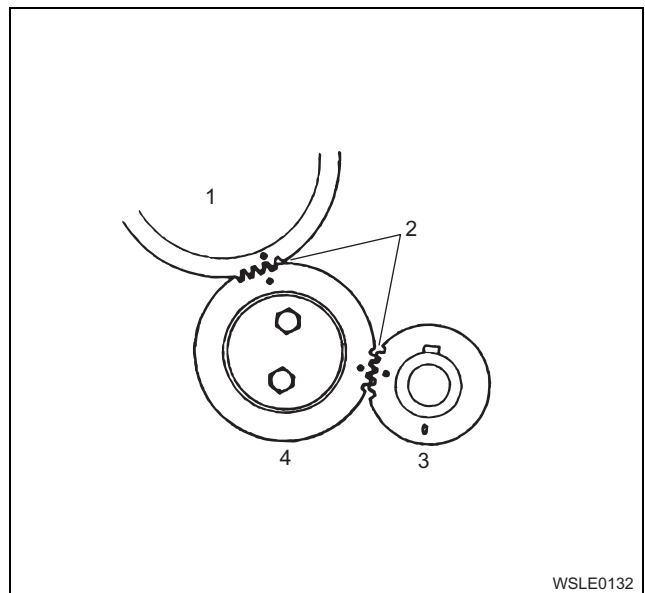
mm {in}		
Standard value	Service limit	Repairing procedure
0.025 — 0.085 {0.00098 — 0.00330}	0.2 {0.008}	Replace the idle gear or the shaft.



LNW21BSH003601

Installation

1. Install the idle gear.
 - a. Install the idle gear shaft to the cylinder block. (The position where the oil hole is located obliquely upward)
 - b. Apply engine oil to the bushing surface and the tooth surface of the idle gear, and the idle gear shaft. Then assemble the idle gear with its timing points (black dots) facing the forward direction and aligning the timing points (black dots) of the camshaft gear and the crank gear at the same time.



WSLE0132

Name

1. Camshaft Gear
2. Timing Point
3. Crank Gear
4. Idle Gear

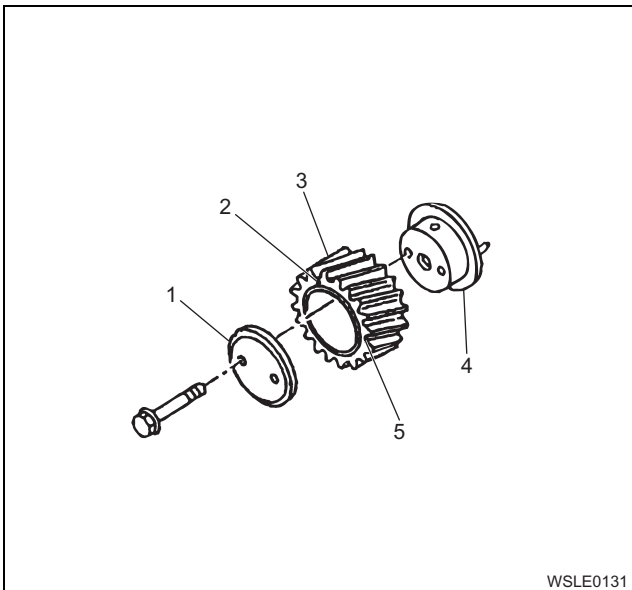
- c. Apply engine oil to the thrust collar sliding surface and the threads and the seating surfaces of the bolts. Then install to the idle gear with the chamfered side of the collar facing the outside, and tighten it with the bolts.

Tightening torque:

20.6 — 30.4 N·m {2.1 — 3.1 kgf·m/15.2 — 22.4 lb·ft}

CAUTION:

Assemble the idle gear shaft aligning the positioning pin with the knock hole.

**Name**

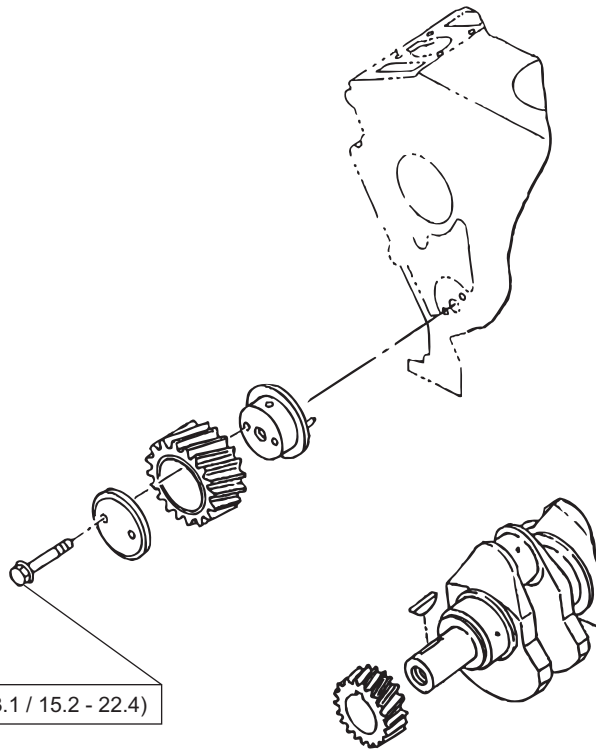
1. Thrust Collar
2. Timing Point
3. Idle Gear
4. Idle Gear Shaft
5. Timing Point

13. Install the fan pulley.
Refer to 1A-14, "Installation, Engine Accessories".
 14. Install the cooling fan and the fan belt.
Refer to 1A-14, "Installation, Engine Accessories".
-
2. Install the timing gear case.
Refer to 1A-76, "Installation, Crankshaft Front Oil Seal".
 3. Install the crank pulley.
Refer to 1A-76, "Installation, Crankshaft Front Oil Seal".
 4. Install the oil pan.
Refer to 1A-67, "Installation, Piston, Connecting Rod".
 5. Install the control link.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
 6. Install the injection pump.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
 7. Install the injection pump housing cover.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
 8. Install the solenoid ASM.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
 9. Install the fuel pipe.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
 10. Install the injection pipe.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
 11. Install the generator bracket.
Refer to 1A-14, "Installation, Engine Accessories".
 12. Install the generator.
Refer to 1A-14, "Installation, Engine Accessories".

Torque Specifications

N·m (kg·m / lb·ft)

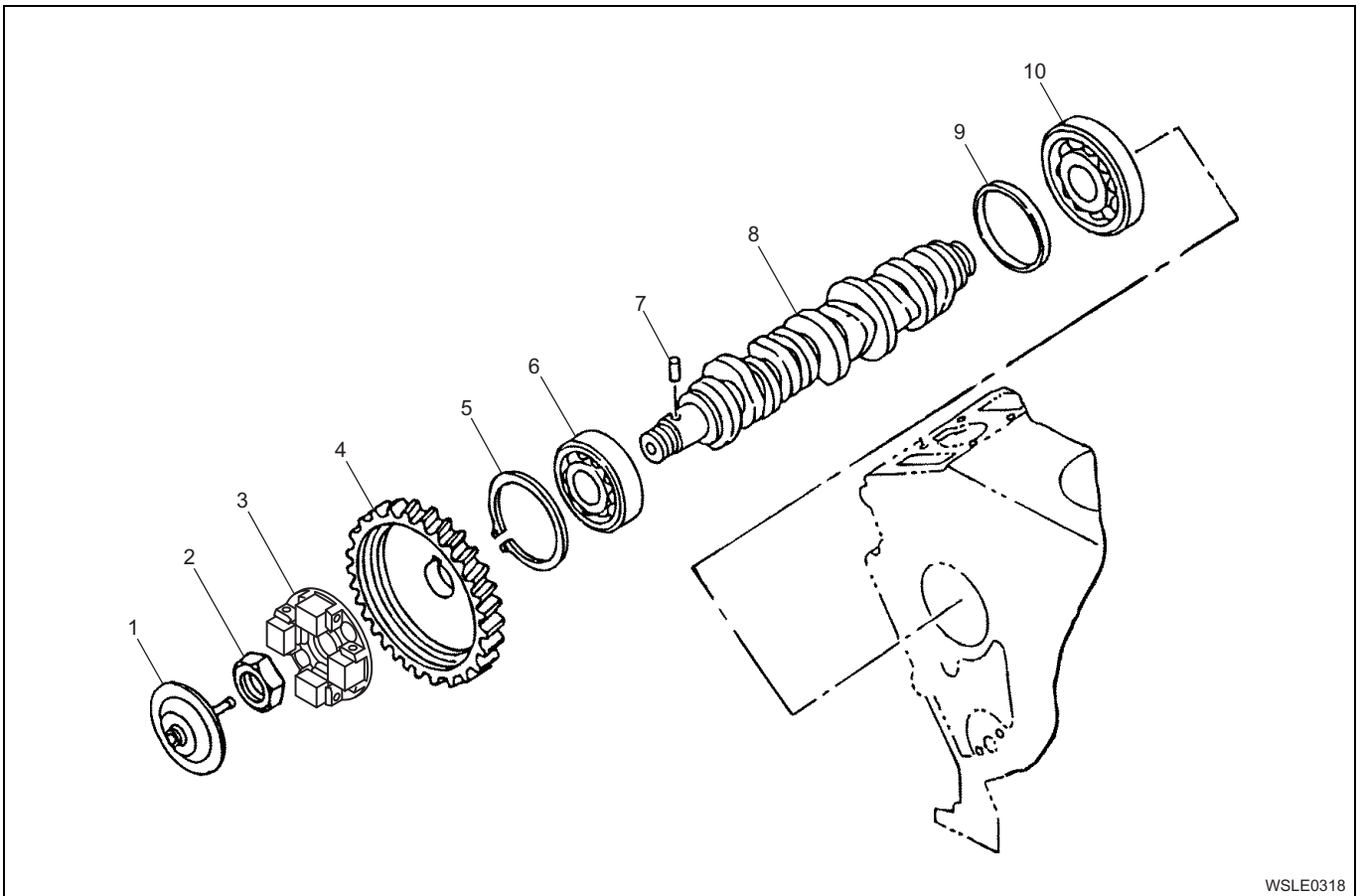
20.6 - 30.4 (2.1 - 3.1 / 15.2 - 22.4)



WSLE0307

Camshaft

Components



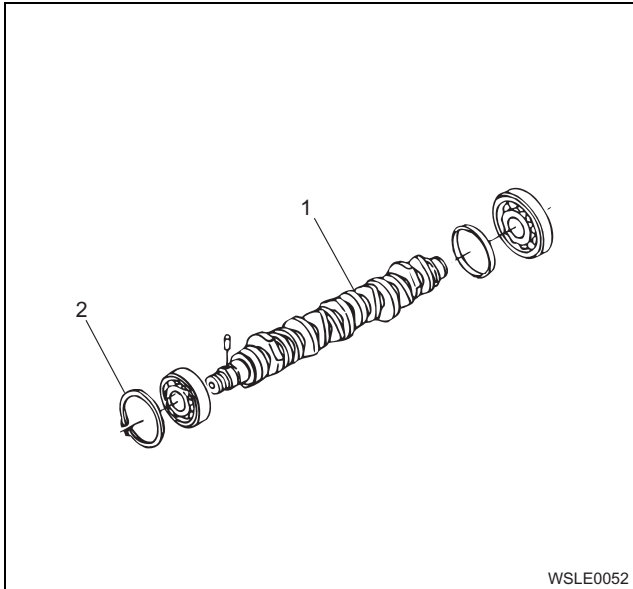
WSLE0318

Name

- | | |
|------------------|--------------|
| 1. Sleeve | 5. Snap Ring |
| 2. Lock Nut | 6. Bearing |
| 3. Flyweight ASM | 7. Pin |
| 4. Camshaft Gear | 8. Camshaft |
| | 9. Wear Ring |
| | 10. Bearing |

Removal

1. Remove the EGR cooler and the bracket.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
2. Remove the cylinder head cover.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
3. Remove the rocker arm bracket.
Refer to 1A-41, "Removal, Rocker Arm Shaft".
4. Remove the cylinder head.
Refer to 1A-47, "Removal, Cylinder Head".
5. Remove the tappet.
Refer to 1A-47, "Removal, Cylinder Head".
6. Remove the timing gear case.
Refer to 1A-74, "Removal, Crankshaft Front Oil Seal".
7. Remove the camshaft gear.
 - a. Pull out the sleeve from the end of the camshaft.
 - b. Remove the lock nut from the camshaft gear, and remove the flyweight ASM and the camshaft gear.
8. Remove the camshaft.
 - a. Remove the snap ring which holds the front bearing of the camshaft from the ring groove of the cylinder block.
 - b. Pull out the camshaft with the bearing from the cylinder block.



Name

- 1. Camshaft
- 2. Snap Ring

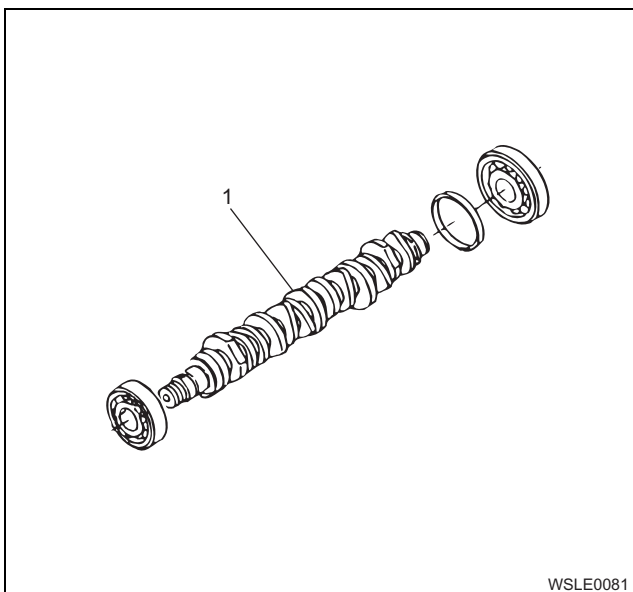
Inspection

Inspection of camshaft

Check the journal portion and the cam portion for wear, damage, and other abnormality.

CAUTION:

The ball bearings are fitted to the front and rear parts of the camshaft. Also, the roller bearing is press-fitted to the cylinder block at the center part. Check that each bearing has no rattle and rotates smoothly with this condition.



Name

- 1. Camshaft

Inspection of journal and cam

- 1. Height of the cam (A – B)

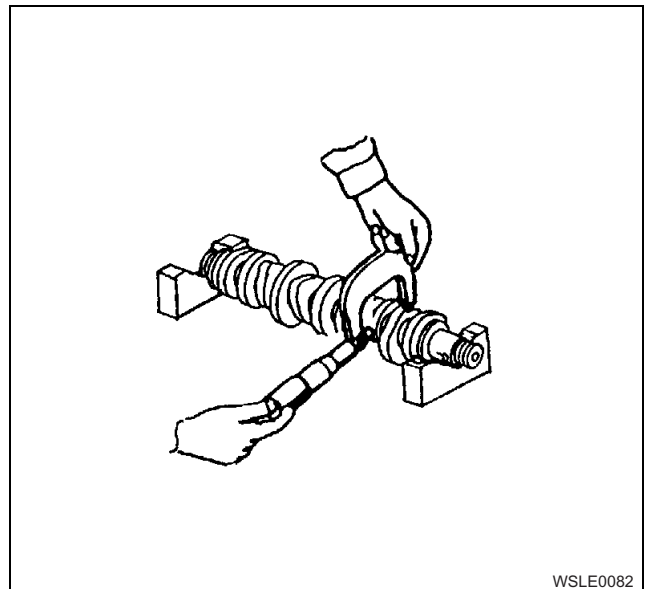
			mm {in}
	Standard value	Service limit	Repairing procedure
Inlet	6.13 {0.241}	5.83 {0.230}	Replace.
Exhaust	6.43 {0.253}	6.13 {0.241}	

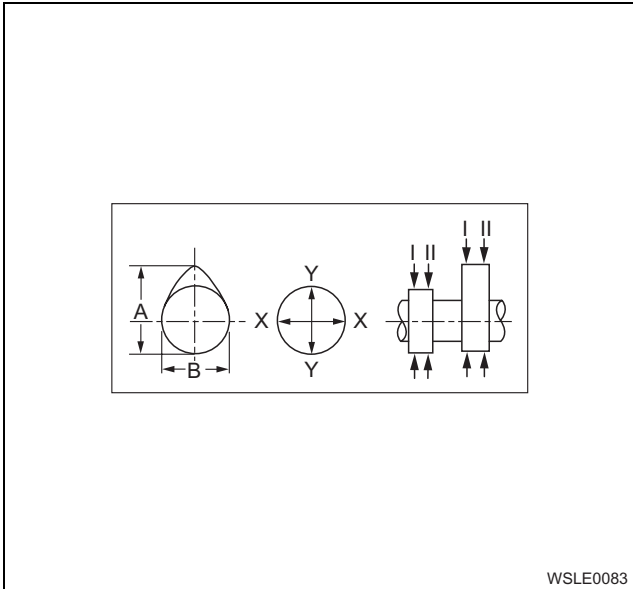
- 2. Center journal diameter (the dimensions in X – X and Y – Y directions)

			mm {in}
Nominal dimension	Service limit	Repairing procedure	
φ52 {2.047}	φ51.92 {2.044}	Replace.	

- 3. Uneven wear of the journal (the difference between the measurements in X – X and Y – Y directions)

			mm {in}
Nominal dimension	Service limit	Repairing procedure	
φ52 {2.047}	0.05 {0.002}	Replace.	

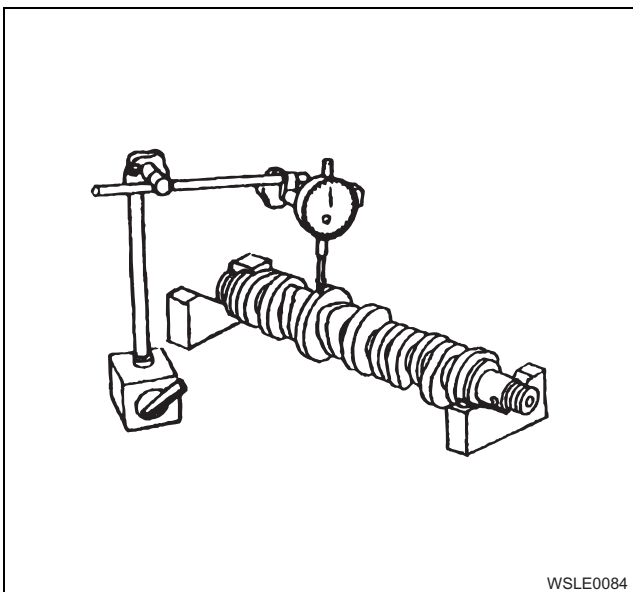




Inspection of camshaft runout

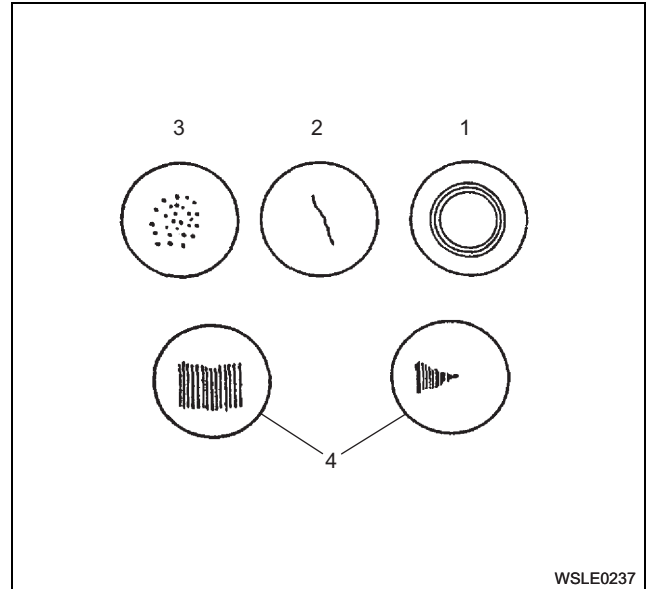
1. Put the camshaft on the V block.
2. Place the dial gauge to the center journal part.
3. Rotate the camshaft once and read the deflection of the indicator.
If the measured value exceeds the limit, replace the camshaft.

mm {in}		
Standard value	Service limit	Repairing procedure
0.02 {0.0008} or less	0.1 {0.0039}	Replace.



Inspection of tappet

Check the contact surface with the camshaft.
If there is pitching, defective contact, vermiculation, or crack, replace the tappet.



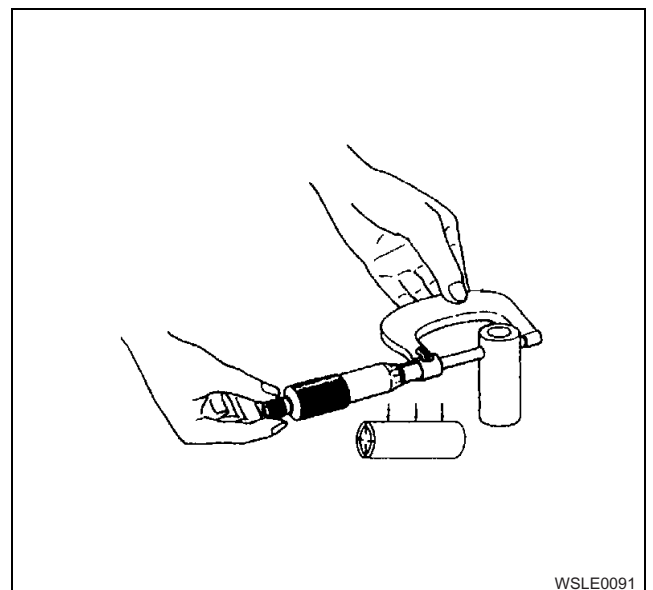
Name

1. Normal
2. Cracks
3. Pitching
4. Abnormal Contact

Inspection for wear of the tappet outside diameter

Use a micrometer to measure the outside diameter of the tappet.
If the measured value exceeds the limit, replace the tappet.

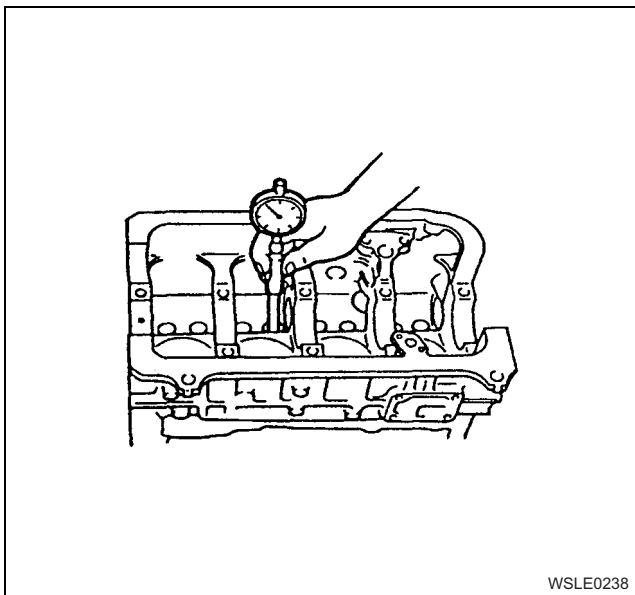
mm {in}	
Outside diameter of the tappet	
Standard value	Service limit
$\phi 20.97 - 20.98$ {0.8256 — 0.8260}	20.92 {0.8240}



Inspection of clearance between the tappet and the cylinder block

Use the bore gauge to measure the bore diameter of the tappet insertion hole on the cylinder block and calculate the clearance.

Clearance between the tappet and the cylinder block hole	
Standard value	Service limit
0.020 — 0.054 {0.0008 — 0.0021}	0.1 {0.0039}



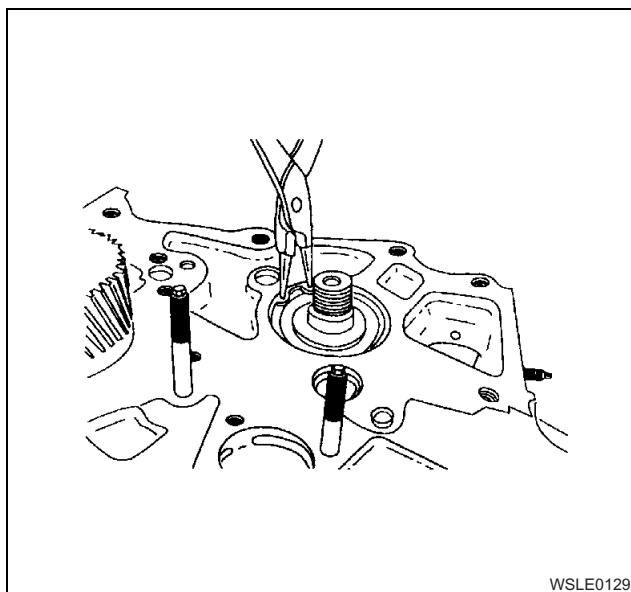
Installation

1. Install the camshaft ASM.
 - a. Apply engine oil to the camshaft journal, bearing, cam surface, and the inside of the cylinder block bearing. Then assemble the camshaft ASM.

CAUTION:

Be careful not to damage the bearing when assembling.

- b. Install the snap ring to the outside of the front bearing, and check that the camshaft rotates smoothly.



2. Install the camshaft gear and the sleeve.
 - a. Install the camshaft gear to the camshaft with its timing point (black dot) facing the forward direction.
 - b. Assemble the flyweight, apply engine oil to the thread and the seating surface of the lock nut, and tighten.

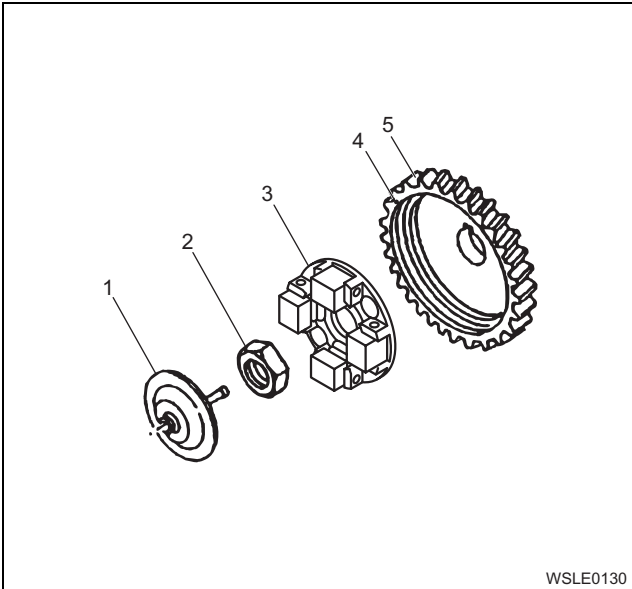
Tightening torque:

68.6 — 88 N·m {6.99 — 8.97 kgf·m/50.5 — 64.9 lb·ft}

- c. Apply engine oil to the sleeve shaft and the sliding surface of the flyweight.
 - d. Insert the sleeve collar section to the concave portion of the flyweight. Then insert the sleeve shaft to the end of the camshaft.

Note:

Check that the sleeve moves smoothly.

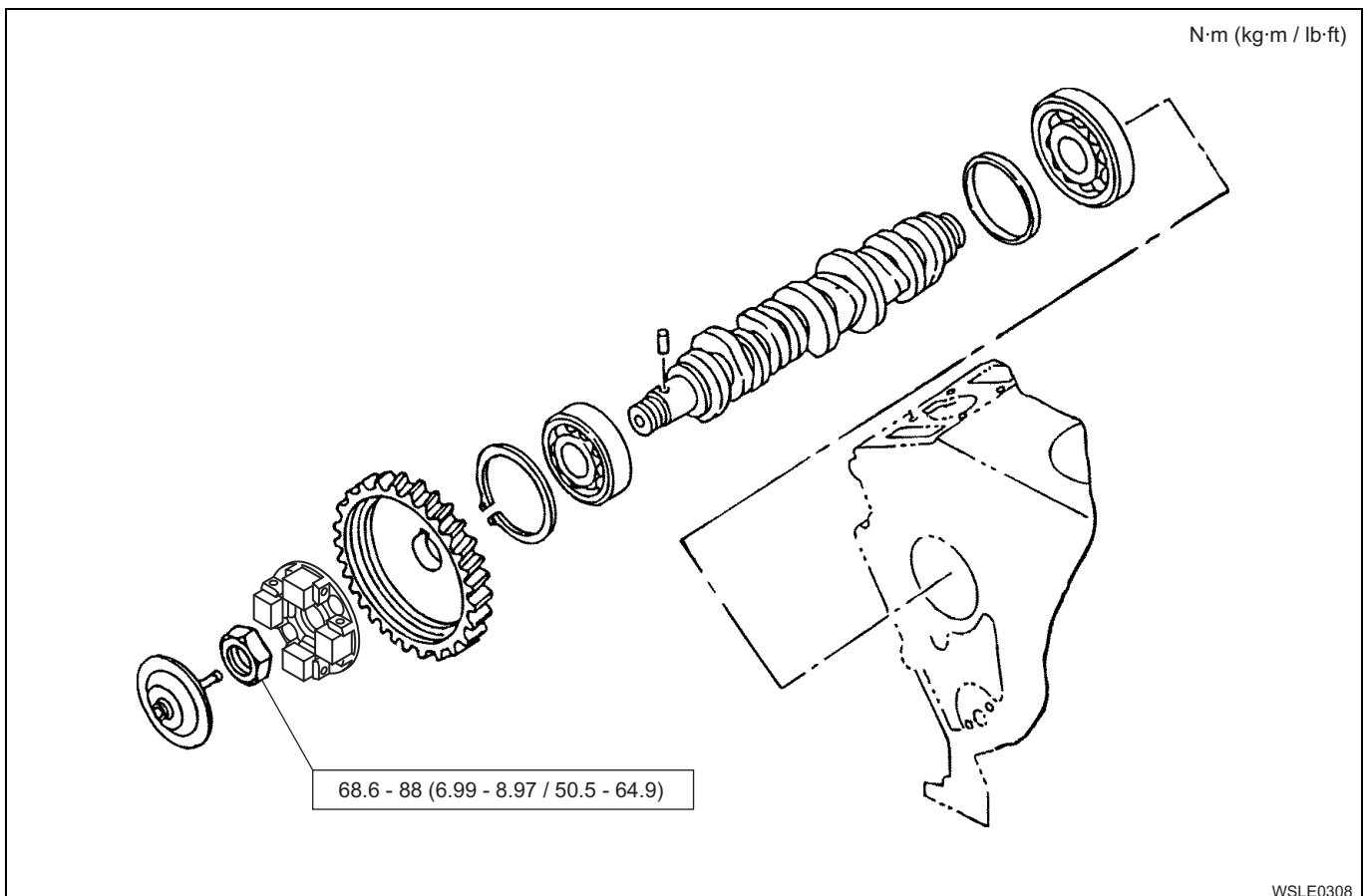


Name

1. Sleeve
2. Lock Nut
3. Flyweight
4. Timing Point
5. Camshaft Gear

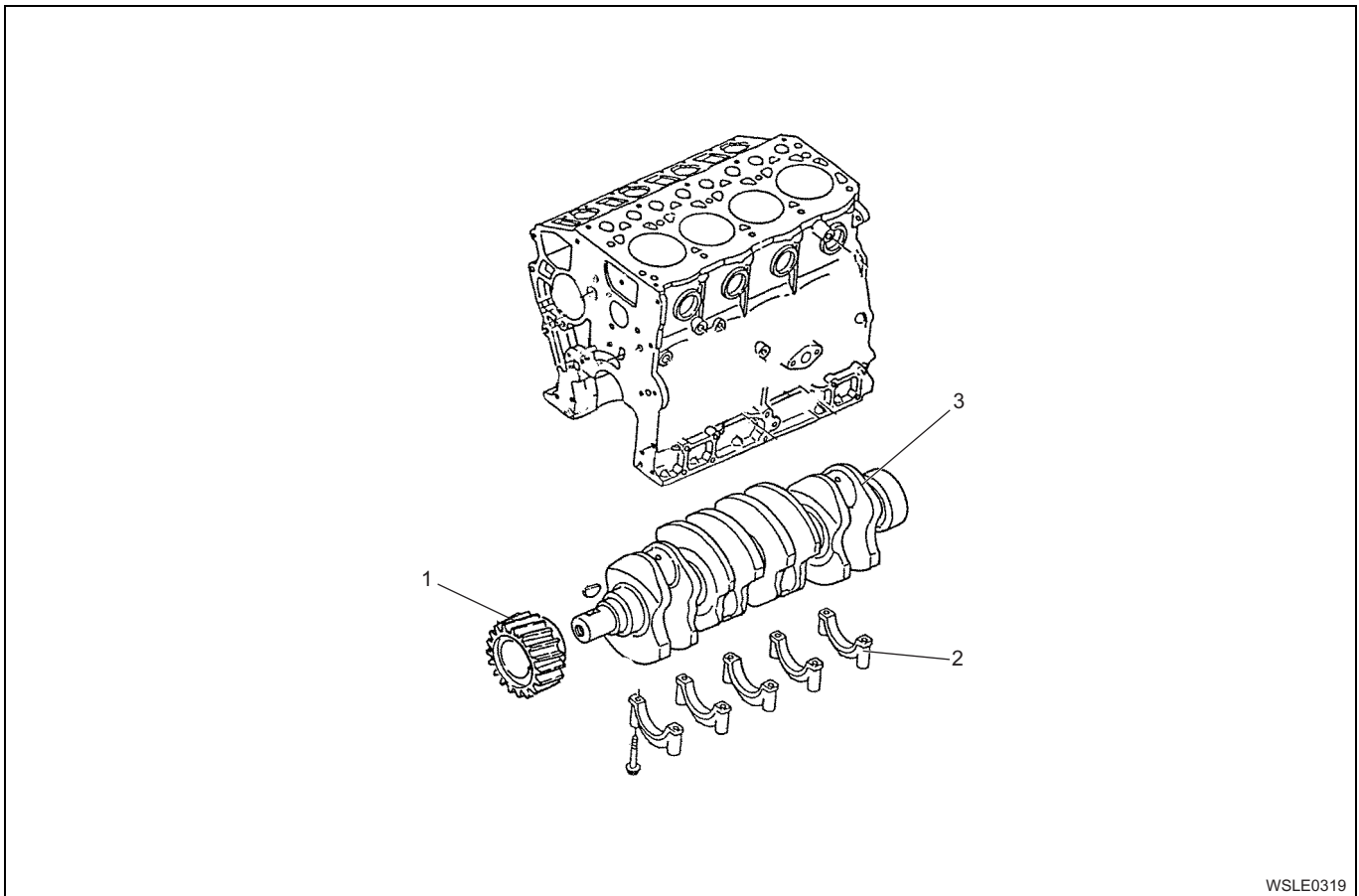
3. Install the timing gear case.
Refer to 1A-76, "Installation, Crankshaft Front Oil Seal".
4. Install the tappet.
Refer to 1A-56, "Installation, Cylinder Head".
5. Install the cylinder head.
Refer to 1A-56, "Installation, Cylinder Head".
6. Install the rocker arm bracket.
Refer to 1A-44, "Installation, Rocker Arm Shaft".
7. Install the cylinder head cover.
Refer to 1A-29, "Installation, Engine Exterior Equipment".

Torque Specifications



Crankshaft

Components



WSLE0319

Name

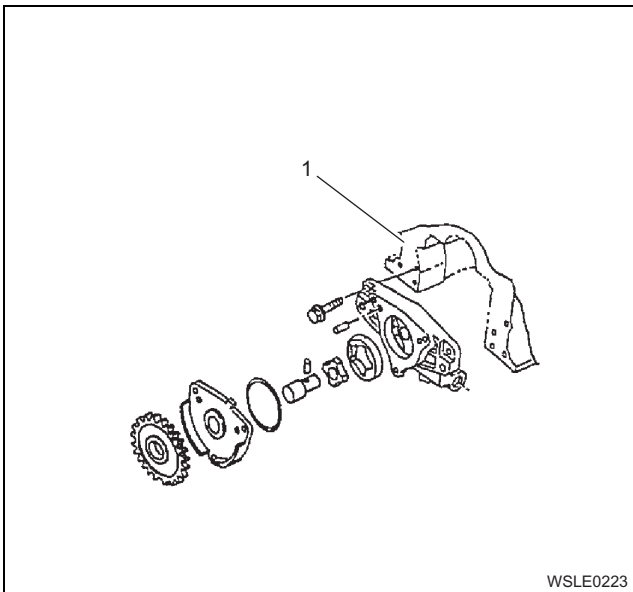
1. Crankshaft Gear
2. Bearing Cap

3. Crankshaft

Removal

1. Remove the engine accessories.
Refer to 1A-14, "Removal, Engine Accessories".
2. Remove the engine exterior equipment.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
3. Remove the rocker arm bracket.
Refer to 1A-41, "Removal, Rocker Arm Shaft".
4. Remove the cylinder head.
Refer to 1A-47, "Removal, Cylinder Head".
5. Remove the piston and the connecting rod.
Refer to 1A-59, "Removal, Piston, Connecting Rod".
6. Remove the flywheel.
Refer to 1A-71, "Removal, Flywheel".
7. Remove the crankshaft front oil seal.
Refer to 1A-74, "Removal, Crankshaft Front Oil Seal".
8. Remove the crankshaft rear oil seal.
Refer to 1A-79, "Removal, Crankshaft Rear Oil Seal".
9. Remove the idle gear.
Refer to 1A-82, "Removal, Timing Gear Train".
10. Remove the camshaft.
Refer to 1A-87, "Removal, Camshaft".

11. Remove the oil pump ASM from the cylinder block.



Name

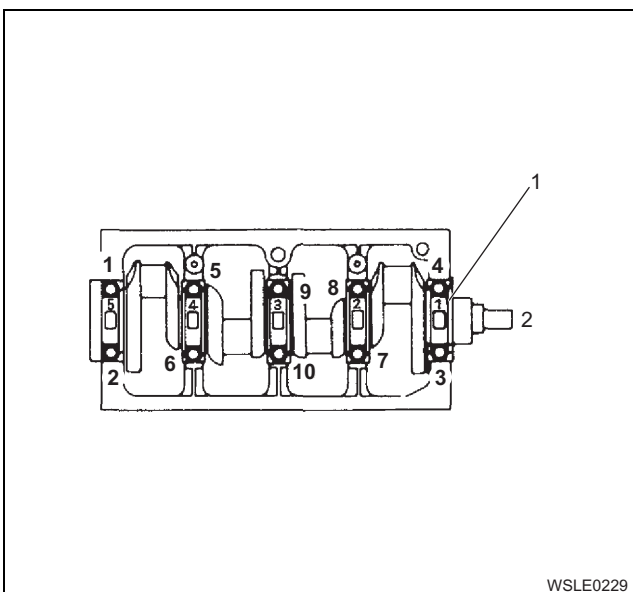
- 1. Cylinder Block

12. Remove the crankshaft.

- a. Gradually loosen the bolts of each bearing cap evenly in the order shown in the illustration. Tap the cap lightly with a copper hammer to remove it with the bearing.
- b. Remove the crankshaft ASM.
- c. Remove the thrust bearing from No.2 journal of the cylinder block.

CAUTION:

Attach tags with each cylinder number to the removed cylinder parts to identify installation positions, and put them in order.



Name

- 1. Arrow Mark
- 2. Front

Disassembly

- 1. Remove the gear from the crankshaft.

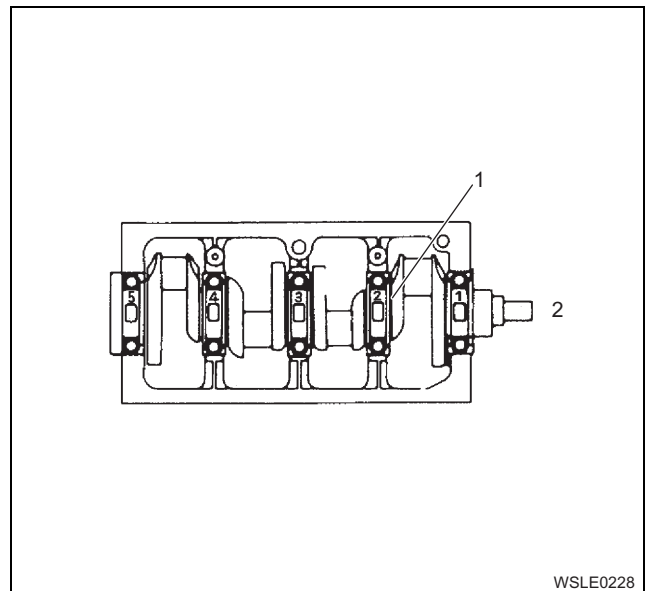
Inspection

Inspection of axial play of the crankshaft

Measure an axial play before removing the crankshaft.

- 1. Pull the crankshaft all the way to the front.
- 2. Insert the thickness gauge to the front side of No.2 journal portion of the crankshaft (thrust bearing installation part) and measure the play. If the measured value exceeds the limit, replace the thrust bearing.

Axial play of crankshaft		mm {in}
Standard value	Service limit	
0.058 — 0.208 {0.0023 — 0.0082}	0.3 {0.012}	



Name

- 1. Measurement of Play
- 2. Front

Inspection of crankshaft

Check for wear, damage, clogging of oil port and other abnormality.

Inspection of outside diameter of the crankshaft journal

Measure the outside diameter of the crankshaft journal, and calculate the amount of wear and uneven wear. If it exceeds the limit, replace the crankshaft.

- 1. Nominal dimension

	mm {in}
Journal	φ60 {2.362}

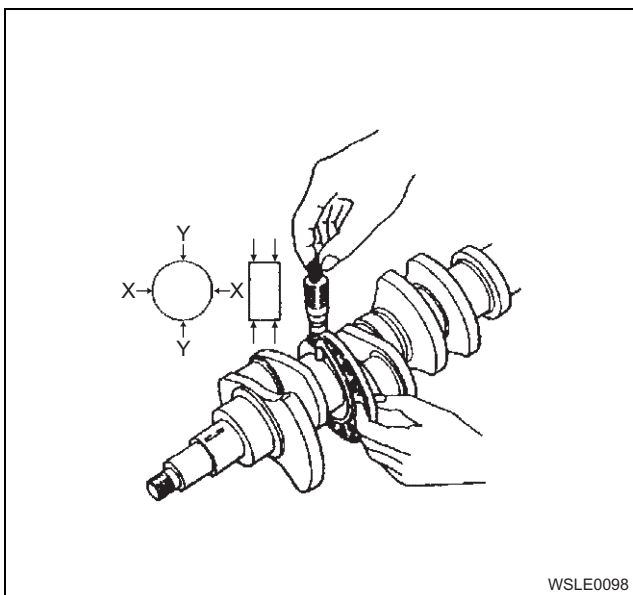
1A-94 4LE1 Engine Mechanical

2. Uneven wear (the difference between the measurements in X – X, Y – Y directions)

mm {in}		
	Service limit	Repairing procedure
Journal	0.05 {0.002}	Replace the crankshaft.

3. Amount of wear

mm {in}		
	Service limit	Repairing procedure
Journal	0.14 {0.0055}	Replace the crankshaft.



Inspection of outside diameter of the crankshaft pin

Measure the outside diameter of the crankshaft pin, and calculate the wear and the uneven wear. If it exceeds the limit, replace the crankshaft.

1. Nominal dimension

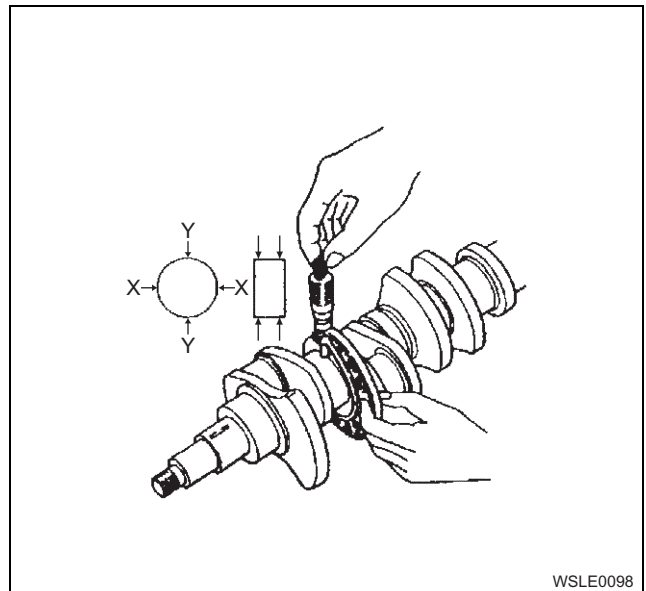
mm {in}		
Pin	Connecting rod small end diameter ($\phi 27$ mm {1.063 in})	$\phi 46$ {1.811}
	Connecting rod small end diameter ($\phi 25$ mm {0.9843 in})	$\phi 49$ {1.929}

2. Uneven wear (the difference between the measurements in X – X, Y – Y directions)

mm {in}		
	Service limit	Repairing procedure
Pin	0.05 {0.002}	Replace the crankshaft.

3. Amount of wear

mm {in}		
	Service limit	Repairing procedure
Pin	0.13 {0.005}	Replace the crankshaft.



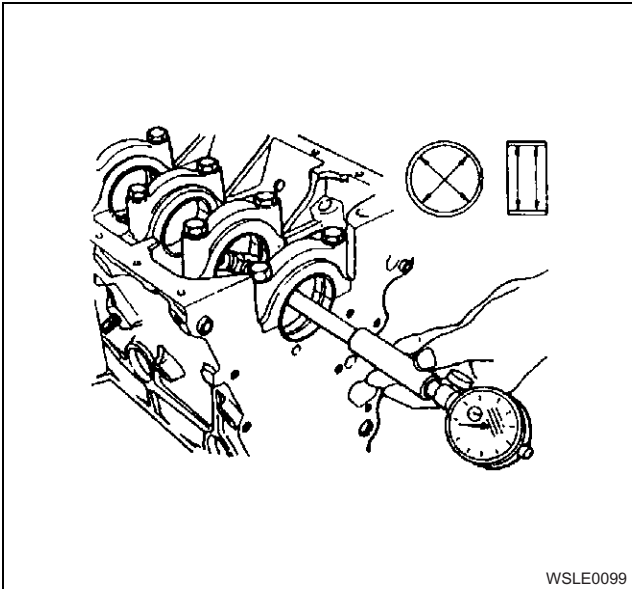
Inspection of clearance between the journal and the bearing

Tighten the bearing cap to the specified torque and measure the inside diameter of the bearing to calculate the clearance.

Tightening torque:

83.4 — 93.2 N·m {8.5 — 9.5 kgf·m/61.5 — 68.7 lb·ft}

Clearance between the journal and the bearing		mm {in}
Standard value	Service limit	Repairing procedure
0.029 — 0.072 {0.0011 — 0.0028}	0.11 {0.0043}	Replace the bearing.

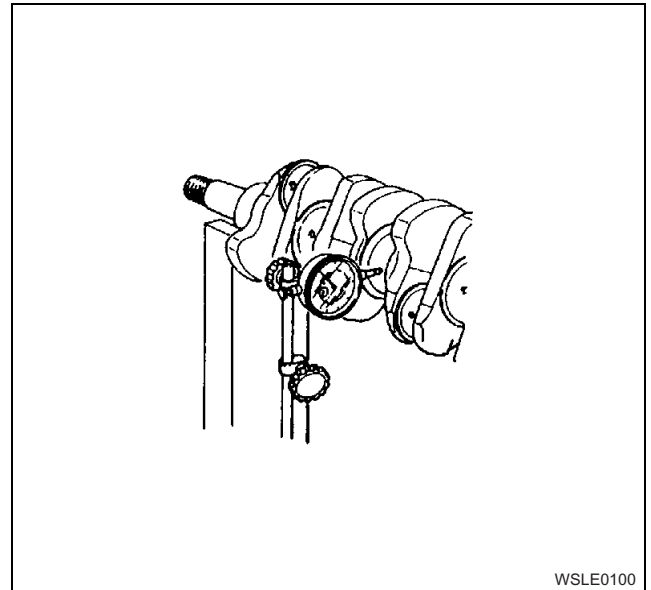


WSLE0099

Inspection of crankshaft runout

Hold the journal portions on both ends of the crankshaft with V block, and measure the runout of the center journal using the dial gauge.

		mm {in}
Standard value	Service limit	Repairing procedure
0.025 {0.00098} or less	0.05 {0.002}	Replace.



WSLE0100

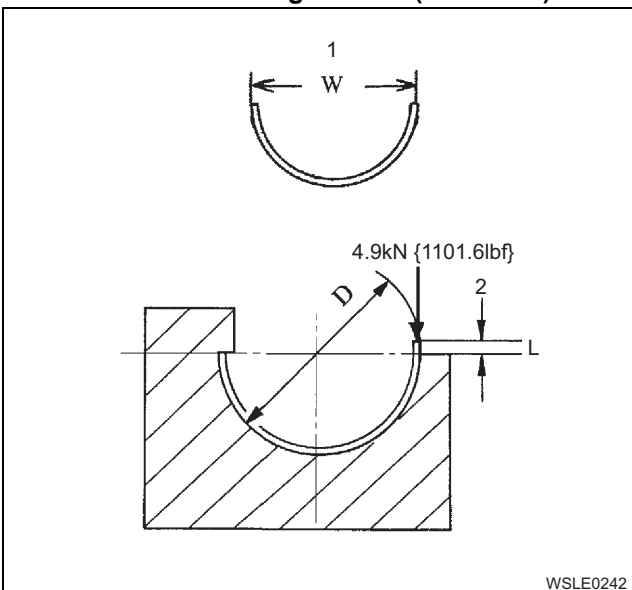
Inspection of tension of the journal main bearing

Check whether the tension of the bearing is sufficient.

		mm {in}
Standard value	Service limit	
W = 64.5 — 65.5 {2.539 — 2.579}	W = 64.1 {2.524}	
D = ϕ 64 {2.520}		
L = 0.02 — 0.06 {0.0008 — 0.00236}		

Repairing procedure: use the one with extrusion and tension, and be careful about sticking of the rear side.

Standard for the bearing tension (reference)



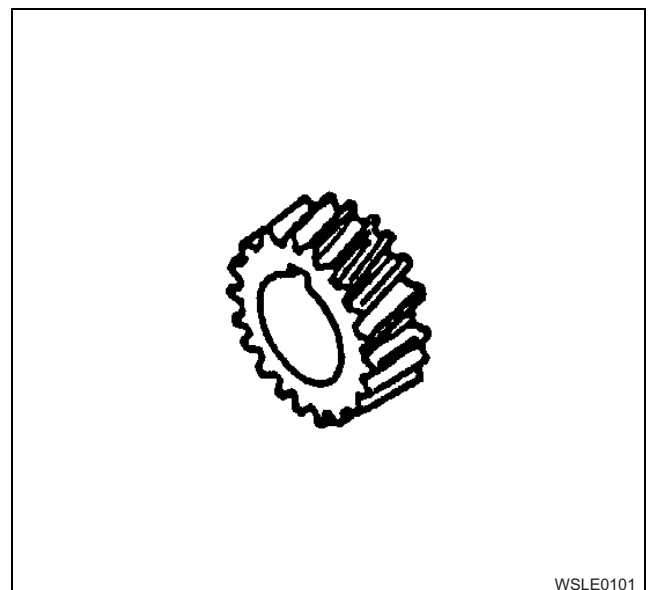
WSLE0242

Name

1. Tension (Free Condition)
2. Extrusion

Inspection of crankshaft gear

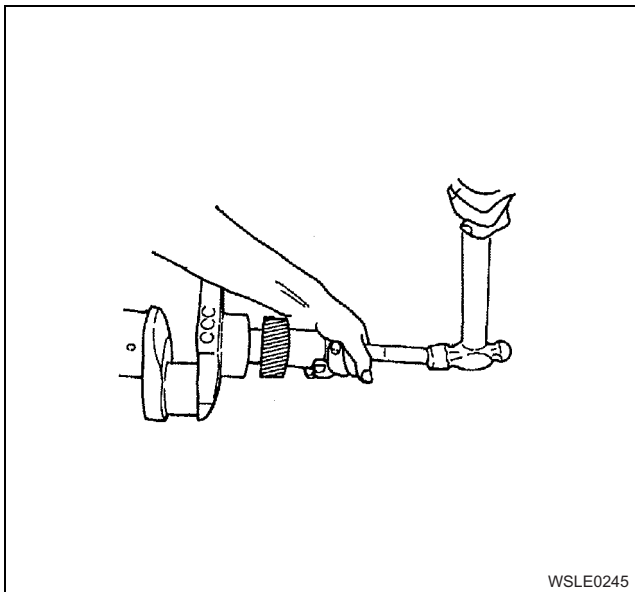
Check visually for damage and other abnormality. Replace if there is damage or serious pitching.



WSLE0101

Reassembly

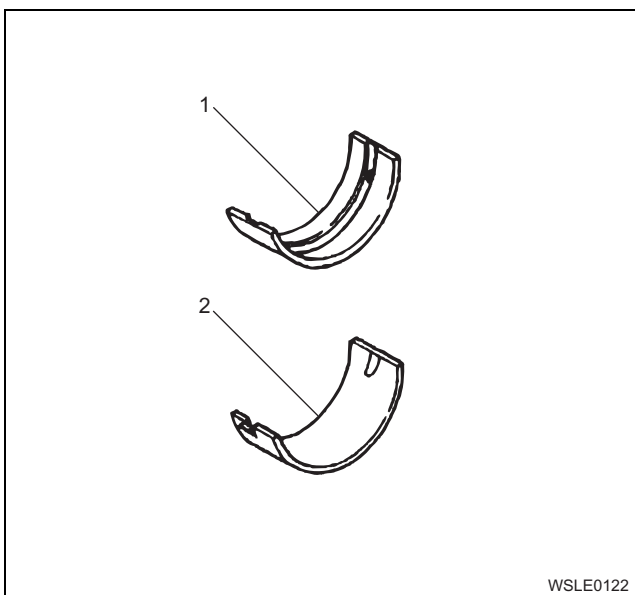
1. Install the crankshaft gear.
Put a brass stick on the gear and strike with a hammer to install.



Installation

1. Install the crankshaft upper bearing.
 - a. While there are the oil holes and oil grooves on the upper bearing (block side), there is none on the lower bearing (bearing cap side). Take care when assembling.

CAUTION:
If assembling the lower bearing and upper bearing inversely, seizure occurs in the crankshaft bearing. Be careful with it.



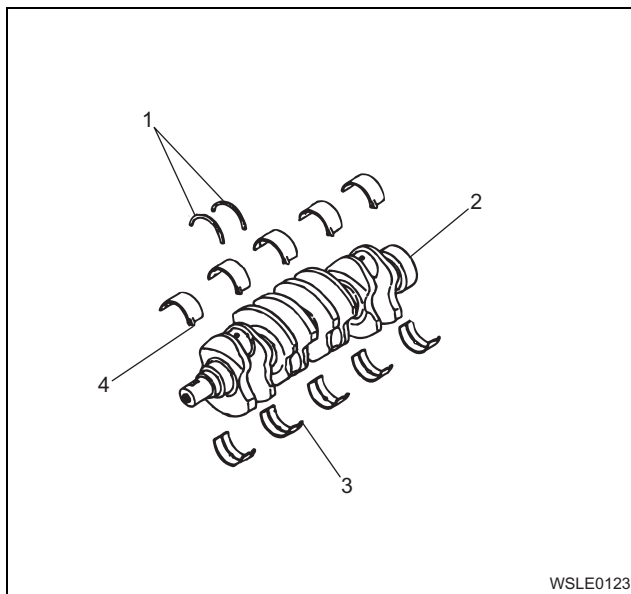
Name

1. Upper Bearing
2. Lower Bearing

- b. Wipe the rear side of the crankshaft bearing and the inside of the crank bearing housing of the cylinder block, and check that there is no foreign matter.
 - c. Assemble the pawl of the bearing to the cutout portion of the cylinder block securely, and apply engine oil sufficiently to the inside of the bearing (sliding surface).
2. Install the crankshaft.
Put the crankshaft on the cylinder block carefully.
3. Install the crankshaft lower bearing.
Assemble the thrust bearing with the oil groove facing outward. (No.2 journal portion)

CAUTION:

- Be sure to prevent the installation position and sliding surface of the bearing from adhering of dirt.
- Be sure to prevent the backside of the bearing (installation position) from adhering of oil.



Name

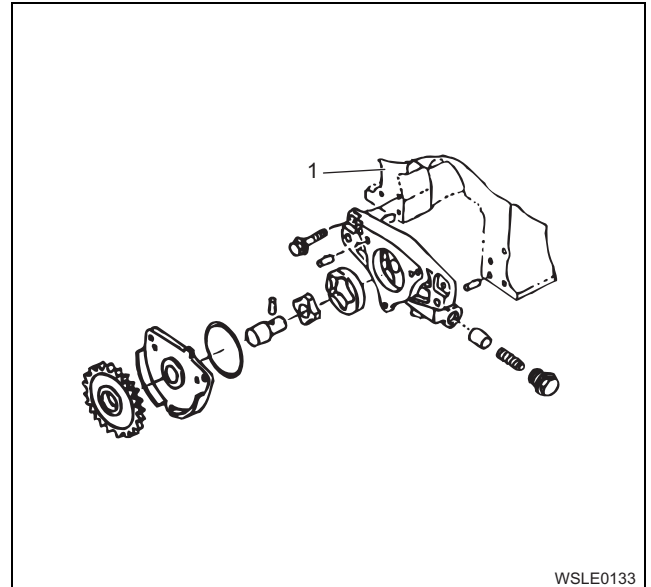
1. Thrust Bearing
2. Crankshaft
3. Upper Bearing Pawl
4. Lower Bearing Pawl

4. Install the crankshaft bearing cap.
 - a. Install the bearings to each bearing cap and apply engine oil sufficiently. Then assemble them from the front so that the arrow marks on the caps facing toward the front of the engine in the order of the marking numbers.
 - b. Apply engine oil to the threads and the seating surface of the bearing cap bolt. Then tighten evenly in several batches in the order shown in the illustration, and at the end, tighten to the specified torque.

Tightening torque:

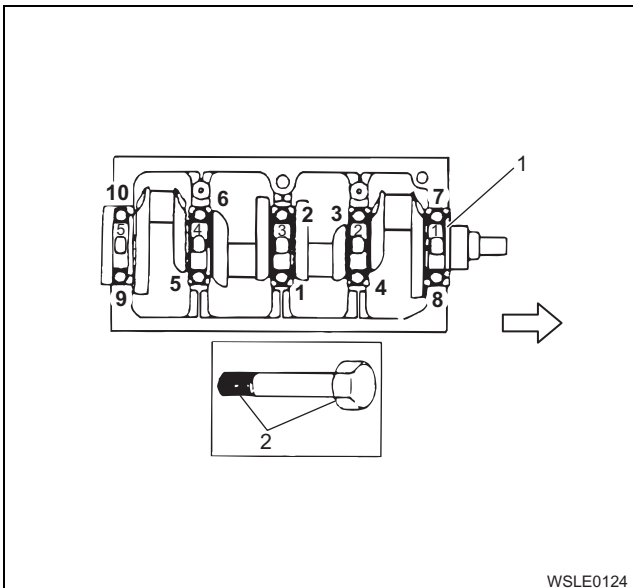
83.4 — 93.2 N·m {8.5 — 9.5 kgf·m/61.5 — 68.7 lb·ft}

- c. After assembling, check that the crankshaft rotates.



Name

1. Cylinder Block



Name

1. Arrow Mark
2. Engine Oil Application

5. Install the oil pump ASM.
 - a. Pour engine oil to the oil pipe and installation port of the oil strainer.
 - b. Install the oil pump ASM to the cylinder block.

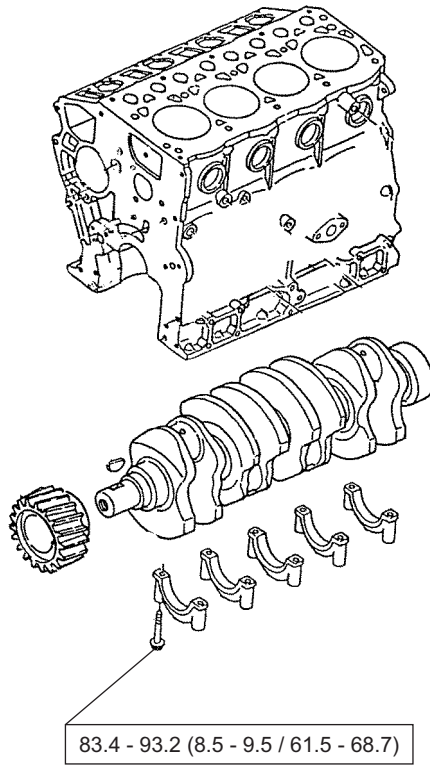
Tightening torque:

18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

6. Install the camshaft.
Refer to 1A-90, "Installation, Camshaft".
7. Install the idle gear.
Refer to 1A-84, "Installation, Timing Gear Train".
8. Install the crankshaft rear oil seal.
Refer to 1A-80, "Installation, Crankshaft Rear Oil Seal".
9. Install the crankshaft front oil seal.
Refer to 1A-76, "Installation, Crankshaft Front Oil Seal".
10. Install the flywheel.
Refer to 1A-72, "Installation, Flywheel".
11. Install the pistons and connecting rods.
Refer to 1A-67, "Installation, Piston, Connecting Rod".
12. Install the cylinder head.
Refer to 1A-56, "Installation, Cylinder Head".
13. Install the rocker arm bracket.
Refer to 1A-44, "Installation, Rocker Arm Shaft".
14. Install the engine exterior equipment.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
15. Install the engine accessories.
Refer to 1A-14, "Installation, Engine Accessories".

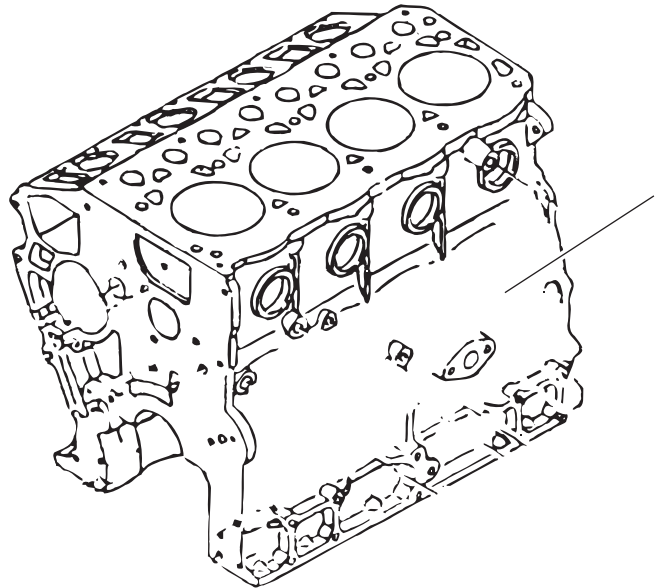
Torque Specifications

N·m (kg·m / lb·ft)



Cylinder Block

Components



WSLE0310

Name

1. Cylinder Block

Removal

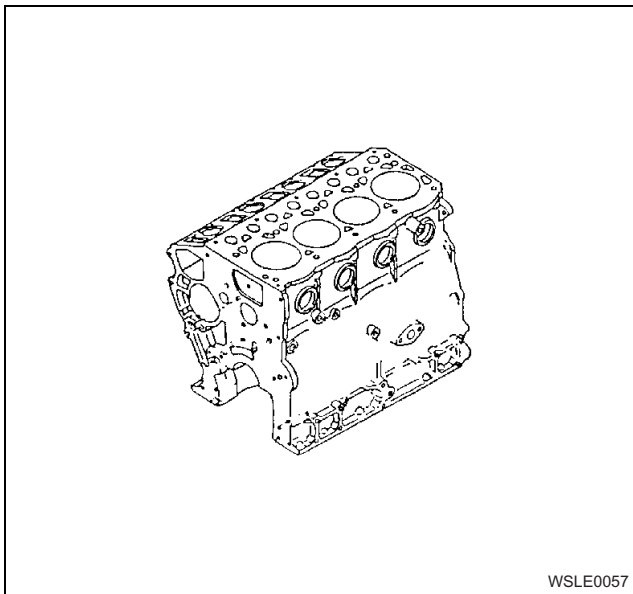
1. Remove the engine accessories.
Refer to 1A-14, "Removal, Engine Accessories".
2. Remove the engine exterior equipment.
Refer to 1A-22, "Removal, Engine Exterior Equipment".
3. Remove the rocker arm bracket.
Refer to 1A-41, "Removal, Rocker Arm Shaft".
4. Remove the cylinder head.
Refer to 1A-47, "Removal, Cylinder Head".
5. Remove the piston and the connecting rod.
Refer to 1A-59, "Removal, Piston, Connecting Rod".
6. Remove the flywheel.
Refer to 1A-71, "Removal, Flywheel".
7. Remove the crankshaft front oil seal.
Refer to 1A-74, "Removal, Crankshaft Front Oil Seal".
8. Remove the crankshaft rear oil seal.
Refer to 1A-79, "Removal, Crankshaft Rear Oil Seal".
9. Remove the idle gear.
Refer to 1A-82, "Removal, Timing Gear Train".
10. Remove the camshaft.
Refer to 1A-87, "Removal, Camshaft".
11. Remove the crankshaft.
Refer to 1A-92, "Removal, Crankshaft".

Inspection

Inspection of cylinder block

Check the cylinder block for wear, damage, water leakage and other abnormality.

1. Use a wooden plug or something to block the water passage and check for leakage.
Water leakage: Water pressure test 490 kPa {71 psi} (for three minutes)
2. Check for damage by the color check.
3. Check the jet hole of the piston cooling and water hole between bores for clogging or something abnormal.



WSLE0057

Inspection of cylinder bore

Measure the cylinder bore at specified positions with a cylinder gauge.

Measurement position: 13 mm {0.512 in} lower from the top surface.

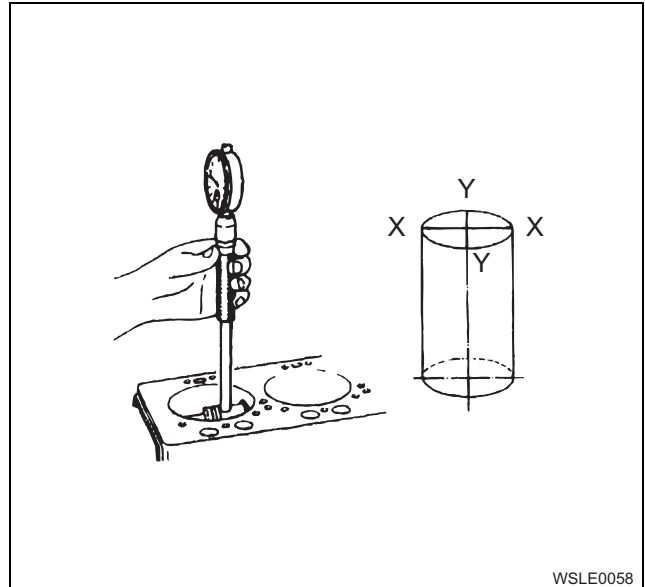
(Measure in the X – X and Y – Y directions.)

(Near top ring)

mm {in}		
Nominal dimension	Service limit	Repairing procedure
$\phi 85$ {3.3465}	$\phi 85.2$ {3.354}	Perform boring along the piston and perform honing.

CAUTION:

- Oversized piston and piston ring are set to 0.25 mm {0.0098 in}.
- Be sure to perform honing after boring.
Honing should be at 0 to 0.03 mm {0 to 0.0012 in} against oversize diameter. Difference of each cylinder bore should be 0.02 mm {0.0008 in} or less.

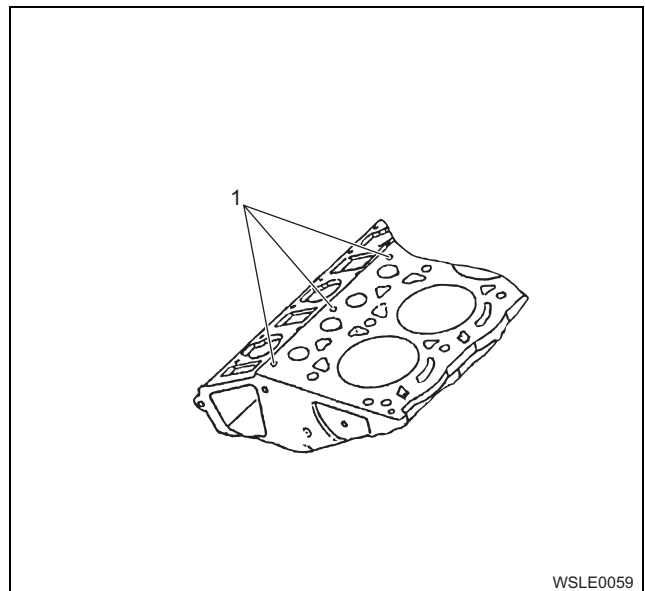


WSLE0058

Cylinder bore diameter and grade mark

Grade mark is stamped to each installation surface of the injection pump of the cylinder block.

mm {in}	
Bore diameter	Grade
$\phi 85.000$ — 85.010 {3.3465 — 3.3468}	A
$\phi 85.011$ — 85.020 {3.3469 — 3.3472}	B
$\phi 85.021$ — 85.030 {3.3473 — 3.3476}	C



WSLE0059

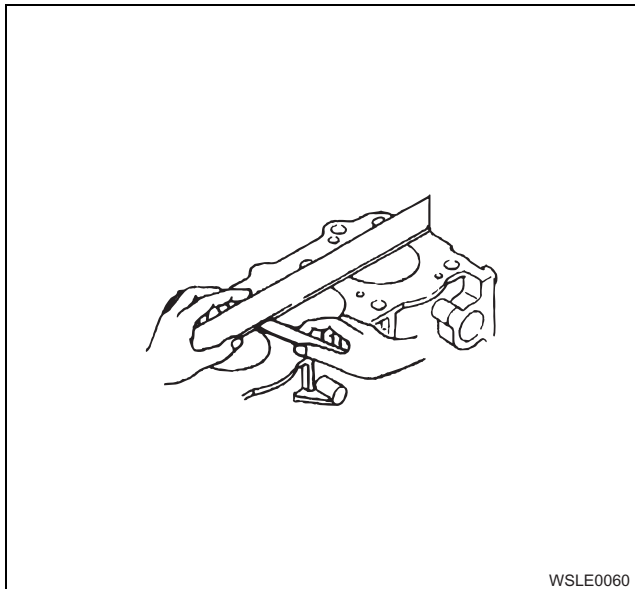
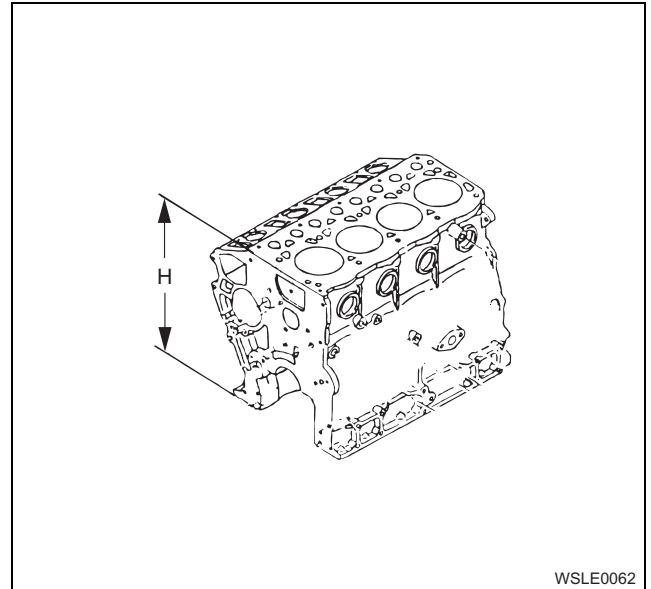
Name

1. Bore Grade Mark (Marking Position)

Inspection of top distortion

Place a straightedge on the four side-directions and the two diagonal directions, and measure the distortion with the thickness gauge.

mm {in}		
Standard value	Abnormal value (need repair)	Repairing procedure
0.075 {0.00295} or less	0.15 {0.006}	Repair it with a surface grinder. The total amount of repaired values of the cylinder head and of the cylinder block should not exceed 0.3 {0.012}. If the measured value exceeds the maximum repaired value, replace the cylinder block.



(Reference) Cylinder block height	mm {in}
Standard value	
307.94 — 308.06 {12.124 — 12.128}	

Installation

1. Install the crankshaft.
Refer to 1A-96, "Installation, Crankshaft".
2. Install the camshaft.
Refer to 1A-90, "Installation, Camshaft".
3. Install the idle gear.
Refer to 1A-84, "Installation, Timing Gear Train".
4. Install the crankshaft rear oil seal.
Refer to 1A-80, "Installation, Crankshaft Rear Oil Seal".
5. Install the crankshaft front oil seal.
Refer to 1A-76, "Installation, Crankshaft Front Oil Seal".
6. Install the flywheel.
Refer to 1A-72, "Installation, Flywheel".
7. Install the pistons and connecting rods.
Refer to 1A-67, "Installation, Piston, Connecting Rod".
8. Install the cylinder head.
Refer to 1A-56, "Installation, Cylinder Head".
9. Install the rocker arm bracket.
Refer to 1A-44, "Installation, Rocker Arm Shaft".
10. Install the engine exterior equipment.
Refer to 1A-29, "Installation, Engine Exterior Equipment".
11. Install the engine accessories.
Refer to 1A-14, "Installation, Engine Accessories".

Special Tool

List of Special Tool

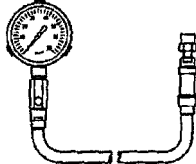



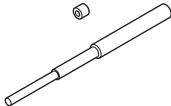

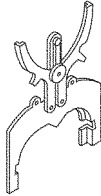
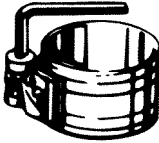

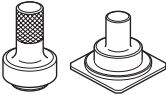
Illustration	Tool No./Tool Name/Rank
 5884026750	5-8840-2675-0 J-26999-12 Compression gauge Rank B
 5884090290	5-8840-9029-0 Compression gauge adapter Rank A
 5884090160	5-8840-9016-0 J-28829 Nozzle tester Rank B
 5884090300	5-8840-9030-0 J-29760 Valve spring remover Rank B
 5884090350	5-8840-9035-0 Valve guide installer Rank B
 5884090330	5-8840-9033-0 JKM-1009 Valve seal setting tool Rank B

Illustration	Tool No./Tool Name/Rank
 1852210290	1-8522-1029-0 Piston ring setting tool Rank B
 5884090180	5-8840-9018-0 J-8037 Piston ring compressor Rank B
 5884090310	5-8840-9031-0 Front oil seal installer Rank A
 5884090320	5-8840-9032-0 Rear oil seal installer Rank A

Engine

4LE1 Cooling System

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Cooling System	1B-2
Service Precautions	1B-2
Explanations on Functions and Operation	1B-2
Function Check	1B-4
Water Pump	1B-7
Components.....	1B-7
Inspection.....	1B-7
Thermostat	1B-8
Inspection.....	1B-8

Cooling System

Service Precautions

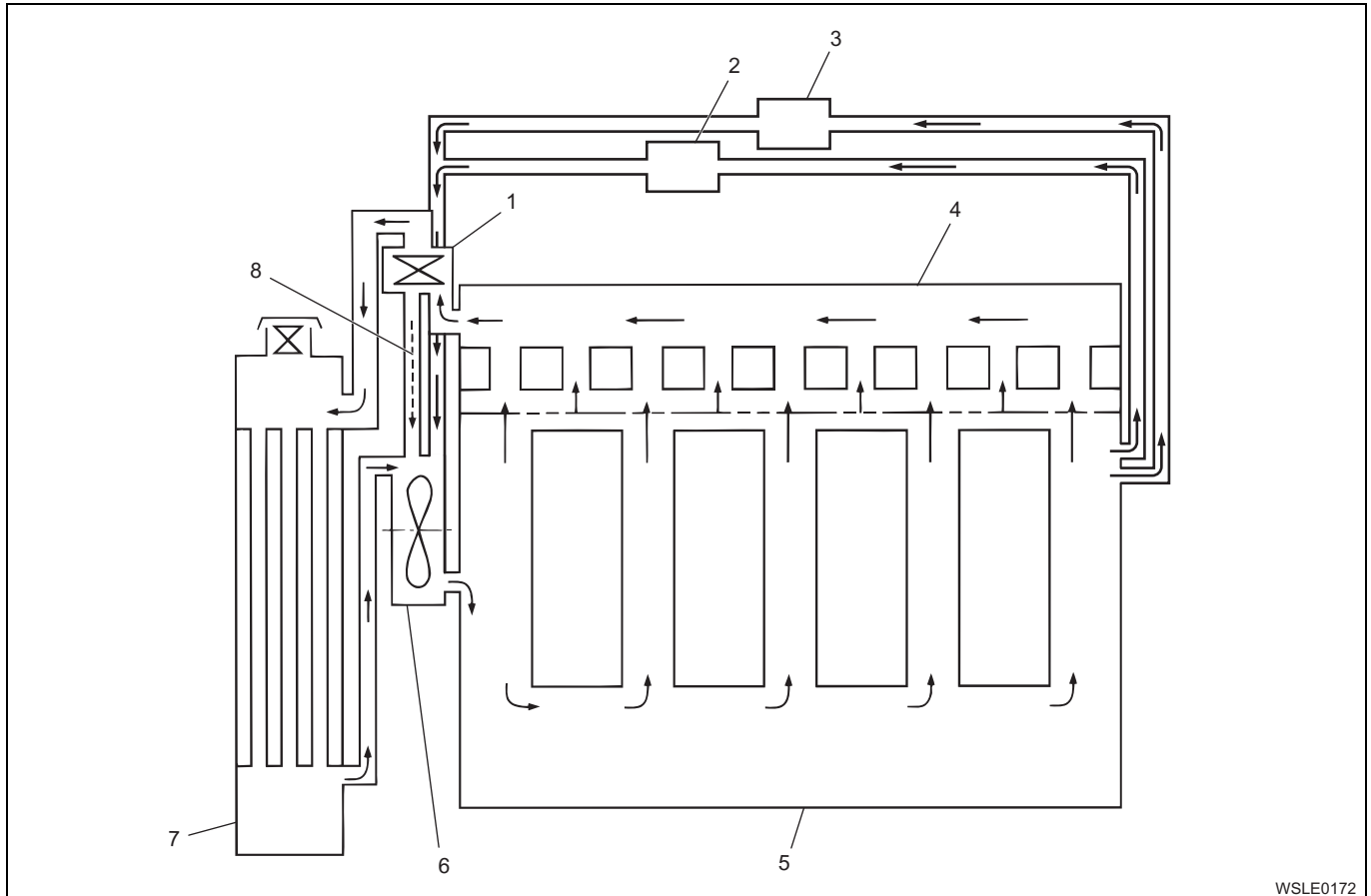
WARNING:

Do not remove the radiator cap when the cooling water is at high temperature. Steam or boiling water will gush out and you may be burnt. To open the radiator cap, cover the cap with a thick cloth when the cooling water is cool, release the pressure by slowly turning the cap, and then remove the cap.

Explanations on Functions and Operation

Cooling water system

The cooling water system, which is the forced circulation system, consists of a water pump, thermostat, and radiator as its main components.



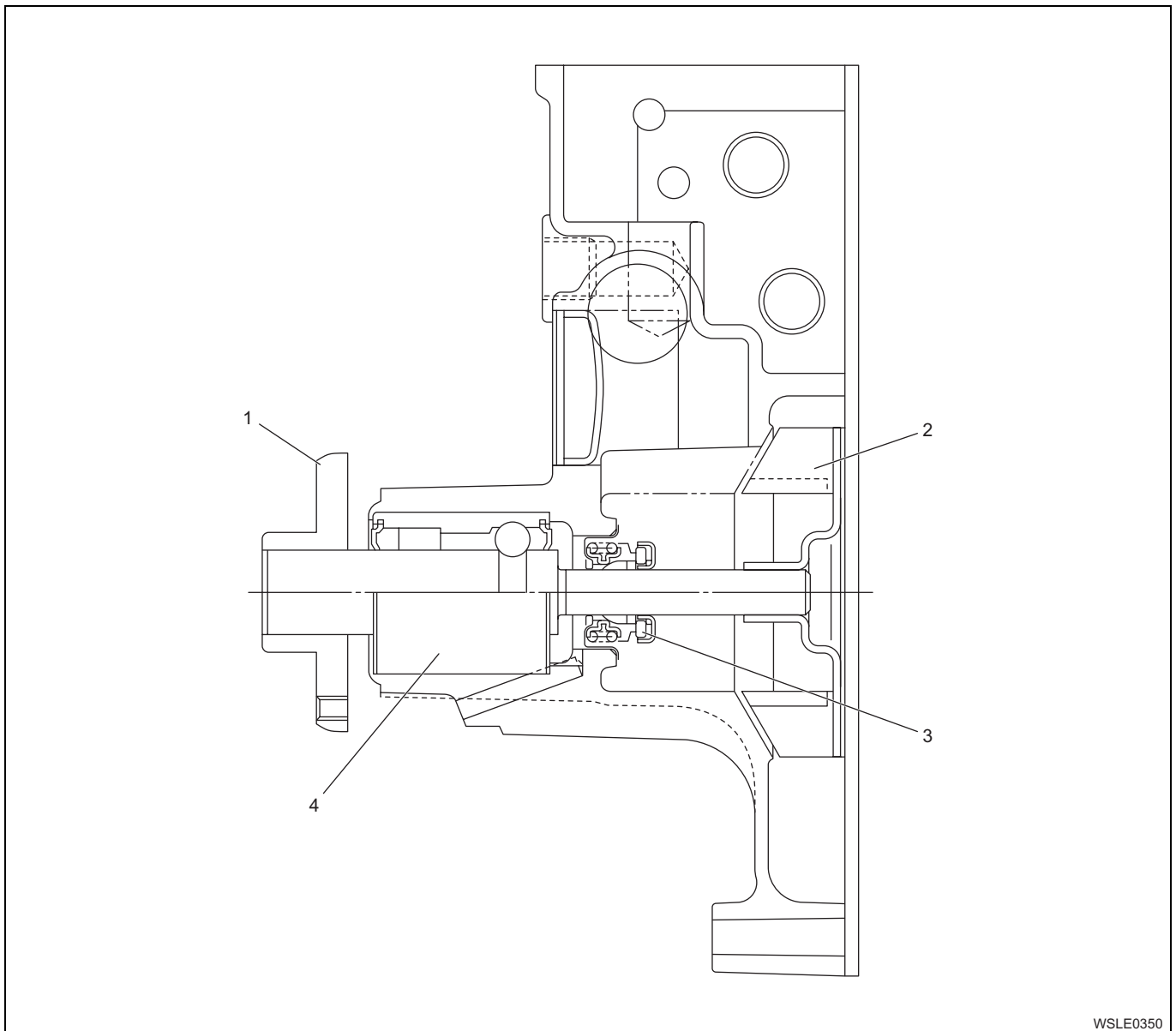
WSLE0172

Name

- | | |
|------------------------------------|-------------------|
| 1. Thermostat (Bottom Bypass type) | 5. Cylinder Block |
| 2. Oil Cooler | 6. Water Pump |
| 3. EGR Cooler | 7. Radiator |
| 4. Cylinder Head | 8. Bypass Circuit |

Water Pump

The water pump, which uses the centrifugal impeller system, is driven by the engine fan belt.



WSLE0350

Name

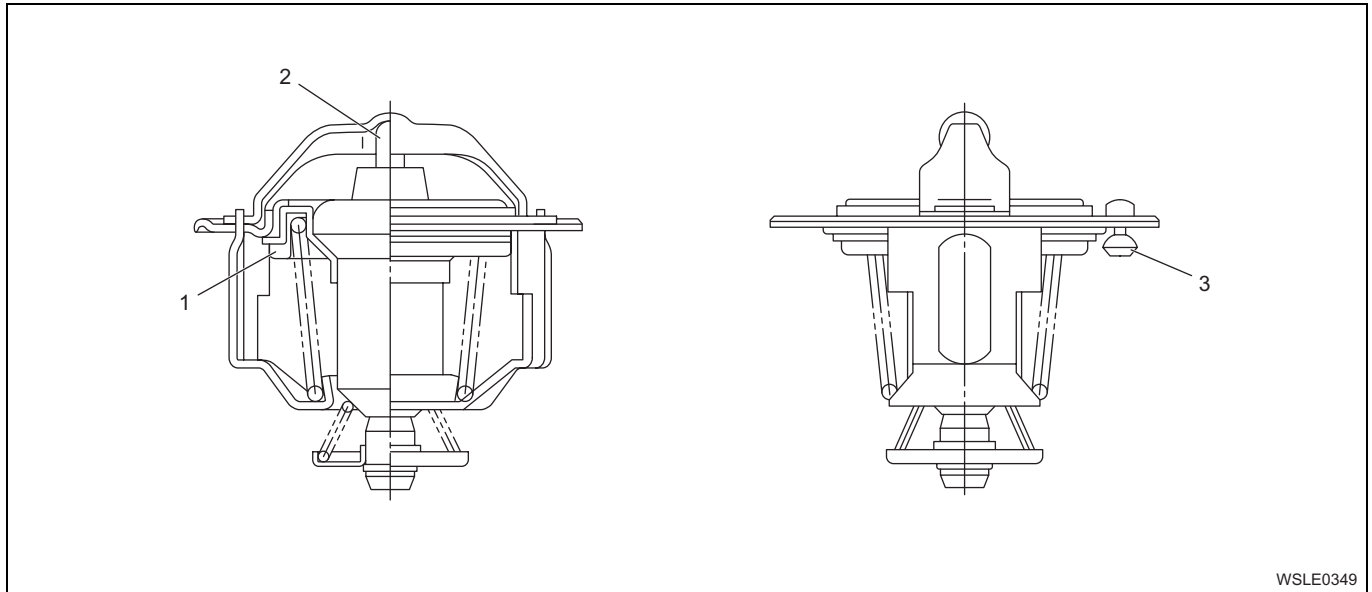
1. Fan Center
2. Impeller

3. Seal Unit
4. Bearing Unit

1B-4 4LE1 Cooling System

Thermostat

The thermostat, which is a wax pellet type, has an valve initial opening temperature of $82\pm 1.5^{\circ}\text{C}$ $\{180\pm 34.7^{\circ}\text{F}\}$.



Name

1. Valve
2. Piston

3. Jiggle Valve

Function Check

Cooling water level check

- Check the cooling water level within the reserve tank and the level is appropriate when the cooling water level is within the MAX (upper limit) and MIN (lower limit) range. In case the volume of the cooling water is deficient, remove the reserve tank cap and replenish the tank with a mixture of tap water (soft water), distilled water or demineralized water and antifreeze in the ratio of 1:1 until the level comes close to the MAX line.

Standard value	
Cooling water level (engine only)	4.2 L {3.7 qts} (with EGR) 2.8 L {3.0 qts} (without EGR)

Cooling water leak check

- Use the radiator cap tester and apply a pressure of 200 kPa {29.0 psi} and check for leaks in the locations given below. Check that the radiator hose and heater hose are not damaged or degraded and the hose clamp is not loose.

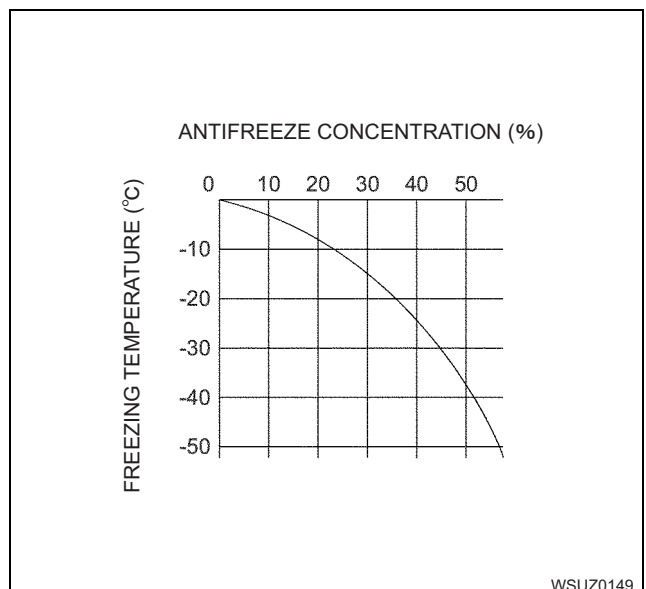
Inspection location

- Radiator ASM, water pump ASM, radiator hose, heater hose

Coolant

1. About the engine coolant concentration

- Take the concentration corresponding to the minimum temperature because the freezing temperature varies according to the concentration of the engine coolant.
- Use only Isuzu genuine engine coolant.
- Use engine coolant with a mix ratio in the range of 30 to 60% because over heating is likely to occur if the ratio is greater than 60% and corrosion prevention is inadequate if the ratio is less than 30%.

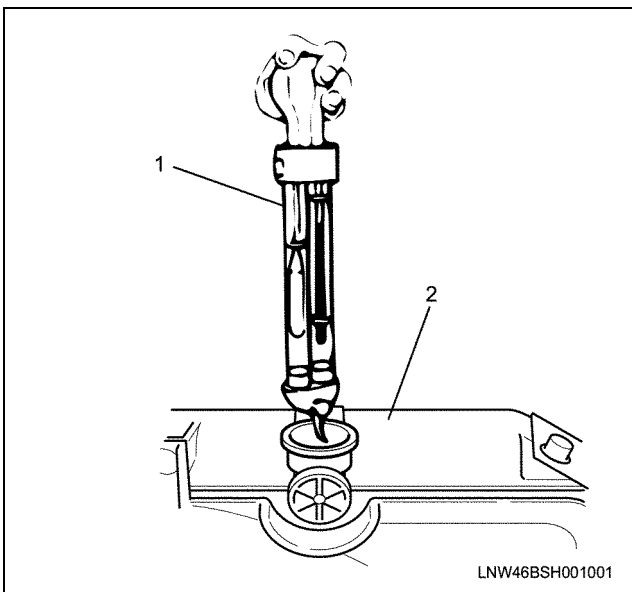


Freezing temperature guideline	Maximum mix ratio L {qts}		Concentration of engine coolant
	Engine coolant	Tap water (soft water), distilled water or demineralized water	
-18°C {-0.4°F}	4.2 {4.4}	7.8 {8.2}	35%
-25°C {-13°F}	5.0 {5.3}	7.0 {7.4}	42%
-35°C {-31°F}	6.0 {6.3}	6.0 {6.3}	50%
-40°C {-40°F}	6.4 {6.8}	5.6 {5.9}	53%

2. Engine coolant concentration measurement

Methods for measuring specific gravity

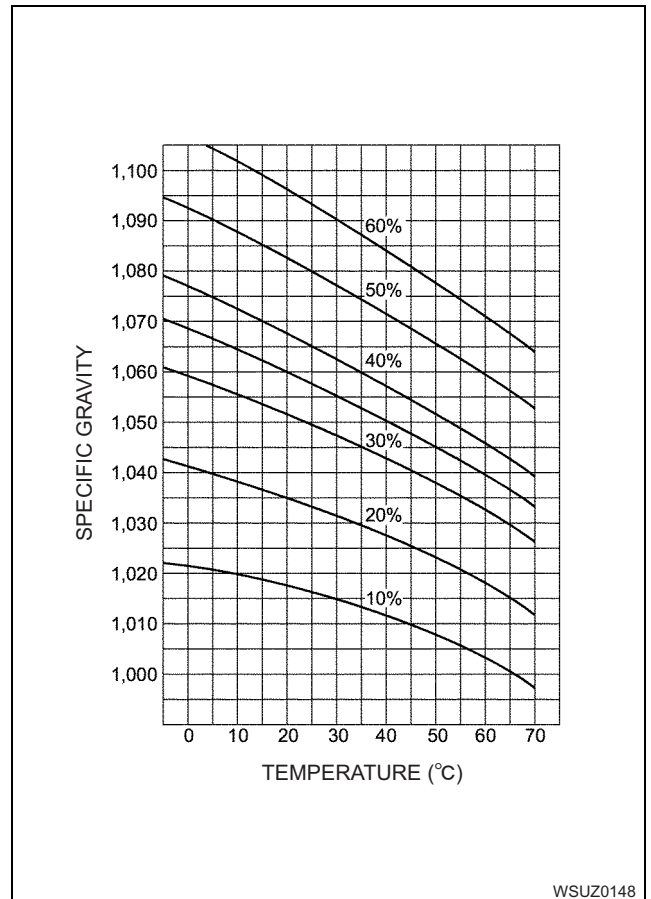
- Measure the specific gravity and the temperature of the cooling water using an antifreeze hydrometer and thermometer. Take precautionary measures as the boiled cooling water may gush out at high temperatures if the cap is removed.
- Use a deep container to suit the height of the specific gravity meter.



Name

1. Antifreeze Hydrometer
2. Radiator

- Fix the temperature of the cooling water being measured in the range of 0 to 50°C {32 to 122°F}.
- Measure the temperature and specific gravity and determine the concentration from the table given below.



WSUZ0148

1B-6 4LE1 Cooling System

Coolant scope method

- Measure the concentration using the coolant scope.

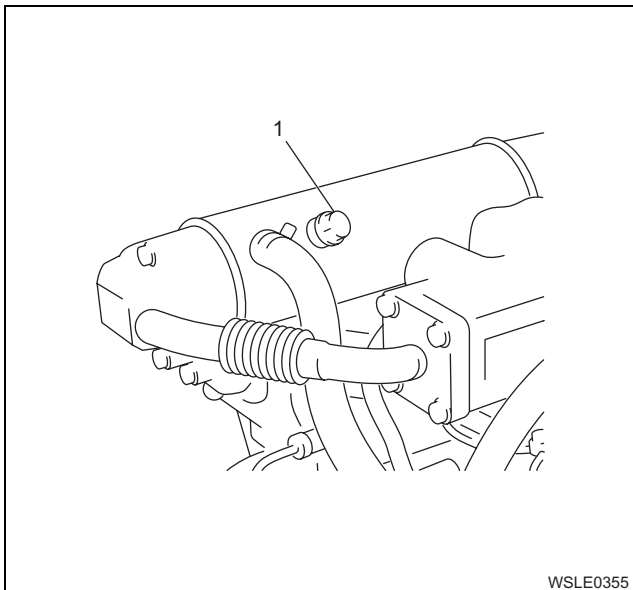
EGR cooler air bleeding procedure

When replacing the coolant, bleed air from the EGR cooler with the following procedure.

Note:

Be sure to replace the coolant when it is cooled.

1. Loosen the air bleed plug (1) on the EGR cooler.



2. Pour coolant into the radiator via its opening.
3. Tighten the plug when the coolant spills over from the air bleed plug.

CAUTION:

If loosening the air bleed plug, be sure to replace the copper packing with new one.

Note:

- Take care to prevent the spilt coolant from getting the exhaust system parts wet.
- Be sure to wipe off the spilt coolant.

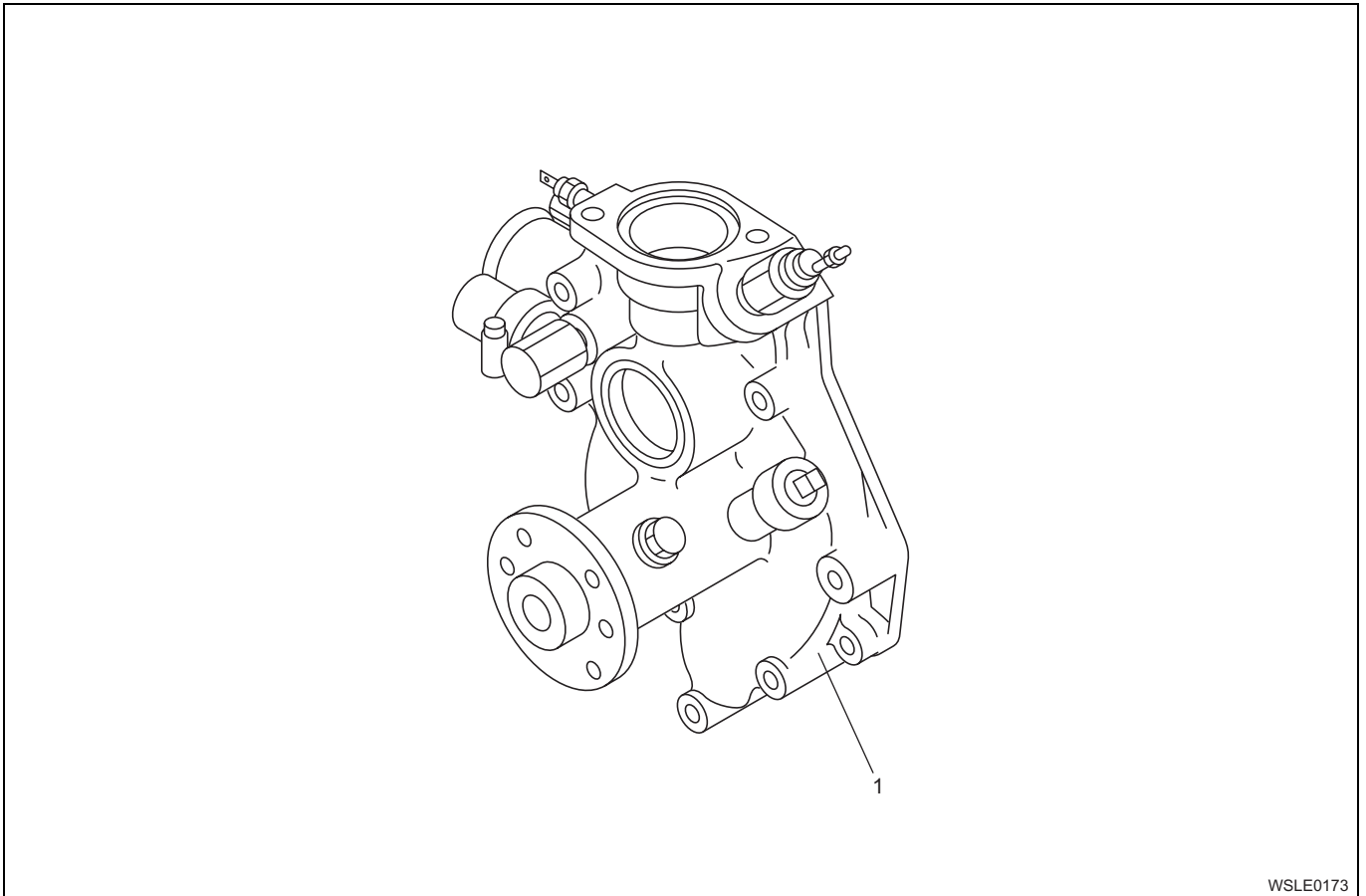
Tightening torque:

24.5 — 30.5 N·m {2.5 — 3.1 kgf·m/18.1 — 22.5 lb·ft}

4. Pour coolant into the radiator via its opening again until it is filled.
5. After filling the radiator, idle the engine for approx. 5 minutes. Air in the cooler comes off and the coolant level is lowered, then stop the engine. After the engine is cooled, check the radiator and the reserve tank coolant levels. If they are low, replenish the coolant.

Water Pump

Components



WSLE0173

Name

1. Water Pump

Inspection

Appearance check

- Check for cracks or damage in the pump body.
- Check for cracks and corrosion in the impeller.
- Check for water leakage from the seal unit.
- If you find abnormalities, replace the water pump ASM.

Inspection of bearing

- Rotate the fan center while pushing it along the radial direction. Confirm that there is no abnormal noise and no excessive play.
- If you find abnormalities, replace the water pump ASM.

Inspection of the bearing rattle

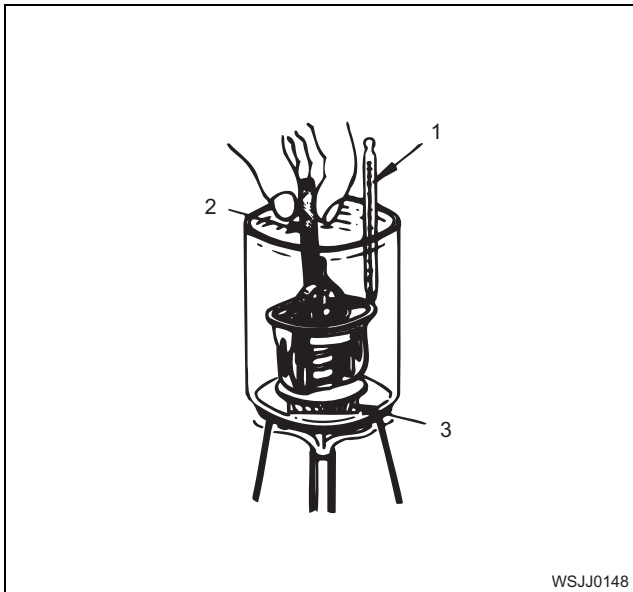
Rattle of the water pump ball bearing		mm {in}
Standard value	Service limit	Repairing procedure
0.008 — 0.010 {0.00031 — 0.00040}	0.2 {0.008}	Replace.

Thermostat

Inspection

Replace it if there is wear, damage, or other abnormality.

Open start temperature	°C {°F}	82 ± 1.5 { 180 ± 34.7 }
Valve lifting height (95°C { 203°F })	mm {in}	With jiggle valve: 9.5 {0.374} or more Without jiggle valve 8.0 {0.315} or more



Name

1. Thermometer
2. Stirrer
3. A Piece of Wood

Engine

4LE1 Fuel System

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Explanations on Functions and Operation	1C-3
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Service Precautions	1C-6
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Fuel System

Service Precautions

Parts of the fuel system such as the internal part of the nozzle holder, holes and clearances that form passages for fuel are finished to a very high degree of accuracy. They are therefore highly sensitive to foreign matter and the entry of foreign matter could cause damage to the fuel passage. Take extreme care not to allow foreign matter to enter.

If water removal agent is used in the fuel then it will absorb moisture in the light oil and may cause rust. Therefore, do not use water removal agent in the fuel tank.

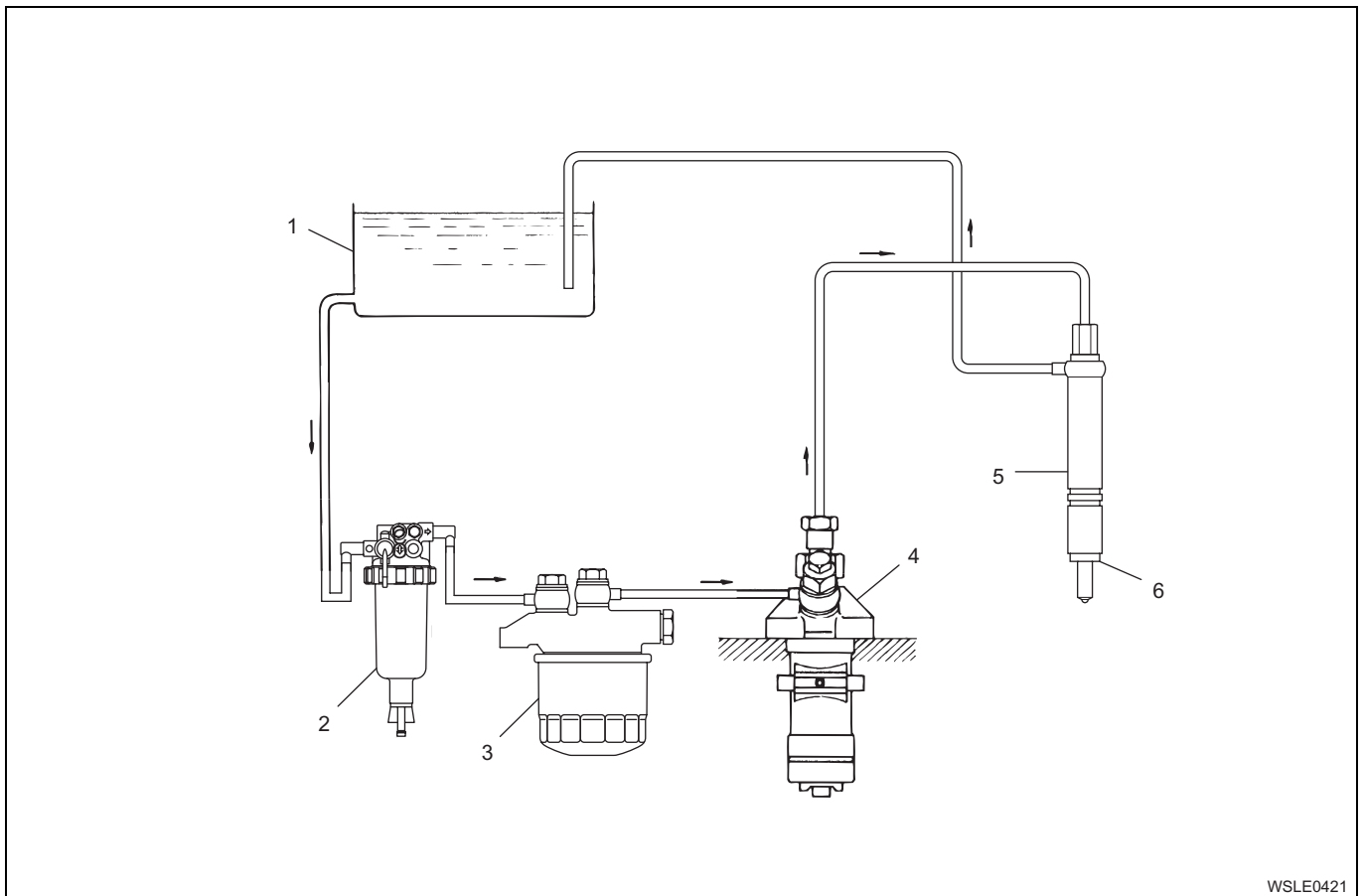
When servicing the fuel system, every precaution must be taken to prevent the entry of foreign material into the system.

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

Discard gaskets and O-rings and replace them with new ones.

Work procedure

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

Explanations on Functions and Operation**Fuel system diagram****Name**

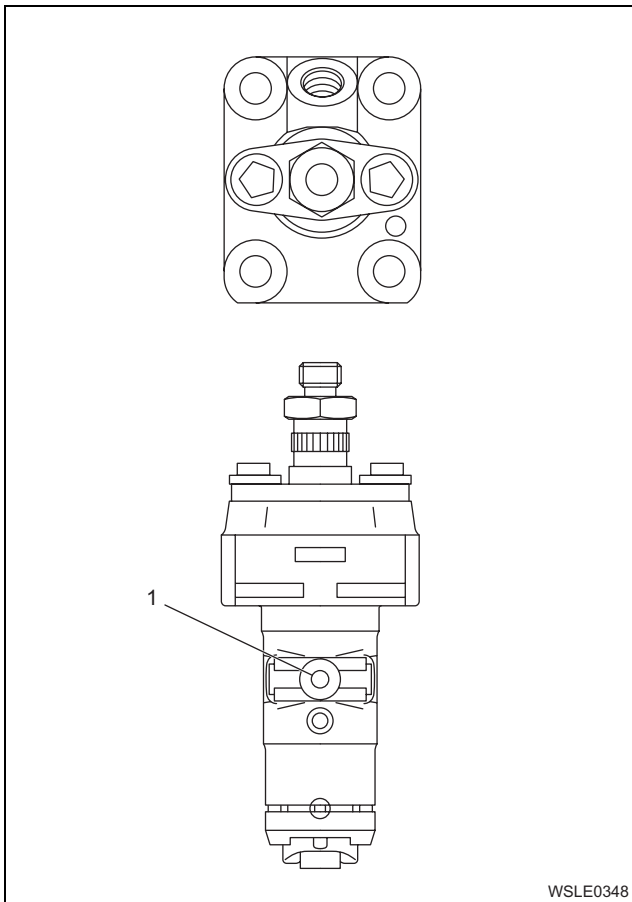
- | | |
|----------------|-------------------|
| 1. Fuel Tank | 4. Injection Pump |
| 2. Sedimenter | 5. Nozzle Holder |
| 3. Fuel Filter | 6. Nozzle |

Note:

- Be careful foreign material does not enter into the fuel system, because the precise fuel system is used.

1C-4 4LE1 Fuel System

Injection pump



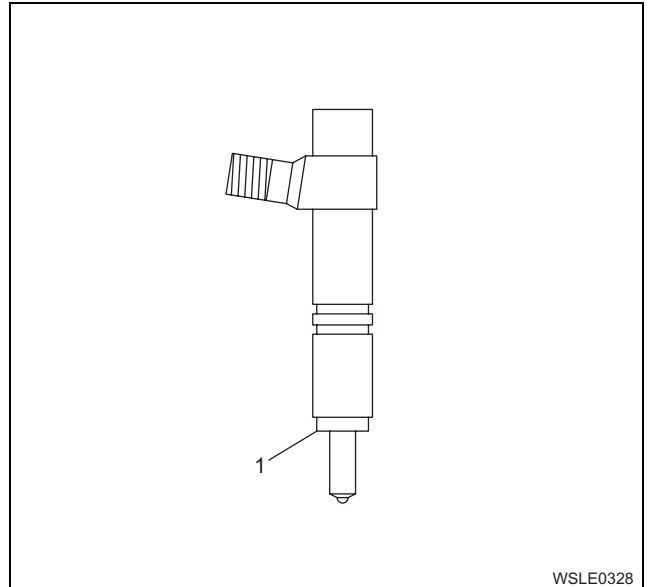
Name

1. Rack Pin

Nozzle holder

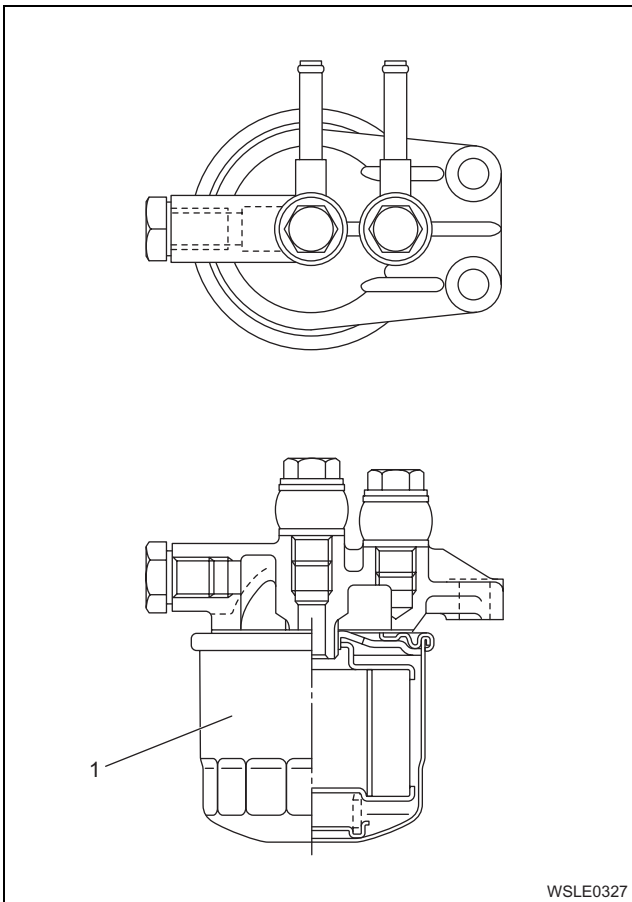
Note:

If a overhaul of the nozzle and inspection and adjustment of the injection pressure are required, contact a BOSCH service center.

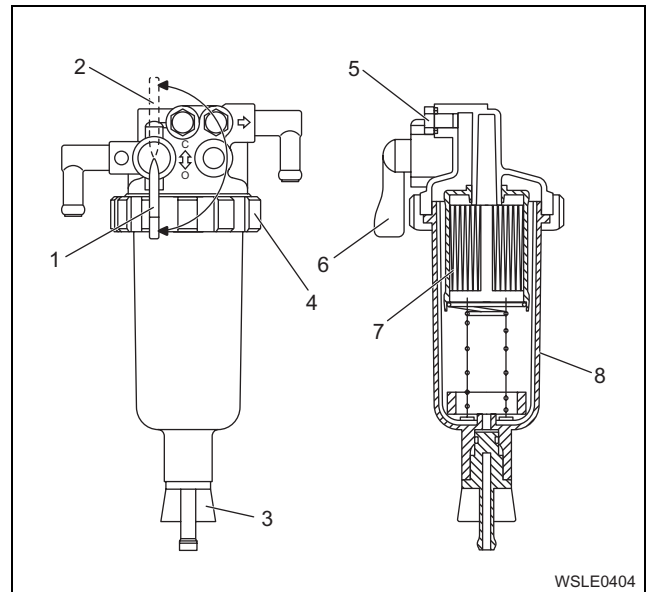


Name

1. Nozzle

Fuel filter**Name**

1. Cartridge

Sedimenter**Name**

1. Lever (Opening Position)
2. Lever (Closing Position)
3. Drain Plug
4. Ring Nut
5. Air Bleed Plug
6. Lever
7. Element
8. Cup

CAUTION:

As the cartridge holds the fuel, take care not to dirty around the system when removing it. Also, take care of fire.

1. Rotate the water sedimenter lever until it stops with its handle right above the supporting point (close) to shut out the fuel flow.
2. Loosen the ring nut to remove the cup and take out the element inside of the sedimenter.
3. Clean the cup and the element and install the new packing in the ring nut.
4. Securely tighten the cup holding the element to the body with the ring nut.
5. After installing, rotate the water sedimenter lever until it stops with its handle right below the supporting point (open) to make the fuel flow.
Engine cannot be started or operated as the fuel is shut out while the water sedimenter lever handle is turned to the right above the supporting point.

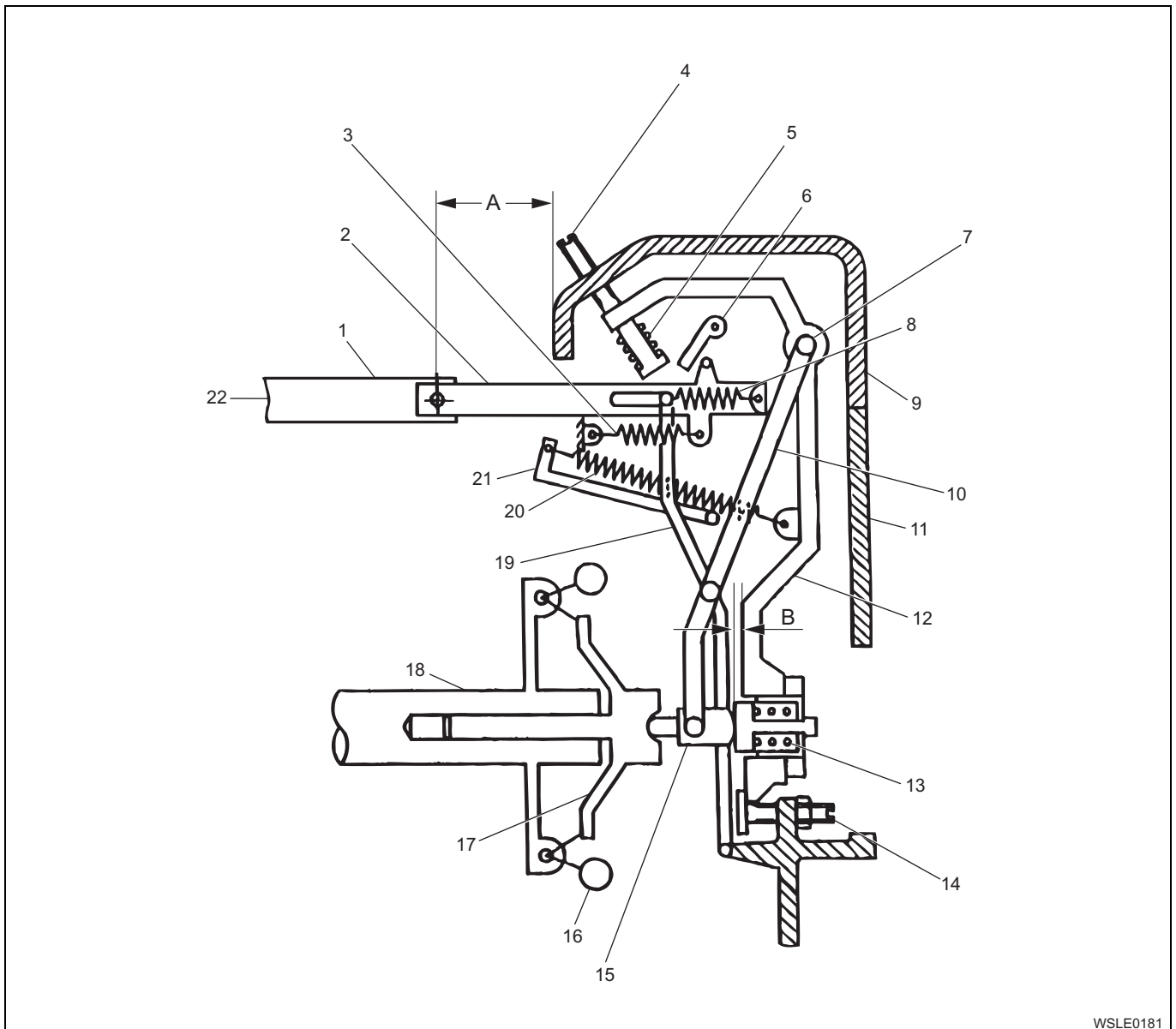
Governor

Service Precautions

1. Engine performance test is required for adjustment of the governor-related parts.
2. Measure the dimensions of A and B in the structure diagram (1) before disassembling, and set them to the same dimensions when reassembling.
3. When you cannot carry out a performance test after reassembling, do not disassemble it.
4. Apply engine oil to each sliding portion (the lever end surface, the shaft hole and the outer circumference of the shaft) when reassembling it.
5. Install the set spring securely to a groove of the pin connecting the floating lever, taking care of the assembly direction.
6. Before installing the start spring, make sure that each lever moves by its weight.
7. After installing the start spring, make sure that each lever moves smoothly.
Also, make sure that each spring operates normally.

Components

Structure diagram (1)

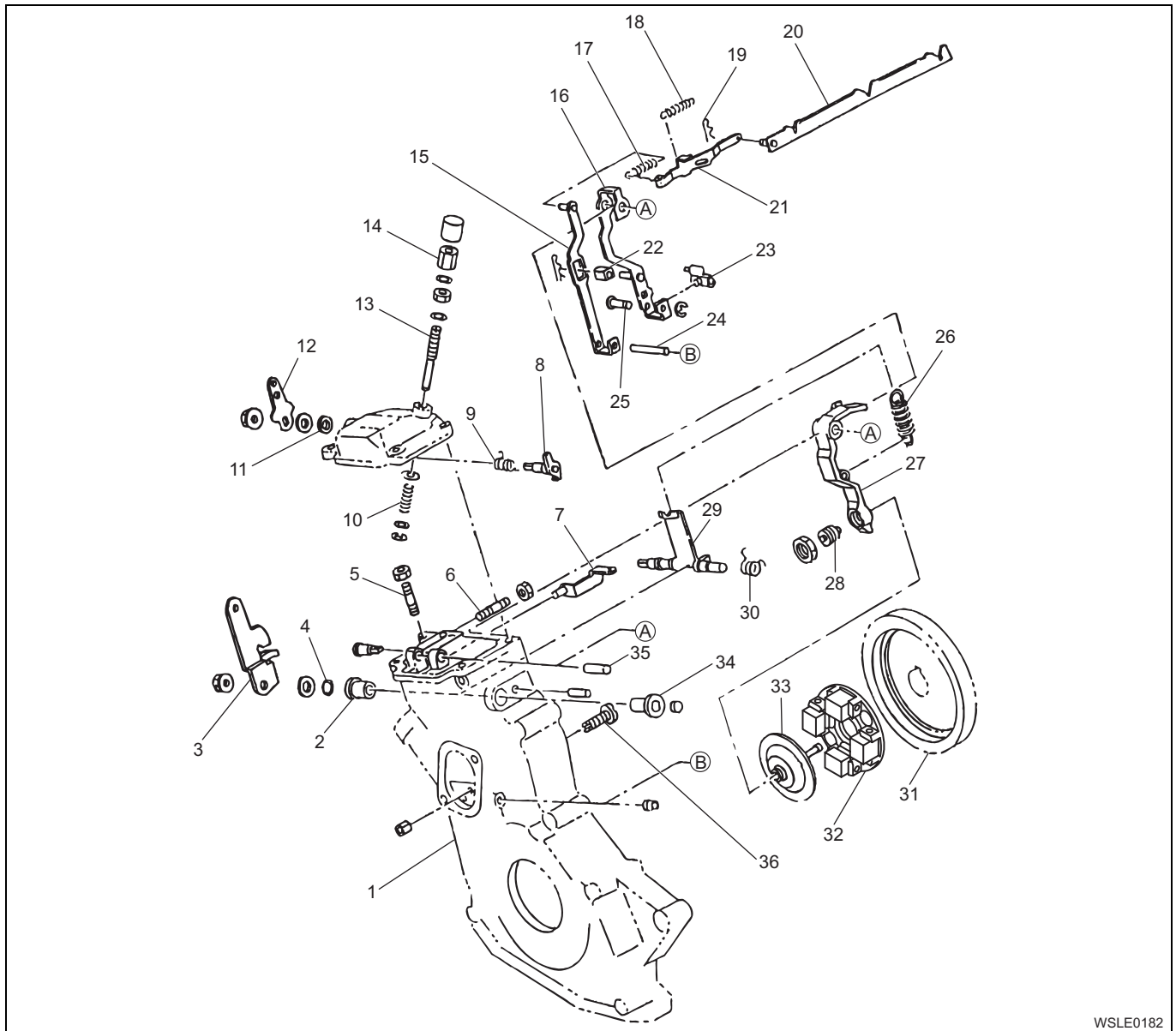


WSLE0181

Name

- | | |
|----------------------|-------------------------|
| 1. Control Link | 12. Tension Lever |
| 2. Link Plate | 13. Angleich |
| 3. Start Spring | 14. Full Load Stopper |
| 4. Idle Speed Screw | 15. Shifter |
| 5. Idle Spring (Sub) | 16. Flyweight |
| 6. Fuel Cut Lever | 17. Sleeve |
| 7. Governor Shaft | 18. Camshaft |
| 8. Set Spring | 19. Floating Lever |
| 9. Governor Cover | 20. Main Spring |
| 10. Guide Lever | 21. Lever (Main Spring) |
| 11. Timing Gear Case | 22. Injection Pump |

Structure diagram (2)



WSLE0182

Name

- | | |
|-------------------------|----------------------------|
| 1. Timing Gear Case | 19. Snap Pin |
| 2. Lever Bushing | 20. Control Link |
| 3. Control Lever | 21. Link Plate |
| 4. O-ring | 22. Guide Piece |
| 5. Speed Control Screw | 23. Shifter |
| 6. Speed Control Screw | 24. Shaft (Floating Lever) |
| 7. Start Spring Bracket | 25. Shifter Shaft |
| 8. Fuel Cut Shaft | 26. Main Spring |
| 9. Return Spring | 27. Tension Lever |
| 10. Idle Spring | 28. Angleich |
| 11. O-ring | 29. Lever (Main Spring) |
| 12. Fuel Cut Lever | 30. Return Spring |
| 13. Set Screw | 31. Cam Gear |
| 14. Cap Nut | 32. Flyweight |
| 15. Floating Lever | 33. Sleeve |
| 16. Guide Lever | 34. Lever Bushing |
| 17. Set Spring | 35. Shaft |
| 18. Start Spring | 36. Full Load Set Screw |

Disassembly

Disassembly of the governor lever-related components

1. Remove the levers and spring from the timing gear case.

Disassembly of the full load stopper

1. Remove the full load stopper from the timing gear case.

Disassembly of the governor cover

1. Remove the fuel cut lever and the idle spring-related components from the governor lever.

Disassembly of the shifter

1. Remove the snap ring and the shaft to remove the shifter from the guide lever.

Disassembly of the control lever-related components

1. Remove the nut to remove the control lever.
2. Take off the hook on the return spring from the projection of the lever (main spring) and pin.
3. Remove the bushing.
4. Remove the return spring.
5. Remove the lever (main spring).

Reassembly

Reassembly of the control lever-related components

1. Put the lever (main spring) through lever holes of the timing gear case.

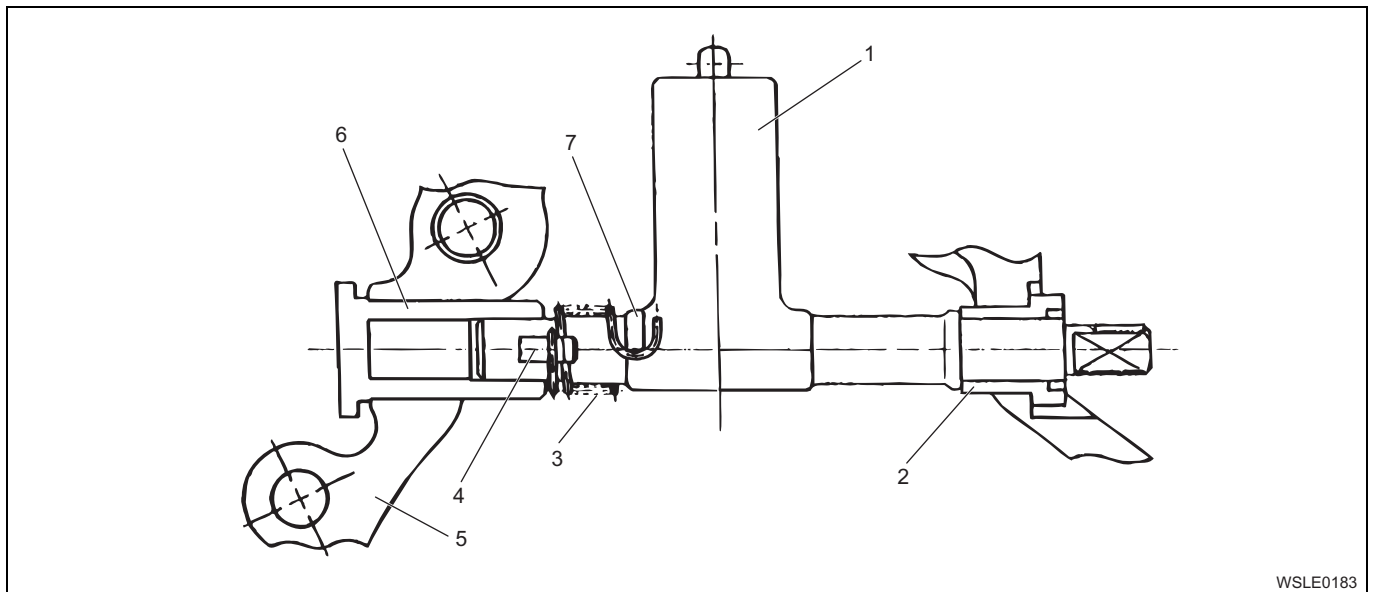
CAUTION:

Put both axes of the lever through lever holes alternately before assembling the bushings.

2. Put the return spring of the control lever through a axis of the lever (main spring).
3. Assemble the bushing.
Assemble the bushing of the lever (main spring), and then assemble the bushing of the control lever.

CAUTION:

Apply Loctite (No.601) to the outer circle of the bushing when assembling the bushing.



WSLE0183

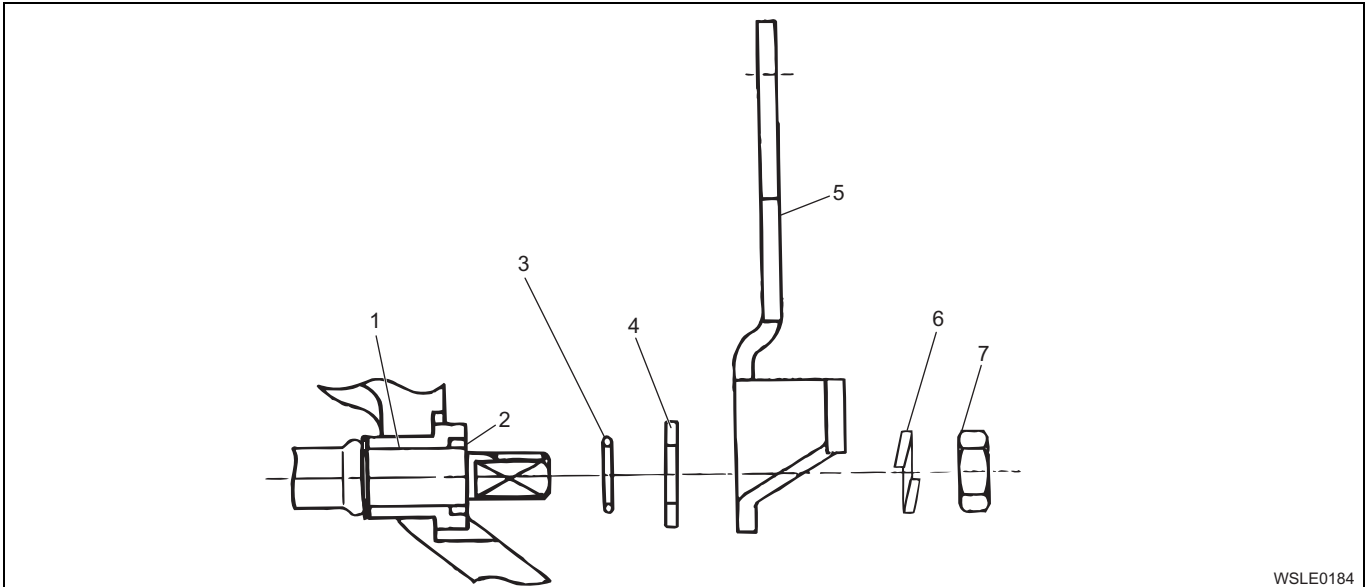
Name

- | | |
|------------------------|---------------------|
| 1. Lever (Main Spring) | 5. Timing Gear Case |
| 2. Bushing | 6. Bushing |
| 3. Return Spring | 7. Protrusion |
| 4. Pin | |

4. Assemble the hooks on both ends of the return spring (control lever) to the protrusion of the lever (main spring) and pin securely.
5. Assemble the control lever.
After installing the O-ring to a groove of the bushing (control lever), assemble the washer and the control lever, and tighten the nut.

Tightening torque:

11.8 — 17.7 N·m {1.2 — 1.8 kgf·m/8.7 — 13.1 lb·ft}

**Name**

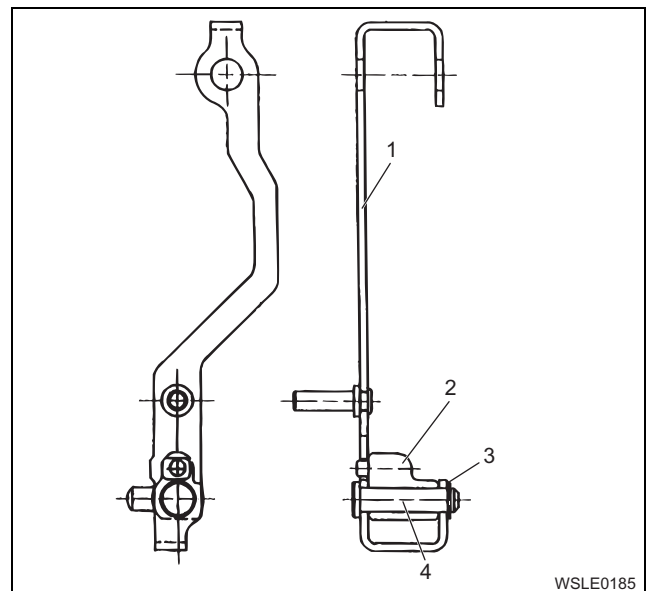
- | | |
|------------|------------------|
| 1. Bushing | 5. Control Lever |
| 2. Groove | 6. Spring Washer |
| 3. O-ring | 7. Nut |
| 4. Washer | |

CAUTION:

- **When tightening the control lever, fix the control lever. (Fix the lever of the main spring. Do not over-tighten it.)**
- **After assembling, make sure that the control lever moves smoothly.**

Reassembly of the shifter

1. Assemble the shifter to the guide lever, put the shaft through it, and assemble the snap ring.
2. Make sure that the shaft rotates smoothly.
3. Make sure that the shifter moves smoothly.

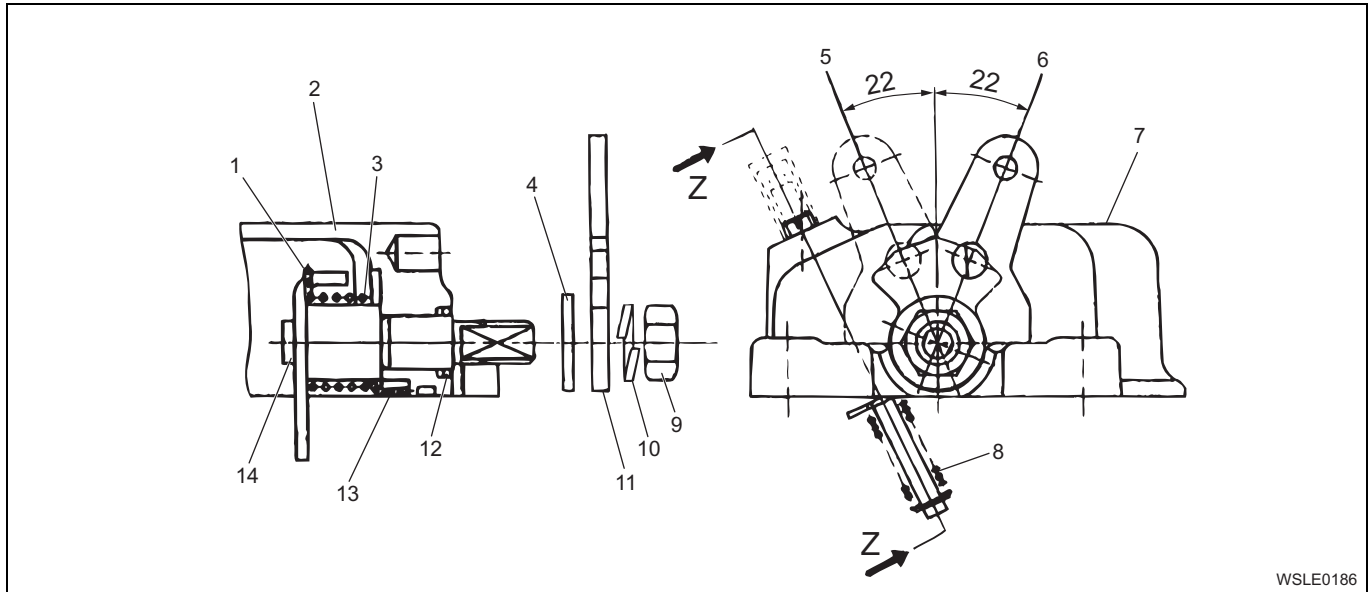
**Name**

1. Guide Lever
2. Shifter
3. Snap Ring
4. Shaft

1C-12 4LE1 Fuel System

Reassembly of the governor cover

Assemble the fuel cut lever and the idle spring-related components to the governor cover.



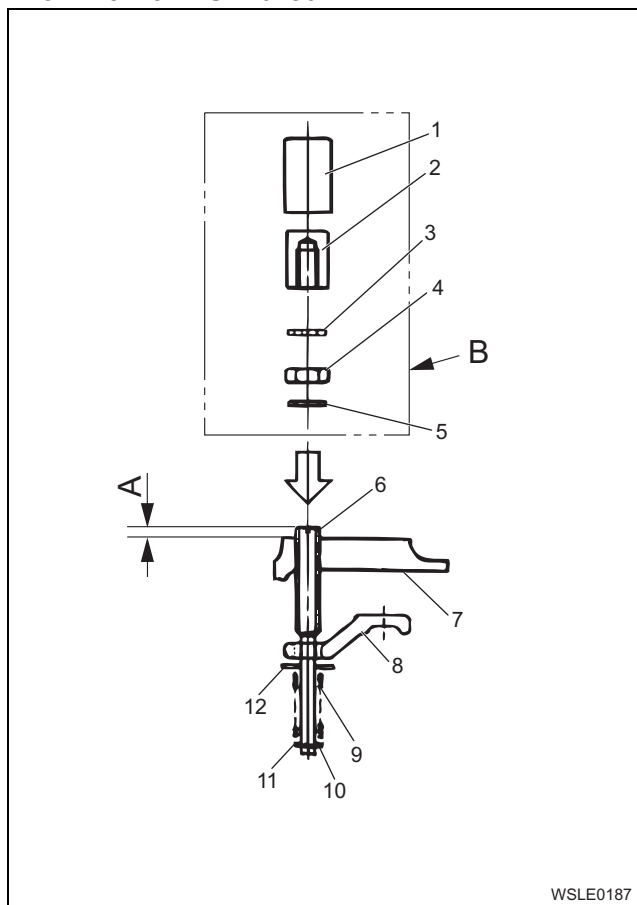
Name

- | | |
|-------------------|--------------------|
| 1. Folding Part | 8. Idle Spring |
| 2. Governor Cover | 9. Nut |
| 3. Return Spring | 10. Spring Washer |
| 4. Thrust Washer | 11. Fuel Cut Lever |
| 5. Stop | 12. O-ring |
| 6. Driving | 13. Cutout Groove |
| 7. Governor Cover | 14. Shaft |

1. Apply engine oil to the sliding surface of the governor cover when assembling the shaft.
2. Assemble the both ends of the return spring to the cutout groove on the bottom of the cover and the folding part of the lever securely.
3. After assembling, make sure that it moves smoothly.
4. When assembling the governor cover to the timing gear case, temporarily tighten it with dimension A in the diagram 2 — 3 mm {0.079 — 0.118 in}. Assemble B part after the performance set.

	mm {in}
Dimension A	(When temporarily assembling) 2 — 3 {0.079 — 0.118}

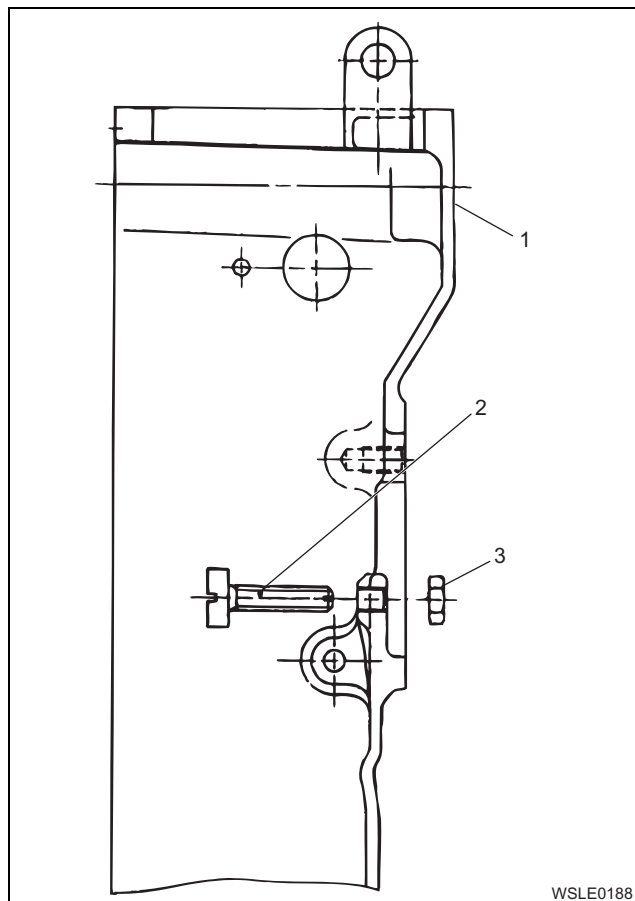
Arrow view of WSLE0186



WSLE0187

Name

1. Cap
2. Cap Nut
3. Packing
4. Lock Nut
5. Packing
6. Idle Screw
7. Governor Cover
8. Tension Lever
9. Idle Spring
10. Snap Ring
11. Washer
12. Washer



WSLE0188

Name

1. Timing Gear Case
2. Full Load Stopper
3. Set Screw Nut

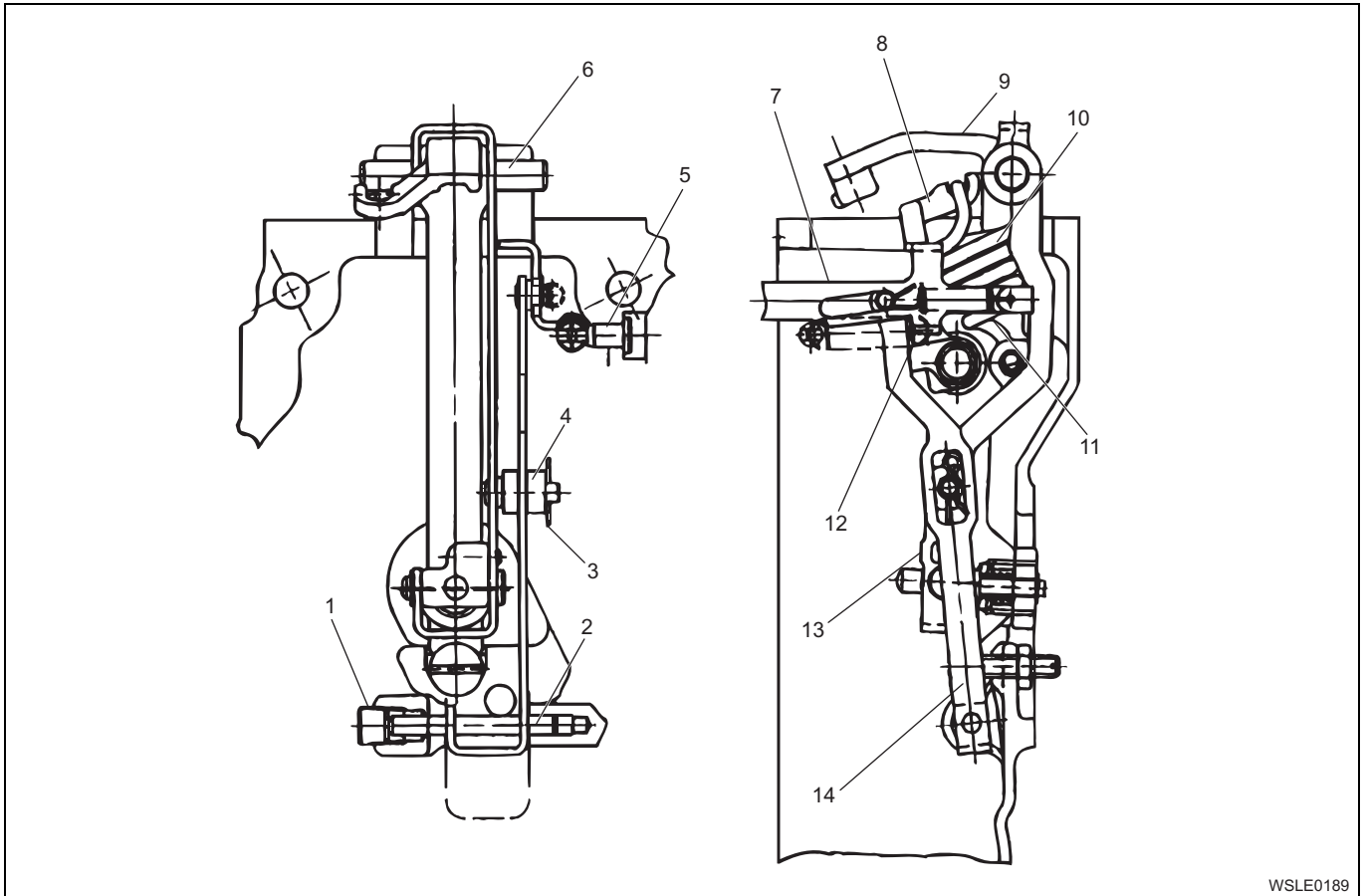
Reassembly of the full load stopper

Install the full load stopper to the timing gear case, and temporarily tighten the nut.

1C-14 4LE1 Fuel System

Reassembly of the governor lever-related components

Assemble each lever and the spring to the timing gear case.



WSLE0189

Name

- | | |
|---------------------------|----------------------|
| 1. Plug | 8. Main Spring Lever |
| 2. Shaft (Floating Lever) | 9. Tension Lever |
| 3. Snap Piece | 10. Main Spring |
| 4. Guide Piece | 11. Set Screw |
| 5. Start Spring Eye | 12. Start Spring |
| 6. Lever Shaft | 13. Guide Lever |
| 7. Link Plate | 14. Floating Lever |

Engine

4LE1 Electrical System

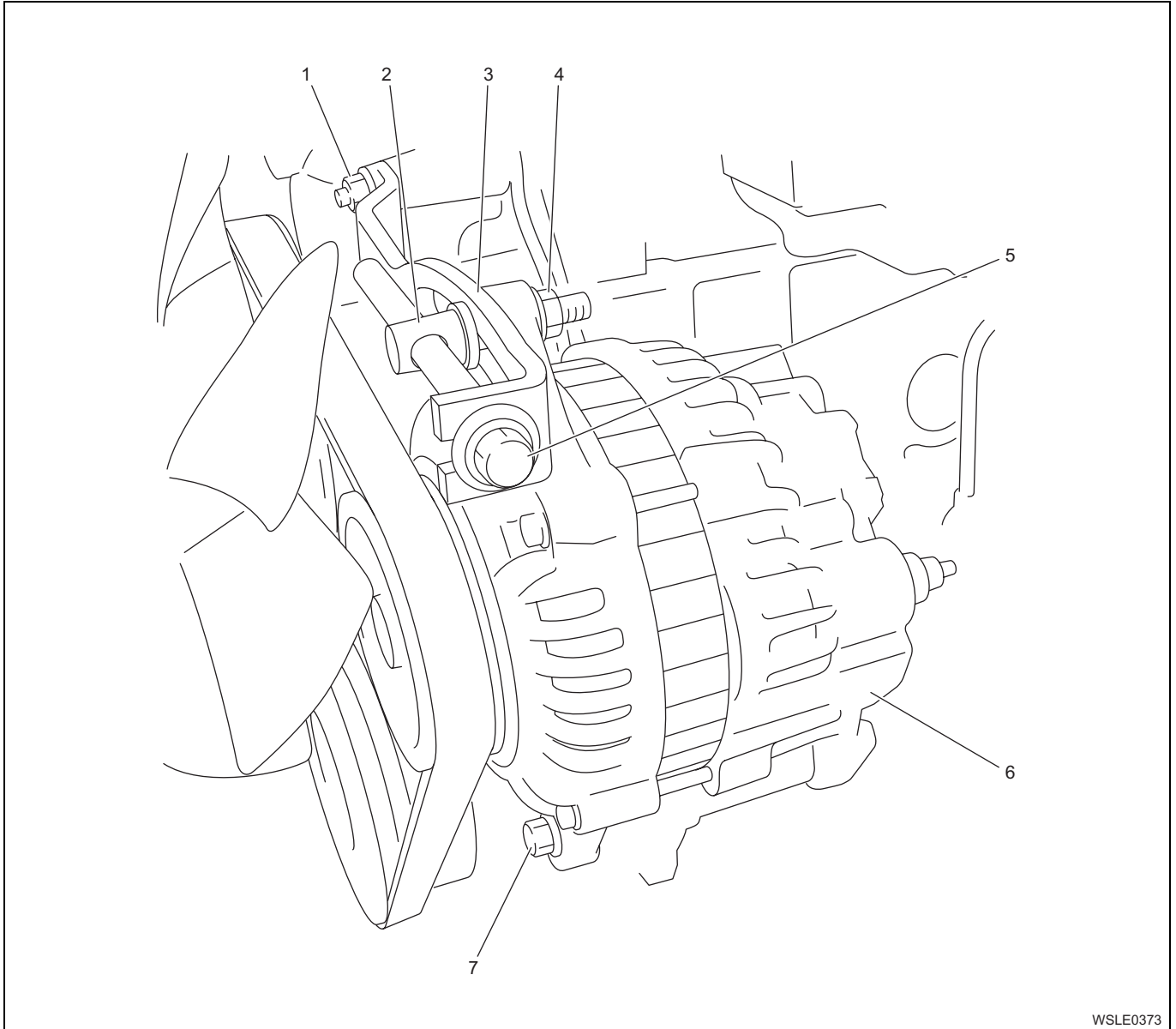
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Charging System

General Description

The main charging system components are the batteries, the generator and the battery charge indicator light circuit. The generator is a self-rectifying type with a built-in regulator.



Name

- | | |
|------------------------------|---------------------------|
| 1. Nut | 5. Tension Adjusting Bolt |
| 2. Sliding Piece | 6. Generator |
| 3. Generator Adjusting Plate | 7. Lower Mounting Bolt |
| 4. Adjusting Nut | |

Maintenance

The most common indication of charging system troubles is an undercharged or overcharged battery.

Since the battery itself may be defective, check the battery first. Check if the battery is discharged because of short circuit, or electrical components left turned on for extended periods.

Keep the generator and all other electrical system terminals clean and tight. A loose or badly corroded terminal connection will create excessive resistance in the circuit and result in hard starting, dim lights, etc.

Inspect the generator system at regular intervals and correct any potential causes of trouble before machine performance is affected.

Diagnosis of charging system

Trouble in the charging system will be evidenced as one or more of the following three conditions:

1. The battery charge warning lamp will stay on.
2. An undercharged battery as evidenced by slow cranking.
3. An overcharge, or overvoltage, condition.

Undercharged battery

Inspection

1. Accessories were not left turned on for extended periods.
2. Drive belt for proper tension.
3. The ECM main relay has been stuck ON with the key switch in OFF position. (Battery voltage is consumed.)
4. Wiring and connections for corrosion or looseness.

Overcharge (or Overvoltage) condition

A charging rate in excess of 29.5 volts (24V model) / 15 volts (12V model) for a prolonged period may cause early electrical system failure.

Blown fuses, light bulbs burned out, and even battery failure may result. If this condition exists, test the generator as described under "Generator Output Test" later in this section.

Noisy generator

Inspection

1. Drive pulley for looseness.
2. Mounting bolts for looseness.
3. Bearings for dirt, damage, or wear.
Generator noise may also be caused by the loose belt, core touch, or worn or damaged diodes and/or starter.

Electrical tests

Before performing the following generator electrical tests on the vehicle, be certain that the system wiring is not defective and generator belts are not slipping. Also, the battery must be fully charged for a valid test of the charging system.

Note:

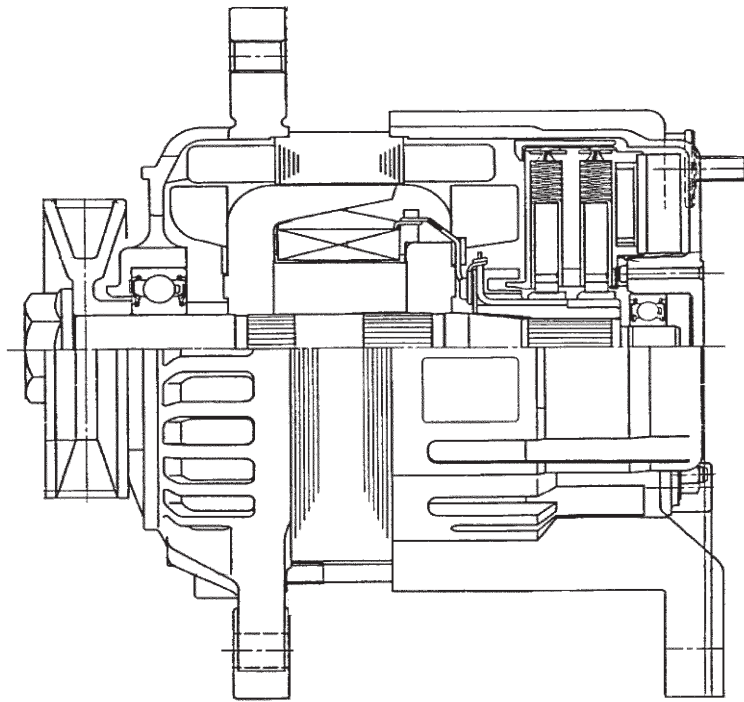
To avoid damage to the vehicle electrical system, always observe the following precautions:

- Do not polarize the generator.
- Do not short across or ground any of the terminals in the charging circuit.
- Never operate the generator with the output terminal open-circuited.
- Be sure the generator and battery have the same ground polarity.
- When connecting a charger or other battery to the machine's battery, connect negative to negative and positive to positive.

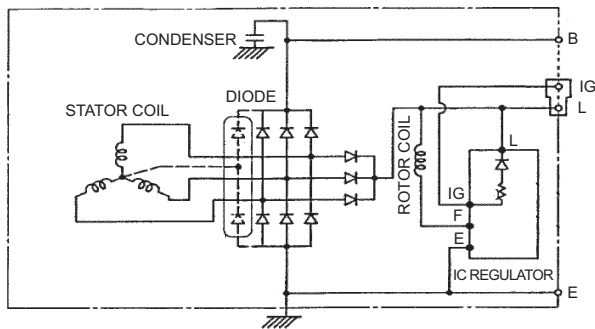
1. With the engine control switch "ON" and engine not running, connect a voltmeter from terminal "E" to ground. The voltmeter should show 0 volts.
2. With the engine control switch "ON" and engine not running, connect a voltmeter from terminal "B" to ground. The voltmeter should show 24 volts (24V model) / 12 volts (12V model) or more.
3. With the engine control switch "ON" and the engine not running, connect a voltmeter from white wire side of the connector to ground. The voltmeter should show 24 volts (24V model) / 12 volts (12V model) or more.
4. With the engine control switch "ON" and the engine not running, the "charge" light should be on. This shows that the current is running into the initiating excitation circuit to the generator.
5. With the engine running and the headlight high beams (if equipped) turned on, read the voltage at the "B" post on the generator. The voltmeter should show 24 volts (24V model) / 12 volts (12V model) or more.
6. If steps 1 through 4 are not OK, check connectors in the harness for looseness or corrosion and retest.
7. If step 5 voltage is low, substitute a known good regulator and test again. If the voltage is still low, bench test the generator.

Generator (12V-50A Hitachi, Ltd.)

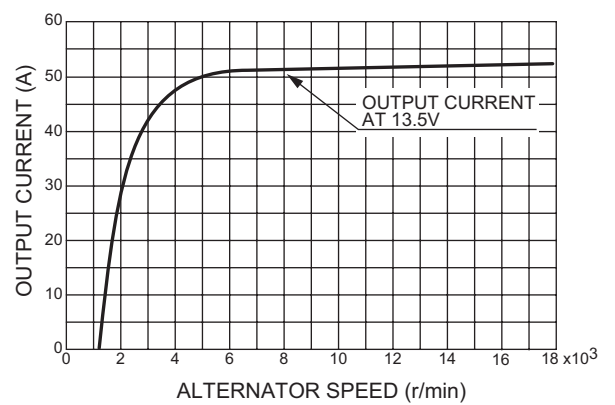
Structure



WSLE0473



WSLE0471



WSLE0470

Removal

- Battery ground cable
1. Electrical wiring at the generator.
 2. Loosen the adjusting nut.
 3. Loosen the ACG adjusting bolt.
 4. Loosen the lower mounting bolt.
 - Loosen the lower mounting bolt while holding the nut located on the back using a tool.
 5. Drive belt.
 6. Generator.

Installation

1. Generator.
 - Tighten the lower mounting bolt while holding the nut located on the back using a tool.

Tightening torque:

M8 bolt: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 bolt: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

2. ACG adjusting bolt.
3. Adjusting nut.

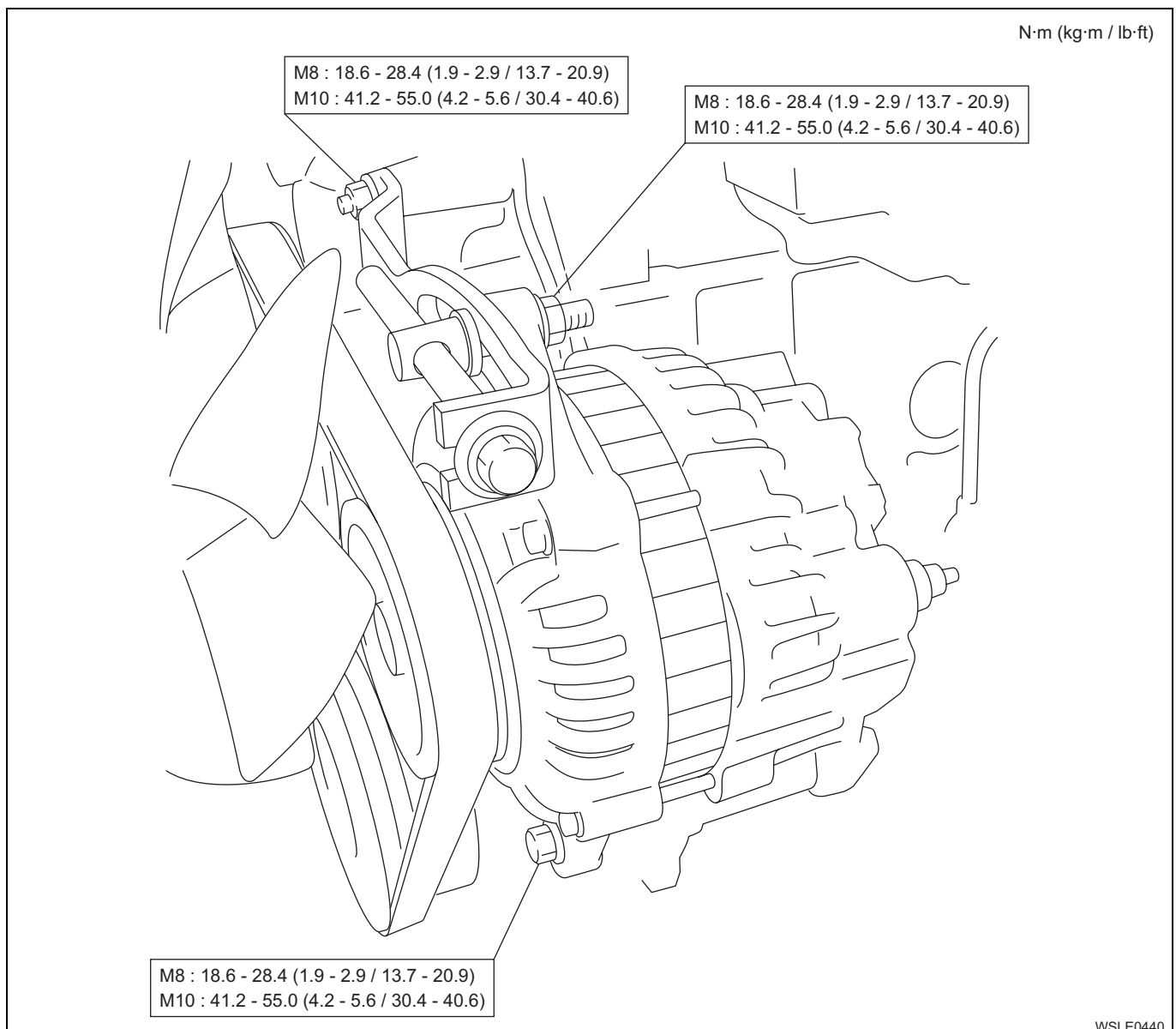
Tightening torque:

M8 nut: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 nut: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

4. Electrical wiring at the generator.
 - Battery ground cable
 - Install wiring (AV5.0 mm², black) from the negative terminal of the generator to the engine ground and connect it to ground securely.

Torque Specifications

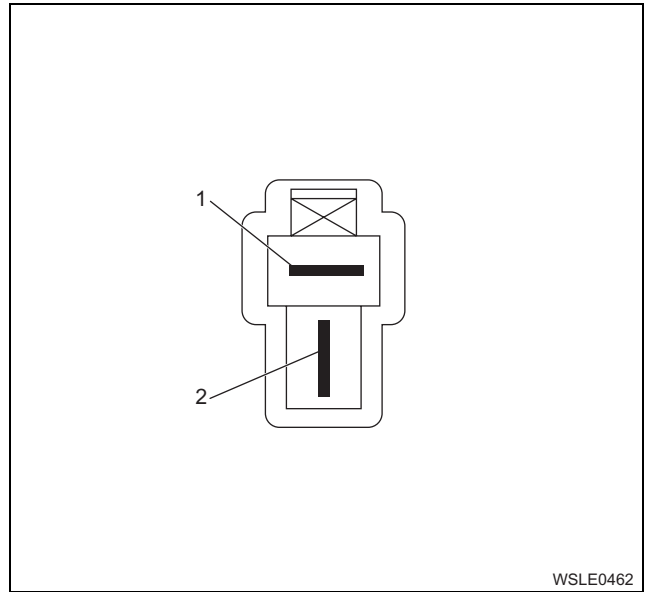


1D-6 4LE1 Electrical System

Specifications

Isuzu Part No.		897228-3180
Nominal output	(V-A)	12-50
Rated speed	(r/min)	5,000
Regulator-type		IC type
Regulated voltage	(V)	14.4±0.3
Mass	(kg)	3.5

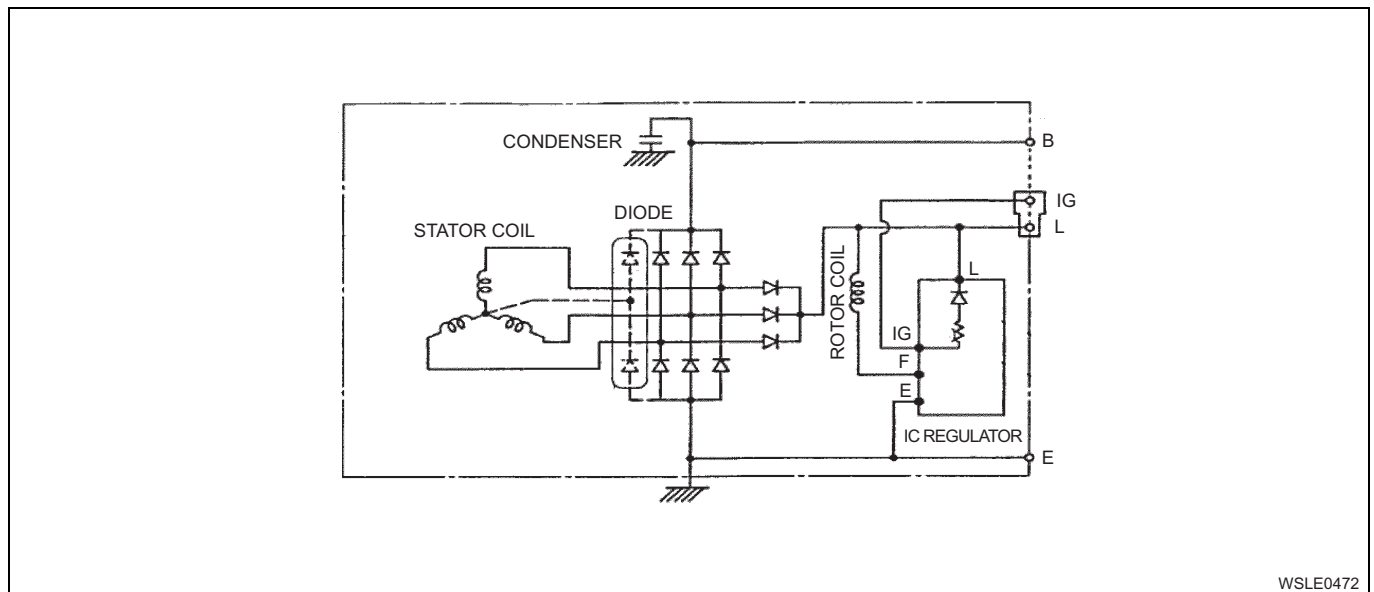
Connector Terminal



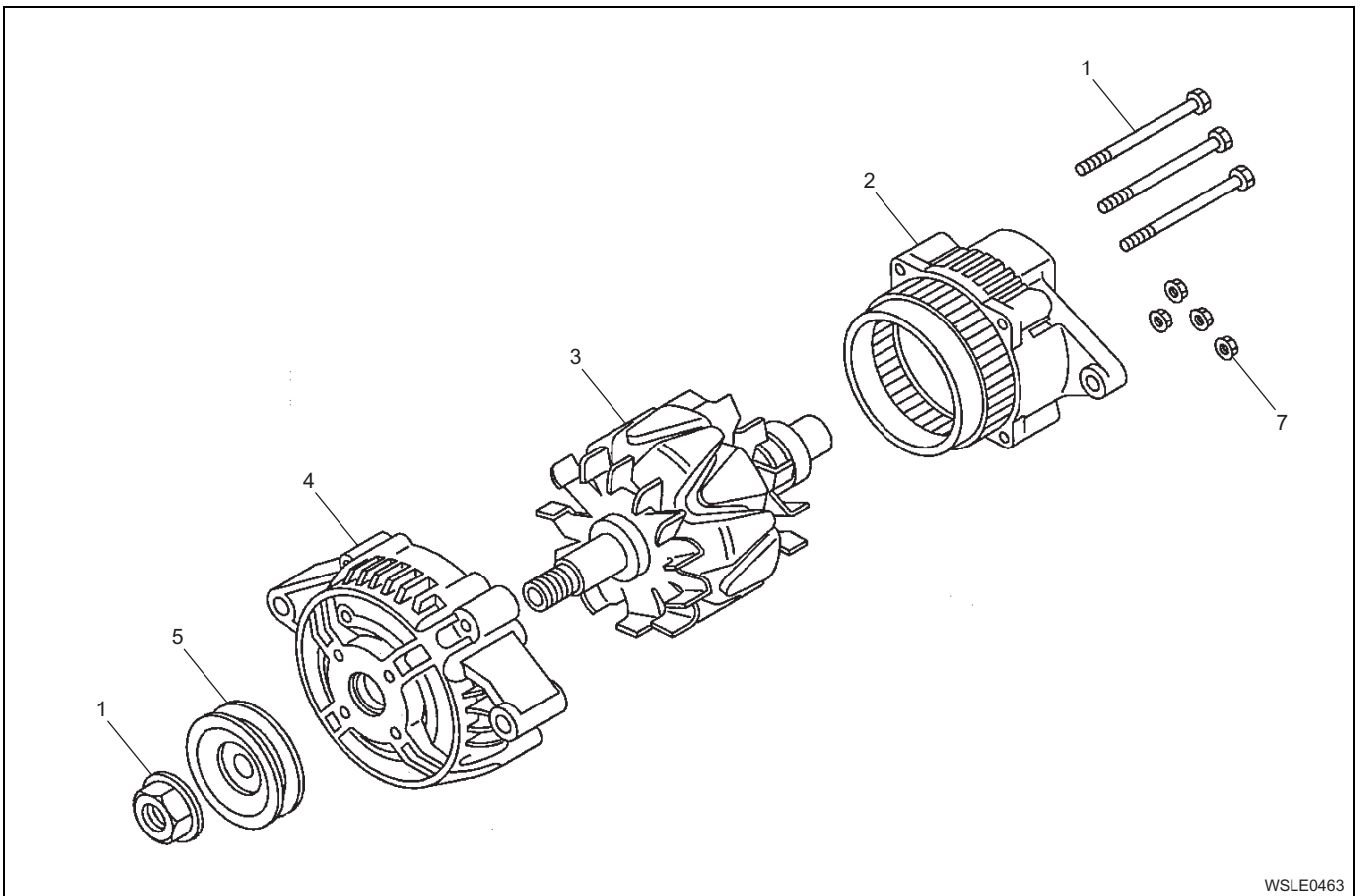
Name

1. IG Terminal
2. L Terminal

Internal Connections



Components



WSLE0463

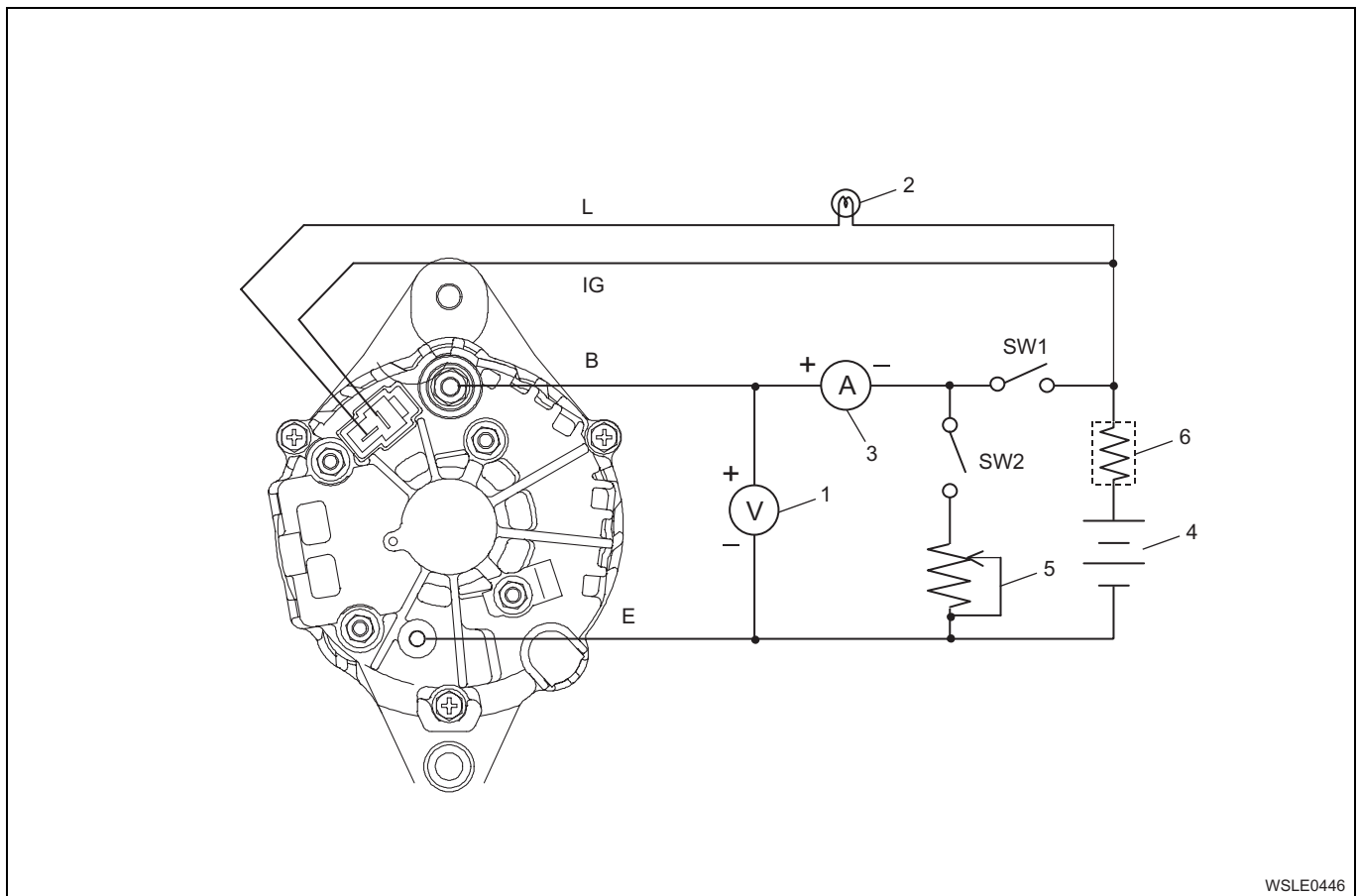
Name

- | | |
|---------------------------|---------------|
| 1. Through Bolt | 5. Pulley |
| 2. Stator, Rear Cover ASM | 6. Pulley Nut |
| 3. Rotor ASM | 7. Nut |
| 4. Front Cover ASM | |

Performance Test

In the performance test of generator, connect as follows and measure the regulated voltage and output current.

Actual wiring diagram for performance test of IC regulator built-in generator



WSLE0446

Name

- | | |
|---------------------------|----------------------|
| 1. Voltmeter | 4. Battery 12 V |
| 2. Charging Lamp 12 V-3 W | 5. Variable Resistor |
| 3. Ammeter | 6. 0.25Ω Resistor |

Regulated voltage measurement of regulator

Close SW1 switch, and raise the generator speed to approximately 5000 rpm. If a voltmeter shows between 14.1 and 14.7 V, the regulated voltage of regulator is normal.

Replace the regulator if the voltmeter shows out of range between 14.1 and 14.7 V.

Specified value of regulated voltage
14.1 — 14.7 V (+20°C {68°F})

Speed of generating 13.5 V

Close SW1 switch and gradually raise the generator speed until a voltmeter shows 13.5 V, then measure the speed.

Judge as normal if the current speed is 1,000 rpm or less.

Measurement of the output current

Close SW1 and SW2 switches and raise the generator speed to 5,000 rpm, then adjust the variable resistor to make the voltmeter show 13.5 V.

In this time, judge as normal if the output current is 50 A or more.

CAUTION:

- Do not cut off battery circuit during generator rotating.
- Do not connect to L terminal if the charging lamp (12 V-3 W) is not used.
Never connect L terminal and B circuit directly. Diode for excitation may be broken.
- Use the following wire to connect between B terminal and the battery (+) terminal, or E terminal and the battery (-) terminal: sectional area 8 mm² {0.012 in²} or more, length 2.5 m {8.2 ft} or less.

Handling

Be careful with the following when handling a generator.

- Connecting the polarities of battery inversely causes generator diode to be broken.
- While the engine runs, never disconnect the wiring of battery terminal and charging circuit.
- Wiring connection to terminal must be performed properly according to terminal symbol.
- Do not perform megger test on semiconductor device.
- Be sure to disconnect the battery terminal (-) before inspection on equipment.
- Do not open/close the battery relay switch while the engine runs.
- Disconnect the battery terminal when charging from external source such as quick charge.
- Do not pour steam cleaner or water directly on it.
- Refer to 1A-14, "Installation, Engine Accessories" for tension adjustment of V-belt.

Trouble and Action

Trouble symptom	Trouble location	Trouble cause	Action to be taken
Charging is impossible.	Wiring and ammeter	Open or short circuit, disconnection	Repair.
	Generator	Open circuit, short to ground, short circuit in each coil	Replace.
		Broken diode	Replace.
	Regulator	Defective regulator	Replace.
		Poor contact in terminal of regulator	Repair.
Insufficient charging	Wiring	Open or short circuit, looseness in connection	Repair.
	Generator	Looseness of generator drive belt	Repair.
		Layer or short circuit in field coil	Replace.
		Layer or short circuit in stator coil	Replace.
		Defective diode	Replace.
		Poor contact in each terminal	Repair.
	Regulator	Defective regulator	Replace.
		Poor contact in terminal of regulator	Repair.
Overcharging	Regulator	Defective regulator	Replace.
Unstable charging current	Wiring	Intermittent contact or nearly disconnected connection in wiring	Repair.
	Generator	Looseness of generator drive belt	Repair.
		Short circuit or nearly disconnected connection in field coil	Repair.
		Short circuit or nearly disconnected connection in stator coil	Repair.
		Poor contact in each terminal	Repair.
	Regulator	Defective regulator	Replace.
		Poor contact in terminal of regulator	Repair.
Noisy generator	Generator	Improper installation of generator	Repair.
		Defective bearing	Replace.
		Contact of rotor core and stator core	Repair.
		Defective diode	Replace.
		Short circuit in stator coil	Replace.

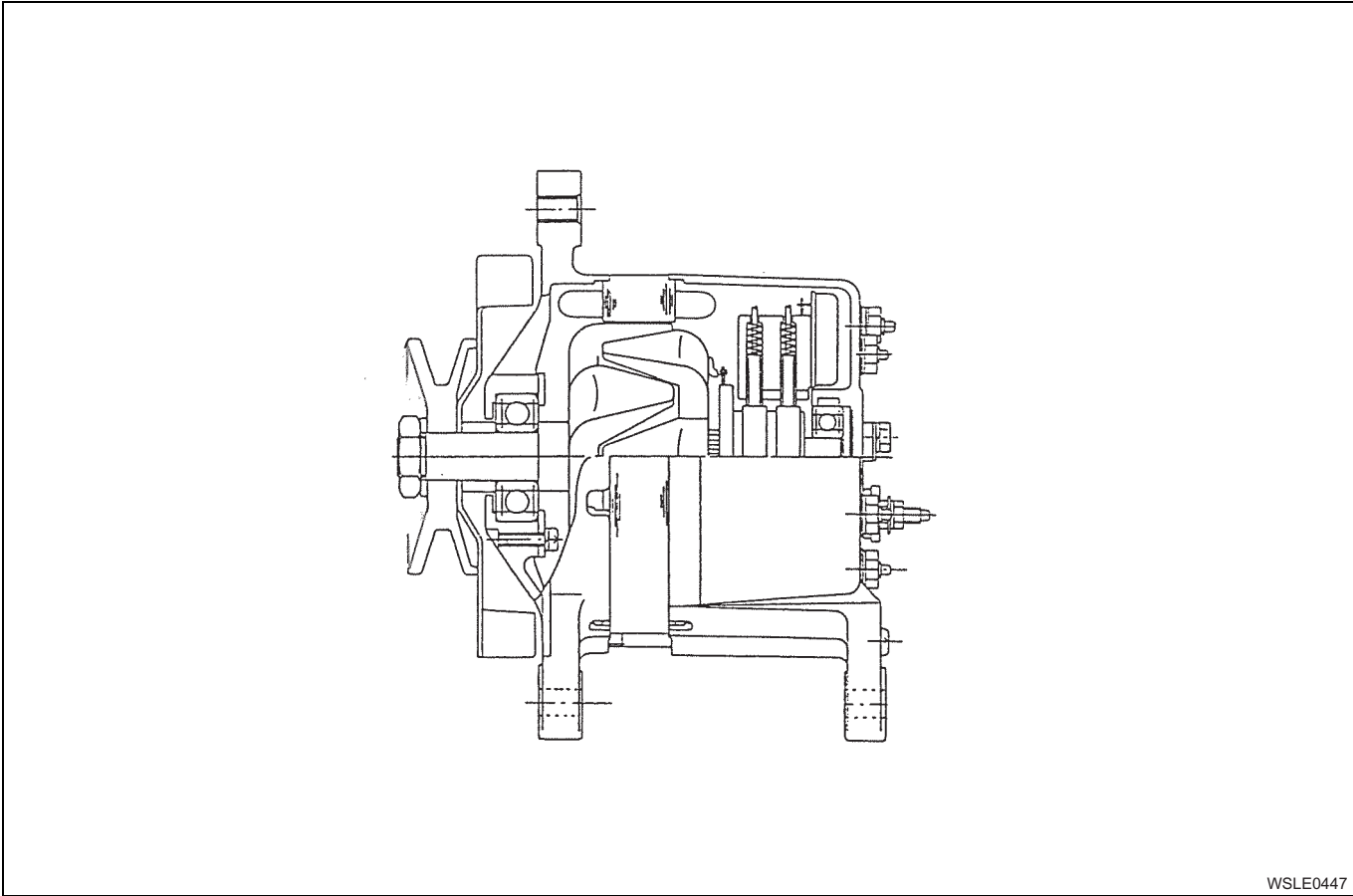
1D-10 4LE1 Electrical System

Maintenance Standard

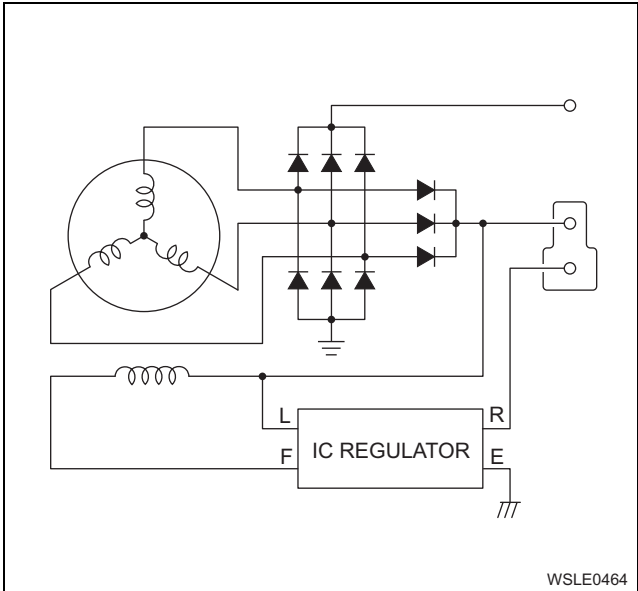
Item		Standard value and limit
Isuzu Part No.		897228-3180
Manufacturer code No.		LR150-715
Rated output		V-A
Output characteristic (hot)	Voltage	V
	Current	A
	Revolution speed	r/min
Field coil resistance		Ω : at 20°C
Regulated voltage by regulator		V
Revolution direction (viewed from pulley side)		Clockwise

Generator (12V-35A Hitachi, Ltd.)

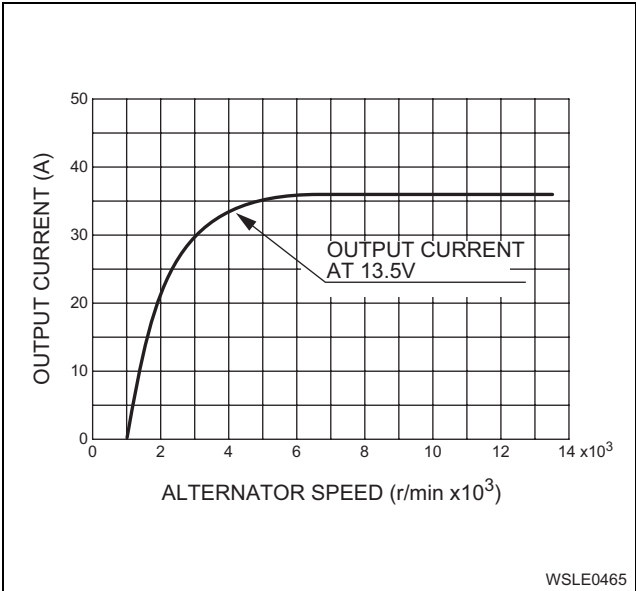
Structure



WSLE0447



WSLE0464



WSLE0465

1D-12 4LE1 Electrical System

Removal

- Battery ground cable
1. Electrical wiring at the generator.
 2. Loosen the adjusting nut.
 3. Loosen the ACG adjusting bolt.
 4. Loosen the lower mounting bolt.
 - Loosen the lower mounting bolt while holding the nut located on the back using a tool.
 5. Drive belt.
 6. Generator.

Installation

1. Generator.
 - Tighten the lower mounting bolt while holding the nut located on the back using a tool.

Tightening torque:

M8 bolt: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 bolt: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

2. ACG adjusting bolt.
3. Adjusting nut.

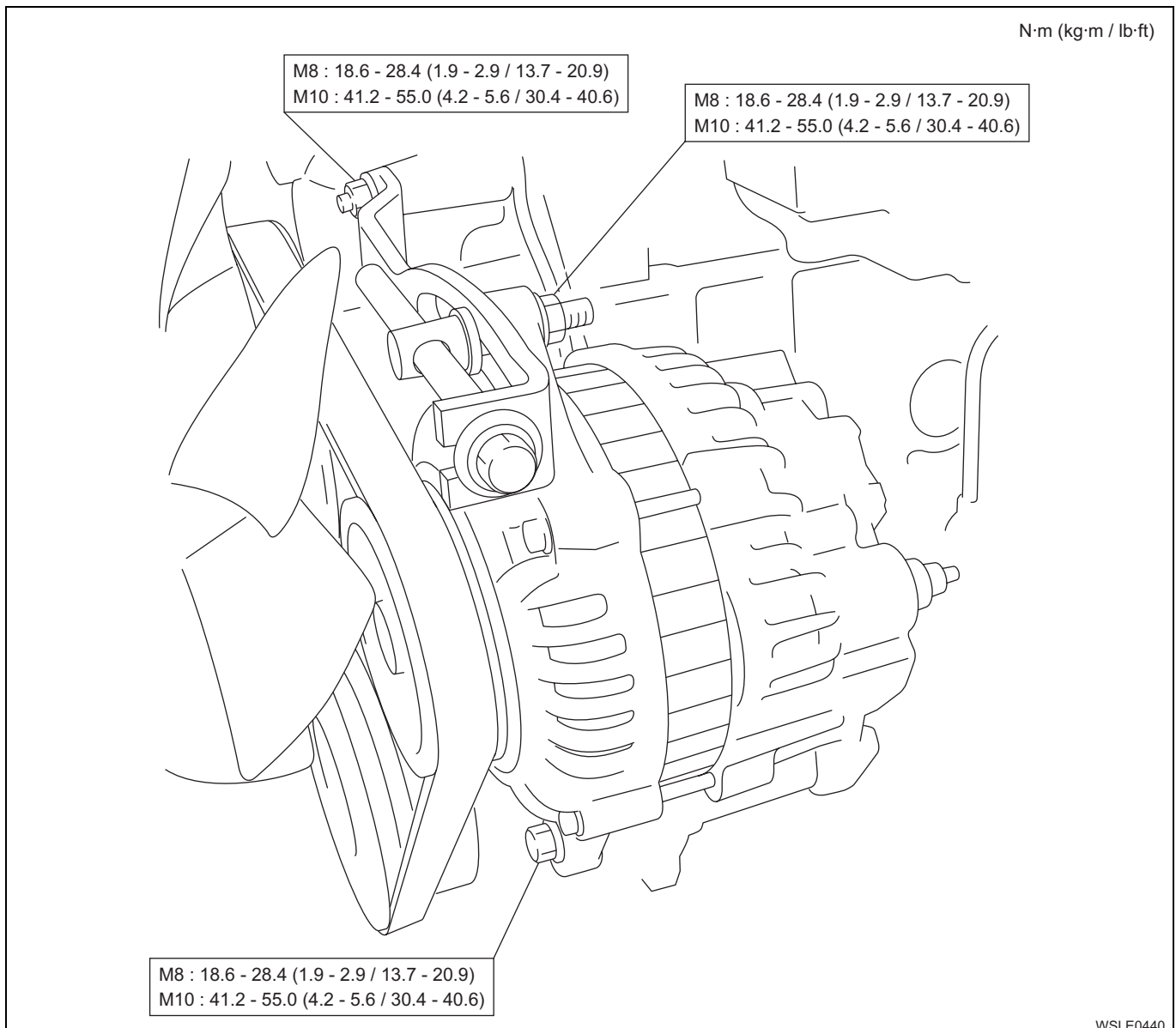
Tightening torque:

M8 nut: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 nut: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

4. Electrical wiring at the generator.
 - Battery ground cable
 - Install wiring (AV5.0 mm², black) from the negative terminal of the generator to the engine ground and connect it to ground securely.

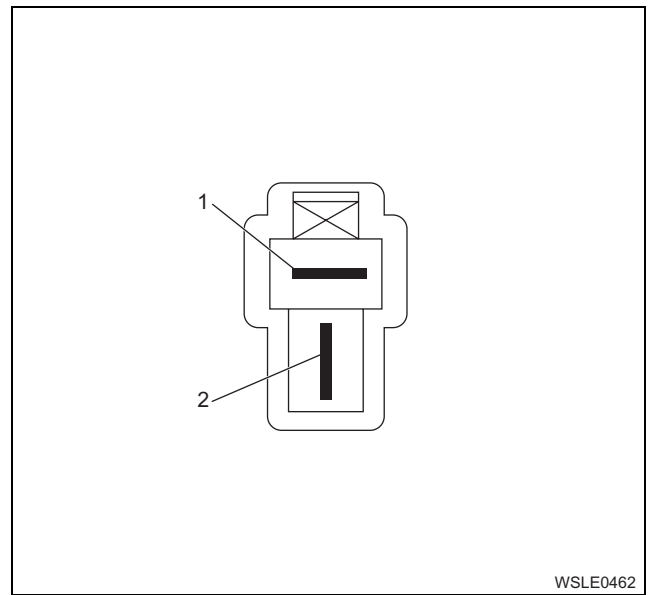
Torque Specifications



Specifications

Isuzu Part No.		894423-7560
Nominal output	(V-A)	12-35
Rated speed	(rpm)	5,000
Regulator-type		IC type
Regulated voltage	(V)	14.2 — 14.8
Mass	(kg)	3.7

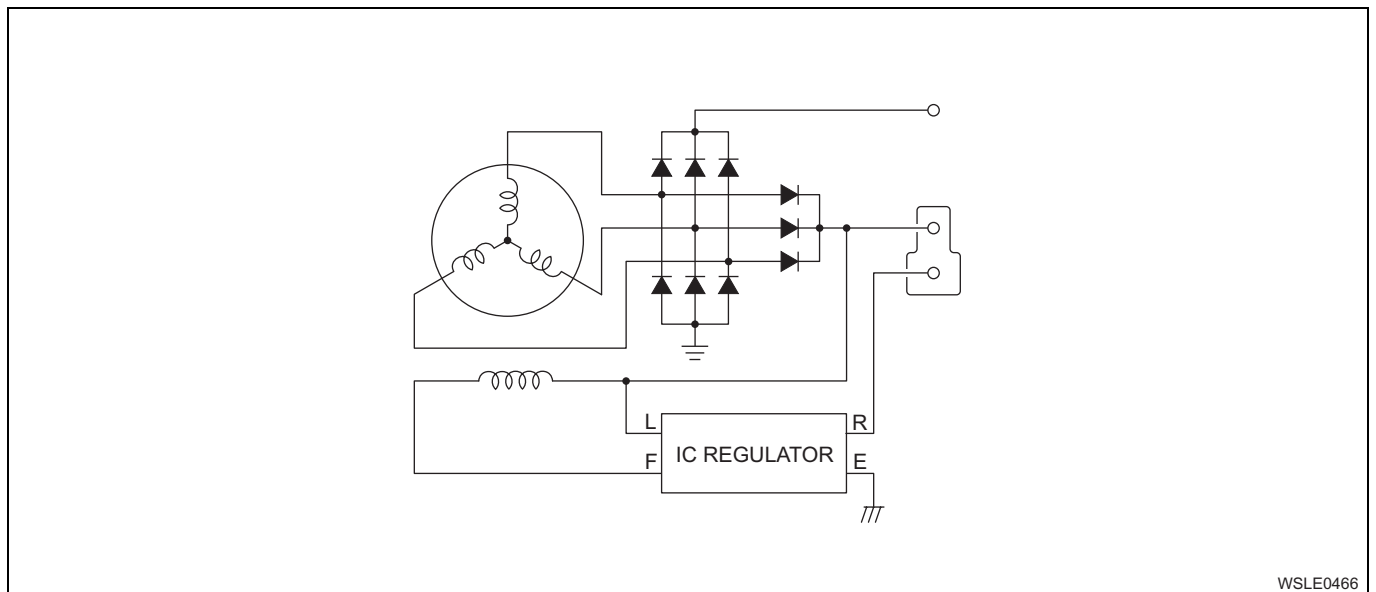
Connector Terminal



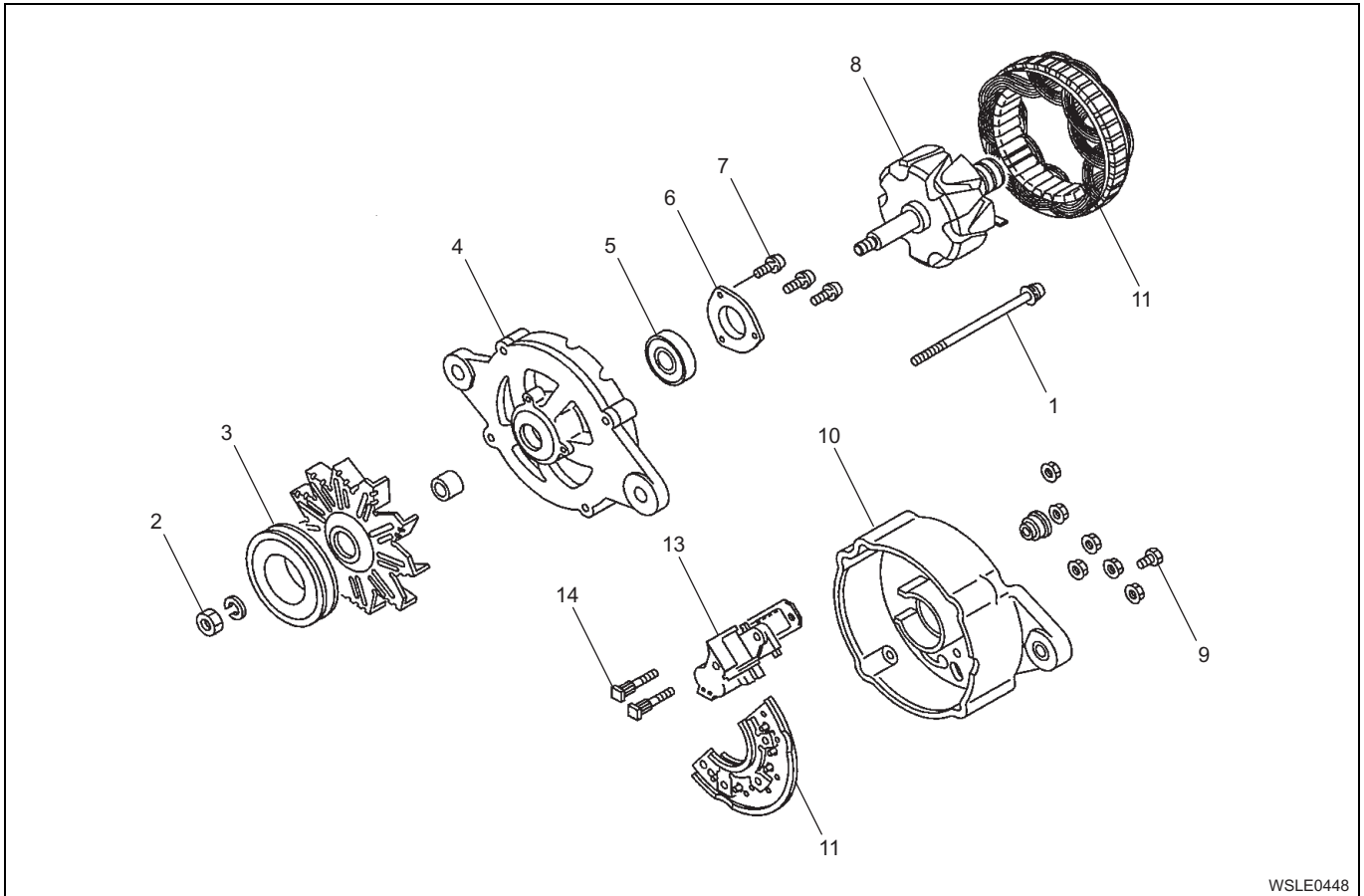
Name

- 1. R Terminal
- 2. L Terminal

Internal Connections



Components



WSLE0448

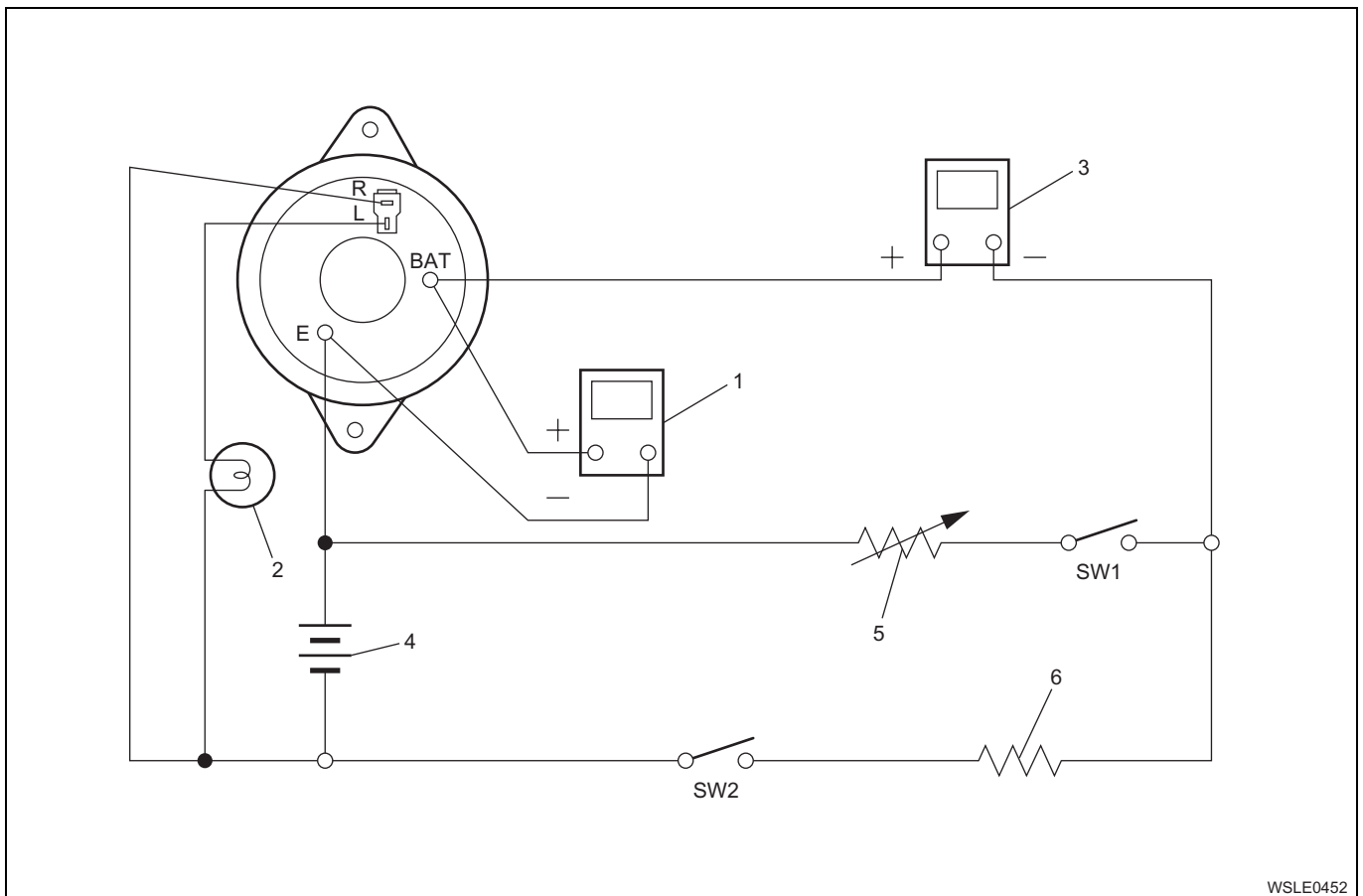
Name

- | | |
|---------------------|---------------------|
| 1. Through Bolt | 8. Front Cover |
| 2. Pulley Nut | 9. Nut |
| 3. Pulley | 10. Rear Cover |
| 4. Rotor Assembly | 11. Stator Assembly |
| 5. Screw | 12. Diode |
| 6. Bearing Retainer | 13. Brush Holder |
| 7. Ball Bearing | 14. Terminal Bolt |

Performance Test

In the performance test of generator, connect as follows and measure the regulated voltage and output current.

Actual wiring diagram for performance test of IC regulator built-in generator



WSLE0452

Name

- | | |
|--------------------------|----------------------|
| 1. Voltmeter | 4. Battery 12 V |
| 2. Charging Lamp 12V-3 W | 5. Variable Resistor |
| 3. Ammeter | 6. 0.25Ω Resistor |

Regulated voltage measurement of regulator

Close SW1 switch, and raise the generator speed to approximately 5,000 rpm. If a voltmeter shows between 14.1 and 14.8 V, the regulated voltage of regulator is normal.

Replace the regulator if the voltmeter shows out of range between 14.1 and 14.8 V.

Specified value of regulated voltage
14.1 — 14.8 V (+20°C {68°F})

13.5 V generated speed

Close SW1 switch and gradually raise the generator speed until a voltmeter shows 13.5 V, then measure the speed.

Judge as normal if the current speed is 1,000 rpm or less.

Measurement of the output current

Close SW1 and SW2 switches and raise the generator speed to 5,000 rpm, then adjust the variable resistor so that the voltmeter shows 13.5 V.

In this time, judge as normal if the output current is 35 A or more.

CAUTION:

- Do not cut off battery circuit during generator rotating.
- Do not connect to L terminal if the charging lamp (12V-3 W) is not used.
Never connect L terminal and B circuit directly.
Diode for excitation may be broken.
- Use the following wire to connect between B terminal and the battery (+) terminal, and E terminal and the battery (-) terminal: sectional area 8 mm² {0.012 in²} or more, length 2.5 m {8.2 ft} or less.

1D-16 4LE1 Electrical System

Handling

Be careful with the following when handling a generator.

- Connecting the polarities of battery inversely causes generator diode to be broken.
- While the engine runs, never disconnect the wiring of battery terminal and charging circuit.
- Wiring connection to terminal must be performed properly according to terminal symbol.
- Do not perform megger test on semiconductor device.
- Be sure to disconnect the battery terminal (-) before inspection on equipment.
- Do not open/close the battery relay switch while the engine runs.
- Disconnect the battery terminal when charging from external source such as quick charge.
- Do not pour steam cleaner or water directly on it.
- Refer to 1A-14, "Installation, Engine Accessories" for tension adjustment of V-belt.

Trouble and Action

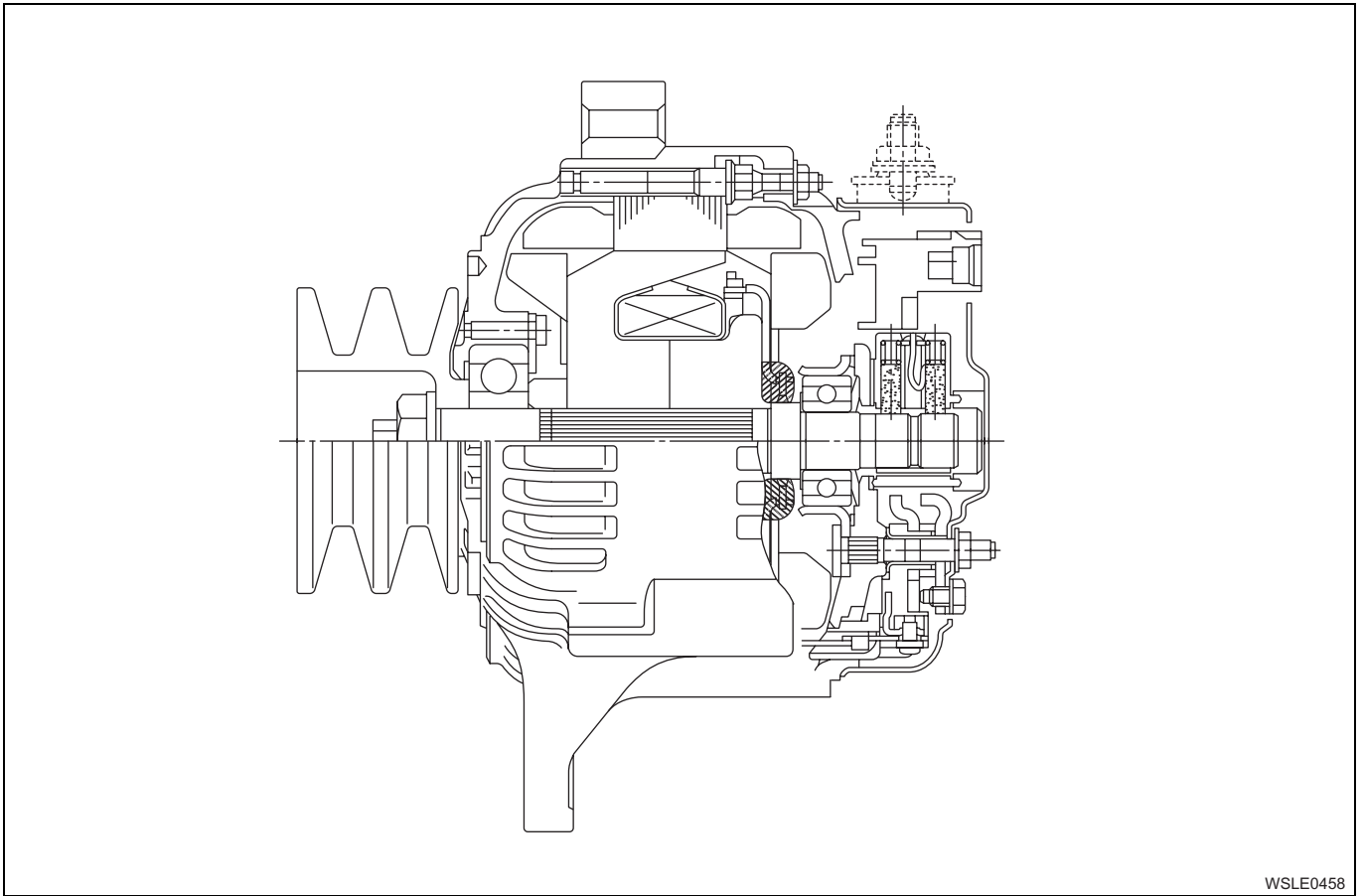
Trouble symptom	Trouble location	Trouble cause	Action to be taken
Charging is impossible.	Wiring and ammeter	Open or short circuit, disconnection	Repair.
	Generator	Open circuit, short to ground, short circuit in each coil	Replace.
		Broken diode	Replace.
	Regulator	Defective regulator	Replace.
		Poor contact in terminal of regulator	Repair.
Insufficient charging	Wiring	Open or short circuit, looseness in connection	Repair.
	Generator	Looseness of generator drive belt	Repair.
		Layer or short circuit in field coil	Replace.
		Layer or short circuit in stator coil	Replace.
		Defective diode	Replace.
		Poor contact in each terminal	Repair.
	Regulator	Defective regulator	Replace.
		Poor contact in terminal of regulator	Repair.
Overcharging	Regulator	Defective regulator	Replace.
Unstable charging current	Wiring	Intermittent contact or nearly disconnected connection in wiring	Repair.
	Generator	Looseness of generator drive belt	Repair.
		Short circuit or nearly disconnected connection in field coil	Repair.
		Short circuit or nearly disconnected connection in stator coil	Repair.
		Poor contact in each terminal	Repair.
	Regulator	Defective regulator	Replace.
		Poor contact in terminal of regulator	Repair.
Noisy generator	Generator	Improper installation of generator	Repair.
		Defective bearing	Replace.
		Contact of rotor core and stator core	Repair.
		Defective diode	Replace.
		Short circuit in stator coil	Replace.

Maintenance Standard

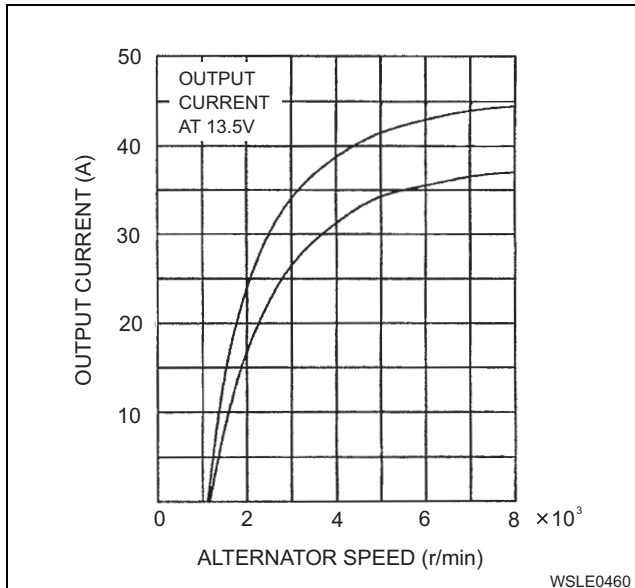
Item		Standard value and limit
Isuzu Part No.		894423-7560
Manufacturer code No.		LR135-127
Rated output V-A		12-35
Output characteristic (hot)	Voltage V	13.5
	Current A	33 or more
	Revolution speed r/min	5,000
Field coil resistance Ω : at 20°C		3.1
Regulated voltage by regulator V		14.2 — 14.8
Revolution direction (viewed from pulley side)		Clockwise

Generator (12V-35A DENSO)

Structure



WSLE0458



Removal

- Battery ground cable
1. Electrical wiring at the generator.
 2. Loosen the adjusting nut.
 3. Loosen the ACG adjusting bolt.
 4. Loosen the lower mounting bolt.
 - Loosen the lower mounting bolt while holding the nut located on the back using a tool.
 5. Drive belt.
 6. Generator.

Installation

1. Generator.
 - Tighten the lower mounting bolt while holding the nut located on the back using a tool.

Tightening torque:

M8 bolt: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 bolt: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

2. ACG adjusting bolt.
3. Adjusting nut.

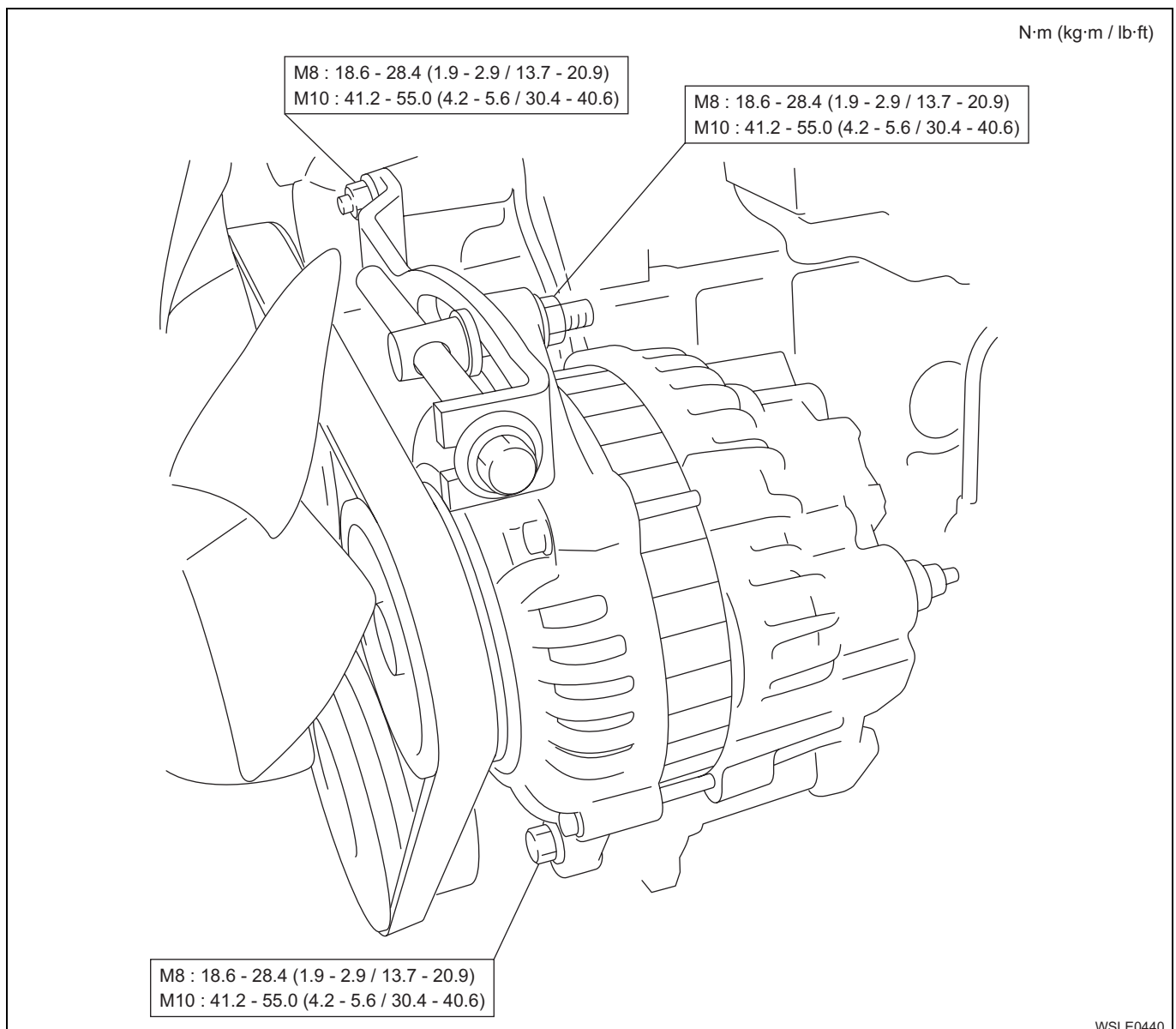
Tightening torque:

M8 nut: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 nut: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

4. Electrical wiring at the generator.
 - Battery ground cable
 - Install wiring (AV5.0 mm², black) from the negative terminal of the generator to the engine ground and connect it to ground securely.

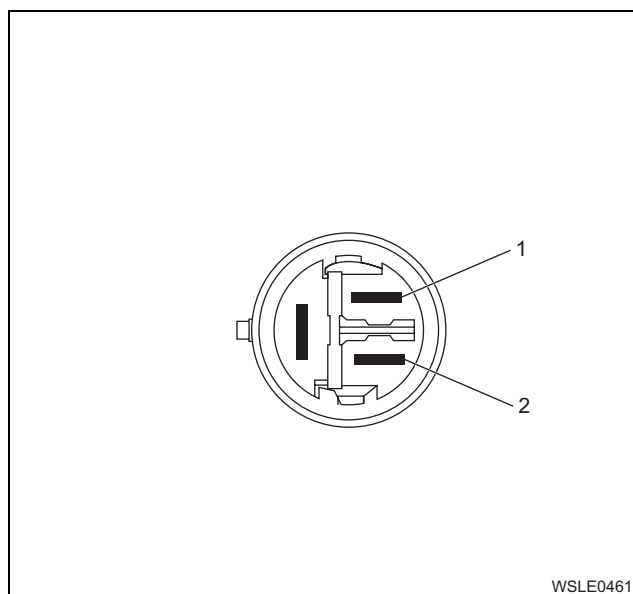
Torque Specifications



Specifications

Isuzu Part No.		897225-1170
Nominal output	(V-A)	12-35
Rated speed	(r/min)	5,000
Regulator-type		IC type
Regulated voltage	(V)	13.5

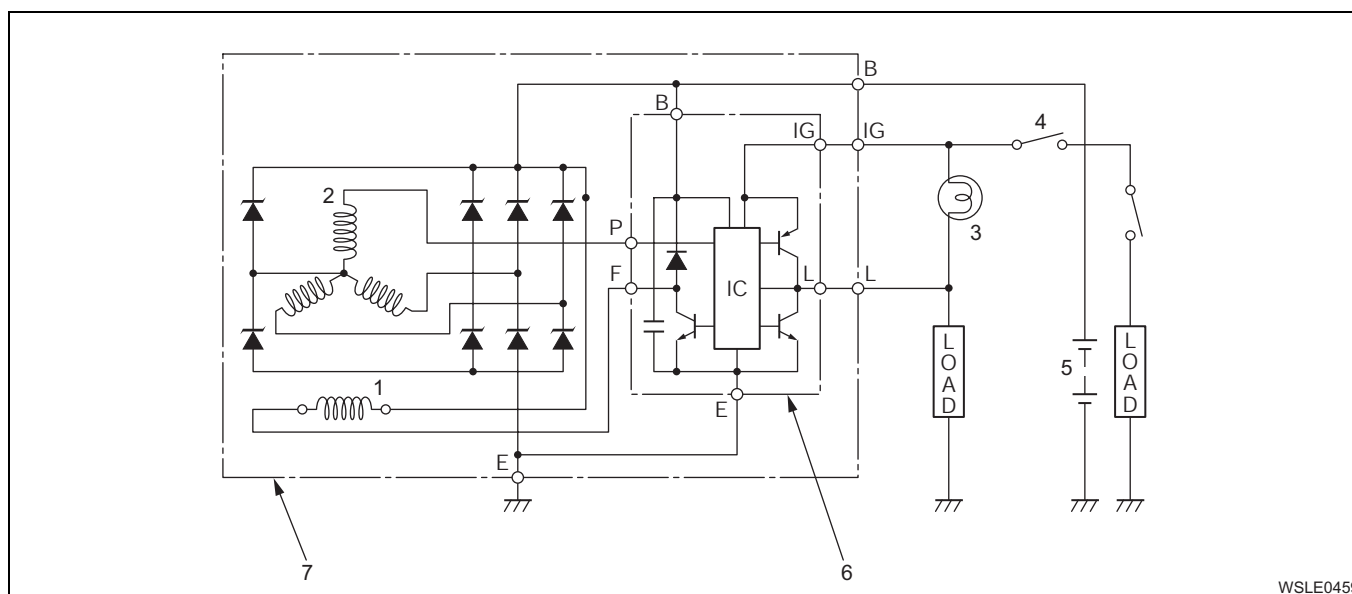
Connector Terminal



Name

1. L Terminal
2. IG Terminal

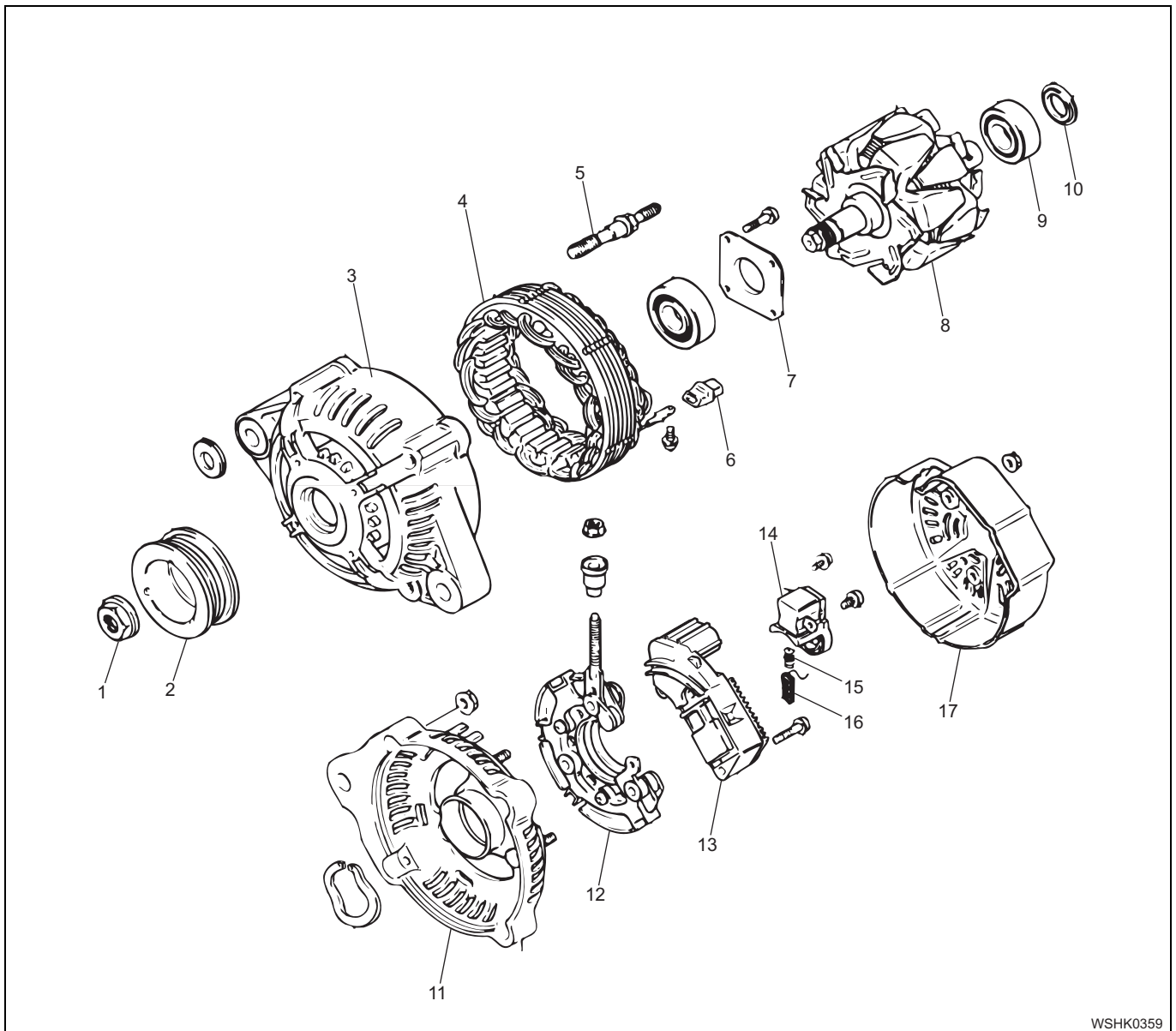
Internal Connections



Name

1. Field Coil
2. Stator Coil
3. Charging Lamp
4. Key Switch
5. Battery
6. IC Regulator
7. Generator

Components



WSHK0359

Name

- | | |
|--------------------|--------------------|
| 1. Nut | 10. Bearing Cover |
| 2. Pulley | 11. Rear End Frame |
| 3. Drive End Frame | 12. Rectifier |
| 4. Stator | 13. IC Regulator |
| 5. Stud Bolt | 14. Brush Holder |
| 6. Bushing | 15. Spring |
| 7. Retainer Plate | 16. Brush |
| 8. Rotor | 17. Rear End Cover |
| 9. Bearing | |

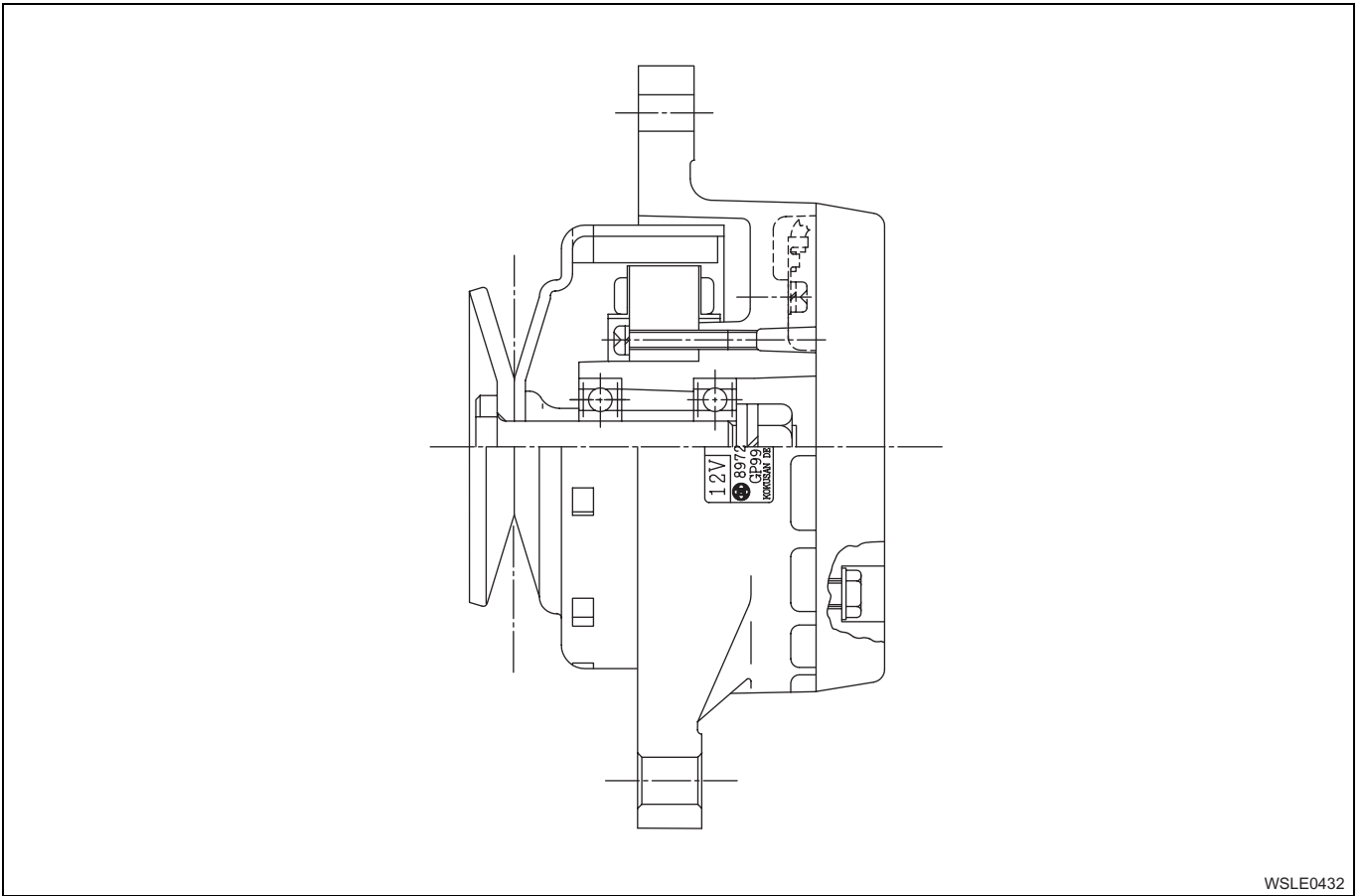
1D-22 4LE1 Electrical System

Maintenance Standard

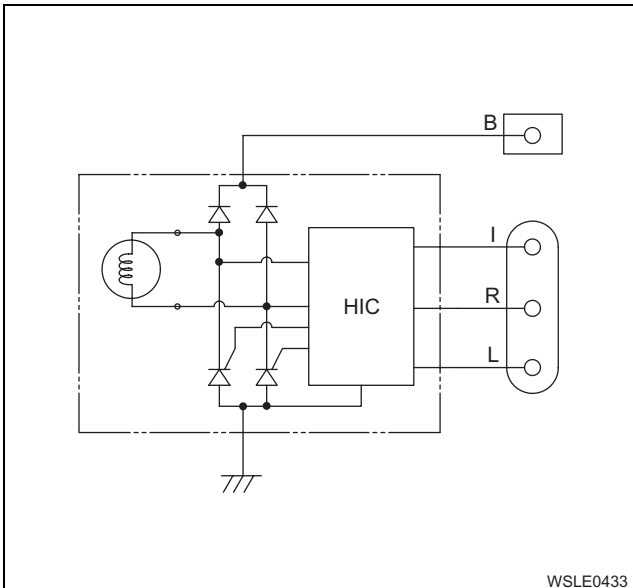
Item		Standard value and limit
Isuzu Part No.		897225-1170
Manufacturer code No.		101211-1240
Rated output		V-A
Output characteristic (cold)	Voltage	V
	Current	A
	Revolution speed	r/min
No load voltage (cold)		V
		r/min
Regulated voltage by regulator		V
Revolution direction (viewed from pulley side)		Clockwise

Generator (12V-20A Hitachi, Ltd.)

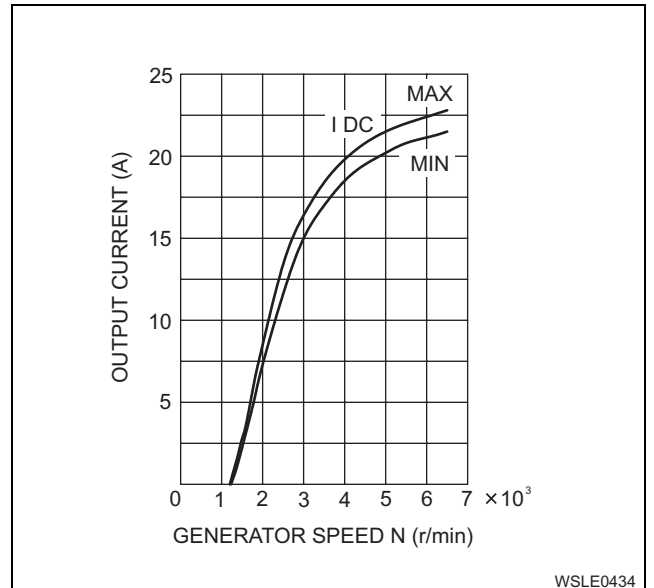
Structure



WSLE0432



WSLE0433



WSLE0434

1D-24 4LE1 Electrical System

Removal

- Battery ground cable
1. Electrical wiring at the generator.
 2. Loosen the adjusting nut.
 3. Loosen the ACG adjusting bolt.
 4. Loosen the lower mounting bolt.
 - Loosen the lower mounting bolt while holding the nut located on the back using a tool.
 5. Drive belt.
 6. Generator.

Installation

1. Generator.
 - Tighten the lower mounting bolt while holding the nut located on the back using a tool.

Tightening torque:

M8 bolt: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 bolt: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

2. ACG adjusting bolt.

3. Adjusting nut.

Tightening torque:

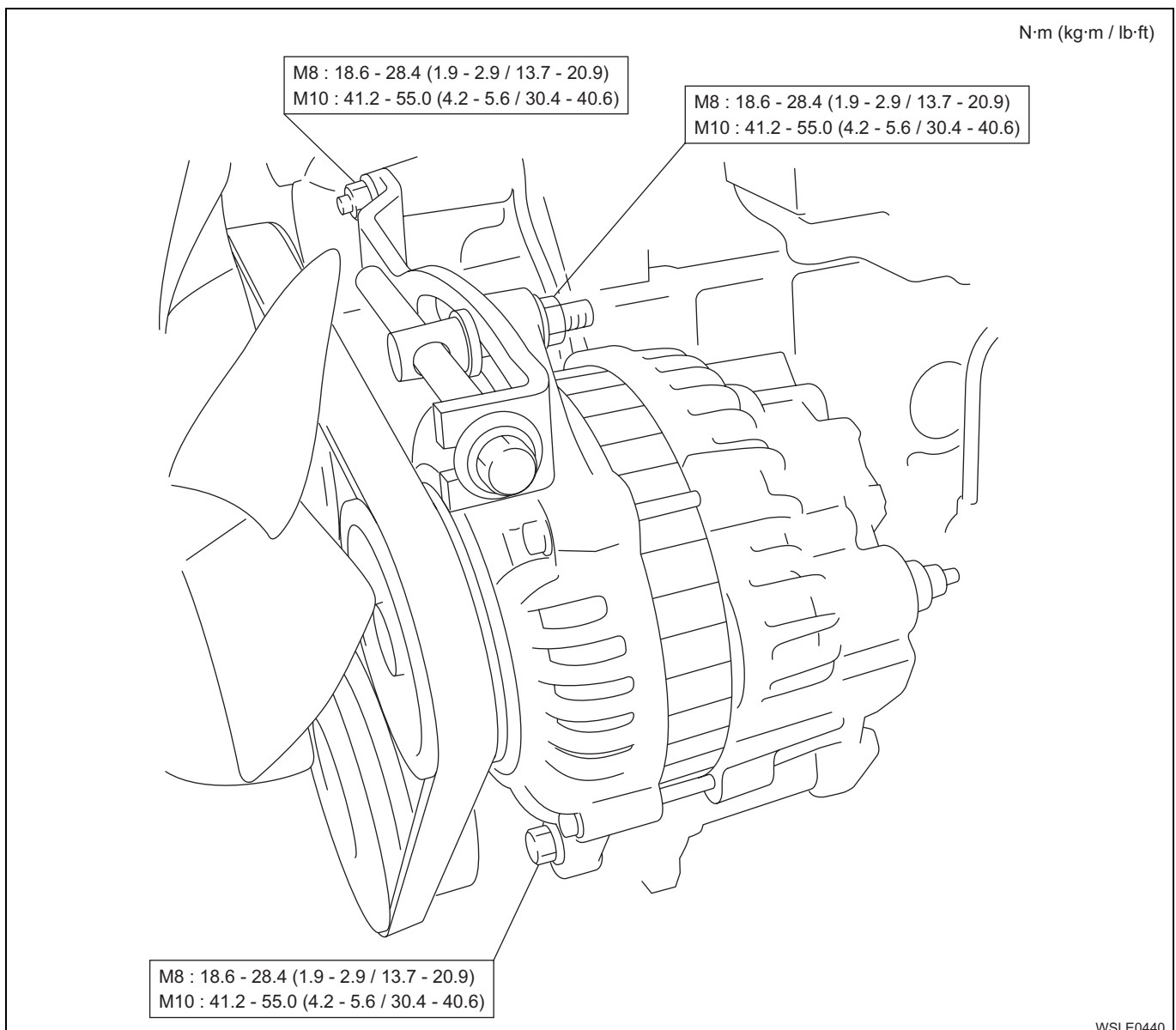
M8 nut: 18.6 — 28.4 N·m {1.9 — 2.9 kgf·m/13.7 — 20.9 lb·ft}

M10 nut: 41.2 — 55.0 N·m {4.2 — 5.6 kgf·m/30.4 — 40.6 lb·ft}

4. Electrical wiring at the generator.

- Battery ground cable
- Install wiring (AV5.0 mm², black) from the negative terminal of the generator to the engine ground and connect it to ground securely.

Torque Specifications

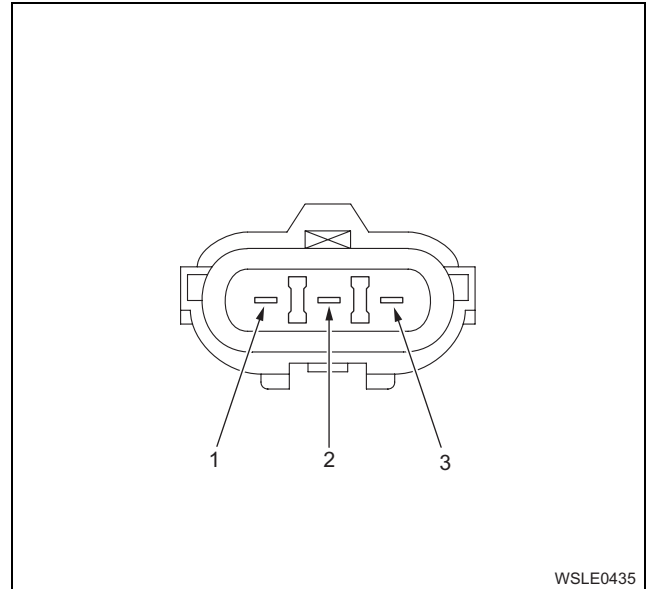


Specifications

Isuzu Part No.	897226-8408
Nominal output (V-A)	12-20
Rated speed (r/min)	5,000
Regulator-type	IC type
Regulated voltage (V)	13.8±0.5
Mass (kg)	2.5

Connector Terminal

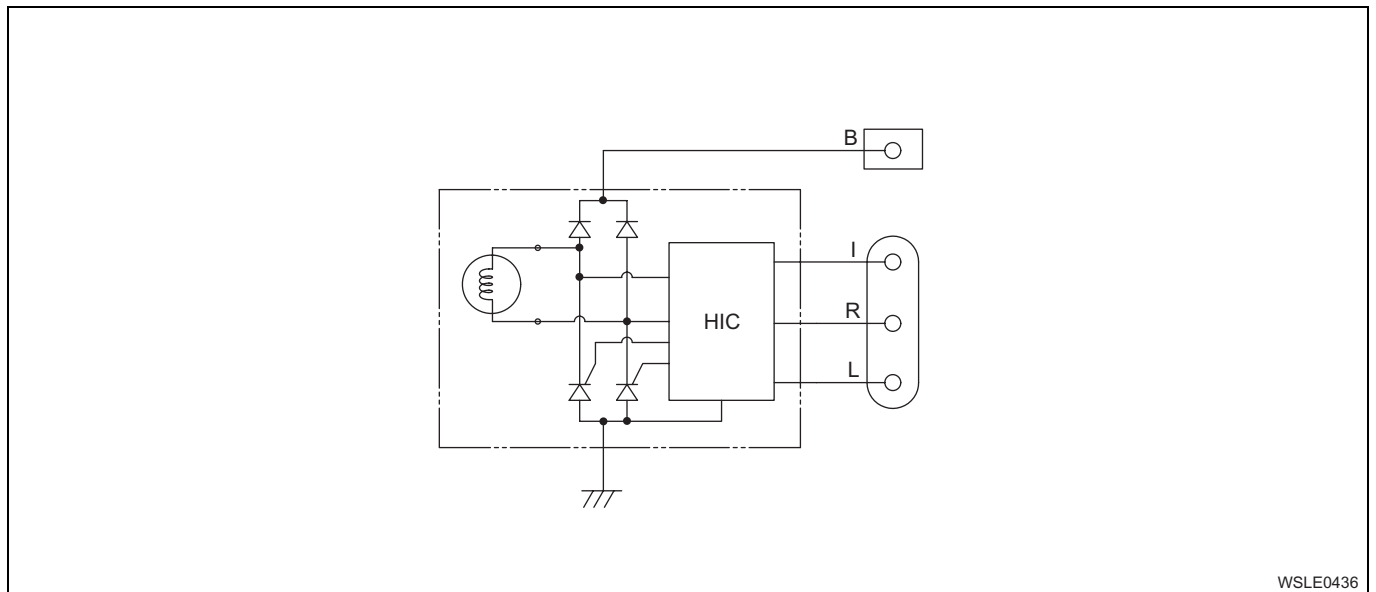
Terminal symbol	Lead wire color	Diameter
I	L	0.75f
R	W/G	0.75f
L	W/R	0.75f



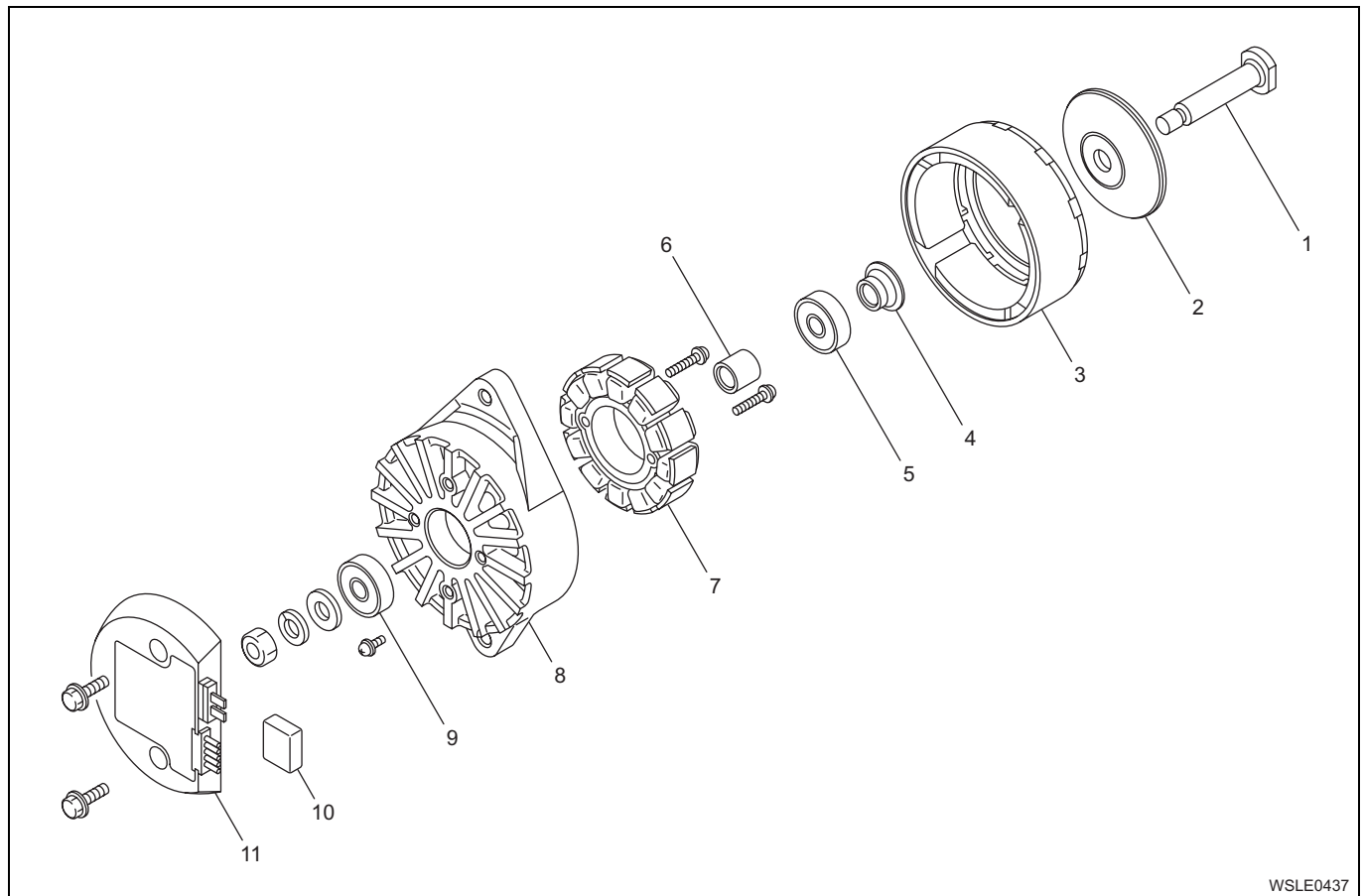
Name

1. I Terminal
2. R Terminal
3. L Terminal

Internal Connections



Components



WSLE0437

Name

- | | |
|-------------|--------------------|
| 1. Shaft | 7. Stator |
| 2. Pulley | 8. Coil Plate |
| 3. Flywheel | 9. Bearing |
| 4. Collar | 10. Terminal Cover |
| 5. Bearing | 11. Regulator ASM |
| 6. Collar | |

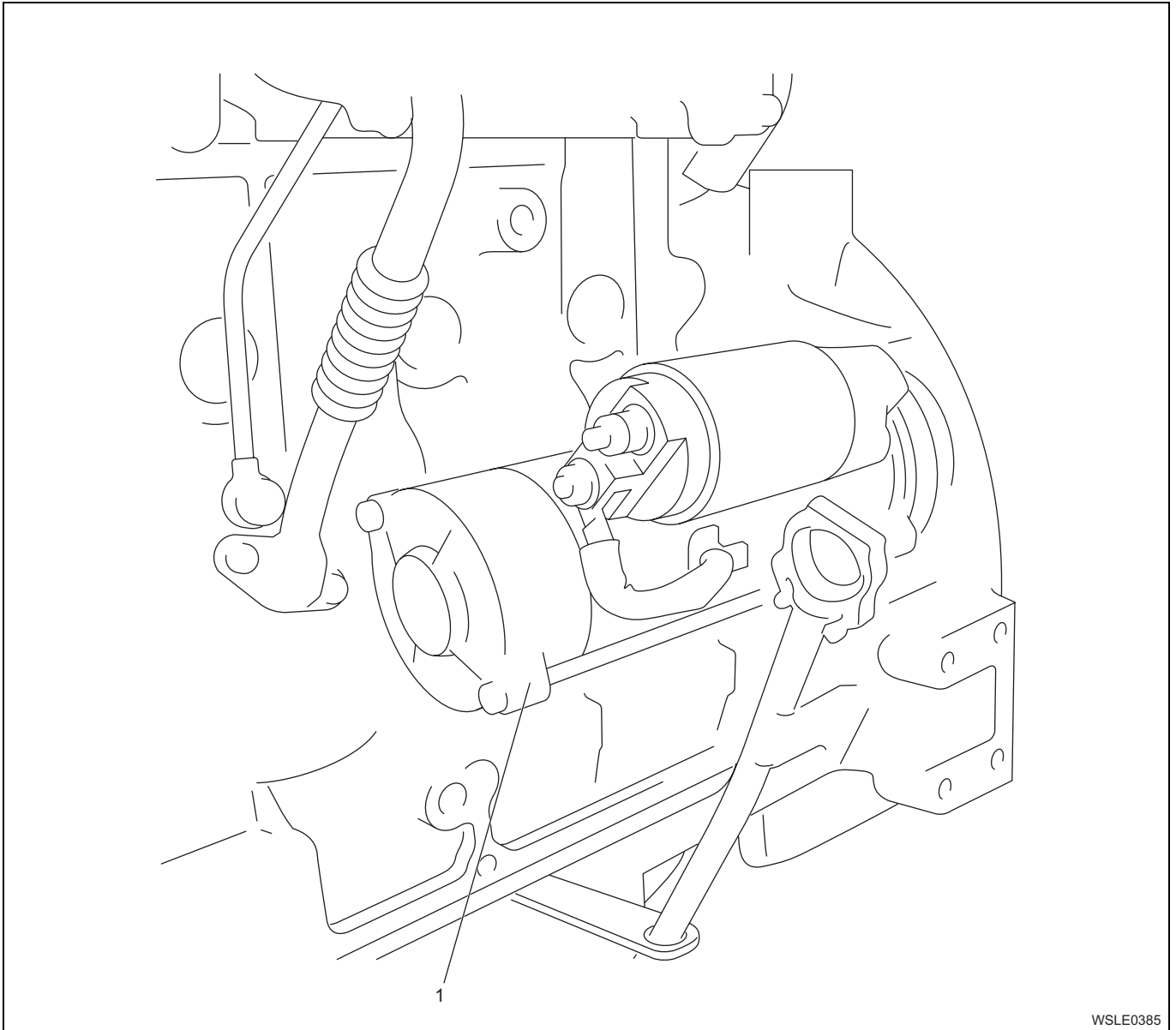
Maintenance Standard

Item		Standard value and limit
Isuzu Part No.		897226-8408
Manufacturer code No.		1A04121K
Rated output		V-A
		12-20
Output characteristic (hot)	Voltage	V
		12
	Current	A
		20 or more
	Revolution speed	r/min
		5,000
Regulated voltage by regulator		V
		13.3-14.3
Revolution direction (viewed from pulley side)		
		Clockwise

Starting System

General Description

The starter is a 2.2 kW (Mitsubishi) or 2.0 kW (DENSO).



WSLE0385

Name

1. Starter

Service Precautions

Handling of starter

1. Precautions on handling

- Improper gap between pinion and ring gear causes faulty mesh. (Gap 2 — 3.5 mm {0.079 — 0.138 in})
Also, the front bracket is installed on the engine side securely.
- Be sure to turn off the battery switch before removal/installation of starter.
- Tightening/inserting wiring must be performed properly. Looseness causes starting trouble due to high contact resistance.

2. Precautions on starting

- Be careful with charging status of battery. Insufficiently-charged battery causes starting trouble.
- After checking engine starting, turn off the starter switch immediately.
- One continuous use should be less than 10 seconds. If re-starting is needed, wait until the pinion stops completely.
- If the starter does not stop rotating when the starter switch is turned off, turn off the battery switch immediately. In this case, check the wiring, switch, etc.

List of Trouble Symptom

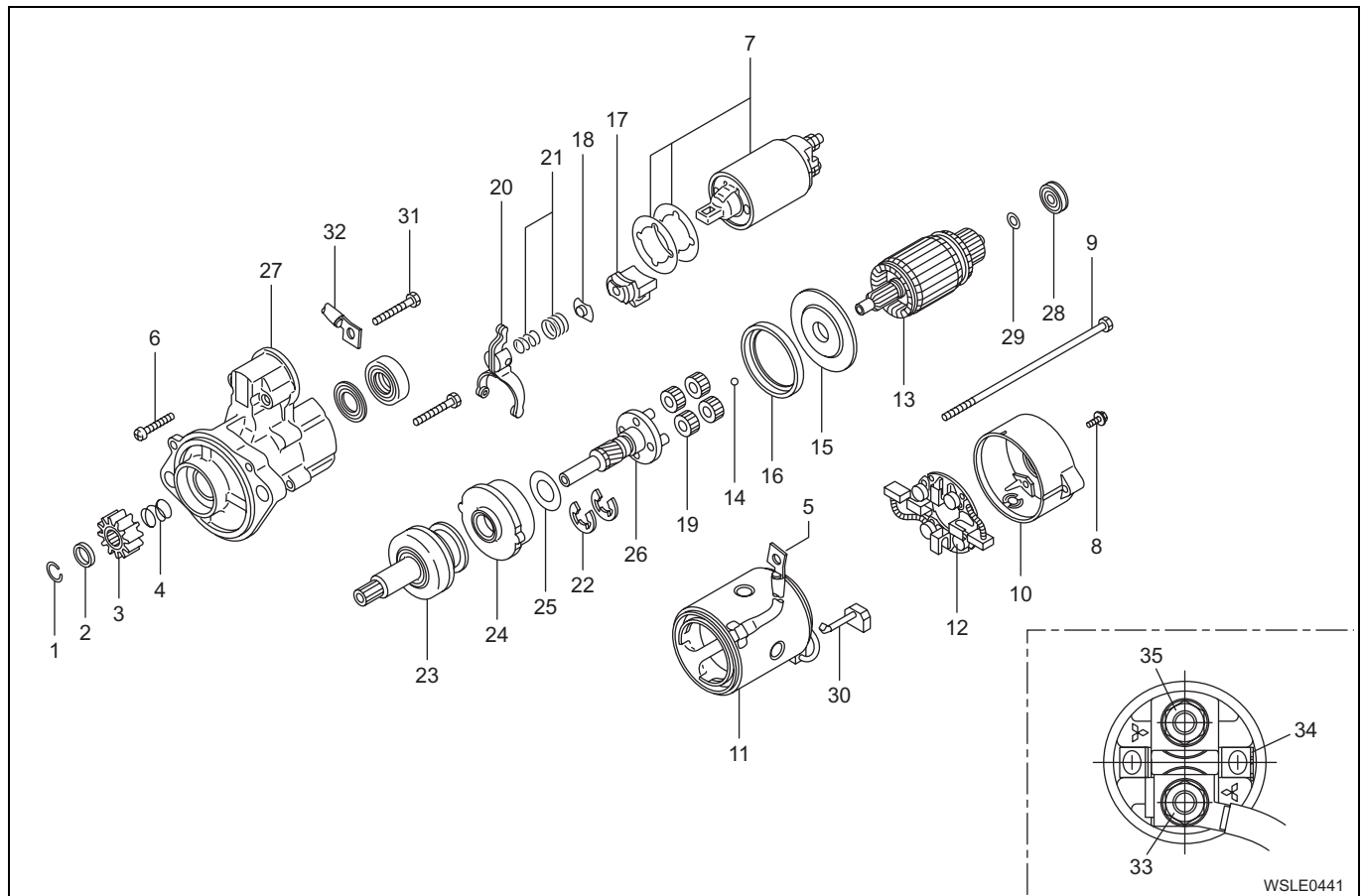
Condition	Possible cause	Correction
Starter does not operate when starter switch is turned on.	Full discharge of battery	Replace the battery.
	Open circuit, poor contact	Repair.
	Poor contact in starter switch or defective tightening of terminal	Repair or replace it.
	Poor contact in starter relay or plug terminal	Repair or replace it.
	Short or open circuit in magnetic switch coil	Replace.
Pinion moves forward but it does not engage with ring gear.	Insufficient capacity of battery	Charge the battery.
	Wear of pinion or ring gear tooth edge	Replace the pinion or the ring gear.
	Dust on pinion shaft	Repair.
Pinion engages and rotates motor but it does not run engine.	Slippage of clutch	Replace the clutch or the starter.
	Breakage of reduction gear	Replace the gear or the starter.
Pinion engages but it does not run engine.	Insufficient capacity of battery	Charge the battery.
	Defective tightening of wiring circuit terminal	Repair.
	Short circuit of armature or field coil	Replace the starter.
	Contamination of commutator	Repair, or replace the starter.
	Fatigue or wear of brush spring	Replace the brush spring or the brush.
	Locking of bearing	Replace the bearing or the starter.
	Poor contact in magnetic switch	Replace the magnetic switch.
When turning starter switch off after engine starts, starter does not stop.	Returning failure of starter switch contact	Replace the starter switch.
	Returning failure of starter relay contact	Replace the starter relay.
	Short circuit in magnetic switch coil	Replace the magnetic switch.

Starter (12V-2.2kW)

Specifications

Manufacturer		Mitsubishi Electric Co.	
Isuzu Part No.		898094-1080	
Manufacturer code No.		M008T76371	
Power output	V-kW	12-2.2	
Rating	Sec	30	
Outside diameter of yoke	mm/in	81.6/3.213	
Revolution direction		Clockwise	
Reduction mechanism		Planetary gear	
Weight	kg	5.8	
Pinion	Module	3.0	
	Pressure angle	14.5	
	The number of teeth	11	
	Gear ratio {ring gear/pinion gear}	9 {99/11}	
No load	Voltage	V	12
	Current	A	44 or less
	Revolution speed	r/min	3,800 or more
Restraint	Voltage	V	8
	Current	A	760 or less
	Torque	N·m {kgf·m}	31.38 {3.2} or more
Pinion engagement voltage		V	16.0 or less

Components



WSLE0441

Name

- | | |
|----------------------------|-----------------------------|
| 1. Snap Ring | 19. Planetary Gear |
| 2. Stop Ring | 20. Lever |
| 3. Pinion | 21. Lever Spring |
| 4. Pinion Spring | 22. E-shaped Retaining Ring |
| 5. Lead Wire with Terminal | 23. Overrunning Clutch |
| 6. Screw | 24. Internal Gear |
| 7. Magnetic Switch | 25. Washer |
| 8. Screw | 26. Gear Shaft |
| 9. Through Bolt | 27. Front Bracket |
| 10. Rear Bracket | 28. Bearing |
| 11. Yoke Assembly | 29. Washer |
| 12. Brush Holder | 30. Brush |
| 13. Armature | 31. Ground Cable Bolt |
| 14. Ball | 32. Ground Cable |
| 15. Plate | 33. M Terminal |
| 16. Packing | 34. S Terminal (C Terminal) |
| 17. Packing | 35. B Terminal |
| 18. Plate | |

Removal

1. Battery ground cable from the battery.
2. Cables and electrical leads from the starter.
3. Two mounting bolts.
4. Starter.

Installation

1. Starter
2. Two mounting bolts.

Tightening torque:

Mounting bolt: 93.2 — 113 N·m {9.5 — 11.5 kgf·m/68.7 — 83.3 lb·ft}

Ground cable bolt: 93.2 — 113 N·m {9.5 — 11.5 kgf·m/68.7 — 83.3 lb·ft}

3. Cables and electrical leads to the starter.
4. Battery ground cable to the battery.

Tightening torque:

M terminal: 9.8 — 11.8 N·m {1.0 — 1.2 kgf·m/7.2 — 8.7 lb·ft}

No Load Test

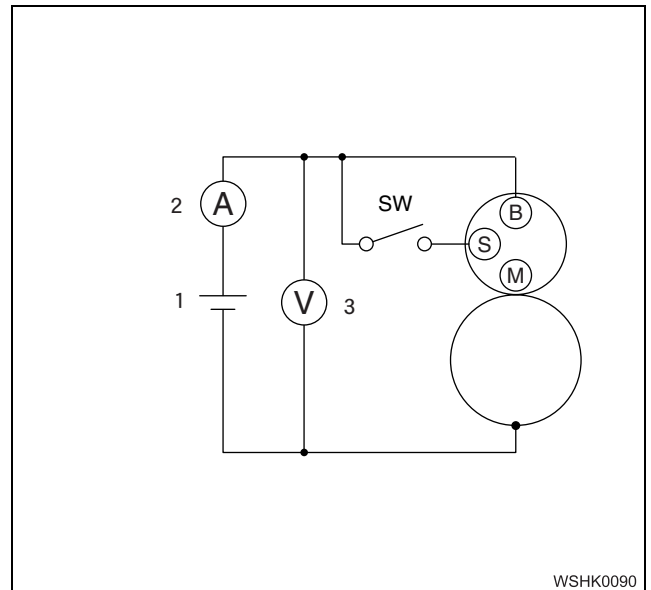
1. Connect the starter as shown in the illustration below.

CAUTION:

Use a thick electric wire and tighten the connected portion securely.

2. Close the switch and read the speed, current and voltage.

If the measured values are out of specified value, disassemble and inspect again.



WSHK0090

Name

1. Battery
2. Ammeter
3. Voltmeter

Maintenance Standard

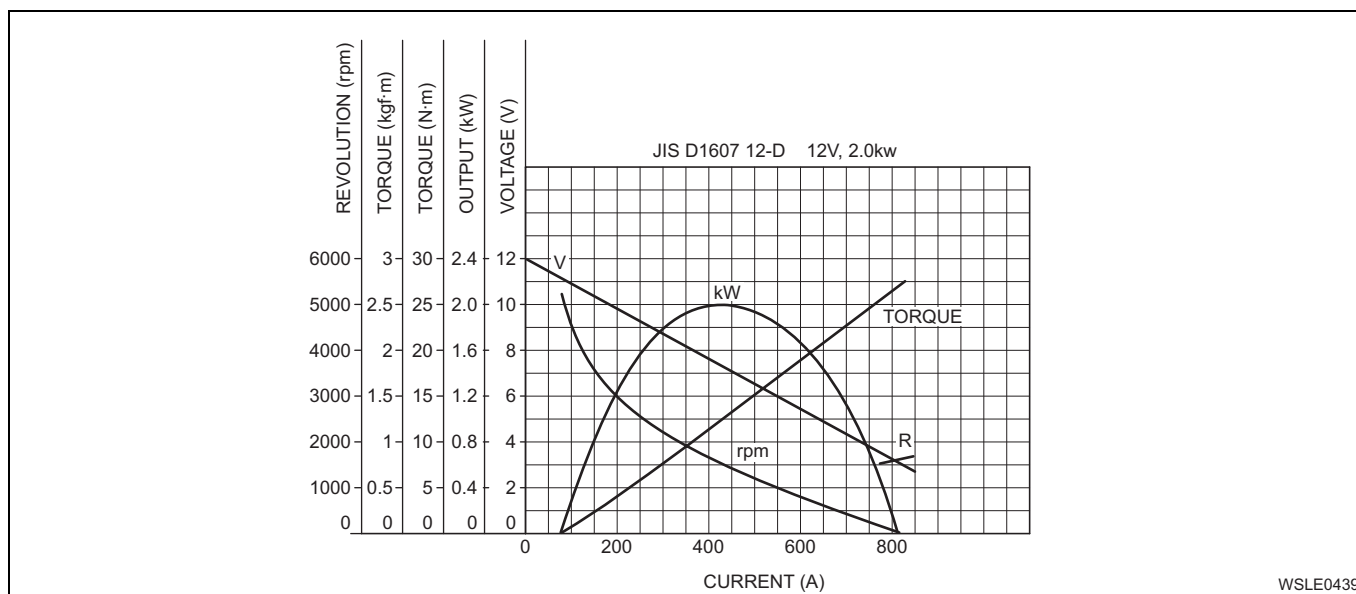
Item		Standard value or limit
No load characteristic	Voltage	V 12
	Current	A 44 or less
	Speed	r/min 3,800 or more
Commutator	Outside diameter	mm/in 32/1.260
	Limit	mm/in 31.4/1.236
Commutator	Undercut	mm/in 0.5/0.020
	Limit	mm/in 0.2/0.008
Brush	Length	mm/in 17.5/0.689
	Limit	mm/in 11/0.433
Brush spring	Pressure	N 26.7 — 36.1
	Limit	N 14.7
Protruded position of pinion		mm/in 0.5 — 2.0/0.020 — 0.079

Starter (12V-2.0kW)

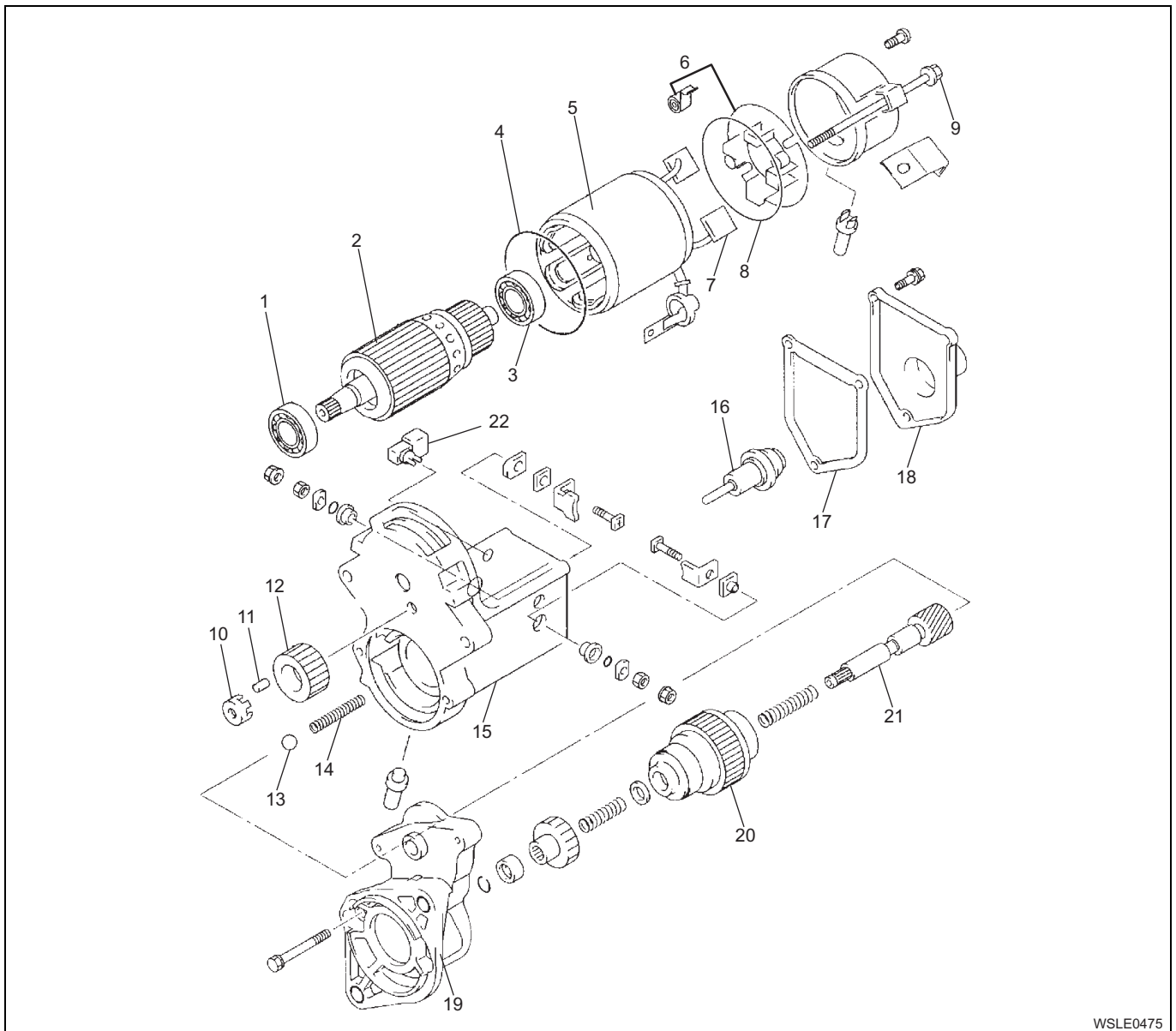
Specifications

Manufacturer		DENSO CORPORATION	
Isuzu Part No.		897112-8652	
Manufacturer code No.		228000-3850	
Power output	V-kW	12-2.0	
Rating	Sec	30	
Outside diameter of yoke	mm/in	78/3.071	
Revolution direction		Clockwise	
Protection		Dust-proof, splash-proof	
Reduction mechanism		Internal gear	
Weight	kg	4.7	
Pinion	Module	2.75	
	Pressure angle	20	
	The number of teeth	9	
	Gear ratio {ring gear/pinion gear}	12 {108/9}	
No load	Voltage	V	7.6
	Current	A	400 or less
	Revolution speed	rpm	1,380 or more
Restraint	Voltage	V	2.4
	Current	A	800 or less
	Torque	N·m {kgf·m}	16.67 {1.7} or more
Pinion engagement voltage		V	8.0 or less

Output Characteristic (reference)



Components



WSLE0475

Name

- | | |
|------------------|---------------------|
| 1. Front Bearing | 12. Idle Gear |
| 2. Armature | 13. Steel Ball |
| 3. Rear Bearing | 14. Coil Spring |
| 4. O-ring | 15. Magnetic Switch |
| 5. Yoke | 16. Plunger |
| 6. Brush Holder | 17. Rubber Cover |
| 7. Brush | 18. Cover |
| 8. O-ring | 19. Drive Housing |
| 9. Through Bolt | 20. Clutch |
| 10. Retainer | 21. Clutch Shaft |
| 11. Roller | 22. C Terminal |

Inspection

CAUTION:

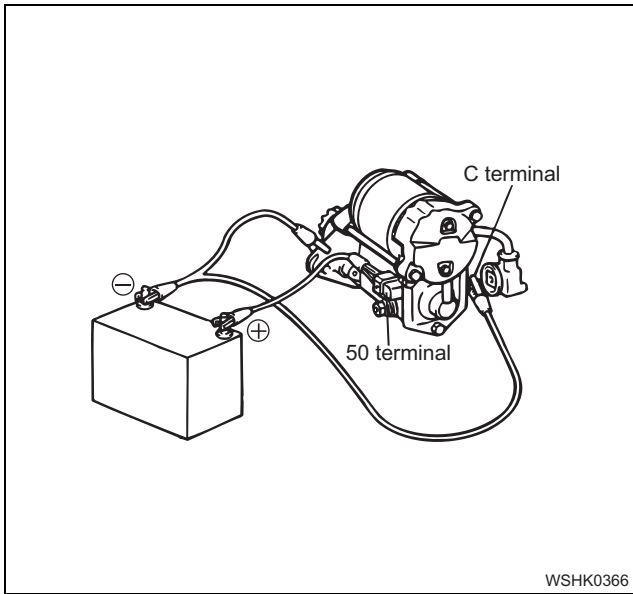
Complete each test within three to five seconds.

Pull-in test

1. Disconnect the lead wire of the C terminal.
2. When connecting as follows, make sure that the pinion gear protrudes.

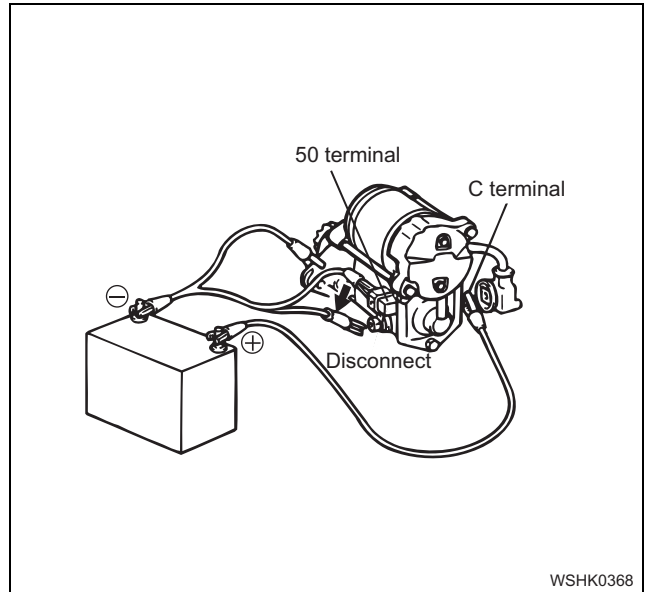
CAUTION:

When performing the inspection, be sure to disconnect the lead wire of the C terminal.



Return test

1. When connecting as follows, make sure that the pinion gear protrudes. When disconnecting the lead to the 50 terminal with the connection, make sure that the pinion gear returns to its original position immediately.

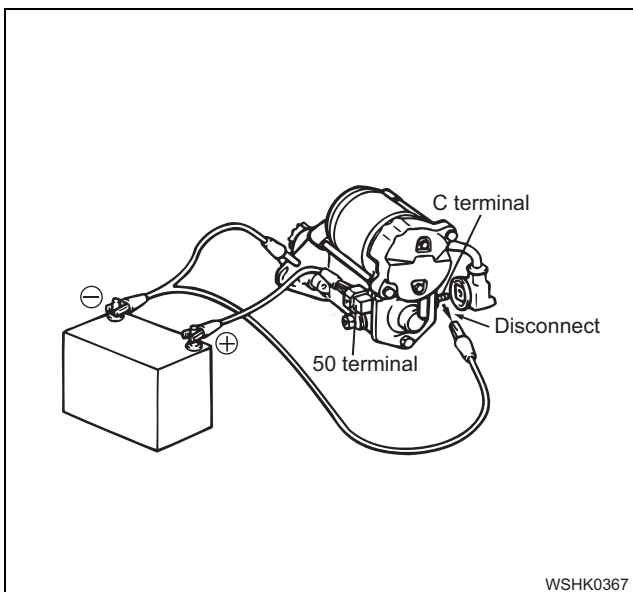


Note:

If you need repairing, bring it to the nearest DENSO service station for needing the special tools in disassemble and assemble.

Hold-in test

1. Make sure that the pinion gear remains out even after disconnecting the test lead wire of the C terminal with pull-in test condition.
2. Disconnect the ground wire and make sure that the pinion gear returns to its original position.



Engine

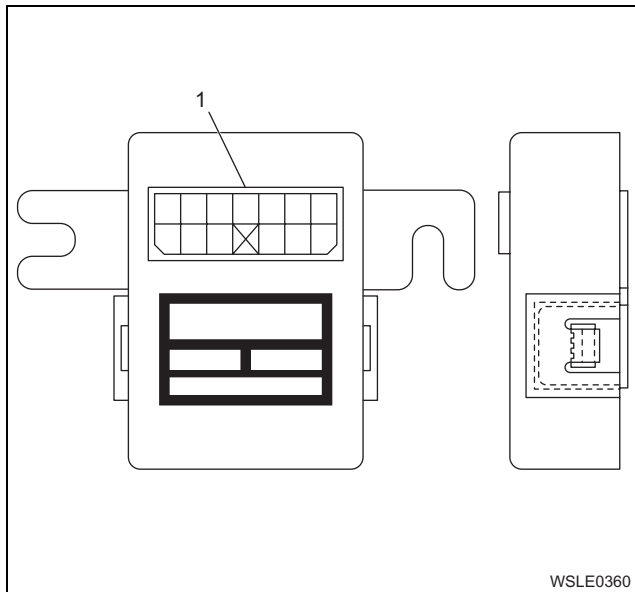
4LE1 Exhaust System

Table of Contents

EGR Control.....	1G-2
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EGR Controller Wiring Diagram	1G-2
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Tachosensor Circuit Diagram.....	1G-3
Boost Pressure Sensor Circuit Diagram	1G-4
Engine Coolant Temperature Control	1G-4
Control When the Sensor Has an Open Circuit .	1G-4
Engine Speed and Boost Pressure Control	1G-4
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EGR Control

Appearance of EGR Controller

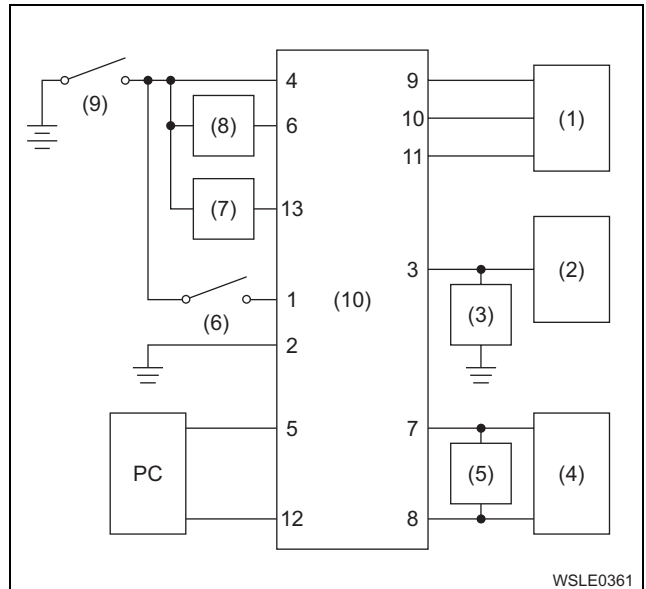


Name

- 1. Connector

EGR Controller Wiring Diagram

The harnesses between the EGR controller and EGR cut solenoid are machine parts. Contact the machine manufacturer if it is found to be faulty.

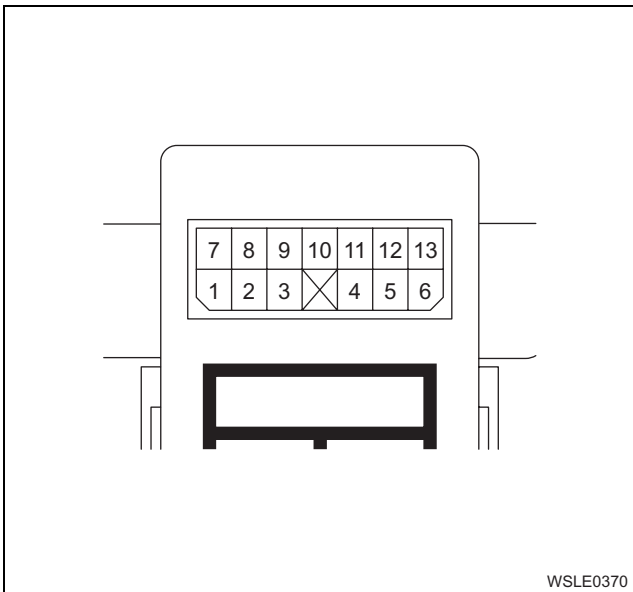


Name

- 1. Boost Pressure Sensor
- 2. Glow Plug Timer
- 3. Engine Coolant Temperature Sensor
- 4. Tachometer
- 5. Tachosensor
- 6. Starter Switch
- 7. EGR Relay
- 8. Stop Relay
- 9. Ignition Switch
- 10. EGR Cut Controller

Connector Pin Layout

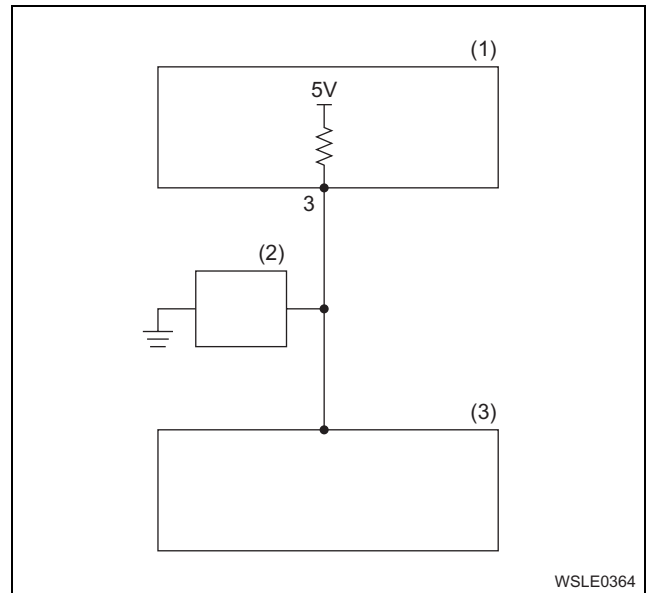
Pins are numbered by the arrangement when viewing the EGR cut controller from the wiring side.



Name

1. Starter Switch
2. EGR Cut Controller GND
3. Engine Coolant Temperature Sensor
4. Ignition Switch (+)
5. (TXD)
6. Stop Relay
7. Tachosensor(+)
8. Tachosensor(-)
9. Boost Pressure Sensor Power Supply
10. Boost Pressure Sensor Signal
11. Boost Pressure Sensor GND
12. (EXD)
13. EGR Relay

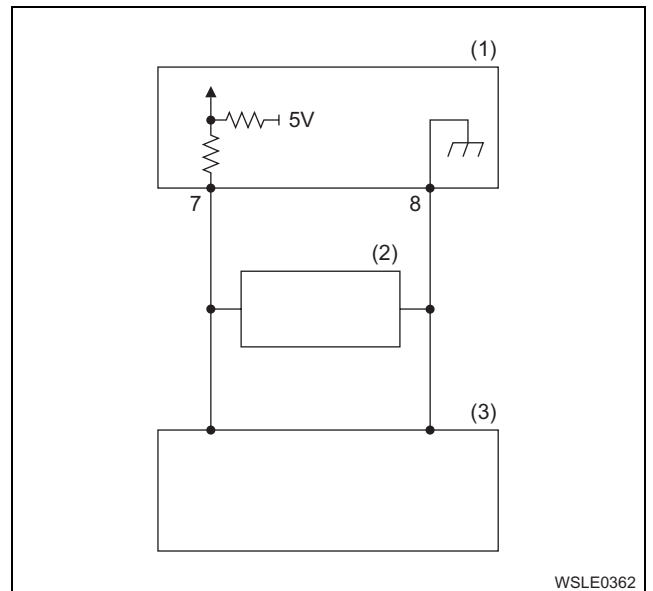
Engine Coolant Temperature Sensor Circuit Diagram



Name

1. EGR Cut Controller
2. Engine Coolant Temperature Sensor
3. Glow Plug Timer

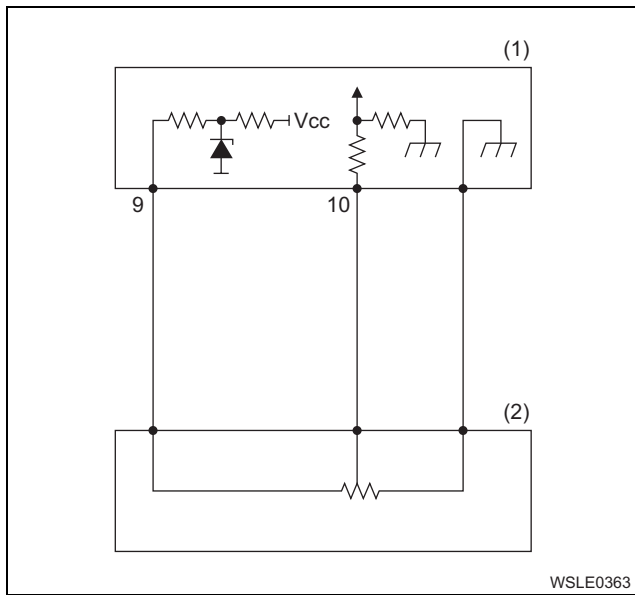
Tachosensor Circuit Diagram



Name

1. EGR Cut Controller
2. Tachosensor
3. Tachometer

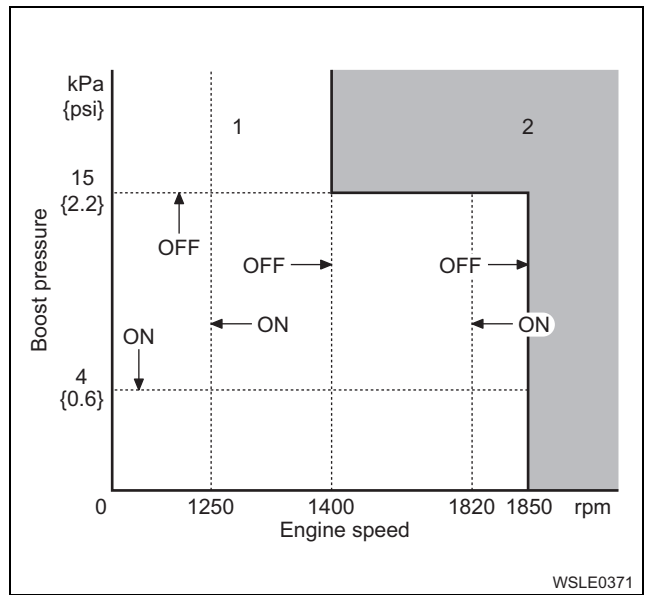
Boost Pressure Sensor Circuit Diagram



Name

1. EGR Cut Controller
2. Boost Pressure Sensor

Engine Speed and Boost Pressure Control



Name

1. EGR Valve Closed
2. EGR Valve Open

Engine Coolant Temperature Control

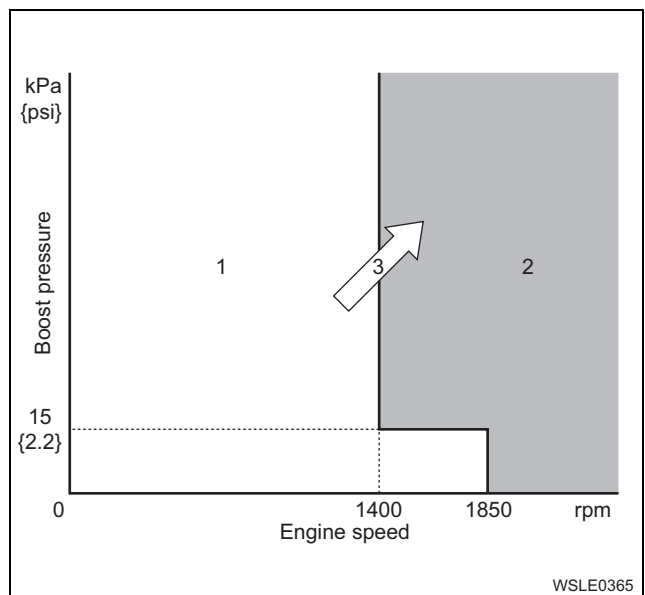
The EGR valve is opened when the engine coolant temperature becomes 60°C {140°F} or more, and is closed when 55°C {131°F} or less.

Control When the Sensor Has an Open Circuit

The following sensors perform backup control when they have an open circuit. In this case, EGR valve operates according to other normal sensors.

Sensor	Backup control when open circuit occurs
Engine coolant temperature sensor	Control as the engine coolant temperature is 60°C {140°F} or more.
Tachosensor	Control as the engine speed is between 1,400 and 1,850 rpm.
Boost pressure sensor	Control as the boost pressure is 15 kPa {2.2 psi} or more.

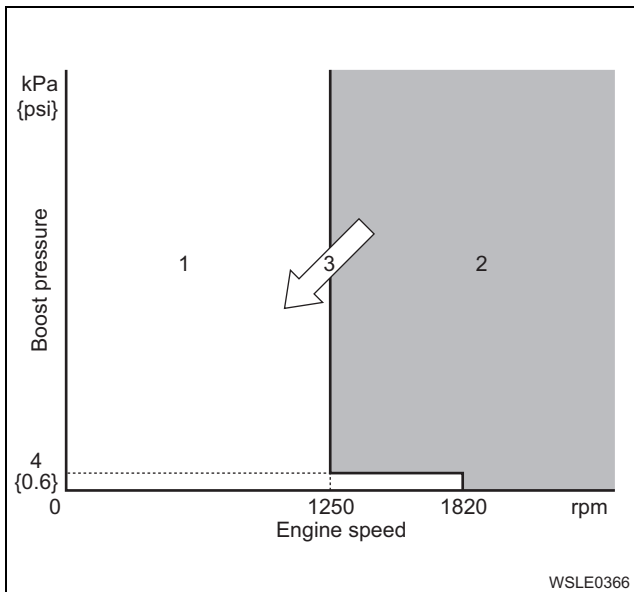
When the engine speed and boost pressure increase



Name

1. EGR Valve Closed
2. EGR Valve Open
3. Engine Speed and Boost Pressure Increase

When the engine speed and boost pressure decrease



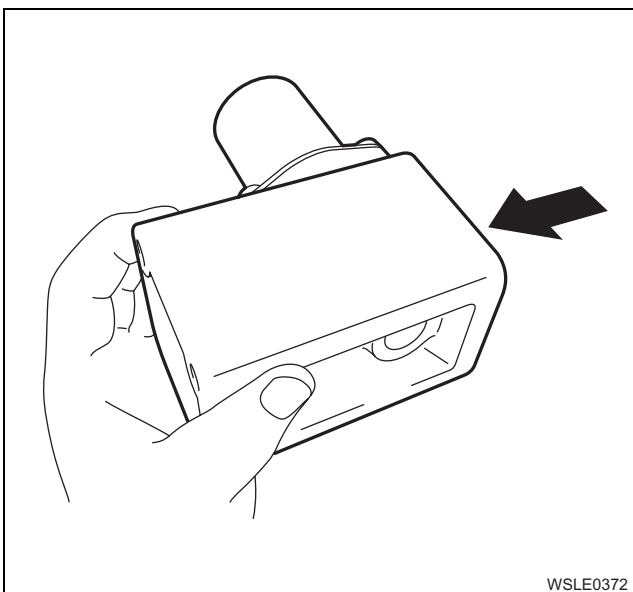
Name

1. EGR Valve Closed
2. EGR Valve Open
3. Engine Speed and Boost Pressure Decrease

Inspection

EGR valve check

1. Shine a light from the direction shown in the illustration.
2. Replace the EGR cut solenoid and valve case together if the light can be seen from the opposite side. The EGR valve has been stuck at opened position.



Engine

4LE1 Lubrication System

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Lubrication System.....	1H-2
Service Precautions	1H-2
Explanations on Functions and Operation	1H-2
Function Check	1H-3
Oil Filter	1H-4
Removal	1H-4
Installation	1H-4
Oil Pump	1H-5
Components.....	1H-5
Inspection.....	1H-5

Lubrication System

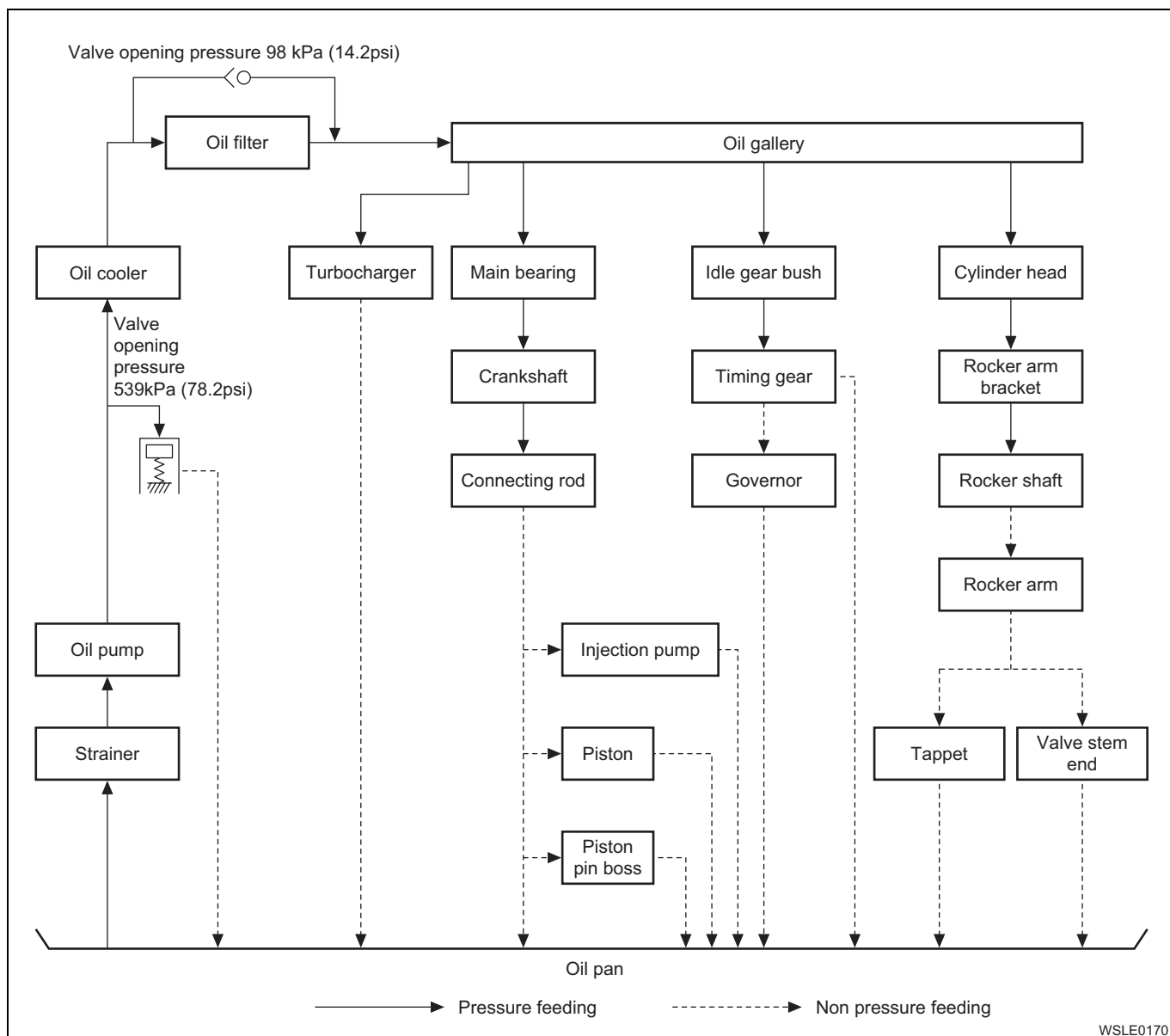
Service Precautions

- During each disassembly, remove the old gasket adhering to each part and mating part completely using a scraper at the location, where the fluid gasket is to be used, clean the traces of oil, moisture and dirt completely using a cloth, and apply the specified new fluid gasket at each location.
- Avoid excessive or insufficient coating volume. Note that seizure may occur in case of excessive coating due to clogging of the oil gallery and oil jet, and oil and water leakage may occur if the coating is insufficient.
- Always, the start and end of the application should be overlapped.

Explanations on Functions and Operation

The lubrication system uses the filter element combined with a full flow bypass, water-cooled oil cooler, and oil jet for piston cooling.

Lubricating system diagram



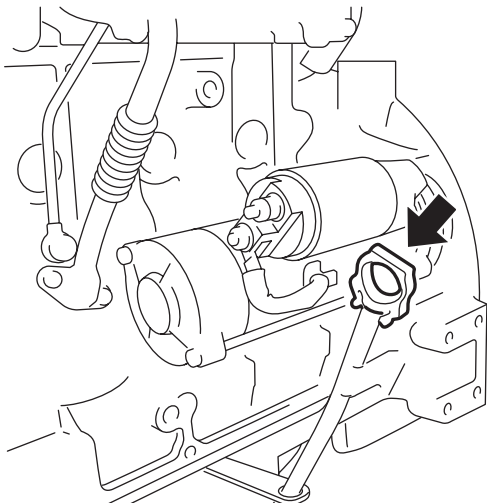
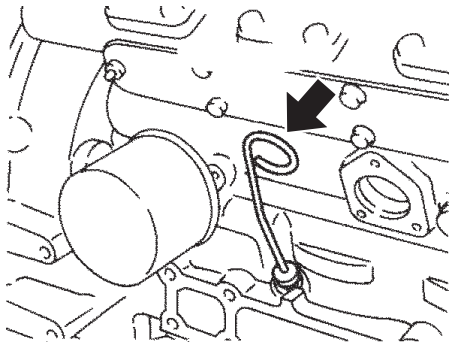
Function Check

Engine oil

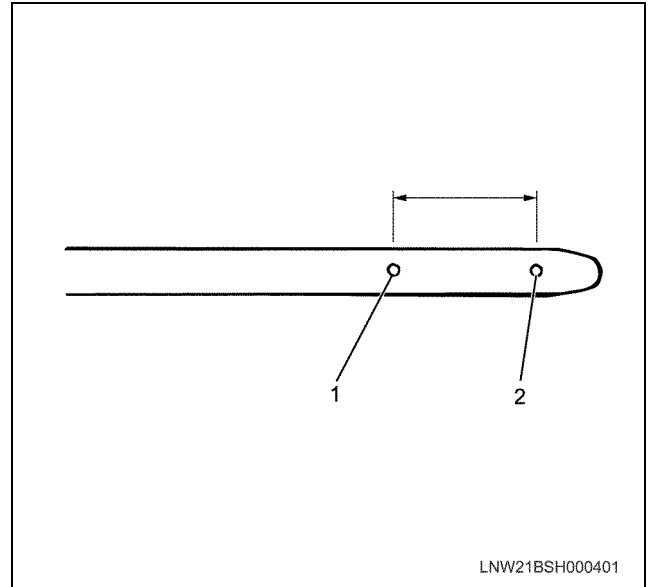
- Ensure the engine is at a level ground. Before starting the engine or when 5 minutes or more have elapsed after stopping the engine, check the engine oil volume using the level gauge. The volume is appropriate if the engine oil is between the upper and lower limits of the level gauge. Replenish the engine oil, if level is below the lower limit. Also, check for contamination of the engine oil.

Note:

Oil level gauge installation position and shape are different depending on the model.



WSLE0400



Name

1. Max.
2. Min.

Engine oil leakage

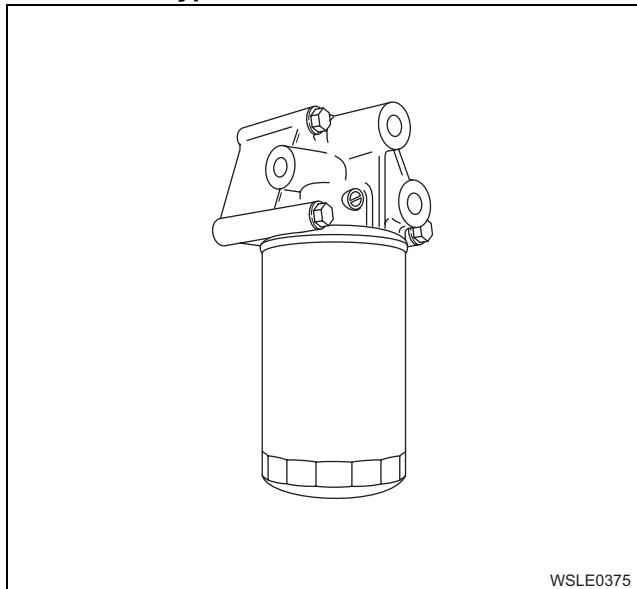
- In the lift up condition, confirm that there are no leaks from the cylinder head cover and oil pan.

Oil Filter

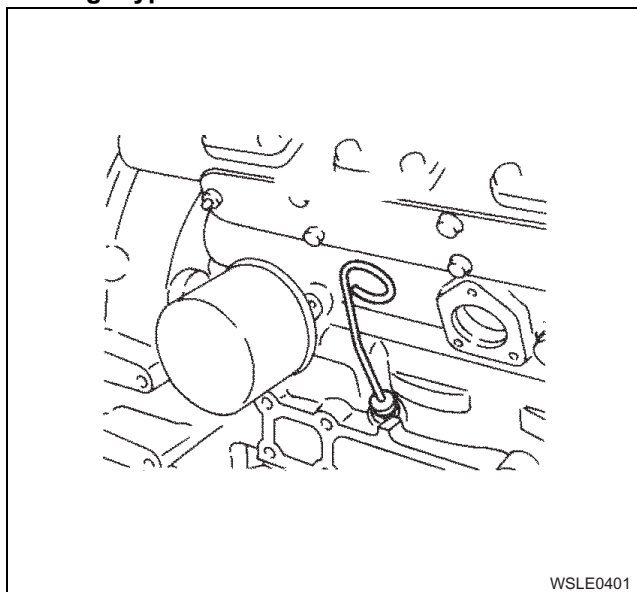
Removal

Remove the oil filter using the oil filter wrench.

Remote filter type



Cartridge type



Installation

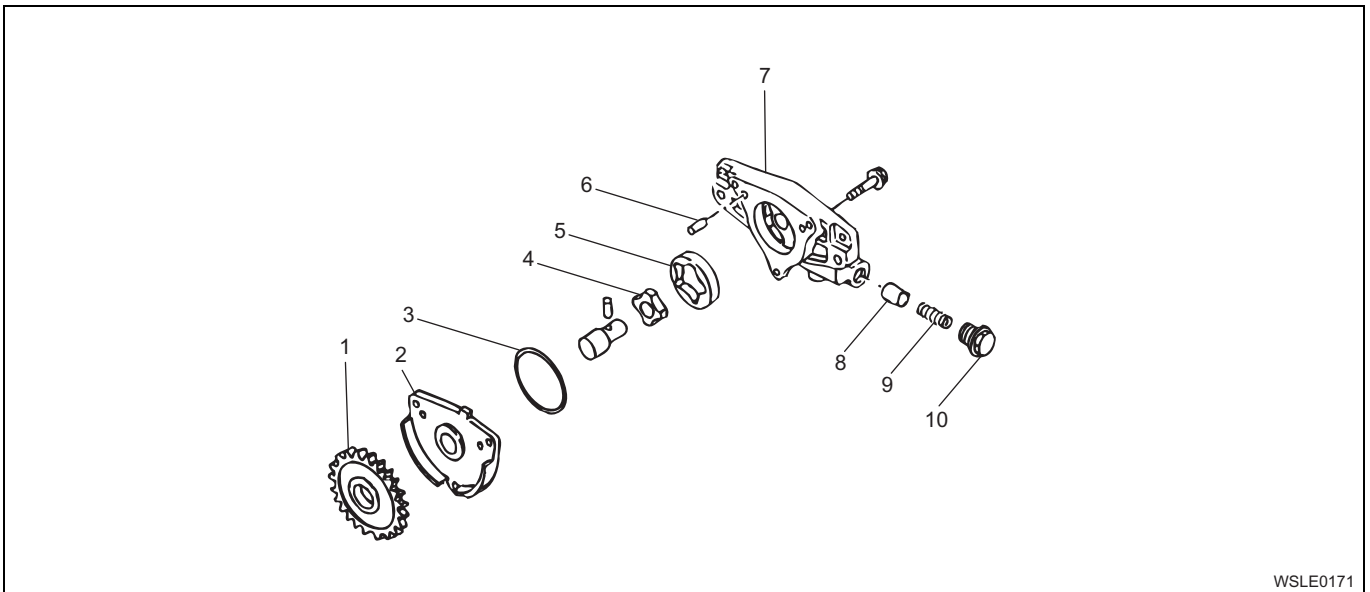
1. Apply engine oil to the O-ring of the oil filter.
2. Install the oil filter using the oil filter wrench.

Tightening torque:

14.7 — 20.6 N·m {1.5 — 2.1 kgf·m/10.8 — 15.2 lb·ft}

Oil Pump

Components



WSLE0171

Name

- | | |
|----------------|------------------|
| 1. Pump Gear | 6. Pin |
| 2. Pump Cover | 7. Oil Pump Body |
| 3. O-ring | 8. Relief Valve |
| 4. Inner Rotor | 9. Spring |
| 5. Outer Rotor | 10. Plug |

Inspection

Replace or repair if there is wear, damage, or any other defect on the rotor, etc.

Inspection of clearance between the outer or inner rotor and the pump cover

Use a thickness gauge and square to measure the clearance between the outer or inner rotor and the pump cover, and replace the outer or inner rotor if they exceed the limit.

mm {in}	Standard value	Service limit	Repairing procedure
4LE1N	0.040 — 0.085 {0.0016 — 0.0033}	0.15 {0.006}	Replace.
4LE1T	0.040 — 0.087 {0.0016 — 0.0034}		

Inspection of clearance between the outer circle of the outer rotor and the pump body

Use a thickness gauge to measure the clearance between the outer rotor and the oil pump body, and replace the outer rotor if they exceed the limit.

mm {in}		
Standard value	Service limit	Repairing procedure
0.28 — 0.41 {0.0110 — 0.0161}	0.4 {0.016}	Replace.

Inspection of tip clearance between the inner rotor and the outer rotor

Use a thickness gauge to measure the tip clearance between the inner rotor and the outer rotor, and replace the inner or outer rotor if it exceeds the limit.

mm {in}		
Standard value	Service limit	Repairing procedure
0.15 {0.0059} or less	0.2 {0.008}	Replace.

Engine

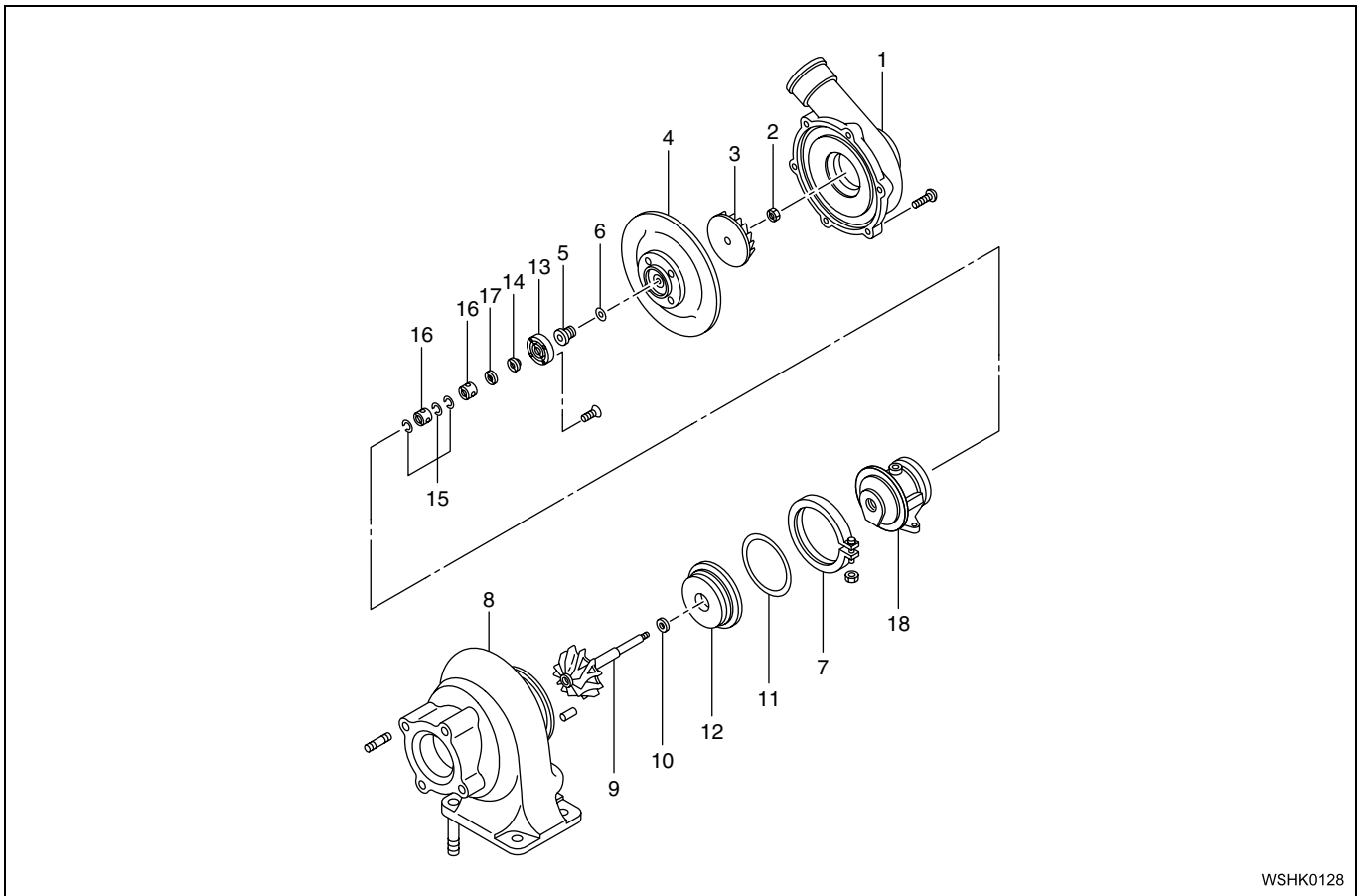
4LE1 Intake System

Table of Contents

Turbocharger.....	1J-2
Components.....	1J-2
Inspection.....	1J-3
List of Measurement Tool.....	1J-3

Turbocharger

Components



Name

- | | |
|------------------------|---------------------|
| 1. Compressor Housing | 10. Seal Ring |
| 2. Nut | 11. Gasket |
| 3. Compressor Impeller | 12. Heat Protector |
| 4. Seal Plate | 13. Thrust Bearing |
| 5. Oil Thrower | 14. Thrust Collar |
| 6. Seal Ring | 15. Snap Ring |
| 7. G Coupling | 16. Floating Metal |
| 8. Turbine Housing | 17. Thrust Bearing |
| 9. Turbine Shaft | 18. Bearing Housing |

CAUTION:

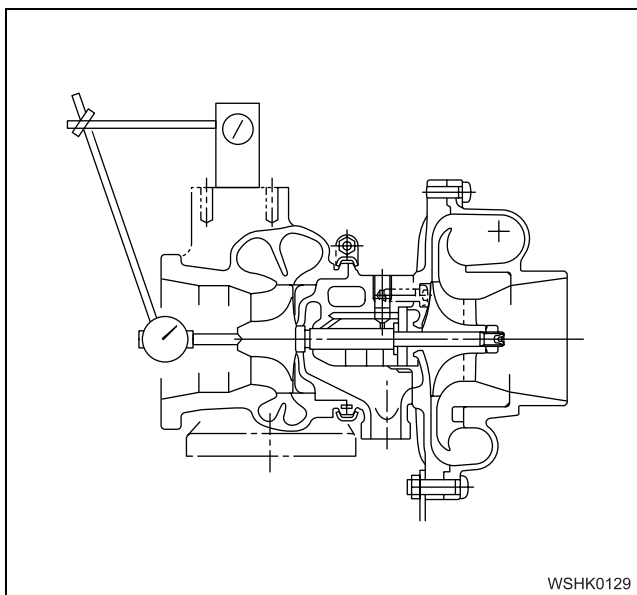
If you perform inspection with the turbocharger removed from the engine, plug the oil port opening before work.

Inspection

- Measurement of axial play of turbine shaft

Axial play	mm {in}
Assembly specification	0.06 — 0.09 {0.0024 — 0.0035}
Service limit	0.11 {0.0043}

If it exceeds the service limit, check the thrust metal, the thrust bushing, and the oil thrower.



List of Measurement Tool

Shape	Name	Part number	Usage
	Dial gauge	—	Measurement of axial play of turbine shaft

Engine

4LE1 Preheating System

Table of Contents

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Explanations on Functions and Operation	1K-2
Glow Plug Check.....	1K-2
List of Trouble Symptom	1K-2

Preheating System

Explanations on Functions and Operation

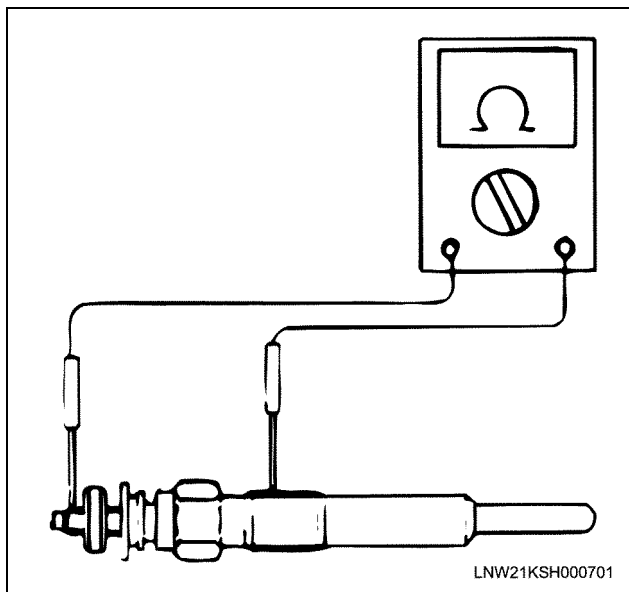
The preheating system consists of the glow plug timer, the glow plugs and the glow indicator lamp. The preheating system is operated when the engine coolant temperature is low, and makes the engine easy to start.

Glow Plug Check

- Use the circuit tester and measure the resistance of the glow plug.
- If the measured value deviates from the specified value, then replace the glow plug.
Resistance value of glow plug is 3Ω .

Note:

Use a set of glow plug from the same manufacturer.



List of Trouble Symptom

Condition	Possible cause	Correction
The glow indicator lamp does not light up.	Slow-blow fuse has blown.	Replace the slow-blow fuse.
	Fuse is unavailable.	Replace the fuse.
	Indicator bulb is burnt out.	Replace the indicator bulb.
Preheating does not work.	Slow-blow fuse has blown.	Replace the slow-blow fuse.
	Defective or faulty glow plug relay connector contact.	Re-mount or replace the glow plug relay.
Preheating time is too long or too short.	Thermo-sensor fault and break in circuit or short circuit.	Replace the thermo-sensor. Repair the circuit.
	Fault in glow plug.	Replace or tighten the glow plug.