

# **Service Guide**

## **9VX3**

# **IHI**

SERIAL NUMBERS  
WB004001- up

**PUB. No.1**

## HYDRAULIC MINI EXCAVATOR

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## SECTION 1 SPECIFICATIONS

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**GENERAL SPECIFICATIONS**

■ **BASE MACHINE PERFORMANCE**

Swing speed	min <sup>-1</sup>	8.7
Travel speed	km / h	1.7 / 3.5
Gradability	% (deg.)	58 (30)

■ **ENGINE**

Engine model	-	YANMAR 2TNV70-PIK
Engine type		Vertical serial water-cooled 4-cycle diesel engine (special eddy current type)
No. of cyl. - bore × stroke	mm	2 - 70 × 74
Total piston displacement	L	0.569
Rated output	kW / min <sup>-1</sup>	7.3 / 2400 [DIN6271, 7.2 / 2400]
Max. torque	N·m / min <sup>-1</sup>	34.8 / 1800

■ **WEIGHT**

Machine mass	kg	890
Average ground bearing pressure	kPa	26

■ **REFILL CAPACITIES - (APPROXIMATE)**

Fuel		L	8.8
Hydraulic fluid	Oil level	L	8.2
	Total amount	L	16.0
Engine oil	Max. level	L	1.8
	Min. level	L	1.2
Coolant	Engine proper	L	0.6
	Total amount	L	2.2

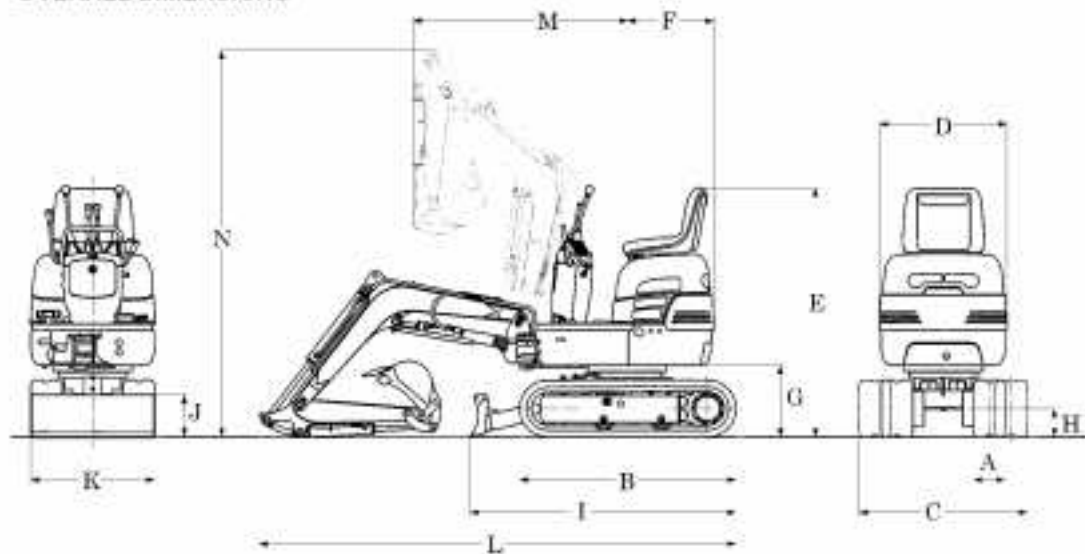
■ BUCKET

◎: Std. applicable

○: Applicable

×: Not applicable

Bucket capacity		Side cutter width (mm)	Number of teeth	Weight (kg)	Combinations		Remarks	Use
ISO(m³)					Std. arm	Long arm		
Heaped	Struck							
0.022	0.013	370	4	18.3	⊙	×	Standard	General digging
0.017	0.011	320	3	16.8	○	⊙	OPT.	Long arm Ditch digging
0.011	0.008	220	2	12.9	○	○	OPT.	Ditch digging

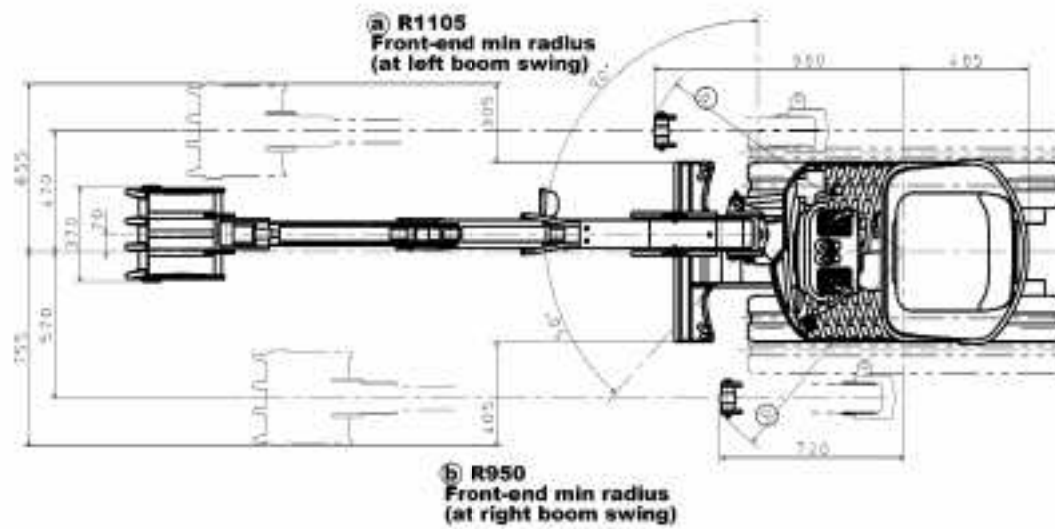
**OVERALL DIMENSIONS****1. OVERALL DIMENSIONS**

Unit: mm

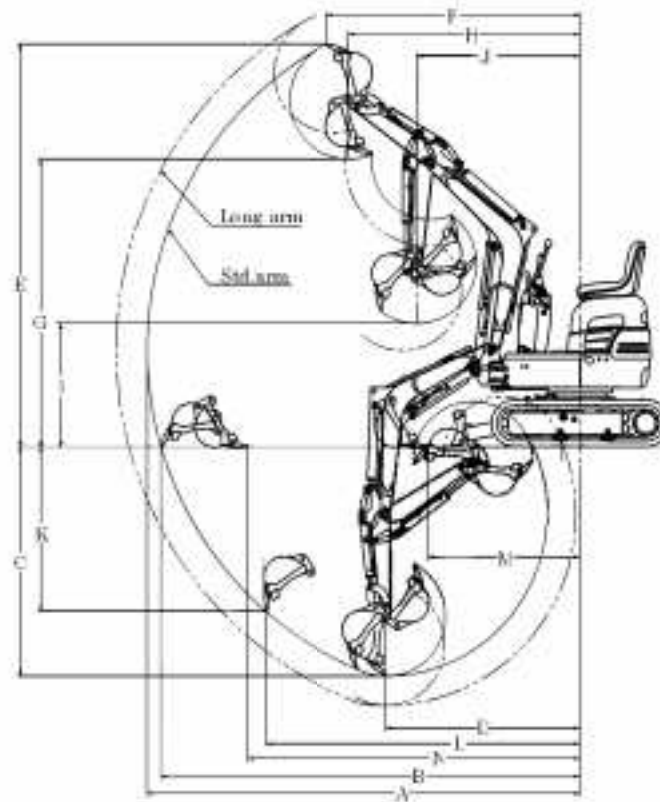
Codes	Description	STD
A	Crawler shoe width	180
B	Overall length of crawler	1220
C	Overall width of crawler	700 ~ 950
D	Width	720
E	Height	1405
F	Rear end swing radius	485
G	Rear end ground clearance	405
H	Mini. ground clearance	160
I	Overall length of undercarriage	1500
J	Blade height	245
K	Blade width	700
L	Overall length	Blade in front 2700 Blade in rear 2980
M	Front end mini. radius at center	1220
N	Arm head clearance	2180

WORKING RANGES

## ■ OFFSET DIGGING WORKING RANGE



■ WORKING RANGE (BACK HOE)



Unit: mm

Key	Description	Std. arm	Long arm
	Std. of bucket capacity (m <sup>3</sup> ), ISO Heaped	0.022	0.017
A	Max. digging radius	2980	3190
B	Max. bucket outreach at ground level	2880	3100
C	Max. digging depth(Not used blade)	1570	1770
D	Radius of max. digging depth	1330	1340
E	Max. digging height	2755	2950
F	Radius of max. digging height	1740	1820
G	Max. dumping height	1970	2150
H	Radius of max. digging height	1590	1700
I	Min. dumping height	850	660
J	Radius of min. dumping height	1120	1220
K	Max. vertical digging depth	1175	1400
L	Radius of max. vertical digging depth	2160	2140
M	Radius of min. digging ground level	1040	990
N	Max. clean-up radius at floor level	2290	2500



## WEIGHT BREAKDOWN

### 1. Total operating weight



Shoe / Cabin Spec.	Weight (kg)
Rubber shoe	890

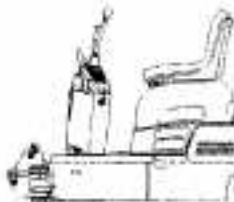
### 2. Base machine



Shoe / Cabin Spec.	Weight (kg)
Rubber shoe	785

This weight is not the mass of the machine body. It includes the weight of water, fuel, blade and others.

### 3. Upper structure



Specification	Weight (kg)
	445

### 4. Under carriage

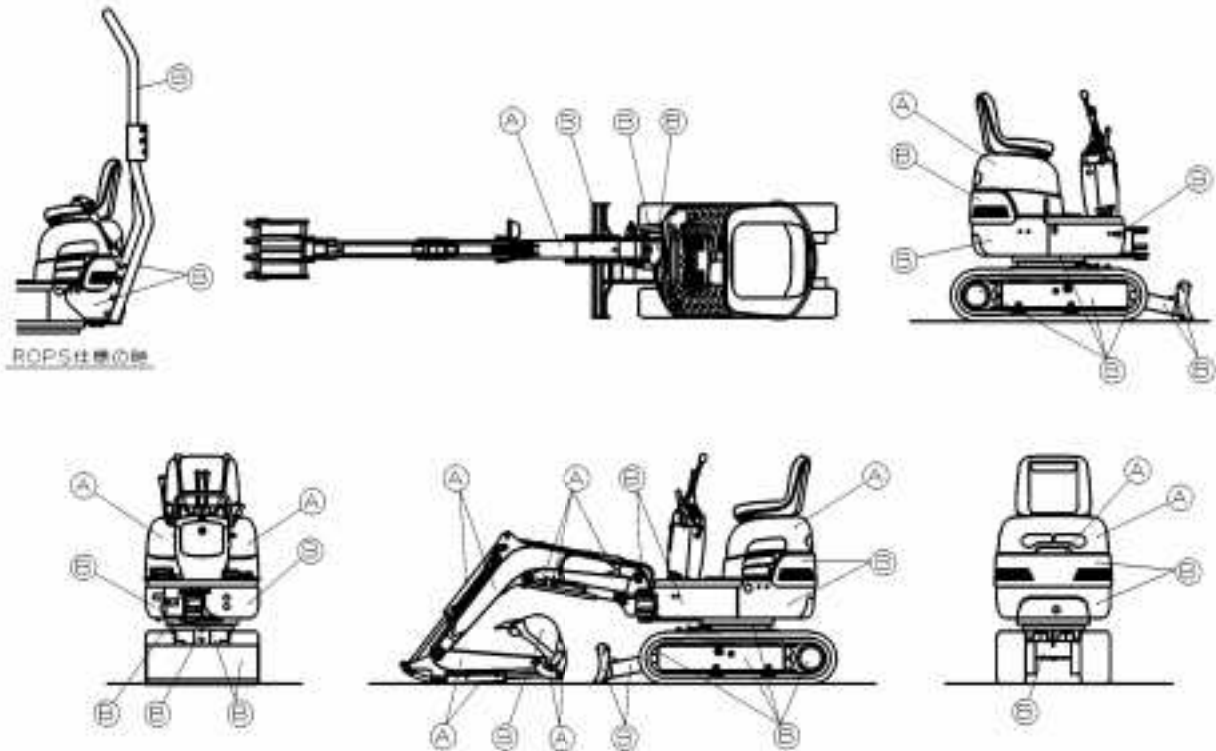


Specification	Weight (kg)
Rubber shoe	340

### 5. Hoe attachment



Specification	Weight (kg)
Standard arm	105
Long arm	108

PAINTING DIAGRAM**Color code for IHI Standard Color**

Code	A	B
Name	Light-green	Dark gray
Munsell No.	2.5BG 6/10	N - 3.0

**Notes:**

- 1 ) Do not coat rubber, sponges, catch metal fixtures, hydraulic hoses, cylinder rods, rod packing, air cleaners, mufflers with paint.
- 2 ) Do not coat operating lever, side box, gauges, pedal, handrail, seat or undercover with paint because each of them have already been painted as a single unit.

**Engine Main Data and Specifications**

Engine model	YANMAR 2TNV70-PIK
Applicable emission control	EPA Tier4
Engine type	Vertical serial water-cooled 4-cycle diesel engine (special eddy current type)
Number of cylinders x Bore x Stroke	2 - $\phi$ 70 x 74
Total piston displacement	0.569L
Compression ratio	23
Output (Net, Output tolerance: $\pm 3\%$ )	7.3kW / 2400min <sup>-1</sup> (Machine name plate indication: 7.3 kW/2400rpm)
Maximum torque	32-34.8N•m/1800 (+100/-100)min <sup>-1</sup>
Fuel consumption	$\leq 286$ g/kW•h
Atmospheric conditions	Room temperature 25°C Atmospheric pressure 100kPa (750mmHg) Relative humidity 30%
Fuel oil condition	JIS K2204 No.2 diesel oil
Non-loaded rotation speed	Maximum : 2570 $\pm$ 25min <sup>-1</sup> , Minimum : 1200 $\pm$ 25min <sup>-1</sup>
Speed fluctuation	Momentary : $\leq 12\%$ , Stabilized : $\leq 7\%$
Stabilization time	$\leq 6$ s
Rotation fluctuation	$\leq 30$ min <sup>-1</sup>
Permissible tilt angle	Continuously 25 degrees (longitudinal and cross) Momentary 30 degrees (longitudinal and cross)
Engine rotating direction	Counterclockwise when viewed from the flywheel side
Engine weight (Dry)	84 (+5/0)kg

Fuel system	
Applicable fuel	JIS K2204 No.2 diesel oil
Fuel injection pump	Bosch aggregated row type (YPES-MIL) unitized with the reduction gear
Filtering system	Full flow filter paper
Governor	Centrifugal all-speed type

Lubrication system	
Applicable lubricant	Class CD 10W30 in new SAE classification
Lubrication pump	Trochoid pump
Lubrication system	Forced lubrication

Cooling system	
Cooling system	Radiator cooling
Radiator	Pressurized and fully closed
Fan	$\phi$ 230-5(suction), Seat between fans T=8 Crank pulley/fan pulley= $\phi$ 110 / 90 (1.222)

Air cleaner	Cyclone type (resin 4 inches)
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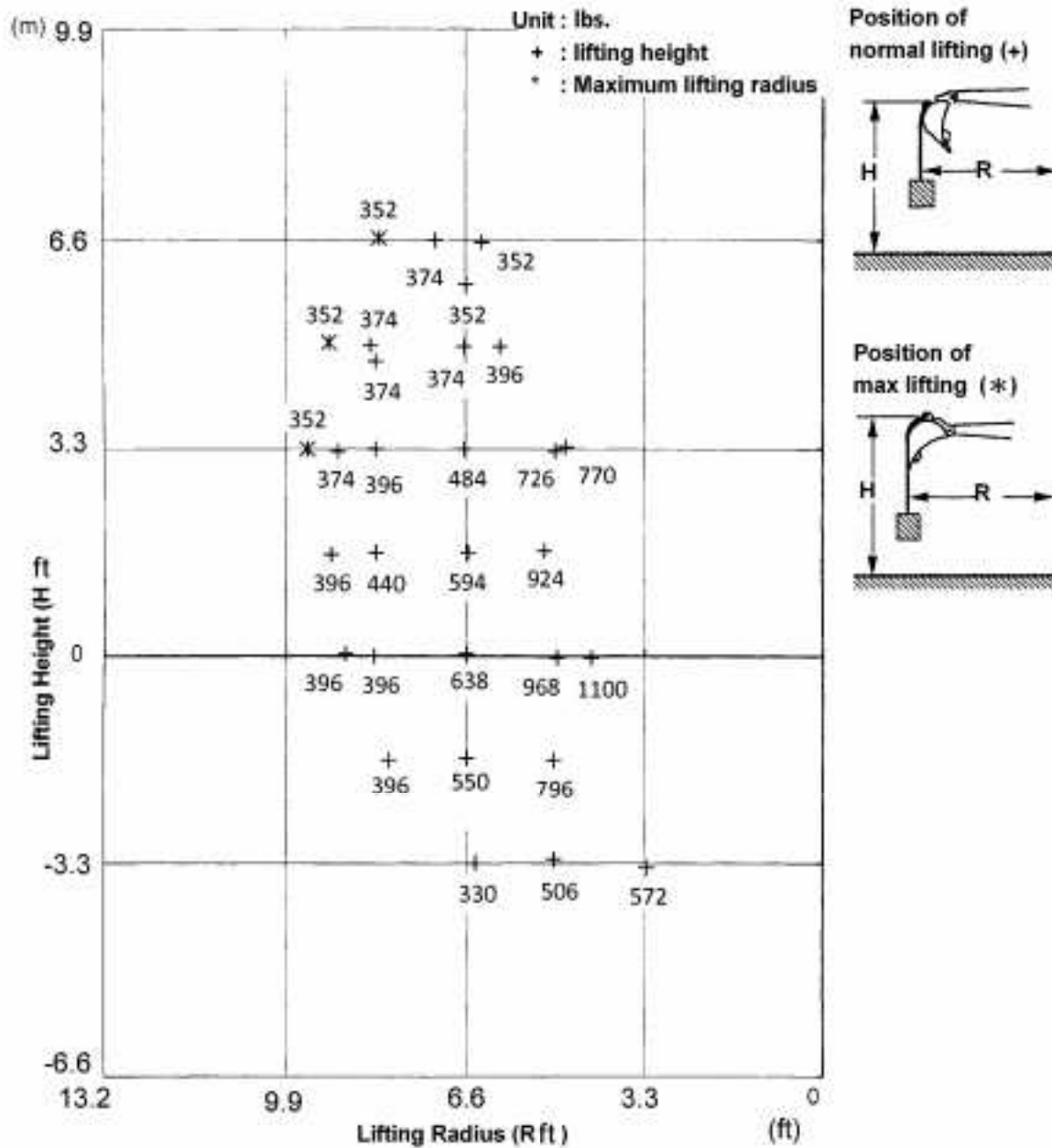
Start system	Electrical
Starter	12V - 1.0kW
Alternator	12V - 20A
Battery (recommended value)	46B24
Auxiliary unit for start	Glow plug (super-quick glow plug)
Stop unit	Stop solenoid from Syncho Start, built-in governor, 12 V (waterproof)
Coolant capacity	Engine 0.6L (engine proper)
Lubricant volume	Total: 1.8L, Effective: 0.6L

LIFTING CAPACITIES

LOAD RATING CHART (SAE METHOD)

Note : At front over end and the Blade fulcrum with equipped standard arm.

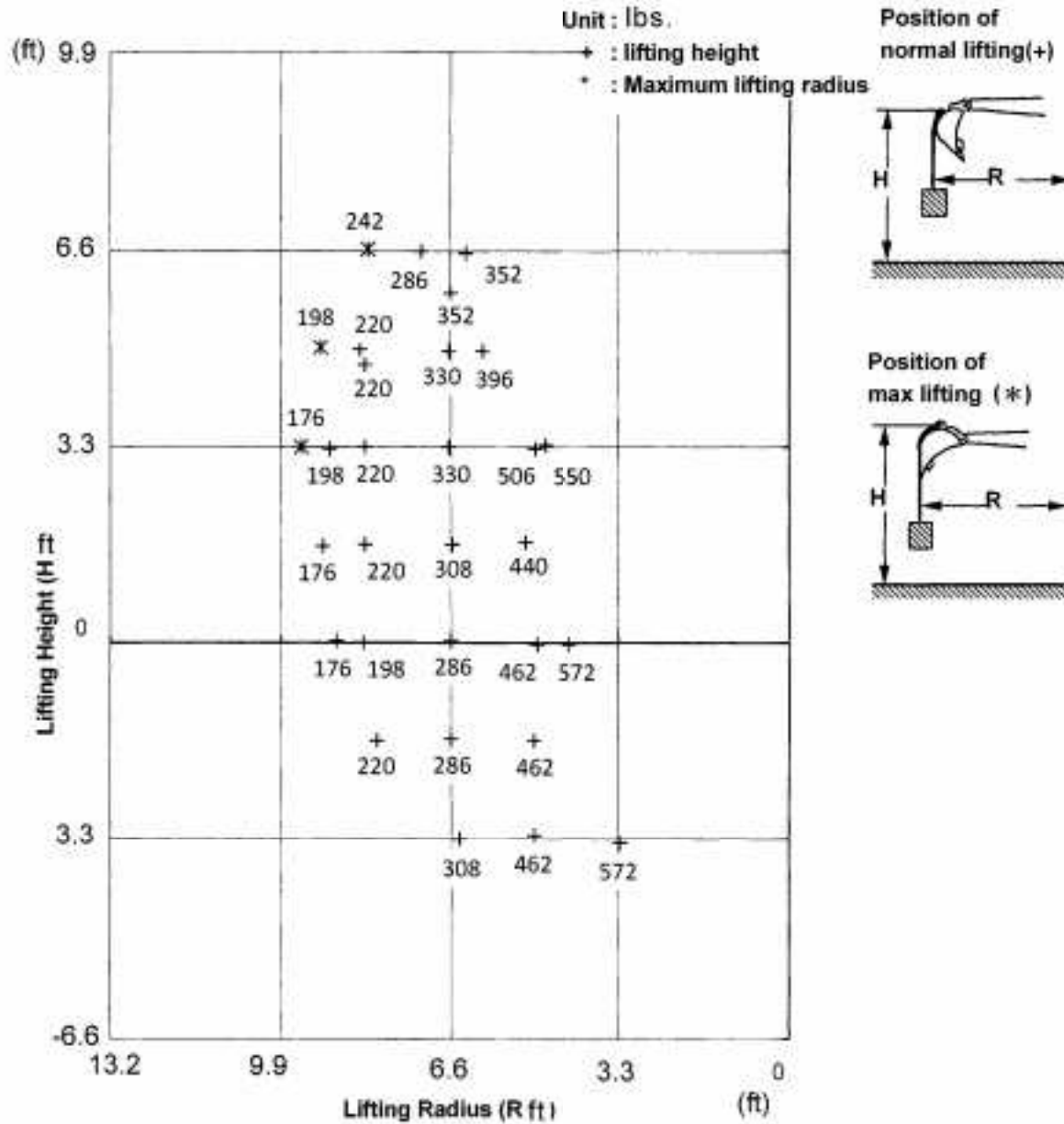
Rated loads do not exceed 87% of hydraulic capacity or 75% stability.




LOAD RATING CHART (SAE METHOD)

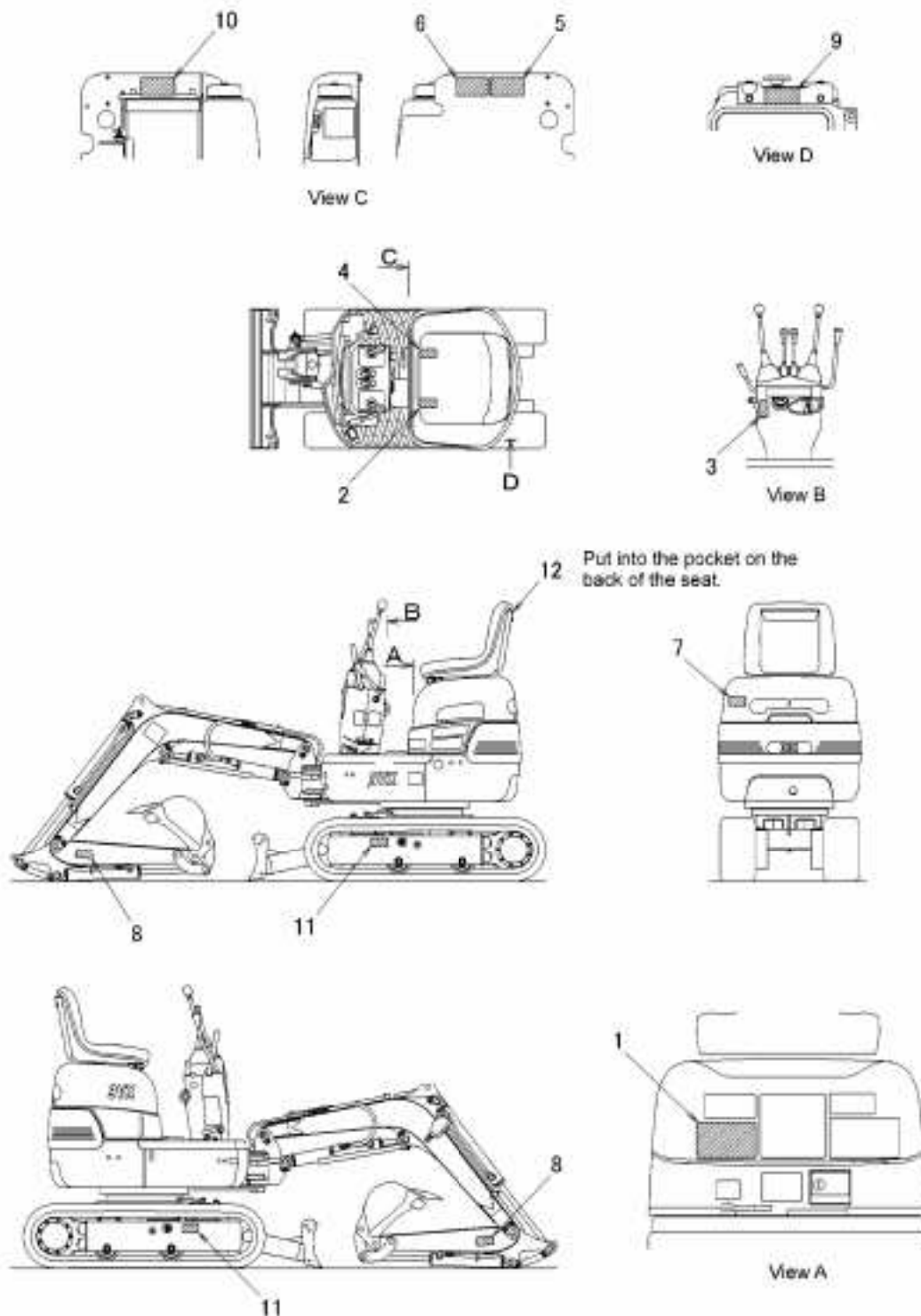
Note : At front over end and the Blade fulcrum with equipped standard arm.

Rated loads do not exceed 87% of hydraulic capacity or 75% stability.



**SAFETY SIGNS AND LABELS**

There are several specific safety signs  on your machine.  
Make sure that you can read all safety signs. Clean or replace these if you cannot read the words.



1. Safety operation  
(440590300)

**SAFETY OPERATION**

1. Before and after everyday's operation, make sure to do daily inspection, lubrication and maintenance.
2. During operation, make sure all lamps are in normal condition and pay special care that people and any obstacles are well clear the machine.
3. Down the bucket on ground and stop the engine when machine is not in use.
4. When travelling on rough ground, try to level the ground as much as possible.
5. Do not squeeze-in below the machine being raised up, by boom.
6. Do not use the bucket like a pickax, hammer or a broom.
7. Avoid to park the machine on inclined ground as much as possible. If not avoidable, put suitable block on the crawler shoes and down the blade to penetrate ground.

**440590300**

2. Read manual !  
(D405 359 00)  
Read manual before operation, maintenance, disassembly, assembly and transportation.



3. Crush hazard  
(D405 508 00)  
Sign indicates a hazard of being crushed or run over by unexpected moving of stopped machine.  
Lower working device to ground, move safety lever to lock position and take engine key with you before leaving machine.



4. Electric power lines  
(D405 506 00)  
Sign indicates an electrocution hazard if machine is brought too near electric power lines. Keep a safe distance from electric power lines.



5. Hazard of rotating parts  
(D405 675 00)



Sign indicates a hazard of rotating parts, such as fan.  
Turn off before inspection and maintenance.

6. Hazard of rotating parts  
(D405 674 00)



Sign indicates a hazard of rotating parts, such as belt.  
Turn off before inspection and maintenance.

7. Keep away from swing area  
(D406 269 00)



Sign indicates a crush hazard by rotation of upper structure of the machine.

Keep away from swinging area of machine.

8. Keep away from machine  
(D405 668 00)  
Sign indicates a hazard of being hit by the working device of the machine.



9. Burn hazard  
(D405 503 00)



Sign indicates a burn hazard from spurting hot water or oil if radiator or hydraulic tank is uncapped while hot.  
Allow radiator or hydraulic tank to cool before removing cap.

10. Electrical hazard  
(D405 504 00)



Sign indicates an electrical hazard from handling the cable.  
Read manual for safe and proper handling.

11. Warning for track adjuster  
(D405 505 00)



Sign indicates a hazard of flying plug from track adjuster that could cause injury.  
Read manual before adjusting track for safe and proper handling.

12. Danger !  
(D405 323 00)



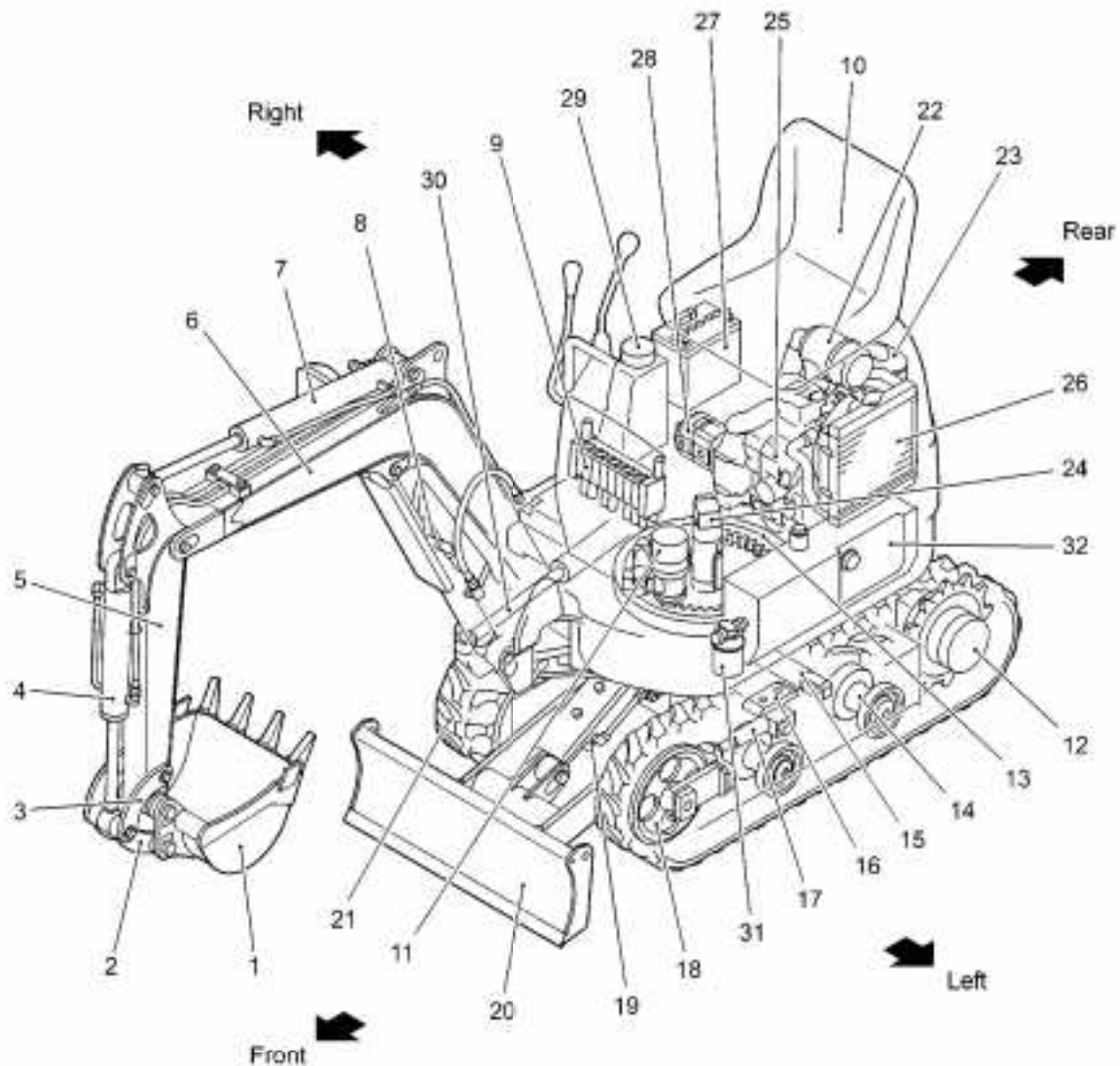
Operation prohibition during inspection and servicing.  
Hang this sign on the control lever during inspection and servicing not to allow any other worker to start the engine or operate the machine.



## SECTION 2 STRUCTURE AND FUNCTION

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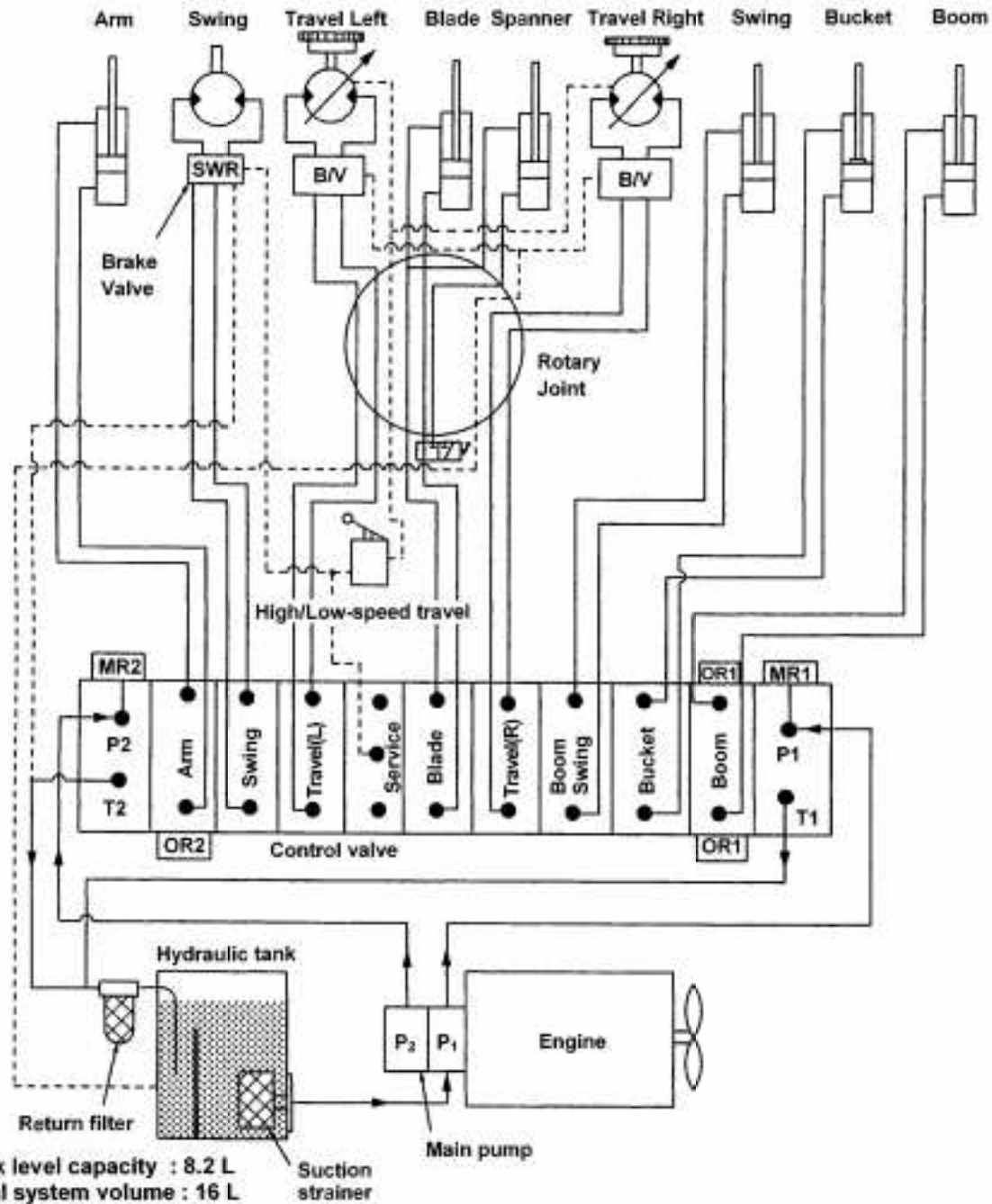
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NOMENCLATURE

- |                      |                                 |                          |
|----------------------|---------------------------------|--------------------------|
| (1) Bucket           | (13) Swing Bearing Sprocket     | (25) Engine              |
| (2) Bucket Link      | (14) Lower roller Track Roller  | (26) Radiator            |
| (3) Arm Link         | (15) Crawler extension cylinder | (27) Battery             |
| (4) Bucket Cylinder  | (16) Slide pad                  | (28) Hydraulic Pump      |
| (5) Arm              | (17) Shoe adjusting device      | (29) Fuel Tank           |
| (6) Boom             | (18) Front Idler                | (30) Boom Swing Cylinder |
| (7) Arm Cylinder     | (19) Blade Cylinder             | (31) Return Filter       |
| (8) Boom Cylinder    | (20) Blade                      | (32) Hydraulic Tank      |
| (9) Control Valve    | (21) Crawler shoe               |                          |
| (10) Operator's Seat | (22) Air Cleaner                |                          |
| (11) Swing unit      | (23) Muffler                    |                          |
| (12) Travel motor    | (24) Rotary Joint               |                          |

Compatible List

Item	Part name	Description	Interchangeability
Undercarriage	Rubber shoe		9VX
	Lower roller	Outer flange roller	9VX
	Slide pad		9VX
	Front idler		9VX
	Blade	Blade width is changed. (Blade width 700mm)	<b>NEW</b>
	Grease cylinder	Valve sheet 24 mm wide.	9VX
Engine	Engine	YANMAR 2TNV70	9VX
Hydraulic equipment	Pump	2PF(4.64cc × 2) With involute spline shaft	9VX
	Control valve	Circuit arrangement : Same as 10Z2, 10VZ	9VX
	Swing motor	With shock-lees valves and parking brake	9VX
	Travel motor	Traveling 2 - step speed	9VX
	Rotary joint	With selector valve	9VX
	Return filter		9VX
	Strainer		9VX
	Cylinder	Arm, Blade, boom swing	9VX
		Boom, bucket, spanner	9VX
Covers	Covers		9VX
Attachment	Bucket		9VX

**HYDRAULIC SYSTEM DIAGRAM****HYDRAULIC SYSTEM DIAGRAM**

Tank level capacity : 8.2 L  
 Total system volume : 16 L

Relief valve set pressure

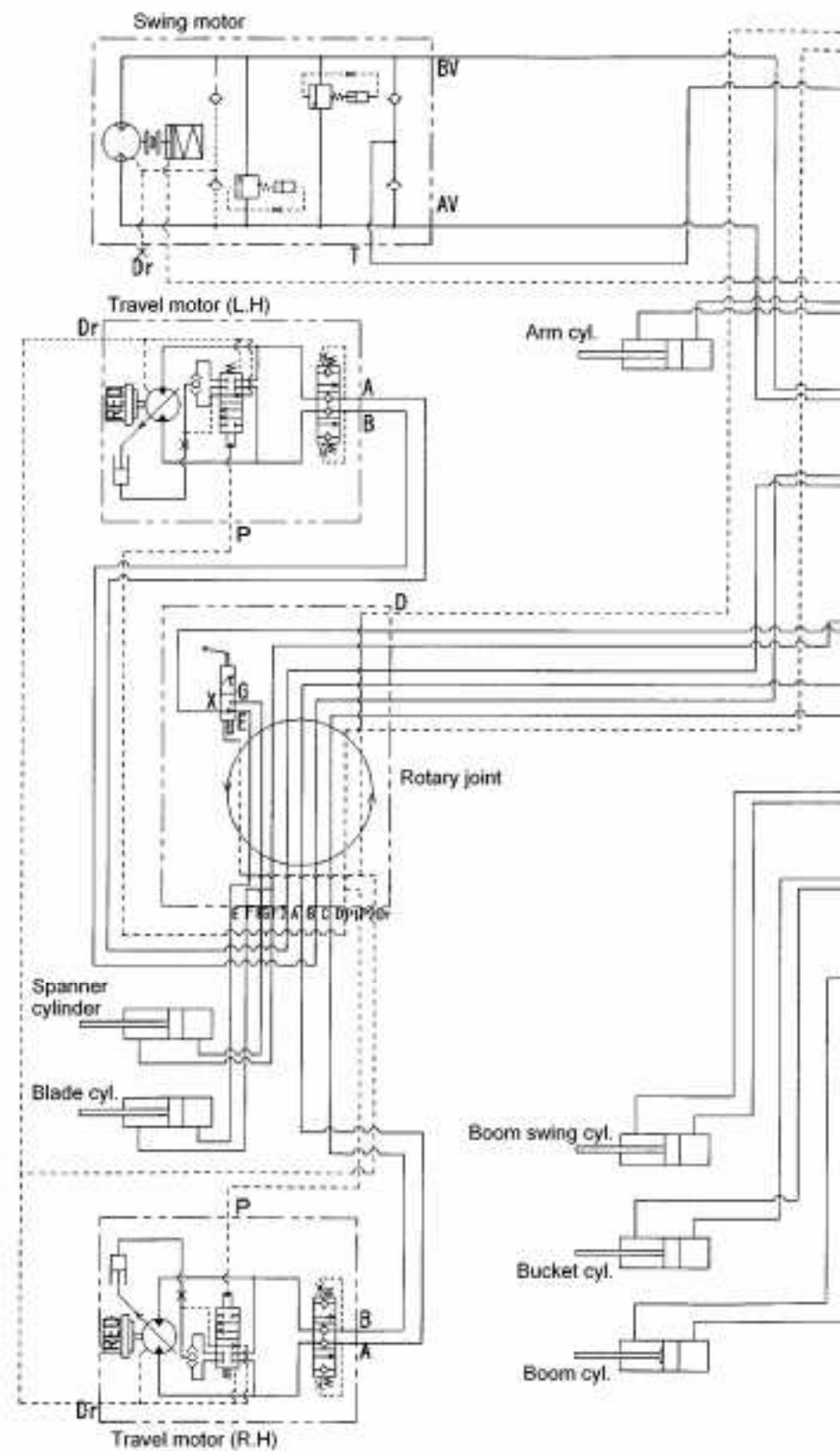
Code	Item	Pressure
		MPa
MR1	Main relief valve P1 Pump	16.2
MR2	Main relief valve P2 Pump	16.2
OR1	Overload relief valve (Boom)	18.6
OR2	Overload relief valve (Arm)	18.6
SWR	Swing relief valve	6.9

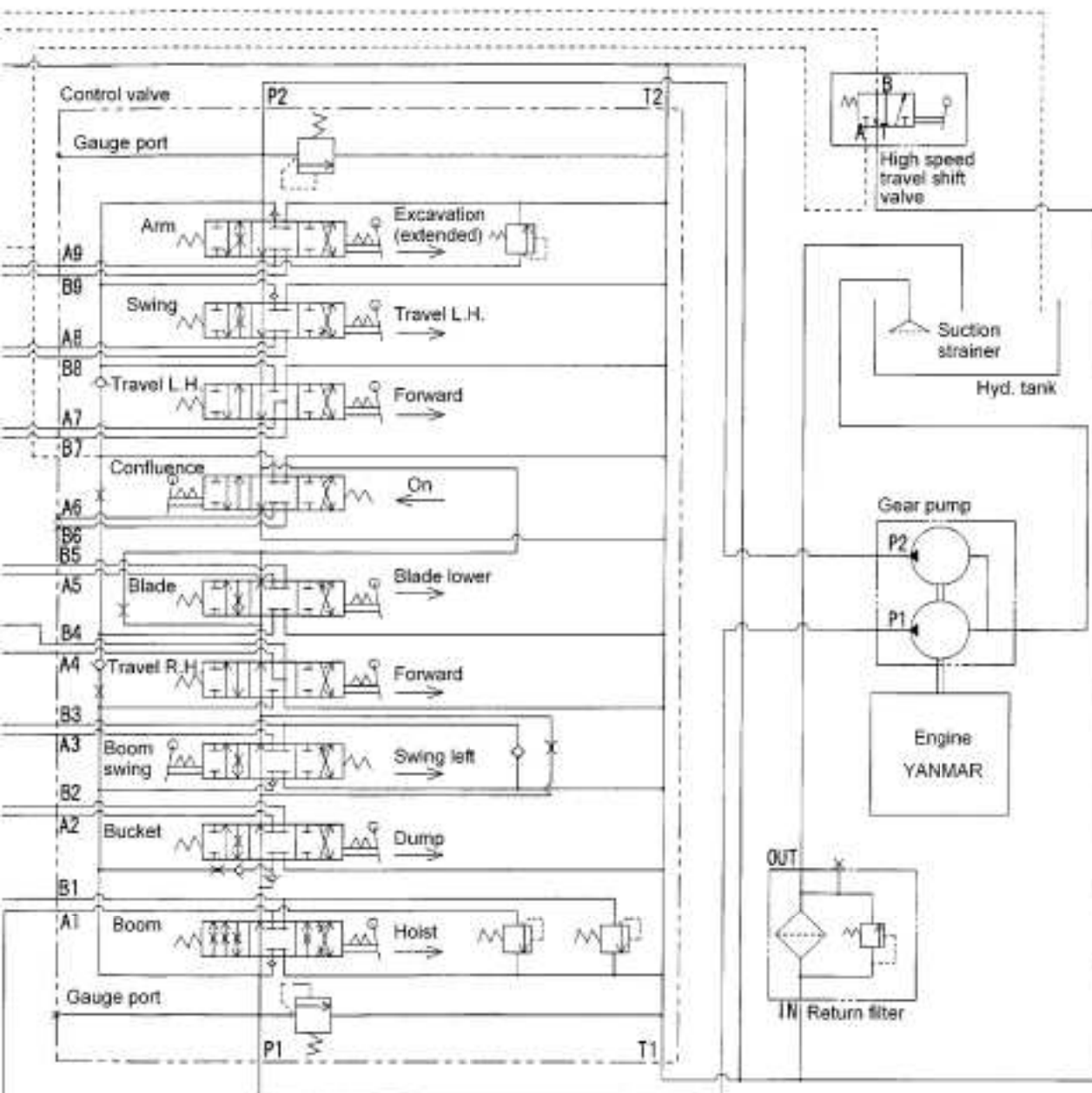
Pump flow rate (Max.):

P1 : 11.1 L/min

P2 : 11.1 L/min

The service port is joint flow by the  
 P1 and P2.



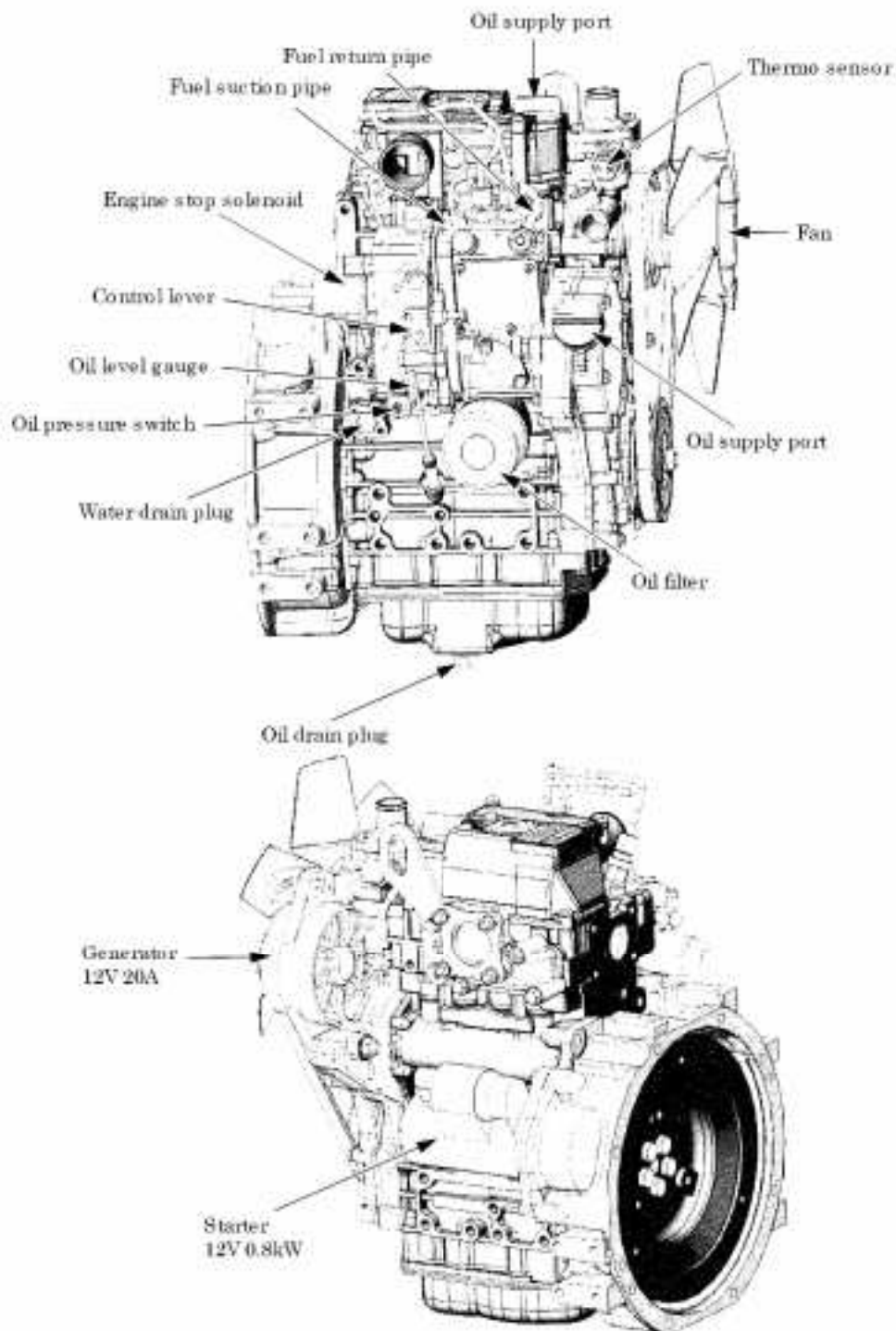
HYDRAULIC SYSTEM DIAGRAM

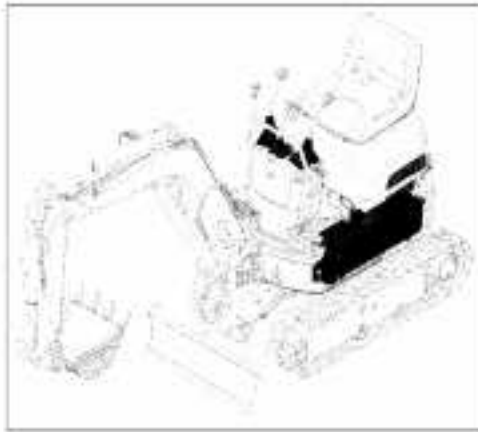
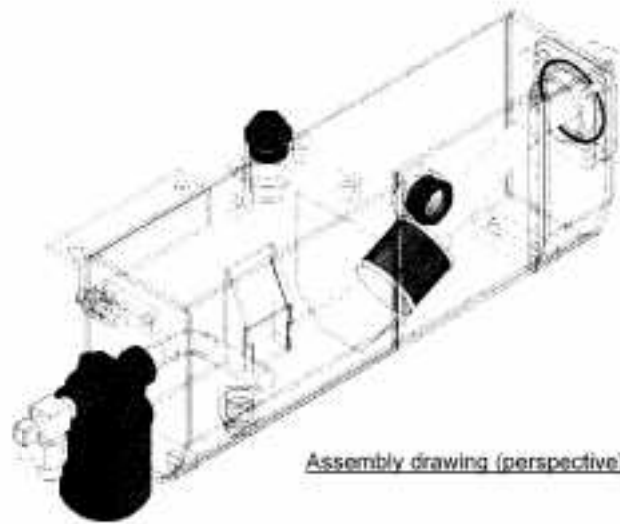
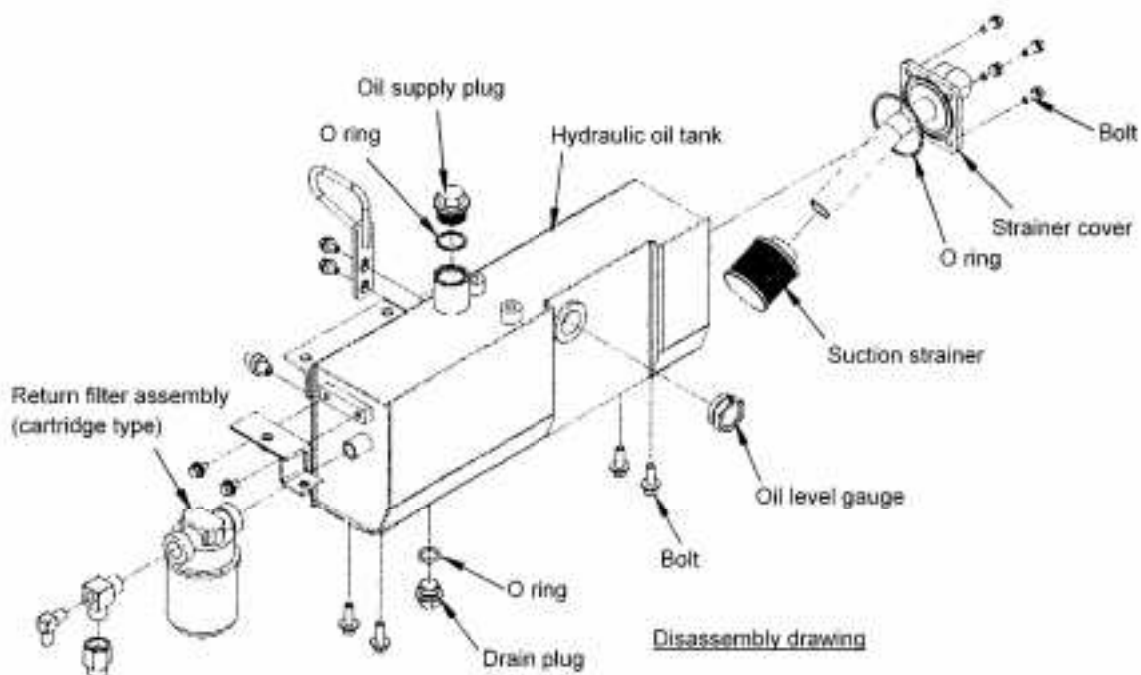
Relief valve set pressure

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**ENGINE AND AUXILIARY COMPONENTS**

(Engine component names, layout)



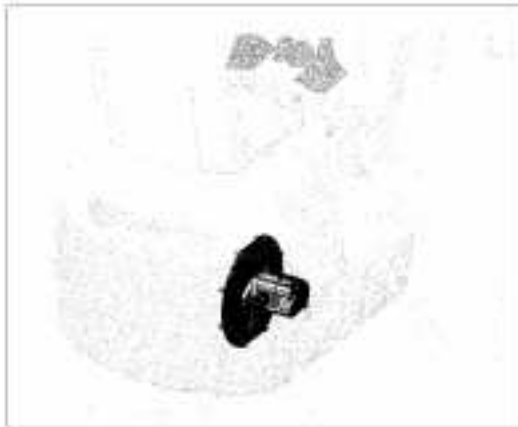
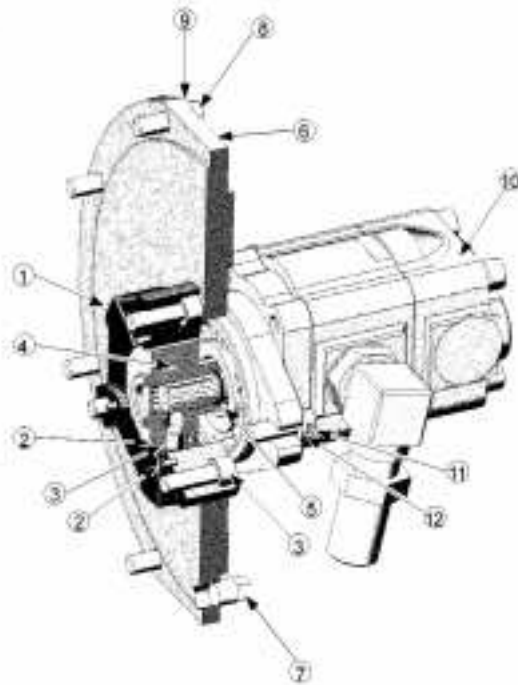
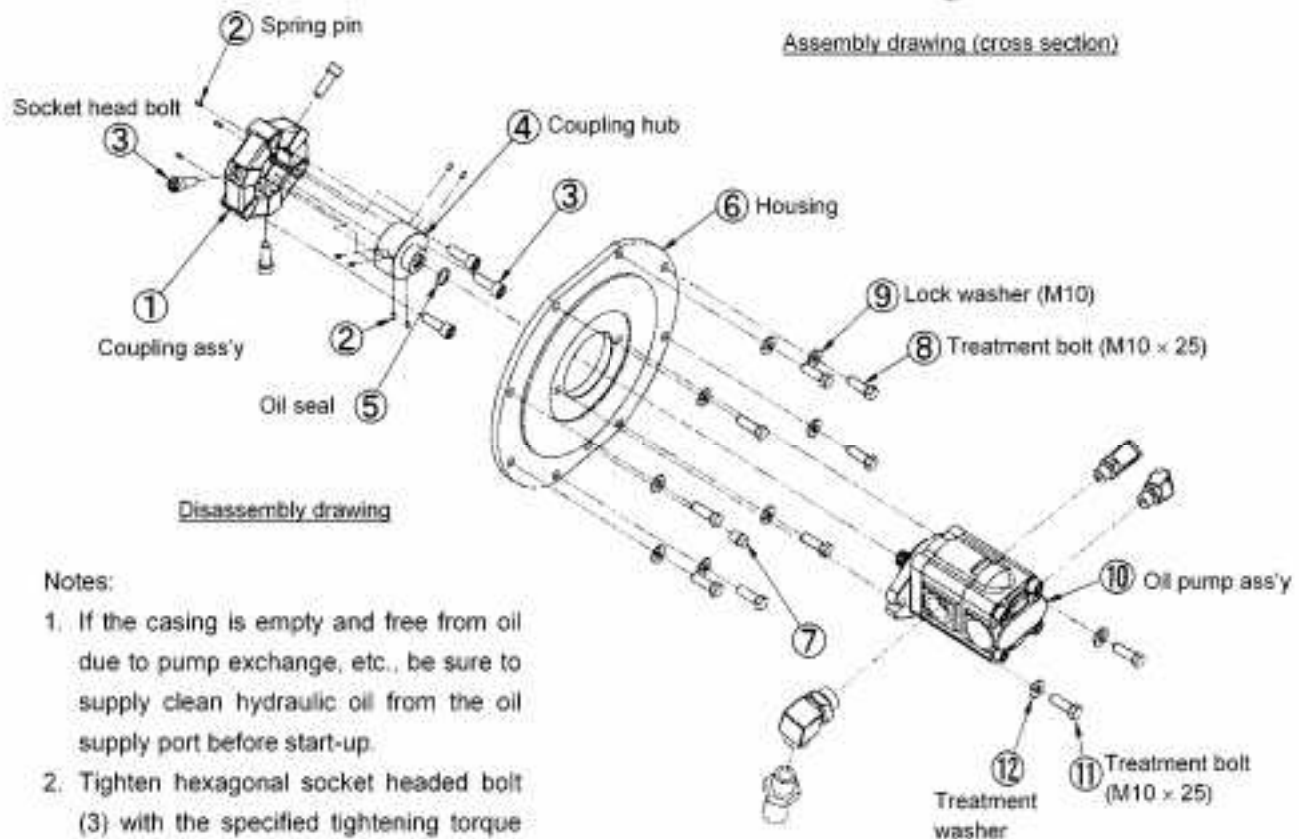
HYDRAULIC TANK ASS'YLayoutAssembly drawing (perspective)Disassembly drawing

Maintenance Intervals (Every Hours)				
	Contents	Initial	After	Brake works
Suction strainer	Cleaning	-	1,000	500
Return filter	Replace	50	500	100

Specifield strainer	Fluid Volume (l)		Replace Intervals	
	Tank level	Total system	General operation	Breaker works
IS-SUPER A Genuine hydraulic oil (wear-resistance hydraulic oil)	8.2	16.0	1,000	500

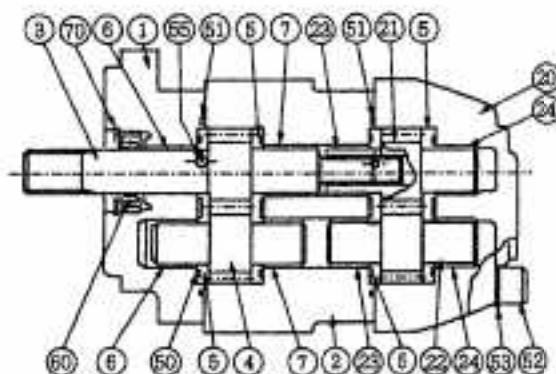
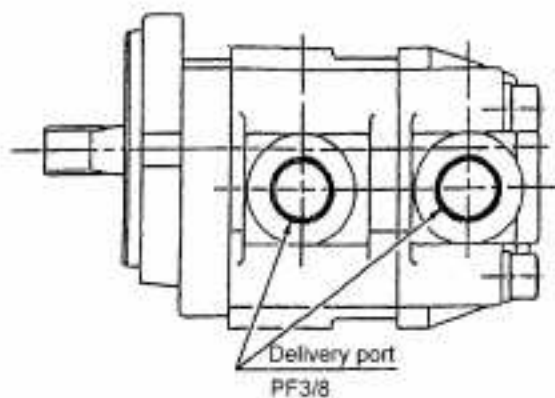


**PUMP DRIVE DEVICE**LayoutAssembly drawing (cross section)Disassembly drawing**Notes:**

1. If the casing is empty and free from oil due to pump exchange, etc., be sure to supply clean hydraulic oil from the oil supply port before start-up.
2. Tighten hexagonal socket headed bolt (3) with the specified tightening torque of 48 to 53 N-m.
3. Before assembling the pump, coat the Never-Seize (special grease) on the spline and fill the space with it.

HYDRAULIC PUMP

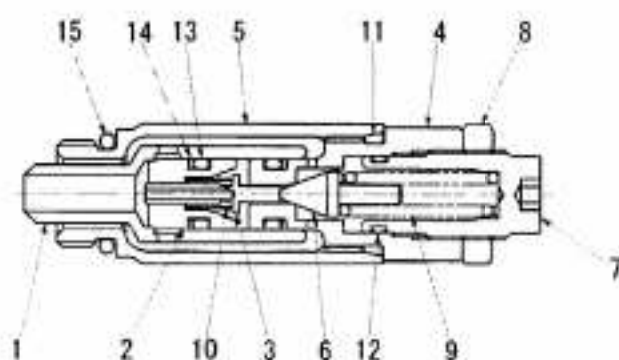
Weight: 3.6kg



Key	Description	Q'ty
1	Front Cover	1
2	Body	1
3	Drive Gear	1
4	Driven Gear	1
5	Side plate	4
6	Bushing	2
7	Bushing	2
20	Body	1
21	Drive Gear	1
22	Driven Gear	1
23	Bushing	2
24	Bushing	2
50	Gasket	4
51	Gasket	2
52	Socket head bolt	4
53	Treatment washer	4
55	Steel Ball	4
60	Oil Seal	1
70	C-shaped stop ring	1

Logical delivery volume : No.1 pump 4.64 cm<sup>3</sup>No.2 pump 4.64 cm<sup>3</sup>

Rated pressure : 18.6 MPa

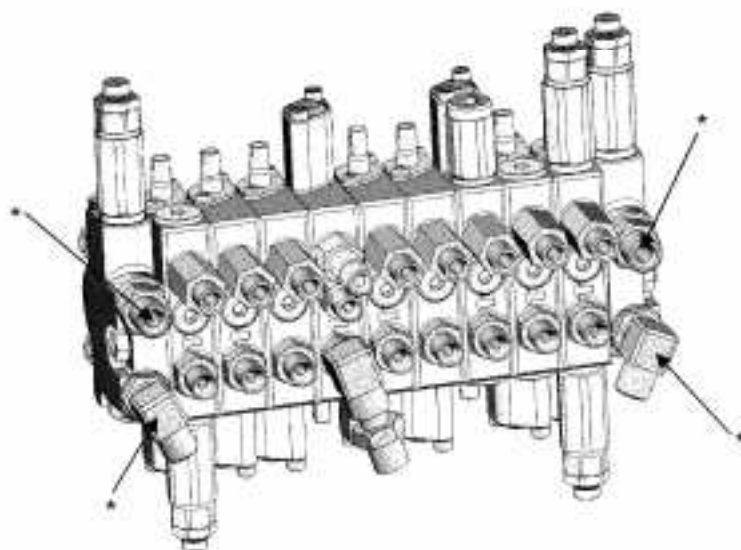


Relief valve assembly drawing cross section

No.	Description	Q'ty
1	Socket	1
2	Adjust pressure valve	1
3	Piston	1
4	Adjustment section	1
5	Main body	1
6	Adjustment valve	1
7	Adjustment spring	1
8	Nut	1
9	Adjustment valve spring	1
10	Adjust valve spring	1
11	O-ring	1
12	O-ring	1
13	O-ring	2
14	Backup ring	2
15	O-ring	1

Pump	Main relief valve setting pressure MPa	
P1	MR1	$16.2^{+0.3}_{-0.2}$ at 12.5 L/min
P2	MR2	$16.2^{+0.3}_{-0.2}$ at 12.5 L/min

Symbol	Overload relief valve setting pressure MPa	
OR1	Boom up	$18.6^{+0.40}_{-0}$ at 5 L/min
OR2	Boom down	$18.6^{+0.40}_{-0}$ at 5 L/min
OR3	Arm pull-off	$18.6^{+0.40}_{-0}$ at 5 L/min



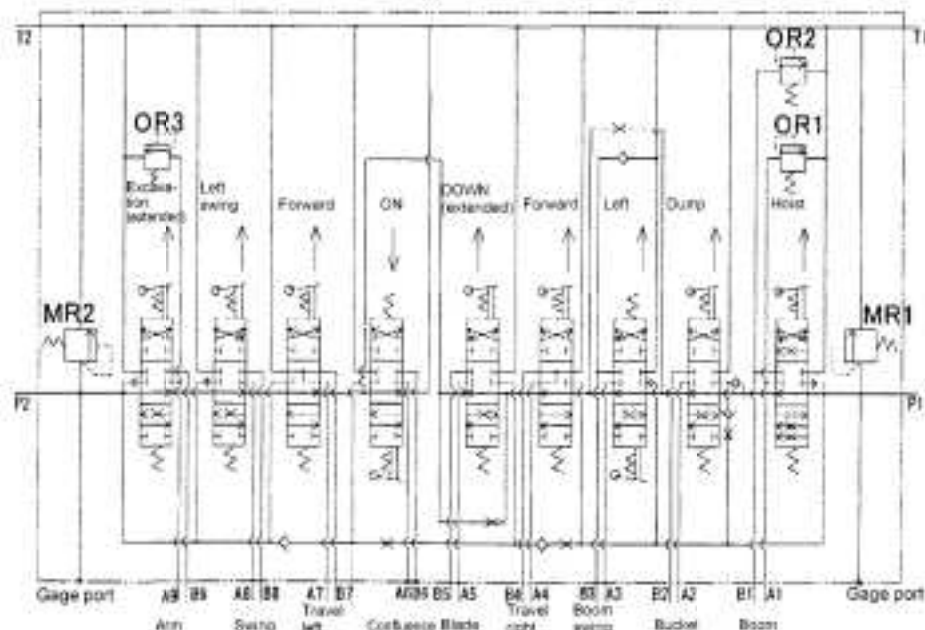
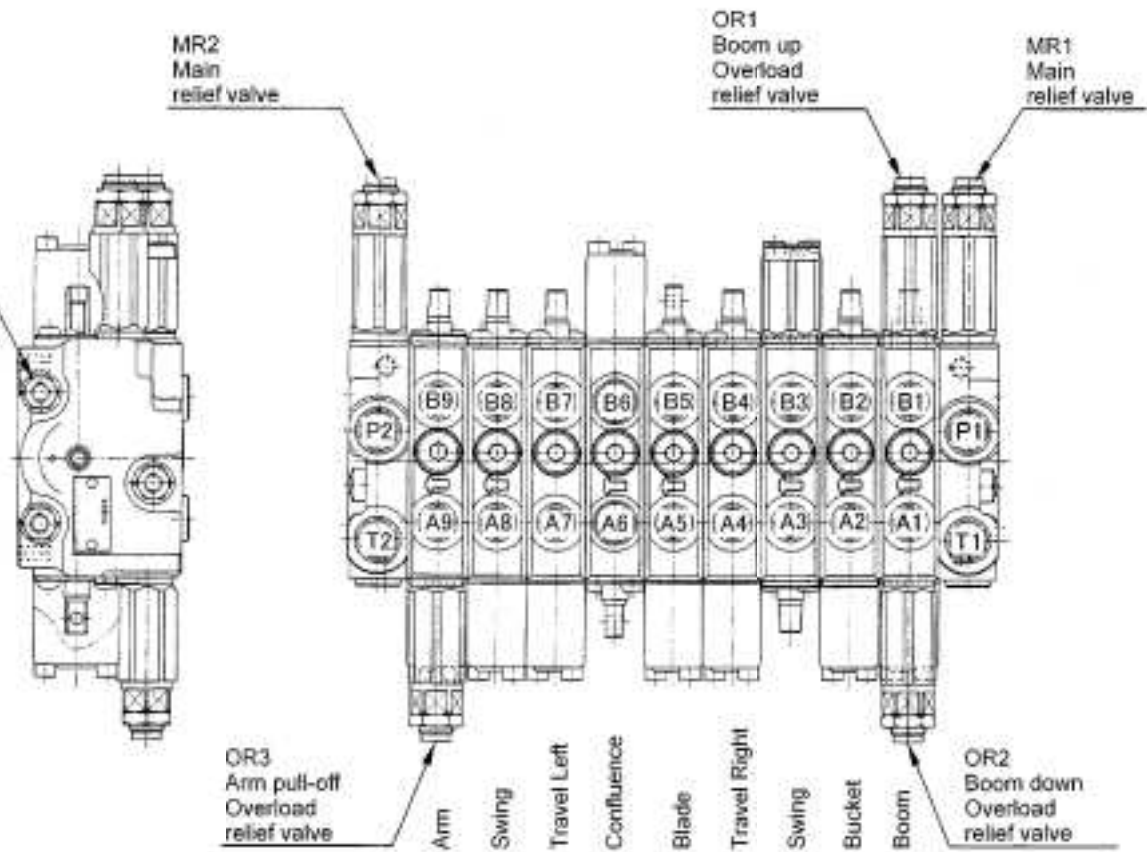
Notes on damages due to over-tightening

- Piping adapter on P/T port marked \*
- Tightening torque:  $69 \pm 0N \cdot m$
- Other piping adapters
- Tightening torque:  $34-44N \cdot m$

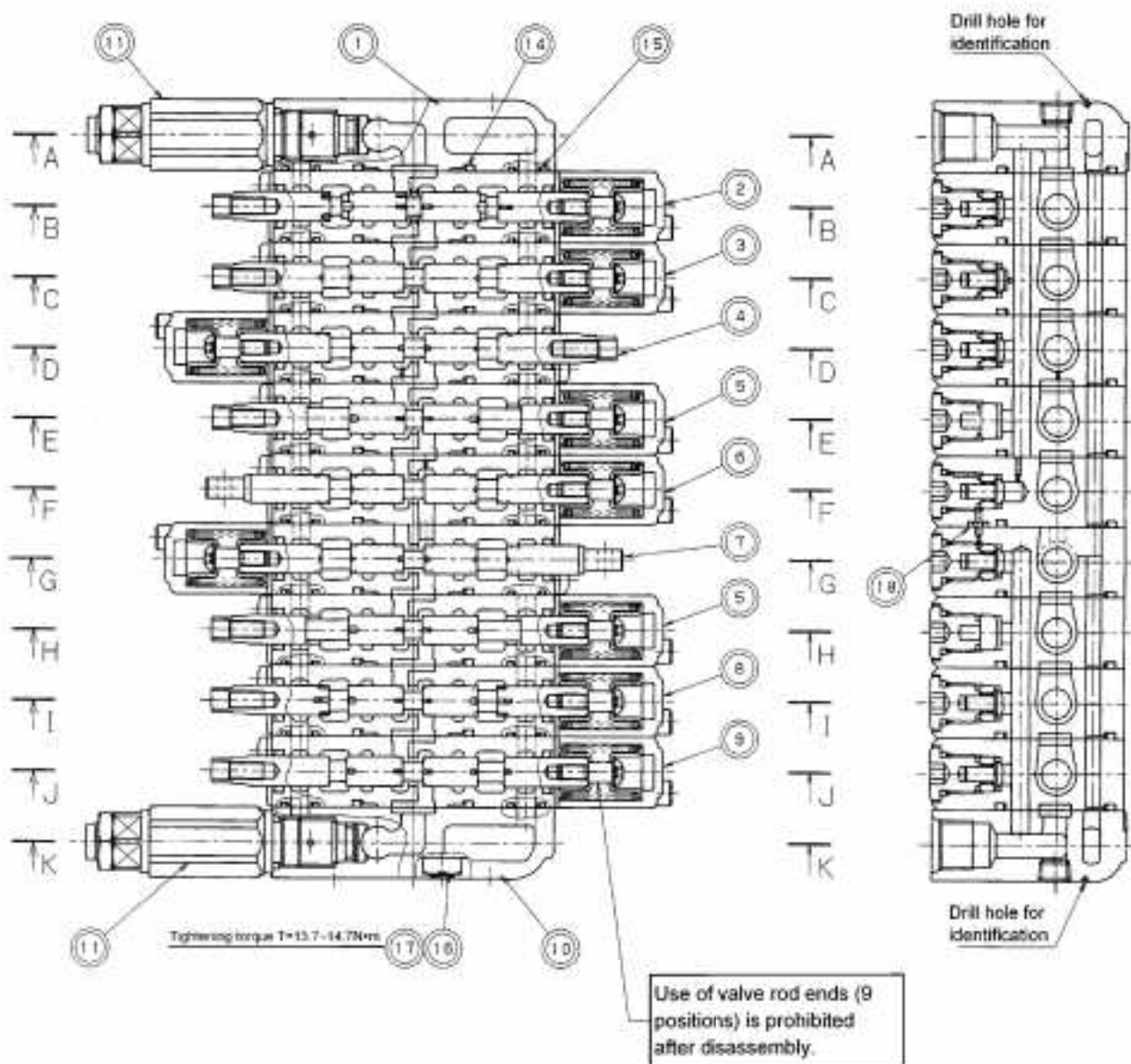
CONTROL VALVE (1)

Weight: 10.5 kg

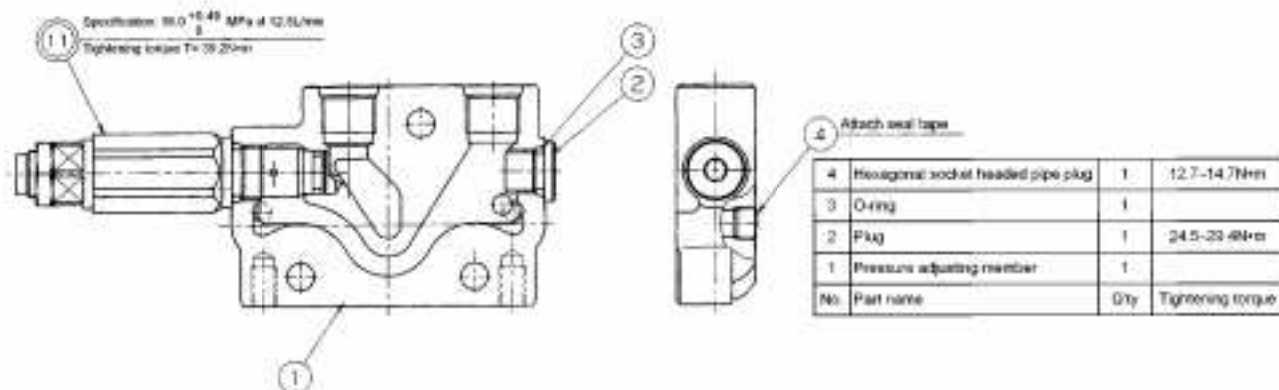
Upon assembling the valve block observe the tightening torque (3 positions).  
13.7~14.7N·m

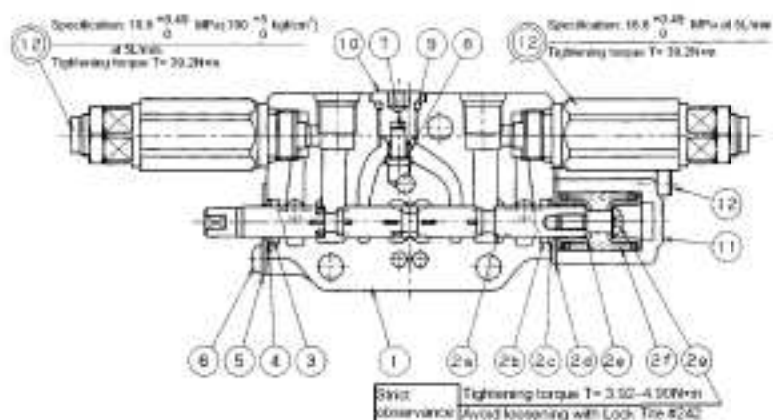


Circuit diagram

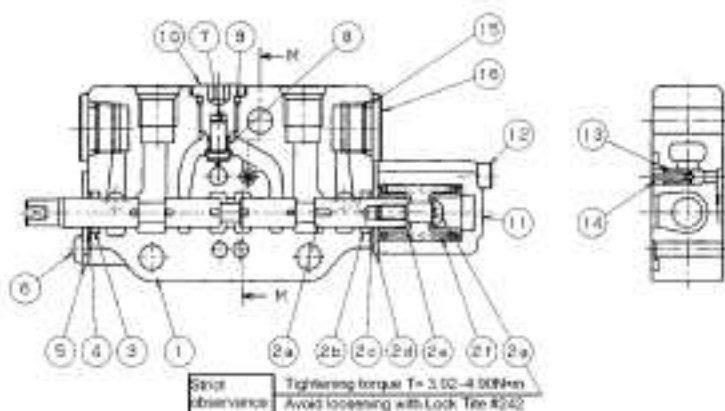


#### Pressure adjusting part assembly

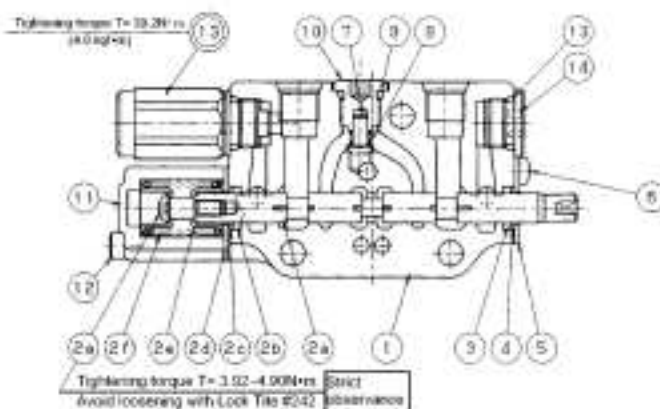


**CONTROL VALVE (2)****Boom switching part assembly B-B**

12	Hexagonal socket headed bolt M5-45	2	3.88~6.88N·m
11	Return spring lid	1	
10	Check valve support	1	24.5~29.4N·m
9	O-ring 18 P11	1	
8	Check valve spring	1	
7	Check valve	1	
6	Cross socket headed small pan screw M5-10	2	1.95~2.94N·m
5	O-ring retainer	1	
4	Backup ring T3P 10A	1	
3	O-ring 1A P10A	1	
g	Valve rod end	(1)	
f	Return spring	(1)	
e	Return spring support	(2)	
d	O-ring retainer	(1)	
c	Backup ring T3P 10A	(1)	
b	O-ring 1A P10A	(1)	
a	Valve rod (boom)	(1)	
2	Valve rod assembly (boom)	1	
1	Switching part body WC	1	
No.	Part name	Qty	Tightening torque

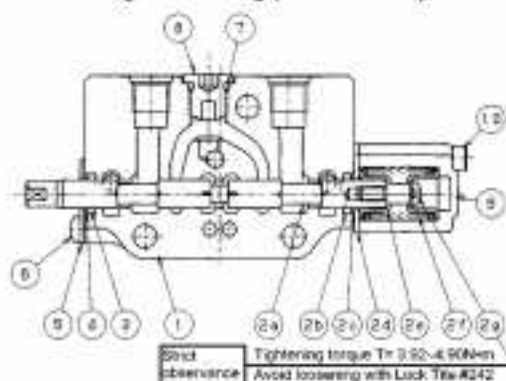
**Bucket switching part assembly C-C**

15	PF 3/8 Plug	2	39.2~49.0N·m
14	O-ring 18 P14	2	
13	Check valve spring	1	
12	Check valve	1	
11	Hexagonal socket headed bolt M5-45	2	3.88~6.88N·m
10	Return spring lid	1	
9	Check valve support	1	24.5~29.4N·m
8	O-ring 18 P11	1	
7	Check valve spring	1	
6	Check valve	1	
5	Cross socket headed small pan screw M5-10	2	1.95~2.94N·m
4	O-ring retainer	1	
3	Backup ring T3P 10A	1	
2	O-ring 1A P10A	1	
g	Valve rod end	(1)	
f	Return spring	(1)	
e	Return spring support	(2)	
d	O-ring retainer	(1)	
c	Backup ring	(1)	
b	O-ring 1A P10A	(1)	
a	Valve rod (bucket)	(1)	
2	Valve rod assembly (bucket)	1	
1	Switching part body RH	1	
No.	Part name	Qty	Tightening torque

**Swing switching part assembly D-D**

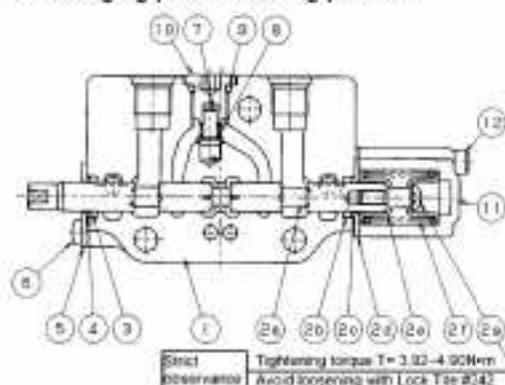
14	PF 3/8 Plug	1	39.2~49.0N·m
13	O-ring 18 P14	1	
12	Hexagonal socket headed bolt M5-45	2	3.88~6.88N·m
11	Return spring lid	1	
10	Check valve support	1	24.5~29.4N·m
9	O-ring 18 P11	1	
8	Check valve spring	1	
7	Check valve	1	
6	Cross socket headed small pan screw M5-10	2	1.95~2.94N·m
5	O-ring retainer	1	
4	Backup ring T3P 10A	1	
3	O-ring 1A P10A	1	
g	Valve rod end	(1)	
f	Return spring	(1)	
e	Return spring support	(2)	
d	O-ring retainer	(1)	
c	Backup ring T3P 10A	(1)	
b	O-ring 1A P10A	(1)	
a	Valve rod (swing)	(1)	
2	Valve rod assembly (swing)	1	
1	Switching part body RD	1	
No.	Part name	Qty	Tightening torque

### Travel to right switching part assembly E-E



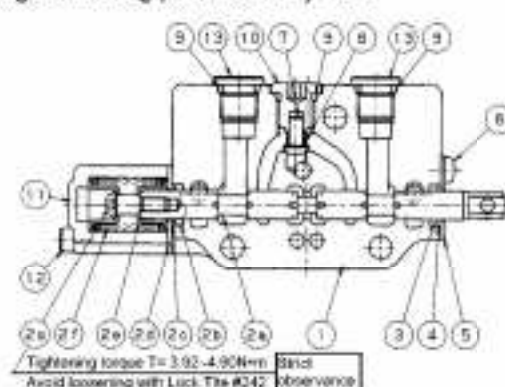
10	Hexagonal socket headed bolt M5-45	2	5.85-6.85N·m
9	Return spring lid	1	
8	Check valve support	1	24.5-29.4N·m
7	O-ring TB P11	1	
6	Cross socket headed small pan screw M5-10	2	1.95-2.94N·m
5	O-ring retainer	1	
4	Backup ring T3P 10A	1	
3	O-ring TA P10A	1	
2	Valve rod assembly (Travel)	1	
1	Switching part body ZA	1	
No.	Part name	Qty	Tightening torque

### Soil discharging plate switching part F-F



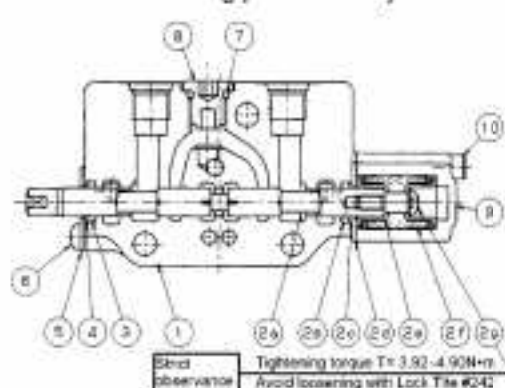
12	Hexagonal socket headed bolt M5-45	2	5.85-6.85N·m
11	Return spring lid	1	
10	Hexagonal socket headed bolt	1	24.5-29.4N·m
9	O-ring TB P11	1	
8	Check valve support	1	
7	Check valve	1	
6	Cross socket headed small pan screw M5-10	2	1.95-2.94N·m
5	O-ring retainer	1	
4	Backup ring T3P 10A	1	
3	O-ring TA P10A	1	
2	Valve rod assembly (bucket)	1	
1	Switching part body ZF	1	
No.	Part name	Qty	Tightening torque

### Merge switching part assembly G-G



13	PF 1/4 plug	2	24.5-29.4N·m
12	Hexagonal socket headed bolt M5-45	2	5.85-6.85N·m
11	Return spring lid	1	
10	Hexagonal socket headed bolt	1	
9	O-ring TB P11	3	
8	Check valve support	1	
7	Check valve	1	
6	Cross socket headed small pan screw M5-10	2	1.95-2.94N·m
5	O-ring retainer	1	
4	Backup ring T3P 10A	1	
3	O-ring TA P10A	1	
2	Valve rod assembly (P.T.G.)	1	
1	Switching part body ZG	1	
No.	Part name	Qty	Tightening torque

### Travel to left switching part assembly H-H



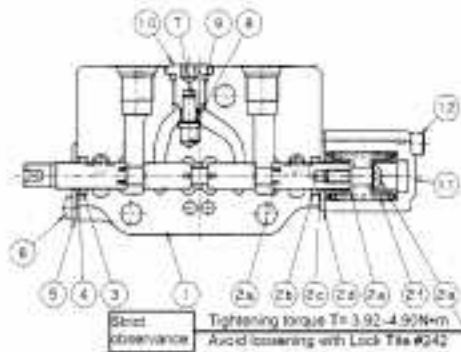
10	Hexagonal socket headed bolt M5-45	2	5.85-6.85N·m
9	Return spring lid	1	
8	Check valve support	1	24.5-29.4N·m
7	O-ring TB P11	1	
6	Cross socket headed small pan screw M5-10	2	1.95-2.94N·m
5	O-ring retainer	1	
4	Backup ring T3P 10A	1	
3	O-ring TA P10A	1	
2	Valve rod assembly (Travel)	1	
1	Switching part body ZA	1	
No.	Part name	Qty	Tightening torque



## CONTROL VALVE (3)

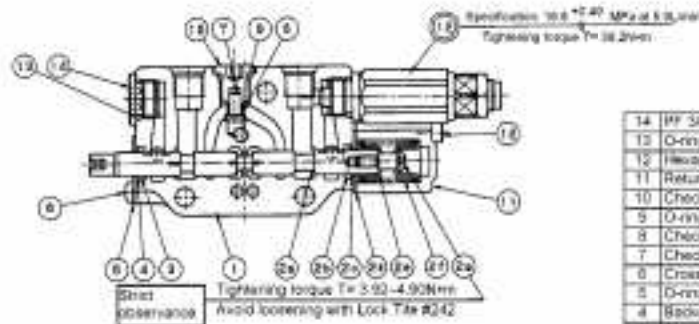
0783 767 UA

## Swing switching part assembly I-I



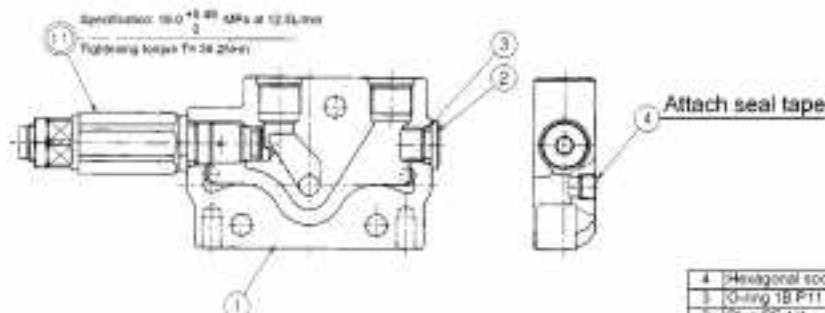
12	Hexagonal socket headed bolt M5-45	2	5.66-6.86N·m
11	Return spring lid	1	
10	Hexagonal socket headed bolt	1	24.5-29.4N·m
9	O-ring 1B P11	1	
8	Check valve spring	1	
7	Check valve	1	
6	Cross socket headed small pan screw M5-10	2	1.95-2.94N·m
5	O-ring retainer	1	
4	Backup ring T3P 10A	1	
3	O-ring 1A P10A	1	
g	Valve rod end	(1)	
f	Return spring	(1)	
e	Return spring support	(2)	
d	O-ring retainer	(1)	
c	Backup ring T3P 10A	(1)	
b	O-ring 1A P10A	(1)	
a	Valve rod (swing)	(1)	
2	Valve rod assembly (swing)	1	
1	Switching part body 2A	1	
No.	Part name	Qty	Tightening torque

## Arm switching part assembly J-J



14	PP 3/8 Plug	1	39.2-49.0N·m
13	O-ring 1B P14	1	
12	Hexagonal socket headed bolt M5-45	2	5.66-6.86N·m
11	Return spring lid	1	
10	Check valve support	1	24.5-29.4N·m
9	O-ring 1B P11	1	
8	Check valve spring	1	
7	Check valve	1	
6	Cross socket headed small pan screw M5-10	2	1.95-2.94N·m
5	O-ring retainer	1	
4	Backup ring T3P 10A	1	
3	O-ring 1A P10A	1	
g	Valve rod end	(1)	
f	Return spring	(1)	
e	Return spring support	(2)	
d	O-ring retainer	(1)	
c	Backup ring T3P 10A	(1)	
b	O-ring 1A P10A	(1)	
a	Valve rod (arm)	(1)	
2	Valve rod assembly (arm)	1	
1	Switching part body 1A	1	
No.	Part name	Qty	Tightening torque

## Pressure adjusting part assembly K-K



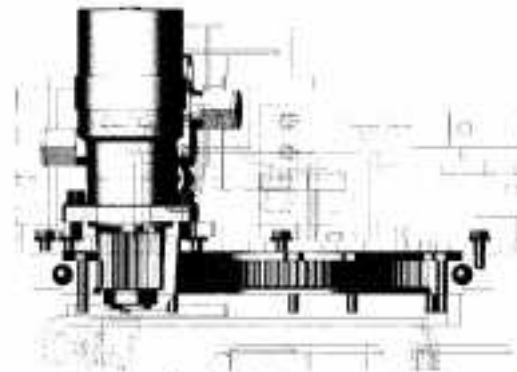
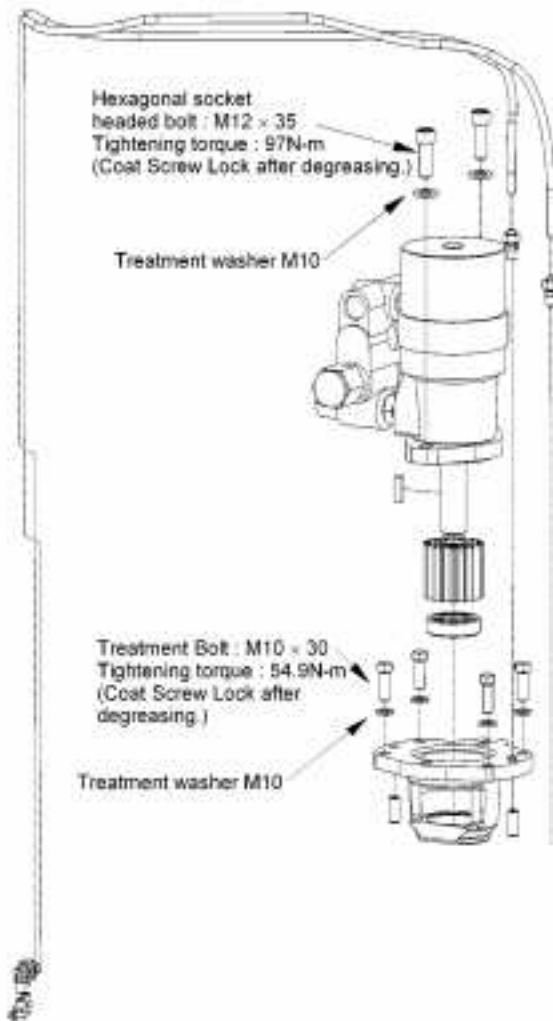
4	Hexagonal socket header pipe plug 1/8	1	12.7-14.7N·m
3	O-ring 1B P11	1	
2	Plug PP 1/4	1	24.5-29.4N·m
1	Super pressure section body BP	1	
No.	Part name	Qty	Tightening torque

The relief valve, anti-cavitation valve, and overload relief valve shown in the partial assembly drawings in the left frame are not included as components of partial assemblies.



**SWING DRIVE DEVICE & BEARING**

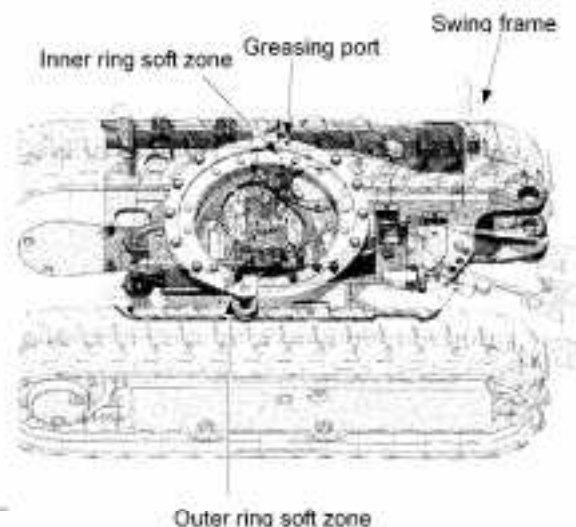
Layout



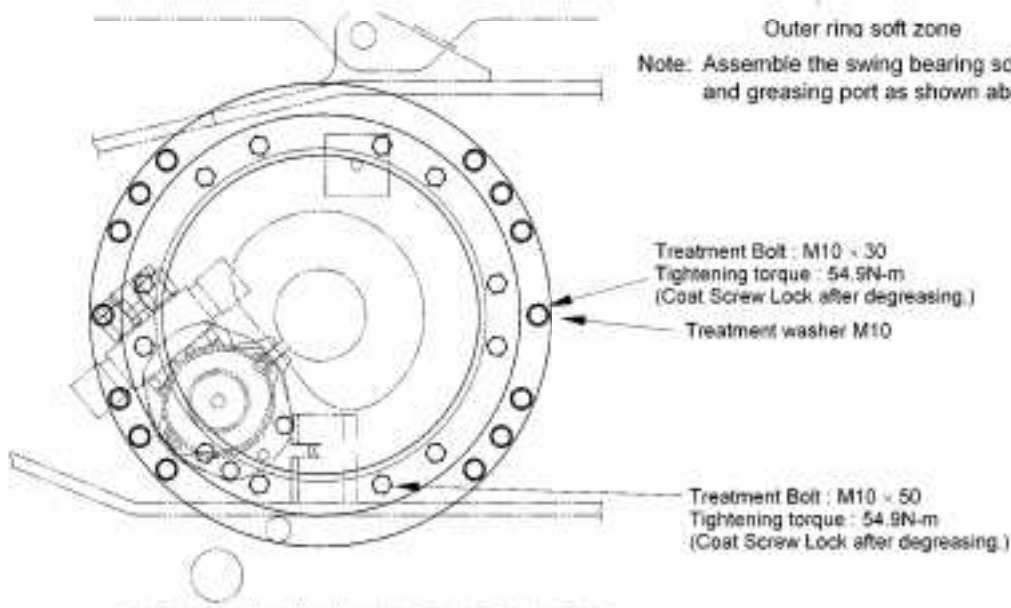
Assembly drawing (cross-sectional)

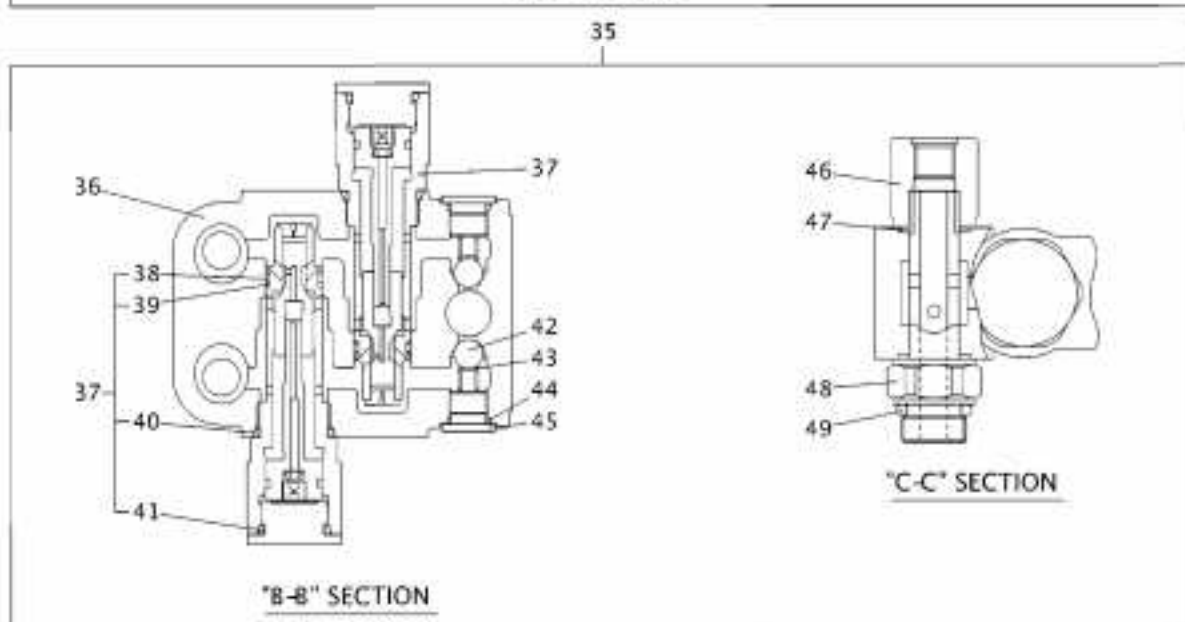
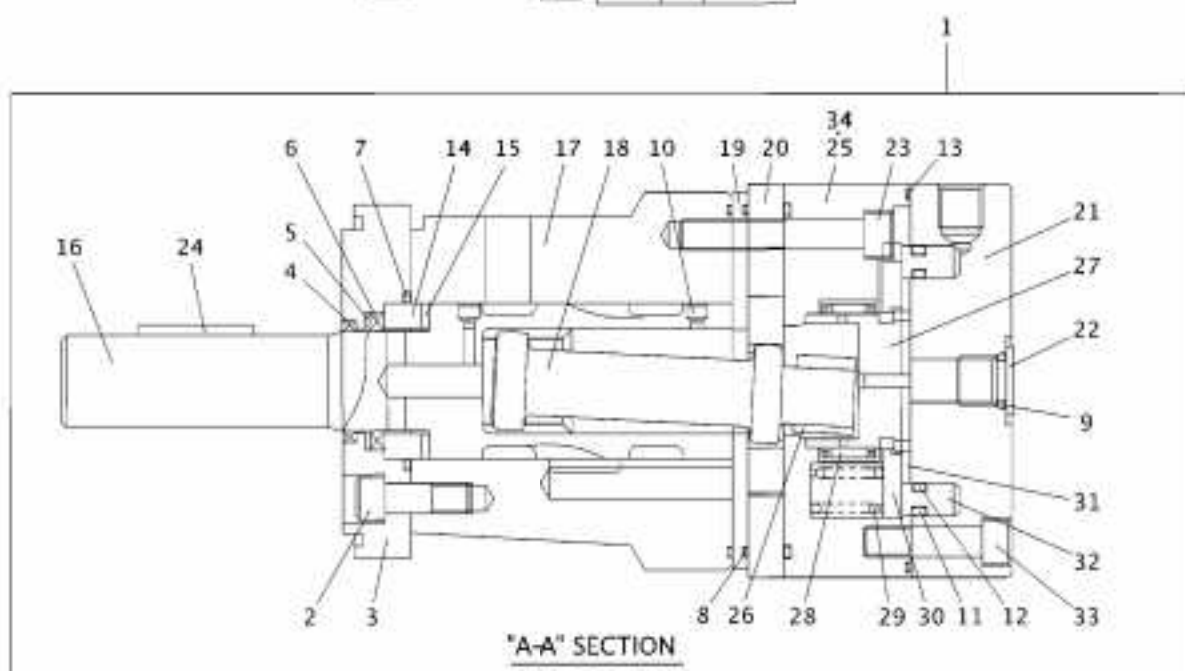
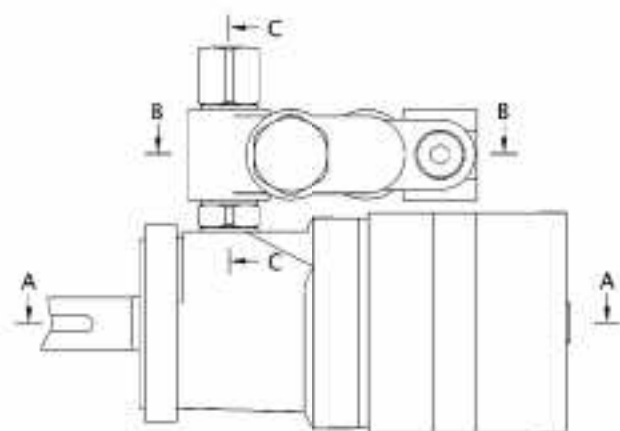
Note:

For bolts of the swing motor and swing bearing, "special tightening" is designated in place.



Note: Assemble the swing bearing soft zone and greasing port as shown above.

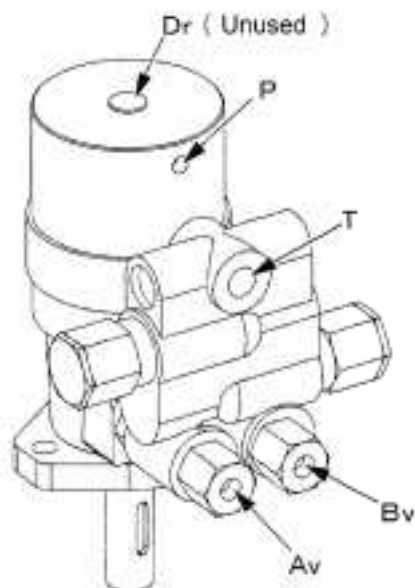
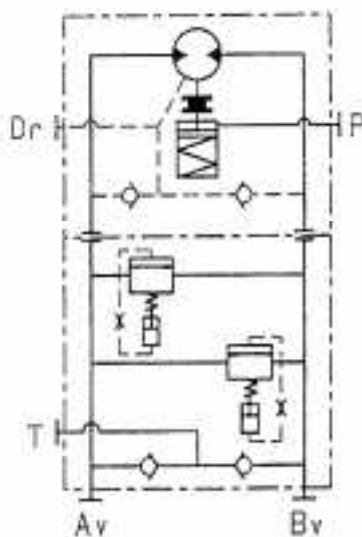




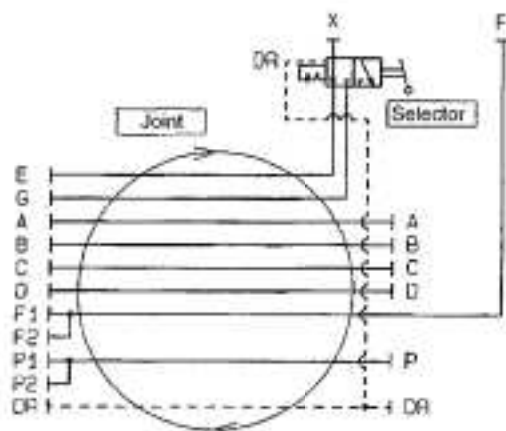
SWING MOTOR ASS'Y

Weight: 16 kg

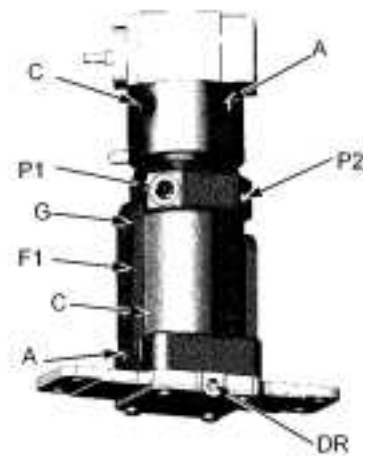
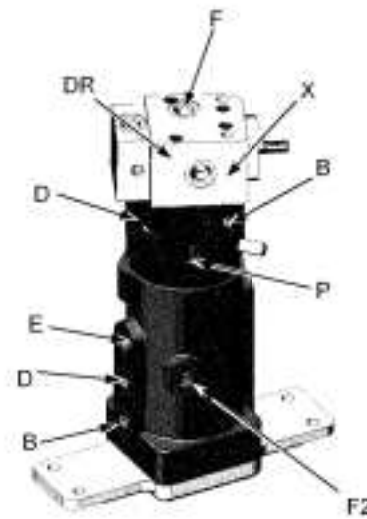
Key	Description	Qty
1	Motor Ass'y	1
2	Ball Socket Head	4
3	Flange	1
4	Seal Dust	1
5	Ring Back-up	1
6	Seal Oil	1
7	Ring O	1
8	Seal	3
9	Ring O	1
10	Pincock	2
11	Ring O	1
12	Ring O	1
13	Ring O	1
14	Bearing, Thrust	1
15	Bearing, Needle	1
16	Shaft	1
17	Housing	1
18	Drive	1
19	Spacer	1
20	Geroler	1
21	Housing, Rear	1
22	Plug	1
23	Ball Socket Head	2
24	Key	1
25	Brake Housing	1
26	Bushing	1
27	Gear Wheel	1
28	Bearing, Needle	1
29	Spring, Coil	2
30	Plate, Push	1
31	Plate, Friction	1
32	Piston	1
33	Ball Socket Head	2
34	Plug	1
35	Valve Ass'y, Shockless	1
36	Body	1
37	Valve Ass'y, Relief	2
38	Ring O	1
39	Ring Back-up	2
40	Ring O	1
41	Ring O	1
42	Ball Seal	3
43	Spring	2
44	Ring O	2
45	Plug, Check	2
46	Adapter	2
47	Ring O	4
48	Valve, Picking	2
49	Ring O	2

External viewHydraulic symbols

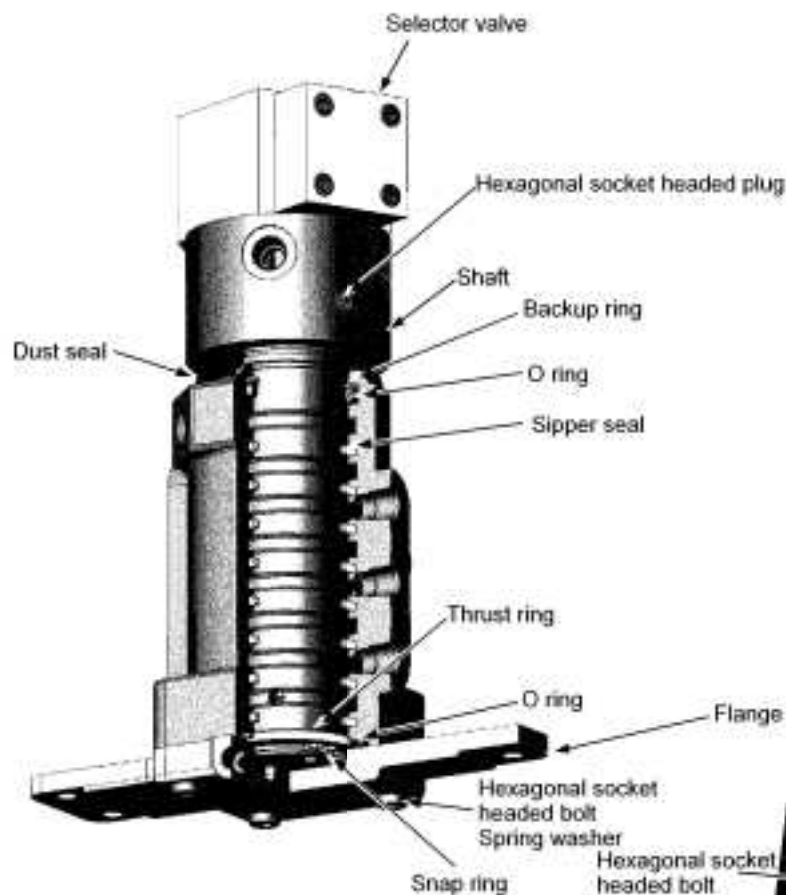
Parking brake	Release pressure(Theoretical)	1.57MPa
Relief valve	Set pressure	6.9MPa at 10L/min



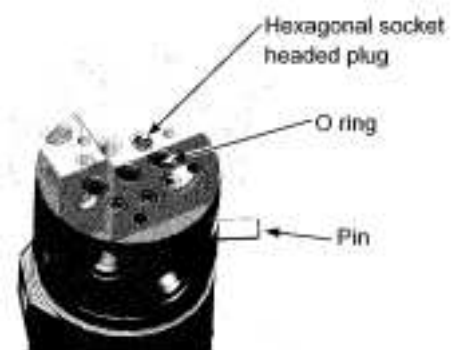
Circuit diagram



Rotary joint external view

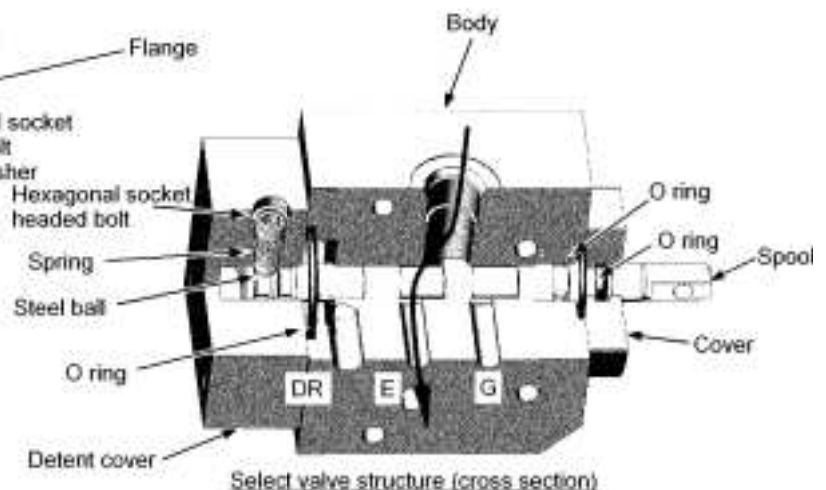


Structure (cross section)



#### Note 1

Upon assembling the rotary joint, assemble the shaft after grease is coated On the seal, O-ring, shaft, etc

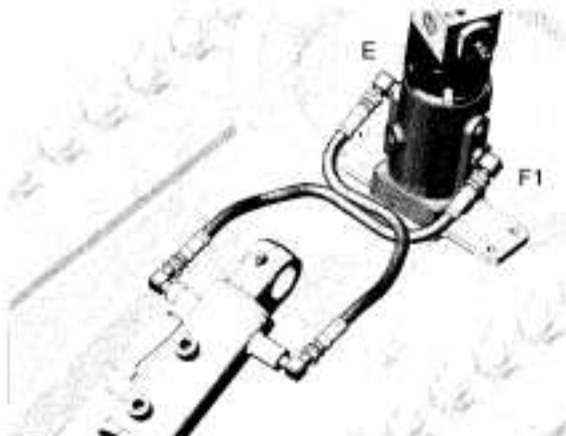
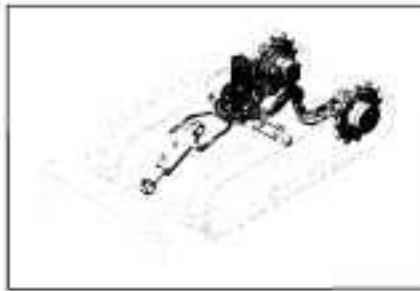


Select valve structure (cross section)

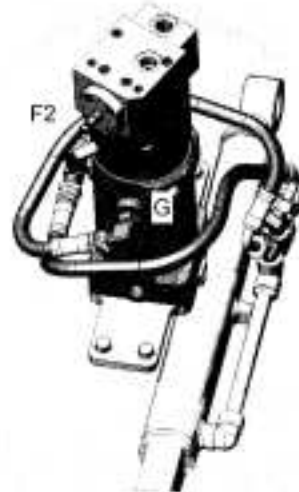
ROTARY JOINT AND LOWER PIPING ASS'Y

Rotary joint assembly:  
weight: 14 kg

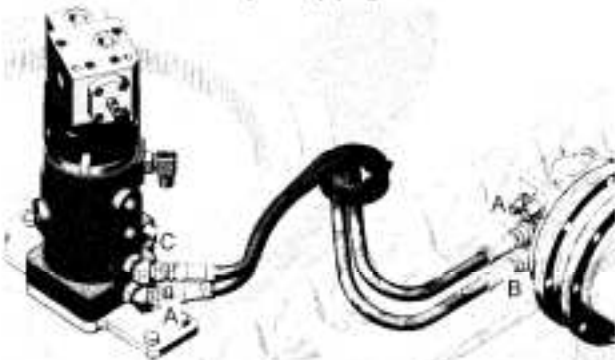
Layout



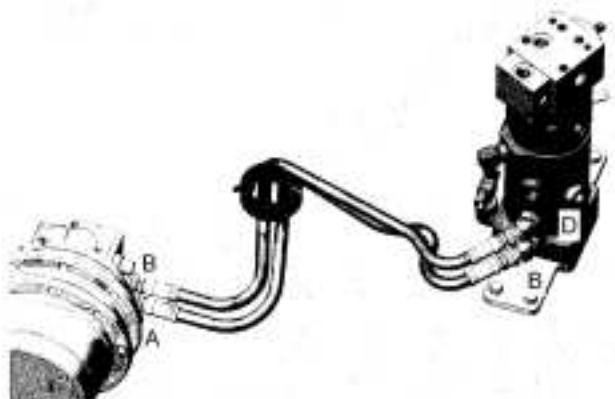
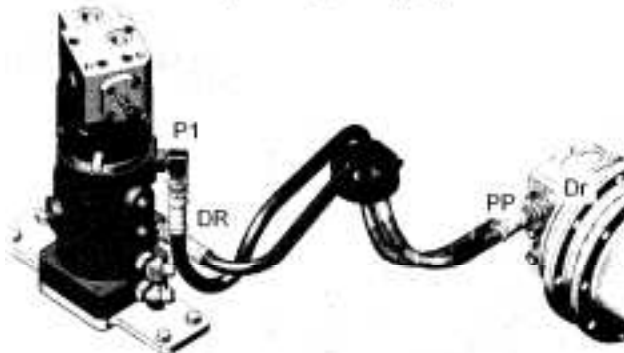
Dozer cylinder piping



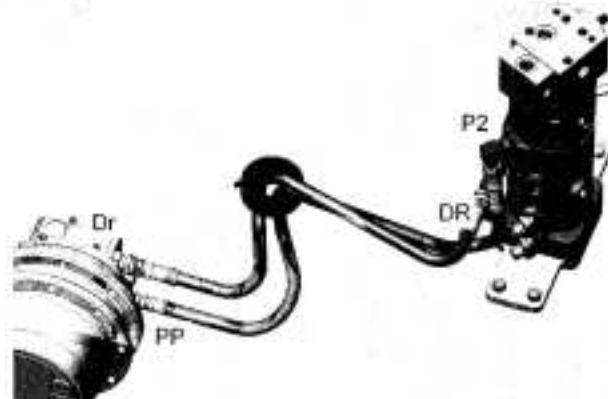
Spanner cylinder piping

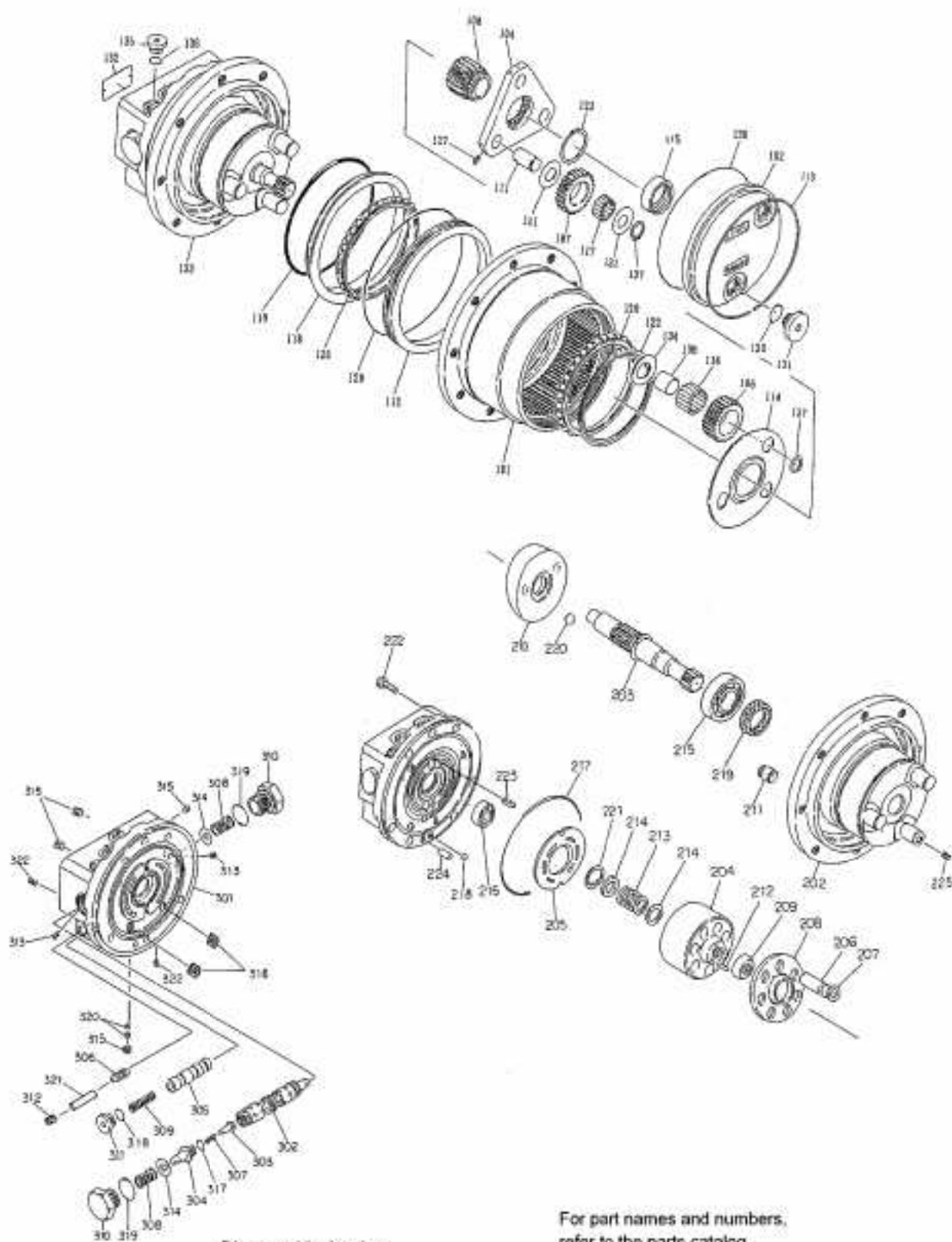


Left-travel motor piping



Right-travel motor piping

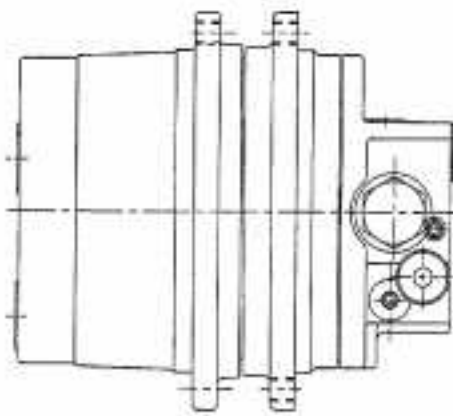
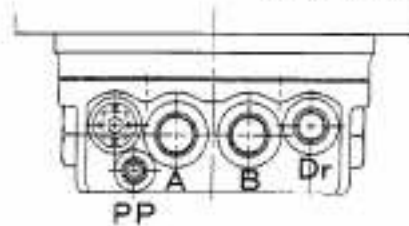




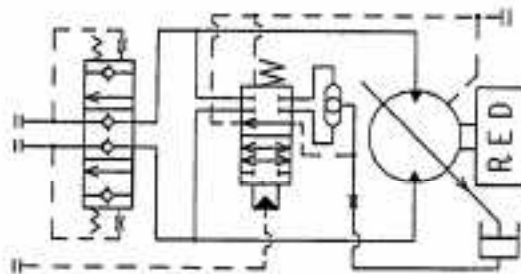
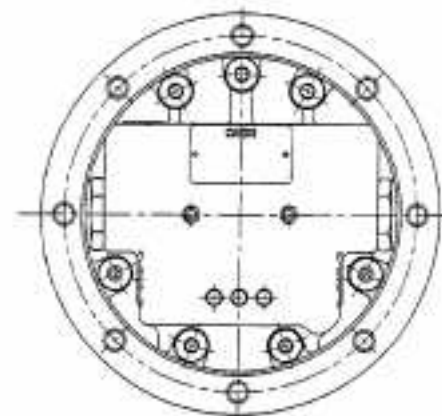
TRAVEL MOTOR AND REDUCTION GEAR ASS'Y

Specified oil	Gear oil, API type, class CD, SAE30
Volume	0.33L

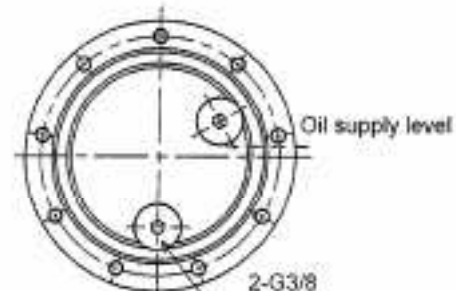
Weight: 17 kg



External view



Hydraulic circuit diagram

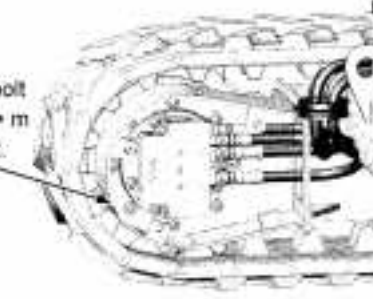


Lubricant supply/drain port



Sprocket mounting bolt  
Tightening torque: 55N • m  
\* Coat Screw Lock #262.

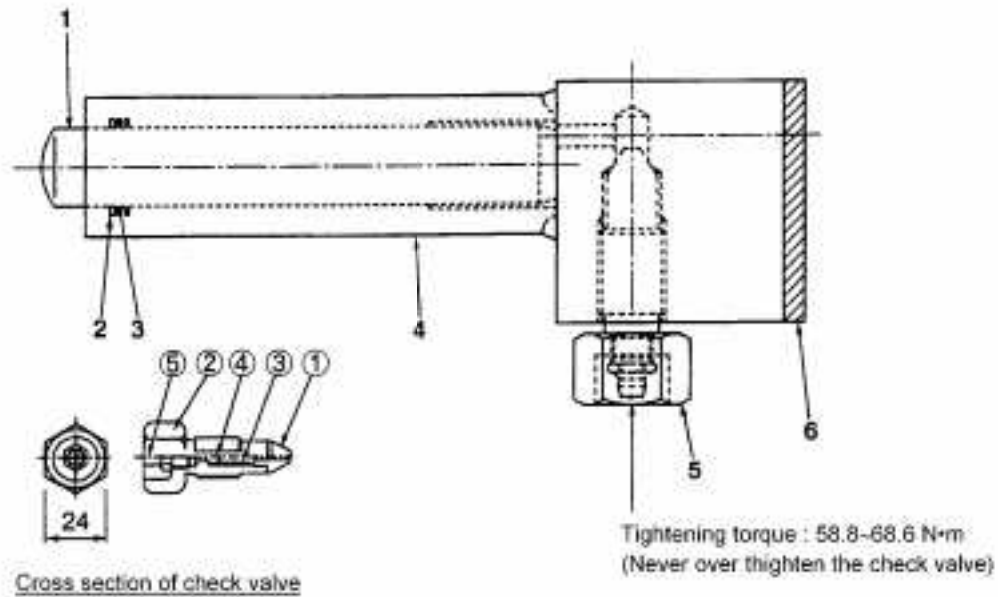
Swing motor mounting bolt  
Tightening torque: 55N • m  
\* Coat Screw Lock #262.



Mounting bolt tightening torque

CRAWLER SHOE ADJUSTING DEVICE

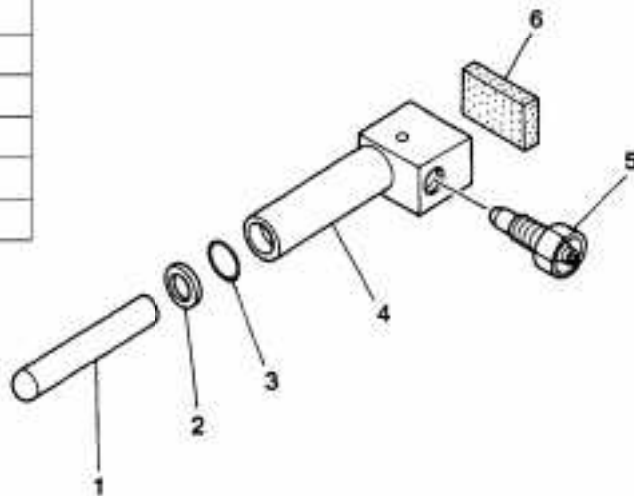
Weight: 1.8 kg



## Notes

- 1) Position the check valve to outside the crawler frame with install the device.
- 2) Loosen the check valve (one turn maximum) and escape the internal grease when loosening the shoe.  
Never loosen the grease fitting. Do not watch the check valve to see if grease is escaping.

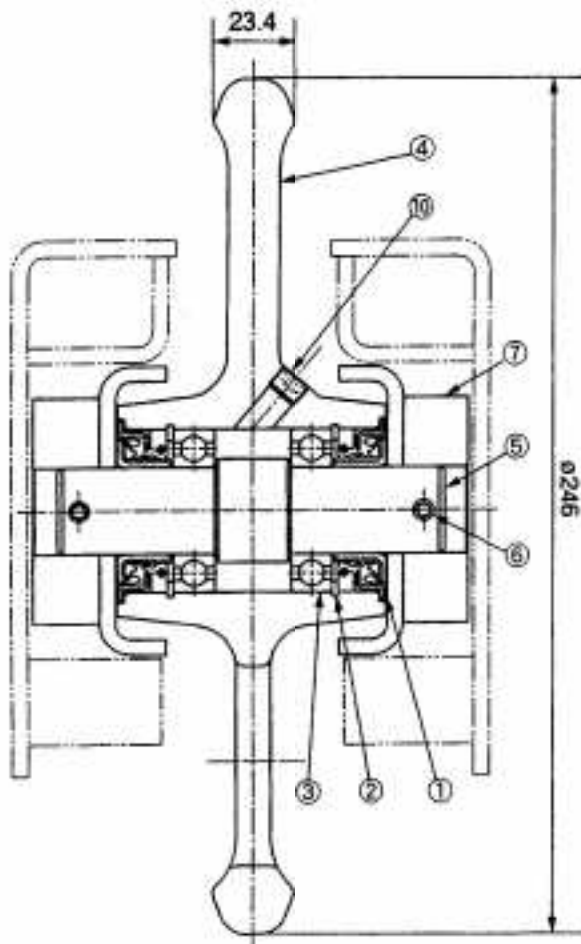
Key	Description	Q'ty
1	Piston	1
2	Back-up Ring	1
3	"O" Ring	1
4	Grease Cylinder	1
5	Check Valve	1
6	Rubber Plate	1





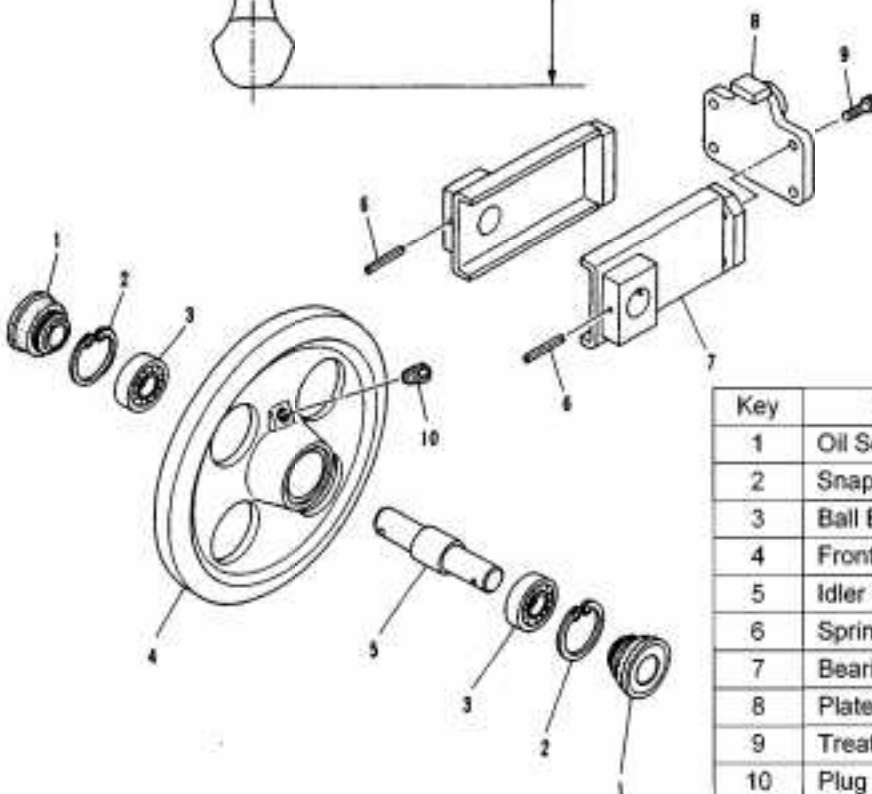
**FRONT IDLER ASS'Y**

Weight: 9.6 kg

**Notes:**

1. Install the plug after fill gear oil (SAE#90-API-GL4) 20CC
2. Inspect oil leak : Apply air press 98 kPa to oil gill hole ⑩ after assembly.

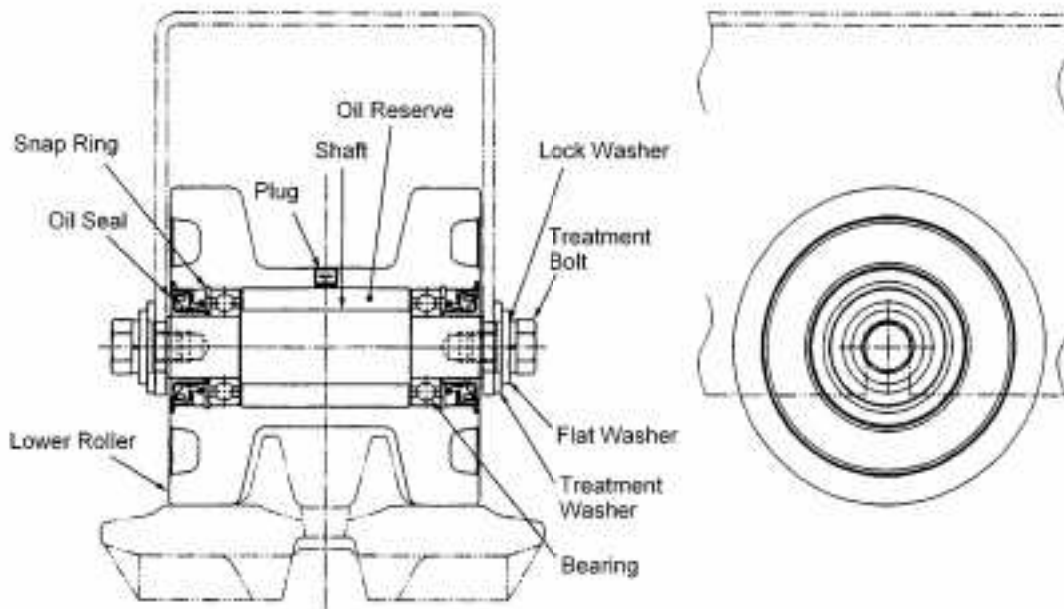
Lubricant type	Q'ty
API - GL4 SAE#90	20 cc



Key	Description	Q'ty
1	Oil Seal	2
2	Snap Ring	2
3	Ball Bearing	2
4	Front Idler	1
5	Idler Shaft	1
6	Spring Pin	2
7	Bearing Block	2
8	Plate	1
9	Treatment Bolt	4
10	Plug	1

**LOWER ROLLER ASS'Y**

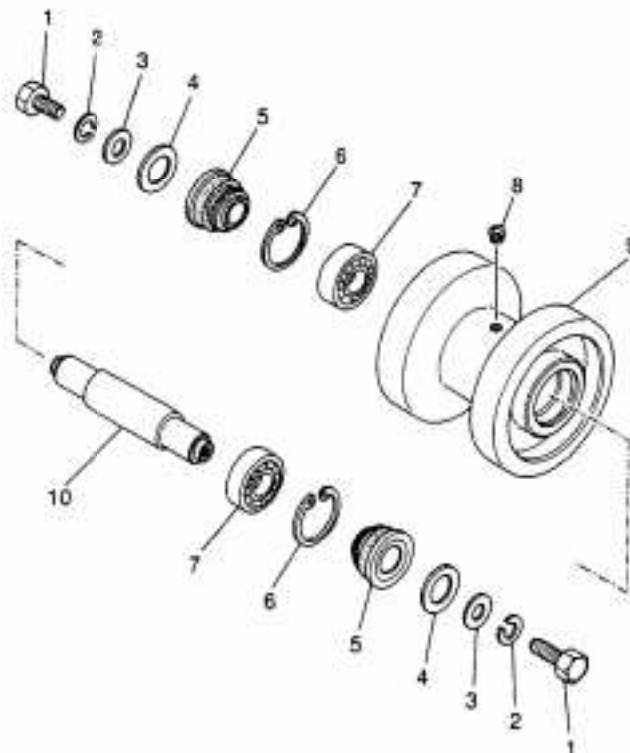
Weight: 5.3kg

**Cross Section of Lower Roller****Notes:**

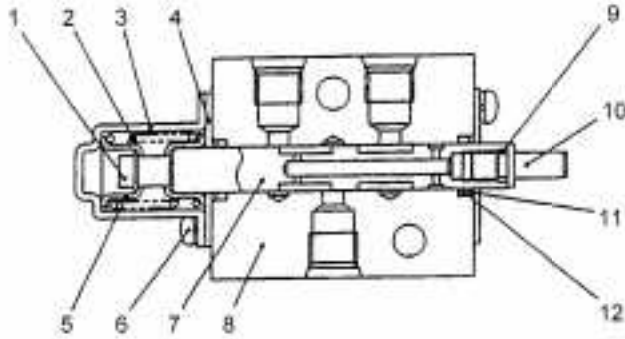
1. Install the plug after fill gear oil (SAE#90-API-GL4) 70CC
2. Inspect oil leak : Apply air press 98 kPa to oil gill hole ① after assembly.

Lubricant type	Q'ty
API - GL4 SAE#90	70 cc

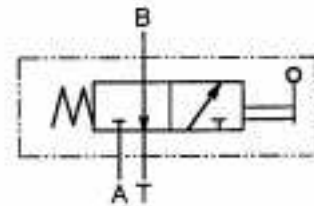
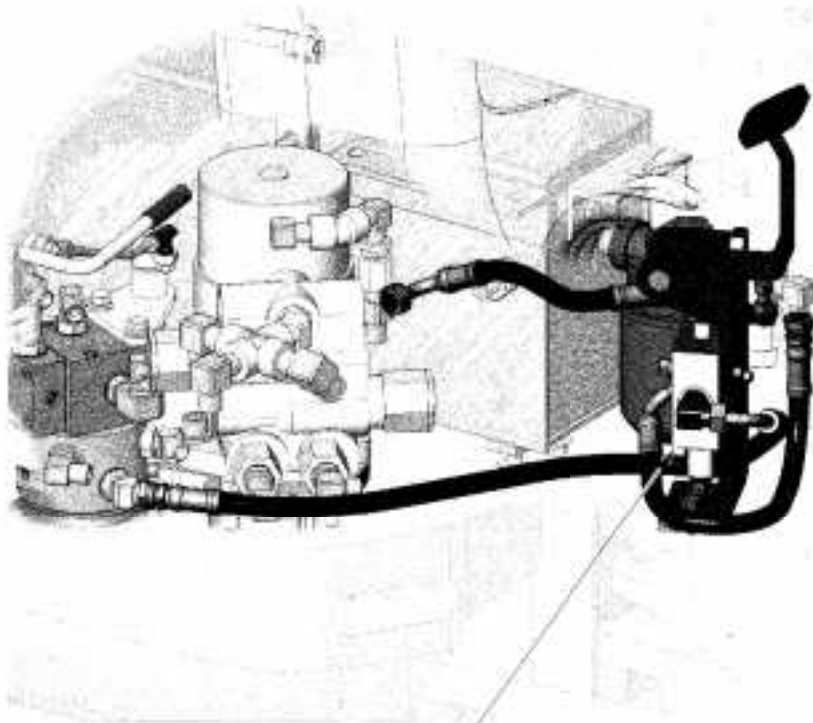
Key	Description	Q'ty
1	Treatment Bolt	2
2	Lock Washer	2
3	Flat Washer	2
4	Treatment Washer	2
5	Oil Seal	2
6	Snap Ring	2
7	Bearing	2
8	Plug	1
9	Lower Roller	1
10	Shaft	1





TRAVEL SPEED SHIFT VALVE ASS'Y

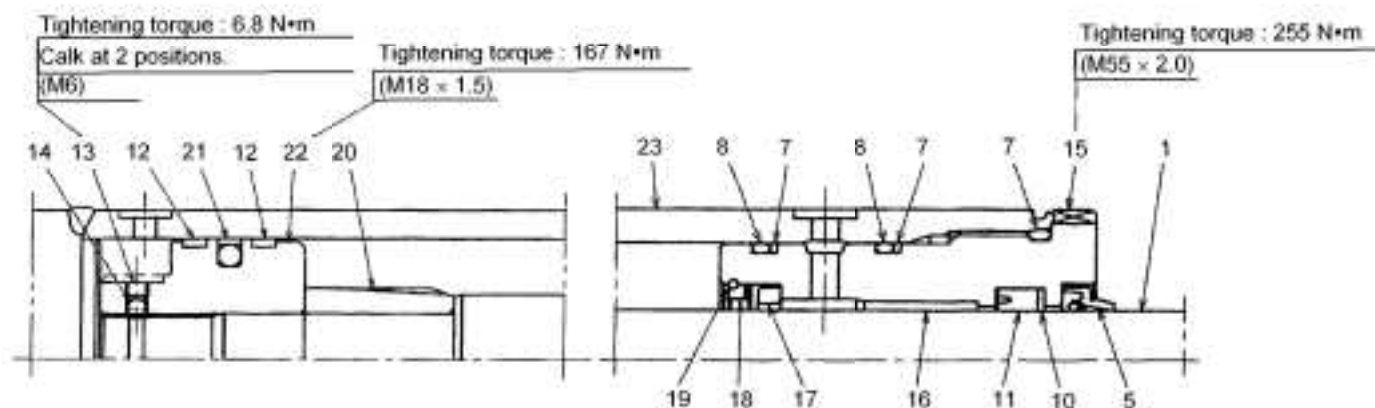
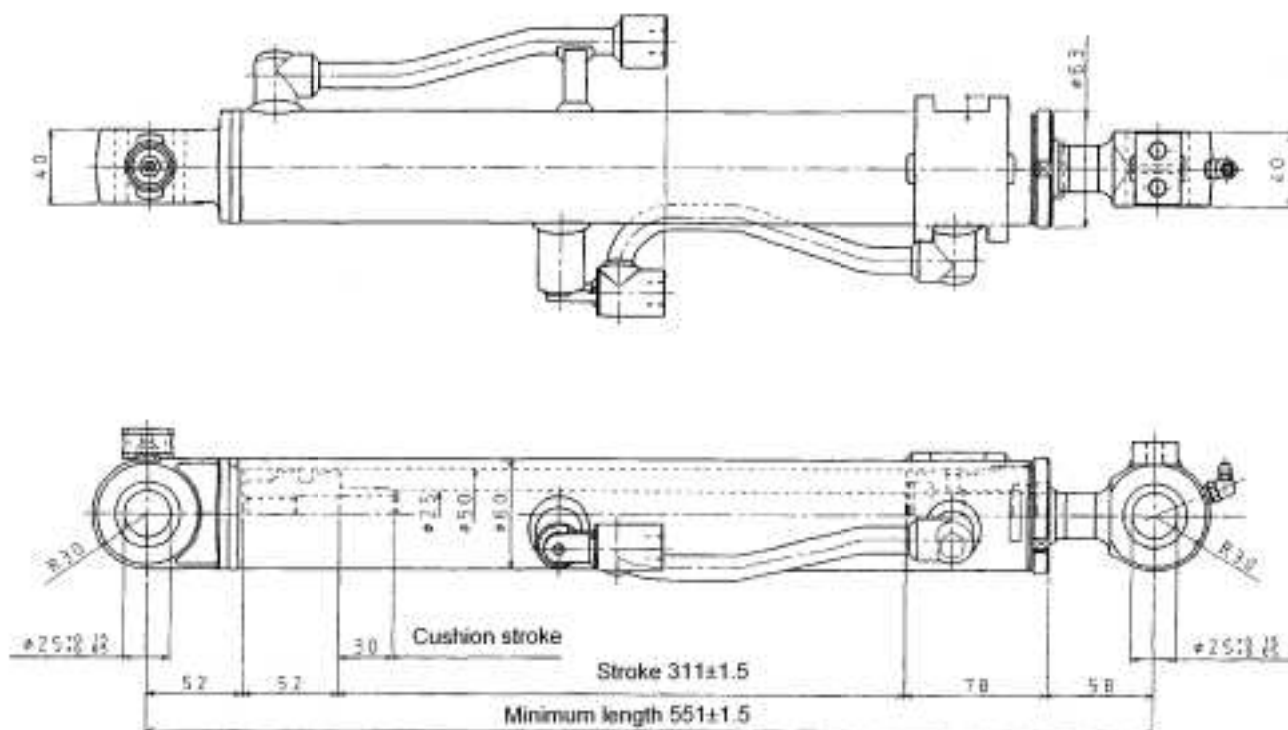
Key	Description	Q'ty
1	Bolt	1
2	Spring	1
3	Spring Cover	1
4	Seal Retainer	2
5	Spring Holder	2
6	Pan Head Screw (W/L.W)	4
7	Spool	1
8	Body	1
9	"O" Ring	1
10	Spool Head	1
11	Back-up Ring	2
12	"O" Ring	2



Hydraulic symbol

Travel Speed Shift Valve

Boom



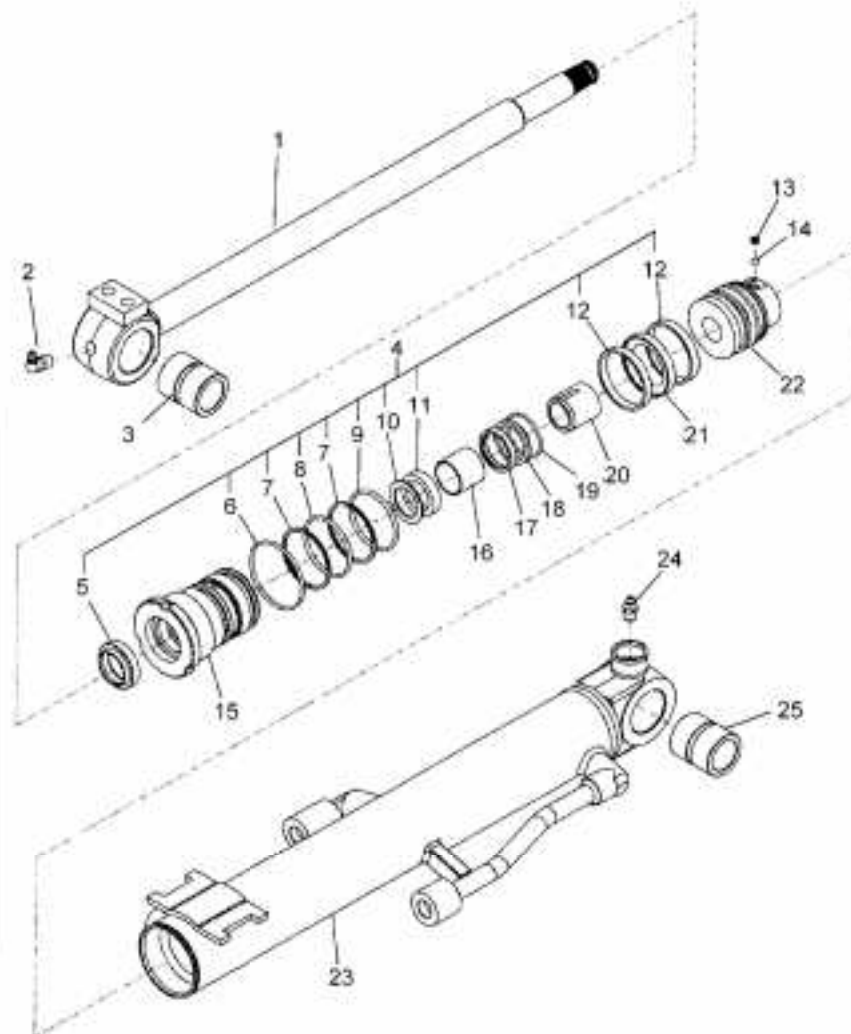
Piston details

Cylinder head details

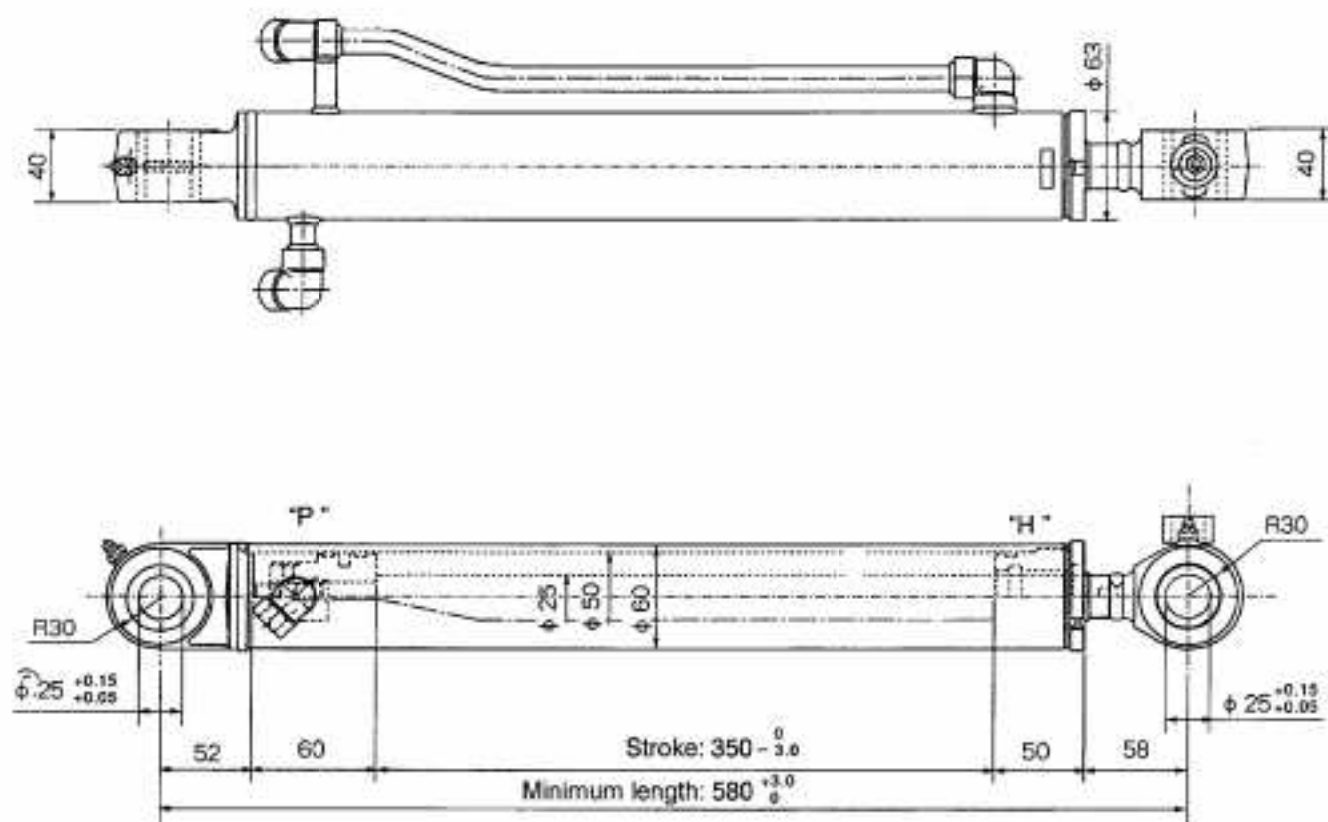
BOOM CYLINDER ASS'Y

Weight: 8.5kg

Key	Description	Q'ty
1	Piston Rod Ass'y	1
2	Bushing	1
3	Grease Nipple	1
4	Seal Kit	1
5	Dust Seal	1
6	"O" Ring	1
7	Back-up Ring	2
8	"O" Ring	1
9	"O" Ring	1
10	Back-up Ring	1
11	"U" Ring	1
12	Back-up Ring	2
13	Set Screw	1
14	Steel Ball	1
15	Cylinder Head	1
16	Bushing	1
17	Cushion Bearing	1
18	Spacer	1
19	Stopper	1
20	Cushion Bearing	1
21	Wear Ring	1
22	Piston	1
23	Cylinder Tube Ass'y	1
24	Grease Nipple	1
25	Bushing	1

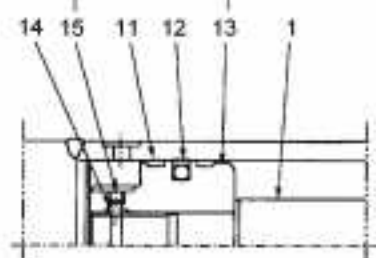


Arm

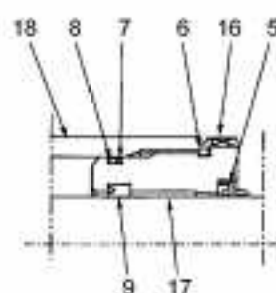


Tightening torque: 9.8 N·m  
(M6 × 1.0)  
Locking 2 points with punch

Tightening torque: 147 N·m  
(M16 × 1.5)



DETAIL "P"

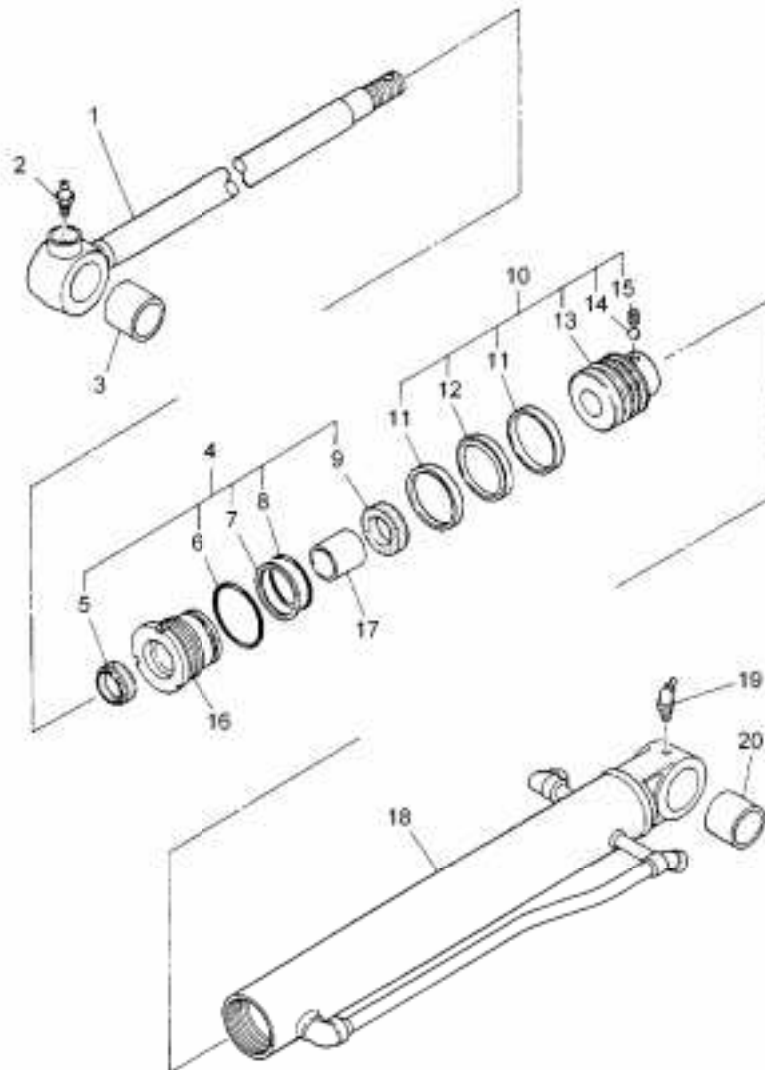


DETAIL "H"

ARM CYLINDER ASS'Y

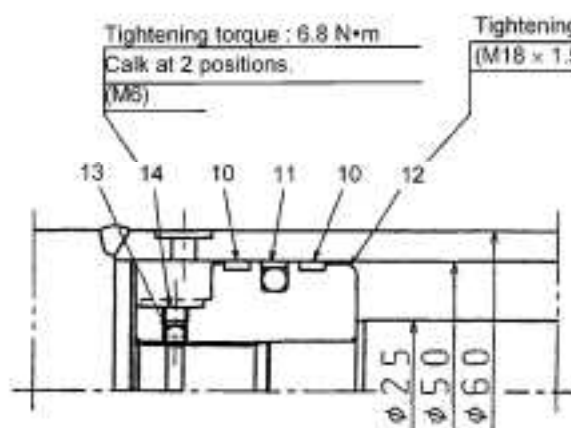
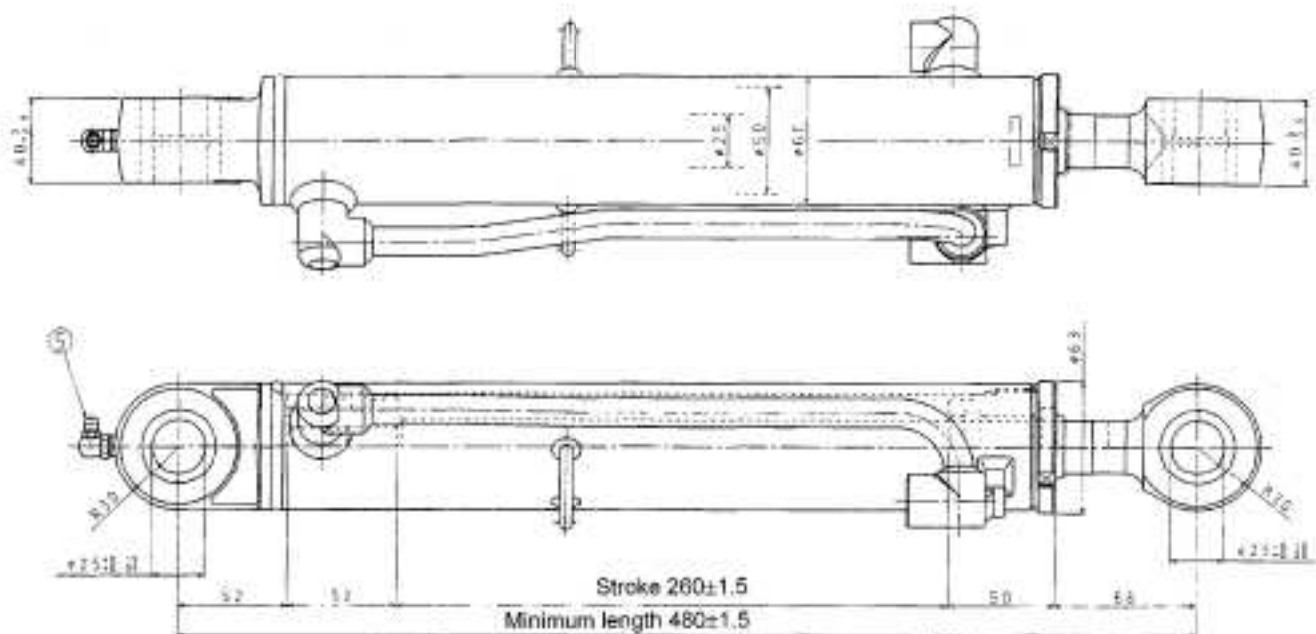
Weight: 9.0 kg

Key	Description	Q'ty
1	Piston Rod Ass'y	1
2	Grease Nipple	1
3	Bushing	1
4	Seal Kit	1
5	Wear Ring	1
6	"O" Ring	1
7	Back-up Ring	1
8	"O" Ring	1
9	"U" Ring	1
10	Piston Ass'y	1
11	Slide Ring	2
12	Seal Ring ass'y	1
13	Piston	1
14	Steel Ball	1
15	Set Screw	1
16	Cylinder Head	1
17	Bushing	1
18	Cylinder tube Ass'y	1
19	Grease Nipple	1
20	Bushing	1

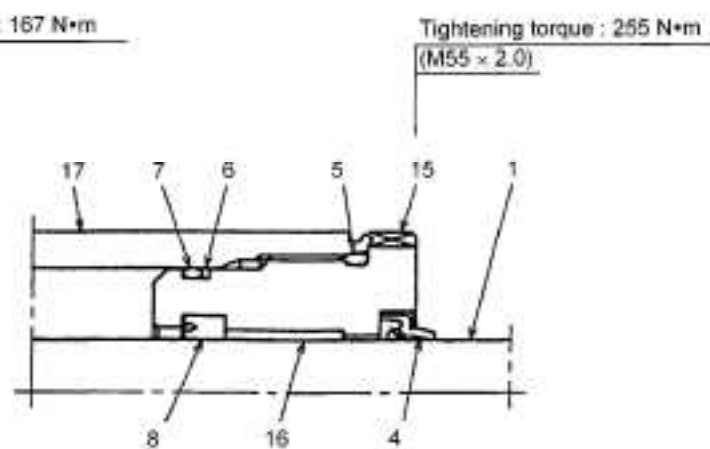




# Bucket



Piston details

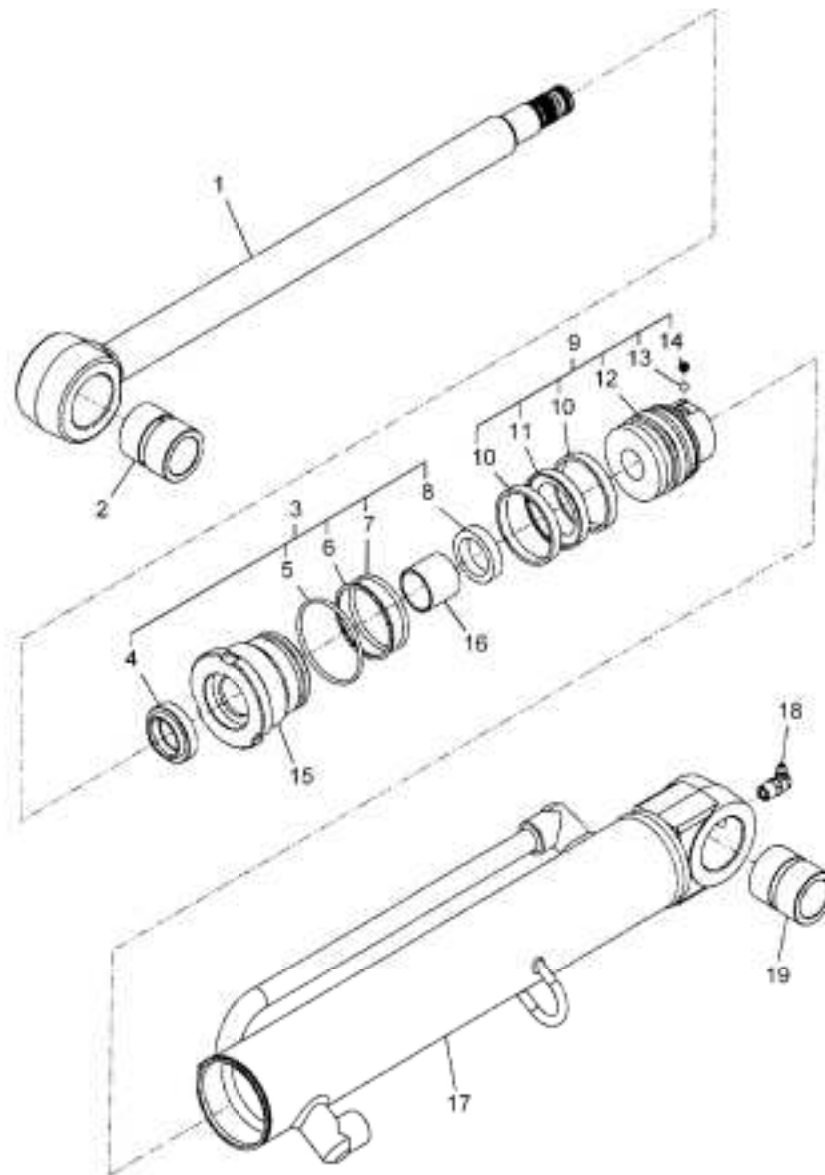


Cylinder head details

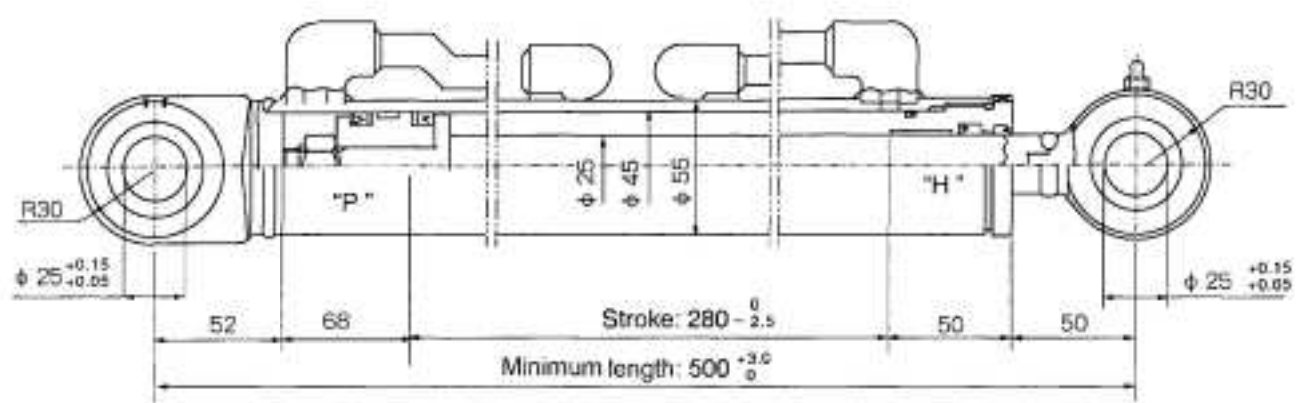
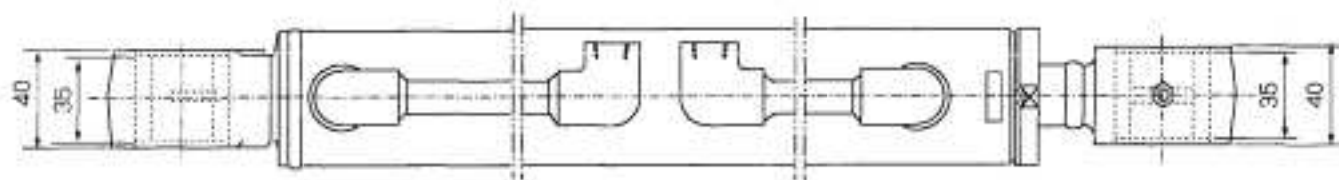
BUCKET CYLINDER ASS'Y

Weight : 7.5kg

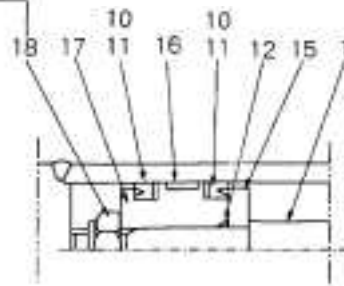
Key	Description	Q'ty
1	Piston Rod Ass'y	1
2	Bushing	1
3	seal kit	1
4	Dust Seat	1
5	"O" Ring	1
6	Back-up Ring	1
7	"O" Ring	1
8	"U" Ring	1
9	Piston Ass'y	1
10	Slide Ring	2
11	Seal Ring Ass'y	1
12	Piston	1
13	Steel Ball	1
14	Set Screw	1
15	Cylinder Head	1
16	Bushing	1
17	Cylinder Tube Ass'y	1
18	Grease Nipple	1
19	Bushing	1



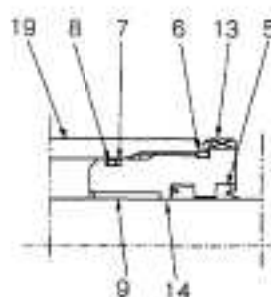
# Boom Swing



Tightening torque: 176 N·m  
(M16 × 1.5)



DETAIL "P"

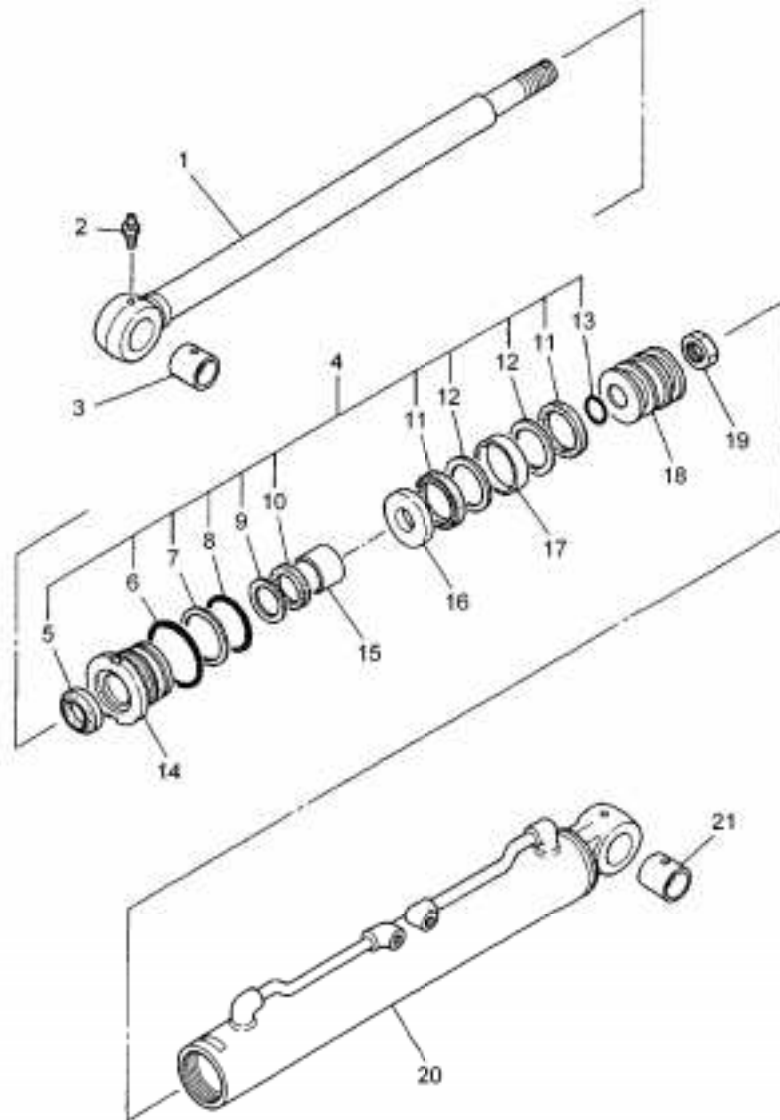


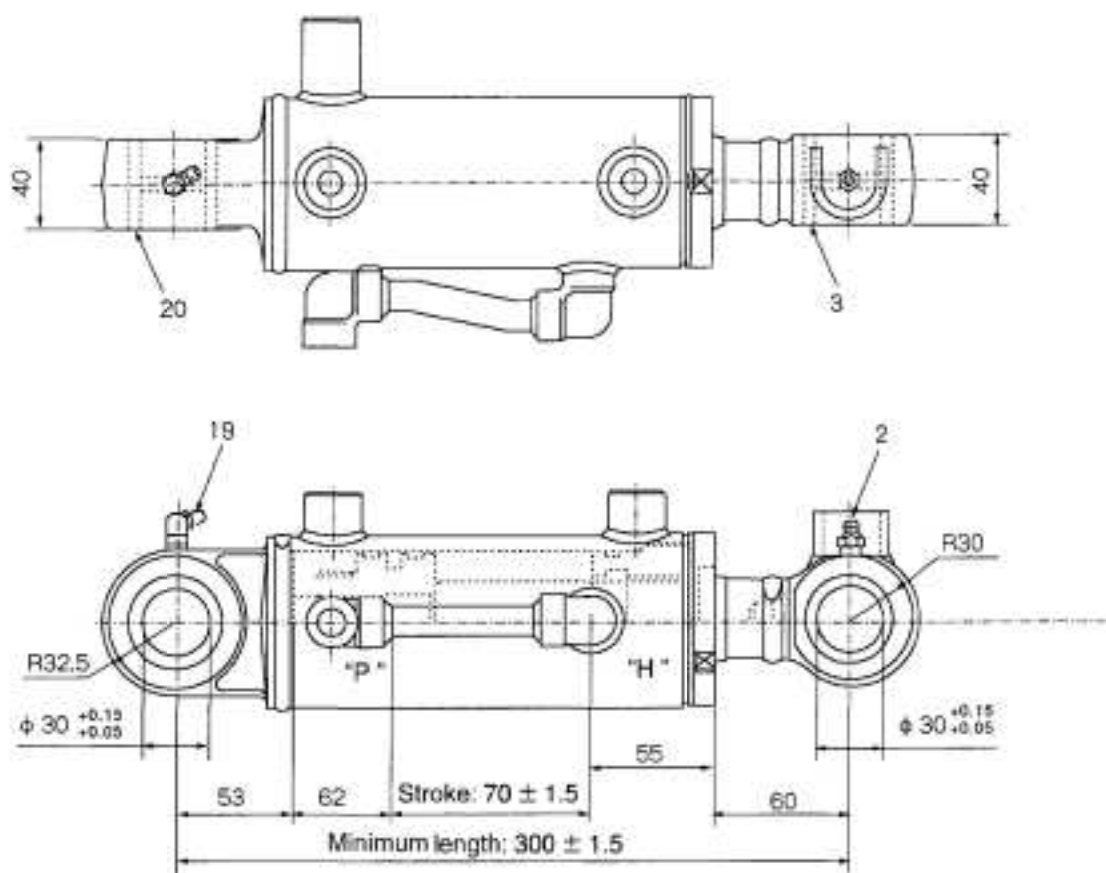
DETAIL "H"

**BOON SWING CYLINDER ASS'Y**

Weight: 8.0 kg

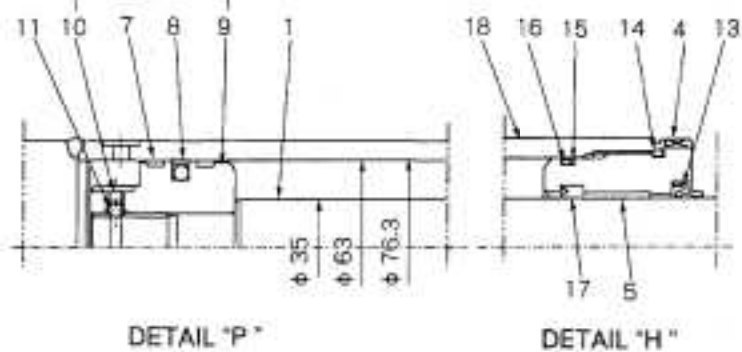
Key	Description	Q'ty
1	Piston Rod Ass'y	1
2	Grease Nipple	1
3	Bushing	1
4	Seal Kit	1
5	Dust Seal	1
6	"O" Ring	1
7	Back-up Ring	1
8	"O" Ring	1
9	Back-up Ring	1
10	"U" Ring	1
11	"U" Ring	2
12	Back-up Ring	2
13	"O" Ring	1
14	Cylinder Head	1
15	Bushing	1
16	"U" Ring Holder	1
17	Wear Ring	1
18	Piston	1
19	"U" Nut	1
20	Cylinder Tube Ass'y	1
21	Bushing	1





Tightening torque: 9.8 N·m  
(M6 × 1.0)  
Locking 2 points with punch

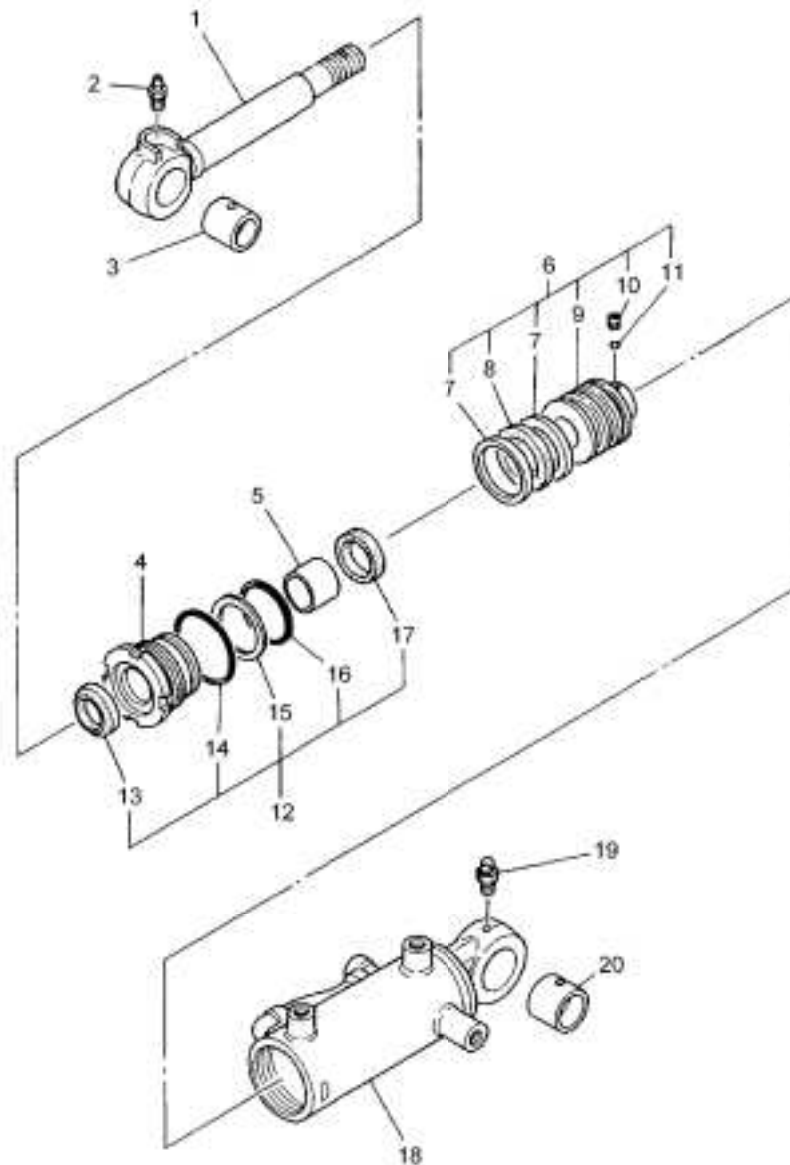
Tightening torque: 397 N·m  
(M24 × 1.5)

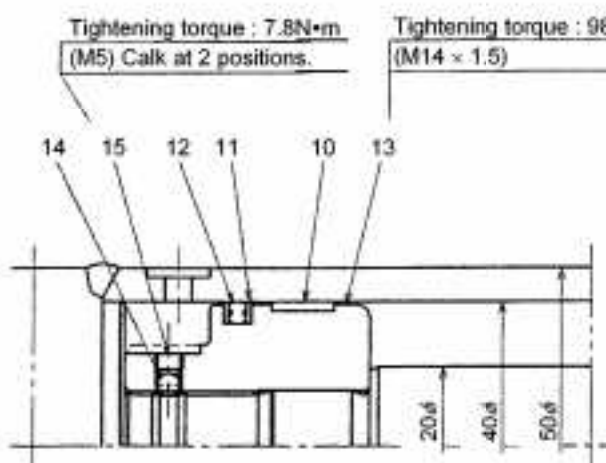
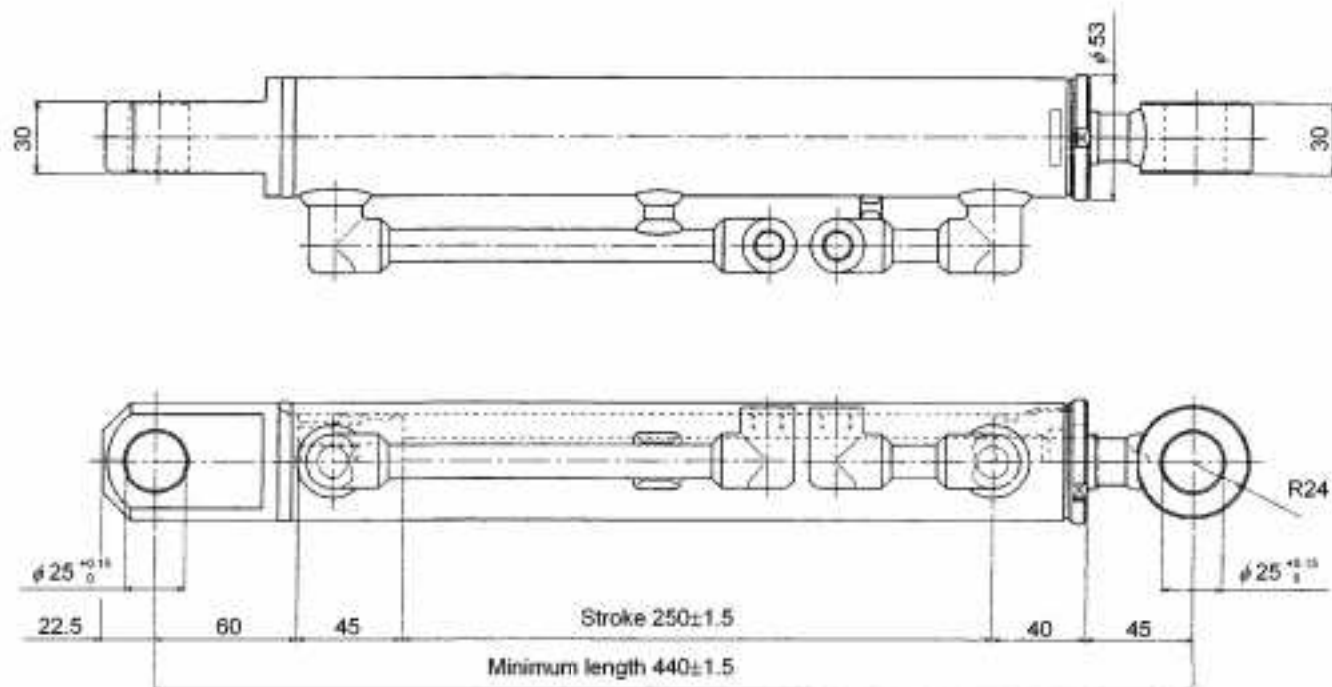


**BLADE CYLINDER ASS'Y**

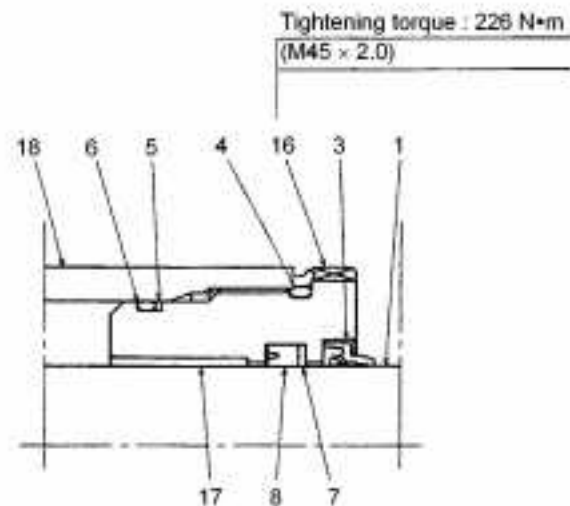
Weight: 8.5 kg

Key	Description	Q'ty
1	Piston Rod Ass'y	1
2	Grease Nipple	1
3	Bushing	1
4	Cylinder Head	1
5	Bushing	1
6	Piston Ass'y	1
7	Slide Ring	2
8	Seal Ring Ass'y	1
9	Piston	1
10	Set Screw	1
11	Steel Ball	1
12	Seal Kit	1
13	Wiper Ring	1
14	"O" Ring	1
15	Back-up Ring	1
16	"O" Ring	1
17	"U" Ring	1
18	Cylinder Tube Ass'y	1
19	Grease Nipple	1
20	Bushing	1





Piston details

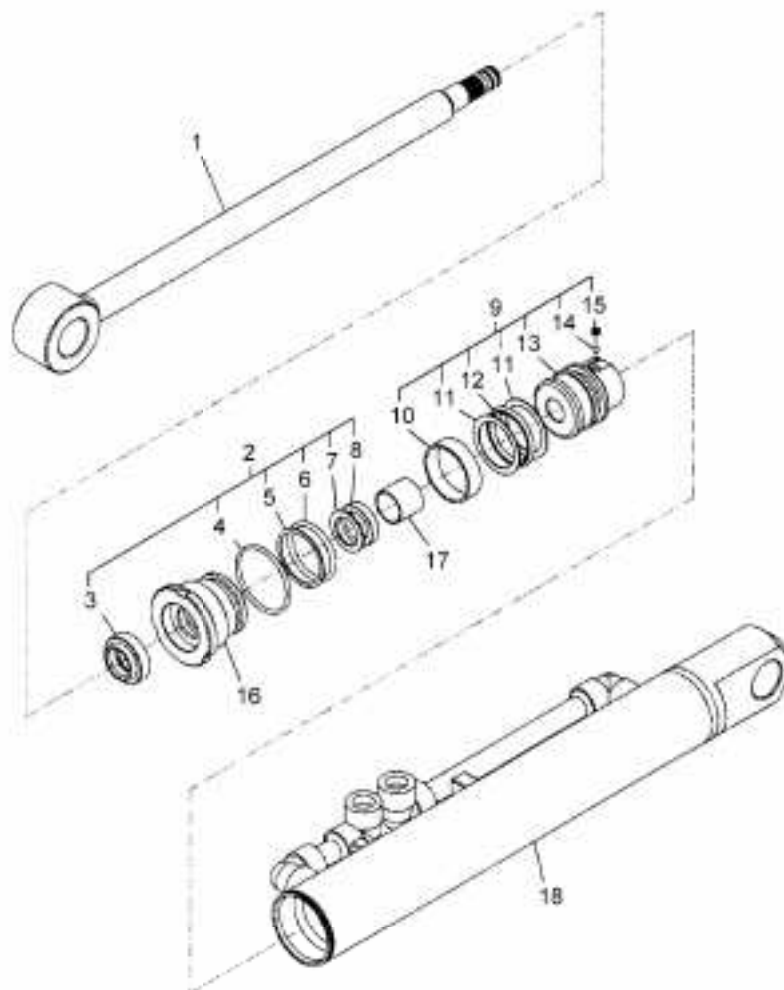


Cylinder head details

SPANNER CYLINDER ASS'Y

Weight : 4.8kg

Key	Description	Q'ty
1	Piston Rod Ass'y	1
2	Seal Kit	1
3	Dust Seal	1
4	"O" Ring	1
5	Back-up Ring	1
6	"O" Ring	1
7	Back-up Ring	1
8	"U" Ring	1
9	Piston Ass'y	1
10	Wear Ring	1
11	Back-up Ring	2
12	Seal	1
13	Piston	1
14	Steel Ball	1
15	Set Screw	1
16	Cylinder Head	1
17	Bushing	1
18	Cylinder Tube Ass'y	1

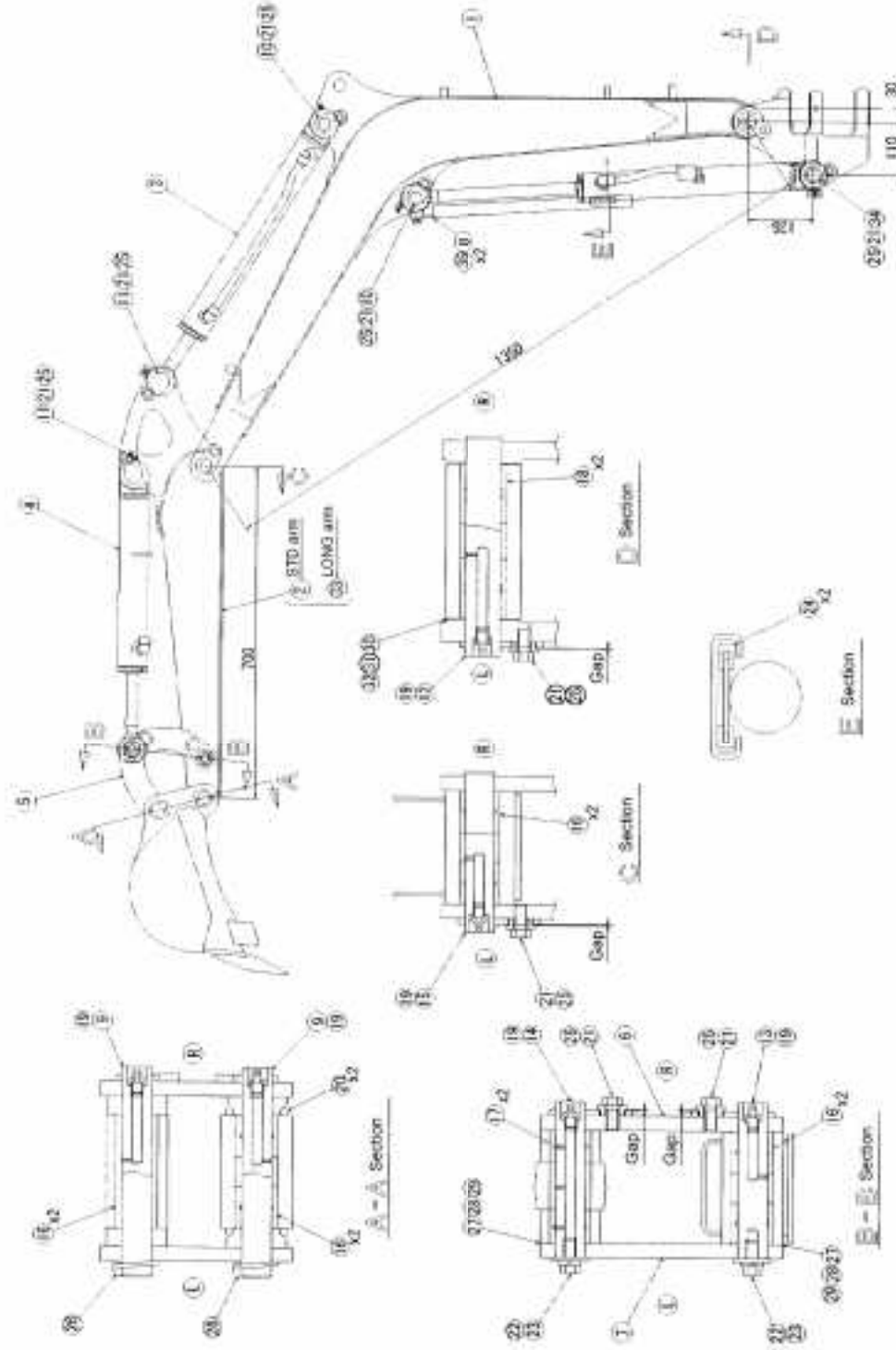




# STRUCTURE AND FUNCTION

9VX3

## ATTACHMENT ASS'Y



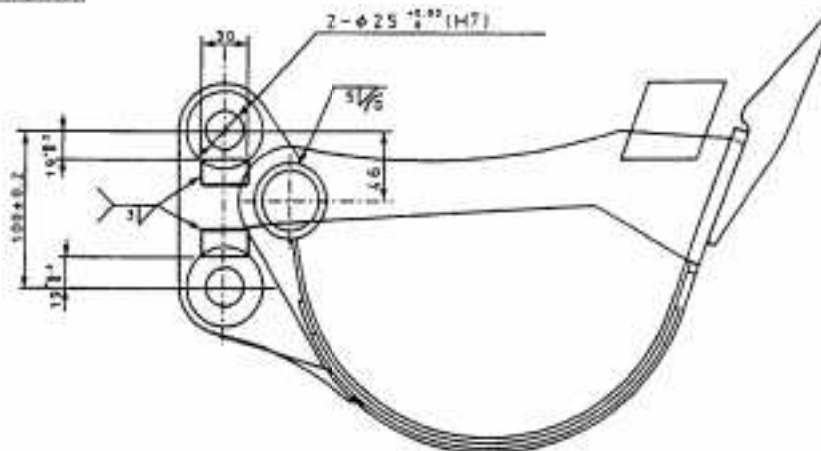
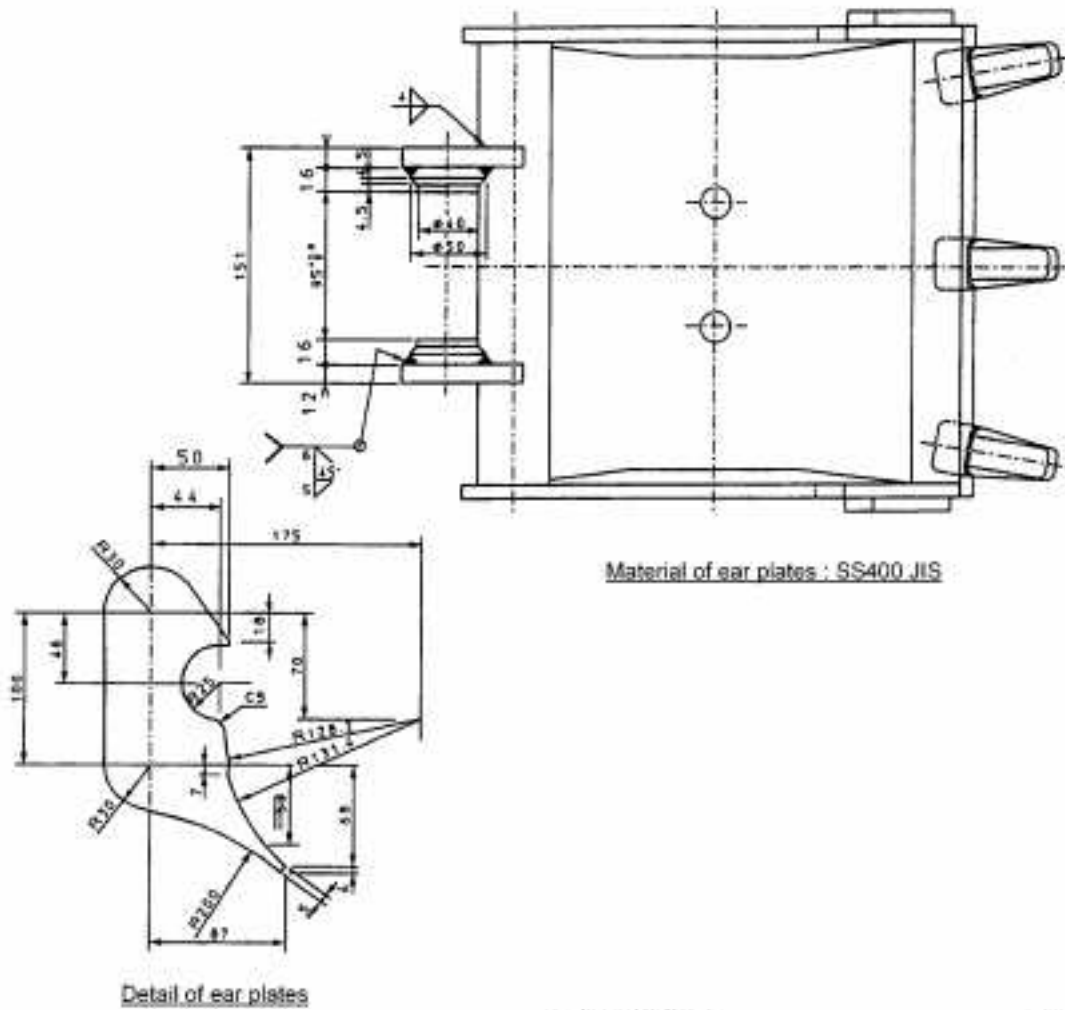
### Note

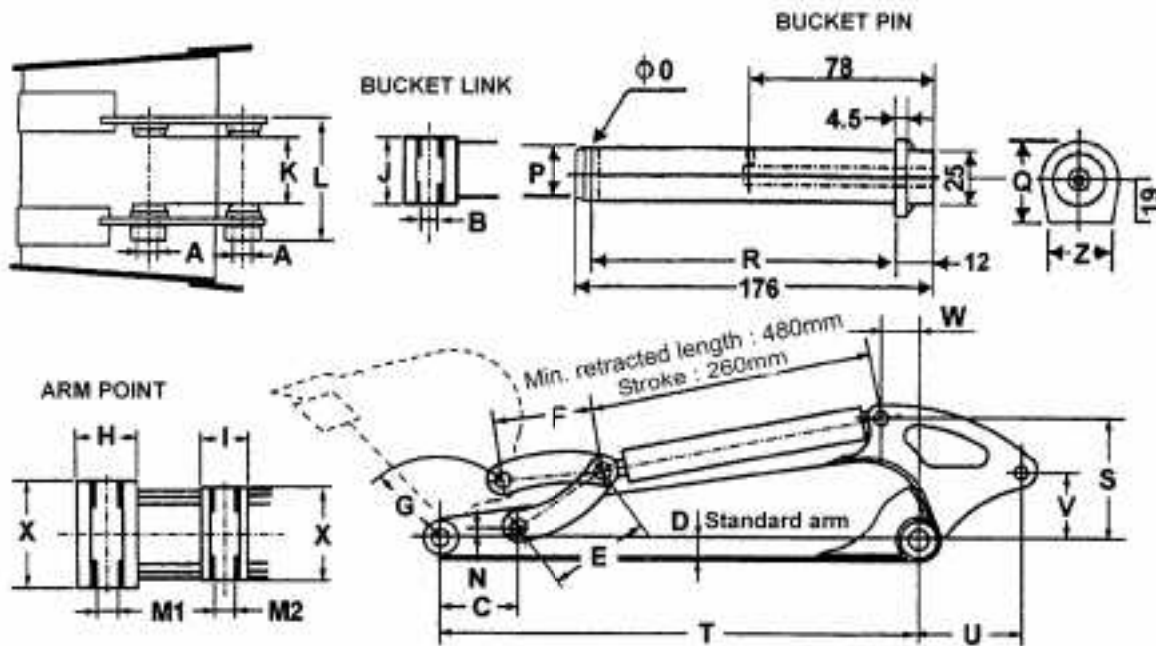
Washers # 21 through 23 are used for looseness adjustment and the quantities are for reference only.  
Use the necessary quantity for assembly according to field adjustment.  
The gap should be 0.5 mm or smaller.

Key	Description	Qty
35	Bolt F • SEMS (SW)	2
34	Pin, Wing	1
33	Arm LONG	1
32	Washer	1
31	Washer	2
30	Washer	2
29	Washer	7
28	Washer	10
27	Washer	10
26	Pin, Ring	2
25	Bushing	9
24	Sleeve	2
23	Washer, flat L	2
22	Bolt F • SEMS (SW)	2
21	Bolt F • HT(S)	9
20	Ring, O	2
19	Pin, Ring	6
18	Bushing	2
17	Bushing	2
16	Bushing	6
15	Pin, Wing	1
14	Pin, Wing	1
13	Pin, Wing	1
12	Pin, Wing	2
11	Pin, Wing	2
10	Pin, Wing	2
9	Pin, Wing	2
8	Cover	1
7	Link Arm (L)	1
6	Link Arm (R)	1
5	Link, Bucket	1
4	Bucket Cyl	1
3	Arm Cyl	1
2	Arm	16 kg
1	Boom	27 kg

BUCKET ASS'Y

(Dimension of the ear plates)



ATTACHMENT DATA**ATTACHMENTS INSTALLATION DATA**

Key	A(hole)	B(hole)	C	D	E	F	G	H	I
Dimensions (mm)	$\phi 25$	$\phi 25$	85	34.5	152.5	140	100	$\phi 60$	$\phi 50.8$

Key	J	K	L	M1(hole)	M2(hole)	N	O	P	Q
Dimensions (mm)	95	95	151	$\phi 25$	$\phi 25$	0	$\phi 6.7$	$\phi 25$	36.5

Key	R	S	T	U	V	W	X	Z
Dimensions (mm)	157	150	700	177.5	95	-20	95	30

**HYDRAULIC SYSTEM (when details are request, see for SERVICE GUIDE)**

1	Type of pump		Fixes gear
2	Max. flow	L/min	11.1 × 2
3	Relief set pressure	MPa	16.2
4	Type of hyd. tank		Pressurized totally enclosed type
5	Oil cooler		Non cooler
6	Service ports		Std. equipped





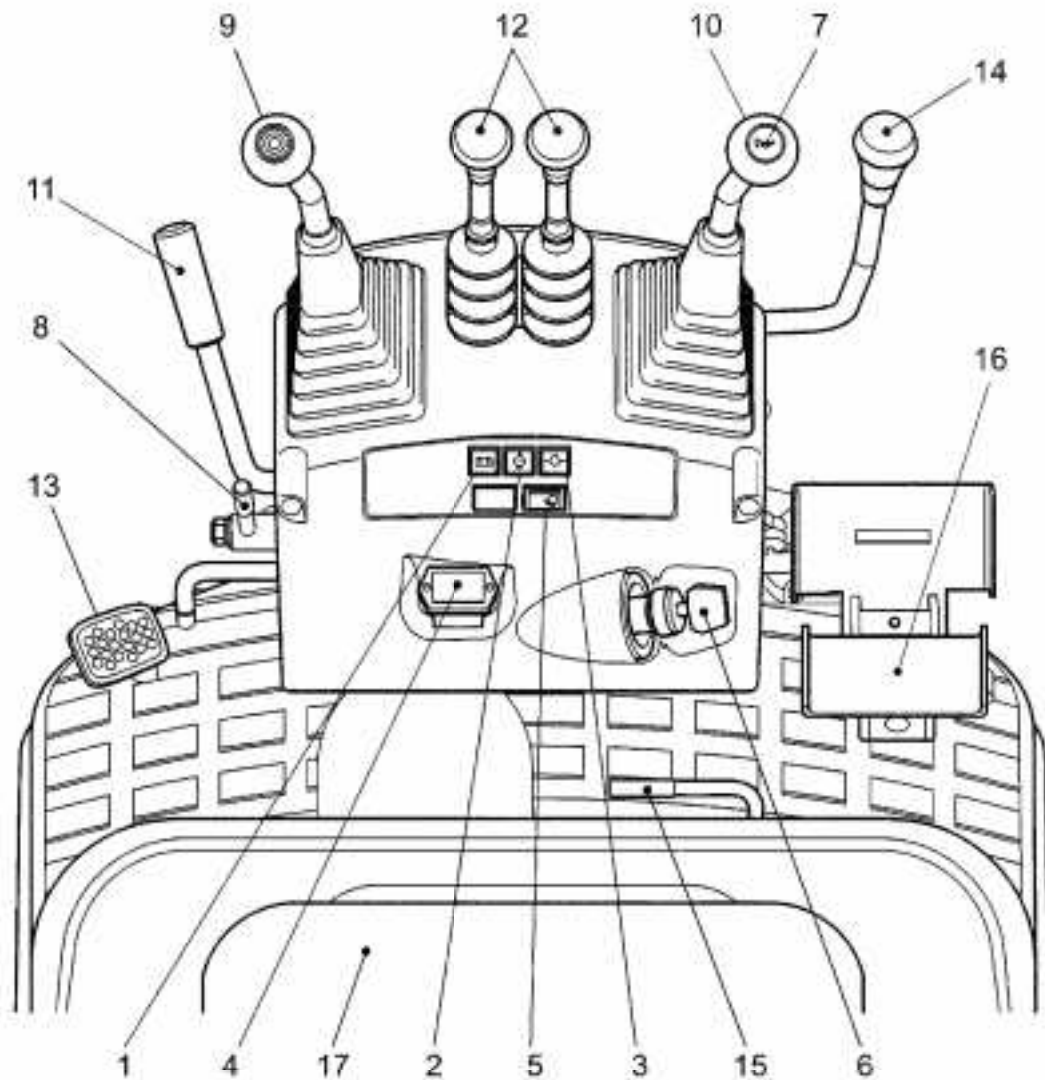
## SECTION 3 OPERATION

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Starting Engine.....	3 - 3 - 1
Jumper Cable Starting .....	3 - 4 - 1
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"Break-in" Operation.....	3 - 5 - 1
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Operating the Special Attachments and Actuators .....	3 - 7 - 1
Traveling the Machine.....	3 - 8 - 1
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Lifting the Machine .....	3 - 11 - 1
Loading and Unloading the Machine .....	3 - 12 - 1
Precaution on Use of Rubber Track Shoe .....	3 - 13 - 1
Parking the Machine .....	3 - 14 - 1
Emergency Engine Stop .....	3 - 14 - 1

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CONTROLS AND INSTRUMENTS

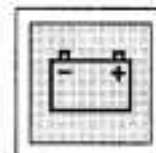


- |   |                                    |
|---|------------------------------------|
| (1) Battery charge warning lamp           | (10) Operating lever (Right)       |
| (2) Engine water temperature warning lamp | (11) Engine throttle lever         |
| (3) Engine oil pressure warning lamp      | (12) Travel lever                  |
| (4) Service hour meter                    | (13) High speed select pedal       |
| (5) Light switch                          | (14) Blade/crawler operation lever |
| (6) Engine start switch                   | (15) Blade/crawler select lever    |
| (7) Horn switch                           | (16) Boom swing pedal              |
| (8) Operation lock lever                  | (17) Operator's seat               |
| (9) Operation lever (Left)                |                                    |

## ① MONITOR LAMPS

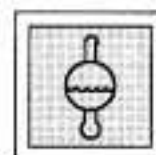
### 1. Battery Charge Warning Lamp

- This warning lamp indicates abnormal condition in battery charging circuit.
- Please stop an engine, when you check during engine rotation, and check the tension of a fan belt, etc.



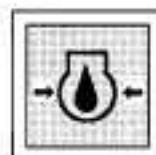
### 2. Engine Water Temperature Warning Lamp

- Engine water temperature warning light
- Overheat of an engine will switch on a lamp.  
(Water temperature lights up at  $110 \pm 3$  °C)
- If the light is switched on, please stop operation, change an engine into an idling state, lower temperature, and check a cooling system.



### 3. Engine Oil Pressure Warning Lamp

- This warning lamp indicates that engine oil pressure has fallen.
- If it lights during operation, stop the engine immediately and check the cause of engine oil pressure's falling.



## ② METER

### 4. Service Hour Meter


- Indicates the total service hours on the engine.
- The last scale shows 1 / 10 hours (6 minutes).
- While the engine is running, the green operation indicator on the right of the meter rotates, indicating that the meter proceeds.
- Even if a machine does not move, if the engine is rotating, meter will advance.
- It becomes a standard of check and maintenance time.





### ③ SWITCHES

#### 5. Light Switch

Push down on the  marked of the switch to turn the light on.  
Push down on the blank half of switch to turn the working light off.



#### 6. Engine Start Switch

##### CAUTION

If the engine does not start after 10 seconds, return the key to **OFF** and wait for two minutes before returning it to **START**.

**OFF** : The engine must be in the **OFF** position to insert or remove the key. Turn the key switch to the **OFF** position before trying to restart the engine. Turn the key switch to the **OFF** position to stop the engine.

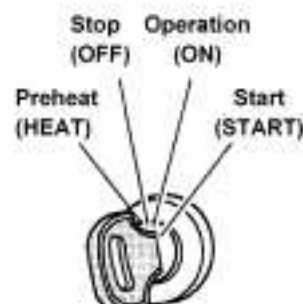
**ON** : Turn the key clockwise to active the electrical system. The key will return to the **ON** position when released from the **START** position.

**START** : Turn the key to the **START** position to crank the engine. Release the key as soon as the engine starts.

**HEAT** : In cold season, preheating is performed to facilitate engine start. (This operation is unnecessary if the engine is warm.) Setting the key to the preheat position starts heating the glow integrated into the engine.

The preheating time should be 4 seconds or shorter. (The glow may be burned if preheating is performed for more than 4 seconds.)

Turn the key to the start position to start the engine immediately after preheating.



Engine Start Switch

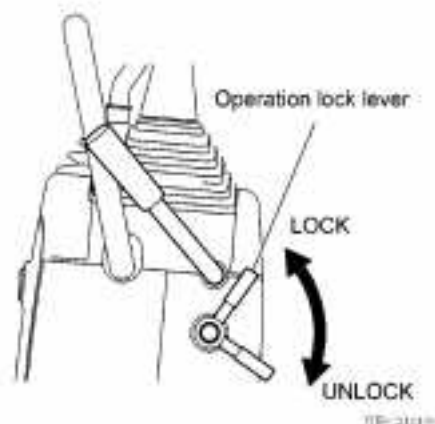
#### 7. Horn switch

Push down on the top of the right operating lever to activate the horn.



**④ MACHINE CONTROLS****8. Operation lock lever**

- This lever is a safety device, which prevents the machine from malfunctioning if the operator's body touches the operation lever when getting on or off the machine.
- Attachment operation and swing operation are locked when the operation lock lever is set to the LOCK position.
- Set the operation lock lever to the UNLOCK position when starting work.

**⚠ WARNING**

- The machine may move in an unexpected way and a serious accident may result, if you touch the operation lever carelessly in the condition where the operation lock lever is not set at the LOCK position.
- Stop the engine and set the operation lock lever to the LOCK position before leaving the machine.
- Note that boom swing operation is not locked even if the operation lock lever is set to the LOCK position.

**WARNING**

This manual gives explanations of the standard operation system (JIS system).

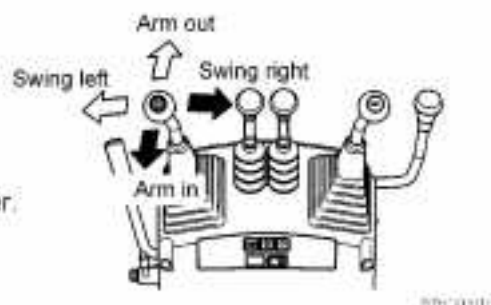
In some types of machines, the actual operation systems may differ from the given explanations.

Improper operation may cause a dangerous accident. Make sure, before starting operation, that machine movements are the same as shown on the operation system label.

## 9. Left operation lever

Use this lever to operate the arm and swing.

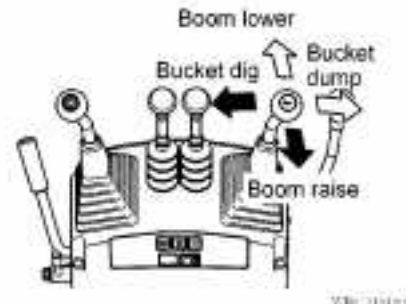
- Arm in: Pull the lever backward.
- Arm out: Push the lever forward.
- Swing left: Turn the lever to the left.
- Swing right: Turn the lever to the right.
- Stop: Release your hand from the lever. The lever returns to the neutral position automatically and operation stops.
- Simultaneous operation: Turn the lever diagonally to operate the arm and swing simultaneously.



## 10. Right operation lever

Use this lever to operate the boom and bucket.

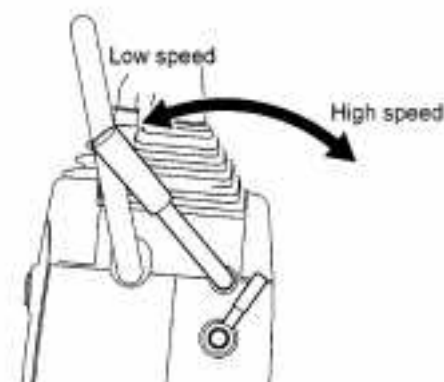
- Boom raise: Pull the lever backward.
- Boom lower: Push the lever forward.
- Bucket dig: Turn the lever to the left.
- Bucket dump: Turn the lever to the right.
- Stop: Release your hand from the lever. The lever returns to the neutral position automatically and operation stops.
- Simultaneous operation: Turn the lever diagonally to operate the boom and bucket simultaneously.



## 11. Throttle lever

Use this lever to adjust the engine speed.

- Low speed: Push the lever forward.
- High speed: Pull the lever backward.



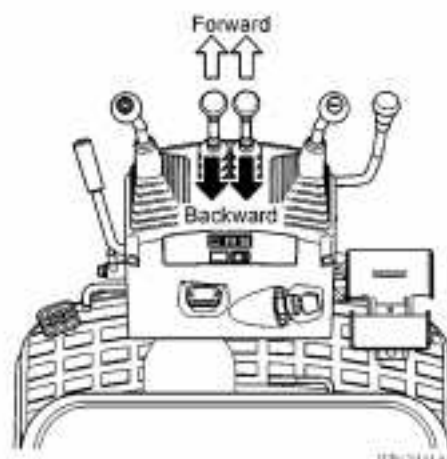
## 12. Travel Levers

Use these levers to control traveling.

**Forward:** Push the right and left travel levers forward.

**Backward:** Pull the right and left travel levers backward.

**Stop:** Release your hands from the levers. The levers return to the neutral positions automatically and operation stops.



### ⚠ WARNING

- If forward movement and backward movement are mistaken during traveling, a serious accident may result.
- Forward movement means forward movement with the blade in the front position. If the blade is at the rear position, the traveling directions are contrary to the lever operations.
- Check if the blade is in the front or rear position before operating the travel levers.

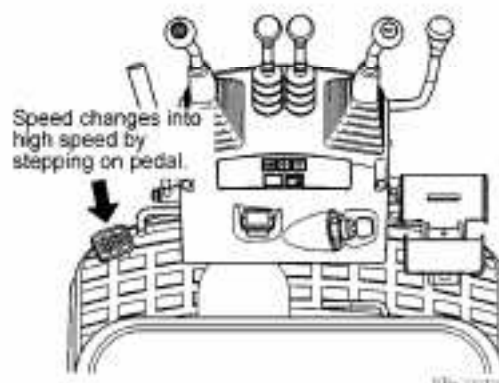
## 13. Travel speed select pedal

### ⚠ CAUTION

Do not travel the machine at the high speed when loading it on a truck or traveling on a steep slope.

The travel speed changes into the high speed when you step on the pedal. The high speed changes into the low speed when you release your foot from the pedal.

The travel speed may be changed during traveling or stopping.

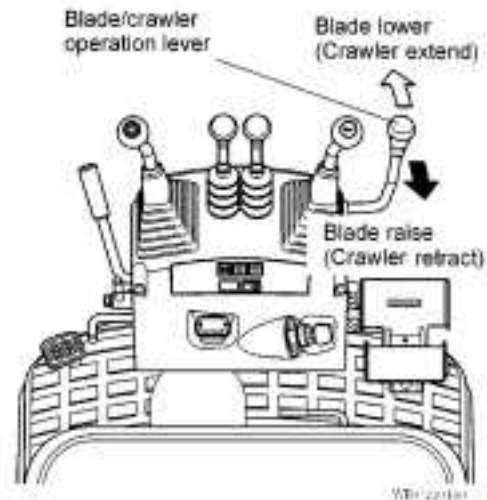


#### 14. Blade/crawler operation lever

##### **CAUTION**

The blade moves down by its own mass if this lever is pushed forward even though the engine is stopping, if the blade/crawler lever is set at the blade position.

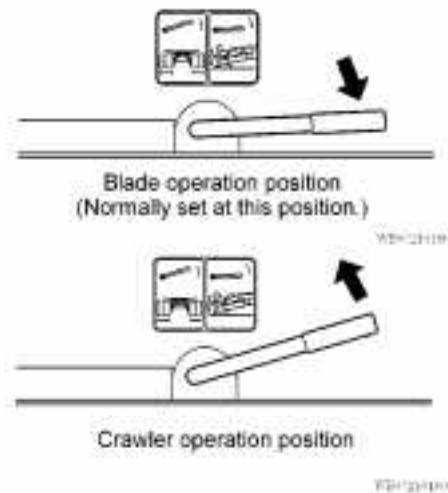
- Blade operation  
Blade raise: Pull the lever backward.  
Blade lower: Push the lever forward.
- Crawler operation  
Crawler retract: Pull the lever backward.  
Crawler extend: Push the lever forward.



#### 15. Blade/crawler select lever

Change blade operation and crawler operation with this lever.

- Blade operation: Push down the lever.  
Crawler operation: Pull up the lever.

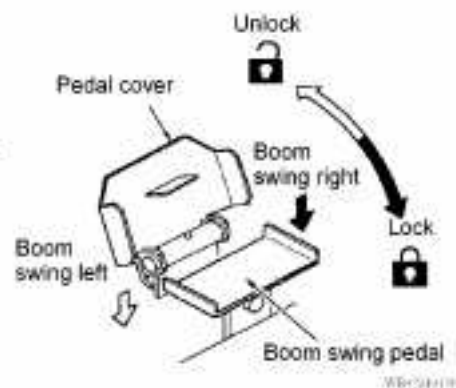


#### 16. Boom swing pedal

- Swing the boom with this pedal.  
Open the pedal cover to the unlock position.  
Boom swing left: Step on the left side of the pedal.  
Boom swing right: Step on the right side of the pedal.

##### **CAUTION**

Protect the pedal with the cover to disable pedal operation when boom swing operation is not needed.



**BEFORE STARTING THE ENGINE**

The following items should be checked each day before start-up or the start operations.

**■ Walk-Around Inspection**

Inspect the loose bolts, trash build up, oil or coolant leaks, broken or worn parts. Inspect the condition of the attachments and the hydraulic components.

Inspect the operator's compartment for cleanliness. Keep it clean.

Inspect any cracks in boom and arm pivot area and cylinder mounting brackets.

Repair if damaged.

Refer to Walk-Around Inspection in the Maintenance Section.

**■ Lubrication**

Perform the daily lubrication as required by the Lubrication Chart.

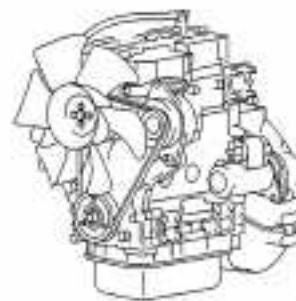
**■ Pre-start Checks**

Check all of oil, coolant and fuel levels.

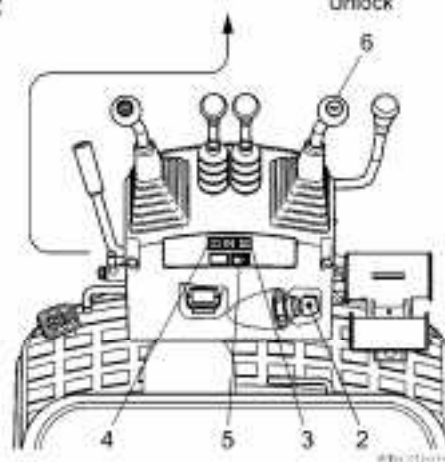
Refer to the Daily in the Maintenance Section for more detailed information.

**STARTING ENGINE****Check before Starting Engine**

1. Sit on the operator's seat and adjust it to the condition where the operation levers and pedals may be used smoothly.
2. Make sure that the operation lock lever (1) is set at the locked position.
3. Make sure that each lever is set at the neutral position.
4. Insert the key into the engine key switch (2). Turn it to the ON (run) position and make sure of the following.
  - The engine oil pressure warning lamp (3) and battery charge warning lamp (4) are lit continuously. (It is normal if the engine oil pressure warning lamp and battery charge warning lamp turn off when the engine starts.)
  - Push the light switch (5) and make sure that the front light is turned on.
  - Push the horn switch (6) and make sure that the horn sounds.



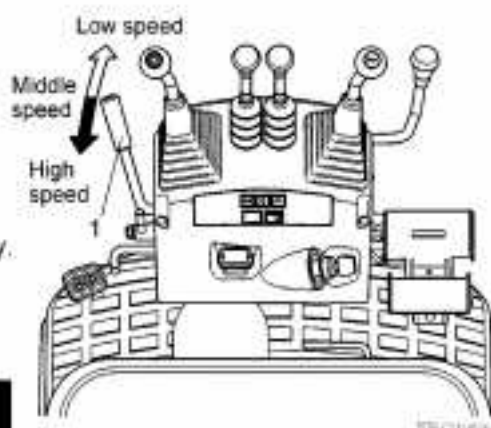
9VX3-000000



9VX3-000000

**Normal Starting**

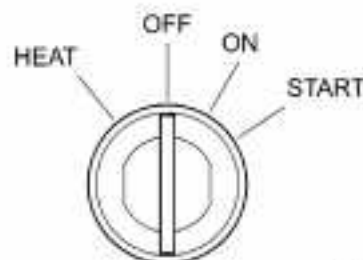
1. Set the throttle lever to the middle speed.
2. Turn the engine key to the START position to start the engine.  
The key returns to the ON (run) position automatically.
3. Release your fingers from the key when the engine starts.  
The key returns to the ON (run) position automatically.
4. Push the operation lock lever down to the unlock position to start work.

**CAUTION**

- Check if there are no persons or obstacles around the machine, turn on the horn, and start then.
- Be sure to sit on the operator's seat and start the engine.

**NOTICE**

Do not turn the starting motor for 15 seconds or more. If the engine fails to start, return the key to the OFF position, wait for 30 seconds, and try to start the engine again.

**Starting in Cold Seasons**

Preheat the engine with the glow plug in cold seasons to make it easy to start the engine.

1. Set the throttle lever (1) to the middle speed.
2. Turn the key counterclockwise and keep it at the HEAT (preheat) position for about 4 seconds.  
The engine oil pressure warning lamp and battery charge warning lamp also turn on when the key is set at the HEAT (preheat) position. However, this does not imply any abnormality.
3. Turn the key to the START position to start the engine.
4. Release your fingers from the key after the engine starts.  
The key returns to the ON (run) position automatically.



JUMPER CABLE STARTING**⚠ WARNING**

Battery gives off flammable fumes that can explode.

When starting from another machine, make sure the machines do not touch.

This will prevent damage to engine bearings and electrical circuits.

Always connect the battery **POSITIVE (+)** to battery **POSITIVE (+)** and the battery **NEGATIVE (-)** to battery **NEGATIVE (-)**.

Jump only with a battery source and with the same voltage as the stalled machine. This machine has a **12** volt starting system. Use only equal voltage for jump starting. Use higher voltage will damage the electrical system.

Be sure the start switch is in the **OFF** position **BEFORE** attaching the jumper cables to the machine to be started.

**Use of Jumper Cables**

1. Move boost start machine near enough to stalled machine for the jumper cables to reach. But, do not allow machines to touch.
2. Lower the bucket to the ground. Move all controls to **HOLD**. Stop the engine on boost machine.
3. On stalled machine, turn the start switch key to **OFF**. Turn off all accessories.
4. Connect **POSITIVE (+)** jumper cable (red) **POSITIVE (+)** cable terminal of discharged battery.  
Do not allow positive **(+)** cable clamp to touch any metal other than battery terminals.
5. Connect **POSITIVE (+)** jumper cable (red) **POSITIVE (+)** cable terminal of boost battery.
6. Connect one end of **NEGATIVE (-)** jumper cable (black) to the **NEGATIVE (-)** boost battery terminal.
7. Make final connection of **NEGATIVE (-)** cable to frame of the stalled machine (not **NEGATIVE (-)** post) away from battery or fuel line.
8. Start the engine on the boost machine.
9. Wait a minimum of two minutes for the batteries in the stalled machine to partially charge.
10. Attempt to start the stalled engine.  
Refer to section on Engine Starting.
11. Immediately after starting the engine, disconnect the jumper cables in reverse order.
12. Conclude failure analysis on starting/charging system of stalled machine as required now that engine is running and charging system is in operation.

**AFTER STARTING THE ENGINE****⚠ CAUTION**

Keep engine speed low until the engine oil pressure warning lamp goes out. If does not go out within 10 seconds, stop the engine and investigate the cause before starting the engine. Failure to do so, can cause engine damage.

With any piece of hydraulically operated equipment, it is **EXTREMELY IMPORTANT** that the hydraulic fluid be thoroughly warmed fluid-up **BEFORE** any work is begun. A warm-up period is time well spent in preventive maintenance.

Practice the following warm-up procedure before attempting full load operations.

1. Allow the engine to warm up at **LOW IDLE** for at least five minutes.  
Engage and disengage attachment control levers to help speed warm-up of hydraulic components.
2. To warm up the hydraulic oil, move the engine throttle lever to medium engine speed.

Run the engine for about five minutes while intermittently holding the bucket control lever in the bucket dump position.

Operate the bucket control lever for 10 to 15 seconds and then return the control lever **HOLD** position to ten seconds.

3. Move the engine throttle lever to maximum engine speed. Run the engine for an additional five minutes while intermittently holding the bucket dump position.  
This will allow the oil to reach relief pressure, which causes it to warm more rapidly.  
Cycle all controls to allow warm oil to circulate through all cylinders and lines.
4. Observe the OK warning monitor frequently during the operation.  
Be sure to perform the pro-operation warm-up procedure whenever the hydraulic oil temperature is lower than 20°C at start-up.

**"BREAK-IN" OPERATION**

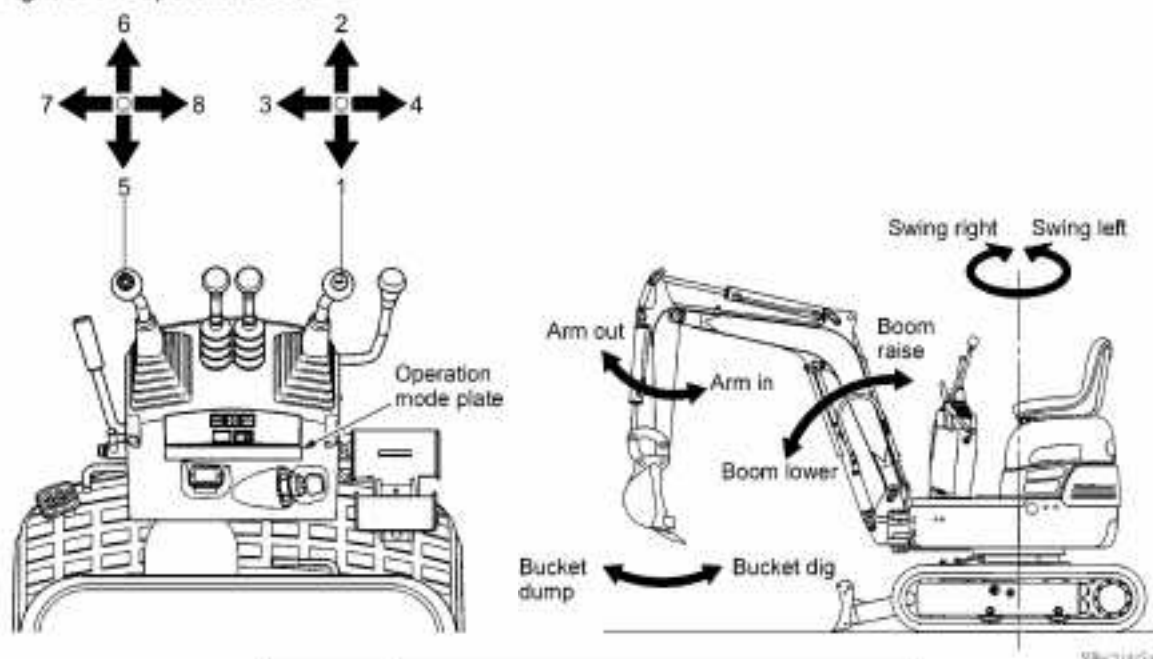
In case of the new machine, as the severe operation from the beginning will have a bad influence upon the machine life, perform the enough break-in operation as described the right table.

Hour meter	Load
Up to 10 hours	About 60% load
Up to 50 hours	About 80% load
After 50 hours	Full load

**BACKHOE OPERATION****LEVER OPERATIONS****Operation Mode**

Three operation patterns are available. The handling methods of the operation levers and machine movements differ with these patterns.

Check the operation mode before using the levers. The operation mode plate is stuck on the right of the operator's seat.



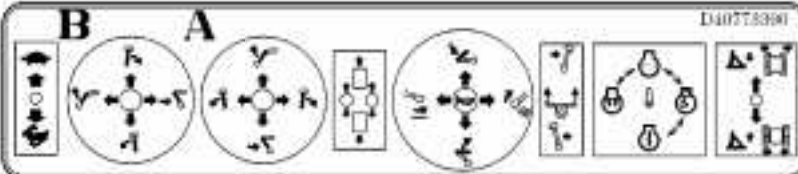
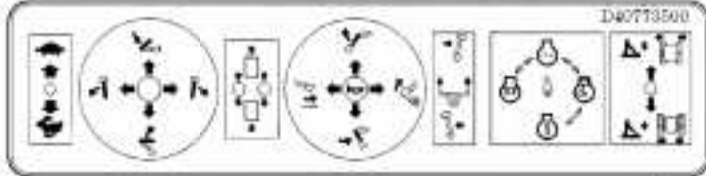
Operation direction	Operation mode		
	Pattern A	Pattern B	Pattern F
1	Boom raise	Boom raise	Arm in
2	Boom lower	Boom lower	Arm out
3	Bucket dig	Bucket dig	Bucket dig
4	Bucket dump	Bucket dump	Bucket dump
5	Arm in	Swing left	Boom raise
6	Arm out	Swing right	Boom lower
7	Swing left	Arm out	Swing left
8	Swing right	Arm in	Swing right

**⚠ WARNING**

Check the action of each operation lever and movement of the machine before starting work in order to prevent accidents, which may result in injury or death, due to improper operations.

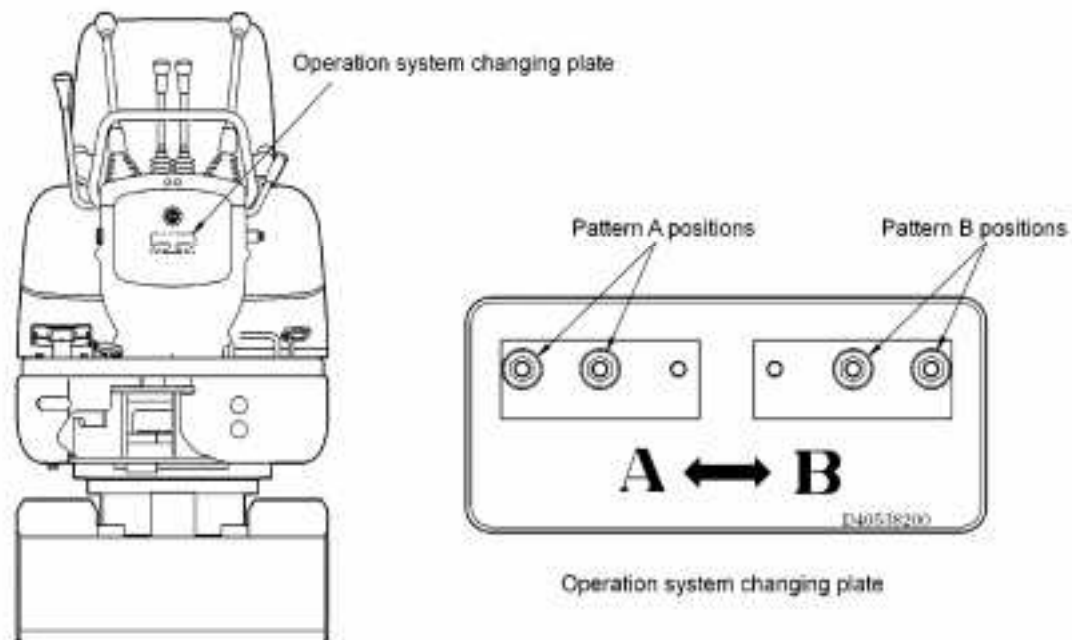
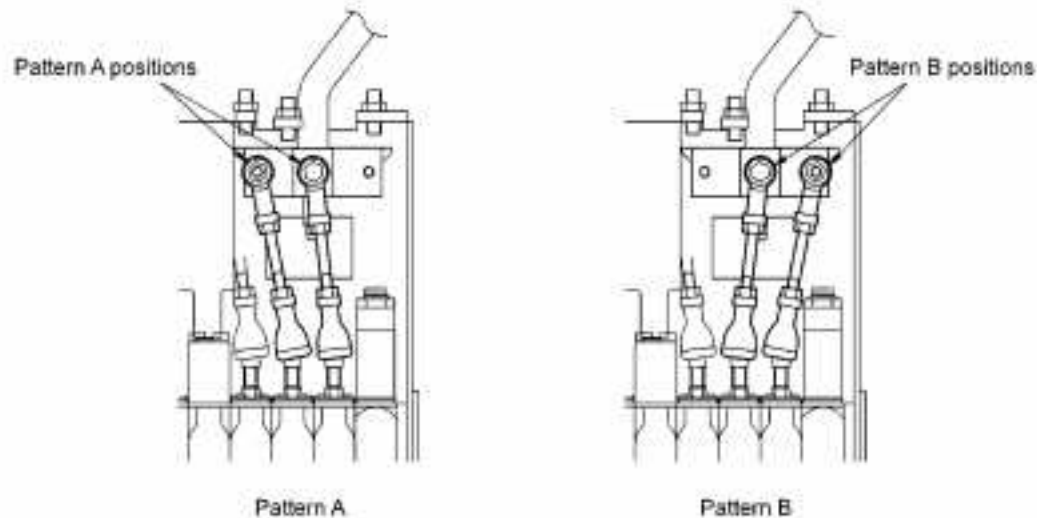
### Operation Mode Plate

The operation mode plate shown below that indicates the operation system of the machine is stuck at the top of the lever stand on the operator's seat side.

Operation mode	Operation mode plate
<p>Pattern AB (AB select type)</p>	
<p>Pattern F</p>	

### Pattern AB changing method

1. It is necessary to re-assemble the reach rods of the left operation lever, if the pattern A operation system (standard operation system) is changed into the pattern B. Open the cover on the front of the lever stand and re-assemble the reach rods.
2. The operation system changing plate is stuck on the inside of the lever stand front cover.
3. Lower the attachment onto the ground and stop the engine before re-assembling the reach rods.



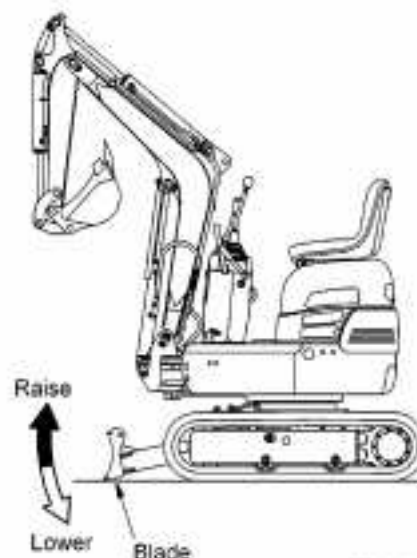
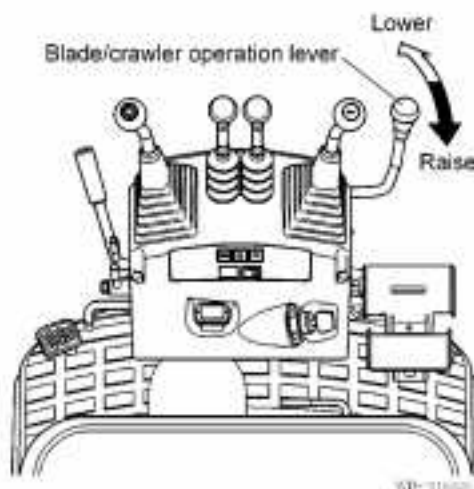
9VB-21-0900

### BLADE OPERATION

Push down the blade/crawler select lever to the blade position and operate the blade/crawler operation lever.

Blade raise: Pull the lever backward.

Blade lower: Push the lever forward.

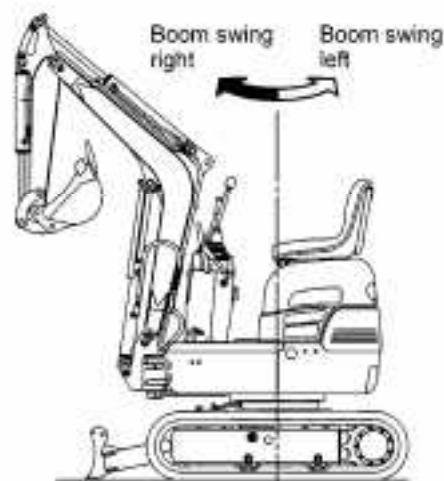
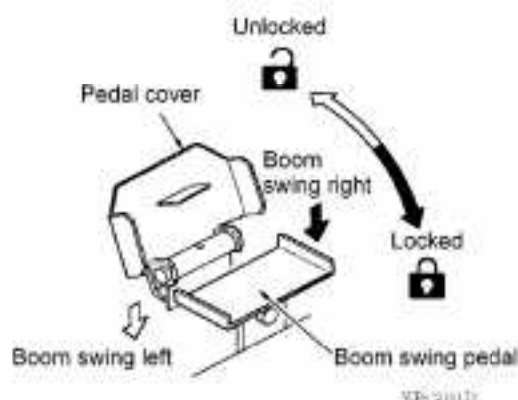


### BOOM SWING OPERATION

Open the pedal cover to the unlock position before starting operation. Step on the right or left position of the boom swing pedal to operate the boom.

Right boom swing: Step on the right side of the pedal.

Left boom swing: Step on the left side of the pedal.



### CAUTION

Put the pedal cover on the pedal and lock it when boom swing is not carried out.

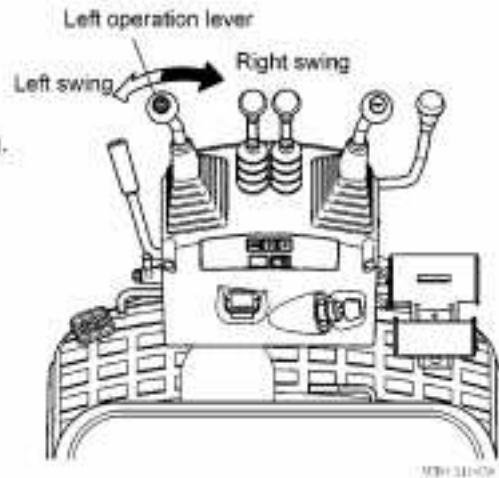
**SWING OPERATION**

Use the left operation lever to swing.

Swing right: Turn the lever to the right.

Swing left: Turn the lever to the left.

Return the lever to the neutral position to stop swinging.

**⚠ WARNING**

Do not let any persons enter the swinging range.

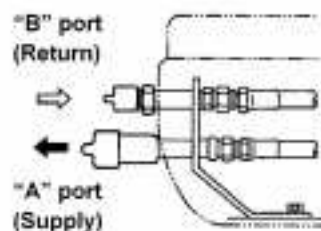
Check the safety around the machine before swinging.

**OPERATING THE SPECIAL ATTACHMENTS AND ACTUATORS (If equipped)****CAUTION**

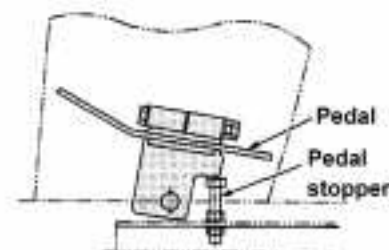
- Select a hydraulic breaker, A wrecking fork and special actuators, etc., which are applicable to the machine body.  
Consult your local IHI dealer to select a special attachment and an actuator.
- Before using a special attachment and an actuator, read and understand their instruction manuals issued by a manufacturer to obtain correct operation and maintenance.

**1. SINGLE ACTION OPERATION****USED : FOR BREAKER AND OTHERS**

- 1) Install the hydraulic hoses, supply hose to "A" port, and return hose to "B" port.
- 2) Open the pedal into unlocked position.
- 3) Push down the pedal, to work the actuator.
- 4) When the power port is out of service, **ALWAYS** set the pedal back to the neutral position and pedal to the locked position.

**Hose connection for the single action****■ ADJUSTMENT OF THE PEDAL STOPPER**

- Adjustment of the pedal stopper when installing the pedal or changing from the double action type, adjust the pedal stopper as follows.
- When the pedal is neutral, adjust the stopper's length so that the pedal and pedal stopper contact.

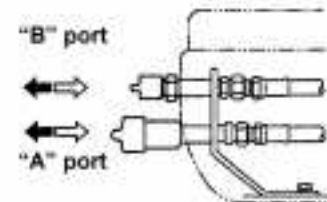
**Stopper setting position**



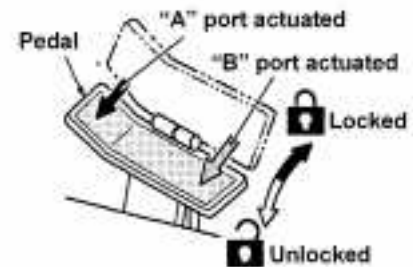
## 2. DOUBLE ACTION OPERATION

### USED : WRECKING FORK AND OTHERS

- 1) Install the hydraulic hoses to "A" port and "B" port which are in front of the machine.
- 2) Open the pedal into unlocked position.
- 3) To actuate the "A" port, push down the tip of the pedal, and to actuate the "B" port, push down the heel of the pedal.
- 4) When the power port is out of service, turn the pedal to the locked position.



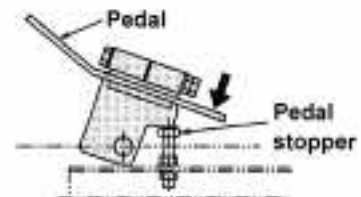
Hose connection for double action



## ■ ADJUSTMENT OF THE PEDAL STOPPER

Adjustment of the pedal stopper when installing the pedal or changing from the single action type, adjust the pedal stopper as follows.

- 1) Push down the heel of the pedal.
- 2) Adjust the stopper length so that the pedal and pedal stopper contact.



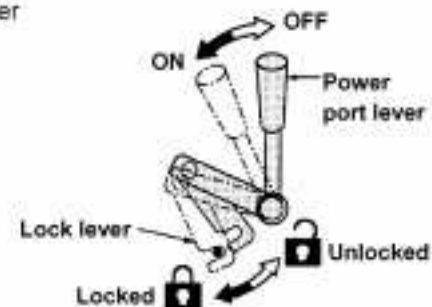
## 3. SINGLE ACTION OPERATION

### USED : FOR POWER PORT WORKS

- 1) Install the hydraulic hoses to "A" port and "B" port which are in front of the machine.
- 2) Move the power port lever to **ON** position and lock lever in the locked position.  
This makes it possible to supply the hydraulic pressure to the high-pressure line of the power port.  
The actuator can be operated by the actuator's control valve.
- 3) When the power port is out of service, **ALWAYS** set the lever back into the neutral position.



Hose connection for power ports



## ⚠ CAUTION

The engine cannot be started if the power port is **ON**.  
Be sure to set the lever in the neutral position before starting the engine.

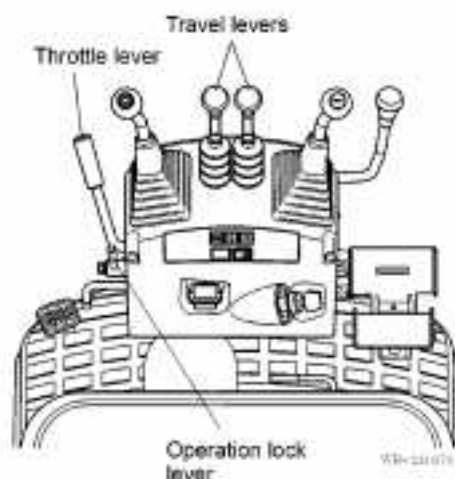
# TRAVELING THE MACHINE

## **TRAVELING**

### **Starting, Traveling and Stopping**

#### **⚠ WARNING**

- If forward movement and backward movement are mistaken in operation with the travel lever, serious accidents may result.
- Check the blade position before traveling. If the blade is behind the machine, operations of the travel levers are reversed.
- Make sure that there are no people around the machine and turn on the horn before starting.



1. Pull the throttle lever to raise the engine speed to the proper speed to traveling.
2. Lower the operation lock lever to unlock it.
3. Raise the bucket and blade to certain height that allow smooth traveling without hitting them.
4. Operate the right and left travel levers as shown below.

#### **• Forward**

Push both travel levers forward to move the machine forward.

(The machine always moves toward the blade when the travel levers are pushed forward.)

#### **• Backward**

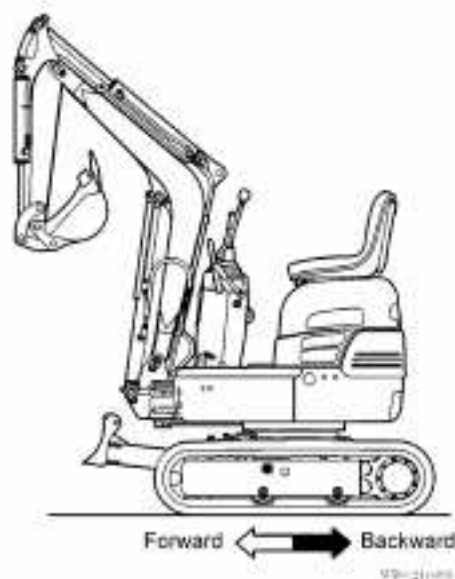
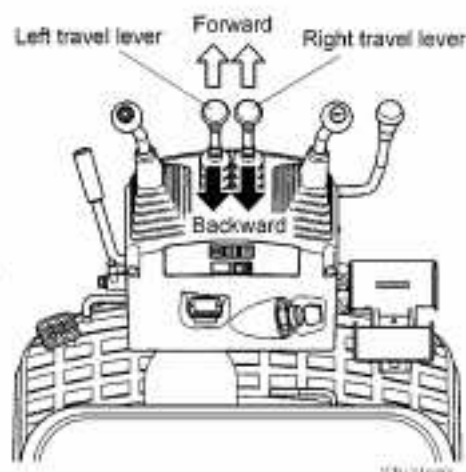
Pull back both travel levers to move the machine backward.

(The machine always moves toward the sprocket when the travel levers are pulled back.)

The traveling speed of the machine can be controlled by the amount of turning the travel levers.)

#### **• Stopping**

Set both travel levers to the neutral positions to stop the machine. When the machine stops, the parking brake is applied automatically.



## Changing Direction

### Turning during traveling

Return the travel lever toward the neutral position a little to change the direction during forward (or backward) traveling.

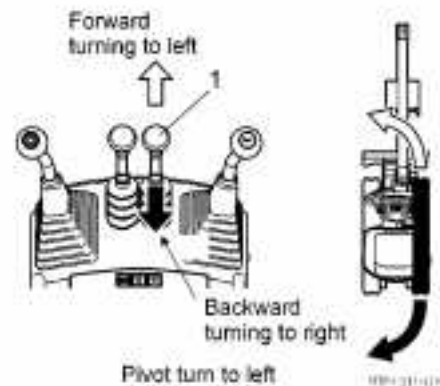
When the lever of the intended turning direction is returned a little, the machine turns slowly in that direction.

### Pivot turning (when blade is in front of machine)

Drive a single crawler to change the direction.

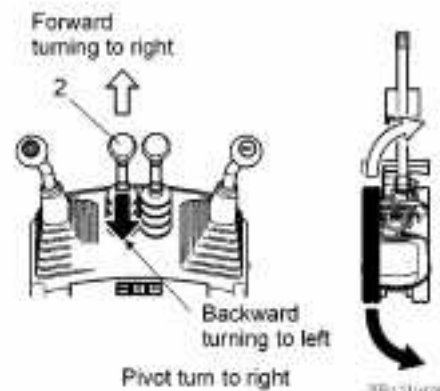
#### 1. Pivot turn to the left

Push the right travel lever (1) to turn the machine forward. Pull it back to turn the machine backward.



#### 2. Pivot turn to the right

Use the left travel lever (2) in the same way.



### Spin turning (when blade is in front of machine)

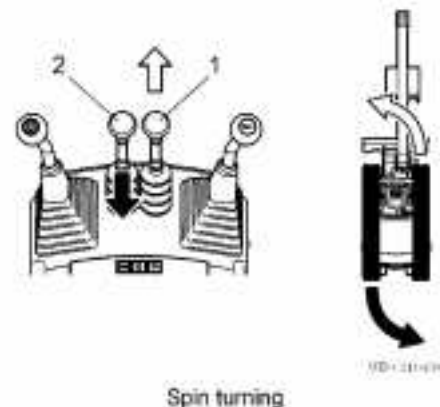
Drive the right and left crawlers in the reverse directions to change the direction without traveling the machine.

#### 1. Spin turning to the left

Push the right travel lever forward and pull back the left lever.

#### 2. Spin turning to the right

Pull back the right travel lever and push the left lever forward.



## HIGH SPEED TRAVEL

### CAUTION

Do not change travel speed ranges while going downhill.  
**NEVER** high speed travel on a grade or loading and unloading the machine.  
 When control shut-off lever is locked, does not shift to high speed travel.

Push down the high speed travel pedal shift to the high speed travel.

When released pedal, shift to the low speed travel.

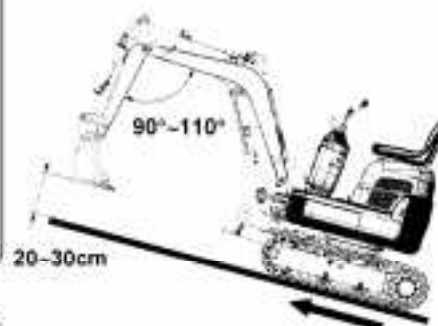
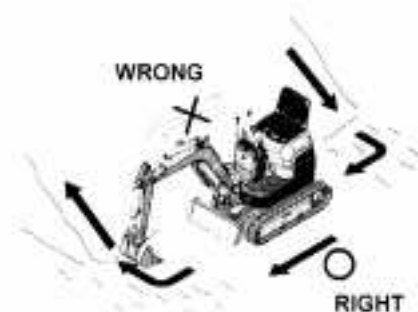
High speed travel  
(Push down)



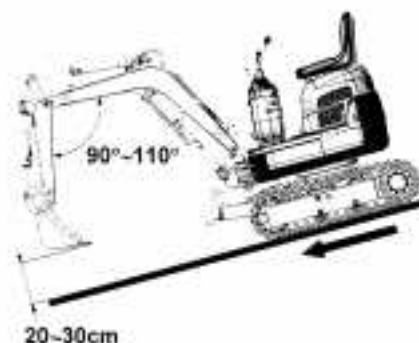
## CAUTION ON TRAVEL ON A GRADE

### CAUTION

- Reduce engine speed when maneuvering in tight quarters or when breaking over a rise.
- Do not change travel speed ranges while going downhill.
- Work up and down slopes rather than sideways, whenever possible. Do not travel across a grade by all means.
- Avoid changing the direction of travel on a slope, which could result in tipping or side slipping of the machine.
- Keep the arm in and carry the boom in a low position.
- When starting up a steep grade or breaking over a rise, keep the boom lowered as close to the ground as possible.



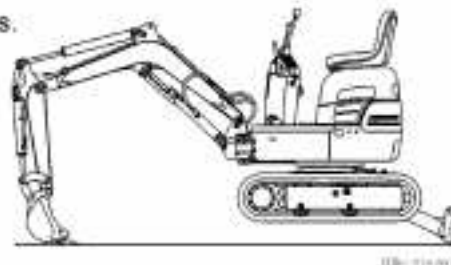
1. When traveling up on a grade inclining by greater than 15°, keep the position in the right illustration and travel with a low engine speed.
2. When traveling down on a grade inclining by greater than 15°, travel with the position in the right illustration.



### CRAWLER EXTENSION/RETRACTION

This machine has crawler extension/retraction mechanisms.  
Extend the crawlers as shown below.

1. Move the blade to the back of the machine and jack up the machine body until the crawlers are lifted from the ground using the attachment and blade in order to extend or retract the crawlers easily.

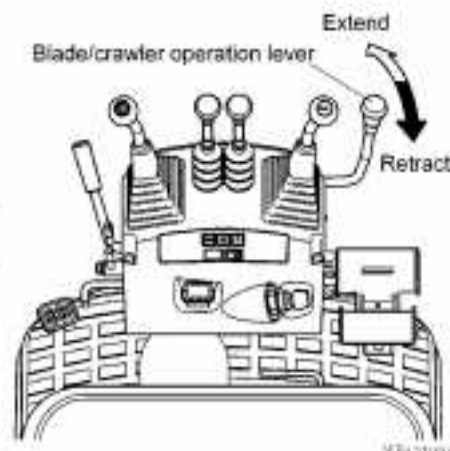


2. Pull up the blade/crawler select lever to the crawler operation position.



Crawler operation position

3. Change the engine speed to the middle speed and operate the blade/crawler operation lever.  
Extending the crawlers: Push the lever forward.  
Retracting the crawlers: Pull the lever backward.



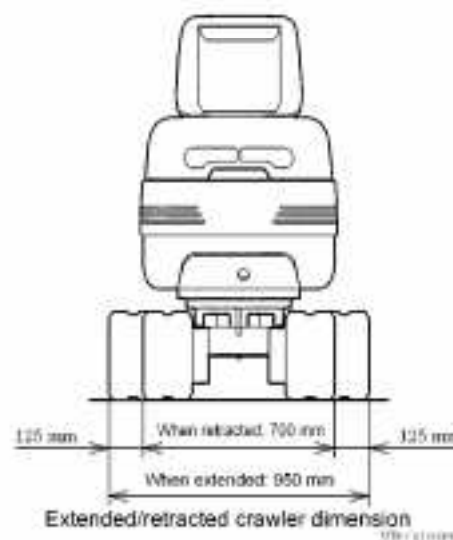
#### NOTICE

Be sure to extend or retract the crawlers on a flat place with no obstacles.

The crawlers may be extended or retracted without jacking up the machine body. However, if there are obstacles on the ground on the side of the crawlers, the resistance increases and may hinder crawler extension or retraction.

#### CAUTION

- The crawlers may retract slightly during operation due to leakage from the hydraulic circuit.  
Extend them to the stroke end occasionally with the blade/crawler operation lever.
- Be sure to travel the machine at the stroke end of the crawler cylinder.  
If the machine is traveled at the middle of the stroke, the travel linearity and operability are deteriorated and the machine body may become faulty.



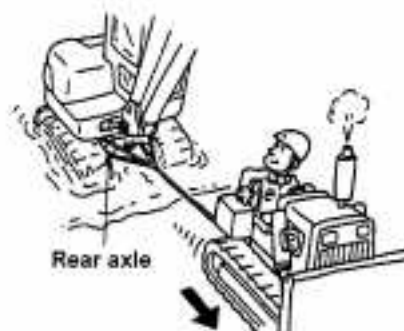
TOWING**⚠ WARNING**

- \* Personal injury or death could result when towing a disabled machine incorrectly.
- \* Follow the recommendations below, to properly perform the towing procedure.
- \* Never use the towing hook at the rear axle to tow the machine.
- \* During towing operation, **NEVER** allow anyone between the towing machine and the towed machine.
- \* Quick machine movement could overload the tow line or bar and cause it to break. Gradual and smooth machine movement will work better.
- \* Keep the tow line angle to a minimum. Do not exceed a 30° angle from the straight ahead position.

If the machine sinks down on a soft ground and cannot crawl up by itself, a wire rope should be attached to the rear axle and the machine should be towed by a towing machine.

To prevent the damage of the wire rope, be sure to place a protector at the corner of the axle.

Use the towing wire rope with sufficient strength to tow the machine.



LIFTING THE MACHINE

**⚠ WARNING**

Improper lifting or tie downs can allow load to shift and cause injury or damage.

- \* Use proper rated cables and slings for lifting.
- \* Position crane for level machine lift.
- \* **NEVER** lift the machine loaded with any personnel.
- \* Use guide or tag lines to prevent the machine from swinging or turning.
- \* Make sure the lifting cables and other lifting devices are strong enough to support the machine.
- \* Use a crane whose lifting capacity meets the weight of the machine.

**Lifting Procedures**

1. Start the engine and swing the machine to position the blade to front.
2. Position the machine on the level ground with the boom, arm and bucket cylinders fully extended.
3. Position the boom at the center of the machine with the boom swing pedal.
4. Stop the engine.
5. Install the cable to the lifting eye on the boom of the center with shackle.
6. Install the cables to the crane hook.
7. Confirm that no obstacles nor personal are around the machine and have the operator leave the machine.
8. Once the machine is lifted off the ground, check that the machine is well balanced.

**⚠ CAUTION**

Wire: 6FI(29) IWRC 10A dia. Or  
above  
Shackle: JIS •B • 2801 BC 16  
or above



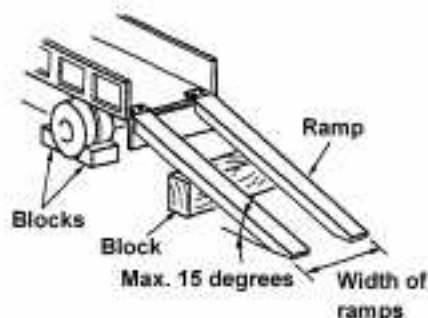
Machine mass (kg)	890
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**LOADING AND UNLOADING THE MACHINE****⚠ WARNING**

- \* Choose as flat ground as possible for loading the machine.
- \* When using loading ramps, be sure there is adequate length, width, firmness and slope.
- \* To prevent the machine from slipping while loading or shifting transit, remove ice, snow or other slippery material from the loading ramps and the truck bed before loading.
- \* **NEVER** operate the high speed travel switch when loading the machine on a trailer or loading ramps.
- \* Perform warm-up the machine before loading and unloading under cold weather.
- \* Do not raise the boom excessively at loading and unloading.
- \* **NEVER** make a turn on a ramp. To make a turn, get off the machine from the ramp first.

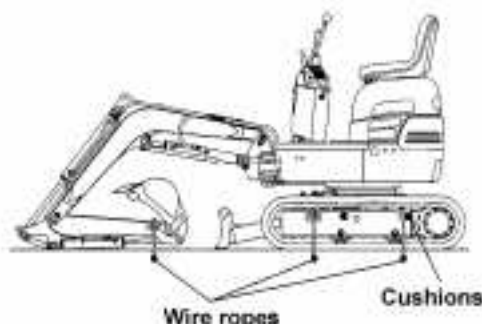
**MACHINE LOADING ONTO A TRUCK.**

1. Block the truck wheels before loading.
2. Install the loading ramps to the truck securely. Maintain the slope of loading ramps within 15 degrees.
3. Position the machine so that it can be run straight on the loading ramps. Never operate control levers other than the travel lever while machine is on the lading ramps.
4. Maintain the machine balance point while traveling over the loading ramp joint areas.
5. Lower the attachment to the bed of truck.
6. Be sure to chock both tracks.

**SECURING THE MACHINE****⚠ WARNING**

Upper structure movement can cause personal injury or death.

1. Align the upper structure with the truck.
2. Move the control shut-off lever to the **LOCKED** position.
3. Turn the engine start switch of **OFF** to stop the engine and remove the key.
4. Block the tracks and secure the machine with tie-downs. Install and fasten proper rated wire rope cables located on the car body and arm point.





**PRECAUTION ON USE OF RUBBER TRACK SHOE****⚠ CAUTION**

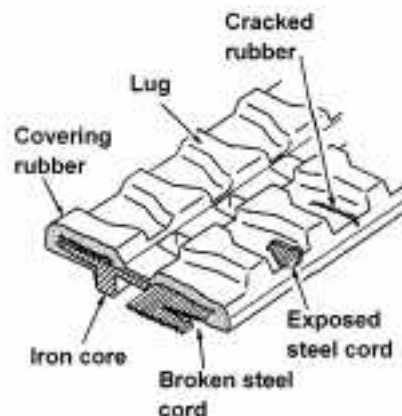
The rubber track shoe may be damaged or worn faster depending on working conditions. Perform working operation properly according to working site conditions and machine operation.

**■ Structure of Rubber track Shoe**

The right illustrates the structure of rubber track shoe. It consists of steel cord to sustain tension, iron core to support it, and covering rubber to them.

**⚠ CAUTION**

If a crack reaches the steel cord, it may be rusted and cut off by moisture. When any crack is detected, repair it immediately with vulcanizer.

**■ Precaution on Use**

1. Adjust the track often enough to keep a proper tension.
  - Insufficient tension slips off the rubber track shoe and wears out the sprocket and iron core extremely.
  - Excessive tension increases travel resistance, which prevents proper travel force and speed. It also causes damages and extreme wear at undercarriage as well as overextension of the rubber track shoe.
2. To prevent damages of the rubber track shoe, avoid the following in travel as much as possible.
  - Pointed rocks or quarry
  - Craggy place such as riverbed or path through woods
  - Steel rods or scraps
  - Steel board or cornered objects of concrete
  - Heat source such as arc
3. Immediately wipe off spilt fuel, hydraulic oil, or grease on the rubber track shoe with a cloth.
4. Avoid sudden spot turns or pivot turns. Make slow turns several times at a low speed.
5. Do not use for long (3 months or more). Store it to avoid direct sunlight or rain.
6. Use the rubber track shoe at a temperature between -25°C and +55°C (-13°F and 131°F) because of a rubber's characteristic.

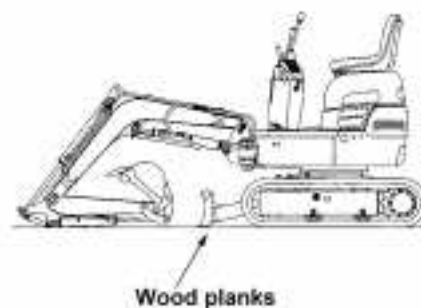
### PARKING THE MACHINE

At the end of a day's work, following steps should be observed as the established machine shut-down procedure.

#### **Machine Stopping**

Park on a level surface, if necessary to park on a grade, block the tracks securely.

1. Move engine throttle lever forward to reduce the engine speed.
2. Release the travel lever to stop the machine.
3. Lower the bucket to the ground and apply slight down pressure.
4. Move the control shut-off lever to the **LOCKED** position.



#### **Freezing Conditions**

If freezing temperature are expected, each crawler frame should be cleaned of mud and dirt and the machine parked on wood planks.

#### **Engine Stopping**

1. Operate the engine at **LOW IDLE** for five minutes.  
This gives the engine a chance to cool off gradually before they are stopped.
2. Turn the start switch key to **OFF**. Remove the key.



**START SWITCH**

#### **Leaving the Machine**

1. Use the steps and handhold, use both handles and face the machine, when dismounting.
2. Inspect the entire machine for leaks, loose connections, signs of wear, crack etc. Report any signs of trouble discovered during this inspection.

### EMERGENCY ENGINE STOP

To stop the engine in emergency, turn the start switch key to "OFF" position.

## SECTION 4 MAINTENANCE

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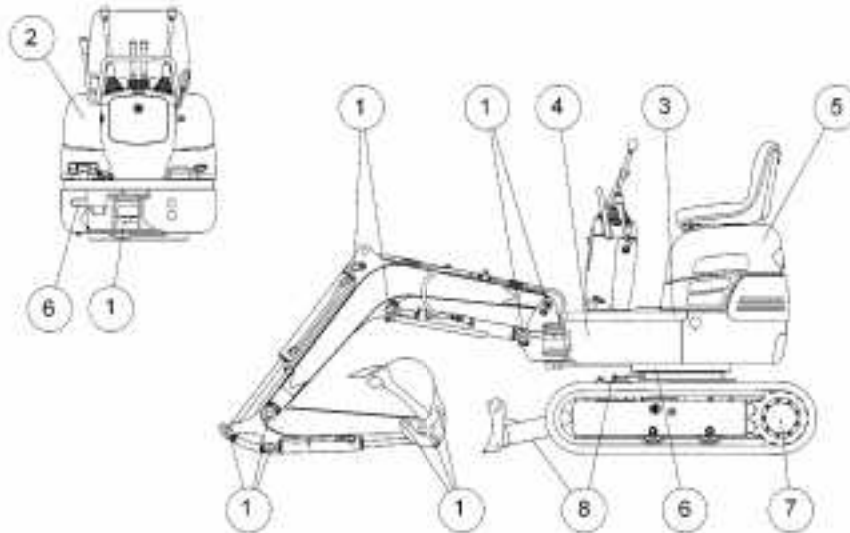
**MAINTENANCE INTERVALS**

Check Point	Item	page
<b>When Required</b>		
Tracks	Check and Adjust Tension	4 - 4 - 1
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<b>Daily Check (8 Service hours)</b>		
Engine Oil	Check Oil Level	4 - 5 - 1
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<b>Every 50 Service Hours (First perform previous service hour items)</b>		
Fuel Tank	Drain Water and Sediment	4 - 6 - 1
Attachment Pins	Lubricate Fitting with Grease	4 - 6 - 1
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Air Cleaner	Clean or Change Filter Elements	4 - 7 - 2
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Fan Belt	Inspect and Adjust	4 - 7 - 5
Engine Coolant	Change Coolant (When not used L.L.C)	4 - 7 - 5
<b>Every 500 Service Hours (First perform previous service hour items)</b>		
Tighten Bolts	Retightening Bolt	4 - 8 - 1
Return Filter	Change Return Filter	4 - 8 - 2
Fuel Filter	Change Filter Element	4 - 8 - 3
Air Cleaner	Change Filter Element	4 - 8 - 4
Travel Drive	Check Oil Level	4 - 8 - 4
<b>Every 1000 Service Hours (First perform previous service hour items)</b>		
Travel Drive	Change Gear Case Oil	4 - 9 - 1
Hydraulic Tank	Change Hydraulic Oil and Clean Strainer	4 - 9 - 2
<b>Every 2 years Service Hours</b>		
Engine Coolant	Change Coolant (When used L.L.C)	4 - 10 - 1

\* Interval given applies only to initial period of use (Break-in).

**LUBRICATION CHART MAINTENANCE AND CHECKS**

The interval of lubrication, maintenance and check is the maximum interval indicated by the service hour meter. It should be shortened in service operating conditions.



Component	Servicing item	Interval					
		First 50 Hr.	Daily	50 Hr.	250 Hr.	500 Hr.	1000 Hr.
1 Attachment pin	Pin lubricate "G"			○			
2 Fuel Tank	Water sediment drain			○			
3 Hydraulic oil Tank	Hydraulic oil "H"		○				●
	Water sediment drain			○			
	Suction strainer cleaning						○
4 Return filter	Cartridge	●				●	
5 Engine	Engine oil "E"	●	○		●		
	Fuel filter					●	
	Oil filter	●			●		
	Radiator "W"		○				
6 Swing bearing	Bearing lubricate "G"			○			
	Ring gear lubricate "G"			○			
7 Traction	Gear lubricate "L"	○				○	●
8 Blade	Pin lubricate "G"			○			

Symbol	G	L	H	E	W	○	●
Kind of lubricant and grade	Grease	Gear oil	Hydraulic fluid	Engine oil	Water	Inspection and maintenance Supply	Change
	EP- 2 Lithium	API-GL- 4, SAE90	Anti-wear (VG-48) hydraulic oil	API-CD SAE10W30			

**RECOMMENDED LUBRICATION TABLE**

LOCATION	REFILL CAPACITIES (APPROXIMATE)	CHANGE INTERVALS	USE	LUBRICANT VISCOSITIES
Diesel Engine	Max. 1.8 liter	250 Hrs.	Cold Regions	API, Class CD SAE20
	Min. 1.2 liter	Initial oil change 50 hours	General	API, Class CD SAE30
			Tropical Regions	API, Class CD SAE40
Hydraulic Oil	Total amount 16 liter	1000 Hrs. (500 Hrs. when breaker used)	Ambient Temperature -5°C	Wear Proof Hydraulic Fluid ISO - VG46
	Tank Capacity 8.2 liter		Ambient Temperature Below -5°C	Wear Proof Hydraulic Fluid ISO - VG32
Track Rollers	0.05 liter (Each)	Upon occasion	—	API, GL-4 ISO-VG320 (SAE90) Gear Oil
Front Idlers	0.02 liter (Each)	Upon occasion	—	
Travel Drives	0.33 liter (Each)	1000 Hrs.	—	API, Class CD SAE30
Lubricate the Fitting	Swing Bearing. Attachment pins, etc.		—	EP2 Lithium Grease

**Note:**

1. Oils in the hydraulic fluid columns marked with \*should be use above 0°C.
2. If the oil becomes dirty or deterioration of the oil's properties are excessive, replace more frequently than described above.
3. Disassemble the track roller and upper roller when replacing the oil in them.

**WHEN REQUIRED MAINTENANCE AND CHECKS**

**TRACKS CHECK / ADJUST**

**⚠ WARNING**

- \* Grease is under high pressure.
- \* **NEVER** remove the grease fitting.
- \* Grease coming out of the check valve under pressure can penetrate the body causing injury or death.
- \* **DO NOT** watch the check valve to see if grease is escaping. Watch the track or track adjustment cylinder to see if the track is being loosened.
- \* Loosen the check valve one turn only.

■ **Measuring Track Tension**

1. Position bucket to the sprocket side. Use boom and blade down pressure to lift the track on both side off the ground.
2. Measure the maximum amount of the track sag from the shoe upper face to the roller face. Properly adjusted track will have approximately 10 to 20 mm slack with rubber shoes.

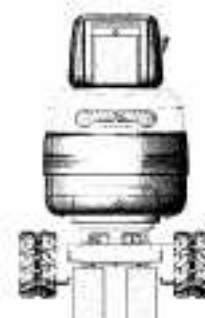
■ **Track Tightening**

1. Add grease through check valve fitting ① until the correct track tension is reached.
2. Move the tracks forward and reverse to equalize the pressure.
3. Check the amount of track sag again and adjust as necessary.

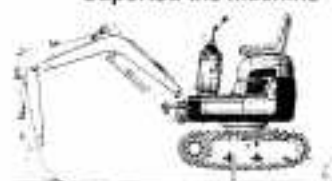
■ **Track Loosening**

1. Remove soil deposited on front idler bearing.
2. Loosen the check valve ② carefully (one turn maximum) until the track begins to loosen.
3. Tighten the check valve ② to 59 to 69 N · m when the desired track tension is reached. **NEVER** over tighten the check valve.
4. Move the tracks forward and reverse.
5. Check the amount of track sag again and adjust as necessary.

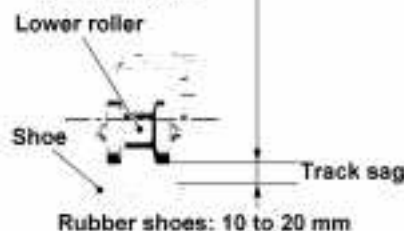
If the correct adjustment cannot be obtained, consult your IHI dealer.



Supported the machine



Jack up until the shoe leaves the ground surface



① Grease nipple  
② Check valve (Width across flat: 24 mm)

# RUBBER TRACK SHOE MAINTENANCE

## **CAUTION**

- \* Rubber track shoe should be repaired or replaced under the next conditions.
- \* If is necessary to repair or replace it, consult your IHI dealer.

### 1. Height of lugs

The rubber track shoe can be used even if it is worn, however, if it is excessively worn, the rubber track shoe is likely to be slippery and more travel force is required. If the remaining lug is less than 5 mm high, replace it with brand-new one.

### 2. Exposure of Steel Cords

If steel cord is exposed because of weary rubber or damage, replace it with brand-new one.

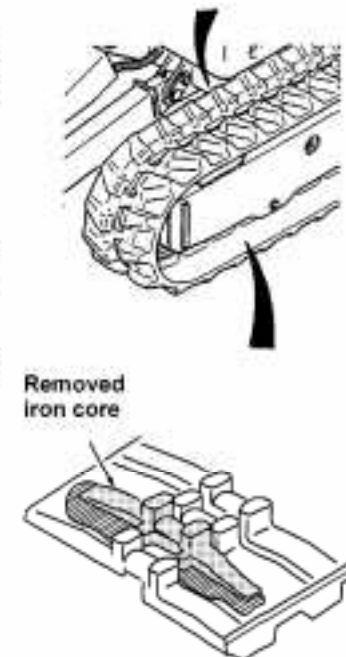
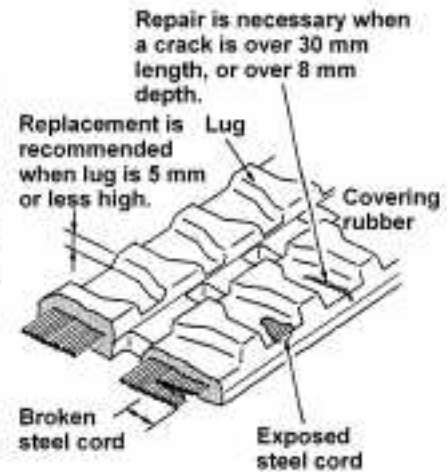
### 3. Break of Steel Cords

When break of steel cord is detected, replace it immediately. If you leave it as it is, the rubber track shoe can be break without expectation, which causes a serious accident.

### 4. Crack of Covering Rubber

If a crack is 30 mm or more long and 8 mm or more deep, repair the cover immediately. If Steel cord appears even if a crack is small, repair it immediately.

Otherwise, water may come into a crack, which rusts steel cords and break the rubber track shoe.





## ELECTRIC SYSTEM

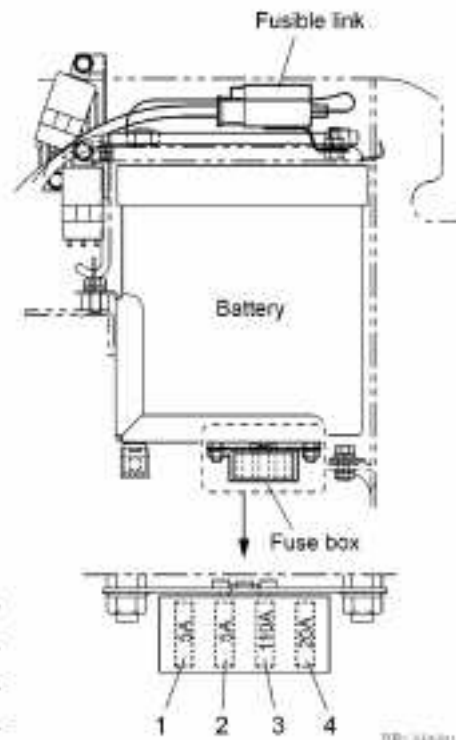
### Replace the Fuses

#### NOTICE

- Be sure to set the engine key switch to the OFF position before replacing the fuses.
- Do not use wires, silver foils, etc. instead of fuses.  
If such materials are used, the wires may overheat and burn, resulting in a fire.

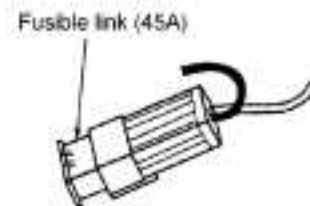
1. Set the engine key switch key to the OFF position.
2. Take off the fuse cover.
3. Replace the blown fuse with a new fuse of the same capacity.

	Fuse capacity	Circuit name
1	5 A	Warning lamps (three), hour meter
2	5 A	Fuel pump
3	10 A	Boom light, horn
4	20 A	Engine stop



### Replace the Fusible Link

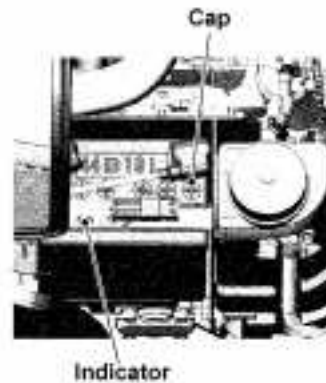
If power is not turned on even though the engine key switch is set to the ON position, the fusible link between the battery and the engine key switch circuit may have blown out. Remove and check the fusible link. Replace it with a new fusible link, if it has blown out.



## BATTERY MAINTENANCE

### **⚠ WARNING**

- Battery give off flammable fumes that can explode.
- Do not smoke when observing the battery electrolyte levels.
- Electrolyte is an acid and can cause personal injury if it contacts skin or eyes.
- If the electrolyte comes in contact with eyes, wash it away with water and call for emergency medical cure.
- Always wear protective glasses when working with battery.
- Battery post, terminals and related accessories contain lead and lead compounds, chemicals known to cause cancer and reproductive harm.  
WASH HAND AFTER HANDLING.



### 1. Cleanliness

Clean the battery surface. Keep the terminals clean and coated with good quality grease. Install the post cover after coating.

### 2. Battery Recharge

Battery should not be allowed to stand in a fully discharged condition, but should be recharged as soon as possible. If battery is out of use for a long time, it must not be allowed to run down completely.

The battery should be given a small recharge, sufficient to bring it back to fully charged state about every one or two months.




Trickle charging is not recommend and during charging as before, care must be taken that temperature of electrolyte does not rise above 40°C for temperate climates and 52°C for battery using lower gravity acids specified for tropical use.

### 3. Inspection

Inspect the electrolyte level look at the indicator or sight level line on the battery.

#### Display of indicator

Shows the standard of charge and electrolyte level.

- |                        |         |   |
|------------------------|---------|---|
| • Good                 | (Blue)  |  |
| • Charge is necessary  | (Red)   |  |
| • Electrolyte shortage | (White) |  |

### 4. Topping Up

Maintain the level to the upper level of the sight level line with distilled water when required. If any electrolyte is spilled, replace it with fresh sulfuric acid of same specific gravity as that of remaining in cell.

Level of electrolyte must never fall below tops of plates.

## CHANGE THE BUCKET

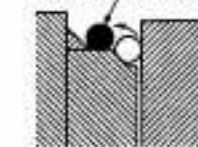
### CAUTION

- \* Bucket pins, when struck with force, can fly out and injure nearby persons. Make sure the area is clear of people when driving bucket pins.
- \* Wear protective glasses when striking a bucket pin to avoid injury to your eyes.
- \* Chips or other debris can fly off objects when struck. Make sure no one can be injured by flying debris before striking any object.

#### ■ Remove the Bucket

1. Place the bucket in a stable position.
2. Move the O-rings from the regular position to the bucket boss.
3. Remove the pins of section A and B, then remove the arm and the bucket.

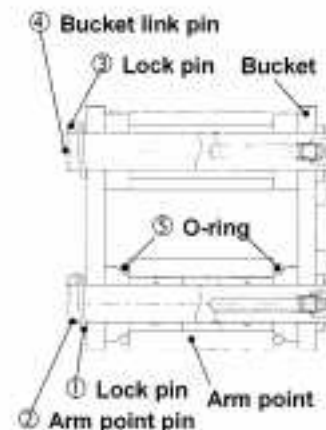
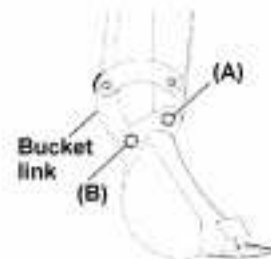
Movement of O-ring



Bucket boss

#### ■ Install the Bucket

1. Clean the removed pins and pin holes and apply coat the grease to them surface.
2. Place a new bucket in a stable position as illustrated.
3. Connect the arm into the hole A, and the link into the hole B with pins.
4. Install a stopper bolt to each pin securely.
5. Move the O-rings for sealing into the regular position.
6. Lubricate each pins with grease.
7. After install the bucket, start the engine and low speed rotate the bucket to the stroke end. Check if anything interrupts the bucket rotation.



# DAILY MAINTENANCE AND CHECKS

## ■ Check the Engine Oil Level

### **CAUTION**

- \* Check the oil level with the engine stopped. **DO NOT** check the oil level with engine running.
- \* **DO NOT** overfill the crankcase to avoid engine damaged. Engine damage can result.
- \* **NEVER** operate the engine when oil level is above **MAX** or **MIN** marks.

1. Place the machine on level ground. Stop the engine.
2. Remove the oil level gauge ① and wipe it clean. Insert oil level gauge ①, then remove it again to read actual oil level. Install oil level gauge ①.
3. Maintain the oil level to the **MAX** mark on the oil level gauge ①. Add oil if necessary.
4. Remove the oil fill plug ② and add oil. Clean and install the oil fill plug ②.
5. Close the access door.



① Oil level gauge

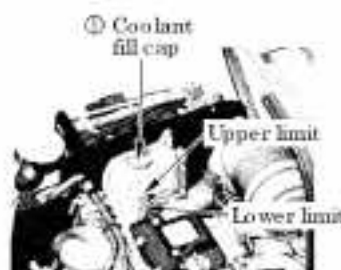


## ■ Check the Coolant Level

### **WARNING**

- \* Steam generated by hot fluid under pressure in radiator can cause personal injury.
- \* Remove filler cap only when cool enough to touch with bare hand.

1. Open the access door on the rear of the machine.
2. Always check the coolant level in the reserve tank. Maintain the coolant level between the **MAX** and **MIN** marks on the reserve tank.
3. Remove the coolant fill cap ① and add the coolant if necessary.
4. If the reserve tank is empty, check the radiator level with the engine stopped. Add coolant to the radiator and the reserve tank.
5. Close the access door.



## ■ Hydraulic Oil Level

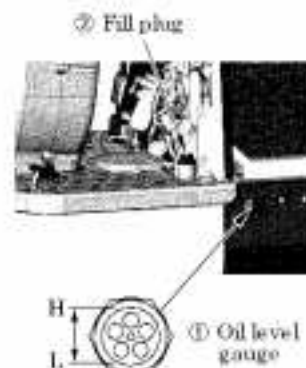
### ⚠ CAUTION

- Always clean around fill plug before removing.
- **DO NOT OVER FILL.**
- **DO NOT OPERATE** the machine when oil level is above **FULL** or **ADD** marks.

1. Place the machine on level ground and lower the bucket to the ground, with the arm and bucket cylinders fully retracted, as shown.
2. Maintain the oil level between the **FULL** and **ADD** marks on the level gauge.
3. Slowly loosen the fill plug to relieve pressure and remove it to add oil if necessary.
4. Clean and install the fill plug. To pressurize the hydraulic tank, refer to "Change Hydraulic Oil" section.

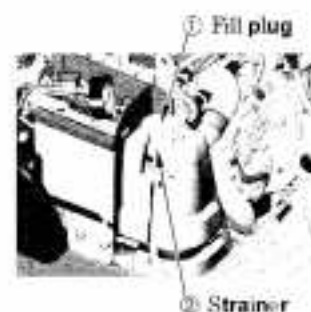
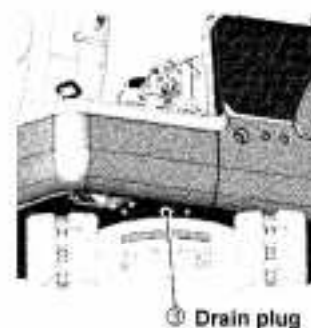


Bucket position at the time of checking the hydraulic oil level.



## ■ Fill Fuel Tank

Fuel can be added to the tank by removing the fill cap on top of the fuel tank. Do not remove strainer in the fill port when fill fuel tank. After completion of refueling, be sure to close and lock the engine cover to protect against vandalism.



# ■ Water Sedimenter

Maintenance intervals :

- Check Level: Daily
- Drain the Water and Sediment : When the float floated up to the bottom of the filter in the sedimenter.

## **⚠ WARNING**

Fuel leaked or spilled onto hot surfaces can cause a fire.

The water sedimenter is located on the rear of the engine.

1. Stop the engine.
2. Turn the fuel stop lever to the "closed" position.
3. Loosen the ring nut ① and remove the bowl ② and the filter ③
4. Drain water and sediment into suitable container.

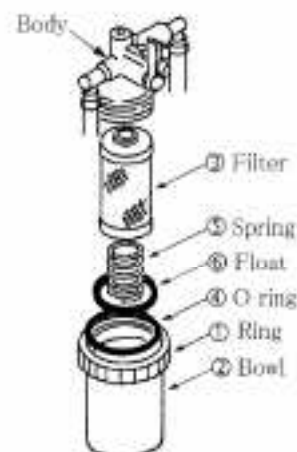
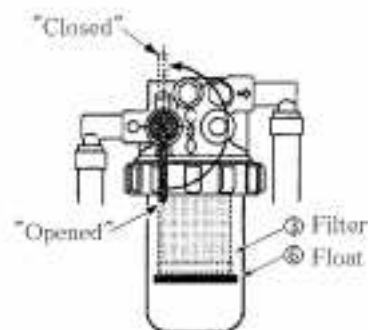
**NOTE:** Always dispose of drained fluids as established by local regulations.

5. Clean the inside surfaces of the body and bowl ②
6. Clean the filter ③
7. Inspect the O ring ④ on bowl replace them if they are worn or damaged.
8. Install a filter ③ to the body. Install a spring ⑤ and float ⑥ into the bowl. Install the bowl ② to the body. Tighten ring nut ①
9. Turn the fuel stop lever to the "opened" position.
10. Priming the system. There should be enough fuel in the system to allow the engine to start.  
Keep the engine start switch key at ON for a period of 20 seconds. which operates the fuel pump and priming automatically.

**NOTE:** Do not start the engine until all fuel system service is completed.



Water sedimenter



Water sedimenter

**■ Walk-Around Inspection**

Inspect the operator's compartment for cleanliness. Keep it clean.

Inspect the loose bolts, tighten any loose bolts. Repair if necessary.

Inspect any cracks in boom and arm pivot area and cylinder mounting brackets.

Repair if damaged.

Inspect attachment cylinders, linkage and bucket for damage or excessive wear. Repair if damaged.

Inspect and remove any trash build up in the engine compartment.

Inspect the cooling system for leaks, faulty hose and trash built up. Correct any leaks and remove any trash from the radiator.

Inspect the hydraulic system for leaks. Inspect the tank, cylinder rod seals, tubes, plugs, joints and fittings. Correct any leaks.

Inspect and repair travel drive leaks. Check oil level if leakage is noticed.

**■ Daily Lubrication**

Perform the daily lubrication as required by the Lubrication Chart.

# **50 HOURS MAINTENANCE AND CHECKS**

First perform previous service hour items

## **FUEL TANK**

### ■ **Drain the Water and Sediment**

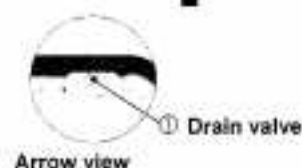
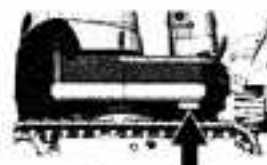
**NOTE:** Before draining the water and sediment, be sure to fill the tank with fuel.

The drain valve located under the fuel tank.

1. Stop the engine.
2. Open the drain valve ①.
3. Drain water and sediment into suitable container.

**NOTE:** Always dispose of drained fluids as established by local regulations.

4. Close the drain valve.



### ■ **Lubrication**

Perform the 50 hours lubrication as required by the Lubrication Chart. Be sure to lubricate all cylinder mounting bushings and pins.

☆ The following maintenance and checks should be made in 50 hours for the initial time only.

Interval given applies only to period of use (break-in.)

- Return filter replacement.
- Engine oil replacement.
- Engine oil filter replacement.



Ring gear grease nipple  
Boom swing cylinder grease nipple  
Swing bearing grease nipple



# 250 HOURS MAINTENANCE AND CHECKS

First perform previous service hour items

## ENGINE OIL AND FILTER

### ■ Change the Oil and Filter

#### **CAUTION**

- \* Hot oil and components can cause personal injury. Do not allow hot oil or components to contact skin.
- \* **DO NOT** overfill the crankcase to avoid engine damaged. Engine damage can result.
- \* **NEVER** operate the engine when oil level is above **MAX** or **MIN** marks.

1. Stop the engine.
2. Remove the crankcase oil drain plug ①. Allow the oil to drain into a container. Install the crankcase drain plug ①.

**NOTE:** Always dispose of used oil and filters as established by local regulations.

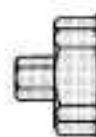
3. Open the engine cover on the rear of machine.
4. Remove the used filter ② by the filter wrench. Use a filter wrench with the type shown at right. Clean the filter housing base.
5. Apply a light coat of engine oil to the gasket of the new filter.
6. Install the new filter by hand. When the seal contacts the base, tighten the filter 3/4 turn more by filter wrench. Do not overtighten.
7. Remove the oil fill plug ③. Fill the crankcase with oil. Refer to "Recommended lubricant table." Clean and install the oil fill plug ③.
8. Before starting the engine, make sure the oil level is between the two notches on oil level gauge ④.
9. Start and run the engine at low idle for two minutes. Inspect for oil leaks. Stop the engine.
10. Wait 10 minutes to allow the oil to drain back into the crankcase. Check the oil level. Maintain the oil level to the FULL mark on dipstick.
11. Close and latch the engine hood.



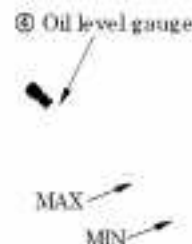
① Drain plug



② Filter cartridge



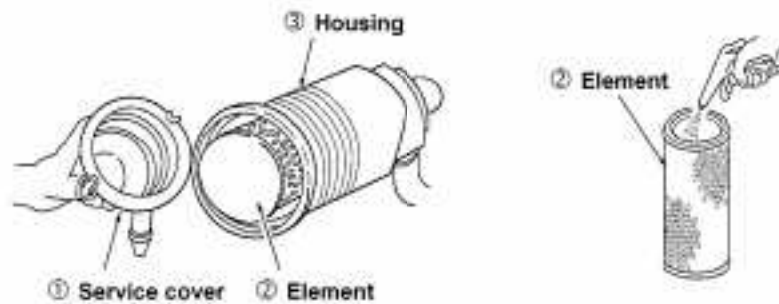
Filter wrench



■ Service the Filter Elements

**CAUTION**

- \* Service the air cleaner only with the engine stopped to prevent engine damage.
- \* Do not clean the filter elements by bumping or tapping them.  
Do not use filter element with the damaged pleats, gaskets or seals.  
Engine damage could result.
- \* When using pressure air for cleaning, wear a protective face shield or protective glasses.



1. Stop the engine.
2. Release the two latches and remove the service cover ①.
3. Remove the element ② from the air cleaner housing ③.

**NOTE:** Remove the seal unit of element gently. The element is radially sealed by the element seal unit and seal tube. To loose the seal unit, move the outer of element gently up and down or right and left or turn the element to remove it.  
Take out the element not to scatter dust.

4. Clean the inside of the cleaner housing ③ and service cover ①.

**NOTE:** Clean the seal tube in the cleaner housing. Dust on the seal tube causes dust leak.

5. Element ② can be cleaned with compressed air 200 kPa (2 kgf/cm<sup>2</sup>) maximum.

Direct air along pleats inside of filter element.

6. Inspect the filter element after cleaning. Do not use a filter element with damaged pleats, gasket or seats.

**NOTE:** The used element may be useful to find a foreign substance on the seal surface of the filter element, which can cause leak. If the striped dust is seen on the seal surface, it is a symptom of dust leak. If such dust seen, inspect if there are foreign substances, on the inside and outside of the housing seal tube.

7. Install a clean element ②. Install and secure the service cover ①.

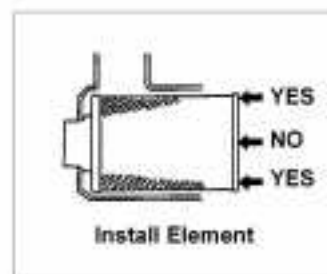
**NOTE:** Insert a new element correctly. When the element seal unit is inserted into the seal tube, its seal surface is extended uniformly to seal the element. To seal the element more accurately, push securely not the center but the outer of the element end surface.



Cleaning Element



Inspect Element



Install Element

## ■ Clean the Fuel Filter Element

### **⚠ WARNING**

- \* Hot oil and components can cause personal injury.
- \* Fuel leaked or spilled on to hot surfaces can cause a fire.

The fuel filter is located rear of the engine.



1. Stop the engine.
2. Turn the fuel stop lever ① to the "closed" (OFF) position.
3. Loosen the ring nut ②.
4. Remove the cup ③ and the element ④.
5. Drain water and sediment into a suitable container.

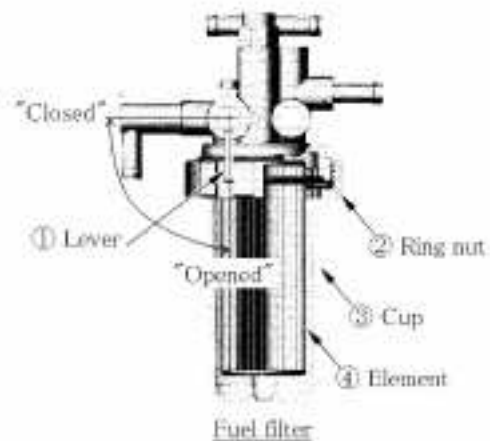
**NOTE:** Always dispose of drained fluids as established by local regulations.

6. Clean the inside surface of the cup and the element ④.
7. Install the clean element ④.
8. Install cup ③. Tighten ring nut ②.
9. Turn the fuel stop lever ① to the "opened" (ON) position.

**NOTE:** Do not start the engine until all fuel system service is completed.

## ■ Priming the system

There should be enough fuel in the system to allow the engine to start. Keep the engine start switch key at ON for a period of 20 seconds, which operates the fuel pump and priming automatically.



### ■ Change the Coolant

Coolant should be drained and changed every 250 service hours or six months. However, when adding "Long-Life-Coolant", the drain period can be extended to 2 years.

Drain the coolant earlier whenever the coolant is dirty or foaming is observed.

See 2 years Maintenance section.



### ■ Fan and Alternator Belt

#### **⚠ WARNING**

- \* Hot components can cause personal injury.
- \* Stop the engine and remove the start switch key.

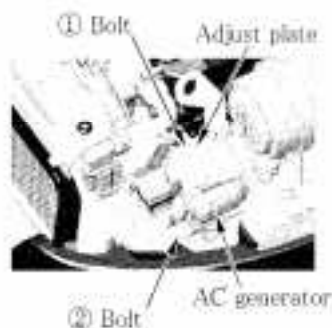
#### Inspect

Stop the engine. Inspect the belt for wear and cracking. To check the belt tension, push the belt inward by hand apply 98N (10kg) force midway between the pulleys. Correctly adjusted belt will deflect 10mm.



#### Adjust

1. To adjust the belt, loosen mounting bolt ① and ②.
2. Move the alternator in or out as required to obtain the correct adjustment.
3. Tighten mounting bolts ① and ②.
4. Check the belt adjustment again after 5 minutes of engine operation at rated speed.



**500 HOURS MAINTENANCE AND CHECKS**

First perform previous service hour items

■ **Check the Fixed Bolt Torque**

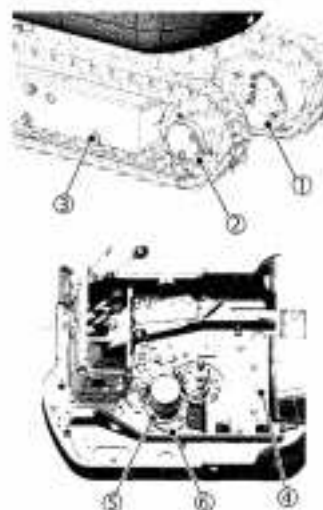
When loosened bolt or nut is found at daily check, tighten it with torque specifications table.

**1. Special torque specifications**

Special tighten is applied for main bolts as illustrated below.

When replacing bolts, apply molybdenum grease to bolts, nuts, and bearing surface of nuts.

Then, tighten them with specified torque.



Items	Tighten point	Wrench Size metric	Thread Size	Tightening Torque (N·m)
①	Travel drive	Bar 8	M10	54
②	Sprocket	Bar 8	M10	54
③	Lower roller	19	M12	97
④	Swing bearing	17	M10	59
⑤	Swing motor	Bar 10	M12	97
⑥	Swing gear case	17	M10 P1.25	55

Newrtonmeter (N·m) is approximately the same as 0.1 kg·m

**2. General torque specifications**

Other than above-mentioned, refer the next table for torques.

Thread Size metric	Wrench size (mm)	Tighten torque	
		Metric coarse H.T. (N · m)	Metric fine H.T. bolt (N · m)
M8	13	23	25
M10	17	47	50
M12	19	83	91
M14	22	134	135
M16	24	208	221
M20	30	411	452
M24	36	715	811

High pressure-hose union nut	
Hose Size (inch)	Tighten torque (N · m)
1/4"	25
3/8"	49
1/2"	59
3/4"	118
1"	137
1-1/4"	167

## Change the Return Filter

### CAUTION

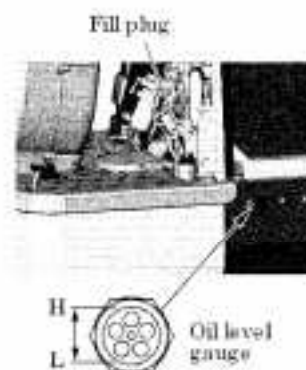
- Hot oil and components can cause personal injury. Do not allow hot oil or components to contact the skin.
- At operating temperature, the hydraulic tank is hot and can be under pressure.
- To relieve the pressure from the hydraulic tank, loosen the oil fill plug ① on the hydraulic tank.
- Remove the return filter ② only after the engine has been stopped and the return filter is cool enough to touch with your bare hand.

- Lower the bucket on the ground and stop the engine.
- Relieve the internal pressure from the hydraulic tank by loosening oil fill plug ①.
- Clean the area to keep dirt out of the filter base ④.
- Remove the used filter ② by filter wrench. Clean the filter base ④.

**NOTE:** This is a cartridge type element. It cannot be reused.

- Coat the gasket ③ of new filter with clean hydraulic oil.
- Install the new filter ② by hand. When the seal contacts the base, tighten an additional 3/4 turn by filter wrench.
- Start and run the engine to fill the filter. Stop the engine. Maintain the oil level between marks on the level gauge. Add oil if necessary.
- Pressurize the hydraulic tank. After fully extending all the cylinders and loosen oil fill plug ① to supply air to the hydraulic tank, tighten the plug again.
- Start and operate the engine. Inspect for leaks on the oil filter ②.

- ☆ When operation breaker works, replace the return filter every 100 hours operation.
- ☆ Replace this filter in 50 hours for the initial time only.



Bucket position at the time of sealing off hydraulic tank.

■ Change the Fuel Filter Element

**⚠ WARNING**

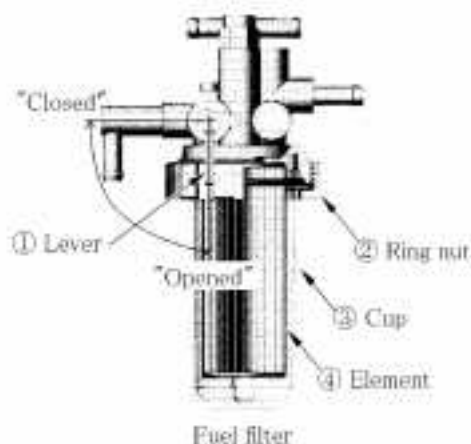
- \* Hot oil and components can cause personal injury.
- \* Fuel leaked or spilled on to hot surfaces can cause a fire.

1. Stop the engine
2. Turn the fuel stop lever ① to the "closed"(OFF) position.
3. Loosen the ring nut ②.
4. Remove the cup ③ and the element ④.
5. Drain water and sediment into a suitable container.

**NOTE:** Always dispose of drained fluids as established by local regulations.

6. Clean the inside surface of the cup.
7. Install the new element ④.
8. Install cup ③. Tighten ring nut ②.
9. Turn the fuel stop lever ① to the "opened" (ON) position.

**NOTE:** Do not start the engine until all fuel system service is completed.

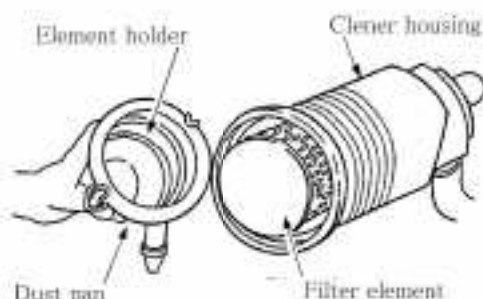




## ■ Change the Air Cleaner Element

The air cleaner is equipped with a "Service-Signal" indicator located on the outlet side of the air cleaner. With the engine running, check indicator each day.

If red signal is in the service level, clean filter element or replace if necessary. Inspect filter gaskets for damage and replace if necessary.



1. Stop the engine.
2. Release the two latches and remove the dust pan.
3. Remove the filter element from the air cleaner housing.
4. Clean the inside of the air cleaner housing.
5. Remove the element holder from the dust pan and clean the element holder.
6. Install a new filter element. Install and secure the dust pan with arrow point upward.
7. Reset the dust indicator by pushing in the reset button.

### ⚠ CAUTION

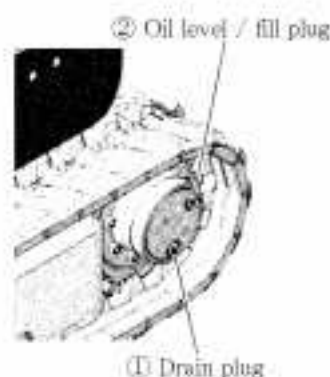
- Service the air cleaner only with the engine stopped. Engine damage could result.

## ■ Check the Travel Drives Oil Level

### ⚠ CAUTION

When the quantity of oil is found to have increased abnormally, it is necessary to check the oil seal of the travel motor. If the seal is leaking, contact a IHI dealer.

1. Position one travel drive with oil drain plug ① at the bottom.
2. Remove the oil level/fill plug ② oil should be to the bottom of the level plug opening.
3. Add oil through the opening of oil level/fill plug ② if necessary.
4. Clean the plugs ② install the plugs ②.
5. Perform procedure on the other travel drive.



**1000 HOURS MAINTENANCE AND CHECKS**

■ **Change the Travel drive Oil**

1. Position one travel drive with drain plug ① at the bottom.
2. Remove drain plug ① and oil level/fill plug ②. Allow the oil to drain into a container.

**NOTE:** Dispose drained material according to local regulation.

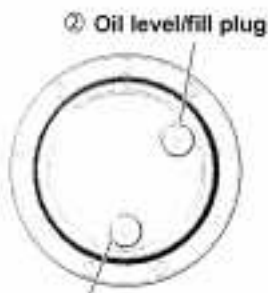
3. Clean the plugs.
4. Install drain plug ①.
5. Fill the travel drive to bottom of level plug opening.

Recommended oil	Refill capacities
Engine oil API CD, SAE30	0.33 Liter

6. Install oil level/fill plug ②.
7. Perform procedure on the other travel reduction.
8. Start the engine and allow the travel drive to turn through several cycles.
9. Stop the engine, check the oil level.
10. Check the drained oil for metal chips or particles. If there are any, consult your IHI dealer.



Travel reduction



① Drain plug

# ■ Change Hydraulic Oil and Clean the Strainer

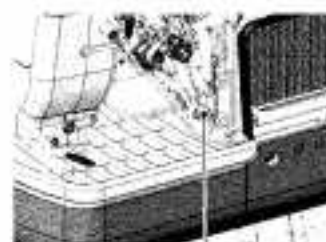
## **CAUTION**

- \* Hot oil and components can cause personal injury. Do not allow hot oil or components to contact the skin.
- \* At operating temperature, the hydraulic tank is hot and can be under pressure.
- \* To relieve the pressure from the hydraulic tank, loosen the oil fill plug ① on the hydraulic tank.
- \* Relieve the tank pressure with engine off by removing fill plug slowly to prevent hot oil from burning.

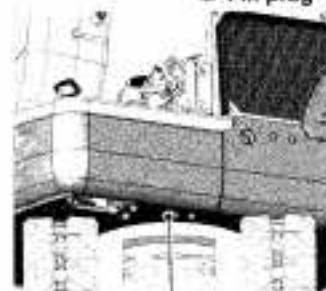


Bucket position at the time of drain the hydraulic oil.

1. Place the machine on level ground, with the arm and bucket cylinder fully retracted and attachments lowered, as shown. Stop the engine.
2. Relieve the internal pressure from the hydraulic tank by loosening the fill plug ①.
3. Clean area thoroughly to keep dirt out of strainer cover unit ⑤ and fill plug ①.
4. Remove the oil drain plug ② drain oil into a container. Drain oil in all parts of the hydraulic system thereafter.



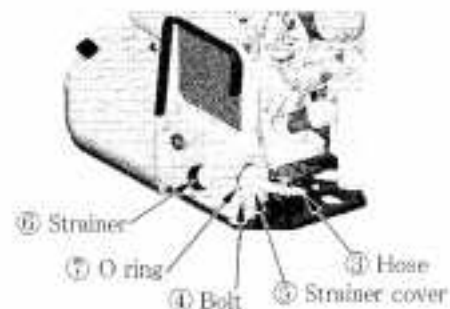
① Fill plug



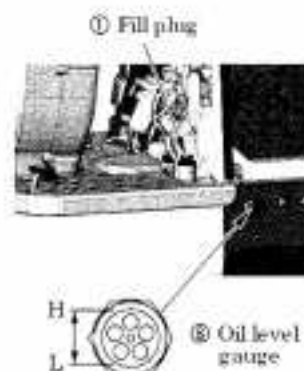
② Drain plug

**NOTE:** Always dispose of used oil as established by local regulation.

5. Remove the suction hoses ③. Remove the bolts ④ and the strainer cover unit ⑤/strainer ⑥ from the hydraulic tank.
6. Inspect the O ring ⑦ and replace it if damaged.
7. Clean the inside of the tank with the clean oil.
8. Clean and install the strainer cover unit ⑤/ strainer ⑥ and the suction hoses ③.
9. Clean and install the drain plug ②.



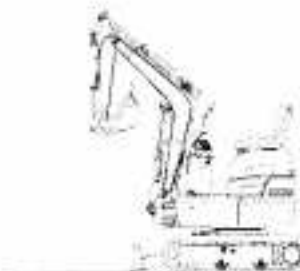
10. Fill the hydraulic tank with oil. See Recommended Lubricant Table.
11. Start and operate the engine at idling speed for 2~3 minutes.
12. Operate the control levers to allow the hydraulic oil to circulate through all hydraulic circuits.
13. Lower the bucket to the ground with the arm and bucket cylinder fully retracted and stop the engine.
14. Maintain the oil level between **FULL** and **ADD** marks on the level gauge ③.
15. Pressurize the hydraulic tank.  
Raise the boom with the arm, boom and bucket cylinder fully extended.
16. Remove the fill plug ① and then install fill plug again.
17. Lower the bucket on the ground and stop the engine.



Bucket position at the time of checking the hydraulic oil level.

**CAUTION**

**Hydraulic Oil Change Intervals for Breaker Works.**  
Hydraulic oil should be changed in every 500 service hours.



Bucket position at the time of sealing off hydraulic tank.

## 2 YEARS MAINTENANCE AND CHECKS

### COOLING SYSTEM COOLANT

#### **⚠ WARNING**

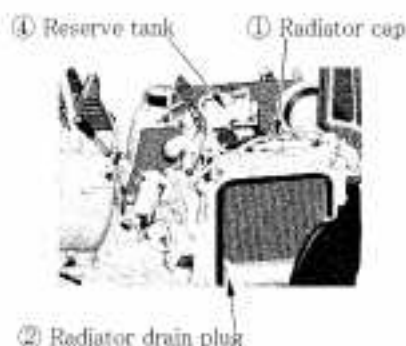
- \* At operating temperature, the engine coolant is hot and under pressure.
- \* Steam can cause personal injury.
- \* Change the coolant only after the engine has been stopped and radiator cap is cool enough to touch with your bare hand.
- \* Remove the radiator cap slowly to relieve Pressure.

#### ■ Change the Coolant

Coolant should be drained and replaced every 250 service hours or six months. However, when adding "Long-Life-Coolant", the drain period can be extended to 2 years.

Drain the coolant earlier whenever the coolant is dirty or foaming is observed.

1. Place the machine on the firm and level ground.
2. Loosen the radiator cap ① slowly to relieve pressure, and remove the cap.
3. Open the radiator drain plug ② and allow the coolant to drain into a container.
4. Remove the radiator drain plug ③ allow the coolant to drain into a container. Drain plug is located under the injection pump on the front side of cylinder body.
5. Close the radiator drain plug ② and drain plug ③. Fill the system with clean water and cleaning solution.
6. Start and operate the engine for 1/2 hour. Stop the engine and drain the cleaning solution.
7. Flush the system with water, with the engine stopped, until the draining water becomes clear.
8. Close the radiator drain plug ② and drain plug ③. Fill the system with clean water and operate the engine for five minutes. Stop the engine and drain the water.
9. Repeat step 7 several times, if necessary, until the drained water becomes clear.
10. Add the coolant solution. See next page.
11. Operate the engine for five minutes with the radiator cap ① off.



12. Maintain the coolant level to the fill port neck.
13. Replace the cap gasket if the gasket is damaged. Install the radiator cap ①.
14. Maintain the coolant level between the MAX and MIN marks on the reserve tank.

#### ■ Clean the Outside of the Radiator Core

When the radiator core is clogged, the cooling air flow is interrupted lowering the cooling efficiency.

Remove dust or debris from the radiator fins.

Clean the radiator with a pressurized air, high pressure water or steam at 500 hours interval.

Whenever the radiator is found to be closed, clean it at any time.



#### ■ Selection of coolant

Long-Life-Coolant (LLC) is supplied to this machine before shipment.

This is a coolant provided with proper ties of Antifreeze, corrosion-proof and fouling-proof.

Its long lasting effects will maintain the machine free from coolant exchange for 2 years through summer and winter seasons.

The Long-Life-Coolant is therefore recommended for use with this machine when exchanging its coolant.

#### ■ Mixing Ratio of Long-Life-Coolant

The mixing rate of Long-Life-Coolant with water determines the freezing point.

Select the mixing ratio for a freezing point lower by 5° than the expected lowest atmospheric temperature.

Normally, the Long-Life-Coolant is used under a mixing ratio of 30 to 50%.

If the mixing ratio is less than 30%, occurrence of rust is feared and when it is over 50%, overheating is feared and sealing components may be deteriorated quicker than usual.

Meanwhile, use city water to mix with Long-Life-Coolant.

Freezing point (°C)	-15	-25	-35
Mixing ration (%)	30	40	50
Quantity of LLC (L)	0.7	0.9	1.1
Quantity of water (L)	1.5	1.3	1.1
Coolant total amount: 2.2L	Engine proper: 0.6 L Radiator and other proper : 1.2 L Reserve tank : 0.4 L		

**UNUSUAL OPERATING CONDITIONS**

Special problems in maintenance and operation are caused by unusual conditions such as extremes in heat, cold and humidity, high altitude, salt water, and dusty or sandy work sites. When operating under such conditions, special precautions must be taken to prevent machine damage, minimize wear, and avoid component deterioration.

**■ Extreme Cold**

In periods of extreme cold, the problems of freeze damage, inadequate lubrication and battery failure may become particularly trouble - some. With the onset of very cold weather, it is advisable to "winterize" the machine by servicing the cooling system and switching to the lubricants recommended for cold weather usage.

Follow the recommendations below when the machine must be operated in very cold conditions.

1. To prevent freeze damage to the cooling system and cracking of the engine block or head, drain and flush the cooling system. Clean the radiator exterior, making certain the air passages through the core and the cooling fins are free of foreign matter.

Refill the cooling system, adding an antifreeze solution recommended by the engine manufacturer in an amount and strength appropriate to the anticipated temperatures. A corrosion inhibitor is recommended.

Never use a chromatic base corrosion inhibitor when the coolant contains ethyl line glycol. Use only non-chromatic base inhibitors.

Inspect the thermostat, clamps, radiator hoses and radiator core for proper condition. Replace or repair any cooling system component found to be defective.

2. Condensation in the fuel tank contaminates the fuel supply with water, which can freeze in the fuel lines and block the fuel flow to the engine.

To minimize this possibility, keep the tank as full as is practical during cold weather.

This may entail refilling the tank more frequently than usual, but the inconvenience is small compared to clearing a blocked fuel line.

If water should be noticed in the fuel supply, drain the tank and refill it with uncontaminated fuel.

3. Lubricate the machine with the lubricants recommended for cold weather operation in the Lubrication Section. If necessary, change the engine oil and other lubricants in order to conform to the recommendations.

4. The battery is more likely to sustain freeze damage if not kept fully charged because its electrolyte will freeze at a higher temperature than that in a fully charged battery. Be certain the battery is charging when the engine is running and use an external charger to restore full charge when the machine is not being operated.

The battery can discharge if snow or ice short circuits the terminals. Keep the battery posts and cable connectors clean and dry. Remove any corrosion with a solution of soda and water.

During extremely cold weather, it is advisable to remove and store the battery in a heated area when the machine is to remain idle overnight or for any extended period.

**⚠ CAUTION**

Water added to the battery can freeze before it mixes with the electrolyte.

During very cold weather, add water to the battery just prior to, or during operation of the machine.

If the machine is not to be run, water may be added if an external charger is connected to the battery.



5. Special attention must be given to the hydraulic oil during very cold weather.

**CAUTION**

**BEFORE** attempting any working operations, warm up the hydraulic oil as described in "After Starting the Engine on Sheet No.2-6".

6. At the end of the work period, or whenever the machine is to be left idle for extended periods, prevent it from being frozen to the ground by parking it on wood, concrete, asphalt or mat surface.

■ **Extreme Heat.**

Like extreme cold, extreme heat requires that precautions be taken with respect to the cooling system, the battery and lubrication.

Protect the machine by performing the following recommended procedures.

1. High temperatures necessitate the use of lubricants which are both more viscous and which resist deterioration at higher operating temperatures. Refer to the Lubrication Section and lubricate the machine using the lubricants recommended for the expected temperatures. Crankcase oil is particularly important because it helps dissipate heat. Check the oil level frequently and add oil as required to maintain required level. Too little oil will hinder heat dissipation.
2. To ensure proper coolant circulation, drain and flush the cooling system, clean any foreign matter from the radiator cooling fins and through-core air passages, replace defective hoses, tighten hose clamps, tension the water pump drive belt properly, eliminate any leaks detected and fill the system with a 50% solution of ethylene glycol.  
A corrosion inhibitor is recommended.  
Engine overheating due to loss of coolant will most often be corrected by **SLOWLY** adding coolant while the engine is running at **FAST IDLE**. Should this fail to correct the problem, drain and flush the system and refill with fresh

coolant (50% solution of ethylene glycol) and a corrosion inhibitor.

Allow the engine to cool before draining and flushing the cooling system.

Water containing more than small concentrations of salt or minerals should not be used in the cooling system. Salt facilitates corrosion and minerals deposit on the coolant passage walls.

Both processes inhibit proper cooling.

3. Increased evaporation rates will cause the battery electrolyte level to fall more rapidly during very hot weather. Check the level frequently and add distilled water as required to maintain the proper level.
4. Air circulation around the engine and battery must not be restricted. Keep air intake and exhaust openings clear of leaves, paper or other foreign matter, which may restrict air flow.
5. Keep the engine clean of dirt. Grease and other substances, which inhibit heat dissipation.
6. Operate engine at full throttle when digging or tracking machine.  
Run the engine only when engaged in work operations or when traveling the machine. Avoid prolonged periods at idle and shut the engine down if operations are interrupted.

■ **Sandy or Dusty Work Sites**

The presence of large amounts of sand or dust at the work site can contribute to accelerated component wear. Either substance will act as an abrasive when deposited on moving parts of the machine.

This problem can be alleviated by increasing the schedule of lubrication and by servicing breathers and fillers at more frequent intervals. Follow the recommendations below when operating in sand or dust on a regular basis.



1. Keep sand and dust out of the hydraulic system by keeping the reservoir filler cap tight and servicing the hydraulic system filters frequently.
2. The fuel system should be kept free of sand and dust by keeping the tank filler cap tight and servicing the fuel filters frequently.
3. The engine breathers and air cleaner should also be serviced frequently to prevent sand and dust from entering the engine. The engine oil and oil filter should be changed at shorter than normal intervals to ensure a clean oil supply to the engine's moving parts.
4. When lubricating the machine, thoroughly clean each grease fitting before attaching the grease gun. Pump generous amounts of grease into all lubrication points, using the fresh grease to pump out old.
5. Adequate ground bearing support may be required for the tracks when operating in soft sand. Be alert for signs of track digging into sand during operations. It may be necessary to back off and fill in area where tracks dig in.  
The increased frequency of lubrication and service discussed above should be determined by observations made at the work site. Inspection will determine how long it takes for lubricants, breathers and filters to accumulate unacceptable amounts of sand or dust. The frequency of lubrication and service should be adjusted accordingly.

#### ■ High Humidity or Saltwater

In some locations, such as coastal areas, the machine may be exposed to the deteriorating effects of salt, moisture, or both. To protect exposed metallic surfaces, wiring, paint and other items, keep them dry and well lubricated where salt or high humidity are encountered. Follow the recommendations below when operating in these conditions.

1. Make frequent inspections for rust and corrosion and remove them as soon as they

are detected. Dry and paint exposed surfaces after rust and corrosion have been removed.

2. Where paint may not be applied, such as on polished or machined surfaces. Coat the area with grease or lubricant to repel water.
3. Keep bearings and their surrounding surfaces well lubricated to prevent the entry of water.
4. Never use saltwater in the cooling system. Internal corrosion will occur and all parts will have to be replaced.
5. Hose down the machine periodically when working in saltwater. If necessary, use an oil soaked cloth to clean moving parts.
6. If the machine is submerged, be sure it is never submerged in water deeper than upper crawler belt.  
If the machine exceeds this limit, disassemble, clean and lubricate the lower.

#### ■ High Altitudes

Variations in altitude alter the fuel-air mixture burned in the engine and affect the engine's performance. At high altitudes, Atmospheric pressures are lower and less oxygen is available for combustion of the fuel. Above 1500 meter, the engine fuel setting may have to be changed to ensure proper performance. Consult engine manufacturer should this problem answer.

Keeping the air cleaner clean and free of obstructions will help alleviate high altitude problems. At high altitudes, closely monitor the engine temperature for overheating.

### LONG TERM STORAGE

#### ■ Before Storage

To protect the cylinder rods, set the machine position in the right illustration.

(To prevent the cylinder rods from being rusted )

To store the machine from long term, follow the next procedures.

- Clean parts of the machine and store indoors.  
If you have to place the machine outdoors, choose a flat place and cover the machine.
- Be sure to perform fill the fuel, lubrication, and oil change.
- Apply grease on the exposed part of the hydraulic cylinder piston rods.
- Store the battery after move the negative terminal and covering it or dismounting the battery from the machine.
- Lock the control levers and pedals with the lock lever and pedal lock.



**Bucket position at the time of long term storage.**

#### ■ During Storage

##### **⚠ WARNING**

If you have to operate the machine indoors to prevent rust, keep good ventilation and gas poisoning by window or entrance.

During storage, operate the machine once a month to maintain films of oil at the lubrication section and charge the battery at the same time.

#### ■ After Storage

After long term storage, follow the next procedures before operating the machine.

- Wipe away grease on the hydraulic cylinder rods.
- Be sure to perform fill the fuel and lubrication.

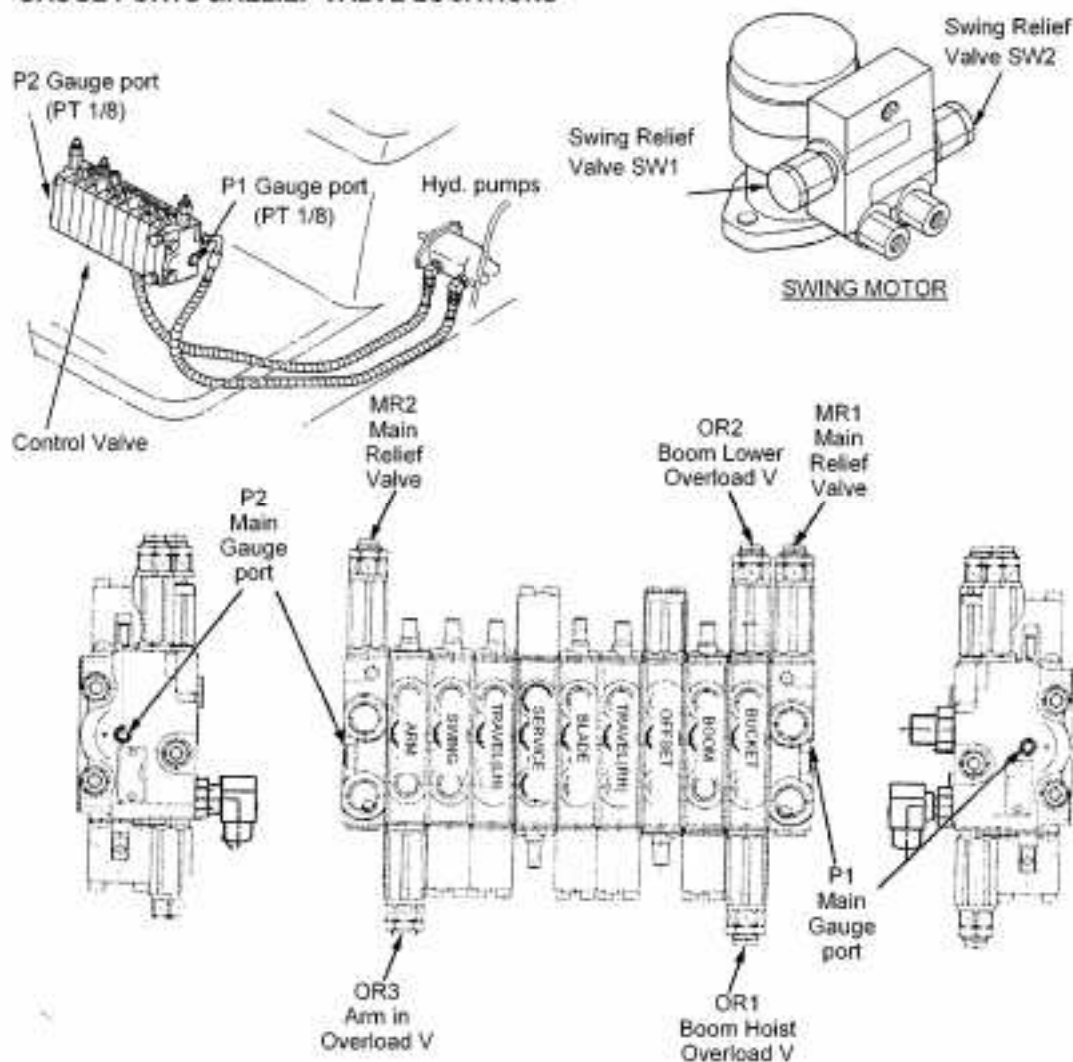
**HYDRAULIC SYSTEM PRESSURE SETTINGS**

**1. SET PRESSURE**

Hyd. Oil Temp.: 50±5°C

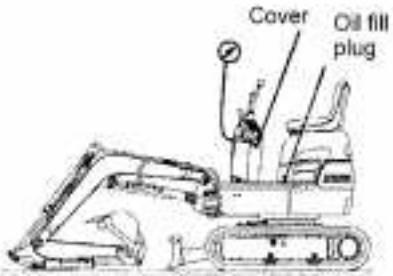
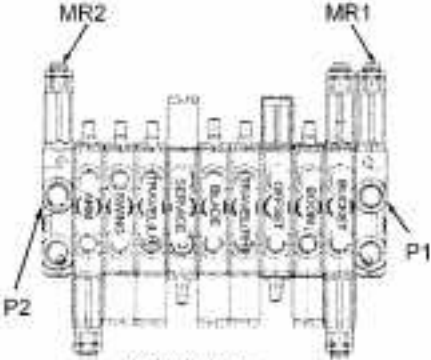
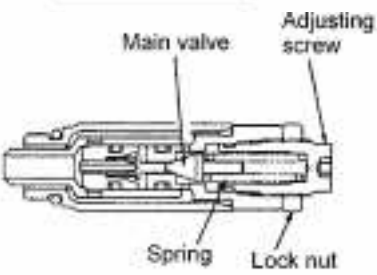
Relief Valves		Gauge Ports	Valve Location	Maintenance Std. MPa	Note
Main	Bucket, Boom, Travel (RH), Boom swing, Service	P1	MR1	16.2 <sup>+0.3</sup> <sub>-0.2</sub>	Rated Engine RPM
	Arm, Swing, Travel (LH), Service	P2	MR2	16.2 <sup>+0.3</sup> <sub>-0.2</sub>	Rated Engine RPM
Overload	Boom (Hoist)	Install Gauge Adapter in Att. Line	OR1	18.6 <sup>+0.5</sup> <sub>0</sub>	Refer to Pressure Measuring Procedure
			OR2		
	Arm (In)		OR3		
Brake	Swing	P2	SW1, SW2	6.4 <sup>+0.5</sup> <sub>0</sub>	Low Idle Engine RPM
	Travel	P1 (RH) P2 (LH)	Not Equipped		Relief the main relief valves

**2. GAUGE PORTS & RELIEF VALVE LOCATIONS**

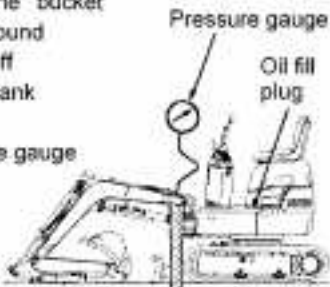
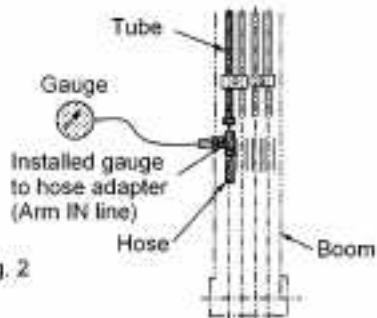
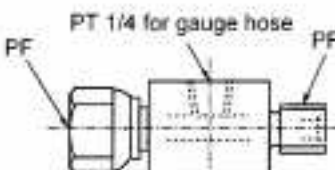
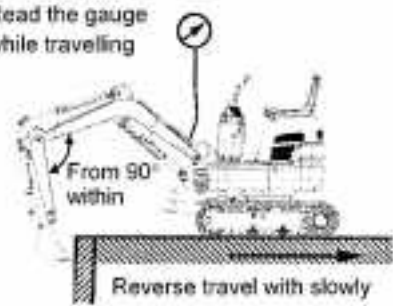


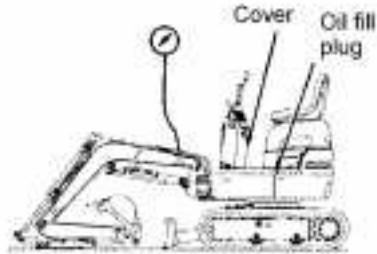
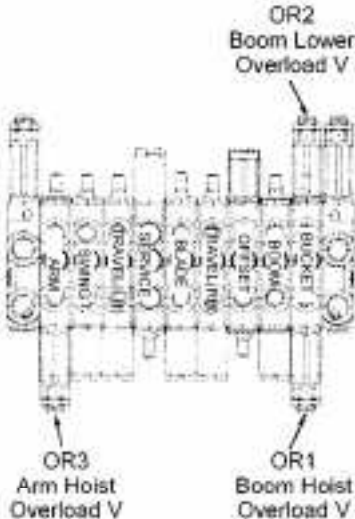
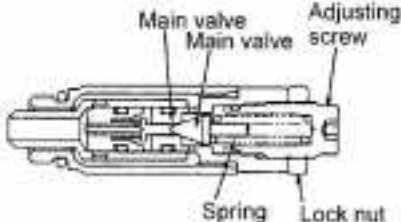
### 3. Main Relief Valve Pressure Measuring and Adjusting Procedure

	Procedures	Note
Conditions	<ol style="list-style-type: none"> <li>1. Engine speed : Maximum revolution</li> <li>2. Hyd. oil Temp. : <math>50 \pm 5^{\circ}\text{C}</math></li> <li>3. Install of pressure gauge : Install the pressure gauge (29.4 MPa) to gauge pods P1, P2 or P3 on the control valve.</li> </ol>	<div data-bbox="1089 296 1256 352" data-label="Image"> </div> <p>Do not remove the gauge port plug until air pressure has been relieved in hydraulic tank and engine off.</p>
Measuring procedures	<ol style="list-style-type: none"> <li>1. Stop the engine. Remove the oil fill plug on the hydraulic tank. Remove the cover and install the pressure gauge to measure port on the control valve. Install the fill plug.</li> <li>2. Measure the MR1 Main relief valve (Operation for Boom, Bucket, Travel R.H. and Service)               <ol style="list-style-type: none"> <li>(1) Start the engine, move the bucket or boom cylinder fully stroked.</li> <li>(2) Move the engine throttle lever to high idle. Move the bucket or boom lever fully stroke to hold it, and measure the pressure.</li> </ol> </li> <li>3. Measure the MR2 Main relief valve (Operation for Arm, Travel L.H. and Service)               <ol style="list-style-type: none"> <li>(1) Start the engine, move the arm cylinder fully stroked. (extend or retract)</li> <li>(2) Move the engine throttle lever to high idle. Move the arm lever fully stroke to hold it, and measure the pressure.</li> </ol> </li> <li>5. Remove the pressure gauge. Apply pipe sealant to the plug. Install the fill plug on the hydraulic tank. Install the cover.</li> </ol>	<div data-bbox="971 541 1360 806" data-label="Image"> </div> <p>Cover Oil fill plug</p> <p>Main relief valves</p> <div data-bbox="948 890 1377 1268" data-label="Image"> </div> <p>MR2 MR1 P2 P1</p> <p>Gauge ports</p> <p>Control valve Ass'y</p>

	Procedures	Note
Adjusting procedures	<p><b>Adjusting the Main relief valve</b></p> <p>If the pressure is lower than the specified value, adjust it according to the following procedure.</p> <p>(Same procedures as MR1, MR2)</p> <ol style="list-style-type: none"> <li>1. Remove the lock nut.</li> <li>2. Start the engine and the engine throttle lever to high idle.</li> <li>3. Move the lever for measuring main relief valve, fully pull to hold it, and adjust the pressure by turning the adjusting screw with a hexagon bar spanner, while measuring the pressure. Adjusting screw turn to clockwise to raise the pressure. (Adjusting screw 1 turn approx. 9.8 MPa change pressure)</li> <li>4. Install and tighten the lock nut.</li> <li>5. After locking, measure the pressure again.</li> <li>6. Stop the engine. Remove the fill plug on the hydraulic tank.</li> <li>7. Remove the pressure gauge. Apply pipe sealant to the plug. Install the plug. Install the fill plug on the hydraulic tank.</li> </ol>	<p><b>WARNING</b></p> <p>Do not remove the gauge port plug until air pressure has been relieved in hydraulic tank.</p>  <p>Main relief valves</p>  <p>Gauge ports</p> <p>Control valve Ass'y</p>  <p>Cross section of Main relief valve</p>

4. Over load Relief Valve Pressure Measuring and Adjusting Procedure

	Procedures	Note
Conditions	<ol style="list-style-type: none"> <li>1. Engine speed : Low idle</li> <li>2. Hyd. oil Temp. : <math>50 \pm 5^{\circ}\text{C}</math></li> <li>3. Install of pressure gauge : Install the pressure gauge (29.4MPa) to the arm dig line with hose adapter.</li> </ol>	<p><b>WARNING</b></p> <p>Do not remove the gauge port plug until air pressure has been relieved in hydraulic tank.</p>
Measuring procedures	<p>Since the over load relief valve has a little of flow, 20 /min, at the pressure setting, no measurement can be made with the pump flow. Measure the pressure following procedure to relieve over load relief valve by setting the arm cylinder with TRAVEL.</p> <ol style="list-style-type: none"> <li>1. Lower the bucket to the ground. Stop the engine. Remove the fill plug on the hydraulic tank. Install the pressure gauge to the arm IN line with hose adapter. Install the fill plug. (Fig 1 &amp;2)</li> <li>2. Measure the over load relief valve. (For arm IN line)               <ol style="list-style-type: none"> <li>(1) Start the engine, move the bucket contact to the hard wall. (Fig. 4)</li> <li>(2) Move the engine throttle lever to low idle. Pull the travel levers fully stroke to hold it, and measure the pressure while traveling. (Fig. 4)</li> <li>(3) For the boom over load relief valves, replace the arm IN over load relief valve with it to measure the Pressure.</li> </ol> </li> <li>3. Lower the bucket to the ground. Stop the engine. Remove the fill plug on the hydraulic tank.</li> <li>4. Remove the pressure gauge and hose adapter. Install the arm IN line hose to tube. Install the fill plug on the hydraulic tank.</li> </ol>	<p>1. Lower the bucket to the ground</p> <p>2. Engine off</p> <p>3. Relieve tank pressure</p> <p>4. Install the gauge</p>  <p>Fig. 1</p>  <p>Fig. 2</p>  <p>Fig. 3 Hose adapter 1/4 : 0472 953 01 3/8 : 0472 953 02</p> <p>Read the gauge while travelling</p>  <p>Fig. 4</p>

	Procedures	Note
Adjusting procedures	<p><b>Adjusting the over load relief valve</b></p> <p>If the pressure is lower than the specified value, adjust it according to the following procedure. (Same procedures for OR1 thru OR3)</p> <ol style="list-style-type: none"> <li>1. Remove the lock nut.</li> <li>2. Adjust the pressure by turning the adjusting screw with a hexagon bar spanner. Adjusting screw turn to clockwise to raise the pressure. (Adjusting screw 1 turn approx. 9.8 MPa change pressure)</li> <li>4. Install and tighten the lock nut.</li> <li>5. After locking, measure the pressure again.</li> <li>6. Lower the bucket to the ground. Stop the engine. Remove the fill plug on the hydraulic tank.</li> <li>7. Remove the pressure gauge and hose adapter. Install the arm IN line hose to tube. Install the fill plug on the hydraulic tank.</li> </ol>	<p><b>WARNING</b></p> <p>Do not remove the over load relief valve until air pressure has been relieved in hydraulic tank and lowered the bucket to the ground.</p>    <p>Cross section of over load relief valve Ass'y</p>



5. Swing Relief Valve Pressure Measuring and Adjusting Procedure

	Procedures	Note
Conditions	<ol style="list-style-type: none"> <li>1. Engine speed : Low idle</li> <li>2. Hyd. oil Temp. : <math>50 \pm 5^{\circ}\text{C}</math></li> <li>3. Install of pressure gauge : Install the pressure gauge (29.4 MPa) to the P2 gauge port.</li> </ol>	<div data-bbox="1089 296 1256 348" data-label="Image"> </div> <p>Upper structure movement can cause personal injury or death. To prevent structure movement, visually inspect to be sure the pin is engaged.</p>
Measuring procedures	<ol style="list-style-type: none"> <li>1. Align the upper structure with the track and engage the swing lock pin and lower the bucket to the ground.</li> <li>2. Stop the engine. Remove the fill plug on the hydraulic tank. Install the pressure gauge on the control valve to P2 gauge port. Install the fill plug.</li> <li>3. Start the engine, move the engine throttle lever to low idle. Move the swing lever right or left fully stroke to hold it, and measure the pressure.</li> <li>4. Stop the engine. Remove the fill plug on the hydraulic tank.</li> <li>5. Remove the pressure gauge. Apply pipe sealant to the plug. Install the fill plug on the hydraulic tank.</li> </ol>	<p>Do not remove the gauge port plug until air pressure has been relieved in hydraulic tank.</p> <p>Align the upper structure with the track and engage the swing lock pin and lower the bucket to the ground.</p> <div data-bbox="992 821 1382 978" data-label="Image"> </div>
Adjusting procedures	<p>This swing relief valve not equipped pressure adjusting device. Do not adjust the pressure.</p> <p>If the pressure is lower than the specified value, replace the swing relief valve ass'y.</p> <ol style="list-style-type: none"> <li>1. Stop the engine. Remove the fill plug on the hydraulic tank.</li> <li>2. Remove the swing relief valve and install the new swing relief valve.</li> <li>3. Install the fill plug on the hydraulic tank.</li> </ol>	<div data-bbox="1078 1094 1403 1461" data-label="Image"> </div> <div data-bbox="976 1482 1411 1829" data-label="Image"> </div>



**SECTION 6 PERFORMANCE STANDARDS****TABLE OF CONTENTS**

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**Performance Judgement Procedures**

If the user points out that "this machine lost power", "the speed of this machine dropped" or "the cylinder's lowering amount is too great", then a performance judgement is required. By so testing, a quantitative performance level is obtained for each section of the machine, and the performance of the machine is restored to its specified level by means of such treatment as the appropriate adjustment, replacement or repair. The machine's "standard value" in terms of which to judge the level of the measured data, and the "allowance value" where the machine performance is lowered but allowable, have been set. When the performance level is measured, if the conditions have changed, a correct judgement is not available. Therefore, measure it under the specified conditions. (Refer to "Performance Measurement Instructions" on the next page.

**1. Measurement Location**

- (1) Flat and solid ground
- (2) Clearing space for the attachment to swing with maximum reach.
- (3) Clearing flat and solid ground where the machine can run 10 m straight.
- (4) Safety measures such as "Keep Off" should be in place for the measurement (using ropes to mark "Keep Off").

The meeting regarding work procedures and signs should be held in advance with other involved parties.

**2. Measuring Instruments**

- (1) Stop watch
- (2) Scale
- (3) Thermometer
- (4) Inclination gauge
- (5) Pen, notebook, chalk and felt pen

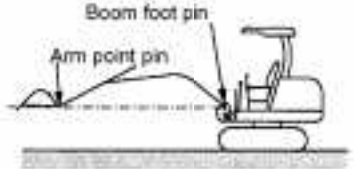
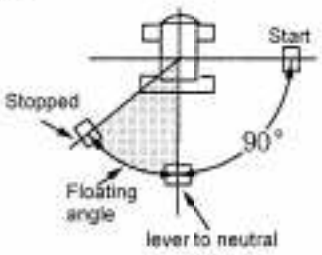
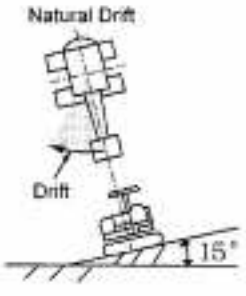
**3. Perform the measurement under the conditions specified.**

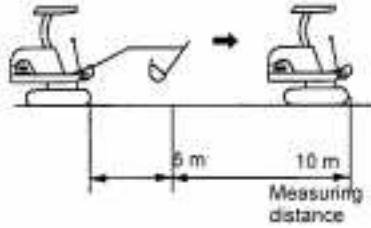
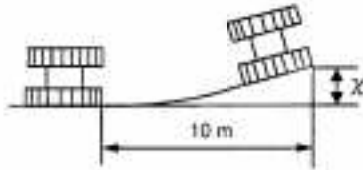
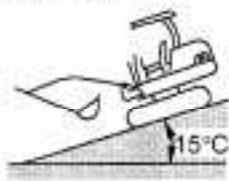
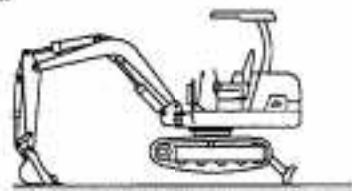
If measurement conditions change, then measured values will in turn change, greatly. If the specified conditions are not followed, record the actual conditions.

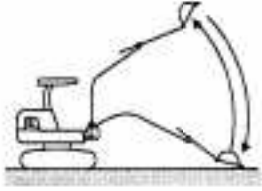
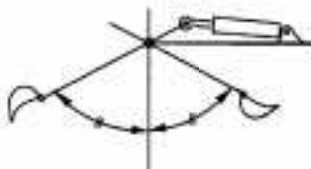
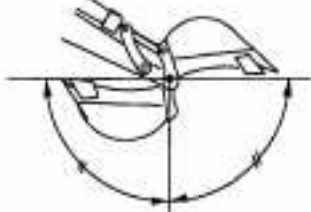
- (1) If the manufacturer is to be consulted because of trouble, report the measurement conditions; in particular, oil temperature and engine speed (max. speed without load, single pump relief, double pump relief)
- (2) The standard values are set under the condition of bucket without load (empty). However if it is noticed that performance is degraded when load is applied (soil is in the bucket), then measure the value in each case. That is often caused by lower oil temperature. Therefore, measure the relief pressure and if it drops, adjust it.
- (3) Perform the measurement three times and base the estimate on the average value. If any of the values is greatly different, there may have been mistaken measurement. Re - measure.

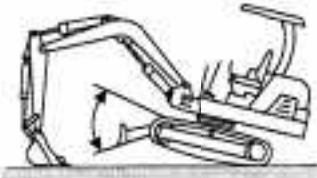
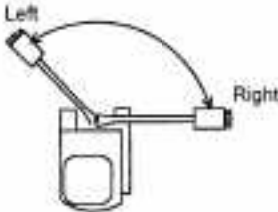
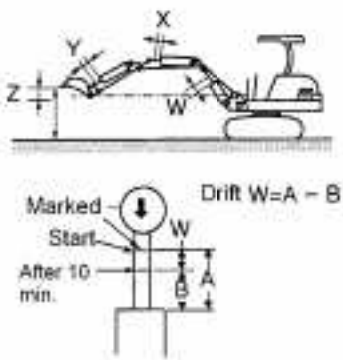
4. If any measured value greatly differs from the standard:
  - (1) Check that the measurement conditions and methods have been appropriate. (Engine speed, oil pressure, oil temperature, ground for measurement, bucket load)
  - (2) Performance has been greatly degraded. In that case the performance will have been degraded because of the maintenance conditions, work type, work conditions, deterioration from age, etc.. In the light of such over – all situation, consider restoring to the allowable level rather than restoring to the standard level.

	ITEM	UNIT	STANDARD	ALLOW.	NOTE
ENGINE	Rated R.P.M	min <sup>-1</sup>	2,400	-	
	Rated Output	kw	7.3	- 5 %	
	Max. Torque	N•m	34.8	- 5 %	
	High Idle (No load)	min <sup>-1</sup>	2,570	± 25	
	Low Idle (No load)	min <sup>-1</sup>	1,200	± 25	
HYDRAULIC	Boom	MPa	16.2 <sup>+0.5</sup> <sub>-0</sub>	16.2 <sup>+0.5</sup> <sub>-0</sub>	<ul style="list-style-type: none"> <li>At hydraulic temperature 50 ± 5 °C</li> </ul>
	Arm		↑	↑	
	Bucket		↑	↑	
	Swing		6.9 <sup>+0.5</sup> <sub>-0</sub>		
	Travel		16.2 <sup>+0.5</sup> <sub>-0</sub>		
	Boom Swing		↑	↑	
	Blade		↑	↑	
LEVER FORCE	Boom	kg	1.3 ± 0.5	←	<ul style="list-style-type: none"> <li>At engine stopped</li> </ul>
	Arm		1.3 ± 0.5	←	
	Bucket		1.3 ± 0.5	←	
	Swing		1.3 ± 0.5	←	
	Travel		2.0 ± 0.5	←	
	Boom Swing		6.0 ± 0.5	←	
	Blade		1.4 ± 0.5	←	
	Throttle		5.0 ± 0.5	←	
SPOOL STROKE	Boom	mm	6.0	←	<ul style="list-style-type: none"> <li>Mechanical control type</li> <li>Check and adjust the stopper of the operation lever in advance</li> </ul>
	Arm				
	Bucket				
	Swing				
	Boom Swing				
	Travel				
	Service				
	Blade				

ITEM	CONDITION	STANDARD	ALLOW.
<p>SWING</p> <p>Upper floats when swing operation is stopped. (Brake working angle)</p>	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p> <p>Fully retracted bucket cylinder and arm cylinder. Arm point pin positioned to be horizontal with boom foot pin.</p>  <p>Return lever to neutral after rotating <math>90^{\circ}</math> with no load. Measure floating angle after stop the machine.</p> 	<p><math>10 \pm 5^{\circ}</math></p>	<p>Below <math>35^{\circ}</math></p>
<p>Swing Operating Speed</p>	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p> <p>Fully retracted bucket cylinder and arm cylinder. Arm point pin positioned to be horizontal with boom foot pin. Measure time required for two turns after one turn is made.</p>	<p>13.8 sec <math>\pm 0.5^{\circ}\text{ sec}</math></p>	<p>Below 16.0 sec</p>
	<p>Engine : Low idling Oil temp : <math>50 \pm 5^{\circ}\text{C}</math> Incline angle : <math>15^{\circ}</math> Fully retracted bucket cylinder and arm cylinder. Arm point pin positioned to be horizontal with boom foot pin. Slant surface crosswise.</p> <p>Measure drift angle after 5 minutes.</p>	<p>Below <math>0^{\circ}</math></p>	<p>Below <math>0^{\circ}</math></p>

ITEM	CONDITION	STANDARD	ALLOW.
TRAVEL  Travel Speed	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p> <p>Level solid ground Time required for 10 m travel after 5 m take off.</p> 	Rubber shoe	
		<p>High Speed 16.2 sec <math>\pm 0.5</math> sec</p> <p>Low Speed 21.2 sec <math>\pm 1.0</math> sec</p>	<p>High Speed below 12.5 sec</p> <p>Low Speed below 23.2 sec</p>
Travel Alignment	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p> <p>Measure turning distance (<math>\chi</math>) after 10 m travel.</p> 	Below 700 mm	Below 1000 mm
Natural Drift 	<p>Engine : Low idling Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p> <p>Measure drift gravity in 5 minutes.</p>	100 mm / 5 min	500 mm / 5 min
Time for Crawler belt	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p> <p>Measure time required for five turns after one turn.</p> 	<p>High Speed 13.6 sec <math>\pm 1.0</math> sec</p> <p>Low Speed 28.2 sec <math>\pm 1.0</math> sec</p>	<p>High Speed below 16.7 sec</p> <p>Low Speed below 32.4 sec</p>

ITEM	CONDITION	STANDARD	ALLOW.
BOOM CYLINDER SPEED	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p>  <p>Arm and bucket cylinder fully retracted. Without measure cushion stroke.</p> <ol style="list-style-type: none"> <li>1. Measure time to raise boom from ground level to maximum height.</li> <li>2. Measure time to lower boom from maximum height to ground level.</li> </ol>	With canopy	
		<p>Hoist 2.7 sec <math>\pm 0.5</math> sec</p> <p>Lower 2.3 sec <math>\pm 0.5</math> sec</p>	<p>Below 3.5 sec</p> <p>Below 3.1 sec</p>
ARM CYLINDER SPEED	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p>  <p>Divided Equally</p> <p>Measure time for full extension or retraction of cylinder. Without measure cushion stroke.</p>	<p>Arm In 3.8 sec <math>\pm 0.5</math> sec</p> <p>Arm Out 2.9 sec <math>\pm 0.5</math> sec</p>	<p>Below 4.9 sec</p> <p>Below 3.8 sec</p>
BUCKET CYLINDER SPEED	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p>  <p>Divided Equally</p> <p>Measure time for full extension or retraction of cylinder.</p>	<p>Dig 2.8 sec <math>\pm 0.5</math> sec</p> <p>Dump 2.2 sec <math>\pm 0.5</math> sec</p>	<p>Below 3.6 sec</p> <p>Below 2.9 sec</p>

ITEM	CONDITION	STANDARD	ALLOW.
BLADE CYLINDER SPEED	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p>  <p>Measure time for full extension or retraction of cylinder.</p>	<p>Hoist 2.3 sec <math>\pm 0.5</math> sec</p> <p>Lower 2.8 sec <math>\pm 0.5</math> sec</p>	<p>Below 3.1 sec</p> <p>Below 3.7 sec</p>
BOOM SWING CYLINDER SPEED	<p>Engine : Rated r.p.m. Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p>  <p>Measure time for full extension or retraction of cylinder. Without measure cushion stroke.</p>	<p>Left 4.6 sec <math>\pm 0.5</math> sec</p> <p>Right 4.7 sec <math>\pm 0.5</math> sec</p>	<p>Below 6.0 sec</p> <p>Below 6.0 sec</p>
CYLINDER DRIFT	<p>Engine : Stopped Oil temp : <math>50 \pm 5^{\circ}\text{C}</math></p> <p>Bucket load : Non load Fully retracted bucket cylinder and arm cylinder. Arm point pin positioned to be horizontal with boom foot pin. Measure the variation of rod length in 10 minutes.</p> 	<p>Boom Cylinder : below 10 mm</p> <p>Arm Cylinder : below 10 mm</p> <p>Bucket Cylinder : below 5 mm</p> <p>Bucket Tooth Point : below 200 mm</p>	<p>Below 20 mm</p> <p>Below 20 mm</p> <p>Below 10 mm</p> <p>Below 400 mm</p>