SERVICE MANUAL
4HK1-6HK1
ISUZU ENGINES

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CNH

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NOTE: CNH Company reserves the right to make changes in the specification and design of the machine without prior notice and without incurring any obligation to modify units previously sold.

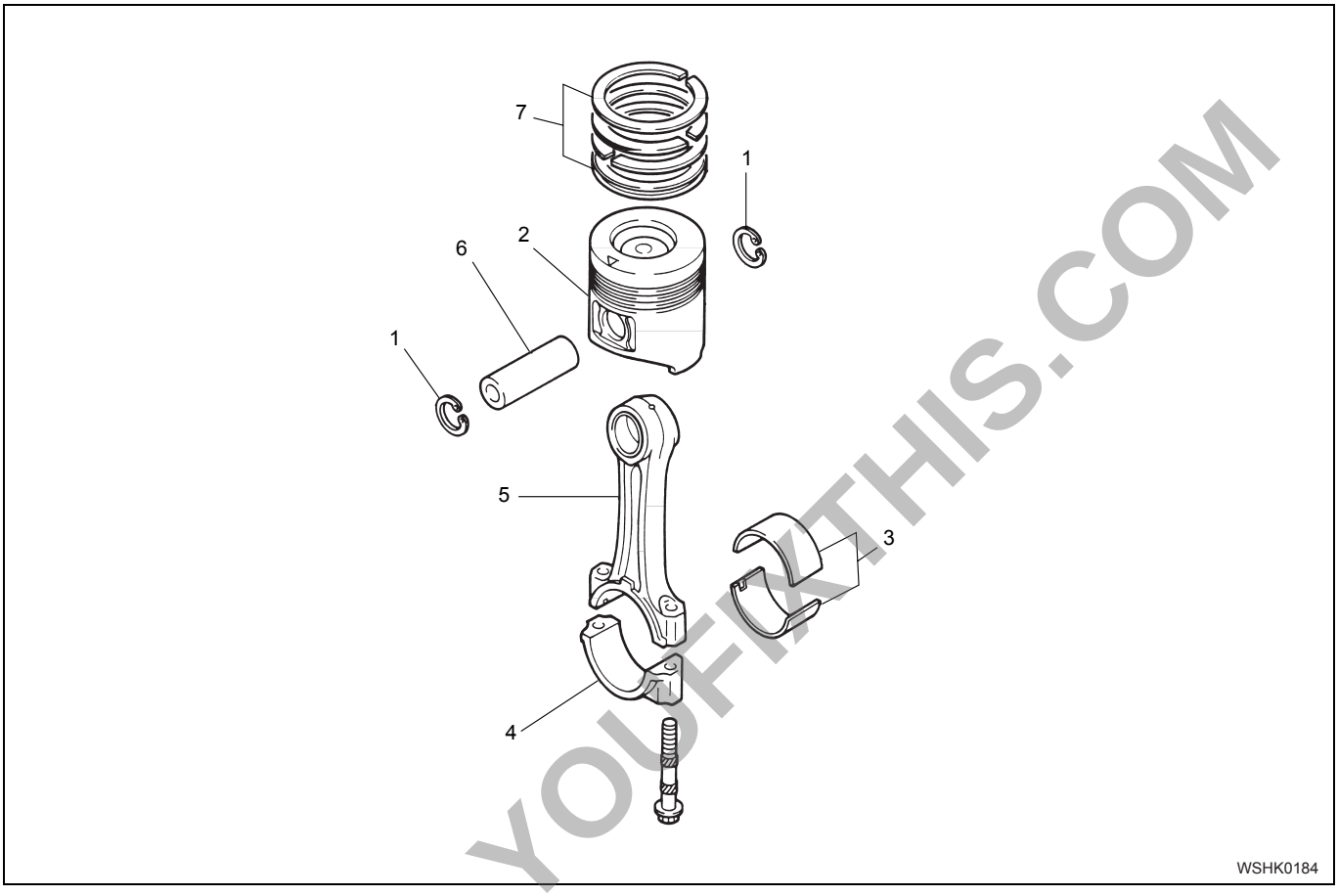
The description of the models shown in this manual has been made in accordance with the technical specifications known as of the date of design of this document.

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Piston, Connecting Rod

Components



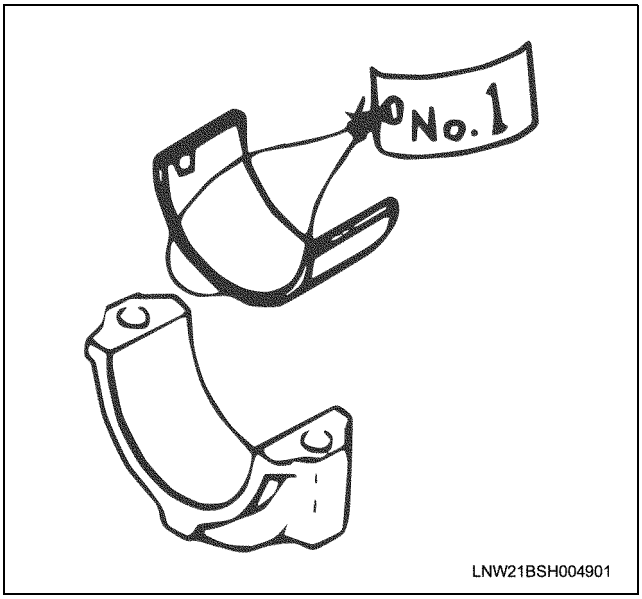
Name

1. Snap Ring
2. Piston
3. Bearing
4. Connecting Rod Cap
5. Connecting Rod
6. Piston Pin
7. Piston Ring

Removal

1. Remove the oil pan.
   Refer to “Oil Pan”.
2. Remove the cylinder head cover.
   Refer to “Cylinder Head Cover”.
3. Remove the rocker arm shaft ASM.
   Refer to “Rocker Arm Shaft ASM”.
4. Remove the camshaft ASM.
   Refer to “Camshaft ASM”.
5. Remove the cylinder head.
   Refer to the “Cylinder Head”.
6. Remove the connecting rod cap.

Caution:
Sort the removed bearings according to cylinders by using tags.



7. Remove the piston and connecting rod.

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Table of standard Isuzu tightening torque

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

Isuzu standard bolts, nuts

N·m {kgf·m}

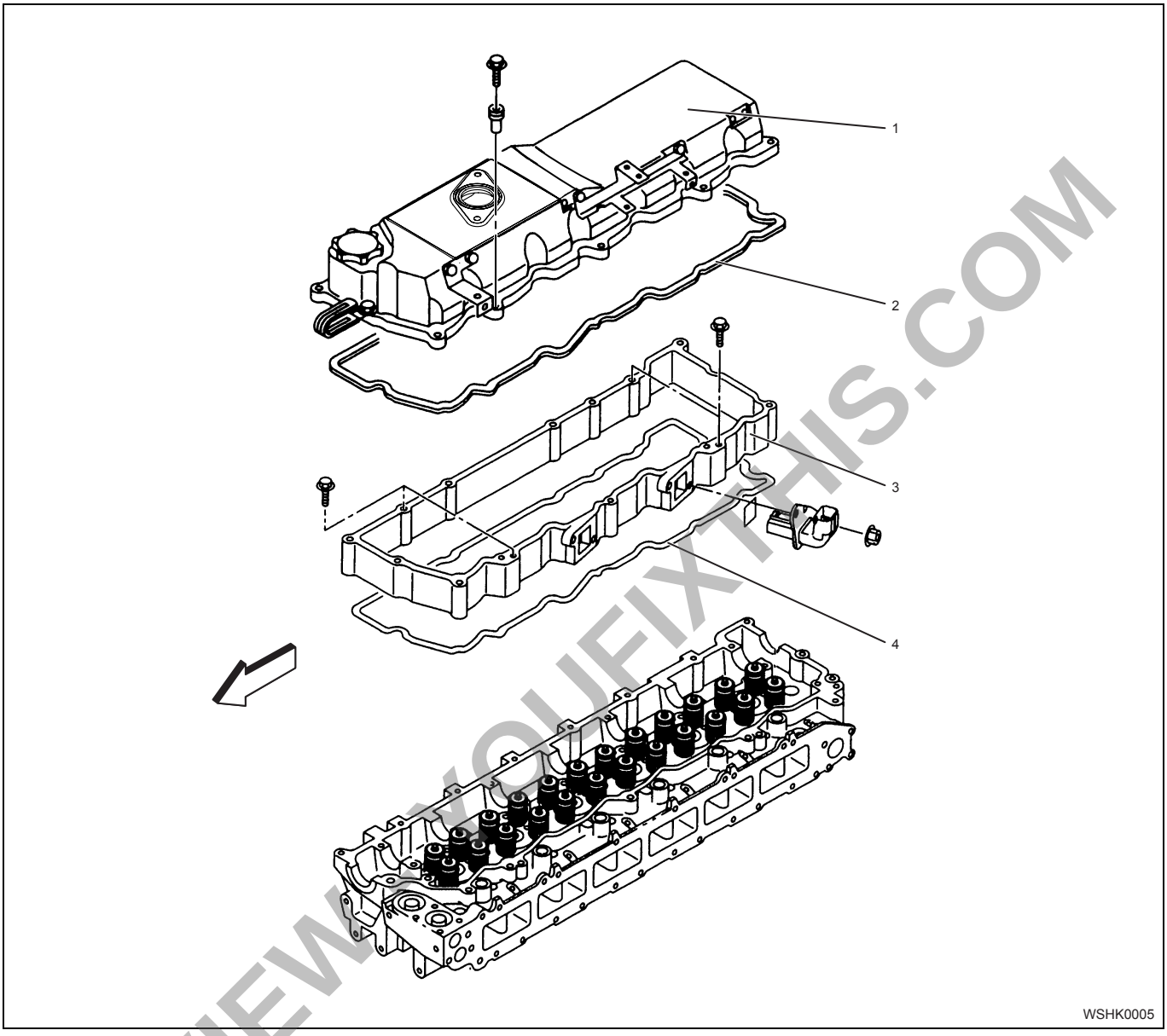
Strength classification	4.8 4T		7T	
Bolt head section shape	Hexagon head bolt	Flange bolt	Hexagon head bolt	Flange bolt
* M10 × 1.5	19.6 ~ 33.3 {2.0 ~ 3.4}	22.3 ~ 37.2 {2.3 ~ 3.8}	27.5 ~ 45.1 {2.8 ~ 4.6}	30.3 ~ 50.4 {3.1 ~ 5.1}
M12 × 1.25	49.0 ~ 73.5 {5.0 ~ 7.5}	54.9 ~ 82.3 {5.6 ~ 8.4}	60.8 ~ 91.2 {6.2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

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

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Name

1. Head Cover
2. Gasket
3. Head Cover Case
4. Gasket

Removal

1. Remove the head cover.
2. Remove the gasket.

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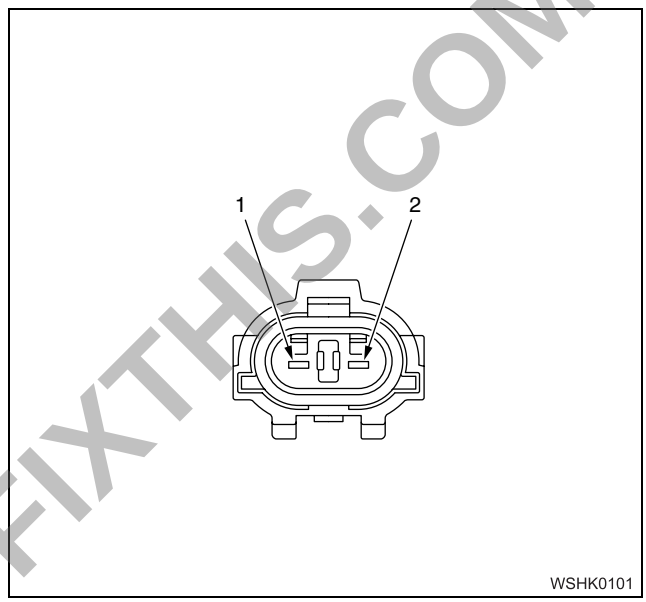
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Specifications

Isuzu Part No.		8973750170
Nominal output	(V-A)	24-50
Rated speed	(rpm)	5000
Regulator-type		IC type
Regulated voltage	(V)	28.5±1
Weight	(kg)	9.5

Connector terminal

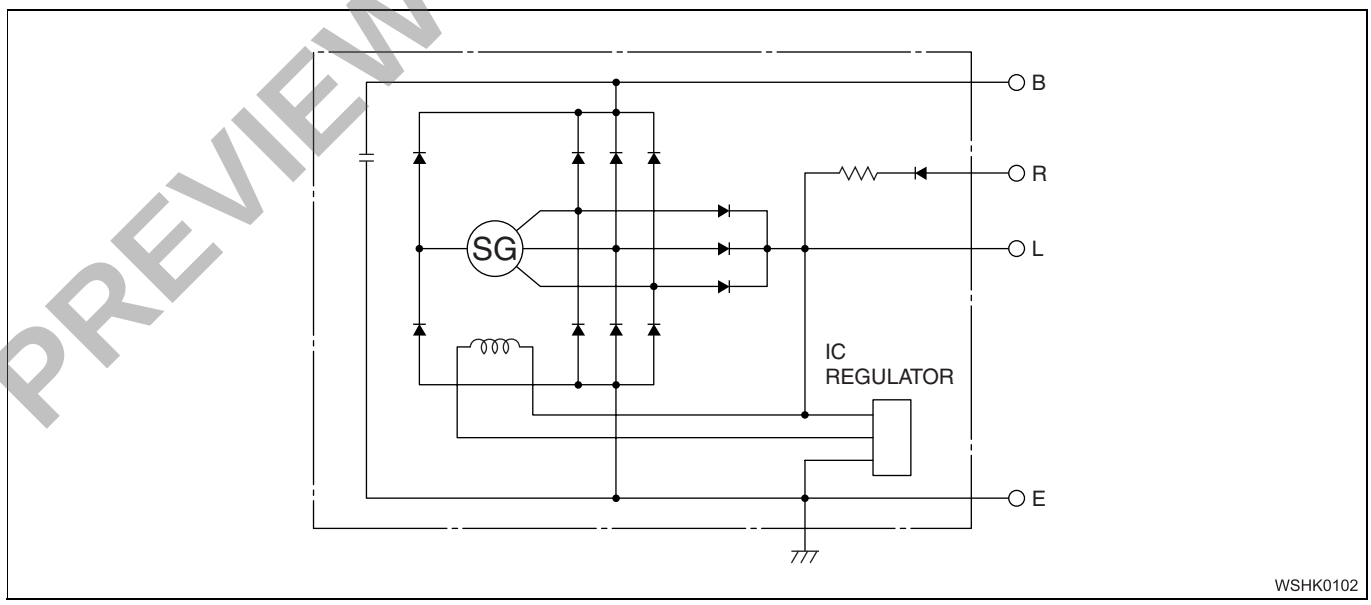
Terminal symbol	Lead wire color	Wire specifications
R	R	AEX 0.75f
L	L	AEX 0.75f



Name

1. R Terminal
2. L Terminal

Internal connections



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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 driven 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
Excessive charging	Regulator	Defective regulator.	Replace
Unstable charging current	Wiring	Intermittent contact or nearly disconnected connection in wiring	Repair
	Generator.	Looseness of generator driven 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

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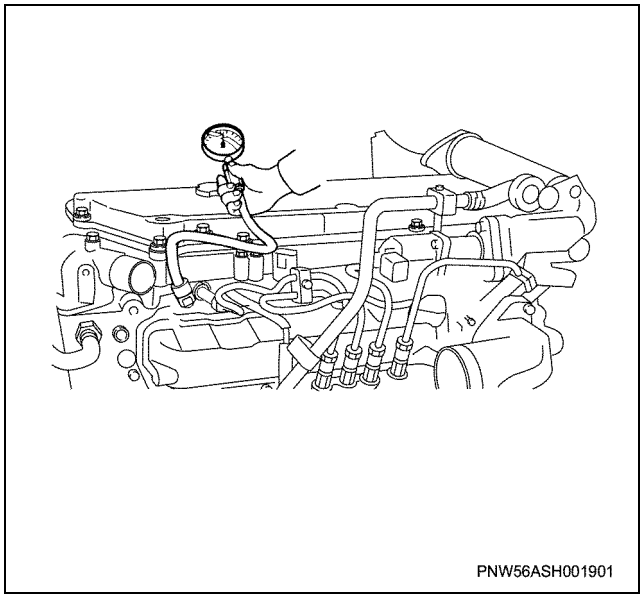
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Main Data and Specifications

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

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

- Turn on the starter to inspect compression pressure.

4HK1

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

6HK1

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

- Measure each cylinder one by one.

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

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

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

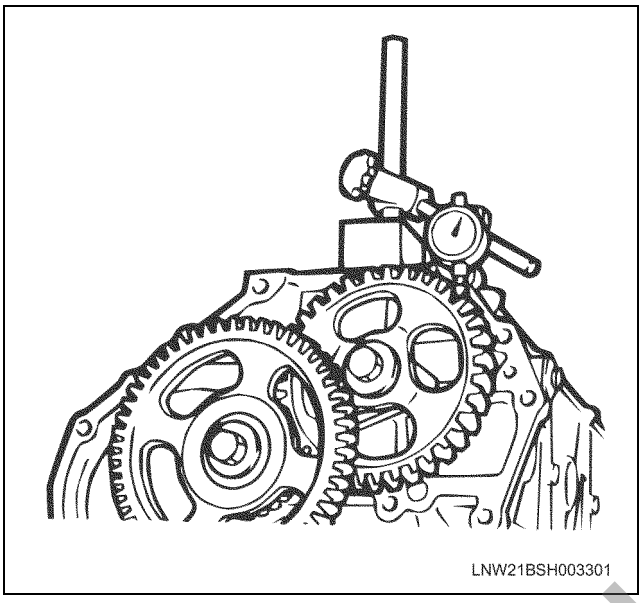
- Install the negative terminal of the battery.

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Backlash of the timing gear	mm (in)
Standard	0.10 – 0.17 (0.004 – 0.006)
Limit	0.30 (0.01)

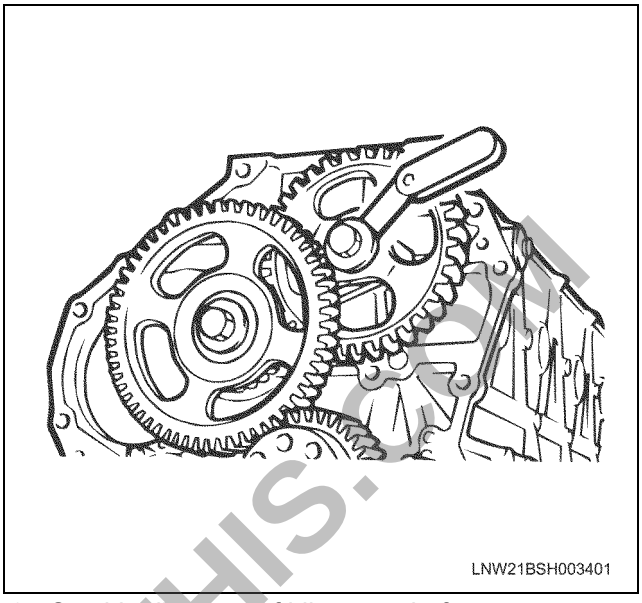
- Measure backlash of the idle gear before removing the idle gear A.



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

Axial play of idle gear	mm (in)
Standard	0.080 – 0.140 (0.003 – 0.006)
Limit	0.20 (0.008)

- Measure an end clearance of the idle gear before removing the idle gear B.



3. Outside diameter of idle gear shaft
   - Use a micrometer to measure an external diameter of each idle gear shaft.
   - If the measurement exceeds the limit, replace the shaft.

4HK1

Outside diameter of idle gear shaft	mm (in)
Standard	29.959 – 29.980 (1.179 – 1.180)
Limit	29.80 (1.173)

External diameter of the idle gear A shaft	mm (in)
Standard	39.959 – 39.975 (1.573 – 1.574)
Limit	39.80 (1.567)

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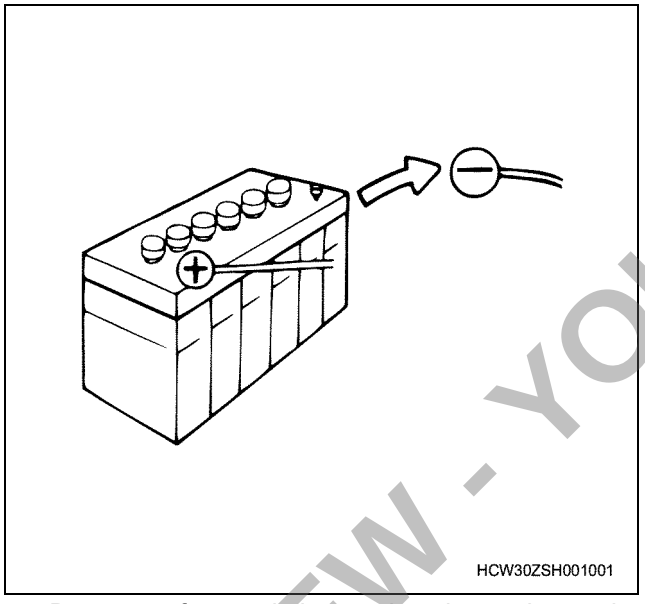
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General Information

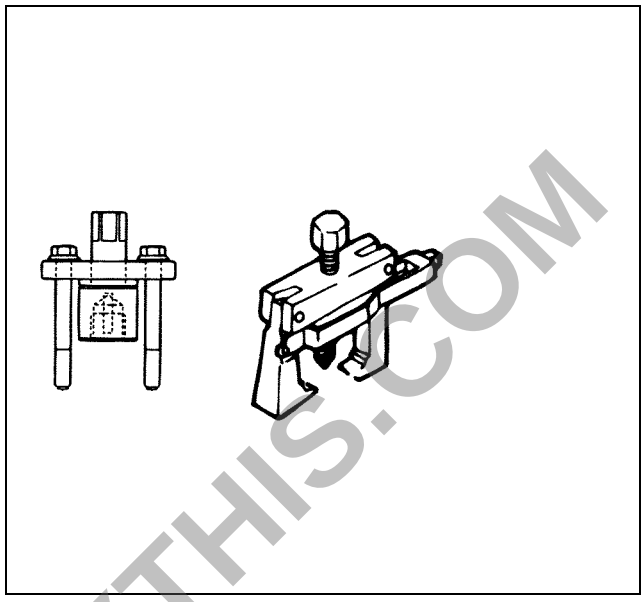
Service Precautions

In order to carry out work safely

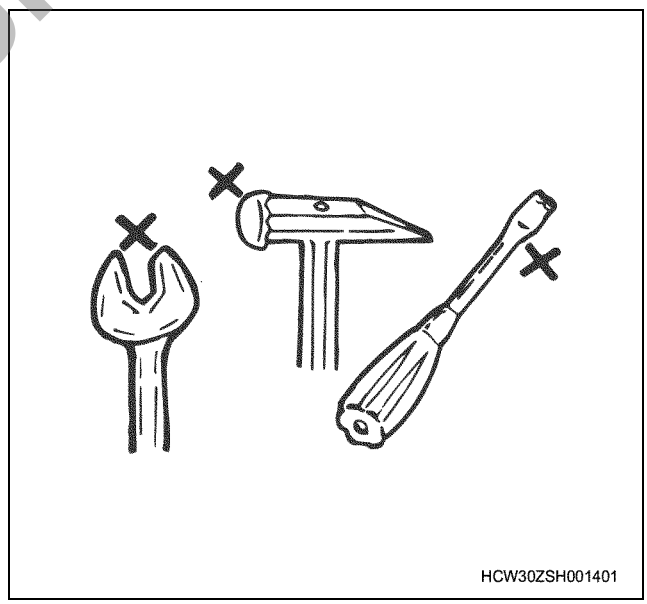
1. Always use an engine stand when taking the engine down from the vehicle.
   Do not place the engine directly onto the ground, or place in a manner that interferes with the oil pan.
2. If you are working together with others, always pay attention to each other's safety.
3. If you are repairing any 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.

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UNITS OF MEASURE

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

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

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

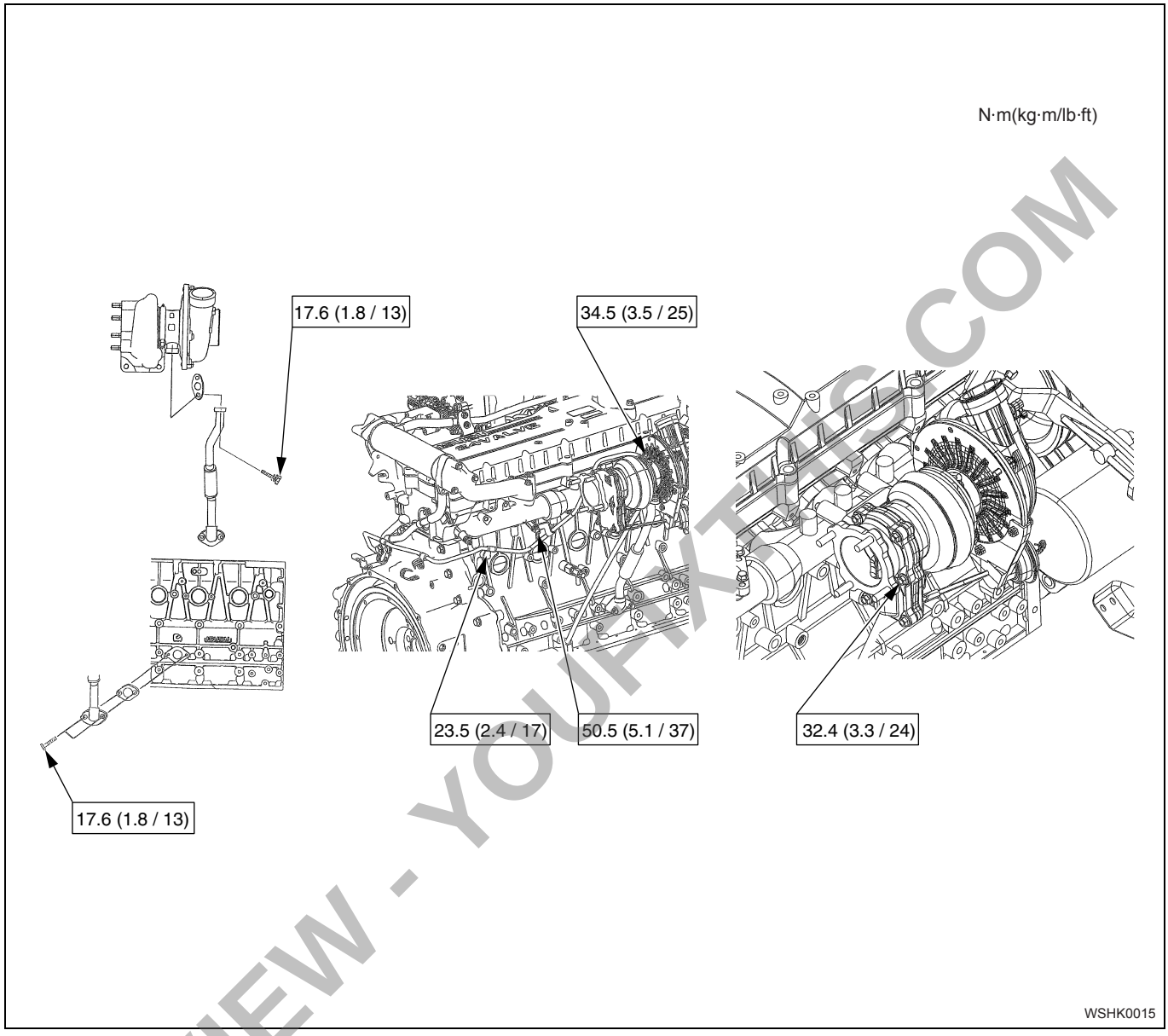
Quantity	To convert from (IS)	Into (Others)	Multiply by
Lenght	mm	in	0.03937
	mm	ft	0.003281
Volume	L	US gal	0.2642
	L	US qt	1.057
	m^3	yd^3	1.308
Mass	kg	lb	2.205
Force	N	kgf	0.10197
	N	lbf	0.2248
Torque	N.m	kgf.m	0.10197
	N.m	lbf.ft	0.7375

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

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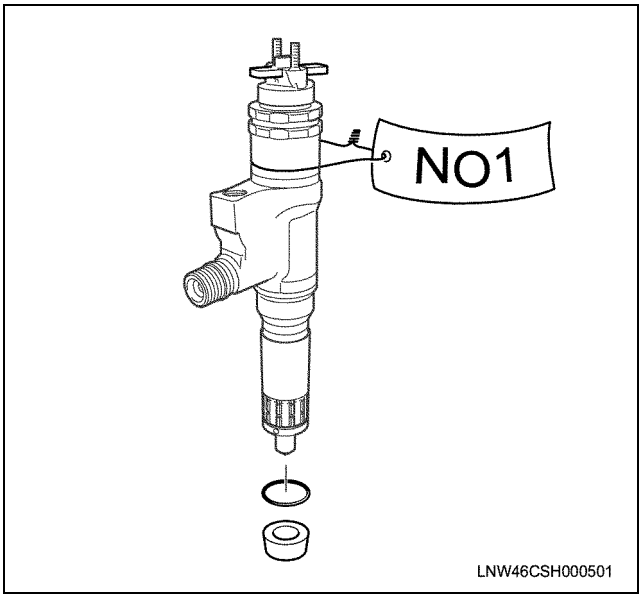
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6HK1



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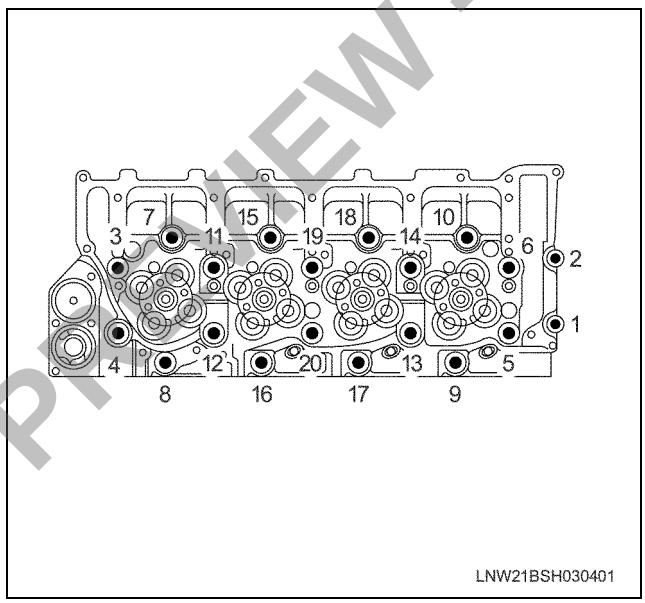
32. Remove the lower head cover.
33. Remove the cylinder head ASM.
    - Loosen the cylinder head bolts in the order described in the drawing.

Caution:
Be sure not to overlook (1) and (2) because they are attached with the flywheel housing with M10 bolts.

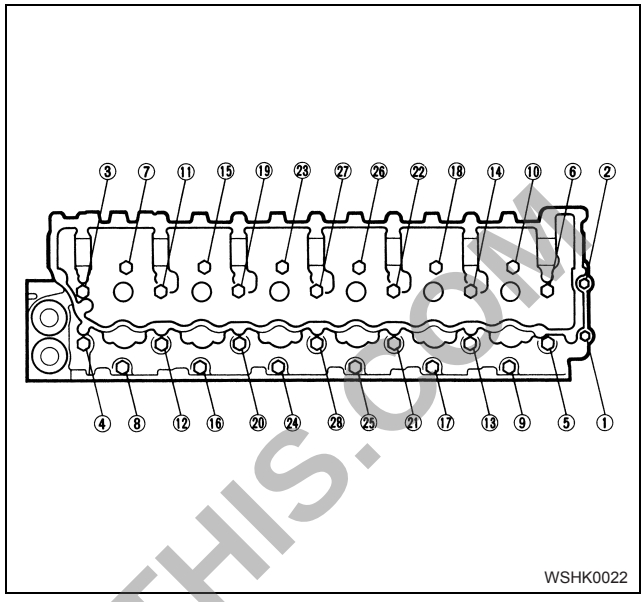
- Remove the cylinder head gasket.

Caution:
Replace the head gasket with a new one once it was removed.

4HK1

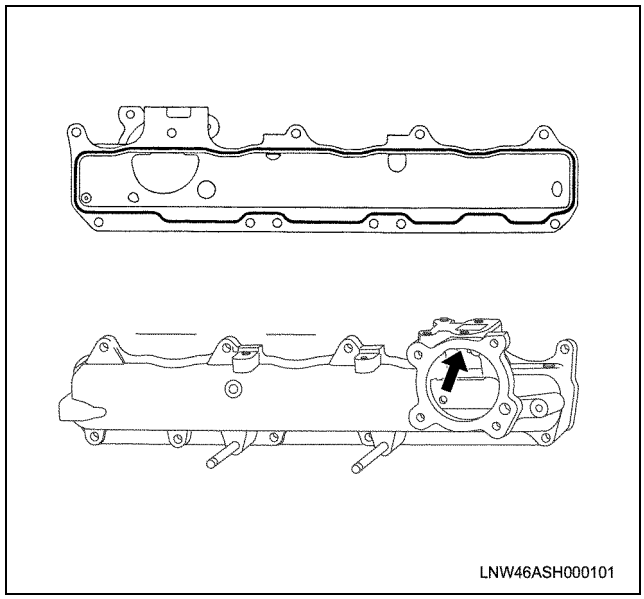


6HK1



Disassembly

1. Remove the case ASM.
   - Be sure not to lose the gasket.
2. Remove the inlet cover.
   - Remove liquid gasket adherent to the removed inlet cover.



* 4HK1 is shown for illustration.

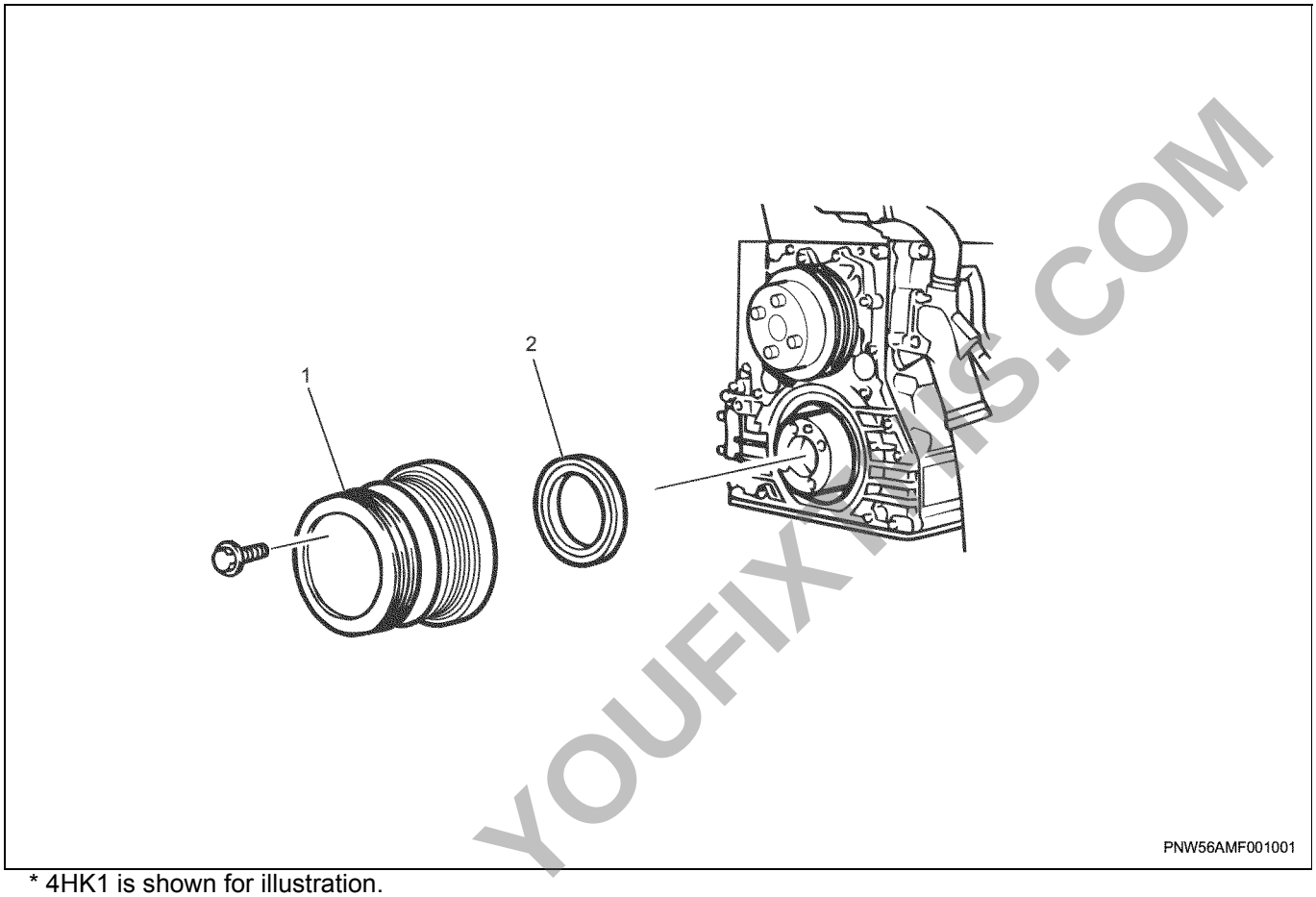
3. Remove the A/C compressor bracket.
4. Remove the exhaust manifold.
   - Remove the heat protector and remove the exhaust manifold.
5. Remove the exhaust gasket.
6. Disconnect the water outlet pipe.
7. Remove the thermostat.

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Crankshaft Front Oil Seal

Components



* 4HK1 is shown for illustration.

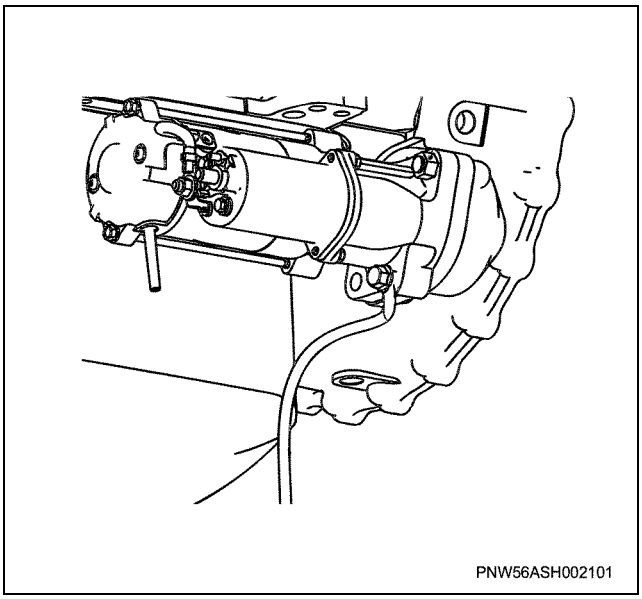
Name

1. Crankshaft Pulley
2. Crankshaft Front Oil Seal

Removal

1. Drain coolant.
2. Remove the starter.
   - Disconnect the starter ground cable.
   - Unscrew two mounting nuts, upper and lower, from the starter to dismount the starter from the flywheel housing.

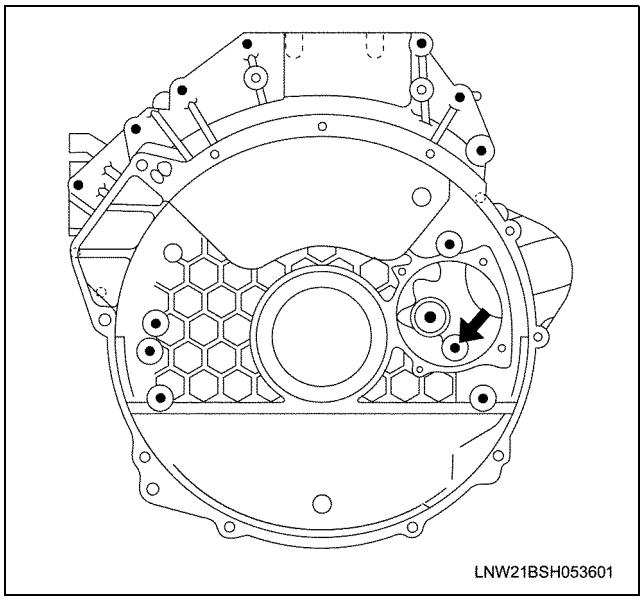
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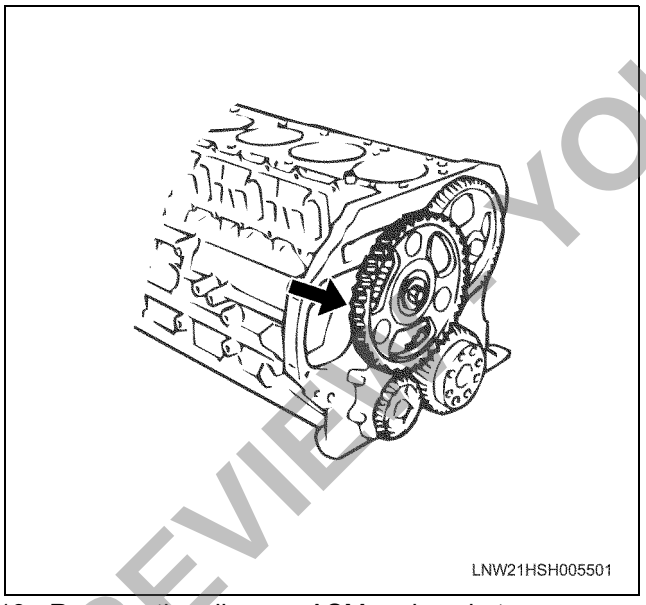
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11. Remove the flywheel housing.
    - Make sure you remove the bolts shown in the figure.

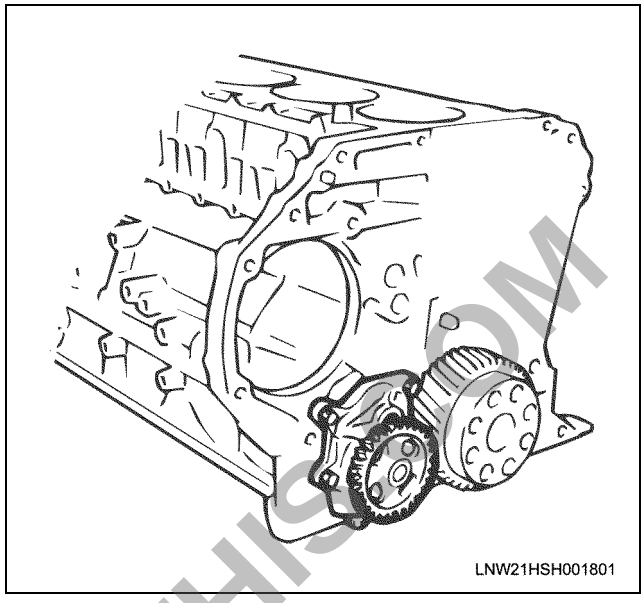


* 4HK1 is shown for illustration.

12. Remove the idle gear A.



13. Remove the oil pump ASM and gasket.

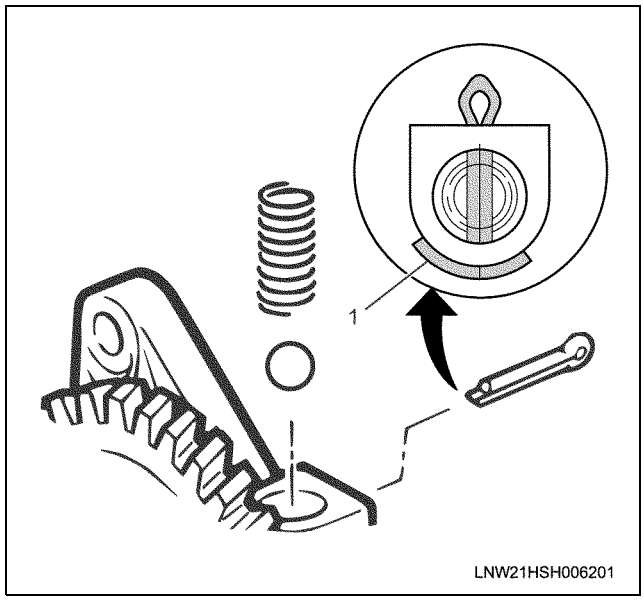


Disassembly

1. Remove the driven gear and shaft.
2. Remove the split pin.
3. Remove the spring.
4. Remove the ball.

Reassembly

1. Install the ball.
2. Install the spring.
3. Install the split pin and fold it according to (1).



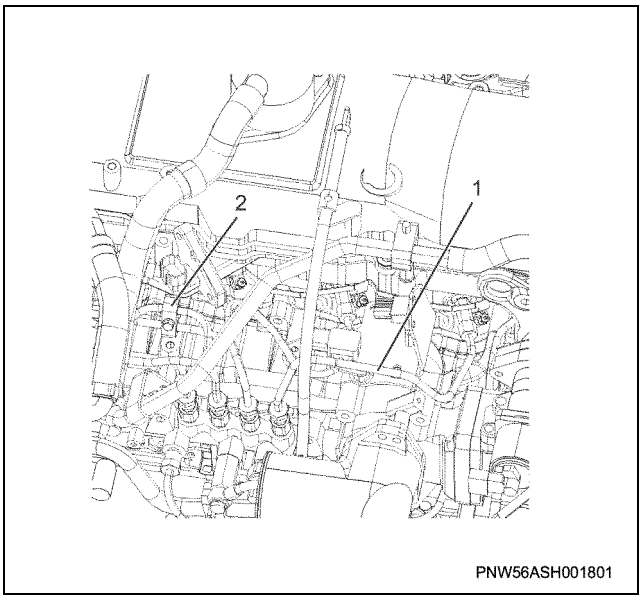
4. Apply engine oil on the driven gear and shaft and mount them on the oil pump body.

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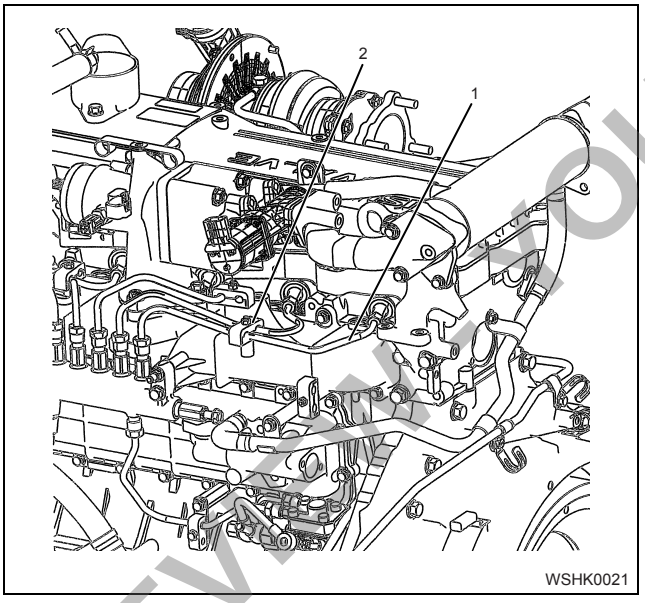
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9. Remove the fuel injection pipe clips and the injection pipes.

4HK1



6HK1



Name

1. Fuel Injection Pipe
2. Pipe Clip

10. Loosen the fuel injector clamp fixing bolts and remove the fuel injectors.

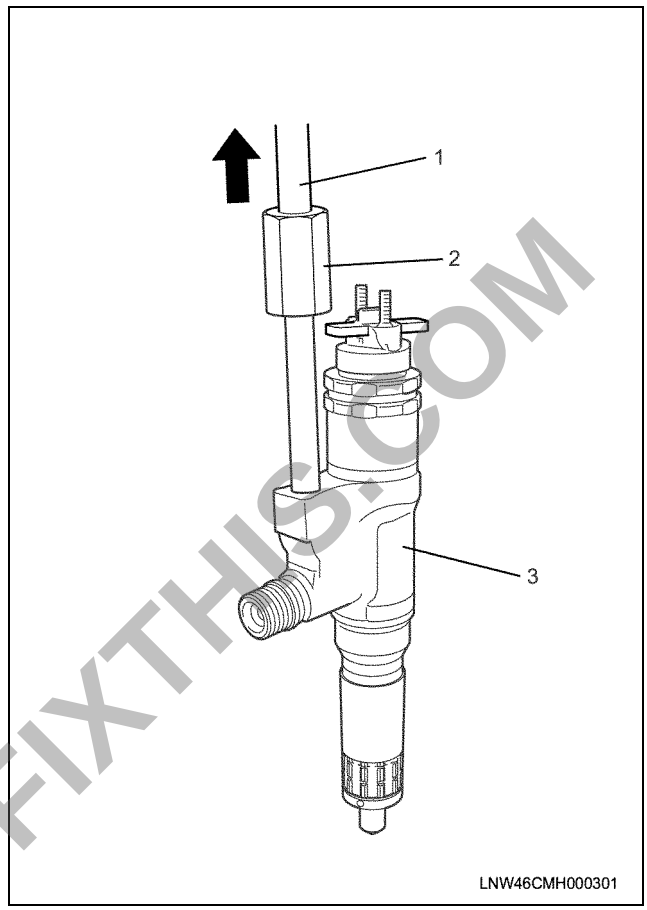
If the fuel injectors are difficult to remove, use the fuel injector remover. Install the fuel injector remover to the leak-off pipe attachment part on the fuel injector. Use a sliding hammer to force the fuel injector clamp off the fuel injector.

Caution:

Do not remove the fuel injector sleeve.

Special tool

Fuel injector remover: 380.002.601
Sliding hammer: 5-8840-0019 (J-23907)



Name

1. Sliding Hammer
2. Remover
3. Fuel Injector ASM

11. Mark each fuel injector with the number of the cylinder from which it was removed. Store the fuel injectors in a safe place. Position the fuel injector so that the nozzle is protected.

Caution:

- Do not tamper with the electromagnetic portion of the fuel injector. Reduced electromagnetic function will result in injector failure.

Recording Fuel Injector Flow Rate Information from the QR plate on the replaced injector housing;

Record all numbers of replaced fuel injector's from QR plate.

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Trouble countermeasure

Trouble symptom	Trouble cause
Starter does not operate when starter switch is turned on.	1. Full discharge of battery 2. Open circuit, poor contact 3. Poor contact in starter switch or improper tightening of terminal 4. Poor contact in starter relay or plug terminal 5. Short or open circuit in magnetic switch coil
Pinion moves forward but it does not engage with ring gear.	1. Insufficient capacity of battery 2. Improper gap of pinion and ring gear 3. Wear of pinion or ring gear tooth edge 4. Dust on pinion shaft 5. Insufficient auxiliary rotation of armature due to insufficient thrust gap of motor
Pinion engages and rotates motor but it does not run engine.	1. Slippage of clutch 2. Breakage of reduction gear
Pinion engages but it does not run engine.	1. Insufficient capacity of battery 2. Too high rotational resistance of engine 3. Improper tightening of wiring circuit terminal 4. Short circuit of armature or field coil 5. Contamination of commutator 6. Fatigue or wear of brush spring 7. Locking of bearing 8. Poor contact in magnetic switch
When turning starter switch off, starter does not stop after engine starts.	1. Retuning failure of starter switch contact 2. Retuning failure of starter relay contact 3. Short circuit in magnetic switch coil

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