

**CX350B**  
**CX370B**  
Crawler Excavator

**SERVICE MANUAL**

Part number 47945155

English

November 2015

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**CASE**  
CONSTRUCTION

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## Engine Oil

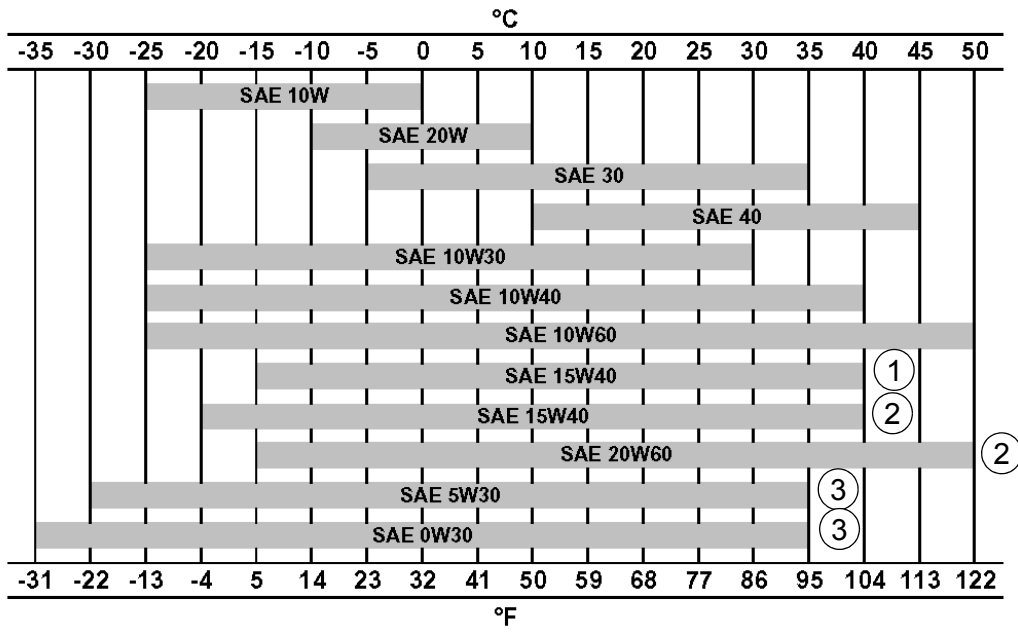
THE CASE/AKCELA No. 1 engine oil is recommended for your engine. This oil ensures proper lubrication of your engine for all operating conditions.

If the CASE/AKCELA Multigrade "No. 1 ENGINE OIL" cannot be obtained, use the oil corresponding to one of the following categories: ACEA E7. API CI-4.



CP02N001

## Oil viscosity / Oil range



CT02M001

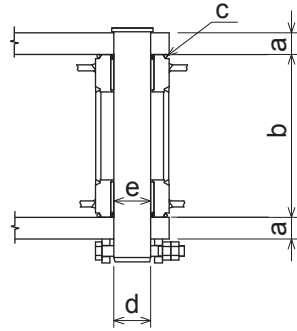
- 1) With mineral base
- 2) With semi-synthetic base
- 3) With synthetic base

**Reference Values (CX370B)**

SP Mode (with standard bucket)

		Item		Unit	Reference value
1	Engine speed	Idling		min <sup>-1</sup>	900 ± 20
		No load A mode			1700 ± 20
		No load H mode			1800 ± 20
		No load SP mode			1900 ± 20
2	Pressure in each section	Main relief	Standard	MPa	34.8 ± 2.0
			Boosted pressure		37.7 ± 2.0
		Boom relief	Up		41.0 ± 2.0
			Down		27.5 ± 2.0
		Arm relief	Out		41.0 ± 2.0
			In		
		Bucket relief	Open		41.5 ± 2.0
			Close		42.5 ± 2.0
		Swing relief	Left and right		32.5 ± 2.0
		Travel relief	Left and right, front and back		
		4th pump relief			
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	10 max.
		Arm cylinder extension			15 max.
		Bucket cylinder retraction			20 max.
		Overall bucket tip falling			250 max.
4	Attachment speed	Boom (bucket open)	Up (stroke 790)	sec.	3.7 ± 0.6
			Down (stroke 790)		3.5 ± 0.6
		Arm	Out		3.5 ± 0.6
			In		4.6 ± 0.6
		Bucket	Open		2.8 ± 0.6
			Close		3.5 ± 0.6

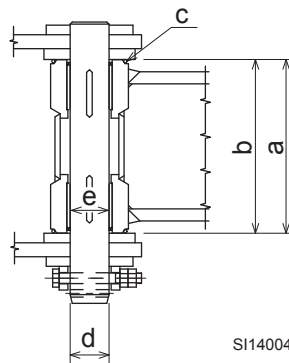
## 8. Connecting rod/Dipper



SI14004-005-a

Part name	Code	Measured dimensions (mm)	Standard value (mm)	Usage limit (mm)	Judgment	Solution
Arm link	a		50	47	Acceptable/Unacceptable	Replacement
Arm	b		375	371	Acceptable/Unacceptable	Replacement
Clearance	c		1.0 - 1.5	Adjust with shims	Acceptable/Unacceptable	Adjust with shims
Pin	d	∅	∅85	∅84	Acceptable/Unacceptable	Replacement
Bushing (arm)	e	∅	∅85	∅86.5	Acceptable/Unacceptable	Replacement

## 9. Compensator/Bucket

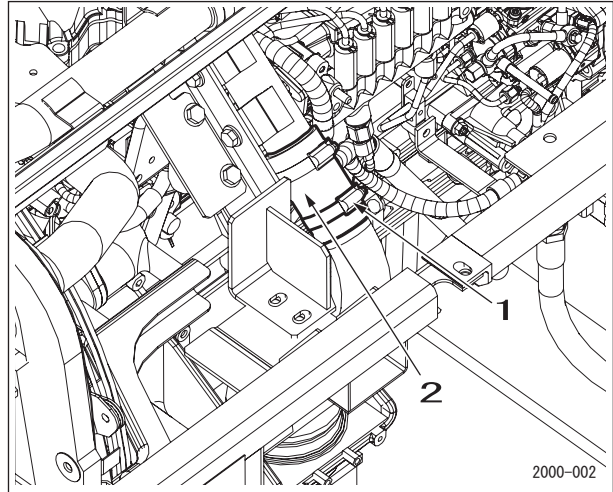


SI14004-005-b

Part name	Code	Measured dimensions (mm)	Standard value (mm)	Usage limit (mm)	Judgment	Solution
Bucket	a		401	406	Acceptable/Unacceptable	Replacement
Bucket link	b		400	397	Acceptable/Unacceptable	Replacement
Clearance	c		1.0 - 3.5	Adjust with shims	Acceptable/Unacceptable	Adjust with shims
Pin	d	∅	∅90	∅89	Acceptable/Unacceptable	Replacement
Bushing (bucket link)	e	∅	∅90	∅91.5	Acceptable/Unacceptable	Replacement

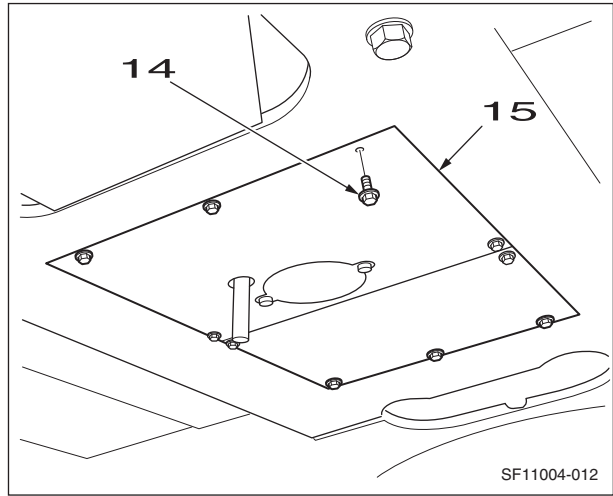
[13] Loosen the hoseband (1) on the inter cooler, and then remove the hose (2).

- Use caps to cover the pipe and hose and prevent the entry of water, dust or dirt
- Tightening torque for hoseband: 8.8 - 9.8 Nm

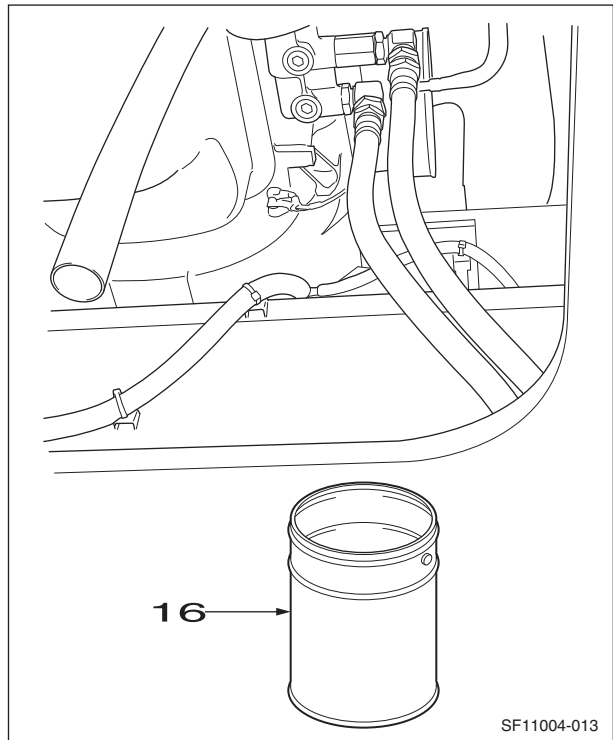


[14] Remove the bolts (14), and then remove the under cover (15).

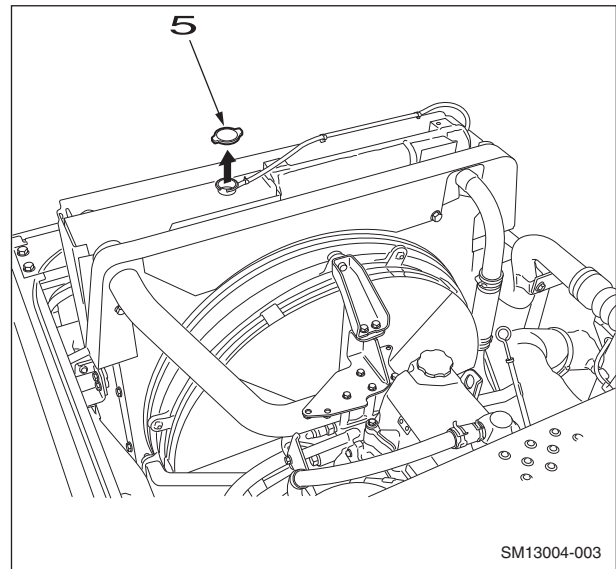
- Use caution when removing as the parts are heavy.



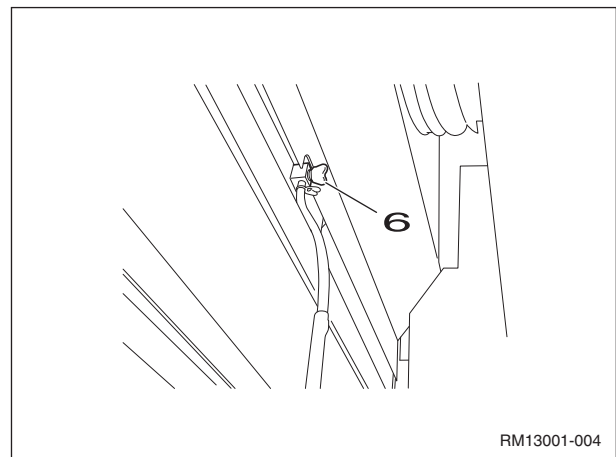
[15] Prepare a waste oil can (16). As the engine oil hose will be removed, first drain the engine oil.



[3] To make it easier to drain the coolant, remove the radiator cap (5).

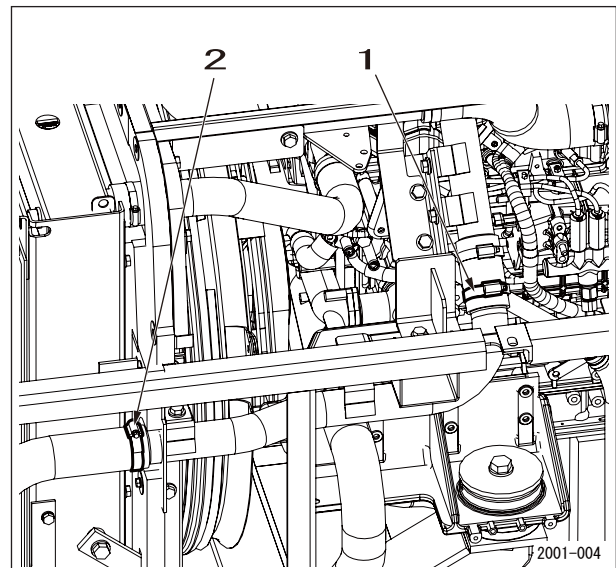


[4] Loosen the drain plug (6), and then drain the coolant.



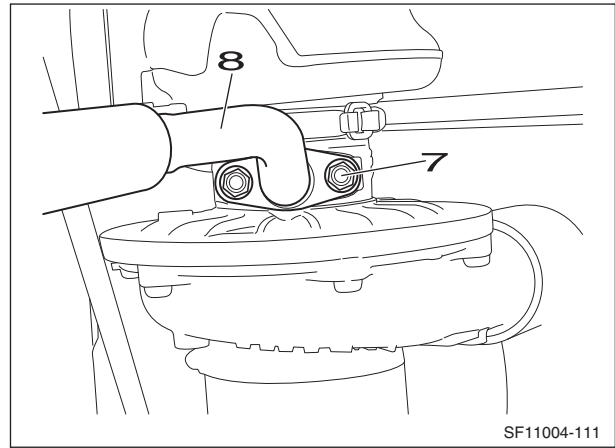
[5] Loosen the hosebands (1) (2).

- Use caps to cover the pipe and hose and prevent the entry of water, dust or dirt.
- Tightening torque for hoseband (1): 8.8 - 9.8 Nm.

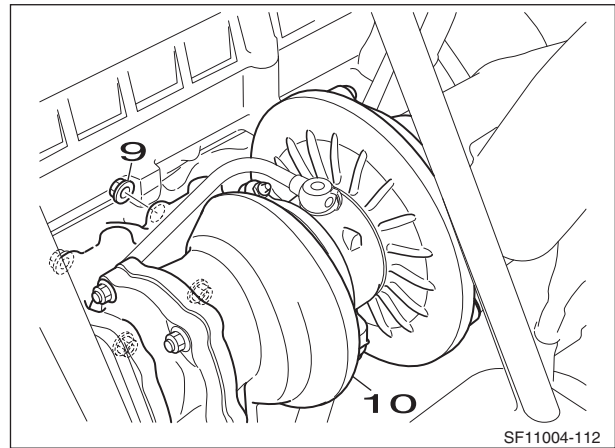


2004-4

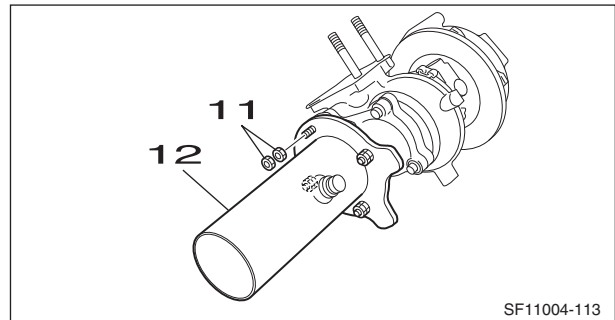
- [4] Use a wrench (10 mm) to remove the 2 bolts (7), and then remove the oil return pipe (8).
- Use caps and plugs to cover the turbo charger and oil return pipe to prevent any entry of water, dust or dirt.



- [5] Use a wrench (14 mm) to remove the 4 nuts (9), and then remove the turbo charger (10).



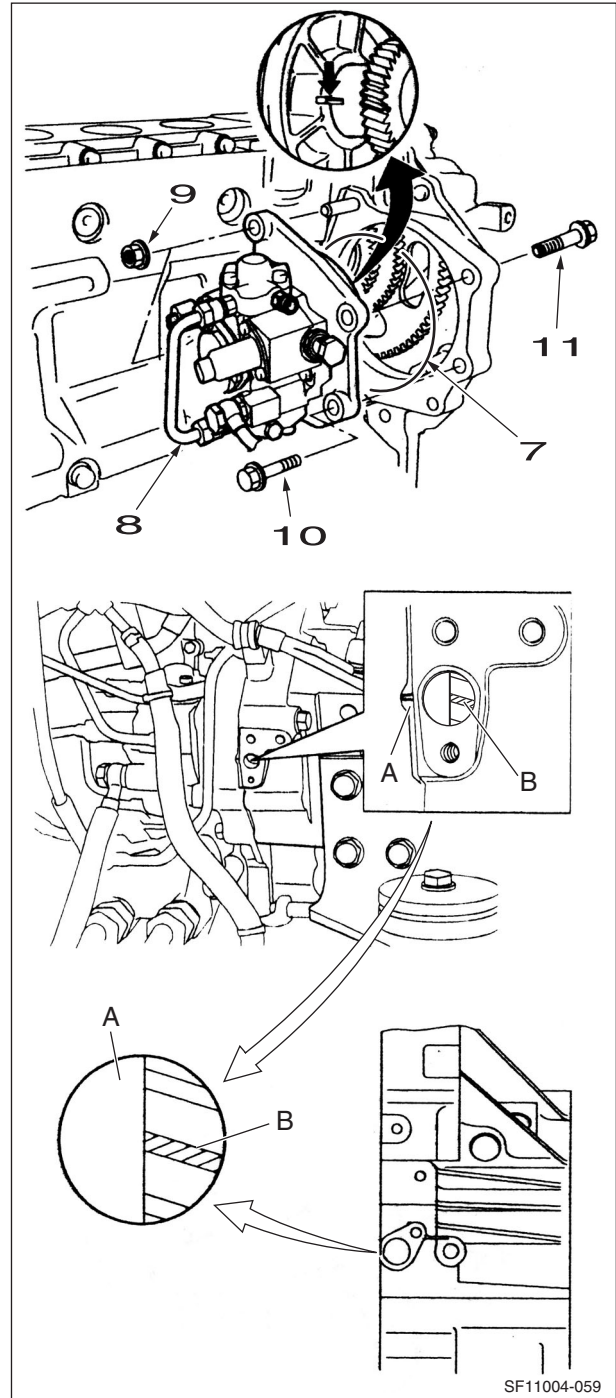
- [6] Use a wrench (13 mm) to remove the 8 nuts (11), and then remove the line (12) from the turbo charger.



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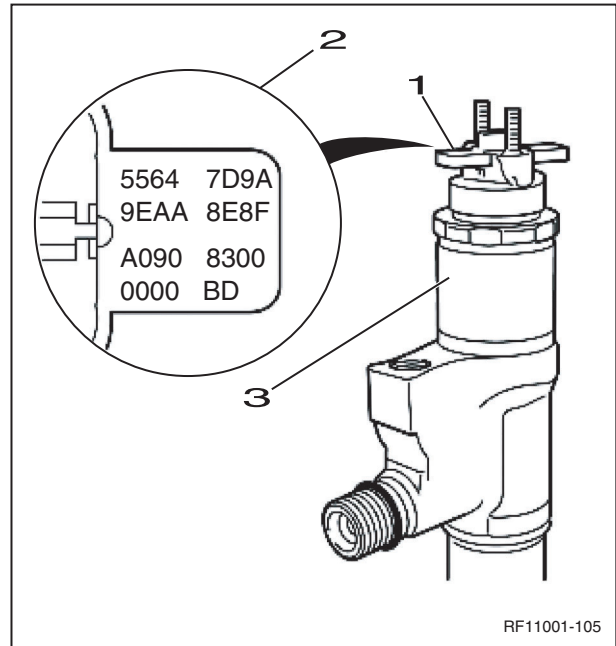
**REMOVAL AND INSTALLATION OF FUEL TANK..... 3**  
**REMOVAL OF FUEL TANK..... 3**  
**INSTALLATION OF FUEL TANK ..... 8**

- [4] Install the O-ring (7) on the supply pump assembly (8).  
Align the supply pump gear position with the reference mark (0 mark) on the gear end face surface and the slit on the pump bracket side.  
Install the supply pump assembly on the engine so that the alignment position is correct.  
Temporarily tighten the bolts (10) and (11) and the nut (9).

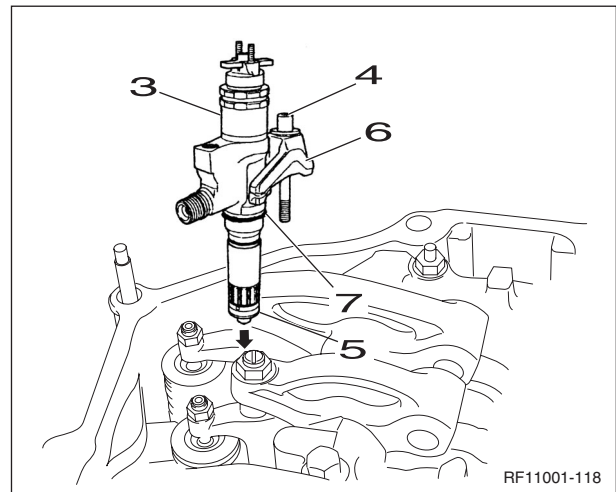


## 2 Installation of injector

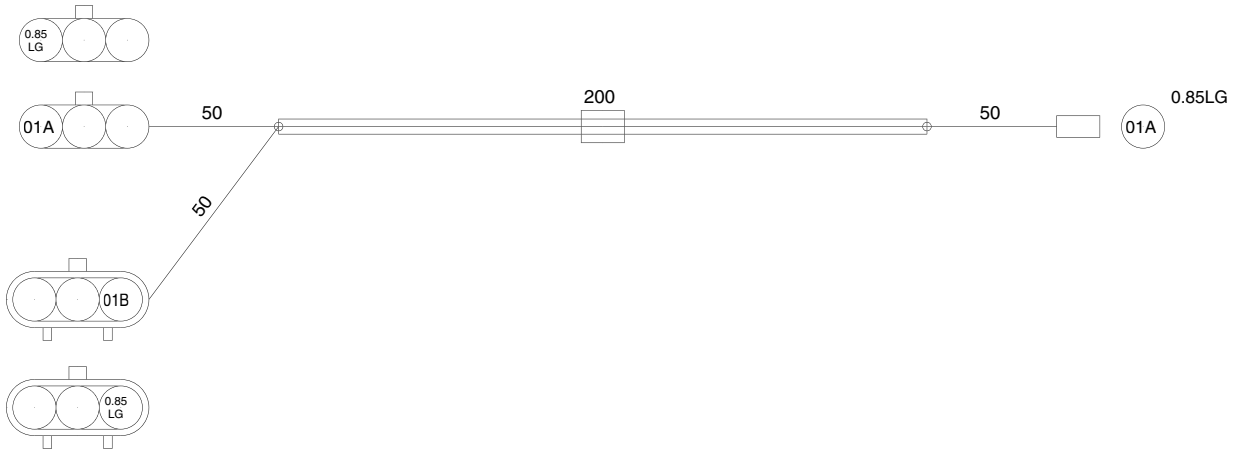
- [1] Record the "QR code" (2) that appears on the top of the QR plate (1) of the replacement injector (3).  
The "QR code" is different for each injector, so match the cylinder to be installed with the injector and record the code.



- [2] Always replace the gasket (5) and O-ring (7).  
Apply Molybdenum to the threaded section of the bolt (4) on the injector clamp (6) and seating surface.  
Install the injector (3) on the cylinder head. As shown in the diagram, insert the injector by pressing it in with the clamp. Temporarily tighten the bolt on the injector clamp.

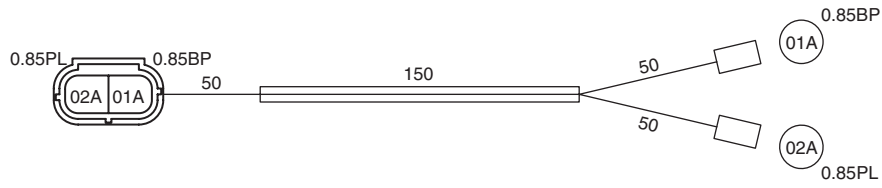


18) For engine governor B (3P)



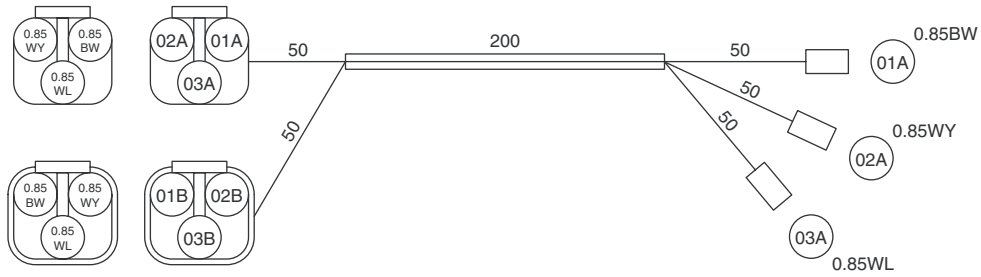
KHP1580

19) For oil temperature sensor (2P)



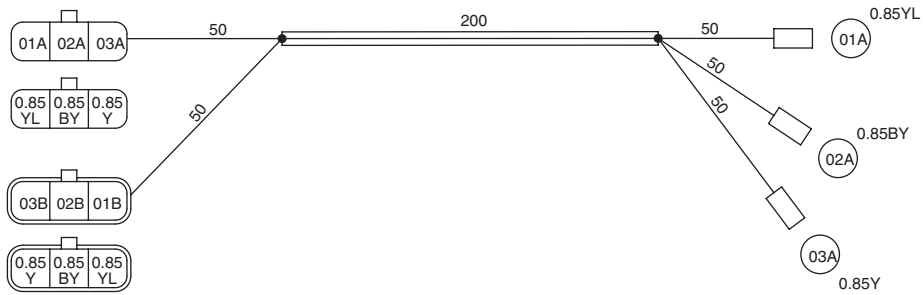
KHP1575

20) For pressure sensor (3P)



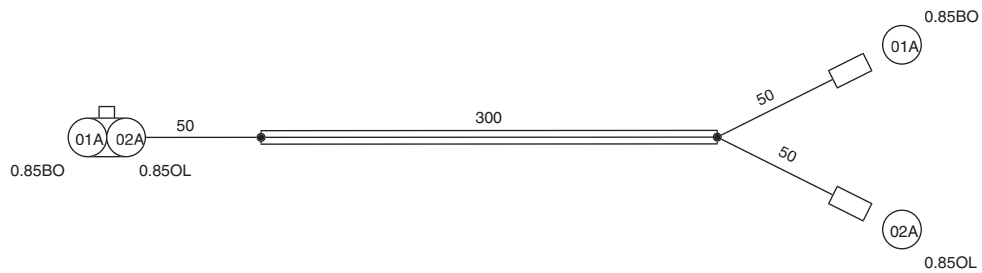
KHP1577

21) For atmospheric pressure sensor (3P)



KHP11020

22) For suction air temperature sensor (2P)



KHP11030

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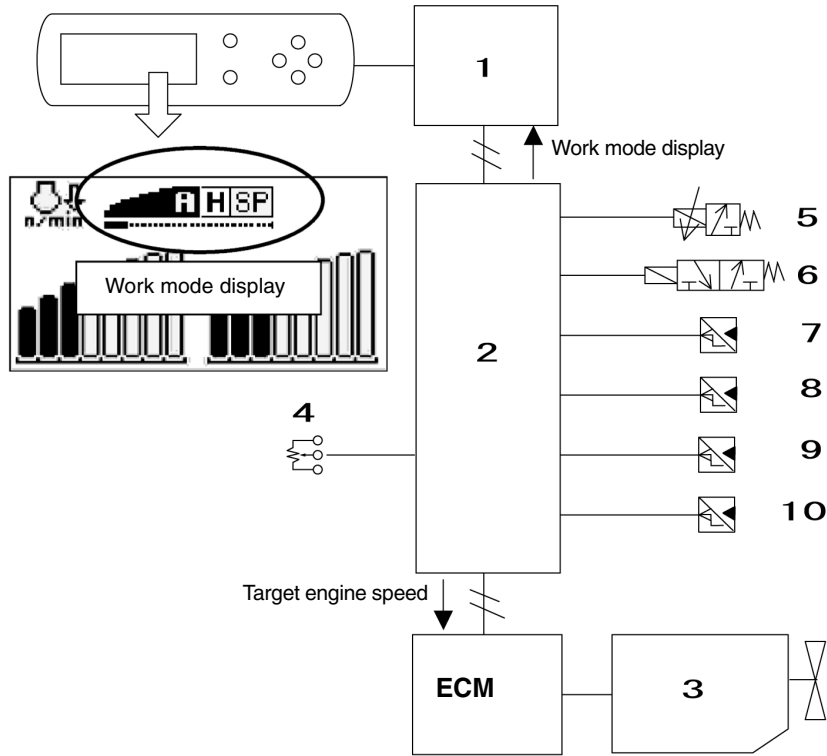
# Pump Control

## 1. Work Mode Control

### a) Purpose:

Work mode control enables the operator to select the work mode to match the work contents, for example emphasizing speed, emphasizing fuel economy, etc.

At the same time, the engine speed is adjusted (throttle adjustment).



1	Monitor	6	Boost solenoid
2	Computer A	7	P1 pressure sensor
3	Engine	8	P2 pressure sensor
4	Throttle volume	9	N1 pressure sensor
5	Pump horsepower control proportional valve	10	N2 pressure sensor

### b) Operation:

#### 1. Manual switchover (main mode)

The operator can select one of the following work modes by turning the throttle volume.

For the correspondence between the throttle volume detents and the work modes, see the attached table.

Mode	Aim	Display	Monitor buzzer
(1) SP mode	Speed emphasis	A H SP	The buzzer buzzes twice when this is selected.
(2) H mode	Balances speed and fuel economy	A H SP	The buzzer buzzes once when this is selected.
(3) A mode	Fuel economy emphasis	A H SP	No buzzing

#### 2. Automatic switchover (submode)

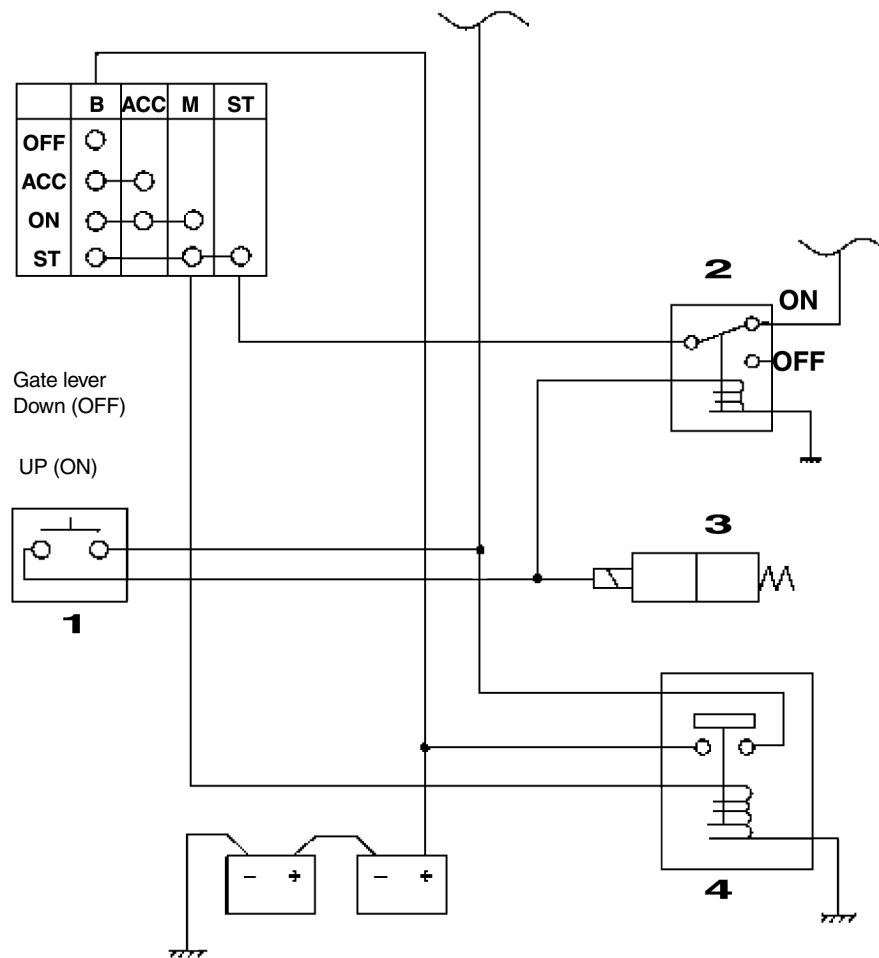
Each of the main modes that can be selected manually has two sub-modes (high and low).

These sub-modes are switched automatically based on the sensor input values.

For the high and low milli-amps, refer to the explanation of the 2. Pump Horsepower Boost Control in next page.

## Valve Control

### 1. Lever Lock



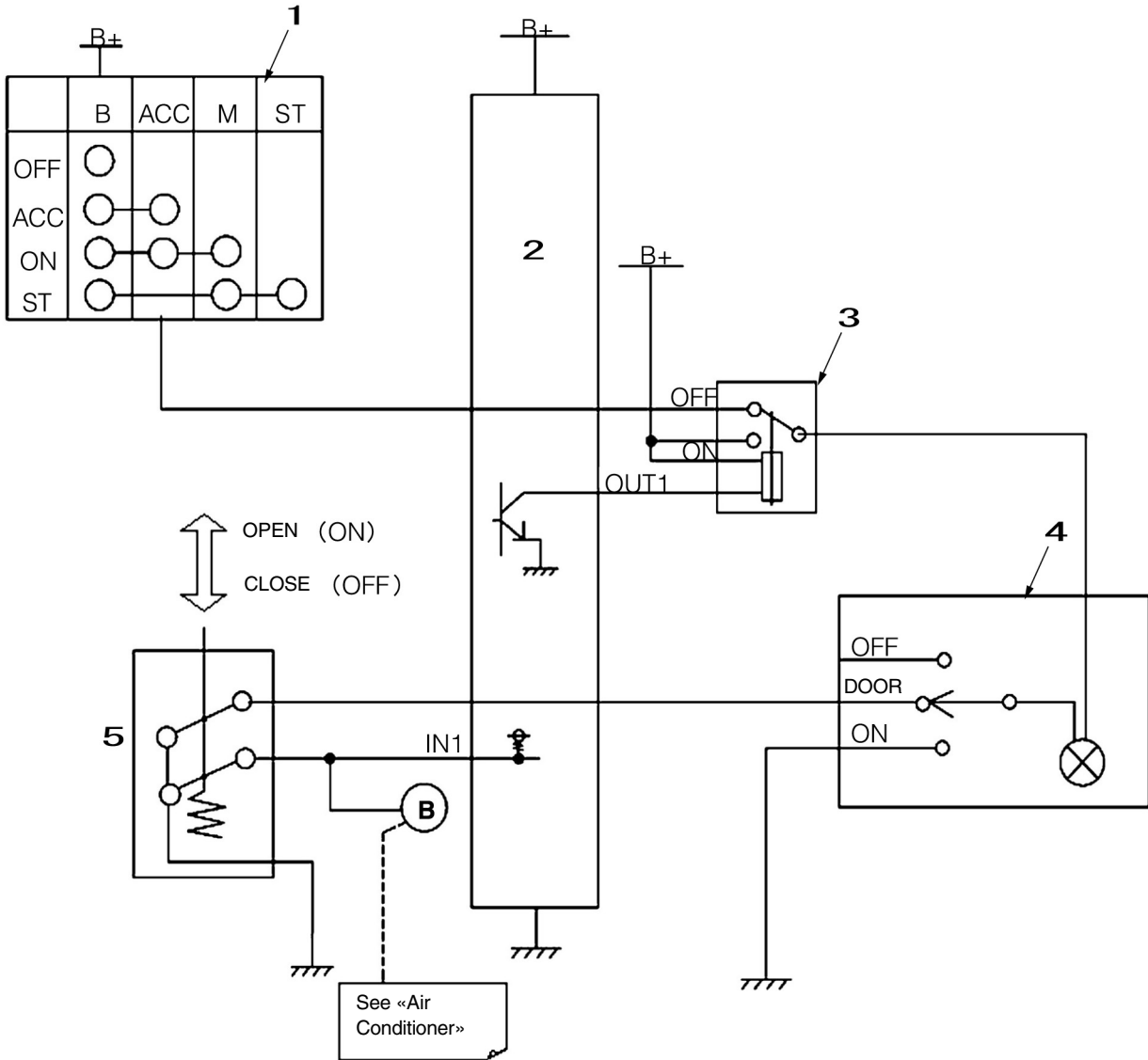
1	Gate lock limit switch	3	Lever lock solenoid
2	Starter cut relay	4	Battery relay

#### Operation explanation:

When the battery relay is excited by the key being switched ON, the power enters the lever lock limit switch. When the gate lever is raised, the lever lock switch (limit switch) comes ON and the lever lock solenoid is operated (For details on neutral start control, see Neutral Start in Explanation of Functions and Operations).

## 4. Room Lamp

### a) Configuration



1	Key switch	4	Room lamp
2	Clock unit	5	Door limit switch
3	Room lamp relay		

- The clock unit is not connected with computer A or B and controls the room lamp relay on its own.
- For the (B) connection destination, see "Air Conditioner".
- The clock unit is connected to the backup power supply and continues to operate even if the key is switched OFF.

### b) Door link

When the room lamp switch is set to the DOOR position, the lamp lights when the door is open and goes out when the door is closed.

### c) Auto lamp off

In **b)**, in order to prevent the battery from being run down, the room lamp goes out 30 seconds after the door is opened. However, this function only works when the key switch is OFF. If it is ACC or ON, auto lamp off does not work (Because even if the room lamp relay is OFF, power is supplied from ACC).

The only purpose of this auto lamp off function is to prevent the battery from being run down if the door is left open with the key OFF.

**b) Operating method**

1. With the engine stopped and the key ON, if the feed switch is flipped down to the Auto side, the fuel feed starts.
2. When the tank is full, the fuel feed stops automatically and the buzzer buzzes to announce that.
3. Returning the feed switch to the center stops the buzzer.
4. To feed more fuel  
Press the feed switch manual side. The fuel is fed while the switch is pressed.

**c) Computer control targets**

Input = Fuel sensor (0 to 100%), engine state (running / stopped)

Output = Feed stop relay

**d) System state (when relay OFF)**

When the feed switch is set to the Auto side, the start relay comes ON and the pump operates.

**e) System state (when relay ON)**

When the feed switch is set to the Auto side, the start relay goes OFF, and the pump does not operate. Also, the buzzer buzzes.

**f) Feed stop relay control (while engine stopped and key ON)**

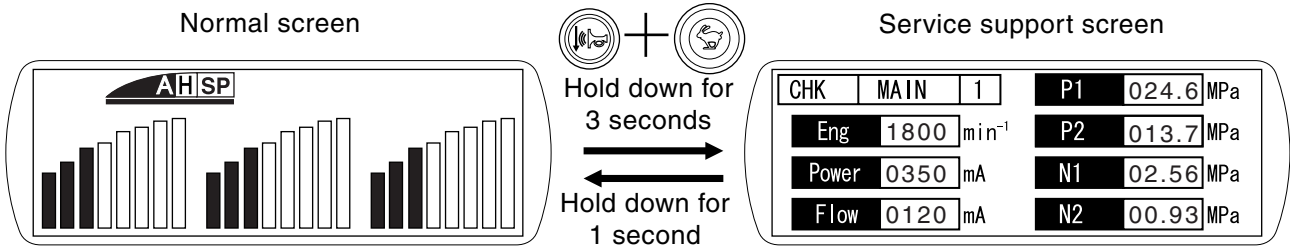
When (fuel level < 94% continuously for 3 seconds), OFF (auto feed enabled)

When (fuel level  $\geq$  94% continuously for 3 seconds), ON (auto feed disabled).

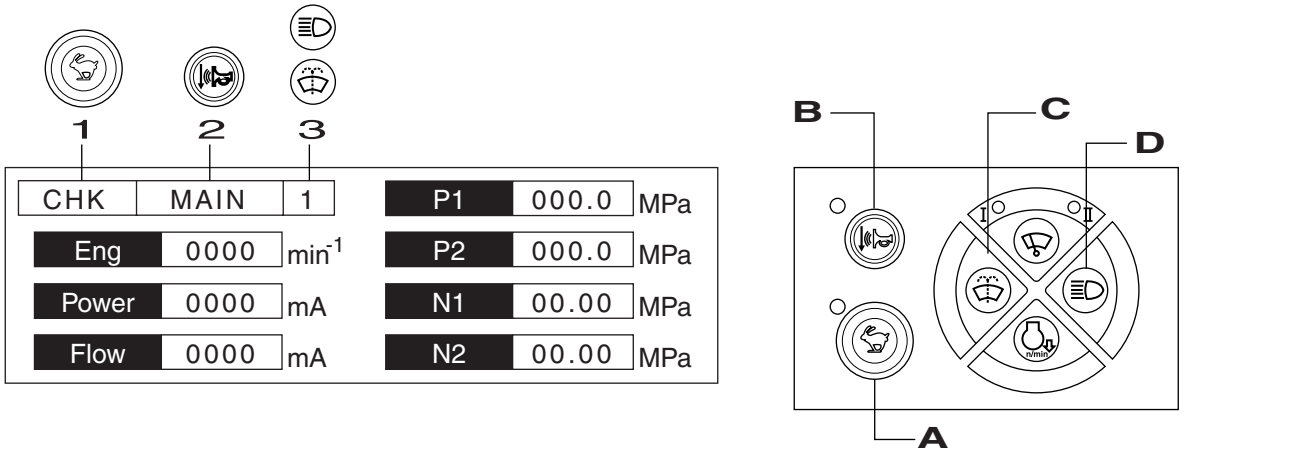
<b>Name</b>	<b>Function</b>
<b>Suction air temperature sensor</b>	Detects the suction air temperature and sends it to the ECM. Optimizes the fuel injection quantity.
<b>Boost pressure sensor</b>	Detects the boost (suction air pressure) inside the intake pipe and sends it to the ECM. Used to control fuel injection with the boost pressure.
<b>Boost temperature sensor</b>	Detects the boost temperature and sends it to the ECM. Used for fuel injection control etc.

**a) Operation for shifting to service support screen**

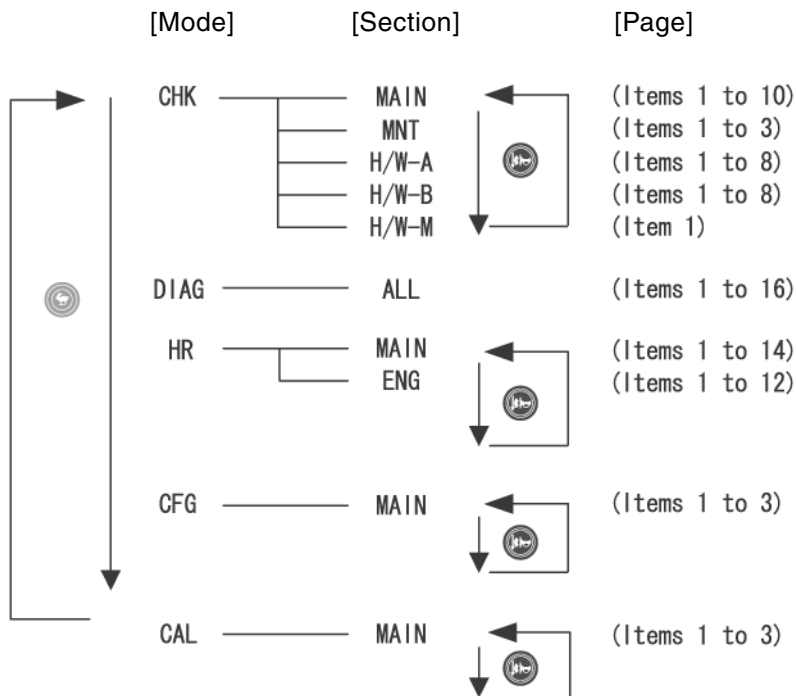
1. If both the travel high-speed switch and the horn volume select switch on the switch panel are held down for 3 seconds, the display switches to the service support screen.
2. If both the high-speed travel switch and the horn volume select switch on the switch panel are held down again for 1 second, the display returns to the normal screen.



**b) Service support screen switching operation**



- A** Mode select switch
  - B** Section select switch
  - C** Page (-)
  - D** Page (+)
- 1 Mode (switching with high speed travel switch **A**)
  - 2 Section (switching with horn volume select switch **B**)
  - 3 Page (switching: forward with light switch **D** and back with washer switch **C**)



2. Displays the time at which the trouble under the cursor first occurred

**1st** **0010** hr ...Occurred first at 10 hours

3. Displays the time at which the trouble under the cursor last occurred

**Last** **0901** hr ...Occurred last at 901 hours

4. Diagnostic trouble code

The troubles are sorted with the last one to occur at the top of the list.

The diagnostic trouble code under the cursor is displayed in (1) - (3).

**DTC1** **7002** ...7002 (faulty N1 pressure sensor)

**DTC2** **0238** ...0238 (Boost pressure sensor abnormally high voltage)

**DTC3** ----

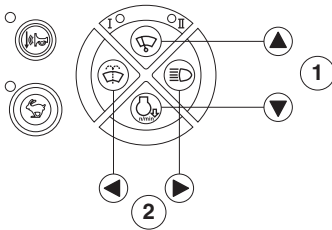
**DTC4** ----

For details on diagnostic trouble code, see the Main Unit Diagnostic Trouble Code List.

Maximum display count

4 codes per page X 16 pages = 64 diagnostic trouble codes are displayed. From the 65th code onward, the oldest code is erased. However, even though these codes are not displayed, the data is retained.

### B) Operation



- 1) Cursor up/down:  
Up operation ... wiper switch  
Down operation ... auto idle switch
- 2) Page forward / back:  
Forward operation ... light switch  
Back operation ... washer switch

### C) Reset

If the washer switch and the light switch are held down for 10 seconds, the trouble log is reset.

2. The flow setting for the selected mode is selected by pressing the wiper switch or auto idle select switch. The flow setting can be set to 10 levels from Level 1 to Level 10.

**CAUTION:** *The set flow is the flow value when SP mode is selected.  
Be careful. If run with the engine speed reduced, the actual flow is not the flow displayed.*

	Unit	
1 pump flow (flow Level 1)	L / min	285
1 pump flow (flow Level 2)	L / min	262
1 pump flow (flow Level 3)	L / min	233
1 pump flow (flow Level 4)	L / min	205
1 pump flow (flow Level 5)	L / min	176
1 pump flow (flow Level 6)	L / min	148
1 pump flow (flow Level 7)	L / min	119
1 pump flow (flow Level 8)	L / min	91
1 pump flow (flow Level 9)	L / min	62
1 pump flow (flow Level 10)	L / min	49
2 pumps flow (flow Level 1)	L / min	571
2 pumps flow (flow Level 2)	L / min	547
2 pumps flow (flow Level 3)	L / min	519
2 pumps flow (flow Level 4)	L / min	490
2 pumps flow (flow Level 5)	L / min	462
2 pumps flow (flow Level 6)	L / min	433
2 pumps flow (flow Level 7)	L / min	405
2 pumps flow (flow Level 8)	L / min	376
2 pumps flow (flow Level 9)	L / min	348
2 pumps flow (flow Level 10)	L / min	335

3. There is no need to do anything to finalize the setting. End by leaving this screen or switching OFF the key.

The factory settings for each mode are as follows.

There are no 4 or 5 settings for the breaker or crusher. Just a hyphen is displayed for these settings.

Mode	Flow display
Breaker circuit 1 / Crusher 1	Level 3 flow
Breaker circuit 2 / Crusher 2	Level 5 flow
Breaker circuit 3 / Crusher 3	Level 7 flow
Breaker circuit 4 / Crusher 4	(Not used)
Breaker circuit 5 / Crusher 5	

Trouble location	Trouble mode	Diagnostic trouble code		Judgment timing	Prerequisites	Occurrence judgment	Recovery judgment
		DTC	Display			Conditions	Conditions
Sensor; Angle (Arm)	Ground short/ disconnection	7061	O	Immediately after key switched ON	Liftcrane or interference prevention selected	Voltage $\leq$ 0.2 V	0.2 V < Voltage < 4.8 V
	Power supply short					Voltage $\geq$ 4.8 V	
Sensor; Angle (Offset)	Ground short/ disconnection	7062	O	Immediately after key switched ON	Liftcrane or interference prevention selected	Voltage $\leq$ 0.2 V	0.2 V < Voltage < 4.8 V
	Power supply short					Voltage $\geq$ 4.8 V	
Pressure switch return filter clog	Disconnection	7063	O	From immediately after key switched ON until engine starts	None	Pressure switch = OFF	Pressure switch = ON

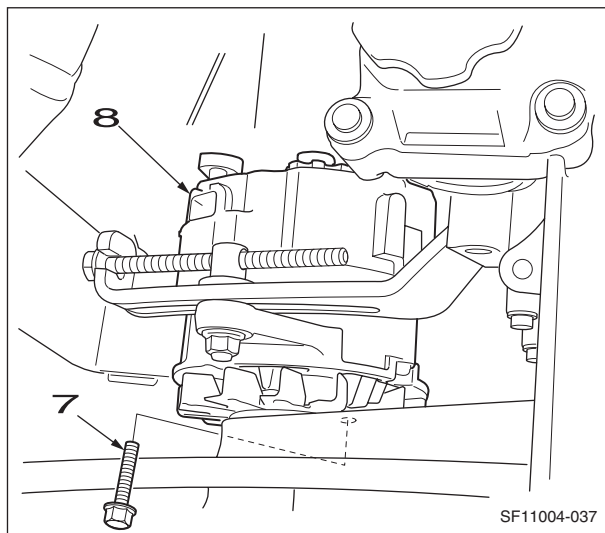
For items for which X is displayed, the “ELEC. PROBLEM” message is not displayed. Also, there is no DTC display on the user screen.

However, the DTC is recorded on the service (DIAG) screen.



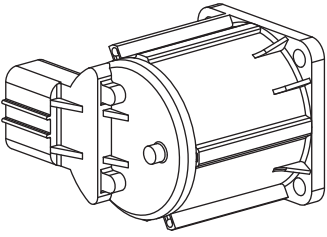
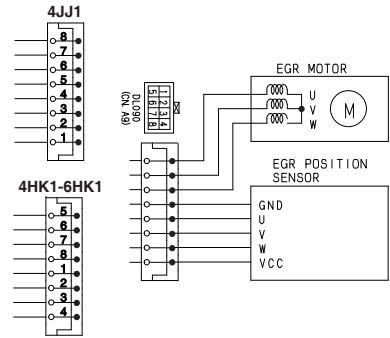
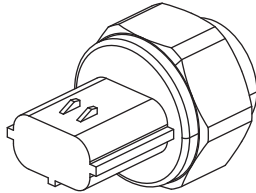
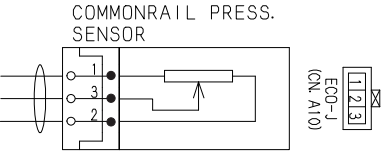
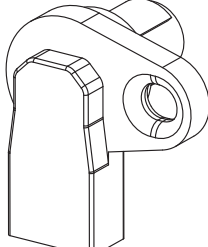
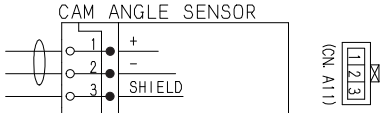
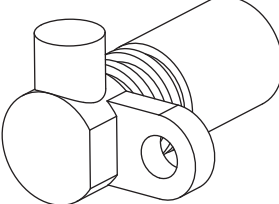
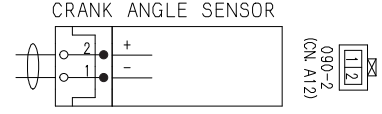
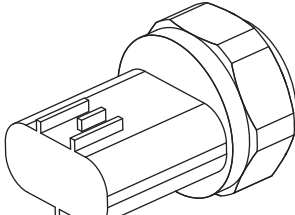
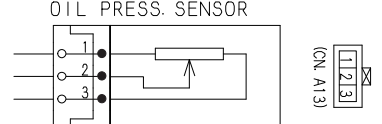
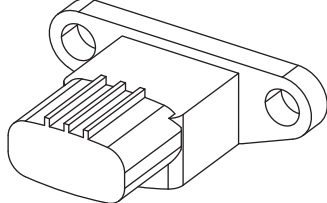
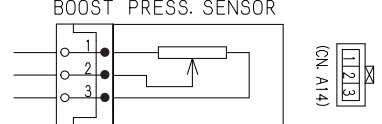
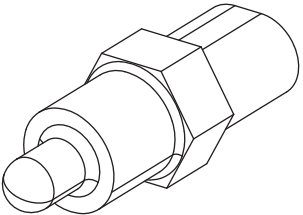
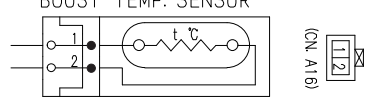
4005-4

- [5] Use a wrench (20 mm) to remove the bolt (7), and then remove the alternator (8).

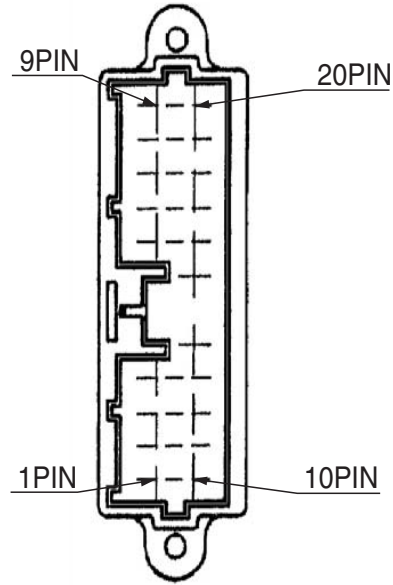
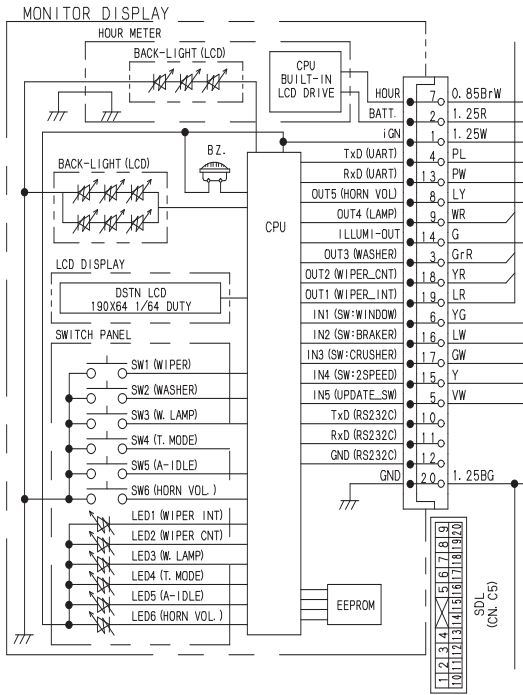


## 2 Installation of alternator

- [1] To install, perform the reverse of the removal procedure.  
Adjust the fan belt according to the tension adjustment procedure.

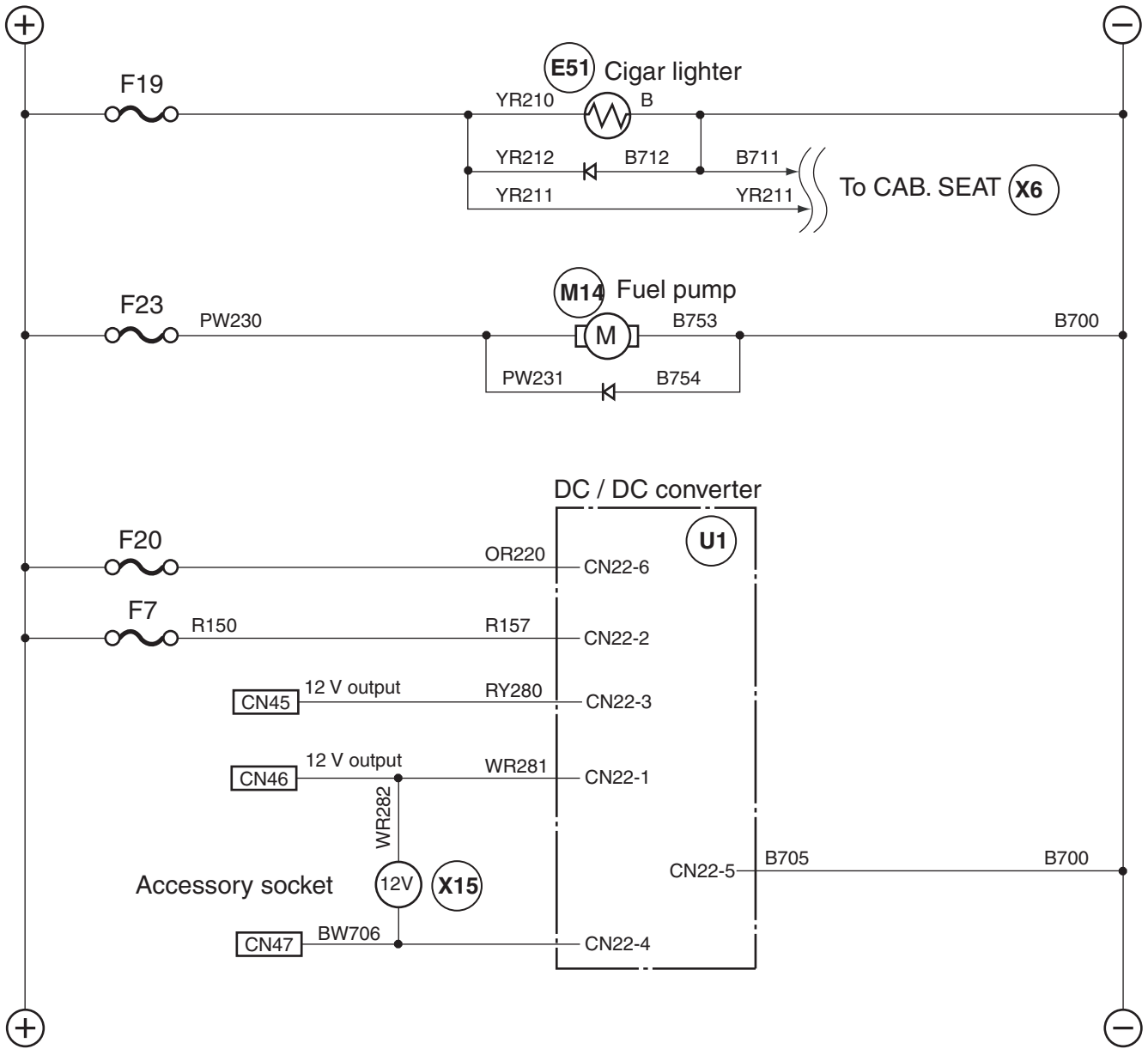
Name	No.	Shape	Circuit	Remarks
EGR motor EGR position sensor	M15  B53			
Common rail pressure sensor	B52			
Cam angle sensor	B50			
Crank angle sensor	B49			
Oil pressure sensor	B21			
Boost pressure sensor	B47			
Boost temperature sensor	B51			

2) Monitor



RST-05-02-001a

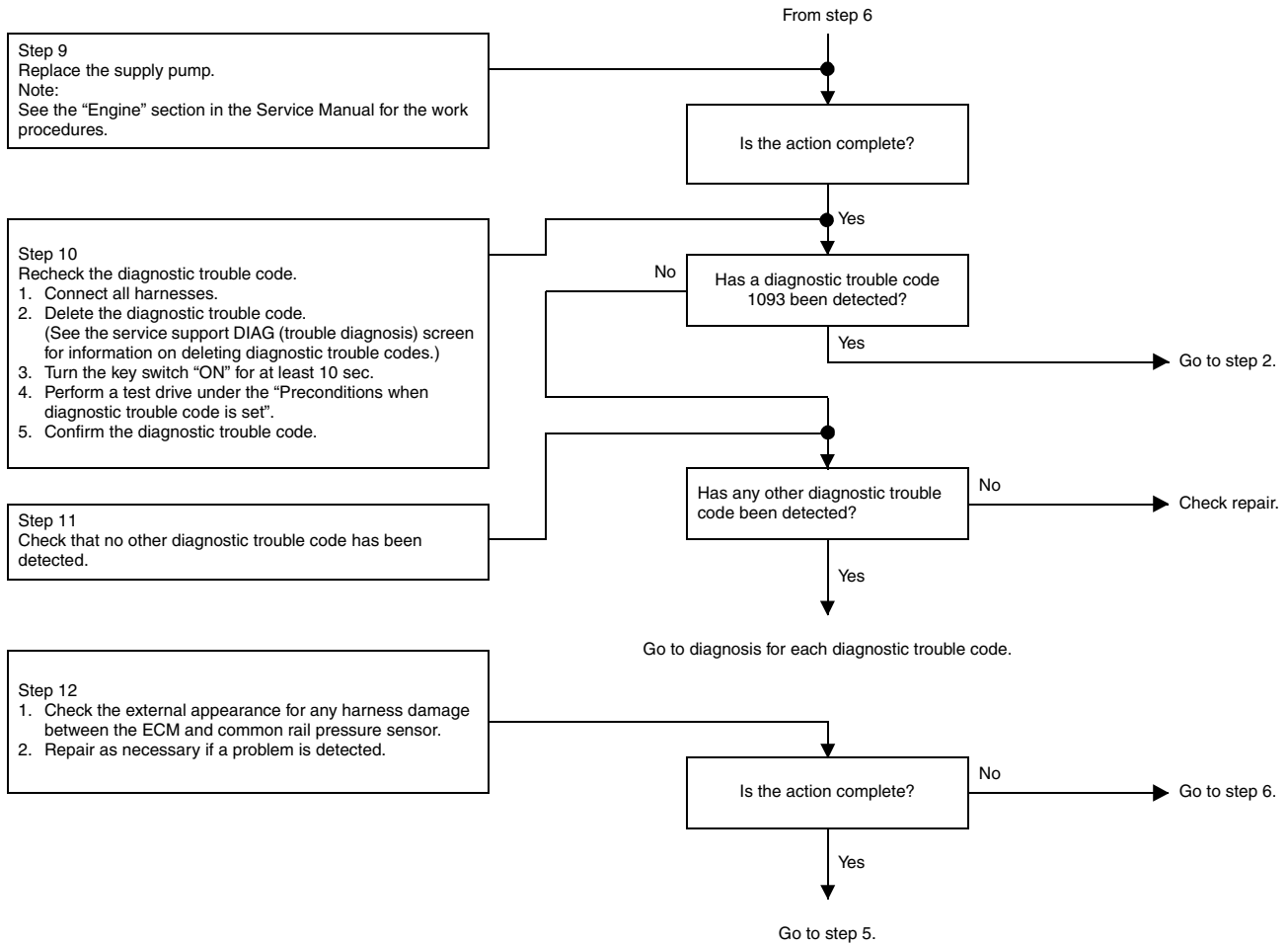
10) Others



RE03003-011

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## Block diagram

BARO SENSOR

AIR INTAKE TEMPERATURE SENSOR

TSHK0029

### Preconditions when DTC is set

- Key switch input voltage is 18 V or higher.
- DTC: 1630, 1632 are not detected.

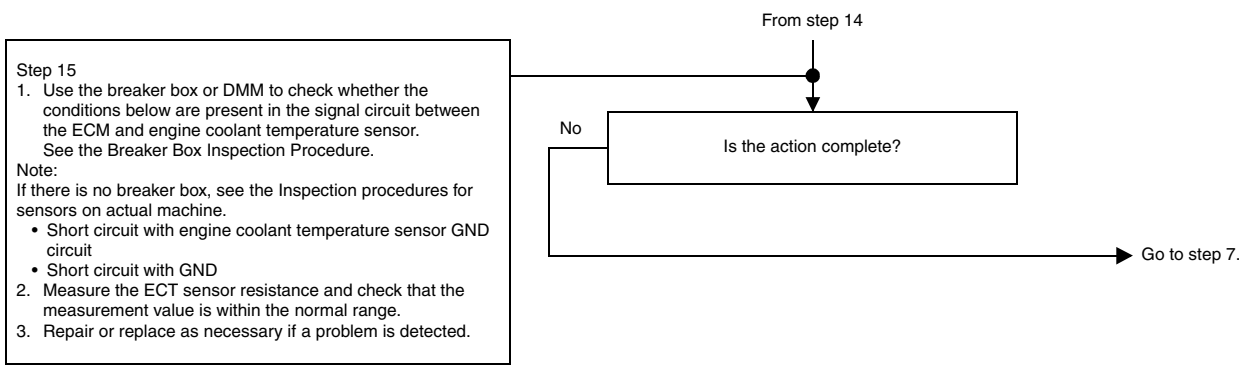
### Diagnostic aid

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

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

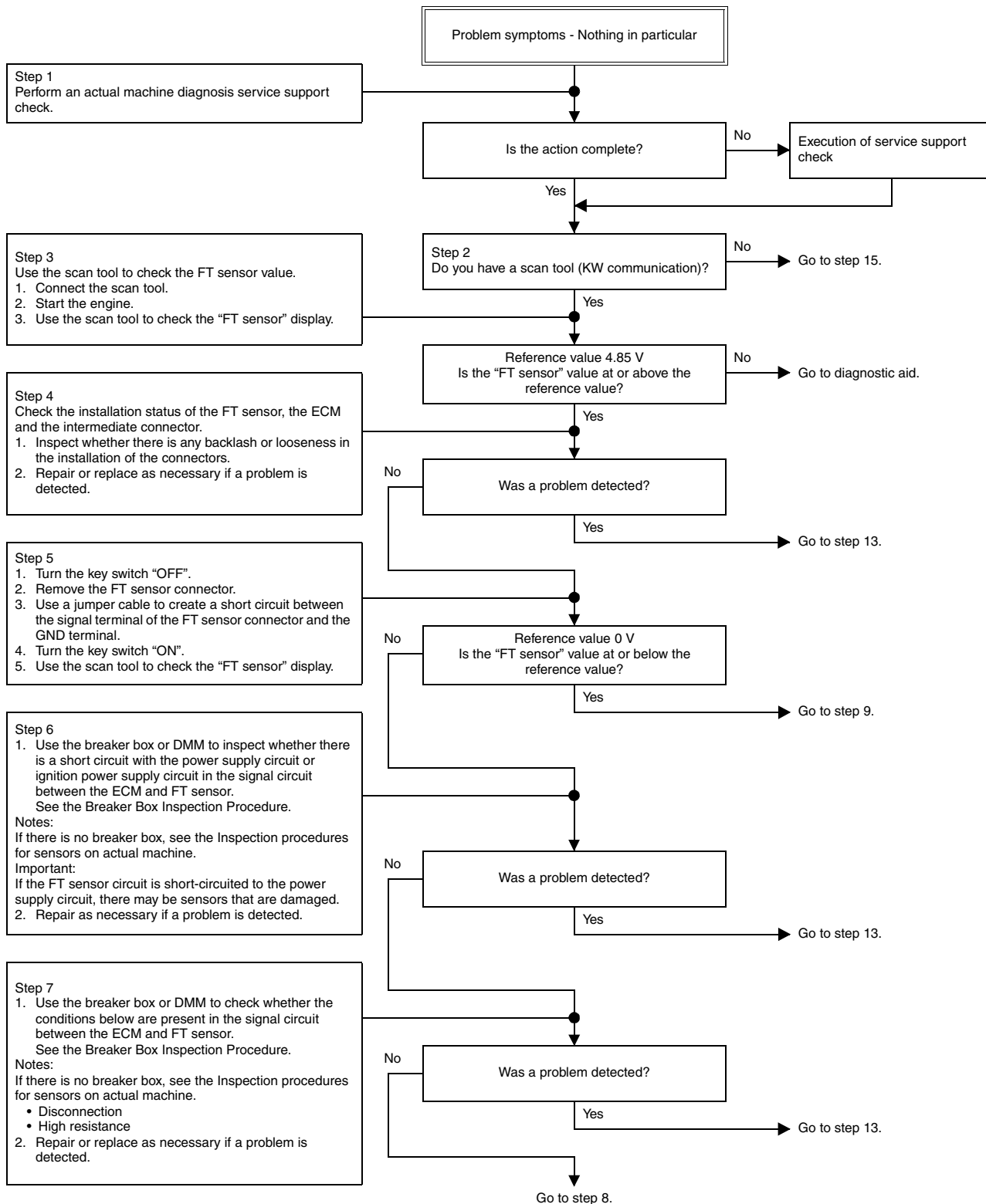
In order to detect these causes, the following inspection is necessary.

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



**DTC: 0183**

**FT (fuel temperature) Sensor Abnormality (abnormally high voltage)**



**Breaker box inspection procedure**

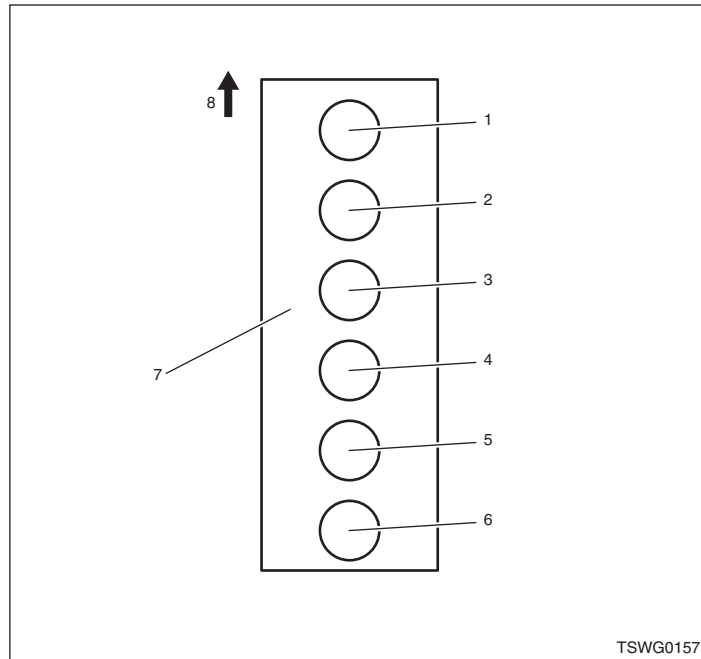
For steps in which breaker box usage is indicated, perform inspection with the following procedure.  
Return to diagnosis step after inspection.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
6	Short circuit with power supply circuit	Voltage value measurement	<ul style="list-style-type: none"> <li>Remove the sensor connector.</li> <li>Key switch "ON"</li> </ul>	82-GND 90-GND	0 V	18 V or higher
7	Disconnection/ high resistance	Resistance measurement	<ul style="list-style-type: none"> <li>Remove the sensor connector.</li> <li>Key switch "OFF"</li> </ul>	87-Sensor connector signal terminal 90-Sensor connector signal terminal	100 $\Omega$ or lower	10 M $\Omega$ or higher
8	Disconnection/ high resistance	Resistance measurement	<ul style="list-style-type: none"> <li>Remove the sensor connector.</li> <li>Key switch "OFF"</li> </ul>	101-Sensor connector GND terminal	100 $\Omega$ or lower	10 M $\Omega$ 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.

## Cylinder No. and injection sequence



### Name

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

Injection sequence: 1 → 5 → 3 → 6 → 2 → 4

### Preconditions when DTC is set

- Main relay power supply voltage is 18 V or higher.
- At least 70 min<sup>-1</sup>
- DTC: 0203, 0611, 1261 are not detected.

### Diagnostic aid

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

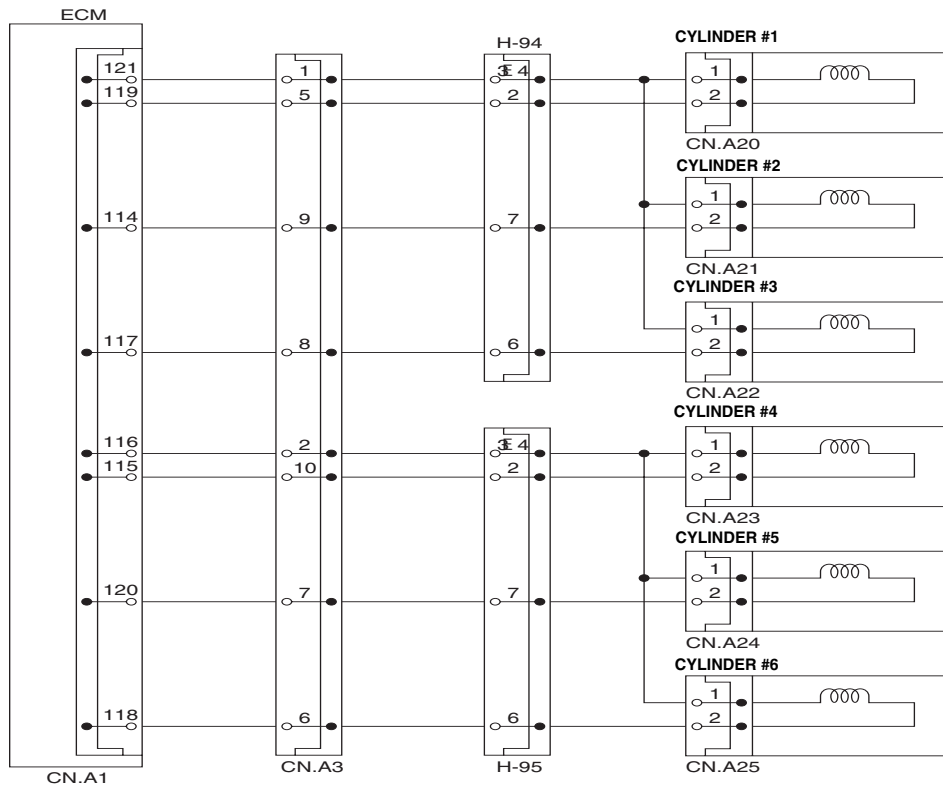
- Harness connector connection problem
- Harness routing problem
- Breakage in harness covering due to friction
- Wire disconnection within harness covering

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

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

4021-100

### Block diagram



TSHK0031

## Block diagram

COMMON RAIL PRESSURE SENSOR

CAM ANGLE SENSOR

SHIELD

CRANK ANGLE SENSOR

TSHK0033

### Recovery from failure

During trouble judgment, about 10 sec. of cranking is necessary.

### Preconditions when DTC is set

- CMP sensor signal is normal.
- DTC: 0335, 0336, 0340, 0341 and 1345 are not detected.
- Engine running

### Diagnostic aid

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

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

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

- Harness connector and ECM connector connection problem
  - Terminal has come out from connector
  - Connection between non-matching terminals
  - Damage to connector lock
  - Terminal and wire connection problem
- Harness damage
  - Inspect the external appearance to check for any harness damage.
  - While moving the connector or harness related to a sensor, confirm the display of the related item in the scan tool data display. The display change shows the trouble location.
- With CKP sensor abnormalities, a DTC will not be detected unless the crank rotates 14 times. Especially with low rotation such as during idling, the engine will stall before the crank rotates 14 times if there is no CKP signal. Accordingly, because no DTC is detected and backup mode is not entered, restarting after engine stalling is possible and specifying the problem location will be difficult. When there is an engine stalling problem, increase engine rotation to the maximum with no load and inspect whether a CKP sensor problem is detected during 14 rotations of the crank. If a CKP sensor problem is detected at the maximum rotation with no load, a DTC will be detected. For intermittent trouble, increase engine rotation to the maximum with no load and inspect whether DTC 0355 is detected.

**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.

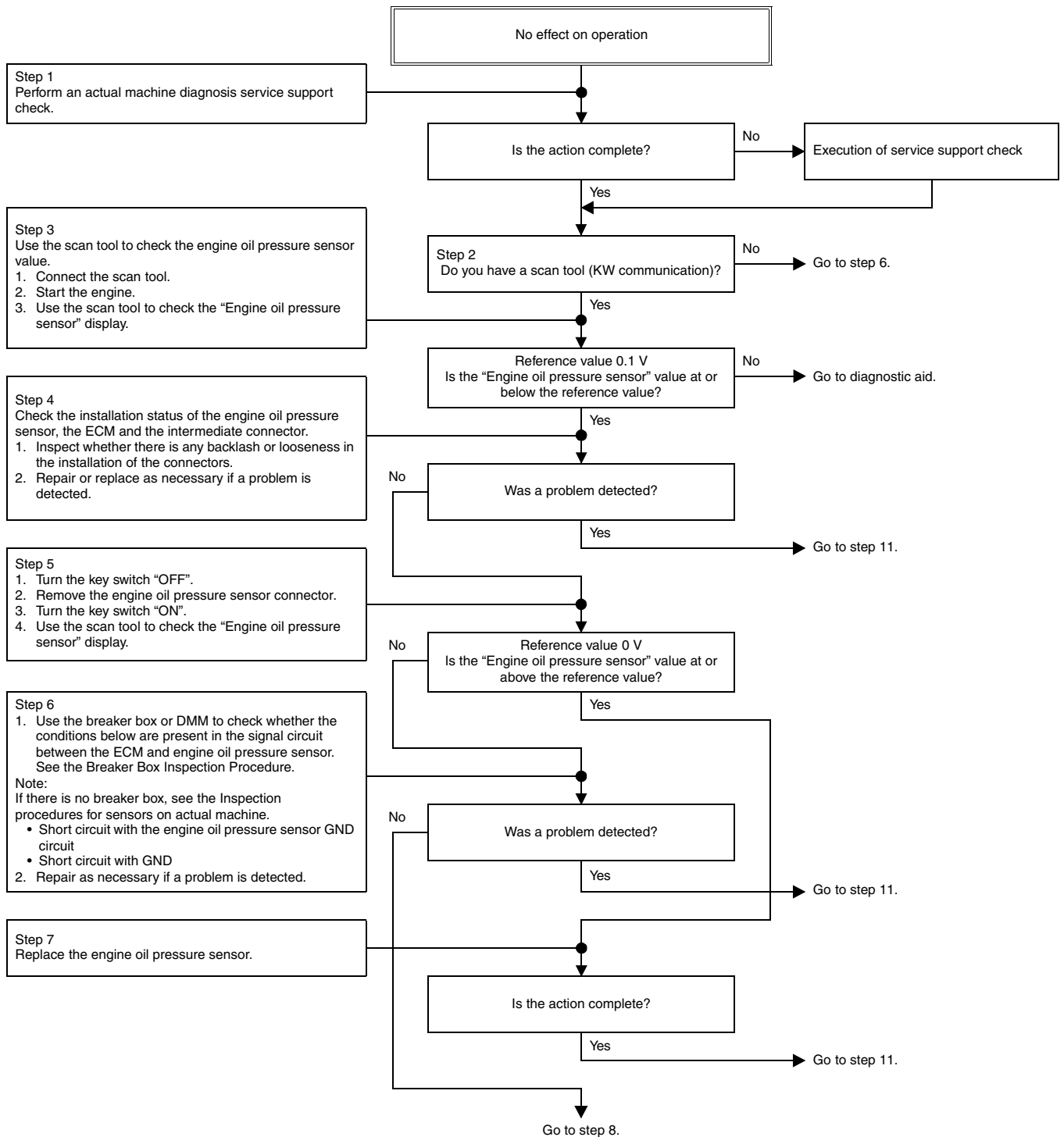
Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
6	Short circuit with other signal circuit	Voltage value measurement	<ul style="list-style-type: none"> <li>Remove the sensor connector.</li> <li>Key switch "ON"</li> </ul>	99-GND	0 V	1 V or higher
7	Short circuit with other signal circuit	Voltage value measurement	<ul style="list-style-type: none"> <li>Remove the sensor connector.</li> <li>Key switch "ON"</li> </ul>	98-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.

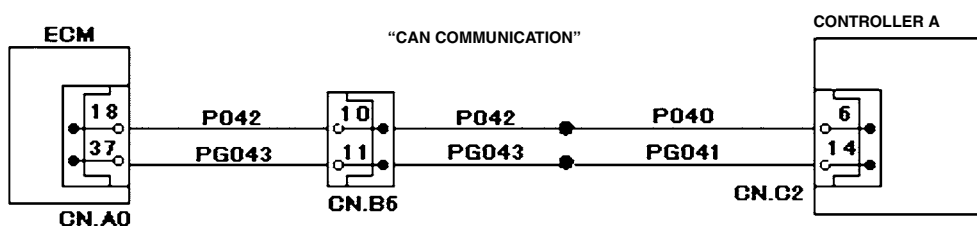
**DTC: 0522**

**Engine Oil Pressure Sensor Abnormality (abnormally low voltage)**



4021-156

## Block diagram



TSHK0023

## Preconditions when DTC is set

- Main relay power supply voltage is 18 V or higher.

**Breaker box inspection procedure**

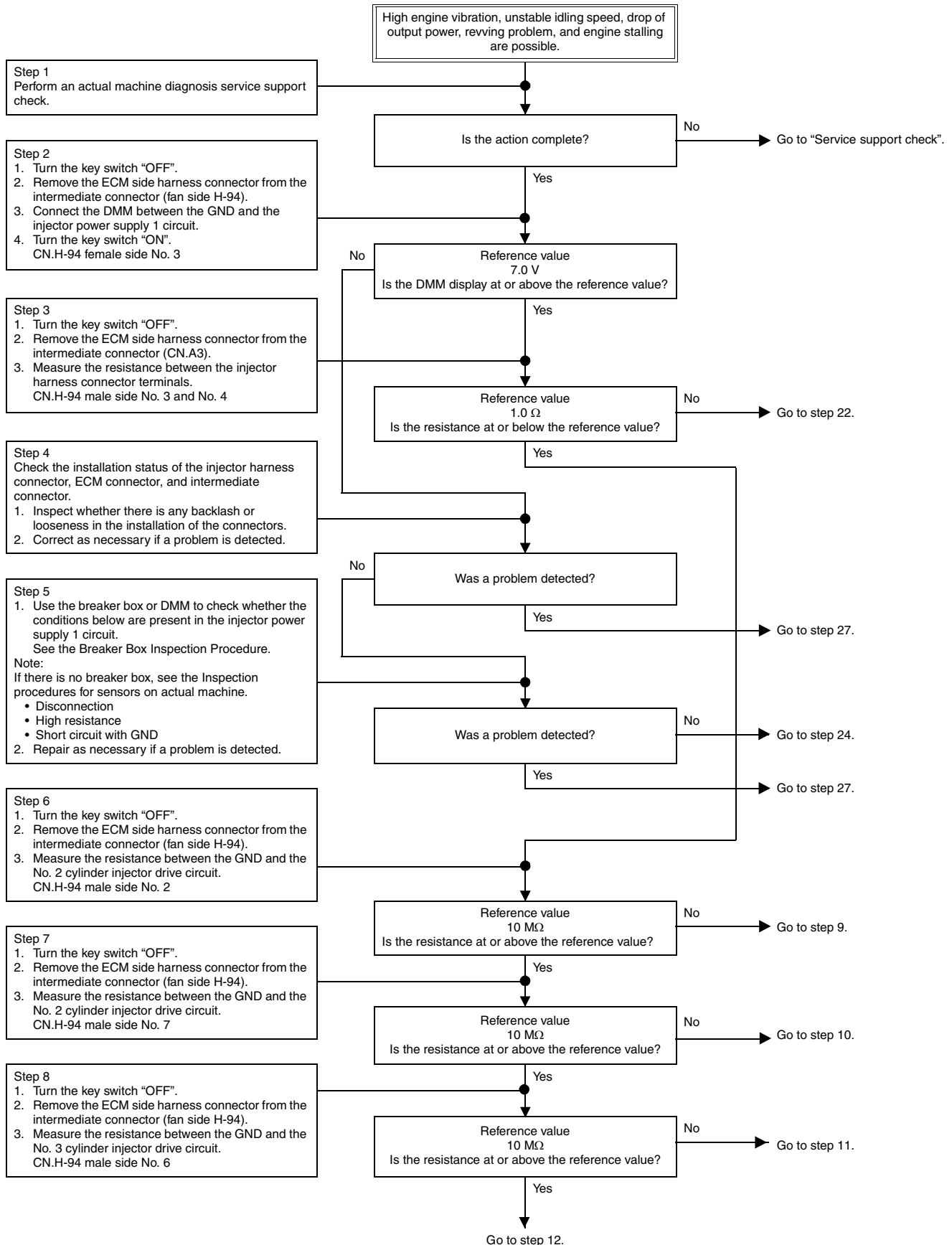
For steps in which breaker box usage is indicated, perform inspection with the following procedure.  
Return to diagnosis step after inspection.

Step	Inspection item	Inspection method	Measurement condition	Measurement terminal No.	Normal value	Abnormal value
9	Short circuit with other signal circuit	Voltage value measurement	<ul style="list-style-type: none"> <li>Remove the sensor connector.</li> <li>Key switch "ON"</li> </ul>	82-GND 90-GND	0 V	1 V or higher

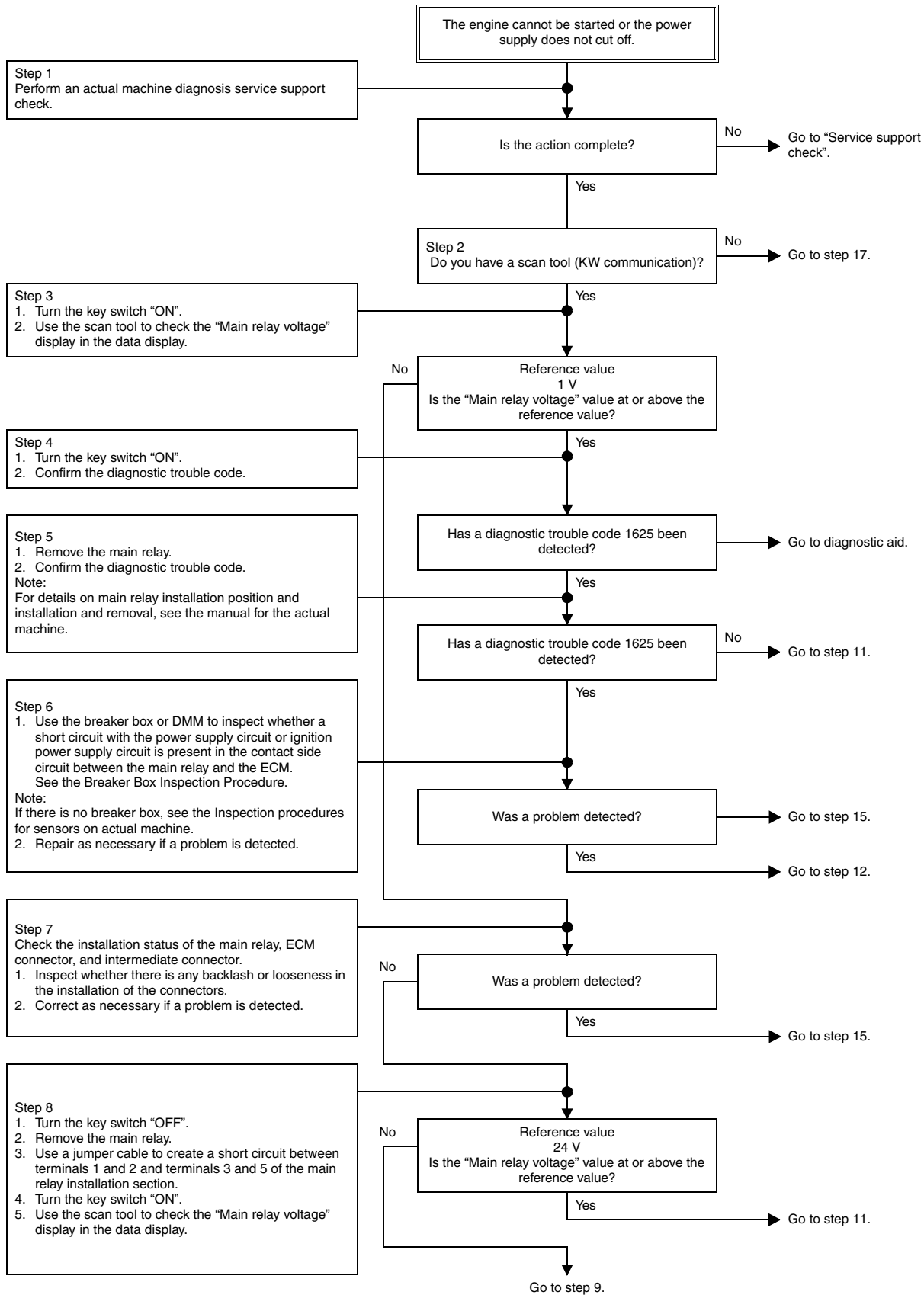
**Inspection procedures for sensors on actual machine**

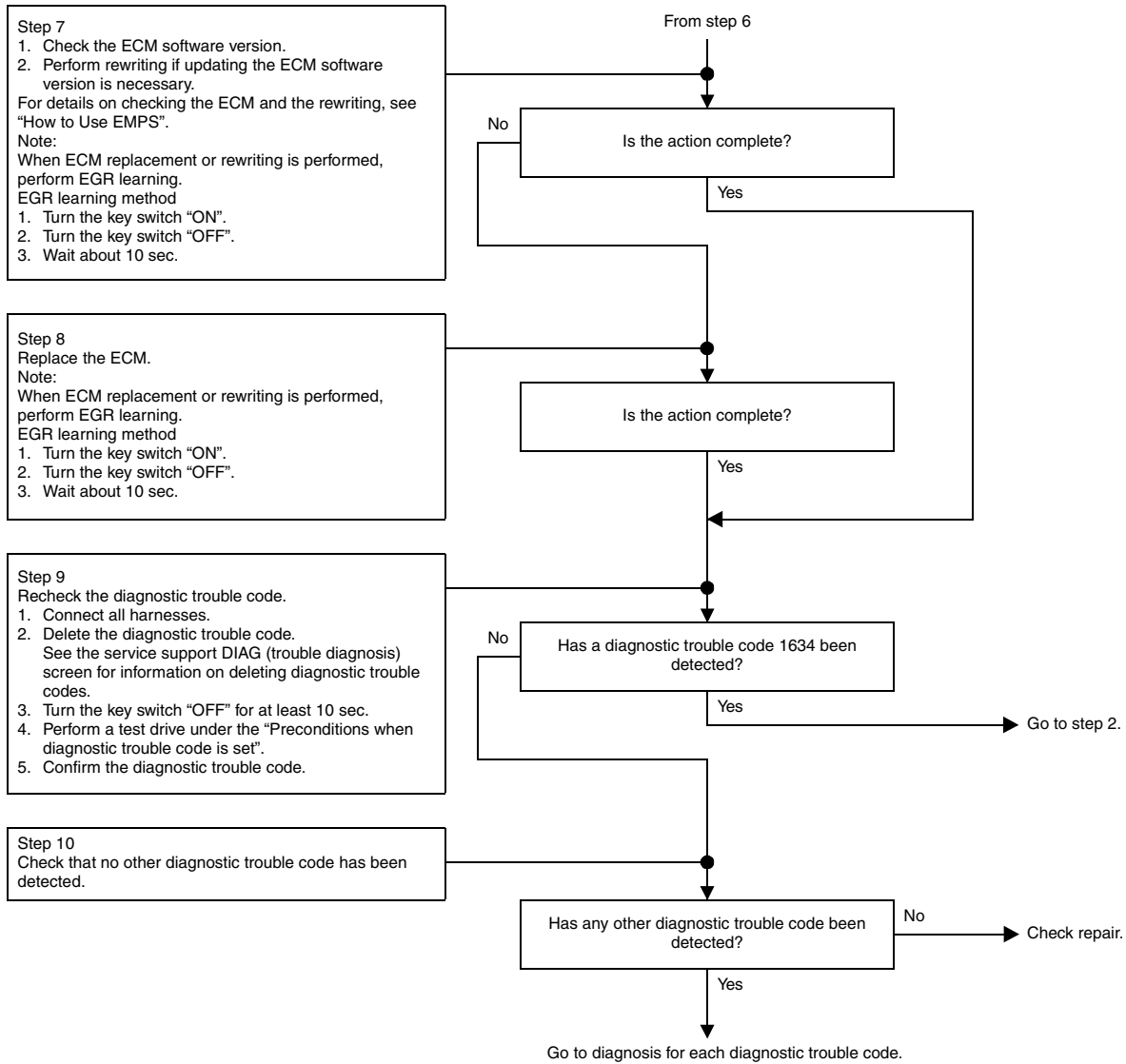
1. Disconnect the intermediate connectors and perform sensor inspection from the engine harness connector.
2. Disconnect the connector from the sensor and short circuit the sensor connector wiring.
3. Inspect the harness disconnection from the intermediate connector.
  - If there is an abnormality in 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: 1261 Injector Common 1 Drive System Abnormality



# DTC: 1625 Main Relay System Abnormality

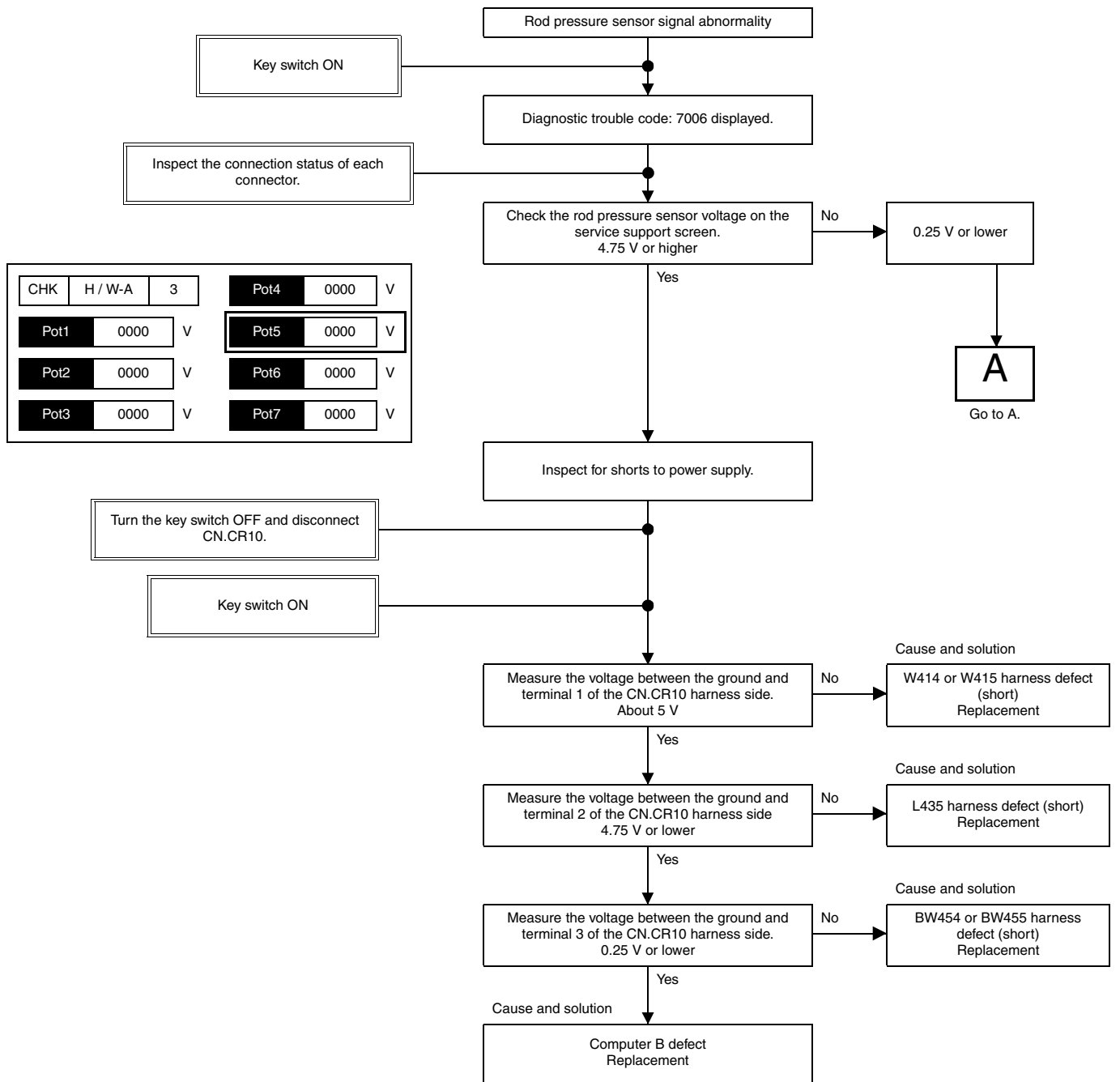


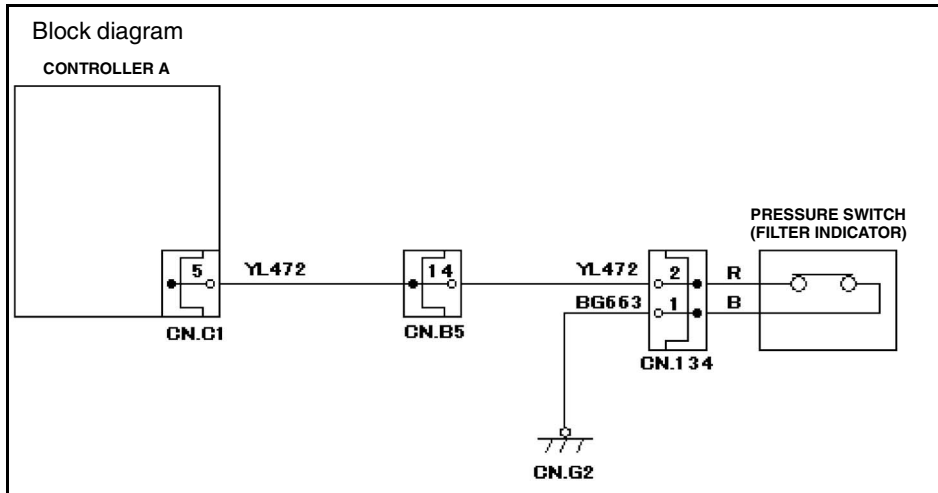


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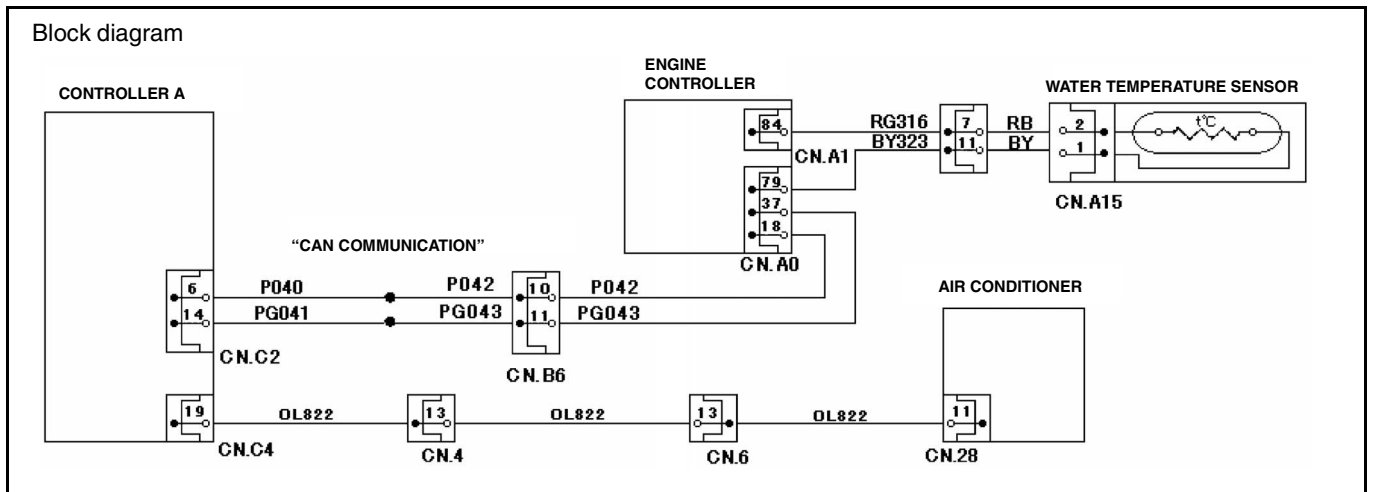
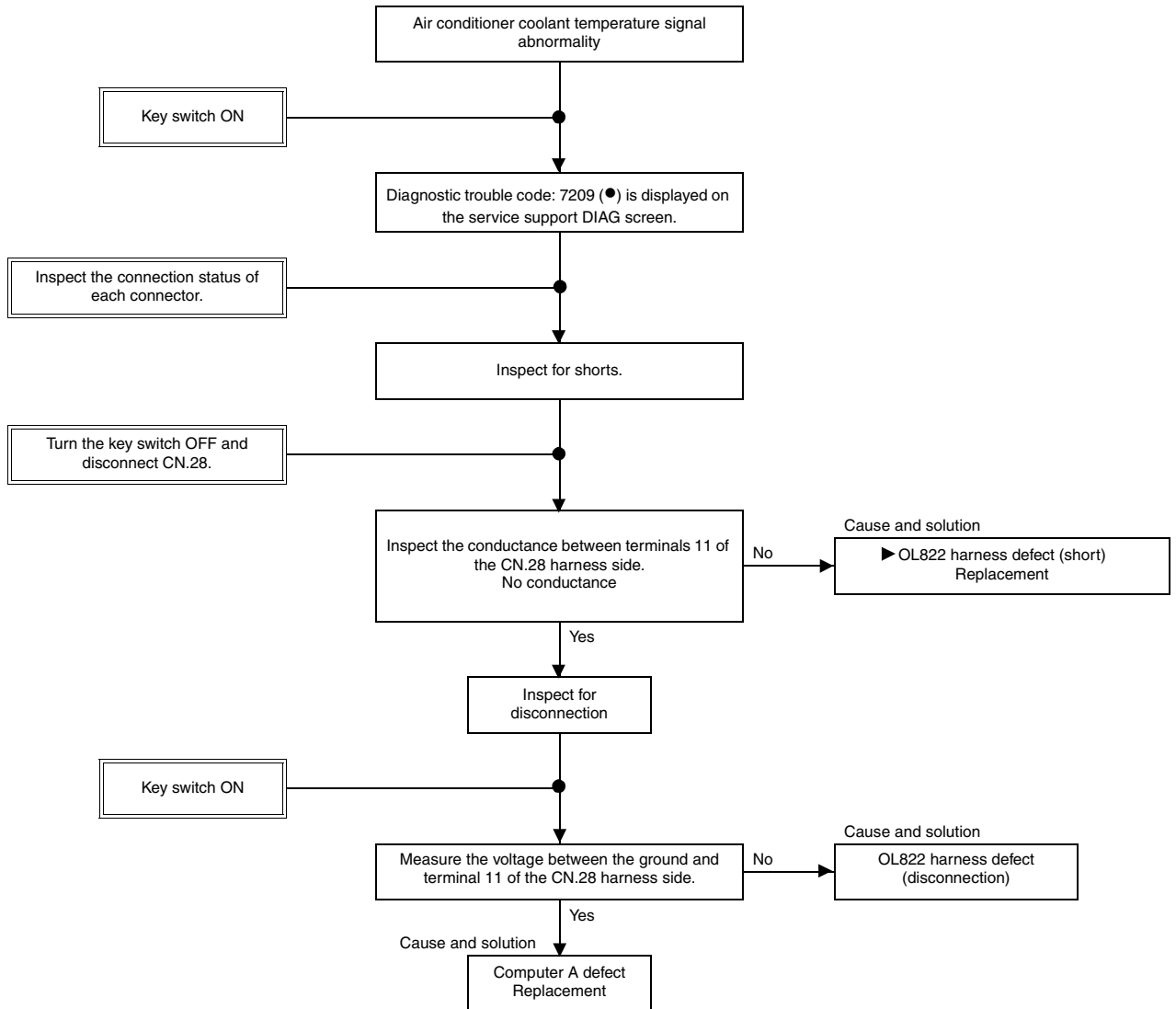
# DTC: 7006 Rod Pressure Sensor Signal Abnormality



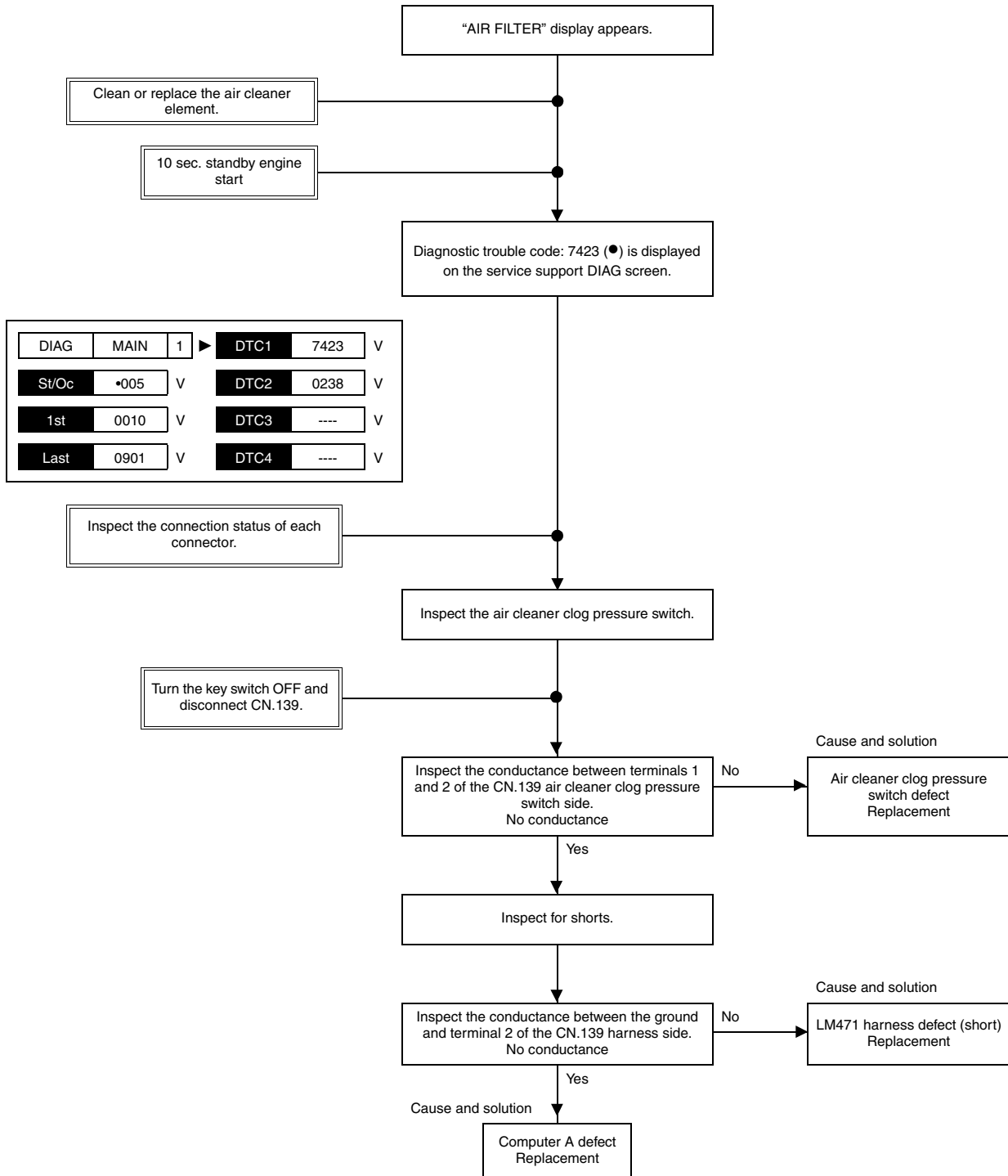


**DTC: 7209**

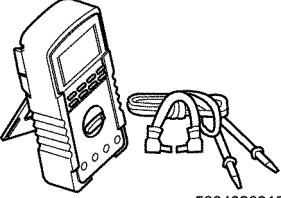
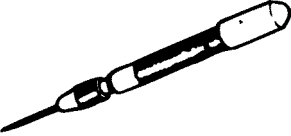
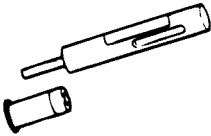


**Air Conditioner Coolant Temperature Signal Abnormality**



# DTC: 7423 Air Cleaner Clogging



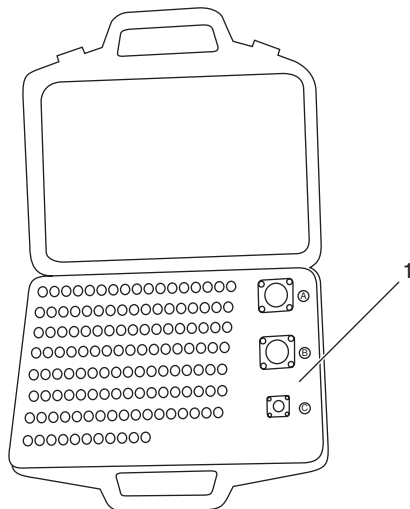
**SPECIAL TOOLS**

Illustration	Tool No. Tool name
 <p>5884026910</p>	<p>Digital multi-meter</p>
 <p>5884006320</p>	<p>Terminal remover</p>
 <p>5884003880</p>	<p>Weather pack terminal remover</p>
	<p>Thermogun</p>
 <p>5884003850</p>	<p>Breaker box 380002653</p>
	<p>EST (Electronic Service tools)</p>



### Breaker Box Inspection Procedure

The breaker box is a tool by which inspection of connector pin, harness disconnections, shorts or the like among the ECM, each sensor, and actuator, for which inspection was normally difficult, can be easily done. The voltage and conduction that is being applied to the ECM pins moves through the breaker box and can be measured using a digital multimeter (5-8840-2691-0). Also, by using scan tools along with the multimeter, even more reliable maintenance inspection can be performed.



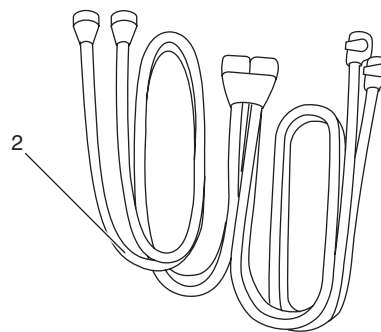
**Important:**

**When inspecting and measuring ECM voltage and conduction, use a breaker box and an adapter harness that is suitable for the main unit to be inspected.**

- **Due to the possibility that the ECM could be damaged, confirm pin locations before work when performing inspection and measurement with the ECM.**

**Note:**

The ECM pin number and breaker box pin number within the diagnosis steps should match.



TSWG0049

**Name**

1. Breaker box

2. Adaptor harness

**Breaker box connection method**

**Caution:**

**Turn the key switch OFF before removing and installing connectors.**

1. Disconnect the ECM connectors from the ECM.
2. Connect the adapter harness connectors to the ECM.
3. Connect the ECM connectors to the adapter harness.
4. Connect the adapter harness to the breaker box.

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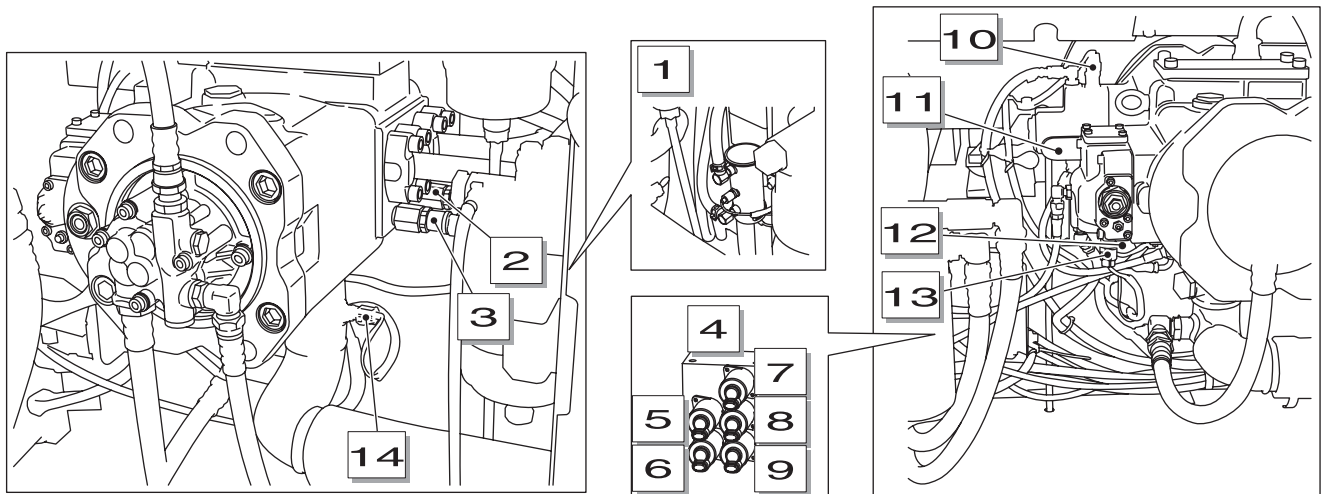
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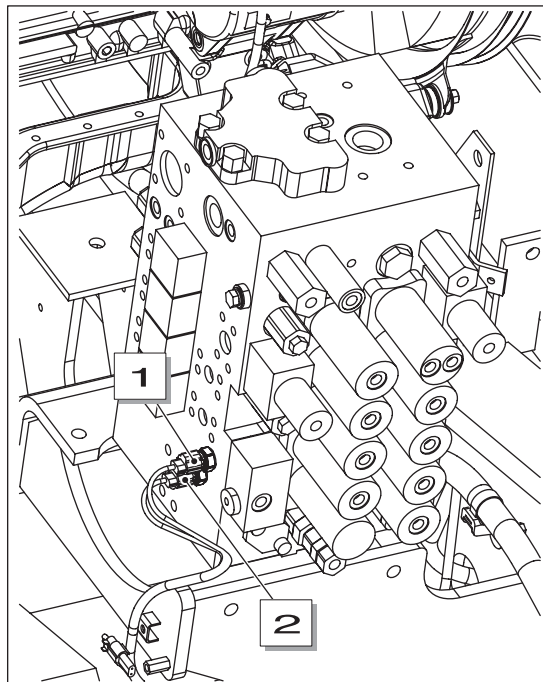
**Main Unit Right Side Layout Diagram (pump compartment)**



TSSA-0013-2

1	Fuel electromagnetic pump	9	Travel speed
2	P1 pressure sensor	10	N1 pressure sensor
3	P2 pressure sensor	11	P1 flow control proportional valve
4	5-stack solenoid valve	12	Horsepower control proportional valve
5	Power save	13	N2 pressure sensor
6	Lever lock	14	Oil temperature sensor
7	Swing lock		
8	Boost pressure		

**Main Unit Center Section Layout Diagram**



TSSA-0014-2

14	Upper side pressure sensor
15	Travel pressure sensor

Pin No.	Terminal name	Connection
41	-	-
42	-	-
43	PG-SIGN	GND
44	-	-
45	-	-
46	IS-START	Key switch start signal
47	ENGSTP	Engine stop switch
48	-	-
49	-	-
50	-	-
51	-	-
52	IS-DIAG	Diagnostic switch
53	-	-
54	-	-
55	-	-
56	-	-
57	-	-
58	-	-
59	-	-
60	SG-5VRT2	Atmospheric pressure sensor, suction air temperature sensor GND
61	SP-5V2	Atmospheric pressure sensor power supply
62	PG-SIGN	GND
63	-	-
64	-	-
65	-	-
66	-	-
67	IA-OILPRESS	Oil pressure sensor signal
68	-	-
69	-	-
70	-	-
71	IA-BARO	Atmospheric pressure sensor signal
72	IA-IAT	Suction air temperature sensor signal
73	-	-
74	IA-THBST	Boost temperature signal
75	-	-
76	-	-
77	-	-
78	-	-
79	SG-5VRT3	Oil pressure sensor
80	SP-5V3	Oil pressure sensor power supply
81	PG-CASE	GND

**H8**

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

**H12**

Terminal No.	
1	-
2	-
3	Injector power supply 2
4	Injector power supply 1
5	OS-INJ3 Signal/injector #3
6	OS-INJ2 Signal/injector #5
7	OS-INJ4 Signal/injector #6
8	OS-INJ1 Signal/injector #1
9	-
10	-
11	OS-INJ6 Signal/injector #4
12	OS-INJ5 Signal/injector #2

**H20**

Terminal No.	
1	CKP +
2	CKP GND
3	CKP shield
4	CMP +
5	CMP GND
6	CMP shield
7	ECT +
8	Boost pressure sensor Vcc
9	Oil pressure sensor Vcc
10	Oil pressure sensor Vout

Terminal No.	
11	Oil pressure sensor GND
12	Common rail pressure sensor Vcc
13	Common rail pressure sensor Vout
14	Common rail pressure sensor GND
15	Boost temperature sensor +
16	Boost pressure sensor Vout
17	Boost pressure sensor GND
18	-
19	-
20	-

**H22**

Terminal No.	
1	Glow

**H94**

Terminal No.	
1	-
2	OS-INJ1 Signal/injector #1
3	Injector power supply 1
4	Injector power supply 2
5	-
6	OS-INJ3 Signal/injector #3
7	OS-INJ5 Signal/injector #2
8	-

**H95**

Terminal No.	
1	-
2	OS-INJ6 Signal/injector #4
3	Injector power supply 2
4	Injector power supply 1
5	-
6	OS-INJ4 Signal/injector #6
7	OS-INJ2 Signal/injector #5
8	-

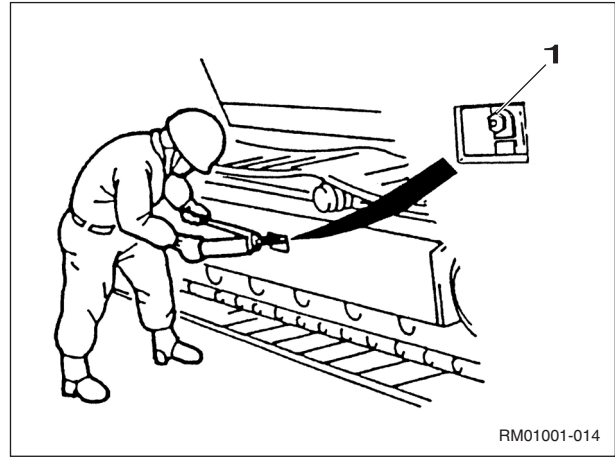
Step	Action	Value	Yes	No
1	<p>Check the fuel quality.</p> <ol style="list-style-type: none"> <li>1. Remove fuel from the fuel tank.</li> <li>2. Fill with appropriate fuel.</li> <li>3. Perform fuel air bleeding.</li> <li>4. Start the engine.</li> </ol> <p>Did the engine start?</p>	-	Go to step 6.	Go to step 2.
2	<p>Check the fuel quantity.</p> <p>Is there a sufficient amount of fuel filled?</p>	-	Go to step 3.	Fill with fuel and go to step 3.
3	<p>Check whether a filter or the like other than a genuine fuel filter, pre-filter, or charge fuel pump has been added to the main unit fuel line.</p> <p>Is there an added filter or the like?</p>	-	Go to step 4.	Go to step 5.
4	<ol style="list-style-type: none"> <li>1. Remove the added filter and perform air bleeding. <ul style="list-style-type: none"> <li>• The diagnostic trouble codes 1093 and 1094 may be detected due to the fuel resistance becoming larger.</li> </ul> </li> <li>2. Start the engine.</li> </ol> <p>Did the engine start?</p>	-	Go to step 6.	Go to step 5.
5	<ol style="list-style-type: none"> <li>1. Check whether the fuel filters (main, pre) are excessively dirty or clogged.</li> <li>2. Check whether the charge fuel pump filter is excessively dirty or clogged.</li> <li>3. Clean or replace as necessary if a problem is detected.</li> <li>4. If it can be seen that air has entered the main filter, investigate the cause and perform a countermeasure.</li> </ol> <p>Is the action complete?</p>	-	Go to step 6.	-
6	<ol style="list-style-type: none"> <li>1. Check for fuel pipe damage, clogging, or connection problems.</li> <li>2. Repair as necessary if a problem is detected.</li> </ol> <p>Is the action complete?</p>	-	Go to step 7.	-
7	<ol style="list-style-type: none"> <li>1. Check whether there are any of the following fuel tank abnormalities. <ul style="list-style-type: none"> <li>• Entry of dirt or the like.</li> <li>• Fuel supply pipe misalignment or damage</li> <li>• Tank crushing, damage</li> <li>• Fuel pipe mis-alignment</li> <li>• Clogging of the feed port</li> <li>• Entry of water</li> </ul> </li> <li>2. Repair as necessary if a problem is detected.</li> </ol> <p>Is the action complete?</p>	-	Go to step 8.	-
8	<p>Perform fuel air bleeding.</p> <p>Note:</p> <p>See the "Engine" section in the Service Manual for the work procedures.</p> <p>Is the action complete?</p>	-	Check repair.	-

Step	Action	Value	Yes	No
15	Inspect the signal detection condition of the CMP sensor. 1. Start the engine. 2. Remove the harness from the CKP sensor. (This operation will cause a diagnostic trouble code to be detected, so make sure to delete the diagnostic trouble code after repairing the main unit.) Is the idling condition normal?	-	Go to step 19.	Go to step 16.
16	Check the engine symptoms again. Have the engine symptoms normalized?	-	Go to step 20.	Go to step 17.
17	Is there an EMPS?	-	Go to step 18.	Go to step 19.
18	1. Check the ECM software version. 2. Perform rewriting if updating the ECM software version is necessary. <b>Note:</b> <b>When ECM replacement or rewriting is performed, perform EGR learning.</b> Is the action complete?	-	Go to step 20.	Go to step 19.
19	Check the mechanical parts of the engine and repair any abnormalities. <ul style="list-style-type: none"> <li>• Compression pressure</li> <li>• Valve system</li> <li>• Flywheel</li> <li>• Camshaft gear</li> <li>• Timing gear</li> <li>• Piston/crank-related</li> </ul> Is the action complete?	-	Go to step 20.	Go to step 2.
20	Repair the main unit and check repair. Is the action complete?	-	Check repair.	-

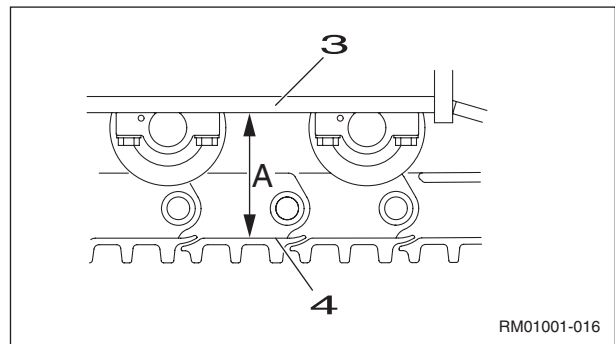
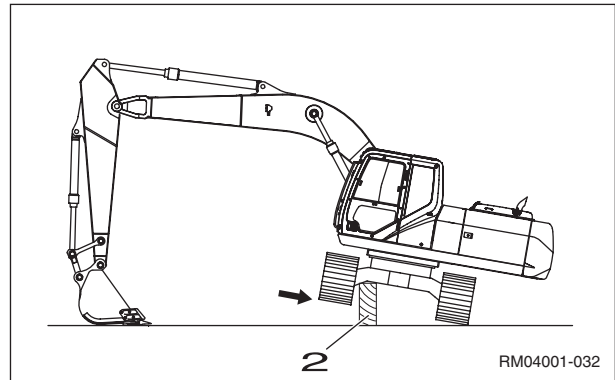
Step	Action	Value	Yes	No
7	Check the engine compression pressure. If a problem is found, perform repair or replacement. Was a problem detected?	-	Go to step 8.	Go to step 9.
8	Inspect for wear around the engine pistons and cylinder liner wear. <b>Note:</b> <b>See the “Engine” section in the Service Manual for the work procedures.</b> Perform repair or replacement for any locations where problems are found. Is the action complete?	-	Check repair.	Go to step 9.
9	Check whether decline of oil are occurring from the valve stem and oil seal. <b>Note:</b> <b>See the “Engine” section in the Service Manual for the work procedures.</b> Perform repair or replacement for any locations where problems are found. Is the action complete?	-	Check repair.	Go to step 10.
10	Perform an overhaul of the water pump. <b>Note:</b> <b>See the “Engine” section in the Service Manual for the work procedures.</b> Is the action complete?	-	Check repair.	-
11	Inspect for oil leaking within the engine and outside the engine. Perform repair or replacement for any locations where problems are found. <b>Note:</b> <b>See the “Engine” section in the Service Manual for the work procedures.</b> Is the action complete?	-	Check repair.	-

## 2 Installation of upper roller

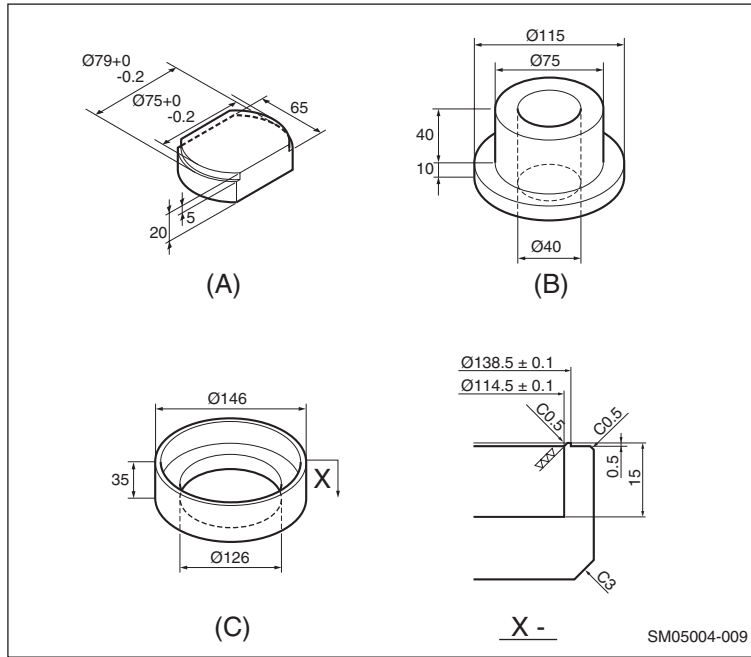
- [1] Perform the reverse of the removal procedure.  
Apply Loctite to the bolts and tighten them to the specified torque.  
Installation specified tightening torque: 521 - 608 Nm.
- [2] Tighten the check valve (1).  
While monitoring the track shoe tension, inject grease into the grease cylinder.



- [3] To adjust the track shoe tension, raise the lower side frame as shown in the diagram.  
Place a wood plank (2) under the lower frame to prevent falling.  
Adjust the tension so that the distance indicated with A between the frame bottom (3) of the center area of the lower side frame and the lowest hanging part of the top of the shoe plate (4) is 340 - 360 mm.



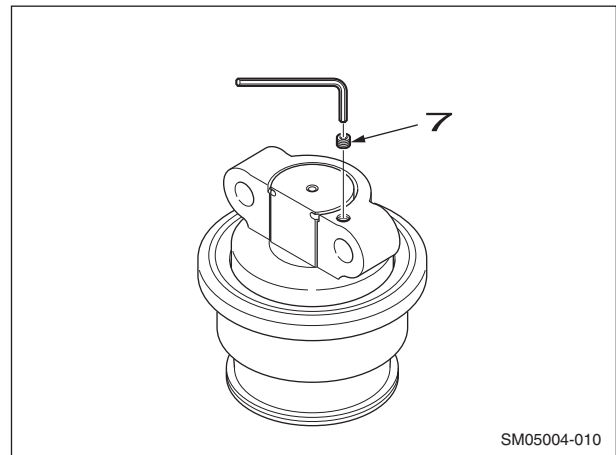
## 2 Jig dimension diagram



## 3 Disassembly procedure

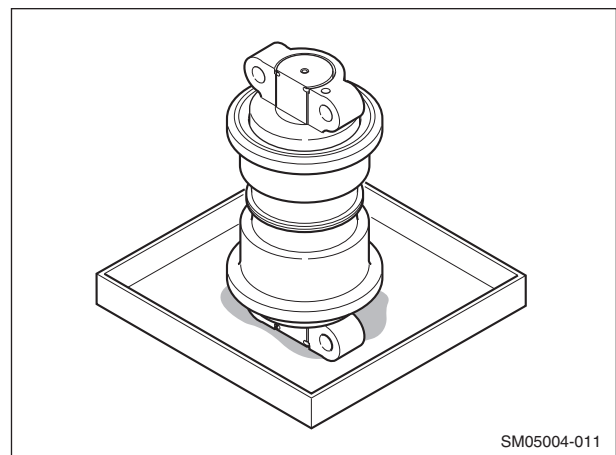
[1] Place the roller vertically and remove the plug (7).

- The plug (7) is coated with seal nylon, which comes off when the plug is removed. To reuse the plug, be sure to use seal tape.



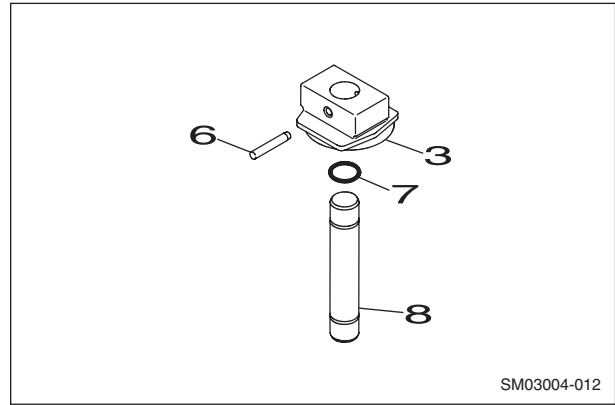
[2] Face down the part of the roller from which the plug was removed and empty the hydraulic oil from within the roller.

- It may take several hours to completely empty the hydraulic oil from the roller.
- Place an oil pan or a similar object under the roller to catch grease.
- Fasten the roller so it does not fall down.

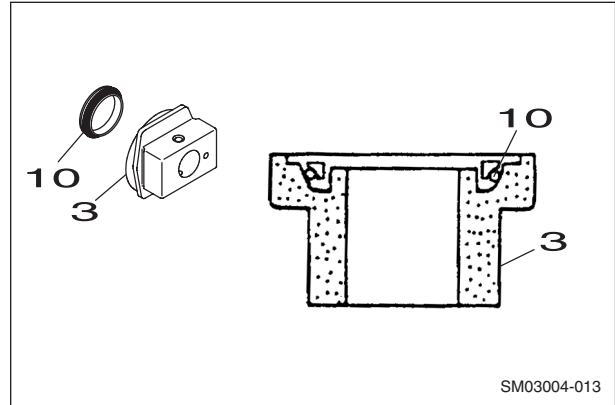


5005-8

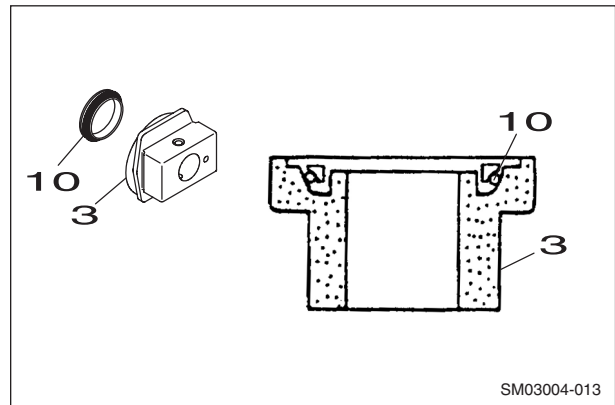
- [5] Remove the pin hub (6) from the hub (3). Next, after removing the hub (3) from the shaft (8), remove the O-ring (7) from the shaft (8).



- [6] Remove the floating seals (10) from the hub (3).

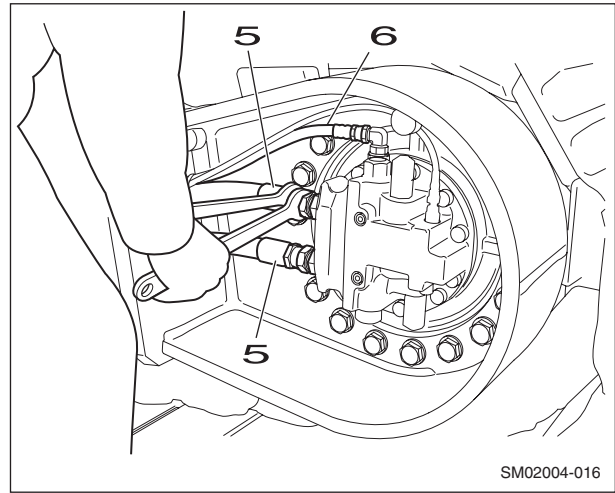


- [7] Remove the floating seals (10) from the roller (9).

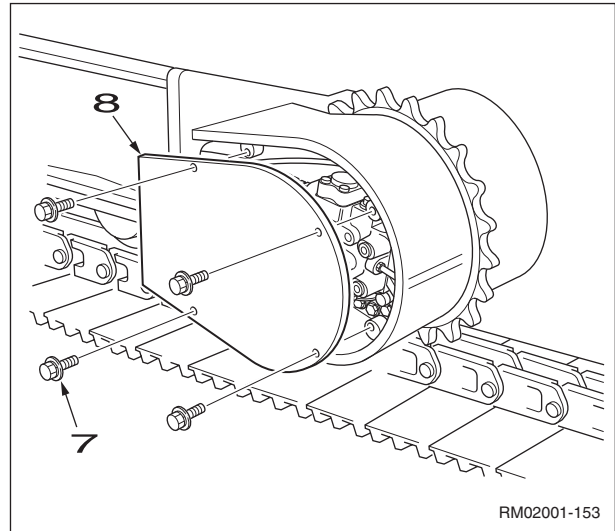


6001-8

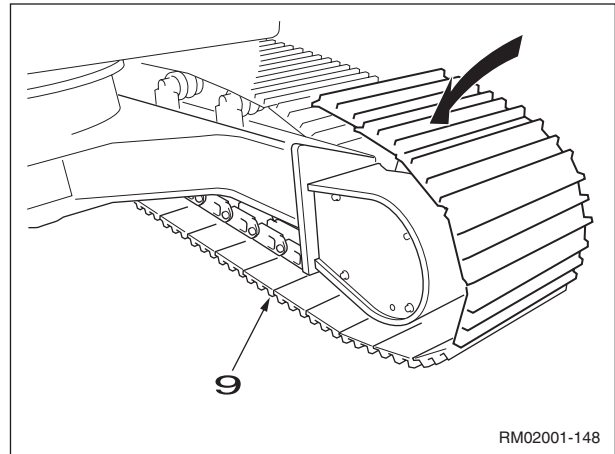
- [4] Use wrenches to install the drain hose (6) and high-pressure hoses (5).



- [5] Install the cover (8), and then use a wrench to install the 4 bolts (7).



- [6] Wrap the shoe (9).



## 2 Reduction gear disassembly procedures

## a) Disassembly preparations

- [1] The unit removed from the actual machine is dirty with dirt and debris.  
Clean the exterior of the unit and let it dry.

<b>Caution:</b>	Perform the disassembly procedure after the reduction gear sufficiently cooled down, otherwise burns can occur.
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- [2] Loosen the drain and the feed plug G3/4 (26) to drain the gear oil inside the reduction gear.

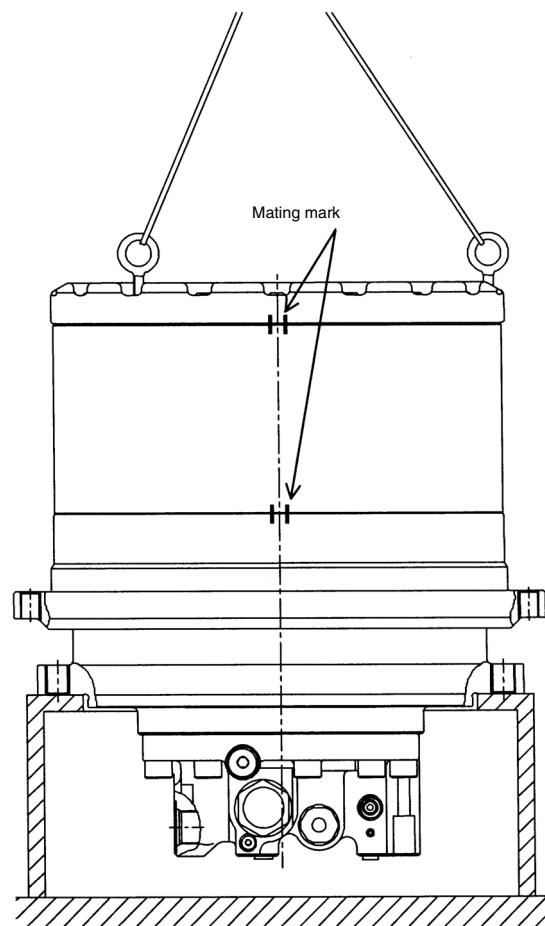
<b>Caution:</b>	When the gear oil is still hot, the pressure inside can cause the oil to spray out.
-----------------	---

- [3] Make reference marks to the outside of each alignment surface so that the part can be assembled in its original form.

## b) Installation to receiving platform of reduction gear (unit)

- [1] Remove 3 hexagon socket head bolts M10x30 (25) screwed into the cover (24) at approximately the same distance apart, and instead, install and suspend the M10 eyebolts, and install the receiving platform with the cover in the raised position and the motor in the lowered position.

<b>Caution:</b>	Be very careful not to get hands stuck between parts or drop the suspended parts on feet. Lift the part in a horizontal position.
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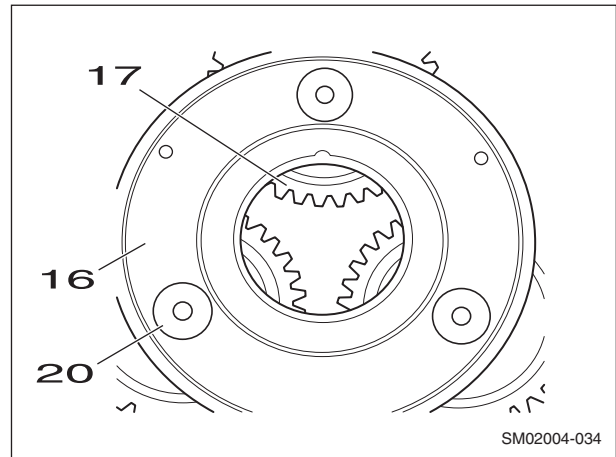
## b) Assembly of the carrier 1 assembly

- [1] Insert the planetary gear 1 (17), needle bearing (19), and thrust washer 1 (18) into the carrier 1 (16).

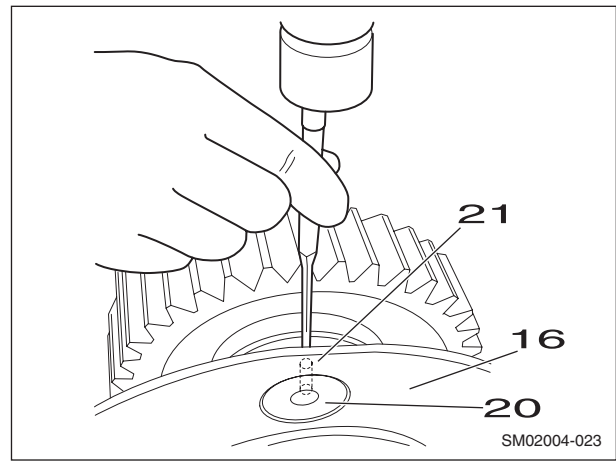
**Caution:**

Be very careful not to get hands stuck between the gear and carrier.

- [2] Align the carrier pin 1 (20) with the spring pin hole and insert it into the carrier 1 (16).

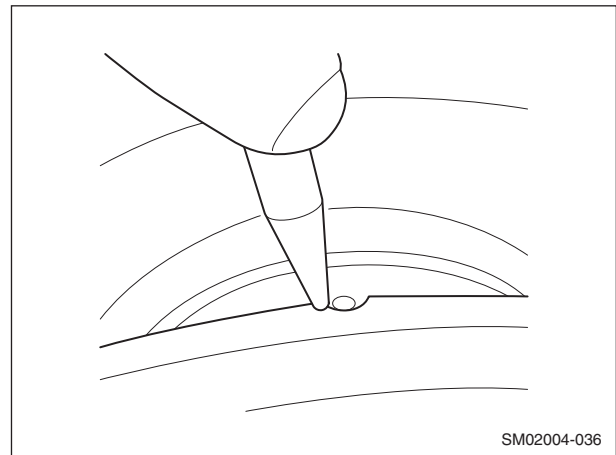


- [3] Insert the spring pin 6x36 (21) into the carrier pin 1 (16) and carrier pin 1 (20). (Hammer it 1 - 2 mm deeper than the striking surface.)



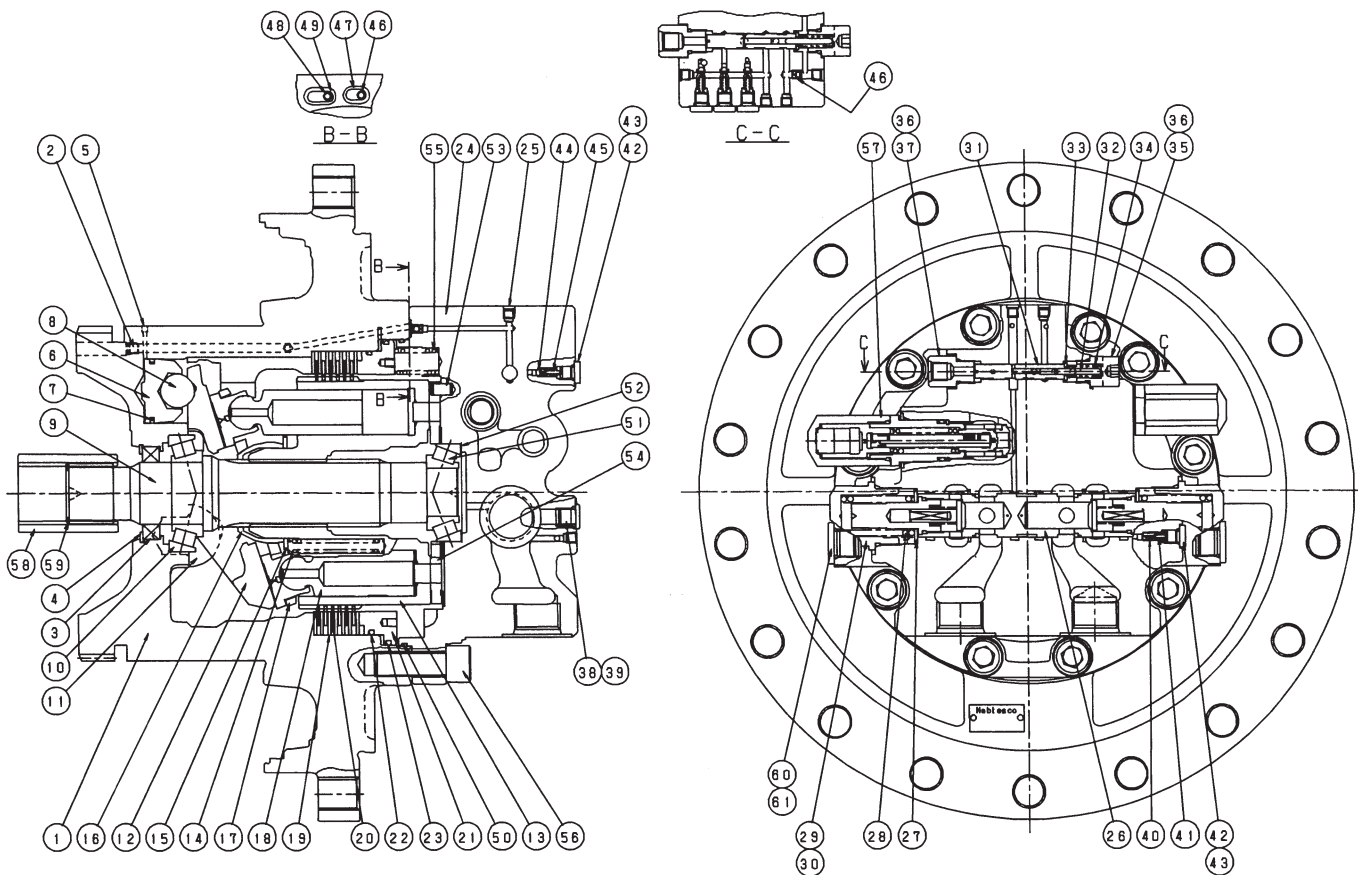
- [4] Caulk at 2 opposing 180° locations.

- For the direction of inserting the spring pin and the caulking method, see "Diagram 1 Spring pin and caulking details".



## 6 Structural diagram

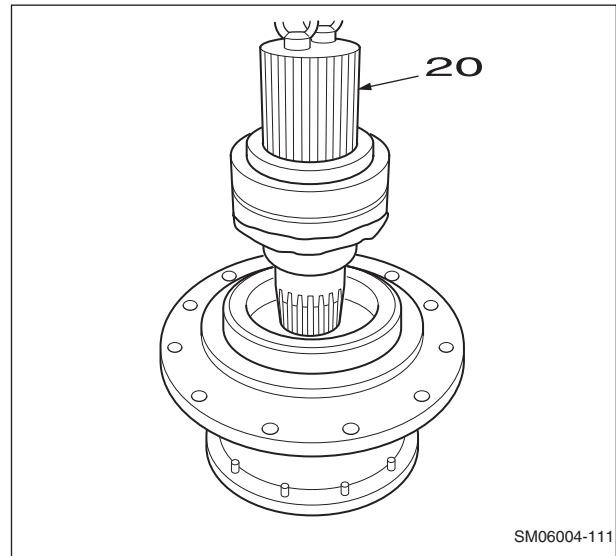
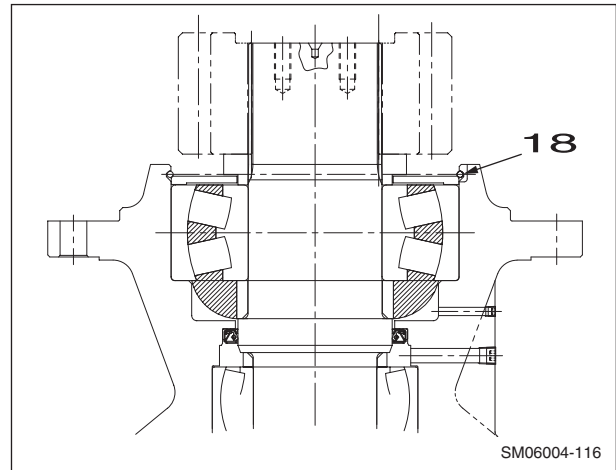
### 1 Travel motor



Code	Part name	Code	Part name	Code	Part name
1	Casing	21	Brake piston	41	Orifice spring (brake valve)
2	NPT 1/16 plug	22	D-ring (small diameter)	42	G1/8 plug
3	Oil seal	23	D-ring (large diameter)	43	O-ring 1B P8
4	Circle R retaining ring IRTW68	24	Rear cover	44	Check valve
5	Expansion plug	25	NPT 1/16 plug (mec)	45	Check valve spring
6	Tilting piston	26	Spool assembly	46	M6 orifice (É"0.6)
7	Tilting piston seal	27	Spring receiver	47	O-ring 1B P12.5
8	Steel ball	28	Spring	48	M6 orifice (É"0.8)
9	Shaft	29	M42 plug	49	O-ring 1B P15
10	Bearing HR32209J	30	O-ring 1B G40	50	O-ring 215.57 × 2.62
11	Pivot	31	Pilot spool	51	Bearing HR32207C
12	Shoe plate	32	Pin	52	Shim
13	Cylinder block	33	Spring receiver	53	Parallel pin
14	Cylinder spring	34	Spring	54	Valve plate
15	Spring receiver	35	Pilot valve plug G3/8	55	Brake spring
16	Spherical joint	36	O-ring 1B P14	56	Hexagon socket head bolt M18 × 50
17	Shoe retainer	37	Joint	57	Overload valve
18	Piston assembly	38	G1/4 plug	58	Coupling
19	Separator plate	39	O-ring 1B P11	59	C retainer ring 40 for hole
20	Friction plate	40	Orifice (brake valve)	60	G1/2 plug
				61	O-ring 1B P18

#### 4 Disassembly of the case subassembly

- [1] Reverse the case subassembly.
- [2] Remove the wire (18).
- [3] Use 2 lifting tap holes (M16) on the gear shaft end section (20) to pull out the shaft subassembly.

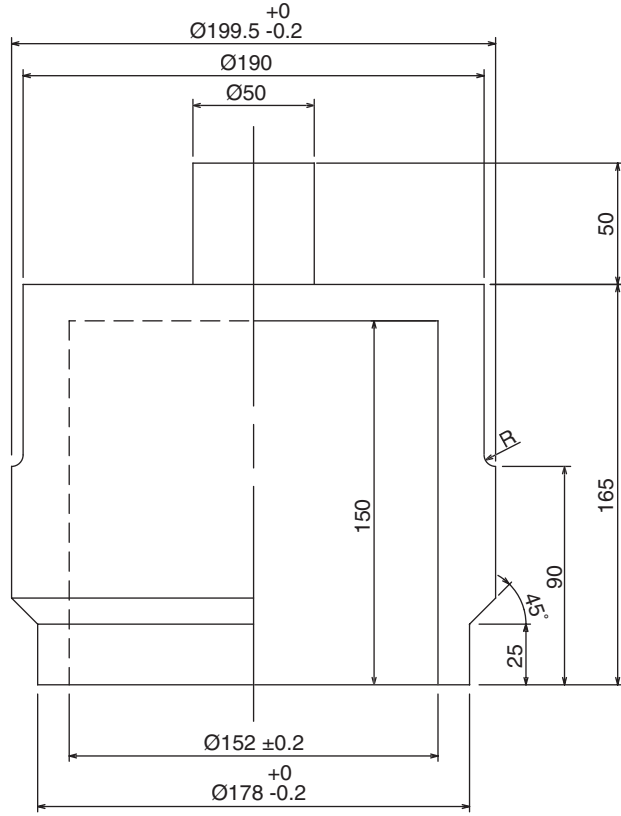


#### 5 Disassembly of shaft subassembly

- This part cannot be disassembled.  
This completes the disassembly.

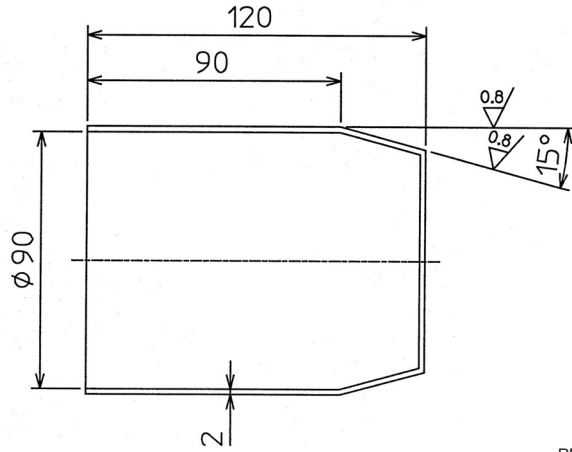
### 3 Jig

Jig1: for assembly of oil seal (70)



SM06004-117

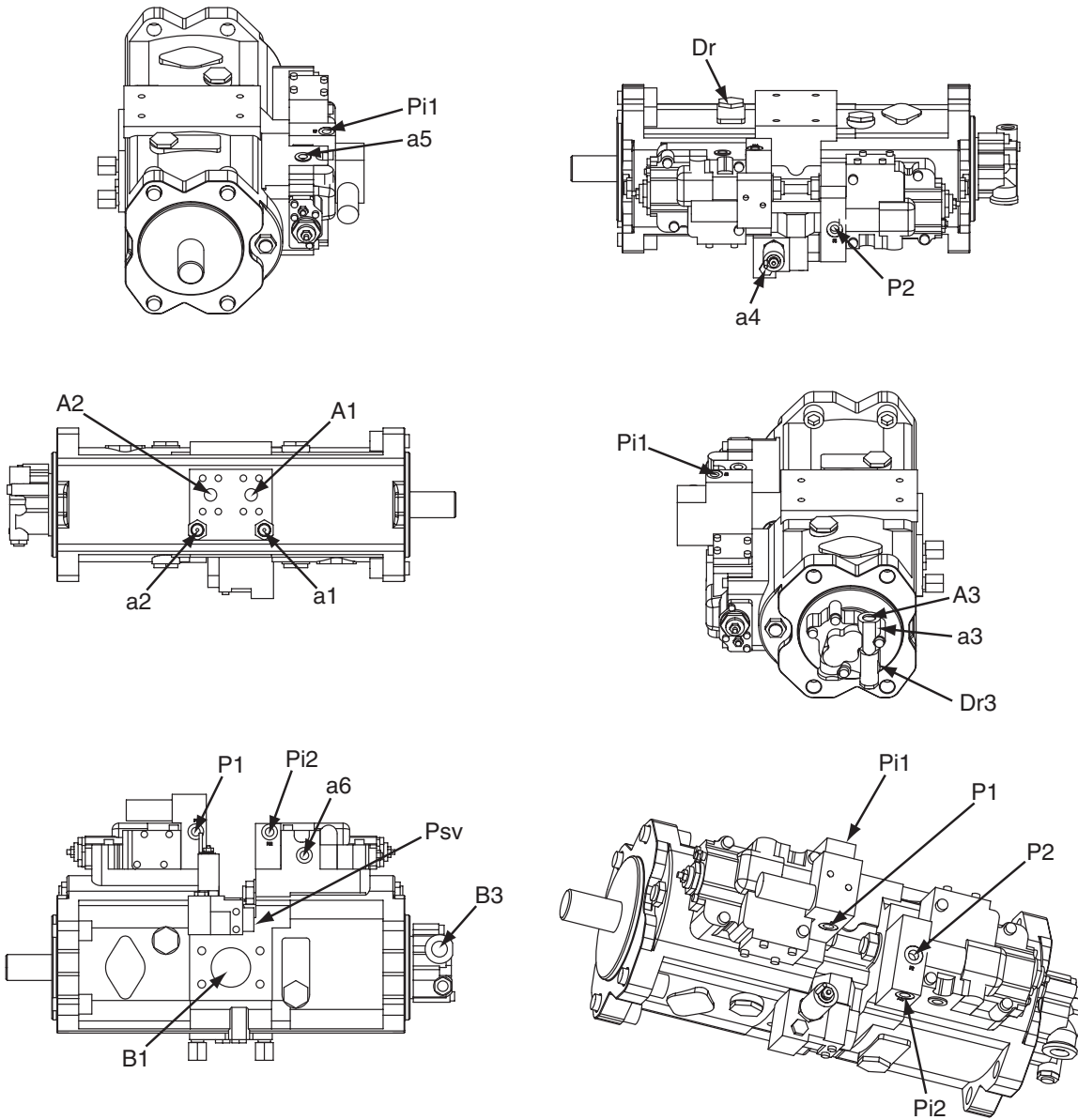
Jig2: for assembly of pinion shaft (61)



RM06001-134

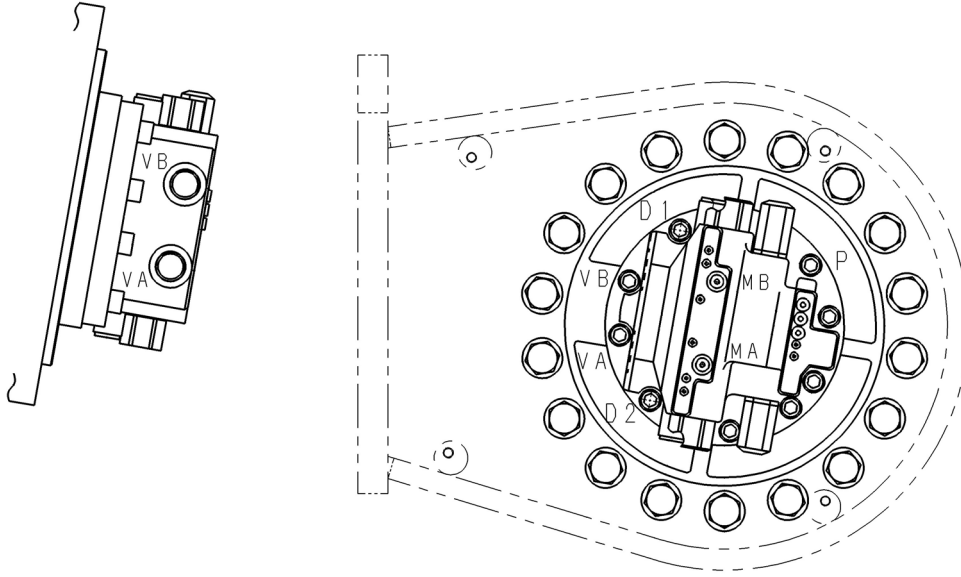
# IDENTIFICATION OF HYDRAULIC COMPONENTS

## Pump



SD06012-001

Port	Description	Location
A1, A2	Discharge port	SAE6000psi 1
B1	Suction port	SAE2500psi 2-3
Dr	Drain port	G 3/4-23
P1	Proportional valve primary pressure port	G 1/4-13
P2	P2 port	G 1/4-13
Psv	Servo assist port	G 1/4-15
Pi1, Pi2	Negative control port	G 1/4-13
a1, a2, a4, a5, a6	Gauge port	G 1/4-15
A3	Gear pump discharge port	G 1/2-19
B3	Gear pump suction port	G 3/4-20.5
a3	Gauge port	G 1/4-14
Dr3	Drain port (gear pump)	G 3/8-15

**Travel motor**

SD06012-005

Port	Description	Location
D1, D2	Drain port	G1/2
P	Pilot port	G1/4
MA, MB	Pressure detection port	G1/4
VA, VB	Main port	G1

## PRESSURE ADJUSTMENT

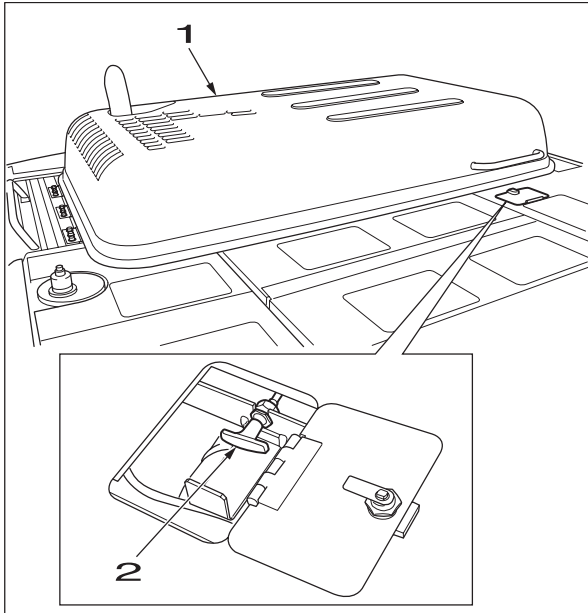
### Main pressure adjustment

#### Adjustment preparation work

Pressure is adjusted with control valves.

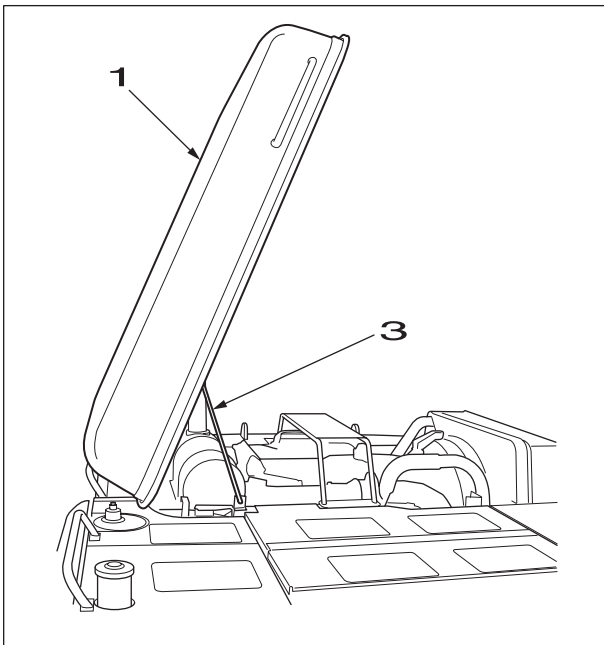
The following preparations are required for adjusting with control valves.

1. Release the two engine hood lock levers (2).



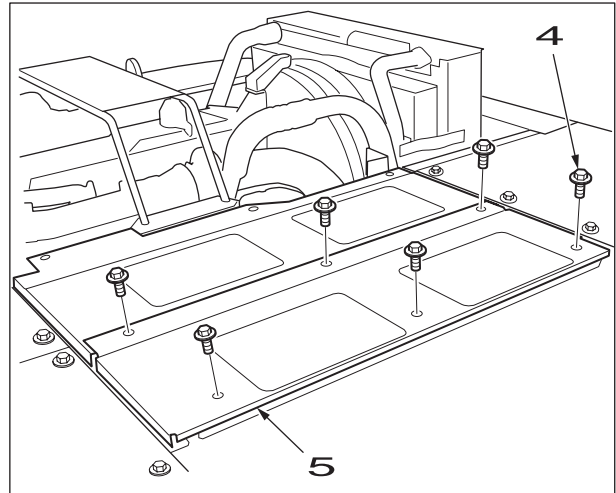
S101009-507

2. Open the engine hood (1). Always check that the lock (3) is locked.



S101009-508

3. Remove the screws (4), then remove the cover (5).



S101009-509

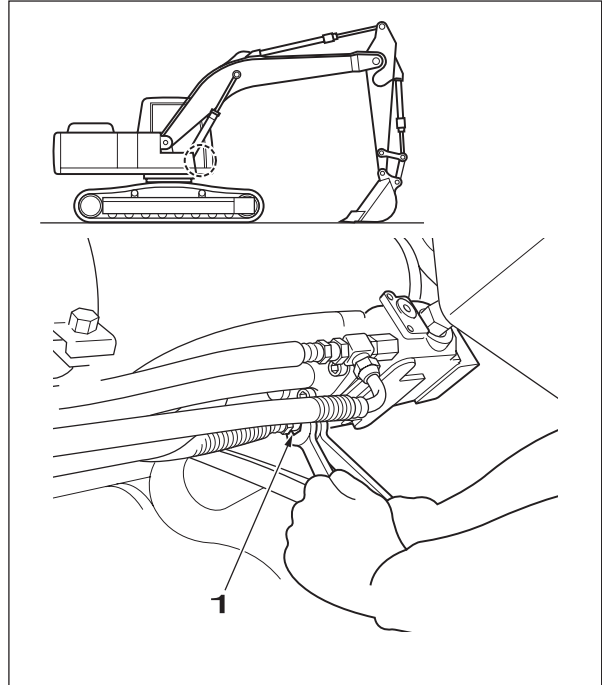
## Safety valve



**WARNING:** The safety valve air bleeding work requires two workers: an operator and an air bleed worker. Decide your signals beforehand and work safely. Set the main unit so that the arm safety valve is at the highest position. (See the figure below.)

### Boom cylinder safety valve

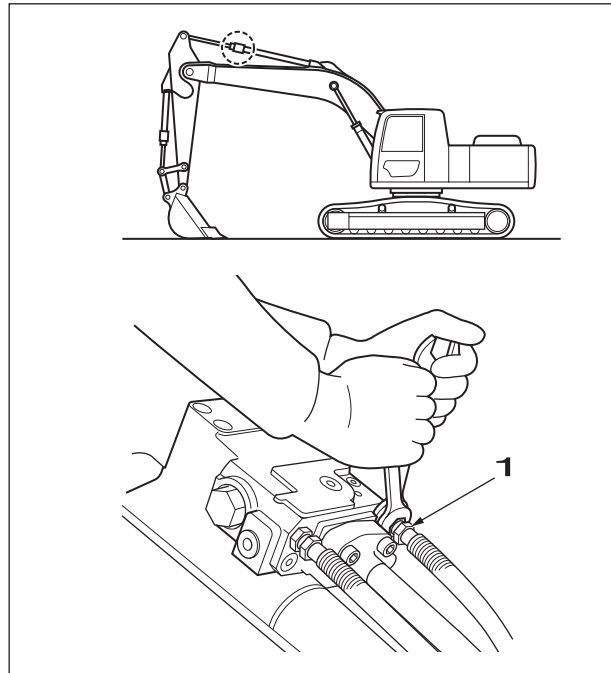
1. Start the engine and lower the boom without jacking up the main unit.
2. In the above state, loosen the hose mouthpiece at the position in the figure.
3. Foaming hydraulic oil comes out from the hose coupling section. When foaming hydraulic oil stops coming out, tighten the hose mouthpiece (1).
4. Execute steps 2 and 3 for the opposite side boom cylinder too.
5. Check boom operations. If there is a delay in the operation response, bleed the air again with the same procedure.



S104009-004

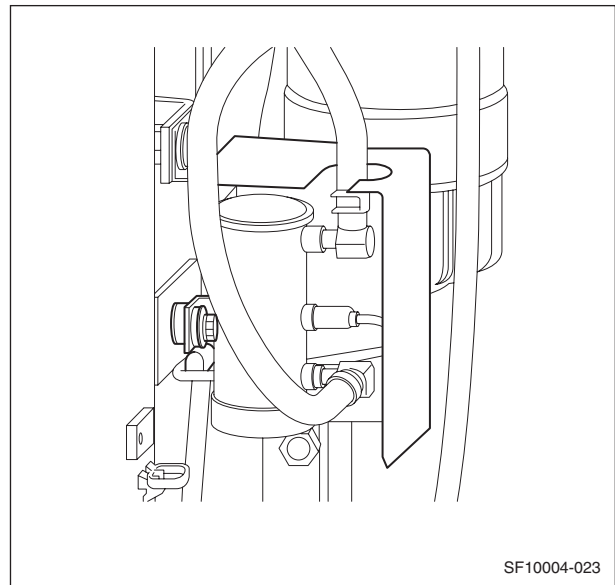
### Arm cylinder safety valve

1. For arm-in operations, bleed the air from the arm cylinder safety valve using the same procedure as for boom cylinder safety valve air bleeding.



S104009-507

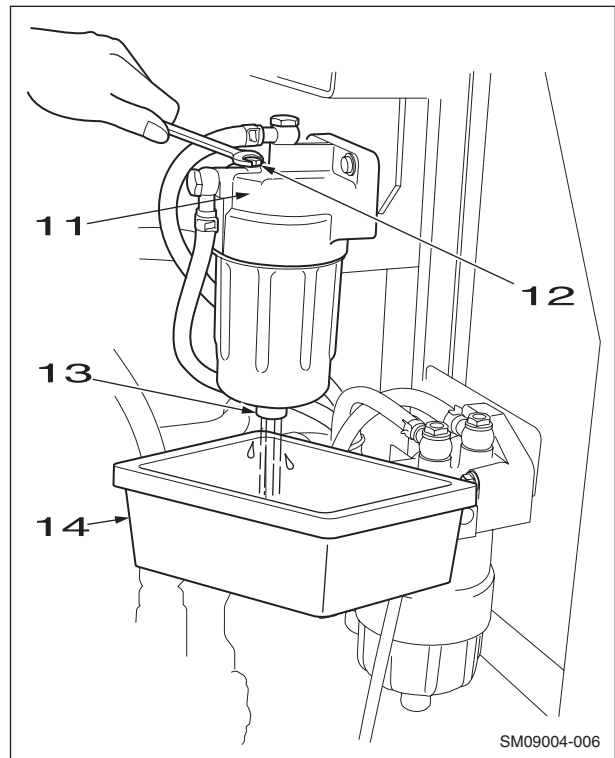
[10] Remove the charge fuel pump filter.



[11] Use a wrench (10 mm) to loosen the air bleed plug (12) of the fuel pre-filter (11).

[12] Loosen the cap (13) at the bottom and drain out any remaining fuel.

- Put a waste oil case (14) underneath.



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## 2 Installation of travel remote control valve

To install, perform the reverse of the removal procedure.

Be careful not to connect the hydraulic hoses in incorrect locations.

Before installing the hoses, check that the hose adapters are not loose and retighten them to the specified torque.

Hose adapter, hydraulic hose tightening torque:  $36.3 \pm 2.0$  Nm.

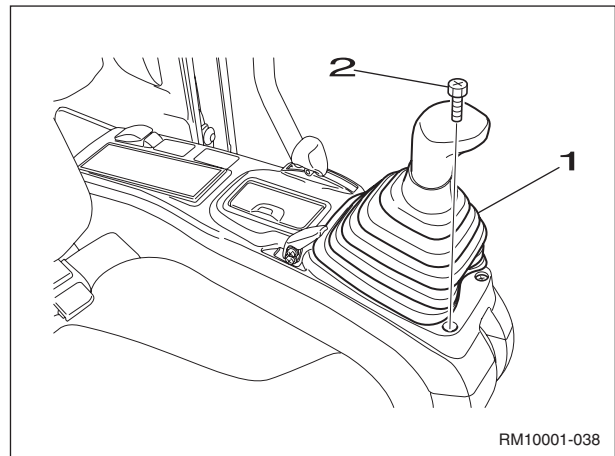
## REMOVAL AND INSTALLATION OF OPERATION CONTROL VALVE

<b>Caution:</b>	Be sure to release hydraulic pressure before beginning work.
-----------------	--

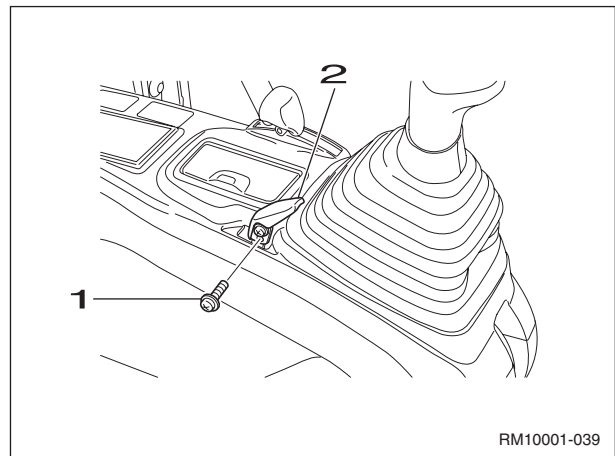
<b>Caution:</b>	Be sure to stop the engine before beginning work.
-----------------	---

### 1 Removal of operation remote control valve (left side)

- [1] Roll up the boot (1) of the control lever, and disassemble the retaining screws (2) from the console top cover.

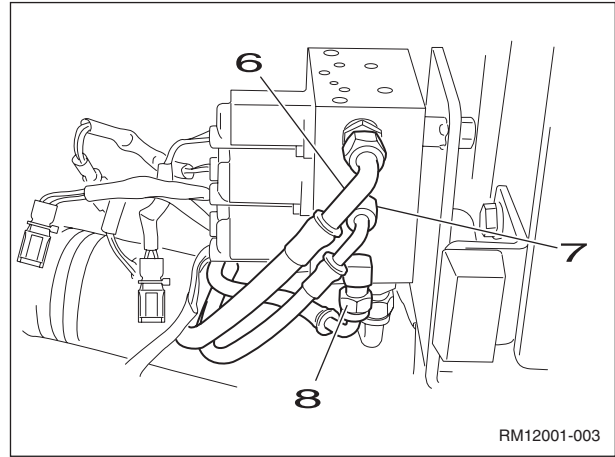


- [2] Disassemble the retaining screws (1) and remove handle (2) of the tilt lever.



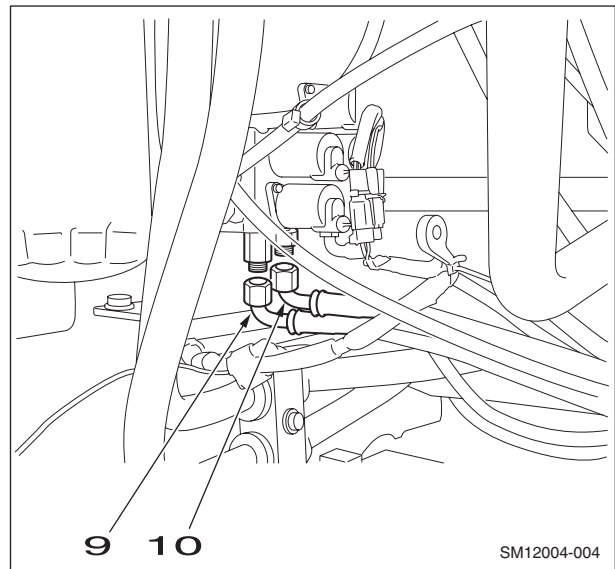
[4] Use wrenches (19 mm, 22 mm) to remove the hoses (6), (7) and (8).

- Mark the solenoid valve and hoses so that the connectors match at the time of assembly.
- Use caps or plugs to cover the solenoid valve and hose to prevent any entry of water, dust or dirt.
- Clean the solenoid valve and hoses by spraying them with a parts cleaner to prevent scratches and prevent dirt from accumulating on the connectors.



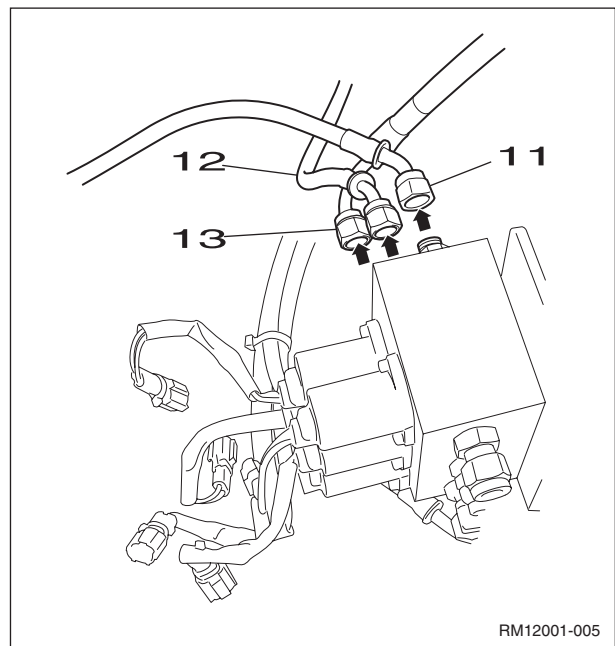
[5] Use a wrench (22 mm) to remove the hoses (9) and (10).

- Mark the solenoid valve and hoses so that the connectors match at the time of assembly.
- Use caps or plugs to cover the solenoid valve and hoses to prevent any entry of water, dust or dirt.
- Clean the solenoid valve and hoses by spraying them with a parts cleaner to prevent scratches and prevent dirt from accumulating on the connectors.

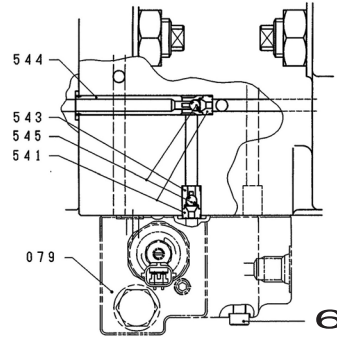
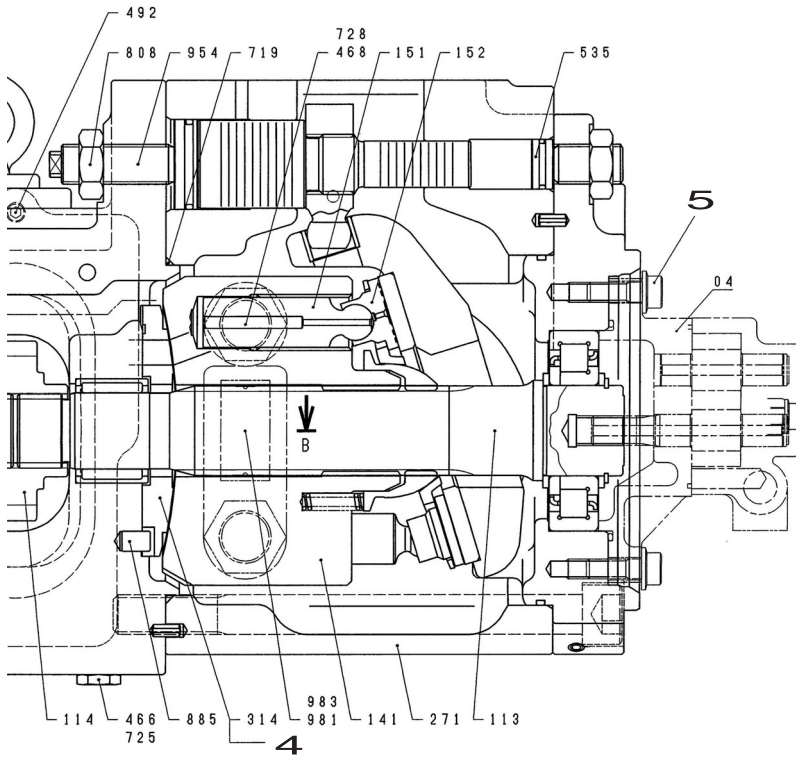


[6] Use wrenches (19 mm, 22 mm) to remove the hoses (11), (12) and (13).

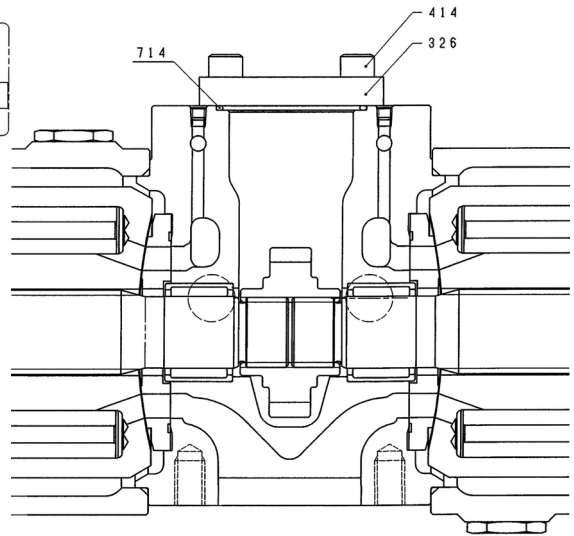
- Mark the solenoid valve and hoses so that the connectors match at the time of assembly.
- Use caps or plugs to cover the solenoid valve and hoses to prevent any entry of water, dust or dirt.
- Clean the solenoid valve and hoses by spraying them with a parts cleaner to prevent scratches and prevent dirt from accumulating on the connectors.



**3 Drive shaft rear side**



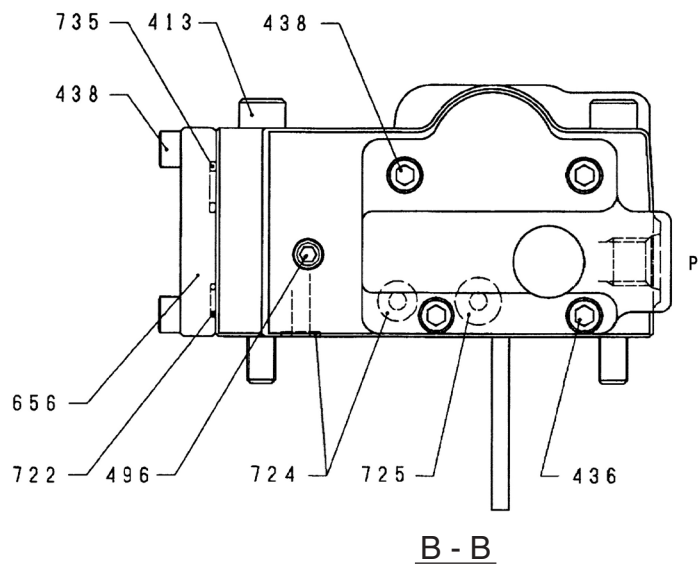
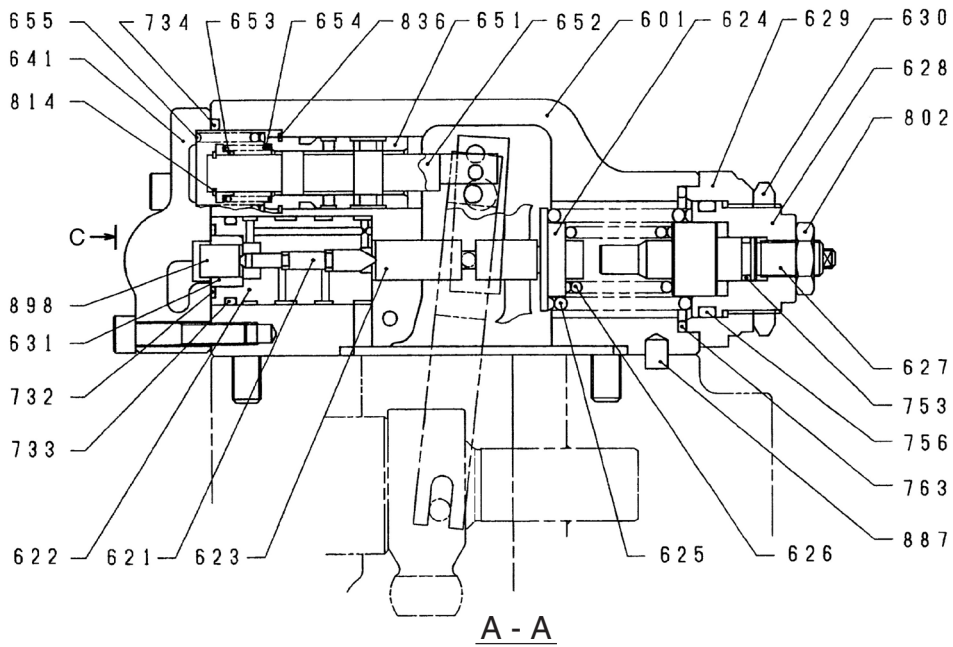
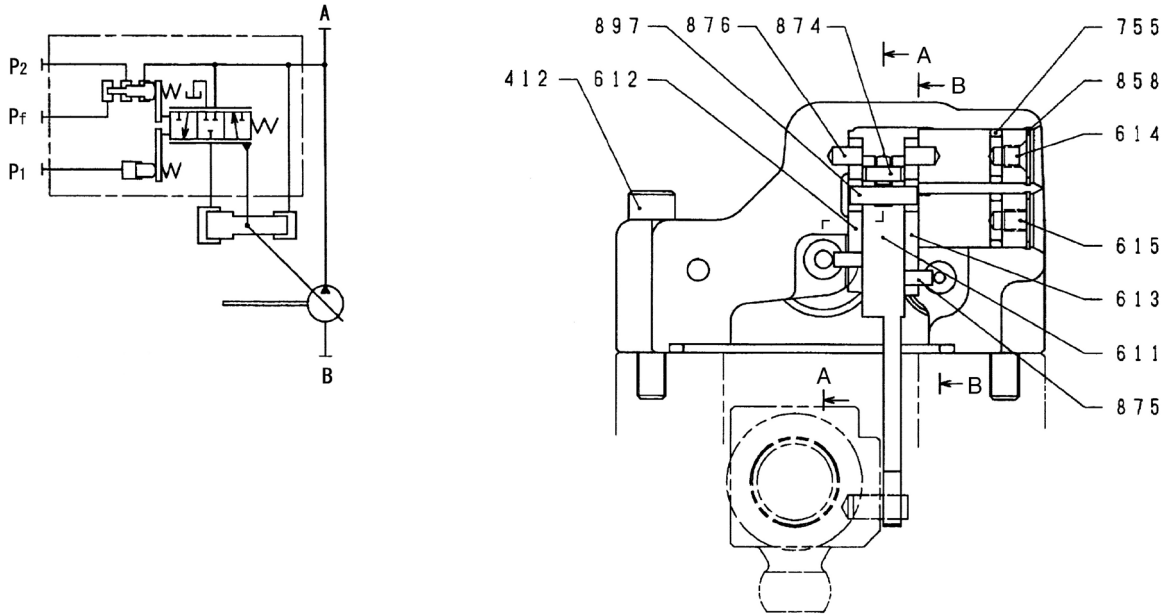
A -



B - B

SD02009-034

### 4 Regulator assembly structural diagram



SM09004-047a

## 2 Assembly of load check valve

- 1) Mount the O-rings (36) in the arm 1 section (E-E cross section), Boom 1 and 2 sections (F-F cross sections), swing section, and bucket section (G-G cross sections) and assemble the poppets (34) and springs (35).

Mount the flanges (37) and tighten with the hexagon socket head bolts (75).

Tightening torque: 58 - 64 Nm

For the arm 2 section (E-E cross section), assemble the sleeve (58), poppet (59) and spring (60), mount the flange (61), and tighten with the hexagon socket head bolts (75).

Tightening torque: 58 - 64 Nm

- 2) Mount the O-ring (36) in the travel section (I-I cross section) and assemble the poppet (51) and spring (35). Tighten the flange (37) with the hexagon socket head bolt (75).

Tightening torque: 58 - 64 Nm

- 3) Assemble the poppet (34) and spring (35) on the common check section (J-J cross section), then insert the spacers (53) with the O-ring (54) and backup ring (55) mounted.

Tighten the flange (52) with the hexagon socket head bolt (75).

Tightening torque: 39 - 44 Nm



### WARNING:

1. Be careful to assemble O-rings and backup rings in the correct locations.
2. If they are assembled backwards, there is a danger of an O-ring being damaged and causing external leaks.

- 4) Mount the O-ring (36) in the option section (H-H cross section) and assemble the poppet (44) and spring (45). Mount the flange (43) and tighten with the hexagon socket head bolts (74).

Tightening torque: 58 - 64 Nm

- 5) Assemble the poppet (49) and spring (48) in the travel section (H-H cross section).

Screw in and tighten the plug (46) with O-ring (47) mounted.

Tightening torque: 107 - 117 Nm

- 6) Assemble the poppet (32) and spring (33) in the arm 1 parallel-tandem section (D-D cross section).

Screw in and tighten the plug assembly (72) with O-ring mounted.

Tightening torque: 73 - 79 Nm

- 7) Assemble the poppet (32), spring (33), and spacer (57) in the arm 2 parallel-tandem section (D-D cross section).

Screw in and tighten the plug assembly (72) with O-ring mounted.

Tightening torque: 73 - 79 Nm.

## 3 Assembly of antidrift valve

- 1) Mount the O-rings (36) and (41) on the antidrift valve installation surfaces in the arm 1 section (E-E cross section) and boom 1 section (F-F cross section).

- 2) Assemble the poppet (38) and spring (39).

- 3) Install the 2 antidrift valve assemblies (67) and tighten with the hexagon socket head bolts (74).

Tightening torque: 39 - 44 Nm

## 4 Assembly of option section

- 1) Install the 2 caps (88) with O-rings (89) mounted and tighten with the hexagon socket head bolts (75).

Tightening torque: 58 - 64 Nm

- 2) Screw in and tighten the 2 plug assemblies (93) with O-rings and backup rings mounted.

Tightening torque: 78 - 88 Nm

## 5 Assembly of arm regeneration release valve

- 1) Mount the O-ring (30) and 2 backup rings (31) in the sleeve (27-2).

- 2) Assemble the piston (27-3) and spool (27-1) in the sleeve and insert into the valve housing.

- 3) Put the spring (26) into the plug (24) with O-ring (25) mounted, then screw into the valve housing and tighten.

Tightening torque: 103 - 113 Nm

## 5 Adjusting the Relief Valves



**WARNING:** This part is neither disassembled nor adjusted. (It is replaced as an assembly.) Therefore, be aware that proper operation is not guaranteed if pressure is adjusted.

### 1 Main relief valves

- 1) Attach an accurate pressure gauge at the entry circuit.
- 2) Run the pump at its rated rpm.
- 3) Switch spools on the control valve. Read the pressure gauge with the cylinder at stroke end.



**WARNING:** Switch spools on the actuator, in which the set pressure of the overload relief valve is higher than that of the relief valve.

### 4) High-pressure setting (1st stage).

- a) Tighten the plug (8) until the piston (10) touches the plug (6) end surface (section marked \*). At this time, the plug (8) (27 mm hexagon diameter) tightening torque must be 19.6 Nm or less.  
However, when tightening the plug (8), be careful that the plug does not turn too. (The A dimension must be at least 4 mm.)
- b) With the plug (6) in the state in [4] 1), tighten and adjust the pressure. (While watching the pressure gauge, tighten in the plug (6) gradually: 1 turn of the plug raises the pressure 28.4 MPa.)  
After setting the pressure, lock with the hexagon nut.

### 5) Low-pressure setting (2nd stage).

With the high-pressure set in 4), loosen the plug (8) and adjust the pressure.  
(When the plug is loosened, the piston moves to the right in the diagram and the spring load drops: 21.3 MPa pressure drop per one rotation.)  
After setting the pressure, lock with the hexagon nut (7).

- 6) Again raise the pressure and check that it reaches the specified pressure.

### 2 Overload Relief Valve



**WARNING:** If the set pressure is higher than the main relief valve, when adjusting as below, the main relief valve operates, so the overload relief valve cannot be adjusted. That is why the relief valve is not disassembled and adjusted but is replaced as an assembly with an assembly that has already been set.

- 1) Switch the control valve spool and read the pressure gauge at the cylinder stroke end.
- 2) Turn the adjuster clockwise until the required pressure is obtained.
- 3) Reference number 69, total of 6 locations: The pressure rises 21.2 MPa for one rotation of the adjuster.
- 4) When the specified pressure is reached, restrain the adjuster so that it does not turn, then tighten the lock nut.  
Tightening torque: 27.5 - 31.4 Nm
- 5) Again raise the pressure and check that it reaches the specified pressure.

	Storage for 1 month or longer	Storage for 6 months or longer (3 months for cylinder alone)	Storage for 1 year or longer
1	Clean any dust from the cylinder, and then apply anti-rust oil to the pin bushings, flange sections, piston rod, and other sections that rust easily.	Operate the cylinder back and forth with clear hydraulic oil, and then pour anti-rust oil into the cylinder and store in compliance with the items on the left for storage of 1 month.	Since there is a danger of packing deterioration, disassemble, inspect, and replace packings. Also, check for rust inside the cylinder.
2	-	If the cylinder cannot be operated, seal in anti-rust oil.	If a cylinder that has been stored for a long time is used as is, oil may leak due to temporary running-in defects of seals.
3	When storing, be extremely careful not to let parts drop, let them collide with anything, or let anything strike them.		

## 2) Mounted on vehicle body

<ol style="list-style-type: none"> <li>1. Operate the cylinder at least once per month</li> <li>2. Retract the cylinder so that as much as possible outside air does not touch the piston rod and apply antirust oil at least once per month to the exposed part of the piston rod.</li> <li>3. Handle carefully to absolutely avoid scratching the piston rod.</li> <li>4. When putting the cylinder into an environment where rust occurs particularly easily, for example due to exposure to sea breezes during export, always apply anti-rust oil to the piston rod and as much as possible protect with polyethylene sheets or VCI paper (vaporizing anti-rust paper).</li> <li>5. Anti-rust oil and other solvents can have negative impacts on seals, so select anti-rust oil carefully and as much as possible keep it off dust seals etc. (For details on anti-rust oil to select, see "6.3) Recommended anti-rust oil".)</li> </ol>
---

## 3) Recommended anti-rust oil

For inside cylinder	Vaporizing anti-rust oil a. Ferro Gard #1009 (from USC Limited) b. Knuckle Oil #105S (from Parker Industries, Inc.)  For both a. and b., add 3 - 5 % of the hydraulic oil. By volume, Ferro Gard: 5/100 Knuckle Oil: 3/100
For piston rod	Anti-rust P-1300 (from the Nippon Oil Corporation)
For machine worked surfaces other than parts with oil sealed in	Select from JIS K 2246 (anti-rust oil) NP-1 through NP-6.

### [3] Assembly and disassembly procedures

#### 1) Preparations ..... Prepare the Following before Starting Disassembly.

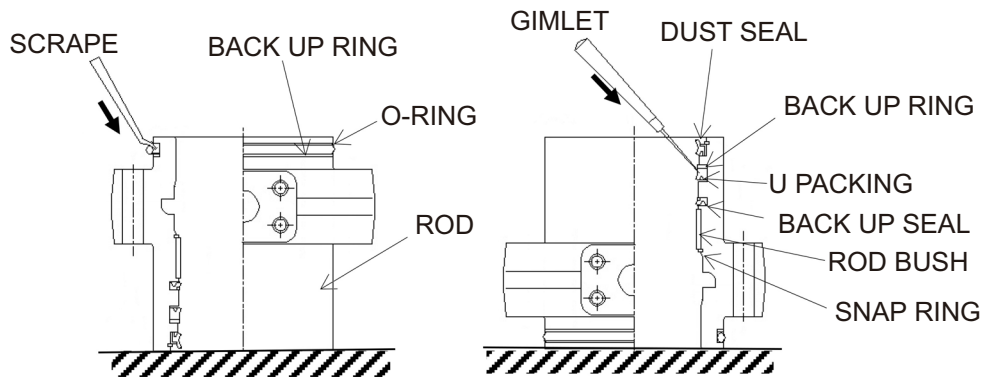
##### (1) Work platform preparation

Prepare a sufficiently spacious, solid and stable work surface so that parts will not fall or move during work.

##### (2) Tool and materials preparation

Prepare the tools and materials shown on the following pages.

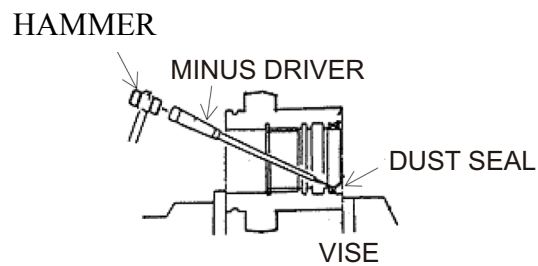
## 11) Remove seals from the rod cover



RM15029-056

Put down the rod cover on the flat floor with cloth things to protect from any damages.

1. First.  
Take out the o-ring, back up ring from a groove of the outer.
2. Turn the rod cover wrong side out.  
Take the Buffer seal, u-packing, back up ring out using the pointed gimlet.
3. Disassembly the dust wiper  
Put a long minus driver at the gap between groove and dust wiper with leaning be careful.  
Not to make any damages.



RM15029-057

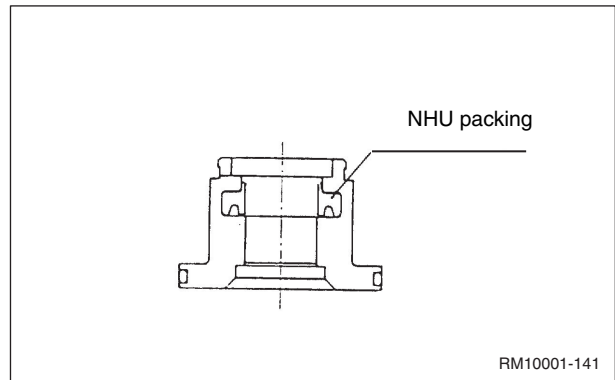
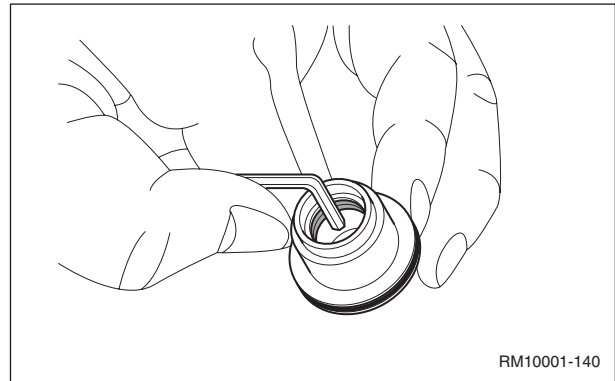
4. You don't have to take the rod bush out except need a replacement (you want to check out the rod bush. Machine the rod cover.)

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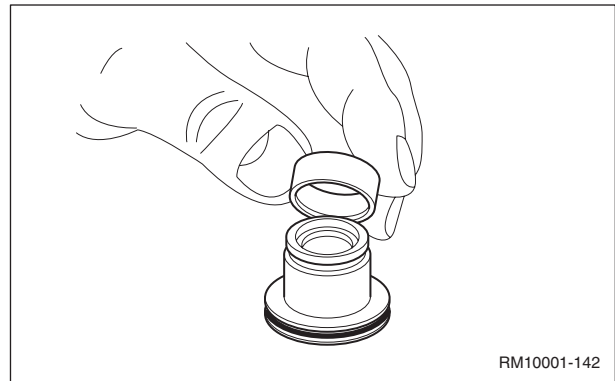
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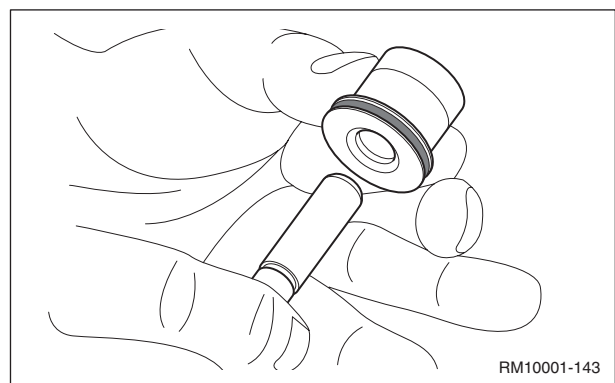
- [13] Install NHU packings (210) into the plugs (202).  
 When installing the NHU packings, be careful of the installation direction. (See the diagram.)  
 Before installing NHU packings, apply a thin layer of grease..



- [14] Install grease cups (203) into the plugs (202).



- [15] Install push rods (214) into the plugs (202).  
 Before installing push rods, apply hydraulic oil to the rod surfaces.  
 Do not press the rods in strongly, as this may damage the NHU packing lip sections.

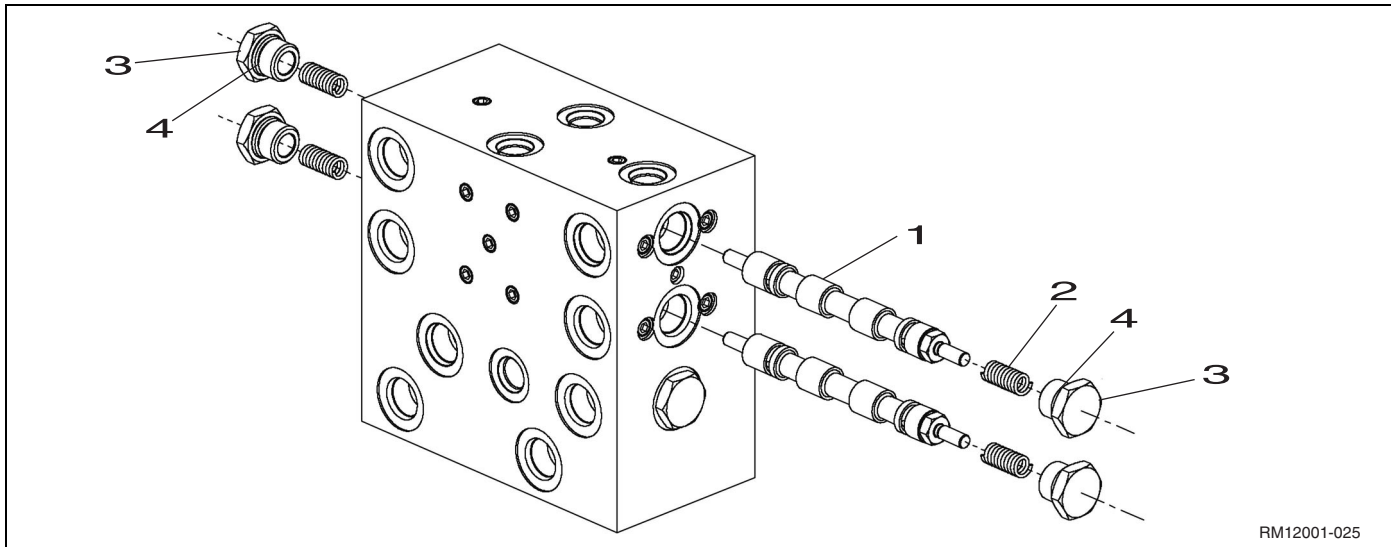


[2] Insert the spool assembly (1) assembled in [1] into the body.

**Caution:** *The spool assembly is symmetrical left/right, so the insertion direction does not matter.*

[3] Insert the springs (2) and assemble the plugs (3) with the O-rings (4) attached.

Tightening torque: 39.2 - 49.0 Nm.



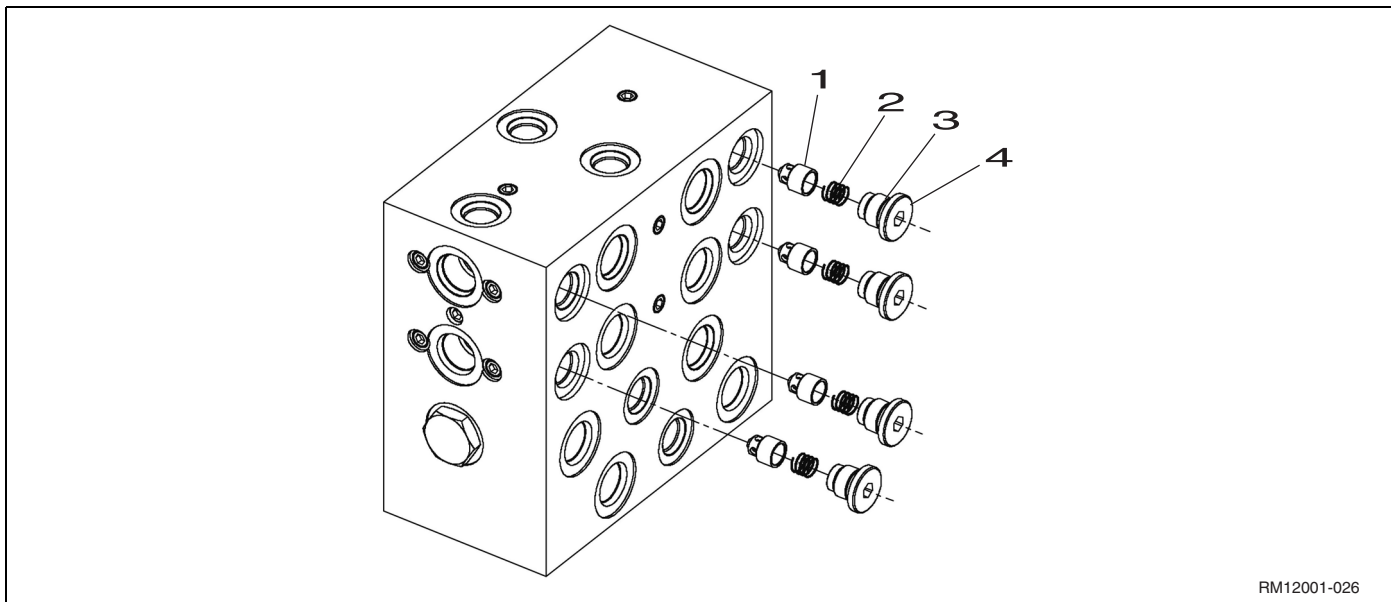
## 2 Check plunger section with throttle

[1] Insert the check plungers (1).

**Caution:** *The check plungers have similar shapes, so be careful to insert each one in its correct position.*

[2] Insert the springs (2) and assemble the plugs (4) with the O-rings (3) attached.

Tightening torque: 29.4 - 31.4 Nm



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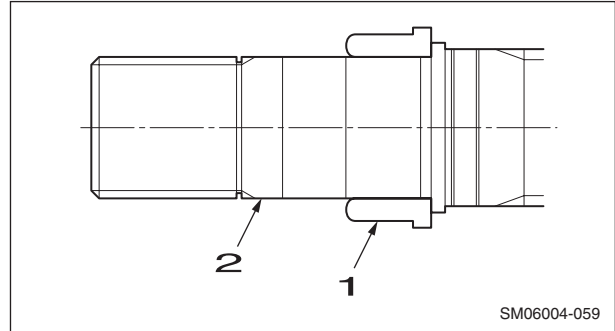
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## 4 Assembly

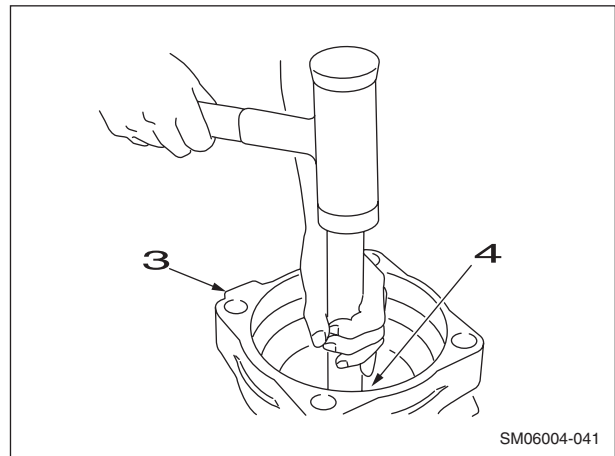
### 1 Preparation before operation.

- 1) Check each part for scratches from use or from disassembly. If there are any scratches, remove them with a whetstone or sandpaper of the necessary grain, clean with pure cleaning oil, then dry off with an air blower.
- 2) Replace seal parts with new ones.
- 3) Thoroughly clean all parts with cleaning fluid and dry with compressed air.
- 4) When assembling sliding sections, apply clean hydraulic oil before assembling.

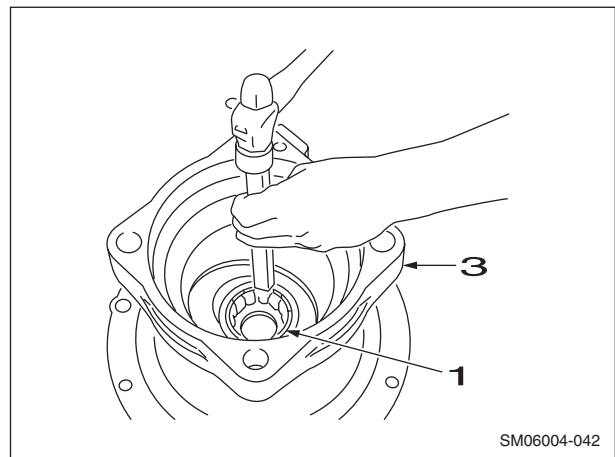
- [1] Place the housing on an appropriate platform with the cover on top.
- [2] If the roller bearing (1) was removed, shrink fit the inner race of the roller bearing to the drive shaft (2).
- Be careful with the direction of the flange of the roller bearing.



- [3] Use a jig to insert the oil seal (4) into the housing (3).
- Be careful with the direction of the oil seal.
  - Apply a thin layer of grease to the oil seal lip section.
  - Be careful to evenly hit it without scratching the outer circumference.



- [4] Use a steel rod to install the outer race of the roller bearing (1) into the housing (3).



Functions	Description	Pages
<b>Arm Circuits</b>		
<b>Arm-out circuit</b>	The flow is merged internally by switching the arm (1) and (2) spool to raise the speed.	<b>Page 36-37</b>
<b>Arm-in forced regenerative circuit</b>	The speed for compound operation is raised by the forced regeneration release valve in the control valve.	<b>Page 38-39</b>
<b>Arm-in load hold valve circuit</b>	1. Load holding valve integrated in the control valve reduces natural drop on the arm-in side. 2. Arm-in pilot pressure enables arm-in operation by releasing the load holding valve	<b>Page 40-41</b>
<b>Bucket circuit</b>		
<b>Bucket-close regenerative circuit (*)</b>	Regeneration within the bucket spool is used to increase speed and prevent cavitation.	<b>Page 44-45</b>
<b>Negative control circuit</b>		
<b>Negative control power save circuit (*)</b>	In the non-operation state, this circuit switches the negative control relief valve set pressure to reduce the pump discharge force and further reduce horsepower consumption.	<b>Page 46-49</b>
<b>Negative control circuit</b>	For no-load operation, this circuit sets the hydraulic pump discharge volume to minimum to reduce horsepower consumption.	<b>Page 50-51</b>
<b>Others</b>		
<b>Cushion circuit</b>	Softens the shock through the work of the cushion valve with heat circuit. This circuit is attached to the boom and arm pilot lines. There is no soft / hard switch. (Inline is disused by the tuning)	<b>Page 52-57</b>
<b>Auto pressure boost circuit</b>	Boosts the main relief pressure from 34.3 - 36.8 MPa according to the engine load ratio and circuit pressure.	<b>Page 60-61</b>
<b>Option circuits</b>		
<b>Breaker circuit</b>	The main control valve has an option section as standard so that it can support a breaker, crusher or other special attachment.	<b>Page 62-63</b>
<b>Option flow adjustment (*)</b>	It is possible to set the flow for the breaker, crusher, or other special attachment application by just operating a switch in the cab. Maximum of 5 applications.	<b>Page 64-65</b>
<b>Multi purpose circuit switch (*)</b>	It is possible to switch the circuit between the breaker and the crusher by just operating a switch in the cab.	<b>Page 66-67</b>
<b>2nd option circuit (*)</b>	Option valve can be added to the top section of the control valve and a 2nd option line can be installed easily.	<b>Page 68-69</b>

**NOTE:** See the tables in the following pages for the relationship between each specification and the optional equipment.

## Swing Brake Circuit (independent operation of swing)

As an example, this section explains the brake circuit operation after the end of a right swing operation.






When the remote control valve is returned to neutral from a right swing operation, the pilot pressure oil is cut off and the control valve swing spool returns to neutral.

The pressurized oil fed to the swing motor A port from the control valve A3 port is cut. At the same time, the destination location is eliminated for the pressurized oil flowing from the swing motor B port to the control valve B3 port, so the pressure rises to the swing motor relief valve set pressure. The pressure generated here becomes a brake force and stops the motor.

When the swing is stopped, the swing motor continues to rotate for a while due to inertial force. In order to make up the shortfall in the oil volume, oil is supplied from the make-up line connected to the swing motor M port from the control valve T3 port to open the make-up check valve and oil is suctioned in to prevent cavitation.

1	Swing motor	9	Lever lock
2	Cushion valve	10	Swing brake
3	Right swing	11	5 stack solenoid valve
4	Left swing	12	Console lever lock switch
5	Swing pilot pressure sensor	13	Computer A
6	Remote control valve (arm, swing)	14	Control valve
7	Hydraulic pump	15	Oil cooler
8	Check valve	16	Upper pilot pressure sensor

### Legend






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

## Boom-down tilting prevention circuit

By operating the remote control valve all the way to the boom-down side at once, even if the boom spool goes its full stroke, negative control pressure is generated by the center bypass bleed-off oil path and the circuit is such that the hydraulic pump does not discharge full flow, so the generation of high pressure is restrained and main unit tilt is reduced. Since the shortfall in the oil volume is compensated by the regenerative circuit, the engine output can be used effectively.

1	Load holding valve check valve	12	Control valve
2	Check valve	13	P2 pressure sensor
3	Oil cooler	14	Hydraulic pump
4	Bleed-off	15	Boom cylinder
5	Cushion valve	16	Boom (1)
6	Boom (up)	17	Travel pilot pressure sensor
7	Boom (down)	18	Upper pilot pressure sensor
8	Remote control valve (boom, bucket)	19	Console lever lock switch
9	Lever lock	20	Monitor display
10	Boost pressure relief	21	Computer A
11	5 stack solenoid valve	22	P1 pressure sensor

### Legend

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

## Negative Control Circuit

### Negative Control Circuit (power save solenoid OFF)






When the remote control valve operation lever is set to neutral, the discharge oil from hydraulic pumps A1 and A2 goes from the control valve P1 and P2 ports through the center bypass oil path, and through the downstream negative control variable relief, and returns to the hydraulic oil tank.

The discharged oil from pilot pump A3 enters the 5 stack solenoid valve P port, flows through the power save solenoid valve, is fed to the control valve Pn1 and Pn2 ports, and holds the P1 and P2 negative control relief at the set pressure of 2.55 MPa.

The negative control pressure oil separated from the center bypass oil path is fed from the Ps1 and Ps2 ports to the hydraulic pump Pi1 and Pi2 ports, moves the pump tilting to the minimum flow side, and the pump discharge flow is reduced.

1	P1 negative control relief	11	N1 negative control pressure sensor
2	P2 negative control relief	12	P1 pressure sensor
3	Control valve	13	P2 pressure sensor
4	Travel pilot pressure sensor	14	N2 negative control pressure sensor
5	Upper pilot pressure sensor	15	Horsepower control proportional valve
6	Computer A	16	P1 flow control proportional valve
7	Console lever lock switch	17	Hydraulic pump
8	Lever lock	18	Check valve
9	Power save	19	Oil cooler
10	5 stack solenoid valve		

### Legend

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

## Auto Pressure Boost Circuit (bucket close)

When an attachment is operated, this circuit boosts the control valve main relief set pressure from 34.3 MPa to 37.3 MPa according to the engine load ratio and hydraulic load pressure, then ends the pressure boost after 8 sec.

As an example, this section explains bucket-close operations.






By moving the remote control valve to the bucket-close side, the pilot pressure oil is fed via the cushion valve to the control valve pb7 port and switches the bucket spool to the close side.

At the same time, the output signal from the upper pilot pressure sensor that detected the pressurized oil separated from the pilot internal path is input to computer A, which judges that there is upper operation. Furthermore, computer A judges that there is a boost in the main pump P1 and P2 pressure, outputs the ON (24 V) signal to the pressure boost relief solenoid, switches the valve, and the pilot pressure oil is fed to the control valve main relief valve PH port to hold the pressure boost relief set pressure for 8 sec.

There is no boost for the option circuit and during travel operation.

1	Cushion valve	11	Upper pilot pressure sensor
2	Bucket (close)	12	Console lever lock switch
3	Bucket (open)	13	Digging force increased
4	Remote control valve (boom, bucket)	14	Monitor display
5	Lever lock	15	Computer A
6	Boost pressure relief	16	P1 pressure sensor
7	5 stack solenoid valve	17	P2 pressure sensor
8	Control valve	18	Hydraulic pump
9	Bucket	19	Check valve
10	Bucket cylinder	20	Oil cooler

### Legend

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

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## **2) Explanation of structures and operations**

### Structure

The casing comprises the front case (361) and gear case (351). Inside the casing the drive gear (353), driven gear (354) pair and the relief valve for setting the discharge pressure are installed. The relief valve comprises the filter (355), poppet (307), seat (308), spring (310), ring (309), adjusting screw (311), and lock nut (312).

In order to prevent oil leaking to the outside, an angle ring (700) and O-ring (710) are mounted on the front case (361).

### Operation

Oil suctioned in from suction port B<sub>3</sub> is discharged from discharge port A<sub>3</sub> by the drive and driven gears.

The discharge oil is held at the set pressure of 3.9 MPa by the relief valve.

Unnecessary discharge oil is drained from the drain port via the relief valve.

### 3] Brake section

The cylinder (111) is coupled with the drive shaft (101) by the gear. Also, the separator plate (743) is constrained for circumferential rotation by the arc groove cut into the casing (301).

When the friction plate (742) that is gear coupled to the cylinder outer circumference section is pressed to the casing (301) by the brake spring (712) via the separator (743) and the brake piston (702), friction force is generated between the friction plate and casing and between the separator plate and the brake piston. The drive shaft is constrained and braked by this friction force.

On the other hand, when brake release pressure is applied to the oil chamber formed between the brake piston and the casing and the hydraulic pressure wins out over the spring force, the brake piston moves, the force pressing the friction plate against the casing disappears, and the brake is released.

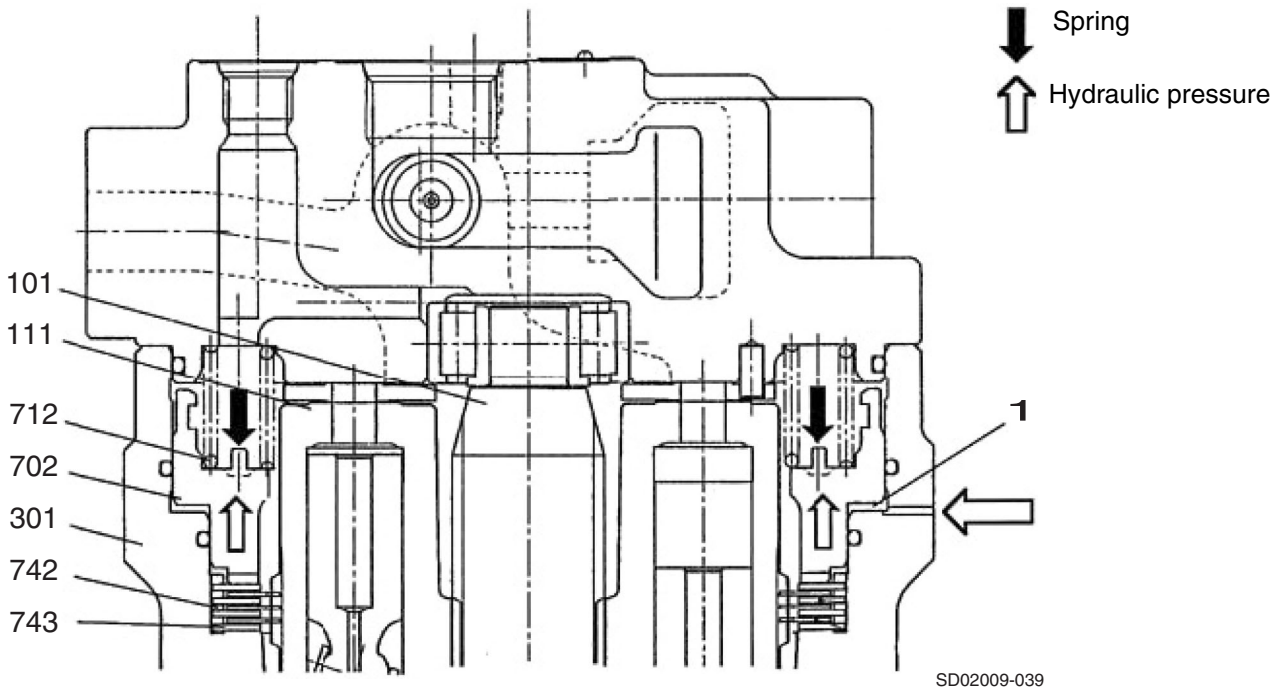
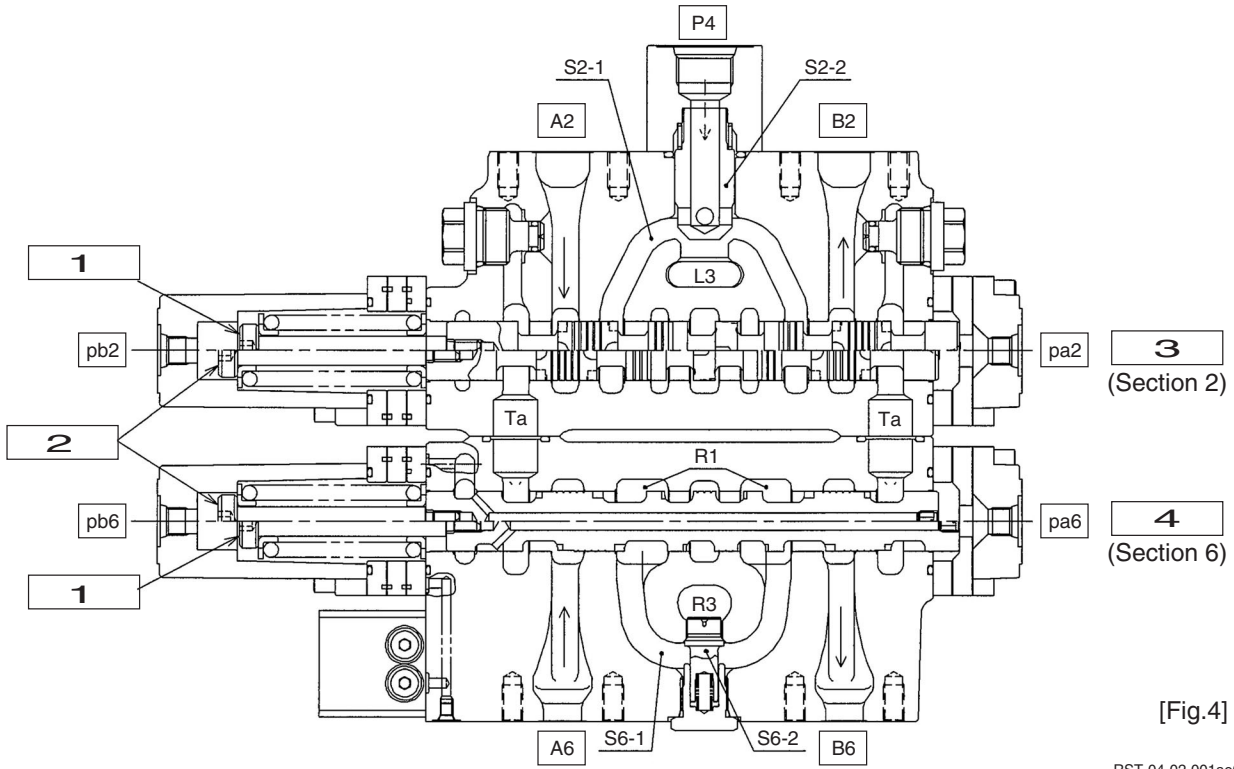


Figure 3 Brake operation diagram

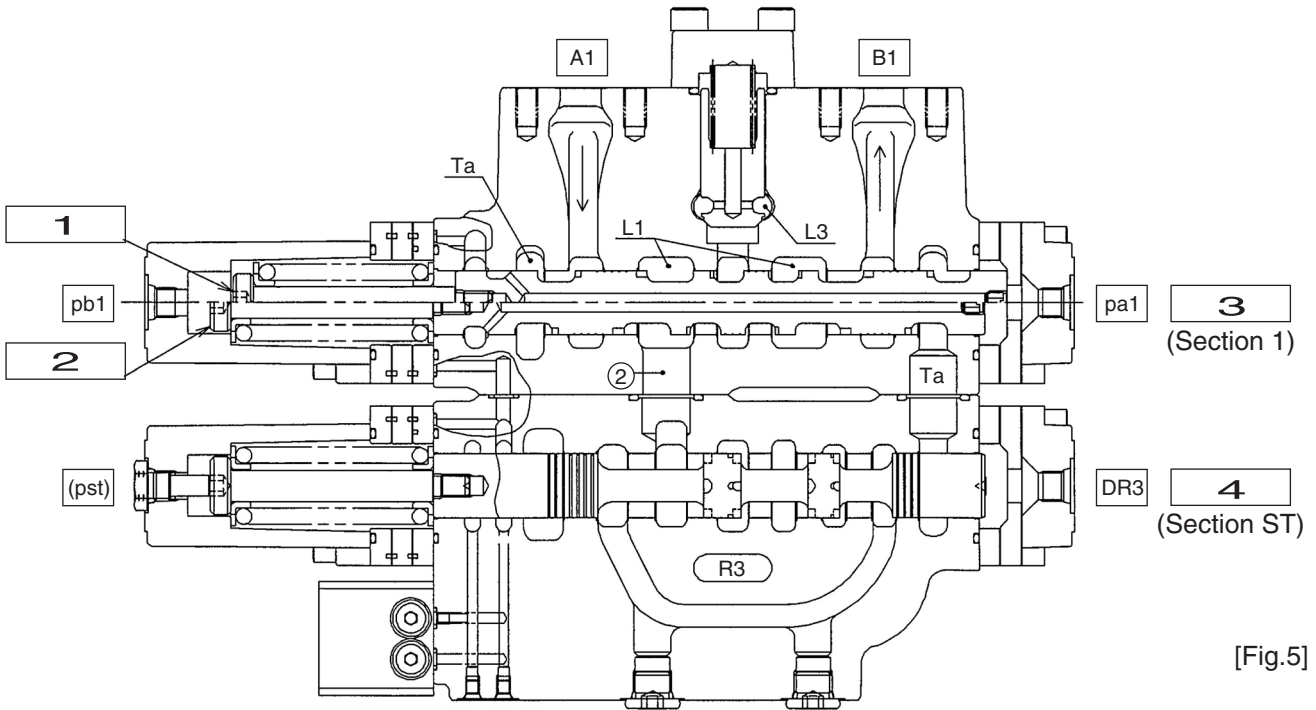
1	Oil chamber
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[Fig.4]

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1	Switching state
2	Neutral state
3	Option
4	Travel



[Fig.5]

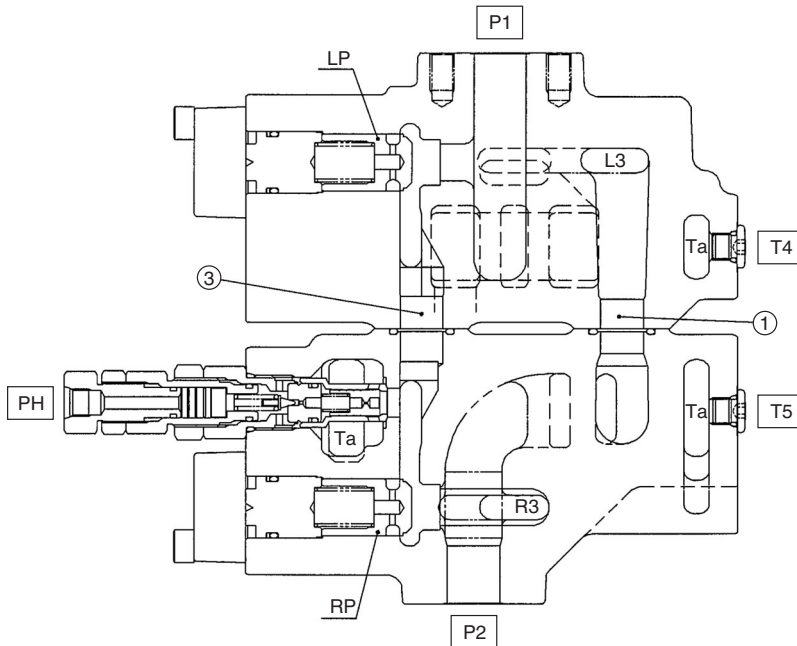
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1	Switching state
2	Neutral state
3	Travel
4	Straight travel

## 8- Relief valve

### 1) Main relief valve [Fig. 17]

The oil fed from the P1 port passes through the poppet (LP) and the oil fed from the P2 port passes through the poppet (RP) and path (3) and is led to the main relief valve. The maximum pressure of the P1 and P2 side pumps is controlled by the operation of the main relief valve.

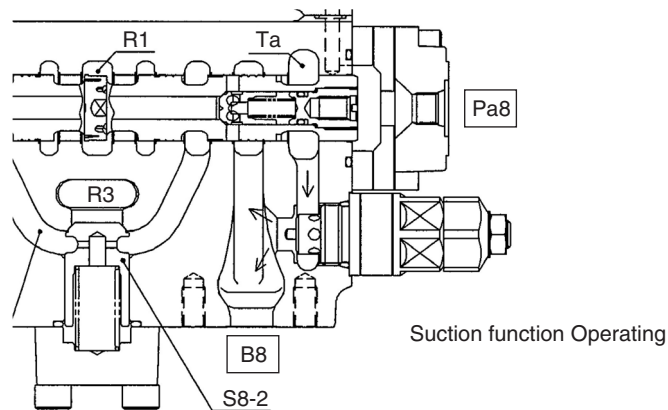


[Fig.17]

RST-04-02-001bb

### 2) Overload relief valve [Fig. 18]

There is an overload relief valve at the boom 1, arm 1, bucket, and add-on cylinder ports to prevent any abnormal rise in actuator pressure, for example due to an external force. This relief valve is also equipped with a function for preventing cavitation (suction function) by taking in oil from the tank when the cylinder port pressure becomes negative pressure.



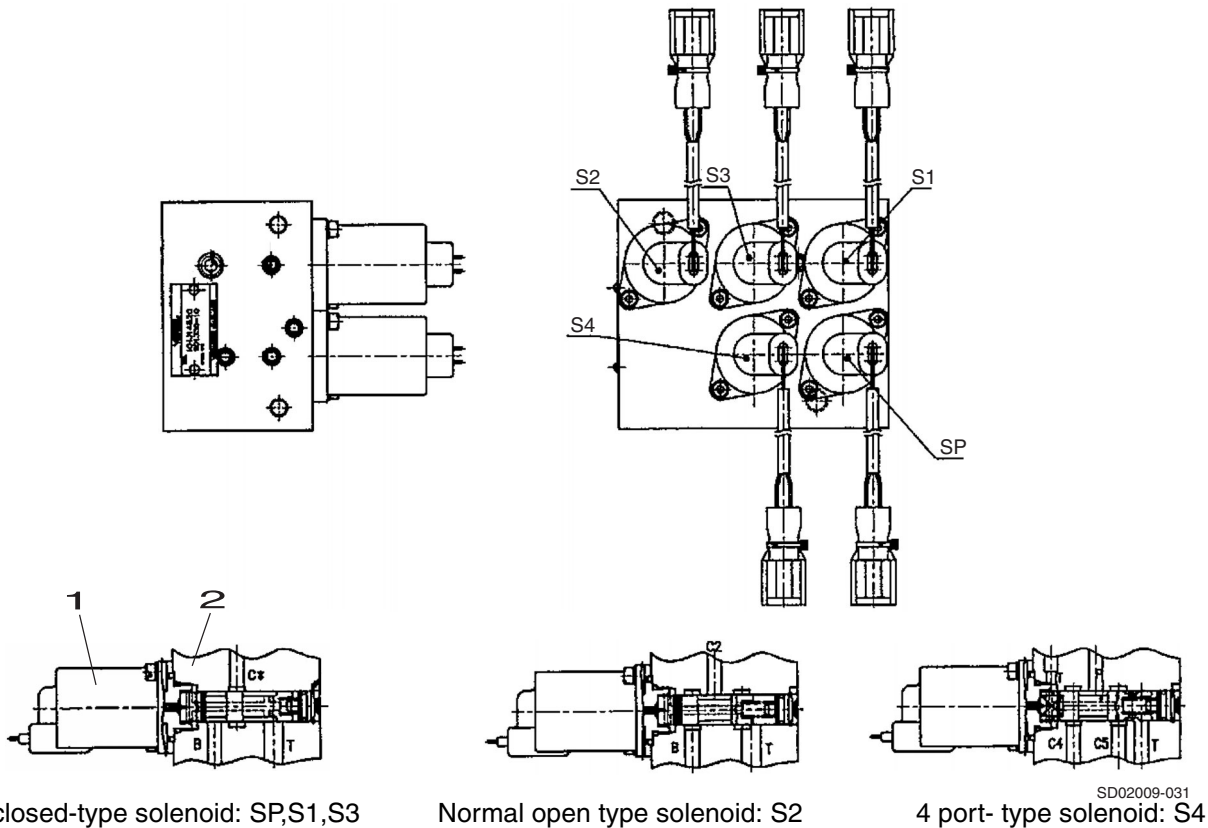
[Fig.18]

RST-04-02-001cb

## 2.5 Stack Solenoid Valve Operation Explanation

### 1) External shape diagram and component parts

This valve is made up of the body and the electromagnetic switchover valve.



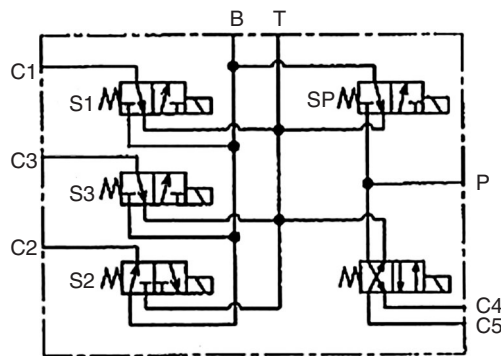
Normal closed-type solenoid: SP,S1,S3

Normal open type solenoid: S2

4 port- type solenoid: S4

1	Electromagnetic switchover valve	2	Body
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### 2) Operation explanation



RST-04-02-001bz

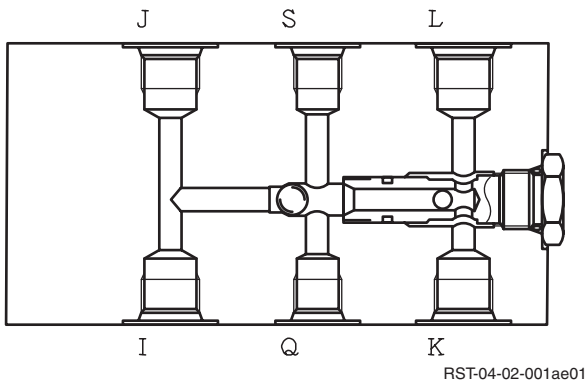
#### Hydraulic circuit diagram

The pressurized oil fed from the P port feeds pressurized oil to the C1 - C5 ports according to the excitation or non-excitation of electromagnetic switchover valves S1 - S4 resulting from exciting electromagnetic switchover valve SP.

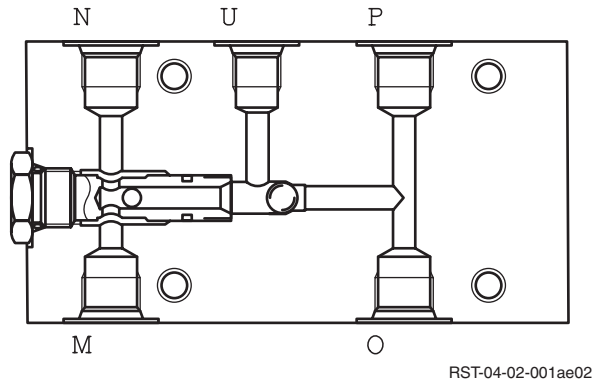
- Electromagnetic switchover valves S1 and S3 -> Oil passing through when valve excited
- Electromagnetic switchover valve S2 -> Oil passing through when valve not excited
- Electromagnetic switchover valve S4 -> Oil passing to C5 when valve excited  
Oil passing to C4 when valve not excited

### 5] Shuttle valve

The steel ball is pressed from the high pressure to the low pressure, of the pressure between the I and J ports and the pressure between the K and L ports. Through this, the high-pressure oil is fed to the S port or the Q port. In the same way, oil is fed to the U port at the higher of the pressures between the M and N ports and between the O and P ports.



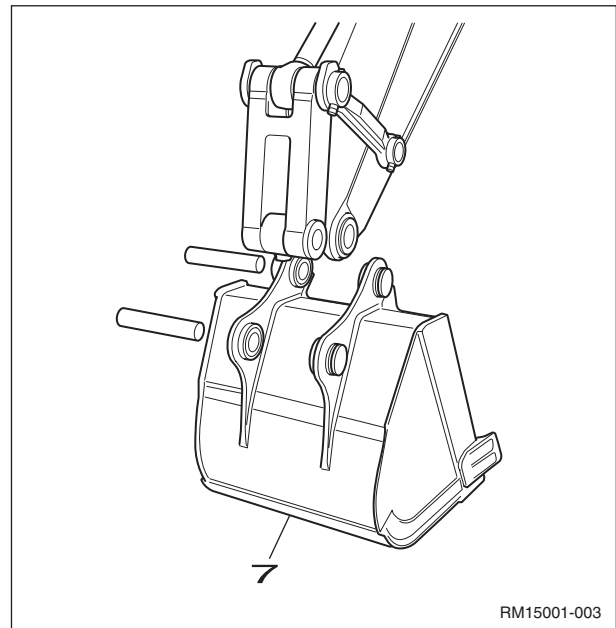
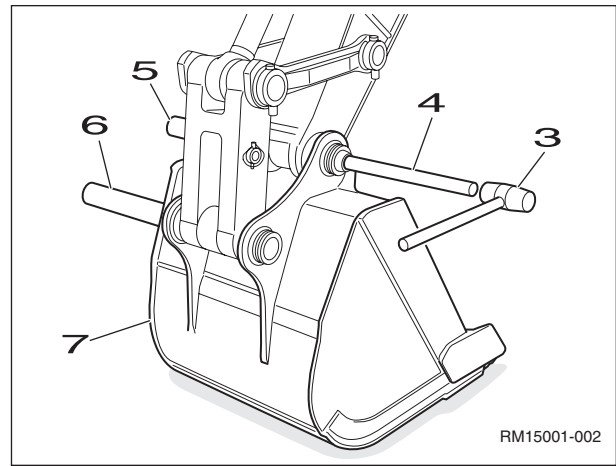
**Figure 8**



**Figure 9**

[3] Use a hammer (3) and striking rod (4) to push the bucket side pin (6) and arm side pin (5) out, and then remove the bucket (7).

- If a pin is hard to remove, there is a load on the pin. Do not force it. Adjust the bucket position.
- When removing the pins, be careful not to damage the O-rings or dust seals.



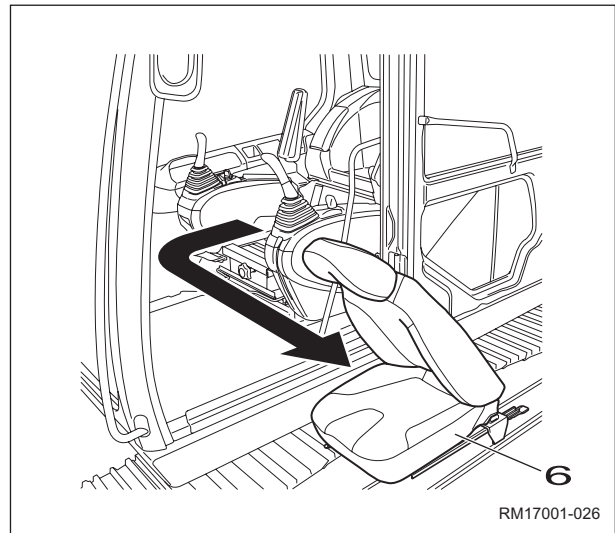
## 2 Installation of bucket

Perform the reverse of the removal procedure.

- Clean each pin and pin hole.
- If a pin is hard to insert, do not force it. Adjust the bucket position.
- When inserting pins, be careful not to damage the O-rings or dust seals.
- As the final step, always grease up.

9004-4

[5] Remove the operator's seat (6).



## 2 Installation of operator's seat

To install, perform the reverse of the removal procedure.

The tightening torque for the seat installation bolts is 19.6 Nm.

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