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4HK1 (62Z7/67Z7) SHOP MANUAL
General Information
Troubleshooting Information

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SHOP MANUAL

ISUZU DIESEL ENGINE

4HK1

General Information
Troubleshooting Information

(For Kawasaki Wheel Loader 62Z7, 67Z7)

Serial No. 62J1-5001 and up
Serial No. 65J5-5001 and up

Recommended liquid gasket

1. Using the thread liquid gasket

Type	Product name	Manufacturer name	Area used (reference)
Silicon type (room temperature vulcanization process)	ThreeBond 1207B ThreeBond 1207C ThreeBond 1215 ThreeBond 1216	ThreeBond ThreeBond ThreeBond ThreeBond	Engine oil seal retainer engine oil pan timing gear case cylinder head cover fuel pump water pump etc.
Water–soluble	ThreeBond 1141	ThreeBond	
Solvent type	ThreeBond 1104 ThreeBond 1194	ThreeBond ThreeBond	
Anaerobic	Loctite 515 Loctite 518 FMD127 (Loctite 5127) Loctite 271	Loctite Loctite Loctite Loctite Loctite	Engine oil seal retainer water pump plug etc.

Caution :

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

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

Note :

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

Caution :

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

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

Caution :

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

Note :

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

Caution :

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

Note :

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

Caution :

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

M24 x 2	: 358.9 to 539.4 N・m { 36.6 to 55.0 kgf・m / 265 to 398 lb・ft }	-	: 430.5 to 711.0 N・m { 43.9 to 72.5 kgf・m / 318 to 524 lb・ft }	-
*M24 x 3	: 338.3 to 507.0 N・m { 34.5 to 51.7 kgf・m / 250 to 374 lb・ft }	-	: 406.0 to 608.0 N・m { 41.4 to 62.0 kgf・m / 299 to 448 lb・ft }	-

Cooling system main specifications

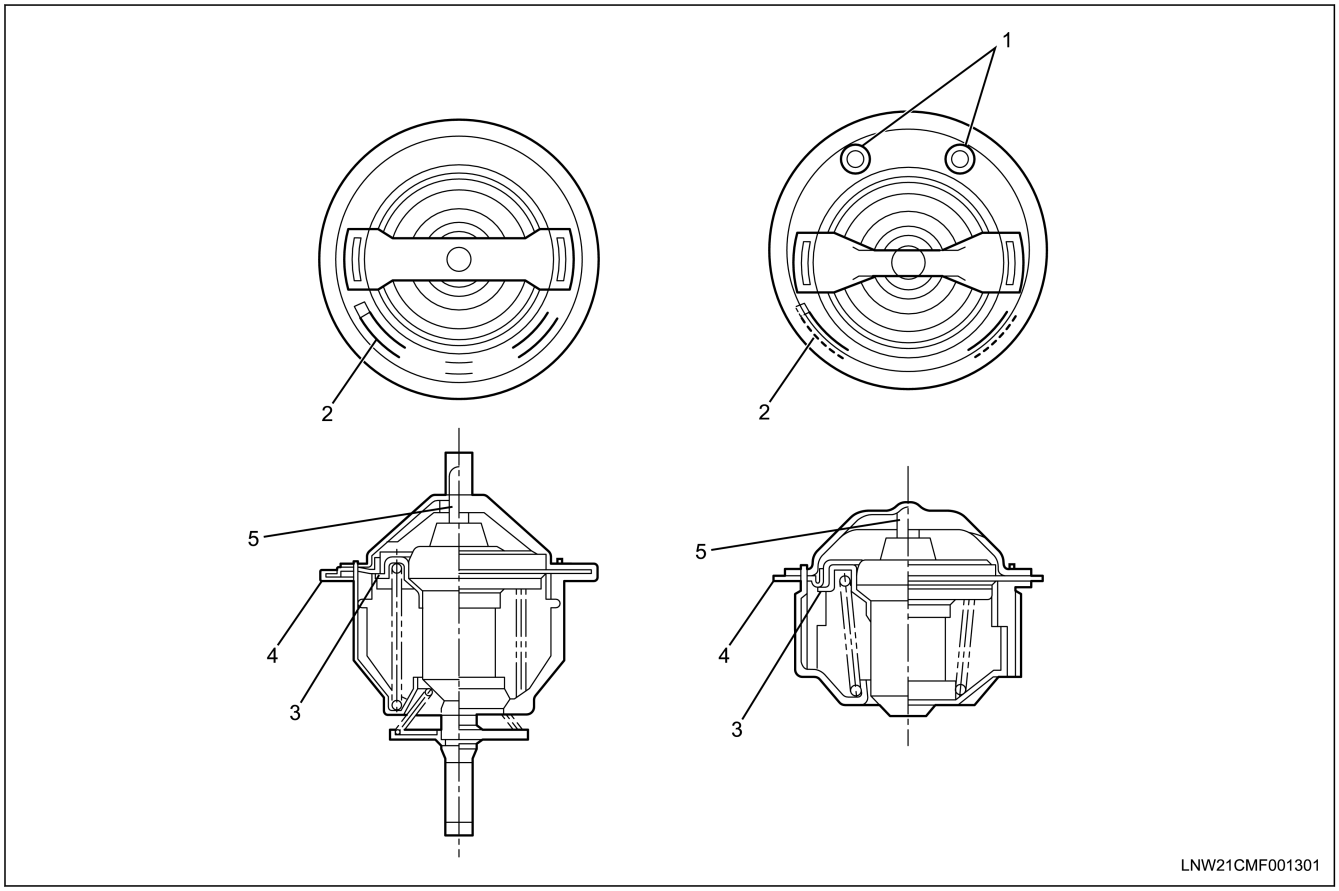
Item	Specifications
Water pump	Centrifugal impeller method
Pulley ratio	0.950
Thermostat	Wax pellet type
Open valve temperature	: 85.0 ℃ { 185 °F } With jiggle valve
	: 82.0 ℃ { 180 °F } Without jiggle valve
Full-open temperature	: 100.0 ℃ { 212 °F } With jiggle valve
	: 95.0 ℃ { 203 °F } Without jiggle valve

Electrical system main specifications

Generator	
Item	Specifications
Isuzu parts number	8980921161
Nominal output	24 V/50 A
Rated rotation count	5,000 r/min
Regulator type	IC type
Regulated voltage	28.5 V±1
Weight	: 9.5 kg { 20.9 lb }

Starter		
Type (Manufacturer)		Nikko
Rating	Voltage	24V
	Output	5 KW
	Time	30 sec
Number of pinion teeth		13
Rotational direction (facing the pinion)		Right
Weight (Approx.)		: 8.0 kg { 17.6 lb }
No-load characteristics	Current/voltage	85 A or less/24 V
	Revolution speed	3,300 rpm or more
Load characteristics	Current/voltage	400 A/18.5 V
	Torque	28.4N・m{2.9kgf・m} or more
	Revolution speed	1,250 rpm or more
Locking characteristics	Current/voltage	1,400 A or less/9 V
	Torque	88.2N・m{9.0kgf・m} or more

Glow plug	
Item	Type
Preheat device model	Glow plug
Glow plug rated voltage/current	23 V/3.5 A



1. Jiggle valve
2. Stamp mark (initial open valve temperature)
3. Valve
4. Gasket
5. Piston

5. Lubrication system

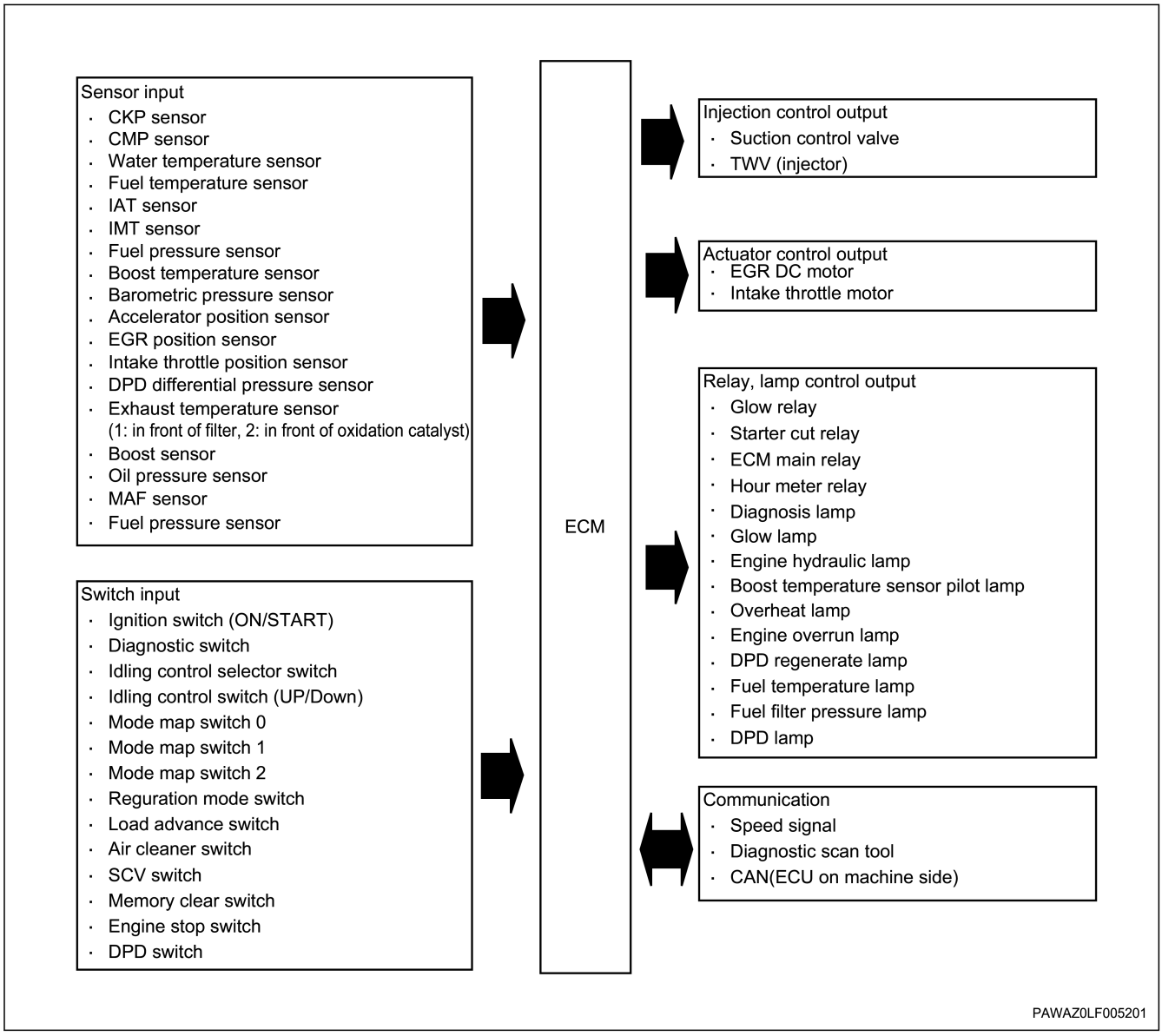
A full-flow bypass integrated filter element, water cooling oil cooler, and piston coolant oil jet are adopted for the lubrication system.

When the engine oil pressure drops to 100 kPa {1.02 kgf/cm2 / 14 psi} or lower, an alarm for engine oil pressure decrease is issued and the engine is stopped.

Increase in engine coolant temperature
When the engine coolant temperature increases to 105˚ C {221˚ F} or higher, an alarm for engine coolant temperature increase is issued and the engine is stopped.

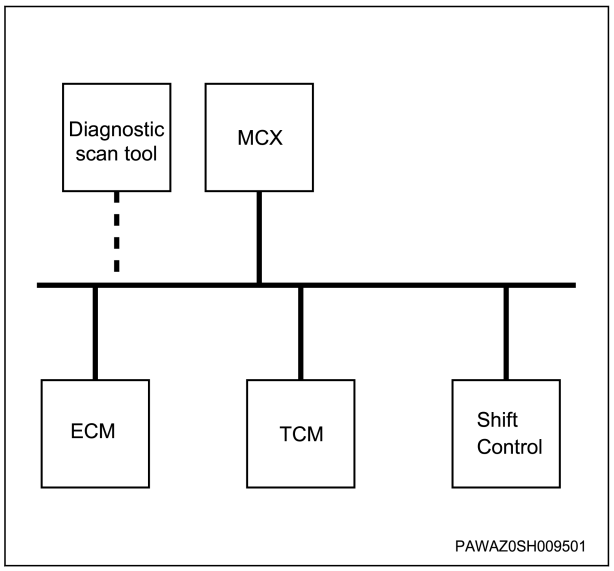
Overrun
When the engine speed reaches to the specified value, an alarm for overrun is issued and the engine is stopped.
It varies depending on the machine manufacturer.

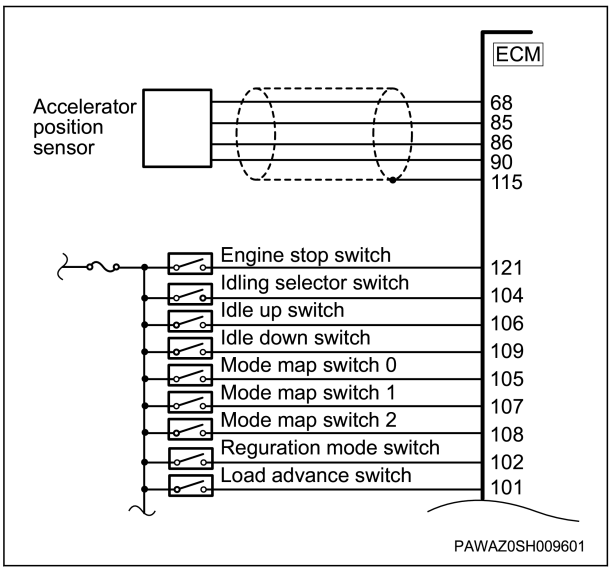
I/O Table



Electronic control fuel injection system
This is the system in which the ECM obtains information such as the engine speed and engine load and sends the electrical signals based on the information to the supply pump, injectors, etc. to properly control the fuel injection amount and injection timing for each cylinder.

Injection amount control
To make the injection amount optimal, the fuel injection amount is controlled by regulating the injector based on mainly the signals from the engine speed and accelerator opening angle or the instructed rotation from the control unit in the machine.

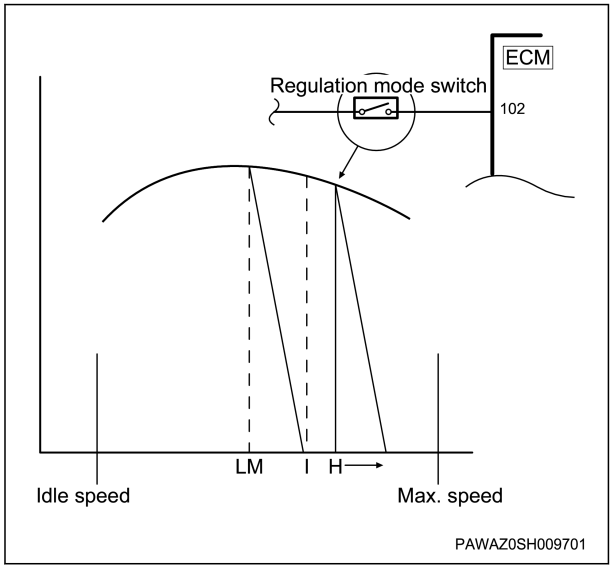




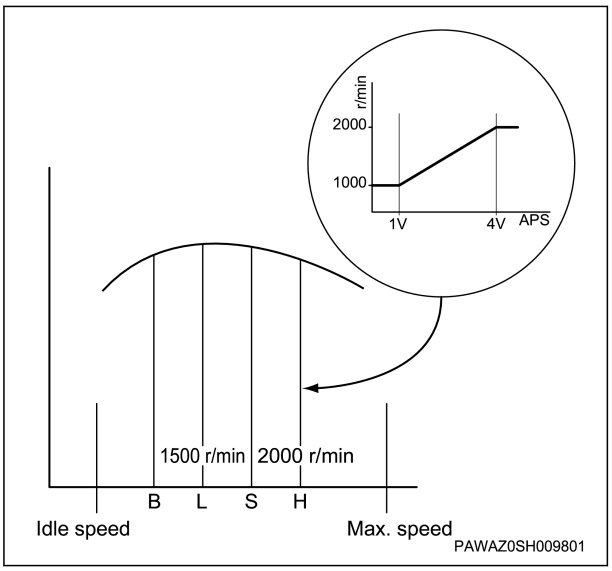
Mode map switch control

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

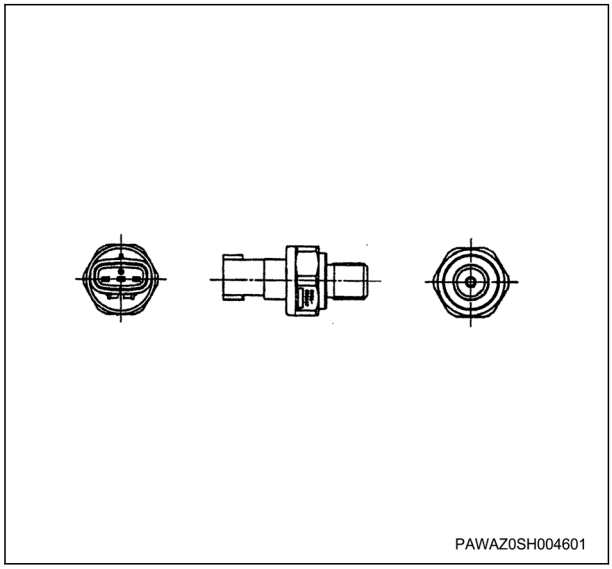


H, S, L, and B modes



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

The voltage becomes higher when the pressure is higher, and it becomes lower when the pressure is lower.



Accelerator position sensor
The accelerator position sensor is installed on the console panel of the machine to supply the voltage signal which varies in accordance with the accelerator volume angle to the ECM. The ECM calculates the accelerator pedal position from the voltage signal, and uses it for fuel injection control and many other controls.

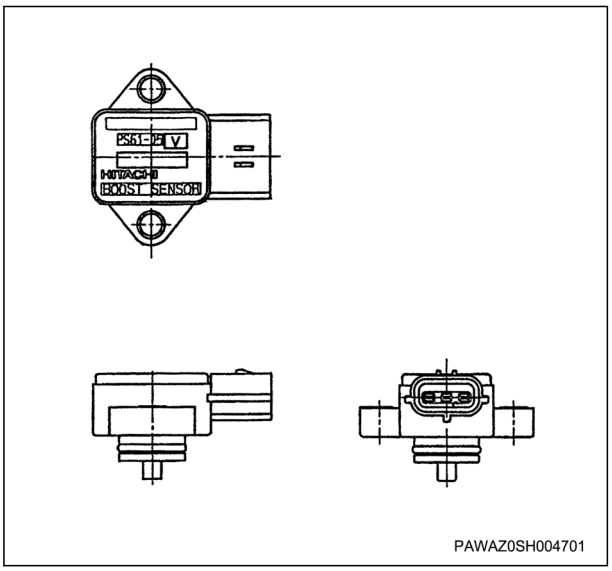
Note：

- As for the installation position of the accelerator position sensor, refer to the manual of the machine.

Barometric pressure sensor
The barometric pressure sensor is installed on the machine side, and it replaces the barometric pressure with the voltage signal. The ECM calculates the barometric pressure from the voltage signal, and uses the barometric pressure to correct the fuel injection amount.

Note：

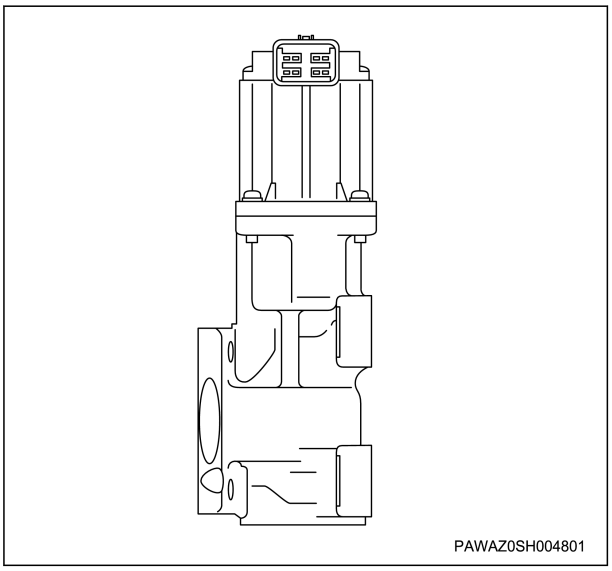
- As for the installation position of the barometric pressure sensor, refer to the manual of the machine.



EGR position sensor
The EGR position sensor is installed inside the EGR valve to detect the EGR valve lift amount.

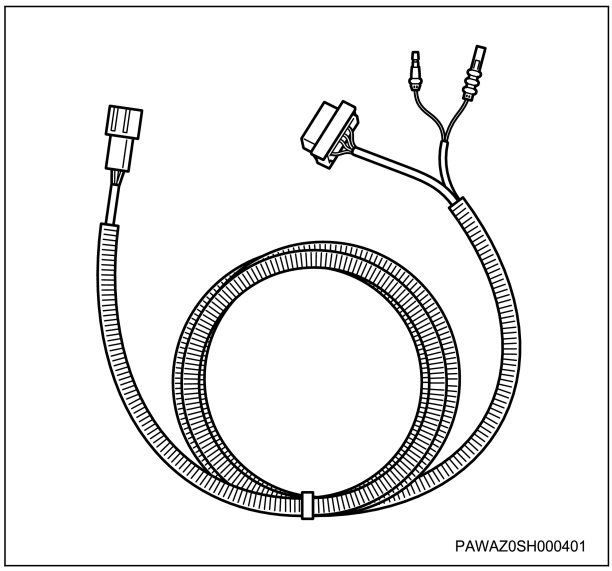
Note：

- Do not disassemble the EGR position sensor. When an abnormality is found, replace the EGR valve assembly.



Boost sensor
The boost sensor detects the boost using the pressure hose between the boost sensor and intake pipe to convert into the voltage signal and sends it to the ECM. The voltage becomes higher when the pressure is higher, and it becomes lower when the pressure is lower. The ECM calculates the boost from the voltage signal sent from the sensor, and uses it to control the fuel injection, etc.

Pin No.	Pin name	Connection
61	PG-POWER	ECM power source GND
62	PG-POWER	ECM power source GND
63	PG-POWER	ECM power source GND
64	PG-POWER	ECM power source GND
65	PG-POWER	ECM power source GND
66	PG-POWER	ECM power source GND
67	PS-+B	Battery power source
68	SP-5V1	Accelerator position sensor power source
69	SP-5V2	Barometric pressure sensor power source
70	SP-5V3	Exhaust differential pressure sensor, fuel filter pressure sensor power source
71	-	-
72	CC-KW2000	Data link connector
73	-	-
74	-	-
75	-	-
76	-	-
77	-	-
78	-	-
79	IA-THE1	Exhaust gas temperature sensor 1 signal
80	IA-THE2	Exhaust gas temperature sensor 2 signal
81	IA-IAT	IAT sensor signal
82	IA-MAF	MAF sensor signal
83	IA-FIPRESS	Fuel filter pressure sensor signal
84	IA-EXHP	Exhaust differential pressure sensor signal
85	IA-ACCEL1	Accelerator pedal position sensor 1 signal
86	IA-ACCEL2	Accelerator pedal position sensor 2 signal
87	IA-BARO	Barometric pressure sensor signal
88	CC-ISOCAN-L	ISO CAN-Low
89	PS-+B	Battery power source
90	SG-5VRT1	Accelerator position sensor GND
91	-	-
92	-	-
93	-	-
94	-	-
95	-	-
96	-	-
97	PG-SIGN	Signal GND
98	-	-
99	IS-SCVSW	SCV switch signal
100	IS-START	Ignition switch ON signal
101	IS-LOAD	Load advance switch signal
102	IS-REG	Regulation mode switch signal
103	IS-AC	Air cleaner switch signal
104	IS-IDLMNL	Idling control change selector switch signal



2. Turn the ignition switch ON.
3. Connect the memory clear terminal to the ground for one second or longer.
4. Turn the ignition switch OFF.
When the ignition switch is turned OFF, the memory is cleared at the same time.
5. Disconnect the Diagnostic switch terminal.

Erasure by ECM
A DTC recorded in the ECM is erased if the same DTC has not been satisfied for 40 consecutive ignition cycles.

About trouble diagnosis scan tool
This tool is effective for diagnosing electrical failures in engine control units and performing system checks.
If you connect the SAE 16/19 adapter to the DLC installed in the unit, it performs communication with the control units of the machine, and enables various diagnoses and tests to be performed.

Functions of the trouble diagnosis scan tool.

Data display

Snapshot

Programming

Actuator test

Caution：

- When conditions such as the running state of the machine or the engine, water temperature, switches and gear position are not met, or when a DTC has been detected, each test may possibly not operate.

ECM reflash
The ECM can be updated by overwriting its control program using the most recent control data issued every 3 months.
Normal reflash
The ECM is reflashed by automatically searching for the ECM part number compatible with the part number currently reflashed.
Forced reflash
The ECM is reflashed by specifying an arbitrary ECM part number.
In this case, a password dedicated for forced reflash is necessary.
Campaign reflash
The ECM is reflashed by selecting the part number during a campaign carried out by the manufacturer.

Rewriting injector QR code
The injector QR code that is required when replacing the injector can be rewritten. This allows fuel compensation to be performed on each injector to optimize the engine condition.

Engine replacement mode
This should be used when changing back to the old ECM part number which requires hardware changes such as addition of machine wiring is performed along with engine replacement, etc.

ECM replacement
When replacing the ECM within the same model, the data can be updated from the current ECM to a trouble diagnosis scan tool and then downloaded it from the trouble diagnosis scan tool to the new ECM after replacement.

Factory shipment settings
Based on the engine serial number, data such as ECM injector QR code can be downloaded to ECM.

Actuator test
The injector test, fuel injection test, rail pressure test, glow plug test, and EGR control test are performed to inspect the operation and function of each target component.

Caution：

- When conditions such as the running state of the machine or the engine, water temperature, switches and gear position are not met, or when a DTC has been detected, each test may possibly not operate.

Links with the HTML manual display
DTC to display the manual along with the failure diagnosis procedure.

Reading saved data
Read in the saved snapshot data to display reproduction.

Caution：

- When using the trouble diagnosis scan tool, refer to the separate instruction manual for the trouble diagnosis scan tool.

10. Reference data value

DPD control system check

1. DPD control system check description of function

The ECM detects the condition of PM accumulations from the exhaust differential pressure sensor. The exhaust differential pressure sensor changes the signal voltage in accordance with changes in the exhaust gas pressure difference between the front and the rear of the DPD filter. When the exhaust differential pressure sensor reaches to a certain amount of PM accumulation, or a certain period of operating hours, DPD automatic regeneration starts. If the automatic regeneration cannot be completed due to driving, the DPD manual regeneration indicator light in the monitor panel blinks to prompt the driver to perform manual regeneration. When regeneration has once started, it must be completed within a certain period of time. After completion of DPD regeneration, purification status of the filter is determined based on the exhaust differential pressure. When the ECM detects excessive amount of PM accumulation, it becomes so hot that it is eroded during regeneration process and cannot control combustion; therefore, DPD regeneration is not allowed to start.

2. DPD control system check inspection

Inspection for determining the failure location in the DPD system

1. Perform the inspection of the engine control system.
2. Turn the ignition switch ON for 30 seconds.
3. Check that the monitor panel functions normally.

・DPD automatic regeneration indicator light illuminates
・DPD manual regeneration indicator light illuminates

Note：

- If it dose not illuminate, inspect the circuit of the DPD indicator light.
- Not all are displayed depending on the machine manufacturers.

4. Turn OFF the ignition switch for 30 seconds.
5. Inspect the amount of engine oil.
6. Connect the trouble diagnosis scan tool to the DTC.
7. Start the engine.
8. Display the scan tool data DPD regeneration switch using a trouble diagnosis scan tool.
9. Check if the data displayed on the DPD regeneration switch of the trouble diagnosis scan tool is turned to ON or OFF when changing each switch.

Note：

- If the ON or OFF operation does not link, inspect the DPD switch and harness.

10. Inspect the installation condition of the exhaust differential pressure sensor.
11. Inspect the exhaust differential pressure sensor.

・Damage on the exhaust differential pressure sensor
・Foreign matter or contamination which interferes with the exhaust differential pressure sensor inlet
・Wrong detection or slow response for the exhaust differential pressure sensor

12. Inspect the exhaust system.
13. Inspect the air intake system.
14. Start the engine and maintain idling for 30 seconds.
15. Confirm that the DPD manual regeneration indicator light blinks.

Note：

- If it comes on, press the DPD switch to perform the DPD manual regeneration.
- If it is not blinking, use the trouble diagnosis scan tool to confirm DPD accumulation status and DPD time status and applicable area based on the DPD status table.

・Compare DPD accumulation status and DPD time status and use the DPD status table to determine DPD regeneration process status.
・To use the DPD status table, confirm the data display values on the trouble diagnosis scan tool and readings in the DPD status table.

Inspection of the starter circuit system

1. Inspection of the starter circuit system description of function

The starter relay on the ECM is turned to ON when the ignition switch moves to the START position. When the starter relay is turned to ON, the starter operates to start the engine.

2. Inspection of the starter circuit system inspection

Inspection when the starter does not operate

1. Turn the emergency stop switch to OFF.

Note：

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

2. Check the DTC.

Note：

- If the DTC P0117, P0340, P0341, P0615, P0651, or P1625 is detected, inspect the corresponding DTC.

3. Turn OFF the ignition switch.
4. Remove the starter cut relay.
5. Inspect the starter cut relay.

・Check the continuity between the switch side terminals.
values: 100Ω or less

6. If a problem is found, replace the relay.
7. Remove the starter relay.
8. Inspect the starter relay.

・Connect the battery between the coil side terminals and check the continuity between the switch side terminals.
values: 100Ω or less

9. If a problem is found, replace the relay.
10. Inspect the ignition switch start signal circuit.

・No open circuits or high resistance should be found between the ignition switch and ECM.
values: 100Ω or less
・No short circuits with the GND should be found between the ignition switch and ECM.
values: 10MΩ or more

11. If a problem is found, repair the circuit.
12. Inspect the starter circuit.

・No open circuit should be found between the ignition switch and starter cut relay.
・No open circuit should be found between the starter cut relay and starter relay.
・No open circuit should be found between the starter relay and GND.
・No open circuit should be found between the starter relay and starter.

13. If a problem is found, repair the circuit.
14. Inspect the starter.

Inspection of the starter

15. If a problem is found, replace the starter.
16. Replace the ECM.

Refer to "*1.Engine 1J.Electrical(4HK1) ECM removal*".

Refer to "*1.Engine 1J.Electrical(4HK1) ECM installation*".

17. After replacing the ECM, perform EGR learning.

Large fuel consumption

1. Large fuel consumption description of symptom

Fuel consumption is significantly larger than indicated in the machine manual.

2. Large fuel consumption diagnostics

・Preliminary inspection

Before using this section, perform the functional inspection and OBD system check to check all of the following.
Since the fuel consumption varies widely depending on the handling of the machine, check the reference fuel consumption (A) of the machine manufacturer. Reference fuel consumption (L {qts}/hour)
Check the actual fuel consumption (B). Actual fuel consumption (L {qts}/hour)
If B is greater than A, refer to the machine manual and check the setting of the unit.
Check whether the actual unit does not have a significant load.
Refer to the inspections and maintenance list in the operation manual and perform the inspection based on the operation time of the machine.
Refer to the machine manual to inspect a machine whose operation time exceeds 3,000 hours.
The ECM and diagnostic light are operating correctly.
DTC check.
Check the condition of the machine, and locate the appropriate symptom.
Check with the customers whether they are using the specified engine oil and fuel.
Check whether engine oil change or periodical maintenance for the air cleaner filter or fuel filter, etc. has been performed.

・Visual inspection

Careful visual inspection is required for several symptom procedures. This can lead to fixing a problem without further inspections, and can save valuable time.
The inspection includes the following.
Proper wiring connections, tightening, and disconnection
Whether the ECM ground is free of dirt, etc. and securely installed in the correct location.
Proper connections, cracks, and twists in the pipes and hoses related to fuel, air, and oil. Extensively check for any leaks or blockage.
Whether there are any fuel leaks, pipe damage, or dents in the fuel system.
Abnormalities of the air intake system parts
Abnormalities of the exhaust system parts

・Diagnostic aids

Fuel system abnormalities such as fuel running out, fuel freezing, mixture of air into the fuel piping, filter abnormalities, piping abnormalities, fuel quality, fuel tank, etc.
Air intake system abnormalities such as EGR valve abnormalities, etc.
Abnormalities of the injector such as excessive fuel injection
Engine body abnormalities such as seizure, insufficient compression pressure, and other mechanical failures, etc.
Failure related to the actual unit equipment such as the oil pressure pump, etc.
ECM failure
Inspect the connector for connection failures and the harness for abnormalities such as abrasions, bending, etc.
Inspect that the wires inside the harness are separate and have not caused a short circuit with other circuits.
Perform inspections for functional diagnosis, and confirm the operation, control of each part, etc. Repair if abnormalities are found.

For the inspection locations of the engine air intake and exhaust system
Inspect the air intake and exhaust system for abnormalities such as clogging, collapsing and damage.
Other than the inspection locations of the engine body, inspect the air cleaner, intercooler, and muffler.

DTC P0045 (Flash Code 33)
Turbocharger Boost Control Solenoid Circuit

1. DTC P0045 description of DTC

The opening angle of the variable nozzle on the turbocharger is controlled by the turbo control unit through operating the motor built into the actuator to activate the control rod in accordance with the signal received from the ECM. The ECM controls the variable nozzle based on the boost pressure, and detects the operation amount of the variable nozzle with the position sensor built into the turbo actuator. When the engine is not under load, the variable nozzle is in the open condition, or the boost pressure is not present. When the engine is under load, the turbo actuator is controlled to close the variable nozzle. As the result, the boost pressure increases. The ECM performs control that changes the boost pressure in accordance with the load requirements for the engine. The ECM communicates with the turbo control unit through CAN communication to perform control. The DTC is set when the ECM detects an open circuit or short circuit in the circuit between the turbo actuator and turbo control unit or an abnormality in communication with the turbo control unit.

2. DTC P0045 condition for setting the DTC

The battery voltage is 20 - 32 V
The ignition switch is ON
Any of the following conditions is satisfied
The turbo control unit detects 34V or higher for longer than 60 seconds
The turbo control unit detects that no change is made in the position sensor signal or that all signals remain in the Low or High state without any change
The turbo control unit detects an open circuit or short circuit in the motor circuit for longer than 3 seconds

3. DTC P0045 action taken when the DTC sets

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

Note：

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

DTC P0113 (Flash Code 22)
Intake Air Temperature Sensor Circuit High

1. DTC P0113 description of DTC

The IAT sensor is a thermistor type sensor to measure the temperature of air taken into the engine. This sensor has a signal circuit and GND circuit. The ECM supplies 5 V to the signal circuit, and the GND circuit connects to the GND. When the IAT sensor is cold, the resistance of the sensor is high. When the air temperature rises, the resistance of the sensor becomes low. The ECM detects the high voltage when the sensor resistance is high. The ECM detects the low voltage when the sensor resistance is low. When the ECM detects that the signal voltage is abnormally high, it sets DTC.

2. DTC P0113 condition for setting the DTC

DTC P060B is not set
The battery voltage is 18 - 32 V
The ignition switch is ON
The engine is running for 3 minutes or longer
The ECM detects that the signal voltage of the IAT sensor is 4.85 V or higher for 4 seconds

3. DTC P0113 action taken when the DTC sets

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

Note：

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

Substitute the default value for IAT sensor.
Limit the fuel injection amount.
Stop the EGR control.

DTC P0202 (Flash Code 272)
Injector Circuit - Cylinder 2

1. DTC P0202 description of DTC

The ECM calculates the optimum fuel injection ON time using the data transmitted from the sensor. The injector power supply circuit supplies the high voltage while the ECM grounds the injector solenoid control circuit as well as drives the injector of each cylinder. The ECM sets a DTC when an abnormality is detected in the No.2 cylinder injector circuit.

2. DTC P0202 condition for setting the DTC

DTCs P1262 and P2149 are not set
The battery voltage is 18 - 32 V
The ignition switch is ON
While the engine is running
Any of the following conditions is satisfied
The ECM detects an open circuit with the injector solenoid
The ECM detects that a short of the injector solenoid control circuit to the voltage circuit or charge voltage circuit occurs

3. DTC P0202 action taken when the DTC sets

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

Note：

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

Stop the injection of the No.2 cylinder.
Stop the EGR control.
Stop the DPD regeneration.

DTC P0340 (Flash Code 14)
Camshaft Position Sensor Circuit

1. DTC P0340 description of DTC

The CMP sensor is installed behind the cylinder head with the camshaft gear. The CMP sensor detects 5 protrusions per 1 revolution of the engine. The camshaft gear has 4 protrusions arranged at 90 degree intervals and 1 reference protrusion. The CMP sensor generates the pulse signal. The sensor has following circuits.
5 V power supply circuit
GND circuit
CMP sensor signal circuit
The ECM monitors the signal pulses from the CKP sensor and CMP sensor to confirm that they are related to each other.
While no CMP sensor signal pulse is detected, the ECM sets DTC when it receives a certain amount of CKP sensor signal pulses.

2. DTC P0340 condition for setting the DTC

DTCs P0016, P0335, P0336, and P0341 are not set
The ignition switch is ON
The CKP sensor signal pulse is detected
The ECM detects that the CMP sensor signal pulse is not generated, while the engine is running

3. DTC P0340 action taken when the DTC sets

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

Note :

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

DTC P042D (Flash Code 49)
Catalyst Temperature Sensor Circuit High Sensor 2

1. DTC P042D description of DTC

The exhaust temperature sensor 2 is installed on the DPD housing. The exhaust temperature sensor 2 is a variable resistor, and measures the temperature of the exhaust gas before entering the oxidation catalyst. This sensor has a signal circuit and GND circuit. The ECM supplies 5 V to the signal circuit, and the GND circuit connects to GND. When the exhaust temperature sensor 2 is cold, the resistance of the sensor is high. When the exhaust temperature rises, the resistance of the sensor decreases. The ECM detects a high voltage when the sensor resistance is high. The ECM detects a low voltage when the sensor resistance is low.
The DTC is set when the ECM detects an abnormally low signal voltage.

2. DTC P042D condition for setting the DTC

DTCs P0112, P0113, P0117, P0118, P060B, P2228, and P2229 are not set
The battery voltage is 18 - 32 V
The ignition switch is ON
The engine coolant temperature is 70˚ C (158˚ F) or higher
The fuel injection amount is a certain value or more
The engine operating time is 0.5 - 10 minutes or longer
The ECM detects that the signal voltage of the exhaust temperature sensor 2 is 4.85 V or higher for 5 seconds

3. DTC P042D action taken when the DTC sets

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

Note：

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

Restrict the fuel injection amount.
Stop the EGR control.

DTC P0638 (Flash Code 61)
Throttle Actuator Control Range/Performance

1. DTC P0638 description of DTC

The ECM controls the intake throttle solenoid to open and close the intake throttle valve according to the engine operating status. The intake throttle valve opening angle is detected by the position sensor and transmitted to the ECM. While the ON command to the intake throttle solenoid is being executed, if the ECM has detected a difference between the actual opening angle and desired opening angle of the intake throttle, it sets DTC.

2. DTC P0638 condition for setting the DTC

DTCs P0122 and P0123 are not set
The battery voltage is 18 - 32 V
The ignition switch is ON
The desired opening angle of the intake throttle is constant
The ON instruction is issued for the intake throttle solenoid
The ECM detects that the difference between the actual and desired opening angles of the intake throttle is 40 % or more for 5 seconds or longer

3. DTC P0638 action taken when the DTC sets

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

Note：

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

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

DTC P1261 (Flash Code 34)
Injector Positive Voltage Control Circuit Group 1

1. DTC P1261 description of DTC

The charge voltage circuit inside the ECM increases the voltage applied to the injector. The charge voltage circuit is divided into 2 banks; the common power supply 1 and common power supply 2. The common power supply 1 supplies power to the injectors of the No. 1 and No. 4 cylinders while the common power supply 2 supplies power to the injectors of the No. 2 and No. 3 cylinders. When the injector charge voltage circuit of the common power supply 1 or 2 of the ECM has been opened, the ECM sets DTC.

2. DTC P1261 condition for setting the DTC

The battery voltage is 18 - 32 V
The ignition switch is ON
The ECM detects an open or short circuit in the ECM internal common power 1 injector charge voltage circuit for longer than 1.3 seconds

3. DTC P1261 action taken when the DTC sets

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

Note：

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

Stop the EGR control.
Stop the DPD regeneration.
Stop the fuel injection for the No.1 and No.4 cylinders.

DTC P2122 (Flash Code 121)
Pedal Position Sensor 1 Circuit Low Input

1. DTC P2122 description of DTC

The accelerator position sensor consists of 2 sensors installed within a single housing. The ECM uses the accelerator position sensor to calculate the desired acceleration and deceleration amounts. The accelerator position sensor 1 has the following circuits
5 V power supply circuit
GND circuit
Accelerator position sensor 1 signal circuit
The accelerator position sensor 1 transmits the signal related to changes of the accelerator pedal angle position to the ECM via the signal circuit. When the ECM has detected that the signal voltage is abnormally low, it sets DTC.

2. DTC P2122 condition for setting the DTC

DTC P060B is not set
The battery voltage is 18 - 32 V
The ignition switch is ON
The ECM detects that the accelerator pedal position sensor 1 signal voltage is 0.2 V or lower for longer than 0.3 seconds

3. DTC P2122 action taken when the DTC sets

When the accelerator position sensors 1 and 2 are faulty, the accelerator opening angle is limited to 0 %.

DTC P2452 (Flash Code 142)
DPD Differential Pressure Sensor Circuit

1. DTC P2452 description of DTC

The exhaust differential pressure sensor is installed near DPD itself. The exhaust differential pressure sensor varies the signal voltage according to changes of the exhaust gas differential pressure between in front and rear of DPD filter.
If the ECM detects that the DPD differential pressure is certain pressure low under certain conditions, it sets DTC.

2. DTC P2452 condition for setting the DTC

DTCs P2454 and P2455 are not detected
The battery voltage is 18 - 32 V
The ignition switch is ON
The engine speed is 2200 r/min or more
The ECM detects that the DPD differential pressure is 0.5 kPa {0.01 kgf/cm2 / 0.1 psi} or lower for longer than 13 seconds

3. DTC P2452 action taken when the DTC sets

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

Note：

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

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

DTC U0411 (Flash code 87)
Turbo Charger Control Module Signal Malfunction

1. DTC U0411 description of DTC

   The ECM and turbo control unit communicate the control and diagnostic information via CAN communication. The ECM outputs data via the CAN-High circuit and input data from other ECUs from the CAN-Low circuit. CAN communication is continuously performed at a constant rate and the data output count and input count are always identical. ECM sets DTC when it has received a CAN communication failure message from the turbo control unit.

2. DTC U0411 condition for setting the DTC

   The battery voltage is 20 - 32 V
   The ECM receives the error message from the turbo control unit

3. DTC U0411 action taken when the DTC sets

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

   Note：

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

   Stop the EGR control.

DTC P0087 (Flash Code 225)
Fuel Rail/System Pressure - Too Low

1. DTC P0087 priority DTC

   DTC P0088

   DTC P0089

   DTC P0091

   DTC P0092

   DTC P0192

   DTC P0193

   DTC P0201

   DTC P0202

   DTC P0203

   DTC P0204

   DTC P2146

   DTC P2149

2. DTC P0087 diagnostics
   1. Start the engine.
   2. Rev the engine a few times in neutral while checking for a DTC with the trouble diagnosis scan tool.
   3. Check to see if the DTC P0087 is detected.
   4. If the DTC P0087 is not detected, replace the fuel filter element.

      Note：

      - An intermittent problem due to foreign matter in the fuel is suspected.

      Refer to "*1.Engine 1C.Fuel System(4HK1) Fuel filter element removal*".

      Refer to "*1.Engine 1C.Fuel System(4HK1) Fuel filter element installation*".
   5. Turn OFF the ignition switch.
   6. Wait for the specified period of time until the fuel pressure is released from the common rail.

      specified time： 2 min
   7. Turn ON the ignition switch.
   8. Check the fuel rail pressure sensor display with the trouble diagnosis scan tool.

      voltage： 0.9 to 1.0 V
   9. If the fuel rail pressure sensor display is outside the specified range, inspect the fuel pressure sensor harness connector for a poor connection.
   10. If a problem is found, repair the harness connector.
   11. Inspect the ECM harness connector for a poor connection.
   12. If a problem is found, repair the harness connector.
   13. Inspect each circuit for high resistance.
   14. If a problem is found, repair the circuit.
   15. If the harness connector and each circuit are normal, replace the fuel pressure sensor.

      Refer to "*1.Engine 1C.Fuel System(4HK1) Common rail assembly removal*".

      Refer to "*1.Engine 1C.Fuel System(4HK1) Common rail assembly installation*".

      Note：

      - Do not replace the fuel pressure sensor separately. If a problem is found, replace the common rail assembly.
   16. If the fuel rail pressure sensor display is within the specified range, start the engine.
   17. Perform the injector stop test with the trouble diagnosis scan tool.
   18. Command each injector OFF, and confirm that the engine speed changes on each injector.
   19. If any injector does not change the engine speed when OFF is instructed, replace the relevant injector.

      Refer to "*1.Engine 1C.Fuel System(4HK1) Injector removal*".

      Refer to "*1.Engine 1C.Fuel System(4HK1) Injector installation*".
   20. When the injector has been replaced, set the injector ID code on the ECM.
   21. Inspect to see if there is clogging with the fuel system between the fuel tank and the fuel supply pump.
   22. If a problem is found, repair the clogging of the fuel system.
   23. Inspect the fuel hose between the fuel tank and the fuel supply pump for a cut and crack.
   24. If a problem is found, replace the fuel hose.

      Note：

      - The fuel hose between the fuel tank and the fuel supply pump becomes negative pressure state when the engine is running.
      - When the fuel hose is not connected securely, the air can enter.

DTC P0093 (Flash Code 227)
Fuel System Leak Detected

1. DTC P0093 priority DTC

   DTC P0087

   DTC P0091

   DTC P0092

   DTC P0192

   DTC P0193

   DTC P0201

   DTC P0202

   DTC P0203

   DTC P0204

   DTC P2146

   DTC P2149

2. DTC P0093 diagnostics

   1. Inspect for fuel leaks on the high-pressure side between the fuel supply pump and injector.

   ・There should be no fuel leakage from the fuel supply pump.
   ・There should be no fuel leakage from the common rail.
   ・There should be no fuel leakage from the pressure limiter valve.
   ・There should be no fuel leakage from the fuel pressure sensor.
   ・There should be no fuel leakage from the fuel pipe between the fuel supply pump and common rail.
   ・There should be no fuel leakage from the fuel pipe between the common rail and injector.
   ・There should be no fuel leakage from the sleeve nut of the fuel pipe.

   2. If fuel leak if found, fix the problem.

   Note：

   - The fuel may leak to the bottom section of the cylinder head cover from the high pressure pipe inlet.
   - The engine oil level increases when the fuel leaks to the bottom portion of the cylinder head cover.
   - Inspect for fuel leaks into the engine oil.
   - Remove and inspect the high pressure pipe joint connected to the injector for a fuel leakage from the sleeve nut.
   - When foreign matter has been attached, replace the injector and the high pressure pipe.

   3. Remove each glow plug from the cylinder head assembly.

   Refer to "*1.Engine 1B.Mechanical(4HK1) Cylinder head assembly removal*".

   4. Inspect for fuel leaks into the combustion chamber
   5. Inspect to see if there is a cylinder from which fuel leaks into the combustion chamber.
   6. If fuel leak is found, replace the corresponding injector.

   Refer to "*1.Engine 1C.Fuel System(4HK1) Injector removal*".

   Refer to "*1.Engine 1C.Fuel System(4HK1) Injector installation*".

   7. When the injector has been replaced, set the injector ID code on the ECM.
   8. Turn OFF the ignition switch.
   9. Wait for the specified period of time until the fuel pressure is released from the common rail.

   specified time： 2 min

   10. Turn ON the ignition switch.
   11. Check the fuel rail pressure sensor display with the trouble diagnosis scan tool.

   voltage： 0.9 to 1.0 V

   12. If the fuel rail pressure sensor display is outside the specified range, inspect the fuel pressure sensor harness connector for a poor connection.
   13. If a problem is found, repair the harness connector.
   14. Inspect the ECM harness connector for a poor connection.
   15. If a problem is found, repair the harness connector.
   16. Inspect each circuit for high resistance.
   17. If a problem is found, repair the circuit.
   18. If the harness connector and each circuit are normal, replace the fuel pressure sensor.

   Refer to "*1.Engine 1C.Fuel System(4HK1) Common rail assembly removal*".

   Refer to "*1.Engine 1C.Fuel System(4HK1) Common rail assembly installation*".

   Note：

   - Do not replace the fuel pressure sensor separately. If a problem is found, replace the common rail assembly.

DTC P0123 (Flash Code 43)
Throttle Position Sensor Circuit High

1. DTC P0123 priority DTC

   DTC P1655

2. DTC P0123 diagnostics
   1. Turn OFF the ignition switch.
   2. Disconnect the harness connector from the intake throttle valve.
   3. Check the intake throttle position sensor display with the trouble diagnosis scan tool.

      voltage： 0.1 V
   4. If the reading is more than or equal to the specified value, inspect the signal circuit between the ECM and the intake throttle position sensor.

      ・There should be no short to the battery or ignition power supply.
      ・There should be no short to the 5 V power supply.
   5. If a problem is found, repair the signal circuit.
   6. Inspect the intake throttle valve harness connector for a poor connection.
   7. If a problem is found, repair the harness connector.
   8. If the harness connector is normal, replace the intake throttle valve.

      Refer to "*1.Engine 1B.Mechanical(4HK1) Intake throttle valve removal*".

      Refer to "*1.Engine 1B.Mechanical(4HK1) Intake throttle valve installation*".
   9. Inspect to see if there is an open circuit or high resistance in the GND circuit between the ECM and the intake throttle position sensor.

      Note：
      - The intake throttle position sensor shares the GND circuit with other sensors.
      - The DTC set on a sensor which shares this circuit may be detected.
   10. If a problem is found, repair the GND circuit.
   11. Check the ECM harness connector for a poor connection.
   12. If a problem is found, repair the harness connector.
   13. If the harness connector is normal, replace the ECM.

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM removal*".

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM installation*".
   14. Set the injector ID code on the ECM.
   15. Perform the unit difference learning of the fuel supply pump to the ECM.
3. DTC P0123 confirm resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   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.

5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P0336 (Flash Code 15)
Crankshaft Position Sensor Circuit Range/Performance

1. DTC P0336 priority DTC

   DTC P0335

   DTC P0340

   DTC P0641

2. DTC P0336 diagnostics

   1. Inspect the CKP sensor circuit.

   ・There should be enough clearing from the wiring or component of the fuel injection unit.
   ・There should be enough clearing from additionally installed electronic components.
   ・There should be enough clearing from the solenoids and relays.

   2. If a problem is found, repair the CKP sensor circuit.
   3. Turn OFF the ignition switch.
   4. Disconnect the harness connector from the ECM.
   5. Inspect the ECM harness connector for a poor connection.
   6. If a problem is found, repair the harness connector.
   7. Disconnect the harness connector from the CKP sensor.
   8. Inspect the CKP sensor harness connector for a poor connection.
   9. If a problem is found, repair the harness connector.
   10. Inspect the CKP sensor.

   Refer to "*1.Engine 1B.Mechanical(4HK1) CKP sensor inspection*".

   11. If a problem is found, replace the CKP sensor.

   Refer to "*1.Engine 1B.Mechanical(4HK1) CKP sensor removal*".

   Refer to "*1.Engine 1B.Mechanical(4HK1) CKP sensor installation*".

3. DTC P0336 confirm resolution

   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   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.

DTC P0428 (Flash Code 48)
Catalyst Temperature Sensor Circuit High Sensor 1

1. DTC P0428 priority DTC

   DTC P0697

2. DTC P0428 diagnostics
   1. Turn OFF the ignition switch.
   2. Disconnect the harness connector from the exhaust gas temperature sensor 1.
   3. Turn ON the ignition switch.
   4. Measure the voltage between the exhaust gas temperature sensor 1 signal circuit and normal GND.

      voltage： 5.5 V
   5. If the reading is more than or equal to the specified value, inspect to see if there is a short circuit to the battery or ignition power supply with the signal circuit between the ECM and the exhaust gas temperature sensor 1.
   6. If a problem is found, repair the signal circuit.
   7. Connect the test cable with fuse between the exhaust gas temperature sensor 1 signal circuit and GND circuit.
   8. Check the exhaust temperature sensor (before the filter) display with the trouble diagnosis scan tool.

      voltage： 0.1 V
   9. If the reading is less than or equal to the specified value, inspect to see if there is a short circuit to the 5 V power supply circuit with the signal circuit between the ECM and the exhaust gas temperature sensor 1.
   10. If a problem is found, repair the signal circuit.
   11. Inspect to see if there is a poor connection with the exhaust gas temperature sensor 1 harness connector.
   12. If a problem is found, repair the harness connector.
   13. If the harness connector is normal, 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*".
   14. Connect the test cable with fuse between the exhaust gas temperature sensor 1 signal circuit and normal GND.
   15. Check the exhaust temperature sensor (before the filter) display with the trouble diagnosis scan tool.

       voltage： 0.1 V
   16. If the reading is more than or equal to the specified value, inspect to see if there is an open circuit or high resistance with the signal circuit between the ECM and the exhaust gas temperature sensor 1.
   17. If a problem is found, repair the signal circuit.
   18. Inspect to see if there is an open circuit or high resistance in the GND circuit between the ECM and the exhaust gas temperature sensor 1.

       Note：
       - The exhaust gas temperature sensor 1 shares the GND circuit with other sensors.
       - The DTC may be detected on a sensor which shares this circuit.
   19. If a problem is found, repair the GND circuit.
   20. Inspect the ECM harness connector for a poor connection.
   21. If a problem is found, repair the harness connector.
   22. If the harness connector is normal, replace the ECM.

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM removal*".

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM installation*".
   23. Set the injector ID code on the ECM.
   24. Perform the unit difference learning of the fuel supply pump to the ECM.
3. DTC P0428 confirm resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   3. Start the engine and warm it up until the coolant temperature exceeds the specified value.

      values： 70 ℃ { 158 °F }
   4. Repeatedly rev the engine in neutral to increase the engine speed while checking the exhaust temperature sensor (in front of the filter) display with the trouble diagnosis scan tool.
   5. Use the trouble diagnosis scan tool to confirm that the exhaust temperature sensor (before the filter) display does not exceed the specified value.

      voltage： 4.8 V
   6. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P0602 (Flash Code 154)
Control Module Programming Error

1. DTC P0602 diagnostics
   1. Confirm that the connecting sections of all tools are securely connected.
   2. Confirm that the programming device is operating normally.
   3. Use the trouble diagnosis scan tool to confirm that the correct injector ID code has been entered to the ECM.

      Note：
      - When the injector ID code has been correctly input, clear the DTC using the trouble diagnosis scan tool.
   4. Turn OFF the ignition switch for at least 30 seconds.
   5. Turn ON the ignition switch.
   6. Use the trouble diagnosis scan tool to check if a DTC has been detected.
   7. If a DTC has been detected, replace the ECM.

      Refer to "*1.Engine 1J.Electrical(4HK1) ECM removal*".

      Refer to "*1.Engine 1J.Electrical(4HK1) ECM installation*".
   8. Set the injector ID code on the ECM.
   9. Perform the unit difference learning of the fuel supply pump to the ECM.
2. DTC P0602 confirm resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   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.

DTC P0687 (Flash Code 416)
ECM/PCM Power Relay Control Circuit High

1. DTC P0687 diagnostics
   1. Turn OFF the ignition switch.
   2. Remove the main relay.
   3. Turn ON the ignition switch.
   4. Use the trouble diagnosis scan tool to see if DTC P0685 is detected.
   5. If the DTC P0685 is not detected, repair the short circuit to the battery power supply of the power supply circuit between the ECM and main relay.
   6. Turn OFF the ignition switch for at least 30 seconds.
   7. Replace the main relay with a glow relay or normal relay.
   8. Turn ON the ignition switch.
   9. Use the trouble diagnosis scan tool to check if DTC P0687 has been detected.
   10. If the DTC P0687 is not detected, replace the main relay.
2. DTC P0687 confirm resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   3. Turn ON the ignition switch.
   4. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P1293 (Flash Code 221)
Fuel Filter Pressure Sensor Circuit Low

1. DTC P1293 priority DTC

   DTC P0697

2. DTC P1293 diagnostics
   1. Turn OFF the ignition switch.
   2. Disconnect the harness connector from the fuel filter pressure sensor.
   3. Turn ON the ignition switch.
   4. Measure the voltage between the 5 V power supply circuit of the fuel filter pressure sensor harness connector and normal GND .

      voltage： 4.5 V
   5. If the reading is less than or equal to the specified value, inspect to see if there is an open circuit or high resistance with the 5 V power supply circuit between the ECM and the fuel filter pressure sensor.

      Note：
      - The fuel filter pressure sensor shares the 5 V power supply circuit with other sensors.
      - The DTC set on a sensor which shares this circuit may be detected.
   6. If a problem is found, repair the 5 V power supply circuit.
   7. Connect the test cable with fuse between the 5 V power supply circuit and signal circuit of the fuel filter pressure sensor harness connector.
   8. Check the fuel filter pressure sensor display with the trouble diagnosis scan tool.

      voltage： 4.5 V
   9. If the reading is more than or equal to the specified value, inspect to see if there is a poor connection with the fuel filter pressure sensor harness connector.
   10. If a problem is found, repair the harness connector.
   11. If the harness connector is normal, replace the fuel filter pressure sensor.

       Refer to "*1.Engine 1C.Fuel System(4HK1) Fuel filter pressure sensor removal*".

       Refer to "*1.Engine 1C.Fuel System(4HK1) Fuel filter pressure sensor installation*".
   12. Inspect the signal circuit between the ECM and the fuel filter pressure sensor.

       ・There should be no open circuit or high resistance.
       ・There should be no short to GND.
   13. If a problem is found, repair the signal circuit.
   14. Inspect the ECM harness connector for a poor connection.
   15. If a problem is found, repair the harness connector.
   16. If the harness connector is normal, replace the ECM.

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM removal*".

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM installation*".
   17. Set the injector ID code on the ECM.
   18. Perform the unit difference learning of the fuel supply pump to the ECM.
3. DTC P1293 confirm resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   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.

DTC P1669 (Flash Code 75)
DPD Lamp Control Circuit

1. DTC P1669 diagnostics
   1. Confirm that the monitor panel operates properly.
   2. Turn OFF the ignition switch.
   3. Inspect the fuse.
   4. If a problem is found, replace the fuse.

      Note：
      - If the fuse is blown again, repair the cause of fuse blowout.
   5. Turn OFF the ignition switch.
   6. Disconnect the harness connector from the ECM.
   7. Turn ON the ignition switch.
   8. Check to see if the DPD light is off.
   9. If the DPD light is not turned off, repair the short circuit to GND in the DPD light control circuit between the ECM and the monitor panel.
   10. Turn OFF the ignition switch.
   11. Remove the fuse.
   12. Turn ON the ignition switch.
   13. Measure the voltage between the DPD light control circuit and GND of the ECM harness connector.

       voltage： 1.0 V
   14. If the reading is more than or equal to the specified value, repair the short circuit to the battery or ignition power supply circuit in the DPD light control circuit between the ECM and the monitor panel.
   15. Turn OFF the ignition switch.
   16. Install the fuse.
   17. Connect the test cable with fuse between the DPD light control circuit and GND of the ECM harness connector.
   18. Turn ON the ignition switch.
   19. If the DPD light turns on, inspect the ECM harness connector for a poor connection.
   20. If a problem is found, repair the harness connector.
   21. If the harness connector is normal, replace the ECM.

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM removal*".

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM installation*".
   22. Set the injector ID code on the ECM.
   23. Perform the unit difference learning of the fuel supply pump to the ECM.
   24. If the DPD light does not turn on, remove the DPD light bulb from the monitor panel.
   25. Inspect the DPD light bulb.
   26. If a problem is found, replace the valve.
   27. Inspect to see if there is an open circuit or high resistance in the ignition power supply circuit between the fuse and the monitor panel.
   28. If a problem is found, repair the ignition power supply circuit.
   29. Inspect to see if there is an open circuit or high resistance in the DPD light control circuit between the ECM and the monitor panel.
   30. If a problem is found, repair the control circuit.
   31. Inspect the monitor panel harness connector for a poor connection.
   32. If a problem is found, repair the harness connector.
   33. When the harness connector is normal, replace the monitor panel.
2. DTC P1669 confirm resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   3. Turn ON the ignition switch, and wait for 40 seconds.
   4. Start the engine.
   5. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

DTC P2228 (Flash Code 71)
Barometric Pressure Circuit Low

1. DTC P2228 priority DTC

   DTC P0651

2. DTC P2228 diagnostics
   1. Turn OFF the ignition switch.
   2. Disconnect the harness connector from the barometric pressure sensor.
   3. Turn ON the ignition switch.
   4. Measure the voltage between the barometric pressure sensor 5 V power supply circuit and GND.

      voltage： 4.5 V
   5. If the reading is less than or equal to the specified value, inspect to see if there is an open circuit or high resistance with the 5 V power supply circuit between the ECM and the barometric pressure sensor.
   6. If a problem is found, repair the 5 V power supply circuit.
   7. Connect the test cable with fuse between the barometric pressure sensor 5 V power supply circuit and the signal circuit.
   8. Check the barometric pressure sensor display with the trouble diagnosis scan tool.

      voltage： 4.5 V
   9. If the reading is more than or equal to the specified value, inspect to see if there is a poor connection with the atmospheric pressure sensor harness connector.
   10. If a problem is found, repair the harness connector.
   11. If the harness connector is normal, replace the barometric pressure sensor.
   12. If the reading is less than or equal to the specified value, inspect the signal circuit between the ECM and the barometric pressure sensor.

   ・There should be no open circuit or high resistance.
   ・There should be no short to GND.

   13. If a problem is found, repair the signal circuit.
   14. Inspect the ECM harness connector for a poor connection.
   15. If a problem is found, repair the harness connector.
   16. If the harness connector is normal, replace the ECM.

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM removal*".

       Refer to "*1.Engine 1J.Electrical(4HK1) ECM installation*".
   17. Set the injector ID code on the ECM.
   18. Perform the unit difference learning of the fuel supply pump to the ECM.

3. DTC P2228 confirm resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   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.

DTC P2456 (Flash Code 47)
DPD Differential Pressure Sensor Learned Position

1. DTC P2456 priority DTC

   DTC P2454

   DTC P2455

2. DTC P2456 diagnostics
   1. Turn OFF the ignition switch.
   2. Disconnect the harness connector from the exhaust differential pressure sensor.
   3. Inspect the exhaust differential pressure sensor harness connector for a poor connection.
   4. If a problem is found, repair the harness connector.
   5. Disconnect the harness connector from the ECM.
   6. Inspect the ECM harness connector for a poor connection.
   7. If a problem is found, repair the harness connector.
   8. Inspect the circuit between the ECM and exhaust differential pressure sensor for an open circuit and high resistance.
   9. If a problem is found, repair the circuit.
   10. If the circuit is normal, replace the exhaust differential pressure sensor.

       Refer to "*1.Engine 1G.Exhaust(4HK1) Exhaust differential pressure sensor removal*".

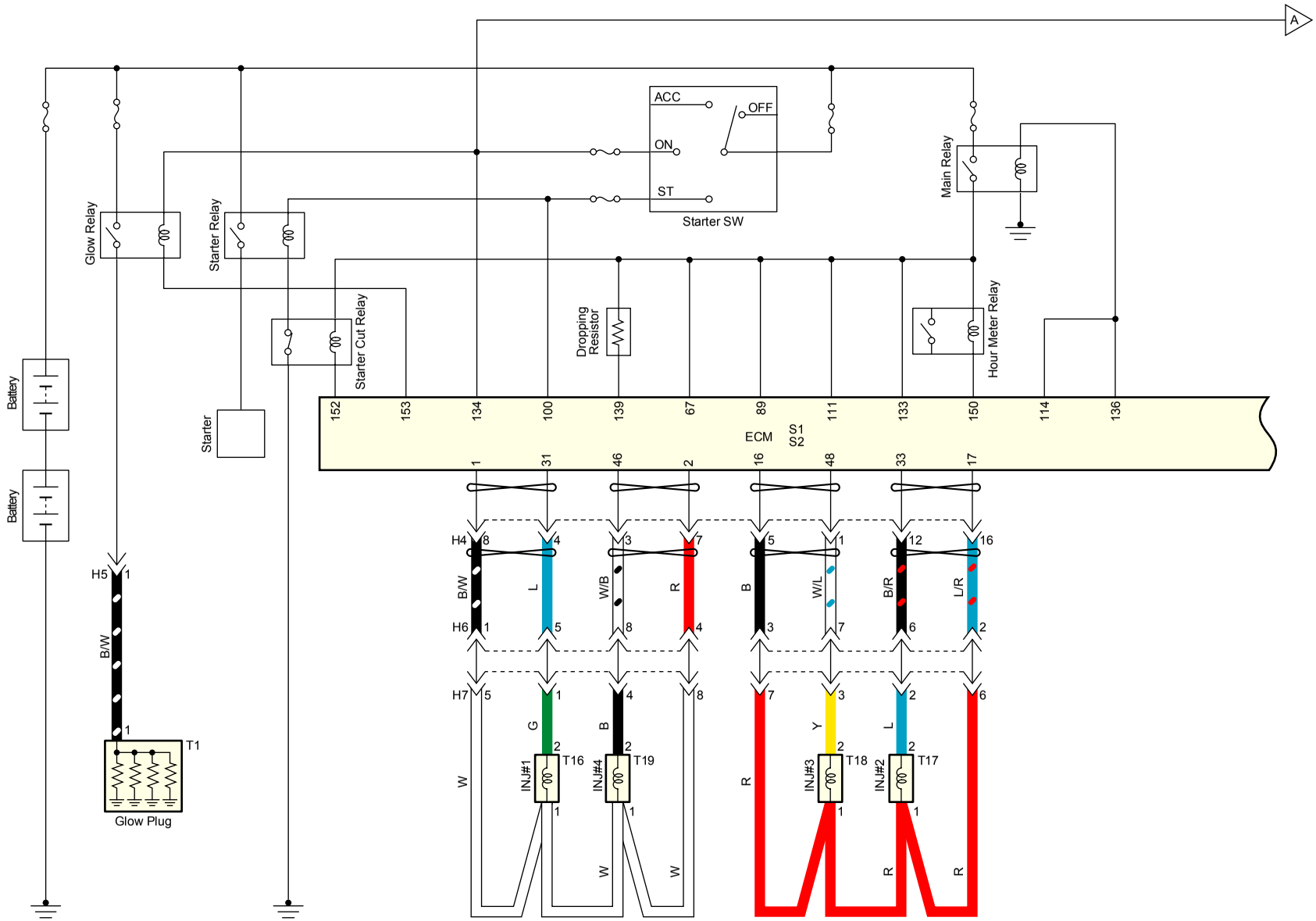
       Refer to "*1.Engine 1G.Exhaust(4HK1) Exhaust differential pressure sensor installation*".

   11. When the exhaust differential pressure sensor has been replaced, perform the 0-point correction.

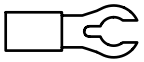
       Refer to "*1.Engine 1G.Exhaust(4HK1) Exhaust differential pressure sensor inspection*".

3. DTC P2456 confirm resolution
   1. Clear the DTC using the trouble diagnosis scan tool.
   2. Turn OFF the ignition switch for at least 30 seconds.
   3. While checking the DTC information with the trouble diagnosis scan tool, turn ON the ignition switch for 30 seconds.
   4. Use the trouble diagnosis scan tool to confirm that a DTC has not been detected.

(Specifications vary depending on each machine. Refer to the machine's manual.)



T1



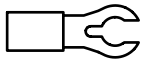
T2

Dark Brown

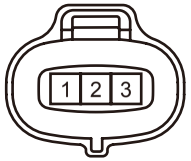
T3

Gray

T4



T5



Black

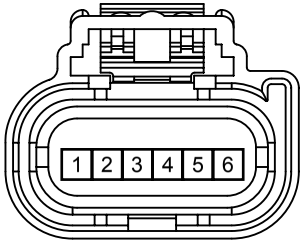
T6

Black

T7

Black

T8

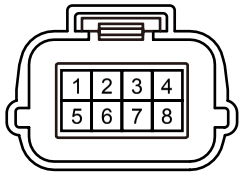


Black

T9

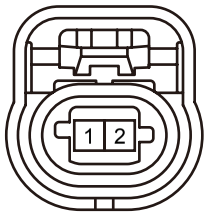
Dark Gray

T10



Dark Brown

T11

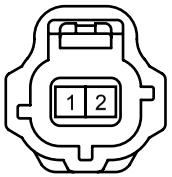


Black

T12

Light Gray

T13



Dark Green

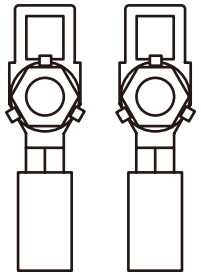
T14

Gray

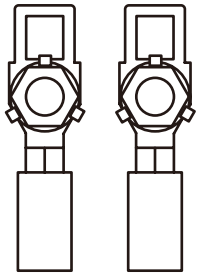
T15

Light Gray

T16



T17



T18