235X3

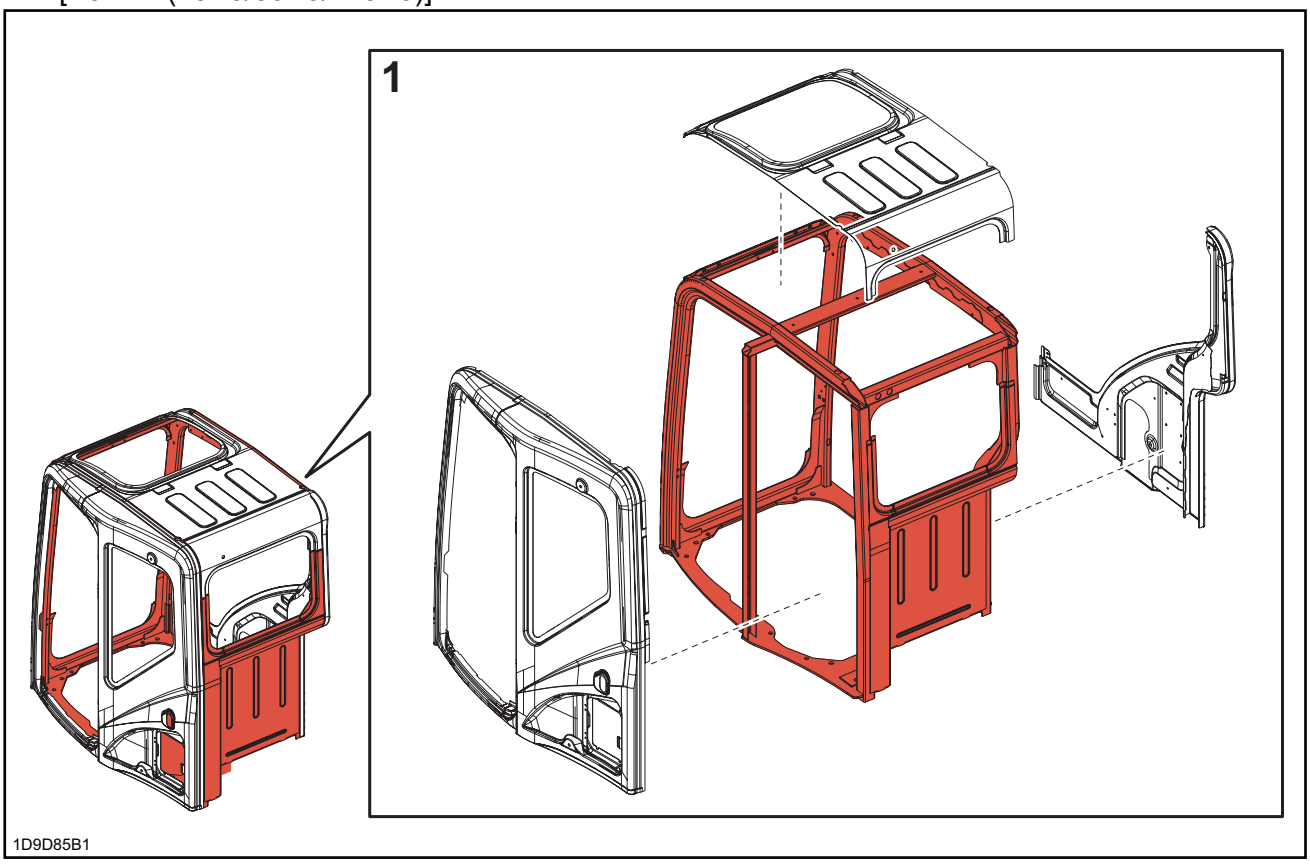
Excavator

SERVICE MANUAL

WLSM2356-08LX

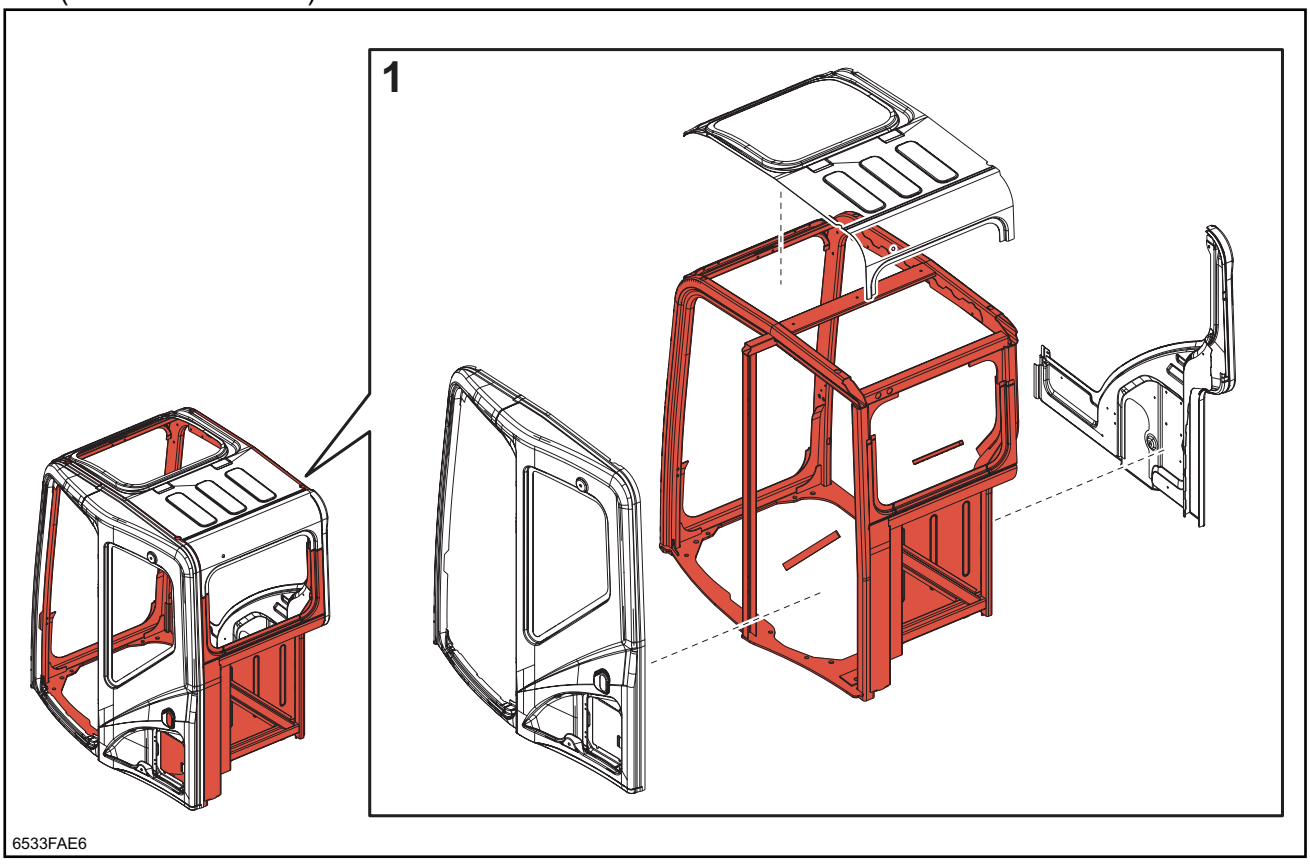
Nov. 2019

[X3 cab (75X3/80X3/145X3)]



[X3 cab (235X3)]

The cab for the MSR model (235X3) is the cab for the MSR model on the diagram (75X3/80X3/145X3) with reinforcement materials added in 3 locations.



When the pressure oil discharged from the hydraulic pump is led to the double counter balance valve P1 port, the check valve (2-1) moves to the left against the spring (3), the oil path C1 (a) is opened, pressure oil flows from the M1 port into the piston motor and attempts to rotate the piston motor.
On the other hand, the return oil from the piston motor flows from the M2 port into the double counter balance valve, and then flows to the check valve (2-2). The P1 port side goes to high pressure and operates the spring chamber 1 (e) and the damper chamber A1 (c), and that oil pressure moves the plunger (1) to the right against the opposite side spring (7-2) with force proportional to the pressure.
At this time, the M2 port return oil flows through the oil path B (f) in the circumferential notch section of the plunger (1) and into the P2 port while generating back pressure at the M2 port and this return oil returns to the tank through the control valve and the piston motor starts rotating.

[3] Counter balance function (Diagram 4)
During piston motor rotation, if the piston motor is forced to rotate by the external load, pumping action occurs in the piston motor, and it runs wild.
In this case, since the P1 port section becomes the suction side of the pump action, that pressure drops.
At the same time, the pressure also drops in the spring chamber 1 (e) and the damper chamber A1 (c).
Therefore, the plunger (1) is moved to the left by the spring (7-2), oil path B (f) is closed, and when the return oil flow stops, the suction side flow stops at the same time.
When the flow of oil through oil path B (f) is stopped, in an instant, the P1 port side pressure rises again due to the hydraulic pump discharge oil and this moves the plunger (1) to the right.
In this way, the plunger (1) moves in small steps when there is pumping action due to the external load to hold the opening surface area of oil path B (f) in an appropriate state.
Therefore, rotation of the piston motor at a speed appropriate to the feed flow from the hydraulic pump is maintained and vacuum in the hydraulic circuit is prevented. This prevents the piston motor from running wild.

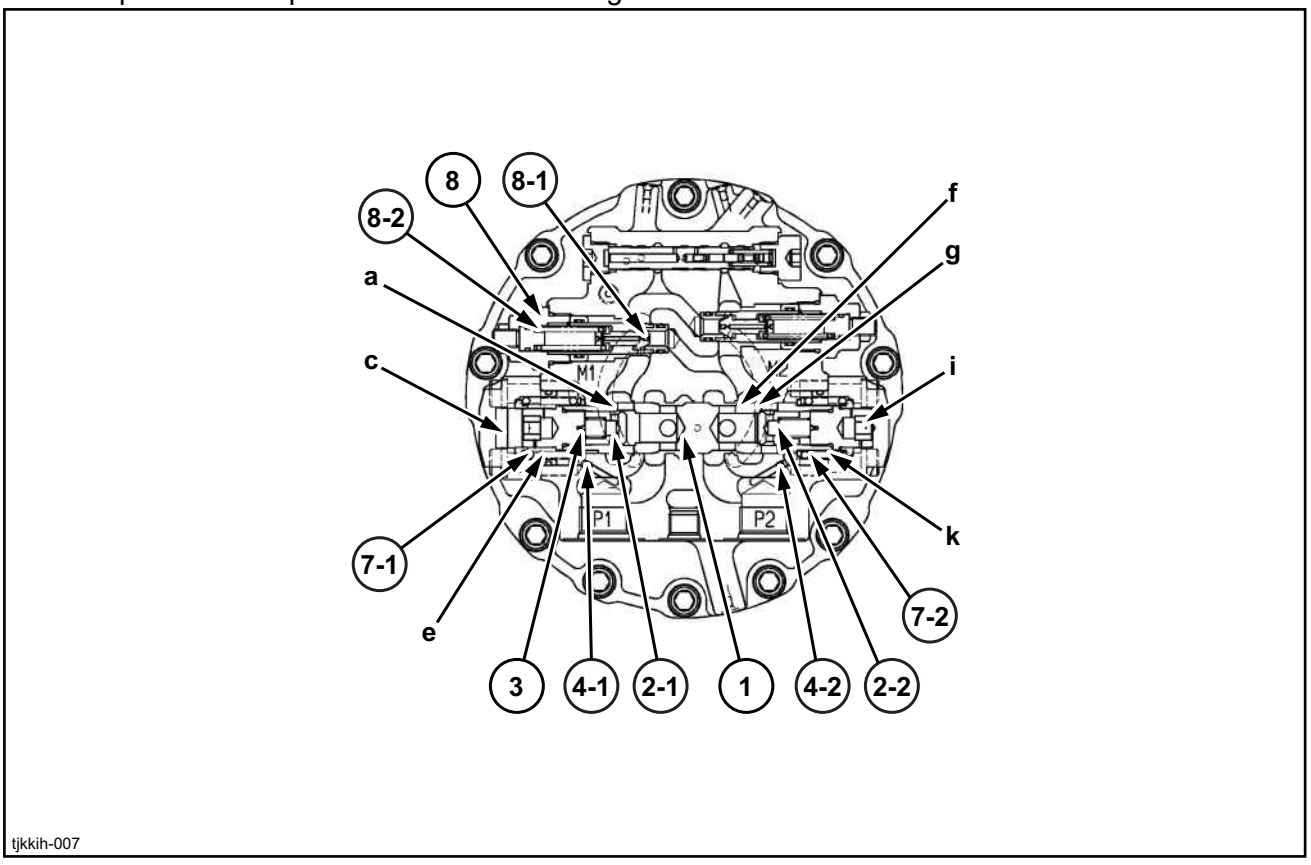


Diagram 4 Double counter balance valve when motor rotating

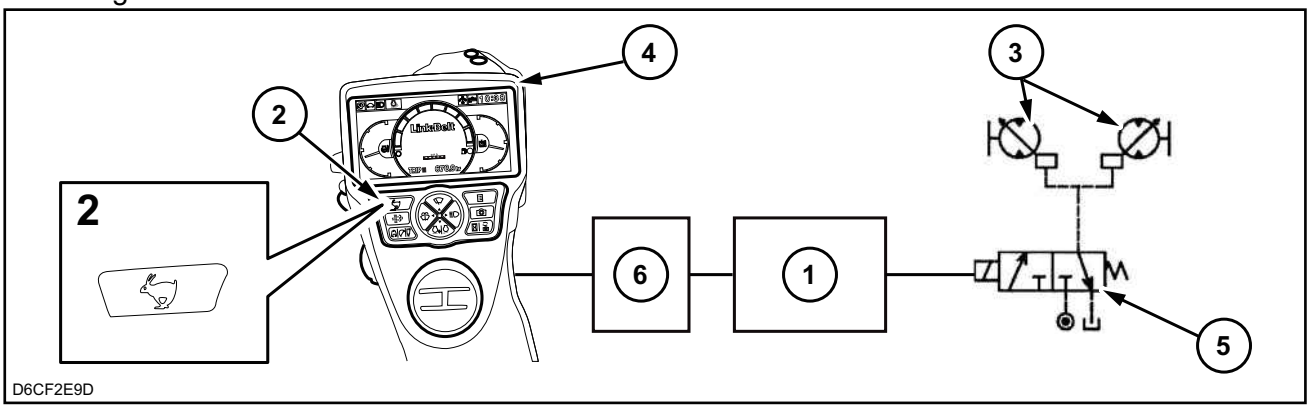
Basic Functions

Travel Speed Selection

Purpose/summary

Changes the travel motor tilting angle by switching the travel speed between low speed and high speed with the switch. (Travel speed switchover)

Configuration



1	Computer A	3	Travel motor	5	Travel 2-speed switchover solenoid
2	Travel 2-speed select switch	4	Monitor	6	Computer B

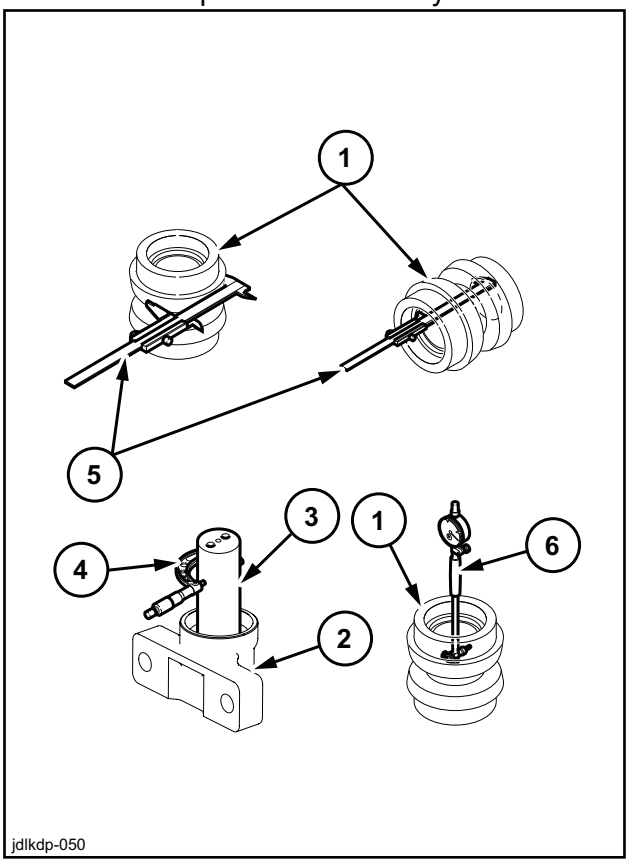
Operation explanation

[1] When the key is turned ON, the travel 2-speed select solenoid turns OFF and the travel mode icon on the monitor is set to low speed.

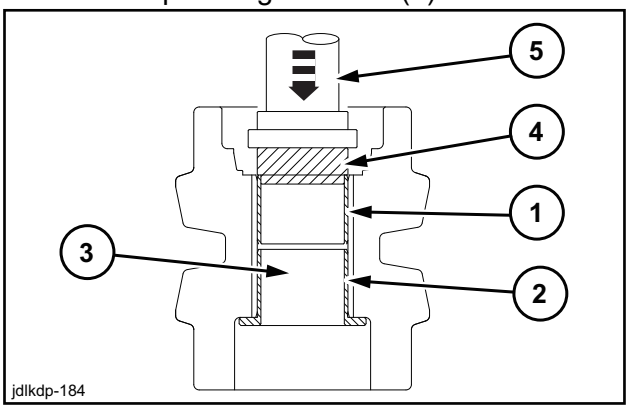
[2] When the travel 2-speed select switch is pressed, the travel 2-speed select solenoid turns ON and the travel mode icon on the monitor is set to high speed.

[3] When the travel 2-speed select switch is pressed again, the travel 2-speed select solenoid turns OFF and the travel mode icon on the monitor is set to low speed.

10. Use a micrometer caliper (4), caliper (5), cylinder gauge (6), to measure the roller (with bushing) (1), bracket (2), and shaft (3) for wear and deformation. Replace with new parts as necessary.

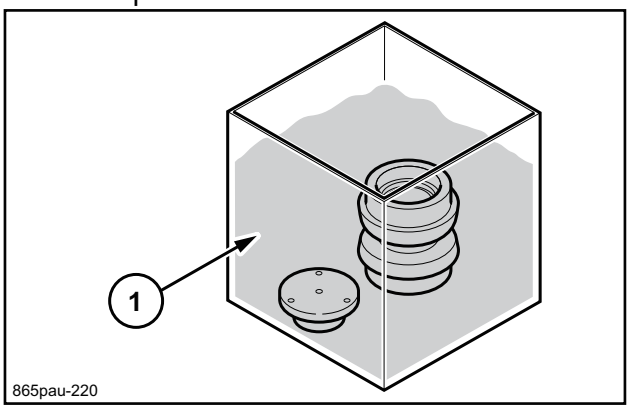


11. When replacing bushings (1) (2), use jig A (4) to restrain it from the side where the shaft (3) was removed and press it out with a pressing machine (5).

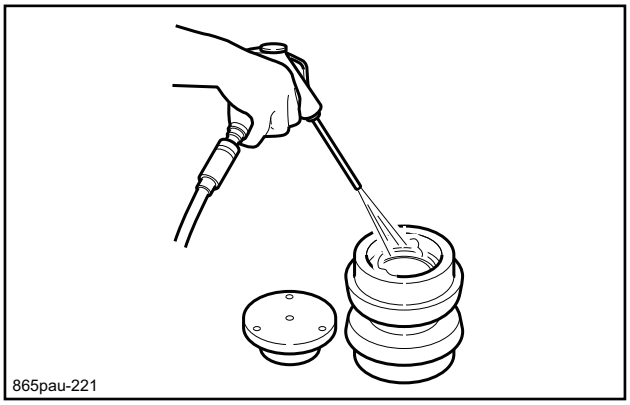


Assembly Procedures

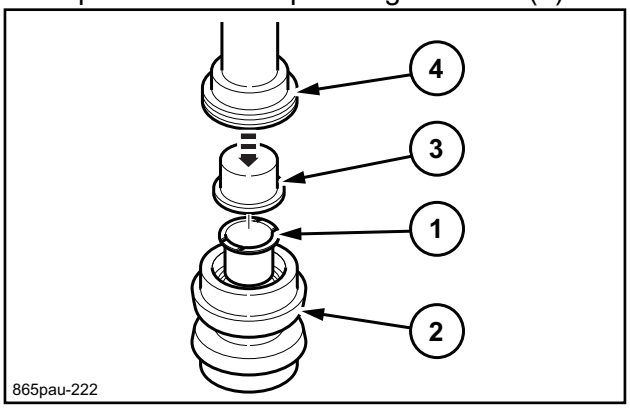
1. Clean all parts.
   - Find a clean location.
   - Place a rubber plate or cloth on the work platform so as not to damage the parts.
   - In order to clean off adhered matter that forms sharp points and causes scratches, immerse parts in cleaning fluid (1) until dirt and grease float to the top.



2. After cleaning the parts, air blow them to remove any remaining cleaning fluid or debris.



3. If the bushing (2) was removed during disassembly, put it into the roller (1). Face up the thrust plate installation side, restrain from above using jig B2 (3), and push in with the pressing machine (4).



Assembly and Disassembly of Take-up Roller

Caution

- To ensure safe operations, wear protective gear before beginning work and follow all precautions.
- When removing devices or positioning devices at the time of installation, use a removal jig and a hammer or steel rod.
- Follow the precautions below when lifting the load.
  - The liftcrane must be operated by a qualified operator.
  - Do not stand or pass under the lifted load.
  - Check the weight of the roller to determine whether it can be carried by hand or whether a liftcrane must be used.
- Fasten the roller to a level surface so it does not roll.
- Be sure to repair any parts damaged during disassembly, and prepare replacement parts in advance.
- If any parts are significantly rusted or dirty, clean them before disassembling.
- Any foreign matter entering the equipment during assembly can create a malfunction. Therefore, after thoroughly cleaning the equipment with cleaning oil, air blow the equipment, and assemble in a clean location.
- When assembling sliding (5) parts, be sure to coat them with new hydraulic oil.
- As a rule, replace all O-rings and other seal parts with new parts.
- The take-up roller is a heavy object and requires at least 2 workers to handle.

Caution

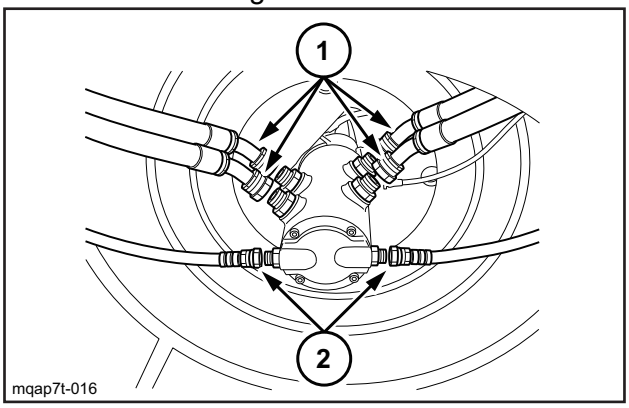
General cautions

- Be careful not to drop precision parts or let bump them with other parts during work.
- Do not forcefully open or hit parts in an effort to speed up operations.
  Pay careful attention and proceed slowly so as not to deform any parts, create any oil leaks, or compromise the efficiency of the equipment, etc.
- Disassembled parts can easily rust or collect dust. Therefore, immediately after disassembling parts, take precautions to prevent the parts from rusting or collecting dust.

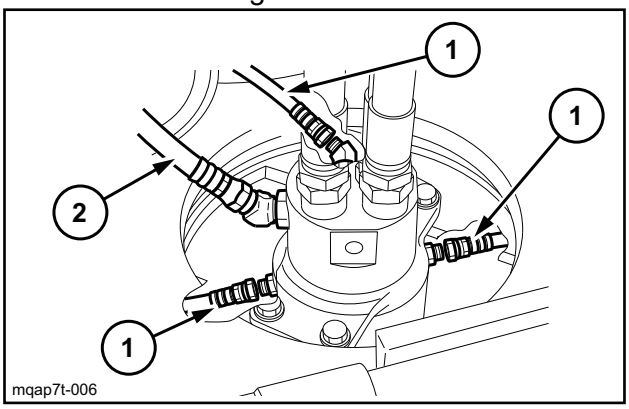
Items to prepare

- Hexagon wrench [6 mm (0.236 in.)]
- Hammer
- Pliers
- Gear puller
- Screwdriver
- Engine oil (API CF 30)
- Specialty jigs
- Pressing machine
- Loctite
- Special fiber cloth (Kimwipe)
- Micrometer caliper
- Caliper
- Cylinder gauge
- Seal tape
- Oil pan (drain pan)
- Water container for inspection

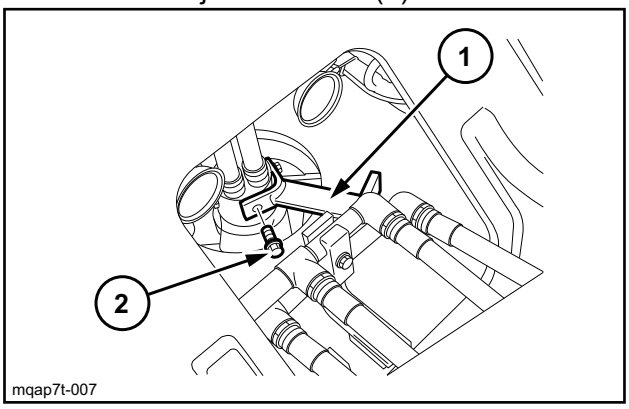
- Clean the center joint and hoses by spraying them with a parts cleaner to prevent scratches and prevent dirt from accumulating on the connectors.



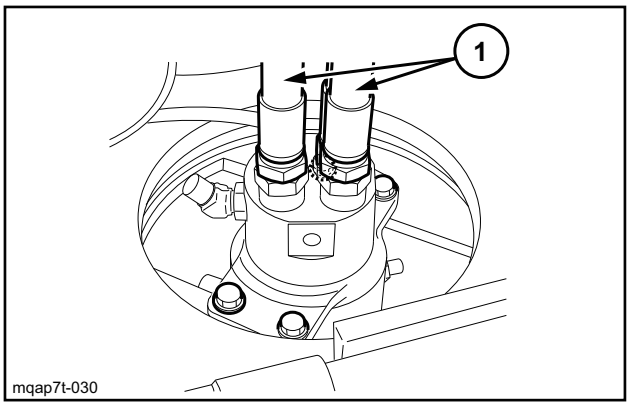
6. Use a wrench [19 mm (0.748 in.)] to remove the pilot hoses (1) and a wrench [27 mm (1.063 in.)] to remove the drain hose (2).
   - Attach caps or plugs to the center joint and hoses to prevent any entry of water, dust or dirt.
   - Clean the center joint and hoses by spraying them with a parts cleaner to prevent scratches and prevent dirt from accumulating on the connectors.



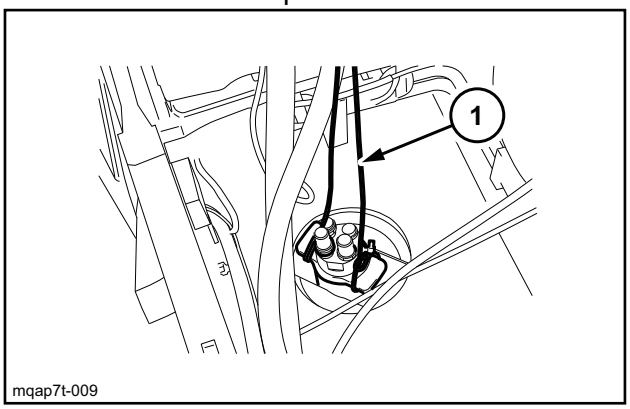
7. Use a wrench [19 mm (0.748 in.)] to remove the 2 bolts (2), and then remove the center joint lock bar (1).



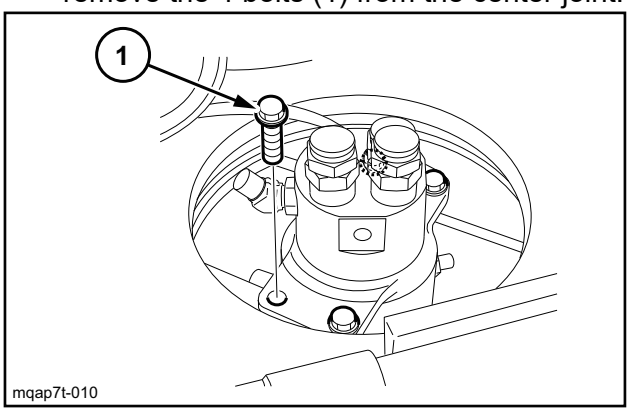
8. Use a wrench [36 mm (1.417 in.)] to remove the 4 travel hoses (1).
   - Mark the hoses so that the connectors can be matched during assembly.
   - Attach caps or plugs to the hoses to prevent any entry of water, dust or dirt.
   - Clean the hoses by spraying them with a parts cleaner to prevent scratches and prevent dirt from accumulating on the connectors.



9. Wrap wire ropes (1) around the center joint and suspend it with a liftcrane so that the center joint does not fall during removal and installation operations.



10. Use a wrench [19 mm (0.748 in.)] to remove the 4 bolts (1) from the center joint.



Assembly and Disassembly of Travel Motor

Tools for Assembly and Disassembly

Use the tools indicated below for the assembly and disassembly of the motor.

Standard Tools

The standard tools required for the assembly and disassembly of this motor are indicated in Table 1.

Table 1. Standard tools for assembly and disassembly

No.	Tool name	Standardized No. Manufacturer name	Type and dimensions	Part used with
1	Preset-type torque wrench	JIS B4650	Nominal size 60	1-2-19
2			Nominal size 120	1-2-8
3			Nominal size 230	
4			Nominal size 450	1-2-20
5			Nominal size 900	24, 28
6			Nominal size 1800	1-2-2-4, 1-2-11, 1-2-14, 29
7			Nominal size 2800	11
8			Nominal size 4200	1-2-7
9			Nominal size 5600	8, 14
10	Rachet handle for socket wrench	JIS B4641		
11	Hexagon bit for socket wrench		Bolt width 2.5 mm (0.0984 in.)	1-2-19
12			Bolt width 4 mm (0.157 in.)	1-2-8
13			Bolt width 6 mm (0.236 in.)	1-2-20
14			Bolt width 8 mm (0.315 in.)	28
15			Bolt width 10 mm (0.394 in.)	1-2-11
16			Bolt width 12 mm (0.472 in.)	11、29
17			Bolt width 14 mm (0.551 in.)	1-2-2-4
18	Torx T-shaped bit	JASO F116-89	Size T50	24
19			Size T90	8, 14
20	Socket for socket wrench	JIS B4636	Bolt width 10 mm (0.394 in.)	1-2-14
21			Bolt width 27 mm (1.063 in.)	1-2-7
22	Hexagon wrench	JIS B4648	Bolt width 2.5 mm (0.0984 in.)	1-2-19
23			Bolt width 4 mm (0.157 in.)	1-2-8
24			Bolt width 6 mm (0.236 in.)	1-2-20
25			Bolt width 8 mm (0.315 in.)	28

Maintenance Standards

Motor Parts Maintenance Standards

Table 6 indicates maintenance standards for motor parts.
Check each part according to the motor parts maintenance standards in Table 6. When a permissible limit has been exceeded or is near being exceeded, perform part repair or replacement according to repair and solution procedures.

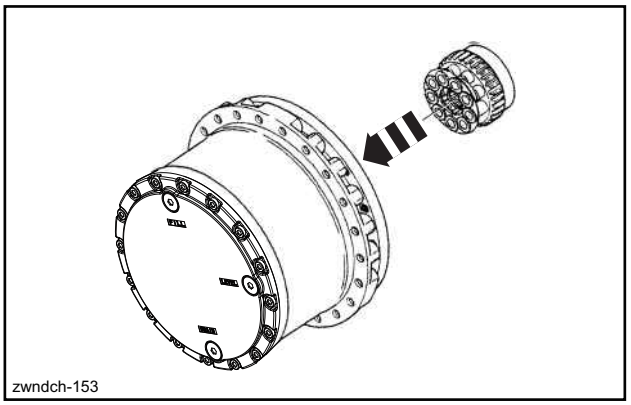
Table 6. Motor parts maintenance standards

Applicable part	Inspection and measurement location	Permissible limit value	Repair, solution procedure
Piston Assembly (1-4-2)	1. Shoe sliding surface	0.8 a degree of roughness Or the surface is rough or there is scratching at least 0.02 mm (0.00079 in.) deep.	Lap the shoe sliding surface (#1000) If the scratching cannot be removed, replace the cylinder block assembly (1-4).
	2. Piston outer diameter	1.2a degree of roughness Or the surface is rough or there is scratching at least 0.02 mm (0.00079 in.) deep.	Replace the cylinder block assembly (1-4).
	3. Piston outer diameters and cylinder block (4-1) bore inner diameters	Gap 0.060 mm (0.002362 in.)	
	4. Shoe ball backlash	0.4 mm (0.0157 in.) of backlash	
Cylinder block (1-4-1)	1. Sliding surface against the valve plate	0.8 a degree of roughness Or the surface is rough or there is scratching at least 0.02 mm (0.00079 in.) deep.	Lap the sliding surface (#1000) If the scratching cannot be removed, replace the cylinder block assembly (1-4).
	2. Bore inner diameter	1.6 a degree of roughness Or the surface is rough or there is scratching at least 0.02 mm (0.00079 in.) deep.	Replace the cylinder block assembly (1-4).
	3. Bore inner diameter and piston assembly (4-2) outer diameter	Gap 0.060 mm (0.002362 in.)	
Cylinder block (1-4-1)	1. Shaft bonding section spline	Diameter between parts 38.749 mm (1.525551 in.) Diameter of measurement pin D3.333 (0.131220 in.) [V1 = 2.80 (0.11024 in.)] mm Or breaking damage is occurring.	Replace the cylinder block assembly (1-4).
Valve plate (1-21)	1. Sliding surface	0.8 a degree of roughness There is scratching at least 0.02 mm (0.00079 in.) deep on the sliding surface. Or seizing is occurring. There is abnormal wear on the sliding surface.	Lap the sliding surface (#1000) If the scratching cannot be removed, replace the valve plate (1-21).
Retainer plate (1-4-3) Retainer holder (1-4-4)	1. Sliding surface	0.8 a degree of roughness There is scratching at least 0.02 mm (0.00079 in.) deep on the sliding surface. Or seizing is occurring.	Replace the retainer plate and retainer holder.
Swash plate (1-5)	1. Sliding surface	0.8 a degree of roughness There is abnormal wear or scratching least 0.02 mm (0.00079 in.) deep on the sliding surface.	Lap the sliding surface (#1000) If the scratching cannot be removed, replace the valve plate (1-21).

[7] Cylinder block assembly attachment
Place the valve plate (1-21) sliding surface side of the cylinder block assembly (1-4) upwards, engage the internal teeth splines of the retainer holder (1-4-4) and cylinder block (1-4-1) with the external teeth splines of the shaft (1-3), and attach the cylinder block assembly to the inside of the flange (1-1).

Caution

1. When performing attachment, check that the piston assemblies (1-4-2), retainer plate (1-4-3) and retainer holder do not come off from the cylinder block assembly.
2. Before performing attachment, apply hydraulic oil to the swash plate (1-5) surface and sliding surfaces of the piston assemblies.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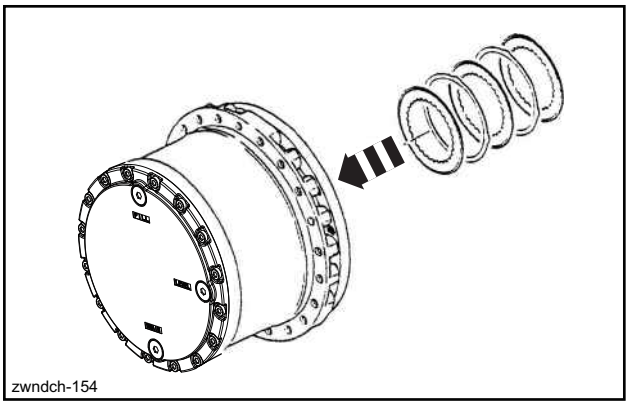
[8] Disk plate attachment
Engage the internal teeth of the disk plates (1-13) with the external teeth of the cylinder block (1-4-1) and attach the disk plates to the flange (1-1).

Also, align the arc sections on the external circumference of the friction plates (1-14) with the notch sections of the flange and attach the friction plates to the flange.
Attach in this manner, attaching the disk plates before the friction plates.

Caution

The disk plates are wet type disk.
Before attachment, immerse the friction material parts in hydraulic oil and have the friction materials thoroughly absorb the hydraulic oil.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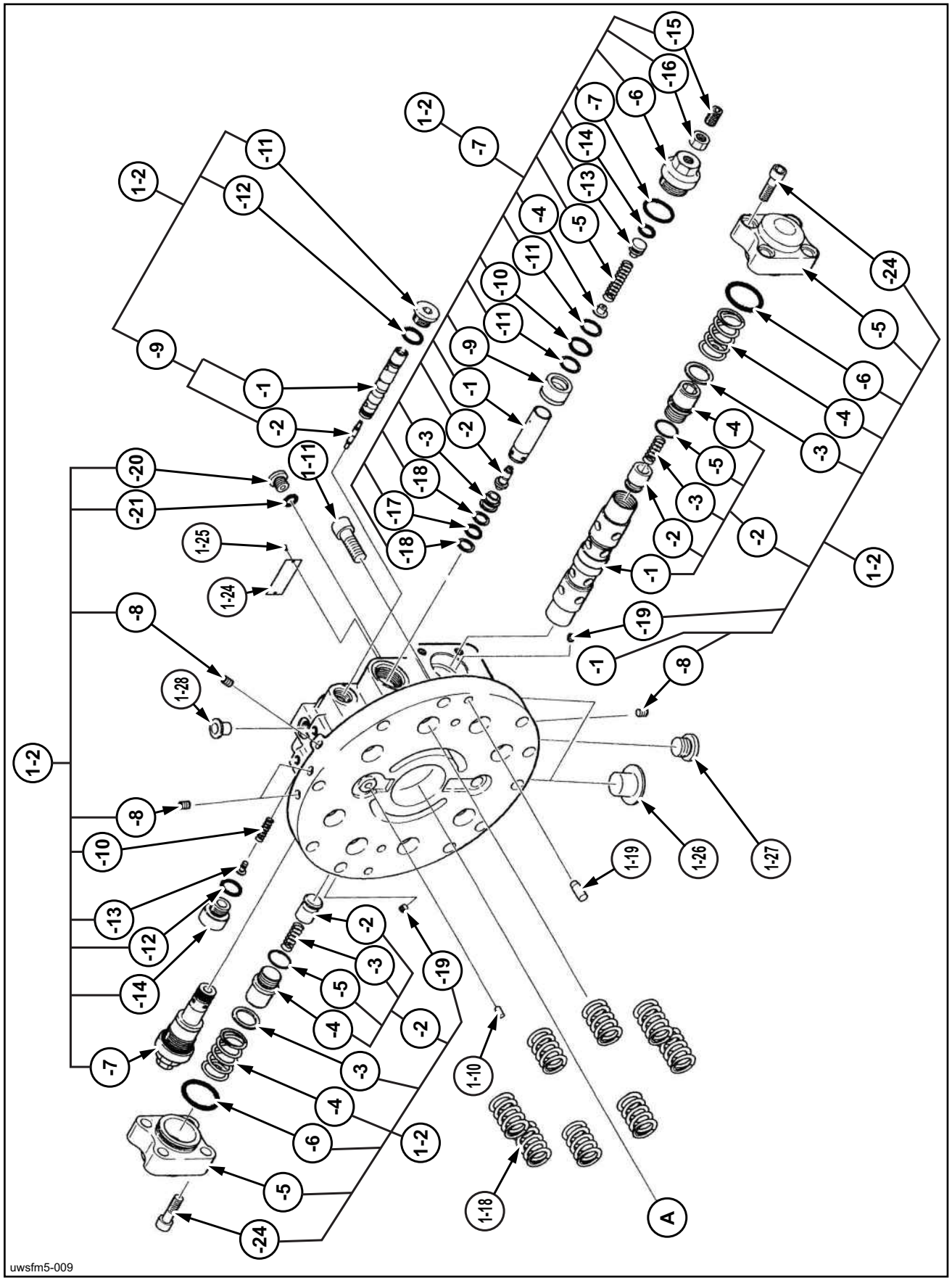
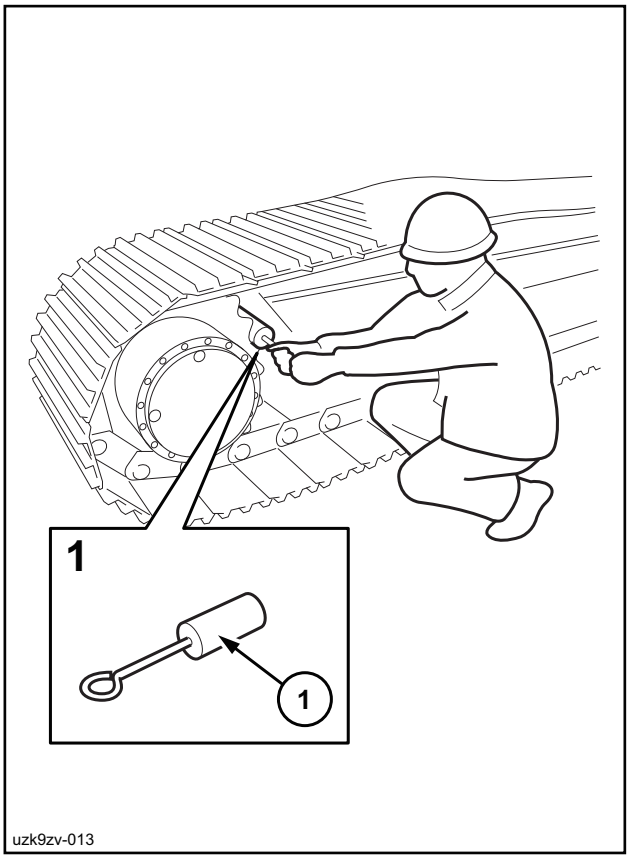
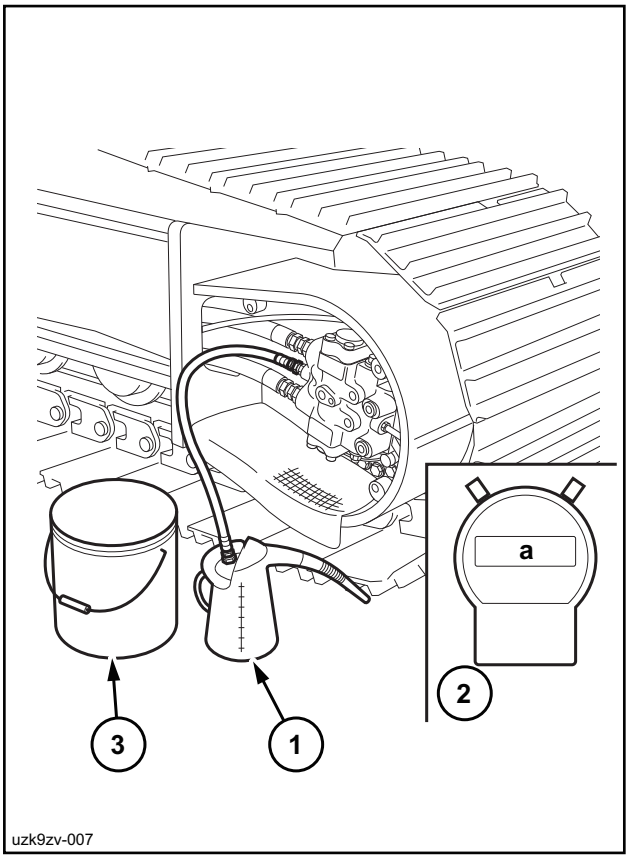
Structural Diagram



6. Catch the stopper (1) between the sprocket section and the frame and lock the travel motor.





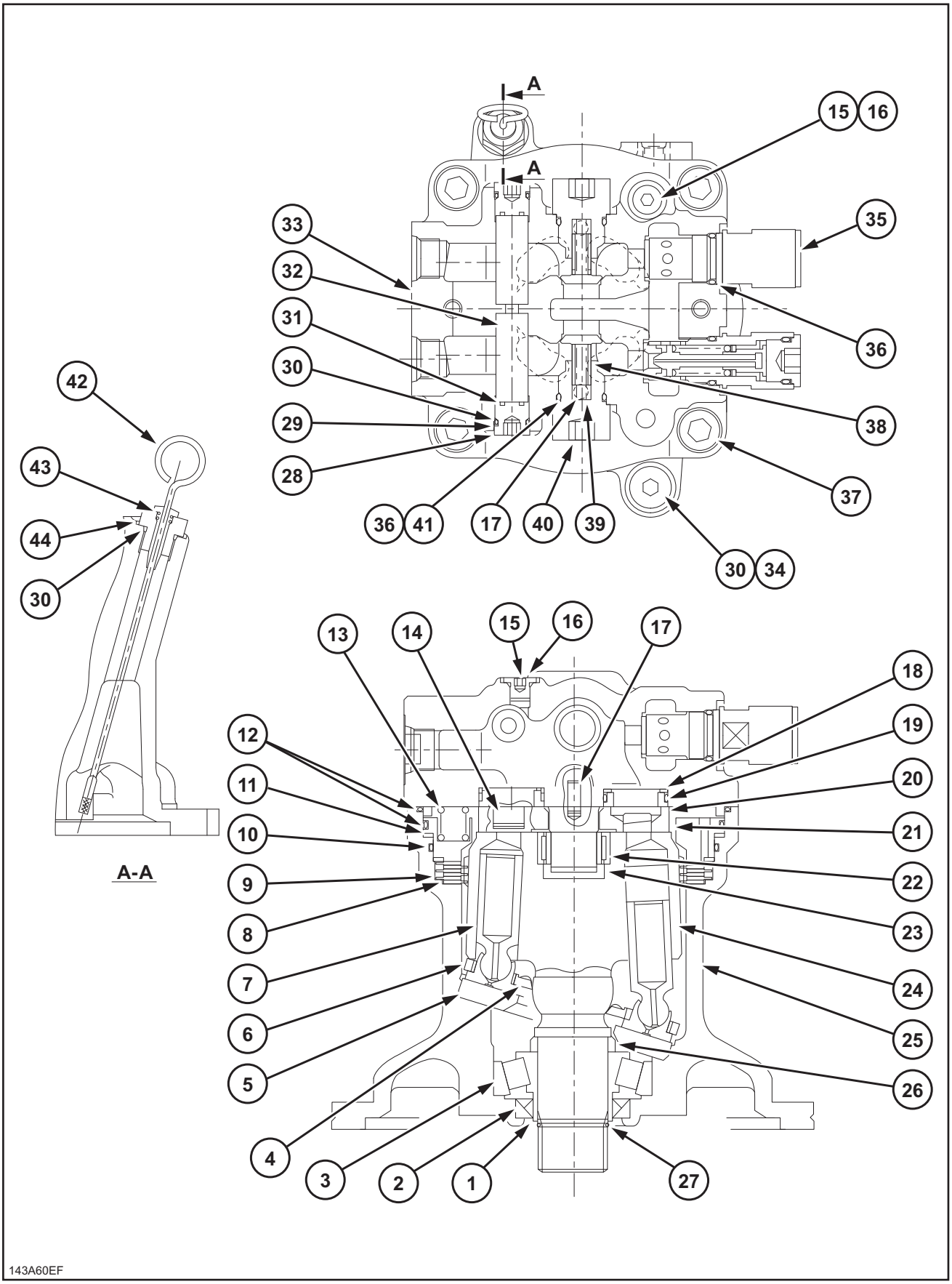
a	30 seconds

7. In SP mode at medium speed, relieve the travel operation, and move the extension hose to the measuring container (1) at the same time the motor starts. (At starting, start measurement with a stop watch (2).) After 30 sec., move the extension hose to the waste oil can (1).
   Measure the volume of oil in the measuring container (1) as the drain volume for 30 sec.

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

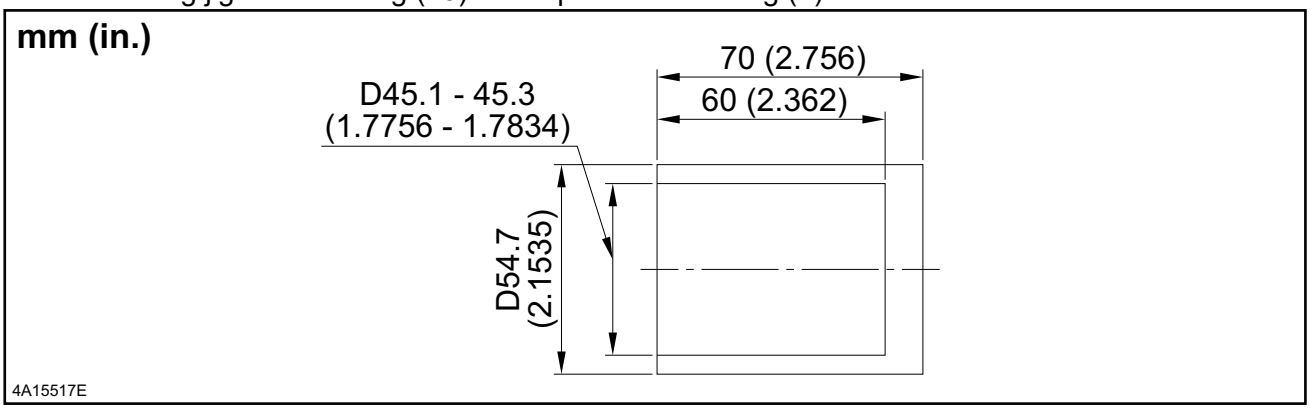
* Measure at least 3 times each for left, right, forward, and backward.

Swing Motor Internal Structure Diagram

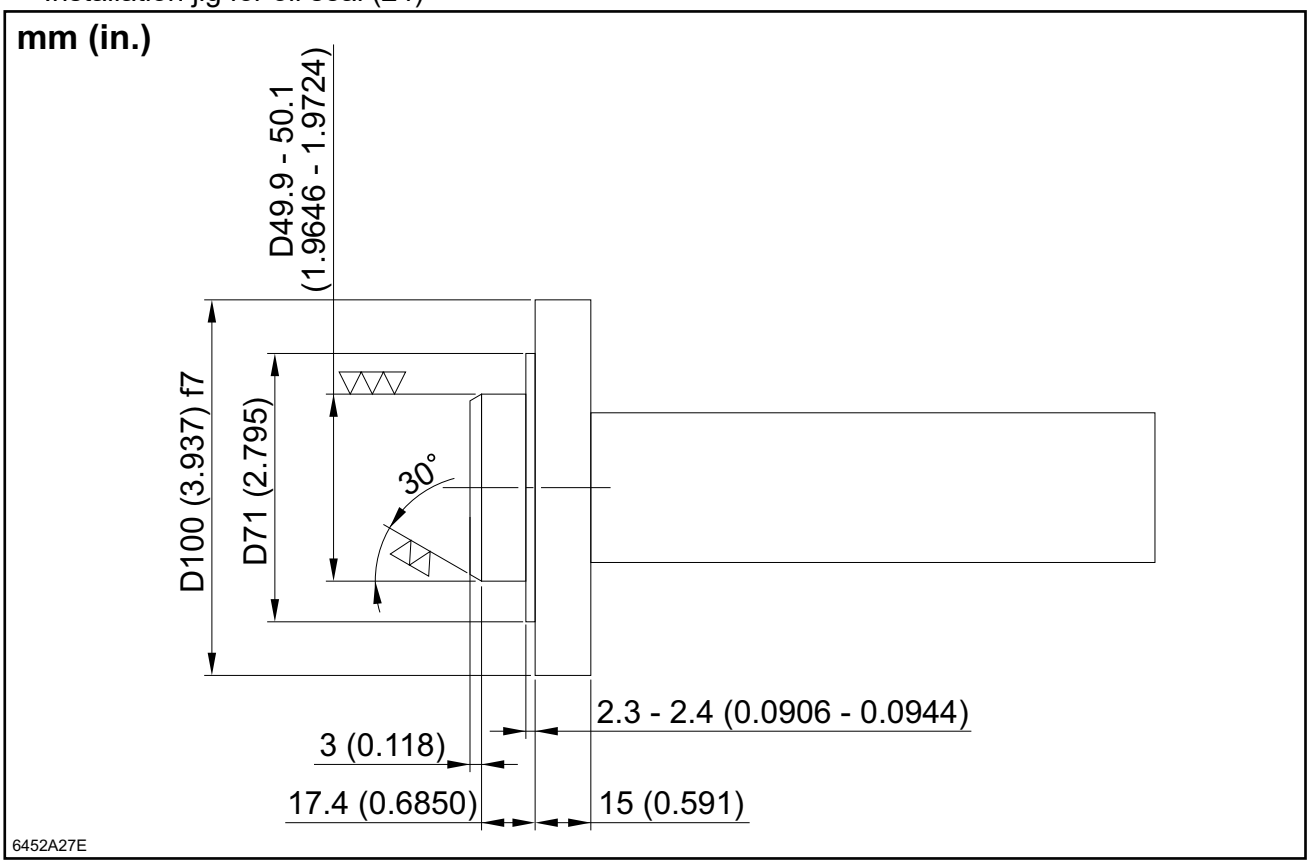


Jig

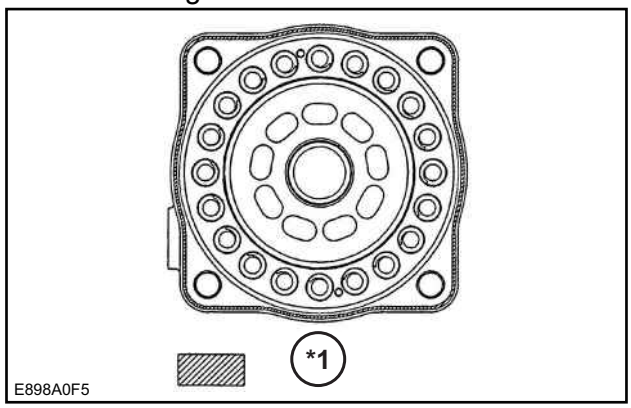
Press fitting jig for inner ring (23) and taper roller bearing (1)



Installation jig for oil seal (24)

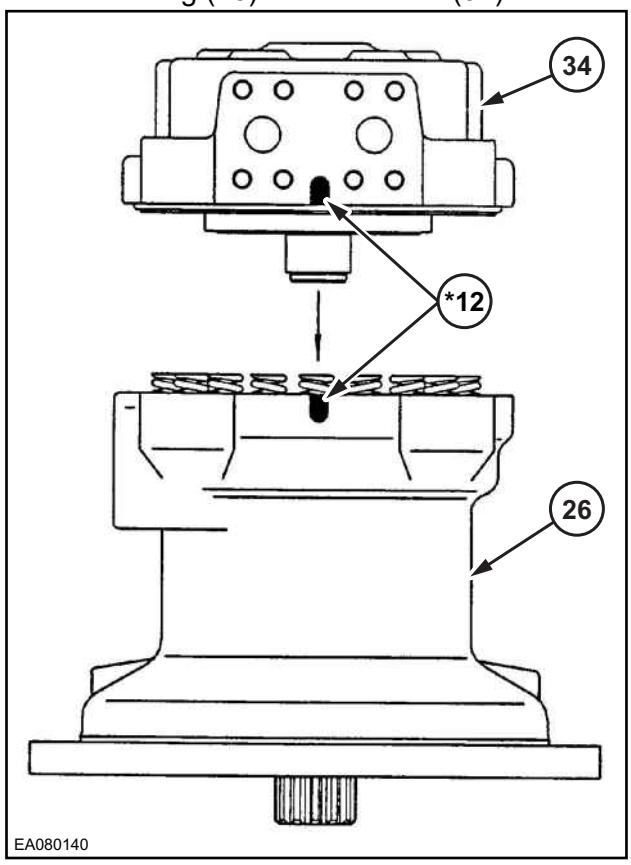


13. Applying liquid packing
Clean and degrease the mating faces of the housing (26) and the cover (34), and then apply liquid packing (ThreeBond 1211 White or equivalent) to them as shown in the left Figure.

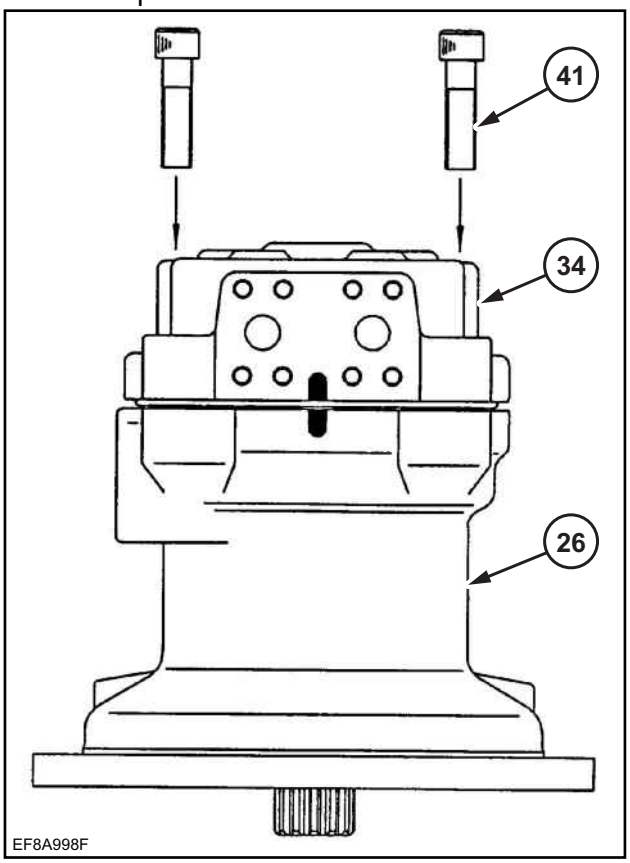


*1	LIQUID PACKING APPLIED

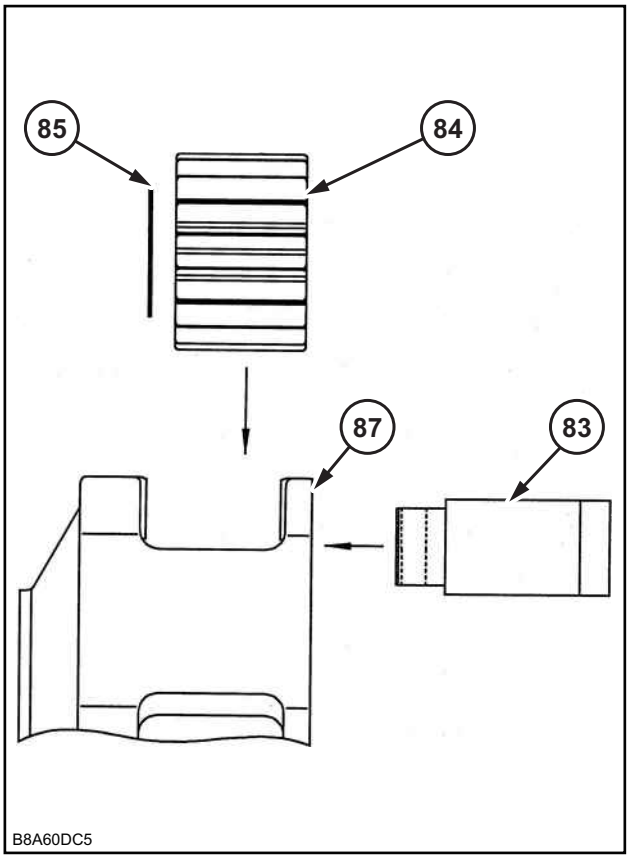
14. Installing covers
Clean and degrease the faces of the cover (34) to be mated with the housing (26), and then lift the cover (34) to install into the housing (26).
- Match the positions of counter marks (*12) which were made on the housing (26) and the cover (34) before disassembly.
- At this point, there is an approximately 4.5 mm (0.1772 in.) gap between the housing (26) and the cover (34).



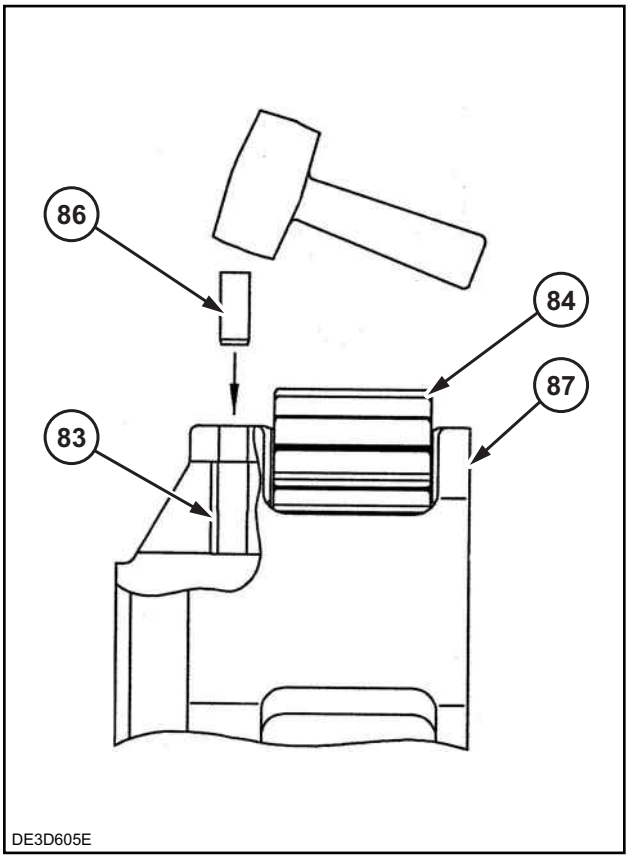
15. Tightening bolts
Tighten the cover (34) to the housing (26). Fasten socket head bolts (41) (WAF 14) with
- tightening torque of 284 N・m (209.50 lbf・ft.).
- In order to install housing (26) and cover (34) straight, tighten four bolts (41) evenly, alternating from one bolt to the other until reaching recommended torque.

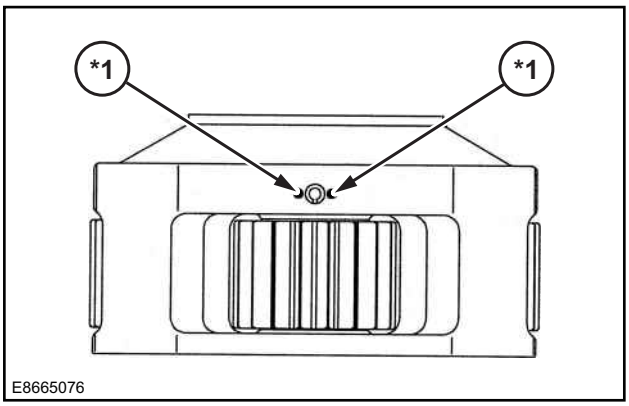


16. Assembling relief assembly and others
Install the relief assemblies (39) (WAF: 14) onto the cover (34) with
tightening torque of 78 N・m (57.54 lbf・ft.).
Install the checks (42) and springs (43) onto the cover (34), and fasten the caps (44) (WAF 14) onto the cover (34) with
tightening torque of 137 N・m (101.06 lbf・ft.). Then install the bypass valve assemblies (30) (WAF 10) onto the cover (34) with
tightening torque of 78 N・m (57.54 lbf・ft.).
- Always install the relief assemblies (39), caps (44), springs (43), checks (42) and bypass valve assemblies (30) into their original locations.



11. Installation of spring pin
    Hammer the spring pin (86) into the shaft 2 assembly (83).
    - Hammer the spring pin in with the crevice facing the spur tooth 5 (84) side.
    - After hammering in the spring pin, caulk the 2 opening locations of holder 2 (87) using a punch. (To stop the spring pin from coming out) (*1)





12. Installation of holder 2 assembly and spur tooth 4
    Insert the holder 2 assembly (88) assembled in [10] while gently engaging the assembly with the inner teeth of the ring gear (73). Additionally, insert the holder 2 assembly while turning it lightly so that spline of the pinion shaft (61) engages correctly.

H. ENGINE

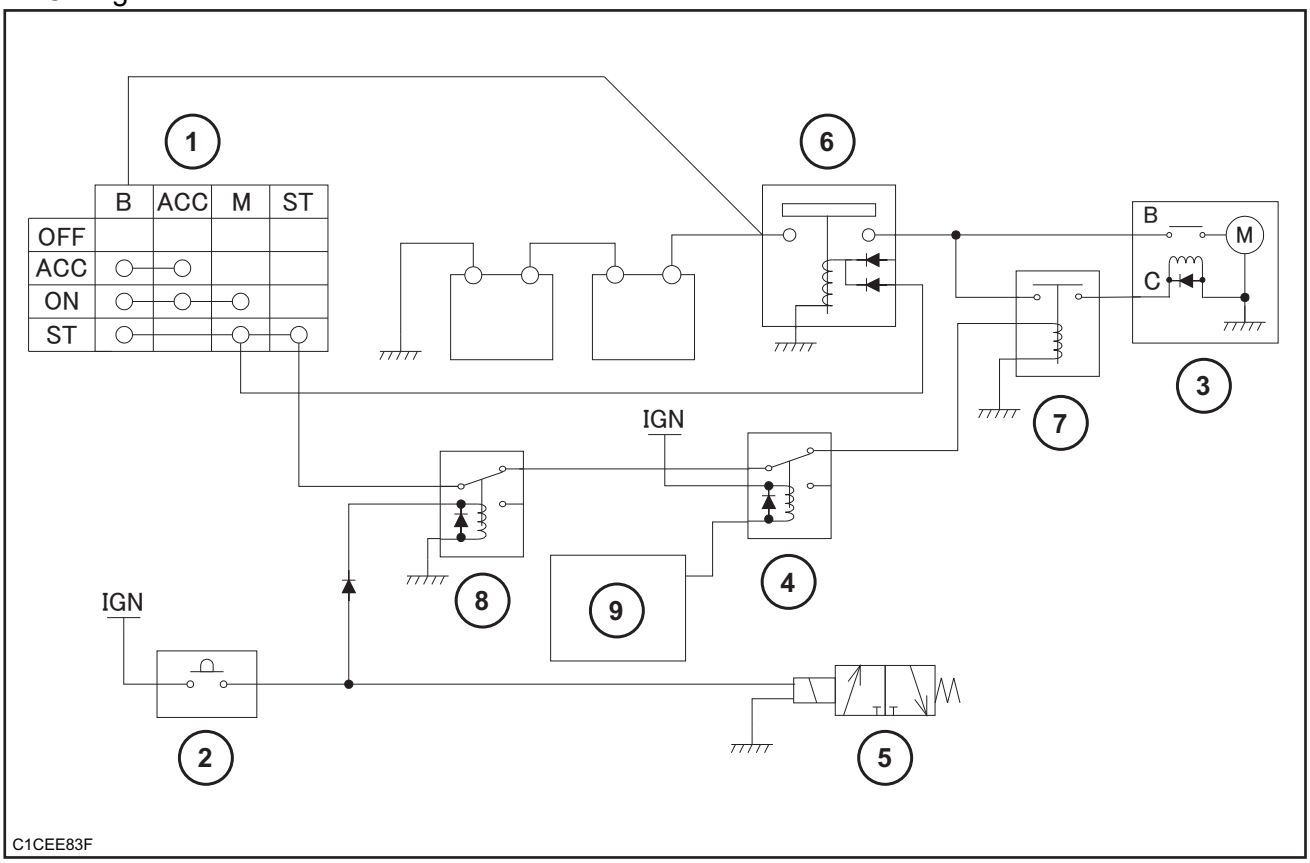
Neutral Start

Purpose/summary

The engine does not start with the gate lock lever lifted. (It will not crank.)

This prevents accidental operation if the operation lever is touched when the engine is started.

Configuration



1	Key switch	4	Starter cut relay	7	Starter relay
2	Gate lock limit switch	5	Gate lock solenoid	8	Neutral start relay
3	Starter motor	6	Battery relay	9	ECM

Operation explanation

[1] When the gate lock lever is unlocked (controls active), the gate lock limit switch (2) is closed.

[2] The neutral start relay (8) is excited.

[3] The signal from the key switch (1) to the starter cut relay (4) is blocked and engine cranking is prohibited.

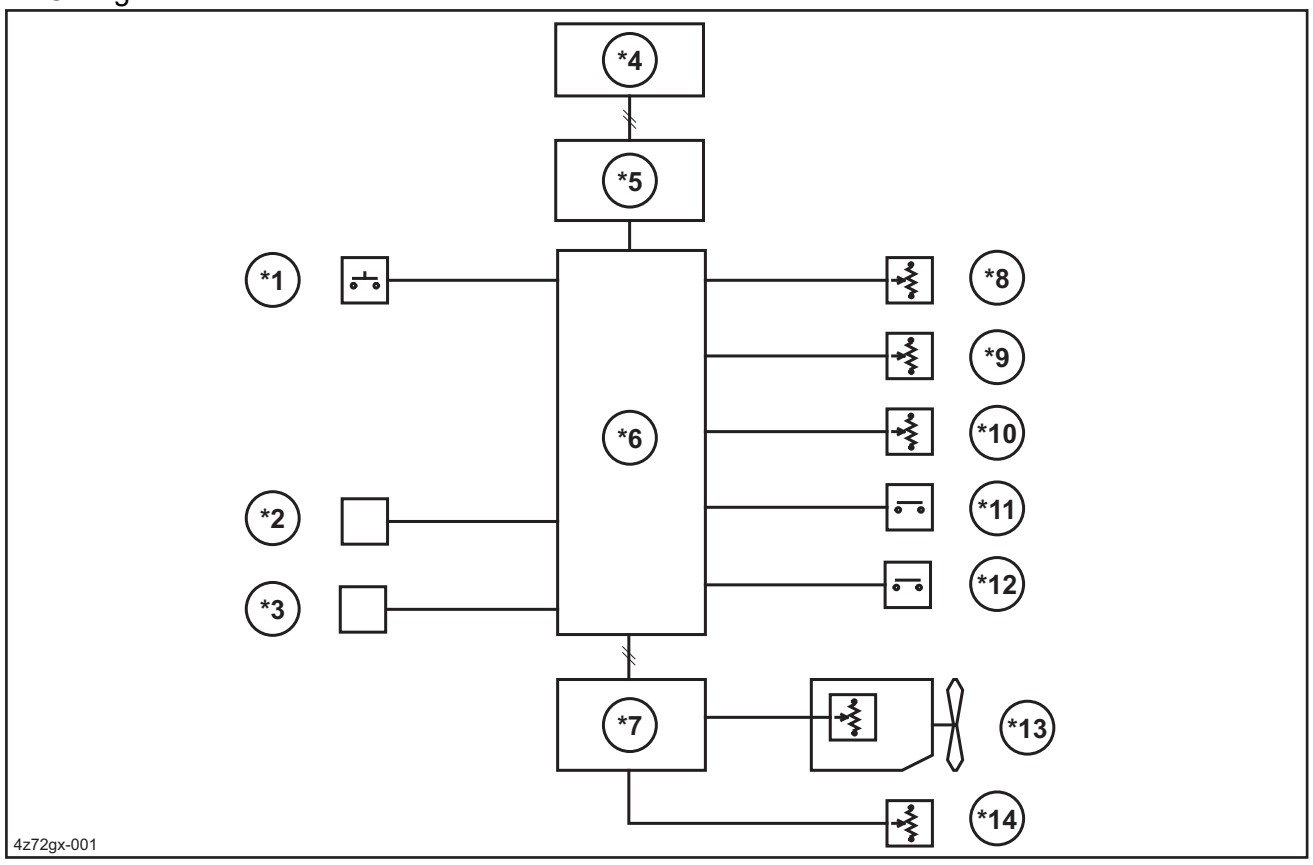
[4] When the gate lock lever is locked (controls inactive), the gate lock limit switch (2) opens, allowing cranking.

Quick Warm Up

Summary

When the outside temperature is low, apply hydraulic load when starting the engine for easy warm up.

Configuration



*1	Key switch	*6	Computer A	*11	Option pressure switch
*2	Pump flow proportional valve (on the hydraulic pump)	*7	ECM	*12	2nd option pressure switch
*3	Boom 2 proportional valve	*8	Upper pressure sensor	*13	Coolant temperature sensor
*4	Color monitor	*9	Swing pressure sensor	*14	Suction air temperature sensor
*5	Computer B	*10	Travel pressure sensor		

Operation explanation

[1] When all the following conditions are detected, quick warm up is started.

- The engine is starting up.
- The engine warm up is not being performed (step 1: low idle 5 min.)
- The machine is not being operated (upper, swing, travel, option 1, or option 2).
- The outside temperature must be equal to or lower than -59.0°F.
- The coolant temperature must be higher than 32.0°F and lower than 176.0°F.
- The sensors (P1, upper, swing, travel, option (1 or 2) are not abnormal.
- DPD regeneration must not be being performed.

[2] This control can be deactivated on the Setup/Parameters screen.

[3] When the engine starts, the speed incrementally increases according to the diagram below if the coolant temperature is lower than 122.0°F (When the coolant temperature is equal to or higher than 122.0°F, normal idle start).

[4] When quick warm up is started, the system sets the pump flow proportional valve current value to minimum flow (740 mA).

[5] Then, 1 sec. later, the system sets the boom 2 proportional valve current value to 540 mA. An icon that indicates the quick warm up start is displayed on the monitor for 2 sec.

- The messages "MANUAL DPD RE-GEN" and "DO NOT OPERATE" are displayed in rotation.
- Computer A drives DPD relay and sends a DPD regeneration signal to the ECM.
- Auto idle/Idling stop control is stopped.
- Hydraulic assisting load control is started (for raising exhaust gas temperature).

[4] Stopping manual regeneration: When the operations below are performed, the ECM regeneration prohibit signal is sent and the automatic regeneration is stopped.
While stopped, the amber DPD lamp flashes.
The message "PUSH DPD SWITCH TO ACTIVATE" is displayed.
The DPD gauge is switched from regeneration progress display to accumulation amount display.
Auto idle/Idling stop control is started.
To restart the regeneration, remove the cause of stoppage, then press the DPD switch.

- The regeneration is stopped when the gate lock limit switch is turned ON (hydraulic operation possible).
- The regeneration is stopped if the DPD switch on the monitor is pressed during automatic regeneration.
- The regeneration is stopped if the exhaust gas temperature reaches 752.0°F or higher.
- When trouble occurs in the hydraulic assist proportional valve during regeneration
- When the throttle is operated

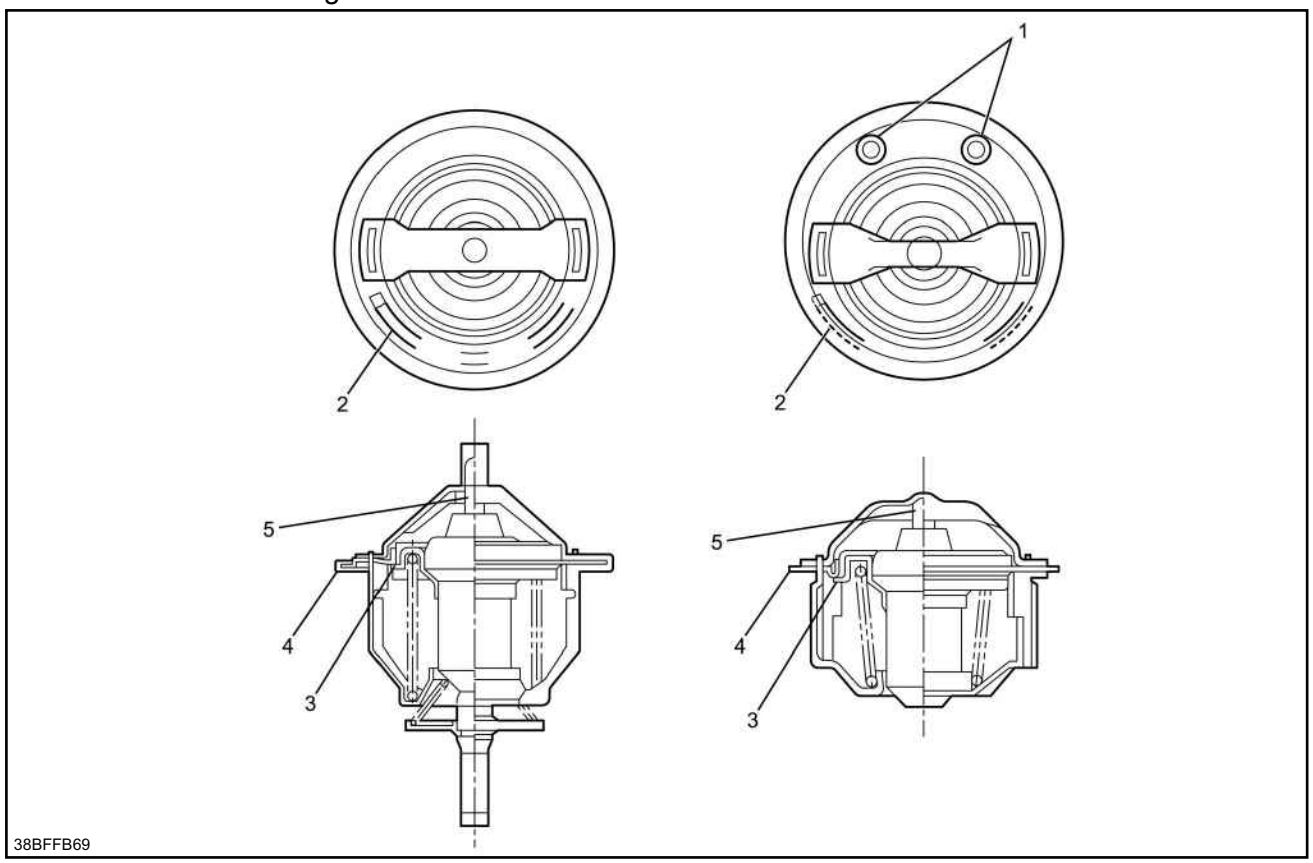
[5] Ending manual regeneration: The system receives the signal for ending manual regeneration from the ECM and ends the control.

- Amber DPD lamp is turned OFF.
- The DPD gauge is switched from regeneration progress display to accumulation amount display.
- The messages "MANUAL DPD RE-GEN" and "DO NOT OPERATE" disappear.
- Auto idle/idling stop control is started.

[6] Regeneration hydraulic load assist: When performing manual regeneration, a load is applied to the pump to raise the exhaust gas temperature.

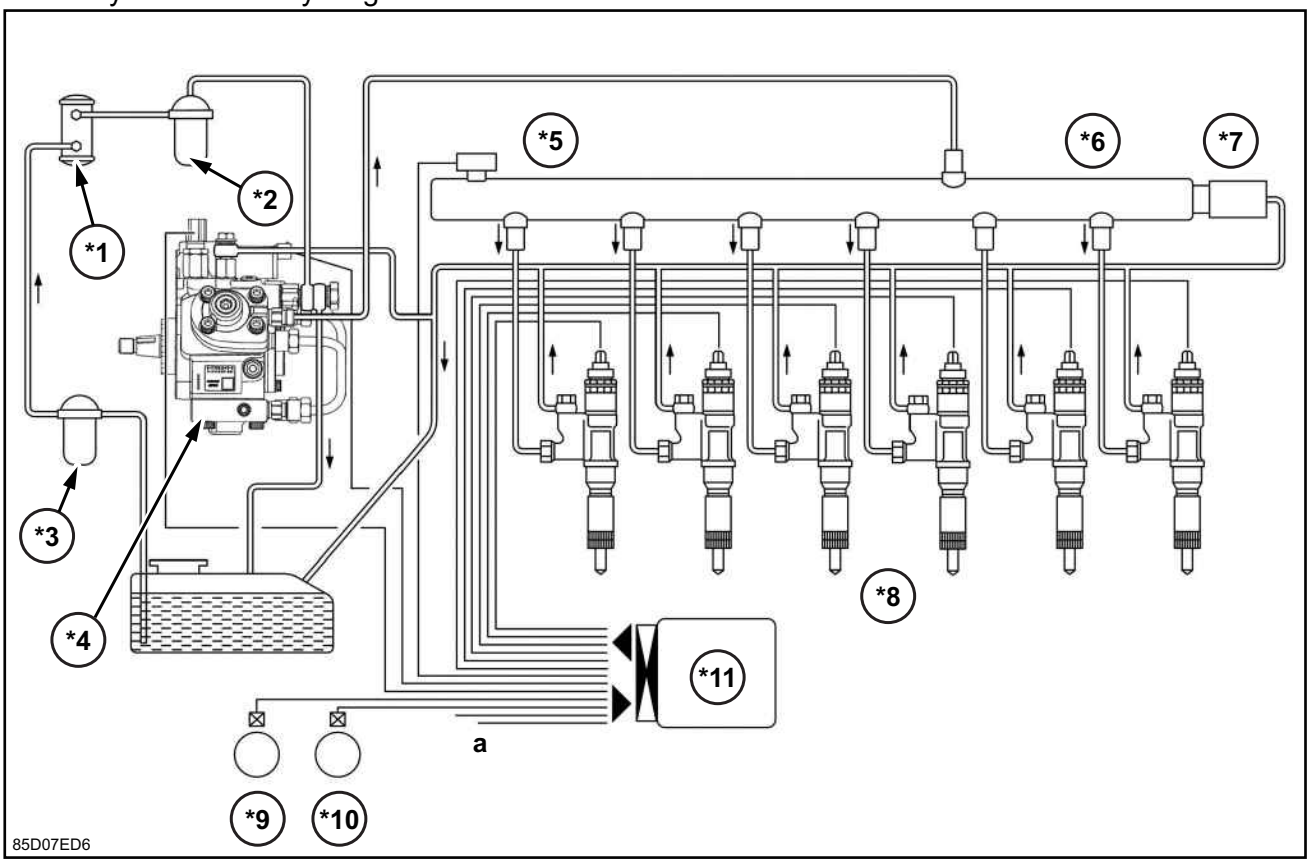
- Computer A sets the pump flow proportional valve to the minimum flow of 740 mA.
- 1 sec. later, computer A sets the boom 2 proportional valve to the maximum load of 600 mA.
- 1 sec. later, computer A sets the pump flow proportional valve to 600 mA.
- 30 sec. later, computer A controls the pump flow proportional valve so that the DPD exhaust gas temperature (before DOC) is constantly at 518.0°F. (Gradually drops at the rate of 50 mA/sec. Update period 15 sec., Update width 5 mA)

Thermostat
The thermostat is the wax pellet type and consists of 2 units. One unit is a bottom bypass type and its initial valve opening temperature is 82.0°C (179.6°F). The other is an inline type and its initial valve opening temperature is 85.0°C (185.0°F). It has a structure that can finely adjust the coolant temperature and is housed in the thermostat housing unit.



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

System summary diagram

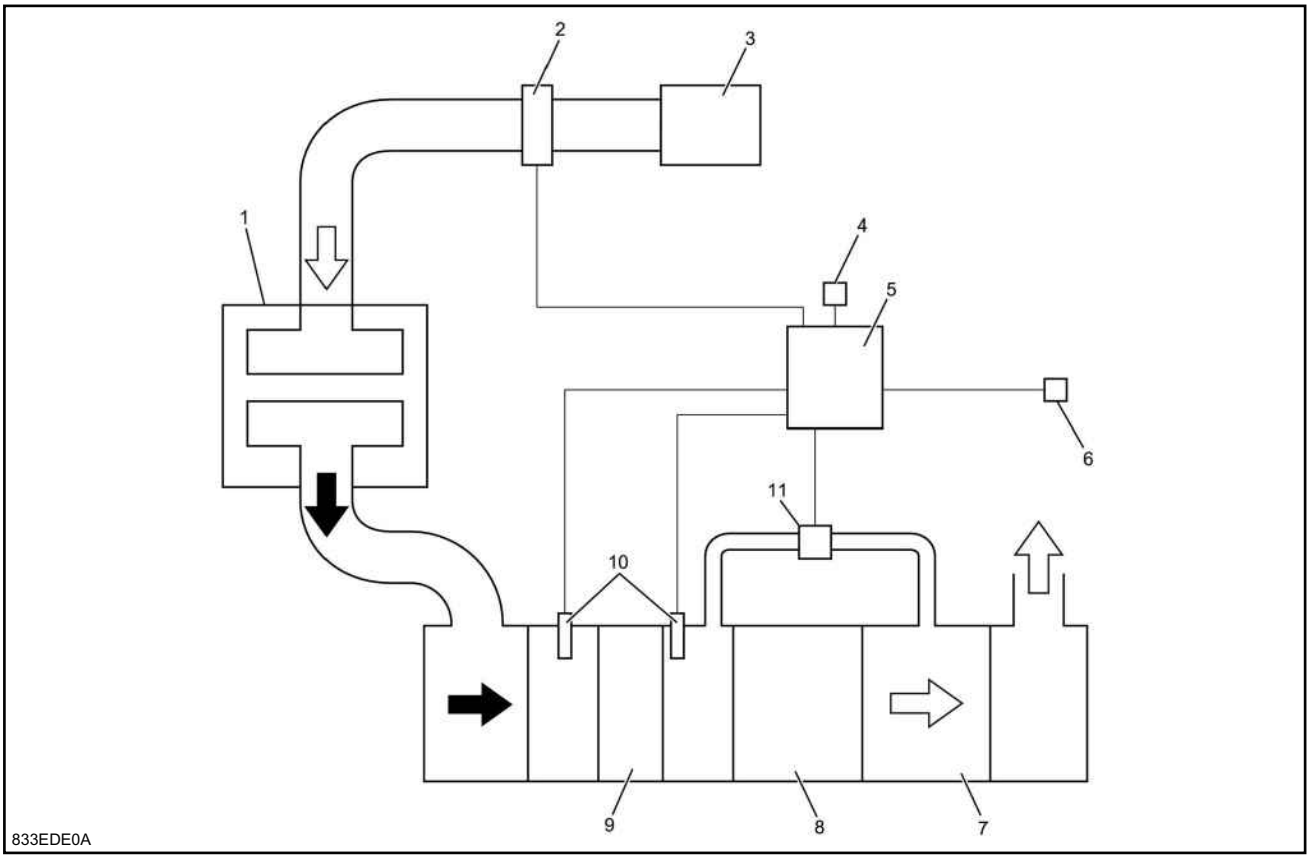


a	Sensors (Throttle, boost, coolant temperature, etc.)

*1	Charge fuel pump	*5	Fuel pressure sensor	*9	CMP sensor
*2	Fuel filter	*6	Common rail	*10	CKP sensor
*3	Pre-fuel filter	*7	Pressure limiter	*11	ECM
*4	Supply pump	*8	Injector		

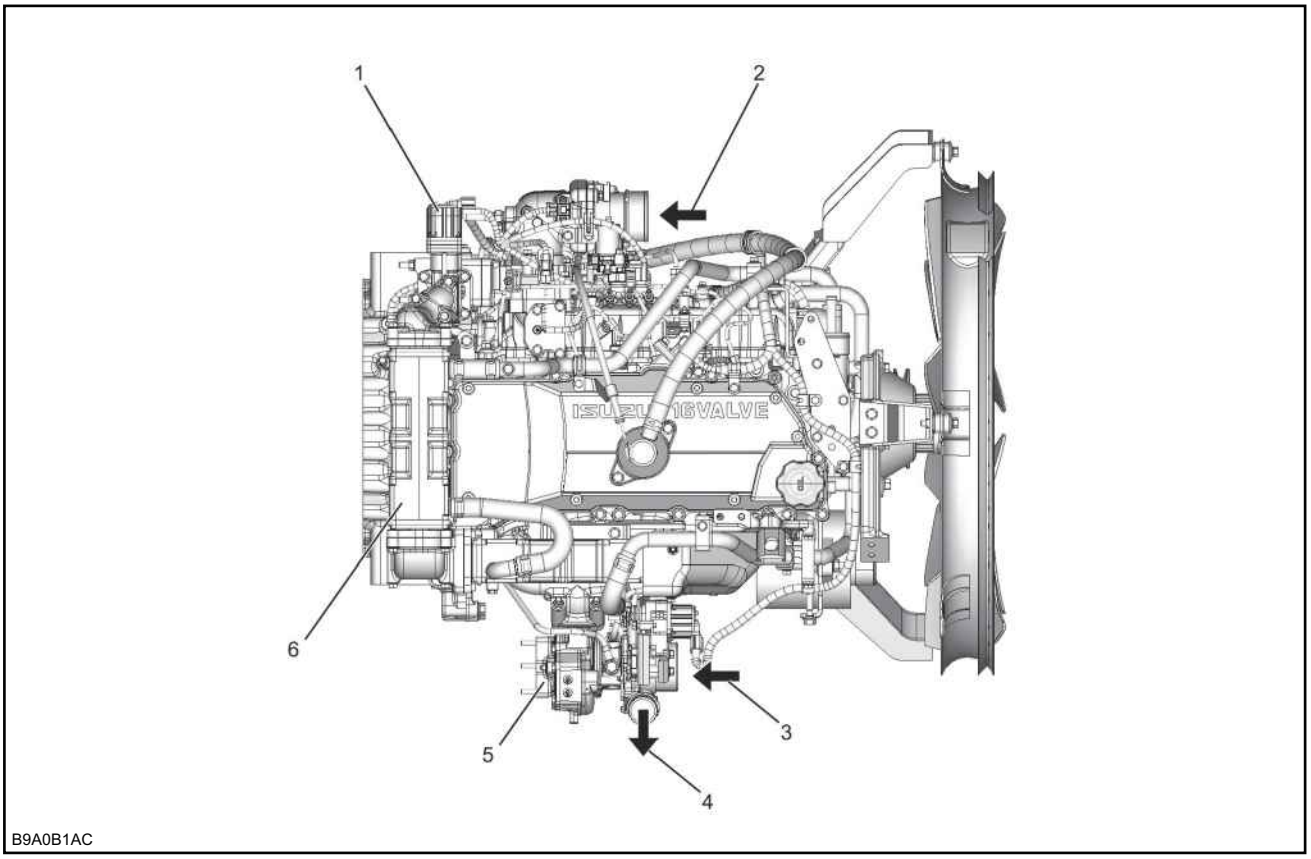
Fuel system

Fuel is supplied to the supply pump from the fuel tank and then supplied to the common rail after a pressure boost by the pump. At this time, the amount of fuel supplied to the common rail is controlled by controlling the suction control valve through signals from the ECM.



1	Engine	5	ECM	9	Oxidation catalyst
2	MAF sensor	6	DPD switch	10	Exhaust gas temperature sensor
3	Air cleaner	7	Silencer	11	DPD differential pressure sensor
4	Sensors	8	Filter		

Pin No.	Terminal name	Connection
4	-	-
5	OM-EBM3	EGR valve DC servo motor power supply input W
6	SP-5V4	Boost sensor power supply
7	SP-Reserved	-
8	IA-MAT	IMT sensor signal
9	IA-THL	Fuel temperature sensor signal
10	IA-THBST	Boost temperature sensor signal
11	IA-PFUEL	Fuel pressure sensor signal
12	IA-OILPRESS	Oil pressure sensor signal
13	IA-MAP	Boost sensor signal
14	IA-IDMPOS	Intake throttle position sensor signal
15	OP-SCVHI	SCV-HI drive
16	OP-COM2A	Injector power supply 2, No. 3 cylinder
17	OP-COM2B	Injector power supply 2, No. 2 cylinder
18	-	-
19	-	-
20	OM-EBM2	EGR valve DC servo motor power supply input V
21	SP-5V5	CKP sensor, fuel pressure sensor power supply
22	SP-5V6	CMP sensor power supply
23	SP-5V7	Oil pressure sensor power supply
24	IA-Reserved	-
25	IA-THW	Coolant temperature sensor signal
26	SG-5VRT4	Boost sensor, EGR position sensor, intake throttle position sensor, fuel temperature sensor ground
27	-	-
28	SG-SLD5	CKP sensor shield
29	IA-Reserved	-
30	OP-SCVHI	SCV-HI drive
31	OS-INJ1	Injector 1, No. 1 cylinder
32	-	-
33	OS-INJ4	Injector 4, No. 2 cylinder
34	-	-
35	OM-EBM1	EGR valve DC servo motor power supply input U
36	-	-
37	-	-
38	-	-
39	-	-
40	SG-5VRT7	Oil pressure sensor, coolant temperature sensor ground
41	SG-5VRT5	IAT sensor, CKP sensor, fuel pressure sensor ground
42	SG-5VRT6	CMP sensor, boost temperature sensor ground
43	SG-SLD6	CMP sensor ground
44	-	-
45	IA-SCVLO	SCV-LO drive



1	EGR valve	3	From air cleaner	5	Exhaust pipe
2	From intercooler	4	To intercooler	6	EGR cooler

High Oil Consumption

1. High oil consumption - symptoms
   Oil consumption is markedly more than what is listed in the manual for the machine.
2. High oil consumption - diagnosis
   - Preliminary inspection
     Before using this section, perform a functional inspection and OBD system check to check all of the following items.
     Check the rough oil consumption of the machine manufacturer (A) as oil consumption will vary widely depending on handling of the machine. Rough oil consumption for engine by itself (rough oil consumption/time): 4 L (4.2 qts)/100 hr.
     Check the actual oil consumption (B).
     Actual oil consumption/hr.
     See the service list table in the Operator's Manual and perform inspection according to the machine usage time.
     For a machine in which the usage time is over 3000 hr., see the manual for the machine and perform the inspections.
     The ECM and monitor are operating correctly.
     Check DTCs.
     Check the condition of the actual machine and find applicable symptoms.
     Confirm with the customer that the stipulated engine oil and fuel are being used.
   - Visual inspection
     Some symptoms detection procedures require careful visual inspection. This allows for problems to be repaired without performing further inspection, which saves valuable time.
     The following items are included in this inspection.
     Is bluish smoke continuously produced during engine running?
     Is excessive blow-by gas being produced?
     Is there any oil mixed in with coolant?
     Check that pipes and hoses for oil are not broken or twisted and that they are correctly connected. Thoroughly check for any leaking or clogging.
     Check for oil leaks and damage and denting on pipes in the lubrication system.
     Check the turbocharger and other suction air system parts abnormalities
   - Diagnostic aid

Static electricity will cause damage, so exercise caution when handling electrical components and performing tests.

Caution

- To prevent damage caused by the discharge of static electricity, do not touch electrical components that have been soldered to the ECM connector pin or ECM circuit board.
- To prevent damage caused by the discharge of static electricity, do not open the packaging for replacement parts until preparations for the installation of those parts are complete.
- To prevent damage caused by the discharge of static electricity, before removing parts from their packaging, connect the packaging with the normal ground of the machine.
- To prevent damage caused by the discharge of static electricity, when handling parts while sliding across the seat, going from a standing position to a sitting one, or walking a certain distance, touch the parts to the normal ground before installing them.

Fuel injection system

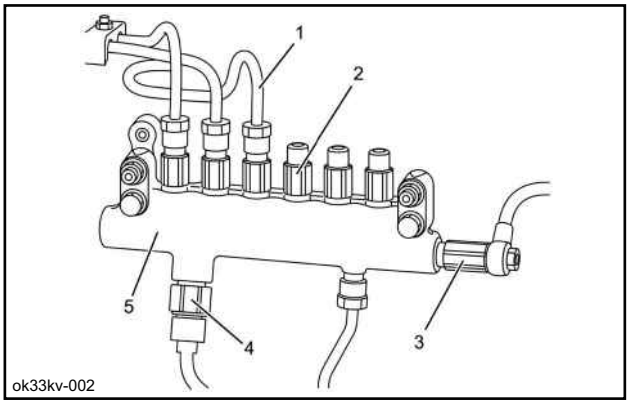
Fuel line

Do not reuse fuel system high-pressure lines or injector pipes.

If they are removed, replace them with new parts.

Do not replace a pressure limiter or fuel pressure sensor alone.

If there is any problem, replace the common rail assembly and all the fuel lines.



1	Injector pipe
2	Flow damper
3	Pressure limiter
4	Fuel pressure sensor
5	Common rail

[3] Programming

Programming guideline

When replacing an ECM or injector, use the trouble diagnosis scan tool and write each data item in the ECM.
For the programming method, see the operator's manual for the trouble diagnosis scan tool.

Points to be checked before programming

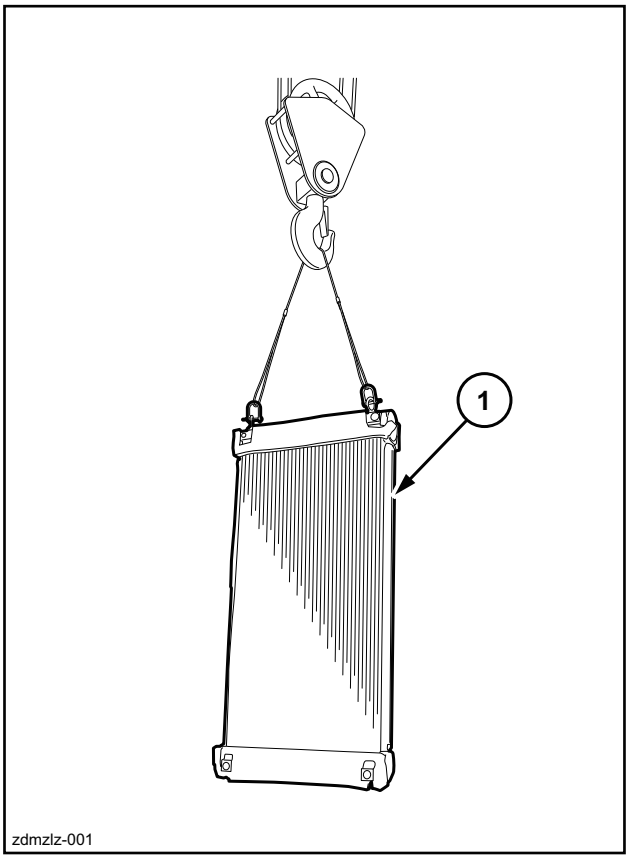
When programming, check the ECM part number as necessary.
When programming, check the engine model as necessary.
When programming, check the engine serial number as necessary.
When programming, check the injector ID code as necessary.

Items for when programming is required

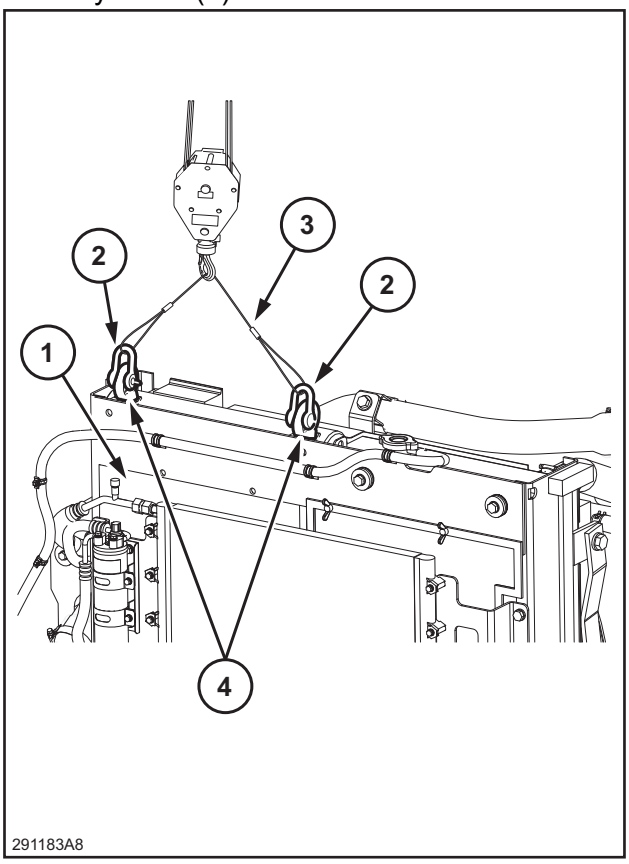
When an ECM is replaced, perform programming.
When the engine is replaced, perform programming.
When an injector is replaced, perform programming.

Installation of Oil Cooler

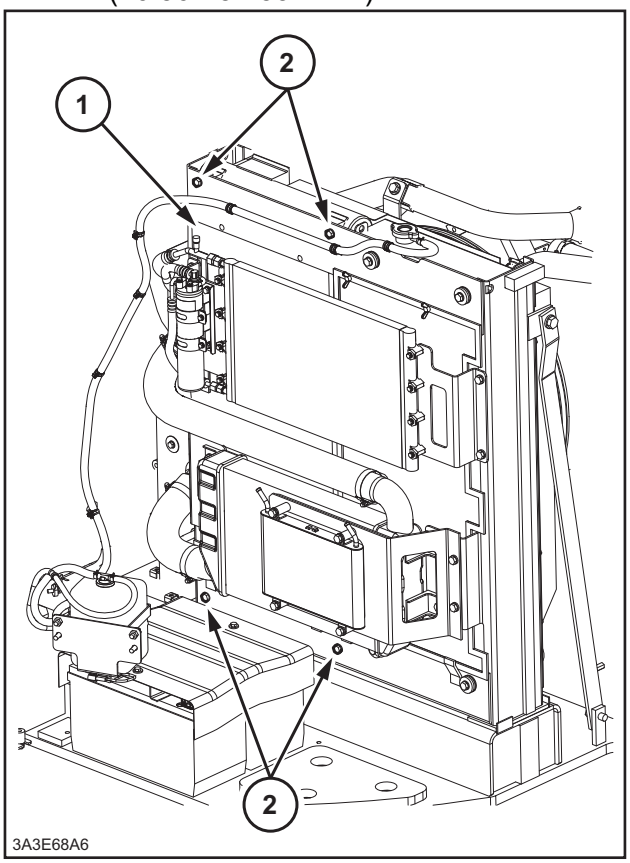
1. Use a liftcrane to lift the oil cooler (1) main unit.



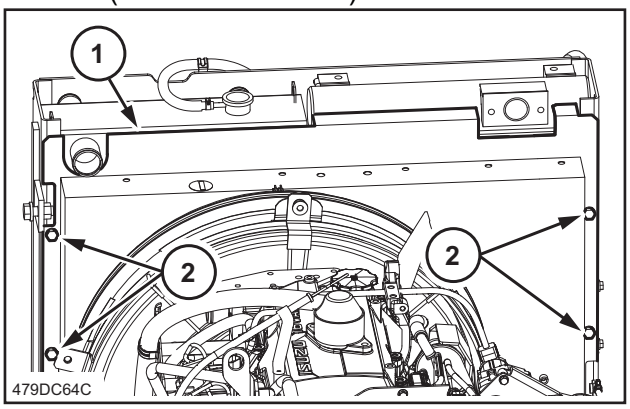
2. Mount the oil cooler (1), and then remove the 2 shackles (2), wire ropes (3), and 2 eyebolts (4).



3. Use a wrench [19 mm (0.748 in.)] to secure the oil cooler (1) with 4 bolts (2).
   - Bolt (2) tightening torque: 36 - 78 N·m (26.56 - 57.53 lbf·ft.)



4. Use a box wrench [13 mm (0.512 in.)] to install the fan shroud (1) with 8 bolts (2).
   - Bolt (2) tightening torque: 9 - 23 N·m (6.64 - 16.96 lbf·ft.)



1	Ventilation hose
2	Oil level gauge guide tube

Removal and Installation of Cylinder Head

Removal of Cylinder Head

1. Battery ground cable Disconnect

[1] Disengage the battery ground cable from the battery.

2. Coolant Drain

[1] Drain the coolant from the radiator.

> ⚠ Caution
>
> ・After the coolant is discharged, make sure to tighten the drain plug.

3. Engine harness Disconnect

[1] Disengage the engine harness from the engine assembly.

> Note
>
> ・Disconnect each connector.

4. 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 assembly.

[4] Disengage the oil feed pipe from the turbocharger assembly.

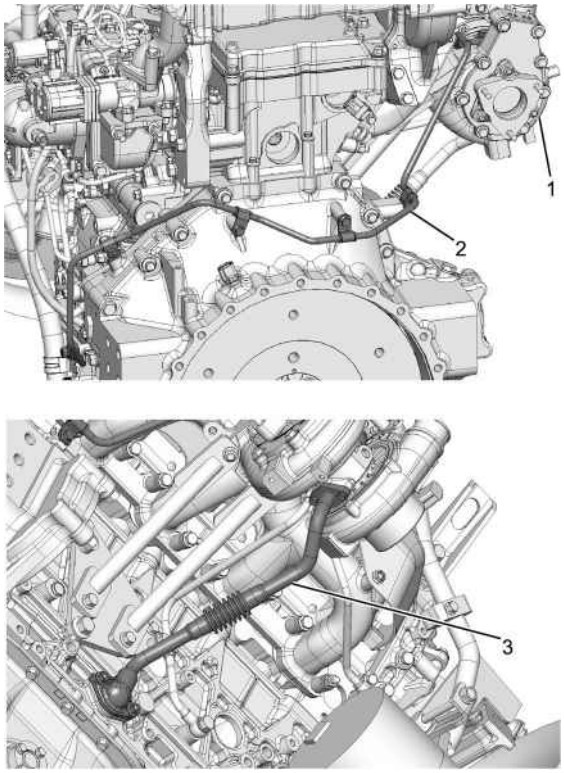
> Note
>
> ・Remove the clip.

[5] Remove the oil feed pipe from the oil port cover.

> Note
>
> ・Remove the clip.

[6] Disengage the oil return pipe from the turbocharger assembly.

[7] Remove the oil return pipe from the cylinder block.



mweq65-070

1	Turbocharger assembly
2	Oil feed pipe
3	Oil return pipe

[8] Disengage the water return pipe from the turbocharger assembly.

[9] Remove the water return pipe from the water pump assembly.

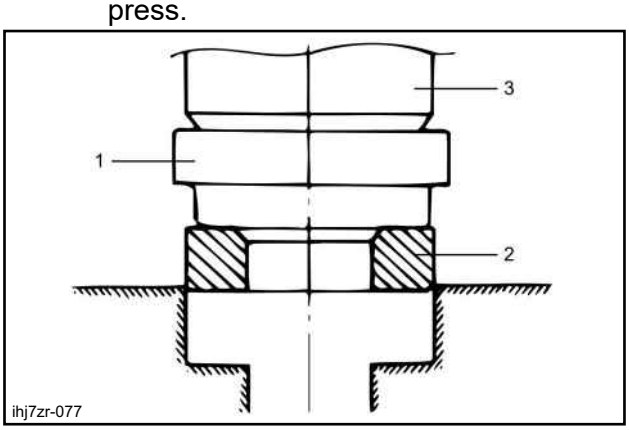
[10] Disengage the water feed pipe from the turbocharger assembly.

> Note
>
> ・Remove the clip.

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

> Note
>
> ・Remove the clip.

[4] Install the valve seat insert to the cylinder head assembly using the press.

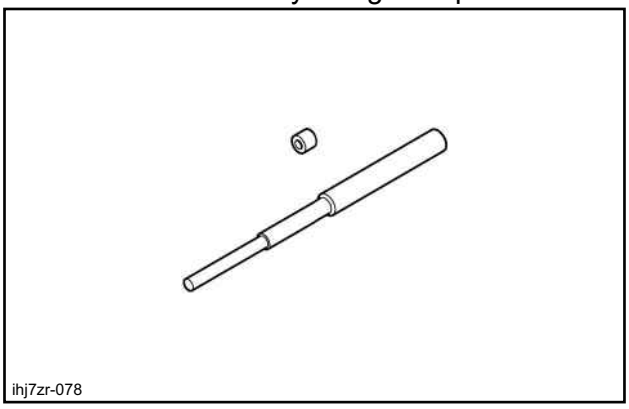


1	Dolly block
2	Valve seat insert
3	Press

5. Valve guide Installation

[1] Apply the engine oil to the valve guide.

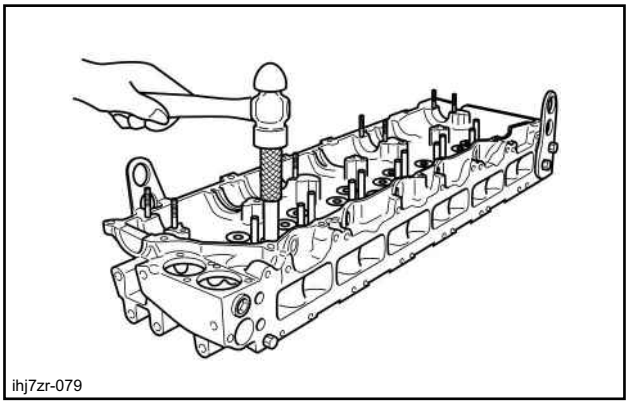
[2] Install the valve guide to the cylinder head assembly using the special tool.



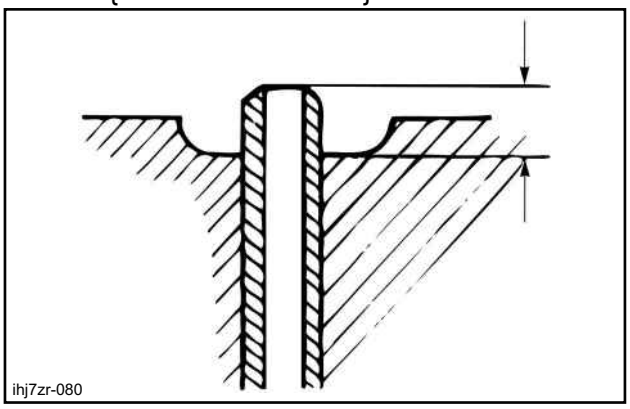
SST: 5-8840-2628-0 - valve guide replacer

Note

・Tap the valve guides from the upper side of the cylinder head.



Specified length： 17.0 - 17.9 mm {0.6693 - 0.7047 in.}



Caution

・When replacing the valve guide, replace it with the valve.

6. Valve stem oil seal Installation

[1] Install the valve spring seat to the cylinder head assembly.

[2] Apply the engine oil to the valve guide.

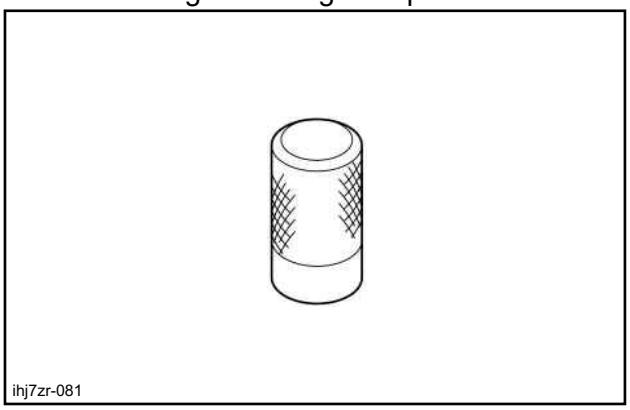
Note

・Apply engine oil to the outer circumference of the valve guide.

Caution

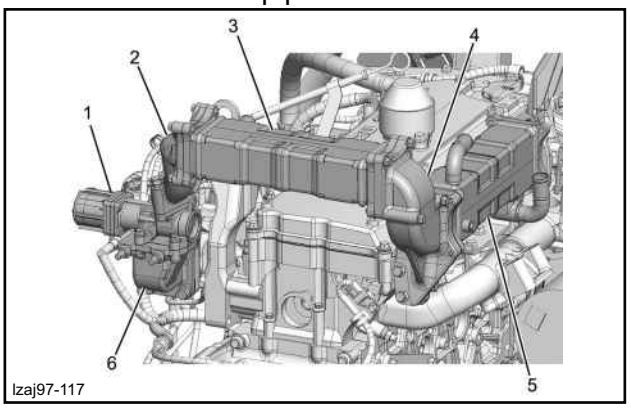
・Use a new valve stem oil seal.

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



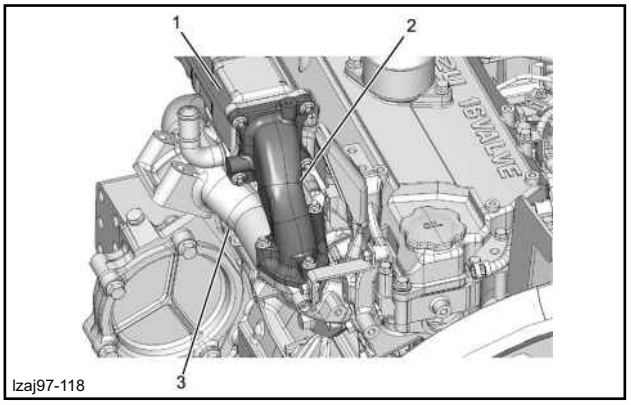
SST: 5-8840-2625-0 - valve stem seal installer

[4] Temporarily tighten the EGR cooler A to the EGR pipe B.



1	EGR valve
2	EGR pipe C
3	EGR cooler B
4	EGR pipe B
5	EGR cooler A
6	EGR pipe D

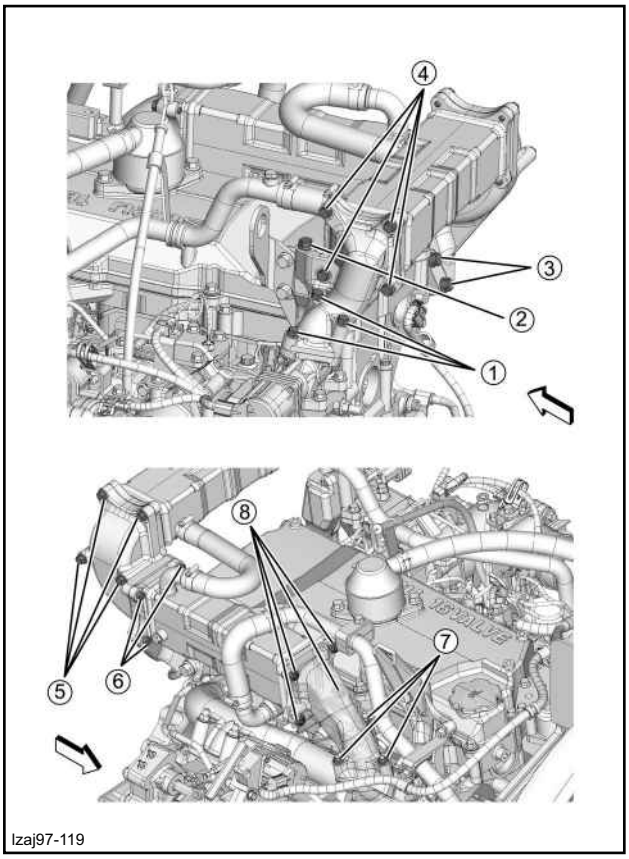
[5] Temporarily tighten the EGR pipe A to the EGR cooler A and the exhaust manifold.



1	EGR cooler A
2	EGR pipe A
3	Exhaust manifold

Note

・Temporarily tighten the all parts and then securely tighten them, using the tightening sequence shown in figure.



[6] Securely tighten the EGR pipe C to the EGR valve.
Tightening torque： 24 N・m {2.4 kgf・m / 18 lb・ft.}

[7] Securely tighten the EGR pipe C to the engine hanger bracket
Tightening torque： 48 N・m {4.9 kgf・m / 35 lb・ft.} No.2 in the diagram

[8] Securely tighten the EGR pipe B to the bracket.
Tightening torque： 48 N・m {4.9 kgf・m / 35 lb・ft.} No.3 in the diagram

[9] Securely tighten the EGR cooler B to the EGR pipe C.
Tightening torque： 24 N・m {2.4 kgf・m / 18 lb・ft.}

[10] Securely tighten the EGR pipe B to the EGR cooler B.
Tightening torque： 24 N・m {2.4 kgf・m / 18 lb・ft.}

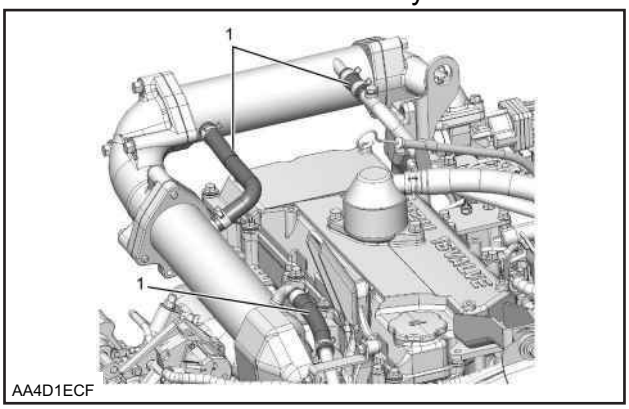
[11] Securely tighten the EGR cooler A to the EGR pipe B.
Tightening torque： 24 N・m {2.4 kgf・m / 18 lb・ft.}

[12] Securely tighten the EGR pipe A to the exhaust manifold.
Tightening torque： 28 N・m {2.9 kgf・m / 21 lb・ft.} No.7 in the diagram

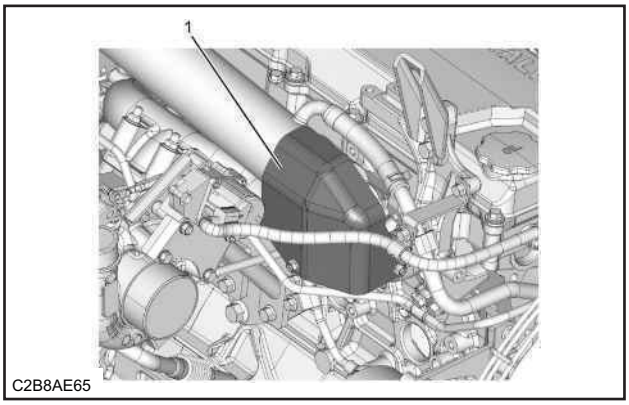
[13] Securely tighten the EGR pipe A to the EGR cooler A.

14. Cylindrical EGR cooler assembly removal

[1] Disconnect the water rubber hose from the EGR cooler assembly.



[2] Remove the EGR heat protector from the exhaust manifold



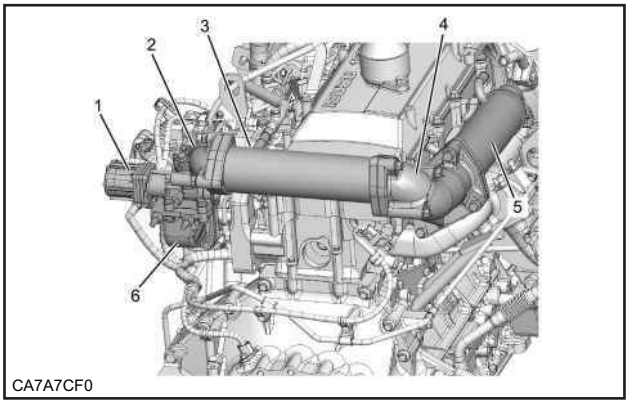
1	EGR heat protector

[3] Remove the EGR cooler A from the exhaust manifold and the EGR pipe A.

[4] Remove the EGR pipe A from the EGR cooler B.

[5] Remove the EGR cooler B from the EGR pipe B.

[6] Remove the EGR pipe B from the EGR valve.

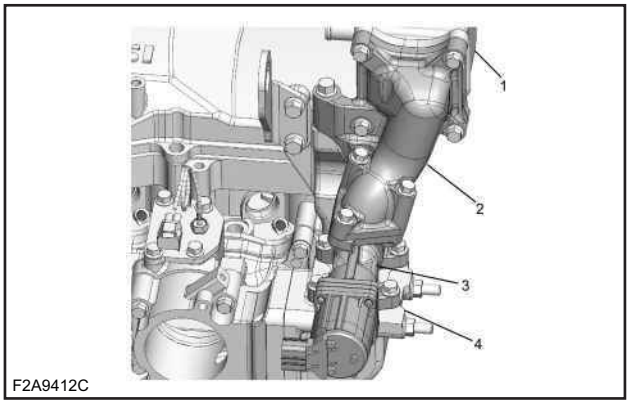


1	EGR valve
2	EGR pipe B
3	EGR cooler B
4	EGR pipe A
5	EGR cooler A
6	EGR pipe C

15. EGR valve Removal

[1] 1. Disengage the harness connector from the EGR valve.

[2] 2. Remove the EGR valve from the EGR pipe D.



1	EGR cooler C
2	EGR pipe C
3	EGR valve
4	EGR pipe D

16. EGR cooler water pipe Removal

[1] Disengage the radiator upper hose from the water outlet pipe.

[2] Remove the EGR cooler water pipe from the engine assembly.

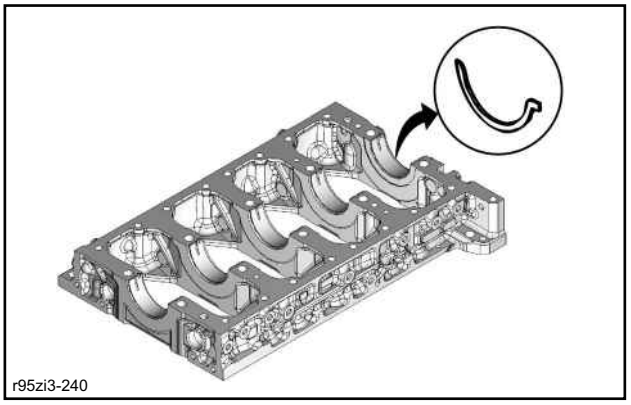
Note

・Remove the EGR cooler water feed pipe and EGR cooler water return pipe.

[10] Install the thrust bearing to the crankcase.

Note

・Install the thrust bearing on the No.5 journal so that the oil groove faces the engine rear.

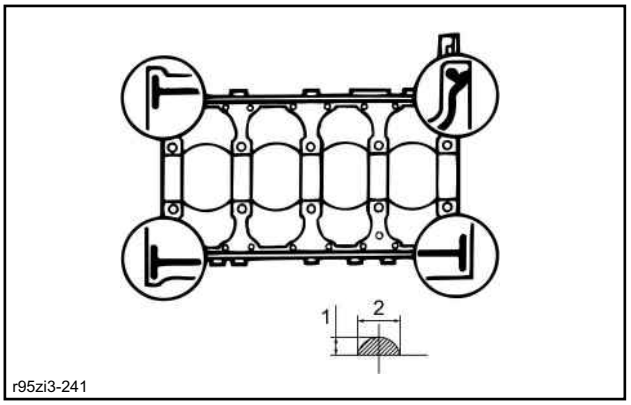


[11] Apply the engine oil to the crankshaft bearing.

[12] Apply the liquid gasket to the crankcase.

Note

・Apply ThreeBond 1207B to the crankcase thoroughly so that there is no break in application of the bead.



1	2 - 3 mm (0.079 - 0.118 in.)
2	3 - 4 mm (0.118 - 0.157 in.)

Caution

・After applying the liquid gasket, install the crankcase within 5 minutes.

[13] Put the crankcase on the cylinder block.

Caution

・Be careful not to let the thrust bearing fall.

[14] Apply the disulfide molybdenum grease to the bolt.

Note

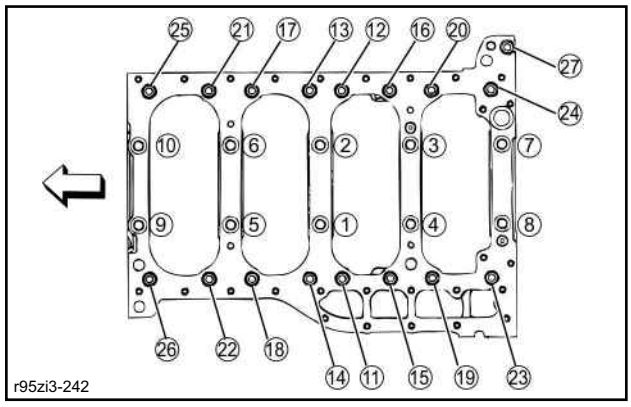
・Apply to the threaded portion and seat surface on the M14 bolt for crankcase installation.

Caution

・Do not apply grease to the M10 bolt.

Note

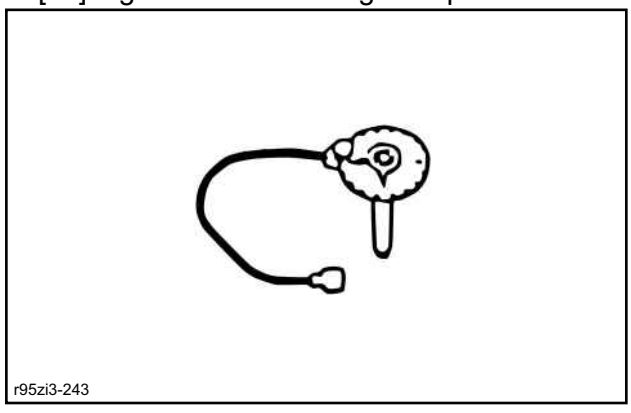
・Tightening order



[15] Tighten the bolt using the torque wrench. Tightening torque： 54 N・m {5.5 kgf・m / 40 lb・ft.} M14 bolt

[16] Tighten the bolt using the torque wrench. Tightening torque： 132 N・m {13.5 kgf・m / 97 lb・ft.} M14 bolt

[17] Tighten the bolt using the special tool.

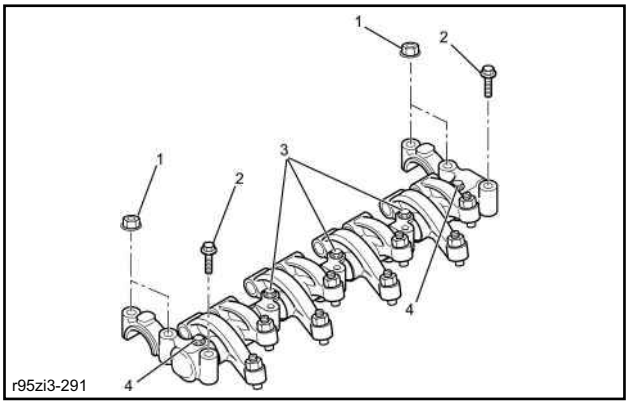


SST: 5-8840-0266-0 - angle gauge

Tightening angle： 30 ° M14 bolt

[18] Tighten the bolt using the torque wrench. Tightening torque： 37 N・m {3.8 kgf・m / 27 lb・ft.} M10 bolt

Rocker arm shaft tightening torque		
Parts		Tightening torque
No.4	Bolt	: 27 N・m {2.8 kgf・m / 20 lb・ft.}



1	Nut
2	Bolt
3	Bolt
4	Bolt

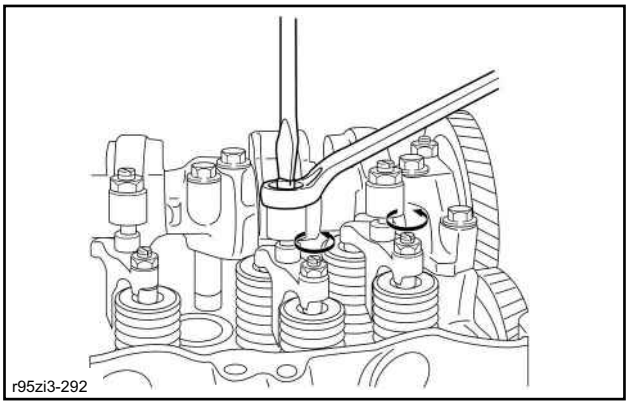
26. Rocker arm shaft Adjustment

Note

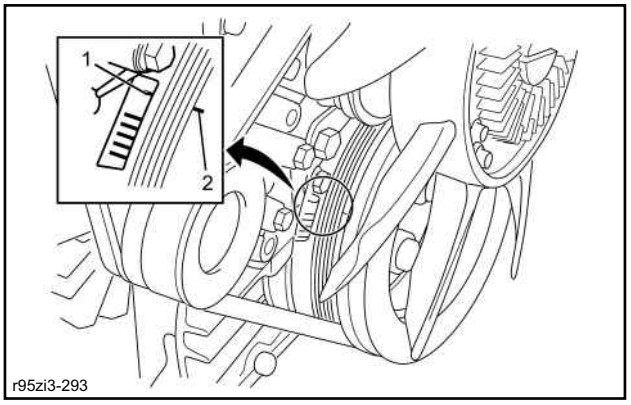
・Valve clearance adjustment

Caution

・Adjust the valve clearance while cool.
・Loosen all adjust screws before adjustment.



[1] Align 1st cylinder to the compression top dead center.



1	Front cover marking
2	0 degree marking on the crankshaft damper

[2] Prepare the feeler gauge.
Thickness : 0.4 mm {0.0157 in.} 2 pieces

Note

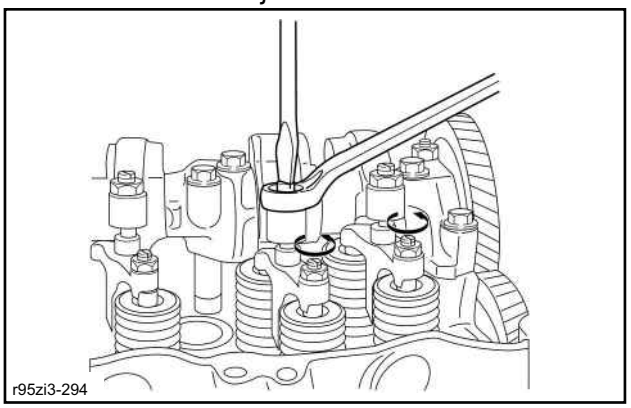
・Insert the thickness gauge between the rocker arm and bridge cap.
・Insert the thickness gauge between the bridge and valve.

[3] Turn the adjust screw.

Note

・When the movement of the thickness gauge becomes stiff, secure the adjust screw nut of the rocker arm.

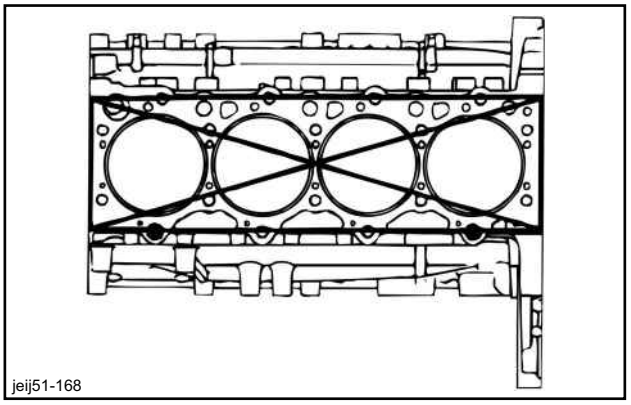
Tightening torque : 22 N・m {2.2 kgf・m / 16 lb・ft.}



Measurement part: 6 section(s)
Limit: 0.2 mm {0.0079 in.}

Caution

・Replace the cylinder block if the measured value exceeds the limit value.

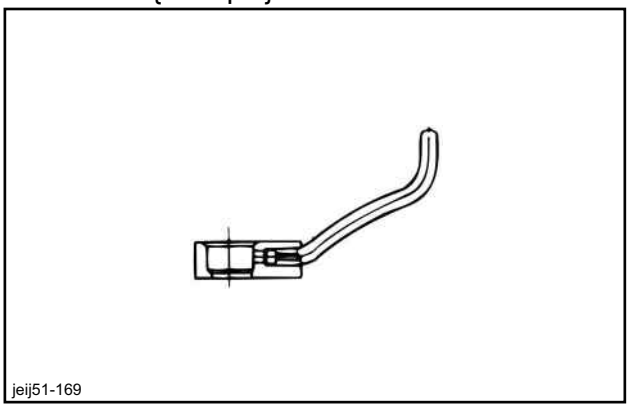

jeij51-168

[8] Inspect the oil jet.

Note

・Oil hole clogging
・The fuel pipe deformation
・Check valve operation

open valve pressure of check valve : 160 kPa {23.2 psi}

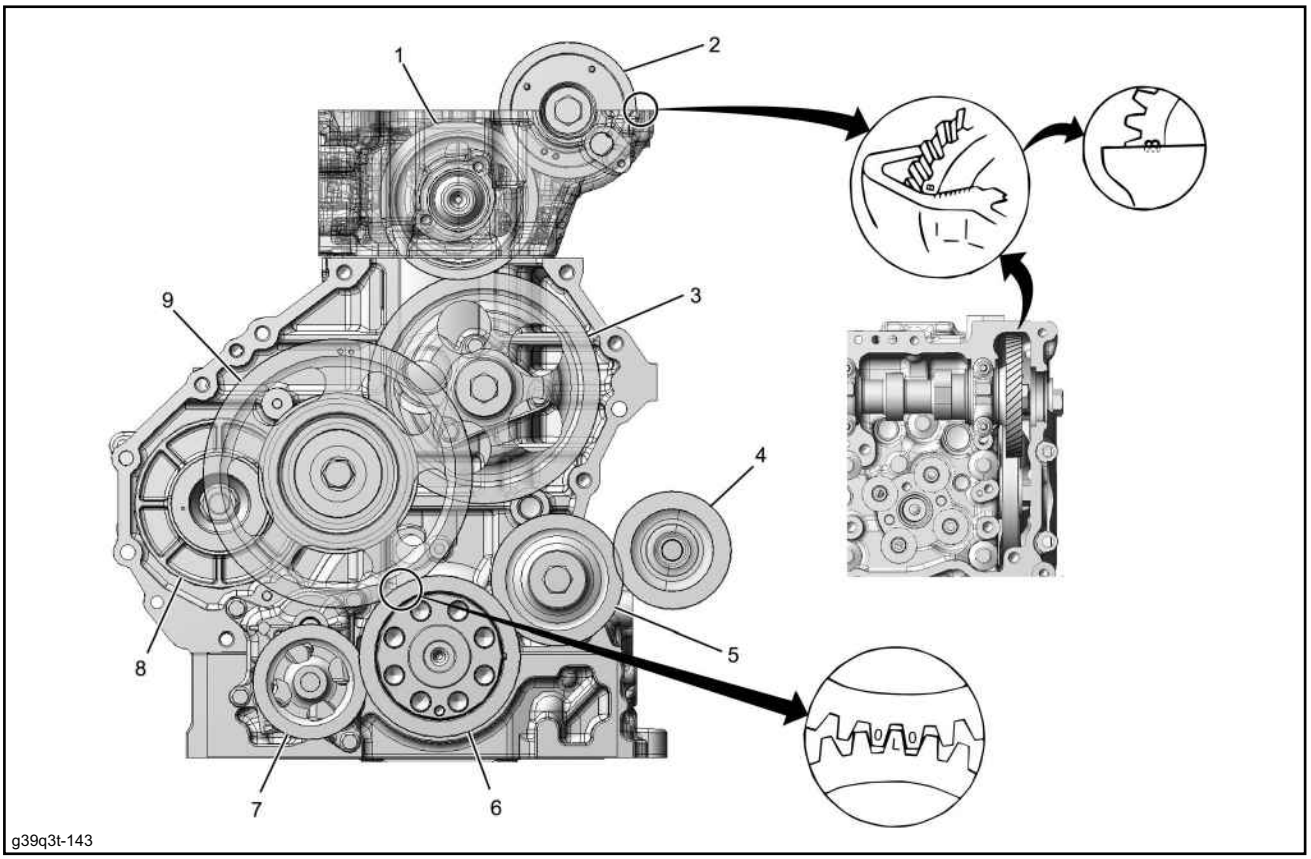

jeij51-169

[5] Apply the engine oil to the bolt.

Note

・Apply engine oil to the threaded portion and seat surface on the idle gear A installation bolt.

[6] Install the idle gear A to the cylinder block.
Tightening torque: 133 N・m {13.6 kgf・m / 98.11 lb・ft.}



1	Idle gear C	4	PTO gear	7	Oil pump drive gear
2	Camshaft gear	5	PTO idle gear	8	Supply pump gear
3	Idle gear B	6	Crankshaft gear	9	Idle gear A

3. Flywheel housing Installation

[1] Clean the cylinder block using the scraper.

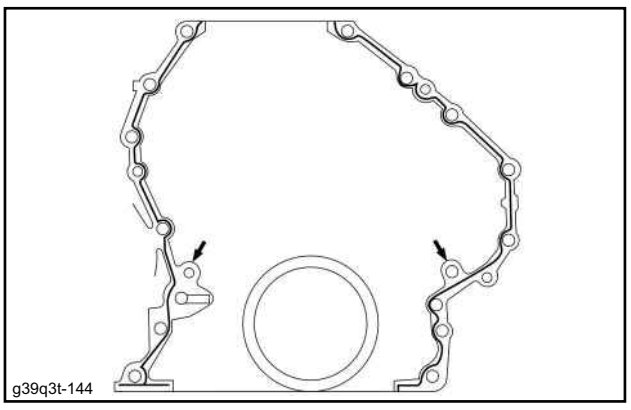
Note

・Remove dust and oil from the flywheel housing installation area.

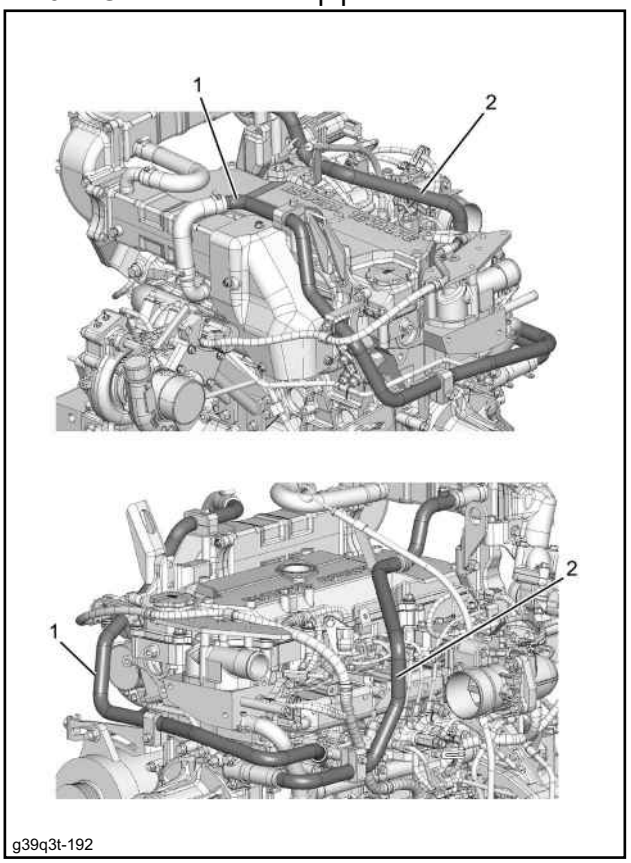
[2] Apply the liquid gasket to the cylinder block.

Note

・Refer to the diagram and apply the ThreeBond 1207B to the cylinder block.



26. EGR cooler water pipe Installation



1	EGR cooler water feed pipe
2	EGR cooler water return pipe

[1] Install the EGR cooler water pipe to the engine assembly.

Note

・Install the EGR cooler water feed pipe and EGR cooler water return pipe.

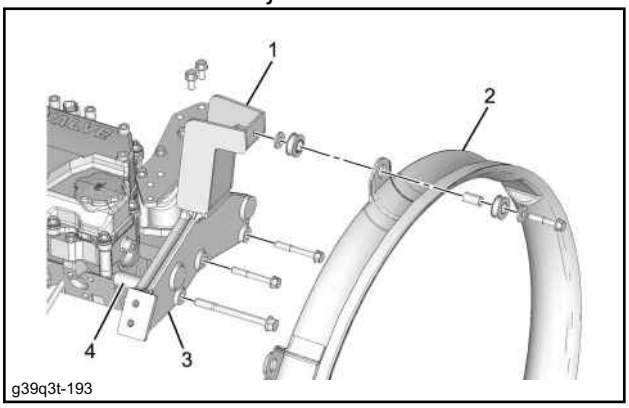
Tightening torque: 24 N・m {2.4 kgf・m / 17.70 lb・ft.} Clamp

[2] Connect the radiator upper hose to the water outlet pipe.

[3] Install the fan guide bracket to the cylinder head assembly.
Tightening torque: 50 N・m {5.1 kgf・m / 36.88 lb・ft.}
Tightening torque: 97 N・m {9.9 kgf・m / 71.56 lb・ft.} The area where the spacer is used

[4] Install the fan guide stay to the fan guide bracket.
Tightening torque: 45 N・m {4.6 kgf・m / 33.20 lb・ft.}

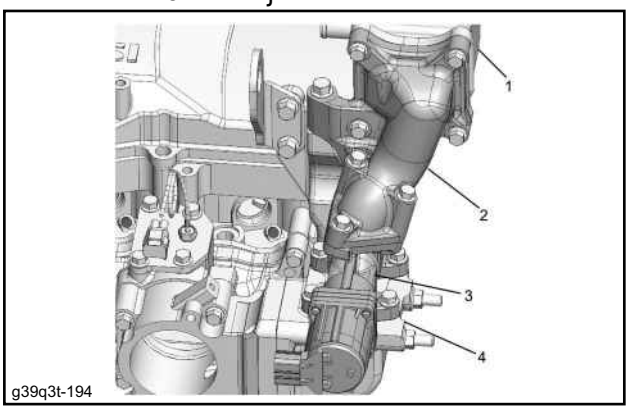
[5] Install the fan guide stay to the fan guide.
Tightening torque: 45 N・m {4.6 kgf・m / 33.20 lb・ft.}



1	Fan guide stay
2	Fan guide
3	Fan guide bracket
4	Spacer

27. EGR valve Installation

[1] Install the EGR valve to the EGR pipe D.
Tightening torque: 24 N・m {2.4 kgf・m / 17.70 lb・ft.}



1	EGR cooler C
2	EGR pipe C
3	EGR valve
4	EGR pipe D

Caution

・Use new gaskets.

[2] Connect the harness connector to the EGR valve.

28. EGR cooler assembly Installation

[1] Temporarily tighten the EGR pipe C to the EGR valve.

[2] Temporarily tighten the EGR cooler B to the EGR pipe C.

[3] Temporarily tighten the EGR pipe B to the EGR cooler B.

Area where the equipment is used	LLC concentration
General area; Area where the lowest temperature is higher than (-12) degrees.	: 30 %
Cold area; Area where the lowest temperature is (-30) degrees.	: 50 %
Area where temperature drop to (-30) degrees.	: 55 %

[1] Inspect the radiator reverse tank.

Note

・If coolant level is MIN or less, add it until it reaches MAX.

⚠ Caution

・When adding coolant, use coolant appropriate for the usage environment.

Volume of coolant： 30.2 L {7.978 US gal.} Engine only

[2] Inspect the water leak using the radiator cap tester.
Inspection pressure： 100.0 kPa {14.505 psi / 2 kgf/cm^2}

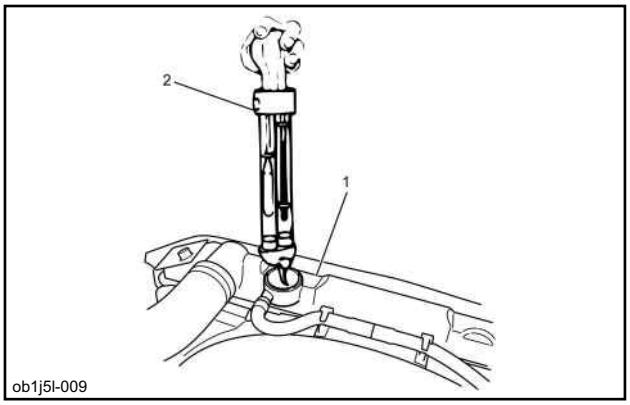
Note

・Inspection locations
・Radiator assembly
・Water pump assembly
・Radiator hose
・Heater hose

[3] Measure the specific gravity using the hydrometer.
Engine coolant temperature： 0 - 50 °C {32 - 122 °F}While in inspection

Note

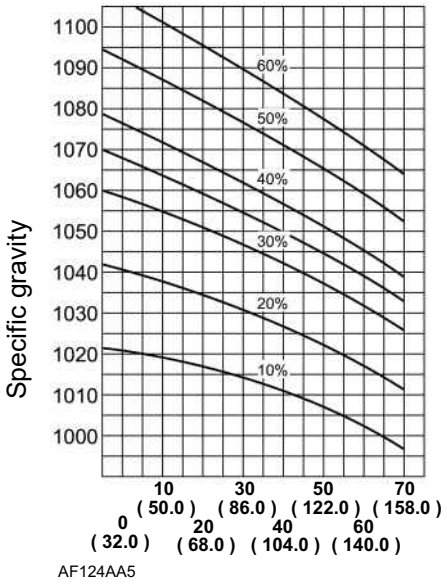
・Use a container that is deeper than the length of the hydrometer.



1	Radiator
2	Hydrometer

[4] Measure the temperature using the thermometer.
Engine coolant temperature： 0 - 50 °C {32 - 122 °F}While in inspection

[5] Calculate the concentration from the measured value.



Note

・Measuring the coolant concentration using a coolant scope is also possible.

Inspection of Cooling Fan Belt

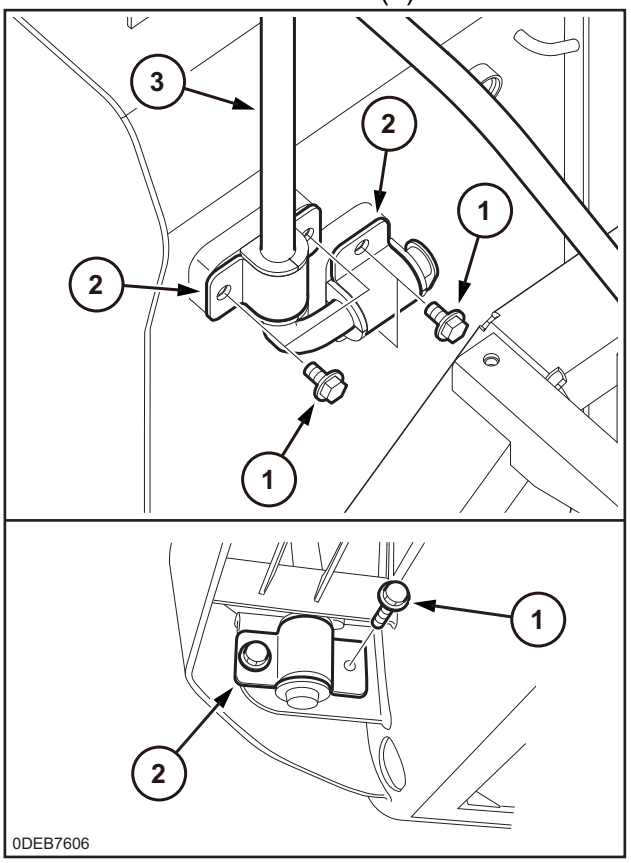
1. Cooling fan belt Inspection

[1] Inspect the cooling fan belt.

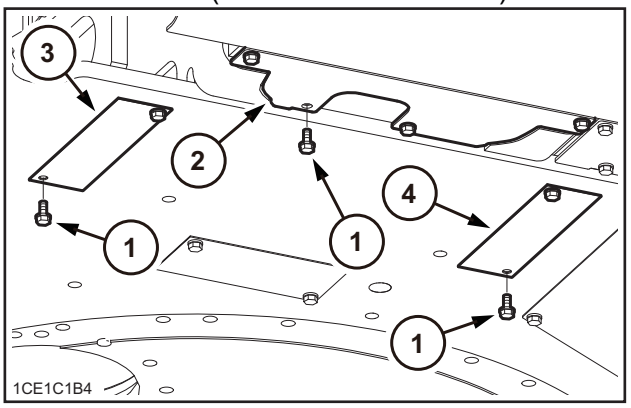
Note

・Inspect for wear or damage.

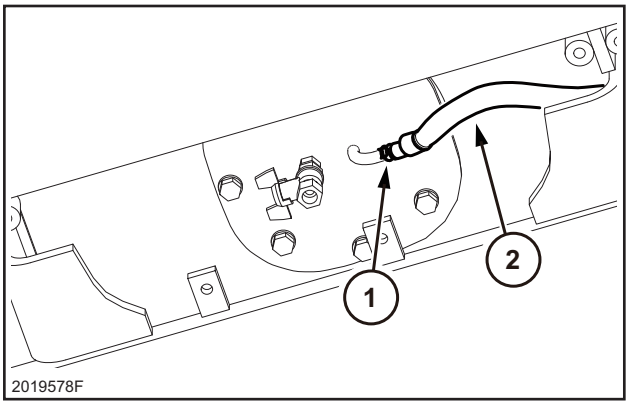
4. Use a wrench [19 mm (0.748 in.)] to remove the 6 bolts (1) and clamp (2), and then remove the handle (3).



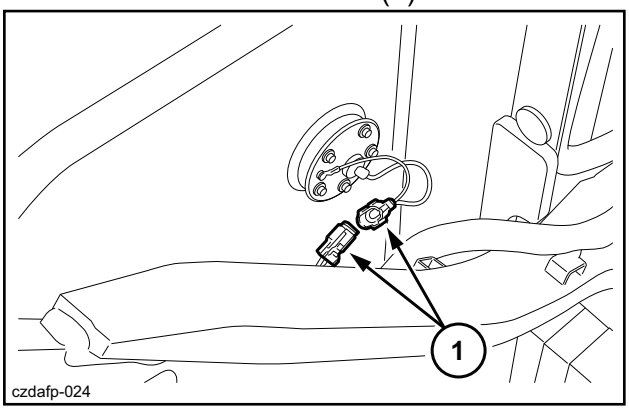
5. Use a wrench [19 mm (0.748 in.)] to remove the 8 bolts (1), and then remove the under covers (2) (3) (4).
Tightening torque for bolt installation: 36.3 - 42.1 N·m (26.778 - 31.057 lbf·ft.)



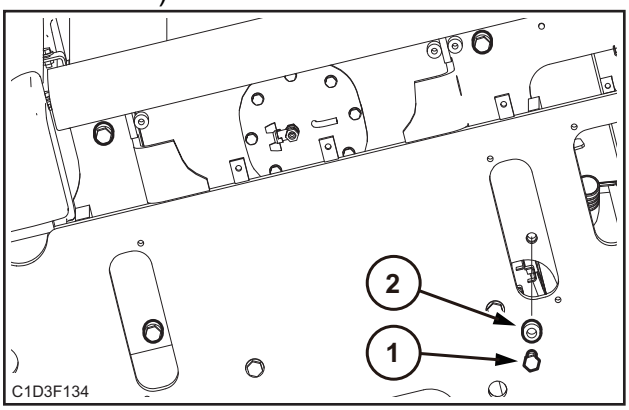
6. Loosen the hose band (1) and remove the hose (2).
   - Mark the fuel tank and hose so that the connectors match at the time of installation.
   - Install caps or plugs to the fuel tank and hose to prevent any entry of water, dust or dirt.



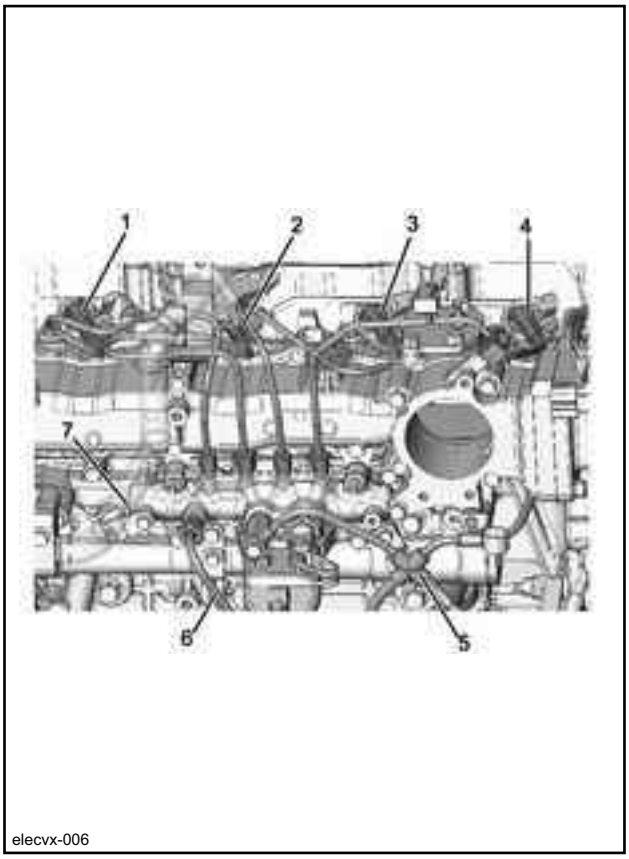
7. Remove the connectors (1).



8. Use a wrench [24 mm (0.945 in.)] to remove the 4 bolts (1) and 4 spacers (2) from the bottom of the fuel tank.
   - Depending on the machine, there may be height adjustment shims between the tank and the frame. Do not lose them.
   - Also, mark or write down the locations where they are and how many.
   - Tightening torque for bolt installation: 232.4 - 276.0 N·m (171.439 - 203.601 lbf·ft.)



9. Install the 4 eyebolts (M12) (1) on top of the fuel tank.
   - After fully tightening the eyebolts, loosen them by about half a rotation.



elecvx-006

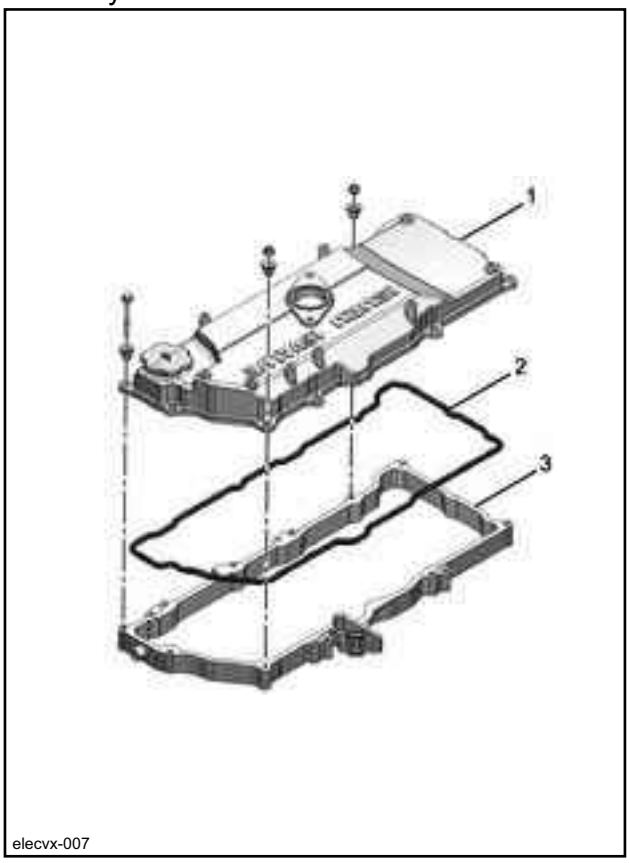
1	No. 1 injection pipe
2	No. 2 injection pipe
3	No. 3 injection pipe
4	No. 4 injection pipe
5	Fuel leak-off pipe
6	Fuel pipe
7	Common rail assembly

7. Removal of cylinder head cover

[1] Detach 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.



elecvx-007

1	Cylinder head cover
2	Gasket
3	Lower cover

8. Removal of lower cover

[1] Remove the connector from the lower cover.

> ⚠ Caution
>
> ・Do not pull on the wires or pry the connector with a screwdriver.

[2] Detach the injector harness from the injector.

> ⚠ Caution
>
> ・Be careful not to damage the injector side stud bolts.

[3] Remove the injector harness from the cylinder head assembly.

Supplement

・Remove the bracket tightening bolts and remove the injector harness together with the bracket.

[4] Preparatory check
Visual inspection of engine room
When implementing the diagnostic procedures, carefully make a visual inspection of the engine room.
This inspection can often lead to solving a problem without taking extra steps.

- Visually inspect all air hoses for punched holes, cuts, disconnections, and appropriate piping.
- Visually inspect the hoses that are difficult to see behind other components.
- For every harness in the engine room, visually inspect that all harnesses are properly connected.
  Inspect that there are no burned or worn areas, that the harnesses are properly fastened and that they are not in contact with sharp edges or the hot exhaust manifold or pipes.

Checking the machine maintenance status
If the maintenance of the actual machine is not performed correctly, the monitor may illuminate.
Restricted oil filters, fuel filters, and crankcase deposits due to lack of oil changes or improper oil viscosity can trigger actual unit faults that were not previously monitored prior to OBD.
Poor vehicle maintenance cannot be classified as a non-machine failure, but since the sensitivity of OBD system checks is high, actual unit maintenance schedules must be further closely followed.
Non-OEM parts
All the OBD system checks are adjusted to operate with the genuine parts.
Therefore, when a commercially sold sensor or switch, etc. is installed, a wrong diagnosis is made, and the monitor comes on.
Accordingly, if general commercially-available sensors or switches are installed, this will cause mistakes in diagnosis and the monitor to show an abnormality display.
If a commercially-available electronic device such as a mobile phone, stereo or anti-theft device is inappropriately installed, an EMI may be emitted to the control system.
As the result, false sensor information is generated causing the monitor to come on.
When conducting a trouble diagnoses, either turn OFF the power for all commercially sold parts or remove them, and then check the failure again.
NOTE
Related system failure
Many OBD system checks go into the backup operation mode based on the instruction from the ECM which is given when the ECM detects a failure in the related systems or components.
When the backup operation mode is activated, the output is reduced to protect the actual unit.

[5] Trouble diagnosis
Basic knowledge of tools required

Note

- When performing the diagnostic procedure, lack of basic knowledge regarding this powertrain could result in an incorrect diagnosis or damage to the powertrain components.
  Do not attempt to diagnose a problem related to the powertrain without having the basic knowledge.
  A basic understanding of hand tools, such as the trouble diagnosis scan tools, is required to utilize the service manual effectively.

About the diagnostic test performed on the actual unit
Past failures

- The diagnostic tests of the previous ignition cycle have been completed.
- The diagnostic tests of the current ignition cycle have passed.
- Problems identified in the diagnostic tests currently do not exist.

Current failures

- The diagnostic tests of the previous ignition cycle have been completed.
- Problems identified in the diagnostic tests currently exist.
- Problems exist in the current ignition cycle.

DPD temperature sensor Installation

1. Exhaust gas temperature sensor Installation

Caution

- Do not subject the tip of the exhaust gas temperature sensor to shock when installing.
- Remove the old anti-seize lubricant on the sleeve nut.
- Apply the anti-seize lubricant on the threaded portion of the sleeve nut.
- Apply Never-Seez High Temperature Stainless Grade: 5-87411-039-0 anti-seize lubricant, manufactured by Bostik in the United states.
- Replace the oxidation catalyst assembly if damage has been found in the sensor installation section of the oxidation catalyst assembly.

[1] Temporarily tighten the exhaust gas temperature sensor to the DPD assembly.

Caution

- To avoid damaging the sensor installation sections due to sensor incorrect assembly, tighten it by hand.

Note

- Exhaust gas temperature sensor identification

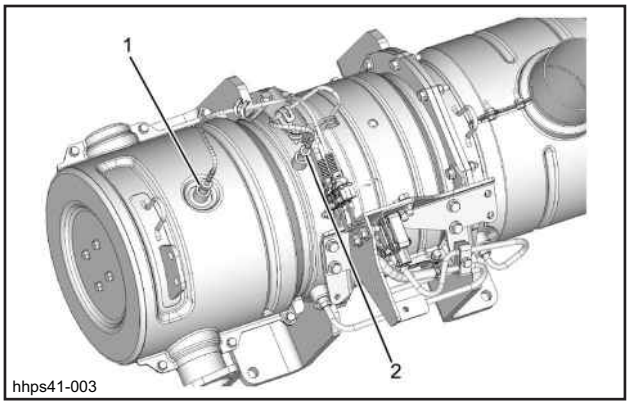
Sensor type	Screw size	Connector color
Exhaust gas temperature sensor 1	M12 x 1.75	Dark gray
Exhaust gas temperature sensor 2	M12 x 1.25	Light gray

[2] Securely tighten the exhaust gas temperature sensor to the DPD assembly.
tightening torque： 30 N・m {3.1 kgf・m / 22 lb・ft.}

[3] Connect the harness connector to the exhaust gas temperature sensor.

Caution

- Be careful not to twist the harness.



1	Exhaust gas temperature sensor 1
2	Exhaust gas temperature sensor 2

Note

- Start the engine after assembling each part, and check for gas leaks from each joint and for vibration.

[5] Display FAULT HISTORY on the service support screen on the monitor and check that no diagnostic trouble code has been detected.
See "Service Support - FAULT HISTORY".

Diagnostic Trouble Code 0091 Fuel Rail Pressure Regulator Control System Low Input

1. Diagnostic trouble code 0091 - diagnosis

[1] Check the indicated rail pressure regulator feedback current with the trouble diagnosis scan tool.
Current: 300 - 900 mA

[2] If it exceeds the standard value, inspect for a short circuit to the battery or ignition power supply in the High side circuit between the ECM and suction control valve.

Note

・If the High side circuit is shorted to the voltage, the engine stalls and does not start.

[3] If a problem is found, repair the High side circuit.

[4] If it is within the standard range, inspect for a short circuit to ground in the Low side circuit between the ECM and suction control valve.

Note

・If the Low side circuit is shorted to ground, the diagnostic trouble code 0091 may not be detected.
・If the Low side circuit is shorted to ground, the engine stalls and does not start.

[5] If a problem is found, repair the Low side circuit.

[6] Turn the starter switch OFF for 30 sec. or longer.

[7] Disconnect the harness connector from the suction control valve.

[8] Connect a test lamp between the High side circuit of the suction control valve and normal ground.

[9] Turn the starter switch ON.

[10] Check if the test lamp illuminates, then goes off.

[11] If it does not go off, inspect the High side circuit between the ECM and suction control valve.
- There must be no disconnection or high resistance.
- There must be no short circuit to ground.
- There must be no short circuit to the Low side circuit.

[12] If a problem is found, repair the High side circuit.

[15] Check the value indicated on the fuel temperature sensor with the trouble diagnosis scan tool.
Voltage value: 0.1 V

[16] If it is below the standard value, inspect for a disconnection or high resistance in the ground circuit between the ECM and fuel temperature sensor.

Note

・The fuel temperature sensor shares use of the ground circuit with other sensors.
・A diagnostic trouble code may be detected for the sensors sharing use of this circuit.

[17] If a problem is found, repair the ground circuit.

[18] Inspect for a disconnection or high resistance in the signal circuit between the ECM and fuel temperature sensor.

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

[20] Inspect for a contact defect in the harness connector of the ECM.

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

[22] If the harness connector is normal, replace the ECM.

[23] Set the injector ID code in the ECM.

[24] Have the ECM learn the fuel supply pump information.

3. Diagnostic trouble code 0183 - check if symptom has disappeared

[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 diagnostic trouble codes will be cleared.

[2] Turn the starter switch OFF for 30 sec. or longer.

[3] Start the engine.

[4] Test the operation.

Note

・Run the engine for at least 3 min.

[5] Display FAULTY HISTORY on the service support screen on the monitor and check that no diagnostic trouble code has been detected.
See "Service Support - FAULTY HISTORY".

Diagnostic Trouble Code 0192 Fuel Rail Pressure Sensor System Low Input

1. Diagnostic trouble code prior to diagnostic trouble code 0192
Diagnostic trouble code 0641

2. Diagnostic trouble code 0192 - diagnosis

[1] Turn the starter switch OFF.

[2] Disconnect the harness connector from the fuel pressure sensor.

[3] Check the value indicated on the fuel rail pressure sensor with the trouble diagnosis scan tool.
Voltage value: 4.5 V

[4] If it is below the standard value, inspect for a short circuit to ground in the signal circuit between the ECM and fuel pressure sensor.

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

[6] Measure the voltage between the 5 V power supply circuit of the fuel pressure sensor and normal ground.
Voltage value: 4.5 V

[7] If it exceeds the standard value, inspect for a contact defect in the harness connector of the fuel pressure sensor.

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

[9] If the harness connector is normal, replace the fuel pressure sensor.
See "Removal of Common Rail Assembly".
See "Installation of Common Rail Assembly".

Note

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

[10] Inspect for a disconnection or high resistance in the 5 V power supply circuit between the ECM and fuel pressure sensor.

Note

・The fuel pressure sensor shares use of the 5 V power supply circuit with other sensors.
・A diagnostic trouble code may be detected for the sensors sharing use of this circuit.

[11] If a problem is found, repair the 5 V power supply circuit.

[37] Inspect for a contact defect in the harness connector of the ECM.
[38] If a problem is found, repair the harness connector.
[39] Inspect the circuit between the ECM and barometric pressure sensor.

Note
・There must be no high resistance.

[40] If a problem is found, repair the circuit.
[41] Replace the barometric pressure sensor.

3. Diagnostic trouble code 0299 - check if symptom has disappeared
[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 diagnostic trouble codes will be cleared.
[2] Turn the starter switch OFF for 30 sec. or longer.
[3] Start the engine.
[4] Test the operation.
[5] Display FAULTY HISTORY on the service support screen on the monitor and check that no diagnostic trouble code has been detected.
See "Service Support - FAULTY HISTORY".

Diagnostic Trouble Code 0335 Crankshaft Position Sensor System Error

1. Diagnostic trouble code prior to diagnostic trouble code 0335
Diagnostic trouble code 0340
Diagnostic trouble code 0641
2. Diagnostic trouble code 0335 - diagnosis
[1] Turn the starter switch OFF.
[2] Disconnect the harness connector from the CKP sensor.
[3] Turn the starter switch ON.
[4] Measure the voltage between the 5 V power supply circuit of the CKP sensor harness connector and normal ground.
Voltage value: 4.5 V
[5] If it is below the standard value, inspect for a disconnection or high resistance in the 5 V power supply circuit between the ECM and CKP sensor.

Note
・The CKP sensor shares use of the 5 V power supply circuit with other sensors.
・A diagnostic trouble code may be detected for the sensors sharing use of this circuit.

[6] If a problem is found, repair the 5 V power supply circuit.
[7] Measure the voltage between the signal circuit of the CKP sensor harness connector and normal ground.
Voltage value: 5.5 V
[8] If it exceeds the standard value, inspect for a short circuit to the battery or ignition power supply in the signal circuit between the ECM and CKP sensor.
[9] If a problem is found, repair the signal circuit.
[10] Measure the voltage between the signal circuit of the CKP sensor harness connector and normal ground again.
Voltage value: 4.5 V
[11] If it is below the standard value, inspect the signal circuit between the ECM and CKP sensor.

Note
・There must be no disconnection or high resistance.
・There must be no short circuit to ground.

Diagnostic Trouble Code 042D Exhaust Temperature Sensor 2 System High Input (before oxidation catalyst)

1. Diagnostic trouble code prior to diagnostic trouble code 042D
   Diagnostic trouble code 0697
2. Diagnostic trouble code 042D - diagnosis
   [1] Turn the starter switch OFF.
   [2] Disconnect the harness connector from the exhaust gas temperature sensor 2.
   [3] Turn the starter switch ON.
   [4] Measure the voltage between the signal circuit of the exhaust gas temperature sensor 2 and normal ground.
   Voltage value: 5.5 V
   [5] If it exceeds the standard value, inspect for a short circuit to the battery or ignition power supply circuit in the signal circuit between the ECM and exhaust gas temperature sensor 2.
   [6] If a problem is found, repair the signal circuit.
   [7] Connect a test cable with fuse between the signal circuit of the exhaust gas temperature sensor 2 and ground circuit.
   [8] Check the value indicated on the exhaust gas temperature sensor (before oxidation catalyst) with the trouble diagnosis scan tool.
   Voltage value: 0.1 V
   [9] If it is below the standard value, inspect for a short circuit to the 5 V power supply circuit in the signal circuit between the ECM and exhaust gas temperature sensor 2.
   [10] If a problem is found, repair the signal circuit.
   [11] Inspect for a contact defect in the harness connector of the exhaust gas temperature sensor 2.
   [12] If a problem is found, repair the harness connector.
   [13] If the harness connector is normal, replace the exhaust gas temperature sensor 2.
   See "Removal of the Exhaust Gas Temperature Sensor".
   See "Installation of the Exhaust Gas Temperature Sensor".
   [14] Connect a test cable with fuse between the signal circuit of the exhaust gas temperature sensor 2 and normal ground.
   [15] Check the value indicated on the exhaust gas temperature sensor (before oxidation catalyst) with the trouble diagnosis scan tool.
   Voltage value: 0.1 V
   [16] If it exceeds the standard value, inspect for a disconnection or high resistance in the signal circuit between the ECM and exhaust gas temperature sensor 2.
   [17] If a problem is found, repair the signal circuit.
   [18] Inspect for a disconnection or high resistance in the ground circuit between the ECM and exhaust gas temperature sensor 2.

Note

- The exhaust gas temperature sensor 2 shares use of the ground circuit with other sensors.
- A diagnostic trouble code may be detected for the sensors sharing use of this circuit.

   [19] If a problem is found, repair the ground circuit.
   [20] Inspect for a contact defect in the harness connector of the ECM.
   [21] If a problem is found, repair the harness connector.
   [22] If the harness connector is normal, replace the ECM.
   [23] Set the injector ID code in the ECM.
   [24] Have the ECM learn the fuel supply pump information.
3. Diagnostic trouble code 042D - check if symptom has disappeared
   [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 diagnostic trouble codes will be cleared.
   [2] Turn the starter switch OFF for 30 sec. or longer.
   [3] Start the engine and warm it up until the coolant temperature reaches the standard value.
   Standard value: 70°C (158°F)

Diagnostic Trouble Code 1093 Fuel Rail Pressure Low Pressure Error

1. Diagnostic trouble code prior to diagnostic trouble code 1093
   Diagnostic trouble code 0087
   Diagnostic trouble code 0091
   Diagnostic trouble code 0092
   Diagnostic trouble code 0192
   Diagnostic trouble code 0193
   Diagnostic trouble code 0201
   Diagnostic trouble code 0202
   Diagnostic trouble code 0203
   Diagnostic trouble code 0204
   Diagnostic trouble code 2146
   Diagnostic trouble code 2149
2. Diagnostic trouble code 1093 - diagnosis
   [1] Turn the starter switch OFF.
   [2] Standby the specified time for the fuel pressure from the common rail to decrease.
   Specified time: 2 min.
   [3] Turn the starter switch ON.
   [4] Check whether the value indicated on the fuel rail pressure sensor is within the standard range with the trouble diagnosis scan tool.
   Voltage value: 0.9 - 1.0 V
   [5] If the value indicated on the fuel rail pressure sensor is outside the standard range, inspect for a contact defect in the harness connector of fuel pressure sensor.
   [6] If a problem is found, repair the harness connector.
   [7] Inspect for a contact defect in the harness connector of the ECM.
   [8] If a problem is found, repair the harness connector.
   [9] Inspect for high resistance in each circuit.
   [10] If a problem is found, repair the circuit.
   [11] If the harness connector and circuits are normal, replace the fuel pressure sensor.
   See "Removal of Common Rail Assembly".
   See "Installation of Common Rail Assembly".

Note

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

   [12] Inspect for any clog in the fuel system between the fuel tank and fuel supply pump.
   [13] If a problem is found, clear the clogged fuel system.
   [14] Inspect for cuts and cracks in the fuel hose between the fuel tank and fuel supply pump.
   [15] If a problem is found, replace the fuel hose.

Note

・The fuel hose from the fuel tank to the fuel supply pump has a weak vacuum when the engine is driving.
・If the fuel hose connection is inadequate, air gets in.
・With air in the fuel system, if the engine speed and load become high, the common rail pressure fluctuates and diagnostic trouble code 1093 may be detected.

   [16] Check that appropriate clamps are used between the fuel tank and fuel supply pump.
   [17] If a problem is found, replace the clamp.
   [18] Operate the priming pump until it becomes difficult to push.

Note

・If there is a leak in the fuel system between the priming pump and fuel supply pump, it does not become difficult to push the priming pump.

   [19] Start the engine.
   [20] Inspect the fuel system high-pressure side and check for fuel leaks between the fuel supply pump and common rail.

Note

・Sometimes a fuel leak occurs from the high-pressure hose inlet to the bottom section of the cylinder head cover.
・If a fuel leak occurs into the bottom section of the cylinder head cover, the engine oil level rises.
・Inspect for fuel leaks into the engine oil.

   [21] If a fuel leak is found, repair it.
   [22] Turn the starter switch OFF.

Diagnostic Trouble Code 2146 Injector Group 1 Voltage Control System Error

1. Diagnostic trouble code 2146 - diagnosis

[1] Turn the starter switch OFF.

[2] Disconnect the harness connector from the injector harness intermediate connector on the cylinder head.

[3] Turn the starter switch ON.

[4] Measure the voltage between the solenoid control circuit and ground.

Note

- Solenoid control circuit of No. 1 cylinder injector and normal ground
- Solenoid control circuit of No. 4 cylinder injector and normal ground

Voltage value: 12.0 V

[5] If it is below the standard value, inspect for a short circuit to ground in the control circuit between the ECM and injector harness intermediate connector.

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

[7] Inspect the charge voltage circuit between the ECM and injector harness intermediate connector.

Note

- There must be no short circuit to the battery or ignition power supply.
- There must be no short circuit to ground.

[8] If a problem is found, repair the charge voltage circuit.

[9] If the charge voltage circuit between the ECM and injector harness intermediate connector is normal, replace the ECM.

[10] Set the injector ID code in the ECM.

[11] Have the ECM learn the fuel supply pump information.

[12] Inspect for a contact defect in the injector harness intermediate connector.

[13] If a problem is found, repair the injector harness intermediate connector.

[14] Disconnect the harness connector from the ECM.

[15] Inspect for a contact defect in the harness connector of the ECM.

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

[17] Inspect for a disconnection or high resistance in the charge voltage circuit between the ECM and injector harness intermediate connector.

[18] If a problem is found, repair the charge voltage circuit.

[19] Remove the cylinder head cover. See "Removal of Cylinder Head Cover".

[20] Inspect the injector harness tightening nut for looseness.

[21] If the tightening nut of the injector harness is loose, tighten it.

[22] Inspect whether foreign matter is in contact with the injector terminal.

[23] If foreign matter is in contact with the injector terminal, remove it.

[24] Inspect for a contact defect in the injector harness intermediate connector.

[25] If a problem is found, repair the intermediate connector.

[26] Check that the insulating resistance of the No. 1 and No. 4 cylinder injectors is at or above the standard value.
Resistance: 1.0 Ω

[27] Replace the injectors that are below the standard value.
See "Removal of Injector".
See "Installation of Injector".

[28] Set the injector ID code in the ECM.

[29] If it exceeds the standard value for all injectors, repair or replace the injector harness.

2. Diagnostic trouble code 2146 - check if symptom has disappeared

[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 diagnostic trouble codes will be cleared.

[2] Turn the starter switch OFF for 30 sec. or longer.

[3] Start the engine.

[4] Display FAULTY HISTORY on the service support screen on the monitor and check that no diagnostic trouble code has been detected.

Diagnostic Trouble Code 0001 CAN Bus Error

1. Diagnostic trouble code 0001 - diagnosis

[1] Turn the starter switch OFF.

[2] Disconnect the harness connector from the ECM.

[3] Measure the resistance between the CAN-High side terminal and CAN-Low side terminal.

Note

・Measure the resistance between the ECM harness connector terminals.

Resistance: About 120.0 Ω

[4] If it is outside the standard range, inspect the CAN-Low circuit and CAN-High circuit between the ECM and machine control unit.

・ There must be no short circuit to the battery or ignition power supply.

・ There must be no disconnection or high resistance.

・ There must be no short circuit to ground.

[5] If a problem is found, repair the CAN circuit.

[6] If the CAN circuit is normal, replace the machine control unit.

[7] Connect the harness connector to the ECM.

[8] Disconnect the harness connector from the machine control unit.

[9] Measure the resistance between the CAN-High side terminal and CAN-Low side terminal.

Note

・Measure the resistance between the ECM harness connector terminals.

Resistance: About 120.0 Ω

[10] If it is outside the standard range, replace the ECM.

[11] Set the injector ID code in the ECM.

[12] Have the ECM learn the fuel supply pump information.

2. Diagnostic trouble code 0001 - check if symptom has disappeared

[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 diagnostic trouble codes will be cleared.

[2] Turn the starter switch OFF for 30 sec. or longer.

[3] Start the engine.

[4] Test the operation.

[5] Display FAULTY HISTOR on the service support screen on the monitor and check that no diagnostic trouble code has been detected.
See "Service Support -FAULTY HISTOR".

■Solenoid Valve (5 stack)

Manufacturer		Yuken Kogyo Co., Ltd.	
Valve specifications			
	Maximum flow	P→B 25 L/min (6.604 gpm) Other 5 L/min (1.321 gpm)	
	Rated pressure	4.5 MPa (652.742 psi)	
	Port size	P.T.B. port	G3/8
		C1, C2, C3, C4, C5 ports	G1/4
Solenoid specifications			
	Operating voltage	DC 20 - 32 V	
	Power consumption	17 W max.	
Weight		6.7 kg (14.7710 lb)	

■Valve for Left/Right Operations

Manufacturer		Kawasaki Heavy Industries, Ltd.
Operating pressure		3.92 MPa (568.6104 psi)
Secondary pressure		0.64 - 2.45 MPa (92.8343 - 355.3815 psi) MPa primary short type
Operating angle	1,3 port	19°
	2,4 port	25°
Weight		1.9 kg (4.1888 lb)

■Remote Control Valve for Travel Operations

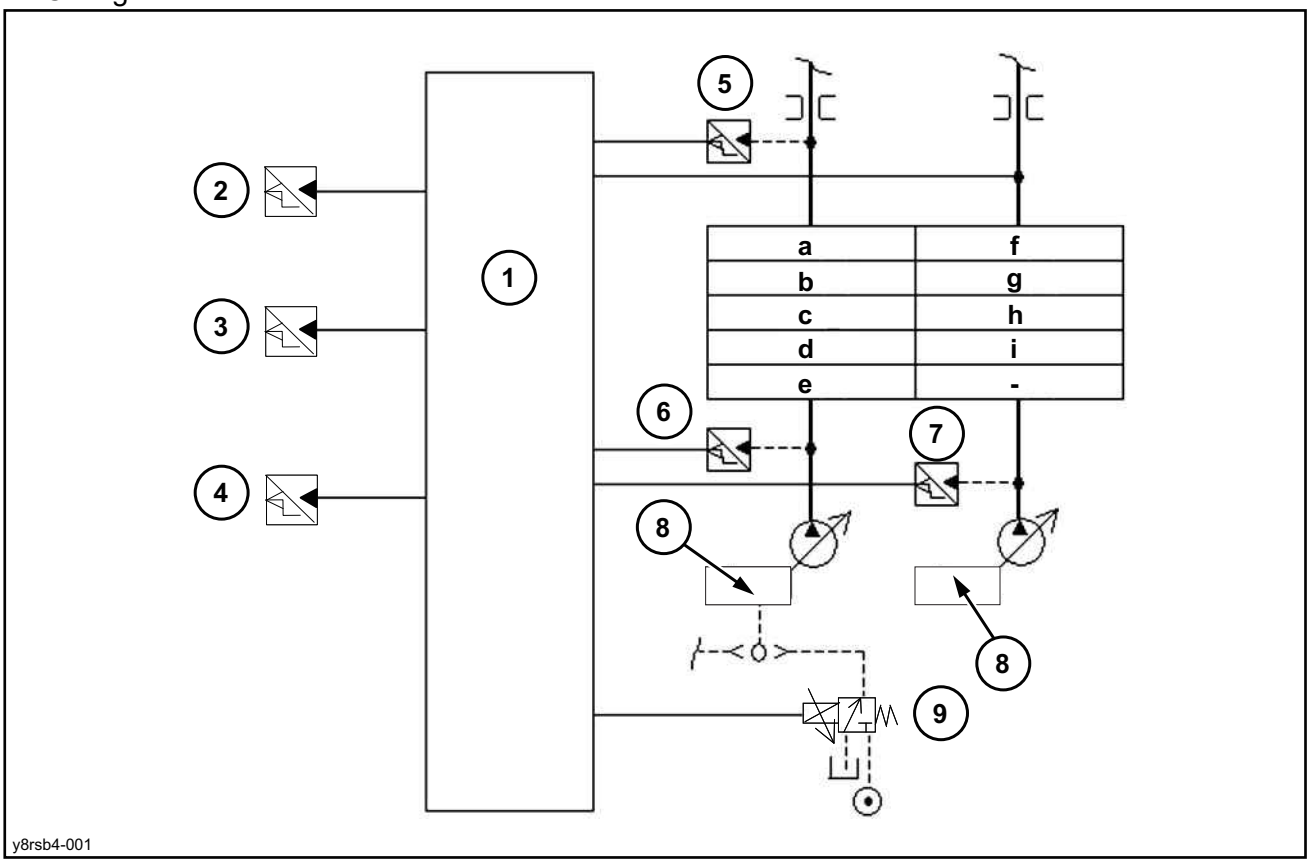
Manufacturer	Kawasaki Heavy Industries, Ltd.
Operating pressure	3.92 MPa (568.6104 psi)
Secondary pressure	0.64 - 2.45 MPa (92.8343 - 355.3815 psi); Primary short type
Operating angle	12.4°
Weight	4.1 kg (9.0390 lb)

Swing Relief Cut

Purpose/summary

When independent swing operation is running, the pump flow is reduced, and the excess oil ejected from the swing motor relief valve is eliminated.

Configuration



1	Computer A	4	1st option pressure sensor	7	P2 pressure sensor
2	Oil temperature sensor	5	N2 pressure sensor	8	Regulator
3	Travel pressure sensor	6	P1 pressure sensor	9	P1 flow control proportional valve

a	Arm (1)	d	Option 1	g	Boom (1)
b	Boom (2)	e	Travel (left)	h	Bucket
c	Swing	f	Arm (2)	i	Travel (right)

Operation explanation

[1] Operation conditions for swing relief cut

The operation starts when all the following conditions are satisfied.

a. Oil temperature is 30°C (86.0°F) or higher

b. When an independent swing operation is performed. (Swing pressure sensor is ON)

c. When travel or option operations are not being performed. (Travel and option pressure sensors are OFF)

[2] Ending conditions for swing relief cut

a. When a swing operation is not being performed (Swing pressure sensor is OFF)

b. When a travel or option operation is performed. (Travel or option pressure sensor is ON)

*1	Center bypass cut
*2	The ground treatment is different.
*3	The hydraulic pressure source is different.

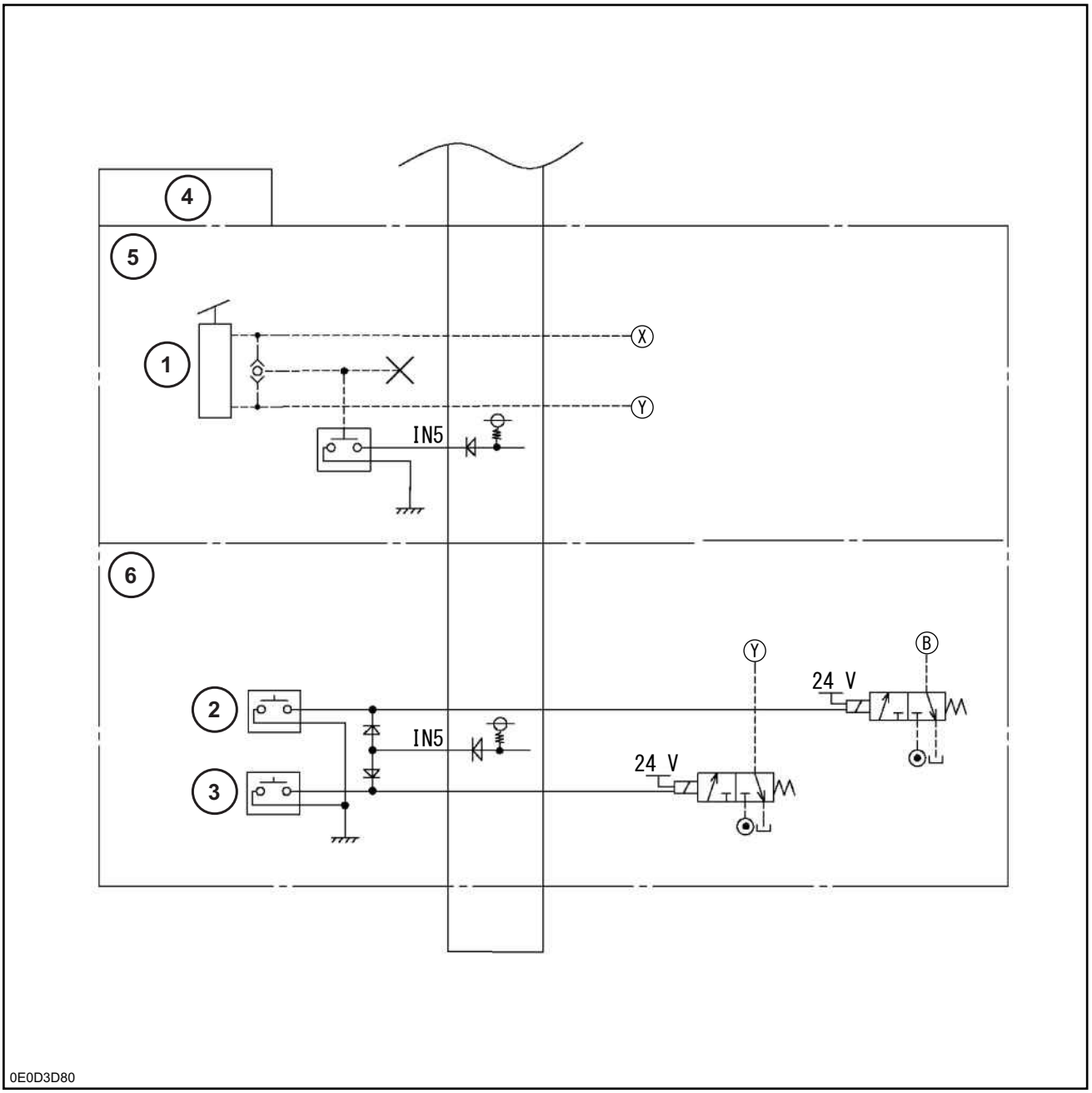
1	Monitor	9	Control valve	17	1st option pressure switch
2	Computer B	10	Crusher	18	1st option switch (L)
3	Breaker mode switch	11	Rotation	19	1st option switch (R)
4	Option select switch	12	3-direction valve	20	1st option
5	Crusher mode switch	13	Shut-off valve	21	Pedal type
6	2 pumps flow switch	14	Solenoid valve for 2 pumps flow	22	Knob switch type
7	2nd option control valve	15	Option switchover solenoid valve		
8	4th pump	16	Option 1 pedal		

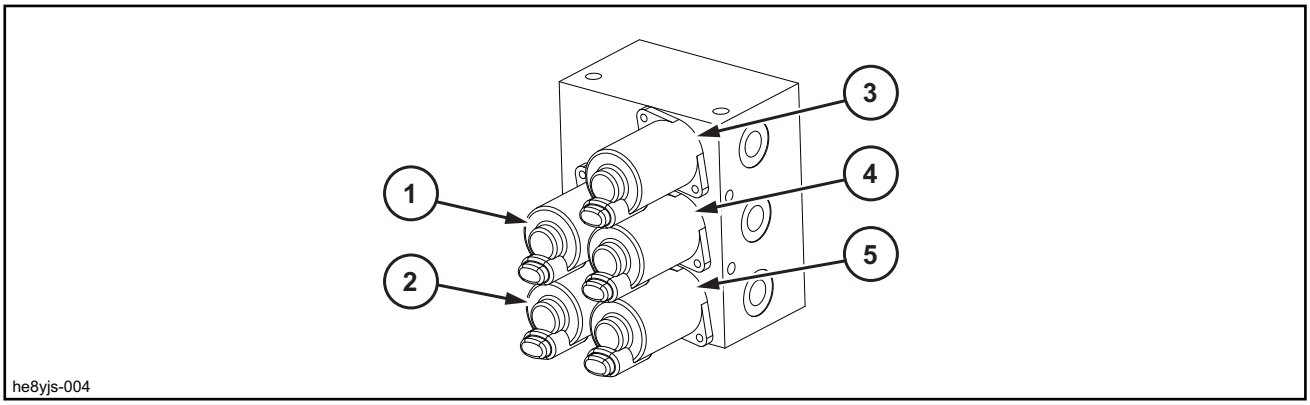
Option select switch switchover (breaker mode ⇔ crusher mode)

Operation explanation

When the option select switch is set to the breaker mode switch side, the option switchover solenoid valve is operated and the shut-off valve and 3-direction valve are switched.

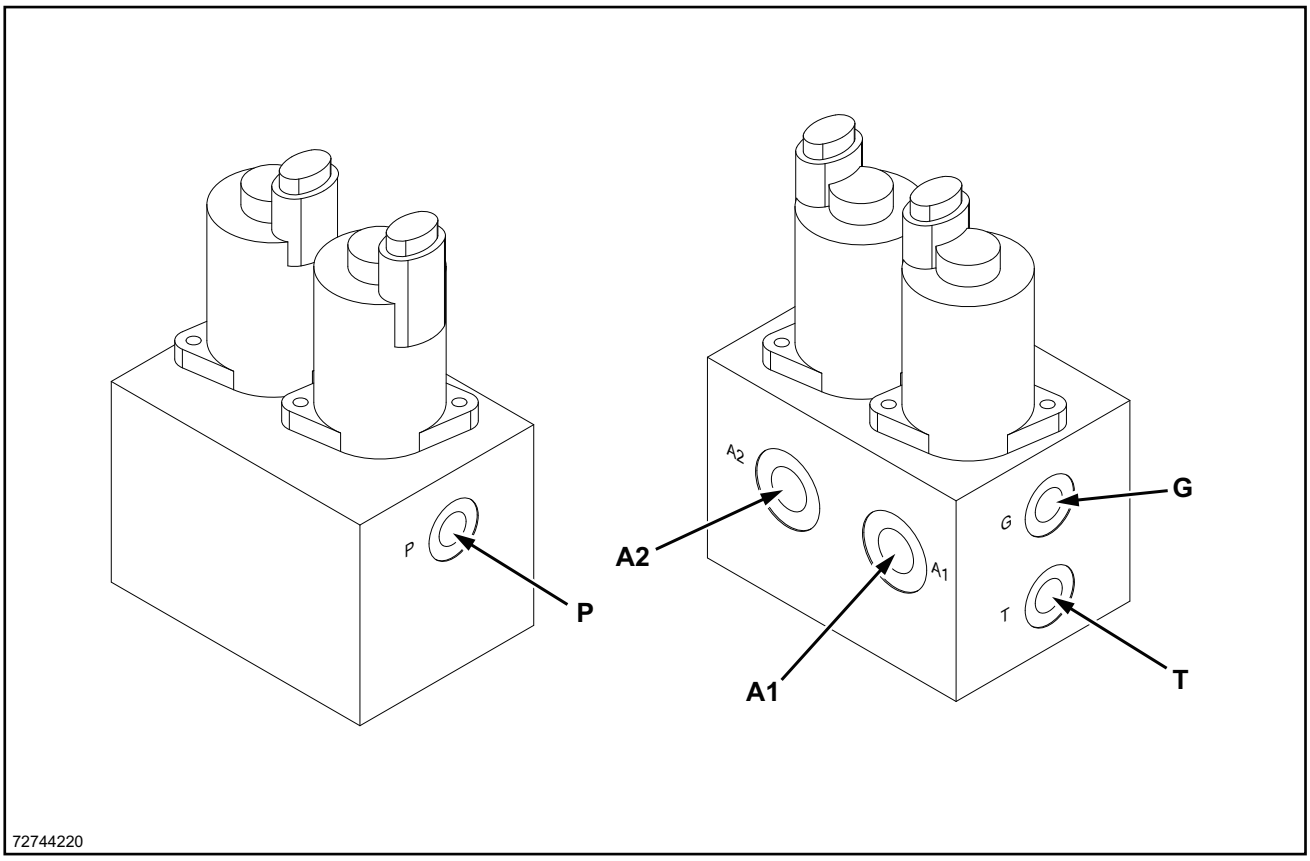
When the switch is switched to the crusher mode, the option switchover solenoid valve goes OFF.





1	Power save solenoid	3	Swing brake solenoid	5	Travel high-speed solenoid
2	Lever lock solenoid	4	Pressure boost relief solenoid		

2 Stack Solenoid Valve



Port	Port size
A1	G1/4
A2	G1/4
T	G1/4
G	G1/4
P	G1/4

Regulator

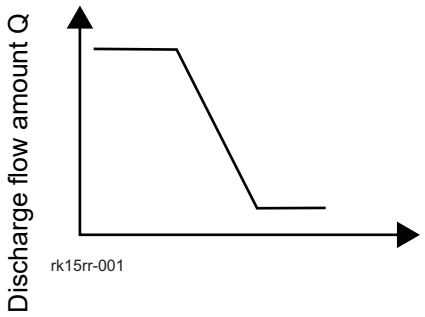
■Regulator Operation Explanation

1. Flow control

・ Operation explanation (See the Regulator Operation Explanation Diagram.)

[1] Flow control

Use pilot pressure Pi to control the pump discharge flow as in the diagram below.



a. Flow reduction operation

When pilot pressure Pi increases, the pilot piston (643) moves to the right and stops at the location where the pilot spring (646) force and hydraulic pressure balance each other. The pin (875) fixed to lever 2 (613) fits into the grooved section of the pilot piston (643). Therefore, as the pilot piston (643) moves, lever 2 rotates with section B (fastened by the fulcrum plug (614) and pin (876)) as the fulcrum. The pin (897) fixed to the feedback lever (611) protrudes into the large opening (section C) of lever 2 (613). Therefore, as lever 2 (613) rotates, the pin (897) moves to the right. The pin (548) fixed to the tilting pin (531) that shakes the swash plate (212) fits into the bolt width section (section D) of the feedback lever (611). Therefore, as the pin (897) moves, the feedback lever (611) rotates with section D as the fulcrum. The spool (652) is coupled to the feedback lever (611) via the pin (874), so the spool (652) moves to the right.

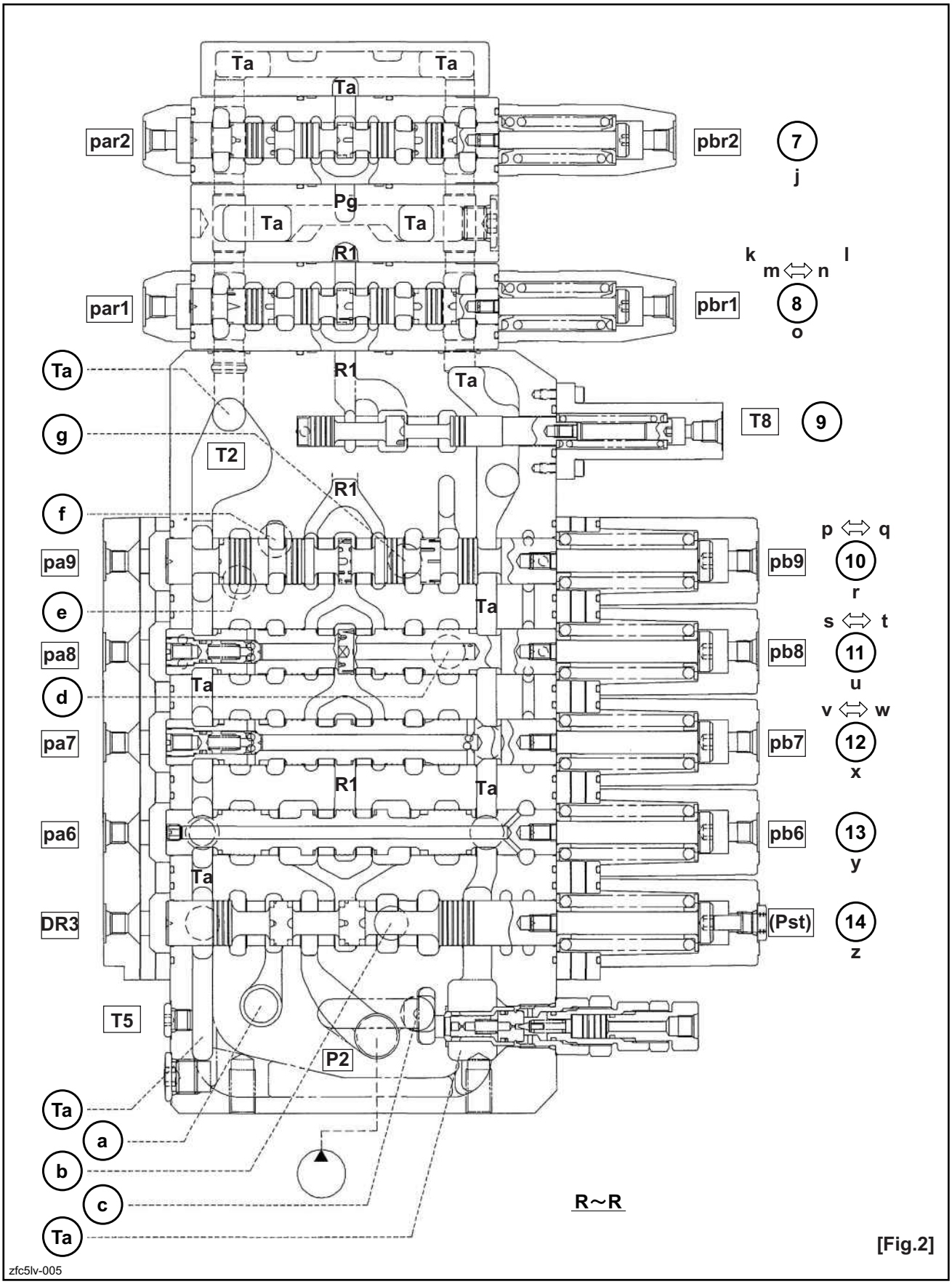
When the spool (652) moves, discharge pressure Pd1 is led to the servo piston large-diameter chamber via the spool and Port Cl. Discharge pressure Pd1 is always led to the servo piston small-diameter chamber. As a result, the servo piston is moved to the right due to the surface area difference and reduces the flow.

When the servo piston (532) moves to the right, section D also moves to the right. The return spring (654) is mounted on the spool (652) and a force pulling the spool to the left is constantly used. Therefore, the pin (897) is pressed into the large opening (section C) of lever 2 (613). Consequently, the feedback lever (611) rotates with section C as the fulcrum in accordance with the movement of section D, and the spool (652) moves to the left. This movement causes the opening between the sleeve (651) and the spool (652) to begin to close, and the servo piston (532) stops at the point where the opening fully closes.

b. Flow increase operation

As pilot pressure Pi decreases, the pilot piston (643) moves to the left due to the force of the pilot spring (646), and lever 2 (613) rotates with section B as the fulcrum. The pin (897) is pressed into the large opening (section C) of lever 2 (613) by the return spring (654) via the spool (652), pin (874), and feedback lever (611). Therefore, in accordance with the rotation of lever 2 (613), the feedback lever (611) rotates with section D as the fulcrum, and the spool (652) moves to the left.

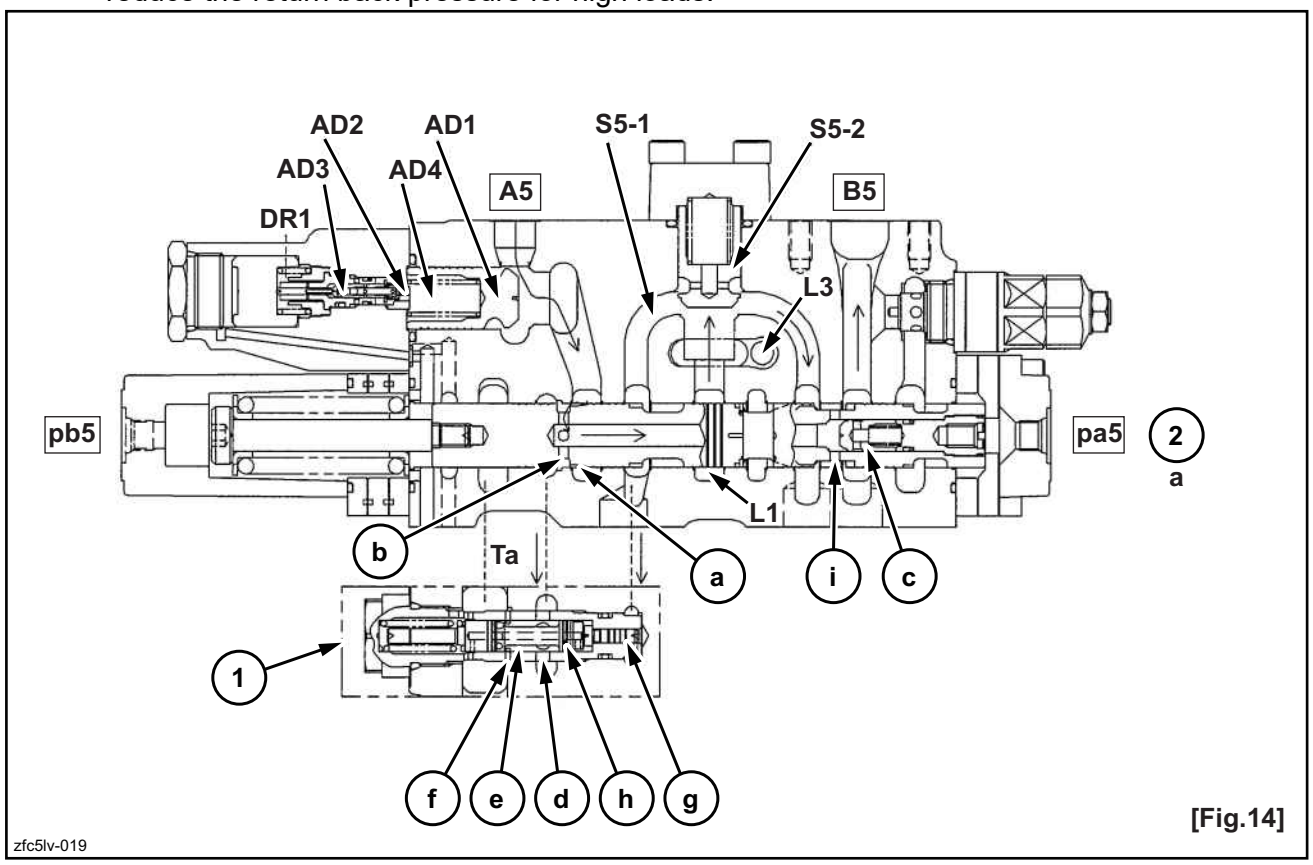
When the spool (652) moves, Port Cl opens to the tank port, so the pressure in the servo piston large-diameter chamber drains out, the servo piston (532) moves to the left due to discharge pressure Pd1 of the small-diameter section and the flow increases.


Ta
Ta
Ta
par2
pbr2
7
j
Pg
Ta
Ta
R1
k
l
m ⇔ n
par1
pbr1
8
o
Ta
R1
Ta
g
T8
9
T2
R1
f
p ⇔ q
pa9
pb9
10
r
e
Ta
s ⇔ t
pa8
pb8
11
u
Ta
d
v ⇔ w
pa7
pb7
12
x
R1
Ta
pa6
pb6
13
y
Ta
DR3
(Pst)
14
z
T5
P2
Ta
a
b
c
Ta
R~R
[Fig.2]
zfc5lv-005

c. Arm in (variable regeneration) [Fig. 14]
For an arm-in operation, after the return oil from Port A5 passes through the notch (a), it divides into 2 paths:

1. The return oil returns to the tank path (Ta) through the fixed orifice (d) in the regeneration control valve, path (e), and the variable orifice (f).
2. The return oil passes through the fixed orifice (b) in the arm 1 spool, the regeneration check (c), and the fixed orifice (i), then merges into the bridge path (S5-1).

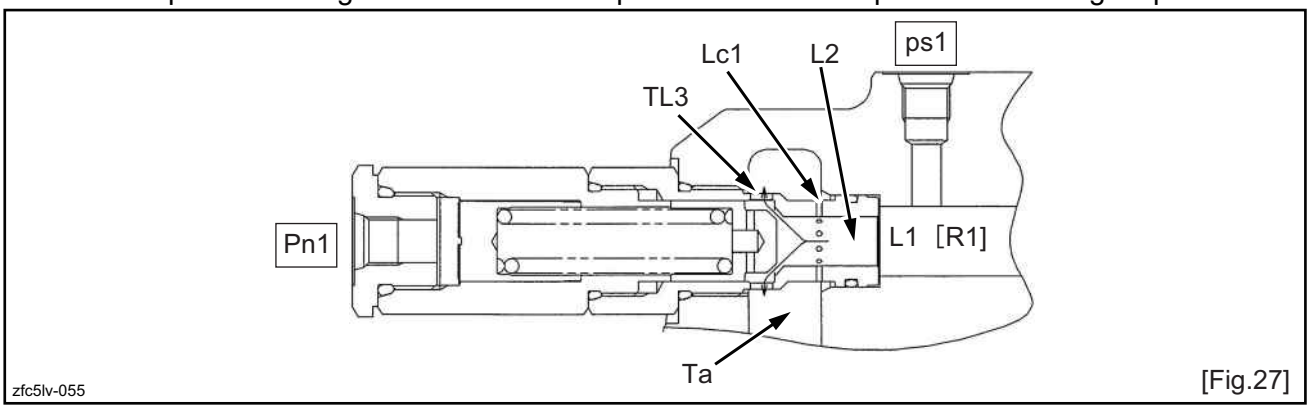
Here, when the bridge path (S5-1) pressure goes higher due to the load pressure at Port B5, the regeneration control valve spool (h) is pressed through the regeneration control valve piston (g), and the opening area of variable orifice (f) section increases, so the quantity of oil returning to the tank path (Ta) increases.
On the other hand, the quantity of oil regenerated at Port B5 decreases.
This variable mechanism allows the system to perform regeneration for low loads and reduce the return back pressure for high loads.



Arm in (variable regeneration)

1	Regeneration control valve (variable)
2	Arm 1 (a: Section 5)

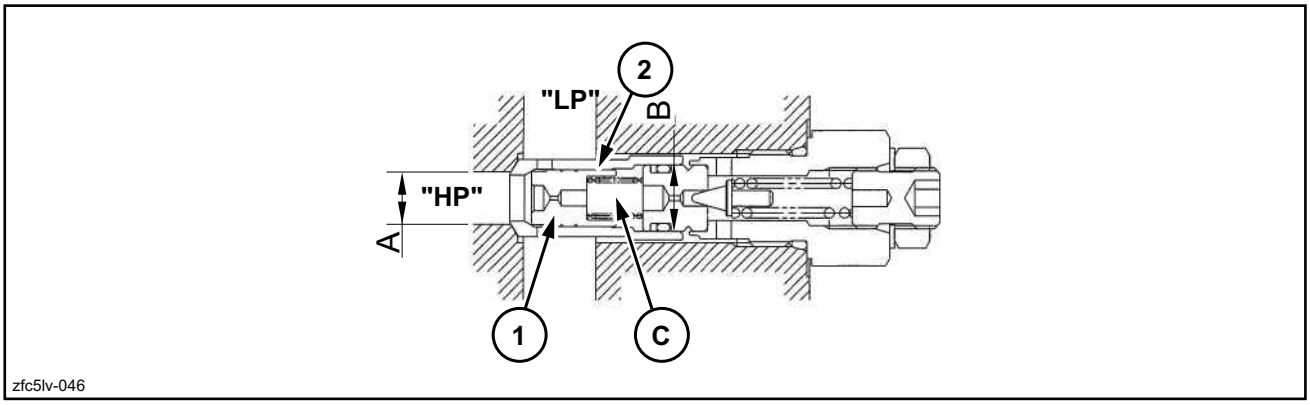
b. Relief operation
When excess oil flows in the path (L2 (R2)), the poppet is operated by the pressure generated in the path (L2 (R2)) by the orifice (Lc1 (Rc1)).
Through this poppet operation, the oil flows out to the tank path [Ta] through the path and the notch hole path of the plug.
This prevents the generation of excess pressure at the low-pressure relief signal port.



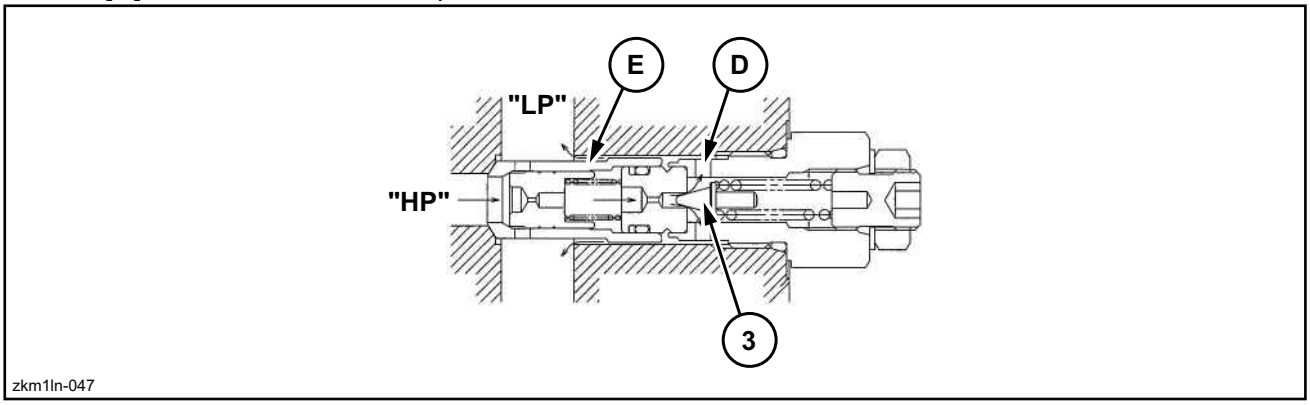
[Fig.27]

[4] Add-on main relief valve

a. Add-on main relief valve operation
This relief valve is incorporated between the neutral path "HP" and the tank path "LP". The oil passes through the metering hole of the main poppet [1] and fills the interior space [C]. Also, the sleeve [2] and the main poppet [1] seat securely operating on the different surface areas "A" and "B".



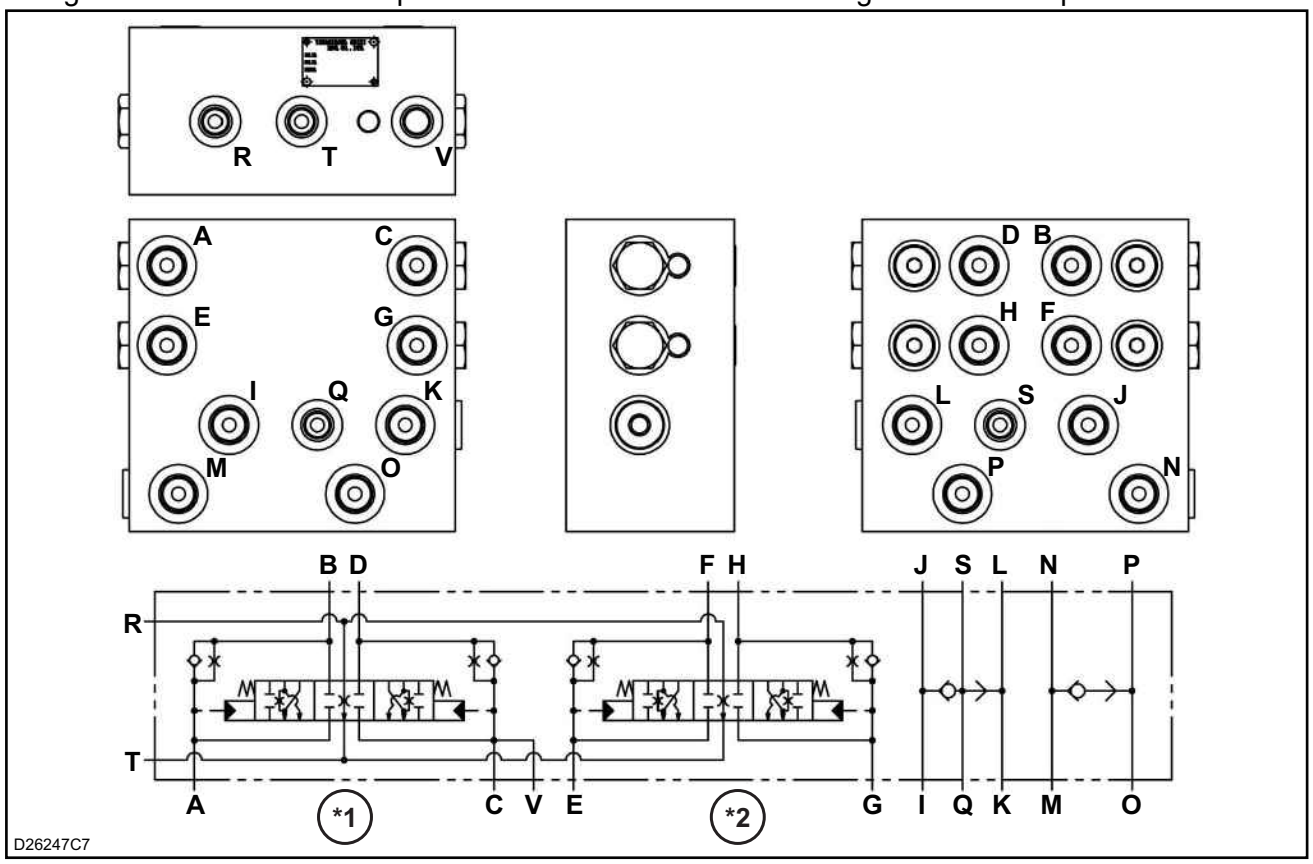
b. When the neutral path "HP" pressure reaches the set pilot spring force, the pilot poppet [3] opens.
The oil flows around the pilot poppet [3], passes through the notch hole [E] and annular gap [D], and is led to the tank path "LP".



Cushion Valve

Structure

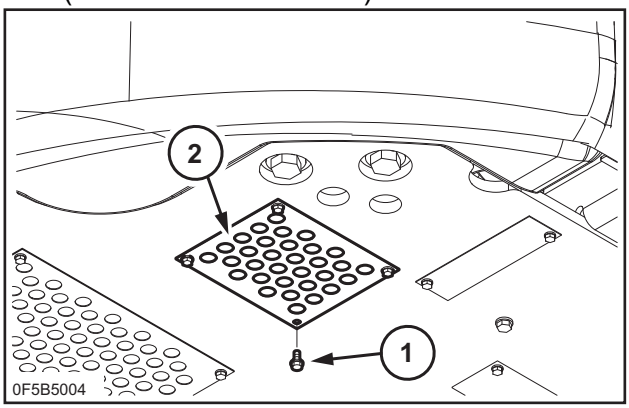
This valve is made up of a shuttle valve section and cushion valve section with a heat circuit.
The cushion valve with a heat circuit is connected between the hydraulic excavator control valve and the pilot operation valve to reduce body shaking (cushion function) caused by emergency stop operations by the operator.
This valve is also equipped with a circuit with which the operator can deliberately disable the cushion function for reverse operations.
The shuttle valve selects the high signal pressure from 2 signal pressure systems.
This valve has 2 circuits.
The heat circuits eliminate the cushion performance fluctuations caused by varied oil viscosity by sending the oil in the oil cooler upstream to Port R to increase the signal line oil temperature.



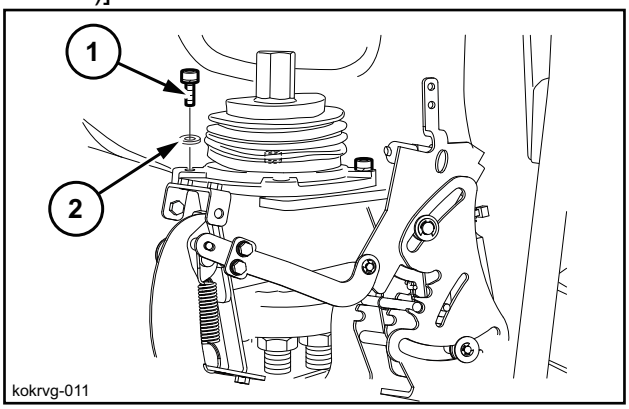
*1	Arm
*2	Boom

- Install the side door (right).(For details, see "Removal and Installation of Side Door".)
- Install the top cover.(For details, see "Removal and Installation of Top Cover".)
- Install the counterweight.(For details, see "Removal and Installation of Counterweight".)

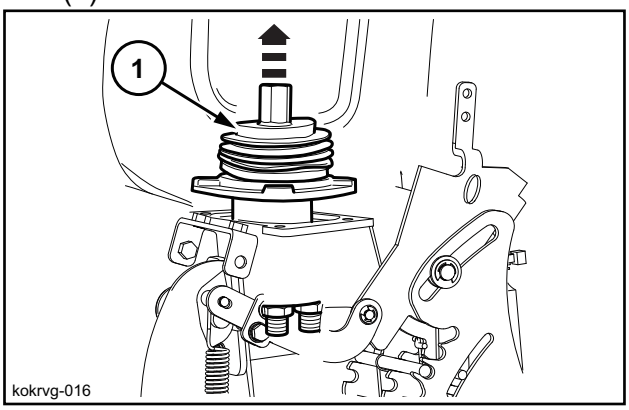
9. Use a wrench [17 mm (0.669 in)] to install the 6 bolts (1) and install the under cover (2).
   Bolt (1) tightening torque: 36.3 - 42.1 N・m (26.779 - 31.056 lbf・ft)



11. Remove the 3 bolts (1) and the 3 washers (2) with a hexagon wrench [5 mm (0.197 in.)].

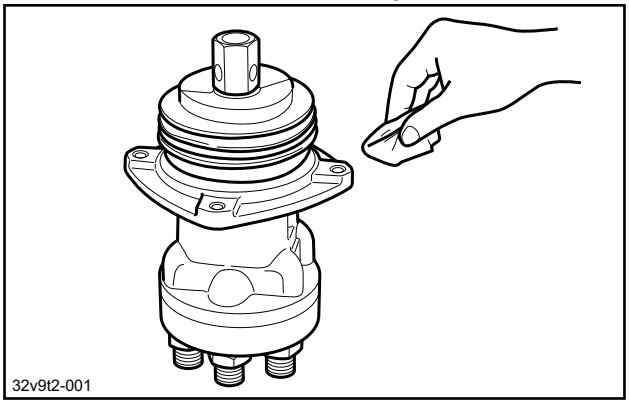


12. Remove the joystick remote control valve (1).

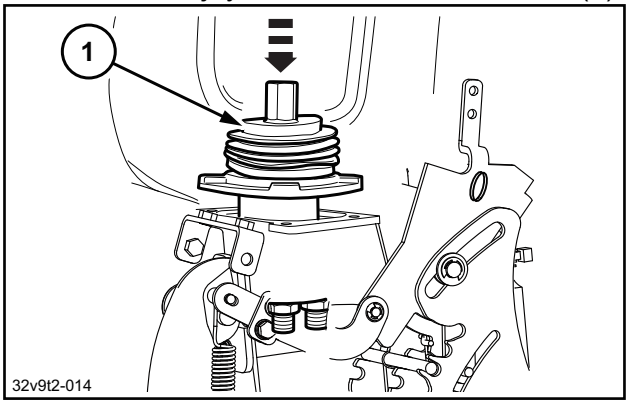


Installation of Operation Remote Control Valve (Left)

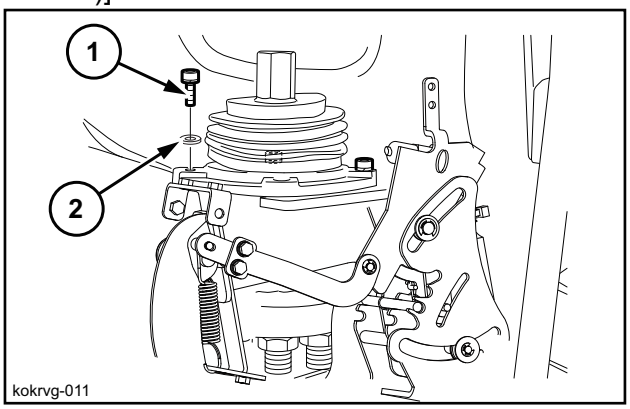
1. Clean each part with a rag etc.



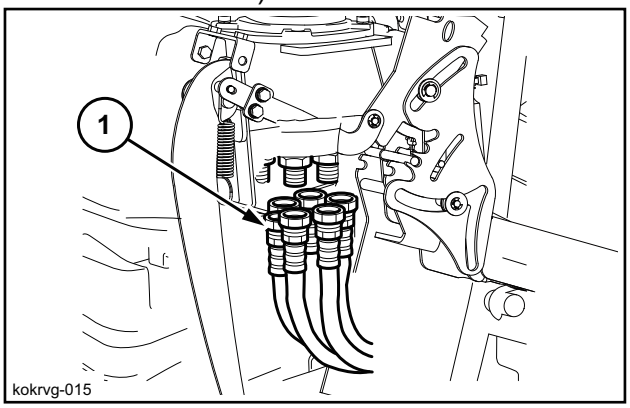
2. Attach the joystick remote control valve (1).



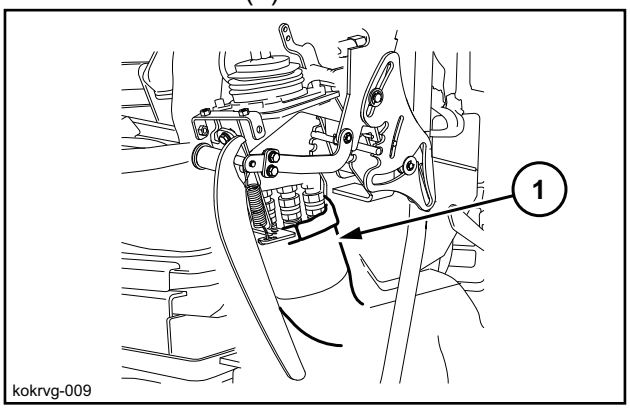
3. Tighten the 3 bolts (1) and the 3 washers (2) with a hexagon wrench [5 mm (0.197 in.)].

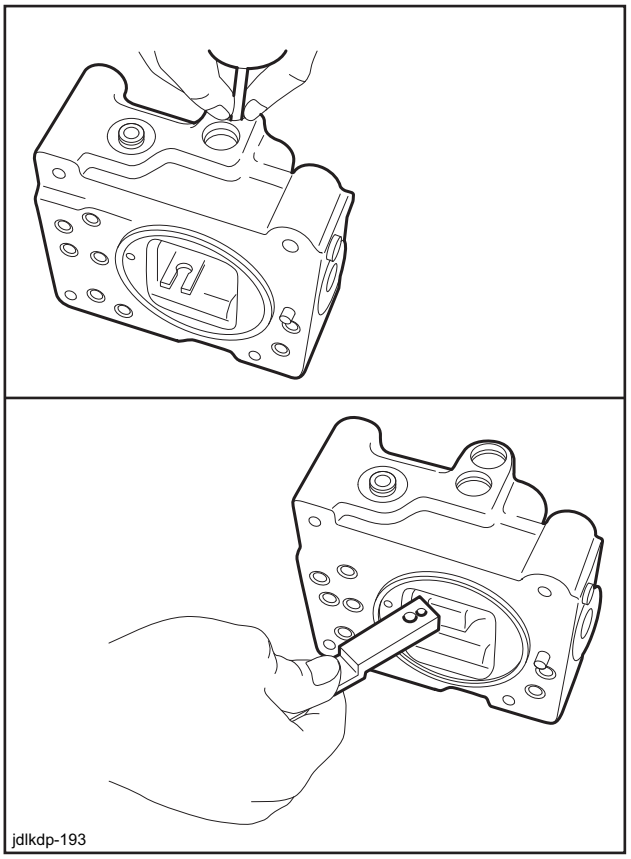


4. Attach the 6 hoses (1) with a wrench [19 mm (0.748 in.)].
   - P port
     Hose adapter tightening torque: 25.4 - 31.4 N•m (18.738 - 23.163 lbf•ft.)
     Hydraulic hose tightening torque: 44 - 54 N•m (32.459 - 39.835 lbf•ft.)
   - T port, 1 to 4 port
     Hose adapter and hydraulic hose tightening torque: 44 - 54 N•m (32.459 - 39.835 lbf•ft.)



5. Put the cover (1) on the hoses.





11. Remove lever 1 (612).
    Do not pull out the pin (875).
12. Pull out the pilot piston (643) and spool (652).
13. Pull out the piston case (622), compensation piston (621), and compensation rod (623) to complete disassembly of the regulator.
    - The piston case (622) can be removed by pushing out the compensation rod (623) from the opposite side of the piston case.

    * The component parts are small, so be very careful not to lose them.

Assembly procedures

The assembly procedure is the reverse of the disassembly procedure. However, follow the precautions below.

[1] Be sure to repair any parts damaged during disassembly, and prepare replacement parts in advance.

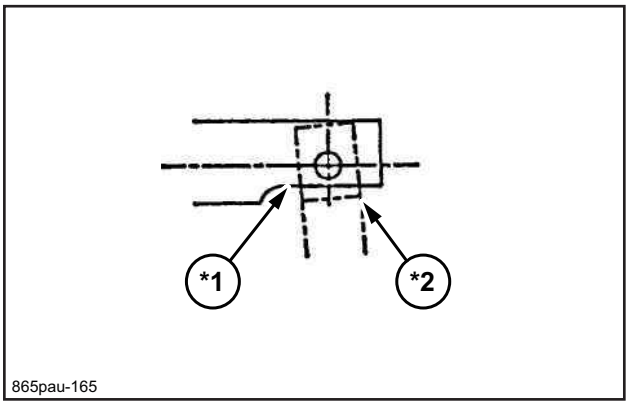
[2] Any foreign matter entering the equipment can create a malfunction. Therefore, after thoroughly cleaning the equipment with cleaning oil, air blow the equipment, and perform assembly in a clean location.

[3] Make sure to tighten bolts and plugs of each section to the specified torque.

[4] Be sure to apply clean hydraulic oil to sliding sections before assembly.

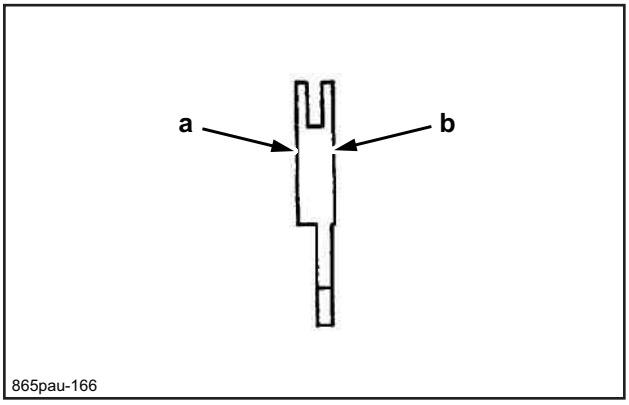
[5] As a rule, replace all seals such as O-rings with new parts.

1. Install the compensation rod (623) into the compensation hole on the casing (601).
2. Insert the pin press fit in lever 1 (612) into the groove on the compensation rod, and install lever 1 on the pin press fit in the casing.
3. Install the spool (652) and sleeve (651) in the casing spool hole.
   - Check that the spool and sleeve slide smoothly in the casing without catching.
   - Be careful to assemble the spool in the correct direction.



*1	Spool
*2	Feedback lever

4. Install the feedback lever (611), and insert the pin (874) in alignment with the pin hole on the feedback lever.
   - This is easier to assemble by inserting the pin into the feedback lever to a small degree in advance.
   - Be careful to assemble the feedback levers in the correct direction.



a	Lever (1) side
b	Lever (2) side (Fulcrum plug, adjusting plug side)

(KR3K-9Y04-HV)
Front side regulator

(KR3K-9X04-HV)
Rear side regulator

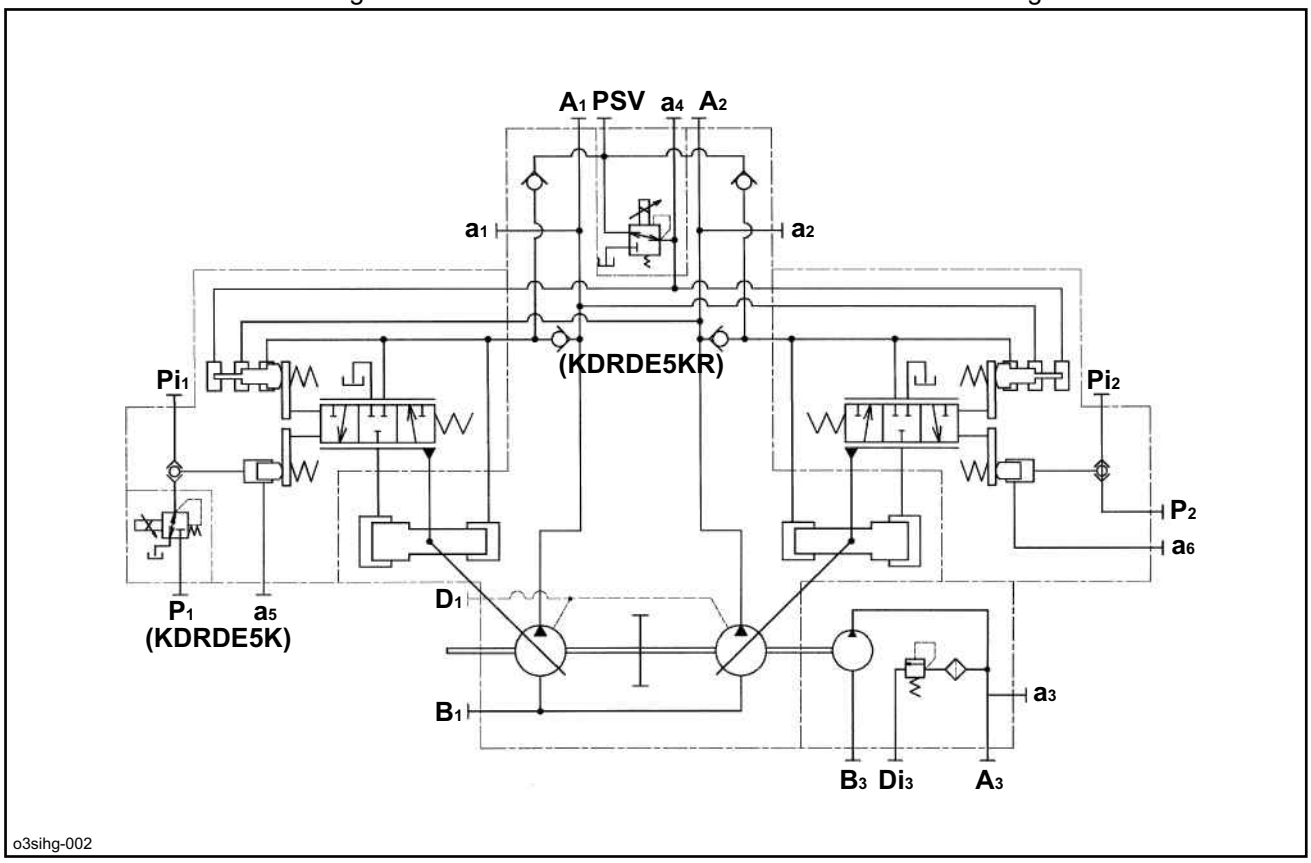


Diagram 1. Regulator operation explanation diagram

8. Disassembly of spool assembly

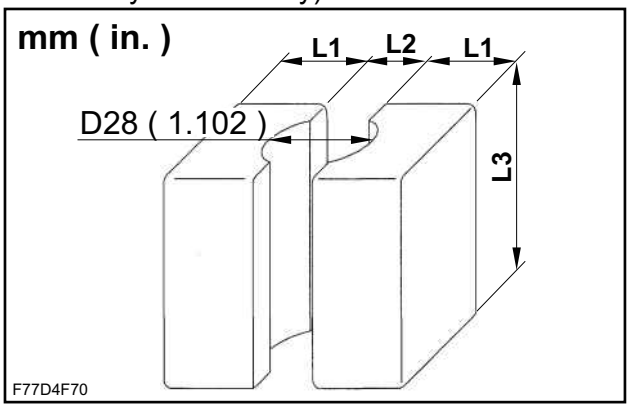
Caution

1.In order to avoid damaging the outer edge of the spool, sandwich the spool with wooden blocks (as in the diagram on the right) and fasten with a vise before starting the work.

2.Since adhesive is applied to the spool end thread section, heat up the outer edge of the spool thread section to break down the adhesive.

3.Heat so that the spool heating temperature is 200 - 250 °C (392.0 - 482.0 °F).
Heat until the spool end loosens easily immediately after the heating.

4.If overheating occurs, replace the spring with a new one. (Wooden blocks for spool assembly/disassembly)



(Wooden blocks for spool assembly/disassembly)

L1	30 - 40 (1.181 - 1.574)
L2	3 - 6 (0.118 - 0.236)
L3	70 - 100 (2.756 - 3.937)

[1] Loosen the spool assembly (2) - (6) and (14) - (17) spool ends [8 mm (0.315 in.) hexagon socket diameter] and disassemble the spring seat and spring.

[2] The spools in spool assemblies (3), (4), (6) and (14) have poppets, springs, plugs, and filters in the spools, but do not disassemble them unless necessary.
When disassembly is required, heat up the outer edge of the spool to break down the adhesive on the thread section, then remove the plug.
When assembling, always replace O-rings and backup rings with new ones.

Disassembly of arm 1 parallel-tandem spool, neutral cut spool section

1. Loosen and remove the hexagon socket head bolts (78) [5 mm (0.197 in.) hexagon socket diameter] for the caps (18) and (86).
2. Remove the O-ring (23) from the cap (18). Remove the O-rings (65) from the housing (1).
3. Pull out the spools (19) and (84) from the valve housing still in the sub-assembly state.
4. Disassembly of spool assembly

Caution

1.In order to avoid damaging the outer edge of the spool, sandwich the spool with wooden blocks for assemble (as in the diagram) and fasten with a vise before starting the work.

2.Since adhesive is applied to the spool end thread section, heat up the outer edge of the spool thread section to break down the adhesive.

3.Heat so that the spool heating temperature is 200 - 250 °C (392.0 - 482.0 °F).
Heat until the spool end loosens easily immediately after the heating.

4.If overheating occurs, replace the spring with a new one.

[1] Loosen the spool (19) spool end (22) [5 mm (0.197 in.) hexagon socket diameter] and disassemble the spring seat (20) and spring (21).

Disassembly of arm regeneration release valve section

Sub-parts in the assembly are expressed as [main number - sub-number].

Caution

1.When removing the plug, pressure left within can make parts fly out dangerously.

2.Slowly loosen the plug to check that there is no resistance due to residual pressure, then disassemble.

1. Loosen and remove the plug (24) [32 mm (1.259 in.) hexagon diameter] and remove the O-ring (25).
2. Remove the spring (26) and spool (27-1) from the sleeve (27-2).
3. Pull out the sleeve (27-2) from the valve housing.

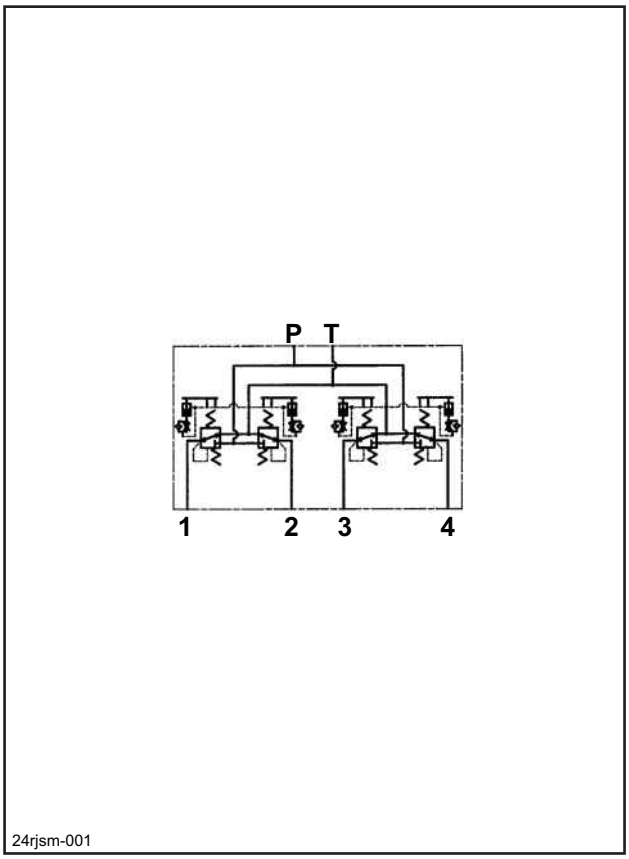
Part list

Code	Part name	Q'ty	Code	Part name	Q'ty
1	Valve housing	1	49	Poppet	1
2	Spool assembly	1	51	Poppet	1
3	Spool assembly	1	52	Flange	2
4	Spool assembly	1	53	Spacer	2
5	Spool assembly	2	54	O-ring	2
6	Spool assembly	1	55	Backup ring	2
7	O-ring	20	56	O-ring	1
10	Cap assembly	1	57	Spacer	1
11	Cap assembly	1	58	Sleeve	1
13	Valve housing	1	59	Poppet	1
14	Spool assembly	1	60	Spring	1
15	Spool assembly	1	61	Flange	1
16	Spool assembly	1	63	O-ring	4
17	Spool assembly	1	64	O-ring	3
18	Cap	1	65	O-ring	10
19	Spool	1	66	O-ring	13
20	Spring seat	2	67	Antidrift valve assembly	2
21	Spring	1	68	Relief valve kit	1
22	Spool end	1	69-1	Relief valve kit	5
23	O-ring	1	69-2	Relief valve kit	1
24	Plug	1	70	Relief valve assembly	2
25	O-ring	1	71	Plug assembly	3
26	Spring	1	72	Plug assembly	9
27	Spool assembly	1	73	Plug assembly	3
28	Cap assembly	1	74	Socket head bolt	12
29	Cap assembly	1	75	Socket head bolt	46
30	O-ring	1	76	Socket head bolt	20
31	Backup ring	2	77	Socket head bolt	8
32	Poppet	2	78	Socket head bolt	4
33	Spring	2	79	Name plate	1
34	Poppet	7	80	Drive screw	2
35	Spring	8	82	Plug	4
36	O-ring	10	83	Socket head bolt	4
37	Flange	6	84	Spool assembly	1
38	Poppet	2	86	Cap	1
39	Spring	2	88	Cap	2
40	Orifice plug	1	89	O-ring	2
41	O-ring	17	90	O-ring	2
42	Body assembly	1	91	Plug	1
43	Flange	1	92	Plug assembly	2
44	Poppet	1	93	Plug assembly	2
45	Spring	1	95	Outlet housing	1
46	Plug	1	96	Tie rod	4
47	O-ring	1	97	Nut	4
48	Spring	1	110	Plug assembly	1

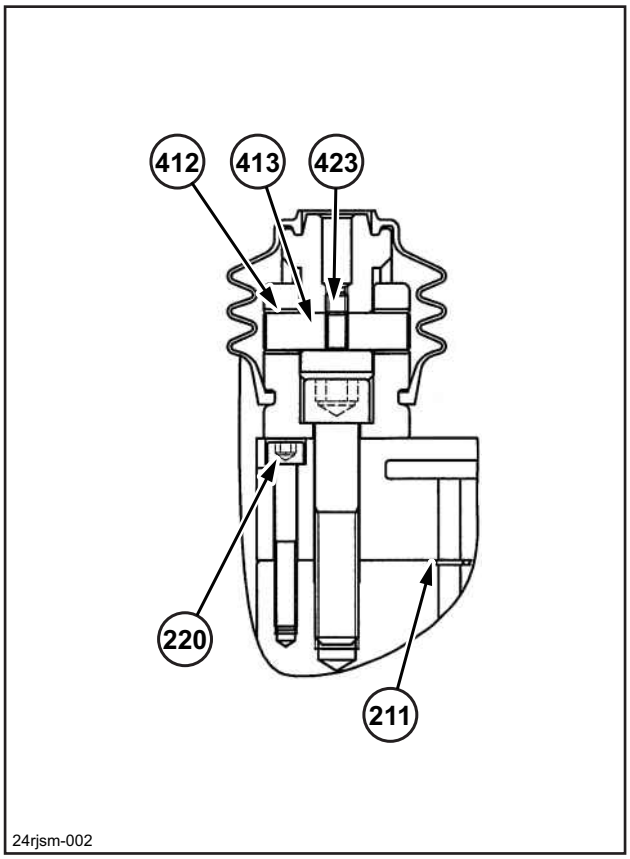
Causes of Trouble and Countermeasures

It is not easy to discover trouble locations.
A few problems that may sometimes occur are listed in the table below.
Repairs are difficult, so refer to the possible causes and solutions in the table.
The table below shows general symptoms, suggested causes, and also solutions.
However, the cause of machine problems are often not rooted in just a single part. Problems are often due to the relationship of one part with another.
Also keep in mind that solutions other than those listed in the table may sometimes be necessary.
The numbers in parentheses after the part names are the codes indicated in "Attached diagram 1 Remote control valve assembly cross-section diagram".
The table below does not include all possible causes and countermeasures.
Further investigation of problems and causes should be done by an experienced and qualified repair person, as necessary.

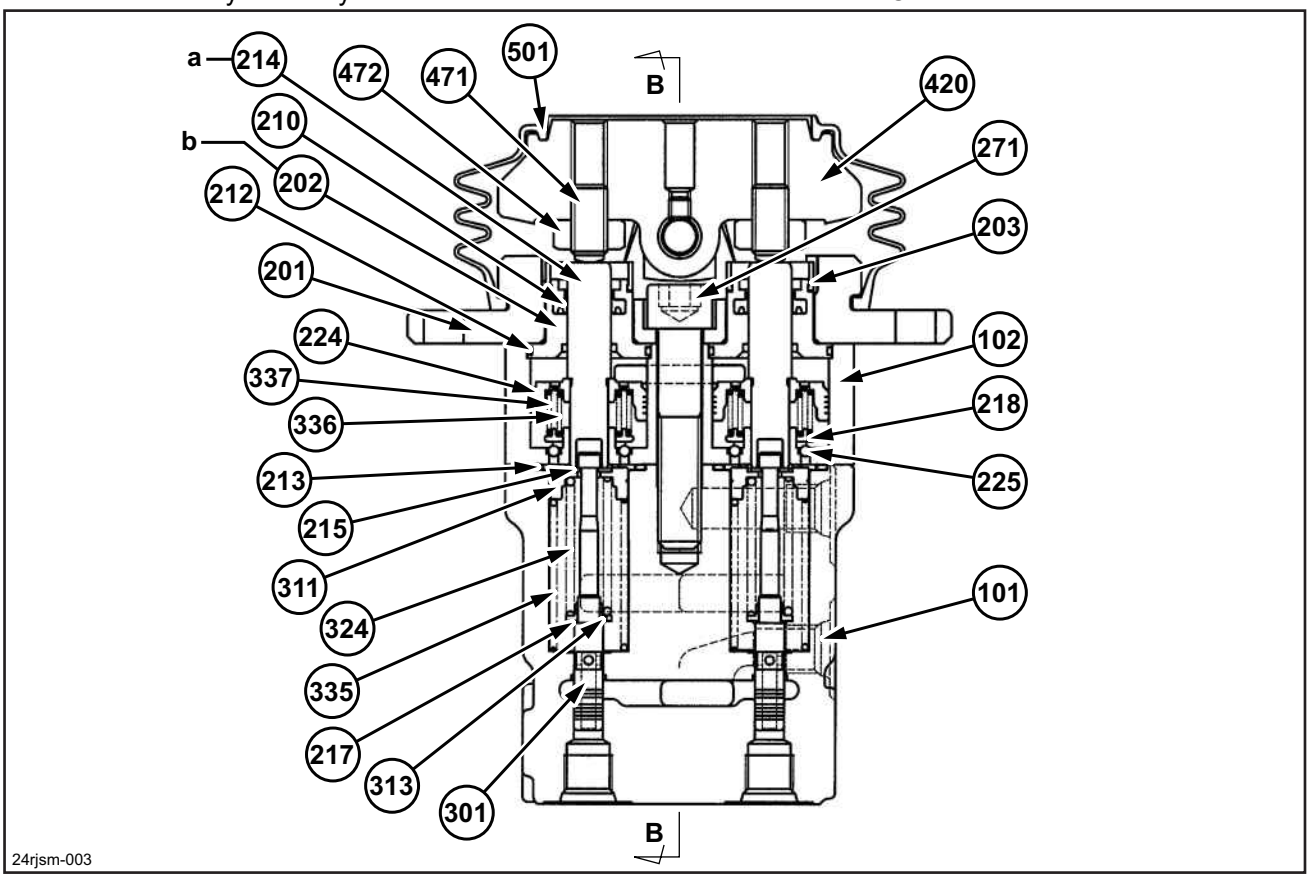
Symptom	Cause	Solution
Secondary pressure is not rising.	1. Insufficient primary pressure 2. Secondary pressure spring (241) is broken or worn. 3. The gap between spool (201) and the casing (101) is abnormally large. 4. There is backlash in the handle section.	1. Maintain primary pressure. 2. Replace it with new part. 3. Replace the remote control valve as one unit. 4. Assemble and disassemble and/or replace the handle section.
Secondary pressure is unstable.	1. Sliding parts are sticking. 2. Tank line pressure is variable. 3. Air is getting into lines.	1. Repair the sticking sections. 2. Return directly to the oil tank. 3. Perform operation several times and let out air.
Secondary pressure is high.	1. Tank line pressure is high. 2. Sliding parts are sticking.	1. Return directly to the oil tank. 2. Repair the sticking sections.



Hydraulic symbols



Cross section B-B

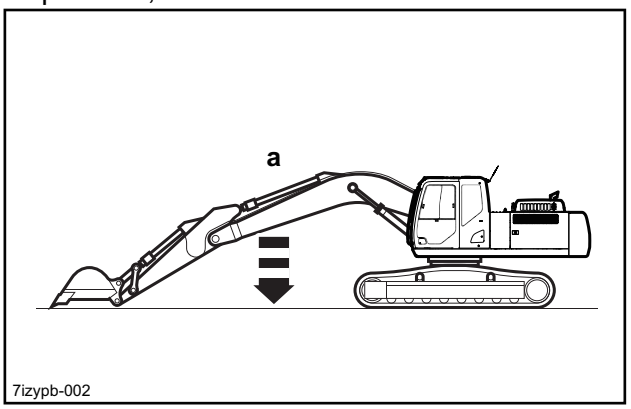


Attached diagram 1. Remote control valve assembly cross-section diagram

2 pumps flow measuring port	P2	P2	No	No	P1	P1
Pressure boost	36.8 MPa (5337.98 psi)					29.4 MPa (4264.58 psi)
Standard pressure	34.3 MPa (4975.34 psi)					29.4 MPa (4264.58 psi)

■Boom-down pressure measurement

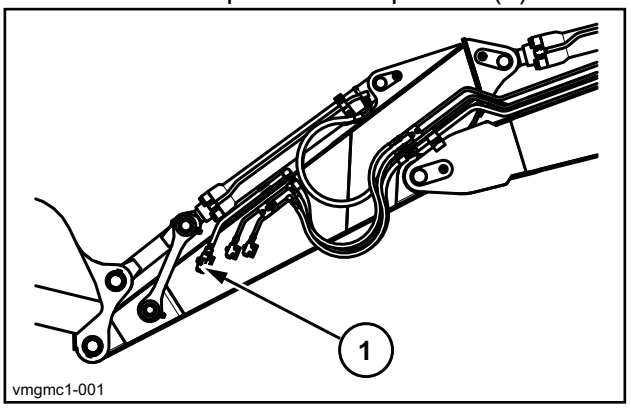
For pressure measurement with the boom down, put the arm cylinder at its out stroke end, open the bucket, put the bucket tip on the ground, carry out the boom-down operation, and measure.



a	Boom-down relief

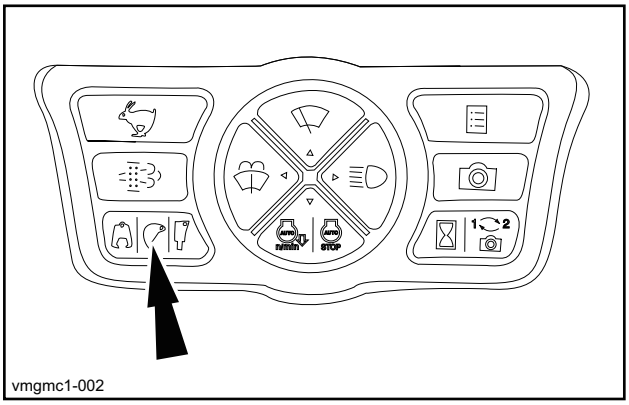
D. Option Line Pressure Measurement

1. Close the option line stop valve (1).



2. Switch the monitor attachment select switch to the option line to be measured. (Breaker/crusher)
3. Measure with the following operations.

Engine speed	1700 min^{-1} (1700 rpm)
Work mode	SP mode
Pedal operation	Option relief
Oil temperature	45 (113.0) - 55°C (131.0°F)
Measuring port	1 pump: P2 port
	2 pumps: P1 port

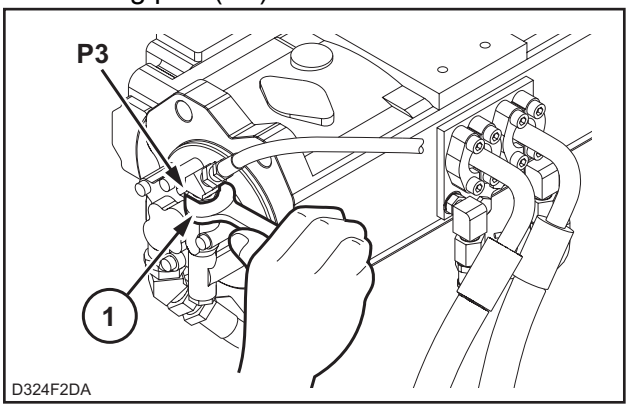


* Adjust the set pressure to match the specifications of the attachment used.

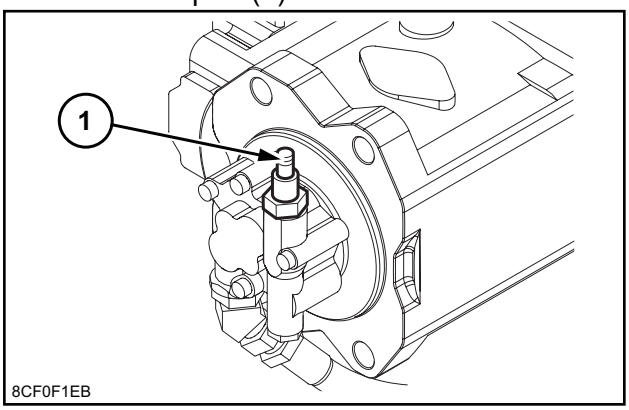
Pilot Pressure Measurement

Installation of Pressure Gauge

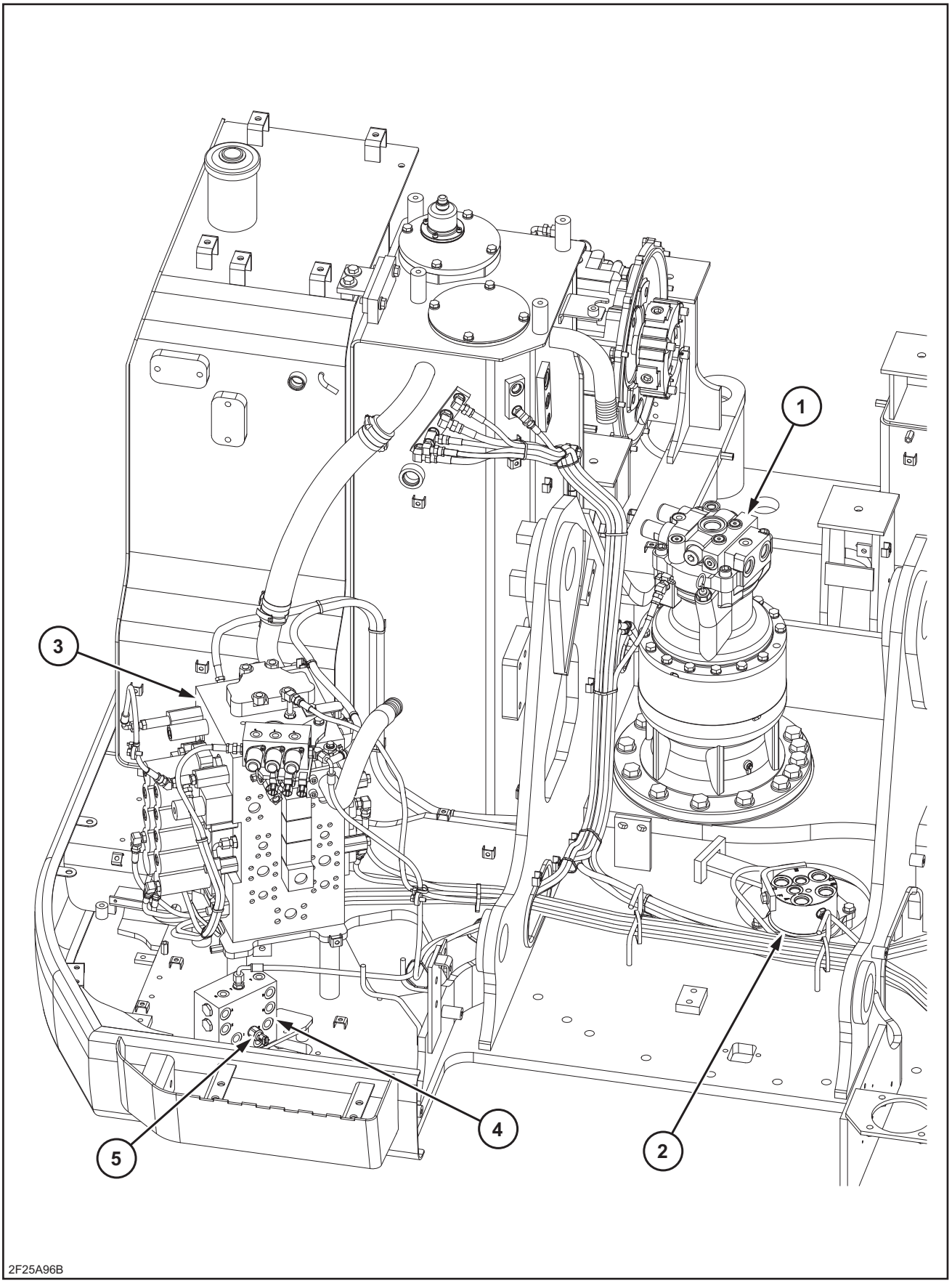
Remove the plug with the wrench (1) to install a pressure gauge at the pump pressure measuring port (P3).



Install the adapter (1).



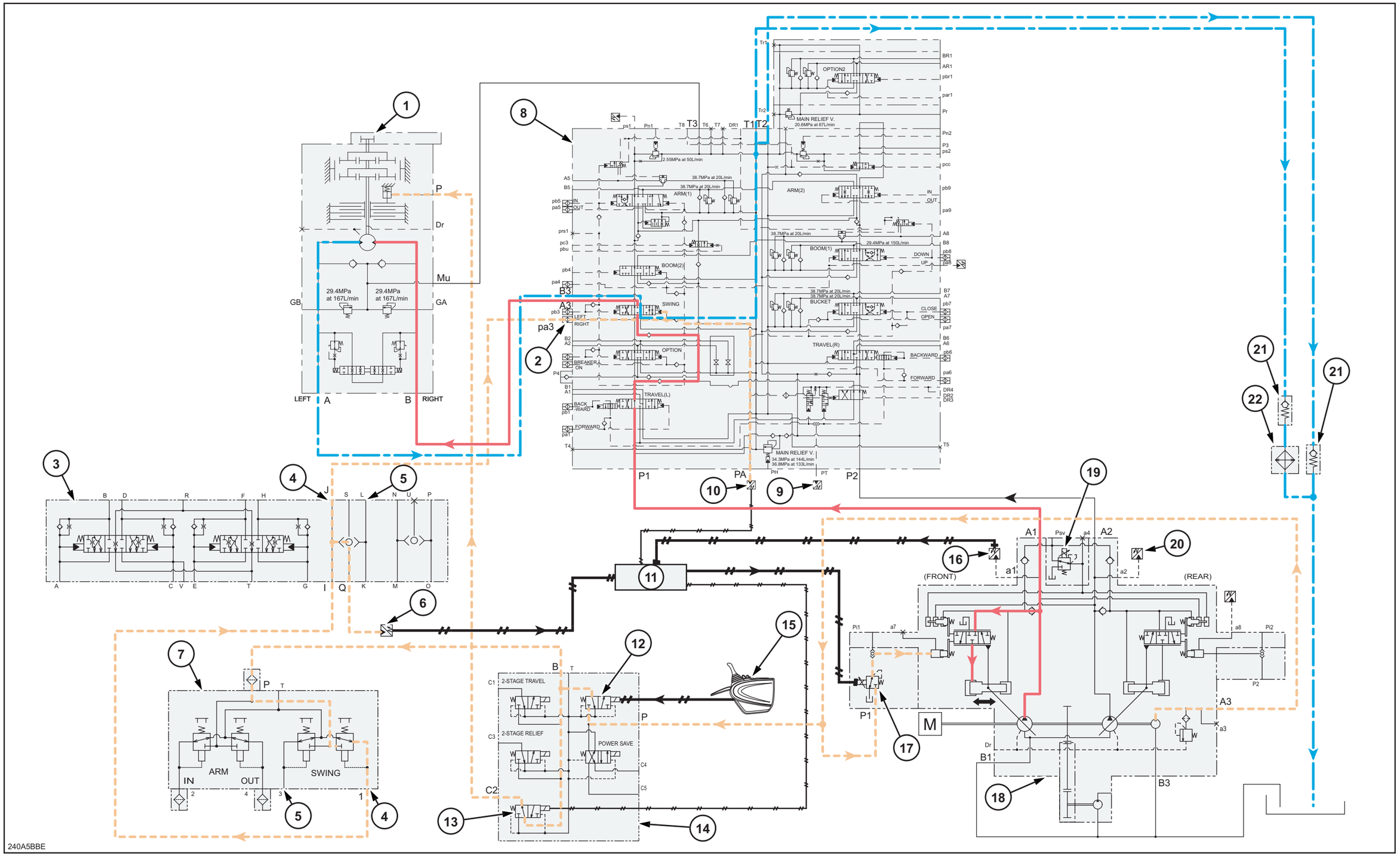
SWING BODY CENTER SECTION HYDRAULIC EQUIPMENT



1	Swing motor	3	Control valve	5	Swing pilot pressure sensor
2	Center joint	4	Cushion valve		

Swing circuit

Swing speed limit control circuit



240A5BBE

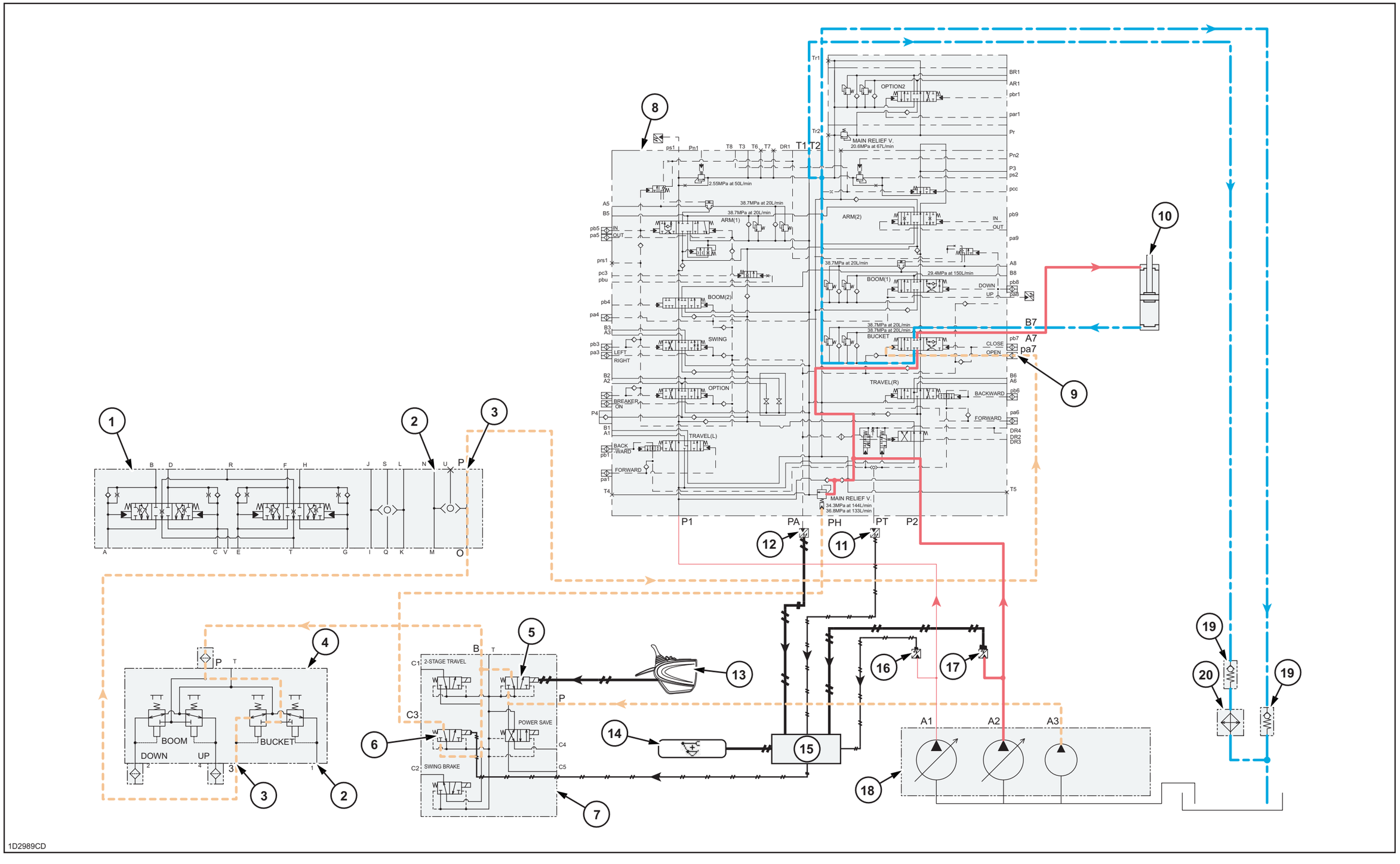
	Pressure line		Pilot tank line
	Tank line		Electric line
	Pilotpressure line		

1	Cushion valve	9	Control valve	17	Computer A
2	Boom (up)	10	Boom load holding valve check valve	18	P1 pressure sensor
3	Boom (down)	11	Boom (1)	19	P2 pressure sensor
4	Boom (2)	12	Boom cylinder	20	Hydraulic pump
5	Remote control valve (boom, bucket)	13	Travel pilot pressure sensor	21	Check valve
6	Lever lock	14	Upper pilot pressure sensor	22	Oil cooler
7	Boost pressure relief	15	Console lever lock switch	23	Boom HBCV check valve
8	5 stack solenoid valve	16	Monitor display		

By operating the remote control valve to the boom-up side, the pilot pressure oil is fed via the cushion valve to the control valve Pa4 port and the boom (2) spool is switched. At the same time, the pilot pressure oil from the Pa4 port separated in the internal path is fed to the boom (1) pilot port and switches the boom (1) spool to the up side.
The discharge oil from hydraulic pump A1 enters the control valve P1 port, is fed from the parallel oil path to the boom (2) spool and merges downstream of the boom (1) spool. The discharge oil from hydraulic pump A2 is fed to the boom (1) spool via the parallel oil path, merges with the discharge oil from boom (2), pushes open the boom load hold valve check valve, (flows through the boom cylinder HBCV check valve when the circuit has an HBCV) and into the bottom side, and the boom-up operation is carried out.
The boom cylinder rod side return oil goes through the boom (1) spool and returns into the hydraulic oil tank.

Bucket circuit

Bucket-open circuit



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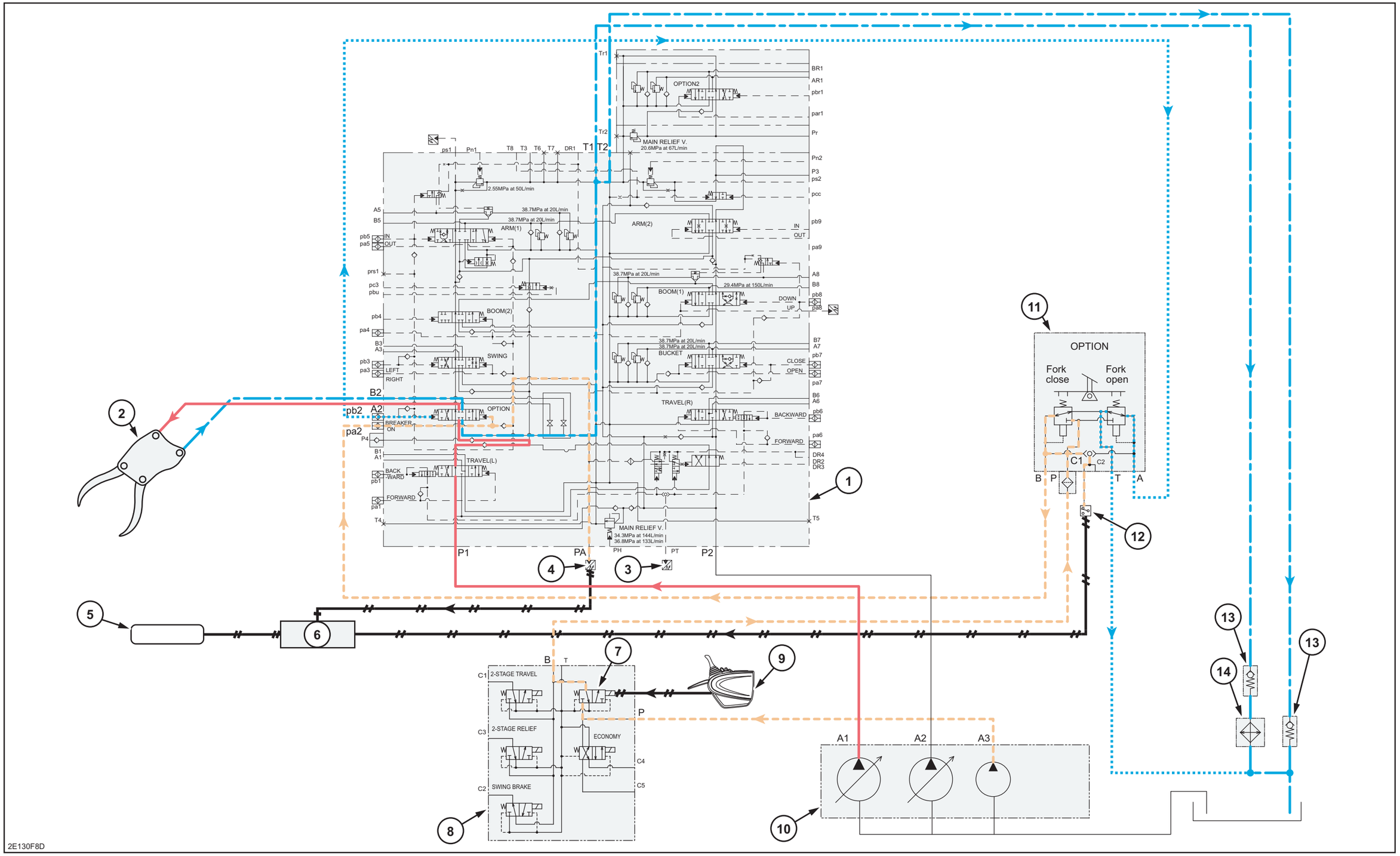
	Pressure line		Pilot tank line
	Tank line		Electric line
	Pilotpressure line		

1	Arm (in)	7	Remote control valve (arm, swing)	13	Console lever lock switch
2	Arm (out)	8	Lever lock	14	Hydraulic pump
3	Cushion spool	9	5 stack solenoid valve	15	Check valve
4	Orifice	10	Control valve	16	Oil cooler
5	Check valve	11	Arm (1)		
6	Cushion valve	12	Arm (2)		

When a remote control valve arm-out operation is carried out, the pilot pressure oil enters from the remote control valve 2 port into the cushion valve, pushes up the internal check valve, and is fed to the control valve pa5 and pa9 ports.
At the same time, the cushion valve cushion spool is switched to the left.
The arm-in side oil pushed out from the control valve pb9 and pb5 ports passes from the cushion valve B port through the cushion spool switched to the left and returns to the hydraulic oil tank.
At this time, the warmed oil from the return line enters the remote control valve through the cushion spool from the cushion valve R port and returns to the hydraulic oil tank, so heat performance is improved.

Double-acting circuit (hydraulic fork)



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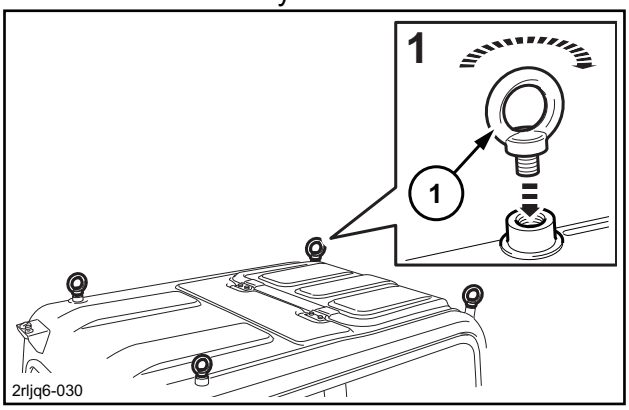
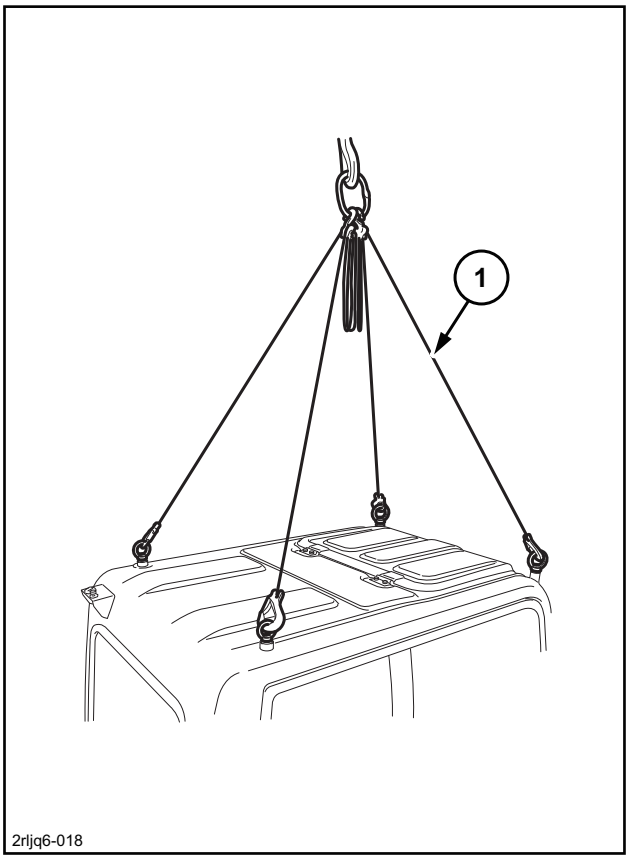
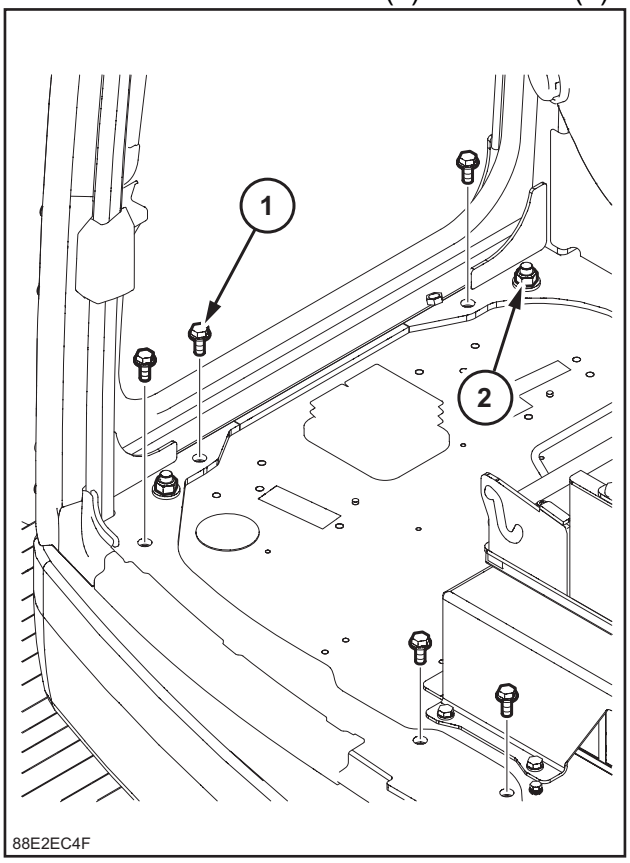
11. Install the 4 eyebolts (M24) (1) in place of the removed caps.
    - Fully tighten the eyebolts, and then loosen them by a half turn.

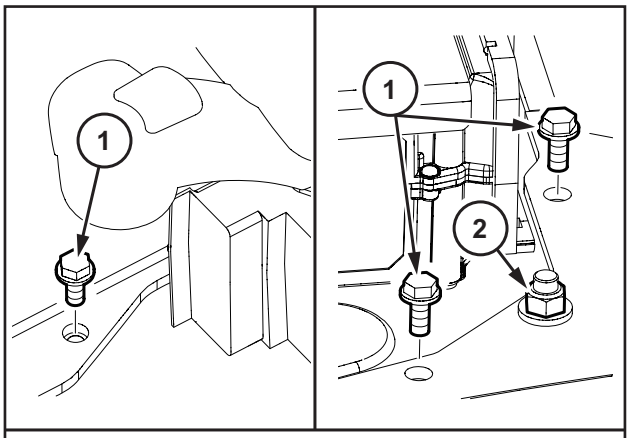


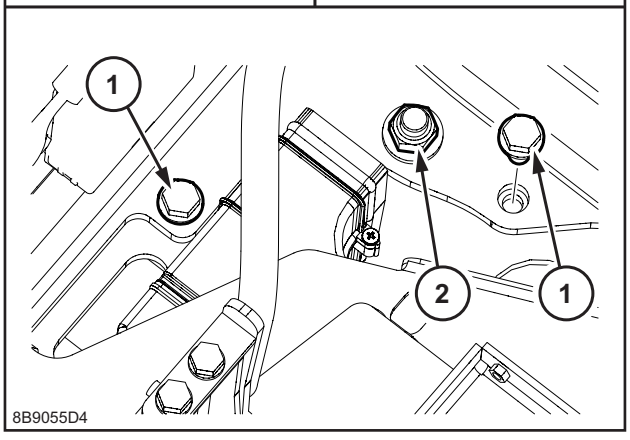
12. Use chains (1) and liftcrane to secure the cab.



13. Use a wrench [19 mm (0.748 in)] to remove the 10 cab bolts (1) and 4 nuts (2).





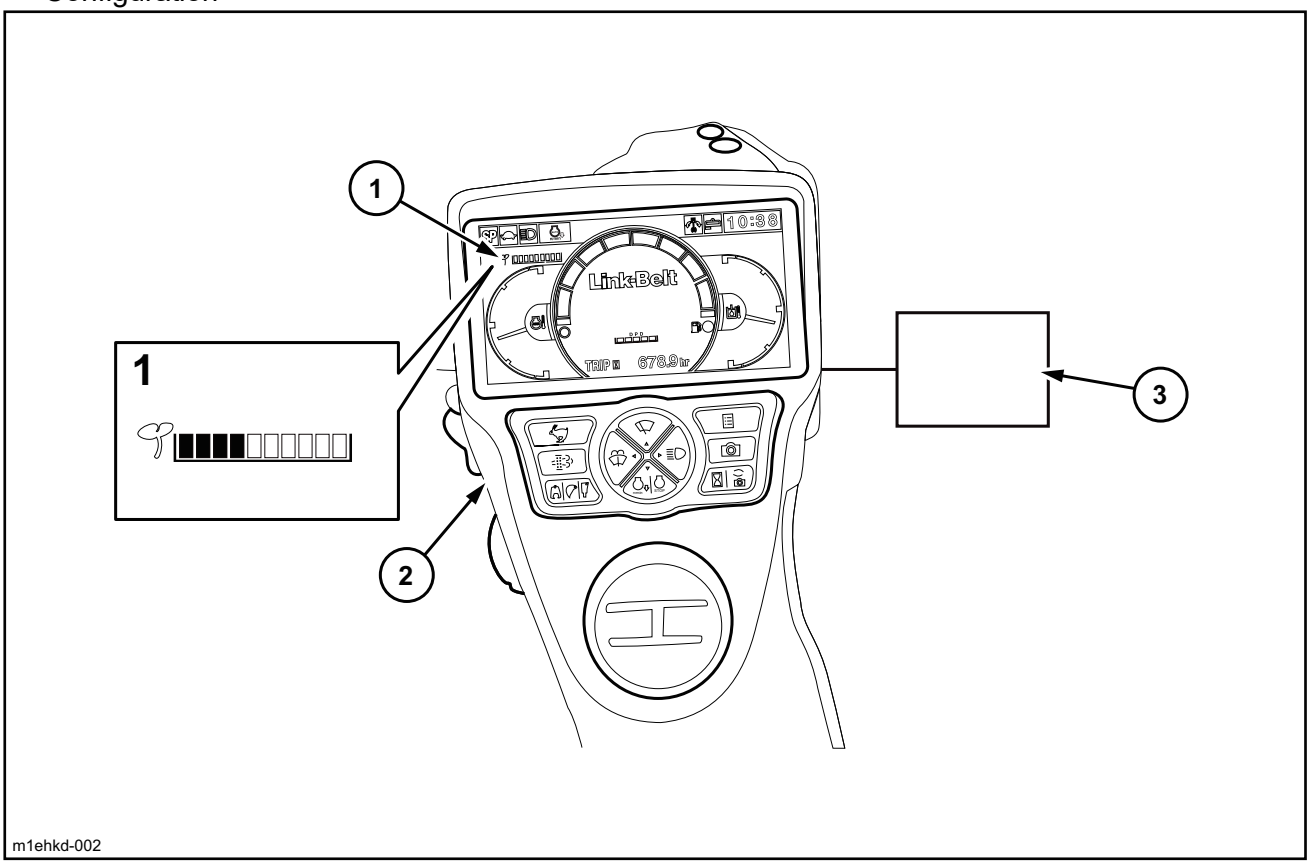


Eco Gauge

Purpose/summary

Displays the energy-saving performance on the monitor. (Energy-saving function)

Configuration



1	Eco gauge
2	Monitor
3	Computer A

Operation explanation

[1] The eco gauge is displayed on the monitor.

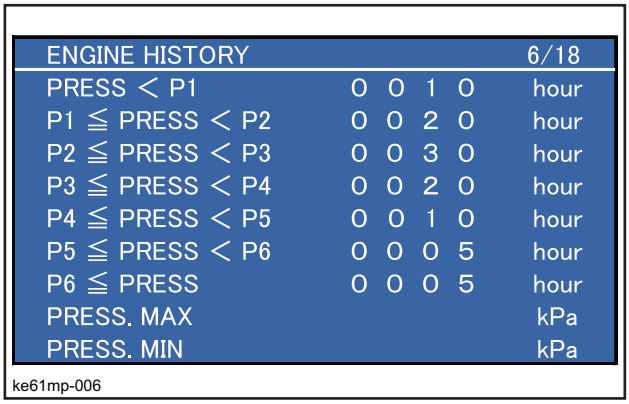
[2] The energy-saving performance is displayed in levels from 0 to 9. (The higher the number, the better the energy-saving performance.)
In SP mode, 0 to 9.
In H mode, 2 to 9.
In A mode, 4 to 9.

[3] Leaving it idle for 3 min. or more makes the gauge drop.

	Unit	130X3	145X3	160X3	210X3	235X3	250X3	300X3	350X3	470X3
or the option is being operated	Y / N	N	N	N	N	N	N	N	N	Y
Transient load milli-amp boost rate (below/ above 300)	mA / 10ms	20 / 5	20/5	20 / 5	20 / 5	20 / 5	20 / 5	20 / 5	20 / 5	20 / 5
Transient load relief judgment	MPa (psi)	30 (4351.61)	30 (4351.61)	30 (4351.61)	30 (4351.61)	30 (4351.61)	30 (4351.61)	30 (4351.61)	33 (4786.77)	30 (4351.61)
Speed limit	Y / N	N	N	N	Y (SP)	N	Y (SP)	N	Y (SP)	N
Speed limit milli-amp	mA	50	50	50	350	50	350	50	370	50

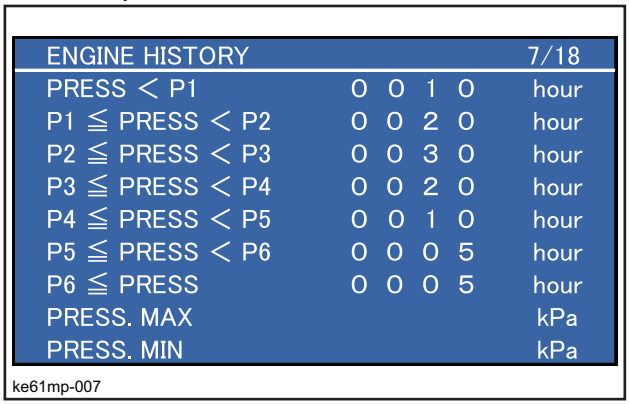
T6 ≦ TEMP.	hour	100 ≦ T
TEMP. MIN	°F	-
TEMP. MAX	°F	Maximum temperature

6. Barometric pressure distribution



PRESS. < P1	hour	P < 100
P1 ≦ PRESS. < P2	hour	100 ≦ P < 140
P2 ≦ PRESS. < P3	hour	140 ≦ P < 180
P3 ≦ PRESS. < P4	hour	180 ≦ P < 220
P4 ≦ PRESS. < P5	hour	220 ≦ P < 260
P5 ≦ PRESS. < P6	hour	260 ≦ P < 300
P6 ≦ PRESS.	hour	300 ≦ P
PRESS. MAX	psi	Maximum pressure
PRESS. MIN	psi	Minimum pressure

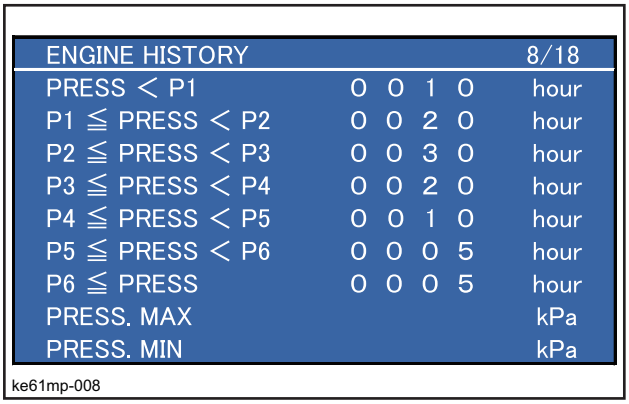
7. Oil pressure distribution



PRESS. < P1	hour	P < 0
P1 ≦ PRESS. < P2	hour	0 ≦ P < 150
P2 ≦ PRESS. < P3	hour	150 ≦ P < 300
P3 ≦ PRESS. < P4	hour	300 ≦ P < 450
P4 ≦ PRESS. < P5	hour	450 ≦ P < 600
P5 ≦ PRESS. < P6	hour	600 ≦ P < 750

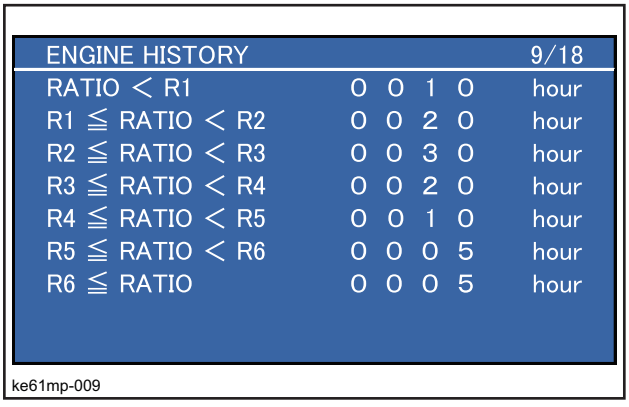
P6 ≦ PRESS.	hour	750 ≦ P
PRESS. MAX	psi	Maximum pressure
PRESS. MIN	psi	Minimum pressure

8. Boost pressure distribution



PRESS. < P1	hour	P < 0
P1 ≦ PRESS. < P2	hour	0 ≦ P < 150
P2 ≦ PRESS. < P3	hour	150 ≦ P < 300
P3 ≦ PRESS. < P4	hour	300 ≦ P < 450
P4 ≦ PRESS. < P5	hour	450 ≦ P < 600
P5 ≦ PRESS. < P6	hour	600 ≦ P < 750
P6 ≦ PRESS.	hour	750 ≦ P
PRESS. MAX	kPa	Maximum pressure
PRESS. MIN	kPa	Minimum pressure

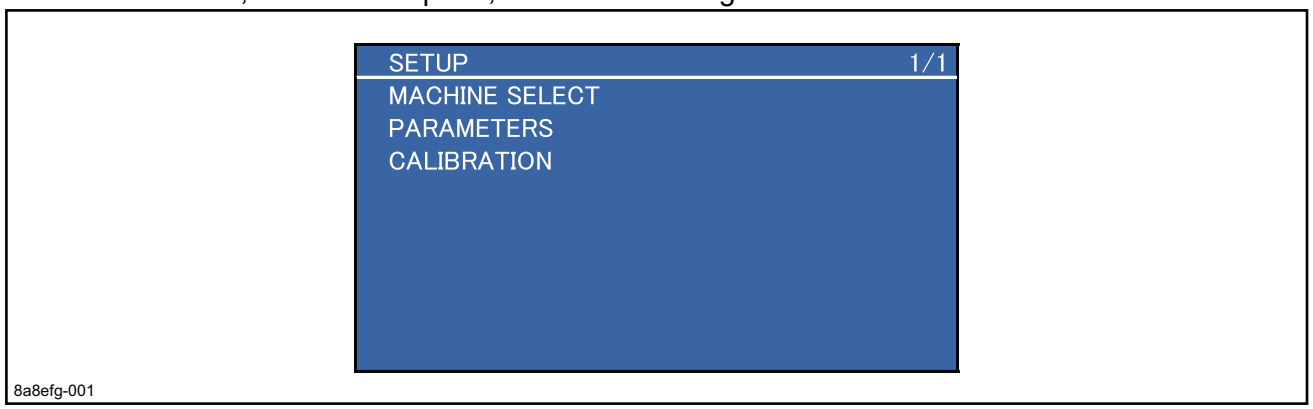
9. Load ratio distribution



RATIO < R1	hour	R < 30
R1 ≦ RATIO < R2	hour	30 ≦ R < 40
R2 ≦ RATIO < R3	hour	40 ≦ R < 50
R3 ≦ RATIO < R4	hour	50 ≦ R < 60
R4 ≦ RATIO < R5	hour	60 ≦ R < 70
R5 ≦ RATIO < R6	hour	70 ≦ R < 80
R6 ≦ RATIO	hour	80 ≦ R

SETUP Screen List

The model selection, work mode speed, etc. can be changed.



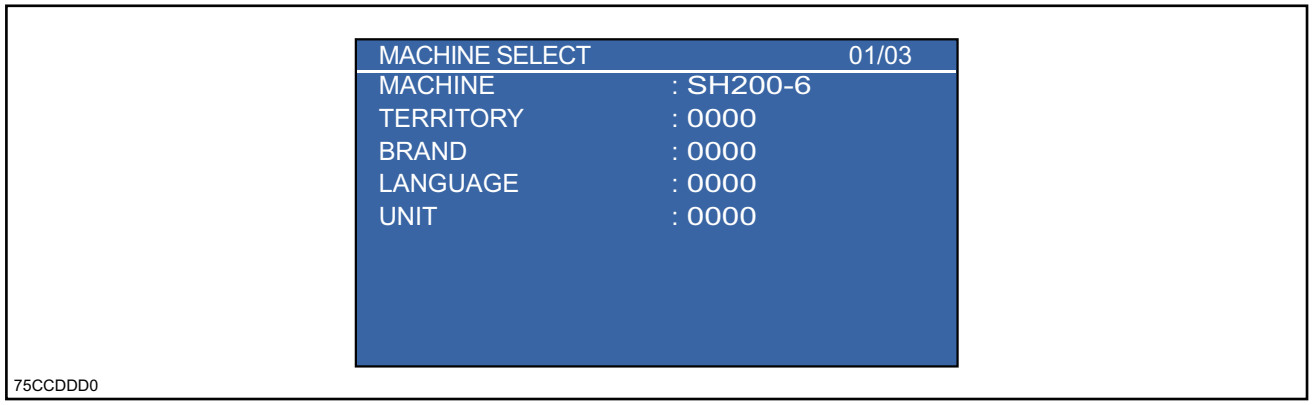
By pressing and on the monitor, MACHINE SELECT, PARAMETERS, etc. can be selected.

Detailed data for the selected item can be seen by pressing [ ].

MACHINE SELECT

Machine destination information, etc. are registered.

1. Model selection



MACHINE	Model
TERRITORY	Destination
BRAND	Brand
LANGUAGE	Language
UNIT	Unit

MACHINE

Model	Remarks
SH0120-6	
SH0150-6	
SH0180-6	
SH0200-6	
SH0240-6	
SH0290-6	
SH0330-6	
SH0450-6	
SH0125-6	
SH0225-6	

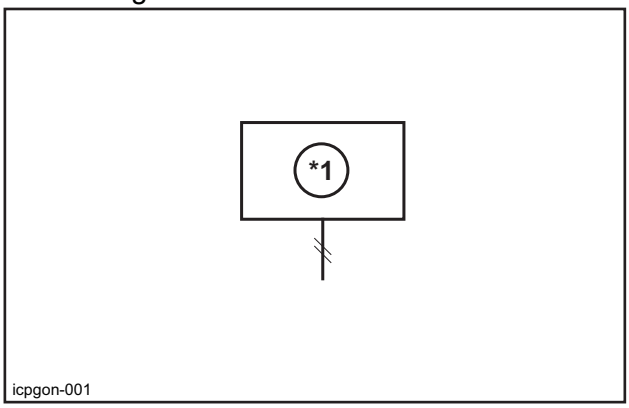
Clock Adjustment

Summary

Adjusts the clock that is displayed on the monitor.

- See the page for information on the clock.

Configuration



*1	Monitor

Operation explanation

[1] The system displays "--:--" on the monitor when the key is turned ON.

[2] The operator sets the time using the "CLOCK ADJUST" function on the menu screen.
Use the right and left buttons to move the cursor and use the top and bottom buttons to change the time, then press the menu switch to confirm the values.

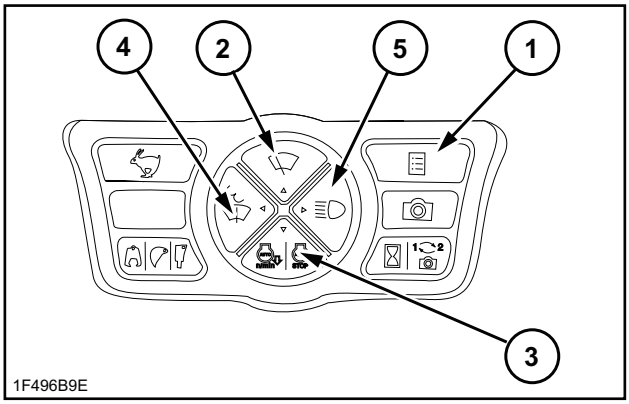
[3] The system displays the time on the monitor.

- The clock data is stored in the monitor, so the data remains stored even if computer B is replaced.

If the monitor is replaced, the time must be set again.

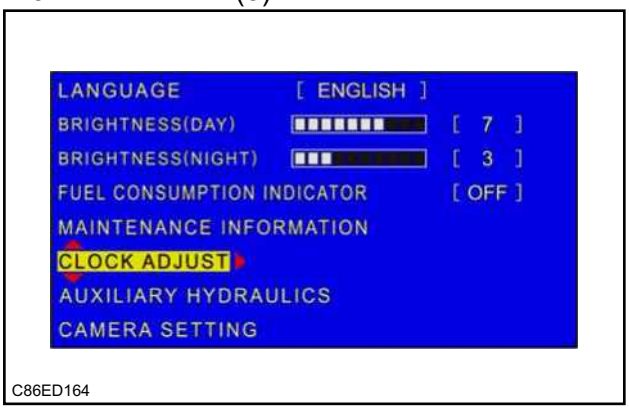
How to adjust the clock

1. Press button (1) to display the menu screen.

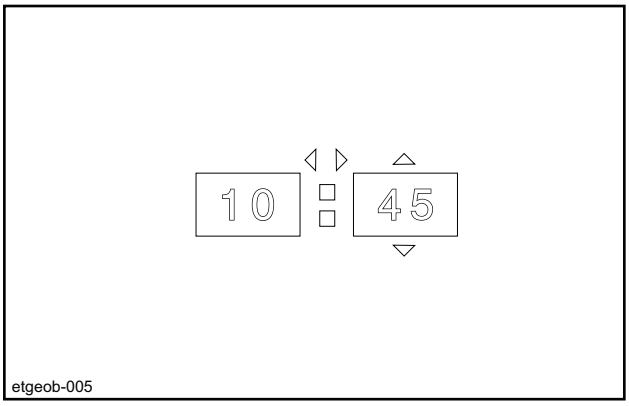


2. Press either button (2) or (3) and select "CLOCK ADJUST" on the menu screen.

3. Press button (5).

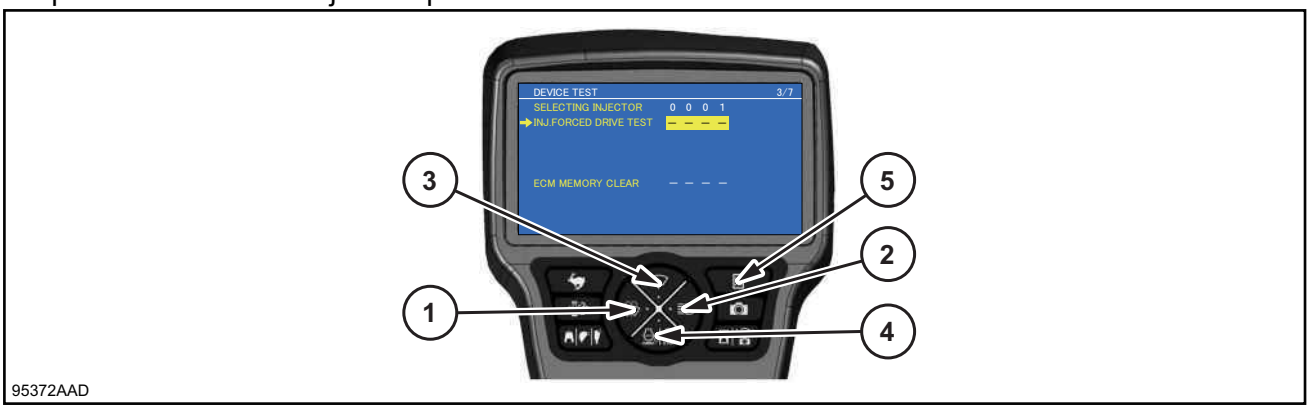


4. Press the buttons to set the time.
   - Press either (2) or (3) to switch between hour and minute.
   - Press either (4) or (5) to increase or decrease the number.
5. Press button (1) to return to the menu screen.



■Injector Forced Drive Test

Purpose: To check the injector operation.



Procedure

-Condition for the test-

With the key ON and engine stopped

Common rail pressure is less than 5 MPa (725.27 psi).

[1] Select the forced drive injector.

Select "SELECTING INJECTOR" (injector select) with switches (3) and (4).

Press the switches (1) and (2) to set the injector number.

[2] Performing a test

Select "INJ.FORCED DRIVE TEST" (injector forced drive test) with switches (3) and (4).

Hold down the switch (2) for 2 sec., then "- - - -" changes to "+ + + +" and the test starts.

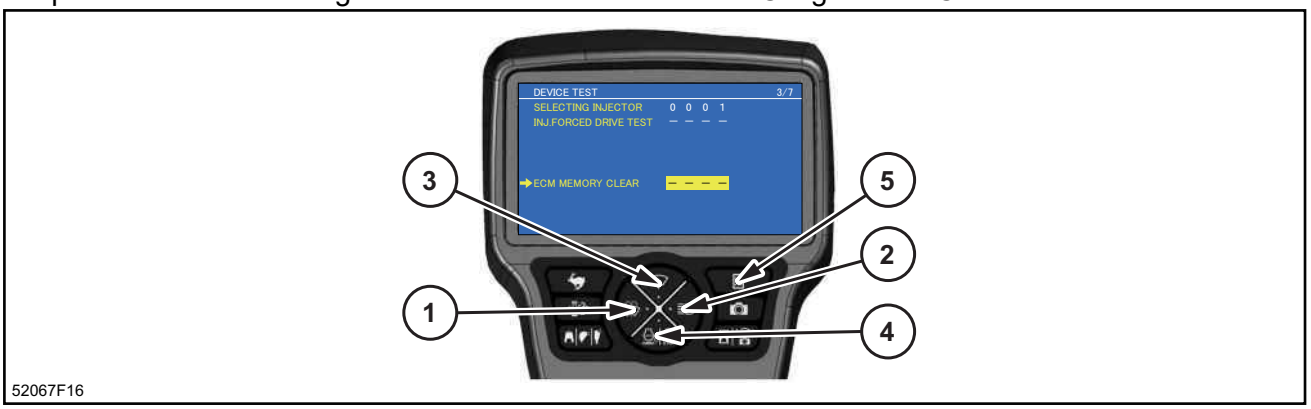
The test continues for 10 sec.

[3] Test finish

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

■ECM Memory Clear

Purpose: To reset the diagnosis mode and to clear the DTC log in the ECM



Procedure

-Condition for the test-

With the key ON and engine stopped

[1] Performing a test

Select "ECM MEMORY CLEAR" with switches (3) and (4).

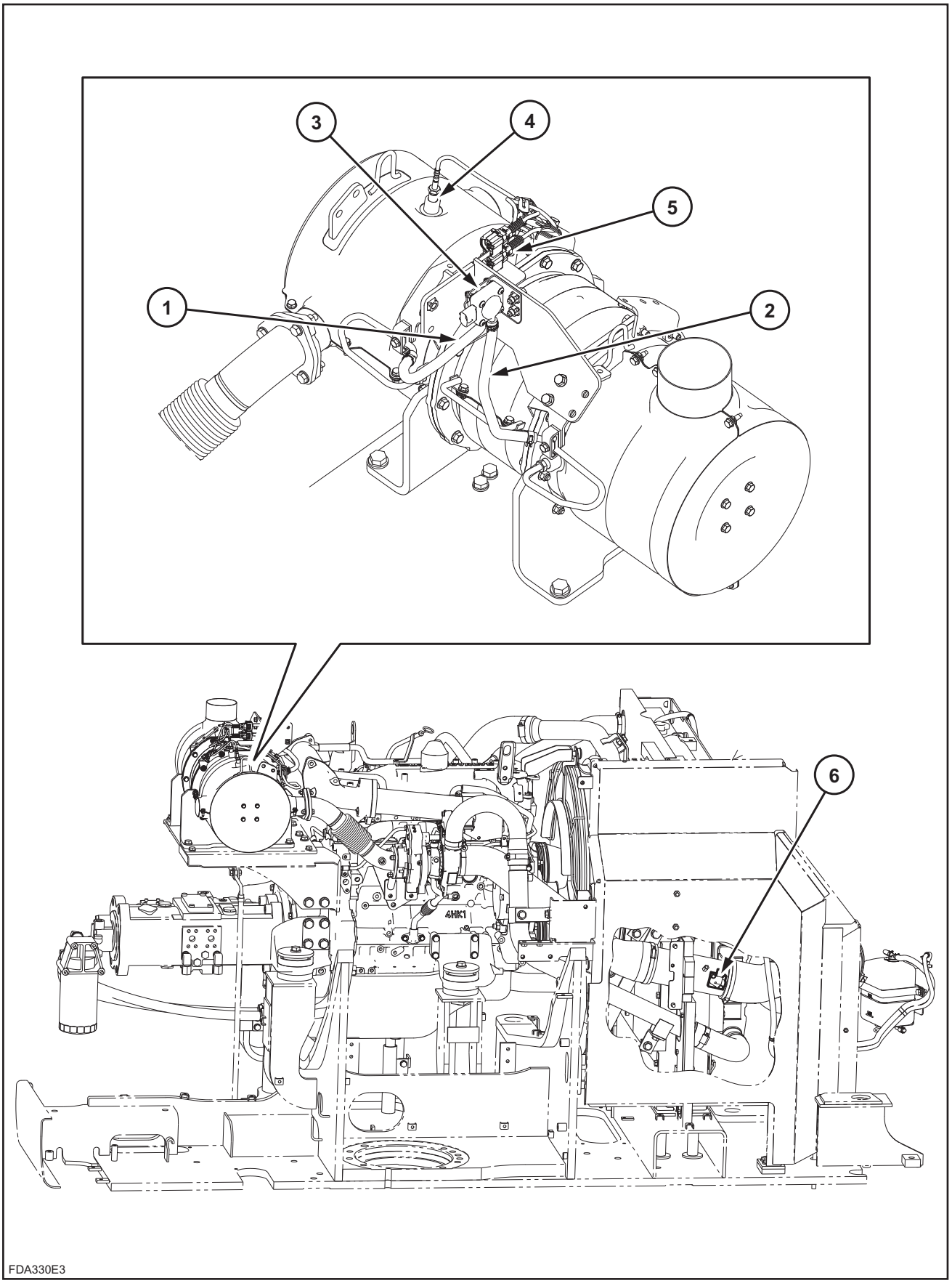
Hold down the switch (2) for 2 sec., then "- - - -" changes to "+ + + +" and returns to "- - - -" automatically.

When the key is turned OFF, "ECM MEMORY CLEAR" is executed and the DTC log in the ECM is cleared.

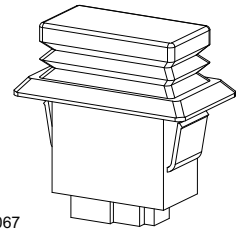
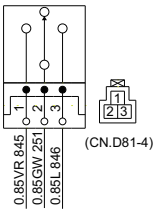
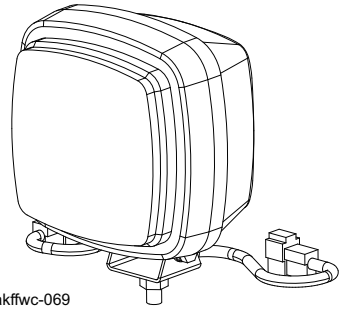
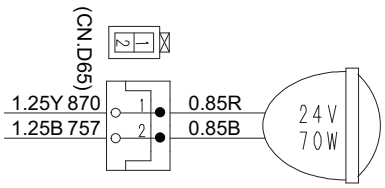
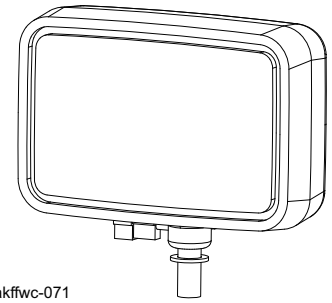
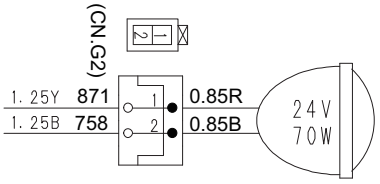
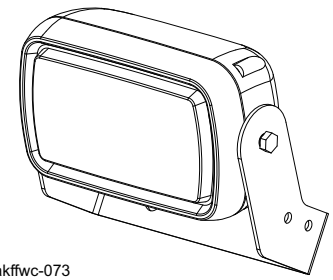
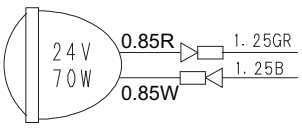
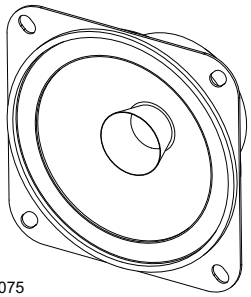
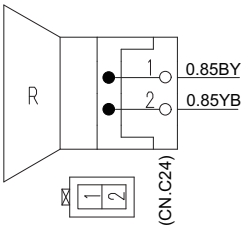
Sequence Circuit Diagram

Code table

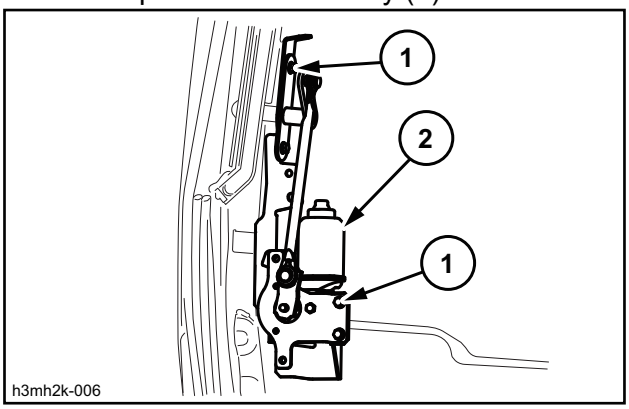
A1	COMPUTER	H8	CCD CAMERA	S54	FRONT WINDOW LIMIT SWITCH
A2	ENGINE CONTROLLER	K2	RELAY-GLOW PLUG	S55	RESERVE TANK LOW SWITCH
A4	WIPER CONTROLLER	K3	RELAY-HORN	S61	REFUEL PUMP SWITCH
A6	BLOWER CONTROLLER	K5	RELAY-ROTARY LIGHT	S62	AIR CLEANER SENSOR
A13	CONTROLLER B	K6	RELAY-AIR CONDITIONER CONDENSER FAN	S70	HORN VOLUME SWITCH
A14	TURBO CONTROLLER	K7	RELAY BATTERY	S71	PRESSURE SWITCH FILTER INDICATOR (BREAKER OPTION)
B1	COOLANT TEMPERATURE SENSOR	K10	RELAY-WORKING LIGHT (UPPERSTRUCTURE / ATTACHMENT)	S85	BEACON (EU)
B2	HYDRAULIC OIL TEMPERATURE SENSOR	K11	RELAY-WORKING LIGHT (CAB)	U1	DC-DC (24V-12V) CONVERTER
B3	FUEL TEMPERATURE SENSOR	K17	BLOWER OFF RELAY	X2	ROTARY LIGHT CONNECTOR
B5	EVAPORATOR SENSOR	K30	REFUEL PUMP RELAY	X3	OPTIONAL POWER CONNECTOR
B21	ENGINE OIL PRESSURE SWITCH	K31	REFUEL PUMP STOP RELAY	X4	ENGINE TEST POINT CONNECTOR
B22	SWING PILOT PRESSURE SWITCH	K34	RELAY STARTER CUT	X5	CONTROLLER TEST POINT CONNECTOR
B26	UPPER PILOT PRESSURE SENSOR	K35	RELAY ROOM LAMP	X6	CAB SEAT COMPRESSOR MOTOR CONNECTOR
B27	TRAVEL PILOT PRESSURE SENSOR	K36	RELAY SPEAKER LEFT	X9	ANTI-THEFT SYSTEM CONNECTOR
B28	SECOND OPTION PILOT CIRCUIT 1 PRESSURE SWITCH	K37	RELAY SPEAKER RIGHT	X15	ACCESSORY SOCKET
B40	PUMP PRESSURE SENSOR (NEGA-CONT. P2)	K63	RELAY ECM	X23	CLEAR MEMORY 1
B42	PUMP PRESSURE SENSOR (P1)	K64	RELAY KEY ON	X24	CLEAR MEMORY 2
B43	PUMP PRESSURE SENSOR (NEGA-CONT. P1)	K65	RELAY BATTERY RL	X25	TO CONTROLLER C
B44	PUMP PRESSURE SENSOR (P2) (BLUE BAND)	K66	RELAY IDLE STOP	X26	EST CONECTOR B
B45	OVERLOAD INDICATOR PRESSURE SWITCH	K67	RELAY DPF	X27	TO GPS UNIT
B47	BOOST PRESSURE SENSOR	K68	RELAY NEUTRAL START	X32	TO DRM
B48	AMBIENT AIR (BAROMETRIC) PRESSURE SENSOR	K69	RELAY STARTER	X33	FOR CRANE
B49	CRANKSHAFT POSITION SENSOR	M1	STARTER MOTOR	X34	FOR FAN REVERSE
B51	BOOST TEMPERATURE SENSOR	M3	WIPER MOTOR	X36	12V OUTPUT(FOR RADIO EU)
B52	COMMON RAIL PRESSURE SENSOR	M4	WASHER MOTOR	Y2	PILOT PRESSURE SOLENOID VALVE (BLUE BAND)
B61	SUNLOAD SENSOR	M5	MOTOR (AIR CHANGING)	Y3	SWING BRAKE SOLENOID VALVE (WHITE BAND)
B82	REFUEL PUMP STOP ALARM	M6	AIR VENT DIRECTION CONTROL MOTOR	Y4	2 STAGE TRAVEL SOLENOID VALVE (RED BAND)
B83	PRESS. SENSOR (PILOT ARM CLOSE)	M7	MOTOR ACTUATOR (AIR MIX)	Y5	POWER-UP SOLENOID VALVE (YELLOW BAND)



1	Sensor hose DPD FT	3	Pressure sensor DPD	5	Thermo-sensor DPD CT
2	Sensor hose DPD RR	4	Thermo-sensor DPD FT	6	MAF sensor

Name	Shape	Circuit	Remarks
Feed pump switch	 akffwc-067	 196DB162	Sumitomo part No.; KHR12900
Lamp (front right housing)	 akffwc-069	 akffwc-070	Specification; 24 V 70 W Sumitomo part No.; KHR2475
Lamp (boom)	 akffwc-071	 akffwc-072	Specification; 24 V 70 W Sumitomo part No.; KHR0957
Lamp (cab top)	 akffwc-073	 akffwc-074	Specification; 24 V 70 W Sumitomo part No.; KHR16240
Speaker (right) (left)	 akffwc-075	 akffwc-076	Sumitomo part No.; KHN30270

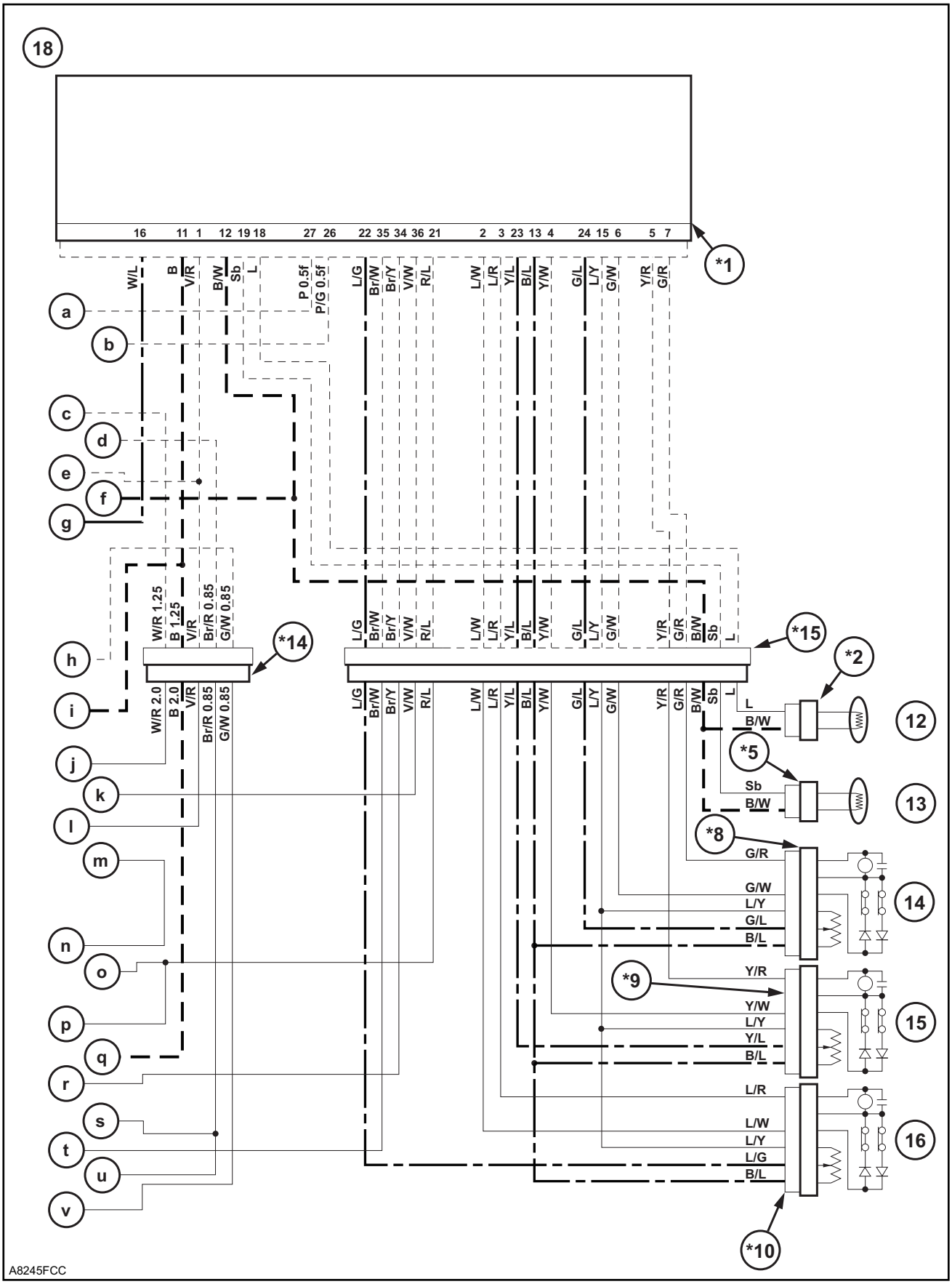
6. Use a box wrench [10 mm (0.394 in)] to remove the 6 bolts (1), and then remove the wiper motor assembly (2).



Installation of wiper motor

To install, perform the reverse of the removal procedure.

- Be careful about the wiper link and wiper arm installation location.
- Check the wiper arm wipe location and stop location.
- Tighten bolts being installed to the specified torque.
  For bolts for which the torque is not specified, see the "Tightening Torque" section.

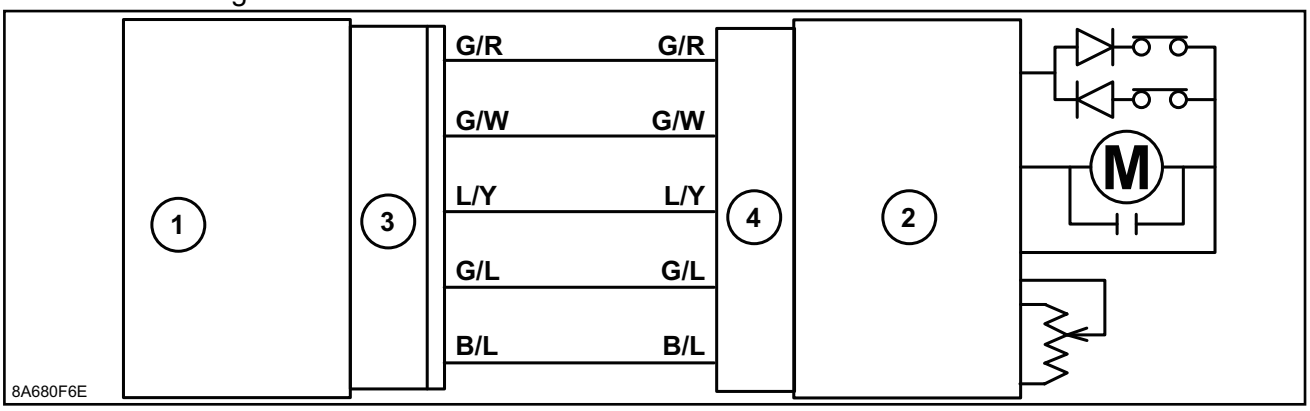


5 V system	
———	5 V is applied constantly
— — —	Analog signal: 0 - 5 V is applied
— — —	GND

Actuator Inspection

Air Mix Motor Actuator Inspection

· Structural diagram



Air mix damper operation defect
↓
See the trouble diagnosis chart.
↓
Specifying the trouble location

1	Control panel	3	Connector 1
2	Air mix motor actuator	4	Connector 9

· Trouble diagnosis chart

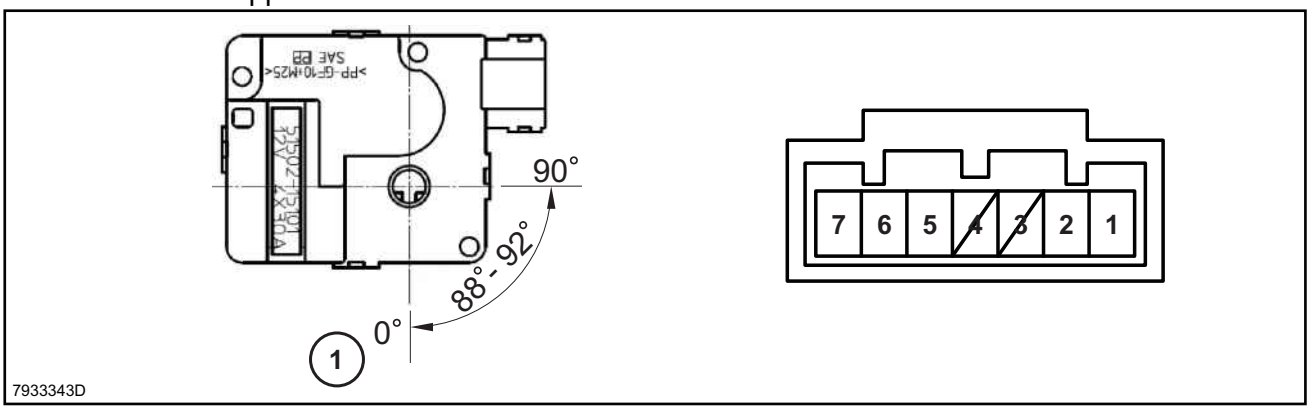
Step	Action	Standard value	Yes	No
1	Press the temperature setting switches and set to COOLMAX [18.0 °C (64.4 °F)]. Does the actuator operate at all?		Go to Step 2	Go to Step 3
2	Is an error displayed?		Go to Step 6	Damper lock or link defect
3	Press the temperature setting switches and set to HOTMAX [32.0 °C (89.6 °F)]. Does the actuator operate at all?		Go to Step 2	Go to Step 4
4	Is an error displayed?		Go to Step 5	Control panel defect
5	Is there continuity in harness between the actuator and control panel?		Actuator defect or damper lock or link defect	Harness defect
6	Remove the actuator connector (9). Is the resistance between L/Y and B/L of the actuator about 4 KΩ?	About 4 KΩ	Go to Step 7	Actuator defect
7	Is there continuity between the G/L and L/Y and between G/L and B/L of the actuator?		Control panel defect	Actuator defect

Set temperature	Air mix motor actuator position
COOLMAX [18 °C (64.4 °F)]	0°
HOTMAX [32 °C (89.6 °F)]	90°

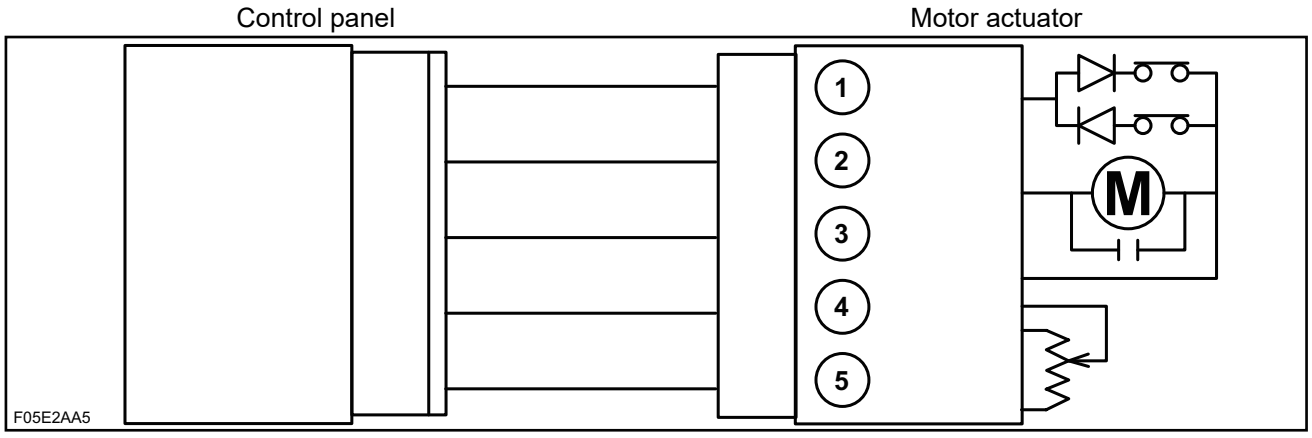
Air Mix Actuator

> **Caution**
>
> The air conditioning system voltage specifications are 24 V, but the motor actuator has 12 V specifications.

The air mix actuator is installed at the center of the air conditioner unit contained behind the link cover. It opens and closes the air mix damper via the link.
Built into the air mix actuator is the potentio-meter which corresponds to the actuator shaft rotation angle.
When the target air mix damper position is determined by the temperature control switch, the control panel reads in the potentio-meter position in the actuator and determines whether the motor turns forward or reverse.
When the motor rotates, the potentio-meter data that corresponds to the rotation angle is sent to the microcomputer. If potentio-meter data for the target door is recognized, a motor OFF signal is sent and the motor is stopped.



1	Position at shipment



1	M/A 1	3	Potentio-meter	5	GND
2	M/A 2	4	DC 5 V		

		Direction of rotation	
		0°→90°	90°→0°
Applied voltage	(1)	-	+
	(2)	+	-

Work Precautions

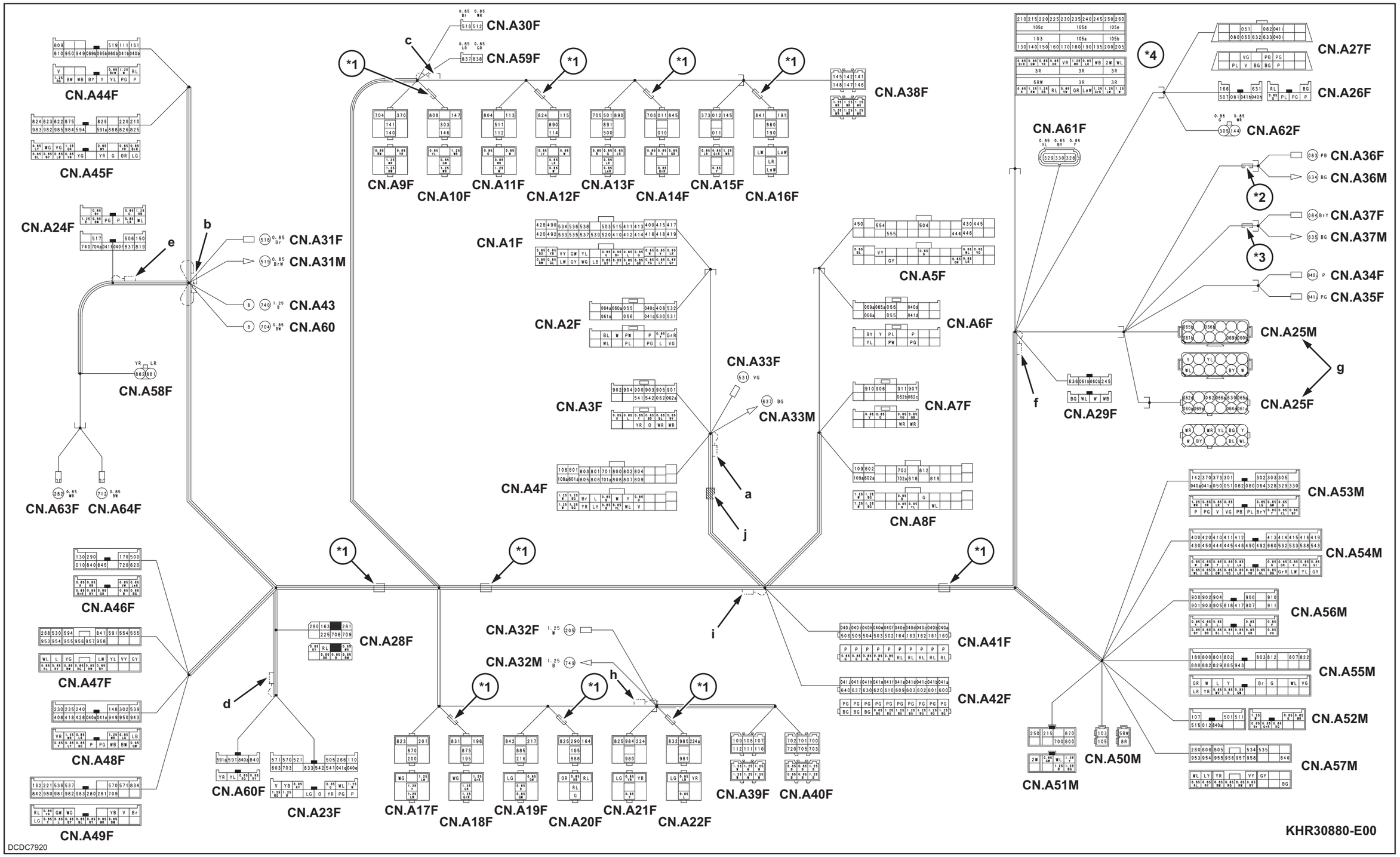
⚠ Warning

- Refrigerant gas filling involves handling dangerous high-pressure gas, so make sure that an experienced and qualified worker with the procedure performs this operation.
- Always wear protective eyewear.
- Gas entering the eyes may cause blindness.
- Refrigerant in the liquid state is very cold [about -26°C (-14.8°F)], so be very careful during handling.
- Refrigerant coming in contact with skin may cause frostbite.

Always use R134a refrigerant.

- Storage
  Keep service cans (hereinafter, cans) with refrigerant in them at 40°C (104.0°F) or below.
  The insides of the cans are highly pressurized and filled with refrigerant, so if the temperature rises, internal pressure may rise abruptly resulting in an explosion.
  Never store cans in direct sunlight, in a closed vehicle, or near open flames.
  Be careful not to drop cans or have them collide with other objects.
- Filling operation
  When heating the can in order to fill them with refrigerant, make sure that the service can valve and gauge manifold low-pressure valve are open. Heat with water at 40°C (104.0°F) or below.
  Direct heating or heating to 40°C (104.0°F) or higher may cause explosions, so use caution.
  If refrigerant filling is done after the engine is started, never open the gauge manifold high-pressure valve.
  This is very dangerous, as the high-pressure gas will flow in the opposite direction and may cause a can or charging hose explosion.
  Be careful not to allow the entry of dust or dirt into the air conditioner circuit.
  Air, moisture and dirt are very bad for the cooling cycle.
  Perform work quickly and accurately, and be especially careful to prevent the entry of foreign matter.
  Be careful not to overfill with gas.

Cab main harness



Note

1.When assembling the ground terminals marked with a ※, it should be confirmed that the frame seating surface is not coated.
If the surface is coated, assembly should be performed after removing the coating.

2.The clamp positions of the electrical wiring that comes out from connectors should be adjusted so that the wiring does not form sharp rounded shapes. (Radius of curve = 10 mm (0.394 in) or more)

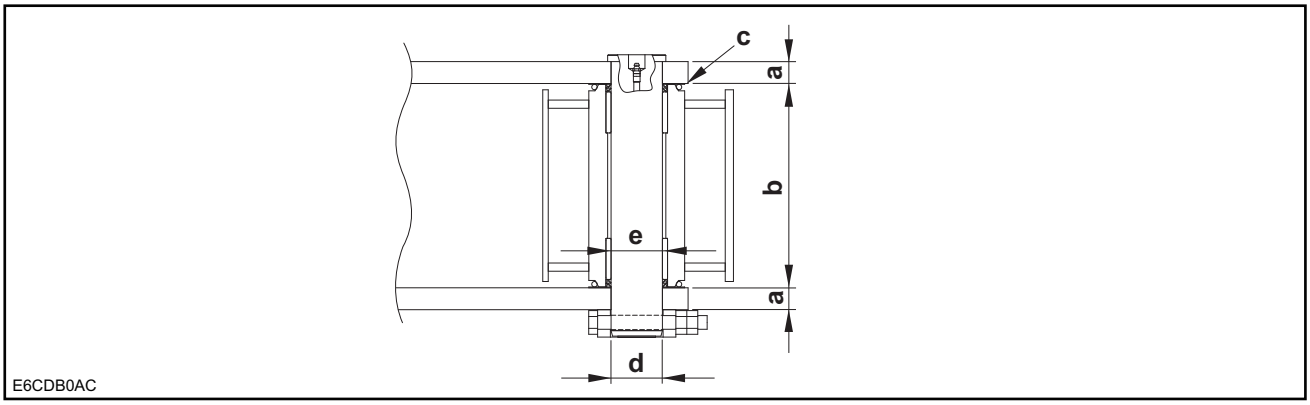
a	Fasten together with fuel line
b	Fasten the air conditioner hose and harness together.
c	Marking position; Align white tape of harness.

*1	Glow relay (engine accessory)	*5	Round terminal M8
*2	Starter relay (engine accessory)	*6	Round terminal M4
*3	M10 (battery accessory)	*7	Harness; Wire (frame main)
*4	M8 (battery accessory)	*8	KRR19120 Harness; Wire (frame main)

Code	Part name	Q'ty	Code	Part name	Q'ty
1	Fuse; High current (model A3 50 A)	2	6	Battery 130E41R (with terminal)	2
2	Fuse (fusible link) 65 A	1	7	Cable; Battery bridge	1
3	Bracket; Battery relay	1	8	Cable; Battery B+ relay	1
4	Relay; Battery	1	9	Cable; Battery	1
5	Cable; Battery ground	1			

CN.D3	Turbo controller (16-pin)	CN.D27	Starter relay B/C (2-pin)
CN.D10	Battery relay B ID tape: Red	CN.D28	Starter relay S/E (2-pin)
CN.D11	Battery relay IGN1	CN.D29	Glow relay coil (2-pin)
CN.D12	Battery relay IGN2	CN.D30	Glow relay1 (1-pin) Electrical wiring color: White stripe on red background
CN.D20	Battery relay coil1 Electrical wiring color: Green	CN.D31	Glow relay2 (1-pin) Electrical wiring color: Blue
CN.D21	Battery relay coil 2 Electrical wiring color: Red stripe on white background	CN.D35	Sensor MAF (5-pin)
CN.D22	Battery relay GND (1-pin)	CN.D74	Beacon harness (2-pin)
CN.D23	Fuse 50 A +B (2-pin) Electrical wiring color: White stripe on red background	CN.D77	Receiver dryer (2-pin)
CN.D24	Fuse 50 A ST (2-pin) Electrical wiring color: Red	CN.D79	Switch; LLC tank (2-pin)
CN.D25	Fuse 65 A IGN (2-pin)	CN.D80	SW Air cleaner (2-pin)
CN.D26	Fuse 15 A CONT (2-pin)		

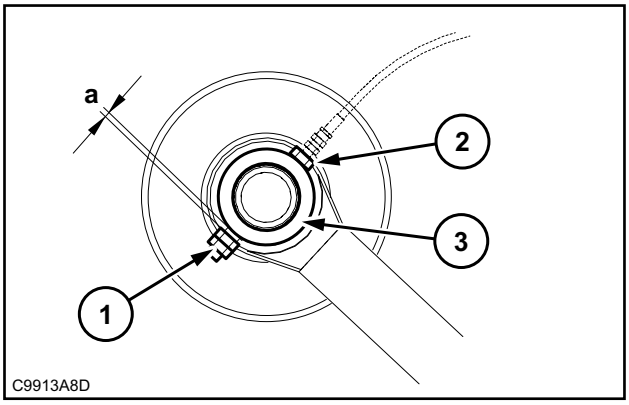
8. Arm and Arm Link Installation Section



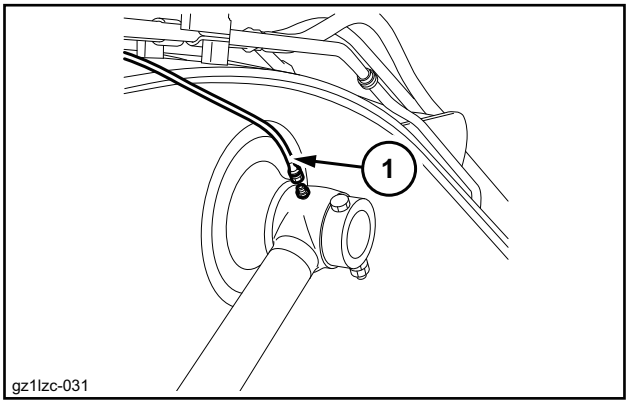
Part name	Code	Measurement dimensions		Standard value		Usage limits		Judgment	Solution
		(mm)	(in.)	(mm)	(in.)	(mm)	(in.)		
Arm link	a			32	1.260	30	1.181	Acceptable/ Unacceptable	Replacement
Arm	b			296	11.654	294	11.575	Acceptable/ Unacceptable	Replacement
Clearance	c			1.0 - 1.5	0.0394 - 0.0591	Shim adjustment	Shim adjustment	Acceptable/ Unacceptable	Adjustment with shims
Pin	d	D	D	D75	D2.953	D74	D2.913	Acceptable/ Unacceptable	Replacement
Bushing (arm)	e	D	D	D75	D2.953	D76.5	D3.0118	Acceptable/ Unacceptable	Replacement

Caution

・When installing the high-strength bolt (2), leave a 1 - 2 mm (0.0394 - 0.0787 in.) gap (a) between the double nuts (1) and retaining ring (3).

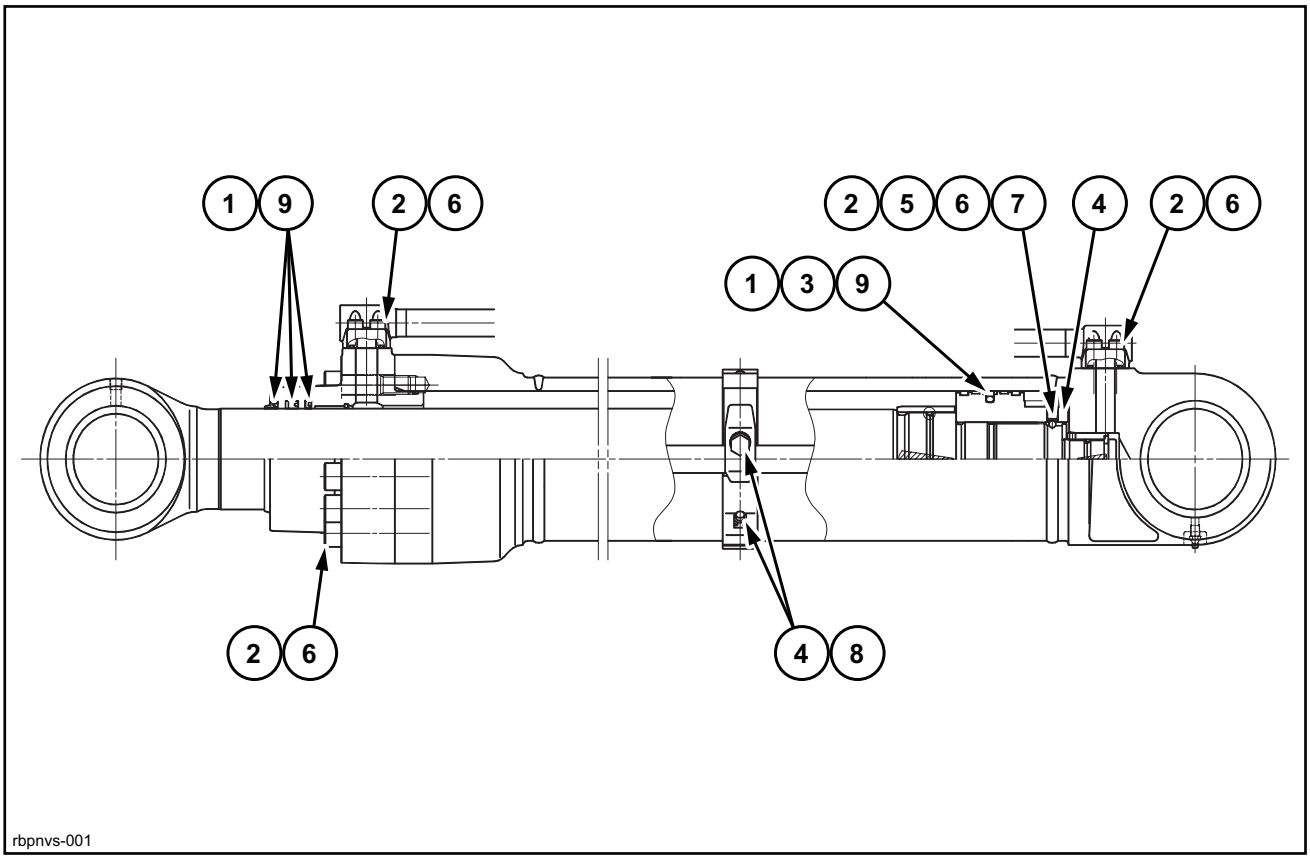


9. Use a wrench [19 mm (0.748 in.)] to install grease hoses (1) on the left and right sides.
   ・Grease up.
   ・When installing as far as the boom, first install the bucket, bucket link, bucket cylinder, arm, arm cylinder according to their respective removal and installation procedures.



Required Tool

■General Tool



Code	N・m	lbf・ft	Code	N・m	lbf・ft
b	267	196.96	e	41.59 - 60.81	30.6805 - 44.8588
c	5340	3939.26	f	50.9 - 74.3	37.549 - 54.810
d	46.2 - 67.6	34.082 - 49.867	g	25.62 - 37.38	18.8996 - 27.5747

Code	mm	in	Code	mm	in
h	150	5.906	q	85	3.346
i	D85	D3.346	r	D100H8	D3.937008 - 3.939133
j	D120	D4.724	s	D95H8	D3.740158 - 3.742283
k	D139	D5.472	t	105	4.134
l	50	1.969	u	90	3.543
m	101	3.976	v	R70	R2.756
n	108	4.252	w	D181	D7.126
o	100	3.937	x	D80	D3.150

Code	Part name	Q'ty	Code	Part name	Q'ty
01	Tube subassembly	1	20	Locking screw	1
02	Rod subassembly	1	21	Steel ball	1
03	Cylinder head	1	22	Pin bushing	1
04	Bushing	1	23	Wiper ring	2
05	Snap ring	1	24	Pin bushing	1
06	Buffer ring	1	25	Wiper ring	2
07	U-ring	1	26	Pipe subassembly	1
08	Backup ring	1	27	Pipe subassembly	1
09	Wiper ring	1	28	O-ring	2
10	O-ring	1	29	Hexagon socket head bolt	8
11	Backup ring	1	30	Band subassembly	1
12	Hexagon socket head bolt	12	31	Band	1
13	Cushion ring	1	32	Bolt	2
14	Cushion seal	1	33	Washer	2
15	Piston	1	34	Pipe holder	2
16	Seal ring assembly	1	35	Bolt	1
17	Backup ring	2	36	Spring washer	1
18	Slide ring	2	37	Grease nipple	1
19	Slide ring	2			

Removal and Installation of Bucket Link

Caution

- Stop the machine on a level location with good footing.
- Be sure to stop the engine before beginning work.
- When working together with others, always be sure to exchange signals and pay adequate attention to safety.
- Always wear protective devices (protective eyewear and safety shoes, etc.) when working with a hammer.

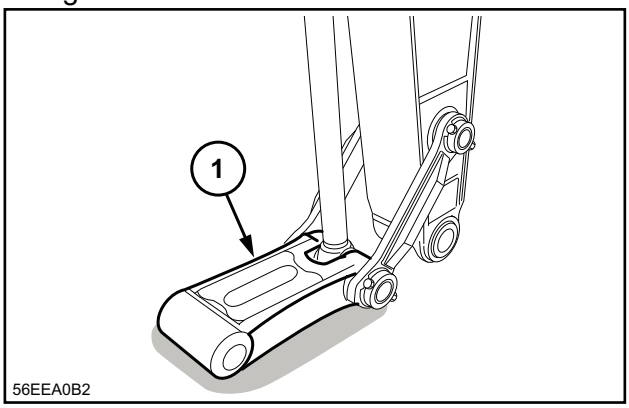
Items to prepare

- 2 wrenches [30 mm (1.181 in.)]
- Hammer
- Striking rod
- Grease
- Rag
- Cleaning fluid

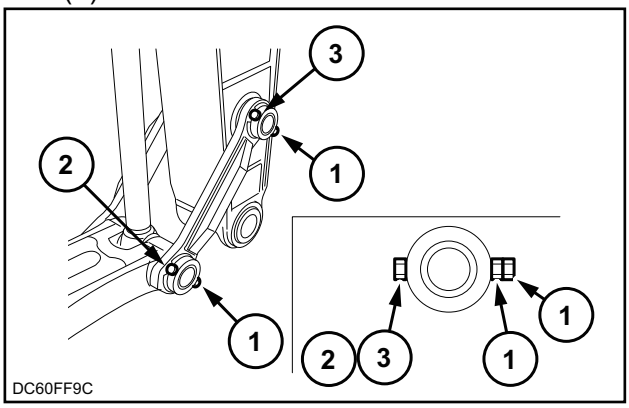
Removal of Bucket Link

- Remove the bucket. (Refer to the "Removal and Installation of Bucket" for detail.)

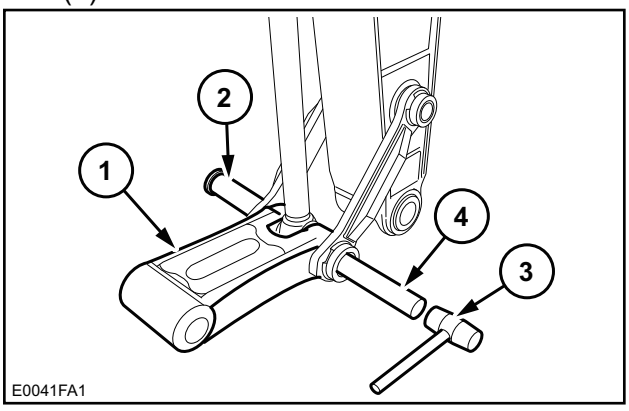
1. Place the bucket link (1) in parallel with the ground.



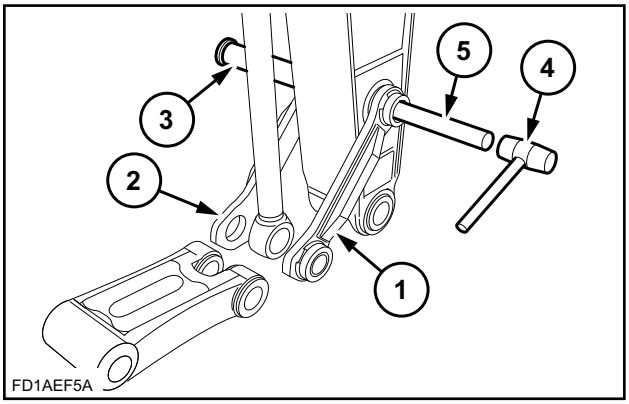
2. Remove the 2 nuts (1) with 2 wrenches [30 mm (1.181 in.)], and pull out the bolts (2) (3).



3. Push out the pin (2) with a hammer (3) and a striking rod (4) to remove the bucket link (1).

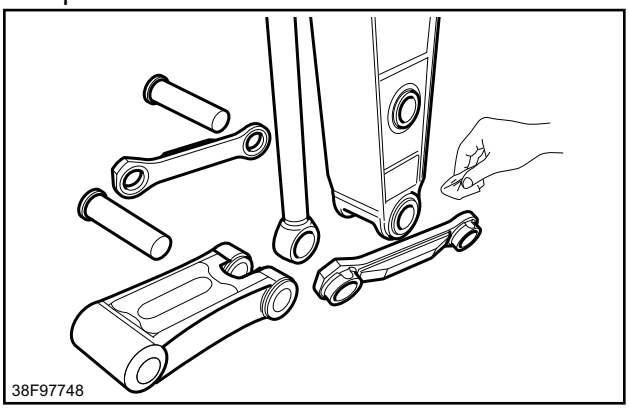


4. Push out the pin (3) with a hammer (4) and a striking rod (5) to remove the arm links (1) (2).
   - When pulling out the pin, be careful not to damage the attached O-ring and dust seal.



Installation of Bucket Link

1. Clean pins and pin holes in respective parts.



2. Push in the pin (1) with a hammer (4) to attach the arm links (2) (3).
   - If it is hard to put in the pin, load is applied to the pin.
   - When inserting the pin, be careful not to damage the attached O-ring and dust seal.

Safety			
			Travel alarm
			Double horn
Battery			2 x 12 V 92 Ah/5HR
Lights			
	Working light	Upper	24 V 70 W x 1
		Boom	24 V 70 W x 1
	Operator's cab room		24 V 10 W x 1

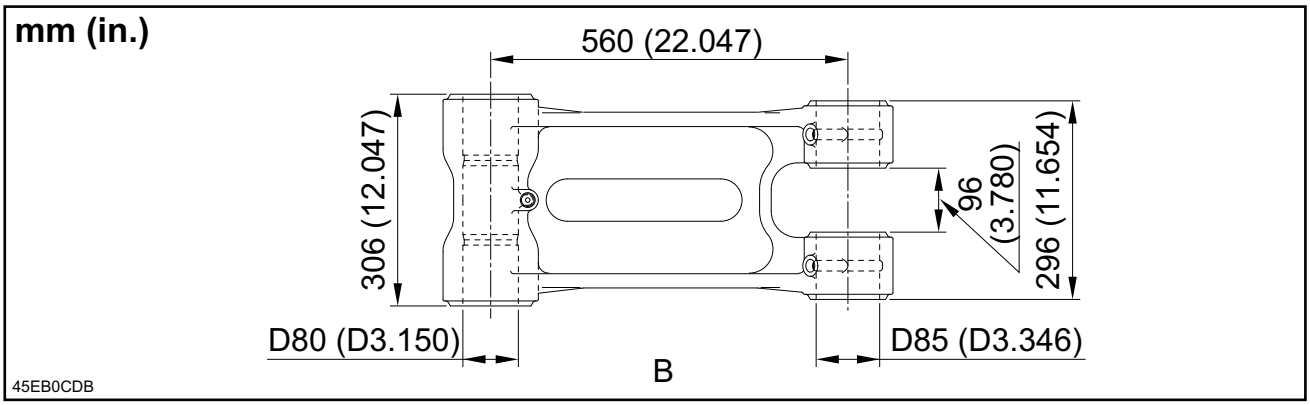
OPERATOR ENVIRONMENT

Operator's cab			
	Smooth and round shape design cab, fabricated by press work		
	Safety glass for all windows		
	Shock-less cab suspension by 4-point fluid mounting		
	Sliding front window with auto lock		
	Built-in type full-color LCD monitor display		
	Membrane switch on monitor display		
	Windshield wiper & washer		
	AM/FM Radio with auto-tuner		
	Floor mat		
	Polycarbonate roof hatch & Sun shade		
	Auto air conditioner		
	Roll-over protective structure (ROPS)		
	Top guard OPG level 1 (in CAB structure)		
Operator's seat			
	KAB 815: Low frequency mechanical suspension with helical springs and double acting hydraulic damper.		
	With following features		
	Manual weight adjustment		Backrest angle adjustment
	Seat height adjustment		Adjustable pivoting armrests
	Adjustable headrest		Retractable seat belt
Others			
	Rear view mirror (Cab side & Right side)		
	Rear view Camera		

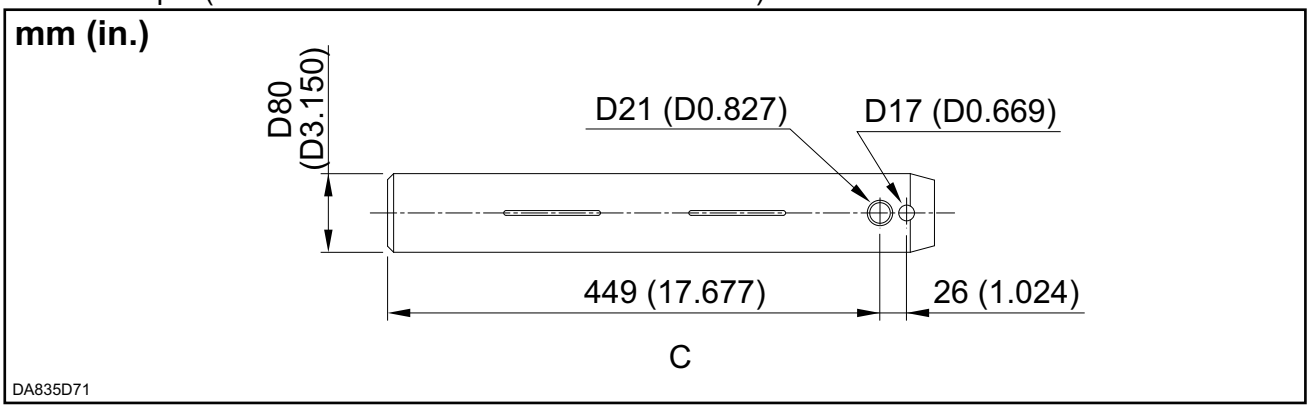
UNDERCARRIAGE

Travel motor		Variable displacement axial piston motor
Brake		Mechanical disc brake
Hydraulic service brake		Brake valve
Final drive		Planetary gear reduction
Travel speeds	High	5.0 km/h (3.107 mph) (Automatic travel speed shifting)
	Low	3.2 km/h (1.988 mph)
Drawbar pull		201 KN (45194.33 lbf)
Number of carrier rollers (each side)		2
Number of track rollers (each side)		8

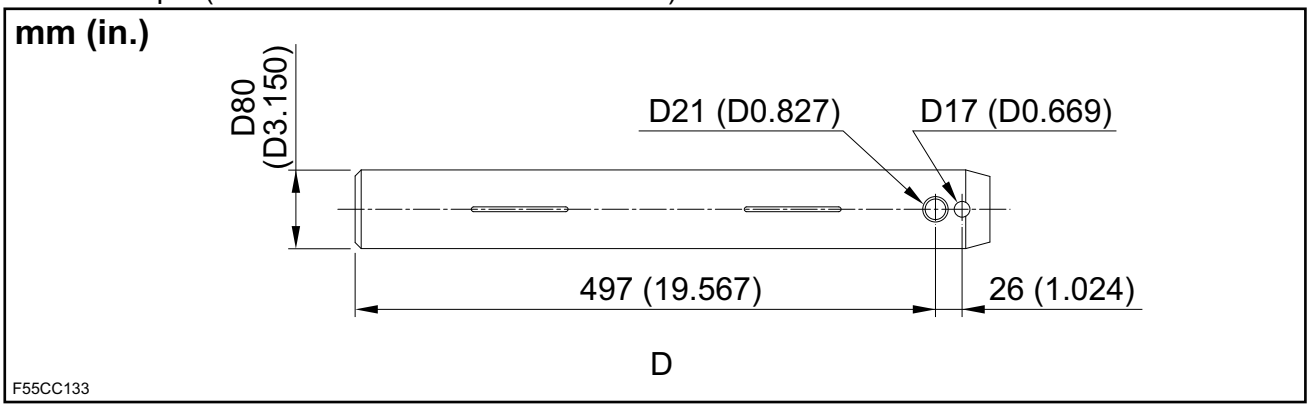
Bucket link



Bucket pin (bucket and bucket link connection section)



Bucket pin (bucket and arm connection section)



WORK RANGE DIAGRAM

Swing Ball Race Bearing Movement Amount and Bucket Tip Movement Amount

Measurement method

[1] **Up and down direction measurement**

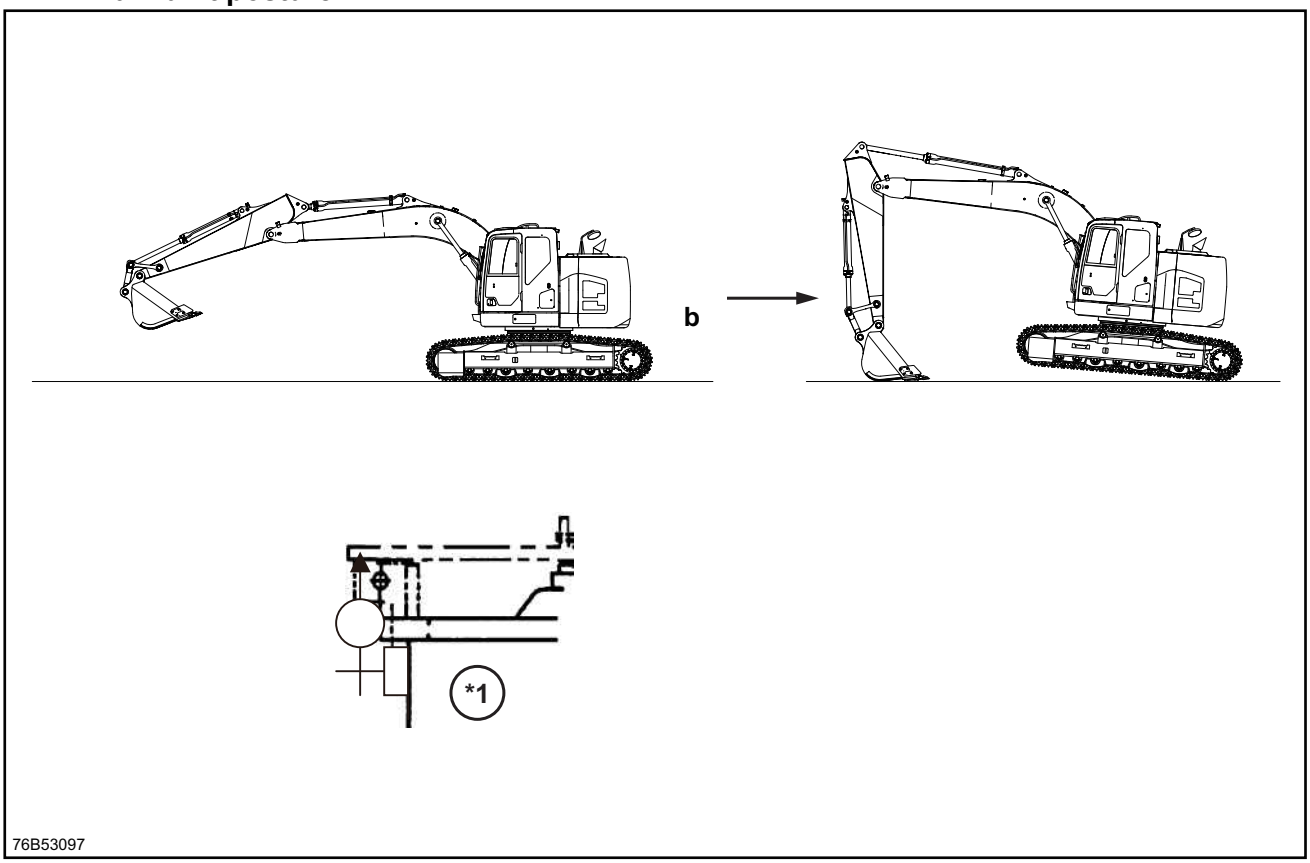
a. Measure the up and down movement amount at 2 locations in front of and behind the ball race.

b. With the arm cylinder extended and the bucket cylinder closed, raise the bottom surface of the bucket 30 cm (11.811 in.) above the ground. Install a dial gauge to the lowering section as shown in the diagram below and perform zero point adjustment.

c. Jack up the main unit and measure the amount of movement with the dial gauge.

* Jack up the main body until the swinging of the dial gauge becomes constant.

Main unit posture



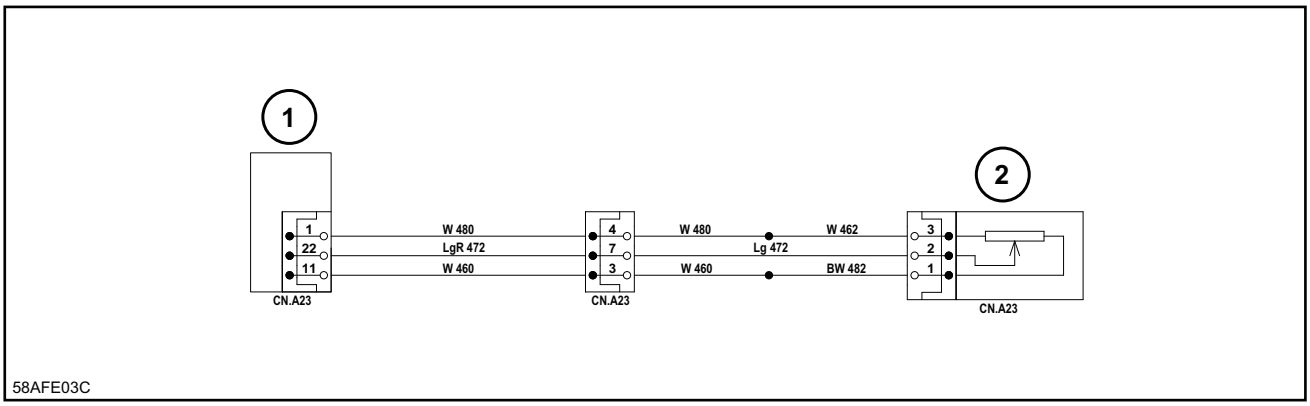
a	Front
b	Rear

*1	Lowering

Diagnostic Trouble Code: 7006 Rod Pressure Sensor Signal Abnormality

Step	Action	Standard value	Yes	No
1	1. Turn the key switch ON. 2. Check whether diagnostic trouble code: 7006 is displayed. Is diagnostic trouble code: 7006 displayed?		Go to Step 2	
2	1. Inspect the connection status of each connector. 2. Check whether diagnostic trouble code: 7006 is displayed. Is diagnostic trouble code: 7006 displayed?		Go to Step 3	
3	1. Check the rod pressure sensor voltage on the service support screen. Is it 4.75 V or higher?	4.75 V or higher	Go to Step 4	When 0.25 V or lower, go to Step 7
4	Inspect for shorts to the power supply. 1. Turn the key switch OFF and disconnect CN.CR10. 2. Turn the key switch ON. 3. Measure the voltage between the ground and terminal 1 of the CN.CR10 harness side. Is it about 5 V?	About 5 V	Go to Step 5	W414 or W415 harness defect (short). Replace
5	1. Measure the voltage between the ground and terminal 2 of the CN.CR10 harness side. Is it 4.75 V or lower?	4.75 V or lower	Go to Step 6	L435 harness defect (short). Replace
6	1. Measure the voltage between the ground and terminal 3 of the CN.CR10 harness side. Is it 0.25 V or lower?	0.25 V or lower	Computer B defect. Replace	BW454 or BW455 harness defect (short). Replace
7	Inspect the rod pressure sensor. 1. Turn the key switch OFF. 2. Disconnect CN.CR10. 3. Check the terminal section of the connector for rust, disconnection, or connection problems. Is the terminal section of the connector normal?		Go to Step 8	Rod pressure sensor defect. Replace
8	Inspect for shorts to ground and disconnections. 1. Inspect for continuity between the ground and terminal 1 of the CN.CR10 harness side. 2. Inspect for continuity between the ground and terminal 2 of the CN.CR10 harness side. Is there continuity?		W414, W415, or L435 harness defect (short). Replace	Go to Step 9
9	1. Inspect for continuity between the ground and terminal 3 of the CN.CR10 harness side. Is there continuity?		Go to Step 10	BW454 or BW455 harness defect (disconnection). Repair or replace
10	1. Turn the key switch ON.	About 5 V	Go to Step 11	W414 or W415 harness defect

Step	Action	Standard value	Yes	No
10	2. Measure the voltage between the ground and terminal 3 of the CN.A23 harness side. Is it about 5 V?	About 5 V	Go to Step 11	(disconnection). Repair or replace
11	1. Measure the voltage between the ground and terminal 2 of the CN.A23 harness side. Is it 0.2 V or higher?	0.2 V or higher	Computer C defect. Replace	Lg472 harness defect (disconnection). Repair or replace



1	Computer C
2	Boom angle sensor