

# **300X4**

Excavator

# **SERVICE MANUAL**

WLSM3007-07LX

Dec. 2018

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## b. Stop operation (Brake operation)

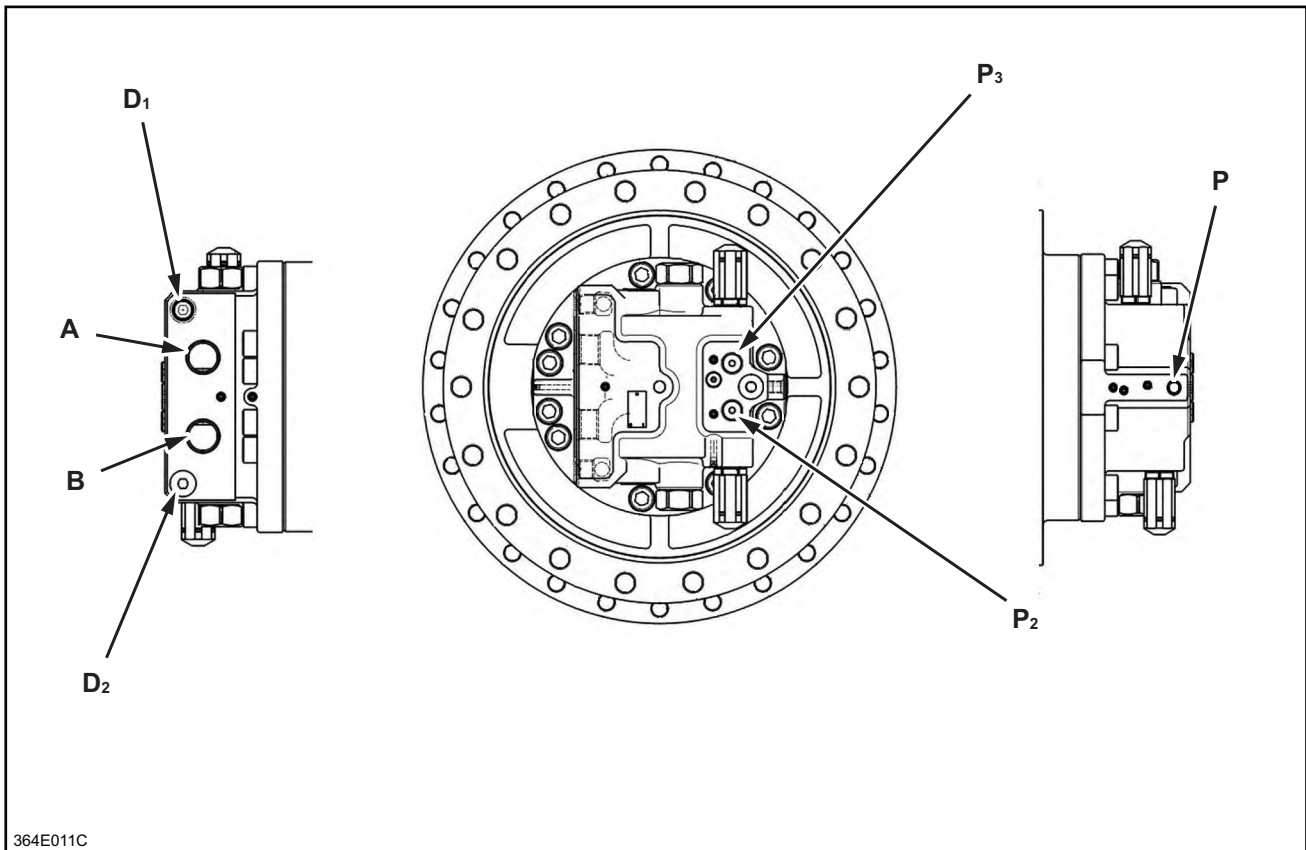
When the pressure oil supplied from the (A) port is stopped during traveling, the hydraulic pressure pushing the spool (323) will be lost, and the spool (323) slid to the right side will attempt to return to a neutral state via the spring retainer (325b) by force of the spring (328b). At this time, the oil in (a) chamber attempts to go through the spool (323) out to the (A) port side; however, back pressure occurs by the orifice effect of spool (323) and spring retainer (325b) to control the return speed of spool (323). Since, at the same time, the hydraulic motor attempts to rotate by inertial force even if the pressure oil is stopped, the return oil of hydraulic motor attempts to return from the (D) port through the clearance (path) between spool groove and rear flange to the (B) port side.

When the spool (323) has returned to a neutral state completely, the hydraulic motor return-side path will be completely interrupted by the spool (323), and the hydraulic motor will stop. During work, this brake valve throttles the hydraulic motor return-side path by the sliding speed control of spool (323) and the groove shape of spool (323) to generate back pressure, thereby smoothly stopping the hydraulic motor that attempts to rotate by inertial force. On the other hand, when the brake is applied to attempt to stop the hydraulic motor, inertial force will work and it will keep rotating to attempt to pump oil in even if supply of the pressure oil is stopped. However, the inlet-side path is interrupted by the spool (323); therefore, no more oil can be supplied and cavitation attempts to occur. At this time, the valve (327a) operates by very slight negative pressure, and opens the oil path between (A) port-side circuit and motor inlet section (C) port to prevent cavitation of the hydraulic motor. Note that, if pressure oil is supplied from the port (B), each motion of the above parts is reversed to stop the hydraulic motor.

## A. LOWER

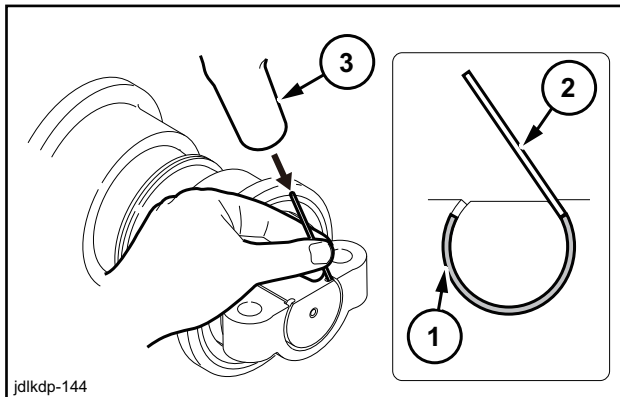
### Port Diagram

#### Travel Motor

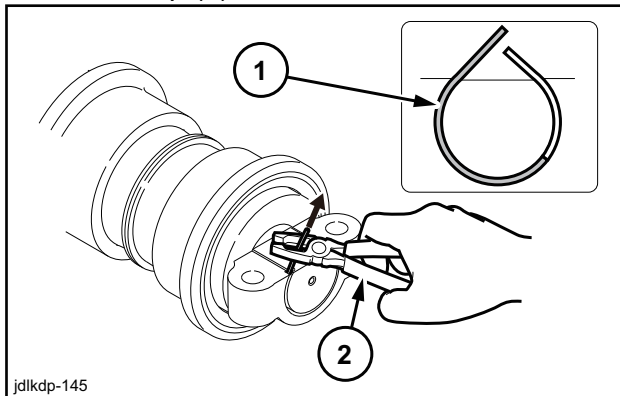


Port	Port name	Port size
D1	Drain port	PF 1/2
D2	Drain port	PF 1/2
A	Main port	PF 1
B	Main port	PF 1
P	Pilot port	PF 1/4
P2	Pressure detection port	2-PF 1/4
P3	Pressure detection port	2-PF 1/4

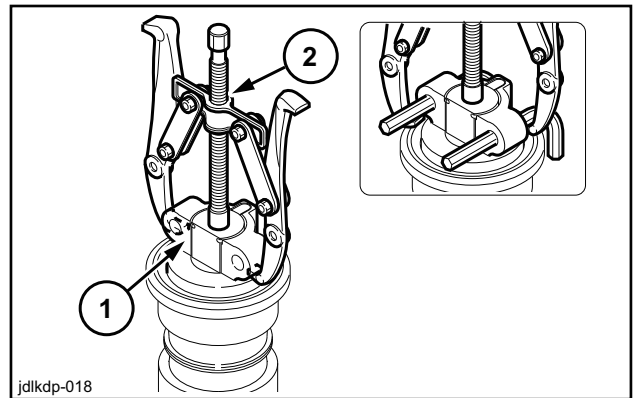
3. Remove the wire clip (1).  
Tap another wire (2) with the hammer (3) from the outside to push out the wire clip that is already in the roller.
  - Place the roller horizontally and secure it so it does not roll before doing this work.
  - The wire in the roller is very securely fixed, so prepare several wire clips. Also be sure to coat with lubricant.



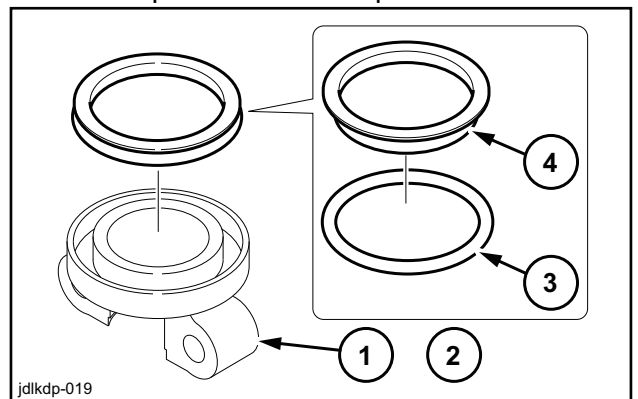
4. Use pliers (2) to remove the pushed out wire clip (1).



5. Use a gear puller (2) to remove the collar (1).  
If the collar is difficult to remove, hook the collar on the bolt and catch the puller on that part.
  - If the collar has rusted or is difficult to remove due to an accumulation of debris, subject it to a shock, for example by hitting it with a hammer, to make it easier to move.
  - When hitting it with a hammer, be careful not to dent it.



6. Check whether the surface of the floating seal (2) sliding against the removed collar (1) has rusted or is damaged. Also make sure the O-ring (3) on the seal ring (4) is not twisted.
  - The O-ring cannot be reused. Replace it with new part.



7. Remove the floating seal (1) on the roller. As described in step 6, check whether the sliding surface has rusted or is damaged. Also make sure the O-ring is not twisted.

## A. LOWER

### Removal and Installation of Center Joint

Job code **JRRJ01**

#### ⚠ Caution

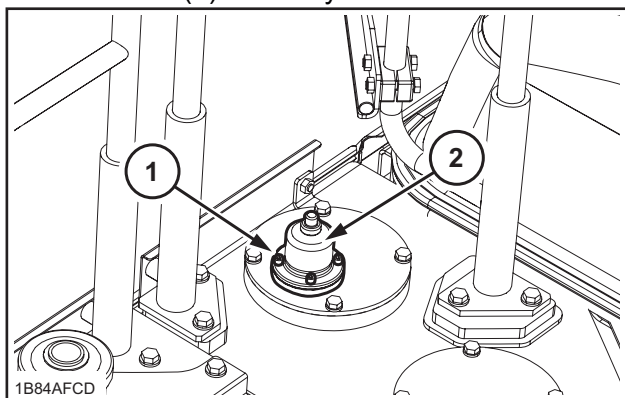
- Make sure to stop the engine before starting work.
- Make sure to check slinging apparatus such as a wire rope before starting work.
- Never allow any person to enter underneath a slung load.

#### Items to prepare

- Wrench [19 mm (0.748 in.), 24 mm (0.945 in.), 27 mm (1.063 in.), 41 mm (1.614 in.)]
- Hexagon wrench [5 mm (0.197 in.), 8 mm (0.315 in.)]
- Box wrench [19 mm (0.748 in.)]
- Dedicated adapter for connecting vacuum pump
- Vacuum pump (power supply for vacuum pump)
- extension cable
- Marking pen
- Cap
- Plug
- Wire rope (that fulfills breaking load)
- Liftcrane (that fulfills slinging capacity)
- Wood plank
- Rag
- Cleaning fluid
- Waste oil can

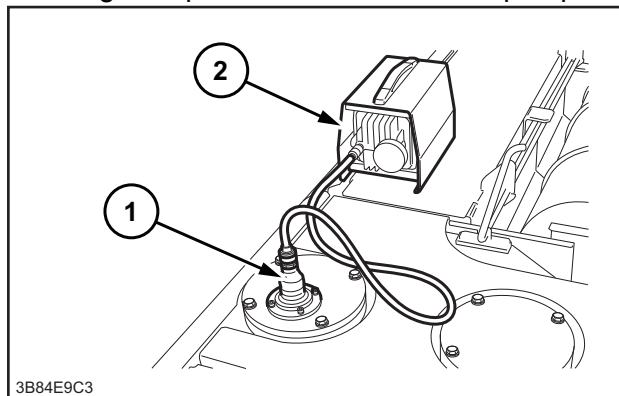
#### Removal of Center Joint

1. Remove the 4 bolts (1) with a hexagon wrench [5 mm (0.197 in.)] to remove the air breather (2) of the hydraulic oil tank.

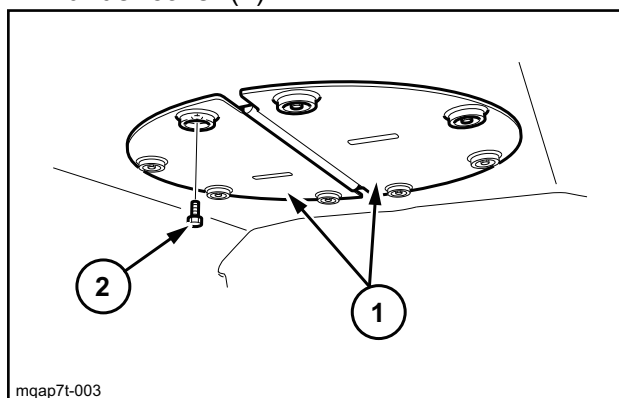


2. Mount the dedicated adapter (1) at the location from which the air breather has been removed and then set the vacuum pump (2).

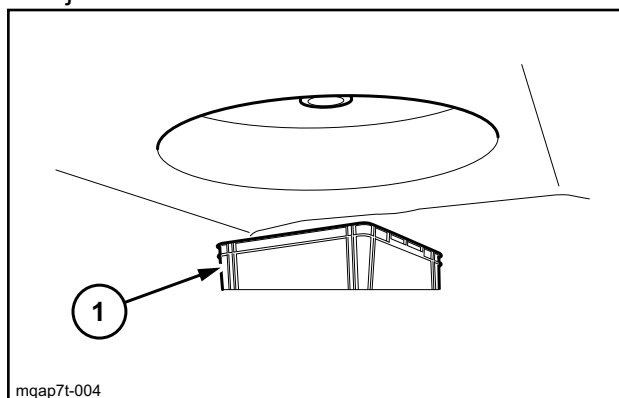
Keep inside of the hydraulic reservoir in negative pressure with a vacuum pump.



3. Remove the 8 bolts (2) with a box wrench [19 mm (0.748 in.)] to remove the lower under cover (1).



4. Prepare a waste oil can (1) in order to receive the oil spilling under the center joint.

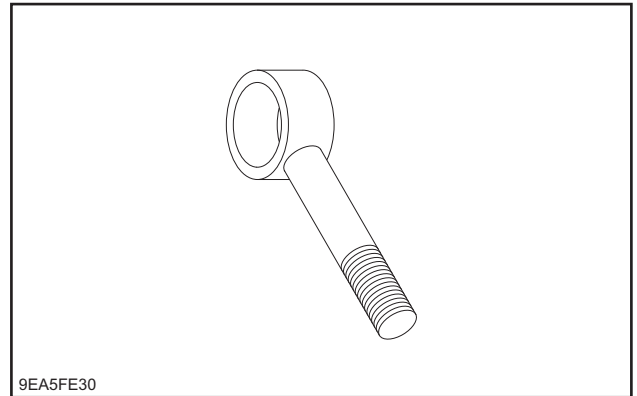


5. Remove the travel hoses (1) with a wrench [41 mm (1.614 in.)], the drain hoses (2) with a wrench [27 mm (1.063 in.)], and the pilot hoses (3) with a wrench [19 mm (0.748 in.)].

- Apply marking to the center joint and the hoses so as to match connections during assembly.

Name: Long eyebolt

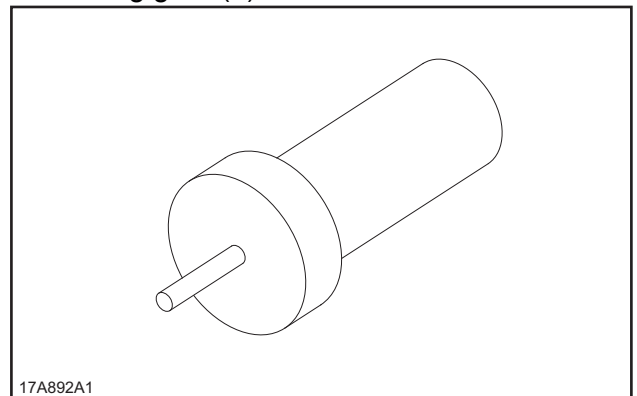
- This is for lifting the travel motor, the carriers (2) and (7), the spindle (101), the housing (15), and the ring gear (1).



Application	"A"
Housing	M 20
Spindle	M 24
Carrier (2)	M 10

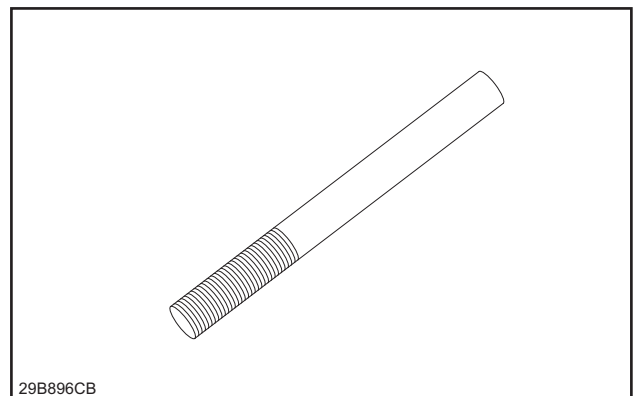
Name: Brake piston removal jig

- This is for removing the brake piston (112) from the ring gear (1).



Name: Guide pin (M18)

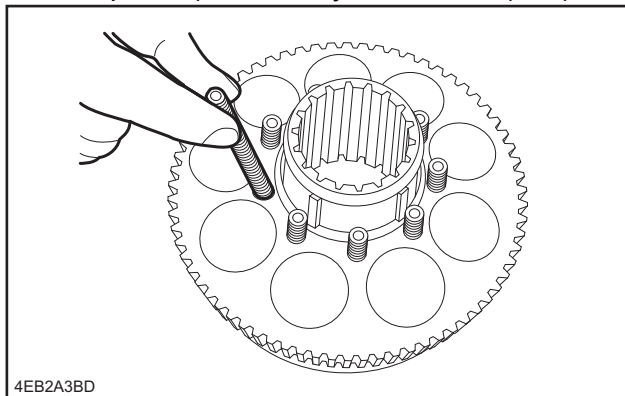
- This is used for easy positioning of the bolt holes in rear flange (301) during disassembly and assembly of rear flange (301).



## A. LOWER

### 4. Assembly of inside of cylinder block

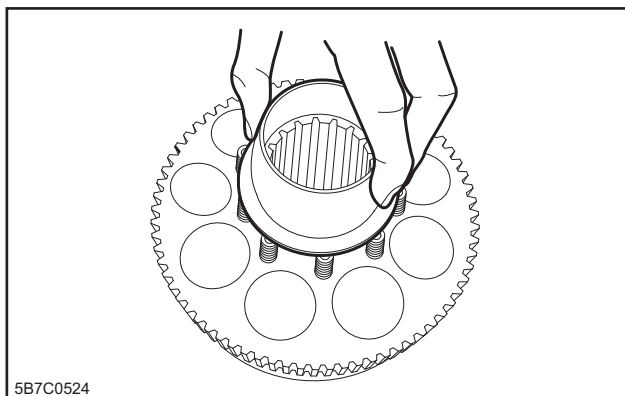
[1] Put the cylinder springs (114) (9 pieces) into the cylinder block (104).



[2] Attach the thrust ball (108) to the cylinder block (104).

#### Note

Be careful not to incline the thrust ball (108) during insertion. If it is left inclined during assembly, this may cause damage to the motor components.



[3] Insert 9 pieces of piston assemblies into the retainer plate (107).

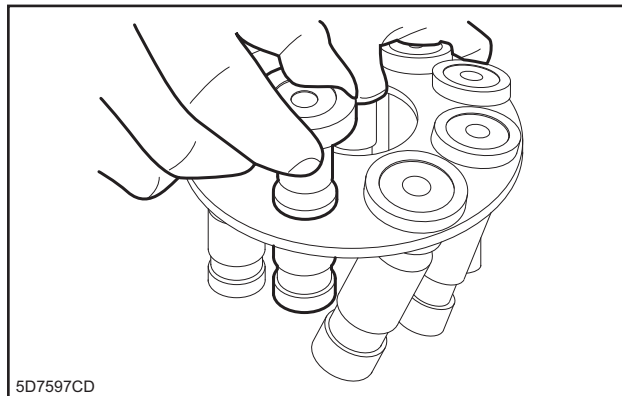
#### Note

After assembly, soak the whole in hydraulic fluid. Make sure that the pre-disassembly combination of the hole in retainer plate (107) and the piston assembly can be recovered.

[4] Assemble the retainer plate (107) and 9 pieces of piston assemblies to the cylinder block (104).

#### Note

Neatly align the retainer plate (107) and the spherical section of thrust ball (108) with each other, and check that they slide.



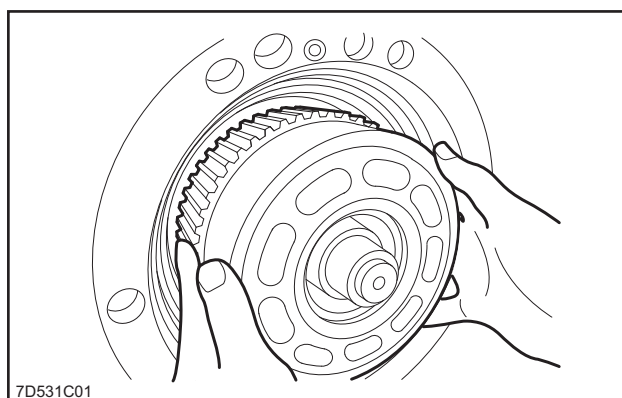
[5] Insert the cylinder block (104) into the shaft (102).

#### Note

When inserting the cylinder block (104), align the spline hole with the spline axis of shaft (102).

#### ⚠ Caution

If the shaft (102) is not fixed, the shaft (102) topples over during insertion and the swash plate (103) separates from the spindle (101) end face, causing assembly failure. Be careful.



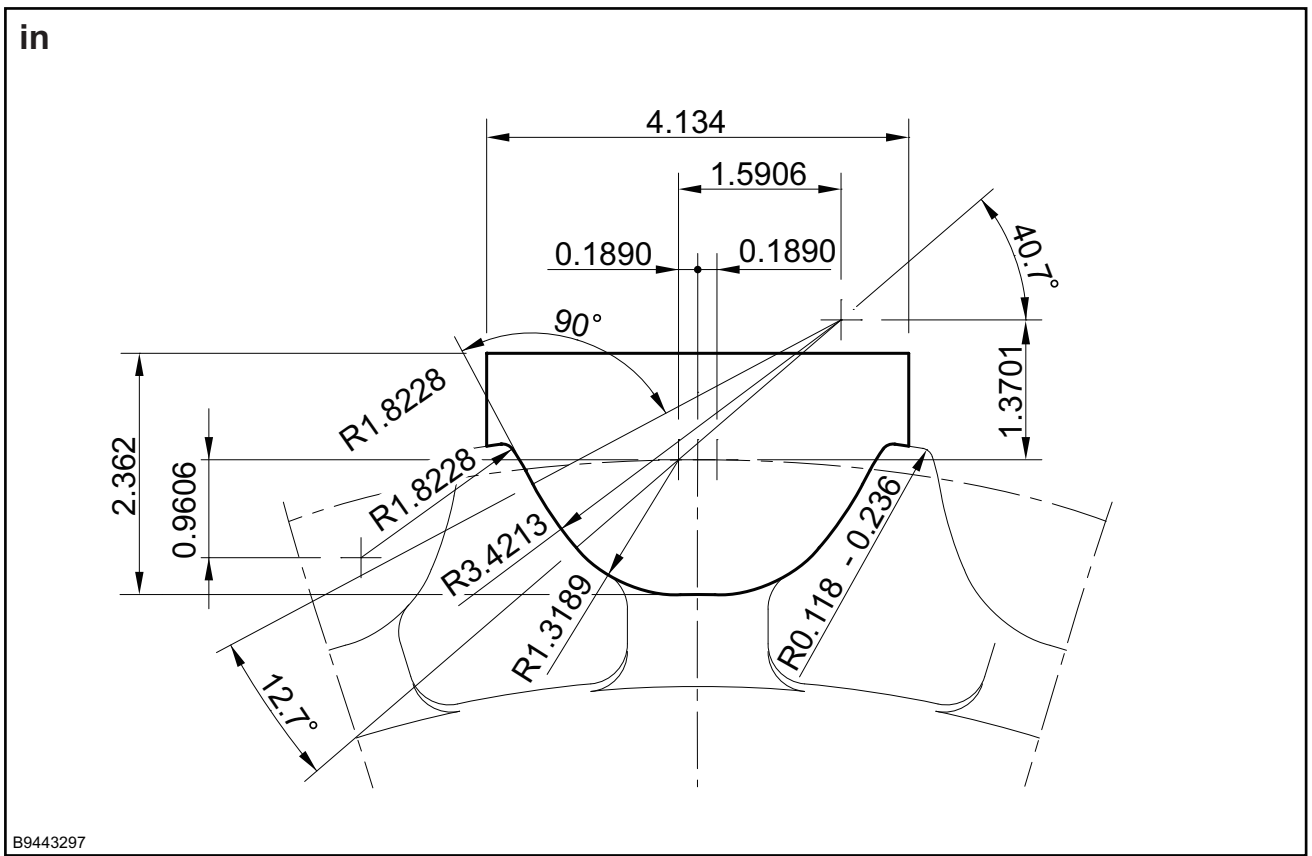
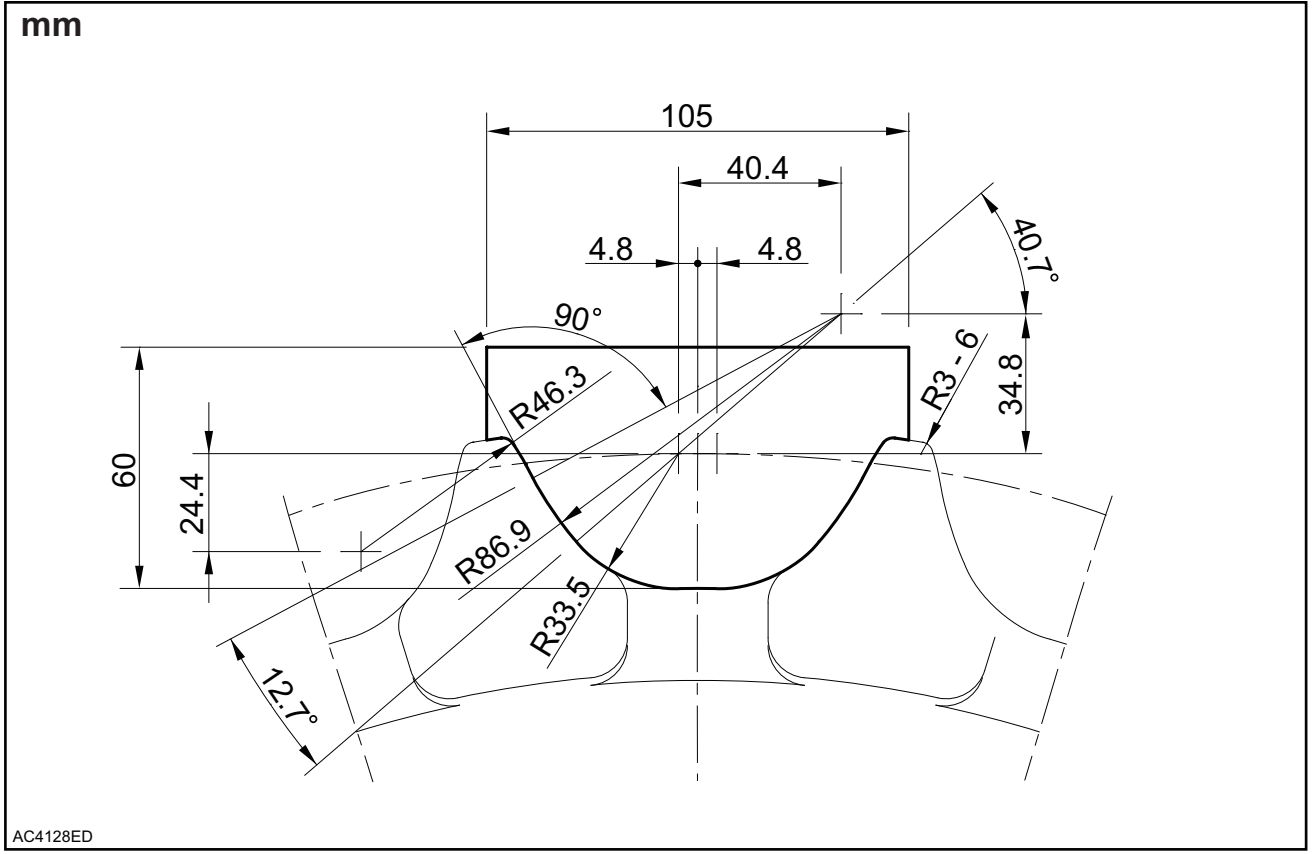
### 5. Assembly of parking brake section

[1] Turn it to locate the rear flange side in the upper part.

#### Note

The friction plate (115) should be soaked in hydraulic fluid before fitting.

Inspection Gauge  
For Drive Sprocket



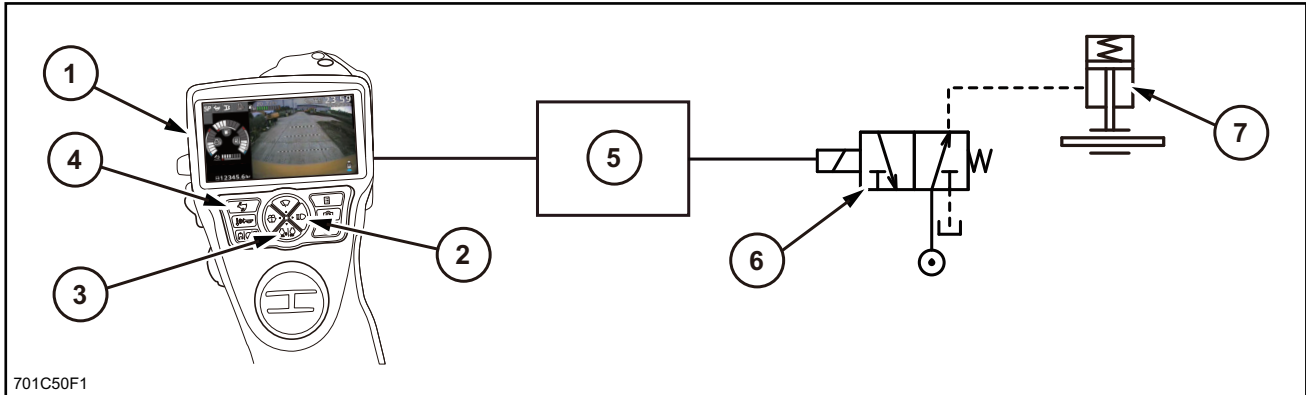
A. LOWER

## B. C. SWING UNIT, COUNTERWEIGHT

### Swing Lock

#### <Purpose/Overview>

The swing lock function prevents any swing by turning ON the swing brake continuously for maintenance purpose such as pressure resistance inspection in plant or swing relief pressure measurement.



1	Monitor	4	Travel mode select switch	7	Swing brake
2	Working light switch	5	Main controller		
3	Auto idle switch	6	Swing brake solenoid		

#### <Control>

##### Operation:

- [1] The monitor monitors statuses of the travel mode select switch, the working light switch, and the auto idle switch to transmit them to the main controller via CAN communication.
- [2] The main controller makes judgment/control of statuses of the respective switches based on received signal to activate the swing brake solenoid (and the free swing solenoid as well depending on the status).

##### Operation condition:

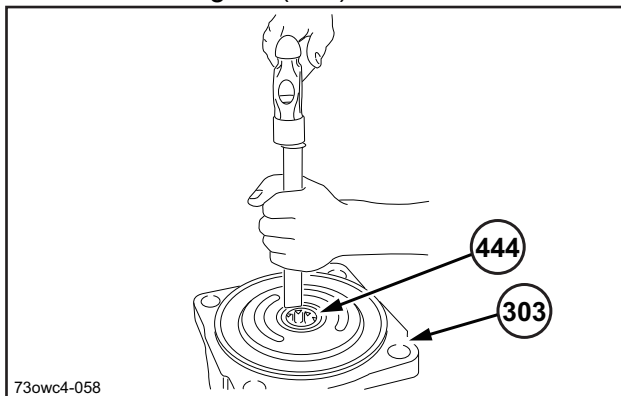
- Pressing and holding down the travel mode select switch + the working light switch + the auto idle switch for 3 seconds turns ON the swing brake to display the swing lock icon on the monitor.
- When turning ON the key, the system starts with the swing lock ON if the swing lock was ON at the previous key OFF. (Sustaining the previous mode)
- The system holds the swing brake ON even with operation of the upper or the swing during swing lock.  
Note: Driving force of the swing motor exceeding brake force may cause swinging even during swing lock.
- Swing lock has a priority in the following cases.
  - When the swing lock is operated during free swing.
  - When the free swing switch is pressed during swing lock.

##### Stop condition

- Pressing and holding down the travel mode select switch + the working light switch + the auto idle switch for 3 seconds during swing lock turns OFF the swing brake to hide the swing lock icon on the monitor.

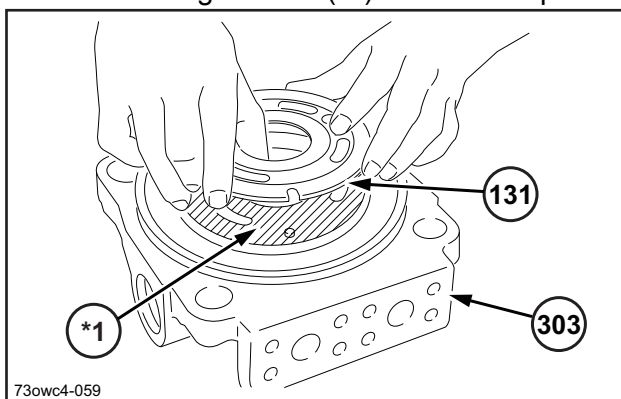
## B. C. SWING UNIT, COUNTERWEIGHT

14. If the roller bearing (444) was removed, use a hammer and steel rod to insert it into valve casing H0 (303).



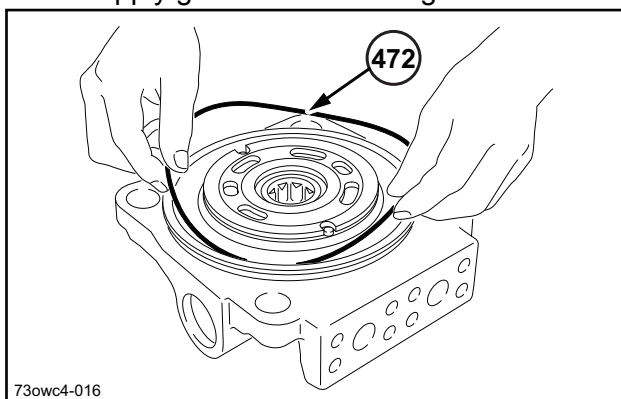
15. Install valve plate B (131) in valve casing H0 (303).

- Apply a thin layer of grease to the matching surface (\*1) of the valve plate.



16. Mount the O-ring (472) to the cover.

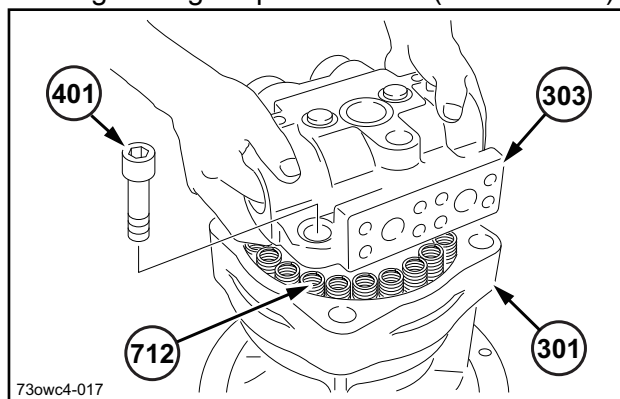
- Apply grease to the O-ring.



17. Install valve casing H0 (303) on casing JA1 (301) and tighten with the bolt (401).

- Be careful with the installation direction of the valve.
- Make sure that valve plate B (131) does not fall over.
- Make sure that the brake springs (712) do not fall over.

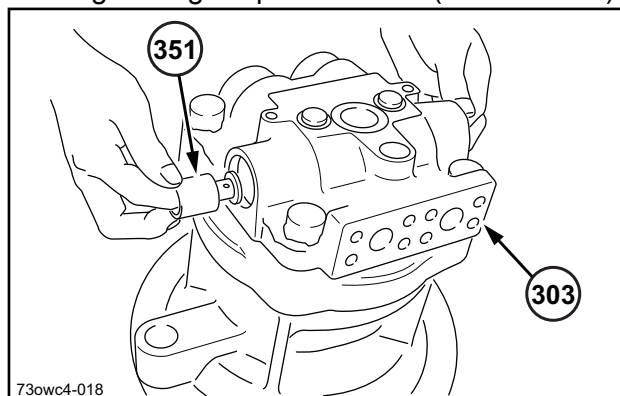
Tightening torque: 430 N·m (317.21 lbf·ft.)



18. Insert plungers H2 (351) and springs (355) into valve casing H0 (303) and tighten the ROMH plugs (469) with the O-rings (488) mounted on them.

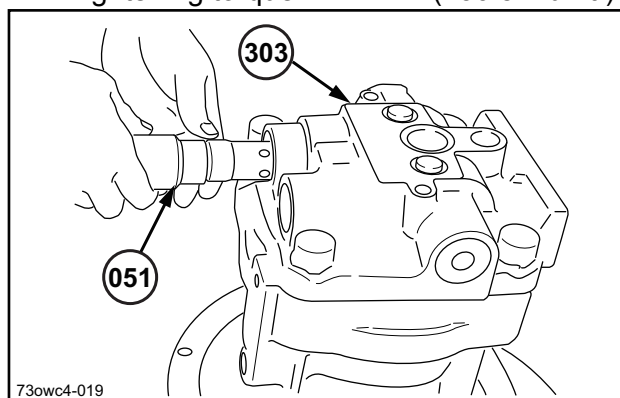
- Check that plunger H2 (351) moves smoothly.

Tightening torque: 539 N·m (397.61 lbf·ft.)



19. Mount the relief valve (051) in valve casing H0 (303).

Tightening torque: 177 N·m (130.57 lbf·ft.)



## H. ENGINE

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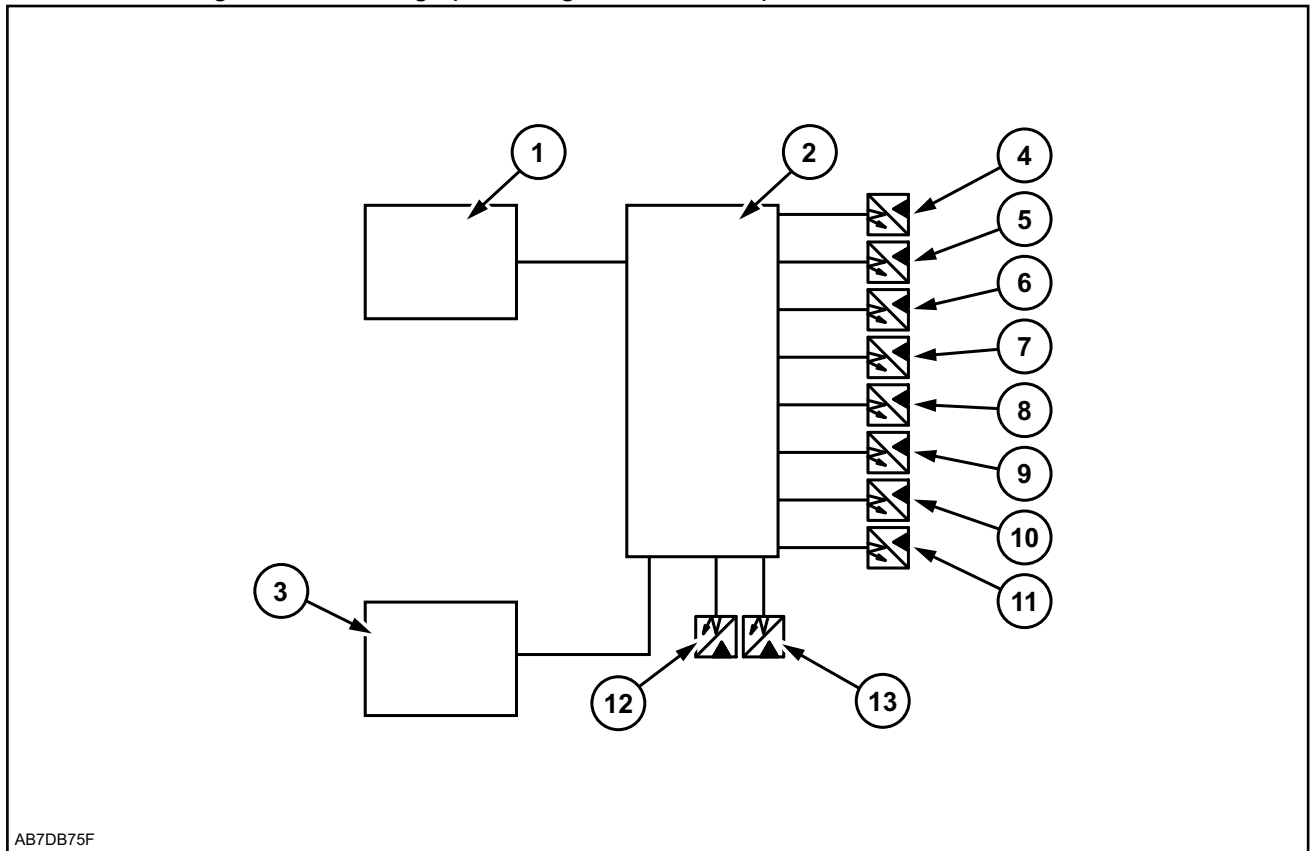
### SCR

Manufacturer	Tokyo Radiator MFG. Co.,Ltd.
Urea capacity	138.1 L
Weight	13.6 kg

**Idle start**

〈Purpose/Overview〉

Starts the engine at low idling speed, regardless of the position of the throttle volume.



1	Throttle volume	6	Arm-out pressure sensor	11	Travel pressure sensor (right/left)
2	Main controller	7	Arm-in pressure sensor	12	Option 1 pressure sensor
3	One-touch idle switch	8	Boom-up pressure sensor	13	Option 2 pressure sensor
4	Bucket-open pressure sensor (upper)	9	Boom-down pressure sensor		
5	Bucket-close pressure sensor (upper)	10	Swing pressure sensor		

〈Control〉

Operation condition:

- If the engine coolant temperature is not low (less than 50°C), reduce the engine speed to low idle speed.

Stop condition:

Low idle speed is canceled in the following conditions.

- When you operate the operation lever.(Either the upper, swing, travel, option 1, or option 2 pressure sensor is ON)
- When you operate the throttle volume.
- When you operate the one-touch idle switch.

## H. ENGINE

Processing and judgment time differ between (1) and (2).

### a) Judgment in normal mode

The concept of judgment flow is as follows. Since this is just a concept, the actual control logic differs a little. It also differs according to the operation condition.

#### Remaining urea level

Step	Judgment condition in normal mode	Yes	No
1	Since the key was ON, 4 seconds have passed, and also DCU-ECM communication is normal.	To step 2	Status quo maintained
2	The remaining urea level remains 0% for 10 seconds.	Final Inducement triggered	To step 3
3	The remaining urea level remains 5% or less for 10 seconds.	Early Inducement triggered	To step 4
4	The remaining urea level remains 10% or less for 10 seconds.	Put into the Warning state	Put into the Normal state

#### Urea solution quality / Urea injection stop / SCR system failure / NCD-target component failure

Step	Judgment condition in normal mode	Yes	No
1	Since the key was ON, 60 seconds have passed, and also DCU-ECM communication is normal.	To step 2	Status quo maintained
2	The abnormality detection state remains for 3.5 hours.	Final Inducement triggered	To step 3
3	The abnormality detection state remains for 3 hours.	Early Inducement triggered	To step 4
4	The abnormality detection state remains for 10 seconds.	Put into the Warning state	Put into the Normal state

#### EGR system failure

Step	Judgment condition in normal mode	Yes	No
1	An EGR system-related error code occurred.	To step 2	Status quo maintained
2	An EGR system failure remains for 100 hours.	Final Inducement triggered	To step 3
3	An EGR system failure remains for 36 hours.	Early Inducement triggered	Put into the Warning state simultaneously with the EGR system failure

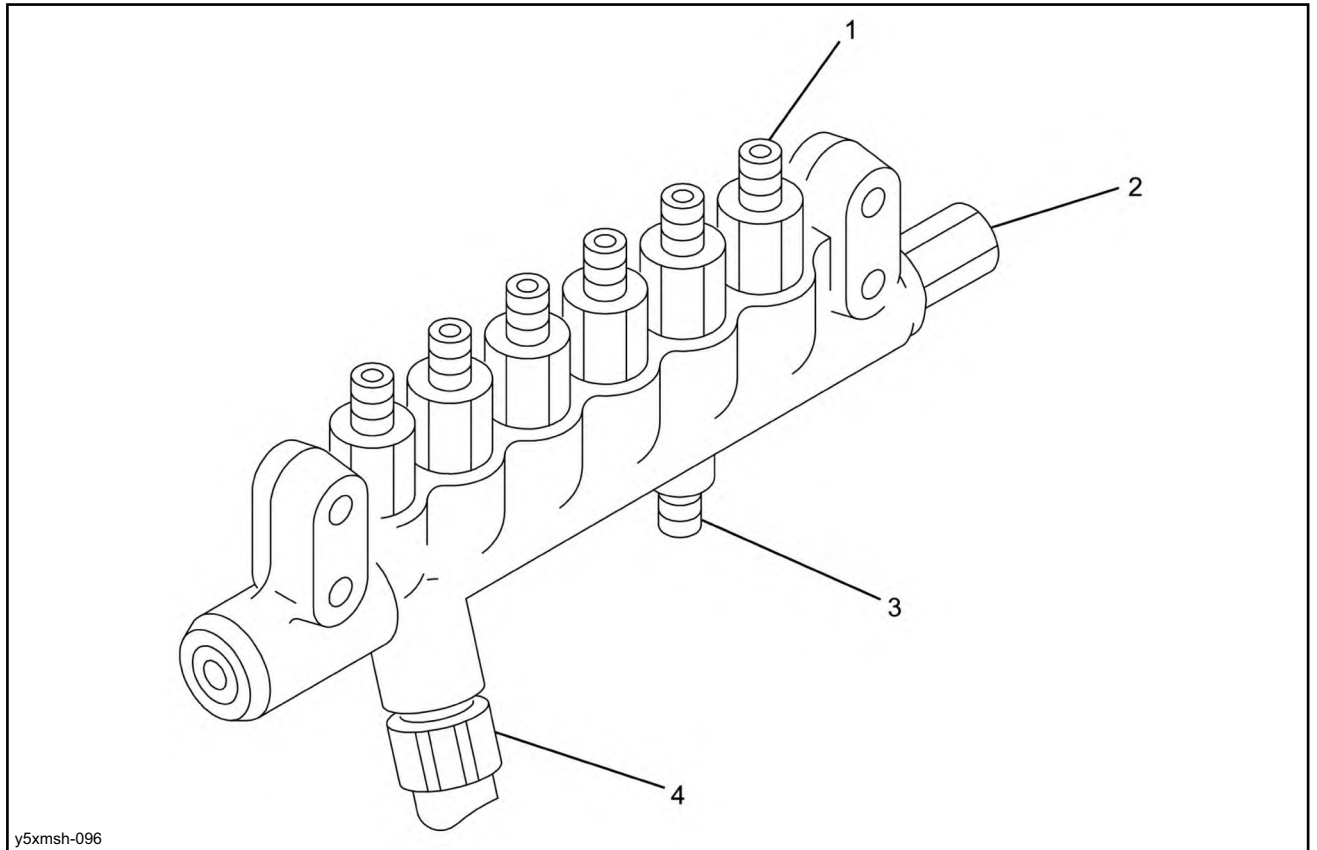
### b) Judgment in repeat offense (repetition) mode

Repeat offense is only triggered when the same failure is repeated.

Transitions between normal and repeat offense states (modes) are shown below.

Step	Status	Yes	No
1	(1) In normal mode	To step 2	-
2	Inducement is triggered.	To step 3	Status quo maintained
3	The inducement condition is cleared.	To step 4	Status quo maintained
4	(2) Repeat offense mode is established.	To step 5	-
5	(2) 40 hours or more have passed since repeat offense mode.	To step 1	To step 4

Common rail



y5xmsH-096

1	Flow damper	3	Fuel inlet
2	Pressure limiter	4	Pressure sensor

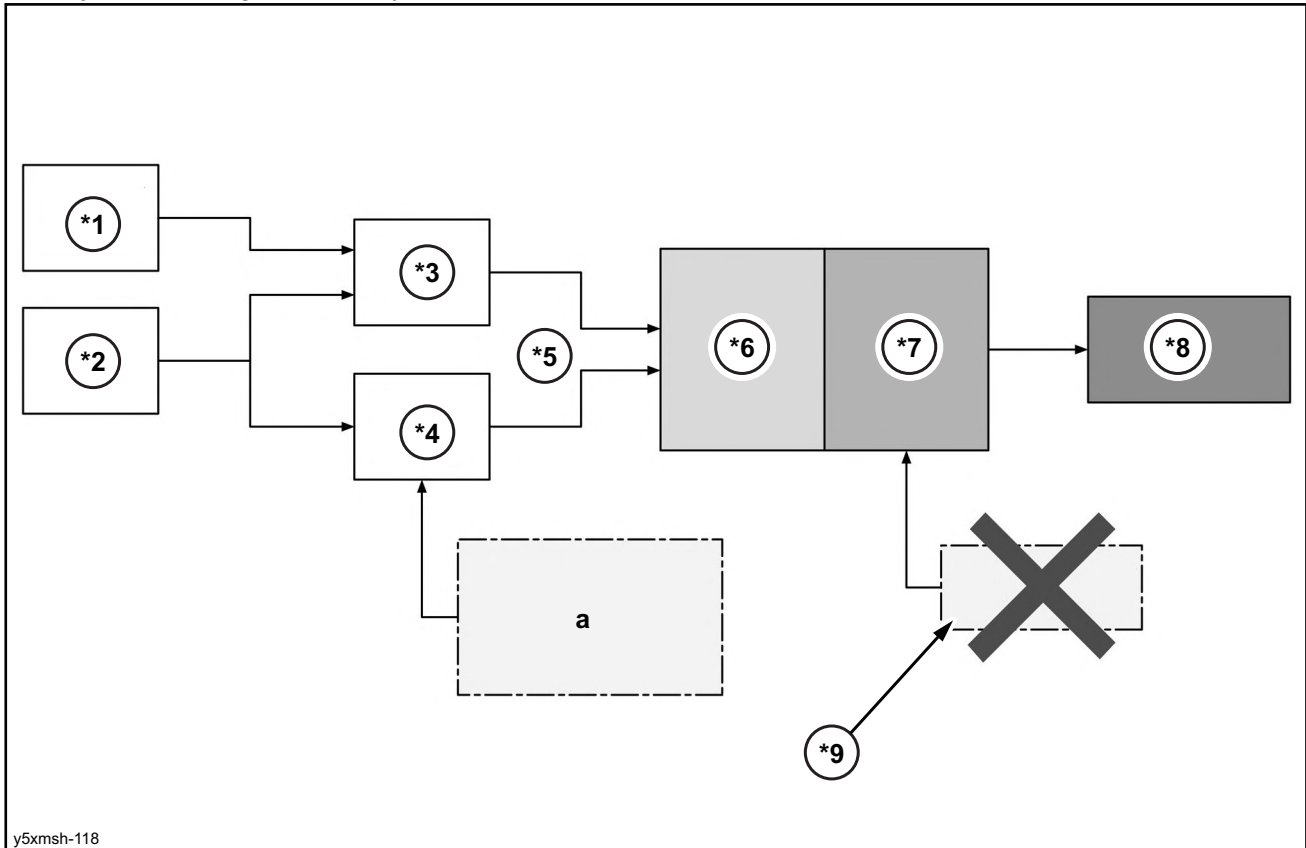
## H. ENGINE

### Electronic control fuel injection system

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

### Injection quantity control

To optimize the injection quantity, the fuel injection quantity is controlled by regulating the injector based mainly on the signals from the engine speed and the accelerator opening position or the instructed rotation from the control unit in the machine.



y5xmsh-118

a	<ul style="list-style-type: none"> <li>· Boost press.</li> <li>· Coolant temp</li> <li>· Barometric press.</li> </ul>
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*1	Accelerator pedal position	*4	Maximum fuel injection quantity	*7	Fuel injection quantity correction
*2	Engine speed	*5	Reduction rate	*8	Injector on time determination
*3	Basic fuel injection quantity	*6	Final fuel injection quantity	*9	Cylinder by cylinder crection

### Injection pressure control

The injection pressure is controlled by regulating the fuel pressure inside the common rail (fuel rail). The proper pressure inside the common rail (fuel rail) is controlled based on calculations of the engine speed, the fuel injection quantity, etc., and the appropriate amount of fuel is discharged and force-fed to the common rail (fuel rail) via regulation of the supply pump.

### Injection timing control

This control is performed by calculating the proper fuel injection timing mainly from the engine speed or the injection quantity in substitution of the timer function to regulate the injector.

### Injection rate control

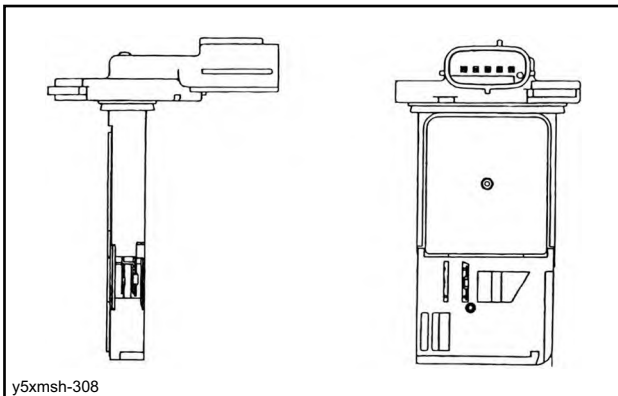
To improve combustion inside the cylinder, only a small amount of fuel is injected first to be ignited, and then the second injection is performed when ignition is made.

This control of the injection timing and injection quantity is performed by regulating the injector.

Maximum fuel injection quantity

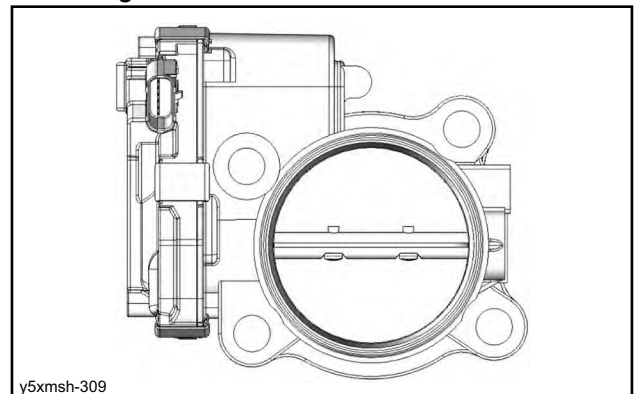
The MAF sensor measures the amount of air entering the engine, and is installed to the duct between the air cleaner and turbocharger. The MAF sensor consists of an MAF sensor and IAT sensor, and measures a portion of the air that passes through the measurement duct. When the amount of air entering the engine is small, it indicates deceleration or idling speed. When the amount of air is large, it indicates acceleration or a high load state.

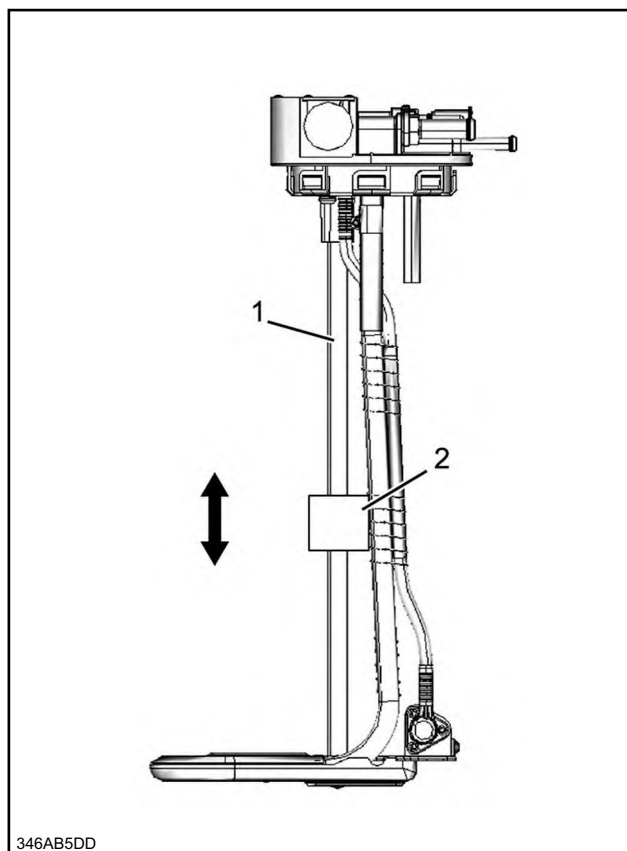
**IAT sensor**  
The IAT sensor is installed to the duct between the air cleaner and the turbocharger. The IAT sensor is a variable resistor located inside the MAF sensor and measures the temperature of the air flowing into the engine. When the IAT sensor is cold, the sensor resistance is high. As the air temperature rises, the sensor resistance decreases. The ECM detects a high voltage in the signal circuit when the sensor resistance is high. The ECM detects a low voltage in the signal circuit when the sensor resistance is low.



**Intake throttle valve**

The intake throttle valve is installed on the inlet of the inlet manifold. The ECM controls the opening position of the intake throttle valve based on the operating conditions of the engine. The motor inside the intake throttle valve is controlled according to duty ratio signals sent from the ECM. The opening position of the intake throttle valve is changed in the appropriate increments from a duty ratio of 0%. The valve closes with increases in duty signals and opens as duty signals decrease. The opening position of the intake throttle valve is detected by the position sensor. The position sensor outputs signals related to the opening position of the intake throttle valve. The ECM detects a low signal voltage when the valve opening is small or closed. Also, the ECM detects a high signal voltage when the valve opening is large.





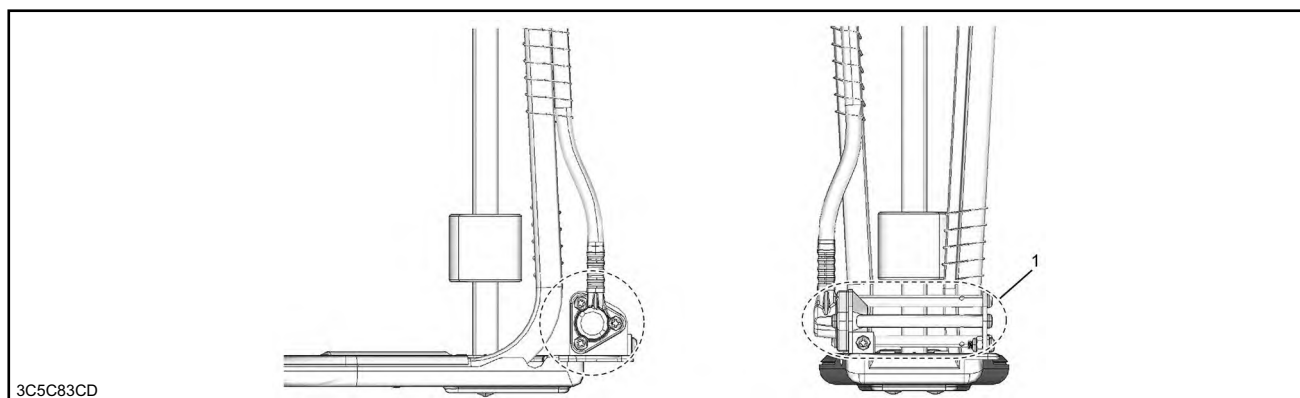
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1	Pipe
2	Float

The urea fluid quality sensor measures the concentration of urea fluid by applying ultrasonic waves to the urea fluid and measuring the time between the transmission and reception of the waves. The DCU determines whether the urea fluid quality is abnormal, based on the signal from the urea fluid quality sensor.

**Note**

- The specifications vary depending on the machine manufacturer.



3C5C83CD

1	Urea fluid quality sensor
---	---------------------------

Pin No.	Connection
11	CAN1 High
12	CAN1 Low
13	-
14	CAN0 High
15	CAN0 Low
16	-
17	-
18	-
19	-
20	-
21	-
22	-
23	-
24	-
25	-
26	-
27	-
28	-
29	-
30	-
31	-
32	-
33	-
34	-
35	-
36	-
37	-
38	-
39	-
40	-
41	-
42	-
43	-
44	-
45	-
46	CAN0 termination switch 1B
47	CAN0 termination switch 1A
48	CAN0 termination switch 2B
49	CAN0 termination switch 2A
50	-
51	-
52	Ignition switch
53	-

## H. ENGINE

### Functional Inspection

#### Engine Compression Pressure Inspection

##### 1. Engine compression pressure inspection - inspection

###### Note

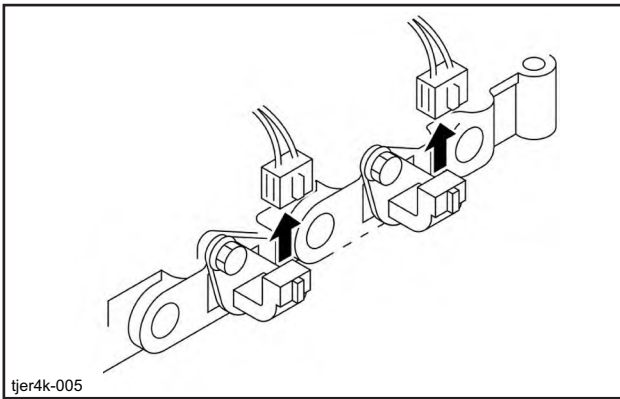
- Warm up the engine.

[1] Remove the glow plug from the cylinder head assembly.

###### Note

- Remove all the glow plugs.

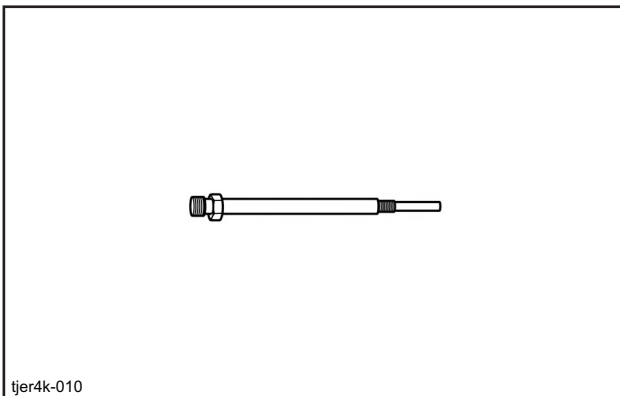
[2] Remove the injector harness connectors from the lower cover.



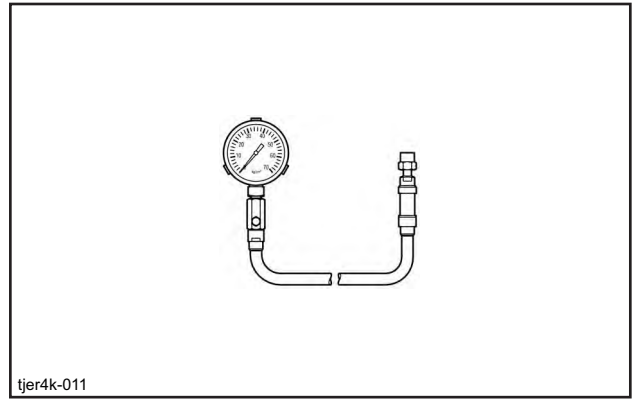
[3] Install the special tool on the cylinder head assembly.

###### Note

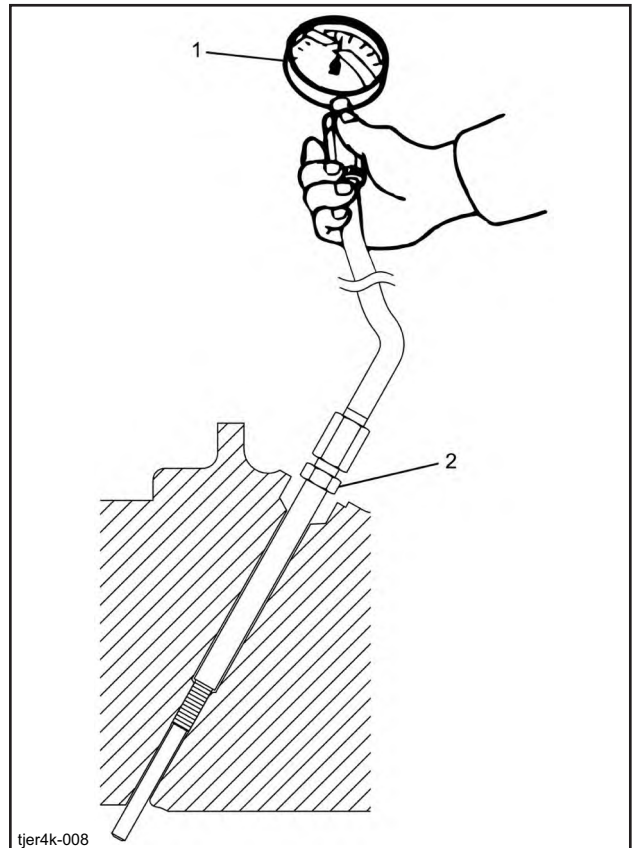
- Insert the compression gauge adapter into the glow plug installation hole to install the compression gauge.



Special tool: 5-8840-2815-0 - Compression gauge adapter



Special tool: 5-8840-2675-0 (5-8531-7002-0) - Compression gauge (adapter)



1	Compression gauge
2	Compression gauge adapter

[4] Measure the compression pressure.

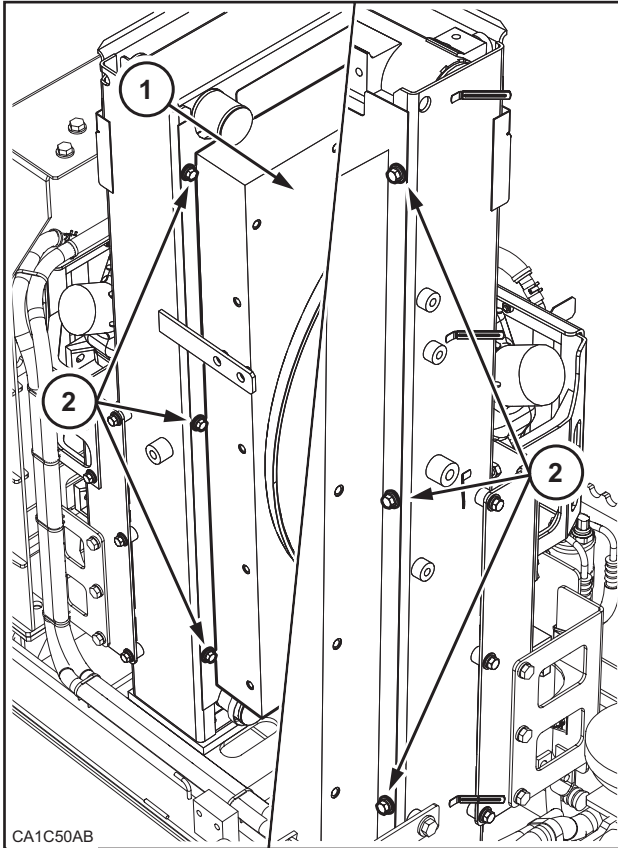
###### Note

- Turn the starter and read the compression pressure when the compression gauge indicator is stable at about 200 min<sup>-1</sup> (200 rpm).
- Measure the compression pressure for all cylinders.

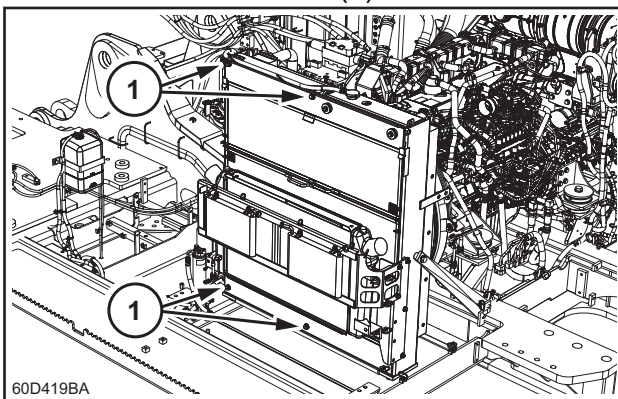
Standard value: 3240.0 kPa (469.974 psi)

Limit value: 2260.0 kPa (327.821 psi)

11. Remove the 6 bolts (2) of the fan shroud (1) with a box wrench to shift the fan shroud (1) toward the engine side.

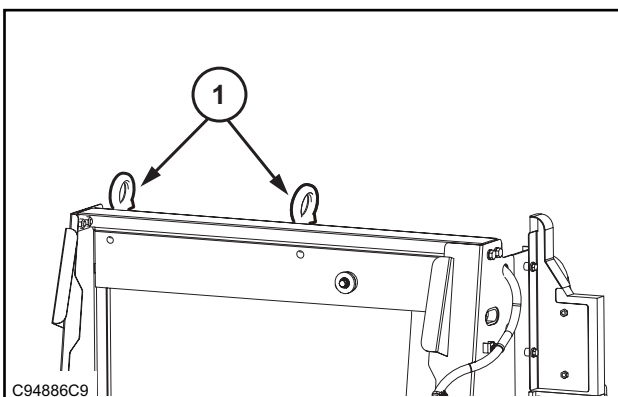


12. Remove the 4 bolts (1) with a wrench.

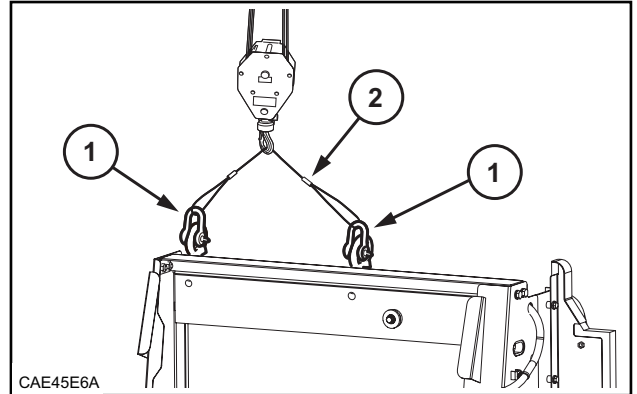


13. Attach the 2 eyebolts (M12) (1) on top of the oil cooler.

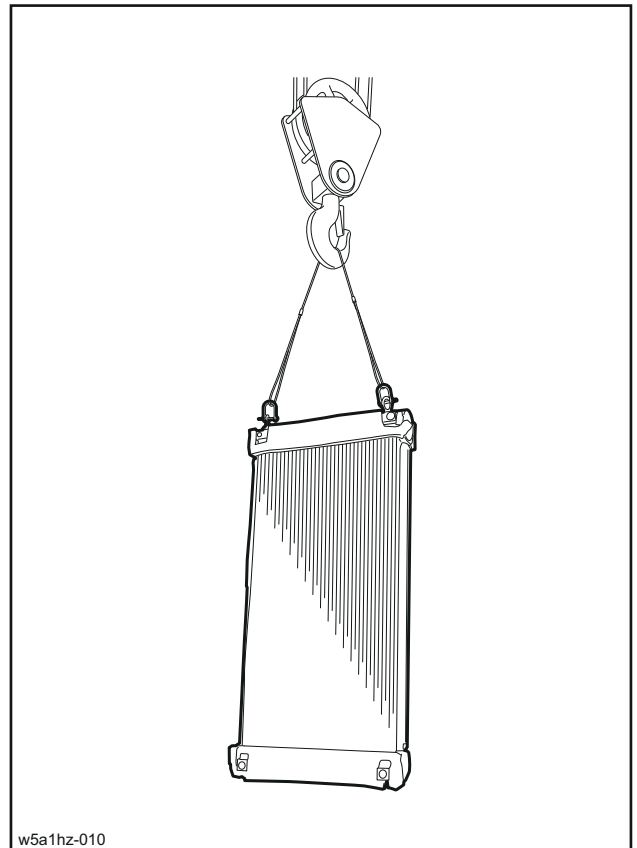
- Tighten up the eyebolt all the way and then loosen it for a half turn.



14. Attach the 2 shackles (1) to the eyebolt and then lift the oil cooler main unit with a wire rope (2) and a liftcrane.



15. Make sure that you have a safe site, and then settle the oil cooler on a wood plank or other block.



#### Installation of Oil Cooler

Mount the oil cooler in the reversed order of the procedure for removal. Check that air is not leaking. Each bolt has to be tightened in the specified torque. The O-ring cannot be used again. Use new one. Refer to the "Bolt Size and Torque Table" for tightening torque for bolts without instruction.

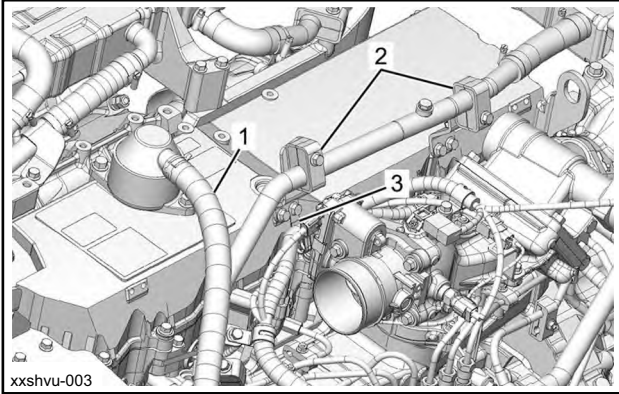
## H. ENGINE

### Removal and Installation of Cylinder Head Cover

#### Cylinder head cover Removal

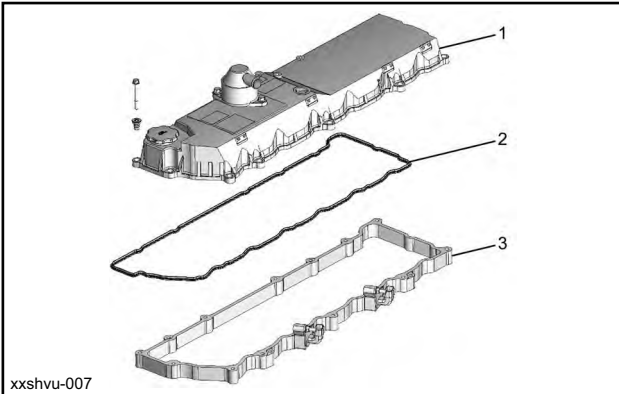
##### 1. Cylinder head cover Removal

- [1] Disengage the water pipe bracket from the cylinder head cover.
- [2] Disengage the ventilation hose from the air breather.



1	Ventilation hose
2	Water pipe bracket
3	Clip

- [3] Remove the cylinder head cover from the lower cover.
- [4] Remove the head cover gasket from the cylinder head cover.



1	Cylinder head cover
2	Head cover gasket
3	Lower cover

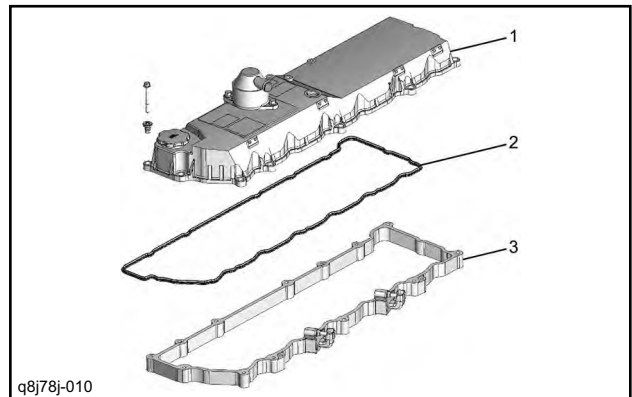
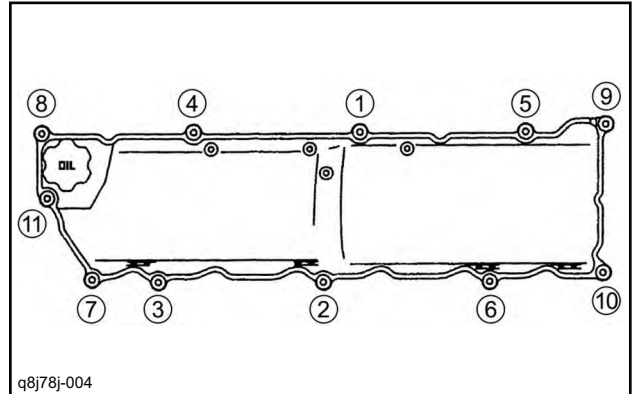
#### Cylinder head cover Installation

##### 1. Cylinder head cover Installation

- [1] Align the head cover gasket to the cylinder head cover.
- [2] Install the cylinder head cover to the lower cover.  
Tightening torque : 9.59 lbf · ft { 1.3 kgf · m / 115.1 lb · in }

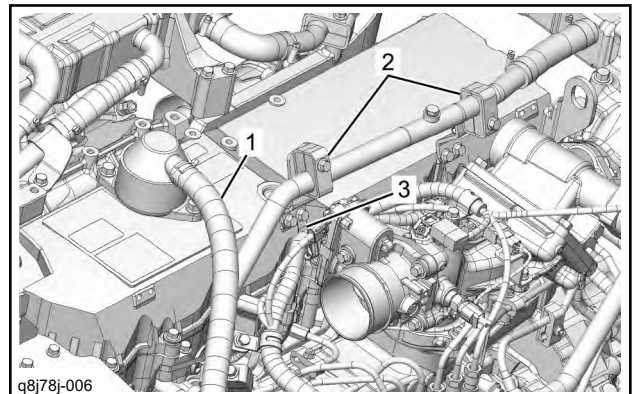
#### Note

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



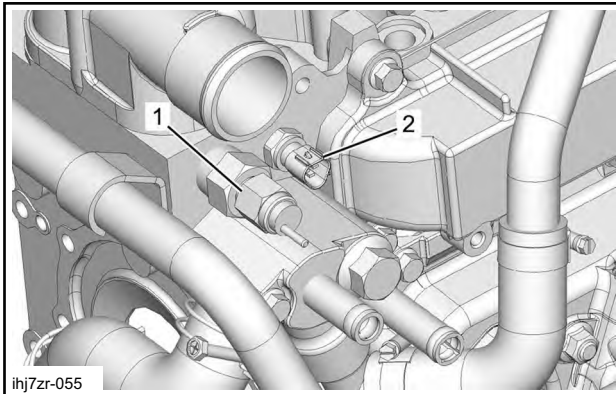
1	Cylinder head cover
2	Head cover gasket
3	Lower cover

- [3] Connect the ventilation hose to the air breather.
- [4] Connect the water pipe bracket to the cylinder head cover.  
Tightening torque : 20 N · m { 2.0 kgf · m / 14.75 lb · ft }



1	Ventilation hose
2	Water pipe bracket
3	Clip

Tightening torque : 25 N · m {2.5 kgf · m / 18.4 lb · ft}



1	Overheat switch
2	Water temperature sensor

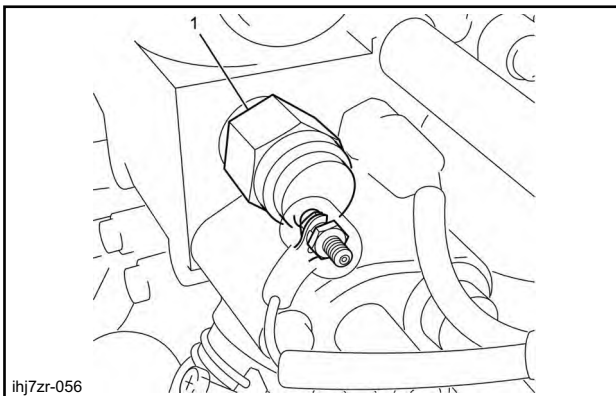
### 13. Overheat switch Installation

[1] Install the overheat switch to the cylinder head assembly.

**Note**

- Apply Loctite 572 to the threaded portion.

Tightening torque : 29 N · m {3.0 kgf · m / 21.4 lb · ft}



1	Overheat switch
---	-----------------

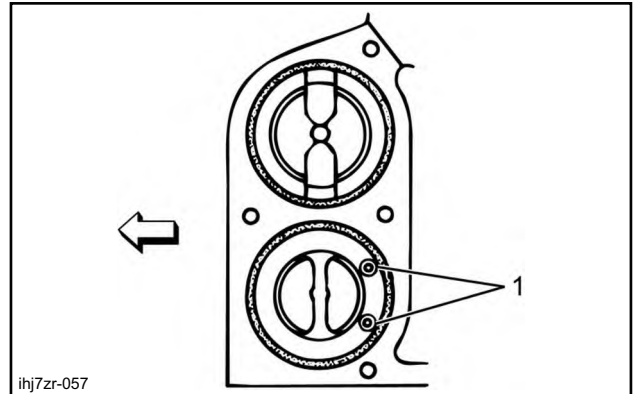
### 14. Thermostat Installation

[1] Install the gasket to the thermostat.

**Caution**

- Use new gaskets.

[2] Install the thermostat to the cylinder head assembly.

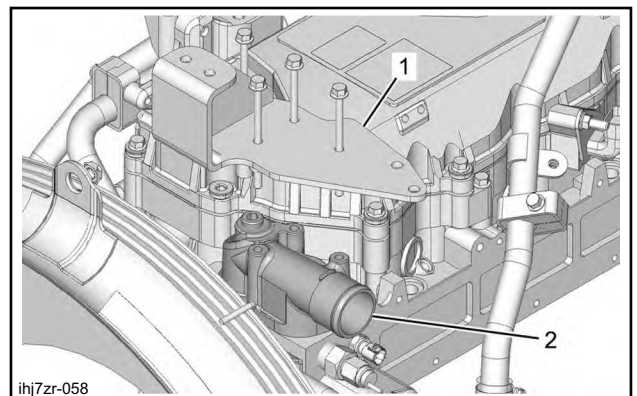


1	Jiggle valve position
---	-----------------------

**Caution**

- Be careful not to mistake the assembly position and direction.

[3] Install the water outlet pipe to the cylinder head assembly.  
Tightening torque : 25 N · m {2.5 kgf · m / 18.4 lb · ft}

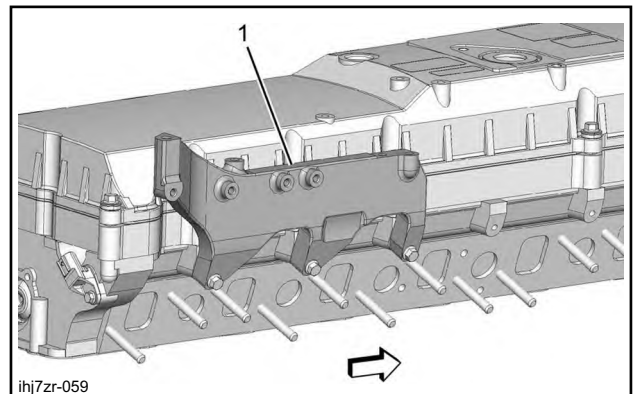


1	Fan guide bracket
2	Water outlet pipe

### 15. Bracket Installation

[1] Install the EGR cooler bracket B to the cylinder head assembly.

Tightening torque : 24 N · m {2.4 kgf · m / 17 lb · ft}

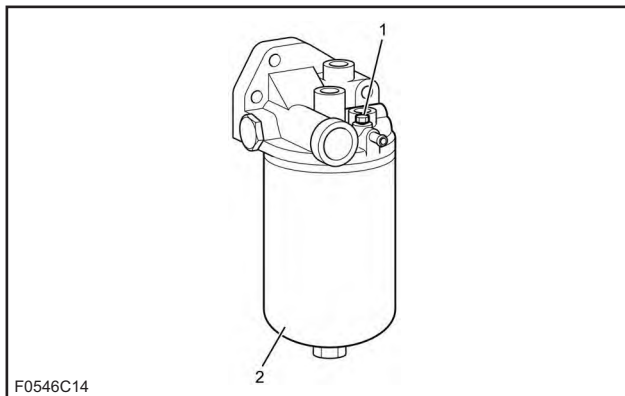


## H. ENGINE

[10] Stop the engine.

### Note

- The following applies to the cartridge-type specification.



1	Air bleeding plug
2	Cartridge-type element

[11] Prepare a pan.

[12] Turn ON the ignition switch.

[13] Loosen the air bleeding plug using a wrench.

### Note

- Check that fuel comes out from around the plug.

[14] Tighten the air bleeding plug using a wrench.  
tightening torque : 10 N · m { 1.0 kgf · m / 89 lb · in }

### ⚠ Caution

- Fully remove any fuel in the area after tightening the plug.

[15] Start the engine.

### Note

- Idle the engine for 5 seconds.

### ⚠ Caution

- Do not change the engine speed when the engine is started.
- If the engine does not start, repeat the process from step 12.

### Note

- Slowly increase the engine speed, and maintain it for 3 minutes.
- Increase the engine speed to the maximum speed.

[16] Stop the engine.

Cylinder head assembly Inspection

1. Bridge cap Inspection

[1] Measure the bridge cap using the dial gauge.

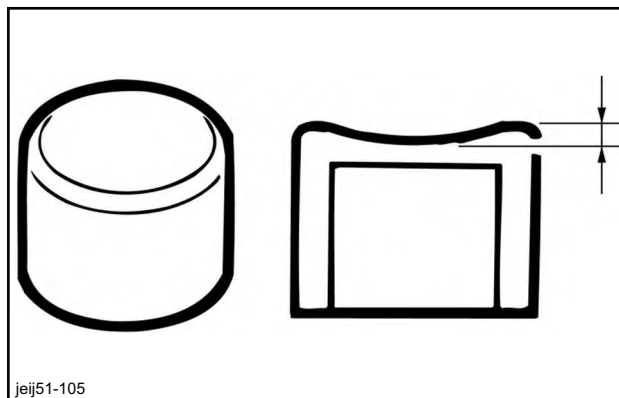
### Note

- Measure the contact surface of the bridge cap and rocker arm.

Limit : 0.1 mm {0.0039 in} Amount of wear on the bridge cap

### ⚠ Caution

- Replace the bridge cap if the measured value exceeds the limit value.
- Replace the bridge cap if it has an abnormal wear such as band-shaped wear.



2. Bridge Inspection

[1] Inspect the bridge.

### Note

- Confirm that the bridge moves smoothly.

43. Idle gear measurement

[1] Align the dial gauge to the idle gear.

Note

- Attach the dial gauge to the idle gear tooth to be measured.

[2] Inspect the backlash.

Note

- Gently move the gear right and left to read the inconsistency on the dial gauge.

⚠ Caution

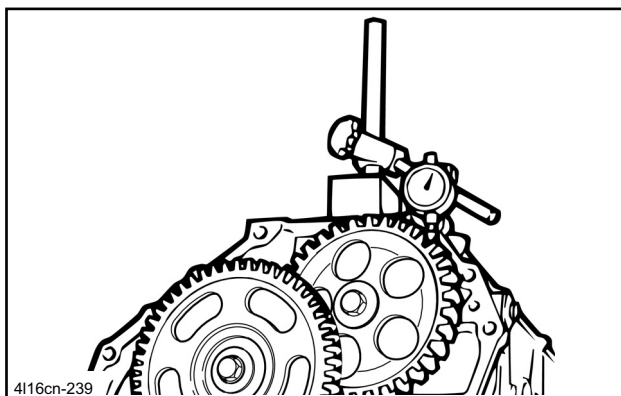
- Measure the idle gear backlash before removing the idle gear A.

specified value : 0.10 - 0.17 mm { 0.0039 - 0.0067in }

limit : 0.30 mm { 0.0118 in }

⚠ Caution

- Replace the idle gear if the measured value exceeds the limit value.



[3] Measure the clearance using the feeler gauge.

Note

- Measure the clearance between the idle gear and the thrust collar.

⚠ Caution

- Measure the play of the idle gear in the axis direction before removing the idle gear B.

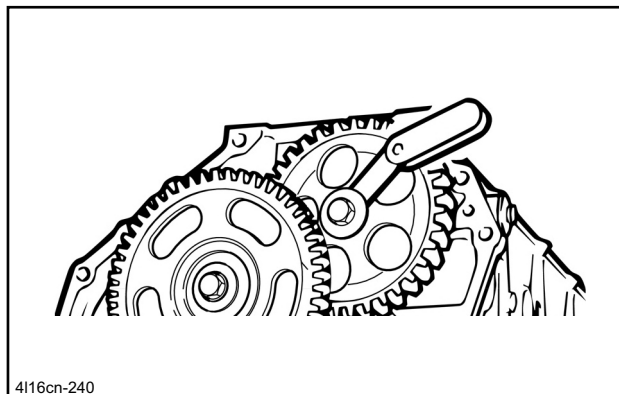
specified value : 0.080 - 0.155 mm

{ 0.0031 - 0.0061 in }

limit : 0.20 mm { 0.0079 in }

⚠ Caution

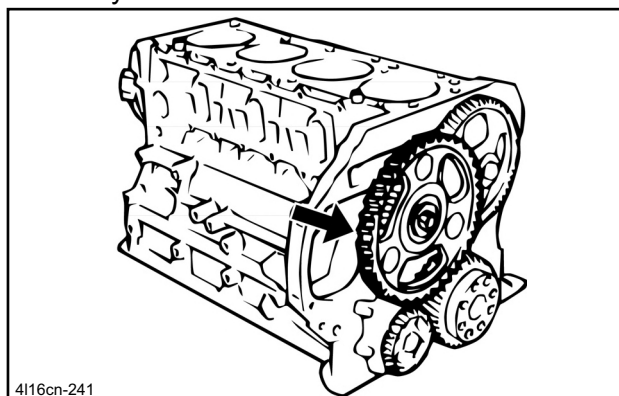
- Replace the idle gear if the measured value exceeds the limit value.



44. Idle gear A removal

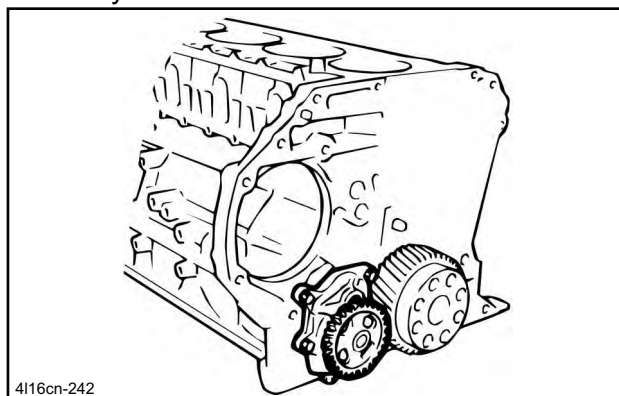
[1] Remove the idle gear A from the idle gear A shaft.

[2] Remove the idle gear A shaft from the cylinder block.



45. Oil pump assembly removal

[1] Remove the oil pump assembly from the cylinder block.

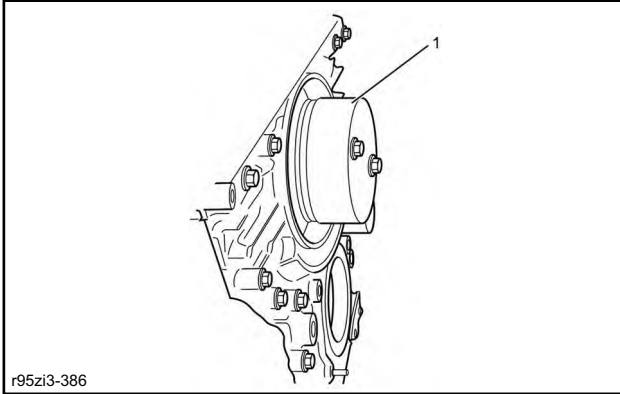


46. Idle gear B removal

[1] Remove the idle gear B from the idle gear B shaft.

## H. ENGINE

[3] Install the adapter to the crankshaft.



1 Adapter

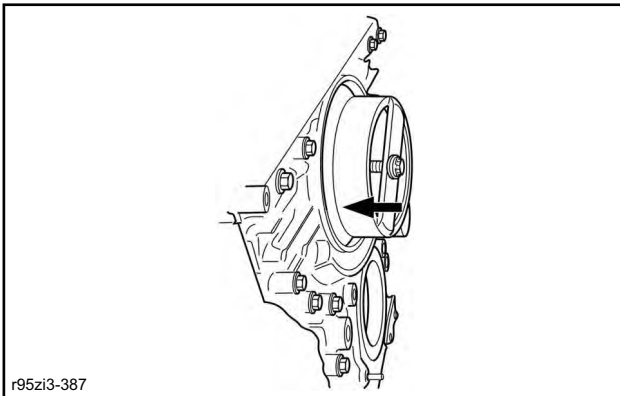
[4] Install the sleeve to the adapter.

[5] Install the center bolt to the sleeve.

[6] Tighten the center bolt using the wrench.

### Note

- Tighten the center bolt until the sleeve touches the adapter.



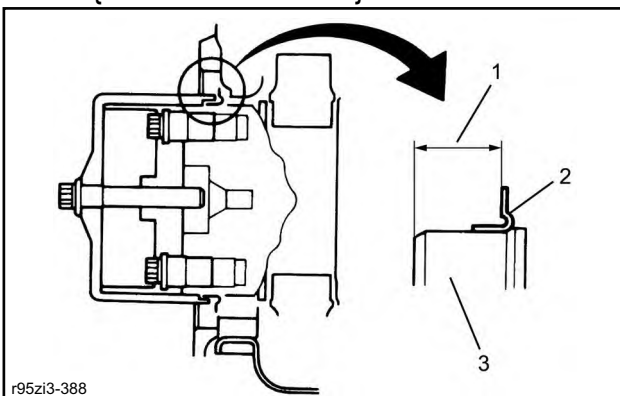
r95zi3-387

[7] Inspect the slinger.

### Note

- Measure the distance between the crankshaft head and the slinger.

Specified value : 17.7 - 18.3 mm  
{ 0.6968 - 0.7205 in }



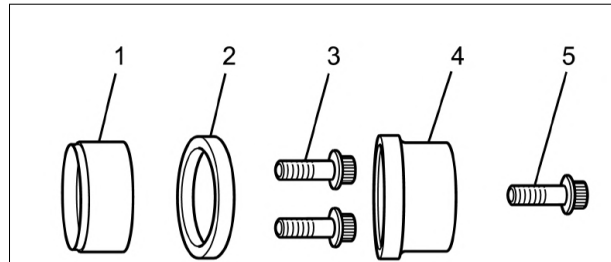
r95zi3-388

1	Slinger press-fitting measurement
2	Slinger
3	Crankshaft

[8] Prepare the special tool.

### Note

- In order to install the crankshaft front oil seal, use the one(s) in the following table from among the parts included in the kit.



2CC0F4A8

Legend	Parts number
1: Adapter	8-9439-6857-0
2: Oil seal	-
3: Adapter tightening bolt	8-9702-0656-0
4: Sleeve	8-9702-0625-1
5: Center bolt	8-9702-0655-0

[9] Apply the engine oil to the crankshaft front oil seal.

### ⚠ Caution

- Apply only to the lip section of the oil seal.

[10] Install the crankshaft front oil seal to the adapter.

[11] Install the sleeve to the adapter.

[12] Install the center bolt to the sleeve.

## Lubrication System

### Removal and Installation of Oil Pan

#### Oil pan Removal

1. Battery ground cable Disconnect
  - [1] Disconnect the battery ground cable from the battery.

#### ⚠ Caution

- While the indicator (LED) of the battery disconnect switch is lit, do not turn OFF the battery disconnect switch or disconnect its negative cable from the battery. (After key OFF, lit for a maximum duration of 3 minutes)

2. Engine oil Drain
  - [1] Remove the drain plug from the oil pan.
  - [2] Drain the engine oil from the oil pan.
  - [3] Install the drain plug to the oil pan.  
Tightening torque : 70 N · m {7.1 kgf · m / 52 lb · ft}
3. Oil pan Removal
  - [1] Disconnect the harness connector from the oil level switch.
  - [2] Remove the oil pan from the crankcase.
  - [3] Remove the gasket from the oil pan.

#### Oil pan Installation

1. Oil pan Installation

#### Note

- The following applies to steel types.

- [1] Apply the liquid gasket to the crankcase.

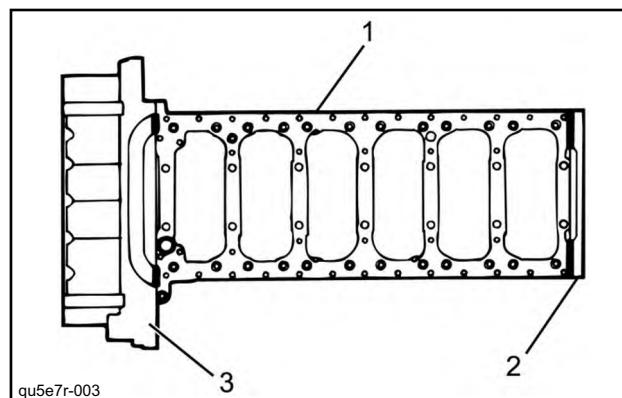
#### Note

- Apply ThreeBond 1207B to each joint of the crankcase, flywheel housing and gear case.

Bead width : 3 mm {0.118 in}  
Bead height : 2 mm {0.079 in}

#### ⚠ Caution

- Install the oil pan within 5 minutes of applying liquid gasket.

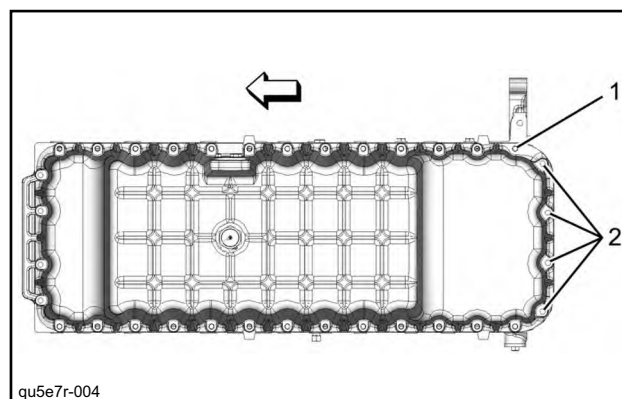


1	Crankcase
2	Timing gear case
3	Flywheel housing

- [2] Install the gasket to the oil pan.
- [3] Install the oil pan to the crankcase.  
Tightening torque : 11 N · m { 1.1 kgf · m / 96 lb · in }  
4 stud bolts  
Tightening torque : 25 N · m {2.5 kgf · m / 18 lb · ft}

#### ⚠ Caution

- Note that one of the bolts has a different length from others.



1	Short bolt installation area
2	Stud bolt installation area

- [4] Connect the harness connector to the oil level switch.

#### Note

- The following applies to aluminum types.

- [5] Apply liquid gasket to the crankcase.

#### Note

- Apply Three Bond 1207B to each joint of the crankcase, flywheel housing and gear case.

bead width : 3.0 mm { 0.118 in }  
bead height : 2.0 mm { 0.079 in }

## H. ENGINE

### [6] Apply liquid gasket to the oil pan.

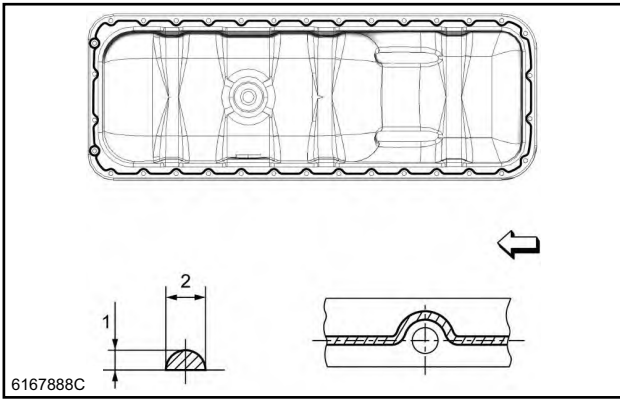
#### Note

- Referring to the diagram, apply ThreeBond 1217H to the oil pan.

#### ⚠ Caution

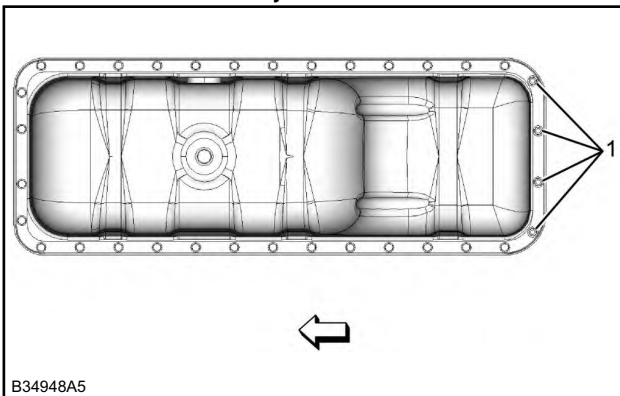
- Apply after cleaning the oil pan installation surface.
- Install the oil pan within 5 minutes of applying liquid gasket.

bead width : 4.0 - 5.5 mm { 0.157 - 0.217 in }  
 bead height : 1.0 - 2.0 mm { 0.039 - 0.079 in } □



1	Bead height
2	Bead width

### [7] Install the oil pan to the crankcase. tightening torque : 24 N · m { 2.4 kgf · m / 18 lb · ft }

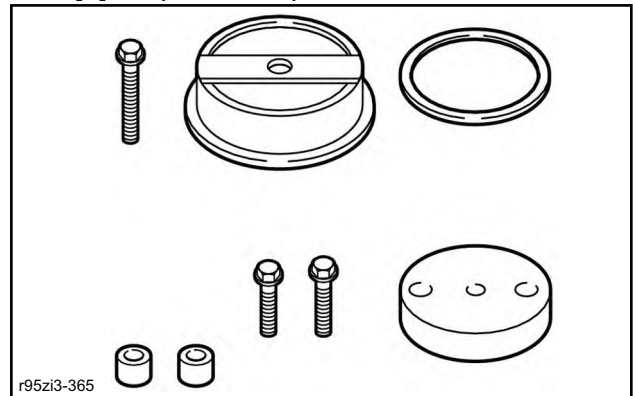


1	Stud bolt installation position
---	---------------------------------

### [8] Connect the harness connector to the oil level switch.

### 5. Crankshaft rear oil seal installation

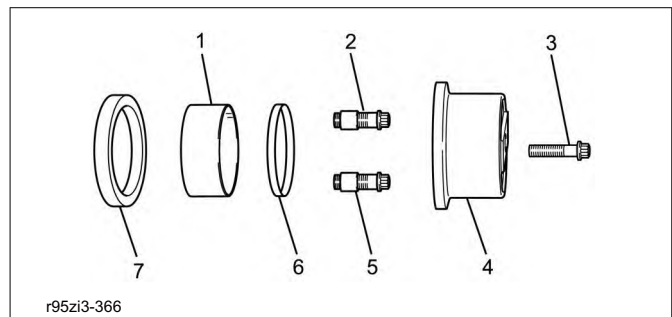
#### [1] Prepare the special tool.



SST: 5-8840-9061-0 - oil seal installer kit

#### Note

- In order to install the crankshaft rear oil seal, use the one(s) in the following table from among the parts included in the kit.



Name		Part number
1	Adapter	5-8840-2709-0
2	Adapter tightening bolt	5-8840-2714-0
3	Center bolt	5-8840-2713-0
4	Sleeve	5-8840-9063-0
5	Collar	5-8840-2710-0
6	Adapter ring	5-8840-2711-0
7	Crankshaft rear oil seal	-

#### [2] Apply the engine oil to the crankshaft rear oil seal.

#### ⚠ Caution

- Apply only to the lip section of the oil seal.

#### [3] Install the crankshaft rear oil seal to the adapter.

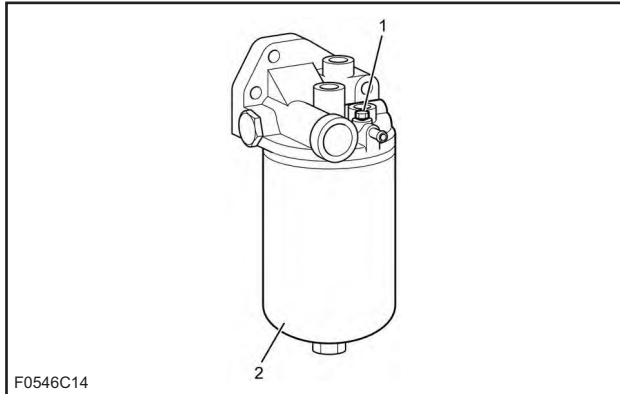
#### [4] Install the adapter to the crankshaft.

#### [5] Install the adapter ring to the sleeve.

[10] Stop the engine.

Note

- The following applies to the cartridge-type specification.



F0546C14

1	Air bleeding plug
2	Cartridge-type element

- [11] Prepare a pan.
- [12] Turn ON the ignition switch.
- [13] Loosen the air bleeding plug using a wrench.

Note

- Check that fuel comes out from around the plug.

- [14] Tighten the air bleeding plug using a wrench.  
tightening torque : 10 N · m { 1.0 kgf · m / 89 lb · in }

**⚠ Caution**

- Fully remove any fuel in the area after tightening the plug.

[15] Start the engine.

Note

- Idle the engine for 5 seconds.

**⚠ Caution**

- Do not change the engine speed when the engine is started.
- If the engine does not start, repeat the process from step 12.

Note

- Slowly increase the engine speed, and maintain it for 3 minutes.
- Increase the engine speed to the maximum speed.

[16] Stop the engine.

Inspection of Oil Pump

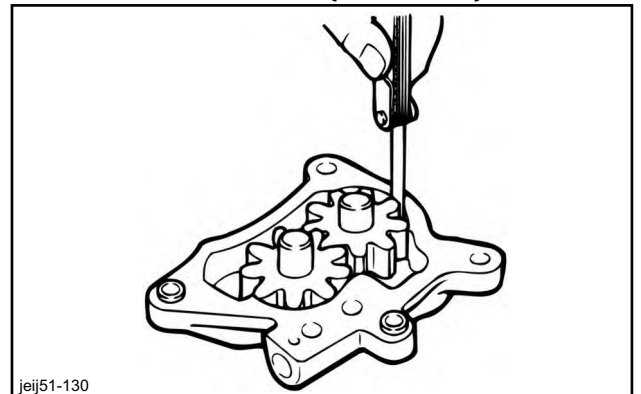
1. Oil pump assembly inspection

[1] Measure the clearance using the feeler gauge.

Note

- The clearance between the inner wall of the body and each gear tooth tip.

Specified value : 0.125 to 0.220 mm  
{ 0.0049 to 0.0087 in }  
limit : 0.30 mm { 0.0118 in }



jeij51-130

**⚠ Caution**

- Replace the gear if the measured value exceeds the limit value.

[2] Measure the shaft using the micrometer.

Note

- Driven gear shaft outer diameter

Specified value : 15.989 to 16.000 mm  
{ 0.6295 to 0.6299 in }  
limit : 15.900 mm { 0.6260 in }

# H. ENGINE

## Exhaust System

### Removal and installation of Oxidation Catalyst Assembly

#### Removal of Oxidation Catalyst Assembly

1. Battery ground cable disconnect  
[1] Disconnect the battery ground cable from the battery.

#### Caution

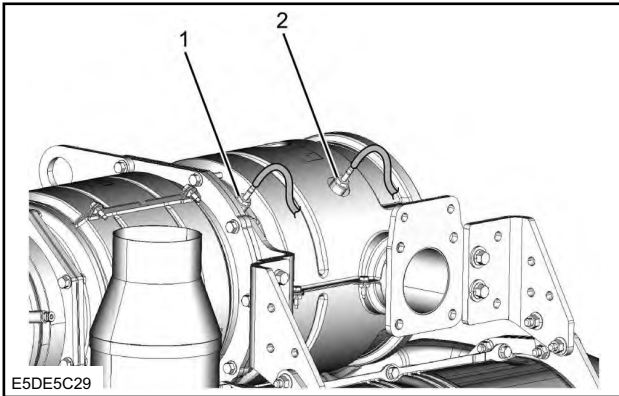
- While the indicator (LED) of the battery disconnect switch is lit, do not turn OFF the battery disconnect switch or disconnect its negative cable from the battery. (After key OFF, lit for a maximum duration of 3 minutes)

2. Exhaust gas temperature sensor removal  
[1] Disconnect the harness connector from the exhaust gas temperature sensor.

#### Note

- To prevent incorrect assembling, make an alignment mark on the connector before disconnecting.
- Remove EGT sensor 1 and 2 together.

- [2] Remove the EGT sensor from the oxidation catalyst assembly.



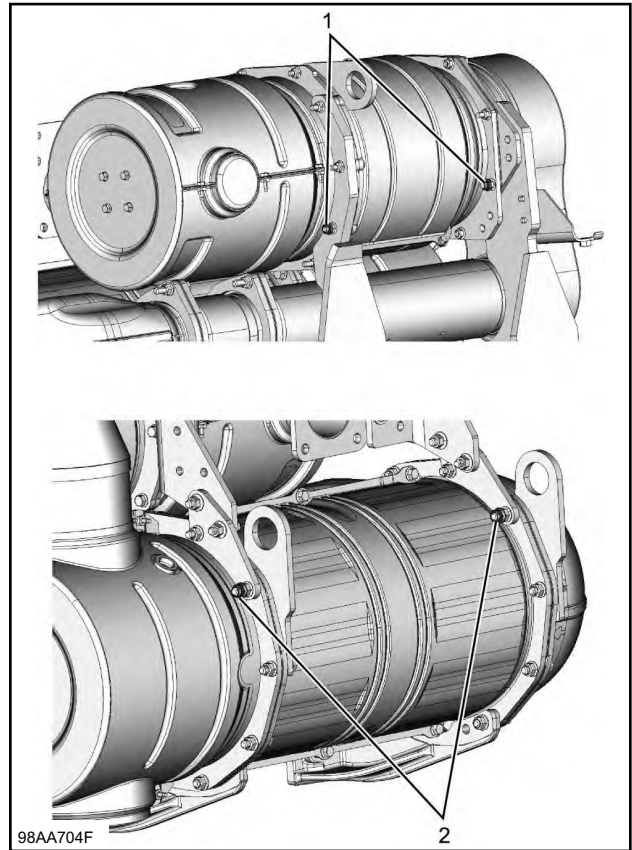
E5DE5C29

1	EGT sensor 1
2	EGT sensor 2

3. Oxidation catalyst assembly removal

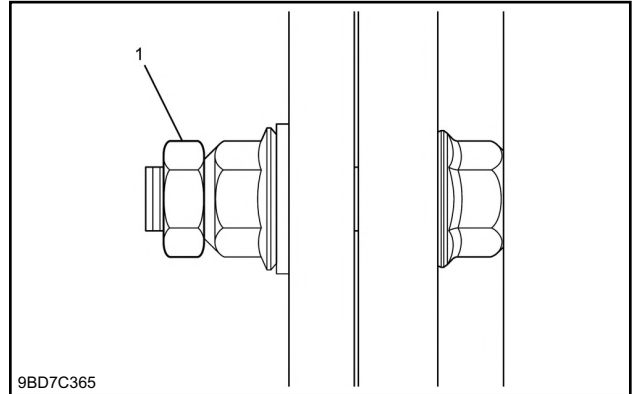
#### Caution

- When disassembling, because nuts that prevent the catalyst from coming off are spot welded, the spot welds need to be removed at the following locations.



98AA704F

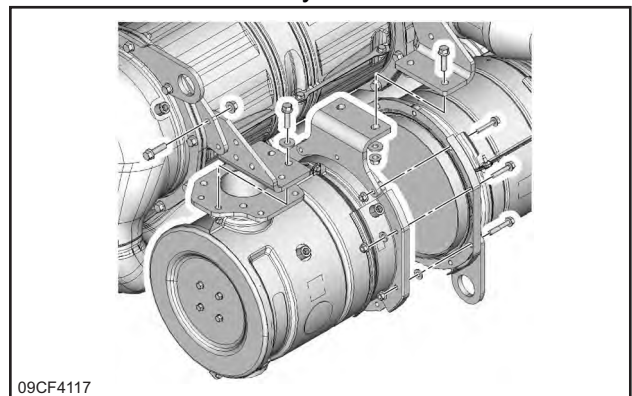
1	Weld location (Oxidation catalyst side)
2	Weld location (Urea SCR side)



9BD7C365

1	Weld nut
---	----------

- [1] Remove oxidation catalyst 1 from oxidation catalyst 2.



09CF4117

**Caution**

- Do not subject the tip of the sensor to impact when installing the EGR gas temperature sensor.
- Do not reuse an EGR gas temperature sensor that has been subjected to impact due to being dropped, etc.

[1] Apply anti-seize lubricant to EGR gas temperature sensor 2.

**Note**

- Apply High Temperature Stainless Never-Seez: 5-87411-039-0, manufactured by Bostik in the U.S., etc. to the threaded portion of EGR gas temperature sensor 2.

[2] Install EGR gas temperature sensor 2 to EGR pipe B.

tightening torque : 19.6 N · m { 2.0 kgf · m / 14 lb · ft }

[3] Install the harness bracket to EGR pipe B.

tightening torque : 23.5 N · m { 2.4 kgf · m / 17 lb · ft }

[4] Connect the harness connector to EGR gas temperature sensor 2.

## 4. EGR gas temperature sensor 1 installation

**Caution**

- Do not subject the tip of the sensor to impact when installing the EGR gas temperature sensor.
- Do not reuse an EGR gas temperature sensor that has been subjected to impact due to being dropped, etc.

[1] Apply anti-seize lubricant to EGR gas temperature sensor 1.

**Note**

- Apply High Temperature Stainless Never-Seez: 5-87411-039-0, manufactured by Bostik in the U.S., etc. to the threaded portion of EGR gas temperature sensor 1.

[2] Install EGR gas temperature sensor 1 to EGR pipe A.

tightening torque : 44 N · m { 4.5 kgf · m / 32 lb · ft }

[3] Install the harness bracket to the fan guide stay.

tightening torque : 23.5 N · m { 2.4 kgf · m / 17 lb · ft }

[4] Connect the harness connector to EGR gas temperature sensor 1.

## 5. Oil level gauge guide tube installation

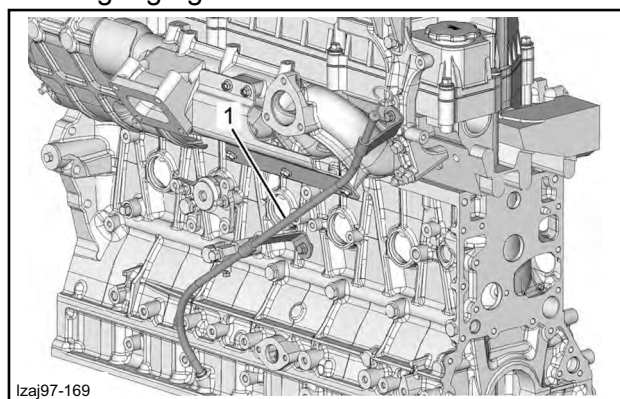
[1] Install the oil level gauge guide tube to the cylinder block.

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

[2] Connect the oil level gauge guide tube to the cylinder head assembly.

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

[3] Install the oil level gauge to the oil level gauge guide tube.



1 Oil level gauge guide tube

## 6. Turbocharger assembly installation

[1] Replenish the turbocharger assembly with the engine oil.

**Note**

- Pour engine oil from the oil feed port and manually rotate the shaft slightly.

**Caution**

- Do not apply force to the turbine blade and compressor.

[2] Align the gasket to the turbocharger assembly.

[3] Install the turbocharger assembly to the exhaust manifold.

tightening torque : 52 N · m { 5.3 kgf · m / 38 lb · ft }

[4] Install the water feed pipe to the cylinder block.

tightening torque : 41 N · m { 4.2 kgf · m / 30 lb · ft }

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

**Caution**

- Use a new gasket.

## H. ENGINE

tightening torque : 9 N · m { 0.9 kgf · m / 79.7 lb · in }

### 4. Injection pipe installation

- [1] Temporarily tighten the injection pipe to the injector.

#### ⚠ Caution

- Use new injection pipes.

- [2] Temporarily tighten the injection pipe to the common rail assembly.

- [3] Securely tighten the injection pipe to the injector.

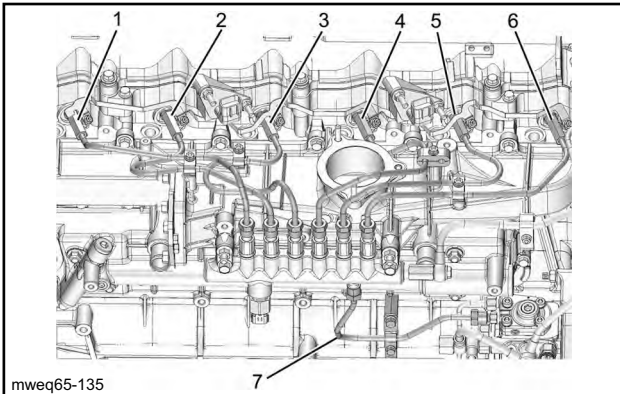
tightening torque : 44 N · m { 4.5 kgf · m / 32.5 lb · ft }

- [4] Securely tighten the injection pipe to the common rail assembly.

tightening torque : 44 N · m { 4.5 kgf · m / 32.5 lb · ft }

- [5] Install the clip to the inlet cover.

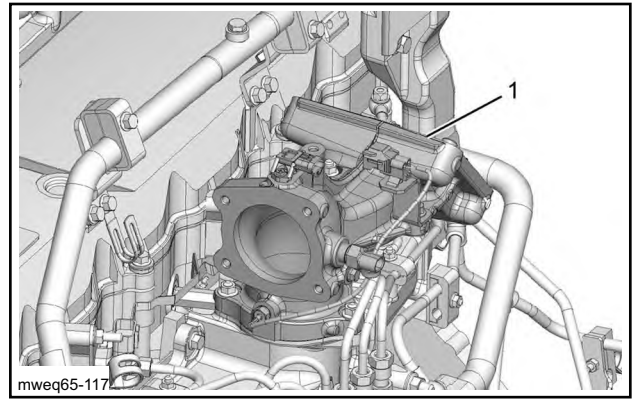
tightening torque : 6 N · m { 0.6 kgf · m / 53.1 lb · in }



1	No.1 injection pipe
2	No.2 injection pipe
3	No.3 injection pipe
4	No.4 injection pipe
5	No.5 injection pipe
6	No.6 injection pipe
7	Fuel pipe

### 5. Inlet pipe installation

- [1] Install the inlet pipe to the inlet cover.  
tightening torque : 25 N · m { 2.5 kgf · m / 18 lb · ft }

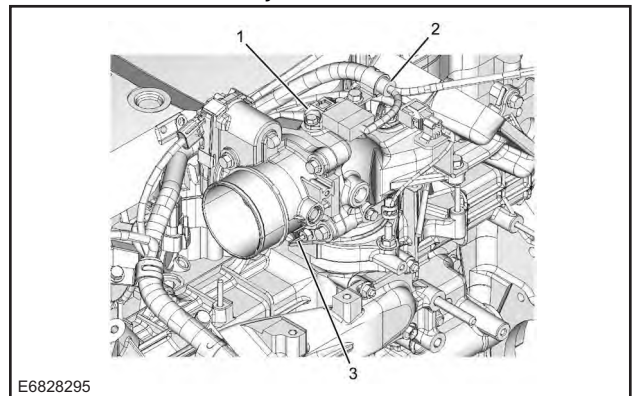


1 Inlet pipe

- [2] Connect the harness connector to the boost pressure sensor/boost temperature sensor.

- [3] Connect the harness connector to the IMT sensor.

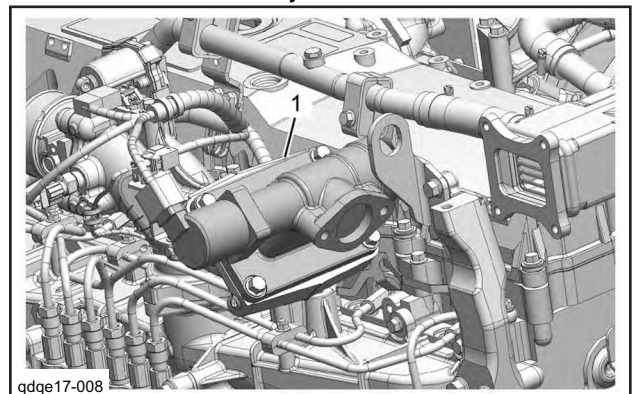
- [4] Install the harness clip to the inlet pipe.  
tightening torque : 24 N · m { 2.4 kgf · m / 17 lb · ft }



1	Boost pressure sensor/boost temperature sensor
2	Harness clip
3	IMT sensor

### 6. EGR valve installation

- [1] Install the EGR valve to the inlet pipe.  
tightening torque : 46 N · m { 4.7 kgf · m / 33.9 lb · ft }



1 EGR valve

18. Fuel leak off pipe assembly removal

- [1] Disconnect the fuel leak-off pipe from the cylinder head.
- [2] Remove the fuel leak-off pipe from the fuel supply pump.

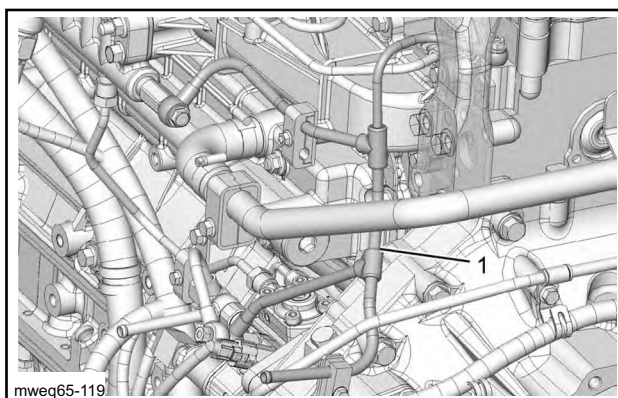
Note

- Remove the eyebolt tightened together with the fuel feed pipe.

- [3] Disconnect the fuel leak-off pipe from the common rail assembly.
- [4] Remove the fuel leak-off pipe from the inlet pipe.

Note

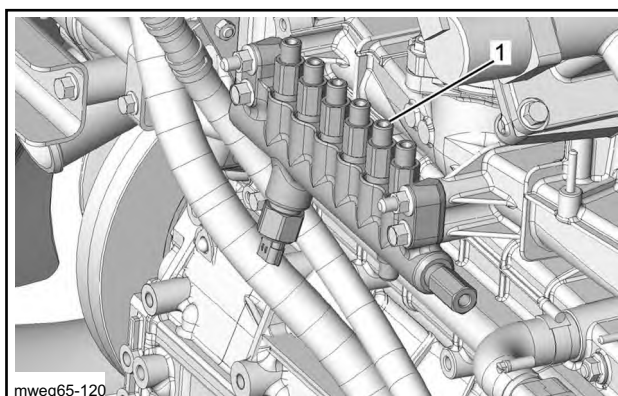
- Remove the clip.



1 Fuel leak-off pipe

19. Common rail assembly removal

- [1] Disconnect the harness connector from the fuel pressure sensor.
- [2] Remove the common rail assembly from the inlet cover.

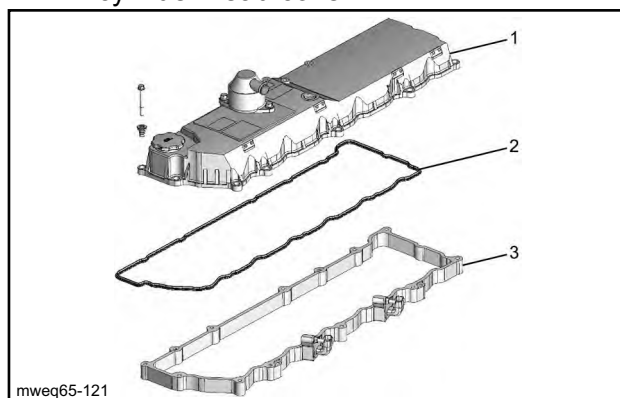


1 Common rail assembly

20. Cylinder head cover removal

- [1] Disconnect the ventilation hose from the air breather.
- [2] Remove the cylinder head cover from the lower cover.

- [3] Remove the head cover gasket from the cylinder head cover.



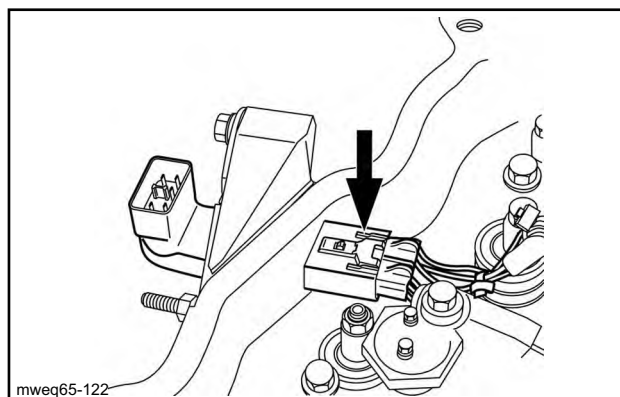
1	Cylinder head cover
2	Head cover gasket
3	Lower cover

21. Injector harness removal

- [1] Remove the connector from the lower cover.

⚠ Caution

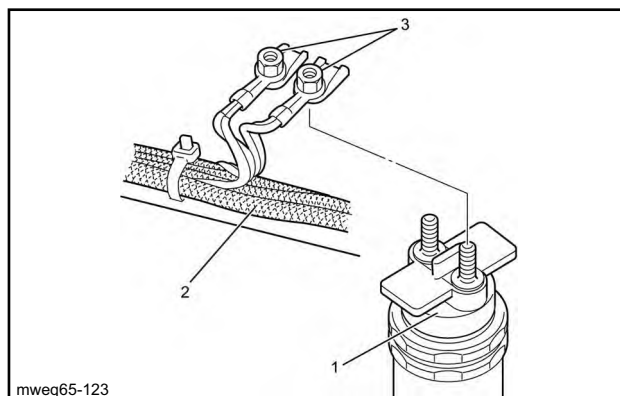
- Do not pull the wire, or pry the connector with a screwdriver.



- [2] Disconnect the injector harness from the injector.

⚠ Caution

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



## H. ENGINE

1	Injector
2	Installation bolt

[3] Temporarily tighten the injection pipe to the injector.

### ⚠ Caution

- Use new injection pipes.

[4] Temporarily tighten the injection pipe to the common rail assembly.

[5] Securely tighten the injector to the cylinder head assembly.  
tightening torque : 30 N · m { 3.1 kgf · m / 22 lb · ft }

[6] Install the injector leak-off pipe to the injector.

### ⚠ Caution

- Use new gaskets.

tightening torque : 14 N · m { 1.4 kgf · m / 126 lb · in }

### 21. Injection pipe installation

[1] Securely tighten the injection pipe to the injector.

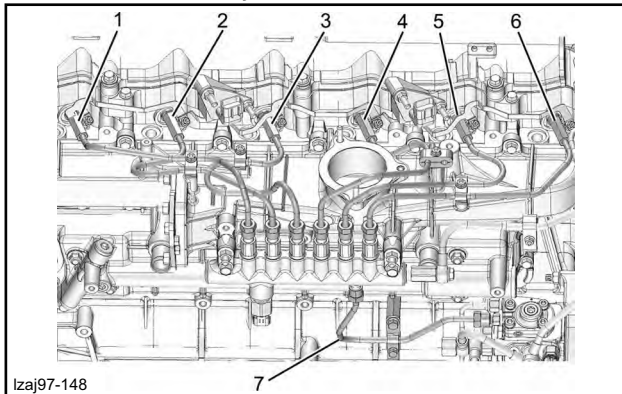
tightening torque : 44 N · m { 4.5 kgf · m / 32.5 lb · ft }

[2] Securely tighten the injection pipe to the common rail assembly.

tightening torque : 44 N · m { 4.5 kgf · m / 32.5 lb · ft }

[3] Install the clip to the inlet cover.

tightening torque : 6 N · m { 0.6 kgf · m / 53.1 lb · in }



Izaj97-148

1	No.1 injection pipe
2	No.2 injection pipe
3	No.3 injection pipe
4	No.4 injection pipe
5	No.5 injection pipe
6	No.6 injection pipe
7	Fuel pipe

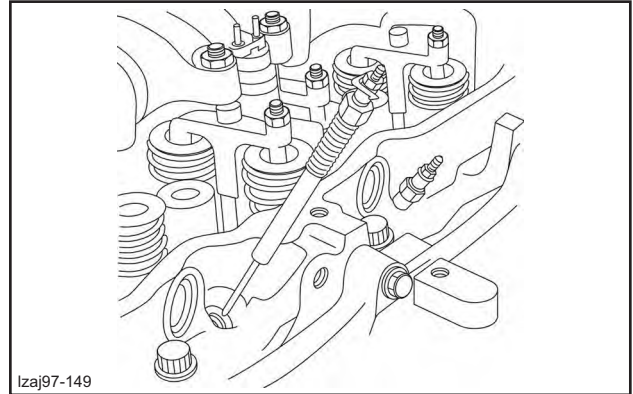
### 22. Glow plug installation

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

tightening torque : 20 N · m { 2.0 kgf · m / 14.8 lb · ft }

### ⚠ Caution

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



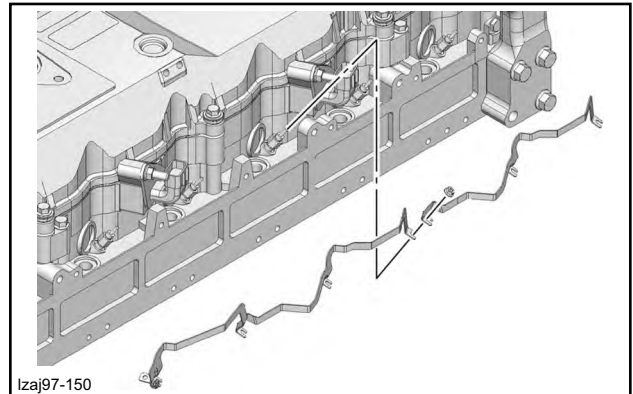
Izaj97-149

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

tightening torque : 1 N · m { 0.1 kgf · m / 8.9 lb · in }

### ⚠ Caution

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



Izaj97-150

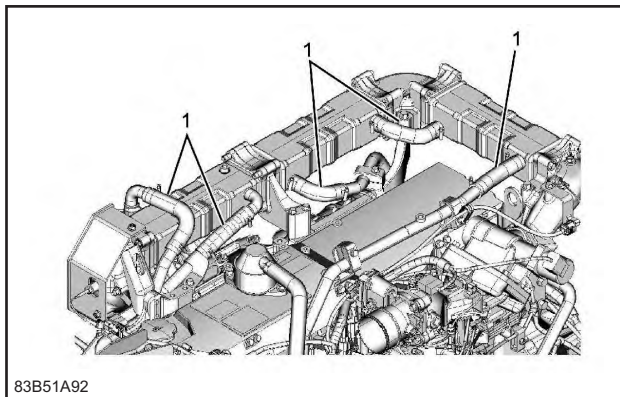
### 23. Injector harness installation

[1] Install the injector harness to the cylinder head assembly.

### Note

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

[19] Connect the water rubber hose to the EGR cooler.



83B51A92

1 Water rubber hose

9. EGR gas temperature sensor 2 installation

**Caution**

- Check the EGR gas temperature sensor 2 connector color, and take care not to assemble incorrectly.
- Because the connector color cannot be identified using the outer surface if the exterior is painted, remove the connector and identify it using the connector interior color.
- If it is difficult to determine the color, remove the connectors of EGR gas temperature sensor 2 and the IMT sensor, and determine the color using the connector interior color.

Sensor name	Connector color
EGR gas temperature sensor 2	Light gray
IMT sensor	Gray

**Caution**

- Do not subject the tip of the sensor to impact when installing the EGR gas temperature sensor.
- Do not reuse an EGR gas temperature sensor that has been subjected to impact due to being dropped, etc.

[1] Apply anti-seize lubricant to EGR gas temperature sensor 2.

Note

- Apply High Temperature Stainless Never-Seez: 5-87411-039-0, manufactured by Bostik in the U.S., etc. to the threaded portion of EGR gas temperature sensor 2.

[2] Install EGR gas temperature sensor 2 to EGR pipe B.

tightening torque : 19.6 N · m { 2.0 kgf · m / 14 lb · ft }

[3] Install the harness bracket to EGR pipe B.

tightening torque : 23.5 N · m { 2.4 kgf · m / 17 lb · ft }

[4] Connect the harness connector to EGR gas temperature sensor 2.

10. EGR gas temperature sensor 1 installation

**Caution**

- Do not subject the tip of the sensor to impact when installing the EGR gas temperature sensor.
- Do not reuse an EGR gas temperature sensor that has been subjected to impact due to being dropped, etc.

[1] Apply anti-seize lubricant to EGR gas temperature sensor 1.

Note

- Apply High Temperature Stainless Never-Seez: 5-87411-039-0, manufactured by Bostik in the U.S., etc. to the threaded portion of EGR gas temperature sensor 1.

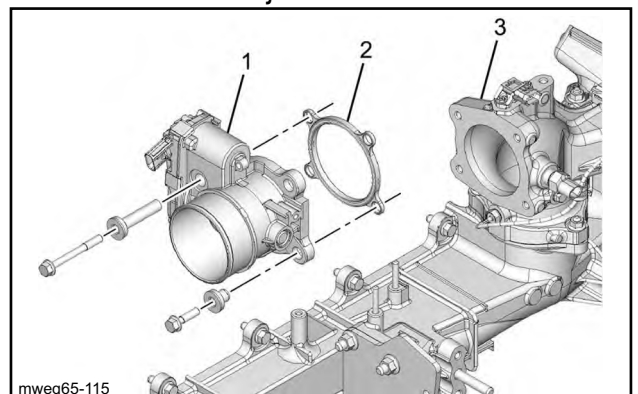
[2] Install EGR gas temperature sensor 1 to EGR pipe A.  
tightening torque : 44 N · m { 4.5 kgf · m / 32 lb · ft }

[3] Install the harness bracket to the fan guide stay.  
tightening torque : 23.5 N · m { 2.4 kgf · m / 17 lb · ft }

[4] Connect the harness connector to EGR gas temperature sensor 1.

11. Intake throttle valve installation

[1] Install the intake throttle valve to the inlet pipe.  
tightening torque : 24 N · m { 2.4 kgf · m / 17 lb · ft }



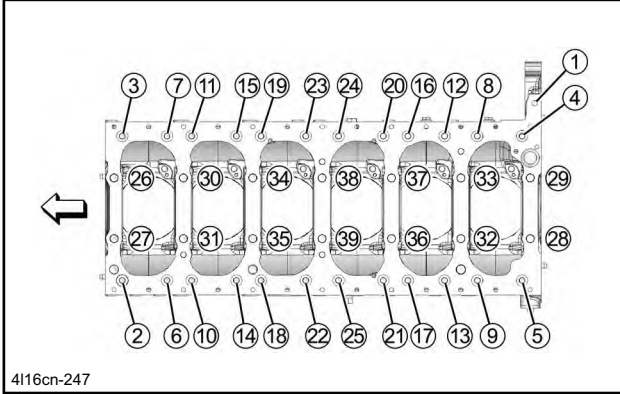
mweq65-115

## H. ENGINE

[2] Remove the crankcase from the cylinder block.

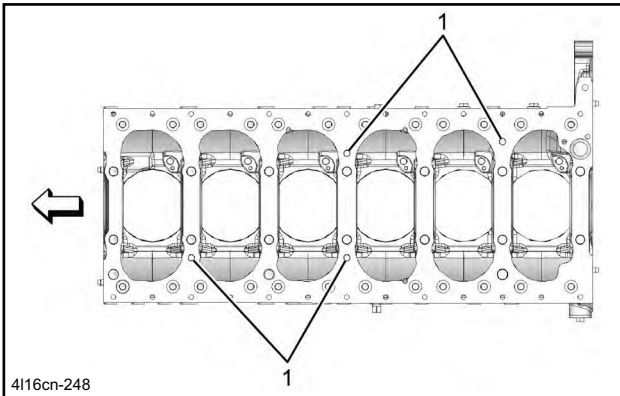
### Note

- Loosening order



### Note

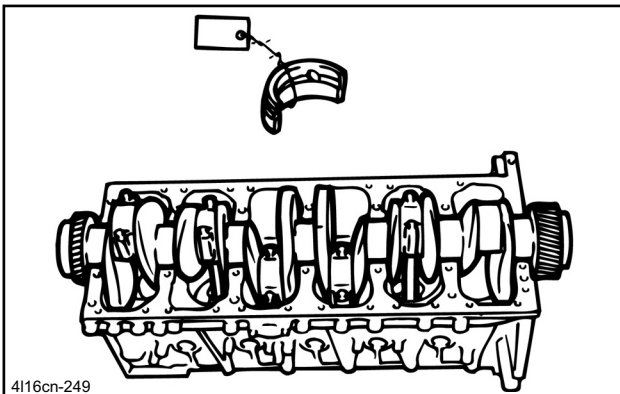
- Using the 4 replacer holes, remove the crankcase.



1 Replacer hole

[3] Remove the thrust bearing from the crankcase.

[4] Remove the crankshaft bearing from the crankcase.



[5] Remove the crankshaft from the cylinder block.

[6] Remove the thrust bearing from the cylinder block.

[7] Remove the crankshaft bearing from the cylinder block.

## Installation of Crankshaft

### 1. Crankshaft bearing preparation

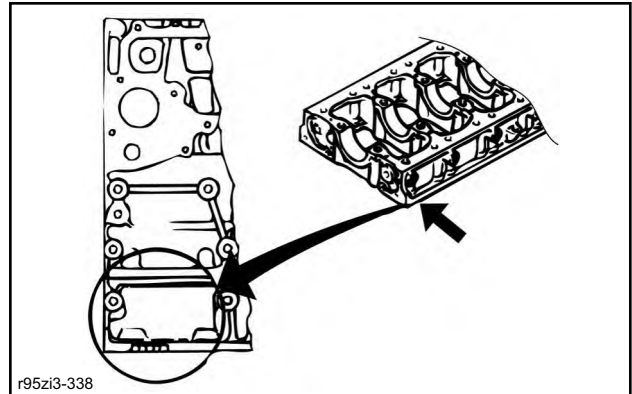
### ⚠ Caution

- When replacing the crankshaft bearing, select the crankshaft bearing following the procedure below.

### [1] Check marking of the crankcase.

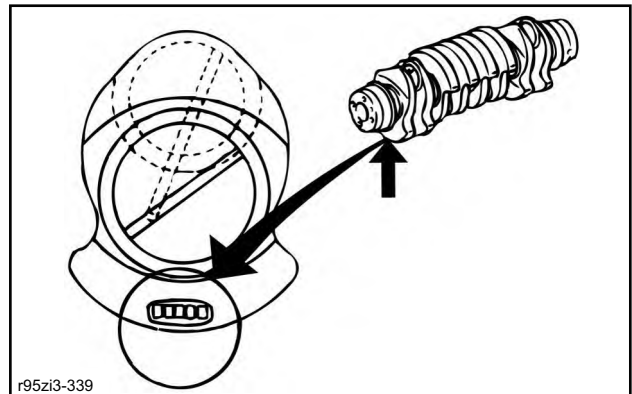
### Note

- The marking on the crankcase indicates the inner diameter grade of the cylinder block journal section.
- Grade indications are lined up as No.1, 2, 3, 4, 5, 6, 7 from the left when looking at the marking section from the front side.



### Note

- Check the marking on the crankshaft.
- The marking on the crankshaft indicates the outer diameter grade of the journal section.
- Grade indications are lined up as No.1, 2, 3, 4, 5, 6, 7 from the left when looking at the marking section from the front side.



[4] Turn the adjust screw.

Note

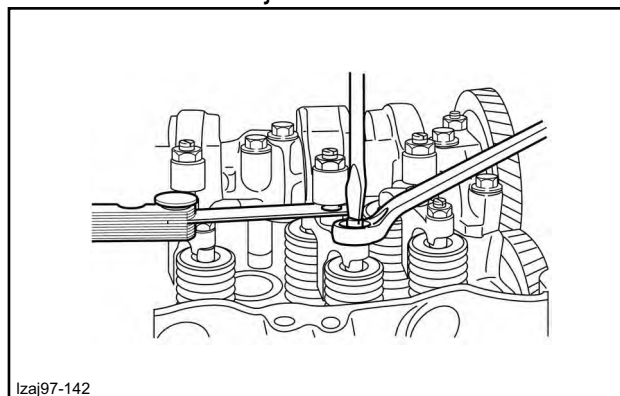
- With the thickness gauge inserted, lightly tighten the adjust screw of the bridge.
- Confirm that the leading end of the adjust screw and valve shaft end have made contact and the movement of the thickness gauge has become stiff.
- Check if the valve shaft end on the opposite side is floating or touching at an angle.
- If it is floating or touching at an angle, slightly loosen the bridge adjust screw and adjust the valve shaft ends on both sides to touch properly.

clearance : less than 0.1 mm { less than 0.0039 in } between valve and bridge

Note

- To prevent turning, fix the bridge adjust screw with a flathead screwdriver, and tighten the adjust screw nut.

tightening torque : 22 N · m { 2.2 kgf · m / 16 lb · ft }



Adjustment table

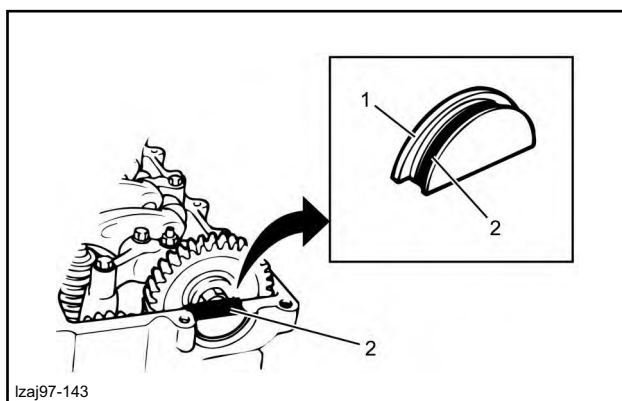
Cylinder No.	1		2		3		4		5		6	
Valve	IN	EX	IN	EX	IN	EX	IN	EX	IN	EX	IN	EX
No.1 cylinder compression top dead center (O mark is an adjustable part)	O	O	O				O	O			O	
No.6 cylinder compression top dead center (O mark is an adjustable part)				O	O				O	O		O

24. Lower cover installation

[1] Apply the liquid gasket to the rubber plug.

Note

- Apply ThreeBond 1207B.



1	Rubber plug
2	Liquid gasket

[2] Install the rubber plug to the cylinder head.

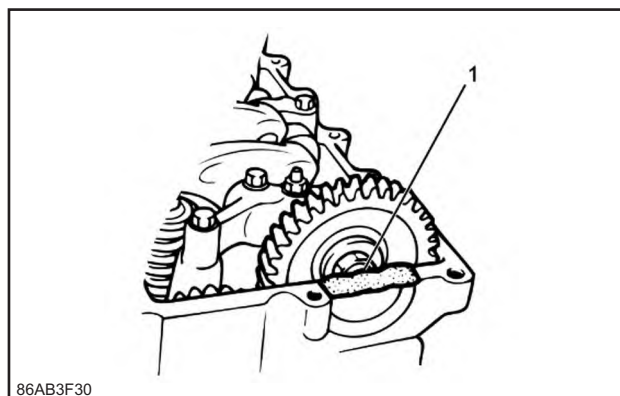
[3] Apply liquid gasket to the rubber plug.

Note

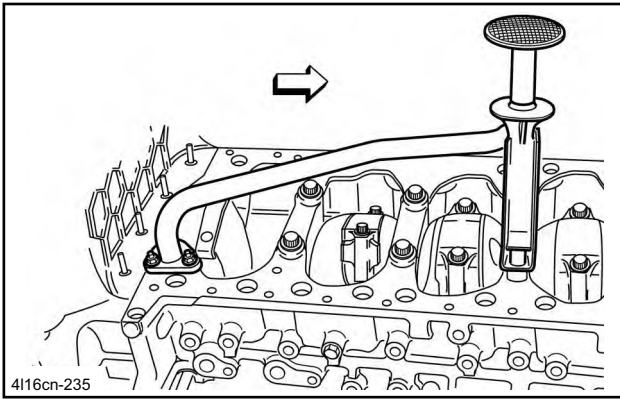
- Apply ThreeBond 1207B to the rubber plug and cylinder head mating surfaces.

⚠ Caution

- After applying the liquid gasket, install the lower cover within 5 minutes.



## H. ENGINE



### 7. Turbocharger assembly removal

- [1] Remove the air cleaner duct from the air cleaner assembly and the turbocharger assembly.
- [2] Remove the air intake hose from the turbocharger assembly and the intercooler.
- [3] Remove the exhaust pipe from the turbocharger.
- [4] Disconnect the oil feed pipe from the turbocharger assembly.

**Note**

- Remove the clip.

- [5] Remove the oil feed pipe from the pipe bracket.

**Note**

- Remove the clip.

- [6] Disconnect the oil return pipe from the turbocharger assembly.
- [7] Remove the oil return pipe from the cylinder block.
- [8] Disconnect the water return pipe from the turbocharger assembly.
- [9] Remove the water return pipe from the cylinder head assembly.
- [10] Disconnect the water feed pipe from the turbocharger assembly.

**Note**

- Remove the clip.

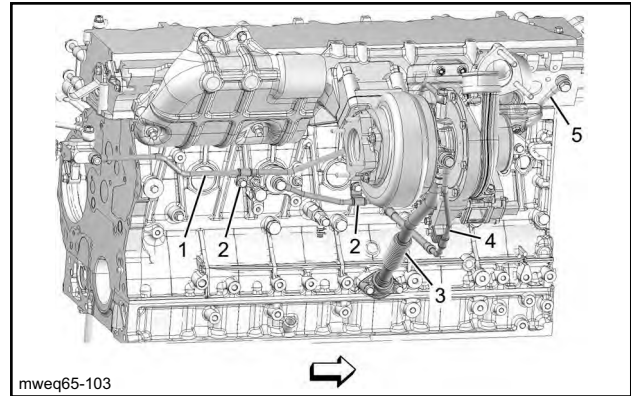
- [11] Remove the water feed pipe from the cylinder block.

**Note**

- Remove the clip.

- [12] Disconnect the harness connector from the turbocharger assembly.

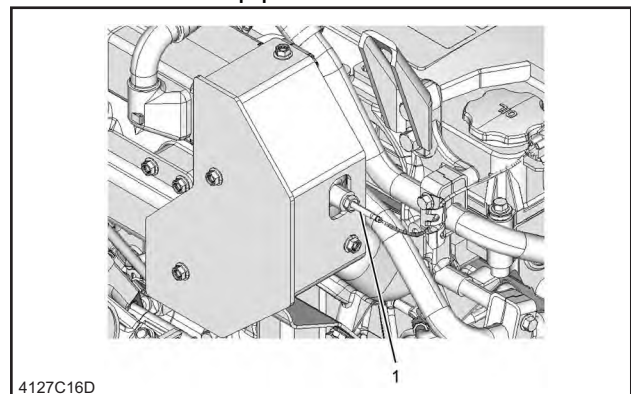
- [13] Remove the turbocharger assembly from the exhaust manifold.



1	Oil feed pipe
2	Clip
3	Oil return pipe
4	Water feed pipe
5	Water return pipe

### 8. EGR gas temperature sensor 1 removal

- [1] Disconnect the harness connector from EGR gas temperature sensor 1.
- [2] Remove the harness bracket from the fan guide stay.
- [3] Remove EGR gas temperature sensor 1 from EGR pipe A.

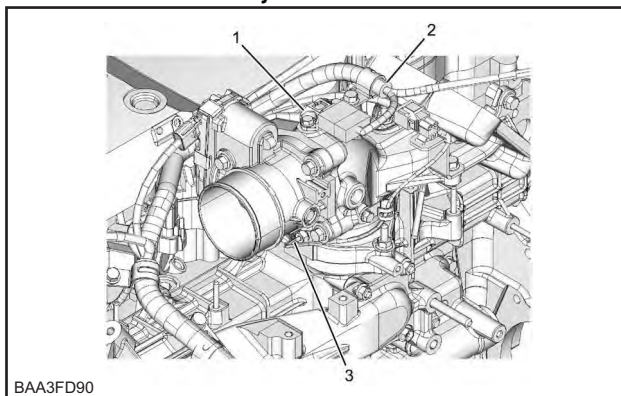


1	EGR gas temperature sensor 1
---	------------------------------

### 9. EGR gas temperature sensor 2 removal

- [1] Disconnect the harness connector from EGR gas temperature sensor 2.
- [2] Remove the harness bracket from EGR pipe B.
- [3] Remove EGR gas temperature sensor 2 from EGR pipe B.

- [2] Connect the harness connector to the boost pressure sensor/boost temperature sensor.
- [3] Connect the harness connector to the IMT sensor.
- [4] Install the harness clip to the inlet pipe. tightening torque : 24 N · m { 2.4 kgf · m / 17 lb · ft }

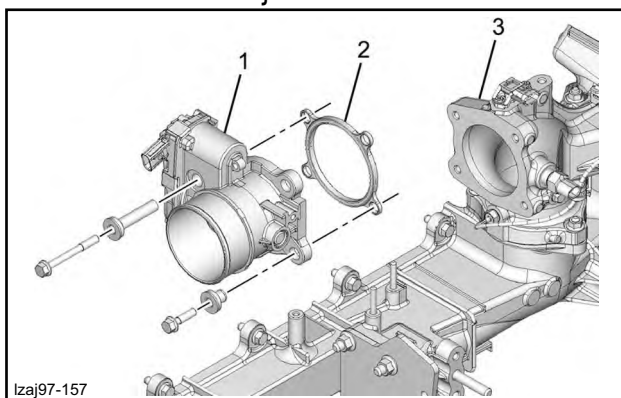


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1	Boost pressure sensor/boost temperature sensor
2	Harness clip
3	IMT sensor

17. Intake throttle valve installation

- [1] Install the intake throttle valve to the inlet pipe. tightening torque : 24 N · m { 2.4 kgf · m / 17 lb · ft }



lzaj97-157

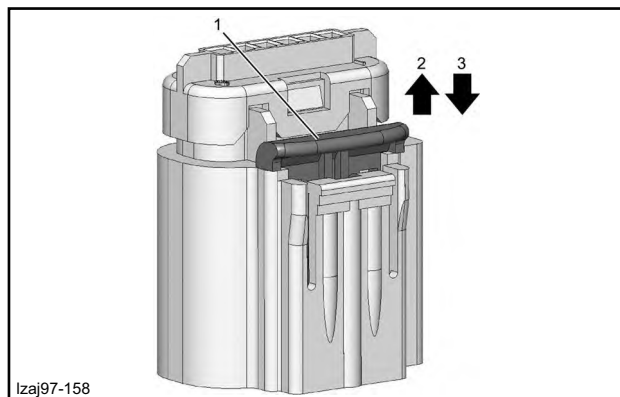
1	Intake throttle valve
2	Gasket
3	Inlet pipe

- [2] Install the air duct to the intake throttle valve.

- [3] Connect the harness connector to the intake throttle valve.

Note

- After connecting the harness connector, press in the lock operation portion to lock.

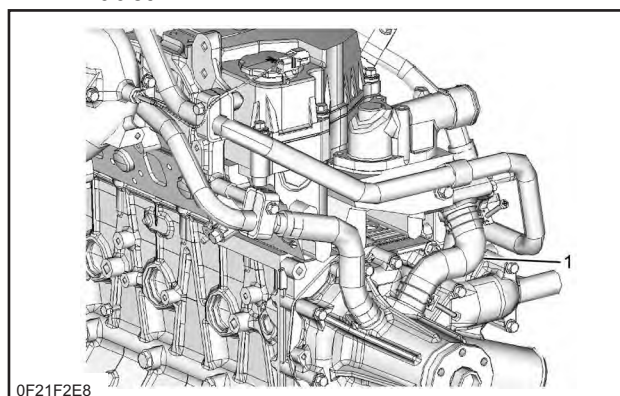


lzaj97-158

1	Lock operation section
2	Lock release
3	Lock

18. EGR cooler water pipe installation

- [1] Install the water bypass hose to the water pump assembly and the water duct.

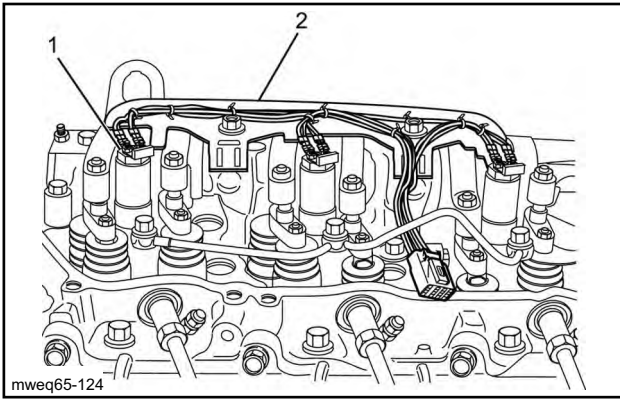


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1	Water bypass hose
---	-------------------

- [2] Install the EGR cooler water pipe to the engine assembly. clamp tightening torque : 20 N · m { 2.0 kgf · m / 14 lb · ft }

## H. ENGINE



1	Injector harness terminal
2	Injector harness bracket

### 4. Lower cover removal

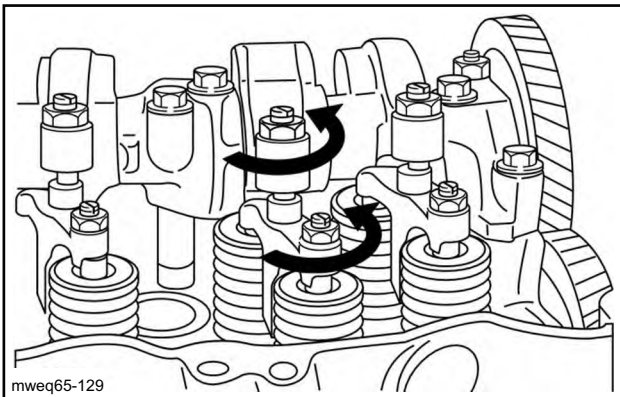
- [1] Remove the lower cover from the cylinder head assembly.
- [2] Remove the rubber plug from the cylinder head assembly.

### 5. Rocker arm shaft removal

- [1] Loosen the adjust screw using a wrench.

#### Note

- Loosen all valve clearance adjustment screws.



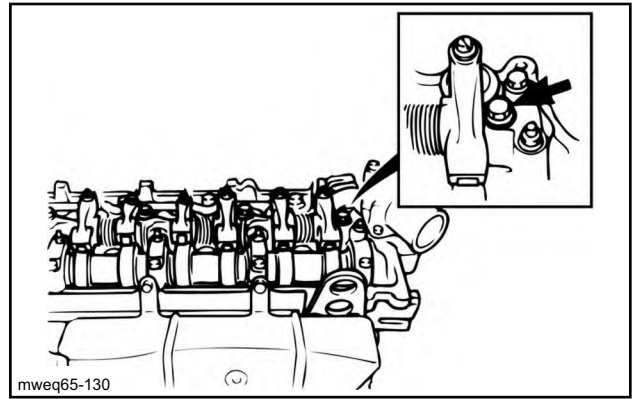
- [2] Remove the rocker arm shaft from the cylinder head assembly.

#### Note

- Evenly loosen the rocker arm shaft bracket and the rocker arm assembly bracket tightening bolts from both ends and remove them.

#### ⚠ Caution

- Be careful not to remove the bolt shown in the diagram.

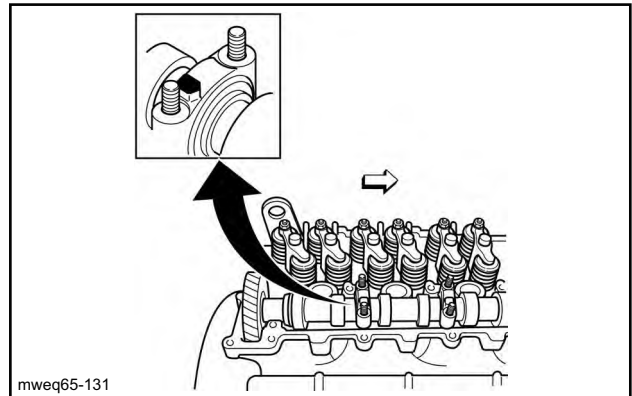


### 6. Camshaft removal

- [1] Remove the camshaft bearing cap from the cylinder head assembly.
- [2] Remove the camshaft bearing from the camshaft bearing cap.
- [3] Remove the camshaft from the cylinder head.
- [4] Remove the camshaft bearing from the cylinder head assembly.

#### Note

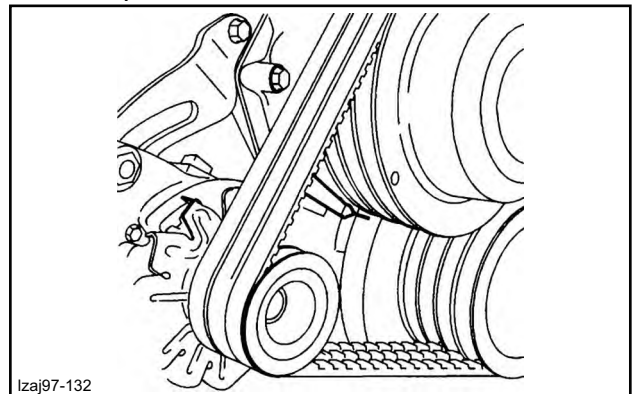
- Temporarily assemble the removed caps and bearings in the original position to avoid a mixup after the bearings have been inspected.

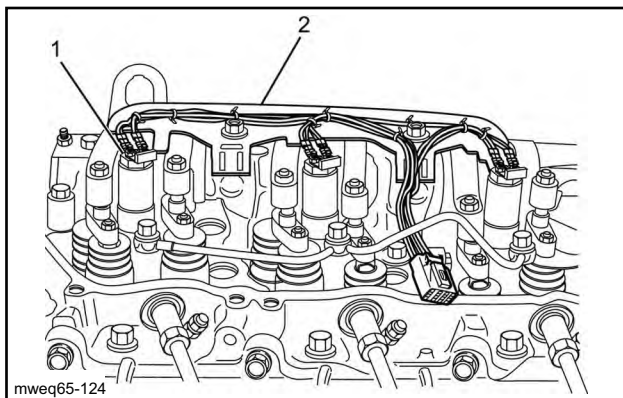


## Installation of Camshaft

### 1. Camshaft installation

- [1] Align No.1 cylinder to the compression top dead center.





mweq65-124

1	Injector harness terminal
2	Injector harness bracket

4. Lower cover removal

[1] Remove the lower cover from the cylinder head assembly.

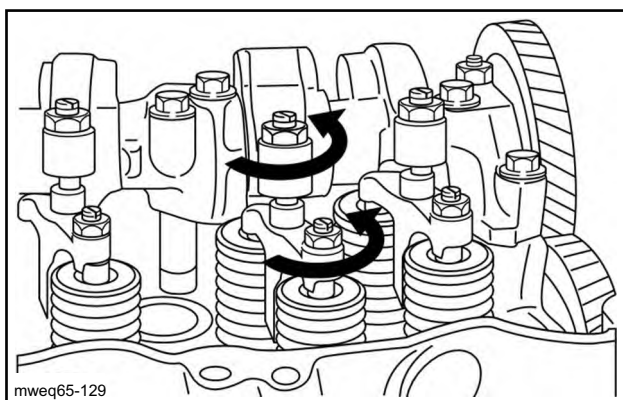
[2] Remove the rubber plug from the cylinder head assembly.

5. Rocker arm shaft removal

[1] Loosen the adjust screw using a wrench.

Note

- Loosen all valve clearance adjustment screws.



mweq65-129

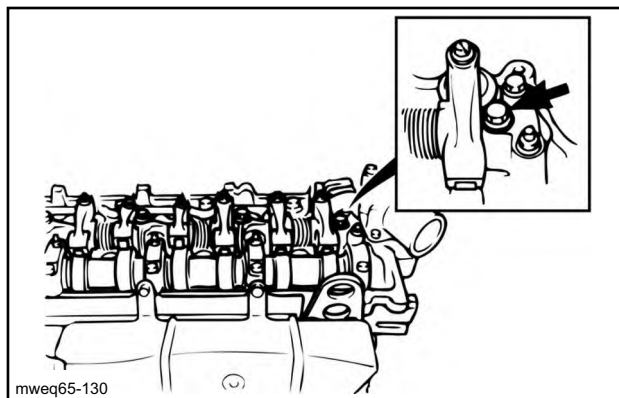
[2] Remove the rocker arm shaft from the cylinder head assembly.

Note

- Evenly loosen the rocker arm shaft bracket and the rocker arm assembly bracket tightening bolts from both ends and remove them.

**⚠ Caution**

- Be careful not to remove the bolt shown in the diagram.



mweq65-130

**Installation of Rocker Arm Shaft**

1. Rocker arm shaft installation

[1] Apply the engine oil to the bracket.

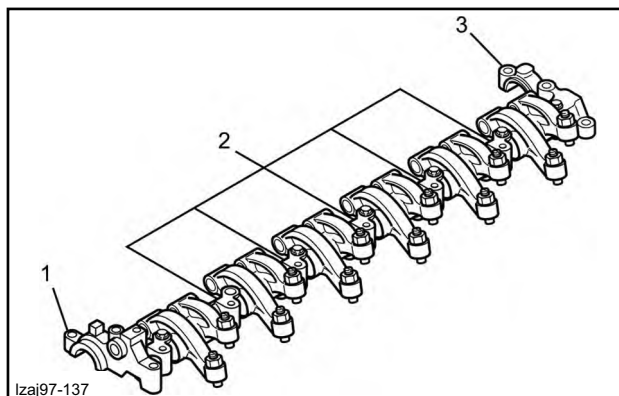
Note

- Apply to each sliding surface.

[2] Apply the engine oil to the rocker arm.

Note

- Confirm that the adjust screw is fully loosened.



izaj97-137

1	Front side camshaft bracket
2	Rocker arm
3	Rear side camshaft bracket

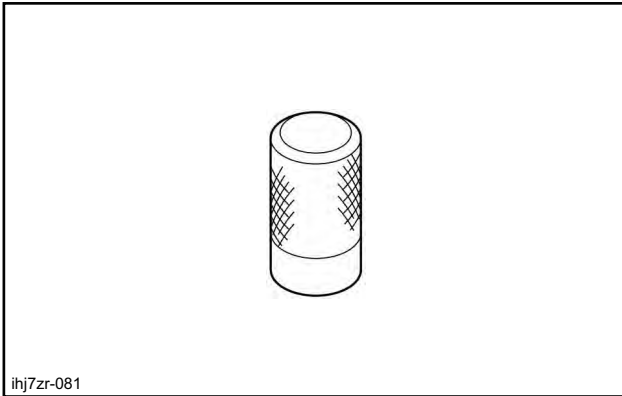
[3] Install the rocker arm shaft to the cylinder head assembly.

Note

- On the camshaft bearing assembly section only, apply oil to the threaded portion of the stud bolts and the seat surface/threaded portion of the nuts, then tighten them.
- Tightening order

# H. ENGINE

[3] Install the valve stem oil seal to the valve guide using the special tool.



ihj7zr-081

SST: 5-8840-2625-0 - valve stem seal installer

[2] Install the valve spring to the cylinder head assembly.

**Note**

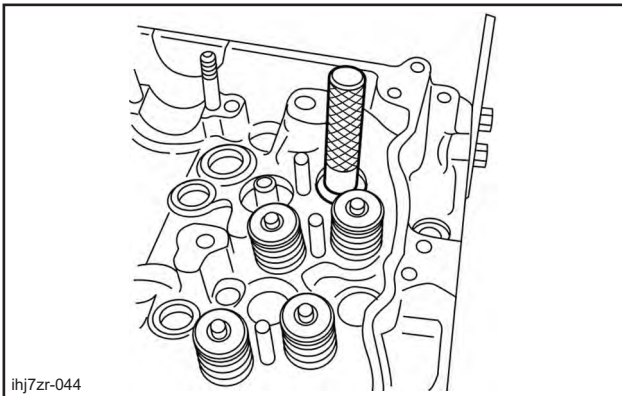
- Turn the valve spring to face the identification paint application area towards the cylinder head assembly.

[3] Install the spring seat to the valve spring.

[4] Secure the valve using air.

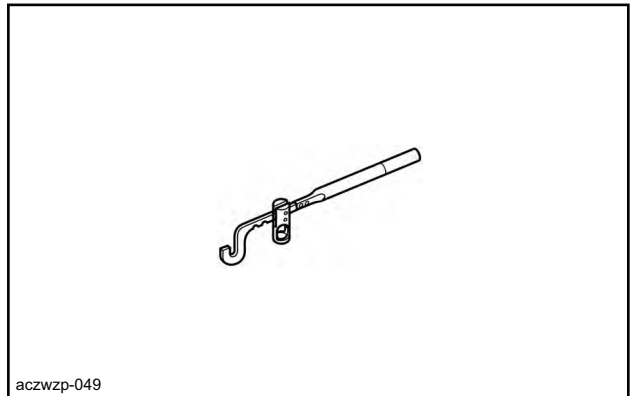
**Note**

- Secure the valve on the closed position by blowing the compressed air into the cylinder from the glow plug hole.



ihj7zr-044

[5] Press the valve spring using the special tool.



aczwzp-049

SST: 5-8840-2621-0 - valve spring replacer

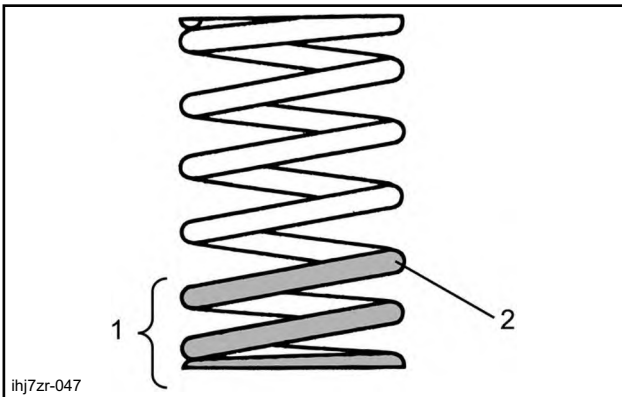
**Caution**

- Inspect the valve stem oil seal for deformation or cracks.
- Confirm that the garter spring has not come loose.

## 2. Valve spring installation

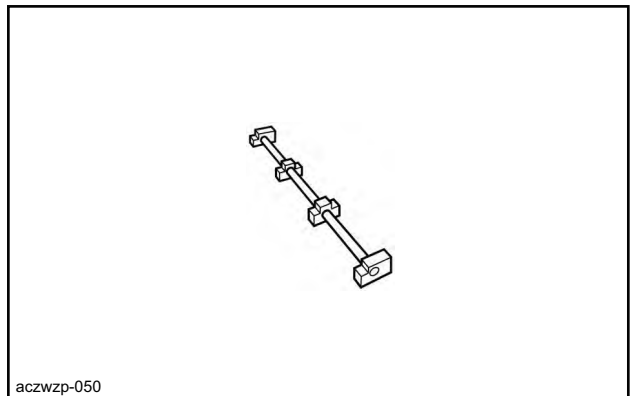
[1] Check the identification paint of the valve spring.

Valve spring identification paint	
Inlet	Blue
Exhaust	White



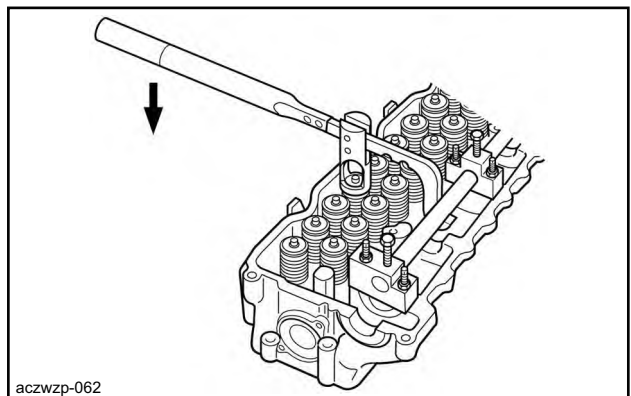
ihj7zr-047

1	Spring pitch (small)
2	Identification paint



aczwzp-050

SST: 8-9439-6862-0 - pivot ASM

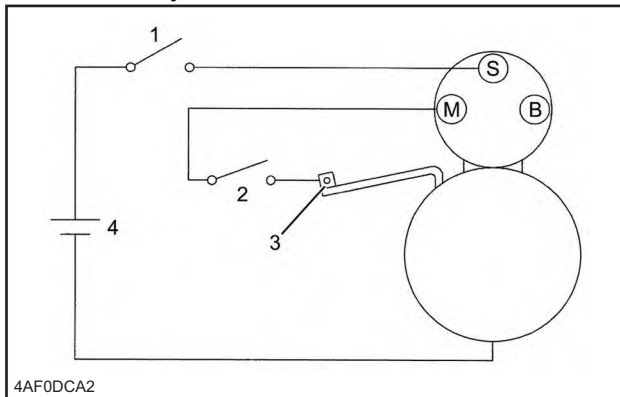


aczwzp-062

1	Pinion
2	Overrunning clutch
3	Stop ring
4	Snap ring
5	Groove
6	Pinion spring

[23] Install the magnetic switch to the front bracket.  
tightening torque : 5 to 9 N · m { 0.5 to 0.9 kgf · m / 44.3 to 79.7 lb · in }

[24] Connect the starter assembly to the battery.



4AF0DCA2

1	SW1
2	SW2
3	Lead wire with terminals
4	Battery 24 V

[25] Close the switch.

Note

- When the switches SW1 and SW2 are closed, the pinion advances to the cranking position and the armature rotates.

[26] Open the switch.

Note

- Open the switch SW2 to stop the rotation of the armature.

[27] Measure the starter assembly using the dial gauge.

Note

- Lightly push back the leading end of the shaft of the overrunning clutch using your hands and measure the travel distance.

Specified value : 0.5 to 2.0 mm { 0.0197 to 0.0787 in }

Note

- If the value is not within the specified value, adjust by increasing or decreasing the number of gaskets located between the magnetic switch and front bracket or replace the lever.

thickness of the gasket : 0.5 mm { 0.0197 in }

Note

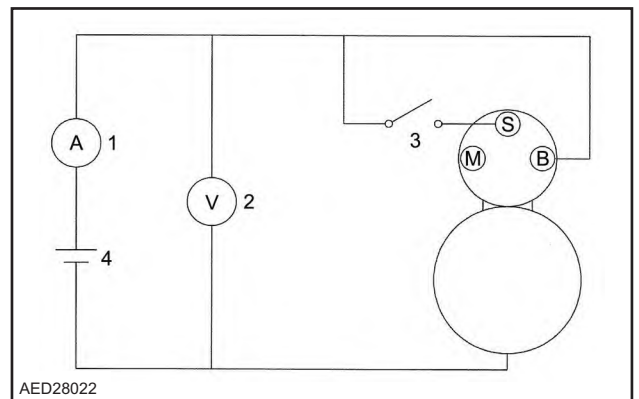
- Number of gaskets used: 2 or less

[28] Connect the lead wire with terminal to the magnetic switch.  
tightening torque : 20 to 26 N · m { 2.0 to 2.7 kgf · m / 14.8 to 19.2 lb · ft } M terminal nut

[29] Connect the starter assembly to the battery.

Note

- Connect the starter assembly as indicated in the diagram after adjusting the pinion protrusion position.



AED28022

1	Current meter
2	Voltage meter
3	SW
4	Battery 24 V

⚠ Caution

- Use a very thick electric wire.
- Fully tighten the joint section.

[30] Close the switch.

Note


- Read the current and voltage.

Voltage : 23.00 V

## H. ENGINE

---

- [14] Tighten the air bleeding plug using a wrench.  
tightening torque : 10 N · m { 1.0 kgf · m / 89 lb · in }


 Caution

- Fully remove any fuel in the area after tightening the plug.

- [15] Start the engine.

Note

- Idle the engine for 5 seconds.

 Caution

- Do not change the engine speed when the engine is started.
- If the engine does not start, repeat the process from step 12.

Note

- Slowly increase the engine speed, and maintain it for 3 minutes.
- Increase the engine speed to the maximum speed.

- [16] Stop the engine.

[3] Select Search.

Note

- Input the engine No. and select Search.

[4] Select Diagnosis.

[5] Select the Engine.

[6] Select Urea SCR.

[7] Select Actuator Test.

[8] Select NOx Sensor Data 1 Reset.

[9] Select Next.

[10] Select Reset.

## H. ENGINE

---

[5] Display ENGINE STATUS on the service support screen on the monitor and check that no DTC has been detected.  
See "Service Support - ENGINE STATUS".

### DTC P0098 Intake Air Temperature (IAT) Sensor 2 Circuit High Voltage

1. DTC P0098 priority DTC  
DTC P06A8

2. DTC P0098 diagnostics

[1] Turn OFF the starter switch.

[2] Disconnect the harness connector from the IMT sensor.

[3] Turn ON the starter switch.

[4] Measure the voltage between the IMT sensor signal circuit and a known good GND.

voltage: 5.5 V

[5] If the reading is more than or equal to the specified value, inspect the signal circuit between the ECM and IMT sensor for a short to the battery or a short to the ignition power supply.

[6] If a problem is found, repair the signal circuit.

[7] Connect a fused jumper wire between the IMT sensor signal circuit and GND circuit.

[8] Observe the 5 V adjustment display of intake air temperature sensor 3 on the trouble diagnosis scan tool.

voltage: 0.1 V

[9] If the reading is less than or equal to the specified value, inspect the signal circuit between the ECM and IMT sensor for a short to the 5 V power supply circuit.

[10] If a problem is found, repair the signal circuit.

[11] Inspect for poor connections at the IMT sensor harness connector.

[12] If a problem is found, repair the harness connector.

[13] If the harness connector is normal, replace the IMT sensor.

Refer to "IMT sensor removal".

Refer to "IMT sensor installation".

[14] Connect a fused jumper wire between the IMT sensor signal circuit and a known good GND.

[15] Observe the 5 V adjustment display of intake air temperature sensor 3 on the trouble diagnosis scan tool.

voltage: 0.1 V

### DTC P0217 Engine Coolant Over Temperature Condition

#### 1. DTC P0217 priority DTC DTC P0117

#### 2. DTC P0217 diagnostics

- [1] Inspect the engine cooling system.  
Refer to "Coolant inspection".  
Refer to "Cooling fan belt inspection".  
Refer to "Thermostat inspection".  
Refer to "Water pump assembly inspection".  
Refer to "Radiator inspection".
- [2] Start the engine while checking the coolant temperature indicated in ENGINE STATUS on the service support screen on the monitor.  
See "Service Support - ENGINE STATUS".
- [3] Wait until the engine has been completely warmed up.
- [4] Check whether the coolant temperature indicated in ENGINE STATUS on the service support screen on the monitor is at or above the standard value.  
See "Service Support - ENGINE STATUS".  
values: 101 °C { 214 °F }
- [5] If the reading is less than the specified value, check the operator if the overheat has occurred due to low engine coolant level, etc.
- [6] Make sure to inspect the engine if it has experienced engine overheat in the past.
- [7] Inspect the engine coolant temperature sensor.  
Refer to "Engine coolant temperature sensor inspection".
- [8] If any abnormality is found in the inspection results, replace the engine coolant temperature sensor.  
Refer to "Engine coolant temperature sensor removal".  
Refer to "Engine coolant temperature sensor installation".

#### 3. DTC P0217 confirm resolution

- [1] Display RESET on the service support screen on the monitor and reset FAULTY HISTORY.  
See "Service Support - RESET Screen List".
  - Note that all the generated DTCs will be cleared.

- [2] Turn OFF the starter switch for at least 30 seconds.
- [3] Start the engine while checking the coolant temperature indicated in ENGINE STATUS on the service support screen on the monitor and wait until the engine is completely warmed up.  
See "Service Support - ENGINE STATUS".
- [4] Observe that the engine coolant temperature display is not more than or equal to the specified value.  
values: 101 °C { 214 °F }
- [5] Display ENGINE STATUS on the service support screen on the monitor and check that no DTC has been detected.  
See "Service Support - ENGINE STATUS".

## H. ENGINE

---

### DTC P0522 Engine Oil Pressure Sensor Circuit Low Input

1. DTC P0522 priority DTC  
DTC P06A9
2. DTC P0522 diagnostics
  - [1] Turn OFF the starter switch.
  - [2] Disconnect the harness connector from the oil pressure sensor.
  - [3] Turn ON the starter switch.
  - [4] Measure the voltage between the 5 V power supply circuit and normal GND of the oil pressure sensor harness connector.  
voltage: 4.5 V
  - [5] If the reading is less than or equal to the specified value, inspect to see if there is an open circuit or high resistance with the 5 V power supply circuit between the ECM and the oil pressure sensor.
  - [6] If a problem is found, repair the 5 V power supply circuit.
  - [7] Connect the test cable with fuse between the 5 V power supply circuit and signal circuit of the oil pressure sensor harness connector.
  - [8] Observe the oil pressure sensor display on the trouble diagnosis scan tool.  
voltage: 4.5 V
  - [9] If the reading is more than or equal to the specified value, inspect to see if there is a poor connection with the oil pressure sensor harness connector.
- [10] If a problem is found, repair the harness connector.
- [11] If the harness connector is normal, replace the oil pressure sensor.  
Refer to "Oil pressure sensor removal".  
Refer to "Oil pressure sensor installation".
- [12] Inspect the signal circuit between the ECM and the oil pressure sensor.
  - There should be no open circuit or high resistance.
  - There should be no short to GND.
- [13] If a problem is found, repair the signal circuit.
- [14] Inspect the ECM harness connector for a poor connection.
- [15] If a problem is found, repair the harness connector.
- [16] If the harness connector is normal, replace the ECM.

Refer to "ECM removal".  
Refer to "ECM installation".

- [17] Set the Injector ID Code, fuel delivery rate, and engine No. for the ECM.
3. DTC P0522 confirm resolution
  - [1] Display RESET on the service support screen on the monitor and reset FAULTY HISTORY.  
See "Service Support - RESET Screen List".
    - Note that all the generated DTCs will be cleared.
  - [2] Turn OFF the starter switch for at least 30 seconds.
  - [3] Start the engine.
  - [4] Perform a test-run under the conditions for running the DTC.

Note
------

- Conditions for setting the DTCs such as engine run time or coolant temperature, etc., vary depending on the DTCs.

- [5] Display ENGINE STATUS on the service support screen on the monitor and check that no DTC has been detected.  
See "Service Support - ENGINE STATUS".

[13] If a problem is found, repair the clogging of the fuel system.

[14] Inspect the fuel hose between the fuel tank and the fuel supply pump for a cut and crack.

[15] If a problem is found, replace the fuel hose.

Note

- The fuel hose between the fuel tank and the fuel supply pump becomes negative pressure state when the engine is running.
- When the fuel hose is not connected securely, the air can enter.
- When the engine speed or the engine load increases while the air has intruded in the fuel system, fluctuation in the common rail pressure is caused, and DTC P1093 may be detected.

[16] Check that an appropriate clamp is used between the fuel tank and the fuel supply pump.

[17] If a problem is found, replace the clamp.

[18] Operate the priming pump until the handle becomes heavy.

Note

- When a leak exists in the fuel system between the priming pump and the fuel supply pump, the pressing weight of the priming pump does not become heavy.

[19] Start the engine.

[20] Inspect the high-pressure side of the fuel system and check for fuel leak between the fuel supply pump and common rail.

Note

- The fuel may leak to the bottom section of the cylinder head cover from the high pressure hose inlet.
- The engine oil level increases when the fuel leaks to the bottom portion of the cylinder head cover.
- Inspect for fuel leaks into the engine oil.

[21] If fuel leak is found, fix the problem.

[22] Turn OFF the starter switch.

[23] Remove the fuel hose on the fuel supply pump side from the fuel filter.

Note

- Use a pan to catch the fuel from the removed fuel hose.
- Clean the pressure gauge and connection hose before connecting to the fuel pipe.
- The fuel supply pump may be damaged due to foreign matter that has entered in the connection hose.

[24] Connect the pressure gauge between the fuel filter and the removed fuel hose.

Note

- Confirm that the fuel system is connected securely.

[25] Remove the air using the priming pump, and crank the engine for the specified period of time or shorter.  
specified time: 5 s

Note

- Repeat this until the engine starts.

[26] Leave the engine idling for the specified period of time or longer.  
specified time: 1 min

[27] While allowing the engine to keep the specified duration and the maximum engine speed, observe the pressure gauge.  
specified time: 1 min

[28] Check if the pressure gauge shows a negative pressure value at or above the specified value during inspection.  
values: (-17.0) kPa { 5 inHg / (-2) psi }

Note

- Fuel clogging is checked with the negative pressure amount in the fuel system.

[29] If the negative pressure is more than or equal to the specified value, inspect to see if there is damage or twisting with the fuel system between the fuel supply pump and the fuel tank.

[30] If a problem is found, repair the fuel system.

[31] Inspect the fuel tank bent hose.

[32] If a problem is found, repair the bent hose.

## H. ENGINE

---

[4] Perform a test-run under the conditions for running the DTC.

Note

- Conditions for setting the DTCs such as engine run time or coolant temperature, etc., vary depending on the DTCs.

[5] Display ENGINE STATUS on the service support screen on the monitor and check that no DTC has been detected.

See "Service Support - ENGINE STATUS".

DTC P2228 Barometric Pressure Sensor Circuit Low

1. DTC P2228 diagnostics

[1] Replace the ECM.

Refer to "ECM removal".

Refer to "ECM installation".

[2] Set the Injector ID Code, fuel delivery rate, and engine No. for the ECM.

2. DTC P2228 confirm resolution

[1] Display RESET on the service support screen on the monitor and reset FAULTY HISTORY.

See "Service Support - RESET Screen List".

- Note that all the generated DTCs will be cleared.

[2] Turn OFF the starter switch for at least 30 seconds.

[3] Start the engine.

[4] Perform a test-run under the conditions for running the DTC.

Note

- Conditions for setting the DTCs such as engine run time or coolant temperature, etc., vary depending on the DTCs.

[5] Display ENGINE STATUS on the service support screen on the monitor and check that no DTC has been detected.

See "Service Support - ENGINE STATUS".

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Diagnostic trouble code\_P1462: Urea Solution Quality Sensor Time-Out Abnormality

1. Diagnostic trouble code: P1462 -  
Diagnostic trouble code to be addressed with higher priority  
Diagnostic trouble code: U029D
2. Diagnostic trouble code P1462 diagnostics
  - [1] Turn OFF the starter switch.
  - [2] Disconnect the urea sensor harness connector.
  - [3] Inspect the urea sensor harness connector.

Note

- There must not be any intermittent problems, poor contact or corrosion.
- Invasion by water or foreign matter should not be there.

- [4] Repair the connector if problems are found.
- [5] Turn ON the starter switch.
- [6] Connect a test lamp between the urea sensor power supply circuit and DCU harness ground connection.
- [7] If the test lamp is not lit, repair any open-circuit or high resistance point in the urea sensor power supply circuit.
- [8] Connect a test lamp between the power supply circuit and ground circuit.
- [9] If the test lamp is not lit, repair any open-circuit or high resistance point in the urea sensor ground circuit.
- [10] Turn ON the starter switch.
- [11] Measure the voltage between ground connection of CAN Low circuit and DCU harness and ground connection of CAN High circuit and DCU harness.  
Standard value: 1.5 - 3.5 V
- [12] If the voltage value is out of the range of standard value, inspect CAN Low circuit and CAN High circuit between urea sensor and DCU.

Note

- Make sure that there is no open circuit or high resistance point in CAN High circuit.
- Make sure that there is no open circuit or high resistance point in CAN Low circuit.
- Make sure that there is no open circuit or high resistance point of terminator.

- [13] Repair the CAN circuit or replace the terminator if problems are found.

- [14] Replace the urea sensor.  
Refer to "Removing the urea sensor".  
Refer to "Installing the urea sensor".

3. Checking diagnostic trouble code P1462 symptom resolution

- [1] Execute DCU MEMORY CLEAR in the device test of the service monitor to reset the diagnostic trouble code.  
Refer to "Service Monitor - Device Test ECM/DCU Memory Clear".

- Note that all the generated diagnostic trouble codes will be cleared.

Note

- Check if the diagnostic trouble code P20C9 is detected at the ECM side when DCU diagnostic trouble codes are deleted.
- Delete if the diagnostic trouble code P20C9 is detected.

- [2] Turn OFF the starter switch.
- [3] Turn ON the starter switch without starting the engine.
- [4] Enable the FAULT HISTORY and ensure that diagnostic trouble code is not detected on the service support screen of monitor.  
Refer to "Service Support - FAULT HISTORY".

## H. ENGINE

---

- [15] If any fault is found, repair the harness connector.
- [16] Replace the urea solution tank temperature sensor.
- [17] Inspect the DCU harness connector for any poor contact.
- [18] If any fault is found, repair the harness connector.
- [19] Replace the DCU.  
Refer to "Removal of DCU".  
Refer to "Installation of DCU".

### 2. Checking diagnostic trouble code P205D symptom resolution

- [1] Execute DCU MEMORY CLEAR in the device test of the service monitor to reset the diagnostic trouble code.  
Refer to "Service Monitor - Device Test ECM/DCU Memory Clear".
  - Note that all the generated diagnostic trouble codes will be cleared.

#### Note

- Check if the diagnostic trouble code P20C9 is detected at the ECM side when DCU diagnostic trouble codes are deleted.
- Delete if the diagnostic trouble code P20C9 is detected.

- [2] Turn OFF the starter switch.
- [3] Turn ON the starter switch without starting the engine.
- [4] Enable the FAULT HISTORY and ensure that diagnostic trouble code is not detected on the service support screen of monitor.  
Refer to "Service Support - FAULT HISTORY".

### DTC P206A Urea Fluid Quality Sensor Circuit

#### 1. DTC P206A diagnostics

- [1] Turn OFF the starter switch.
- [2] Disconnect the urea fluid sensor harness connector.
- [3] Inspect the urea fluid sensor power supply circuit between the starter switch and the urea fluid sensor for an open circuit or high resistance.
- [4] If a problem is found, repair the urea fluid sensor power supply circuit.
- [5] Inspect the urea fluid sensor harness connector.

#### Note

- There should be no intermittent conditions, poor connections, or corrosion.
- There should be no water intrusion or adhering foreign material.

- [6] If a problem is found, repair the connector.

- [7] Replace the urea fluid sensor.  
Refer to "DEF sensor removal".  
Refer to "DEF sensor installation".

#### 2. DTC P206A confirm resolution

- [1] Execute DCU MEMORY CLEAR in the device test of the service monitor to reset the diagnostic trouble code.  
Refer to "Service Monitor - Device Test - ECM/DCU Memory Clear".
  - Note that all the generated diagnostic trouble codes will be cleared.

#### Note

- After clearing the DCU DTC, observe whether ECM DTC P20C9 is set.
- If DTC P20C9 is set, clear it.

- [2] Turn OFF the starter switch until communication with the trouble diagnosis scan tool is discontinued.
- [3] Turn ON the starter switch without starting the engine.
- [4] Check if the following parameters change to "No" on the trouble diagnosis scan tool.
  - Urea fluid concentration sensor error
  - Urea fluid conductivity sensor error
  - Urea fluid tank temperature sensor error
  - Urea fluid sensor error

Refer to "Service Support - ENGINE STATUS".

Standard value: 750 kPa {109 psi}

- [6] Enable the FAULT HISTORY and ensure that diagnostic trouble code is not detected on the service support screen of monitor.

Refer to "Service Support - FAULT HISTORY".

Diagnostic trouble code\_P20E9: Urea Solution High Pressure Abnormality

1. Diagnostic trouble code: P20E9 - Diagnostic trouble code to be addressed with higher priority  
 Diagnostic trouble code: P204B  
 Diagnostic trouble code: P204C  
 Diagnostic trouble code: P204D  
 Diagnostic trouble code: P208B
2. Diagnostic trouble code: P20E9 diagnostics

- [1] Inspect back flow pipe between urea solution supply module and urea solution tank.

Note

- Clogging due to twisting and curving should not be there.
- Clogging due to foreign matter should not be there.
- Clogging due to freezing of urea solution should not be there.
- Change in layout, which is outside the standard of urea solution line, should not be there.

 Caution

- Do not blow air into urea solution connector of urea solution supply module.

- [2] Repair or replace if problems are found.

- [3] Inspect the back flow line of urea sensor.

Note

- Clogging due to twisting and curving should not be there.
- Clogging due to freezing of urea solution should not be there.

- [4] Replace the urea sensor if problems are found.

Refer to "Removing the urea sensor".

Refer to "Installing the urea sensor".

- [5] Inspect the back floe connector of urea solution supply module.

Note

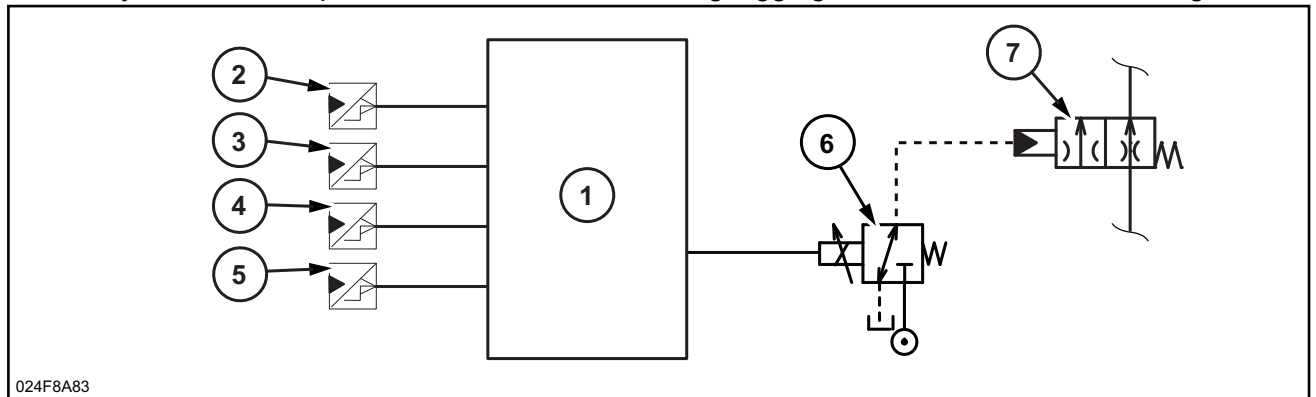
- Clogging of check valves and fixed closure should not be there.
- Clogging due to deformation of connector should not be there.



**Arm 2 Semi-parallel Control**

<Purpose/Overview>

The system reduces pressure loss of the arm during digging work and late half of leveling work.



1	Main controller	4	Pressure sensor (bucket)	7	Arm 2 semi-parallel spool
2	Pressure sensor (boom)	5	Pressure sensor (travel)		
3	Pressure sensor (arm)	6	Arm 2 semi-parallel electromagnetic proportional valve		

<Control>

Operation:

The controller judges work state based on signal of the pressure sensors (boom, arm, bucket or travel) to control the electromagnetic proportional valve.

Operation condition:

[1] No lever operation

The arm 1 semi-parallel spool opening is narrowed.

[2] Operation 1 (boom, arm, bucket)

The system divides the combination of boom up/down and arm out/in into the following seven types (including independent operation), and controls the state of the arm 2 semi-parallel spool opening through the supplemental use of bucket pilot pressure, boom cylinder pressure, and arm cylinder bottom pressure.

- Boom up + Arm in: The arm 2 semi-parallel spool opening is changed according to the digging state.
- Boom up + Arm out: The arm 2 semi-parallel spool opening is opened.
- Boom down + Arm out: The arm 2 semi-parallel spool opening is opened.
- Boom down + Arm in: The arm 2 semi-parallel spool opening is narrowed.
- Independent boom operation (both up and down): The arm 2 semi-parallel spool opening is narrowed.
- Independent arm-in operation: The arm 2 semi-parallel spool opening is narrowed.
- Independent arm-out operation: The arm 2 semi-parallel spool opening is opened.

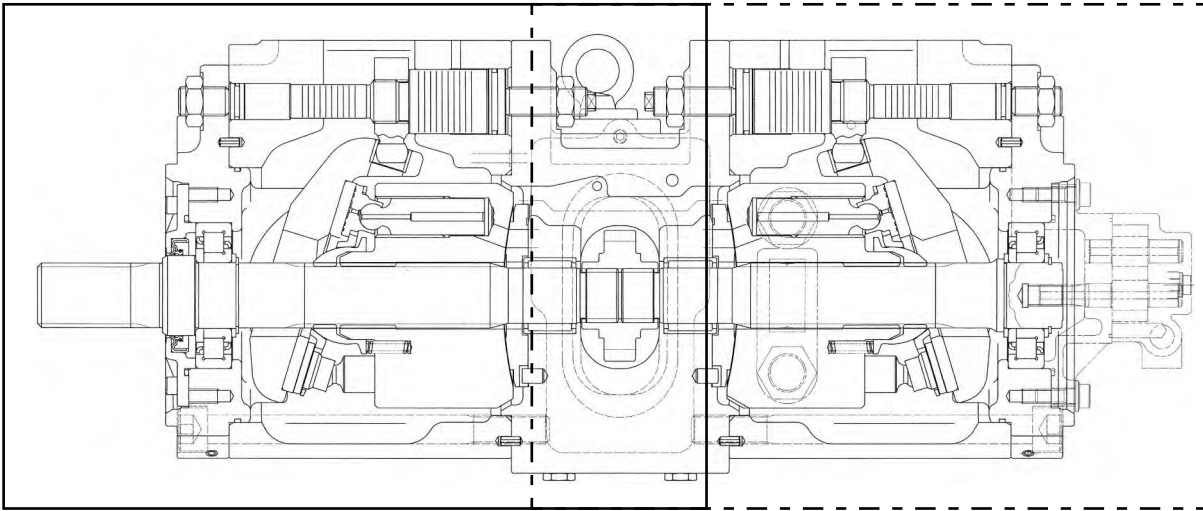
[3] Operation 2 (travel, swing, option)

During traveling or crane mode ON, the arm 2 semi-parallel spool opening is narrowed unconditionally.

J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)

Hydraulic Pump Internal Structure Diagram

Overall view

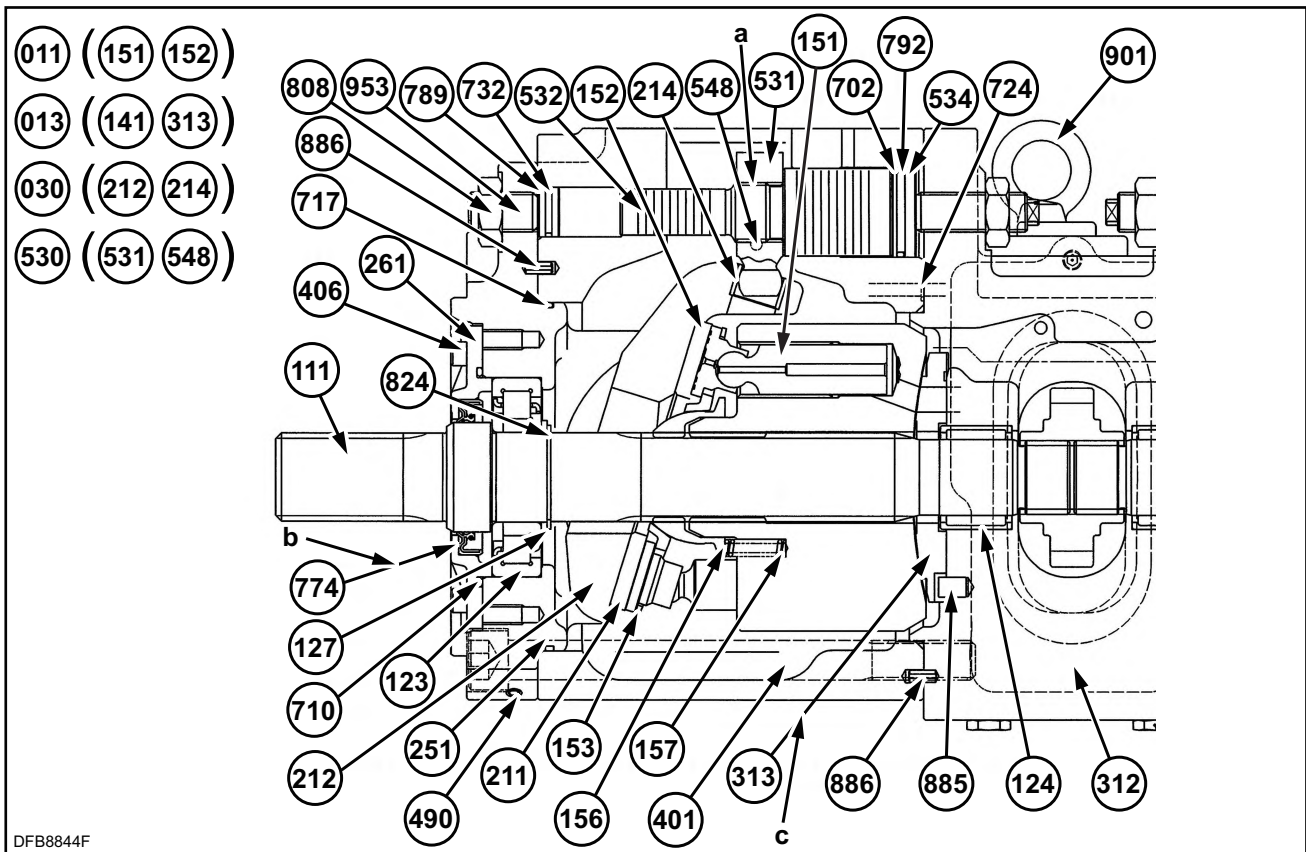


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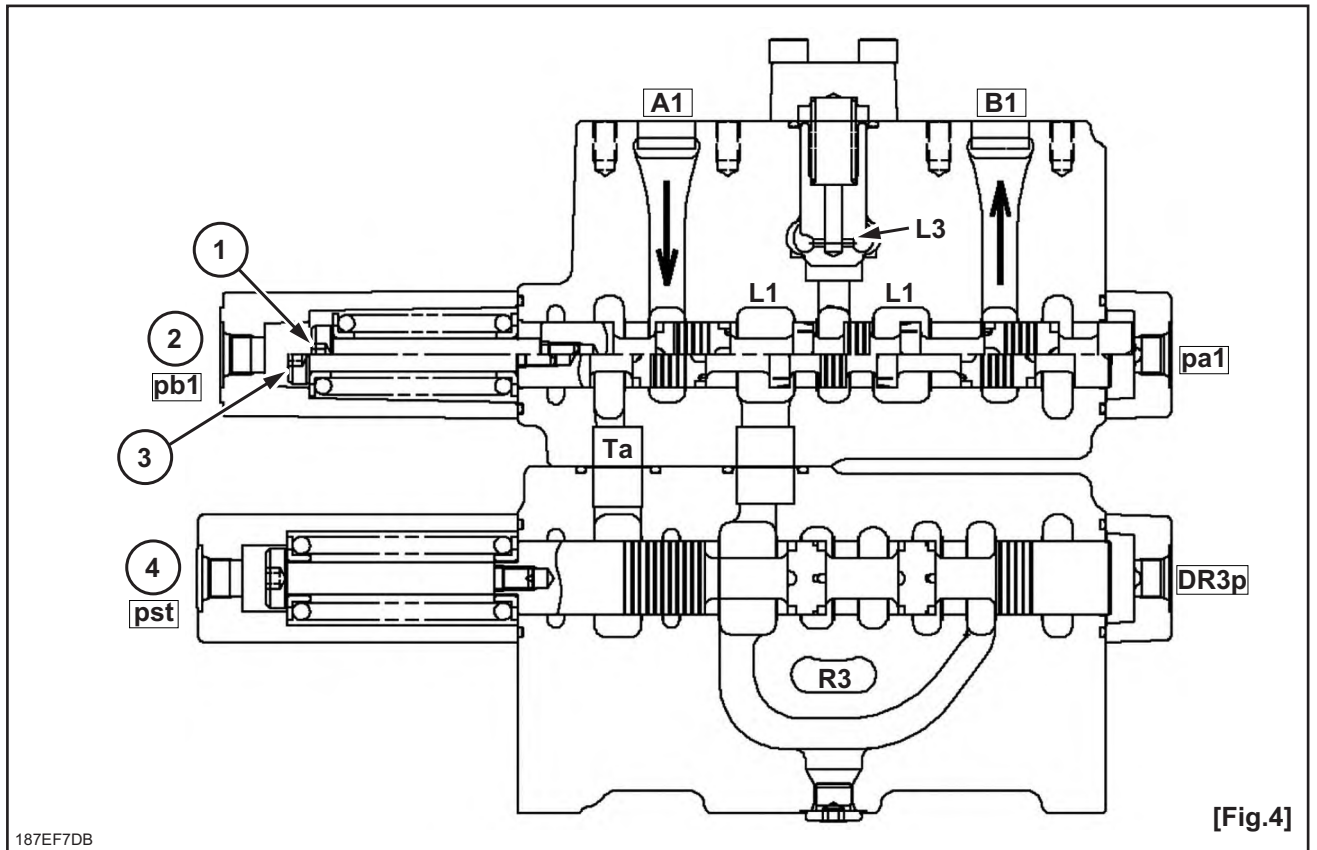
Drive shaft front side

Drive shaft rear side

■ Drive Shaft Front Side



DFB8844F



1	Switching state
2	Travel (section 1)
3	Neutral state
4	Travel straight (section ST)

## J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)

### 6. Add-on [Fig. 25, 26]

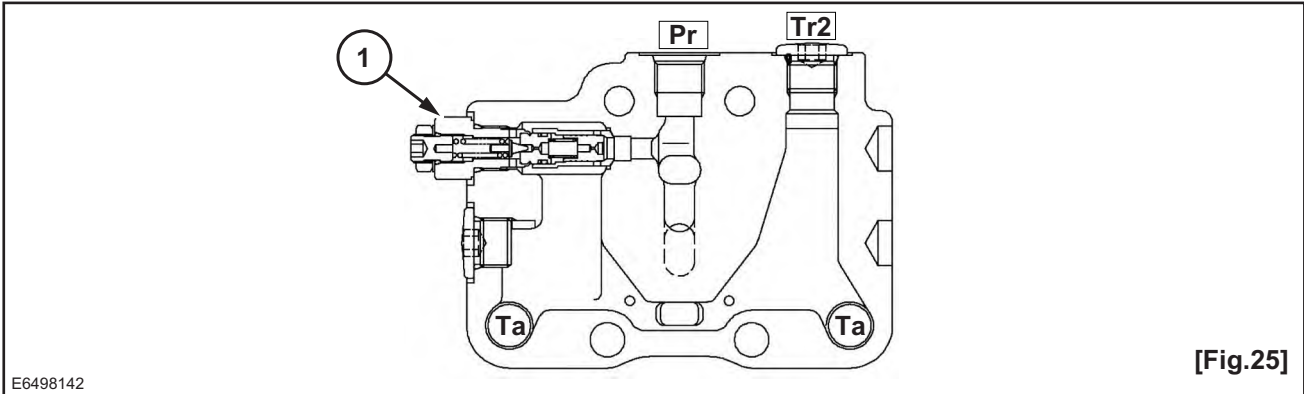
#### [1] Main relief valve for add-on [Fig. 25]

Oil fed from the Pr port is led to the main relief valve for add-on. Activation of the relief valve regulates the maximum pressure of the Pr pump.

#### [2] Spool section [Fig. 26]

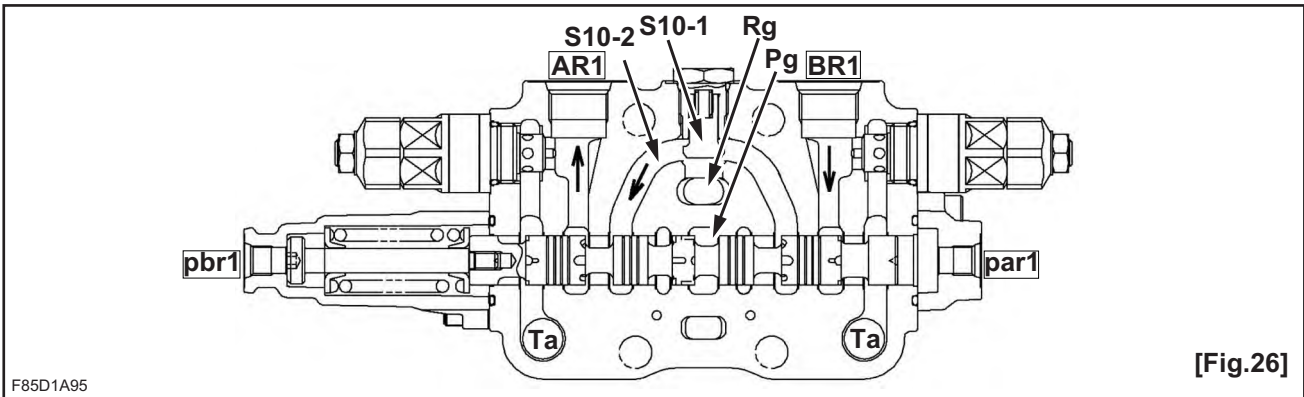
The neutral path (Pg) closes when the spool is switched by pressurizing it from the pilot port par1 (pbr1) of the add-on (section 10). Oil fed from the Pg port flows to the AR1 (BR1) port via the load check valve (S10-1), path (S10-2) and neck of the spool from the parallel path (Rg).

Returning oil returns to the tank path (Ta) via neck of the spool from the BR1 (AR1) port.



E6498142

1	Main relief valve for add-on
---	------------------------------



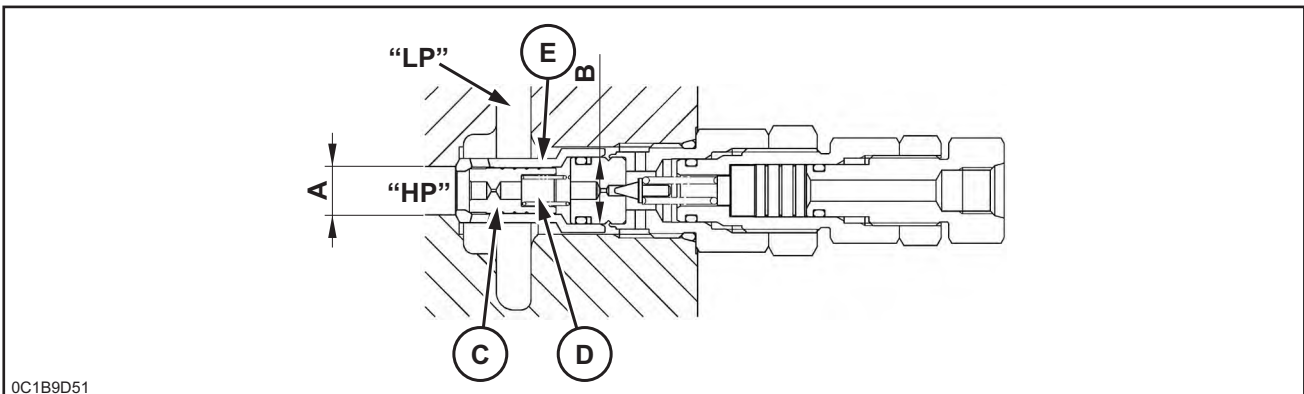
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### Activation of Relief Valve

#### 1. Main relief valve

##### [1] Main unit main relief valve activation

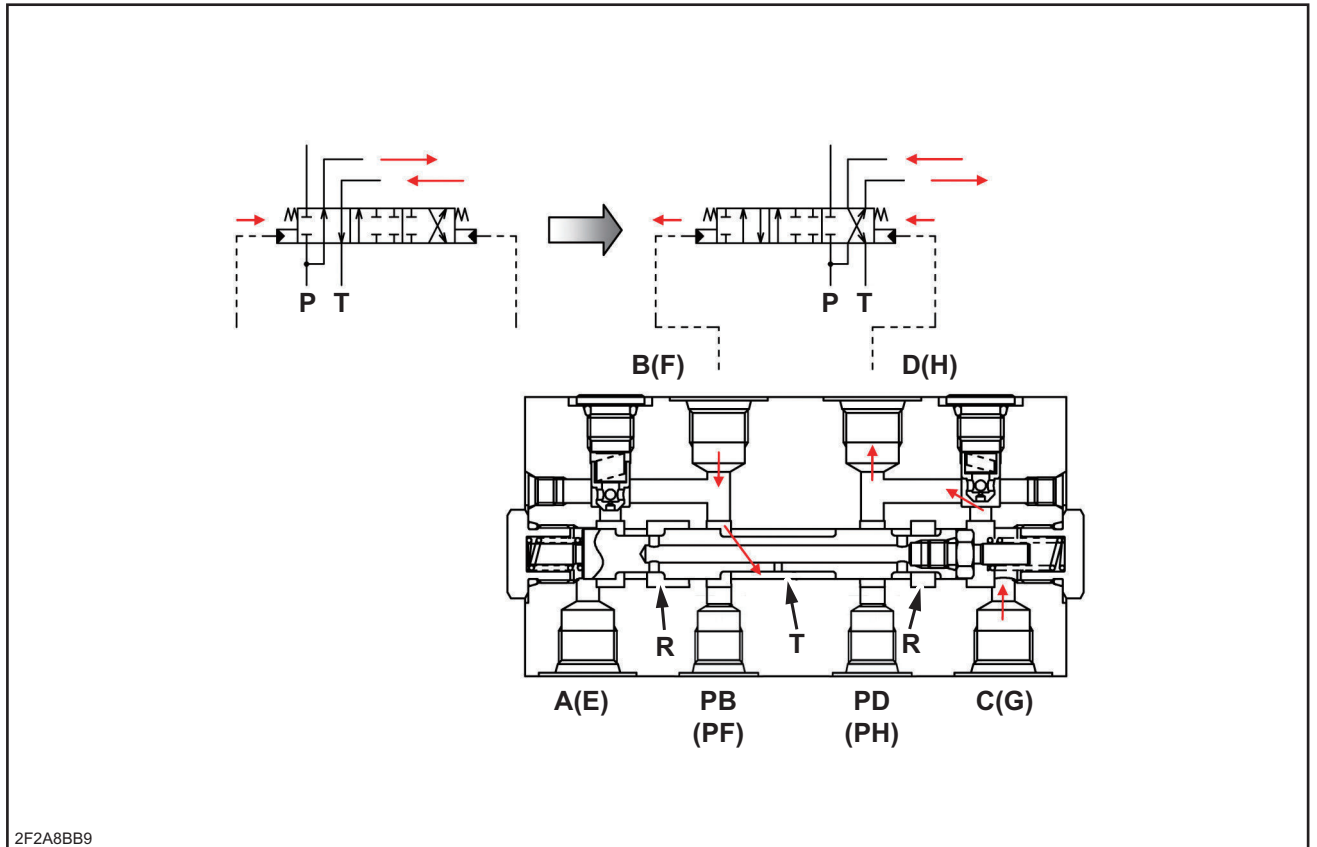
- a. The relief valve is incorporated between the neutral path "HP" and the low-pressure path "LP" to allow oil to flow via the orifice hole of the main poppet (C) to fill the internal space (D). And, the sleeve (E) and the main poppet (C) are securely seated due to difference of areas between "A" and "B."



3. Reverse operation

When the pressure oil being supplied from the pilot operation valve to the port A (or the port C, E, G) is switched to the port C (or the port A, E, G), the pressure oil acting on the spool of the control valve will be pushed back to the port B.

Since the oil pushed back flows into the port T without passing through the orifice in the check plunger, the spool speed of the control valve is not controlled, and the cushion function is not activated.



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## J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)

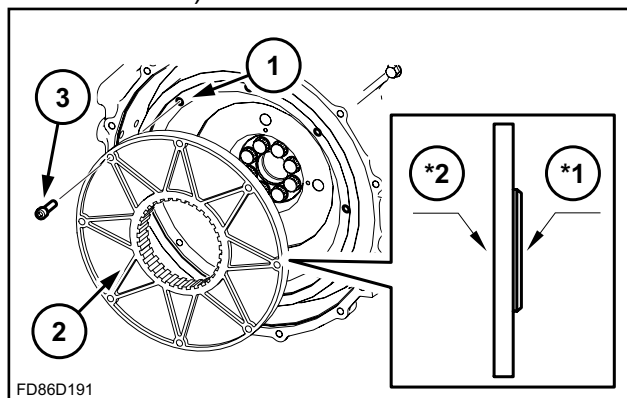
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- [2] Tighten the hexagon socket head bolt (3) with a hexagon wrench [8 mm (0.315 in.)] to attach the flange (2) to the engine flywheel (1).

**⚠ Caution**

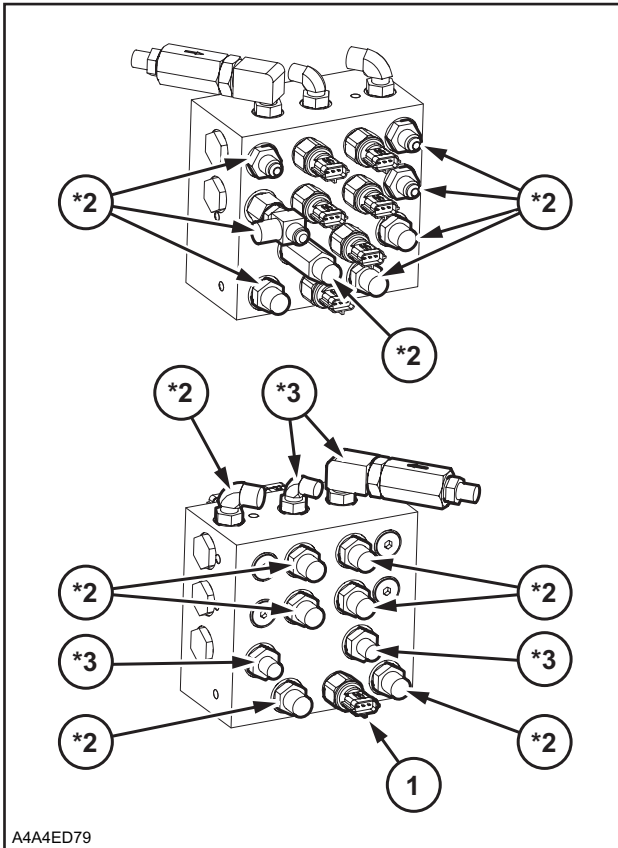
When attaching the flange (2), pay attention to the shape of the flange center and ensure that the (\*2) side is on the hydraulic pump side.

- Tightening torque: 49 N•m (36.15 lbf•ft.)



*1	Engine side
*2	Hydraulic pump side

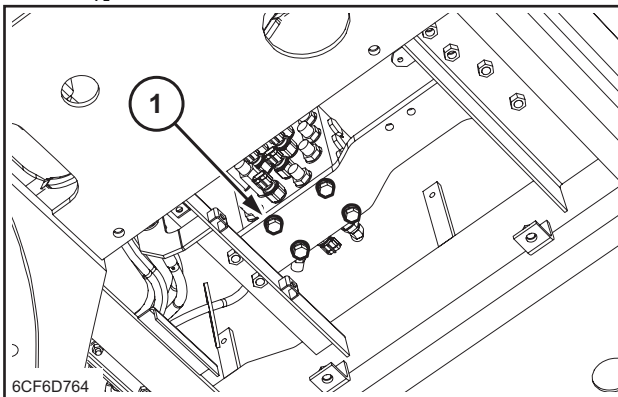
3. Install the hydraulic pump. (Refer to the "Removal and Installation of Hydraulic Pump" for details.)



A4A4ED79

*2	Use a wrench [22 mm (0.866 in.)].
*3	Use a wrench [19 mm (0.748 in.)].

5. Remove the 4 bolts (1) at bottom of the cushion valve with a wrench [17 mm (0.669 in.)] to remove the cushion valve.



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### Installation of Cushion Valve

Mount the cushion valve in the reversed order of the procedure for removal.

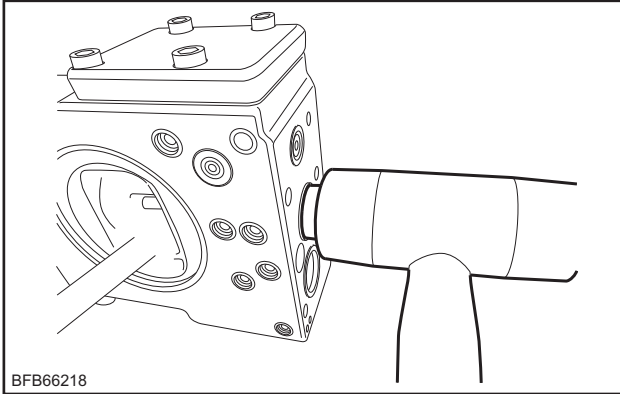
Each bolt has to be tightened in the specified torque.

Refer to the "Standard Torque Data for Cap Screws and Nuts" for those without specified torque.

## J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)

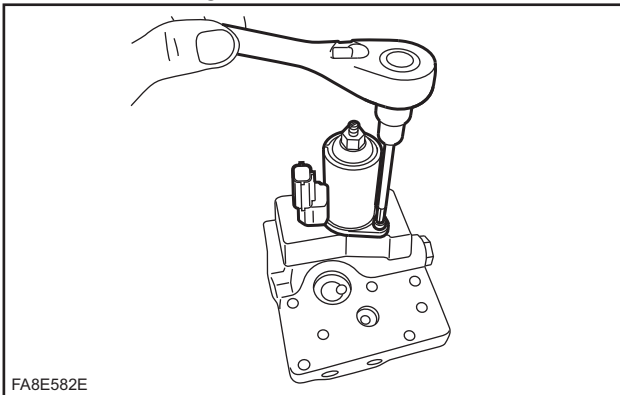
11. Assemble the set spring (655) to the spool (652) hole, and assemble the compensation piston (621), the piston case (622), and the pin (898) to the compensation hole.

- Check whether the pin (898) moves smoothly.

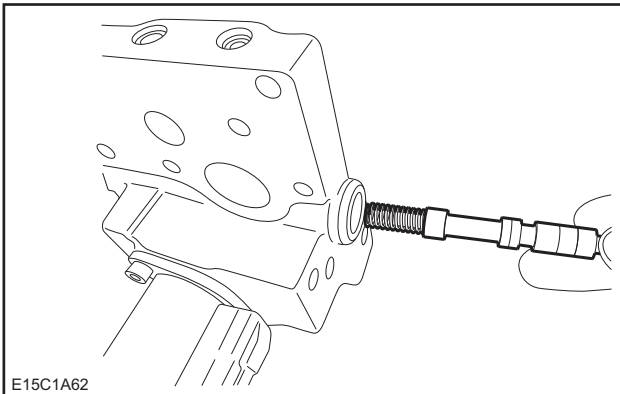


12. Attach the electromagnetic proportional pressure reducing valve (079) to the pilot cover (641), and tighten the hexagon socket head bolt (418).

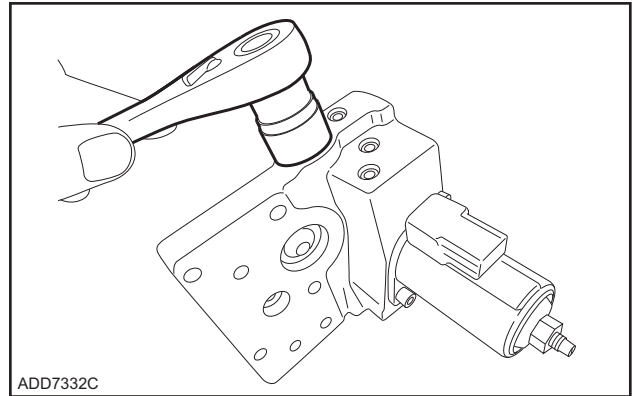
- Pay attention to the damage at the connector section of the electromagnetic proportional pressure reducing valve (079).



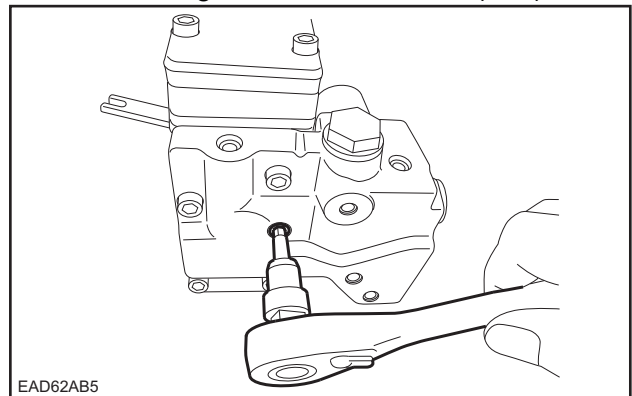
13. Assemble the spool (642) and the spring (662) to the pilot cover (641).



14. Attach the VP plug (466) to the pilot cover (641).

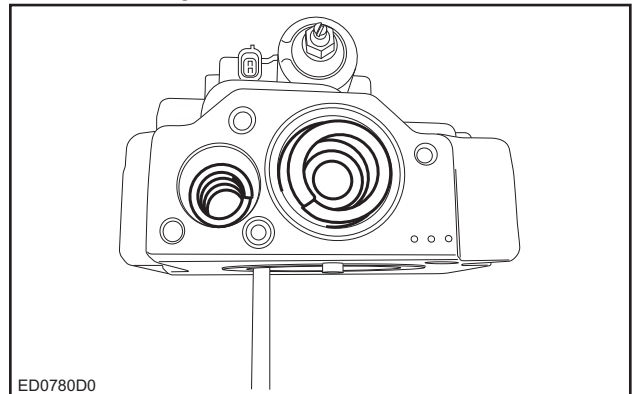


15. Attach the pilot cover (641), and tighten the hexagon socket head bolt (439).



16. Assemble the spring seat (Q) (644), the pilot spring (646), and the adjusting ring (Q) (645) to the pilot hole, and assemble the spring seat (Q) (644), the inner spring (626), and the outer spring (625) to the compensation hole.

- Observe the correct orientation of the spring seat (Q) (644).



**J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)**

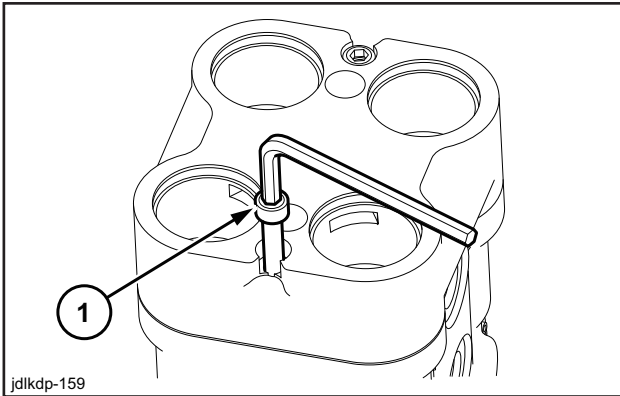
**Part List**

Code	Part Name	Quantity	Code	Part Name	Quantity
1	Valve housing	1	40	Spacer	2
2	Spool assembly	1	41	O-ring	2
3	Spool assembly	1	42	Backup ring	2
4	Spool assembly	1	43	O-ring	1
5	Spool assembly	2	44	Spool assembly	1
6	Spool assembly	1	45	Spool assembly	1
7	O-ring	20	46	Spacer	1
8	Cap	6	47	Sleeve	1
9	Cap	4	48	Poppet	1
10	Cap	10	49	Spring	1
11	Valve housing	1	50	Flange	1
12	Spool assembly	1	51	O-ring	10
13	Spool assembly	1	52	O-ring	8
14	Spool assembly	1	53	Antidrift valve assembly	2
15	Spool assembly	1	54	Relief valve kit	1
16	Cap	1	55-1	Relief valve kit	5
17	Spool assembly	1	55-2	Relief valve kit	1
18	O-ring	4	56	Relief valve assembly	2
19	Cap	3	57	Plug assembly	4
20	Spool assembly	1	58	Plug assembly	4
21	Poppet	2	60	Socket head bolt	12
22	Spring	2	61	Socket head bolt	40
23	Poppet	7	62	Socket head bolt	40
24	Spring	8	63	Socket head bolt	10
25	O-ring	8	64	Socket head bolt	8
26	Flange	6	65	Name plate	1
27	Poppet	2	66	Drive screw	2
28	Spring	2	67	O-ring	3
29	O-ring	2	68	Cap	2
30	O-ring	6	69	O-ring	2
31	Flange	1	70	Plug	1
32	Poppet	1	71	O-ring	1
33	Spring	1	72	Plug assembly	2
34	Plug	1	73	Plug assembly	2
35	O-ring	1	75	Outlet housing	1
36	Spring	1	76	Tie rod	4
37	Poppet	1	77	Nut	4
38	Poppet	1	81	Plug assembly	1
39	Flange	2			

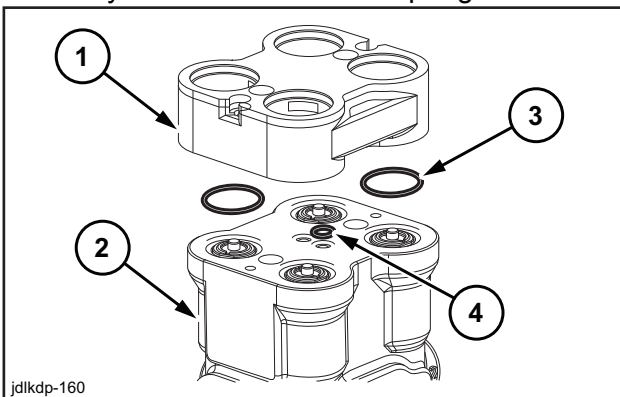
J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)

## J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)

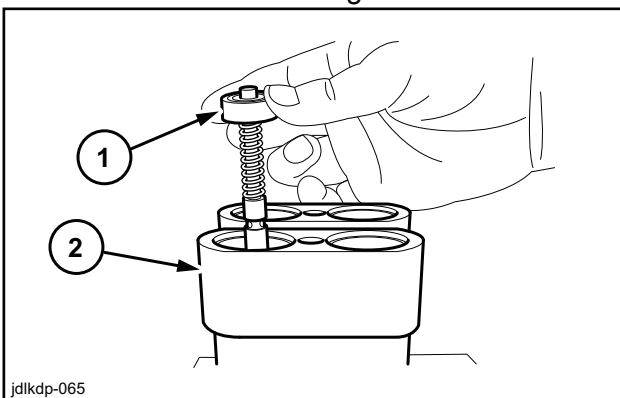
13. Use the hexagon wrench to remove the hexagon socket head bolts (1).



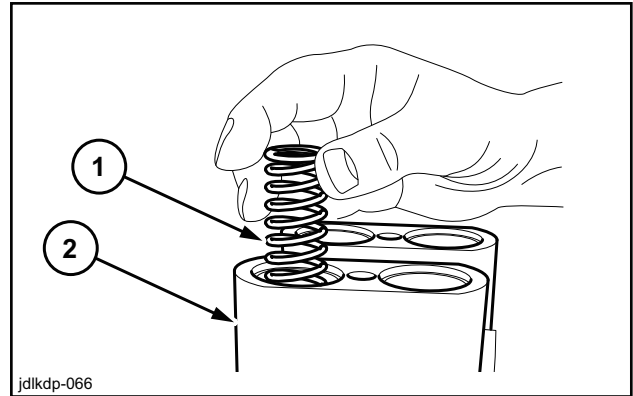
14. Remove the damper casing (1) and remove the O-rings (4) (3) from the casing.
- Record the positions of the damper casing in relation to the casing (2).
  - Be careful when removing parts, as the pressure reducing valve assembly may fly off due to the return springs.



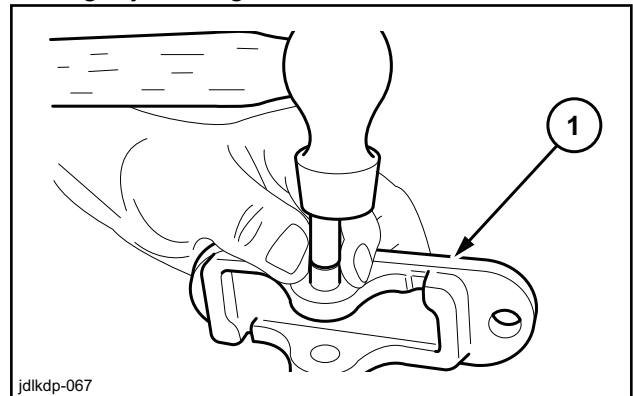
15. Remove the pressure reducing valve assemblies (1) from the casing (2).
- Record the positions of these parts in relation to the casing holes.



16. Remove the return springs (1) from the casing (2).

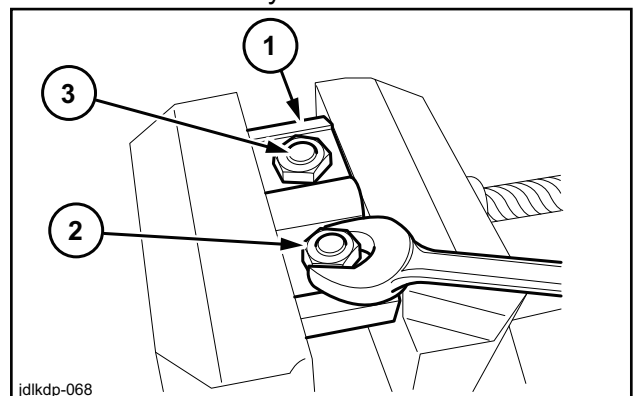


17. Lay the covers (1) on their sides on a level surface, place the special tool 1 against the bushings, and remove the bushings by lightly striking them with a hammer.

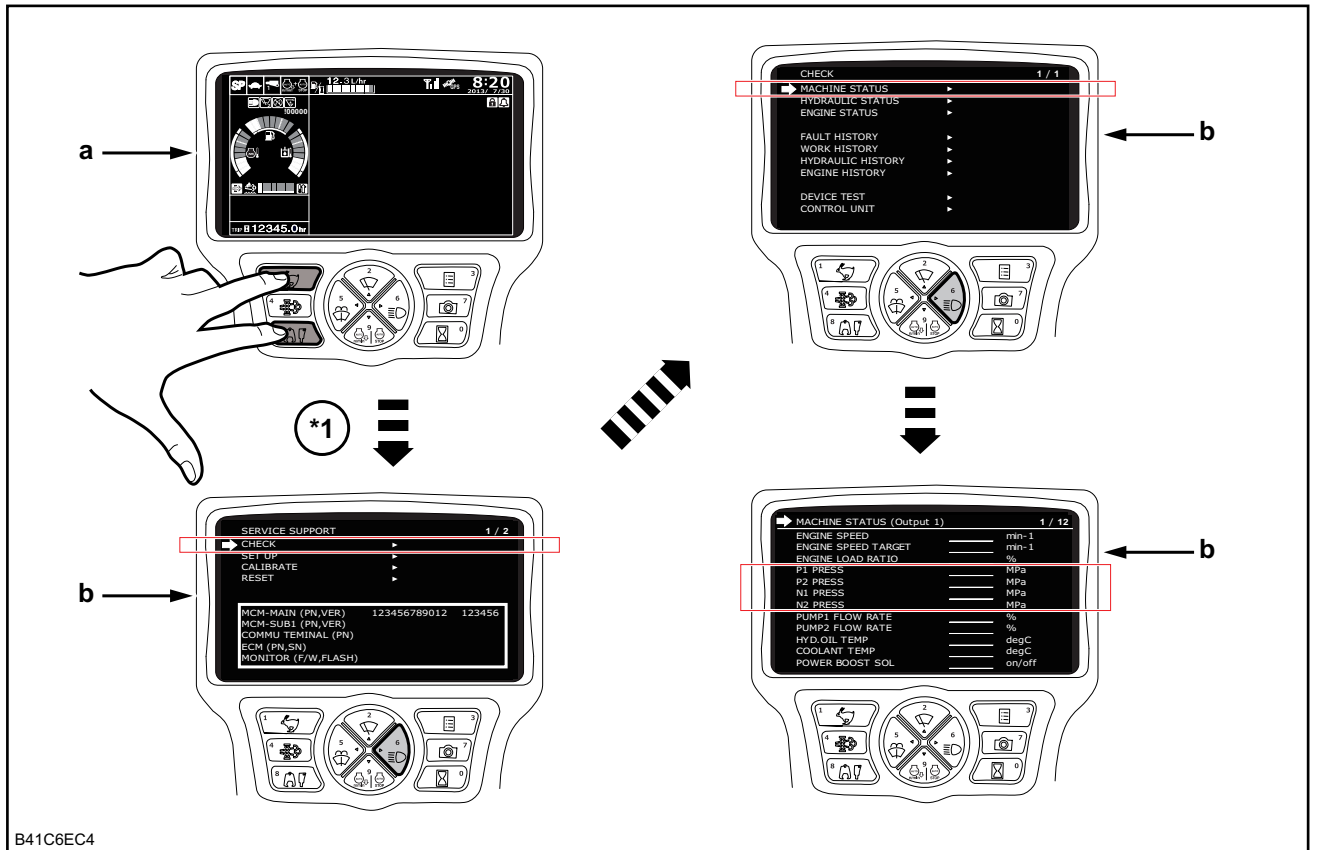


18. Secure each cam assembly (1) in a vise, use a wrench to loosen the lock nuts (2), and remove the lock nuts and locking screws (3).

- As neutral adjustment of locking screws is necessary during assembly, handle them as part of the cam assembly as long as replacement of locking screws is not necessary.



# J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)

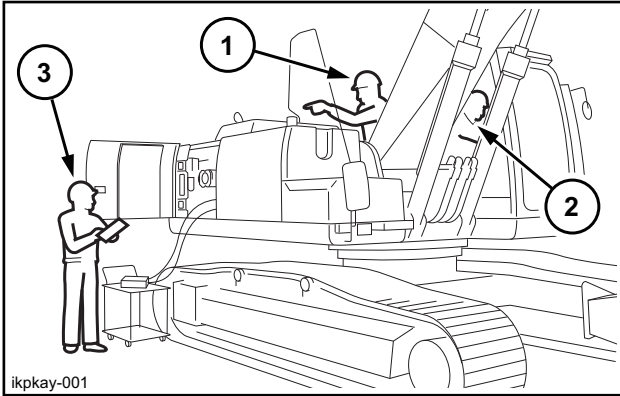


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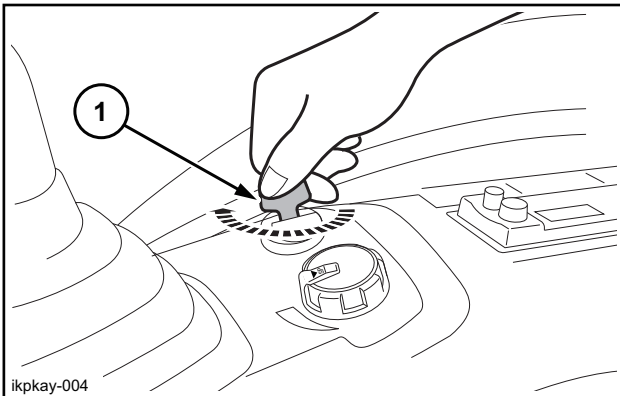
a	Normal screen
b	Service support screen
*1	Hold down for 3 sec.

## J. HYDRAULIC EQUIPMENT (PUMP, OPERATION SYSTEM VALVE)

(Worker 2 (2): Operator)  
 (Worker 3 (3): Flow, pressure measurement, recording)



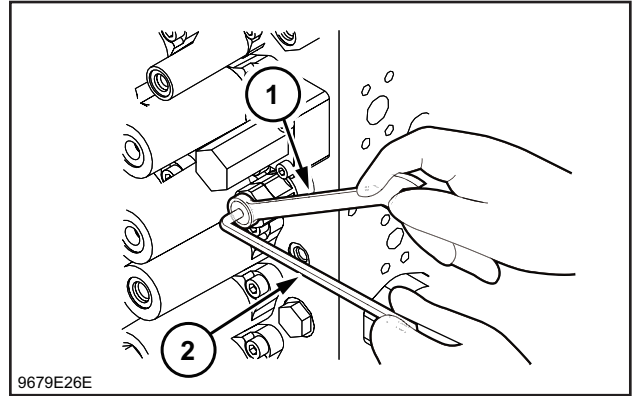
2. The operator starts the engine following the work instructor's signal.
3. Check the hydraulic fluid temperature (50°C (112°F)) on the monitor. Check whether the engine speed and the pump current are normal values.
4. The operator instructs the worker 1 to perform relief operation with the arm out.






1	Ignition key
---	--------------

5. The worker 2 reduces the arm-out port relief. (Min: 24 MPa (3481.29 psi) P1+P2)
6. Start a flow measurement.
7. Perform relief operation with the arm out.
8. Measure data in increments of 2.0 MPa (290.11 psi) (P1+P2).
  - \* Perform the measurement up to 24.0 to 76.0 MPa (3481.29 to 11024.08 psi), and finish it when the highest pressure is reached.
9. Remove the flow meter.
  - \* This is because the maximum pressure gauge of the flow meter exceeds the tolerance from 40 MPa (5802.15 psi).
10. Set the arm-out port relief valve to normal pressure again. (For details of the adjustment, refer to "Pressure Adjustment.")

11. Work is completed by removing the pressure gauge and others to resume to normal condition.



1	Lock nut, 17 mm (0.669 in.)
2	Hexagon wrench, 6 mm (0.236 in.)

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

1	Swing motor	7	Remote control valve (arm, swing)	13	Console lever lock switch
2	Swing	8	Control valve	14	P1 pressure sensor
3	Cushion valve	9	Main computer	15	P1 flow control proportional valve
4	Right swing	10	Lever lock	16	Hydraulic pump
5	Left swing	11	Swing brake	17	Check valve
6	Swing pilot pressure sensor	12	5 stack solenoid valve	18	Oil cooler

This control is for suppressing increases in the swing speed accompanying increased pump flow. (Only in H and SP modes)

For independent swing operation, due to the swing pilot pressure sensor input electric signal, the main computer outputs a signal to the P1 flow control proportional valve.

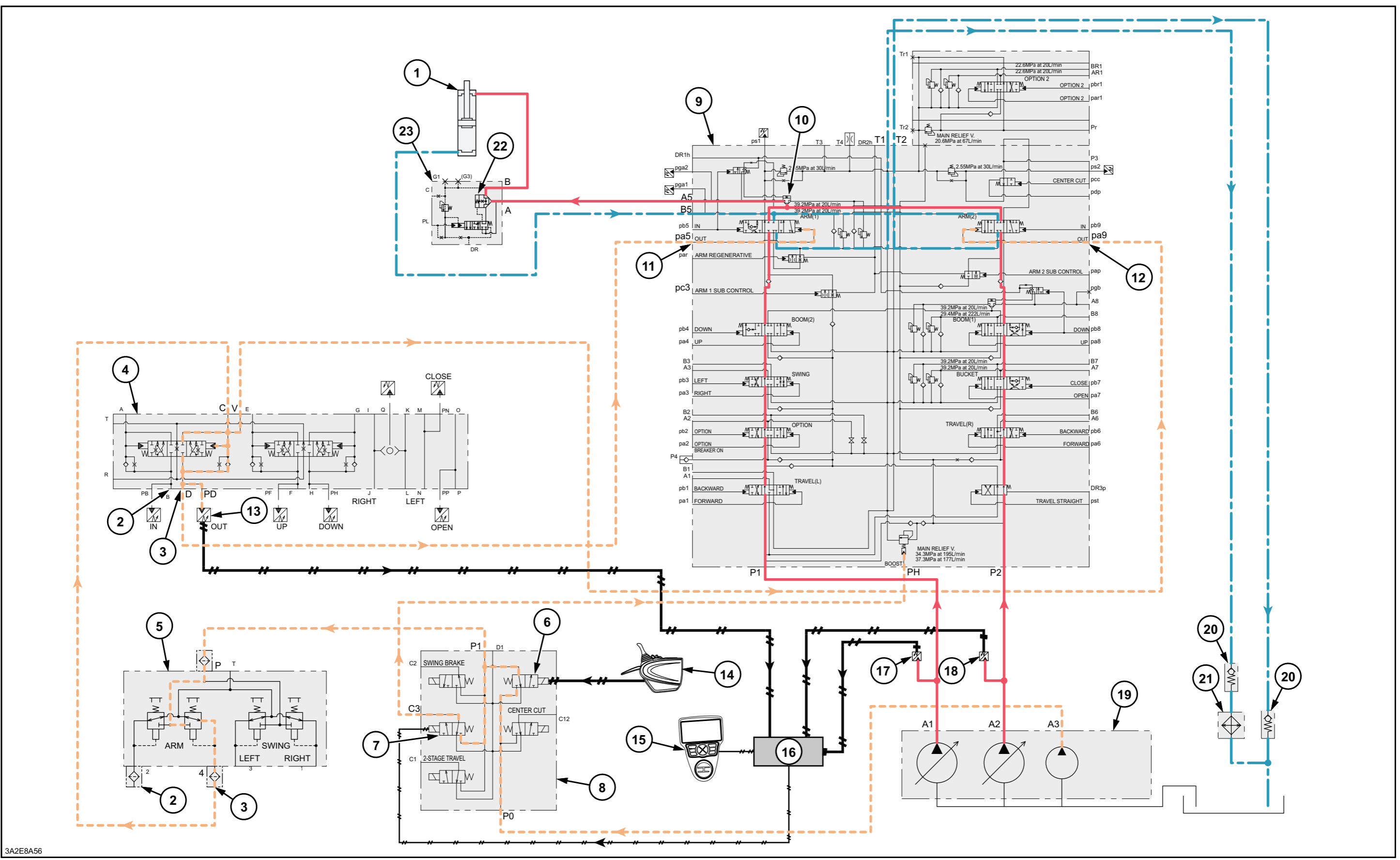
The discharge oil from the hydraulic pump A3 is fed to the P1 flow control proportional valve.

The output signal from the main computer to the P1 flow control proportional valve reduces the hydraulic pump A1 side discharge flow.

The control is canceled when a compound operation is performed.

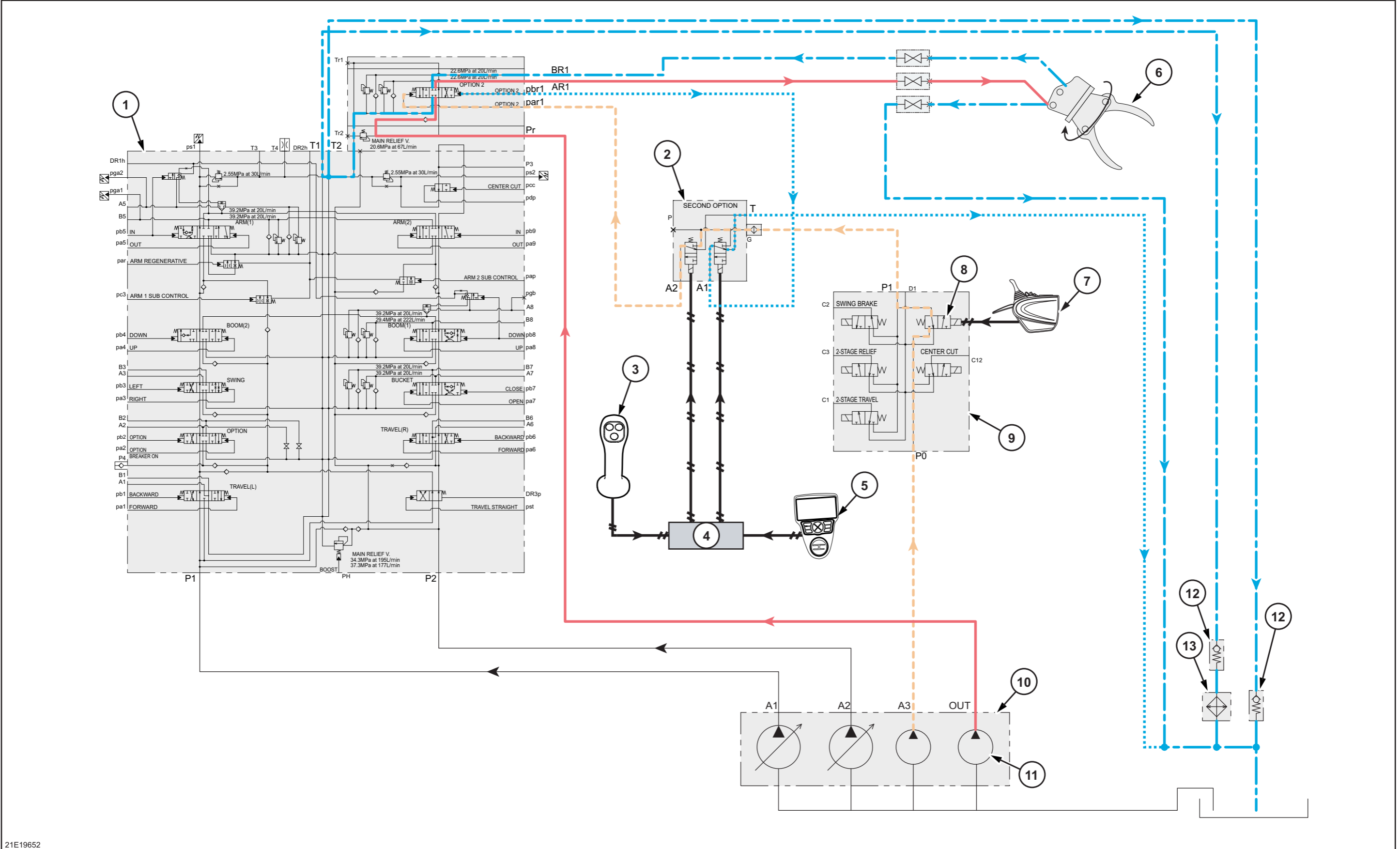
# Arm Circuit

## Arm-out Circuit (with HBCV)



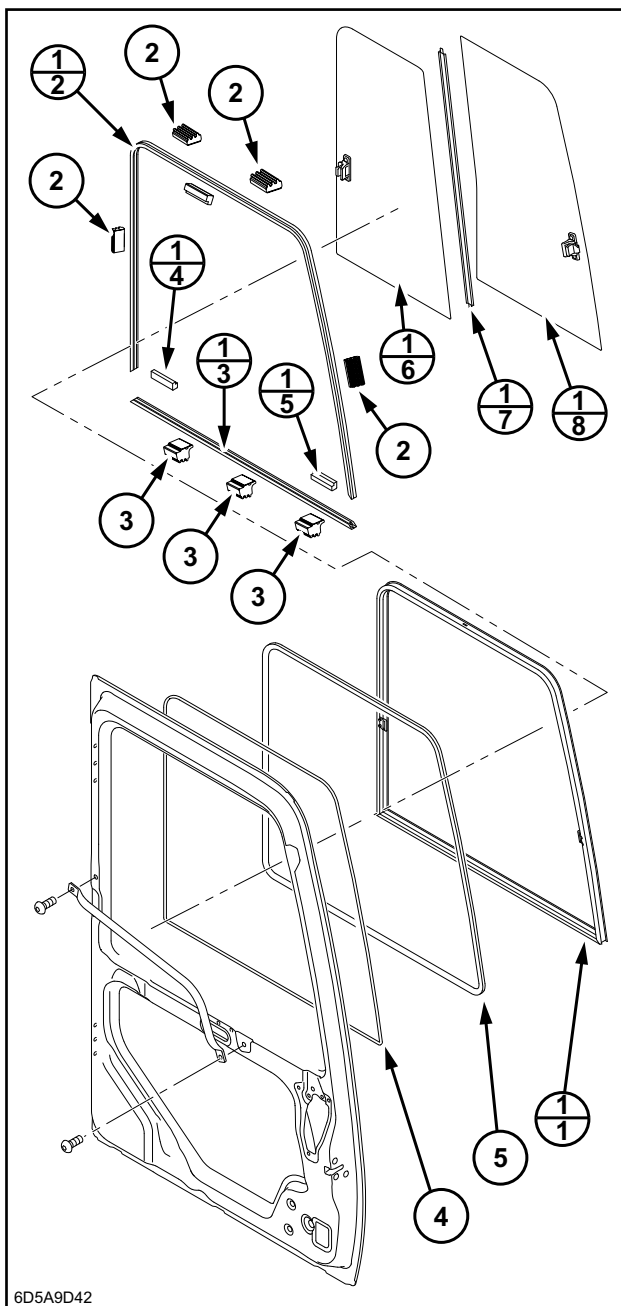


2nd Option Circuit (hydraulic rotation fork)

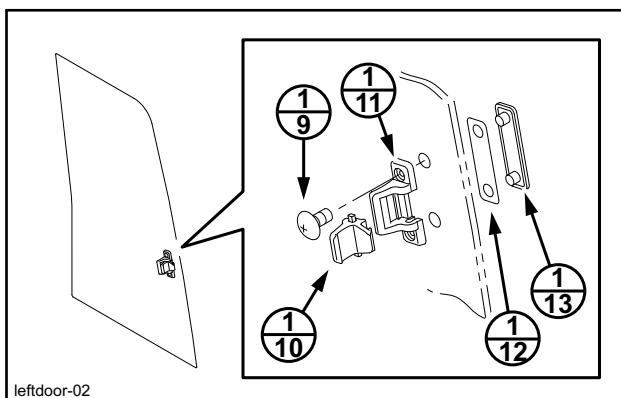


Items to prepare

1. Part



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leftdoor-02

	Part name	Quantity
-2	Rail	1
-3	Rail	1
-4	Rubber stopper RR	1
-5	Rubber stopper FRT	1
-6	Glass (Rear side)	1
-7	Center seal	1
-8	Glass (Front side)	1
-9	Tapping screw M5	4
-10	Window lock	2
-11	Window lock base	2
-12	Rubber packing	2
-13	Retainer	2
2	Spacer (Small)	4
3	Spacer (Large)	3
4	Seal sponge	1
5	Finisher	1

2. Adhesive

Equivalent to #560 (Sunstar Engineering Inc.)

3. Primer

Equivalent to #435 - 97B (Sunstar Engineering Inc.)

**Caution**

- Before using, take out the primer from the low-temperature warehouse and let it return to the room temperature.
- Shake the container well before opening to allow the carbon in the primer to disperse. (Shake the container for 20 minutes or more.)

4. Cleaner

Equivalent to #435 - 11 (Sunstar Engineering Inc.)

5. Tools

- Hexagon wrench [6 mm (0.236 in.)]
- Cutter
- Rag
- Packing tape
- Paint brush

**Removal of Door (Upper) Sash Glass**

1. Remove the 2 bolts (1) with a hexagon wrench [6 mm (0.236 in.)] to remove the door handrail (2).  
Next, remove the finisher (3).

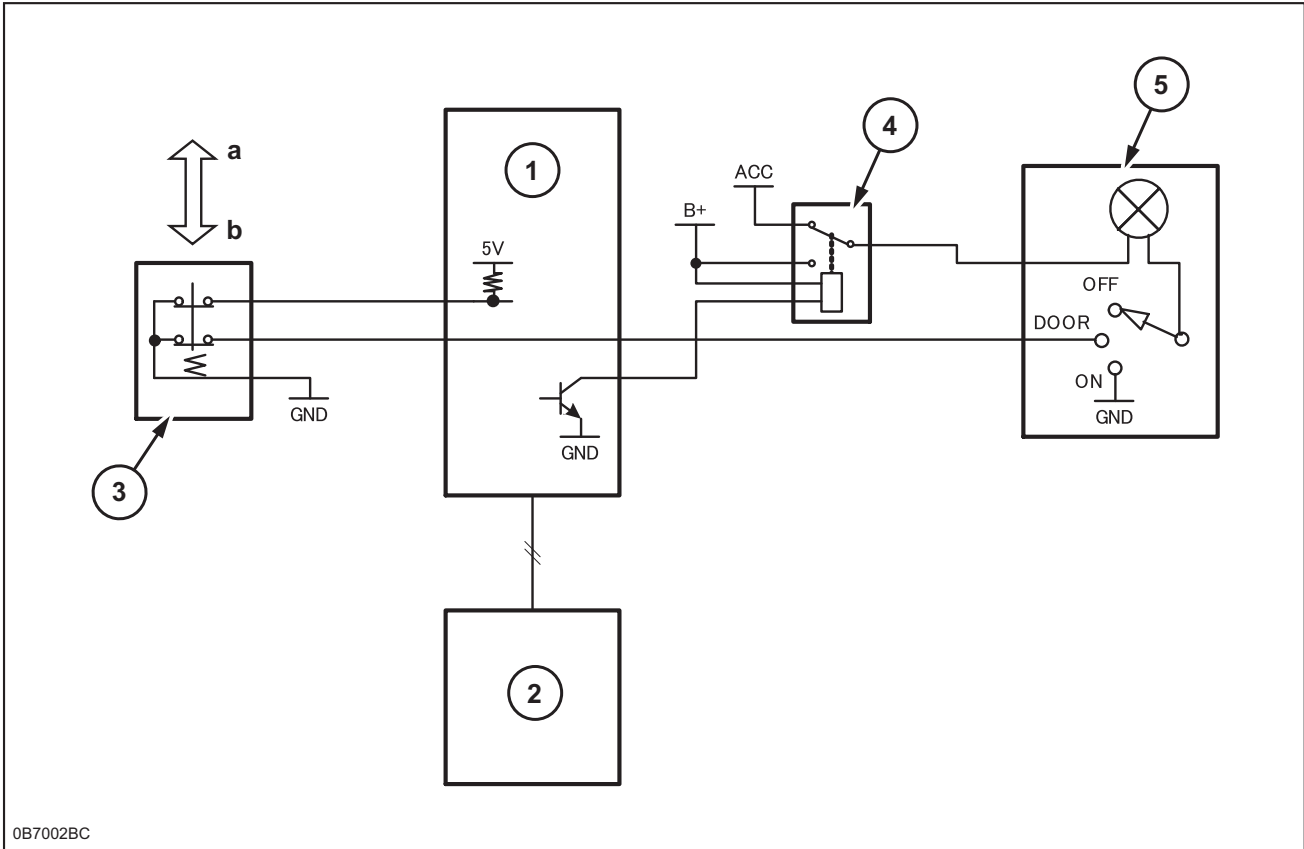
	Part name	Quantity
1	Sash components	1
-1	Frame	1

## R. ELECTRICAL PARTS

### Room Lamp

<Purpose/Overview>

The room lamp is turned ON/OFF linked to open/close of the door. The room lamp is turned off automatically after elapsing 30 seconds with the door left open. (Battery drain prevention function)



a	OPEN (ON)
b	CLOSE (OFF)

1	Main controller	3	Door limit switch	5	Room lamp
2	ECM	4	Room lamp relay		

Position and function of the room lamp select switch:

Position	Function
OFF	Always lamp OFF
DOOR	Lamp ON with door opened, OFF with closed
ON	Always lamp ON

Display	Explanation	Unit	Minimum	Maximum
FRONT WINDOW CLOSED	Front window SW	on/off	----	++++
DOOR CLOSED	Door close SW	on/off	----	++++
GATE CLOSED	Gate open/close SW	on/off	----	++++
GATE LOCK SOL	Gate Lock SOL	on/off	----	++++
QUICK COUPLER SW	Quick coupler SW	on/off	----	++++
QUICK COUPLER SOL	Quick coupler SOL	on/off	----	++++
QUICK COUPLER BUZZER	Quick coupler buzzer	on/off	----	++++

6/11

➔ MACHINE STATUS (Accessory 2)
6/11

ONE-TIME WIPER SW	_____	on/off
WIPER-INT OUT	_____	on/off
WIPER-CNT OUT	_____	on/off
WASHER OUT	_____	on/off
WORKING SIGNAL OUT	_____	
RADIO MUTE RELAY	_____	on/off
ROOM LAMP RELAY	_____	on/off
WORKING LIGH RELAY	_____	on/off
AUTO REFUEL STOP RELAY	_____	
TRAVEL ALARM BUZZER	_____	on/off
MAG.LIFT CUT RELAY	_____	

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Display	Explanation	Unit	Minimum	Maximum
ONE-TIME WIPER SW	One-time wiper SW	on/off	----	++++
WIPER-INT OUT	Wiper INT output	on/off	----	++++
WIPER-CNT OUT	Wiper CNT output	on/off	----	++++
WASHER OUT	Washer output	on/off	----	++++
WORKING SIGNAL OUT	-	-	-	-
RADIO MUTE RELAY	Radio mute REL	on/off	----	++++
ROOM LAMP RELAY	Room lamp REL	on/off	----	++++
WORKING LIGHT RELAY	Working light REL	on/off	----	++++
AUTO REFUEL STOP RELAY	Refueling stop REL	on/off	----	++++
TRAVEL ALARM BUZZER	Travel alarm BUZ	on/off	----	++++
MAG. LIFT CUT RELAY	Lift cut REL	on/off	----	++++

7/11

➔ MACHINE STATUS (GPS)
7/11

LATITUDE1	_____	
LATITUDE2	_____	
LONGTUDE1	_____	
LONGTUDE2	_____	
UTC(YEAR)	_____	
UTC(MONTH.DAY)	_____	
UTC(HOUR)	_____	
UTC(MIN.SEC)	_____	
GPS STATUS	_____	
TIME ZONE DIFF	_____	

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Display	Explanation	Unit	Minimum	Maximum
LATITUDE1	GPS latitude 1 (deg.)	deg	0	9999

## R. ELECTRICAL PARTS

Display	Explanation	Unit	Judgment condition	Judgment start condition
2 SCREEN CAMERA TIME	Camera displaying time with 2 screens	hour	When the camera layout on the meter screen is D, E, F, and G	Key ON

7/11

→ WORK HISTORY <span style="float: right;">7/11</span>	
CRANE MODE TIME	_____ hour
ANTI-INTF. CANCEL TIME	_____ sec
ANTI-INTF. CANCEL COUNT	_____ times
MAGNET MODE TIME	_____ hour
MAGNET ON TIME	_____ hour
MAGNET ON COUNT	_____ times
ANTI-INTF. BACKUP TIME	_____
ANTI-INTF. BACKUP COUNT	_____

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Display	Explanation	Unit	Judgment condition	Judgment start condition
CRANE MODE TIME	Crane mode ON time	hour	Crane mode = ON	Engine in operation
ANTI-INTF. CANCEL TIME	Anti-interference temporary cancellation time	sec	Anti-interference temporary cancellation SW = ON	Engine in operation
ANTI-INTF. CANCEL COUNT	Anti-interference temporary cancellation count	times	Anti-interference temporary cancellation SW OFF → ON	Engine in operation
MAGNET MODE TIME	Lifting magnet mode ON time	hour	Lifting magnet SW = ON	Engine in operation
MAGNET ON TIME	Lifting magnet suctioning time	hour	Lifting magnet suction SW = ON	Engine in operation
MAGNET ON COUNT	Lifting magnet suction operation count	times	Lifting magnet suction SW OFF → ON	Engine in operation
ANTI-INTF. BACKUP TIME	Anti-interference backup time			
ANTI-INTF. BACKUP COUNT	Anti-interference backup count			

8/11

→ WORK HISTORY <span style="float: right;">8/11</span>	
WIPER-INT. MODE	_____ hour
WIPER-CNT. MODE	_____ hour
WASHER OPR. COUNT	_____ times
ONE-TIME WIPER COUNT	_____ times
WINDOW-OPEN	_____ hour
WINDOW-OPEN COUNT	_____ times
DOOR-OPEN	_____ hour
DOOR-OPEN COUNT	_____ times

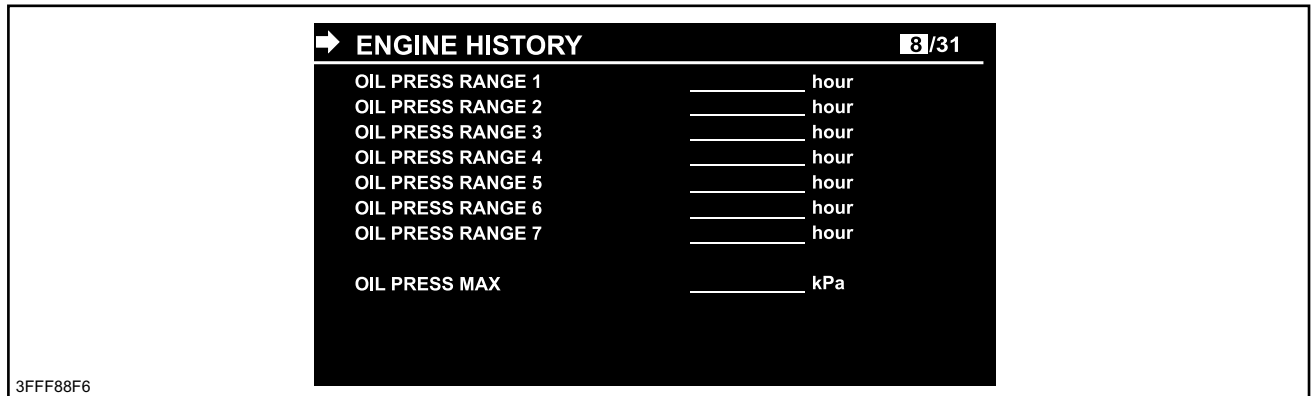
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Display	Explanation	Unit	Judgment condition	Judgment start condition
WIPER-INT. MODE	Wiper (INT) operation time	hour	Wiper control mode = INT	Key ON
WIPER-CNT. MODE	Wiper (CNT) operation time	hour	Wiper control mode = CNT	Key ON
WASHER OPR. COUNT	Washer operation count	times	Washer SW OFF → ON	Key ON

## R. ELECTRICAL PARTS

Display	Explanation	Unit	Judgment condition	Judgment start condition
BARO PRESS RANGE 4	Barometric pressure; time distribution	hour	Less than 87 KPa	In 10 sec. after the engine starts
BARO PRESS RANGE 5	Barometric pressure; time distribution	hour	Less than 96 KPa	In 10 sec. after the engine starts
BARO PRESS RANGE 6	Barometric pressure; time distribution	hour	Less than 105 KPa	In 10 sec. after the engine starts
BARO PRESS RANGE 7	Barometric pressure; time distribution	hour	105 KPa or more	In 10 sec. after the engine starts
BARO PRESS MIN	Maximum value of boost temperature	kPa (psi)	-	In 10 sec. after the engine starts

8/31

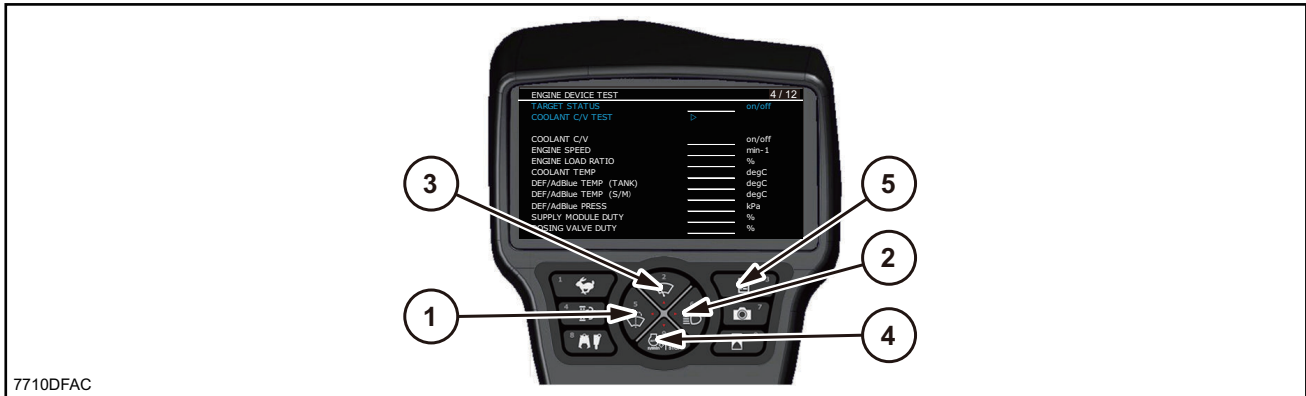


Display	Explanation	Unit	Judgment condition	Judgment start condition
OIL PRESS RANGE 1	Oil pressure; time distribution	hour	Less than 0 KPa	In 10 sec. after the engine starts
OIL PRESS RANGE 2	Oil pressure; time distribution	hour	Less than 150 KPa	In 10 sec. after the engine starts
OIL PRESS RANGE 3	Oil pressure; time distribution	hour	Less than 300 KPa	In 10 sec. after the engine starts
OIL PRESS RANGE 4	Oil pressure; time distribution	hour	Less than 450 KPa	In 10 sec. after the engine starts
OIL PRESS RANGE 5	Oil pressure; time distribution	hour	Less than 600 KPa	In 10 sec. after the engine starts
OIL PRESS RANGE 6	Oil pressure; time distribution	hour	Less than 750 KPa	In 10 sec. after the engine starts
OIL PRESS RANGE 7	Oil pressure; time distribution	hour	750 KPa or more	In 10 sec. after the engine starts
OIL PRESS MAX	Maximum value of oil pressure	kPa (psi)	-	In 10 sec. after the engine starts

## R. ELECTRICAL PARTS

### ■CCV Operation Test

Purpose: To check the coolant control valve operation.



Display	Explanation	Unit	Remarks
TARGET STATUS	Coolant control valve status	on/off	Items selectable. Select ++++ and ---- when it is open and closed respectively. (Initial value: ----)
COOLANT C/V TEST	Coolant control valve operation test	-	The coolant control valve is driven (for 10 seconds).
COOLANT C/V	Coolant control valve operation	on/off	on++++, off----
ENGINE SPEED	Actual engine speed	min <sup>-1</sup> (rpm)	
ENGINE LOAD RATIO	Engine torque (load ratio)	%	
COOLANT TEMP	Coolant temperature	degC	
DEF/AdBlue TEMP(TANK)	Urea temperature (inside tank)	degC	
DEF/AdBlue TEMP(S/M)	Urea temperature (inside supply module)	degC	
DEF/AdBlue PRESS	Urea pressure	KPa (psi)	
SUPPLY MODULE DUTY	Supply module DUTY	%	
DOSING VALVE DUTY	Dosing DUTY	%	

#### Procedure

-Condition for the test-  
None

#### [1] Set the CCV status.

Select "TARGET STATUS" (coolant control valve status) using SW (3) and (4).

Use SW (1) and SW (2) to turn it OFF and ON respectively.

After the setting is completed, press SW (5).

#### [2] Test execution

Select "COOLANT C/V TEST" (coolant control valve operation test) using SW (3) and (4).

Hold down SW (2) for 3 seconds, then ">" changes to "▶" and the test starts.

The test will be continued for 10 seconds.

#### [3] Test finish

After 10 seconds, the engine automatically returns to the normal state.

FAN

Value	Contents	Remarks
0	Standard fan	Only 1 can be selected when the model selection is 46t or more. When the model selection is less than 46t, 1 cannot be selected. If, with 1 selected, the sub-46t model is selected, 0 will be selected forcibly.
1	Hydraulic drive fan	
2	Reversible Fan	

ICT

Value	Contents	Remarks
0	None	"?" appears in white when the screen is changed.
1	Yes	

BUCKET POSITION SENSOR

Value	Contents	Remarks
0	None	"?" appears in white when the screen is changed.
1	Angle sensor	

GCHC

Value	Contents	Remarks
0	None	Fixed at 0 when the 1st option line circuit is 0 (None), 1 (Independent), 4 (Multi-purpose 1 pump flow), or 5 (Multi-purpose 2 pumps flow).
1	Yes	

DIMENSIONS

- Transition to this screen is enabled only with the following settings in the model selection screen.

OVERLORD-WARNING	2: Yes (Japan Type)
ANTI-INTFERENCE	1: Yes

- Items that can be specified vary with the following combination.


OVERLOAD-WARNING	2: Yes (Japan Type)
ANTI-INTFERENCE	1: Yes
ELEVATOR CAB	0: None, 1: Yes
LIFTING MAGNET	0: None, 1: SPS, 2: XXX
BUCKET CYLINDER SENSOR	0: None, 1: Angle sensor

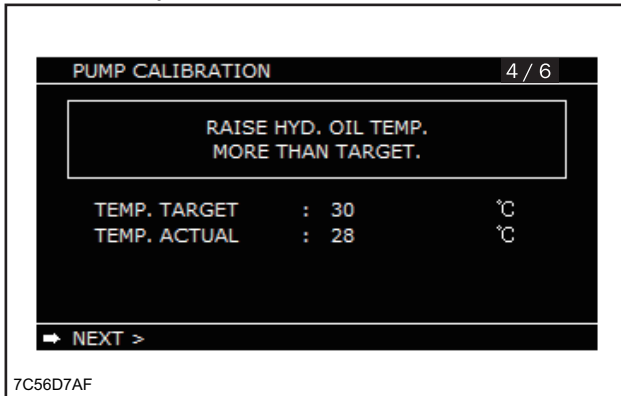
1/3


DIMENSIONS		1 / 3
ATT. DIMENTION TYPE	:	0
BOOM/ARM WEIGHT TYPE	:	-
END-ATT.WEIGHT TYPE	:	-
ELEVATOR CAB TYPE	:	0
CAB FRONT GUARD TYPE	:	0
AUTO CRANE MODE	:	0

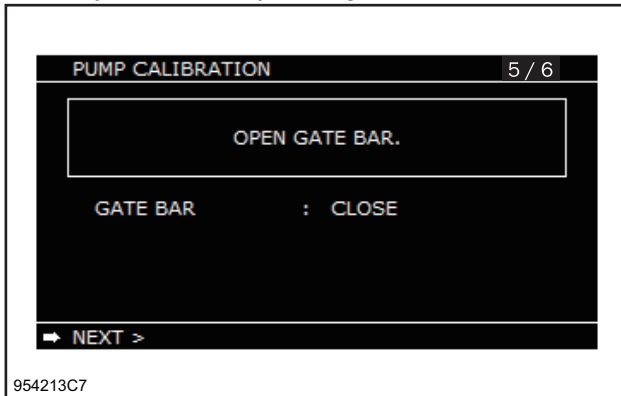
2DA355AA


## R. ELECTRICAL PARTS

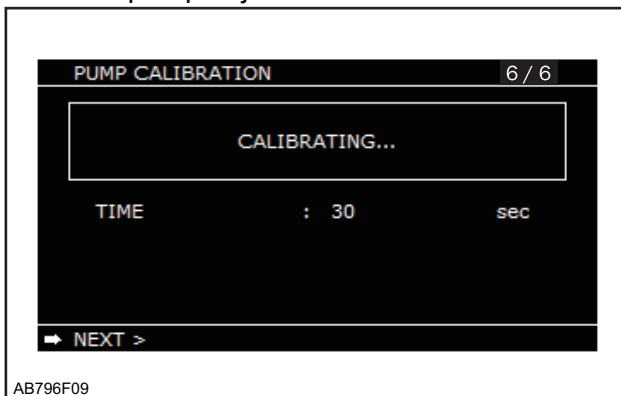
4. When the work mode is turned to the SP mode and  is pressed, the system displays the oil temperature raise screen.



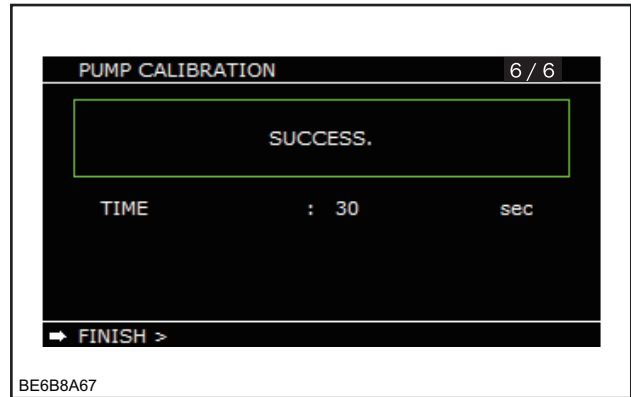
5. When the oil temperature reaches the target value and  is pressed, the system displays the gate open screen.




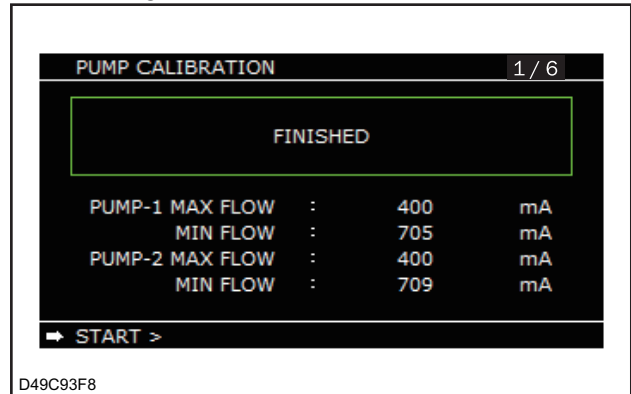
6. When the gate is opened and  is pressed, the system displays a screen indicating an adjustment in progress and the pump adjustment starts.



7. When the pump adjustment is finished, the system displays the (green) result screen.

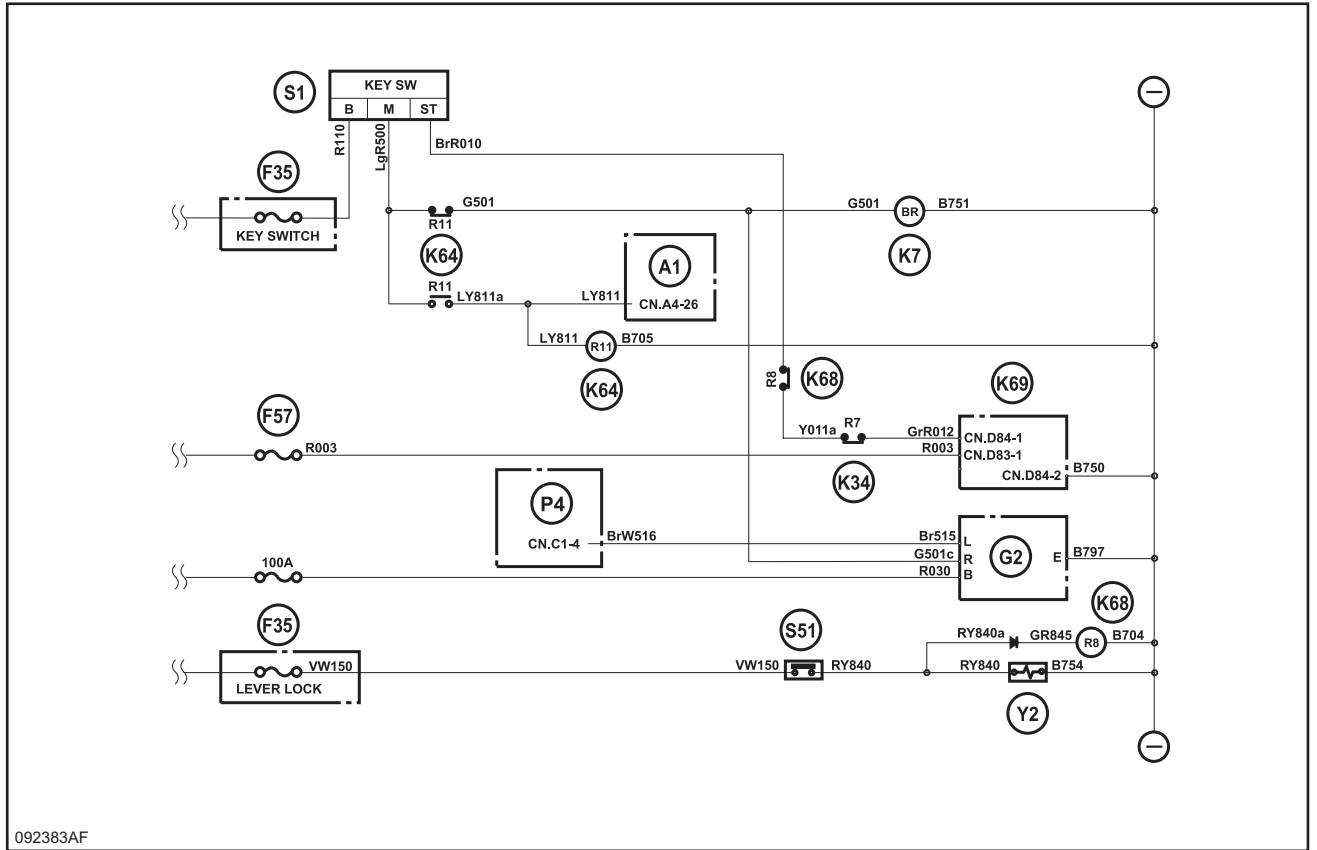


8.  Press this, and the system will display the (green) initial screen.



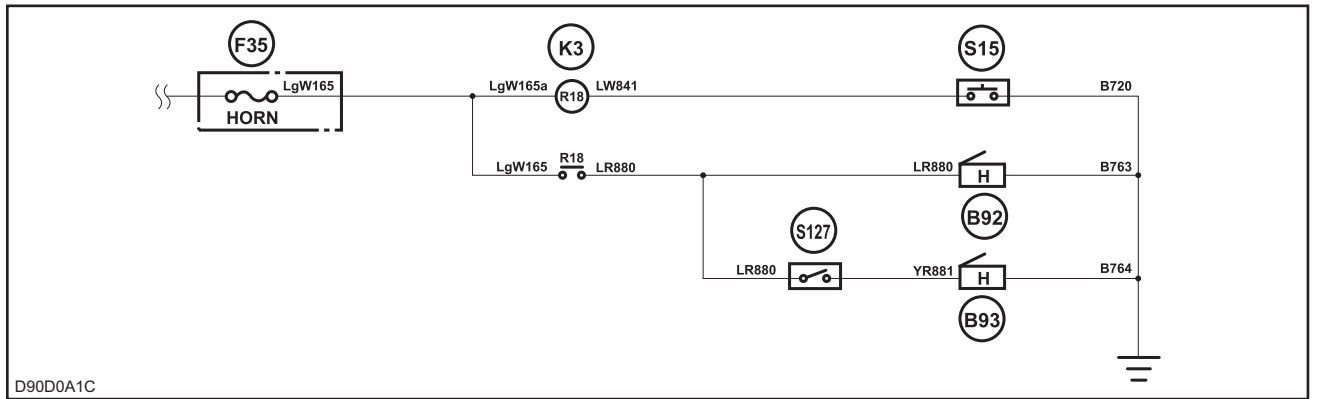
- If the calibration fails or you press the menu SW in the middle of the process, the system will be interrupted and display the (red) result screen "FAILURE" with an error code.

Gate Lock

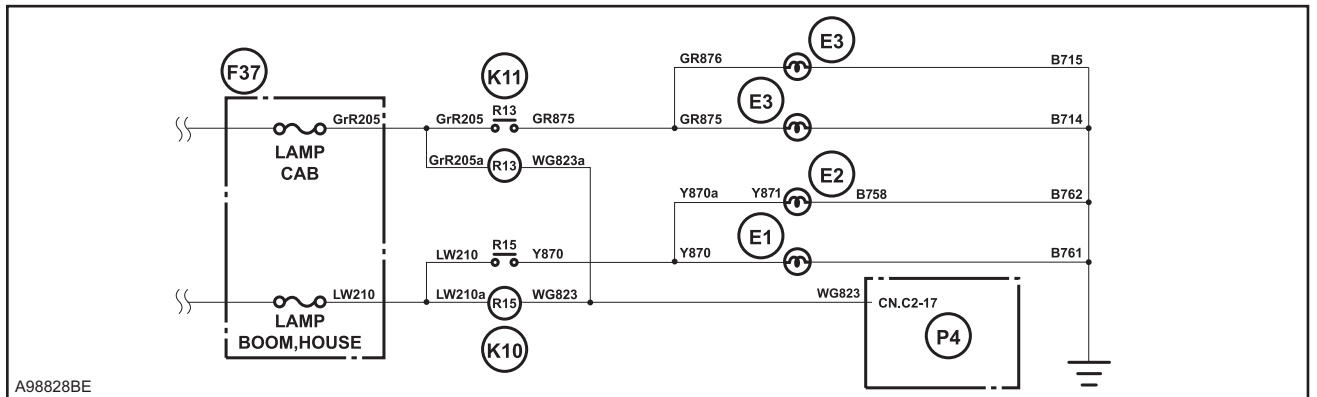


R. ELECTRICAL PARTS

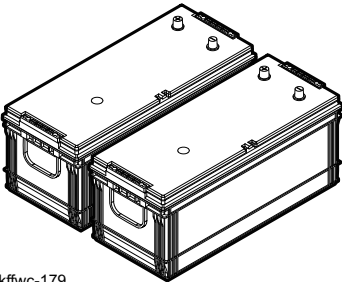
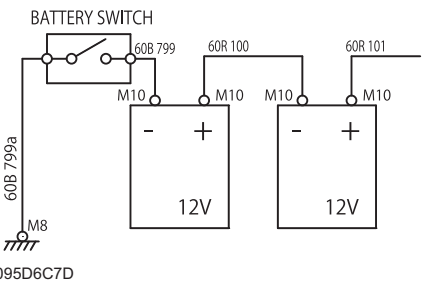
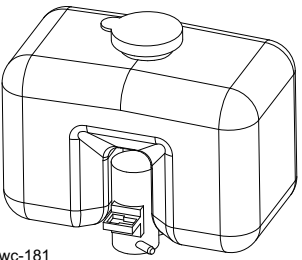
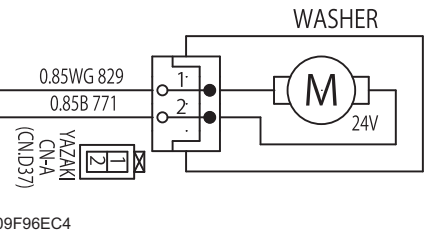
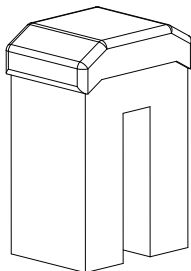
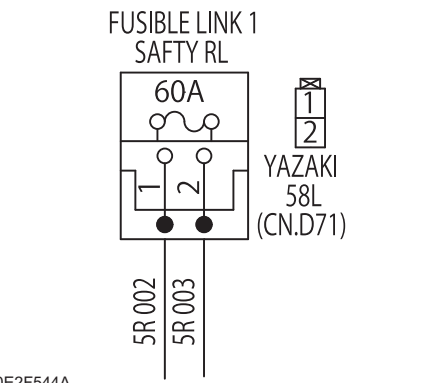
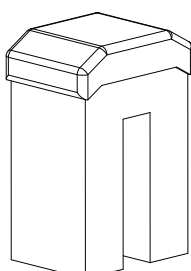
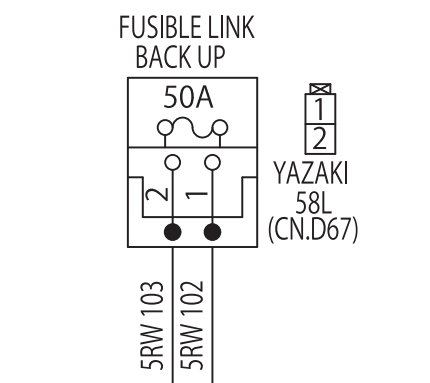
Horn



Working Light



# R. ELECTRICAL PARTS

Name	Shape	Circuit	Remarks
Battery	 <p>akffwc-179</p>	 <p>BATTERY SWITCH</p> <p>60B 799a M8 095D6C7D</p> <p>60B 799 60R 100 60R 101 M10 M10 M10 M10</p> <p>12V 12V</p>	Model: 180G51 Sumitomo Part No.: KHR4197
Washer motor	 <p>akffwc-181</p>	 <p>WASHER</p> <p>0.85WG 829 0.85B 771 YAZAKI CNA (CN.D37)</p> <p>1 2 M 24V</p> <p>09F96EC4</p>	Sumitomo Part No.: KHR2261 (tank + motor)
Fusible link (safety relay 1) (safety relay 2)	 <p>akffwc-185</p>	 <p>FUSIBLE LINK 1 SAFTY RL</p> <p>60A</p> <p>1 2 YAZAKI 58L (CN.D71)</p> <p>5R 002 5R 003</p> <p>0E2F544A</p>	Rated current: 60 A Sumitomo Part No.: KHR12950
Fusible link (back-up)	 <p>akffwc-185</p>	 <p>FUSIBLE LINK BACK UP</p> <p>50A</p> <p>2 1 YAZAKI 58L (CN.D67)</p> <p>5RW 103 5RW 102</p> <p>104FA2F7</p>	Rated current: 50 A Sumitomo Part No.: KHR3850

## Removal and Installation of Wiper Controller

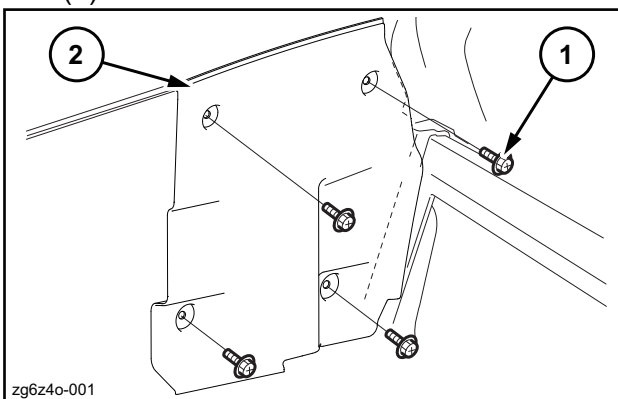
Job code	<b>RZWP03</b>
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### Items to prepare

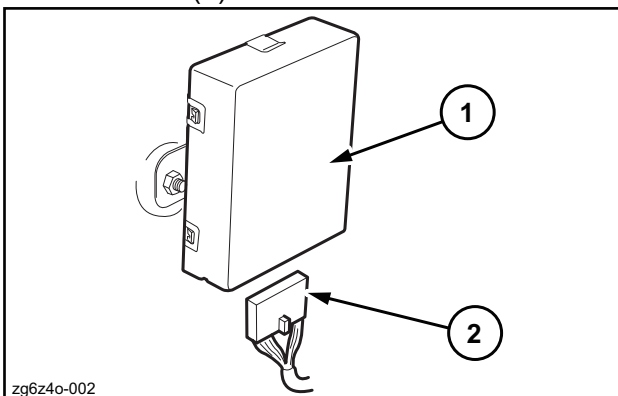
- Wrench [ 10 mm ( 0.394 in. ) ]
- Box wrench [ 10 mm ( 0.394 in. ) ]
- Phillips screwdriver
- Flathead screwdriver

### Removal of Wiper Controller

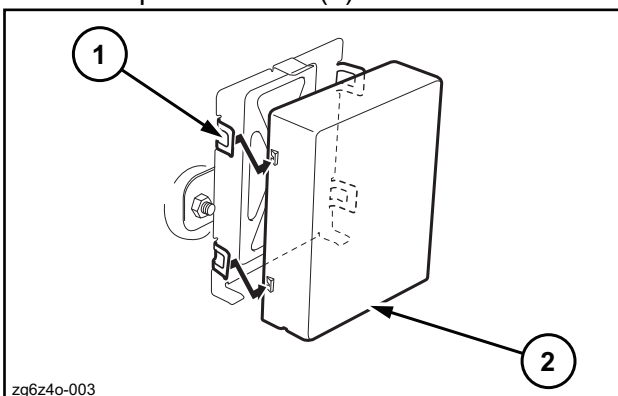
1. Use the Phillips screwdriver or box wrench [ 10 mm ( 0.394 in. ) ] to remove the 4 bolts (1), and then remove the side rear B trim (2).



2. Remove the connector (2) from the wiper controller (1).



3. Use a flathead screwdriver to slightly bend the 4 installation clips (1), and then remove the wiper controller (2).



### Installation of wiper controller

To install, perform the reverse of the removal procedure.

Tighten bolts being installed to the specified torque.

For bolts for which the torque is not specified, see the "Tightening Torque" section.

## R. ELECTRICAL PARTS

Code	Part name	Q'ty	Code	Part name	Q'ty	Code	Part name	Q'ty
1	Solar radiation sensor	1	8	Duct; H and C box	1	15	Duct; Intake-B (Fresh)	1
2	Duct; Face-A	1	9	Bracket; Box	1	16	Unit; Air conditioner	1
3	Duct; Def-A	1	10	Box; Hot and cool	1	17	Duct; Foot	1
4	Grille; Air vent	7	11	Duct; Vent (Left)	1	18	Duct; Def-B	
5	Duct; Face-B	1	12	Duct; Vent (Right)	1	19	Control panel (AC)	1
6	Duct; Def-C	1	13	Air filter (Fresh)	1	20	Drain hose	2
7	Duct; Face-C	1	14	Duct; Intake-A (Fresh)	1	21	Flange plate	1

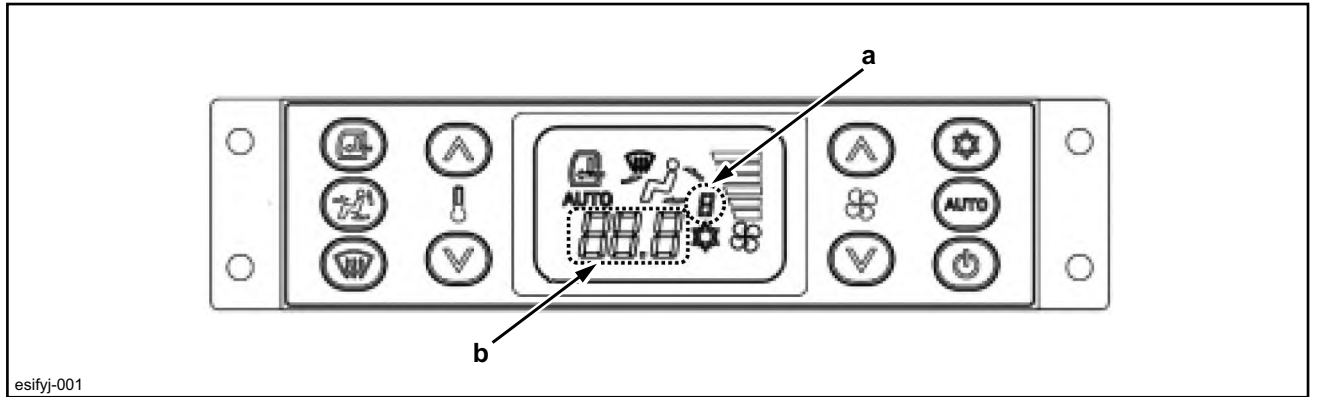
a	Monitor display	e	Heater hose (Eng.Out)	i	Should be connected with the console harness.
b	Trim side; Front (Right)	f	Cooler hose (Suction)	j	Wire harness (Console)
c	Trim side; Front (Left)	g	Cooler hose (Liquid)	k	Floor
d	Heater hose (Eng.Return)	h	Cover; Top (Console left)		

## Self-diagnosis Function with Panel Display



### Abnormality Display and Self-check Procedures

Motor actuator and sensor abnormalities can be checked on the panel display.

#### ■Abnormality Display Position



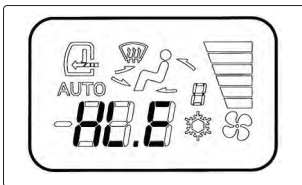
a	This segment display appears only in the monitor mode.
b	3 digit segment

Abnormalities are indicated with the numbers and letters displayed on the 3 digit segment display and a flashing  or .

#### ■Explanation of Abnormality Display

##### ■Motor Actuator Abnormality

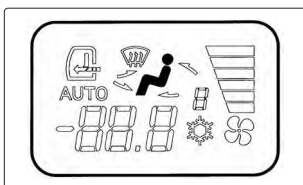
###### 1. HL.E displayed on 3 digit segment display



mhs6vk-001

Indicates that the air mix motor actuator harness is disconnected or air mix motor actuator connector is disconnected. This is also displayed when the air mix motor actuator is locked due to air mix motor actuator abnormality and link abnormality.

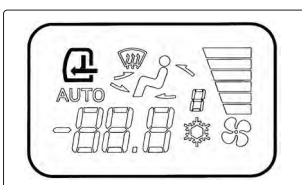
###### 2. flashes



mhs6vk-002

Indicates that the blow mode motor actuator harness is disconnected or blow mode motor actuator connector is disconnected.

###### 3. or flashes



mhs6vk-003

Indicates that the inside/outside air motor actuator harness is disconnected or inside/outside air motor actuator connector is disconnected.

## R. ELECTRICAL PARTS

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### Work Procedures

Air Conditioner Refrigerant Filling is Divided into the "Vacuum Operation" and "Gas Filling Operation".

1. The "vacuum operation" consists of eliminating moisture in the air conditioner circuit.

If there is any moisture left inside the air conditioner circuit, various problems may occur during operation such as freezing in the small hole of the expansion valve causing the circuit to clog and rust developing in the circuit.

For this reason, perform vacuuming before filling the circuit with refrigerant. This operation consists of eliminating moisture inside the circuit through boiling and evaporation.

2. The "gas filling operation" consists of filling the circuit with refrigerant after the vacuum operation.

Gas filling does not only affect the cooling capabilities of the air conditioner, it also affects the life of the parts which make up the circuit.

Severely overfilling the circuit will cause pressure inside the circuit to be abnormally high, and this will cause reductions in the cooling ability of the air conditioner.

Additionally, if pressure is extremely low, the circulation of lubricating oil within the compressor will be poor and this will cause seizing with sliding parts of the compressor.

Because the gas filling operation itself involves handling high-pressure gas, performing the operation using an incorrect procedure is very dangerous.

Follow the operation and observe all precautions indicated in this text to correctly perform refrigerant filling.

### Operation Chart

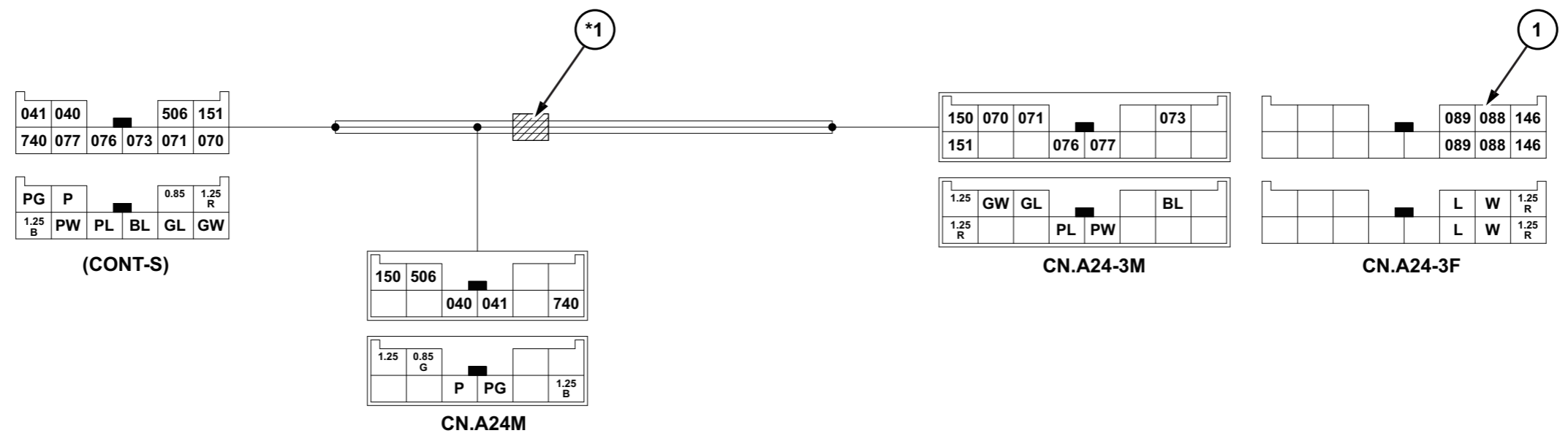
Vacuuming operation	Vacuumping start	30 min. or longer (750 mmHg or less)
	↓	
	Vacuumping stop	Let sit for 5 min.
	↓	
	Airtightness check	Gauge display abnormality (connectors check and repair)
Refrigerant filling operation	↓	
	Refrigerant filling	Fill with refrigerant gas up to a gauge pressure of 0.098 MPa (14.21525 psi).
	↓	
	Gas leak check	
	↓	
	Refrigerant filling	

# R

## Electrical Connector Wiring Diagram

### Contents

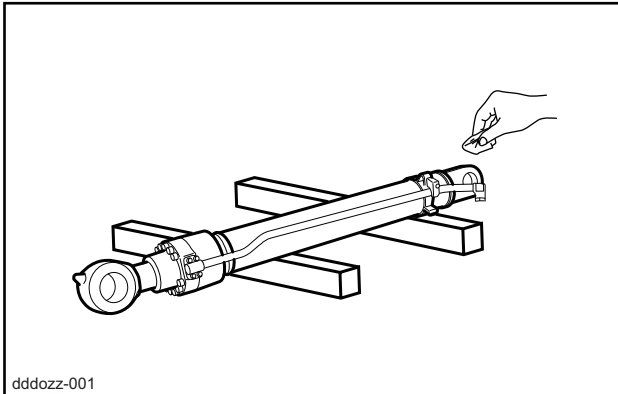
Frame Main Harness .....	2
Control Valve Harness .....	4
SCR Harness .....	6
Light Harness (boom light) .....	8
Travel Harness .....	10
Cab Main Harness .....	12
Indicator Jumper .....	14
Console Harness .....	16
GPS Computer Harness .....	18
GPS Computer Intermediate Harness .....	20
Camera Harness (rear camera) .....	22
Camera Intermediate Harness (right camera) .....	24
Camera Intermediate Harness (left camera) .....	26



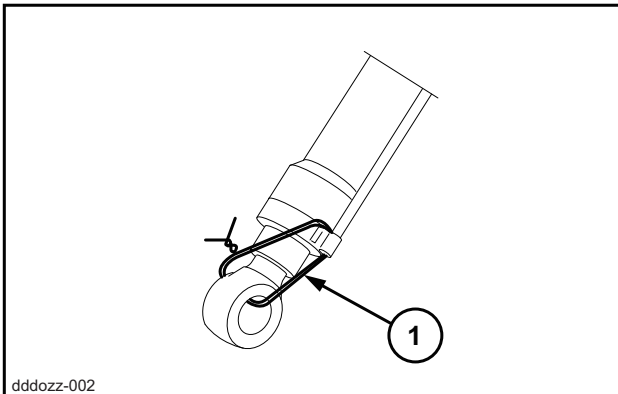
### Installation of Bucket Cylinder

- Tighten lines and bolts being installed to the specified torque.
- When the torque is not specified, check the "Bolt Size and Torque Table".

1. Clean each pin and pin hole.

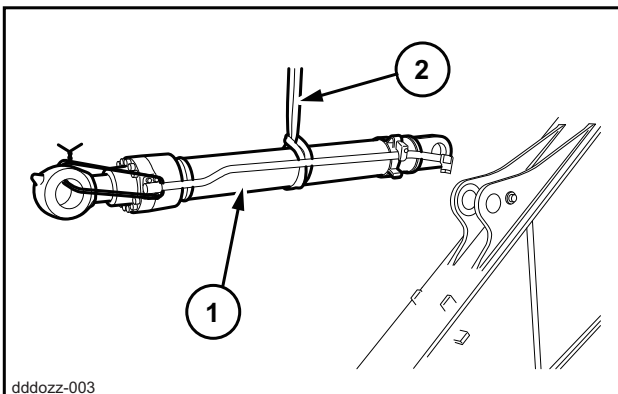


2. Tie the cylinder rod with wire (1) so that it cannot come out.



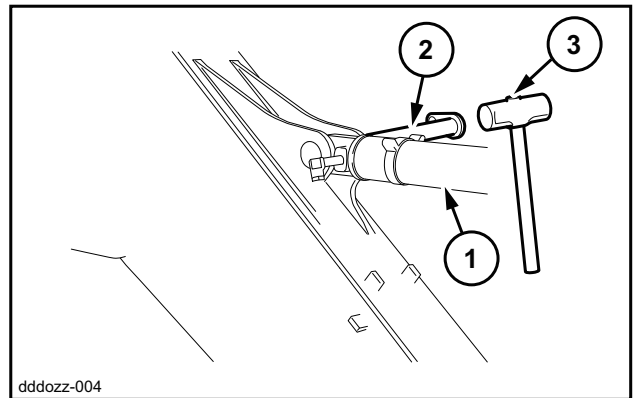
3. Use a liftcrane and nylon sling (2) to lift the bucket cylinder (1).

- Wrap the nylon sling to the inside of the line so that it is not crushed.

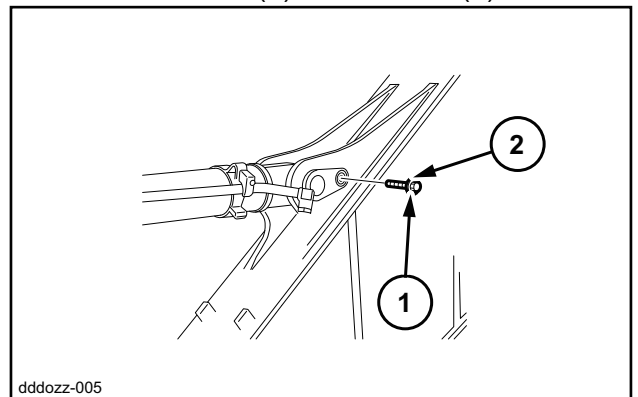


4. Align the bucket cylinder (1) with the arm and use a hammer (3) to push in the pin (2).

- If a pin is hard to insert, the cylinder is tilted.
- When inserting the pin, be careful not to damage the installed O-rings or dust seals.

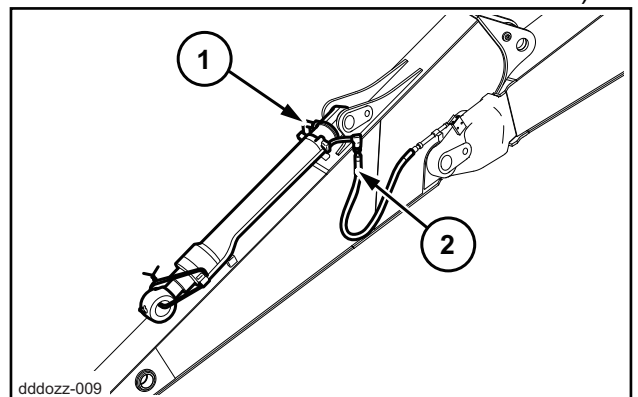


5. Use a wrench [ 19 mm ( 0.748 in. ) ] to install the bolt (1) and washer (2).



6. Use 2 wrenches [ 36 mm ( 1.417 in. ) ] to install the hoses (1) (2).

- Install the bucket link. (For details, see "Removal and Installation of Bucket Link".)
- Install the bucket. (For details, see "Removal and Installation of Bucket".)



## V. ATTACHMENTS

Item	Symptom	Related part	Problems	Countermeasure and solution
4	Operation defect Movement is not smooth.	Cylinder tube	There are dents.	Replace with a new one. Inspect the seal and sliding parts the same as above.
		Piston rod Cylinder tube Sliding part	Abnormal wear of sliding parts and damage, foreign matter caught at the piston section or the cylinder head sliding section	1. Replace with a new one. Inspect the seal and sliding parts the same as above. 2. Remove the foreign matter. Inspect the seal and sliding parts the same as above.
	Internal oil leak The piston rod extends and retracts on its own and drops abnormally during operation. Also, the stipulated speed is not output.	Piston seal	There are scratches, wear, or other damage.	Replace with a new one. Also inspect the cylinder tube interior surfaces.
		Cylinder tube	There are scratches and rust on interior surface.	1. Use honing or a whetstone to eliminate the scratches and rust and make the surface smooth. If the scratches cover too large an area to be repaired, replace the cylinder tube with a new one. 2. Replace with a new piston seal.
		Piston nut	Tightening is insufficient.	1. Tighten to the specified torque. See "Assembly Procedures". 2. The piston rod thread section could be stretched. Measure the diameter where the rod and piston fit together and if this area is tapered, replace the piston rod assembly.
		Valves	Leak from valve.	Inspect the amount of valve leakage and perform maintenance.
	Operation is unsteady.	Air	There is air remaining in the cylinder.	Perform air bleeding operation. 1. Cylinder with no air bleeding Bleed out the air by moving the cylinder back and forth a few times at low pressure and low speed. 2. Cylinder with air bleeding (air breather) After securing the machine so that the cylinder does not move, bleed the air from the air breather.  <div style="border: 1px solid black; padding: 2px; display: inline-block;">hint</div> The cylinder may extend or retract somewhat when the cylinder stops suddenly. This phenomenon occurs due to the compressibility of the hydraulic oil. This occurs particularly easily for cylinders with long strokes.

## V. ATTACHMENTS

*1	After tightening, crimp two locations around the perimeter by punching.	*5	To the bottom center	*9	Female screw effective depth: 21 (0.827)
*2	Hexagon bolt width: 115 (4.528)	*6	Pay attention to orientation of semi-circle during assembly.	*10	112 (4.409) or more for both sides
*3	Outer periphery knurling processing	*7	Slit direction is as indicated in the diagram.	*11	With poly-cap
*4	Cushion stroke	*8	Serial No. stamping position		

L1	Maximum retracted length: 2286 (90)
L2	Stroke: 1650 (64.961)

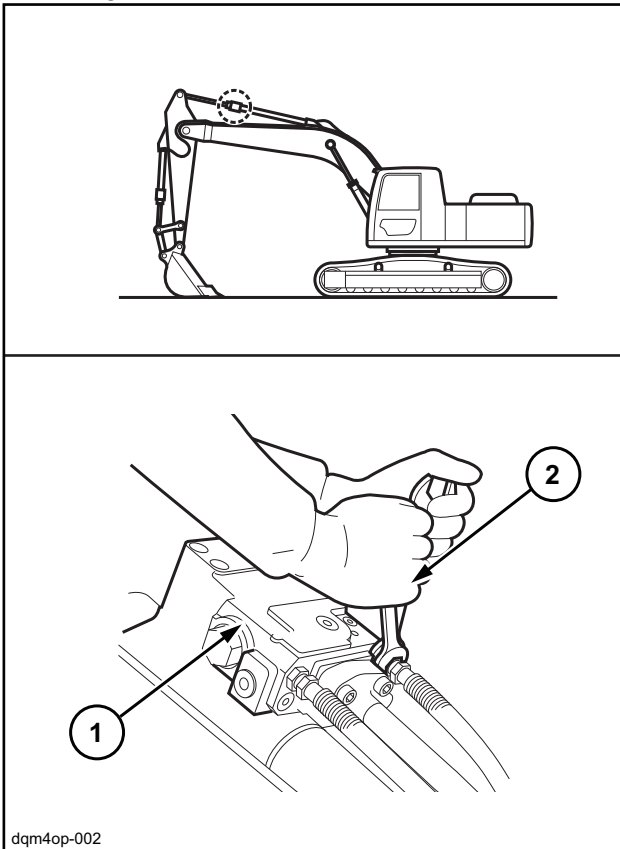
Code	Part name	Quantity	Code	Part name	Quantity
01	Tube subassembly	1	22	Retaining screw	1
02	Rod subassembly	1	23	Steel ball	1
03	Cylinder head	1	24	Cushion ring	1
04	Bushing	1	25	Cushion seal	1
05	Snap ring	1	26	Stopper	2
06	Buffer ring	1	27	Snap ring	1
07	U-ring	1	28	Pin bushing	1
08	Backup ring	1	29	Wiper ring	4
09	Wiper ring	1	30	Pin bushing	1
10	O-ring	1	31	Pipe subassembly	1
11	Backup ring	1	32	O-ring	1
12	Hexagon socket head bolt	12	33	Hexagon socket head bolt	4
13	Cushion ring	1	34	Band subassembly	1
14	Cushion seal	1	35	Band	1
15	Piston	1	36	Bolt	2
16	Seal ring assembly	1	37	Washer	2
17	Backup ring	2	38	Pipe holder	1
18	Slide ring	2	39	Bolt	1
19	Slide ring	2	40	Spring washer	1
20	Shim	1	41	Grease nipple	1
21	Nut	1			

## V. ATTACHMENTS

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### Arm Cylinder HBCV

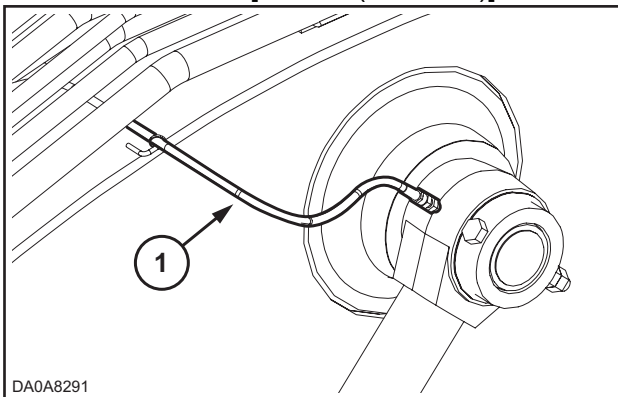
For arm-in operations, bleed the air from the arm cylinder HBCV (1) using the same procedure as for boom cylinder HBCV air bleeding.



dqm4op-002

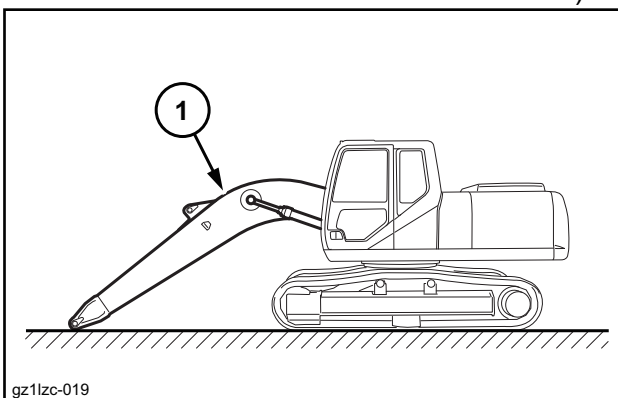
2	Hose mouthpiece
---	-----------------

12. Attach the right and left grease hoses (1) with a wrench [19 mm (0.748 in.)].



13. Have end of the boom (1) contact ground.

- Refer to "Removal and Installation of Boom Cylinder" for the procedure to install the boom cylinder as well.
- Install the arm.(Refer to "Removal and Installation of Arm" for details.)
- Install the arm cylinder.(Refer to "Removal and Installation of Arm Cylinder" for details.)
- Install the bucket cylinder.(Refer to "Removal and Installation of Bucket Cylinder" for details.)
- Install the bucket link.(Refer to "Removal and Installation of Bucket Link" for details.)
- Install the bucket.(Refer to "Removal and Installation of Bucket" for details.)

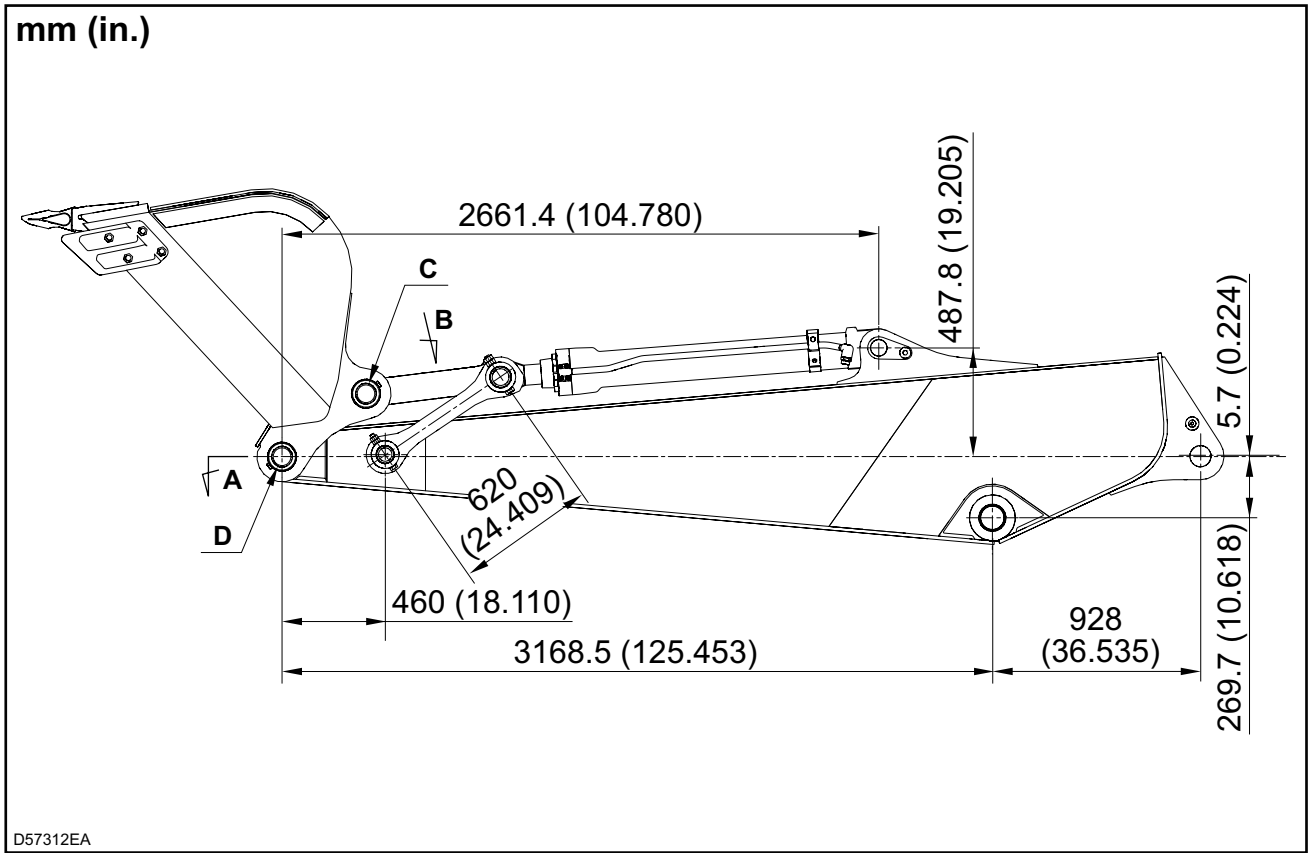


14. Install the urea solution tank cover.  
To install, reverse the removal procedure.  
(Refer to "Removal of Boom" for details.)

**Arm Dimension**

**Standard Arm [3.18 m (10.43 ft.)]**

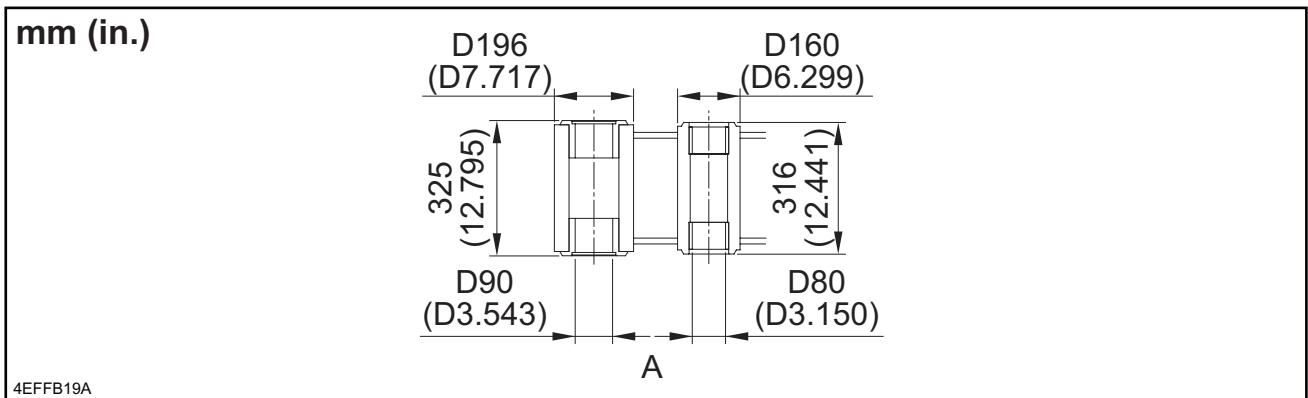
Overall Arm

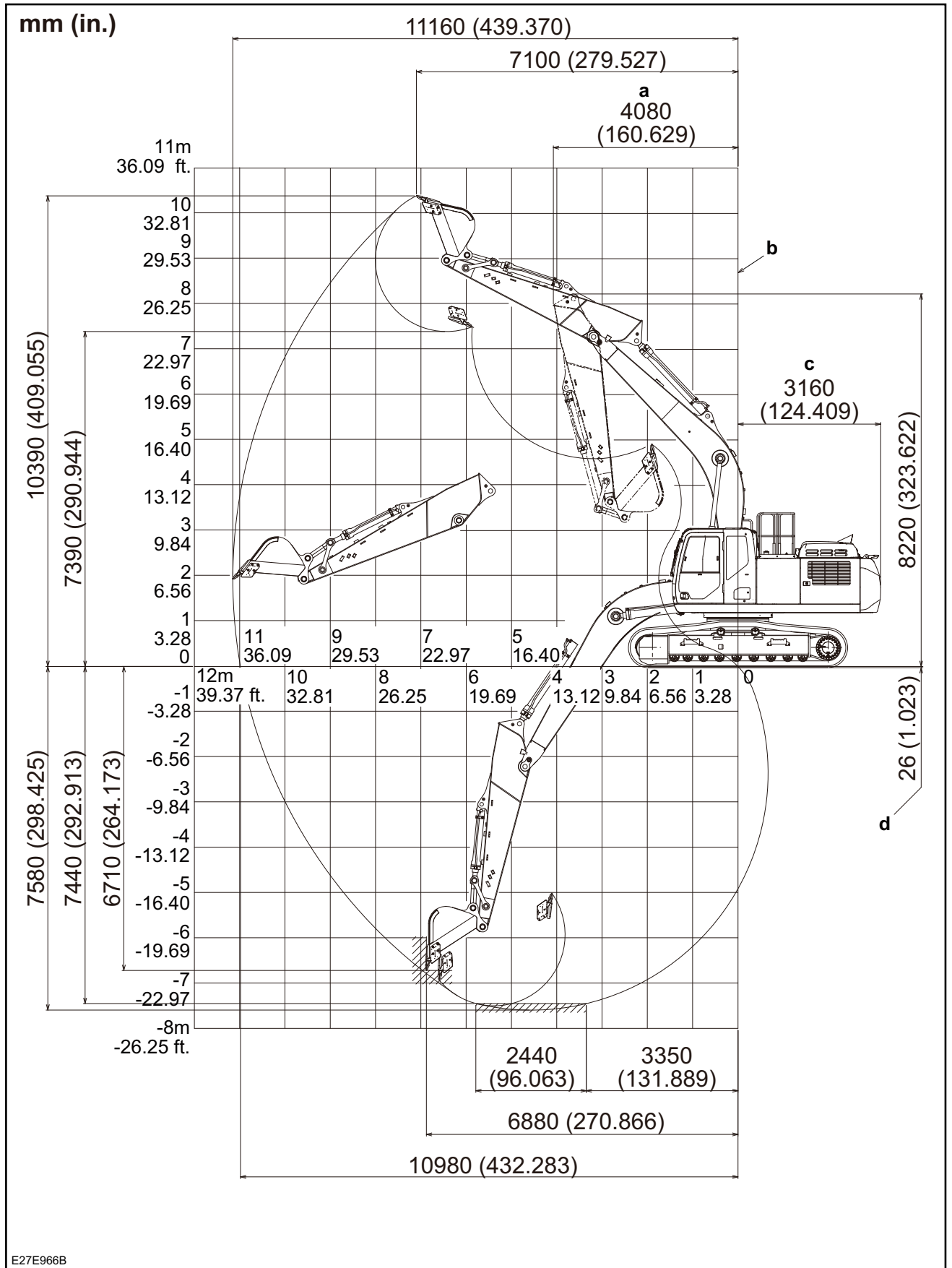


Bucket Cylinder [mm (in.)]

Maximum retracted length	1692.0 (66.614)
Stroke	1078.0 (42.441)
Cylinder top width	105.0 (4.134)

Arm Boss



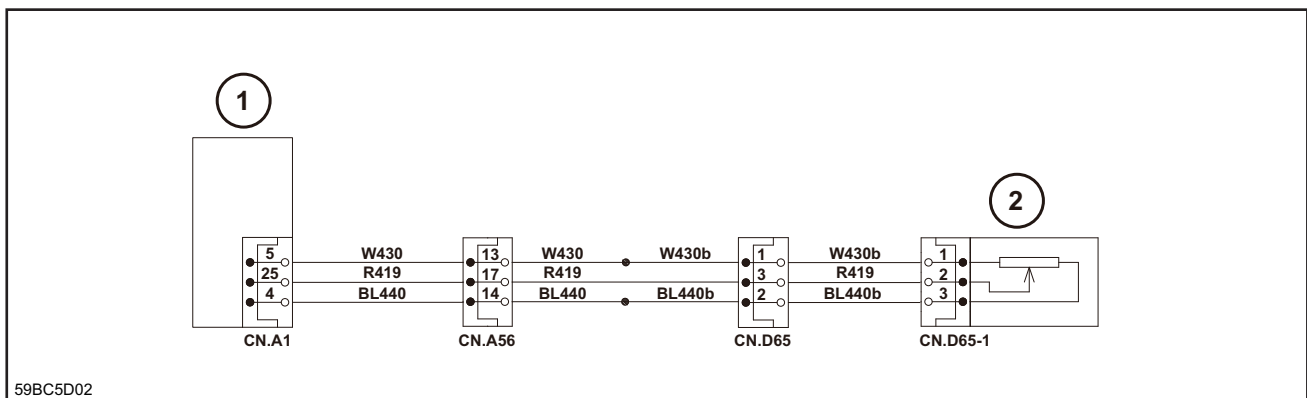


Z. OTHER

a	Minimum swing radius	c	Swing radius (rear end)
b	Swing center	d	Grouser shoe lug height

## Z. OTHER

Step	Action	Standard value	Yes	No
10	1. Turn the key switch ON. 2. Measure the voltage between CN.D65-1 harness side terminal No. 1- GND. Is it about 5 V?	About 5 V	Go to Step 11	Repair or replace the W430b and W430 harnesses because they are faulty (disconnected).
11	1. Measure the voltage between CN.D65-1 harness side terminal No. 2- GND. Is it 0.25 V or higher?	0.25 V or higher	Replace the main controller because it is faulty.	R419 harness defect (disconnection). Repair or replace



59BC5D02

1	Main controller
2	Pressure sensor (N1)

## Diagnostic Trouble Code: 7069 Pressure Sensor Arm-Out Pilot Abnormality

Step	Action	Standard value	Yes	No
1	<ol style="list-style-type: none"> <li>Turn the key switch ON.</li> <li>Check whether the diagnostic trouble code: 7069 is displayed.</li> </ol>		Go to Step 2	
2	<ol style="list-style-type: none"> <li>Turn the key switch OFF.</li> <li>Inspect the connectivity of each connector for poor insertion and wiring terminal disconnection.</li> <li>Disconnect each connector, and check for any wiring terminal abnormality. If there is no abnormality, reconnect the connectors.</li> <li>Turn ON the key switch, and check whether the diagnostic trouble code: 7069 is displayed.</li> </ol>		Go to Step 3	
3	<ol style="list-style-type: none"> <li>Check whether the voltage of pressure sensor is 4.75 V or more at the service support screen.</li> </ol>	4.75 V or higher	Go to Step 4	When it is 0.25 V or less, go to step 8.
4	<p>Inspect for a short circuit in the power supply.</p> <ol style="list-style-type: none"> <li>Turn OFF the key switch and remove the CN.D28.</li> <li>Turn the key switch ON.</li> <li>Measure whether the voltage between CN.D28 harness side terminal No. 1-GND is 5 V or more.</li> </ol>	About 5 V	Go to Step 5	Replace the WL435e, WL435, and WB435 harnesses because they are faulty (short-circuited).
5	<ol style="list-style-type: none"> <li>Measure whether the voltage between CN.D28 harness side terminal No. 2-GND is 4.75 V or less.</li> </ol>	4.75 V or less	Go to Step 6	Replace the YR407 harness because it is faulty (short-circuited).
6	<ol style="list-style-type: none"> <li>Measure whether the voltage between CN.D28 harness side terminal No. 3-GND is 0.25 V or less.</li> </ol>	0.25 V or less	Go to Step 7	Replace the BW445e and BW445 harnesses because they are faulty (short-circuited), or go to step 8.
7	Faulty main controller			Replace the main controller.
8	<ol style="list-style-type: none"> <li>Inspect the arm-out Pi pressure sensor.</li> <li>Turn the key switch OFF.</li> <li>Remove the CN.D28.</li> <li>Measure whether the resistance between CN.D28 pressure sensor side terminal No. 1-3 is about 10 <math>\Omega</math>.</li> </ol>	About 10 $\Omega$	Go to Step 9	Replace the arm-out Pi pressure sensor because it is faulty.
9	<p>Inspect for shorts to ground and disconnections.</p> <ol style="list-style-type: none"> <li>Inspect whether there is continuity between CN.D28 harness side terminal No. 1-GND.</li> </ol>		Replace the WL435e, WL435, WB435, and YR407 harnesses because they are faulty (short-circuited).	Go to Step 9

## Z. OTHER

### Diagnostic Trouble Code: 7206 Option Return Line Switchover Solenoid Abnormality

Step	Action	Standard value	Yes	No
1	1. Turn the key switch ON. 2. Check whether diagnostic trouble code: 7206 is displayed. Is diagnostic trouble code: 7206 displayed?		Go to Step 2	
2	1. Inspect the connection status of each connector. 2. Check whether diagnostic trouble code: 7206 is displayed. Is diagnostic trouble code: 7206 displayed?		Go to Step 3	
3	In order to inspect the option line switchover solenoid 1. Turn OFF the key switch and remove the CN.G1. 2. Measure the resistance between CN.G1 option line switchover solenoid side terminal No. 1-2. Is it 34 Ω to 47 Ω?	34 Ω - 47 Ω	Go to Step 4	Replace the option line switchover solenoid because it is faulty.
4	Inspect for shorts. Inspect the continuity between CN.G1 harness side terminal No. 1-GND. Is there continuity?		Replace the V809 harness because it is faulty (short-circuited).	Go to Step 5
5	Inspect for disconnection. 1. Remove the CN.A5. 2. Inspect the continuity between CN.A5 harness side terminal No. 1-CN.G1 harness side terminal No. 1. Is there continuity?		Go to Step 6	Repair or replace the V809 harness because it is faulty (disconnected).
6	Inspect the continuity between CN.G1 harness side terminal No. 2-GND. Is there continuity?		Replace the main controller because it is faulty.	Repair or replace the B730, B720, and B700 harnesses because they are faulty (disconnected).

## Diagnostic Trouble Code: 7271 Tilting 2 Proportional Valve Abnormality

step	Action	Standard value	Yes	No
1	<ol style="list-style-type: none"> <li>1. Turn ON the key switch.</li> <li>2. Check whether the diagnostic trouble code: 7271 is displayed.</li> </ol>		Go to step 2.	
2	<ol style="list-style-type: none"> <li>1. Turn OFF the key switch.</li> <li>2. Inspect the connectivity of each connector for poor insertion and wiring terminal disconnection.</li> <li>3. Disconnect each connector, and check for any wiring terminal abnormality. If there is no abnormality, reconnect the connectors.</li> <li>4. Turn ON the key switch, and check whether the diagnostic trouble code: 7271 is displayed.</li> </ol>		Go to step 3.	
3	<ol style="list-style-type: none"> <li>1. Reset the diagnostic trouble code at the service support screen.</li> <li>2. Check whether the diagnostic trouble code: 7271 is displayed.</li> </ol>		Go to step 4.	Go to step 5.
4	<p>Inspect for a short circuit.</p> <ol style="list-style-type: none"> <li>1. Turn OFF the key switch and remove the CN.D64.</li> <li>2. Inspect whether there is continuity between CN.D64 harness side terminal No. 1-GND.</li> </ol>		Replace or repair the L912a harness because it is faulty (short-circuited).	Replace the main controller because it is faulty.
5	<p>Inspect the proportional valve.</p> <ol style="list-style-type: none"> <li>1. Turn OFF the key switch.</li> <li>2. Remove the CN.D64.</li> <li>3. Inspect whether there is continuity between CN.D64 proportional valve side terminal No. 1-2.</li> </ol>		Go to step 6.	Replace the proportional valve because it is faulty.
6	<p>Inspect for a disconnection.</p> <ol style="list-style-type: none"> <li>1. Remove the CN.A1.</li> <li>2. Inspect whether there is continuity between CN.A1 harness side terminal No. 3-CN.D64 harness side terminal No. 1.</li> </ol>		Go to step 7.	Repair or replace the L912a harness because it is faulty (disconnected).
7	<p>Inspect whether there is continuity between CN.A1 harness side terminal No. 1-CN.D64 harness side terminal No. 2.</p>		Replace the main controller because it is faulty.	Repair or replace the BL912b and LY912b harnesses because they are faulty (disconnected).

## Z. OTHER

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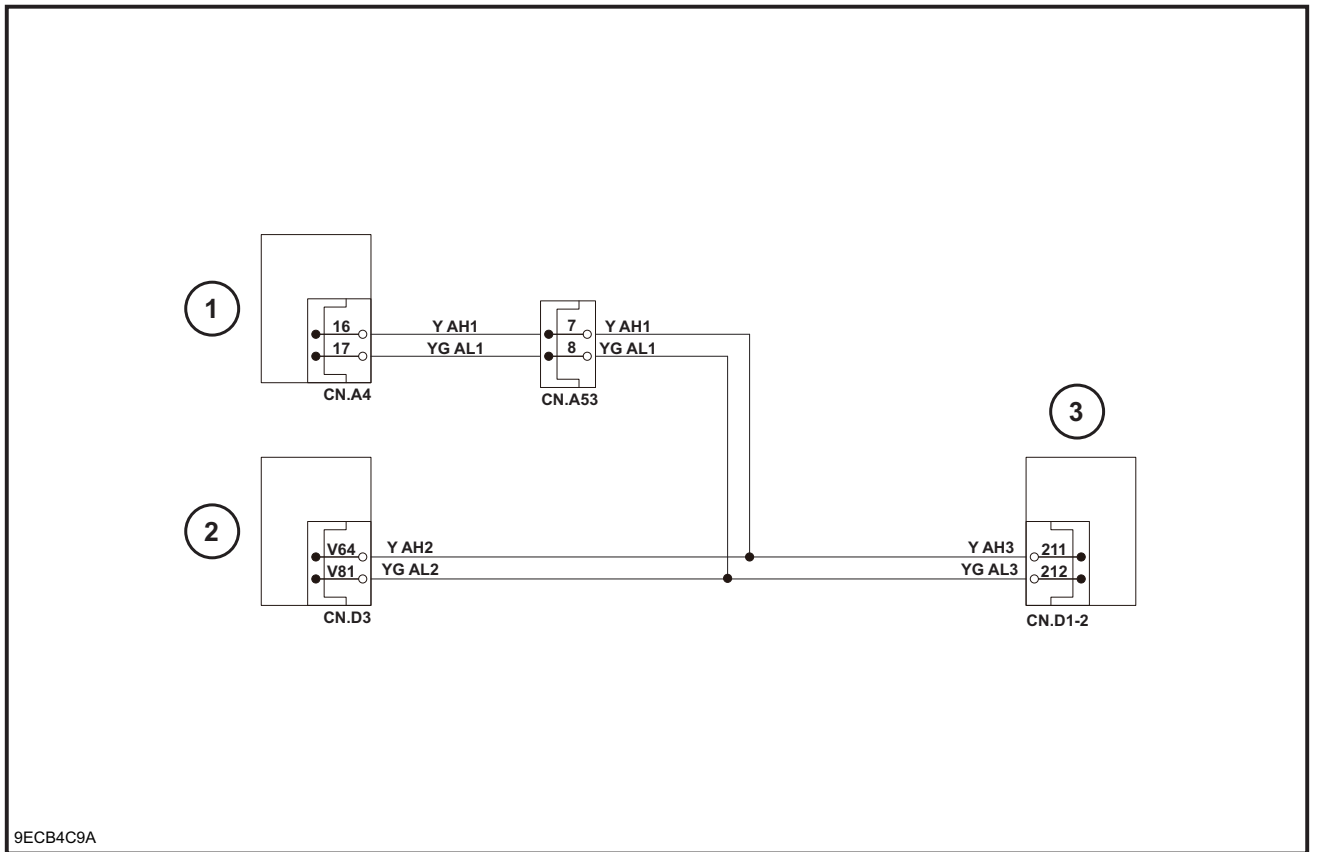
### Diagnostic Trouble Code: 7430 Inducement (Remaining Urea Level Low) - Final

This diagnostic trouble code is not displayed on the monitor when trouble occurs.

(On the monitor, the REFILL DEF icon and the REFILL DEF message appear.)

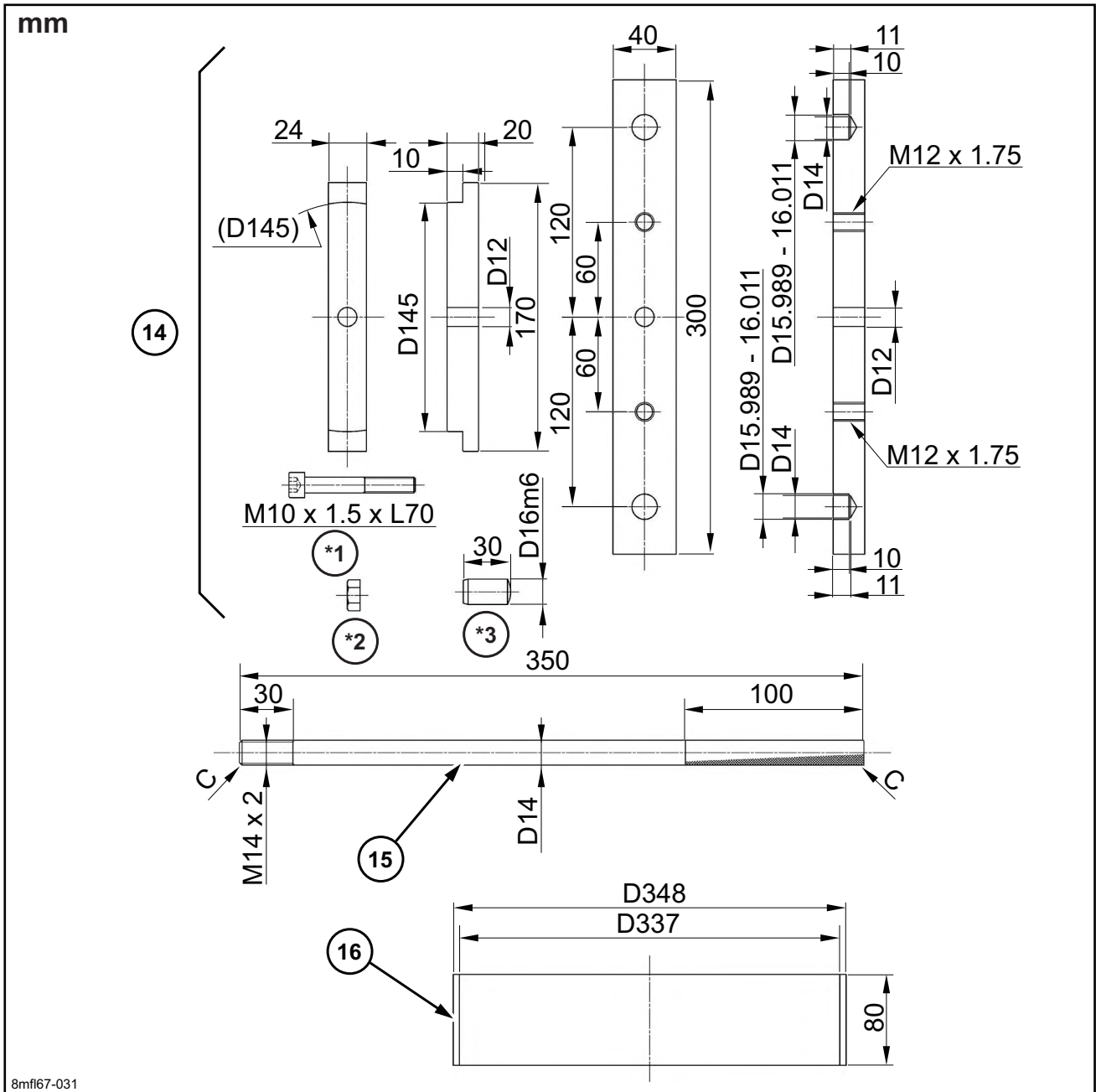
The trouble history is recorded on the service support screen.

Step	Action	Standard value	Yes	No
1	1. Check that "REFILL DEF" is displayed. 2. On the service support screen, check whether diagnostic trouble code: 7430 is displayed. Is diagnostic trouble code: 7430 displayed?		Go to Step 2.	
2	1. Inspect the connection status of each connector. 2. Check whether diagnostic trouble code: 7430 is displayed. Is diagnostic trouble code: 7430 displayed?		Go to Step 3.	
3	Reset the diagnostic trouble code on the service support screen. Check whether diagnostic trouble code 7430 is displayed.		Go to Step 4.	
4	Check the level of DEF/AdBlue® (urea solution). Sufficient level?		Go to Step 5.	Refill DEF/AdBlue® (urea solution).
5	Check whether other diagnostic trouble codes are displayed at the same time. Displayed?		Troubleshoot the other diagnostic trouble codes.	Main controller defect. Replace.



9ECB4C9A

1	Main controller
2	Engine computer
3	Dosing controller



8mfl67-031

Code	Order No.	Jig name	Remarks
14		Holder C subassembly lifting jig	*1: Socket head bolt (1 piece) *2: M10 nut (1 piece) *3: JIS B1354 Type A equivalent (2 pieces)
15		Motor-assembly disassembly and assembly rod	
16		Angular bearing press-fit jig	

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