ISUZU

DIESEL ENGINE 4HK1

Interim Tier 4 Compatible

WORKSHOP MANUAL

ENGINE

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This Workshop Manual deals only with the screen toned section(s) in the table below.

Section	Sub Section	
ENGINE	0	Introduction
	14A	Service Information Guide
	15B	Maintenance Information
	15C	Functional Inspection
	15D	Sympton
	15E	DTC Information
	1A	Engine Control
	1B	Mechanical
	1C	Fuel System
	1D	Cooling
	1E	Lubrication
	1F	Induction
	1G	Exhaust
	1H	Aux. Emission Control Devices
	1J	Electrical
ETM	-	Using the Wiring Diagram
	-	Engine
	-	Location Diagram
	-	Connector list

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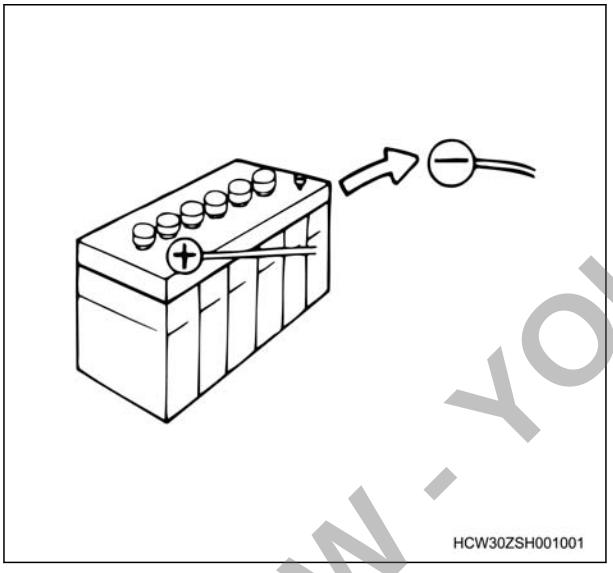
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Introduction

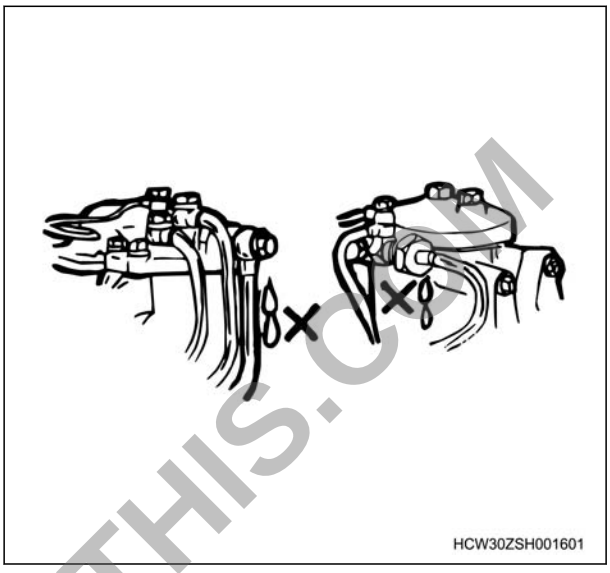
Safety Information

1. Repair work Safety Information

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



4. Do not leave the engine running for an extended period of time or perform painting in a poorly ventilated working environment.
5. Make sure to use only the special tools if the procedure requires them for the work. Performing the procedure using other tools may cause damage to parts or personal injury.
6. Inspect the tools, instruments, and special tools regularly, and prepare them before working. Do not use tools such as a wrench that has lost its edges, a hammer with frayed edges, or a chipped chisel.
7. When performing work using a device such as a grinder, crane or welder, make sure to pay sufficient attention to the handling precautions.
   Wear work clothes and safety equipments in the other operations as well.
8. Be sure to check that there is no fuel leaks when performing maintenance on fuel systems.



9. When handling volatile materials, be extremely careful to not let them catch fire.
   Also make sure to wipe away any oil that sticks to rubber parts, as it can cause deterioration.

2. Replacement parts and parts number Safety Information

1. Whenever disassembly is performed, make sure to replace the packing, oil seals, O-rings, crimping lock nuts, bending lock plate, and split pins, etc., with new ones.
2. Since the part numbers indicated in this manual may differ from the supply system and are subject to change, make sure to check the supply system and part numbers in the parts catalog.

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Plastic gauge

1. Using the plasti-gauge

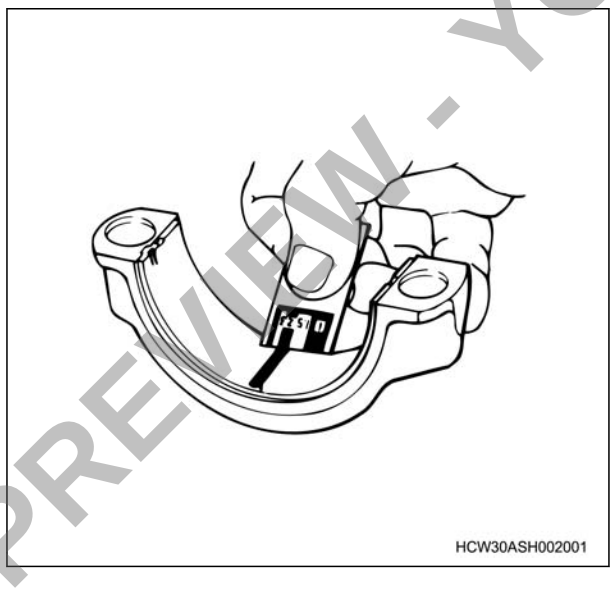
Type	Measurable range
PG・(Green)	: 0.025 to 0.076 mm { 0.00098 to 0.00299 in }
PR・(Red)	: 0.051 to 0.152 mm { 0.00201 to 0.00598 in }
PB・(Blue)	: 0.102 to 0.229 mm { 0.00402 to 0.00902 in }

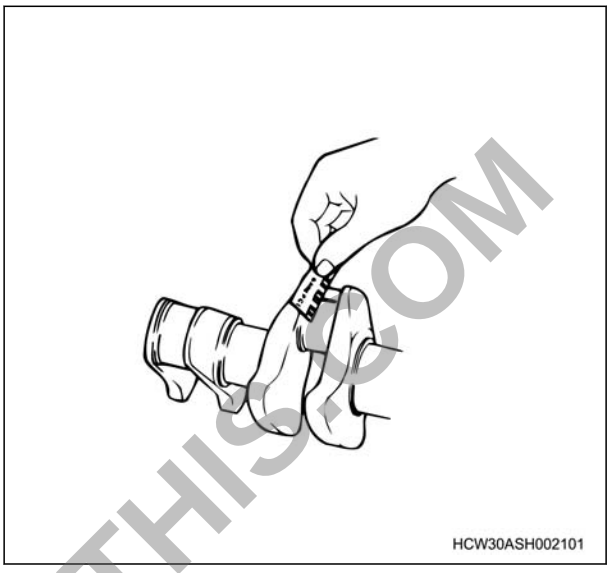
Method for measuring the gap between the connecting rod bearing and crank pin Clean the connecting rod and bearing, and assemble them on the connecting rod. Cut the plastic gauge to the width of the crank pin and lay it parallel avoiding the crank pin oil hole. Align the markings on the connecting rod and on the cap to assemble it on the crank pin. Apply molybdenum disulfide to the threaded portion and seat surface of the tightening bolts. Alternately tighten them so that the cap is at the specified torque.

Caution：

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

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





Method for measuring the gap between the crank bearing and crank journal
Clean the installation surfaces of the cylinder block and crankcase bearing, and assemble them on the cylinder block and crankcase. Gently place the crankshaft on the cylinder block, and lock it into place by turning it approximately 30 degrees. Cut the plastic gauge to the width of the crank journal and lay it parallel avoiding the journal oil hole. Gently place the crankcase on the cylinder block, and apply molybdenum disulfide to the threaded portion and seat surface of the tightening bolts. Tighten in the specified order at the specified torques.

Caution：

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

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

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Strength category	4.8 4T		7T	
Bolt head shape	Hex bolt	Flange bolt	Hex bolt	Flange bolt
M6 x 1	: 3.9 to 7.8 N・m { 0.4 to 0.8 kgf・m / 35 to 69 lb・in }	: 4.6 to 8.5 N・m { 0.5 to 0.9 kgf・m / 41 to 75 lb・in }	: 4.9 to 9.8 N・m { 0.5 to 1.0 kgf・m / 43 to 87 lb・in }	: 5.7 to 10.6 N・m { 0.6 to 1.1 kgf・m / 50 to 94 lb・in }
M8 x 1.25	: 7.8 to 17.7 N・m { 0.8 to 1.8 kgf・m / 69 to 157 lb・in }	: 10.5 to 19.6 N・m { 1.1 to 2.0 kgf・m / 93 to 173 lb・in }	: 11.8 to 22.6 N・m { 1.2 to 2.3 kgf・m / 9 to 17 lb・ft }	: 13.5 to 25.0 N・m { 1.4 to 2.5 kgf・m / 10 to 18 lb・ft }
M10 x 1.25	: 20.6 to 34.3 N・m { 2.1 to 3.5 kgf・m / 15 to 25 lb・ft }	: 23.1 to 38.5 N・m { 2.4 to 3.9 kgf・m / 17 to 28 lb・ft }	: 27.5 to 46.1 N・m { 2.8 to 4.7 kgf・m / 20 to 34 lb・ft }	: 31.0 to 51.7 N・m { 3.2 to 5.3 kgf・m / 23 to 38 lb・ft }
*M10 x 1.5	: 19.6 to 33.3 N・m { 2.0 to 3.4 kgf・m / 14 to 25 lb・ft }	: 22.3 to 37.2 N・m { 2.3 to 3.8 kgf・m / 16 to 27 lb・ft }	: 27.5 to 45.1 N・m { 2.8 to 4.6 kgf・m / 20 to 33 lb・ft }	: 30.3 to 50.4 N・m { 3.1 to 5.1 kgf・m / 22 to 37 lb・ft }
M12 x 1.25	: 49.0 to 73.5 N・m { 5.0 to 7.5 kgf・m / 36 to 54 lb・ft }	: 54.9 to 82.3 N・m { 5.6 to 8.4 kgf・m / 40 to 61 lb・ft }	: 60.8 to 91.2 N・m { 6.2 to 9.3 kgf・m / 45 to 67 lb・ft }	: 68.1 to 102.1 N・m { 6.9 to 10.4 kgf・m / 50 to 75 lb・ft }
*M12 x 1.75	: 45.1 to 68.6 N・m { 4.6 to 7.0 kgf・m / 33 to 51 lb・ft }	: 51.0 to 76.5 N・m { 5.2 to 7.8 kgf・m / 38 to 56 lb・ft }	: 56.9 to 84.3 N・m { 5.8 to 8.6 kgf・m / 42 to 62 lb・ft }	: 62.7 to 94.0 N・m { 6.4 to 9.6 kgf・m / 46 to 69 lb・ft }
M14 x 1.5	: 76.5 to 114.7 N・m { 7.8 to 11.7 kgf・m / 56 to 85 lb・ft }	: 83.0 to 124.5 N・m { 8.5 to 12.7 kgf・m / 61 to 92 lb・ft }	: 93.2 to 139.3 N・m { 9.5 to 14.2 kgf・m / 69 to 103 lb・ft }	: 100.8 to 151.1 N・m { 10.3 to 15.4 kgf・m / 74 to 111 lb・ft }
*M14 x 2	: 71.6 to 106.9 N・m { 7.3 to 10.9 kgf・m / 53 to 79 lb・ft }	: 77.2 to 115.8 N・m { 7.9 to 11.8 kgf・m / 57 to 85 lb・ft }	: 88.3 to 131.4 N・m { 9.0 to 13.4 kgf・m / 65 to 97 lb・ft }	: 94.9 to 142.3 N・m { 9.7 to 14.5 kgf・m / 70 to 105 lb・ft }
M16 x 1.5	: 104.0 to 157.0 N・m { 10.6 to 16.0 kgf・m / 77 to 116 lb・ft }	: 115.6 to 173.3 N・m { 11.8 to 17.7 kgf・m / 85 to 128 lb・ft }	: 135.3 to 204.0 N・m { 13.8 to 20.8 kgf・m / 100 to 150 lb・ft }	: 150.1 to 225.2 N・m { 15.3 to 23.0 kgf・m / 111 to 166 lb・ft }
*M16 x 2	: 100.0 to 149.1 N・m { 10.2 to 15.2 kgf・m / 74 to 110 lb・ft }	: 109.4 to 164.2 N・m { 11.2 to 16.7 kgf・m / 81 to 121 lb・ft }	: 129.4 to 194.2 N・m { 13.2 to 19.8 kgf・m / 95 to 143 lb・ft }	: 142.5 to 213.8 N・m { 14.5 to 21.8 kgf・m / 105 to 158 lb・ft }
M18 x 1.5	: 151.0 to 225.6 N・m { 15.4 to 23.0 kgf・m / 111 to 166 lb・ft }	-	: 195.2 to 293.2 N・m { 19.9 to 29.9 kgf・m / 144 to 216 lb・ft }	-
*M18 x 2.5	: 151.0 to 225.6 N・m { 15.4 to 23.0 kgf・m / 111 to 166 lb・ft }	-	: 196.1 to 294.2 N・m { 20.0 to 30.0 kgf・m / 145 to 217 lb・ft }	-
M20 x 1.5	: 206.0 to 310.0 N・m { 21.0 to 31.6 kgf・m / 152 to 229 lb・ft }	-	: 269.7 to 405.0 N・m { 27.5 to 41.3 kgf・m / 199 to 299 lb・ft }	-
*M20 x 2.5	: 190.2 to 286.4 N・m { 19.4 to 29.2 kgf・m / 140 to 211 lb・ft }	-	: 249.1 to 374.6 N・m { 25.4 to 38.2 kgf・m / 184 to 276 lb・ft }	-
M22 x 1.5	: 251.1 to 413.8 N・m { 25.6 to 42.2 kgf・m / 185 to 305 lb・ft }	-	: 362.8 to 544.3 N・m { 37.0 to 55.5 kgf・m / 268 to 401 lb・ft }	-
*M22 x 2.5	: 217.7 to 327.5 N・m { 22.2 to 33.4 kgf・m / 161 to 242 lb・ft }	-	: 338.3 to 507.0 N・m { 34.5 to 51.7 kgf・m / 250 to 374 lb・ft }	-

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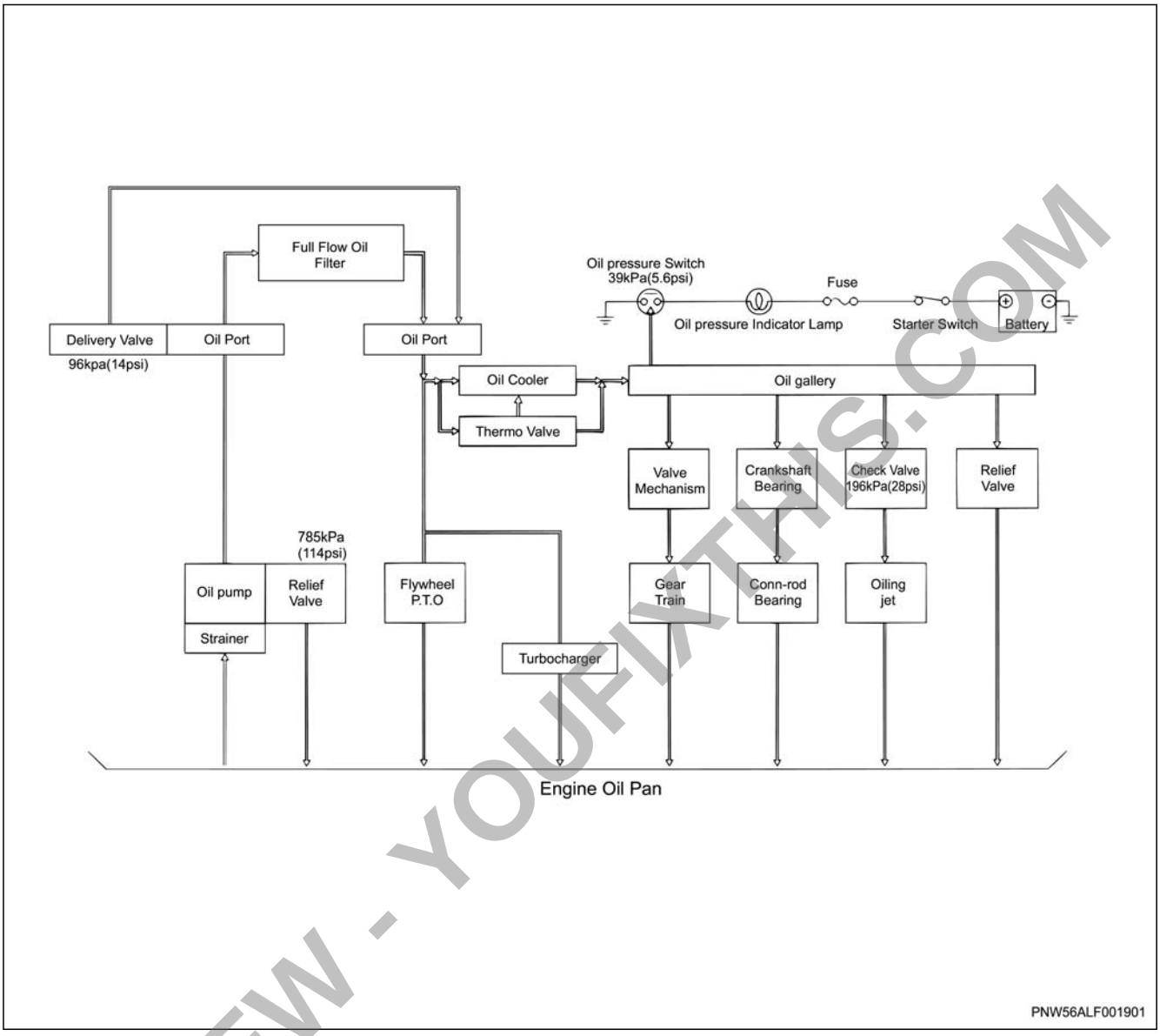
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Item		Engine model 4HK1
Type		Diesel/ 4-cycle /water cooling, inline 4 cylinder OHC
Shape of combustion chamber		Direct injection type
Cylinder liner type		Dry type
Cylinder bore x stroke		115 mm {4.53 in} × 125 mm {4.92 in}
Displacement		5.193 L {316.88 cu・in}
Compression ratio		17.5
Compression pressure		: 3.23 MPa { 32.9 kgf/cm2 / 468 psi } 3.23 MPa {32.9 kgf/cm2 / 468 psi}
Idling rotation speed		800 r/min
valve clearance	Intake	: 0.4 mm { 0.016 in } While cool
	Exhaust	: 0.4 mm { 0.016 in } While cool
Ignition method		Compression ignition
Injection order		1,3,4,2
Lubricant system		
Lubricating type		Pressure type
Oil pump type		Gear type
Lubrication oil amount		: 20 to 27 L { 5.2 to 7.1 US gal }
Oil filter type		Full-flow / partial-flow united filter (cartridge type)
Oil cooling type		Built-in type, water cooled
Cooling system		
Cooling type		Water cooling
Radiator type		Corrugated fin (pressure type)
Water pump type		Centrifugal, belt type
Thermostat type		2 wax type unit
Open valve temperature of the thermostat valve		: 82.0 ℃ { 180 °F } Without jiggle valve
		: 85.0 ℃ { 185 °F } With jiggle valve
Coolant container		: 14.5 L { 3.8 US gal }
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 holes, inner diameterφ0.14mm {0.0055 in}
Charging system		
Generator type		AC type
Output		24 V/50 A
Regulator type		IC
Starting system		
Starter type		Reduction type
Output		24 V/5.0 kW
Preheat system type		glow plug
Glow plug standard voltage/current		23 V/3.5 A

Cleaning system main specifications

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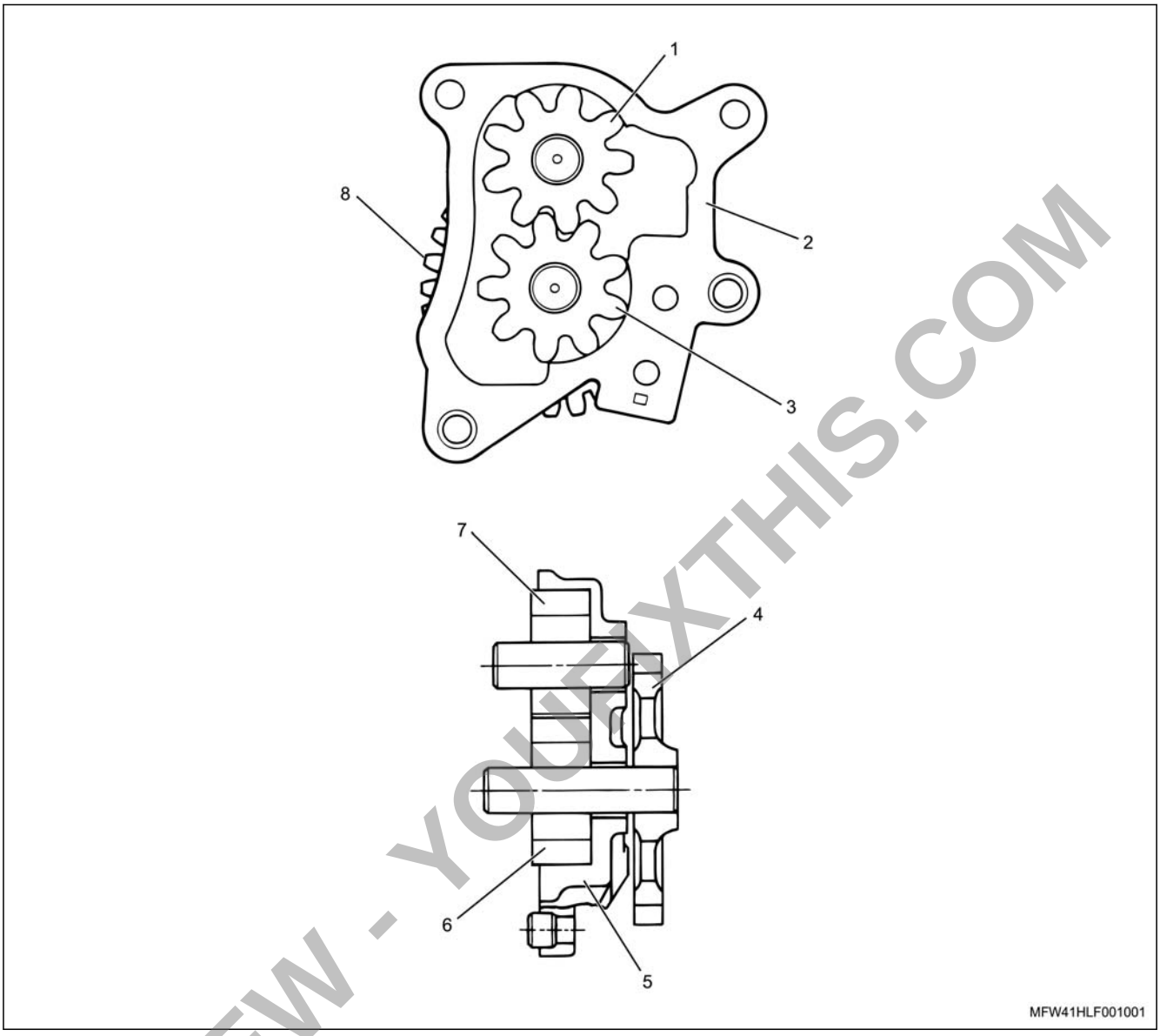
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Oil pump structural diagram

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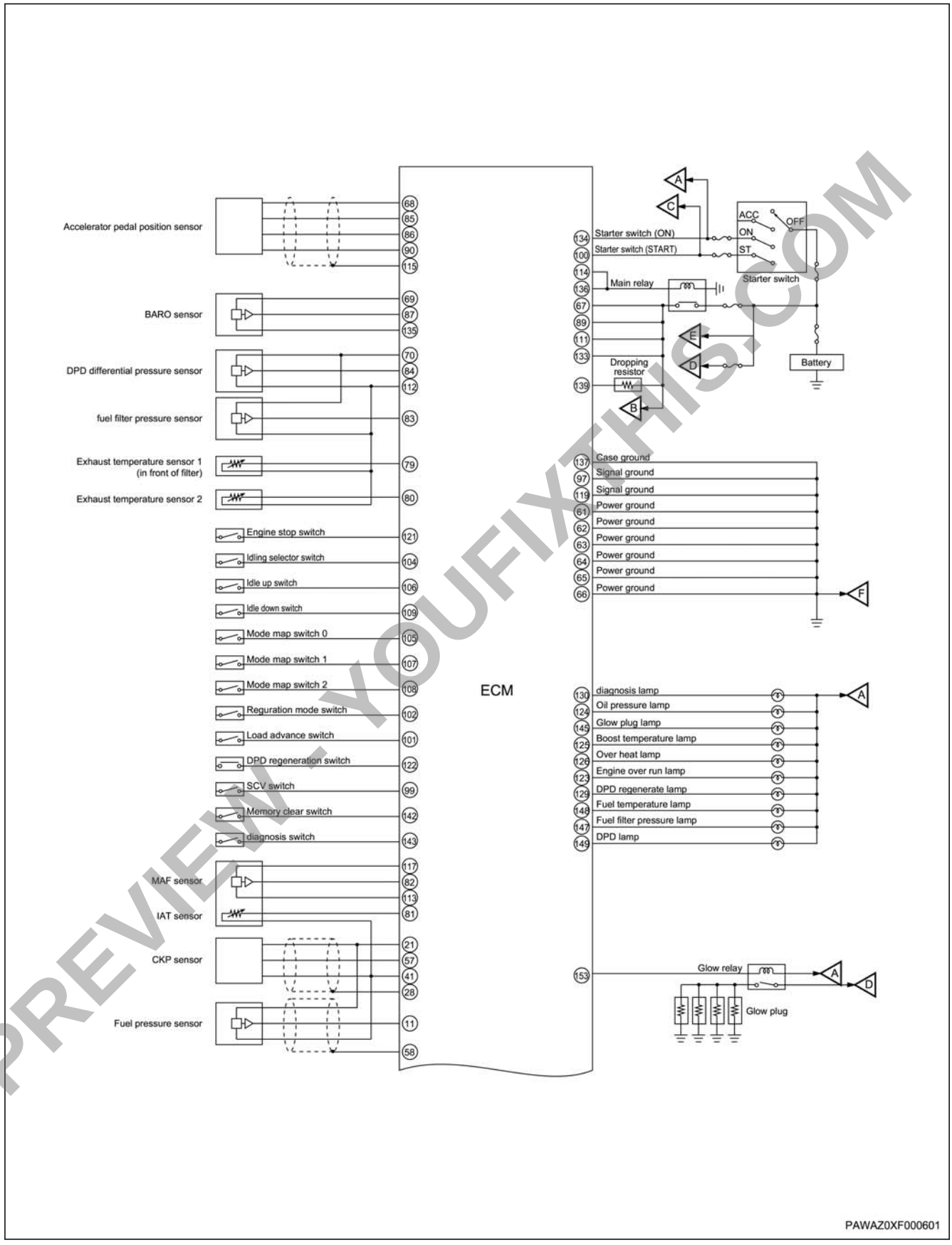
1. Driven gear assembly
2. Oil pump body
3. Drive gear assembly
4. Oil pump drive gear
5. Oil pump body
6. Drive gear assembly
7. Driven gear assembly
8. Oil pump drive gear

6. Induction system

Turbocharger structural diagram

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Introduction to the trouble diagnosis

1. Introduction to the trouble diagnosis

1. About trouble diagnosis
   The following trouble diagnosis procedure is extremely important to resolve problems of all electric/electronic systems.
   Neglecting to implement these steps may result in requiring unnecessary repairs. Read and understand the procedure carefully and proceed with the trouble diagnosis.
   Also, use available functions and the trouble diagnosis scan tool to perform the trouble diagnosis and system check.

2. Trouble diagnosis procedure
   Checking complaints from customer
   ・Use the check sheet to organize the trouble situation.

Performing preliminary inspection
・Perform overall visual inspection.
・Check the past maintenance history.
・Detect any abnormality such as abnormal noise, smell, etc.
・Collect the failure trouble DTC information to provide effective repair.
・Inspect for an abnormality by comparing to the standard value.

Inspect the service information
・Check the market service bulletin.

Perform inspection for the displayed code.
・Inspect the item shown by DTC.

Perform an inspection for problems according to symptoms
・Check the item that is not displayed in the DTC.

NOTE
System trouble diagnosis type
The system diagnosis method is a standardized method applied for repairing all electric/electronic systems.
Failures in electric/electronic systems often occur in the following steps unlike common actual unit failures.

Initial stage of failure
The failure occurs sporadically and for a short time, often times the driver does not notice it. At this stage, the customer's complaint is unclear, and the malfunction cannot be reproduced. However, the ECM may have recorded the failure.
Past malfunction, past failures

Middle stage of failure
The failure occurs sporadically and for a short time, but may occur repeatedly at intervals, and occurs under specific conditions.
The customer complaint is clear, but the failure conditions are unclear.
Therefore, the person performing the diagnosis can reproduce the failure by understanding its conditions.
Intermittent failures, intermittent

Stage where failure is realistic
The occurrence of the failure is set, and the customer complaint is real and clear.
Therefore, the person performing the diagnosis can reproduce the failure. However, there may sometimes be more than 2 causes for the failure.
Current malfunction, Current failures

3. Diagnosis
   Fully understand the description given by the customer using the Engine Control System Check Sheet.

Note：
・When questioning, do not ask randomly but focus on the system that is inferred to be defective based on the malfunction phenomenon.

Determine failure information accurately.
Have concrete understanding based on 5W1H.
Low air temperature, at start or on a steady basis, near the engine parts, metallic sound, etc.

Check points
・Failure symptoms
・Month and Date, Time, Frequency of occurrence
・Road conditions
・Driving conditions, Operation conditions, Weather
・Feeling of symptom

Engine control system check sheet
When receiving the actual unit from the customer at the service factory, the failure symptoms and the data on occurrence of failure must be confirmed with the customer based on the engine control check sheet.

・Failure symptoms may not be able to be reproduced at the service factory.
・The customer's complaint may not always be a malfunction.
・Notification of incorrect malfunction conditions to the person in charge of repairs may result in unnecessary man-hours for repairs.
・ The check sheet assists actual unit diagnosis, repair, and repair confirmation at the vehicle servicing station.

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Description Engine

DTC Information

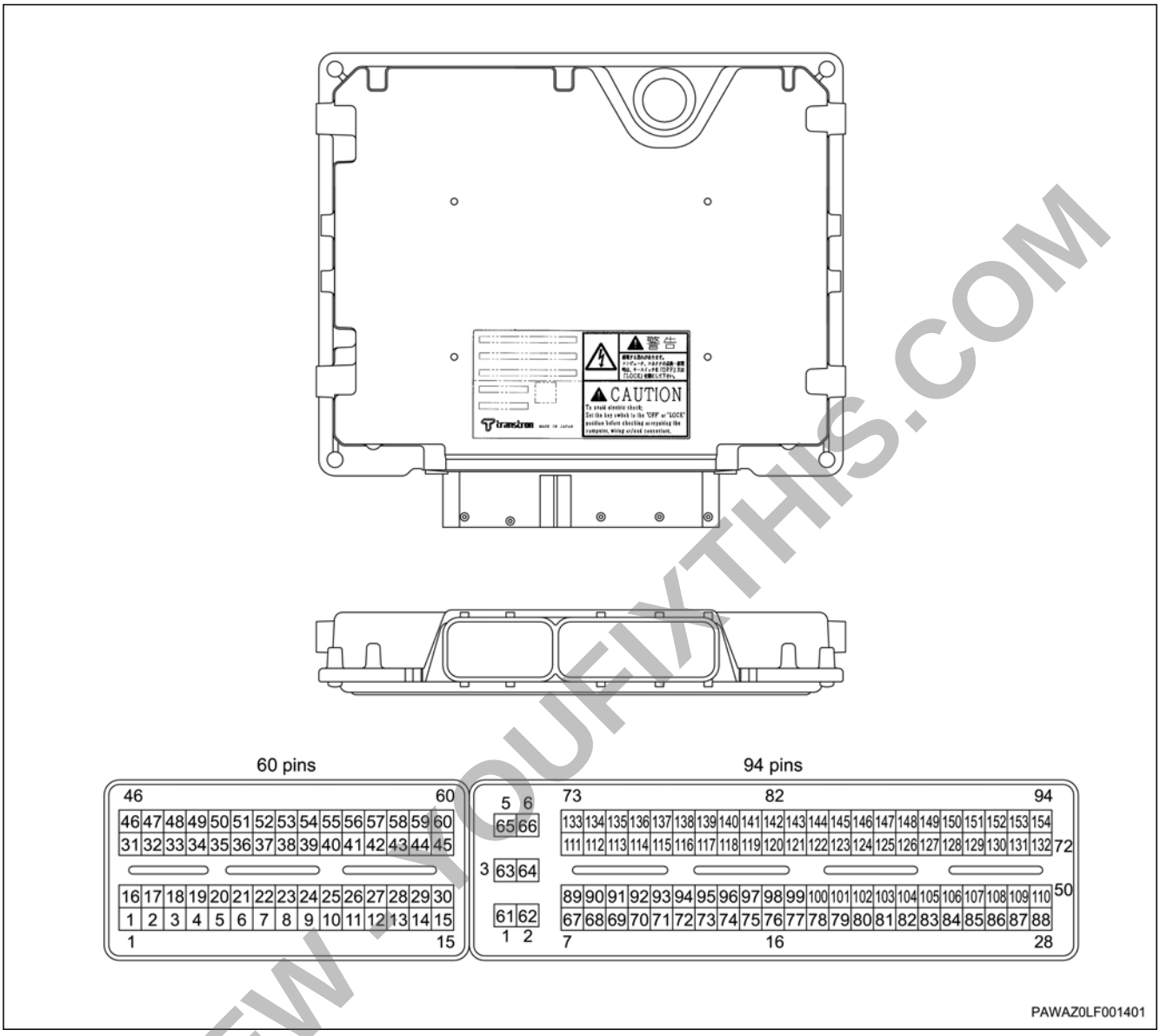
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60 pin connector

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Description Engine

Maintenance Information

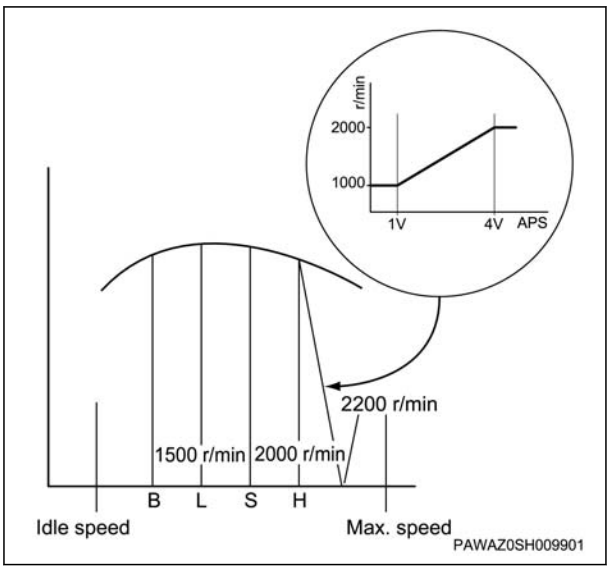
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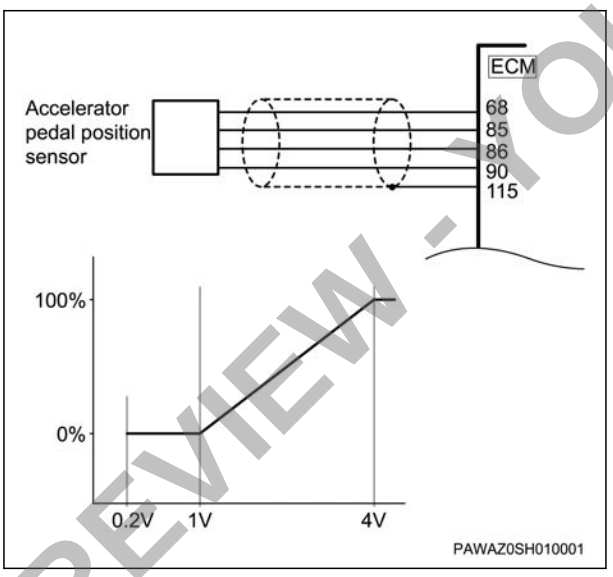
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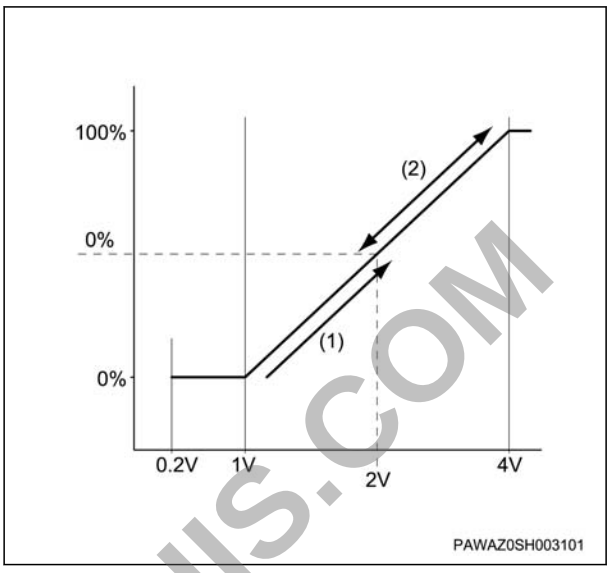
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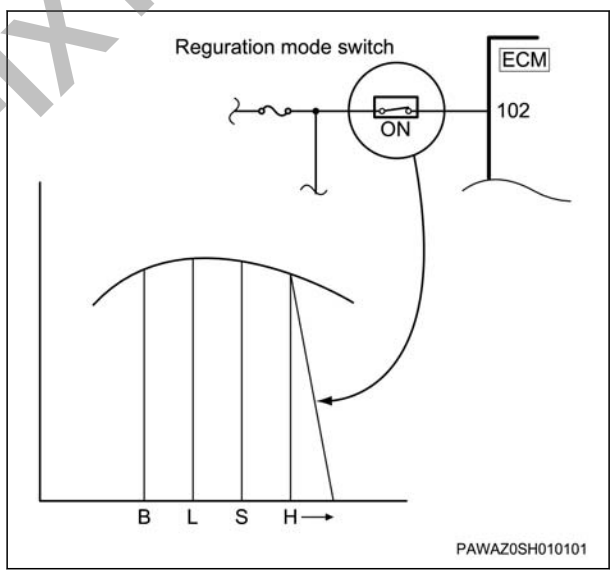
Accelerator position switch
By operating the accelerator position switch, the output voltage changes between 1 V and 4 V.
Voltages between 0.2 V and 1.05 V are recognized as 1 V. When the voltage is lowered below 0.2 V or raised above 1.05 V, an error is detected.
In addition, if the ECM terminals 85 and 86 are not at the same potential, DTC P2138 is detected.



Accelerator position switch, with APS learning control
If the APS learning control is available, for example, when the ignition cycle ends with the accelerator position as 2 V (1), the accelerator position learning causes the 2 V status to be recognized as the opening angle 0 % and the control range is set to 2 V to 4 V (2).



Regulation mode switch
When an input from the regulation mode switch is present, the engine RPM changes as follows.



Idling control
By operating the idling control change switch during the warm-up operation, the minimum idling RPM can be adjusted. In addition, by operating the idling control change switch, the minimum idling RPM can be automatically set to the optimum value in accordance with the engine coolant temperature.

Note：

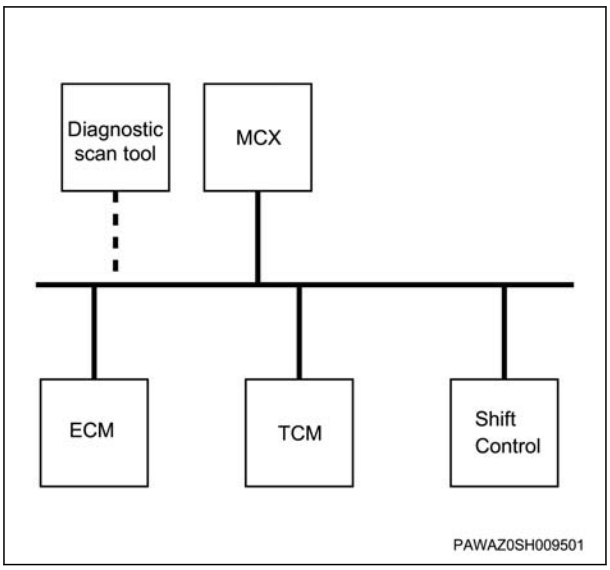
- The specifications vary depending on the actual unit, so availability of functions also differ.

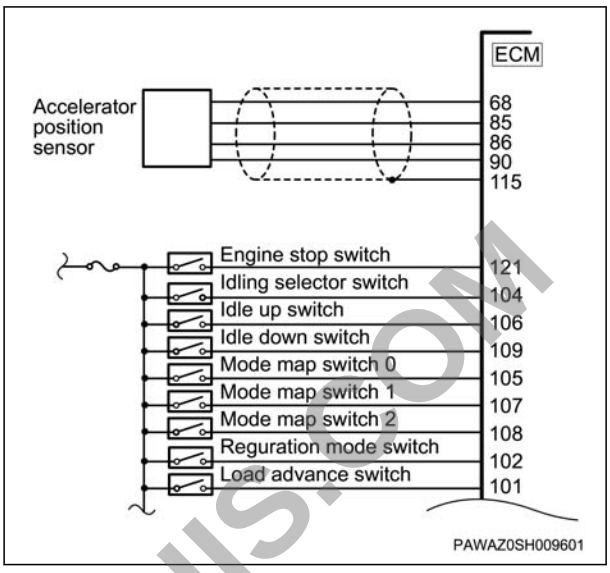
Idling control change switch
By operating the idling control change switch, the idling control functions can be switched.

The idling control switch

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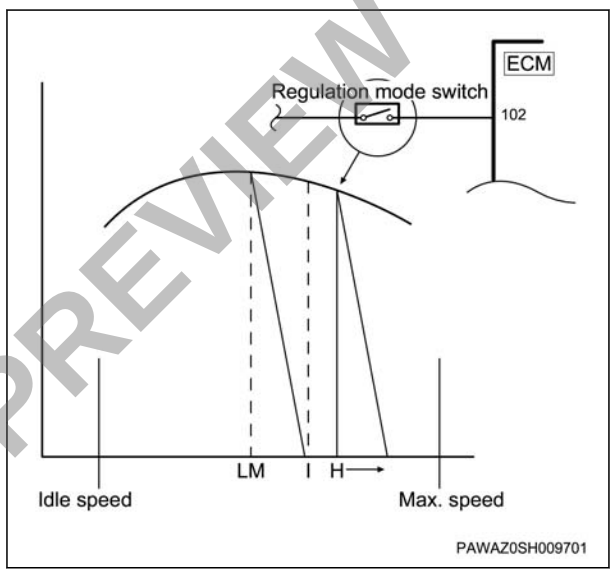




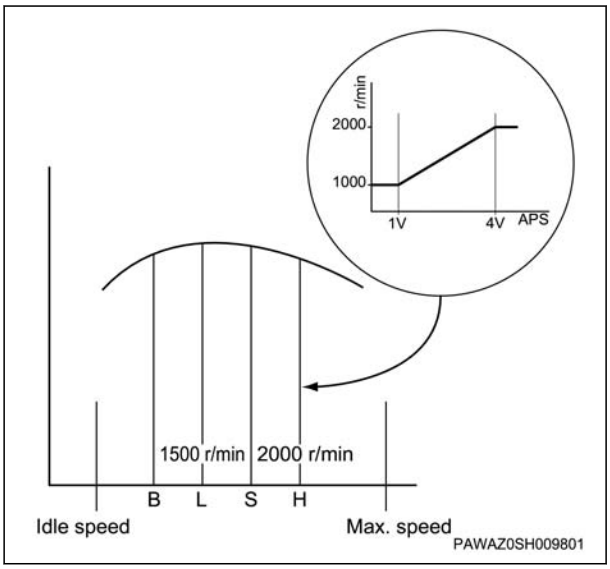
Mode map switch control

Operation mode	Outer switch			Control
	MAP0	MAP1	MAP2	
H	OFF	OFF	OFF	Basic operations
	OFF	ON	ON	
	ON	ON	ON	
S	ON	OFF	OFF	Maximum rotation count control #1
L	OFF	ON	OFF	Maximum rotation count control #2
I	OFF	OFF	ON	Constant rotation operation #1
B	ON	ON	OFF	Maximum rotation count control #3
LM	ON	OFF	ON	Constant rotation operation #2

I, LM and H modes



H, S, L, and B modes



H, S, L, and B modes (irrigation pump)

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Introduction

Introduction

(All)

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Starting system check

1. Starting system check Description of Function

This diagnosis chart is an organized approach to identifying a condition that causes the status for when an engine does not start. The appropriate system diagnosis can be performed with this diagnostic chart.

- The battery should be fully charged when performing this diagnosis.
- The battery cable should be securely connected when performing this diagnosis.
- The rotation speed during cranking should be normal when performing this diagnosis.
- The appropriate fuel should be sufficiently supplied when performing this diagnosis.
- No fuel leaks should be found when performing this diagnosis.
- No air should be mixed into the fuel when performing this diagnosis.
- The air cleaner element should be clean when performing this diagnosis.
- The fuel filter should be clean when performing this diagnosis.

2. Starting system check Inspection

Inspection when the starter operates and cranks but the engine does not start

1. Turn the emergency stop switch to OFF.

Note：

- If the actual unit does not have an emergency stop switch setting, do not perform this operation.

2. Inspect the overheat switch circuit.

Note：

- If the actual unit does not have a overheat switch setting, do not perform this operation.

3. Repair the circuit if a problem is discovered.
4. Check the DTC.

Note：

- If the DTC is detected, inspect the corresponding DTC.

5. Check the SCV F/B display using a trouble diagnosis scan tool while cranking the engine.

standard： 900 mA

6. Repair the SCVLO drive circuit if it is below the standard value.
7. Remove the harness connector from the SCV.
8. Crank the engine.

Note：

- If the engine starts, diagnose the DTC P0090.

9. Inspect the fuel system if the engine does not start.
10. Inspect the engine coolant temperature sensor.
11. Inspect the fuel pressure sensor.
12. Inspect the EGR position sensor.
13. Inspect the injector.
14. Inspect the engine mechanical timing.
15. Inspect the installation status of the flywheel.
16. Inspect the air intake system.
17. Inspect the exhaust piping for collapsing, damage, and exhaust leakage.
18. Repair or replace the part found to have a problem.

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DTC P0697 (Flash Code 57)
Sensor Reference Voltage 3 Circuit

1. DTC P0697 Description of DTC

The ECM supplies 5 V power to the following sensors via the power supply circuit 3.
DPD differential pressure sensor
Exhaust gas temperature sensors 1 and 2
Fuel filter pressure sensor
The ECM also supplies 5 V power to the following sensors via the power supply circuit 7.
Oil pressure sensor
ECT sensor
Water temperature sensor
The 5 V power supply circuits 3 and 7 are independent of each other outside the ECM, but they share a bus inside the ECM. Therefore, when one of the sensor 5 V power supply circuits is shorted, the entire 5 V power supply circuits 3 and 7 may be affected. The ECM monitors the voltage of the 5 V power supply circuits 3 and 7, and sets DTC when the ECM has detected that the voltage is abnormally low or high.

2. DTC P0697 Condition for setting the DTC

DTC P060B is not set
The battery voltage is between 16 and 32 V
The starter switch is ON
When the ECM has detected that voltages of the 5 V power supply circuit 3 or 7 has been 4.5 V or lower or 5.5 V or higher for longer than 0.4 seconds

3. DTC P0697 Action taken when the DTC sets

Failure is indicated in the monitor on the actual unit, or the diagnostic light is turned on.

Note：

- Depending on the manufacturer of the actual unit, the failure indication may not be shown.

Restrict the fuel injection amount.
Stop the EGR control.
Stop the DPD regeneration.

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DTC P0426 (Flash Code 143)
Catalyst Temperature Sensor Circuit Range/Performance Sensor 1

1. DTC P0426 Priority DTC

   DTC P0093

   DTC P0427

   DTC P1093

2. DTC P0426 Diagnostics

   1. Inspect the exhaust gas temperature sensor 1.

      Refer to "*1.Engine 1G.Exhaust(4HK1) Exhaust gas temperature sensor Inspection*".

   2. If a problem is discovered, replace the exhaust gas temperature sensor 1.

      Refer to "*1.Engine 1G.Exhaust(4HK1) Exhaust gas temperature sensor Removal*".

      Refer to "*1.Engine 1G.Exhaust(4HK1) Exhaust gas temperature sensor Installation*".

   3. Inspect the DPD filter for a damage.

      Refer to "*1.Engine 1G.Exhaust(4HK1) DPD assembly Inspection*".

   4. If a problem is discovered, replace the DPD filter.

      Refer to "*1.Engine 1G.Exhaust(4HK1) DPD assembly Disassembly*".

      Refer to "*1.Engine 1G.Exhaust(4HK1) DPD assembly Reassembly*".

   5. Perform the DPD regeneration data reset with the trouble diagnosis scan tool.

3. DTC P0426 Confirm Resolution

   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn the starter switch OFF for 30 seconds or longer.
   3. Start the engine.
   4. Perform a test-run.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

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limit： 29.85 mm { 1.1752 in } Diameter

4. Inlet valve Inspection

1. Measure the inlet valve using the micrometer.

Note：

- Outer diameter of the valve stem

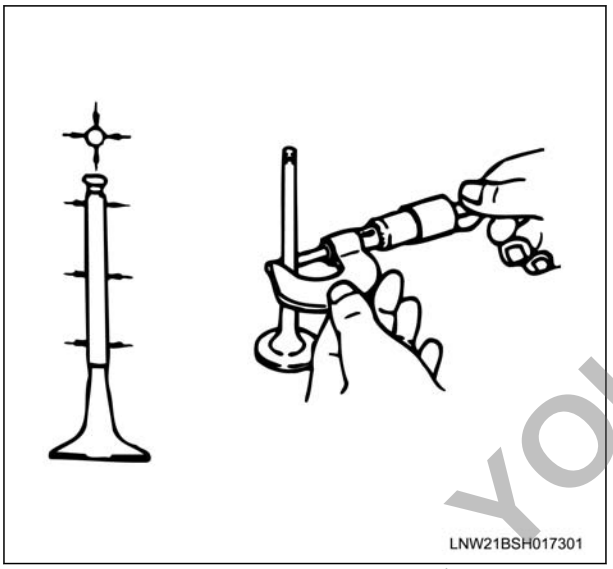
measurement part： 3 section(s)

Specified value： 8.00 mm { 0.3150 in } Diameter

limit： 7.88 mm { 0.3102 in } Diameter

Caution：

- Replace the inlet valve and valve guide if the measured value is under the limit value.



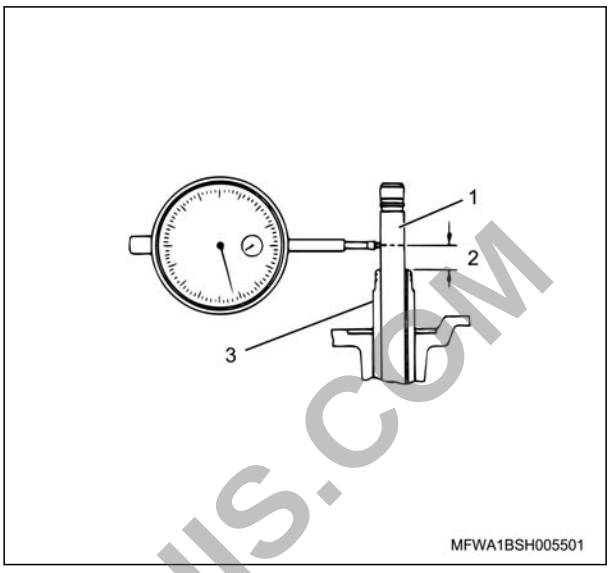
2. Install the inlet valve to the valve guide.
3. Measure the valve guide clearance using the dial gauge.

Note：

- Valve guide clearance

Specified value： 0.039 to 0.071 mm { 0.0015 to 0.0028 in }

limit： 0.2 mm { 0.0079 in }



1. Valve
2. The position 10 mm under the valve guide head
3. Valve guide

Caution：

- Replace the inlet valve and valve guide if the measured value exceeds the limit value.

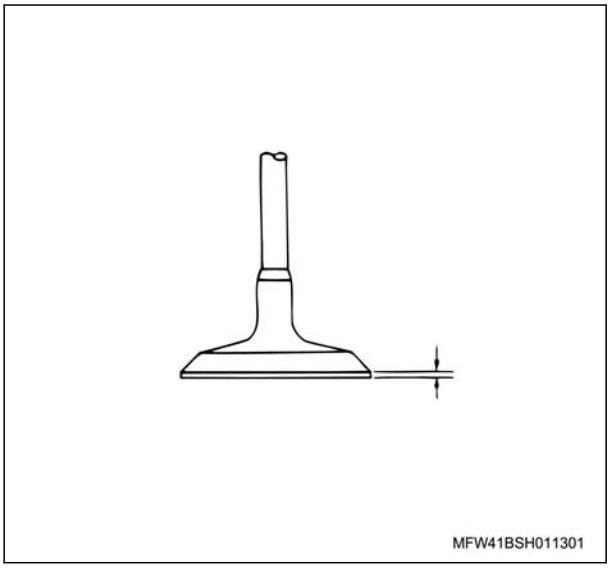
4. Measure the inlet valve using the micrometer.

Note：

- Valve thickness

Specified value： 1.71 mm { 0.0673 in }

limit： 1.30 mm { 0.0512 in }



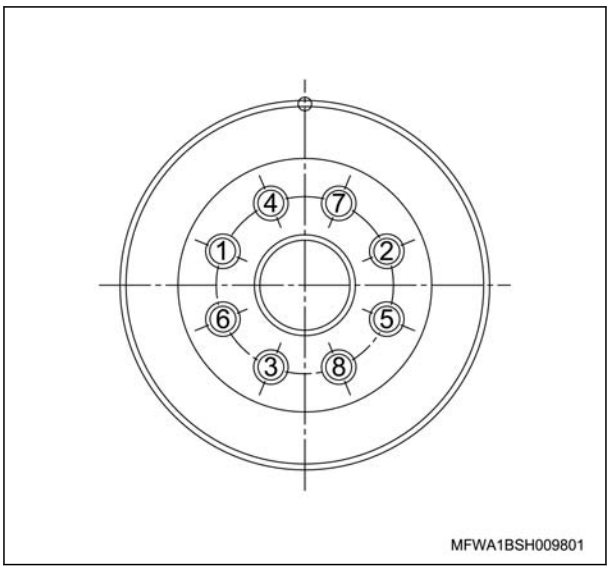
Caution：

- Replace the inlet valve and valve guide if the measured value exceeds the limit value.

5. Inspect the inlet valve using the red lead primer.

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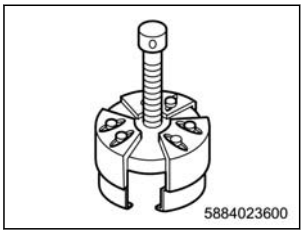


Caution :

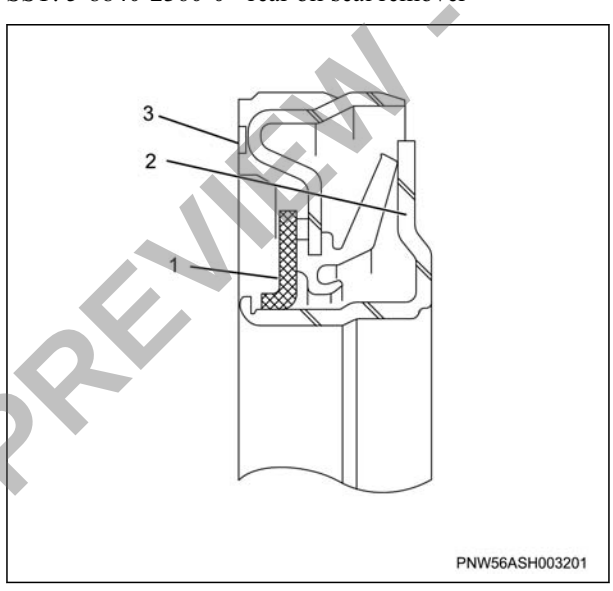
- Fix the flywheel firmly so that it will not rotate.

35. Crankshaft rear oil seal Removal

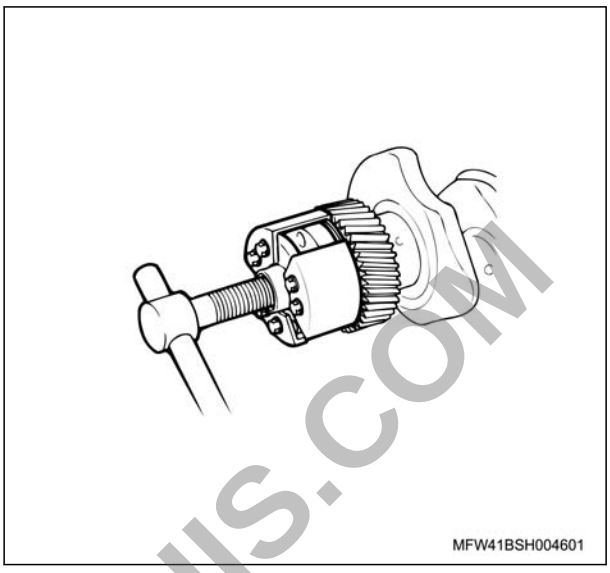
1. Remove the crankshaft rear oil seal from the crankshaft using the special tool.



SST: 5-8840-2360-0 - rear oil seal remover



1. Felt
2. Slinger
3. Crankshaft rear oil seal



Caution :

- Be careful not to damage the oil seal press-fitting surface.

Note :

- Remove the slinger and oil seal together.
- If the slinger of the remover is easy to come off, the outer circumference of the jig can be tightened using a clip band to improve the workability.

36. Oil pan Removal

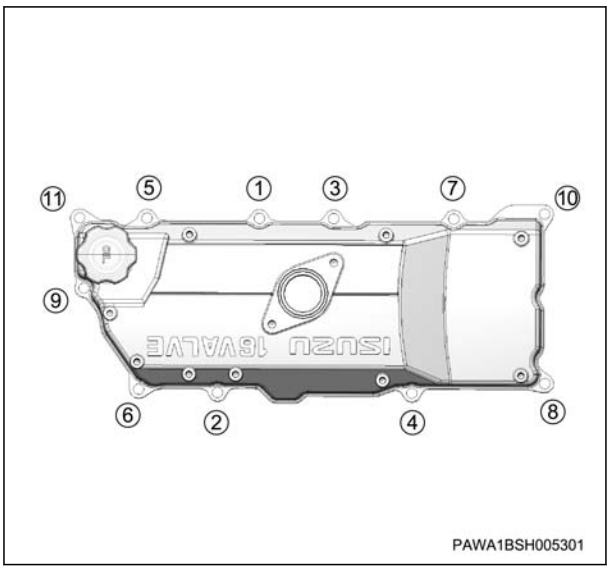
1. Disengage the harness connector from the oil level switch.
2. Remove the oil pan from the crankcase.
3. Remove the gasket from the oil pan.

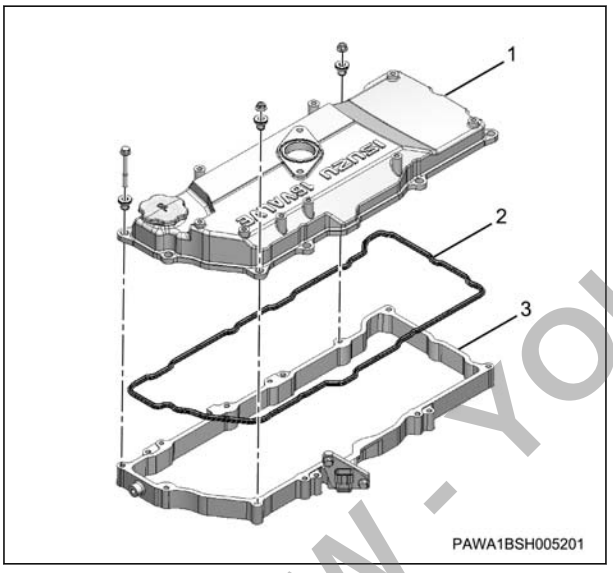
37. Oil strainer Removal

1. Remove the oil strainer from the crankcase.
2. Remove the O-ring from the oil strainer.

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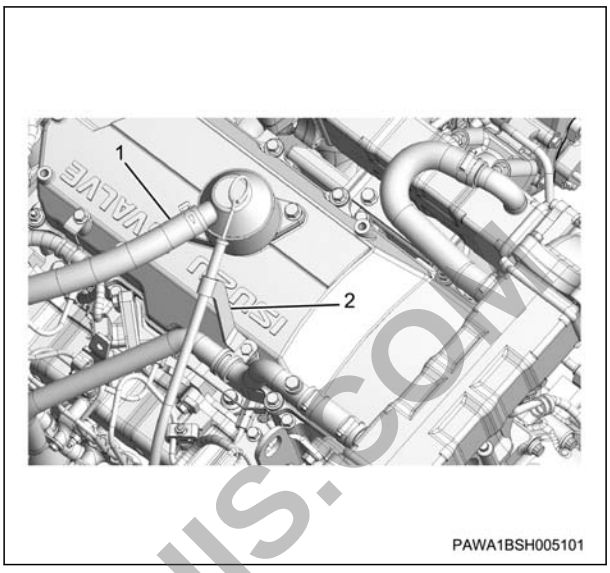




1. Cylinder head cover
2. Gasket
3. Lower cover

3. Connect the ventilation hose to the air breather.
4. Connect the oil level gauge guide tube to the cylinder head cover.

tightening torque : 19 N・m { 1.9 kgf・m / 14 lb・ft }

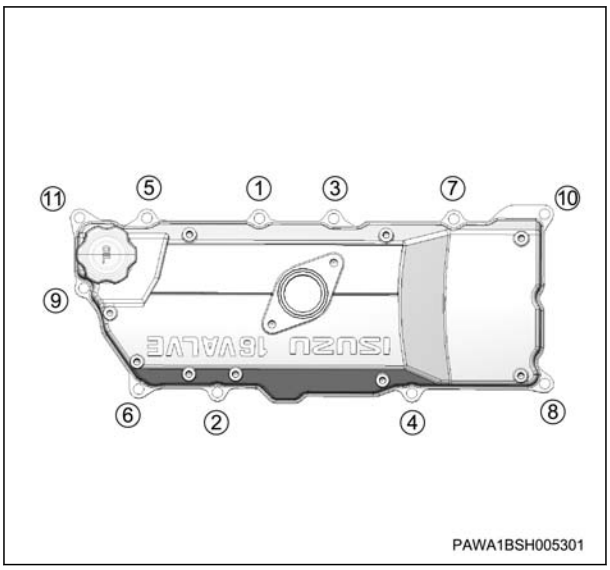


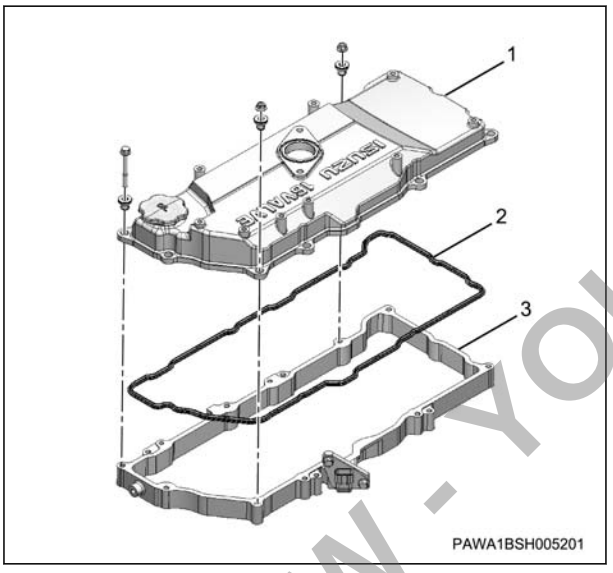
1. Ventilation hose
2. Oil level gauge guide tube

9. Battery ground cable Connect
   1. Connect the battery ground cable to the battery.

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

3. Connect the ventilation hose to the air breather.

15. Oil level gauge guide tube Installation

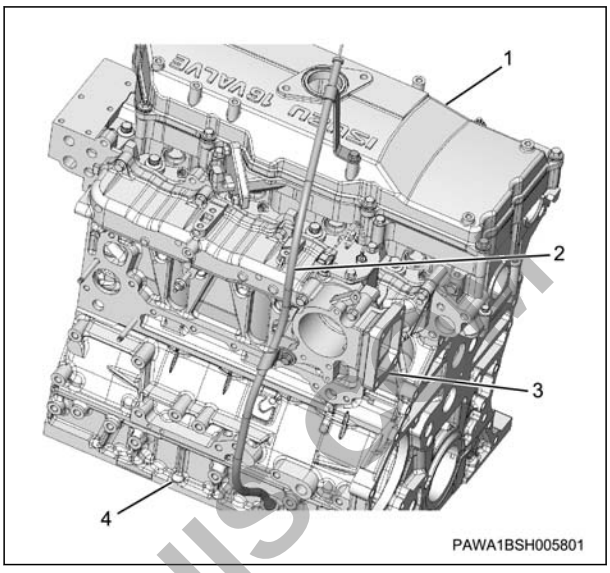
1. Install the oil level gauge guide tube to the cylinder block.
2. Connect the oil level gauge guide tube to the case.

tightening torque : 19 N・m { 1.9 kgf・m / 14 lb・ft }

3. Connect the oil level gauge guide tube to the cylinder head cover.

tightening torque : 19 N・m { 1.9 kgf・m / 14 lb・ft }

4. Install the oil level gauge to the oil level gauge guide tube.



1. Cylinder head cover
2. Oil level gauge guide tube
3. Case
4. Cylinder block

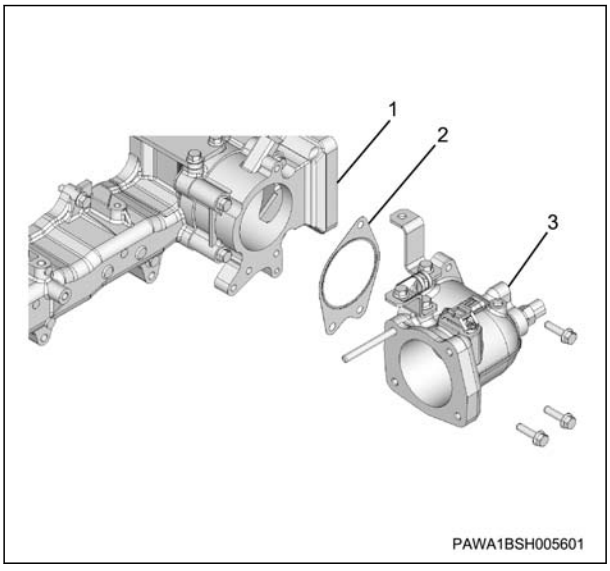
16. Inlet pipe Installation

1. Install the inlet pipe to the case.

tightening torque : 24 N・m { 2.4 kgf・m / 17 lb・ft }

Caution :

- Use new gaskets.



1. Case
2. Gasket
3. Inlet pipe

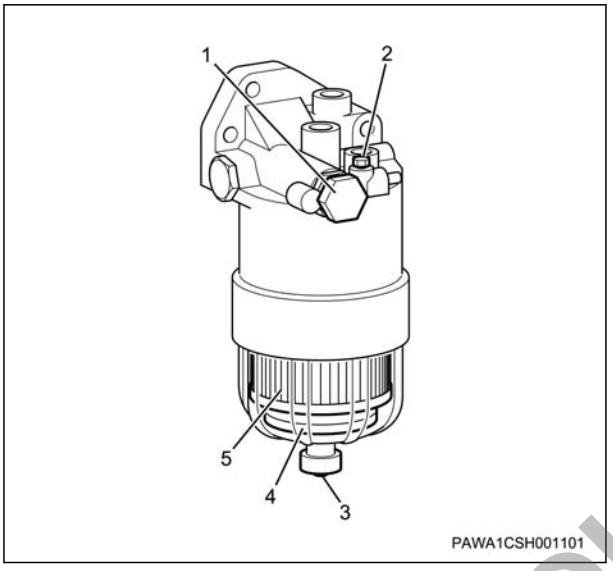
2. Connect the harness connector to the IMT sensor.
3. Connect the harness connector to the EGR valve.
4. Connect the harness connector to the boost temperature sensor.

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Installation

1. Fuel filter Installation
   1. Install the fuel filter to the actual unit.
   2. Install the fuel return hose to the fuel filter.
   3. Install the fuel feed hose to the fuel filter.
   4. Connect the harness connector to the fuel filter pressure sensor.

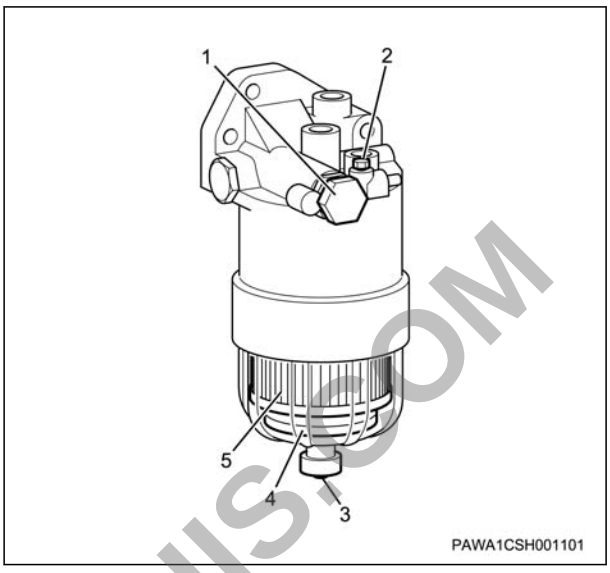


1. Priming pump
2. Plug
3. Drain plug
4. Case
5. Fuel filter element

2. Fuel Air bleed

Caution：

- To prevent engine failure, be sure to perform air removal after the installation or removal of fuel system parts.



1. Priming pump
2. Plug
3. Drain plug
4. Case
5. Fuel filter element

1. Prepare the pan.
2. Turn ON the starter switch.

Note：

- This is for the models with an electromagnetic pump.

3. Loosen the plug using the wrench.
4. Operate the priming pump.

Number of times： 20 count(s) or more

Note：

- Confirm that fuel comes out from around the plug.

5. Tighten the plug using the wrench.
6. Operate the priming pump.

Number of times： 10 count(s) or more

Note：

- Wait for the specified time after operating the priming pump.

specified time： 1 min

7. Loosen the plug using the wrench.

Note：

- Remove the air in the fuel filter.

8. Tighten the plug using the wrench.
9. Operate the priming pump.

Number of times： 10 count(s) or more

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3. Install the gasket to the lower cover.
4. Install the lower cover to the cylinder head assembly.

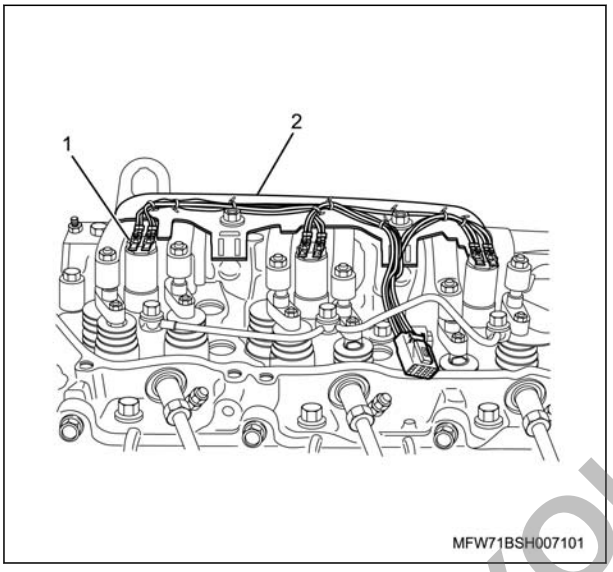
tightening torque： 18 N・m { 1.8 kgf・m / 13 lb・ft }

5. Install the injector harness to the cylinder head assembly.

Note：

- Tighten the bolts on the bracket and install the injector harness together with the bracket.

tightening torque： 48 N・m { 4.9 kgf・m / 35 lb・ft }



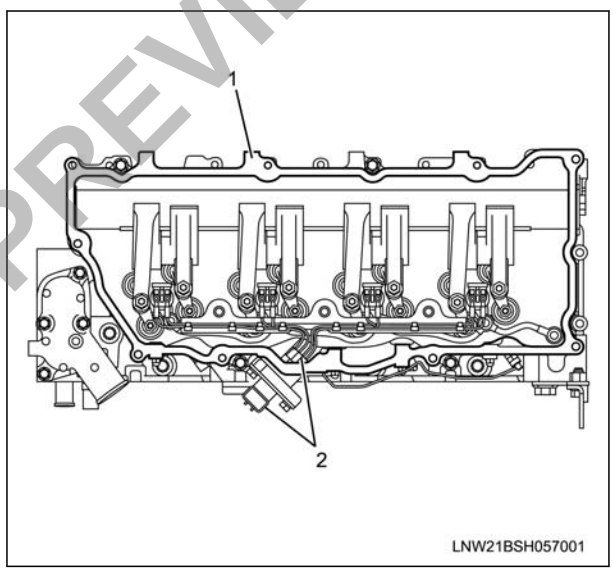
1. Injector harness terminal
2. Injector harness bracket

6. Connect the injector harness to the injector.

tightening torque： 2 N・m { 0.2 kgf・m / 18 lb・in }

Caution：

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



1. Lower cover
2. Connector

7. Install the connector to the lower cover.

tightening torque： 2 N・m { 0.2 kgf・m / 18 lb・in }

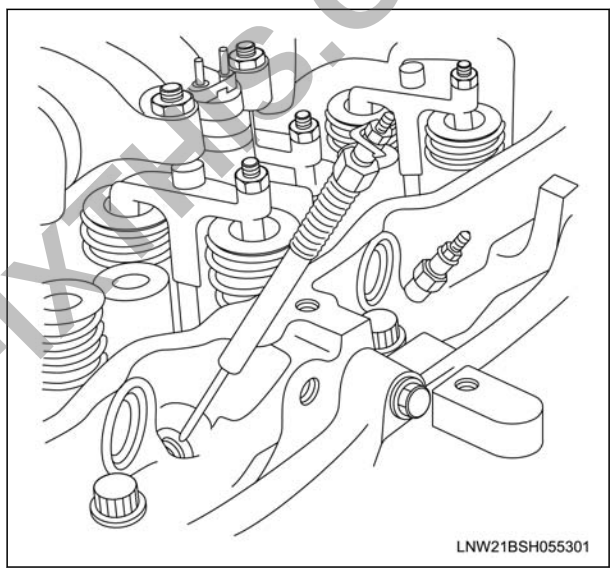
21. Glow plug Installation

1. Install the glow plug to the cylinder head assembly.

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

Caution：

- Be careful not to exceed the specified torque when tightening.



2. Install the glow plug connector to the glow plug.

tightening torque： 1 N・m { 0.1 kgf・m / 11 lb・in }

Caution：

- Confirm that the glow plug connector does not interfere with the surrounding parts.

22. Cylinder head cover Installation

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

tightening torque： 18 N・m { 1.8 kgf・m / 13 lb・ft }

Note：

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

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