

SERVICE MANUAL

Relex 22-7

SER. NO. HY2270001~

 **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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11. Hydraulic Cylinder
12. Swivel Joint
13. Crawler
14. Spring Case and Grease Cylinder
15. Idler
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17. Track Roller
18. Electrical Equipment
19. Troubleshooting

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.

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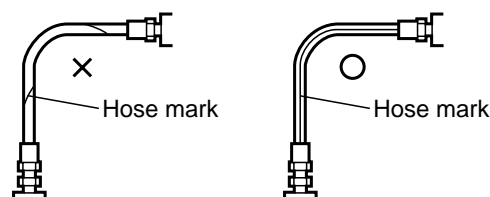
Electrical equipment, rubbers and V belts (which are easily affected by water and oil) must be handled carefully in order to prevent soiling them.

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.

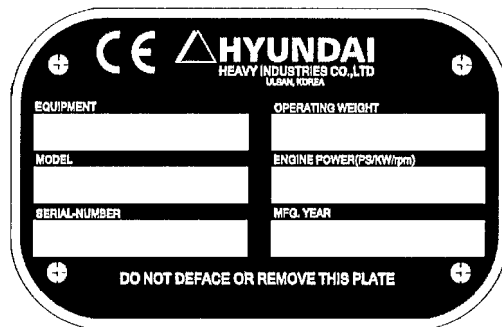
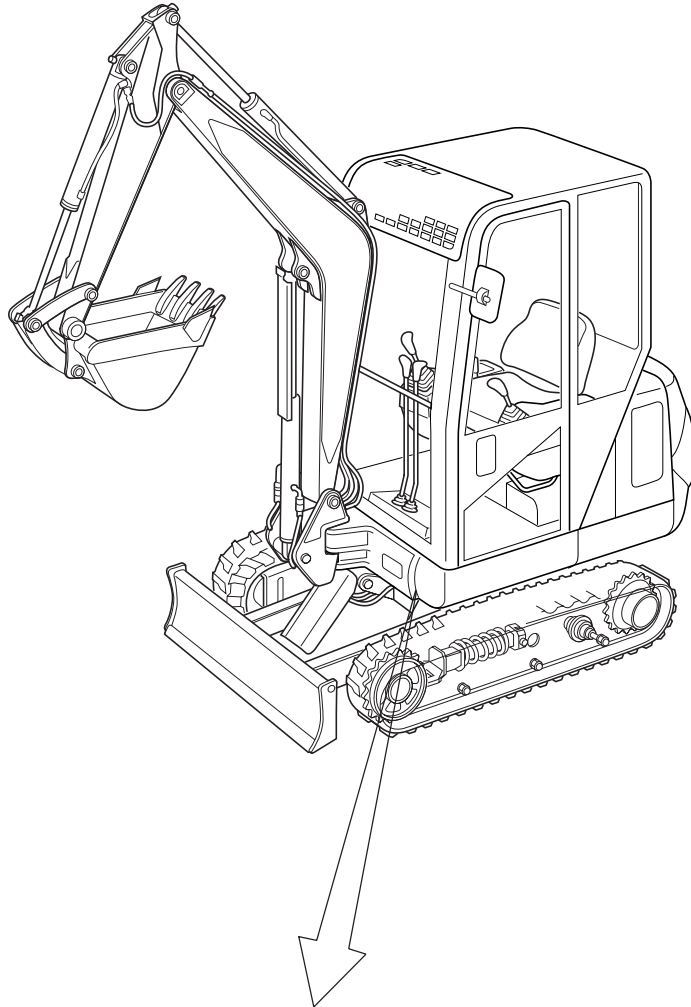


2 OUTLINE

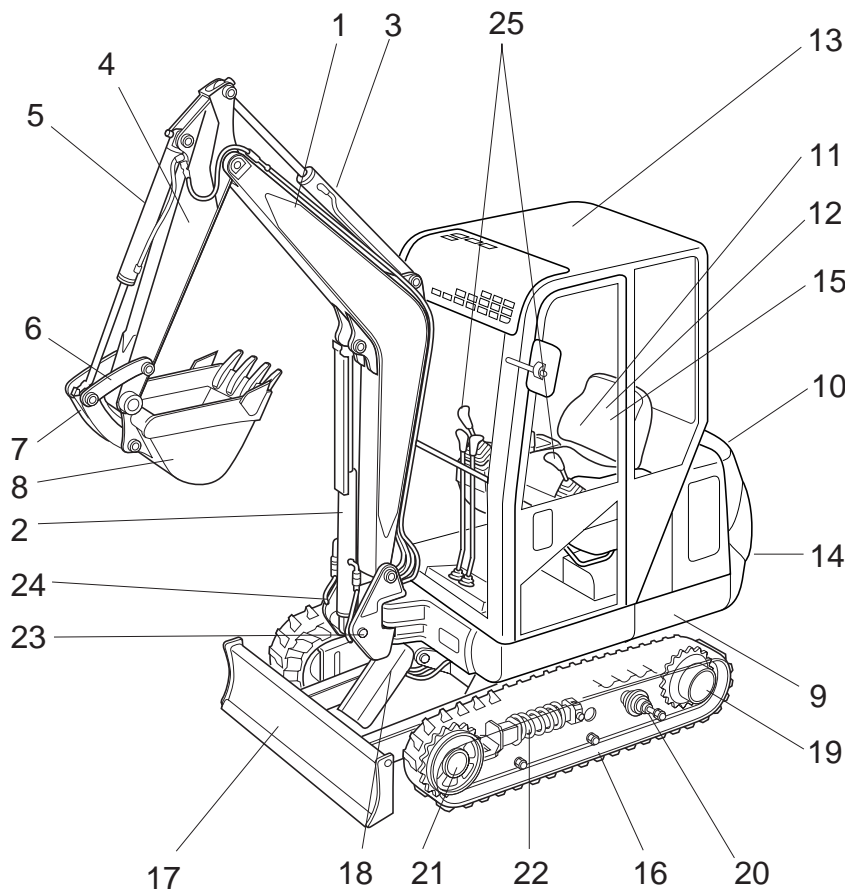
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- 2-5 Oil and grease supply points
- 2-6 List of supply oil and grease
- 2-7 When to repair
- 2-8 Hydraulic circuit diagram

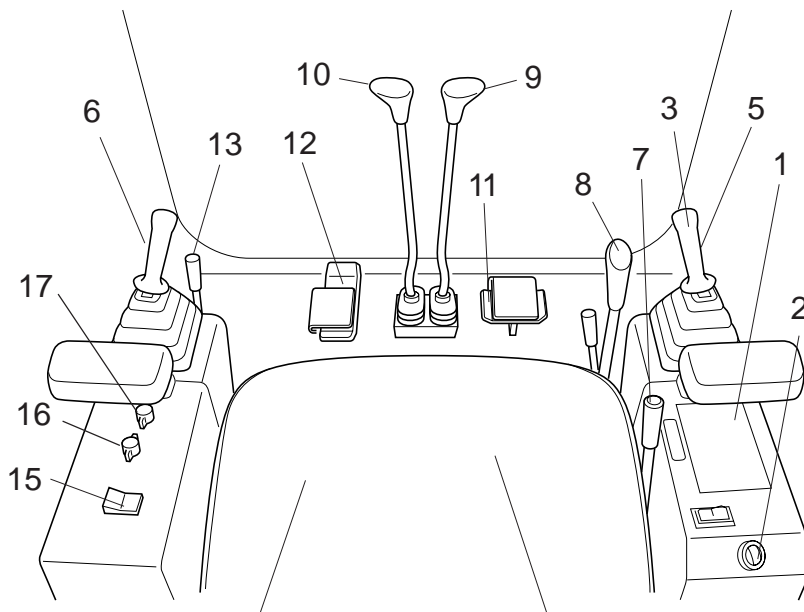
2-1 Location of Serial Number



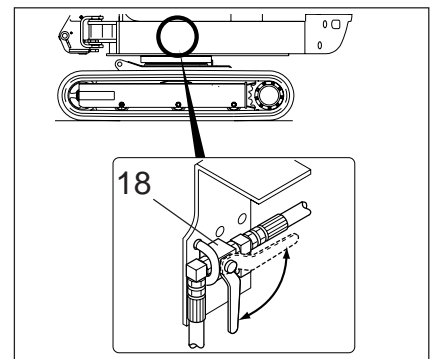
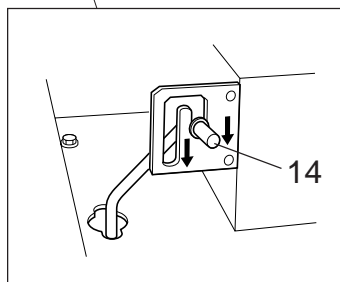
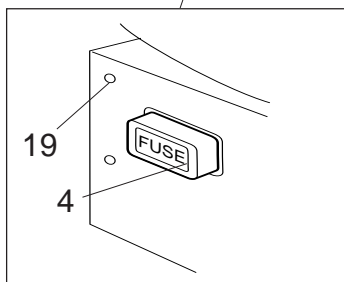
2-2 Name of each part



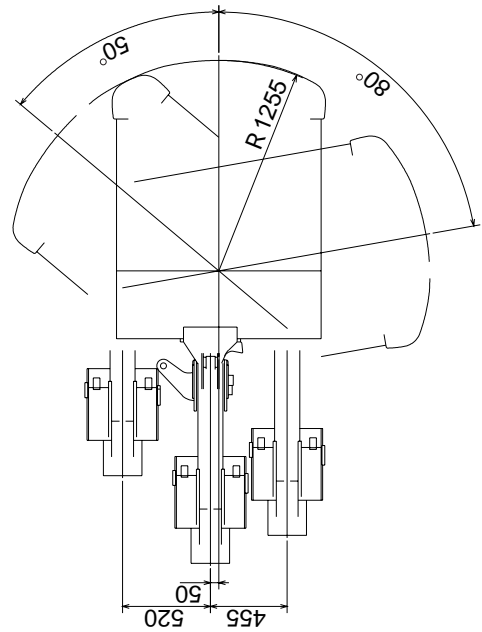
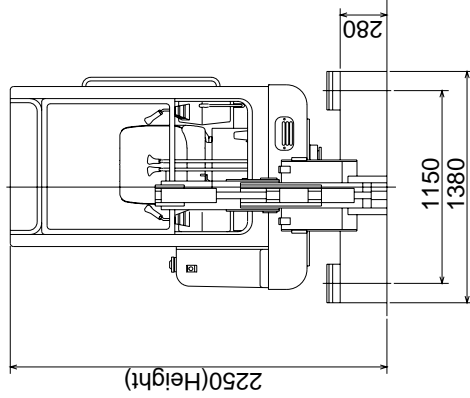
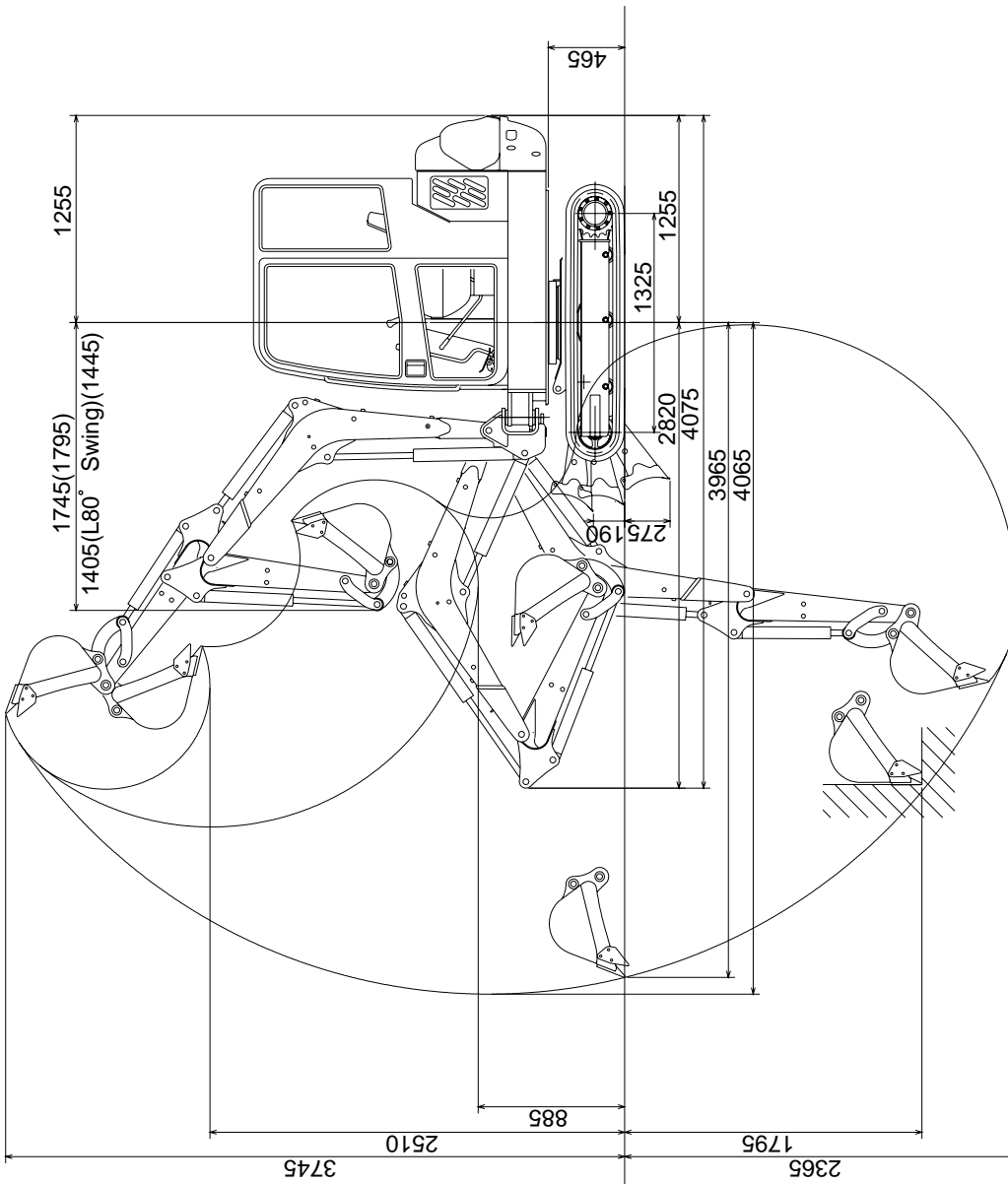
1. Boom
2. Boom cylinder
3. Arm cylinder
4. Arm
5. Bucket cylinder
6. Bucket links
7. Dump link
8. Bucket
9. Swing frame
10. Engine cover
11. Fuel tank
12. Hydraulic tank
13. Cabin
14. Counter weight
15. Operator's seat
16. Crawler
17. Dozer blade
18. Dozer cylinder
19. Travelling motor
20. Track roller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



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 pedal
12. P.T.O. pedal
13. Safety lock lever
14. Slew lock pin
15. Overdrive switch
16. Heater switch(for Cabin)
17. Wiper switch(for Cabin)
18. Manual boom lowering lever
19. Cigarette lighters



2-3 Dimensions and Specifications



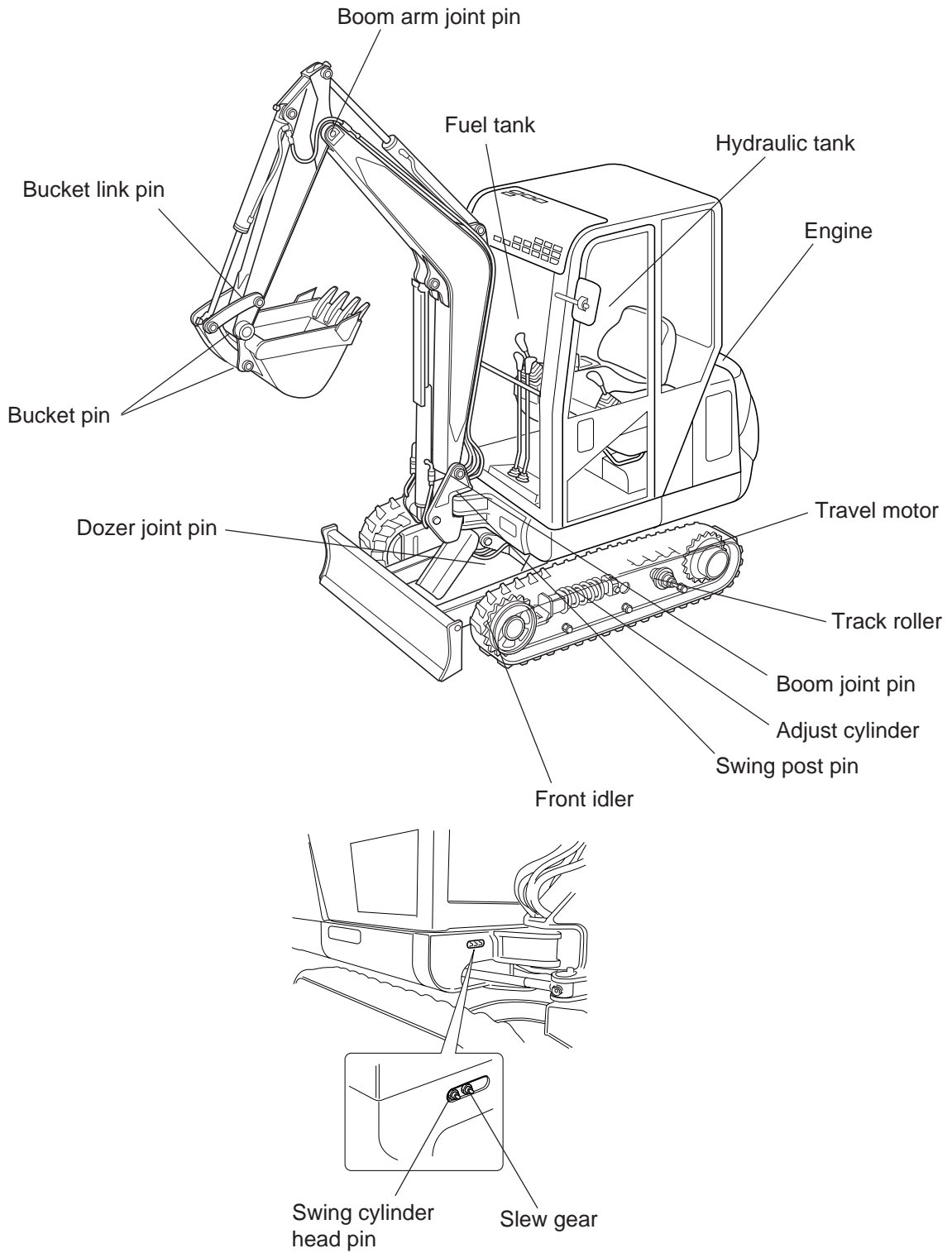
Model		Robex22-7	
Machine weight	Canopy rubber		2,080
	Canopy steel		2,130
	Cabin rubber		2,200
	Cabin steel		2,250
Standard bucket capacity/width		m ³ /mm	0.06 / 450
Engine	Type		MITSUBISHI L3E
	Displacement		cc
	Rated output		kW(PS) / min ⁻¹
Dimensions	Overall length		mm
	Overall width		mm
	Overall 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	Piston × 2+Gear
		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	Cabin rubber	kPa
		Cabin steel	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 / 82

2-4 Weight list

Unit: kg

Part name		Part name	
Boom	70	Slew bearing	29
Arm	40	Track frame	179
Bucket	57	Dozer	74
Dump link	9.4	Crawler(steel)	84×2
Bucket link(R)	1.7	Crawler(rubber)	59×2
Bucket link(L)	2.0	Idler	8×2
Boom joint pin	2.0	Adjust cylinder	12×2
Arm joint pin	1.7	Track roller	5.0×6
Bucket pin	1.7×2	Sprocket	4×2
Bucket link pin	1.5	Slew motor	15
Swing post	36	Turning motor	25×2
Swing post pin	4.1	Joystick	2.0×2
Swing frame	258	Engine	94
Hydraulic oil tank	28	Radiator	7.0
Fuel tank	16	Battery	12
Engine cover(A)(B)	24	Seat plate	16.5
Engine cover(C)	8.0	Swivel joint	11
Counter weight	200	Pump	15
Boom cylinder	20	Pump frange	9
Arm cylinder	20	Control valve	23
Bucket cylinder	17	Tops roof	110
Swing cylinder	16	Cabin	230
Dozer cylinder	13		

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)	29 ℓ	Diesel fuel with freezing point below -7°C	
Engine lubricating oil	3.5 ℓ	SAE10W-30	
Travel motor (reduction gear)	0.33 ℓ	SAE 30	
Hydraulic tank	33 ℓ	ISO VG 46	
Track roller (1 piece)	100cm 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
Amount of antifreeze	1.3 ℓ	1.6 ℓ	2.0 ℓ	2.3 ℓ	2.7 ℓ	3.2 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
	Lubricating oil of track roller/Front Idler reduction gear						Replace oil
18	Electrical wiring	Inspect					
19	Water and oil leakage in each body part	Inspect					
20	Inspect and grease attachment	Inspect attachment	Supply oil and grease				

2-7-3 Prestart inspections

(1)Prestart inspections

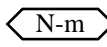
	Item	Content	Remarks
1	Engine oil pan	Check oil level	Before starting engine
2	Fuel tank	Check fuel level	Check that the fuel level is above the center of level gauge.
3	Radiator	Check water level	Check that the amount of water in sub-tank is within a specified level.
4	Each oil/grease supply point	Oil 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

At prestart inspections, always check the bolts and nuts for looseness. If any bolt or nut is loose, retighten according to the table below.

 Tightening torque of the bolt and nut (Body)

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

 Tightening torque of the hydraulic pipings

PT screw

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

PF screw

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

2-7-4 Maintenance after the first 50 service hours

	Item	Content	Remarks
1	Engine oil pan and Engine oil filter	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

2-7-5 Maintenance every 50 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
6	Radiator fin	Clean the fins	Dust sticking to the fin affects the cooling effect and causes overheating
12	Slew bearing	Inspect and grease	Always grease the machine after it is used in water
14	Battery	Liquid quantity	Whether the liquid level is proper or not. If short, add distilled water
		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

2-7-6 Maintenance after the first 100 service hours

	Item	Content	Remarks
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

2-7-7 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

2-7-8 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

2-7-9 Maintenance after the first 500 service hours

	Item	Content	Remarks
17	Lubricating oil of slew and travelling reduction gears	Replace lubricating oil	Replace oil after the first 500 service hours. Every 1,000 service hours after this (Refer to Table of Oil/Grease Supply Points)

2-7-10 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	Replace the element	

2-7-11 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
17	Lubricating oil of slew and travelling reduction gears	Replace the lubricating oil	Refer to Table of Oil/Grease Supply Points. (For new machine, every 500 service hours)

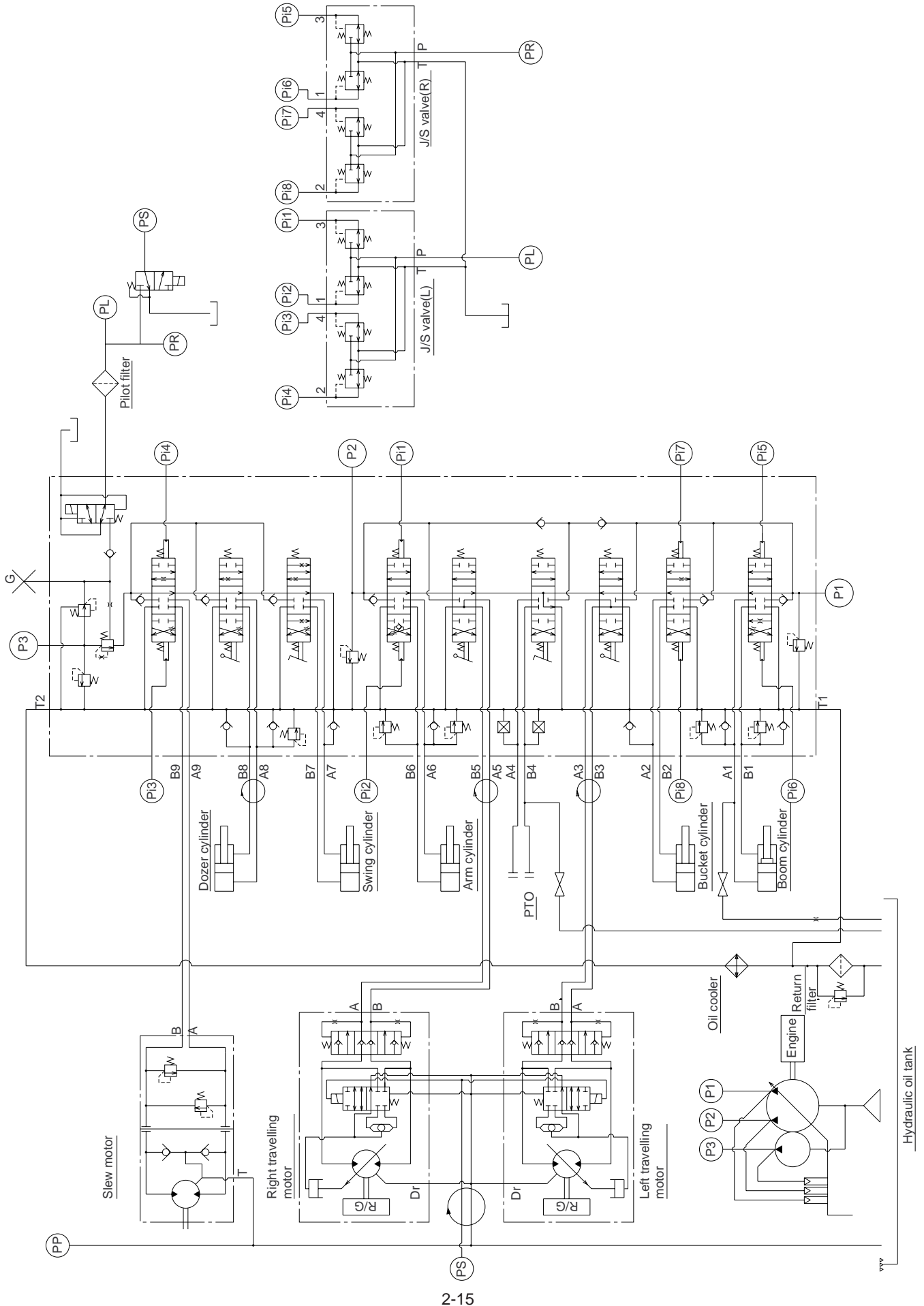
2-7-12 Maintenance every 2,000 service hours

	Item	Content	Remarks
15	Track roller	Replace	

Table of Oil/Grease Supply Points

No.	Oil/Grease Supply Point	Specified oil (genuine part)	Quantity	Time
1	Travelling motor	Gear oil 85W	330 cm ³	Every 1,000 service hours (At first, replace after the first 500 service hours)
2	Track roller		100 cm ³	Every 2,000 hours
3	Front idler		40 cm ³	Every 2,000 hours

2-8 Hydraulic circuit diagram



Item	
Boom cylinder	ø65×ø35-450st
Arm cylinder	ø65×ø35-500st
Bucket cylinder	ø60×ø40-400st
Swing cylinder	ø60×ø35-425st
Dozer cylinder	ø70×ø40×100st
Slew motor	2-160DOS-E3768
Travel motor	PHV-190-39-1-8003A

	Item		
Pump capacity	P1	10cm ³ /rev	
	P2	10cm ³ /rev	
	P3	6.4cm ³ /rev	
Pressure	Main relief	P1	18.6MPa(190kgf/cm ²)
		P2	18.6MPa(190kgf/cm ²)
		P3	17.2MPa(175kgf/cm ²)
	Port relief		22.5MPa(230kgf/cm ²)
	Slew		11.8MPa(120kgf/cm ²)
Pump flow rate	Q1	24 ℓ /min.	
	Q2	24 ℓ /min.	
	Q3	15.4 ℓ /min.	
Engine	Type	L3E	
	Constant output	12.5kW(17ps)	
	Speed	2,400min ⁻¹	
	Torque	55 N-m/1,600min ⁻¹	

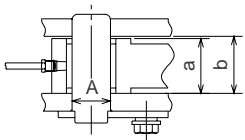
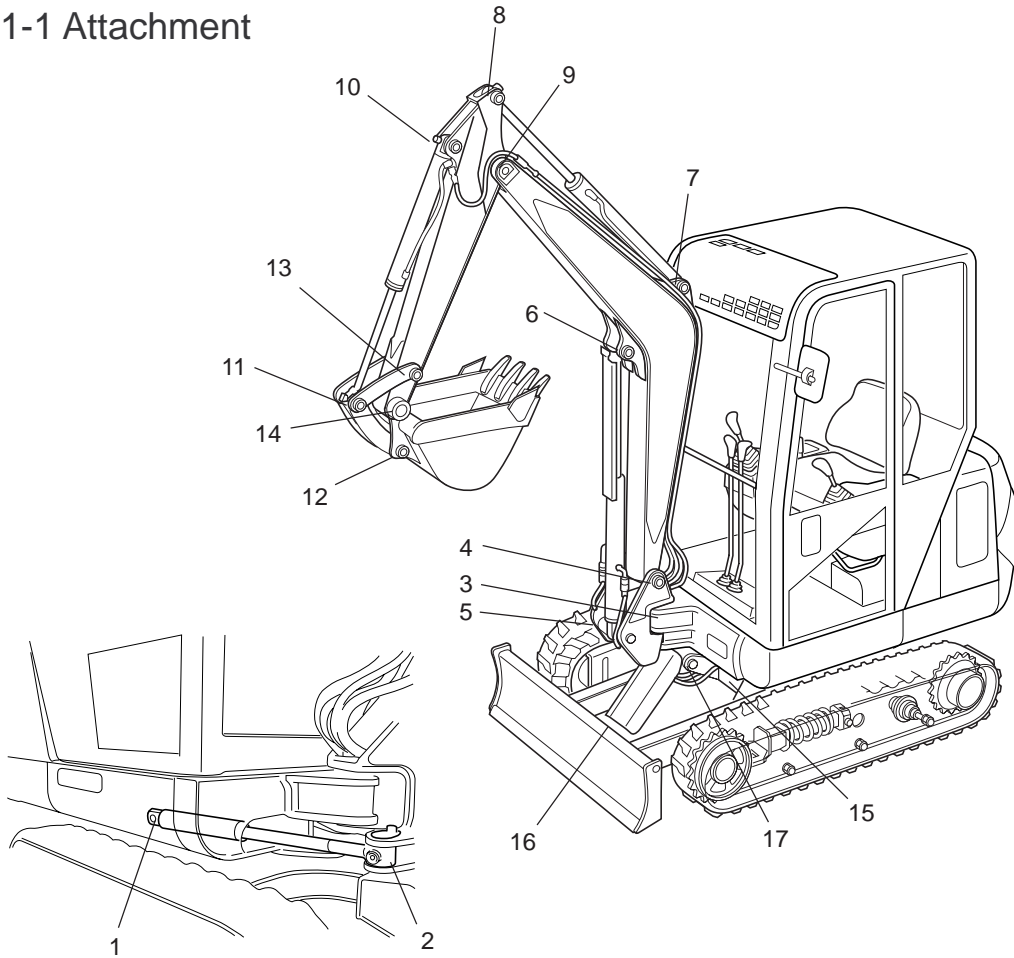
3 ATTACHMENT

CONTENTS

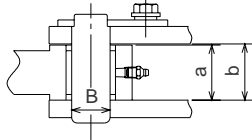
- 3-1 Standard of maintenance
 - 3-1-1 Attachment
- 3-2 Inspection and adjustment
 - 3-2-1 Measuring the fall of the attachment of its own weight
 - 3-2-2 Measuring the speed of the attachment cylinder

3-1 Standard of maintenance

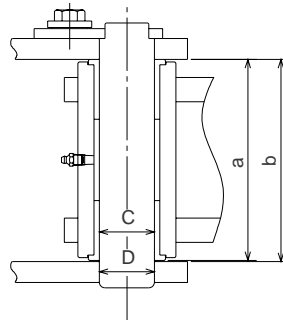
3-1-1 Attachment



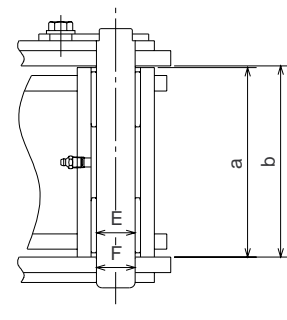
1. Swing cylinder head



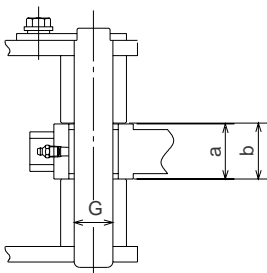
2. Swing cylinder rod



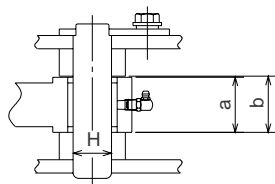
3. Swing post bracket and swing post



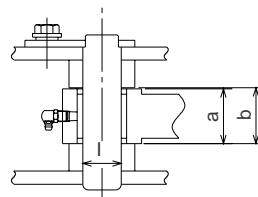
4. Boom joint



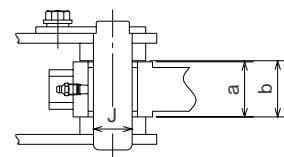
5. Boom cylinder head



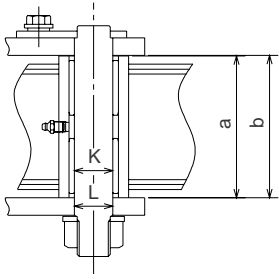
6. Boom cylinder rod



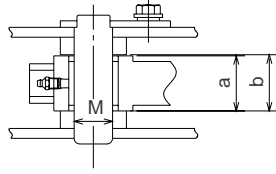
7. Arm cylinder head



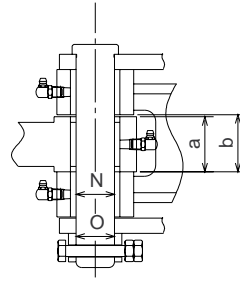
8. Arm cylinder rod



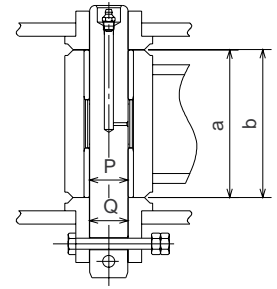
9. Boom/arm joint



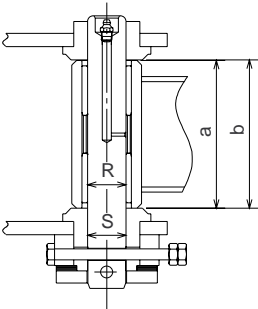
10. Bucket cylinder head



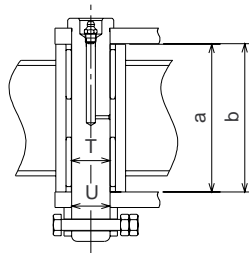
11. Bucket cylinder rod



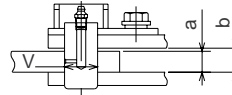
12. Bucket/dump link joint



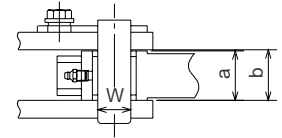
13. Arm/bucket link joint



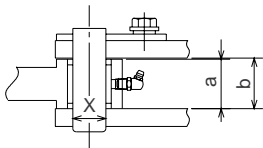
14. Arm/bucket joint



15. Dozer joint



16. Dozer cylinder head



17. Dozer cylinder rod

Unit: mm

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

Unit: mm

No.	Item	Criterion			Spacer	
		a	b	Standard clearance	Part Number	Dimension
1	Clearance between swing cylinder head and swing post	52	50	2.0 ~ 3.5	MBU3-00020 MBU3-00021	ø36×t0.5 ø36×t1.0
2	Clearance between swing cylinder rod and head bracket	51	50	1.0 ~ 2.5	//	//
3	Clearance between swing post and frame	184	183	1.0 ~ 2.0	MBU3-00026 MBU3-00027	ø51×t0.5 ø51×t1.0
4	Clearance between boom and swing post	174	172.5	1.2 ~ 2.8	MBU3-00020 MBU3-00021	ø36×t0.5 ø36×t1.0
5	Clearance between boom cylinder head and swing post	51	50	1.0 ~ 2.5	//	//
6	Clearance between boom cylinder rod and boom	51	50	0.5 ~ 2.0	//	//
7	Clearance between arm cylinder head and boom	51	50	0.5 ~ 2.0	//	//
8	Clearance between arm cylinder rod and arm	51	50	0.5 ~ 2.0	//	//
9	Clearance between boom and arm	129.5	129	0.5 ~ 2.0	//	//
10	Clearance between bucket cylinder head and arm	51	50	0.5 ~ 2.0	//	//
11	Clearance between bucket cylinder rod and dump link	52	50	1.0 ~ 2.5	//	//
12	Clearance between dump link and bucket	135	134.5	1.0 ~ 2.5		
13	Clearance between arm and bucket link	135	134.5	0.5 ~ 1.0	MBU3-00020 MBU3-00021	ø36×t0.5 ø36×t1.0
14	Clearance between arm and bucket	135	134.5	0.5 ~ 1.0		
15	Clearance between dozer and frame	22	19	2.5 ~ 3.5		
16	Clearance between dozer cylinder head and frame	46	45	0.5 ~ 2.0		
17	Clearance between dozer cylinder rod and dozer	46	45	0.5 ~ 2.0		

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

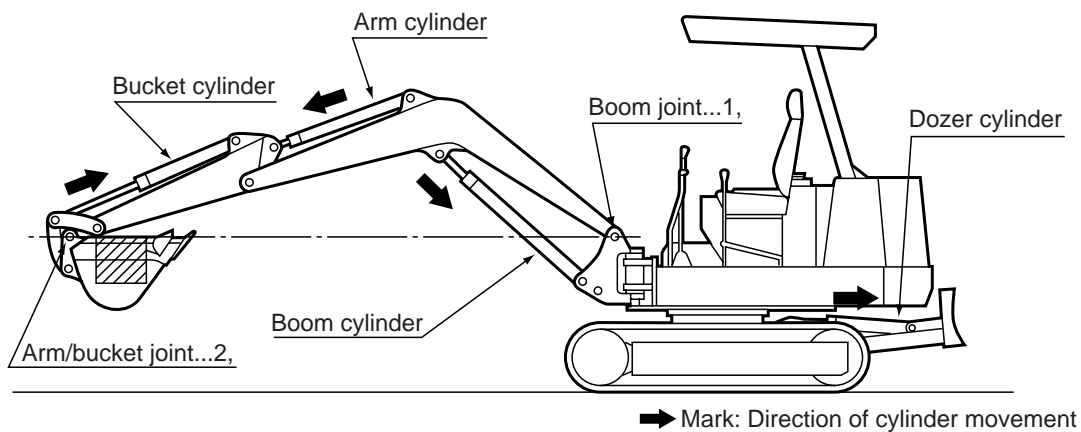
Draw a reference line on the cylinder head with a Magic Marker and measure the length from the line to the cylinder tube. Measure the length again 3 minutes later. Then record the difference in the length

Unit: mm or less

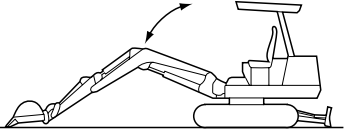
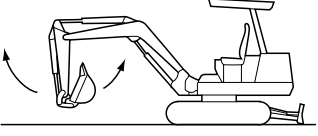
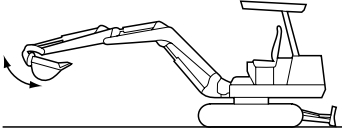
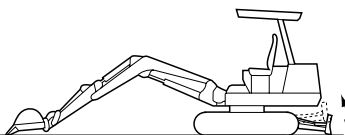
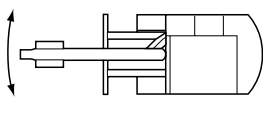
Cylinder name	Standard value	Allowance
Boom cylinder	3	10
Arm cylinder	3	10
Bucket cylinder	3	10
Dozer cylinder	3	10

Make 1 and 2 the same height.

W: Weight	About: 108kg
-----------	--------------



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 Extend cylinder to the Maximum length Make bucket teeth touch the ground		Up	2.3 ± 0.5	3.3
		Down	2.3 ± 0.5	3.3
ARM Extend cylinder to the maximum length Retract cylinder to the minimum length		Dig	2.6 ± 0.5	3.6
		Dump	2.9 ± 0.5	3.9
BUCKET Extend cylinder to the maximum length Retract cylinder to the minimum length		Dig	2.9 ± 0.5	3.9
		Dump	2.3 ± 0.5	3.3
DOZER Lift dozer to the maximum height Make Dozer contact the ground		Up	1.2 ± 0.3	1.5
		Down	0.8 ± 0.3	1.1
SWING Retract cylinder to the minimum length Extend cylinder to the maximum ground		Right swing	6.6 ± 0.5	7.6
		Left swing	6.3 ± 0.5	7.3

4 ENGINE

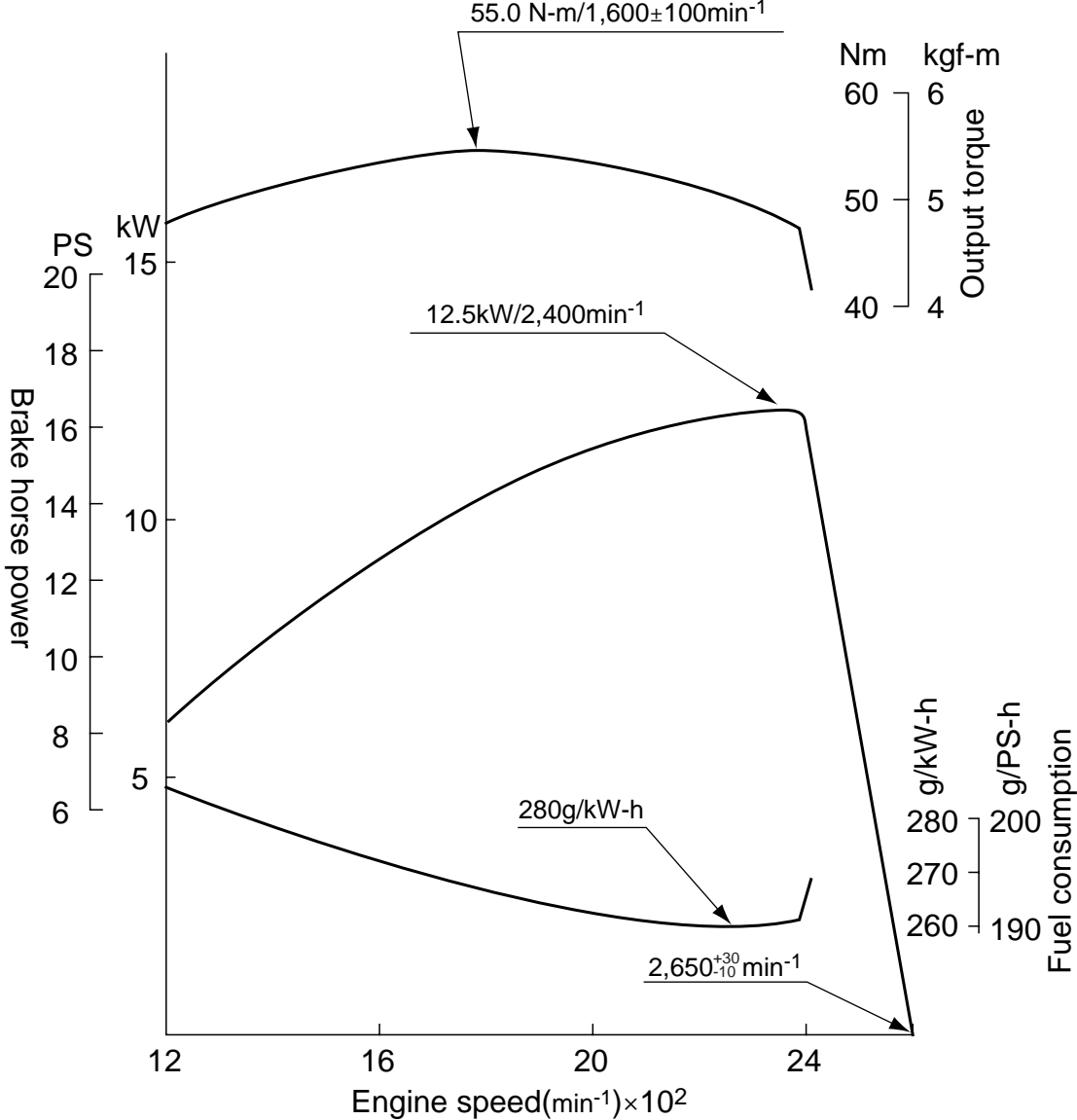
CONTENTS

- 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

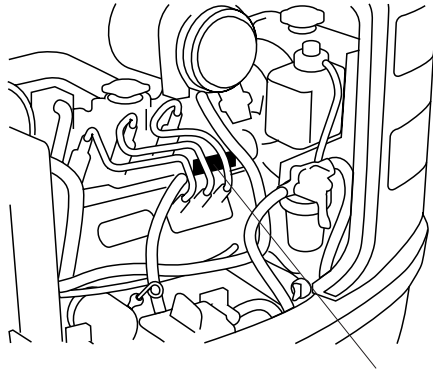
Engine		L3E-W231NSA
Type		Vertical 4 cycle 3 cylinder
Number of cylinders–bore × stroke		3–76 mm×70mm(2.99"× 2.76")
Displacement(cc)		952 cm ³
Ignition order		1–3–2
Dimensions	Overall length	640mm
	Overall width	450mm
	Overall height	550 mm
Performance	Rated output	12.5kW(17ps)/ 2,400 min ⁻¹
	Maximum torque	55N-m / 1,600min ⁻¹
	Maximum idling speed(rpm)	2,650 min ⁻¹
	Minimum idling speed(rpm)	1,100 min ⁻¹ ±30
	Fuel consumption(g/ps.h)	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	$2,450^{+50}_0 \text{ min}^{-1}$

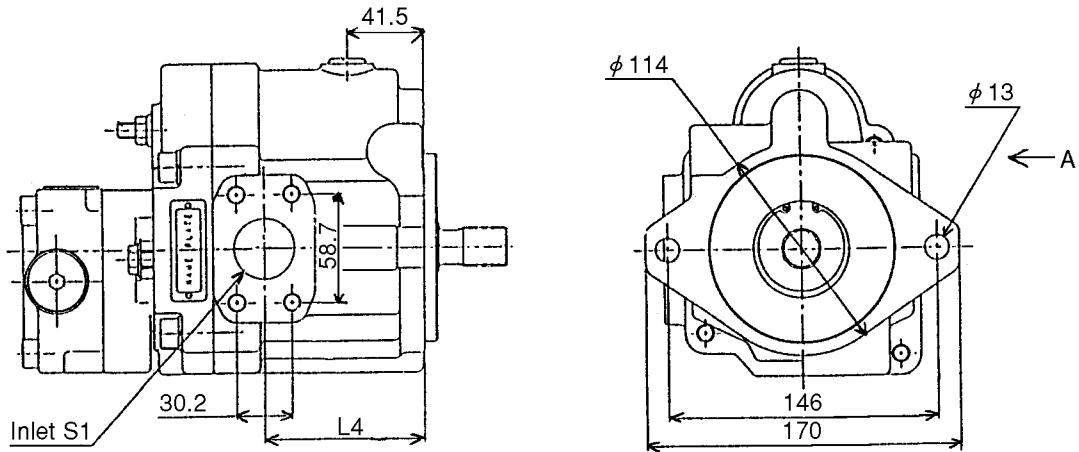
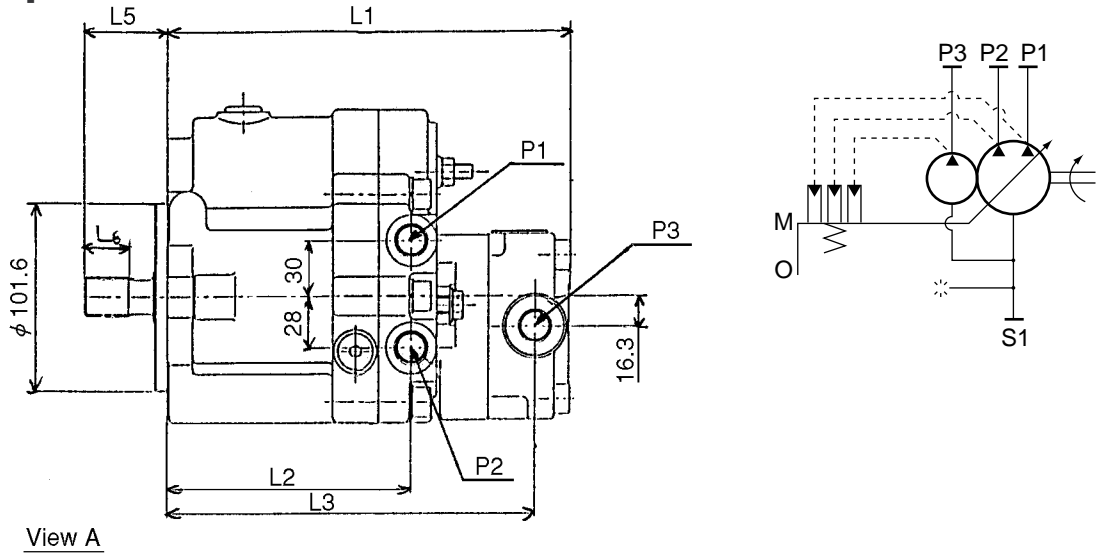
5

MAIN PUMP

CONTENTS

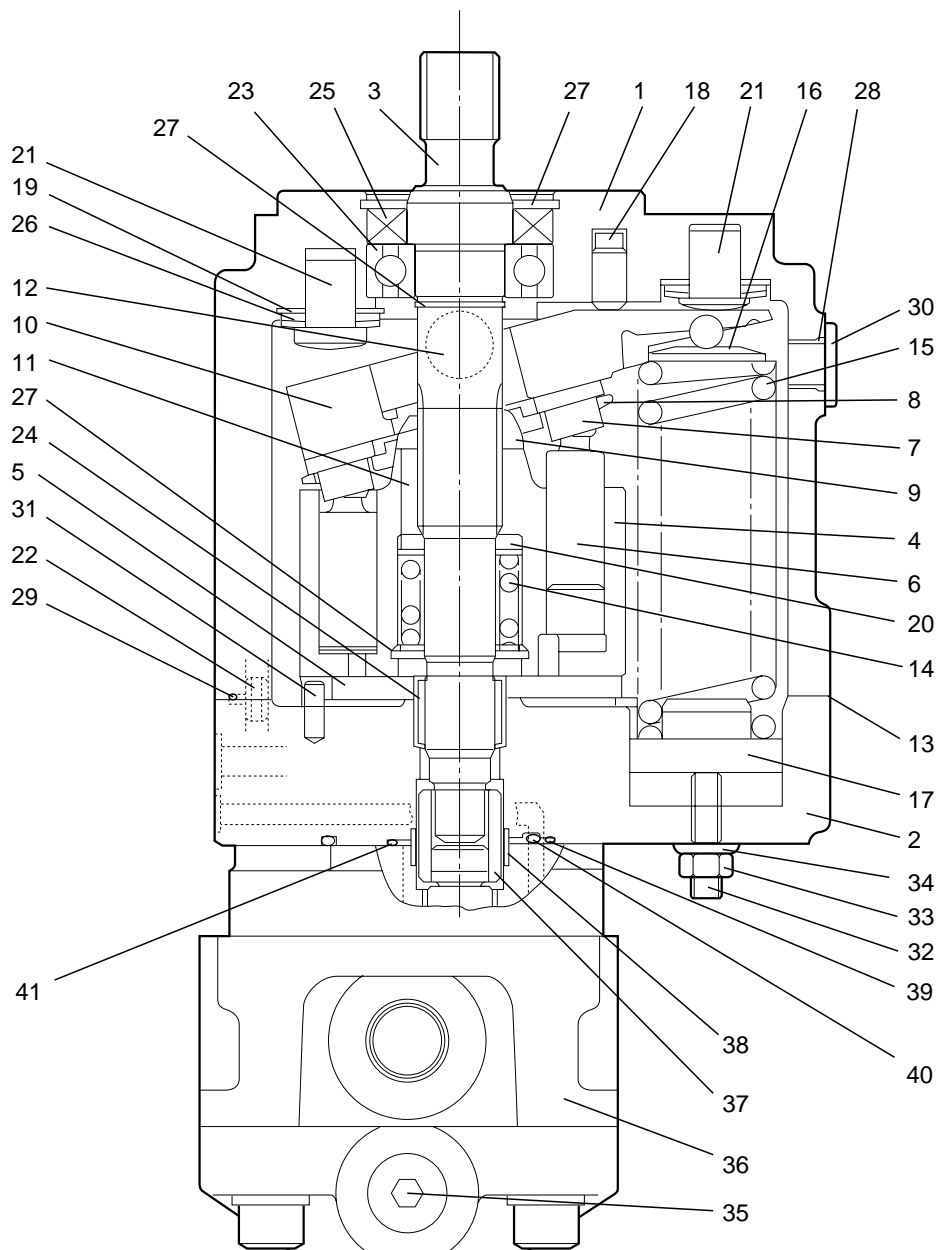
- 5-1 Specification
- 5-2 Structure
- 5-3 Removing and installing the pump
 - 5-3-1 Removing the pump
 - 5-3-2 Installing the pump
- 5-4 Performance test of the hydraulic pump
 - 5-4-1 Measuring instrument
 - 5-4-2 Preparation
 - 5-4-3 Connecting tester
 - 5-4-4 Measuring procedure

5-1 Specification



pump type		PVD-08-20L3PS-6G-4920A
Port size	S1	SAE J518b-1 1/4
	P1	PF3/8
	P2	PF3/8
	P3	PF3/8
L1		221mm
L2		134mm
L3		201.5mm
L4		88mm
L5		45mm
L6		24mm
Displacement(rev)	P1	10mm
	P2	10mm
	P3	6.4mm
Rated pressure	P1	18.6MPa(190kgf/cm ²)
	P2	18.6MPa(190kgf/cm ²)
	P3	17.2MPa(175kgf/cm ²)
Direction of rotation		Clockwise seen from shaft side
Weight		15kg

5-2 Structure



- | | | |
|------------------|--------------------|----------------------|
| 1. Body | 15. Spring T1 | 29. O-ring |
| 2. Body | 16. Spring holder | 30. Plug |
| 3. Shaft | 17. Spring guide | 31. Spring pin |
| 4. Cylinder | 18. Rod | 32. Socket head bolt |
| 5. Valve plate | 19. Washer | 33. Nut |
| 6. Piston | 20. Retainer | 34. Seal washer |
| 7. Shoe | 21. Stopper pin | 35. Plug |
| 8. Shoe holder | 22. Pin | 36. Gear pump |
| 9. Barrel holder | 23. Bearing | 37. Coupling |
| 10. Swash plate | 24. Bearing | 38. Collar |
| 11. Needle | 25. Oil seal | 39. O-ring |
| 12. Pin | 26. Conical washer | 40. O-ring |
| 13. Packing | 27. Snap ring | 41. O-ring |
| 14. Spring C | 28. O-ring | |

5-3 Removing and installing the pump

5-3-1 Removing the pump

1. Remove the nipple, TEE, elbow and hoses around the pump. Attach a cap to the removed hoses to keep dust off. Store the nipples and elbows in treated oil.
2. Remove the pump mounting bolts(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.

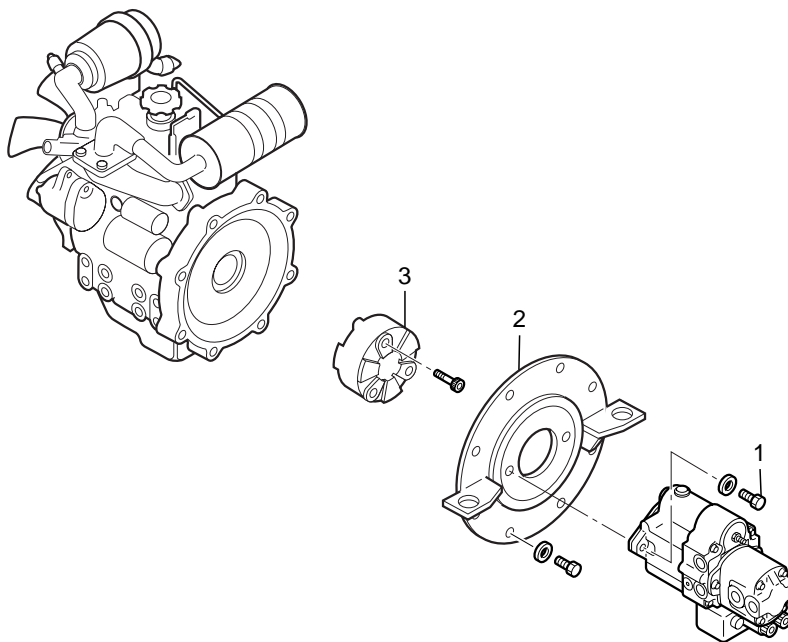
5-3-2 Installing the pump

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
M12 × 30ℓ	9~11.5 kg-m

* Precautions on installing the pump

1. Make sure there is no misalignment.



5-4 Performance test of the hydraulic pump

5-4-1 Measuring instrument

Hydraulic pressure tester	Measuring range of flow rate (/min)	7 ~ 200 ℓ
	Measuring range of pressure	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 PF3/ 8-PF3/ 8×1m)	

5-4-2 Preparation

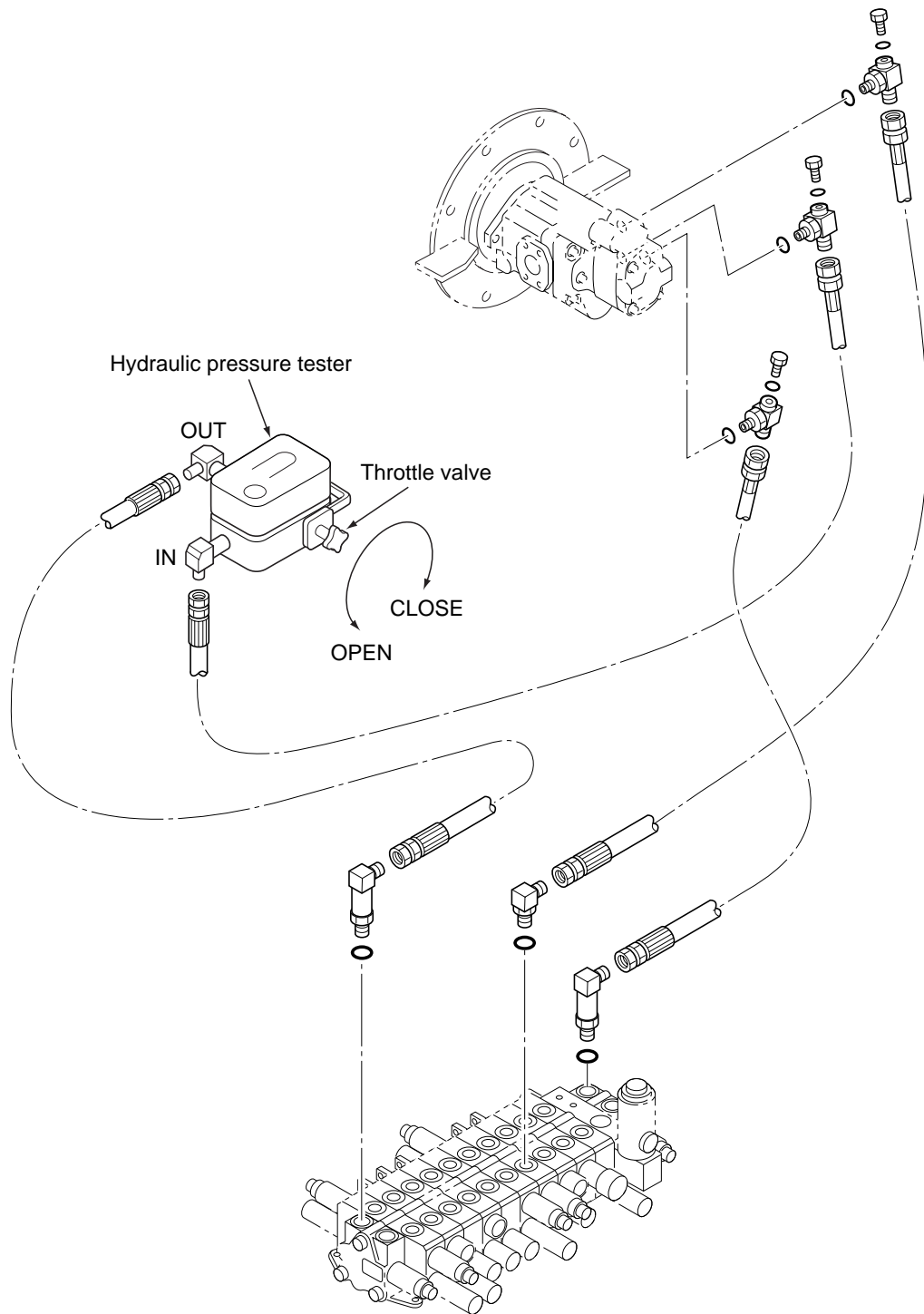
1. Park machine on flat ground and stop engine.

5-4-3 Connecting tester

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

5-4-4 Measuring procedure

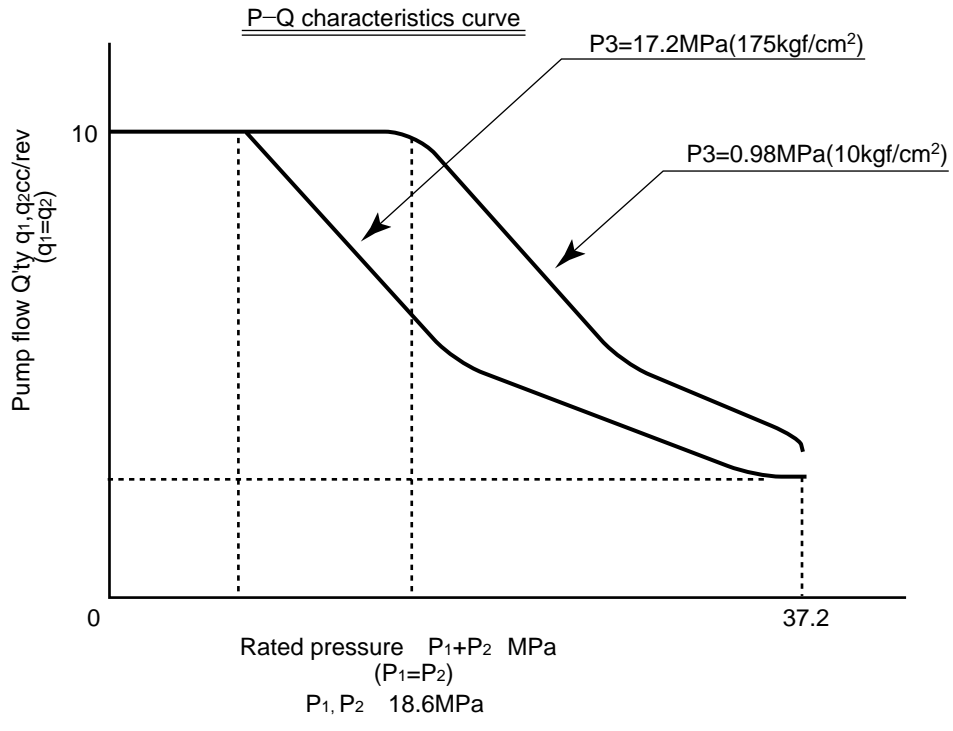
Open the throttle valve of the tester and start the engine. Read the pressures on the pressure gauge and measure the flow at that time. At the same time, record the engine speed.



5-4-5 P-Q characteristic curve

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

$$\frac{P_1+P_2}{2} = \frac{175+10}{2} = 100$$

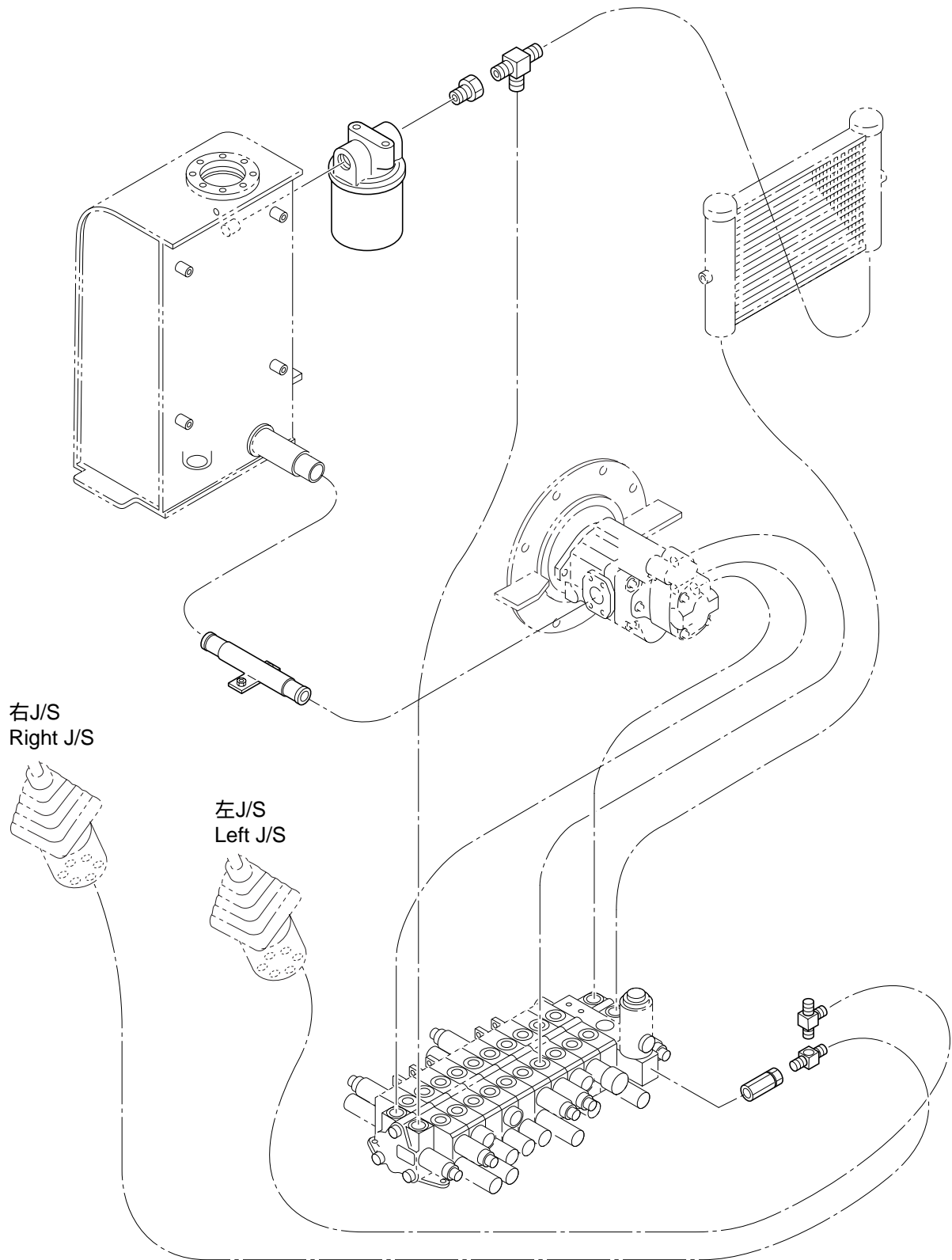


6 HYDRAULIC OIL FILTER

CONTENTS

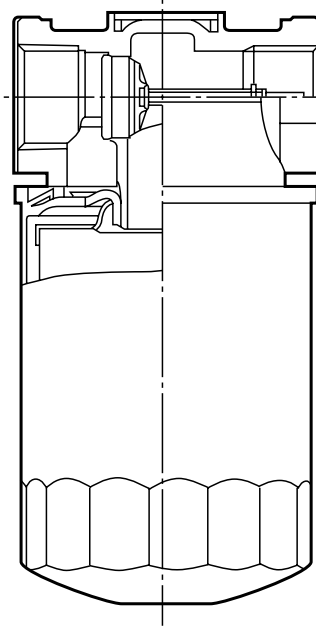
- 6-1 Installation
- 6-2 Hydraulic oil filter
 - 6-2-1 Line filter
 - 6-2-2 Suction filter
 - 6-2-3 Pilot filter
- 6-3 Maintenance procedure
 - 6-3-1 Replacing the line filter
 - 6-3-2 Replacing the suction filter
 - 6-3-3 How to clean the suction filter

6-1 Installation



6-2 Hydraulic oil filter

6-2-1 Line filter (SP08)

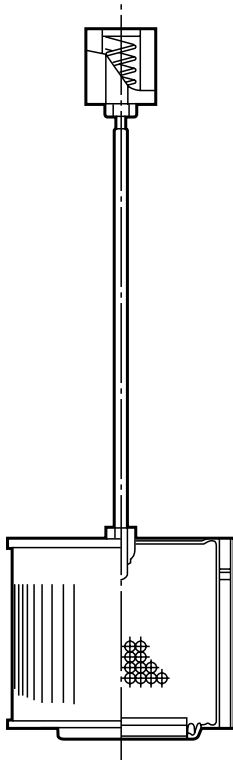


Filtration accuracy	10 μ
Filtration capacity	50 ℓ /min (Max.)
Opening pressure of bypass valve	0.15MPa (1.5kgf/cm ²)
Proof pressure	0.69MPa (7kgf/cm ²)
Oil temperature	-20°C~120°C

2-PT1

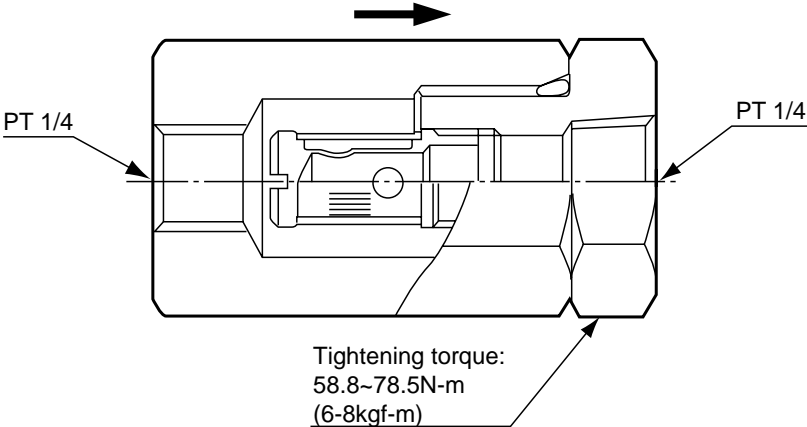
Tightening torque
19.6Nm(2kgf/m)

6-2-2 Suction filter



Grain size	150 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 which retain the filter to the hydraulic oil tank, and pull off the filter.(6-2-2).
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.

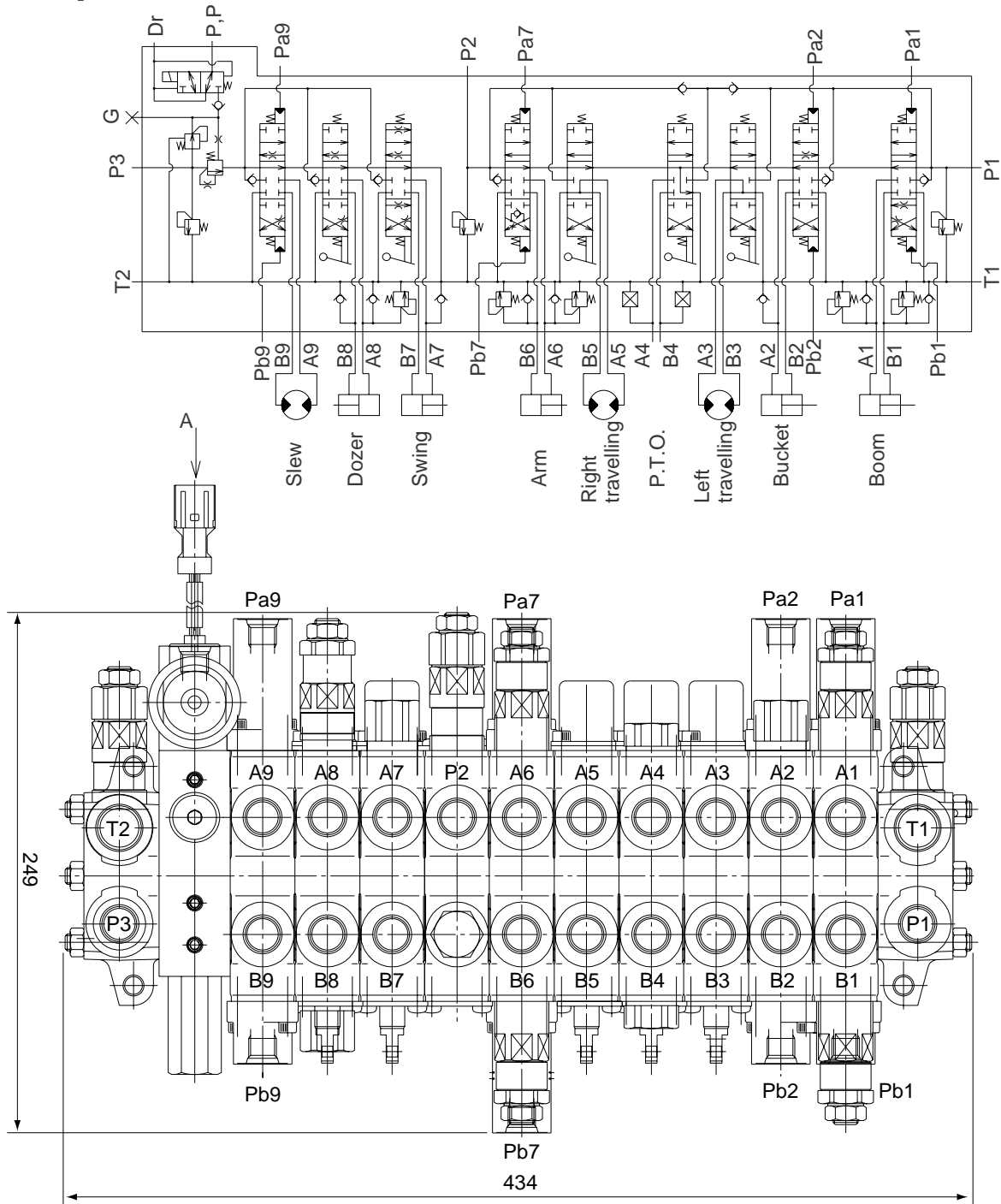
Total amount of hydraulic oil : 33 ℓ

7 CONTROL VALVE

CONTENTS

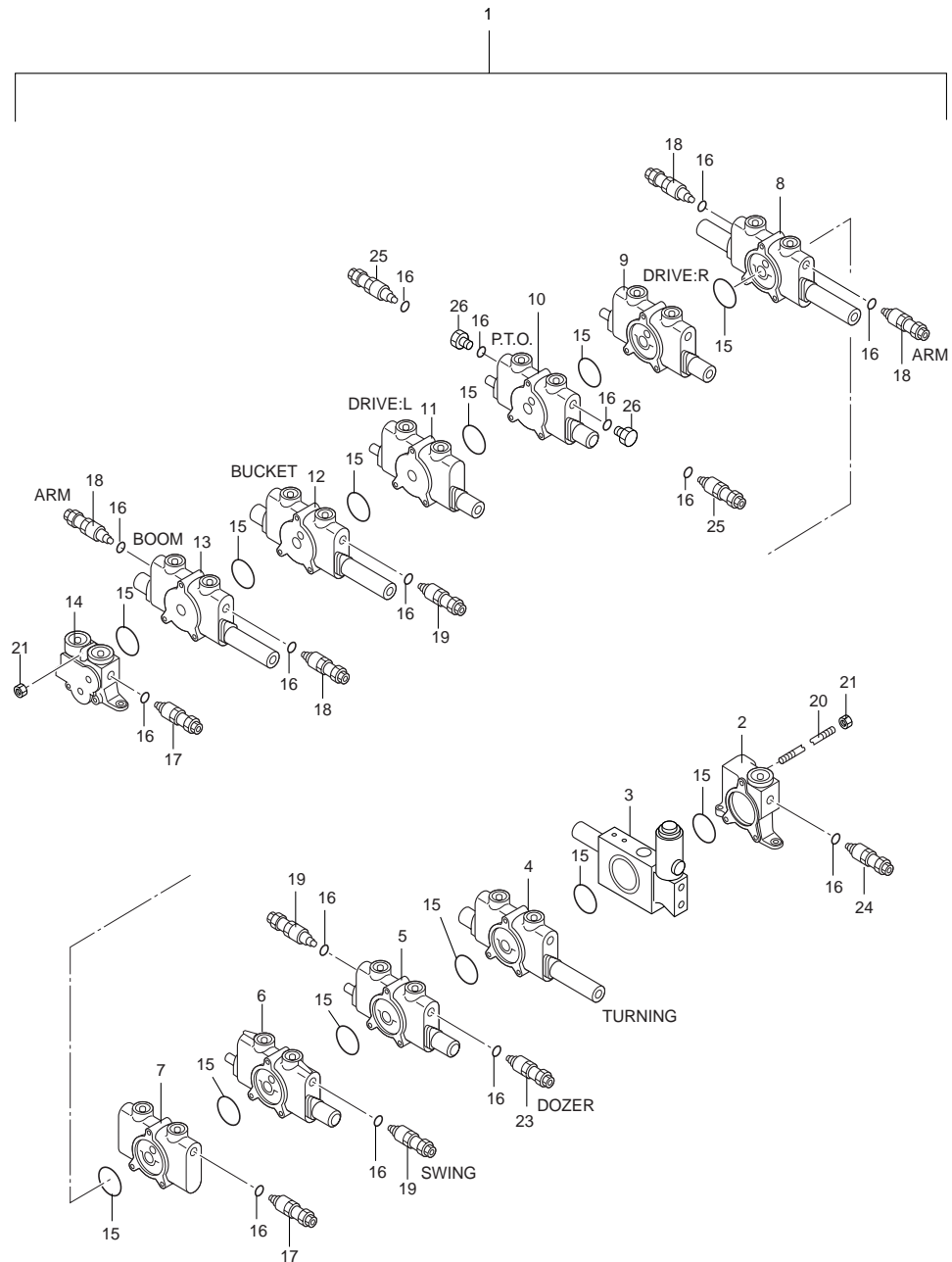
- 7-1 Specification
- 7-2 Disassembly and assembly
 - 7-2-1 Replacing the O ring on the contact surface and each block assembly
 - 7-2-2 Replacing the O ring on the spool
 - 7-2-3 Removing the load check valve and replacing the O ring
 - 7-2-4 Replacing the relief valve assembly and the O ring
- 7-3 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

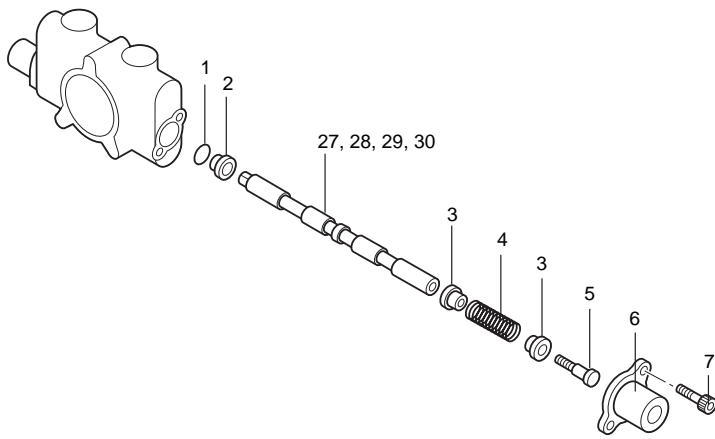


Port	Port size
T1,T2	G 1 / 2
A1~A9, B1~B9, P1 ~ P3	G 3 / 8
Pa1,Pa2,Pa7,Pa9,P.P Pb1,Pb2,Pb7,Pb9,Dr	G 1 / 4

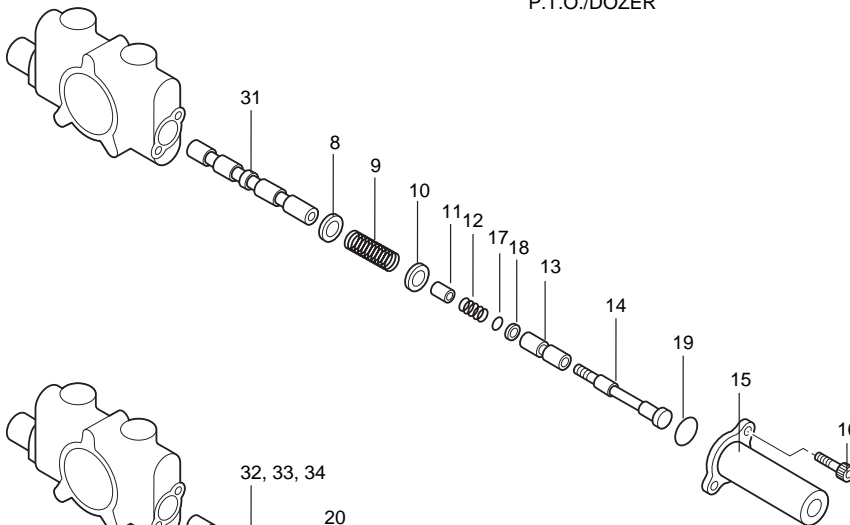
P1 and P2 Main relief pressure	18.6MPa(190kgf/cm ²)at 24 l / min
P3 Main relief pressure	17.2MPa(175kgf/cm ²)at 16 l / min
A1, B1, A6, B6, A8 Port relief pressure	22.5MPa(230kgf/cm ²)at 5 l / min



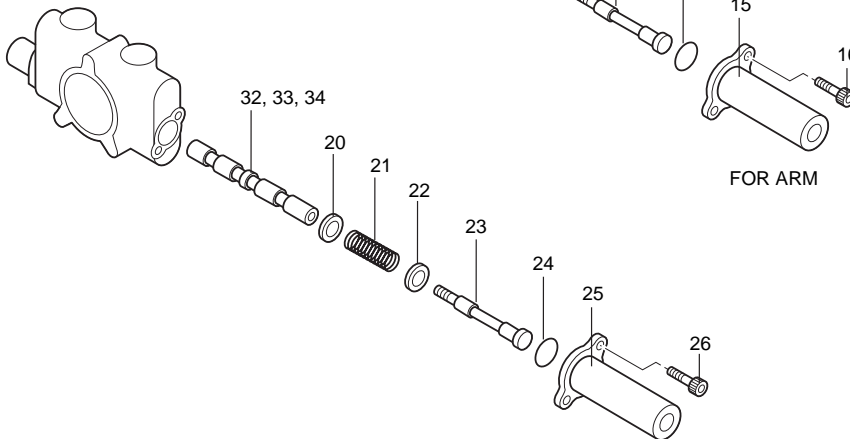
- | | |
|---------------------------|-------------------------------|
| 1. Control valve assembly | 14. Block assembly |
| 2. Block assembly | 15. O-ring |
| 3. Block assembly | 16. O-ring |
| 4. Block assembly | 17. Relief valve assembly |
| 5. Block assembly | 18. Relief valve assembly |
| 6. Block assembly | 19. Anti-boild valve assembly |
| 7. Block assembly | 20. Rod |
| 8. Block assembly | 21. Nut |
| 9. Block assembly | 22. Relief valve assembly |
| 10. Block assembly | 23. Relief valve assembly |
| 11. Block assembly | 24. Relief valve assembly |
| 12. Block assembly | 25. Relief valve assembly |
| 13. Block assembly | 26. Plug |



FOR DRIVE(R)(L)/SWING
P.T.O./DOZER



FOR ARM



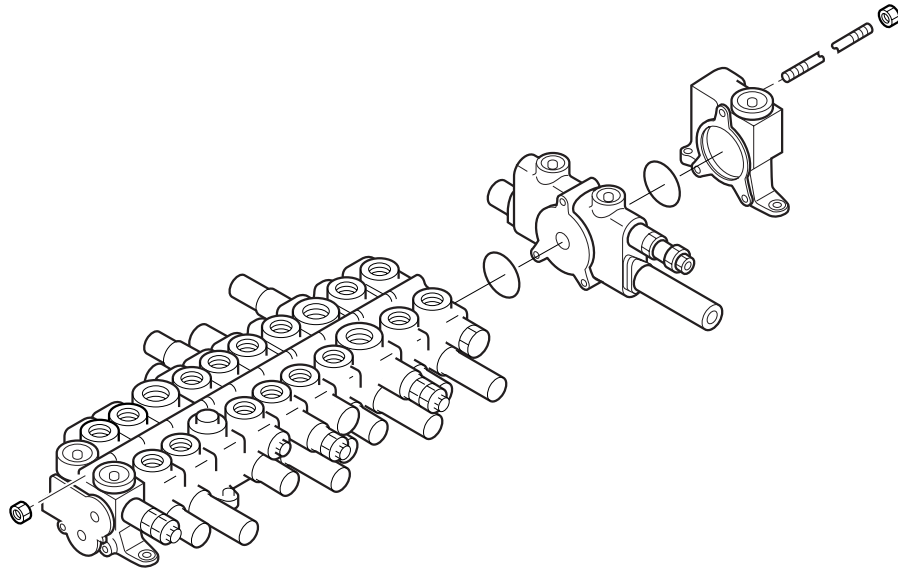
FOR BOOM/BUCKET/TURNING

- | | |
|---------------------|----------------------|
| 1. O-ring | 15. Cap |
| 2. Wiper ring | 16. Socket head bolt |
| 3. Spring seat | 17. O-ring |
| 4. Spring | 18. Wiper ring |
| 5. Cap screw | 19. O-ring |
| 6. Cap | 20. Spring seat |
| 7. Socket head bolt | 21. Spring |
| 8. Spring seat | 22. Spring sea |
| 9. Spring | 23. Spur end |
| 10. Spring seat | 24. O-ring |
| 11. Poppet | 25. Cap |
| 12. Spring | 26. Socket head bolt |
| 13. Spacer | 27~34. Spool |
| 14. Spool end | |

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 2.4kgf-m. While tightening them, check that the spool of each block operates smoothly.



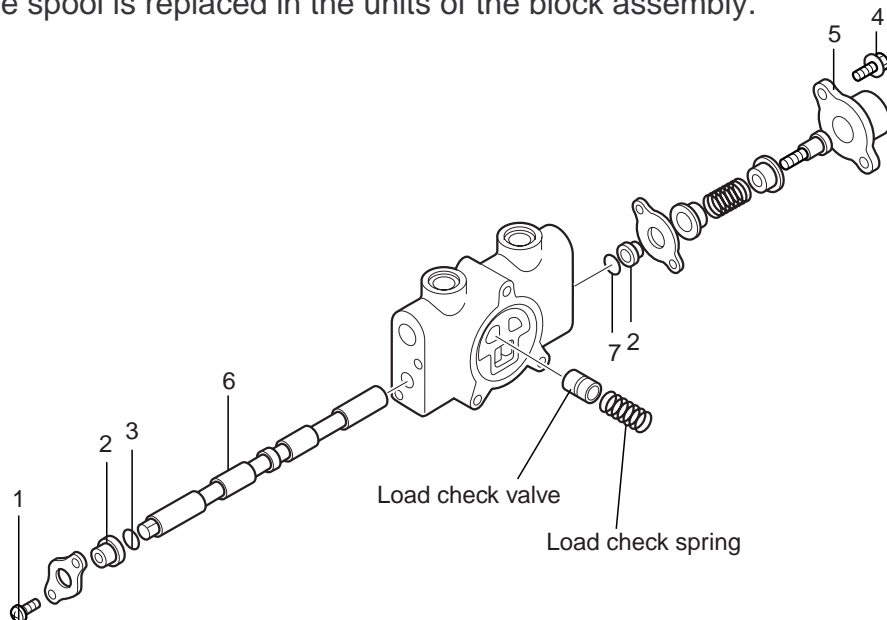
7-2-2 Replacing the O ring on the spool

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 (4) and remove the cap (5).
Take out spool (6) and replace O-ring (7)
- 2) Rinse the spool and insert it in the body.
- 3) When installing the spring cap, be careful not to damage the O-ring.
Tightening torque of the cap mounting screw is 0.9 kgf-m.
The spool is replaced in the units of the block assembly.



7-2-3 Removing the load check valve

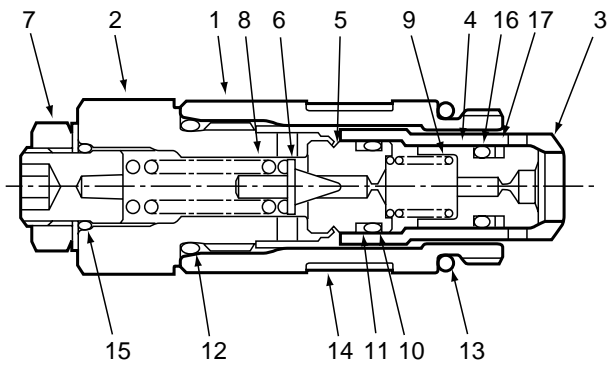
1. Remove the load check spring and load check valve from the valve block.
2. Keep each load check valve in order so as not to confuse it with other valve block.
2. Clean the parts sufficiently before assembling them.

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

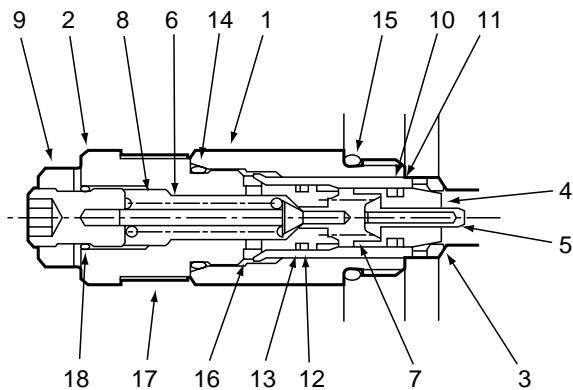
7-3-1 Main relief valve



- | | | |
|-----------------|-----------------|--------------------|
| 1. Cap | 7. Adjuster kit | 13.O-ring |
| 2. Plug | 8. Pilot spring | 14.Name plate |
| 3. Sleeve | 9. Spring | 15.O-ring (1B-P10) |
| 4. Main poppet | 10. O-ring | 16.O-ring |
| 5. Pilot sheet | 11. Backup ring | 17.Backup ring |
| 6. Pilot poppet | 12. O-ring | |

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

7-3-2 Port relief valve



- | | | |
|-----------------|-----------------|---------------------|
| 1. Cap | 7. Spring | 13. Backup ring |
| 2. Plug | 8. Pilot spring | 14. O-ring |
| 3. Poppet | 9. Adjuster kit | 15. O-ring |
| 4. Poppet | 10. O-ring | 16. Wave washer |
| 5. Piston | 11. Backup ring | 17. Name plate |
| 6. Pilot poppet | 12. O-ring | 18. O-ring (1B-P10) |

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

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.

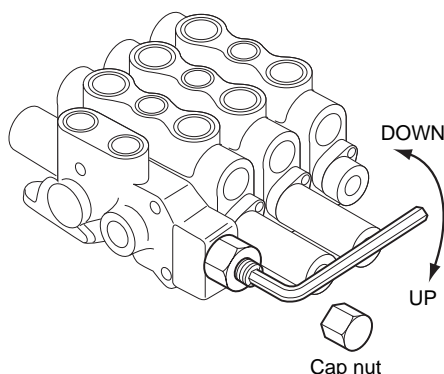
When stocking a valve for a long time, plug each port to prevent dust and water from entering it.

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. 17.8MPa (181kgf/cm ²) per rotation
Port relief valve	Approx. 15.7MPa (160kgf/cm ²) per rotation

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

8

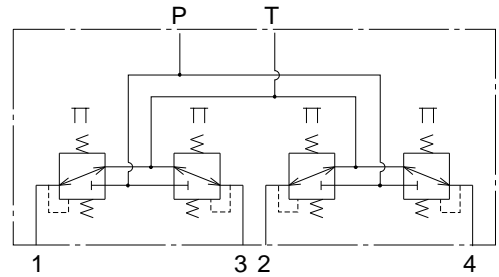
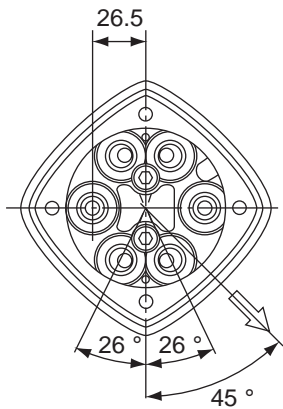
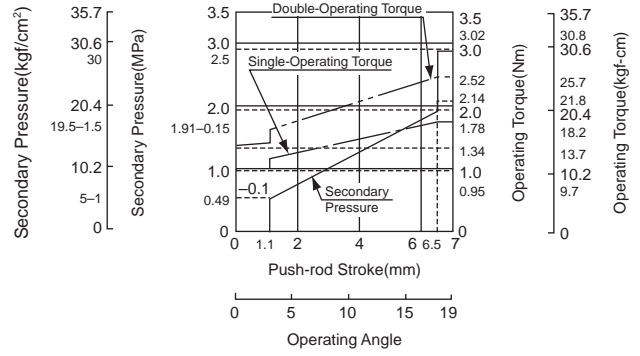
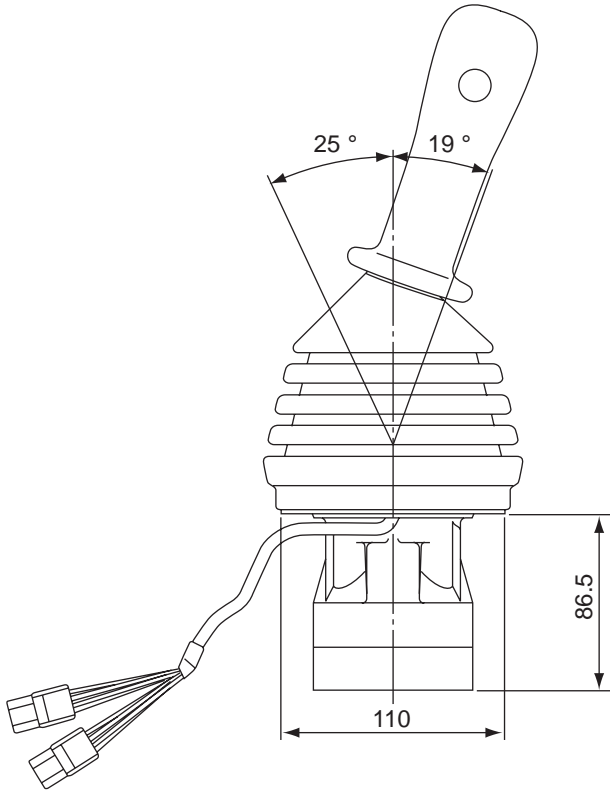
JOYSTICK (PILOT VALVE)

CONTENTS

8-1 Specification

8-2 Structure

8-1 Specification

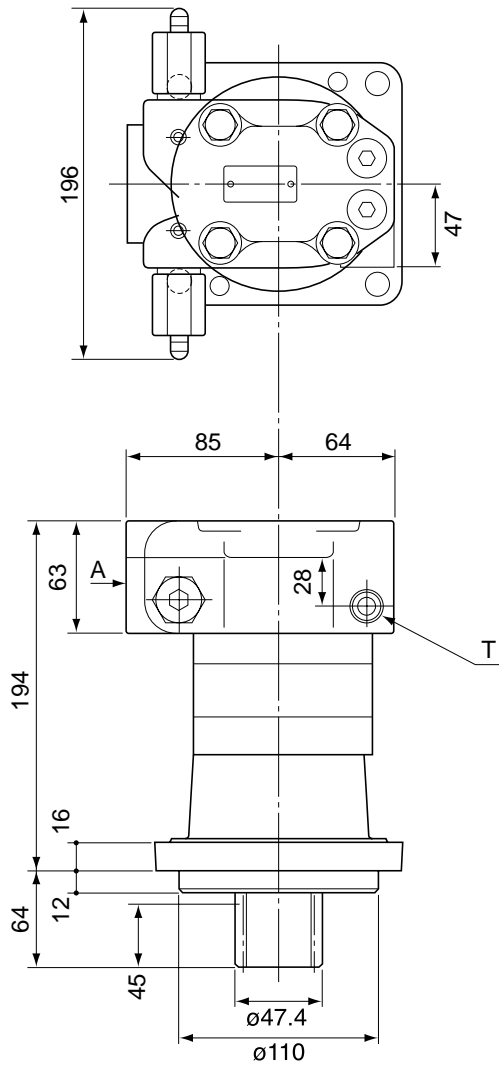


9 SLEW MOTOR

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

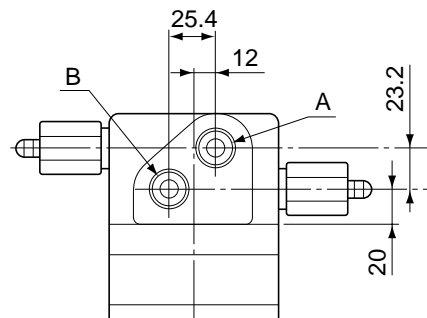


Direction of rotation
(seen from the output shaft)

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

Port	Port size
A	G 3/8 O-ring Port
B	G 3/8 O-ring Port
T	G 3/8 O-ring Port

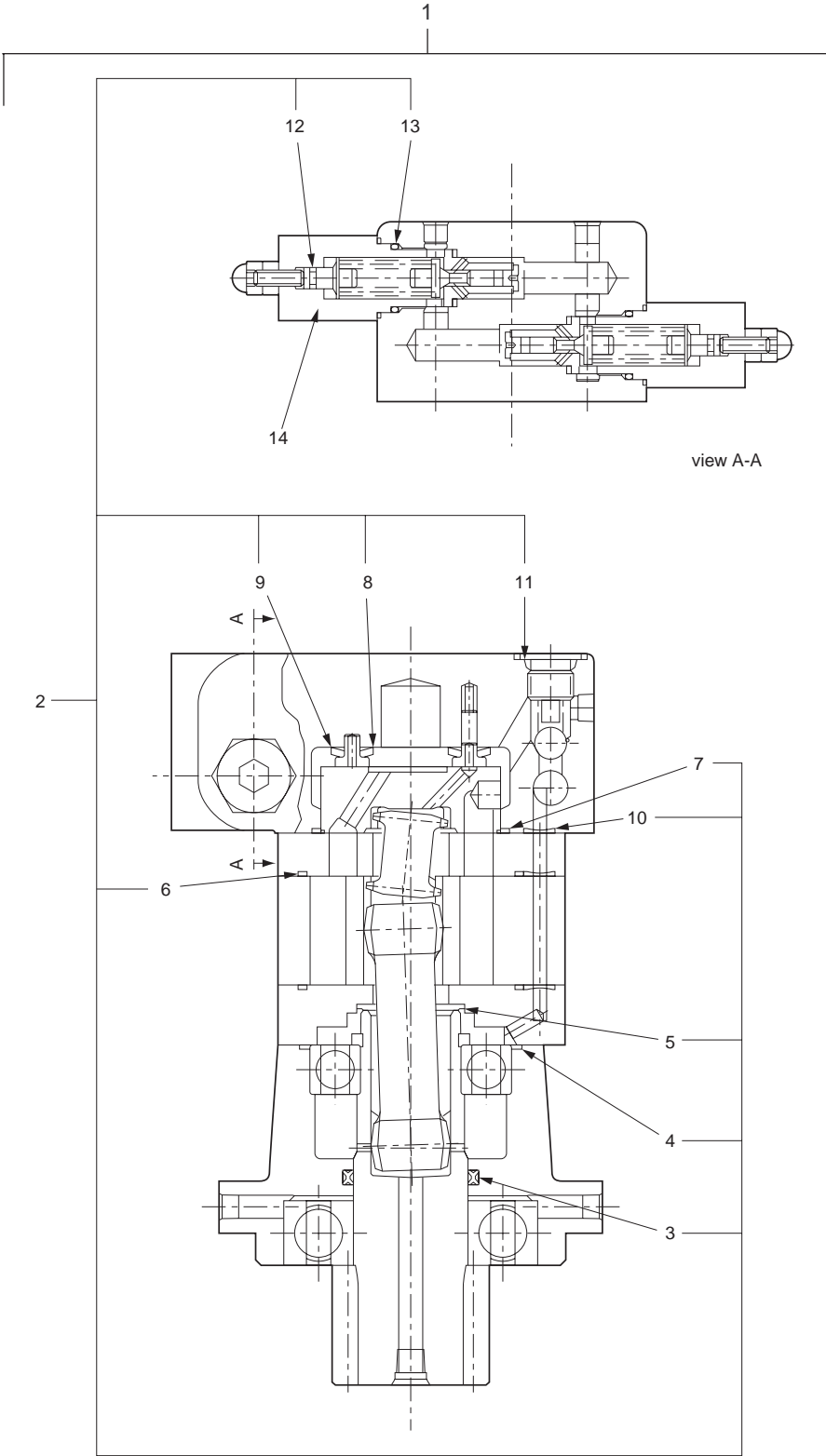
Initial oil replace	500Hr
Second and later replace	1,000Hr



View A

	Type	2-160DOS-E3768
Hydraulic motor	Output torque	296 Nm(30.2kgf-m)
	Output speed	78min ⁻¹
	Capacity	158 cm ³ /rev
	Flow rate	30 ℓ /min.
	Overload relief set pressure	11.8MPa(120kgf/cm ²) at 12 ℓ /min.
Pinion gear	Module	3
	No. of threads Z	13
Weight		15kg

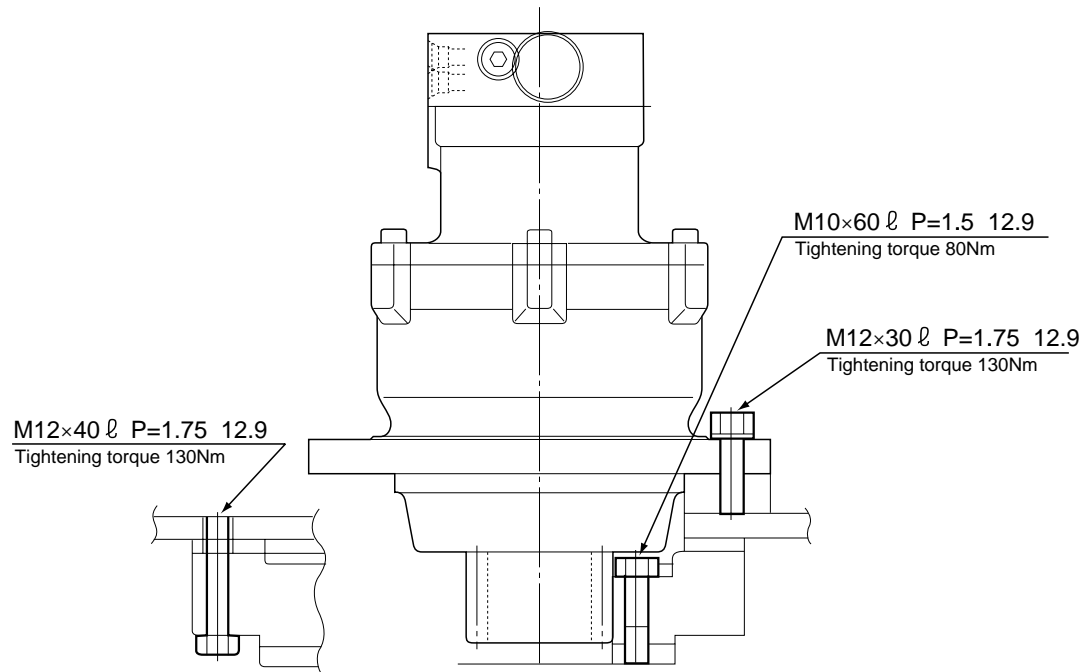
9-2 Structure



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

9-3 Standard of maintenance

9-3-1 Slew bearing and slew case

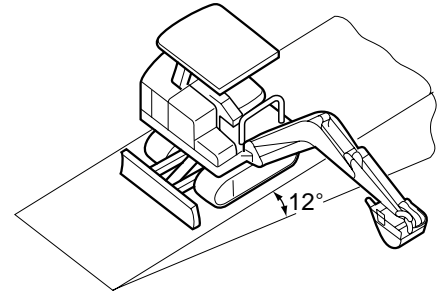


9-4 Inspection and adjustment

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

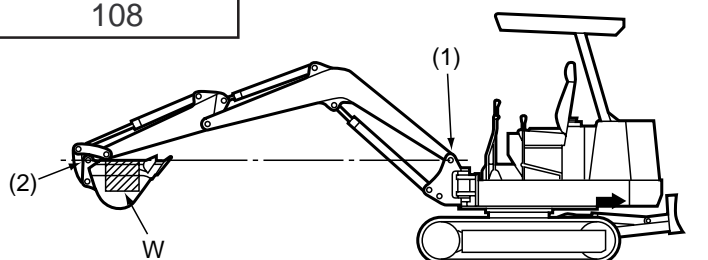
Standard value	Allowance	Weight W kg
100	200	108

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	108



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

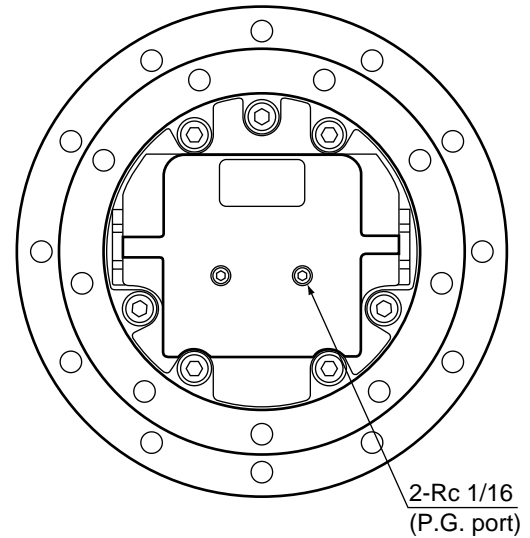
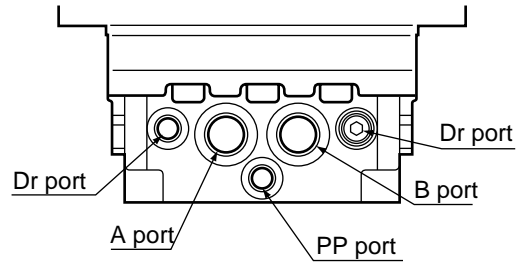
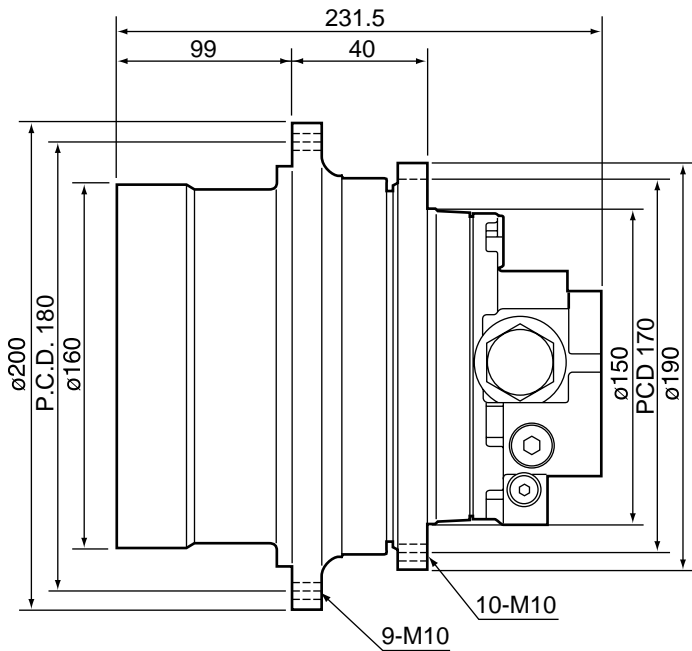
Standard value	Allowance
26 ± 4	42

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

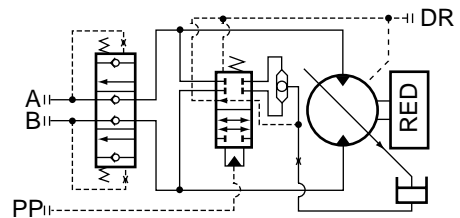
10-1 Specification



Direction of rotation (viewing from output axis)

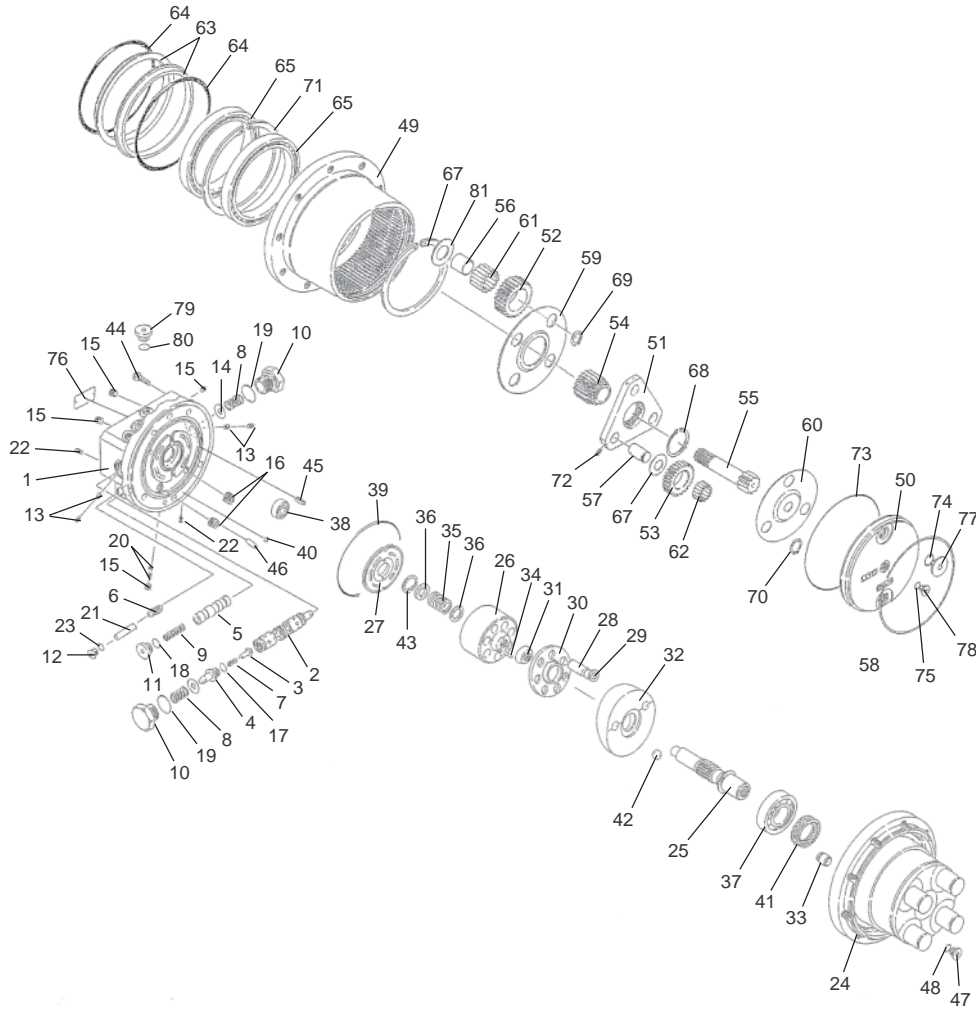
Direction of rotation	Oil pouring port	Oil discharging port
Clockwise	B	A
Counterclockwise	A	B

Port	Port size
A,B	G 3/8
PP,Dr	G 1/4



Item		Item		
Reduction gear	Output torque (Nm)	1,859(190kgf-m)	Others	
	Output speed (min ⁻¹)	36.3/69.6		
	Reduction ratio	1/39		
	Capacity (cm ³ /rev)	16.1/8.4		
Hydraulic motor	Working pressure (MPa)	18.6(190kgf/cm ²)	Equivalent capacity (cm ³ /rev)	627.9/327.6
	Output speed of hydraulic motor (min ⁻¹)	1416/2714	Oil	ISO-VG46
	Flow rate (ℓ/min)	22.8	Oil temperature(°C)	-20~100
			Filtering (μM)	10
			Lubricating oil	Engine oil equivalent to SAE-30CD(330cm ³)
			Weight(kg)	25

10-2 Structure

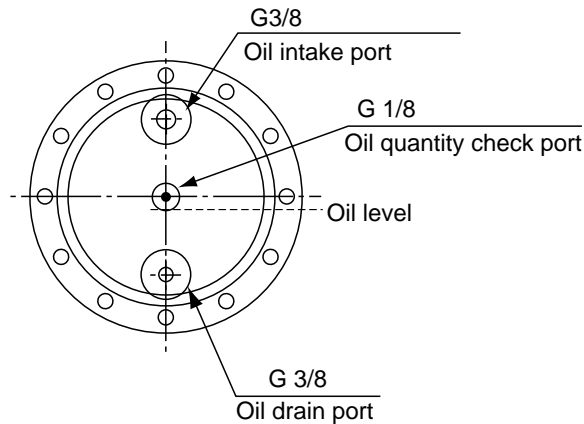


- | | | |
|---------------------|--------------------|--------------------|
| 1. Body-1 | 28. Piston | 55. S2 gear |
| 2. Spool | 29. Shoe | 56. Ring |
| 3. Check valve | 30. Shoe holder | 57. B2 pin |
| 4. Spring guide | 31. Barrel holder | 58. O-snap ring |
| 5. Spool | 32. Swash plate | 59. Thrust plate 1 |
| 6. Shuttle spool | 33. Control piston | 60. Thrust plate 2 |
| 7. Spring V1 | 34. Pin | 61. Needle |
| 8. Spring V2 | 35. Spring C | 62. Needle |
| 9. Spring V3 | 36. Retainer | 63. Floating seat |
| 10. Plug | 37. Bearing | 64. O-ring |
| 11. Plug | 38. Bearing | 65. Bearing |
| 12. Plug | 39. O-ring | 66. Thrust washer |
| 13. Choke | 40. O-ring | 67. Snap ring |
| 14. Ring | 41. Oil seal | 68. Snap ring |
| 15. Plug | 42. Ball | 69. Snap ring |
| 16. Pulg | 43. Snap ring | 70. Snap ring |
| 17. O-ring | 44. Screw | 71. Snap ring |
| 18. O-ring | 45. Spring pin | 72. Spring pin |
| 19. O-ring | 46. Pin | 73. O-ring |
| 20. Choke | 47. Plug | 74. O-ring |
| 21. Needle | 48. O-ring | 75. O-ring |
| 22. Plug | 49. Body | 76. Name plate |
| 23. O-ring | 50. Cover | 77. Plug |
| 24. Body 2 | 51. Carrier 2 | 78. Plug |
| 25. Shaft | 52. B1 gear | 79. Plug |
| 26. Cylinder barrel | 53. B2 gear | 80. O-ring |
| 27. Valve plate | 54. S1 gear | 81. Thrust washer |

10-3 Handling the travelling motor

Add lubricating oil according to the following procedure.

1. The cover has three plugs. Turn the motor so that oil intake port is the top of the motor. Use them as the oil intake port, oil quantity check port and oil drain port, starting from the top in that order.



2. First, remove the plugs from the oil intake and oil quantity check port with an Allen wrench.
3. Add lubricating oil through the oil intake until the oil comes out of oil quantity check port.
4. Plug the oil intake, oil drain and oil quantity check port.

Amount of lubricating oil	330cc
---------------------------	-------

Schedule for replacing lubricating oil:

First: After the first 500 service hours
 Second and later times : Every 1,000 service hours

Standard maintenance

Tightening torque

Sprocket tightening torque	72 N-m
Motor tightening torque	72 N-m

10-4 Measuring crawler idling and travelling time

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

Unit : sec

Standard value	
Low	31±2
High	53±2

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

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

Standard value	
Low	19±2
High	33±2

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

10-5 Inspection and adjustment

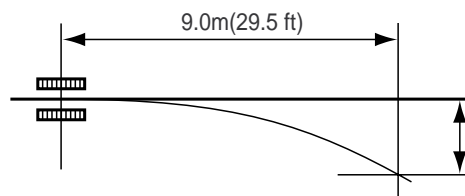
1. Measuring meander distance in travelling

Measure the meandering distance by travelling on hard ground.

Unit : mm or less

Standard value	Max.
200	500

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

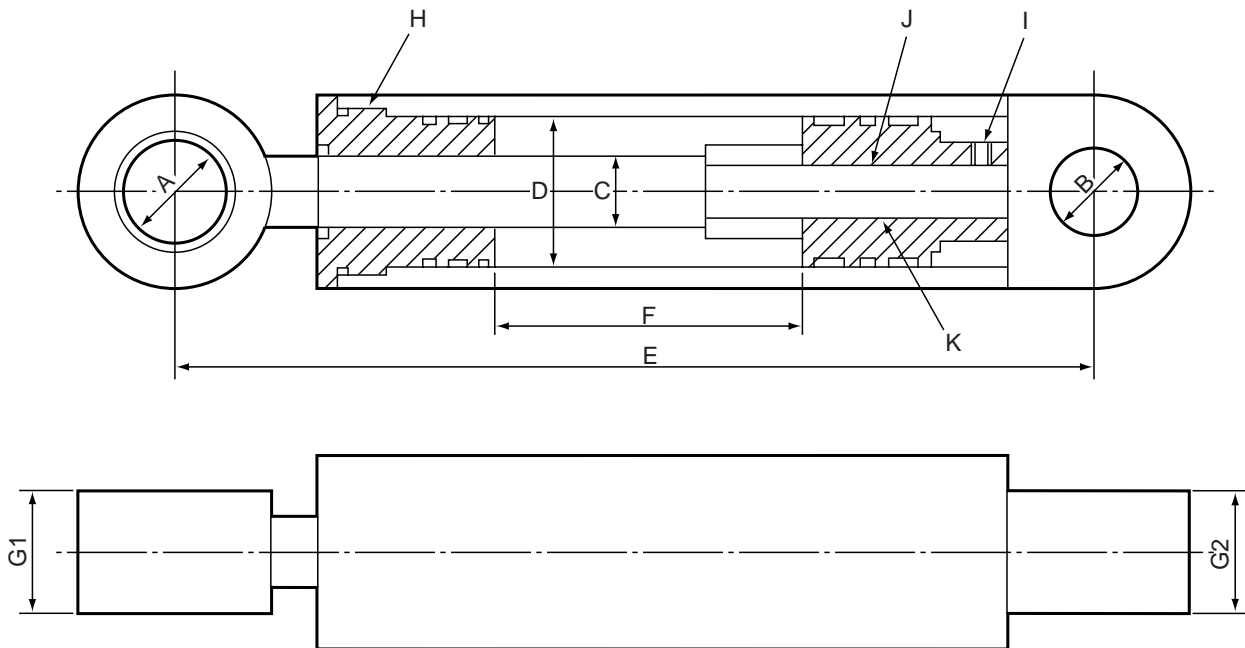


11 HYDRAULIC CYLINDER

CONTENTS

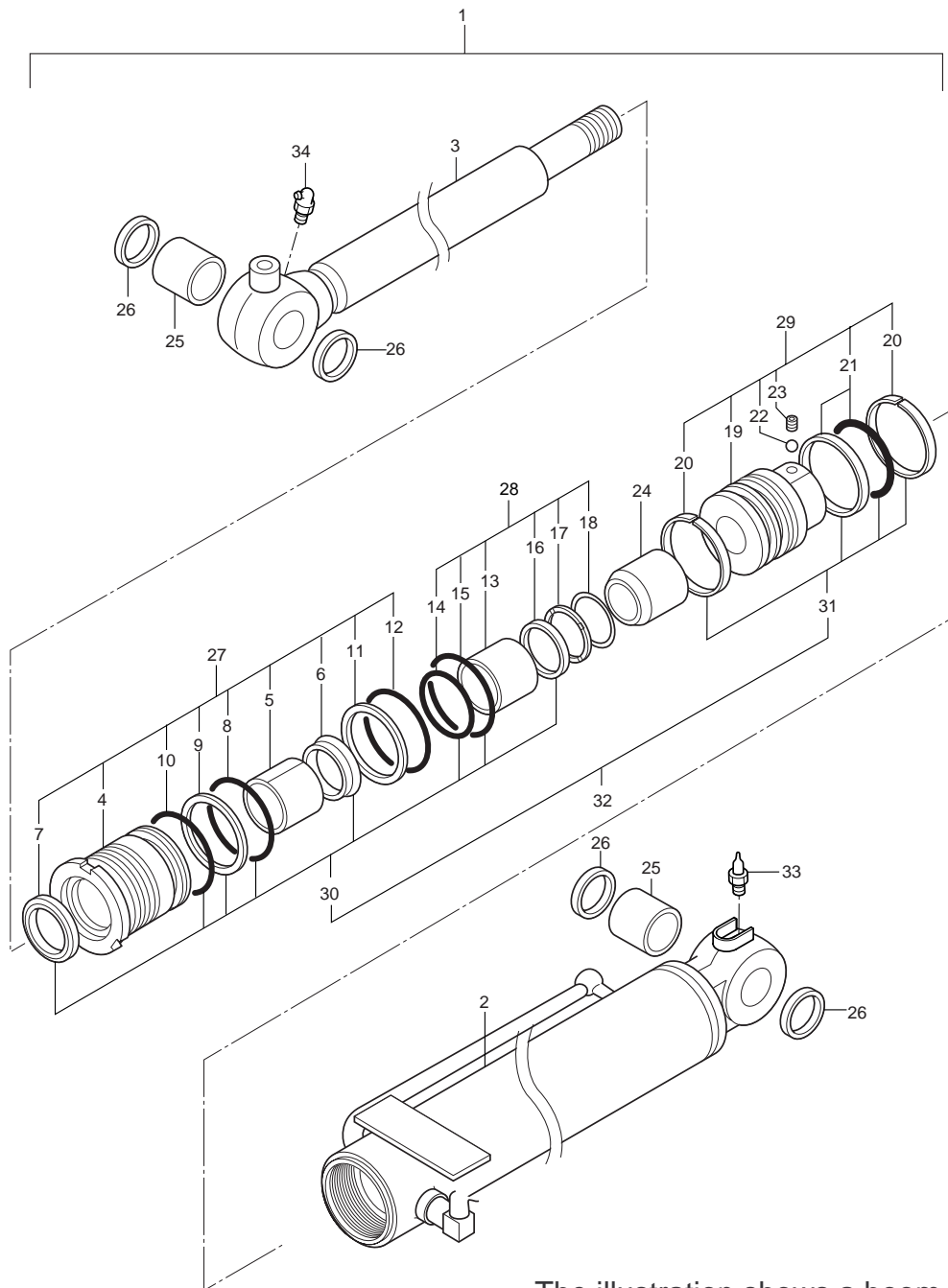
- 11-1 Structure
- 11-2 Disassembly and assembly
 - 11-2-1 Disassembly procedure
 - 11-2-2 Procedure for disassembling inner parts
- 11-3 Assembly
 - 11-3-1 Assembly procedure
 - 11-3-2 Inspection procedure
 - 11-3-3 Precautions for assembly

11-1 Structure



Item		Cylinder	Boom	Arm	Bucket	Swing	Dozer
Weight kg			20	20	17	16	13
Trust force*	Pushing	kN	61.8		52.6		71.6
	Pulling	kN	43.9		34.7		48.2
A	Pin diameter (rod)	mm	ø35				ø30
B	Pin diameter (head)	mm	ø35				ø30
C	Rod diameter	mm	ø35				ø40
D	Cylinder bore	mm	ø65		ø60		ø70
E	Maximum extended length	mm	1,195	1,295	1,095	1,160	555
	Maximum contracted length	mm	745	795	695	735	455
F	Stroke	mm	450	500	400	425	100
G1	Clevis width	mm	50				45
G2							
H	Tightening torque	N-m(kgf-m)	294(30.0)		284(29.0)		304(31.0)
I	tightening torque	N-m(kgf-m)	6.8(0.7)				
J	Tightening torque	N-m(kgf-m)	469(47.8)		399(40.7)		559(57.0)
K	Size of piston screw (size × pitch)		M24 × 1.5				M27 × 1.5
Main relief Pressure MPa(kgf-cm ²)			18.6(190)				

11-2 Disassembly and assembly



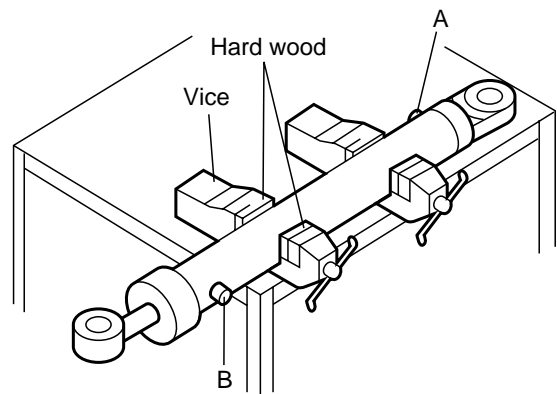
The illustration shows a boom cylinder.

- | | | |
|-------------------|--------------------------|--------------------|
| 1. Cylinder Ass'y | 13. Seal ring Ass'y | 25. Pin bush |
| 2. Tube | 14. Steel ball | 26. Dust seal |
| 3. Rod | 15. Set screw | 27. Cylinder seal |
| 4. Cylinder head | 16. Pin bush | 28. Retainer |
| 5. Rod bush | 17. Dust seal | 29. Piston |
| 6. U-ring | 18. Cylinder head Ass'y | 30. Rod packing |
| 7. Wiper ring | 19. Piston Ass'y | 31. Piston packing |
| 8. O-ring | 20. Rod packing Ass'y | 32. Packing |
| 9. Backup ring | 21. Piston packing Ass'y | 33. Grease nipple |
| 10. O-ring | 22. Packing Ass'y | 34. Grease nipple |
| 11. Piston | 23. Set screw | |
| 12. Slide ring | 24. Cushion bearing | |

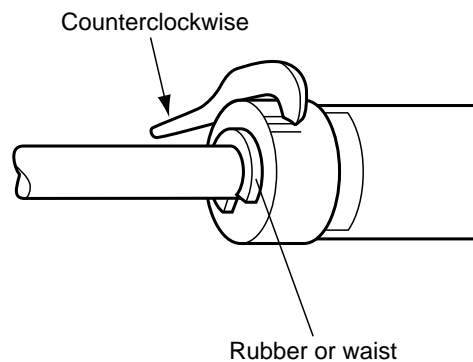
11-2-1 Disassembly procedure

1. Hold the cylinder with the vice.

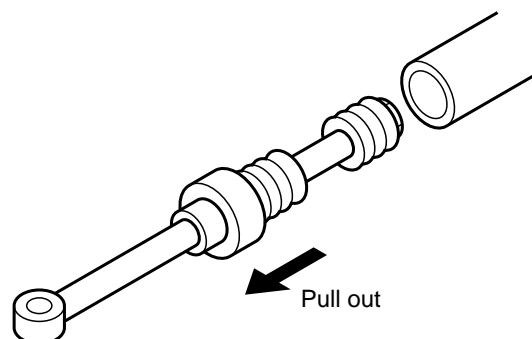
Tighten the vice carefully; do not deform the cylinder. Blow air alternately from ports A and B and operate the piston rod to drain oil from the cylinder inside. To remove the piston, pull the piston rod about a third of the length.



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



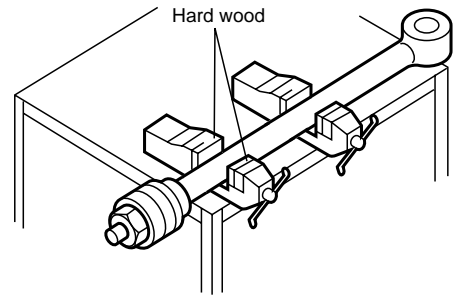
3. Disassembling the piston rod assembly
Slowly turn the piston rod assembly to remove it from the cylinder tube assembly. Place the removed piston rod assembly on a wooden bench or a waste to prevent damage.



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

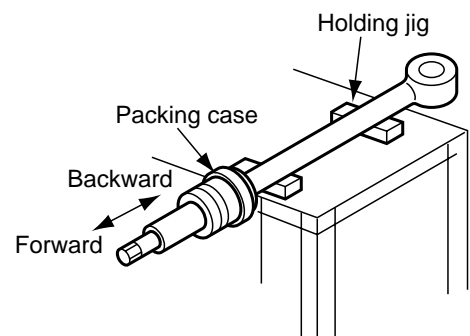
1. Remove the piston assembly from the piston rod assembly (after removing the set bolts). Then remove the cushion bearing in the direction of the arrow.

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.

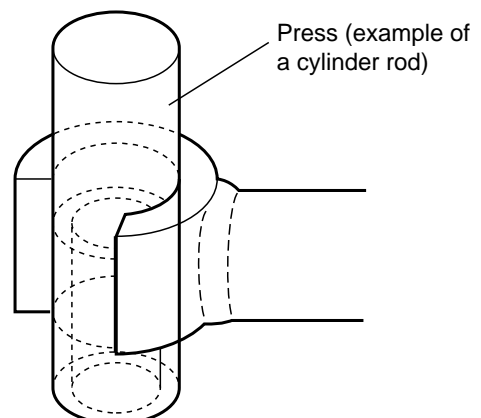


3. Disassembling the packing assembly

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

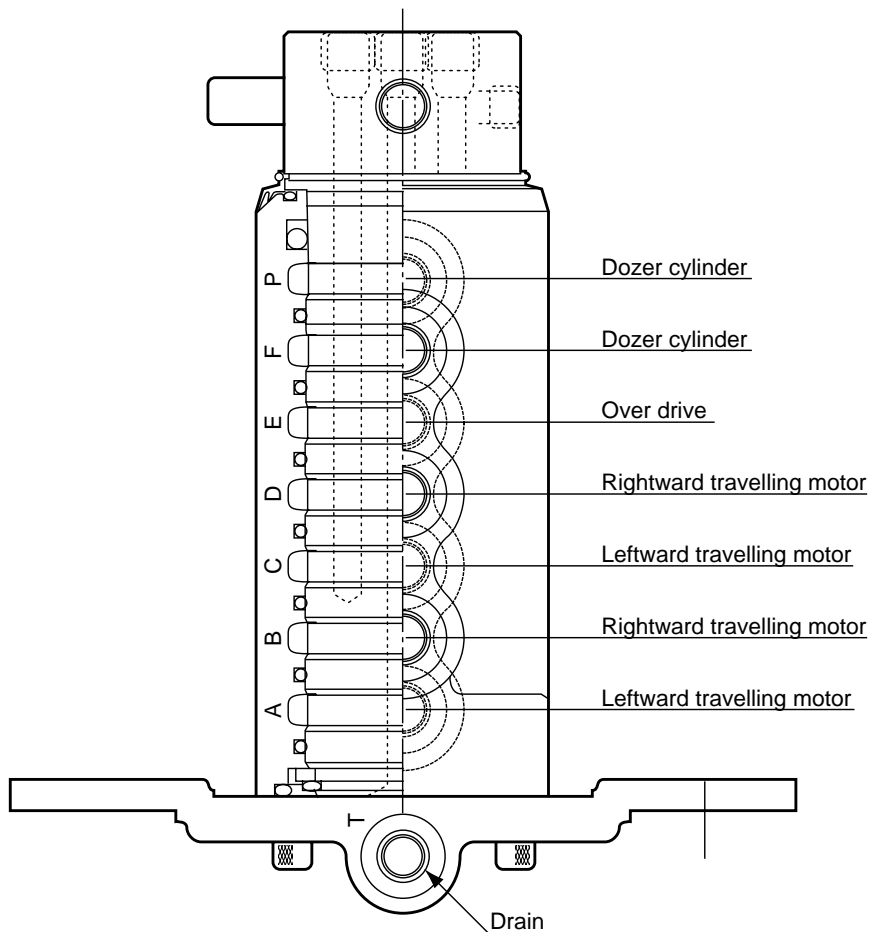
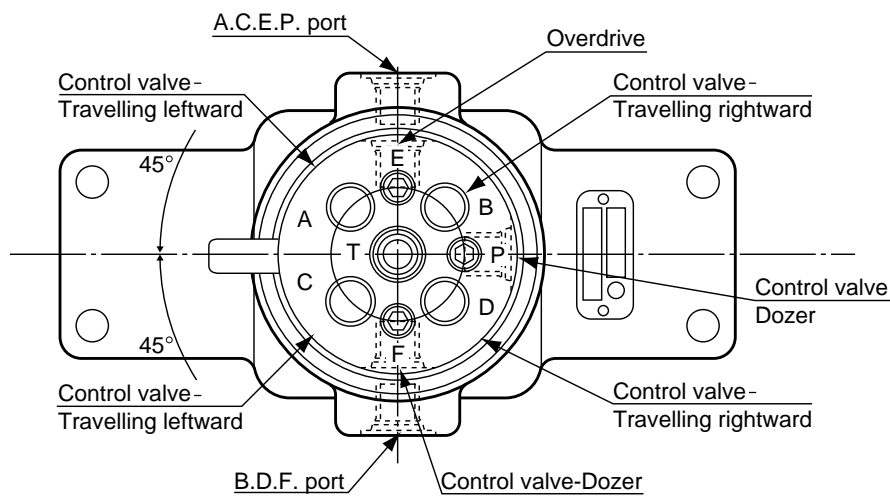
12-1 Specification and Structure

12-2 Structure, disassembly and assembly

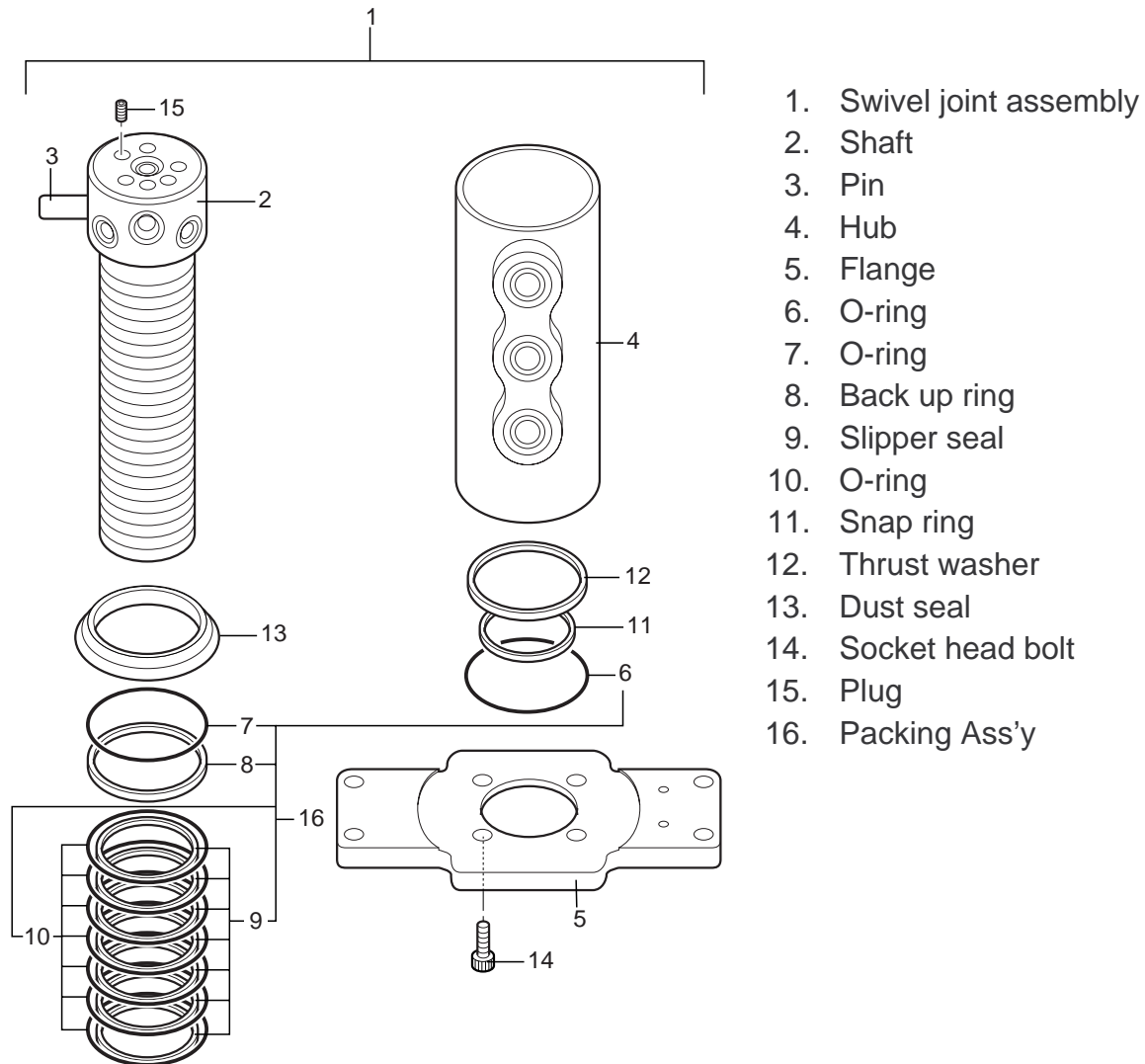
12-1 Specification and Structure

Working pressure	0.3MPa(3kgf/cm ²)	T
	3.4Mpa(35kgf/cm ²)	E
	18.6MPa(190kgf/cm ²)	A ~ D, F, P
Screw size(Body)	G 1/4	E, F, P, T
	G 3/8	A ~ D
Screw size(Shaft)	R 1/4	E, F, P, T
	R 3/8	A ~ D
Working speed	rpm	

*A to F and P, T denote the position of the port.



12-2 Structure, disassembly and assembly



Disassembly:

1. Remove bolt (14) and Flange (5).
2. Remove the snap ring (11).
3. Remove the shaft (2) from the hub (4) upward. Because the shaft is tightened by the tension of the O ring, tap a hammer on the shaft by rotating it and pull it up.
 * Be careful so that O ring does not become trapped.

Assembly:

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

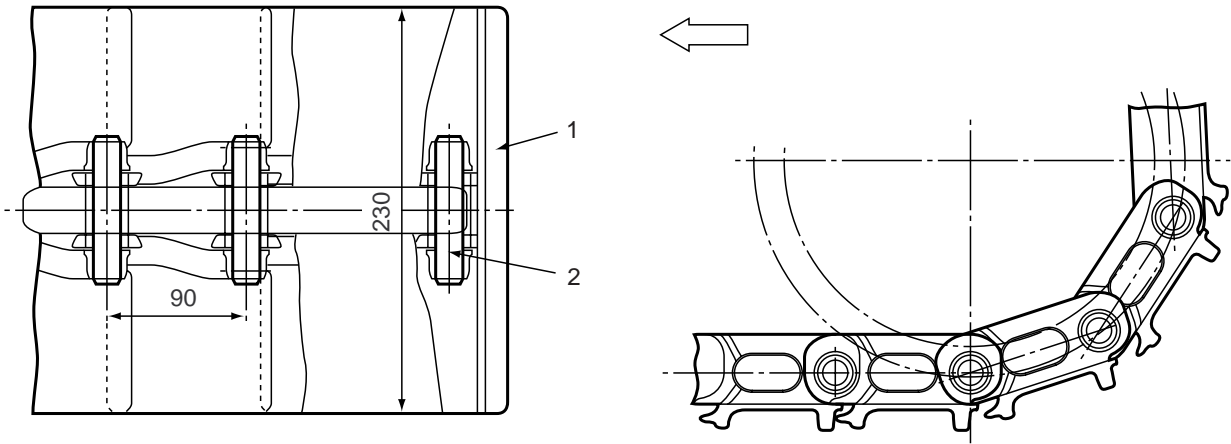
13 CRAWLER

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

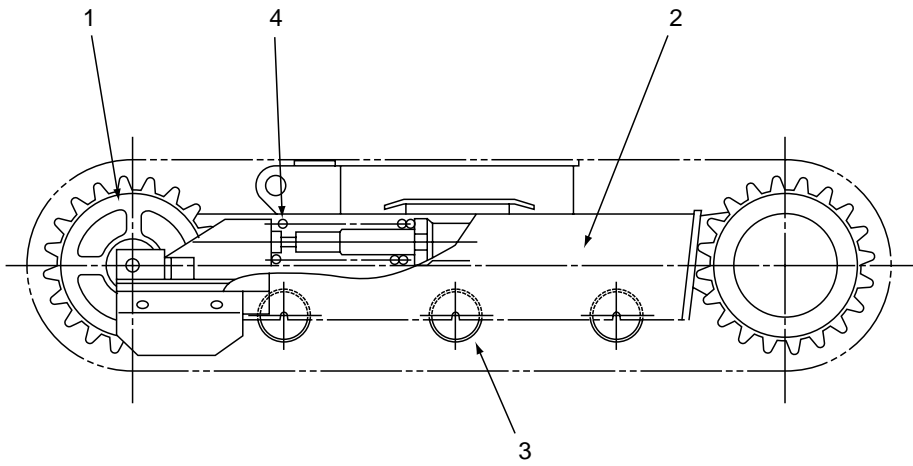
13-1 Structure and operation

13-1-1 Crawler (steel)



- 1. Shoe
- 2. Pin

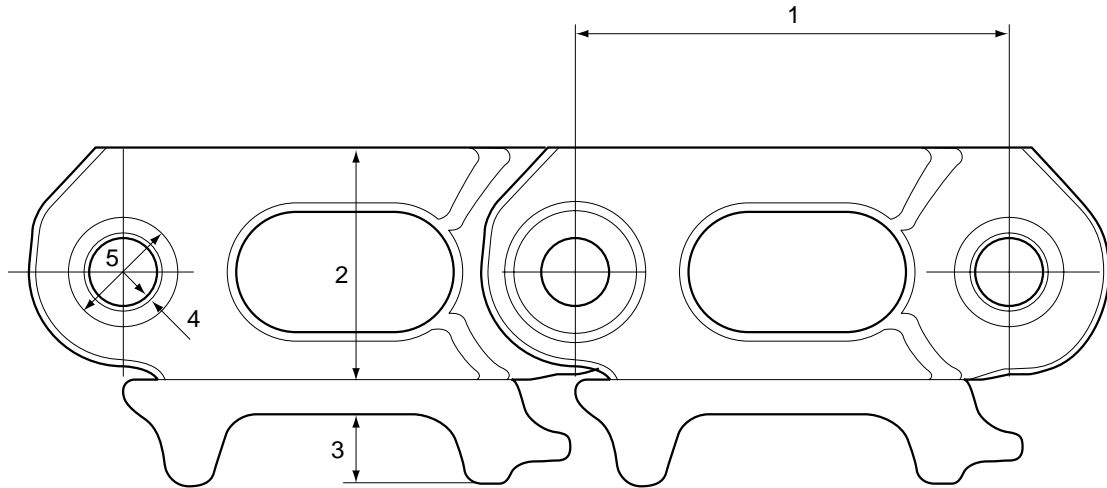
13-1-2 Track frame



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

13-2 Standard of maintenance

13-2-1 Crawler (steel)



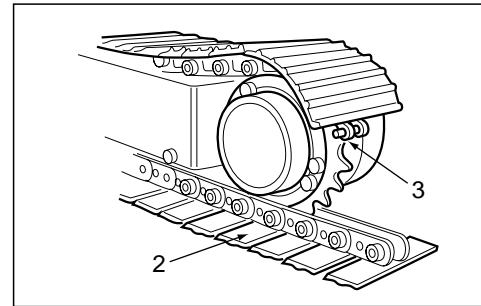
No.	Item	Unit	Standard value	Allowance	Remarks
1	Link pitch	mm	90	94	Measure by stretching 5 links except for the master link
2	Link height		46	43	Pad or replace
3	Grouser height		115	7	Pad or replace
4	Pin clearance		0.2	2	Replace
5	Bush outer diameter		22.15	21	Replace

13-3 Disassembly and assembly

13-3-1 Installing the crawler

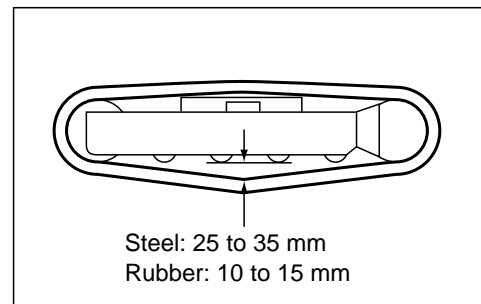
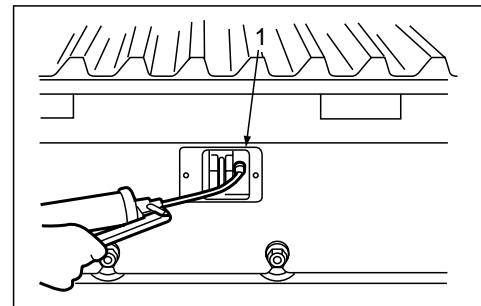
1. Crawler

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

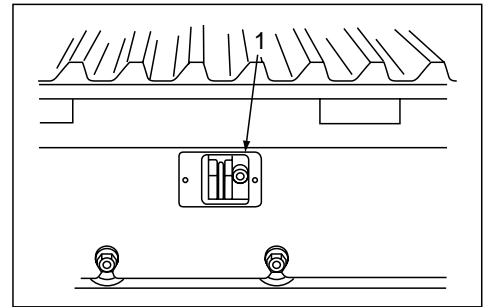
Tighten the cartridge valve (1) of the adjust cylinder, grease and adjust the tension.



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

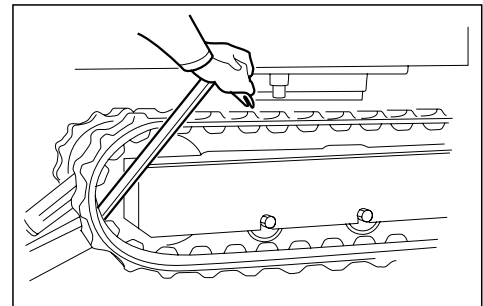
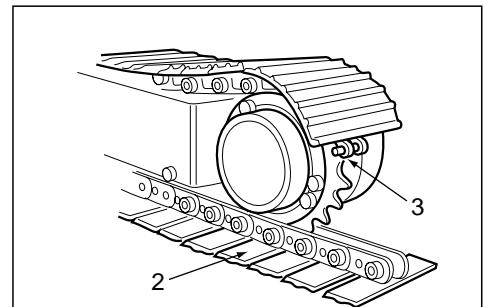
1) Lift the main frame with attachment and put blocks under to lift the machine.

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

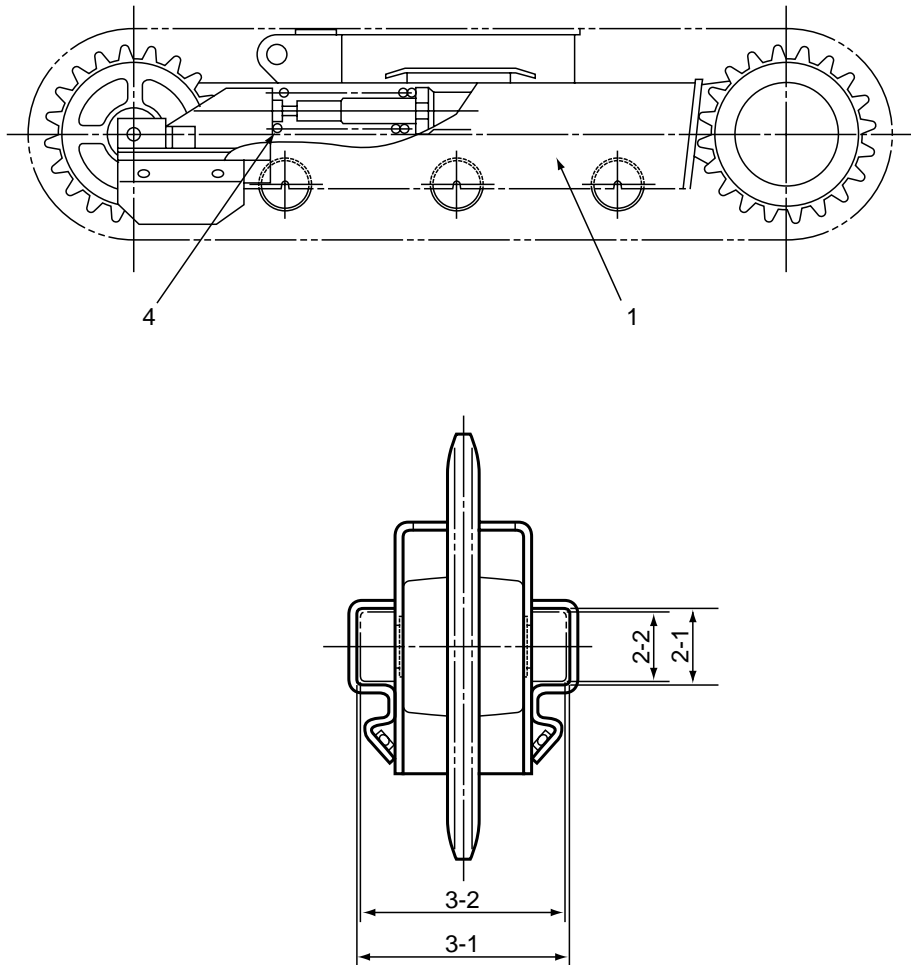
Weight (steel crawler): 148 kg (74×2)

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)



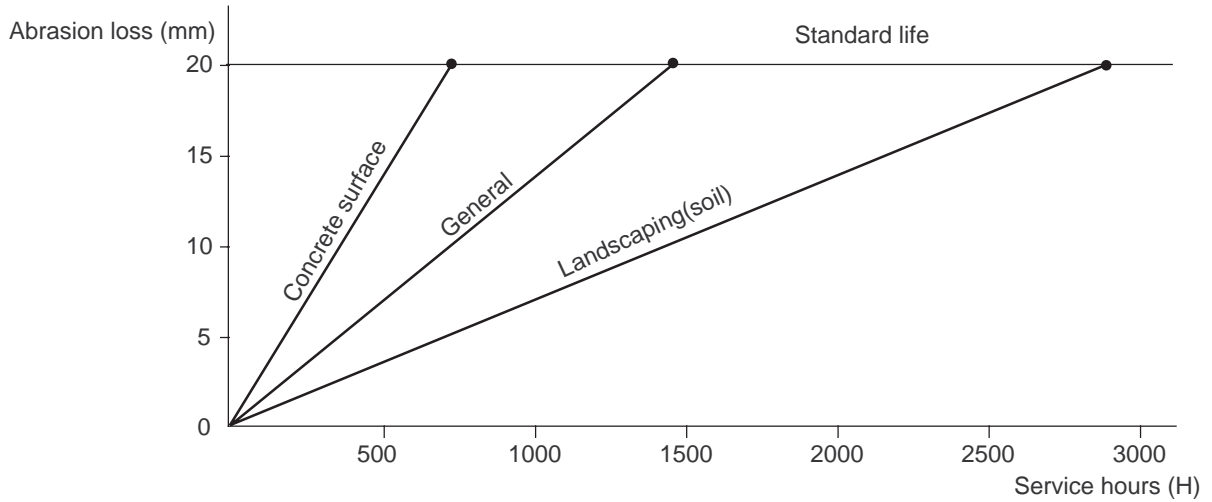
13-3-3 Track frame spring



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	152	Replace
		3-2 Idler support	150	
4	Spring (free length)	Standard value	274	Replace
		Set length	207	

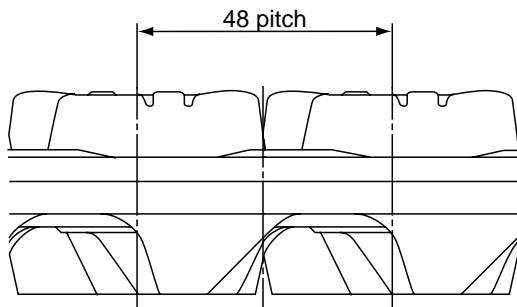
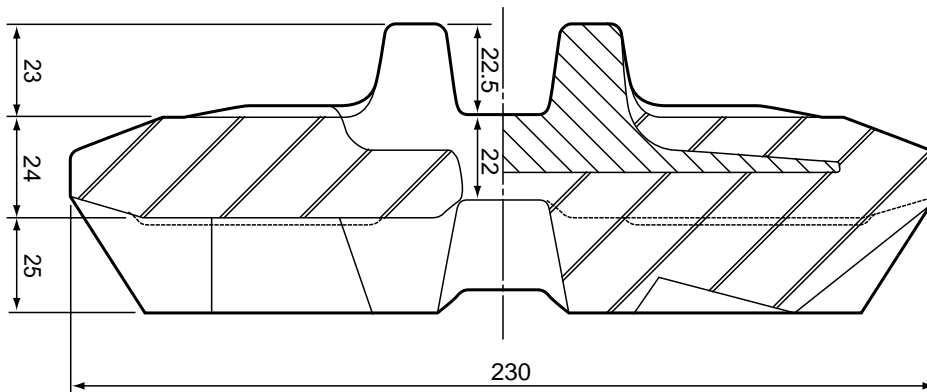
13-3-4 Life of the rubber crawler



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		3,552±10
Steel cord	Tension	5690N/piece
Steel cord	No. of cords	16±2×2row
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

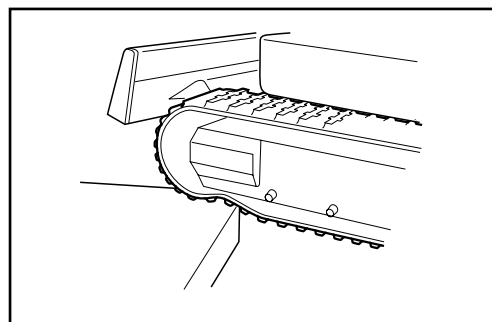
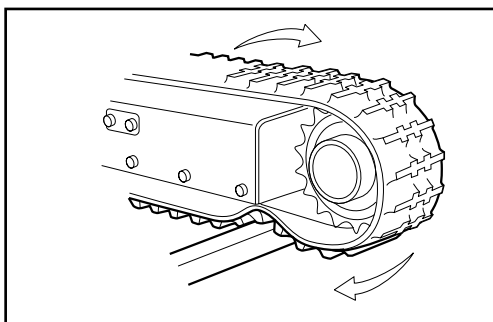
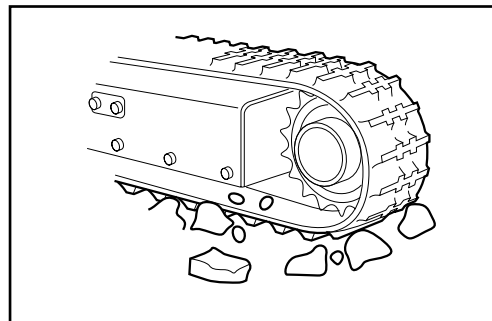
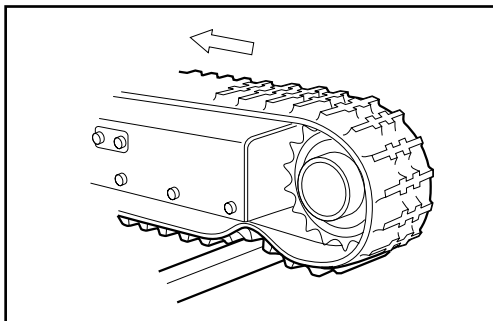
If you spill fuel or hydraulic fluid on the rubber crawler, clean it promptly.

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

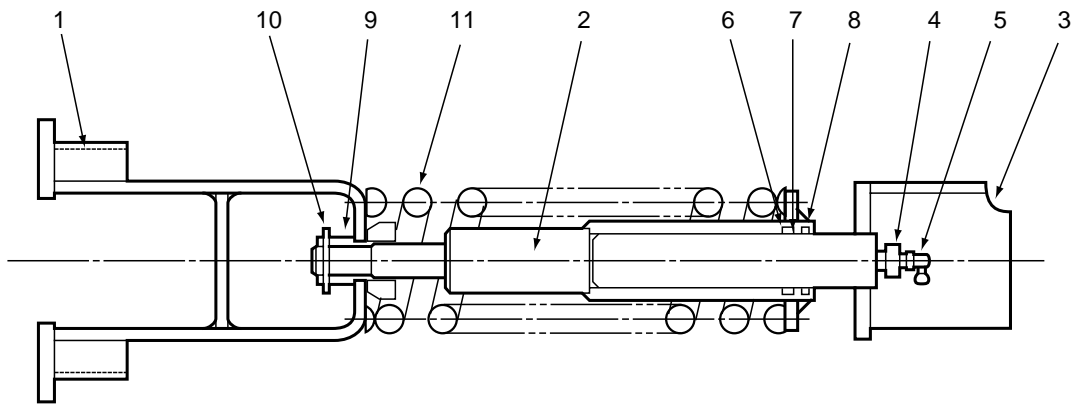
14-2 Specification of spring

14-3 Disassembly and assembly

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

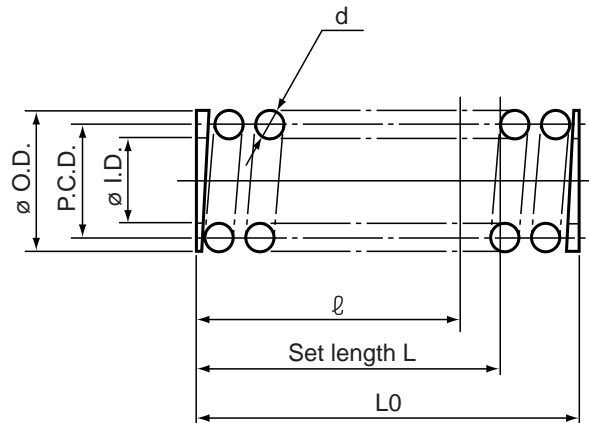
14-3-2 How to disassemble and assemble the
spring case

14-1 Structure



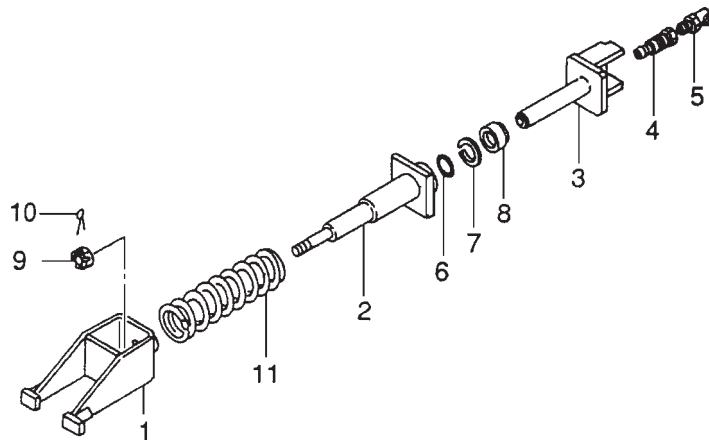
- | | |
|----------------------------|--------------------------|
| 1. Idler fork | 7. Back up ring (T2-P30) |
| 2. Cylinder | 8. Spacer(DSI) |
| 3. Rod | 9. Castle nut |
| 4. Cartridge valve | 10. Split pin |
| 5. Grease nipple (PT1/8-C) | 11. Spring |
| 6. O-ring (1B-P30) | |

14-2 Specification of spring



Name	Value	Name	Value
No. of active coils	8.5	l Length at max. shrinkage mm	140
Total number of coils	10.5	\varnothing O.D. (outer diameter)mm	80
Spring constant N/mm	288	P.C.D. (Center diameter) mm	64
Set force kN	14.1	\varnothing I.D. (Inner diameter) mm	48
Force at max. shrinkage kN	33.4	Wire diameter d mm	16
L_0 Free length mm	256	L set length mm	207

14-3 Disassembly and assembly



- | | |
|----------------------------|--------------------------|
| 1. Idler folk | 7. Back up ring (T2-P30) |
| 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 (1B-P30) | |

Cylinder effective stroke: 67 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: 207 mm

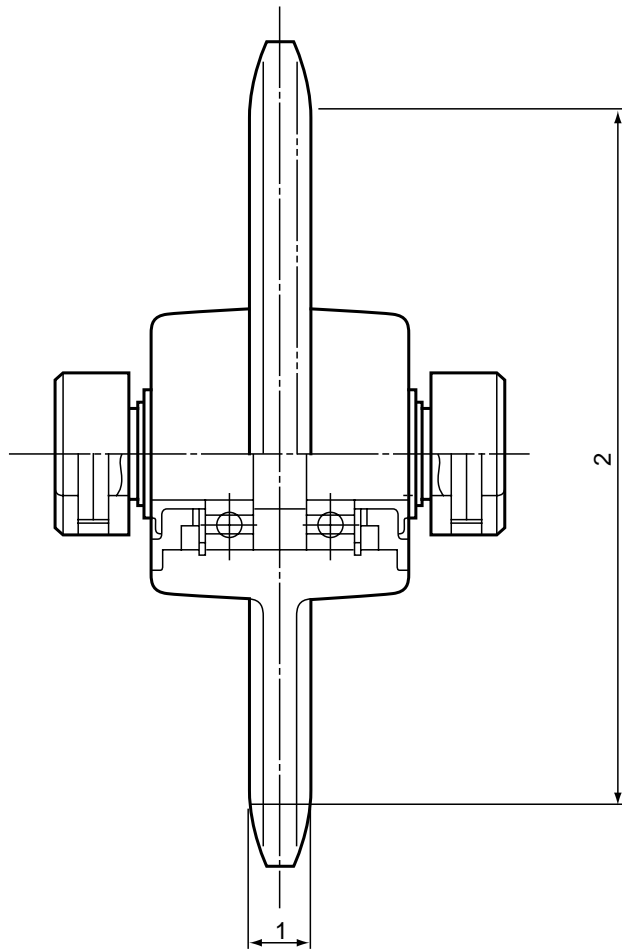
15 IDLER

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	ø253	ø241	Pad or replace
3	Number of teeth		19	—	
4	Quality of lubricating oil	cm ³	40	—	Engine oil or gear oil

16 SPROCKET

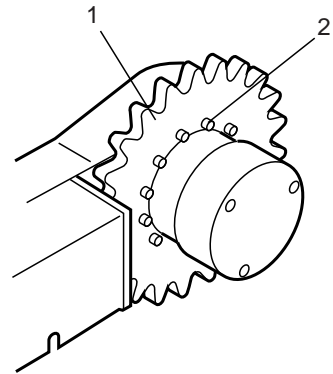
CONTENTS

- 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

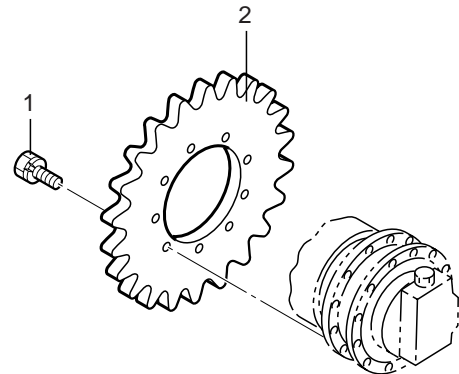
16-1-1 Removing the sprocket

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.



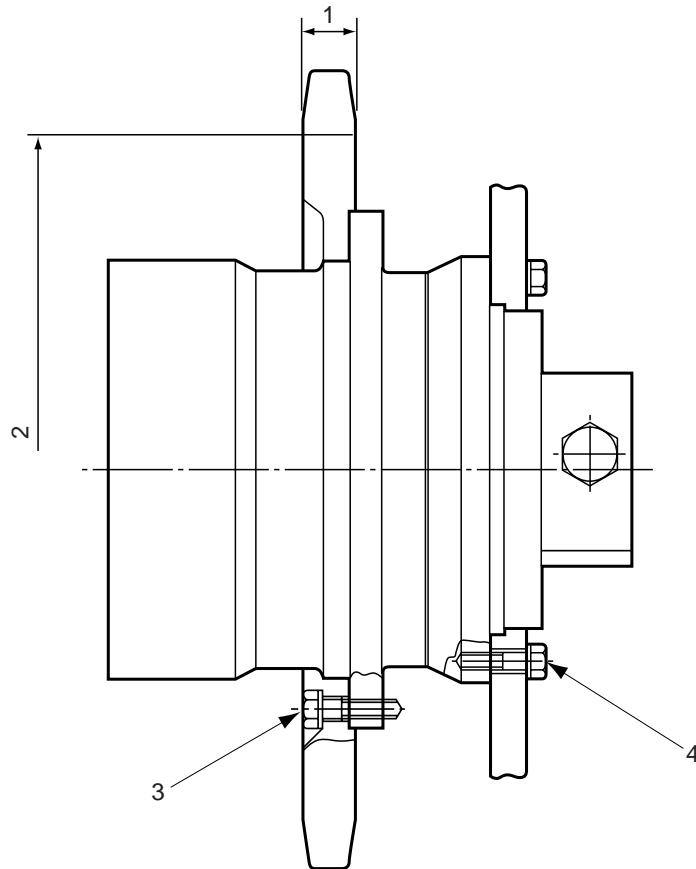
16-1-2 Installing the sprocket

1. Sprocket
Attach the sprocket to travelling motor assembly and tighten the mounting bolts (1).
Tightening torque: 72N-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	ø253	ø241	Pad or replace
3	Tightening torque of sprocket mounting bolt	N-m	72	—	(M10 P1.5)
4	Tightening torque of motor mounting bolt	N-m	72	—	(M10 P1.5)

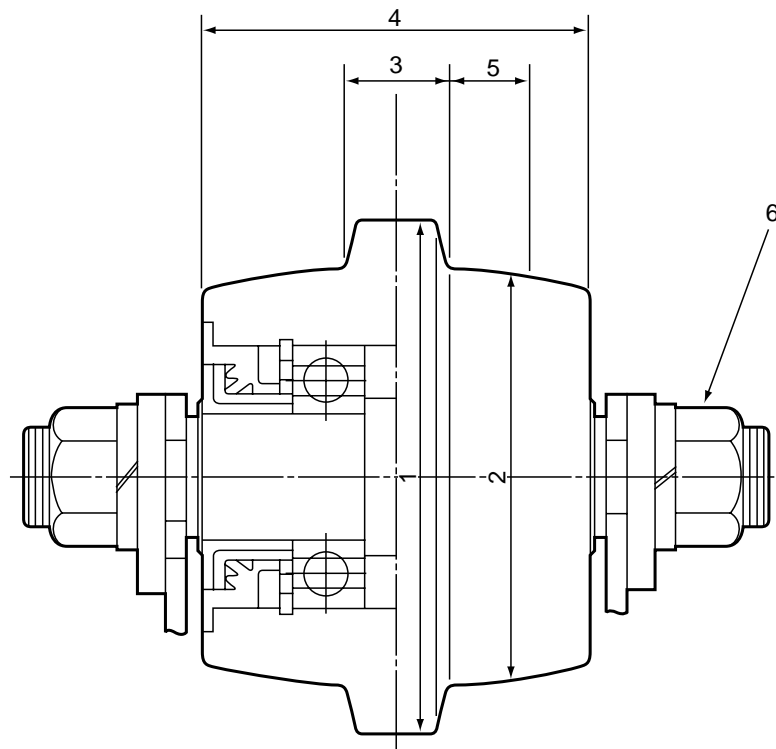
17 TRACK ROLLER

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	ø106	ø98	Pad or replace
2	Outer diameter of tread	mm	ø86	ø83	Pad or replace
3	Width of projected part	mm	22	19	Pad or replace
4	Overall width	mm	99	—	Pad or replace
5	Width of tread	mm	28	—	Pad or replace
6	Tightening torque for mounting roller	N-m	318	←	M20 × P2.5
7	Quantity of lubricating oil	cm ²	100	←	Gear oil or engine oil

18 ELECTRICAL EQUIPMENT

CONTENTS

- 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

18-2 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 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.

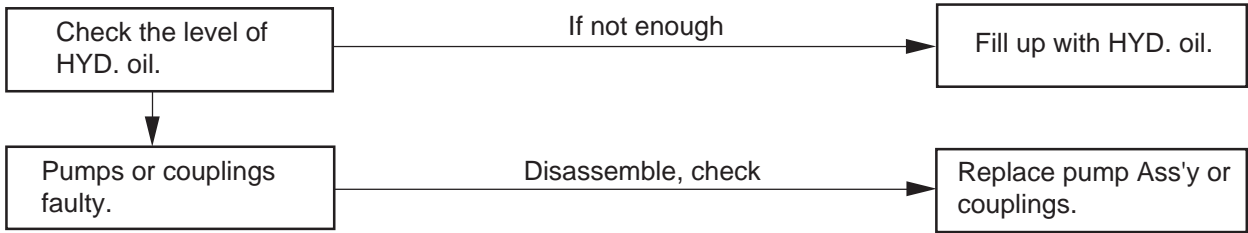
19 TROUBLESHOOTING

CONTENTS

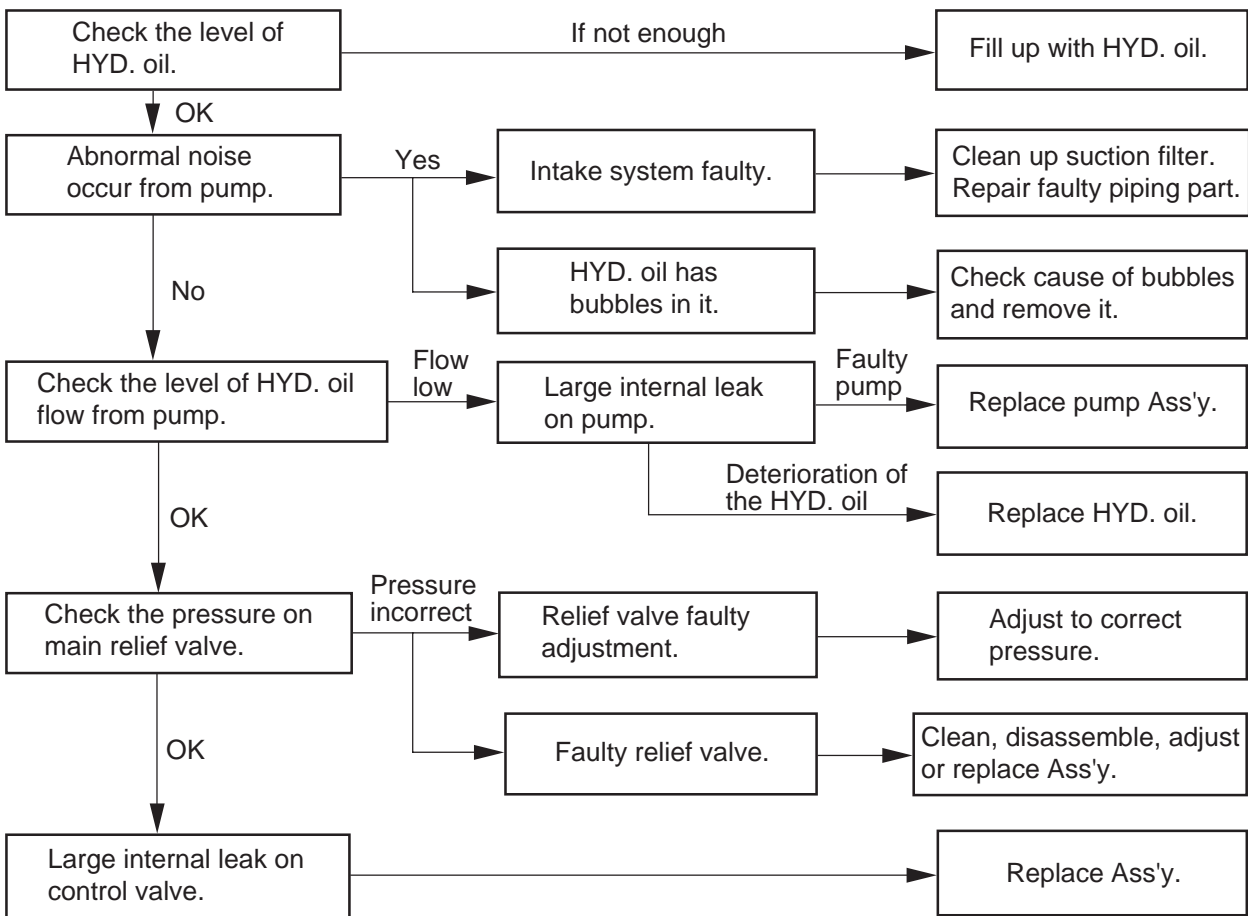
- 19-1 Troubleshooting
 - 19-1-1 All functions not operational
 - 19-1-2 Operation power is weak
 - 19-1-3 No operation on boom, arm, bucket slewing
- 19-2 Travelling system
 - 19-2-1 Right (or left) hand side of crawler does not work correctly
 - 19-2-2 Travelling meander by slow speed on only right (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

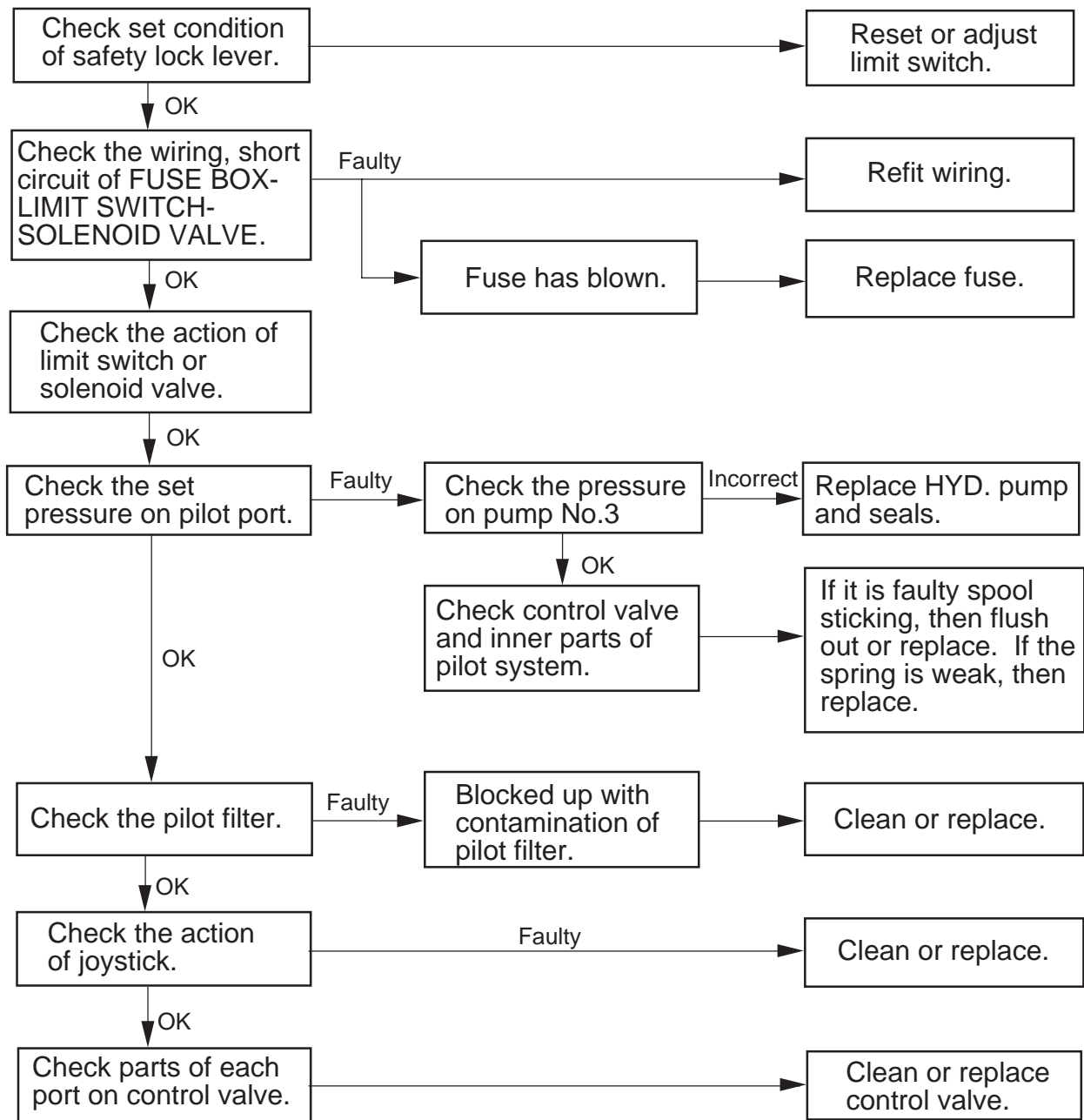
19-1-1 All functions not operational



19-1-2 Operation power is weak

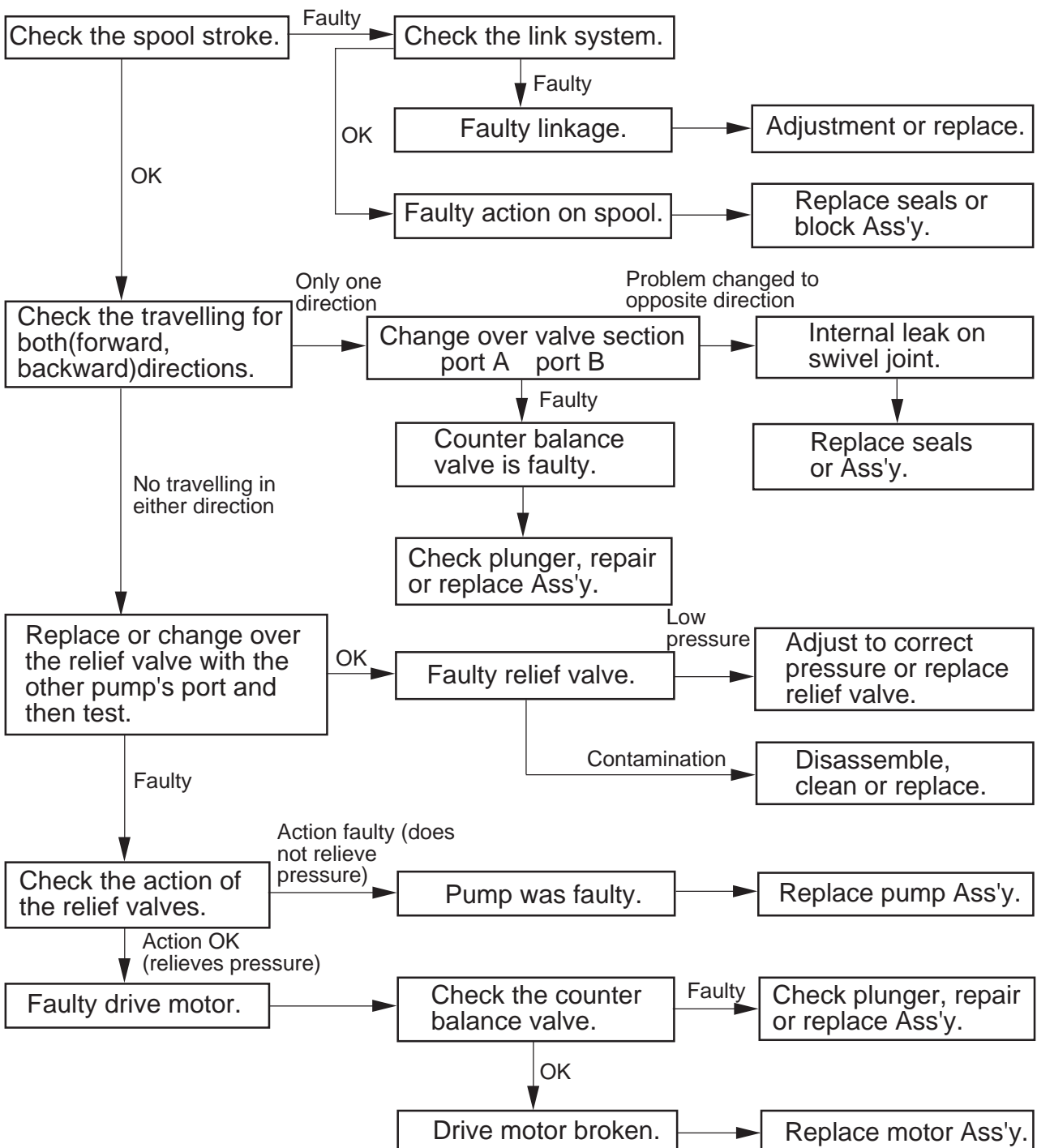


19-1-3 No operation on boom, arm, bucket & slewing

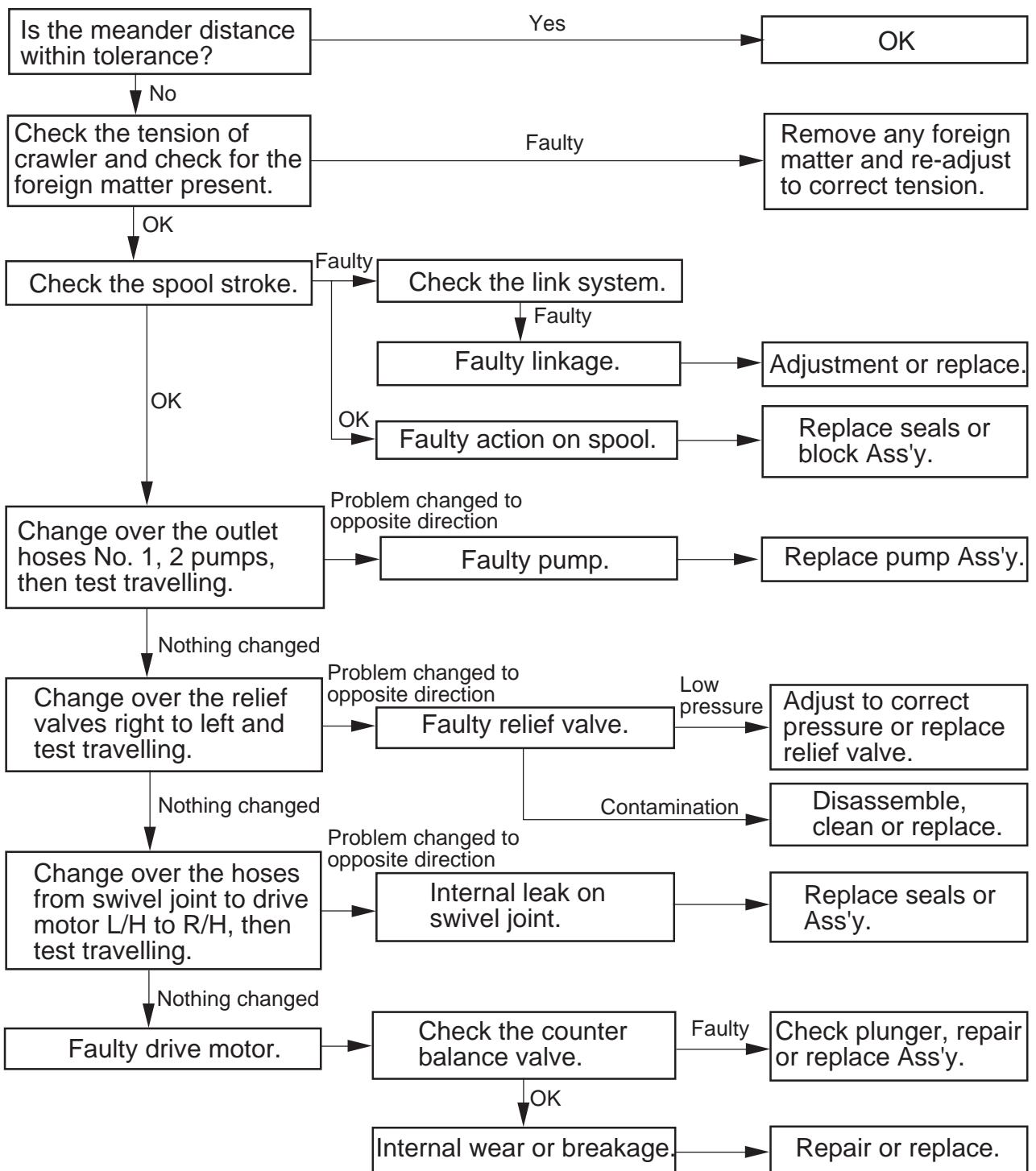


19-2 Travelling system

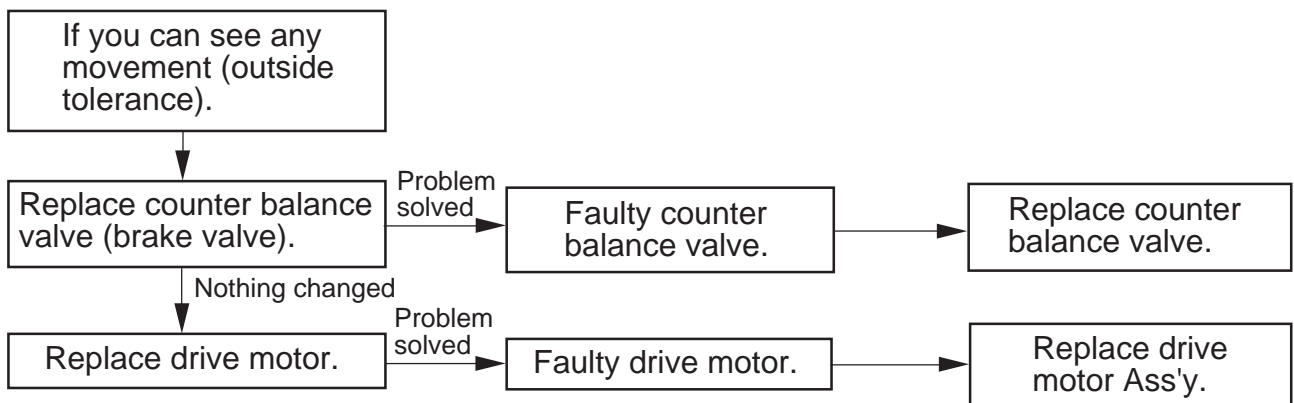
19-2-1 Right (or left) hand side of crawler does not work correctly



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

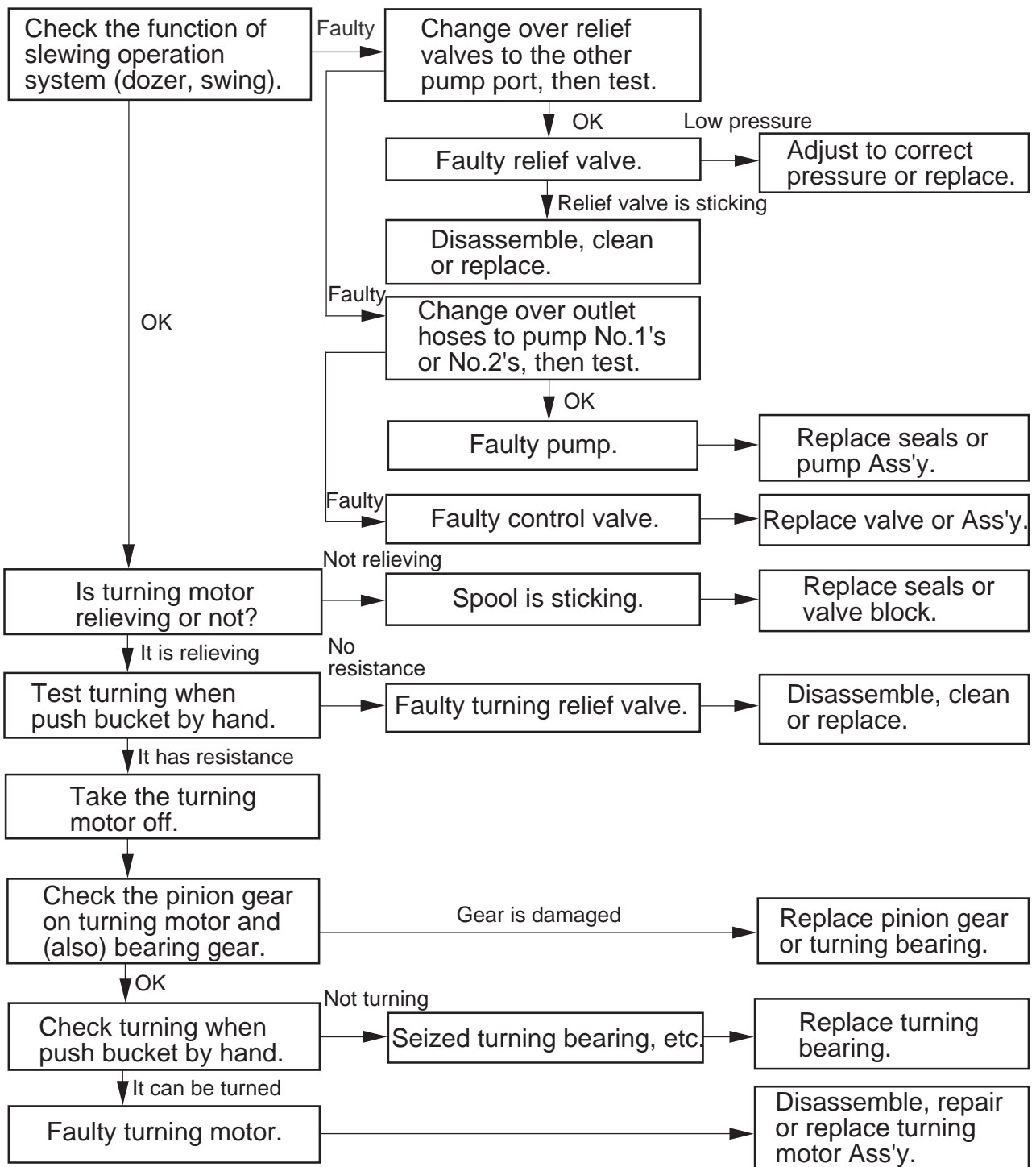


19-2-3 Machine fails to hold on incline

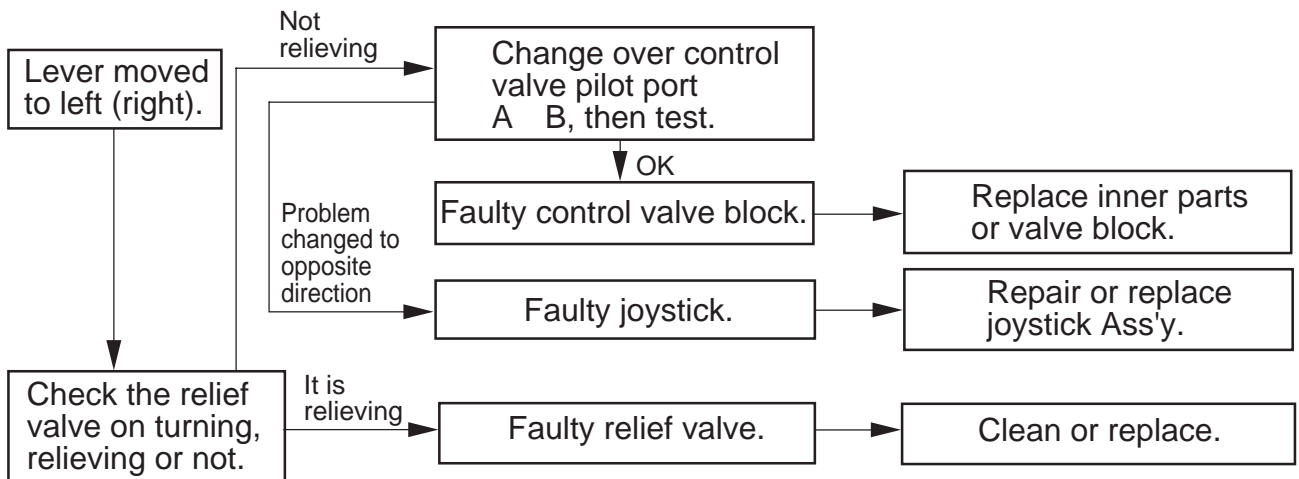


19-3 Slewing system

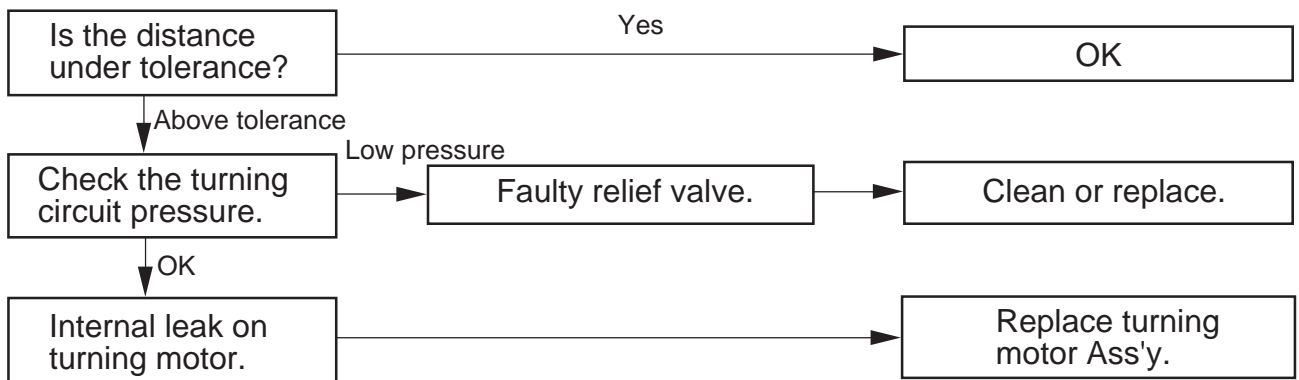
19-3-1 No operation both (right/left) slewing.



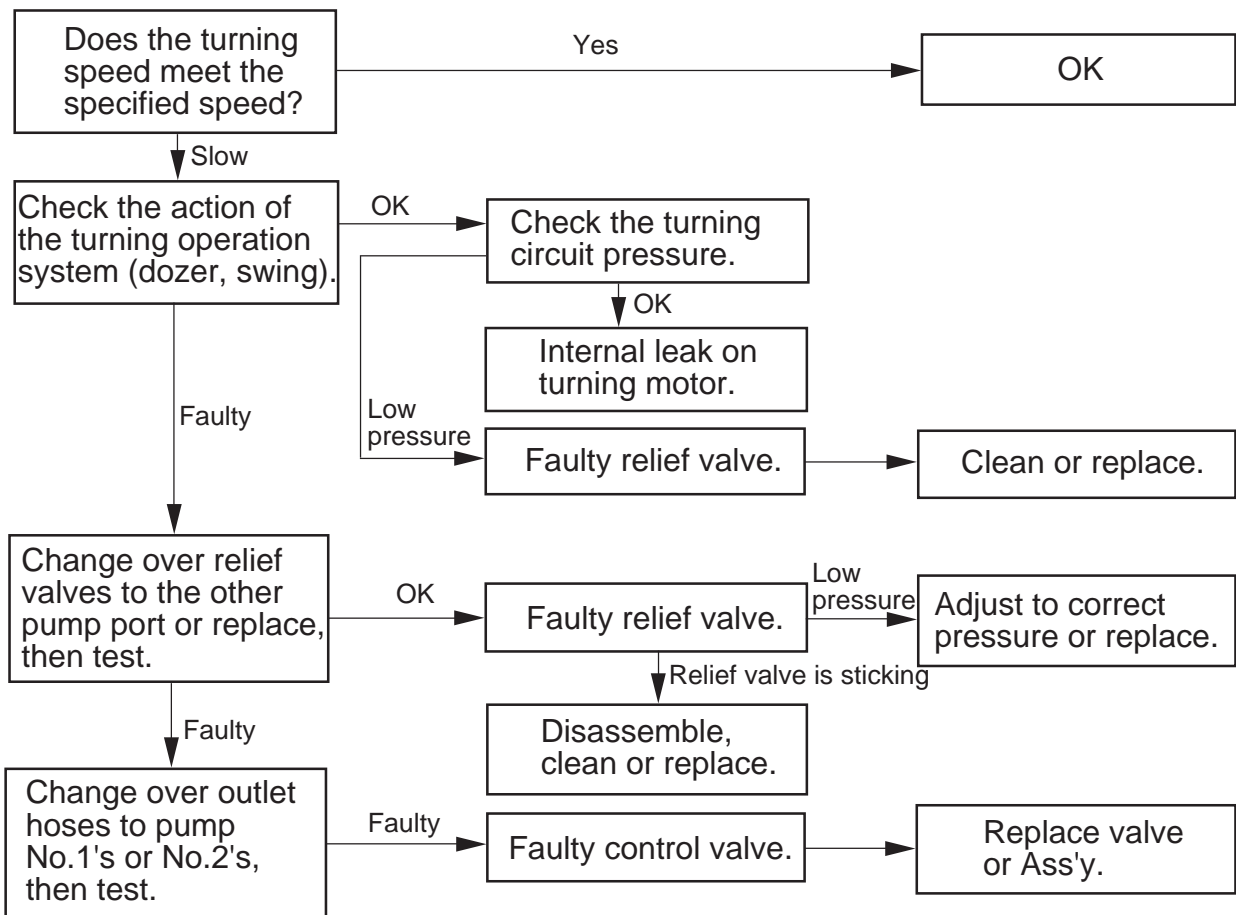
19-3-2 It is possible to turn right (left) but not left (right)



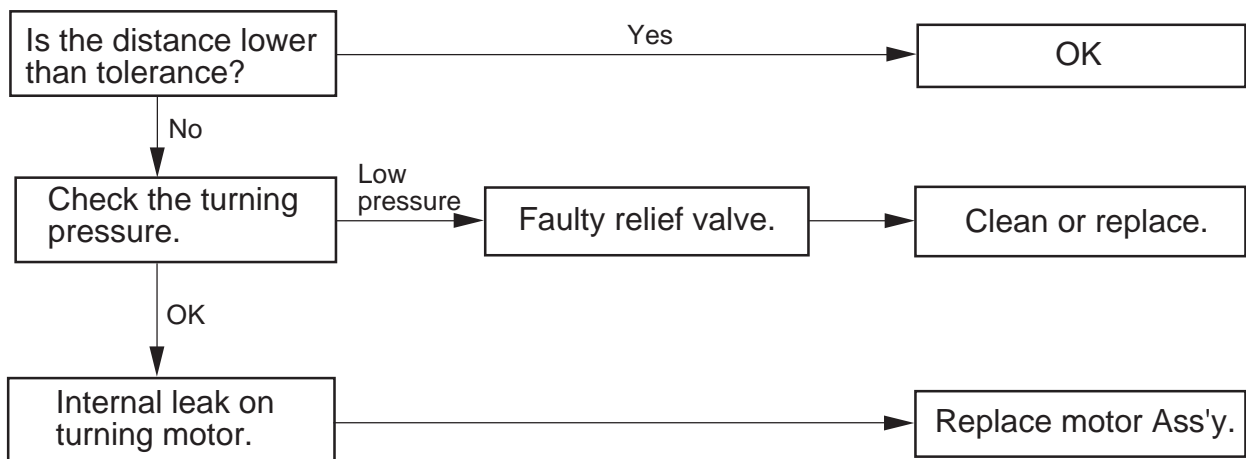
19-3-3 Turning acceleration slow, the overturn is higher than tolerance



19-3-4 Extreme slow turning speed

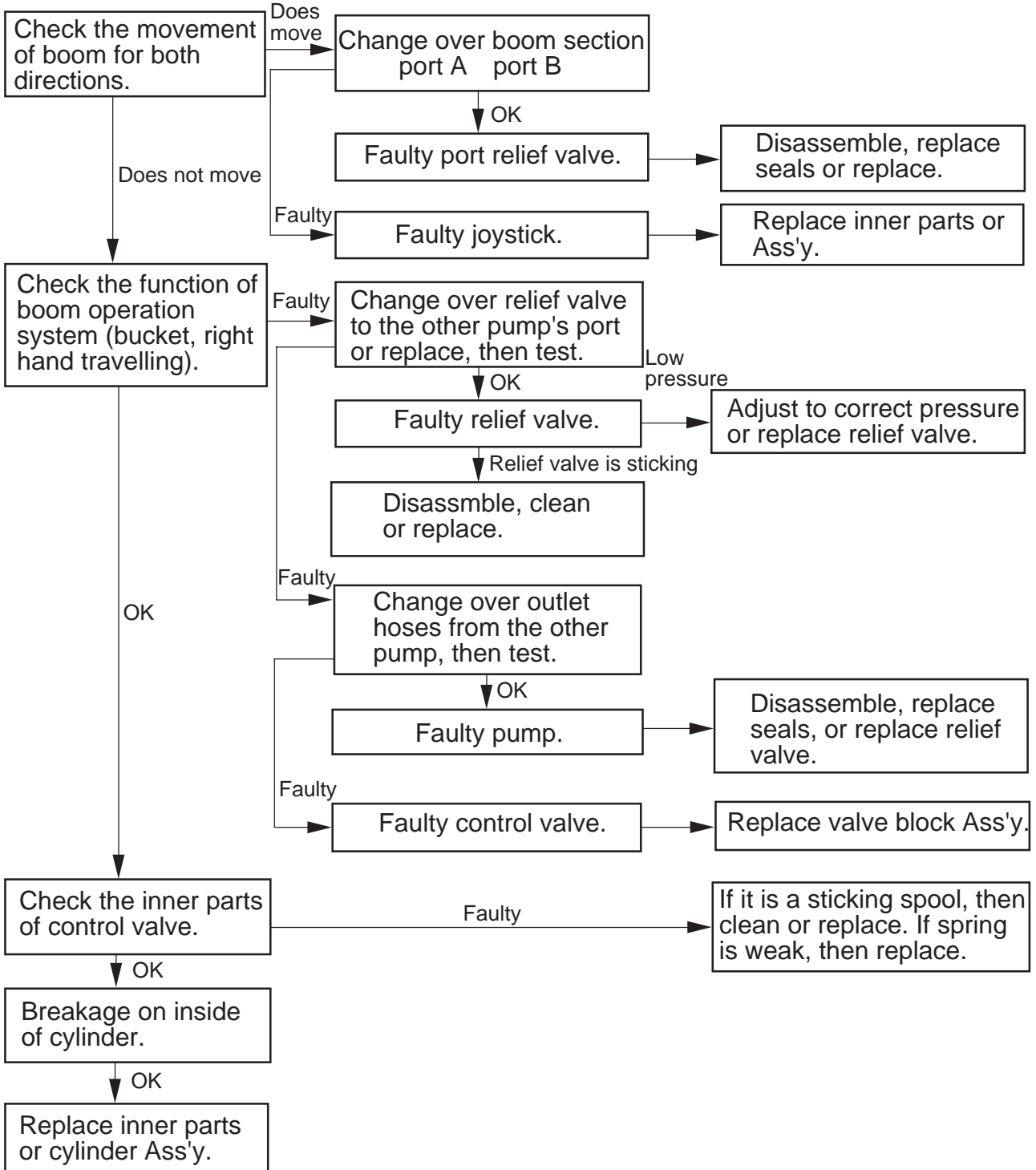


19-3-5 Turning movement when the machine is parked on a slope

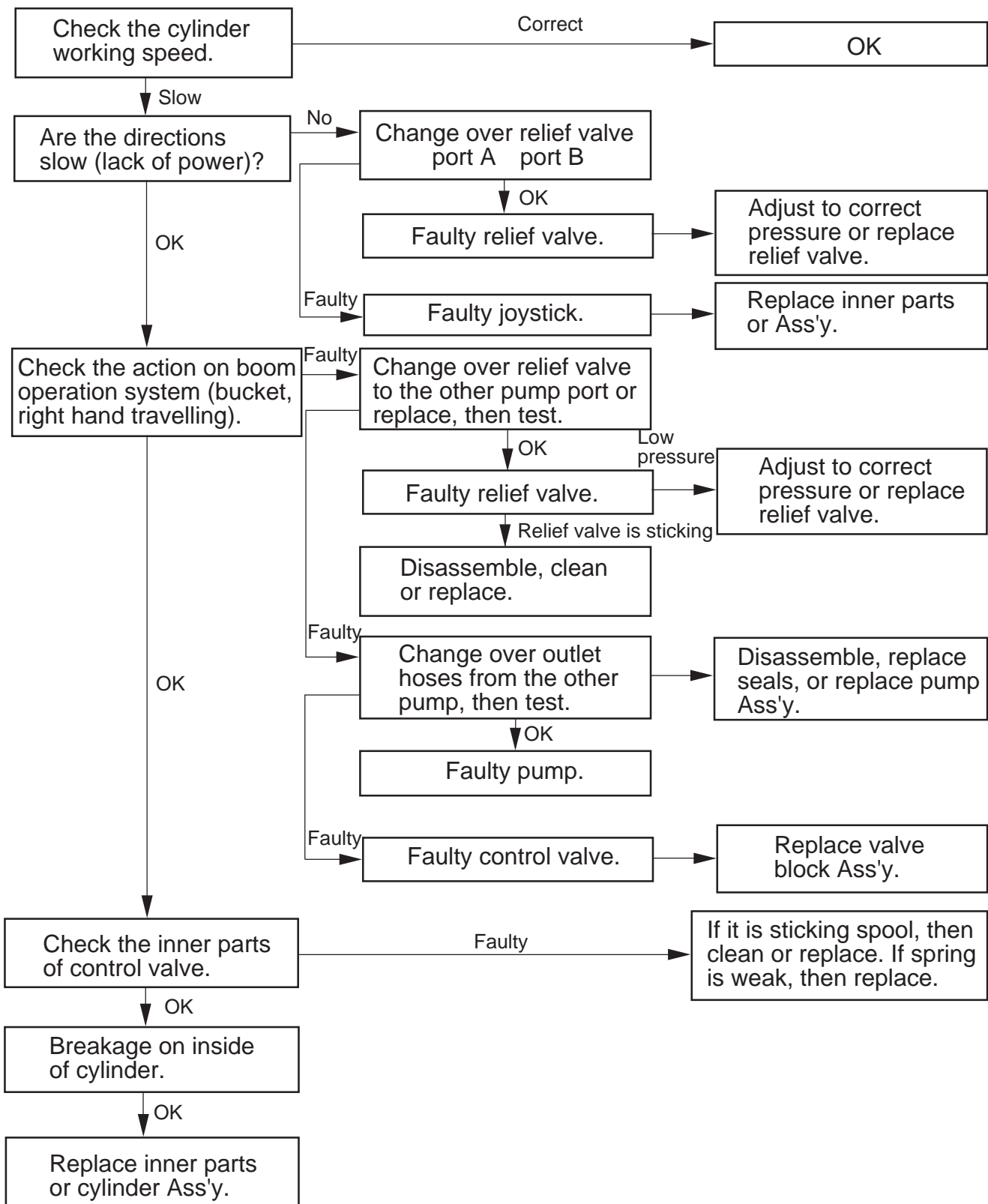


19-4 Boom system(for arm and bucket cylinders the same method as follows)

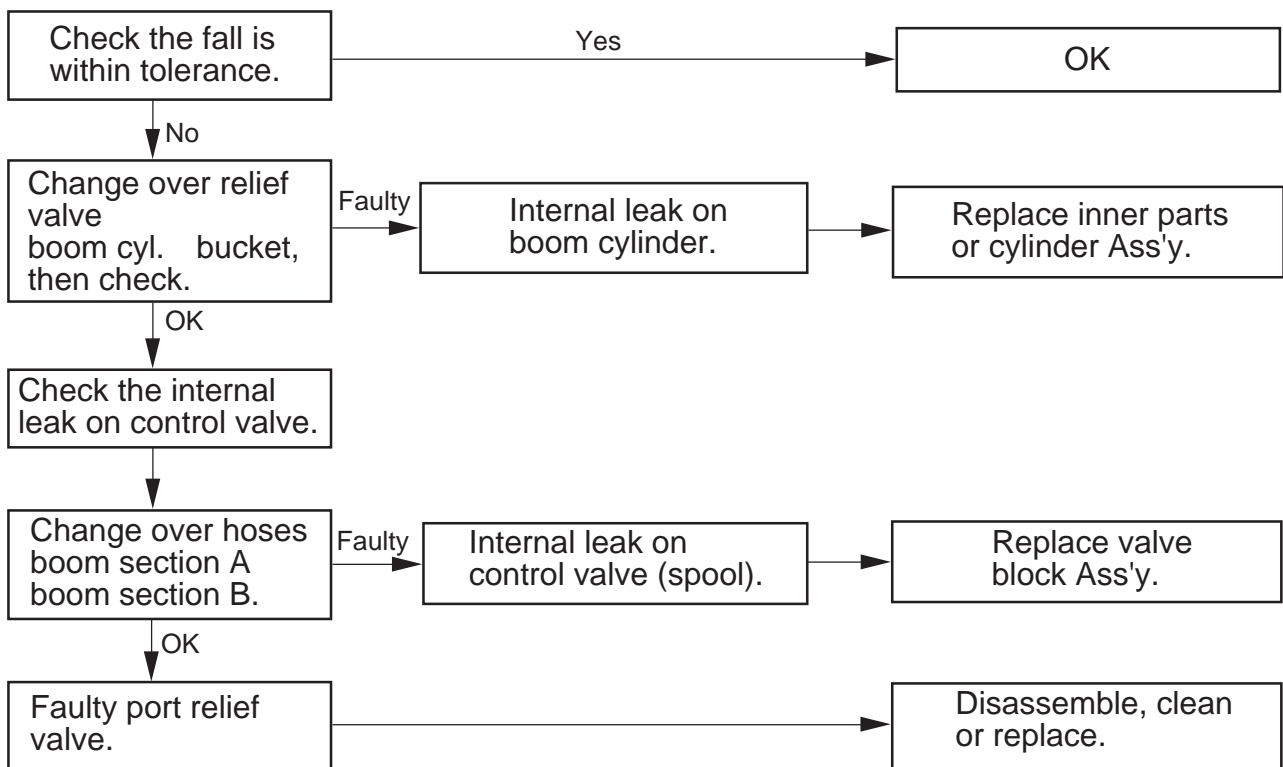
19-4-1 No movement on boom cylinder



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

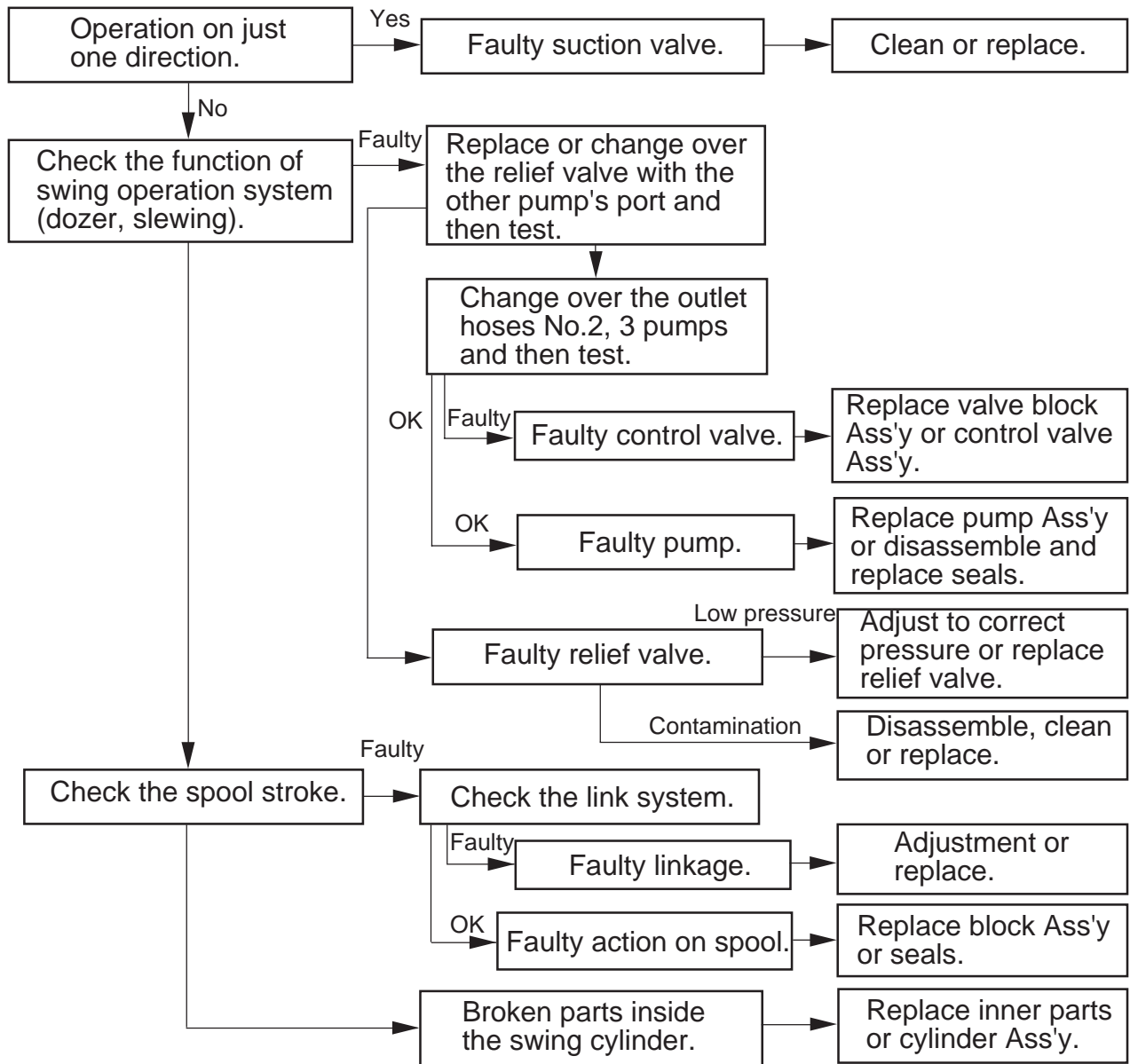


19-4-3 Natural fall of boom



19-5 Swing system

19-5-1 No movement on swing system



19-5-2 Drifting swing cylinder

