

SERVICE MANUAL

Robex 16-7

SER. NO. HY1670001~

 **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:

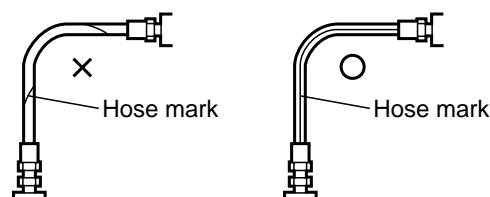
Electrical equipment, rubbers and V belts (which are easily affected by water and oil) must be handled carefully in order to prevent soiling them.

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.

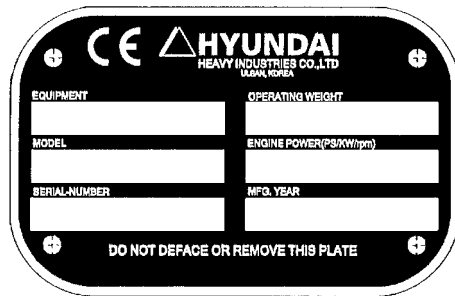
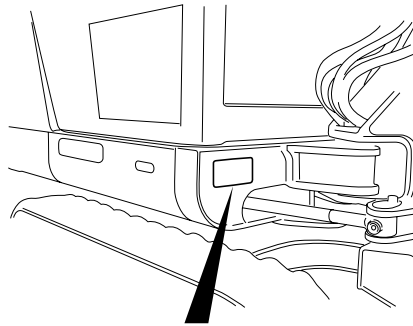


2 OUTLINE

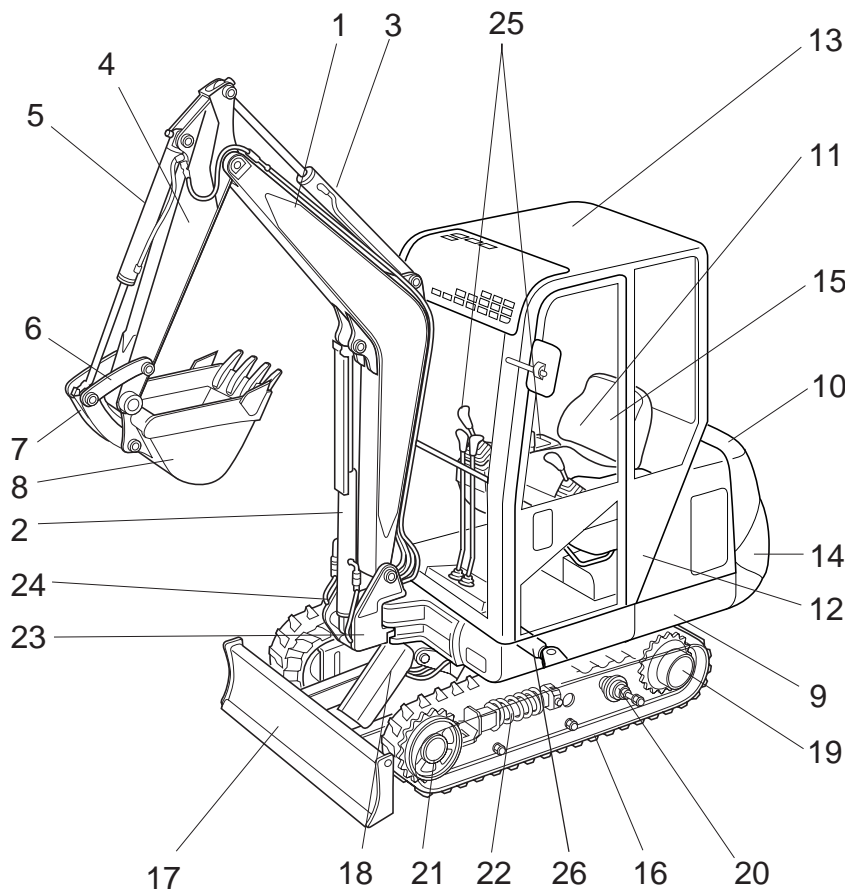
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- 2-7 When to repair
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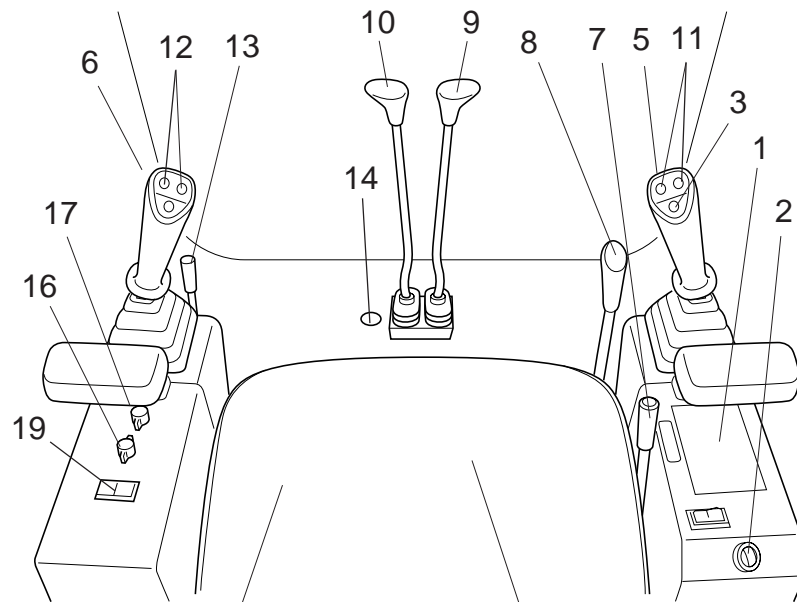
2-1 Location of Serial Number



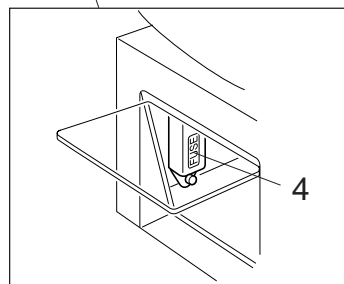
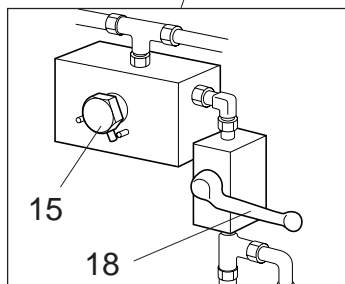
2-2 Name of each part



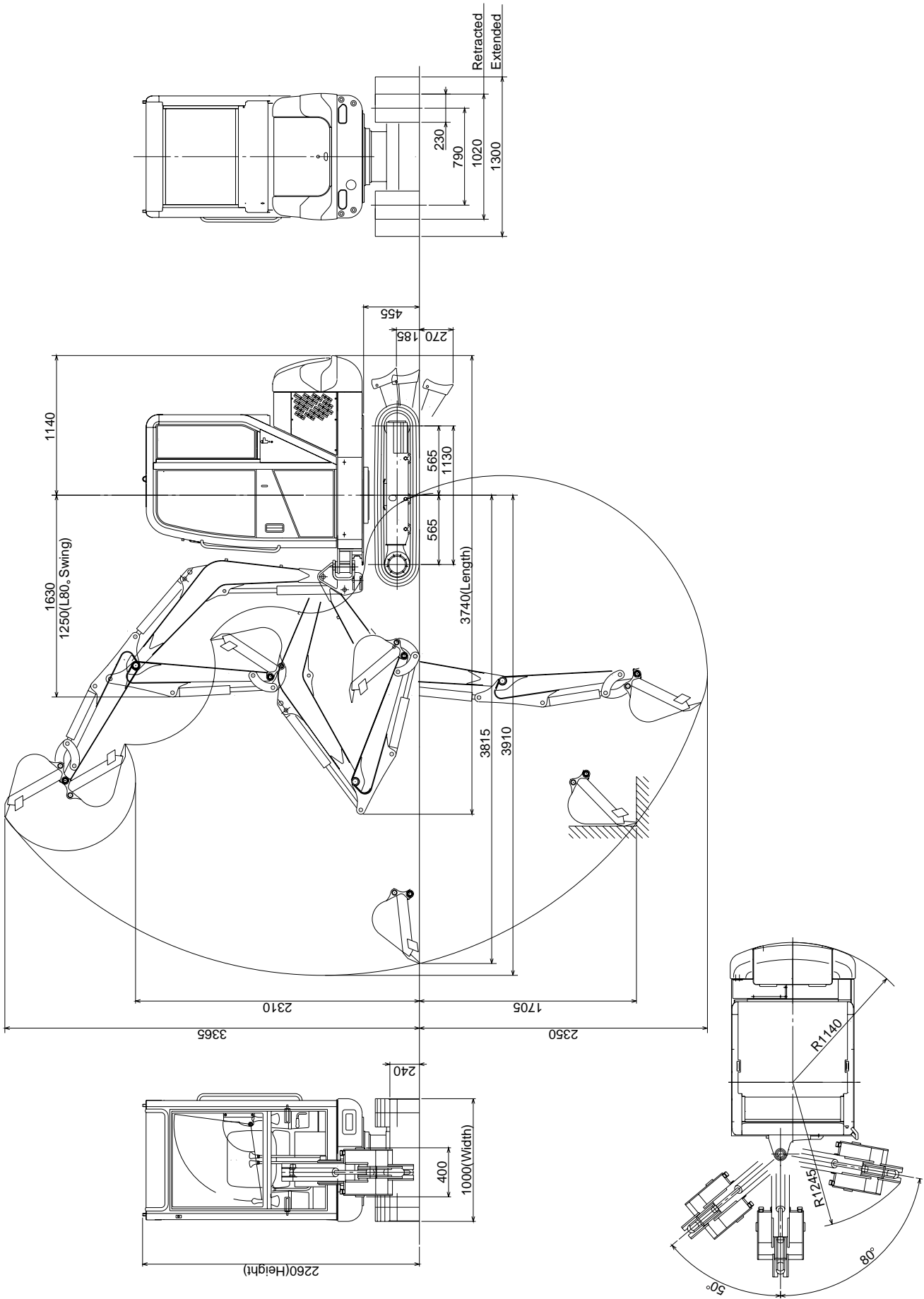
1. Boom
2. Boom cylinder
3. Arm cylinder
4. Arm
5. Bucket cylinder
6. Bucket links
7. Dump link
8. Bucket
9. Swing frame
10. Engine cover
11. Fuel tank
12. Hydraulic tank
13. Roof
14. Counter weight
15. Operator's seat
16. Crawler
17. Dozer blade
18. Dozer cylinder
19. Travel motor
20. Track roller
21.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



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 operation lever
9. Right travelling lever
10. Left travelling lever
11. Swing operation switch
12. P.T.O. operation switch
13. Safety lock lever
14. Swing lock pin
15. P.T.O. select lever
16. Heater switch(for Cabin)
17. Wiper switch(for Cabin)
18. Manual boom lowering lever
19. Extend switch



2-3 Dimensions and Specifications



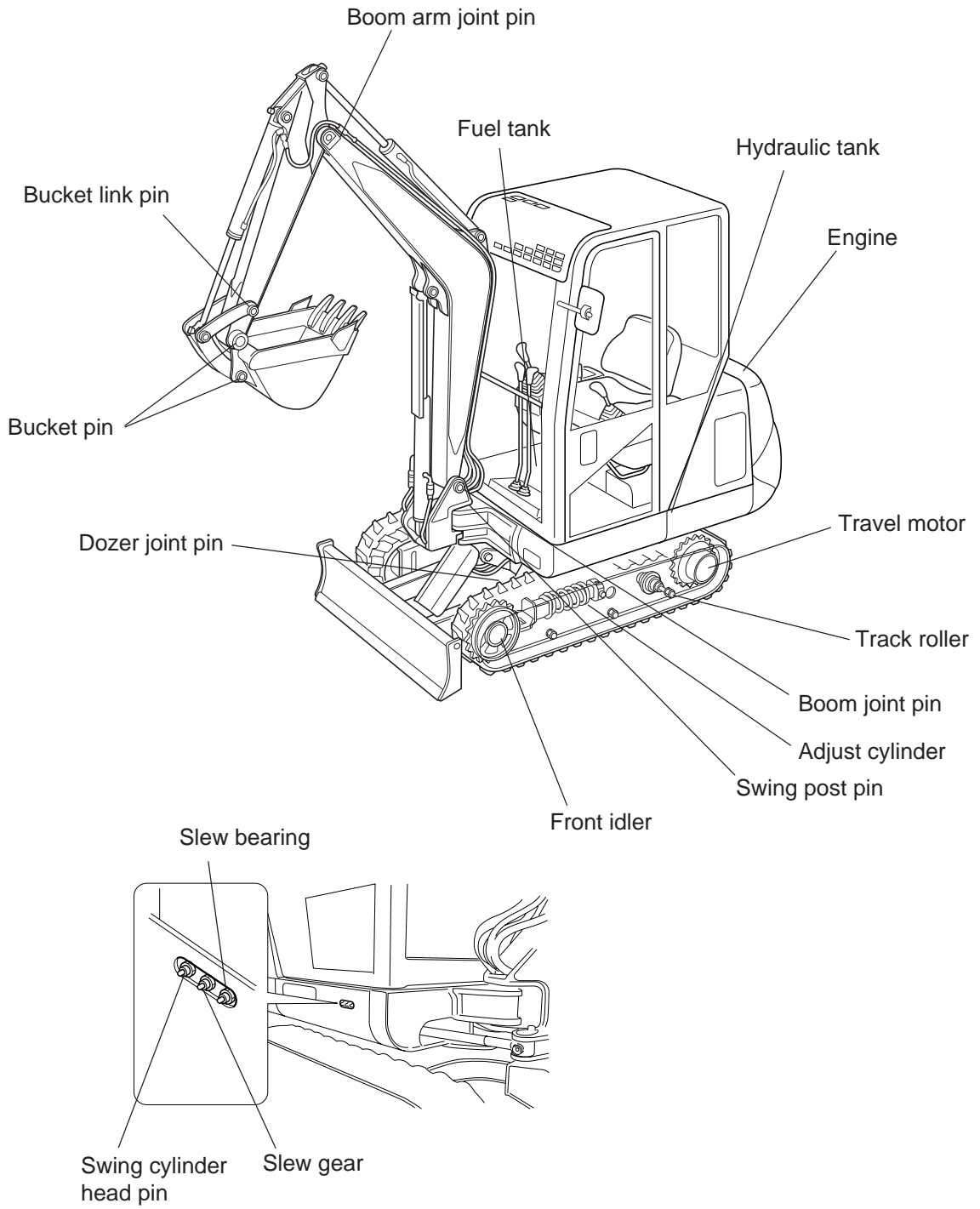
Model		Robex16-7	
Machine weight	Canopy rubber		1,520
	Canopy steel		1,570
	Cabin rubber		1,630
	Cabin steel		1,680
Standard bucket capacity/width		m ³ /mm	0.04 / 400
Engine	Type		MITSUBISHI L3E
	Displacement		cc
	Rated output		kW(PS) / min ⁻¹
Dimensions	Overall length		mm
	Overall width		mm
	Overall height		mm
Working range	Max.digging depth		mm
	Max.vertical digging depth		mm
	Max.digging height		mm
	Max.dumping height		mm
	Max.digging radius		mm
	Reach at ground		mm
	Min. turning radius	front	mm
		swing	mm
	Rear turning radius		mm
Boom swing angle L/R		deg	
Performance	Max.digging force(Bucket)		kN
	Max.digging force(Arm)		kN
	Max.drawbar pull		kN
	Travel speed(low) / (high)		km / h
	Slew speed		min ⁻¹
	Gradeability		Angle
Hydraulic system	Pump	Type	Gear×3
		Oil flow	ℓ / min
	P.T.O	Oil flow	ℓ / min
	Main relief pressure		MPa
Underbody	Dozer blade width×height		mm
	Shoe width×tumbler center		mm
	Ground pressure	Roof rubber	kPa
		Cabin rubber	kPa
	Type of travelling motor		Piston
	Crawler tension system		Grease cylinder
Capacity	Hyd.oil capacity		ℓ
	Fuel capacity		ℓ
	Engine oil capacity		ℓ
	Cooling water capacity		ℓ
Noise level LwA/LpA		dB	93 / 84

2-4 Weight list

Unit: kg

Part name		Part name	
Boom	58	Slew bearing	17.7
Arm	24.5	Equalizer	56.1
Bucket	32.3	Track frame(R)	50
Dump link	3.6	Track frame(L)	46.7
Bucket link(R)	1.6	Dozer	36.5
Bucket link(L)	1.9	Crawler(steel)	74×2
Boom joint pin	1.8	Crawler(rubber)	51×2
Arm joint pin	1.9	Idler	8×2
Bucket pin	0.8×2	Adjust cylinder	10.6×2
Swing post	24.5	Track roller	2.9×6
Swing post pin	3.2	Sprocket	4×2
Swing frame	162	Slew motor	23
Hydraulic oil tank	29	Turning motor	14×2
Fuel tank	16	Joystick	3.5×2
Engine cover(A)	17.6	Console box	9.6×2
Engine cover(B)	2.7	Engine	94
Counter weight	83	Radiator	6.9
Operator cabin	200	Battery	12.5
Boom cylinder	12.5	Seat plate	12
Arm cylinder	12	Swivel joint	8
Bucket cylinder	12	Pump	5.4
Swing cylinder	12.5	Control valve	24
Dozer cylinder	8.5	TOPS ROOF	85
Extend cylinder	11	Cabin	200

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	5.6 ℓ	Soft water (antifreeze is mixed in water)	
Fuel tank (effective capacity)	20 ℓ	Diesel fuel with freezing point below -7°C	
Engine lubricating oil	3.5 ℓ	SAE10W-30	
Travel motor (reduction gear)	0.25 ℓ	SAE 30	
Hydraulic tank	24 ℓ	ISO VG 46	
Track roller (1 piece)	22cm ³	SAE 30	
Front idler (1 piece)	40cm ³	SAE 30	

Genuine oil

Be sure to use Castrol Hyspin 46.

Table of recommended Lubricants

No.	LUBRICANT	SHELL	MOBIL
1	Engine Oil	Myrina oil 10W-30	Delvac Super10W-30
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	—	—

*Use class CD engine oil (API Service Classification)

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	-30°C
Injection rate	1.1 ℓ	1.4 ℓ	1.7 ℓ	2.0 ℓ	2.4 ℓ	2.8 ℓ

Engine inside capacity	Radiator capacity	Reserve tank capacity	Total
1.7 ℓ	3.5 ℓ	0.4 ℓ	5.6 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					

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	10 to 12 mm 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.

Tightening torque of bolts and nuts (main machine)

Material Size	8.8	10.9	12.9
M6	12.5 N-m	16 N-m	20 N-m
M8	30 N-m	39 N-m	45 N-m
M10	62 N-m	72 N-m	80 N-m
M12	100 N-m	120 N-m	130 N-m
M14	160 N-m	195 N-m	228 N-m
M16	250 N-m	305 N-m	340 N-m

Tightening torque for hose fitting

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

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
$1\frac{1}{4}$	400

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 2-6

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)

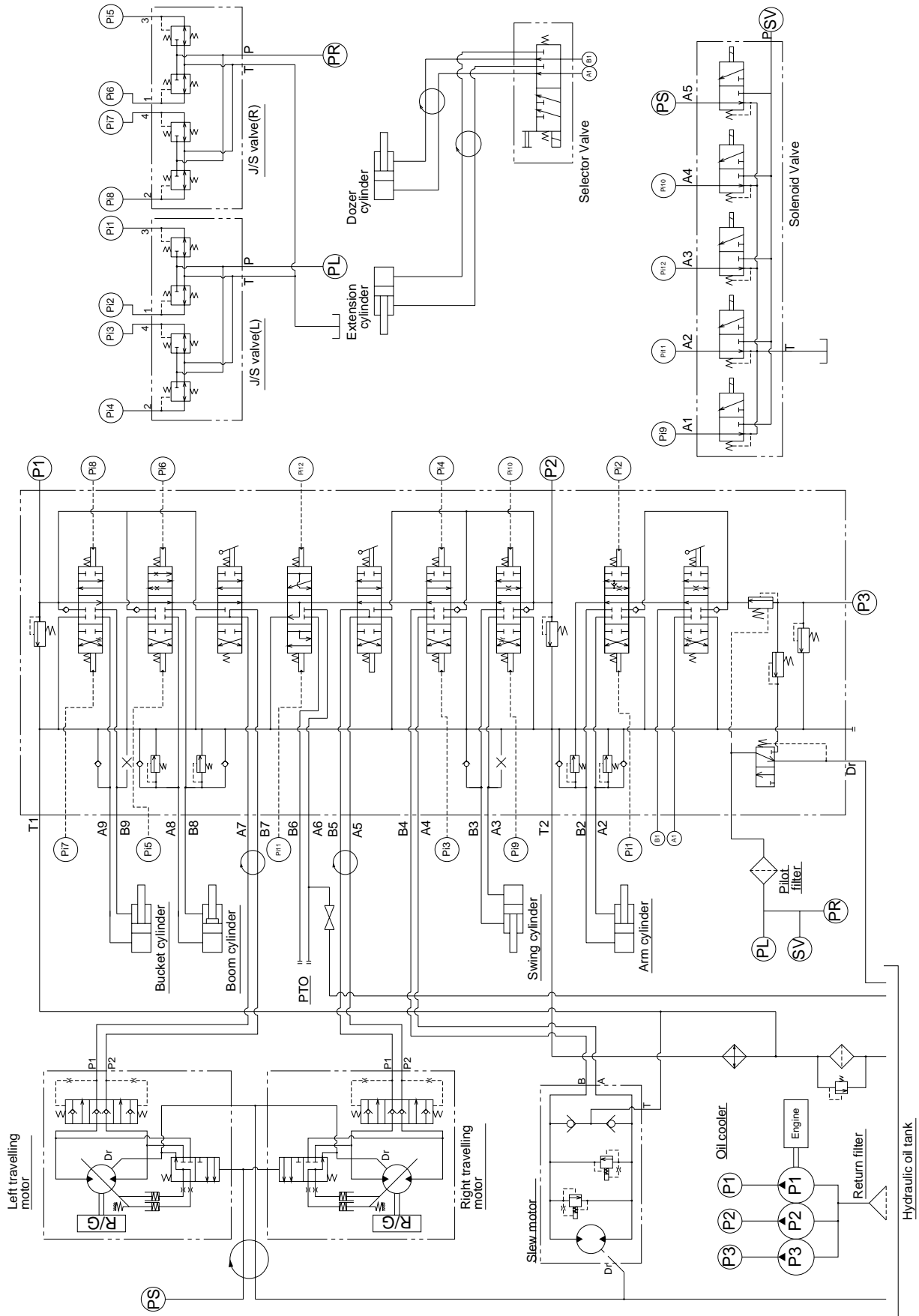
2-7-9 Maintenance every 2,000 service hours

	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	Travel motor	Gear oil 85W	250 cm ³	Every 1,000 service hours (At first, replace after the first 500 service hours)
2	Track roller		22 cm ³	Every 2,000 hours
3	Front idler		40 cm ³	Every 2,000 hours

2-8 Hydraulic circuit diagram



Item	
Boom cylinder	ø60×ø35×360st
Arm cylinder	ø60×ø35×396st
Bucket cylinder	ø60×ø35×300st
Swing cylinder	ø60×ø30×339st
Dozer cylinder	ø60×ø30×100st
Extend cylinder	ø55×ø30×340st
Slew motor	2-160 DOS-E3754
Travel motor	MAG-12V-110E

	Item		
Pump capacity	P1	6.5cm ³ /rev	
	P2	6.5cm ³ /rev	
	P3	6.5cm ³ /rev	
Pressure	Main relief	P1	18.6 MPa
		P2	18.6 MPa
		P3	18.6 MPa
	Port relief		20.6 MPa
	Slew		9.32 MPa
Pump flow rate	Q1	15.7 ℓ /min.	
	Q2	15.7 ℓ /min.	
	Q3	15.7 ℓ /min.	
Engine	Type	L3E-W231NSA	
	Constant output	12.5kW(17ps)	
	Speed	2,400min ⁻¹	
	Torque	55 N-m/1,600min ⁻¹	

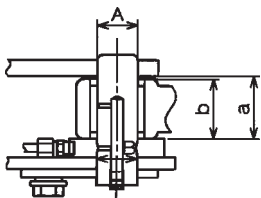
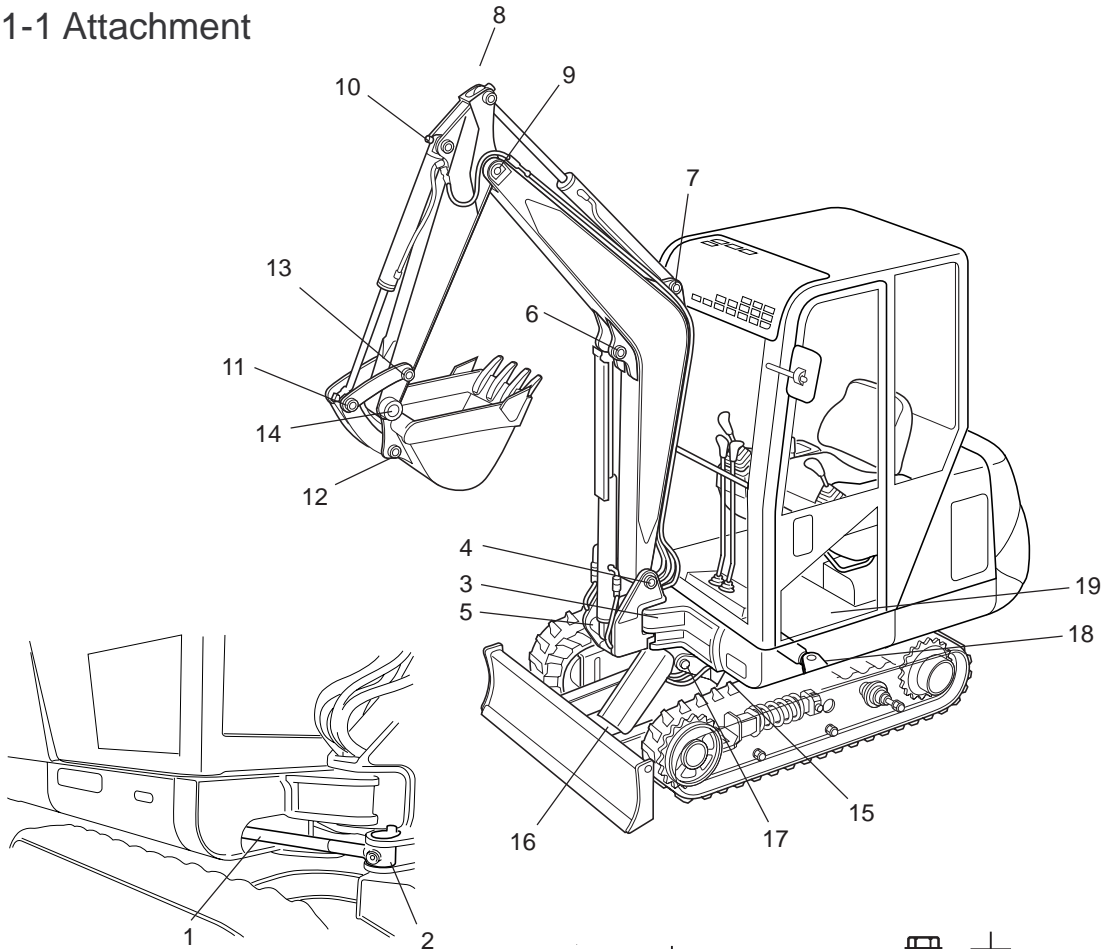
3 ATTACHMENT

CONTENTS

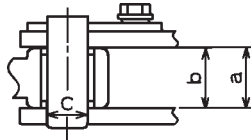
- 3-1 Standard of maintenance
 - 3-1-1 Attachment
- 3-2 Inspection and adjustment
 - 3-2-1 Measuring the fall of the attachment of its own weight
 - 3-2-2 Measuring the speed of the attachment cylinder

3-1 Standard of maintenance

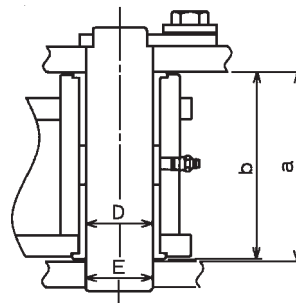
3-1-1 Attachment



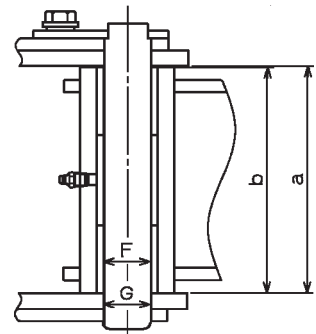
1. Swing cylinder head



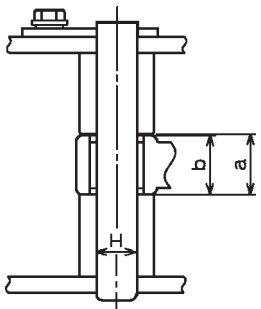
2. Swing cylinder rod



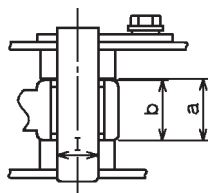
3. Swing post bracket and swing post



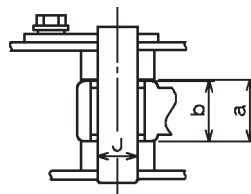
4. Boom joint



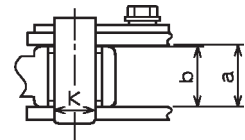
5. Boom cylinder head



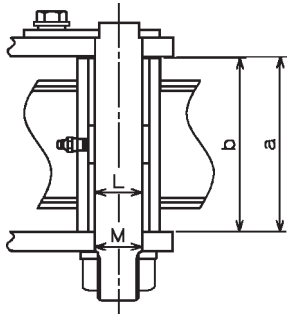
6. Boom cylinder rod



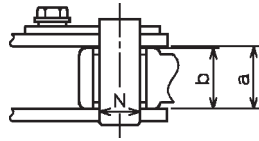
7. Arm cylinder head



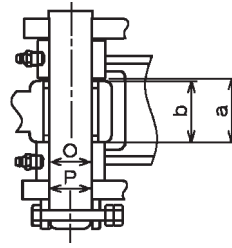
8. Arm cylinder rod



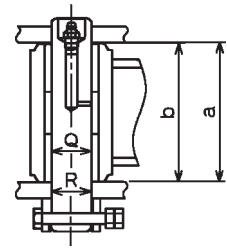
9. Boom/arm joint



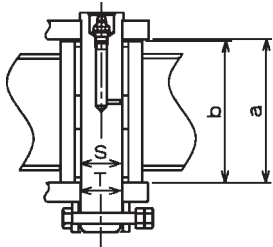
10. Bucket cylinder head



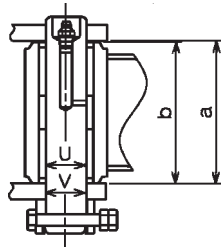
11. Bucket cylinder rod



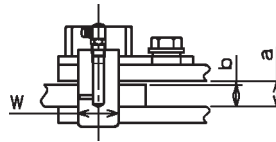
12. Bucket/dump link joint



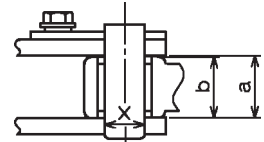
13. Arm/bucket link joint



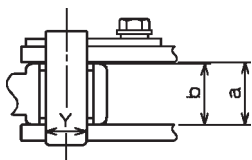
14. Arm/bucket joint



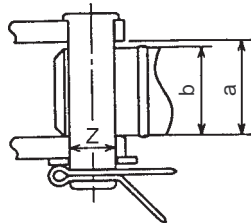
15. Dozer joint



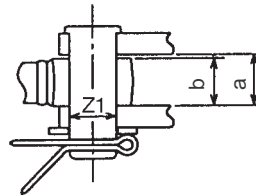
16. Dozer cylinder head



17. Dozer cylinder rod



18. Extend cylinder head



19. Extend cylinder rod

Unit: mm

No.	Item	Basic Dimension	Allowable Clearance
A	Swing cylinder head pin and head bracket	ø30	1.0
B	Swing cylinder head pin and the boss of head bracket	ø30	1.0
C	Swing cylinder rod pin and swing post	ø30	1.0
D	Swing post pin and bush	ø50	1.0
E	Swing post pin and swing post bracket	ø50	1.0
F	Boom joint pin and bush	ø35	1.0
G	Boom joint pin and swing post	ø35	1.0
H	Boom cylinder head pin and swing post	ø30	1.0
I	Boom cylinder rod pin and boom	ø30	1.0
J	Arm cylinder head pin and boom	ø30	1.0
K	Arm cylinder rod pin and arm	ø30	1.0
L	Boom/ arm joint pin and bush	ø35	1.0
M	Boom/ arm joint pin and boom	ø35	1.0
N	Bucket cylinder head pin and arm	ø30	1.0
O	Bucket cylinder rod pin and dump link	ø30	1.0
P	Bucket cylinder rod pin and bucket link	ø30	1.0
Q,U	Bucket pin and bush	ø30	1.0
R,V	Bucket pin and bucket	ø30	1.0
S	Bucket link pin and bush	ø30	1.0
T	Bucket link pin and bucket link	ø30	1.0
W	Dozer joint pin and frame	ø30	1.0
X	Dozer cylinder head pin and dozer	ø30	1.0
Y	Dozer cylinder rod pin and frame	ø30	1.0
Z	Extend cylinder head pin and frame	ø34.8	1.0
Z1	Extend cylinder rod pin and frame	ø34.8	1.0

Unit: mm

No.	Item	Criterion			Spacer	
		a	b	Standard clearance	Part Number	Dimension
1	Clearance between swing cylinder head and swing post	47	45	2.0~3.5	NOS3-00005 NOS3-00006	ø31.5×t0.5 ø31.5×t1.0
2	Clearance between swing cylinder rod and head bracket	46	45	1.0~2.5	//	//
3	Clearance between swing post and frame	140	138	2.0~3.3	MBU3-00026 MBU3-00027	ø51×t0.5 ø51×t1.0
4	Clearance between boom and swing post	168	167	0.7~1.3	MBU3-00020 MBU3-00021	ø36×t0.5 ø36×t1.0
5	Clearance between boom cylinder head and swing post	46	45	1.0~2.5	NOS3-00005 NOS3-00006	ø31.5×t0.5 ø31.5×t1.0
6	Clearance between boom cylinder rod and boom	46	45	0.5~2.0	//	//
7	Clearance between arm cylinder head and boom	46	45	0.5~2.0	//	//
8	Clearance between arm cylinder rod and arm	46	45	0.5~2.0	//	//
9	Clearance between boom and arm	129.5	128.5	0.7~2.3	MBU3-00020 MBU3-00021	ø36×t0.5 ø36×t1.0
10	Clearance between bucket cylinder head and arm	46	45	0.5~2.0	NOS3-00005 NOS3-00006	ø31.5×t0.5 ø31.5×t1.0
11	Clearance between bucket cylinder rod and dump link	47	45	2.0~3.0	//	//
12	Clearance between dump link and bucket	105	104	0.7~2.3	//	//
13	Clearance between arm and bucket link	105.5	104	1.2~1.8	//	//
14	Clearance between arm and bucket	105	104	0.7~1.8	//	//
15	Clearance between dozer and frame	19	16	2.5~3.5		
16	Clearance between dozer cylinder head and frame	46	45	1.0~2.5		
17	Clearance between dozer cylinder rod and dozer	46	45	0.5~2.0		
18	Clearance between extend cylinder head and frame	70	65	5.0		
19	Clearance between extend cylinder rod and frame	38	35	3.0~3.5		

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

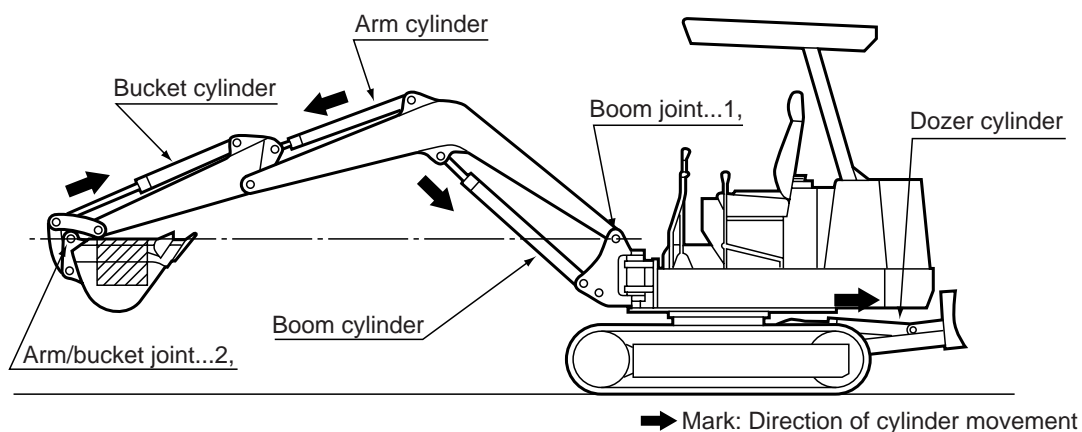
Draw a reference line on the cylinder head with a Magic Marker and measure the length from the line to the cylinder tube. Measure the length again 3 minutes later. Then record the difference in the length

Unit: mm or less

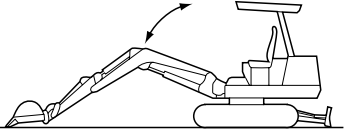
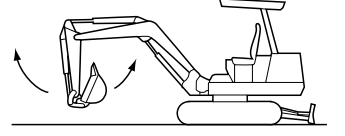
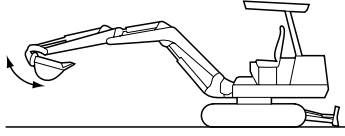
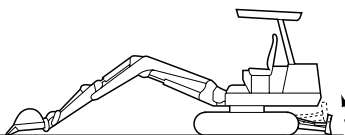
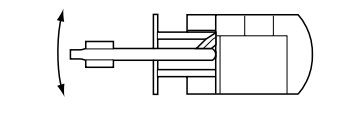
Cylinder name	Standard value	Allowance
Boom cylinder	15	30
Arm cylinder	15	30
Bucket cylinder	15	30
Dozer cylinder	10	20

Make 1 and 2 the same height.

W: Weight	About: 60 kg
-----------	--------------



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	2.4 ± 0.5	3.4
Extend cylinder to the Maximum length		Down	2.0 ± 0.5	3.0
Arm Retract cylinder to the minimum length		Dig	2.9 ± 0.5	3.9
Extend cylinder to the maximum length		Dump	3.0 ± 0.5	4.0
Bucket Retract cylinder to the minimum length		Dig	3.3 ± 0.5	4.3
Extend cylinder to the maximum length		Dump	2.4 ± 0.5	3.4
Dozer Make dozer contact the ground		Up	1.0 ± 0.3	1.5
Lift dozer to the maximum height		Down	0.5 ± 0.3	1.0
Swing Retract cylinder to the minimum length		Right swing	4.0 ± 0.5	5.0
Extend cylinder to the maximum ground		Left swing	4.1 ± 0.5	5.1

4 ENGINE

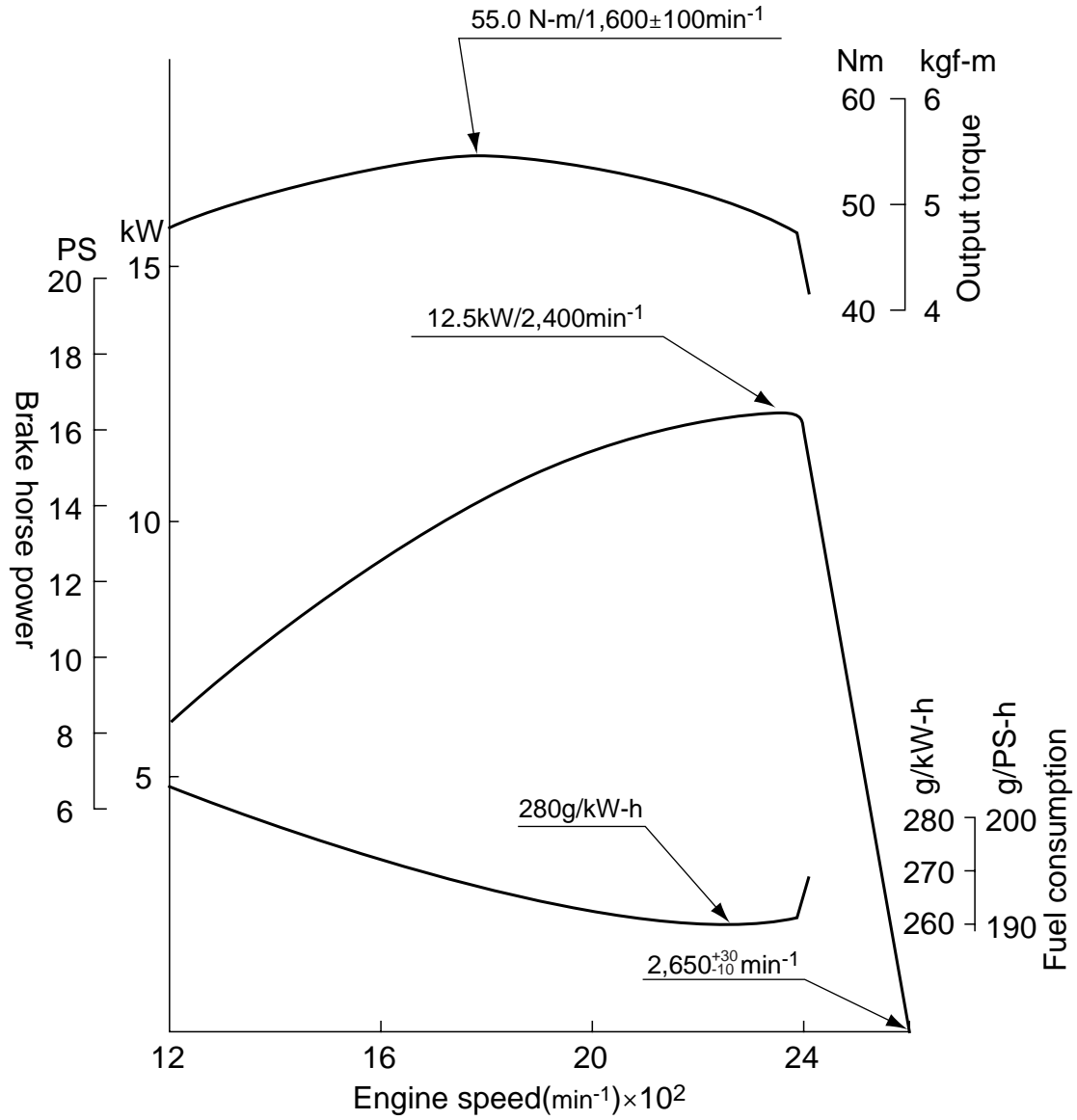
CONTENTS

- 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

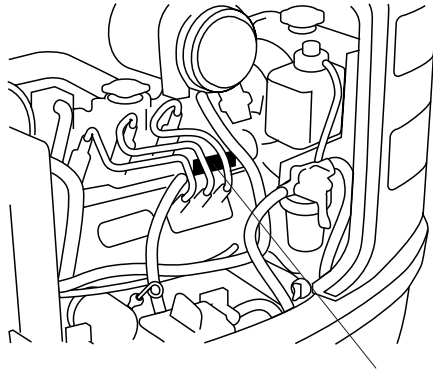
Engine		L3E-W231NSA
Type		Vertical 4 cycle 3 cylinder
Number of cylinders–bore × stroke		3–76 mm×70mm
Displacement(cc)		952 cm ³
Ignition order		1–3–2
Dimensions	Overall length	640mm
	Overall width	450mm
	Overall height	550 mm
Performance	Rated output	12.5kW(17ps)/ 2,400 min ⁻¹
	Maximum torque	55N-m/ 1,600min ⁻¹
	Maximum idling speed	2,650 min ⁻¹
	Minimum idling speed	1,100 min ⁻¹ ±30
	Fuel consumption	280g/kW-h(206 g/ps.h)
Dry weight		88kg
Fuel oil		Diesel fuel
Fuel pump		Bosh type
Governor		Centrifugal type
Generator		12V × 40A
Starter		12V × 1.2kW
Battery		12V × 36Ah

4-2 Performance curve



4-3 Location of serial number

4-3-1 Engine



Engine No. (identification plate)

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

Conditions	Idling speed
Maximum idling speed	$2,550^{+50}_0 \text{ min}^{-1}$
Speed when 1P relief is used	$2,500^{+50}_0 \text{ min}^{-1}$

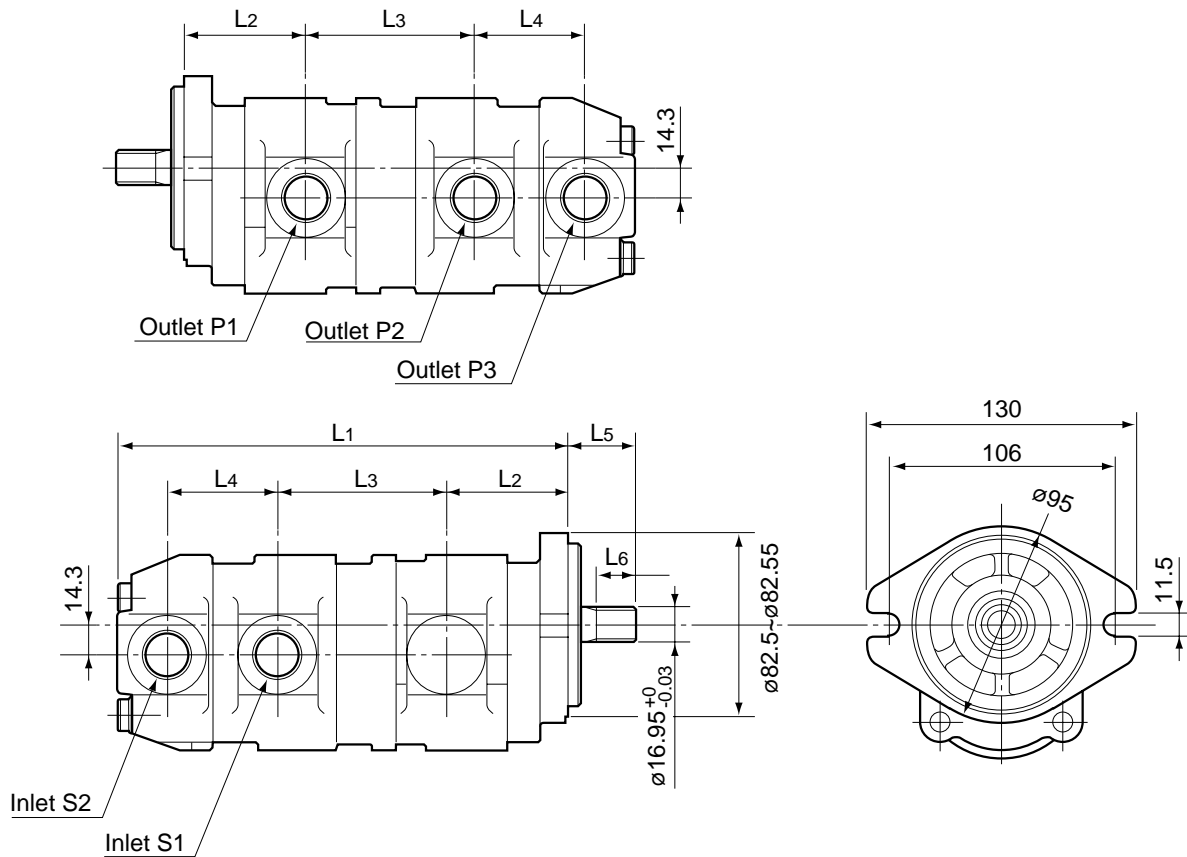
5

MAIN PUMP

CONTENTS

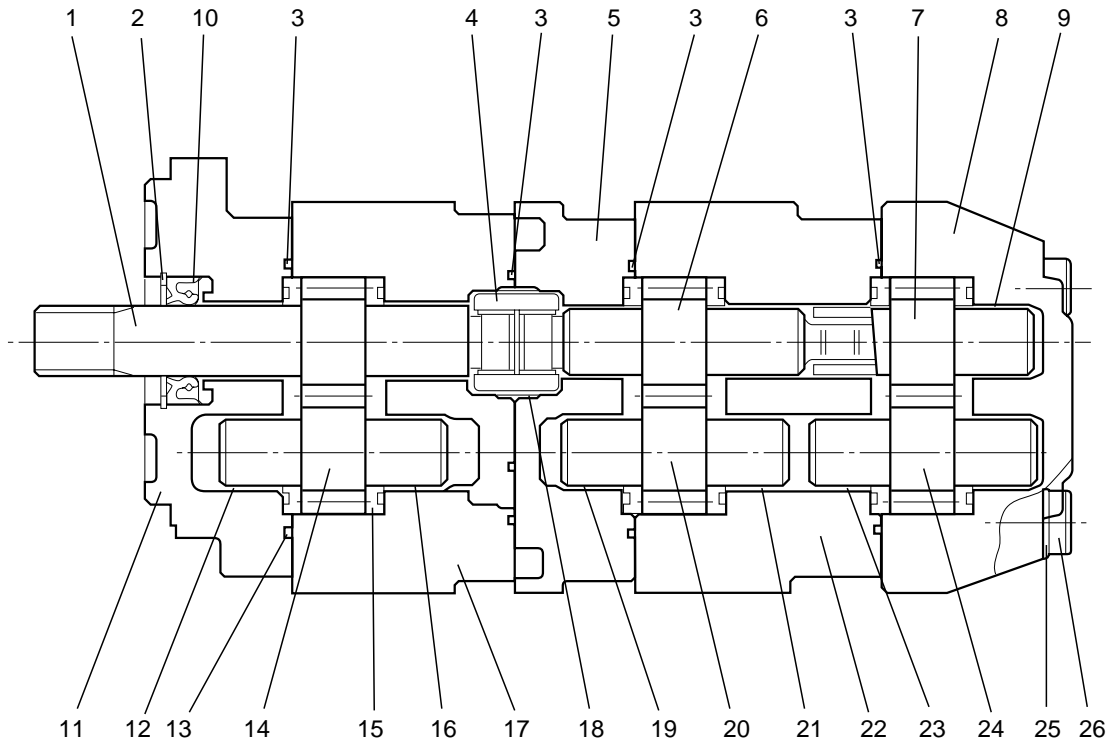
- 5-1 Specification
- 5-2 Structure
- 5-3 Removing and installing the pump
 - 5-3-1 Removing the pump
 - 5-3-2 Installing the pump
- 5-4 Performance test of the hydraulic pump
 - 5-4-1 Measuring instrument
 - 5-4-2 Preparation
 - 5-4-3 Connecting tester
 - 5-4-4 Measuring procedure

5-1 Specification



Pump type		YPT2A656565A2H9-R
Port size	S1	PF3/4
	S2	PF3/4
	P1	PF3/8
	P2	PF3/8
	P3	PF3/8
L1		223mm
L2		58.5mm
L3		84.5mm
L4		53.5mm
L5		36mm
L6		21mm
Displacement(rev)	P1	6.54cc
	P2	6.54cc
	P3	6.54cc
Rated pressure		18.6MPa(190kgf/cm ²)
Direction of rotation		Clockwise seen from shaft side
Weight		5.4kg

5-2 Structure



- | | | |
|------------------|-----------------|-----------------------------------|
| 1. Driven gear | 10. Oil seal | 19. Bush |
| 2. Snap ring | 11. Front cover | 20. Driven gear |
| 3. Gasket | 12. Bush | 21. bush |
| 4. Coupling | 13. Gasket | 22. Body |
| 5. Adaptor plate | 14. Driven gear | 23. Bush |
| 6. Driven gear | 15. Slide plate | 24. Driven gear |
| 7. Driven gear | 16. Bush | 25. Washer |
| 8. Body | 17. Body | 26. Hexagonal socket
head bolt |
| 9. Bush | 18. Collar | |

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(1).
3. Remove the pump 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.

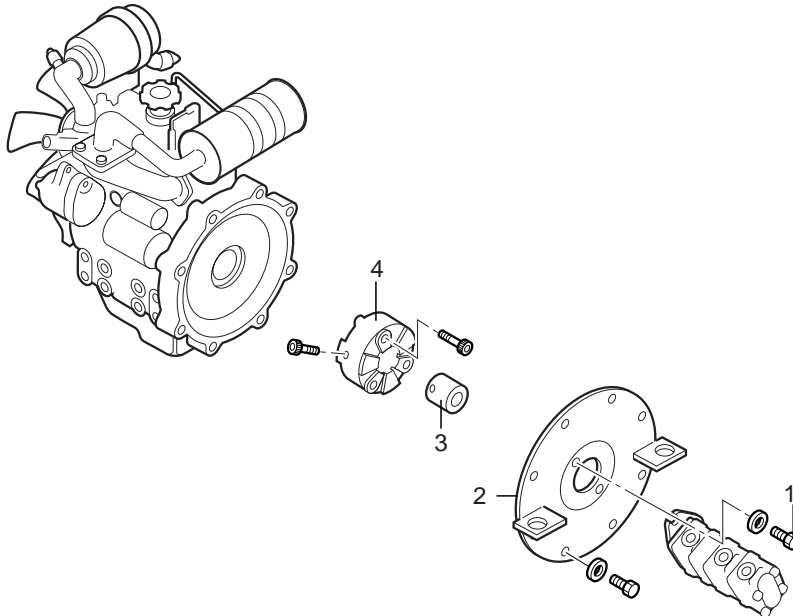
5-3-2 Installing the pump

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 1, tighten the left and right side bolts slowly and evenly.

Bolt	Tightening torque
M10 × 30 ℓ	60.8 N-m(6.2kgf-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 (ℓ/min)	7 ~ 200 ℓ
	Measuring range of pressure	0 ~ 34.3MPa(350kgf/cm ²)
	Measuring range of temperature (°C)	0 ~ 150
	Port size	PF1 O ring type
Pressure gauge	49.0MPa(500kg/cm ²), 4.9MPa(50kgf/cm ²)	
Tachometer	Diesel tachometer (digital type)	
Hose for testing	Equivalent to the hose of 20.6MPa (210kgf/cm ²) high pressure (Nominal size PF1/ 2-PF1/ 2 × 1m)	

5-4-2 Preparation

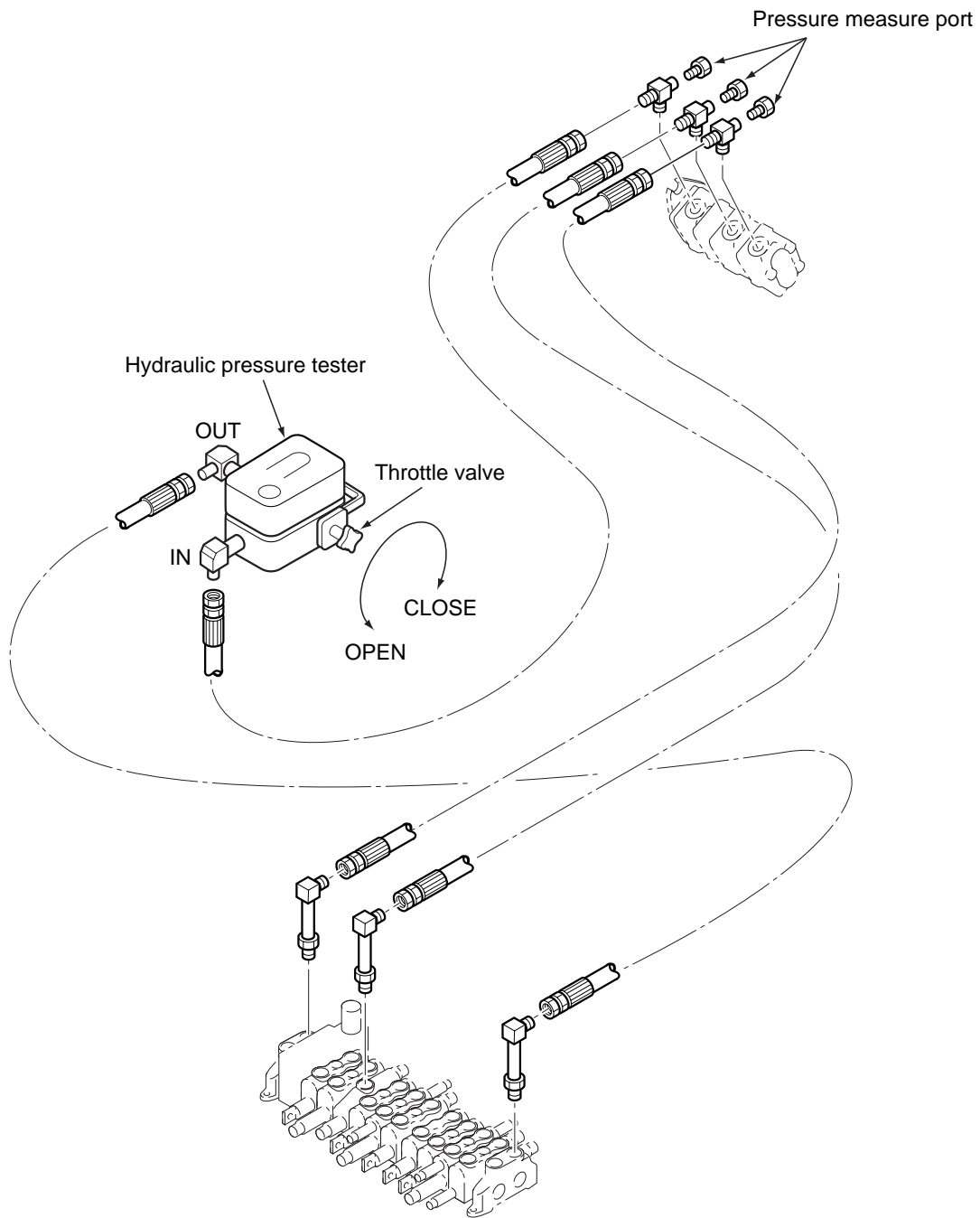
1. Park machine on flat ground and stop engine.

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.

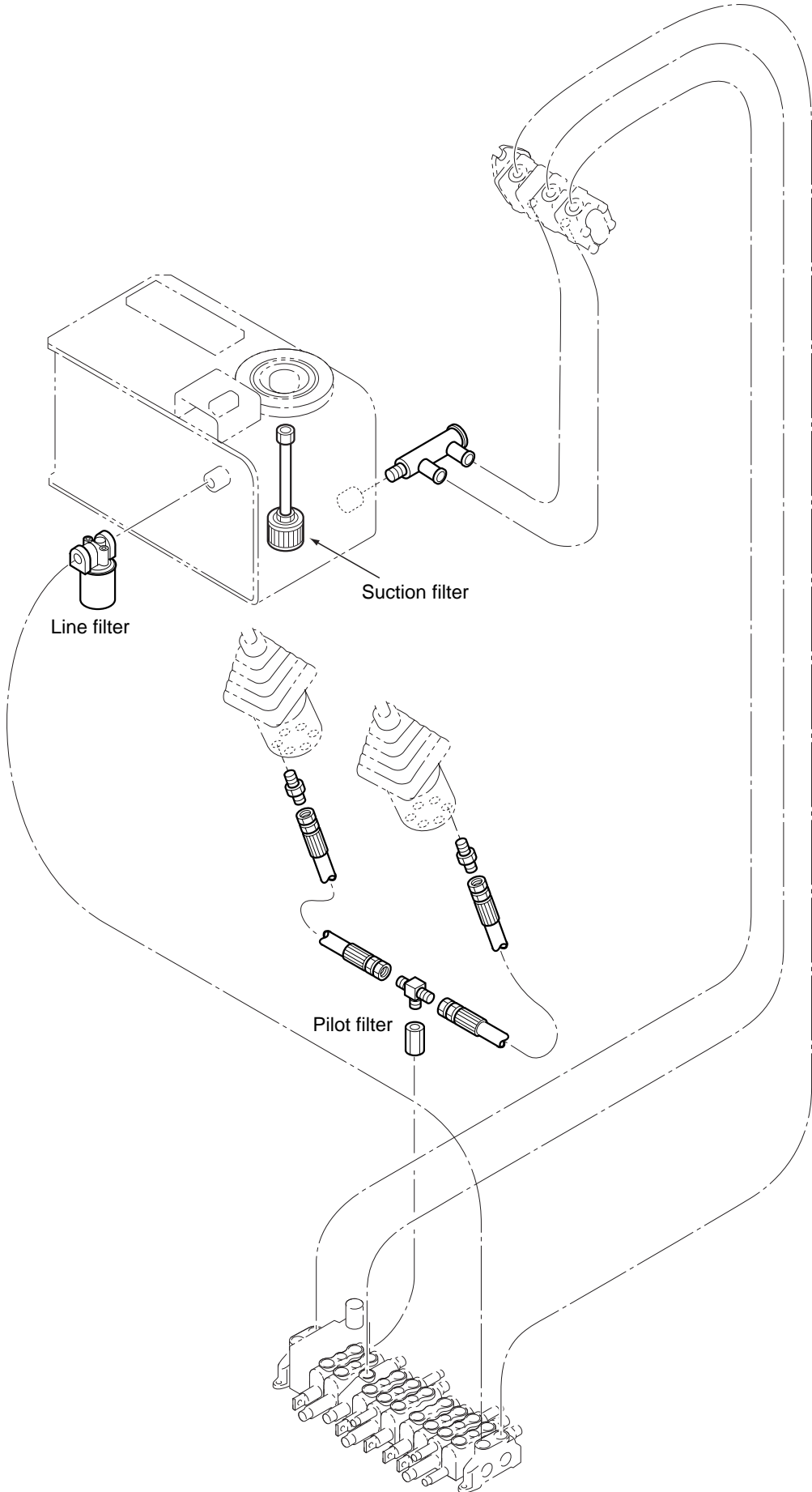


6 HYDRAULIC OIL FILTER

CONTENTS

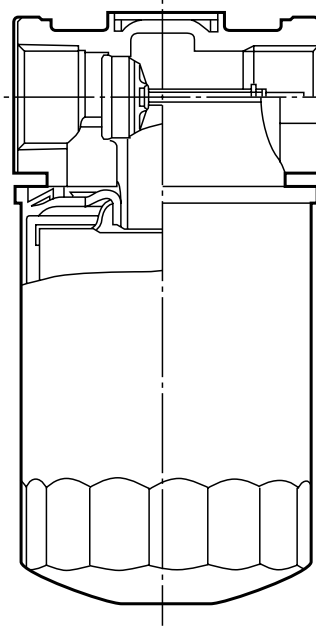
- 6-1 Installation
- 6-2 Hydraulic oil filter
 - 6-2-1 Line filter
 - 6-2-2 Suction filter
 - 6-2-3 Pilot filter
- 6-3 Maintenance procedure
 - 6-3-1 Replacing the line filter
 - 6-3-2 Replacing the suction filter
 - 6-3-3 How to clean the suction filter

6-1 Installation



6-2 Hydraulic oil filter

6-2-1 Line filter (SP08)

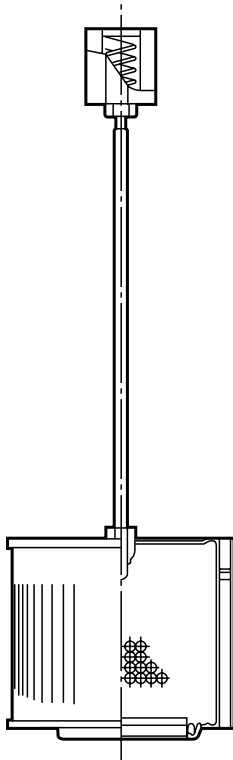


Filtration accuracy	10 μ
Filtration capacity	50 ℓ /min (Max.)
Opening pressure of bypass valve	0.15MPa (1.5kgf/cm ²)
Proof pressure	0.69MPa(7kgf/cm ²)
Oil temperature	-20°C~120°C

2-PT1 "

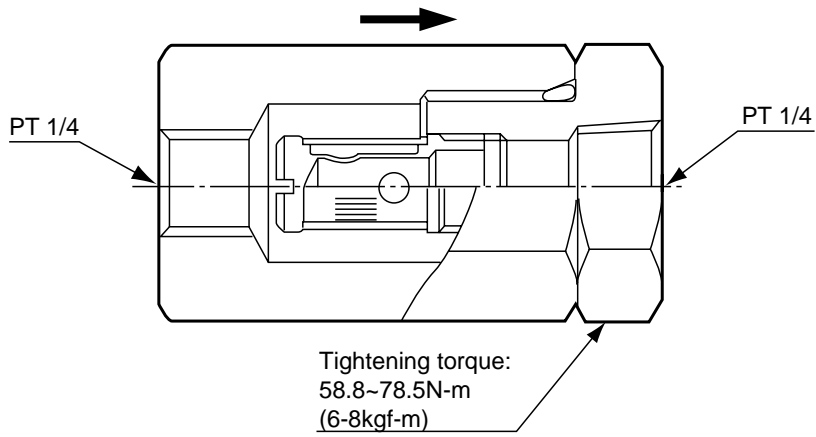
Tightening torque
19.6Nm(2kgf/m)

6-2-2 Suction filter



Grain size	100 mesh
Oil temperature	-20°C~120°C

6-2-3 Pilot filter



Filtration capacity	2 ℓ /min.(Max.)
Proof pressure	3.92MPa(40kgf/cm ²)
Filtration accuracy	31 μ
Filtration area	5 cm ²
Oil temperature	-30°C~120°C

6-3 Maintenance procedure

6-3-1 Replacing the line filter

1. Stop the engine.
2. Remove the line filter 6-2-1 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 wrench (27 mm 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.

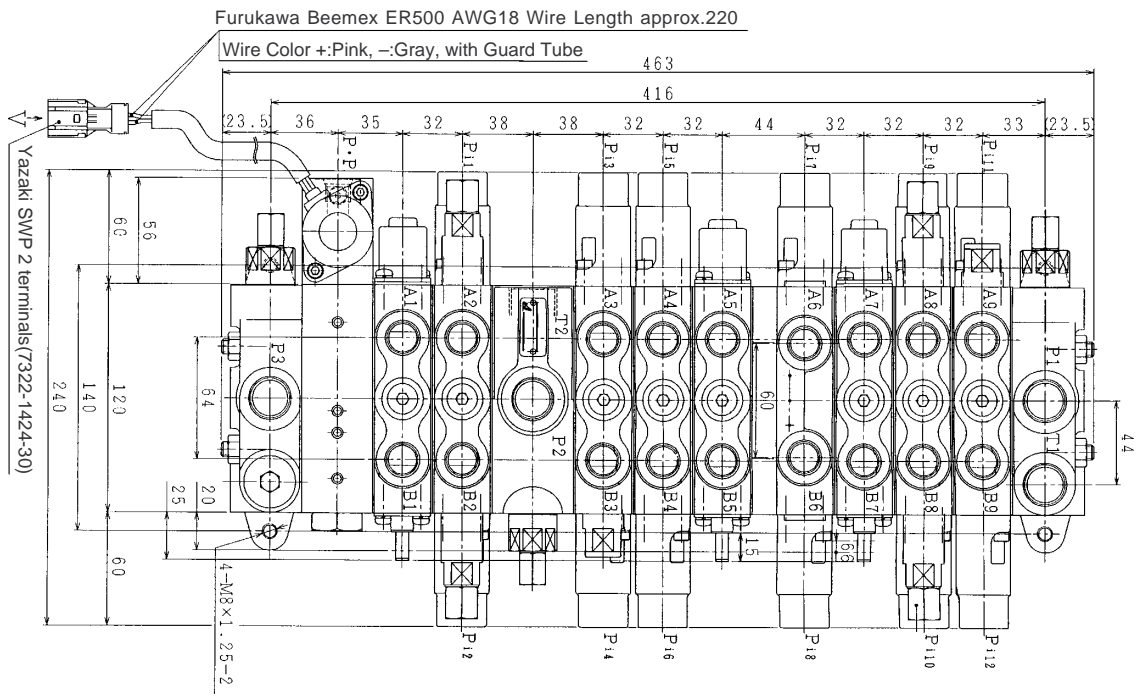
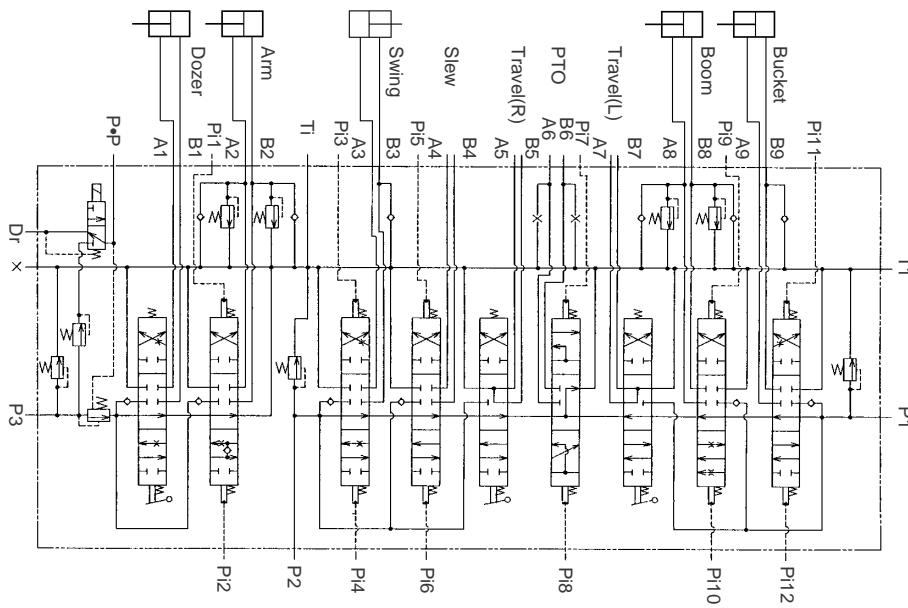
Total amount of hydraulic oil : 24 ℓ

7 CONTROL VALVE

CONTENTS

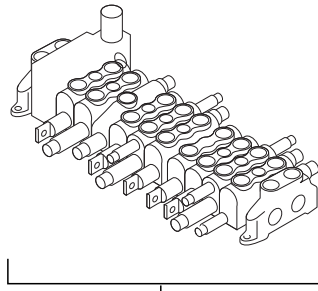
- 7-1 Specification
- 7-2 Disassembly and assembly
 - 7-2-1 Replacing the O ring on the contact surface and each block assembly
 - 7-2-2 Replacing the O ring on the spool
 - 7-2-3 Removing the load check valve and replacing the O ring
 - 7-2-4 Replacing the relief valve assembly and the O ring
- 7-3 Structure of the relief valve
 - 7-3-1 Main relief valve
 - 7-3-2 Port relief valve
 - 7-3-3 Suction valve
- 7-4 Precautions for handling
 - 7-4-1 Handling
 - 7-4-2 Installation
 - 7-4-3 Operation

7-1 Specification

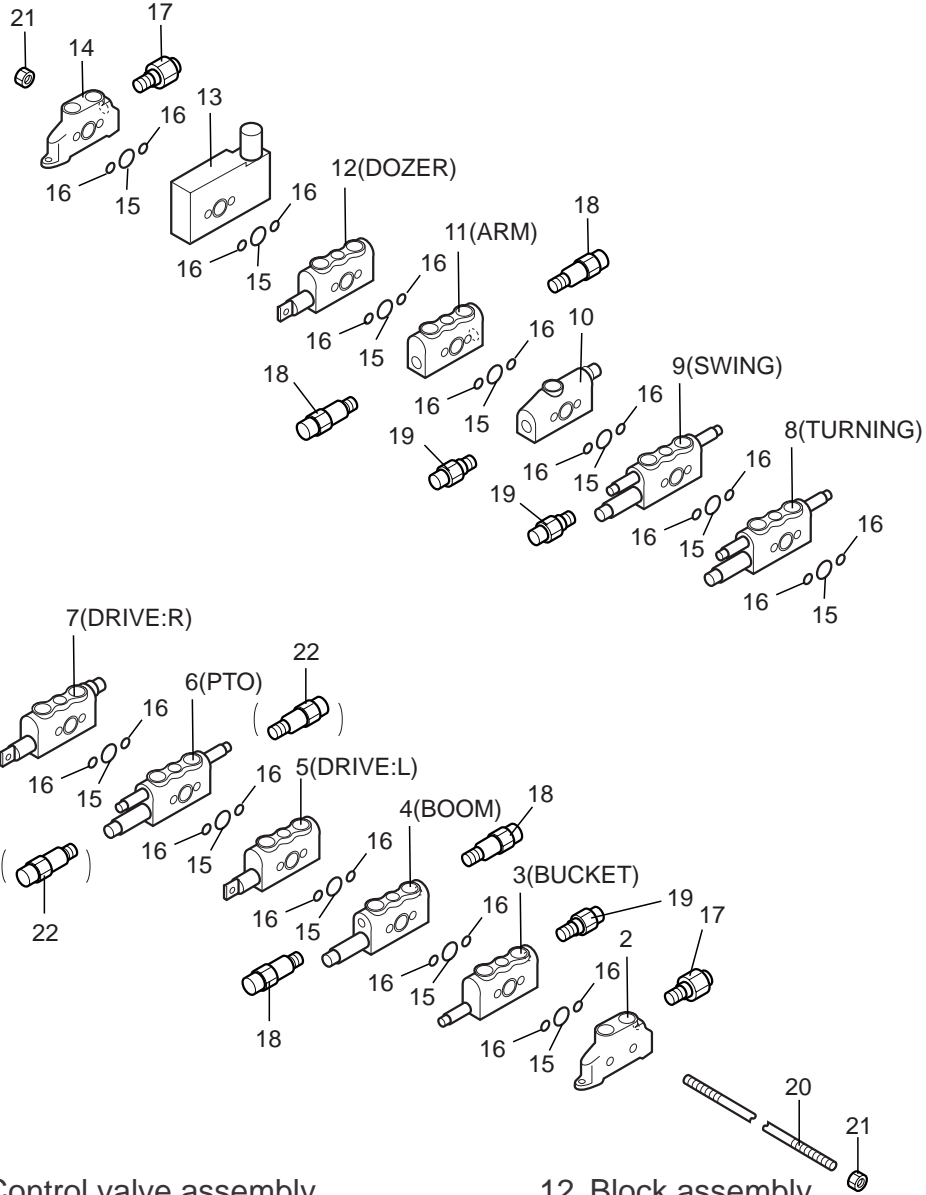


Port size	
T2	PF 3 / 4
P1,P2,P3,T1	PF 1 / 2
A1~A9, B1~B9	PF 3 / 8
Pi1~8, P•P	PF1 / 4
Dr	PT1 / 8

P1 and P2,P3 Main relief pressure	18.6MPa(190kgf/cm ²)at 14.5 ℓ /min
A2, B2, A8, B8 Port relief pressure	20.6MPa(210kgf/cm ²)at 5 ℓ /min

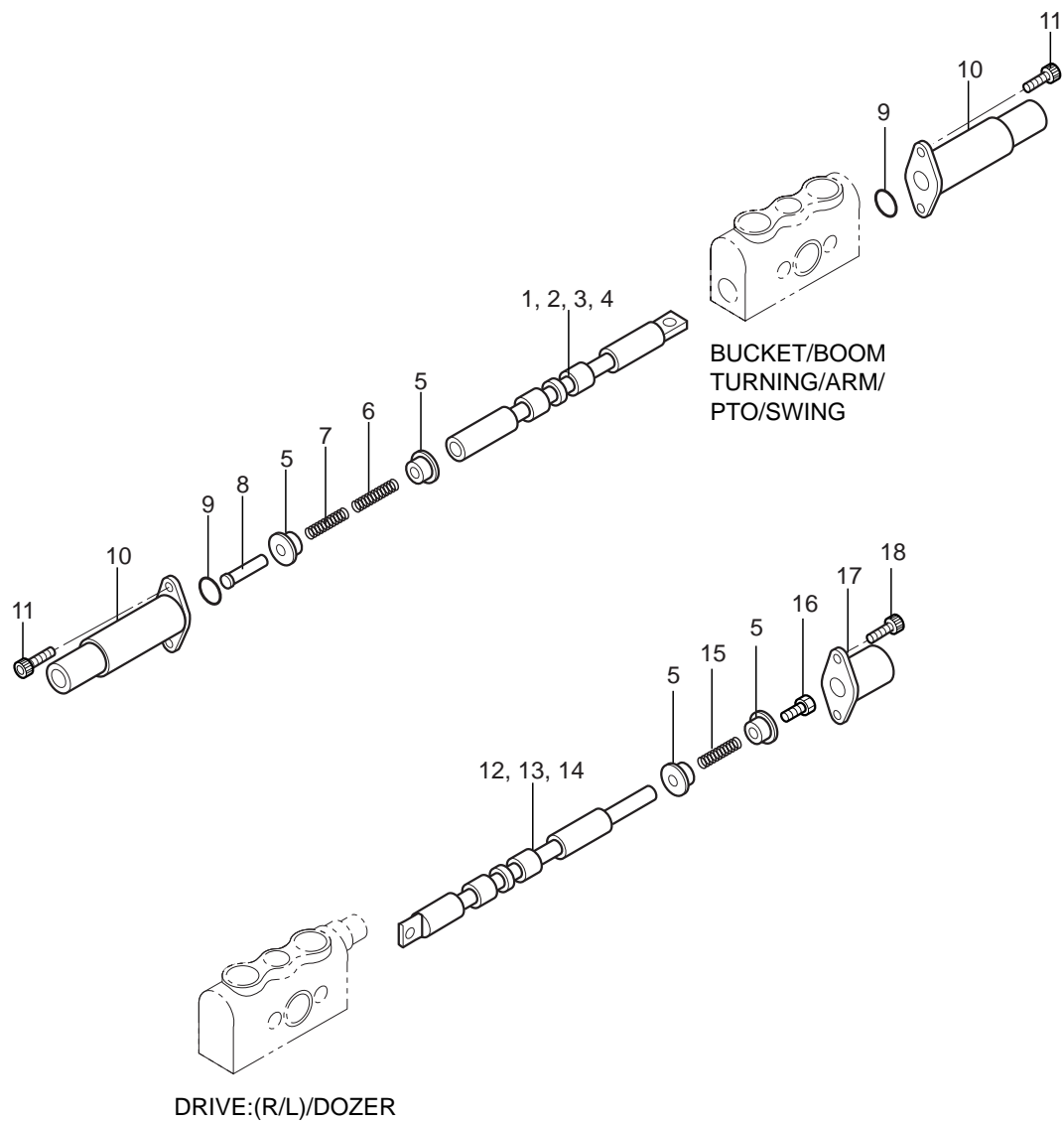


1



- 1. Control valve assembly
- 2. Block assembly
- 3. Block assembly
- 4. Block assembly
- 5. Block assembly
- 6. Block assembly
- 7. Block assembly
- 8. Block assembly
- 9. Block assembly
- 10. Block assembly
- 11. Block assembly

- 12. Block assembly
- 13. Block assembly
- 14. Block assembly
- 15. O-ring
- 16. O-ring
- 17. Relief valve assembly
- 18. Relief valve assembly
- 19. Relief valve assembly
- 20. Rod
- 21. Nut
- 22. Relief valve assembly



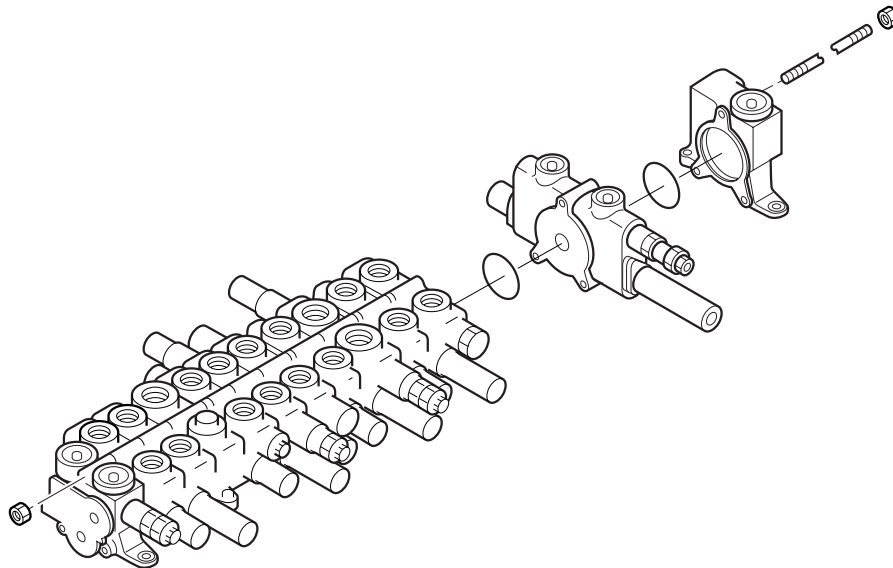
1. Spool
2. Spool
3. Spool
4. Spring
5. Spring holder
6. Spring
7. Spring
8. Spool end
9. O-ring

10. Cover
11. Socket head bolt
12. Open spool
13. Spool
14. Spool
15. Spring
16. Bolt
17. Cover
18. Panhead screw

7-2 Disassembly and assembly

7-2-1 Replacing the O ring on the contact surface and each block assembly

1. Loosen the nut of tie rod.
2. Remove each block. Be careful not to damage the machine contact surface.
3. When disassembled, it is recommended to replace the O rings on the contact surface.
4. When assembling, clean the contact surface so that no dust sticks to the surface. Then attach the O ring and reassemble in the reverse order of the above procedure. When attaching the O ring, give grease to it.
5. Tighten nut temporarily.
6. After tightening, place them on their side. Pressing the inlet cover and end cover from above, check the level of the mounting legs and tighten the nut.
The tightening torque of the tie rod nut is 23.5N-m(2.4kg-m). While tightening them, check that the spool of each block operates smoothly.



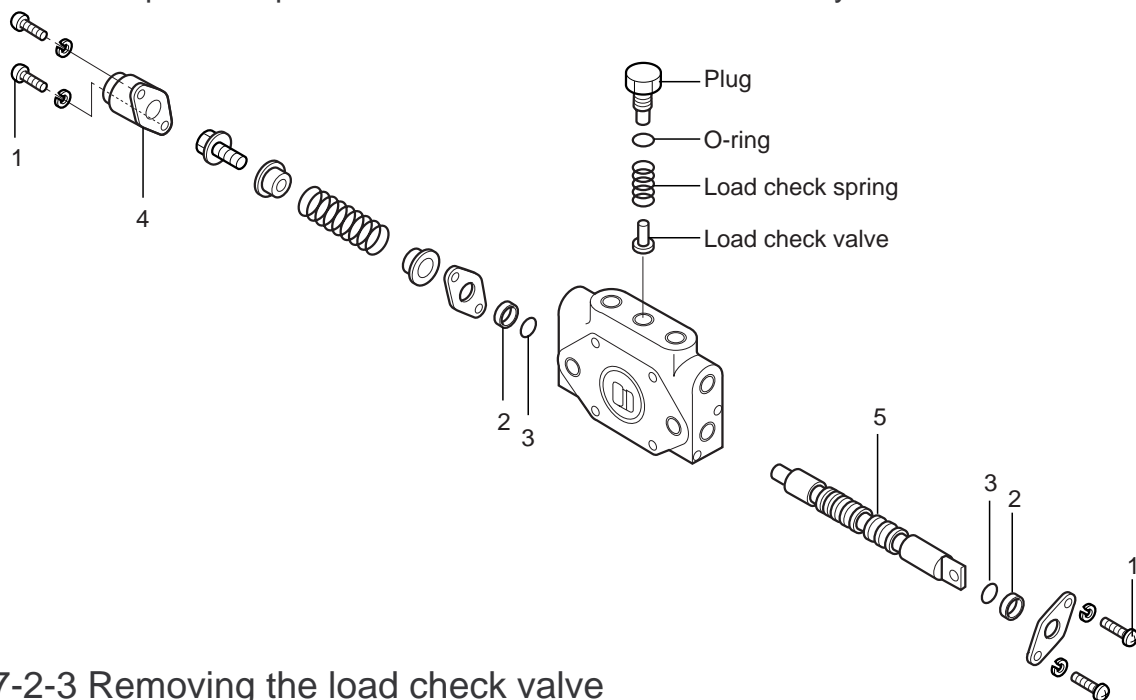
7-2-2 Replacing the O ring on the spool

1. On the lever side

- 1) Remove the mounting screws (1) of the O-ring presser from the block.
- 2) Replace the backup ring (2) and O-ring (3).
- 3) When mounting the O-ring presser, be sure not to damage the O-ring.

2. On the cap side

- 1) Loosen the cap mounting screws (1) and remove the cap (4).
Take out spool (5) and replace O-ring (3)
- 2) Rinse the spool and insert it in the body.
- 3) When installing the spring cap, be careful not to damage the O-ring.
The spool is replaced in the units of the block assembly.



7-2-3 Removing the load check valve

1. Loosen the plug and remove the load check spring and load check valve from the valve block.
2. Clean the parts sufficiently before assembling them.

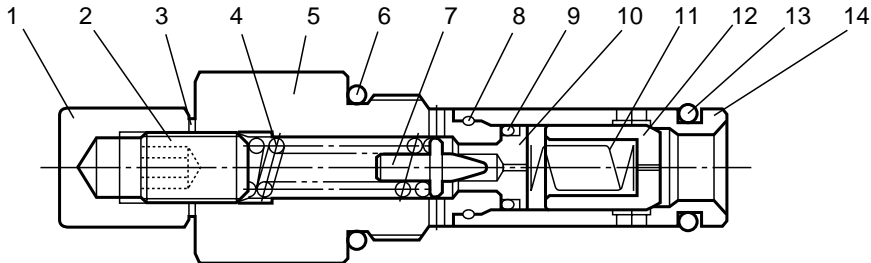
7-2-4 Replacing the relief valve assembly and the O-ring.

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

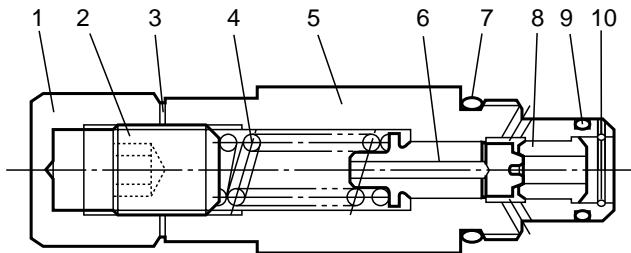
7-3-1 Main relief valve

Part	Tightening torque
Cap nut	29.4N-m(3.0kgf-m)
Installation of the relief valve	68.6N-m(7.0kgf-m)



- | | | |
|--------------|-----------------|------------|
| 1. Cap nut | 6. O-ring | 11. Spring |
| 2. Set screw | 7. Needle valve | 12. Poppet |
| 3. Gasket | 8. Wire | 13. O-ring |
| 4. Spring | 9. O-ring | 14. Sleeve |
| 5. Housing | 10. Seat valve | |

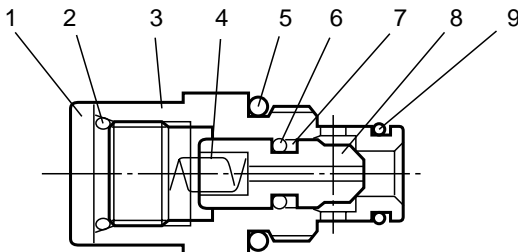
7-3-2 Port relief valve



Part	Tightening torque
Cap nut	29.4N-m(3.0kgf/m)
Installation of the relief valve	68.6N-m(7.0kgf-m)

- | | | |
|--------------|-------------------|-----------|
| 1. Cap nut | 5. Relief housing | 9. O-ring |
| 2. Set screw | 6. Poppet | 10. Clip |
| 3. Gasket | 7. O-ring | |
| 4. Spring | 8. Seat | |

7-3-3 Suction check valve



Part	Tightening torque
Plug	29.4N-m(3.0kgf/m)
Installation of the check valve	68.6N-m(7.0kgf/m)

- | | | |
|-----------|-----------|----------------|
| 1. Plug | 4. Spring | 7. Backup ring |
| 2. O-ring | 5. O-ring | 8. Poppet |
| 3. Body | 6. O-ring | 9. O-ring |

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

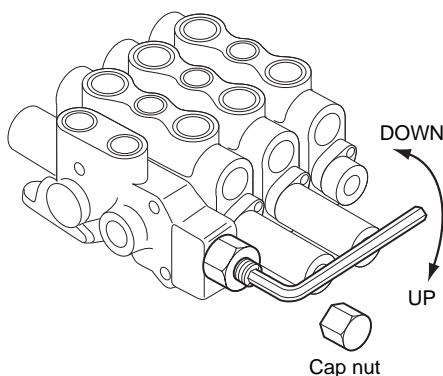
1. Tighten the valve joints with the specified tightening torque. Be careful so that no unnecessary force acts on the valve through the piping.
2. Install the operation link so that the spool moves correct in the direction of shaft.
3. Be careful when welding near a valve, because the high temperature and spatter may damage the O ring of the spool and the dust seal.
4. Do not paint the spool.
5. 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. 6.9MPa (70kgf/cm ²) per rotation
Port relief valve	Approx. 8.8MPa (90kgf/cm ²) per rotation

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

8

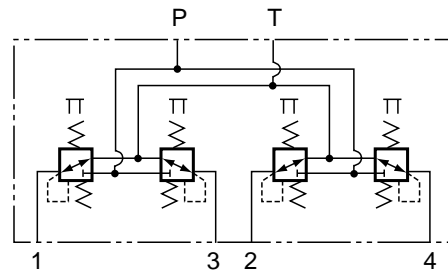
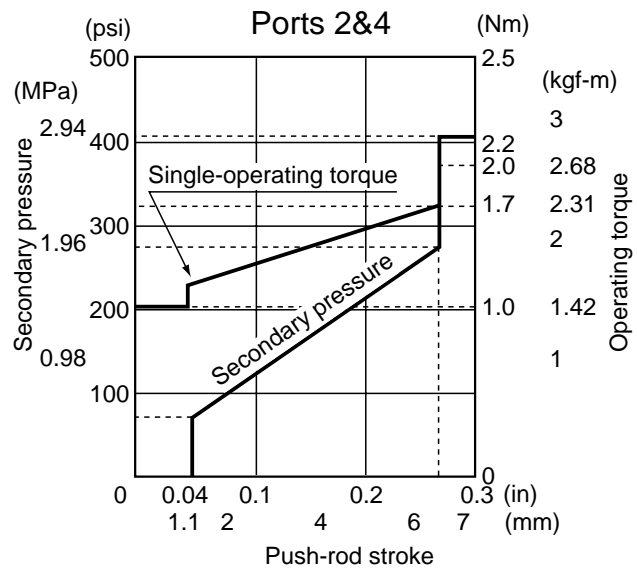
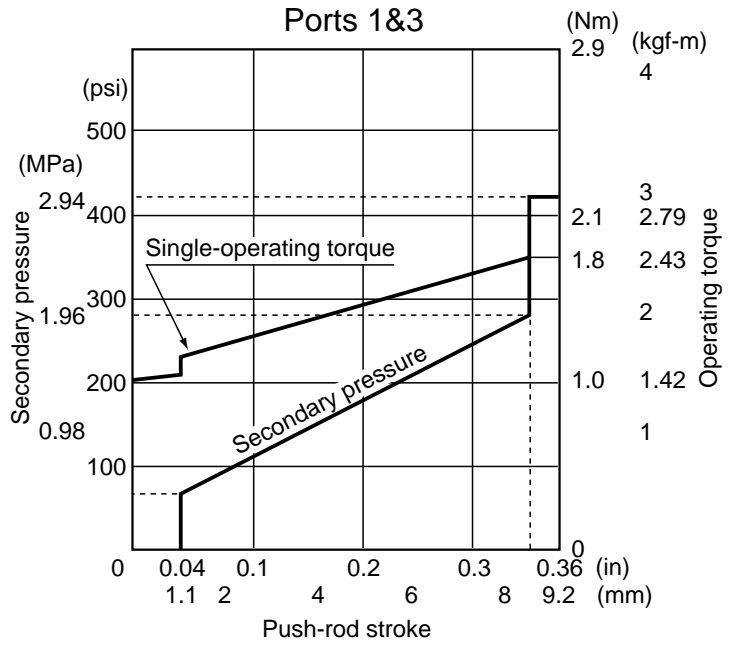
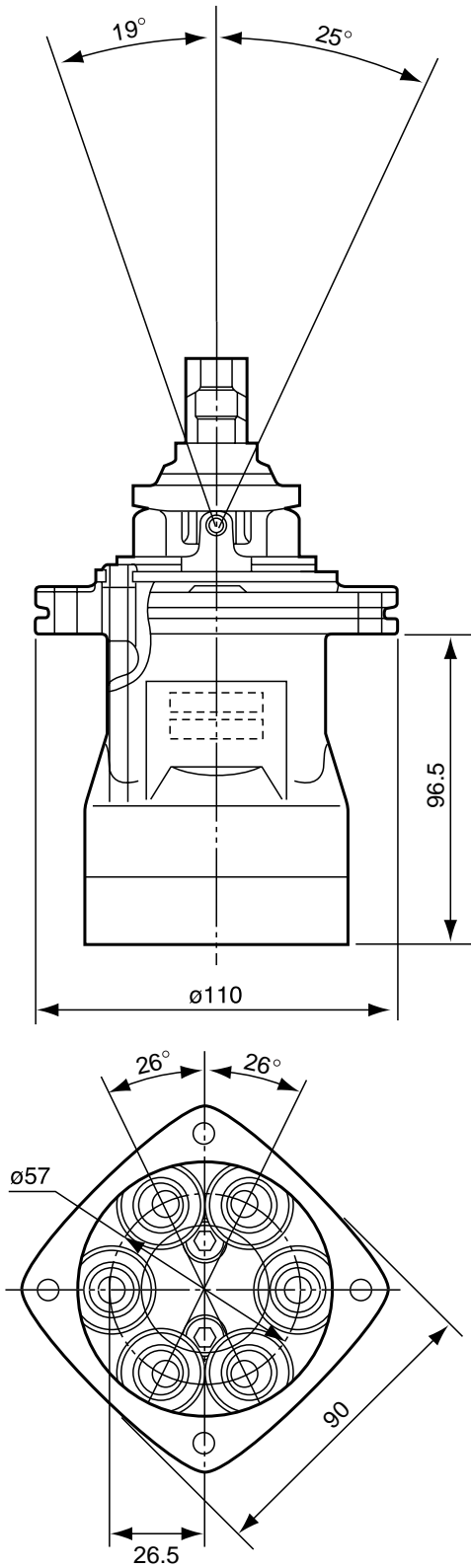
JOYSTICK (PILOT VALVE)

CONTENTS

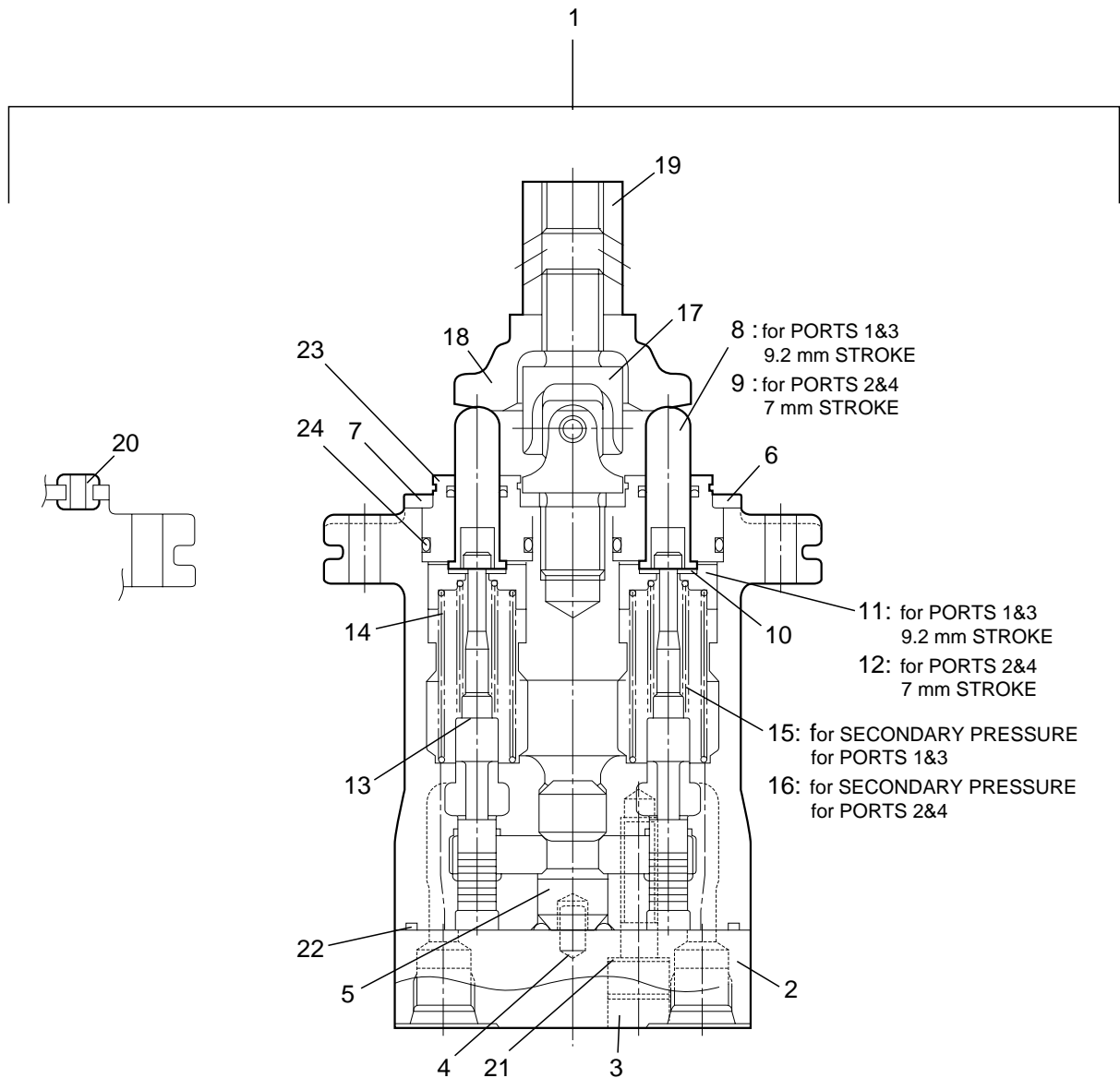
8-1 Specification

8-2 Structure

8-1 Specification



8-2 Structure



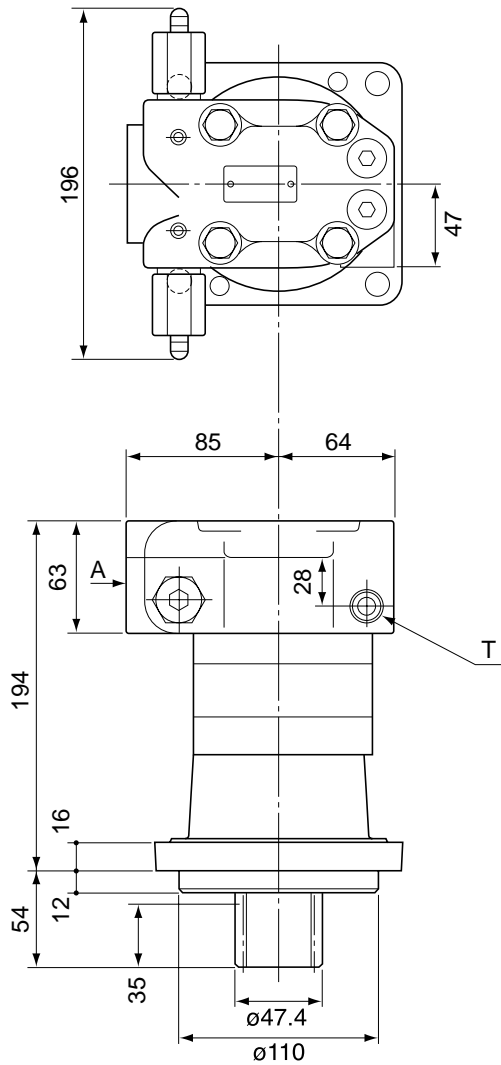
- | | | |
|-------------------------|-----------------|--------------------|
| 1. Joystick valve Ass'y | 9. Push rod | 17. Joint |
| 2. Port plate | 10. Washer | 18. Circular plate |
| 3. Socket head bolt | 11. Spring seat | 19. Adjusting nut |
| 4. Spring pin | 12. Spring seat | 20. Bush |
| 5. Bush | 13. Washer 2 | 21. Seal washer |
| 6. Plate | 14. Spring | 22. O-ring |
| 7. Plug | 15. Spring | 23. Seal |
| 8. Push rod | 16. Spring | 24. O-ring |

9 SLEW MOTOR

CONTENTS

- 9-1 Specification
- 9-2 Structure
- 9-3 Standard of maintenance
 - 9-3-1 Slew bearing & slew case
- 9-4 Inspection and adjustment
 - 9-4-1 Measuring the natural slew distance
 - 9-4-2 Measuring the over slew distance after stopping
 - 9-4-3 Measuring the required time for slewing

9-1 Specification

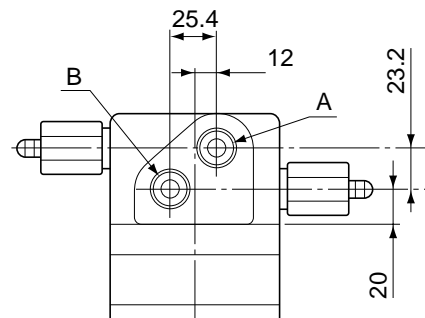


Direction of rotation
(seen from the output shaft)

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

Port	Port size
A	PF 3/8
B	PF 3/8
T	PF 3/8

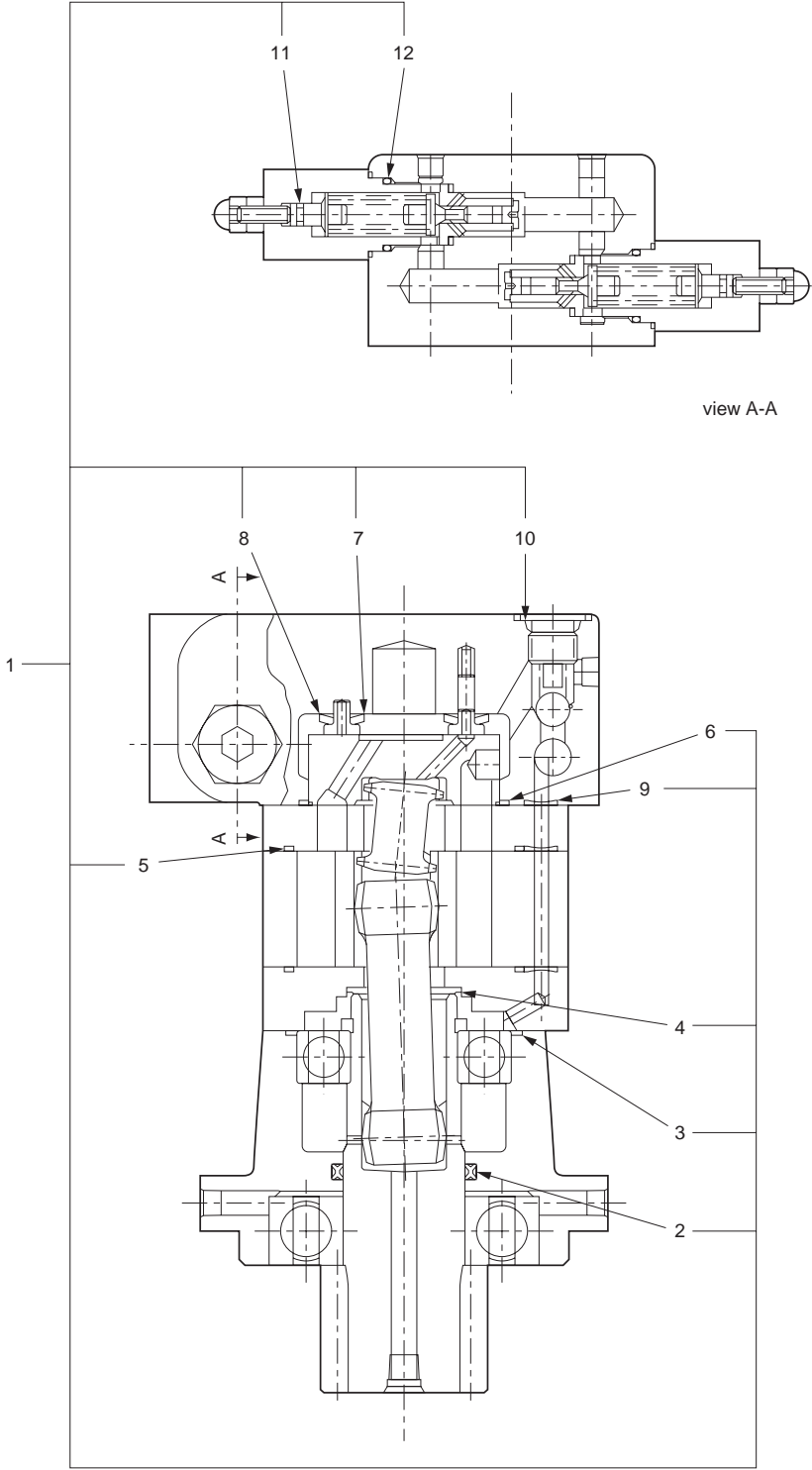
Initial oil replace	500Hr
Second and later replace	1,000Hr



View A

	Type	2-160 DOS-E3754
Hydraulic motor	Output torque	234 Nm(23.9kgf-m)
	Output speed	78min ⁻¹
	Capacity	158 cm ³ /rev
	Flow rate	12.4 ℓ /min.
	Overload relief set pressure	9.32MPa(95kgf/cm ²) at 12 ℓ /min.
Pinion gear	Module	3
	No. of threads Z	13
Weight		15kg

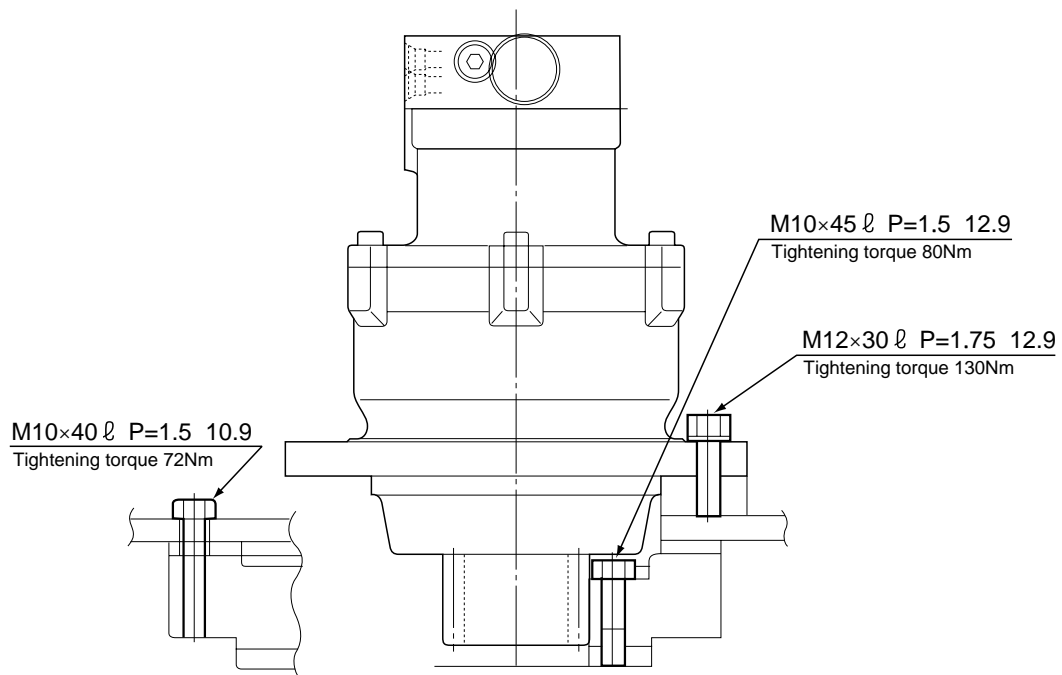
9-2 Structure



- 1. Slew motor Ass'y
- 2. X-ring
- 3. O-ring
- 4. Seal, shaft face
- 5. O-ring
- 6. O-ring
- 7. Seal, inner face
- 8. Seal, outer face
- 9. O-ring
- 10. O-ring
- 11. O-ring
- 12. O-ring

9-3 Standard of maintenance

9-3-1 Slew bearing and slew case

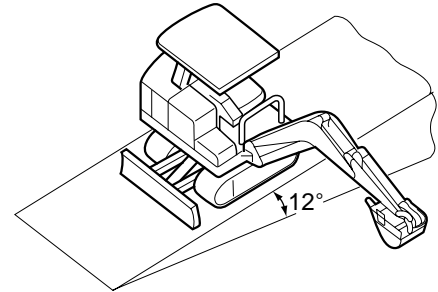


9-4 Inspection and adjustment

9-4-1 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

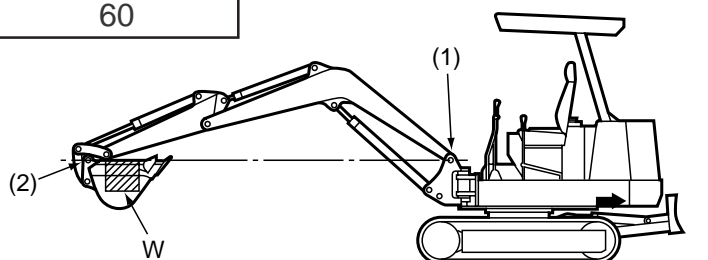
Standard value	Allowance	Weight W kg
100	200	60

9-4-2 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	60



9-4-3 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

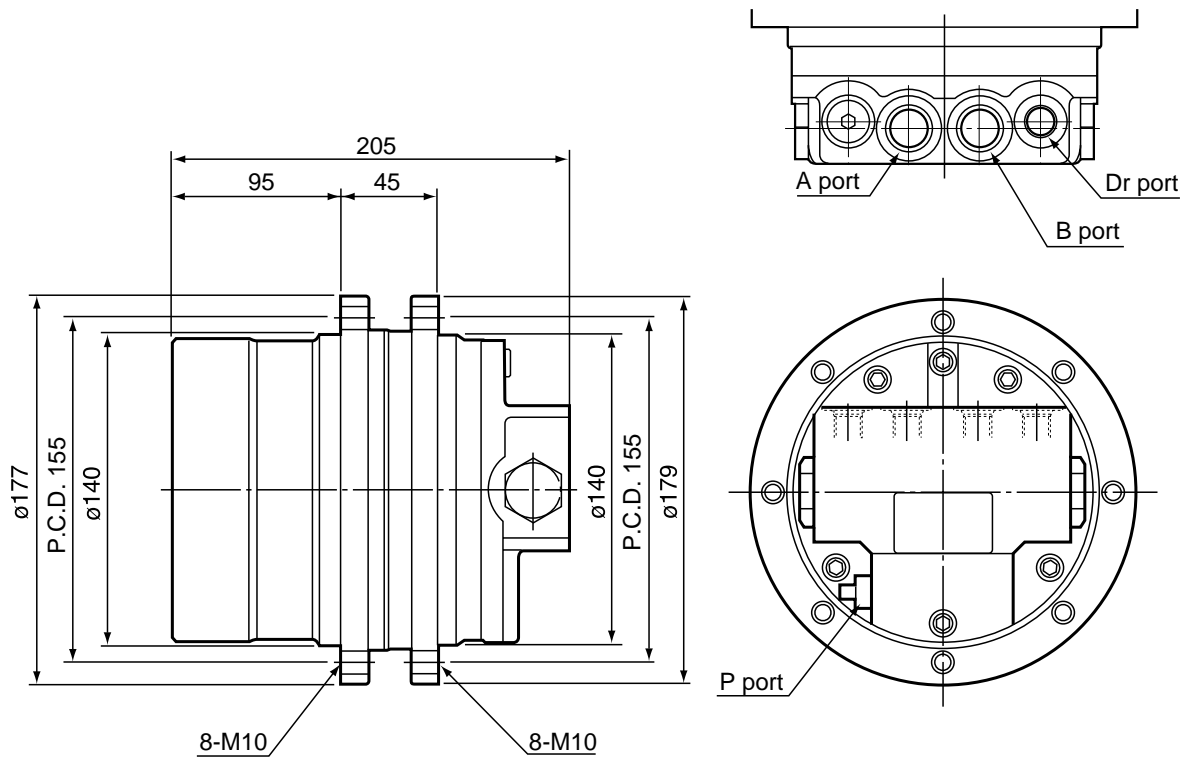
Standard value	Allowance
26 ± 4	42

10 TRAVEL MOTOR

CONTENTS

- 10-1 Specification
- 10-2 Structure
- 10-3 Operation
- 10-4 Handling the travel motor
- 10-5 Measuring travel motor idling
and travelling time
- 10-6 Inspection and adjustment

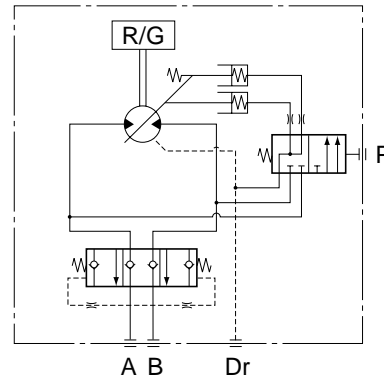
10-1 Specification



Direction of rotation (viewing from output axis)

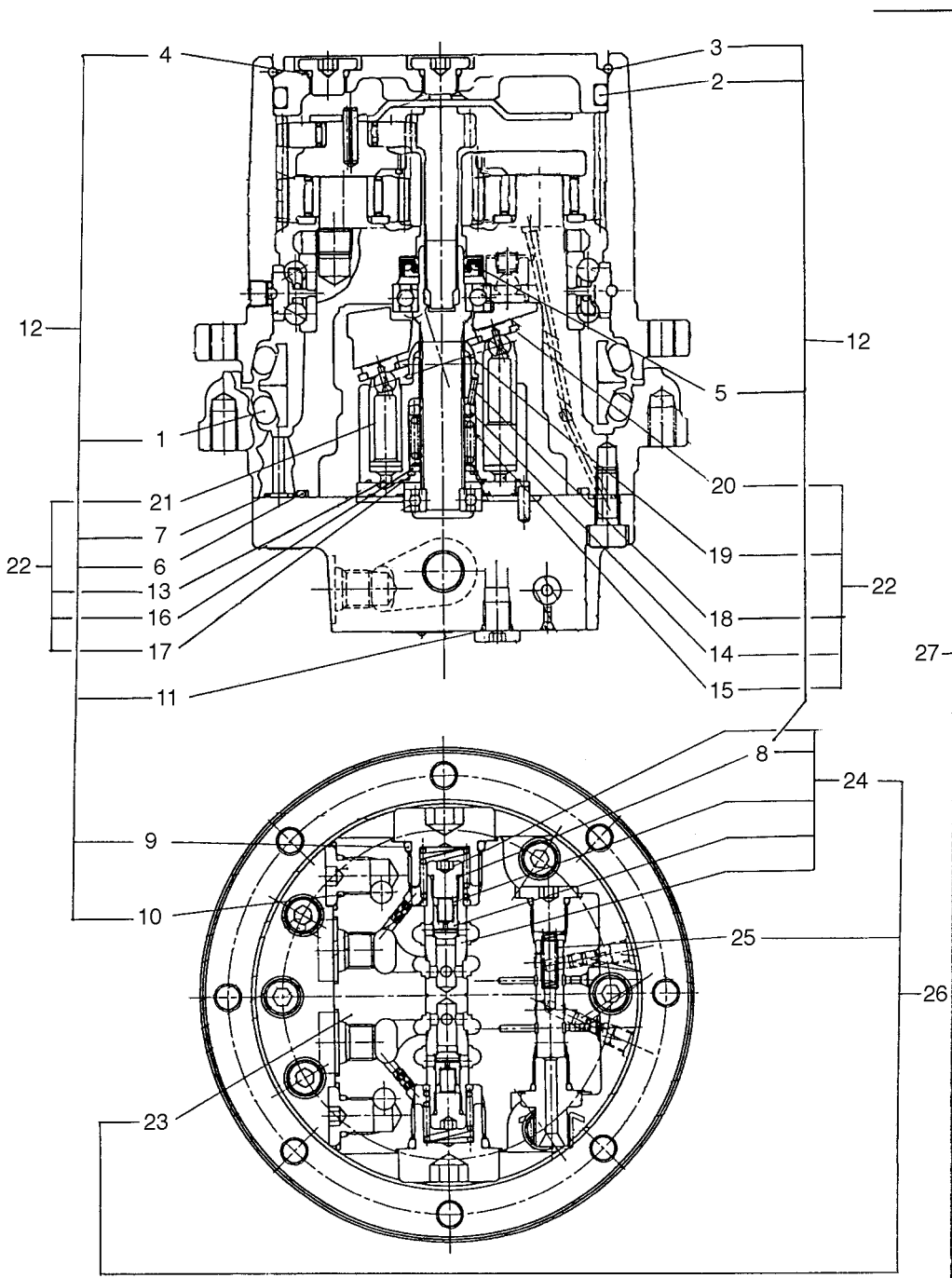
Direction of rotation	Oil pouring port	Oil discharging port
Clockwise	B	A
Counterclockwise	A	B

Port	Port size
A,B	PF1/4
P,Dr	PF1/4



Item		Item		
Reduction gear	Output torque (KNm)	1.23/0.62	Others	
	Output speed (min ⁻¹)	37.9/75.4		
	Reduction ratio	1/33.22		
	Capacity (cc/rev)	12.46 / 6.27		
Hydraulic motor	Working pressure (MPa)	18.6(190kgf/cm ²)	Equivalent capacity (cc/rev)	414/208
	Output speed of hydraulic motor (min ⁻¹)	1260/2500	Oil	ISO-VG46
	Flow rate (ℓ/min)	15.7	Oil temperature(°C)	-20~100
			Filtering (μM)	10
			Lubricating oil	Engine oil equivalent to SAE-30CD(250cm ³)
			Weight(kg)	19

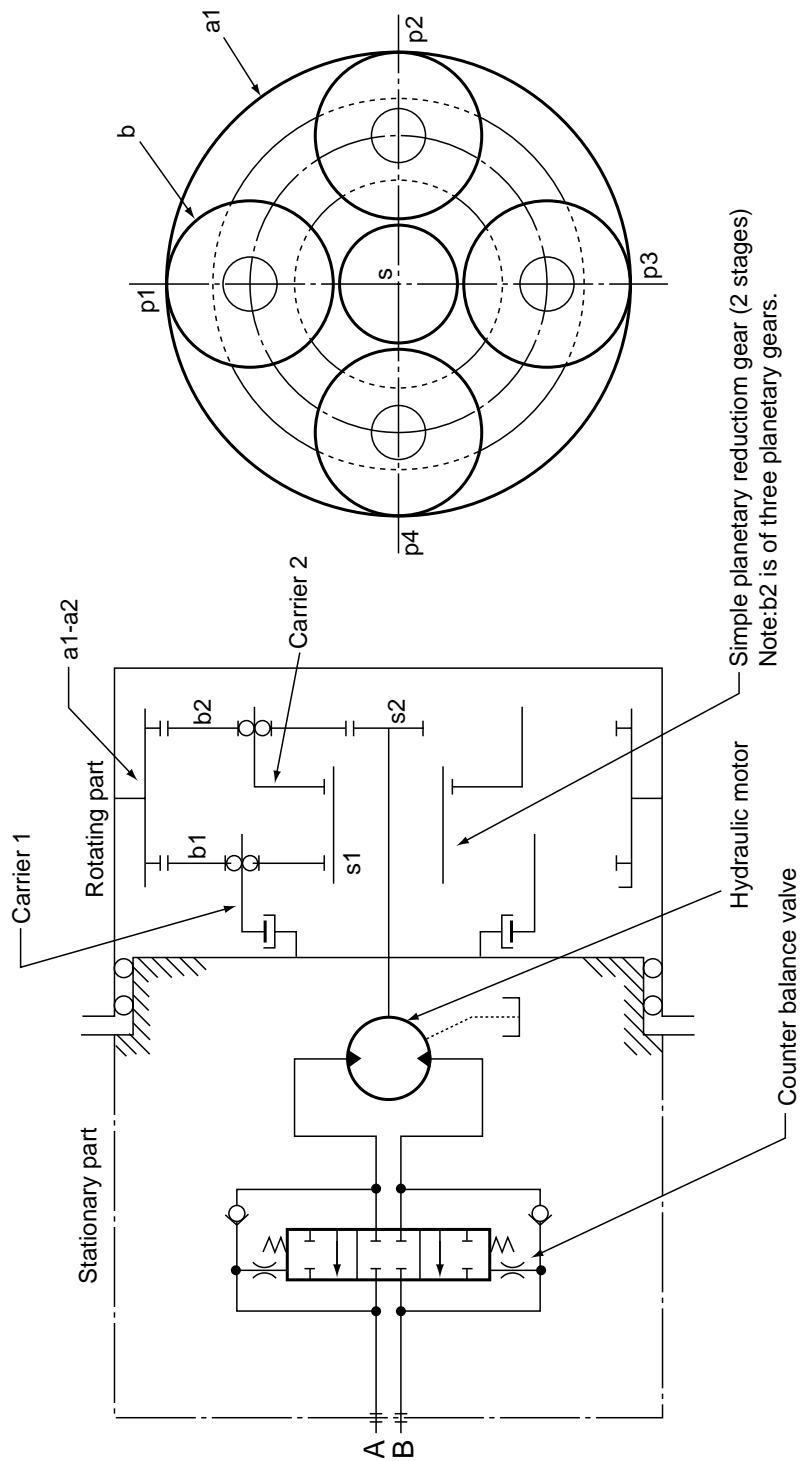
10-2 Structure



- | | | |
|-------------------|---------------------|-------------------------|
| 1. Seal, floating | 10. O-ring | 19. Holder, retainer |
| 2. O-ring | 11. O-ring | 20. Plate, retainer |
| 3. Wire | 12. Seal kit | 21. Piston Ass'y |
| 4. O-ring | 13. Cylinder, block | 22. Block kit, cylinder |
| 5. Seal, oil | 14. Holder, spring | 23. Plate, base |
| 6. O-ring | 15. Spring | 24. Plunger Ass'y |
| 7. O-ring | 16. Washer | 25. Spool |
| 8. O-ring | 17. Ring, snap | 26. Plate kit, base |
| 9. O-ring | 18. Pin | 27. Drive motor Ass'y |

10-3 Operation

Principle of motor operation



Operation

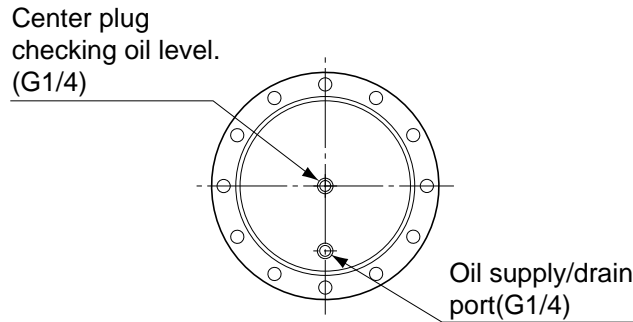
On the above figure, gear s2 is connected by a spline to the output shaft of the hydraulic motor, and the speed of gear s2 is reduced once by gears s2, b2, a2.

This reduced speed is reduced again by gears s1, b1, a1 connected by a spline to carrier 2 and transmitted through an internal gear a1, 2 to the rotating part to be a driving force for travelling.

10-4 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 quantity check port, oil intake and oil drain ports, starting from the top in that order.



2. First, remove the plugs from the (A) 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 (A) port, then wind seal tape around the plug before tightening.

Amount of lubricating oil	250 cc
---------------------------	--------

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	72.6N-m(7.4kgf-m)
Motor tightening torque	72.6N-m(7.4kgf-m)

10-5 Measuring crawler idling and travelling time

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

Unit : sec

Standard value
15.4±1

(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.

Unit : sec

Standard value
34±3

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

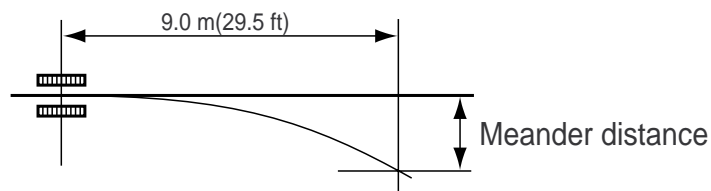
10-6 Inspection and adjustment

1. Measuring meander distance in travelling
Measure the meandering distance by travelling on hard ground.

Unit : mm or less

Standard value
565

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

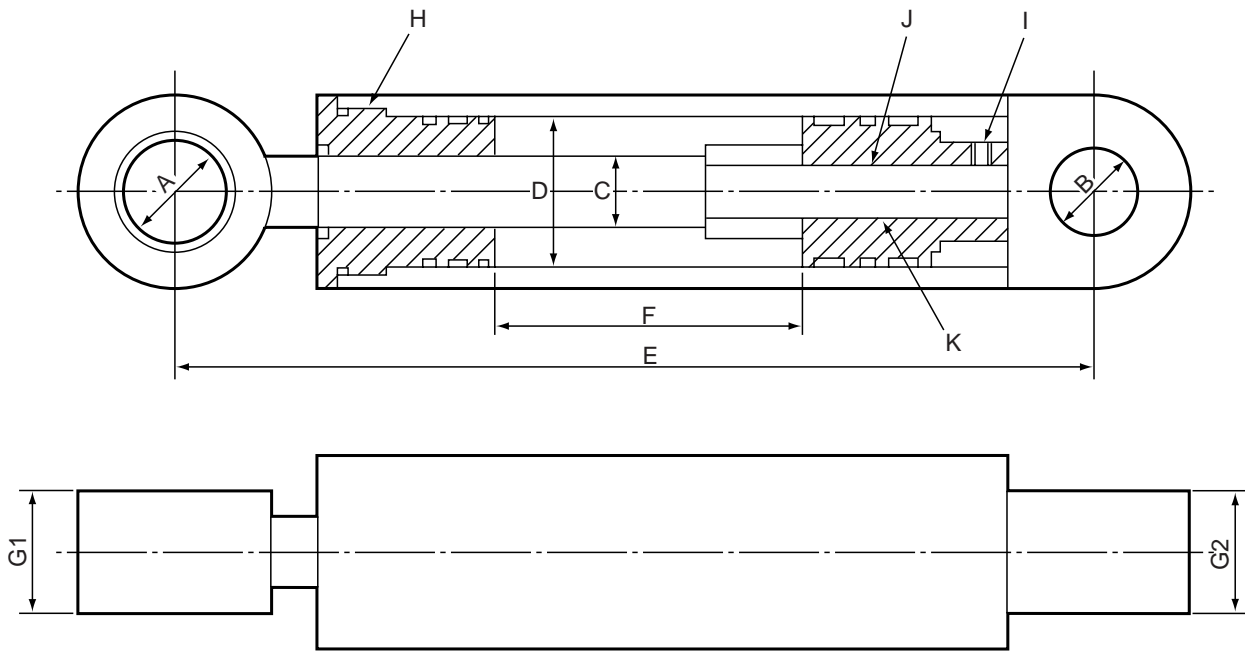


11 HYDRAULIC CYLINDER

CONTENTS

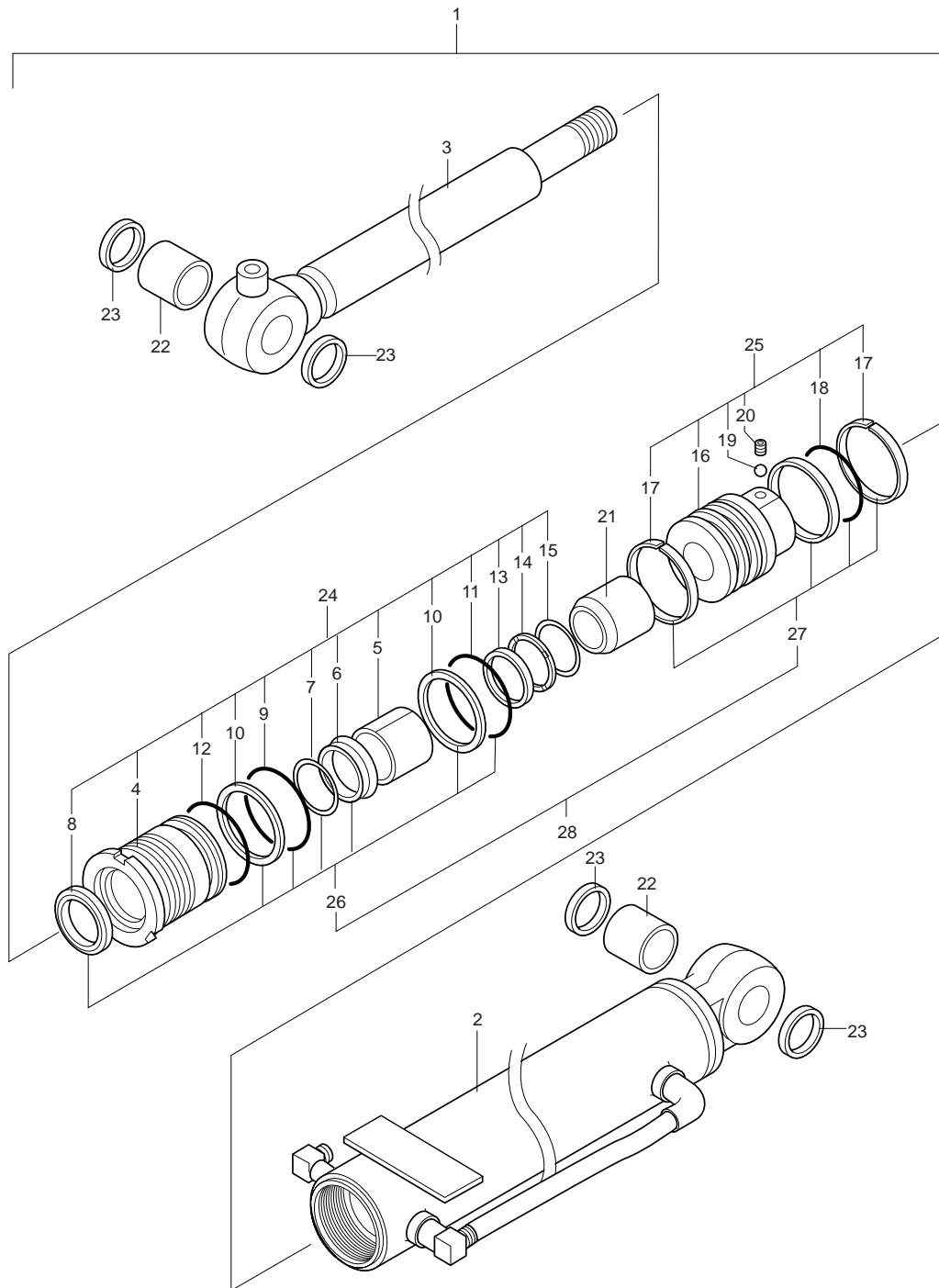
- 11-1 Structure
- 11-2 Disassembly and assembly
 - 11-2-1 Disassembly procedure
 - 11-2-2 Procedure for disassembling inner parts
- 11-3 Assembly
 - 11-3-1 Assembly procedure
 - 11-3-2 Inspection procedure
 - 11-3-3 Precautions for assembly

11-1 Structure



Item		Cylinder	Boom	Arm	Bucket	Swing	Dozer	Extend	
Weight kg(lb)			12.5	12	12	12.5	8.5	11	
Trust force*	Pushing	KN	54						
	Pulling	KN	40.5						
A	Pin diameter (rod)	mm	ø30						
B	Pin diameter (head)	mm	ø30						ø35
C	Rod diameter	mm	ø35			ø30			
D	Cylinder bore	mm	ø60						ø55
E	Maximum extended length	mm	980	1,016	820	974	555	876	
	Maximum contracted length	mm	620	620	520	635	455	536	
F	Stroke	mm	360	396	300	339	100	340	
G1	Clevis width	mm	45						35
G2									65
H	Tightening torque	N-m(kgf-m)	284(29)						265(27)
I	Tightening torque	N-m(kgf-m)	6.8(0.7)						9.8(1.0)
J	Tightening torque	N-m(kgf-m)	314(32)		373(38)		314(32)	-	
K	Size of piston screw (size × pitch)		M20×1.5		M24×1.5		M20×1.5		
*Main relief pressure MPa(kgf-cm ²)			19.1(190)						

11-2 Disassembly and assembly



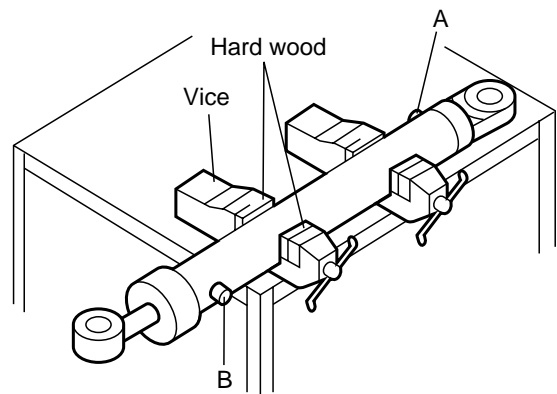
The illustration shows a boom cylinder.

- | | | |
|-------------------|---------------------|--------------------------|
| 1. Cylinder Ass'y | 9. Backup ring | 17. Dust seal |
| 2. Tube | 10. O-ring | 18. Cylinder head Ass'y |
| 3. Rod | 11. Piston | 19. Piston Ass'y |
| 4. Cylinder head | 12. Slide ring | 20. Rod packing Ass'y |
| 5. Rod bush | 13. Seal ring Ass'y | 21. Piston packing Ass'y |
| 6. U-ring | 14. Steel ball | 22. Packing Ass'y |
| 7. Wiper ring | 15. Set screw | |
| 8. O-ring | 16. Pin bush | |

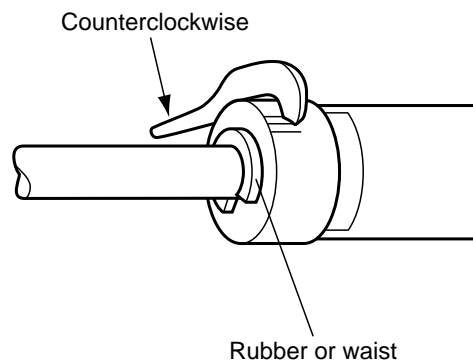
11-2-1 Disassembly procedure

1. Hold the cylinder with the vice.

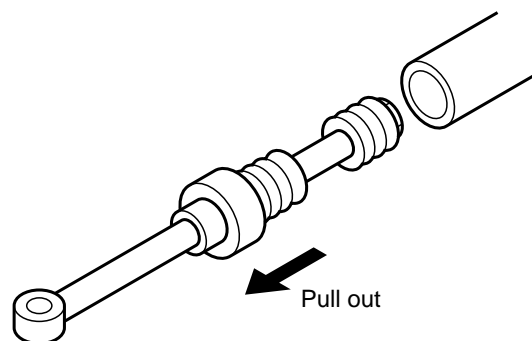
Tighten the vice carefully; do not deform the cylinder. Blow air alternately from ports A and B and operate the piston rod to drain oil from the cylinder inside. To remove the piston, pull the piston rod about a third of the length.



2. Loosen and remove the cylinder head from the cylinder tube assembly with a hook wrench.



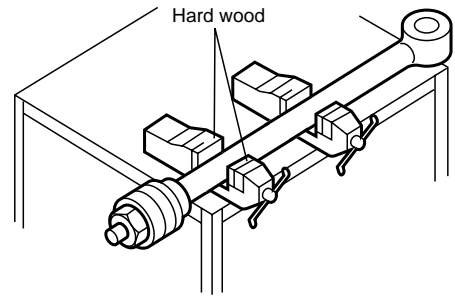
3. Disassembling the piston rod assembly
Slowly turn the piston rod assembly to remove it from the cylinder tube assembly. Place the removed piston rod assembly on a wooden bench or a waste to prevent damage.



4. Disassembling the piston assembly

Hold the piston rod assembly with a 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.



11-2-2 Procedure for disassembling inner parts

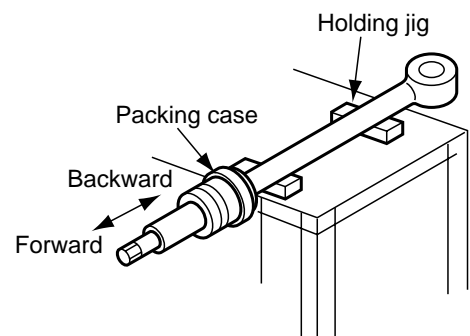
1. Remove the piston assembly from the piston rod assembly (after removing the set bolts). Then remove the cushion bearing in the direction of the arrow.

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.

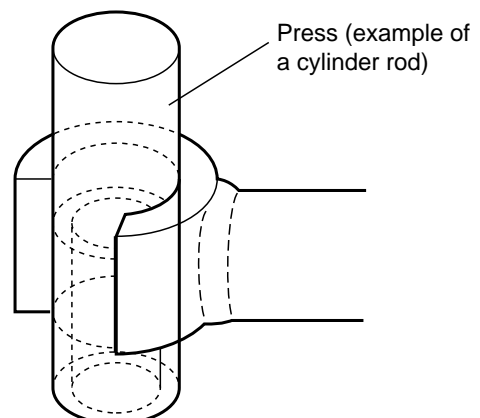


3. Disassembling the packing assembly

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



11-3 Assembly

11-3-1 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

11-3-2 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.

11-3-3 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, bucket and swing) and seal rings (arm and swing).
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 11-1).
5. Check fully before starting assembly work.

12 SWIVEL JOINT

CONTENTS

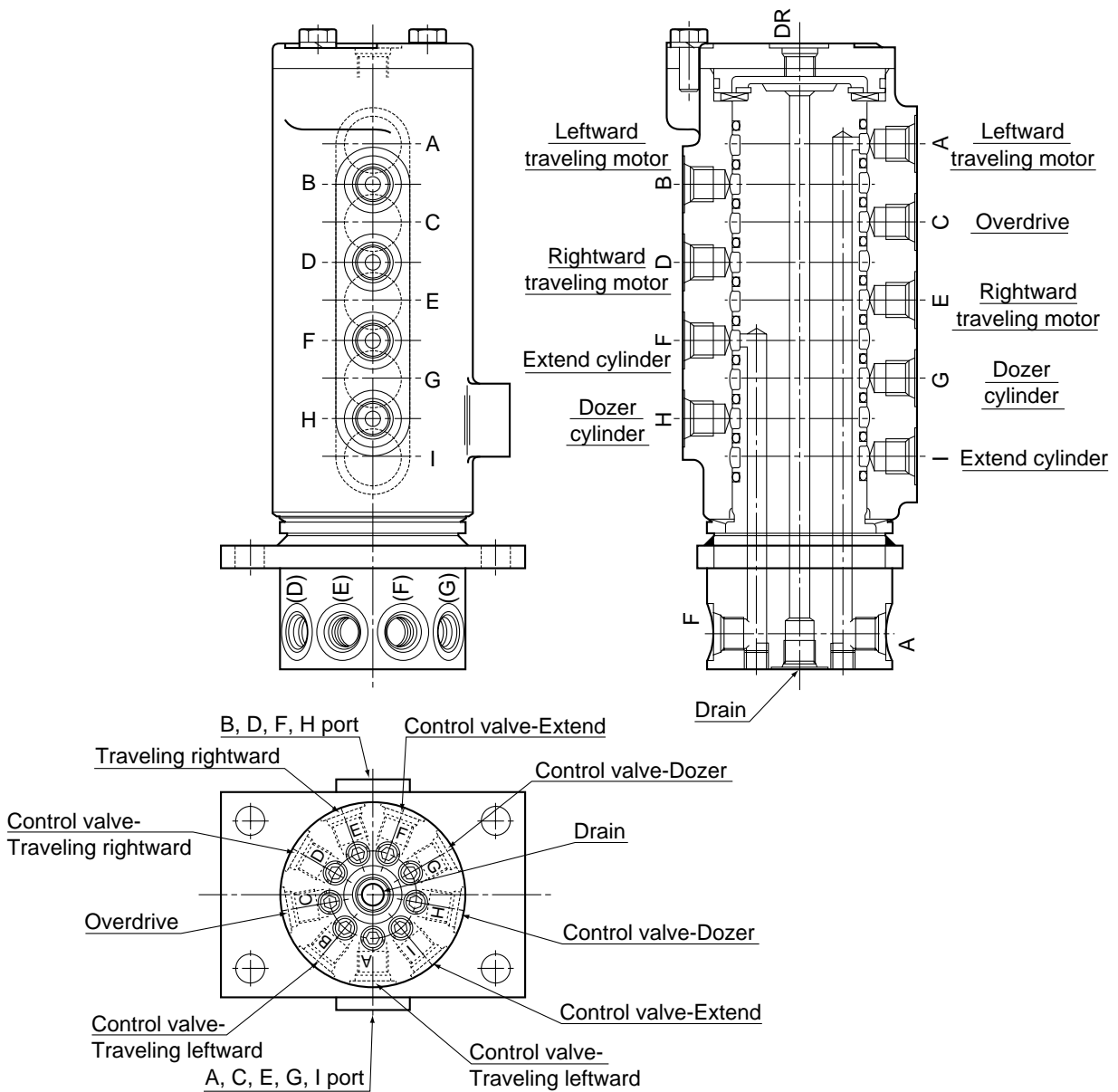
12-1 Specification and Structure

12-2 Structure, disassembly and assembly

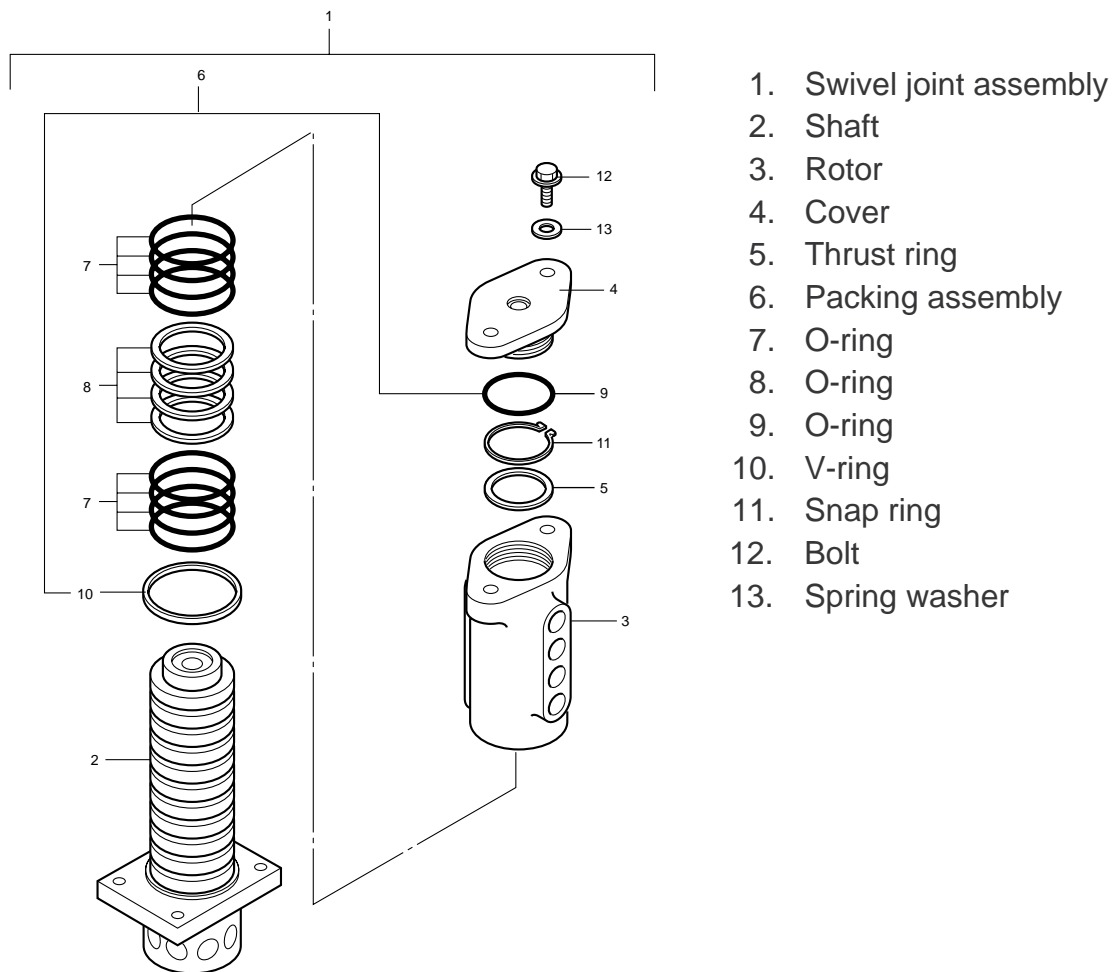
12-1 Specification and Structure

Working pressure	0.3MPa(3kgf/cm ²)	DR
	18.6MPa(190kgf/cm ²)	A~I
Screw size	PF 1/4	DR
	PF 1/4	A~I
Working speed	15 min ⁻¹	

*A to I and Dr denote the position of the port.



12-2 Structure, disassembly and assembly



Disassembly:

1. Remove bolt (12) and cover(4).
2. Remove the snap ring (11).
3. Remove the shaft (2) from the rotor(3). 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.

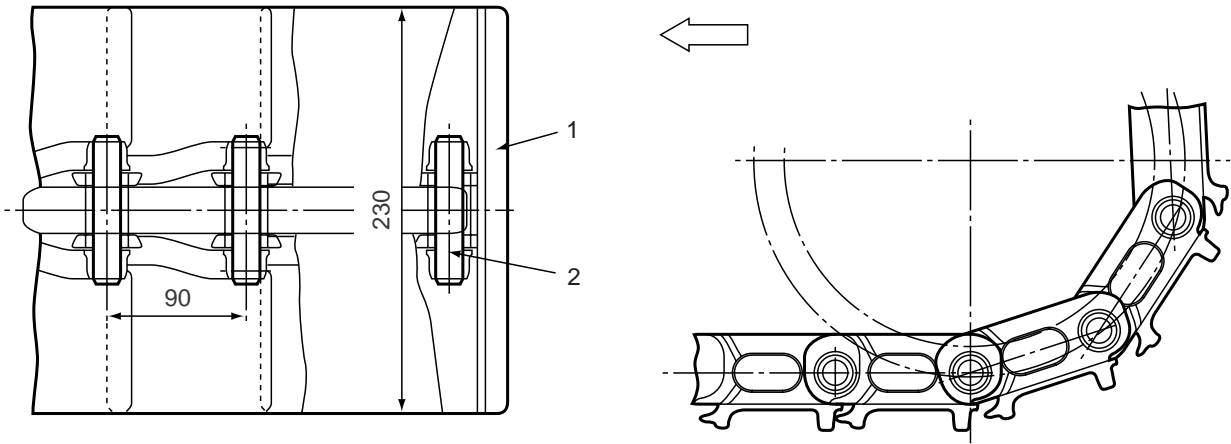
13 CRAWLER

CONTENTS

- 13-1 Structure and operation
 - 13-1-1 Crawler (Steel)
 - 13-1-2 Track frame
- 13-2 Standard of maintenance
 - 13-2-1 Crawler (Steel)
- 13-3 Disassembly and assembly
 - 13-3-1 Installing the crawler
 - 13-3-2 Removing the crawler
 - 13-3-3 Track frame spring
 - 13-3-4 Life of the rubber crawler
 - 13-3-5 Handling the rubber crawler

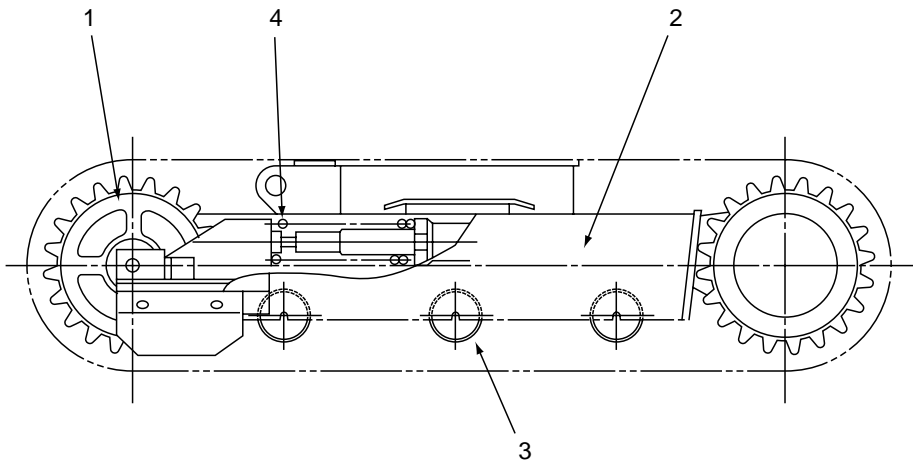
13-1 Structure and operation

13-1-1 Crawler (steel)



- 1. Shoe
- 2. Pin

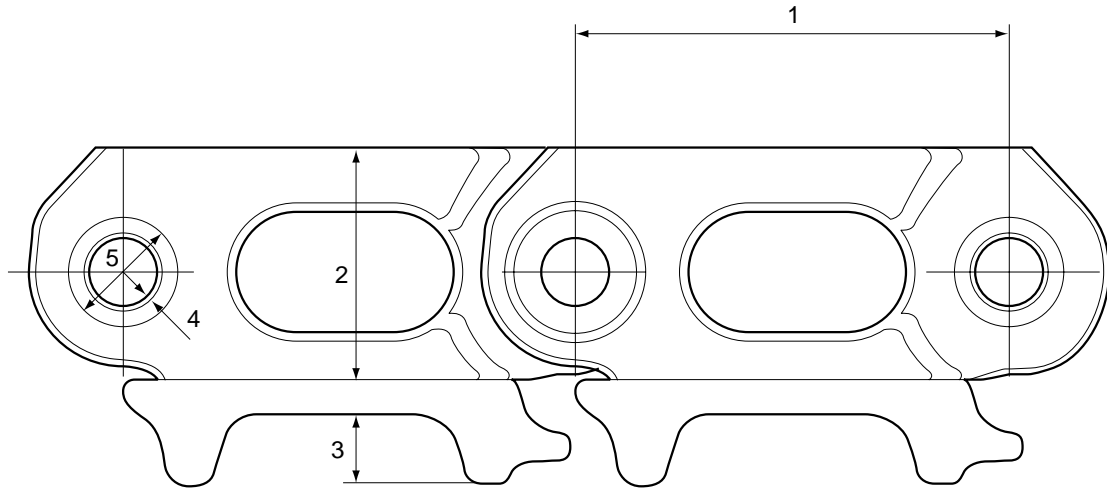
13-1-2 Track frame



- 1. Idler
- 2. Track frame
- 3. Track roller
- 4. Spring

13-2 Standard of maintenance

13-2-1 Crawler (steel)



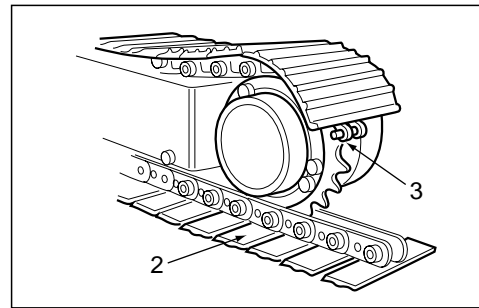
No.	Item	Unit	Standard value	Allowance	Remarks
1	Link pitch	mm	90	94	Measure by stretching 5 links except for the master link
2	Link height		46	43	Pad or replace
3	Grouser height		115	7	Pad or replace
4	Pin clearance		0.2	2	Replace
5	Bush outer diameter		22.15	21	Replace

13-3 Disassembly and assembly

13-3-1 Installing the crawler

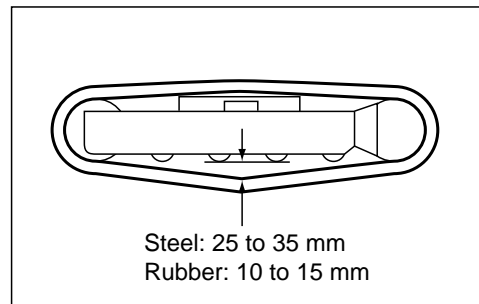
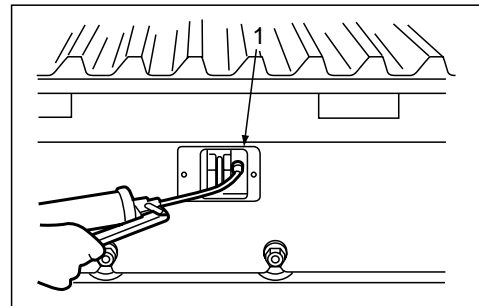
1. Crawler

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

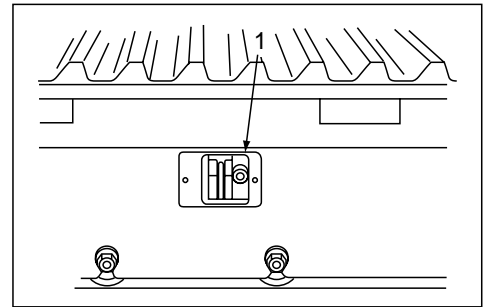
Tighten the cartridge valve (1) of the adjust cylinder, grease and adjust the tension.



13-3-2 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

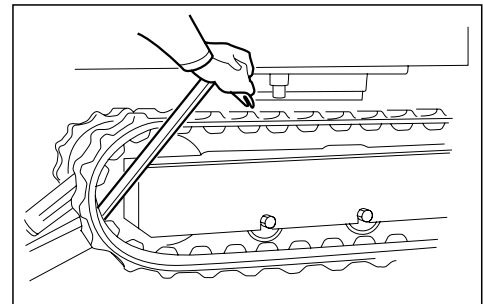
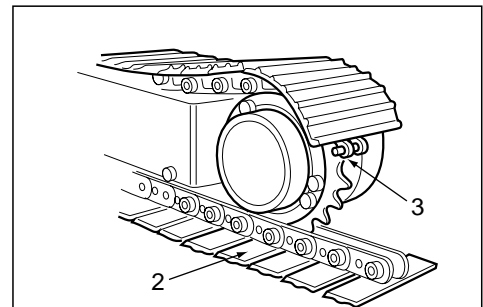
1) Lift the main frame with attachment and put blocks under to lift the machine.

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

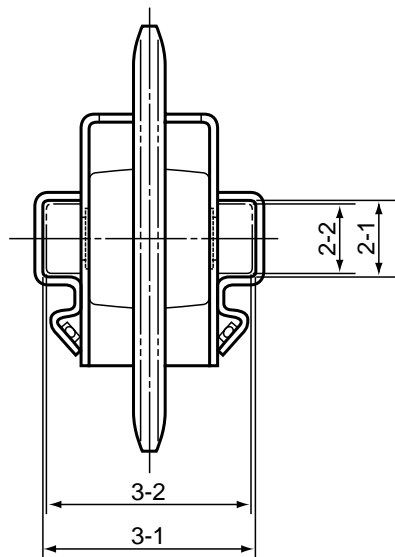
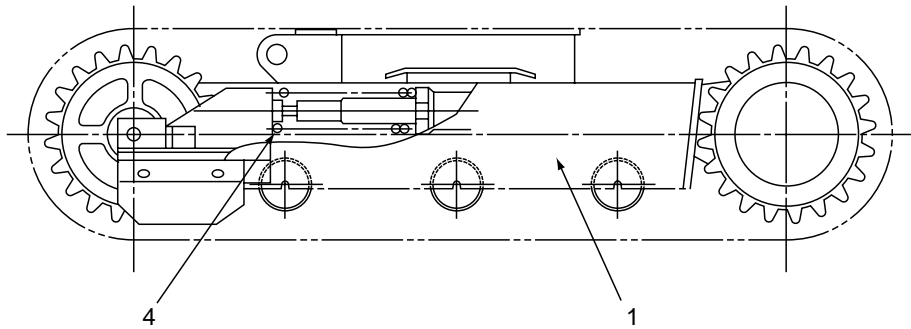
Weight (steel crawler): 148 kg (74×2)

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): 102 kg (51×2)



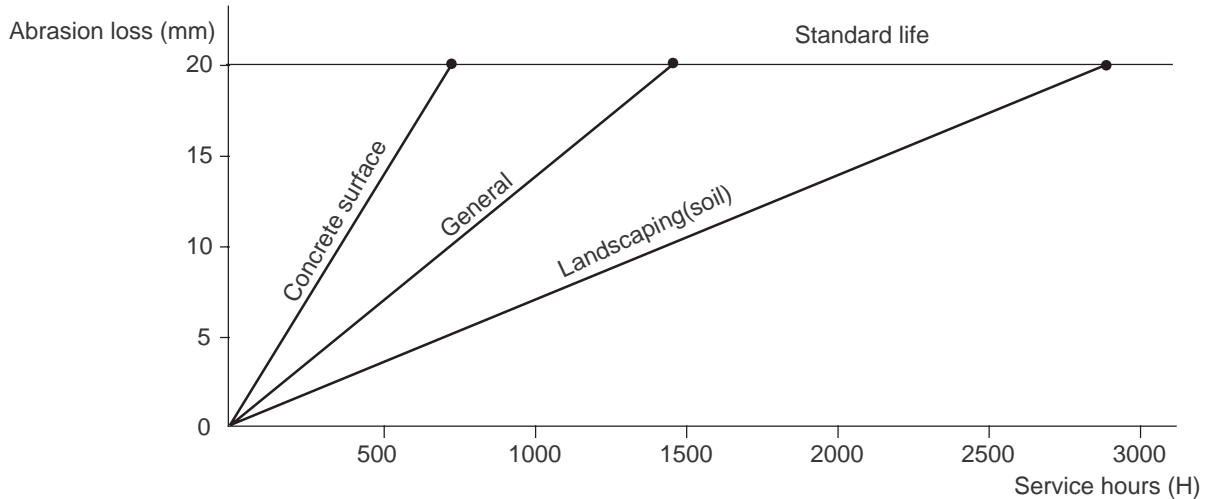
13-3-3 Track frame spring



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	52^{+1}_{-0}	
		2-2 Idler frame	50	
3	Distance between left and right faces of idler guide	3-1 Track frame	151	Replace
		3-2 Idler support	150	
4	Spring (free length)	Standard value	261	Replace
		Set length	223	

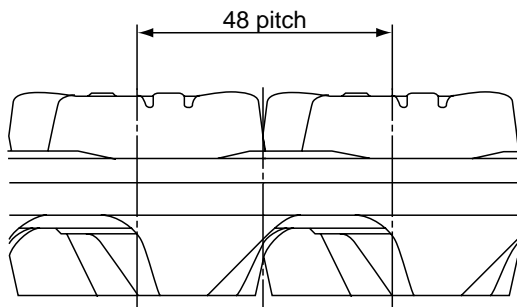
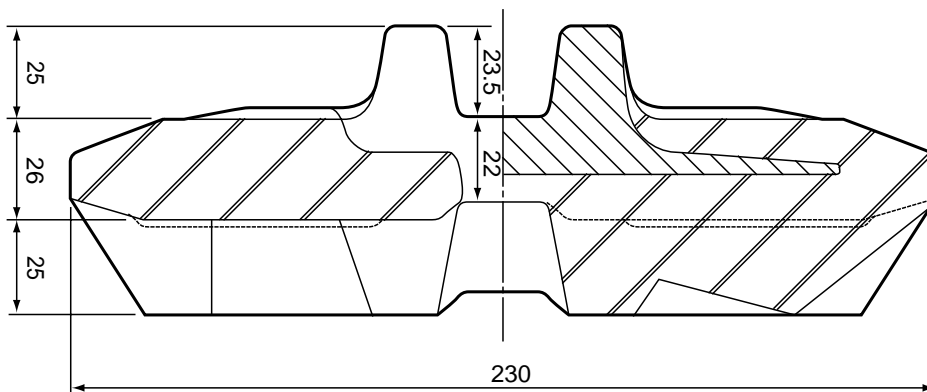
13-3-4 Life of the rubber crawler



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		3,168±10
Steel cord	Tension	580 kg/piece
Steel cord	No. of cords	12±2
Range of working temperature		-25°C~55°C
Width × pitch		230×48

13-3-5 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

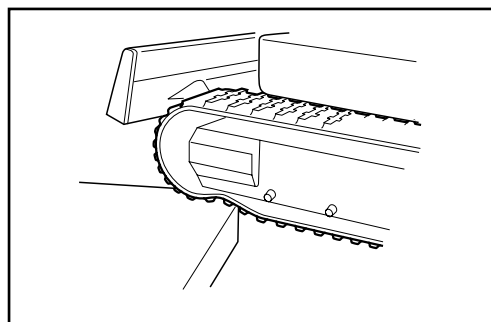
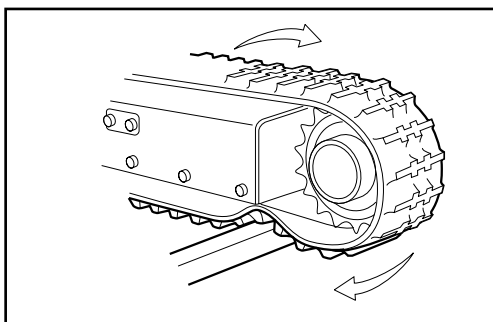
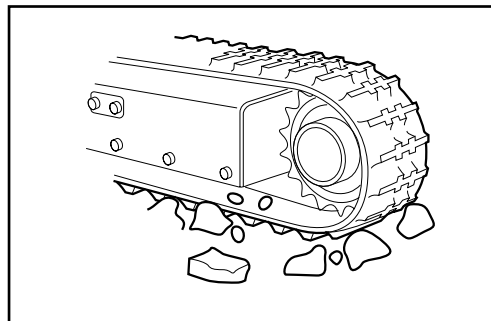
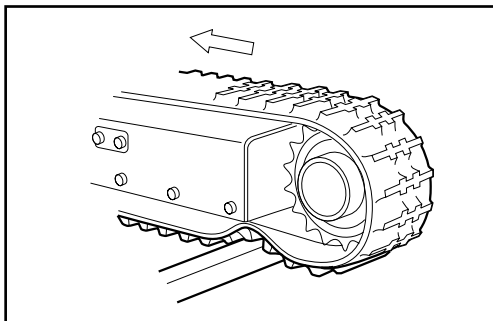
If you spill fuel or hydraulic fluid on the rubber crawler, clean it promptly.

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.



14 SPRING CASE AND GREASE CYLINDER

CONTENTS

14-1 Structure

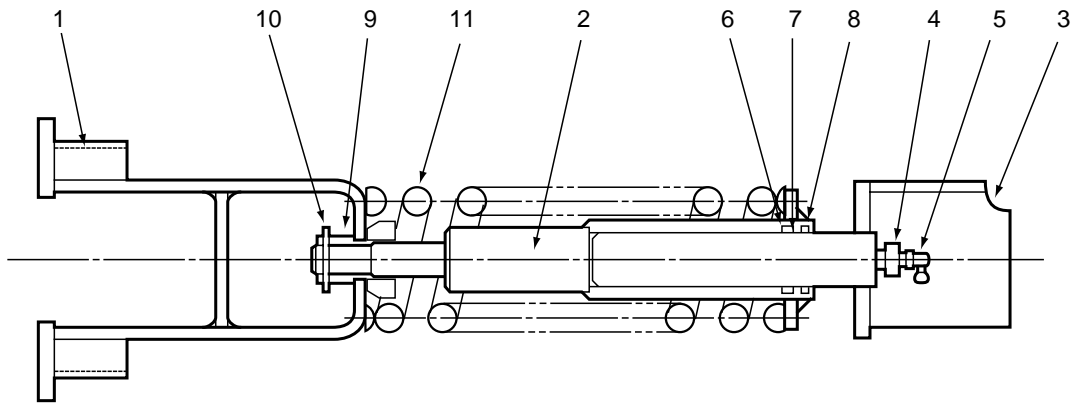
14-2 Specification of spring

14-3 Disassembly and assembly

14-3-1 How to disassemble and assemble the adjust
cylinder

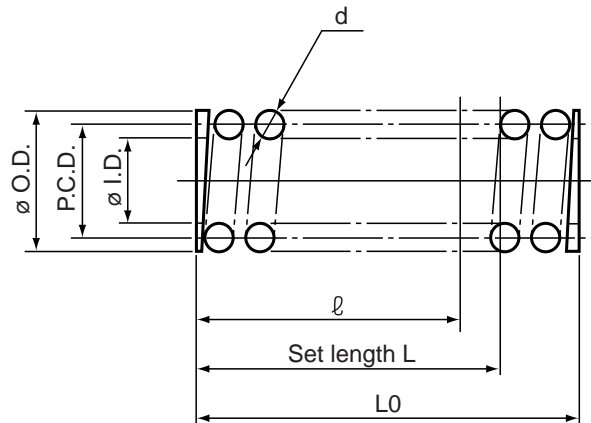
14-3-2 How to disassemble and assemble the
spring case

14-1 Structure



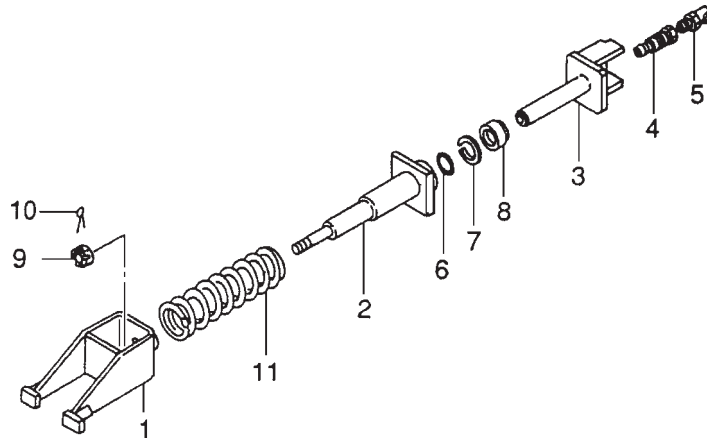
- | | |
|----------------------------|--------------------------|
| 1. Idler folk | 7. Back up ring (T2-P40) |
| 2. Cylinder | 8. Spacer(DSI) |
| 3. Rod | 9. Castle nut |
| 4. Cartridge valve | 10. Split pin |
| 5. Grease nipple (PT1/8-C) | 11. Spring |
| 6. O-ring (IB-P30) | |

14-2 Specification of spring



Name	Value	Name	Value
No. of active coils	7	ℓ Length at max. shrinkage mm	198
Total number of coils	9	\varnothing O.D. (Outer diameter)mm	76
Spring constant kgf/mm	22.2	P.C.D. (Center diameter) mm	62
Set force kg	840	\varnothing I.D. (Inner diameter) mm	48
Force at max. shrinkage kg	1,400	Wire diameter d mm	14
Lo Free length mm	260	L set length mm	223

14-3 Disassembly and assembly



- | | |
|--------------------------------|--------------------------|
| 1. Idler folk | 7. Back up ring (T2-P40) |
| 2. Cylinder | 8. Spacer (DSI) |
| 3. Rod | 9. Castle nut |
| 4. Cartridge valve (T2-IB-P40) | 10. Split pin |
| 5. Grease nipple (PT1/8-C) | 11. Spring |
| 6. O-ring (IB-P30) | |

Cylinder effective stroke: 150 mm

14-3-1 How to disassemble and assemble the adjust cylinder

1. Disassembly

- Remove the cartridge valve from the adjust cylinder rod.
- Remove the cylinder rod from the adjust cylinder tube.
- Remove the snap ring, spacer, dust seal, backup ring and O-ring.

2. Assembly

The assembly procedure is the reverse of the disassembly procedure.

- Attach the O-ring, backup ring and spacer to adjust cylinder tube.
*Coat grease on the O-ring and dust seal before assembly.
- Attach the adjust cylinder rod to adjust the cylinder tube carefully so that the seals are not damaged. Apply grease before hand in the adjust cylinder tube. Attach the cartridge valve to the adjust cylinder rod so that the screw on the second step reaches the tapped hole. 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 adjust cylinder tube.
- Coat grease on the piston of the cylinder tube rod before assembly.
Tightening torque of the cartridge valve: 183 to 206 N-m

14-3-2 How to disassemble and assemble the spring case

1. Disassembly

Lower the spring force between the front idler and adjust cylinder tube using a pressing machine and the special purpose tool.

- a. Remove the castle nut for the mounting spring.
- b. Remove the spring from adjust cylinder tube.

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 adjust cylinder tube using the special tool and set the spring to the specified position with the castle nut.

After adjustment, completely bend the split pin.

Spring set length: 233 mm

15 IDLER

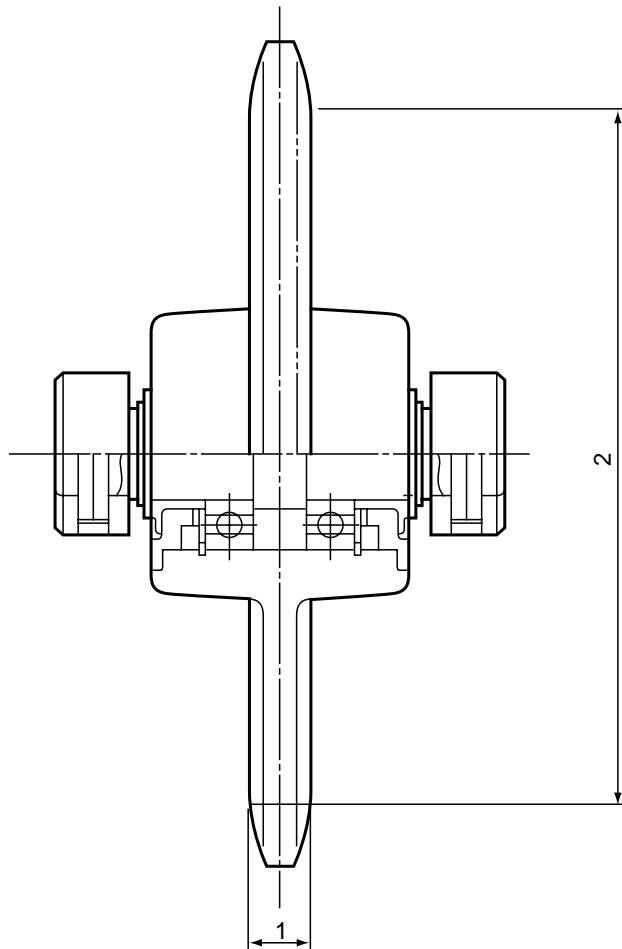
CONTENTS

15-1 Standard of maintenance

15-1-1 Idler

15-1 Standard of maintenance

15-1-1 Idler



No.	Item	Unit	Standard value	Allowance	Remarks
1	Width of idler teeth	mm	22	16	Pad or replace
2	Minor diameter	mm	ø269	ø257	Pad or replace
3	Number of teeth		19	—	
4	Quality of lubricating oil	cm ³	40	—	Engine oil or gear oil

16 SPROCKET

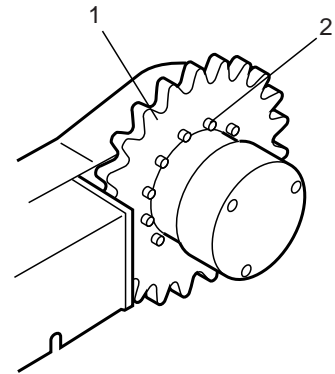
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- 16-1 Disassembly and assembly
 - 16-1-1 Removing the sprocket
 - 16-1-2 Installing the sprocket
- 16-2 Standard of maintenance
 - 16-2-1 Sprocket

16-1 Disassembly and assembly

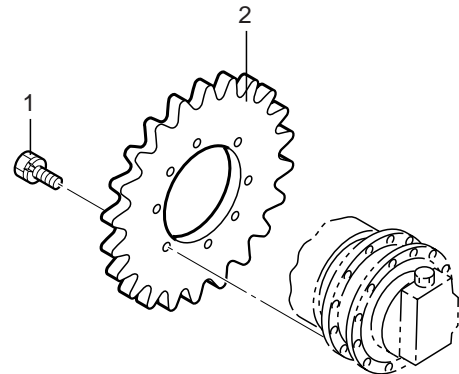
16-1-1 Removing the sprocket

1. Crawler
Refer to the explanation on crawler removal.
2. Sprocket
Remove sprocket mounting bolts (1) and then sprocket (2) from the travelling motor assembly.



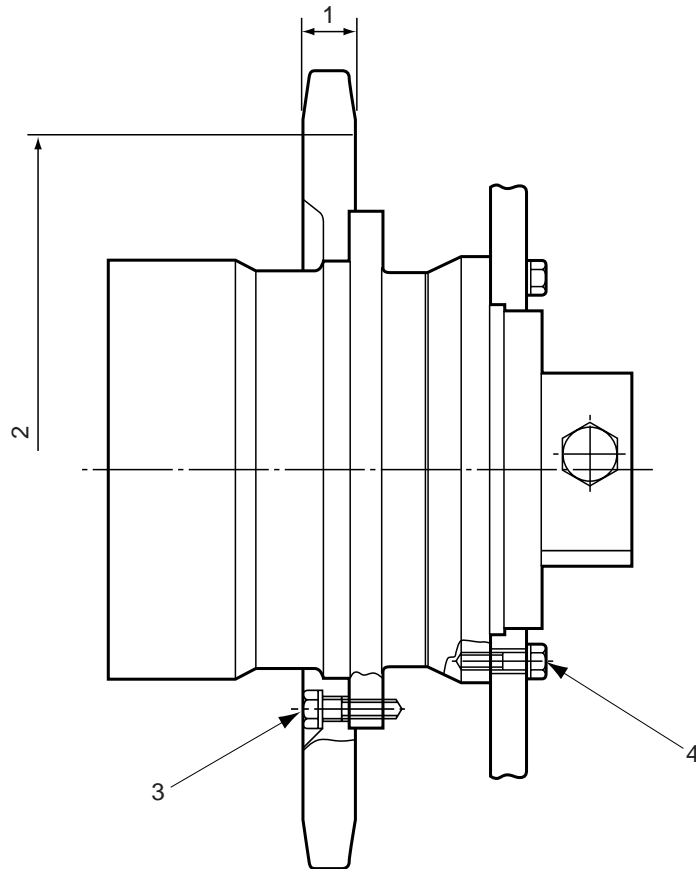
16-1-2 Installing the sprocket

1. Sprocket
Attach the sprocket to travelling motor assembly and tighten the mounting bolts (1).
Tightening torque: 82N-m (8.4kgf-m)
2. Crawler
Refer to the explanation of crawler installation.



16-2 Standard of maintenance

16-2-1 Sprocket



No.	Item	Unit	Standard value	Allowance	Remarks
1	Width of sprocket teeth	mm	22	16	Pad or replace
2	Minor diameter of sprocket	mm	ø265	ø257	Pad or replace
3	Tightening torque of sprocket mounting bolt	N-m	82 (8.4kgf-m)	←	Tighten some more. (M10 P1.5)
4	Tightening torque of motor mounting bolt	N-m	82 (8.4kgf-m)	←	Tighten some more. (M10 P1.5)

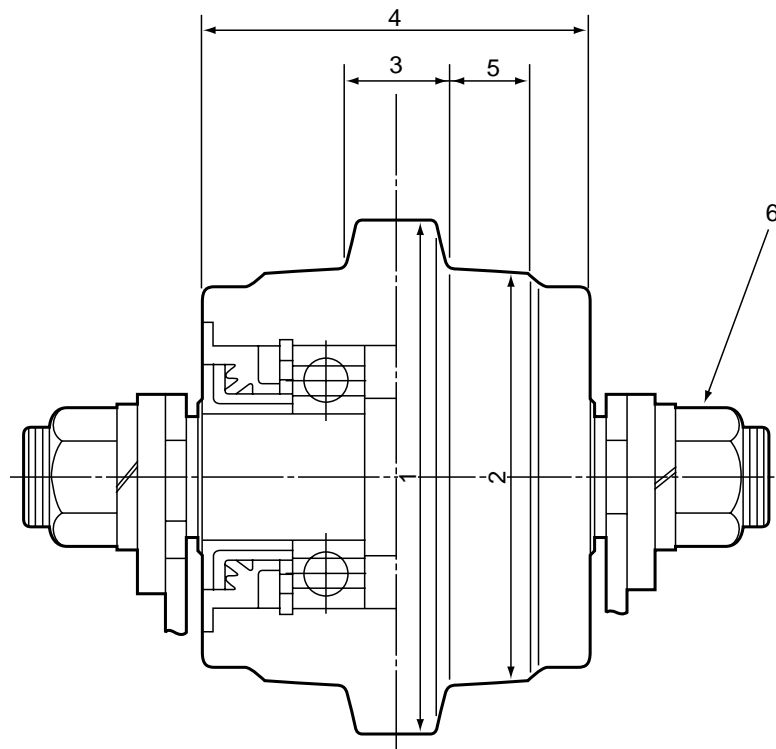
17 TRACK ROLLER

CONTENTS

- 17-1 Standard of maintenance
 - 17-1-1 Track roller

17-1 Standard of maintenance

17-1-1 Track roller



No.	Item	Unit	Standard value	Allowance	Remarks
1	Outer diameter of projected part	mm	ø100	ø92	Pad or replace
2	Outer diameter of tread	mm	ø80	ø77	Pad or replace
3	Width of projected part	mm	22	19	Pad or replace
4	Overall width	mm	80	—	Pad or replace
5	Width of tread	mm	80	—	Pad or replace
6	Tightening torque for mounting roller	N-m	170(17.3kgf-m)	←	Tighten some more.(M16 P2.0)
7	Quantity of lubricating oil	cm ³	22	←	Gear oil or engine oil

18 ELECTRICAL EQUIPMENT

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18-1 Structure and function

18-1-1 Electric circuit diagram

18-2 Failure and remedy

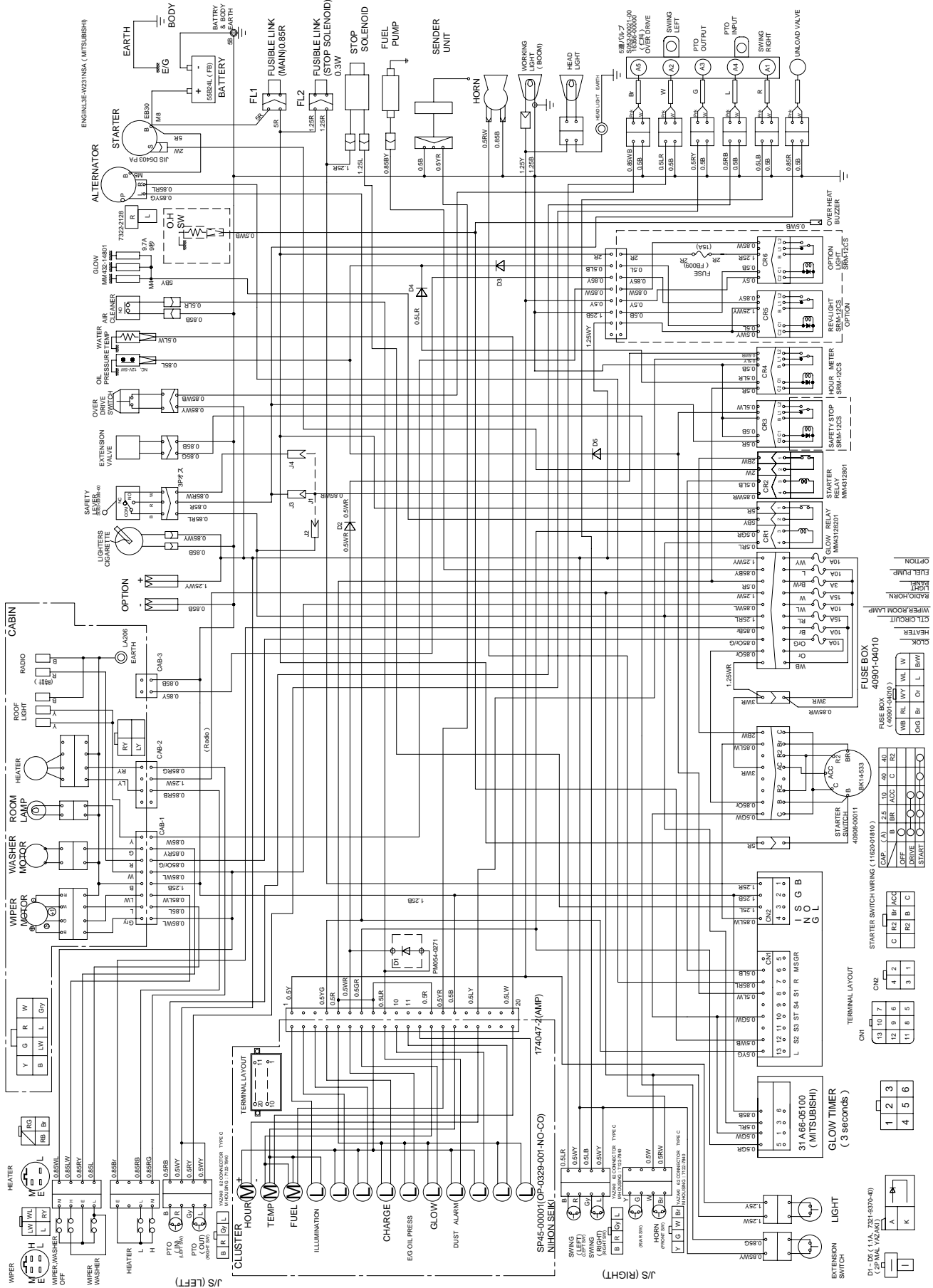
18-2-1 Starter system

18-2-2 Alternator system

18-1 Structure and function

18-1-1 Electric circuit diagram

COLOR CODE	CODE
R	RED
BL	RED/BLU
RY	RED/YEL
RYL	RED/YEL/BLU
RYW	RED/WHIT
BLW	RED/BLK
L	BLU
UL	BLU/RED
ULY	BLU/YEL
ULW	BLU/WHIT
Y	YEL
YL	YEL/BLU
YLW	YEL/WHIT
G	GRN
GR	GRN/RED
GRW	GRN/WHIT
W	WHIT
WL	WHIT/BLU
WLW	WHIT/WHIT
BLK	BLK
BLW	BLK/WHIT
BL	BLK/BLU



18-2 Failure and remedy

18-2-1 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>

18-2-2 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.

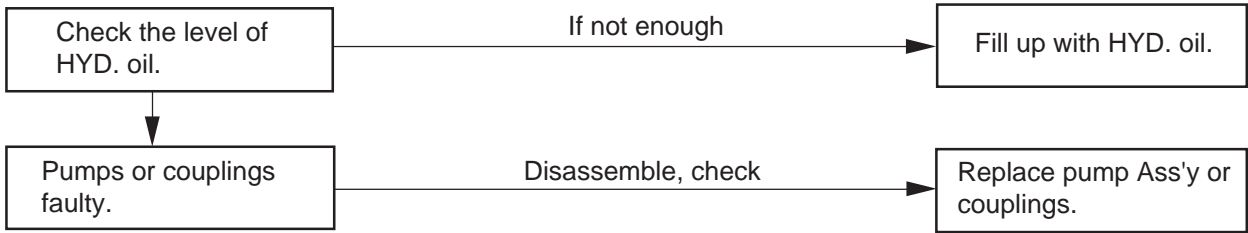
19 TROUBLESHOOTING

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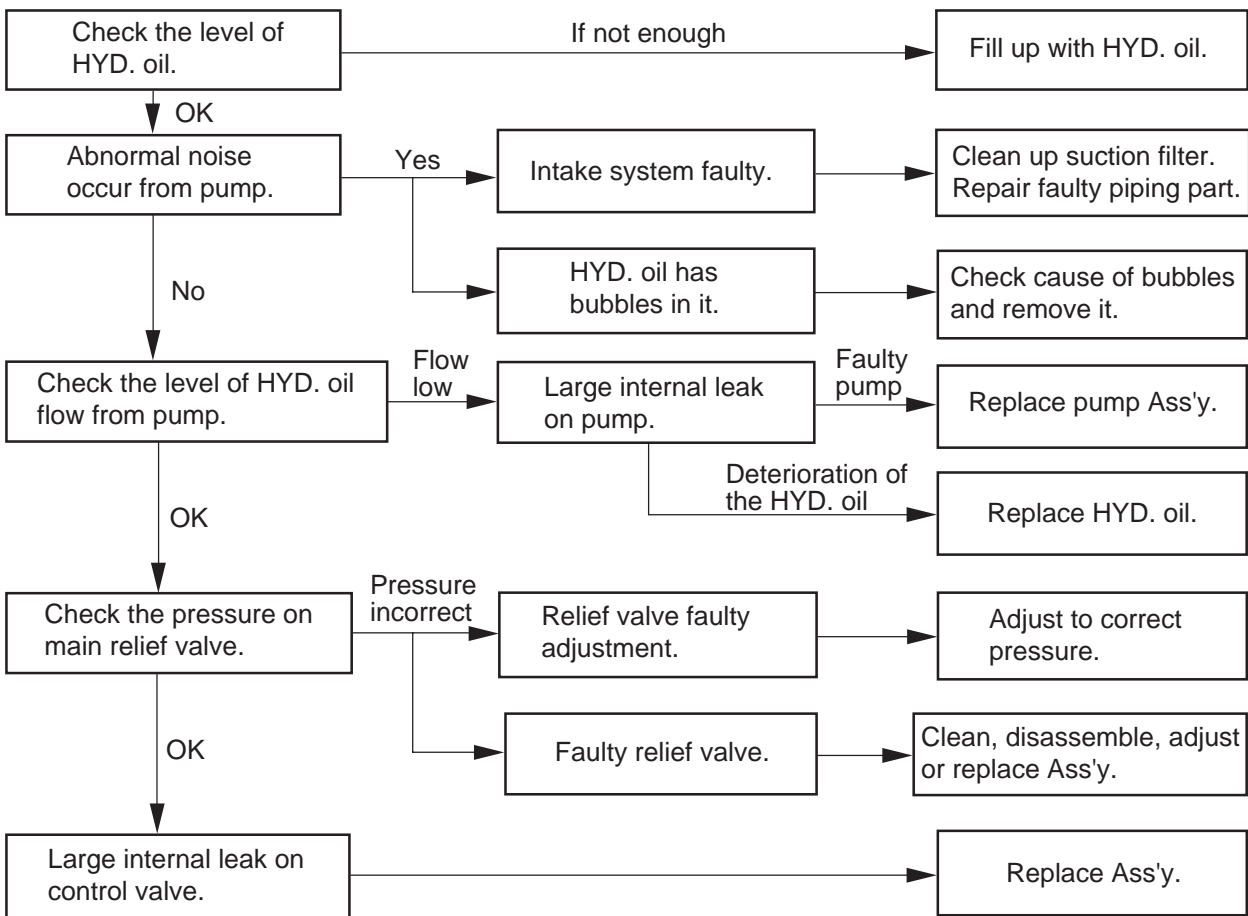
- 19-1 Troubleshooting
 - 19-1-1 All functions not operational
 - 19-1-2 Operation power is weak
 - 19-1-3 No operation on boom, arm, bucket slewing
- 19-2 Travelling system
 - 19-2-1 Right (or left) hand side of crawler does not work correctly
 - 19-2-2 Travelling meander by slow speed on only right (left) hand side
 - 19-2-3 Machine fails to hold on incline
- 19-3 Slewing system
 - 19-3-1 No operation both (right/left)slewing
 - 19-3-2 It is possible to turn right (left) but not left (right)
 - 19-3-3 Turning acceleration slow, the overturn is higher than tolerance
 - 19-3-4 Extreme slow turning speed
 - 19-3-5 Turning movement when the machine is parked on a slope
- 19-4 Boom system (for arm and bucket cylinders the same method as follows.)
 - 19-4-1 No movement on boom cylinder
 - 19-4-2 Slow action or lack of power on boom cylinder
 - 19-4-3 Natural fall of boom
- 19-5 Swing system
 - 19-5-1 No movement on swing system
 - 19-5-2 Drifting swing cylinder

19-1 Troubleshooting

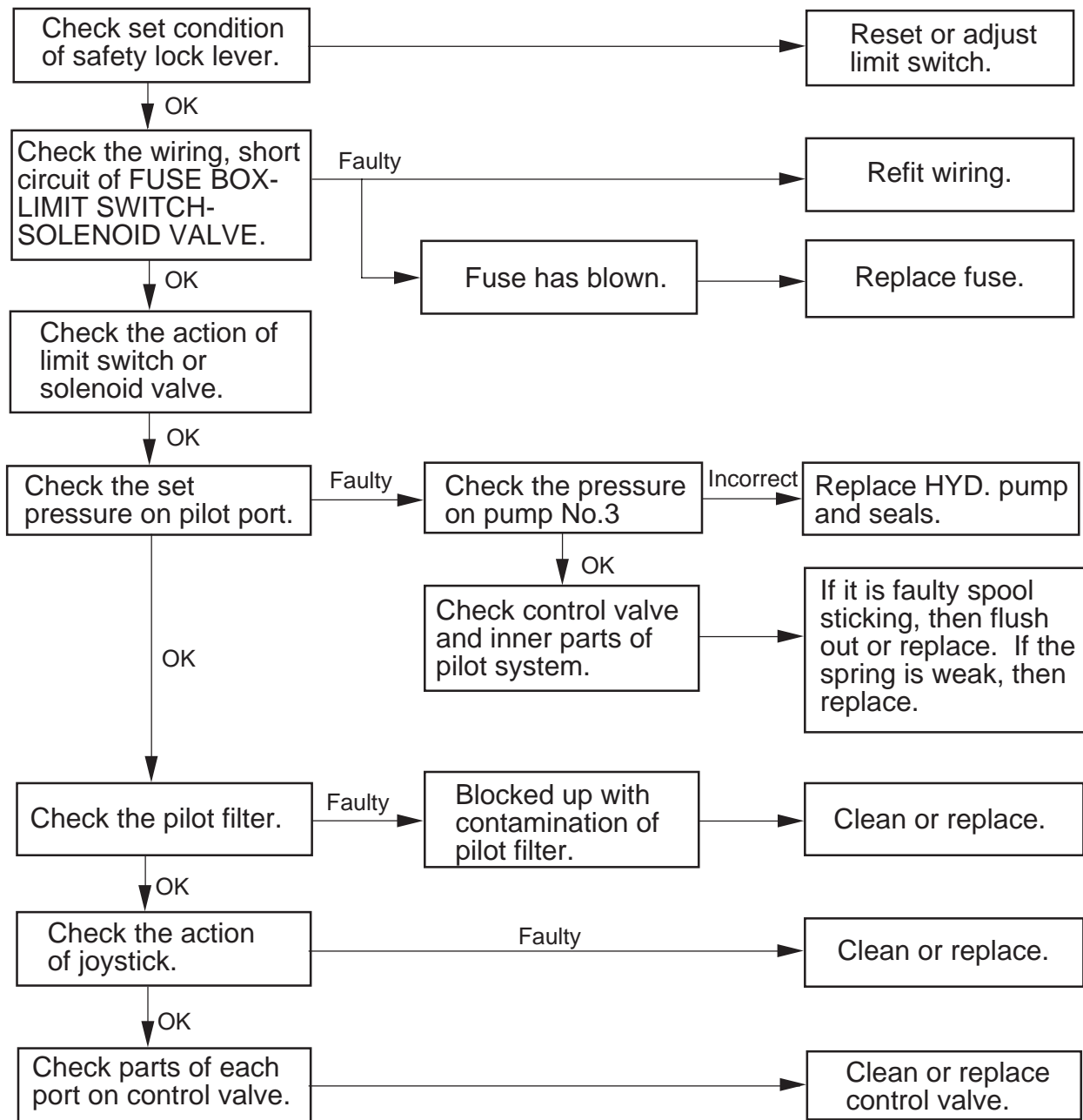
19-1-1 All functions not operational



19-1-2 Operation power is weak

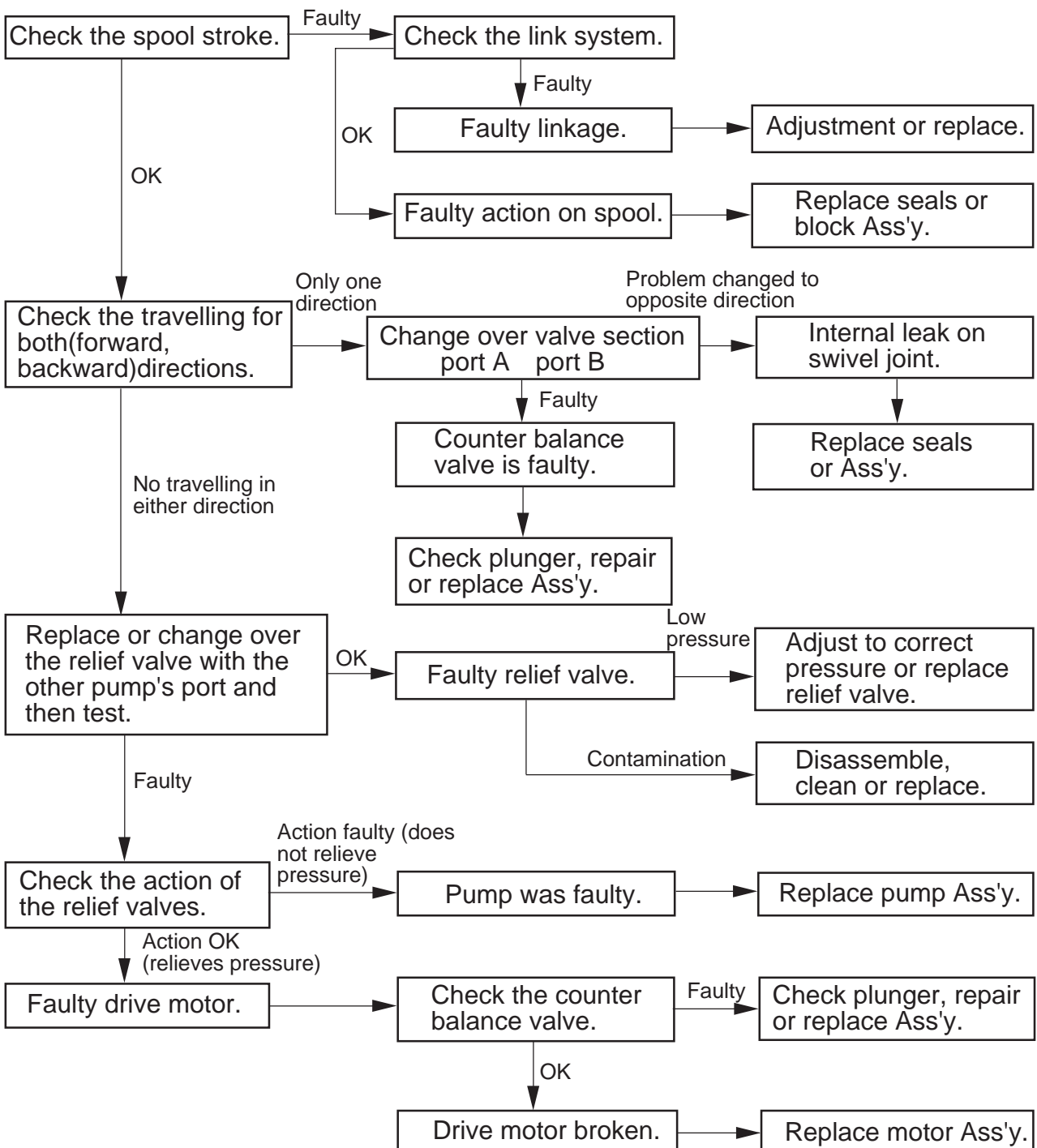


19-1-3 No operation on boom, arm, bucket & slewing

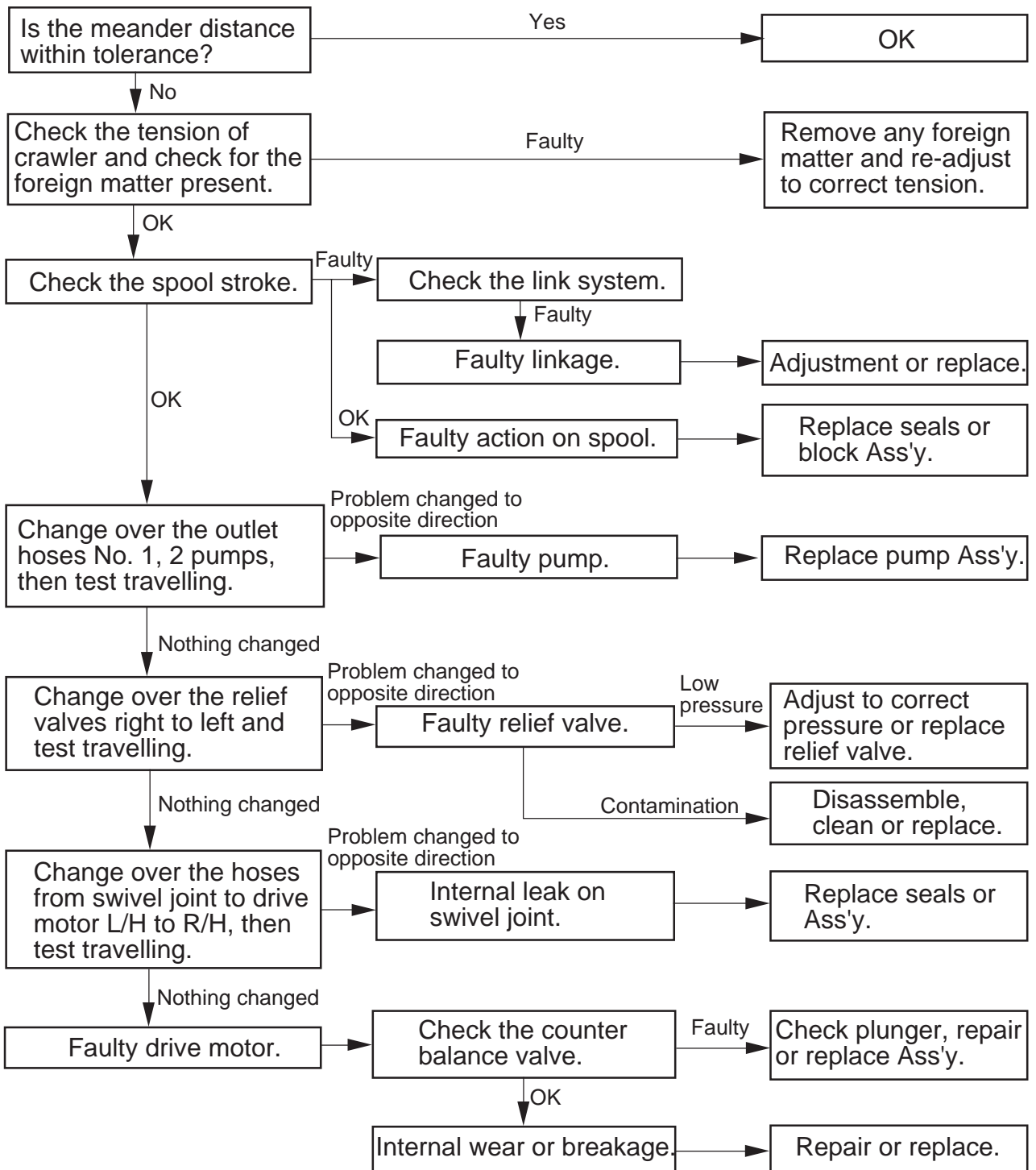


19-2 Travelling system

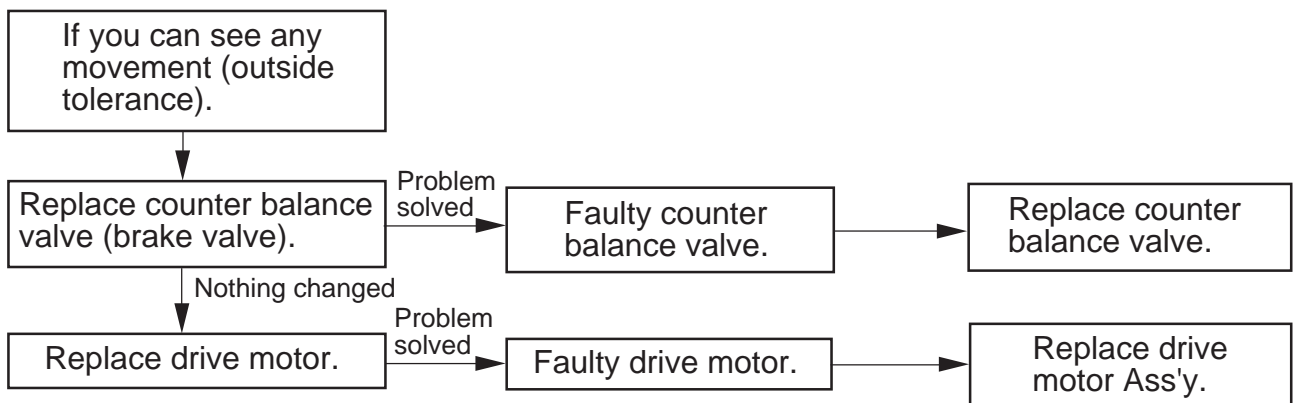
19-2-1 Right (or left) hand side of crawler does not work correctly



19-2-2 Travelling meander by slow speed on only right (left) hand side.

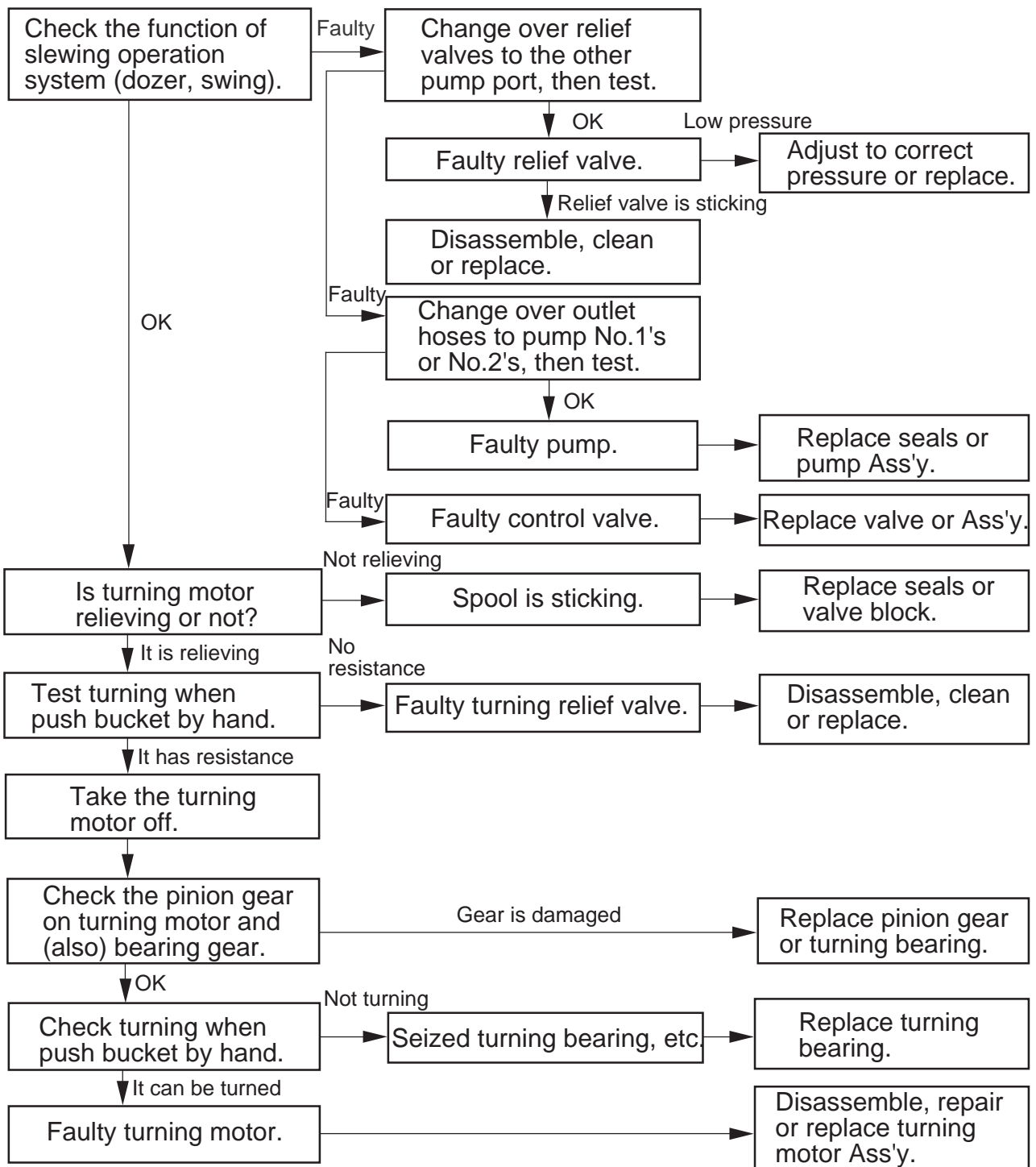


19-2-3 Machine fails to hold on incline

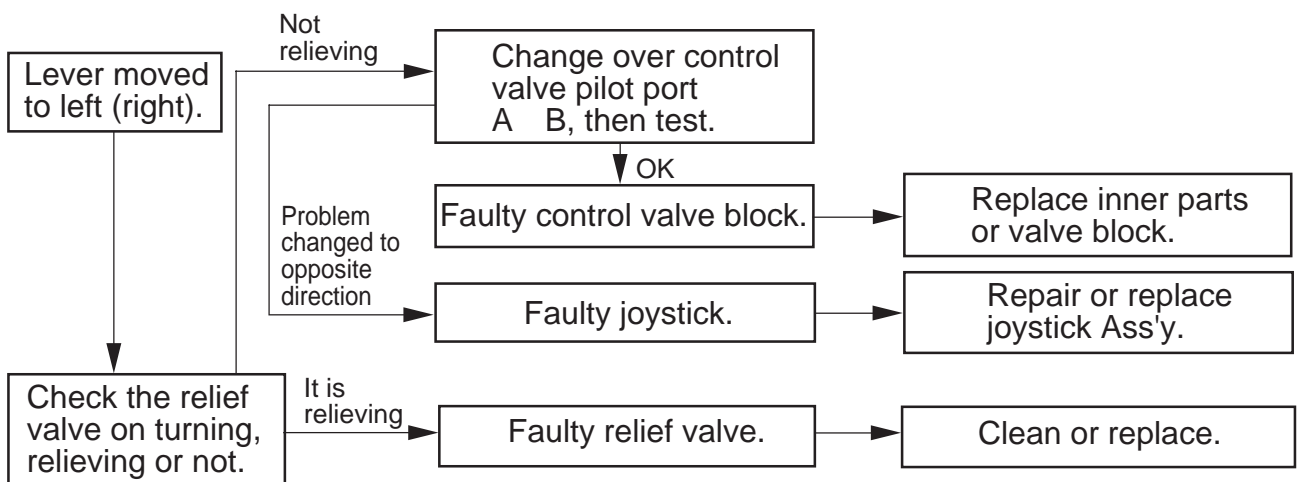


19-3 Slewing system

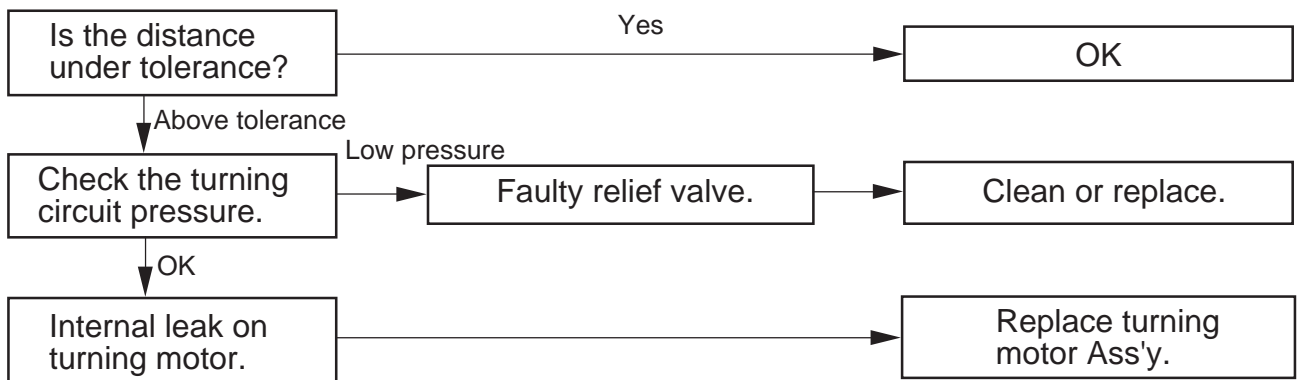
19-3-1 No operation both (right/left) slewing.



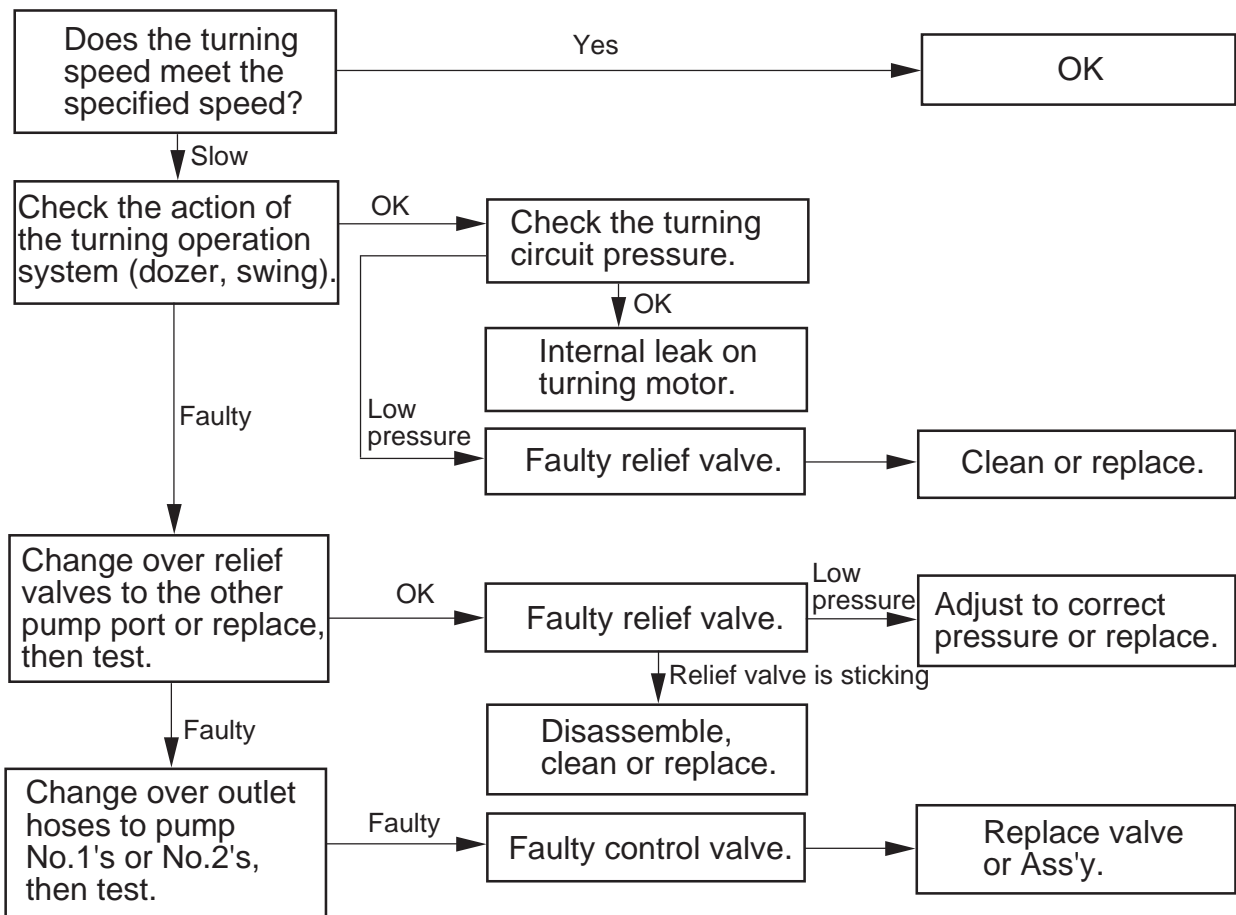
19-3-2 It is possible to turn right (left) but not left (right)



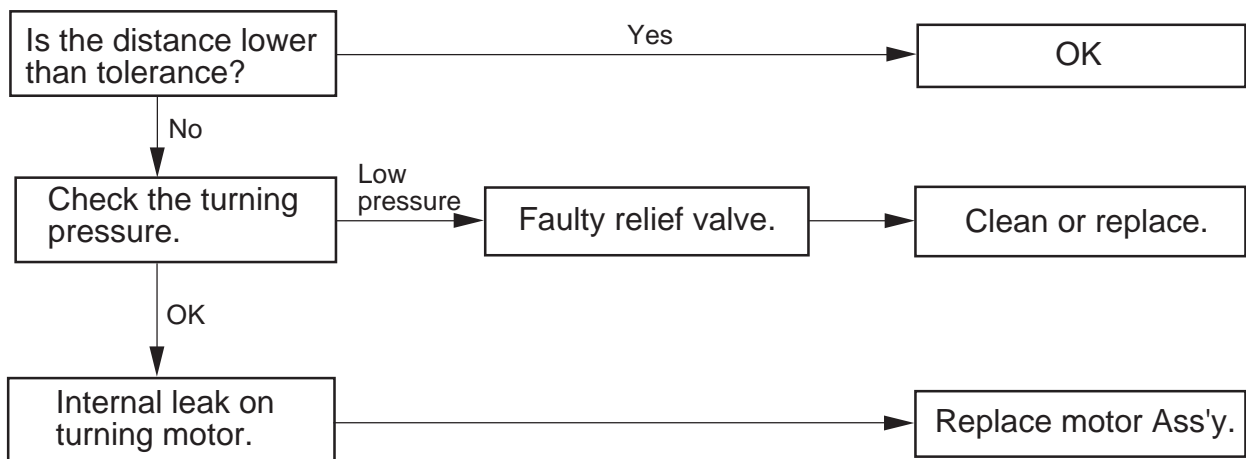
19-3-3 Turning acceleration slow, the overturn is higher than tolerance



19-3-4 Extreme slow turning speed

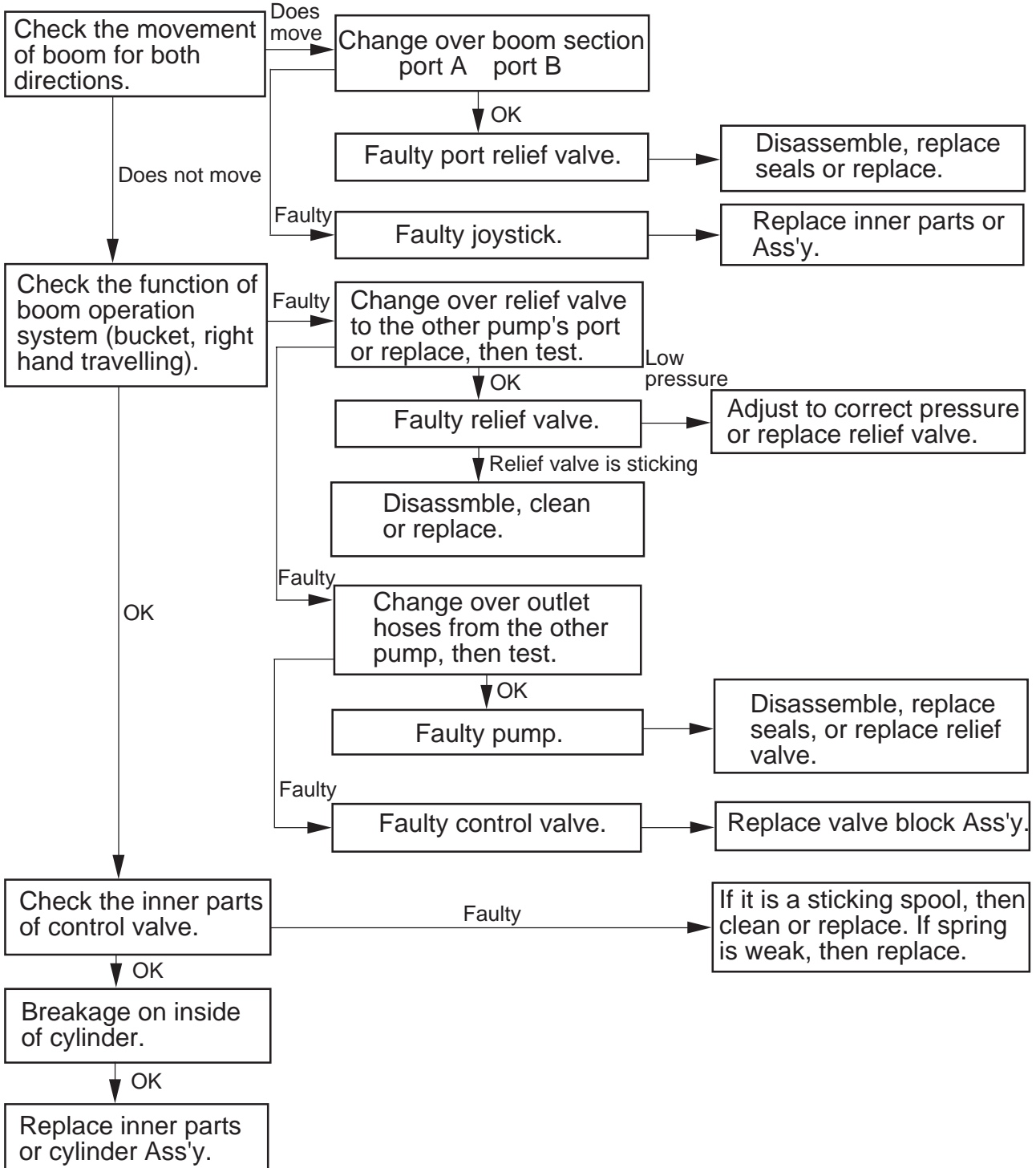


19-3-5 Turning movement when the machine is parked on a slope

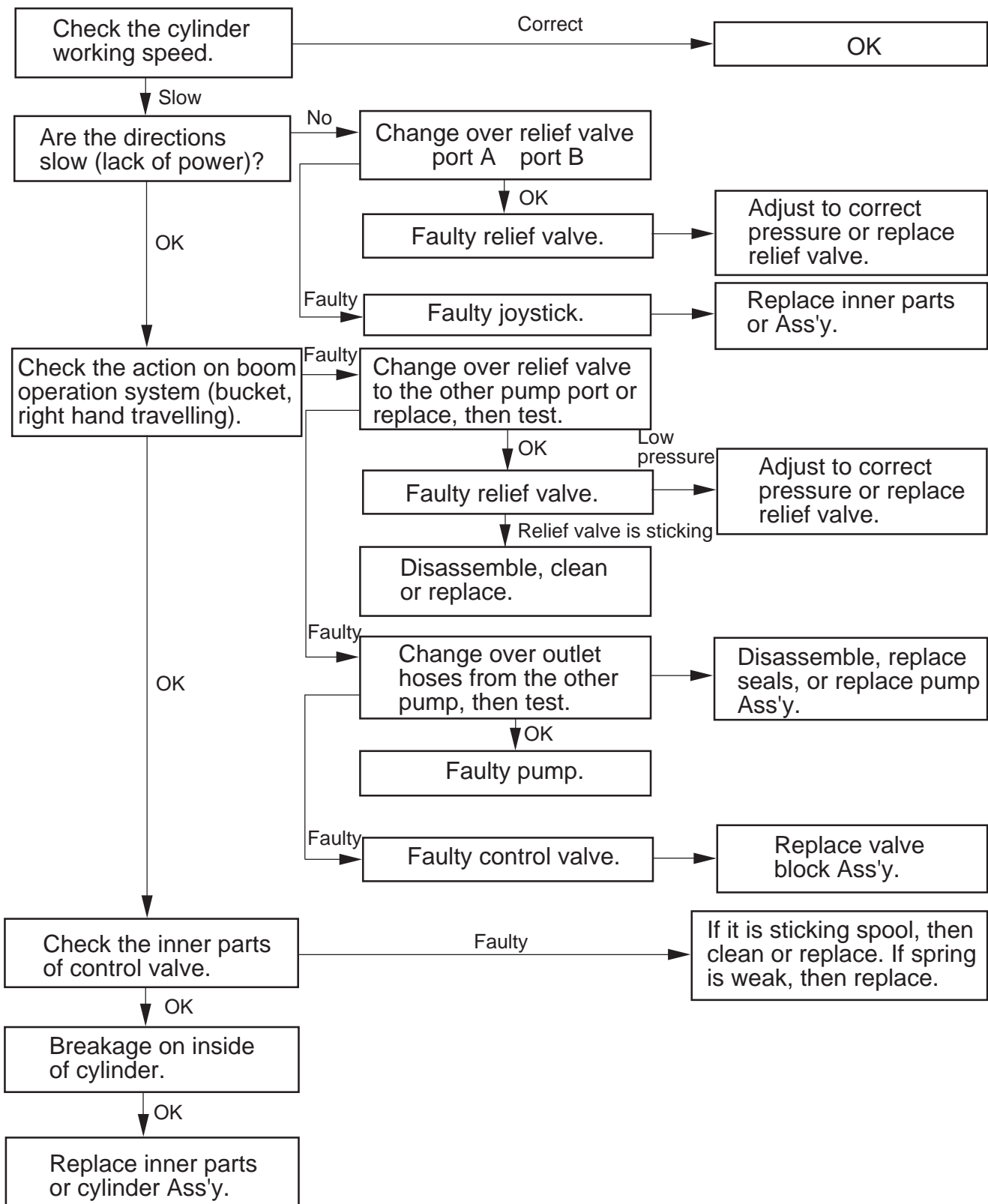


19-4 Boom system(for arm and bucket cylinders the same method as follows)

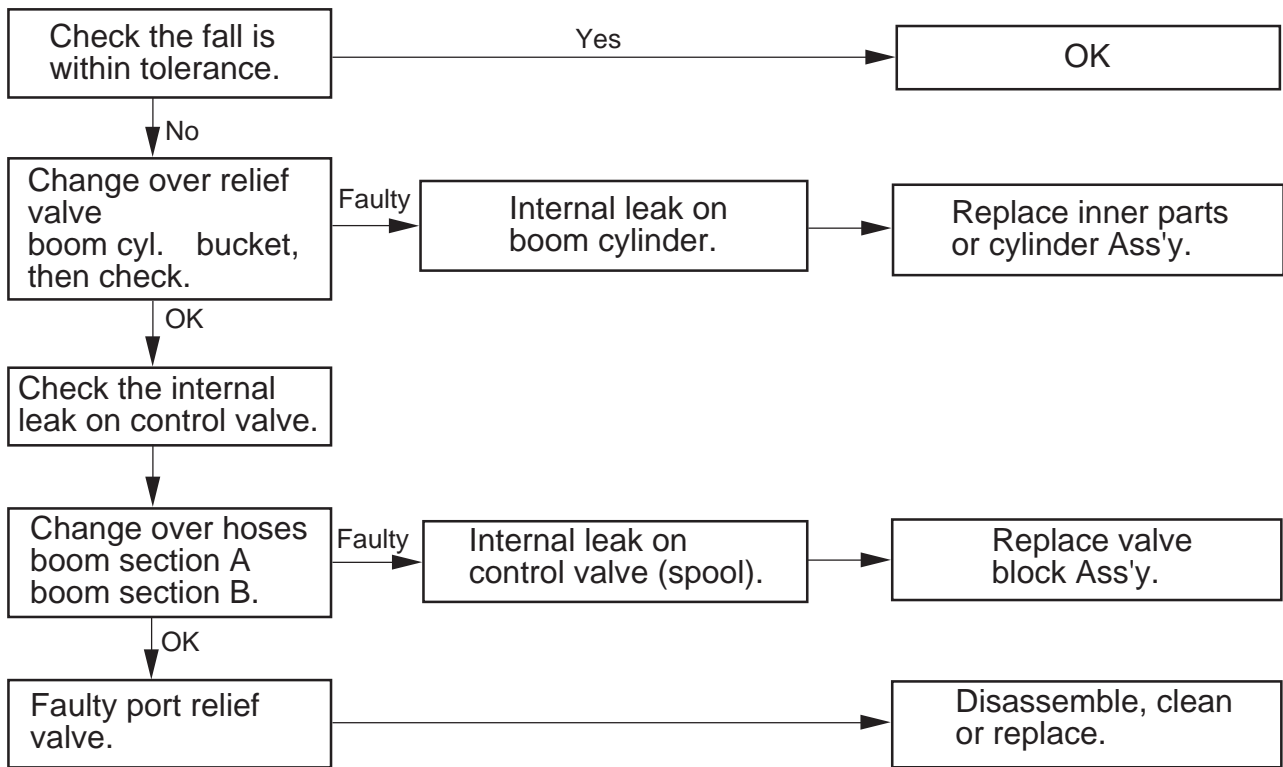
19-4-1 No movement on boom cylinder



19-4-2 Slow action or lack of power on boom cylinder

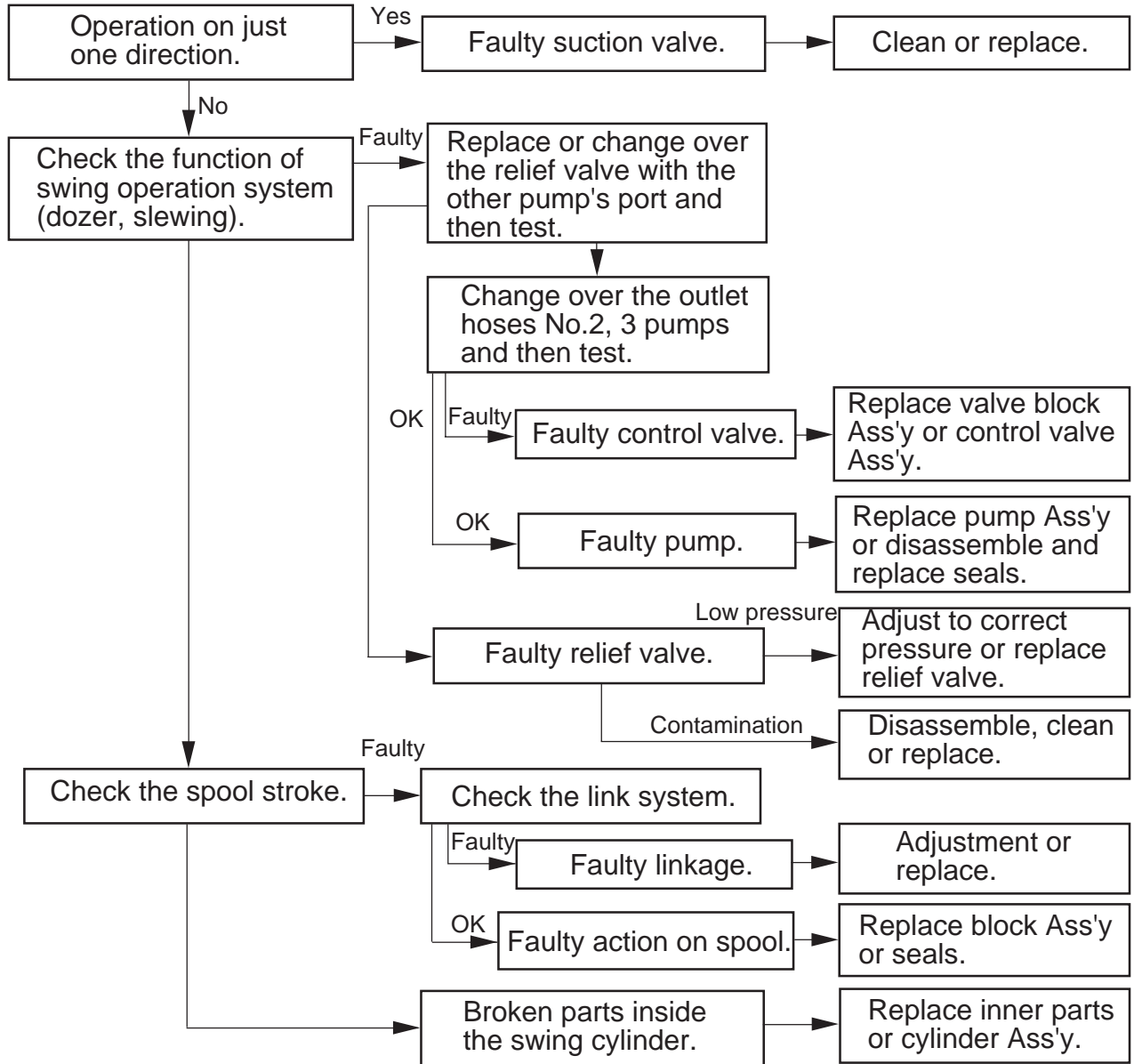


19-4-3 Natural fall of boom



19-5 Swing system

19-5-1 No movement on swing system



19-5-2 Drifting swing cylinder

