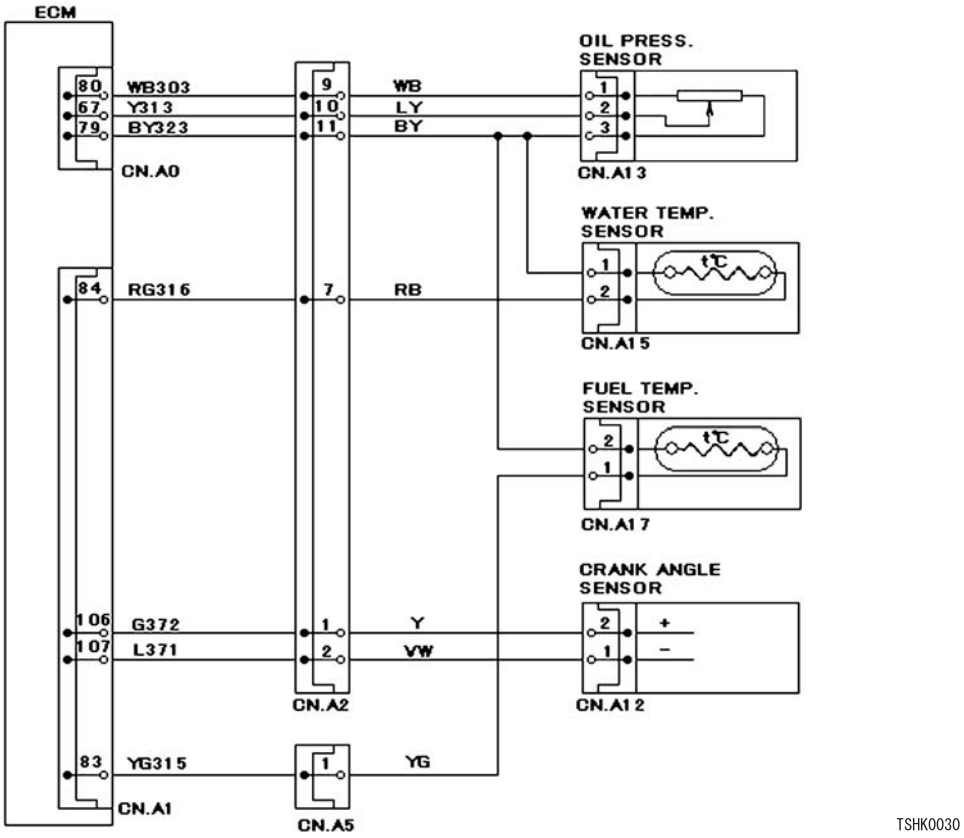
Introduction

This Troubleshooting Manual explains troubleshooting of the engine electronic control fuel injection system (common rail type) and main unit of the hydraulic excavator equipped with 4JJ1 type engine.
(SH130-5, SH160-5)

Extensive use of this manual is useful for performing accurate and quick maintenance procedures.

Sumitomo (S.H.I) Construction Machinery Manufacturing Co.,Ltd
Customer Support Dept.

6 → **Block diagram.**



7 → **Recovery from failure.**

- Fault judgement needs 3 to 10 minutes.

8 → **Preconditions when DTC is set.**

- Key switch input voltage is 18 V or more.
- DTC:1630 or 1633 is not detected.

9 → **Diagnostic aid.**

- DTC may be set at a overheat condition.
- After starting the engine, the thermostat begins to open when the engine coolant temperature rises (85 ˚C), and the engine coolant temperature is stabilized.
- To make sure the correct performance of the ECT sensor, check with various temperatures using the reckoner table between temperature and resistance.

If the sensor is faulty, operationality may be affected.
If the intermittent trouble is suspected, followings may be the cause.

- Improper connection of harness connector.
- Defective harness routing.
- Worn harness cladding.
- Wire disconnection inside harness cladding.

TSSA-0004E

6	Circuit explanation System circuit diagram related to trouble
7	Recovery from failure Record of recovery to normal operation after trouble was eliminated.
8	Preconditions when diagnostic trouble code is set Conditions for judging presence of trouble with preconditions met.
9	Diagnostic aid All of the causes of expected trouble are listed, and important ideas for diagnosis are gathered. Make sure to read this before trouble diagnosis.

Terminology explanation

Diagnostic trouble code

Each time that the key switch is turned ON, the ECM and computer A performs a self-test for most all of the wiring and component parts. If a system problem is detected, this is saved in the memory of the ECM and computer A and back-up control is performed depending on the diagnostic trouble code.Also, abnormalities that affect the shovel main unit will cause a message to be displayed to inform the operator.

Ignition cycle

The ignition cycle refers to the machine operation cycle of turning the key ON, running the machine, and turning the key OFF used to satisfy the prescribed main unit diagnosis criteria.

Data link connector (DLC)

The equipment for communicating with the control unit is a data link connector (DLC).Also, the DLC is provided in order to connect with scan tools.The general uses of scan tools are shown below.

- Identification of saved diagnostic trouble codes
- Reading of serial data

Note:
See the main unit manual as the DLC installation location and whether or not there is a DLC will vary according to the shovel main unit.

ECM OFF

If the key switch is turned OFF, power to the ECM will be completely turned OFF and the ECM will go into the ECM OFF state after about 10 sec. or more.

Comprehensive diagnosis operations of component parts monitoring

To make the engine operate normally, comprehensive diagnosis of component parts is necessary.

Input component parts:

Confirm the input component parts in order to inspect for circuit disconnections and values outside of the prescribed range.
The following are sensors for input component parts, but sensors are not limited to just these.

- Crankshaft position (CKP) sensor
- Camshaft position (CMP) sensor
- Coolant temperature sensor
- Boost pressure sensor
- Common rail pressure sensor

Output component parts:

Output component parts diagnose whether responses to control unit commands are appropriate or not.Confirm whether there are any circuit disconnections and whether any values are outside the prescribed ranges.
The following are circuits in output components parts that are checked, but circuits are not limited to just these.

- SCV
- Lamp, relay control
- EGR valve

Examples of symptoms in which injector inspection is necessary

Symptoms for which an injector operation problem is sometimes the cause include lack of engine power, unstable rotation, and abnormal engine noises.
However, because these are mechanical problems (spray deficiencies, clogging, seizing), a diagnostic trouble code does not display.
Temperature measurement using a thermogun is an effective trouble diagnosis method.
Symptom examples that appear in this manual for which injector inspection is necessary are listed below.

Problem symptoms

- Engine starting defects
- Engine hunting, rough idling
- Engine output deficiencies
- Great deal of white smoke in exhaust gas
- High fuel consumption

Sorting Methods Using Noncontact Infrared Thermometer

The 3 injector sorting methods are shown below. The sorting method will vary depending on the difficulty of judgment which will vary according to the existence of certain tools and the model, so see "Diferrence by each machine manufacturer".

Sorting methods

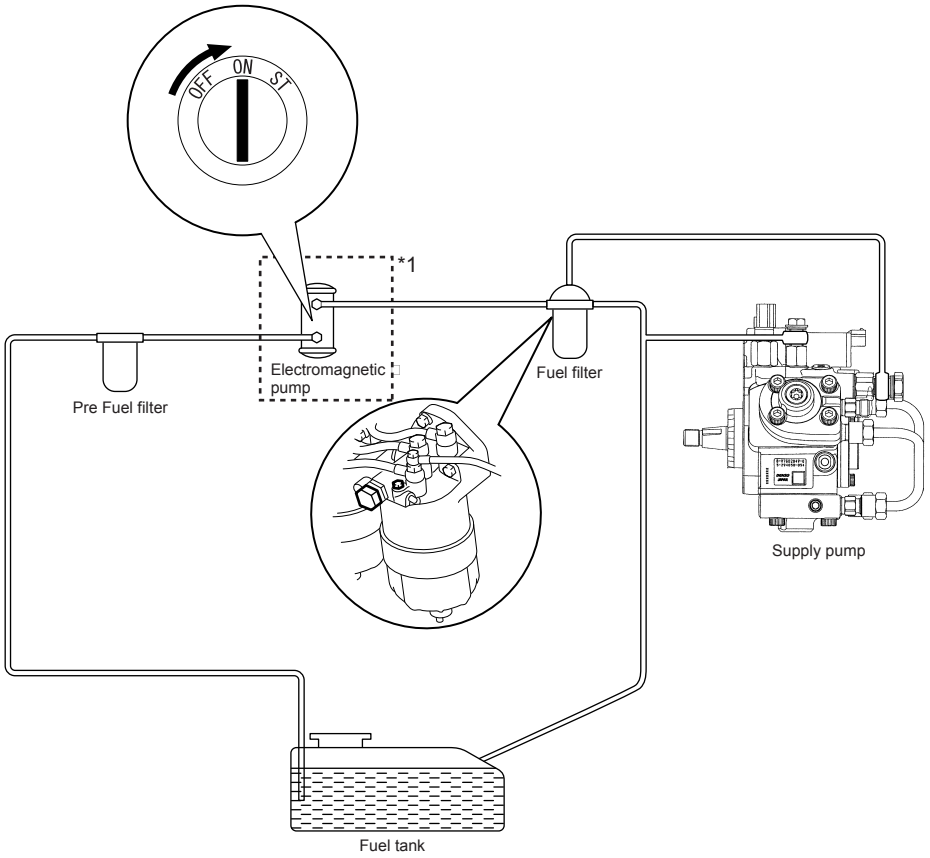
1. Judgement method using injector balance test performed with trouble diagnosis tool using Tech-II KW, CAN communication.
   - See "Injector balance test, Tech2, How to use trouble diagnosis-related tool" for the balance test method.
2. Judgment method using injector balance test in which communication with the ECM is not performed and an injector checker is used to disconnect the injector power line for a short period.ECM
   - See "How to use injector checker, How to inspect injector".
3. Judgment method in which measurement and comparison of exhaust gas temperature increase tendencies is performed using a noncontact infrared thermometer.

When there are no trouble diagnosis tools and only injector checker methods are used, proficiency in judgment may be required depending on the main unit type.If judgment is difficult, the judgment method consisting of comparing exhaust pipe temperatures using a noncontact infrared thermometer is recommended.

Measurement method

Use an infrared thermometer that is capable of measuring temperatures of 500 °C and perform continuous measurement at the rated point in which the engine condition is stable (For shovels, this is the point from 2 pumps relief.) and measurement can be done.
If the exhaust pipe temperature of one of the cylinders is markedly lower than the others when each of the cylinder temperatures is measured and compared during a measurement period 3 to 5 min. after the engine has stabilized, it is judged that there is a problem with this cylinder.

Fuel system air bleeding



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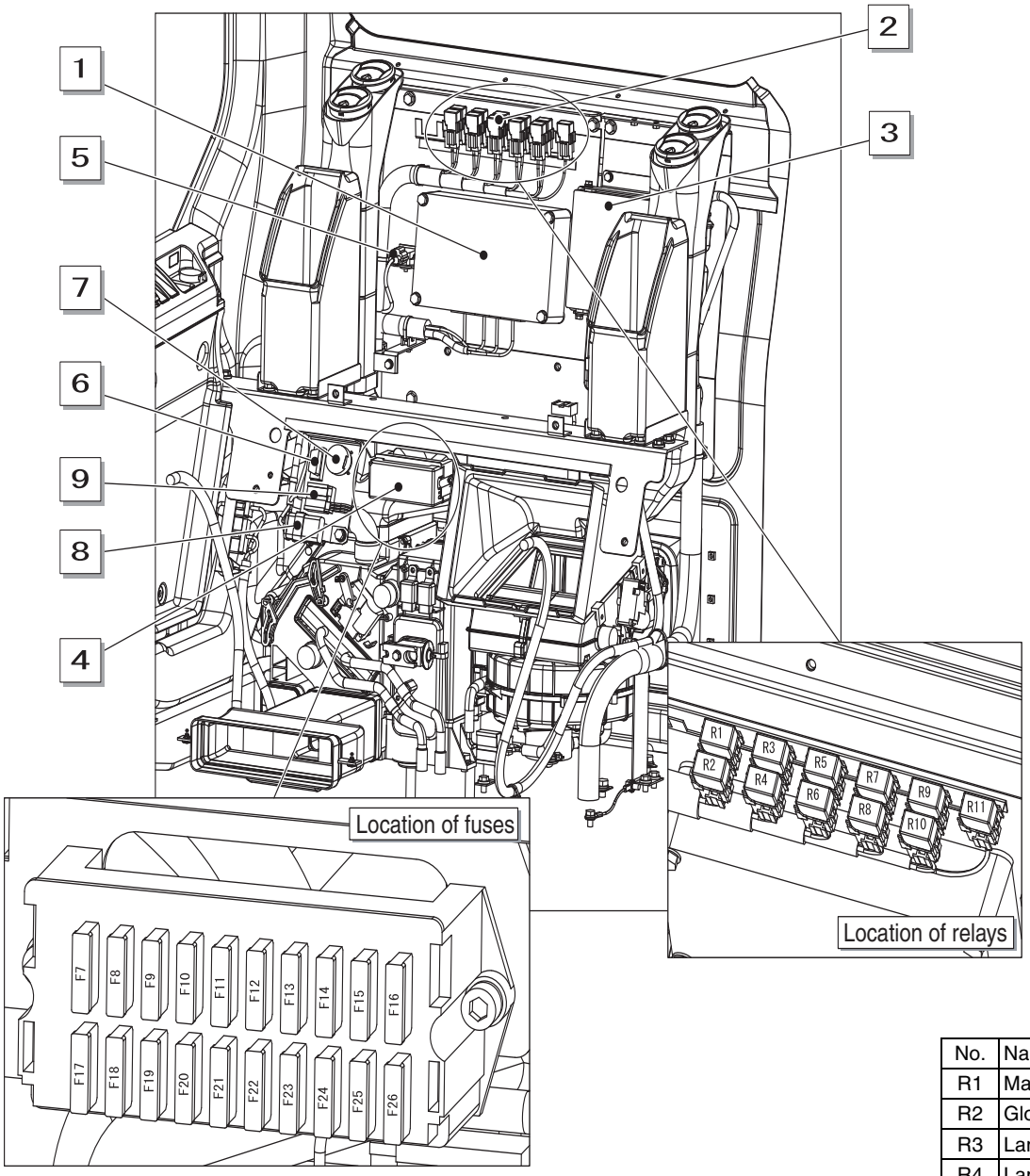
1. Place a suitable drip pan under the air bleed plug.
2. Turn the key switch ON to operate the charge fuel pump.
3. Sufficiently loosen the fuel filter air bleed plug and operate the priming pump at least 20 times until fuel begins to spill out from near the plug.
4. Tighten the plug and operate the priming pump at least 10 times until fuel is fully filled.
   After waiting about 1 min., loosen the plug and bleed the air out of the fuel filter.(Repeat this at least 3 times until air no longer comes out from the plug.)
5. Securely fasten each plug and wipe away any spilled fuel around the plugs.Operate the priming pump until fuel is fully filled and fuel has reached the engine. (10 - 15 times)

EGR (exhaust gas recirculation)

EGR system is an abbreviation for "exhaust gas recirculation" system. The EGR system recirculates part of the exhaust gas in the intake manifold and mixes inactive gases with the suction air to reduce the combustion temperature and suppress the generation of nitrogen oxides (NOx).
The EGR quantity is controlled by the operation (opening and closing) of the EGR valve, which is installed between the exhaust manifold and the intake manifold.The ERG quantity is determined from the engine speed and engine load ratio (fuel injection quantity), the EGR valve is operated, and the EGR amount is controlled.
A cooling system (EGR cooler) is installed in the EGR gas path to cool the high-temperature EGR gas with this EGR cooler. This cooled EGR gas is mixed with new air intake to make the combustion temperature lower than with normal EGR, which contributes to the reduction of NOx.(Cooled EGR)



No.	PART NAME	
F7	BACK UP RADIO, ROOM LAMP	10A
F8	ENGINE PRE-HEAT	30A
F9	OPTION LINE	10A
F10	AIR-CONDITIONER UNIT	5A
F11	AIR-CONDITIONER BLOWER	15A
F12	AIR-CONDITIONER COMPRESSOR	5A
F13	SOLENOID	10A
F14	WIPER WASHER	15A
F15	HORN	10A
F16	LAMP (BOOM, HOUSE)	15A

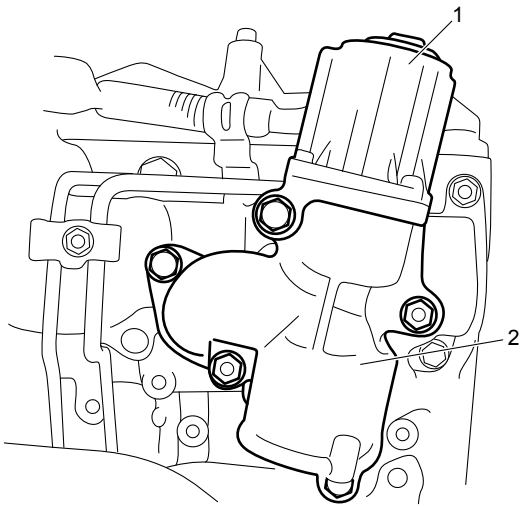
No.	PART NAME	
F17	FUEL FEED PUMP	20A
F18	CLOCK BACK MONITOR	10A
F19	CIGAR LIGHTER KAB SEAT	15A
F20	DC CONVERTER	10A
F21	TRAVEL ALARM BEACON	10A
F22	SPARE (CRANE)	15A
F23	ELEC. FUEL PUMP	10A
F24	LAMP (SPARE)	15A
F25	LOCK LEVER (GATE)	10A
F26	LAMP (CAB)	15A

No.	Name
R1	Main relay
R2	Glow relay
R3	Lamp relay
R4	Lamp relay (CAB)
R5	Horn relay L
R6	Horn relay R
R7	Speaker relay R
R8	Speaker relay L
R9	Room lamp relay
R10	Beacon relay
R11	Starter cut relay

RE01004-002

1	Computer A
2	Relay
3	ECM (engine control module)
4	Fuse box
5	Atmospheric pressure sensor
6	TECH II service connector
7	EST service connector
8	Computer A service connector
9	Computer S service connector

EGR sensor



TSJJ0125

Name

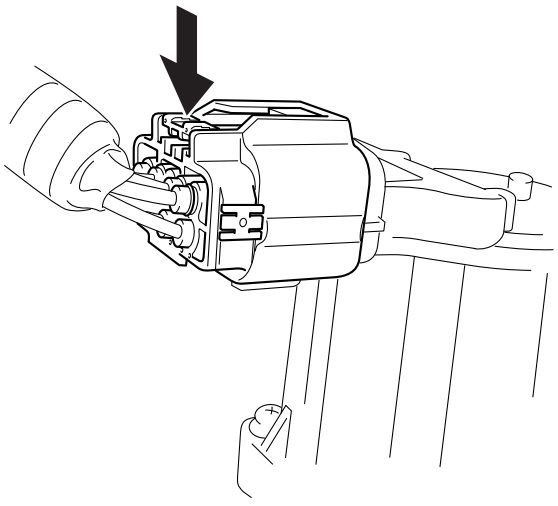
1. EGR sensor
2. EGR valve

Installed within the EGR valve and detects the EGR valve lift amount.

Note:
Do not disassemble the EGR sensor.If there is a problem, replace the entire EGR valve assembly.

Removal

- Remove the connector, remove the 12 mm installation bolt and nut, and remove the EGR valve assembly.

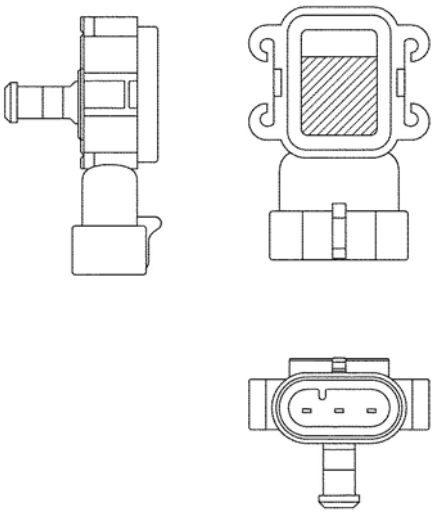


TSJJ0009

Installation

Tightening torque: 27 N•m

Boost pressure sensor



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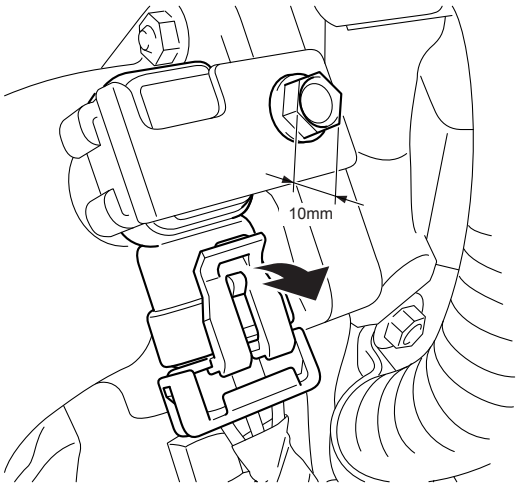
The boost pressure sensor uses a pressure hose between the boost pressure sensor and the intake pipe to detect the boost (suction air pressure), converts this pressure into a voltage signal and sends this to the engine control module (ECM).The higher the pressure, the higher the voltage, and the lower the pressure, the lower the voltage.The ECM calculates the boost (suction pressure) from the voltage signal sent from the sensor and uses this for fuel injection control.

Removal

- Remove the connector, remove the 2 10 mm installation bolts and hose, and remove the sensor.

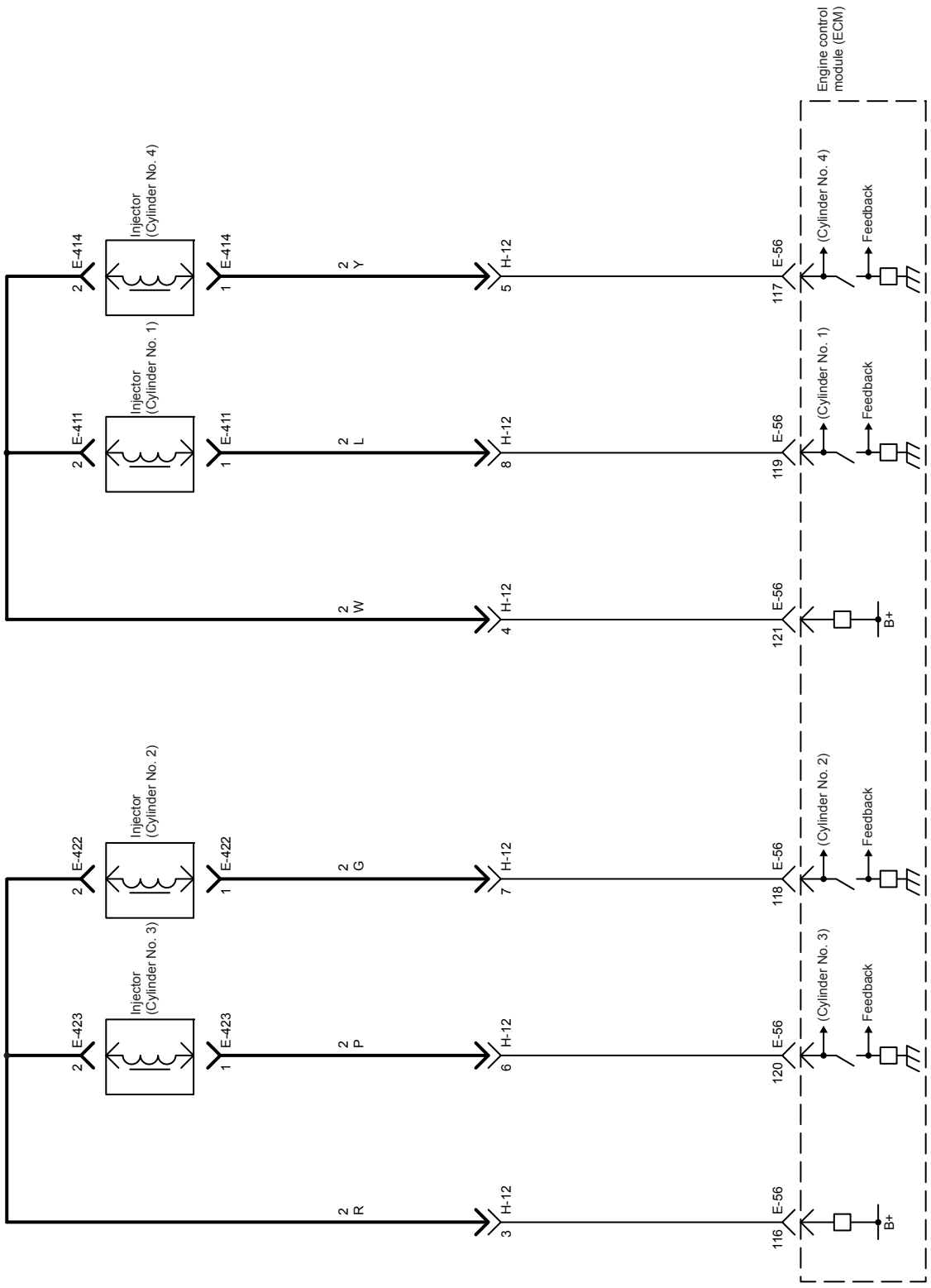


TSJJ0014

Installation

Tightening torque: 10 N•m

Injector circuit



TSJJ0024

E423

Terminal No.	
1	OS-INJ2 Signal/injector #3
2	Injector power supply 2

H1

Terminal No.	
1	Glow

H6

Terminal No.	
1	SCV-Lo
2	SCV-Hi
3	Fuel temperature sensor +
4	ECT (meter)
5	-
6	Overheat switch

H8

Terminal No.	
1	EGR sensor U
2	EGR sensor V
3	EGR sensor W
4	EGR Vcc
5	EGR motor U
6	EGR motor V
7	EGR motor W
8	EGR GND

H12

Terminal No.	
1	-
2	-
3	Injector power supply 2
4	Injector power supply 1
5	OS-INJ3 Signal/injector #4
6	OS-INJ2 Signal/injector #3
7	OS-INJ4 Signal/injector #2
8	OS-INJ1 Signal/injector #1
9	-
10	-
11	-
12	-

H20

Terminal No.	
1	CKP GND
2	CKP Vout
3	CKP shield
4	CKP Vcc
5	CMP Vout
6	CMP/common rail pressure sensor shield
7	ECT +
8	Boost pressure sensor Vcc
9	Oil pressure sensor Vcc
10	Oil pressure sensor Vout
11	Oil pressure sensor GND
12	Common rail pressure sensor Vcc
13	Common rail pressure sensor Vout
14	Common rail pressure sensor GND
15	Boost temperature sensor +
16	Boost pressure sensor Vout
17	Boost pressure sensor GND
18	CMP GND
19	CMP Vcc
20	-

H22

Terminal No.	
1	Glow

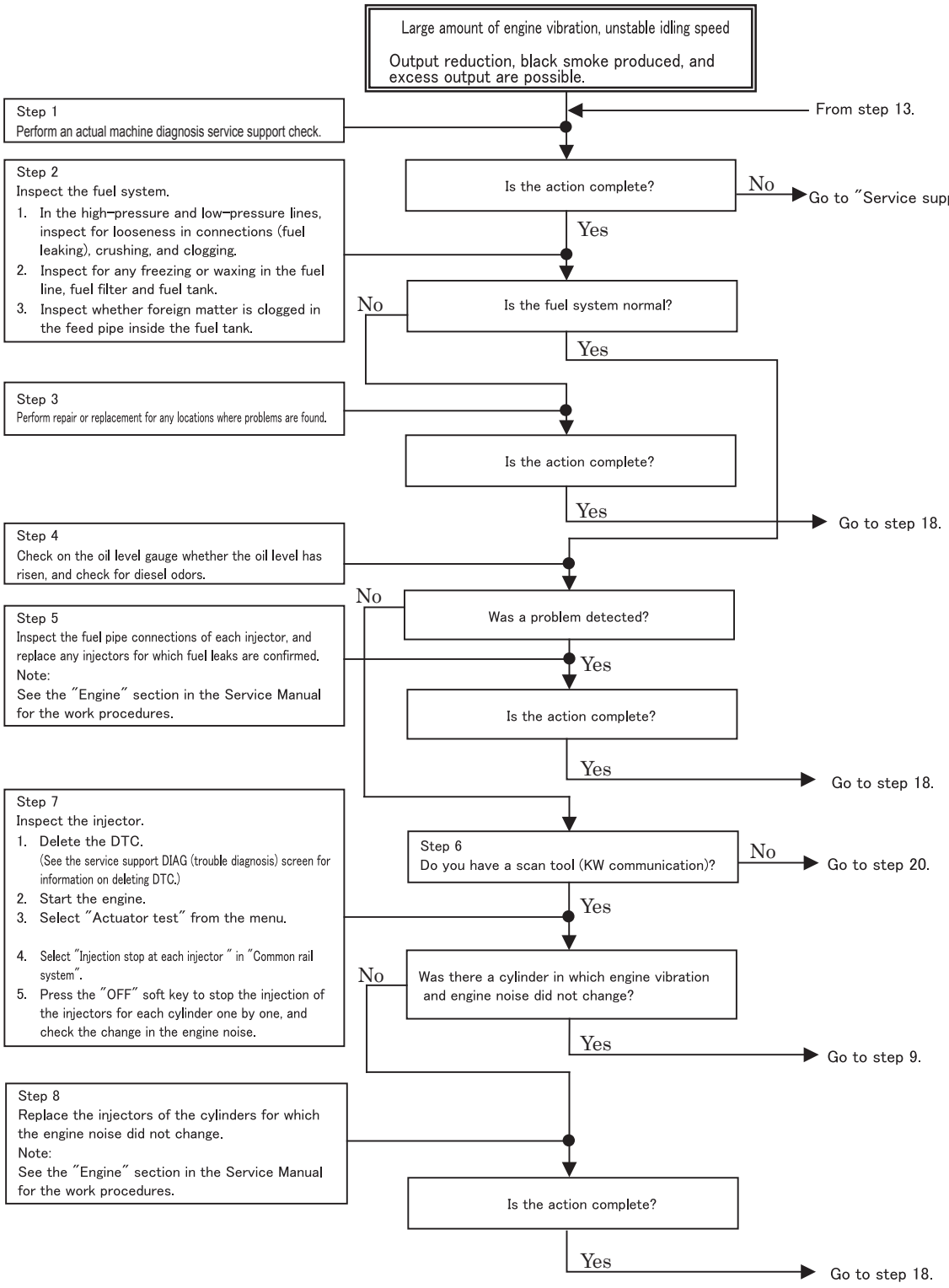
Test explanation

The numbers shown below correspond to step numbers in the table.
4. If the SCV-LOW circuit is short-circuited with the ground, the SCV drive current will not rise above 900 mA.
5. If the engine starts with the SCV connector disconnected, there is a possible abnormality in the SCV system.If the engine does not start, there is a possible abnormality in the fuel system.
6. Check the signal and operation of each sensor and injector.

Step	Action	Value	Yes	No
1	Is there an emergency stop switch mounted?	-	Turn the switch "OFF" and go to step 2.	Go to step 2.
2	1. Turn the key switch "ON". 2. Crank the engine for 15 sec. 3. Confirm the diagnostic trouble code. Was a diagnostic trouble code detected?	-	Go to diagnosis for the detected diagnostic trouble code.	Go to step 3.
3	1. Inspect the SCV-LOW circuit between the ECM and SCV. 2. Correct the circuit as necessary if a problem is detected. Is the action complete?	-	Go to step 4.	-
4	1. Inspect whether any of the abnormalities listed below are present. ・ Lag in engine mechanical timing ・ Flywheel installation position problem ・ Excessive clogging in suction air system ・ Excessive clogging in exhaust system 2. Repair as necessary if a problem is detected. Was a problem detected?	-	Go to step 5.	-
5	1. Delete the diagnostic trouble code. 2. Turn the key switch "OFF" for at least 10 sec. 3. Start the engine. Was a problem detected?	-	Go to step 6.	Go to step 3.
6	Confirm the diagnostic trouble code. Was a diagnostic trouble code detected?	-	Go to diagnosis for the detected diagnostic trouble code.	Check repair and go to "Trouble Diagnosis by Service Support".

DTC	DTC name	Detected item	Preconditions when DTC is set	DTC setting conditions	Trouble judgment time	Behavior during trouble	Recovery from failure	Conceivable cause
0201	No. 1 cylinder injector drive system disconnection	No. 1 cylinder injector electrical wiring disconnection or short	・ Main relay power supply voltage is 18 V or higher. ・ At least 70 min^{-1} ・ DTC: 0611, 1261 are not detected.	No No. 1 cylinder injector monitor input signal	About 3 sec.	High engine vibration, unstable idling speed, output reduction, revving problem Back-up: No. 1 cylinder injector injection stop, EGR stop	*1	Wiring problem (disconnection, short, high resistance) between ECM and No. 1 cylinder injector intermediate connector No. 1 cylinder injector terminal looseness Wiring problem (disconnection, high resistance) between No. 1 cylinder injector intermediate connector and No. 1 cylinder injector terminal No. 1 cylinder injector problem ECM internal problem
0202	No. 2 cylinder injector drive system disconnection	No. 2 cylinder injector electrical wiring disconnection or short	・ Main relay power supply voltage is 18 V or higher. ・ At least 70 min^{-1} ・ DTC: 0612, 1262 are not detected.	No No. 2 cylinder injector monitor input signal	About 3 sec.	High engine vibration, unstable idling speed, output reduction, revving problem Back-up: No. 2 cylinder injector injection stop, EGR stop	*1	Wiring problem (disconnection, short, high resistance) between ECM and No. 2 cylinder injector intermediate connector No. 2 cylinder injector terminal looseness Wiring problem (disconnection, high resistance) between No. 2 cylinder injector intermediate connector and No. 2 cylinder injector terminal No. 2 cylinder injector problem ECM internal problem
0203	No. 3 cylinder injector drive system disconnection	No. 3 cylinder injector electrical wiring disconnection or short	・ Main relay power supply voltage is 18 V or higher. ・ At least 70 min^{-1} ・ DTC: 0612, 1262 are not detected.	No No. 3 cylinder injector monitor input signal	About 3 sec.	High engine vibration, unstable idling speed, output reduction, revving problem Back-up: No. 3 cylinder injector injection stop, EGR stop	*1	Wiring problem (disconnection, short, high resistance) between ECM and No. 3 cylinder injector intermediate connector No. 3 cylinder injector terminal looseness Wiring problem (disconnection, high resistance) between No. 3 cylinder injector intermediate connector and No. 3 cylinder injector terminal No. 3 cylinder injector problem ECM internal problem
0204	No. 4 cylinder injector drive system disconnection	No. 4 cylinder injector electrical wiring disconnection or short	・ Main relay power supply voltage is 18 V or higher. ・ At least 70 min^{-1} ・ DTC: 0611, 1261 are not detected.	No No. 4 cylinder injector monitor input signal	About 3 sec.	High engine vibration, unstable idling speed, output reduction, revving problem Back-up: No. 4 cylinder injector injection stop, EGR stop	*1	Wiring problem (disconnection, short, high resistance) between ECM and No. 4 cylinder injector intermediate connector No. 4 cylinder injector terminal looseness Wiring problem (disconnection, high resistance) between No. 4 cylinder injector intermediate connector and No. 4 cylinder injector terminal No. 4 cylinder injector problem ECM internal problem
0219	Overrun	Abnormally high engine rotation	Key switch input voltage is 18 V or higher.	When the engine speed exceeded the set speed SH130-5 : 2200 min^{-1} SH160-5 : 2400 min^{-1}	About 1 sec.	Output reduction Back-up: Injection quantity restriction 1 If engine speed falls, control is released.	*2	Engine main unit abnormality (common rail, supply pump, injector) Necessary to check whether other DTCs appear Mechanical engine trouble (turbo damage, engine oil mixed in) ECM internal problem

DTC: 0087
Abnormally Low Common Rail Pressure (supply pump not sending pressure)



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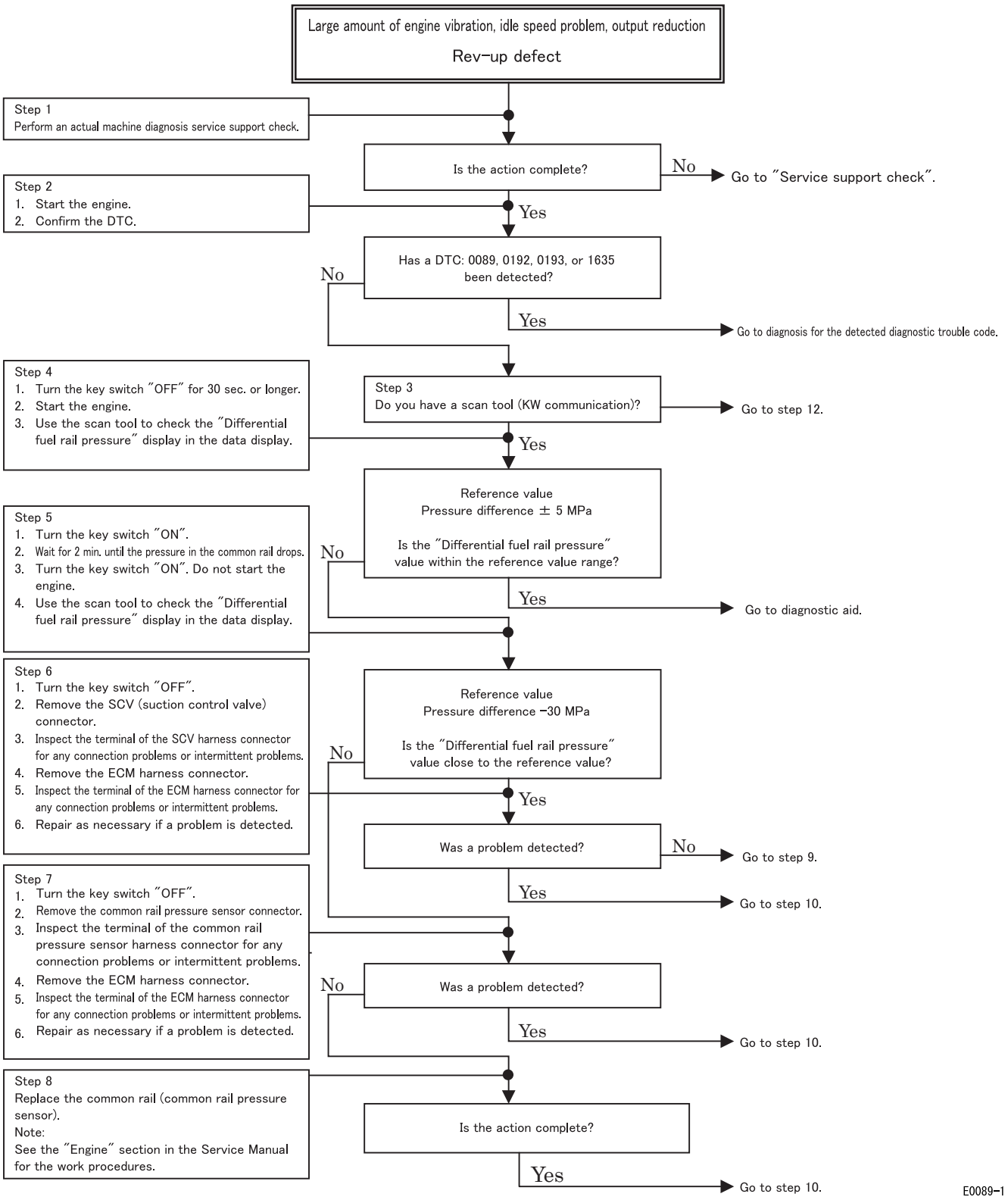
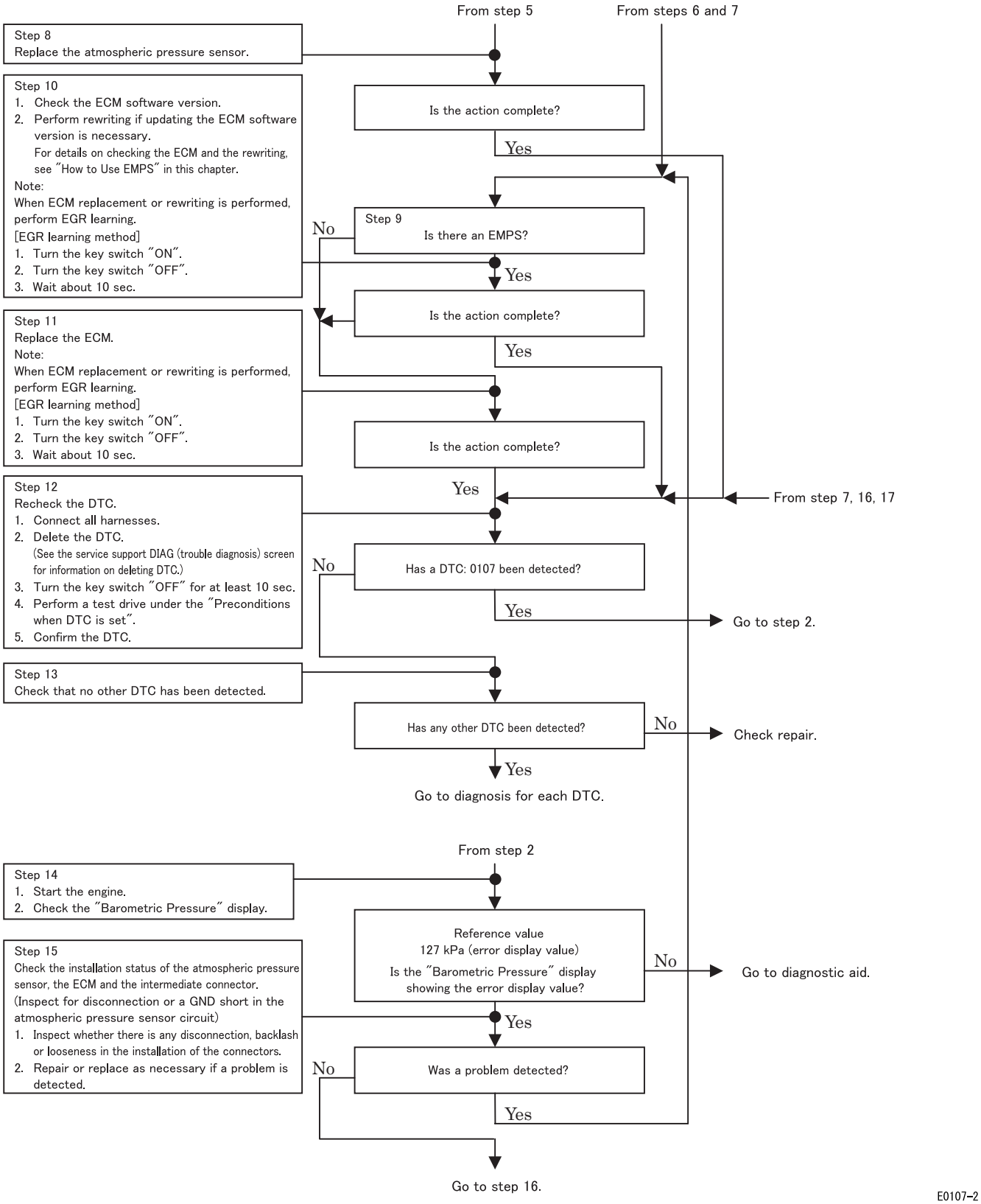
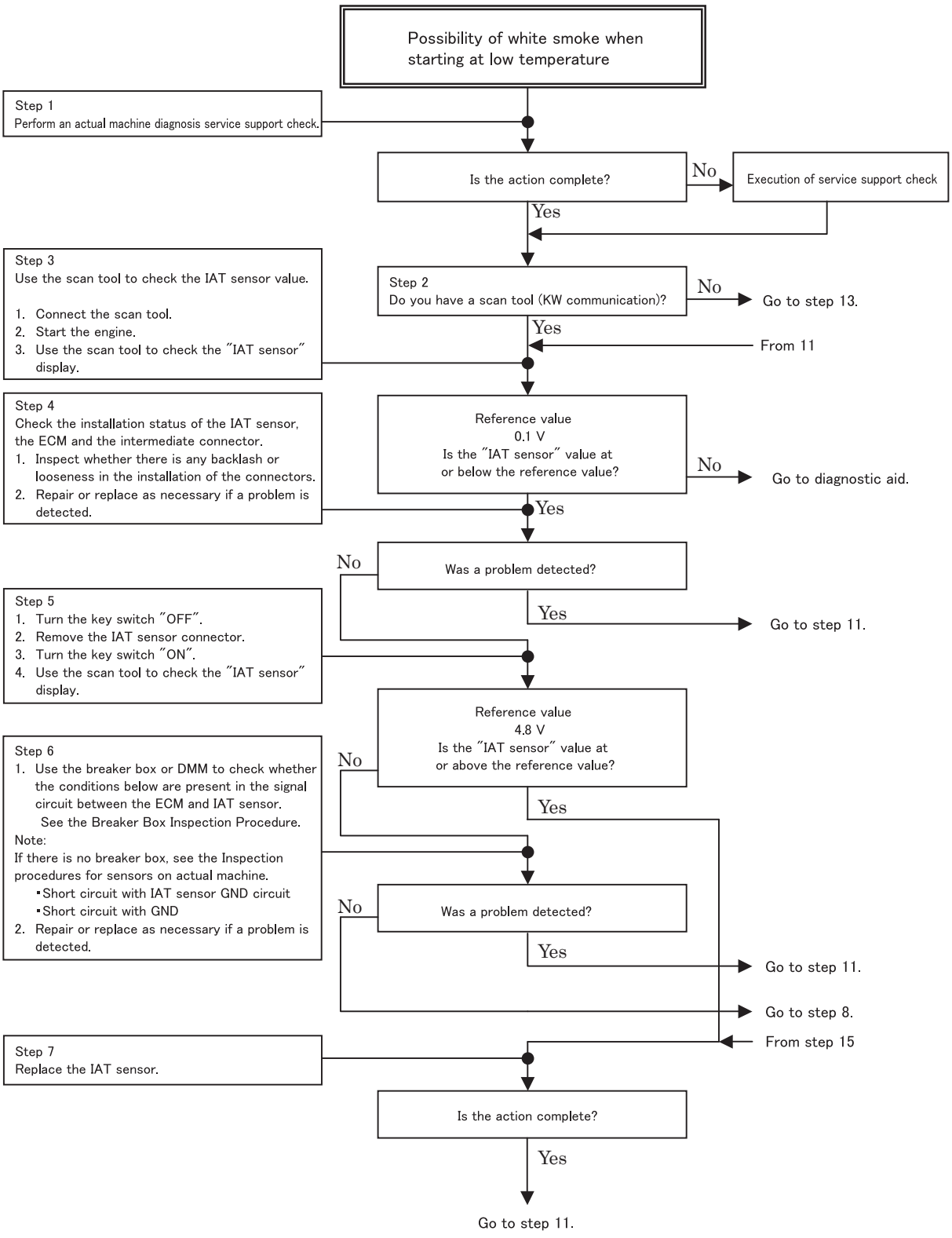
DTC: 0089
Common Rail Pressure Abnormality (supply pump sending too much pressure)




From step 5
From steps 6 and 7
Step 8
Replace the atmospheric pressure sensor.
Step 10
1. Check the ECM software version.
2. Perform rewriting if updating the ECM software version is necessary.
For details on checking the ECM and the rewriting, see "How to Use EMPS" in this chapter.
Note:
When ECM replacement or rewriting is performed, perform EGR learning.
[EGR learning method]
1. Turn the key switch "ON".
2. Turn the key switch "OFF".
3. Wait about 10 sec.
Is the action complete?
Yes
Step 9
Is there an EMPS?
No
Yes
Step 11
Replace the ECM.
Note:
When ECM replacement or rewriting is performed, perform EGR learning.
[EGR learning method]
1. Turn the key switch "ON".
2. Turn the key switch "OFF".
3. Wait about 10 sec.
Is the action complete?
Yes
Is the action complete?
Yes
From step 7, 16, 17
Step 12
Recheck the DTC.
1. Connect all harnesses.
2. Delete the DTC.
(See the service support DIAG (trouble diagnosis) screen for information on deleting DTC.)
3. Turn the key switch "OFF" for at least 10 sec.
4. Perform a test drive under the "Preconditions when DTC is set".
5. Confirm the DTC.
Has a DTC: 0107 been detected?
No
Yes
Go to step 2.
Step 13
Check that no other DTC has been detected.
Has any other DTC been detected?
No
Check repair.
Yes
Go to diagnosis for each DTC.
From step 2
Step 14
1. Start the engine.
2. Check the "Barometric Pressure" display.
Reference value
127 kPa (error display value)
Is the "Barometric Pressure" display showing the error display value?
No
Go to diagnostic aid.
Step 15
Check the installation status of the atmospheric pressure sensor, the ECM and the intermediate connector.
(Inspect for disconnection or a GND short in the atmospheric pressure sensor circuit)
1. Inspect whether there is any disconnection, backlash or looseness in the installation of the connectors.
2. Repair or replace as necessary if a problem is detected.
Yes
Was a problem detected?
No
Yes
Go to step 16.
E0107-2

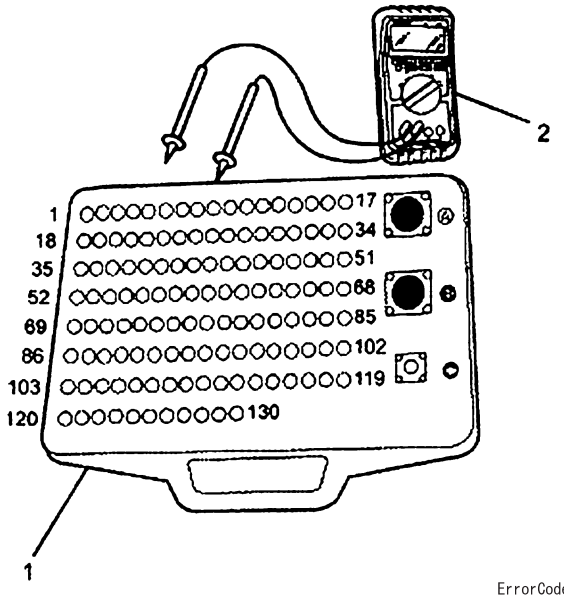
DTC: 0112
IAT (suction air temperature) Sensor Abnormality (abnormally low voltage)



E0112-1

Breaker box inspection procedure

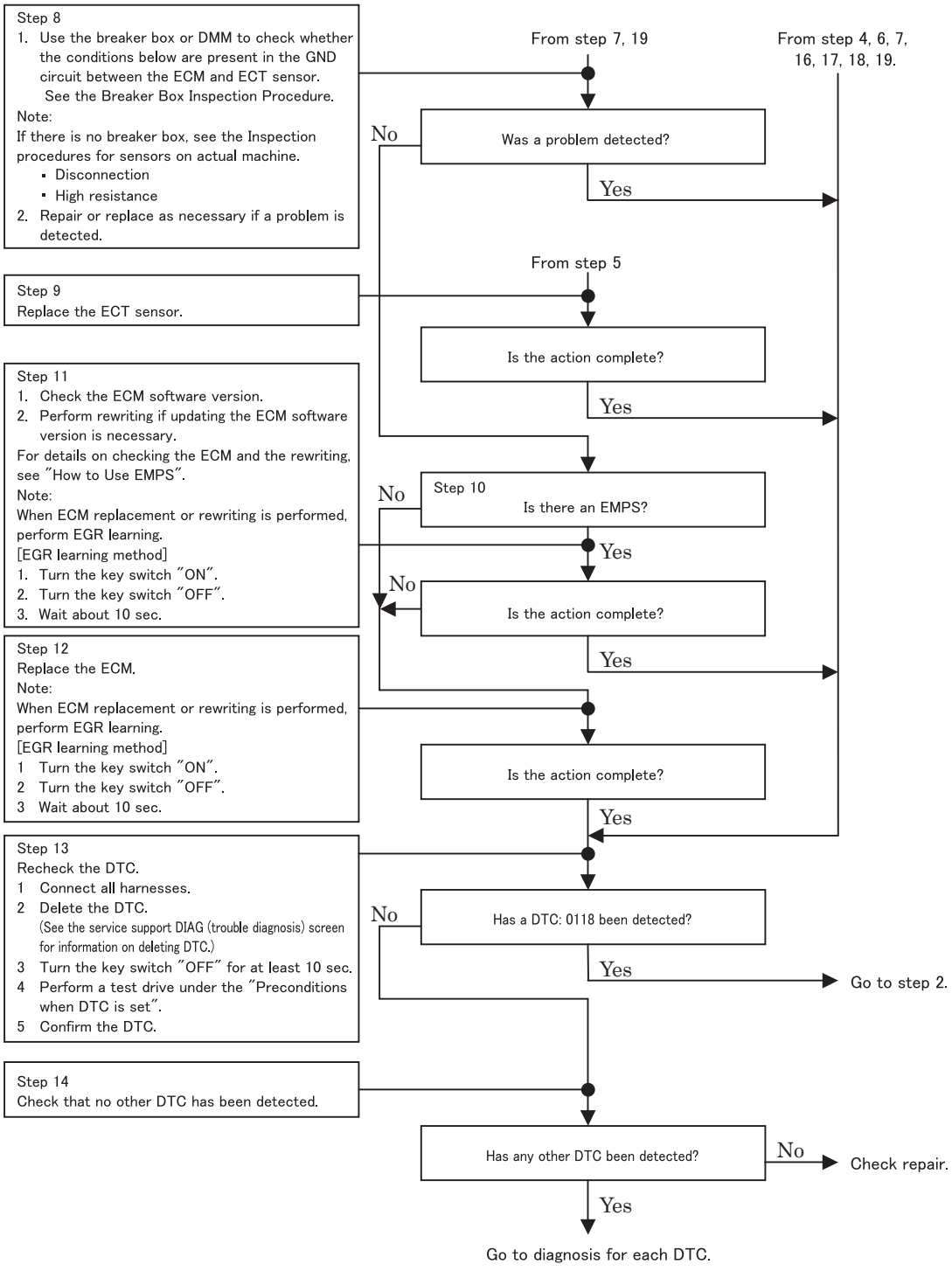
For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.



Name

1. Breaker box
2. DMM

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
6	Short circuit with power supply circuit	Voltage value measurement	• Remove the sensor connector. • Key switch "ON"	72 - GND	0 V	18 V or higher
7	Disconnection/ high resistance	Resistance measurement	• Remove the sensor connector. • Key switch "OFF"	72 - Sensor connector signal terminal	100 MΩ or lower	10 MΩ or higher
8	Disconnection/ high resistance	Resistance measurement	• Remove the sensor connector. • Key switch "OFF"	60 - Sensor connector signal terminal	100 Ω or lower	10 MΩ or higher


Step 8
1. Use the breaker box or DMM to check whether the conditions below are present in the GND circuit between the ECM and ECT sensor.
See the Breaker Box Inspection Procedure.
Note:
If there is no breaker box, see the Inspection procedures for sensors on actual machine.
▪ Disconnection
▪ High resistance
2. Repair or replace as necessary if a problem is detected.
From step 7, 19
From step 4, 6, 7, 16, 17, 18, 19.
Was a problem detected?
No
Yes
Step 9
Replace the ECT sensor.
From step 5
Is the action complete?
Yes
Step 11
1. Check the ECM software version.
2. Perform rewriting if updating the ECM software version is necessary.
For details on checking the ECM and the rewriting, see "How to Use EMPS".
Note:
When ECM replacement or rewriting is performed, perform EGR learning.
[EGR learning method]
1. Turn the key switch "ON".
2. Turn the key switch "OFF".
3. Wait about 10 sec.
Step 10
Is there an EMPS?
No
Yes
Is the action complete?
No
Yes
Step 12
Replace the ECM.
Note:
When ECM replacement or rewriting is performed, perform EGR learning.
[EGR learning method]
1 Turn the key switch "ON".
2 Turn the key switch "OFF".
3 Wait about 10 sec.
Is the action complete?
Yes
Step 13
Recheck the DTC.
1 Connect all harnesses.
2 Delete the DTC.
(See the service support DIAG (trouble diagnosis) screen for information on deleting DTC.)
3 Turn the key switch "OFF" for at least 10 sec.
4 Perform a test drive under the "Preconditions when DTC is set".
5 Confirm the DTC.
Has a DTC: 0118 been detected?
No
Yes
Go to step 2.
Step 14
Check that no other DTC has been detected.
Has any other DTC been detected?
No
Check repair.
Yes
Go to diagnosis for each DTC.

E0118–2

Diagnostic aid

- Check that the temperature of the FT sensor and IAT (suction air temperature) sensor are close in value before starting when the engine is cool.

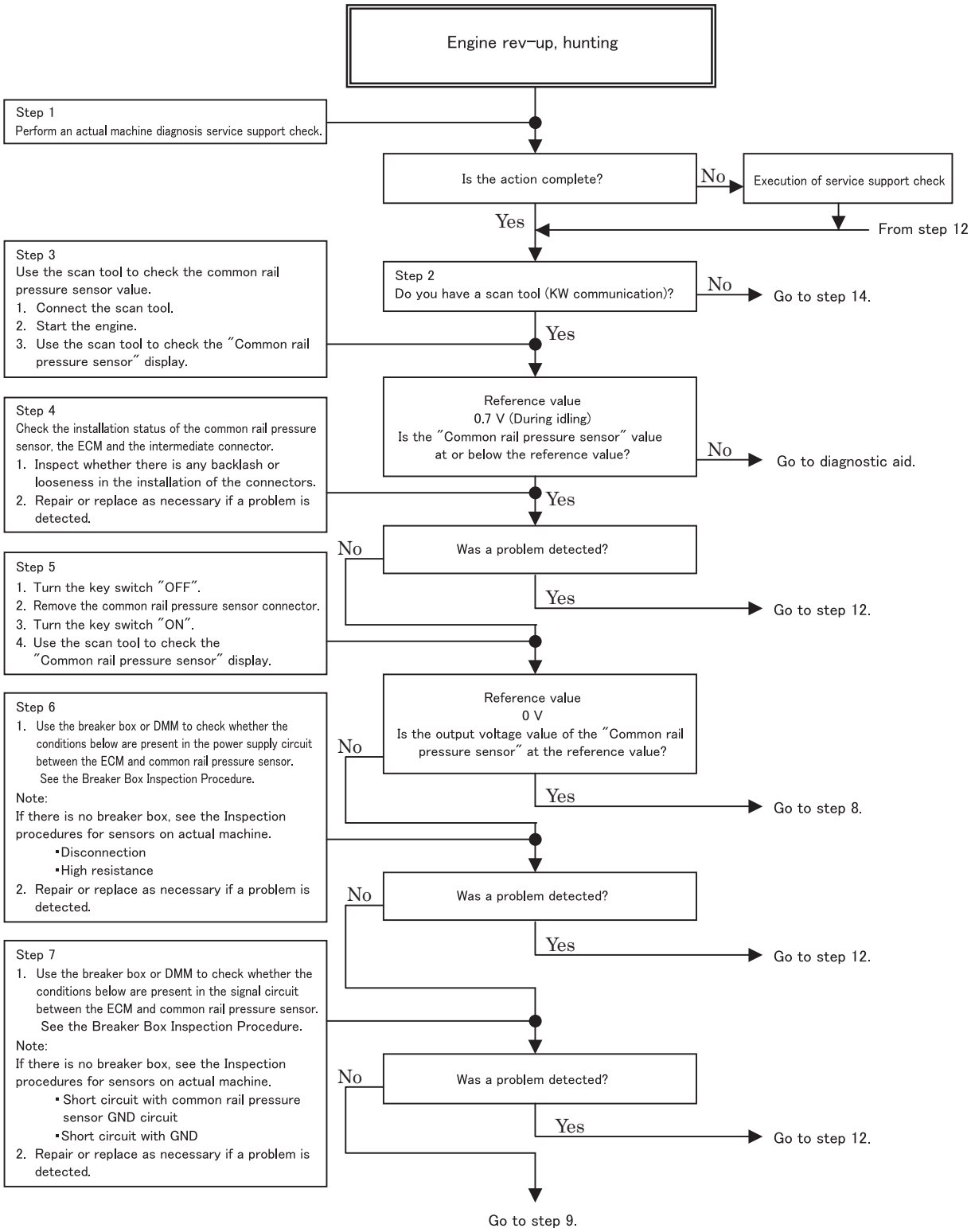
If an intermittent problem is suspected, the cause may be one of the following.

- Harness connector connection problem
- Harness routing problem
- Breakage in harness covering due to friction
- Wire disconnection within harness covering

In order to detect these causes, the following inspection is necessary.

- Harness connector and ECM connector connection problem
  - Terminal has come out from connector
  - Connection between non-matching terminals
  - Damage to connector lock
  - Terminal and wire connection problem
- Harness damage
  - Inspect the external appearance to check for any harness damage.
  - While moving the connector or harness related to a sensor, confirm the display of the related item in the scan tool data display. The display change shows the trouble location.

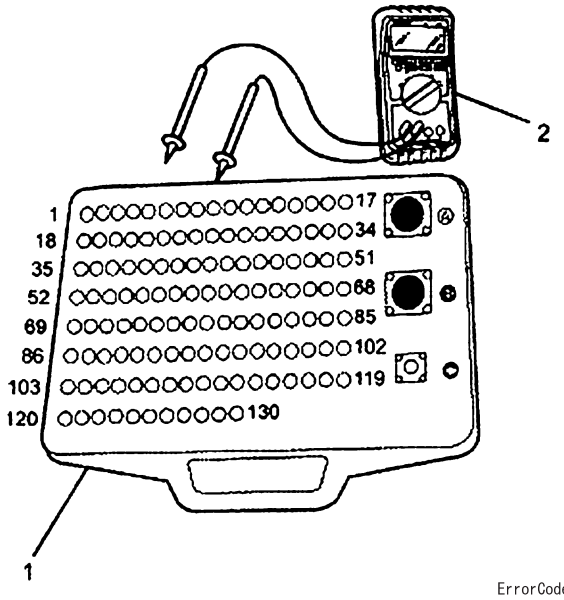
DTC: 0192
Common Rail Pressure Sensor Abnormality (abnormally low voltage)



E0192-1

Breaker box inspection procedure

For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.

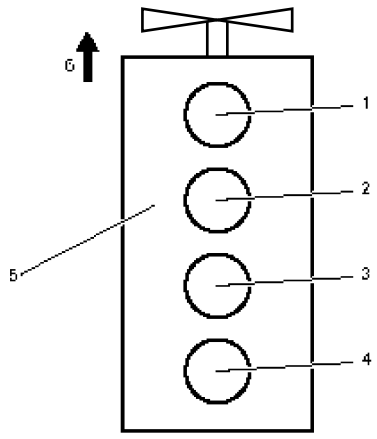


Name

1. Breaker box
2. DMM

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
6	Short circuit with power supply circuit	Voltage value measurement	• Remove the sensor connector. • Key switch "ON"	82 - GND 90 - GND	0 V	18 V or higher
7	Disconnection/ high resistance	Resistance measurement	• Remove the sensor connector. • Key switch "OFF"	87 - Sensor connector signal terminal 90 - Sensor connector signal terminal	100 Ω or lower	10 MΩ or higher
8	Disconnection/ high resistance	Resistance measurement	• Remove the sensor connector. • Key switch "OFF"	101 - Sensor connector GND terminal	100 Ω or lower	10 MΩ or higher

Cylinder No. and injection sequence



ErrorCode03

Name

1. 1st cylinder
2. 2nd cylinder
3. 3rd cylinder
4. 4th cylinder
5. Cylinder block
6. Engine front

Injection sequence: 1 → 3 → 4 → 2

Preconditions when DTC is set

- Main relay power supply voltage is 18 V or higher.
- At least 70 min^{-1}
- DTC: 0612, 1262 are not detected.

Diagnostic aid

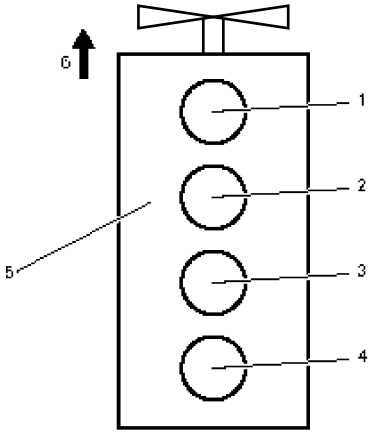
If an intermittent problem is suspected, the cause may be one of the following.

- Harness connector connection problem
- Harness routing problem
- Breakage in harness covering due to friction
- Wire disconnection within harness covering

In order to detect these causes, the following inspection is necessary.

- Harness connector and ECM connector connection problem
  - Terminal has come out from connector
  - Connection between non-matching terminals
  - Damage to connector lock
  - Terminal and wire connection problem
- Harness damage
  - Inspect the external appearance to check for any harness damage.
  - While moving the connector or harness related to a sensor, confirm the display of the related item in the scan tool data display. The display change shows the trouble location.

Cylinder No. and injection sequence



ErrorCode03

Name

1. 1st cylinder
2. 2nd cylinder
3. 3rd cylinder
4. 4th cylinder
5. Cylinder block
6. Engine front side

Injection sequence: 1 → 3 → 4 → 2

Preconditions when DTC is set

- Main relay power supply voltage is 18 V or higher.
- 70 min^{-1}
- DTC: 0611, 1261 are not detected.

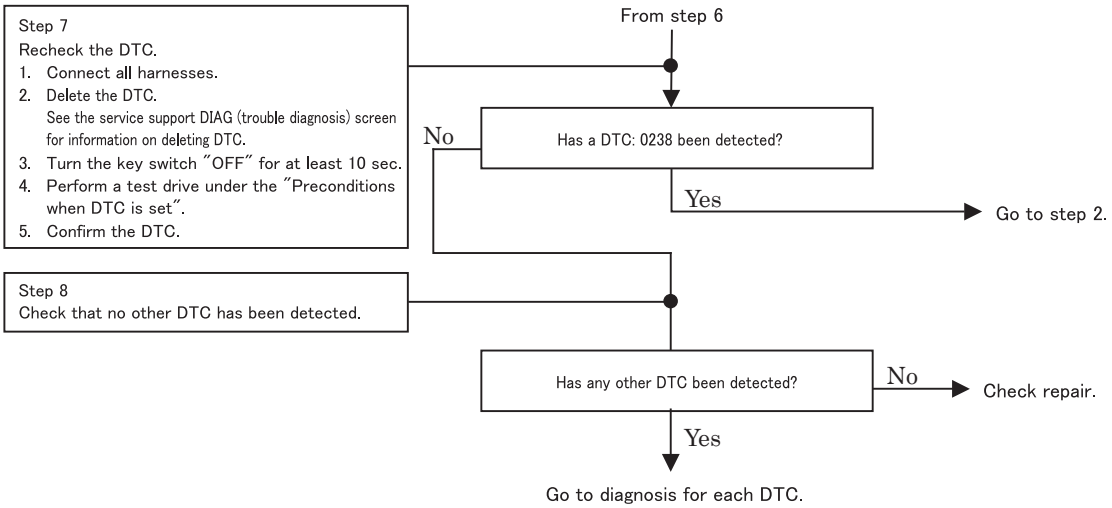
Diagnostic aid

If an intermittent problem is suspected, the cause may be one of the following.

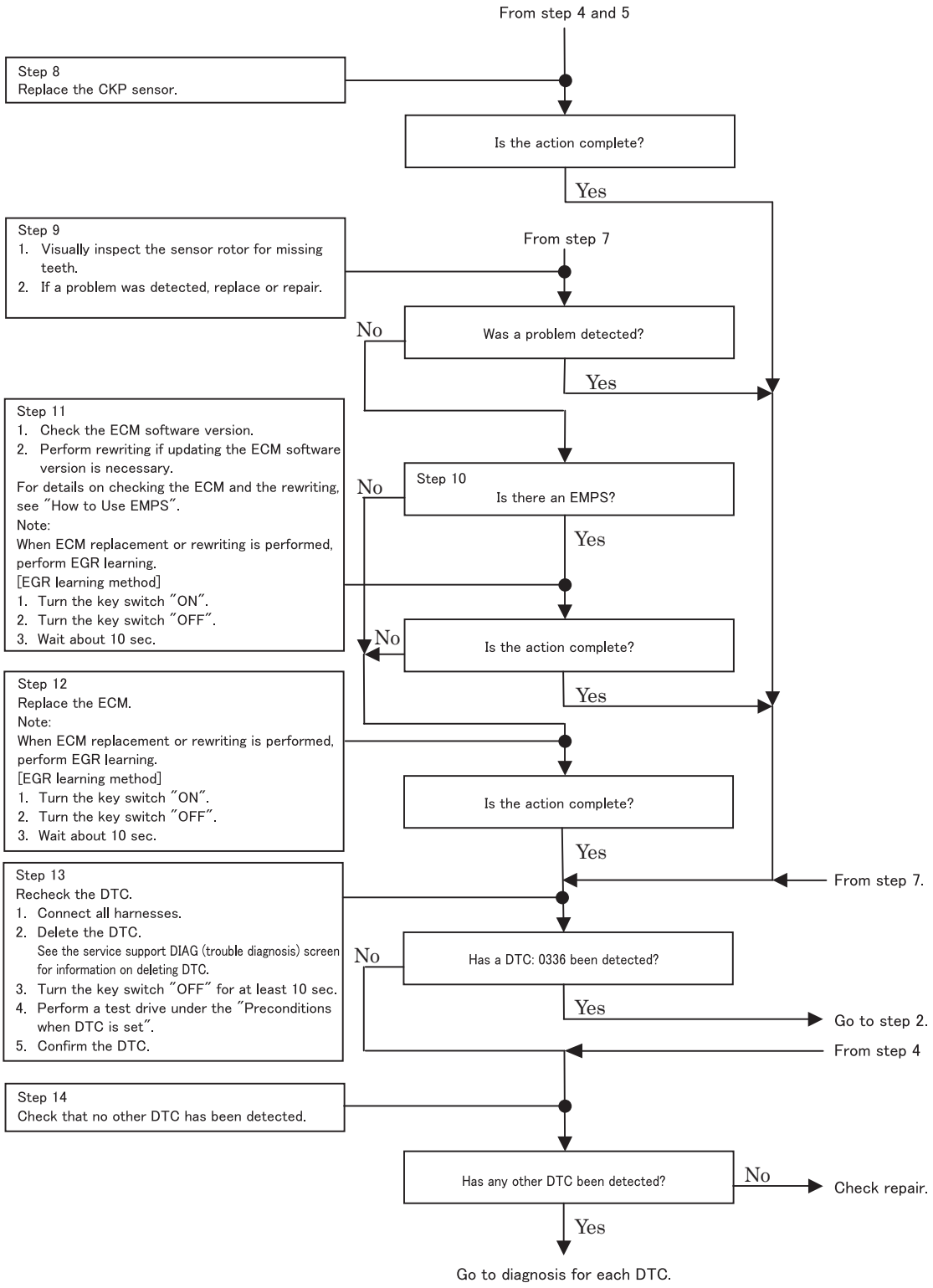
- Harness connector connection problem
- Harness routing problem
- Breakage in harness covering due to friction
- Wire disconnection within harness covering

In order to detect these causes, the following inspection is necessary.

- Harness connector and ECM connector connection problem
  - Terminal has come out from connector
  - Connection between non-matching terminals
  - Damage to connector lock
  - Terminal and wire connection problem
- Harness damage
  - Inspect the external appearance to check for any harness damage.
  - While moving the connector or harness related to a sensor, confirm the display of the related item in the scan tool data display. The display change shows the trouble location.

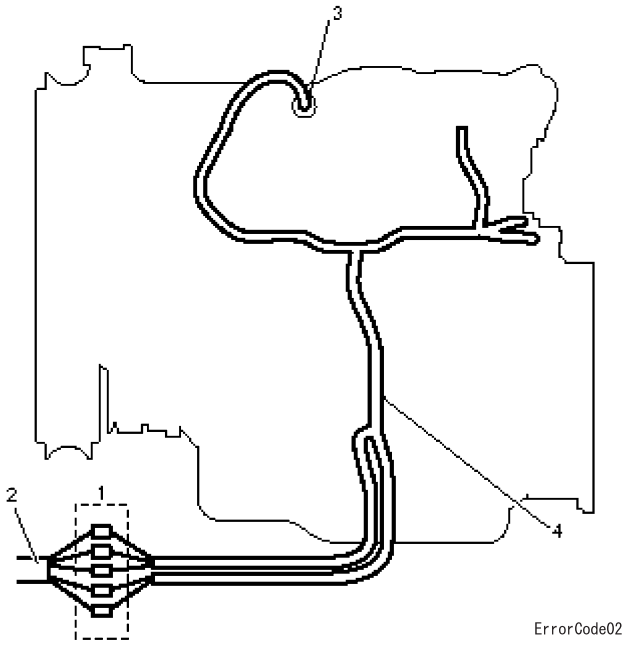

Step 7
Recheck the DTC.
1. Connect all harnesses.
2. Delete the DTC.
See the service support DIAG (trouble diagnosis) screen for information on deleting DTC.
3. Turn the key switch "OFF" for at least 10 sec.
4. Perform a test drive under the "Preconditions when DTC is set".
5. Confirm the DTC.
From step 6
Has a DTC: 0238 been detected?
No
Yes
Go to step 2.
Step 8
Check that no other DTC has been detected.
Has any other DTC been detected?
No
Check repair.
Yes
Go to diagnosis for each DTC.

E0238-2


From step 4 and 5
Step 8
Replace the CKP sensor.
Is the action complete?
Yes
Step 9
1. Visually inspect the sensor rotor for missing teeth.
2. If a problem was detected, replace or repair.
From step 7
No
Was a problem detected?
Yes
Step 11
1. Check the ECM software version.
2. Perform rewriting if updating the ECM software version is necessary.
For details on checking the ECM and the rewriting, see "How to Use EMPS".
Note:
When ECM replacement or rewriting is performed, perform EGR learning.
[EGR learning method]
1. Turn the key switch "ON".
2. Turn the key switch "OFF".
3. Wait about 10 sec.
No
Step 10
Is there an EMPS?
Yes
No
Is the action complete?
Yes
Step 12
Replace the ECM.
Note:
When ECM replacement or rewriting is performed, perform EGR learning.
[EGR learning method]
1. Turn the key switch "ON".
2. Turn the key switch "OFF".
3. Wait about 10 sec.
Is the action complete?
Yes
From step 7.
Step 13
Recheck the DTC.
1. Connect all harnesses.
2. Delete the DTC.
See the service support DIAG (trouble diagnosis) screen for information on deleting DTC.
3. Turn the key switch "OFF" for at least 10 sec.
4. Perform a test drive under the "Preconditions when DTC is set".
5. Confirm the DTC.
No
Has a DTC: 0336 been detected?
Yes
Go to step 2.
From step 4
Step 14
Check that no other DTC has been detected.
Has any other DTC been detected?
No
Check repair.
Yes
Go to diagnosis for each DTC.

E0341–2

Inspection procedures for sensors on actual machine



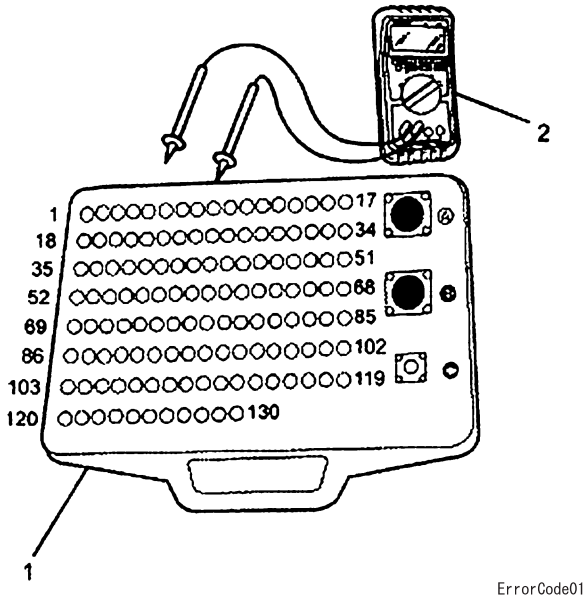
Name

1. Engine-actual machine intermediate connector
2. Actual machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the intermediate connectors and perform sensor inspection from the engine harness connector.
2. Disconnect the connector from the sensor and short circuit the sensor connector wiring.
3. Inspect the harness disconnection from the intermediate connector.
   - If there is an abnormality in both procedures 1 and 2, repair the harness and repeat inspection from procedure 1.
   - If there is an abnormality in procedure 1 only, replace the sensor.

Breaker box inspection procedure

For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.

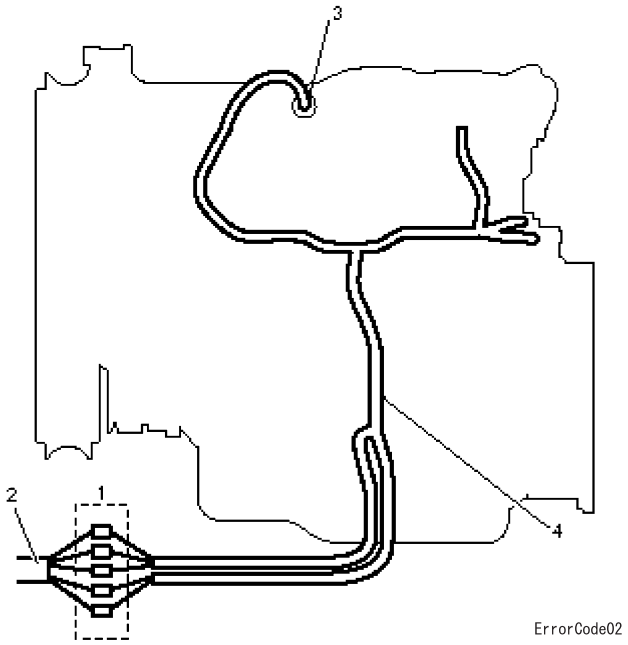


Name

1. Breaker box
2. DMM

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
8	Disconnection/ high resistance	Resistance measure-ment	• Remove the relay. • Key switch "OFF"	10 - FL12 connector No. 1 terminal	10 MΩ or lower	10 MΩ or higher
	Short circuit with GND	Resistance measure-ment	• Remove the relay. • Key switch "OFF"	10 - GND	10 MΩ or higher	10 MΩ or lower
10	Short circuit with power supply circuit	Voltage value mea-surement	• Remove the relay. • Key switch "ON"	10 - GND	0 V	16 V or higher

Inspection procedures for sensors on actual machine

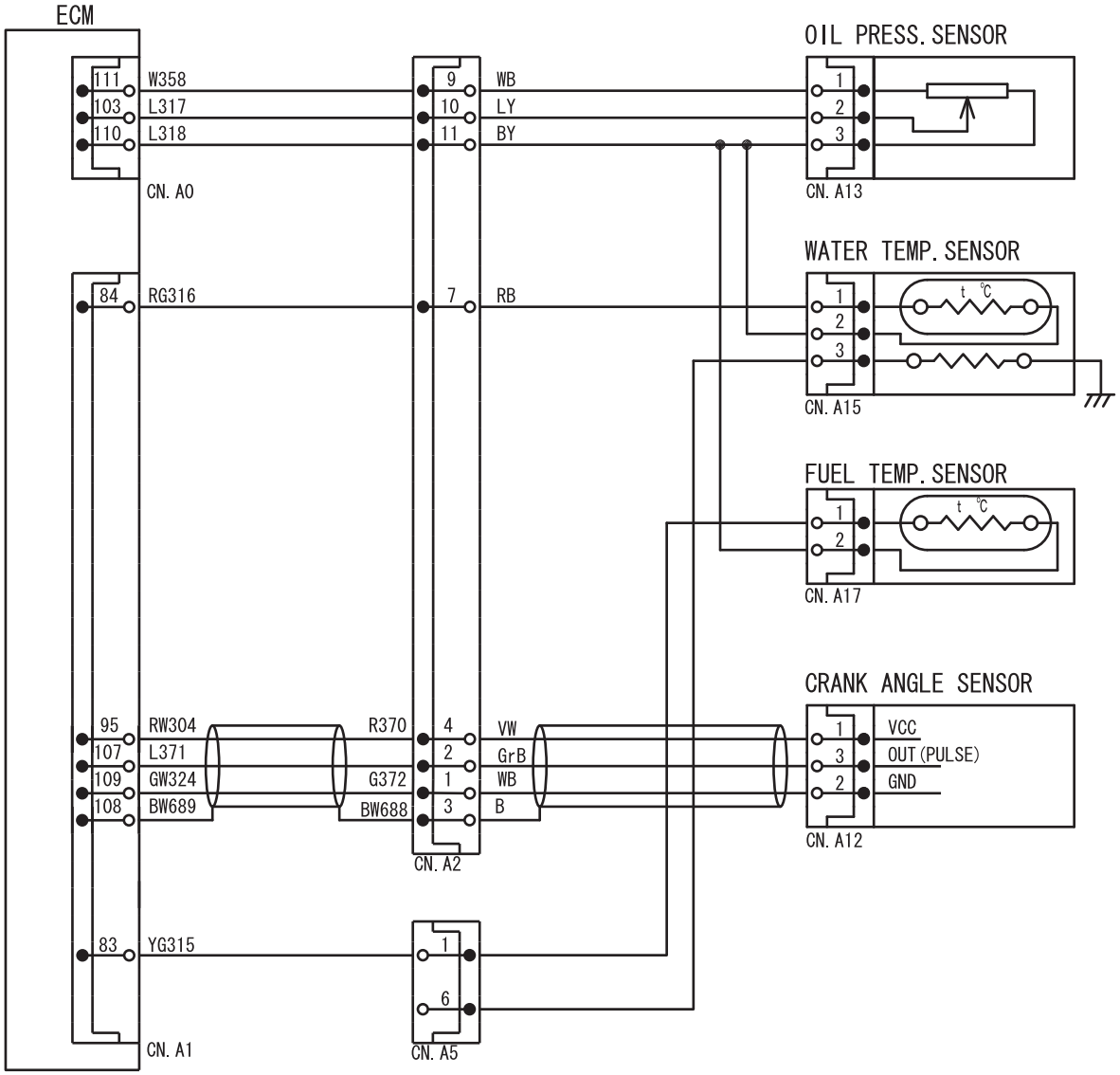


Name

1. Engine-actual machine intermediate connector
2. Actual machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the intermediate connectors and perform sensor inspection from the engine harness connector.
2. Disconnect the connector from the sensor and short circuit the sensor connector wiring.
3. Inspect the harness disconnection from the intermediate connector.
   - If there is an abnormality in both procedures 1 and 2, repair the harness and repeat inspection from procedure 1.
   - If there is an abnormality in procedure 1 only, replace the sensor.

Block diagram



Preconditions when DTC is set

- Key switch input voltage is 18 V or higher.
- DTC: 1633 is not detected.

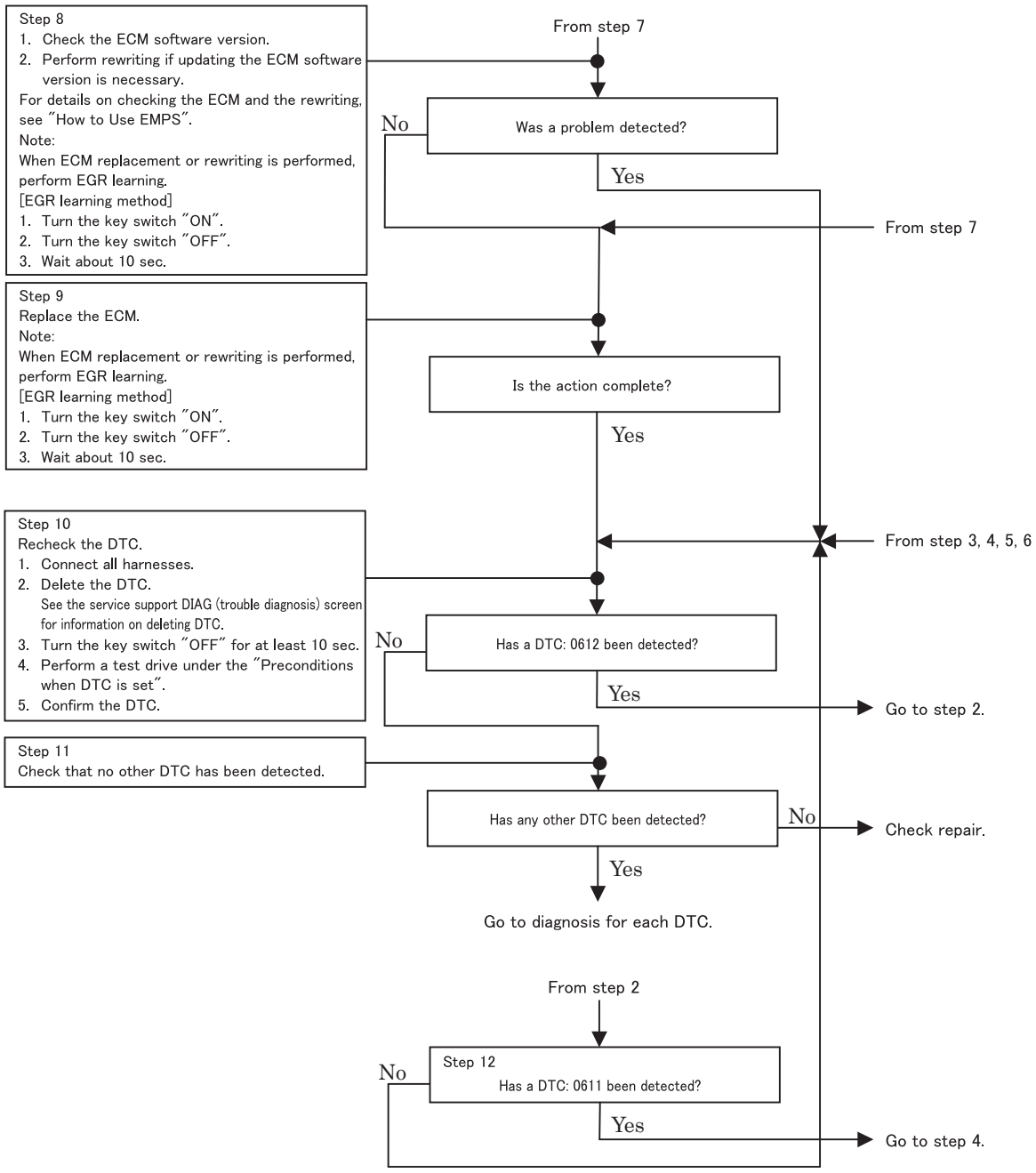
Diagnostic aid

If an intermittent problem is suspected, the cause may be one of the following.

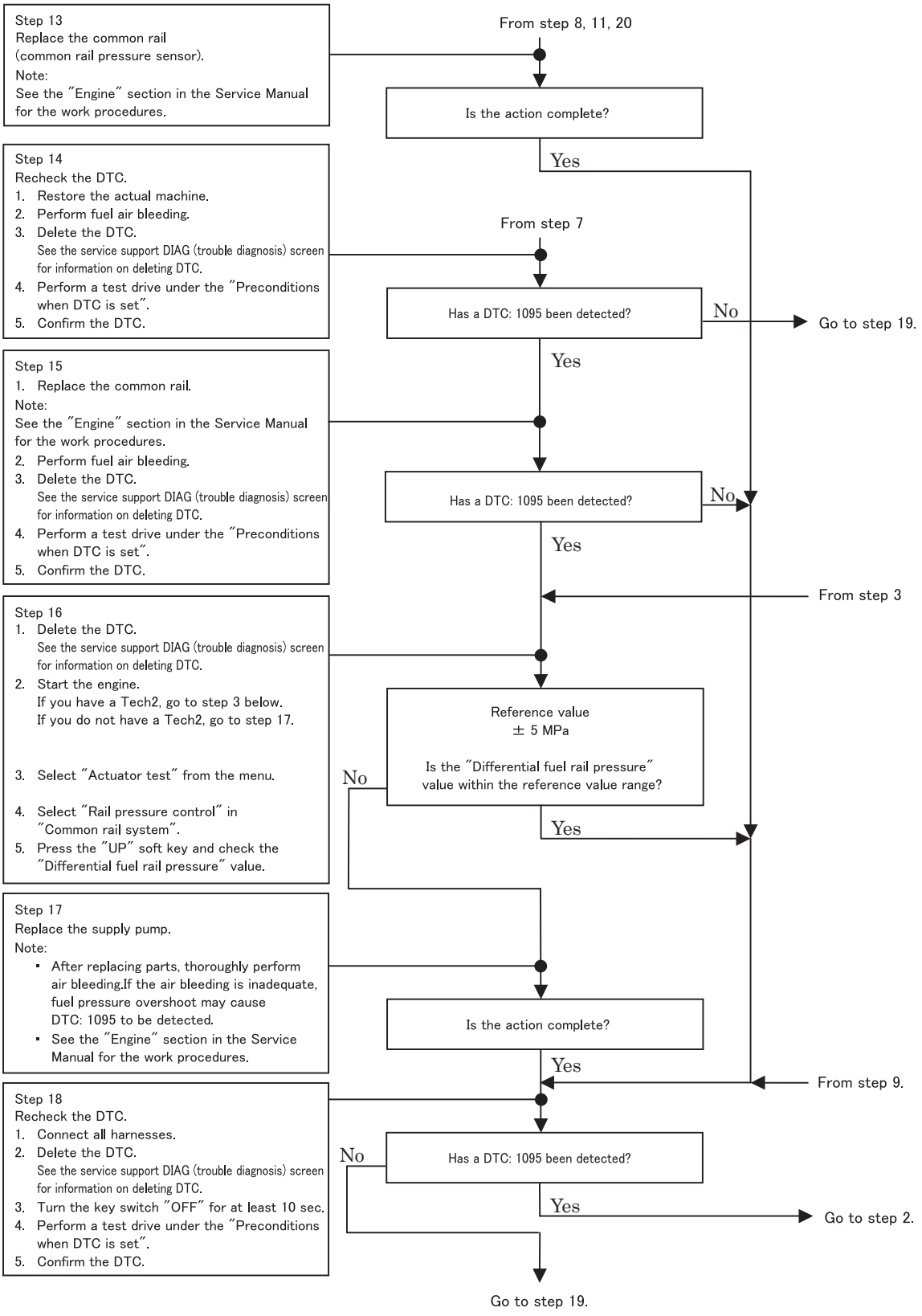
- Harness connector connection problem
- Harness routing problem
- Breakage in harness covering due to friction
- Wire disconnection within harness covering

In order to detect these causes, the following inspection is necessary.

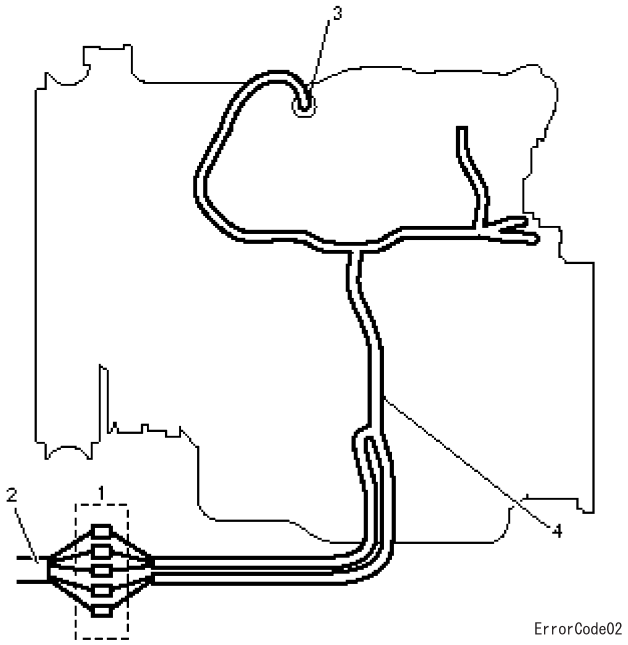
- Harness connector and ECM connector connection problem
  - Terminal has come out from connector
  - Connection between non-matching terminals
  - Damage to connector lock
  - Terminal and wire connection problem
- Harness damage
  - Inspect the external appearance to check for any harness damage.
  - While moving the connector or harness related to a sensor, confirm the display of the related item in the scan tool data display. The display change shows the trouble location.


Step 8
1. Check the ECM software version.
2. Perform rewriting if updating the ECM software version is necessary.
For details on checking the ECM and the rewriting, see "How to Use EMPS".
Note:
When ECM replacement or rewriting is performed, perform EGR learning.
[EGR learning method]
1. Turn the key switch "ON".
2. Turn the key switch "OFF".
3. Wait about 10 sec.
From step 7
Was a problem detected?
No
Yes
From step 7
Step 9
Replace the ECM.
Note:
When ECM replacement or rewriting is performed, perform EGR learning.
[EGR learning method]
1. Turn the key switch "ON".
2. Turn the key switch "OFF".
3. Wait about 10 sec.
Is the action complete?
Yes
From step 3, 4, 5, 6
Step 10
Recheck the DTC.
1. Connect all harnesses.
2. Delete the DTC.
See the service support DIAG (trouble diagnosis) screen for information on deleting DTC.
3. Turn the key switch "OFF" for at least 10 sec.
4. Perform a test drive under the "Preconditions when DTC is set".
5. Confirm the DTC.
Has a DTC: 0612 been detected?
No
Yes
Go to step 2.
Step 11
Check that no other DTC has been detected.
Has any other DTC been detected?
No
Check repair.
Yes
Go to diagnosis for each DTC.
From step 2
Step 12
Has a DTC: 0611 been detected?
No
Yes
Go to step 4.

E0612–2


Step 13
Replace the common rail
(common rail pressure sensor).
Note:
See the "Engine" section in the Service Manual
for the work procedures.
From step 8, 11, 20
Is the action complete?
Yes
Step 14
Recheck the DTC.
1. Restore the actual machine.
2. Perform fuel air bleeding.
3. Delete the DTC.
See the service support DIAG (trouble diagnosis) screen
for information on deleting DTC.
4. Perform a test drive under the "Preconditions
when DTC is set".
5. Confirm the DTC.
From step 7
Has a DTC: 1095 been detected?
No
Go to step 19.
Yes
Step 15
1. Replace the common rail.
Note:
See the "Engine" section in the Service Manual
for the work procedures.
2. Perform fuel air bleeding.
3. Delete the DTC.
See the service support DIAG (trouble diagnosis) screen
for information on deleting DTC.
4. Perform a test drive under the "Preconditions
when DTC is set".
5. Confirm the DTC.
Has a DTC: 1095 been detected?
No
Yes
From step 3
Step 16
1. Delete the DTC.
See the service support DIAG (trouble diagnosis) screen
for information on deleting DTC.
2. Start the engine.
If you have a Tech2, go to step 3 below.
If you do not have a Tech2, go to step 17.
3. Select "Actuator test" from the menu.
4. Select "Rail pressure control" in
"Common rail system".
5. Press the "UP" soft key and check the
"Differential fuel rail pressure" value.
Reference value
± 5 MPa
Is the "Differential fuel rail pressure"
value within the reference value range?
No
Yes
Step 17
Replace the supply pump.
Note:
▪ After replacing parts, thoroughly perform
air bleeding.If the air bleeding is inadequate,
fuel pressure overshoot may cause
DTC: 1095 to be detected.
▪ See the "Engine" section in the Service
Manual for the work procedures.
Is the action complete?
Yes
From step 9.
Step 18
Recheck the DTC.
1. Connect all harnesses.
2. Delete the DTC.
See the service support DIAG (trouble diagnosis) screen
for information on deleting DTC.
3. Turn the key switch "OFF" for at least 10 sec.
4. Perform a test drive under the "Preconditions
when DTC is set".
5. Confirm the DTC.
No
Has a DTC: 1095 been detected?
Yes
Go to step 2.
Go to step 19.
E1095-3

Inspection procedures for sensors on actual machine



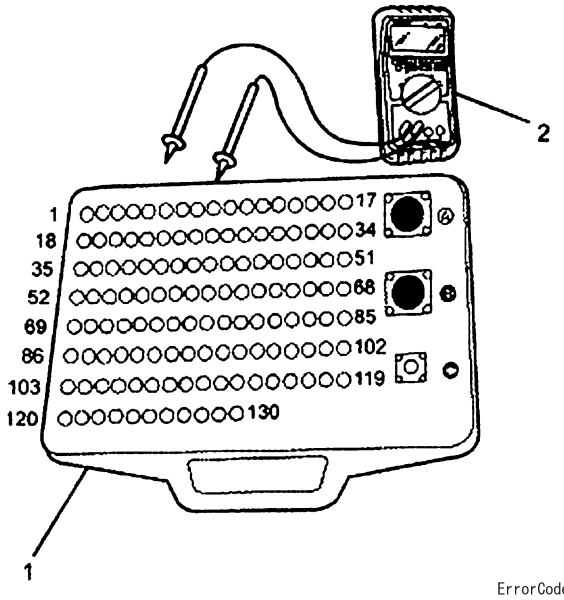
Name

1. Engine-actual machine intermediate connector
2. Actual machine harness
3. Sensor connector
4. Engine harness

1. Disconnect the intermediate connectors and perform sensor inspection from the engine harness connector.
2. Disconnect the connector from the sensor and short circuit the sensor connector wiring.
3. Inspect the harness disconnection from the intermediate connector.
   - If there is an abnormality in both procedures 1 and 2, repair the harness and repeat inspection from procedure 1.
   - If there is an abnormality in procedure 1 only, replace the sensor.

Breaker box inspection procedure

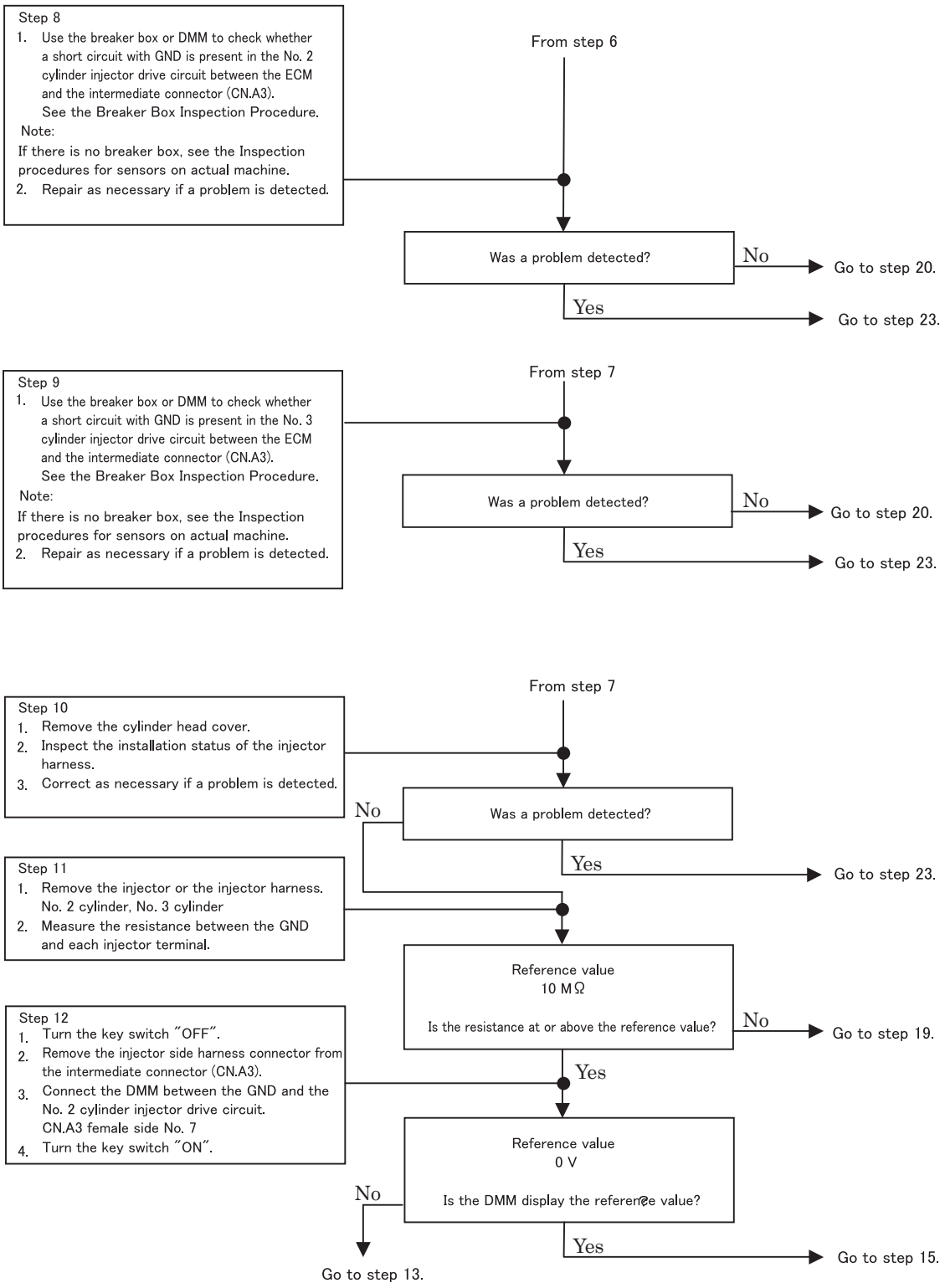
For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.



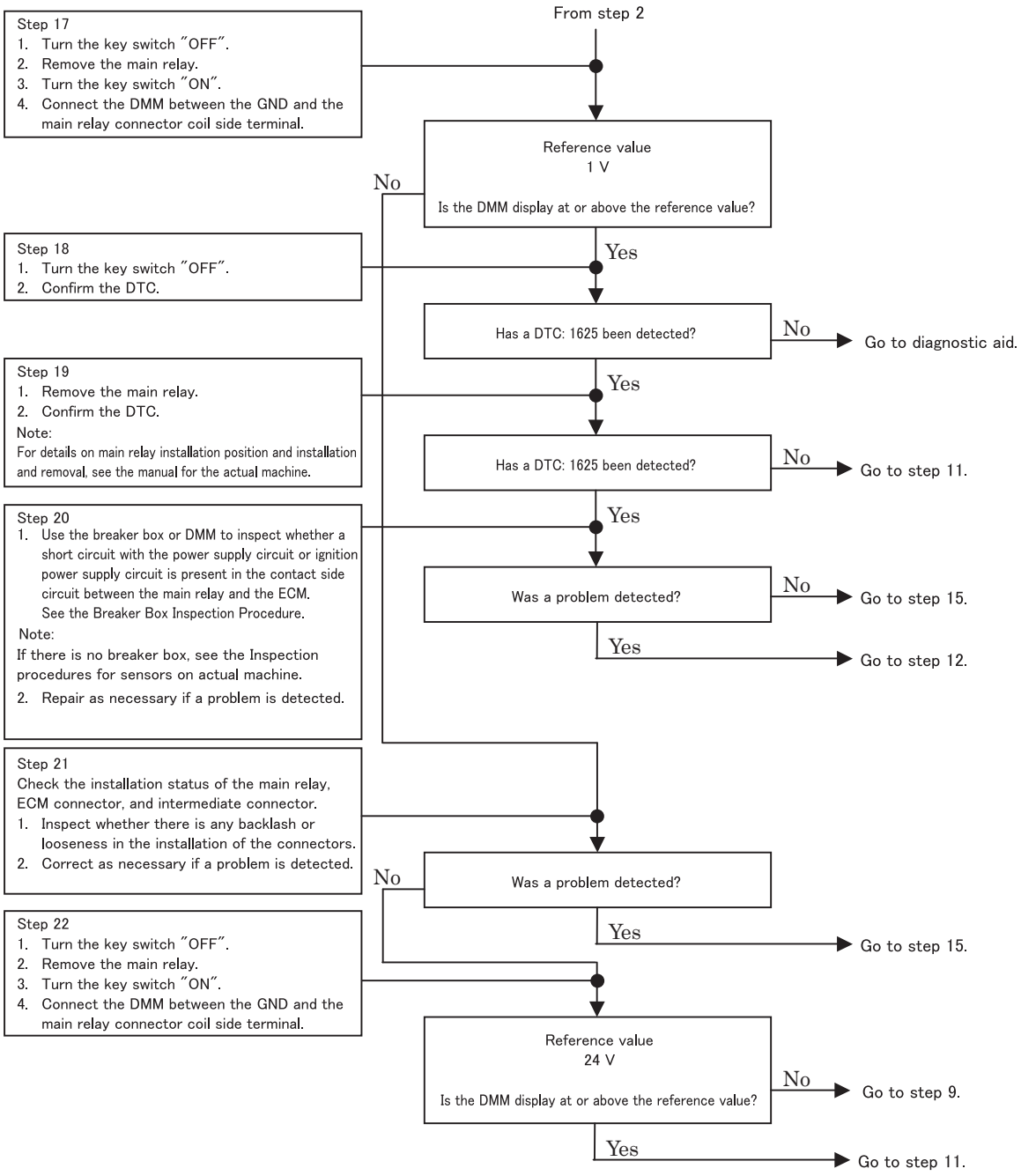
Name

1. Breaker box
2. DMM

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
5	Short circuit with other signal circuit	Voltage value measurement	• Remove the sensor connector. • Key switch "ON"	84 - GND	0 V	1 V or higher

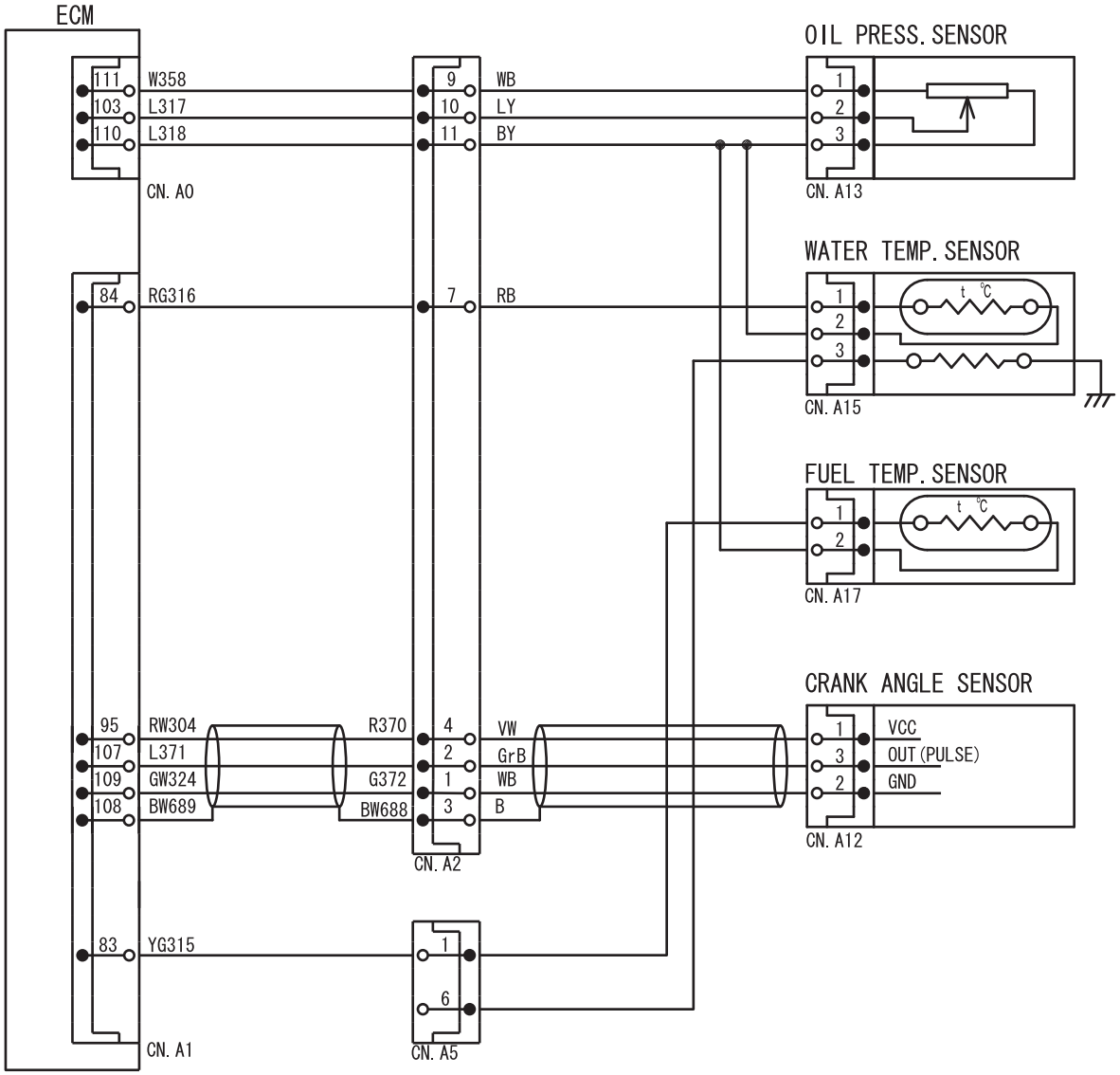

Step 8
1. Use the breaker box or DMM to check whether a short circuit with GND is present in the No. 2 cylinder injector drive circuit between the ECM and the intermediate connector (CN.A3).
See the Breaker Box Inspection Procedure.
Note:
If there is no breaker box, see the Inspection procedures for sensors on actual machine.
2. Repair as necessary if a problem is detected.
From step 6
Was a problem detected?
No
Go to step 20.
Yes
Go to step 23.
Step 9
1. Use the breaker box or DMM to check whether a short circuit with GND is present in the No. 3 cylinder injector drive circuit between the ECM and the intermediate connector (CN.A3).
See the Breaker Box Inspection Procedure.
Note:
If there is no breaker box, see the Inspection procedures for sensors on actual machine.
2. Repair as necessary if a problem is detected.
From step 7
Was a problem detected?
No
Go to step 20.
Yes
Go to step 23.
Step 10
1. Remove the cylinder head cover.
2. Inspect the installation status of the injector harness.
3. Correct as necessary if a problem is detected.
From step 7
No
Was a problem detected?
Yes
Go to step 23.
Step 11
1. Remove the injector or the injector harness. No. 2 cylinder, No. 3 cylinder
2. Measure the resistance between the GND and each injector terminal.
Reference value
10 MΩ
Is the resistance at or above the reference value?
No
Go to step 19.
Step 12
1. Turn the key switch "OFF".
2. Remove the injector side harness connector from the intermediate connector (CN.A3).
3. Connect the DMM between the GND and the No. 2 cylinder injector drive circuit.
CN.A3 female side No. 7
4. Turn the key switch "ON".
Yes
Reference value
0 V
Is the DMM display the reference value?
No
Go to step 13.
Yes
Go to step 15.

N E1262–2


From step 2
Step 17
1. Turn the key switch "OFF".
2. Remove the main relay.
3. Turn the key switch "ON".
4. Connect the DMM between the GND and the main relay connector coil side terminal.
Reference value
1 V
Is the DMM display at or above the reference value?
No
Yes
Step 18
1. Turn the key switch "OFF".
2. Confirm the DTC.
Has a DTC: 1625 been detected?
No
Go to diagnostic aid.
Yes
Step 19
1. Remove the main relay.
2. Confirm the DTC.
Note:
For details on main relay installation position and installation and removal, see the manual for the actual machine.
Has a DTC: 1625 been detected?
No
Go to step 11.
Yes
Step 20
1. Use the breaker box or DMM to inspect whether a short circuit with the power supply circuit or ignition power supply circuit is present in the contact side circuit between the main relay and the ECM. See the Breaker Box Inspection Procedure.
Note:
If there is no breaker box, see the Inspection procedures for sensors on actual machine.
2. Repair as necessary if a problem is detected.
Was a problem detected?
No
Go to step 15.
Yes
Go to step 12.
Step 21
Check the installation status of the main relay, ECM connector, and intermediate connector.
1. Inspect whether there is any backlash or looseness in the installation of the connectors.
2. Correct as necessary if a problem is detected.
Was a problem detected?
No
Yes
Go to step 15.
Step 22
1. Turn the key switch "OFF".
2. Remove the main relay.
3. Turn the key switch "ON".
4. Connect the DMM between the GND and the main relay connector coil side terminal.
Reference value
24 V
Is the DMM display at or above the reference value?
No
Go to step 9.
Yes
Go to step 11.

E1625-3

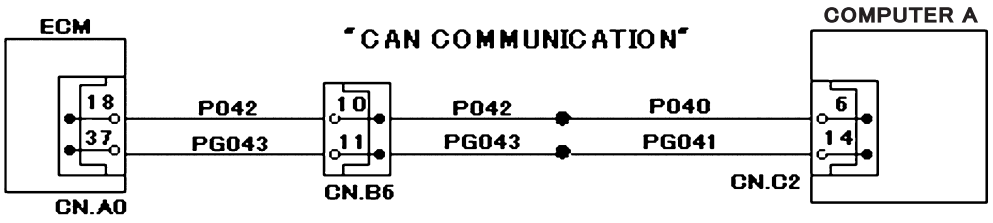
Block diagram



Preconditions when DTC is set

- DTC: 1630 is not detected.
- Key switch input power supply voltage is higher than 16 V and lower than 32 V.

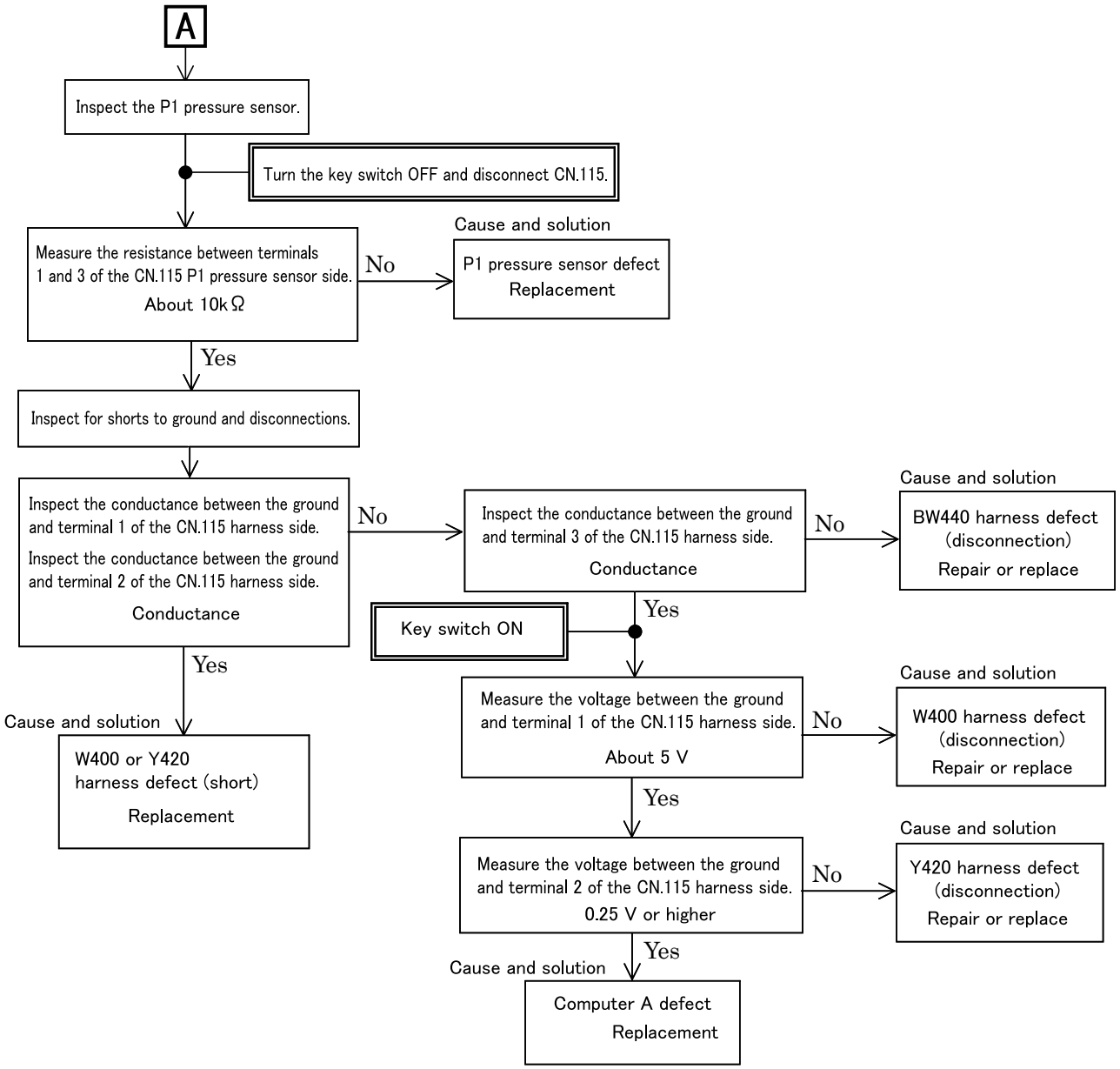
Block diagram



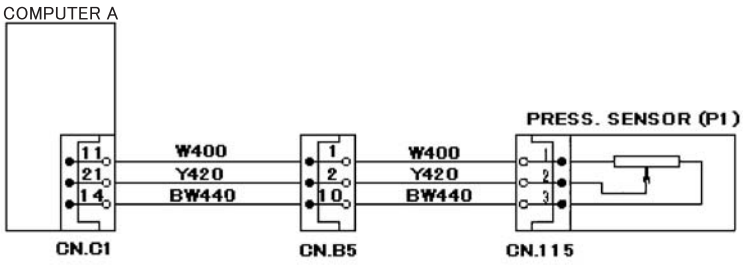
TSHK0023

Preconditions when DTC is set

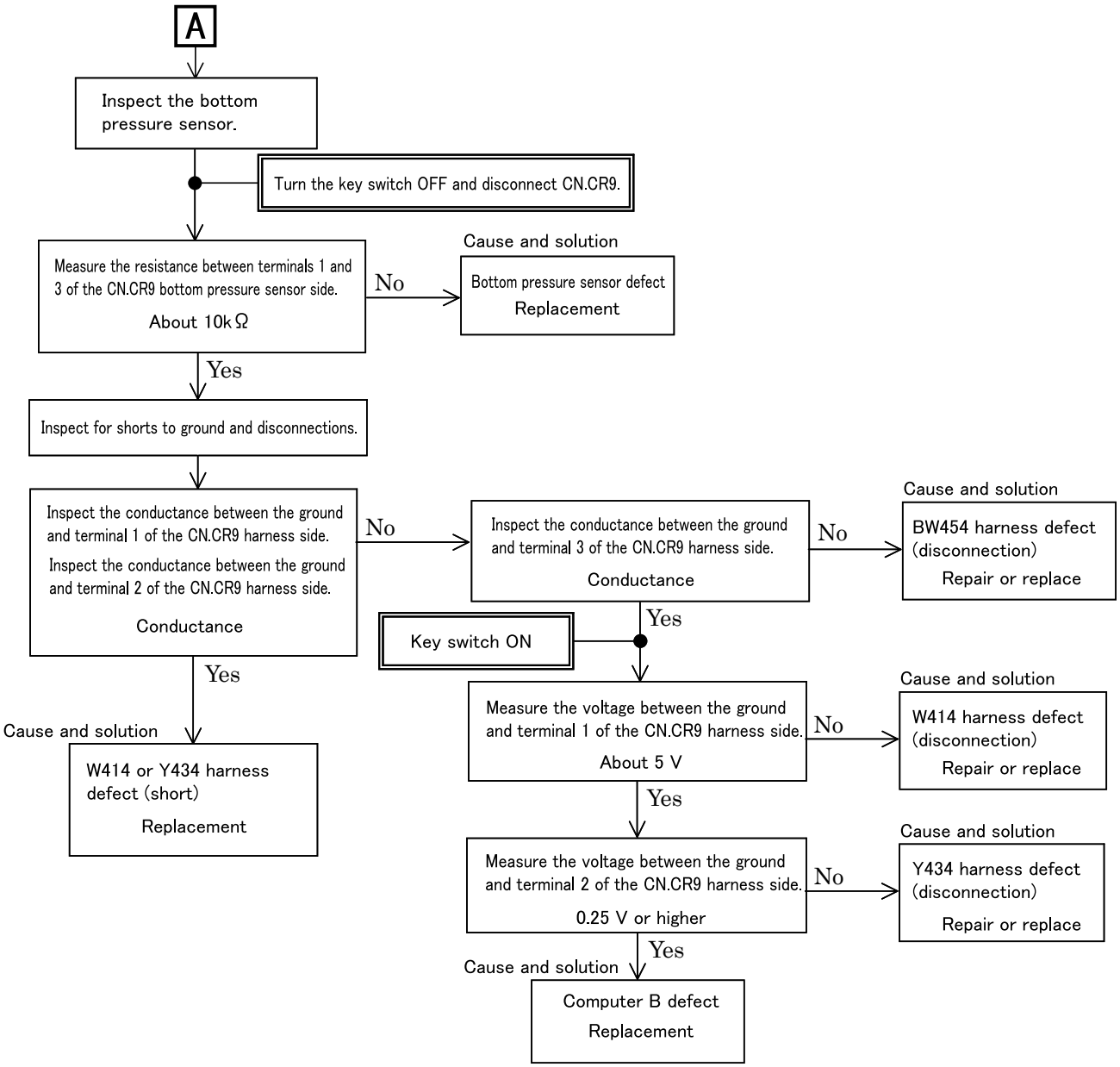
- Key switch input power supply voltage is 20 V or higher.



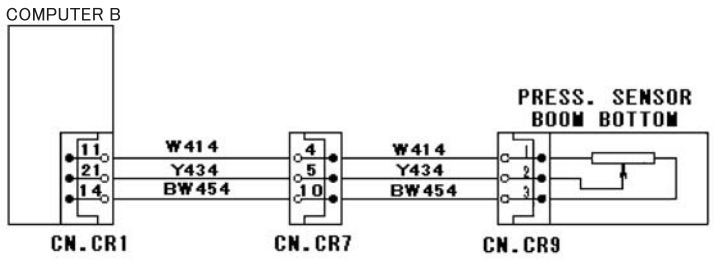
Block diagram



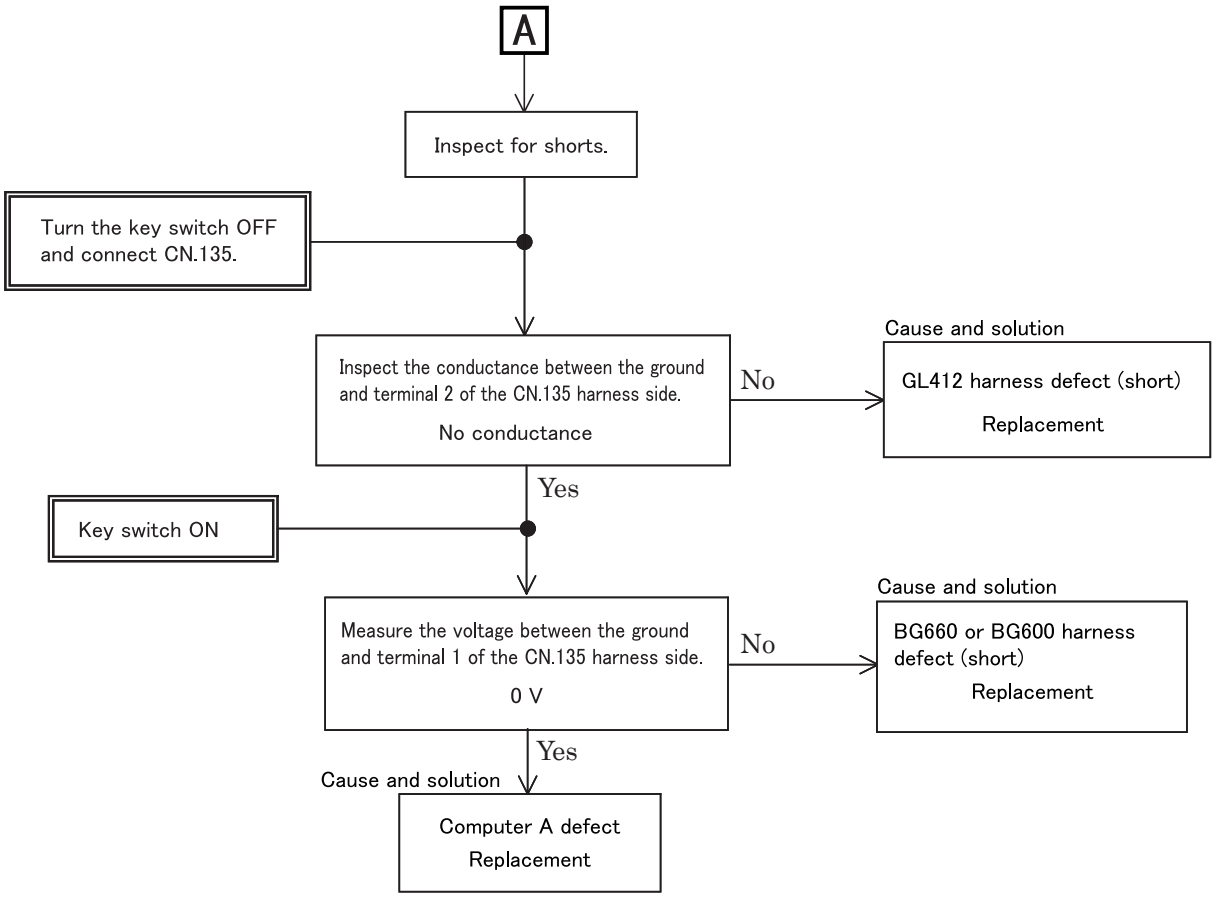
7000-2



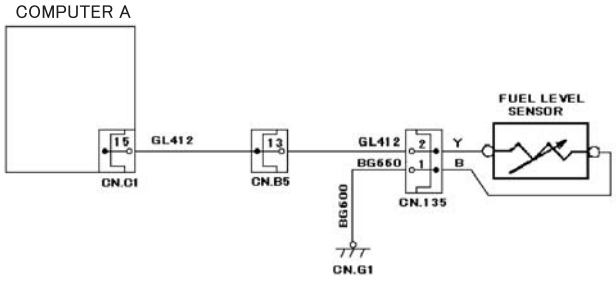
Block diagram



7005-2



Block diagram



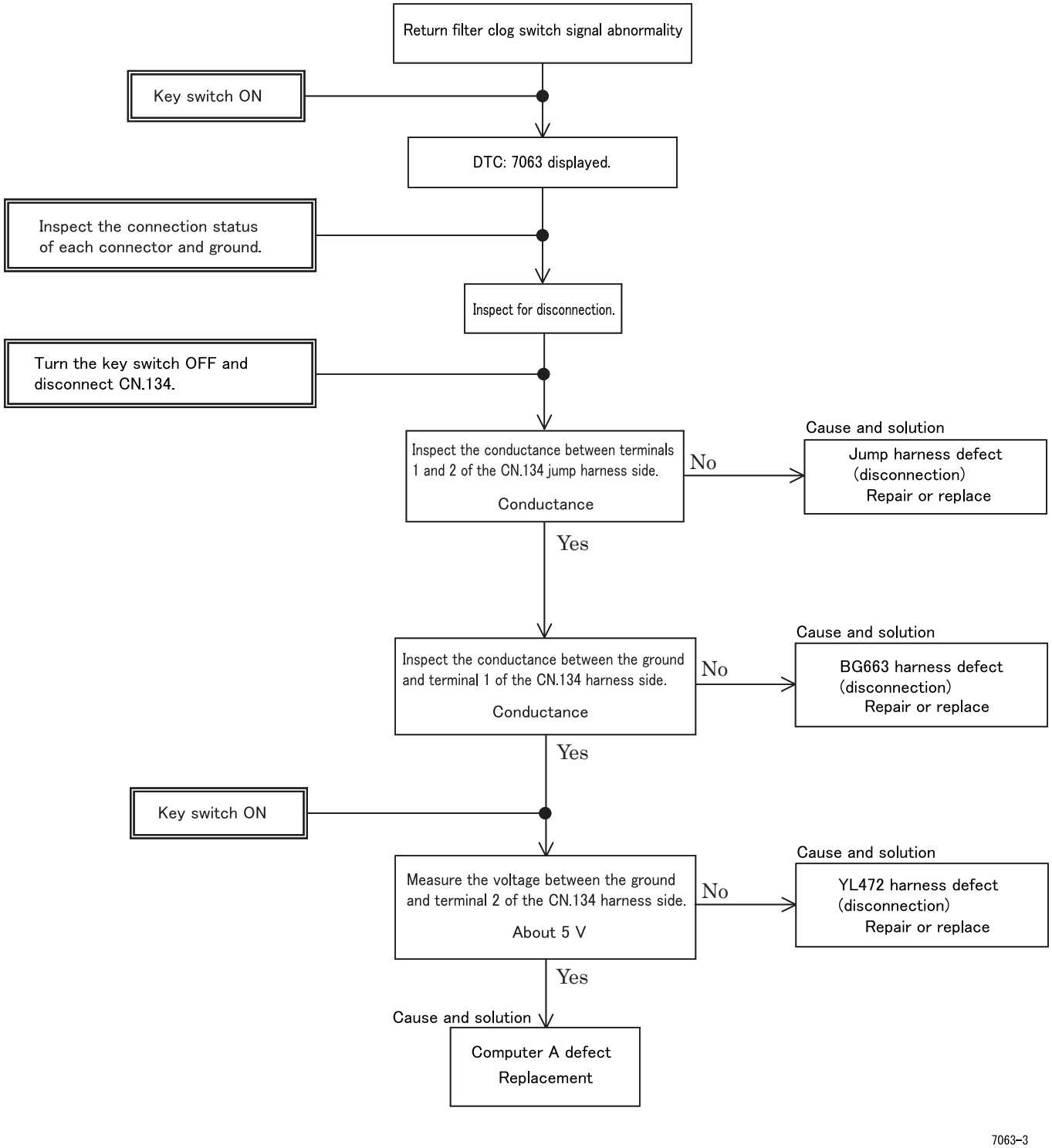
Float position and resistance

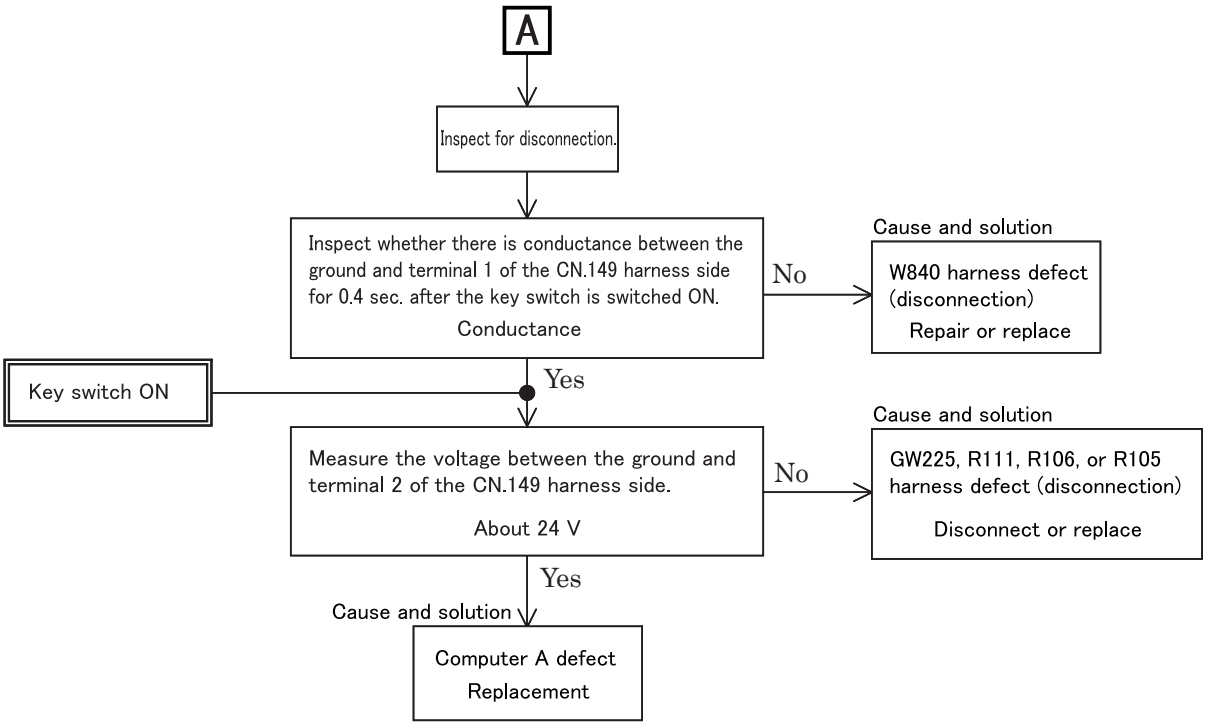
Float position	FULL	HALF	EMPTY
Resistance (Ω)	10 (tolerance of 0 to -4)	38	80 (tolerance of 0 to 10)

* Temperature conditions: 20 ± 15 ℃

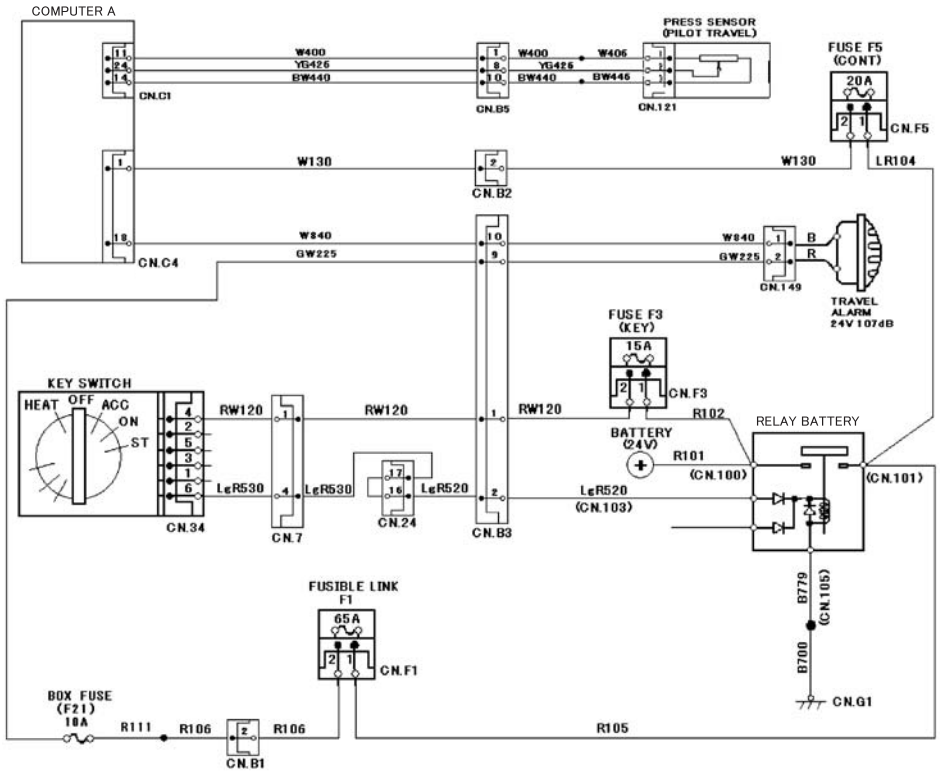
7040-2

(Other than breaker specifications)



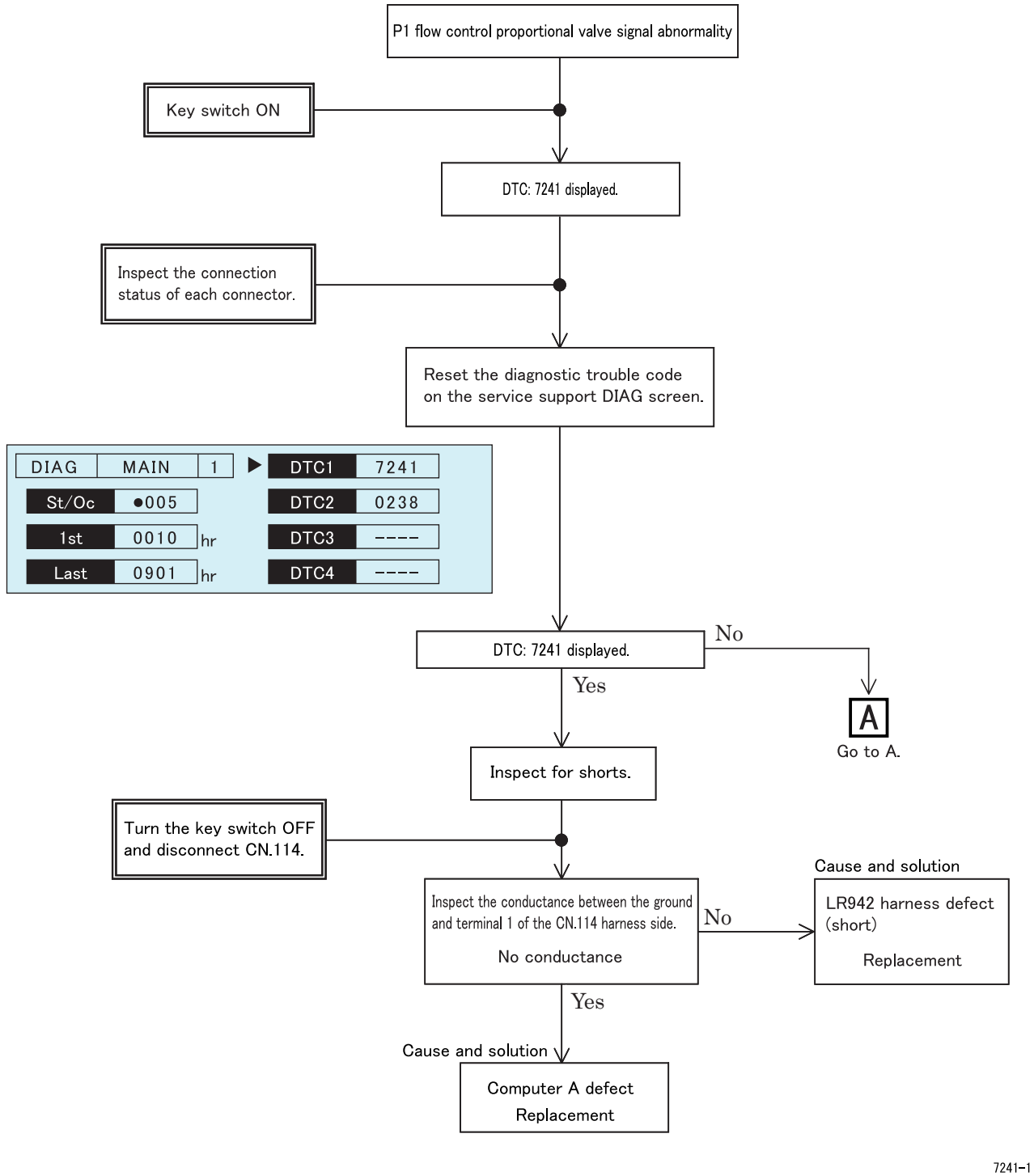


Block diagram

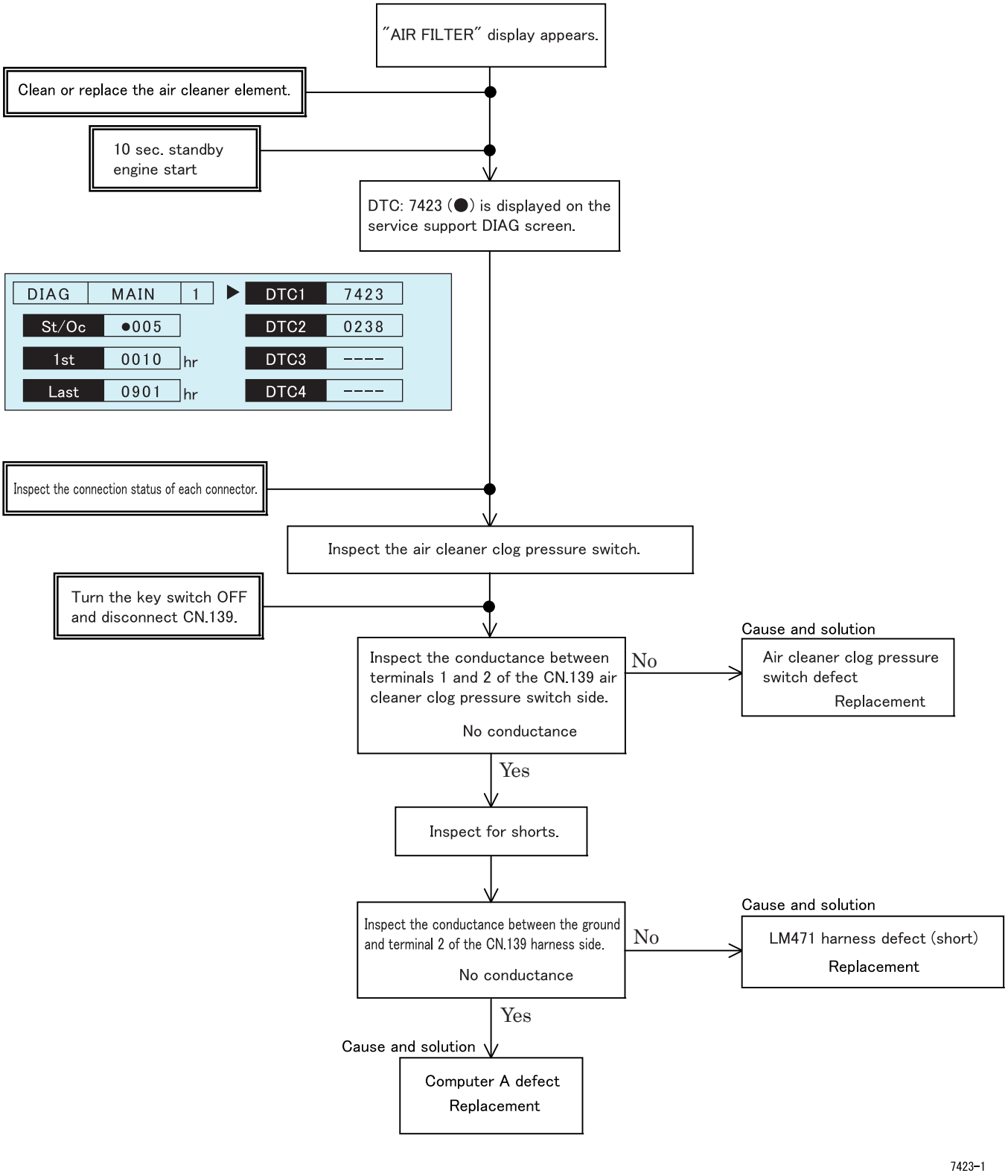


7203–2

DTC: 7241
P1 Flow Control Proportional Valve Signal Abnormality



DTC: 7423
Air Cleaner Clogging



7423-1

Engine Start Problem

Preliminary inspection

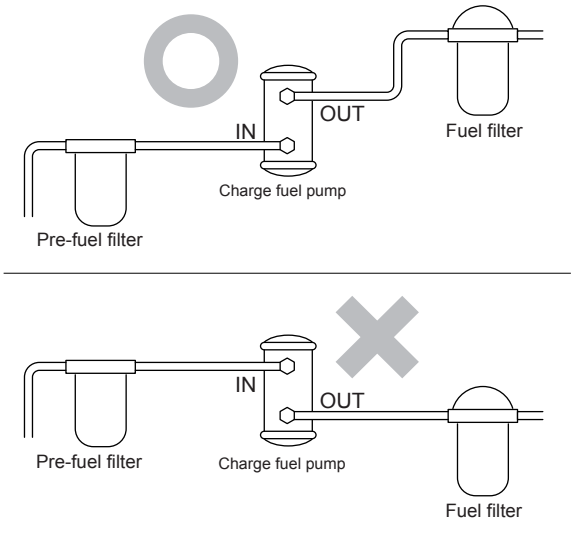
Before using this section, implement a "Service support monitor check" and check all of the following items.

- Check whether there is an excessive load on the main unit side.
- The ECM and shovel controller are operating correctly.
- Check diagnostic trouble codes.
- Check the condition of the main unit and find applicable symptoms in the problem symptom list. Implement the procedure indicated in the symptom chart.
- Confirm with the customer that the stipulated engine oil and fuel are being used.

Visual inspection

Some symptoms detection procedures require careful visual inspection. This allows for problems to be repaired without performing further inspection, which saves valuable time. The following items are included in this inspection.

- Check whether the fuel filter is dirty or clogged.
- Check for connector connection problems (connections are properly connected up to a clicking sound being heard). Especially important for CKP and CMP sensors.
- Check whether the battery terminal voltage is low.
- Check for correct wiring connections, tightness, and disconnections
- Check whether the power supply for commercially-available accessories is being diverged from the ECM power supply.
- Check whether the ECM ground is dirty and check that it is securely installed in the correct location.
- Check that pipes and hoses for fuel, air, and oil are not broken or twisted and that they are correctly connected. Thoroughly check for any leaking or clogging.
- Check whether the layout of the fuel filter, pre-filter and charge fuel pump makes it easy for air pockets to form.



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Due to the Sumitomo genuine pre-filter not having an air-bleed plug, check that parts are arranged so that air pockets will not occur.
Also, check that the layout of the charge fuel pump suction and discharge ports is appropriate. Correct layouts where the suction port of the charge fuel pump is on the upper side or the discharge port faces in the moving direction of the actual machine.

- Check for fuel leaks and damage and denting on pipes in the fuel system.
- Suction air system parts abnormality
- Exhaust system parts abnormality

Diagnostic aid

- If there is a CKP sensor abnormality, the engine should be cranked for at least 14 sec. at a speed of at least 60 min^{-1} because the abnormality will not be diagnosed unless the crank rotates at least 14 times.
- CKP sensor diagnostic trouble codes for CKP sensor problems may not be detected during low rotation of the engine. For intermittent trouble, increase engine rotation to the maximum and check whether a diagnostic trouble code related to the CKP sensor is detected.
- Fuel system abnormality (fuel cut-off, fuel freezing, air entering fuel line, filter abnormality (main, gauze clogging), line abnormality, fuel quality, fuel tank (debris, fuel suction abnormality)
- Suction air system abnormality (filter clogging, suction air line abnormality)
- If low viscosity fuel such as kerosene is used, this will contribute to friction in the supply pump and plunger areas that will cause discharge problems and starting starting problems. In these cases, replacement of the supply pump is necessary.
  If a starting problem occurs, check with the customer what fuel is being used. If a low viscosity fuel such as kerosene is being used, instruct the customer not to use low viscosity fuels because the same problem will occur even if the supply pump is replaced.
- Long-term storage fuels and mixed fuels such as biofuels that contain organic materials oxidize easily. Fuel that has oxidized will contribute to friction in cam shaft-related parts inside the supply pump, and this will cause starting problems due to discharge problems. In these cases, replacement of the supply pump is necessary. Supply pump replacement due to long-term storage fuels and mixed fuels such as biofuels that contain organic materials is not covered under warranty, so instruct the customer not to use these fuels.
- If fuel with a high water content is used, add a large-scale sedimenter to the pre-fuel filter so that water will not enter the fuel system.
- Supply pump abnormality (no fuel pressure feed)
  The supply pump diagnostic trouble code ECM judgment for no fuel pressure feed will not be detected unless an engine rotation of 900 rpm or less and an absolute pressure of 15 MPa (2176 psi) or less is maintained for at least 3 sec.
  Accordingly, if there is a supply pump abnormality and no fuel pressure feed and the engine does not start, no diagnostic trouble code will be detected.

Step	Action	Value	Yes	No
12	Inspect the installation condition of the crankshaft position (CKP) sensor and camshaft position (CMP) sensor. Inspect whether there are any installation problems such as rattling with the CKP sensor and CMP sensor. Are the installation conditions normal?	-	Go to step 18.	Go to step 13.
13	Correct the installation condition of the CKP and CMP sensor. Is the action complete?	-	Go to step 18.	-
14	Inspect the signal detection condition of the CKP sensor. 1. Start the engine. 2. Remove the harness from the CMP sensor. (This operation will cause a diagnostic trouble code to be detected, so make sure to delete the diagnostic trouble code after repairing the main unit.) Is the idling condition normal?	-	Go to step 21.	Go to step 15.
15	Inspect the signal detection condition of the CMP sensor. 1. Start the engine. 2. Remove the harness from the CKP sensor. (This operation will cause a diagnostic trouble code to be detected, so make sure to delete the diagnostic trouble code after repairing the main unit.) Is the idling condition normal?	-	Go to step 21.	Go to step 16.
16	Check the engine symptoms again. Have the engine symptoms normalized?	-	Go to step 22.	Go to step 17.
17	Is there an EMPS?	-	Go to step 18.	Go to step 19.
18	1. Check the ECM software version. 2. Perform rewriting if updating the ECM software version is necessary. **Note:** **When ECM replacement or rewriting is performed, perform EGR learning.** Is the action complete?	-	Go to step 22.	Go to step 21.
19	Replace the ECM. **Note:** **When ECM replacement or rewriting is performed, perform EGR learning.** **For information on EGR learning, see the "Engine Control Module (ECM) · ECM installation" in P.39.** Is the action complete?	-	Go to step 22.	Go to step 20.
20	Return the ECM to the condition before replacement. **Note:** **When ECM replacement or rewriting is performed, perform EGR learning.** **For information on EGR learning, see the "Engine Control Module (ECM) · ECM installation" in P.39.** Is the action complete?	-	Go to step 21.	-

Abnormal Noise

Preliminary inspection

Before using this section, implement a "Service support monitor system check" and check all of the following items.

- See the Service Text and perform abnormal noise inspection.
- The ECM and shovel controller are operating correctly.
- Check diagnostic trouble codes.
- Check the condition of the main unit and find the applicable symptoms in the Contents. Implement the procedure indicated in the symptom chart.
- Confirm with the customer that the stipulated engine oil and fuel are being used.

Visual inspection

Some symptoms detection procedures require careful visual inspection. This allows for problems to be repaired without performing further inspection, which saves valuable time. The following items are included in this inspection.

- Check for correct wiring connections, tightness, and disconnections
- Check whether the ECM ground is dirty and check that it is securely installed in the correct location.
- Check that pipes and hoses for fuel, air, and oil are not broken or twisted and that they are correctly connected. Thoroughly check for any leaking or clogging.
- Check for fuel leaks and damage and denting on pipes in the fuel system.
- Suction air system parts abnormality
- Exhaust system parts abnormality

Diagnostic aid

- Fuel system abnormality (fuel cut-off, fuel freezing, air entering fuel line, filter abnormality (main, gauze clogging), line abnormality, fuel quality, fuel tank (debris, fuel suction abnormality)
- Suction air system abnormality (EGR valve abnormality)
- Injector abnormality (Fuel is not injected.)
- Engine main unit abnormality (seizing, compression pressure deficiency, other mechanical trouble)
- Trouble related to main unit-side device (hydraulic pump, etc.)
- ECM trouble (main unit, power supply, GND)
- Perform inspection to check whether there are any connector connection problems, abnormalities involving friction or breaking in harnesses, and whether any wires inside harnesses are touching another circuit and causing a short. Also, perform function diagnosis inspection, check operations and control in each area, and repair any abnormalities.

Step	Action	Value	Yes	No
1	Specify the location where the abnormal noise is occurring, and confirm the noise. Is the abnormal noise a metallic noise?	-	Repair or replace the problem part.	Go to step 2.
2	Perform a pre-injection stop test. Select "pre-injection stop" from the menu of the breaker box or circuit tester and perform the test. Was there a cylinder in which engine vibration and engine noise did not change?	-	Go to step 4.	Go to step 3.
3	Inspect the injector. 1. Delete the diagnostic trouble code. 2. Start the engine. 3. See "Injector Inspection Methods Using a Thermogun". Was there a cylinder with little temperature change?	-	Go to step 4.	Go to step 5.
4	Replace the injector for the cylinder with little temperature change. **Note:** **See the "Engine" section in the Service Manual for the work procedures.** Is the action complete?	-	Check repair.	-
5	Inspect the EGR valve. ・ EGR valve main unit abnormality Perform repair or replacement for any locations where problems are found. Is the action complete?	-	Check repair.	Go to step 6.
6	See the "Engine" section of the Service Manual and perform inspection of engine problems. Perform repair or replacement for any locations where problems are found. Is the action complete?	-	Check repair.	-