

SERVICE MANUAL

EI60C Blade Runner Crawler Excavator

Part number 47497833A

English
October 2012



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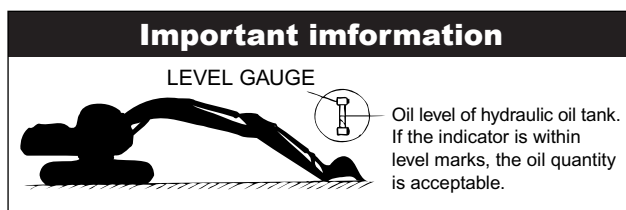


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(5) Installing hydraulic equipment

1. Confirm hydraulic oil and lubrication oil.
2. Air release is required in the following cases ;
 - a. Change of hydraulic oil
 - b. Replacement of parts on suction pipe side
 - c. Removing and attaching hydraulic pump
 - d. Removing and attaching swing motor
 - e. Removing and attaching travel motor
 - f. Removing and attaching hydraulic cylinder
3. For air bleed of hydraulic pump and swing motor, loosen drain plug on the upper part, start engine, and run in low idling, then bleed air until hydraulic oil is comes out. After completion of comes, tighten plug securely.
4. For air bleed of travel motor and hydraulic cylinder, starts engine and operate it for 10 minutes or more at no-load and low speed.
5. Air in pilot circuit can be bled out by only operating digging, swing and traveling motions thoroughly.
6. Check hydraulic oil level.
Move attachments to hydraulic oil check position, and check hydraulic oil level of tank. Refill oil if the oil level is lower than the specified level.
How to check oil level of hydraulic oil tank

**WARNING**

If hydraulic oil and lubricating oil are not filled and also air bleed is not performed, the hydraulic equipment may be damaged.

WARNING

For cylinder, don't move it to the stroke end at beginning.

2. SPECIFICATIONS

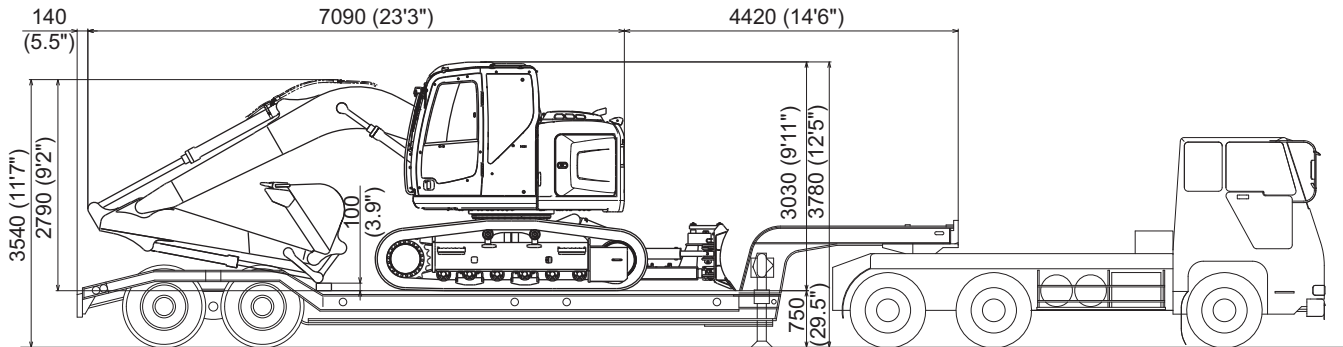
2.4 TRANSPORTATION

2.4.1 OVERALL DIMENSIONS OF MACHINE ON A TRAILER

(1) 4.68m (15ft-4in) Boom+2.38m (7ft-10in) Arm+0.5m³ (0.65cu-yd) Bucket

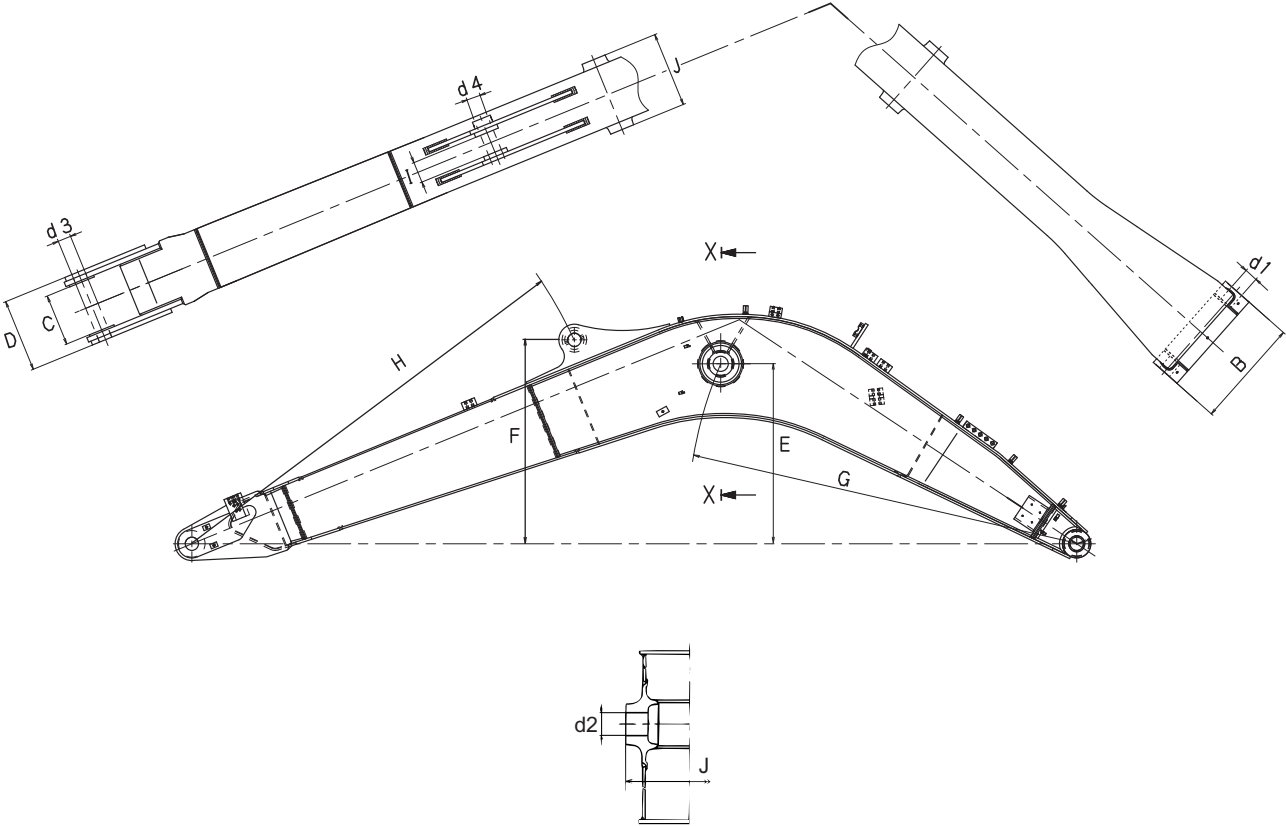
Item/Shoe type	500mm (19.7in)
Width : mm (ft-in)	2,490 (8'2")
Weight: kg (lbs)	15,600kg (34,400 lbs)

Unut: mm(ft-in)



3.1 BOOM

3.1.1 BOOM DIMENSIONAL DRAWING



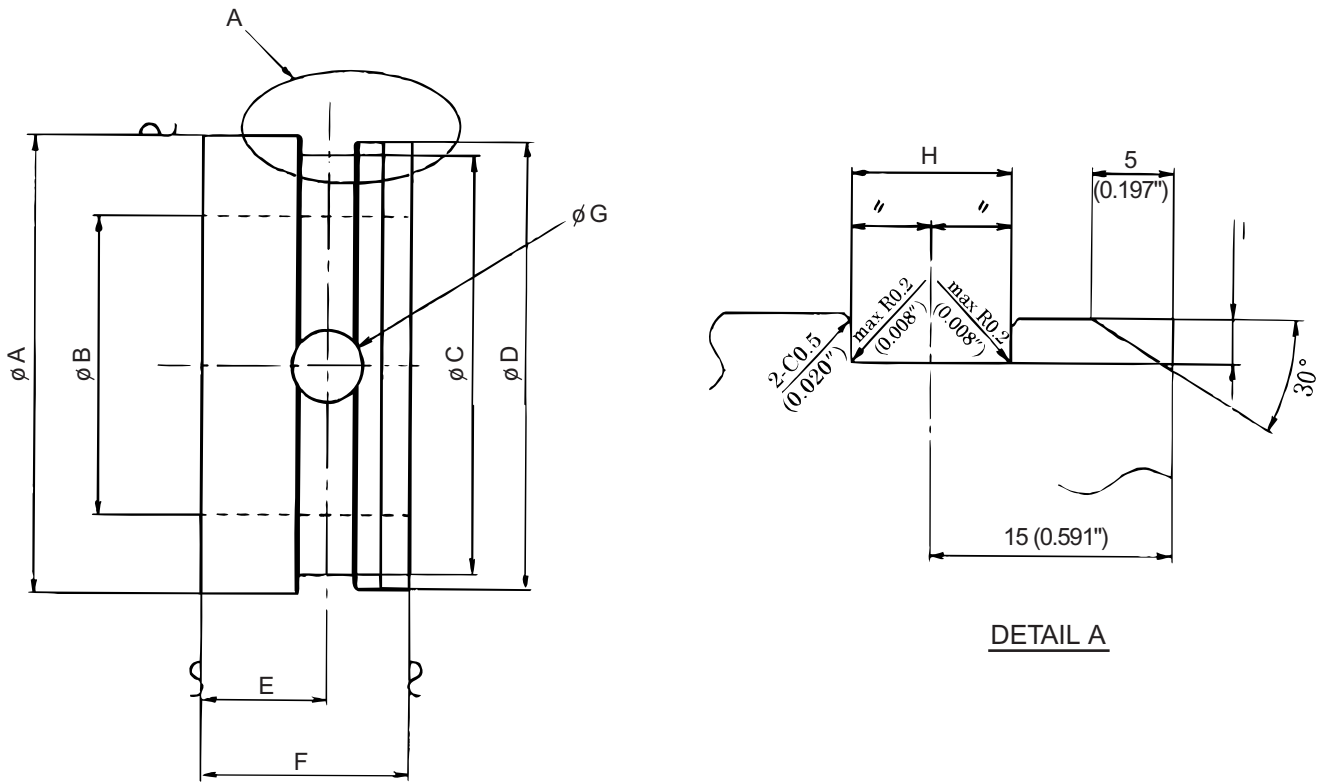
SECTION X-X

Boom dimensional drawings

4.68M(15ft-4in) BOOM		STD
		YY02B00434F1
No.	NAME	DIMENSIONS: mm (ft-in)
A	Boom length	4,680 (15'4")
B	Boom foot width	575 (22.6")
C	Boom end inner width	274 (10.8")
D	Boom end outer width	386 (15.2")
E	Height of boom cylinder rod pin	952 (37.5")
F	Height of arm cylinder (head side) pin	1,079 (3.6")
G	Distance between pins of boss	R2,110 (6.11")
H	Distance between pins of bracket	R2,293 (7.6")
I	Arm cylinder (head side) inner width	111 (4.4")
J	Outer width of bracket on the arm cylinder (rod side) mounting	399 (15.7")
d1	Boom foot pin dia.	70 dia. (2.76")
d2	Boom cylinder (rod side) pin dia.	80 dia. (3.15")
d3	Pin dia. of boom end.	70 dia. (2.76")
d4	Arm cylinder (head side) pin dia.	70 dia. (2.76")

3. ATTACHMENT DIMENSIONS

3.3.4 BOSS SECTION DIMENSIONAL DRAWING



Dimension of boss section

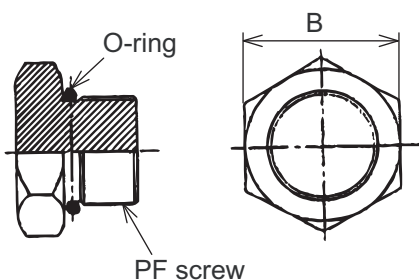
Unit : mm (ft-in)

Type of bucket	Capacity of bucket m ³ (cu·yd)	Part No. of bucket	Part No. of boss	øA	øB	øC	øD	E	F	øG	H	I
Normal digging	[STD]											
	0.50 (0.45)	YY61B00072F1	YY61B01005P1	101.6	69	94.5	99.5	15	30	15	13	2.5
	0.24 (0.22)	YY61B00079F1		(4.0")	(2.72")	(3.72")	(3.92")	(0.591")	(1.18")	(0.591")	(0.512")	(0.098")
	0.31 (0.27)	YY61B00080F1										
	0.38 (0.33)	YY61B00081F1	2418P26832	101.6	69	94.5	99.5	19	34	15	13	2.5
	0.45 (0.40)	YY61B00075F1		(4.0")	(2.72")	(3.72")	(3.92")	(0.748")	(1.34")	(0.591")	(0.512")	(0.098")
	0.57 (0.50)	YY61B00082F1										
0.70 (0.60)	YY61B00083F1											

Bucket capacity : SAE heaped (Struck)

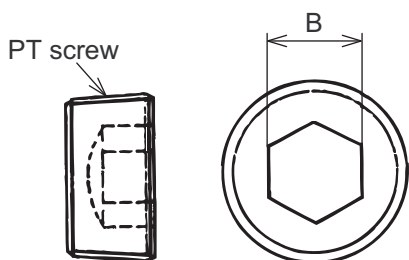
11.5.2 PLUG FOR HYDRAULIC EQUIPMENT

(1) PF screw



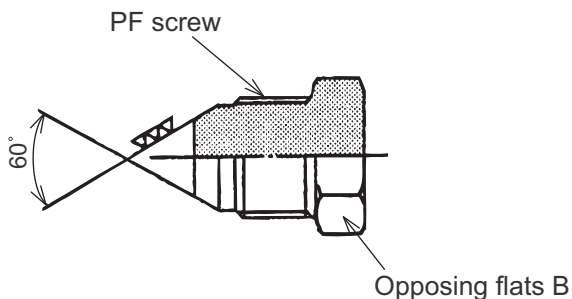
PF screw	Plug parts No.	B mm	O-ring parts No.	Nominal O-ring
PF1/4	ZE72X04000	19	ZD12P01100	1B P11
PF3/8	ZE72X06000	22	ZD12P01400	1B P14
PF1/2	ZE72X08000	27	ZD12P01800	1B P18
PF3/4	ZE72X12000	36	ZD12P02400	1B P24
PF1	ZE72X16000	41	ZD12P02900	1B P29

(2) PT screw

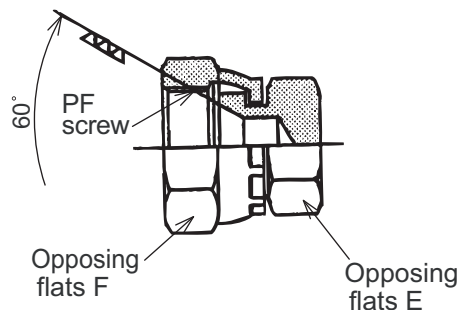


PT screw	Plug parts No.	B mm
PT1/8	ZE82T02000	5
PT1/4	ZE82T04000	6
PT3/8	ZE82T06000	8
PT1/2	ZE82T08000	10
PT3/4	ZE82T12000	14
PT1	ZE82T16000	17
PT1 1/4	ZE82T20000	22
PT1 1/2	ZE82T24000	22

(3) Plug for(F)flare hose



PF screw	Plug parts No.	B mm
PF1/4	2444Z2728D1	14
PF3/8	2444Z2728D2	17
PF1/2	2444Z2728D3	22
PF3/4	2444Z2728D4	27
PF1	2444Z2728D5	36

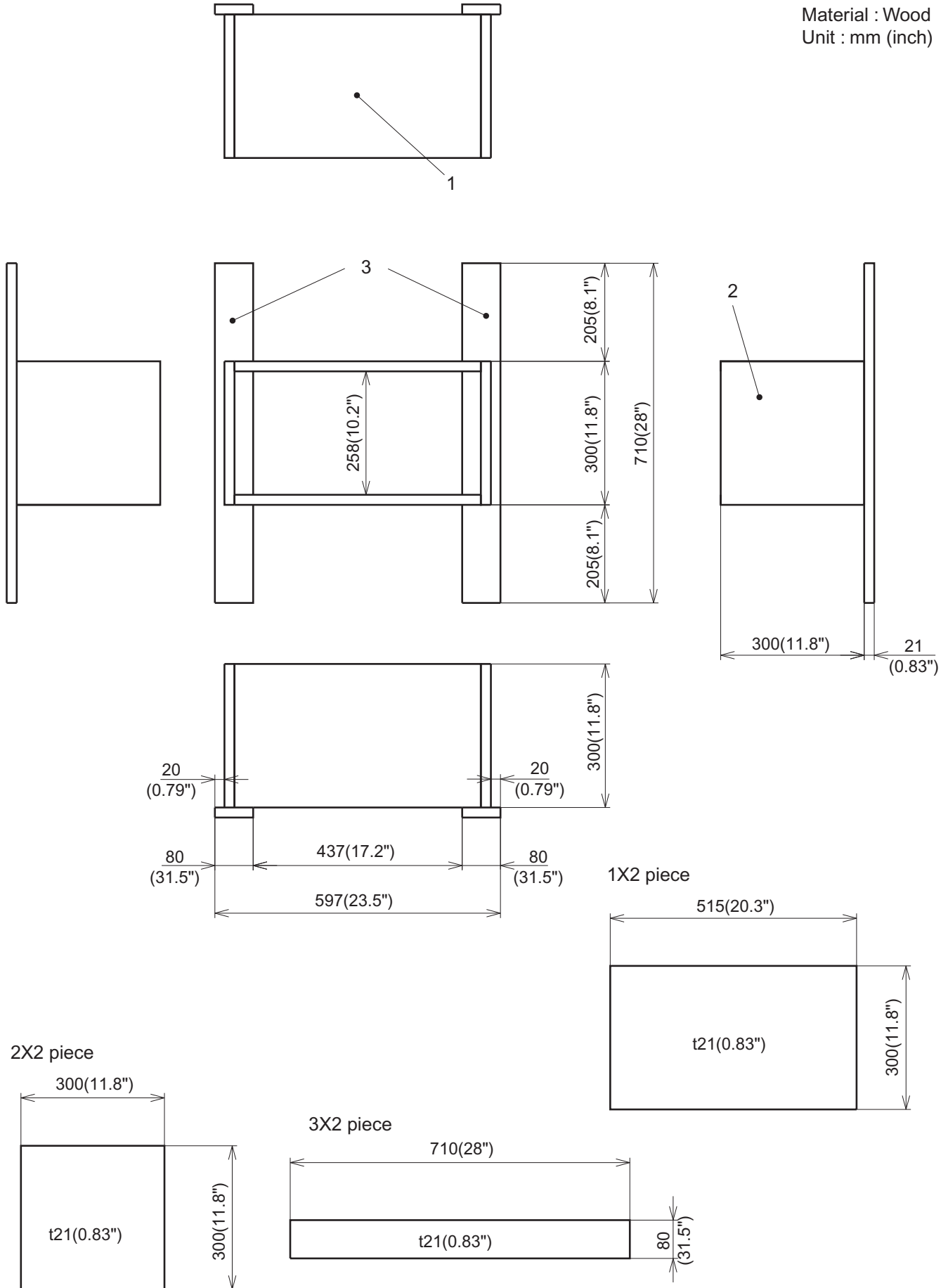


PF screw	Plug parts No.	E mm	F mm
PF1/4	2444Z2729D1	14	19
PF3/8	2444Z2729D2	17	22
PF1/2	2444Z2729D3	23	27
PF3/4	2444Z2729D4	27	36
PF1	2444Z2729D5	36	41
PF1 1/4	2444Z2729D6	40	50

11. TOOLS

11.13 ENGINE MOUNTING PEDESTAL

Material : Wood
Unit : mm (inch)



Engine stand

12. STANDARD MAINTENANCE TIME TABLE

03 Swing frame (2/3)

Group	Location	Work to be done	Unit	Remarks	Unit: Hour
80	Pump relation			See 33.1.8	
81	Pump ASSY	Detach/attach	1 pc.		2.2
82	-Hydraulic oil tank cover	Detach/attach	1 pc.		0.2
83	-Strainer & stopper	Detach/attach	1 pc.		0.3
84	-Piping	Detach/attach	1 set		1.0
85	-Pump slinging	Detach/attach	1 pc.		0.4
86	-Cleaning	Cleaning	1 pc.		0.1
87	-Vent air	Adjust	1 pc.		0.1
88	Pump ASSY	O/H	1 pc.		3.0
	Other necessary works	Detach/attach	1 pc.	Guard, Counterweight	1.0
90	Swing motor unit relation			See 33.1.20	
91	Swing motor ASSY	Detach/attach	1 pc.	2.2	
92	-Piping	Detach/attach	1 set	0.8	
93	-Mounting bolt	Detach/attach	1 set	0.6	
94	-Unit slinging	Detach/attach	1 pc.	0.4	
95	-Cleaning and sealant	Cleaning	1 set	0.2	
96	Swing motor	O/H	1 pc.	3.0	
97	Swing reduction gear	O/H	1 pc.	3.5	
100	Swivel joint relation			See 33.1.21	
101	Swivel joint ASSY	Detach/attach	1		2.5
102	-Piping (Top part only)	Detach/attach	1 set		0.6
103	-Whirl stop bolt	Detach/attach	1		0.2
104	-Cover	Detach/attach	1		0.3
105	-Joint & elbow	Detach/attach	1 set		0.3
106	-Mounting bolt	Detach/attach	1 set		0.3
107	-Swivel joint slinging	Detach/attach	1		0.3
108	-Cleaning	Cleaning	1 set		0.2
109	Swivel joint	O/H	1 set		3.0
	Other necessary works	Detach/attach	1 set	Lower piping	0.5
120	Main control valve			See 33.1.15	
121	Main control valve ASSY	Detach/attach	1 pc.		2.0
122	-Attach tag to port name of pipe	Preparation	1 pc.		0.5
123	-Piping	Detach/attach	1 set		1.2
124	-Bracket mounting bolts	Detach/attach	1 set		0.1
125	-Valve slinging	Detach/attach	1 pc.		0.1
126	Main control valve ASSY	Detach/attach	1 set		5.0
	Other necessary works	Detach/attach	1 set	Guard	1.0
130	Valve relation				
131	Solenoid valve ASSY (7-section)	Detach/attach	1		1.0
132	-Attach tag to port name of pipe	Preparation	1		0.2
133	-Piping	Detach/attach	1 set		0.5
134	-Mounting bolts	Detach/attach	1 set		0.3
	Other necessary works	Detach/attach	1 set	Guard	0.6
135	Hydro valve assy (Swing pilot line)	Detach/attach	1 set		0.3

12

13. MAINTENANCE STANDARD AND TEST PROCEDURE

13.2 PERFORMANCE INSPECTION STANDARD TABLE

Note

Unless otherwise specified, measure it on "H" mode.

13.2.1 STANDARD VALUE TABLE

Inspection Item				Measuring Position			Standard value	Tolerance		Unit	Adjusting Point	Measuring condition							
				Position	Size	Port		Hi	Lo										
Standard Measuring condition	Cleanliness of hydraulic oil				Hydraulic oil in tank			NAS 9 or less	—	—	Class	—	Sampling						
	Hydraulic oil temperature				Tank surface			50 (122)	+ 5 (41)	- 5 (23)	°C (°F)	—	Atmospheric temp						
	Water temperature				Radiator surface			75 (167)	+ 15 (59)	- 15 (5)		—	50°C~10°C (122°F~14°F)						
	Engine speed	H mode Lo idle				Measure the engine speed at multi display on the gauge cluster, or measure with diesel speed meter.			1100	+ 30	- 30	min ⁻¹	Adjustment not required	LOW throttle					
		H mode Hi idle							2000	+ 30	- 30			Full throttle (HI idle)					
		H mode Decel							1150	+ 30	- 30			Perform all measurement with the air-conditioner "OFF".					
S mode Hi idle				1900	+ 30				- 30										
ECO mode Hi idle				1800	+ 30				- 30										
High pressure circuit	Pilot primary pressure circuit				G pump	Main pump	PF1/4	a4	5.0 (725)	+ 0.5 (+73)	0	MPa (psi)	PR1	HI idle					
	Main relief valve pressure	ATT		P1	a1			34.3 (4970)	+ 0.7 (+100)	- 0.5 (-73)	MR1		Boom up						
				P2															
		Boost		P1										a2	—	—	—	MR1	—
				P2															
	Over load relief valve pressure	Boom		R	a1			37.8 (5480)	0	- 4.0 (-580)	OR4		Boom down						
				H															
		Arm		R	a2			37.8 (5480)	0	- 4.0 (-580)	OR8		Arm out						
				H															
		Bucket		R	a1			37.8 (5480)	0	- 4.0 (-580)	OR7		Arm in						
				H															
		Swing		RH	a2			28.0 (4060)	+ 3.4 (+493)	+ 0.5 (+73)	OR2		Bucket dump						
				LH															
		Travel	RH	FW	a1			34.3 (4970)	+ 1.7 (+240)	- 0.5 (-73)	OR1		Bucket digging						
				RV															
			LH	FW										a2	34.3 (4970)	+ 1.7 (+240)	- 0.5 (-73)	OR6	Swing RH
				RV															
									—	Simultaneous operation of travel RH and LH									
									—										
									—										
								—											

13.6 MEASURING SWING PERFORMANCES

13.6.1 SWING SPEED

(1) Purpose

Measure the swing time and confirm the performances between the hydraulic pump and the swing motor of the swing drive system.

(2) Conditions

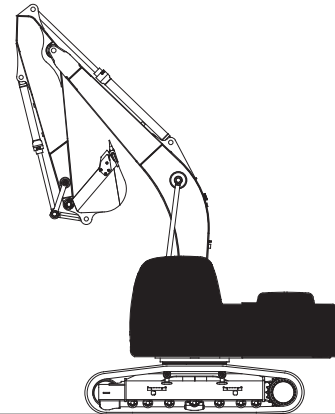
Hydraulic oil temperature;
45 to 55C degrees (113 to 131F degrees)
Firm, level ground
Engine revolution; Hi idle

(3) Preparation

Put the bucket empty and extend the boom, arm and bucket cylinder fully.
And the machine becomes a position of minimum reach.

(4) Measurement

Swing the machine by bringing the swing lever to its full stroke. Measure the time required to make two turns after one turn of preliminary run and calculate the time required for one turn.



Swing speed measuring position (at the min. reach)

Swing speed		Unit : sec/rev	
Measuring position	Standard value	Reference value for remedy	Service limit
Swing speed at min. reach	5.3~6.5	6.5~8.1	8.6~

13.6.2 PERFORMANCE OF SWING BRAKE

(1) Purpose

Confirm the braking torque performances by the swing relief valve.

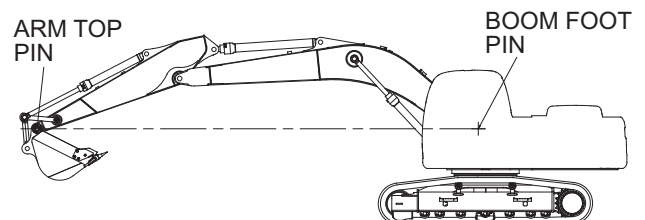
(2) Conditions

Hydraulic oil temperature;
45 to 55C degrees (113 to 131F degrees)
Firm, level ground
Engine revolution; Hi idle

(3) Preparation

1. Put the bucket empty, retract the arm cylinder fully and extend the bucket cylinders fully. And move the boom so that the arm top pin is positioned at same height with boom foot pin.

2. Put a matching mark on the outer circumference of the swing bearing of the upper frame side and of the track frame side. Place two poles (flags) on the front and back of the extended line of the matching mark.



Swing brake performance measuring position

13. MAINTENANCE STANDARD AND TEST PROCEDURE

13.10 EXHAUST GAS POST-CLEANING DEVICE

13.10.1 HANDLING OF EXHAUST GAS POST-CLEANING DEVICE

After about 15 hours operating time, some quantity of soot is trapped by filter. And the soot is deposited in the exhaust gas post-cleaning device. And this exhaust gas post-cleaning device is changed to regeneration mode automatically. This regeneration system uses soot combustion to generate.

To avoid malfunction of the exhaust gas post-cleaning device, observe the following points. (According to working conditions, this deposition time varies.)

During automatic soot combustion for regeneration, the exhaust sound changes, but this change of sound does not show any malfunction of system.



Mark is displayed on the monitor, but the operator can continue the machine operation.

Notice

When some quantity of soot is trapped by filter and deposits in exhaust gas post-cleaning device, this device starts combustion treatment (Regeneration) automatically. This function prevents abnormal deposit of soot, and keeps the purification capacity in good condition at all times. We make soot combustion during working possible by use of high-performance catalyst and common rail fuel injection system.

A. Do not use unspecified fuel.



Use the low-sulfur diesel fuel (S50: Sulfur content 50 ppm or lower). In cold area, use appropriate low-sulfur diesel fuel. If you use unspecified fuel, it adversely affects the engine and the exhaust gas post-cleaning device, and it causes white smoke and malfunction.

B. Use recommended brand engine oil.

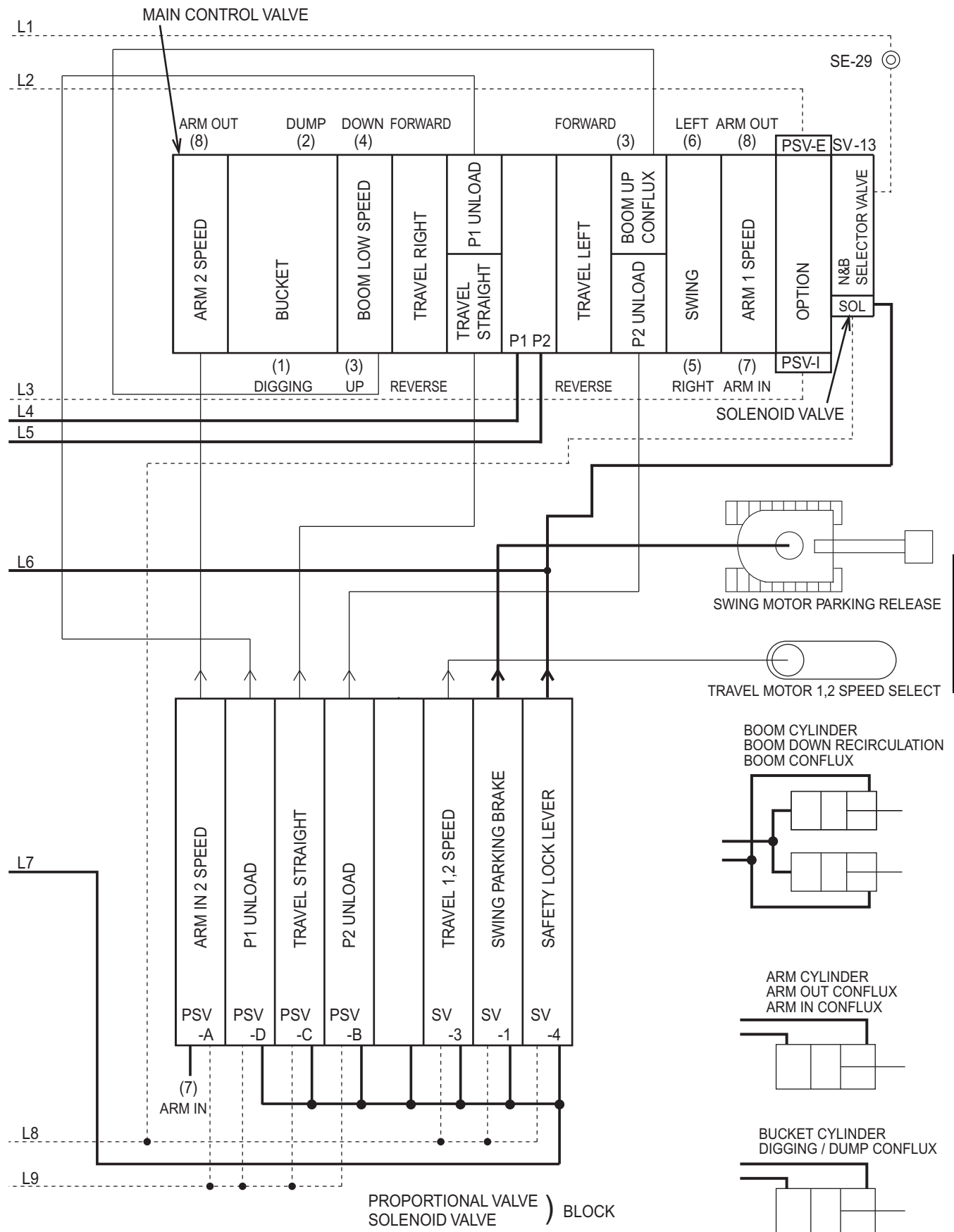


To maintain the function of exhaust gas post-cleaning device for long periods, use recommended brand engine oil.

C. Do not modify the tail-pipe.

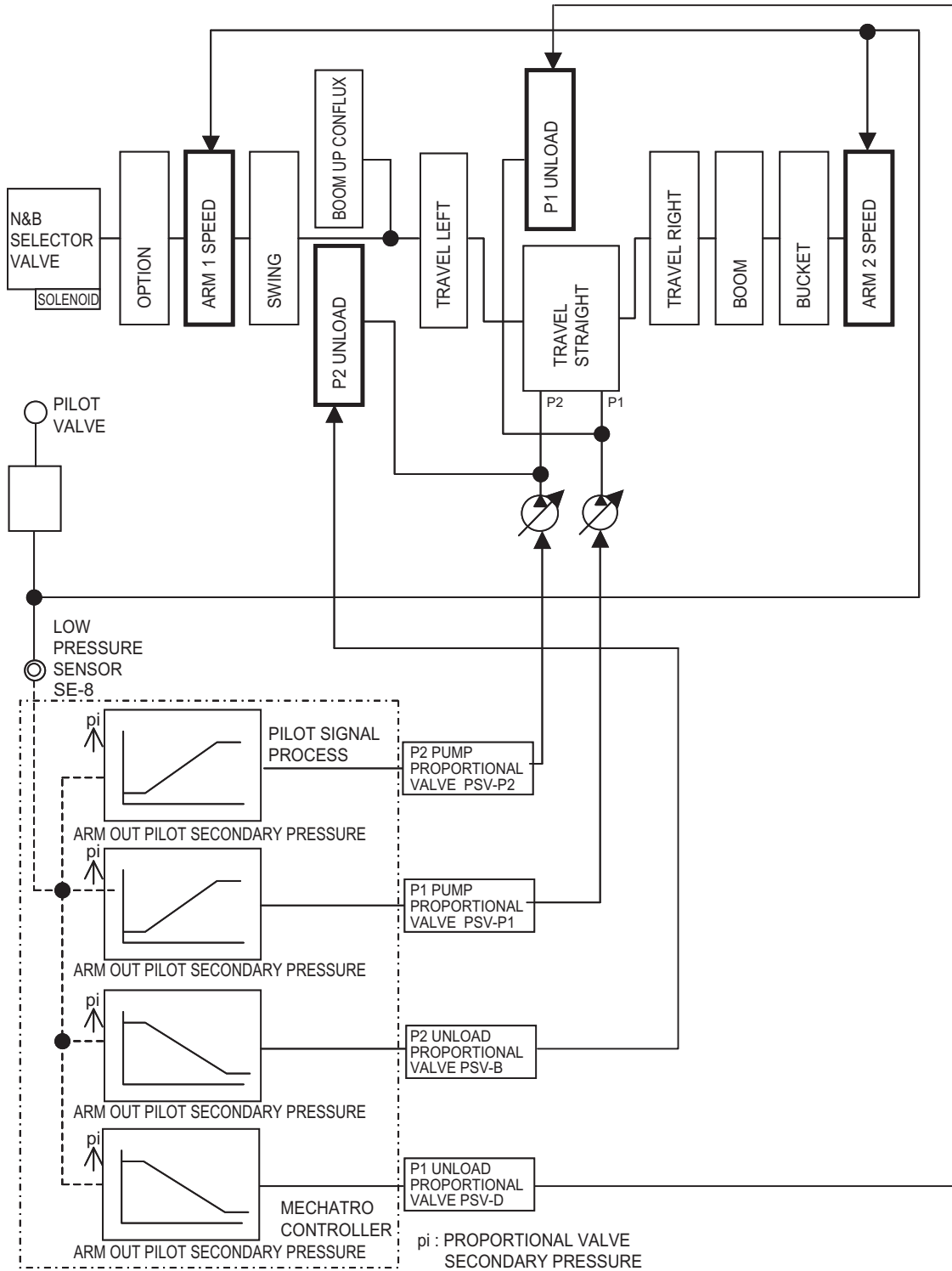


To avoid adverse effect, do not modify the tail-pipe. If tail-pipe direction or length is modified, it causes adverse effect to the exhaust gas post-cleaning device.



21. MECHATRO CONTROL SYSTEM

21.1.7 ARM-OUT CONFLUX CONTROL



(1) Nibbler circuit

1. Select nibbler mode through select switch.
2. Nibbler display appears on gauge cluster.
3. The return oil from the nibbler passes through selector valve and option spool and led to tank line of main control valve.
4. When selecting nibbler mode through select switch, the breaker pressure sensor has not function to output. It is in normal when there is no output from sensor in nibbler mode, and in cases of other than above, error display is output to gauge cluster.

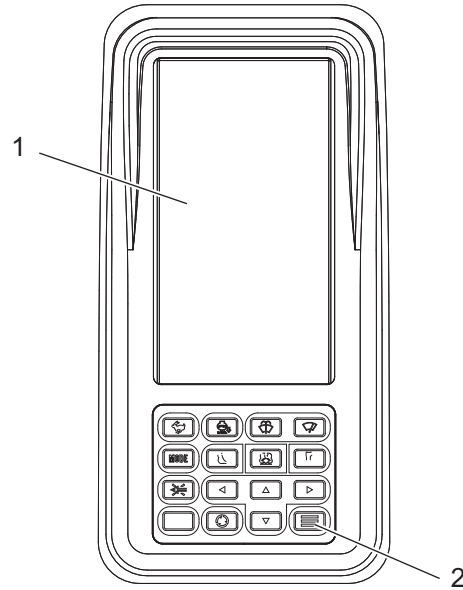
(2) Breaker circuit

1. Select breaker mode through select switch.
2. Breaker display appears on gauge cluster.
3. The return oil from the breaker passes through selector valve and directly returns into hydraulic oil tank.
4. When selecting breaker mode through select switch, the breaker pressure sensor outputs signal. It is in normal when there is an output from sensor in breaker mode, and in cases of other than above, error display is output to gauge cluster.

21. MECHATRO CONTROL SYSTEM

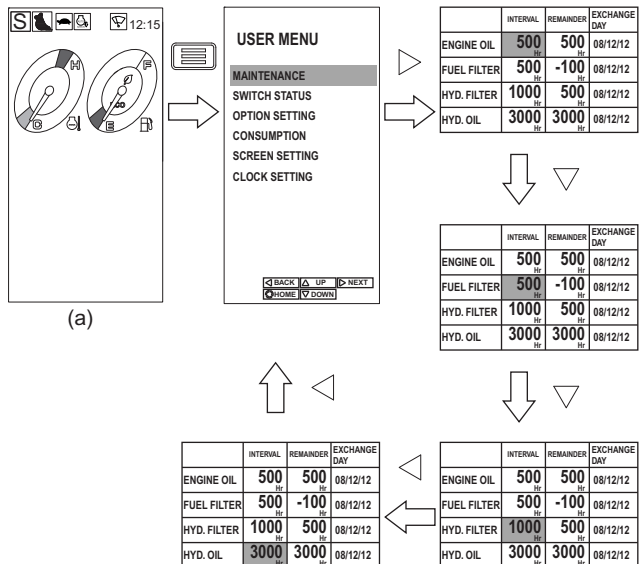
(7) Maintenance screen displays

This screen displays the remaining time to the end of recommended replacement/change interval specified for filter/oil.



After turning starter key switch ON or starting engine, Then, the display returns to "SERVICE ADJUST 1-2" screen (c). This display shows the recommended replacement time of engine oil, time for next engine oil change and date of previous engine oil change.

For the initial set value of recommended replacement/change time, see the following table.



Replacement interval

Item	Default
Engine oil	500 Hr
Fuel filter	500 Hr
Hydraulic oil filter	1,000 Hr
Hydraulic oil	5,000 Hr

This menu is available for confirmation of the following items.

The maintenance screen changes each time the screen change switch is pressed.

1.

Remaining time display to the engine oil change

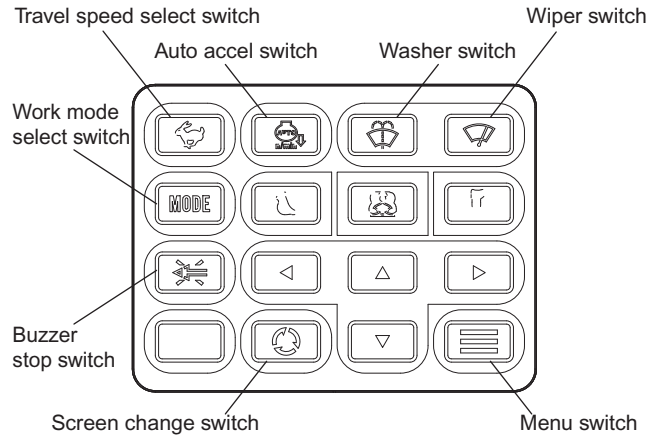
This display shows the remaining time of "INTERVAL, REMAINING TIME, EXCHANGE DAY".

	INTERVAL	REMAINDER	EXCHANGE DAY
ENGINE OIL	500 Hr	500 Hr	08/12/12
FUEL FILTER	500 Hr	500 Hr	08/12/12
HYD. FILTER	1000 Hr	1000 Hr	08/12/12
HYD. OIL	5000 Hr	5000 Hr	08/12/12

21. MECHATRO CONTROL SYSTEM

21.2.5 SET PROCEDURE OF MAINTENANCE SCHEDULE

This machine is equipped with multi-display which makes confirmation of remaining time to the coming replacement/change time of engine oil, fuel filter, hydraulic oil filter and hydraulic oil. When the remaining time reaches to Zero (0), replace or change them and perform the initial setting in the following order.



Notice

Interval of replacement of parts is mentioned below.

- Engine oil: 500 Hr
- Fuel filter: 500 Hr
- Hydraulic filter: 1,000 Hr
- Hydraulic oil: 5,000 Hr

Notice

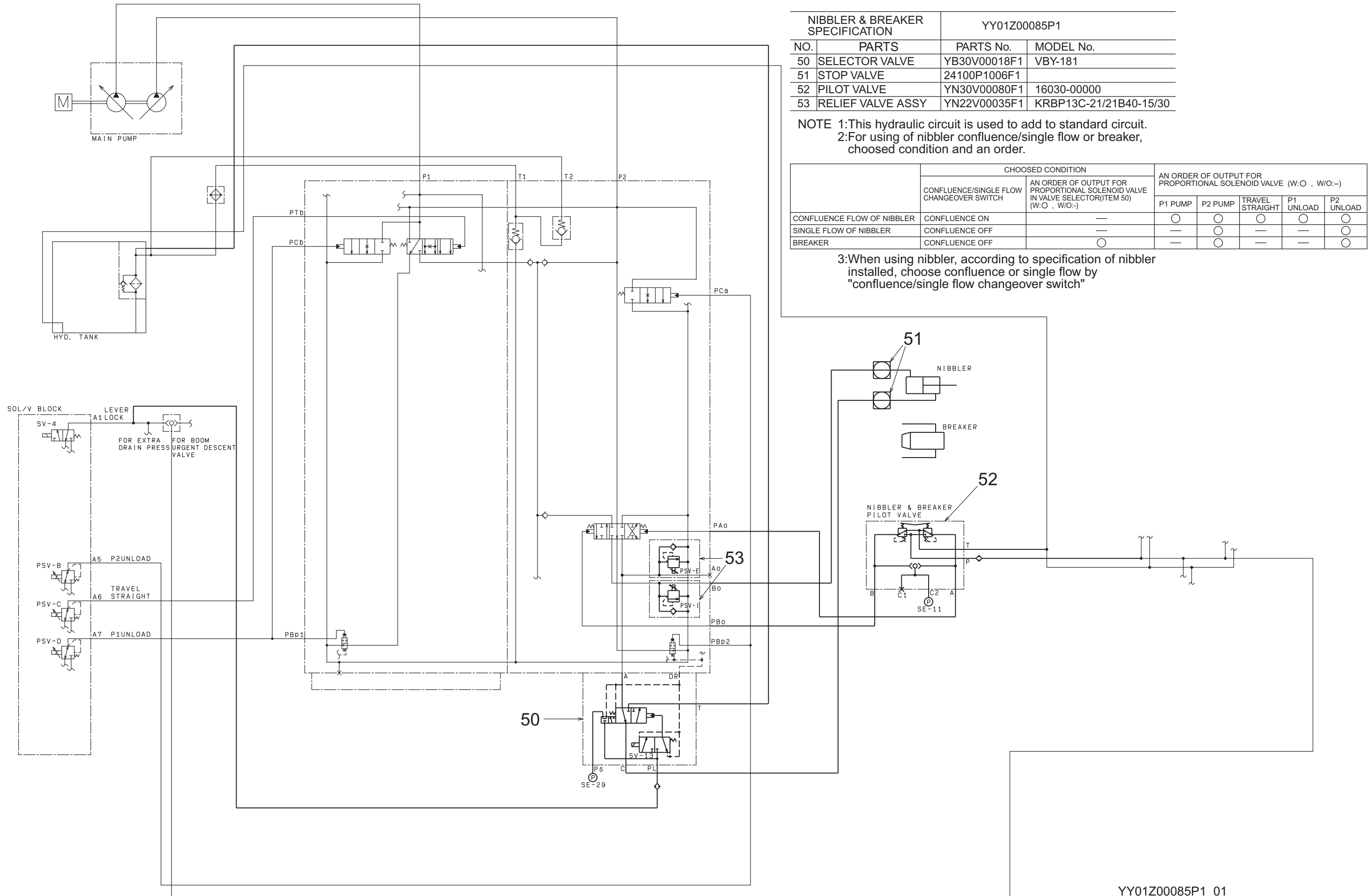
1. The engine oil change time is displayed on the multi-display by 500 hours as a warning, but the buzzer does not sound.
2. The fuel filter change time is displayed on the multi-display by 500 hours as a warning, but the buzzer does not sound.
3. The hydraulic oil filter change time is displayed on the multi-display by 1000 hours as a warning, but the buzzer does not sound.
4. The hydraulic oil change time is displayed on the multi-display by 5000 hours as a warning, but the buzzer does not sound.

5) Summary of display and drive item

No.	Item	Remarks
1	Monitar display	LCD dot 120X168
2	-	
3	-	
4	Buzzer	Piezo-electricity type
5	Screen change switch	
6	Buzzer stop switch	
7	Work mode select switch	
8	Digging mode switch	
9	Nibbler mode switch	
10	Breaker mode switch	
11	Up arrow switch	
12	Down arrow switch	
13	Next arrow switch	
14	Back arrow switch	
15	Back light	LED

22. HYDRAULIC SYSTEM

22.2.2 N&B SPECIFICATION (OPTION)

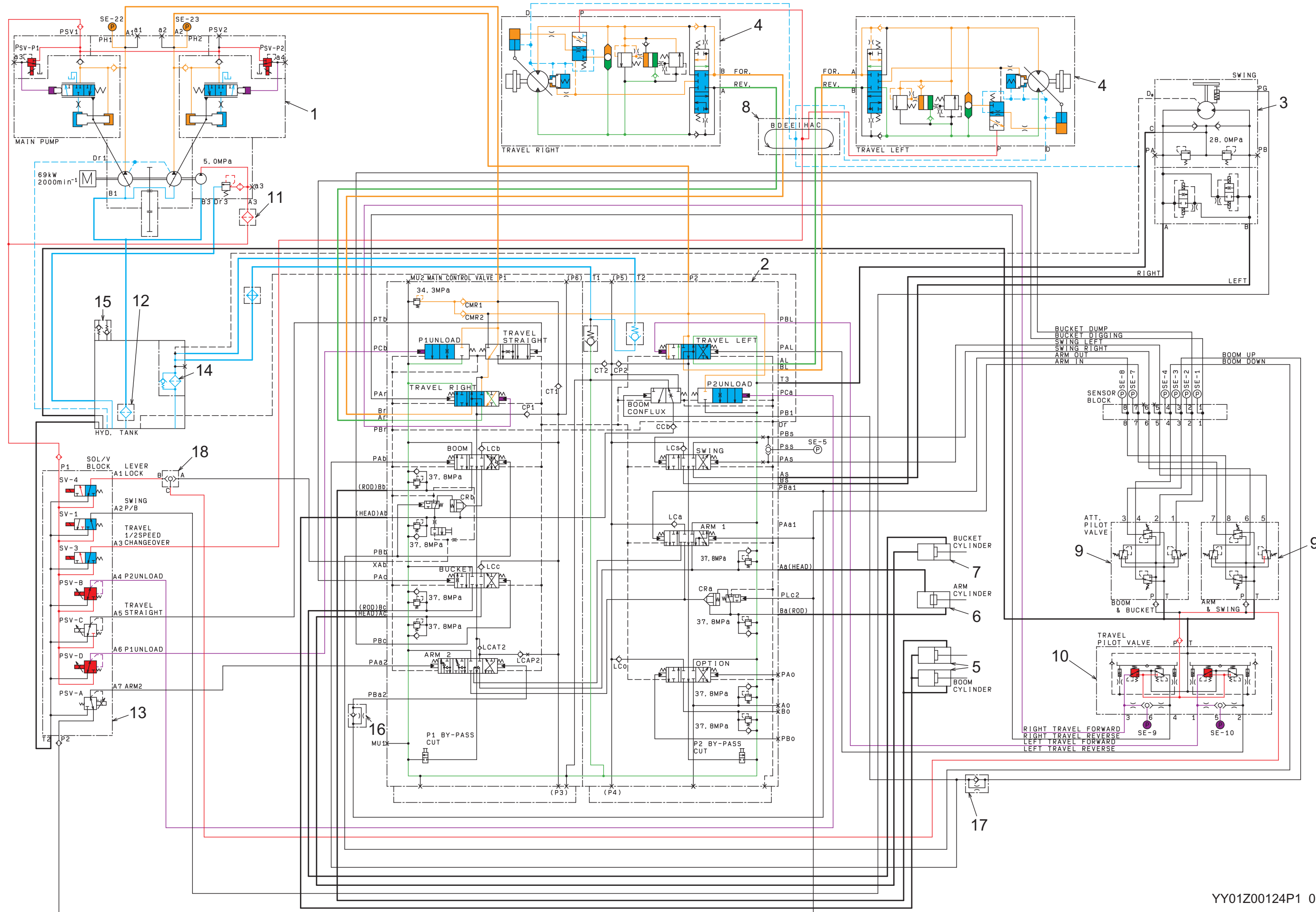


NIBBLER & BREAKER SPECIFICATION		YY01Z00085P1	
NO.	PARTS	PARTS No.	MODEL No.
50	SELECTOR VALVE	YB30V00018F1	VBV-181
51	STOP VALVE	24100P1006F1	
52	PILOT VALVE	YN30V00080F1	16030-00000
53	RELIEF VALVE ASSY	YN22V00035F1	KRBP13C-21/21B40-15/30

NOTE 1: This hydraulic circuit is used to add to standard circuit.
 2: For using of nibbler confluence/single flow or breaker, choosed condition and an order.

	CHOSED CONDITION	AN ORDER OF OUTPUT FOR PROPORTIONAL SOLENOID VALVE IN VALVE SELECTOR (ITEM 50) (W/O, W/O:-)	AN ORDER OF OUTPUT FOR PROPORTIONAL SOLENOID VALVE (W/O, W/O:-)				
			P1 PUMP	P2 PUMP	TRAVEL STRAIGHT	P1 UNLOAD	P2 UNLOAD
CONFLUENCE FLOW OF NIBBLER	CONFLUENCE ON	—	○	○	○	○	○
SINGLE FLOW OF NIBBLER	CONFLUENCE OFF	—	—	○	—	—	○
BREAKER	CONFLUENCE OFF	○	—	○	—	—	○

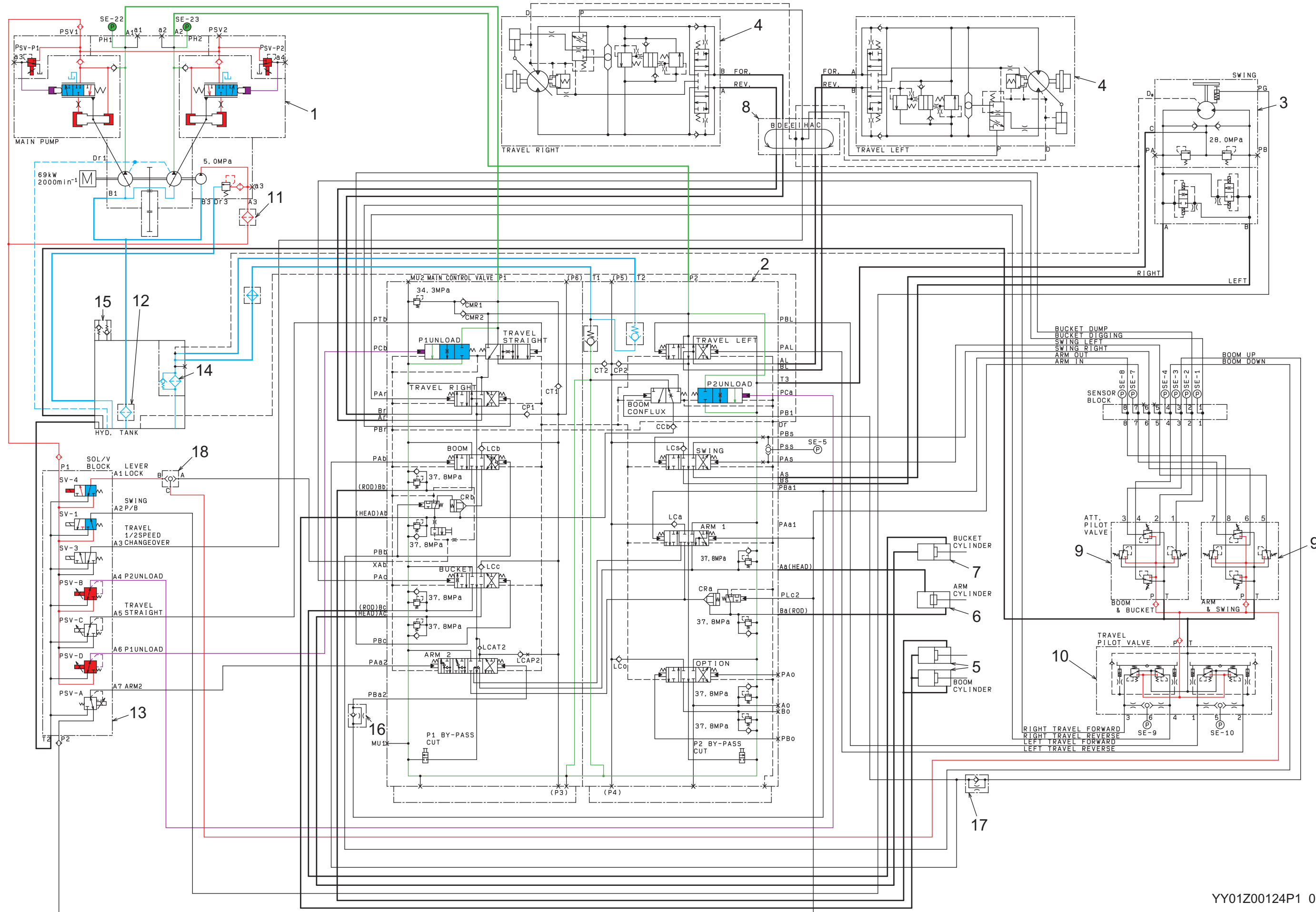
3: When using nibbler, according to specification of nibbler installed, choose confluence or single flow by "confluence/single flow changeover switch"



TRAVEL CIRCUIT : Travel 2nd speed, RH & LH simultaneous operation.

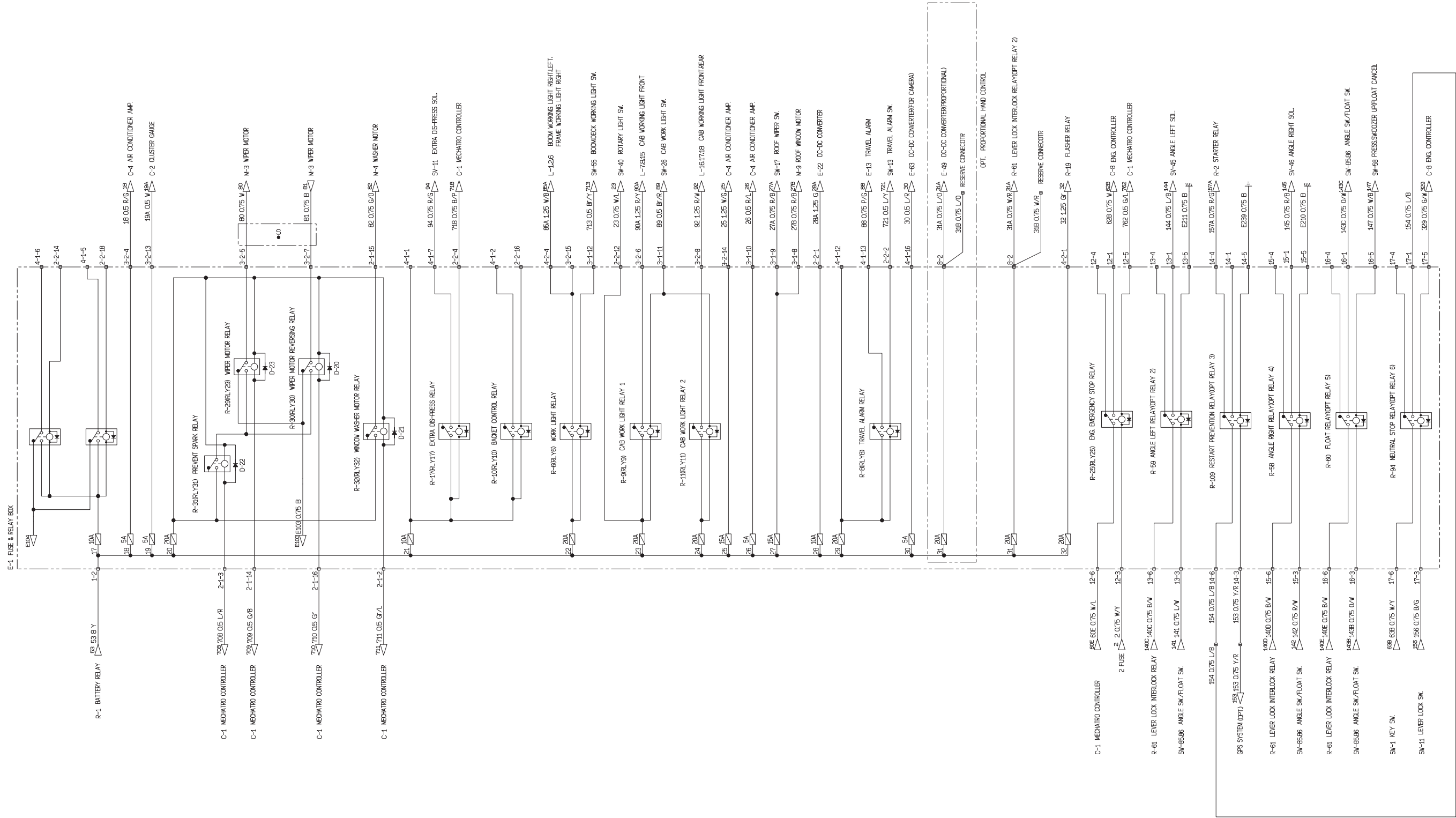
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PRESSURE DRAIN (RELEASE) CIRCUIT : At pressure release mode.

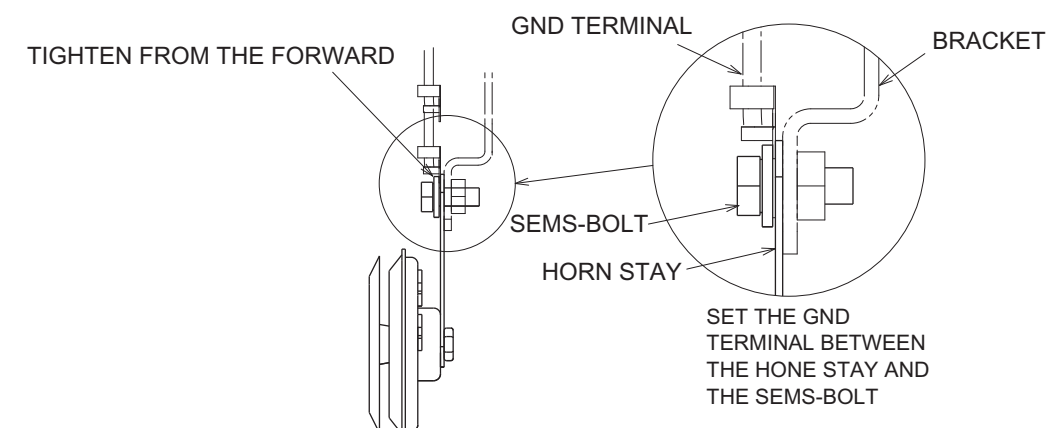
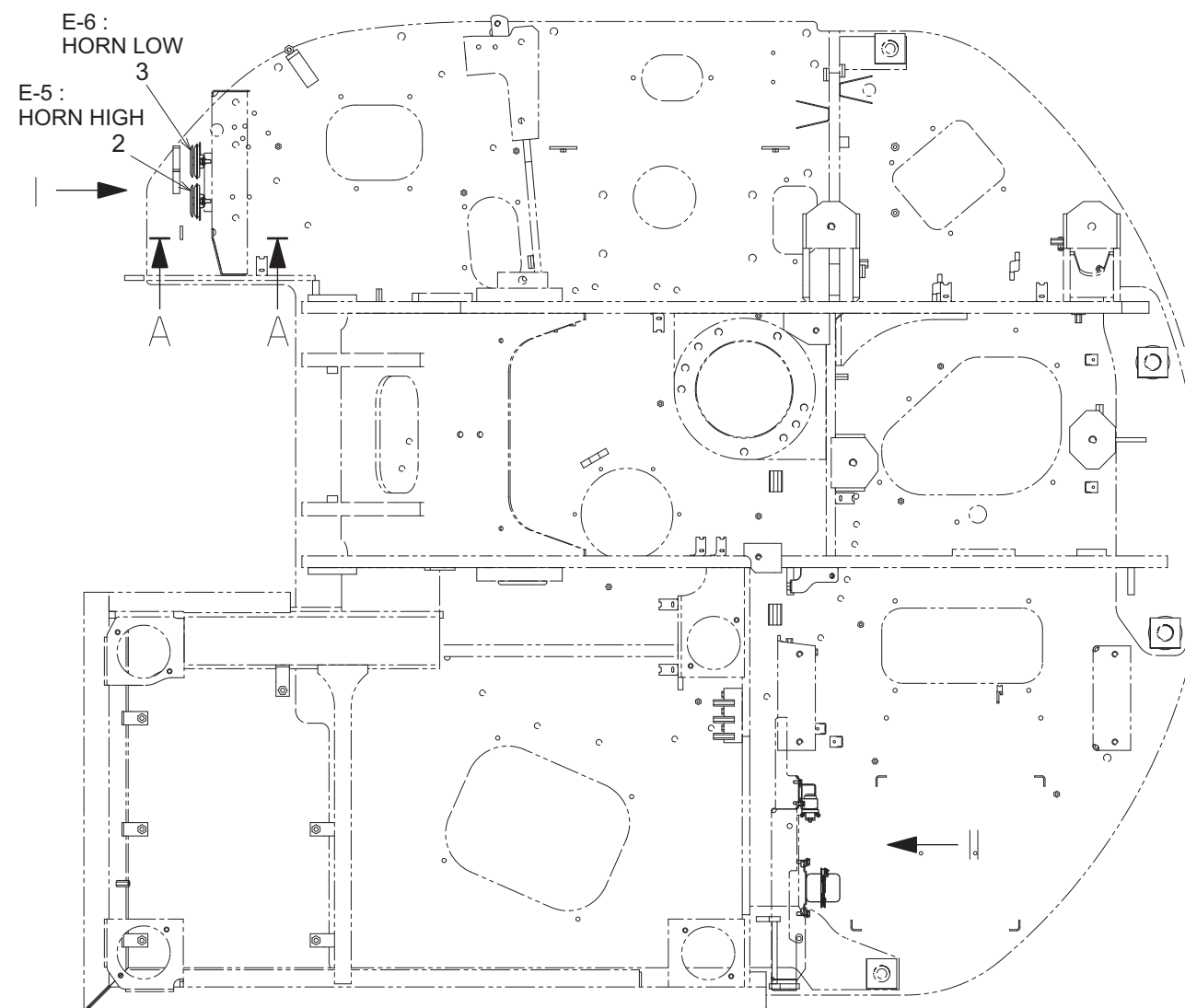
YY01Z00124P1 01



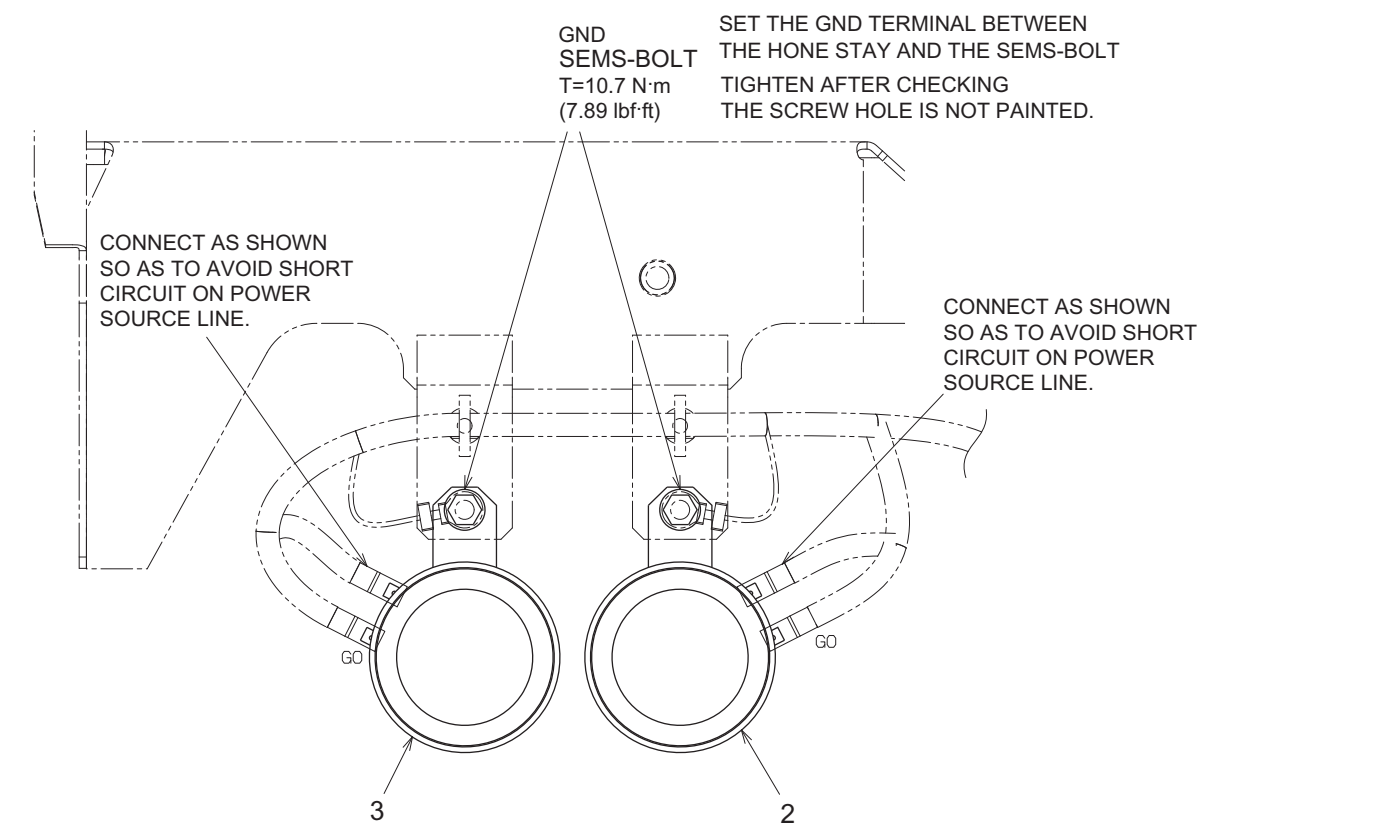
23.3.6 UPPER ELECTRIC ASSY

UPPER ELECTRIC ASSY		YY03E00008F1	(01)	
ITEM	PART NAME	PART No.	Q'TY	REMARKS
1	BATTERY RELAY	YN24S00008F1	1	
2	HORN	LC53S00001D1	1	HIGH
3	HORN	LC53S00001D2	1	LOW

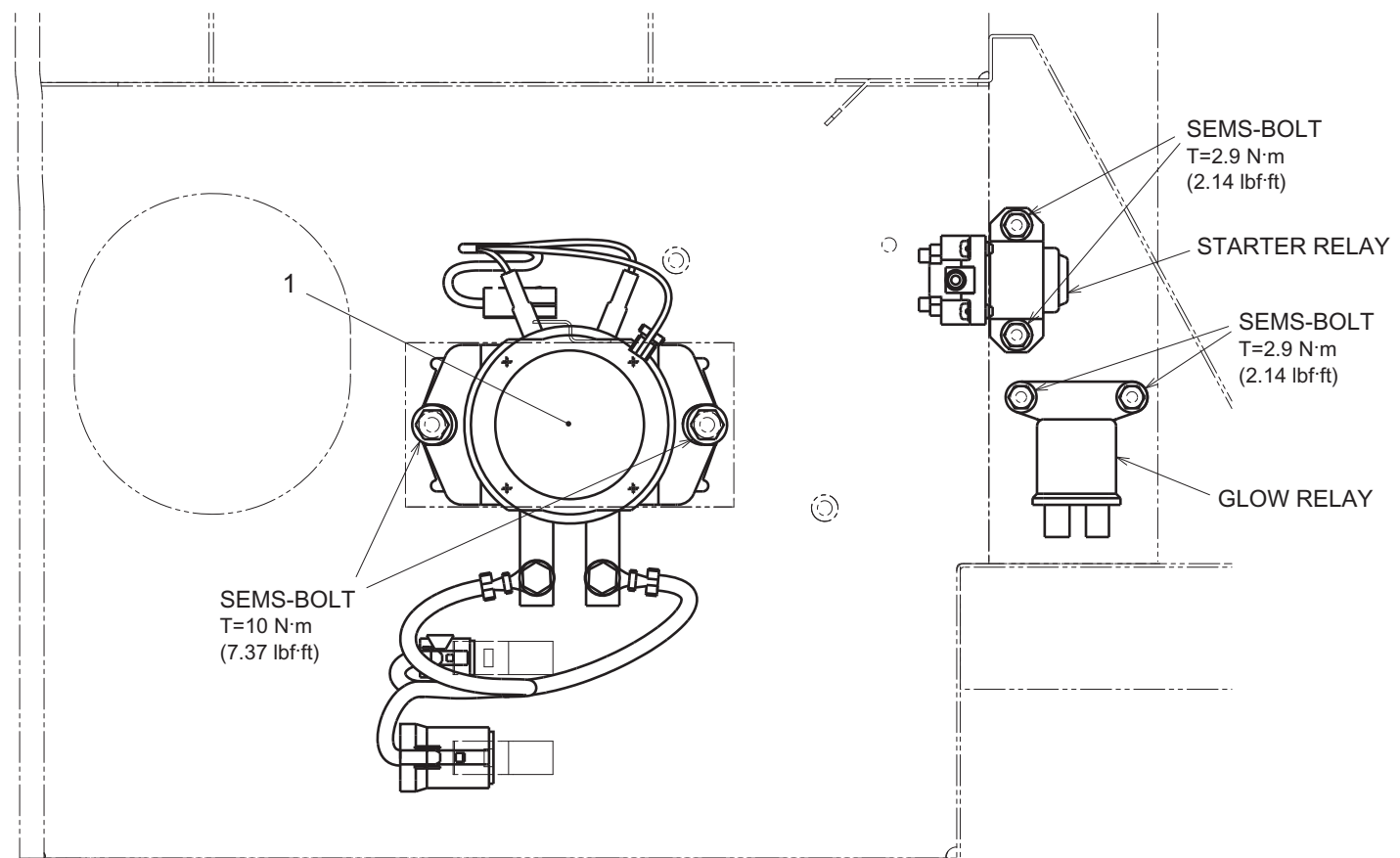
T=TIGHTNING TORQUE



SECTION AA

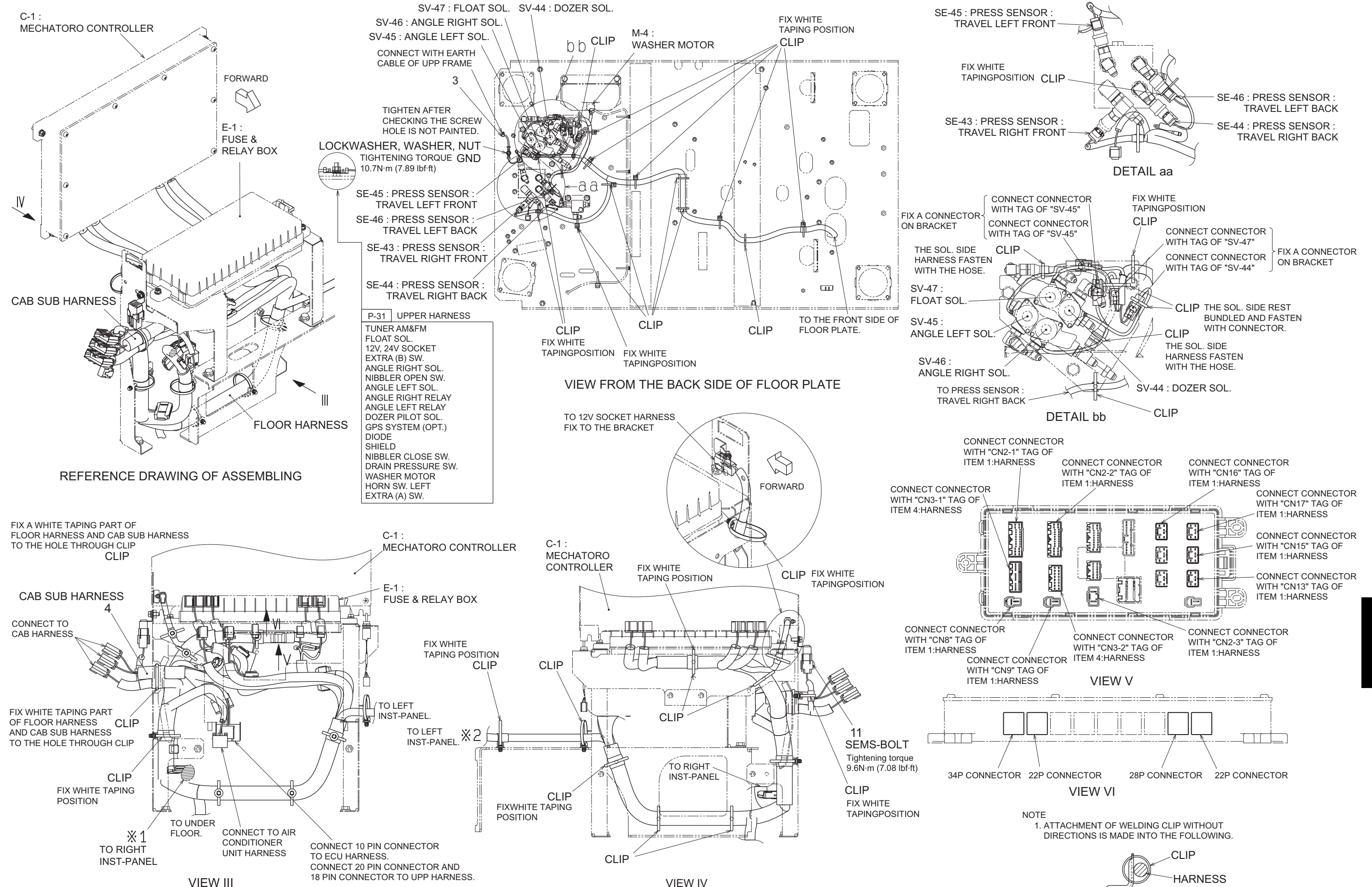


VIEW I



VIEW II (DETAIL OF BATTERY RELAY INATAL)

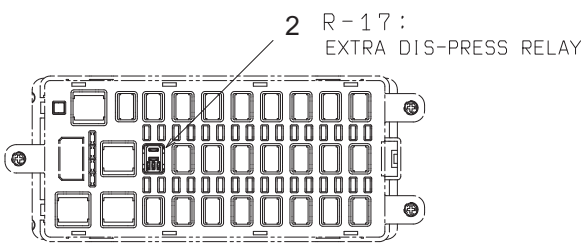
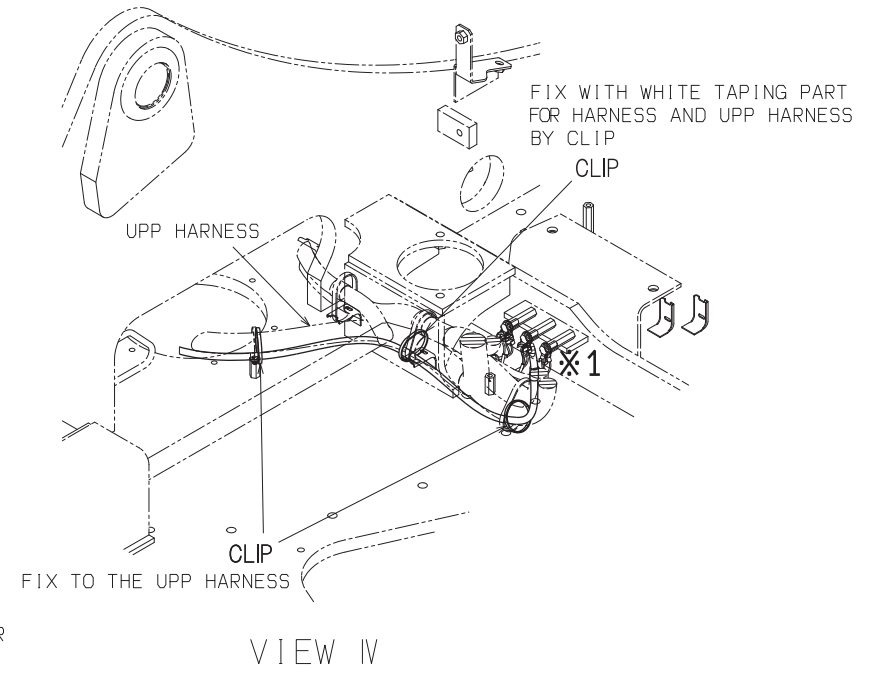
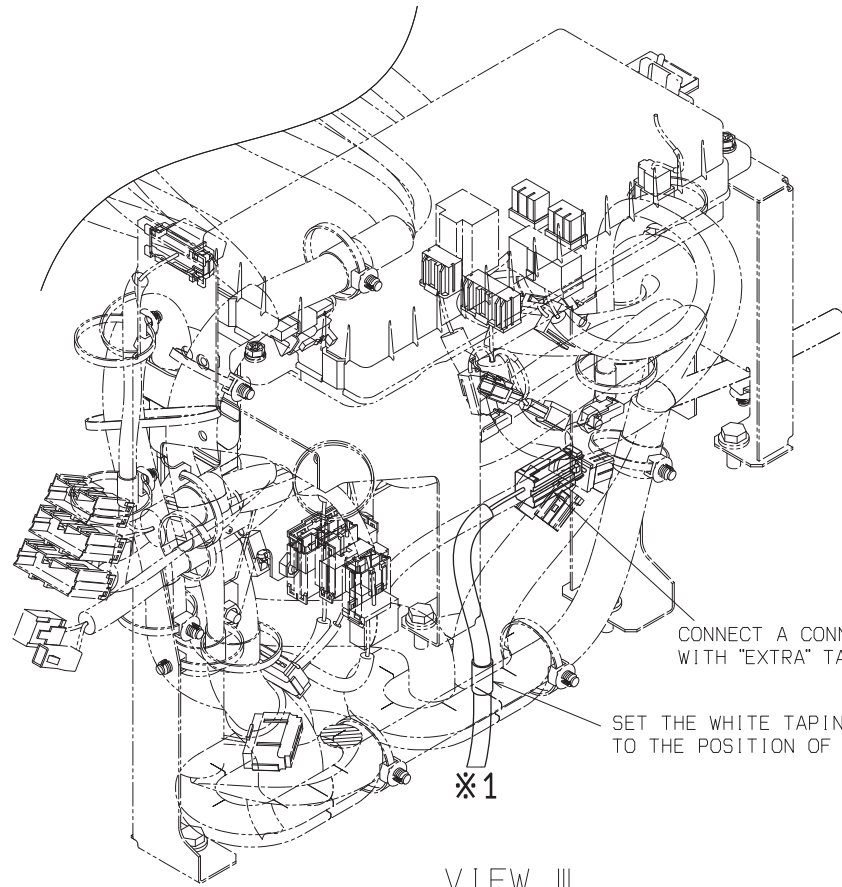
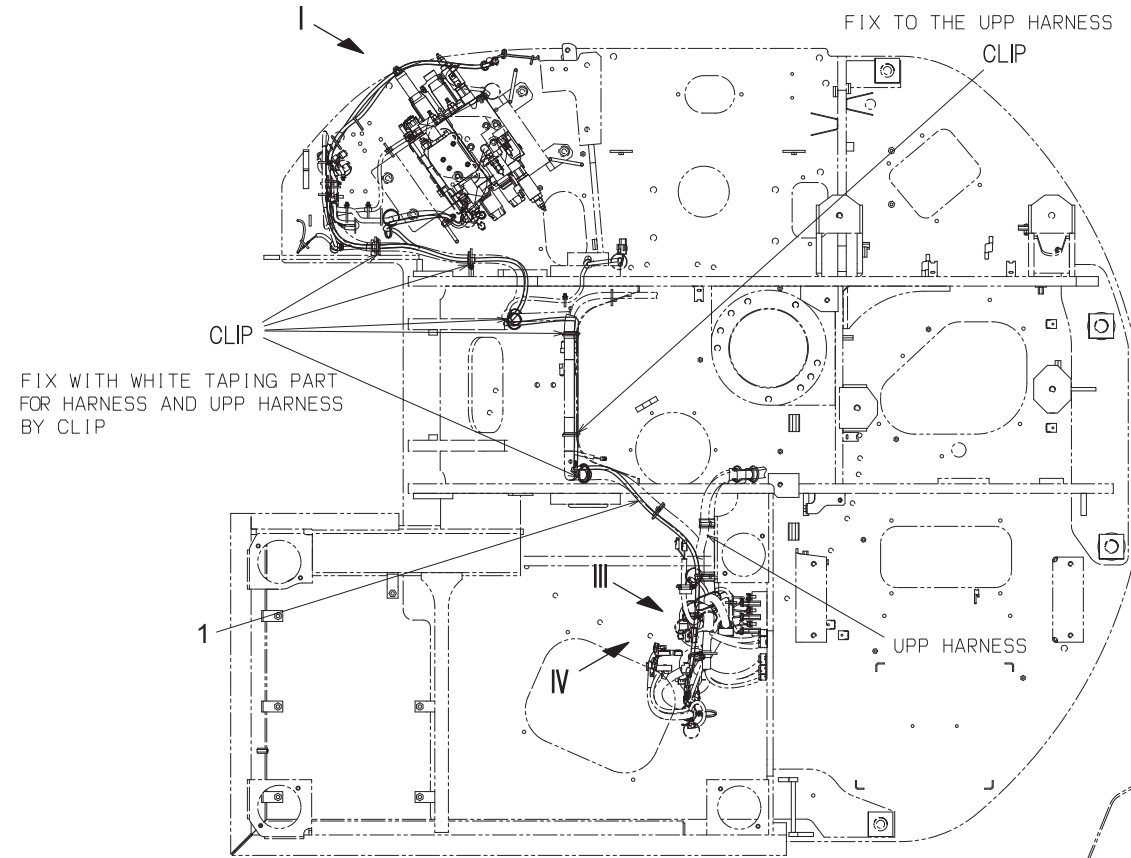
23.3.8 UPPER HARNESS ASSY (FLOOR PLATE) (2/2)



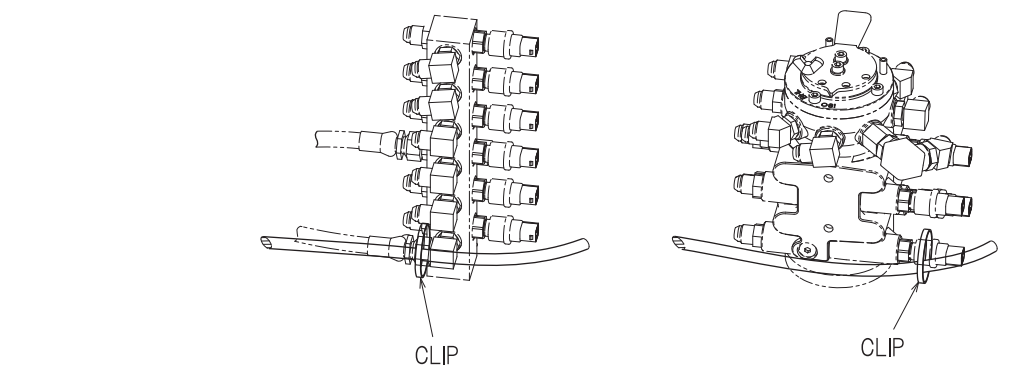
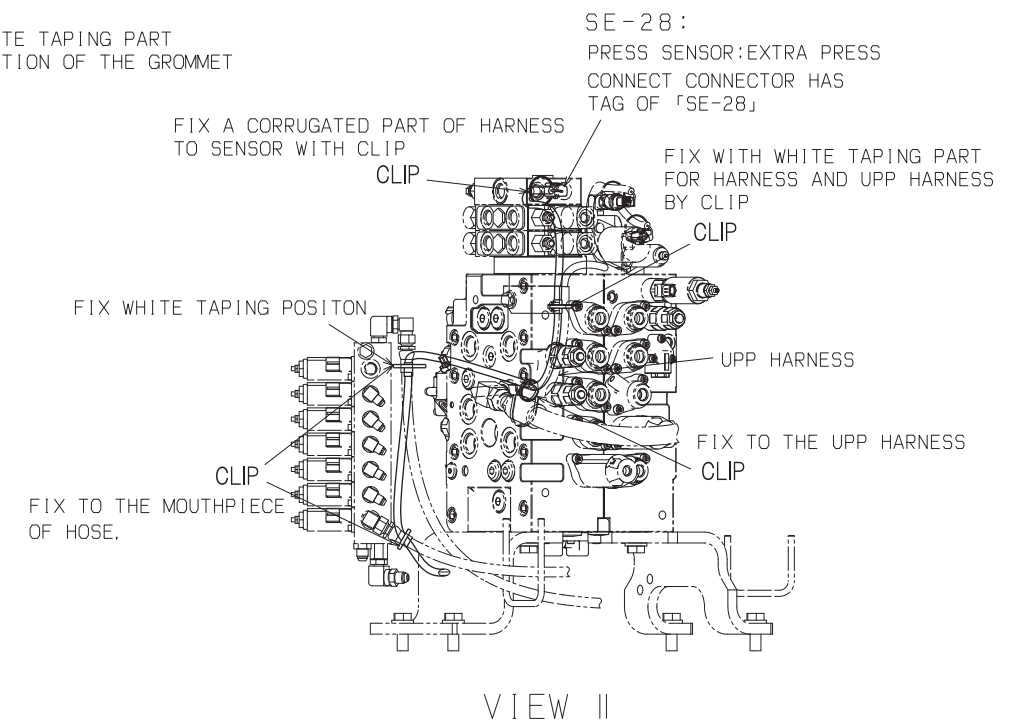
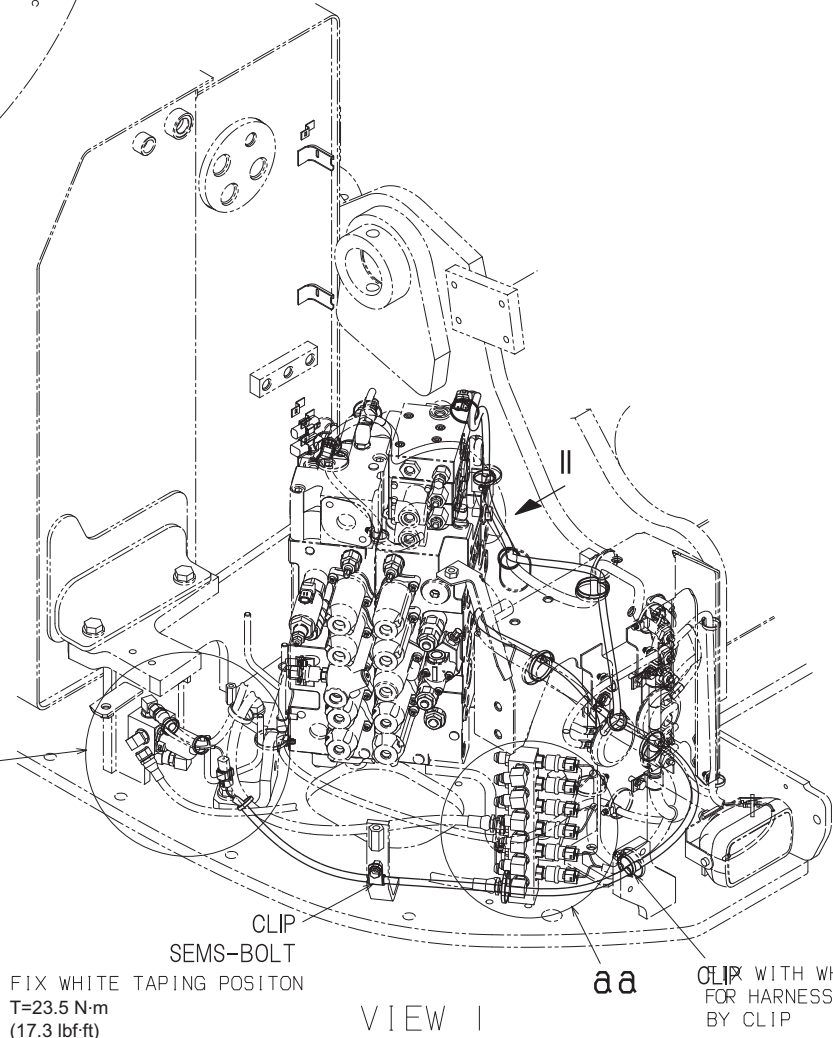
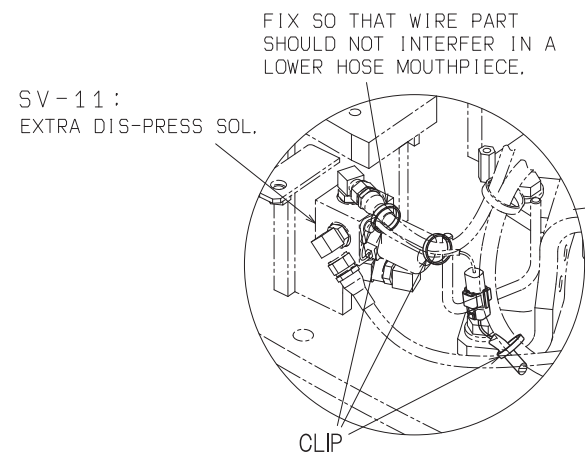
23. ELECTRICAL SYSTEM

23.3.11 UPPER HARNESS ASSY (EXTRA)

UPPER HARNESS ASSY		YY13E00185F1	(01)	
ITEM	PART NAME	PART No.	Q'TY	REMARKS
1	HARNESS	YY13E01357P1	1	EXTRA
2	RELAY	YN24S00010P1	1	



INSIDE OF FUSE & RELAY BOX

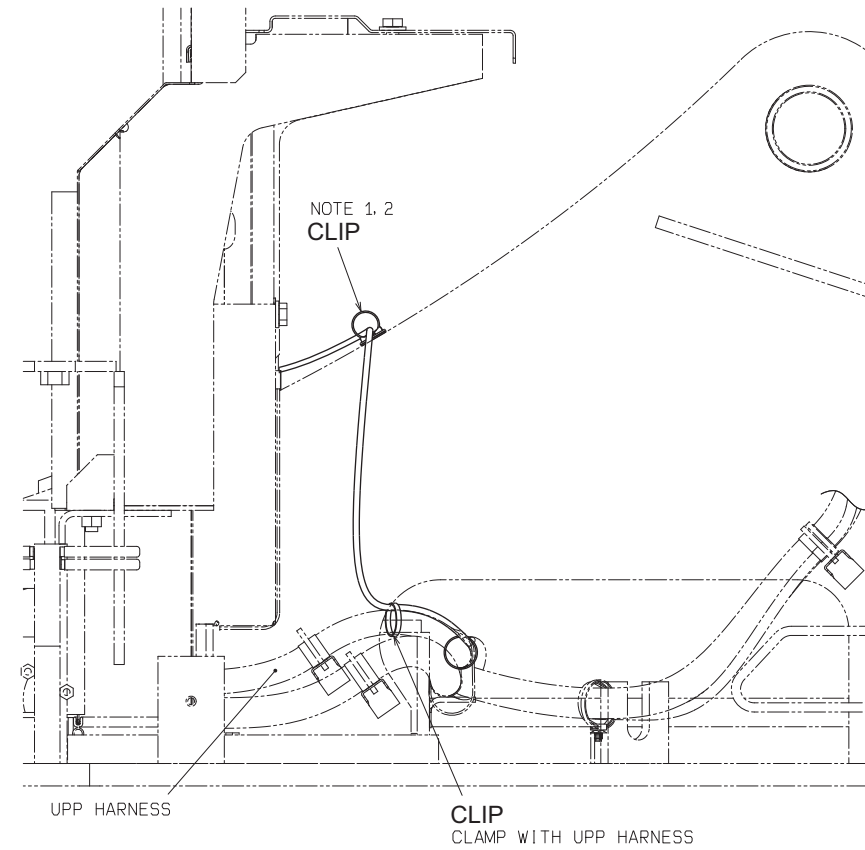
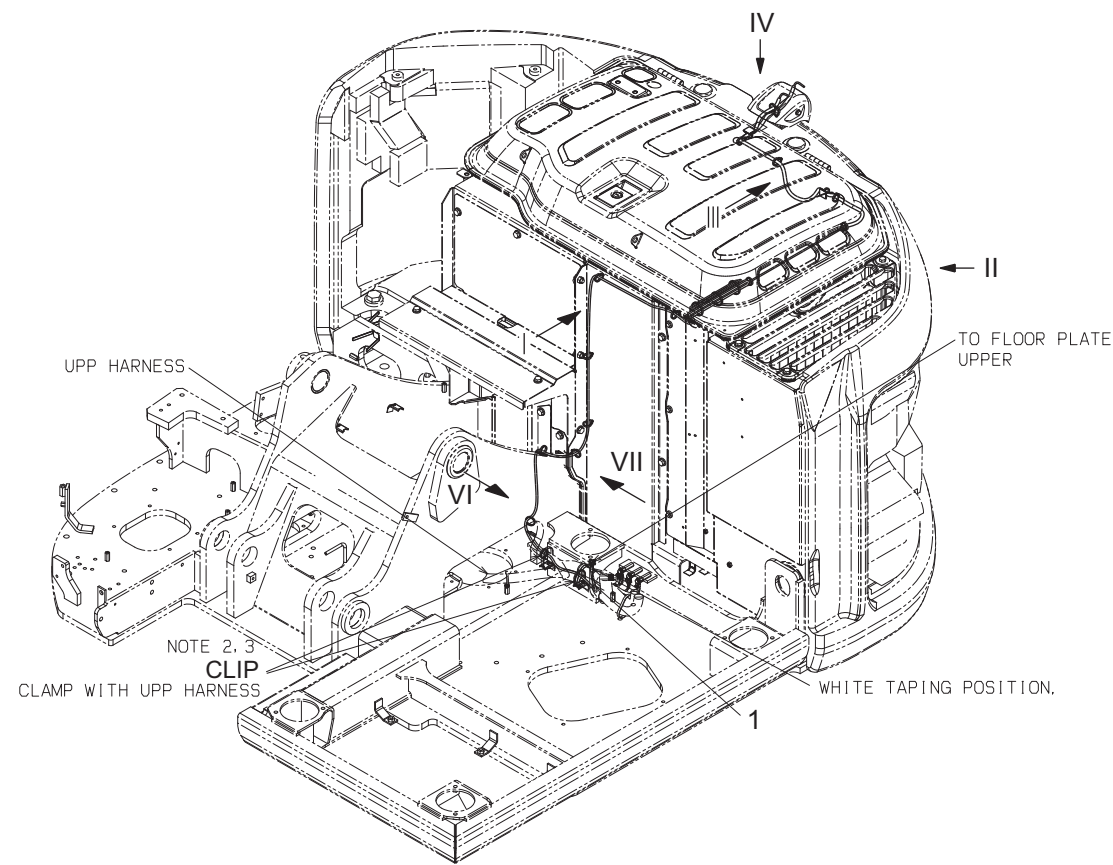


DETAIL aa: CASE OF SENSOR BLOCK

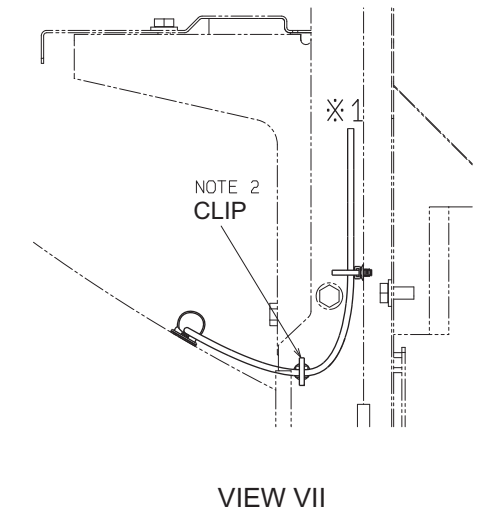
DETAIL aa: CASE OF MULCH

23.3.15 HARNESS ASSY (1/2)

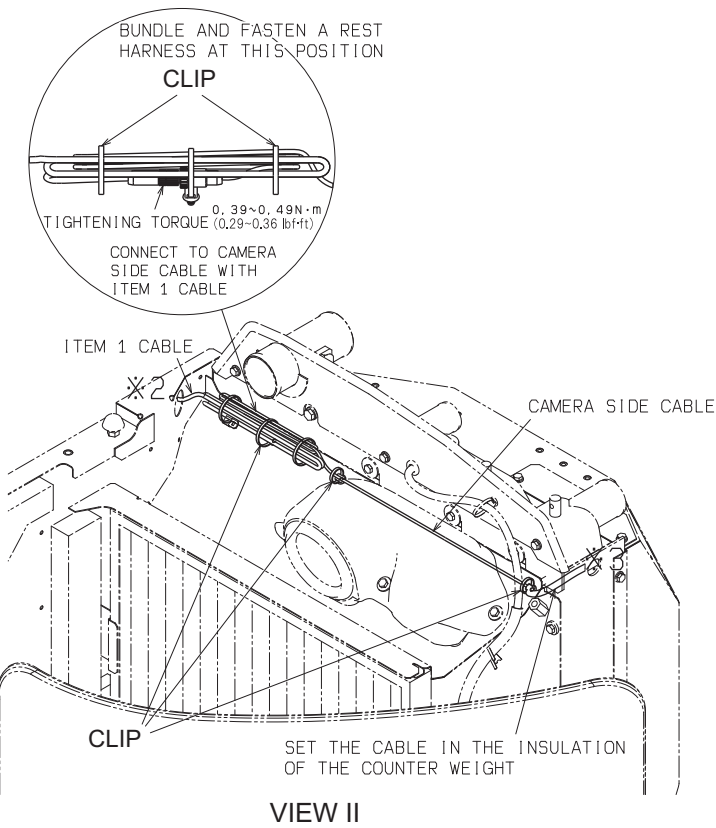
UPPER HARNESS ASSY		YY11E00044F1	(05)	
ITEM	PART NAME	PART No.	Q'TY	REMARKS
1	CABLE	YY11E01166D2	1	



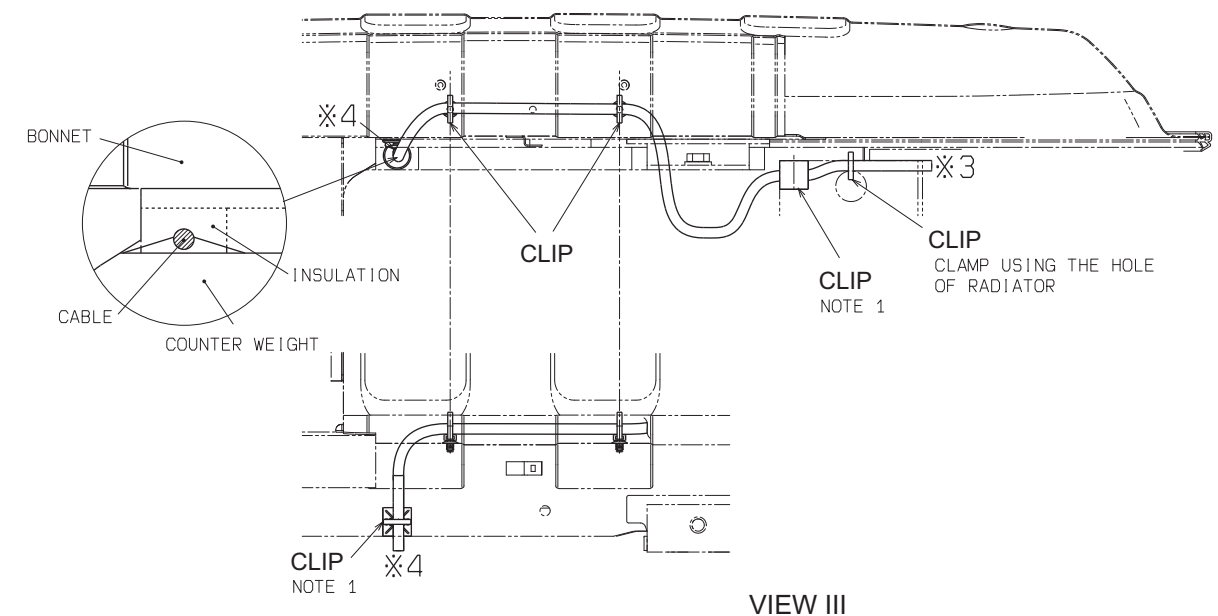
VIEW VI



VIEW VII



VIEW II

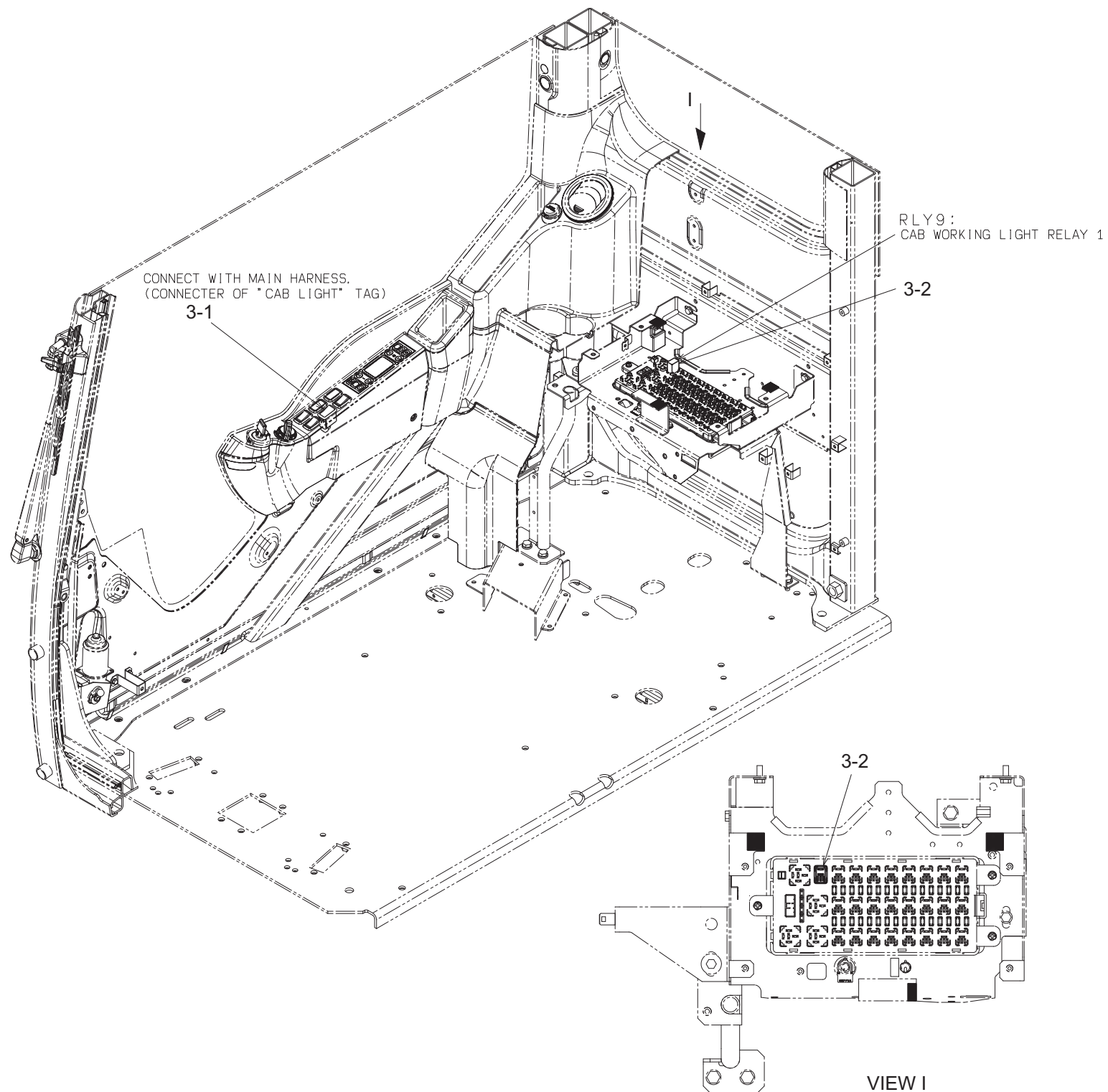


VIEW III

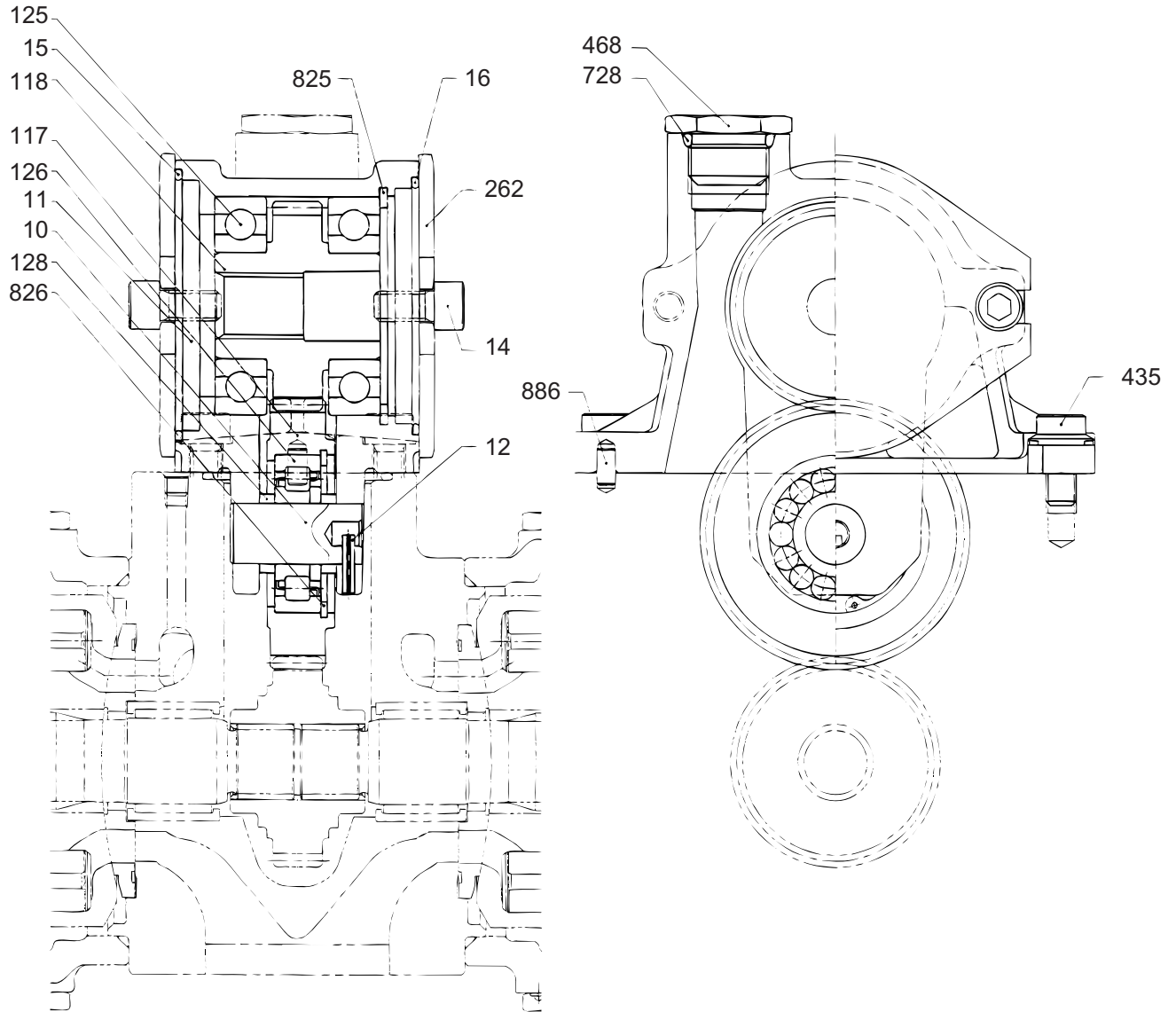
23. ELECTRICAL SYSTEM

23.3.18 CAB LIGHT INSTALL (SWITCH)

LIGHT INSTALL		LQ80E00017F7	(02)	
ITEM	PART NAME	PART No.	Q'TY	REMARKS
3	SWITCH INSTALL	LQ50E00008F1	1	
3-1	SWITCH	YN50S00040D4	1	
3-2	RELAY	YN24S00010P1	1	



(3) PTO gear case



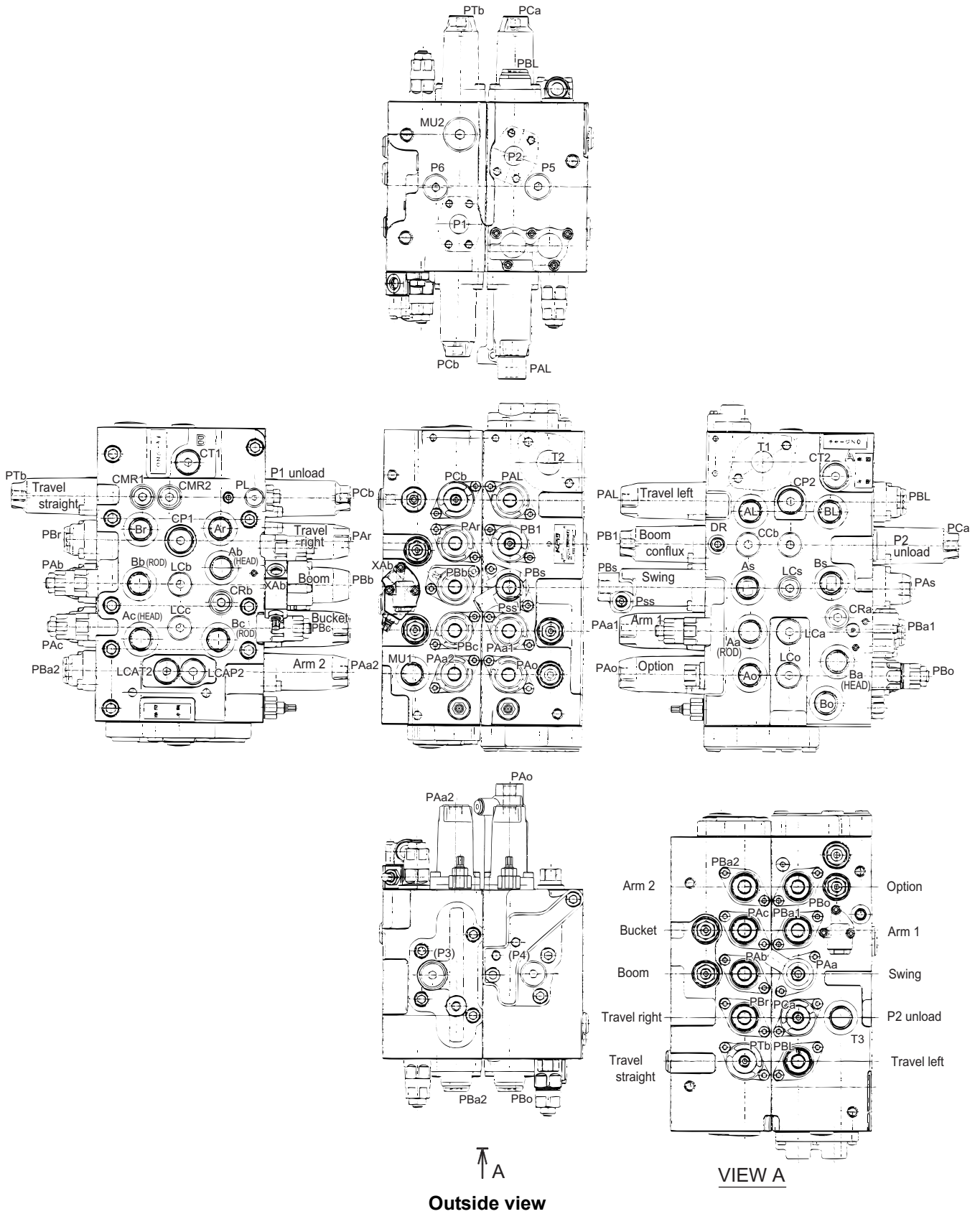
No.	Parts	Q'TY	No.	Parts	Q'TY
10	Idle shaft	1	126	Roller bearing	1
11	Gear case	1	128	Bearing spacer	2
12	Sprig pin	1	262	Cover	2
14	Capscrew; M10X20	4	435	Flange socket; M10X20	4
15	O-ring; 1B G85	1	468	VP plug; PF3/4	1
16	O-ring; 1B G80	1	728	O-ring; 1B P24	1
117	2nd gear	1	825	Snap ring	1
118	3rd gear	1	826	Snap ring	1
125	Ball bearing	2	886	Pin	2

24. COMPONENTS SYSTEM

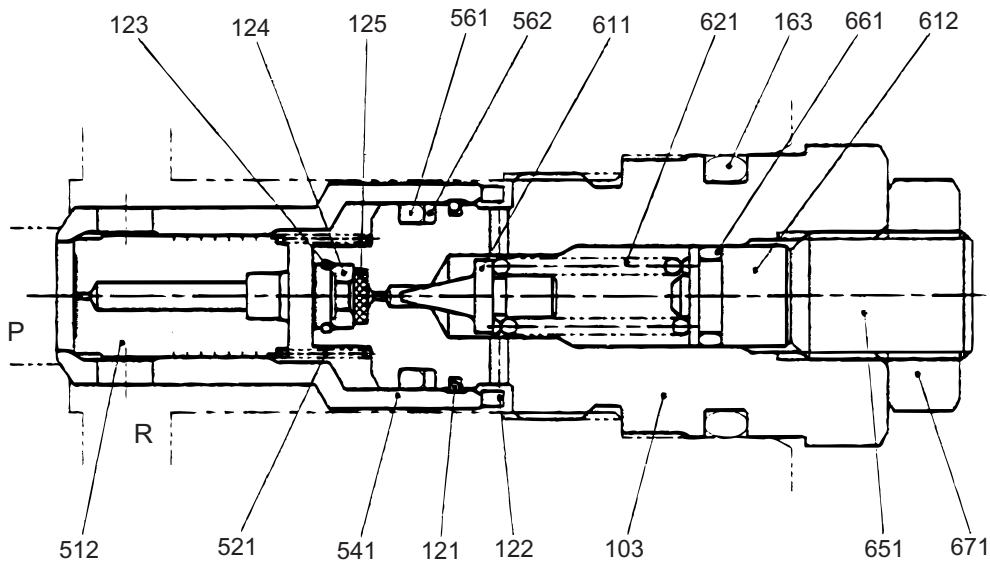
24.1.2 CONTROL VALVE

24.1.2.1 SPECIFICATIONS

24.1.2.1.1 OUTSIDE VIEW



(2) Main relief valve (601)



Main relief valve

Tightening torque N-m (lbf-ft)	No.	NAME	Q'TY	Tightening torque N-m (lbf-ft)	No.	NAME	Q'TY
69~78 (51~58)	103	Plug ; M27	1		541	Seat	1
	121	C-ring	1		561	O-ring	1
	122	Spacer	1		562	Back up ring	1
	123	C-ring	1		611	Poppet	1
	124	Filter stopper	1		612	Spring seat	1
	125	Filter	1		621	Spring	1
	163	O-ring	1		651	Adjust screw	1
	512	Plunger	1		661	O-ring	1
	521	Spring	1	28~31 (21~23)	671	Lock nut ; M14	1

24. COMPONENTS SYSTEM

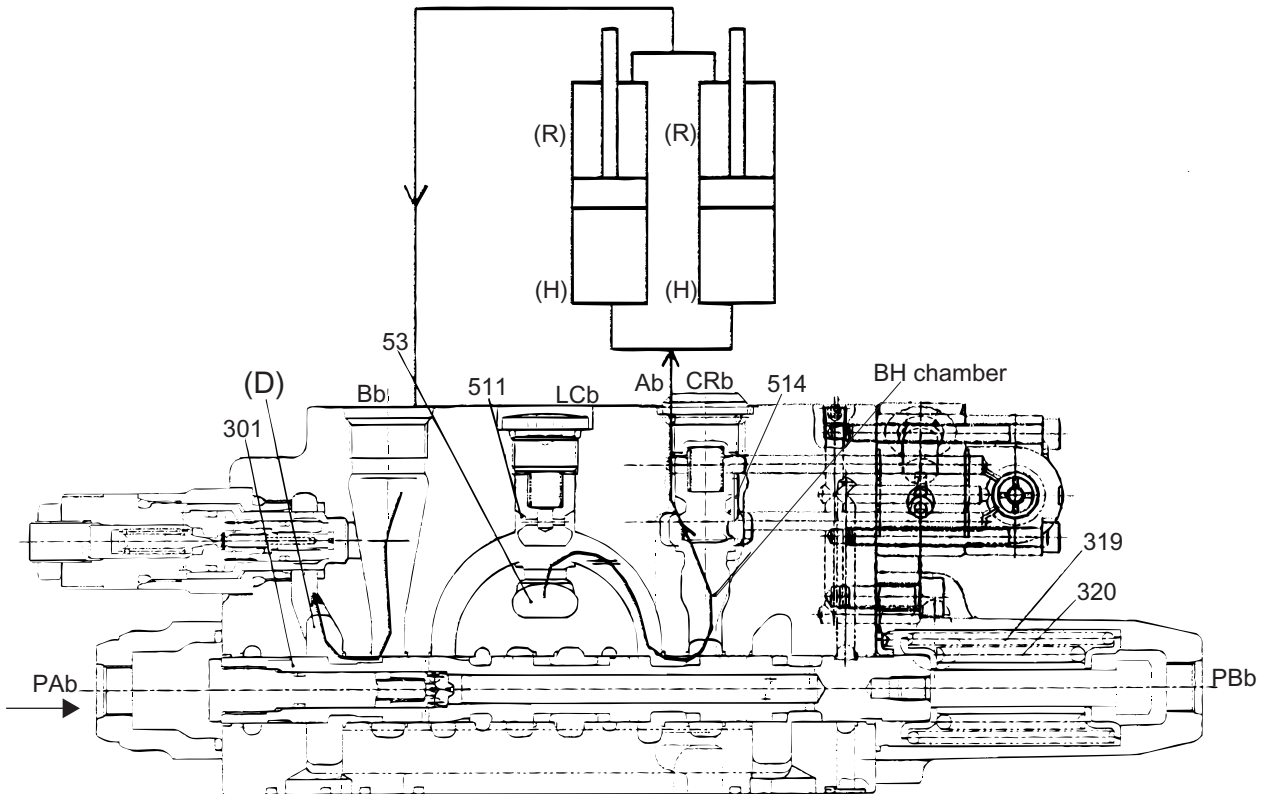
(4) Boom

1. In boom up operation

On starting boom up operation, the pilot pressure enters port PAb and boom spool (301) moves rightward against the force of springs (319) (320), and simultaneously the secondary pressure of solenoid proportional valve [XI] acts on port PCa and switches unloading spool (309).

The hydraulic oil delivered by hydraulic pump P1 flows into parallel passage (53), pushes and opens load check valve LCb (511), and flows through between the perimeter of boom spool (301) and casing through U-shaped passage, and supplied to bucket cylinder head side (H) through port (Ab).

In the meantime, the return oil from boom cylinder rod side (R) passes through between the perimeter of boom spool (301) and casing, flows through low pressure circuit (D) and boost check valve (517), and returns to the hydraulic tank through tank port T1.

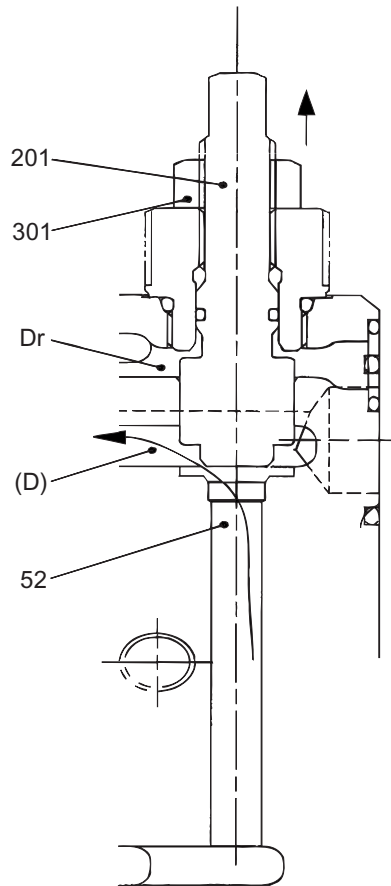


In boom up operation (Boom spool)

2. At the time when failure occurred

When the electric system is failed, P1 unload spool (309) stops at neutral position. Hydraulic oil entered from P1 pump is blocked with P1 unload spool (309). And pump pressure rises to set pressure of main relief valve because oil flows through center by-pass passage (52) and it is blocked with by-pass cut valve (606). Meanwhile, the hydraulic oil flows from center by-pass passage (52) flows low pressure passage (D) through by-pas cut valve (606).

Therefore when the electric system is failed, P1 unloading spool (309) is shifted to the neutral position. And passage to low pressure passage (D) is blocked, but because center by-pass passage (52) is connected to low pressure passage (D) through by-pass cut valve (606), the abnormal rise of the pump pressure is prevented.



By-pass cut valve (In condition of failure)

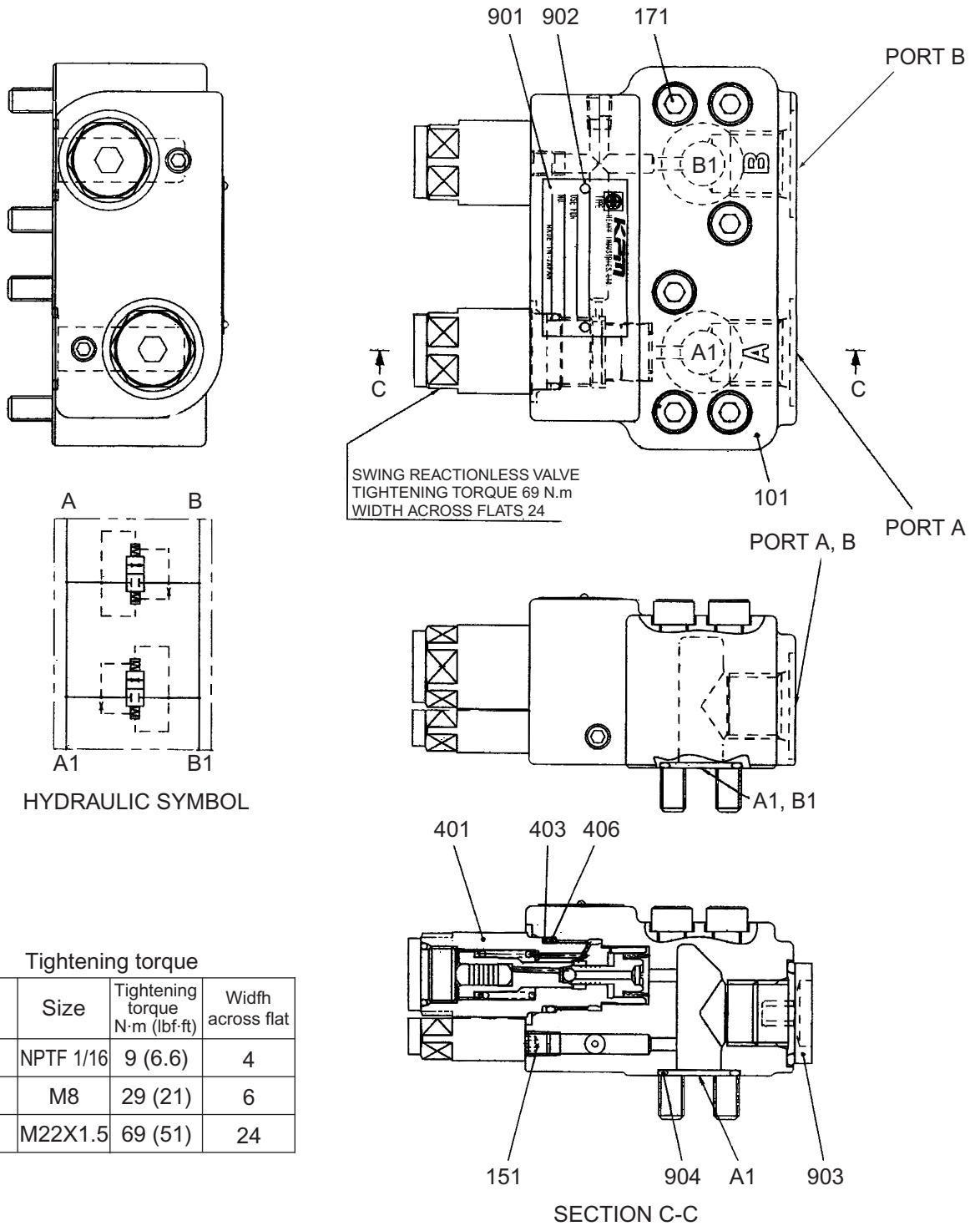
24. COMPONENTS SYSTEM

(4) Operation in the area where the tilting angle of the lever is large.
(varies with the model)

If the lever is inclined beyond a certain angle on certain models, the top end of the spool contacts the bottom of the bore of the push rod. This keeps the output pressure connected with the P port pressure.

Furthermore, on a model in which a spring seat and a spring are built in the push rod, the bottom of the bore of the push rod contacts the spring if the lever is turned beyond a certain angle. This causes the secondary pressure gradient to change by the spring action. Thereafter, the bottom of the bore of the push rod contacts the top end of the spring seat, keeping the output pressure connected with the P port.

(2) Anti-reaction valve



Tightening torque

No.	Size	Tightening torque N·m (lbf·ft)	Width across flat
151	NPTF 1/16	9 (6.6)	4
171	M8	29 (21)	6
401	M22X1.5	69 (51)	24

Tightening torque N-m (lbf-ft)	No.	Parts	Q'ty	Tightening torque N-m (lbf-ft)	No.	Parts	Q'ty
	101	Casing	1		403	O-ring : 1B P20	2
9 (6.6)	151	Plug : NPTF1/16	4		404	Back-up ring	2
29 (21)	171	Socket bolt : M8X60	6		903	Plug	2
69 (51)	401	Swing reactionless valve : M22	2		904	O-ring : 1B P22	2

24. COMPONENTS SYSTEM

Travel motor

No.	NAME	Q'TY	No.	NAME	Q'TY	No.	NAME	Q'TY
1	CASING	1	21	BALL	1	41	O-RING; 1B P14	2
2	REAR COVER	1	22	PIVOT	2	42	O-RING; 190.17X2.62	1
3	CYLINDER BLOCK	1	23	PISTON SEAL	1	43	OVERLOAD RELIFE VALVE	2
4	SHOE RETAINER	1	24	M6 RESTRICTOR (ø0.6)	2			
5	FRICTION PLATE	3	25	OIL SEAL	1	44	SPOOL	1
6	BRAKE PISTON	1	26	SPRING	3	45	PLUG; PF3/8	1
7	SEPARATOR PLATE	4	27	SPRING (CYLINDER)	9	46	SPRING RETAINER	1
8	VALVE PLATE	1	28	SPRING (BRAKE)	12	47	PIN	1
9	SHAFT	1	29	BEARING	1	48	SPRING	1
10	COUPLING	1	30	BEARING	1	49	CONNECTOR	1
11	SHOE PLATE	1	31	SOCKET BOLT; M16X45	8	50	SPOOL ASSY	1
12	BALL JOINT	1	32	SHIM	1~2	51	COVER	2
13	SPRING RETAINER	1	33	PARALLEL PIN; ø6X12	1	52	SPRING	2
14	PISTON ASSY	9	34	PLUG; NPT1/16	1	53	SPRING RETAINER	2
15	D RING (SMALL)	1	35	PLUG; NPT1/16 (Meck: TB)	10	54	RESTRICTOR VALVE	2
16	D RING (LARGE)	1	36	PLUG	1	55	SPRING	2
17	CHECK VALVE	3	37	PLUG; PF1/8	3	56	PLUG	2
18	SNAP RING	1	38	PLUG; PF1/4	2	57	O-RING; 42.52X2.62	2
19	SNAP RING	1	39	O-RING; 1B P8	5	58	O-RING; 1B P9	2
20	TILTING PISTON	1	40	O-RING; 1B P11	4	59	SOCKET BOLT; M12X35	8

24.1.7.5 FUNCTIONAL PRINCIPLE OF REDUCTION GEAR

The reduction gear reduces the revolution transmitted from the hydraulic motor and converts it to powerful rotating power.

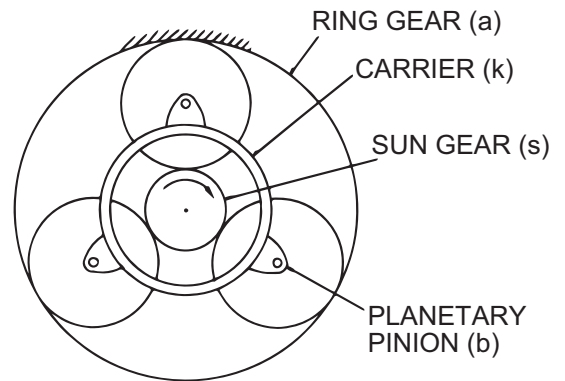
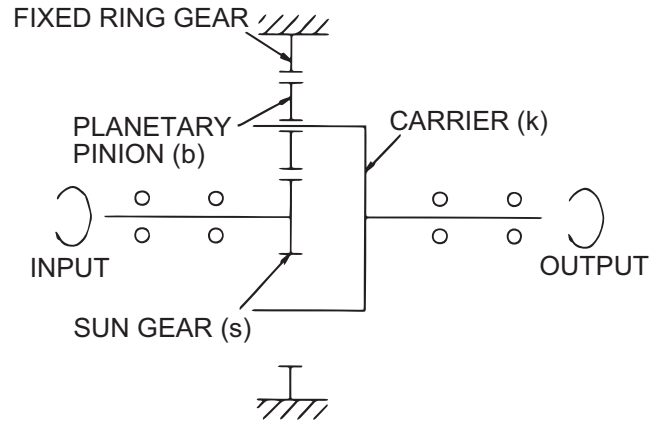
The reduction gear employs a planetary 2-stage reduction method.

The planetary mechanism consists of a sun gear, a planetary gear, a (planetary) carrier, and a ring gear.

If the sun gear (s) on the input side is rotated, the planetary gear (b) revolves meshed with the fixed ring gear (a) while rotating by itself.

This revolution is transmitted to the carrier (k) to convey torque.

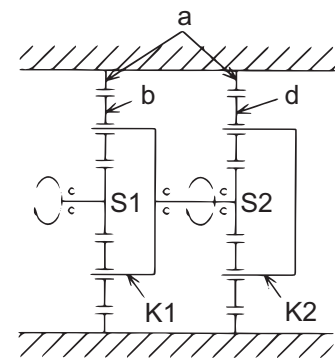
This is the planetary gear mechanism.



Planetary gear mechanism

In Fig. 2-stage reduction mechanism, if the sun gear S1 on the input side rotates, planetary motion occurs between gear S1, a and b. The revolution of gear b conveys the input of carrier K1 to the No.2 sun gear S2 to cause planetary motion to occur between gear S2, a and d.

On that occasion, since carrier K2 is fixed to the frame body, gear d transmits the power to the ring gear and makes ring gear a rotate.



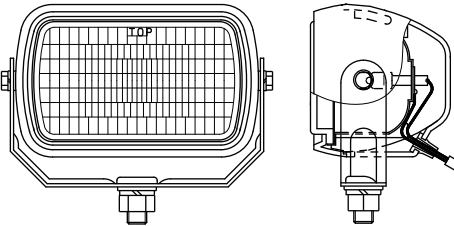
2-stage reduction mechanism

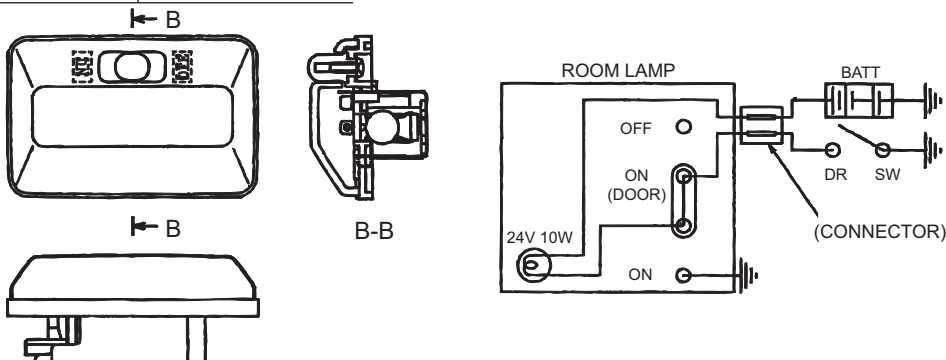
24. COMPONENTS SYSTEM

24.2 ELECTRICAL EQUIPMENT

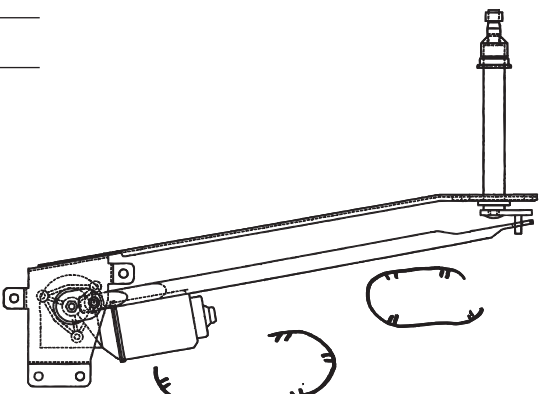
24.2.1 ELECTRICAL EQUIPMENT LIST

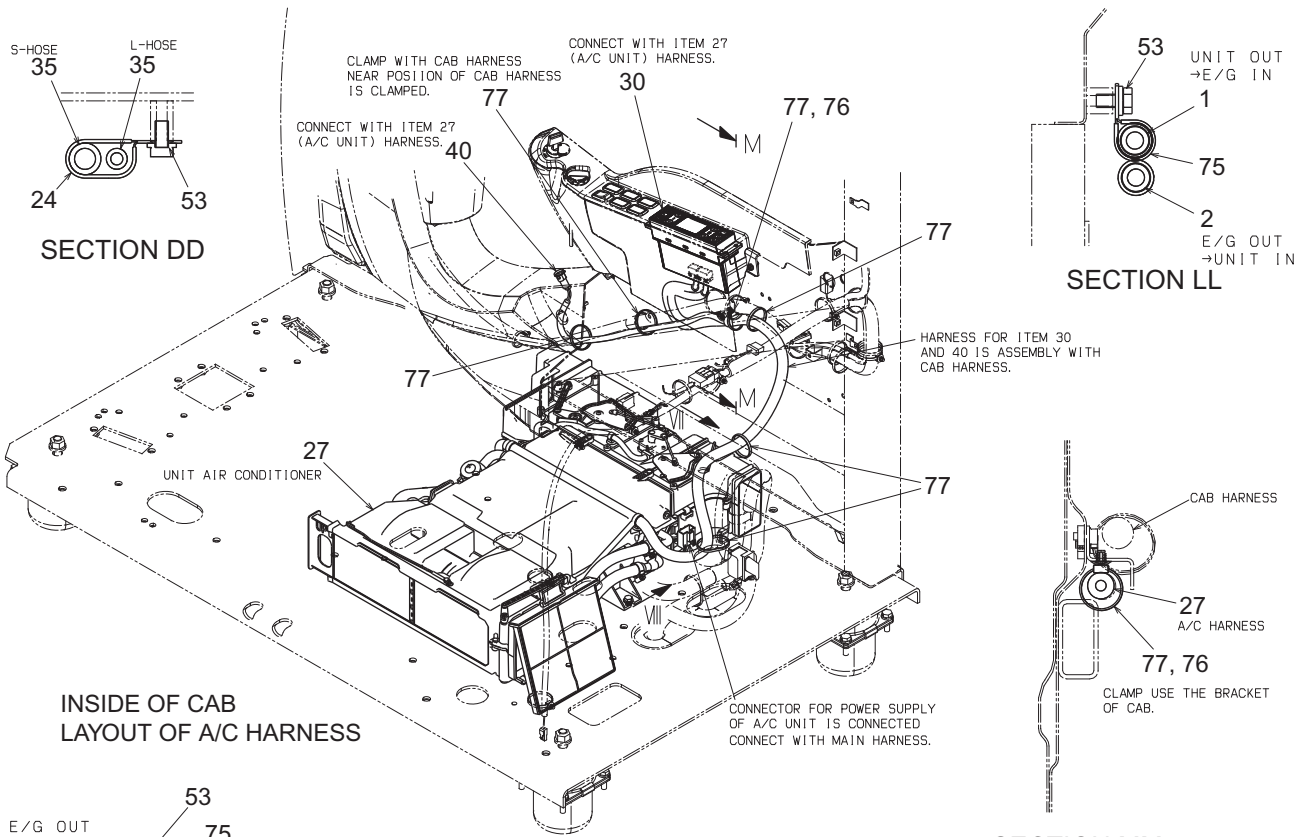
Group	Code	Part Name	Part No.
(C) Controller	C - 1	Mechatro controller	YN22E00425F1
	C - 2	Gauge cluster	YN59S00028F5
	C - 4	Air-con controler (including panel)	YY20M01228P1
	C - 8	Engine controller	16E10-00060
(D) Diode	D - 4	Diode	YN02D01001P1(4P)
	D - 5	Diode	Accessory of relay box
	D - 6	Diode	↑
	D - 9	Diode	↑
	D - 10	Diode	↑
	D - 12	Diode	↑
	D - 13	Diode	↑
	D - 14	Diode	↑
	D - 16	Diode	↑
	D - 17	Diode	↑
	D - 20	Diode	↑
	D - 21	Diode	↑
	D - 22	Diode	↑
	D - 23	Diode	↑
	D - 25	Diode	YN02D01001P1(4P)
	D - 32	Diode	YN02D01001P1(2P)
(E) Electric fittings	E - 1	Fuse and Relay box	YY24E00021F1
	E - 2	Alternator	32G68-02300
	E - 3	Hour meter	LQ58S00002P1
	E - 5	Horn high	LC53S00001D1
	E - 6	Horn low	LC53S00001D2
	E - 7	Tuner AM & FM	YN54S00046P2
	E - 8	Speaker left	LQ54S00003S002
	E - 9	Speaker right	↑
	E - 10	Receiver dryer	LQ54S00005P1
	E - 11	Air-con compressor	YX91V00001F1
	E - 12	Battery	YN72S00001P1
	E - 22	DC-DC converter	YT77S00001P1
	E - 23	12V socket	YN81S01002P1
	E - 35	Glow	32A66-07021
	E - 46	Rear camera	YN55S00009F1
	E - 49	DC-DC converter (proportional)	YN77S00069P1
	E - 63	DC-DC converter (for camera)	YN77S00040P1

L - 2, 7, 8 Light (Halogen) YT80S00002F1 YT80S00002F2 Frame work light Cab working light front LH02 - 01501 ~	Type	NS-1184FF	
	Bulb	DC 24V,70W	
	Effective area of lens	69.2cm ²	
			CA104 OR EQUIVALENT R CB104 OR EQUIVALENT W VINYL TUBE (BLACK)

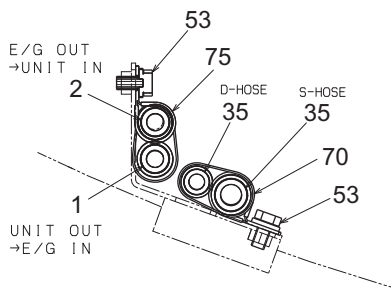
L - 5 Light LQ02C00031S020 Room light LY03 - 001-- ~ LH02 - 01501 ~	Bulb	24V, 10W	
	← B		
	← B		
	B-B		

M - 1 Motor 32A66-11200 Starter motor YH07 - 09001 ~ LH02 - 01501 ~	MODEL	PART No.	RATED OUTPUT OF STARTER
	—	32A66-11200	24V-3.2KW

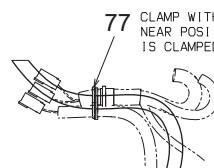
M - 3 Motor LQ53C00003S001 Wiper motor WB02 - 00101 ~ LH02 - 01501 ~	Maker's P/No.	191-11H0-D	



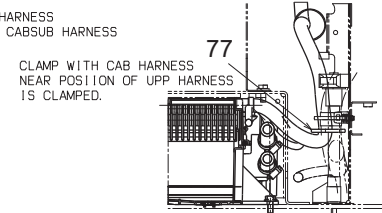
INSIDE OF CAB LAYOUT OF A/C HARNESS



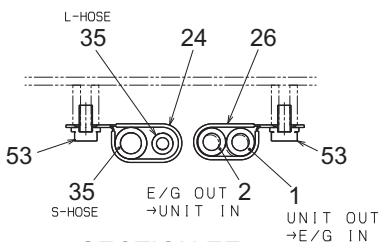
SECTION KK



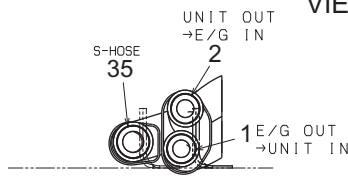
VIEW VII



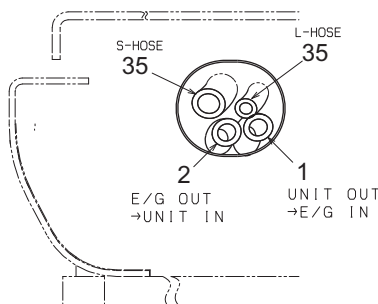
SECTION MM



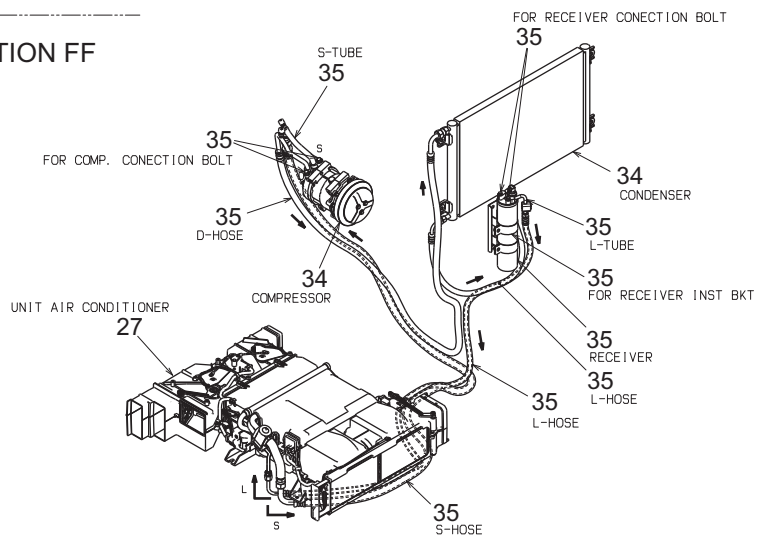
SECTION EE



SECTION FF



SECTION PP



A/C CIRCUIT DIAGRAM

Air conditioner piping (4/4)

25. AIR-CONDITIONER SYSTEM

(4)

Amount of Oil for Compressor

The compressor SD7H (HD type) is filled with 135cc (8.2cuin) of oil. If the oil volume is small, seizure at high revolution and shortening of service life will occur. If the oil volume is large, the cooling ability will be deteriorated.

Once the air-conditioner is operated, part of the oil is dispersed in the refrigeration circuit. Therefore, when replacing the parts in right Table, adjust the oil level to that of table.

(5)

Before performing operation, stop the engine and turn off all power supplies to the equipment related to the air-conditioner.

(6)

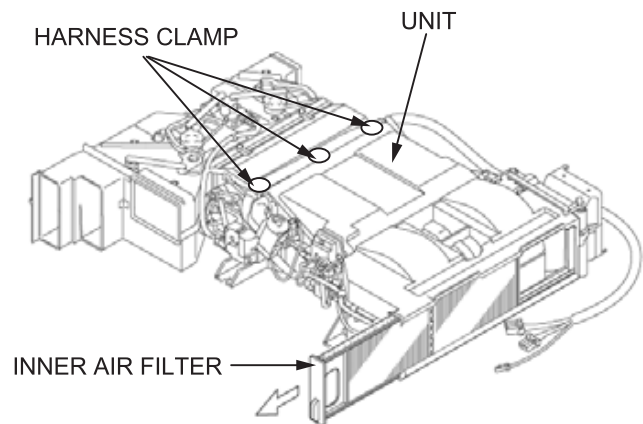
After the operation is over, confirm that all faults have been repaired completely, by operating the air-conditioner.

REPLACED PARTS	AMOUNT TO BE FILLED IN
EVAPORATOR	40 cc (2.4cu·in)
CONDENSER	40 cc (2.4cu·in)
COMPRESSOR	Drain out the volume of oil left in the compressor to be replaced, from the new compressor.
RECEIVER DRYER	20 cc (1.2cu·in)
HOSES	20 cc (1.2cu·in)

DISASSEMBLY AND ASSEMBLY OF UNIT

(1) Removing inner air filter

Slide the inner air filter leftward and remove it from the unit.

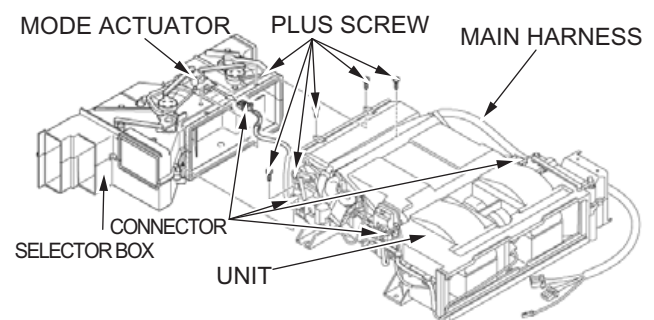


(2) Removing selector box

Remove 6 plus screws, remove connector connected to the mode actuator on mode selector box, and separate the mode selector box from the unit.

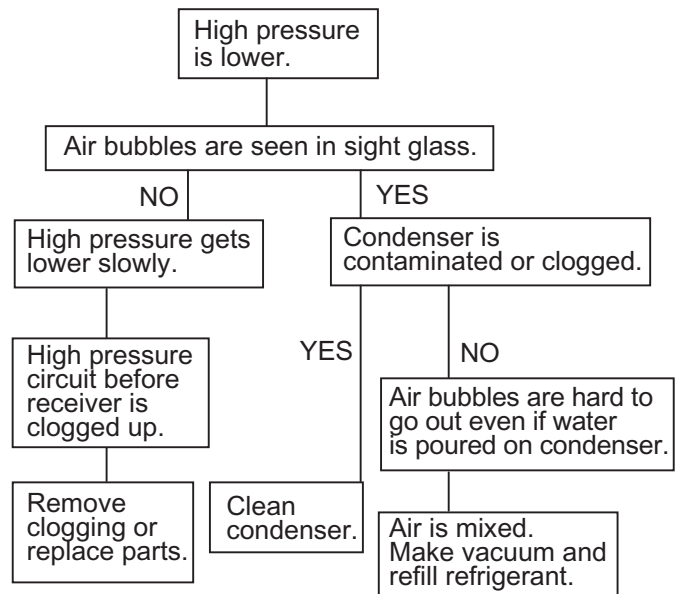
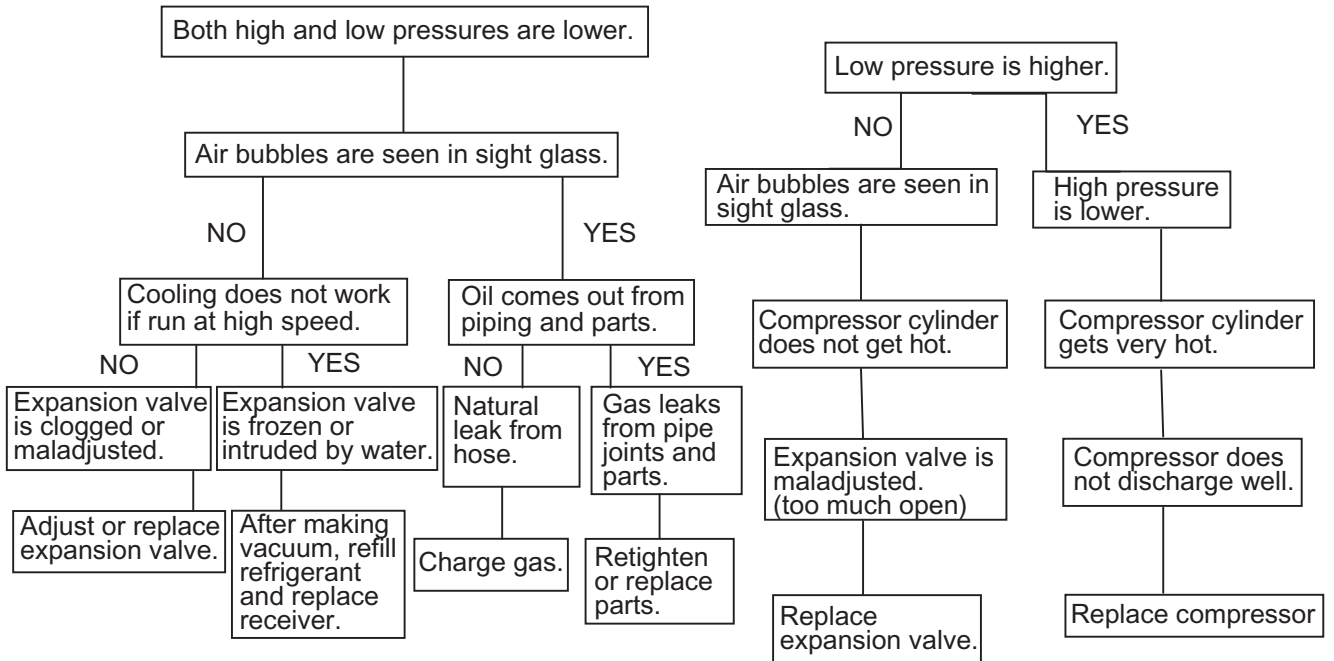
(3) Removing main harness

Pull out 3 harness clamps from the unit, and disconnect all connected connectors and remove harness on the body from the unit.



25. AIR-CONDITIONER SYSTEM

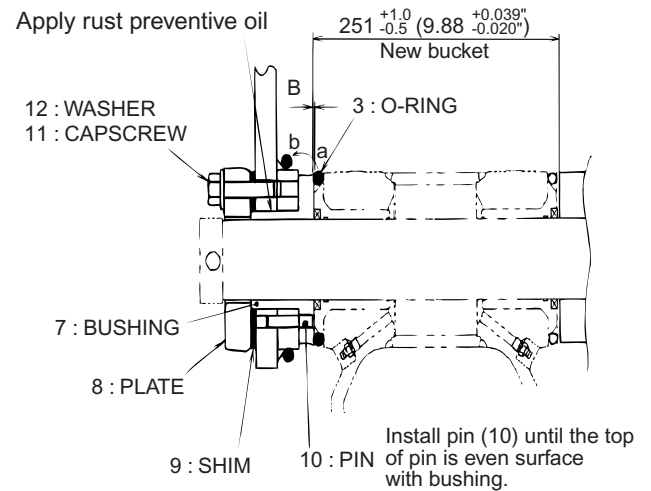
Trouble of refrigeration cycle.



32.1.2.3 PROCEDURE FOR ADJUSTING CLEARANCE

Adjustment of clearance between bucket and arm

- (1) Shift O-ring (3) toward the bucket boss, using a spatula. (a-->b)
- (2) When adjusting clearance (B), bring the non-adjusting side of the bucket in contact with the arm.
- (3) Measure clearance (B) and check that it is within 1.0 mm (0.04 in).
- (4) Adjust clearance (B) where it is more than 1.0 mm (0.04 in).
- (5) An average of 5 shims (9) of 1mm (0.04in) thickness are set in the plate (8) fixed by the three capscrews (11). The clearance can be decreased by 1mm (0.04in) if one shim is removed.
Tools: Socket: 22 mm,
Tightening torque : 181 N-m (133 lbf-ft)
- (6) After adjustment, tighten the capscrews evenly.
-The gap exceeding the specified dimension causes early wear.
- (7) Operate the bucket and confirm that the total sum of both clearance is within 1.0 mm (0.04 in).
- (8) Replace O-ring (3) on its original position.



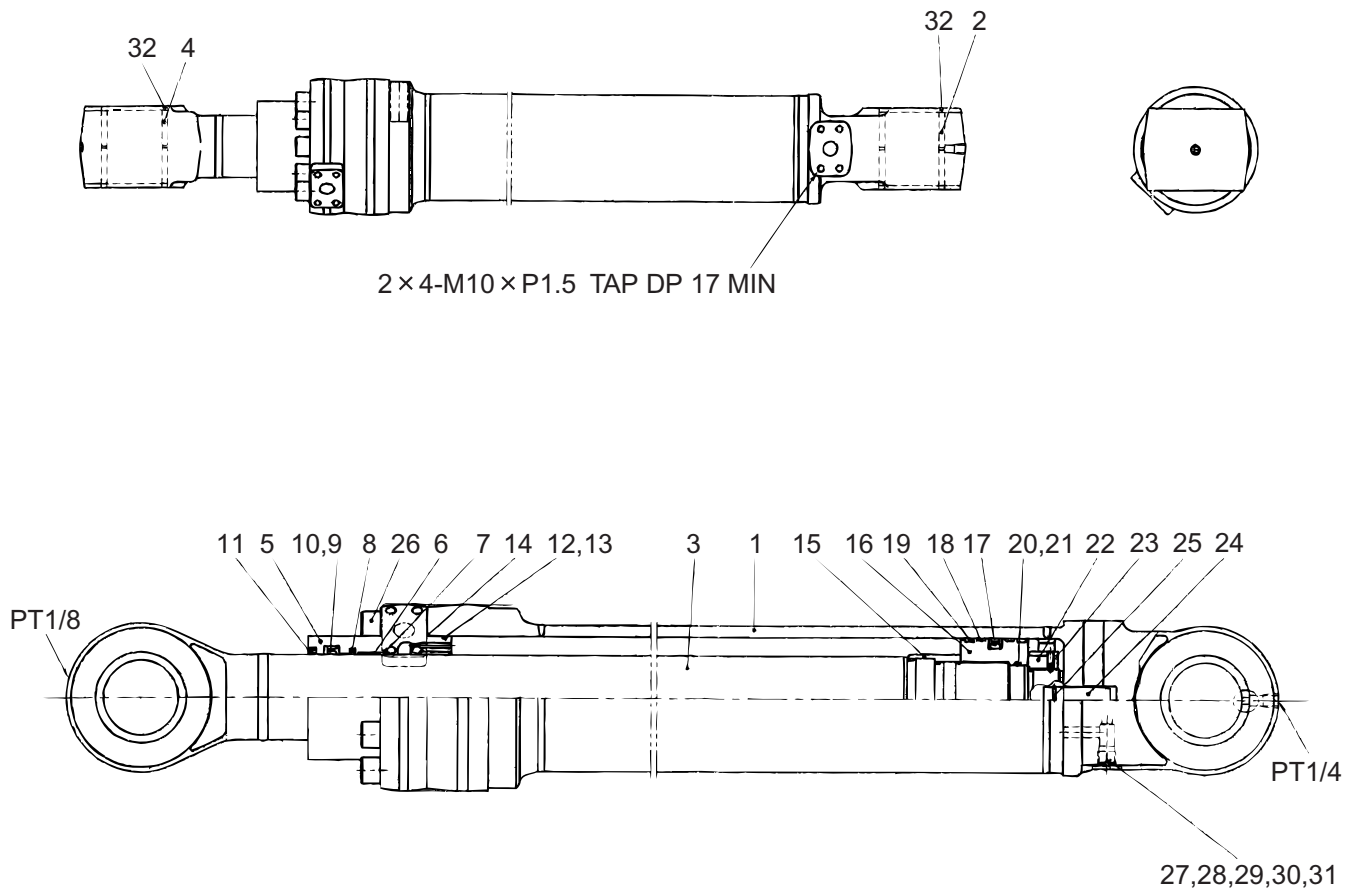
Adjusting clearance between bucket and arm

CAUTION

- When shifting O-ring (3) by means of a spatula, use care so as not to damage O-ring (3).
- Remove shims (9), push out bushing (7) rightwards by means of three capscrews (11) and adjust clearance (B) so it settles within the standard value evenly all round.

32. ATTACHMENTS

32.2.1.2 CONSTRUCTION OF CYLINDER (GENERAL EXAMPLE OF CYLINDER)



P/No YY01V00054F4

No.	Parts name	Q'TY	No.	Parts name	Q'TY	No.	Parts name	Q'TY
1	Cylinder tube	1	12	O-ring : 1B G110	1	23	Set screw : M8	1
2	Oiles bush	2	13	Back-up ring	1	24	Cushion plunger	1
3	Rod assy	1	14	O-ring : 1B G115	1	25	Stop ring	1
4	Oiles bush	2	15	Cushion ring	1	26	Socket bolt : M16	10
5	Rod cover	1	16	Piston	1	27	Check valve	1
6	DD-bushing	1	17	Slip seal	1	28	Spring	1
7	Retaining ring	1	18	Wear ring	2	29	Spring	1
8	Buffer seal	1	19	Dust ring	2	30	O-ring : 1B P14	1
9	U-packing	1	20	O-ring	1	31	Plug : PT3/8	1
10	Back-up ring	1	21	Back-up ring	2	32	Wiper ring	4
11	Dust seal	1	22	Piston nut	1			

Note: In case of piston with piston nut type, the parts with * are not used.

CAUTION

-Rod packing (9) is harder than other packing and it would be difficult to deform them in a heart shape. In such a case, put a U-ring in the groove obliquely by hand as deep as possible and push in the last part with a push bar till it is set with a click.

-Buffer ring (8) should be fitted taking care of the fitting direction. The reverse fitting may cause deformation, damage, etc. of the piston due to high pressure generated between the buffer ring and Rod packing (9).

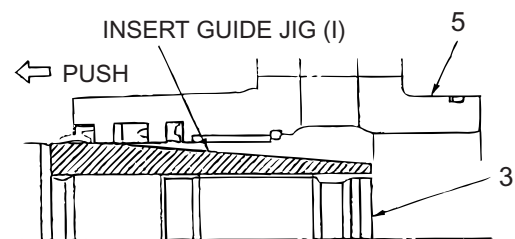
-If Rod packing (9) is set upside down, the lip may be damaged. Check that it is positioned correctly.

-Attach back-up ring (13) on the open air side of O-ring (12). (See above Fig.).

32.2.1.5.4 INSERTING ROD COVER ASSY TO PISTON ROD

Inserting rod cover (5) to piston rod assy by the following procedure.

- (1) Fix piston rod assy on working bench.
- (2) Install rod cover (5) on piston rod (3) with inserting guide jig (I) as shown in right Fig. paying attention for the lip section of Rod packing not to be caught on the stepped section.



Inserting rod cover (5)

CAUTION

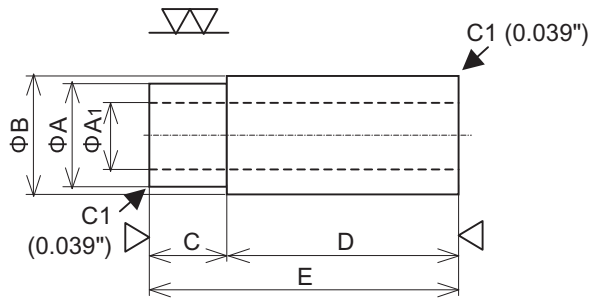
-For the rod the outer diameter of piston installing section is small, insert spacer on the faucet section of rod first, and attach inserting guide jig.

-Apply hydraulic oil on the inserting guide jig and outer surface of piston rod lightly to make the insertion smooth.

32. ATTACHMENTS

32.2.1.9.9 ROD BUSHING PRESSING JIG

MATERIAL : SS400 (JIS)



Inner diameter : $\phi A1 = \phi A - 20 (0.878'')$
 (Even if there is not the bore $\phi A1$,
 there is no problem.)

Rod bushing pressing jig

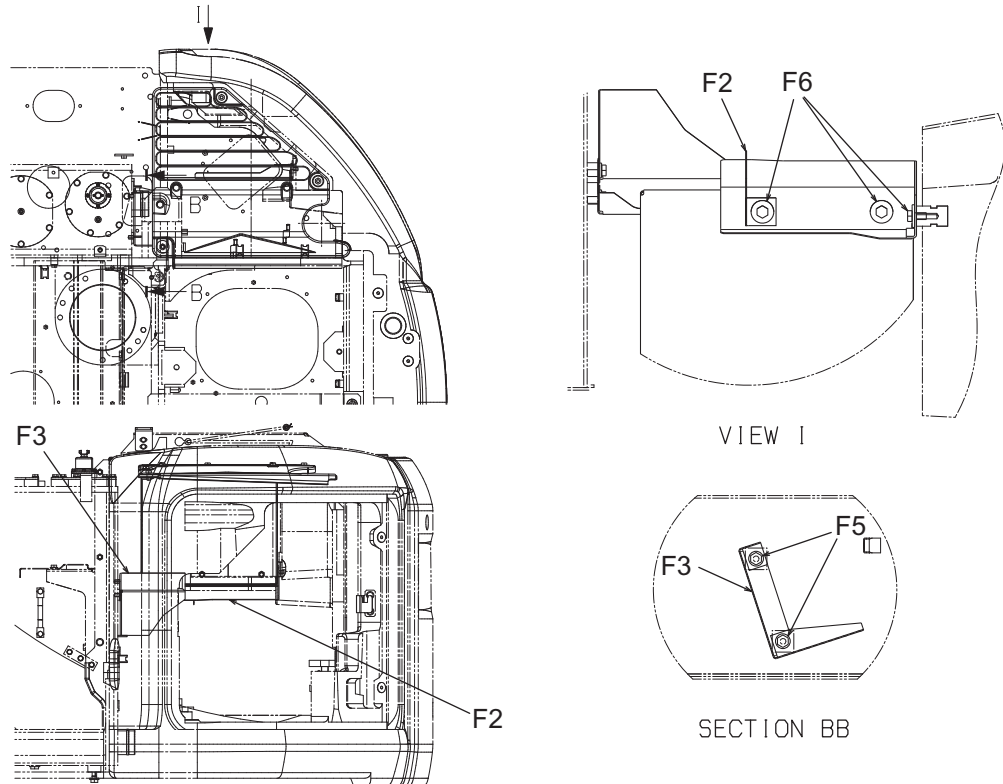
Unit : mm (in)

CYLINDER	A	B	C	D	E
ARM	$80^{0}_{-0.1}$ ($3.150^{0}_{-0.0039}$)	84.8 ± 0.1 (3.339 ± 0.0039)	30 (1.14)	90 (3.54)	120 (4.72)
BOOM	$75^{0}_{-0.1}$ ($2.953^{0}_{-0.0039}$)	74.8 ± 0.1 (2.945 ± 0.0039)	30 (1.14)	90 (3.54)	120 (4.72)
BUCKET	$65^{0}_{-0.1}$ ($2.559^{0}_{-0.0039}$)	64.8 ± 0.1 (2.551 ± 0.0039)	30 (1.14)	90 (3.54)	120 (4.72)

(3) Remove guard (F2), (F3)

1. Remove 3 capscrews (F6) M12X25.
2. Remove guard (F2).
3. Remove 2 sems bolts (F5) M12X25.
4. Remove guard (F3).

Tools: Socket: 19mm

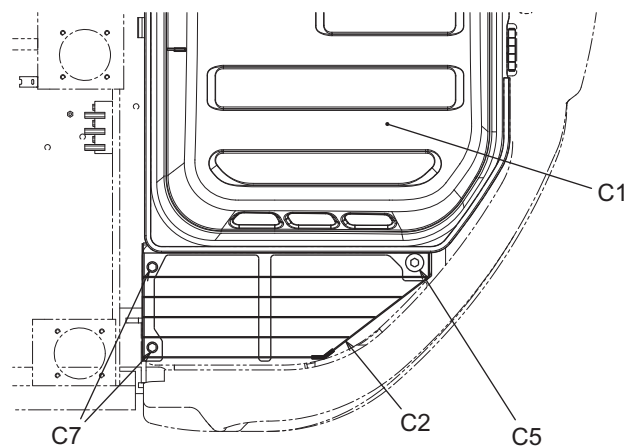


Removing guard (F2), (F3)

(4) Remove bonnet assy (C2)

1. Remove a capscrew (C5) M12X25.
2. Remove 2 sems bolts (C7) M12X20.
3. Remove bonnet assy (C2).

Tools: Socket: 19mm



Removing bonnet assy (C2)

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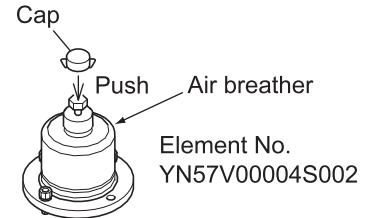
33. UPPER SLEWING STRUCTURE

33.1.7 HYDRAULIC TANK

33.1.7.1 PREPARATION FOR REMOVAL

(1)
Remove panel assy (A5), cover assy (A6)(A7) and bonnet assy (C1).
(See 33.1.4 GUARD.)

(2)
Release internal pressure of tank
Remove cap on air breather and push valve (head of bolt) by your finger.



Bleeding internal pressure of tank



Keep pressing until the hissing stops.

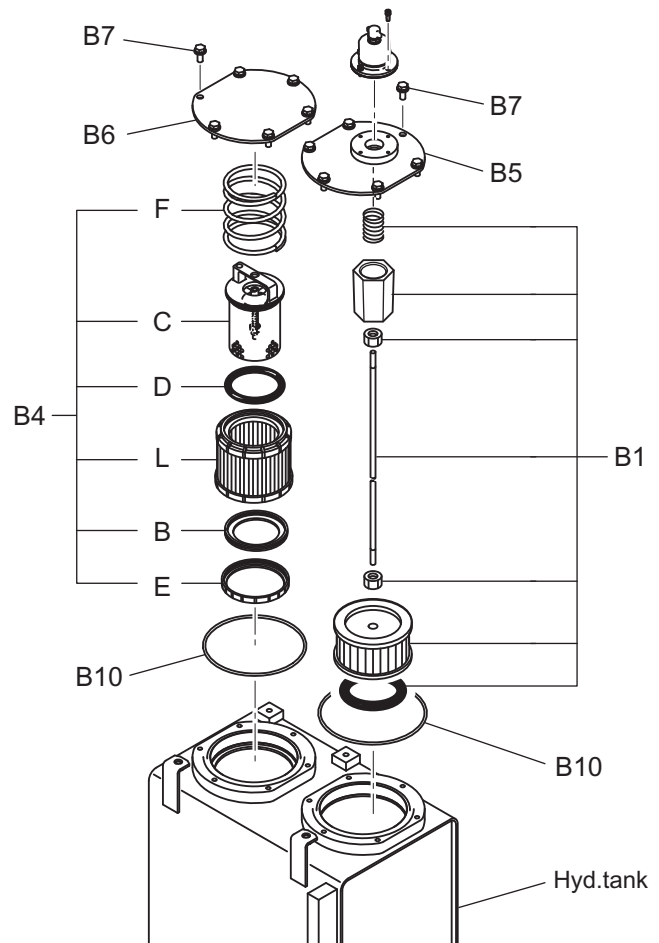
(3)
Remove cover (B5).
1. Remove 6 sems bolts (B7) M10X25.
Tools: Socket: 17mm
2. Remove cover (B5)
3. Remove suction strainer (B1).

(4)
Remove cover (B6).
1. Remove 6 sems bolts (B7) M10X25.
Tools: Socket: 17mm
2. Remove cover (B6).
3. Remove filter element (B4).

(5)
Turn the handle of element assy (C), and disassemble the removed filter element (B4).

Disassemble parts: (F), (C), (D), (L), (B), (E)

(6)
Draining hydraulic oil
Place pump in tank and drain hydraulic oil.
Capacity of tank: 146 L (39 gal)



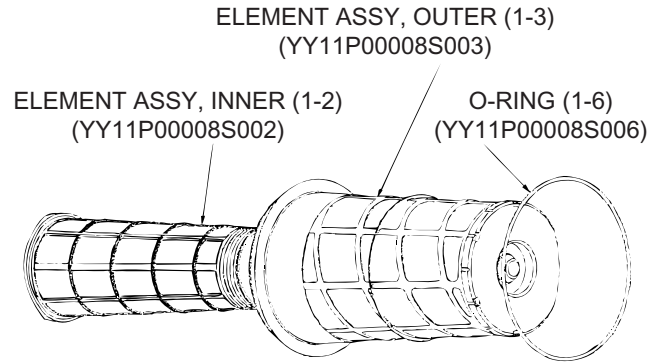
Remove cover (B5), (B6)

33.1.9.3 INSTALLATION

- (1) Installing is the reverse order of removing with attention paid to the following items:
 1. Put in air hoses (2), (3) to the end as shown in Fig."Removing air cleaner".
 2. Tightening torque:

No.	Name	Tightening torque N·m (lbf·ft)
1-8	Indicator	2 (1.48)
6,7	Clip	5.9 (4.4)
8	Capscrew	17.5 (12.9)

REPLACING PARTS



33. UPPER SLEWING STRUCTURE

7.

Lift and remove inter-cooler using lifting eyes and hoist on the inter-cooler.

Weight : 7.7kg (17 lbs)

Confirm the missing of rubber bushing under the inter-cooler.

8.

Disconnection of oil cooler tube Disconnect tube (C7), (C8) from upper and lower of cooler, and drain hydraulic oil. (See Fig."Removing hydraulic oil tube (C7),(C8)")

9.

Lift cooler temporarily using cooler head flange for slinging.

10.

Loosen 4 bolts (13) M10X25 attaching oil cooler.

11.

Lift the oil cooler.

Weight : 12.7kg (28 lbs)

Note

There is no predetermined sequential order in removing radiator core, inter-cooler core and oil cooler. Removing these components can be done as necessary.

(3) Installing

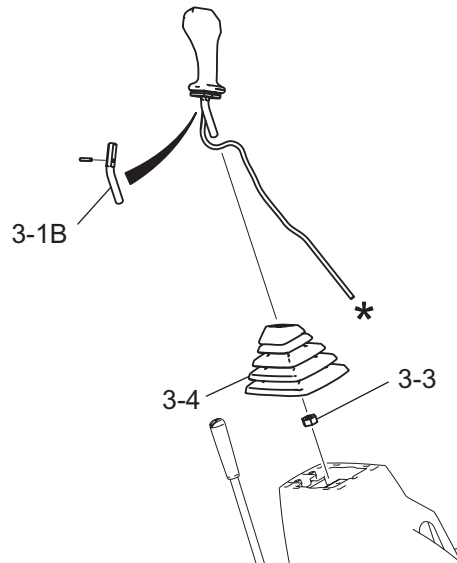
Installing is done in the reverse order of removing.

33.1.17 PILOT VALVE (FOR ATT)

33.1.17.1 PREPARATION FOR REMOVING

The removing procedure for right and left is the same, so the preparation for left side is described here.

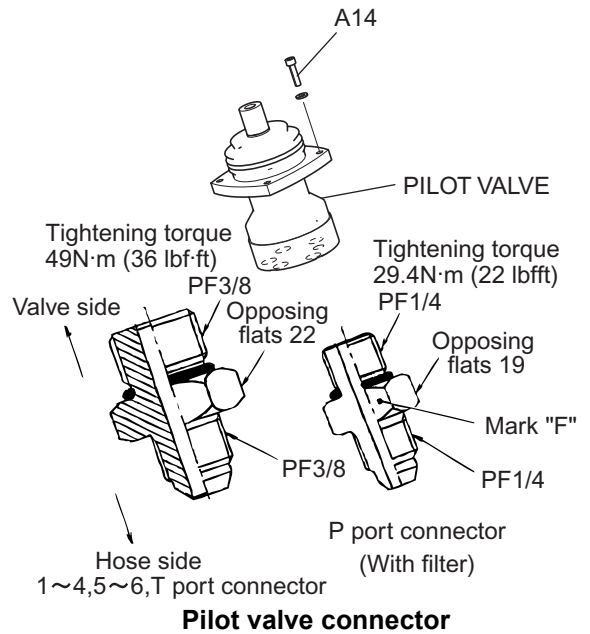
- (1) Put attachment on ground, stop engine and release pressure in tank.
- (2) Remove left console cover (1-4D), (1-5E) assy referring to Section 33.1.14 CONSOLE COVER.
- (3) Disconnect harness connector for horn at * position.
- (4) Attach a tag to the hose to make assembly work easier.



Installing and removing boot and lever part

33.1.17.2 REMOVAL

- (1) Remove hoses from your side to far side in order.
Tools: Spanner: 19mm, 22mm
- (2) Move the boot (3-4) up and loosen nut (3-3).
(See above Fig.)
Tools: Spanner: 22mm
- (3) Turn and loosen lever (3-1B) tightened in pilot valve, and remove lever assy in a set. (See above Fig.)
- (4) Remove 4 capscrews (A14) M6X25. (See right Fig.)
Tools: Allen wrench: 5mm
- (5) Remove pilot valve.
- (6) Plug hose ends.
Plug PF1/4, PF3/8

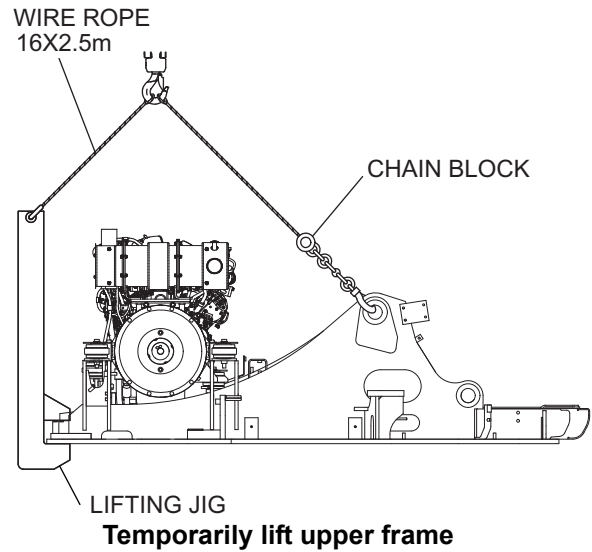


33. UPPER SLEWING STRUCTURE

33.1.22 UPPER FRAME

33.1.22.1 PREPARATION FOR REMOVING

- (1) Remove attachment
(See chapter 32)
- (2) Remove cab (See 33.1.2 CAB)
- (3) Remove guard (See 33.1.4 GUARD)
- (4) Remove counterweight
(See 33.1.11 COUNTERWEIGHT)
- (5) Remove swivel joint
(See 33.1.21 SWIVEL JOINT)

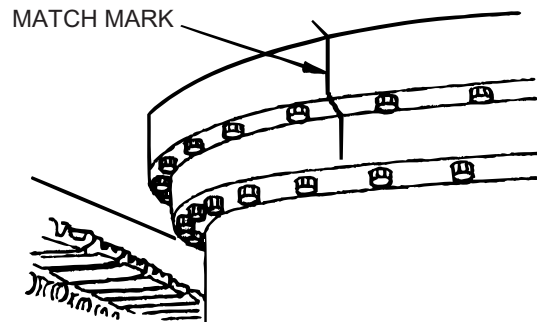


33.1.22.2 REMOVAL

- (1) Lifting up upper frame temporarily
Attach 2 upper-frame hoisting jigs to attaching holes of counterweight. Attach 2 chain blocks to holes of boom foot pin and use these four points and hoist upper-frame.

Wire rope;
16 dia. (0.630")X2.5 m(8 ft-2 in), 2 pcs.
16 dia. (0.630")X1.5 m(4 ft-11 in), 2 pcs
Chain block; For 1,000 kg (2,205 lbs) 2 pcs.

- (2) Marking match marks on swing bearing
Put match marks on upper frame and swing bearing.

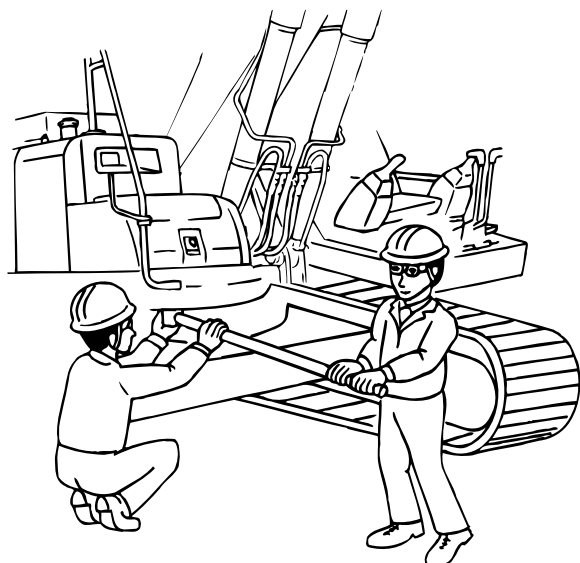


Matching mark on swing bearing and upper frame

- (3) Removing upper frame attaching bolts
Remove 33 capscrews (B31) M16X85 and a reamer bolt (B30) used to install swing bearing and upper frame.

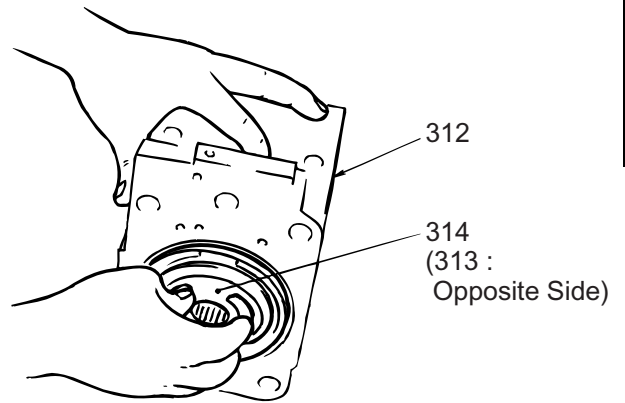
Tools: Socket: 24mm

- (4) Slings upper frame
Sling according to above Fig, and remove upper frame and put it on a stand.
Weight: Approx. 3.5 ton (7,700 lbs)



7. Installing valve plate

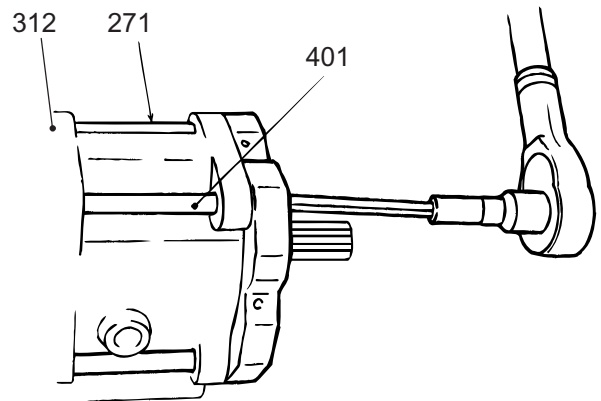
Install valve plate (313), (314) to valve block (312) by aligning pin.
 -Do not mistake the suction and delivery sides of the valve plate.



Installing valve plates (313), (314)

8. Installing valve block

Install valve block (312) to pump casing (271), (272) and fasten them together with socket bolts (401).
 Tools: Allen wrench: 14mm
 Tightening torque ; 240 Nom (177 lbft)
 -Work will be promoted if assembly is started from the rear pump.
 -Exercise care so as not to mistake the direction of the valve block (312). (Install it so the regulator comes up as seen from the front side and the suction flange comes on the right.)
 -Insert the 1st gear into the valve block beforehand and connect it with the spline of the shaft.



Installing valve block (312)

9. Installing gear pump

Install gear pump (04) and fasten them together socket bolts (435).

Tools: Allen wrench: 6mm,
 Tightening torque; 17 N-m (12.5 lbf-ft)

10. Installing regulator and PTO cover

Pinch feedback pin of tilting pin in feedback lever of the regulator and PTO cover (326), install the regulator and fasten socket bolt.

(See Fig."Regulator exploded view"]

Socket bolt (415): For regulator

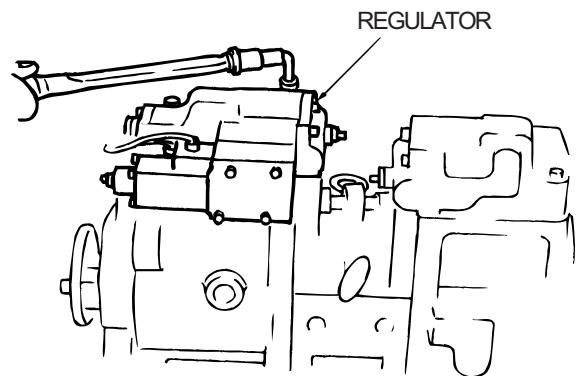
Tools: Allen wrench: 6mm,

Tightening torque; 29 N-m (21 lbf-ft)

Socket bolt (414): PTO Cover (326)

Tools: Allen wrench: 8mm,

Tightening torque; 57 N-m (42 lbf-ft)



Installing regulator and PTO cover

-Do not mistake the front regulator for the rear regulator.

11. Installing drain port plug

The work is complete when drain port VP plugs (468) have been set.

Tools: Allen wrench: 10mm

Tightening torque; 110 N-m (81 lbf-ft)

33. UPPER SLEWING STRUCTURE

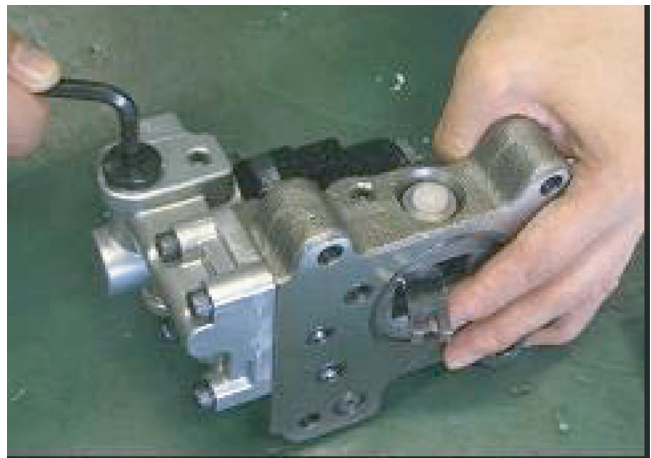
8.
Installing valve casing (See Fig."Regulator exploded view")
Attach valve casing (325) fitted with solenoid proportional reducing valve (079) to casing (601) and fasten them together with socket bolts (407).



Installing valve casing (325)

9.
Installing ROH-plug
Install ROH-plug (466) to A port of valve casing (601).
And install ROH-plug (466) to Psv port too.
(In cased KR76-0E13PV)

This completes assembly.



Installing ROH-plug (466)

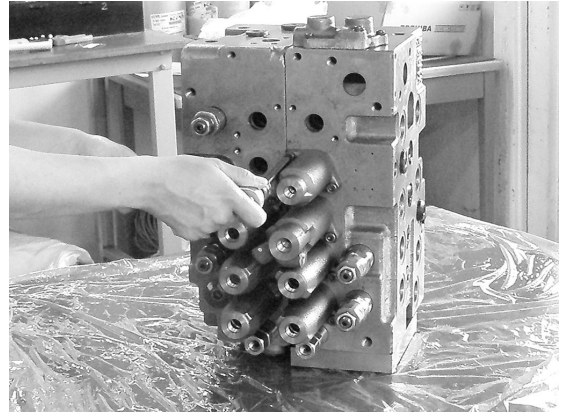
33.2.2.3.3 Disassembling the boom conflux spool

(1)

Loosen socket bolts (273) and remove spring cover (202) for boom conflux and O-ring (261).

(2)

Draw out the assy of boom conflux spool (305), spring seat (331), springs (321), (322), stopper (339) and bolt (333) from casing A (101).



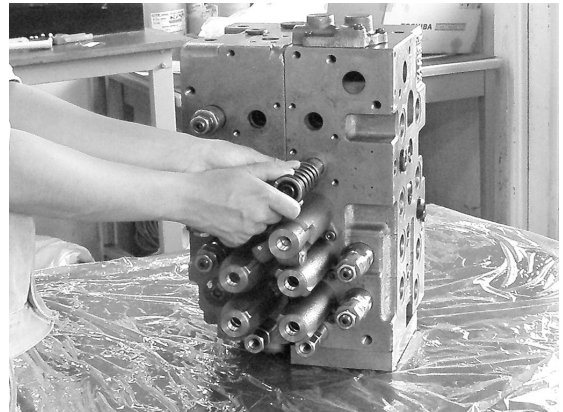
Removing spring cover (202)

Note

When drawing out the spool assy, use care so as not to score casing A (101).

(3)

Fix the boom conflux spool with vise via a protective plate (aluminum plate, etc.) and remove bolt (333). Then separate spring seat (331), springs (321), (322) and stopper (339) from boom conflux spool (305).



Drawing out boom conflux spool (305) assy

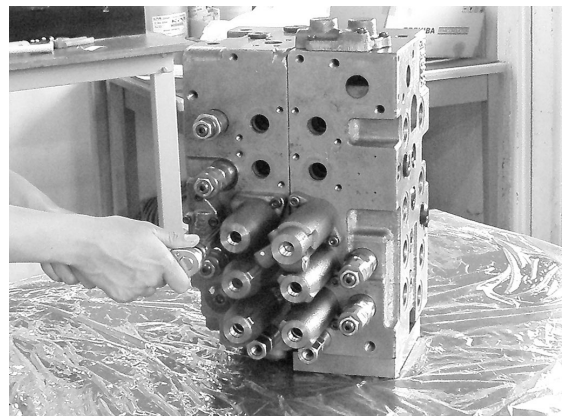
33.2.2.3.4 Disassembling the boom spool

(1)

Loosen socket bolts (273) and remove spring cover (203) for boom spool and O-ring (261), (266).

(2)

Draw out the assy of boom spool (301), spring seat (331), springs (319), (320), stopper (339) and bolt (333) from casing B (102).



Removing spring cover (203)



When drawing out the spool assy, take care so as not to score casing B (102).

33. UPPER SLEWING STRUCTURE

33.2.2.3.20 Inspection after disassembly

Thoroughly clean all disassembled parts with wash oil, and dry them with jet air. Place each part on a clean sheet of paper or cloth for inspection.

(1) Control valve

1. Inspect the entire surface of each part for burrs, scratches, cuts, and other defects.
2. Confirm that the O-ring groove surface of the casing or the block is free from foreign matter, dents or rust.
3. If the check valve seat of the casing or the block has dents or damage on its surface, smooth it by lapping.
4. Confirm that O-ring or the outer circumference of the sliding part of a manual spool is free from scratches, dents, and the like. Remove any small defects with an oil stone or lapping compound.
5. Manually confirm that all sliding and fitted parts move smoothly. Confirm that all grooves and passages are free from foreign matter.
6. Replace any broken or deformed spring with new one.
7. Of a relief valve malfunctions, repair it by following the relief valve disassembly and reassembly procedures.
8. Replace all O-ring with new ones.



Take care not leave lapping compound behind in the casing or block.

(2) Relief valve

1. Make sure that the poppet and the seat surface at the tip of the seat are without fault and that the contact surface is even all over.
2. Manually confirm that the main poppet slides smoothly onto and off the seat.
3. Confirm that the outer circumference of the main poppet and the inner circumference of its seat are free from defects such as scratches.
4. Confirm that each spring is free from breakage, deformation, and excessive wear.
5. Confirm that the orifices of the main poppet and its seat are not clogged.
6. Replace all O-rings with new ones. (Between casing and seal)

33.2.2.4 REASSEMBLY

- (1) Here, only the reassembly procedures are described. Regarding drawings, refer to the disassembly procedures.
- (2) Figures in parentheses after part names in this instruction represent those item numbers in the structural sectional drawing. (Fig."Section(1/6)" to Fig."Section(6/6)")
- (3) Precautions on reassembling O-ring
 1. Confirm that O-rings are free from defects caused by poor handling.
 2. Apply thin coat of grease or hydraulic oil to O-rings and their mating parts.
 3. Do not stretch O-rings to the extent that they become permanently set.
 4. When installing O-rings, do not roll them into place. Twisted O-rings do not easily untwist by themselves after installation, and can cause oil leaks.
 5. Use a torque wrench to tighten each attaching bolt. Tighten to the specified torque in "Maintenance Standards."

33.2.2.4.1 Installing check valve

- (1) Load check valve, conflux check valve, and so on
Attach poppet (511) and spring (521) in place, place O-ring (561) in plug (551) and tighten them to the specified torque. (8 places)
- (2) Load check valve of swing section
Attach poppet (511) and spring (524) in place, place O-ring (561) in plug (556) and tighten them to the specified torque. (1 place)
- (3) Load check valve of arm 2 section
Attach poppet (515) and spring (521) in place, place O-ring (561) in plug (551) and tighten them to the specified torque. (1 place)

33.2.2.6.2 Relief valve

Trouble	Cause	Remedy
1. No pressure rise.	Main or pilot poppet of relief valve is sticking and valve is open, or there is foreign matter on valve seat.	Check for foreign matter on each poppet. Confirm that each component slides smoothly. If failure is found, replace it in an assembly.
2. Unstable relief pressure.	Main or pilot poppet of relief valve seat is damaged.	If failure is found, replace it an assembly.
3. Incorrect relief pressure setting.	1) Wear due to foreign matter.	1) Replace damaged assembly
	2) Loosened locknut or adjusting screw.	2) Adjust pressure.
4. Oil leak.	1) Damaged seat. Damaged O-ring.	Confirm that each component operates smoothly. Replace damaged or worn component. 1) If failure is found, replace it an assembly.
	2) Sticking component due to foreign matter.	2) Confirm that there are no scratches, scores, or foreign matter present before reassembling. If failure is found, replace it an assembly.

33. UPPER SLEWING STRUCTURE

33.2.3.6 TROUBLESHOOTING

It is very difficult to find defective section. The following table explains the several estimated causes. For repair, refer to the estimated causes and corrective actions.

The following table explains general phenomenon, estimated causes and corrective actions. However, most machine problems are not caused by the failure of only one part, but involve relations with other parts. Therefore corrective action other than those described in this table is often required. The following table does not cover causes and corrective actions for all the troubles. So it may be necessary to perform further investigation of troubles and causes.

Phenomenon	Possible Cause	Corrective action
Secondary pressure does not rise.	<ol style="list-style-type: none"> 1. Primary pressure is insufficient. 2. Secondary pressure springs (241) are broken or fatigued. 3. Clearance between spool (201) and casing (101) is abnormally large. 4. Handle has a looseness. 	<ol style="list-style-type: none"> 1. Secure primary pressure. 2. Replace with new ones. 3. Replace spool (201). 4. Disassembly and reassembly or replace handle section.
Secondary pressure is unstable.	<ol style="list-style-type: none"> 1. Sliding parts are caught. 2. Tank line pressure varies. 3. Air has mixed into pipeline. 	<ol style="list-style-type: none"> 1. Repair the unsmoothed section. 2. Bring pressure directly to oil tank. 3. Bleed air by operating it several times.
Secondary pressure is high.	<ol style="list-style-type: none"> 1. Tank line pressure is high. 2. Sliding parts are caught. 	<ol style="list-style-type: none"> 1. Bring pressure directly to oil tank. 2. Correct.

33.2.4.3 DRAIN OF HYDRAULIC PILOT CONTROL UNIT

- (1) When removing the retaining plate, the throttle kit or the shuttle valve kit, it is necessary to drain the pilot unit.
- (2) Reassemble the pilot unit control completely.
- (3) Install the pilot unit control in the machine.
- (4) Slightly unscrew the check valve plug using a 4mm socket wrench. (See right Fig.)
- (5) Switch on the machine.
- (6) Operate gently the pedal until the bubbles disappear.
- (7) Tighten the check valve plug.
-Torque: 5 N-m (3.7 lbf-ft)
- (8) Repeat the operation for the other check valve plug.



33. UPPER SLEWING STRUCTURE

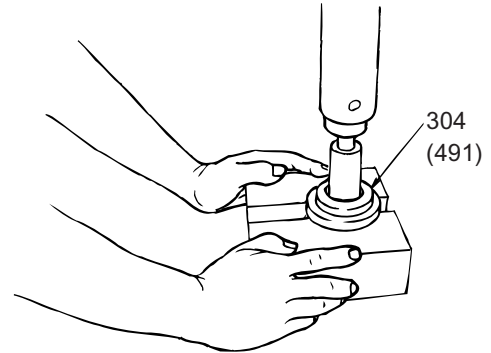
Note

You may knock on the inner race of the roller bearing with a steel bar, but knock on it evenly all around so the bearing is not damaged.

Do not use the removed bearing again.

(16) Remove oil seal

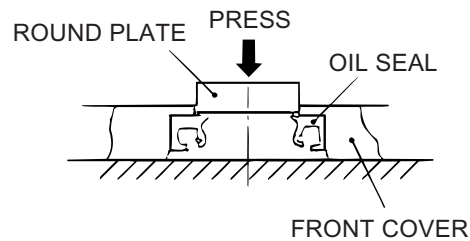
Draw out oil seal (491) from front cover (304), utilizing the jig.



Removing oil seal

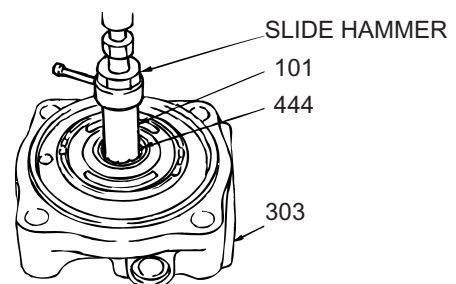
CAUTION

Do not reuse the removed oil seal.



(17) Remove roller bearing

Separate roller bearing (444) from valve casing (303), using a slide hammer bearing puller.



Removing roller bearing (444)

Note

Do not reuse the removed bearing.

33.2.5.3.2 DISASSEMBLY PROCEDURE

(1) Remove swing motor unit and drain oil

Remove the swing motor unit from the machine, loosen plug (902) at the oil outlet, discharge the gear oil and place the unit on a work bench.

Note

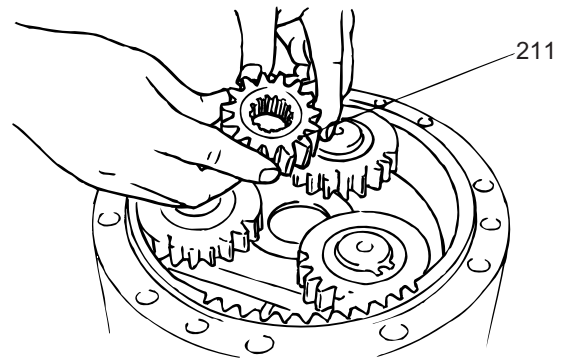
Receive gear oil in a clean container and inspect for the presence of worn particles.

(2) Remove hydraulic motor

Loosen socket bolts (602) and remove the hydraulic motor.

Tools: Allen wrench: 10mm

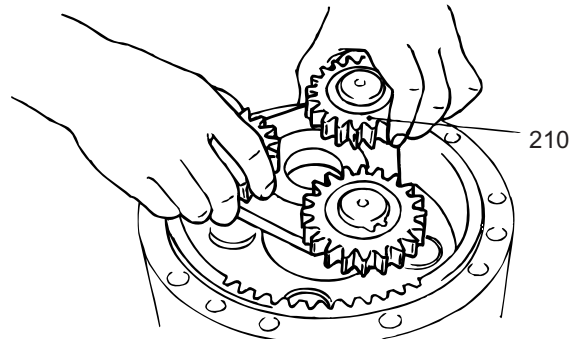
(3) Remove No.1 sun gear (211)



Removing No.1 sun gear

(4) Remove No.1 carrier assy

Remove the No.1 carrier assy with the No.1 planetary gear (210) and others.



Removing No.1 carrier assy

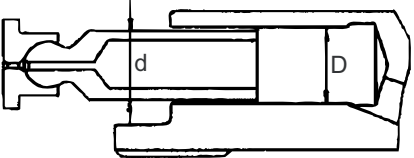
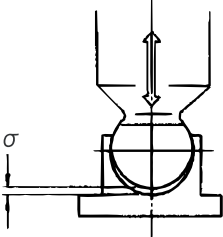
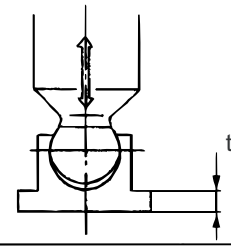
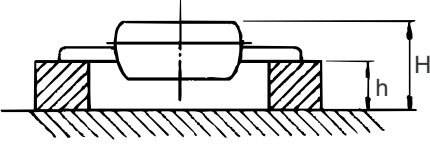
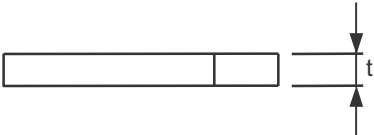
33. UPPER SLEWING STRUCTURE

33.2.5.4 MAINTENANCE STANDARDS

33.2.5.4.1 SWING MOTOR

(1) Replacement standards for parts

If part are worn out beyond the below standards, replace or recondition them. However if they show excessive damage on their surface, replace them.

Item	Standard Dimension mm (in)	Recommended Value for replacement mm (in)	Remedy
Clearance between piston and cylinder bore (D-d) 	0.016 (0.00063)	0.046 (0.00181)	Replace piston or cylinder.
Gap between piston and caulked part of shoe (σ) 	0	0.3 (0.012)	Replace piston and shoe assembly.
Thickness of shoe (t) 	4.0 (0.157)	3.8 (0.150)	Replace piston and shoe assembly.
Assembled height of shoe plate and retainer (H-h) 	5.5 (0.217)	5.0 (0.197)	Replace a spherical bushing and a retainer plate as a pair.
Thickness of friction plate 	3.5 (0.138)	3.1 (0.122)	Replace.

33.2.6.2.5 Assembly

Prior to assembly, clean each parts (excluding the O-ring and seal), and arrange in the sequence of assembly. Apply grease on the groove of seal to be installed on seal assembly (5) and O-ring (18).

(1) Assembling seals to body

1.

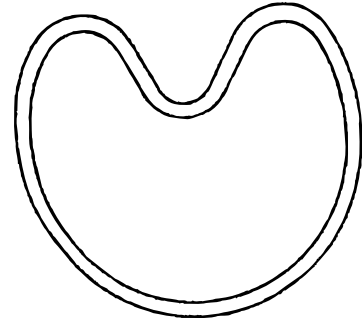
Apply hydraulic oil to O-ring (18) thinly and insert it in O-ring groove. Check the twist of O-ring

2.

Slipper ring is assembled, after first inserting the back-up ring, by slightly-distorting the shape as shown in Right Fig. Also after inserting all of the seals, be certain that these are installed in the seal groove by use of the spatula.

3.

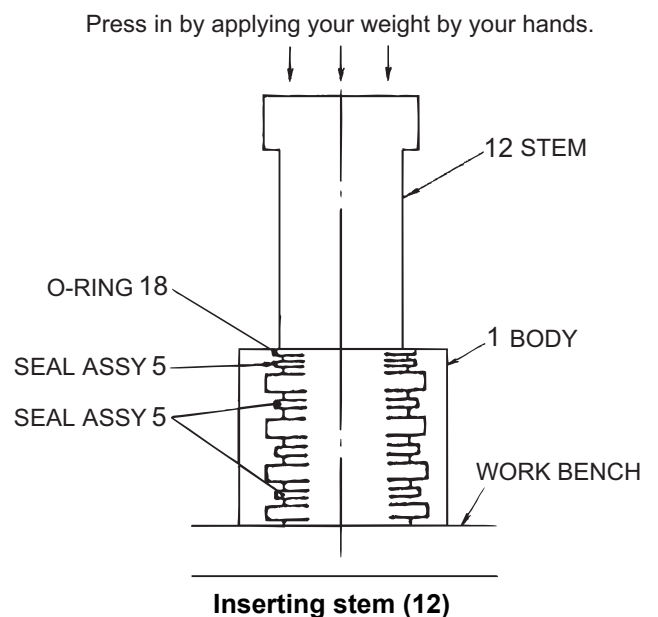
Assemble seal (5) by the same procedure above mentioned.

**Inserting slipper ring (5)****CAUTION**

Remove grease, hydraulic oil and vaseline from the groove of seal. And insert seal (5).
Seals (5) have no back-up ring.

(2) Assembling stem

Lightly coat the outer circumference of stem (12) and the inner surface of body (1) with grease or vaseline and slowly insert stem (12) into body (1).

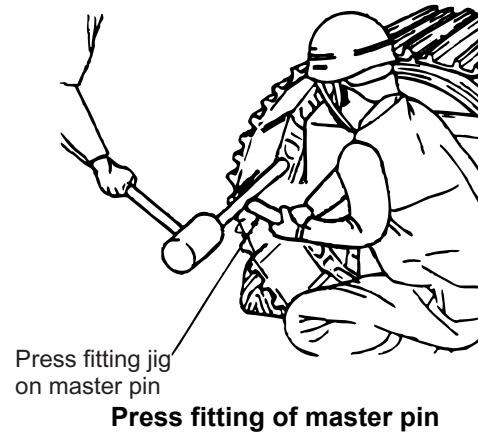
**CAUTION**

-If stem (12) is pressed in too fast, the seal may be damaged. Do it slowly.
-The clearance between body (1) and stem (12) is about 0.1mm (0.004in). Push stem straight along the shaft center.

34. TRAVEL SYSTEM

(4) Press fitting of master pin

Apply press fitting jig on master pin, and strike it with a mallet to press fit.

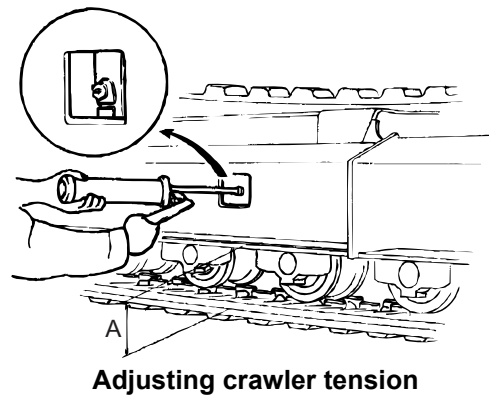


(5) Adjusting crawler tension (See right Fig.)

After installing, adjust tension of crawler.

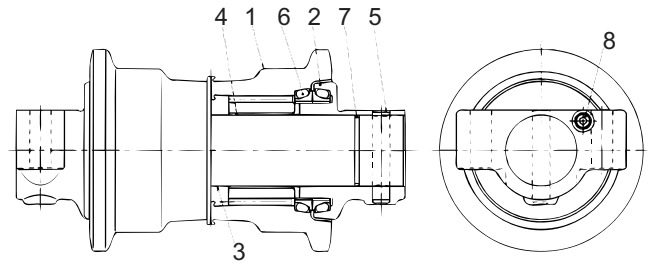
Tools: Socket: 19 mm

	Standard dimension A
Dimension of iron crawler in a max. slackened condition	320~350mm (12.6~13.8in)



34.1.4.4 CONSTRUCTION

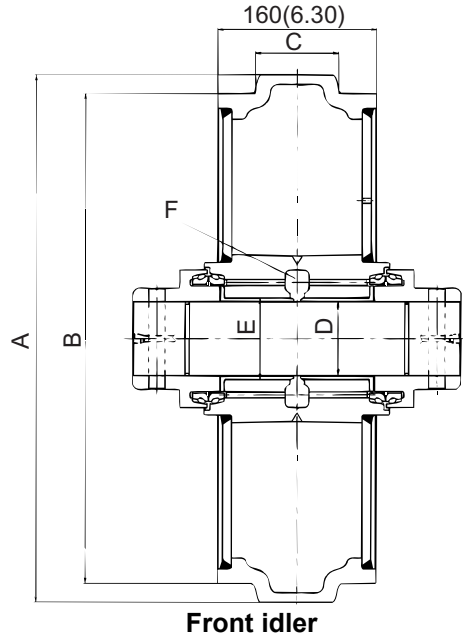
LOWER ROLLER		YN64D00019F1	
No.	NAME	Q'TY	REMARKS
1	ROLLER	1	
2	COLLAR	2	
3	SHAFT	1	
4	BUSHING	2	
5	PIN	2	
6	FLOATING SEAL	2	
7	O RING	2	1A G60
8	PLUG	2	PT1/4



Construction of lower roller

34. TRAVEL SYSTEM

34.1.5.3.3 MAINTENANCE STANDARD



Unit : mm (in)

No.	ITEM	STANDARD VALUE		REPAIRABLE LEVEL	SERVICE LIMIT	REMEDY	
A	Dia. of idler projection	$\varnothing 535$ (21.1)		—	—	Replace	
B	Tread dia.	$\varnothing 497$ (19.6)		$\varnothing 490$ (19.3)	$\varnothing 487$ (19.2)		
C	Flange width	84 ± 0.5 (3.307 \pm 0.020)		78 (3.07)	76 (2.99)		
D	Clearance between shaft and bushing	Basic dimension	Tolerance		Fit	Fit	Replace bushing
		$\varnothing 75$ (2.95275)	Shaft	- 0.03 (-0.00118) - 0.06 (-0.00236)	Clearance 1.5 (0.059)	Clearance 2.0 (0.079)	
E	Interference between idler and bushing	$\varnothing 83$ (3.26771)	Hole	+ 0.035 (+0.00138) 0	Interference 0	Clearance 0.01 (0.0004)	
F	Oil	Engine oil API grade CD #30, 200cc (12.2cu•in)				Refill	
	Idler rotation	Rotates smoothly by hand				Reassemble	

34.1.7.3 INSTALLING

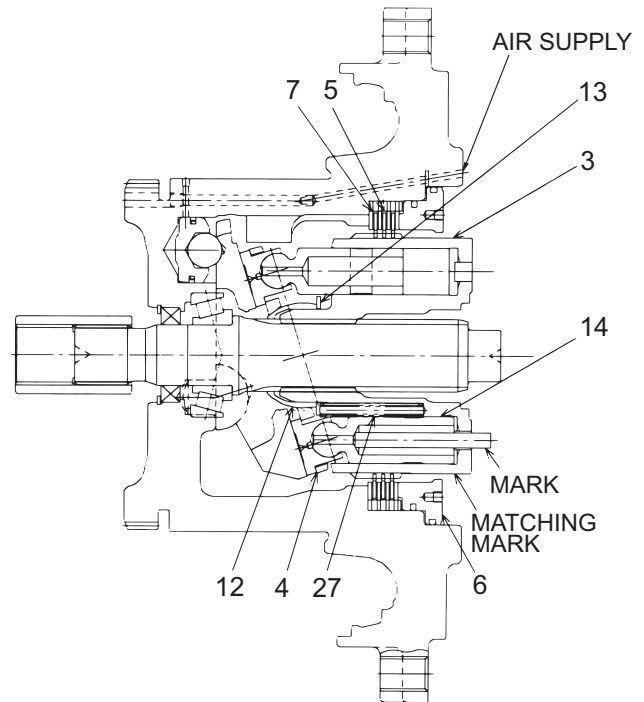
Installing of the travel motor piping is performed in the reverse order of removal.

1. Cleaning
Check that contact surface of travel motor and crawler frame is free from burr and stain.
2. Tightening torque
Tighten capscrew and hydraulic pipes to the torque specified in "Tightening Torque".
3. Fill inside from motor drain port to casing with hydraulic oil before piping for drain. When starting operation, operate motor in low idling and at low speed for several minutes, and check it for possible oil leakage and noise.

NAME	SIZE	TOOLS HEX	NO.	TIGHTENING TORQUE N·m(lbf·ft)	REMARKS
SEMS BOLT	M12	19	6	83.4(61)	APPLY LOCTITE #262
CAPSCREW	M18 M20	27 30	3A 3	397(293) 539(398)	
FLARELESS NUT FOR PIPES, SLEEVE	φ28X4.0	36	—	275(206)	
HOSE CAP	PF1/4	19	—	29.4(21.7)	
	PF1/2	27	—	78.5(57.9)	
CONNECTOR	PF1/4	19	—	36.3(27)	
	PF1/2	27	—	108(80)	
	PF1	41	—	255(188)	

34. TRAVEL SYSTEM

- (8) Put such a bar (marked) that does not score cylinder block (3) (such as a coiled paper shaped like a pipe) into the hole of piston (14) and give a matching mark on the outer surface of cylinder block (3).
- (9) Remove cylinder block (3), spring retainer (13) and spring (27).
- (10) Remove separator plate (7) and friction plate (5).
- (11) Take off nine piston assy (14), shoe retainer (4) and ball joint (12) at the same time.



Removing the cylinder block

CAUTION

With piston assy (14) and shoe retainer (4) removed, match the mark with the matching mark and put them into the cylinder block.
This operation is to insure that the pistons are reassembled where they were.

CAUTION

Take care so as not to score the moving surfaces. Scored ones can not be used again.

CAUTION

The piston and the shoe are caulked together and can not be separated.

(Reference)

The above-mentioned explanations are associated with a single motor, but the motor with a reduction gear may be separated the same way. The motor with a reduction gear may be disassembled more easily in some cases as the shaft does not swing too much.

(5) Oil leaks.

Symptom	Cause	Remedy
Oil leaks.	<ol style="list-style-type: none"> 1. Bolts and plugs are loosen. 2. O-rings are galled. 3. Oil is leaking into gear casing. 	<ol style="list-style-type: none"> 1. Tighten bolts or plugs to a specified torque. 2. Replace O-ring. 3. Replace oil seal.

(6) The motor speed does not change from high to low.

Symptom	Cause	Remedy
Motor does not change from high to low speed.	Spool of pilot valve is stuck.	Check and repair pilot valve.

(7) Abnormal sound occurs.

Symptom	Cause	Remedy
Intense vibration and sound occur when brake is operated slowly or with other circuits.	Spool malfunctions. Air remains in circuit and valve.	Bleed air.
Spool is stuck.	Correct or replace.	

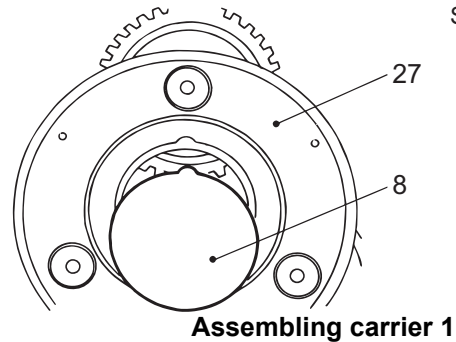
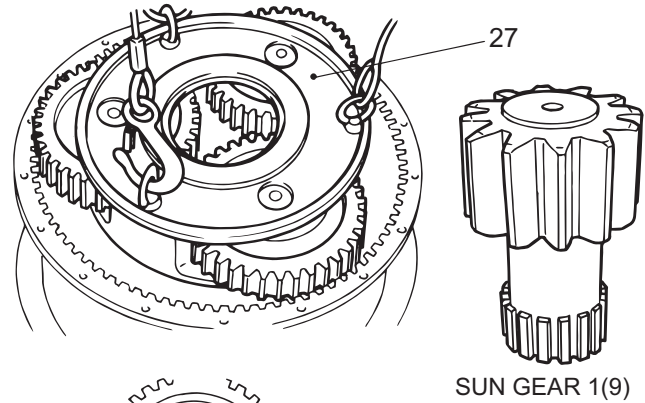
(8) Hunting occurs when machine goes down a slope.

Symptom	Cause	Remedy
Hunting is intense during inching.	Spool malfunctions. -Spool and body are stuck. -Seat of restrictor valve is poor.	Correct or replace.
Interference with negative brake -Spring at end of spool is fatigued or broken.	Correct or replace.	

34. TRAVEL SYSTEM

(9) Installing carrier 1 assy

1. Put the carrier 1 assy into ring gear (17). Turn the planetary gear (6) by hand to correct position and engage it with sun gear 2 (10).
2. Insert sun gear 1 (9).
3. Put thrust plate (8) into carrier 1 (27).

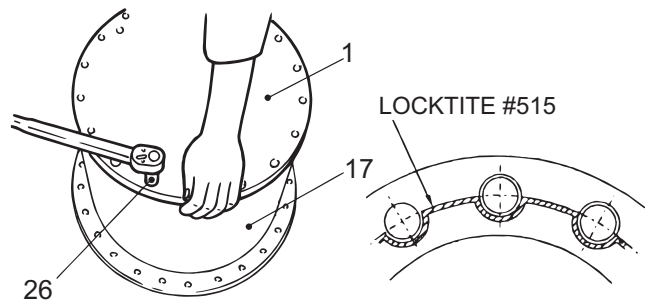


(10) Installing cover

1. Apply Loctite #515 to the matching surface between cover (1) and ring gear (17). Then install cover (1) to ring gear (17).
2. Apply Loctite #242 to fifteen socket bolt (24) and tighten them up.

Tools: Allen wrench: 8mm

Tightening torque: 79N-m (58 lbf-ft)



Installing cover (1)

(11) Filling gear oil

Fill in gear oil (SAE90, API Grade GL-4, 5.5 lit.) through the socket plug PT3/4 (26), place seal tape on the plug and attach it to cover (1).

Tools: Allen wrench: 14mm

Tightening torque: 98N-m (72 lbf-ft)

46. TROUBLE SHOOTING (BY ERROR CODES)

Error code	A025		
Trouble	Not yet adjusted engine or failed adjustment of pump proportional valve (B adjustment)		
Judging condition	Pump proportional valve adjustment is missed. Or it is impossible to set the adjusting value within the adjusting range.		
Symptom	Deviated from the rated output, but no problem in normal operation		
Control in the event of failure	Workable with the default proportional valve output.		
Returned in normal condition	The pump proportional valve adjustment is completed normally.		
Service diagnosis checking screen	Screen No.	6	E-1 P1 PUMP
	Screen No.	6	E-2 P2 PUMP
	Screen No.		
Checking object		Checking contents and remedy	
1	-Checking		Carry out pump adjustment (B adjustment). When "ERROR PUMP" was displayed during adjustment, refer to the section "Adjustment procedure - Measures to be taken with the adjustment failed"
2	-Mechatronics controller		Check that the error is corrected after replacement of controller.
3			

Error code	A035		
Trouble	Not yet adjusted unload valve or failed adjustment of unload valve (C adjustment)		
Judging condition	The adjustment of unload valve is missed. Or the adjusting value can not be set in the adjusting range.		
Symptom	It is not normal output, but no problem in normal operation		
Control in the event of failure	Work with the aid of output by default proportional valve.		
Returned in normal condition	The adjustment of unload valve is completed normally.		
Service diagnosis checking screen	Screen No.	7	D-1 P1 UN-LOAD (BP-CUT)
	Screen No.	7	D-2 P2 UN-LOAD (BP-CUT)
	Screen No.		
Checking object		Checking contents and remedy	
1	-Checking		Carry out adjustment of unload valve (C adjustment). When "ERROR PUMP" was displayed during adjustment, refer to the section "Adjustment procedure - Measures to be taken with the adjustment failed"
2	-Mechatronics controller		Check that the error is corrected after replacement of controller.
3			

46. TROUBLE SHOOTING (BY ERROR CODES)

Error code	B052		
Trouble	Bucket digging pressure sensor outputs error		
Judging condition	After starter switch ON and engine does not start yet. And the input voltage from the bucket digging pressure sensor after starter switch ON is in the range of 1.4V or more to less than 4.7V.		
Symptom	The bucket digging operability becomes poor.		
Control in the event of failure	Normal control		
Returned in normal condition	Not returned automatically under normal condition. Switch the power OFF once and turns on it again.		
Service diagnosis checking screen	Screen No.	5	B-5 BUCKET DIG
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-Bucket digging pressure sensor SE-1	When B052 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.	
2	-Wiring between bucket digging pressure sensor and controller CN-124F CN-101F	When B052 is displayed after turning the starter switch on after the connector is exchanged with other sensor. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.	
3	-Mechatronic controller	Check that the error is corrected after replacement of controller.	

Error code	B053		
Trouble	Bucket digging pressure sensor's wiring is disconnected.		
Judging condition	The input voltage from bucket digging pressure sensor is 0.1V or less.		
Symptom	The bucket digging speed slows down a little.		
Control in the event of failure	Set proportional valve output rate of P1 and P2 pumps to constant current. (Current when all operation is in neutral.) Only on independent operation of boom-up, set output of P1, P2 unload proportional valves to 750mA.		
Returned in normal condition	It returns automatically in normal condition.		
Service diagnosis checking screen	Screen No.	5	B-5 BUCKET DIG
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-Bucket digging pressure sensor SE-1	When B053 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.	
2	-Wiring between bucket digging pressure sensor and controller CN-124F CN-101F	When B053 is displayed after turning the starter switch on after the connector is exchanged with other sensor. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.	
3	-Mechatronic controller	Check that the error is corrected after replacement of controller.	

46. TROUBLE SHOOTING (BY ERROR CODES)

Error code	B163		
Trouble	P1 side option pressure sensor's wiring is disconnected.		
Judging condition	The input voltage from P1 side option pressure sensor is 0.1V or less.		
Symptom	The P1 side option does not work.		
Control in the event of failure	Set proportional valve output rate of P1 and P2 pumps to constant current. (Current when all operation is in neutral.) Only on independent operation of boom-up, set output of P1 unload proportional valve to 750mA. But normal control is done when the left control pedal selection is ON.		
Returned in normal condition	It returns automatically in normal condition.		
Service diagnosis checking screen	Screen No.	5	B-16 P1 OPT.
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-P1 side option pressure sensor SE-20	When B163 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.	
2	-Wiring between P1 side option pressure sensor and controller CN-304F CN-102F	When B163 is displayed after turning the starter switch on after the connector is exchanged with other sensor. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.	
3	-Mechatronic controller	Check that the error is corrected after replacement of controller.	

46. TROUBLE SHOOTING (BY ERROR CODES)

Error code	C034		
Trouble	Boom head pressure sensor's power source is shortcut.		
Judging condition	The input voltage from boom head pressure sensor is 4.7V or more.		
Symptom	Indication load value of High-reach crane becomes abnormal.		
Control in the event of failure	Normal control		
Returned in normal condition	It returns automatically in normal condition.		
Service diagnosis checking screen	Screen No.	6	C-3 BOOM-HEAD
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-Boom head pressure sensor SE-24	When C034 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.	
2	-Wiring between boom head pressure sensor and controller CN-706F CN-104F	When C034 is displayed after turning the starter switch on after the connector is exchanged with other sensor. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.	
3	-Mechatronic controller	Check that the error is corrected after replacement of controller.	

Error code	C043		
Trouble	Boom rod pressure sensor's wiring is disconnected.		
Judging condition	The input voltage from boom rod pressure sensor is 0.1V or less.		
Symptom	Indication load value of High-reach crane becomes abnormal.		
Control in the event of failure	Normal control		
Returned in normal condition	It returns automatically in normal condition.		
Service diagnosis checking screen	Screen No.	6	C-4 BOOM-ROD
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-Boom rod pressure sensor SE-25	When C043 is cancelled and other error occurs by turning starter switch on after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.	
2	-Wiring between boom rod pressure sensor and controller CN-705F CN-104F	When C043 is displayed after turning the starter switch on after the connector is exchanged with other sensor. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.	
3	-Mechatronic controller	Check that the error is corrected after replacement of controller.	

Error code	F013		
Trouble	ATT boost solenoid valve and output transistor ON are failure, and disconnection.		
Judging condition	The feed-back signal is 24V level while exciting command is not output.		
Symptom	ATT boost is not available or is leaving available.		
Control in the event of failure	Normal control		
Returned in normal condition	The feed-back signal is grounding level while exciting command is not output.		
Service diagnosis checking screen	Screen No.	3	F-1 POWER BOOST
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-ATT boost solenoid valve SV-2	When F013 is cancelled and other error occurs by exchanging the connector for other solenoid valve. Check solenoid valve unit for possible failure. If failure found, replace it.	
2	-Wiring between ATT boost solenoid valve and controller CN-117F CN-105F	When F013 is displayed after the connector is exchanged with other solenoid valve. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.	
3	-Mechatro controller	Check that the error is corrected after replacement of controller.	

Error code	F021		
Trouble	Swing parking solenoid valve and output transistor OFF are failure, and grounding is short-circuit.		
Judging condition	The feed-back signal is grounding level while exciting command is output.		
Symptom	Swing parking is not available.		
Control in the event of failure	Normal control		
Returned in normal condition	The feed-back signal is 24V level while exciting command is output.		
Service diagnosis checking screen	Screen No.	3	F-2 SWING-BRAKE
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-Swing parking solenoid valve SV-1	When F021 is cancelled and other error occurs by exchanging the connector for other solenoid valve. Check solenoid valve unit for possible failure. If failure found, replace it. Check solenoid valve unit for possible failure. If failure found, replace it.	
2	-Wiring between swing parking solenoid valve and controller CN-123F CN-105F	When F021 is displayed after the connector is exchanged with other solenoid valve. Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.	
3	-Mechatro controller	Check that the error is corrected after replacement of controller.	

46. TROUBLE SHOOTING (BY ERROR CODES)

Error code	I111		
Trouble	Reception of CAN1 communication is abnormal. (Passive error)		
Judging condition	Reception from engine controller can not receive correctly.		
Symptom	It has been affected little.		
Control in the event of failure	Keep the last receiving condition.		
Returned in normal condition	It returns automatically in normal condition.		
Service diagnosis checking screen	Screen No.		
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-Wiring between ECU and controller CN-12F CN-101F	Check wiring for possible failure according to the wiring checking procedure and repair it if necessary. (There is a possibility of false disconnection.)	
2	-Mechatro controller	Check that the error is corrected after replacement of controller.	

Error code	I113		
Trouble	Reception of cluster communication is abnormal. (Time-out error)		
Judging condition	Reception from gauge cluster can not receive correctly. It has been affected little.		
Symptom	It has been affected little.		
Control in the event of failure	It can be operated in condition that coolant temperature is 20C degrees.		
Returned in normal condition	It returns automatically in normal condition.		
Service diagnosis checking screen	Screen No.	2	G-5 WATER TEMP
	Screen No.		
	Screen No.		
Checking object		Checking contents and remedy	
1	-Wiring between ECU and controller CN-12F CN-101F	Check wiring for possible failure according to the wiring checking procedure and repair it if necessary.	
2	-Mechatro controller	Check that the error is corrected after replacement of controller.	

47. TROUBLESHOOTING (BY TROUBLE)

TABLE OF CONTENTS

47.1	HYDRAULIC SYSTEM	47-3
47.2	ELECTRIC SYSTEMS	47-38
47.2.1	WIRING CHECKING PROCEDURE	47-38
47.2.2	TROUBLE	47-40
47.3	ENGINE RELATED TROUBLESHOOTING	47-43

47. TROUBLESHOOTING (BY TROUBLE)

No.	Sections	Contents/normal value		Corrective action, others
9	Command current value of bypass valve	Carry out service diagnosis	Check that the current value does not change regardless of operation. No.12 D-15 -See Service Diagnosis Data List. Operation No.1 is nil. Operation No.18 is travel right in full lever and idling. Operation No.19 is travel left in full lever and idling.	-Check pressure sensor of travel. -In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
10	Proportional valve secondary pressure of bypass valve	Measure the proportional valve secondary pressure directly (G port)	High idling pressure is 0.8MPa or less regardless of neutral/operation.	Replace proportional valve
11	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage	Replace
12	Lock valve poppet <Trouble> Boom down is low.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface	Replace (Check on the casing side for damage)
13	Holding valve (poppet) <Trouble> Boom down is slow.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface	Replace (Check on the casing side for damage)
14	Boom spool <Trouble> Boom down is slow.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage.	Replace (Check on the casing side for damage)
15	Check boom spool and recirculation <Trouble> Machine can not be lifted by supporting with boom.	Disassembly and investigation	Free from abnormal resistance against sliding Spring is free from breakage.	Replace spool assembly
16	Spool of bypass valve	Visual check	When removing, there is no abnormal resistance against sliding. Free from abnormal damage etc. on outside surface. Spring should be free from breakage.	Replace the spool (Check on the casing side for damage.)
17	Main relief valve <Trouble> Relief pressure is low.	Check set pressure	-See Service Diagnosis Data List Operation No.3 boom up full lever and relief	Reset or replace

No.	Sections	Contents/normal value		Corrective action, others
11	Actual measuring current value of travel straight proportional valve (Check this trouble by only swing operation)	Carry out service diagnosis	Check that the value is not change regardless of operation -See Service Diagnosis Data List Operation No. 1 Operation is nil Operation No.18 Travel right full lever & idling Operation No.19 Travel left full lever & idling	-Check pressure sensor of travel -In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
12	Secondary pressure of travel straight proportional valve (Check this trouble by only swing operation)	Measure directly the proportional valve secondary pressure at the ports A6 (travel straight) of 7 sections solenoid block	0.8MPa or less in high idling operation regardless of neutral/ operation	Replace proportional valve
13	Command current value of bypass valve	Carry out service diagnosis	Check that the current value does not change regardless of operation. No.15 D-15 -See Service Diagnosis Data List. Operation No.1 is nil. Operation No.18 is travel right in full lever and idling. Operation No.19 is travel left in full lever and idling.	Check pressure sensor of travel. In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
14	Proportional valve secondary pressure of bypass valve	Measure the proportional valve secondary pressure directly (G port)	High idling pressure is 0.8MPa or less regardless of neutral/ operation.	Replace proportional valve
15	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage	Replace
16	Travel straight spool <Trouble> P2 pressure is low.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage.	Replace (Check on the casing side for damage)
17	Spool of bypass valve	Visual check	When removing, there is no abnormal resistance against sliding. Free from abnormal damage etc. on outside surface. Spring should be free from breakage.	Replace the spool (Check on the casing side for damage.)
18	Swing spool <Trouble> P2 pressure is high.	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage.	Replace (Check on the casing side for damage)

47. TROUBLESHOOTING (BY TROUBLE)

(20) Breaker works slowly and power is poor

(In case of conflux, check p1 unload/pump and travel straight)

No.	Sections	Contents/normal value		Corrective action, others
1	Pressure sensor for optional attachment	Carry out service diagnosis	-See Service Diagnosis Data List Operation No.16 P2 side OPT full lever and relief	Check and replace pressure sensor Check remote control valve
2	Remote control valve	Measure directly remote control pressure of travel right and left	Check that pressure is 2.1MPa or more in optional attachment full lever and high idling operation	Check remote control valve
3	Actual measuring current value of P1/P2 unload proportional valve	Carry out service diagnosis	-See Service Diagnosis Data List Operation No.16 P2 side OPT full lever and relief	-In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
4	Secondary pressure of P1, P2 unload proportional valve	Measure the proportional valve secondary pressure directly at the ports A7 and A5 of 7 sections solenoid block	Check that P1/P2 unload secondary pressures are within the range of 0.5 to 1.2MPa	Replace proportional valve
5	Actual measuring current value of travel straight proportional valve	Carry out service diagnosis	-See Service Diagnosis Data List Operation No.16 P2 side OPT full lever & relief	-Check voltage of low pressure sensor other than sensor for optional attachment -In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
6	Secondary pressure of travel straight proportional valve	Measure directly the proportional valve secondary pressure at the ports A6 (travel straight) of 7 sections solenoid block	Check that travel straight secondary pressure is 2.7MPa or more in optional attachment full lever and high idling operation	Replace proportional valve
7	P1 by-pass cut valve <Trouble> Only P1 pressure is low.	Visual check	No problem for sliding ability of main poppet and no contamination on orifice No problem for sliding ability of internal piston (Check it through PBp2 port.)	Clean or replace

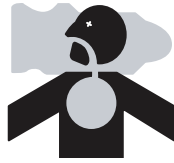
Factors \ Trouble		Fuel system				Intake and exhaust system			Lubrication system			Cooling system		
		Failure of injector	Failure of supply pump	Improper fuel injection time	Fuel leak into the head cover	Turbocharger oil drain tube clogged	Seal of turbocharger worn, damaged	Seizing and interference of turbocharger	Damage of EGR cooler	Failure of oil pump	Failure of relief valve	Failure of regulator valve	Leak and crush of hydraulic piping	Damage of water pump
Faulty starting	Poor start ability (Take a long time)	<input type="radio"/>	<input type="radio"/>											
	Faulty engine starting/engine does not rotate.													
	Faulty engine starting/engine rotates but no exhaust gas (No fuel injection)													
	Faulty engine starting/exhaust gas is emitted but engine does not start (With fuel injection)	<input type="radio"/>	<input type="radio"/>											
Insufficient rotation	Engine poor run-up (Low follow-up ability)	<input type="radio"/>	<input type="radio"/>				<input type="radio"/>							
	Rotation in bad condition (hunting)													
Poor output	Engine stalled during operation.		<input type="radio"/>											
	Output is lowered.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>			<input type="radio"/>							
	Overheating			<input type="radio"/>									<input type="radio"/>	<input type="radio"/>
Other failures	Exhaust smoke is black	<input type="radio"/>	<input type="radio"/>				<input type="radio"/>							
	Exhaust smoke is white	<input type="radio"/>		<input type="radio"/>		<input type="radio"/>	<input type="radio"/>	<input type="radio"/>						
	Larger oil consumption (or blue exhaust gas)					<input type="radio"/>	<input type="radio"/>					<input type="radio"/>		
	Early contamination of oil				<input type="radio"/>	<input type="radio"/>	<input type="radio"/>			<input type="radio"/>				
	Larger fuel consumption	<input type="radio"/>		<input type="radio"/>	<input type="radio"/>									
	Intruding of oil in coolant, back flow, reduction of coolant quantity						<input type="radio"/>		<input type="radio"/>					
	Hydraulic pressure down (Monitor lights up)								<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>		
	Oil quantity increased. (Intruding of water and fuel)	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>									
	Vibration	<input type="radio"/>												

Be Careful of Exhaust Gas Poisoning

 **WARNING**

Be careful of Ventilation to Operate Engine

If the engine is installed in an enclosed area, and the exhaust gas is ducted outside, make sure that duct joints are free from gas leak. Exhaust gas from the engine sometimes contains harmful components. Operating the engine in an ill-ventilated area can cause gas poisoning.



Be Careful of Hearing Loss

 **WARNING**

Wear Ear Plugs

Always wear ear plugs when entering the machine room (engine room). Combustion sound and mechanical noise of engine can cause hearing loss.



Be Careful of Falling

 **WARNING**

Lift Engine Carefully

Use slings or wire ropes strong enough to lift the load considering the engine weight. To lift the engine, hitch the proper slings to the lifting hangers prepared on the engine. To lift the engine, keep the engine in a well-balanced position, thinking carefully of the engine center of gravity.



The hangers prepared on the engine are designed for lifting the weight of engine only. In the case where the generator, marine gear, and others are installed to the engine, consideration that the additional weight will not affect the hangers of the engine.

Keep the angle formed by slings attached to hangers within 60°. If the angle exceeds this limit, excessive load may be applied to the hangers and damage the hangers. If the wire rope contacts the engine directly, place a cloth or other soft pad to avoid damage to the engine and wire rope. Remove the engine part if necessary.

Do not Climb Onto the Engine

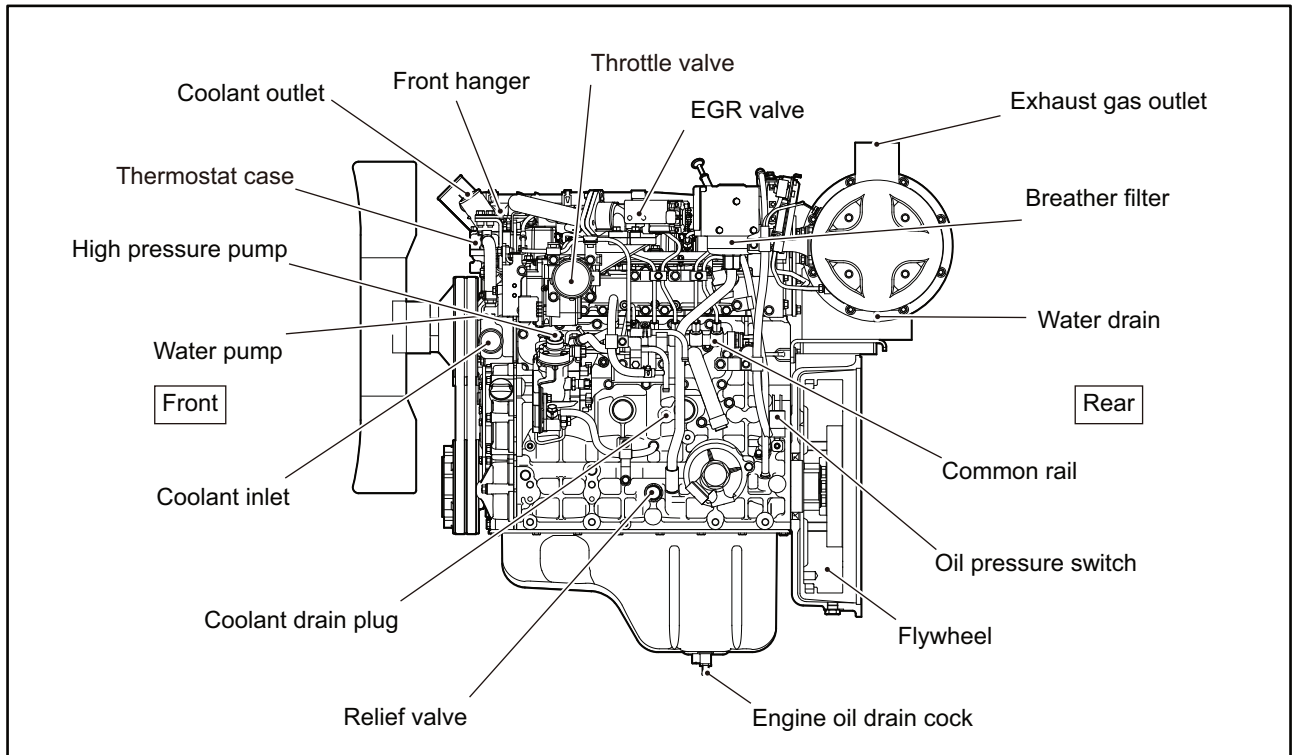
Do not climb onto the engine, nor step on any engine parts on the engine sides. To work on parts located high on the engine, use a ladder, footing, and others to prevent from slipping and falling. Climbing onto the engine may result in engine part damage and your injury by falling down.

Always Prepare a Stable Footing

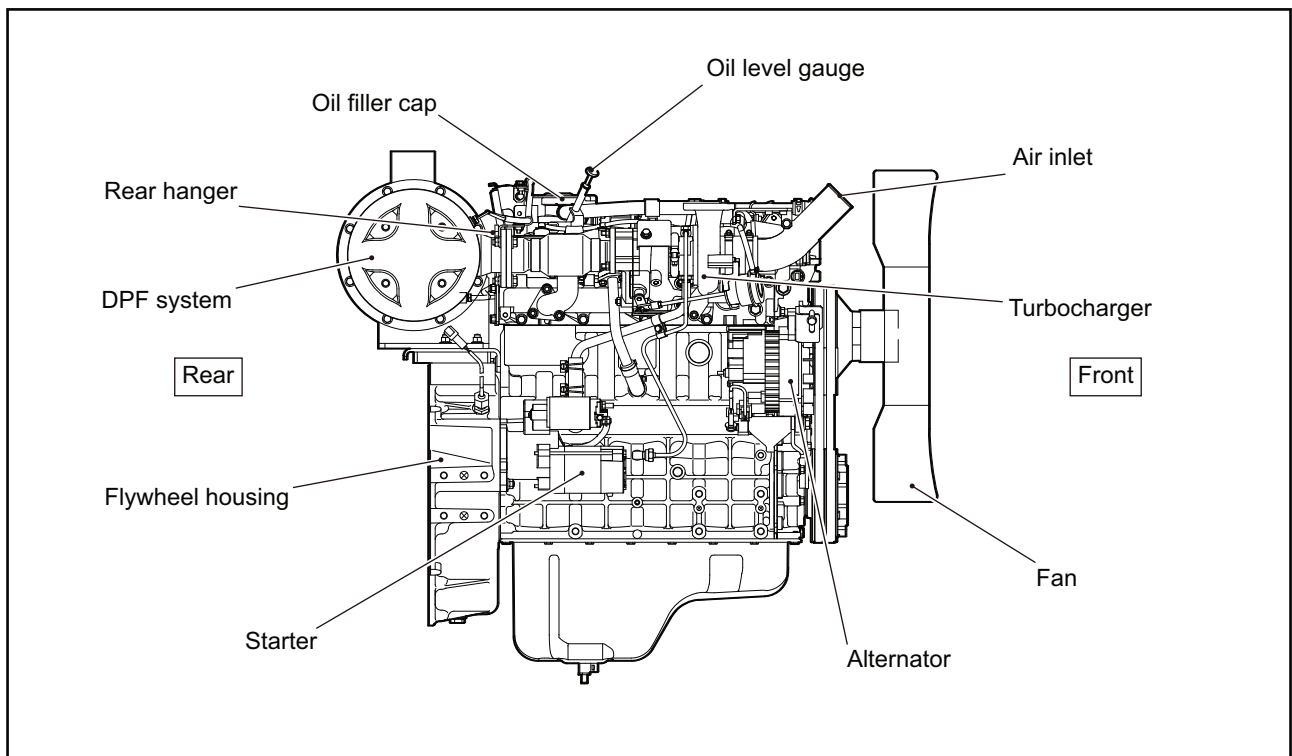
When working on the upper part of the engine and other hard-to-reach places, use a stable footing. Standing on an old footstool or parts box may result in personal injury. Do not put any unnecessary objects on a footing.



1. External View



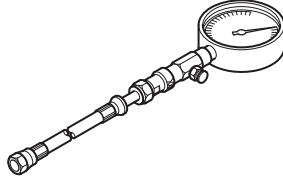
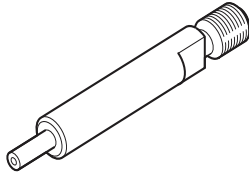

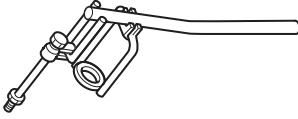
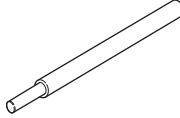
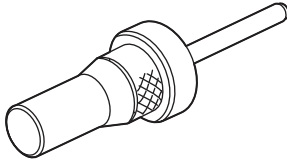
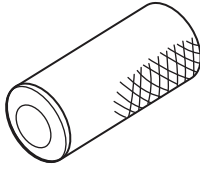
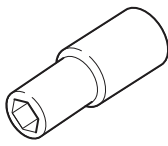
Left Side View



Right Side View

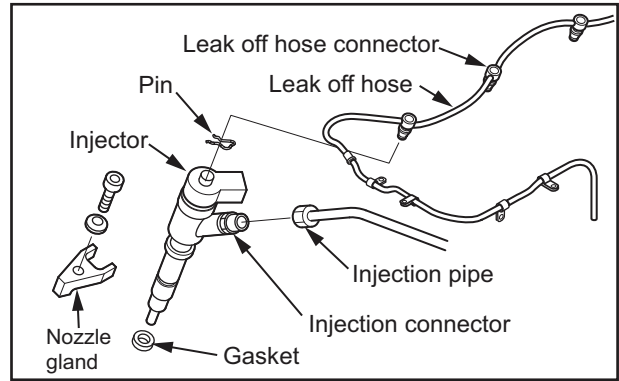
Item			Nominal value	Standard value	Limit value	Remarks	
Piston	Outside diameter (at piston skirt)	Standard	ø 94 [3.70]	93.915 to 93.945 [3.6974 to 3.6986]	93.730 [3.6902]		
		Over size		0.25 [0.0098]	94.165 to 94.195 [3.7073 to 3.7085]	93.980 [3.7000]	
				0.50 [0.0197]	94.415 to 94.445 [3.7171 to 3.7183]	94.230 [3.7098]	
	Protrusion from crankcase				0.7 [0.028]	Bearing Inspection of clearance Thickness when the gasket is installed 1.2 ± 0.05 [0.047 ± 0.0020]	
	Clearance between piston pin bore and piston pin outside diameter				0 to 0.015 [0.00 to 0.0006]	0.050 [0.0020]	
	Weight difference in one engine				5 g [0.176 oz.] or less		
	Clearance between piston ring and ring groove	No.1 compression			0.076 to 0.096 [0.0030 to 0.0038]	0.200 [0.0079]	
No.2 compression			0.045 to 0.085 [0.0018 to 0.0033]	0.150 [0.0059]			
Oil			0.020 to 0.060 [0.0008 to 0.0024]	0.150 [0.0059]			
Piston ring	Piston ring end gap	No.1 compression		0.30 to 0.50 [0.0118 to 0.0197]	1.50 [0.0591]		
		No.2 compression		0.50 to 0.70 [0.0197 to 0.0276]	1.50 [0.0591]		
		Oil		0.30 to 0.50 [0.0118 to 0.0197]	1.50 [0.0591]		
Piston pin	Outside diameter		ø 34 [1.34]	33.995 to 34.000 [1.3384 to 1.3386]			
	Clearance between connecting rod bush- ing			0.02 to 0.06 [0.0008 to 0.0024]	0.080 [0.0032]		
	Bushing inside diameter		ø 34 [1.34]	34.020 to 34.055 [1.3394 to 1.3407]			
Connecting rod	Connecting rod bend and twist			0.05/100 [0.0020/3.94] or less	0.15 [0.0059]		
	Clearance between crankpin and connect- ing rod bearing			0.030 to 0.090 [0.0012 to 0.0035]	0.200 [0.0079]		
	End play			0.15 to 0.35 [0.0059 to 0.0138]	0.50 [0.0197]	Replace connecting rod bearings	
	Weight difference in one engine			10 g [0.353 oz.] or below			
Flywheel	Flatness			0.15 [0.0059] or less	0.50 [0.0197]		
	Runout			0.15 [0.0059] or less	0.50 [0.0197]		
Camshaft	Runout			0.04 or [0.0016] or less	0.10 [0.0039]	Sgtraightness ø 0.02 Repair with press or replace.	
	Cam lift (major axis - minor axis)	Inlet	6.682 [0.2631]	6.382 to 6.782 [0.2513 to 0.2670]	6.182 [0.2434]		
		Exhaust	6.722 [0.2646]	6.422 to 6.822 [0.2528 to 0.2686]	6.222 [0.2450]		
	journal Outside diameter	No. 1, 2	ø 54 [2.13]	53.94 to 53.96 [2.1236 to 2.1244]	53.90 [2.1220]		
		No. 3	ø 53 [2.09]	52.94 to 52.96 [2.0842 to 2.0850]	52.90 [2.0827]		
End play			0.10 to 0.25 [0.0039 to 0.0098]	0.30 [0.0118]	Replace thrust plate.		

1. Special Tools

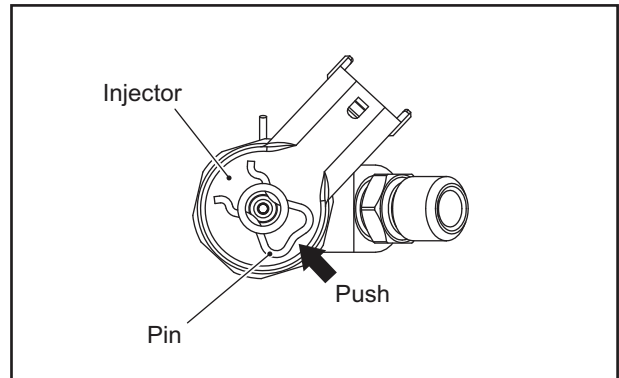
Tool name	Part No.	Illustration	Remarks
Compression gauge	35A91-03100		Engine compression pressure measuring 0 to 7 MPa {0 to 71.4 kgf/cm ² } [0 to 1015 psi]
Gauge adapter	32A91-01100		Compression Pressure - Measure
Socket for turning	58309-73100		Engine turning
Valve spring pusher	30691-04500		Valve spring installation/removal
Valve guide remover	32A91-00300		Valve guide removal
Valve seat ring caulking tool	Inlet: 36791-00200 Exhaust: 34491-03020		Valve seat ring installation
Stem seal installer	32A91-10200		Stem seal installation
Socket	34491-00300		Rocker bracket installation thrust plate of camshaft installation/ removal

1.1 Injector - Remove

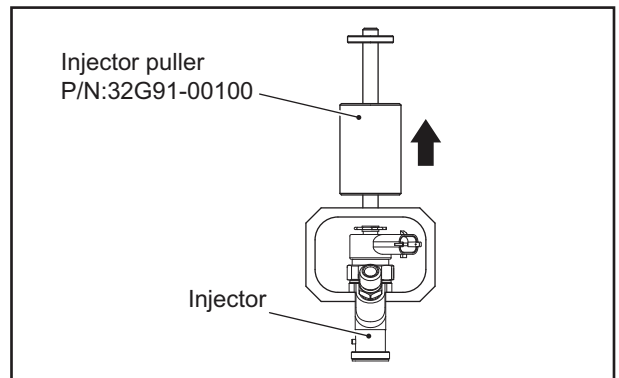
- (1) Fix the fuel inlet connector of injector with wrench, loosen the injection pipe nut and remove the injection pipe.
- (2) Fully press the pin at the top injector and remove the leak-off hose.
- (3) Disconnect the harness connector of main harness and the injector connector.
- (4) Remove the injector together with the nozzle gland using the injector puller.
- (5) Remove the gasket at injector inserting port in cylinder head.



Injector - Remove



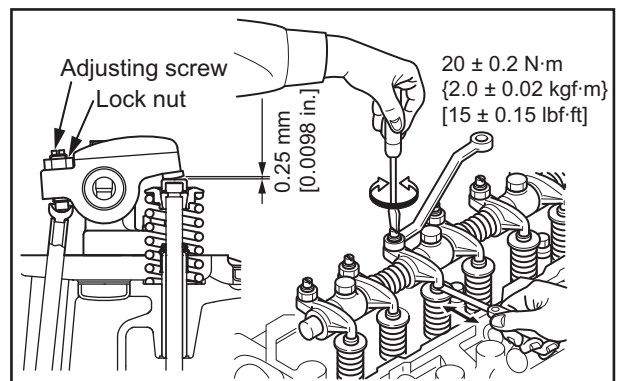
Pin at the Top of Injector



Injector - Remove

1.2 Inspection of Valve Clearance

Inspect the valve clearance, and know the current condition. For the inspection procedure, refer to "Valve Clearance - Inspect and Adjust" of "ASSEMBLY OF BASIC ENGINE."



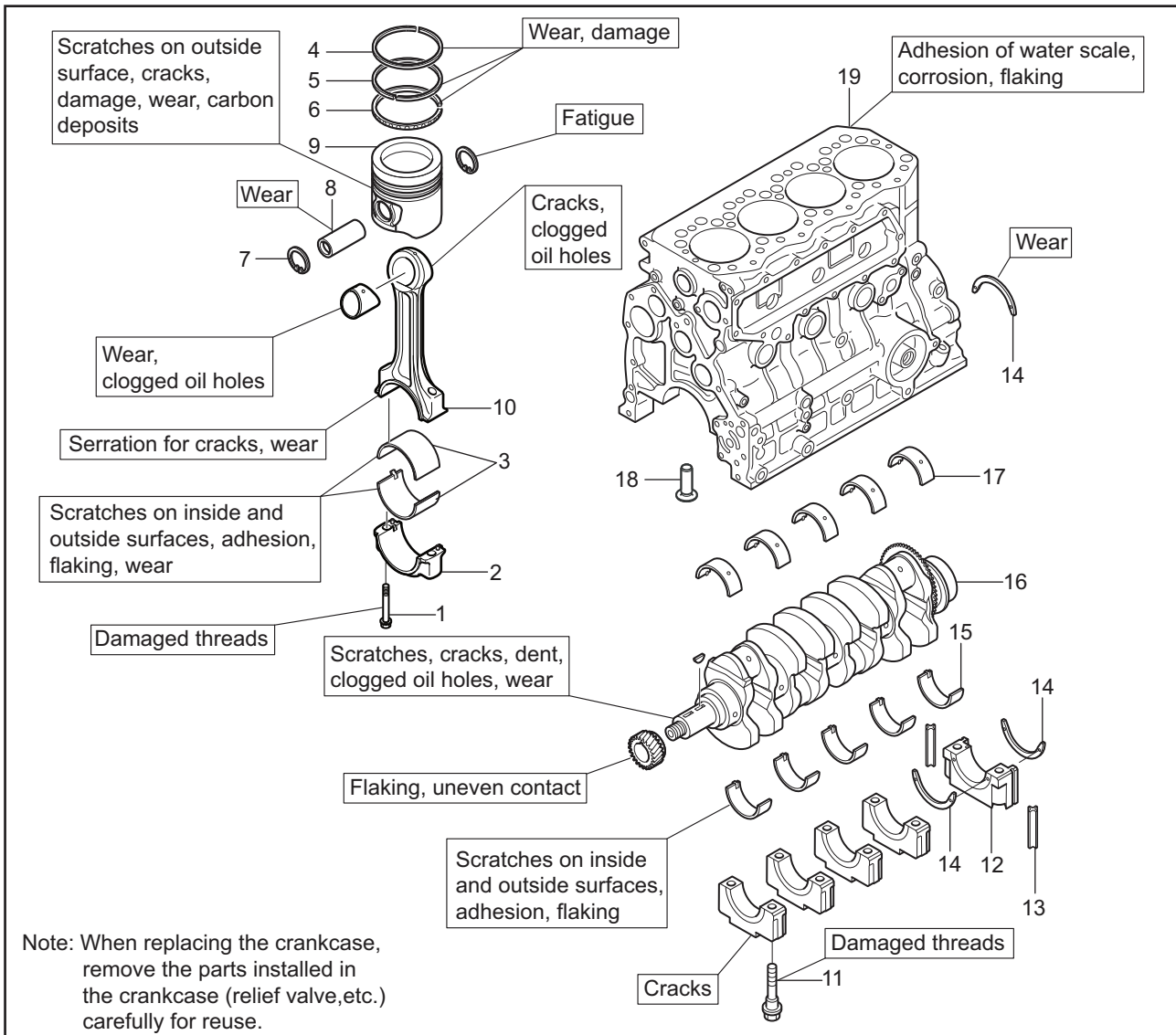
Inspection of Valve Clearance

4. Piston, Connecting rod, Crankshaft and Crankcase - Disassemble and Inspect

Understanding of the current engine condition before disassembling is very important to know the cause of trouble and do the efficient work.

Depending on the maintenance work or purpose, it is desirable to inspect some of the following items before proceeding with any job.

- ♦Piston Protrusion - Measure
- ♦Connecting Rod End Play - Measure
- ♦Crankshaft End Play - Measure
- ♦Cylinder inside diameter - Measure



Piston, Connecting rod, Crankshaft and Crankcase - Disassemble and Inspect

Disassembling sequence

- | | | |
|--------------------------|--------------------------|-----------------------|
| 1 Bolt | 8 Piston pin | 15 Lower main bearing |
| 2 Connecting rod cap | 9 Piston | 16 Crankshaft |
| 3 Connecting rod bearing | 10 Connecting rod | 17 Upper main bearing |
| 4 No. 1 compression ring | 11 Main bearing cap bolt | 18 Tappet |
| 5 No. 2 compression ring | 12 Main bearing cap | 19 Crankcase |
| 6 Oil ring | 13 Side seal | |
| 7 Snap ring | 14 Thrust plate | |

1.8 Valve and Valve Seat - Lap

Lap the valve and valve seat whenever the valve seat is refaced or the valve is replaced, or the contact surfaces fail to keep a pressure in the pressure test after assembling.

- (1) Apply a thin coat of lapping compound evenly to valve seat face.

Note:(a) Do not allow the compound to adhere to the valve stem.

(b) The compound spreads more evenly when it is mixed with a small amount of engine oil.

(c) Use a medium-grain compound (125 to 150 mesh) for initial lapping, then use the fine-grain compound (200 mesh) for finishing.

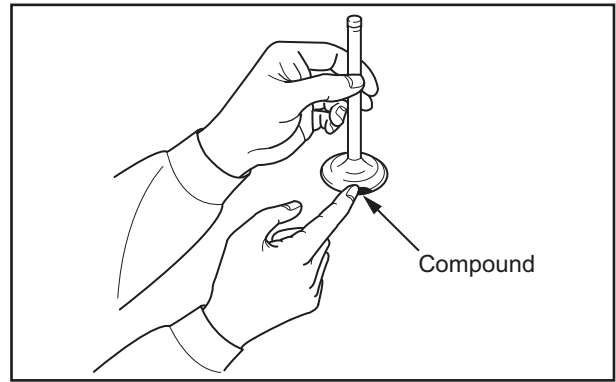
- (2) Use a valve lapper for lapping.

Tap the valve against the valve seat while rotating the valve little by little.

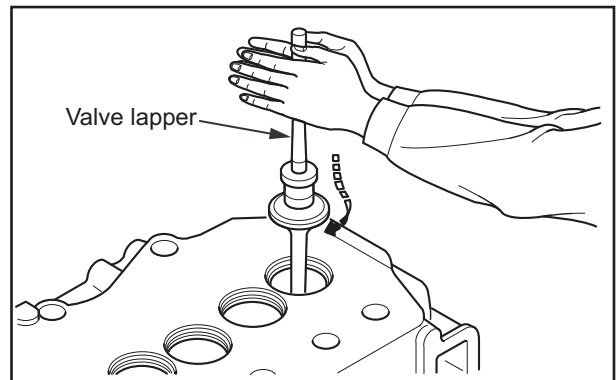
- (3) Clean off the compound using diesel fuel.

- (4) Apply engine oil to mating surfaces, and lap for finishing.

- (5) Apply a thin coat of lead-free coloring paste on the valve face, and tap the valve face against the valve seat using a valve lapper to check the contact condition.



Compound - Apply

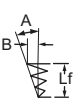


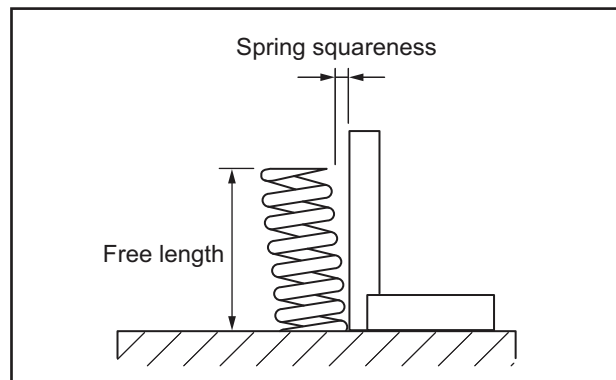
Valve and Valve Seat Ring - Lap

1.9 Squareness and Free Length of Valve Spring - Measure

Measure the squareness and the free length of valve spring.

If the specified limit or standard value is exceeded, replace the valve spring with a new one.

Nominal value	Standard value	Limit value
Free length	48.85 mm [1.9232 in.]	47.60 mm [1.8740 in.]
Squareness	 <p>A=1.5° or less B=1.3 mm [0.051 in.] or less Lf= 48.85 mm [1.9232 in.]</p>	At the whole length B=1.5 mm [0.059 in.]
set length / load	43 mm [1.69 in.]/176 to 196 N {17.9 to 20.0 kgf} [39.57 to 44.06 lbf]	43 mm [1.69 in.]/147 N {15.0 kgf} [33.05 lbf]

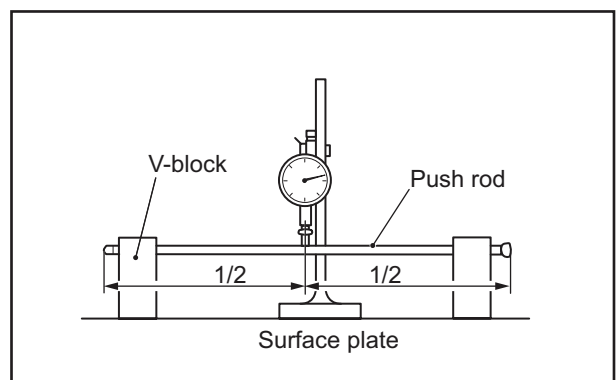


Squareness and Free Length of Spring - Measure

1.10 Push rod Runout - Measure

Measure the runout of pushrod in the total indicator reading (TIR). If the run out exceeds the limit, replace the push rod with a new one.

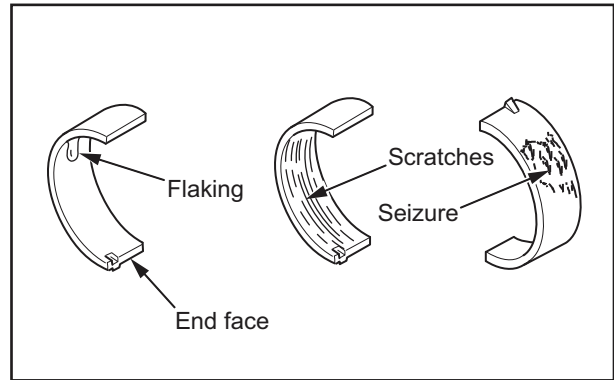
Item	Limit value	Remarks
Push rod runout	0.6 mm [0.024 in.]	TIR



Push rod Runout - Measure

4.13 Connecting Rod Bearing - Inspect

Inspect the sliding surface, back surface and end surfaces of the connecting rod bearing. If there is any defect such as local contact, sliding scratches, corrosion and foreign material inclusion, replace the bearing with a new one.



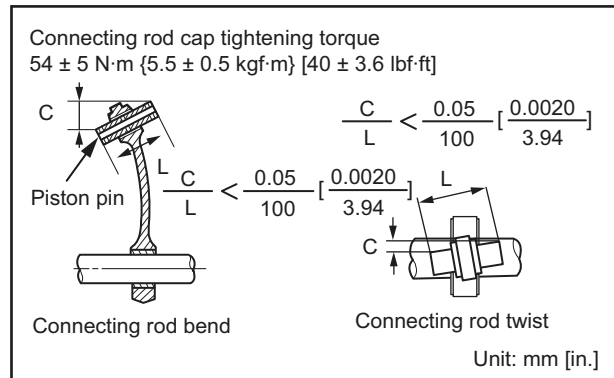
Connecting Rod Bearing - Inspect

4.14 Connecting Rod Bend and Twist - Inspect

(1) Measure the dimensions of C and L as shown in the illustration to check the bend and twist of the connecting rod. Straighten the connecting rod with a press machine so that the measured value meets the standard.

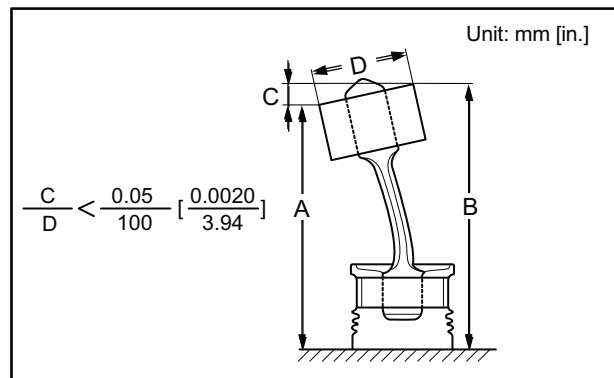
Note: Before checking the bend and twist, tighten the connecting rod cap to the specified torque.

(2) To inspect the connecting rod with the piston installed, turn the piston upside down and place it on a surface plate. Insert a round bar having the same diameter as the crankpin into the big-end bore, and measure the height of the bar with a dial gauge.



Connecting Rod Bend and Twist - Inspect

Item	Standard value	Limit value
Connecting rod bend and twist	0.05/100 mm [0.0020/3.94 in.] or less	0.15/100 mm [0.0059/3.94 in.]



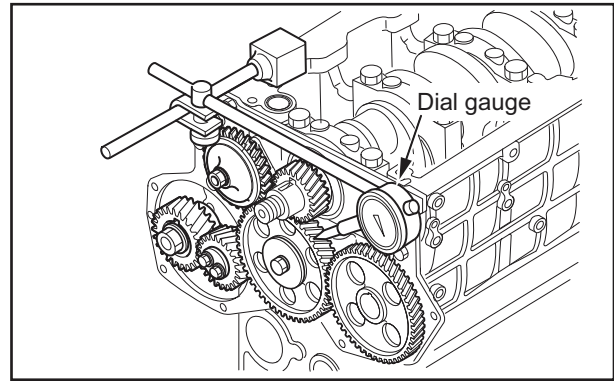
Measuring with Dial Gauge

4.	Cylinder Head and Valve Mechanism - Assemble	7-19
4.1	Cylinder Head - Assemble	7-19
4.2	Measurement of Valve Sinkage.....	7-19
4.3	Cylinder Head Gasket - Install.....	7-20
4.4	Cylinder Head Assembly - Install.....	7-20
4.5	Cylinder Head Bolt - Tighten.....	7-20
4.6	Push rod - Insert	7-20
4.7	Rocker Shaft Assembly - Install.....	7-21
4.8	Valve Clearance - Check and Adjust.....	7-22
4.9	Injector - Install	7-23
4.10	Valve Clearance - Adjust	7-23
4.11	Rocker Cover - Install	7-23

2.7 Timing Gear Backlash - Measure

Measure the backlash of timing gears using either method: measure the gear backlash with a dial gauge applying its probe to a tooth flank on the pitch circle at a right angle to the tooth axis, or measure the clearance between gears by inserting thickness gauges between the engaging gear teeth. If the value exceeds the limit, replace the gears with new ones.

Item	Standard value	Limit value
Timing gear backlash	0.05 to 0.15 mm [0.0020 to 0.0059 in.]	0.25 mm [0.0098 in.]

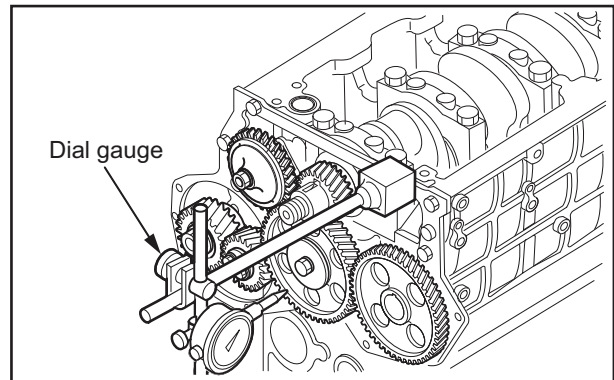


Timing Gear Backlash - Measure

2.8 Idler Gear End Play - Measure

Measure the end play of the idler gear. If the value exceeds the limit, replace the thrust plate with a new one.

Item	Standard value	Limit value
Idler gear end play	0.05 to 0.20 mm [0.0020 to 0.0079 in.]	0.35 mm [0.0138 in.]

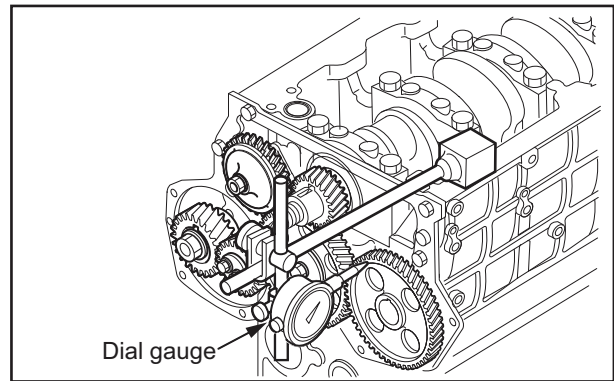


Idler Gear End Play - Measure

2.9 Camshaft End Play - Measure

Measure the camshaft end play. If the value exceeds the limit, replace the thrust plate with a new one.

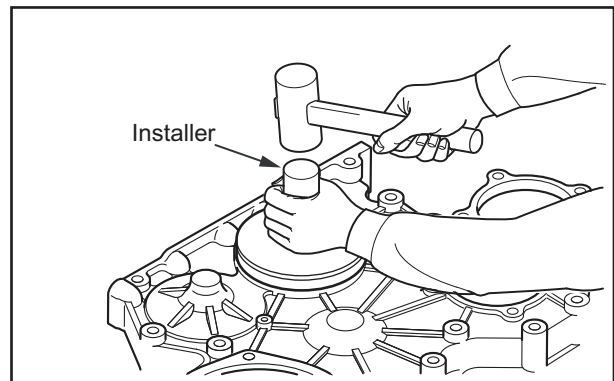
Item	Standard value	Limit value
Camshaft end play	0.10 to 0.25 mm [0.0039 to 0.0098 in.]	0.30 mm [0.0118 in.]



Camshaft End Play - Measure

2.10 Front Oil Seal - Install

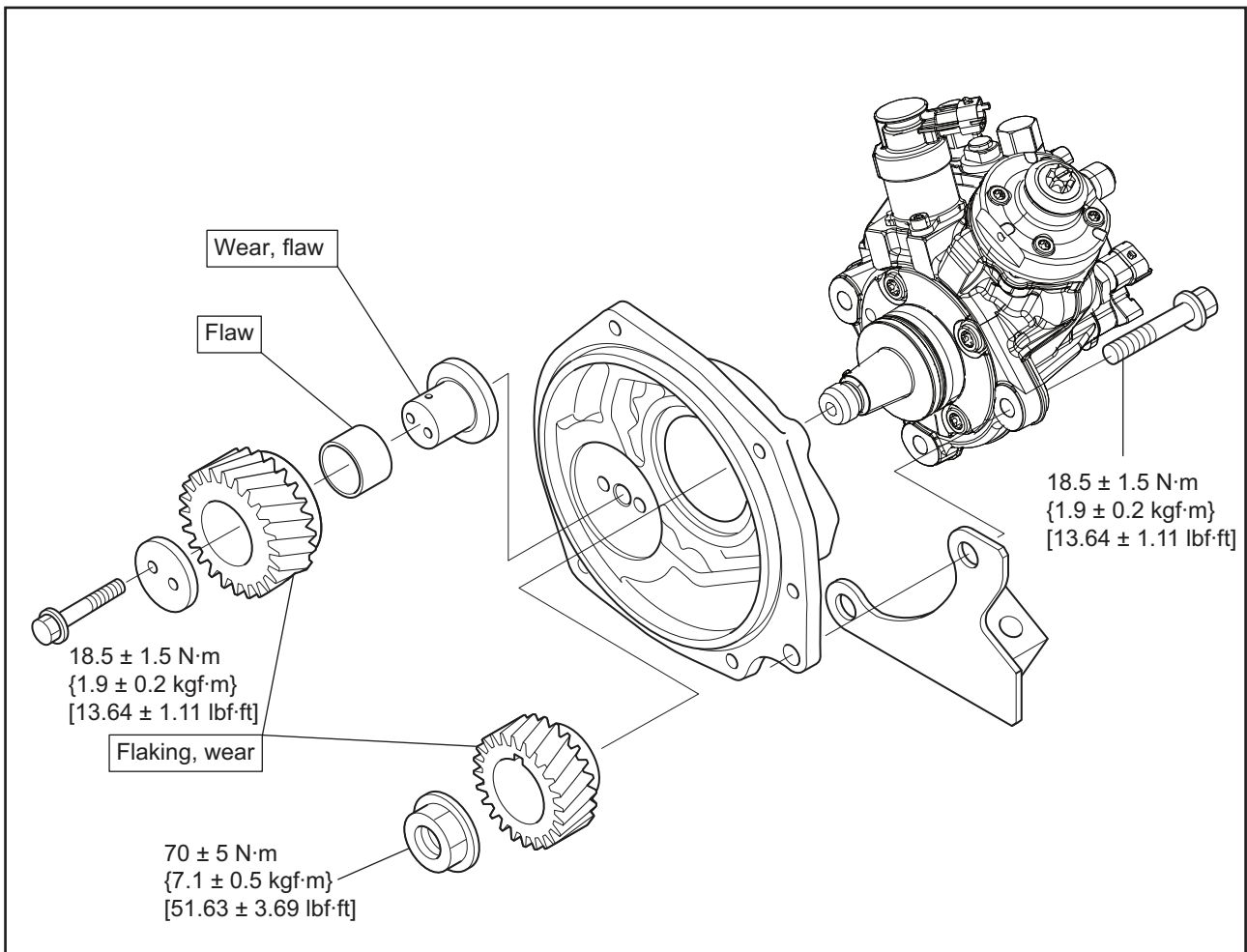
Using an installer, install new oil seal to the timing gear case. Make sure the oil seal is flush with the gear case.



Front Oil Seal - Install

6. Fuel System - Install

6.1 Fuel System - Install (1)



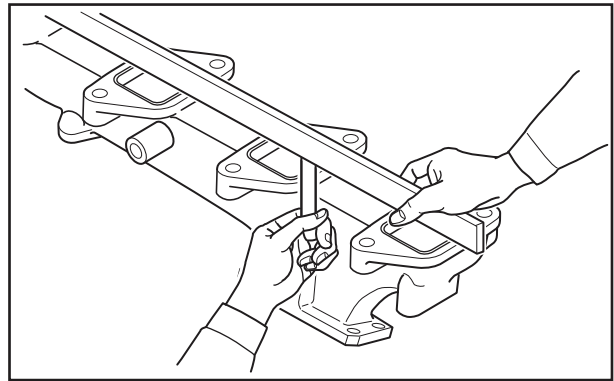
Fuel System - Install (1)

2. Inlet and Exhaust Systems - Disassemble, Inspect and Assemble

2.1 Exhaust Manifold Distortion - Measure

- (1) Check the flange for crack.
- (2) Check the flange surface for distortion. If the distortion exceeds the standard, reface the surface.

Item	Standard value
Exhaust manifold distortion	0.2 mm [0.008 in.] or less



Exhaust Manifold Distortion - Measure

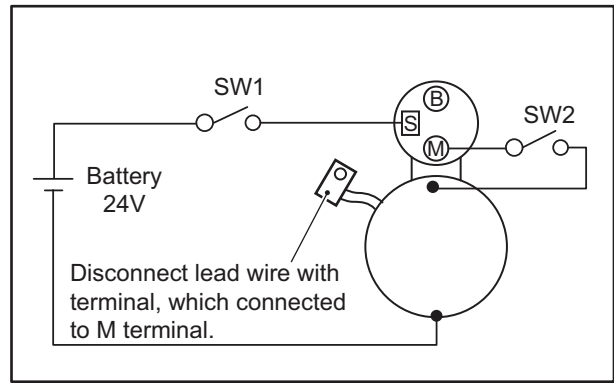
2.2.1 Pinion set - Remove

CAUTION

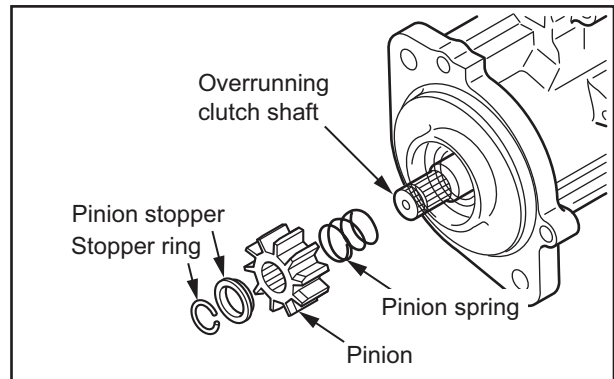
The starter will generate heat if the current is being applied. Remove the pinion within 10 seconds.

- (1) Connect the starter to the circuit as shown in the illustration.
- (2) Turn the switches SW1 and SW2 ON to move the pinion out, and turn the SW2 OFF to stop the rotation of the armature and the pinion.
- (3) Place an appropriate tube on the pinion stopper. Tap the tube with a hammer to drop the pinion stopper to the clutch side. This will expose the stopper ring.
- (4) Remove the stopper ring with pliers and remove the pinion.

Note: Do not reuse the stopper ring and pinion stopper when assembling.



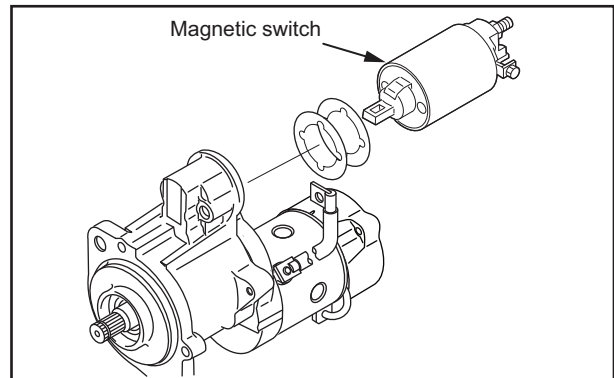
Connection to move the pinion forward



Pinion - Remove

2.2.2 Magnetic switch - Remove

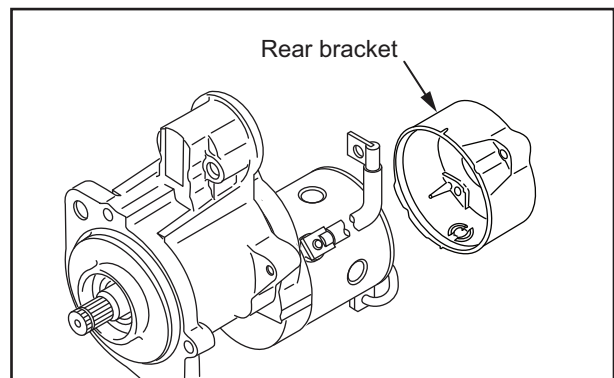
Remove the magnetic switch screws and the M terminal nut, and remove the magnetic switch.



Magnetic switch - Remove

2.2.3 Rear bracket - Remove

- (1) Remove the through bolts and brush holder screws.
- (2) Remove the rear bracket.



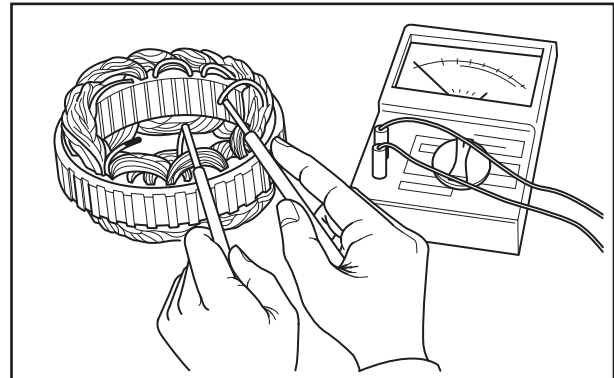
Rear bracket - Remove

2.6 Alternator - Inspect and Repair

2.6.1 Stator - Inspect

(1) Continuity between lead wires - Inspect

Check that there is continuity between a pair of lead wires. If there is no continuity, replace the stator with a new one.

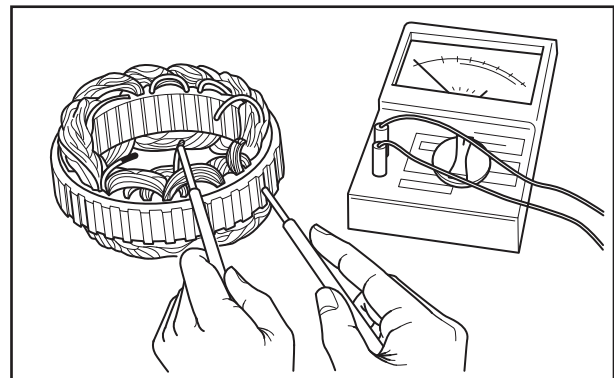


Continuity between lead wires - Inspect

(2) Isolation between lead wire and core - Inspect

Check that there is no continuity between stator lead wires and the stator core. If there is continuity, replace the stator with a new one.

Note: The core cannot be replaced as a single item.



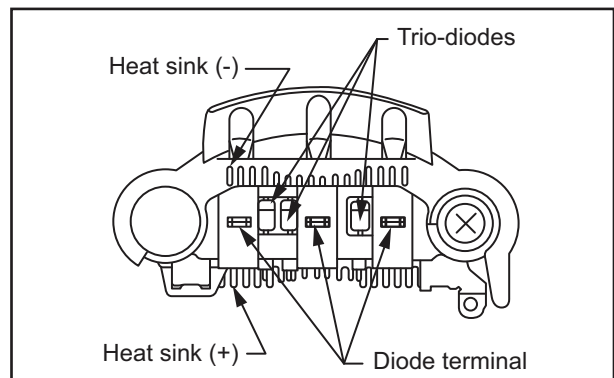
Isolation between lead wire and core - Inspect

2.6.2 Rectifier - Inspect

Check that the diodes in the rectifier function properly.

Inspection should be conducted at both positive and negative sides alternately, and if there is infinite resistance in both sides, it means open circuit, and if there is zero ohm indication, or close to zero ohm, it means short circuit. If defective, replace the rectifier with a new one.

Note: Use the largest measuring range. The current that flows during the test is much lower than the current that normally flows in the rectifier. Therefore, the tester may not indicate resistance accurately in some cases. When the measuring range is small, this tendency becomes larger.

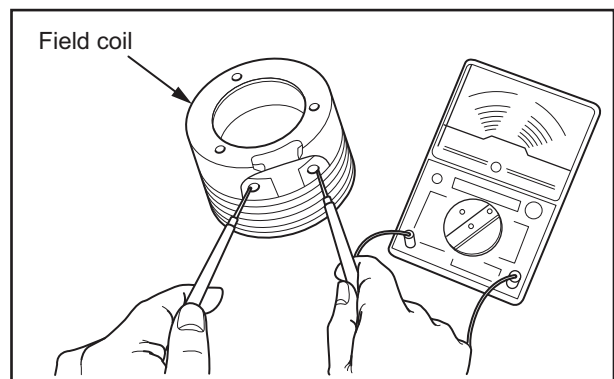


Rectifier - Inspect

2.6.3 Field coil - Inspect

Measure resistance between the terminals of the field coil. If the measurement is not within the tolerance, replace the field coil with a new one.

Item	Standard value
Field coil resistance (20 °C [68 °F])	7.3 to 8.5 Ω



Field coil - Inspect

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