CX470B
Crawler Excavator

SERVICE MANUAL

Part number 48004716
English
March 2016

CASE
CONSTRUCTION

Engine fuel, maintenance of fuel filters and fuel storage

In order to meet the emission control regulation of 3rd-stage, the engine components have been made precisely and they are to be used under high-pressure conditions.

Therefore, the specified fuel must be used for the engine.

As a matter of course, not only the guarantee will not be given for the use of a fuel other than the specified but also it may invite a serious breakdown.

In addition, since suitable specifications for the fuel filter elements have been established for this engine, use of the genuine filter is essential.

The following describes the specifications and the requirements of the fuel to be applied, and maintenance of the fuel and the fuel elements.

Fuel to be applied

Selection of fuel

Following conditions must be met for the diesel engines, that is the one;

1 In which no dust even fine one is mixed,
2 With proper viscosity,
3 With high cetane rating,
4 With good flow properties in lower temperature,
5 With not much sulfur content, and
6 With less content of carbon residue

Applicable standards for diesel fuel

Applicable Standard	Recommendation
JIS (Japanese Industrial Standard)	NO.2
DIN (Deutsche Industrie Normen)	DIN 51601
SAE (Society of Automotive Engineers)	
Based on SAE-J-313C	NO. 2-D
BS (British Standard) Based on BS/2869-197	Class A-1
EN590	

If a standard applied to the fuel for the diesel engine is stipulated in your country, check the standard for details.

Requirements for diesel fuel

Although conditions required for the diesel fuel are illustrated above, there are other requirements exerting a big influence on its service durability and service life.

Be sure to observe the following requirements for selecting fuel.

Sulfur content ..... 2500 ppm or less
HFRR* ..... 460 mm or less
Water content ..... 0.05 wt% or less

* HFRR (High-Frequency Reciprocating Rig.): An index showing lubricating properties of the fuel.

Sulfur content reacts to moisture to change into sulfuric acid after combustion.

Use of a fuel containing much sulfur content allows it to accelerate internal corrosion and wear.

In addition, much sulfur content quickens deterioration of engine oil allowing its cleaning dispersive property to be worse which results in acceleration of wear of sliding portions.

HFRR is an index that indicates lubricating property of a fuel.

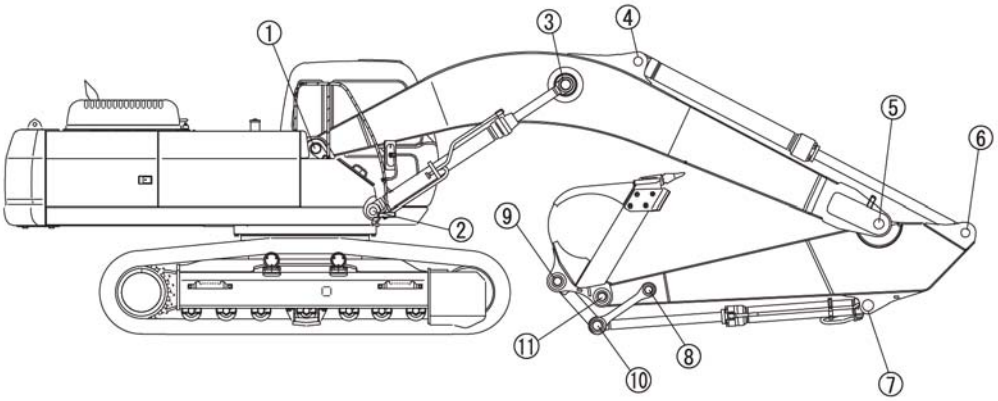
Large value of the index means poor lubrication so that seizure of the machine components may result if such a fuel is used.

Since a fuel with high HFRR value also has lower viscosity, it can easily be leaked out.

New Machine Performance

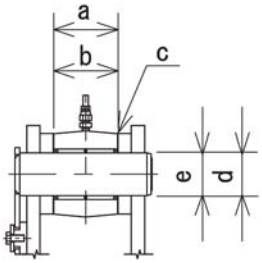
SP Mode (with standard bucket)

Item				Unit	Reference value
1	Engine speed	Idling		min^{-1}	900 ± 10
		No load A mode			1750 ± 10
		No load H mode			1900 ± 10
		No load SP mode			2000 ± 10
2	Pressure in each section	Main relief	Standard	MPa	30.6 ± 2.0
			Boosted pressure		33.8 ± 2.0
		Boom relief	Up		40.5 ± 2.0
			Down		28.0 ± 2.0
		Arm relief	Out		40.5 ± 2.0
			In		
		Bucket relief	Open		39.5 ± 2.0
			Close		40.5 ± 2.0
		Swing relief	Left and right		30.6 ± 2.0
		Travel relief	Left and right, front and back		33.8 ± 2.0
		4th pump relief			20.6 ± 2.0
		Pilot pump			3.9 ± 1.0
		Option relief	For crusher		-
			For breaker		-
3	Natural fall distance (position change) for each cylinder with no load (in 10 min.)	Boom cylinder retraction		mm	13 max.
		Arm cylinder extension			19 max.
		Bucket cylinder retraction			22 max.
		Overall bucket tip falling			250 max.
4	Attachment speed	Boom (bucket open)	Up (stroke 941)	sec.	4.5 ± 0.6
			Down (stroke 941)		3.7 ± 0.6
		Arm	Out		3.6 ± 0.6
			In		4.5 ± 0.6
		Bucket	Open		3.0 ± 0.6
			Close		4.3 ± 0.6



TI14011-002

4. Boom and arm cylinder installation section



TI14011-006

Part name	Code	Measured dimensions (mm)	Standard value (mm)	Usage limit (mm)	Judgment	Solution
Boom	a		156	162	Acceptable/ Unacceptable	Replacement
Boom cylinder (foot section	b		155	153	Acceptable/ Unacceptable	Replacement
Clearance	c (a - b)		1.0 - 3.0	Shim adjustment	Acceptable/ Unacceptable	Adjust with shims
Pin	d	ϕ	ϕ 120	ϕ 119	Acceptable/ Unacceptable	Replacement
Bushing (arm cylinder)	e	ϕ	ϕ 120	ϕ 121.5	Acceptable/ Unacceptable	Replacement

NOTES

REMOVAL AND INSTALLATION OF RADIATOR

Warning:	• Do not remove the radiator cap when the radiator coolant temperature is high. Hot liquid could spray out.

Caution:	• Be sure to release hydraulic pressure before beginning work. • Be sure to stop the engine before beginning work. • Be sure to inspect the wire rope and other lifting equipment before beginning work. • Do not stand or pass under the suspended load.

Items to prepare

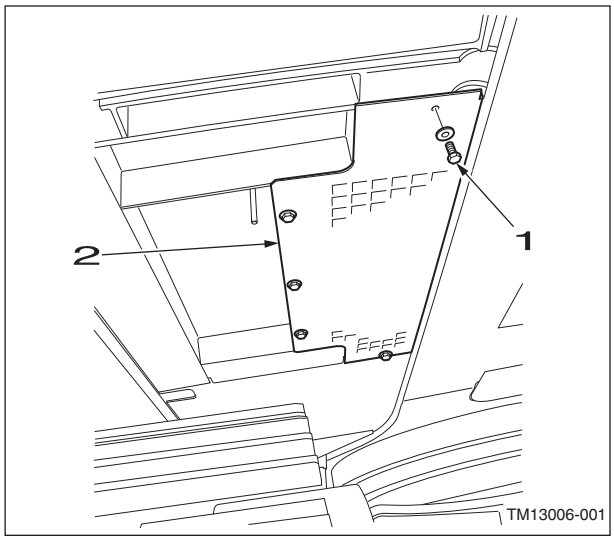
- Wrench set
- Box wrench set
- Hexagon wrench
- Pliers
- Shackle (with the required lifting capacity) x 2
- Wire rope (with the required breaking load)
- Liftcrane (with the required lifting capacity)
- Caps
- Plugs
- Drain tank
- Drain hose
- Rag
- Cleaning fluid
- Wood planks, etc.

1 Removal of radiator

[1] Open the engine hood.

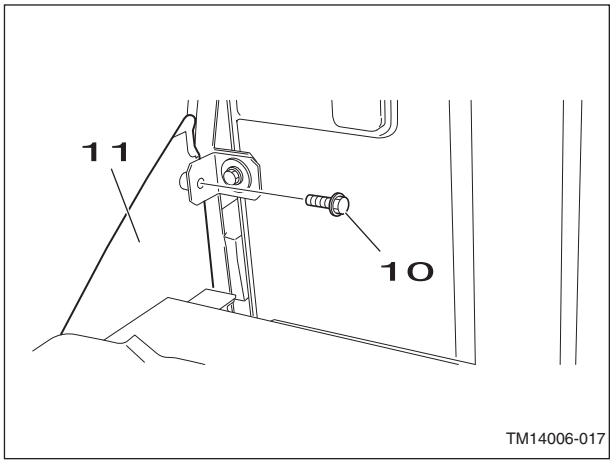
[2] Drain the hydraulic oil from the hydraulic oil tank. (See Operator's Manual for details of this procedure).

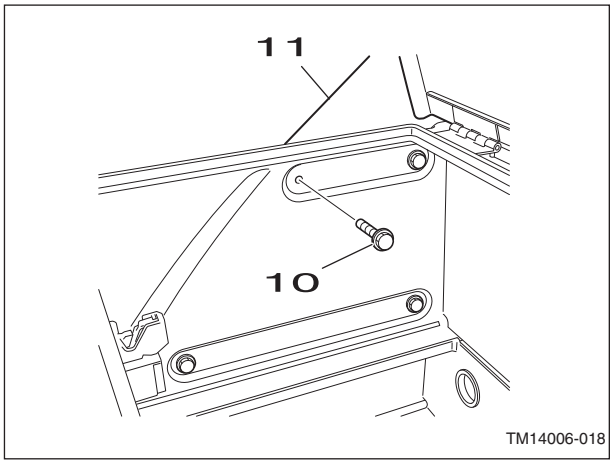
[3] Use a wrench (19 mm) to remove the 5 bolts (1), and then remove the under cover (2).



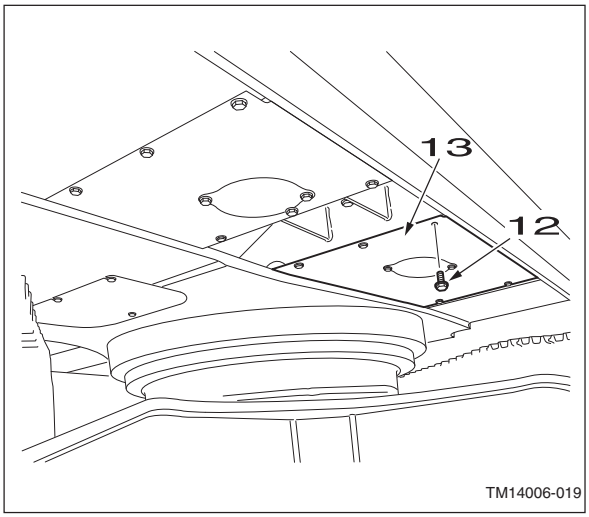
NOTES

[6] Use a wrench (19 mm) to remove the 5 bolts (10) from the fuel tank side cover (11), and then remove the side cover.





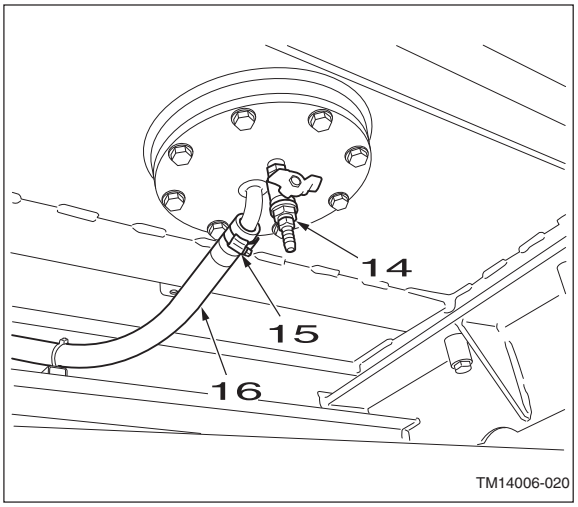
[7] Use a wrench (19 mm) to remove the 5 bolts (12), and then remove the under cover (13).



[8] Use the drain cock (14) on the bottom of the tank to drain out any fuel that does not drain out but remains at the bottom of the tank.

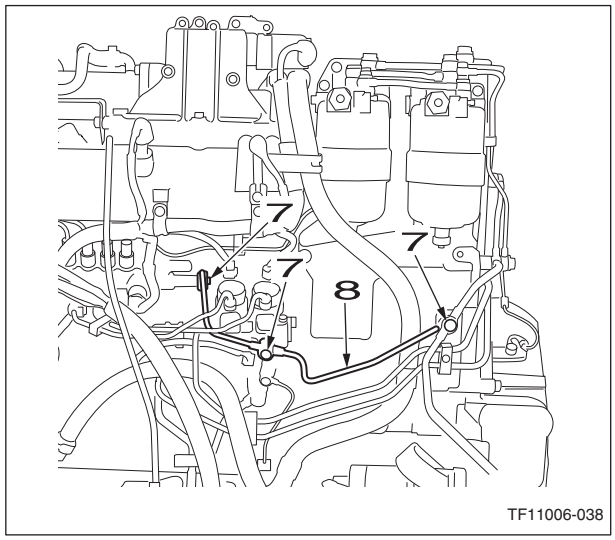
[9] Loosen the hose band (15), and then remove the hose (16).

- Mark the fuel tank and hose so that the connectors match at the time of assembly.
- Attach caps or plugs to the fuel tank and hose to prevent any entry of water, dust or dirt.



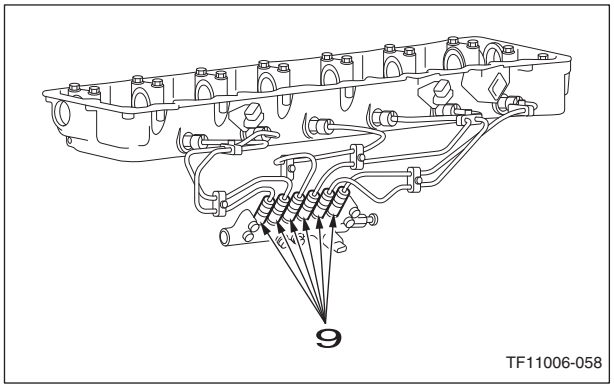
[5] Use a wrench (14 mm) to remove the 3 eyebolts (7), and then remove the fuel return pipe (8).

- Replace the removed lines in the same way as the common rail.
- Use caps or plugs to cover the line to prevent any entry of water, dust or dirt.
- Clean the line by spraying with a parts cleaner to prevent scratches and prevent dirt from accumulating on the connectors.

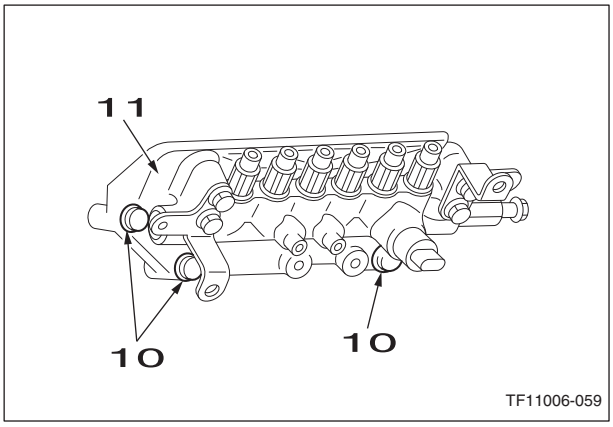


[6] Use a wrench (17 mm) to remove 6 sleeve nuts (9).

- Replace the removed lines in the same way as the common rail.
- Use caps and plugs to cover the lines to prevent any entry of water, dust or dirt.
- Clean the lines by spraying with a parts cleaner to prevent scratches and prevent dirt from accumulating on the connectors.



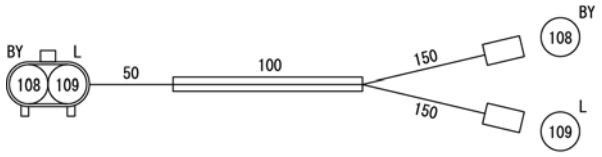
[7] Use a wrench (12 mm) to remove the 3 bolts (10), and then remove the common rail assembly (11).



5) Pressure switch (main harness side)

Part number : KHP11890

Old part number : WDB0055-9

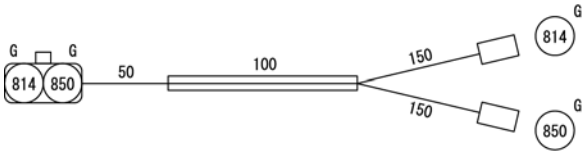


330-1-04-02-13e

6) Receiver dryer

Part number : KHP11900

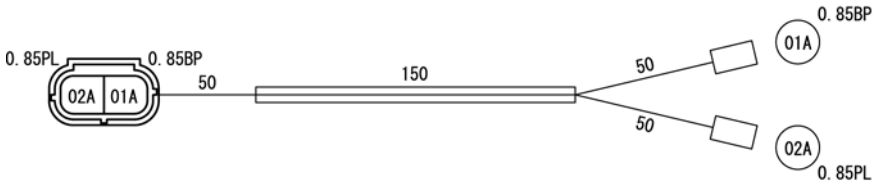
Old part number : WDB0055-10



330-1-04-02-13f

7) Oil temperature sensor

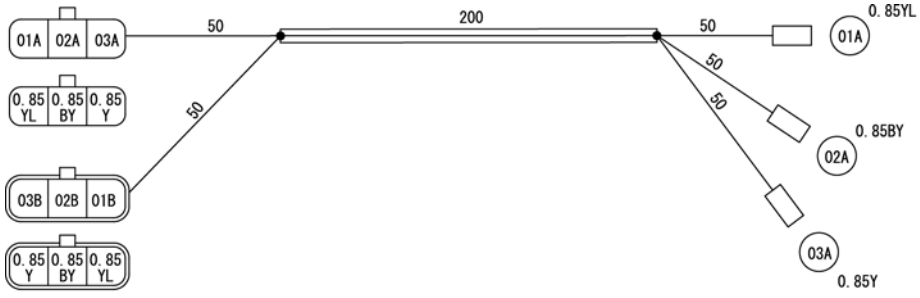
Part number : KHP1575



330-1-04-02-13g

8) Atmospheric pressure sensor

Part number : KHP11020



330-1-04-02-13i

This page has been left blank intentionally

3. Pump Horsepower Cut Control

a) Purpose:

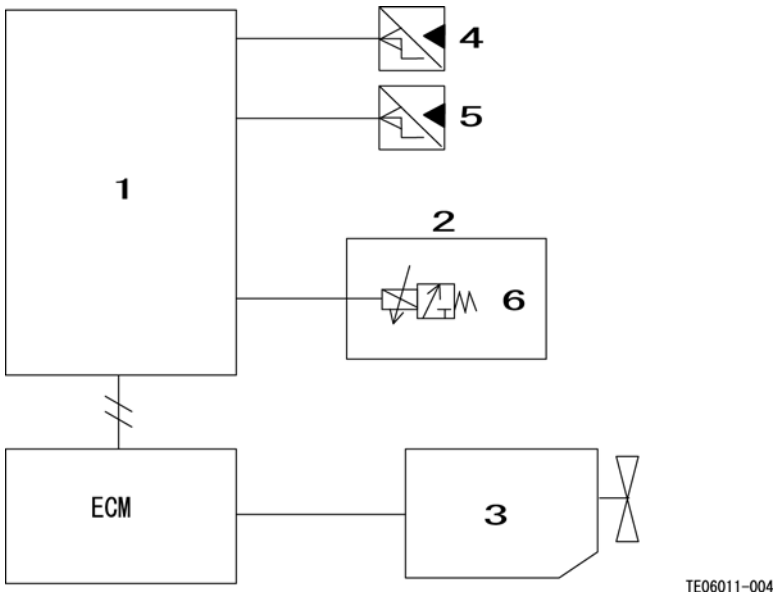
The pump milli-amp is controlled in order to prevent black smoke under overload and engine speed drop and in order to improve energy saving.

The control methods are the following three.

1. Overload reduction control

2. Engine stalling prevention control

3. PID control



1	Computer A	**4**	P1 pressure sensor
2	Pump	**5**	P2 pressure sensor
3	Engine	**6**	Pump horsepower control proportional valve

b) Overload reduction control

When the engine is under overload, the milli-amp to the pump horsepower proportional valve first drops to 50mA.

After that, the milli-amp is gradually raised while watching the difference between the actual engine speed and the target engine speed.

Overload reduction control is executed in all work modes.

- The engine is judged to be overloaded when the following conditions are met.

1. Sharp lever operation

When there is sharp lever operation, this is judged from the upper pressure sensor state.

2. Operation for high loads and sharp loads

Judged from the P1 or P2 pump pressure sensor and from the pump main pressure boost state.

c) Engine stalling prevention control

When the target engine speed is 1450 min^{-1} or less, the milli-amp is 50 mA.

d) PID control

When the engine actual speed falls 30 min^{-1} or more below the target engine speed, the milli-amp is gradually lowered.

When the difference of the actual engine speed from the target engine speed falls below 30 min^{-1} the milli-amp rises to the target for the each mode.

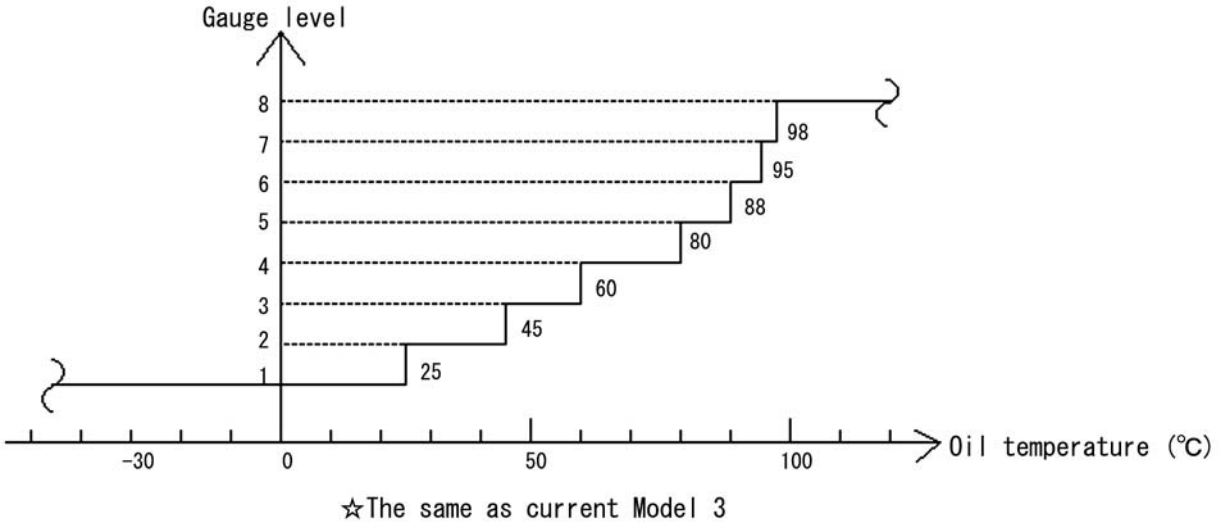
Backup control

If trouble occurs in a pressure sensor (P1, P2, upper), the overload restriction control is not carried out.

If trouble occurs in the pump horsepower control proportional valve, the output from the computer A stops.

c) Gauge and oil temperature

The gauge level is judged based on the figure below.



RST-05-06-001bq

d) Preventing flickering

When the temperature moves up or down near the gauge level fluctuation threshold (for example 25 °C [77°F]), the gauge goes on and off repeatedly causing flickering. In order to prevent that, the gauge level is judged using the temperature (judgment oil temperature) after the following processing.

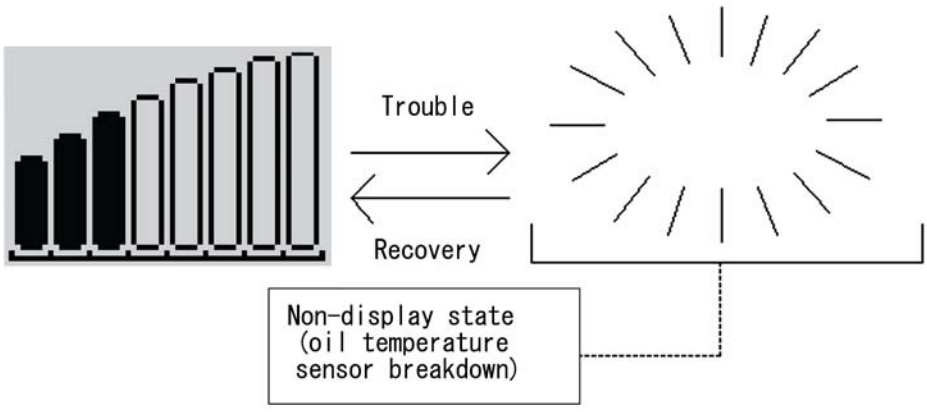
- Judgment oil temperature = Average of the oil temperatures obtained the past 32 times
- Oil temperature obtained period = 1 second
- Bar graph update period = 32 seconds (updates when the 32nd oil temperature obtained)

e) Trouble mode

If trouble occurs in the oil temperature sensor, the bar graph itself is not displayed (Only for trouble due to short).

If trouble occurs in UART communications (send: computer -> monitor), the display is fixed at the last state sent.

When the trouble is recovered from, the display returns to normal.



RE06004-023

- Oil temperature obtained during trouble.

  If a meaningless oil temperature were obtained and the processing in **d)** carried out, display upon recovery would be strange. In order to prevent this, the oil temperature is not obtained during an oil temperature sensor trouble.

f) Message display

When the gauge level reaches 8, "OVERHEAT" is displayed on the monitor and the buzzer buzzes.

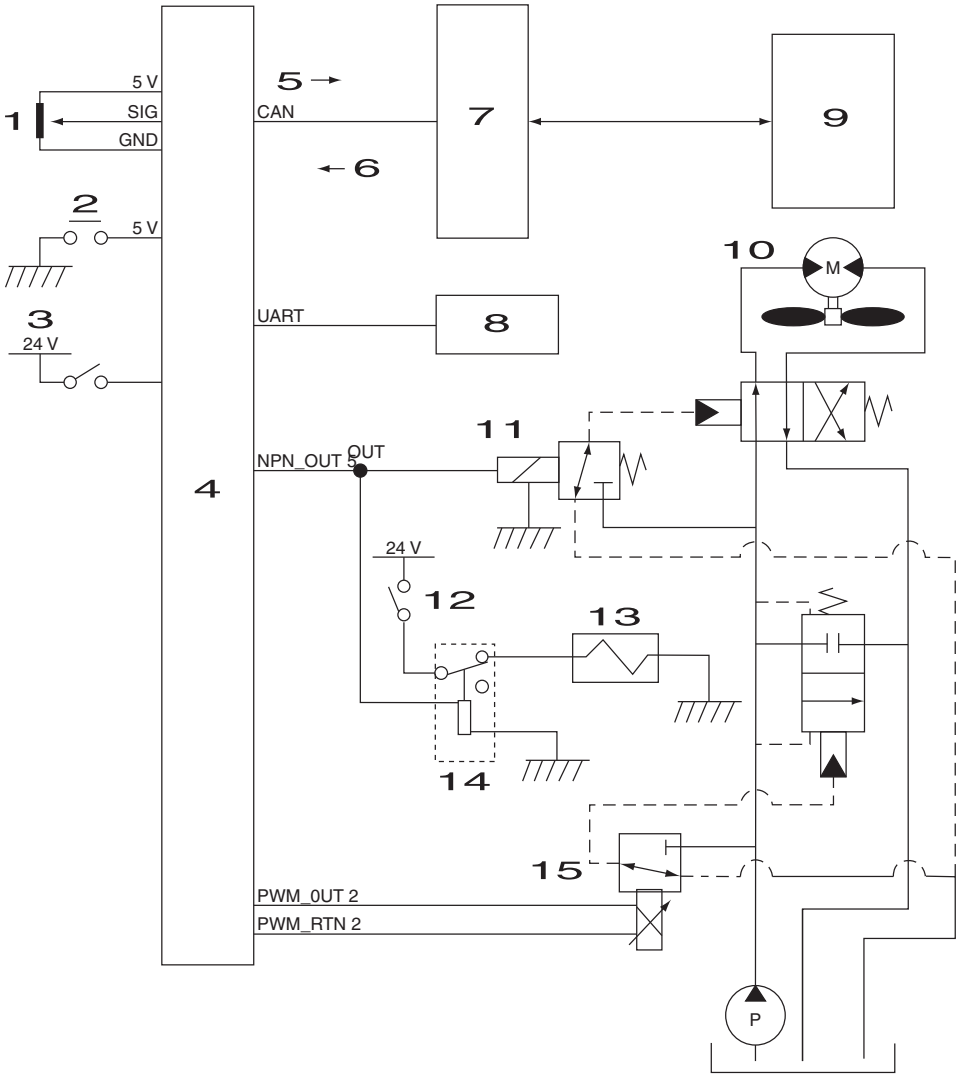
5. Control Of Hydraulic Driven Fan

a) Outline of control

Main control of hydraulic driven fan is illustrated below.
Detailed description for each section is shown after next section.

1. Fan speed control according to water temperature
2. Spool stick prevention control
3. Engine start/stop control
4. Reversing fan control (cleaning mode)
5. Actual fan speed checking mode

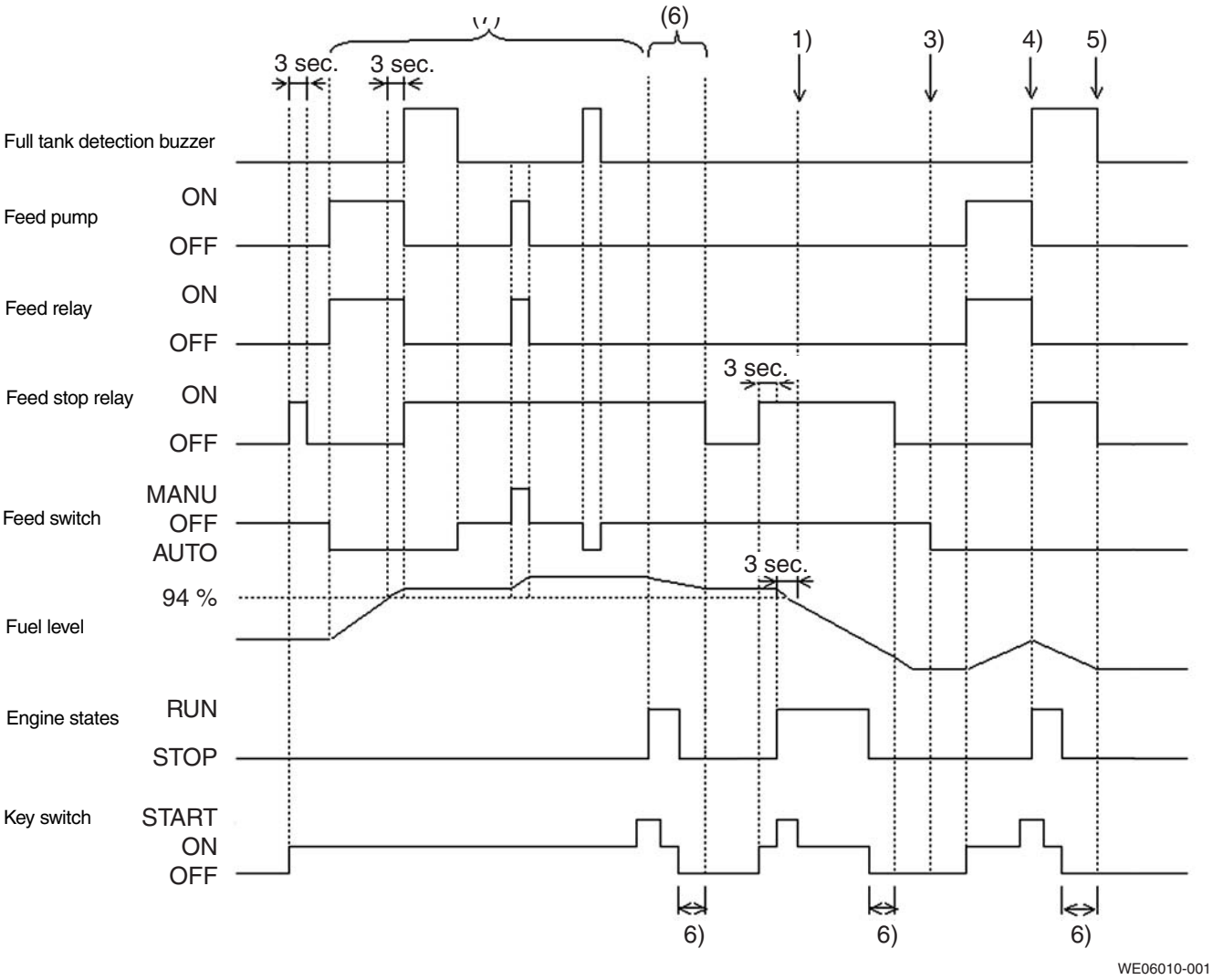
b) Basic circuit configuration



WE06010-011

1	Throttle volume	**8**	Monitor
2	Reversing fan switch	**9**	Engine
3	Key switch	**10**	Fan motor
4	Computer A	**11**	Solenoid valve for reversing fan
5	Target speed	**12**	Gate limit switch
6	Target engine speed	**13**	Lever lock solenoid
	Engine coolant temperature	**14**	Relay
	Diagnostic trouble code	**15**	Fan speed control electromagnetic proportional valve
7	Engine control		

g) Time chart

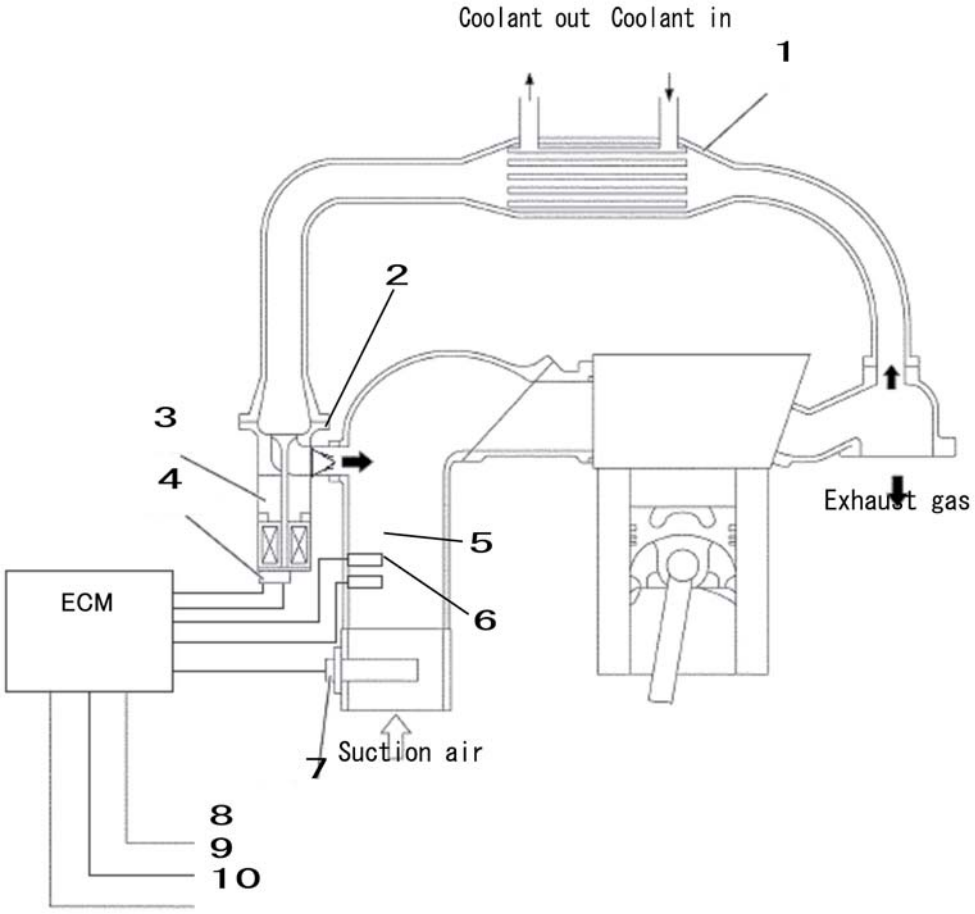


1. Even if the level falls below 94 %, no fuel can be fed as the engine is running.
2. Stopped, so fuel can be fed.
3. Fuel feed is not possible unless the key is switched ON.
4. If the engine is started during fuel feeding, the fuel feed stops.
5. When the operator forgets and leaves the switch switched to the Auto side, the pump operates during the power-cut delay (When fuel level under 98%).
6. Power-cut delay.

h) Trouble mode

If trouble occurs in an input (fuel sensor), output (feed stop relay) or communication (CAN), the system goes into trouble mode and the feed stop relay is fixed to OFF. Be careful. In trouble mode, even if the feed switch is set to Auto, the fuel feed is not stopped.

4. EGR (exhaust gas recirculation)



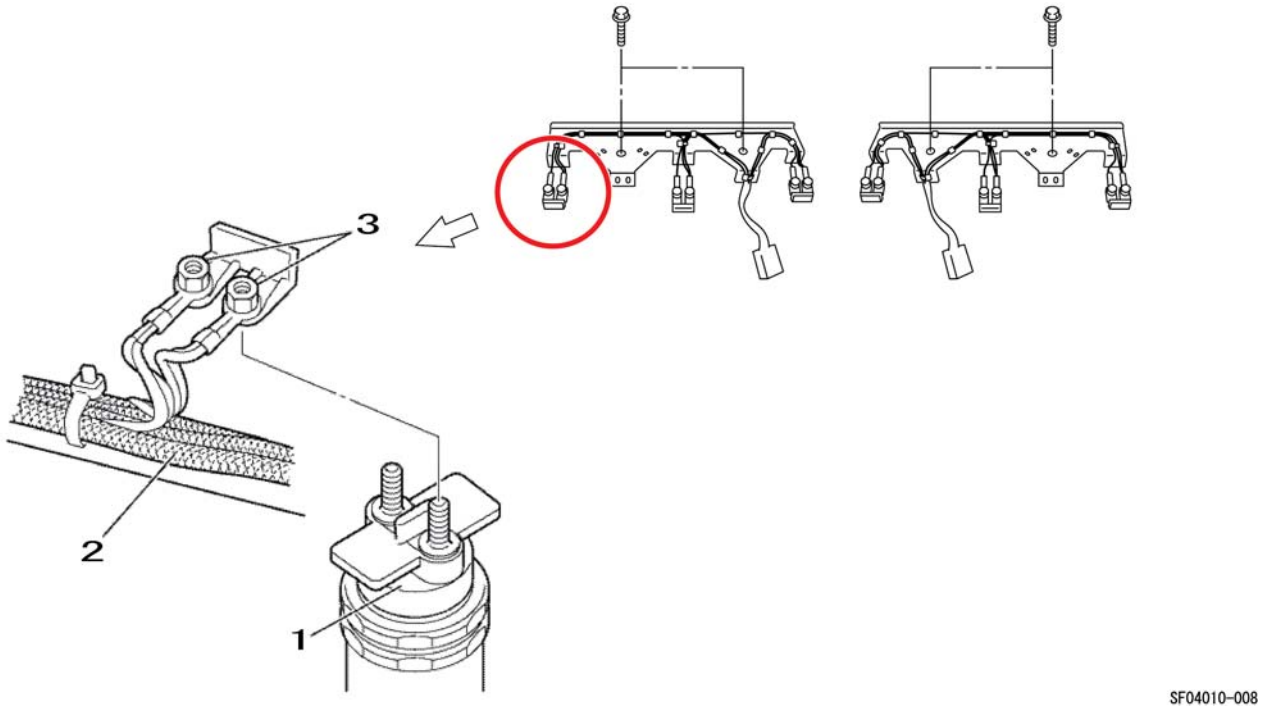
1	EGR cooler	6	Boost pressure sensor
2	Lead valve	7	Suction air temperature sensor
3	EGR valve	8	Engine speed
4	EGR position sensor	9	Engine coolant temperature
5	Boost temperature sensor	10	Engine load

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) 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)

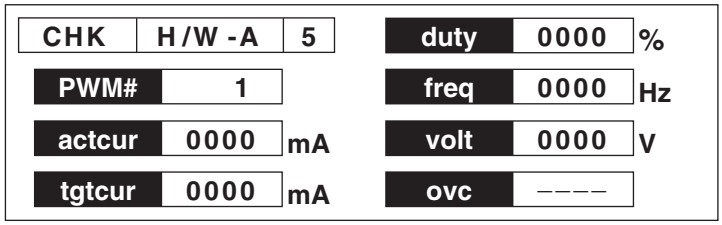
Furthermore, a lead valve is used in the EGR system to suppress EGR gas back flow and allow the EGR gas to only flow in one direction.

Be careful. High voltage of 118 V or higher is applied to the injectors. Disconnect the battery cable ground before replacing injectors.



1	Injector
2	Injector harness
3	Injector nut

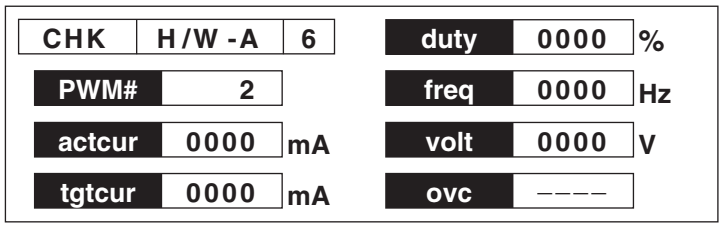
5) PWM data



WE07013-030

PWM# : PWM channel number
actcur : Actual milli-amp for horsepower control proportional valve
tgtcur : Target milli-amp for horsepower control proportional valve
duty : Duty
freq : Frequency
volt : Voltage
ovc : Overcurrent detection status (+: Overcurrent, - Normal)

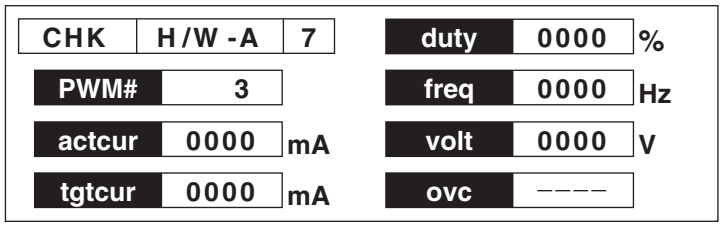
6) PWM data



WE07013-031

PWM# : PWM channel number
actcur : Actual milli-amp for hydraulic fan proportional valve
tgtcur : Target milli-amp for hydraulic fan proportional valve
duty : Duty
freq : Frequency
volt : Voltage
ovc : Overcurrent detection status (+: Overcurrent, - Normal)

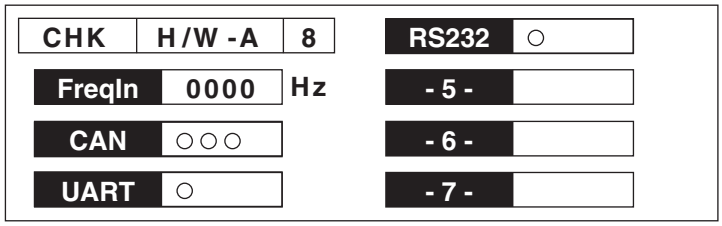
7) PWM data



WE07013-032

PWM# : PWM channel number
actcur : Actual milli-amp for flow control proportional valve
tgtcur : Target milli-amp for flow control proportional valve
duty : Duty
freq : Frequency
volt : Voltage
ovc : Overcurrent detection status (+: Overcurrent, - Normal)

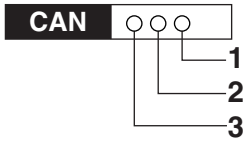
8) Frequency and communication



WE07013-033

FreqIn : Frequency input
CAN : CAN reception state
UART : UART reception state
RS232 : RS232C communication state
- 5 - : *
- 6 - : *
- 7 - : *

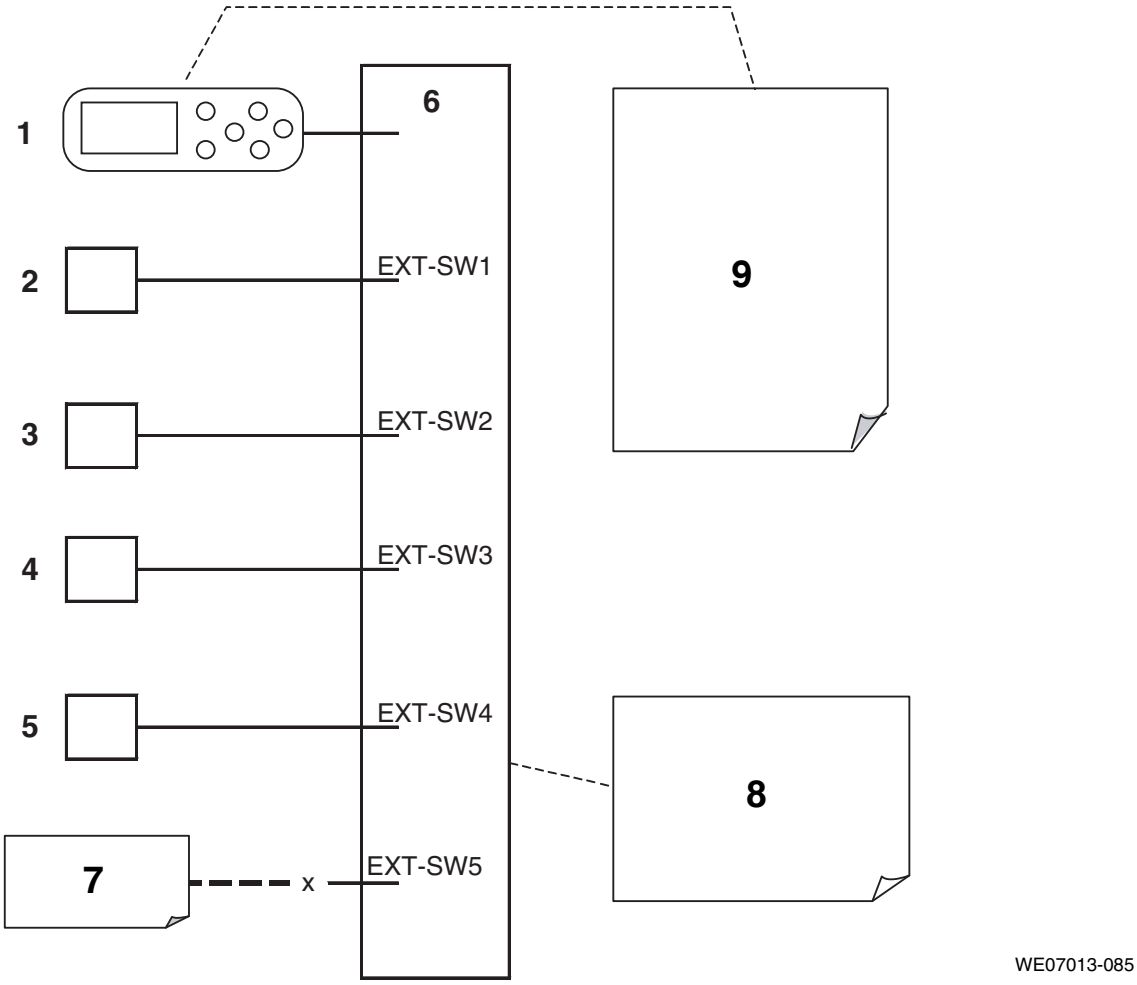
Input /output state (● = Receiving)



WE07013-034

1	Computer S reception state
2	Computer B reception state
3	ECM reception state

B) Configuration



1	Switch panel	**6**	Monitor
2	2 pumps flow switch	**7**	Not used
3	Front window limit switch	**8**	No communications with computer A (monitor alone)
4	Breaker mode switch	**9**	Wiper switch Washer switch Working light switch Travel high-speed select switch Auto idle switch Horn volume select switch
5	Crusher mode switch		

C) Differences from CHK screen [CHK | H/W-M | 1]

Monitor main unit input/output can also be checked on the CHK screen. However, for the CHK screen,
1) after the switch input is sent to computer A with communication,
2) the switch input is processed by computer A and
3) the results are sent to the monitor as screen data
and displayed. On the monitor switch check screen, the switch input recognized by the monitor itself is displayed directly on the screen (without involving communication or computer A), so it is possible to diagnose purely the switches themselves.

2. Main Unit Diagnostic Trouble Code List

1) Electrical troubles (input) [7000-7199]

Trouble location	Trouble mode	Diagnostic trouble code		Judgment timing	Prerequisites	Occurrence judgment	Recovery judgment
		DTC	Dis-play			Conditions	Conditions
Sensor; Pressure (P1)	Ground short/ disconnection	7000	O	Immediately after key switched ON	None	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Pressure (P2)	Ground short/ disconnection	7001	O	Immediately after key switched ON	None	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Pressure (N1)	Ground short/ disconnection	7002	O	Immediately after key switched ON	None	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Pressure (N2)	Ground short/ disconnection	7003	O	Immediately after key switched ON	None	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Pressure (Overload)	Ground short/ disconnection	7004	O	Immediately after key switched ON	EU selected as destination	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Pressure (Bottom)	Ground short/ disconnection	7005	O	Immediately after key switched ON	Liftcrane selected	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage > 4.75 V	
Sensor; Pressure (Rod)	Ground short/ disconnection	7006	O	Immediately after key switched ON	Liftcrane selected	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Pressure (Upper)	Ground short/ disconnection	7020	O	Immediately after key switched ON	None	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Pressure (Swing)	Ground short/ disconnection	7021	O	Immediately after key switched ON	None	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Pressure (Travel)	Ground short/ disconnection	7022	O	Immediately after key switched ON	None	Voltage ≤ 0.25 V	0.25 V < Voltage < 4.75 V
	Power supply short					Voltage ≥ 4.75 V	
Sensor; Fuel level	Disconnection	7040	O	Immediately after key switched ON	None	Resistance ≥ 100 Ω	2Ω < Resistance < 100Ω
	Short					Resistance ≤ 2 Ω	
Sensor; Oil temperature	Disconnection	7041	O	3 minutes after engine starts	None	Resistance ≥ 67 200 Ω (Voltage ≥ 4.93 V)	111 Ω < Resistance < 67 200 Ω (0.5 V < Voltage < 4.93 V)
	Short			Immediately after key switched ON		Resistance ≤ 111 Ω (Voltage ≤ 0.5 V)	
Monitor thermistor (*1)	Disconnection	7045	X	Immediately after key switched ON	None	Trouble bit received from monitor	No trouble bit received from monitor
	Short						
Sensor; Angle (Boom)	Ground short/ disconnection	7060	O	Immediately after key switched ON	Liftcrane or interference prevention selected	Voltage ≤ 0.2 V	0.2 V < Voltage < 4.8 V
	Power supply short					Voltage ≥ 4.8 V	
Sensor; Angle (Arm)	Ground short/ disconnection	7061	O	Immediately after key switched ON	Liftcrane or interference prevention selected	Voltage ≤ 0.2 V	0.2 V < Voltage < 4.8 V
	Power supply short					Voltage ≥ 4.8 V	

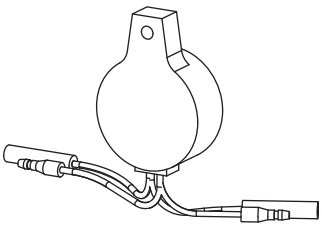
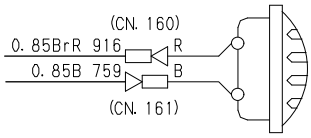
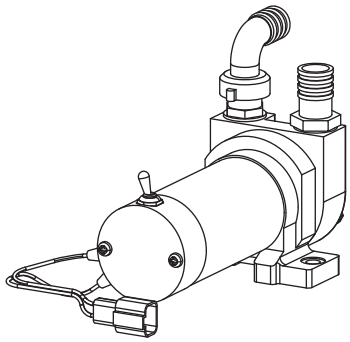
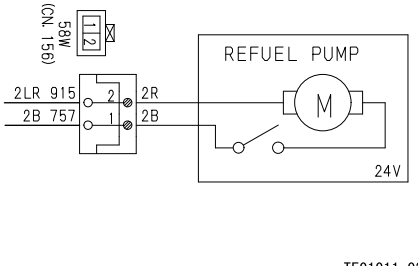
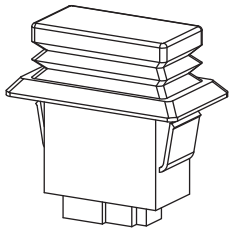
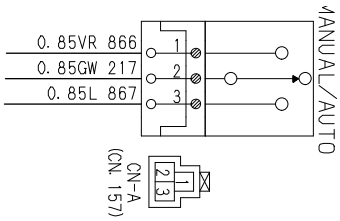
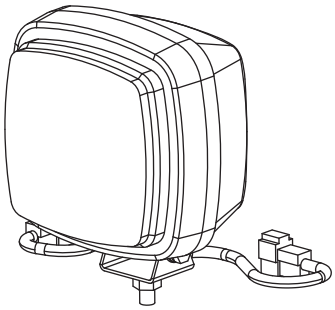
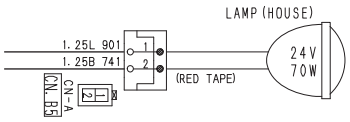
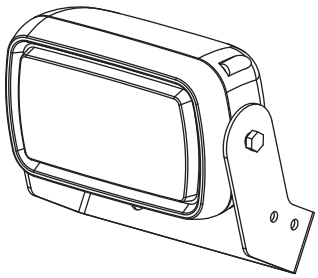
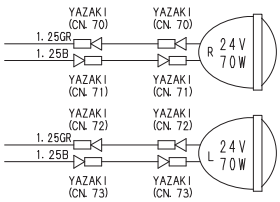
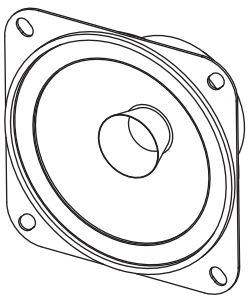
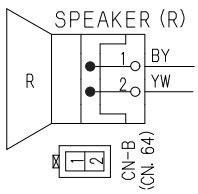
Section

4020

ELECTRICAL EQUIPMENT
&
ELECTRIC CIRCUIT DIAGRAMS

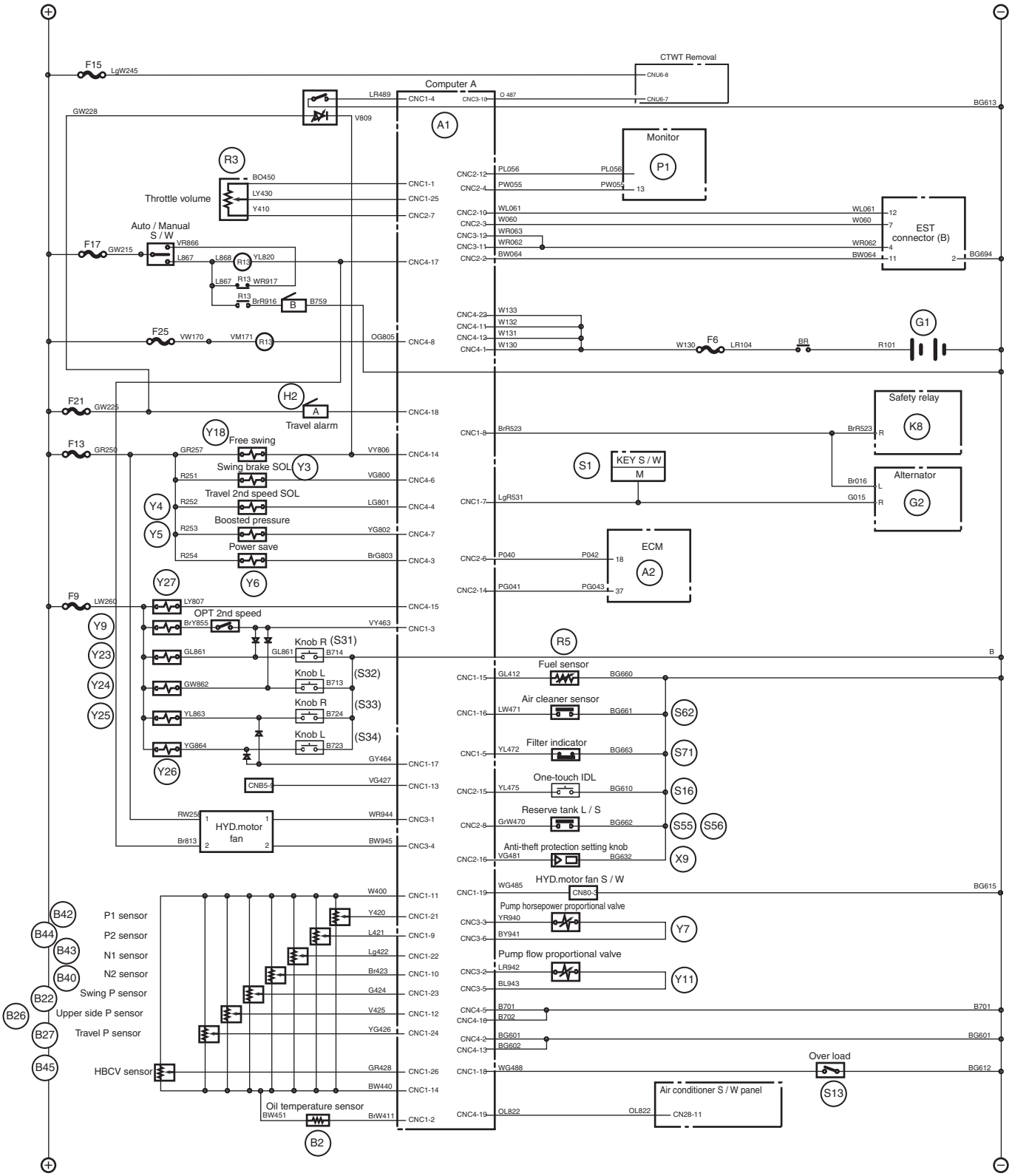
CNH

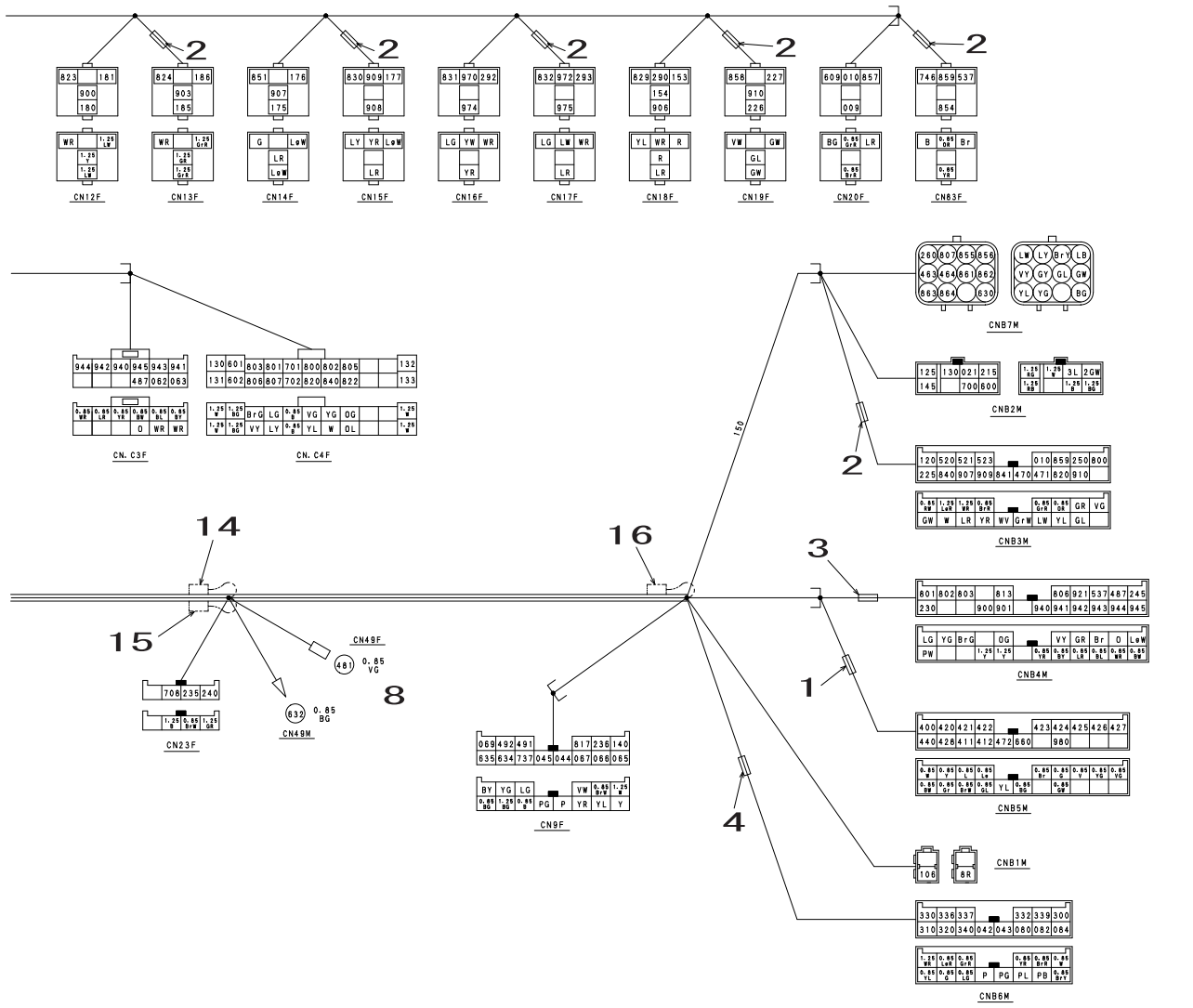
Printed in France
March 2016

Name	Shape	Circuit	Remarks
Alarm (feed pump)			Part No.: KHR4024
Feed pump			Part No.: KHR12840
Feed pump switch			Part No.: KHR11520
Lamp (right side house)			Model: 24 V 70 W Part No.: KHR2475
Lamp (cab top)		 WE01010-105	Model: 24 V 70 W Part No.: KHR16240
Speakers (R)			Part No.: CAP2284

Bloc Diagram

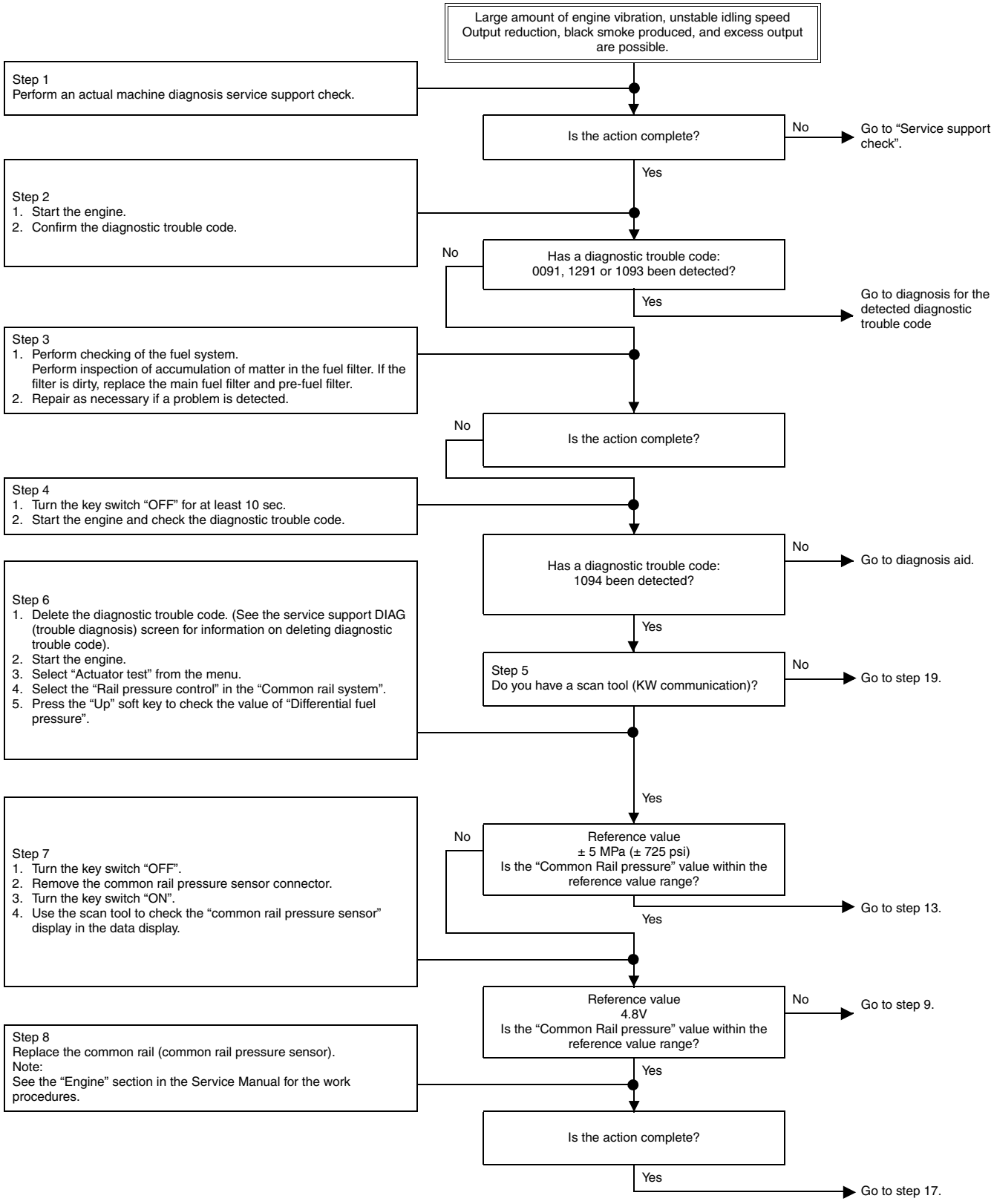
1) Computer A





KHR18803-E01

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



Breaker box inspection procedure

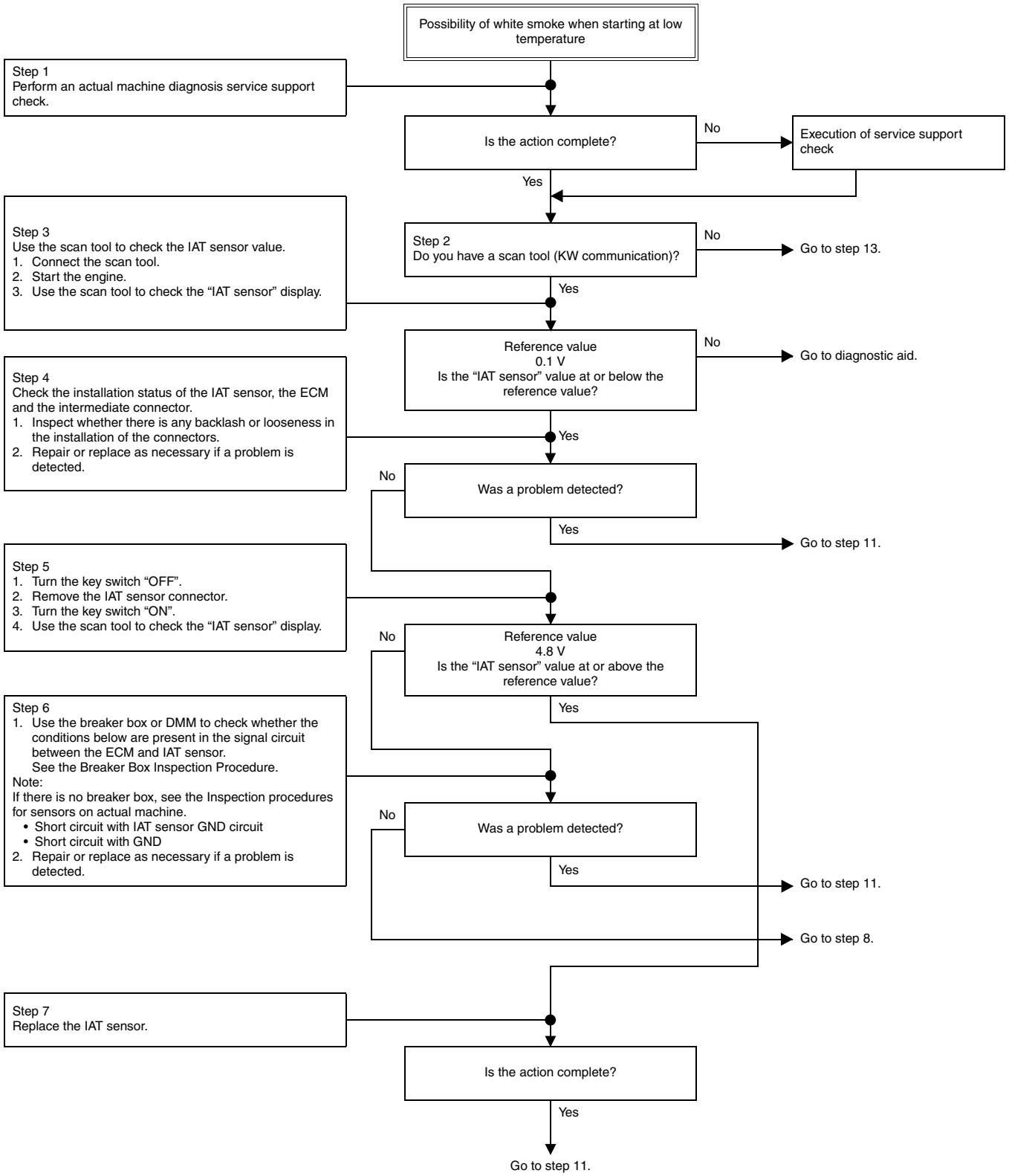
For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
4	Disconnection/ high resistance	Resistance measurement	• Remove the PCV connector. • Key switch “OFF”	105-PCV terminal 113-PCV terminal 89-PCV terminal 97-PCV terminal	5 Ω or lower	10 M Ω or higher
	Short circuit with GND	Resistance measurement	• Remove the PCV connector. • Key switch “OFF”	105-GND 113-GND 89-GND 97-GND	10 M Ω or higher	100 Ω or lower
5	Short-circuit between terminals	Resistance measurement	• Remove the PCV connector. • Key switch “OFF”	105-89 105-97 113-89 113-97	10 M Ω or higher	100 Ω or lower
	Short circuit with power supply circuit	Voltage value measurement	• Remove the PCV connector. • Key switch “ON”	105-GND 113-GND 89-GND 97-GND	0 V	18 V or higher
	Short circuit with other signal circuit	Voltage value measurement	• Remove the PCV connector. • Key switch “ON”	105-GND 113-GND 89-GND 97-GND	0 V	1 V or higher

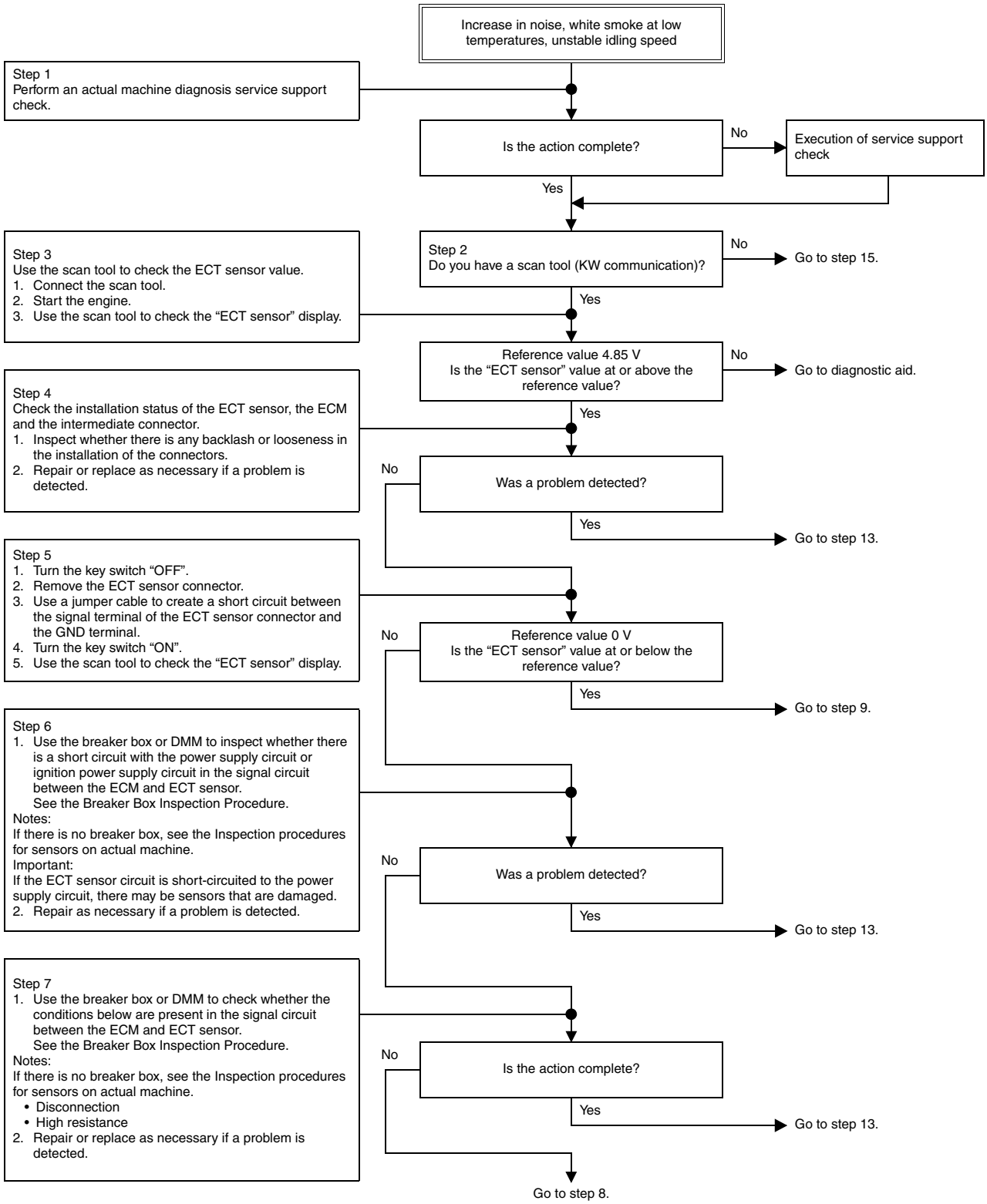
Inspection procedures for sensors on actual machine

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.

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



DTC: 0118
ECT (engine coolant temperature) Sensor Abnormality (abnormally high voltage)



Diagnostic aid

- Check that the temperature of the FT sensor and IAT (intake 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.

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.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
6, 17	Short circuit with power supply circuit	Voltage value measurement	• Remove the sensor connector. • Key switch “ON”	83-GND	0 V	18 V or higher
7, 18	Disconnection/ high resistance	Resistance measurement	• Remove the sensor connector. • Key switch “OFF”	83-Sensor connector signal terminal	100 Ω or lower	10 M Ω or higher
8, 19	Disconnection/ high resistance	Resistance measurement	• Remove the sensor connector. • Key switch “OFF”	79-Sensor connector GND terminal	100 Ω or lower	10 M Ω or higher

Inspection procedures for sensors on actual machine

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

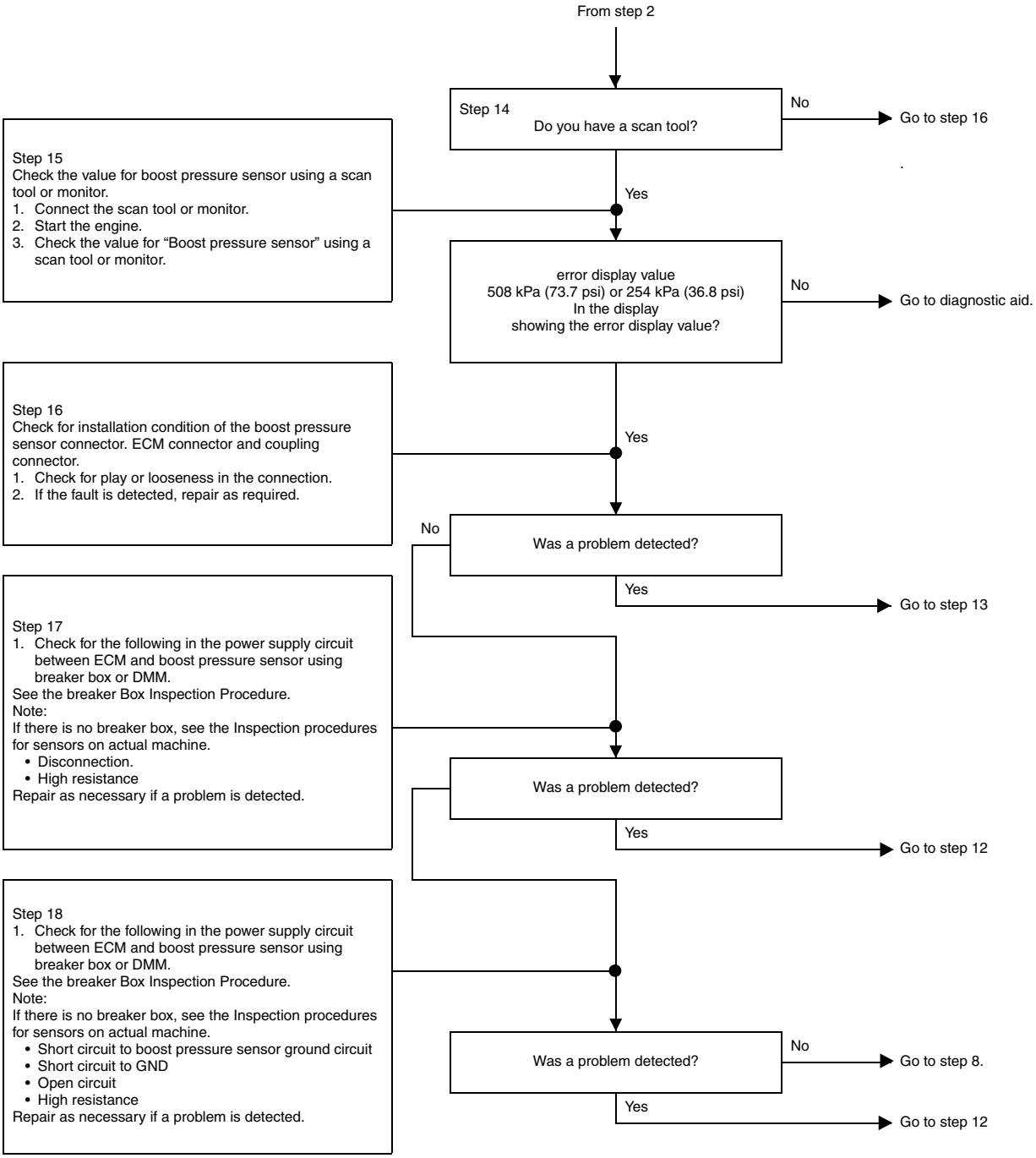
For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
4	Disconnection/ high resistance	Resistance measure-ment	• Remove the intermedi-ate connector. • Key switch “OFF”	119-Intermediate connector terminal (CN.A3 No. 5)	100 Ω or lower	10 M Ω or higher

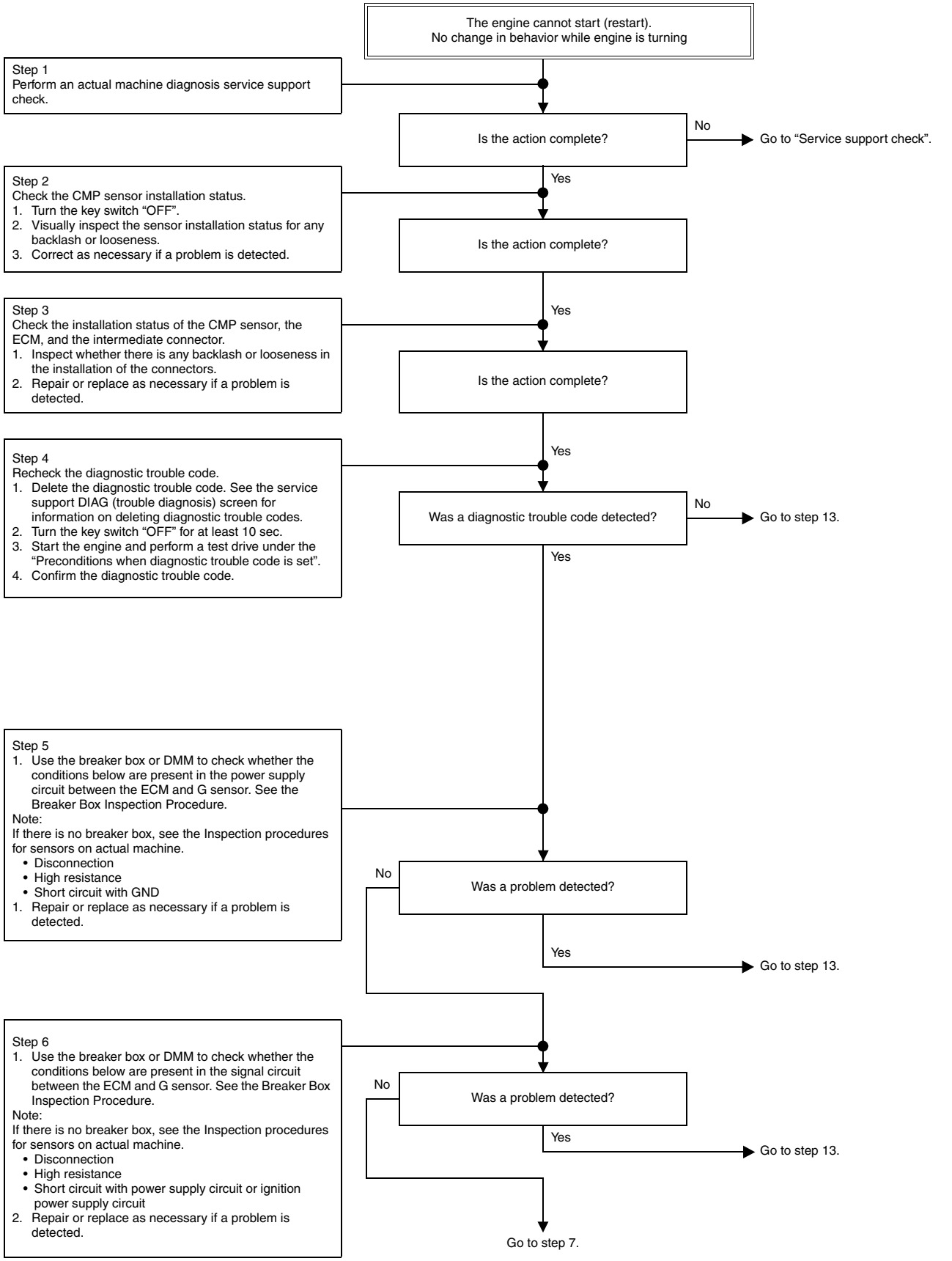
Breaker box inspection procedure

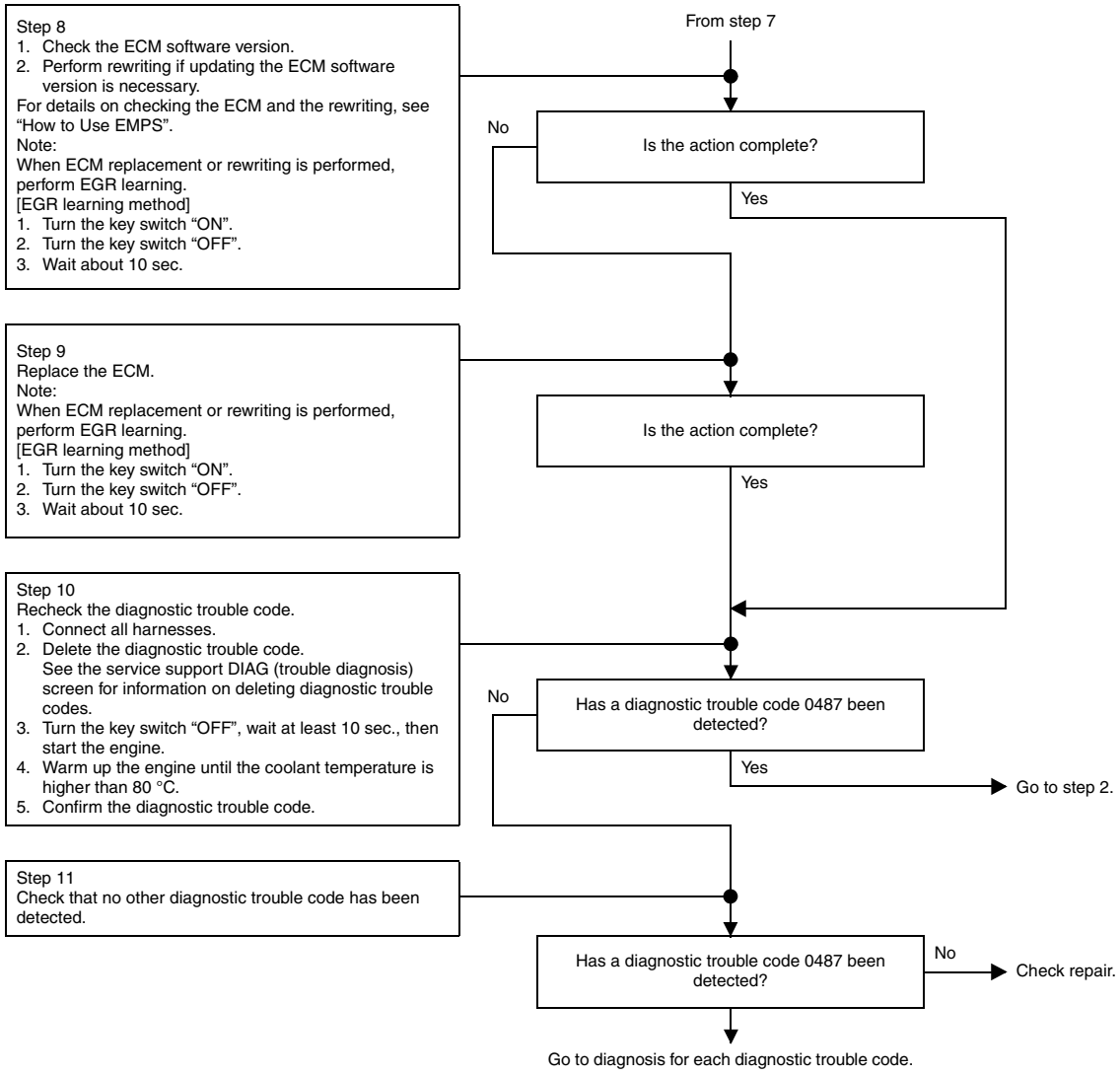
For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
4	Disconnection/ high resistance	Resistance measure-ment	• Remove the intermedi-ate connector. • Key switch “OFF”	115-Intermediate connector terminal (CN.A3 No. 10)	100 Ω or lower	10 M Ω or higher


From step 2
Step 14
Do you have a scan tool?
No
Go to step 16
Yes
Step 15
Check the value for boost pressure sensor using a scan tool or monitor.
1. Connect the scan tool or monitor.
2. Start the engine.
3. Check the value for “Boost pressure sensor” using a scan tool or monitor.
error display value
508 kPa (73.7 psi) or 254 kPa (36.8 psi)
In the display
showing the error display value?
No
Go to diagnostic aid.
Yes
Step 16
Check for installation condition of the boost pressure sensor connector. ECM connector and coupling connector.
1. Check for play or looseness in the connection.
2. If the fault is detected, repair as required.
No
Was a problem detected?
Yes
Go to step 13
Step 17
1. Check for the following in the power supply circuit between ECM and boost pressure sensor using breaker box or DMM.
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
Repair as necessary if a problem is detected.
Was a problem detected?
Yes
Go to step 12
Step 18
1. Check for the following in the power supply circuit between ECM and boost pressure sensor using breaker box or DMM.
See the breaker Box Inspection Procedure.
Note:
If there is no breaker box, see the Inspection procedures for sensors on actual machine.
• Short circuit to boost pressure sensor ground circuit
• Short circuit to GND
• Open circuit
• High resistance
Repair as necessary if a problem is detected.
Was a problem detected?
No
Go to step 8.
Yes
Go to step 12

DTC: 0340
G Sensor Abnormality (no signal)




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
No
Is the action complete?
Yes
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
Step 10
Recheck the diagnostic trouble code.
1. Connect all harnesses.
2. Delete the diagnostic trouble code.
See the service support DIAG (trouble diagnosis) screen for information on deleting diagnostic trouble codes.
3. Turn the key switch “OFF”, wait at least 10 sec., then start the engine.
4. Warm up the engine until the coolant temperature is higher than 80 °C.
5. Confirm the diagnostic trouble code.
No
Has a diagnostic trouble code 0487 been detected?
Yes
Go to step 2.
Step 11
Check that no other diagnostic trouble code has been detected.
Has a diagnostic trouble code 0487 been detected?
No
Check repair.
Go to diagnosis for each diagnostic trouble code.

Breaker box inspection procedure

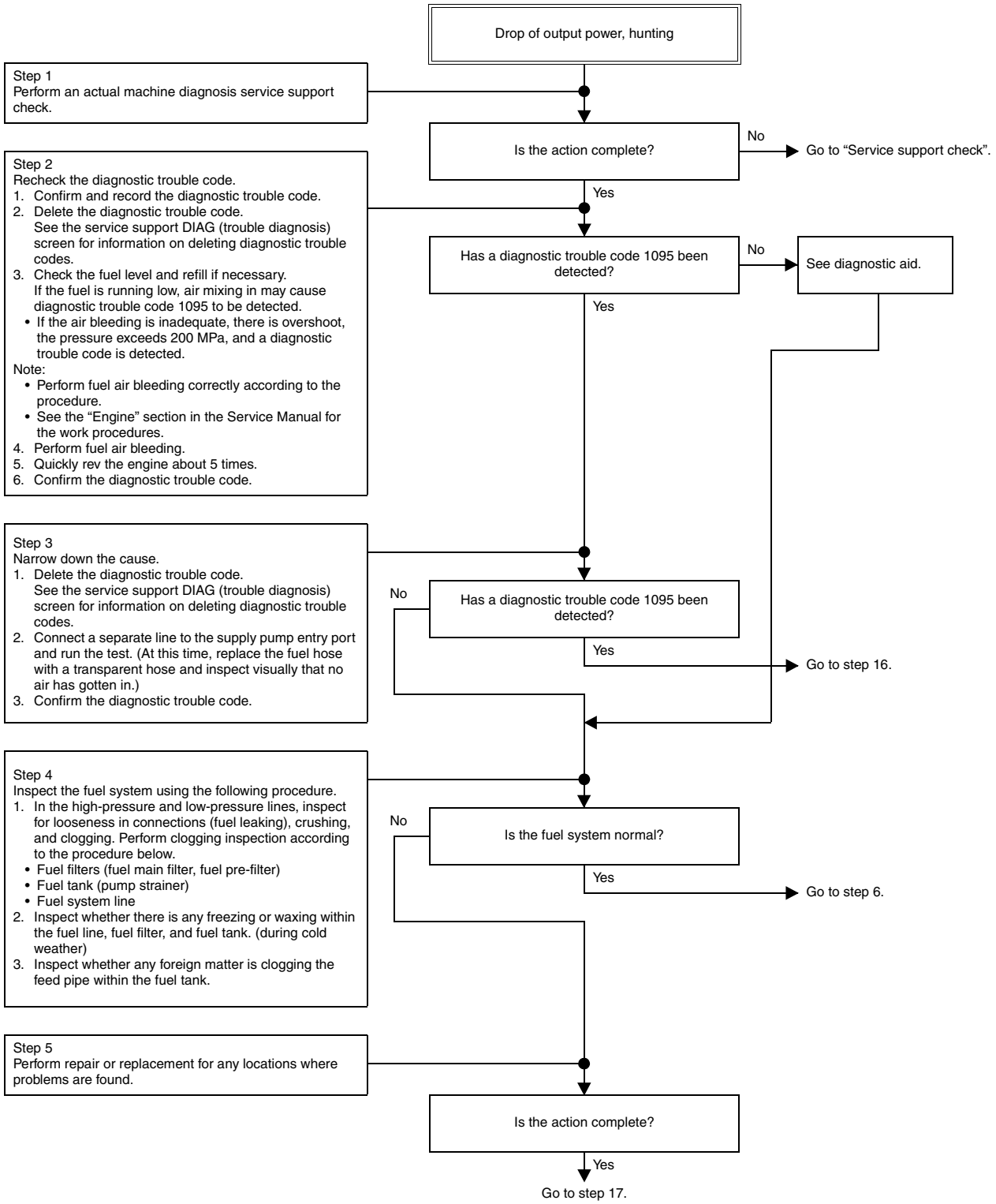
For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
6, 16	Short circuit with power supply circuit	Voltage value measurement	• Remove the sensor connector. • Key switch “ON”	67-GND	0 V	18 V or higher
7, 17	Disconnection/ high resistance	Resistance measurement	• Remove the sensor connector. • Key switch “OFF”	67-Sensor connector signal terminal	100 Ω or lower	10 M Ω or higher
8, 18	Disconnection/ high resistance	Resistance measurement	• Remove the sensor connector. • Key switch “ON”	79-Sensor connector GND terminal	100 Ω or lower	10 M Ω or higher

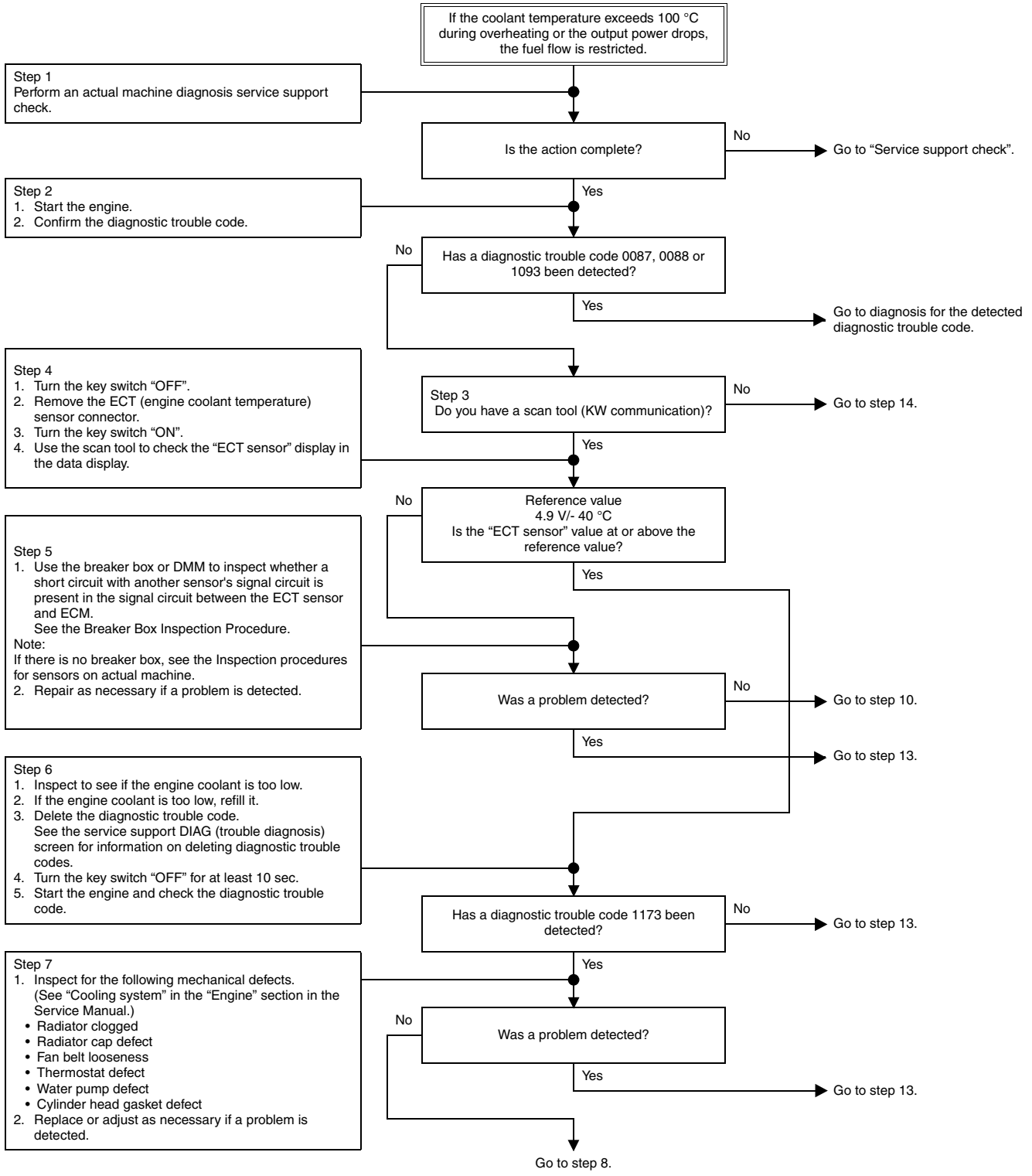
Inspection procedures for sensors on actual machine

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.

DTC: 1095
Pressure Limiter Open



DTC: 1173
Overheat



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.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
5	Disconnection/ high resistance	Resistance measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	116-Female-side terminal (CN.A3 No. 2)	100 Ω or lower	10 M Ω or higher
	Short circuit with GND	Resistance measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	116-GND	10 M Ω or higher	100 Ω or lower
9	Short circuit with GND	Resistance measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	115-GND	10 M Ω or higher	100 Ω or lower
10	Short circuit with GND	Resistance measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	120-GND	10 M Ω or higher	100 Ω or lower
11	Short circuit with GND	Resistance measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	118-GND	10 M Ω or higher	100 Ω or lower
18	Short circuit with power supply circuit	Voltage value measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	115-GND	0 V	18 V or higher
19	Short circuit with power supply circuit	Voltage value measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	120-GND	0 V	18 V or higher
20	Short circuit with power supply circuit	Voltage value measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	118-GND	0 V	18 V or higher
21	Short circuit with power supply circuit	Voltage value measurement	• Remove the ECM-side harness connector from the intermediate connector. • Key switch “OFF”	116-GND	0 V	18 V or higher

Breaker box inspection procedure

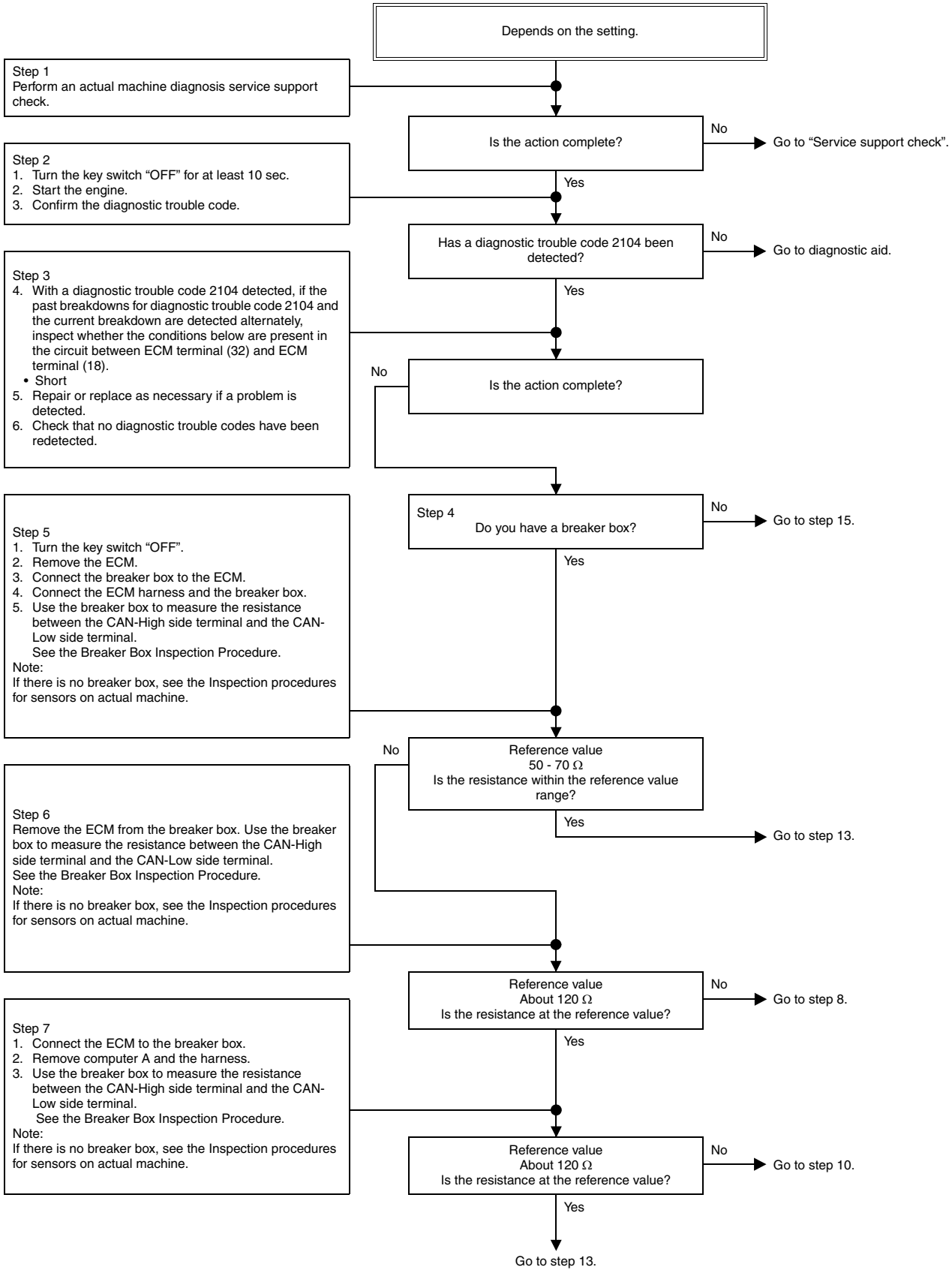
For steps in which breaker box usage is indicated, perform inspection with the following procedure.
Return to diagnosis step after inspection.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
6, 20	Short circuit with power supply circuit	Voltage value measurement	• Remove the relay. • Key switch “ON”	2-GND 5-GND	0 V	18 V or higher
10	Disconnection/ high resistance	Resistance measurement	• Remove the relay. • Key switch “OFF”	2-Relay installation section No. 2 terminal 5-Relay installation section No. 2 terminal 21-Relay installation section No. 5 terminal 40-Relay installation section No. 5 terminal	100 Ω or lower	10 M Ω or higher
	Short circuit with GND	Resistance measurement	• Remove the relay. • Key switch “OFF”	2-GND 5-GND 21-GND 40-GND	10 M Ω or higher	100 Ω or lower

Inspection procedures for sensors on actual machine

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.

DTC 2104
CAN Bus Abnormality



A

Inspect the N2 pressure sensor.

Turn the key switch OFF and disconnect CN.118.

Measure the resistance between terminals 1 and 3 of the CN.118 N2 pressure sensor side.
About 10 kΩ

No

Cause and solution
N2 pressure sensor defect
Replacement

Yes

Inspect for shorts to ground and disconnections.

Inspect the conductance between the ground and terminal 1 of the CN.118 harness side.
Inspect the conductance between the ground and terminal 2 of the CN.118 harness side.

Conductance

No

Inspect the conductance between the ground and terminal 3 of the CN.118 harness side.
Conductance

No

Cause and solution
BW440 or BW443 harness defect (disconnection)
Repair or replace

Yes

Key switch ON

Yes

Cause and solution
W400, W403 or Br423 harness defect (short)
Replacement

Measure the voltage between the ground and terminal 1 of the CN.118 harness side.
About 5 V

No

Cause and solution
W400 or W403 harness defect (disconnection)
Repair or replace

Yes

Measure the voltage between the ground and terminal 2 of the CN.118 harness side.
0.25 V or higher

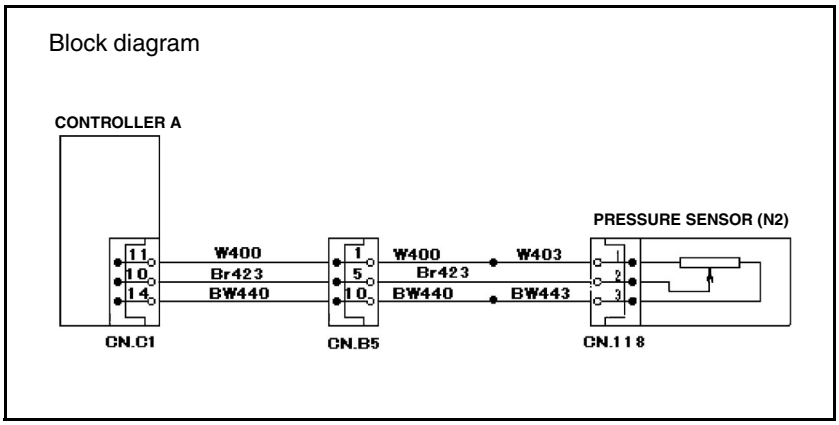
No

Cause and solution
Br423 harness defect (disconnection)
Repair or replace

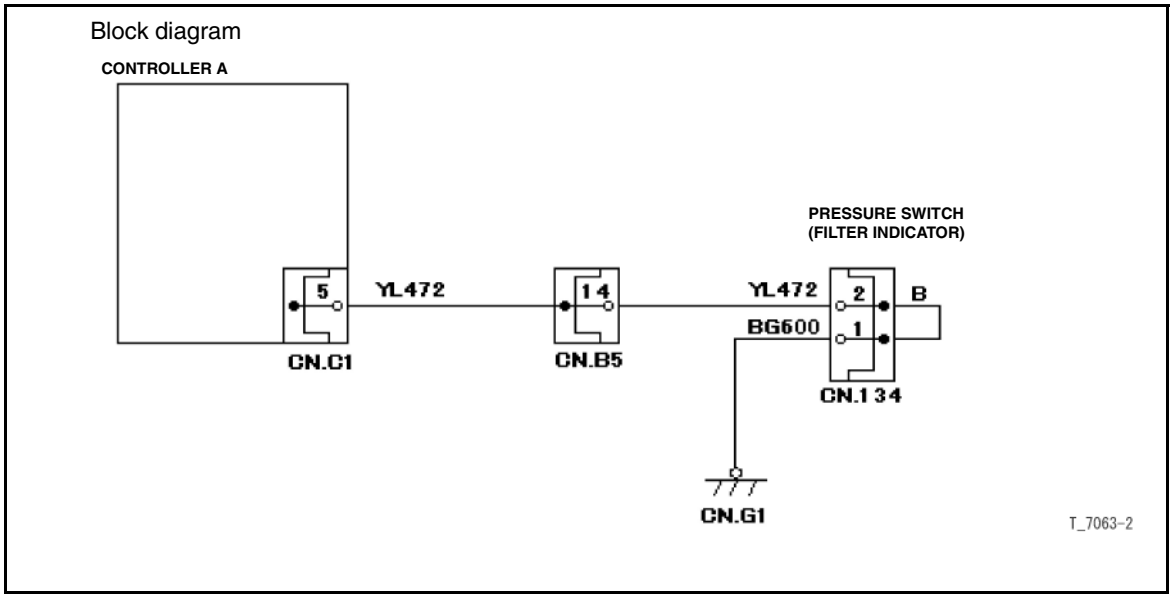
Yes

Cause and solution
Computer A defect
Replacement

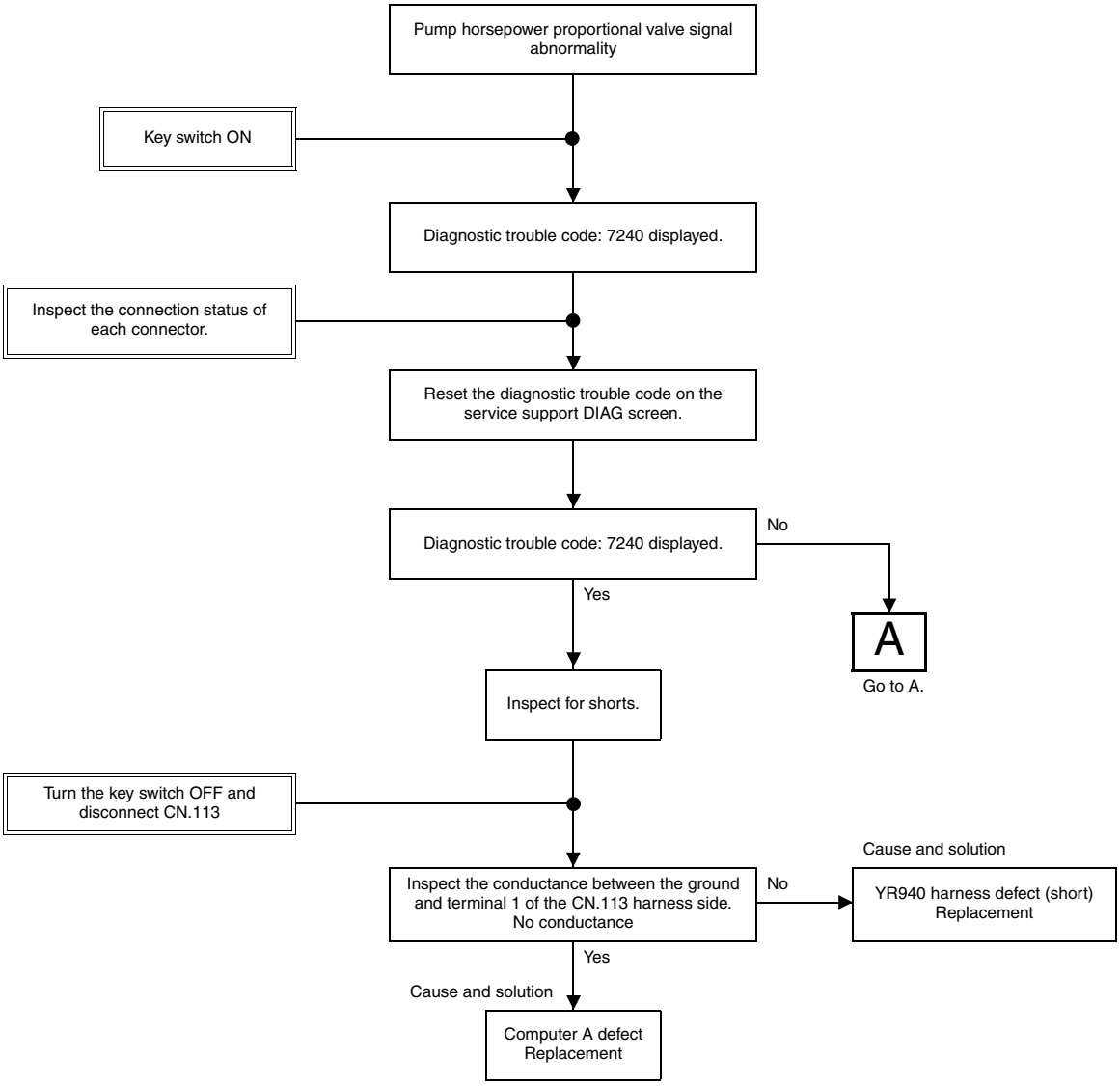
Block diagram



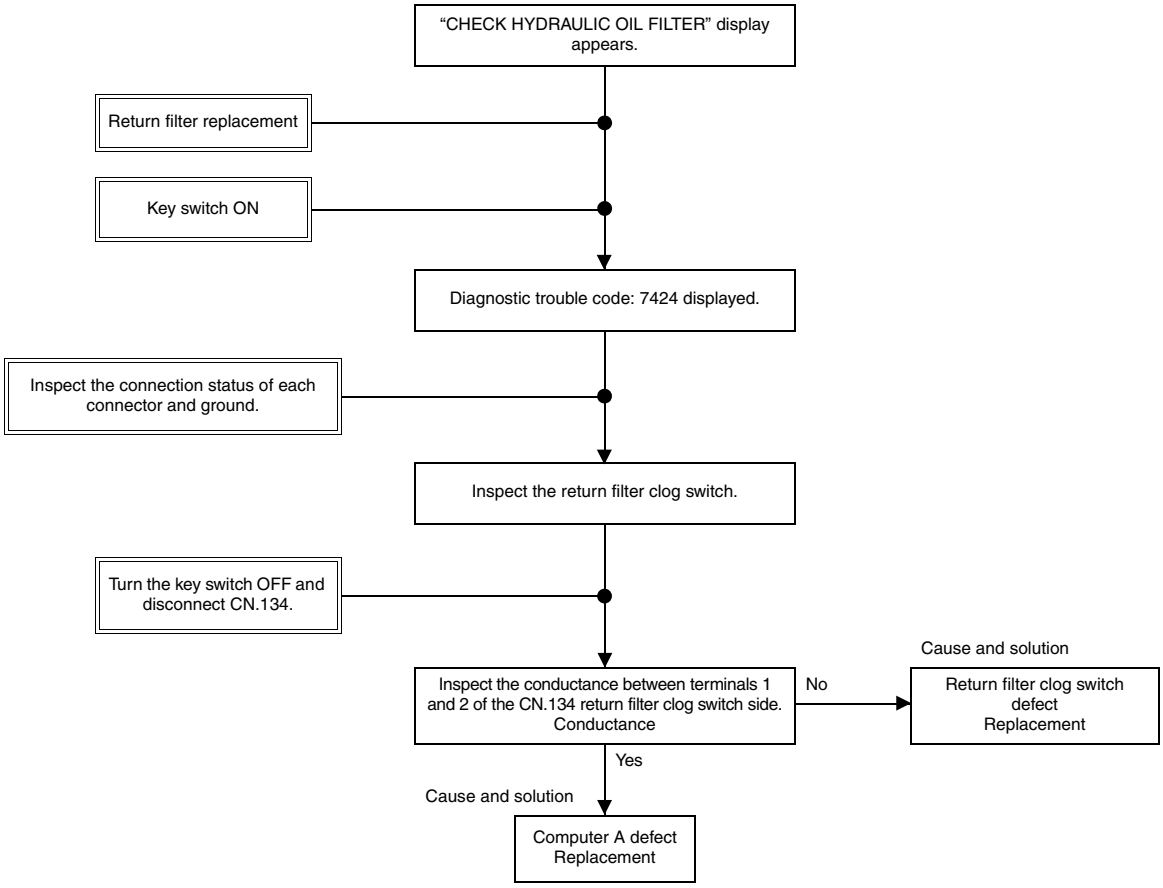
Block diagram

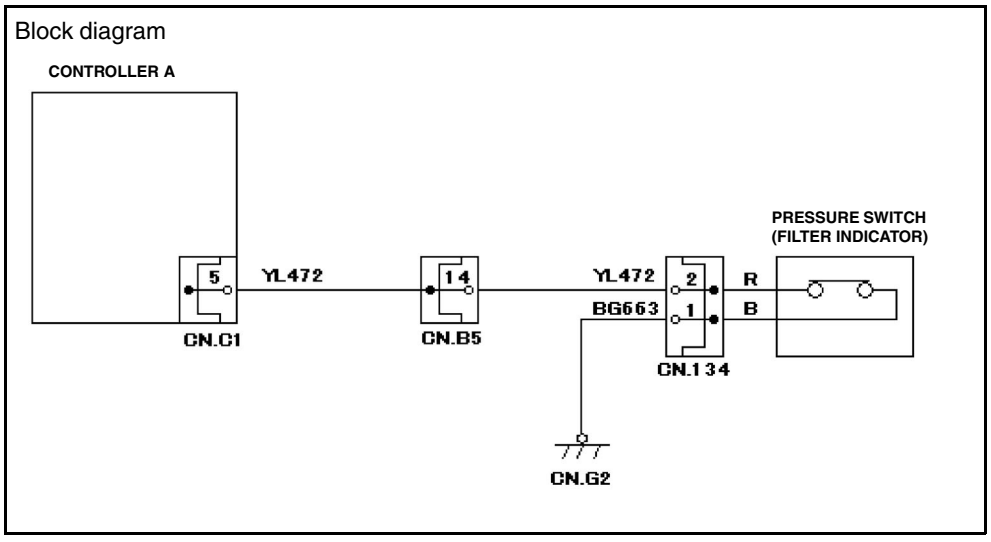


DTC: 7240
Pump Horsepower Proportional Valve Signal Abnormality



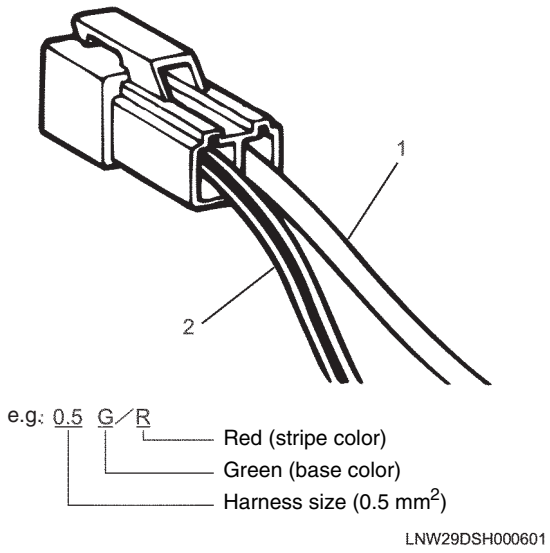
DTC: 7424
Return Filter Clogging (breaker specifications)





About Wiring Colors

All harnesses are distinguished through the color of their wire coating. In some electrical systems, the main circuit is distinguished with a single color and the sub-circuits of the main circuit are distinguished with color stripes. Size and color in the wiring diagrams are indicated using the following method.



Name

1. Single color
2. Color stripe

Symbol	Color	Symbol	Color
B	Black	BR	Brown
W	White	LG	Light green
R	Red	GR	Gray
G	Green	P	Peach
Y	Yellow	SB	Sky blue
L	Blue	V	Violet
O	Orange		

Diagnostic Trouble Code Reading Procedure

Diagnostic trouble code reading with the trouble indicator monitor

If a diagnostic trouble code occurs, a diagnostic trouble code and message will display in the main unit trouble indicator monitor.

When the diagnostic trouble code is in the memory

Accurately follow the specified diagnostic trouble code chart to perform repair.

When there is no diagnostic trouble code

Select the symptom from diagnosis for each symptom. Complete repair according to the diagnosis procedure. Inspection can also be performed referencing function diagnosis.

When there is no applicable symptom

1. Investigate the complaint in detail.
2. Create the diagnosis plan.
3. Use wiring diagrams and operation principles.

In similar cases where the repair history can be obtained, request technical support. This will combine technical knowledge with effective use of useful service information.

When the problem is intermittent

Problems that do not necessarily appear all of the time are referred to as intermittent. Follow the steps below to resolve intermittent problems.

1. Confirm the diagnostic trouble code information and data indication.
2. Evaluate symptoms and conditions stated by the customer.
3. Use a check sheet or another method to check circuits or electrical system component parts.

When trouble is not detected

This status indicates that the main unit is judged to be operating normally. The status stated by the customer is sometimes normal operation. The customer's complaint should be checked through comparison with a separate main unit that is operating normally. Depending on the situation, however, the problem is sometimes an intermittent one. Before returning the main unit, the complaint should be checked in the status stated by the customer.

1. Reinvestigate the complaint.
   When a complaint cannot be sufficiently detected or confirmed, it is necessary to re-perform diagnosis and recheck the complaint. As stated above in “When the problem is intermittent”, it is possible that the complaint is either an intermittent problem or normal operation.
2. Perform repair and confirm results.
   If the cause has been confirmed, perform repair. Confirm that the main unit operates correctly and confirm that the symptoms have been corrected. This includes main unit confirmation tests and other methods under the following conditions for confirming whether a complaint has been resolved.
   - Perform a test under the status stated by the customer to check the complaint.
   - When a diagnostic trouble code is diagnosed, recreate the status in which the diagnostic trouble code was set while checking the scan tool data and confirm whether repair has been done.

Engine Control System

Engine Control (common rail) System Functions and Operation Explanation

Overview and further information of engine control system

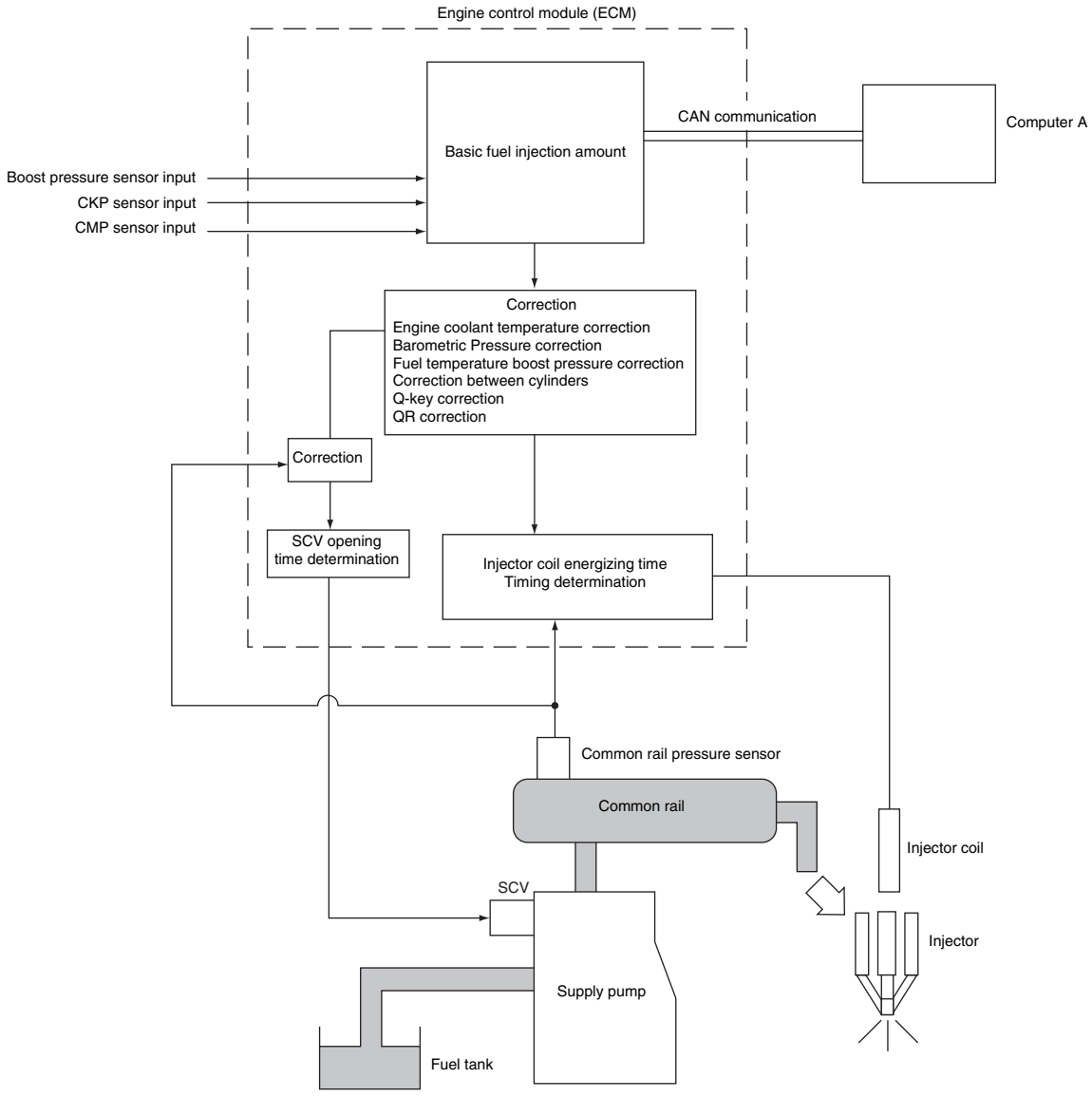
The engine control system is an electronic control system for engine control in order to always maintain optimum combustion status in accordance with the operation conditions. It consists of the following.

- Electronic control fuel injection system (common rail type)
- EGR (exhaust gas recirculation)
- Idling control

Also, the engine control system also has the following system control functions apart from engine control.

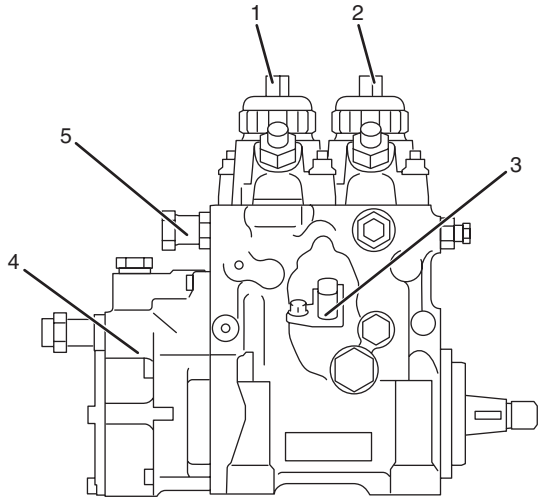
- Engine rotation signal output
- Self-diagnosis function
- CAN (Controller area network) communication (SAE J1939/21, SAE J1939/11)

System control summary diagram



TSHK0001

Supply pump



TSUZ0009

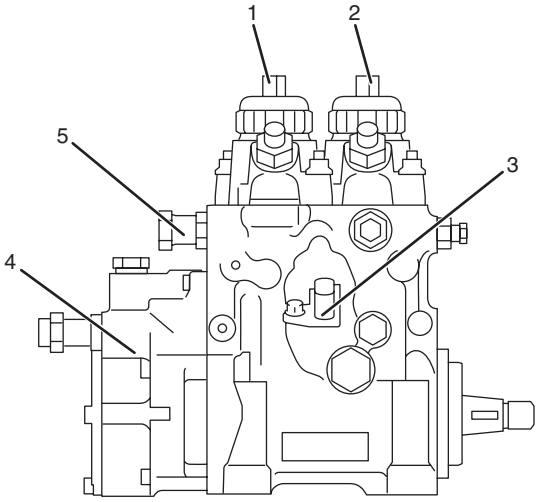
Name

1. PCV #1
2. PCV #2
3. G sensor
4. Feed pump
5. Fuel temperature sensor

The supply pump uses the force of the engine rotation to raise the fuel pressure and pressure feed fuel to the common rail. Also, the PCV (suction control valve), fuel temperature (FT) sensor, and feed pump are installed on the supply pump.

Note:
See the “Engine” section in the Service Manual for the work procedures.

PCV (Pressure control valve)



TSUZ0009

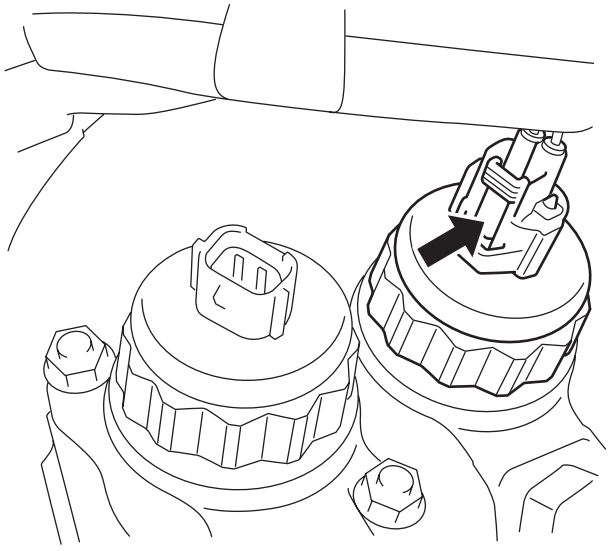
Name

1. PCV #1
2. PCV #2

The PCV (suction control valve) is installed on the supply pump and controls the fuel pressure feed (discharge volume) to the common rail. The engine control module (ECM) controls the electrified time to the PCV and controls the fuel discharge volume.

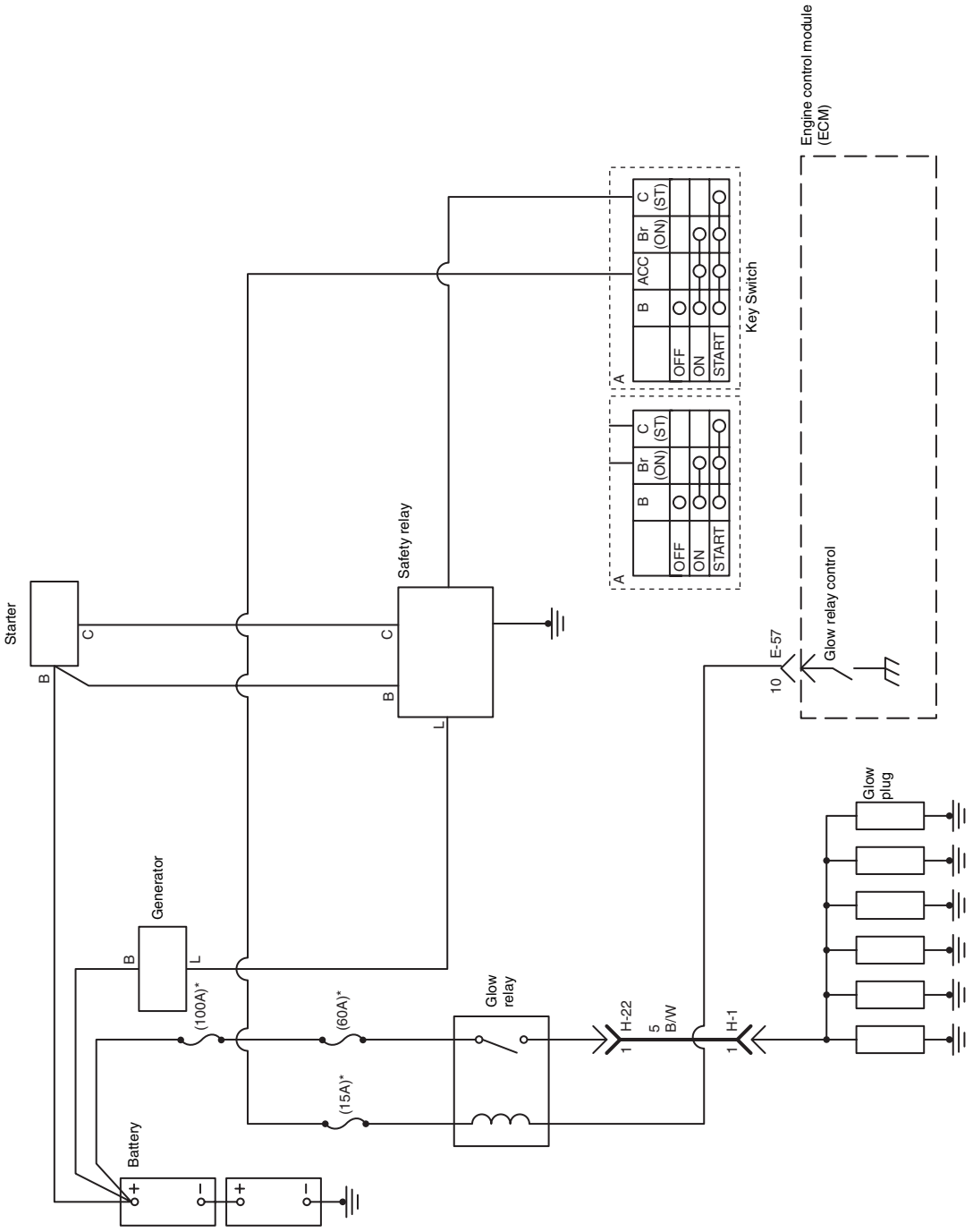
Removal

- Do not replace the PCV.
- If there is a problem, replace the entire supply pump assembly.

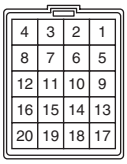
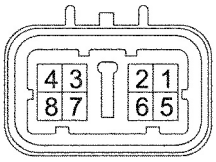
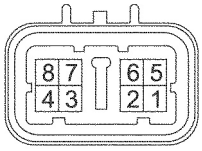


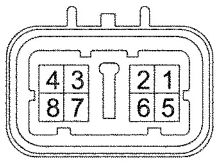
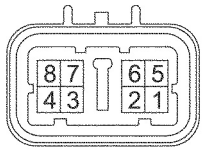
TSWG0194

Starter, glow circuit



TSWG0068

	Connector Face
H-20	 020-501
	Actual machine harness side (female terminal) (light gray)
H-22	 001-034
	Engine harness side (female terminal) (light gray)
H-22	 001-003
	Actual machine harness side (male terminal)
H-94	 008-046
	Engine harness side (male terminal) (dark gray)
H-94	 008-047
	Cylinder head outside (female terminal) (dark gray)
H-94	 008-052
	Cylinder head inside (female terminal) (dark gray)
H-94	 008-051
	Injector harness side (male terminal)
H-95	 008-046
	Engine harness side (male terminal) (dark gray)

	Connector Face
H-95	 008-047
	Cylinder head outside (female terminal) (dark gray)
H-95	 008-052
	Cylinder head inside (female terminal) (dark gray)
H-95	 008-051
	Injector harness side (male terminal)

Problem Symptom List

Problem Symptom List

Symptom	Definition
Engine start problem	Cranking rotation is low. Cranking rotation is normal, but the engine does not start (no initial ignition). Engine starts (ignition occurs), but engine rotation cannot be stabilized and maintained. Revving also cannot be done.
Engine stalling	Engine cranking is done, but the engine will not start for a long time. The engine starts after a long time or stops just after starting.
Engine hunting, unstable idling speed	The engine idling speed varies or the engine idling speed changes. When the problem is severe, the engine or main unit vibrates. If any of these states becomes severe, it may cause the engine to stall.
Engine output deficiency	The engine output is below what is expected, and output does not change even if the accelerator lever (throttle lever) is raised. Responsivity is poor.
Excessive white smoke in exhaust gas	There is a great deal of white smoke during operation.
Excessive black smoke in exhaust gas	There is a great deal of black smoke during operation.
Abnormal noise	The engine combustion noise is abnormal.
High fuel consumption	Fuel consumption markedly exceeds what is listed in the Service Text. The case indicated here shows that there is no main unit-side problem and engine inspection is necessary.
High oil consumption	Oil consumption is markedly less than what is listed in the Service Text. The case indicated here shows that there is no main unit-side problem and engine inspection is necessary.

Excessive Black Smoke in Exhaust Gas

Preliminary inspection

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

- 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.

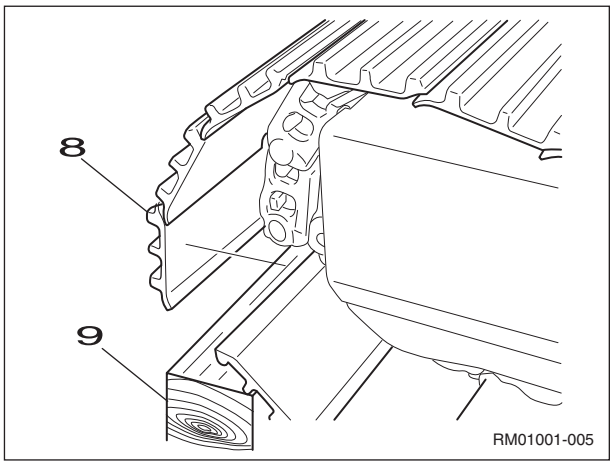
- Check whether the air cleaner element is dirty or clogged.
- Check for correct wiring connections, tightness, and disconnections
- Check whether the power supply for commercially-available accessories is being diverged from the ECM power supply.
- Check whether the ECM ground is dirty and check that 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 for fuel leaks and damage and denting on pipes in the fuel system.
- Intake air system parts abnormality
- Exhaust system parts abnormality

Diagnostic aid

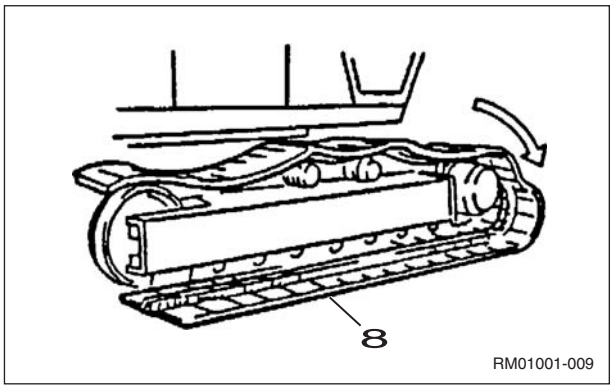
- Fuel quality (non-regulation product being used)
- Intake air system abnormality (filter clogging, intake air line abnormality)
- EGR control system abnormality
- Exhaust system abnormality (exhaust pipe abnormality)
- Coolant temperature sensor abnormality
- Boost pressure sensor trouble (sensor, line)
- Engine main unit trouble (compression pressure deficiency, piston-related, turbo charger, rise of oil)

Step	Action	Value	Yes	No
1	Perform “Trouble Diagnosis by Service Support” Is the action complete?	-	Go to step 2.	-
2	Perform checking of the intake air system. Is the action complete?	-	Go to step 3.	Go to “Checking the Intake Air System”.
3	Perform checking of the EGR control system. Is the action complete?	-	Go to step 4.	Go to “Checking the EGR Control System”.
4	Check the reed valve of the EGR. If the fault is detected, repair as required. Is the procedure completed?	-	Go to step 5.	-
5	Perform checking of the fuel system. Is the action complete?	-	Go to step 6.	Go to “Checking the Fuel System”.
6	Perform checking of the exhaust system. Is the action complete?	-	Go to step 7.	Go to “Checking the Exhaust System”.
7	Check the engine symptoms again. Have the engine symptoms normalized?	-	Go to step 14.	Go to step 8.
8	Check the mechanical parts of the engine and repair any abnormalities. 1. Valve system (valve clearance) Is the action complete?	-	Go to step 9.	-
9	Check the engine symptoms again. Have the engine symptoms normalized?	-	Go to step 14.	Go to step 10.
10	Is there an EMPS?	-	Go to step 11.	Go to step 12.
11	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 12.	Go to step 12.
12	Check the engine symptoms again. Have the engine symptoms normalized?	-	Go to step 14.	Go to step 13.

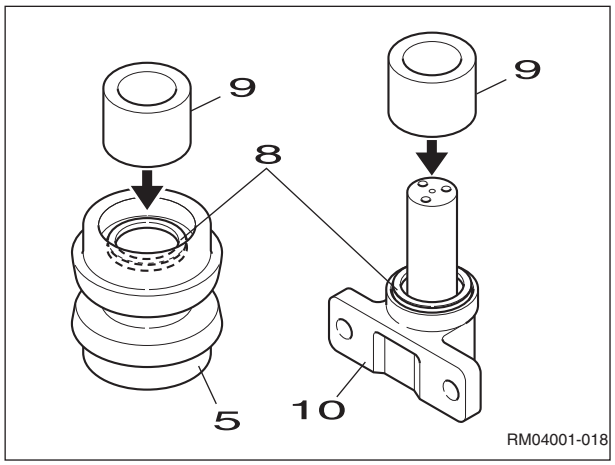
[6] Remove the track shoe (8).
At this time, place a wood plank (9) under the bottom track shoe so that it does not fall.



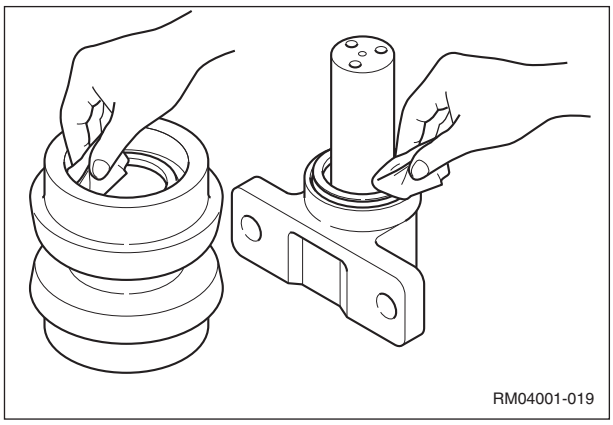
[7] Start the engine, raise the lower side frame of the track shoe removal side about 20 cm, slowly set the travel lever to backwards, and move the track shoe to remove it from the lower frame.



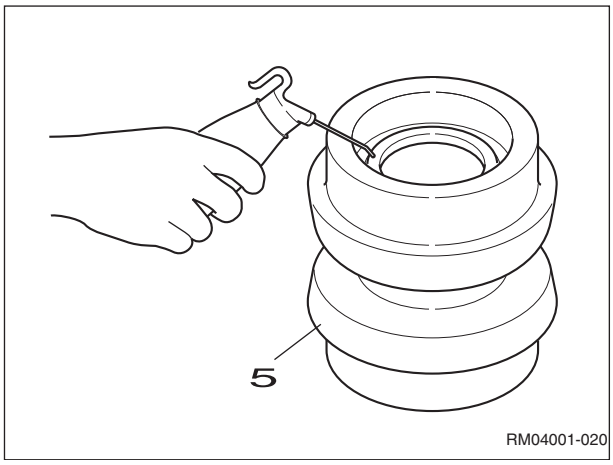
[5] Insert the floating seal (8) into the roller (5) and bracket (10). Use jig C (9) to press it into position.



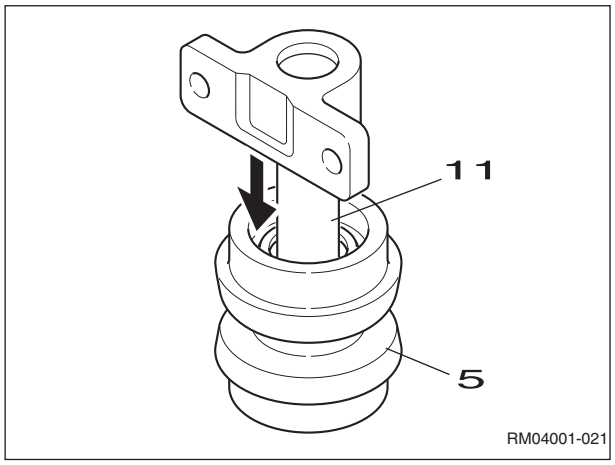
[6] Use a special fiber cloth to wipe the surfaces of the floating seals to increase adhesion and prevent dust from entering.



[7] Apply hydraulic oil to the roller (5).

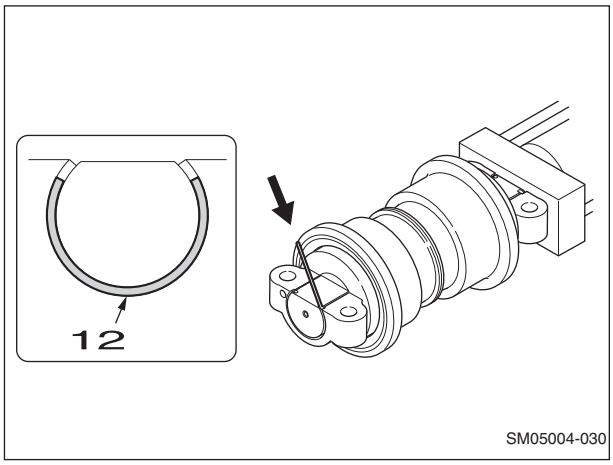


[8] Attach the shaft (11) to the roller (5).

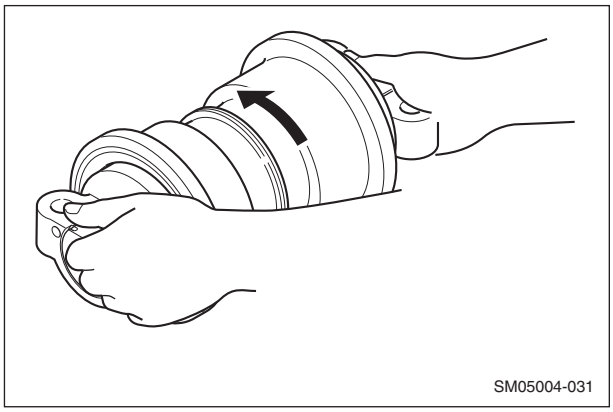


[9] Attach the wire clip (12).

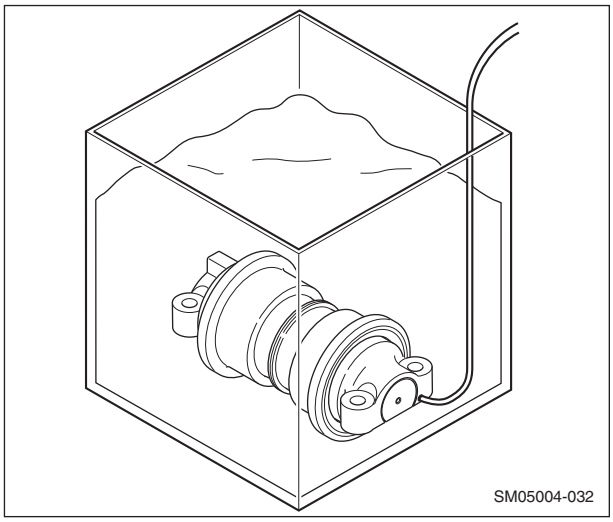
- When attaching the wire clip, secure the roller main unit so that it does not roll.



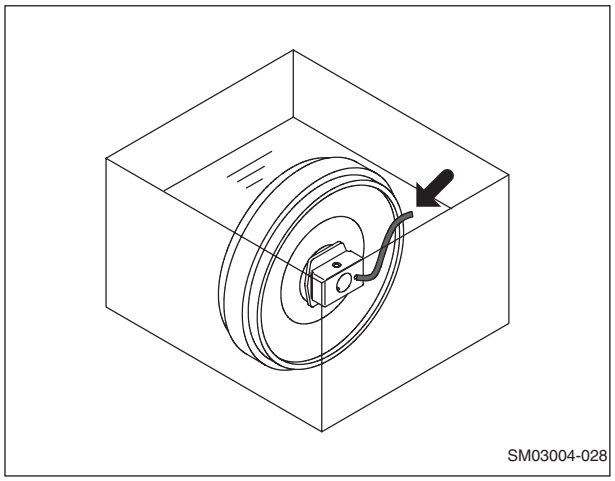
[10]Turn the main unit and check that the roller rotates properly.



[11]Inject compressed air (0.2 MPa) from the oil fill port and immerse in water to check that there are no leaks.

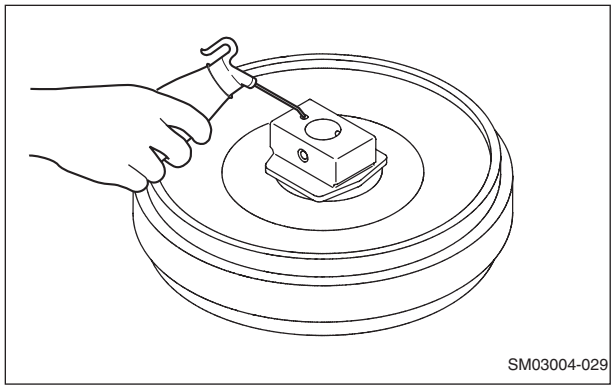


[12]Inject compressed air (0.2 MPa) from the oil fill port and immerse in water to check that there are no leaks.



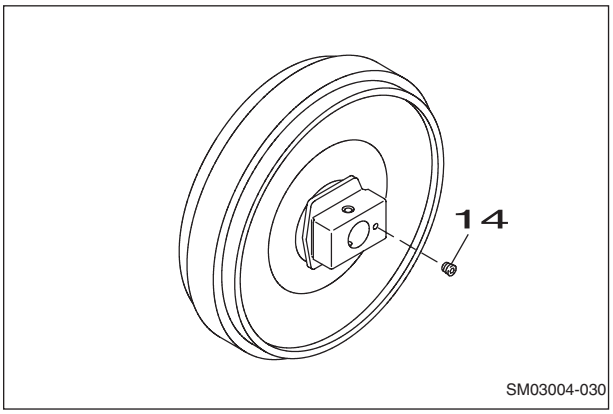
[13]Fill engine oil (190 cc) into the roller main unit.

- The roller main unit can be very unstable, so give consideration to securing it.



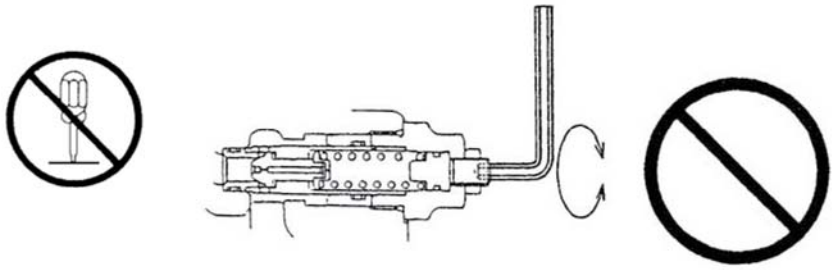
[14]After filling the oil, use a hexagon wrench (6 mm) to tighten the plug (14) with the nylon seal applied.

- To reuse a plug, wrap it with seal tape.



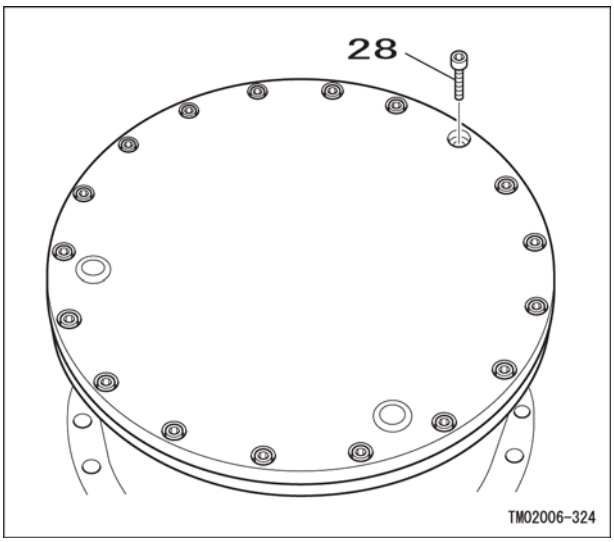
Safety cautions

Be sure to follow these precautions.

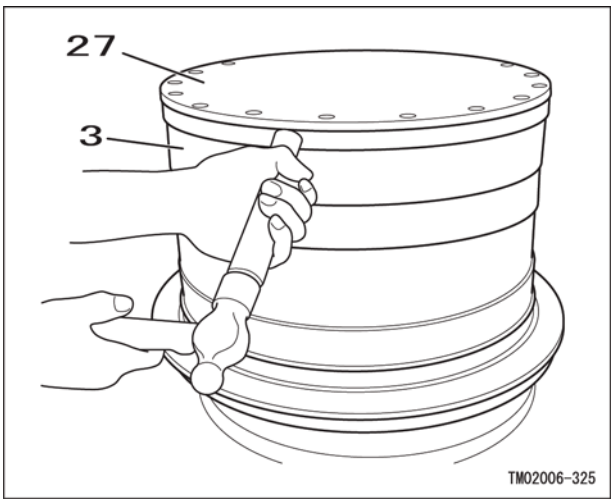
Warning:	Do not tamper with the relief valve adjuster. The set pressure of the relief valve may change and cause the motor to run out of control, which could cause personal injury or damage the machine.  RM02001-020

c) Removal of reduction gear cover

[1] Remove the remaining hexagon socket head bolts M12x30 (28).



[2] The contact surfaces of the cover (27) and ring gear (3) are coated with sealant, so place a metal pin against the projected part of the cover and use a hammer to strike it obliquely upward to remove the cover.

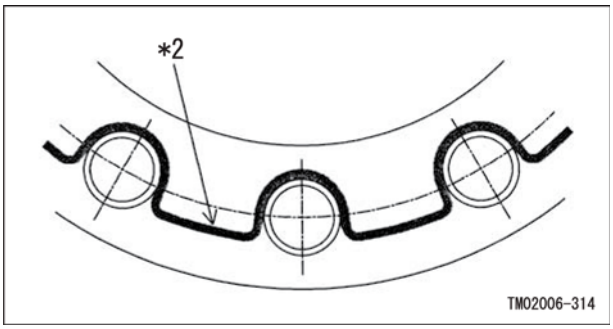


Caution:	Be very careful not to get hands stuck between parts or drop the suspended parts on feet.

d) Assembly of the housing assembly

[1] Thoroughly coat the housing (1) surface that matches with the ring gear (3) with Loctite #515 (*2).

[2] Install 3 M24 eyebolts on the housing (1) and lift with a wire, align the reference marks, and install onto the ring gear (3).

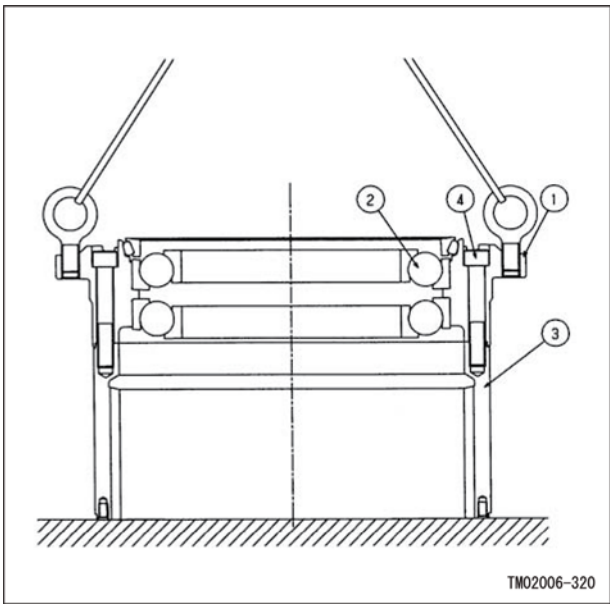


Applying Loctite to the housing end surface

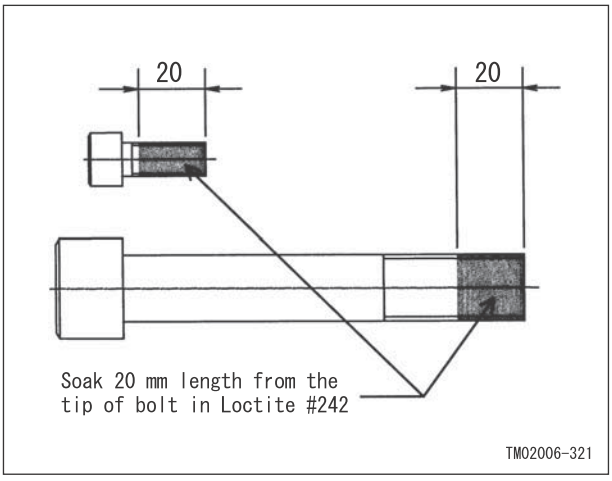
Caution:	• Be very careful not to get hands stuck between parts or drop the suspended parts on feet. • Lift the part in a horizontal position.

[3] Coat the 26 hexagon socket head bolts M20x120 (4) with Loctite #242 then tighten the bolts to the tightening torque of 461 ± 44.1 Nm.

- For details on applying Loctite #242 to the bolts, see "Method of applying Loctite #242".



Applying of the housing assembly



Method of applying Loctite #242

2 Weak startup of the hydraulic motor.

Symptom	Cause	Countermeasure
The set pressure is normal, but there is a delay in the release of the parking brake.	Spool operation defect. (Spool sticking)	Repair or replace.
The parking brake is released, but startup is delayed.	The hydraulic oil viscosity is too high.	Raise the oil temperature.
The parking brake is released, but startup is weak.	1. The parking brake is not fully released. (Orifice of release pressure path is clogged.)	1. Check the orifice clog.
	2. Debris is caught in the relief valve.	2. Clean the relief valve, and then inspect or replace the seat surface.
	3. Seizing of sliding sections.	3. Inspect and repair or replace the sliding parts.

3 Rotation speed does not reach the setting value.

Symptom	Cause	Countermeasure
Rotation speed does not reach the setting value.	1. Insufficient oil flow amount.	1. Check the pump discharge volume and the oil pressure path up to the motor.
	2. The shoe, cylinder block, or valve plate shows signs of wear or serious damage.	2. Inspect and repair or replace the part (s).

4 The brake does not operate.

Symptom	Cause	Countermeasure
The brake does not operate.	Parking brake operation problem. a) Wear on the friction plate. b) Broken spring.	Inspect and repair or replace the brake piston, friction plate, and spring(s).
The reverse brake works.	Spool operation defect a) Sticking of the spool and main unit. b) Sticking of the check valve or debris is caught in the check valve. c) Orifice hole is clogged.	Repair or replace.

5 Oil leak

Symptom	Cause	Countermeasure
Oil leak.	1. Bolt and plug loosening.	1. Retighten to the specified torque.
	2. Gouging of O-ring(s).	2. Replace O-ring.
	3. Leak inside gear casing.	3. Replace the oil seal(s).

2 Disassembly of the planetary carrier No.1 subassembly

This part cannot disassembled because it has been caulked.

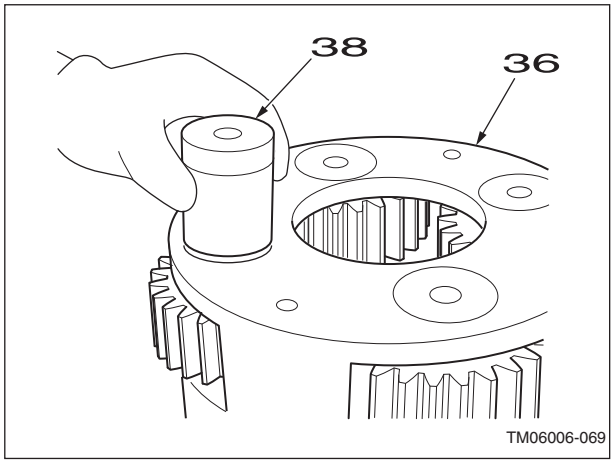
3 Disassembly of the planetary carrier No.2 subassembly

[1] Use a jig to insert the spring pin 10 × 40 (40) all the way to the back of the planetary carrier No. 2 (36). At this time, be careful not to forcefully insert the part, as this can scratch the inner diameter of the pin hole of the planetary carrier No.2 (36).

TM06006-349

[2] Tap from the casting hole on the bottom of the planetary carrier No. 2 (36) and pull out the planetary pin No. 2 (38). At this time, be careful not to drop the planetary gear No.2 (37) and side plate No.2 (39).

[3] Pull out the spring pin 10 × 40 (40) from the spring pin hole of the planetary pin No. 2 (38). When securing the planetary pin No. 2 (38) in a vise, use a rag so as not to scratch the pin.



[4] Perform steps [1] to [3] for 4 locations.

4 Disassembly of the case subassembly

[1] Reverse the case subassembly.

[2] Remove the special wire (14).

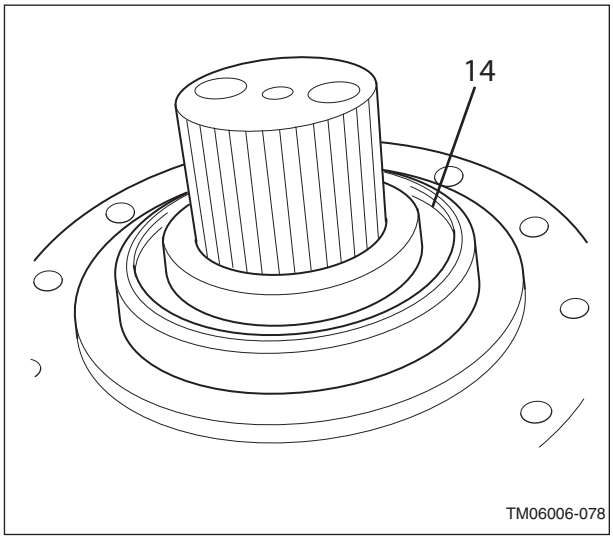
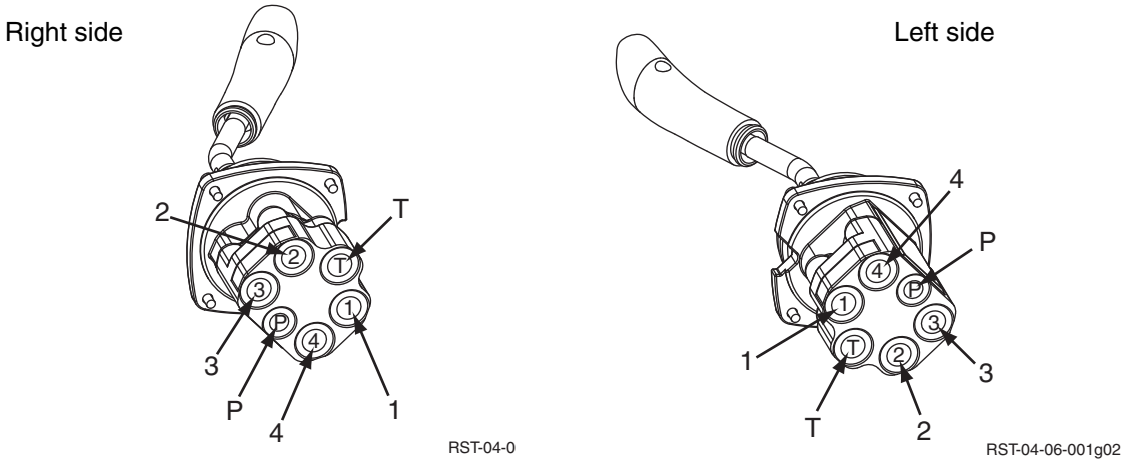


TABLE OF CONTENTS

WARNING: *This symbol is used in this manual to indicate important safety messages. Whenever you see this symbol, carefully read the message which follows. Your safety depends on it.*

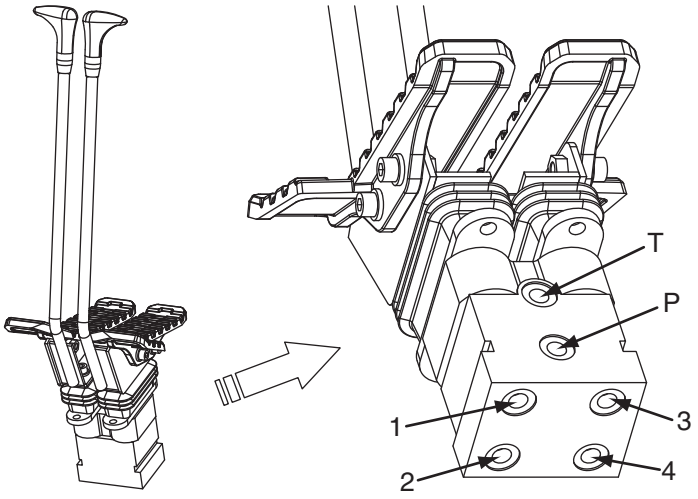
4. Remote control valves (upper, travel)

(1) Remote control valves (left, right)



Right side	Port name	Left side	Port name	Port size
1	Bucket close	1	Swing right	G3/8
2	Boom-down	2	Arm-in	G3/8
3	Bucket open	3	Swing left	G3/8
4	Boom-up	4	Arm-out	G3/8
P	Pressure	P	Pressure	G1/4
T	Return	T	Return	G3/8

(2) Remote control valve (Travel)



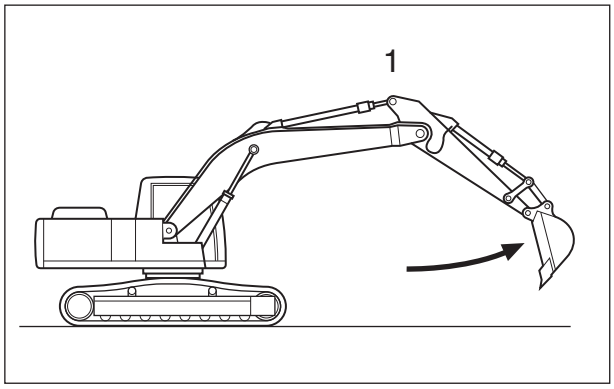
Port	Port name	Port size
1	Backward left	G1/4
2	Forward left	G1/4
3	Backward right	G1/4
4	Forward right	G1/4
P	Pressure	G1/4
T	Return	G1/4

Attachment pressure measurement

Example: Arm-out pressure measurement

Measure with the following operations.

Engine speed	2000 min^{-1}
Work mode	SP mode
Lever operation	Arm-out relief
Oil temperature	45 - 55°C
Measuring port	1 pump: P1 port
	2 pumps: P2 port
Set pressure	Boosted pressure: 34.3 MPa (4975 Psi)
	Standard: 31.4 MPa (4554 psi)



1	Arm-out relief

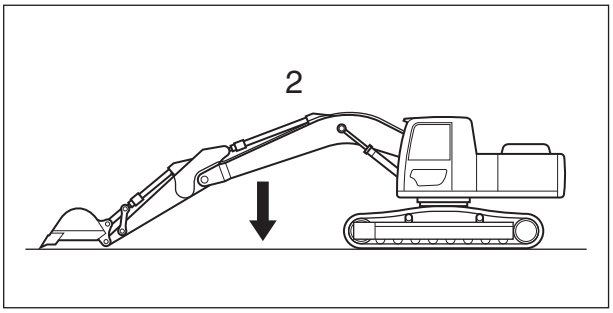
When the attachment operates, since the pressure boost operates automatically, the set boosted pressure can be checked for about 8 s. After 8 s or more, the standard set pressure can be checked.

Measure relieving each cylinder with the arm out/in, the bucket open/close, and the boom up.

Lever operation	Arm out	Arm in	Bucket open	Bucket close	Boom up	Boom down
Engine speed	2000 min^{-1}					
Work mode	SP mode					
Oil temperature	45 - 55°C (113 to 131°F)					
1 pump flow measuring port	P1	P1	P2	P2	P2	P2
2 pumps flow measuring port	P2	P2	No	No	P1	No
Boosted pressure	34.3 MPa 4975 Psi	34.3 MPa 4975 Psi	34.3 MPa 4975 Psi	34.3 MPa 4975 Psi	34.3 MPa 4975 Psi	24.5 MPa 3553 Psi
Standard pressure	31.4 MPa 4554 Psi	31.4 MPa 4554 Psi	31.4 MPa 4554 Psi	31.4 MPa 4554 Psi	31.4 MPa 4554 Psi	24.5 MPa 3553 Psi

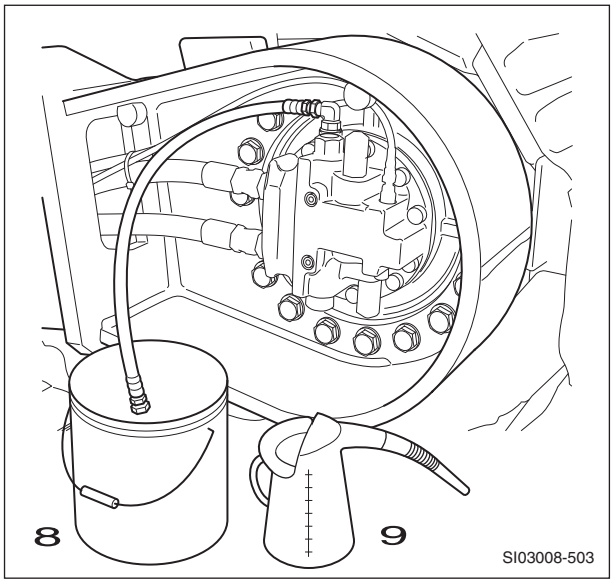
Boom-down pressure measurement

For pressure measurement with the boom down, put the arm cylinder at its out stroke end, open the bucket, put the bucket tip on the ground, carry out the boom-down operation, and measure.

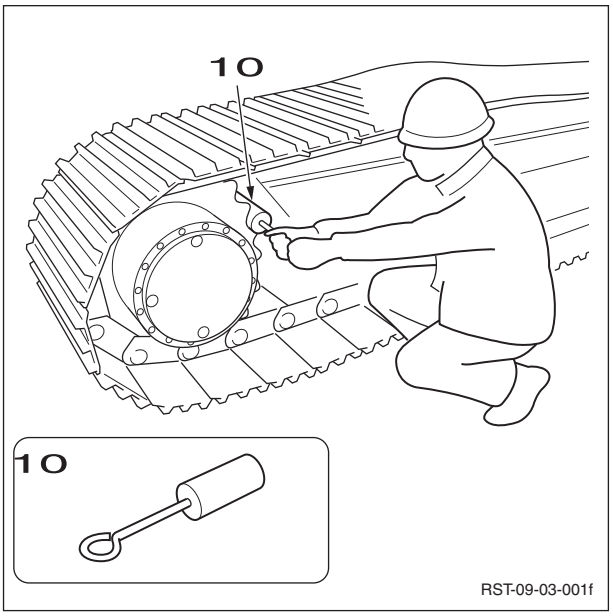


2	Boom-down relief

6. Prepare a waste oil receiver (8) and measuring container (9) and set them as in the figure below.



7. Catch the stopper (10) between the sprocket section and the frame and lock the travel motor.



8. In SP mode at medium speed, relieve the travel operation and at the same time the motor starts, move the extension hose to the measuring container (9).
(When the motor starts, start measurement with a stop watch (11).)

9. After 30 seconds, move the extension hose to the waste oil can (8).

10. Measure the volume of oil in the measuring container as the drain volume for 30 seconds.

	Forward		Backward	
	1st speed	2nd speed	1st speed	2nd speed
Right				
Left				

- Measure at least three times each for left, right, advance, and retreat.

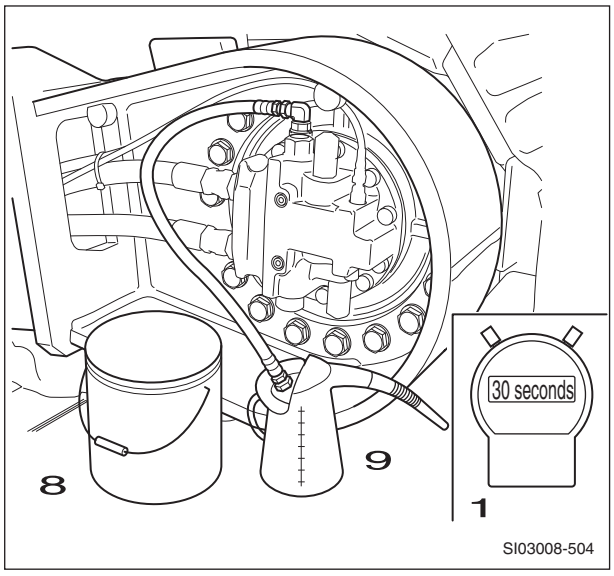


TABLE OF CONTENTS

Section

8005

REMOVAL AND INSTALLATION OF THE ATTACHMENT CYLINDERS

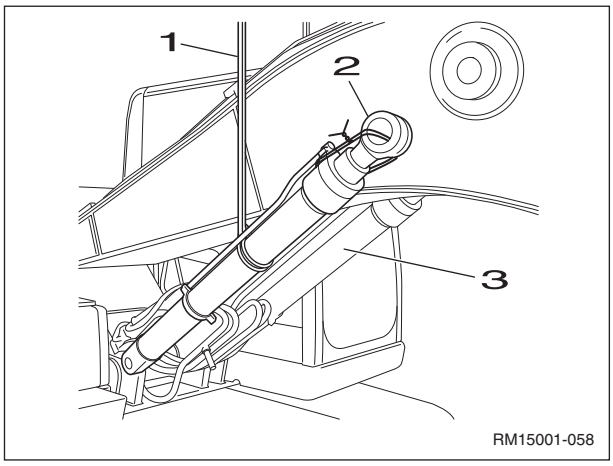
Printed in France
March 2016

CNH

[14] Use a liftcrane and nylon sling (1) to lift up and remove the boom cylinder (2).

[15] Place the boom cylinder (2) on the crosstie.

[16] Remove the cab side cylinder (3) with the same procedure.

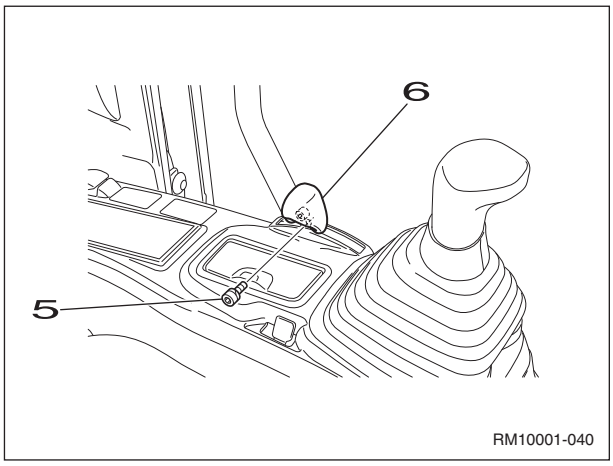


2 Installation of boom cylinder

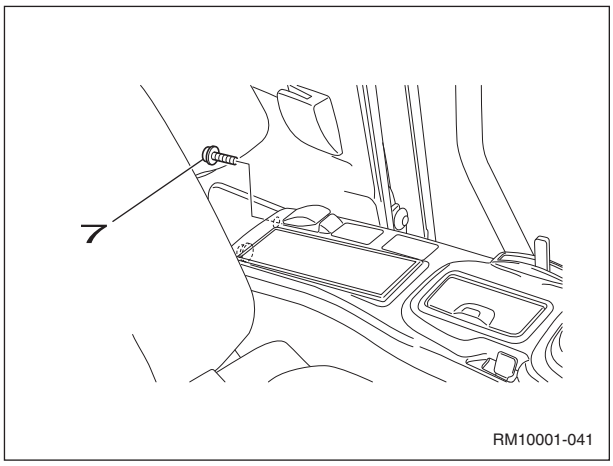
To install, perform the reverse of the removal procedure.

- Clean each pin and pin hole.
- When inserting pins, be careful not to damage the dust seals.
- As the final step, always grease up.

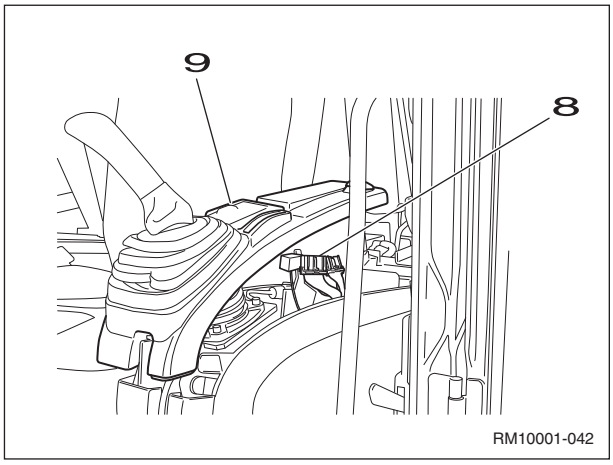
[3] Use a hexagon wrench (5 mm) to remove the 2 bolts (5), and remove the grip (6) of the gate lock lever.



[4] Use the Phillips screwdriver to remove the 2 screws (7) of the console top cover.

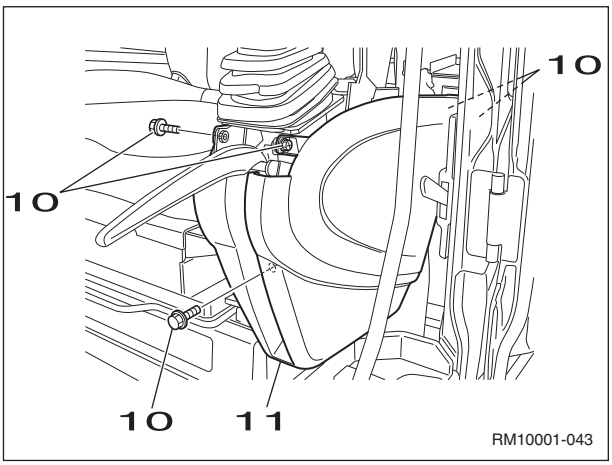


[5] Remove 3 connectors (8) and remove the console top cover (9).



[6] Use the Phillips screwdriver or box wrench (10 mm) to remove the 5 bolts (10).

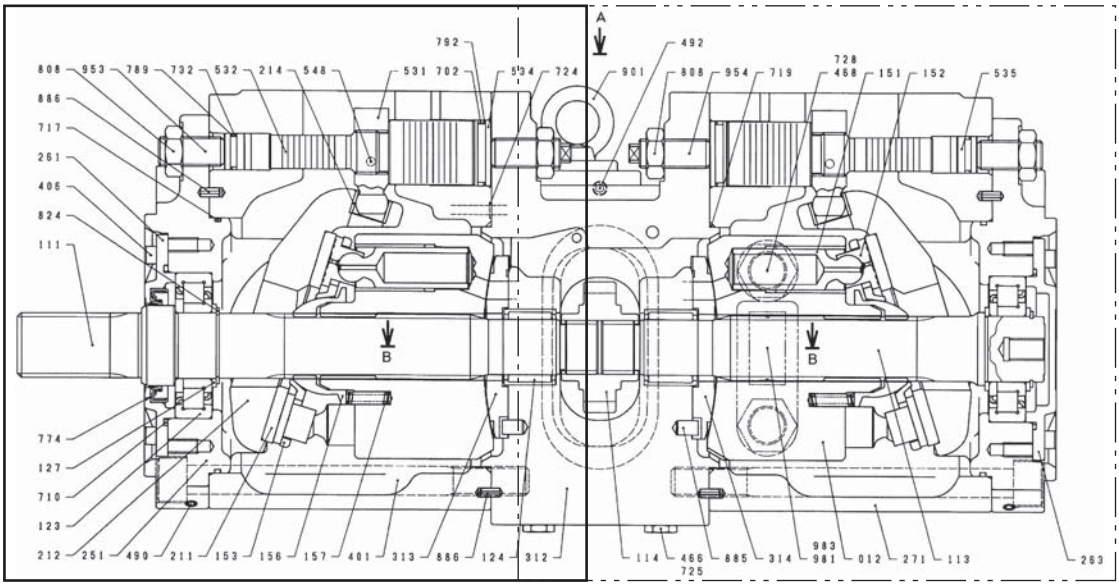
[7] Remove the cover (11).



NOTES

5 Overall view

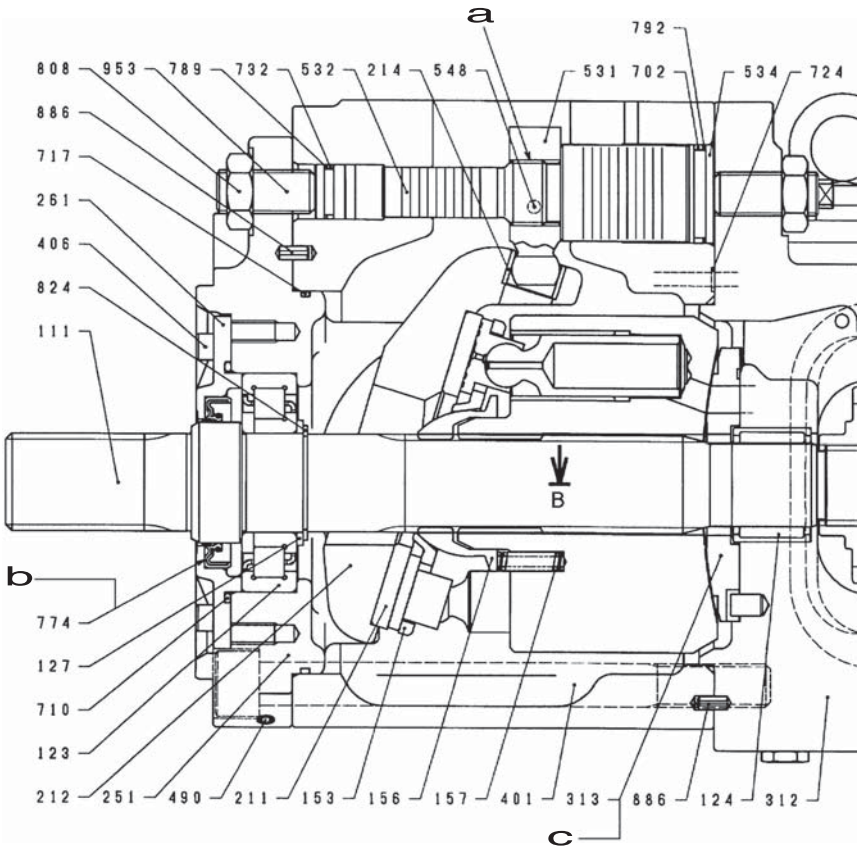
(1) Attached diagram 1. Pump assembly cross-section diagram



TM06009-303

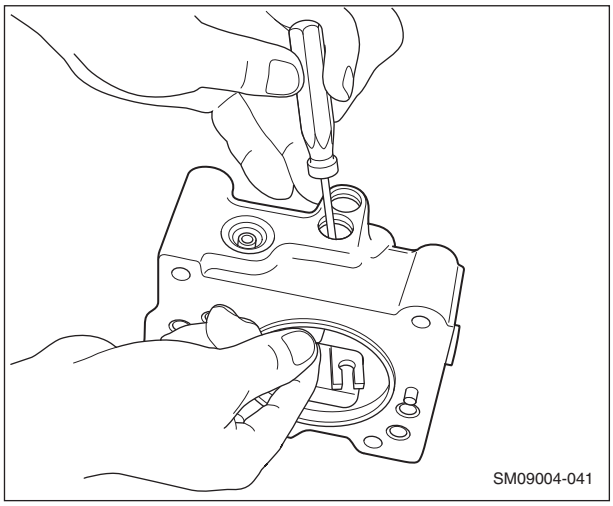
Drive shaft front side Drive shaft rear side

(2) Drive shaft front side

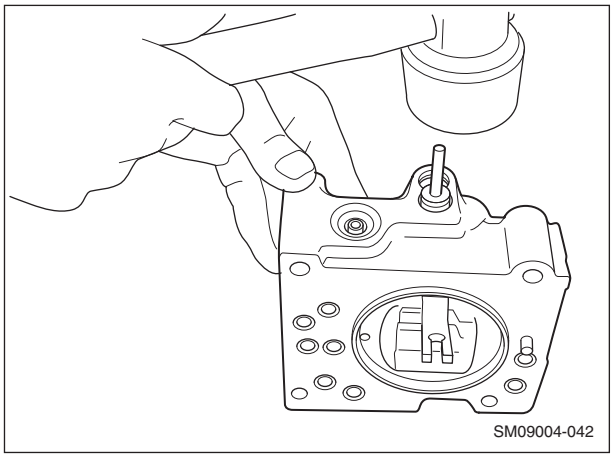


TM09006-304

[7] Insert the pin press fit in lever 2 (613) into the groove on the pilot piston, and assemble the lever 2.



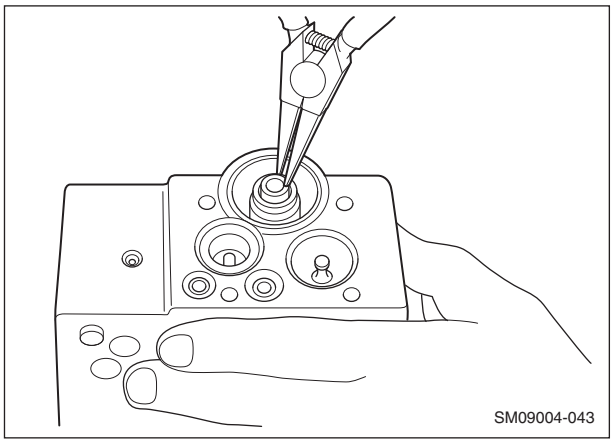
[8] Assemble the fulcrum plug (614) and install the locking ring (858) so that the pins press fit in the fulcrum plug are inserted into the pin holes on lever 2.



[9] Insert the adjusting plug (615), and install the locking ring (858).

- Be careful to insert the fulcrum plug and adjusting plug into the correct openings.
- At this time, check that the backlash from the movement of the feedback lever is not too great and that the feedback lever does not catch on anything.

[10] Install the return spring (654) and spring seating (653) into the spool holes, and install the stop ring (814).



d) Assembly of boom and arm antidrift valve

1) Install the poppet (46) and spring (33).
Install O-rings (35) and (77) on the body.
Pass the hexagon socket head bolts (63) into the body assembly (47) and tighten.
Tightening torque: 103 - 113 Nm

⚠ **Caution:**	When installing the antidrift valve assembly (47), make sure the spring (33) is securely seated in the antidrift valve assembly spring seating.

e) Assembly of relief valve

1) Screw in and tighten the overload relief valve (49). Total of 5 locations.
Tightening torque: 78 - 88 Nm

2) Screw in and tighten the overload relief valve (72). Total of 1 location.
Tightening torque: 123 - 127 Nm

3) Screw in and tighten the main relief valve (48).
Tightening torque: 93 - 108 Nm

4) Screw in and tighten the negative control relief valves (50).
Tightening torque: 103 - 113 Nm

f) Assembly of subspool (58)

1) Assemble the spool assembly (58) into the same position as before disassembly.

2) Install the cap (84) with the O-ring (57) attached. Pass the hexagon socket head bolts (85) into the cap and tighten. Tightening torque: 14.4 - 16 Nm

3) Install the plug (96) in the tip of the cap (84) and tighten.
Tightening torque: 38 - 42 Nm

⚠ **Caution:**	Line up the spool straight with the opening and insert it slowly. After inserting the spool, slide it by hand to check for any sticky or rough feeling. If a spool is left inserted that feels sticky or rough, there is a danger of a spool operation defect. See this caution when inserting the spool hereafter.

g) Assembly of subspool (24)

1) Assemble the spool assembly (24) into the same position as before disassembly.

2) Install the spring seat (21) and spring (25).

3) Screw in and tighten the plug (27) with the O-ring (26) attached.
Tightening torque: 93 - 108 Nm

h) Assembly of subspool (20)

1) Assemble the spool assembly (20) into the same position as before disassembly.

2) Install the spring seat (21) and spring (22).

3) Screw in and tighten the plug (23) with the O-ring (62) attached.
Tightening torque: 93 - 108 Nm

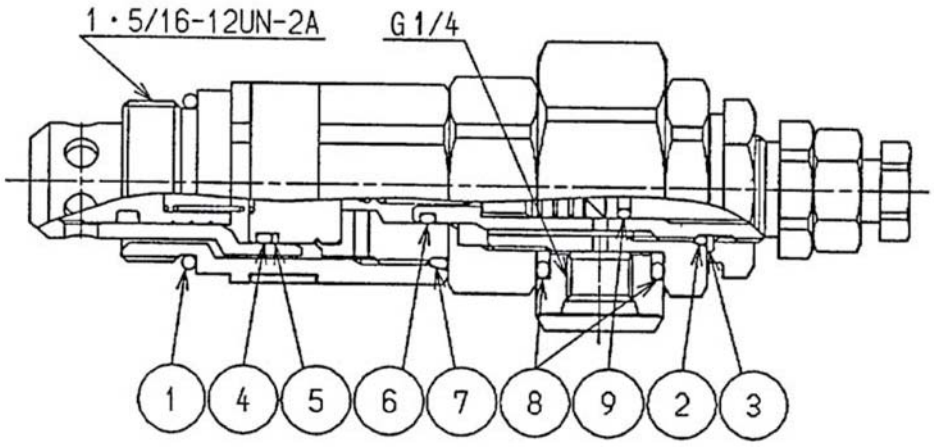
i) Assembly of main spool (3) - (11)

1) Assemble O-rings (14) in the valve housings (1) and (2).

2) Install a short cap (64) on the straight travel spool (7).
Install a short cap (73) on the boom 1 spool (5).
Install short caps (13) on the other spools.
Put the hexagon socket head bolts (63) into the short caps and tighten.
Tightening torque: 103 - 113 Nm

3) Assemble the sub-assembled spools (3) - (11) in the spool holes in the same location as before disassembly.

Reference number [48]: Relief valve kit

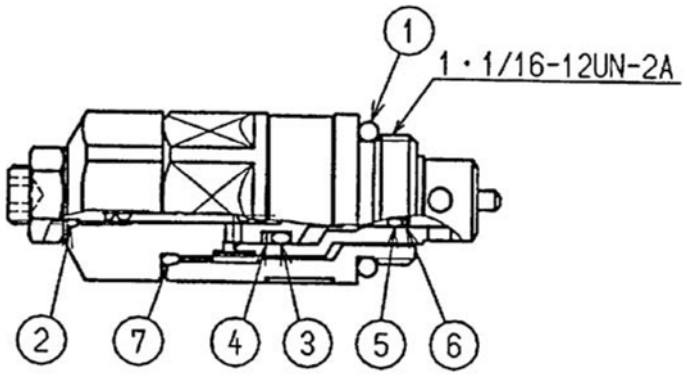


450-7-04-01-18t

Set pressure MPa	Flow L/min
Hi: 34.3 ± 0.5	315
Lo: 31.3 ± 0.5	340

Code	Part name	Q'ty
1	O-ring	1
2	O-ring	1
3	Backup ring	1
4	O-ring	1
5	Backup ring	1
6	O-ring	1
7	O-ring	1
8	O-ring	2
9	O-ring	1

Reference number [49]: Relief valve kit



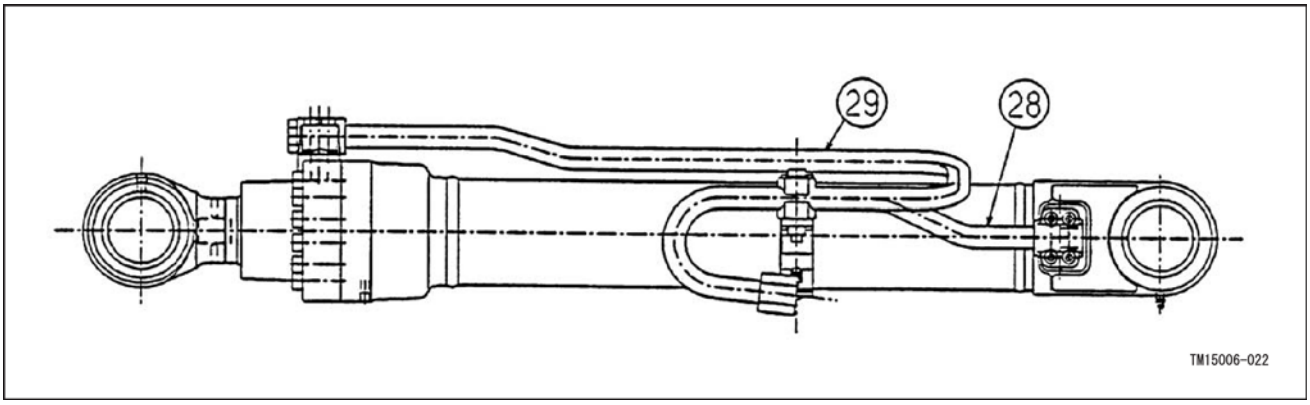
450-7-04-01-18u

Set pressure MPa	Flow L/min
36.3 ± 0.5	20

Code	Part name	Q'ty
1	O-ring	1
2	O-ring	1
3	O-ring	1
4	Backup ring	2
5	O-ring	1
6	Backup ring	2
7	O-ring	1

[3] Pipes (28), (29)

One set is positioned at the port on both the extension side and retraction side of the cylinder tube (1). Have the function of feeding and draining high-pressure oil from the connection openings of the flexible hoses to the cylinder tube port.



(7) Assembly procedures

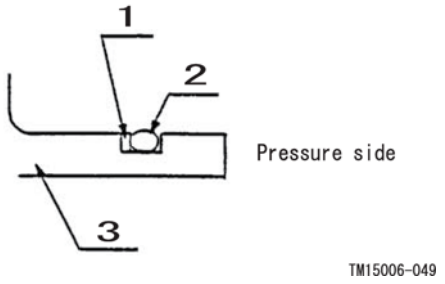
Caution:	• If a part with peeling paint is assembled, be careful that the peeled paint does not get inside the cylinder.

1) Replacement of seal

[1] When disassembling the cylinder, replace all the seals.

[2] O-ring
Clean the mounting groove well, and then mount the backup ring (1) and O-ring (2). Foreign matter in the groove section can cause an oil leak.
Be careful about the location of the backup ring (1).

- Apply grease or hydraulic oil to the backup ring (1) and O-ring (2) so that they slide easily, then attach them. If they are sliding poorly, the O-ring (2) may become twisted during assembly, which can cause oil leaks.

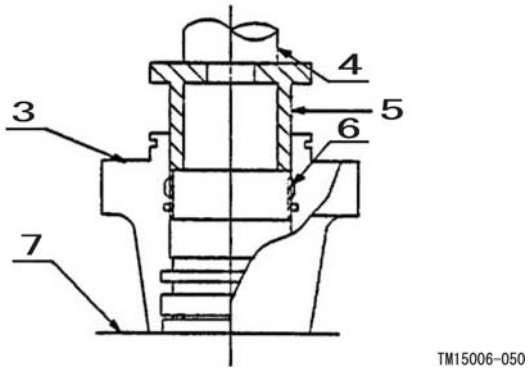


2) Cylinder head

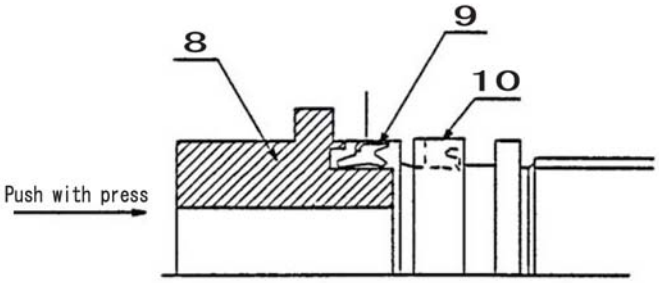
[1] Use the jig (5) to press fit the DU bushing (6) with a press.

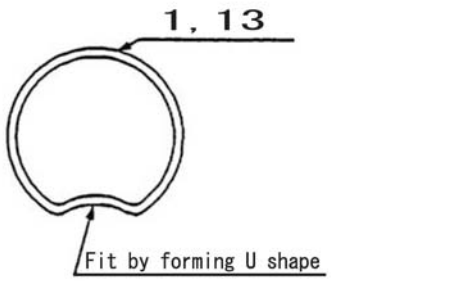
[2] Use the jig (8) to press fit the wiper ring (9) with a press.

[3] Mount the backup ring (1) and U-ring in the U-ring groove (10) in that order. After mounting, check that there are no wrinkles or other permanent deformations remaining.



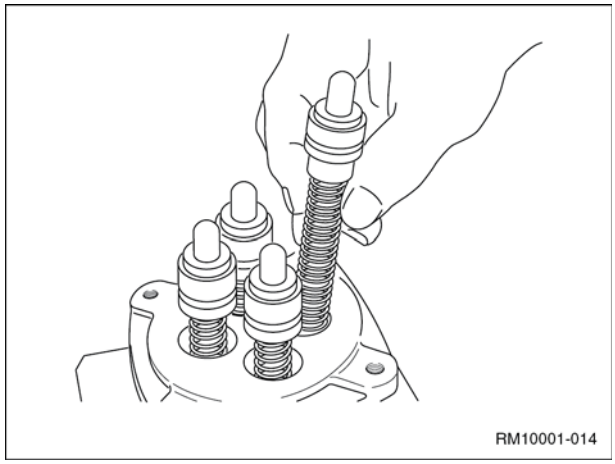
4	Hydraulic press





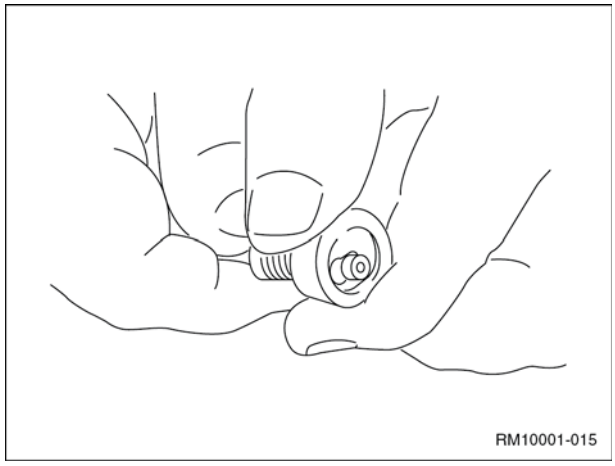
[8] Remove the push rods (212), plugs (211), pressure reducing valve assemblies and the return springs (221) from the casing (101).

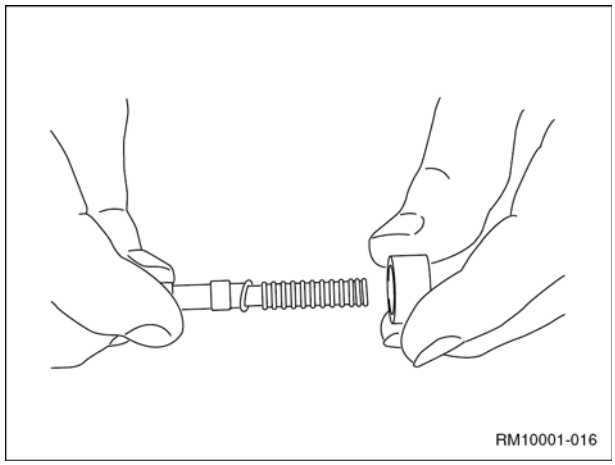
- Record the relation of parts to the casing hole positions through marking, etc).

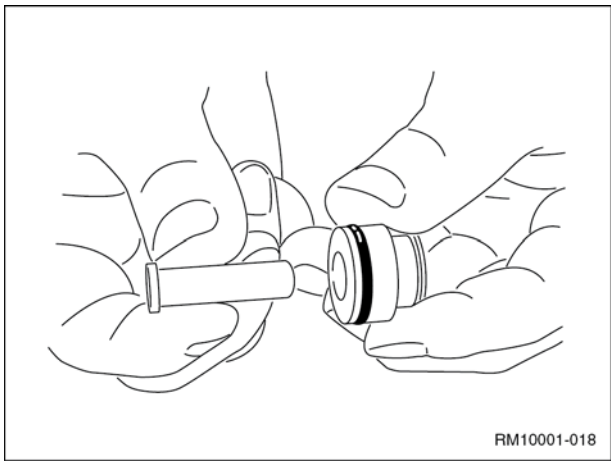


[9] For disassembly of pressure reducing valves, press in the spring seatings, move the spring seatings (216) to the side while bending the secondary pressure springs (241), and remove the springs from the spools (201) by passing the springs through the larger hole of the spring seatings.
Next, separate the spools, spring seatings, secondary pressure springs, and washers (217).

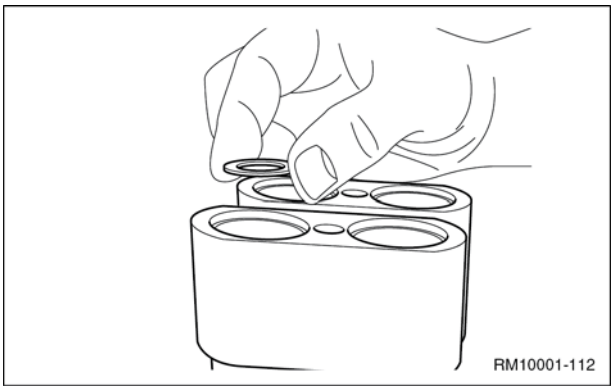
- Be careful not to scratch the surface of the spools.
- Do not lower the spring seats by 6 mm or more.
- Handle as an assembly until assembly is performed.



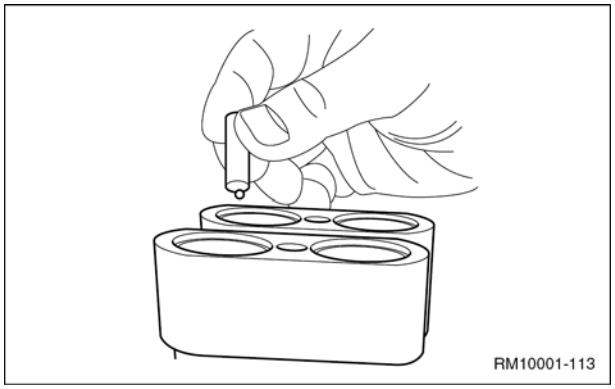




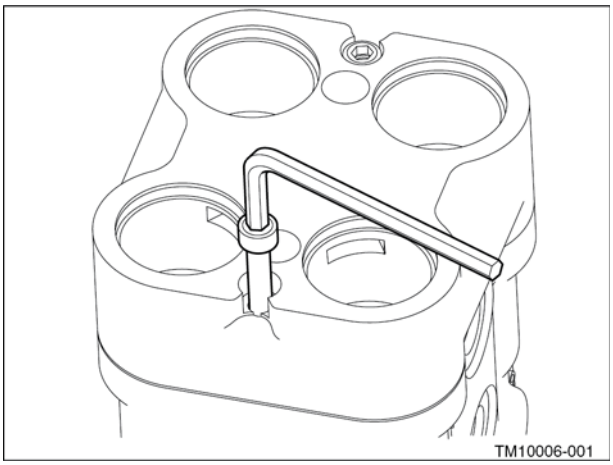
[12]Remove the spring seats (218) from the casing (101).
Record the position of the spring seatings in relation to the casing holes.



[13]Use a magnet, etc. to remove steel balls (225).
Be careful not to lose steel balls.



[14]Use the hexagon wrench to remove the hexagon socket head bolts (220).

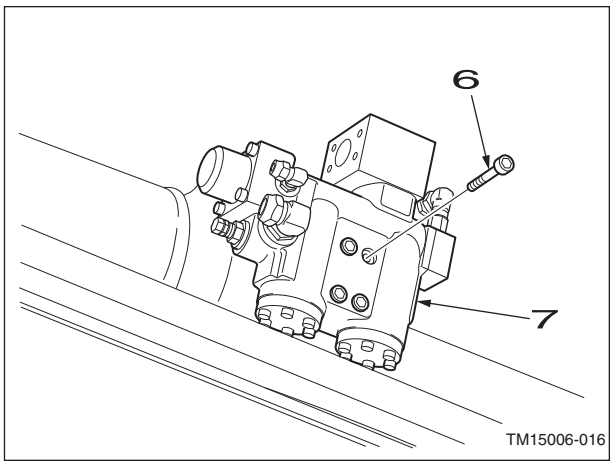


Code	Part name	Qty	Code	Part name	Qty
101	Casing	1	271	Hexagon socket head bolt	2
102	Casing (damper)	1	301	Spool	4
201	Cover	2	311	Spring seating	4
202	Plug	4	313	Washer 3	4
203	Grease cup	4	324	Spring	4
210	NHU packing	4	335	Spring	4
211	O-ring	2	336	Spring	4
213	O-ring	4	337	Spring	4
214	Push rod	4	412	Bushing	4
245	Washer 1	8	413	Camshaft	2
217	Washer 2	4	420	Cam	2
218	Spring seating	4	423	Hexagon socket head locking screw	2
220	Hexagon socket head bolt	2	471	Locking screw	4
224	Piston 2D08	4	472	Lock nut	4
225	Steel ball	2	501	Bellows	2

1 Tightening torque list

Code	Screw size	Tightening torque
220	M6	8.8 ± 1 Nm
271	M12	55.5 ± 9.8 Nm
423	M6	6.9 ± 1 Nm (Loctite coating)
472	M10	33.3 ± 3.4 Nm

[3] Use a hexagon wrench (12 mm) to remove the 4 bolts (6), then remove the arm HBCV (7).



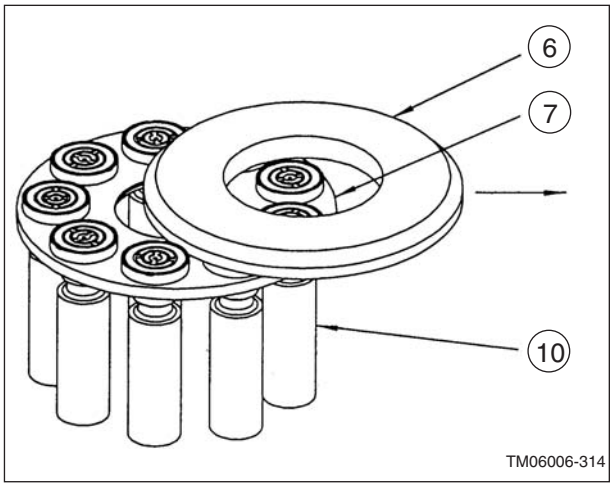
2 Installation of arm HBCV

- To install, perform the reverse of the removal procedure.
- The tightening torque for line installation and HBCV installation is 145 ± 27.5 Nm.

3) Removal of cam plate.

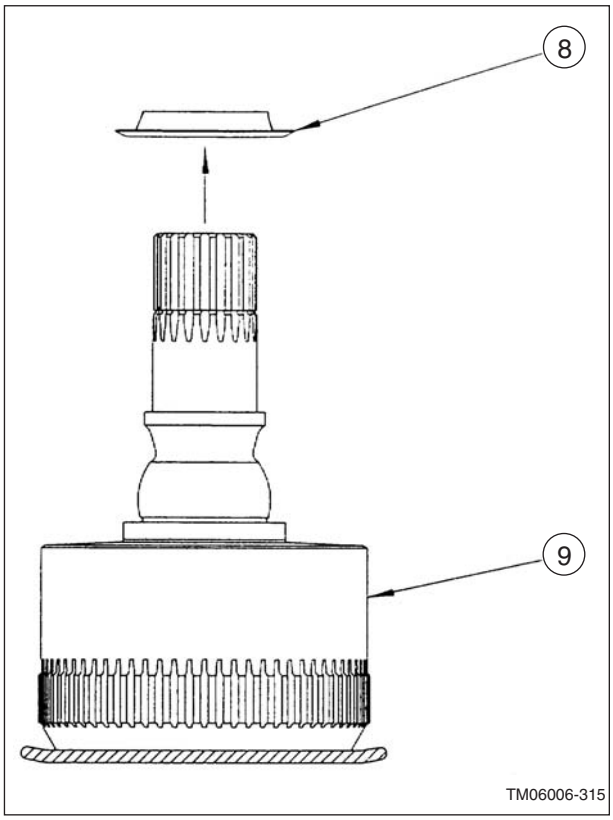
Remove the cam plate (6) so that it slides on the piston assembly (10) sliding surfaces.

- Be very careful with handling to prevent scratching of the cam plate (6) or piston (10) assembly sliding surfaces.



4) Removal of receiving spring.

Remove the receiving spring (8) from the cylinder (9).



Code	Part name	Qty.	Code	Part name	Qty.
1	Retaining ring	1	24	Cover	1
2	Inner race	1	25	Parallel pin	2
3	Oil seal	1	26	Parallel pin	1
4	Tapered roller bearing	1	27	Balance plate	1
5	Housing	1	28	Needle bearing	1
6	Cam plate	1	29	Retaining ring	1
7	Return plate	1	30	O-ring	2
8	Receiving spring	1	31	Relief assembly	2
9	Cylinder	1	32	Hexagon socket head bolt	7
10	Piston assembly	9	33	Cap	2
11	Friction plate	4	34	O-ring	5
12	Partner plate	4	35	Cap	2
13	Piston	1	36	Spring	2
14	O-ring	1	37	Backup ring	2
15	O-ring	2	38	O-ring	2
16	Spring	19	39	Check valve	2
17	Teflon ring	4	40	O-ring	2
18	Disc spring	4	41	Backup ring	2
19	Bushing	4	42	Bypass valve assembly	2
20	Cap	2	43	Level gauge assembly	1
21	O-ring	2	44	O-ring	1
22	Hexagon socket head bolt	1	45	Cap	1
23	Piston	2			

Straight Travel Circuit

As an example, this section explains simultaneous travel and boom-up operations.

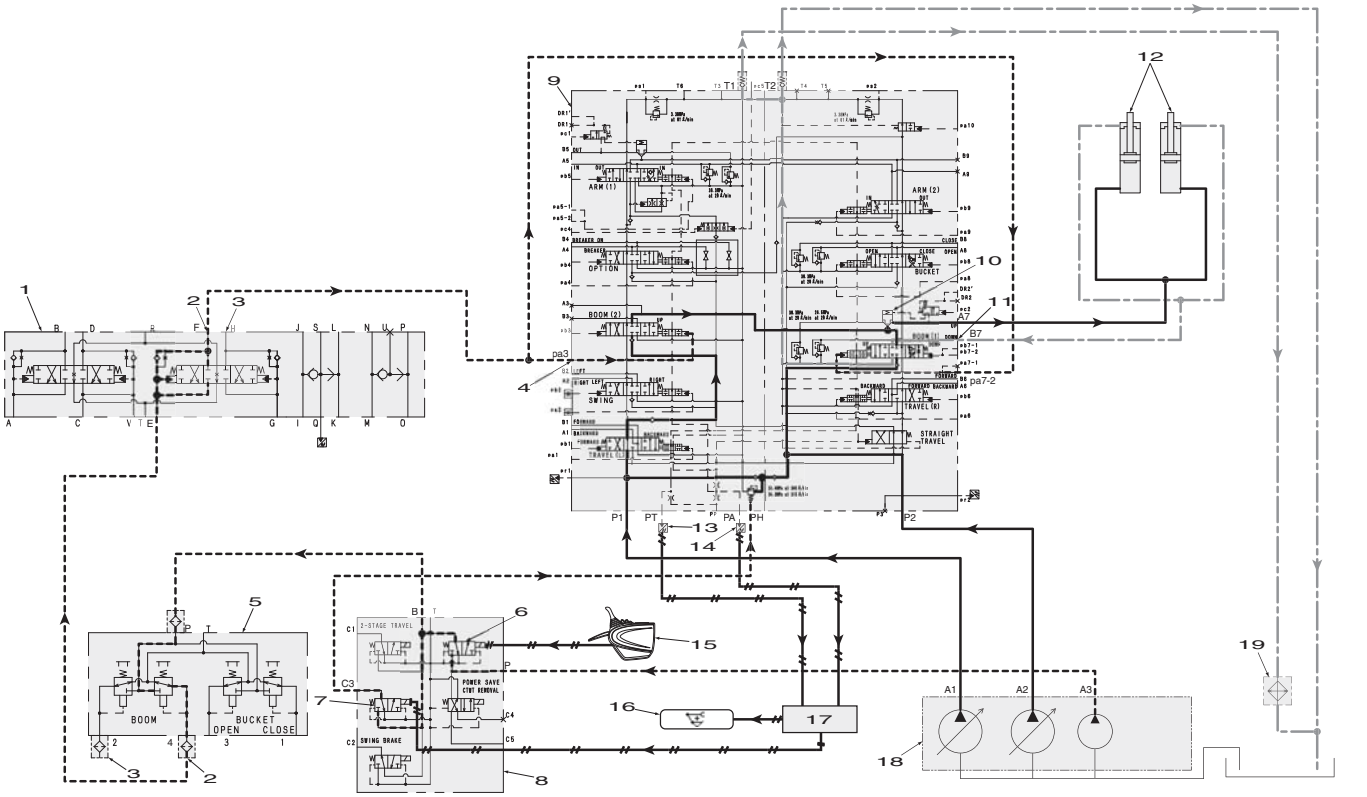
The pilot pressure oil that has entered from the control valve PP port is connected to the tank side through the paths of the travel spool and upper (boom, arm, bucket, swing) spool. When travel + boom-up operation is performed, all of the circuits connected to the tank are cut off by the spool. Due to this, the destination for the pilot pressure oil that has entered from the PP port disappears, the source pressure (3.9 MPa) operates on the straight travel valve pilot chamber, and the straight travel valve switches.

Through the straight travel valve being switched, it is possible for the control valve P1 pressurized oil to drive the left and right travel motors and for the control valve P2 pressurized oil to drive the upper. Because the left and right motors are driven by 1 pump, the left and right motors have the same pressure and straight travel is possible. Furthermore, the P2 excess pressurized oil is fed to the travel side via the check valve with travel merge orifice to minimize the drop in speed. The same operations are carried out when travel and an upper actuator other than for the boom are operated simultaneously.

Legend

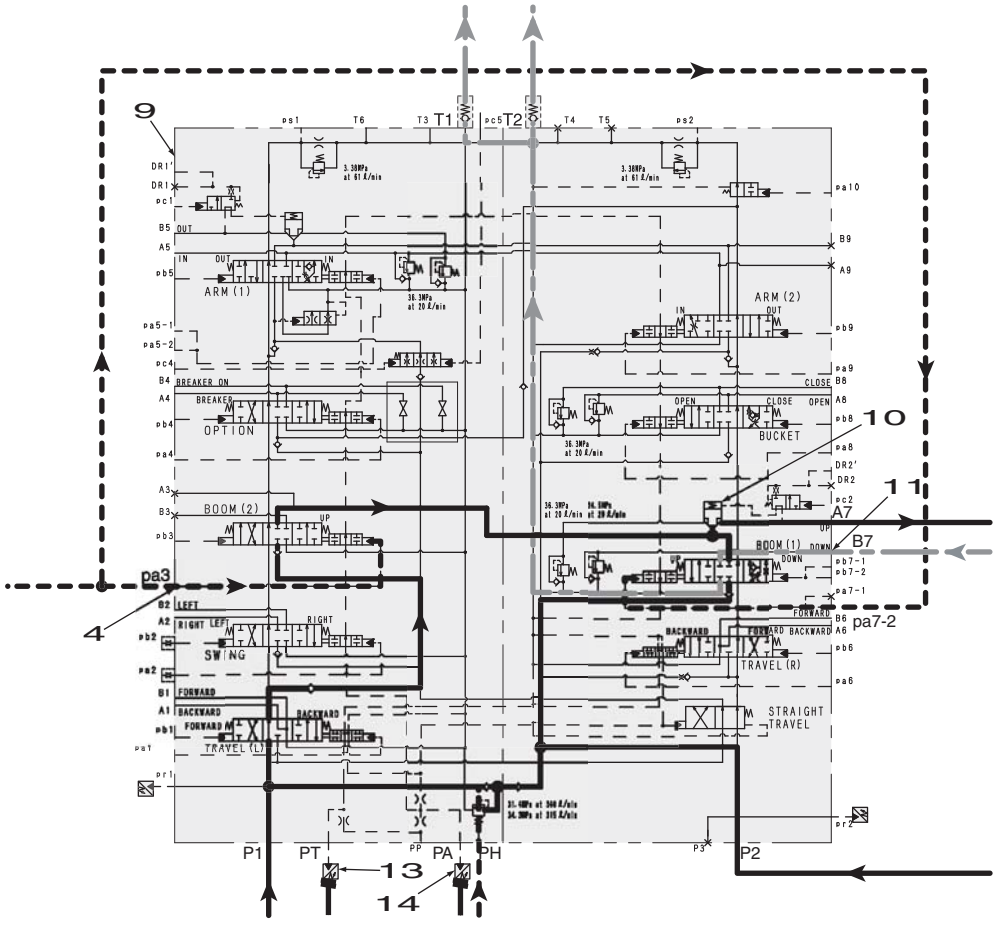
1	Travel motor	9	Straight travel valve	17	Travel remote control valve
2	Boom (up)	10	Travel high-speed select switch	18	Oil cooler
3	Boom (down)	11	Travel high speed	19	Backward left
4	Cushion valve	12	Lever lock	20	Forward left
5	Remote control valve (boom, bucket)	13	5 stack solenoid valve	21	Backward right
6	Control valve	14	Console lever lock switch	22	Forward right
7	Travel (left)	15	Hydraulic pump	23	Computer A
8	Travel (right)	16	Boom cylinder		

Overall View (without HBCV)



TD04012-010a

Enlarged View (without HBCV)



TD04012-010b

ARM CIRCUIT

Arm-out Circuit (with/without HBCV)

By moving the remote control valve to the arm-out side, the pilot pressure oil is fed via the cushion valve to the control valve pb5 port and pb9 port and switches the arm (1) and (2) spools to the out side.

The discharge oil from hydraulic pump A1 enters the control valve P1 port and is fed from the center bypass oil path to the arm (1) spool. The discharge oil from hydraulic pump A2 enters the control valve P2 port, flows from the center bypass oil path and through the arm (2) spool and merges downstream of the arm (1) spool.

Switching the arm spool lets the oil flow through the load holding valve check valve and into the arm cylinder rod side, carrying out the arm-out operation.

When the circuit has an HBCV, switching the arm spool lets the oil flow through the load holding valve check valve to push open the arm cylinder HBCV check valve and flow into the rod side, carrying out the arm-out operation.

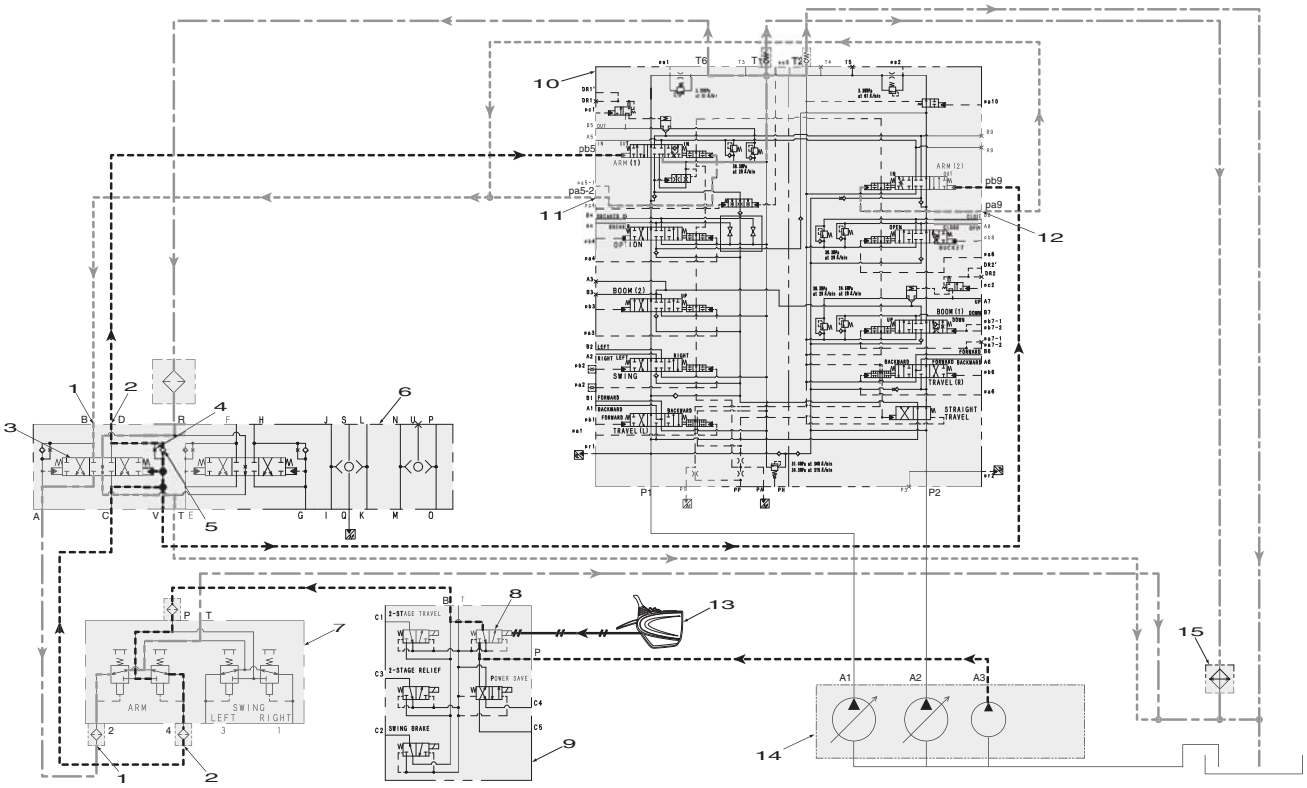
The arm cylinder bottom side return oil goes through the arm (1) and (2) spools and returns to the hydraulic oil tank.

Legend

- Pressure Line
- Tank line
- Drain line
- Pilot pressure line
- Pilot tank line
- Electric Line

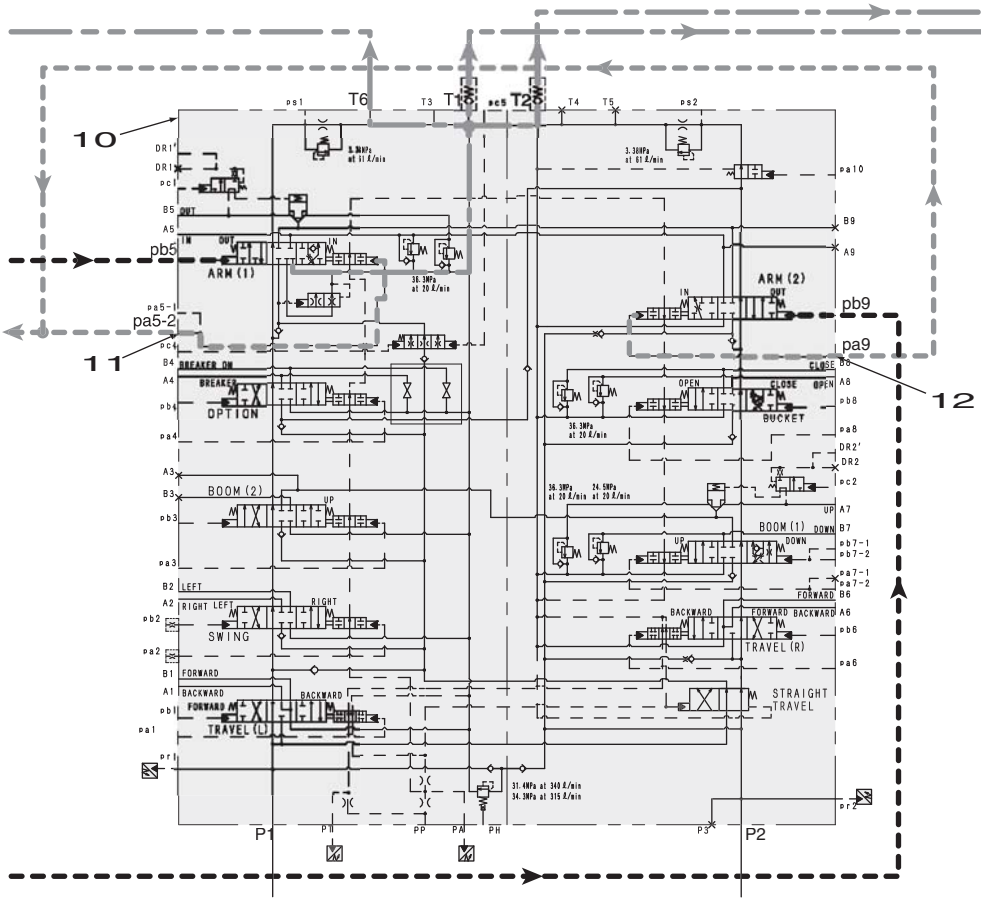
1	Arm cylinder	12	Arm (2)
2	Arm (in)	13	Travel pilot pressure sensor
3	Arm (out)	14	Upper pilot pressure sensor
4	Cushion valve	15	Console lever lock switch
5	Remote control valve (arm, swing)	16	Monitor display
6	Lever lock	17	Computer A
7	Boost pressure relief	18	P1 pressure sensor
8	5 stack solenoid valve	19	P2 pressure sensor
9	Control valve	20	Hydraulic pump
10	Load holding valve check valve	21	Oil cooler
11	Arm (1)	22	Arm HBCV

Overall View



TD04012-024a

Enlarged View



TD04012-024b

Multi-purpose Circuit (2 pumps flow crusher)

When the remote control valve is operated, the pilot pressure is fed to the control valve pb4 (or pa4) and switches the option spool and the hydraulic pump A1 discharge oil flows to the end attachment.

By switching the 2 pumps flow switch in the cab, power passes through the solenoid valve and the solenoid valve is switched.

The pilot pressure that is split after passing through the remote control valve passes through the solenoid valve and enters the pa10 port.

This switches the spool and blocks the center bypass circuit. The discharge oil from the blocked hydraulic pump A2 travels via the merge path and merges upstream of the option spool with the discharge oil from the hydraulic pump A1.

At this time, the option pilot pressure switch signal is detected, and the pump P1 flow control proportional valve adjusts to the set discharge volume through the output signal from computer A.

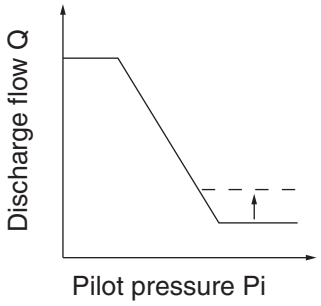
Legend

- Pressure Line
- Tank line
- Drain line
- Pilot pressure line
- Pilot tank line
- Electric Line

1	Control valve	9	Multi-purpose circuit switch	17	Horsepower control proportional valve
2	3-direction valve	10	Lever lock	18	Pressure sensor
3	Crusher	11	5 stack solenoid valve	19	P1 flow control proportional valve
4	2 stack merge solenoid valve	12	Console lever lock switch	20	Pressure sensor
5	Option remote control valve	13	Neutral cut valve	21	Hydraulic pump
6	Pressure switch	14	Pressure sensor	22	Stop valve
7	Monitor display	15	Pressure sensor	23	Relief valve
8	Computer A	16	Radiator		

2- Minimum flow adjustment

Loosen the hexagon nut (808) and tighten (or loosen) the hexagon socket head locking screw (953) to adjust the flow control characteristic. Similar to the maximum flow adjustment, this does not change other control characteristic. However, if the hexagon socket head locking screw is tightened too much, the required power may increase at the time of maximum discharge pressure (during relief), so adjust this carefully.



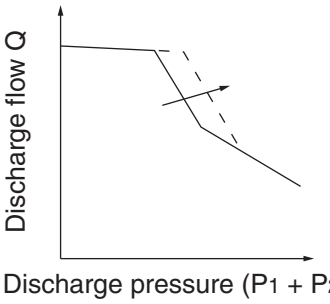
TD02011-008

3- Input horsepower adjustment

This regulator uses the simultaneous full-horsepower control method. Therefore, when changing the horsepower setting, adjust the adjusting screws of both the front and rear pumps to the same amount.
The pressure change value resulting from adjustment is the value when pressure boost is simultaneously performed with both pumps.

1)Outer spring adjustment

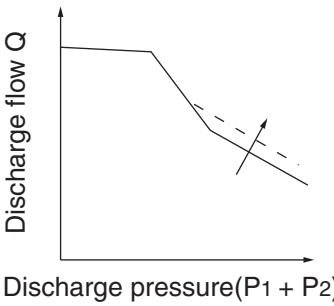
Loosen the hexagon nut (630) and tighten (or loosen) the adjusting screw C (628) to adjust the outer spring. As the adjusting screw is tightened, the control diagram shifts to the right as in the diagram on the right and the input horsepower increases. When the adjusting screw C is rotated N times, the inner spring setting also changes. Therefore, return the adjusting ring C (627) by rotating it N x A times in the opposite direction.



TD02011-009

2)Inner spring adjustment

Loosen the hexagon nut (802) and tighten (or loosen) the adjusting ring C (627). As the adjusting screw is tightened, the flow increases as in the diagram on the right and the input horsepower increases.



TD02011-010

e) Brake valve section

Spool switchover pressure: 0.59 - 0.95 MPa
Check valve cracking pressure: 0.015 MPa

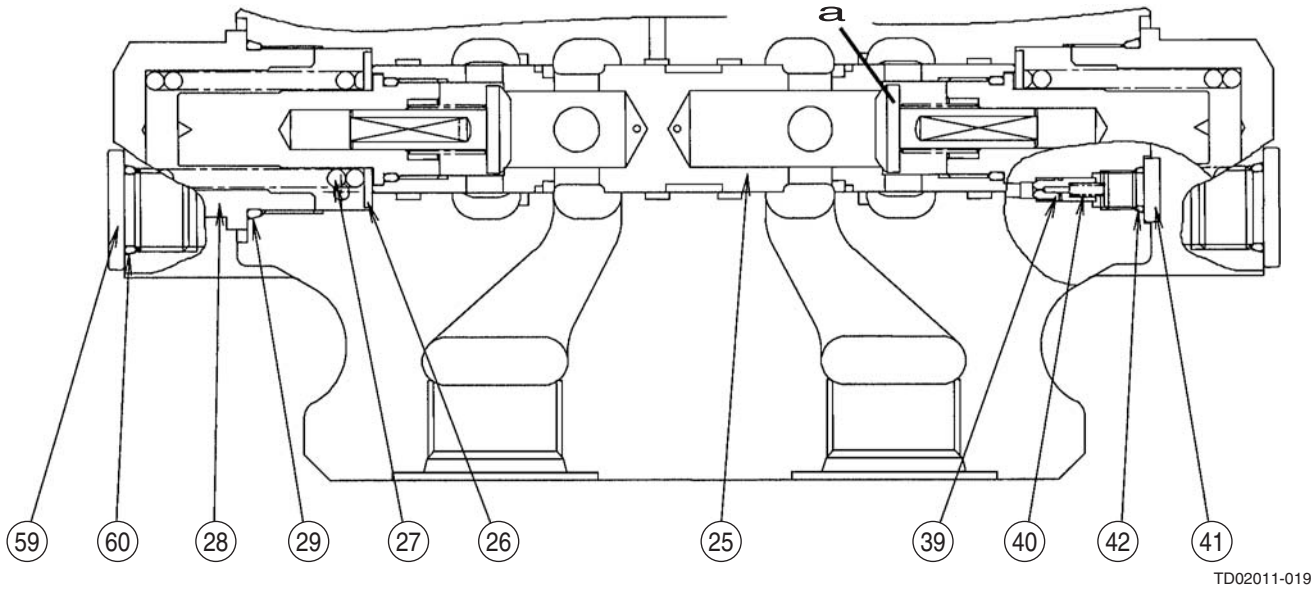
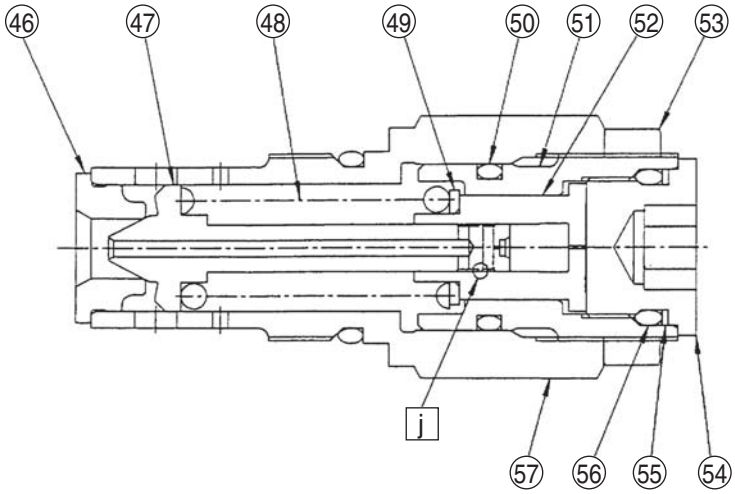


Diagram 3 Brake valve section

[1] Spool
Shut-off of hydraulic motor discharge oil and orifice operation are automatically performed by switchover of this spool (25), and holding, acceleration, stop, and counter balance operations affect the hydraulic motor.

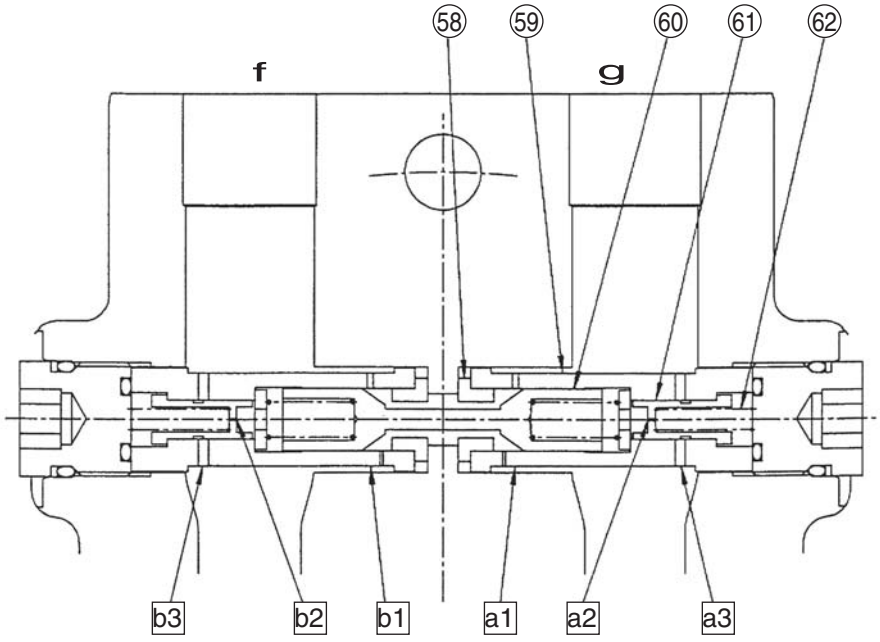
[2] Check valve (a) (built into spool)
This is the oil feed path of the hydraulic motor and provides a discharge oil locking function. Therefore, this is the hydraulic motor suction valve as well as the holding valve.

9) External adjustment shockless relief internal structure diagram



300-1-02-03-01c

10)Bypass valve internal structure diagram



TD02011-030

f	B port
g	A port

4) Anti-drift Valve

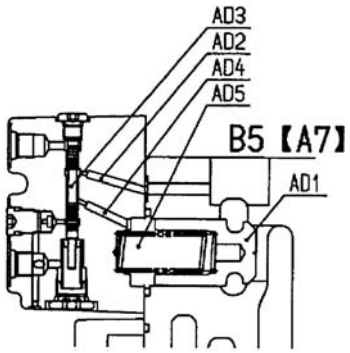
The antidrift valve is mounted on the arm rod (boom bottom side) cylinder port to prevent the arm (boom) cylinder from dropping naturally.

In neutral [Fig. 17], the cylinder port pressure is led from path (AD1) through the spool (AD3) neck section and into the spring chamber (AD5) from path (AD4).

The pressure difference from the spring force and poppet surface area difference keeps the poppet (AD1) securely seated.

During arm damp (boom up) [Fig. 18], oil fed from the pump pushes open the poppet (AD1) and flows out to the cylinder port.

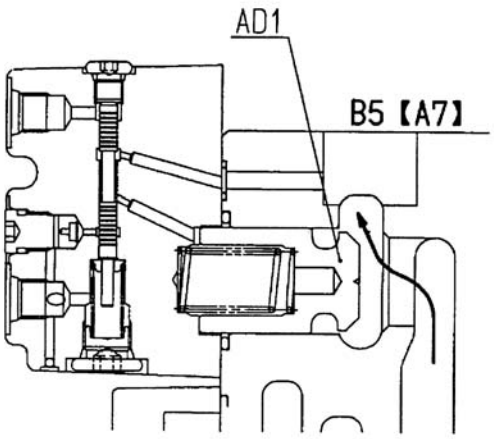
During arm crowd (boom down) [Fig. 19], the Pc1(Pc2) port is pressurized to switch the spool (AD3), thereby leading the oil in the spring chamber (AD5) from path (AD6) to the drain port DR1' (DR2'). As a result, the poppet (AD1) opens and the return oil from the cylinder port flows to the tank path (Ta).



[Fig.17]

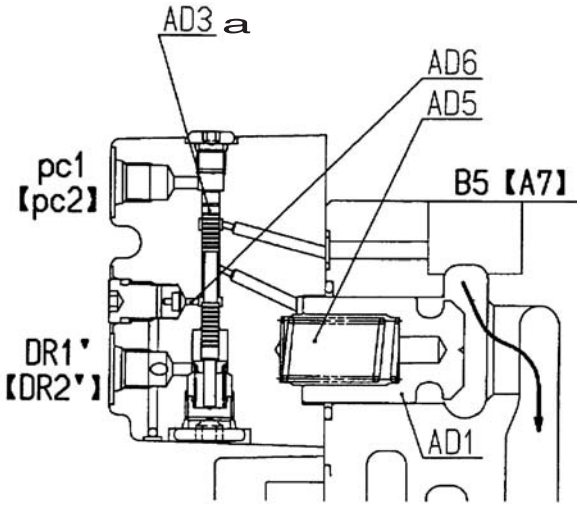
TD02011-044

Neutral State



[Fig.18]

Arm damp (boom up)



[Fig.19]

TD02011-045

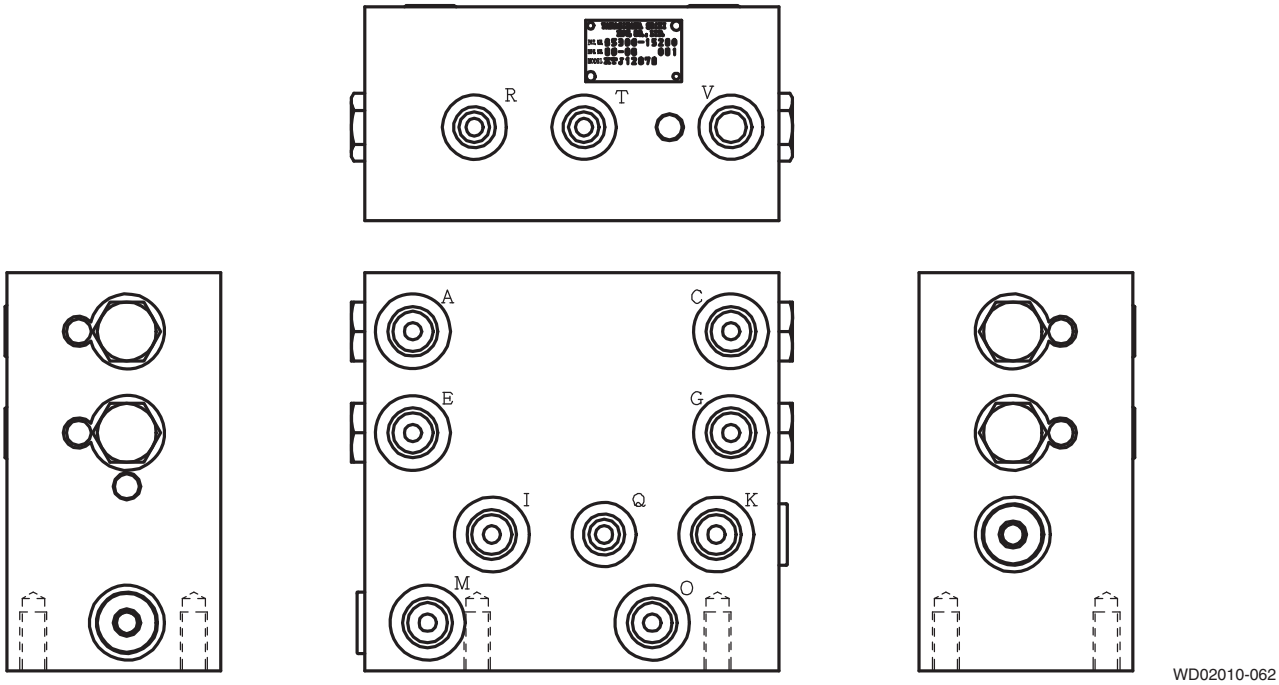
Arm crowd (boom down)

a	Spool switching state

5. CUSHION VALVE

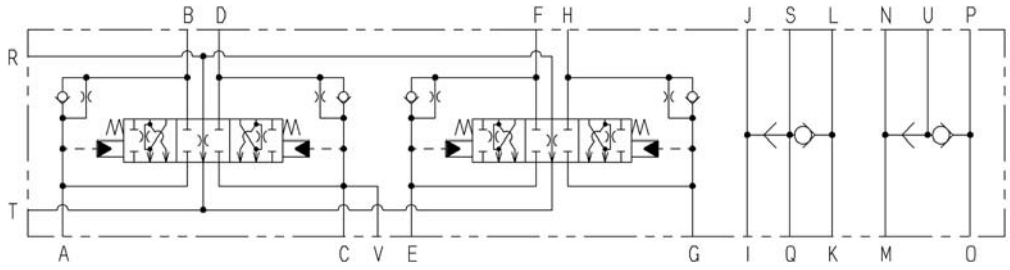
1) Valve summary

This valve is made up of a shuttle valve section and cushion valve section with heat circuit.
The cushion valve with a heat circuit is connected between the hydraulic shovel control valve and the pilot operation valve to reduce body shaking (cushion function) caused by emergency stop operations by the operator.
This valve is equipped with a circuit with which the operator can deliberately disable the cushion function for reverse operations.
The shuttle valve selects the high-pressure signal pressure from 2 signal pressure systems. This valve has 2 circuits.



WD02010-062

Figure 1 External shape diagram



WD02010-063

Figure 2 Hydraulic system diagram

REMOVAL AND INSTALLATION OF COUNTERWEIGHT

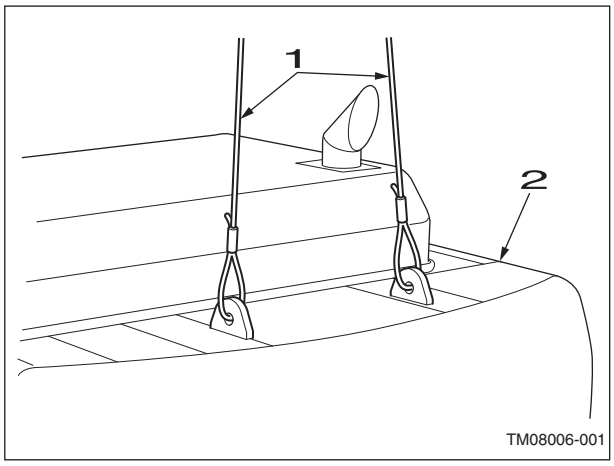
Caution:	• Be sure to stop the engine before beginning work. • Be sure to inspect the wire rope and other lifting equipment before beginning work. • Do not stand or pass under the suspended load. • Thoroughly secure the removed counterweight with the wire ropes and crane so that it does not fall over.

Items to prepare

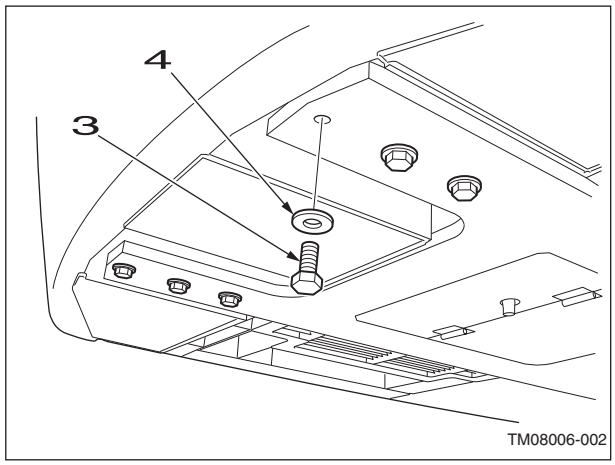
- Box wrench (46 mm)
- Balance lifting device
- Wire ropes (with the required breaking load) × 4
- Liftcrane (with the required lifting capacity)
- Wood planks, etc.
- Rag
- Cleaning fluid

1 Removal of counterweight

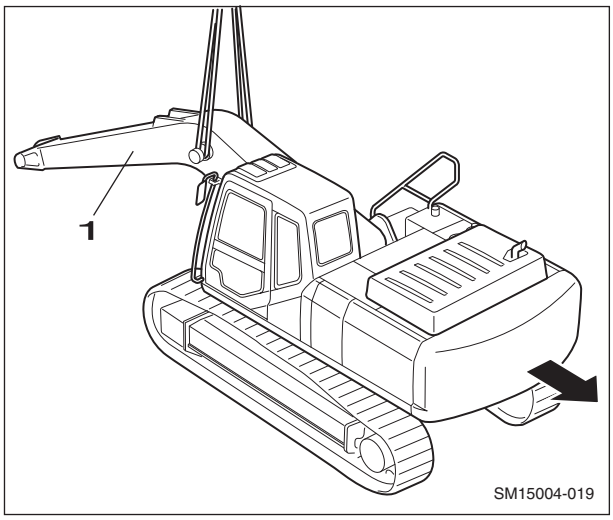
[1] Use the wire ropes (1) and liftcrane to secure the counterweight (2) so that it does not fall during removal and installation operations.



[2] Use a box wrench (46 mm) to remove the 6 bolts (3) and washers (4) on the counterweight.



[19] Back up the machine and remove the boom (1).



2 Installation of boom

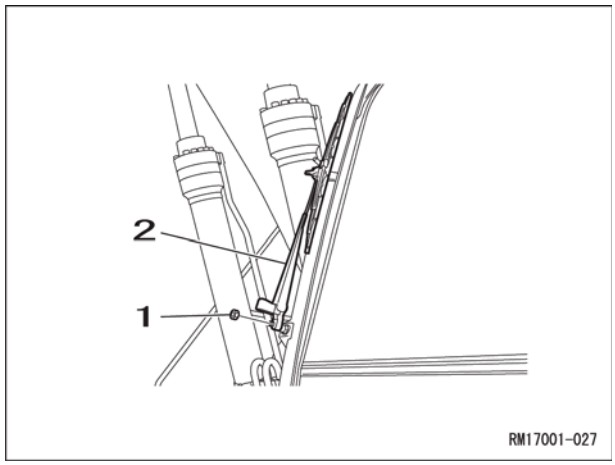
To install, perform the reverse of the removal procedure.

- Clean each pin and pin hole.
- When inserting pins, be careful not to damage the dust seals.
- As the final step, always grease up.

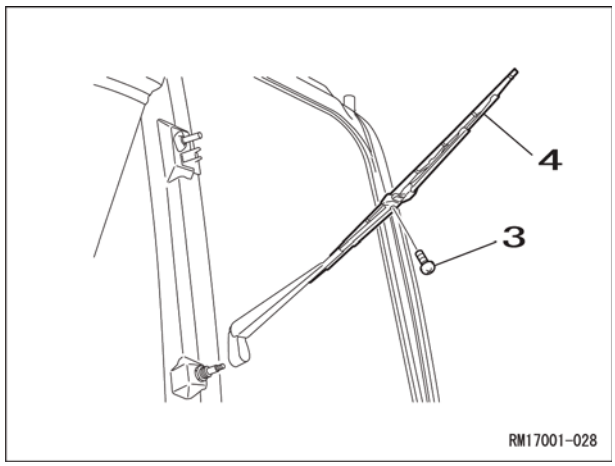
REMOVAL AND INSTALLATION OF WIPER

1 Removal of wiper

[1] Use a wrench (17 mm) to remove the nut (1), and then remove the wiper arm (2).

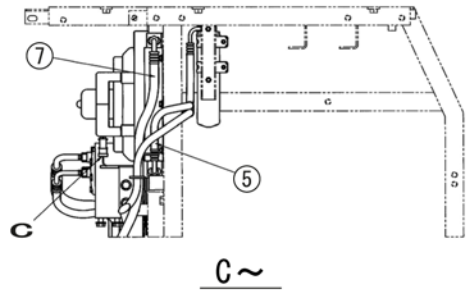


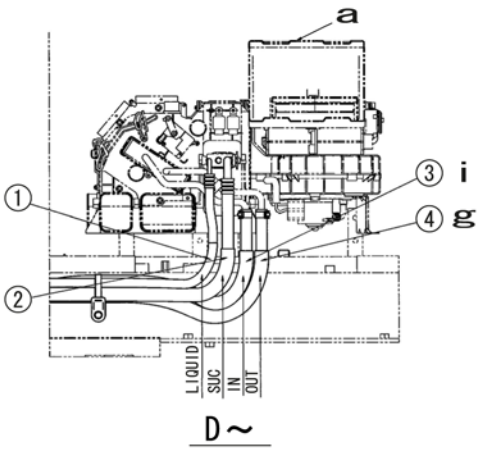
[2] Use the Phillips screwdriver to remove the screw (3), and then remove the wiper (4).



2 Installation of wiper

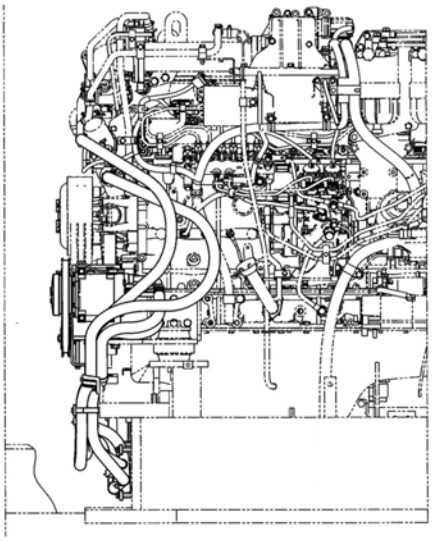
To install, perform the reverse of the removal procedure.

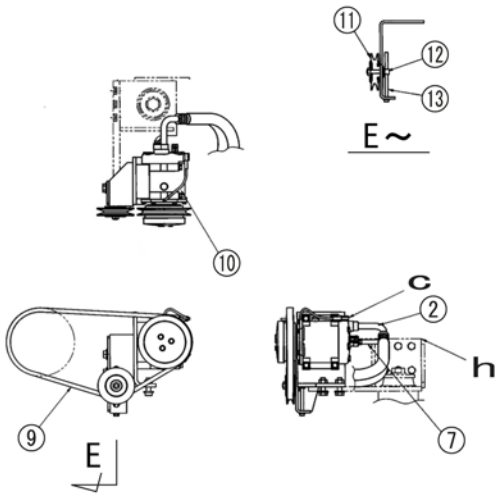




Code	Part name	Q'ty
1	Cooler hose (liquid 2)	1
2	Cooler hose (suction)	1
3	Rubber hose	1
4	Rubber hose 1	1
5	Cooler hose (liquid 1) 1	1
6	Dryer receiver (D60.5) 1	1
7	Cooler hose (discharge) 1	1
8	Condenser air conditioner (electric fan) 1	1
9	V belt (B-49) 1	1
10	Compressor air conditioner 1	1
11	Tension pulley (with cover) 1	1
12	Slide shaft 1	1
13	Adjuster bolt 1	1

a	Air conditioner unit
b	Engine
c	Frame main harness
d	Housing frame (front left)
e	Discharge hose
f	Suction hose
g	From air conditioner unit to engine
h	Support engine
i	From engine to air conditioner unit





KTR11180-E00

7. Trouble Detection and Control after Trouble Detected

1) Summary explanation

If there is trouble in a motor actuator drive line or sensor controller input circuit, the trouble is detected and control from then on changed as described below.

In any of these cases, once trouble has been detected, even when that location is returned to normal, trouble control is not ended. Trouble control is only ended when the ignition key power supply is switched OFF or when air conditioner operation is stopped with the ON / OFF switch on the operation panel. However, motor actuator restriction is only ended by switching OFF the main key power supply.

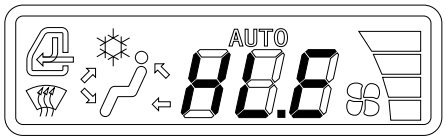
2) Trouble in a motor actuator and its input / output circuits

a) Disconnection detection

Immediately after the main key power supply is switched ON, if a motor actuator potentiometer line is disconnected or shorted, the display in the table below for that motor actuator is carried out and that motor actuator is not driven until the main key power is switched OFF, then ON again.

Disconnection detection display

Trouble location	Trouble display
Air mix motor actuator	HL.E is displayed on the set temperature display LCD. (See the figure below.)
Blow mode motor actuator	The passenger icon display flashes.
Refresh / recirculate motor actuator	Potentiometer line not used



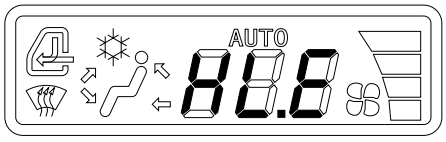
RST-07-03-001m

b) Motor lock detection

If the output shaft rotation angle for a motor actuator does not reach its target value within 15 seconds, this is treated as lock detection, output to that motor is stopped, and trouble is displayed on the controller according to the trouble location.

Motor lock detection display

Trouble location	Operation panel trouble display
Air mix motor actuator	HL.E is displayed on the set temperature display LCD. (See the figure below.)
Blow mode motor actuator	The passenger icon display flashes.
Refresh / recirculate switch motor actuator	The refresh / recirculate mark flashes.

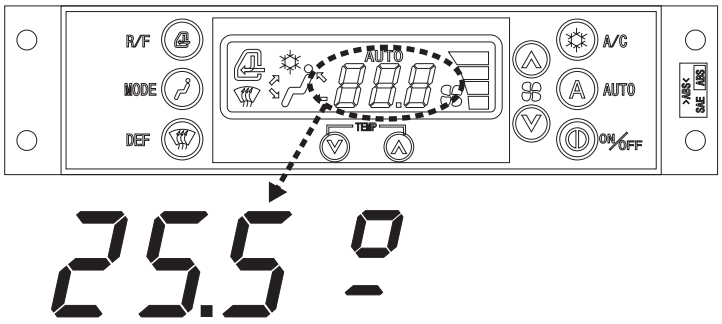


RST-07-03-001m

3) Explanation of Monitor Mode

When sensor trouble is displayed, the sensor status (disconnection, short) can be checked in monitor mode.

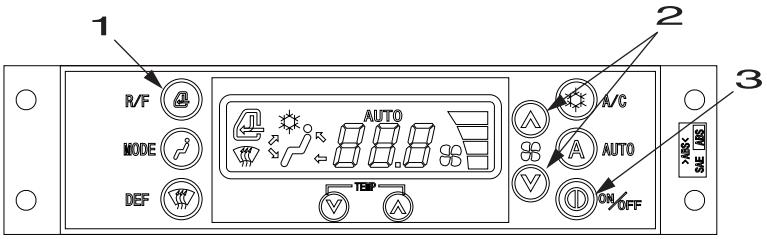
a) Monitor mode display position



RST-07-05-001g

- (25.5) = Three-digit 7 segment (°) = 7 segment dedicated to monitor display

b) Monitor mode display operation method



1	Refresh / recirculate switch
2	Blower switch UP / DOWN switch
3	ON / OFF switch

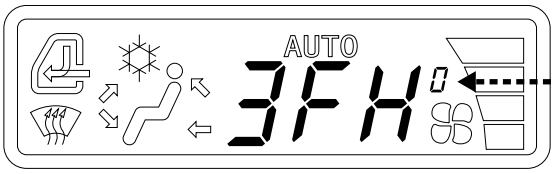
RG05002-02

1. Hold down the refresh / recirculate switch and the ON / OFF switch at the same time for one second or longer.

2. Press the AUTO switch.
(All the segments light up for one second, then the system enters monitor mode.)

3. Numbers 0 to 9 or letters A to F are displayed in the first and second digit of the three-digit 7-segment display.
"H" is displayed in the third digit.

4. The 0 to 2 display on the dedicated 7-segment display is carried out with the blower UP / DOWN switches. The necessary sensor is selected from the table below.



7-segment display table indicated to monitor

0	Inside air sensor
1	Evaporator sensor
2	Solar radiation sensor

(Display other than the above (3 to 9, B to F) is not used during service)

RG05002-03

5. To end the monitor display, either hold down the refresh / recirculate switch and the ON / OFF switch at the same time for one second or longer or switch the vehicle main switch OFF.

CAUTION:

1. During monitor mode, operations and settings of basic control through all the switches are not possible until the air conditioner control operation is stopped and monitor mode ended.

2.During monitor mode, even if a sensor is repaired, the trouble display is recorded in memory, and until the ON / OFF switch is switched OFF, then ON again, the trouble display is not ended.

ASSEMBLY AND DISASSEMBLY OF UNIT

Caution:	• Be sure to stop the engine before beginning work.

Caution:	• When replacing the evaporator, resupply and check the compressor oil quantity.

1 Removal of blower unit

[1] Remove the inside air filter (1), remove the 4 T5 x 14 screws (2), and remove the intake case (3).

[1] Remove the 3 T5 x 14 screws (5) that are used to install the blower case (4) and unit case, and remove the blower case.