

SERVICE MANUAL

Relex 75-7

SER. NO. HY7570001~

 **HYUNDAI**
HEAVY INDUSTRIES CO.,LTD.

INTRODUCTION

To insure a long life for the machine and the engine and to prevent failure and problems, proper operation, maintenance and repairs are indispensable.

This service manual includes an “outline,” “structure and operation,” “inspection and adjustment,” “disassembly and assembly,” “standard maintenance,” and “repair and replacement of parts” of the machine which are necessary to carry out the inspections and repairs in the repair shop.

We hope that this manual helps you to efficiently and effectively carry out repairs by providing an accurate description of the product and the correct repair techniques.

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1 PRECAUTIONS ON MAINTENANCE

1. Correct operation

Correct operation means to follow the correct “procedure” and “method.”

Procedure focuses on speed and accuracy of each job.

In the method, are addressed what type of facility, tools, instruments, materials, oil should be used, how and which part should be checked, adjusted or disassembled, and what matters to attend to.

2. Precautions on operation

1. Safety check

Check that stoppers and sleepers are correctly installed for the vehicle jack-up operation.

2. Preparation

Prepare all of the tools and inspect and adjust the instruments.

3. For efficiency

1) Understand the state before disassembly.

What is the problem? Is disassembly absolutely necessary?

2) Before disassembly

Determine whether match marks are necessary. For the electrical system, disconnect the cable from the battery terminal.

3) Precautions for disassembly

In stead of checking all of the disassembled parts at once, check each part individually as it is disassembled. When removing the hydraulic unit or the hoses, mount a dust cap on the connection.

4) Repair of disassembled parts

Keep the disassembled parts in order. Clearly distinguish the parts to be replaced with new parts from those to be reused. Packings, seals, rings, split pins must be replaced.

NOTE:

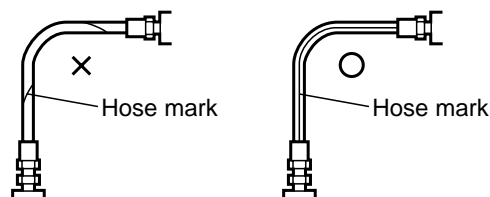
Electrical equipment, rubbers and V belts (which are easily affected by water and oil) must be handled carefully in order to prevent soiling them.

5) Clean disassembled parts

Thoroughly clean the disassembled parts.

6) Assembly

Perform the assembly correctly (tightening torque, application of Three Bond, screw lock, grease, use of seal tape, etc.). Also install the hose correctly.

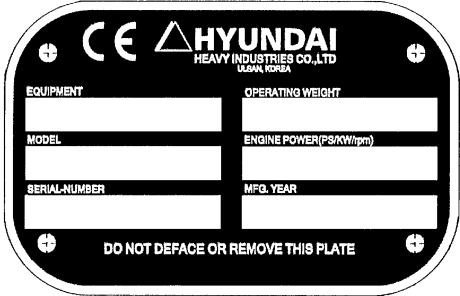
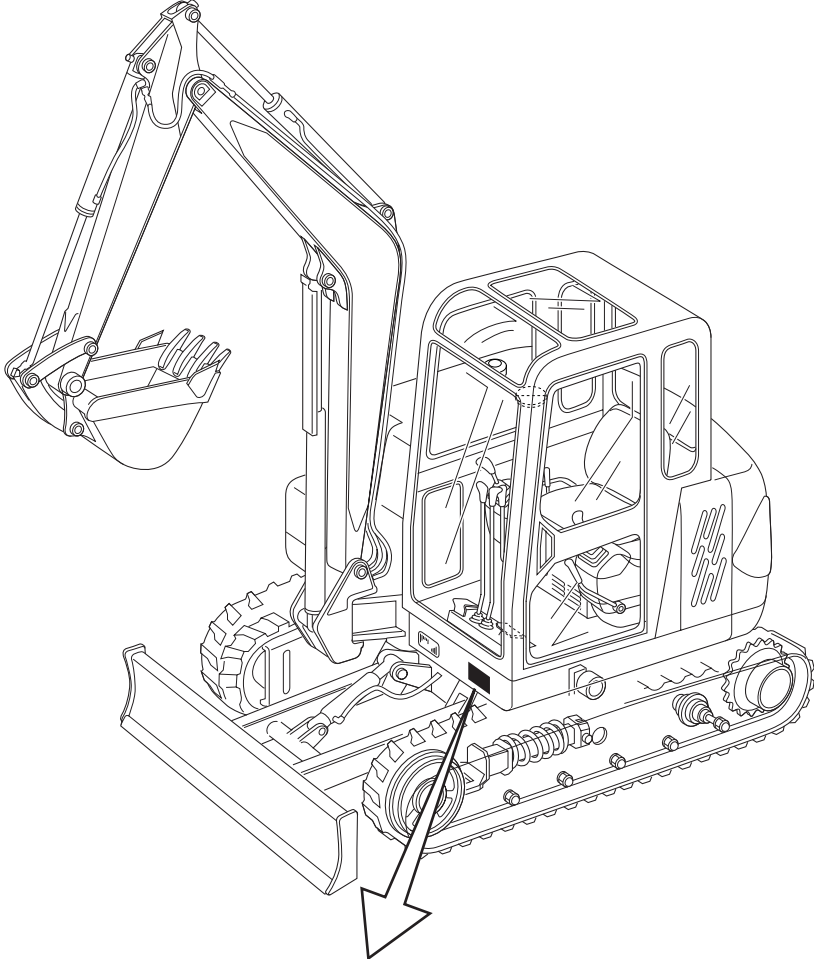


2 OUTLINE

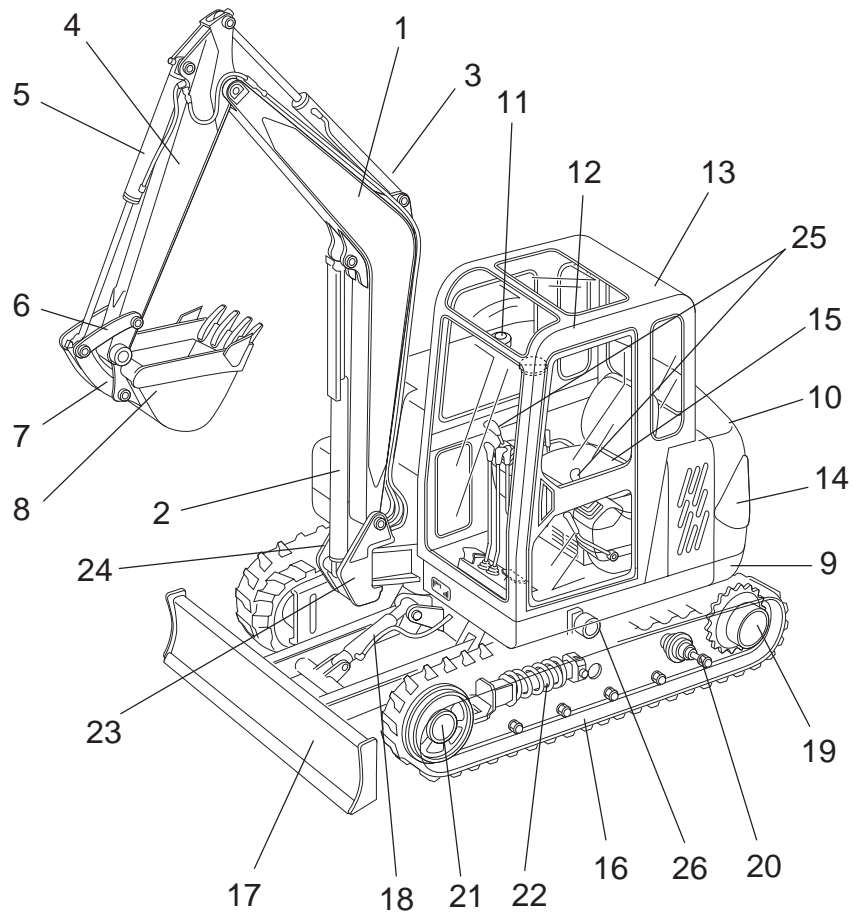
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- 2-7 When to repair
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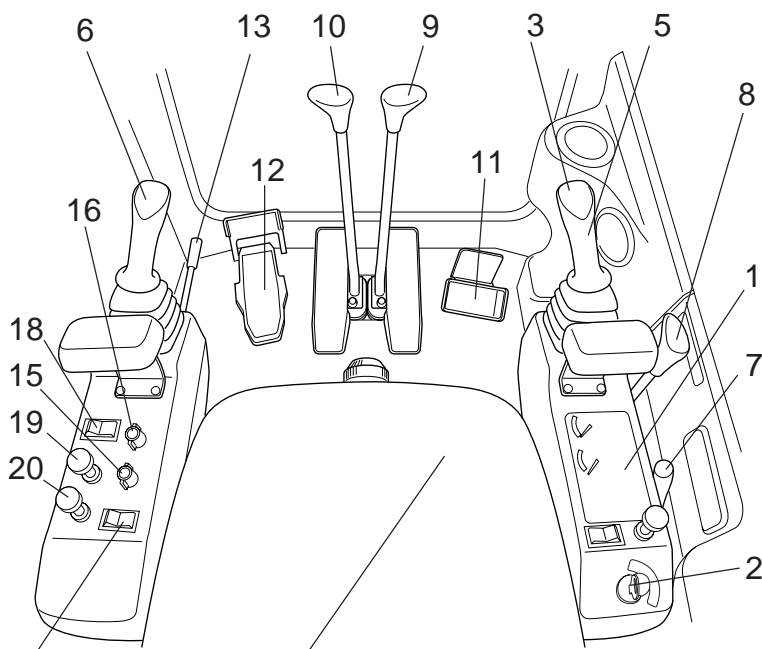
2-1 Location of Serial Number



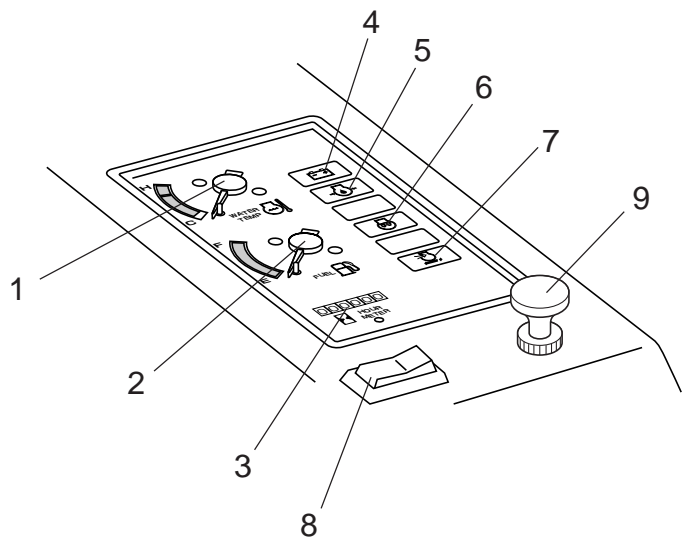
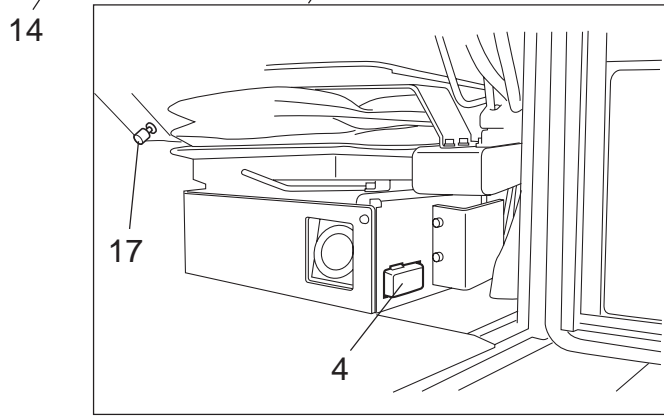
2-2 Name of each part



- | | |
|--------------------|-----------------------|
| 1. Boom | 14. Counter weight |
| 2. Boom cylinder | 15. Operator's seat |
| 3. Arm cylinder | 16. Crawler |
| 4. Arm | 17. Dozer blade |
| 5. Bucket cylinder | 18. Dozer cylinder |
| 6. Bucket links | 19. Drive/Track motor |
| 7. Dump link | 20. Track roller |
| 8. Bucket | 21. Front idler |
| 9. Swing frame | 22. Grease cylinder |
| 10. Engine cover | 23. Swing post |
| 11. Fuel tank | 24. Swing cylinder |
| 12. Hydraulic tank | 25. Operation levers |
| 13. Cabin | 26. Carrier roller |

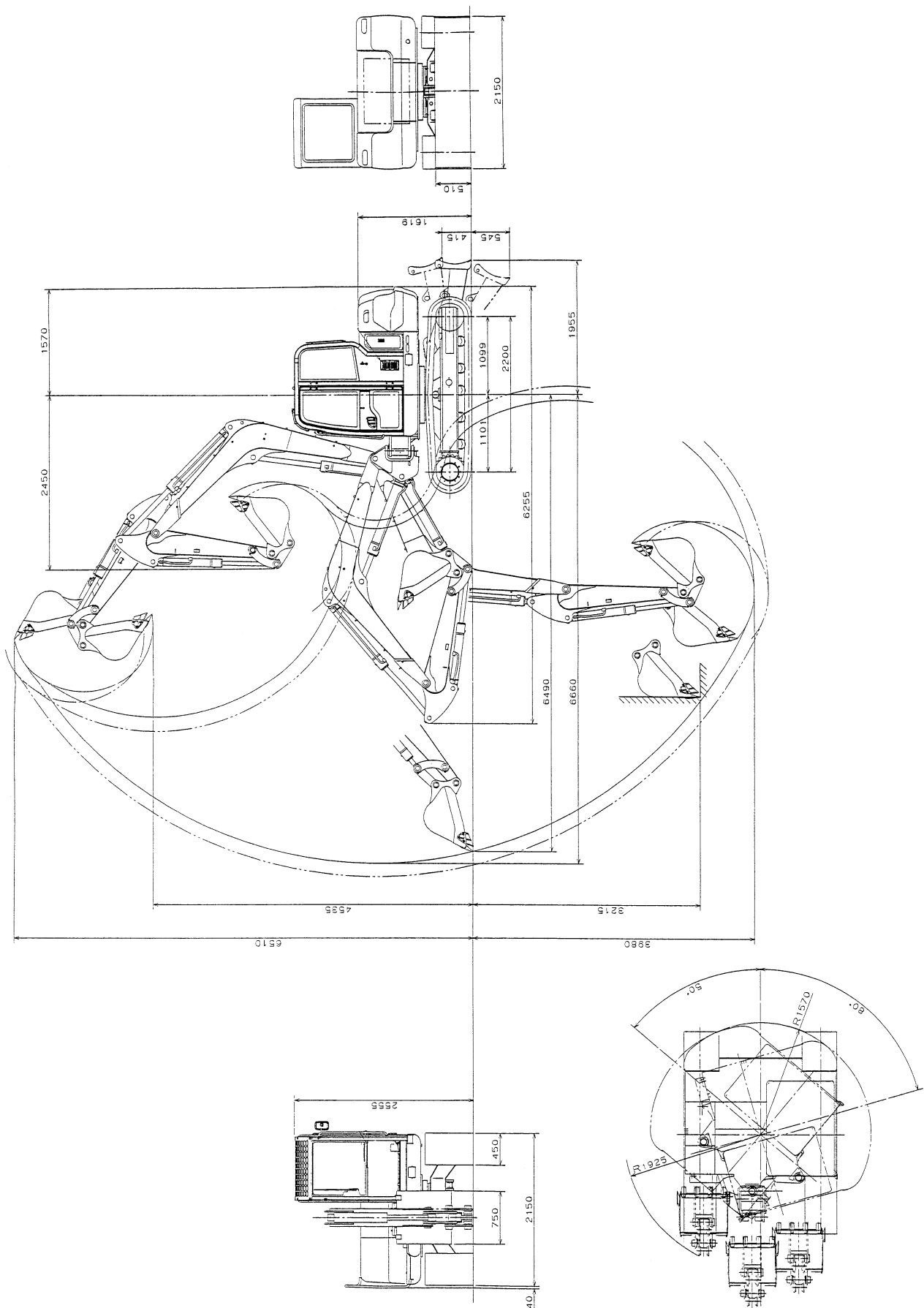


1. Meter unit
2. Starter switch
3. Horn switch
4. Fuse box
5. Right operation lever
6. Left operation lever
7. Accelerator lever
8. Dozer lever
9. Right travel lever
10. Left travel lever
11. Swing pedal
12. P.T.O. pedal
13. Safety lock lever
14. Over drive switch
15. Heater switch (for cabin)
16. Wiper switch (for cabin)
17. Cigarette lighter
18. A/C switch (option)
19. Change lever (heater↔A/C)
20. Change lever (fresh air) (option)



1. Water temperature meter
2. Fuel gauge
3. Hour meter
4. Charge lamp
5. Engine oil pressure lamp
6. Glow lamp
7. Air filter lamp
8. Head light switch
9. Heater change lever (cold↔warm)

2-3 Dimensions and Specifications



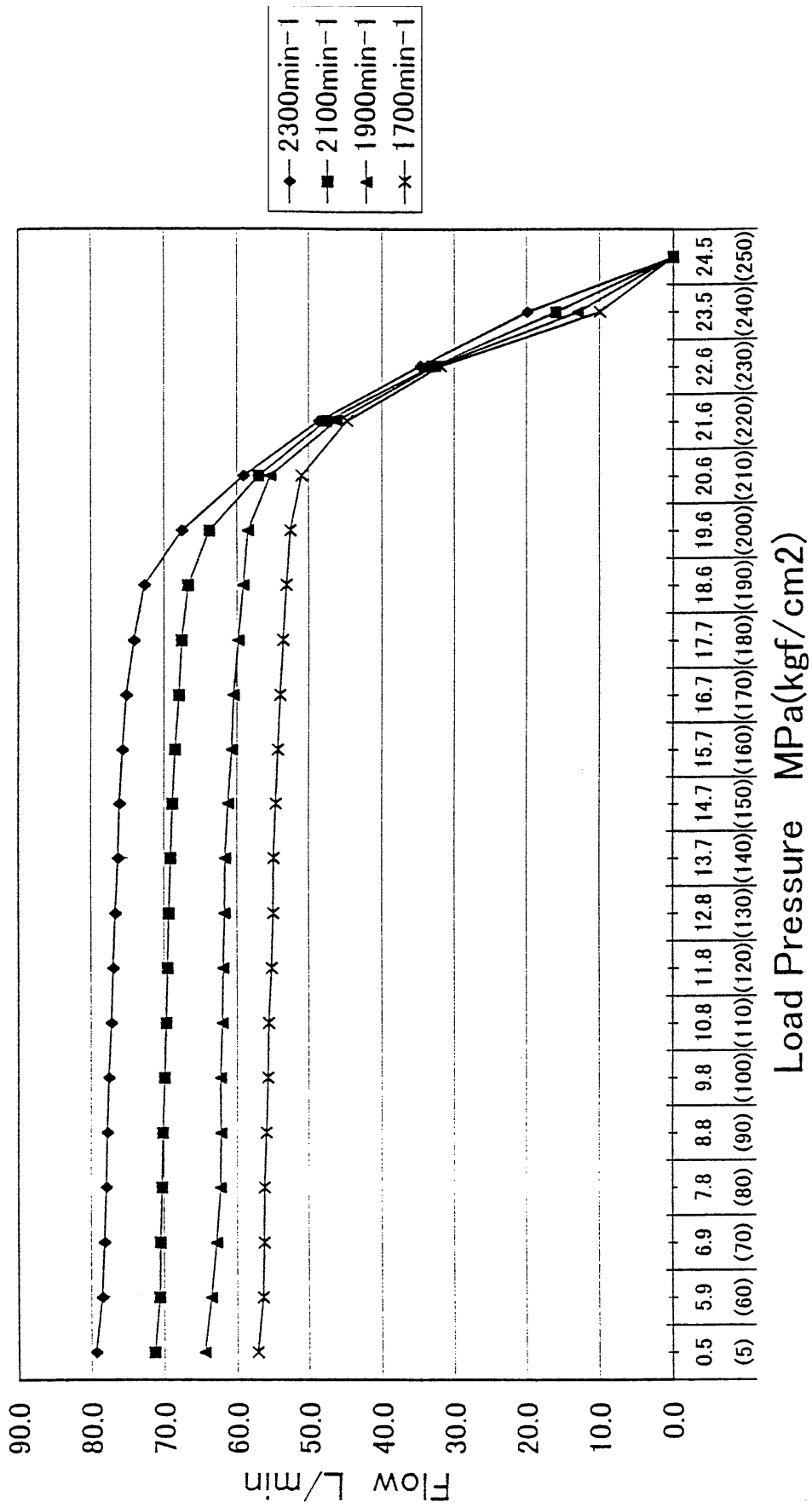
Description		Unit	Robex75-7	
Machine weight	Rubber shoe	Kg	7430	
	Steel shoe		7530	
Standard bucket	Capacity	m ³	0.25	
	Width	mm	750	
Engine	Maker, model		MITSUBISHI S4S	
	Rated power	ps(kW)/min ⁻¹	55.5(40.8)/2300	
	Displacement	cc	3331	
Working range	Max.digging depth	mm	3980	
	Max.vertical digging depth		3215	
	Max.digging height		6510	
	Max.dumping height		4535	
	Max.digging reach		6660	
	Min.swing radius		Front	2450
			Swing	1925
	Rear end radius		1570	
Boom swing angle	deg	Left80/Right50		
Dimension	Overall length	mm	6255	
	Overall width		2150	
	Overall height		2555	
	Dozer(width × height)		2150×510	
Performance	Travel speed	km/hr	3.1 / 4.8	
	Swing speed	min ⁻¹	9.7	
	Gradeability	deg(%)	30(58)	
	Max.digging force	Bucket	kN(kgf)	53.6(5465)
		Arm		39.8(4061)
Max. drawbar pull		57.5(5865)		
Under-carriage	Ground pressure	Canopy&rubber shoe	33.9(0.35)	
		Cabin&rubber shoe	34.4(0.35)	
	Tumbler distance × track gauge	mm	2200×1700	
	Track shoe width	450		
	Type of travelling motor		Piston shoe-in type	
Crawler tension system		Grease cylinder		
Hydraulic	Type of hydraulic pump		Piston×2, Gear×1	
	Pump oil flow	ℓ/min	2×78.2+46.7	
	Auxiliary circuit oil flow		78.2	
	Relief valve setting pressure	MPa(kgf/cm ²)	25.5/23.5(260/240)	
Capacity	Hydraulic oil tank	ℓ	85	
	Engine oil		7.5	
	Fuel tank		130	
	Cooling water		10.0	
Noise	Noise level(LwA/LpA)	dB	98 / 78	

2-4 Weight list

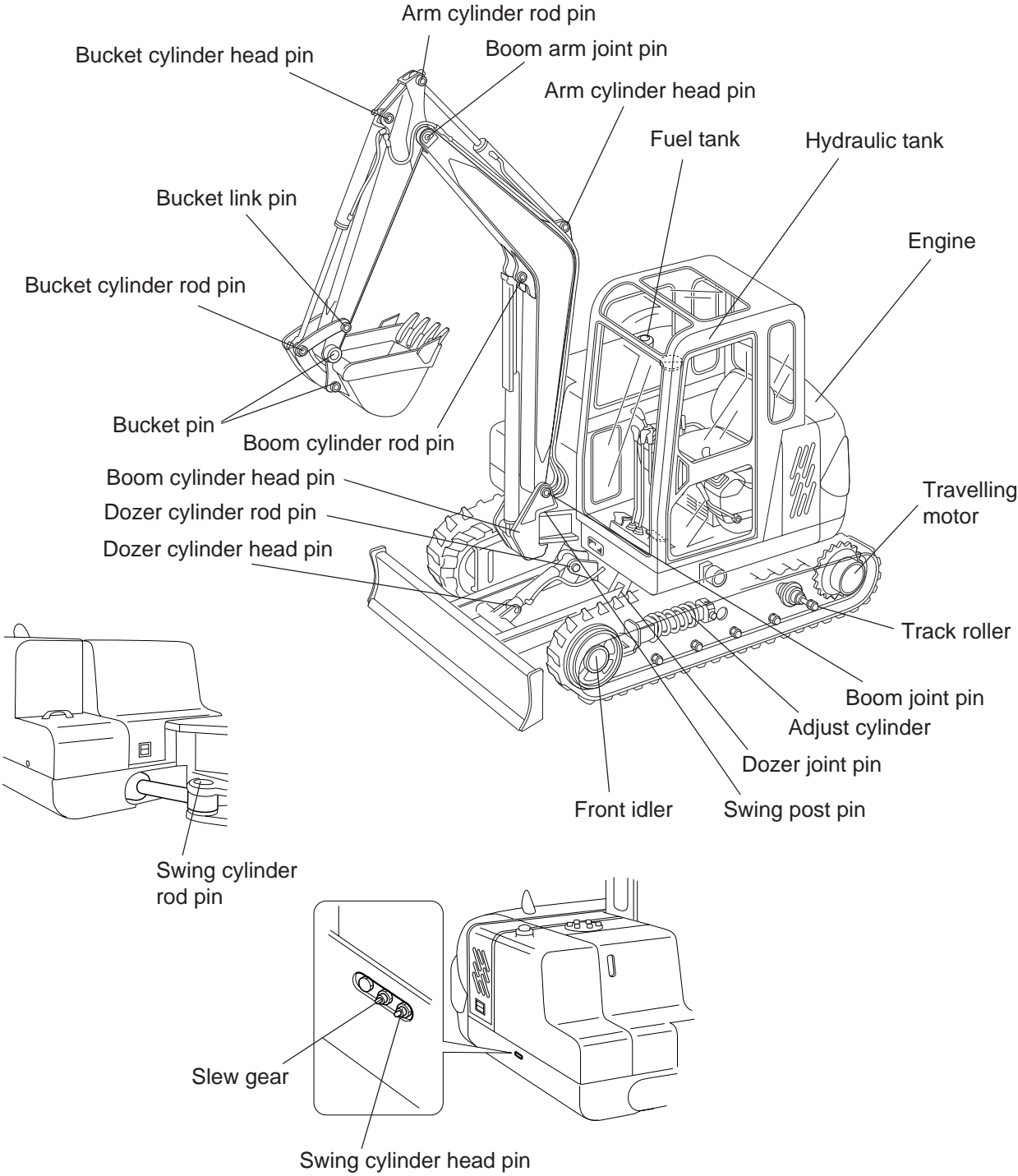
Unit: kgf

Part name	Weight	Part name	Weight
Boom	310	Track frame	1025
Arm	160	Dozer	390
Bucket	165	Steel crawler	425×2
Dump link	24	Rubber crawler	370×2
Bucket link	9.0×2	Idler	50×2
Boom joint pin	12.5	Spring case	40×2
Arm joint pin	8.5	Track roller	14.5×8
Bucket pin	8.0×2	Carrier roller	8
Swing post	207	Sprocket	20×2
Swing post pin	19.7	Turning motor	70
Swing frame	880	Drive motor	86×2
Hydraulic oil tank	55	Lever stand	12×2
Fuel tank	37	Engine	245
Engine cover(A)	30	Radiator	39
Engine cover(B)	25	Battery	22
Engine cover(C)	20	Battery cover	12
Weight(R)(L)	300×2	Tank cover	16
Weight(Center)	290	Pilot valve (drive)	10.8
Operator cabin	300	Pilot valve	1.2×3
Boom cylinder	100	Swivel joint	21
Arm cylinder	80	Control valve	50
Bucket cylinder	50	Pump	58
Swing cylinder	89	Seat plate	12.7
Dozer cylinder	60	Seat	31
Turning bearing	100	Joystick	3.5×2

Robex75-7 PTO flow



2-5 Oil and grease supply points



2-6 List of lubrication

Name	Quantity of oil/water	Type of oil according to ambient condition	
		-10°C~40°C	-20°C~0°C
Engine cooling water	10.0 ℓ	Soft water (antifreeze is mixed in water)	
Fuel tank (effective capacity)	130 ℓ	Diesel fuel with freezing point below -7°C	
Engine lubricating oil	7.5 ℓ	SAE 15W-40	
Travelling motor (reduction gear)	1500 cc	SAE 30-CD	
Hydraulic tank	85 ℓ	ISO VG 46	
Track roller (1 piece)	80 cc	SAE 30-CD	
Front idler (1 piece)	70 cc	SAE 30-CD	

Genuine oil

Be sure to use Castrol Hyspin 46.

Table of recommended Lubricants

No.	LUBRICANT	SHELL	MOBIL
1	Engine Oil	Myrina oil 15W-40	Delvac Super15W-40
2	Gear Oil	Spirax Heavy Duty 140	Mobilub HD 85W-140
3	Hydraulic Oil	ISO VG 46 (equivalent)	ISO VG46 (equivalent)
4	Cup Grease	Alvinia 2	Mobilux 2
5	Anti Freeze	Anti Freeze	Anti Freeze
6	Diesel Fuel	—	—

*The engine oil SAE-CD 15W=40 or equivalent at the time of shipment is used for the lubricating oil for slewing and travelling speed reducer.

Cooling water (antifreeze)

*To prevent the cooling system from freezing, add antifreeze to the cooling water. Replace the cooling water after 1 year from its delivery, because the effect will decrease.

*Use "Long-life coolant" for the antifreeze.

*Mixing ratio of antifreeze.

Temperature	-5°C	-10°C	-15°C	-20°C	-25°C
Injection rate	2.2	2.8	3.5	4.0	4.5

Engine inside capacity	Radiator capacity	Reserve tank capacity	Total
4.9 ℓ	3.8 ℓ	1.3 ℓ	10.0 ℓ

2-7 When to repair

It is difficult to judge when to perform periodic inspections, maintenance and repairs. Although the wearing rate of each component differs depending on the grade of daily inspection, the skill in machine operation, the working conditions, the quality of used lubricating oil, the frequency of oil replacement, the quality of land to be dug, the digging rate, the schedule for maintenance and repairs should be decided considering the state of engine, the indication of the hour meter, the degree of wear in each part, the state of hydraulic system, your experience and data.

2.7.1 Category of maintenance

Prestart-up inspection	Execute every day before beginning operation
Maintenance after the first 25 service hours	Execute every 25 hours by the hour meter
Maintenance after the first 50 service hours	Execute once a week (every 50 hours by the hour meter)
Maintenance after the first 100 service hours	Execute every 100 hours by the hour meter
Maintenance after the first 250 service hours	Execute every 250 hours by the hour meter
Maintenance after the first 300 service hours	Execute every 300 hours by the hour meter
Maintenance after the first 500 service hours	Execute every 500 hours by the hour meter
Maintenance after the first 1,000 service hours	Execute every 1,000 hours by the hour meter
Maintenance after the first 2,000 service hours	Execute every 2,000 hours by the hour meter

2-7-2 Maintenance procedure

	Inspection and maintenance item	Inspection and maintenance interval (hours)					
		7	50	100	250	500	1,000
1	Engine oil pan	Check oil level	Replace the engine oil (New machine only)		Replace the engine oil		Clean
	Engine oil filter		Replace the cartridge (New machine only)		Replace the cartridge		
2	Fuel filter			Check and clean		Replace the element	
3	Engine valve clearance		Inspect and adjust (New machine only)			Inspect and adjust	
4	Fan belt	Check and adjust					
5	Fuel tank	Check oil level	Drain water and sediment, clean strainer				
6	Radiator (sub-tank)	Check water level				Replace and clean	
	Radiator fin		Check and clean				
7	Air cleaner			Check and clean		Replace the element	
8	Hydraulic oil tank	Check oil level			Drain water and sediment		Replace oil
9	Hydraulic line filter			Replace the cartridge (New machine only)		Replace the cartridge	
10	Hydraulic suction filter			Clean the element (New machine only)		Replace the element	
11	Bucket teeth and others	Inspect					
12	Slew bearing		Inspect and grease				
13	Inspect crawler tension (grease cylinder) and grease the crawler	Check and adjust					
14	Battery liquid amount and specific gravity		Inspect, clean and supply distilled water				
15	Inspect each body part for loosening and damage	Check and tighten					
16	Each lever and instrument	Inspect					
17	Lubricating oil of slew/travelling reduction gear					Replace oil (after the first 500 service hours only for a new machine)	Replace oil
18	Electrical wiring	Inspect					
19	Water and oil leakage in each body part	Inspect					
20	Inspect and grease attachment	Inspect attachment					
21	PTO filter element				Replace the element		

2-7-3 Prestart inspections

(1)Prestart inspections

	Item	Content	Remarks
1	Engine oil pan	Check oil level	Before starting operation
2	Fuel tank	Check fuel level	Check that the fuel level is above the center of level gauge.
3	Radiator	Check water level	Check that the amount of water in sub-tank is within a specified level.
4	Each oil/grease supply point	Oil and grease	Refer to page 2-6
5	Inspect each body part for looseness and damage	Looseness, removal, water and oil leakage	Refer to tightening torque list.
6	Each lever and instrument	Operation check	Whether abnormal operation exists or not
7	Hydraulic oil tank	Check oil level	Add oil if its level falls below the specified level. (Be careful of the position of machine.)
8	Bucket teeth and others	Wear	Check whether the replacement of parts is necessary or not.
9	Electrical wiring	Looseness and tears	Loosened terminal, torn covering, etc.
10	Fan belt	Check and adjust	10mm(0.4") to 12mm(0.5") sag at the center

(2)Post operation inspections

	Item	Content	Remarks
1	Each body part	Clean, check for water and oil leaks. Looseness, failure, etc.	Treatment of the part where cleaning was not sufficient such as dirt sticking to the body or muddy water remaining on the body.
2	Fuel tank	Fuel supply	Add fuel
3	Cooling water	Drain	Only when the danger of freezing exists

Tightening torque list:

In the present inspection, always check for loosened bolts or nuts and correctly tighten them according to the following tightening torque list.

⬡ N-m ⬡ Tightening torque of the bolt and nut (Body)

Material Size	8.8 N·m	10.9 N·m	12.9 N·m
M6	12.5	16	20
M8	30	39	45
M10	62	72	80
M12	100	120	130
M14	160	195	220
M16	250	305	340

⬡ N-m ⬡ Tightening torque of the hydraulic pipings

PT screw

Torque Size	N·m
$\frac{1}{4}$	36
$\frac{3}{8}$	55
$\frac{1}{2}$	86
$\frac{3}{4}$	130
1	195
$1\frac{1}{4}$	300
$1\frac{1}{2}$	400

PF screw

Torque Size	N·m
$\frac{1}{4}$	27-30
$\frac{3}{8}$	47-52
$\frac{1}{2}$	57-63
$\frac{3}{4}$	108-120
1	126-140

2-7-4 Maintenance every 50 service hours

	Item	Content	Remarks
1	Engine oil pan	Replace engine oil and filter	Only for a new machine. After this, every 250 service hours
3	Engine valve clearance	Inspect and adjust	Only for a new machine. After this, every 500 service hours
5	Fuel tank	Drain sediment and water	Remove the drain plug on the lower part of the tank
		Clean the strainer	Wash strainer with diesel fuel
	Radiator fin	Clean the fins	Dust sticking to the fin affects the cooling effect and causes overheating
6	Slew bearing	Inspect and grease	Always grease the machine after it is used in water
12	Battery	Liquid quantity	Whether the liquid level is proper or not. If short, add distilled water
14	Battery	Specific gravity	1.26 when fully charged; 1.20 when discharged (Recharge the battery when 1.20.)
		Clean	Clean each part, brush and connect terminal and apply grease
20	Each oil/grease supply point	Oil and grease	Refer to page 2-8

2-7-5 Maintenance every 100 service hours

	Item	Content	Remarks
2	Fuel filter	Clean the element	After cleaning, open the cock to vent air
7	Air cleaner	Clean the dust cover, clean or replace the element	Check also for a loosened band
9	Hydraulic line filter	Replace the cartridge	Only for a new machine. After this, every 500 service hours
10	Hydraulic suction filter	Clean the element	Only for a new machine. After this, every 500 service hours

2-7-6 Maintenance every 250 service hours

	Item	Content	Remarks
1	Engine oil	Replace the engine oil	Remove the drain plug on the lower part of the tank. (After 50 service hours for a new machine)
	Engine oil filter	Replace the cartridge	After 50 service hours for a new machine
8	Hydraulic oil tank	Drain water and sediment	After air is vent, loosen the drain plug
17	Lubricating oil of slew and travelling reduction gears	Replace lubricating oil	Replace oil after the first 200 service hours. Every 1,000 service hours after this (Refer to Table of Oil/Grease Supply Points)

2-7-7 Maintenance every 500 service hours

	Item	Content	Remarks
2	Fuel filter	Replace the element	Clean the inside of bowl
3	Engine valve clearance	Check valve clearance	Clearance between the valve and the rocker
6	Radiator	Replace cooling water and clean the radiator	Remove the drain plug, clean the radiator and add water to the sub-tank up to the specified level.
7	Air cleaner	Replace the element	
9	Hydraulic line filter	Replace the cartridge	After 100 service hours for a new machine
10	Hydraulic suction filter	Clean the element	

2-7-8 Maintenance every 1,000 service hours

	Item	Content	Remarks
1	Engine oil pan	Clean engine oil pan	
8	Hydraulic oil tank	Replace the hydraulic oil and clean the oil tank	Clean the inside of the tank
12	Lubricating oil of slew and travelling reduction gears	Replace the lubricating oil	Refer to Table of Oil/Grease Supply Points. (For new machine, every 200 service hours)

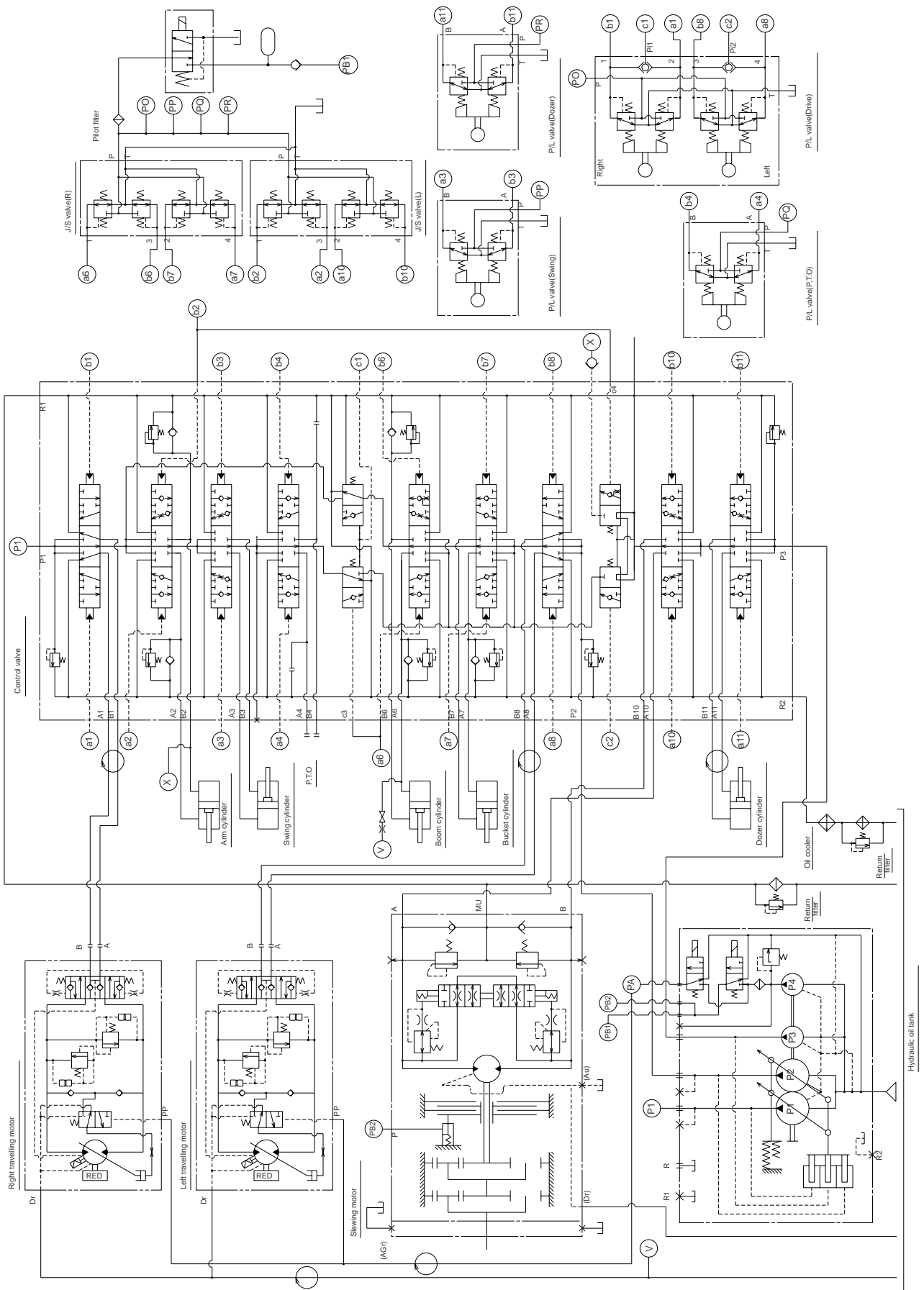
2-7-9 Maintenance every 2,000 service hours

	Item	Content	Remarks
15	Track roller	Replace	

Table of Oil/Grease Supply Points

No.	Oil/Grease Supply Point	Specified oil (genuine part)	Quantity	Time
1	Travelling motor	API Classification CD Class SAE30	1500 cc	Every 1,000 service hours (At first, replace after the first 500 service hours)
2	Track roller		100 cc	Every 2,000 hours
3	Front idler		100 cc	Every 2,000 hours

2-8 Hydraulic circuit diagram



Item	
Boom cylinder	ø120×ø70×830st
Arm cylinder	ø100×ø65×875st
Bucket cylinder	ø90×ø55×660st
Swing cylinder	ø120×ø70×650st
Dozer cylinder	ø120×ø70×225st
Slew motor	SG025E-101
Travel motor	PHV-500-64B-1S1-8772A

	Item		
Pump capacity	P1	34.0cc/rev	
	P2	34.0cc/rev	
	P3	20.3cc/rev	
	P4	4.5cc/rev	
Pressure	Main relief	P1	25.5MPa
		P2	25.5MPa
		P3	23.5MPa
	P4	2.9MPa	
	Port relief	27.4MPa	
	Slew	22.5MPa	
Pump flow rate	Q1	78.2 ℓ /min	
	Q2	78.2 ℓ /min	
	Q3	46.7 ℓ /min	
Engine	Type	S4S	
	Constant output	40.8 kW(55.5ps)	
	Speed	2,300 min ⁻¹	
	Torque	180 N·m(17.6 kgf-m)/1,800 min ⁻¹	

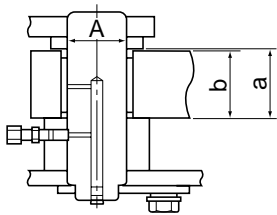
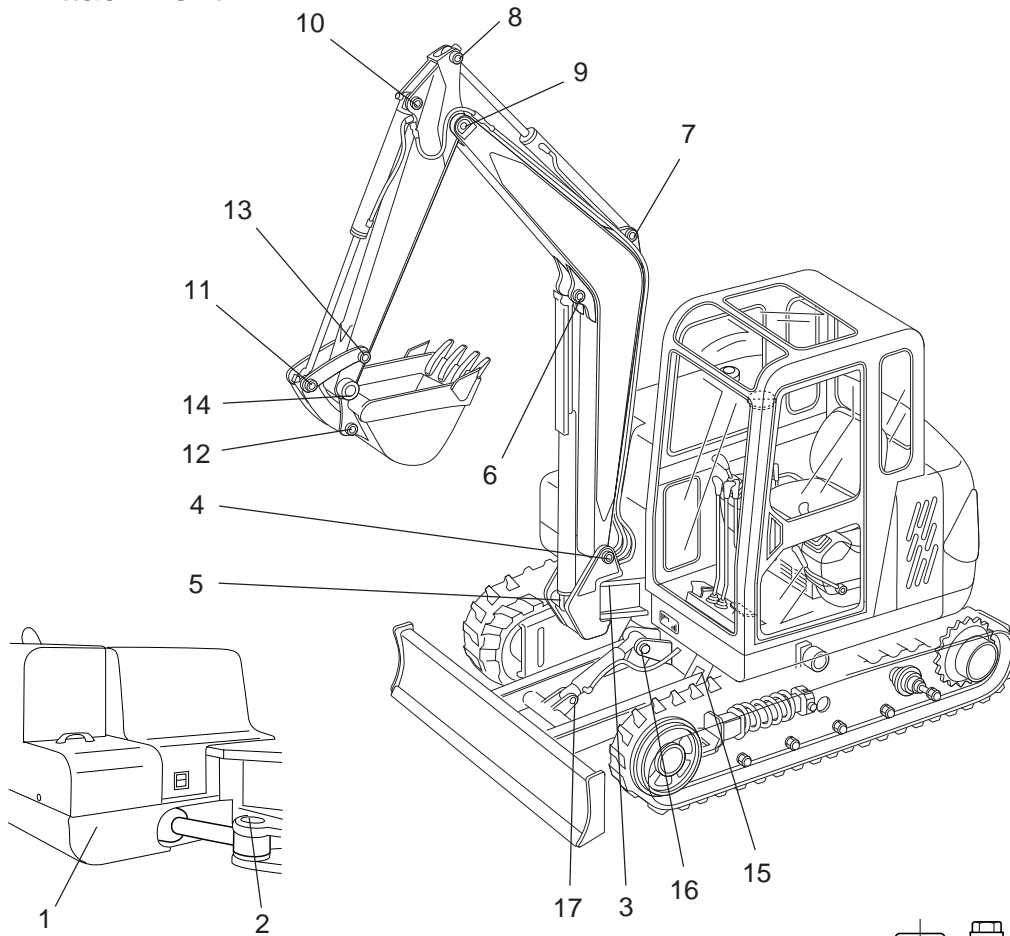
3 ATTACHMENT

CONTENTS

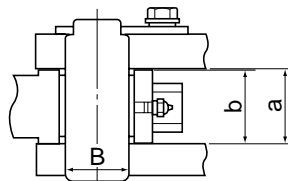
- 3-1 Standard of maintenance
 - 3-1-1 Attachment
- 3-2 Inspection and adjustment
 - 3-2-1 Measuring the fall of the attachment of its own weight
 - 3-2-2 Measuring the speed of the attachment cylinder

3-1 Standard of maintenance

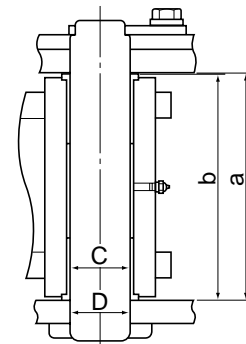
3-1-1 Attachment



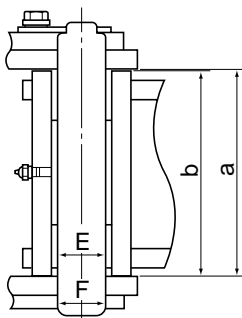
1. Swing cylinder head



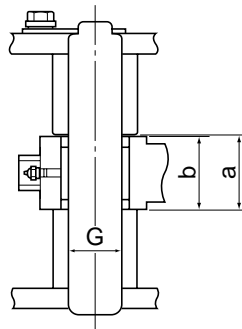
2. Swing cylinder rod



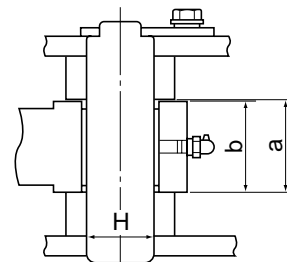
3. Swing post bracket and swing post



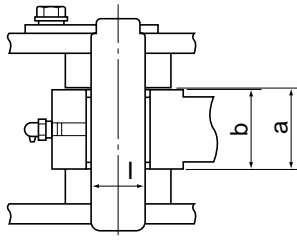
4. Boom joint



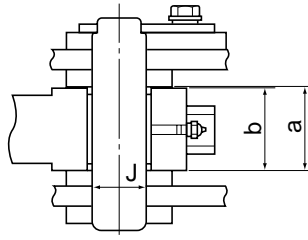
5. Boom cylinder head



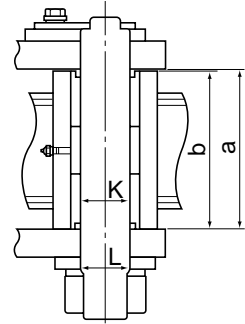
6. Boom cylinder rod



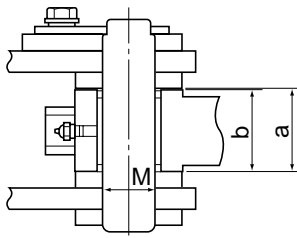
7. Arm cylinder head



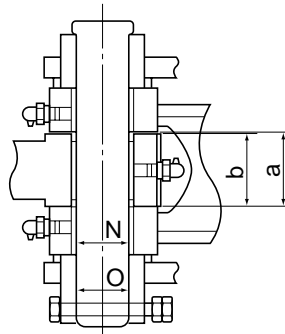
8. Arm cylinder rod



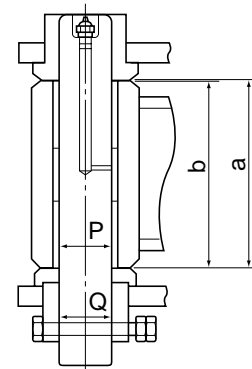
9. Boom/arm joint



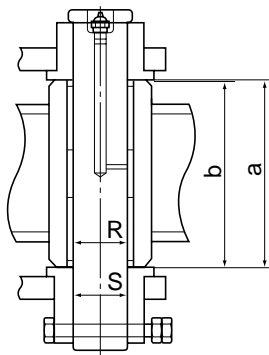
10. Bucket cylinder head



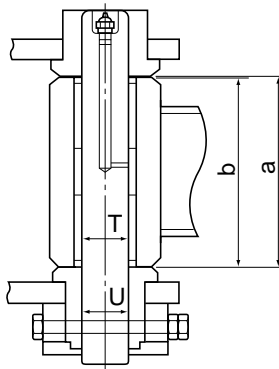
11. Bucket cylinder rod



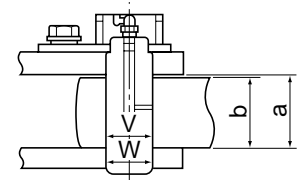
12. Bucket/dump link joint



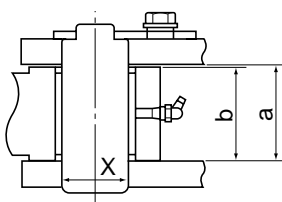
13. Arm/bucket link joint



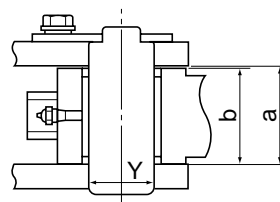
14. Arm/bucket joint



15. Dozer joint



16. Dozer cylinder rod



17. Dozer cylinder head

Unit: mm(in)

No.	Item	Basic Dimension	Allowable Clearance
A	Swing cylinder head pin and head bracket	ø70(2.76")	1.0(0.04")
B	Swing cylinder rod pin and swing post	ø70(2.76")	1.0(0.04")
C	Swing post pin and bush	ø80(3.15")	1.0(0.04")
D	Swing post pin and swing post bracket	ø80(3.15")	1.0(0.04")
E	Boom joint pin and bush	ø70(2.76")	1.0(0.04")
F	Boom joint pin and swing post	ø70(2.76")	1.0(0.04")
G	Boom cylinder head pin and swing post	ø70(2.76")	1.0(0.04")
H	Boom cylinder rod pin and boom	ø70(2.76")	1.0(0.04")
I	Arm cylinder head pin and boom	ø60(2.36")	1.0(0.04")
J	Arm cylinder rod pin and arm	ø60(2.36")	1.0(0.04")
K	Boom/ arm joint pin and bush	ø60(2.36")	1.0(0.04")
L	Boom/ arm joint pin and boom	ø60(2.36")	1.0(0.04")
M	Bucket cylinder head pin and arm	ø60(2.36")	1.0(0.04")
N	Bucket cylinder rod pin and dump link	ø60(2.36")	1.0(0.04")
O	Bucket cylinder rod pin and bucket link	ø60(2.36")	1.0(0.04")
P,T	Bucket pin and bush	ø60(2.36")	1.0(0.04")
Q,U	Bucket pin and bucket	ø60(2.36")	1.0(0.04")
R	Bucket link pin and bush	ø60(2.36")	1.0(0.04")
S	Bucket link pin and bucket link	ø60(2.36")	1.0(0.04")
V	Dozer joint pin and dozer	ø59.8(2.35")	1.0(0.04")
W	Dozer joint pin and frame	ø59.8(2.35")	1.0(0.04")
X	Dozer cylinder rod pin and frame	ø70(2.76")	1.0(0.04")
Y	Dozer cylinder head pin and dozer	ø70(2.76")	1.0(0.04")

Unit: mm(in)

No.	Item	Criterion			Spacer	
		a	b	Standard clearance	Part Number	Dimension
1	Clearance between swing cylinder head and head bracket	92(3.62")	90(3.54")	2.0~3.5(0.08"~0.14")	NSS3-60009 NSS3-60010 NSS3-60011	ø71×t0.5 ø71×t1.0 ø71×t1.6
2	Clearance between swing cylinder rod and swing post	82(3.23")	80(3.15")	2.0~3.5(0.08"~0.14")	∕	∕
3	Clearance between swing post and frame	342.5(13.48")	342(13.46")	0.5~2.0(0.02"~0.08")		
4	Clearance between boom and swing post	302(11.89")	300(11.81")	2.0~4.5(0.08"~0.18")	NSS3-60009 NSS3-60010 NSS3-60011	ø61×t0.5 ø61×t1.0 ø61×t1.6
5	Clearance between boom cylinder head and swing post	92(3.62")	90(3.54")	2.0~3.5(0.08"~0.14")	∕	∕
6	Clearance between boom cylinder rod and boom	92(3.62")	90(3.54")	1.5~3.0(0.06"~0.12")	∕	∕
7	Clearance between arm cylinder head and boom	92(3.62")	90(3.54")	1.5~3.0(0.06"~0.12")	NSS3-60005 NSS3-60007 NSS3-60008	ø61×t0.5 ø61×t1.0 ø61×t1.6
8	Clearance between arm cylinder rod and arm	82(3.23")	80(3.15")	2.0~3.5(0.08"~0.14")	∕	∕
9	Clearance between boom and arm	222(8.74")	220(8.66")	1.5~3.0(0.06"~0.12")	∕	∕
10	Clearance between bucket cylinder head and arm	82(3.23")	80(3.15")	2.0~3.5(0.08"~0.14")	∕	∕
11	Clearance between bucket cylinder rod and dump link	82(3.23")	80(3.15")	1.5~3.0(0.06"~0.12")	∕	∕
12	Clearance between dump link and bucket	183(7.20")	180(7.09")	3.0~5.0(0.12"~0.20")	∕	∕
13	Clearance between arm and bucket link	180(7.09")	180(7.09")	0.0~0.5(0"~0.02")	∕	∕
14	Clearance between arm and bucket	183(7.20")	180(7.09")	3.0~3.5(0.12"~0.14")	∕	∕
15	Clearance between dozer and frame	68(2.68")	65(2.56")	3.0~4.0(0.12"~0.16")		
16	Clearance between dozer cylinder rod and frame	82(3.23")	80(3.15")	2.0~3.0(0.08"~0.12")		
17	Clearance between dozer cylinder head and dozer	82(3.23")	80(3.15")	2.0~3.5(0.08"~0.14")		

3-2 Inspection and adjustment

3-2-1 Measuring the natural fall of the attachment

1. Measuring the location of the attachment

Set the temperature of the hydraulic oil to $50\pm 5^{\circ}\text{C}$. Adjust the height of arm/bucket joint so that it equals that of the boom joint. Then, retract the dozer cylinder to the minimum length and stop the engine.

2. Measurement

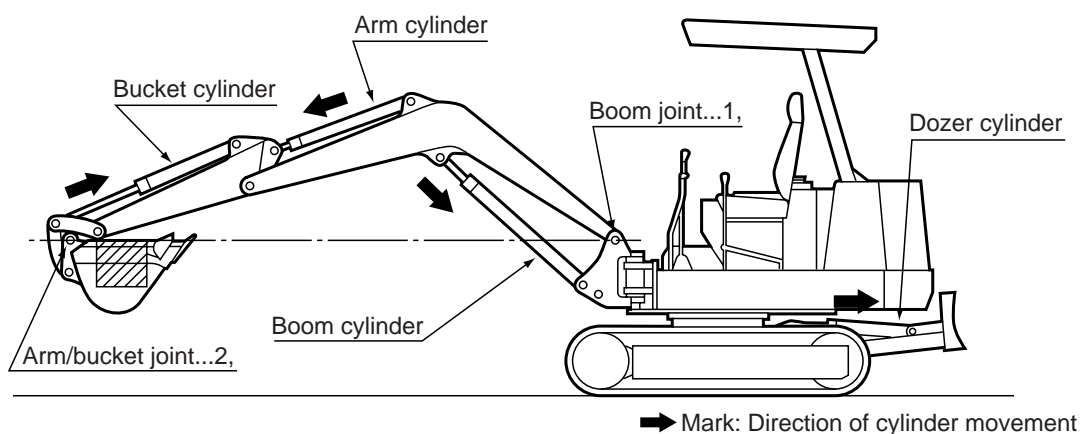
Draw a reference line on the cylinder head with a Magic Marker and measure the length from the line to the cylinder tube. Measure the length again 3 minutes later. Then record the difference in the length

Unit: mm (or less)

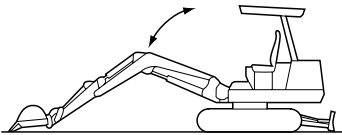
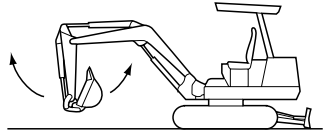
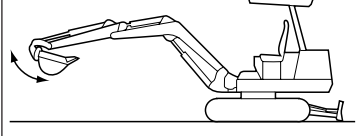
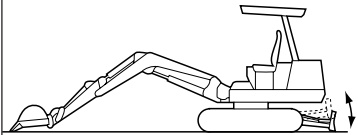
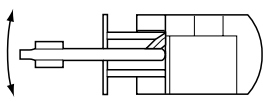
Cylinder name	Standard value	Allowance
Boom cylinder	8	16
Arm cylinder	12	24
Bucket cylinder	6	12
Dozer cylinder	4	8

Make 1 and 2 the same height.

W: Weight	About: 450 kg
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3-2-2 Measuring the speed of attachment cylinder
(at full engine speed and oil temperature $50\pm 5^{\circ}\text{C}$)

Condition	Machine position	Unit	New standard value	Allowable limit
Boom Make bucket teeth touch the ground		Up	3.4 ± 0.5	4.7
Extend cylinder to the Maximum length		Down	3.2 ± 0.3	4.5
Arm Retract cylinder to the minimum length		Dig	3.4 ± 0.6	4.7
Extend cylinder to the maximum length		Dump	3.3 ± 0.3	4.6
Bucket Retract cylinder to the minimum length		Dig	3.1 ± 0.5	4.3
Extend cylinder to the maximum length		Dump	2.1 ± 0.3	2.9
Dozer Make dozer contact the ground		Up	2.1 ± 0.4	2.8
Lift dozer to the maximum height		Down	1.9 ± 0.4	2.5
Swing Retract cylinder to the minimum length		Right swing	7.7 ± 0.6	10.1
Extend cylinder to the maximum ground		Left swing	6.6 ± 0.6	8.8

4 ENGINE

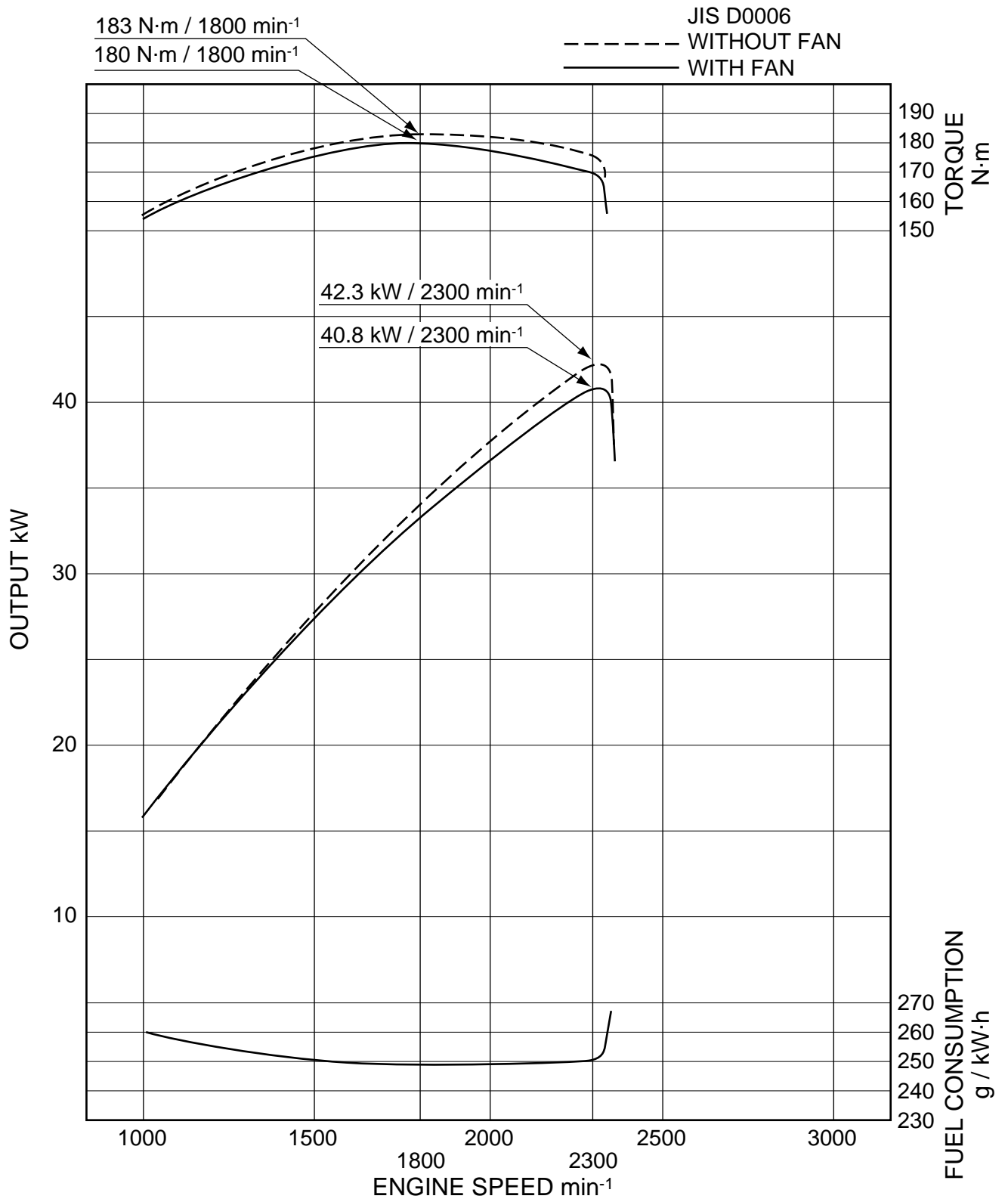
CONTENTS

- 4-1 Specification
- 4-2 Performance curve
- 4-3 Location of serial number
 - 4-3-1 Engine
 - 4-3-2 Standard engine speed

4-1 Specification

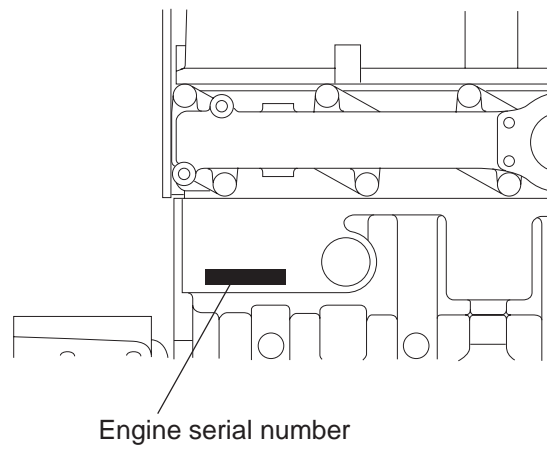
Engine		S4S
Type		In-line 4 cylinder-4 cycle overhead valve type
Number of cylinders–bore × stroke		4–94 mm × 120 mm
Displacement		3,331 cc
Ignition order		1–3–4–2
Dimensions	Overall length	781 mm
	Overall width	558 mm
	Overall height	773 mm
Performance	Rated net power	40.8 kW(55.5 ps) / 2,300 min ⁻¹
	Maximum torque	180 N-m / 1,800 min ⁻¹
	Maximum idling speed	2,460±50 min ⁻¹
	Minimum idling speed	1,200±20 min ⁻¹
	Fuel consumption	247 g/kW/h
Dry weight		245 kg
Fuel oil		Diesel fuel
Fuel pump		Bosh type
Governor		Centrifugal type
Generator		12V × 45A
Starter		12V × 3.0 kW
Battery		12V × 92AH(5HR)

4-2 Performance curve



4-3 Location of serial number

4-3-1 Engine



4-3-2 Standard engine speed (at new machine delivery)

Conditions	Idling speed
Maximum idling speed	2,460 ± 50 rpm
Speed when 1P relief is used	2,420 rpm
Speed when 2P relief is used	2,420 rpm

4-4 Inspection and maintenance procedure for engine parts

Inspecting and Adjusting Valve Clearance

The valve clearance should be inspected and adjusted when the engine is cold.

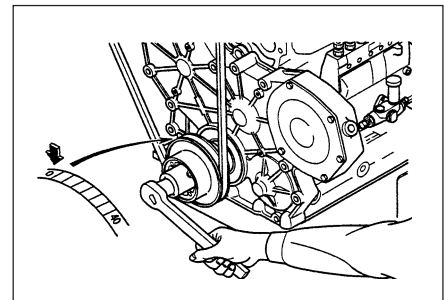
		Unit:mm(in.)
		Standard
Valve clearance (when engine is cold)	Inlet	0.25(0.0098)
	Exhaust	

(1) Inspecting valve clearance

- (a) Inspect the valve clearance in the firing order by turning the crankshaft 180° in the normal direction to bring each piston to the top dead center on the compression stroke.

Firing order

Cylinder No.	S4S	1-3-4-2
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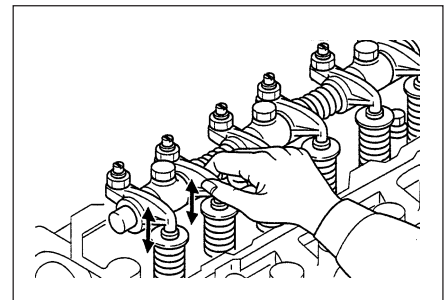


Checking top dead center of No. 1 piston on compression stroke(1)

- (b) Attach a socket and ratchet handle to the crankshaft pulley tightening nut, and turn the crankshaft.(Turning socket:58309-73100)

		Unit:mm(in.)
Width across flats of crankshaft pulley tightening nut		46(1.81)

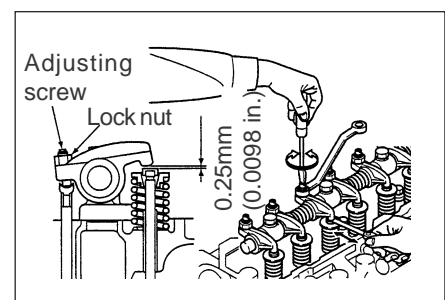
- (c) When the No. 1 piston is at the top dead center on the compression stroke, the "0" line stamped on the circumference of the crankshaft pulley is aligned with the pointer of the timing gear case, and the inlet and exhaust valves are not lifted off their seats by the pushrods.
- (d) Insert a feeler gage between the rocker arm and valve cap to inspect the clearance.



Checking top dead center of No. 1 piston on compression stroke (2)

(2) Adjusting valve clearance

- (a) Loosen the lock nut, insert a feeler gage between the rocker arm and valve cap, and while measuring the clearance, tighten or loosen the adjusting screw until the feeler gage moves slightly tight.
- (b) After adjusting the clearance, securely tighten the lock nut, and inspect the clearance again.



Adjusting valve clearance

Inspecting and Adjusting Injection Nozzles

Conduct the following inspections and, if faulty, repair or replace as required.

(1) Checking fuel injection nozzle for valve opening pressure

- (a) Install the fuel injection nozzle onto the nozzle tester. Pump the tester handle up and down to bleed air.
- (b) Pump the tester handle at a rate of approx. one cycle per second while observing the pointer of the tester.

Note: The pointer should rise slowly and, during fuel injection, should vibrate. The pressure at which the pointer starts to vibrate is the valve opening pressure.

- (c) If the measured pressure does not conform to the standard value, disassemble and adjust by changing the thickness of the washer.

Unit: MPa(kgf/cm²)(psi)

		Standard
Valve opening pressure	Swirl chamber	11.77 to 12.75 (120 to 130) (1710 to 1850)
	Direct injection	18.14 to 19.12 (185 to 195) (2630 to 2770)

- (d) Change in washer thickness by 0.1 mm (0.004 in.) results in a pressure change of 1.0 MPa (10kgf/cm²)(142 psi).

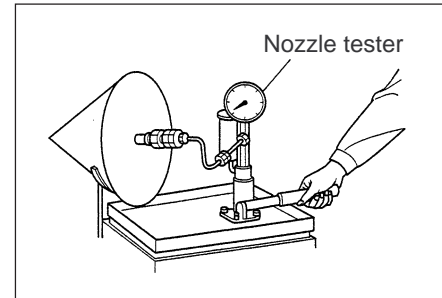
Washers are available in 10 different thicknesses at intervals of 0.05 mm (0.002 in.) in the range between 1.25 and 1.70 mm (0.049 and 0.067 in.).

⚠ CAUTION

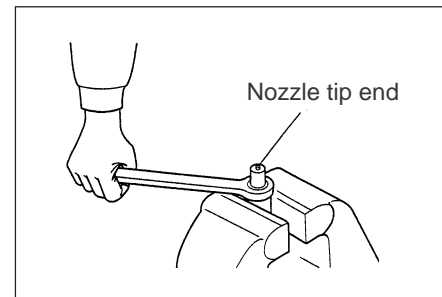
Never touch the spray of fuel from the fuel injection nozzle during inspection.

(2) Checking fuel spray pattern from fuel injection nozzle

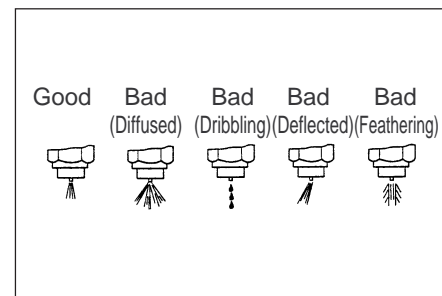
- (a) When checking the valve opening pressure using the nozzle tester, also check for such as clogged nozzle hole, fuel spray pattern and fuel leakage from the spray hole.
- (b) When the tester handle is pumped at a rate of approx. one cycle per second, fuel should be sprayed in a fairly straight pattern.



Checking fuel injection nozzle for valve opening pressure



Replacing fuel injection nozzle tip assembly



Fuel spray patterns

- (3) Cleaning or replacing when spraying badly
- (a) Loosen the nozzle retaining nut to remove the nozzle tip assembly. Clean the needle valve and the nozzle tip body.

⚠ CAUTION

When removing the nozzle tip assembly, never tap on the end of the assembly.

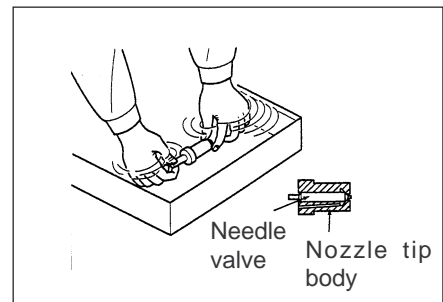
- (b) Wash the needle valve and the nozzle tip body in clean wash oil. Reassemble them in clean light oil.

Note: The needle valve and the nozzle tip body are precision machined parts. Handle with care and never change their combination.

- (c) Assemble the fuel injection nozzle, tightening the nozzle retaining nut to the specified torque.
- (d) If the fuel spray pattern is still not good, replace the nozzle tip assembly.

Note: (a) Never touch the sliding surface of the needle valve with your hands.

- (b) If the nozzle tip assembly is to be replaced, remove the seal peel (synthetic resin film) from the new nozzle tip assembly, and slide the nozzle and needle valve in clean wash oil to remove the anti-corrosive agent completely.



Cleaning fuel injection nozzle tip components

Measuring Compression Pressure

1. Preparation for Inspection

Perform the following checks prior to inspection.

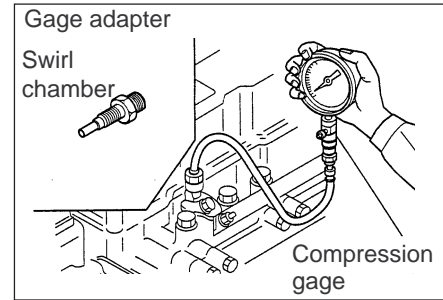
- (1) Make sure the engine oil, air cleaner, starter, and are normal.
- (2) Make sure the engine is warm.

2. Inspection

- (1) Move the control lever to STOP position.
- (2) Remove the glow plugs from all cylinders. Install the special tool gage adapter and a compression gage onto the cylinder being measured.

Special tool	Part No.
Compression gage	33391-02100
Gage adapter	30691-21100

- (3) While cranking the engine with the starter, read the compression gage. Note the reading at which the gage needle stabilizes.
- (4) If the measured value is at or below the limit, overhaul the engine.



Testing the compression pressure

▲ CAUTION

- (a) Measure all cylinders for compression pressure. Do not measure only one cylinder and make assumption about the other cylinders as this will lead to a wrong conclusion.
- (b) Compression pressure varies depending on the engine speed. Keep the specified engine speed when measuring the compression pressure.

		Standard	Limit
Engine speed		300 min ⁻¹	
Valve opening pressure	Swirl chamber	3.23 MPa (33 kgf/cm ²) (469 psi)	2.84 MPa (29 kgf/cm ²) (413 psi)
	Direct injection	2.94 MPa (30 kgf/cm ²) (427 psi)	2.64 MPa (27 kgf/cm ²) (384 psi)

▲ CAUTION

It is important to regularly check the compression pressure so that you can tell the difference.

- New or overhauled engines have slightly higher compression pressure.
- The compression pressure settles to the standard value as the piston and valve seats fit in.
- As wear progresses further, the compression pressure drops.

Disassembly

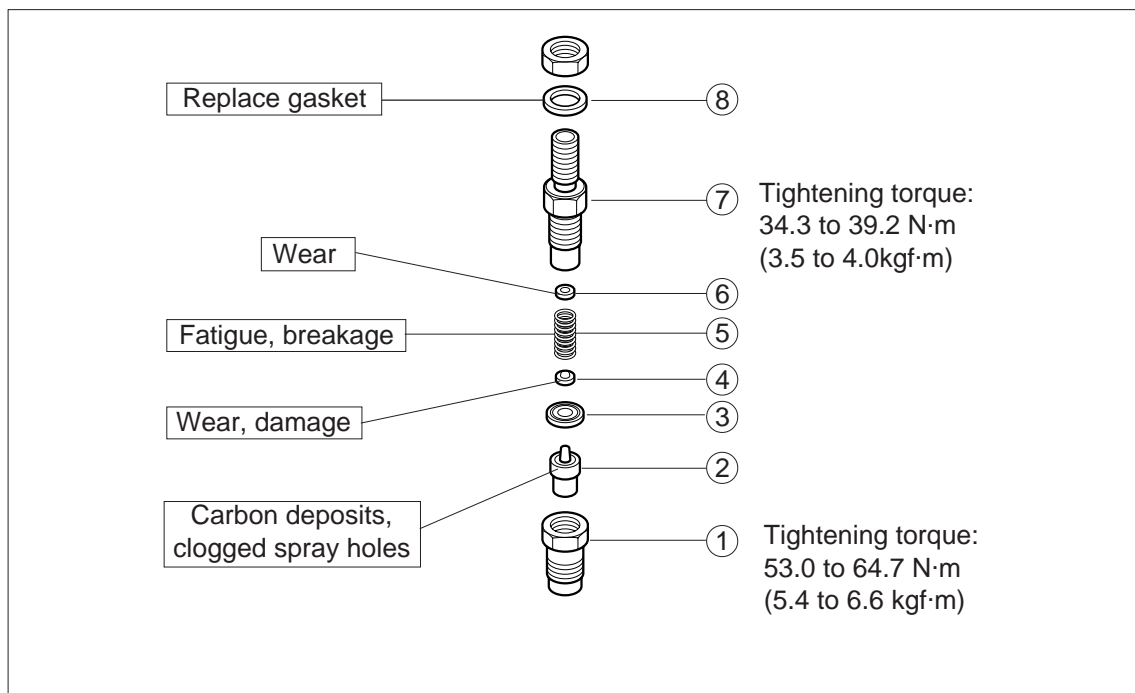
If the tested part is evaluated as a reject, it must be disassembled and the defective part must be replaced.

- 1) Fix the nozzle holder in a vice and loosen the retaining nut. Do not hold the retaining nut with the vice as this could damage it.
- 2) Take out the pressure spring shim, distance piece and nozzle chip.
 - * **Scrape the stuck carbon off with a wooden tool and soak the parts in gas oil.**
 - Carefully handle the needle valve of nozzle tip not to damage it.**

Inspection

Replace the defective part.

- 1) Insert the nozzle chip into the retaining nut and securely set it.
- 2) Put the distance piece, retaining pin, pressure spring and disassembled shims on the nozzle tip.
- 3) Tighten the nozzle holder body with fingers only.
- 4) Fix the nozzle holder in a vice and tighten the retaining nut to the specified torque.



Disassembly of fuel injection nozzle (swirl chamber specification)

<Disassembly sequence>

- | | |
|-----------------------|-----------------|
| ① Nozzle | ⑤ Spring |
| ② Nozzle tip assembly | ⑥ Washer |
| ③ Piece | ⑦ Nozzle holder |
| ④ Pin | ⑧ Gasket |

Fastener	Sizes mm(in)				Tightening Torque N-m{kgf-m}(lbf-ft)
	Nominal Diameter	Thread Pitch	Width Across Flats	Length from Bottom of Head	
Cylinder head bolts					"Wet"
Main bolts	M14	1.5	22(0.9)	104(4.1)	159-169{16.2-17.2}(117.2-124.4)
Sub-bolts	M12	1.25	17(0.7)	104(4.1)	110-121{11.2-12.3}(81.0-89.0)
Rocker stay bolts (standard)	M10	1.25	14(0.6)	65(2.6)	29.4-41.2{3.0-4.2}(21.7-30.4)
Rocker cover bolts (standard)	M8	1.25	12(0.5)	—	9.80-12.7{1.0-1.3}(7.2-9.4)
Thermo switch(cylinder head mounting portion)	PT3/8	—	—	—	39.2{4}(28.9)
Blind plug for gear case governor shaft hole	PT1/2	—	—	—	39.2-49.0{4-5}(28.9-36.2)
Crankshaft pulley nut	M20	1.5	30(1.2)	—	196-245{20-25}(144.7-180.8)
Main bearing cap nuts	M10	1.25	17(0.7)	81(3.2)	49.0-53.9{5.0-5.5}(36.2-39.8)
Connecting rod cap nuts	M9	1.0	14(0.6)	—	39.2-49.0{4.0-4.3}(28.9-31.1)
Flywheel mounting bolts	M12	1.25	19(0.7)	29(1.1)	127-137{13-14}(94.0-101.3)
Oil pan drain plug	M18	—	19(0.7)	—	49.0-53.9{5-6}(36.2-43.4)
Oil relief plug	M18	1.5	22(0.9)	8(0.3)	39.2-49.0{4-5}(28.9-36.2)
Oil filter	M20	—	—	—	10.8-12.7{1.1-1.3}(8.0-9.4)
Fuel injection pipe nuts	M12	1.5	—	—	*24.5-29.4{2.5-3.0}(18.1-21.7)
Fuel injection nozzle	M20	1.5	21(0.8)	—	49.0-68.6{5-7}(36.2-50.6)
Nozzle retaining nut	M16	0.75	21(0.8)	—	34.3-42.2{3.5-4.0}(25.3-39.2)
Glow plugs	M10	1.25	12(0.5)	—	14.7-19.6{1.5-2.0}(10.8-14.5)
Glow plug lead nut	M4	0.7	7(0.3)	—	0.98-1.47{0.1-0.15}(0.7-1.1)
ETR solenoid retaining nut	M30	1.5	36(1.4)	—	49.0{5}(362)
Hollow screw	M14	1.5	21(0.8)	—	19.6-24.5{2.0-2.5}(14.5-18.1)
Air vent screw(fuel injection pump)	M8	1.25	12(0.5)	—	9.8-13.7{1.0-1.4}(7.2-10.1)
Alternator B terminal	M6	—	—	—	3.9-5.9{0.4-0.6}(2.9-4.3)
Fuel injection pump delivery valve holder	—	—	19(0.7)	—	39.2-49.0{4-5}(28.9-36.2)
Fuel injection pump adjusting plate bolts	—	—	10(0.4)	—	3.9-5.9{0.4-0.6}(2.9-4.3)
Fuel leakoff pipe nuts	M12	1.5	—	—	20.6-24.5{2.1-2.5}(15.2-18.1)
Starter B terminal	M8	1.25	—	—	9.8-11.8{1.0-1.2}(7.2-8.7)
Oil pan bolts	M8	1.25	12(0.5)	—	9.8-12.7{1.0-1.3}(14.5-21.7)
Oil strainer nuts	M16	1.5	24(0.9)	—	24.5-29.4{2.5-3.0}(18.1-21.7)

Note:

"Wet" means that the threads of the relevant item should be coated with engine oil before rightening, The item whose torque specifications are marked with asterisks(*) must be tightened using special tools in order that the torque may be controlled precisely.

Tightening Torques for Standard Bolts and Nuts

Unit:N-m{kgf-m}{lbf-ft}

Bolt Size	4T	7T
M6	—	7.85-9.80{0.8-1.0}{5.8-7.2}
M8	9.80-12.7{1.0-1.3}{7.2-9.4}	14.7-21.6{1.5-2.2}{10.8-15.9}
M10	17.7-24.5{1.8-2.5}{13.0-18.1}	29.4-41.2{3.0-4.2}{21.7-30.4}
M12	9.4-41.2{3.0-4.2}{21.7-30.4}	53.9-73.5{5.5-7.5}{39.8-54.2}

Note:

- a. The table above applies only to standardized bolts and nuts.
All torques shown assume use of spring washer together with bolts and nuts.
All bolts and nuts appearing in this manual should be tightened according to this table unless otherwise indicated.
- d. Standard bolts and nuts should be tightened in "dry" condition, without lubricating threads with oils.

Tightening Torques for Standard Eye Bolts(for Dry Condition)

Nominal Diaerer x Thread Pitch mm	Width Across Flars mm(in)	Torque		
		Strength Class: 4r		
		N-m	kgf-m	lbf-ft
M8x1.25	12(0.47)	8±1	8±0.1	5.8±0.7
M10x1.25	14(0.55)	15±2	15±0.2	15±1.4
M12x1.25	17(0.67)	25±3	25±0.3	18.0±2.2
M14x1.5	22(0.87)	34±4	35±0.4	25.3±2.9
M16x1.5	24(0.94)	44±5	4.5±0.5	32.5±3.6
M18x1.5	27(1.06)	74±5	75±0.5	54.2±3.6
M20x1.5	30(1.18)	98±10	10.0±1.0	72.3±7.2
M24x1.5	36(1.42)	147±15	15.0±1.5	108.5±10.8
M27x1.5	42(1.61)	226±20	23.0±2.0	166.3±14.5

Tightening Torques for Standard Union Nuts(for Dry Condition)

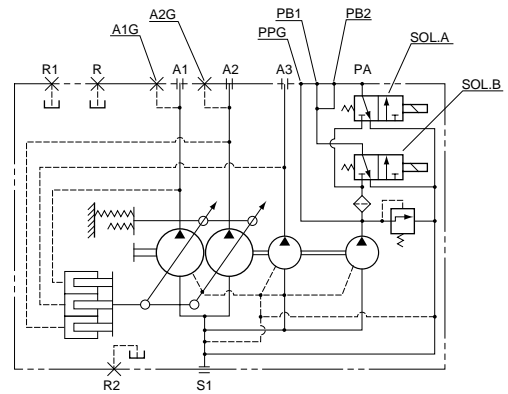
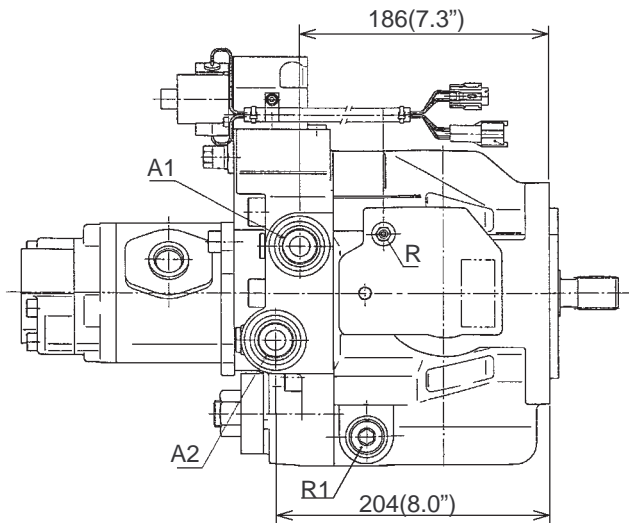
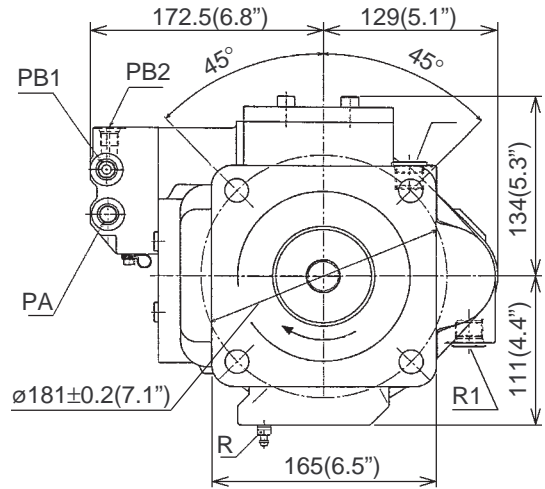
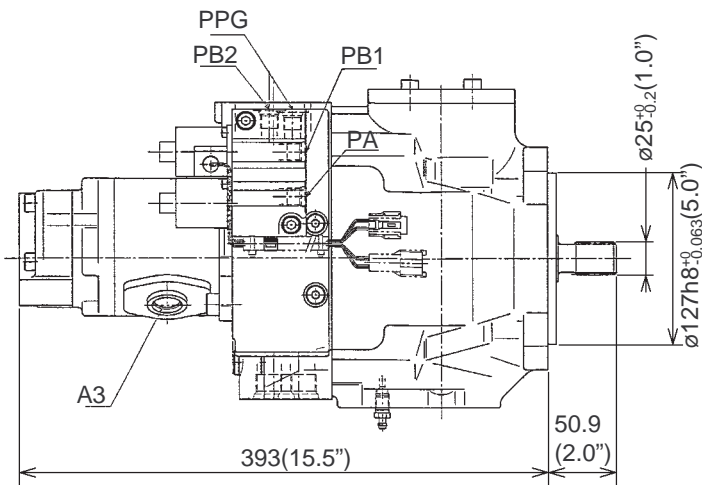
Nominal Diameter	Internal Nominal Diameter x Thread Pitch mm	Width Across Flars mm(in)	N-m	kgf-m	lbf-ft
63	M14x1.5	19(0.7)	39	4	29
80	M16x1.5	22(0.9)	49	5	36
100	M20x1.5	27(1.1)	78	8	58
120	M22x1.5	30(1.2)	98	10	72
150	M27x1.5	32(1.3)	157	16	116
180	M30x1.5	36(1.4)	196	20	145
200	M30x1.5	36(1.4)	196	20	145
220	M33x1.5	41(1.6)	245	25	181
254	M36x1.5	41(1.6)	294	30	217

5 MAIN PUMP

CONTENTS

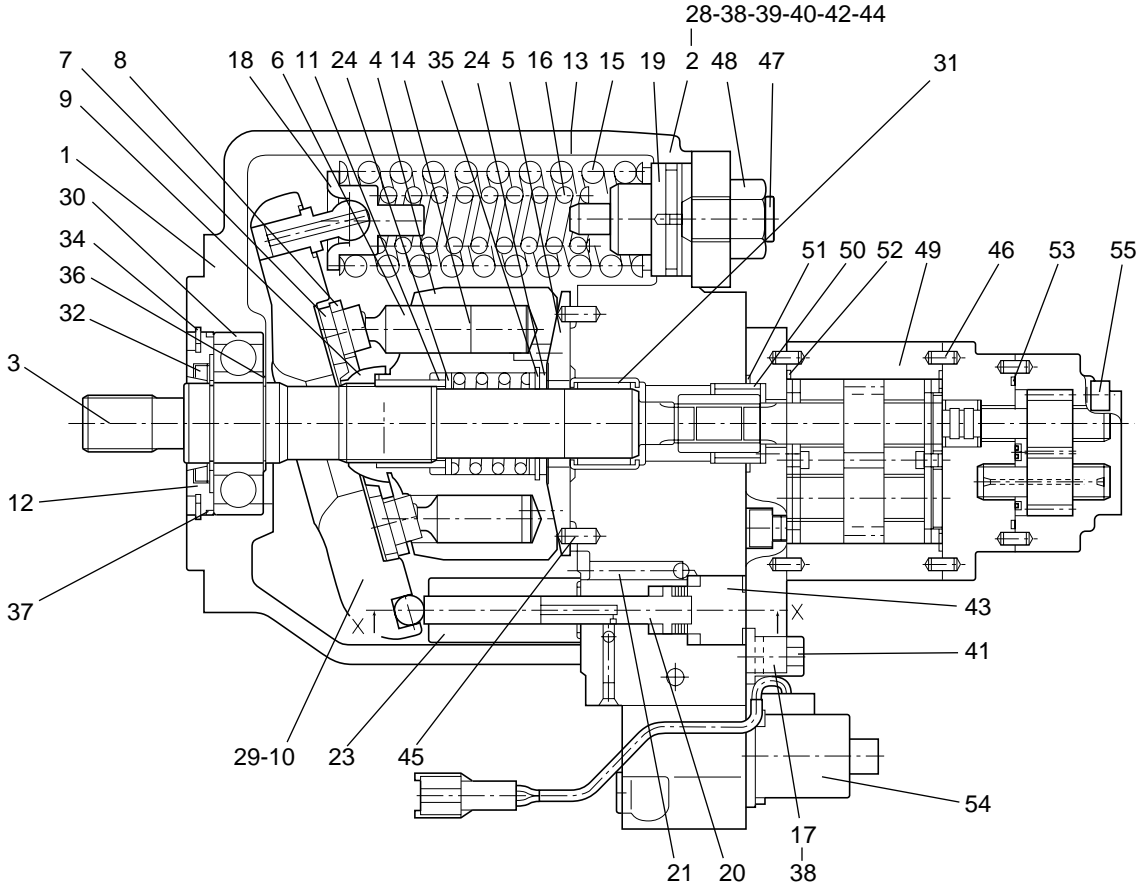
- 5-1 Specification
- 5-2 Structure
- 5-3 Removing and installing the pump
 - 5-3-1 Removing the pump
 - 5-3-2 Installing the pump
- 5-4 Performance test of the hydraulic pump
 - 5-4-1 Measuring instrument
 - 5-4-2 Preparation
 - 5-4-3 Connecting tester
 - 5-4-4 Measuring procedure
 - 5-4-5 P-Q characteristic curve

5-1 Specification



Pump type		AP2D36LV1RS7-938-3			
Displacement cc / rev		P1	P2	P3	PA,PB
		34.0	34.0	20.3	4.5
Rated pressure MPa		25.5	25.5	23.5	3.4
Port size	S1	$\phi 55$			
	P1,P2	PF $\frac{3}{4}$			
	P3	PF $\frac{1}{2}$			
Direction of rotation		Clockwise seen from shaft side			
Weight		58 kg			

5-2 Structure



- | | | |
|--------------------|--------------------|-----------------------|
| 1. Body(S) | 20. Rod. P | 39. O-ring |
| 2. Body(H) | 21. Rod. G | 40. O-ring |
| 3. Shaft | 22. | 41. Socket head bolt |
| 4. Cylinder barrel | 23. Control piston | 42. Parallel pin |
| 5. Valve plate | 24. Retainer | 43. Socket head plug |
| 6. Piston | 25. | 44. Plug |
| 7. Shoe | 26. | 45. Spring pin |
| 8. Shoe holder | 27. | 46. Spring pin |
| 9. Barrel holder | 28. Choke | 47. Set screw |
| 10. Swash plate | 29. Choke | 48. Nut |
| 11. Needle | 30. Ball bearing | 49. Pump Ass'y |
| 12. Seal holder | 31. Needle bearing | 50. Coupling |
| 13. Packing | 32. Oil seal | 51. O-ring |
| 14. Spring | 33. | 52. O-ring |
| 15. Spring(T1) | 34. Snap ring | 53. O-ring |
| 16. Spring(T2) | 35. Snap ring | 54. Valve block Ass'y |
| 17. Sleeve | 36. Snap ring | 55. Socket head bolt |
| 18. Spring holder | 37. O-ring | |
| 19. Spring guide | 38. O-ring | |

5-3 Removing and installing the pump

5-3-1 Removing the pump

1. Remove the nipple, TEE, elbow and hoses around the pump. Attach a cap to the removed hoses to keep dust off. Store the nipples and elbows in treated oil.
2. Remove the pump mounting bolts(5).
3. Remove the pump 1 from the flange 2. If removal is difficult, insert a screwdriver and remove the pump little by little with equal force applied on the right and left sides.

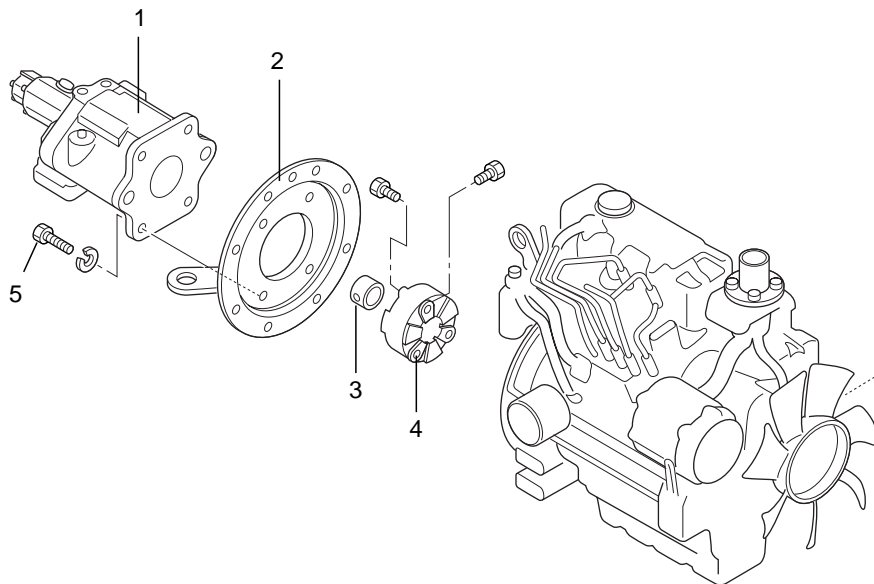
5-3-2 Installing the pump

1. Replace with a new pump and install it on the pump flange 2. Check that the spline of the shaft fits smoothly with the boss of the coupling.
When tightening the bolts 5, tighten the left and right side bolts slowly and evenly.

Bolt	Tightening torque
M16 × 40 ℓ	305 N·m

* Precautions on installing the pump

1. When tightening the coupling boss 3, be careful so that coupling 4 does not tilt.
Note) Make sure there is no misalignment.



5-4 Performance test of the hydraulic pump

5-4-1 Measuring instrument

Hydraulic pressure tester	Measuring range of flow rate (/min)	7~200 ℓ
	Measuring range of pressure (MPa)	0 ~ 34.3
	Measuring range of temperature (°C)	0 ~ 150
	Port size	PF1 O ring type
Pressure gauge	49 MPa, 4.9 MPa	
Tachometer	Diesel tachometer (digital type)	
Hose for testing	Equivalent to the hose of 27.4 MPa high pressure (Nominal size PF1/ 2-PF1/ 2 × 1m)	

5-4-2 Preparation

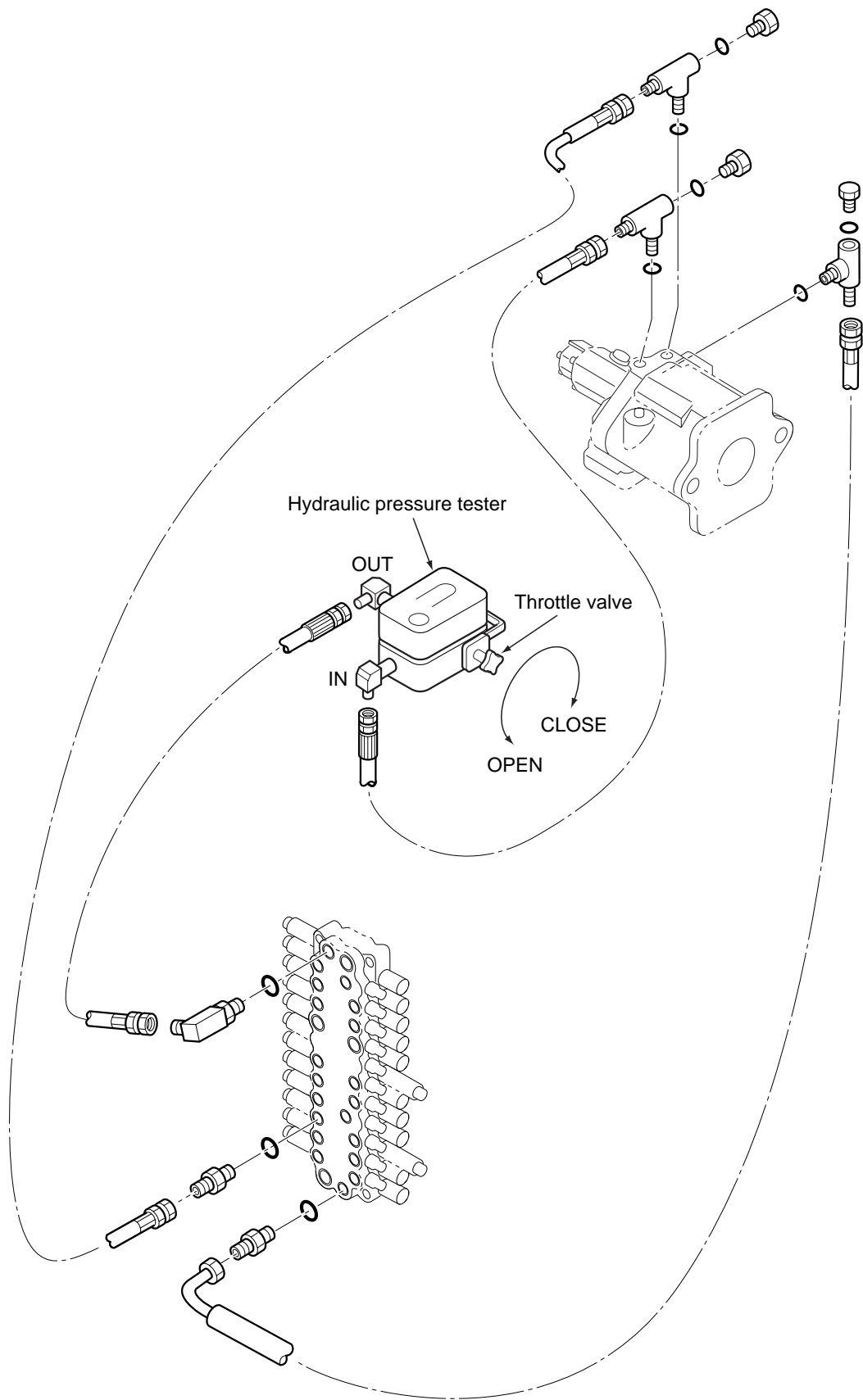
1. Park machine on flat ground and stop engine.

5-4-3 Connecting tester

1. Remove the hose on the pump port of the control valve.
2. Connect the removed hose to the outlet of the tester.
3. Connect the hose on the discharge of the pump to the inlet of the tester.
4. Connect pressure gauge to port measuring port.

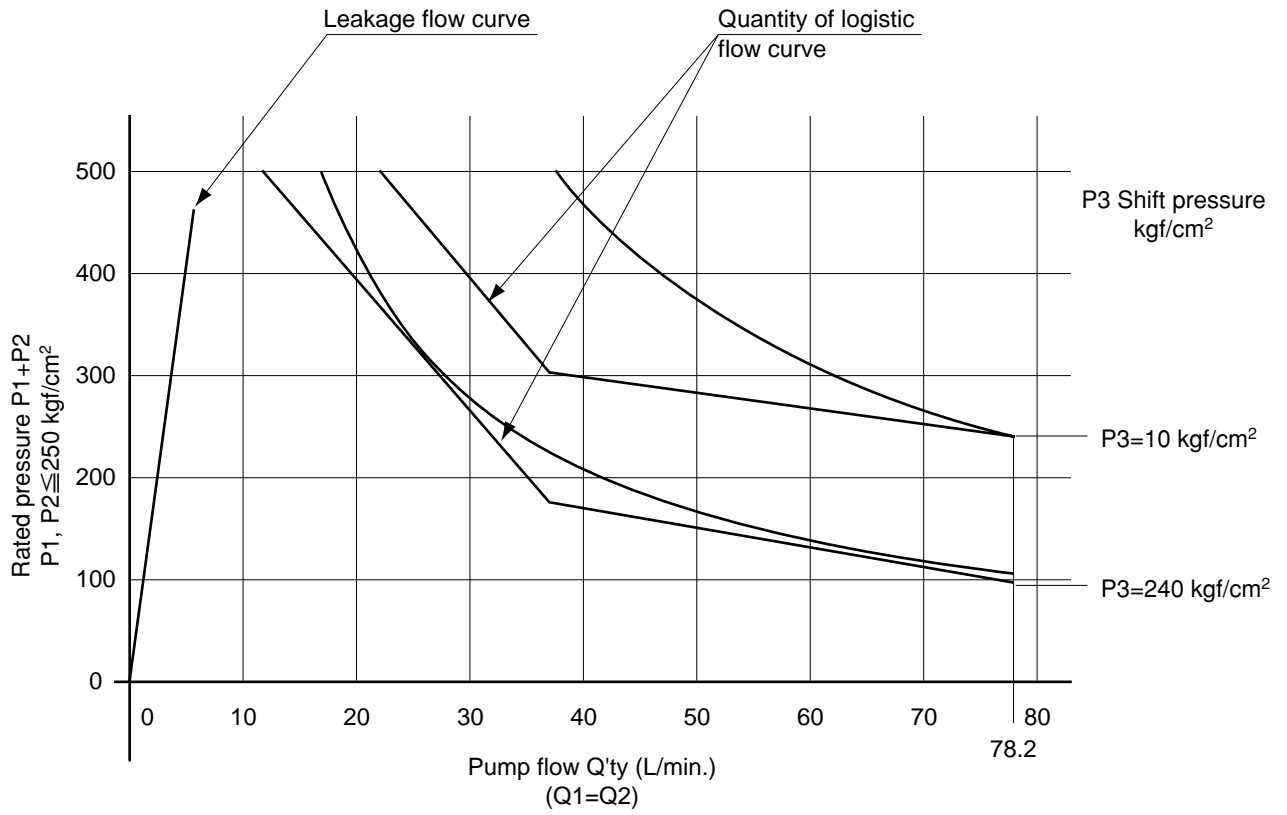
5-4-4 Measuring procedure

Open the throttle valve of the tester and start the engine. Read the pressures on the pressure gauge and measure the flow at that time. At the same time, record the engine speed.



5-4-5 P-Q characteristic curve

How to indicate a pressure value on P-Q characteristic curve.

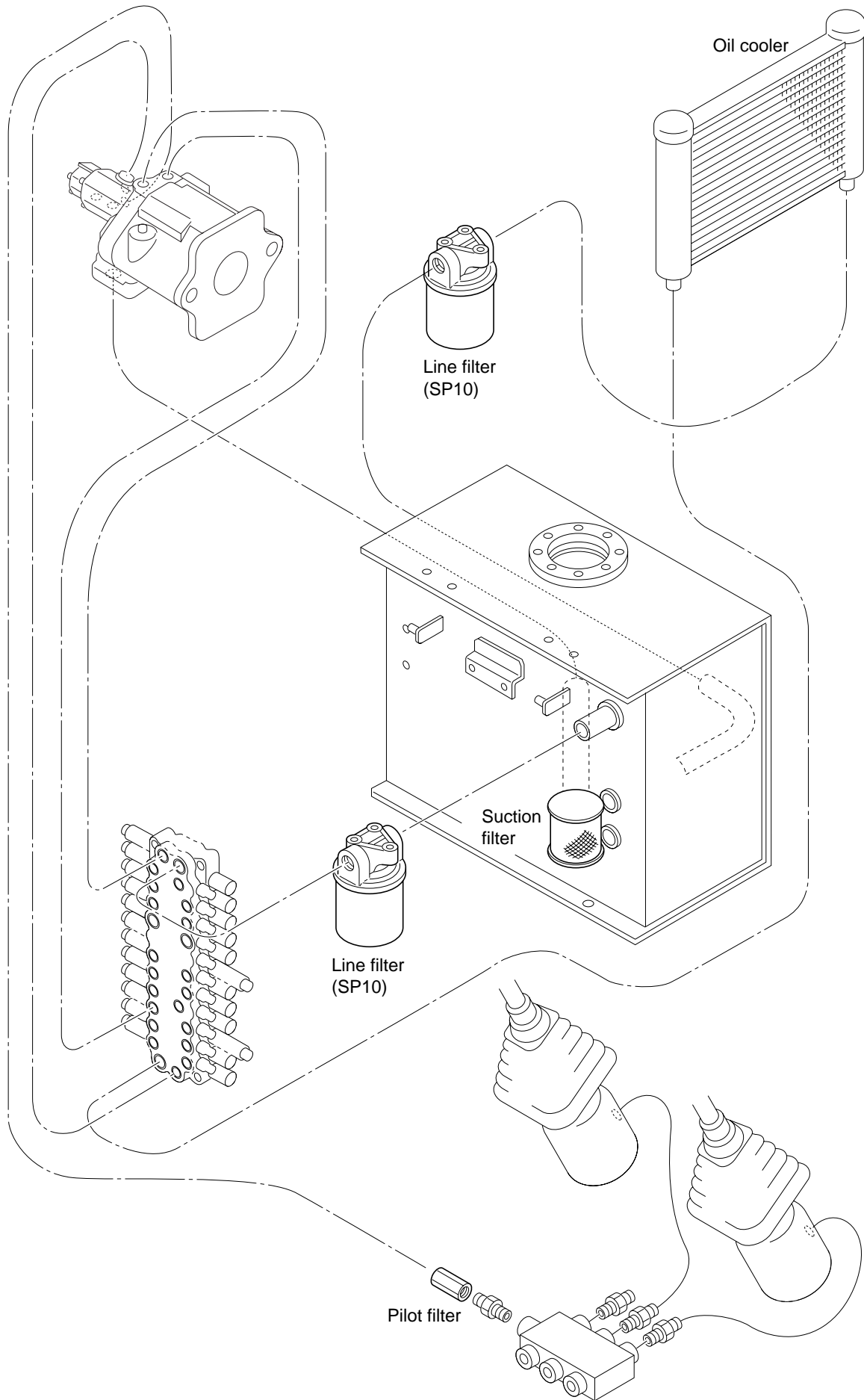


6 HYDRAULIC OIL FILTER

CONTENTS

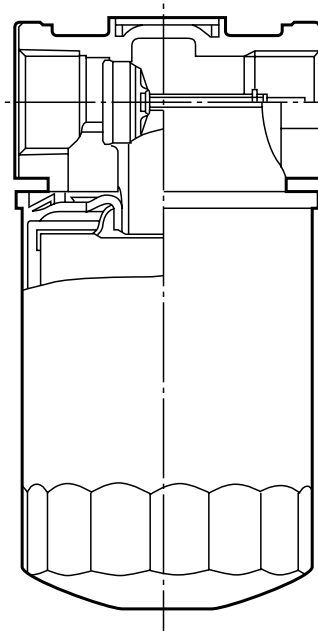
- 6-1 Installation
- 6-2 Hydraulic oil filter
 - 6-2-1 Line filter (SP10)
 - 6-2-2 Suction filter
 - 6-2-3 Pilot filter
- 6-3 Maintenance procedure
 - 6-3-1 Replacing the line filter
 - 6-3-2 Replacing the suction filter
 - 6-3-3 Replacing the pilot filter
 - 6-3-4 How to clean the suction filter

6-1 Installation



6-2 Hydraulic oil filter

6-2-1 Line filter(SP10)

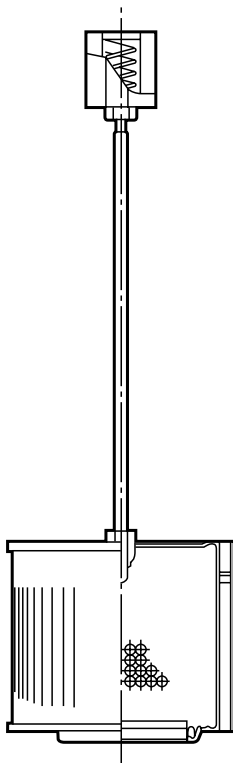


Filtration accuracy	10 μ
Filtration capacity	125 l /min (Maximum)
Opening pressure of bypass valve	0.103 MPa
Proof pressure	1.5 MPa
Oil temperature	-20°C~100°C

2·PF 1 1/4

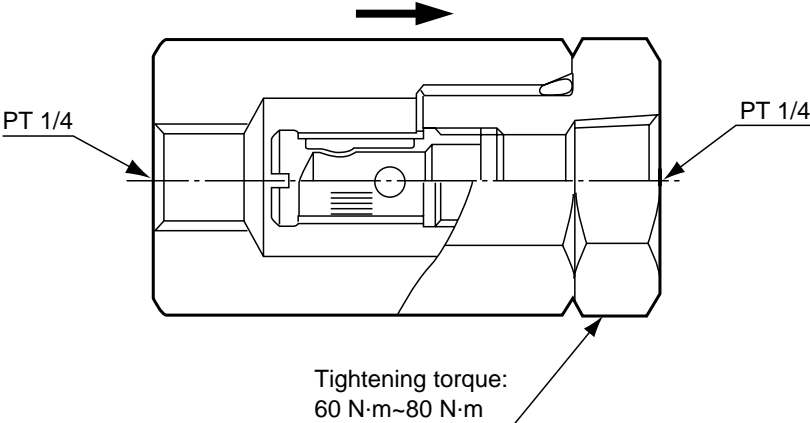
Tightening torque
20 N·m

6-2-2 Suction filter



Grain size	80 mesh
Oil temperature	-20°C~120°C

6-2-3 Pilot filter



Filtration capacity	2 ℓ/min.(Max.)
Proof pressure	3.9 MPa
Filtration accuracy	31 μ
Filtration area	5 cm ² (0.78 in ²)
Oil temperature	-20°C~120°C

6-3 Maintenance procedure

6-3-1 Replacing the line filter

1. Stop the engine.
2. Remove the line filter 6-2-2 with a filter wrench.
3. Check whether any foreign matter is sticking inside the element. If necessary, replace the cartridge assembly.

* In general, inspect and maintain line filters after the first 100 service hours, then every 500 service hours.

6-3-2 Replacing the suction filter

1. Stop the engine.
2. Remove the bolts and spring washers which retain the filter to the hydraulic oil tank, and pull off the filter.
3. Remove the suction filter to check whether the net of the element is damaged.

* Replace with a new one if the net is damaged or the mesh is widened.

6-3-3 Replacing the pilot filter

1. Stop the engine.
2. Remove the pilot filter 6-2-3 with a spanner (27 mm(1.06") width).
3. Remove the filter to check whether the net of the element is damaged.

* Replace with a new one if the net is damaged or the mesh is widened.

6-3-4 How to clean the suction filter

1. Prepare a can with clean treated oil. Immerse the element in it.
2. Using a brush, wash out foreign matter sticking to the element. Use a hard brush if the element is heavily stained.
3. After cleaning, blow compressed air inside the strainer to blow off the treated oil.
4. While cleaning the element, check the hydraulic oil tank at the same time, remove any sediment inside the tank and rinse out the tank.
5. Attach pipes to install the filter to the tank. When installing the filter, fit the O ring in the flange side groove firmly so that hydraulic oil does not leak.
6. Add new hydraulic oil through the hydraulic oil intake.

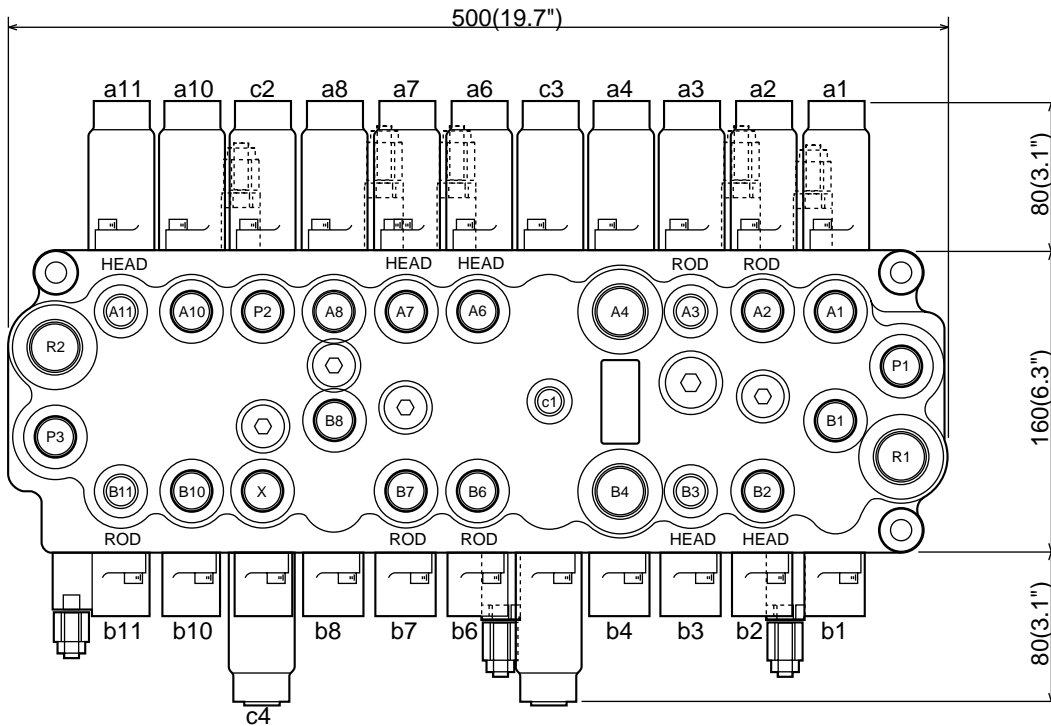
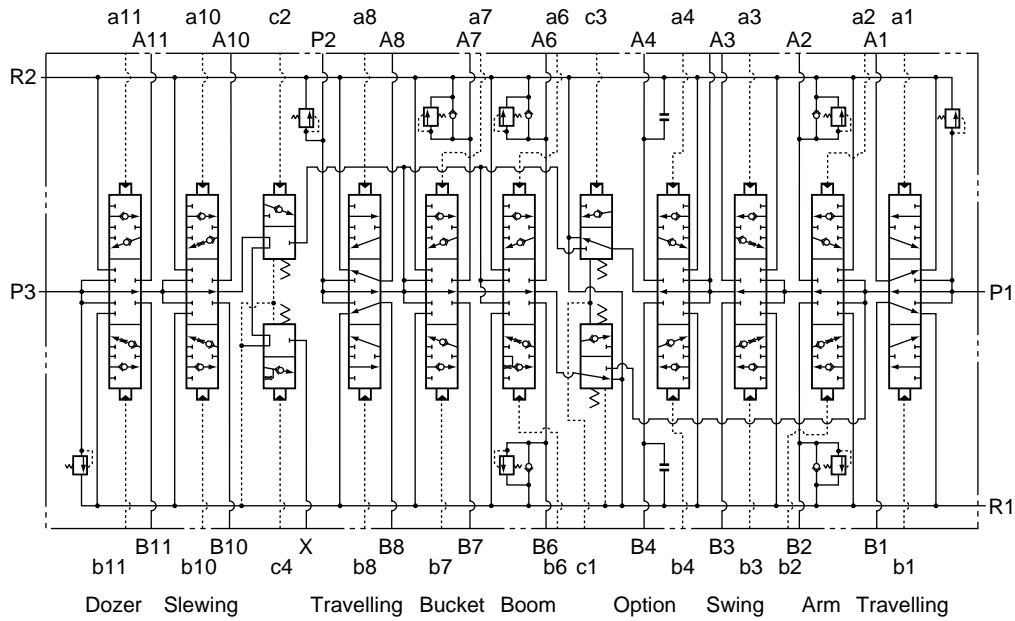
Total amount of hydraulic oil : 85 ℓ

7 CONTROL VALVE

CONTENTS

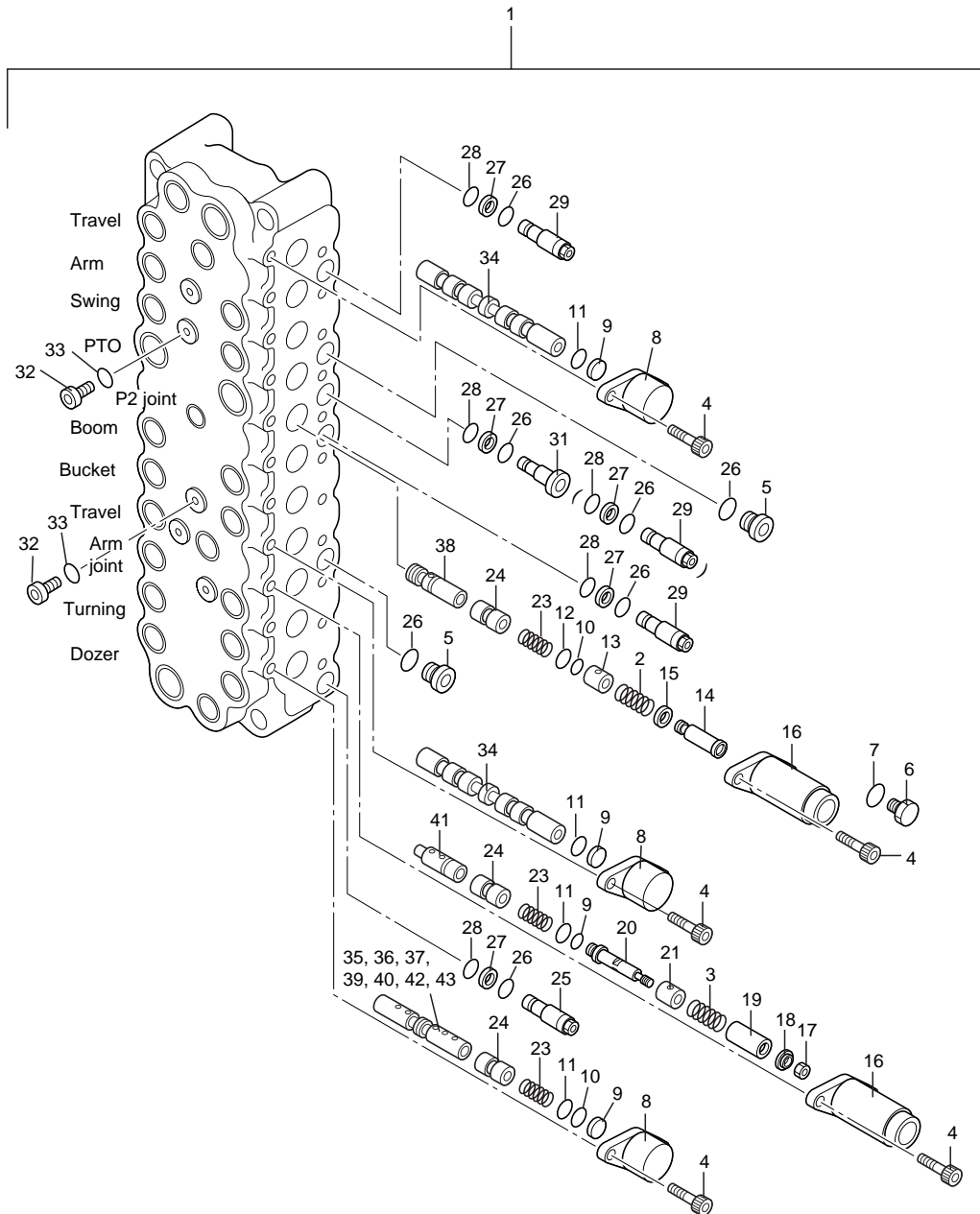
- 7-1 Specification
- 7-2 Disassembly and assembly
 - 7-2-1 Replacing the O-ring on the spur
 - 7-2-2 Replacing the relief valve assembly and the O-ring
- 7-3 Structure of the relief valve
 - 7-3-1 Main relief valve
 - 7-3-2 Port relief valve
- 7-4 Precautions for handling
 - 7-4-1 Handling
 - 7-4-2 Installation
 - 7-4-3 Operation

7-1 Specification



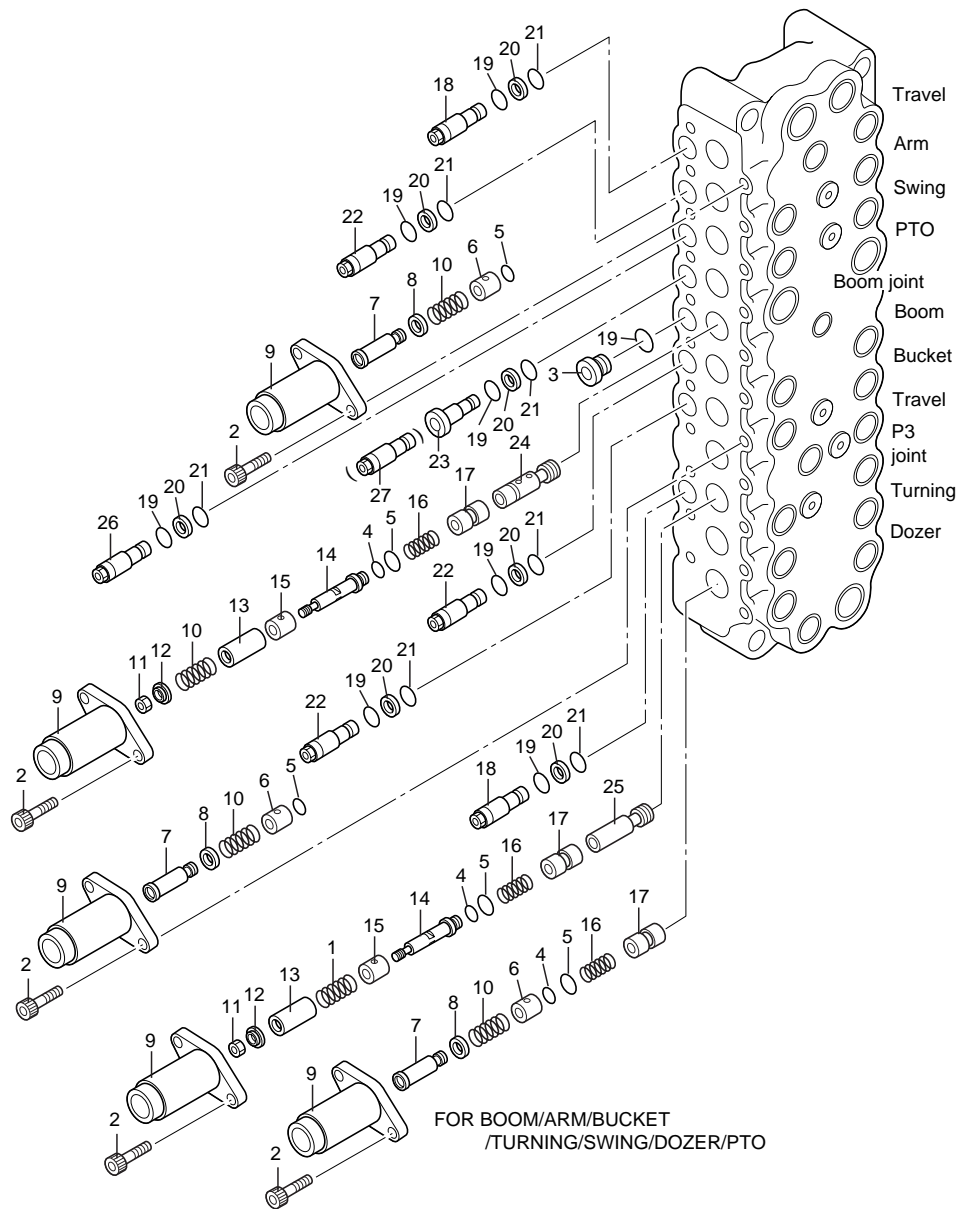
Port size	
R1, R2, A4, B4	PF 3 / 4
P1, P2, P3 A1, A2, A6, A7, A8, A10 B1, B2, B6, B7, B8, B10 X	PF 1 / 2
A3, B3, A11, B11	PF 3 / 8

P1 and P2 Main relief pressure	25.5 MPa at 75 ℓ/min
P3 Main relief pressure	23.5 MPa at 48 ℓ/min
A2, B2, A6, B6, A7 Port relief pressure	27.4 MPa at 20 ℓ/min



FOR BOOM/ARM/BUCKET
/TURNING/SWING/DOZER/PTO

- | | | | |
|----|---------------------|----|-------------------|
| 1 | CONTROL VALVE ASS'Y | 23 | SPRING |
| 2 | SPRING | 24 | CHECK |
| 3 | SPRING | 25 | MAIN RELIEF ASS'Y |
| 4 | BOLT | 26 | O-RING |
| 5 | CAP | 27 | RING, BACKUP |
| 6 | CAP | 28 | O-RING |
| 7 | O-RING | 29 | PORT RELIEF ASS'Y |
| 8 | COVER | 30 | CAP |
| 9 | CAP PL | 31 | PLUG |
| 10 | O-RING | 32 | CAP |
| 11 | O-RING | 33 | O-RING |
| 12 | O-RING | 34 | PLUNGER M1 |
| 13 | GUIDE, SPRING | 35 | PLUNGER C2 |
| 14 | CAP PL | 36 | PLUNGER S1 |
| 15 | SPACER | 37 | PLUNGER S2 |
| 16 | COVER | 38 | SPUR |
| 17 | NUT | 39 | PLUNGER B2 |
| 18 | SPACER | 40 | PLUNGER C1 |
| 19 | SPACER | 41 | SPOOL |
| 20 | CAP PL | 42 | PLUNGER D9 |
| 21 | GUIDE, SPRING | 43 | PLUNGER D3 |
| 22 | O-RING | 44 | PORT RELIEF ASS'Y |



- | | | | |
|----|-------------------|----|----------------------|
| 1 | SPRING | 23 | PLUG |
| 2 | BOLT | 24 | SPOOL |
| 3 | CAP | 25 | SPOOL |
| 4 | O-RING | 26 | ANTIVOID VALVE ASS'Y |
| 5 | O-RING | 27 | PORT RELIEF ASS'Y |
| 6 | GUIDE, SPRING | | |
| 7 | CAP PL | | |
| 8 | SPACER | | |
| 9 | COVER | | |
| 10 | SPRING | | |
| 11 | NUT | | |
| 12 | SPACER | | |
| 13 | SPACER | | |
| 14 | CAP PL | | |
| 15 | GUIDE, SPRING | | |
| 16 | SPRING | | |
| 17 | CHECK | | |
| 18 | MAIN RELIEF ASS'Y | | |
| 19 | O-RING | | |
| 20 | RING, BACKUP | | |
| 21 | O-RING | | |
| 22 | PORT RELIEF ASS'Y | | |

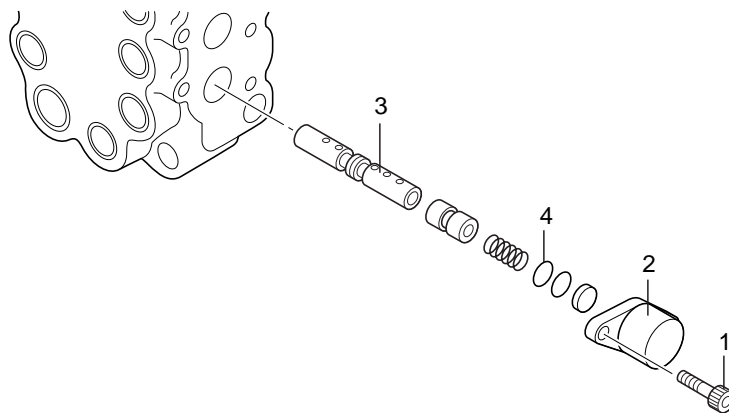
7-2 Disassembly and Assmebly

7-2-1 Replacing the O-ring on the spur

- 1) Loosen the cap mounting screws (1) and remove the cap (2).
Take out spur (3) and replace O-ring (4)
- 2) Rinse the spur and insert it in the body.
- 3) When installing the spring cap, be careful not to damage the O-ring.
Tightening torque of the cap mounting screw is 9 N·m.

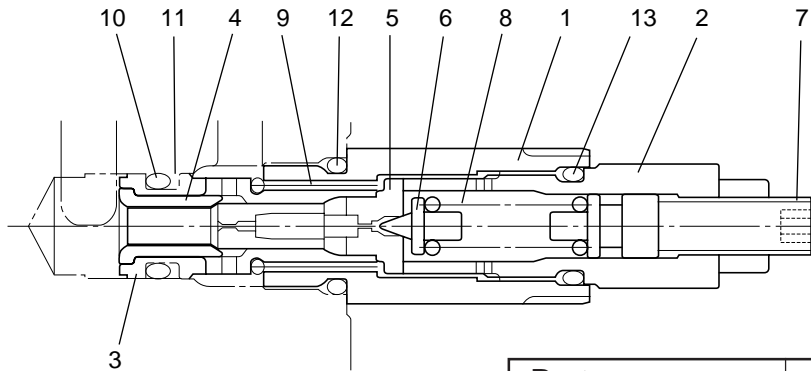
7-2-2 Replacing the relief valve assembly and the O-ring.

1. Remove the inlet section assembly and the relief valve.
2. If necessary, replace the O-ring or the relief valve assembly.
3. During installation, give grease to the O-ring.
4. When the relief set, cap nut of adjusting screw and hexagon nut are loosened, always check relief set pressure using the pressure gauge.
At this time, the relief set pressure and flow rate shall be conformed to the specification indicated on the page of external drawing.
5. When the relief valve assembly is removed, check whether the small hole on the center of relief piston is clogged with foreign matter.



7-3 Structure of the relief valve

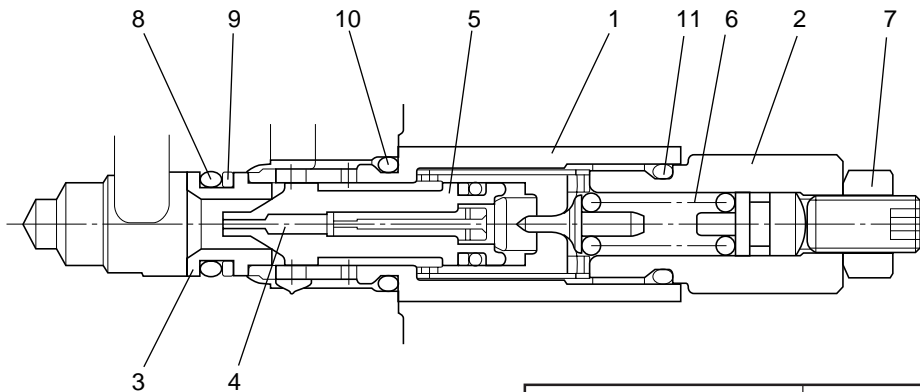
7-3-1 Main relief valve



Part	Tightening torque
Cap nut	30 N·m
Installation of the relief valve	70 N·m

- | | |
|-----------------|--------------------|
| 1. Cap | 8. Pilot spring |
| 2. Plug | 9. Spring |
| 3. Sleeve | 10. O-ring(1B-P10) |
| 4. Main poppet | 11. Backup ring |
| 5. Pilot sheet | 12. O-ring(1B-P14) |
| 6. Pilot poppet | 13. O-ring |
| 7. Adjuster kit | |

7-3-2 Port relief valve



Part	Tightening torque
Cap nut	30 N·m
Installation of the relief valve	70 N·m

- | | |
|-----------------|--------------------|
| 1. Cap | 7. Adjuster kit |
| 2. Plug | 8. O-ring(1B-P10) |
| 3. Poppet | 9. Backup ring |
| 4. Piston | 10. O-ring(1B-P14) |
| 5. Pilot poppet | 11. O-ring |
| 6. Spring | |

7-4 Precautions for handling (Installation and operation should conform to the following items.)

7-4-1 Handling

When handling and carrying valves, be careful neither to drop them nor bang the spool end and cap.

When stocking a valve for a long time, plug each port to prevent dust and water from entering it.

7-4-2 Installation

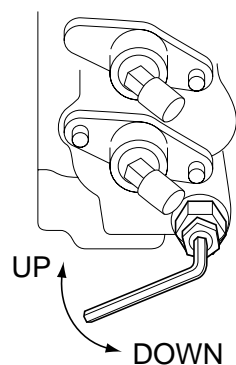
1. Tighten the valve joints with the specified tightening torque. Be careful so that no unnecessary force acts on the valve through the piping.
2. Be careful when welding near a valve, because the high temperature and spatter may damage the O-ring of the spur and the dust seal.
3. Never remove the plug on each port to prevent dust from entering until piping work begins.

7-4-3 Operation

1. Before operation, check that the hydraulic circuit and the oil are both clean (cleanliness of hydraulic oil must be higher than the NAS12 class).
2. Keep the oil temperature between -20°C and 80°C . If the temperature falls below 0°C , warm up the machine.
3. Never raise the set pressure of the main relief valve and port relief valve beyond the specified set pressure. If the set pressure differs from the specified value, adjust it in the following manner.

1) Procedure for adjusting the main relief valve:

- a. Install a pressure gauge between the pump and control valve in the measuring position. If there is a mounting hole for the pressure gauge, use it.
- b. Raise the temperature of the hydraulic oil to 50 to 60°C and set the engine speed to the rated value.
- c. Operate the control lever to read the indication of the pressure gauge when cylinder reaches the stroke end.
- d. When raising the pressure, remove the cap nut and turn adjusting screw of the relief valve installed on the inlet section clockwise with an Allen wrench.



Relief valve pressure adjustment	
Main relief valve	Approx. 7.2 MPa per rotation
Port relief valve	Approx. 33.3 MPa per rotation

- e. Always lock the valve when it is set to the specified pressure.

8

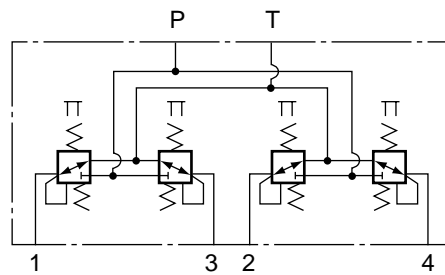
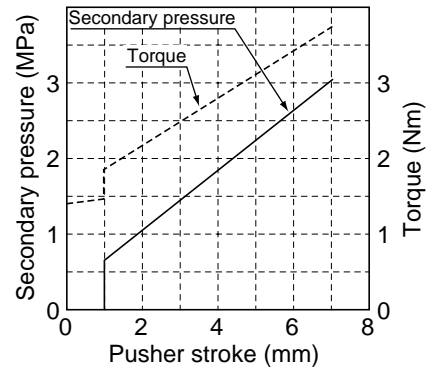
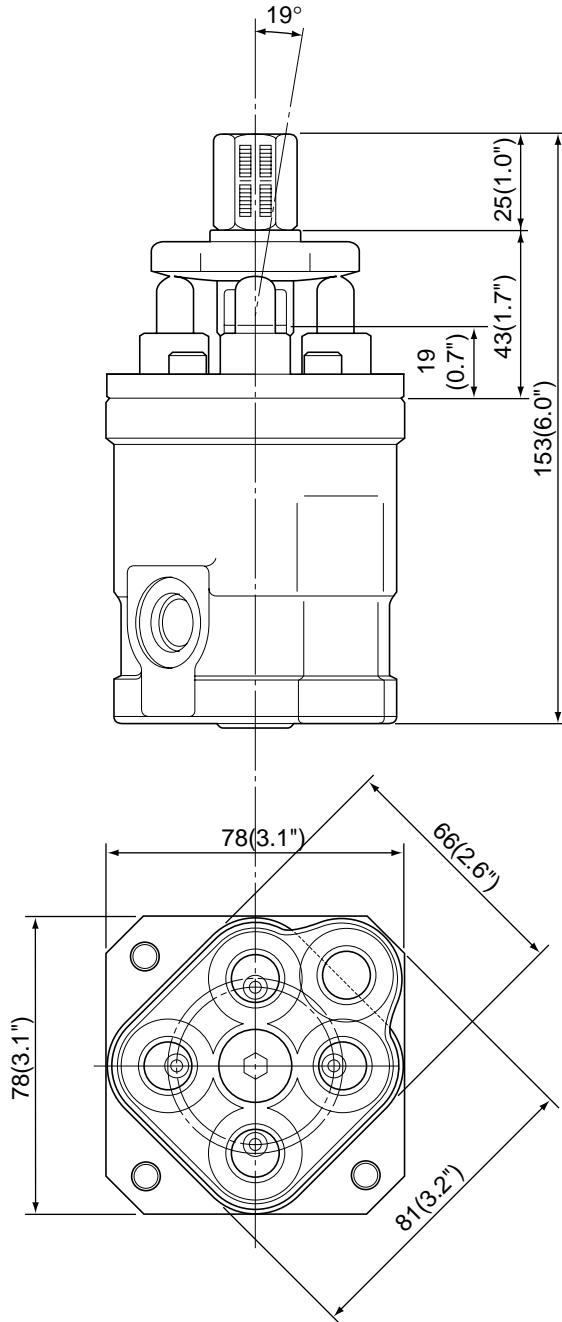
JOYSTICK (PILOT VALVE)

CONTENTS

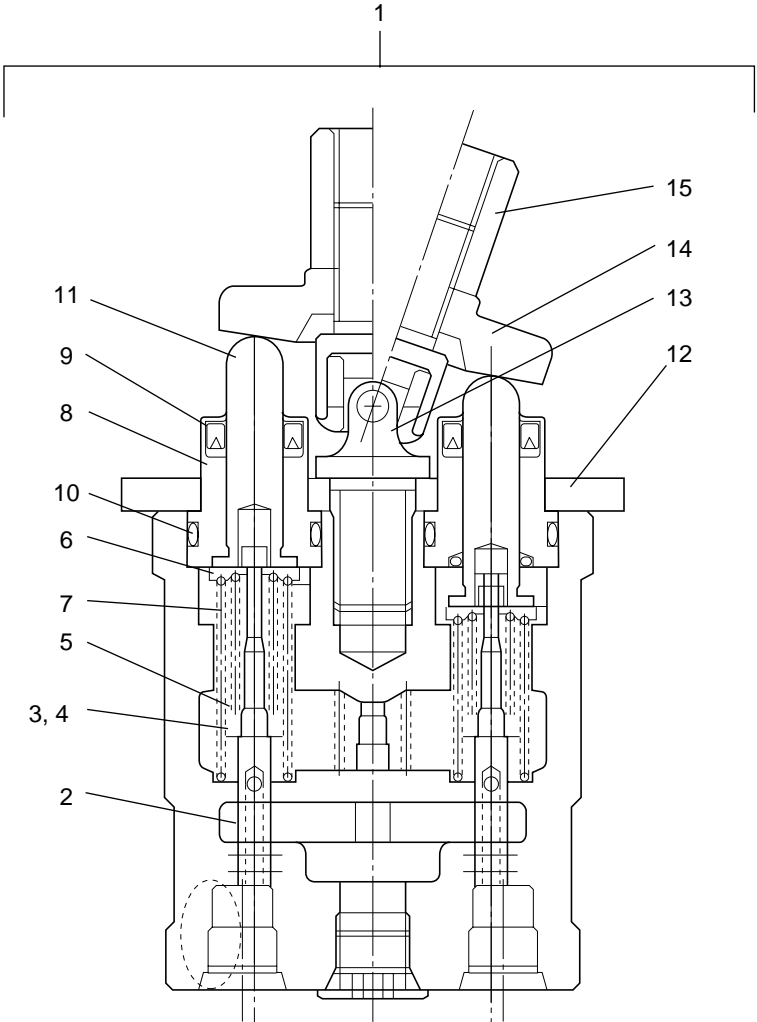
8-1 Specification

8-2 Structure

8-1 Specification



8-2 Structure



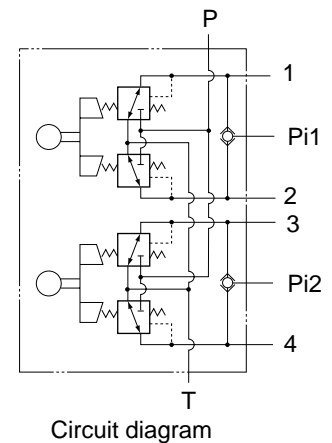
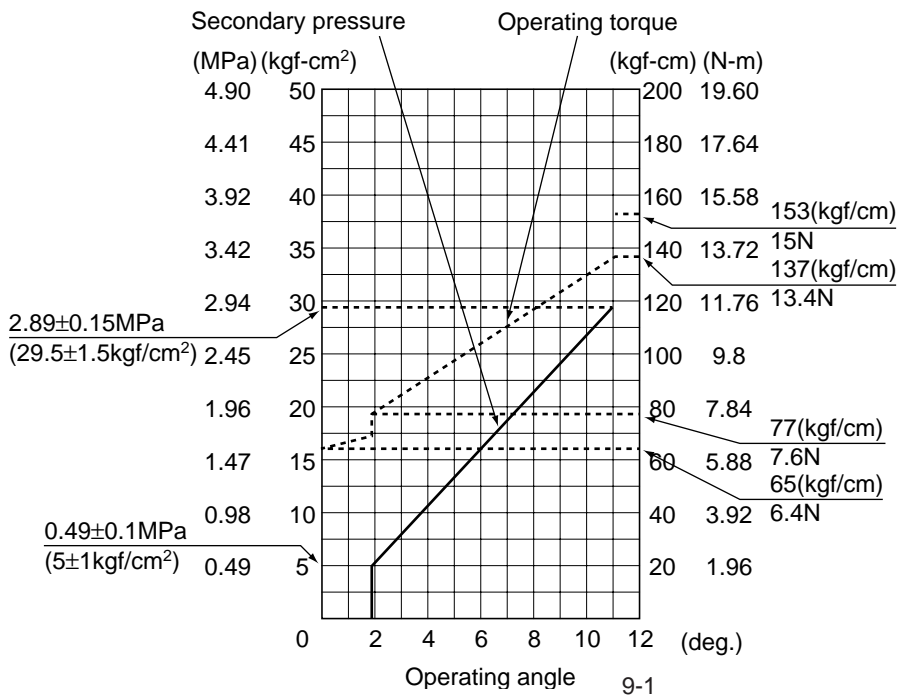
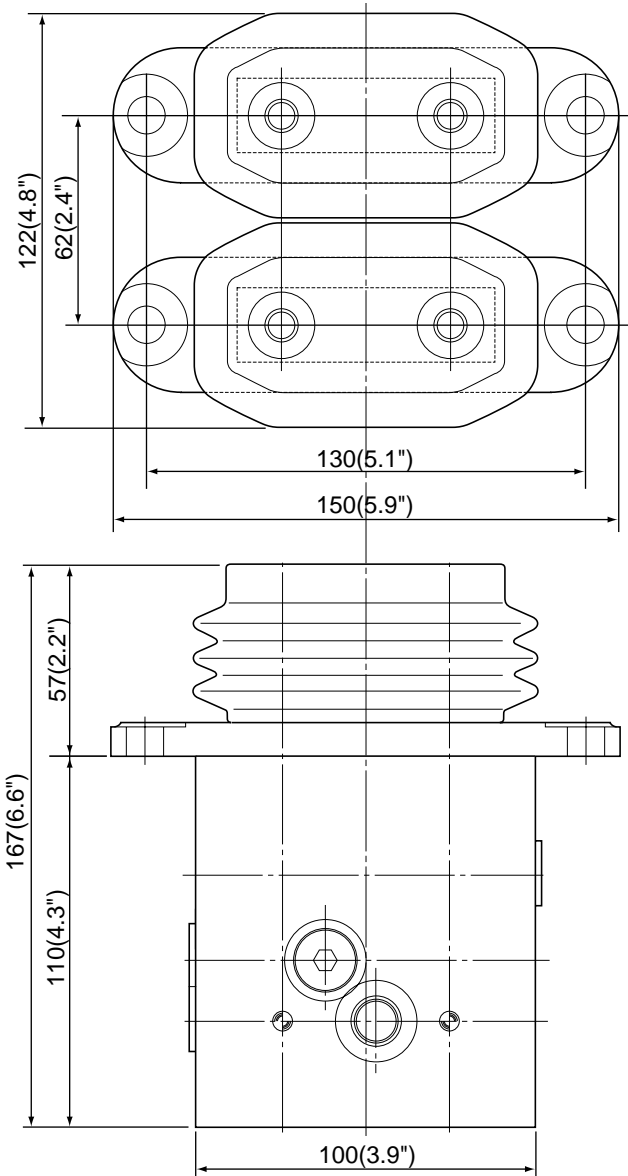
- | | | | |
|---|----------------------|----|------------------|
| 1 | JOYSTICK VALVE ASS'Y | 9 | SEAL, OIL |
| 2 | SPOOL | 10 | O-RING |
| 3 | SPACER | 11 | PUSHER |
| 4 | SHIM | 12 | PLATE |
| 5 | COMPRESSER, SPRING | 13 | JOINT, UNIVERSAL |
| 6 | GUIDE, SPRING | 14 | CAM |
| 7 | COMPRESSER, SPRING | 15 | SCREW, JOINT |
| 8 | BUSHING | | |

9 PILOT VALVE(1) (TRAVEL)

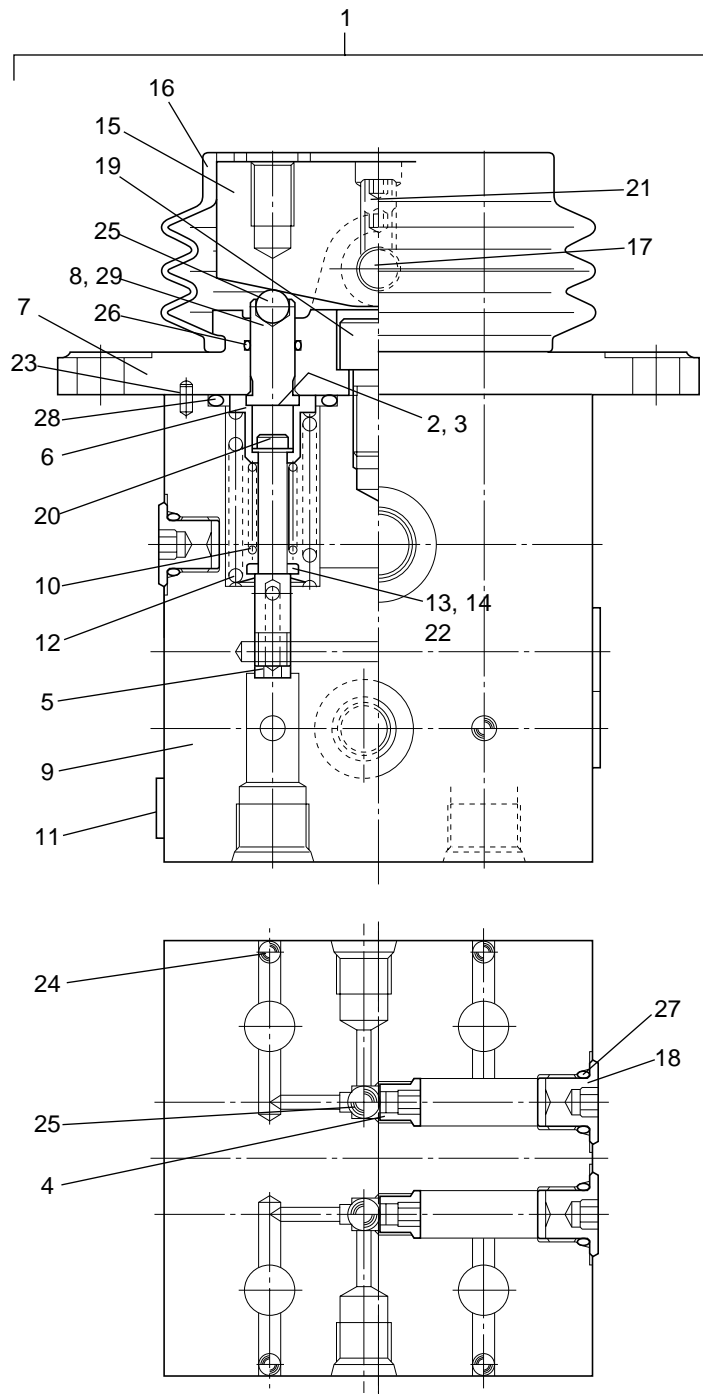
CONTENTS

- 9-1 Specification
- 9-2 Structure

9-1 Specification



9-2 Structure



1 PILOT VALVE ASS'Y
 2 SHIM
 3 SHIM
 4 SHEET
 5 SPOOL
 6 SLEEVE
 7 COVER
 8 PUSHER
 9 BODY
 10 SPRING, COMP

11 PLATE
 12 SPRING, COMP
 13 SHIM
 14 SHIM
 15 CAM
 16 BOOT
 17 PIN
 18 PLUG
 19 BOLT
 20 FLANGE, BOLT

21 SCREW
 22 WASHER
 23 PIN
 24 STEEL BALL
 25 STEEL BALL
 26 O-RING
 27 O-RING
 28 O-RING
 29 PUSHER ASS'Y

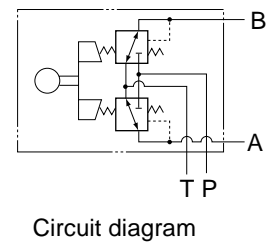
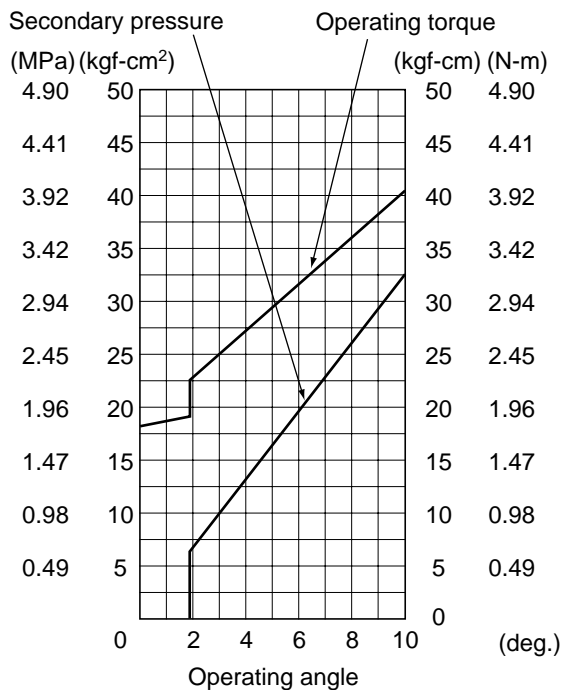
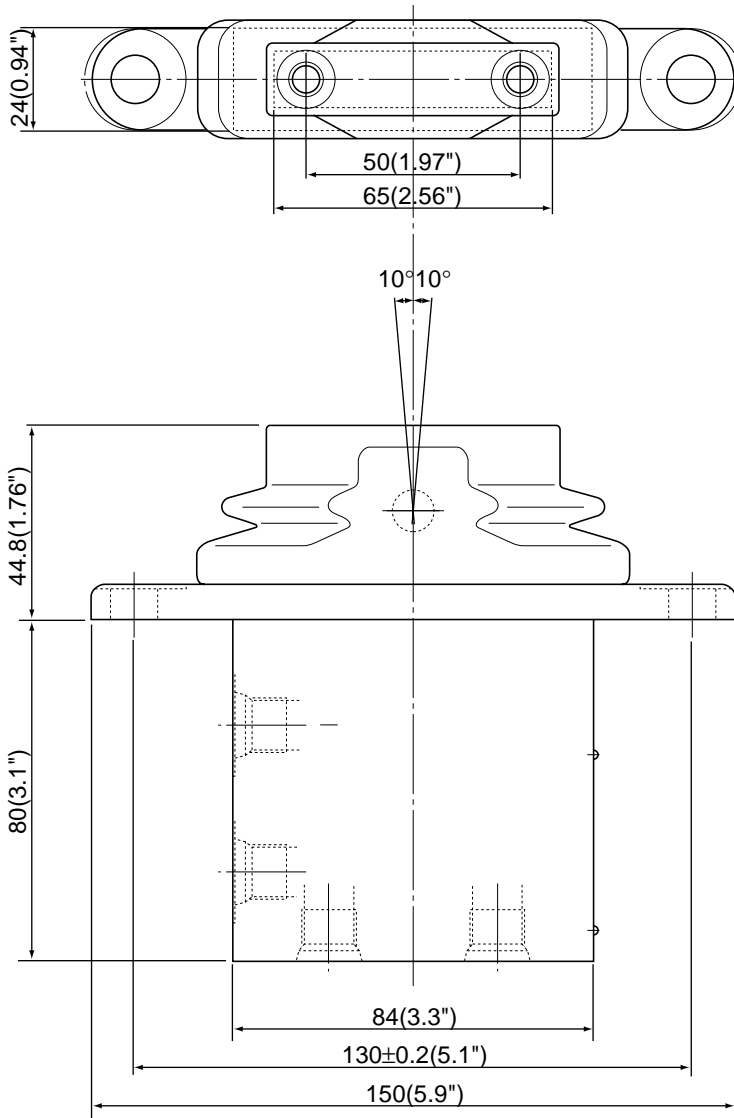
10 PILOT VALVE(2) (SWING · PTO)

CONTENTS

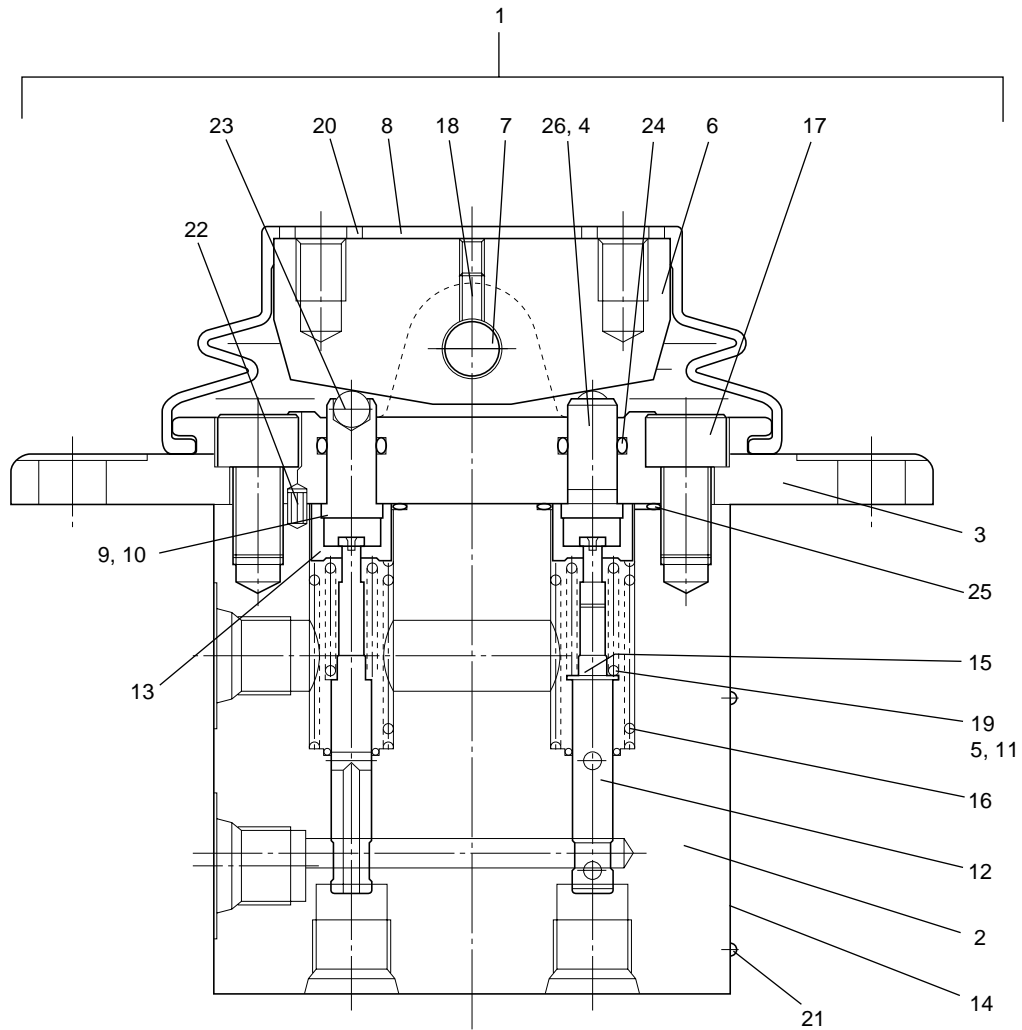
10-1 Specification

10-2 Structure

10-1 Specification



10-2 Structure



- | | | | |
|----|----------------|----|--------------|
| 1 | PILOT VALVE | 14 | PLATE, NAME |
| 2 | BODY | 15 | SPRING, COMP |
| 3 | COVER | 16 | SPRING, COMP |
| 4 | PUSHER | 17 | BOLT |
| 5 | SHIM | 18 | SCREW |
| 6 | CAM | 19 | WASHER |
| 7 | PIN | 20 | WASHER |
| 8 | BOOT | 21 | SCREW |
| 9 | SHIM | 22 | PIN, SPRING |
| 10 | SHIM | 23 | STEEL BALL |
| 11 | SHIM | 24 | O-RING |
| 12 | SPOOL | 25 | O-RING |
| 13 | HOLDER, SPRING | 26 | PUSHER ASS'Y |

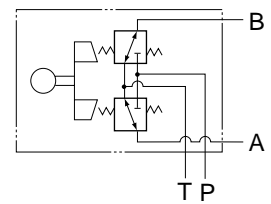
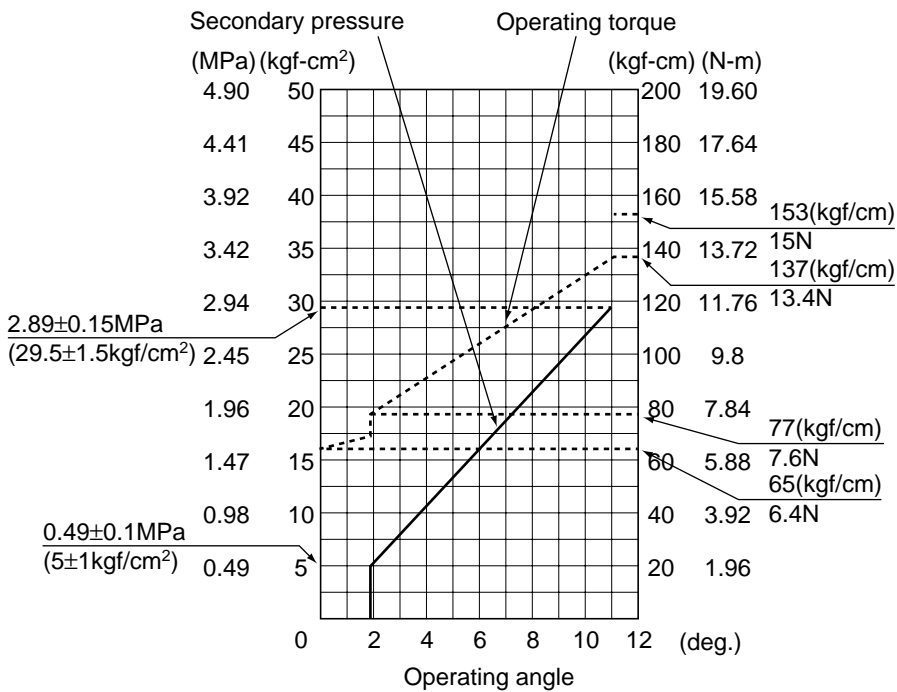
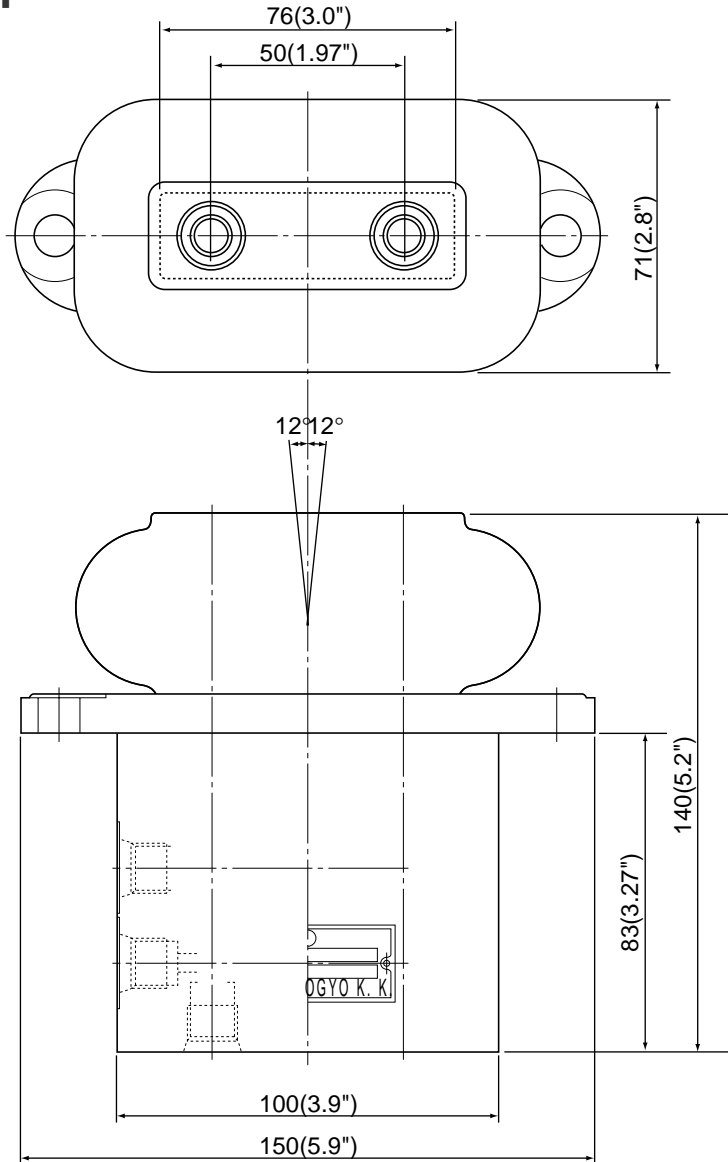
11 PILOT VALVE(3) (DOZER)

CONTENTS

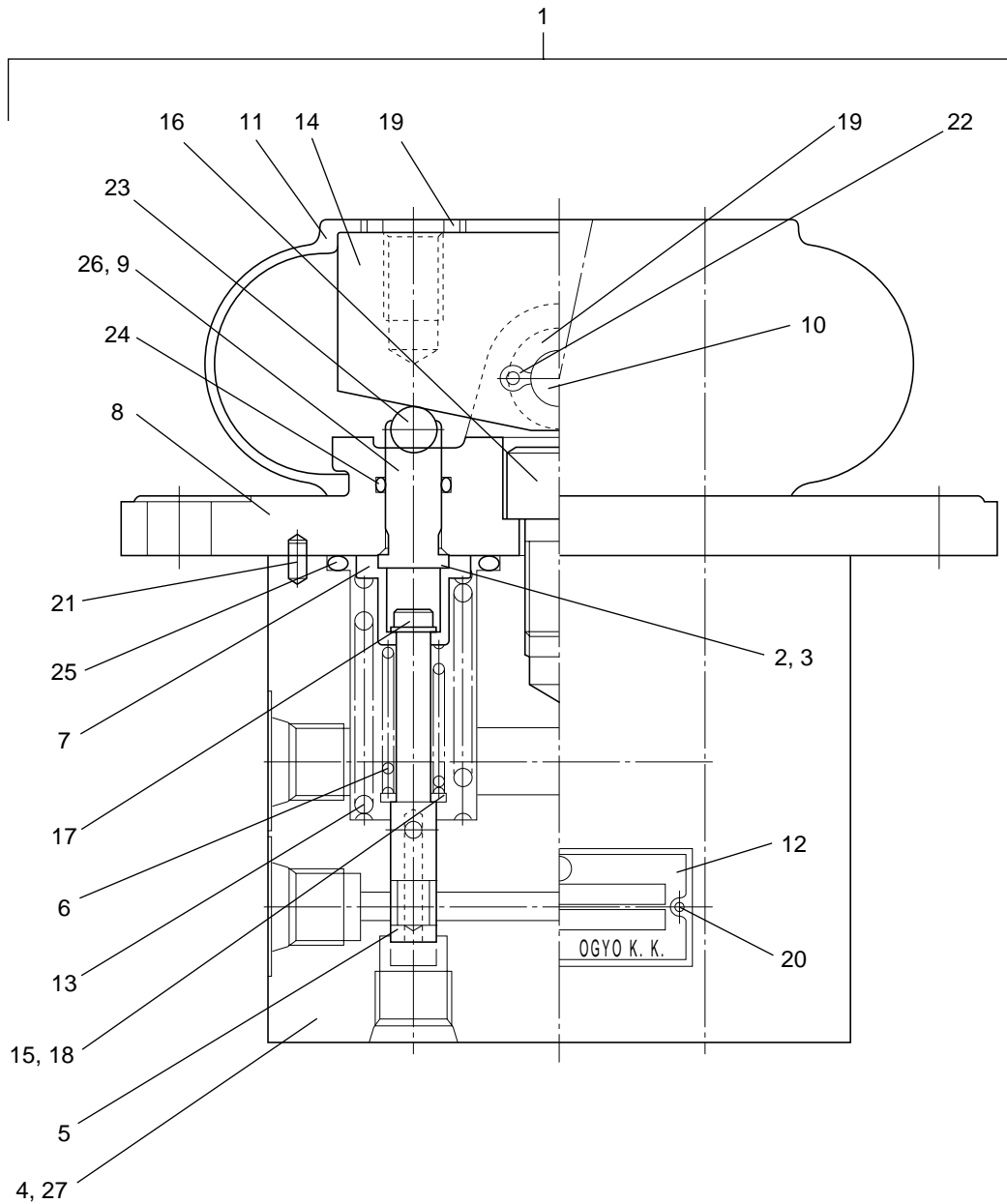
11-1 Specification

11-2 Structure

11-1 Specification



11-2 Structure



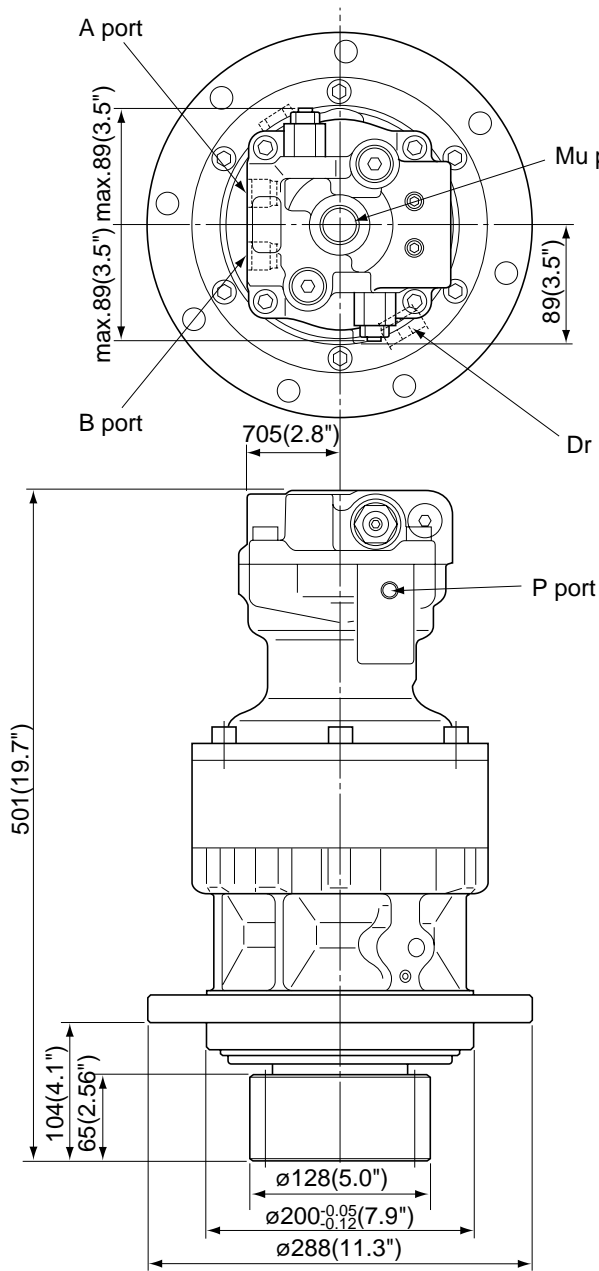
- | | | | |
|----|-------------------|----|--------------|
| 1 | DOZER PILOT VALVE | 15 | SHIM |
| 2 | SHIM | 16 | BOLT |
| 3 | SHIM | 17 | BOLT |
| 4 | BODY | 18 | WASHER |
| 5 | SPOOL | 19 | WASHER |
| 6 | SPRING COMP | 20 | SCREW |
| 7 | SLEEVE | 21 | SPRING PIN |
| 8 | COVER | 22 | PIN |
| 9 | PUSHER | 23 | STEEL BALL |
| 10 | PIN | 24 | O-RING |
| 11 | BOOT | 25 | O-RING |
| 12 | PLATE, NAME | 26 | PUSHER ASS'Y |
| 13 | SPRING COMP | 27 | BODY ASS'Y |
| 14 | CAM | | |

12 SLEW MOTOR

CONTENTS

- 12-1 Specification
- 12-2 Structure
- 12-3 Standard of maintenance
 - 12-3-1 Slew bearing & slew case
- 12-4 Inspection and adjustment
 - 12-4-1 Measuring the natural slew distance
 - 12-4-2 Measuring the over slew distance after stopping
 - 12-4-3 Measuring the required time for slewing

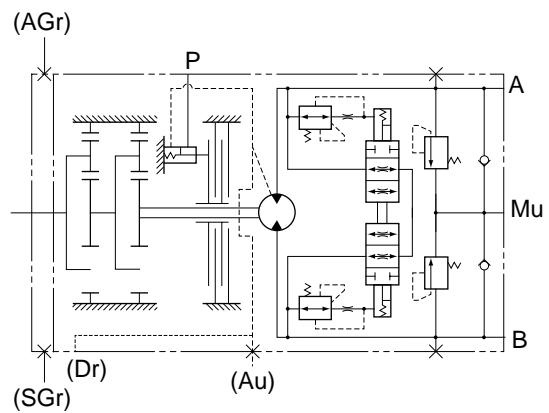
12-1 Specification



Direction of rotation
(seen from the output shaft)

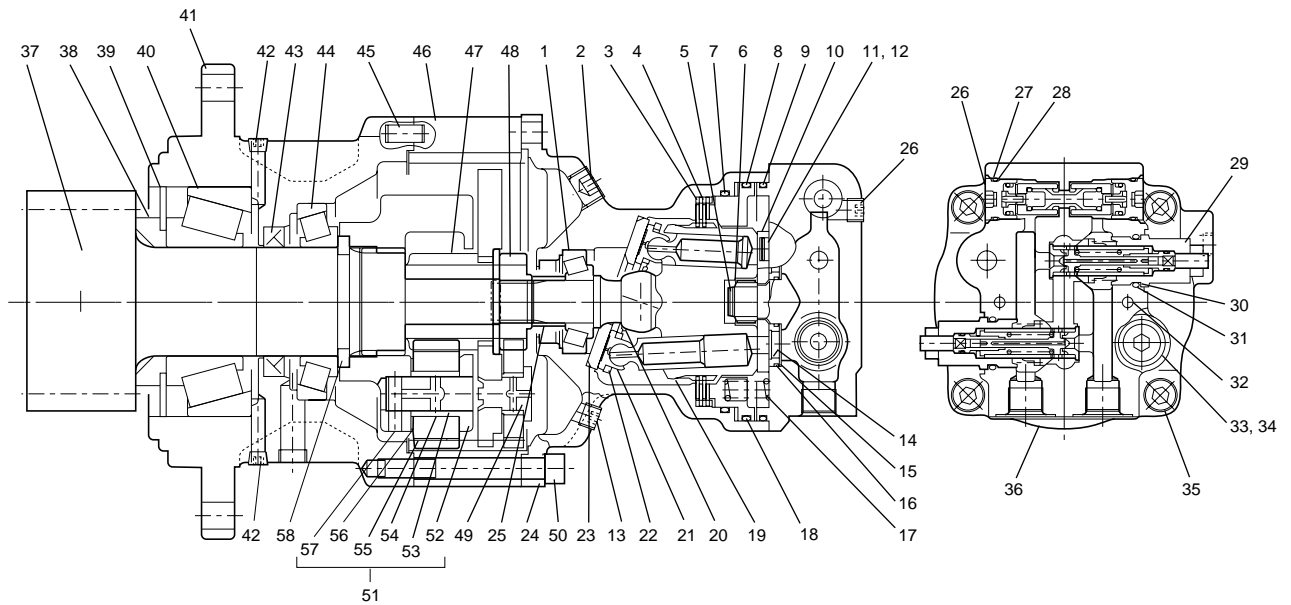
Direction of rotation	Oil inlet	Oil outlet
Clockwise	A	B
Counterclockwise	B	A

Port	Port size
A	PF1/2
B	PF 1/2
Mu	PF 3/4
Dr	PT 3/8



	Type	SG025E-118
Reduction	Output torque	2200 N·m
	Output speed	49 min ⁻¹
	Reduction ratio	1/15.537
Hydraulic motor	Capacity	45.5 cc / rev
	Maximum speed	960 min ⁻¹
	Flow rate	45 ℓ / min
	Overload relief set pressure	22.5 MPa at 43.2 ℓ
Pinion gear	Module	8
	No. of threads Z	11
Weight		70 kg

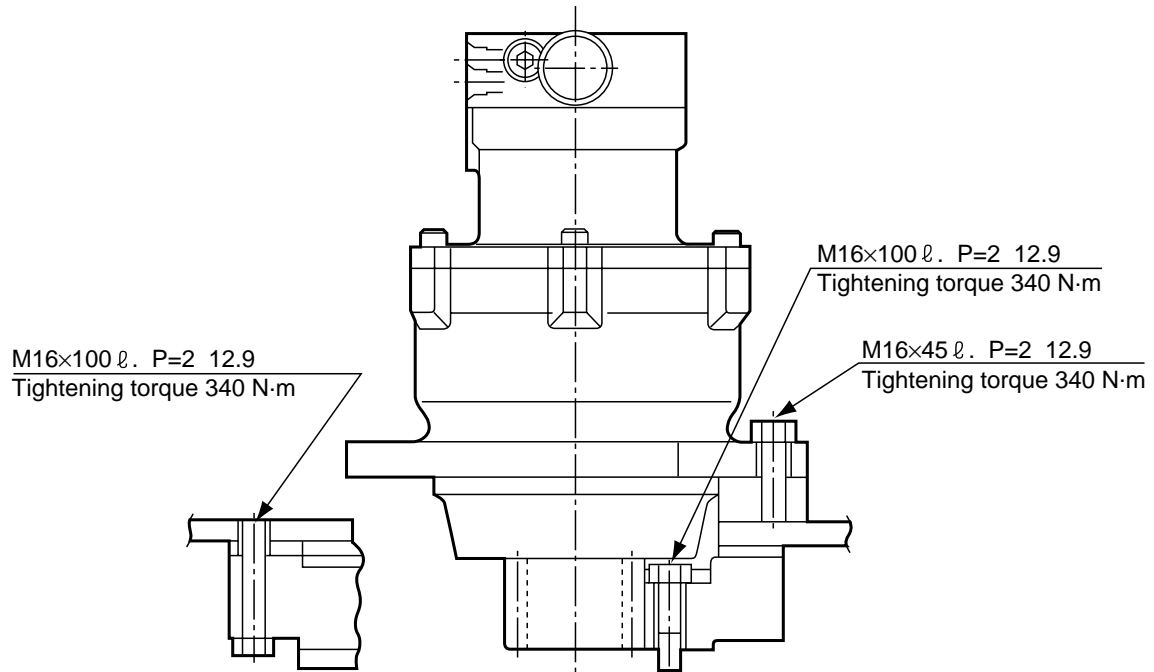
12-2 Structure



- | | | |
|---------------------------|----------------------------|----------------------------|
| 1. Tapered roller bearing | 21. Piston Ass'y | 41. Gear case |
| 2. Plug | 22. Return plate | 42. Plug |
| 3. Lining plate | 23. Cam plate | 43. Oil seal |
| 4. Plate | 24. Housing | 44. Tapered roller bearing |
| 5. Snap ring | 25. Inner ring | 45. Pin |
| 6. Needle bearing | 26. Bypass valve Ass'y | 46. Ring gear |
| 7. O-ring | 27. Back-up ring | 47. Spool gear 4 |
| 8. O-ring | 28. O-ring | 48. Sun gear |
| 9. O-ring | 29. Relief Ass'y | 49. Holder Ass'y 1 |
| 10. Balance plate | 30. Back-up ring | 50. Hexagon socket bolt |
| 11. Piston | 31. O-ring | 51. Holder Ass'y 2 |
| 12. Teflon ring | 32. Parallel pin | 52. Holder 2 |
| 13. Plug | 33. Plug | 53. Shaft 2 |
| 14. Bush | 34. O-ring | 54. Bush 2 |
| 15. Scrowave | 35. Hexagon socket bolt | 55. Spool gear 5 |
| 16. Teflon ring | 36. Cover | 56. Thrust plate |
| 17. Spring | 37. Pinion shaft | 57. Spring pin |
| 18. Piston | 38. Collar | 58. Collar |
| 19. Cylinder | 39. Plate | |
| 20. Backing spring | 40. Tapered roller bearing | |

12-3 Standard of maintenance

12-3-1 Slew bearing and slew case

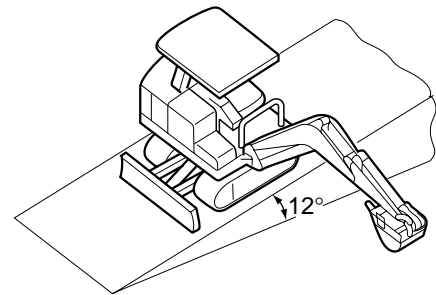


12-4 Inspection and adjustment

12-4-1 Measuring the natural slew distance

1. Position of the machine

Maintain the hydraulic oil temperature at $50\pm 5^{\circ}\text{C}$. Make a slope or use a sleeper to incline the machine by 12° . Set the attachment diagonally, put a weight (W) in the bucket (filling the bucket with soil), retract the arm cylinder to the minimum length, make the boom parallel to the slope and stop engine.



2. Measurement

Put a mark on the slew bearing outer race and the truck frame and measure the flow rate (deviation rate) of 3 minutes. (Moving distance of slew bearing outer race)Valid gear length

Unit mm or less

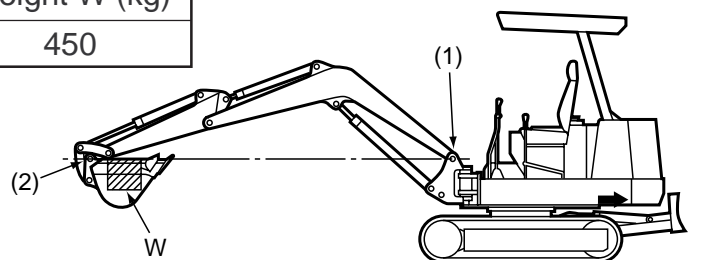
Standard value	Allowance	Weight (W) kg
100	200	450

12-4-2 Measuring the over slew distance after stopping

Maintain the oil temperature at $50\pm 5^{\circ}\text{C}$ while the engine is running at full speed. Stretch the arm to the maximum length on a flat place. Make the boom joint pin (1) and arm bucket pin (2) put on a horizontal line, put a weight(W) in the bucket (filling the bucket with soil), slew the Machine by one turn and measure the over slew length (at bucket edge) after stopping.

Unit : deg

Standard value	Weight W (kg)
45 ± 3	450



12-4-3 Measuring the required time for slewing

Extend the bucket cylinder to maximum length, empty the bucket and measure the required time for slewing 5 turns following the first turn.

Unit : sec or less

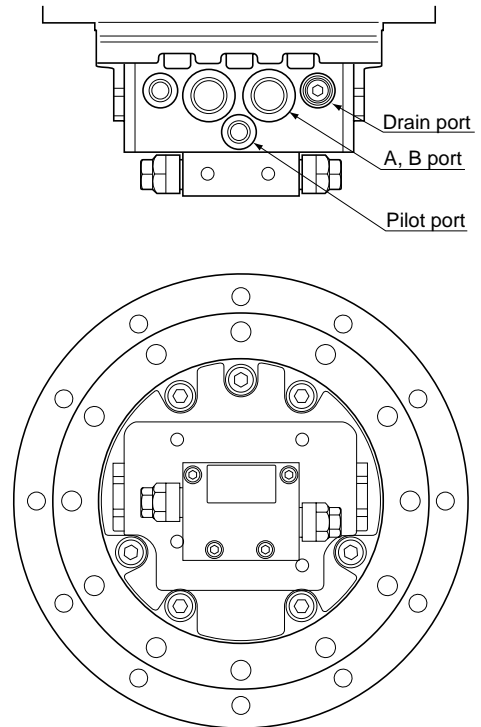
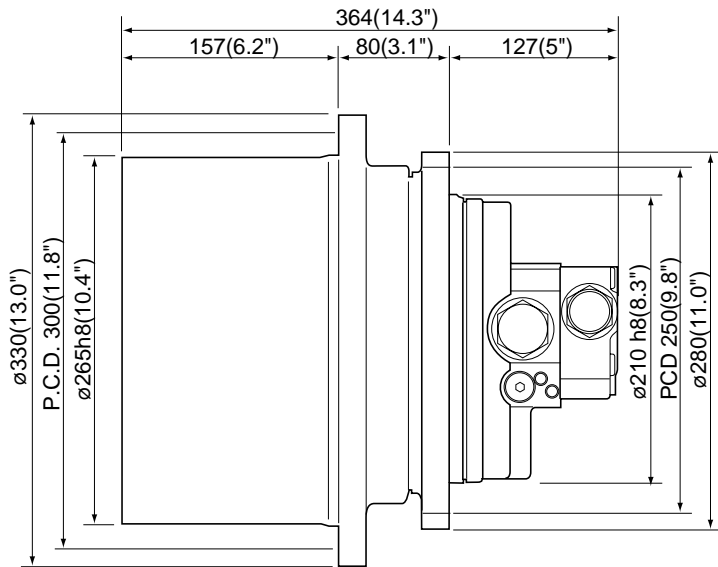
Standard value	Allowance
32 ± 3	40

13 TRAVEL MOTOR

CONTENTS

- 13-1 Specification
- 13-2 Structure
- 13-3 Handling the travelling motor
- 13-4 Measuring travelling motor idling
and travelling time
- 13-5 Inspection and adjustment

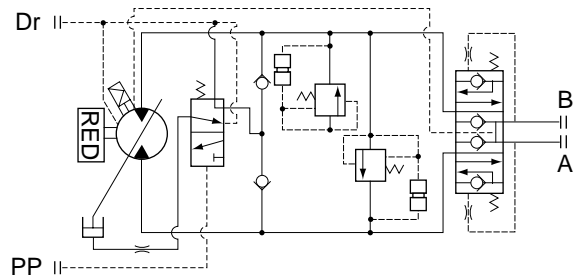
13-1 Specification



Direction of rotation (viewing from output axis)

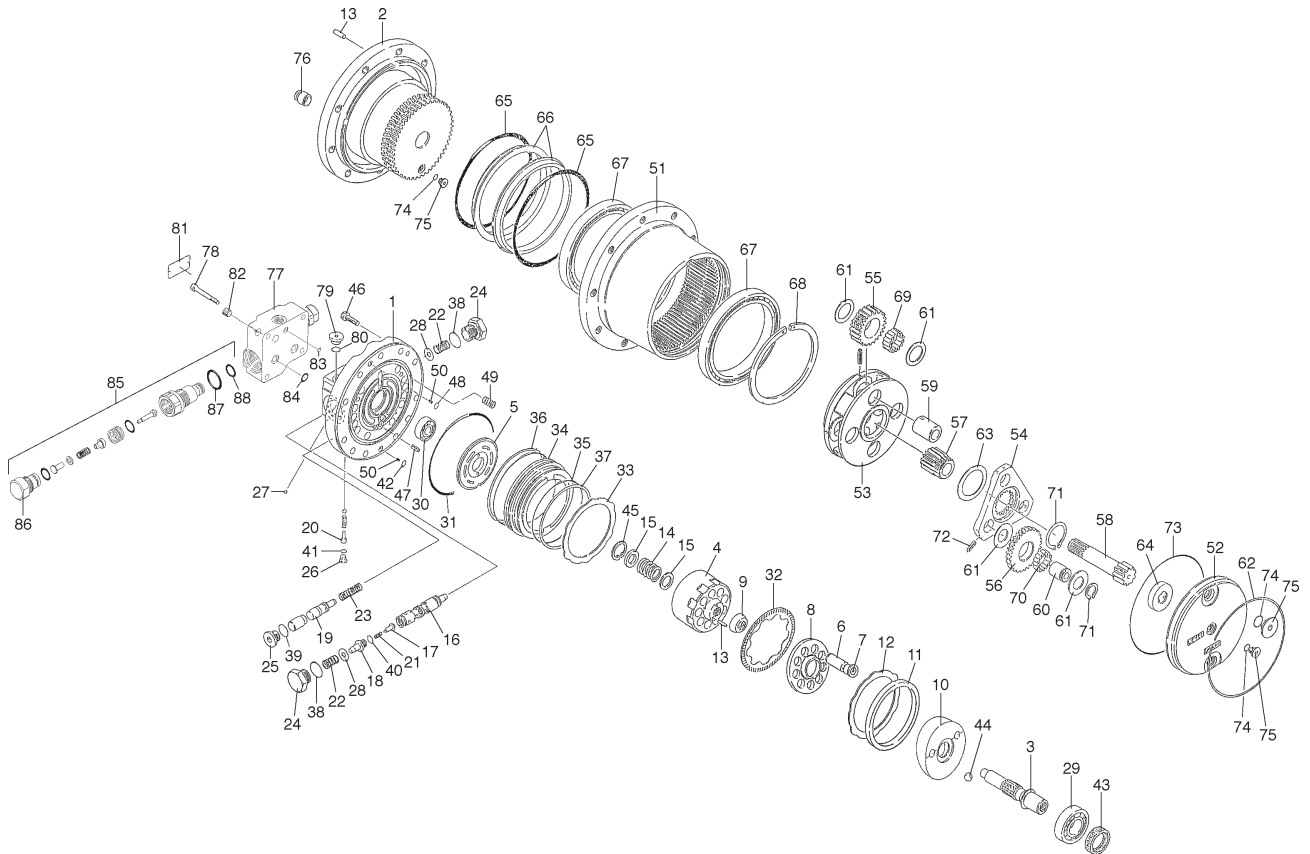
Direction of rotation	Oil pouring port	Oil discharging port
Clockwise	B	A
Counterclockwise	A	B

Port	Port size
A,B	PF1/2
Pilot	PF1/4
Dr	PF1/4



Item		Item		
Reduction gear	Output torque N·m	8320	Others	
	Output speed min ⁻¹	28.6/49.2		
	Reduction ratio	1/64.25		
	Capacity cc / rev	38.3 / 22.3		
Hydraulic motor	Working pressure MPa	24.5	Equivalent capacity cc / rev	2460.8 / 1432.8
	Output speed of hydraulic motor min ⁻¹	1,839 / 3,158	Oil	ISO-VG46
	Flow rate / min	72.6	Oil temperature(°C)	-20~100
			Filtering (μM)	10
			Lubricating oil cc	SAE-30-CD 1500
			Weight kg	86

13-2 Structure

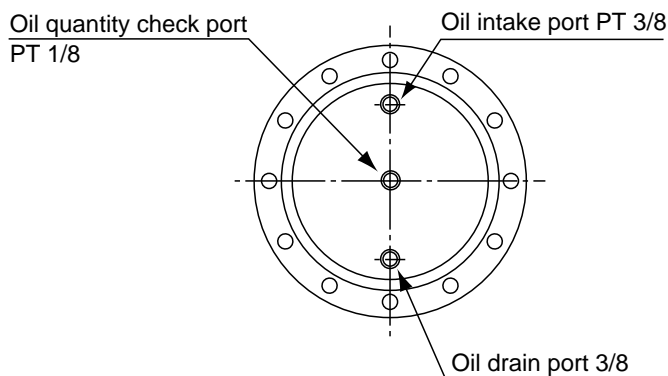


- | | | |
|--------------------|---------------------------|----------------------------|
| 1. Body-1 | 31. O-ring (AS568-258-70) | 61. Thrust washer |
| 2. Body-2 | 32. Disk plate | 62. Snap ring |
| 3. Shaft | 33. Steel plate | 63. Thrust washer |
| 4. Cylinder barrel | 34. O-ring(1B-G140) | 64. Slide ring |
| 5. Valve plate | 35. O-ring (1B-G130) | 65. O-ring |
| 6. Piston | 36. Backup ring(T3-G140) | 66. Floating seat |
| 7. Shoe | 37. Backup ring(T3-G130) | 67. Bearing |
| 8. Shoe holder | 38. O-ring (1B-P25) | 68. Snap ring |
| 9. Barrel holder | 39. O-ring (1B-P14) | 69. Needle |
| 10. Swash plate | 40. O-ring (1A-P12.5) | 70. Needle |
| 11. Brake spacer | 41. O-ring (1B-P8) | 71. Snap ring (S-38) |
| 12. Steel plate | 42. O-ring (1B-P7) | 72. Spring pin (5×32AW) |
| 13. Pin | 43. Oil seal | 73. O-ring |
| 14. Spring C | 44. Ball | 74. O-ring |
| 15. Retainer | 45. Snap ring(H-35) | 75. Plug |
| 16. Spool | 46. Screw(M10×30) | 76. Control piston |
| 17. Check valve | 47. Spring pin(6×16AW) | 77. Relief valve |
| 18. Spring guide | 48. O-ring(1B-P7) | 78. Screw (M10×30) |
| 19. Spool | 49. Spring B | 79. Plug |
| 20. Spring guide | 50. Choke | 80. O-ring (1B-P11) |
| 21. Spring V1 | 51. Body | 81. Name plate |
| 22. Spring V2 | 52. Cover | 82. Plug |
| 23. Spring V3 | 53. Carrier I | 83. O-ring(1B-P7) |
| 24. Plug | 54. Carrier II | 84. O-ring(1B-P12) |
| 25. Plug | 55. B1 gear | 85. Relief valve cartridge |
| 26. Plug | 56. B2 gear | 86. Plug |
| 27. Choke | 57. S1 gear | 87. O-ring(1B-P28) |
| 28. Ring | 58. S2 gear | 88. O-ring(1B-P15) |
| 29. Bearing (6206) | 59. B1 pin | |
| 30. Bearing (6302) | 60. B2 pin | |

13-3 Handling the travelling motor

Add lubricating oil according to the following procedure.

1. The cover has two plugs. Turn the motor so that two plugs are at the right angle to the floor. Use them as the oil intake port, oil quantity check and oil drain ports, starting from the top in that order.



2. First, remove the plugs from the oil intake and oil quantity check port with an Allen wrench.
3. Add lubricating oil through the oil intake until the oil comes out of the intake port.
4. Plug the oil intake and oil quantity check port, then wind seal tape around the plug before tightening.

Amount of lubricating oil	1500cc
---------------------------	--------

Schedule for replacing lubricating oil:

First: After the first 200 service hours or 2 months
 Second and later times : Every 1,000 service hours or 1 year

Standard maintenance

Tightening torque

Sprocket tightening torque	220 N·m
Motor tightening torque	305 N·m

13-4 Measuring crawler idling and travelling time

1. Idle crawler for ten turns and measure the required time.

Unit : sec

Standard value	
Low	70.0±2
High	43.3±2

(Engine running at full speed and oil temperature of 50±5°C)

2. After travelling 3m on ground level, measure the required time to travel 20m.

Standard value	
Low	25.0±1.5
High	16.6±1.0

(Engine running at full speed and oil temperature of 50±5°C)

13-5 Inspection and adjustment

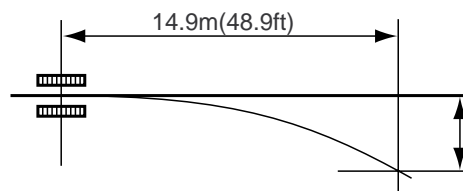
1. Measuring meander distance in travelling

Measure the meandering distance by travelling on hard ground.

Unit : mm or less

Standard value
930

(Engine running at full speed and oil temperature of 50 ± 5°C)

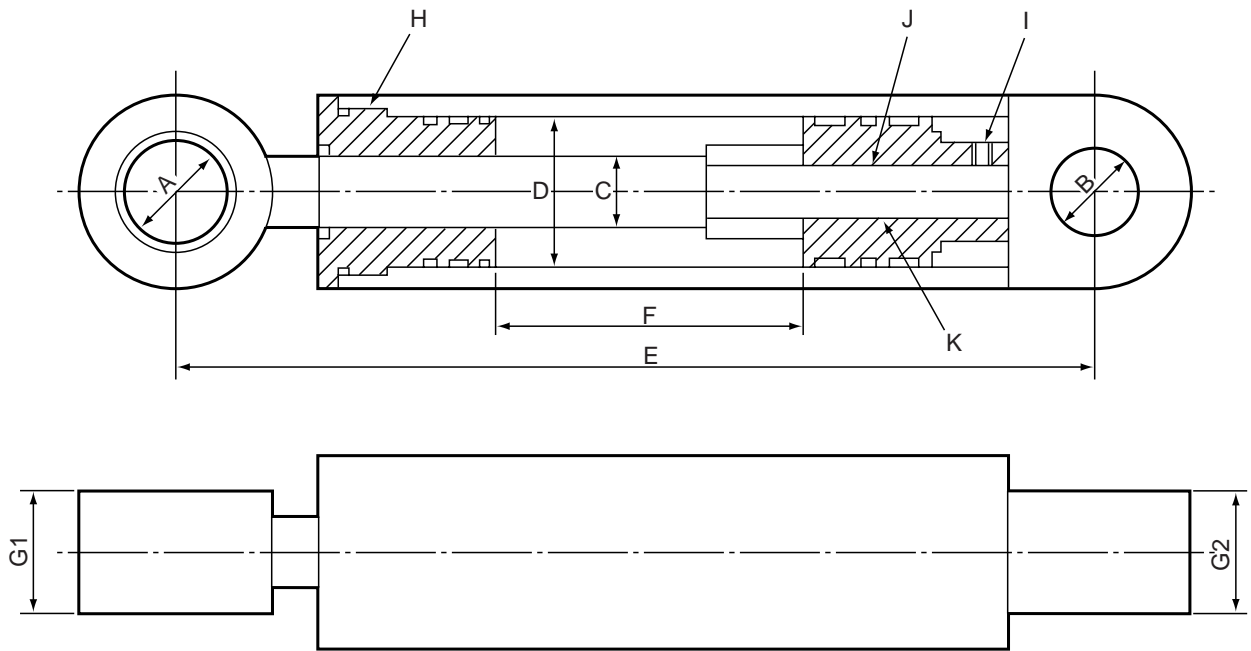


14 HYDRAULIC CYLINDER

CONTENTS

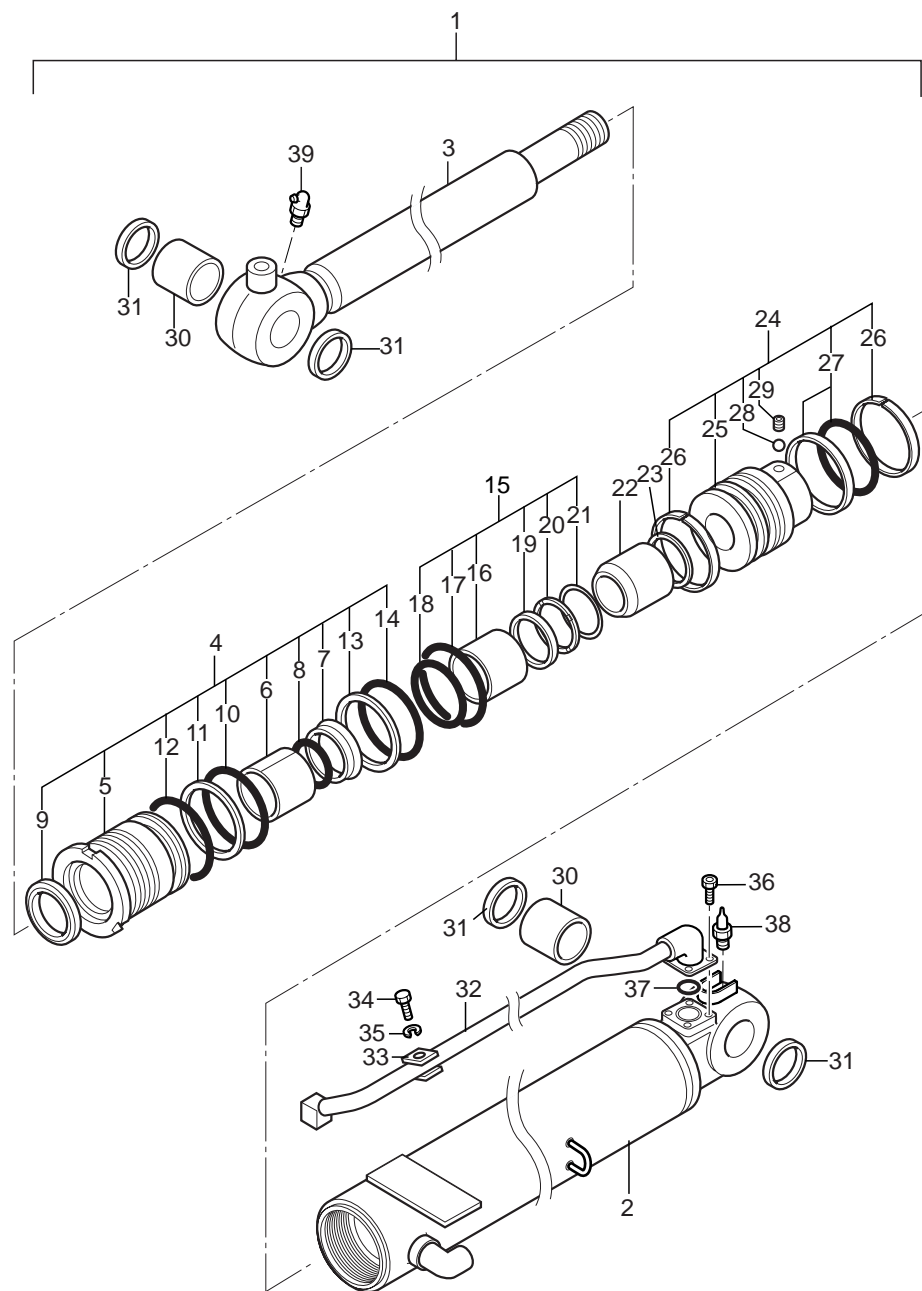
- 14-1 Structure
- 14-2 Disassembly and assembly
 - 14-2-1 Disassembly procedure
 - 14-2-2 Procedure for disassembling inner parts
- 14-3 Assembly
 - 14-3-1 Assembly procedure
 - 14-3-2 Inspection procedure
 - 14-3-3 Precautions for assembly

14-1 Structure



Item		Cylinder	Boom	Arm	Bucket	Swing	Dozer
Weight kg			106	90	57	89	48
Trust force*	Pushing	ton	28.3	19.6	15.9	26.0	26.0
	Pulling	ton	18.7	11.3	10.0	17.2	17.2
A	Pin diameter (rod)	mm	ø70	ø60	ø60	ø70	ø70
B	Pin diameter (head)	mm	ø70	ø60	ø60	ø70	ø70
C	Rod diameter	mm	ø70	ø65	ø55	ø70	ø70
D	Cylinder bore	mm	ø120	ø100	ø90	ø120	ø120
E	Maximum extended length	mm	2130	2220	1741	1730	870
	Maximum contracted length	mm	1310	1345	1081	1080	645
F	Stroke	mm	820	875	660	631	225
G1	Clevis width	mm	90	80	80	80	80
G2			90	90	80	90	80
H	Tightening torque	N·m	450	400	360	450	450
I	Tightening torque	N·m	35	17	17	35	35
J	Tightening torque	N·m	3600	2350	1750	3300	3300
K	Size of piston screw (size × pitch)		M45 × 2.0	M42 × 2.0	M39 × 2.0	M45 × 2.0	M45 × 2.0
*Main relief pressure		MPa	24.5	24.5	24.5	24.5	23.5

14-2 Disassembly and assembly



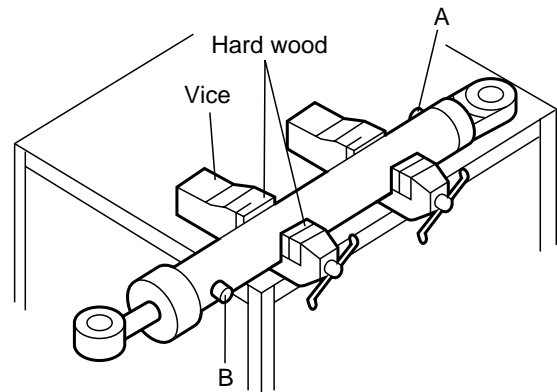
The illustration shows a boom cylinder.

- | | | |
|------------------------|---------------------|-------------------|
| 1. Cylinder Ass'y | 14. Stopper | 27. Seal ring |
| 2. Tube | 15. Retainer Ass'y | 28. Steel ball |
| 3. Rod | 16. Retainer | 29. Set screw |
| 4. Cylinder head Ass'y | 17. O-ring | 30. Pin bush |
| 5. Cylinder head | 18. Backup ring | 31. Dust seal |
| 6. Bush | 19. Cushion ring | 32. Pipe |
| 7. U-ring | 20. Spacer | 33. Plate |
| 8. Backup ring | 21. Stopper | 34. Bolt |
| 9. Wiper ring | 22. Cushion bearing | 35. Spring washer |
| 10. O-ring | 23. Shim | 36. Bolt |
| 11. Backup ring | 24. Piston Ass'y | 37. O-ring |
| 12. O-ring | 25. Piston | 38. Grease nipple |
| 13. Connector | 26. Slide ring | 39. Grease nipple |

14-2-1 Disassembly procedure

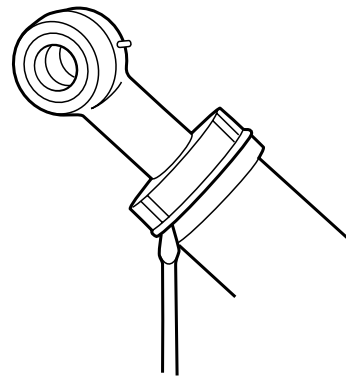
1. Hold the cylinder with the vices.

Tighten the vice carefully; do not deform the cylinder. Blow air alternately from ports A and B and operate the piston rod to drain oil from the cylinder inside. To remove the piston, pull the piston rod about a third of the length.

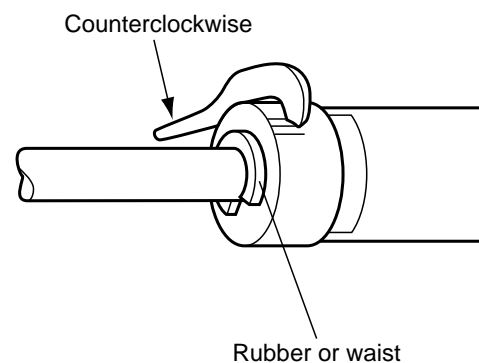


2. Disassemble the rod cover.

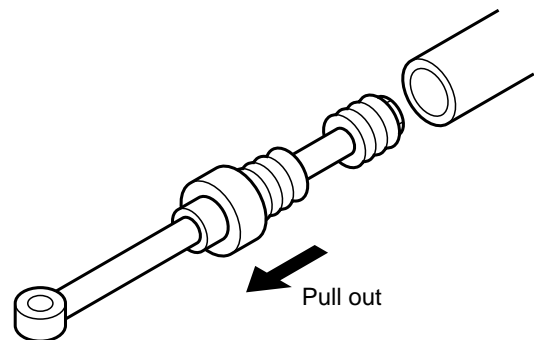
Make the backup ring smoothly with a screwdriver (or hammer).



3. Loosen and remove the rod cover from the cylinder tube assembly with a hook wrench.



4. Disassembling the piston rod assembly
Slowly turn the piston rod assembly to remove it from the cylinder tube assembly. Place the removed piston rod assembly on a wooden bench or a waste to prevent damage.

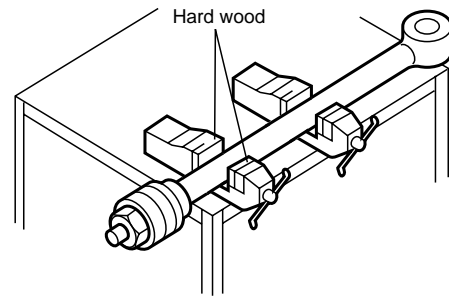


5. Disassembling the piston assembly

Hold the piston rod assembly with vice.

- Put the waste between hard wood and the piston to prevent the surface sliding from being damaged.
- Set the piston rod assembly on a level block so that it becomes parallel to the level block.

Be careful because the piston rod assembly may come out of the vice and be damaged if it is set diagonally.



14-2-2 Procedure for disassembling inner parts

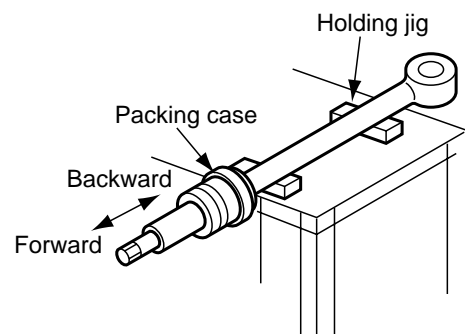
1. Remove the piston assembly from the piston rod assembly (after removing the set bolts). Then remove the cushion bearing in the direction of the arrow.

2. Disassembling rod cover

Put piston rod assembly on a holding jig on the work bench.

Make a working face for the rod cover assembly on the workbench and move the rod cover to and fro to remove it.

Remove the backup ring then the O ring with a screwdriver. If they are to be reused, be careful not to damage them.

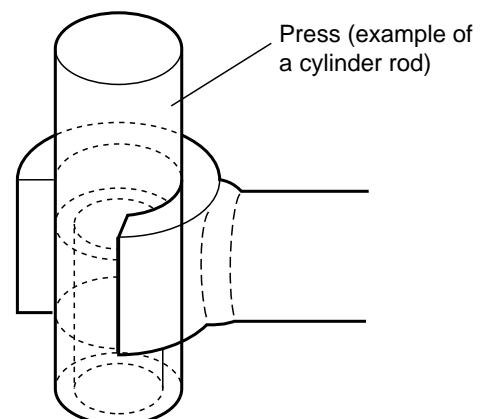


3. Disassembling the packing assembly

Remove the packing by prying it with an eyelet or a screwdriver. Be careful not to damage the groove of the cover and piston. Because it is difficult to remove the dust seal and rod packing without damaging them, remove them by inserting a eyelet or a similar tool and prying them out. Be careful not to damage the groove on the cover and piston.

4. Disassembling the piston rod and cylinder tube assembly

As the bushes are pressed to fit the rod head, press them out with a pressing machine to remove them. For a spherical bearing, the snap ring must be removed first.



14-3 Assembly

14-3-1 Assembly procedure

1. The assembly procedure is the reverse of disassembly.
2. Before assembly, check whether metallic powder or other foreign matter is not sticking to any of the parts and whether the parts can be reused.
3. Coat hydraulic oil on each part before assembling them.
4. Assemble beforehand the parts into the following assemblies.

- Cylinder tube assembly
- Rod cover assembly
- Piston rod
- Piston assembly

14-3-2 Inspection procedure

Clean each disassembled part with light oil or treated oil except for the packings. Packings are cleaned with petroleum hydraulic oil.

Other types of oil will remarkably shorten the life of the packing.

Thoroughly clean the sliding surface, oil hole, O ring, packing groove, etc. If the part is not used for a long time after being cleaned, execute a rust proof treatment.

(Coating hydraulic oil is effective for rust prevention to a certain degree.)

1. Check all parts for flaws, cracks, deformation, rust, or burrs which may affect the operation. (Inside of the tube, rod, etc.)
2. Check each part for metallic powder or other foreign matter sticking to it.
3. Check the sliding surface of piston rod for damage, uneven abrasion, discoloring, or any defect which may affect its operation.
4. Packings and seals are usually replaced with new one. If you must reuse them, check that there are no tears, cuts or foreign matter sticking to the packing.

14-3-3 Precautions for assembly

Assemble the cylinder while paying attention to the following matters.

1. Replace the packings with new ones before assembly.
2. Execute assembly work paying attention to the direction of cushion bearings (boom, arm and bucket) and seal rings.
3. Replace the set bolts with new ones.
In assembling, after tightening the set bolts, further tighten and firmly fix them by hitting with punch at two points on the periphery.
4. Tighten the rod cover, piston and nuts with a specified tightening torque shown in the attached table (page 14-1).
5. Check fully before starting assembly work.

15 SWIVEL JOINT

CONTENTS

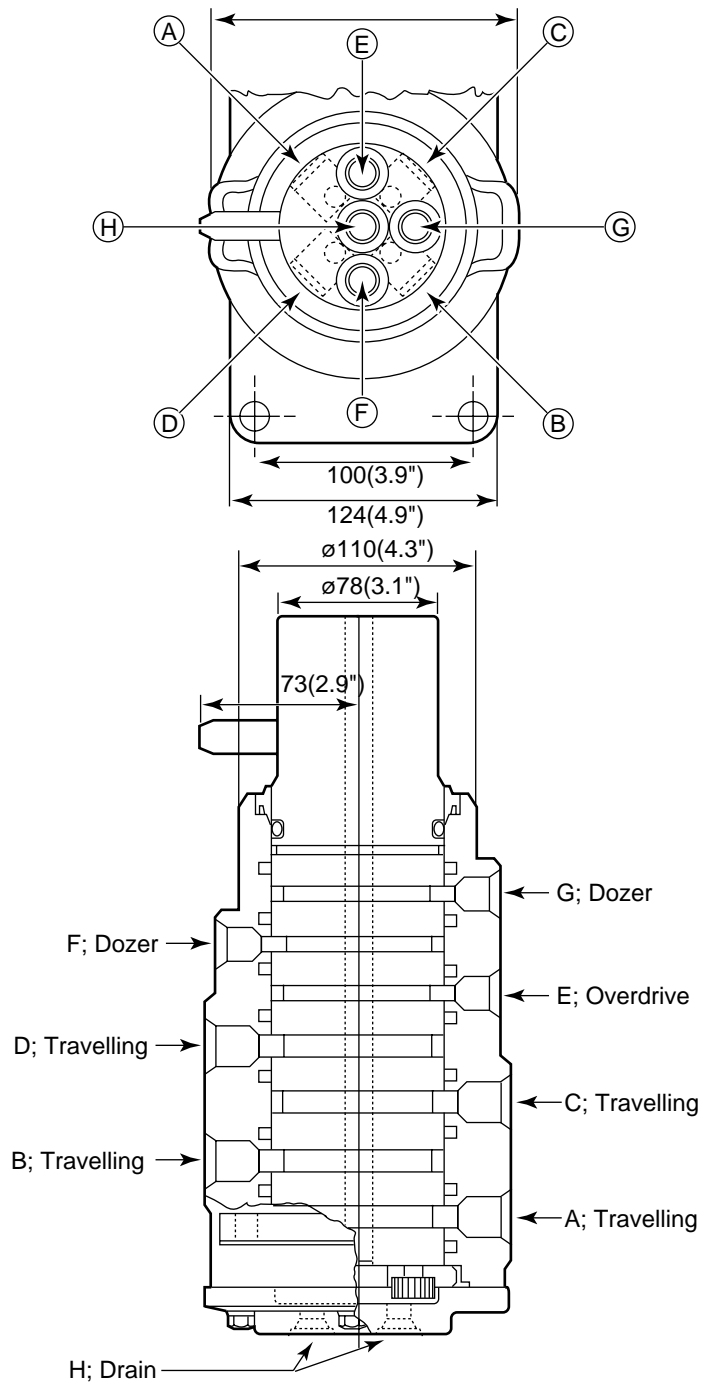
15-1 Specification and Structure

15-2 Structure, disassembly and assembly

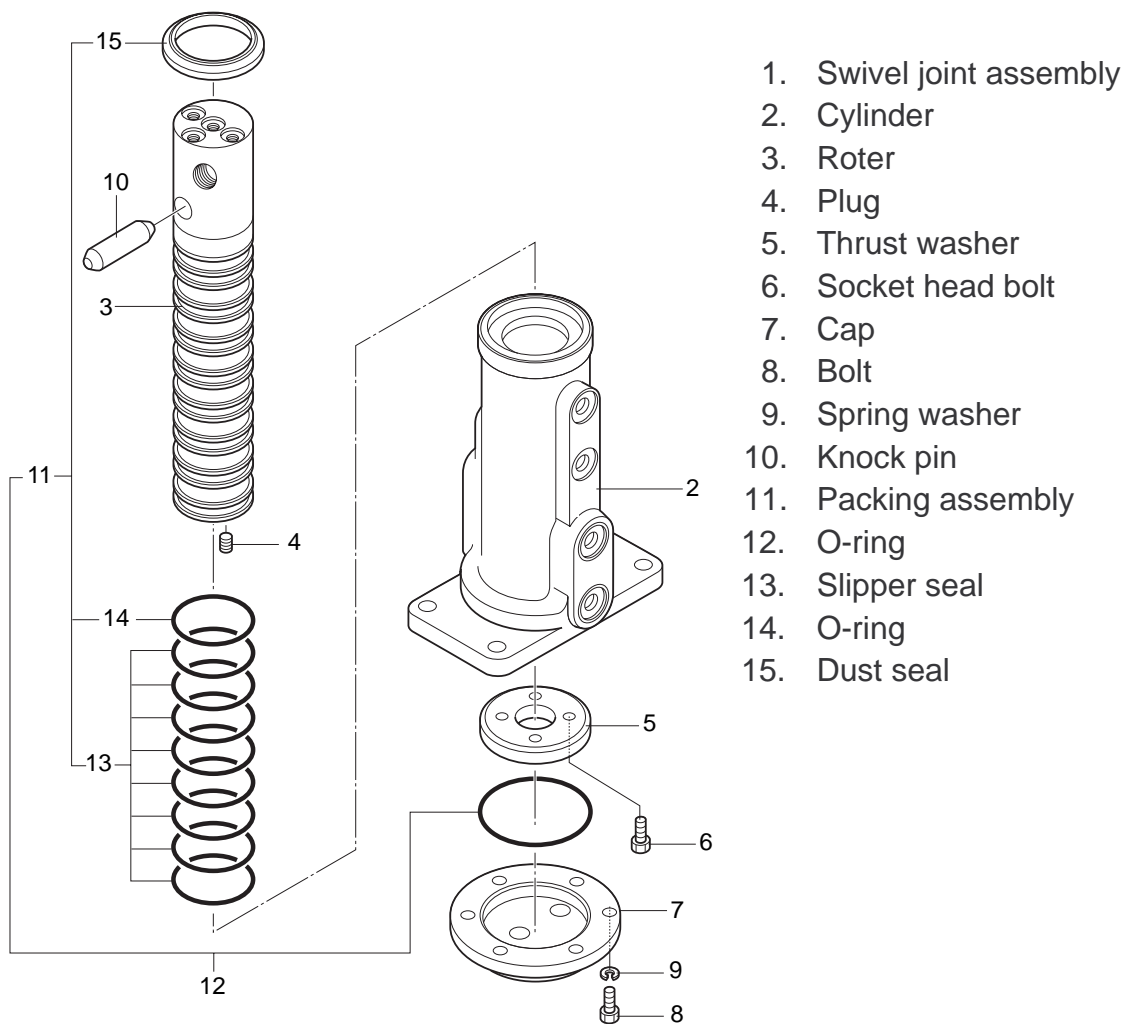
15-1 Specification and Structure

Working pressure	0.49 MPa	H
	0.98 MPa	E
	24.5 MPa	A~D,F,G
Screw size	PF 1/4	E~H
	PF 1/2	A~D
Working speed	10 min ⁻¹	

*A to H denote the position of the port.



15-2 Structure, disassembly and assembly



Disassembly:

1. Remove bolt (8) and cap(7).
2. Remove the bolts (6) and washer thrust (5).
3. Remove the shaft (3) from the hub (2) upward. Because the shaft is tightened by the tension of the O ring, tap a hammer on the shaft by rotating it and pull it up.
 * Be careful so that O ring does not become trapped.

Assembly:

1. Before assembly, check the O ring and sliding part for flaws and other defects.
2. Assembly is usually executed in the opposite order of disassembly.
 Coat a little hydraulic oil or grease on the O rings before assembly.

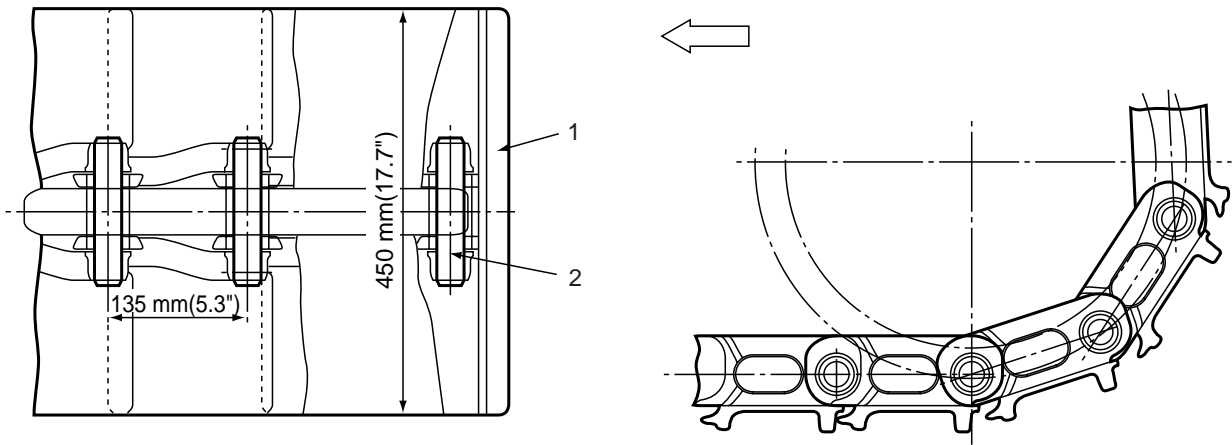
16 CRAWLER

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- 16-1 Structure and operation
 - 16-1-1 Crawler (Steel)
 - 16-1-2 Track frame
- 16-2 Standard of maintenance
 - 16-2-1 Crawler (Steel)
- 16-3 Disassembly and assembly
 - 16-3-1 Installing the crawler
 - 16-3-2 Removing the crawler
 - 16-3-3 Track frame spring
 - 16-3-4 Life of the rubber crawler
 - 16-3-5 Handling the rubber crawler

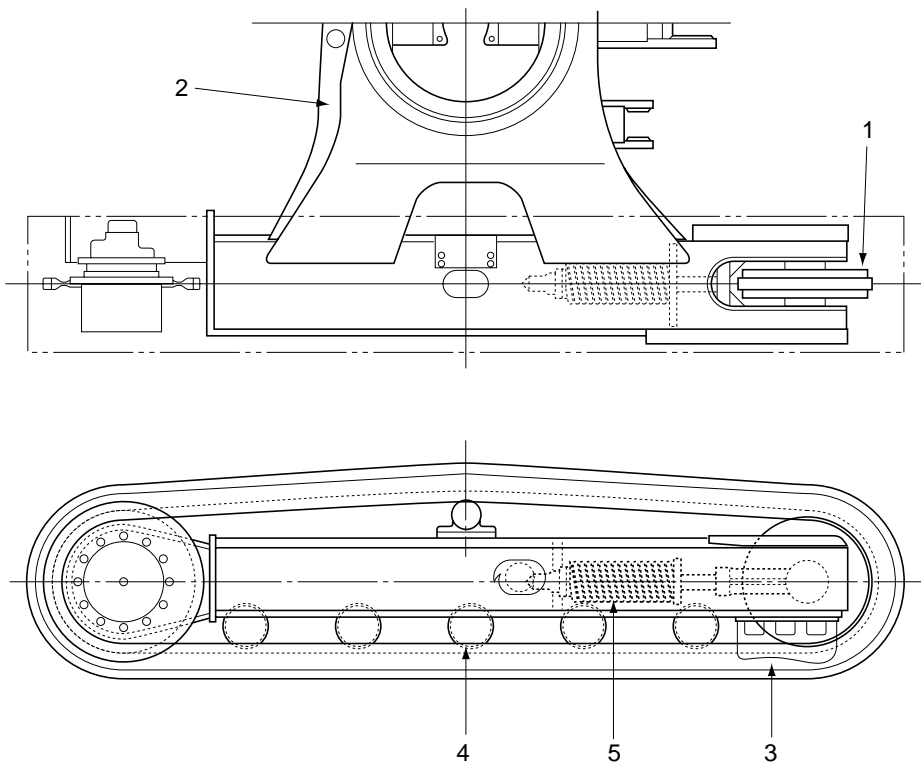
16-1 Structure and operation

16-1-1 Crawler (steel)



- 1. Shoe
- 2. Pin

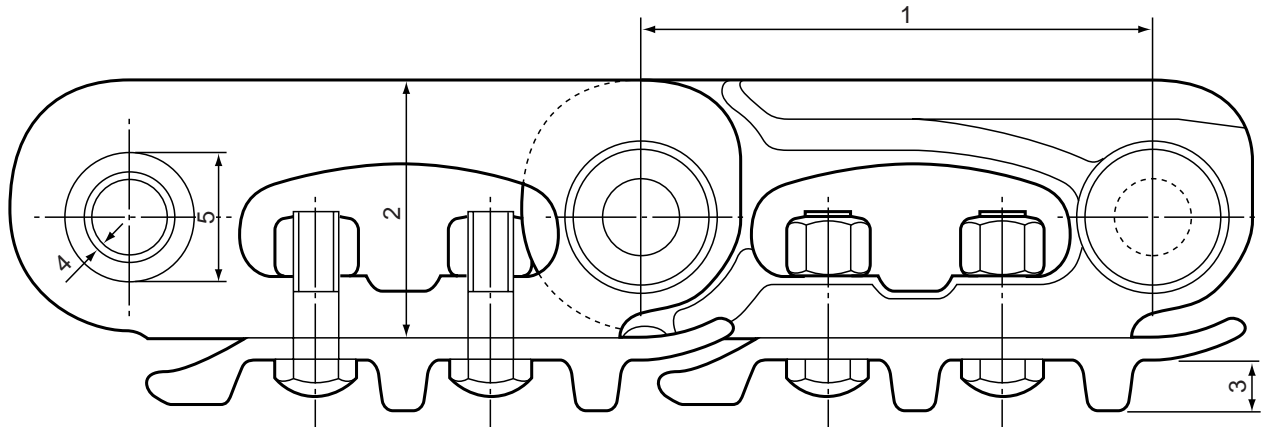
16-1-2 Track frame



- 1. Idler
- 2. Track frame
- 3. Guard (for steel crawler)
- 4. Track roller
- 5. Spring

16-2 Standard of maintenance

16-2-1 Crawler (steel)



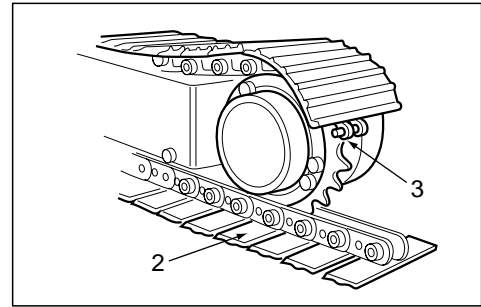
No.	Item	Unit	Standard value	Allowance	Remarks
1	Link pitch	mm	135	137	Measure by stretching 5 links except for the master link
2	Link height		75	68	Pad or replace
3	Grouser height		14	7	Pad or replace
4	Pin clearance		0.2	2	Replace
5	Bush outer diameter		41	37	Replace
6	Shoe bolt tightening torque	N·m	220 ± 20	—	Additional tightening M12P=1.25

16-3 Disassembly and assembly

16-3-1 Installing the crawler

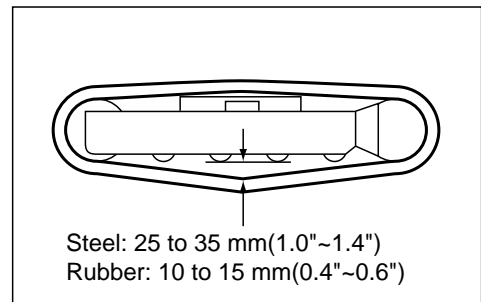
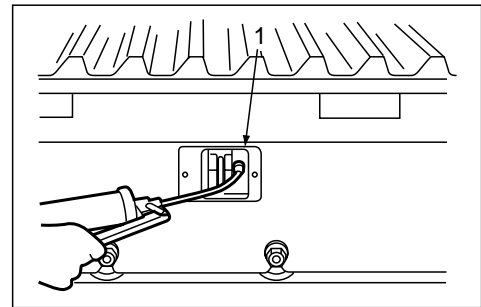
1. Crawler

After the sprocket put on the crawler (2), drive motor to bring it above the idler and for steel crawler, fix the master pin (3) into the hole. For a rubber crawler, the crawler by using the idler as it is. Install steel bar and heavy duty hammer into the undercarriage.



2. Tension the crawler

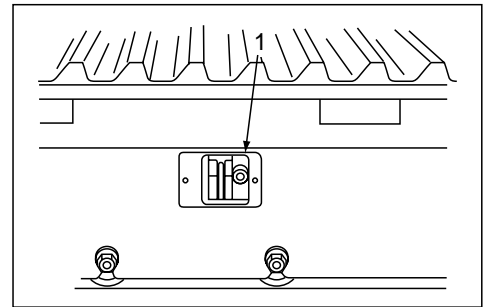
Tighten the cartridge valve (1) of the adjust cylinder, grease and adjust the tension.



16-3-2 Removing the crawler

1. Loosen the crawler.

By loosen the cartridge valve (1) of the adjust cylinder, drain grease and loosen the crawler (2).



2. Crawler

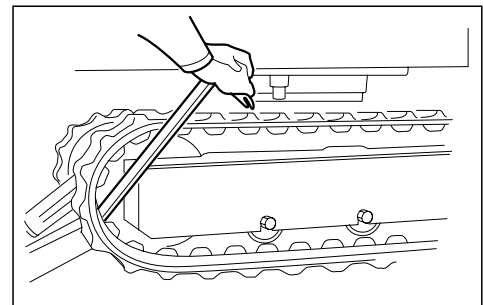
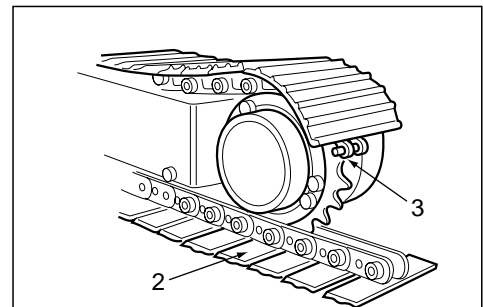
1) Lift the main frame with attachment and put blocks under to lift the machine.

2) Turning in the direction of the idler side, remove crawler master pin (3) and then the crawler (2) from track frame.

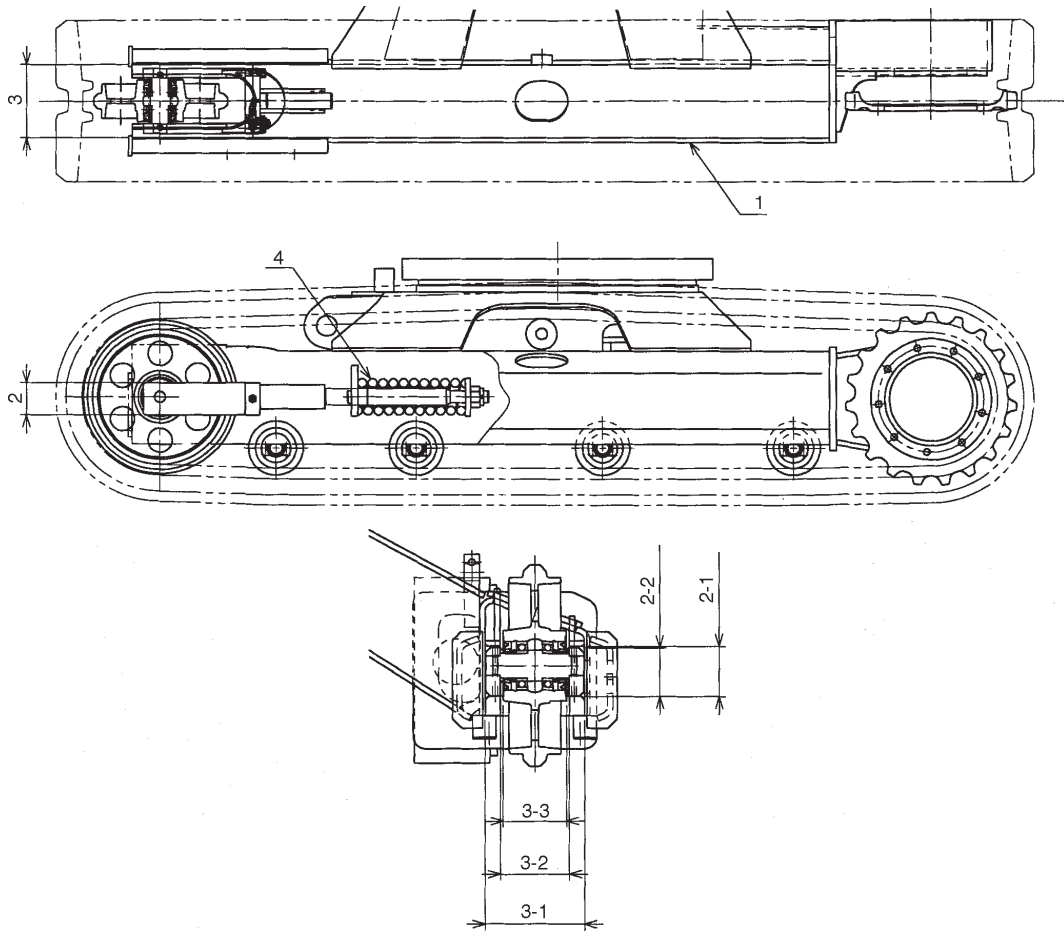
Weight (steel crawler): 850 kg (425×2)

3) As rubber crawler is endless and of solid material, push the idler to the end and remove the rubber crawler by using steel bar from the idler.

Weight (rubber crawler): 740 kg (370×2)



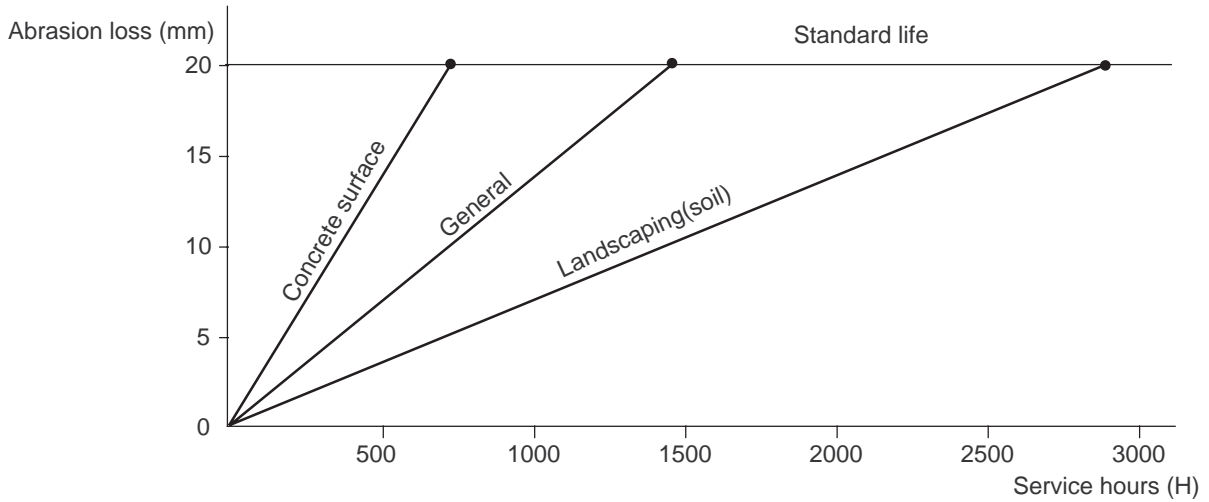
16-3-3 Track frame spring



Unit: mm

No.	Item	Standard		Remedy	
1	Deformation of frame	Allowable limit		Correct	
		Bend	5 (Overall length of track frame)		
		Twist	10 (Twist between left and right crawler frames)		
	Opening of idler	5			
2	Distance between upper and lower faces of idler guide	Standard value		Pad or replace	
		2-1	Track frame		104
		2-2	Idler frame		100
3	Distance between left and right faces of idler guide	3-1	Track frame	270	Replace
		3-2	Track frame	154	
		3-3	Idler support	150	
4	Spring	Standard value (free length)		Replace	
		301			Set length 321

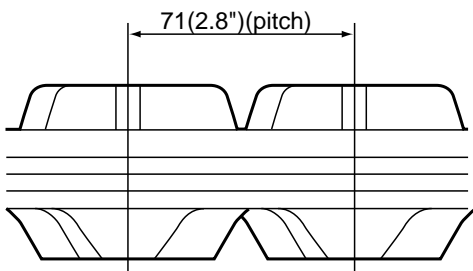
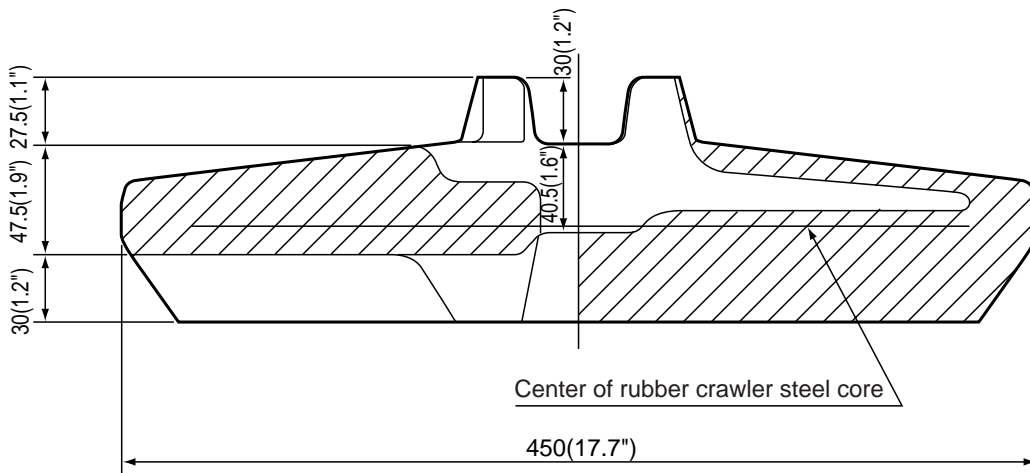
16-3-4 Life of the rubber crawler



Check the remaining life of the rubber crawler by the abrasion loss in the rubber crawler height as shown in the figure below. Note that the life slightly differs depending on the conditions of site and the operation of the machine.

PRECAUTIONS:

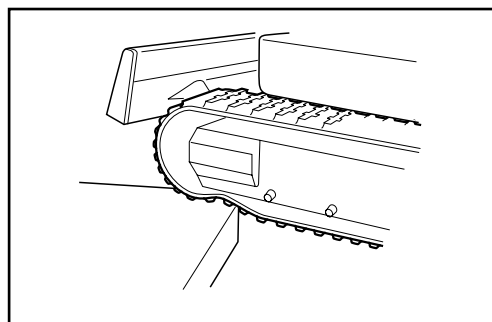
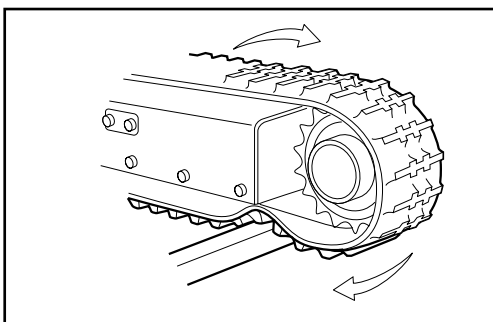
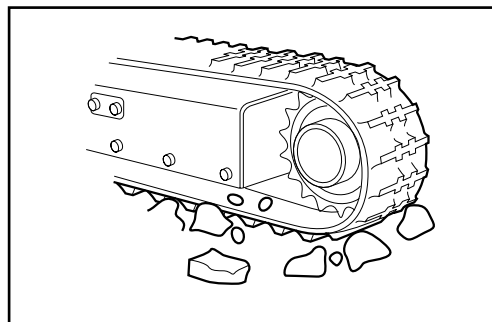
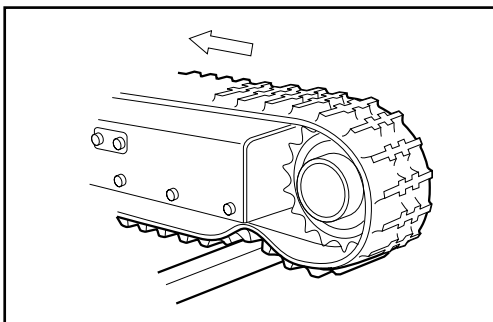
- (1) Wipe immediately if fuel or hydraulic oil sticks to rubber crawler.
- (2) Check that there are no sharp edges protruding on the ground.
- (3) Avoid using on beach. (This may affect the adhesion of the core metal.)
- (4) If the machine is going to be stored for a long time, never store it where it will be directly exposed to sunlight.



Description		Value
Total length of rubber crawler		6106 ± 20
Steel cord	Tension	1,000 kg / piece
Steel cord	No. of cords	52 ± 4
Range of working temperature		-25°C~55°C
Width × pitch		450 × 71

16-3-5 Handling the rubber crawler

1. Do not run over or turn on a sharp edge
If you run over or turn on a projecting sharp edge or a stepped grade, the machine will partially load on the rubber crawler and split it or cut the threads of the rubber crawler and the inner steel cord.
2. Prevent foreign matter from entering the rubber crawler
Foreign matter will strain the crawler and cut it.
3. No sharp turns
Do not turn sharply on a road with a high-friction factor (such as a concrete road).
4. Keep oil products away from the rubber crawler
If you spill fuel or hydraulic fluid on the rubber crawler, clean it promptly.
5. Protect from salt
Do not operate on beach (Core metal will rust due to salt corrosion).
6. Store indoors
If the machine is not used for a long time, keep it indoors to prevent exposure to direct sunlight and rain.



17 SPRING CASE AND GREASE CYLINDER

CONTENTS

17-1 Structure

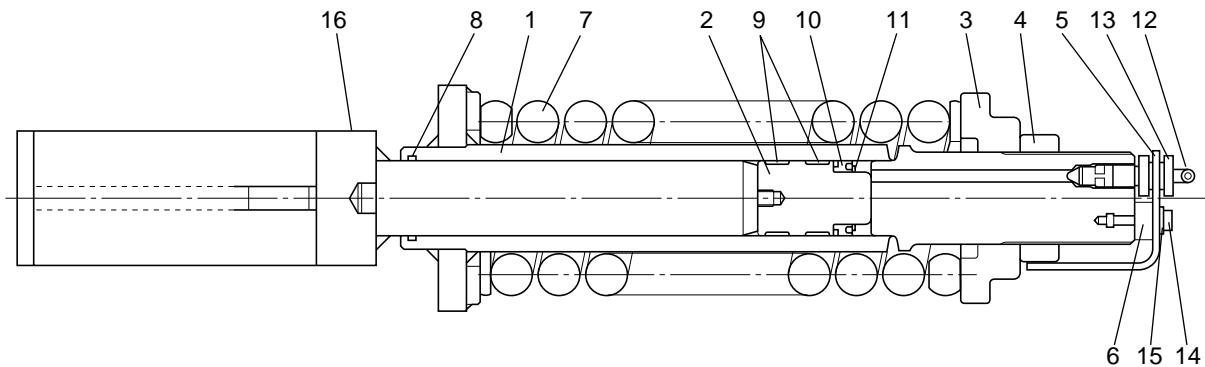
17-2 Specification of spring

17-3 Disassembly and assembly

17-3-1 How to disassemble and assemble the adjust
cylinder

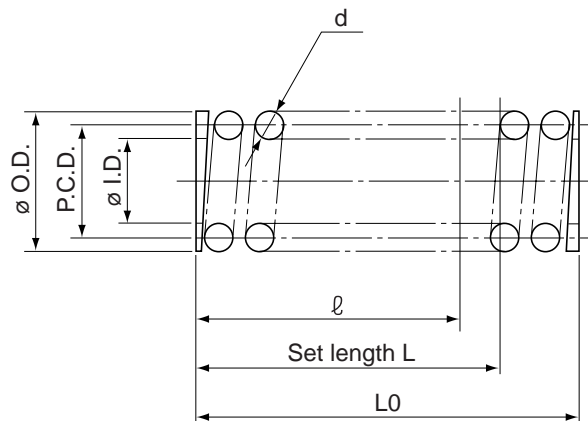
17-3-2 How to disassemble and assemble the
spring case

17-1 Structure



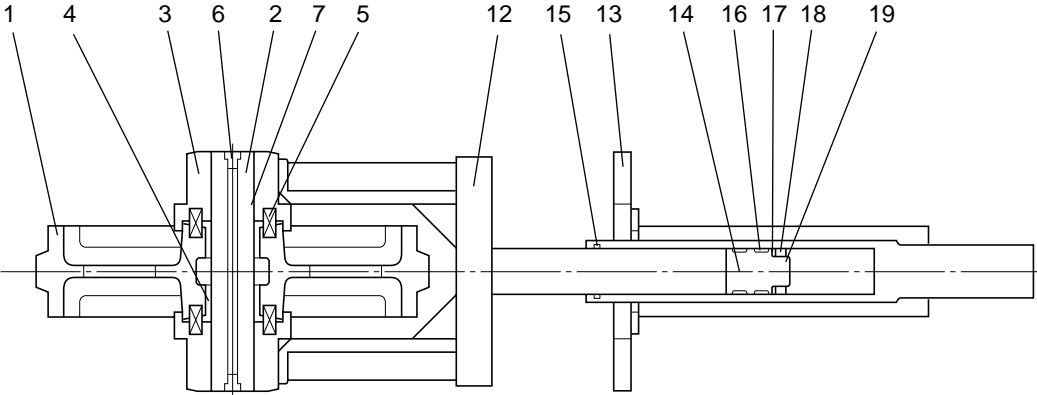
- | | |
|-------------------|-------------------|
| 1. Cylinder | 9. Wear ring |
| 2. Piston | 10. Packing |
| 3. Flange | 11. Snap ring |
| 4. Nut (M62×P2.0) | 12. Grease nipple |
| 5. Stopper | 13. Valve |
| 6. Spacer | 14. Bolt |
| 7. Spring | 15. Spring washer |
| 8. O-ring(1B-P50) | 16. Yoke |

17-2 Specification of spring

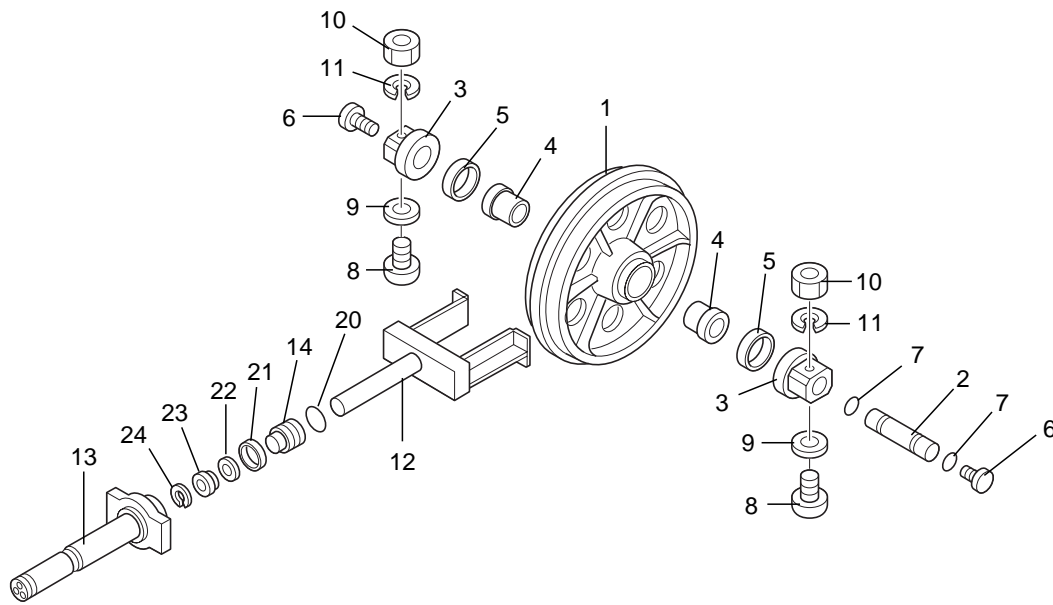


Name	Value	Name	Value
No. of active coils	8	ℓ Length at max. shrinkage mm	266
Total number of coils	10	\varnothing O.D. (outer diameter)mm	130
Spring constant (kgf/mm)	72.4	P.C.D. (Center diameter) mm	102
Set force kg	4750±380	\varnothing I.D. (Inner diameter) mm	74±1.5
Force at max. shrinkage kg	8732	Wire diameter d mm	28
Lo Free length mm	386.5	L set length mm	321

17-3 Disassembly and assembly



- 1. Idler
- 2. Shaft
- 3. Hub
- 4. Bronze
- 5. Floating seal
- 6. Plug
- 7. O-ring
- 8. Belt, lock
- 9. Spacer
- 10. Nut
- 11. Spring washer
- 12. Idler yoke
- 13. Tube
- 14. Piston
- 15. O-ring
- 16. Wear ring
- 17. Backup ring
- 18. Piston seal
- 19. Retaining ring



Cylinder effective stroke: 150 mm

17-3-1 How to disassemble and assemble the adjust cylinder

1. Disassembly

- a. Remove the Spring Ass'y(See 17-3-2 How to disassembled and assemble the spring Ass'y).
- b. Remove the piston (13) from the cylinder.
- c. Remove the O-ring (20).

2. Assembly

The assembly procedure is the reverse of the disassembly procedure.

- a. Attach the O-ring to adjust cylinder.
*Coat grease on the O-ring before assembly.
- b. Attach the piston to the cylinder carefully so that the wear rings are not damaged. Apply grease before hand in the cylinder. Attach the spring to cylinder(See 17-3-2) 2. Assembly.

Note:

- Coat grease on the piston of the cylinder before assembly.

17-3-2 How to disassemble and assemble the spring Ass'y

1. Disassembly

Lower the spring force between the support assembly and support using a pressing machine and the special purpose tool.

- a. Remove the cartridge valve and the bolts tightening the stopper.
- b. Remove the nut for the mounting spring.
- c. Remove the spring from cylinder.

Note:

- Be careful when using the tool when removing the spring. Also, be careful during assembly.

2. Assembly

The assembly procedure is the reverse of disassembly.

Attach the spring to cylinder using the special tool and set the spring to the specified position with the nut.

When attaching the adjust cylinder rod, tighten the cartridge valve after checking that grease comes out of the grease drain hole.

Note:

- Adjust and assemble carefully so that air does not remain in the cylinder.
Spring set length: 321mm

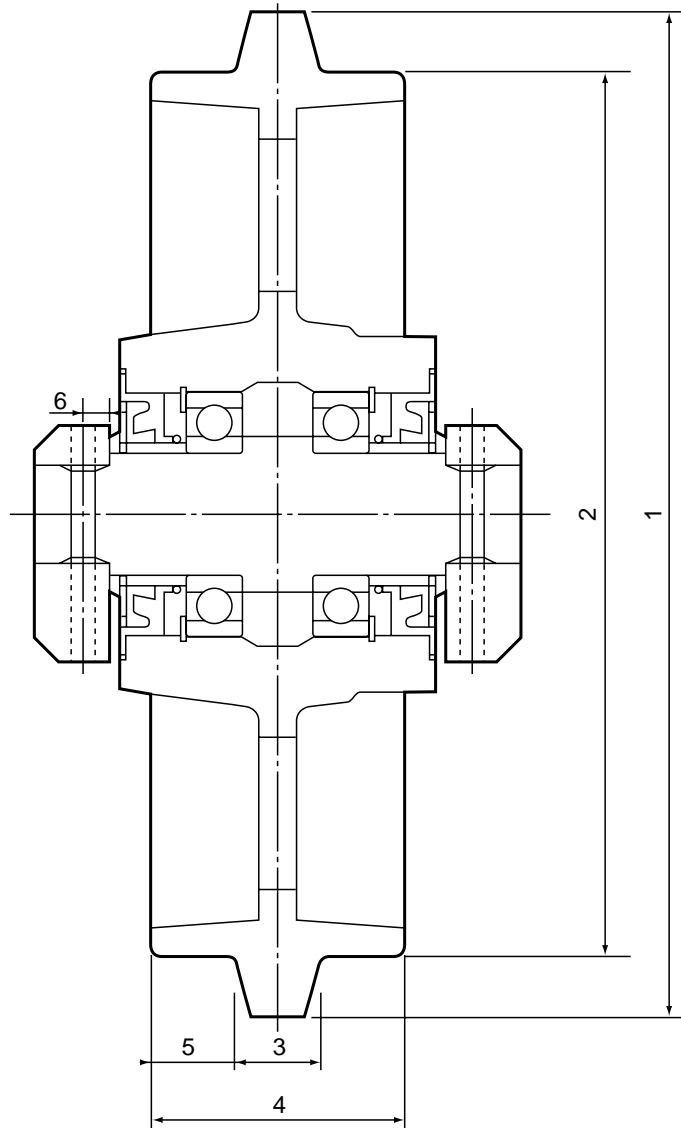
18 IDLER

CONTENTS

18-1 Standard of maintenance

18-1-1 Idler (for Rubber and Steel)

18-1-1 Idler (for Rubber and Steel)



No.	Item	Unit	Standard value	Allowance	Remark
1	Outer diameter projected part	mm	ø456	ø450	Pad or replace
2	Outer diameter of tread	mm	ø406	ø400	Pad or replace
3	Width of projected part	mm	43	39	Pad or replace
4	Overall width	mm	100	92	Pad or replace
5	Width of tread	mm	28.5	32.5	Pad or replace
6	Side clearance of Idler	mm	0.2~0.3	1.5	Replace of oil seal
7	Quantity of lubricating oil	cc	70	—	Gear oil or engine oil

19 SPROCKET

CONTENTS

- 19-1 Disassembly and assembly
 - 19-1-1 Removing the sprocket
 - 19-1-2 Installing the sprocket
- 19-2 Standard of maintenance
 - 19-2-1 Sprocket

19-1 Disassembly and assembly

19-1-1 Removing the sprocket

1. Crawler

Refer to the explanation of crawler removal.

2. Sprocket

Remove sprocket mounting bolts (2) and then sprocket (1) from the travelling motor assembly.

(Fig 19-1-1)

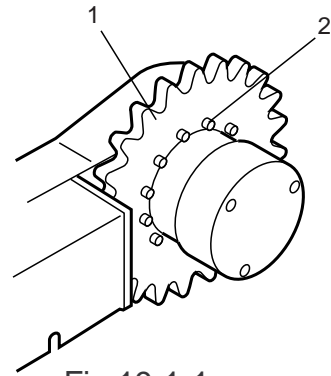


Fig 19-1-1

19-1-2 Installing the sprocket

1. Sprocket

Attach the sprocket to travelling motor assembly and tighten the mounting bolts (1).

Tightening torque: 200 N·m

2. Crawler

Refer to the explanation of crawler installation.

(Fig 19-1-2)

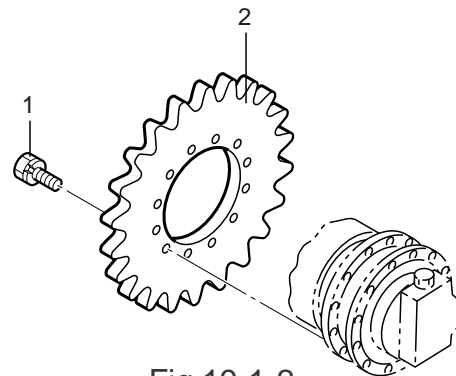
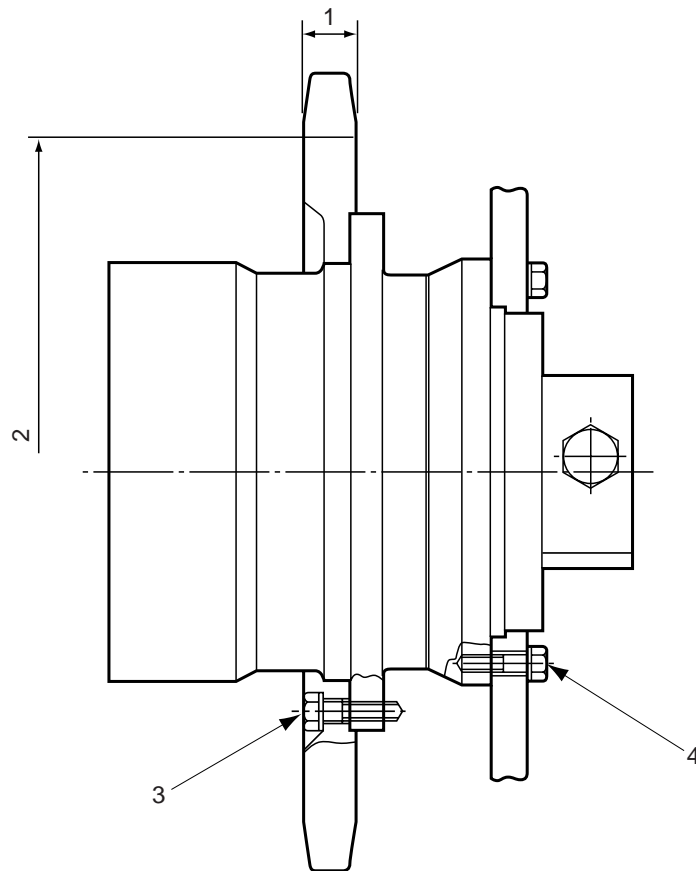


Fig 19-1-2

19-2 Standard of maintenance

19-2-1 Sprocket



No.	Item	Unit	Standard value	Allowance	Remarks
1	Width of sprocket teeth	mm	40	37	Pad or replace
2	Minor diameter of sprocket	mm	ø459	ø453	Pad or replace
3	Tightening torque of sprocket mounting bolt	N·m	200	—	Tighten some more. (M14 P2.0)
4	Tightening torque of motor mounting bolt	N·m	310	—	Tighten some more. (M16 P2.0)

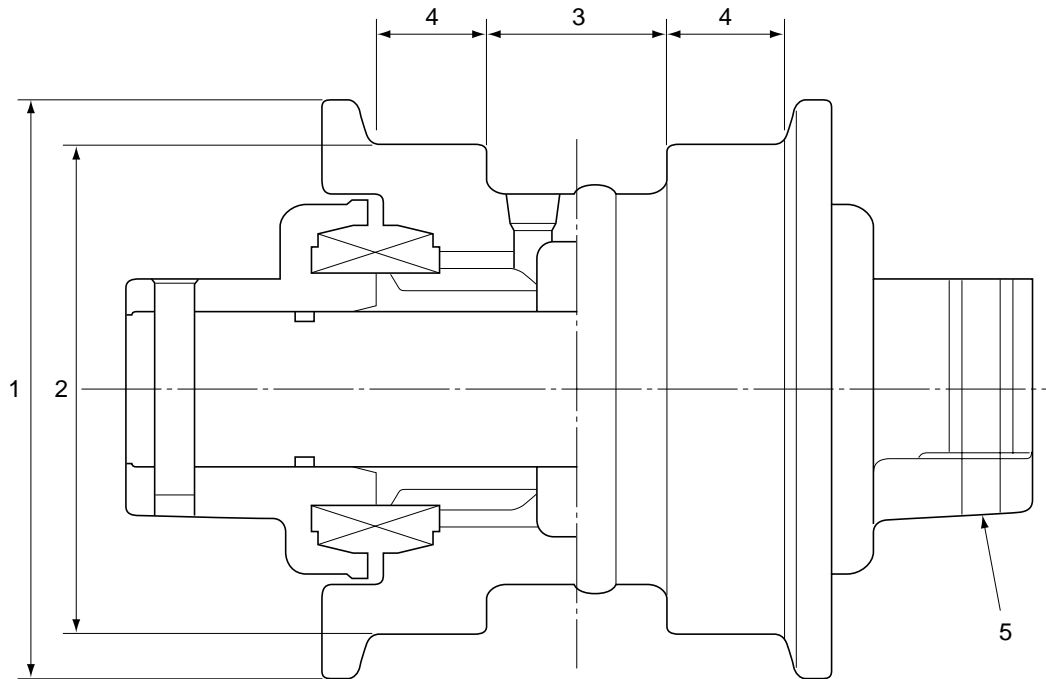
20 TRACK ROLLER

CONTENTS

- 20-1 Standard of maintenance
 - 20-1-1 Track roller (for Steel)
 - 20-1-2 Track roller (for Rubber)

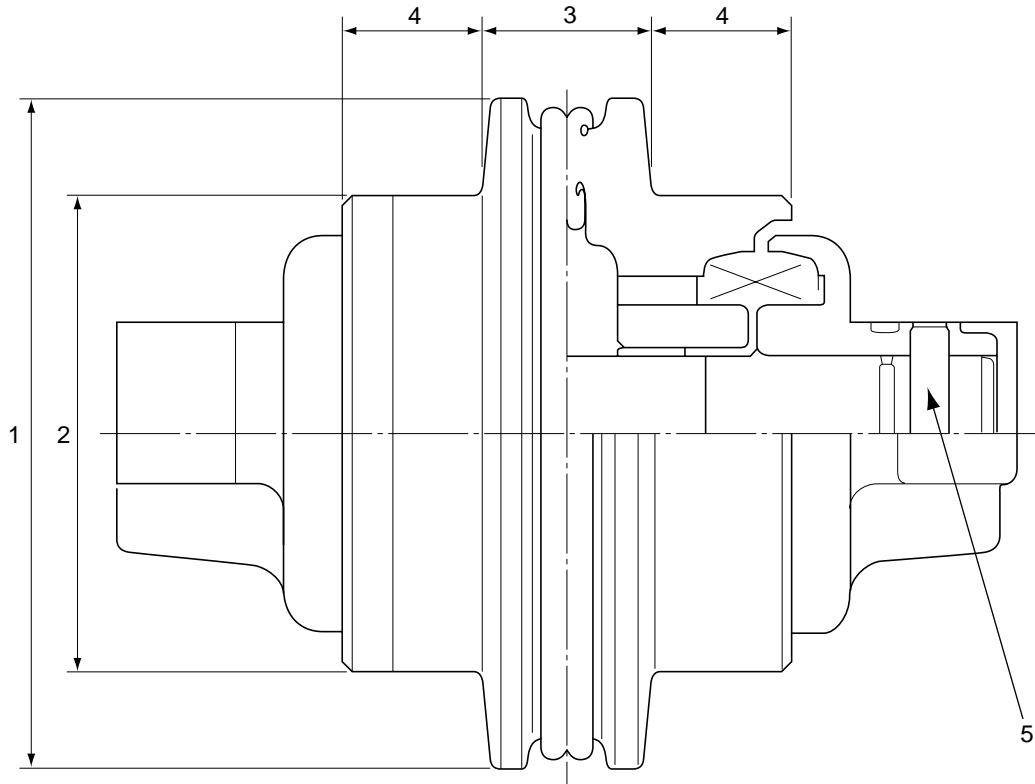
20-1 Standard of maintenance

20-1-1 Track roller (for Steel)



No.	Item	Unit	Standard value	Allowance	Remarks
1	Outer diameter of projected part	mm	ø147	ø138	Pad or replace
2	Outer diameter of tread	mm	ø126	ø118	Pad or replace
3	Width of projected part	mm	45	50	Pad or replace
4	Width of tread	mm	30	22.5	Pad or replace
5	Tightening torque for mounting roller	N·m	180	—	Tighten some more(M14-P2.0)
6	Quantity of lubricating oil	cc	70~80	—	Gear oil or engine oil

20-1-2 Track roller (for Rubber)



No.	Item	Unit	Standard value	Allowance	Remarks
1	Outer diameter of projected part	mm	ø177	ø169	Pad or replace
2	Outer diameter of tread	mm	ø125	ø122	Pad or replace
3	Width of projected part	mm	45	36	Pad or replace
4	Width of tread	mm	37.5	32.5	Pad or replace
5	Tightening torque for mounting roller	N·m	180	—	Tighten some more(M14-P2.0)
6	Quantity of lubricating oil	cc	70~80	—	Gear oil or engine oil

21 CARRIER ROLLER

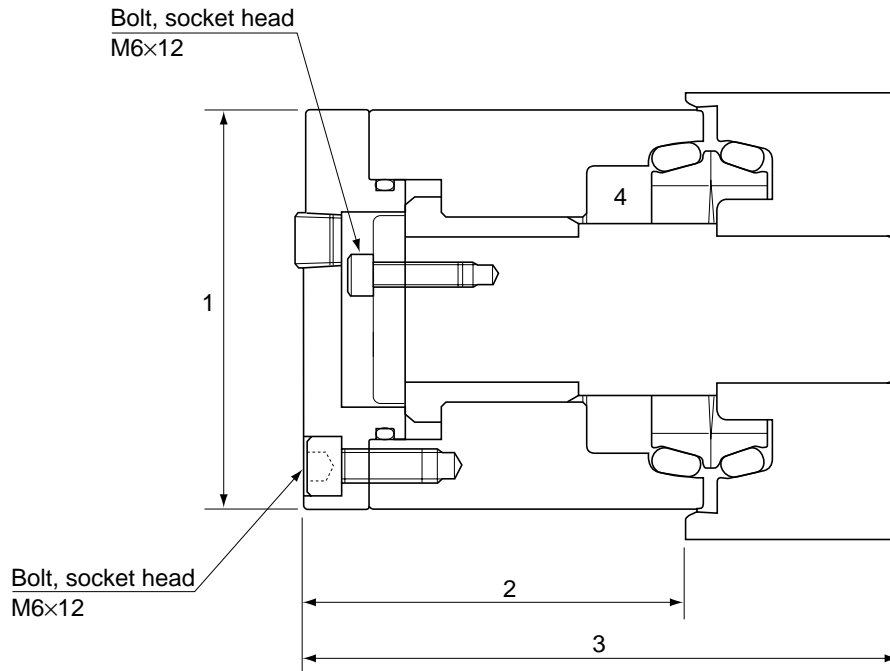
CONTENTS

21-1 Standard of maintenance

21-1-1 Carrier roller

21-1 Standard of maintenance

21-1-1 Carrier roller



No.	Item	Unit	Standard value	Allowance	Remarks
1	Outer diameter of projected part	mm	ø94	ø90	Pad or replace
2	Width of projected part	mm	117	115	Pad or replace
3	Overall width	mm	167	165	Pad or replace
4	Quantity of lubricating oil	cc	52	—	Gear oil or engine oil

22 ELECTRICAL EQUIPMENT

CONTENTS

22-1 Structure and function

22-1-1 Electric circuit diagram

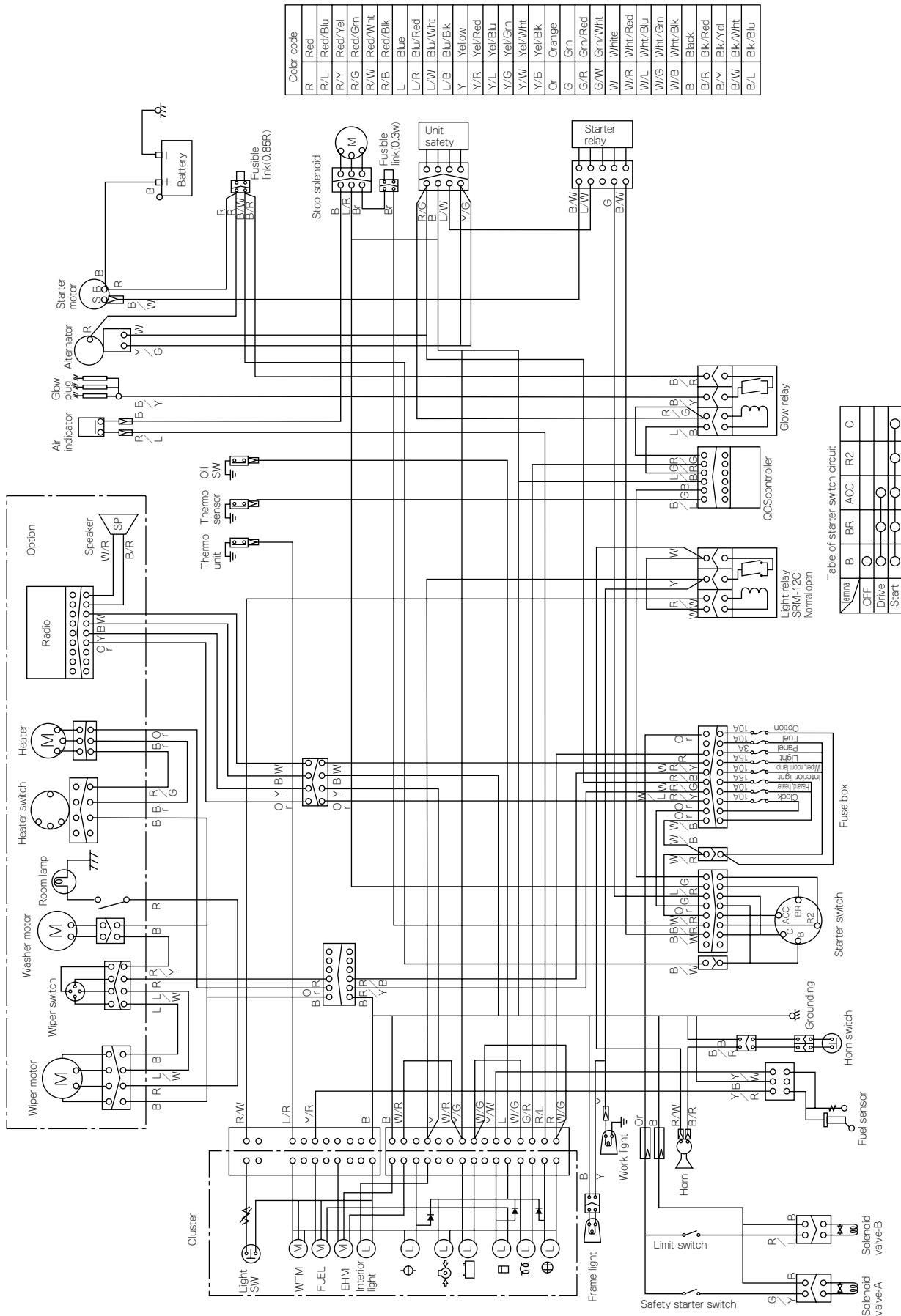
22-2 Failure and remedy

22-2-1 Starter system

22-2-2 Alter nator system

22-1 Structure and function

22-1-1 Electric circuit diagram



22-2 Failure and remedy

22-2-1 Starter system

Failure	Cause	Remedy
Pinion does not come out even when the starter switch is pressed.	<ul style="list-style-type: none"> - Disconnection of the wire harness, loose connection of the battery or switch terminal. - Spline which engaged with the pinion of armature shaft is caught and the pinion cannot move. - Malfunction of the plunger of magnetic switch, disconnection or the short-circuit of coil 	<p>Reconnect and tighten connections.</p> <p>Free the spline</p> <p>Correct or replace</p>
Starter does not rotate even when the pinion engages with the ring gear.	<ul style="list-style-type: none"> - Disconnection of the cable between the battery and the magnetic switch, loosening (bad earth) of the connecting wire between magnetic switch and motor terminals - Improper engagement of pinion and ring gear - Wrong installation - Brush is worn out or brush spring is touching. - Commutator is dirty. - Malfunction of armature or field coil - Loosening of field coil and brush - Loose connection of contractor - Contact surface of contractor is rough. 	<p>Reconnect cable, tighten connections (make good earth).</p> <p>Correct the engagement.</p> <p>Reinstall Replace or adjust.</p> <p>Clean commutator. Correct or replace</p> <p>Tighten coil and brush. Tighten connections. Correct or replace</p>
Starter rotates at its full speed before the pinion engages with the ring gear.	<ul style="list-style-type: none"> - Wrong adjustment of plunger gap (distance l) - Permanent set of pinion sleeve spring. 	<p>Adjust</p> <p>Replace</p>
Engine does not start even when the pinion engages with the ring gear and the starter rotates.	<ul style="list-style-type: none"> - Malfunction of overrun clutch 	<p>Replace</p>
Starter does not stop even when starter switch is turned off.	<ul style="list-style-type: none"> - Short-circuit inside switch - Contractor drops and is always connected. 	<p>Replace switch</p> <p>Replace</p>

22-2-2 Alternator system

Failure	Cause	Remedy
Cannot be charged.	<ul style="list-style-type: none"> - Cords between terminals are disconnected or connectors are in loose connection. - Improper earth connection - Brush and slip ring do not contact. - Coil is disconnected or burnt. - Diode is damaged. 	<p>Reconnect cord-tighten connections.</p> <p>Make good earth connections. Connect or replace Replace Replace</p>
Insufficient charge	<ul style="list-style-type: none"> - Loose connection of cords between each terminal - Fan belt slips. - Improper contact or insufficient movement of brush and slip ring - Short-circuit of coil - Defective diode 	<p>Tighten connections.</p> <p>Adjust. Clean slip ring and brush holder.</p> <p>Replace Replace</p>
Overcharge	<ul style="list-style-type: none"> - Defective alternator 	Replace
Noise	<ul style="list-style-type: none"> - Wrong installation - Defective fan belt - Defective bearing 	<p>Connect. Replace. Replace.</p>
Fuse melts.	<ul style="list-style-type: none"> - Diodes on (+) and (-) sides broke down. - Capacitor broke down. - Alternator internal short-circuited 	Replace.

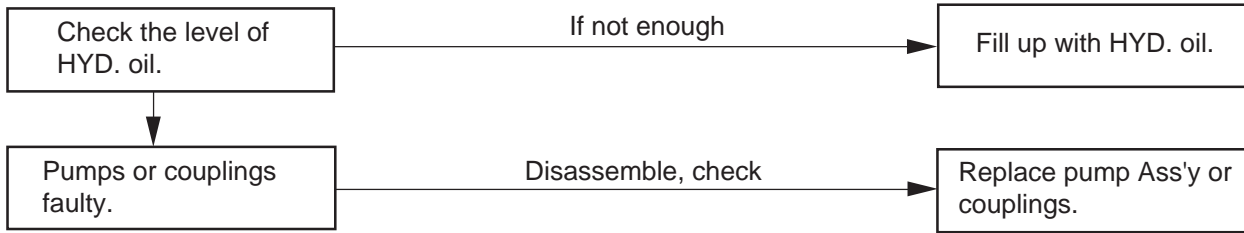
23 TROUBLESHOOT- ING

CONTENTS

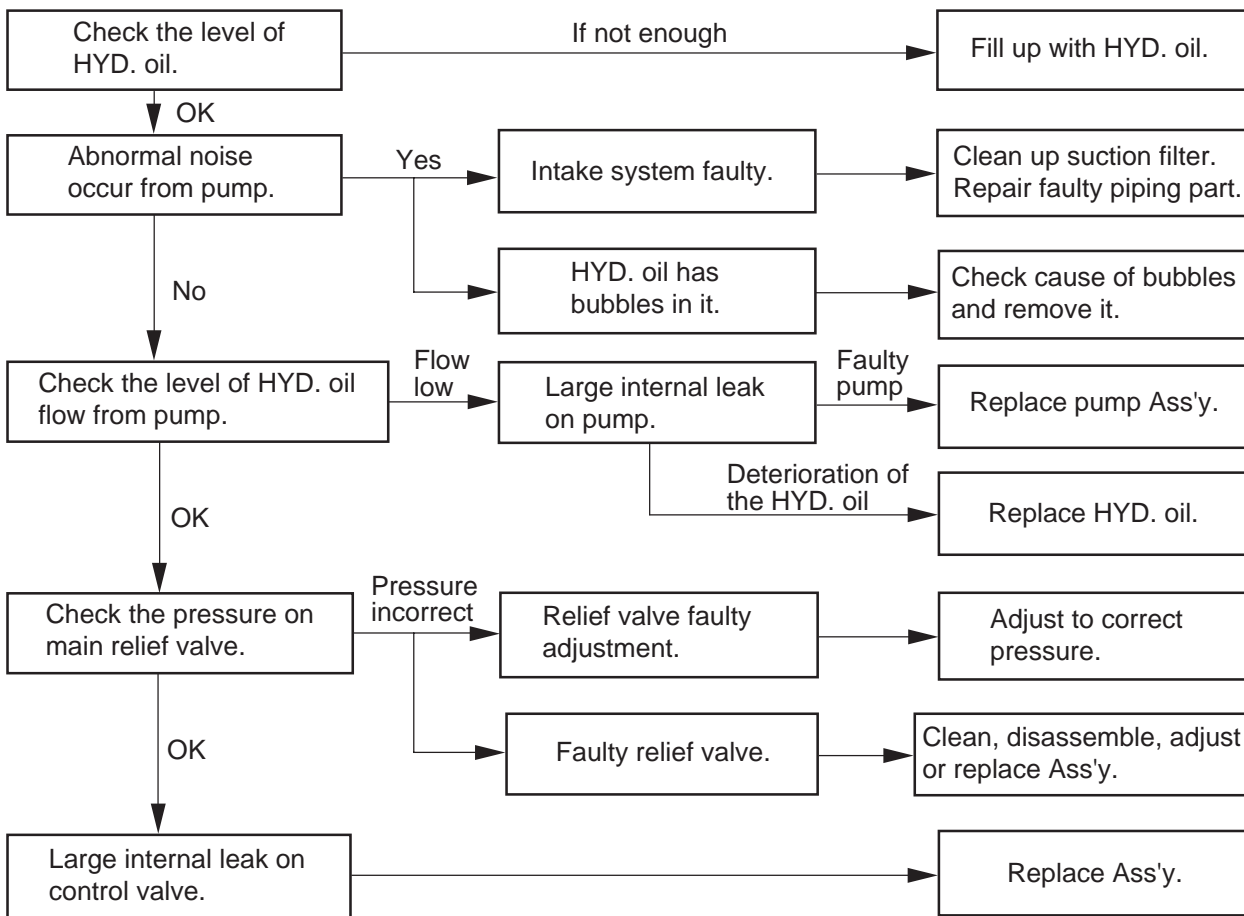
23-1 Troubleshooting

23-1 Troubleshooting

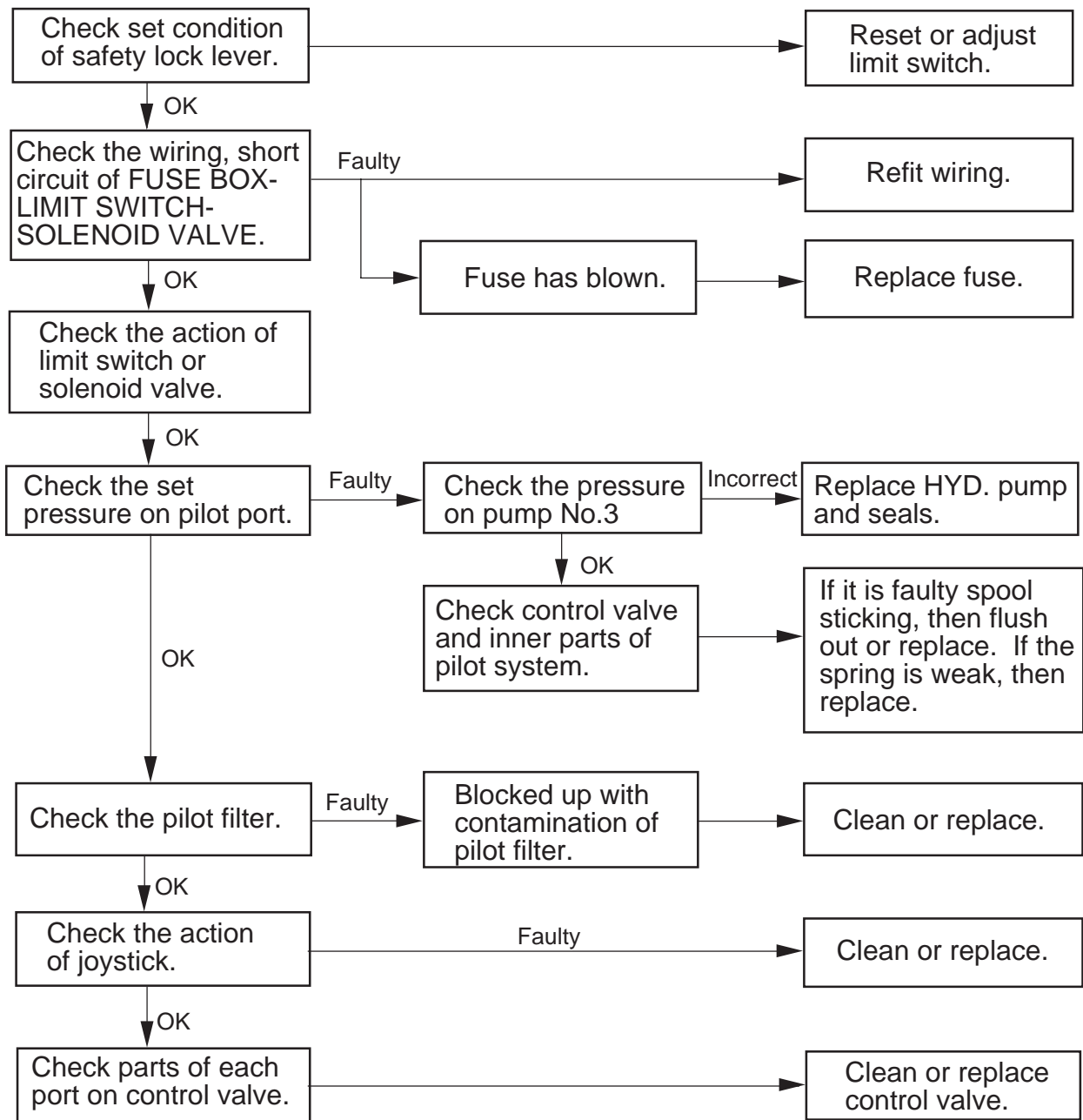
23-1-1 All functions not operational



23-1-2 Operation power is weak

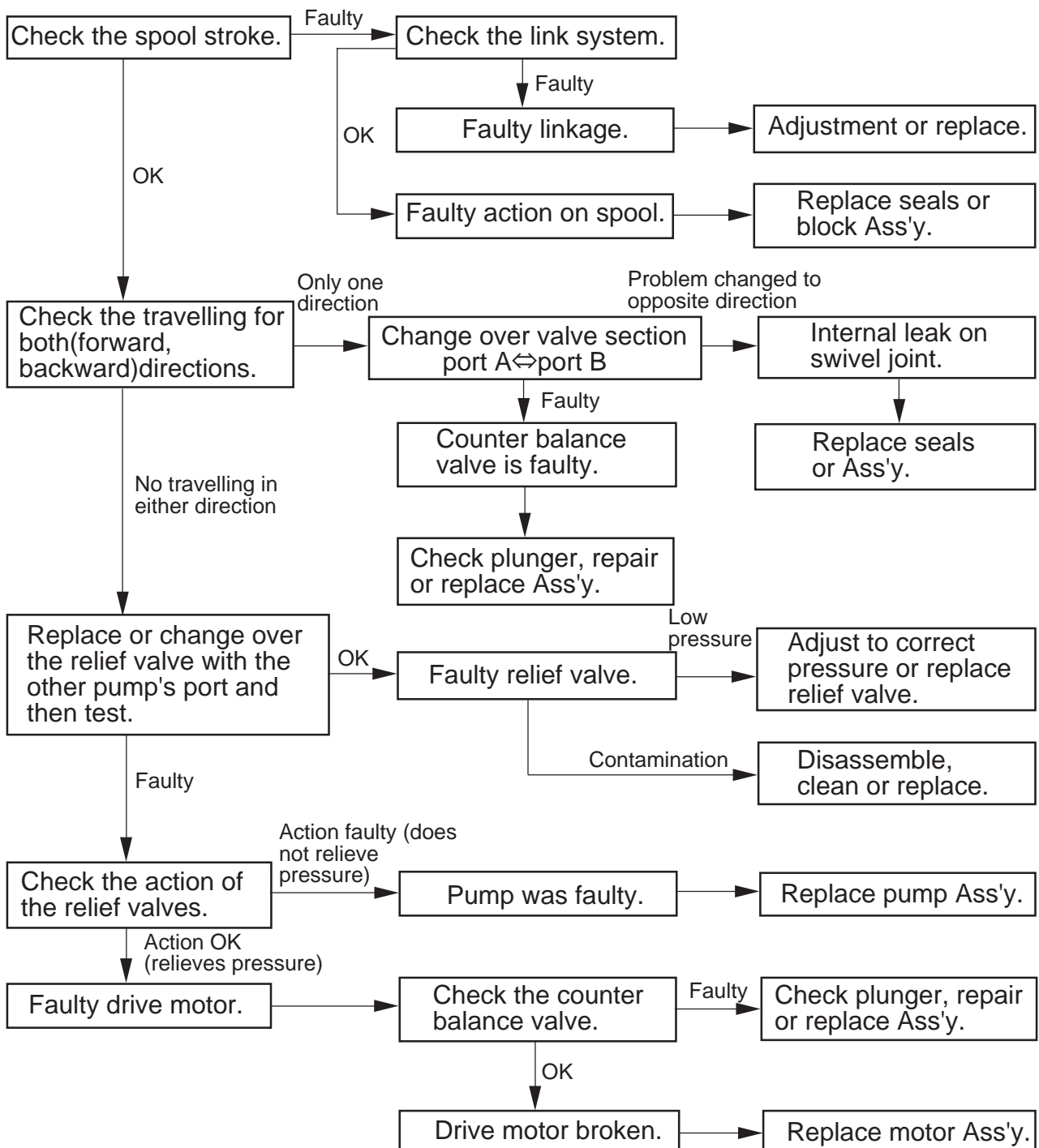


23-1-3 No operation on boom, arm, bucket & slewing

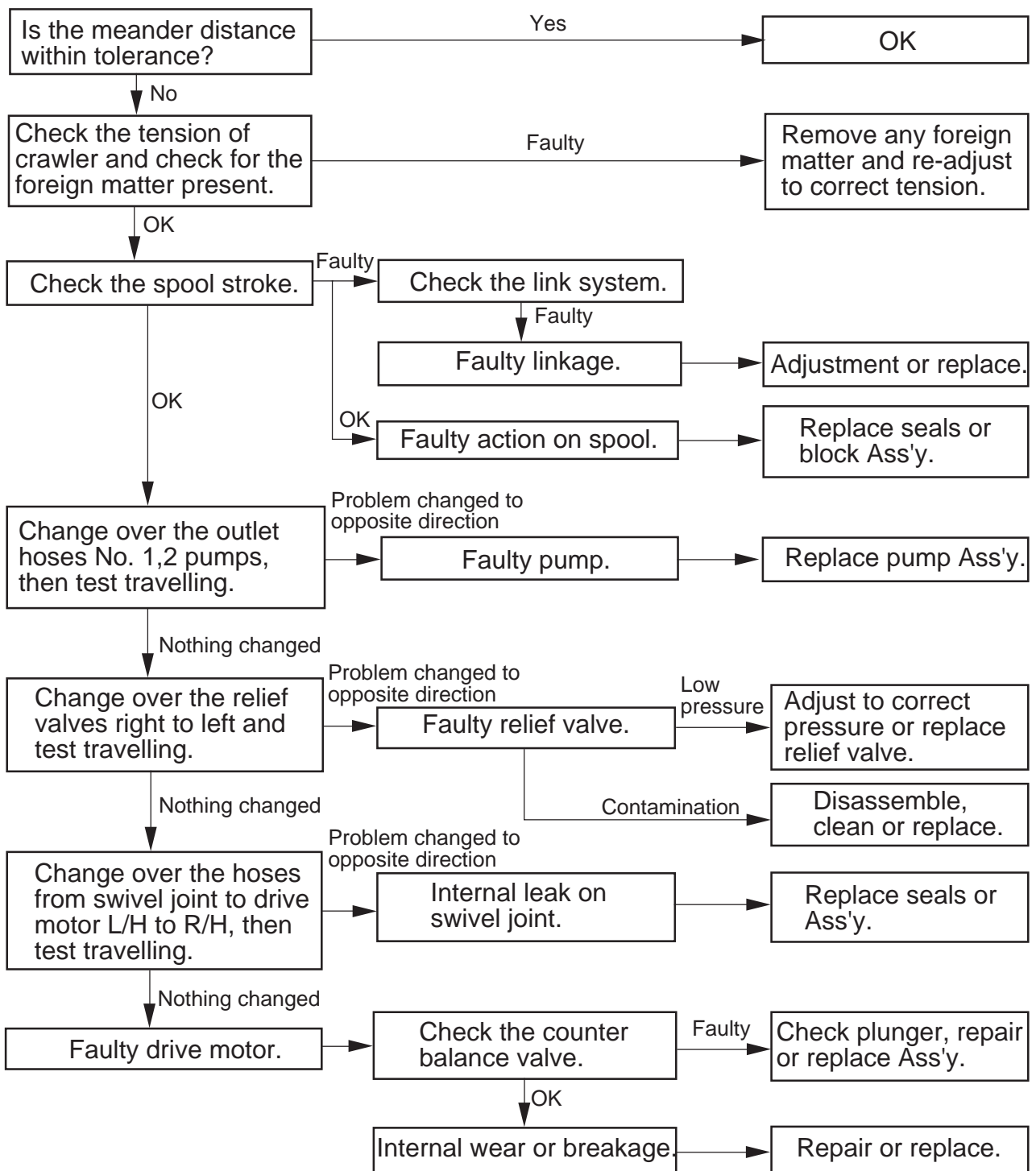


23-2 Travelling system

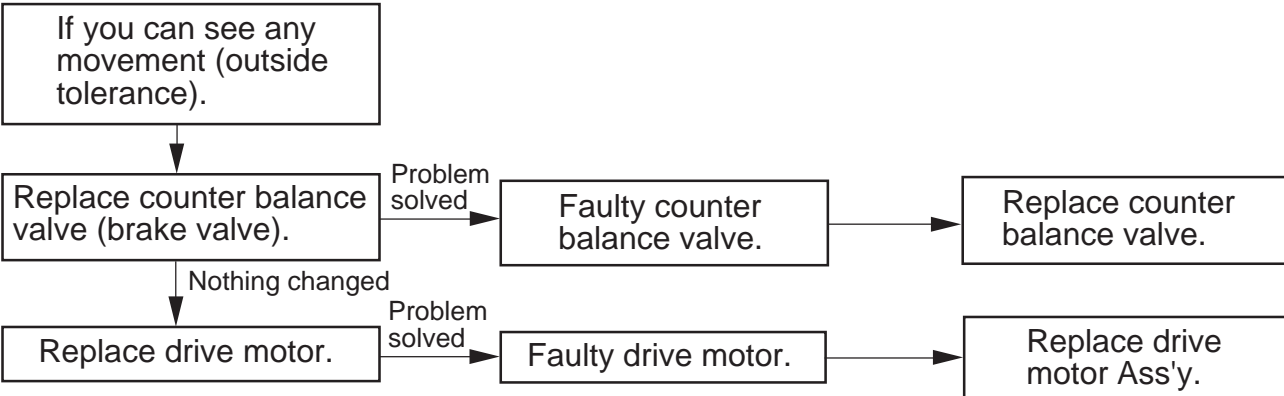
23-2-1 Right (or left) hand side of crawler does not work correctly



23-2-2 Travelling meander by slow speed on only right (left) hand side.

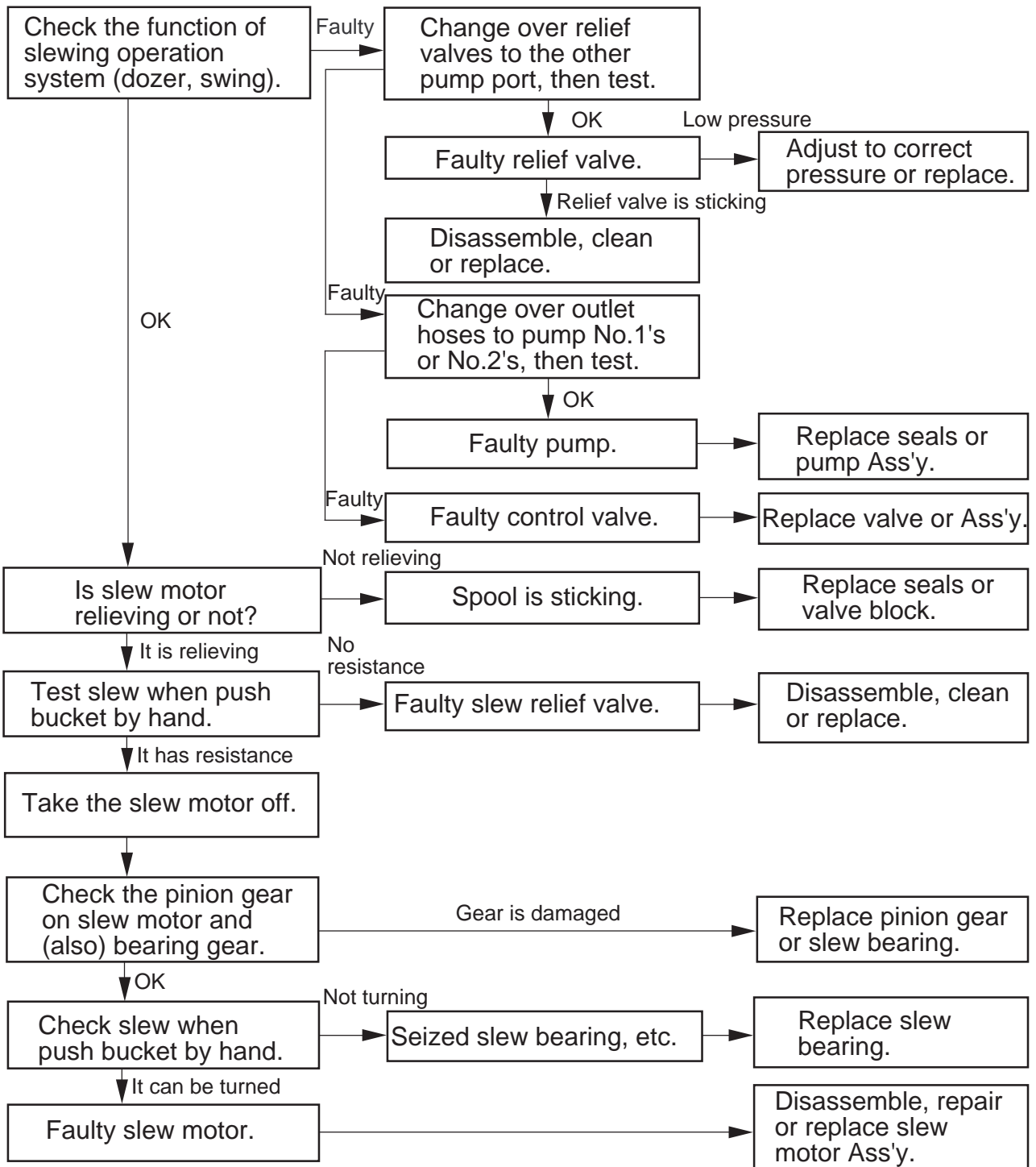


23-2-3 Machine fails to hold on incline

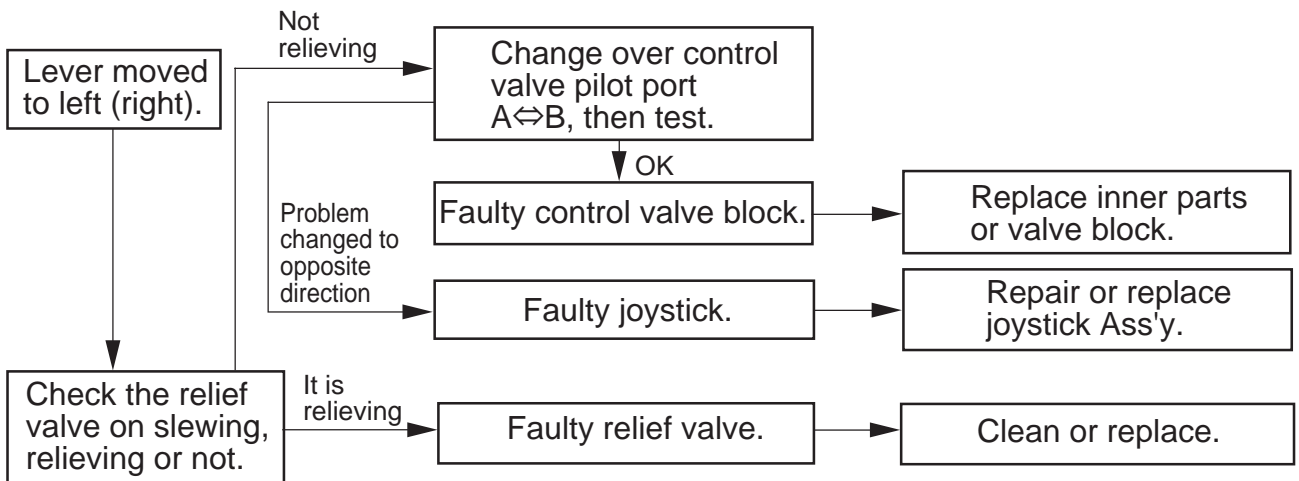


23-3 Slewing system

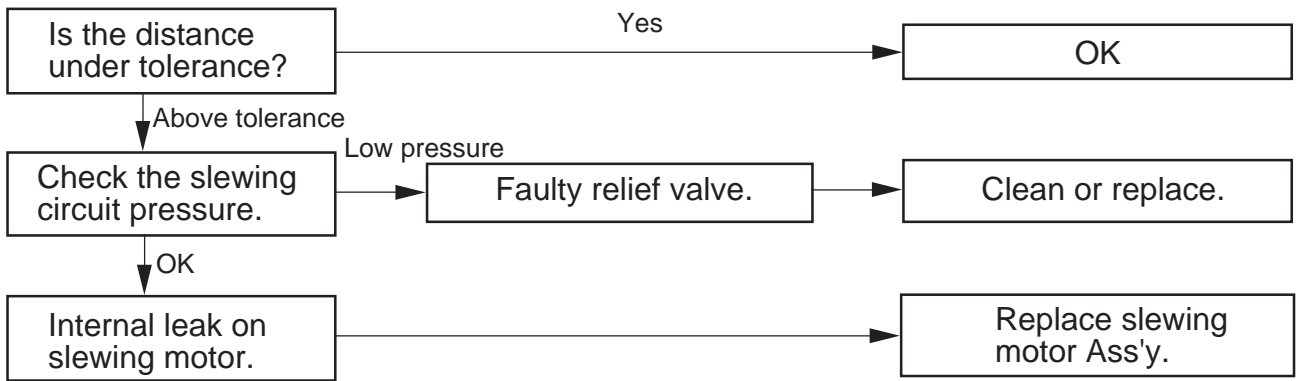
23-3-1 No operation both (right/left) slewing.



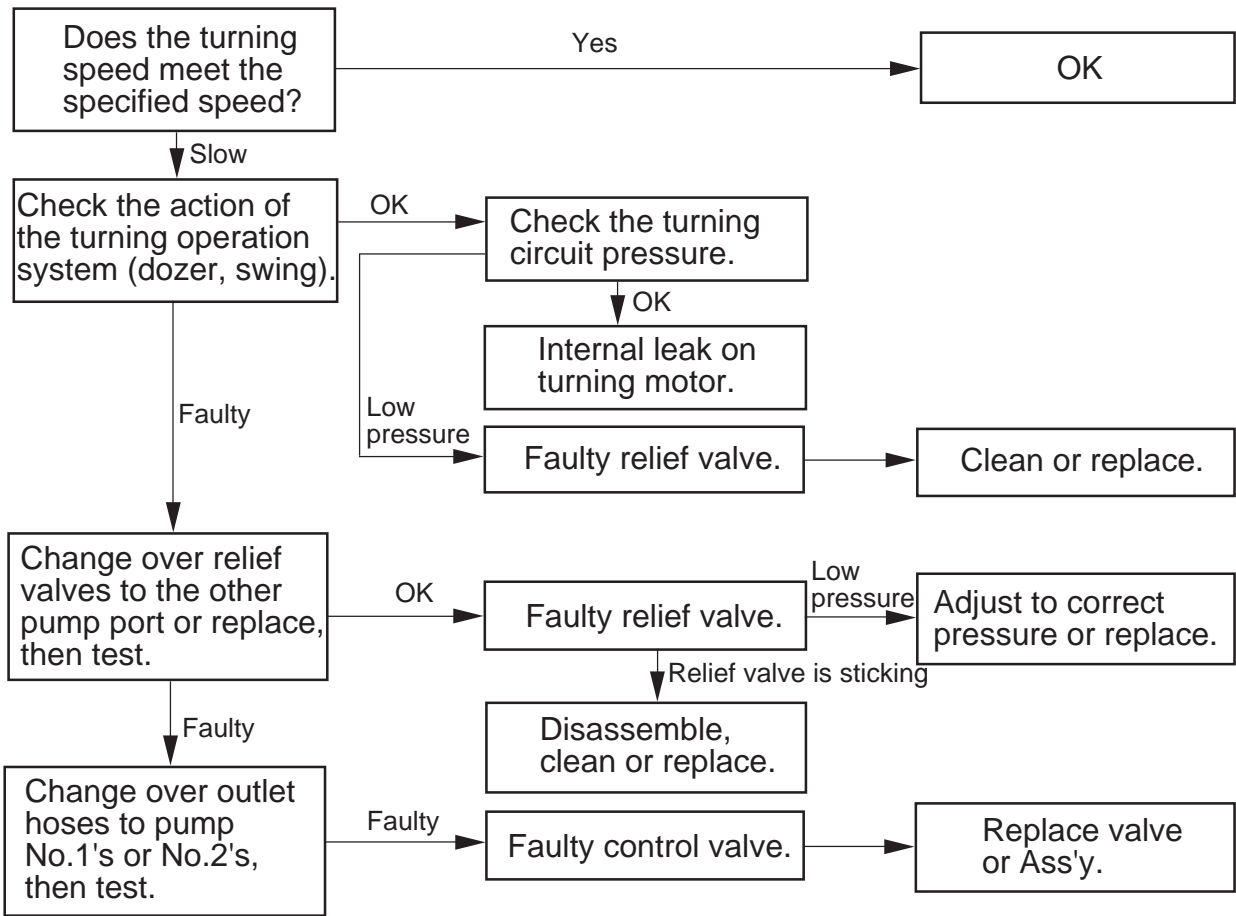
23-3-2 It is possible to turn right (left) but not left (right)



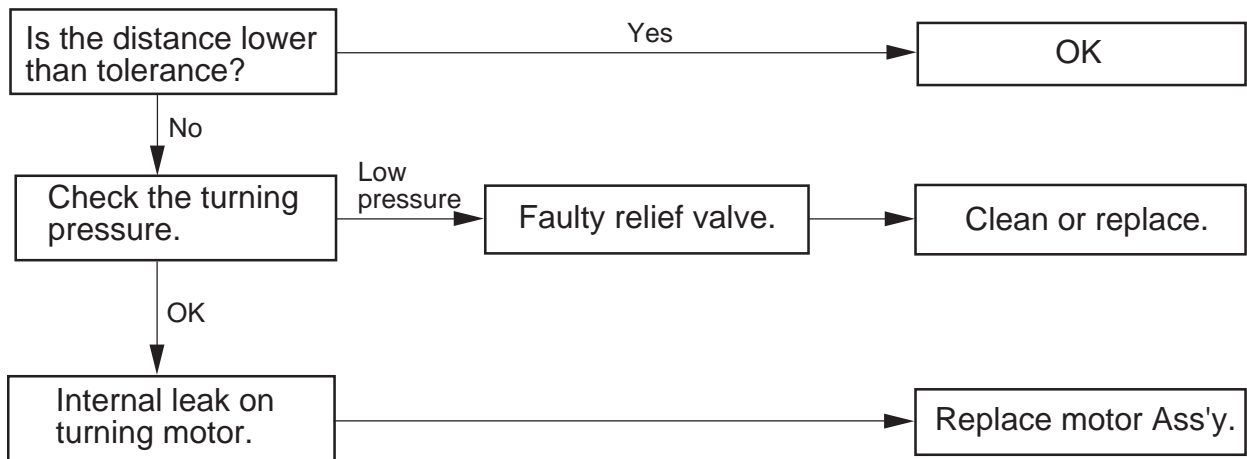
23-3-3 Slewing acceleration slow, the overturn is higher than tolerance



23-3-4 Extreme slow turning speed

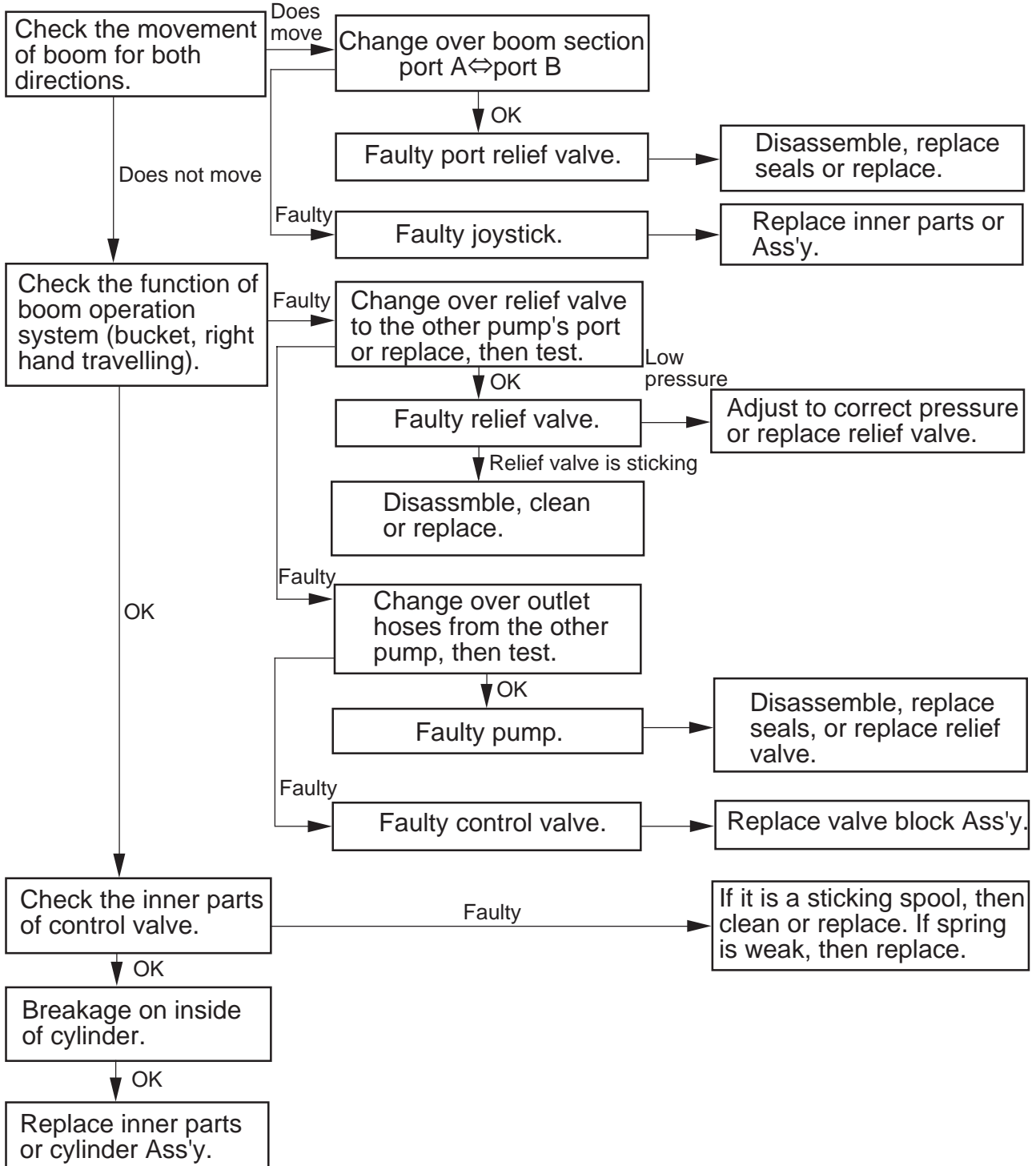


23-3-5 Turning movement when the machine is parked on a slope

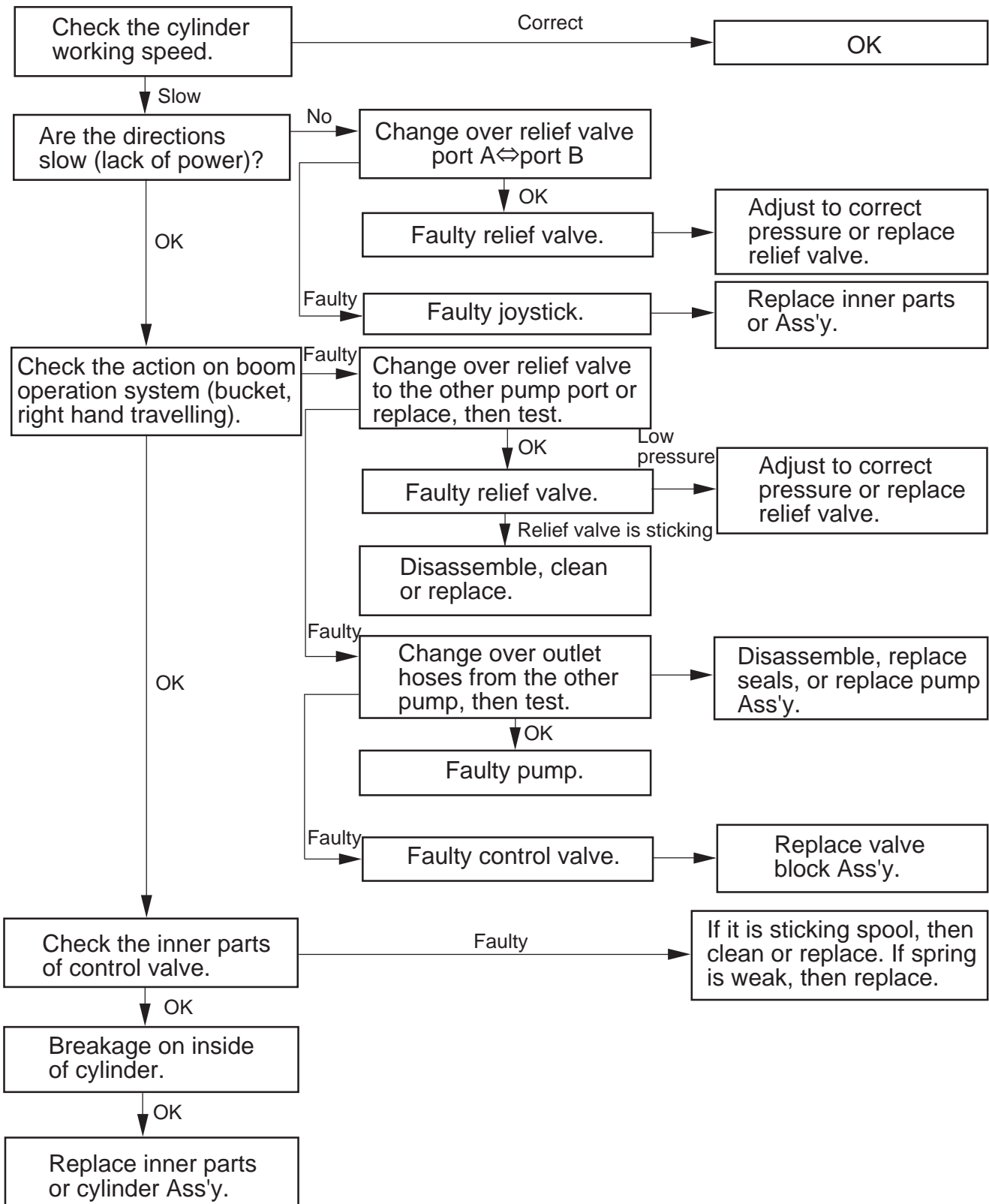


23-4 Boom system(for arm and bucket cylinders the same method as follows)

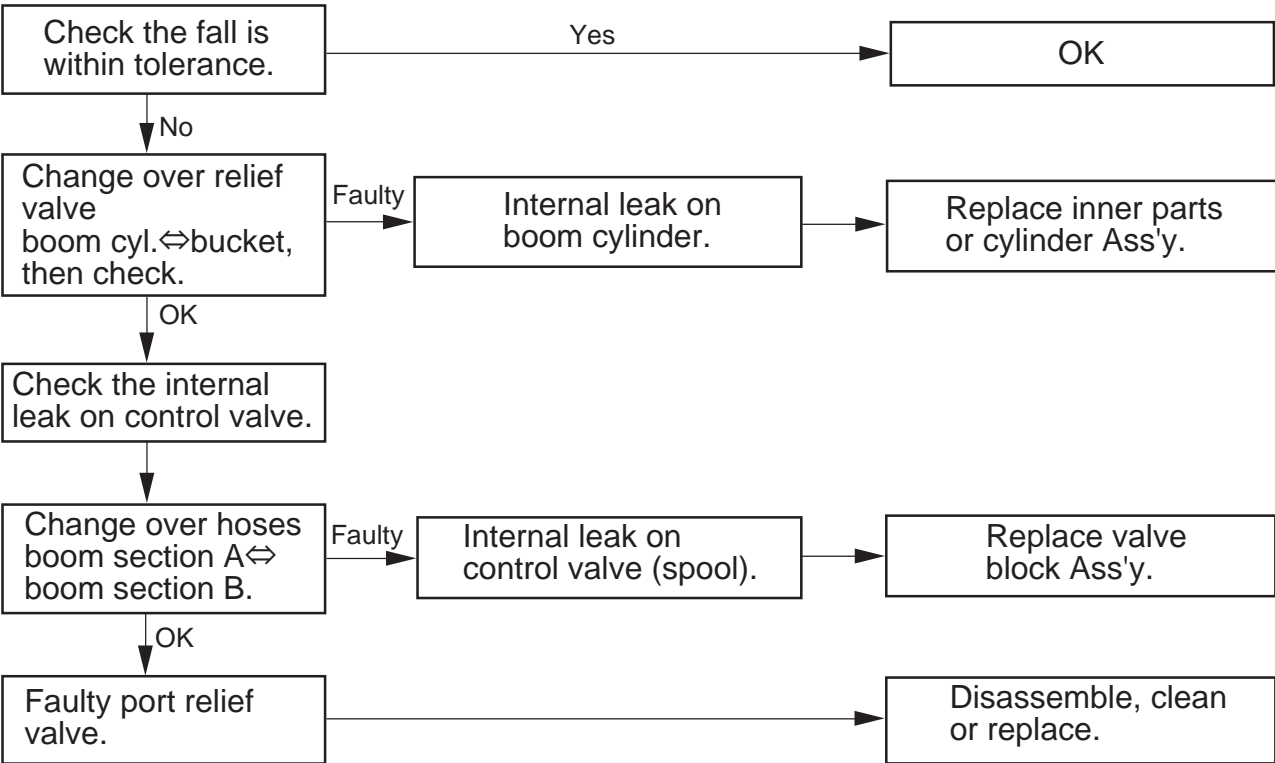
23-4-1 No movement on boom cylinder



23-4-2 Slow action or lack of power on boom cylinder

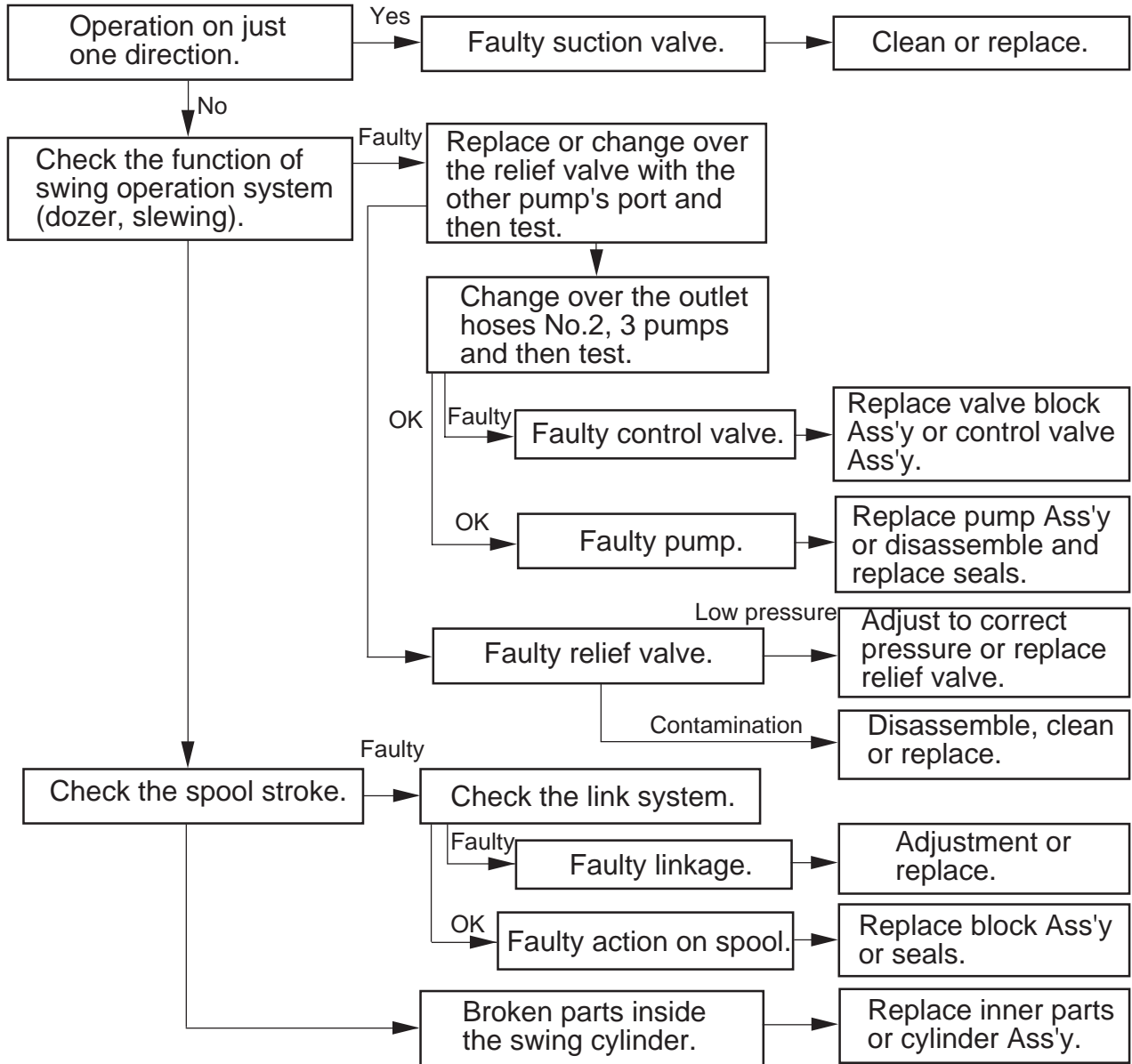


23-4-3 Natural fall of boom



23-5 Swing system

23-5-1 No movement on swing system



23-5-2 Drifting swing cylinder

