KOBELCO

SHOP MANUAL

HYDRAULIC EXCAVATOR

SK850LC

SUPER ACERA

TIER 3

S5LY0001E02

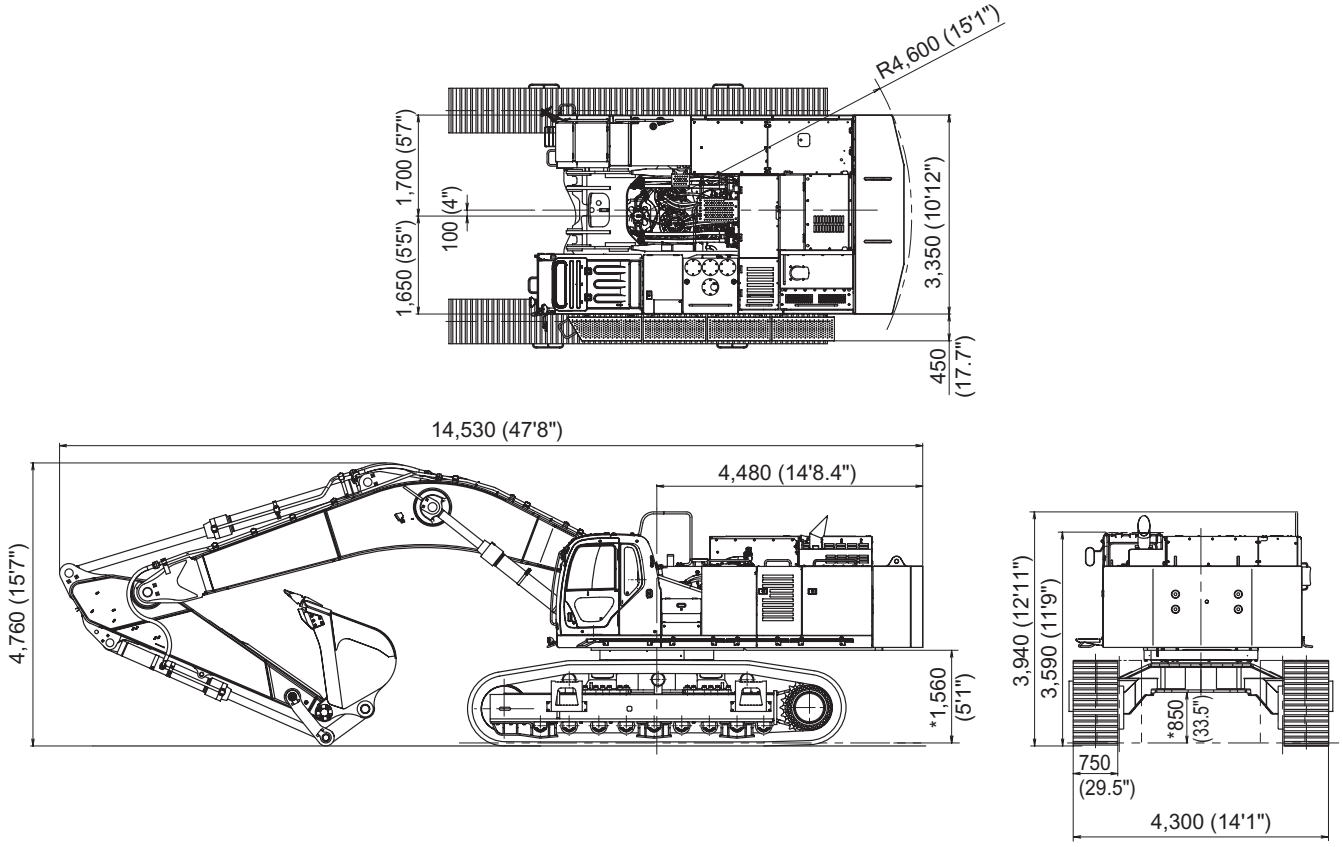
Issued October 2009

APPLICABLE:
SK850LC. . . . . LY01-00101~

Issue	Date of Issue	Applicable Machines	Remarks	
First edition	July, 2006	SK330-8 : LC10-07001~ SK350LC-8 : YC10-03501~	S5YN0118E01 (ASIA, OCE)	K
↑	August, 2006	SK200-8 : YN11-45001~ SK210LC-8 : YQ11-06001~	↑ (ASIA, OCE)	K
↑	October, 2006	SK250-8: LQ12-06001~ SK260LC–8 : LL12-05001~	↑ (ASIA, OCE)	K
↑	December, 2006	SK850LC: LY01-00101~	↑	K

2.2 GENERAL DIMENSIONS

2.2.1 SK850LC [8.25m (27ft-1in) Boom+3.60m (11ft-10in) Standard Arm+3.50m³ (4.58cu•yd) Bucket]

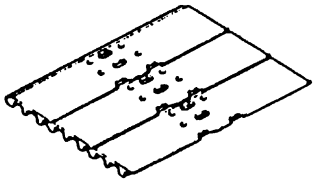


Note

Dimensions marked * do not include the height of the shoe lug.

2.7 TYPE OF CRAWLER

2.7.1 SK850LC

Shape	Shoe width mm (in)	Overall width of crawler (Working / Tranporting) mm (ft-in)	Ground pressure kPa (psi)
Grouser shoe  51 LINKS	650 (25.6)	4,200 (13'9")/3,400 (11'2")	106 (15.37)
	750 (29.5)	4,300 (14'1")/3,500 (11'6")	92 (13.34)
	900 (35.4)	4,450 (14'7")/3,800 (12'6")	78 (11.31)

3.2.2 ARM MAINTENANCE STANDARD

(1) Clearance of pin and bushing

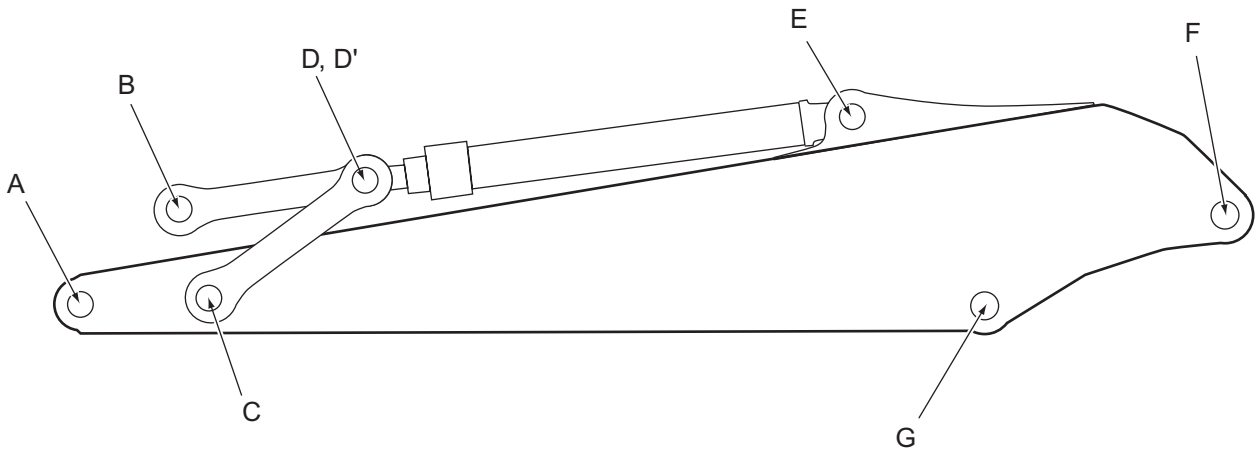


Fig. 3-5 Clearance of pin and bushing on arm section

Unit : mm (in)

No.	Item	Pin part No.	Standard dimensions			Clearance			Remedy
			Pin dia.	Pin dia. tolerance	Bushing i.d. tolerance	Standard value	Repairable level	Service limit	
A	Arm point	LV12B01084P2	ø130 (5.118)	–0.020 (-0.0008) –0.060 (-0.0024)	+0.205 (+0.0081) +0.112 (+0.0044)	+0.265 (+0.0104) +0.132 (+0.0052)	2.0 (0.08)	2.5 (0.10)	Replace bushing or pin
B	Bucket link (Bucket side)				+0.224 (+0.0088) +0.112 (+0.0044)	+0.284 (+0.0112) +0.132 (+0.0052)			
C	Idler link (Connected part of arm)	LV12B01086P1	ø110 (4.331)	0 (0) –0.040 (-0.0016)	+0.213 (+0.0084) +0.122 (+0.0048)	+0.253 (+0.0100) +0.122 (+0.0048)			
D	Bucket link (Idler link side)	LV12B01087P1	ø140 (5.512)		+0.224 (+0.0088) +0.113 (+0.0044)	+0.264 (+0.0104) +0.113 (+0.0044)			
D'	Bucket cylinder (Rod side)				+0.300 (+0.0118) +0.100 (+0.0039)	+0.340 (+0.0134) +0.100 (+0.0039)			
E	Bucket cylinder (Head side)	LV12B01079P1	ø130 (5.118)	+0.030 (+0.0012) –0.030 (-0.0012)		+0.330 (+0.0130) +0.070 (+0.0028)			
F	Arm cylinder (Rod side)	LV12B01100P2	ø140 (5.512)	+0.020 (+0.0008) –0.020 (-0.0008)		+0.320 (+0.0126) +0.080 (+0.0031)			
G	Arm foot (Connected part of boom)	LV12B01075P1			+0.211 (+0.0083) +0.120 (+0.0047)	+0.231 (+0.0091) +0.100 (+0.0039)			

Table 11-2 Tightening torques for metric fine threads (not plated)

Torque value Unit : N•m (lbf•ft)

Classification		4.8T		7T		10.9T	
Nominal size		No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M8	P=1.0	11.3±1.1 (8.3±0.8)	9.5±1.0 (7.0±0.7)	24.5±2.0 (18.1±1.5)	20.6±2.0 (15.2±1.5)	44.1±3.9 (32.5±2.9)	37.3±3.9 (27.5±2.9)
M10	P=1.25	22.6±2.0 (16.7±1.5)	18.7±1.9 (13.8±1.4)	48.1±4.9 (35.5±3.6)	41.2±3.9 (30.3±2.9)	87.3±8.8 (64.4±6.5)	73.5±6.9 (54.2±5.1)
M12	P=1.25	39.2±3.9 (28.9±2.9)	33.3±2.9 (24.6±2.1)	85.3±8.8 (62.9±6.5)	71.6±6.9 (52.8±5.1)	154±16 (114±12)	129±13 (95.2±9.6)
M16	P=1.5	92.2±8.8 (68.0±6.5)	77.5±7.8 (57.2±5.8)	196±20 (145±15)	169±17 (125±13)	363±39 (268±29)	304±29 (224±21)
M20	P=1.5	186±19 (137±14)	155±16 (114±12)	402±39 (297±29)	333±29 (246±21)	726±69 (535±51)	608±59 (448±44)
M24	P=2	314±29 (232±21)	265±29 (195±21)	686±69 (506±51)	569±59 (420±44)	1240±118 (915±87)	1030±98 (760±72)
M30	P=2	637±59 (470±44)	530±49 (391±36)	1390±137 (1030±101)	1157±118 (853±87)	2500±255 (1840±188)	2080±206 (1530±152)
M33	P=2	853±88 (629±65)	706±70 (521±52)	1860±186 (1370±137)	1550±155 (1140±114)	3350±334 (2470±246)	2790±275 (2060±203)
M36	P=3	1070±108 (789±80)	892±88 (658±65)	2330±226 (1720±167)	1940±196 (1430±145)	4200±422 (3100±311)	3500±353 (2580±260)

11.9 SUCTION STOPPER

11.9.1 COMPONENTS

No.	NAME	PARTS No.	Q'TY
	SUCTION STOPPER ASSY	—	
1	ROD	YZ33H01028P1	1
2	NUT	ZN16C08007	1
3	COVER	YZ33H01027P1	1
4	O-RING	ZD12P16000	1

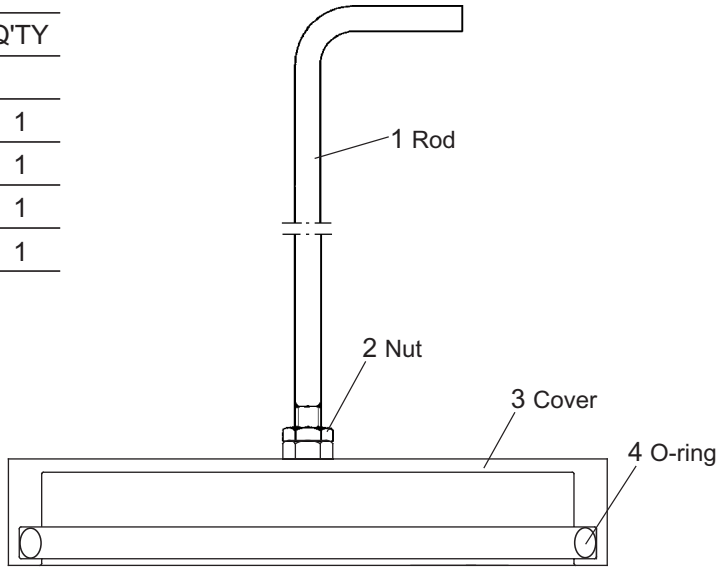


Fig. 11-1 Components of suction stopper

11.9.2 DIMENSION

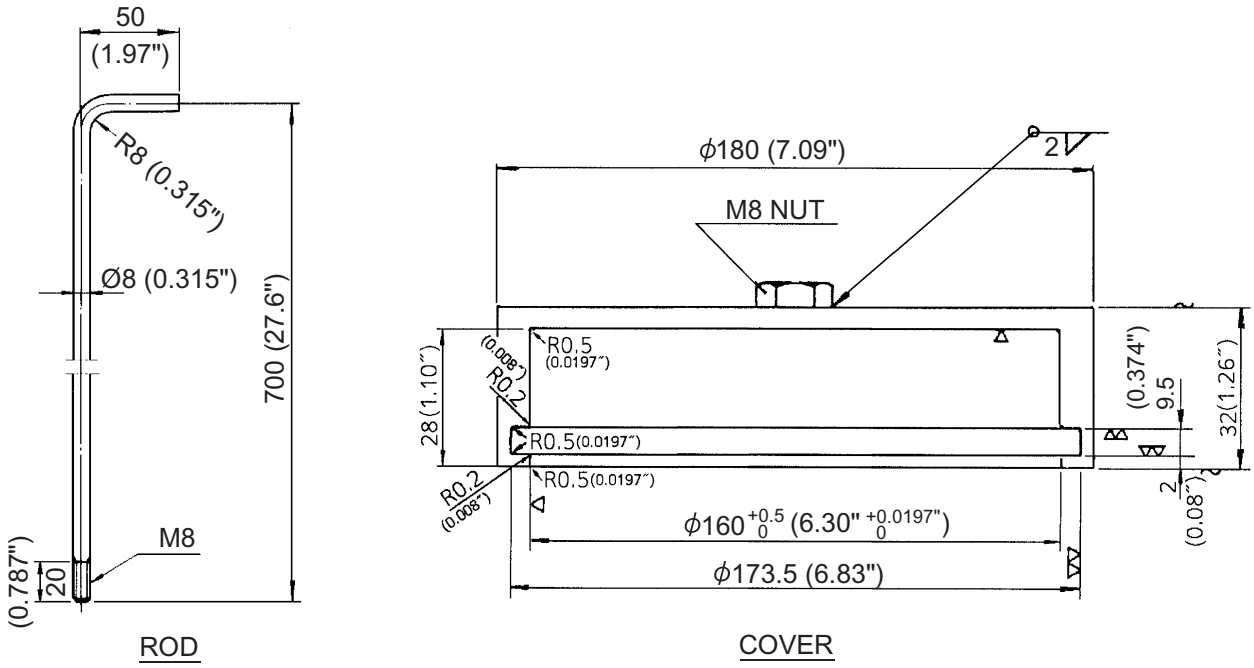


Fig. 11-2 Dimension of suction stopper

13.4.3 PRESSURE ADJUSTMENT POSITION

(1) Main control valve

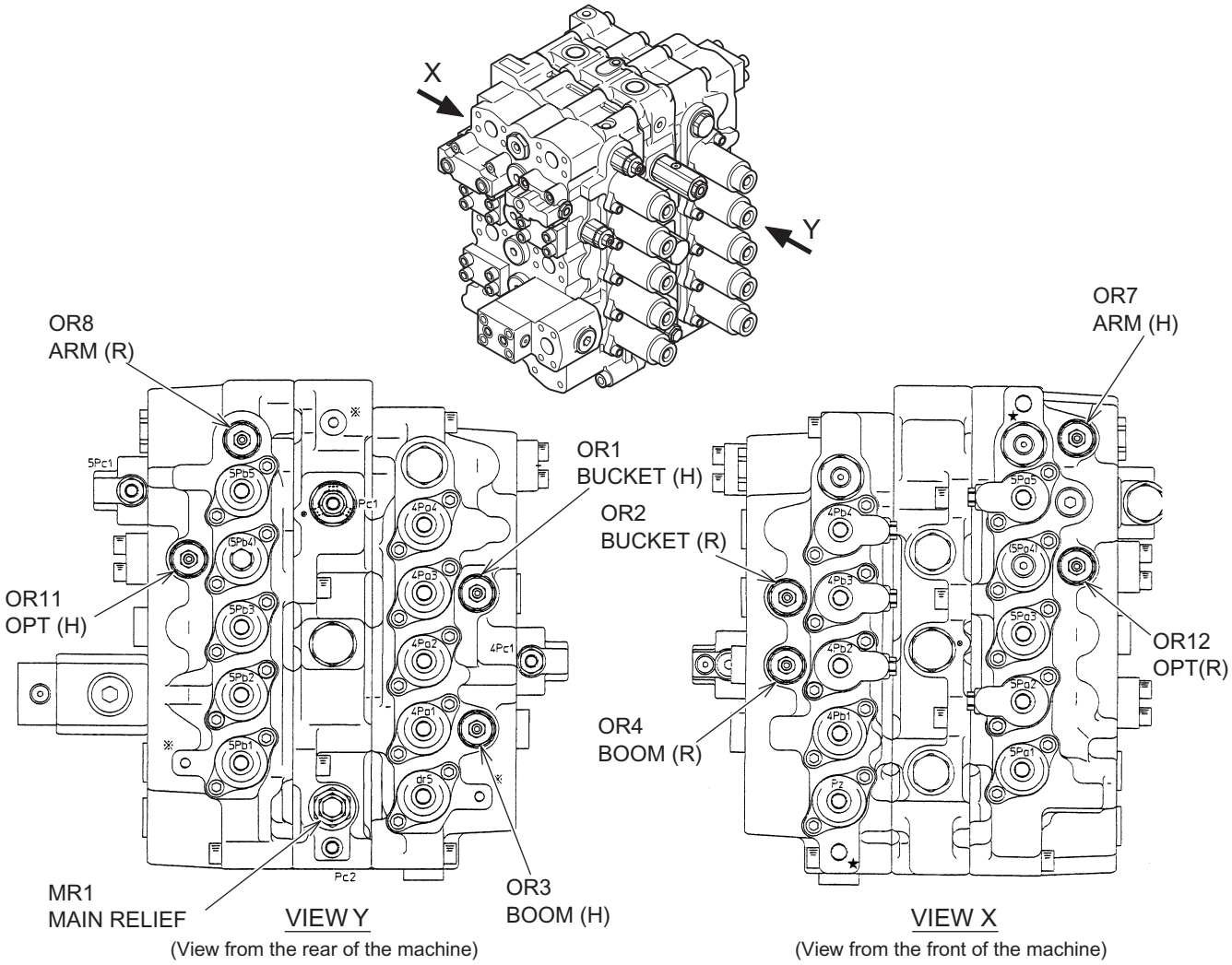


Fig. 13-4

(2) Relief valve for fan drive

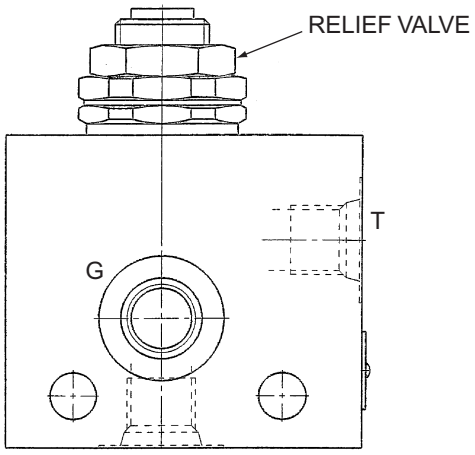


Fig. 13-5 Pilot relif valve position

13.8.2.4 ADJUSTING PROCEDURE

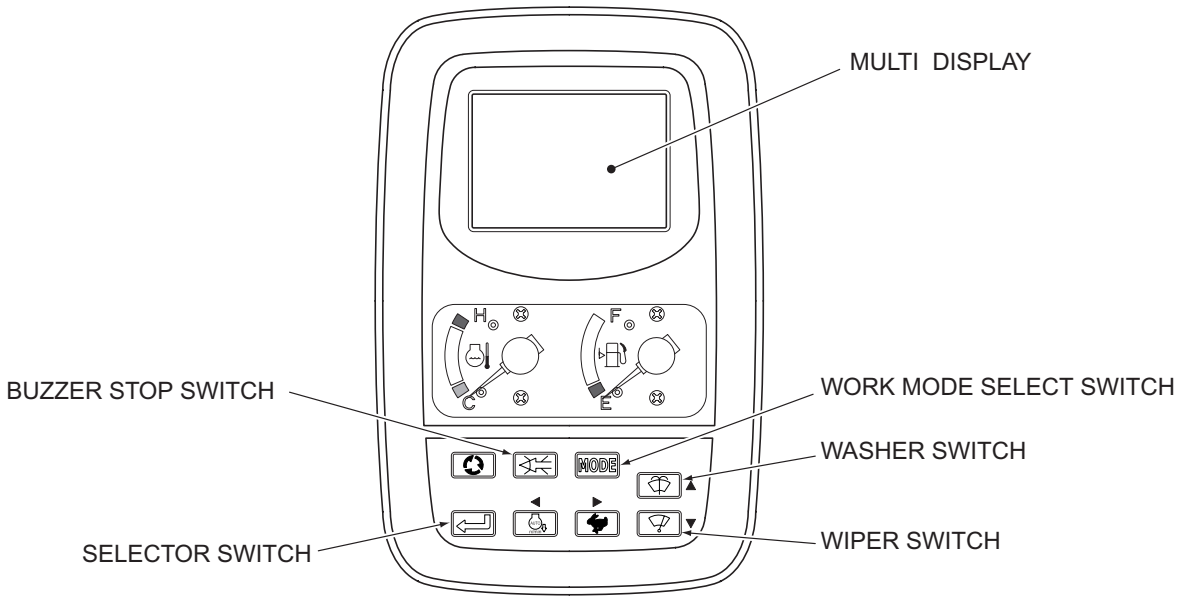


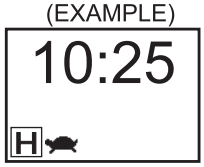
Fig. 13-28 Gauge cluster

(1) Adjustment of engine ("A" adjustment)

Procedure

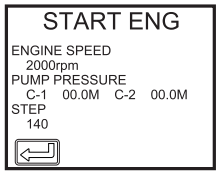
1) Turn starter key switch ON keeping the work mode selector switch on the gauge cluster pressed, and hold it for 5~10 seconds, and then release it. (If the engine is started, the following indication is not displayed. Therefore do not start the engine.)

MULTI DISPLAY (EXAMPLE)

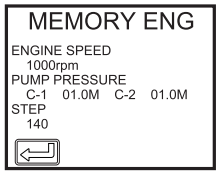


2) Keep buzzer stop switch on gauge cluster pressed for 5 seconds and release it and the screen for selecting adjustment is displayed. When adjustment data is not entered in mechatro controller, "READY" is indicated. If the adjustment operation is once performed, "FIN" is indicated.
And the lever lock solenoid is automatically released, disabling all operations.

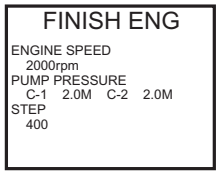
3) Press selector switch on gauge cluster to display "START ENG".
"Engine SPEED", P1, P2 "PUMP PRESSURE" and "STEP" (acceleration command voltage) are indicated.



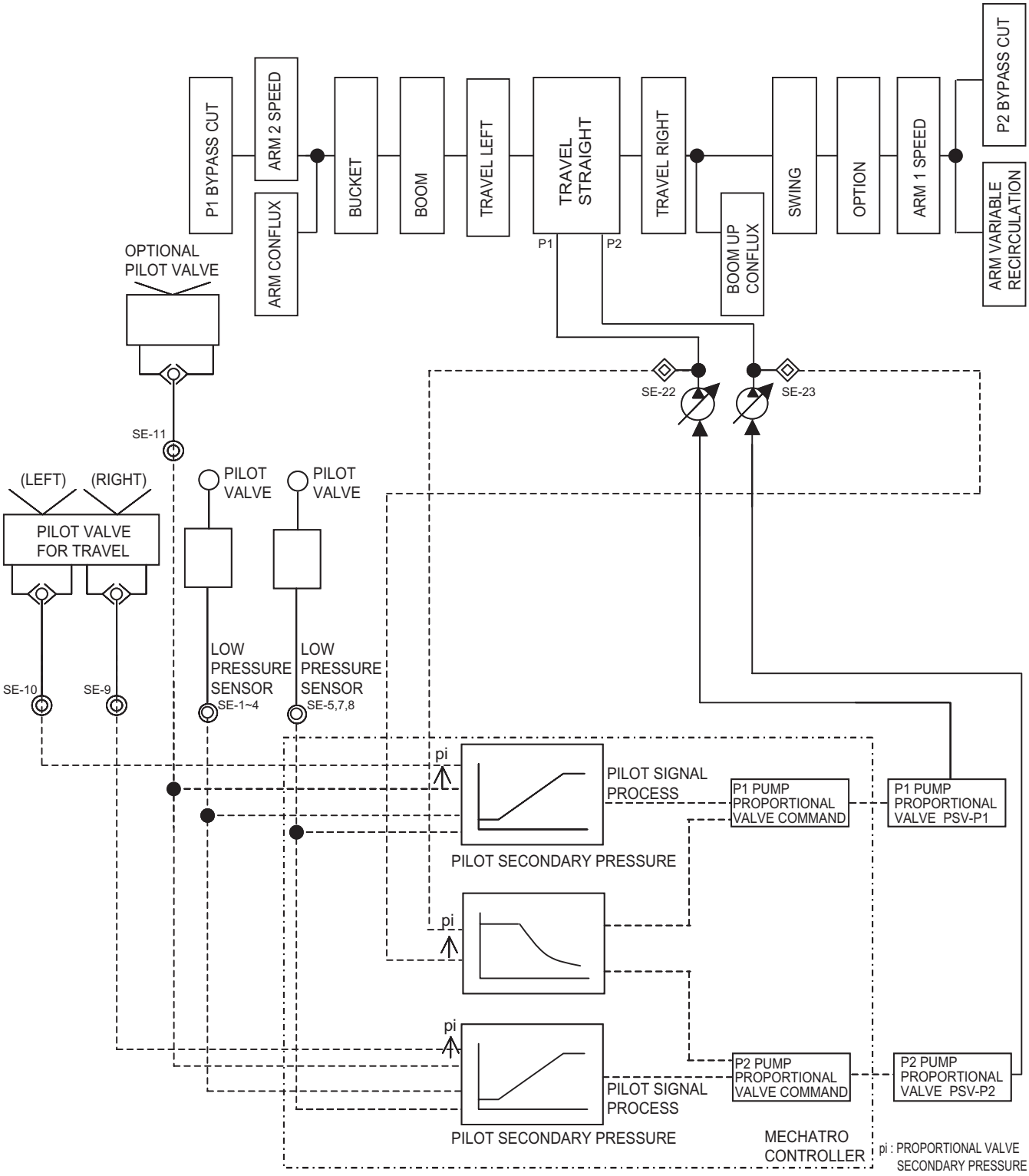
4) After starting engine, press selector switch on gauge cluster, and "MEMORY ENG" is displayed, the engine speed is automatically increased, and the adjustment of engine is performed.
(When trying to limit engine speed, press selector switch on gauge cluster at the speed as it is, and the adjustment of engine is terminated. The subsequent torque adjustment is not performed, and default value is written.)



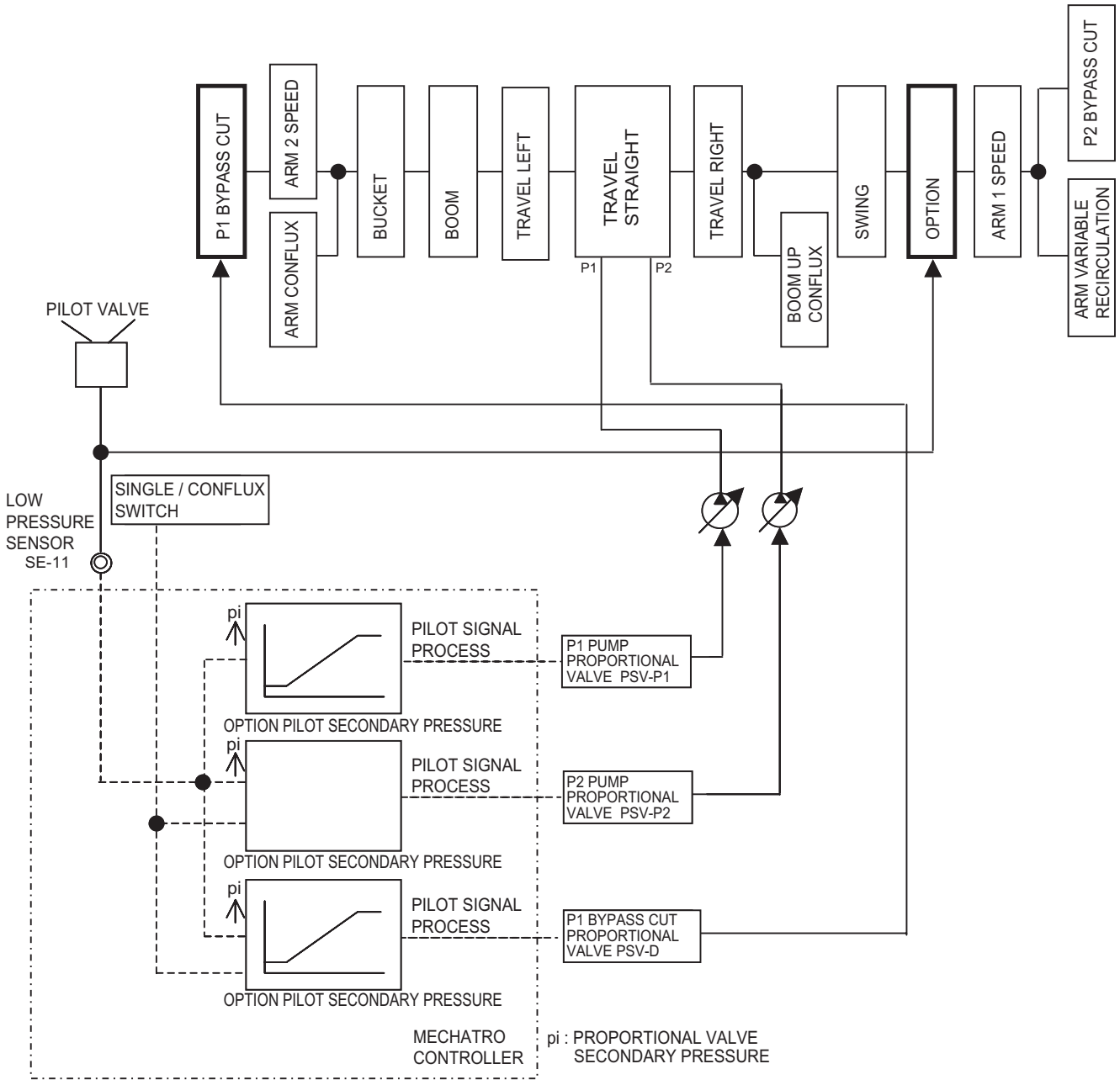
5) When normal HIGH idling speed is detected, the adjustment is completed. And "FINISH ENG" is displayed.
(Press the buzzer stop switch on gauge cluster while this display is appeared, and the adjustment of engine is completed. The subsequent torque adjustment is not performed, and default value is written.)



21.1.2 POSITIVE CONTROL & P-Q CONTROL



21.1.9 OPTION CONFLUX CONTROL (OPTION)



(1) Select the Conflux with the aid of Conflux/Single switch.

(2) On starting option operation, option operating pilot pressure switches option spool and is input to low pressure sensor.

(3) The output voltage of low pressure sensor is input to mechatro controller and the mechatro controller processes pilot signal and outputs command according to the input voltage to P1 and P2 pump proportional valves and P1 bypass cut proportional valve.

(4) Each proportional valves output pilot proportional valve secondary pressure according to the command output by mechatro controller and changes P1 and P2 pump delivery rate and switches P1 bypass cut valve of the control valve.

(5) The P2 side passage is connected to P1 port because of the P1 bypass cut valve switched and P1 pump delivery oil confluxes P2 pump delivery oil.

21.2.3 SERVICE DIAGNOSIS DISPLAY FUNCTION

The current service diagnosis is displayed on multi display based on the data received from mechatro controller. This section explains the operating procedure and examples of each screen. The values in display changes according to the conditions like engine speed, attachment position, etc.

(1) Service diagnosis display screen operating procedure

1) Turn starter switch ON keeping buzzer stop switch pressed.
2) After logo mark is displayed, the screen changes in service diagnosis mode.
   The service diagnosis screen "Mode No.1", "Screen No.1" is displayed first.
   The service diagnosis is classified into three modes, 1, 2, and 3, and the present mode is displayed in "Screen No.1".
   The screen number each mode can display differs. The screen number displayed by each mode is as follows.
   - Mode No.1 : Screen No.1~No.30
   - Mode No.2 : Screen No.1, Screen No.31~No.40
   - Mode No.3 : Screen No.1, Screen No.41~No.50
3) The screen changes each time each switch is pressed from now on.
   Washer switch: Screen gains by 1 in order. (No.2→No.3→No.4→...)
   Wiper switch: Screen loses by 1 in order. (No.24→No.23→No.22→...)
   Auto idling switch: Service diagnosis number advances from No.1 to No.3, and then returns to No.1. (No.1→No.2→No.3→No.1→...)
   Travel 1, 2 speed switch: Service diagnosis number advances from No.3 to No.1, and then returns to No.3. (No.3→No.2→No.1→No.3→...)
4) Turn key switch OFF and the display of service diagnosis mode is closed.

21.2.4 TROUBLE HISTORY DIAGNOSIS

The items of error detected by mechatro controller self diagnosis function are stored in mechatro controller as one of history. And the errors are able to be indicated on the multi display.
The warning content is indicated partially in "Travel history screen".
The error code for self diagnosis is stored.

(1) How to display

1) Turn starter switch on.
2) Press buzzer stop switch for 10 seconds continuously 5 times and the trouble history screen is displayed.

(Example)

No errors	NO ERROR
Error detected in the past	１０５３０Ｈｒ　Ｆ０２３ ８５００Ｈｒ　Ｇ０３３ ３０００Ｈｒ　Ｐ１２１１ １５００Ｈｒ　Ｃ０１３

3) Transmit trouble history data (One or many) and hour meter to gauge cluster.
   - Hour meter and 4 failure data are displayed on screen.
   - In case of more than 4 failure data, 4 data is displayed at a time for 10 seconds by turns.
4) Paging (Up and down)
   - Press washer switch (▲), and the item moves upward.
   - Press wiper switch (▼), and the item moves downward.
5) Turn starter switch off, and the display is disappeared.

(2) How to delete contents of trouble history

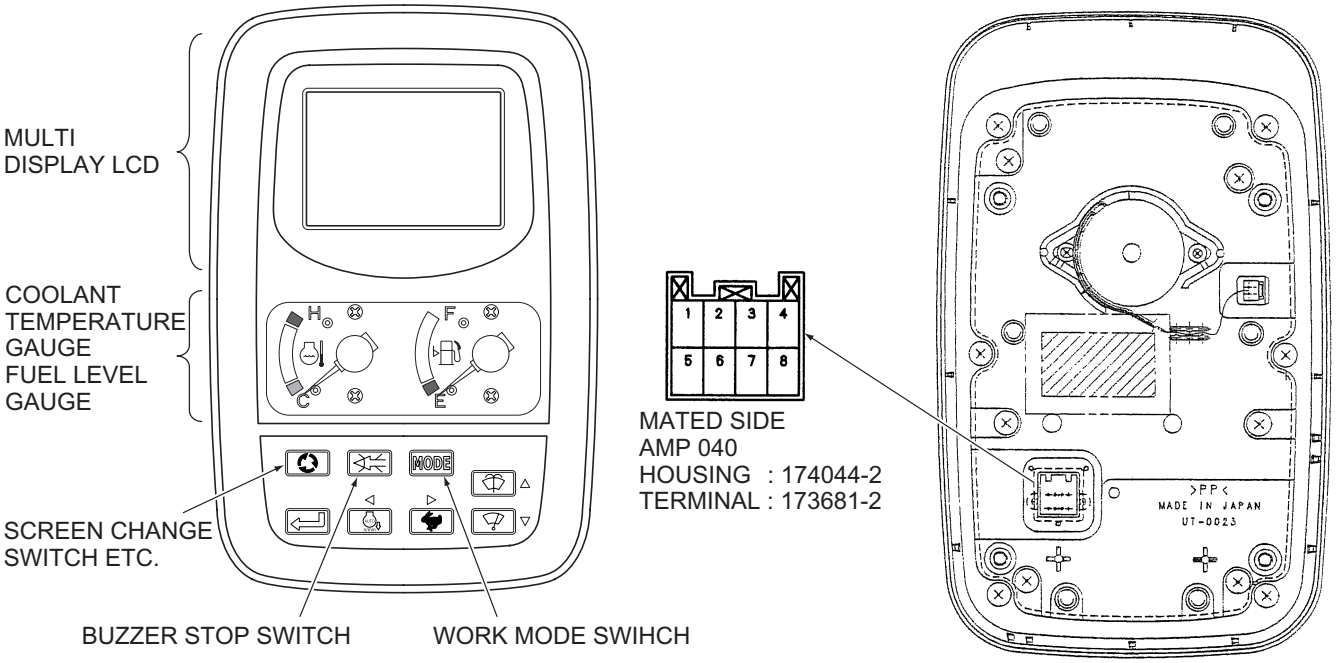
1) Display trouble history screen.
2) Press work mode change switch and buzzer stop switch simultaneously for 10 seconds or more.
3) When "NO ERROR" is displayed, the deletion is completed.
4) Turn starter switch off.

Note

All the stored items are erased. It is impossible to erase data partially.

(2) Gauge cluster (symbol C-2)

1) General view



2) Connector CN-600 (Harness side)

No.	Item name	Wire color	No.	Item name	Wire color
1	Gauge cluster → Mechatro controller (RS232C communication)	White	5	GND source (+24V Battery direct connection)	Yellow / Black
2	Mechatro controller → Gauge cluster (RS232C communication)	Red	6	GND	Black
3	Reserved	—	7	Source (+24V starter switch ON)	White
4	Reserved	—	8	GND (RS232C communication)	Black

3) Function

a. It processes signals by communication between the gauge cluster and the mechatro controller, displays them in lamps, displays them in LCDs and actuates the buzzer.

b. It outputs coolant temperature signals, fuel level signals and panel switch signals to the mechatro controller through the communication port.

4) Summary of display and drive item

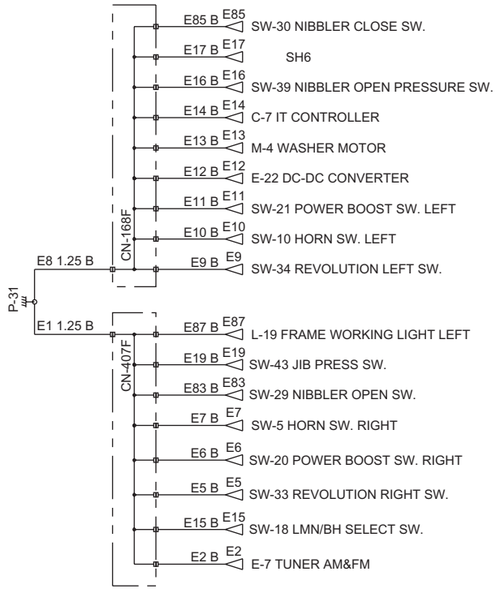
No.	Item	Remarks
1	Monitar display	LCD dot 120×168
2	Gauge display (Coolant temp., Fuel level)	Stepping motor
3	—	
4	Buzzer	Piezo-electricity type
5	Screen change switch	
6	Buzzer stop switch	
7	Work mode select switch	
8	Back light	LED

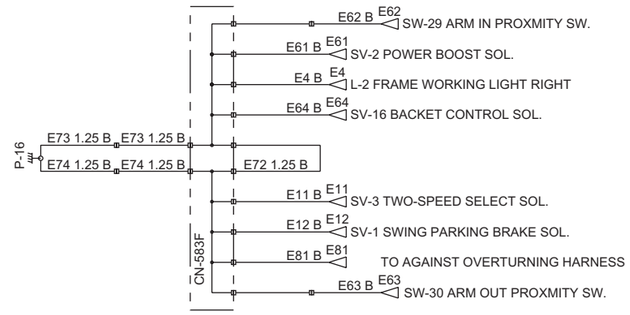
HYDRAULIC COMPONENT SPECIFICATIONS

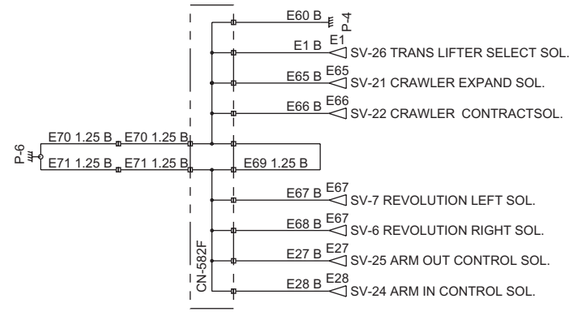
SPECIFICATION / ITEM		1	2	3	4	5	6	7	8	9	10	11	12	13	14
NAME		PUMP ASSY. HYD	PUMP ASSY. HYD	PUMP ASSY. GEAR	VALVE ASSY. CONTROL	CYLINDER. BOOM	CYLINDER. ARM	CYLINDER. BUCKET	MOTOR ASSY. SWING	MOTOR ASSY. SWING	SWIVEL JOINT	MOTOR ASSY. PROPEL	VALVE ASSY. RELIEF	MANIFOLD	ACCUMULATOR
P/NO.		LV10V00007F1	LV10V00002F1	LV10V00003F1	LV30V00009F1	LV01V00001F2	LV01V00003F2	LV01V00004F1	LV15V00004F1	LV15V00005F1	LV55V00002F1	LV53D00007F2	LC22V00001F2	YN50V00011F2	2445R373F1
VENDOR		KPM	REXROTH	SHIMADZU	TOSHIBA	KOYO	KOYO	KOYO	KPM+KOBELCO	KPM+KOBELCO	ZENOAH KOMATSU	KYB+OOKUBOHAGRUMA	NISHINA	YAMASHIN	NOK
TYPE		K3V280SH16AL-YT1K-HV	A10V071ED72/31L-PSC12K68P-S	SGP2B16F1H9-L137	UK36-302				M5X180CHB	M5X180CHB	VCJ110-5	MSF-340VP-EH15	16331-00000	MH0395BA002A	MU70-300
MASS	kg	155	33	4.7	400	780	1057	713	73	73	69	858	2.0	1.3	1.1
WORKING PRESSURE	MPa	33	18.5	4.9	33	33	33	33	30	30	33	33	5.0	5.0	5.0
DISPLACEMENT VOLUME	cm³/rev	280	71	16.7					158.9	158.9		337.2/212.6			
P/B TORQUE	N-m								846	846		1120N·m以上			
GEAR RATIO									23.385	23.385		97.8			
AUTO 2 SPEED SET PRESSURE	MPa														
ROD DIA.	mm					Ø145	Ø150	Ø140							
TUBE DIA.	mm					Ø210	Ø220	Ø200							
STROKE	mm					1800	2175	1570							
FILTRATION RATING														95μm	
FILTRATION AREA	cm²													140	
CRACKING PRESSURE	kPa													20	
MACHINE SPEC.															

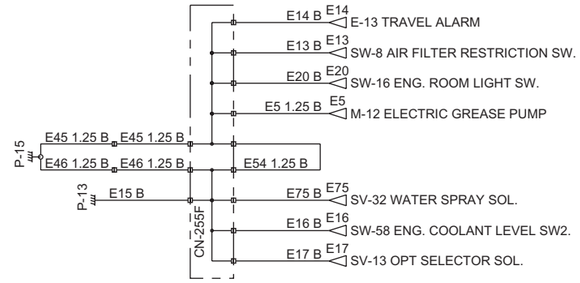
SPECIFICATION / ITEM		15	16	17	18	19	20	21	22	23	24	25	26	27	28
NAME		VALVE ASSY.SOLENOID	VALVE. PILOT	VALVE. PILOT(TRAVEL)	VALVE ASSY.SOLENOID	VALVE. SHUTTLE	VALVE. CHECK(S/R)	VALVE. CHECK	VALVE. CHECK	FILTER. DRAIN	FILTER ASSY. RETURN	STRAINER. SUCCTION	BREATHER ASSY	VALVE. CHECK	MOTOR ASSY. HYD
P/NO.		YY35V00012F1	YN30V00111F1	YN30V00105F1	LS35V00002F1	YN26V00001F2	YN21V00005F6	LV21V00003F1	LV21V00004F1	LV50V00003F1	LS52V01001F1	LV50V00002F1	LV57V00002F1	EZ21V00002F1	LV15V00006F1
VENDOR		KPM	KPM	REXROTH	KPM	FUJI KOATU	NISHINA	YAMASHIN	YAMASHIN	YAMASHIN	YAMASHIN	YAMASHIN	YAMASHIN	NISHINA	REXROTH
TYPE		V0407154720	PV48K2	6TH6 NRZ	V030905333		-	VAG0003A001A	VA1600SA003A	SP08L-30-10	FZ1F1	SB48	AB6510	06265-00000	A2FM32/61W-VSB-020-S
MASS	kg	10.9	1.9	8.0	1.8	0.5	0.1	0.35	0.4		2.4	2.0	0.6	0.4	9.5
WORKING PRESSURE	MPa	5.0	5.0	5.0	5.0	5.0	5.0								18.5
DISPLACEMENT VOLUME	cm³/rev														32
P/B TORQUE	N-m														
GEAR RATIO															
AUTO 2 SPEED SET PRESSURE	MPa														
ROD DIA.	mm														
TUBE DIA.	mm														
STROKE	mm														
FILTRATION RATING										10μ	$\beta_{10}\geqq 8$	177μm	10μ		
FILTRATION AREA	cm²									3550	22500	6720	235		
CRACKING PRESSURE	kPa							150	500	100	150			100	
MACHINE SPEC.															

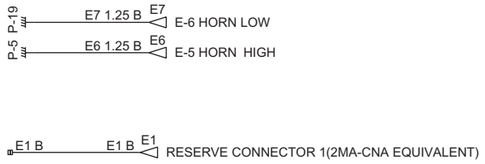
SPECIFICATION / ITEM		29	30	31	32
NAME		MOTOR ASSY. HYD	VALVE ASSY. RELIEF	VALVE. CHECK(S/R)	VALVE. CHECK(S/R)
P/NO.		LV15V00009F1	LV22V00003F1	YN21V00005FB	YN21V00005FG
VENDOR		REXROTH	REXROTH	NISHINA	NISHINA
TYPE		A2FM23/61W	MO-7000-902-0	-	-
MASS	kg	9.5	1.5	0.1	0.1
WORKING PRESSURE	MPa	18.5	18.5	5.0	5.0
DISPLACEMENT VOLUME	cm³/rev	22.9			
P/B TORQUE	N-m				
GEAR RATIO					
AUTO 2 SPEED SET PRESSURE	MPa				
ROD DIA.	mm				
TUBE DIA.	mm				
STROKE	mm				
FILTRATION RATING					
FILTRATION AREA	cm²				
CRACKING PRESSURE	kPa				
MACHINE SPEC.					

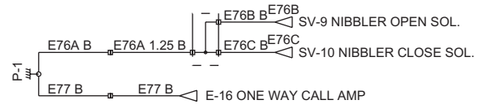


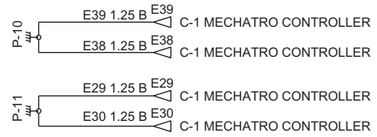


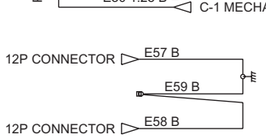


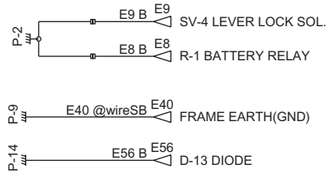


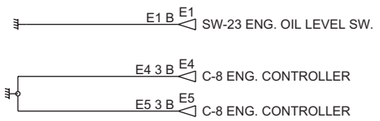


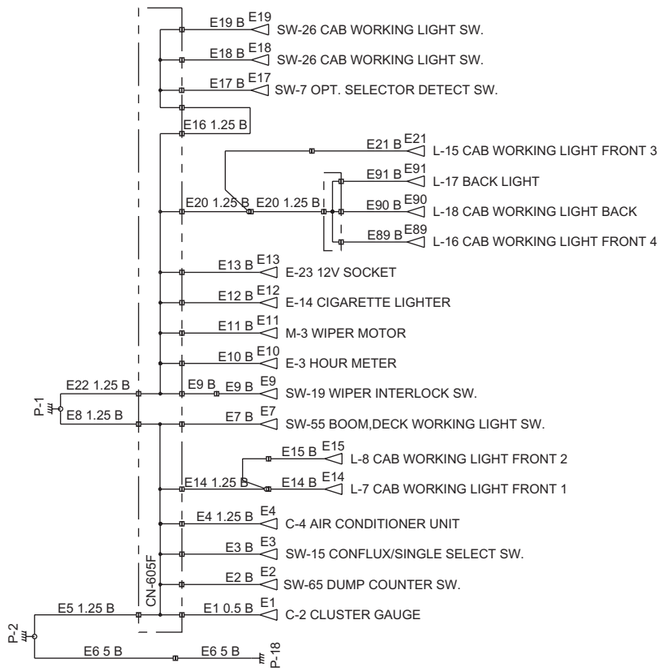








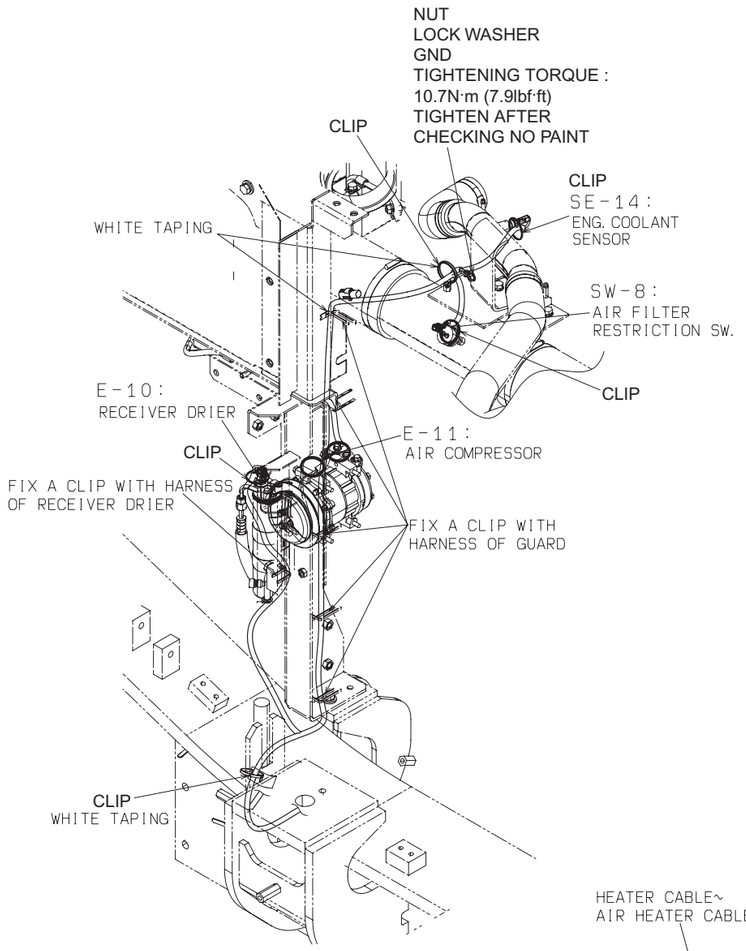




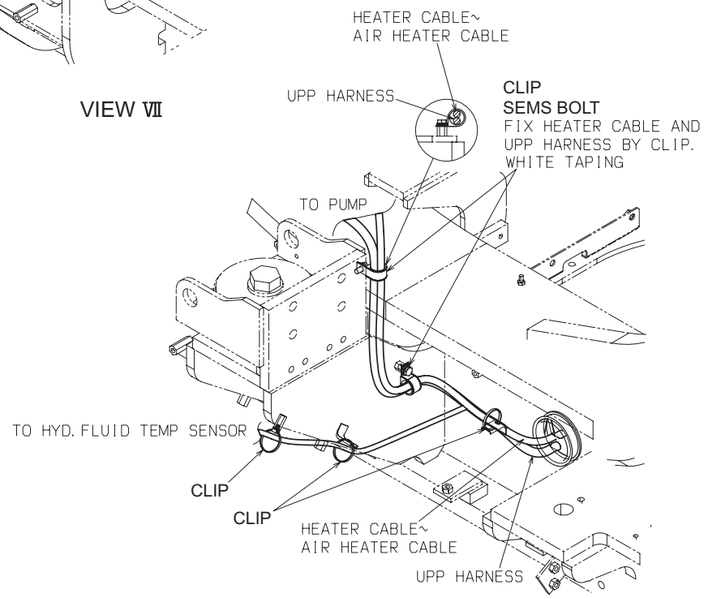
(8/8)

LV03Z00004P1 01

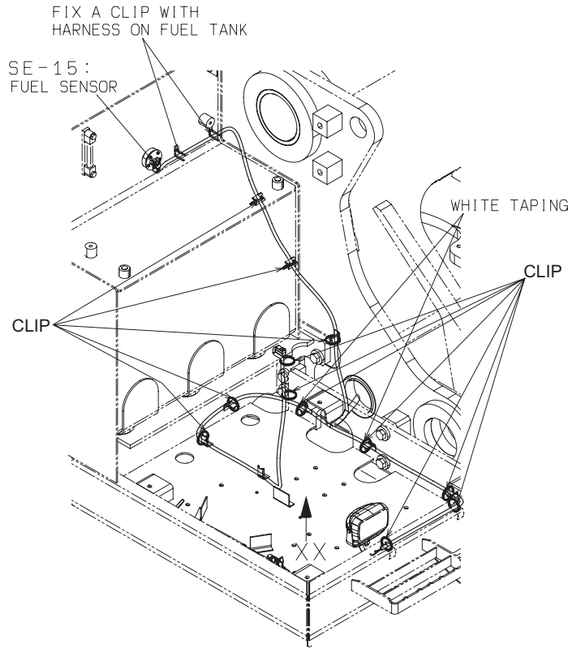
23.3.6 UPPER HARNESS ASSY (4/6)



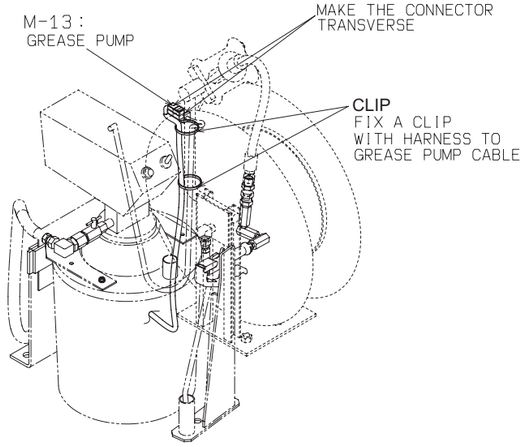
VIEW Ⅶ



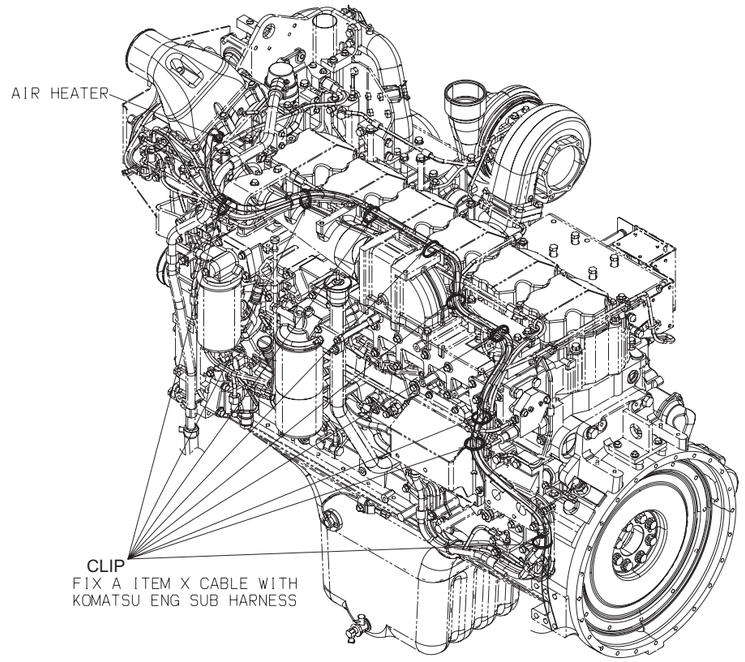
VIEW Ⅵ



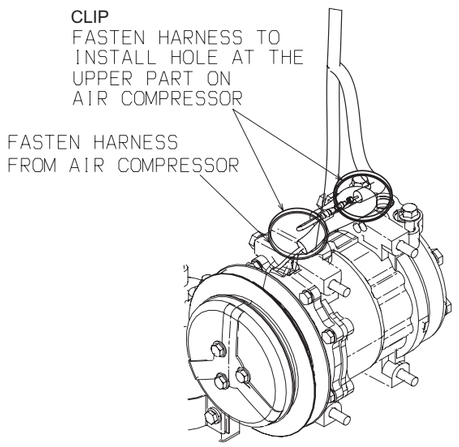
VIEW Ⅷ



VIEW XX



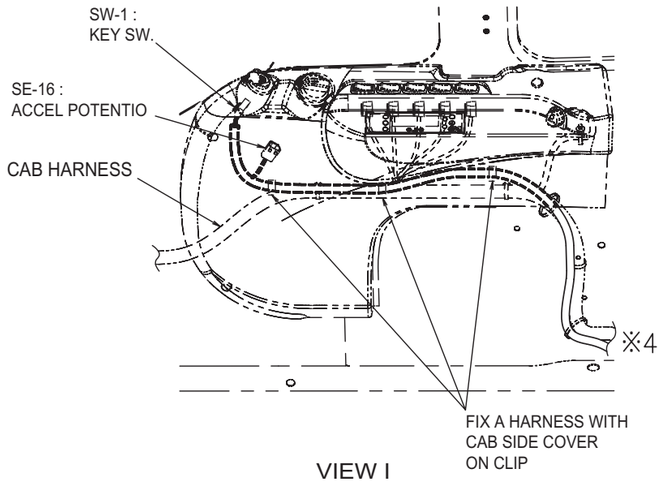
DETAIL OF ENG. ITEM 7 ROUTE



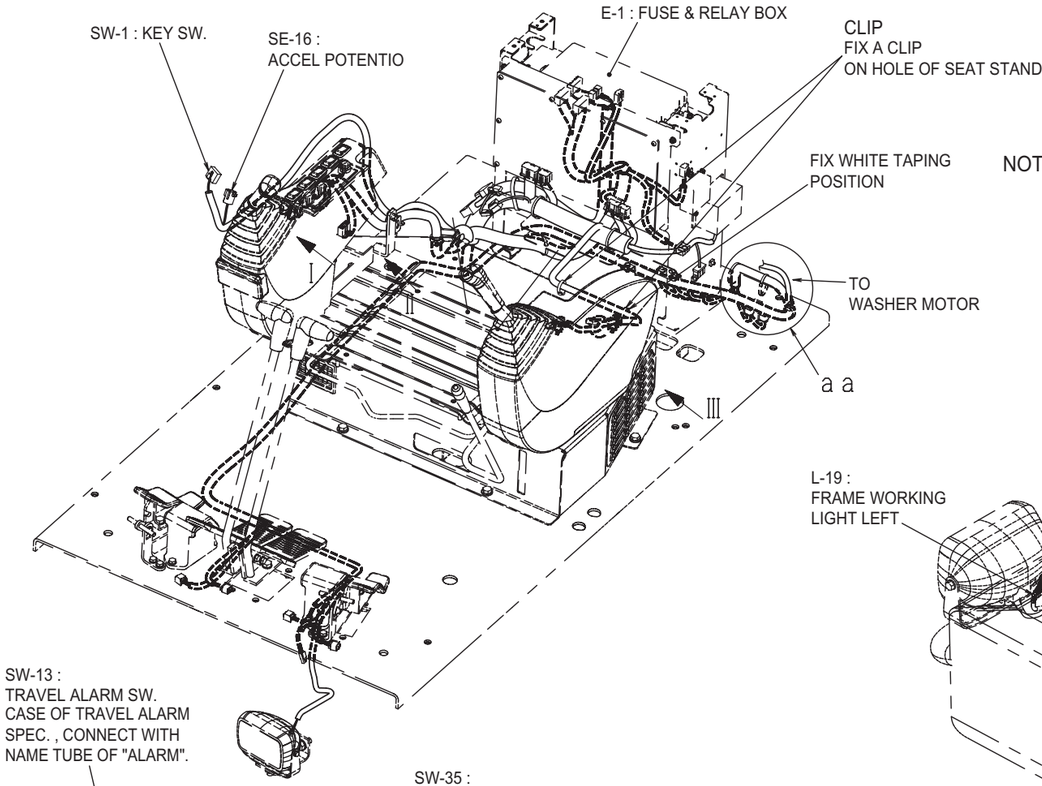
DETAIL OF AIR COMPRESSOR

23.3.8 UPPER HARNESS ASSY (FLOOR PLATE) (1/2)

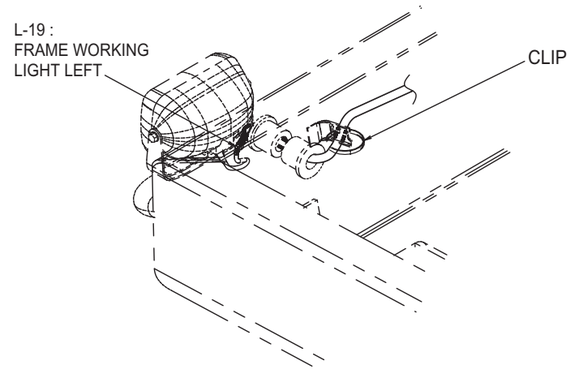
UPPER HARNESS ASSY		LV13E00006F1	(02)	
ITEM	PART NAME	PART No.	Q'TY	REMARKS
1	HARNESS	LV13E01030P2	1	FLOOR
4	HARNESS	LC13E01186P1	1	CAB SUB HARNESS
8	CABLE	LE13E01005P1	1	FLOOR GROUND HARNESS



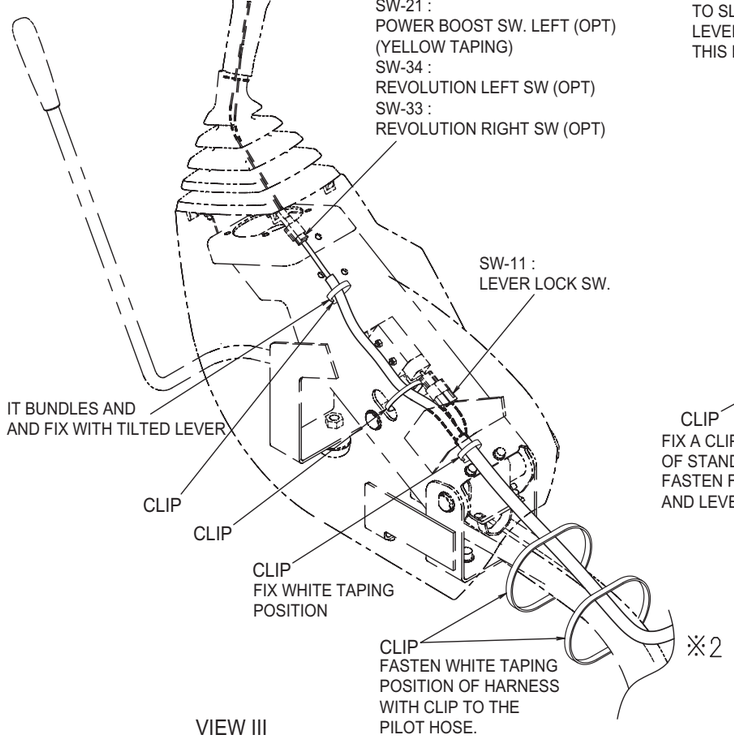
VIEW I



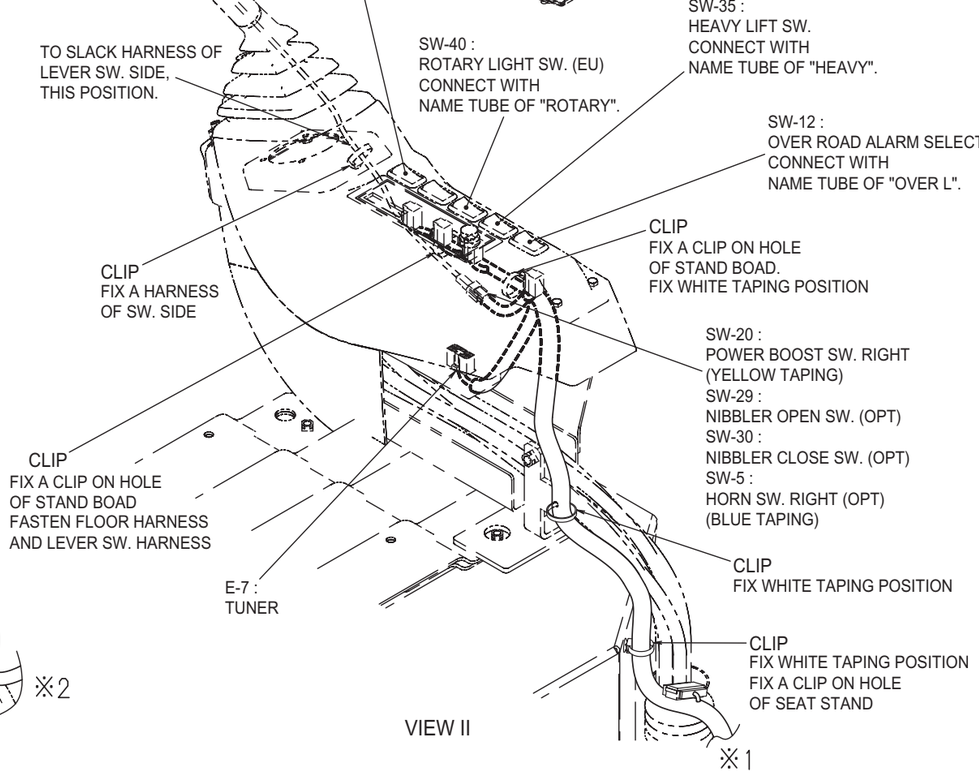
NOTE : 1. ATTACHMENT OF WELDING CLIP WITHOUT DIRECTIONS IS MADE INTO THE FOLLOWING.



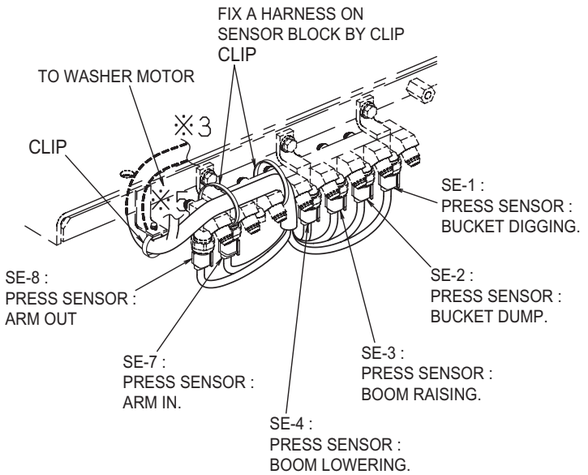
DETAIL OF CONNECT FRAME WORKING LIGHT LEFT



VIEW III



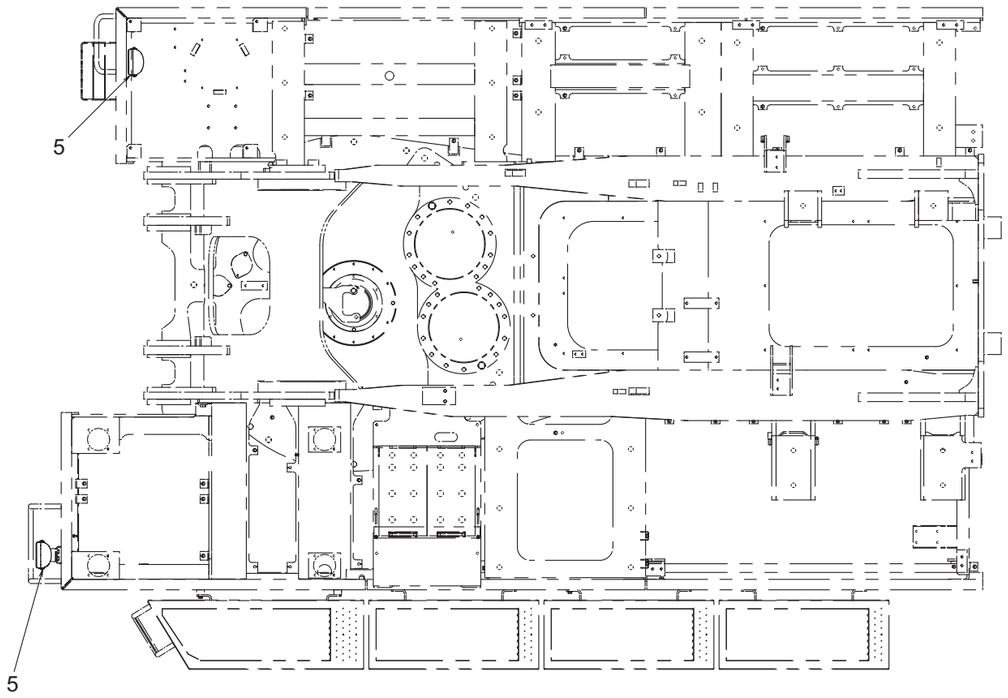
VIEW II



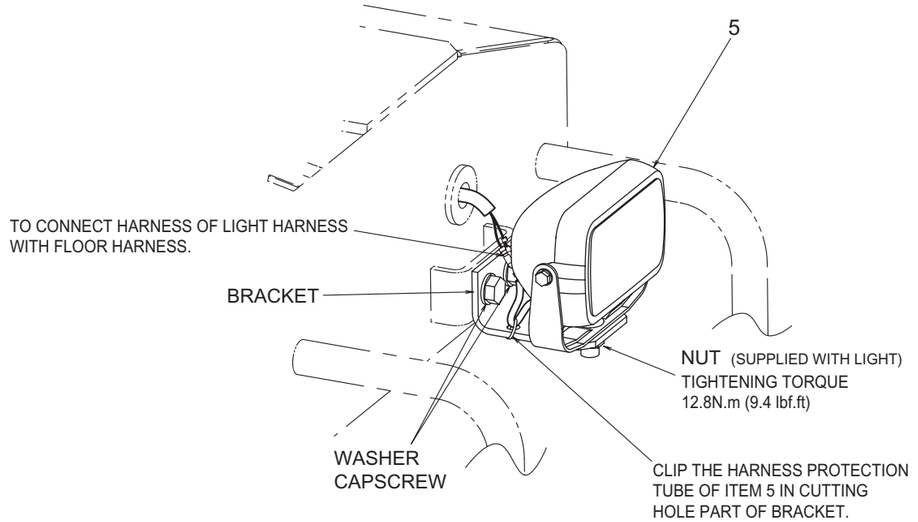
DETAILED FIG FOR aa

23.3.12 INSTALLING UPPER LIGHT

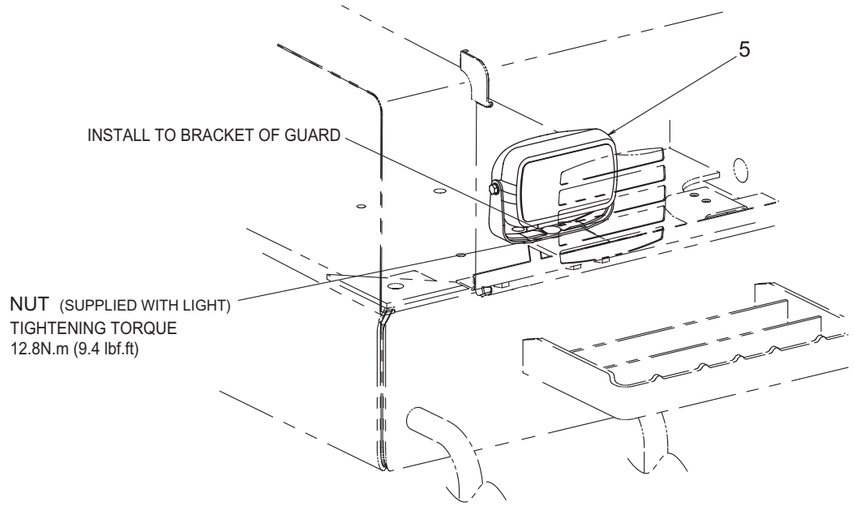
INSTALLING UPPER LIGHT		LV80E00001F1	(01)	
ITEM	PART NAME	PART No.	Q'TY	REMARKS
5	LIGHT	YN80S00010F2	2	



NOTE :
ITEM 5, TIGHTENING TORQUE 12.8N·m (9.4 lbf·ft)



HOW TO INSTALL LIGHT AT RIGHT SIDE DECK



HOW TO INSTALL LIGHT AT LEFT SIDE DECK

24.1.2 GEAR PUMP

24.1.2.1 SUMMARY

(1) Outside view and hydraulic port

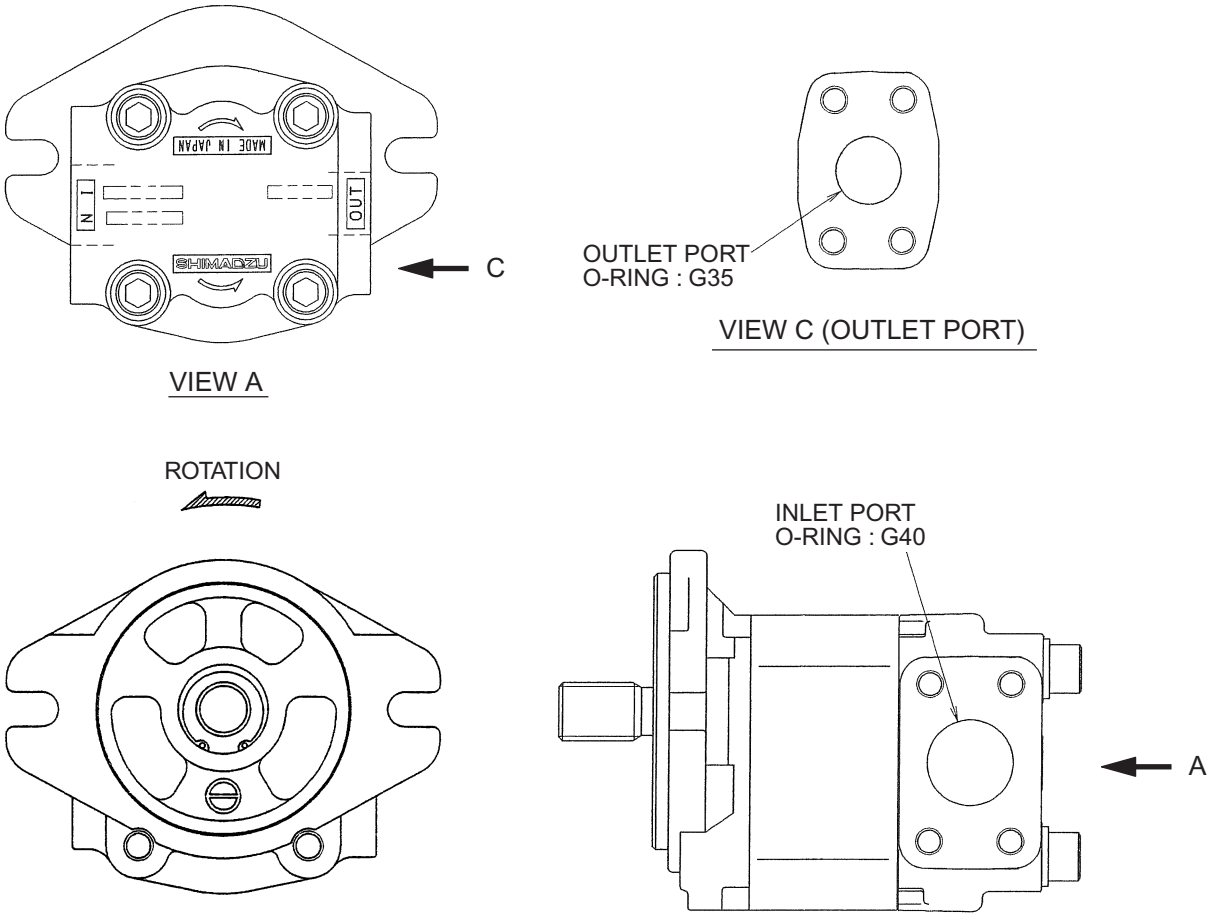


Fig. 24-4 Gear pump

(2) Specification

ITEM		GEAR PUMP
PARTS No.		LV10V00003F1
PUMP MODEL		SGP2B16F1H9-L137
DISPLACEMENT	cm^3	16.7
RATED PRESSURE	MPa (psi)	20.6 (2,987)
WORKING PRESSURE	MPa (psi)	5.0 (725)
WORKING SPEED	min^{-1}	650~2000
WEIGHT	kg (lb)	4.7 (10.4)

24.1.5.3 OPERATION

(1) Lever in neutral (See Fig. 24-8)
The action of spring (509) (for secondary pressure setting) that determines the output pressure of the pilot valve does not act upon spool (201). Therefore, spool (201) (for return) is pushed up by spring (221) [spring seat (216)]. The output ports (2,4) connect with the T port. The result is that the output pressure is equal to the tank pressure.

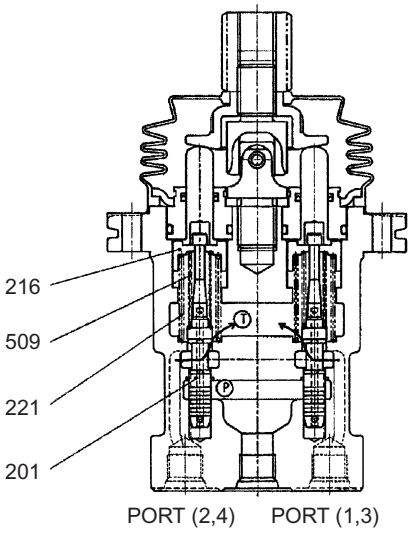


Fig. 24-8 Lever in neutral

(2) When the pilot lever is tilted (See Fig. 24-9)
When the lever is tilted and the push rod (511) strokes, the spool (201) [spring seat (216)] moves downward to make the port P to connect with the port 2, 4, with the result that the oil of the pilot pump flows to the port 2 ,4 to produce a pressure.

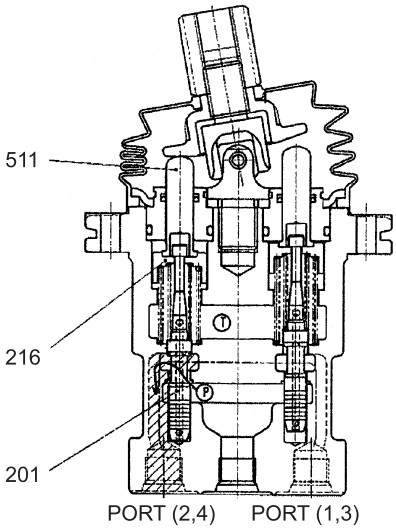


Fig. 24-9 When the lever is tilted

(3) Lever held (See Fig. 24-10)
When the pressure at ports (2,4) rises to a level equivalent to the action of spring (509) that is set by tilting the lever, the hydraulic pressure balances the spring action. When the pressure of ports (2,4) rises above a set value, ports (2,4) and the P port close while ports (2,4) and the T port open. When the pressure at ports (2,4) falls below a set value, ports (2,4) and the P port open while ports (2,4) and the T port close. Thus the secondary pressure is kept constant.

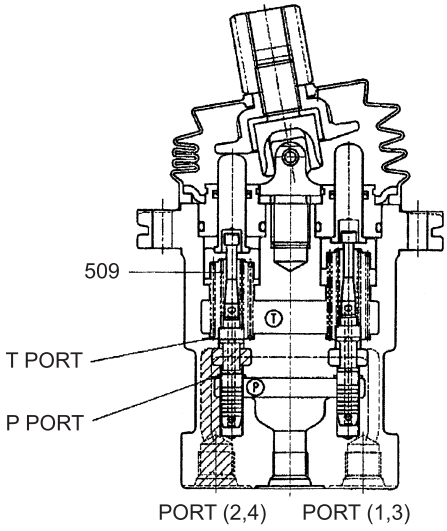


Fig. 24-10 When the lever is held

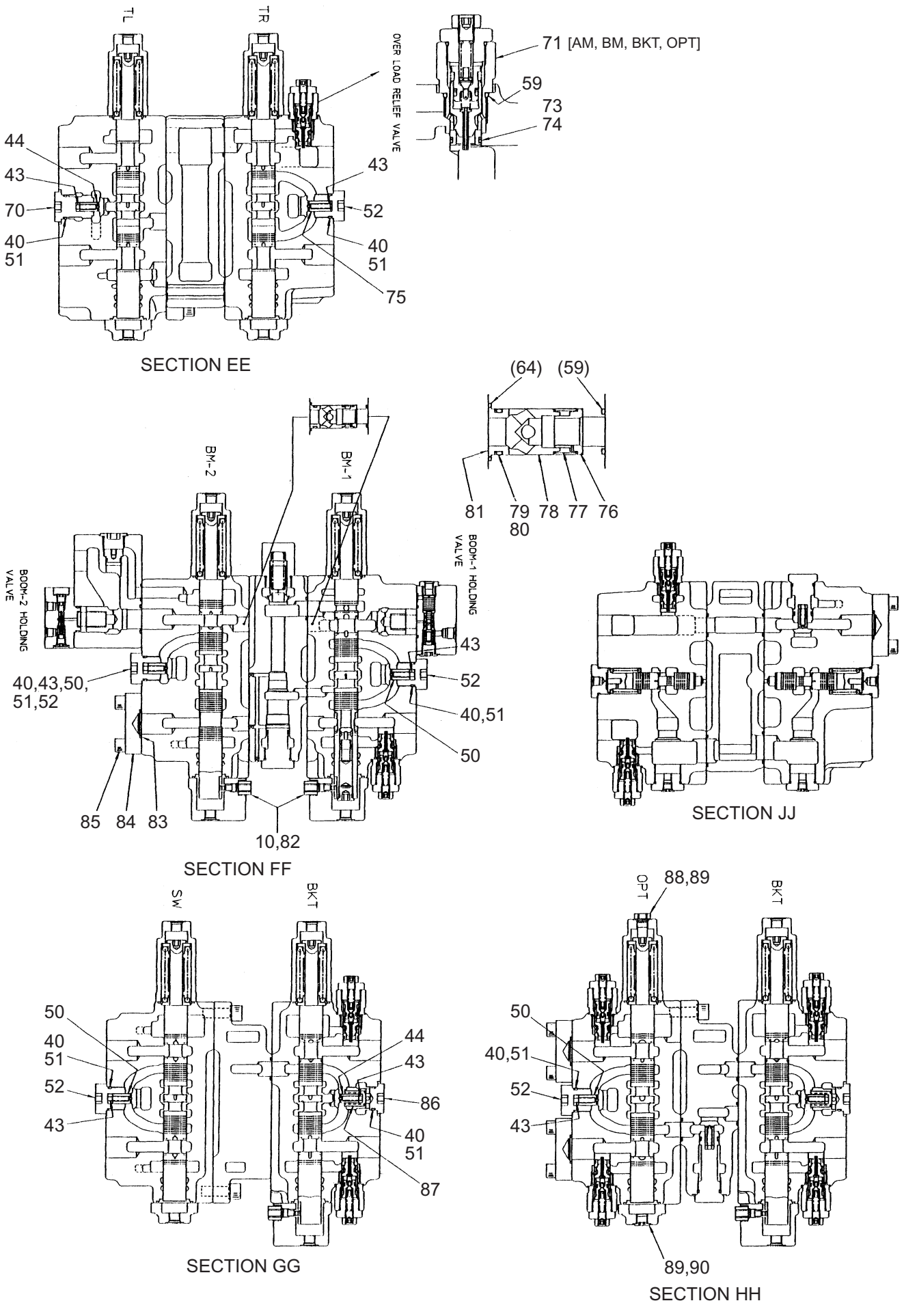


Fig. 24-14 Construction of control valve (3/5)

(2) Swing reduction

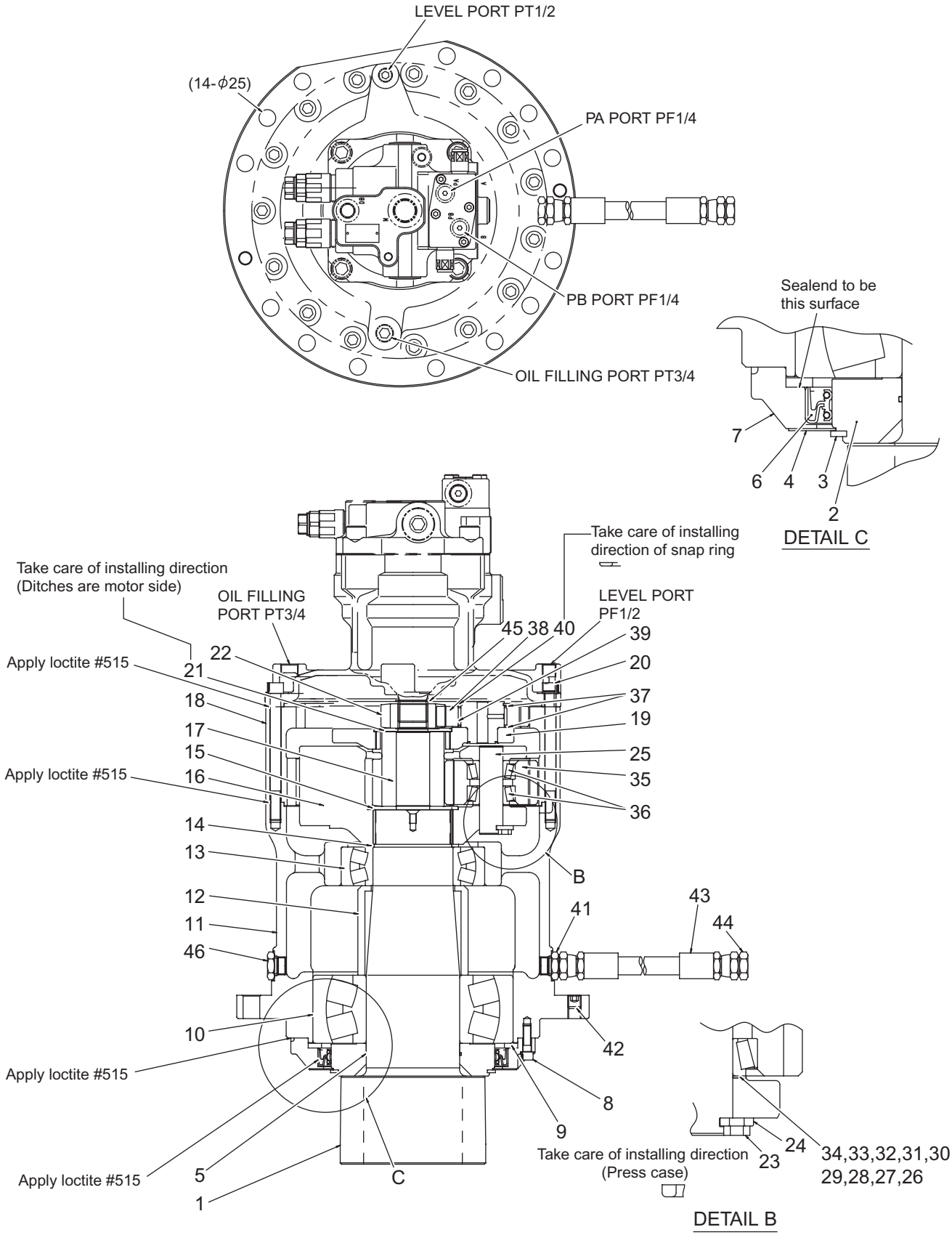


Fig. 24-19 Swing reduction

24.1.10 SWIVEL JOINT

24.1.10.1 OUTSIDE VIEW AND HYDRAULIC PORT

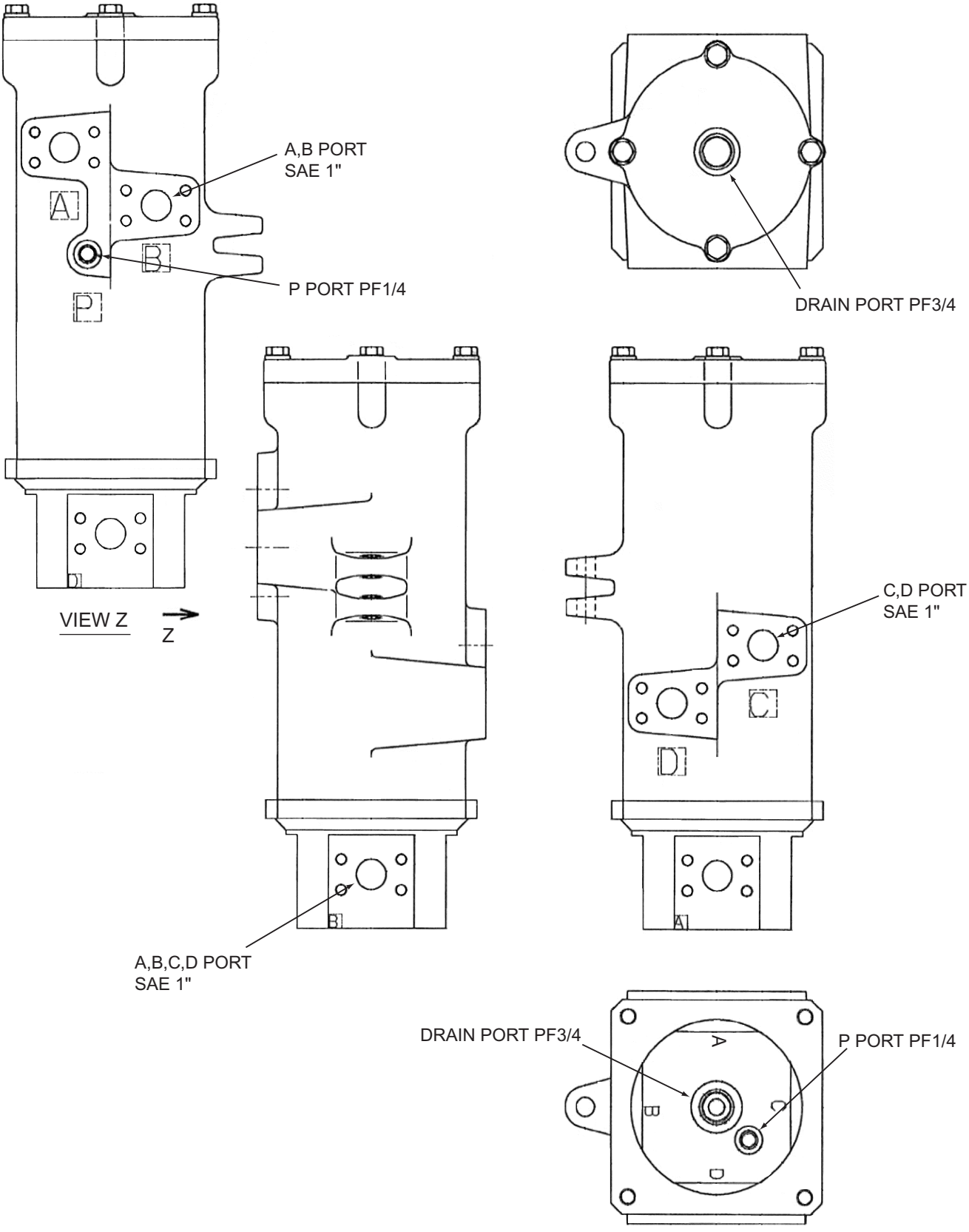


Fig. 24-24 General view of swivel joint

Group	Code	Name		Parts No.
(SE) Sensor	SE - 1	Pressure sensor : Bucket digging		YX52S00013P1
	SE - 2	Pressure sensor : Bucket dump		↑
	SE - 3	Pressure sensor : Boom up		↑
	SE - 4	Pressure sensor : Boom down		↑
	SE - 5	Pressure sensor : Swing		↑
	SE - 7	Pressure sensor : Arm in		↑
	SE - 8	Pressure sensor : Arm out		↑
	SE - 9	Pressure sensor : Travel RH		↑
	SE - 10	Pressure sensor : Travel LH		↑
	SE - 11	(Pressure sensor : P2 OPT.)		↑
	SE - 13	E/G speed sensor		Engine accessory
	SE - 14	Engine water thermo sensor		YT52S00001P1
	SE - 15	Fuel sensor		LV52S00001F1
	SE - 16	Accel potentiometer		YN52S00032P1
	SE - 20	(Pressure sensor : P1 OPT.)		YX52S00013P1
	SE - 21	Hyd. fluid temp sensor		YT52S00001P1
	SE - 22	Pressure sensor : Pump P1		YN52S00048P1
	SE - 23	Pressure sensor : Pump P2		↑
(SV) Solenoid	SV - 1	Swing parking brake SOL.	(YY35V00012F1) Solenoid valve assy	YB35V00006F1
	SV - 3	Two speed select SOL		YT35V00013F1
	SV - 4	Safety lock lever SOL		↑
(SW) Switch	SW - 1	Key switch (For North America)		YN50S00026F1
	SW - 1	Key switch (For NHK)		YN50S00026F2
	SW - 4	Swing parking brake release switch		YN50S00047P1
	SW - 5	Horn switch (RH)		YN50E00017P1
	SW - 7	E/G oil pressure switch		Engine accessory
	SW - 8	Air filter clogging switch		LV11P01017F1
	SW - 10	Horn switch (LH)		YN50E00017P1
	SW - 11	Safety lock lever switch		YN50S00041F1
	SW - 12	Overload display switch		YN50S00040D6
	SW - 13	Travel alarm switch (Opt.)		YN50S00040DF
	SW - 15	Conflux/single select switch (Opt.)		YN50S00040DD
	SW - 16	Engine room light switch (for NHK)		YT50S00005P1
	SW - 17	Swing flusher select switch (for North America)		YT50S00004P1
	SW - 19	Wiper interlock switch		YT50S00004P1
	SW - 23	Engine oil level switch		—
	SW - 24	Engine coolant level switch 1		YZ05P01002S004
	SW - 26	Cab work light switch (Opt.)		YN50S00040D4
	SW - 55	Boom, deck work light switch		YN50S00040D1
	SW - 58	Coolant level switch 2		YZ05P01002S004

File No. Name of part Part No. Use Applicable Machine	Specification	Description
SE - 16 Potentio meter YN52S00032P1 Accel dial YN11 - 45001 ~ YQ11 - 06001 ~ LC10 - 07001 ~ YC10 - 03501 ~ LY01 - 00101 ~	Total resistance value: 2KΩ Effective electric angle: 120° Number of notches: 10(90°) Source voltage: 5V	Notch part Potentio Bracket Dial 5V WIN GND R Y B 3MA JM II + AMP HOUSING : 174359-2 TERMINAL : 171661-1
SE - 22, 23 Pressure sensor (High pressure) YN52S00048P1 P1 pump P2 pump YN11 - 45001 ~ YQ11 - 06001 ~ LC10 - 07001 ~ YC10 - 03501 ~ LY01 - 00101 ~	Pressure range: 0~50MPa (7250 psi) Max. allowable press.: 120MPa (17400 psi) Operating source voltage: 5+0.5V DC Insulation resistance: 100MΩ or more/DC50V megger (Between casing and terminal)	Electric diagram (Arrangement) APT Vcc Vout GND (CONTROLLER) +5VDC A/D P3/8 Tightening torque : 73.5 N·m (54.2 lbf·ft) O ring P14 JIS B2401 Source (+) Output (+) Common (+) Econo seal J series (Mark II (+) 3 pole
PSV - A, B, C, D Proportional solenoid valve Hydraulic solenoid valve Hydraulic symbol A3 to A6 (YY35V00012F1) YB35V00005F1 LY01 - 00101 ~		YB35V00006F1 YT35V00013F1 YN35V00005F1 YN35V00005F1 YT35V00013F1 YN35V00005F1 YN35V00005F1 T=7N·m P2 P1 T HYDRAULIC SYMBOL SV-1 SV-3 PSV-A PSV-D PSV-C PSV-B SV-4 A8 A7 A6 A5 A4 A3 A2 A1 Swing parking Travel 1,2 speed Arm 2-variable recirculation P1 By-pass cut Travel straight P2 By-pass cut Lever lock

25.2.2 CONSTRUCTION

(1) Air conditioner unit

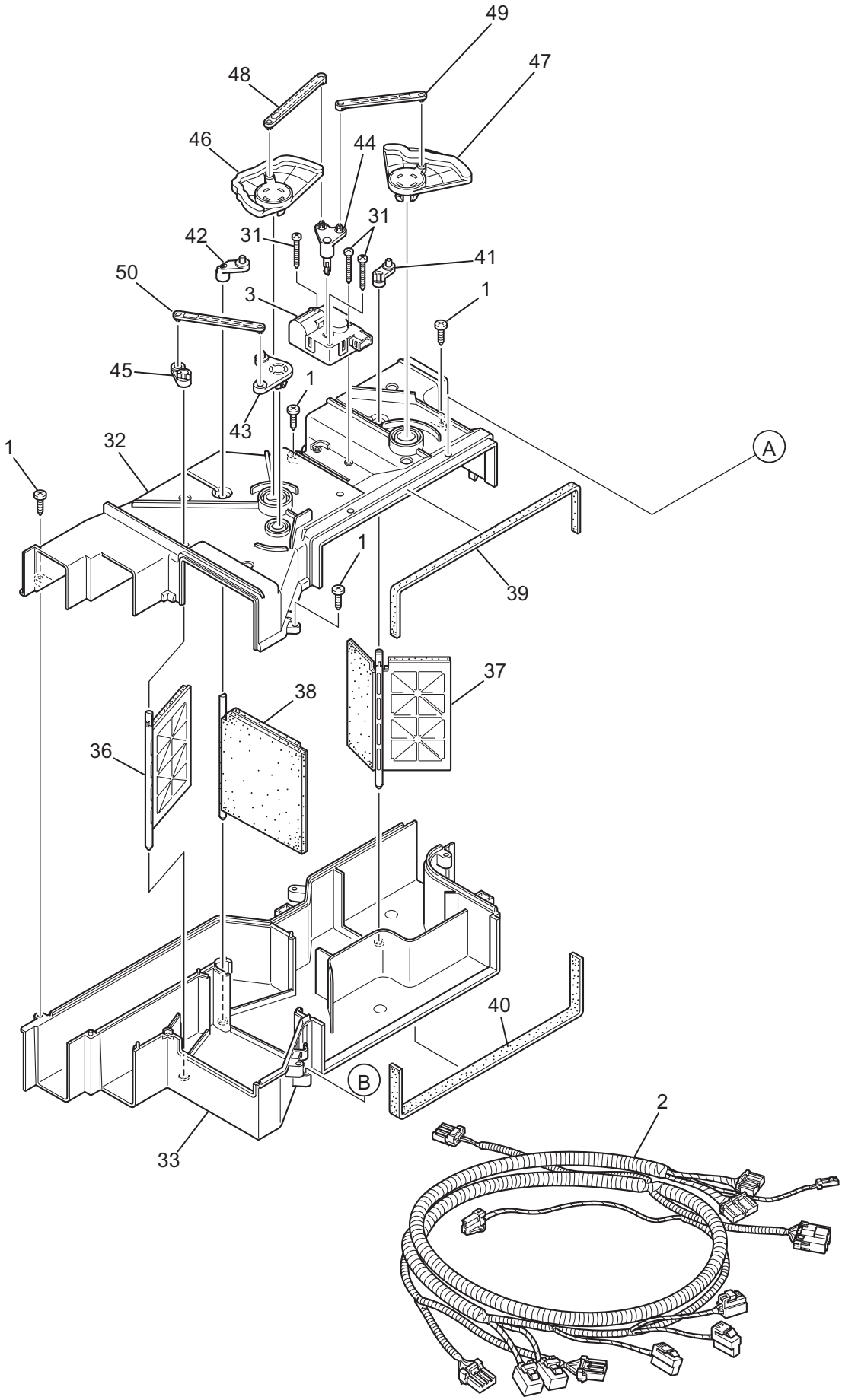


Fig. 25-2 Air conditioner unit (1/2)

Fig. 25-10 shows how the block type expansion valve is constructed. The temperature sensing part is provided in the shaft of the expansion valve to directly detect the refrigerant temperature at the outlet of the evaporator. The diaphragm contains R134a in saturated state. The pressure in the diaphragm changes according to the temperature detected by the sensor. The change in the pressure causes the force acting upon the diaphragm to vary accordingly.
The high-pressure high-temperature liquid refrigerant that is fed from the receiver side reduces the pressure abruptly as it passes through the valve (throttling action). On that occasion, part of the refrigerant evaporates by the very heat of the refrigerant and cooled off. The result is that low-pressure low-temperature damp refrigerant vapor is fed to the evaporator. The opening of the valve is determined by the equilibrium between the pressure (low) of the evaporator side, the action of the adjust spring and the pressing force of the diaphragm (the temperature of the refrigerant at the outlet of the evaporator to be sensed by the thermowell). The feed rate is controlled automatically so that under the pressure in the evaporator, the refrigerant is properly overheated (3~8 degrees C) and goes out of the evaporator. This action is carried out by sensing the refrigerant temperature at the outlet of the evaporator as against the inlet pressure of the evaporator and consequently controlling the feed rate of the refrigerant.

This means that if the refrigerant pressure drop in the evaporator is excessive, it is difficult to control the overheating or the feed rate of the refrigerant. For this reason, the smaller the pressure drop of the evaporator, the better. The expansion valve senses the pressure and the temperature at the outlet of the evaporator and controls the overheating of the refrigerant and the refrigerant supply to the evaporator more securely. The air-conditioner of this machine adopts a block type expansion valve.

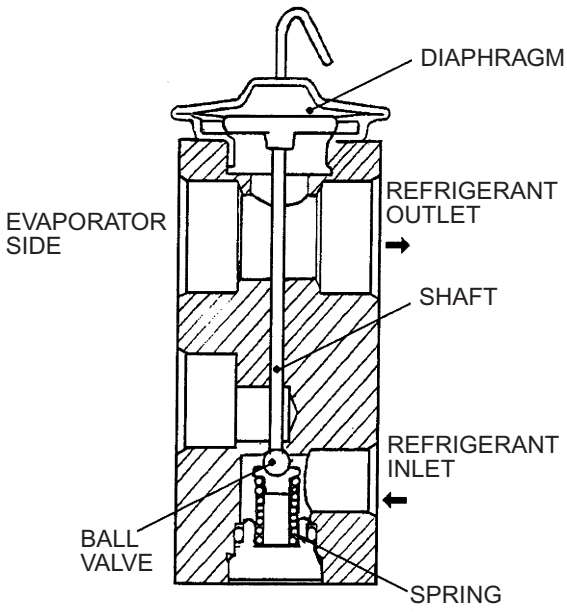


Fig. 25-10 Block type expansion valve

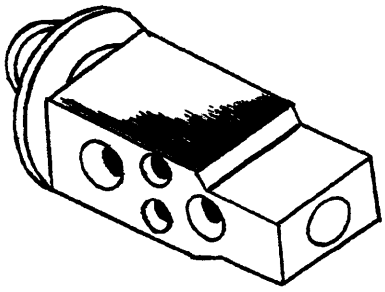


Fig. 25-11 Expansion valve outside view

25.6.3 CHARGING PROCEDURE

25.6.3.1 VACUUM MAKING OPERATION

(1) Connecting gauge manifold (See Fig. 25-25)

1) Close the high pressure valve (HI) and the low pressure valve (LO) of the gauge manifold.

2) Connect the charging hoses (red and blue) with the service valves of the compressor.

Red hose :

High pressure side (HI) of the gauge manifold→high pressure side (DIS) of compressor

Blue hose :

Low pressure side (LO) of gauge manifold→low pressure side (SUC) of compressor

⚠CAUTION

- Do not mistake the high pressure hose for the low pressure hose in any circumstances when connecting them. Put the hose in firmly till a clicking sound is heard.

3) Connect the center valve of the gauge manifold with the charging hose of the vacuum pump.

⚠CAUTION

Some kinds of gauge manifolds are not equipped with an open/close valve in the center.

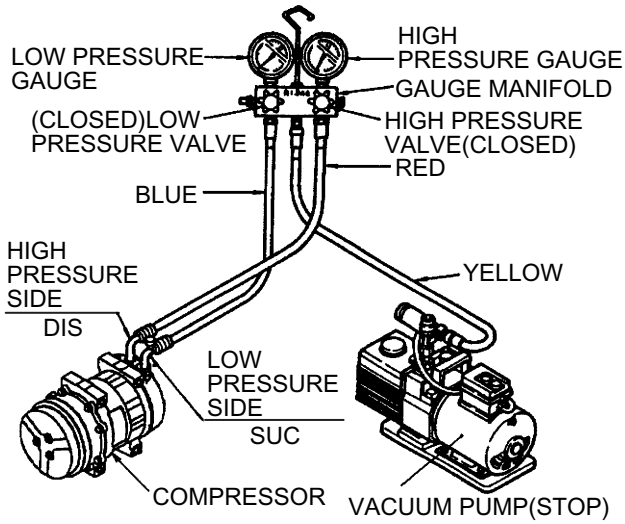


Fig. 25-25

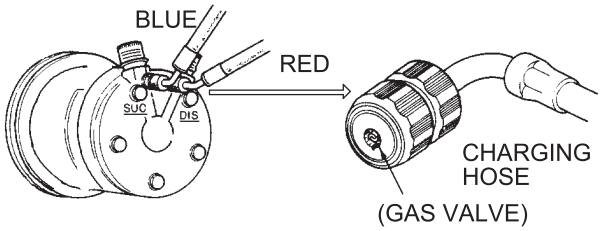


Fig. 25-26 Connecting gauge manifold

(5) The actuator for inner and outer
The actuator for inner and outer air flow select is installed on the blower intake unit, and opens and closes inner and outer air damper through the link.

The actuator for inner and outer air flow select contains position detection switch which is switched with the movement of shaft of the actuator.
When the inner and outer damper position is set by the inner and outer switch on the control panel, the control unit reads the signal of the position detection switch in the actuator and determines the rotation direction of motor in either normal rotation or reverse rotation. Then as the motor rotates, the position detection switch also rotates and makes it stop at the set position of the inner and outer air damper.

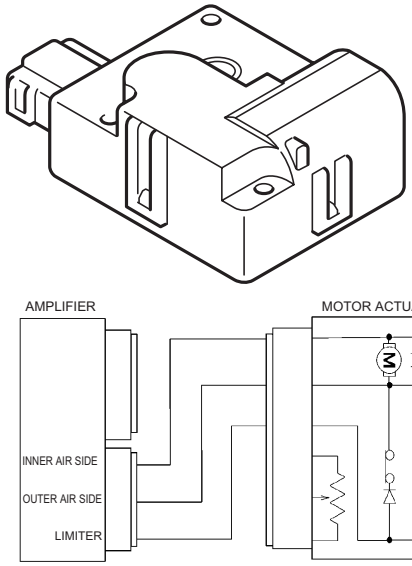


Fig. 25-38

(6) Evaporator sensor
This sensor is used to control the evaporator outlet temperature with the compressor ON-OFF to protect the evaporator from freezing, and this evaporator sensor functions as a sensor of this control.

- Evaporator sensor inspecting items
  (Specification)
  Terminal resistance :
  at 0 degree C : 7.2 kΩ
  at 25 degree C : 2.2kΩ

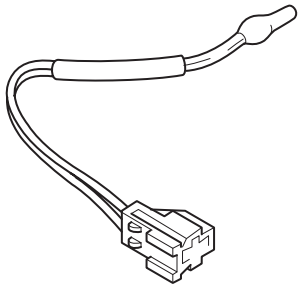


Fig. 25-39

(7) Dual pressure switch
This dual pressure switch is attached on L-hose and is used to turn OFF the compressor, and employs dual type (for high and low pressure control) to protect the cooler cycle from possible failure at the time when abnormal pressure was generated on the high pressure side.

SPECIFICATION OF DUAL PRESSURE SWITCH

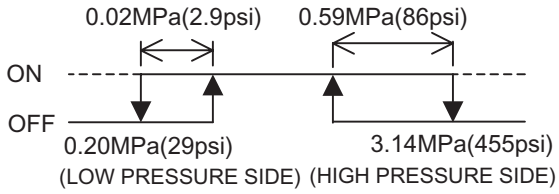


Fig. 25-40

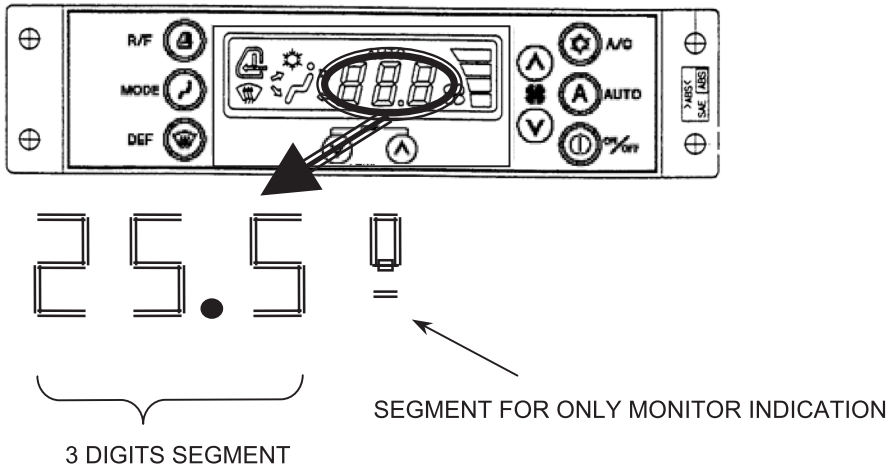
(8) Solar radiation sensor
This solar radiation sensor, which is used to correct the solar radiation to the auto air conditioner detects the strength and solar orientation of sunbeam after transforming them into current by means of photo diode.
Inspection : Check for the continuity between terminals.

Fig. 25-41

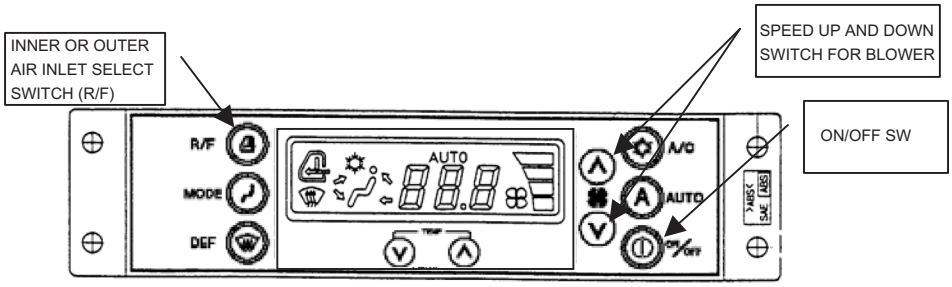
25.9.3 EXPLANATION OF MONITOR MODE

When error of 25.9.2 (2) sensors is displayed, the monitor mode is available to identify the sensor condition (disconnection, short circuit).

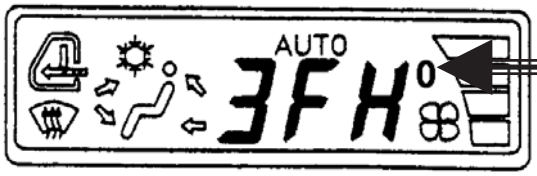
(1) Position of monitor mode indication



(2) Operation of monitor mode



1) Press inner and outer air flow select switch and ON/OFF switch simultaneously for 1 second.
2) Press AUTO switch.
   (After all segments are lit on for 1 second, the mode is switched into monitor mode.)
3) Any figures of figures from 0 to 9 or any letters of alphabet from A to F are displayed on the 3rd digit and 2nd digit of segment in three digits. The 1st digit is indicated by "H".
4) Any digit indicated by one of figures 0 to 2 for the exclusive segment in three digits is selected by pressing UP or DOWN of blower switch, and the required sensor is selected from the list below.



SEGMENT ASSIGNMENT LIST

0	INNER AIR SENSOR
1	EVAPORATOR SENSOR
2	SOLAR RADIATION SENSOR

(Excluding above mentioned indications, for example "from 3 to 9 and from B to F" are not used at service work.)

5) The monitor display is terminated by pressing the inner and outer air flow select switch (R/F) and ON/OFF switch for 1 second again, or turning off the main switch of excavator.

Notes)

1. The air conditioner is turned off while the monitor mode is in operation, and all switches are not available for operation and setting until the monitor mode is cancelled.
2. Even if each sensor is corrected while the monitor mode is in operation, the error display is memorized. Therefore turn on ON/OFF switch again, and the error display is disappeared.

(3) Removing bucket attaching pin (K)
Lift up bucket, position it so that bucket attaching pin (K) is not loaded, adjust bucket link, and pull out bucket attaching pin (K).
Weight :
Pin (K) : 95 kg (209 lbs)

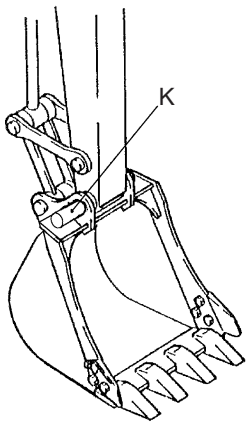


Fig. 32-4 Removing bucket attaching pin

(4) Removing bucket drive pin (J)
Put bucket on the ground, position it so that the bucket drive pin (J) is not loaded, adjust bucket link, and pull out pin (J).
Insert the pin (J) which is pulled out of the bucket into the hole of bucket once again.
Weight :
Pin (J) : 95 kg (209 lbs)

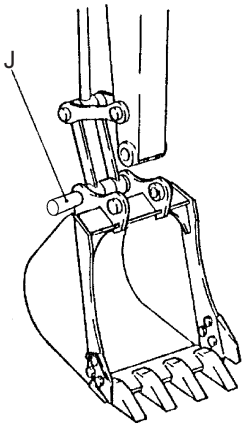


Fig. 32-5 Removing bucket drive pin

32.1.2.2 ATTACHING BUCKET

(1) Attaching bucket drive pin (J)
Attach bucket drive pin (J) first, then continue in the reverse procedure of the pulling out.

WARNING

- **When aligning the pin holes, do not put your finger in the pin holes in any circumstances, but align them visually.**
- **Check that the seals are not scored and replace a faulty one if necessary.**
- **When inserting the pin, coat the shaft with grease.**
- **Method of fastening the lock nut**
  Secure clearance to the boss and make certain that the capscrew turns lightly.
- **Capscrew lock nut tightening torque**

SIZE	TIGHTENING TORQUE
M24	181 N·m (133 lbf·ft)

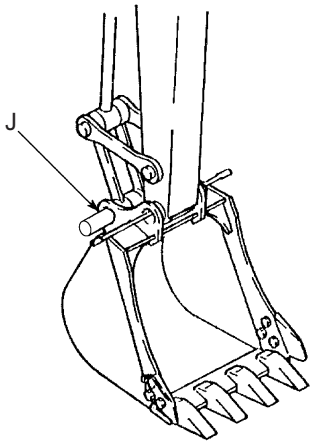
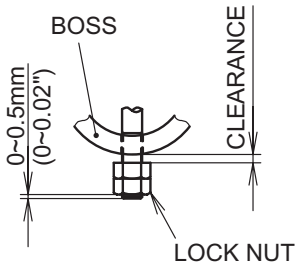


Fig. 32-6 Attaching bucket



32.2.1.1.3 TOOLS

Tools and jigs vary with types of cylinder, but it is necessary to prepare the tools in Table 32-1 as a guideline.

Table 32-1 Tools and Jigs

Tool / Jig	Remarks	Tool / Jig	Remarks
Hammer	1. Steel hammer 2. Wooden or plastic mallet	Spatula	Metallic one with smooth corners.
Screwdriver	A few types of large and small sizes	Jig	1. For fitting slipper seal 2. For holding slipper seal 3. For inserting piston rod bushing 4. For pressing in wiper ring
Chisel	Flat chisel		
Vise	One having an operation wide enough to hold cylinder head O.D. and tube mounting pins (clevis)		
Wrench	1. Hook wrench and power wrench 2. Extension pipe for wrenches	Measuring instruments	1. Slide calipers 2. Micrometer 3. Cylinder gauge (Fig. 32-25) 4. V-block

Note

For the details of special tools and jigs, refer to the back pages of this section.

32.2.1.1.4 EXTERNAL CLEANING

The cylinder taken off the excavator has dust and foreign matter, and grease is usually adhered to the clevis part. For this reason, remove external soil and contamination from the cylinder with water and steam before bringing it into the workshop.

- The following describes the construction of arm cylinder. (Both cushining mechanism type) When disassembling and servicing the cylinder, confirm the construction of cylinder referring to Parts Manual.

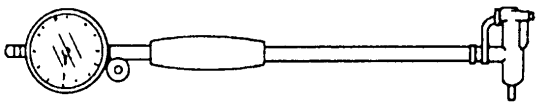


Fig. 32-25 Cylinder gauge

32.2.1.1.5 DISCHARGING OIL

Place a wooden-block on the work bench and place the cylinder on it to prevent it from rotating. Charge air into ports A and B alternately to actuate the piston rod till the hydraulic oil in the cylinder is drained out. At this time, connect a suitable hose to each port so that the hydraulic oil may not gush out.

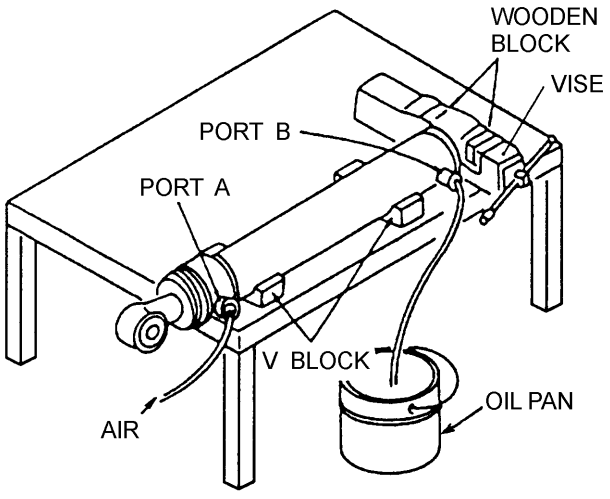


Fig. 32-26 Discharging oil

(4) Assembling cylinder assy

1) Fix cylinder.

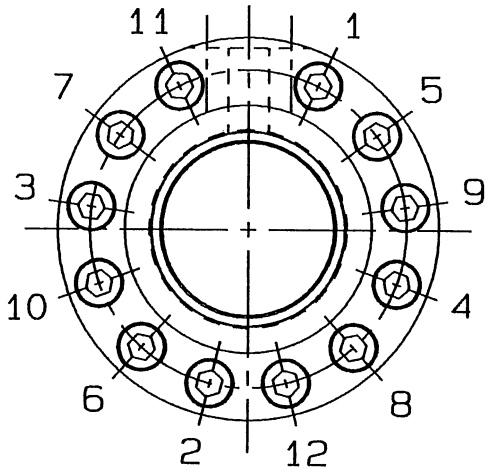
2) Insert piston rod assy.

- Apply hydraulic oil to the inside face of cylinder mouth and the outside face of piston assy.
- Insert piston rod while aligning the rod center to the cylinder center.

⚠CAUTION

Insert piston rod assy into cylinder, paying attention to slide ring and wear ring not to be missed.

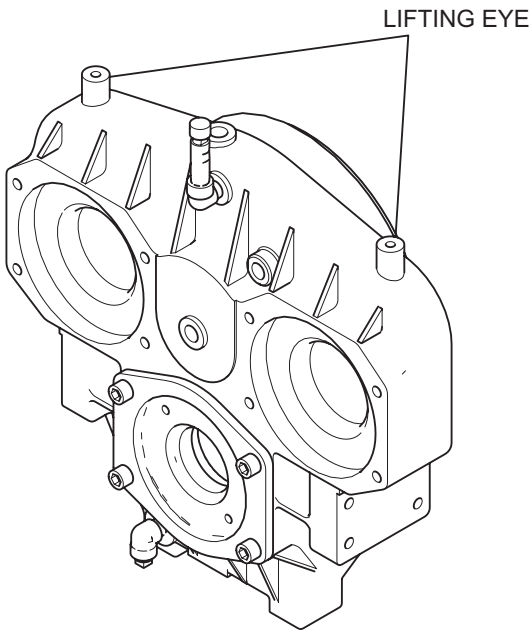
3) Locate rod cover at the required position and tighten bolts in order as shown in the figure to the specified torque.



(4) Hoist slightly the power divider with eyebolts attached to lifting eyes provided on the power divider.
(Eye bolt size: M16)
Loosen capscrews (7), and move the power divider towards opposite side of engine slowly, and hoist the power divider slowly.
The weight of power divider is about 300kg (662 lbs).

Note

- Remove power divider from engine, paying attention to power divider not to swing.
(The swinging of power divider may cause damage of oil seal.)
- Remove power divider from engine, paying attention to main shaft not to drop.
(It is unknown whether the main shaft is left on the engine side or power divider side.)

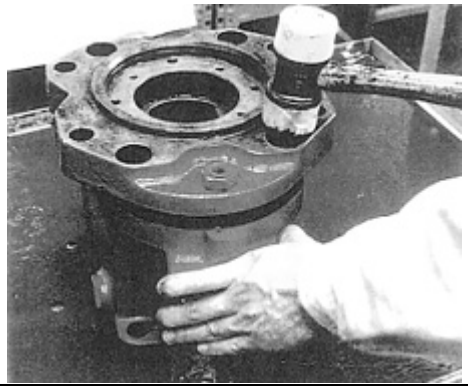
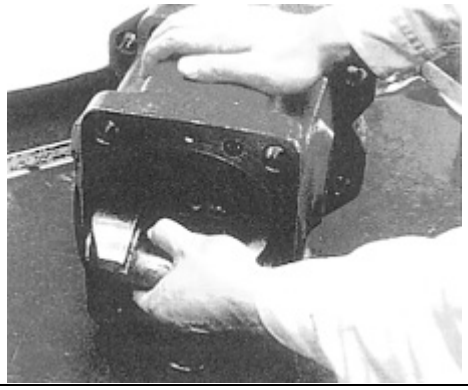
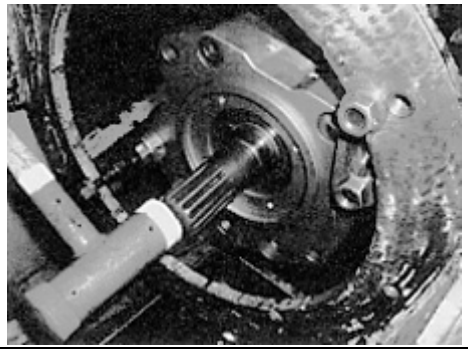


POWER DIVIDER

33.2.1.4 ASSEMBLING PROCEDURE

Assemble it in the reverse order of disassembling.
Assemble pump paying particular attention to the following items.

1) Do not fail to repair the damaged parts during disassembly and prepare parts to be replaced beforehand.
2) Clean every part adequately by wash oil and air blow it before assembling.
3) Apply proper hydraulic oil to sliding section and bearings before assembling.
4) Replace seal parts like O-ring, oil seal and so on with new ones as a general rule.
5) Tighten bolts and plugs to the specified torque in "Service Standard" with torque wrench prepared beforehand.

No.	WORK CONTENTS	NOTES
1	Attach swash plate support (251) to pump casing (271) while striking softly with mallet. 	1) When servo piston, tilting pin, stopper L and stopper S are removed, attach them to pump casing beforehand. 2) Tighten servo piston and tilting pin with the jig to protect feed back pin from damaging. Apply Loctite (medium strength) to the threaded section.
2	Place pump casing, directing regulator attaching face downward, fit tilting bushing of swash plate to tilting pin (531), and attach swash plate (212) to swash plate support (251) properly. 	1) Check that swash plate moves smoothly by both hands. 2) Apply grease to swash plate, swash plate support and sliding face to enhance the workability to install drive shaft.
3	Install drive shaft F (111) which is assembled with roller bearing (123), bearing spacer (127) and stop ring (824) to the swash plate support (251). 	1) Do not strike drive shaft with mallet. 2) Install outer race of bearing with mallet and fit it securely by making use of steel bar and equivalent.

33.2.4 CONTROL VALVE

33.2.4.1 PREPARATION FOR DISASSEMBLY

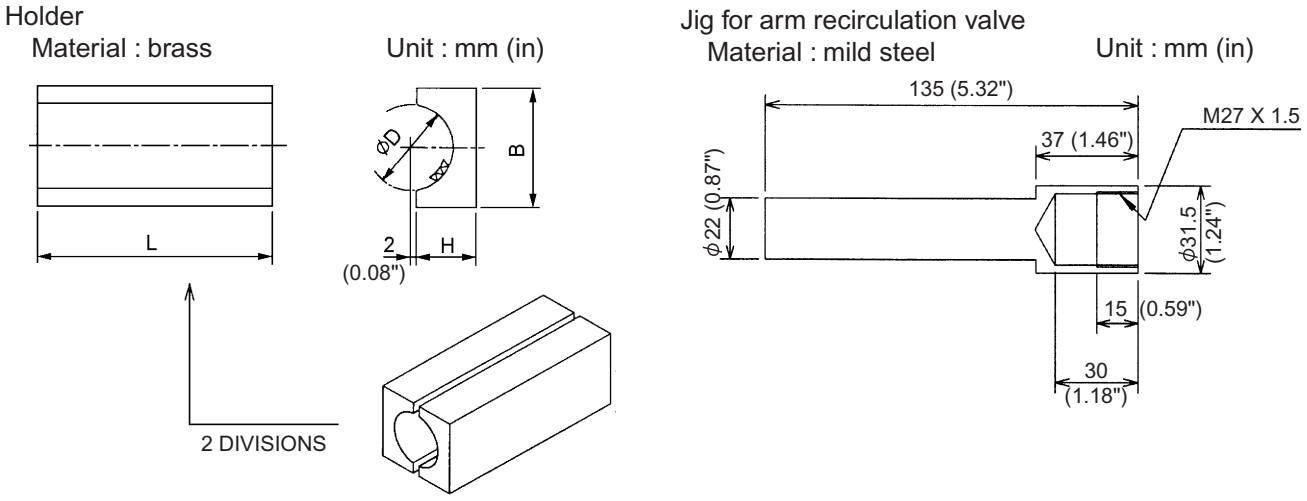
(1) General cautions

1) Since hydraulic components are finished to precision with small clearance, it is necessary to disassemble and reassemble them in clean, less dusty place.
   Use clean tools and cleaning oil and handle components with sufficient care.
2) If the control valve is removed from the machine, clean ports thoroughly and put a plug in each port so as to prevent entry of dust and water.
   When installing the control valve back to the machine, do not remove plugs until the valve is properly piped.
3) Study the structural drawing before beginning work and prepare necessary parts according to the purpose and the scope of the work. Some parts are not available loosely but in assemblies.
   Therefore, prepare parts beforehand according to the Parts Manual.

(2) Cautions to be exercised in disassembly

1) Since components are finished to high precision, handle them with sufficient care. Use care so as not to bump components against each other or drop them.
2) Do not strike or twist components by force even if they are tight, or the components develop burrs or are broken.
   This makes the components impossible to be assembled and results in oil leakage and deterioration in performances.
   Therefore, handle components with full care.
3) Attach a tag to each component so it is reassembled in a correct position.
4) Once disassembled, do not reuse O-rings and backup rings.
   (Remove them with the tip of a steel wire shaped in a spatula. Take care so the groove is not scored.)
5) If parts are left, as they are halfway during disassembly or after disassembly, they may rust due to moisture and dust. When interrupting the work for unavoidable reason, use care so as to prevent parts from rusting or being exposed to dust.

- **Replacing the main plungers**
  Since the main plunger is selectively fitted to the housing, it is designated as 'not service part'. Therefore, note that in principle the main plunger cannot be replaced in the field. In case the plunger must be replaced for some reason, inform us with the model and the manufacturing number that are stamped on the nameplate.



	ϕD	L	B	H
For main plunger	36 (1.42")	90 (3.54")	50 (1.97")	25 (0.98")

Fig. 33-5 Jigs

1) Remove sleeve (131), and remove spring (136) and spool (138).

: 46mm
Tightening torque : 176.5N•m (130 lbf•ft)

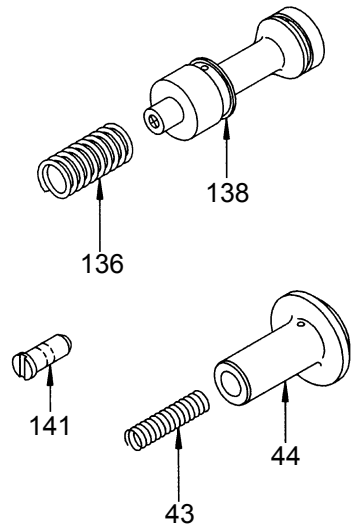


Fig. 33-37 Disassembling cover

2) Using jig, remove sleeve (144), and remove piston (141), spring (43) and check valve (44).

: 46mm
Tightening torque : 176.5N•m (130 lbf•ft)

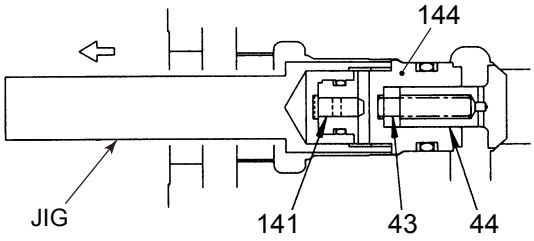


Fig. 33-38 Removing check valve (44) and spring (43)

3) Remove cap (130), and remove piston (132) and spring (135).

: 30mm
Tightening torque : 78.5N•m (58 lbf•ft)

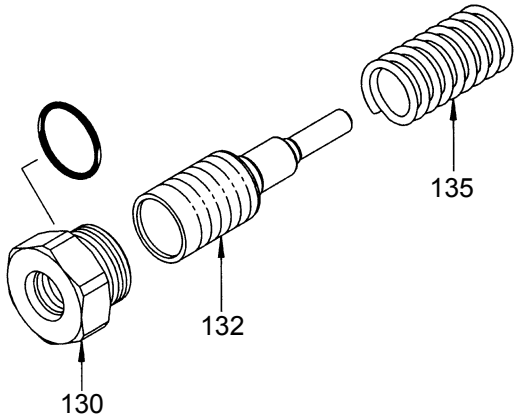


Fig. 33-39 Removing piston (132)

33.2.4.3 ASSEMBLY

(1) Cautions to be exercised in assembly

1) Take care the same way as in disassembly.
2) Before proceeding to assembly, clean parts free from metallic particles and foreign matter and make sure that the parts are free from burrs and dents. Eliminate burrs and dents with an oilstone or the like
3) Replace O-rings and backup rings with new ones.
4) Handle O-rings and backup rings with care so as not to score them.
(Apply a small amount of grease to make the surface smooth.)
5) Tighten bolts and caps to specified torque.

(2) Assembly procedure
Assembly is the reverse order of disassembly.

33.2.5.5 MAINTENANCE STANDARDS

Check item	Standard	Remarks
Leakage	When leakage quantity reaches to 1000cc/ min. or more where handle is set in neutral position, or to 2000cc/min. or more in operation, replace spool with new one. If leaked, even if the spool is replaced, replace pilot valve assy with new one.	Conditions Primary pressure 2.94 MPa (426 psi) Hydraulic oil viscosity 23 cSt
Spool	When the wear of sliding section is 10 μm more than the that of non sliding section, replace it with new one.	This condition may be the same as the above.
Push rod	When the wear of top is 1mm (0.04in) or more, replace it with new one.	
Looseness of control section	When looseness of 2mm (0.08in) or more on circular plate (302) on control section and joint section (301) due to wear is pro- duced, replace them with new ones.	In case of the looseness due to the loosening on tightening section, adjust it.
Stability of operation	When trouble such as noise, hunting, drop of primary pressure, etc. has occurred in op- eration, and it does not restore after taking corrective action according to below 33.2.5.6 (TROUBLESHOOTING), replace pilot valve assy with new one.	

Note

- O-ring, etc. should be replaced with new one at every disassembling.
- If socket bolt (125) was loosened, seal washer (121) should be replaced.

33.2.5.6 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.

Trouble	Cause	Remarks
Secondary pressure does not rise .	1) Primary pressure is insufficient. 2) Secondary pressure springs (241) are broken or fatigued. 3) Clearance between spool (201) and cas-ing (101) is abnormally large. 4) Handle has a looseness.	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.	1) Sliding parts are caught. 2) Tank line pressure varies. 3) Air has mixed into pipeline.	1) Repair the unsmoothed section. 2) Bring pressure directly to oil tank. 3) Bleed air by operating it several times.
Secondary pressure is high	1) Tank line pressure is high. 2) Sliding parts are caught.	1) Bring pressure directly to oil tank. 2) Correct.

33.2.6.3 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 Fig. 33-88)

(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.

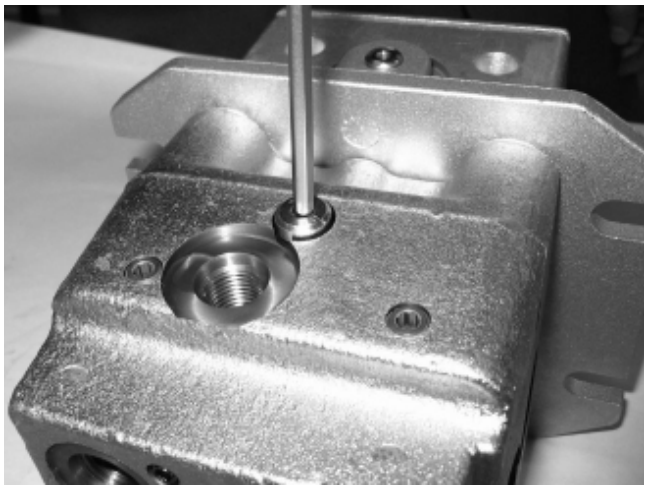


Fig. 33-88

10) Fit O-rings (706), (707) to casing (301). In that case, if the O-rings are coated with grease, they are hard to tear off when brake piston (702) is inserted.

11) Assemble brake piston (702) into casing (301).

12) Assemble brake spring (712) into brake piston (702). In that case, make sure that a spring is placed securely in the spot faced part of the brake piston.

- This operation is necessary only where roller bearing (444) is removed.

13) Insert the outer race of roller bearing (444) into valve casing (303), while lightly tapping the steel rod placed on the outer race, using a hammer.

14) Assemble valve plate (131) into valve casing (303) and fit O-ring (472) in it.

15) Install valve casing (303) to casing (301) and fasten them with socket bolts (401).
: 17 mm,
Tightening torque : 431 N•m (320 lbf•ft)

16) Fit plunger (351) and spring (355) to valve casing (303). Then tighten ROMH plug (469) fitted with O-ring (488) against valve casing (303).
: 17 mm,
Tightening torque : 539 N•m (398 lbf•ft)

17) Fit relief valve (051) to valve casing (303).
: 41 mm,
Tightening torque : 177 N•m (130 lbf•ft)

18) Fit anti-reaction sub assy (052) to valve casing (303).
: 6 mm,
Tightening torque : 29 N•m (22 lbf•ft)

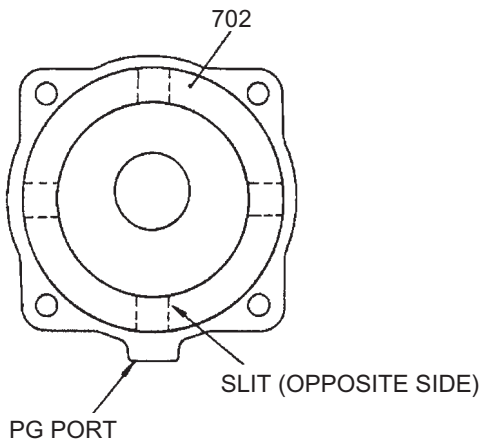


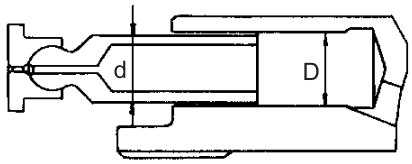
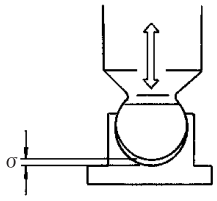
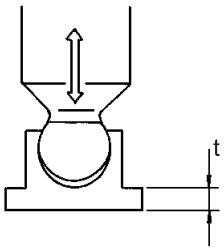
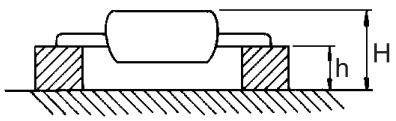
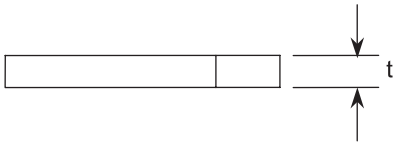
Fig. 33-102 Assembling brake piston

33.2.7.4 MAINTENANCE STANDARDS

33.2.7.4.1 SWING MOTOR

(1) Replacement standards for parts

The following are the standards to determine whether or not parts may be reused from values taken at disassembly. These are only general standards and in case the motor displays poor performance or parts shows extreme damage and discoloration before disassembly, it is most important to determine how many parts should be replaced, depending upon the purpose of disassembly and the remaining service life of the motor that the user expects.

Item	Standard Dimension mm (in)	Recommended Value for Replacement mm (in)	Remedy
Clearance between piston and cylinder bore (D-d) 	0.032 (0.0013)	0.062 (0.0024)	Replace piston or cylinder.
Gap between piston and caulked part of shoe (σ) 	0	0.3 (0.0112)	Replace piston and shoe assy.
Thickness of shoe (t) 	6.0 (0.236)	5.8 (0.228)	Replace piston and shoe assy.
Assembled height of retainer plate and spherical bushing (H-h) 	7 (0.276)	6.5 (0.256)	Replace a spherical bushing and a retainer plate as a pair.
Thickness of friction plate 	4.0 (0.157)	3.6 (0.142)	Replace.

(2) Maintenance standard

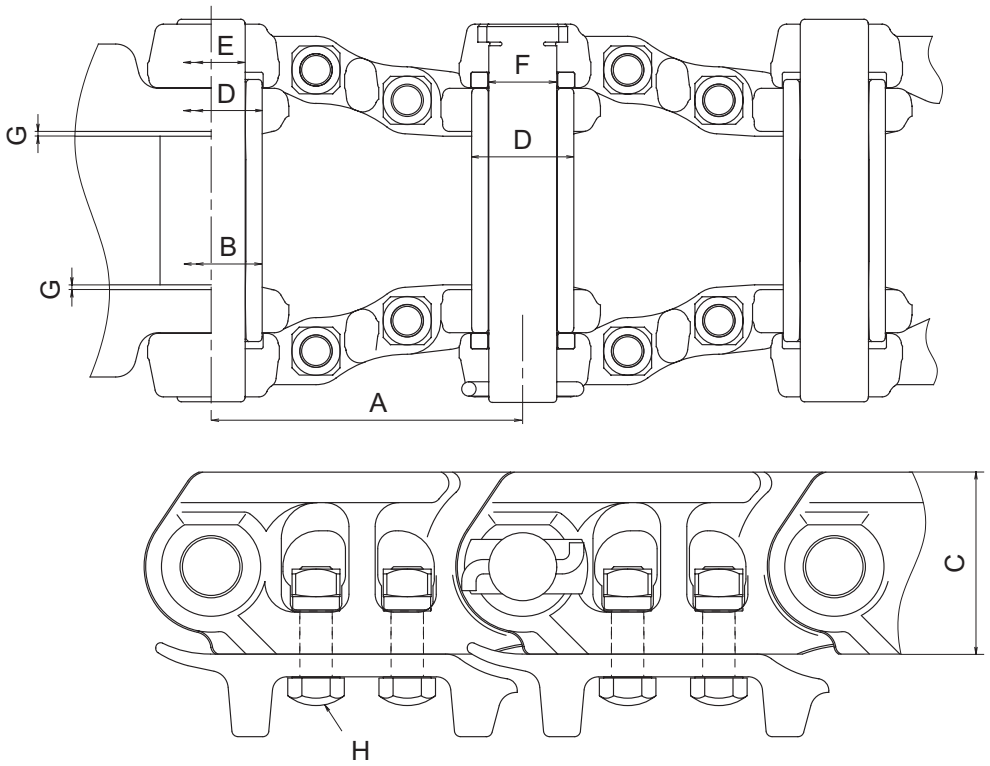


Fig. 34-2

Unit : mm (in)

No.	ITEM	STANDARD VALUE			REPAIRABLE LEVEL	SERVICE LIMIT	REMEDY
A	Link pitch	260.35 (10.25)			263.8 (10.39)	265.8 (10.46)	Replace the link assy if the service limit is exceeded
B	O.D. of bushing	ø 85.35 (3.36)			ø81 (3.19)	ø80 (3.15)	
C	Height of link	152 (5.984)			145 (5.709)	142 (5.591)	
D	Interference between bushing and link	Basic dimension	Tolerance		Fit	Fit	Replace
		ø 85.35 (3.36)	Shaft	+ 0.05 (+ 0.002) 0 (0)	Interference 0.30 (0.012)	Interference 0.26 (0.0102)	
E	Interference between track pin and link	ø 57 (2.244)	Shaft	+ 0.246 (+ 0.01) + 0.146 (+ 0.006)	Interference 0.20 (0.008)	Interference 0.17 (0.007)	
F	Interference between master pin and link	ø 56.8 (2.236)	Shaft	+ 0.035 (+ 0.001) 0 (0)	Interference 0.1 (0.004)	Interference 0.13 (0.0051)	Replace Link
G	Clearance between links	0.6 (0.024) (one side)			10 (0.394) (both side)	12 (0.472) (both side)	Replace
H	Tightening torque of shoe bolt	1,961 N•m (1,450 lbf•ft)					Reassembly

34.1.6 SPROCKET

(1) Maintenance standard (LV51D01001P1)

SPECIFICATION	PITCH	131.4 mm (5.173 in)		NUMBER OF TEETH	23
	ROLLER DIA.	ø 85.35 mm (3.36in)		PITCH DIA.	964.986 (37.992 in)

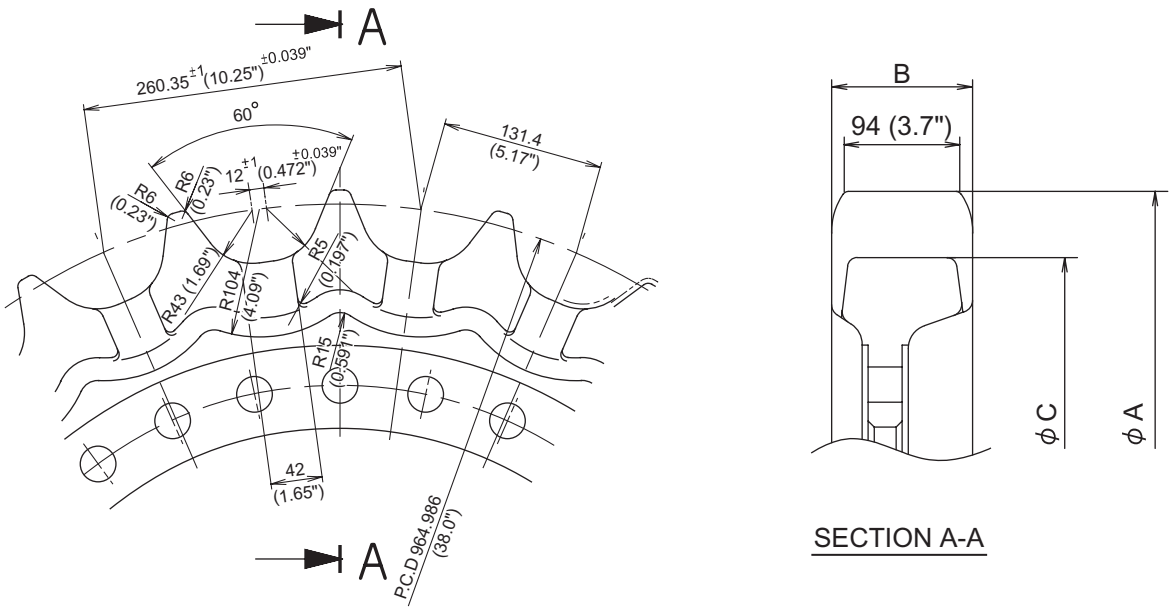


Fig. 34-13 Sprocket

Unit:mm (in)

No.	NAME	STANDARD VALUE	REPAIRABLE LEVEL	SERVICE LIMIT	REMEDY
A	O.D. of sprocket	ø 988 (38.9)	ø 978 (38.5)	ø 976 (38.4)	Reinforcement weld, repair or replace.
B	Width of sprocket teeth	$116\ ^{0}_{-3}$ ($4.567\ ^{0}_{-0.118}$)	110 (4.33)	108 (4.25)	Replace.
C	O.D. of sprocket bottom	ø 879.1 (34.61)	ø 870 (34.3)	ø 868 (34.2)	Reinforcement weld, repair or replace.

34.2.3.1 DISASSEMBLY

(1) Removing cap (11)
Fix the motor on a stable work bench, loosen eight socket bolts (16) and remove cap (11).
Next, remove spring seat (10), spring (9) and spring seat (8).

: 10 mm

Note

Cap (11) is pressed out by spring (9). Therefore, do the work, taking care of the following.

- Loosen socket bolts (16) evenly all round.
- Loosen socket bolts (16), holding down cap (11).

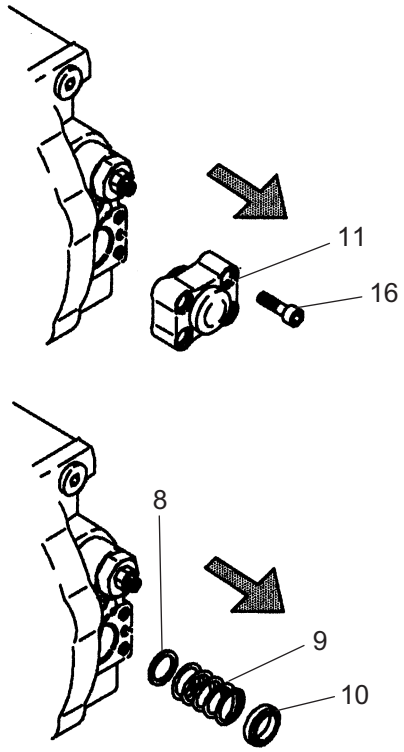


Fig. 34-18 Removing the cap assy

(2) Removing spool assy (3)
Push the end of spool (3) lightly so part of spool (3) comes out of base plate (2). Then, hold the end of spool (3) by hand and draw out spool (3) from base plate (2), while turning it by hand.

Note

Spool assy (3) and base plate (2) are combined to a very small fit. For this reason, execute the work, paying attention to the following.

- In case spool assy (3) gets stuck halfway and does not come out, do not try to force it out. If it is pulled out by force, the bore surface of base plate (2) and the outer surface of spool assy (3) are scored.
  In case plunger gets stuck halfway, do as follows:
  Put spool assy (3) back into base plate (2) by lightly tapping the end face of it with plastic mallet. Then make sure that the spool assy (3) moves smoothly and draw out the spool assy (3) once again, turning it by hand.
- Do not disassemble spool assy (3) unless it is necessary; the outer surface of it may be scored at disassembly.

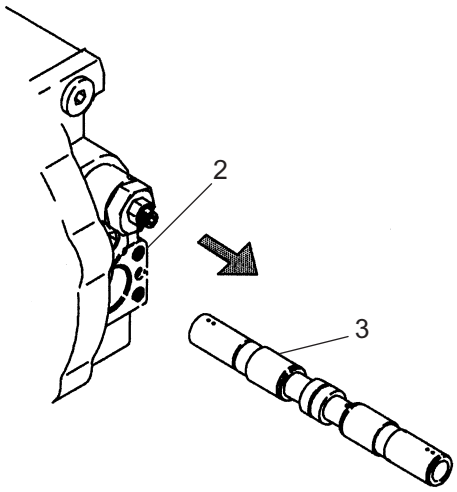


Fig. 34-19 Removing double counterbalance valve spool (3)

3) Install 9 piston assemblies (47) to retainer plate (48) directing tapered face around retainer plate (48) downward.

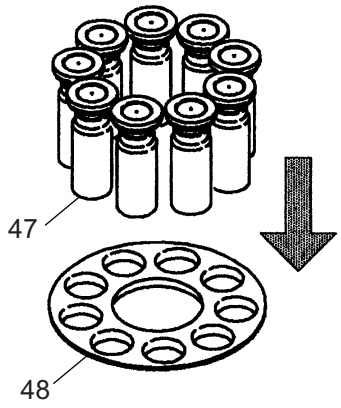


Fig. 34-42 Installing piston assy (47)

4) Install piston assy (47) and retainer plate (48) to cylinder block (45).

Note

Coat the piston holes (9 pcs.) in cylinder block (45) with hydraulic oil, before installing piston assy (47).

- Coat the spherical surface of retainer plate (48) with hydraulic oil, before assembling it.

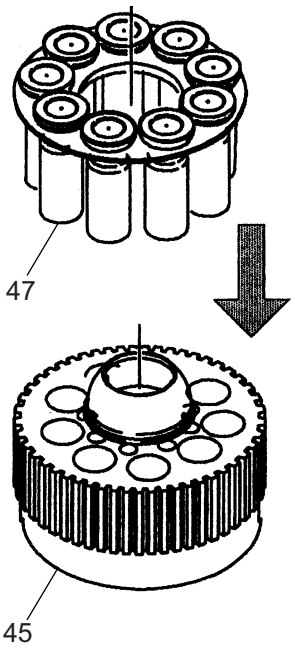


Fig. 34-43 Assembling retainer plate (48)

(8) Assembling cylinder block (45)
Engage the inner tooth splines of retainer holder (49) and cylinder block (45) with the outer tooth spline of shaft (44) so the sliding surface of cylinder block (45) in contact with valve plate (46) faces upwards. Then assemble cylinder block (45) into casing (1).

Note

At assembly, take care so piston assy (47), retainer plate (48) and retainer holder (49) do not come off from cylinder block (45).

- Before assembly, coat the surface of swash plate (50) and the sliding surface of piston assy (47) with hydraulic oil.

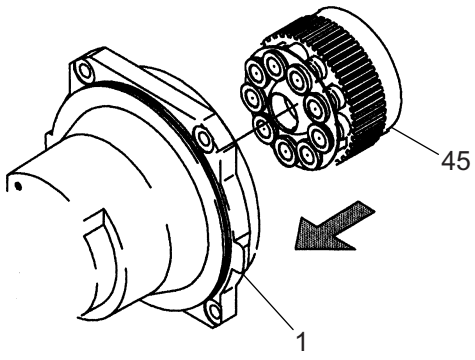
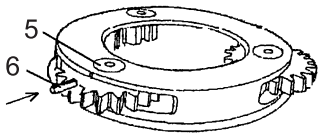


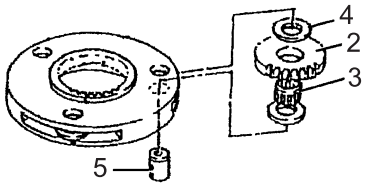
Fig. 34-44 Assembling cylinder block (45)

(3) Disassembly of the carrier assy

1) Press spring pin (6) down into shaft A (5) and remove the shaft A (5) (with spring pin) from carrier A (1).



2) Remove planetary gear A (2), needle bearing (3), thrust washer (4) and washer (7) out of carrier A (1).
Disassemble 2nd & 3rd stage in the same way. But needle bearings are not used in 2nd and 3rd stage



TROUBLE	PROBABLE CAUSE	REMEDY
Oil leak	Bolts in matching surface loosen. This developed oil leakage.	Retighten fastening bolts to a specified torque.
	Oil is leaking as oil seal, O-ring and packing are broken.	Disassemble and replace seals. Confirm the temperature of hydraulic oil. In case the operating oil temperature has risen above 80°C (176°F), check the cooler and cool down the hydraulic oil temperature below 80°C (176°F).
	Since the sliding surface of piston motor is worn, the drain rate increased. This caused the oil seal to break and developed an oil leak.	Disassemble and check the worn condition of sliding surface. Repair or replace according to the shop manual. Review oil seals. Clean parts and reassemble.
	Drain pressure increases as drain pipe is stuck with foreign matter or drain pipe is too small or long. This caused oil seal to break and developed an oil leak.	Disassemble and replace oil seals. Clean drain pipe and eliminate foreign matter. Review piping system so as to decrease the line resistance.
Abnormal sound and revolution and pressure variations occur due to cavitation.	Hydraulic oil level in hydraulic tank fell, entrapped air and developed aeration.	Confirm the hydraulic oil level in hydraulic oil tank and refill hydraulic oil according to the instructions of the machine proper.
	Motor is installed improperly or the location of hydraulic oil tank is improper. Therefore, hydraulic oil is discharged from motor piping and motor circuits while the hydraulic device is not running. The motor developed aeration immediately after motor was driven.	Confirm the motor orientation and if it is wrong, correct it to the correct orientation. Check that the oil level in the hydraulic oil tank is above the motor level and if not, fill oil higher than the motor level. Before running, place a self supply circuit so hydraulic oil is filled up in motor circuit and piping.
	When motor makes pumping action, motor inlet pressure becomes negative due to malfunctioning double counterbalance valve. This causes the motor to develop cavitation.	Disassemble and repair or replace double counterbalance valve according to the shop manual.
Motor stopped while running	Engine stalled because of too much load.	Review load condition and change it to a suitable level.
	Motor stalled as the sliding surface of piston motor was seized.	Check the spec (flow and motor revolution in particular). if the motor revolution exceeds a limit value, decrease the flow. Replace motor as insides of motor are broken beyond reuse.

46.2 CLASSIFICATION OF FAILURE AND TROUBLESHOOTING

Classify failures into the following 3 types and carry out the troubleshooting.

No.	Classes of failure	Troubleshooting
A	When error code after self-diagnosis is displayed on gauge cluster	Carry out troubleshooting according to the error code.
B	When no failure is detected currently but error code after self diagnosis is remained in trouble history	When it is hard to recreate the failure situation, cancel the data in the history and reproduce the failed situation or suppose the cause according to the troubleshooting by error code, and then repair it.
C	When error code after self diagnosis is not displayed or is not remained in the history	• Carry out troubleshooting according to instructions in Chapter 47 "TROUBLESHOOTING BY TROUBLE". • Carry out troubleshooting according to instructions in Chapter 48 "TROUBLE DIAGNOSIS MODE".

46.3 THE BLOWN FUSE OF MECHATRO CONTROLLER

If the fuse of mechatro controller has blown, the following display appears on the gauge cluster.

(1) The blown fuse of mechatro controller

a. Blown fuse 5A of mechatro controller :
"DATA COMMUNICATION ERROR" is displayed on the gauge cluster in the condition where the controller program is not executed.

b. Blown fuse 20A of mechatro controller
The controller functions normally but the power supply applied when the controller drives the solenoid, etc. stops.
Many error codes are displayed on the gauge cluster.
D013, D023, D033, D063,
E013, E023, F021

46.4 TROUBLESHOOTING BY ERROR CODE

When error code was displayed on the gauge cluster with the aid of self-diagnosis display function, carry out the troubleshooting referring to applicable page in the contents of error codes.

Error Code	Trouble	Described page
A015	Engine adjustment (A adjustment) is not adjusted yet or is failed.	46-7
A025	Pump propo. valve adjustment (B adjustment) is not adjusted yet or is failed.	46-7
A215	Written data of ROM adjustment data is incorrect.	46-8
A225	Writing of ROM adjustment data is incorrect.	46-8
A235	Written data of ROM hour meter data is incorrect.	46-9
A245	Writing of ROM hour meter data is incorrect.	46-9
A255	Writing of proportional valve adjustment data is incorrect.	46-10
B012	Incorrect output of boom up pressure sensor	46-10
B013	Disconnection of boom up pressure sensor	46-11
B014	Short-circuit of boom up pressure sensor	46-11
B022	Incorrect output of boom down pressure sensor	46-12
B023	Disconnection of boom down pressure sensor	46-12
B024	Short-circuit of boom down pressure sensor	46-13
B032	Incorrect output of arm out pressure sensor	46-13

Table 46-15

Error code		B033		
Trouble		Arm-out pressure sensor's wiring is disconnecting.		
Judging condition		The input voltage from arm-out pressure sensor is 0.1V or less.		
Symptom		Shock at stopping of arm-out is great.		
Control in the event of failure		Set proportional valve output rate of P1 and P2 pumps to 0mA. (Hydraulic pump emergency mode) Set output of P1 unload proportional valve to 0mA. (Valve emergency mode)		
Returned in normal condition		It returns automatically in normal condition.		
Service diagnosis checking screen		Screen No.	5	B-3 ARM OUT
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	• Arm-out pressure sensor SE-8			When B033 is cancelled and other error occurs after exchanging the connector with other sensor. Check sensor unit for possible failure. If failure found, replace it.
2	• Wiring between arm-out pressure sensor and controller CN-131F CN-101F			When B033 is displayed 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	• Mechatro controller			Check that the error is corrected after replacement of controller.

Table 46-16

Error code		B034		
Trouble		Arm-out pressure sensor's power source is shortcut.		
Judging condition		The input voltage from arm-out pressure sensor is 4.7V or more.		
Symptom		Shock at stopping of arm-out is great.		
Control in the event of failure		Set proportional valve output rate of P1 and P2 pumps to 0mA. (Hydraulic pump emergency mode) Set output of P1, P2 unload proportional valves to 0mA. (Valve emergency mode)		
Returned in normal condition		It returns automatically in normal condition.		
Service diagnosis checking screen		Screen No.	5	B-3 ARM OUT
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	• Arm-out pressure sensor SE-8			When B034 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 arm-out pressure sensor and controller CN-131F CN-101F			When B034 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	• Mechatro controller			Check that the error is corrected after replacement of controller.

Table 46-35

Error code		B162		
Trouble		P1 side option pressure sensor outputs error		
Judging condition		After starter switch ON and engine does not start yet. And the input voltage from the P1 side option pressure sensor after starter switch ON is in the range of 1.4V or more to less than 4.7V.		
Symptom		The P1 side option 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.	6	B-16 P1 OPT.
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	• P1 side option pressure sensor SE-20			When B162 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 B162 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. 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.

Table 46-36

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 0mA. (Hydraulic pump emergency mode) Set output of P1 unload proportional valve to 0mA. (Valve emergency mode) 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.	6	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	• Mechatro controller			Check that the error is corrected after replacement of controller.

Table 46-55

Error code	D132			
Trouble	Failure of output transistor ON at arm variable recirculation proportional valve.			
Judging condition	The feed-back value from proportional valve is 1000mA or more.			
Symptom	Operation of arm in becomes slow.			
Control in the event of failure	Arm variable recirculation proportional valve outputs 0mA with mechatro controller.			
Returned in normal condition	It returns automatically in normal condition.			
Service diagnosis checking screen	Screen No.	16	D-12 Arm variable recirculation proportional valve	
	Screen No.			
	Screen No.			
Checking object			Checking contents and remedy	
1	• Arm variable recirculation proportional valve PSV-A		In case that D132 is cancelled, and other error occurs by exchanging the connector with other proportional valve connector. Check proportional valve unit for possible failure. If failure found, replace it.	
2	• Wiring between arm variable recirculation proportional valve and controller CN-145F CN-105F		In case that D132 is displayed continuously after the connector is exchanged with connector of other proportional 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.	

Table 46-56

Error code	D133			
Trouble	Disconnection of wiring at arm variable recirculation proportional valve.			
Judging condition	The feed-back value from proportional valve is 100mA or less.			
Symptom	Operation of arm in becomes slow.			
Control in the event of failure	Arm variable recirculation proportional valve outputs 0mA with mechatro controller.			
Returned in normal condition	It returns automatically in normal condition.			
Service diagnosis checking screen	Screen No.	16	D-12 Arm variable recirculation proportional valve	
	Screen No.			
	Screen No.			
Checking object			Checking contents and remedy	
1	• Arm variable recirculation proportional valve PSV-A		In case that D133 is cancelled, and other error occurs by exchanging the connector with other proportional valve connector. Check proportional valve unit for possible failure. If failure found, replace it.	
2	• Wiring between arm variable recirculation proportional valve and controller CN-145F CN-105F		In case that D133 is displayed continuously after the connector is exchanged with connector of other proportional 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.	

Table 46-74

Error code		H014		
Trouble		Accel potentiometer's power source is shortcut.		
Judging condition		The input voltage from accel potentiometer is 4.7V or more.		
Symptom		LOW idling is fixed.		
Control in the event of failure		LOW idling is fixed.		
Returned in normal condition		It returns automatically in normal condition.		
Service diagnosis checking screen		Screen No.	2	H-1 ACCEL VOLT.
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	• Accel potentiometer SE-16			Measure the resistance between terminals of accel potentiometer. 1.6~2.4k Ω Turn the potentiometer and measure resistance between signal and GND.
2	• Wiring between accel potentiometer and controller CN-402F CN-102F			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.

Table 46-75

Error code		H081		
Trouble		Failure of grounding short-circuit at coolant temperature sensor.		
Judging condition		The input voltage of coolant temperature sensor becomes 0.1V or less.		
Symptom		Rotation number of fan is held in maximum speed.		
Control in the event of failure		Fan is controlled according to hydraulic oil temperature sensor. When hydraulic oil temperature sensor is broken down, fan pump proportional valve outputs 500mA with mechatro controller.		
Returned in normal condition		It returns automatically in normal condition.		
Service diagnosis checking screen		Screen No.	2	Engine coolant temperature
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	• Coolant temperature sensor SE-14			Check sensor unit for possible failure. If resistance value is without 10 to 900 ohm, replace it.
2	• Wiring between arm variable recirculation potentiometer and controller T-2 CN-104F			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.

Table 46-90

Error code	R144			
Trouble	Swing flasher relay error			
Judging condition	The mechatro controller output line to swing flasher relay is short-circuited with the power source.			
Symptom	Left swing flasher does not light.			
Control in the event of failure	Relay output is stopped.			
Returned in normal condition	When the power is OFF			
Service diagnosis checking screen	Screen No.	22	D14	
	Screen No.			
	Screen No.			
Checking object			Checking contents and remedy	
1	• Swing flasher relay R-19		When error is cancelled after removing connector (CN-74F) of swing flasher relay, check relay unit for failure, replace it with new one if failed. When resistance between relays (HB) and (HC) is 0 Ω, it is in abnormal condition. 	
2	• Wiring between swing flasher relay and controller CN-74F, CN-109F		When R144 is left displayed with the relay removed Check that no power 24V is produced on relay (-) line (as shown right upper figure B) according to the wiring checking procedure and replace it if necessary.	
3	• Mechatro controller		Check that the error is corrected after replacement of controller.	

Table 46-91

Error code	R154			
Trouble	Travel alarm relay error			
Judging condition	The mechatro controller output line to travel alarm relay is short-circuited with the power source.			
Symptom	Travel alarm does not actuate.			
Control in the event of failure	Relay output is stopped.			
Returned in normal condition	When the power is OFF			
Service diagnosis checking screen	Screen No.	23	D15	
	Screen No.			
	Screen No.			
Checking object			Checking contents and remedy	
1	• Travel alarm relay R-8		When error is cancelled after removing of travel alarm relay, check relay unit for failure, replace it with new one if failed. When resistance between relays (1) and (2) is 0 Ω, it is in abnormal condition. 	
2	• Wiring between travel alarm relay and controller CN-109F, CN2-2 •Fuse & relay box E-1		When R154 is left displayed with the relay removed Check that no power 24V is produced on relay (-) line according to the wiring checking procedure and replace it if necessary. When no failure found after checking on wiring and R154 is left displayed. Replace fuse/relay box.	
3	• Mechatro controller		Check that the error is corrected after replacement of controller.	

(4) Poor fine operability

No.	Sections	Contents/normal value		Corrective action, others
1	Pressure sensor	Carry out service diagnosis	•See Service Diagnosis Data List Operation No. 1 Operation is nil •All low pressure sensors are 0MPa to 0.1MPa	Replace pressure sensor
2	Actual measuring current value of P1/P2 pump proportional valve	Carry out service diagnosis	•No.9 E-1 P1 pump E-2 P2 pump •See Service Diagnosis Data List Operation No. 1 Operation is nil	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
3	Secondary pressure of P1, P2 pump proportional valve	Measure the pump proportional valve secondary pressure directly. (Ports a3, a4)	Check that P1/P2 pump proportional valve pressures are within the range of 0.5~1.0MPa in control lever neutral and high idling operation	Replace proportional valve Check regulator
4	Slow return check valve of pilot line (in case of boom up or arm out)	Visual check	Check that slow return check valve installed on pilot line is free from dust entered	Clean and replace

(5) Slow boom up, insufficient power

No.	Sections	Contents/normal value		Corrective action, others
1	Boom up pressure sensor	Carry out service diagnosis	•See Service Diagnosis Data List Operation No.3 boom up full lever and relief	Check and replace pressure sensor Check remote control valve
2	Remote control valve	Measure directly remote control pressure of boom up	Check that pressure is 3.0MPa or more in boom up full lever and high idling operation	Check remote control valve When equipped with multi control valve, check it while changing lever pattern
3	Pump pressure sensor	Carry out service diagnosis for P1, P2 pump pressures in operation.	•See Service Diagnosis Data List Operation No.4 boom up full lever and in operation	When there is difference between P1 and P2 pump pressures, check high pressure sensor.
4	Actual measuring current value of P1/P2 pump proportional valve	Carry out service diagnosis	•No.9 E-1 P1 pump E-2 P2 pump •See Service Diagnosis Data List Operation No.4 boom up full lever & in operation	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure.
5	Secondary pressure of P1, P2 pump proportional valve	Measure the pump proportional valve secondary pressure directly (Ports a3, a4)	Check that P1/P2 pump proportional valve pressures are within the range of 1.8 to 3.0MPa in boom up full lever and high idling operation	Replace proportional valve
6	P2 by-pass cut valve <Trouble> Only P2 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 and replace
7	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage	Replace
8	Lock valve poppet <Trouble> Both P1 and P2 pressures are 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)

(15)Travel speed is slow/poor

No.	Sections	Contents/normal value		Corrective action, others
1	Travel right and left pressure sensor	Carry out service diagnosis	•See Service Diagnosis Data List Operation No.18 Travel right full lever and idling Operation No.19 Travel left full lever and idling	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 travel right (left), forward (reverse) full lever and high idling operation	Check remote control valve
3	Actual measuring current value of P1/P2 pump proportional valve	Carry out service diagnosis	•No.9 E-1 P1 pump E-2 P2 pump •See Service Diagnosis Data List Operation No.18 Travel right full lever & idling Operation No.19 Travel left full lever & idling	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 pump proportional valve	Measure the pump proportional valve secondary pressure directly (Ports a3, a4)	Check that P1/P2 unload secondary pressures are within the range of followings in travel right (left), forward (reverse) full lever and high idling operation Travel right (P1 pump): 2.7MPa or more Travel left (P2 pump): 2.7MPa or more	Replace proportional valve
5	Actual measuring current value of travel straight proportional valve	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 voltage of low pressure sensor other than sensor for travel •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	0.8MPa or less in high idling operation regardless of neutral/operation	Replace proportional valve
7	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage Check sealing ability of shuttle valve and entry of dust in orifice	Replace
8	Travel straight spool <Trouble> P1 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)
9	Travel spool <Trouble> Pump pressure is high.	Visual check of targeted spool	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)
10	Travel motor relief valve	Check set pressure	Check P1 and P2 pump pressures are 32MPa or more in right and left travel levers full lever (relief operation at locked crawler belt) and high idling	If P1 is low, right travel motorÅfs relief valve is failed. If P2 is low, left travel motorÅfs relief valve is failed.

47.2.2 TROUBLE

(1) Engine does not stop.

(2) "CPU DATA COMMUNICATION ERROR" is displayed on multi display.

(3) Auto accel does not actuate. (The engine speed does not automatically slow down.)

(4) Auto accel does not actuate. (The engine speed does not automatically speed up.)

(5) Wiper does not function.

Foreword and general information

(Rev. 2005/11)

Safety notice

Important safety notice

Proper service and repair are extremely important for safe machine operation. The service and repair techniques recommended by Komatsu and described in this manual are both effective and safe. Some of these techniques require the use of tools specially designed by Komatsu for the specific purpose.

To prevent injury to workers, the symbol ⚠ is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

1. General precautions

⚠ Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully before operating the machine.

1) Before carrying out any greasing or repairs, read all the safety plates stuck to the machine. For the locations of the safety plates and detailed explanation of precautions, see the Operation and Maintenance Manual.
2) Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt, water, or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.
3) When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear safety glasses when hitting parts with a hammer.
   - Always wear safety glasses when grinding parts with a grinder, etc.
4) When carrying out any operation with 2 or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs in the operator's compartment.
5) Only qualified workers must carry out work and operation which require license or qualification.
6) Keep all tools in good condition, learn the correct way to use them, and use the proper ones of them. Before starting work, thoroughly check the tools, machine, forklift, service car, etc.
7) If welding repairs are needed, always have a trained and experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, shielding goggles, cap and other clothes suited for welding work.
8) Before starting work, warm up your body thoroughly to start work under good condition.

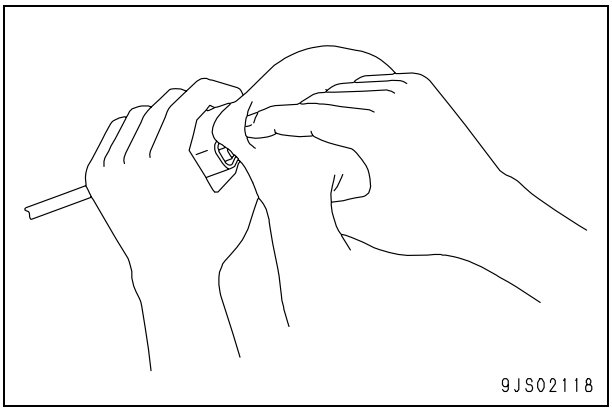
Safety points

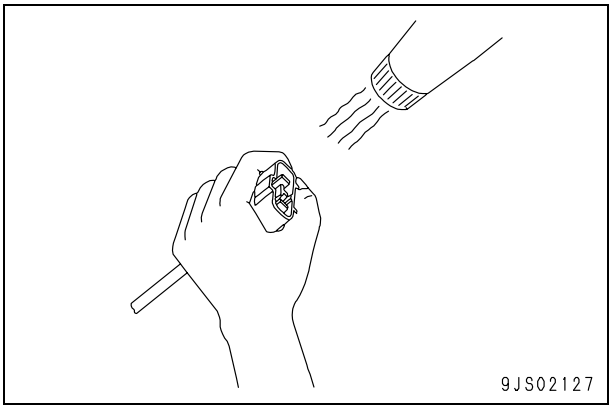
1	Good arrangement
2	Correct work clothes
3	Following work standard
4	Making and checking signs
5	Prohibition of operation and handling by unlicensed workers
6	Safety check before starting work
7	Wearing protective goggles (for cleaning or grinding work)
8	Wearing shielding goggles and protectors (for welding work)
9	Good physical condition and preparation
10	Precautions against work which you are not used to or you are used to too much

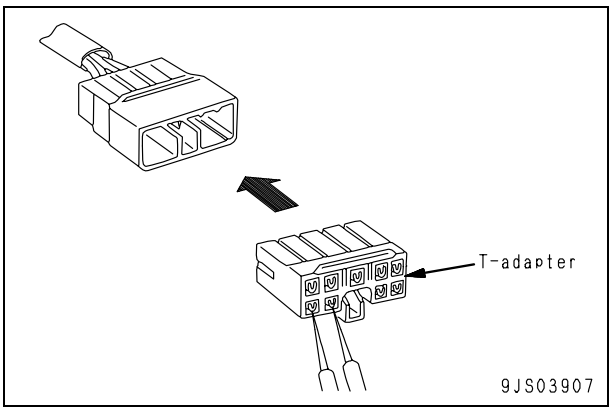
2. Preparations for work

1) When disassembling or assembling, support the machine with blocks, jacks, or stands before starting work.

4) Drying wiring harness
If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.
   1] Disconnect the connector and wipe off the water with a dry cloth.
      ★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.
   2] Dry the inside of the connector with a dryer.
      If water gets inside the connector, use a dryer to dry the connector.
      ★ Hot air from the dryer can be used, but regulate the time that the hot air is used in order not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.
   3] Carry out a continuity test on the connector.
      After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
      ★ After completely drying the connector, blow it with contact restorer and reassemble.







Liters to U.K. Gallons

1 ℓ = 0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.699	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

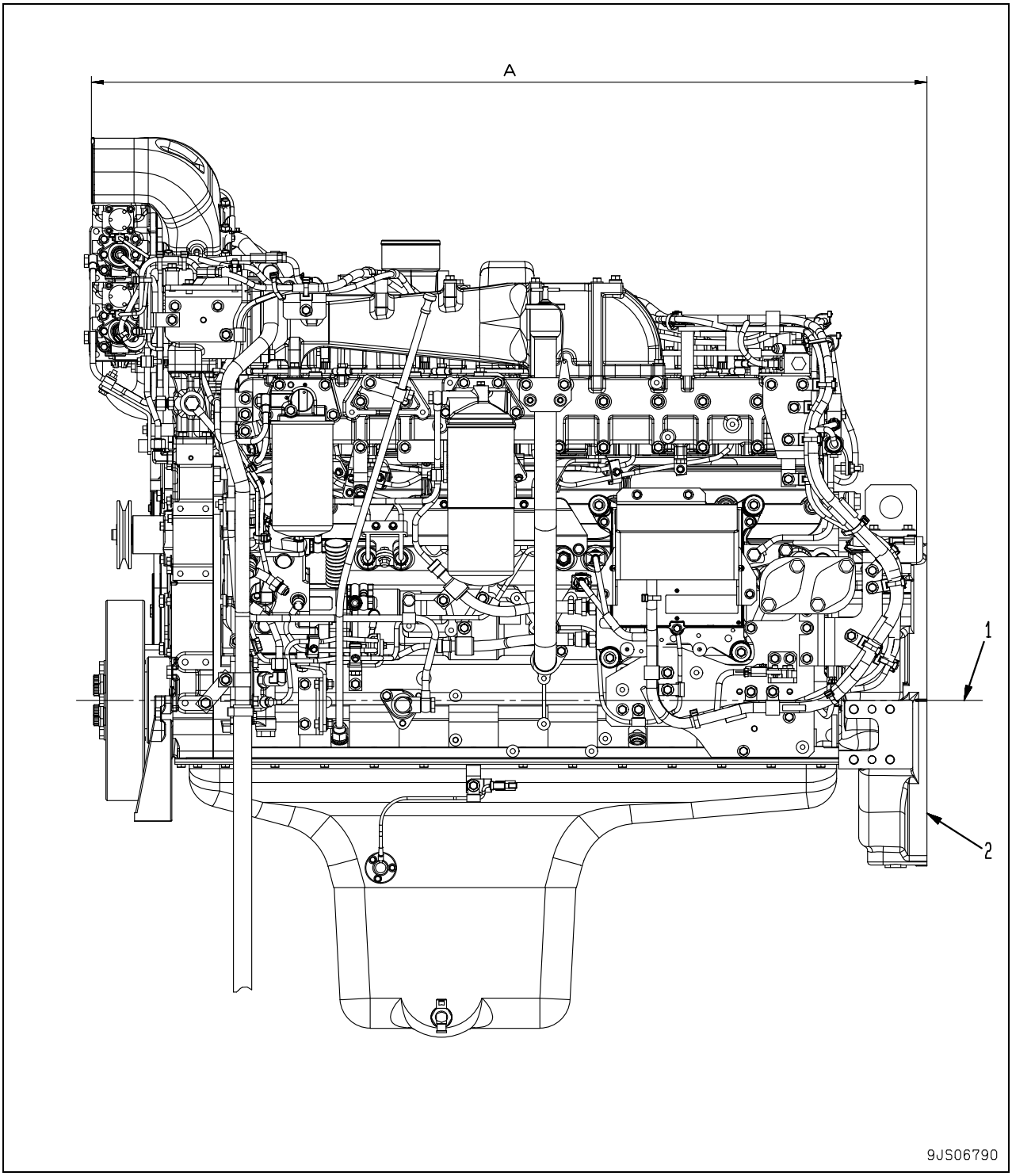
kgm to ft.lb

1 kgm = 7.233 ft.lb

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

General view

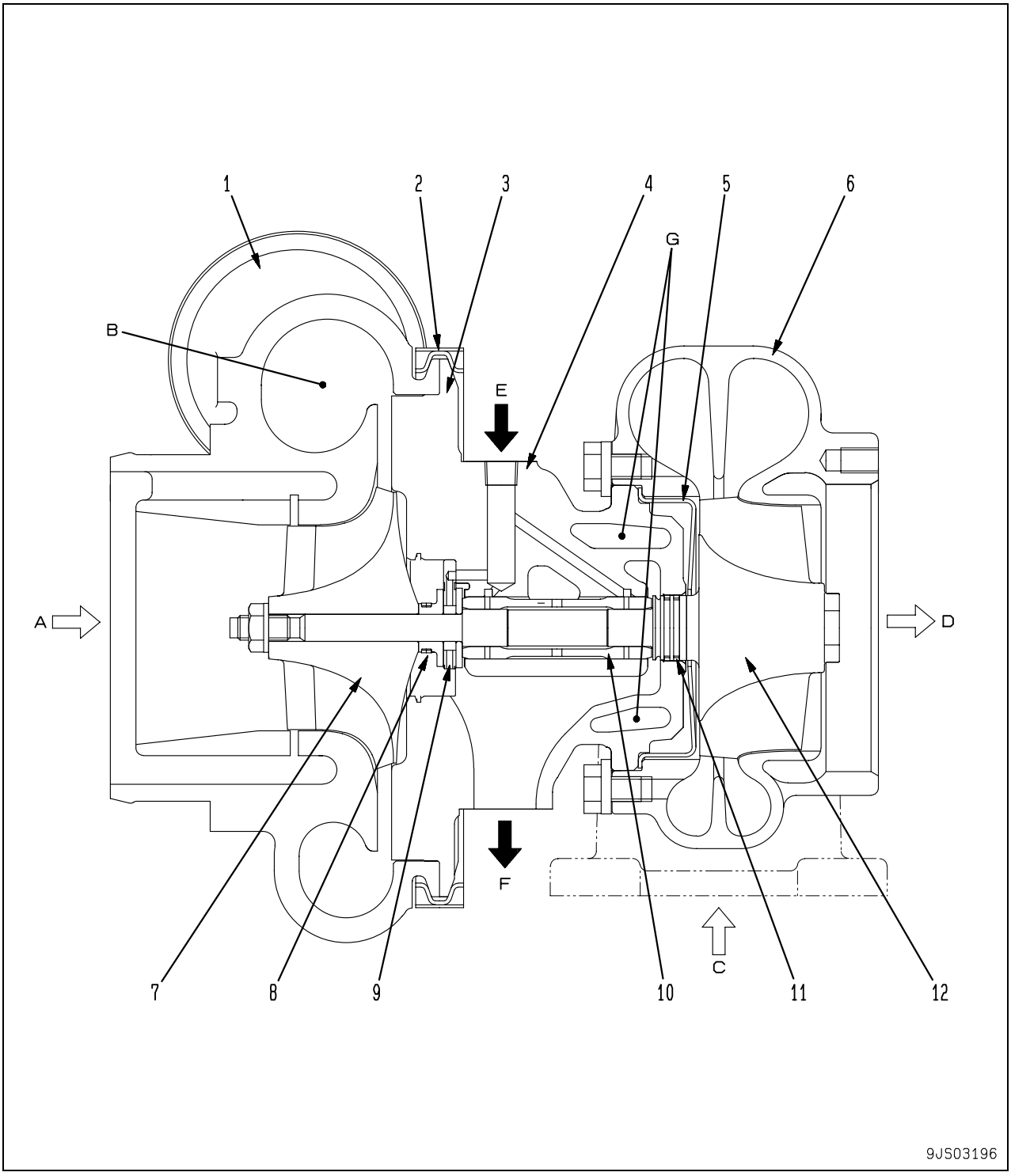
SAA6D140E-5 (Left side view of engine)
Machine model: For construction and industrial



★ The shape is subject to machine models.

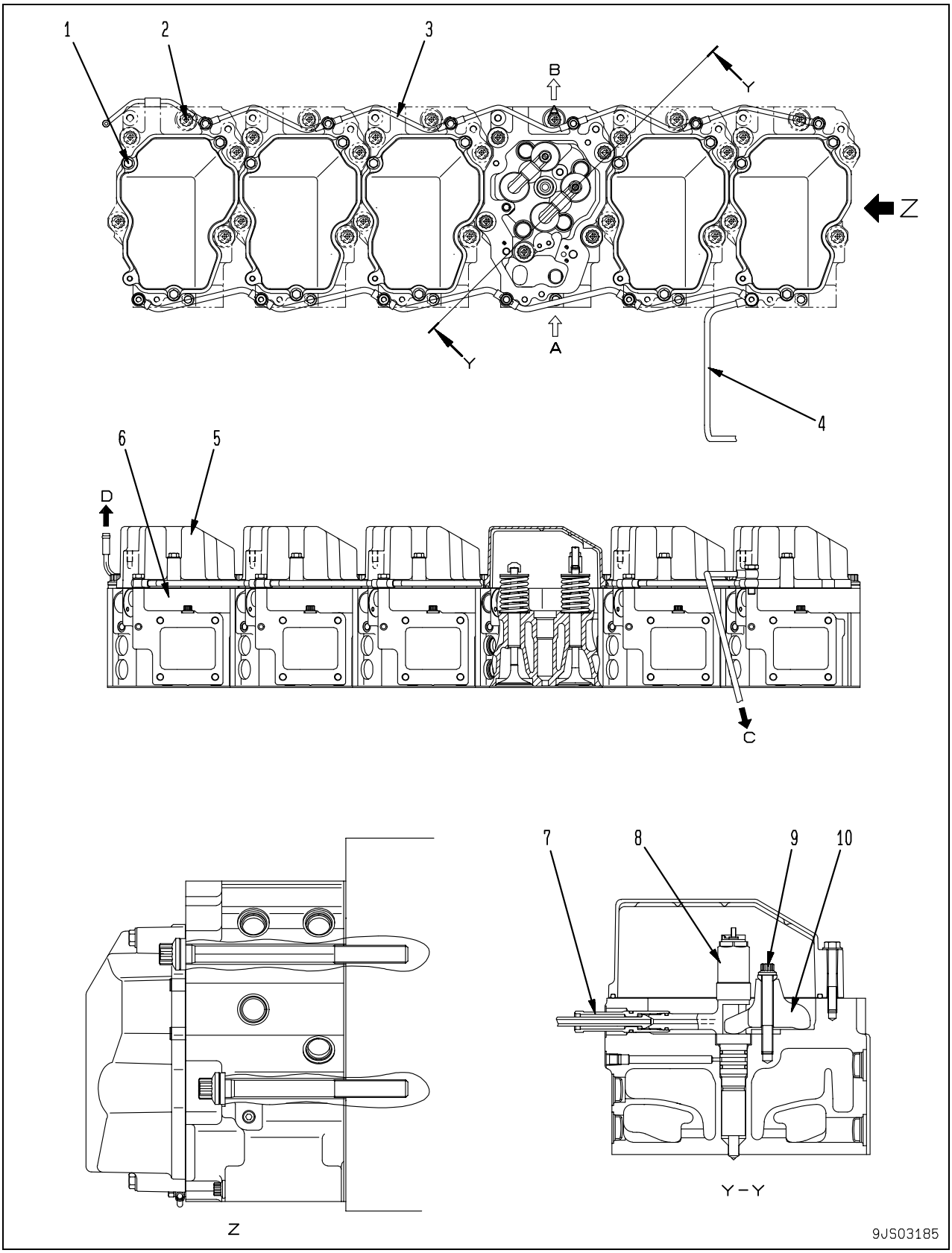
1. Center of crankshaft
2. Rear face of flywheel housing

Turbocharger
Model: KTR110L



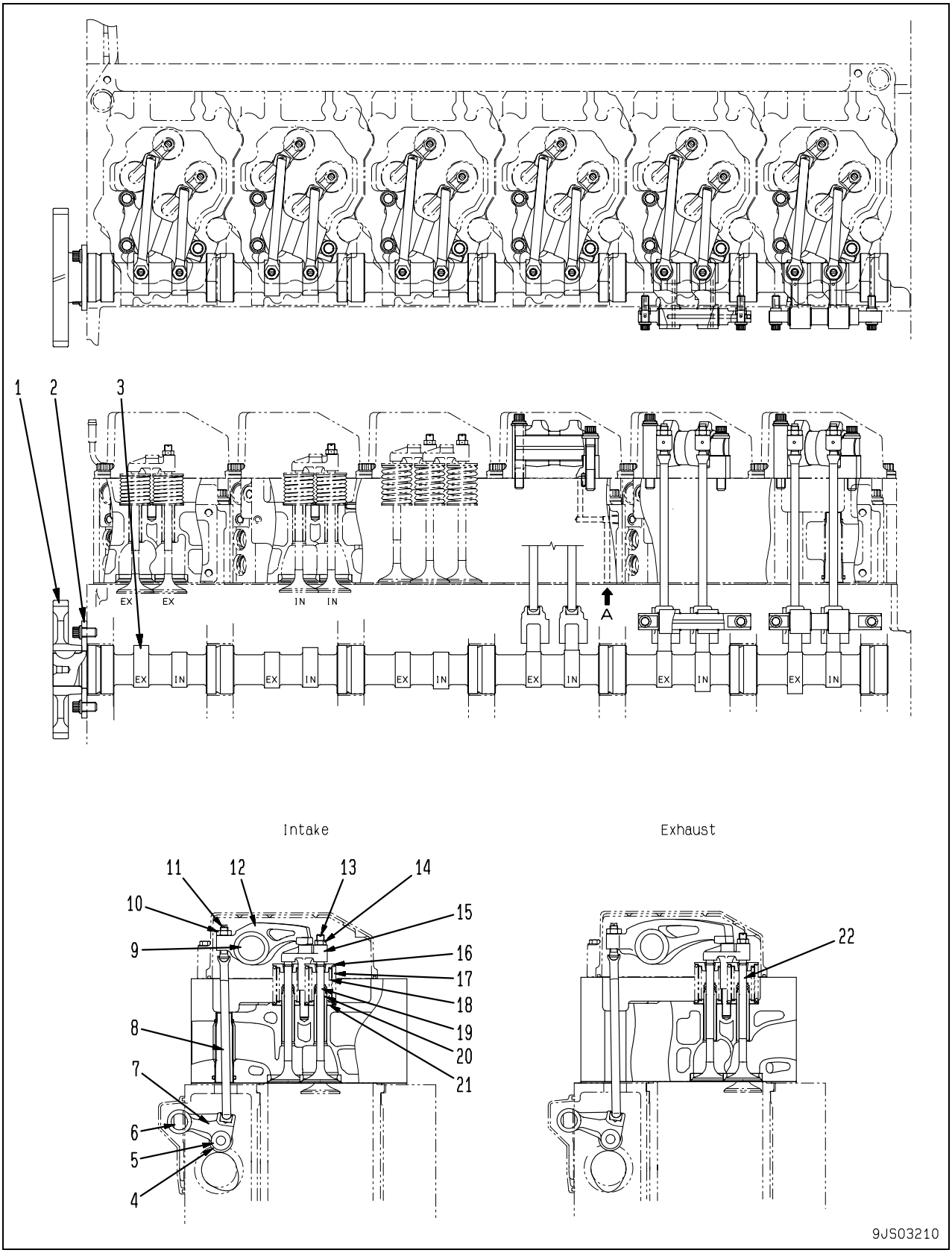
Engine unit

Cylinder head

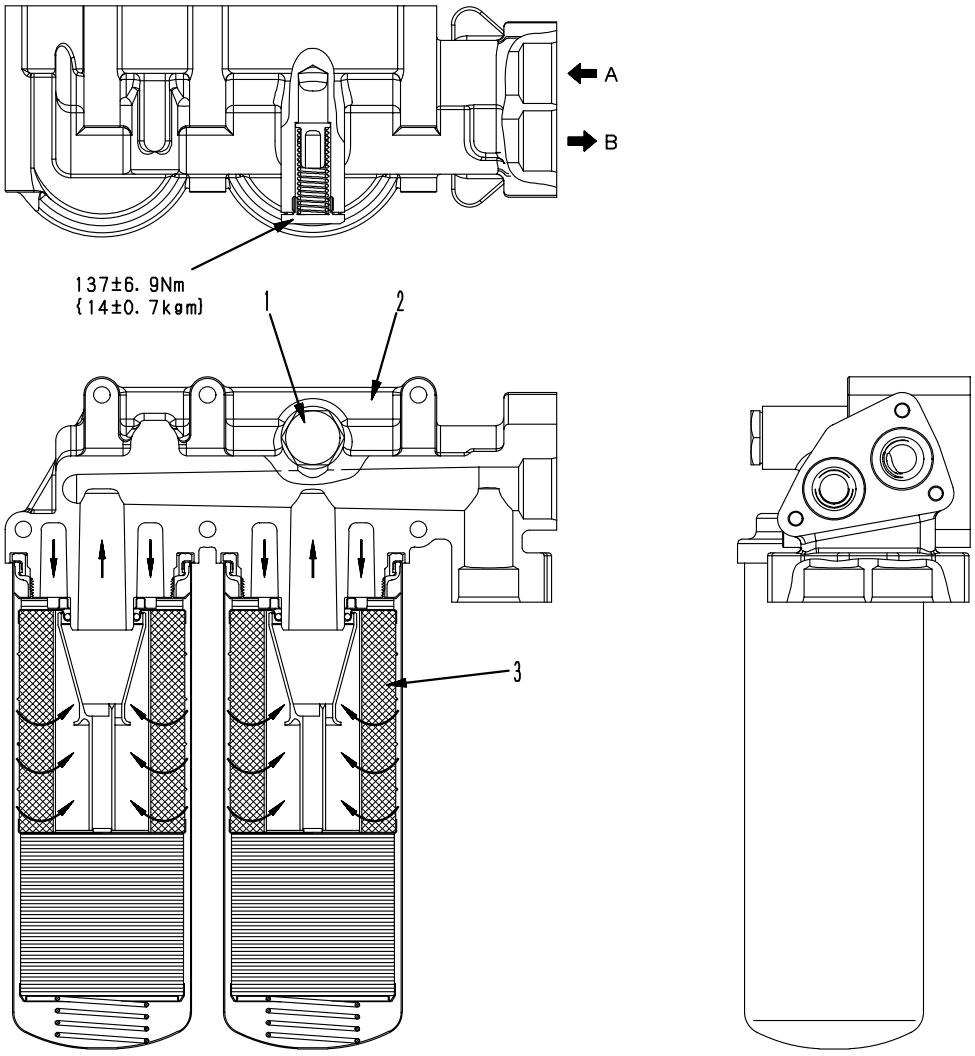


★ The shape is subject to machine models.

Valve system



Oil filter



★ The shape is subject to machine models.

A: Oil inlet
B: Oil outlet

1. Safety valve
2. Filter head
3. Cartridge

Specifications

Oil filter

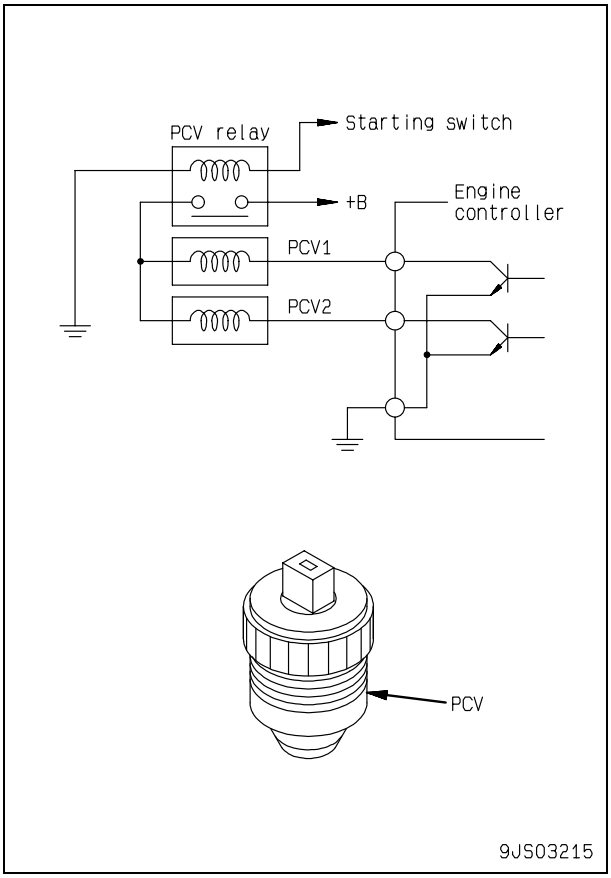
Filtration area: 0.44 m^2 (Full flow)

Safety valve

Cracking pressure: 343 ± 19.6 kPa {3.5 ± 0.2 kg/cm^2}

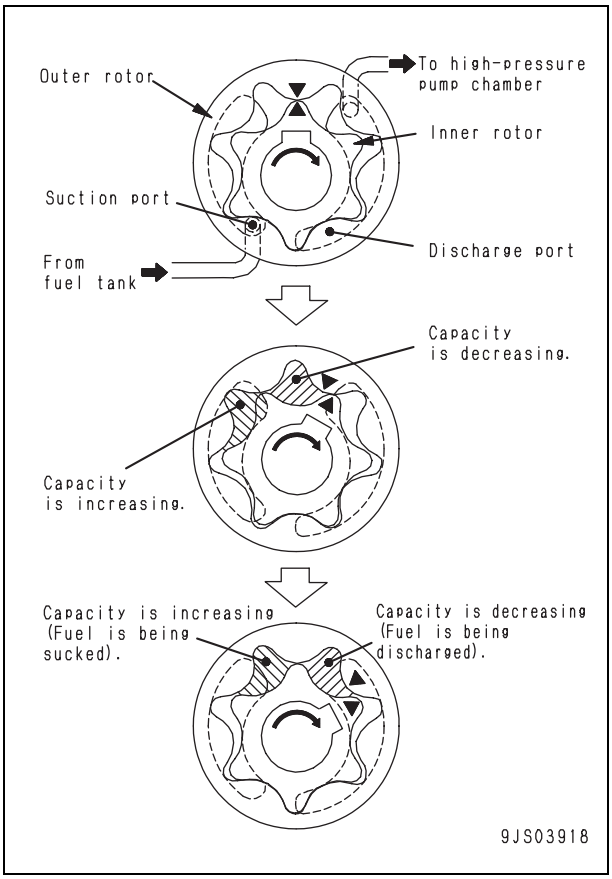
1) PCV (Pressure control valve)

- The PCV adjusts the fuel delivery from the fuel supply pump to adjust the common rail fuel pressure. The delivery from the fuel supply pump to the common rail is decided by the timing of energizing the PCV.



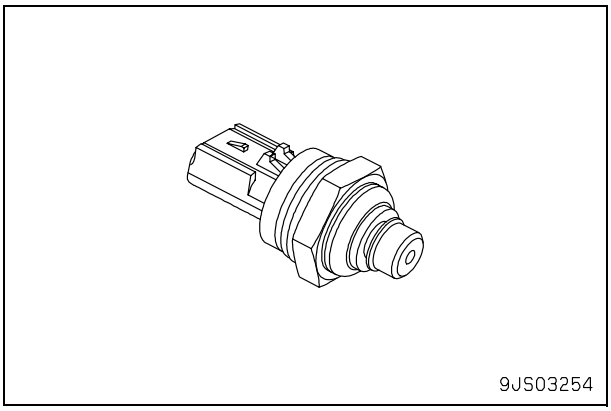
2) Feed pump

- The feed pump built in the fuel supply pump assembly draws the fuel from the fuel tank and sends it through the fuel filter to the high-pressure pump chamber.
- The outer and inner rotors of the feed pump are rotated by the camshaft.
- The fuel is sucked in on the suction side and discharged on the delivery side according to the increase and decrease of the spaces between the outer and inner rotors.

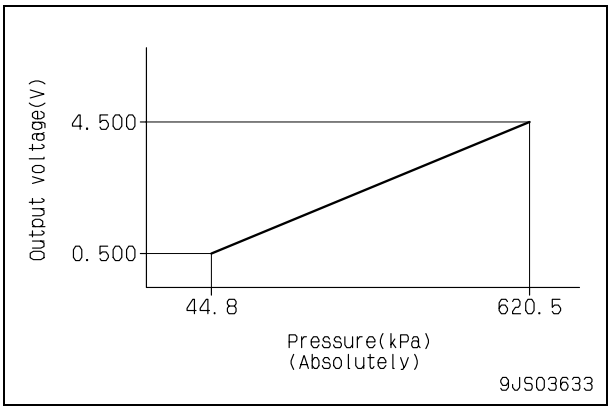


1) EGR inlet pressure sensor

- This sensor is used to sense the EGR pressure.



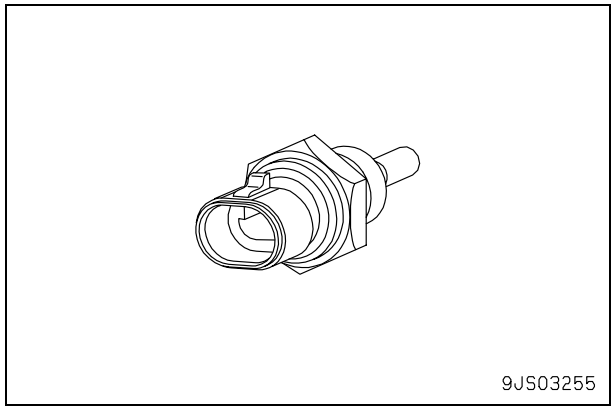
- The following graph shows the output characteristics of the EGR inlet pressure sensor.

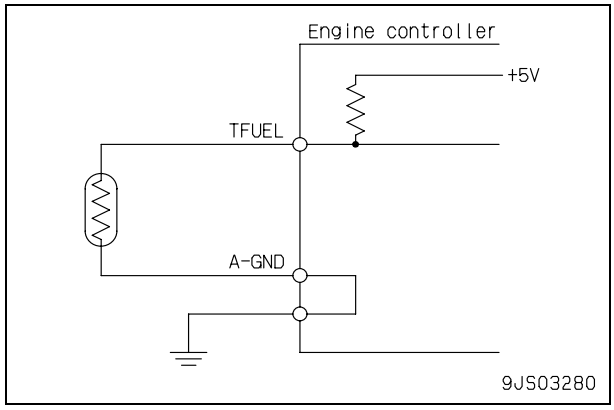


★ The EGR inlet pressure sensor may not be installed, depending on the applicable machine.

2) Fuel temperature sensor

- The fuel temperature sensor senses the fuel temperature and sends it to the engine controller. The sensor unit is a thermistor the resistance of which changes according to the temperature.
- The engine controller applies voltage to the thermistor and senses the temperature by the voltage divided by the resistance in the computer and the resistance of the thermistor.

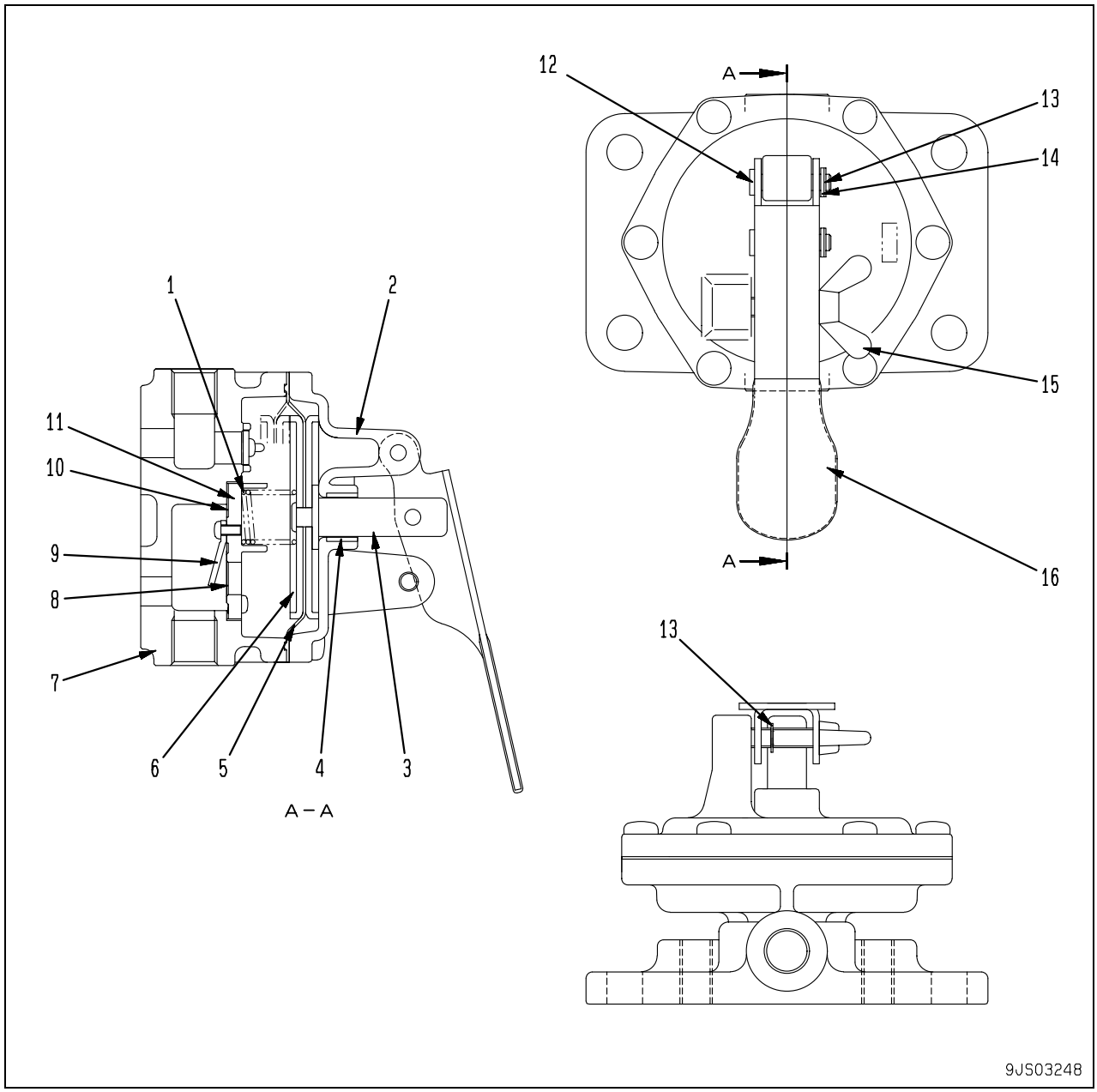




- Tightening torque for sensor:
  23 ± 3 Nm {2.3 ± 0.3 kgm}

Priming pump

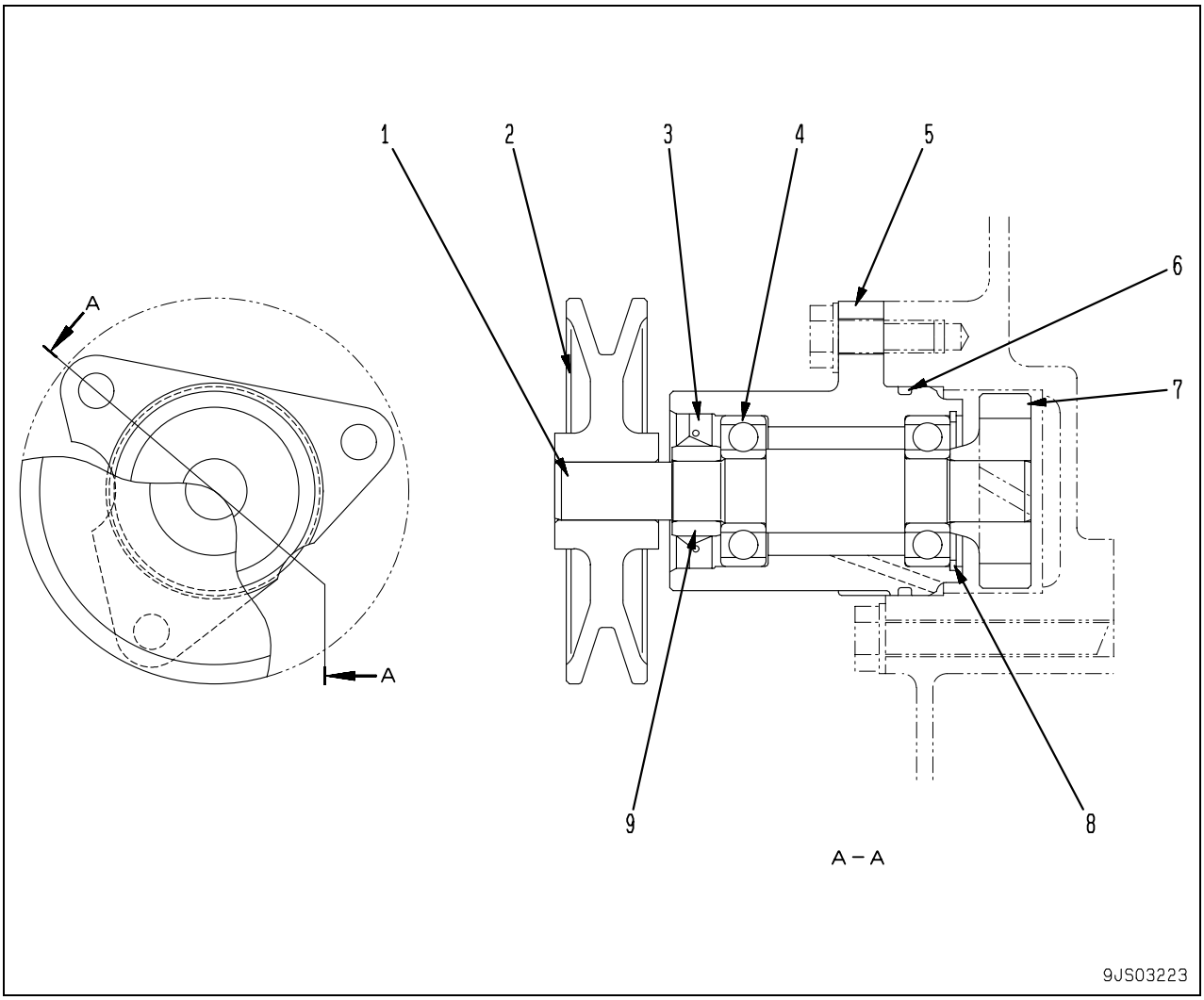
★ The priming pump may not be installed, depending on the applicable machine.



1. Spring
2. Cover
3. Shaft
4. Bushing
5. Diaphragm
6. Diaphragm cover
7. Body
8. Check valve
9. Valve stopper
10. Packing
11. Check valve body
12. Lever pin
13. E-ring
14. Washer
15. Bolt
16. Lever

Accessories

Front PTO



★ The shape is subject to machine models.

1. Shaft
2. Pulley
3. Oil seal
4. Bearing (2 pieces)
5. Housing
6. O-ring
7. Gear (Number of teeth: 14)
8. Snap ring
9. Sleeve

KOMATSU SAA6D140E-5 engine

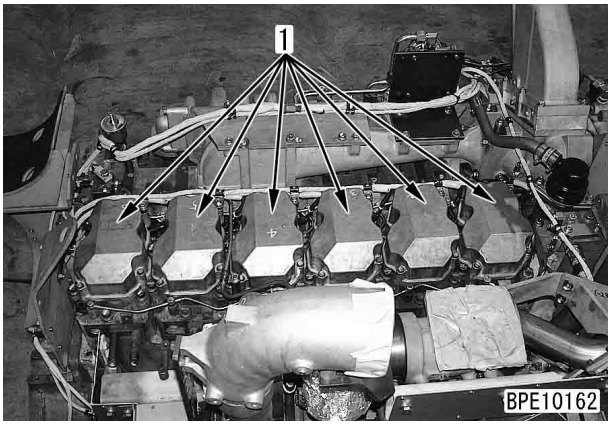
Form No. SEN01852-00

Adjusting valve clearance

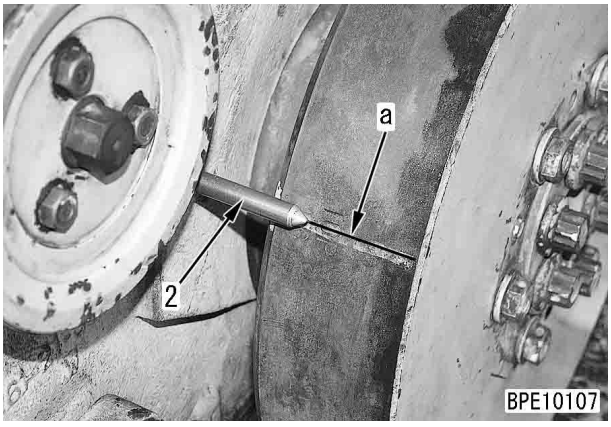
★ Adjusting tool for valve clearance

Symbol	Part No.	Part name
C	Commercially available	Thickness gauge

1. Remove 6 cylinder head covers (1).



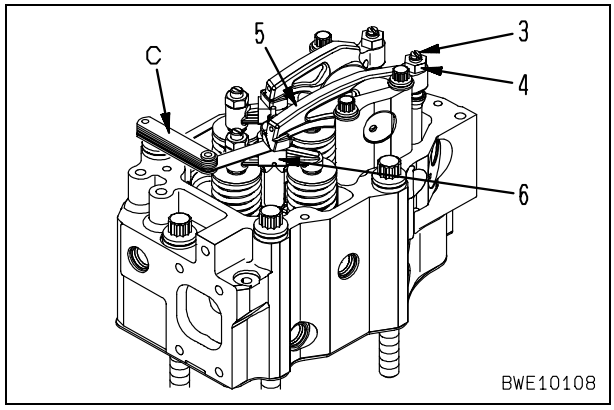
2. Rotate the crankshaft forward to bring the stamped “1.6TOP” line (a) of the damper to pointer (2) and set the No. 1 cylinder to the compression top dead center.
   ★ Rotate the crankshaft with the hexagonal part at the end of the water pump drive shaft.
   ★ When the No. 1 cylinder is at the compression top dead center, the rocker arm of the No. 1 cylinder can be moved by the valve clearance with the hand. If the rocker arm cannot be moved, rotate the crankshaft one more turn.



3. While fixing adjustment screw (3), loosen locknut (4).
   ★ After setting the No. 1 cylinder to the compression top dead center, adjust the valve clearance of the No. 1 cylinder.

4. Insert thickness gauge **C** in the clearance between rocker arm (5) and crosshead (6) and adjust the valve clearance with adjustment screw (3).
   ★ With the thickness gauge inserted, turn the adjustment screw to a degree that you can move the thickness gauge lightly.
   ★ Valve clearance
   Intake valve: 0.35 mm, Exhaust valve: 0.57 mm

5. While fixing adjustment screw (3), tighten locknut (4).
   Locknut: **45.1 – 51.0 Nm {4.6 – 5.2 kgm}**
   ★ After tightening the locknut, check the valve clearance again.



6. After adjusting the No. 1 cylinder, rotate the crankshaft forward by 120° and adjust the clearance of each cylinder according the firing order.
   ★ Firing order: 1 – 5 – 3 – 6 – 2 – 4

7. After finishing adjustment, return the removed parts.
   Cylinder head cover mounting bolt:
   29.4 – 34.3 Nm {3.0 – 3.5 kgm}

Testing fuel system for leakage

⚠ **Very high pressure is generated in the high-pressure circuit of the fuel system. If fuel leaks while the engine is running, it is dangerous since it can catch fire.**
After testing the fuel system or removing its parts, test it for fuel leakage according to the following procedure.

★ Clean and degrease the engine and the parts around it in advance so that you can test it easily for fuel leakage.

1. Spray color checker (developer) over the fuel supply pump, common rail, fuel injector, and joints of the high-pressure piping.

2. Run the engine at speed below 1,000 rpm and stop it after its speed is stabilized.

3. Inspect the fuel piping and devices for fuel leakage.
   ★ Inspect mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

4. Run the engine at low idle.

5. Inspect the fuel piping and devices for fuel leakage.
   ★ Inspect mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

6. Run the engine at high idle.

7. Inspect the fuel piping and devices for fuel leakage.
   ★ Inspect mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.

8. Run the engine at high idle and load it.
   ★ When testing the engine mounted on the machine, stall the torque converter or relieve the oil from the hydraulic pump.

9. Inspect the fuel piping and devices for fuel leakage.
   ★ Inspect mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and inspect again from step 1.
   ★ If no fuel leakage is detected, inspection is completed.

Error code (Display of lamps)	Failure phenomenon
553	Rail Press. High Error 1
559	No-pressure Feed By Supply pump 1
689	Eng. Ne Speed Sensor Error
731	Eng. Bkup Speed Sensor Phase Error
757	All Engine Controller Data Lost Error
778	Eng. Bkup Speed Sensor Error
1228	EGR Valve Servo Error 1
1625	EGR Valve Servo Error 2
1626	Bypass Valve Solenoid Drive Short Circuit Error
1627	Bypass Valve Solenoid Drive Open Error
1628	Bypass Valve Servo Error 1
1629	Bypass Valve Servo Error 2
1631	Bypass Valve Lift Sensor High Error
1632	Bypass Valve Lift Sensor Low Error
2185	Throttle Sens. Sup. Volt. High Error
2186	Throttle Sens. Sup. Volt. Low Error
2249	No-pressure Feed By Supply pump 2
2271	EGR Valve Lift Sensor High Error
2272	EGR Valve Lift Sensor Low Error
2351	EGR Valve Solenoid Drive Short Error
2352	EGR Valve Solenoid Drive Open Error
2555	Intake Air Heater Relay Open Error
2556	Intake Air Heater Relay Short Error

S-1 Starting performance is poor

General causes why starting performance is poor

- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel
- Coolant in exhaust pipe

★ The common rail fuel injection system (CRI) recognizes the fuel injection timing electrically. Accordingly, even if the starting operation is carried out, the engine may not start until the crankshaft revolves 2 turns at maximum. This phenomenon does not indicate a trouble, however.

			Causes														
			Clogged air cleaner element	Cracked EGR cooler (Coolant in exhaust pipe)	Defective contact of valve, vale seat	Worn piston ring, cylinder	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogged fuel filter, element	Clogged feed pump gauze filter	Stuck, seized supply pump plunger	Defective injector	Defective intake air heater system	Defective alternator (regulator section)	Defective alternator (generator section)	Defective, deteriorated battery
Questions	Confirm recent repair history																
	Degree of use of machine	Operated for long period	△	△					△	△						△
	Starting performance	Became worse gradually	○	○	◎	◎			○	○						
		Engine starts easily when warm											◎			◎
	Non-specified fuel is being used								○	○	○	○				
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎						◎	◎	○	○				
	Engine oil must be added more frequently					◎										
	When engine is preheated or when temperature is low, preheating monitor does not indicate normally (if monitor is installed)												◎			
	During operation, charge level monitor indicates abnormal charge (if monitor is installed)													◎	◎	
	Dust indicator is red (if indicator is installed)		◎													
	Air breather hole of fuel tank cap is clogged						◎									
	Fuel is leaking from fuel piping							◎			○					
	When priming pump is operated, it makes no reaction or it is heavy							◎	○	○						
	Starting motor cranks engine slowly			○												◎
	While engine is cranked with starting motor	If air bleeding plug of fuel filter is removed, fuel does not flow out							◎	◎						
		If spill hose from injector is disconnected, little fuel spills									◎					
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎				
	Engine does not pick up smoothly and combustion is irregular				○	○						◎				
	There is hunting from engine (rotation is irregular)						○	◎	○	○						
	Blow-by gas is excessive					◎										
Troubleshooting	Inspect air cleaner directly		●													
	When EGR cooler outlet gas piping is removed, coolant containing antifreeze flows out (*1)			●												
	When compression pressure is measured, it is found to be low				●	●										
	When air is bled from fuel system, air comes out							●								
	Inspect fuel filter, strainer directly								●							
	Inspect feed pump gauze filter directly									●						
	Carry out troubleshooting according to “No-pressure feed by supply pump (*2)” in E-mode										●					
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change											●				
	When starting switch is turned to HEAT, intake air heater mount does not become warm												●			
	Is voltage 20 – 30 V between alternator terminal B and terminal E with engine at low idle?	Yes												●		
		No													●	
	When specific gravity of electrolyte and voltage of battery are measured, they are low															●
		Remedy	Clean	Replace	Correct	Replace	Clean	Correct	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Replace

S-7 Exhaust gas color is black (incomplete combustion)

General causes why exhaust gas color is black

- Insufficient intake of air
- Excessive injection of fuel
- Defective condition of fuel injection
- Improper selection of fuel
- There is overheating
  → See “S-14 Coolant temperature becomes too high (Overheating)”
- Controller is controlling in derate mode (limiting injection rate (output) because of an error in electrical system)
- EGR valve is stuck open (There is much EGR gas and intake of air is insufficient)
- EGR gas pressure piping is clogged (Exhaust gas is mixed in intake air during acceleration and deceleration)

			Causes																	
			Clogged air cleaner element	Seized turbocharger, interference of turbocharger	Stuck EGR valve	Clogged EGR gas pressure piping	Defective contact of valve and valve seat	Improper valve clearance	Leakage of air between turbocharger and cylinder head	Crushed, clogged muffler	Worn piston ring, cylinder liner	Stuck, seized supply pump plunger	Clogged, seized injector	Abnormally worn injector	Clogged fuel spill piping (on cylinder head side)	Improper fuel injection timing	Improper fuel injection pressure	Defective coolant temperature sensor, wiring harness
Questions	Confirm recent repair history																	
	Degree of use of machine	Operated for long period	△		△		△				△		△					
	Color of exhaust gas	Suddenly became black		◎	○	○						○	○					
		Gradually became black	◎			◎			○				○	○				
		Blue under light load									◎							
	Non-specified fuel is being used											○	○					
	Oil must be added more frequently										◎							
	Power was lost	Suddenly		◎						○		○	○					
		Gradually	○				○		○		○							
Check items	Dust indicator is red (if indicator is installed)		◎															
	Muffler is crushed									◎								
	Air leaks between turbocharger and cylinder head, clamp is loosened								◎									
	Engine is operated in low-temperature mode at normal temperature														○	○	○	
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											○	◎					
	When engine is cranked, interference sound is generated around turbocharger		◎															
	When engine is cranked, abnormal sound is generated around cylinder head							◎										
	Torque converter stall speed or pump relief speed is high (Fuel is injected excessively)												○	○				
	Exhaust noise is abnormal		○							◎			○					
	Engine does not pick up smoothly and combustion is irregular		○	○			○	○	○		○	◎						
	Blow-by gas is excessive										◎							
	If spill hose from injector is disconnected, abnormally much fuel spills													◎				
Troubleshooting	Inspect air cleaner directly		●															
	When turbocharger is rotated by hand, it is found to be heavy			●														
	Carry out troubleshooting according to “Abnormality in EGR valve servo (*1)” in E-mode				●													
	Check EGR gas pressure piping directly (*2)					●												
	When compression pressure is measured, it is found to be low						●				●							
	Inspect valve clearance directly							●										
	When muffler is removed, exhaust color improves									●								
	Carry out troubleshooting according to “No-pressure feed by supply pump (*3)” in E-mode											●		●				
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change												●					
	Inspect fuel spill piping (on cylinder head side) directly														●			
	Carry out troubleshooting according to “Abnormality in coolant temperature sensor (*4)” in E-mode																	●
		Remedy	Clean	Replace	Replace	Replace	Replace	Adjust	Correct	Replace	Replace	Replace	Replace	Replace	Correct	Adjust	Adjust	Replace

S-15 Abnormal noise is made

General causes why abnormal noise is made

- Abnormality due to defective parts
- Abnormal combustion
- Air sucked in from intake system

★ Judge if the noise is an internal noise or an external noise before starting troubleshooting.

★ The engine is operated in the low-temperature mode while it is not warmed up sufficiently. Accordingly, the engine sound becomes a little larger. This does not indicate abnormality, however.

★ When the engine is accelerated, it is operated in the acceleration mode and its sound becomes a little larger for up to about 5 seconds. This does not indicate abnormality, however.

			Causes													
			Leakage of air between turbocharger and cylinder head	Interference of turbocharger, seized turbocharger	Cracked, leaking EGR gas piping	Broken dynamic valve system (valve, rocker lever)	Defective inside of muffler (dividing board out of position)	Improper valve clearance	Excessive wear of piston ring, cylinder liner	Improper gear train backlash	Removed, seized gear train bushing	Deformed cooling fan, loose fan belt, interference of fan belt	Clogged, seized injector	Dirt caught in injector	Improper fuel injection timing (abnormality in coolant temperature sensor)
Questions	Confirm recent repair history															
	Degree of use of machine	Operated for long period							△							
	Condition of abnormal noise	Gradually occurred							○			○				
		Sudden occurred		○	○	○					○					
	Non-specified fuel is being used												○			
	Oil must be added more frequently								◎							
	Metal particles are found when oil filter is drained								◎		◎					
Check items	Air leaks between turbocharger and cylinder head		◎													
	When engine is cranked, interference sound is generated around turbocharger			◎												
	When engine is cranked, abnormal sound is generated around EGR gas piping				◎											
	When engine is cranked, abnormal sound is generated around cylinder head					◎		◎								
	When engine is cranked, beat noise is generated around muffler						◎									
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low												◎	○		
	Color of exhaust gas	Blue under light load							◎							
		Black	○	◎				○								
	Engine does not pick up smoothly and combustion is irregular												◎			
	Abnormal noise is loud when engine is accelerated							○		○		○	○			
	Blow-by gas is excessive								◎							
Troubleshooting	When turbocharger is rotated by hand, it is fount to be heavy			●												
	Inspect EGR gas piping directly				●											
	Inspect dynamic valve system directly					●										
	When muffler is removed, abnormal noise disappears						●									
	Inspect valve clearance directly							●								
	When compression pressure is measured, it is found to be low								●							
	Inspect gear train directly									●	●					
	Inspect fan and fan belt directly											●				
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change												●	●		
	Abnormal noise is heard only when engine is started													●		
	Confirm with INSITE or with monitoring function on applicable machine side														●	
		Remedy	Replace	Replace	Replace	Correct	Replace	Adjust	Replace	Replace	Replace	Correct	Replace	Correct	Correct	

E-3 Error code [122] Charge Air Press Sensor High Error

Error code	Trouble	Abnormally high level in charge pressure sensor
122		
Contents of trouble	• Signal voltage in charge pressure sensor circuit is abnormally high.	
Action of controller	• Limits output and continues operation. • Fixes charge pressure to default value and continues operation.	
Problem that appears on machine	• Output drops. • Black smoke is produced during acceleration.	
Related information	• Different machine models may have different connector Nos.	

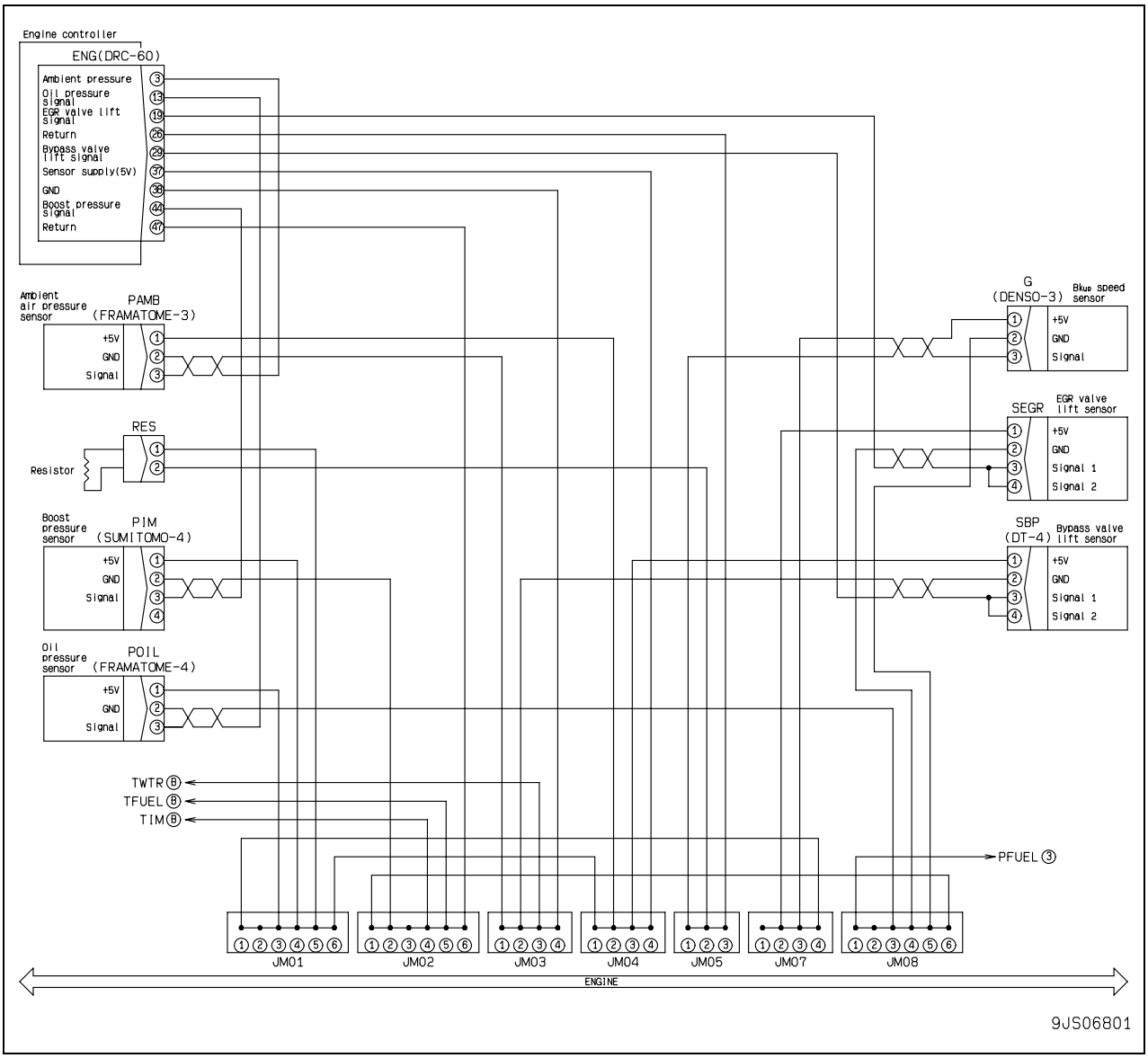
	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective sensor power supply system	If error code [**187**] or [**227**] is indicated, carry out troubleshooting for it first.			
	2	Defective charge pressure sensor (Internal trouble)	★ Prepare with starting switch OFF, then turn starting switch ON or start engine and carry out troubleshooting.			
			PIM		Voltage	
			Between (1) – (2)	Power supply	4.75 – 5.25 V	
			Sensor voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.			
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between ENG (female) (37) – PIM (female) (1)		Resistance	Max. 1 Ω
			Wiring harness between ENG (female) (47) – PIM (female) (2)		Resistance	Max. 1 Ω
			Wiring harness between ENG (female) (44) – PIM (female) (3)		Resistance	Max. 1 Ω
	4	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between ENG (female) (37) – PIM (female) (1) and chassis ground		Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (47) – PIM (female) (2) and chassis ground		Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (44) – PIM (female) (3) and chassis ground		Resistance	Min. 1 MΩ
	5	Short circuit in wiring harness (with another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between ENG (female) (37) – PIM (female) (1) and between ENG (female) (47) – PIM (female) (2)		Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (37) – PIM (female) (1) and between ENG (female) (44) – PIM (female) (3)		Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (47) – PIM (female) (2) and between ENG (female) (44) – PIM (female) (3)		Resistance	Min. 1 MΩ
	6	Defective engine controller	★ Prepare with starting switch OFF, then turn starting switch ON or start engine and carry out troubleshooting.			
			ENG		Voltage	
			Between (37) – (47)	Power supply	4.75 – 5.25 V	

E-10 Error code [144] Coolant Temp. Sensor High Error

Error code	Trouble	Abnormally high level in coolant temperature sensor
144		
Contents of trouble	• Signal voltage in coolant temperature sensor circuit is abnormally high.	
Action of controller	• Fixes coolant temperature to default value and continues operation.	
Problem that appears on machine	• Engine does not start easily. • Exhaust gas color becomes bad at low temperature.	
Related information	• Different machine models may have different connector Nos.	

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective coolant temperature sensor (Internal trouble)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			TWTR (male)	Coolant temperature	Resistance	
			Between (A) – (B)	10 – 100°C	0.6 – 20 kΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between ENG (female) (15) – TWTR (female) (A)		Resistance	Max. 1 Ω
			Wiring harness between ENG (female) (38) – TWTR (female) (B)		Resistance	Max. 1 Ω
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between ENG (female) (15) – TWTR (female) (A) and chassis ground		Resistance	Min. 1 MΩ
	4	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			ENG (female)	Coolant temperature	Resistance	
			Between (15) – (38)	10 – 100°C	0.6 – 20 kΩ	

Circuit diagram related to sensor power supply 2 (5 V)



E-24 Error code [272] PCV1 Open Error

Error code	Trouble	Disconnection in PCV1
272		
Contents of trouble	• There is disconnection in PCV1 circuit of supply pump.	
Action of controller	• Stops outputting signal to PCV1.	
Problem that appears on machine	• Output drops (PCV2 is also abnormal, engine stops.)	
Related information	• Different machine models may have different connector Nos.	

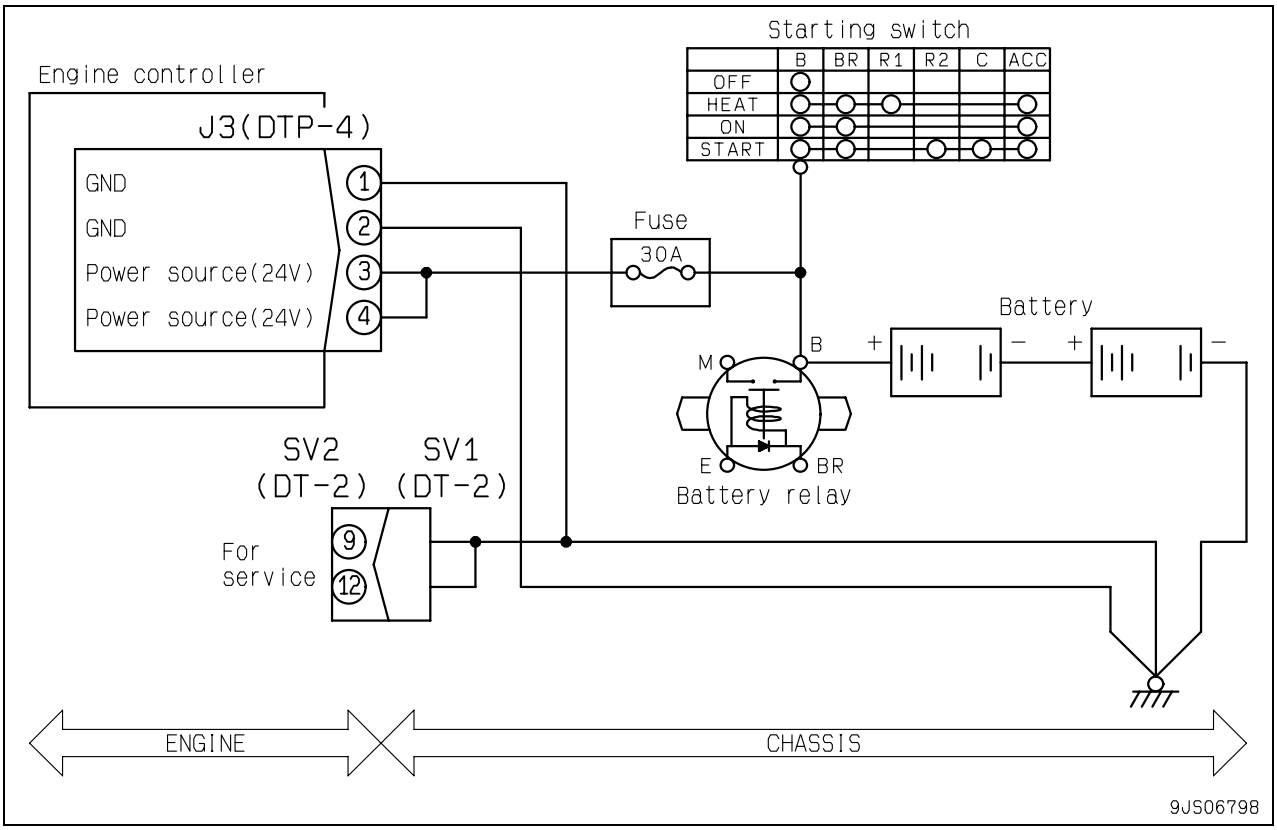
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective supply pump PCV1 (Internal disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			PCV1 (male)	Resistance	
			Between (1) – (2)	2.3 – 5.3 Ω	
			Between (1), (2) – chassis ground	Min. 1 MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between ENG (female) (4) – PCV1 (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between ENG (female) (5) – PCV1 (female) (2)	Resistance	Max. 1 Ω
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between ENG (female) (4) – PCV1 (female) (1) and chassis ground	Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (5) – PCV1 (female) (2) and chassis ground	Resistance	Min. 1 MΩ
	4	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			ENG (female)	Resistance	
			Between (4) – (5)	2.3 – 5.3 Ω	
			Between (4), (5) – chassis ground	Min. 1 MΩ	

E-29 Error code [324] Injector #3 (L/B #3) System Open/Short Error

Error code	Trouble	Disconnection or short circuit in injector #3 (L/B #3) system
324		
Contents of trouble	• There is disconnection or short circuit in injector #3 circuit.	
Action of controller	• Continues drive control but cannot inject fuel into abnormal cylinder. (Even if only 1 cylinder is abnormal, abnormality of multiple cylinders may be displayed.)	
Problem that appears on machine	• Output drops.	
Related information	• Different machine models may have different connector Nos.	

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective injector #3 (Internal trouble)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN3 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1 Ω	
			Between (1), (2) – chassis ground	Min. 1M Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between ENG (female) (55) – CN3 (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between ENG (female) (52) – CN3 (female) (2)	Resistance	Max. 1 Ω
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between ENG (female) (55) – CN3 (female) (1) and chassis ground	Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (52) – CN3 (female) (2) and chassis ground	Resistance	Min. 1 MΩ
	4	Defective engine controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			ENG (female)	Resistance	
			Between (55) – (52)	0.4 – 1.1 Ω	
			Between (55), (52) – chassis ground	Min. 1M Ω	

Circuit diagram related to controller power supply



★ This circuit diagram is an example of connection.

E-41 Error code [451] Rail Press. Sensor High Error

Error code	Trouble	Abnormally high level in common rail pressure sensor
451		
Contents of trouble	• Signal voltage in common rail pressure sensor circuit is abnormally high.	
Action of controller	• Cannot control common rail pressure. • Limits output and continues operation.	
Problem that appears on machine	• Engine performance decreases. • Output drops.	
Related information	• Different machine models may have different connector Nos.	

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply	If error code [**352**] or [**386**] is indicated, carry out troubleshooting for it first.		
	2	Defective common rail pressure sensor (Internal trouble)	★ Prepare with starting switch OFF, then turn starting switch ON or start engine and carry out troubleshooting.		
			PFUEL		Voltage
			Between (1) – (3)	Power supply	4.75 – 5.25 V
			Between (2) – (3)	Signal	0.25 – 4.6 V
			Sensor voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between ENG (female) (33) – PFUEL (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between ENG (female) (25) – PFUEL (female) (2)	Resistance	Max. 1 Ω
			Wiring harness between ENG (female) (47) – PFUEL (female) (3)	Resistance	Max. 1 Ω
	4	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between ENG (female) (33) – PFUEL (female) (1) and chassis ground	Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (25) – PFUEL (female) (2) and chassis ground	Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (47) – PFUEL (female) (3) and chassis ground	Resistance	Min. 1 MΩ
	5	Short circuit in wiring harness (with another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between ENG (female) (33) – PFUEL (female) (1) and between ENG (female) (25) – PFUEL (female) (2)	Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (33) – PFUEL (female) (1) and between ENG (female) (47) – PFUEL (female) (3)	Resistance	Min. 1 MΩ
			Wiring harness between ENG (female) (25) – PFUEL (female) (2) and between ENG (female) (47) – PFUEL (female) (3)	Resistance	Min. 1 MΩ

E-46 Error code [731] Eng. Bkup Speed Sensor Phase Error

Error code	Trouble	Abnormality in engine Bkup speed sensor phase
731		
Contents of trouble	• Engine Bkup sensor circuit detected abnormality in phase.	
Action of controller	• Controls with engine Ne speed sensor signal, if abnormality occurs during operation. • Cannot control fuel injector, if abnormality occurs at start.	
Problem that appears on machine	• Engine operates normally, if abnormality occurs during operation. • Engine does start easily or at all, if abnormality occurs at start.	
Related information		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective engine Ne speed sensor system	Engine Ne speed sensor may be defective. Carry out troubleshooting for [**689**] (E-45).
	2	Defective engine Bkup speed sensor system	Engine Bkup speed sensor may be defective. Carry out troubleshooting for [**778**] (E-48).

E-47 Error code [757] All Engine Controller Data Lost Error

Error code	Trouble	Loss of all data in engine controller
757		
Contents of trouble	• All data in engine controller are lost.	
Action of controller	• None in particular.	
Problem that appears on machine	• Engine continues operation normally, but it may stop during operation or may not be able to start.	
Related information		

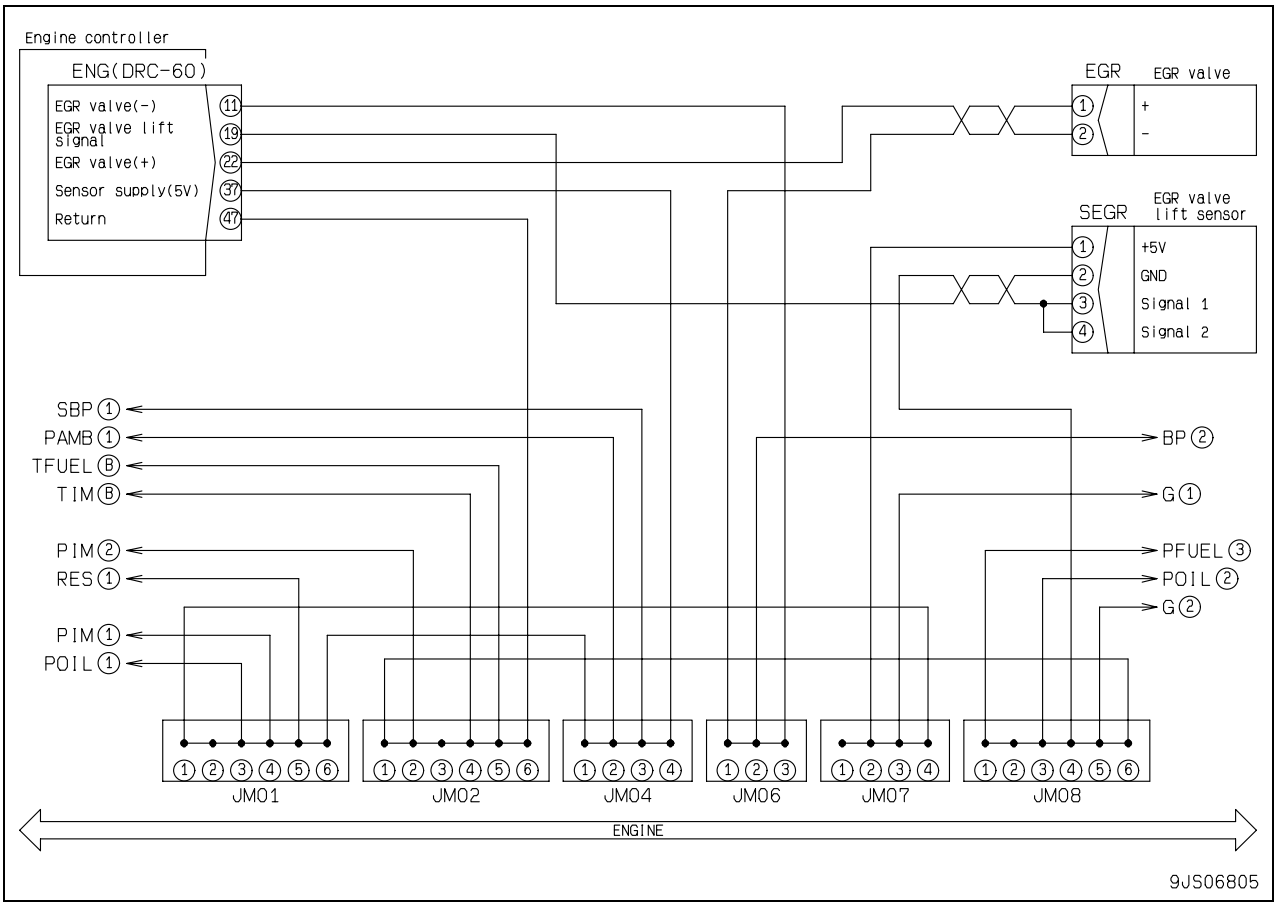
Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for E-1 error code [**111**].	

E-54 Error code [1629] Bypass Valve Servo Error 2

Error code	Trouble	Abnormality in bypass valve servo 2
1629		
Contents of trouble	• Abnormality (level 2) occurred in bypass valve servo.	
Action of controller	• Limits output and continues operation (Cannot control EGR).	
Problem that appears on machine	• Output drops.	
Related information		

Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for E-53 Error code [**1628**].	

Circuit diagram related to EGR valve solenoid & lift sensor



General information on disassembly and assembly

How to read this manual

Disassembly

- In Disassembly section, the work procedures, precautions and know-how for carrying out those procedures, and quantity of the oil and coolant drained are described.
- The meanings of the symbols used in Disassembly section are as follows.

⚠ Precautions related to safety in execution of work

★ : Know-how or precautions for work

 : Quantity of oil or coolant drained

 : Weight of part or component

Assembly

- In Assembly section, the work procedures, precautions and know-how for carrying out those procedures, and quantity of the oil and coolant added are described.
- The meanings of the symbols used in Assembly section are as follows.

⚠ : Precautions related to safety in execution of work

★ : Know-how or precautions for work

 : Type of coating material

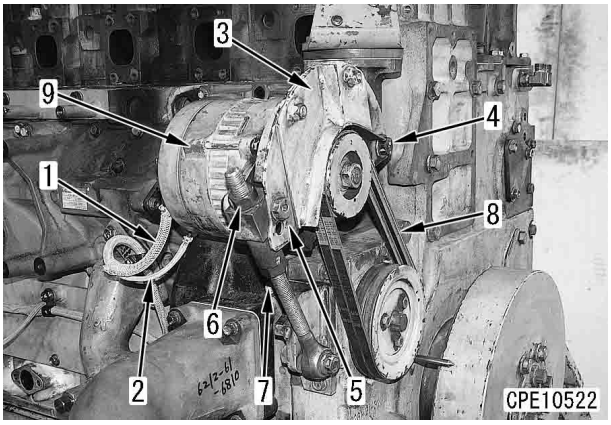
 : Tightening torque

 : Quantity of oil or coolant to be added

 : Weight of part or component

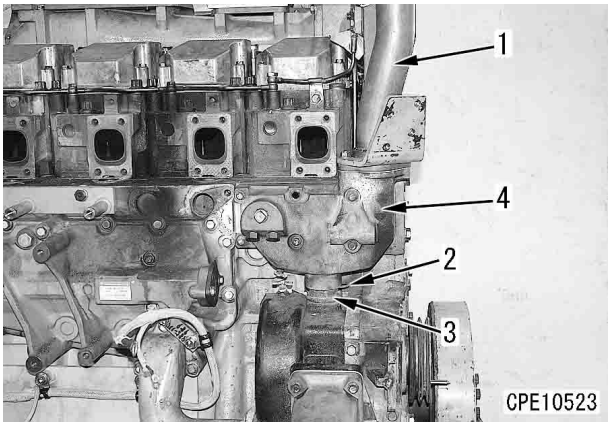
18. Alternately assembly

1) Disconnect terminal B (1) and terminal R (2).
2) Remove cover (3).
3) Loosen alternator mounting bolt (4) and clamping bolt (5).
4) Loosen locknut (6) and tension adjustment nut (7) and remove V-belt (8).
5) Remove mounting bolt (4) and clamping bolt (5) and remove alternator assembly (9).



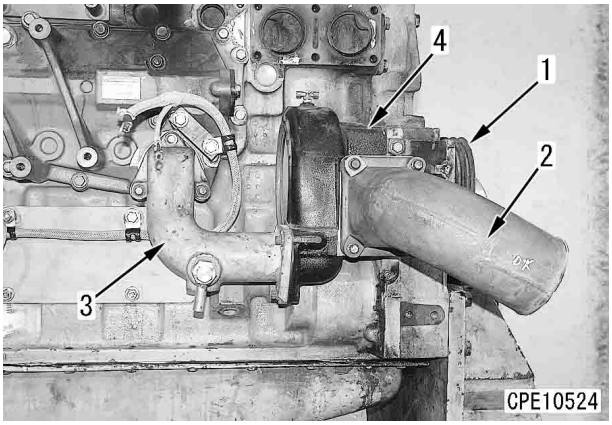
19. Thermostat assembly

1) Remove tube (1)
2) Remove snap ring (2) and push bypass tube (3) into the thermostat case.
3) Remove the 5 mounting bolts and thermostat assembly (4).
   ★ One of the 5 mounting bolts is used to clamp the thermostat assembly and cover together and has been removed already.



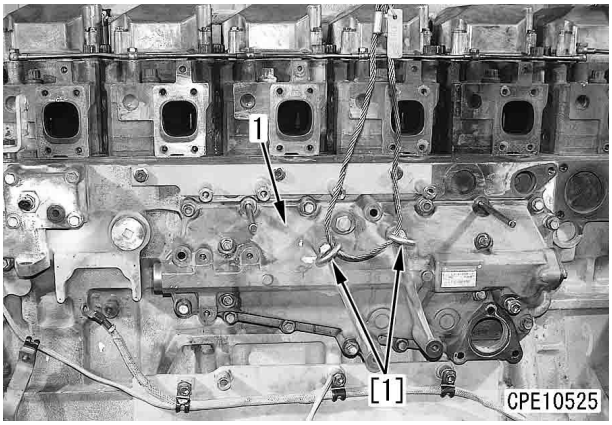
20. Water pump assembly

1) Remove alternator drive pulley (1).
2) Remove tubes (2) and (3).
3) Remove water pump assembly (4).



21. Oil cooler assembly

1) Using eyebolts [1], sling the oil cooler assembly temporarily.
2) Remove the 16 mounting bolts and oil cooler assembly (1).
   Oil cooler assembly: **35 kg**



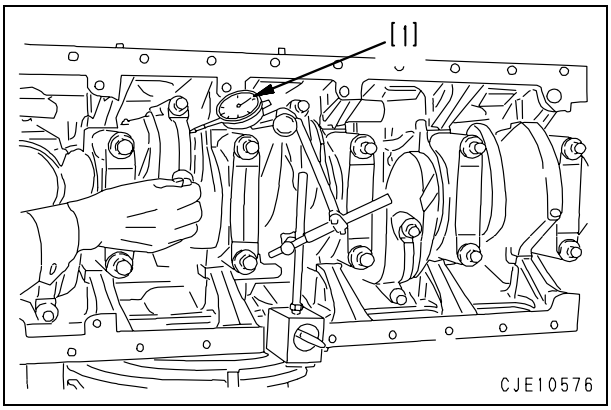
22. Oil filter, fuel filter, and corrosion resistor

Remove oil filter (1), pre-fuel filter (2), main fuel filter (3), and corrosion resistor (4).

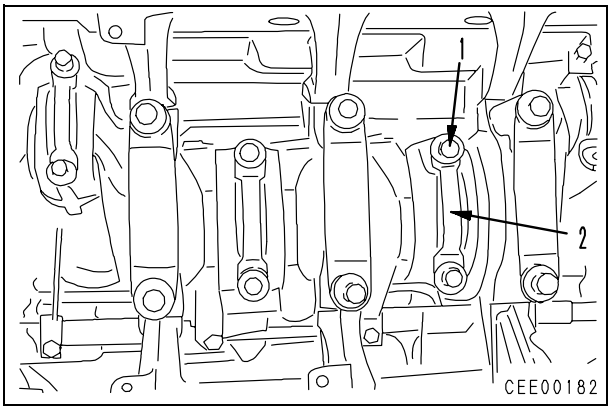
★ Pre-fuel filter (2) may be installed on the applicable machine side.

59. Piston and connecting rod assembly

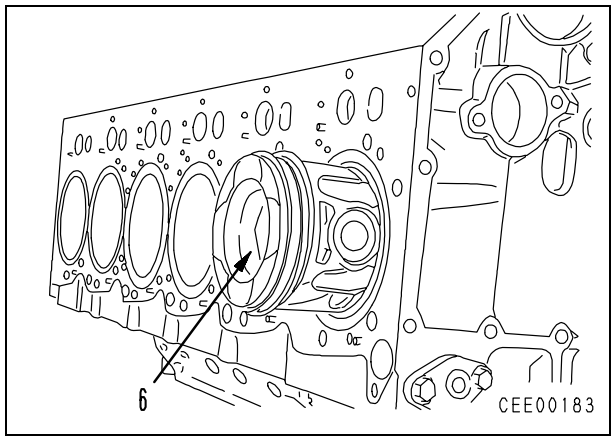
★ Before removing the piston and connecting rod assembly, measure its end play with dial gauge [1], if necessary.



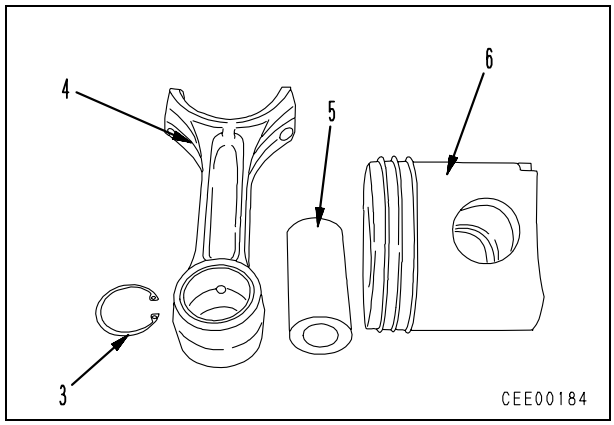
1) Check the stamped No. of the connecting rod cap.
   - The cap No. and cylinder No. must be the same.
   - The cap No. must be stamped on the cam side.
   - ★ If the No. is not stamped, stamp it before removing the connecting rod.
2) Rotate the crankshaft and bring the piston to be removed to the bottom dead center.
3) Scrub the carbon off the top wall of the cylinder liner with fine sandpaper.
4) Remove connecting rod cap mounting bolts (1).
5) Hit connecting rod cap (2) with a plastic hammer so lightly that the threads of the connecting rod bolts will not be damaged and remove connecting rod cap (2) and connecting rod bearing as a unit.



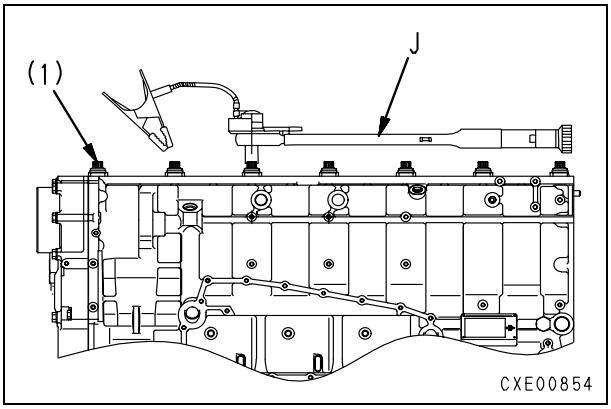
6) Push in and remove the piston and connecting rod assembly with a wood bar, etc. from the oil pan side, while supporting piston (6) on the cylinder head side.
   - ★ Take care not to damage the inside of the cylinder with a corner of the connecting rod.
7) Remove the other piston and connecting rod assemblies according to the above procedure.
   - ★ Take care not to damage the sliding portions of the pistons and bearings.
   - ★ Assemble each connecting rod and cap temporarily so that they will not be assembled with other ones and keep them and the bearing together.



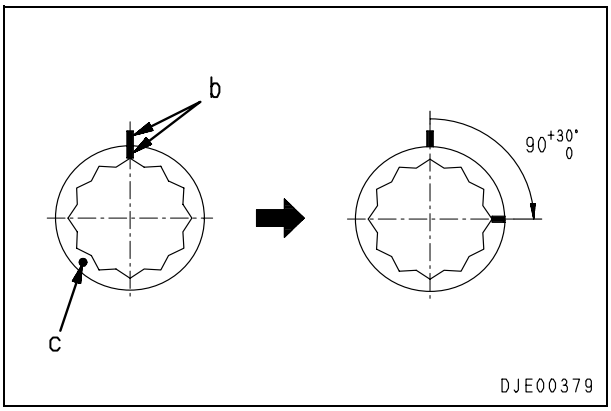
8) Disassemble the piston and connecting rod assembly according to the following procedure.
   1] Remove 2 snap rings (3).
   2] While supporting connecting rod (4), remove piston pin (5) to disconnect piston (6) and connecting rod.



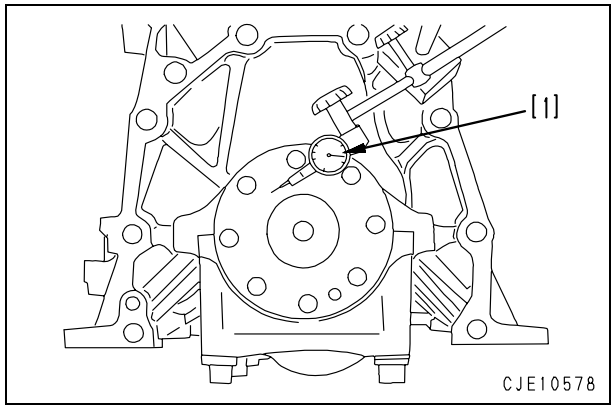
8) Tighten main cap mounting bolts (1) according to the following procedure.
   ★ Tighten the bolts from the center one to the outer ones in order.
   Threaded portion of mounting bolt and washer:
   Engine oil (EO30)
   Mounting bolt
   1st time:
   108 – 128 Nm {11 – 13 kgm}
   2nd time:
   230 – 240 Nm {23.5 – 24.5 kgm}
   3rd time:
   Using tool **J**, tighten the bolt by 90° (+30°/0).



   ★ When not using tool **J**, make marks (**b**) on the main cap and bolt with paint, then tighten the bolt by 90° (+30°/0).
9) Make punch mark (**c**) on the mounting bolt head.
   ★ When a new bolt is used, do not make a punch mark on its head.



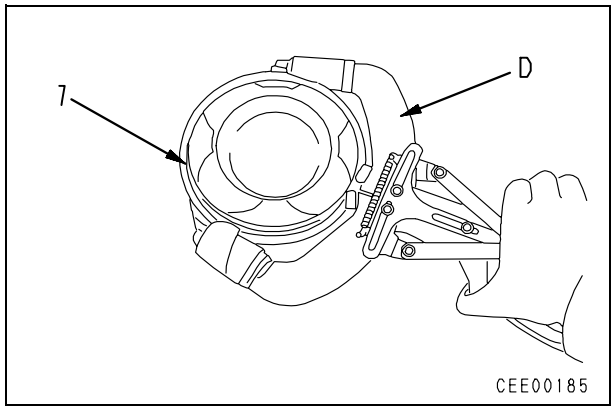
10) Check that the crankshaft turns smoothly.
11) Measure the end play of the crankshaft with dial gauge [1].
   ★ End play: **0.140 – 0.315 mm**
   ★ If the end play is out of the standard, correct it. For details, see “Structure, function and maintenance standard”.



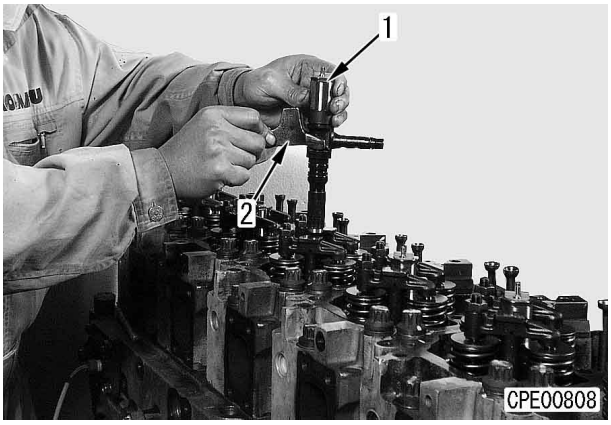
4. Piston and connecting rod assembly
   ★ Select the grade of the piston according to the grade of the cylinder liner.
   - Set grade (Stamp): S, L
   - Stamping position
     Cylinder liner: Top end
     Piston: Top surface

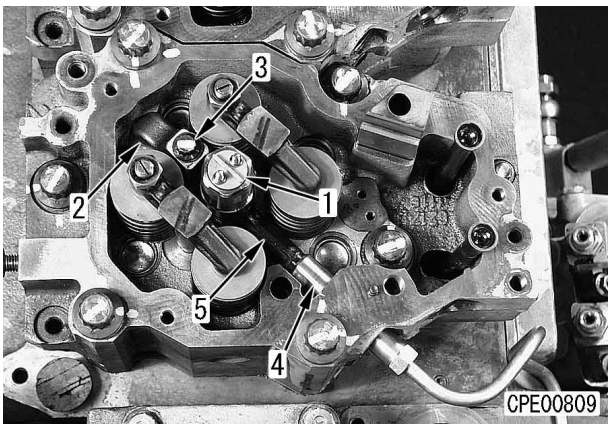
1) Using tool **D**, fit piston rings (7) to the piston.
   ★ Fit the top ring and second ring to the piston with the stamped mark side up.
   - Stamp on top ring: 1RS
   - Stamp on second ring: 2RX

   ★ Take the expander out of the oil ring and fit it to the piston first and then fit the oil ring. At this time, check that the expander is fitted to the ring groove perfectly.



5) Insert high-pressure pipe sleeve (4) in the hole to insert the fuel high-pressure pipe and fix it temporarily, matching it to injector connector (5).
   ★ Tighten the sleeve nut on the common rail side temporarily, too, to prevent the high-pressure pipe from leaning.
6) Tighten holder (2) permanently.
   ★ While pulling the high-pressure pipe in the opposite direction to the injector, tighten bolt (3).
   Holder mounting bolt:
   58.8 – 73.5 Nm {6.0 – 7.5 kgm}
   ★ After tightening the holder, remove the high-pressure pipe and install the other injectors in order according to the above procedure.

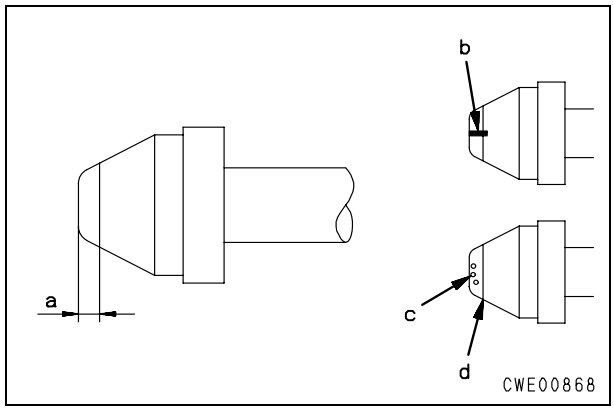




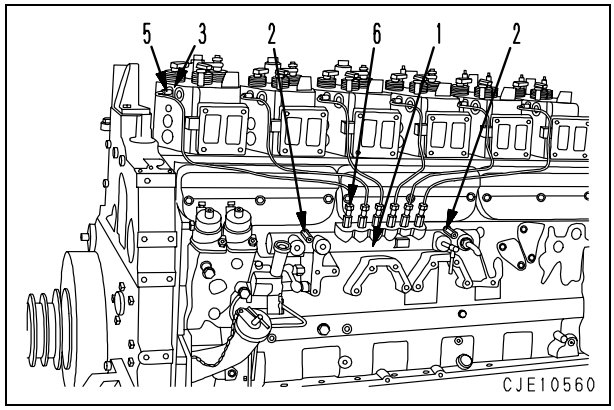
21. Common rail and high-pressure pipe

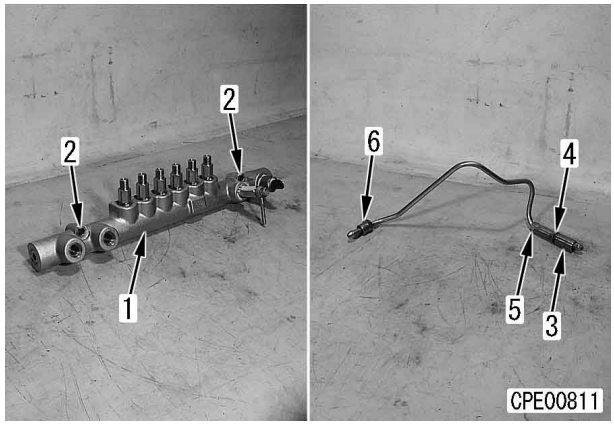
⚠ Before installing the high-pressure pipe, check it for the following defects. If there is any of these defects, it can cause fuel leakage. Accordingly, replace the high-pressure pipe.

- Check the taper seal of the connecting part (Part (a): Part of 2 mm from the end) for visible lengthwise slit (b) and dent (c).
- Check part (d) (end of the taper seal: Part at 2 mm from the end) for stepped-type wear (fatigue) which your nail can feel.



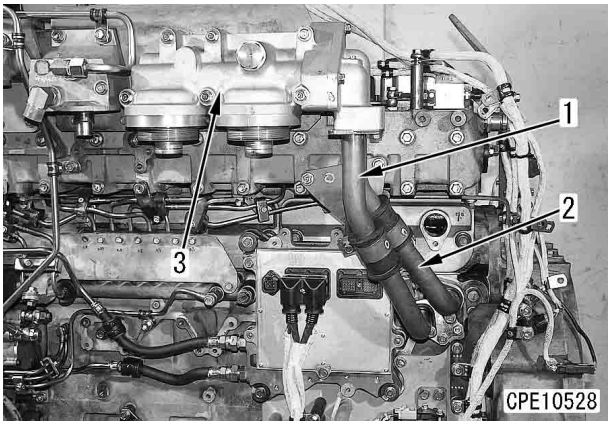
1) Secure common rail (1) temporarily with special bolts (2).
2) Fit O-ring (4) to high-pressure pipe sleeve (3). Matching them to the injector connector, tighten sleeve nut (5) and sleeve nut (6) on the common rail side temporarily. (Tighten the sleeve nuts temporarily in the order of No. 4, No. 5, No. 2, No. 3, No. 1, and No. 6.)
   O-ring: **Engine oil (EO30)**
3) Tighten special bolts (2) permanently.
   Special bolt:
   59 – 74 Nm {6.02 – 7.55 kgm}





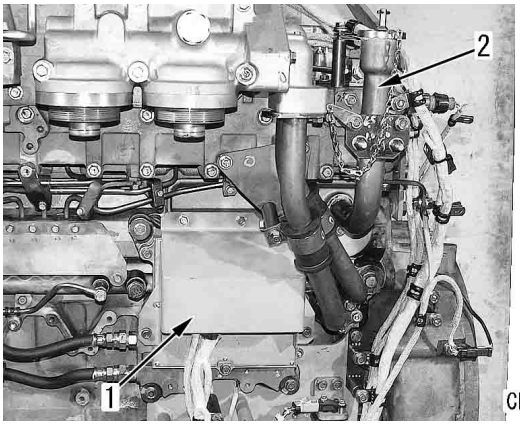
41. Oil filter head

1) Install oil filter head (3).
2) Fit the O-ring and install oil tubes (2) and (1).



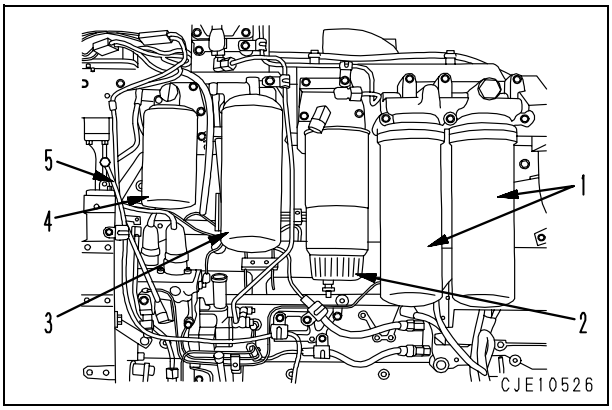
42. Oil filler and controller cover

1) Fit the O-ring, install oil filler (2) and tighten the clamp.
   ★ The position of the oil filler depends on the applicable machines.
2) Install controller cover (1).



43. Oil filter, fuel filter and corrosion resistor

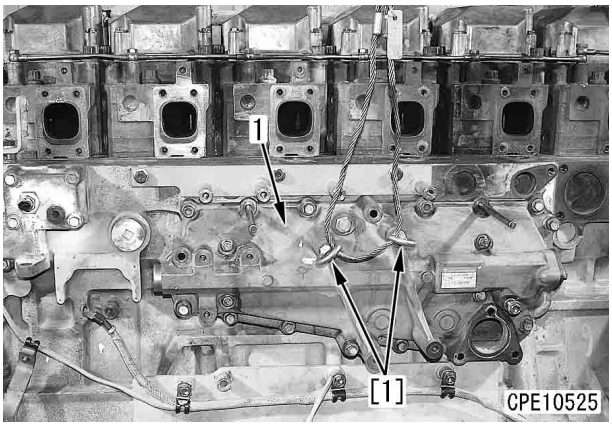
1) Install oil drain tube (5) of the EGR valve and bypass valve.
2) Install corrosion resistor (4), main fuel filter (3), pre-fuel filter (2) and oil filter (1).
   ★ Pre-fuel filter (2) may not be installed.



44. Oil cooler assembly

Using eyebolts [1] and guide bolt, fit the gasket, install oil cooler assembly (1) and tighten the 16 mounting bolts.

Oil cooler assembly: **35 kg**



45. Water pump assembly and thermostat assembly

1) Fit the O-ring, install water pump assembly (1) and tighten the mounting bolts temporarily.
   ★ The mounting bolts are also used to secure the timing gear case.