

Service Guide

17VX3

IHI

SERIAL NUMBERS
WR004001- up

PUB. No.1

1204

HYDRAULIC MINI EXCAVATOR

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SECTION 1 SPECIFICATIONS

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GENERAL SPECIFICATIONS

■ BASE MACHINE PERFORMANCE

Swing speed	min ⁻¹	9.5
Travel speed	km / h	2.1 / 4.0
Gradability	% (deg.)	58 (30)

■ ENGINE

Engine model	-	YANMAR 3TNV70
Engine type		4cycle, water cooled, over-head, valve, indirect injection
No. of cyl. - bore × stroke	mm	3 - 70 × 74
Total piston displacement	L	0.854
Rated output	kW / min ⁻¹	10.5 / 2300 [DIN6271, 10.4 / 2300]
Max. torque	N•m / min ⁻¹	51.8 / 1600

■ WEIGHT

			STD	with ADD Weight
Machine mass	Rubber shoe	kg	1220	1320
	Steel shoe		1280	1380
Average ground bearing pressure	Rubber shoe	kPa	26.2	27.8
	Steel shoe		27.8	29.4

■ AMOUNT OF FUEL, OIL, COOLANT

Fuel		L	20
Hydraulic fluid	Oil level	L	19
	Total amount	L	23
Engine oil	Max. level	L	3.8
	Min. level	L	2.1
Coolant	Engine proper	L	0.9
	Total amount	L	3.6

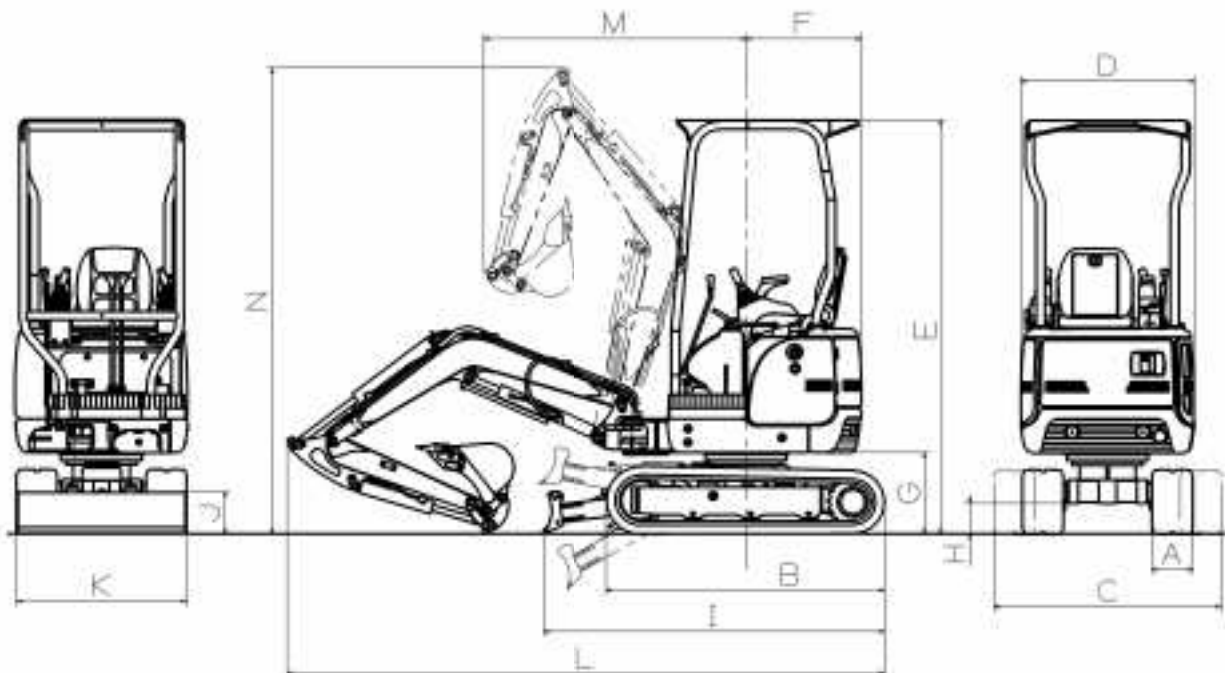
■ BUCKET

◎: Std. applicable

○: Applicable

×: Not applicable

Bucket capacity		Side cutter width (mm)	Number of teeth	Weight (kg)	Combinations		Remarks	Remarks
ISO(m ³)					Std. arm	Long arm		
Heaped	Struck							
0.044	0.025	450	3	47	⊙	×	Standard	General digging
0.024	0.015	300	2	35	○	○	OPT.	Ditch digging
0.033	0.018	350	3	41	○	⊙	OPT.	Long arm Ditch digging
0.055	0.029	500	3	49	○	×	OPT.	Loading

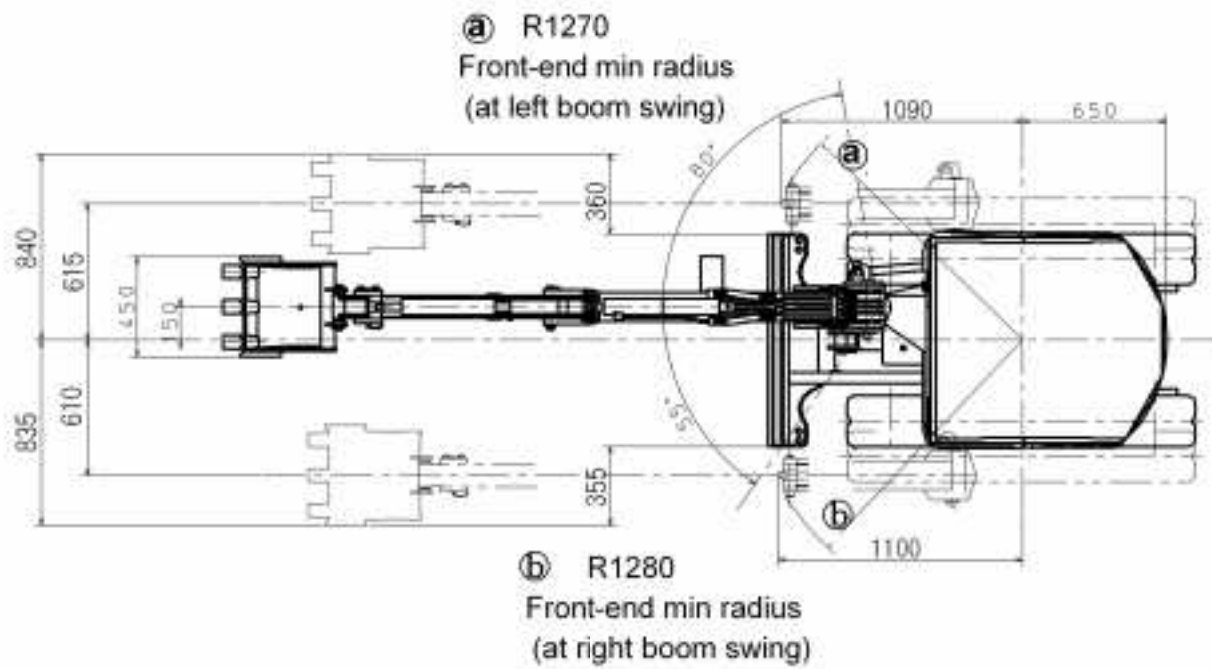
OVERALL DIMENSIONS

Unit: mm

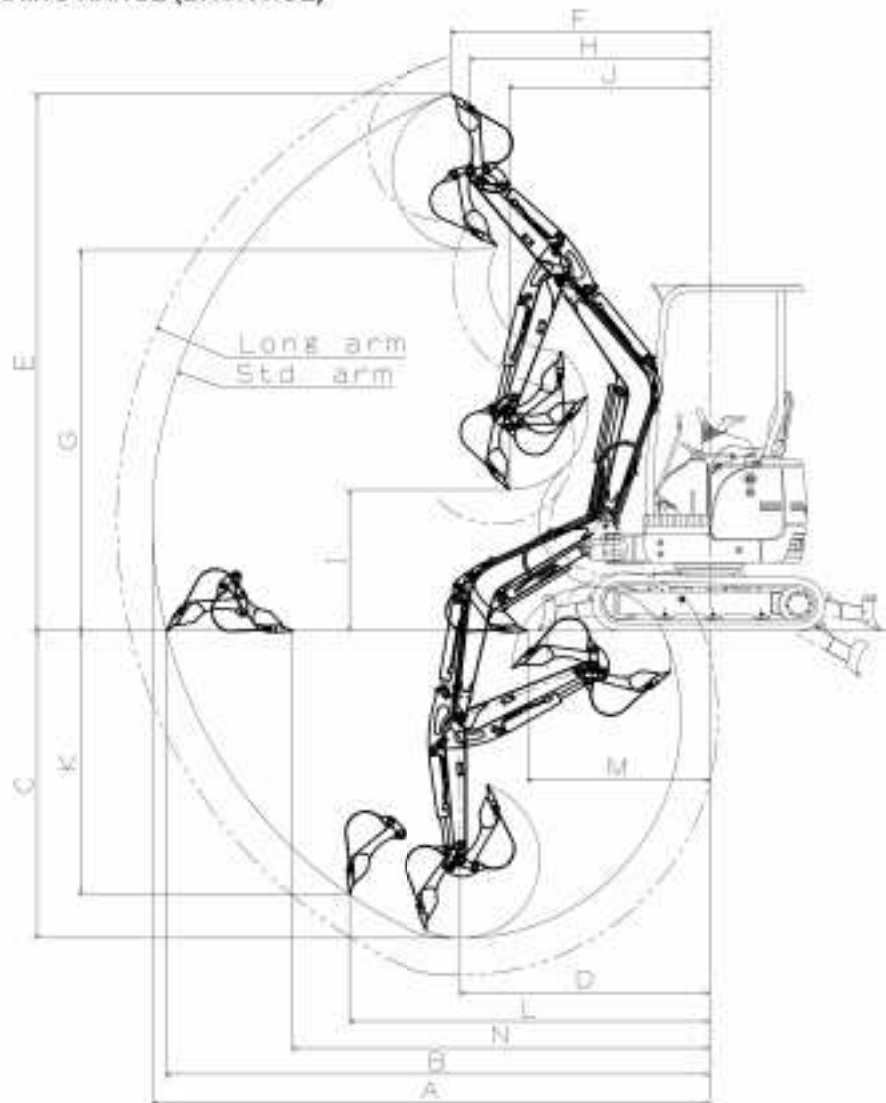
Codes	Description	STD		ADD Weight	
		Rubber shoe	Steel shoe	Rubber shoe	Steel shoe
A	Crawler shoe width	230	230	230	230
B	Overall length of crawler	1570	1540	1570	1540
C	Overall width of crawler	960~1280	960~1280	960~1280	960~1280
D	Canopy	980	980	980	980
E	Canopy	2330	2330	2330	2330
F	Rear end swing radius	650	650	720	720
G	Rear end ground clearance	460	460	460	460
H	Mini. ground clearance	175	175	175	175
I	Overall length of undercarriage	1930	1930	1930	1930
J	Blade height	235	235	235	235
K	Blade width	960	960	960	960
L	Overall length Blade in front	3380	3380	3380	3380
	Blade in rear	3750	3750	3750	3750
M	Front end mini. radius at center	1490	1490	1490	1490
N	Arm head clearance	2630	2630	2630	2630

WORKING RANGE

■ BOOM SWING DIGGING WORKING RANGE



■ WORKING RANGE (BACK HOE)

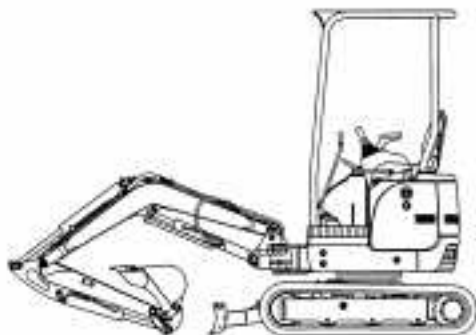


Unit: mm

Key	Description	Std. arm	Long arm
	Std. of bucket capacity (m ³), ISO Heaped	0.044	0.033
A	Max. digging radius	3760	3990
B	Max. bucket outreach at ground level	3660	3910
C	Max. digging depth(Not used blade)	2100	2350
D	Radius of max. digging depth	1680	1680
E	Max. digging height	3610	3810
F	Radius of max. digging height	1740	1900
G	Max. dumping height	2560	2760
H	Radius of max. dumping height	1610	1770
I	Min. dumping height	950	720
J	Radius of min. dumping height	1350	1440
K	Max. vertical digging depth	1770	2010
L	Radius of max. vertical digging depth	2430	2490
M	Radius of min. digging ground level	1220	1120
N	Max. clean-up radius at floor level	2810	3040

WEIGHT BREAKDOWN**WEIGHT BREAKDOWN**

1. Machine weight at transported style



Shoe / Cabin Spec.	Weight (kg)
Rubber shoe / Canopy 4P	1550
Steel shoe/Canopy 4P	1620
(With ADD CWT + 100 kg)	

2. Base machine



Shoe / Cabin Spec.	Weight (kg)
Rubber shoe / Canopy 4P	1360
Steel shoe/Canopy 4P	1430
(With ADD CWT + 100 kg)	

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)
Canopy 4P	830
(With ADD CWT + 100 kg)	

4. Under carriage

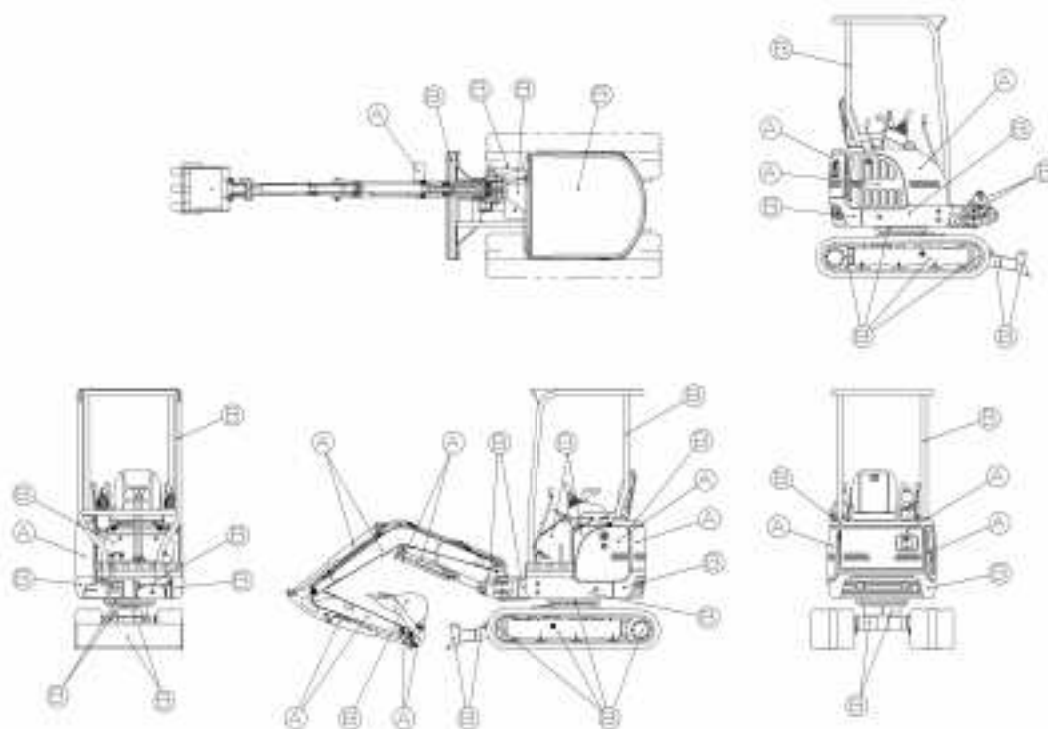


Specification	Weight (kg)
Rubber shoe	530
Steel shoe	600

5. Hoe attachment



Specification	Weight (kg)
Standard arm	190
Long arm	200

PAINING 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 3TNV70-QIK
Applicable emission control	EPA Tier2
Engine type	Vertical serial water-cooled 4-cycle diesel engine (indirect injection)
No. of cylinder - bore × stroke	3 - ϕ 70 × 74
Total piston displacement	0.854L
Compression ratio	23
Output (Net, Output tolerance: $\pm 3\%$)	10.5kW / 2300min ⁻¹ (Machine name plate indication: 10.5 kW/2300rpm)
Maximum torque	47.5–51.8N·m/1600 \pm 100 min ⁻¹
Fuel consumption	≤ 279 g/kW·h
Atmospheric conditions	Room temperature 25°C Atmospheric pressure 100kPa (750mmHg) Relative humidity 30%
Fuel oil condition	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)
Non-loaded rotation speed	Maximum : 2460(+25/-25)min ⁻¹ , Minimum : 1250(+25/-25)min ⁻¹
Speed fluctuation	Momentary : $\leq 12\%$, Stabilized : $\leq 7\%$
Stabilization time	≤ 6 s
Rotation fluctuation	≤ 30 min ⁻¹
Permissible tilt angle	Continuously 30 degrees (longitudinal and cross) Momentary 35 degrees (longitudinal and cross)
Engine rotating direction	Counterclockwise when viewed from the flywheel side
Engine weight (Dry)	98 (+5/0)kg

Fuel system	
Applicable fuel	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)
Fuel injection pump	Bosch YPES type (YPES-ML) 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	$\phi 290$ -5(suction), Seat between fans T=18 Crank pulley/fan pulley = $\phi 110/90$

Air cleaner	Cyclone type (resin 4 inches) double element
-------------	--

Start system	Electrical
Starter	12V-1.1kW
Alternator	12V-20A
Battery (recommended value)	55B24
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 0.9L (engine proper)
Lubricant volume	Total: 3.8L, Effective: 1.7L (oil pan)

LIFTING CAPACITIES TABLES

LOAD RATING CHART (SAE method)

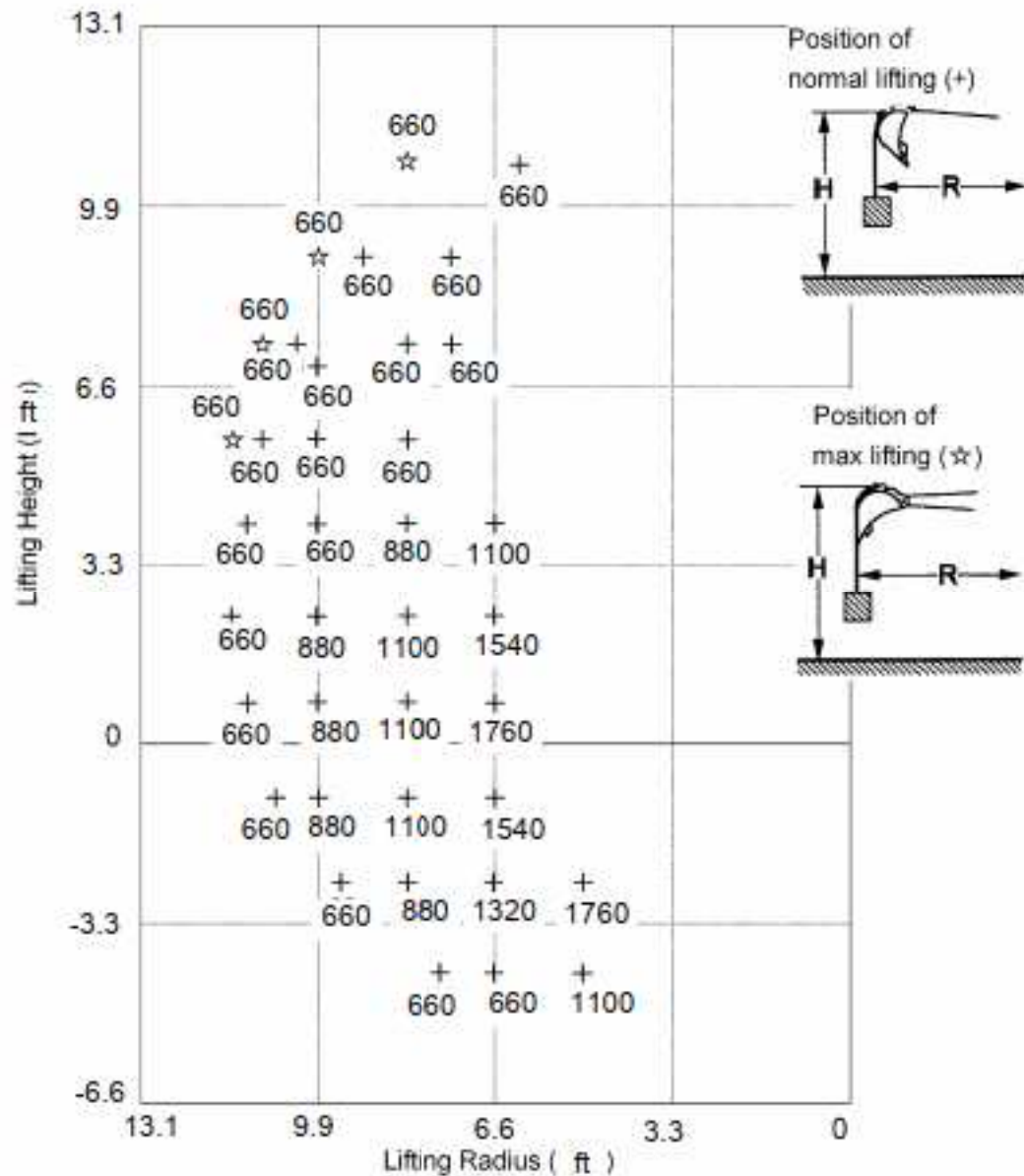
Note : At front over end and the Blade fulcrum with equipped standard arm.

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

Unit : lbs.

+ : Lifting height

☆ : Maximum lifting radius



LIFTING CAPACITIES TABLES

LOAD RATING CHART (SAE method)

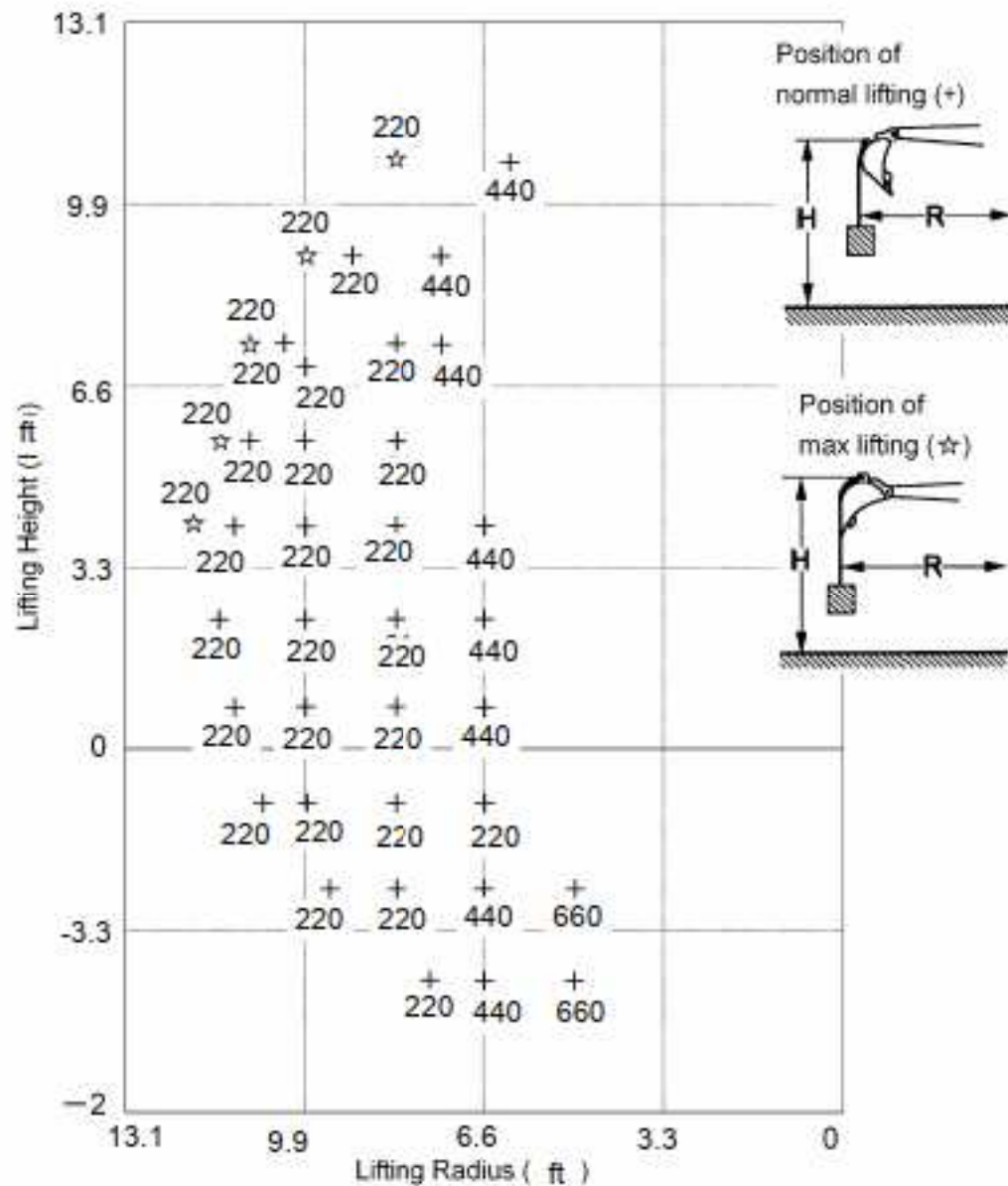
Note : At over side; at crawler width contraction; with equipped standard arm.

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

Unit : lbs.

+ : Lifting height

☆ : Maximum lifting radius



LIFTING CAPACITIES TABLES

LOAD RATING CHART (SAE method)

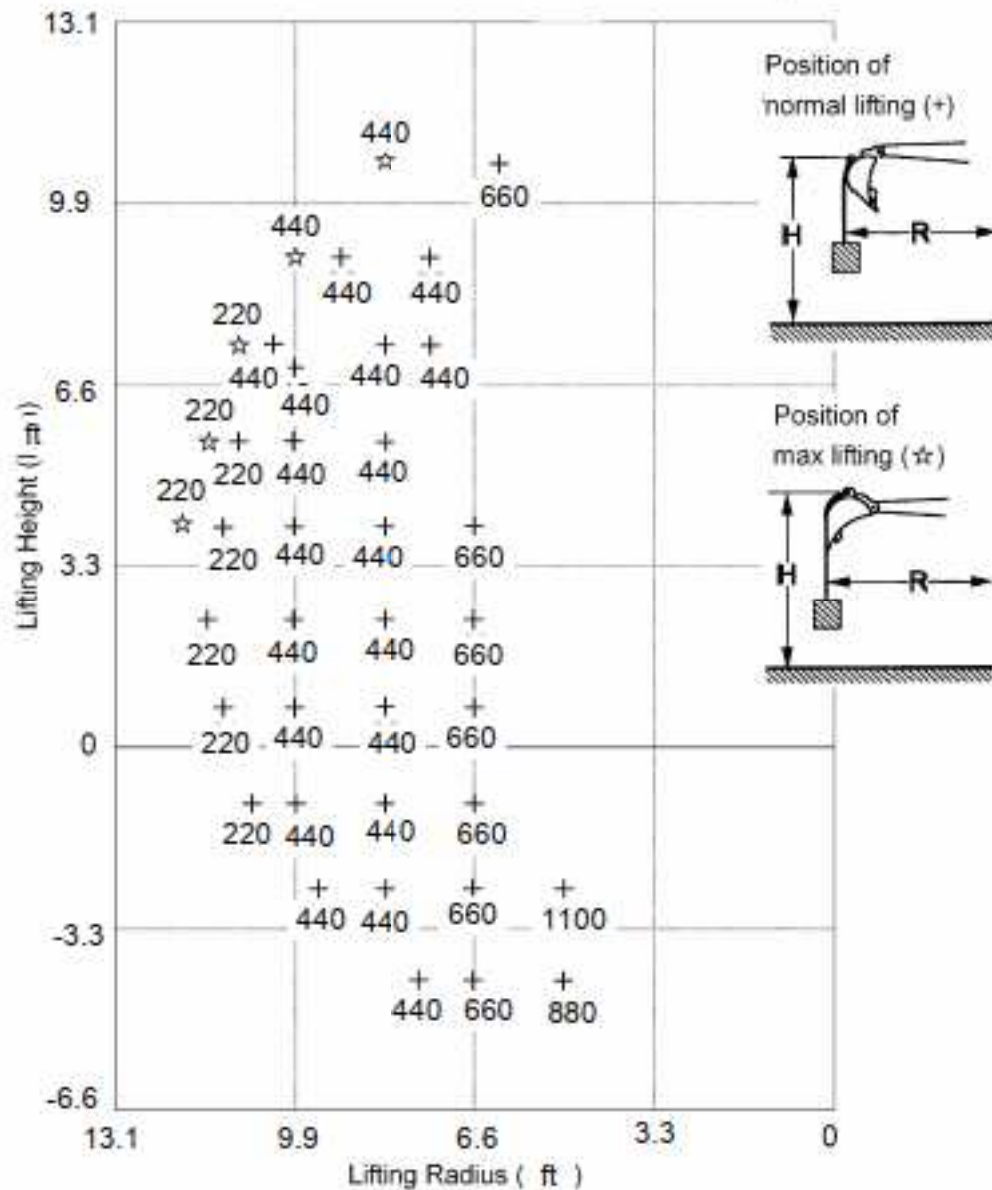
Note : At over side; at crawler width expansion; with equipped standard arm.

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

Unit : lbs.

+ : Lifting height

☆ : Maximum lifting radius



LIFTING CAPACITIES TABLES

LOAD RATING CHART (SAE method)

Note : ADD. CWT specification

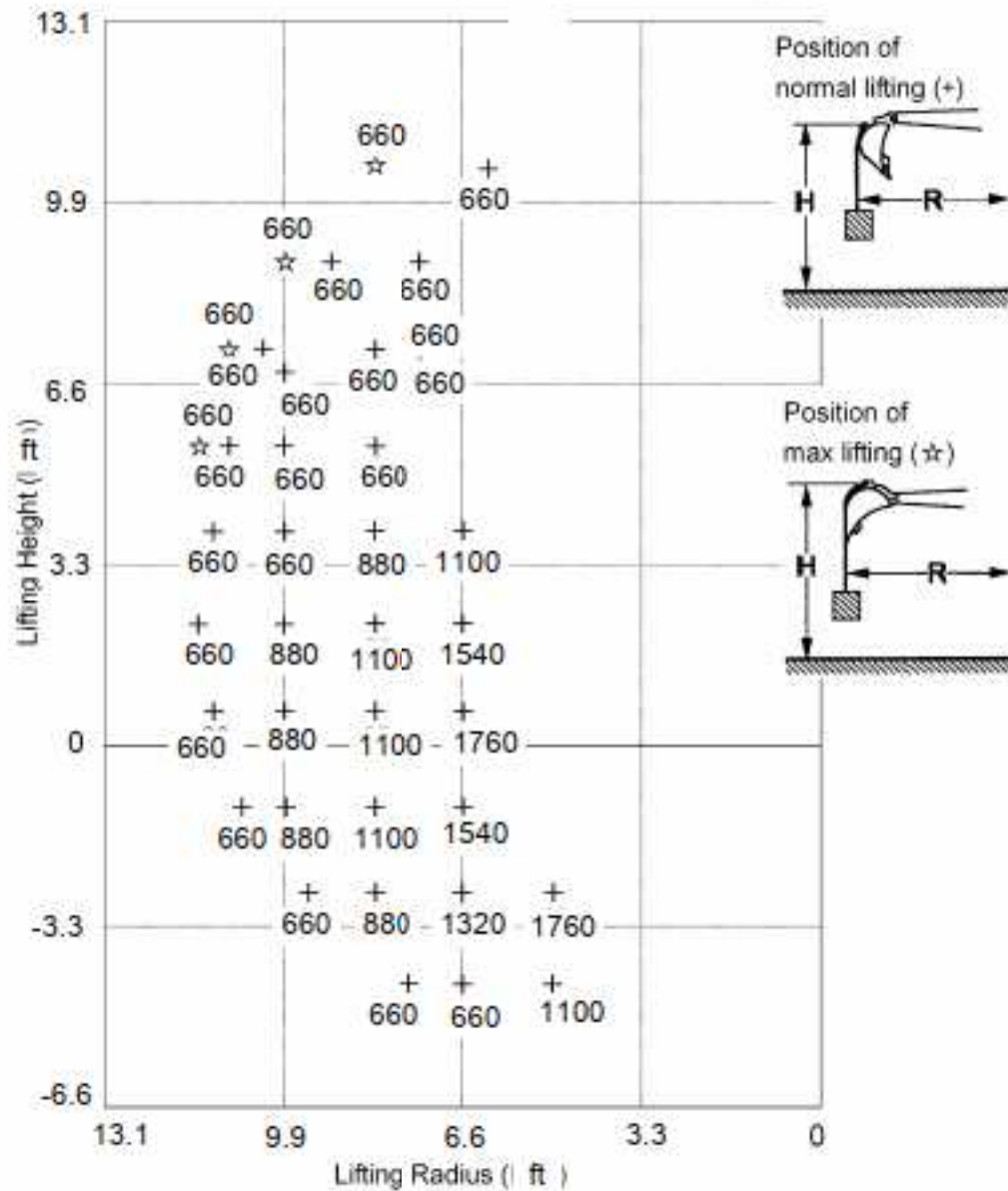
At front over end and the blade fulcrum with equipped standard arm.

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

Unit : lbs.

+ : Lifting height

☆ : Maximum lifting radius



LIFTING CAPACITIES TABLE

LOAD RATING CHART (SAE method)

Note : ADD. CWT specification

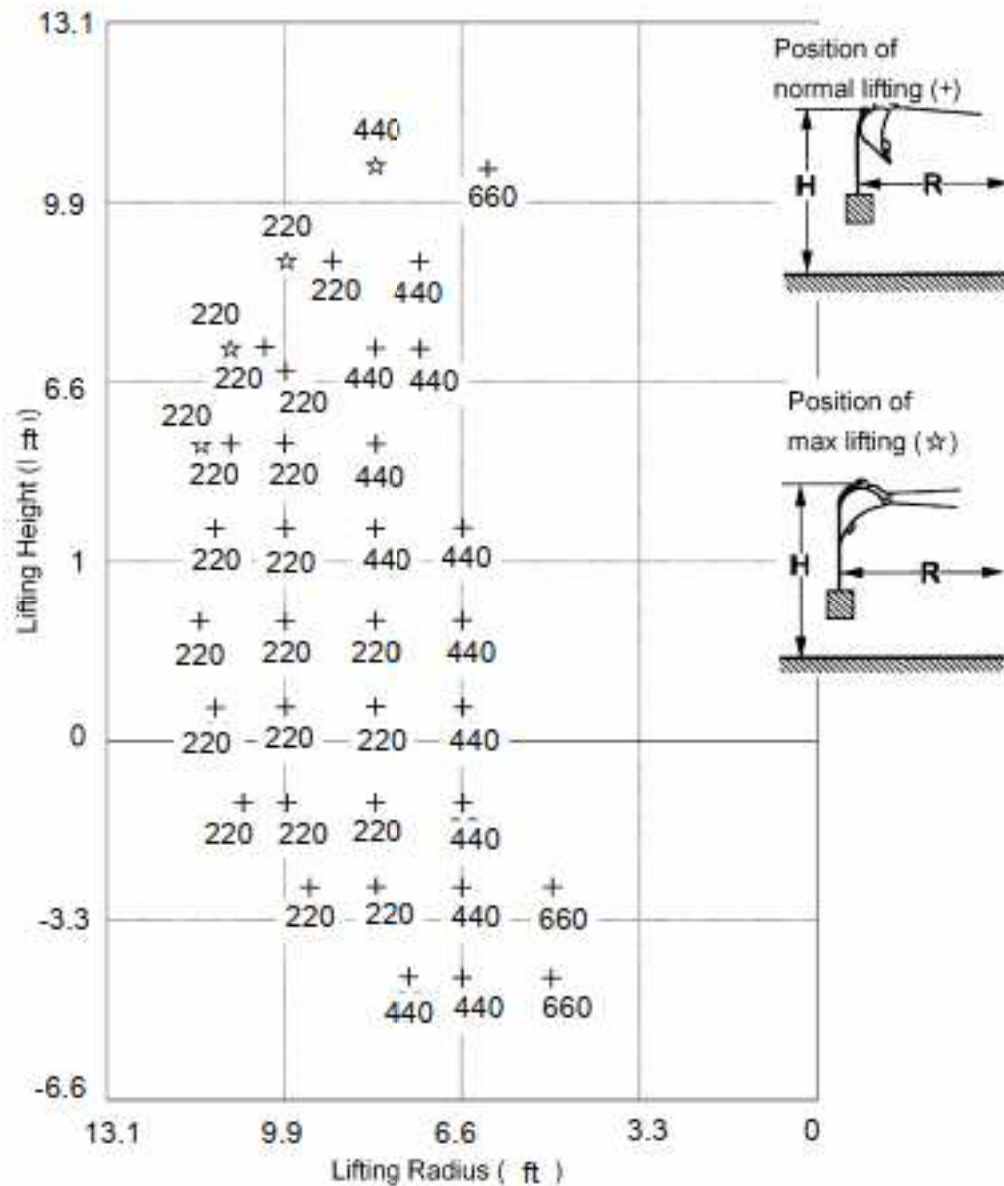
At over side ; at crawler width contraction; with equipped standard arm.

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

Unit : lbs.

+ : Lifting height

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LIFTING CAPACITIES TABLE

LOAD RATING CHART (SAE method)

Note : ADD. CWT specification

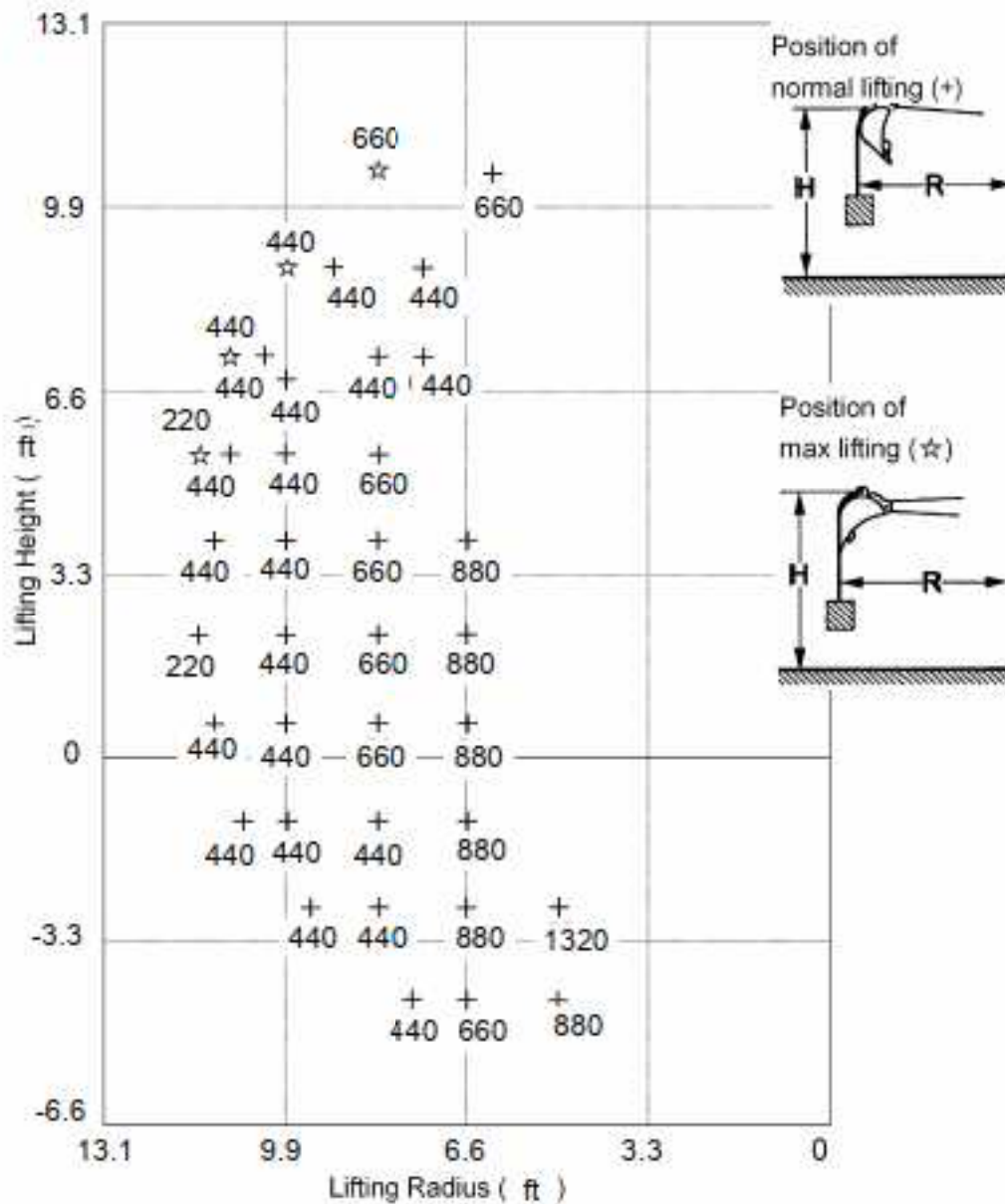
At over side, at crawler width expansion, with equipped standard arm.

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

Unit : lbs.

+ : Lifting height

☆ : Maximum lifting radius



WARNING SIGNS AND LABELS

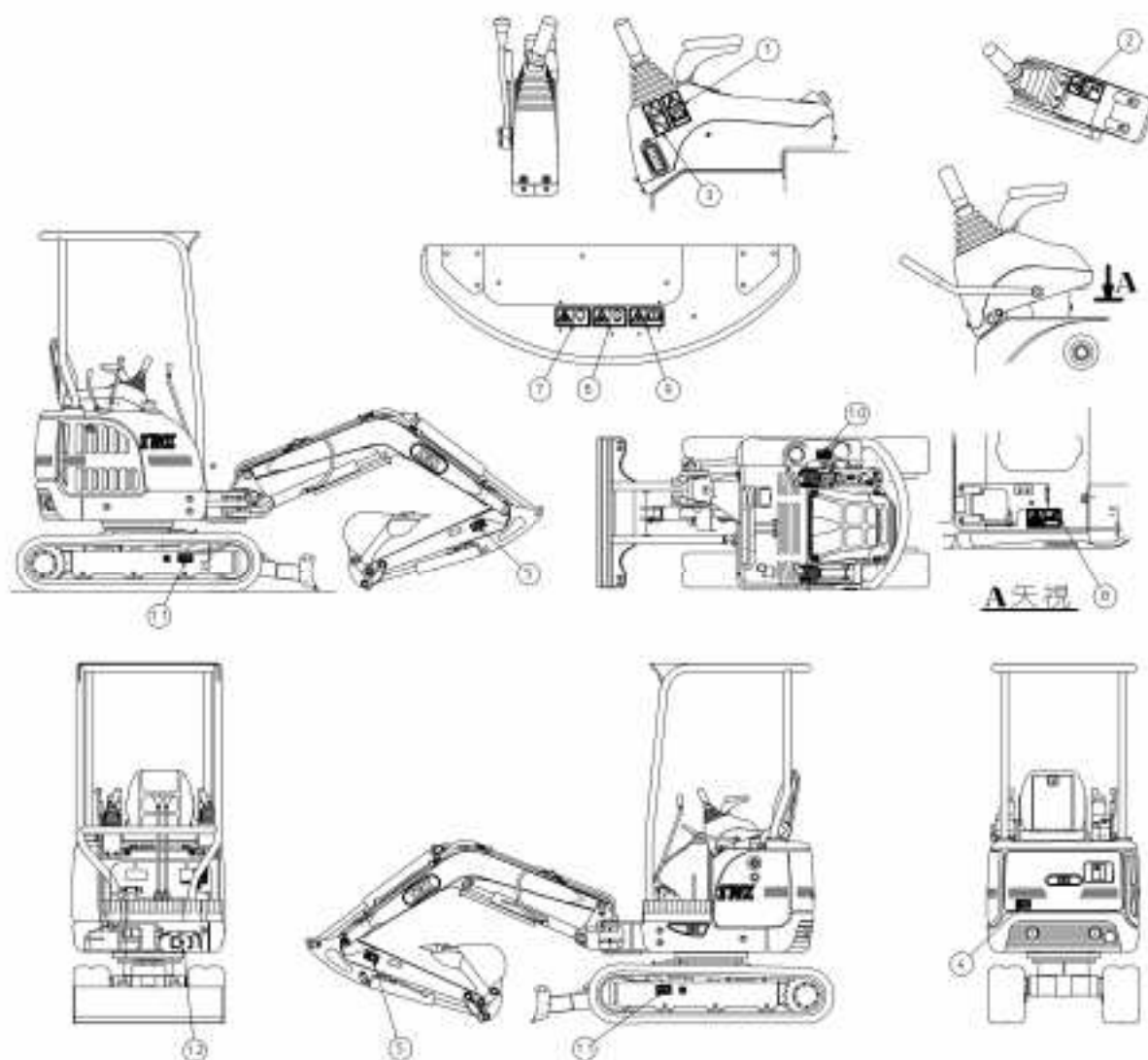
There are several specific safety signs on your machine. Their exact location and description of the hazard are reviewed in this section.

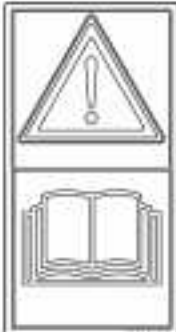







Please take the time to familiarize yourself with these safety signs.

Make sure that you can read all safety signs. Clean or replace these if you cannot read the words or see the pictures. When cleaning the labels use a cloth, water and soap. Do not use solvent, gasoline, etc.

You must replace a label if it is damaged, missing or cannot be read. If a label is on a part that is replaced, make sure a new label is installed on the replaced part.

See your IHI dealer for new labels.

Located warning levels

Illustrated symbol	Recommended explanation	Illustrated symbol	Recommended explanation
① 	Read manual before operation, maintenance, disassembly, assembly and transportation. • Part No.: D405 359 00	② 	Sign indicates a hazard of being crushed or run over by unexpected moving of stopped machine. Lower working device to lock position and remove engine key with you before leaving machine. • Part No.: D405 508 00
③ 	Sign indicates an electrocution hazard if machine is brought too near electric power lines. Keep a safe distance from electric power lines. • Part No.: D405 506 00	④ 	Sign indicates a crush hazard by rotation of upper structure of the machine. Keep away from swing area of machine. • Part No.: D406 269 00
⑤ 	Sign indicates a hazard of being hit by the working device of the machine. Keep away from machine during operation. • Part No.: D405 668 00	⑥ 	Sign indicates a hazard of rotating parts, such as belt. Turn off before inspection and maintenance. • Part No.: D405 674 00
⑦ 	Sign indicates a hazard of rotating parts, such as fan. Turn off before inspection and maintenance. • Part No.: D405 675 00	⑧ 	Do not put your hand in the machine. Otherwise, you might get your hand caught in it. • Part No.: D406 262 00

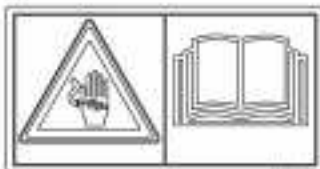
Illustrated
symbol

Recommended
explanation

Illustrated
symbol

Recommended
explanation

⑨



Sign indicates an electrical hazard from handling the cable.

Read manual for safe and proper handling.

• Part No.: D405 504 00

⑩



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.

• Part No.: D405 503 00

⑪



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

• Part No.: D405 505 00



⑫ **DANGER!**

Attach a DO NOT OPERATE warning tag to start switch or controls before servicing or repairing the machine.

Do not start the engine or move any of the controls if there is DO NOT OPERATE or similar warning tag attached to the start switch or controls.

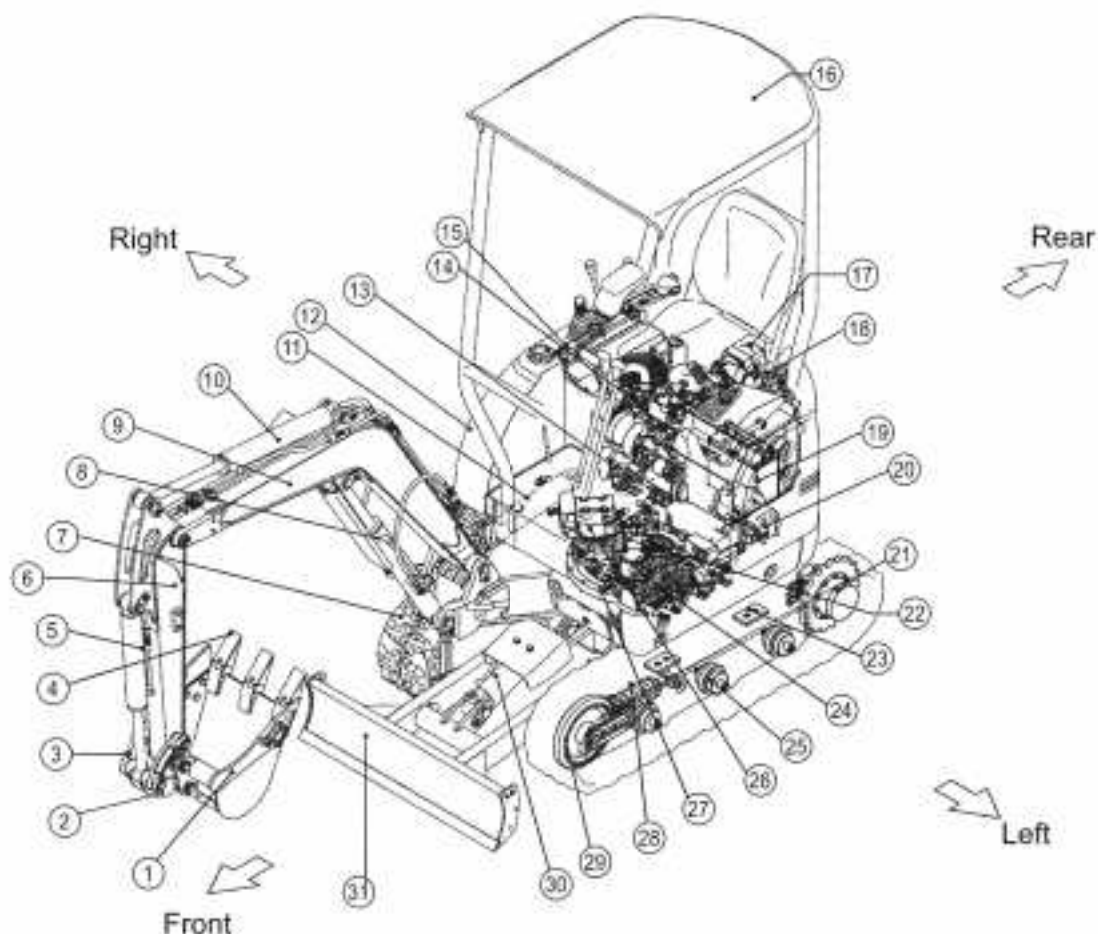
Keep in the tool box do not use warning tag.

• Part No.: D405 323 00

SECTION 2 STRUCTURE

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Hook in Stalling Procedure	-

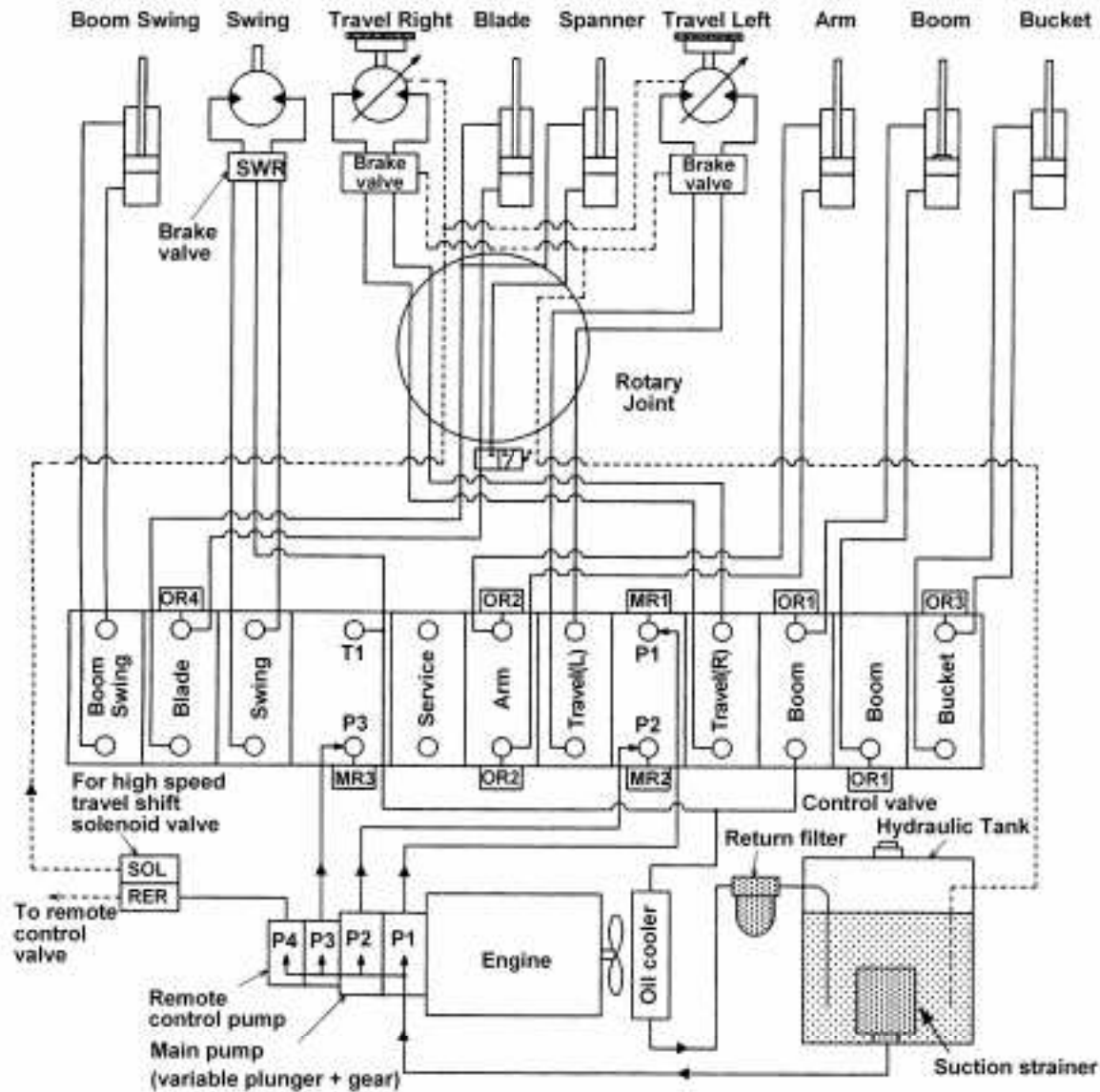
NOMENCLATURE

Typical Example

- | | | |
|--------------------------|---------------------|-------------------------------|
| (1) Bucket | (12) Fuel Tank | (23) Guide plate |
| (2) Bucket Link | (13) Muffler | (24) Control Valve |
| (3) Arm Link | (14) Engine | (25) Lower roller |
| (4) Tooth | (15) Radiator | (26) Swing Drive (with motor) |
| (5) Bucket Cylinder | (16) Canopy | (27) Swing Bearing |
| (6) Arm | (17) Air Cleaner | (28) Track Adjuster |
| (7) Crawler Shoe | (18) Return Filter | (29) Front Idler |
| (8) Boom Cylinder | (19) Hydraulic Tank | (30) Blade Cylinder |
| (9) Boom | (20) Hydraulic Pump | (31) Blade |
| (10) Arm Cylinder | (21) Travel motor | |
| (11) Boom Swing Cylinder | (22) Rotary Joint | |

HYDRAULIC SYSTEM DIAGRAM

HYDRAULIC SYSTEM DIAGRAM



Relief valve set pressure

Code	Item	Pressure
		MPa
MR1	Main relief valve P1 Pump	20.6
MR2	Main relief valve P2 Pump	20.6
MR3	Main relief valve P3 Pump	18.1
OR1	Overload relief valve (Boom)	24.5
OR2	Overload relief valve (Arm)	24.5
OR3	Overload relief valve (Bucket)	24.5
OR4	Overload relief valve (Blade)	20.6
SWR	Swing relief valve	15.2
RER	Remote control relief valve	2.9

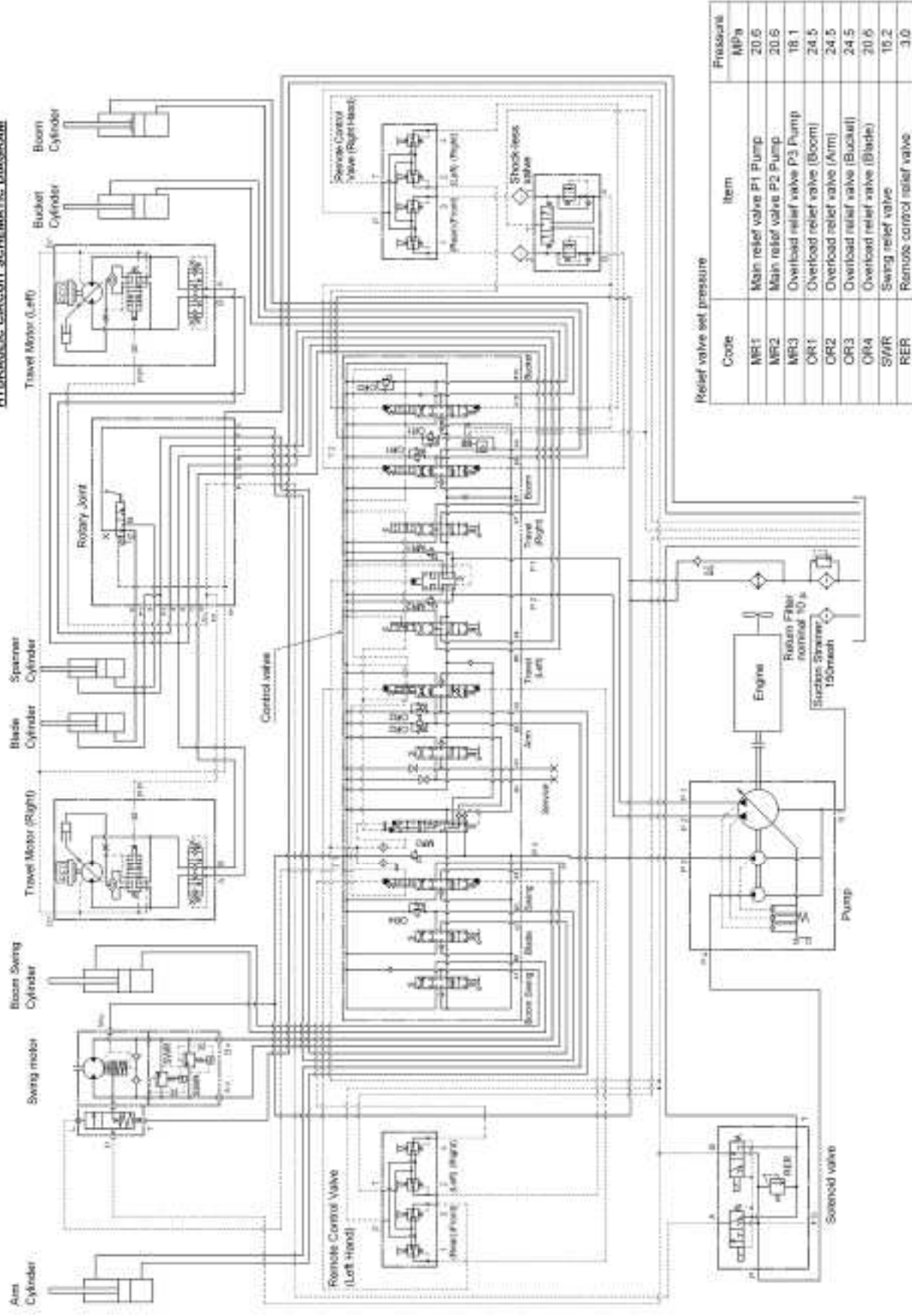
Tank level capacity
19 liters

Total system volume
23 liters

Pump flow rate (Max.):
P1 : 17.2 liter/min
P2 : 17.2 liter/min
P3 : 12.0 liter/min

The service ports used
the flow shared by the
P2 and P3 pump.

HYDRAULIC CIRCUIT SCHEMATIC DIAGRAM

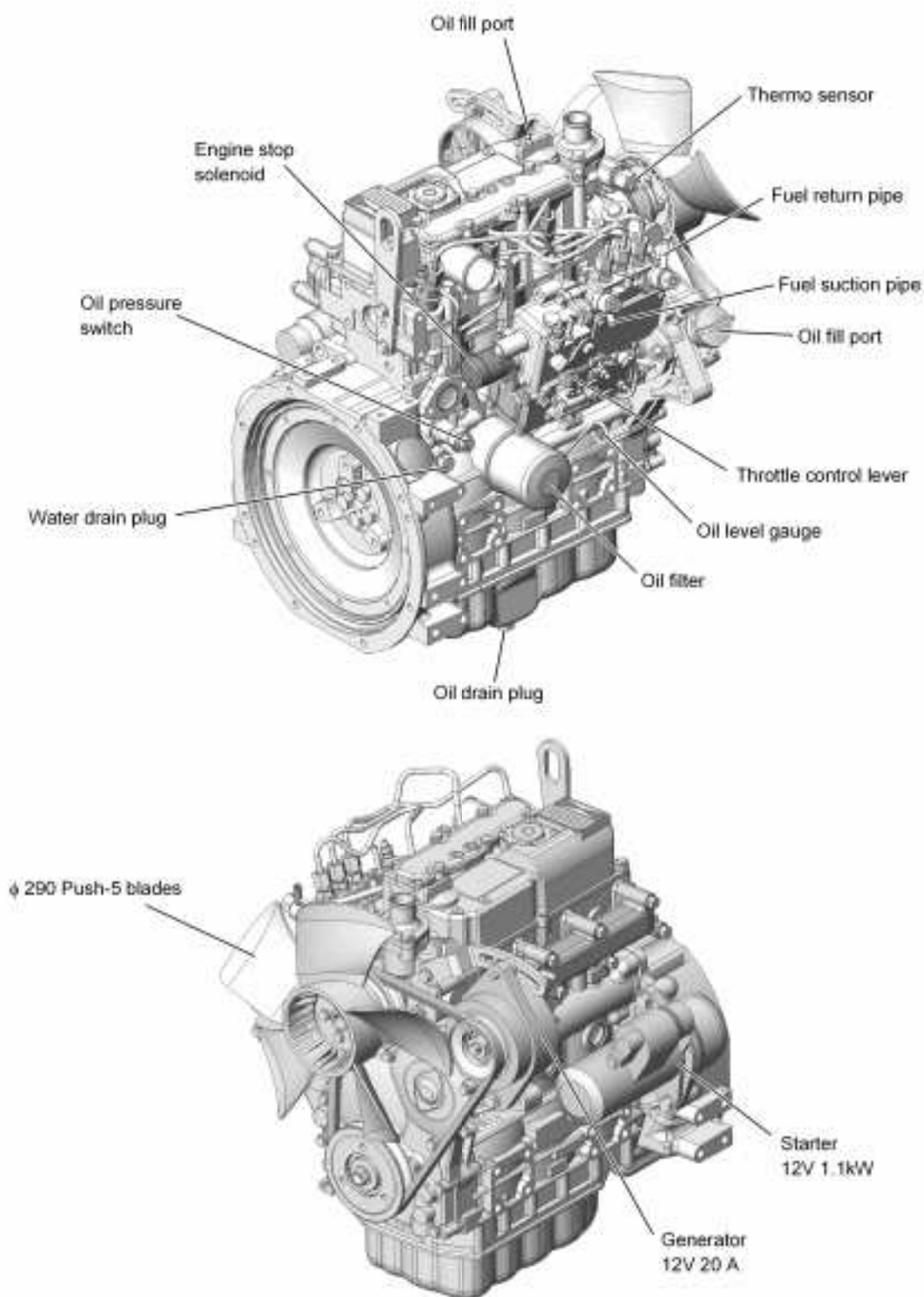


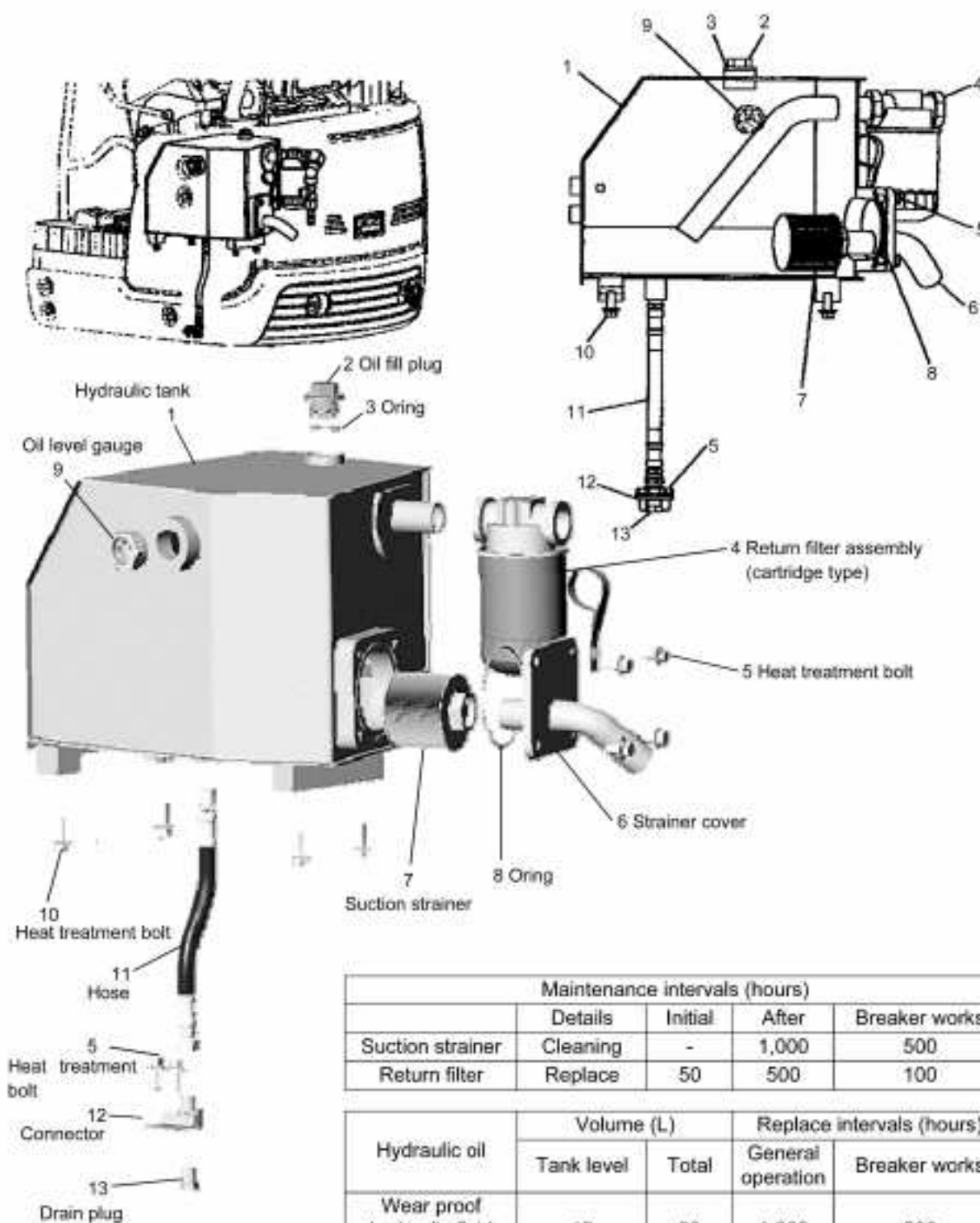
Compatible List

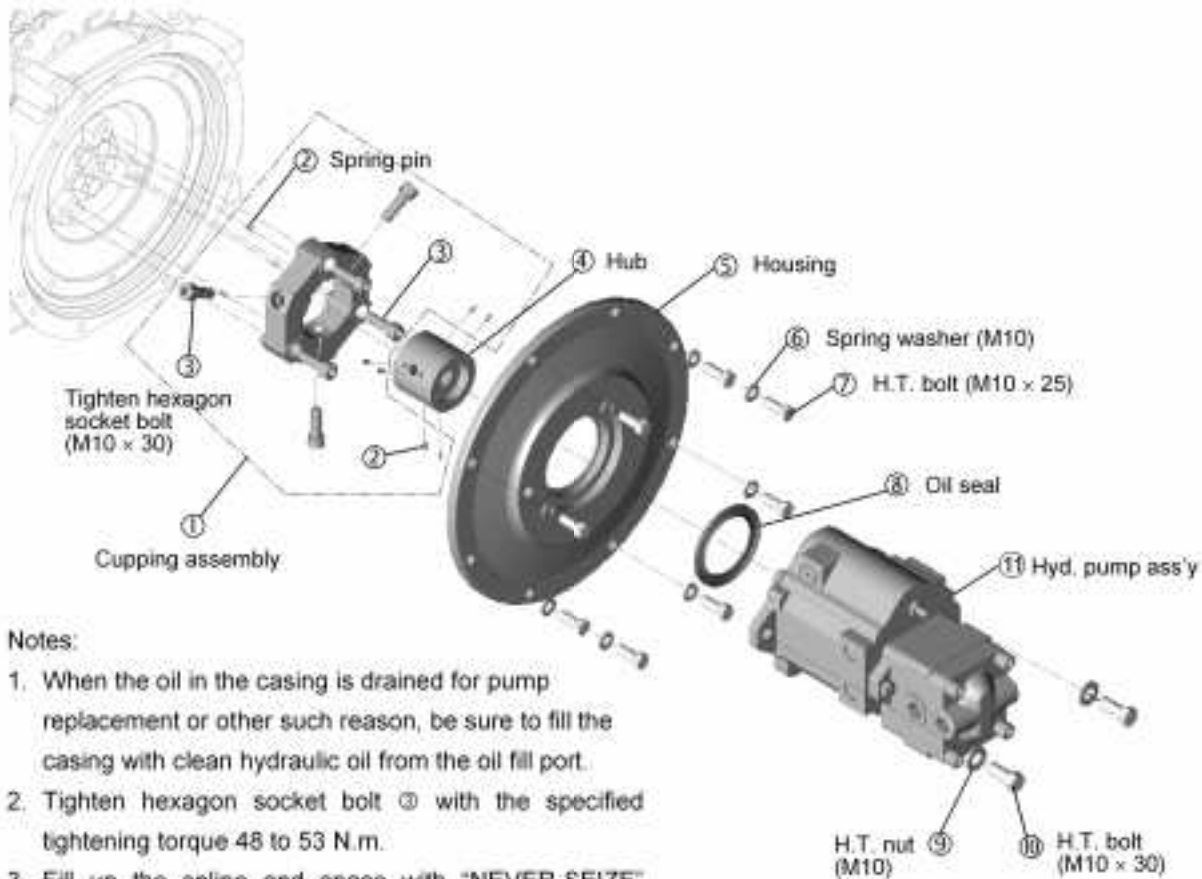
Item	Part name	Description	Interchangeability
Undercarriage	Rubber shoe		15VX
	Lower roller	For rubber	15VX
		For steel	
	Slide pad	Made of resin	15VX
	Front idler		15VX
	Blade	Blade width 960 mm	New
	Shoe tension device		15VX
Engine	Engine	Yanmar 3TNV70 Push fan (ϕ 290)	15VX
Hydraulic equipment	Pump	2PV + 2PF	15VX
	Control valve	Spare valves as standard equipment	15VX
	Swing motor	With shock-less valves	15VX
	Travel motor	Travel : 2 speeds	15VX
	Rotary joint		15VX
	Return filter		15VX
	Strainer		15VX
	Cylinder		15VX
Covers	Covers	Engines cover change, How to open was horizontally changed from length.	New
Attachment	Bucket	The 18S tooth type. The bolt-tightening type side cutter.	15VX

ENGINE AND AUXILIARY COMPONENTS

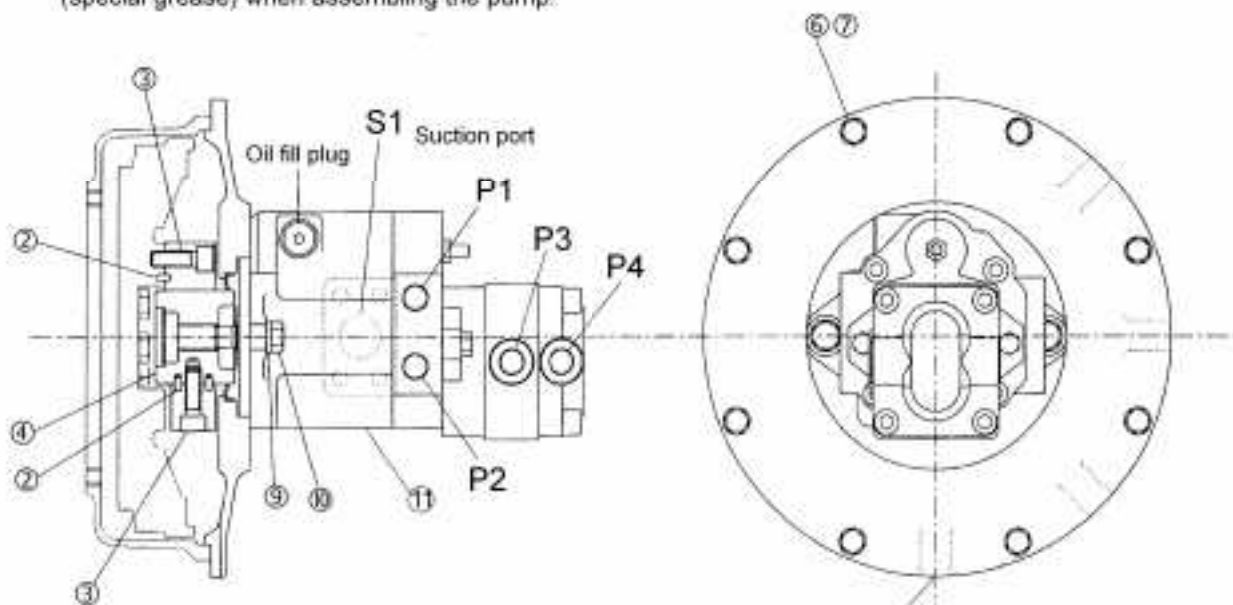
(Engine component name, layout)



HYDRAULIC TANK ASSEMBLY

PUMP DRIVE DEVICE ASSEMBLY**Notes:**

1. When the oil in the casing is drained for pump replacement or other such reason, be sure to fill the casing with clean hydraulic oil from the oil fill port.
2. Tighten hexagon socket bolt ③ with the specified tightening torque 48 to 53 N.m.
3. Fill up the spline and space with "NEVER-SEIZE" (special grease) when assembling the pump.

**Cross Section of Pump Drive Device**

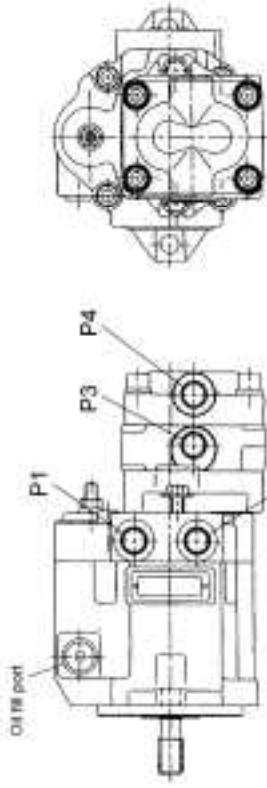
When assembling the housing, be sure to install the housing groove at the place shown in the figure above.

STRUCTURE

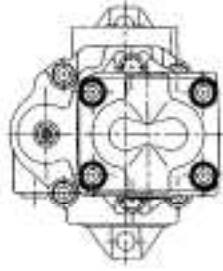
17VX3

HYDRAULIC PUMP ASSEMBLY

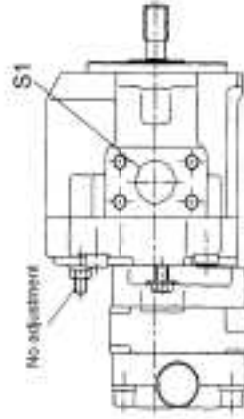
Weight: 14 kg



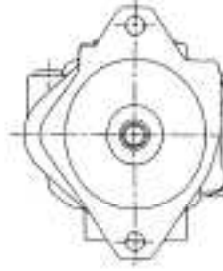
View from pump front side



View from gear pump side

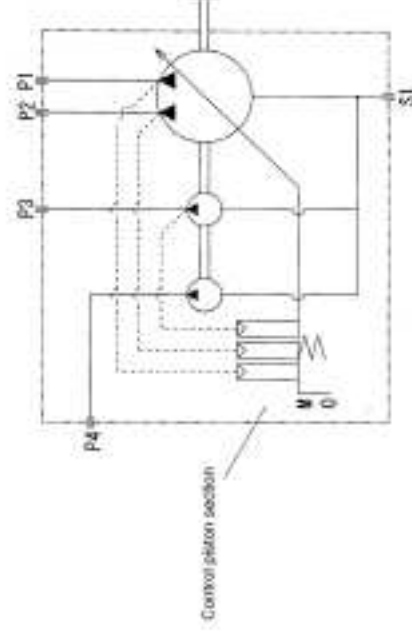
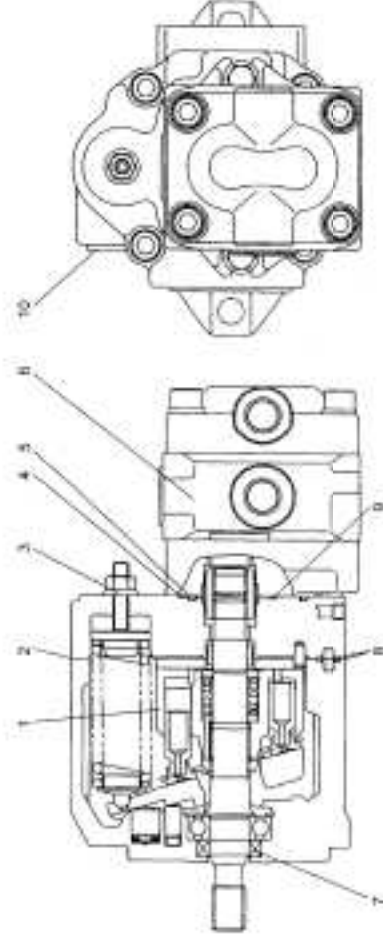


View from pump back side



View from shaft direction

Refer to the Parts Catalog for the names and No. of parts of hydraulic pump



Pump hydraulic circuit diagram

NOTICE

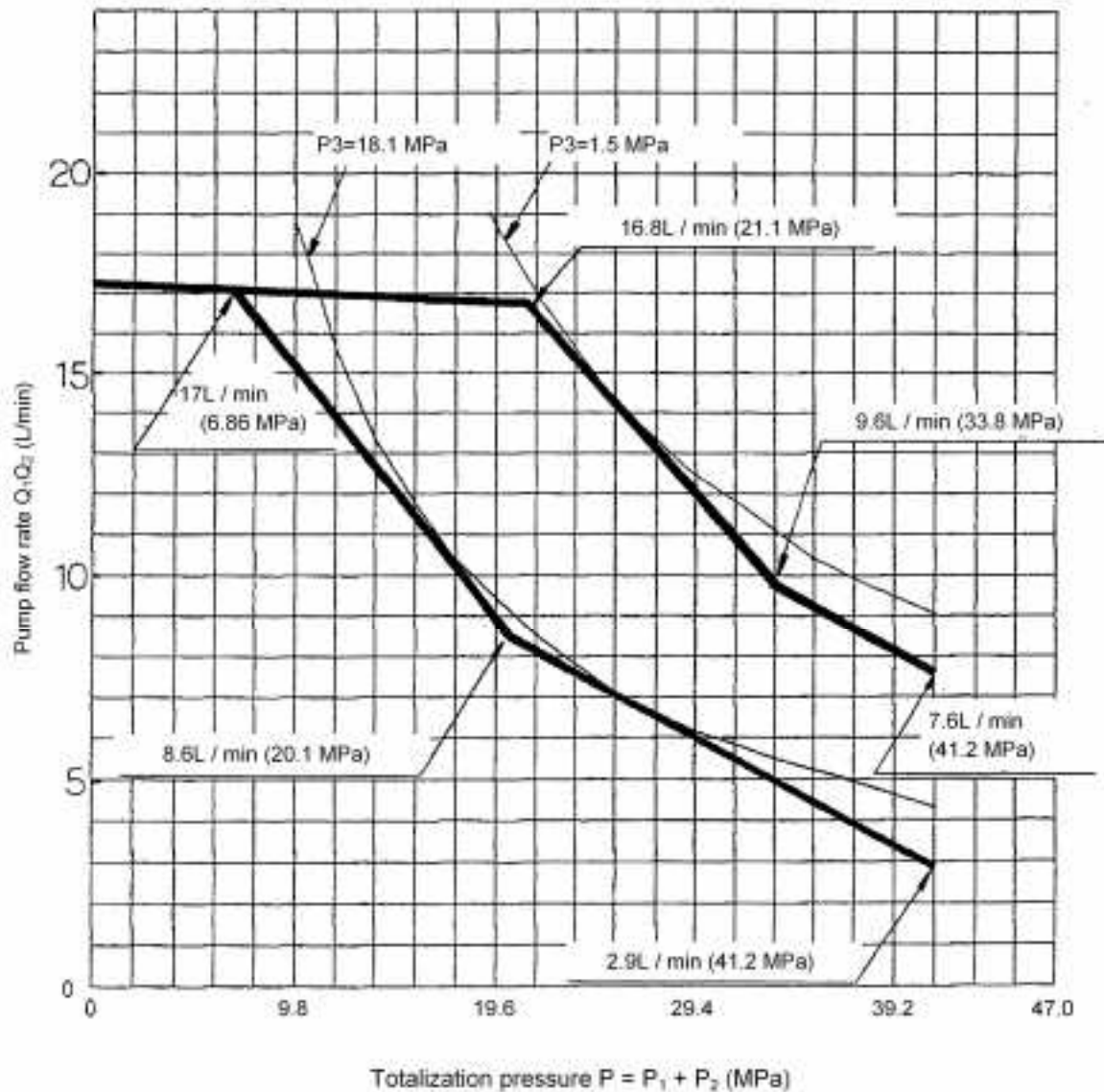
1. Never start the engine before fill the pump casing with hydraulic oil.
2. Fill the pump casing with hydraulic oil after replace hydraulic oil or replace the pump assembly.

PORT

Port	Pod name	Pod size
S1	Suction	SAE J518b-1
P1 • P2	Delivery	GS/8
P3 • P4	Delivery	GS/8

Hydraulic Pump Performance

No. of Pump	P1 • P2		P3		P4
Type of pump	Plunger		Gear		Gear
Working pressure: MPa	20.6		18.1		3.4
Delivery rate: cm ³ /rev	7.5 × 2	1.3 × 2	5.2		2.7
Flow rate: L/min	17.3 × 2	2.9 × 2	12.0		6.2
P3 Shift pressure: MPa	1.47	18.1	1.47	18.1	
Control system	Total power control with power shift circuit				
Used revolution: min ⁻¹	Rated 2,300 (Max. 2,460)				

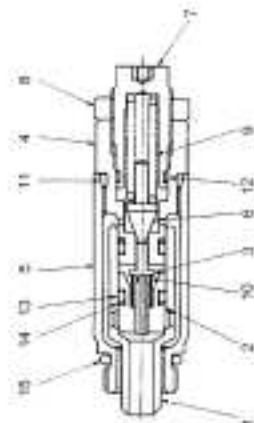
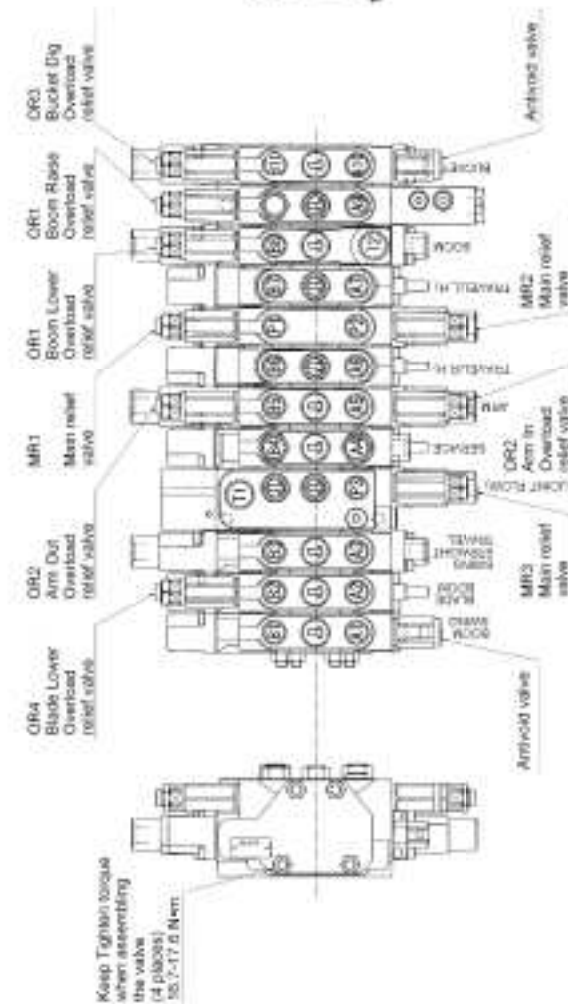
P - Q performance

STRUCTURE

17963

CONTROL VALVE ASSEMBLY

Weight: 27 kg

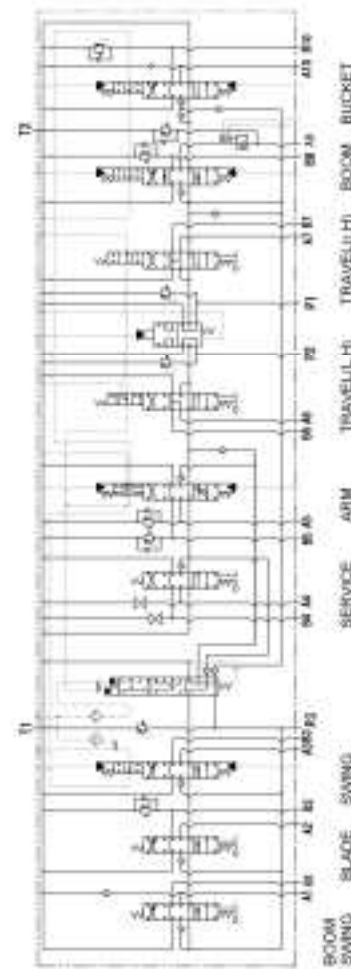


Gross-section of relief valve assembly

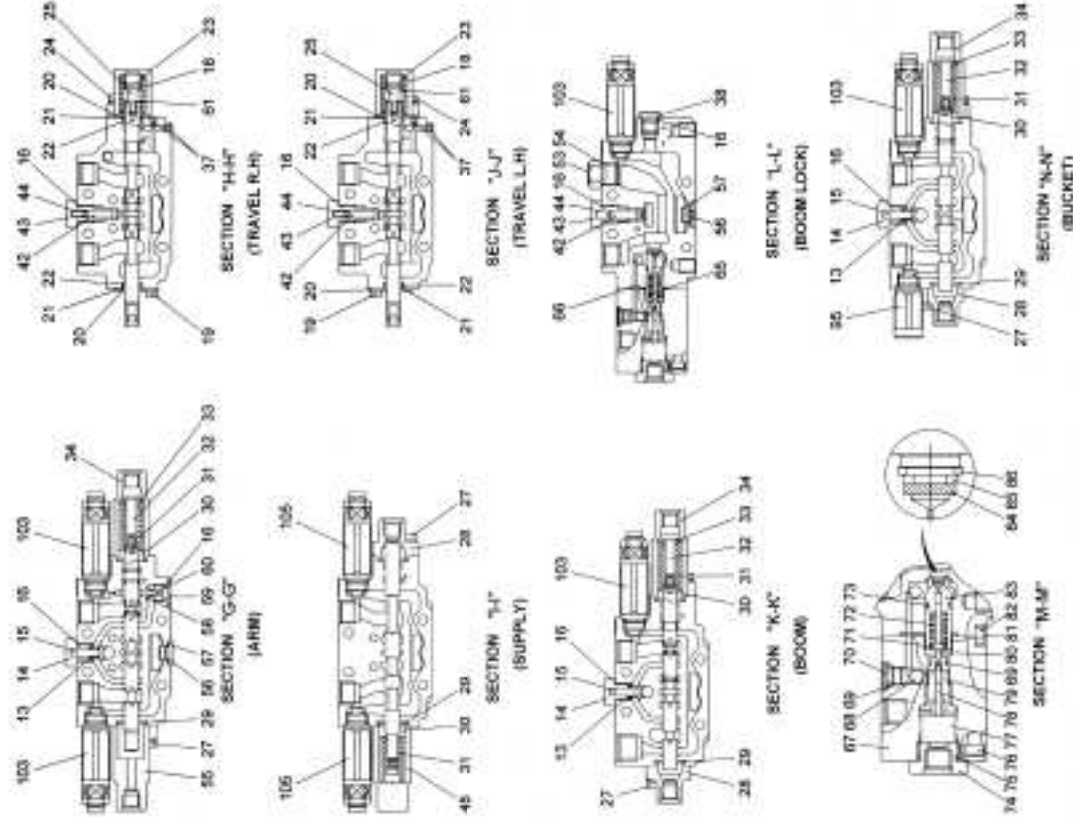
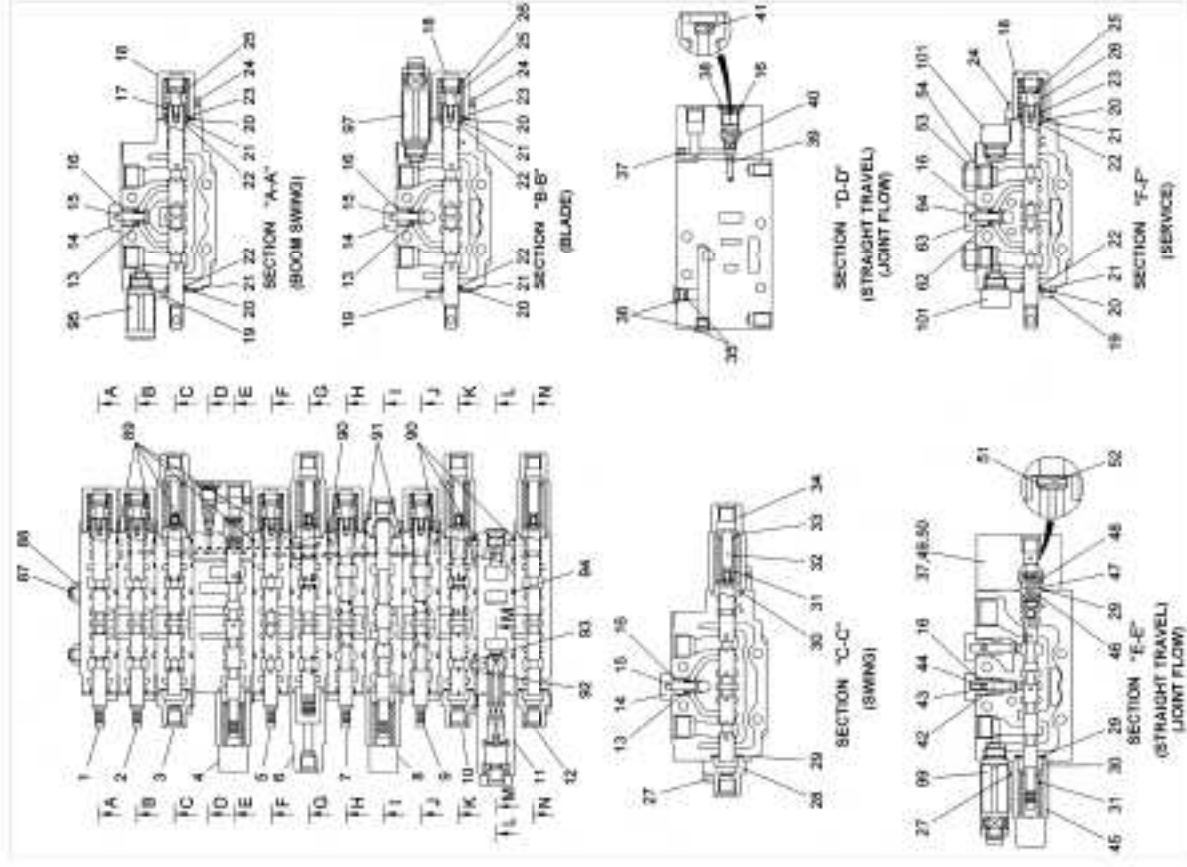
No.	Name	Qty
1	Socket	1
2	Regulator	1
3	Piston	1
4	Adjusting part	1
5	Pressure-regulating part	1
6	Regulating valve	1
7	Adjusting screw	1
8	Nut	1
9	Regulating valve spring	1
10	Pressure-regulating valve spring	1
11	O ring	1
12	O ring	1
13	O ring	2
14	Back-up ring	2
15	O ring	1

Pump	Main relief valve set pressure MPa
P1	MR1 20.6 ^{+0.5} / _{-0.5} at 17.2 L/min
P2	MR2 20.6 ^{+0.5} / _{-0.5} at 17.2 L/min
P3	MR3 18.1 ^{+0.5} / _{-0.5} at 12.0 L/min

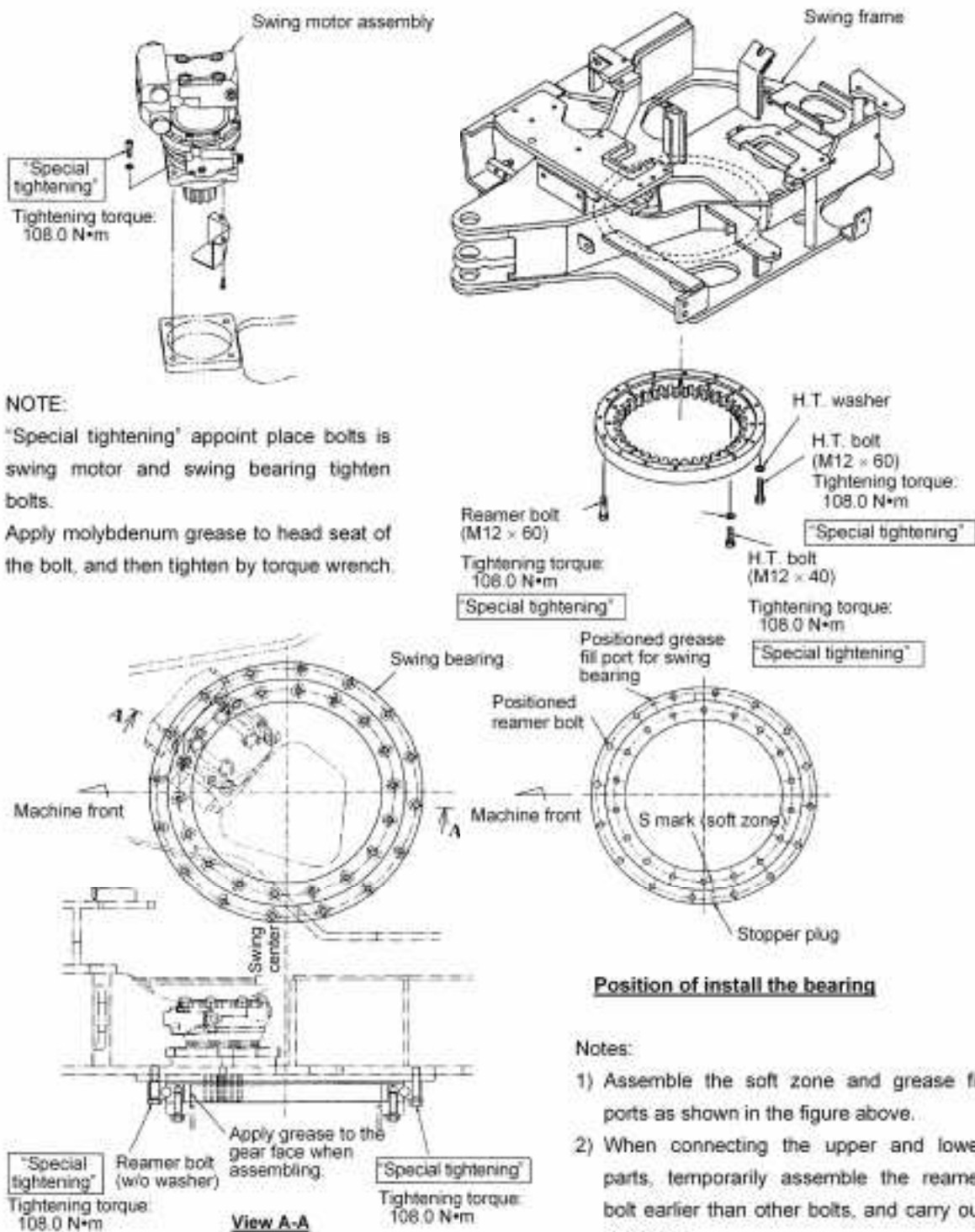
Valve No.	Over load relief valve set pressure MPa
OR1	24.5 ^{+0.5} / _{-0.5} at 5 L/min
OR2	24.5 ^{+0.5} / _{-0.5} at 5 L/min
OR3	24.5 ^{+0.5} / _{-0.5} at 5 L/min
OR4	20.6 ^{+0.5} / _{-0.5} at 5 L/min



CONTROL VALVE ASSEMBLY



Refer to Control Valve Assy in the Hydraulic
Instrument Section Parts Catalog

SWING DRIVE DEVICE & BEARING ASSEMBLY

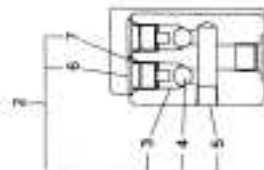
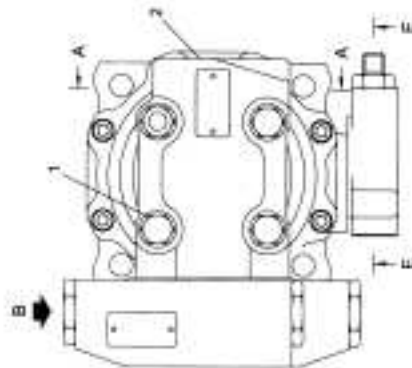
STRUCTURE

1 TVX3

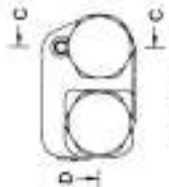
Weight: 23 kg

BOOM CYLINDER ASS'Y

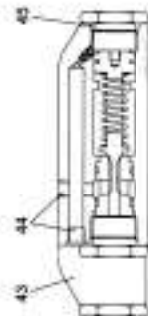
Refer to the Parts Catalog for the names and No. of parts



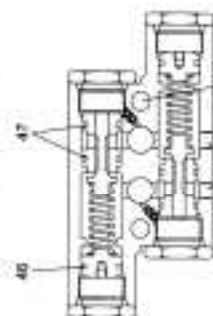
Cross section "A-A"
(Relief valve)



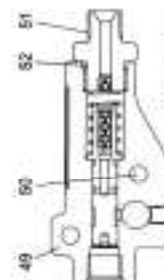
Details of "B"
(Relief valve)



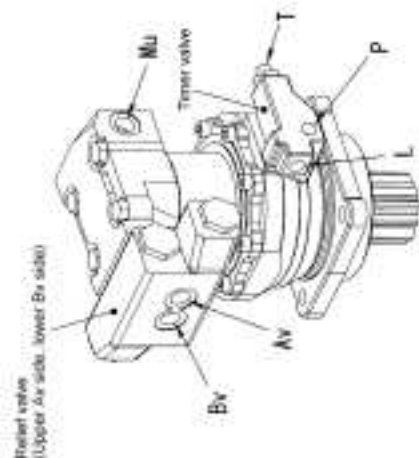
Cross section "C-C"
(Relief valve)



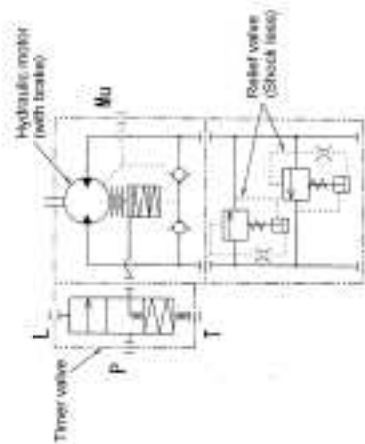
Cross section "D-D"
(Relief valve)



Cross section "E-E"
(Timer valve)



Relief valve
(Upper Ax side, lower Bx side)



Hydraulic Symbols

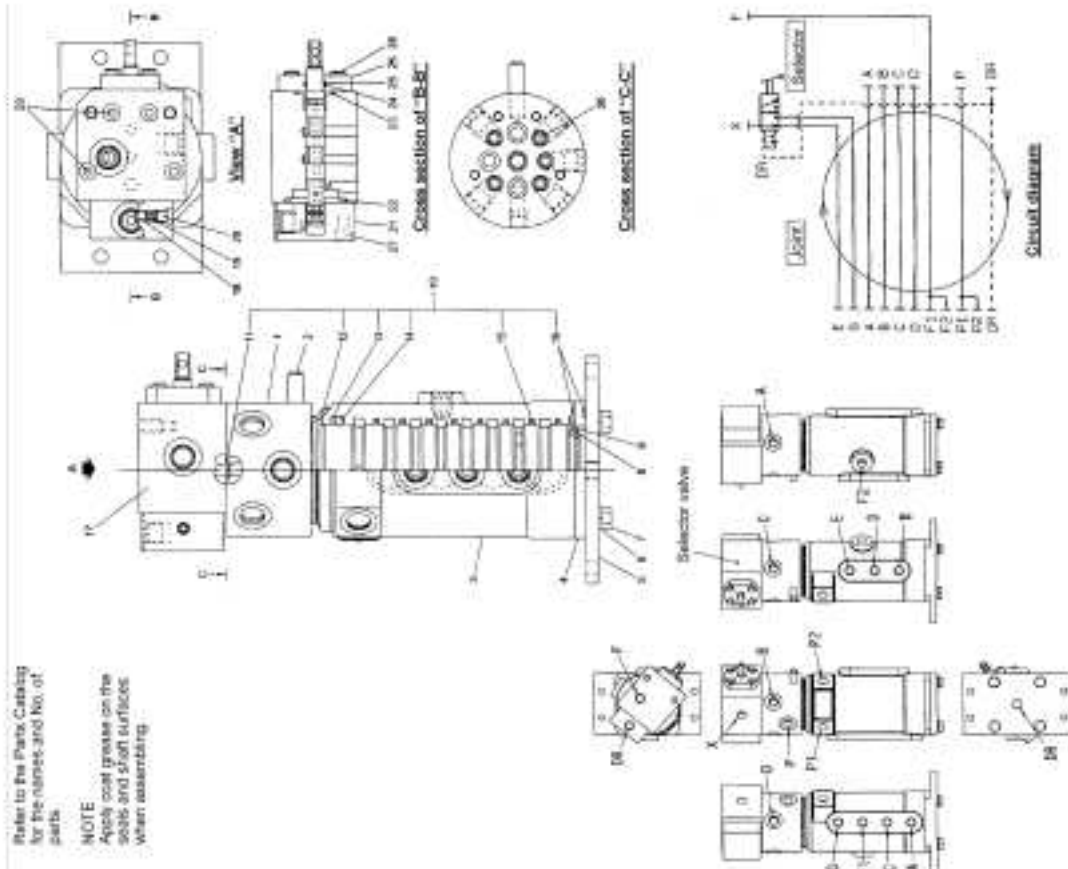
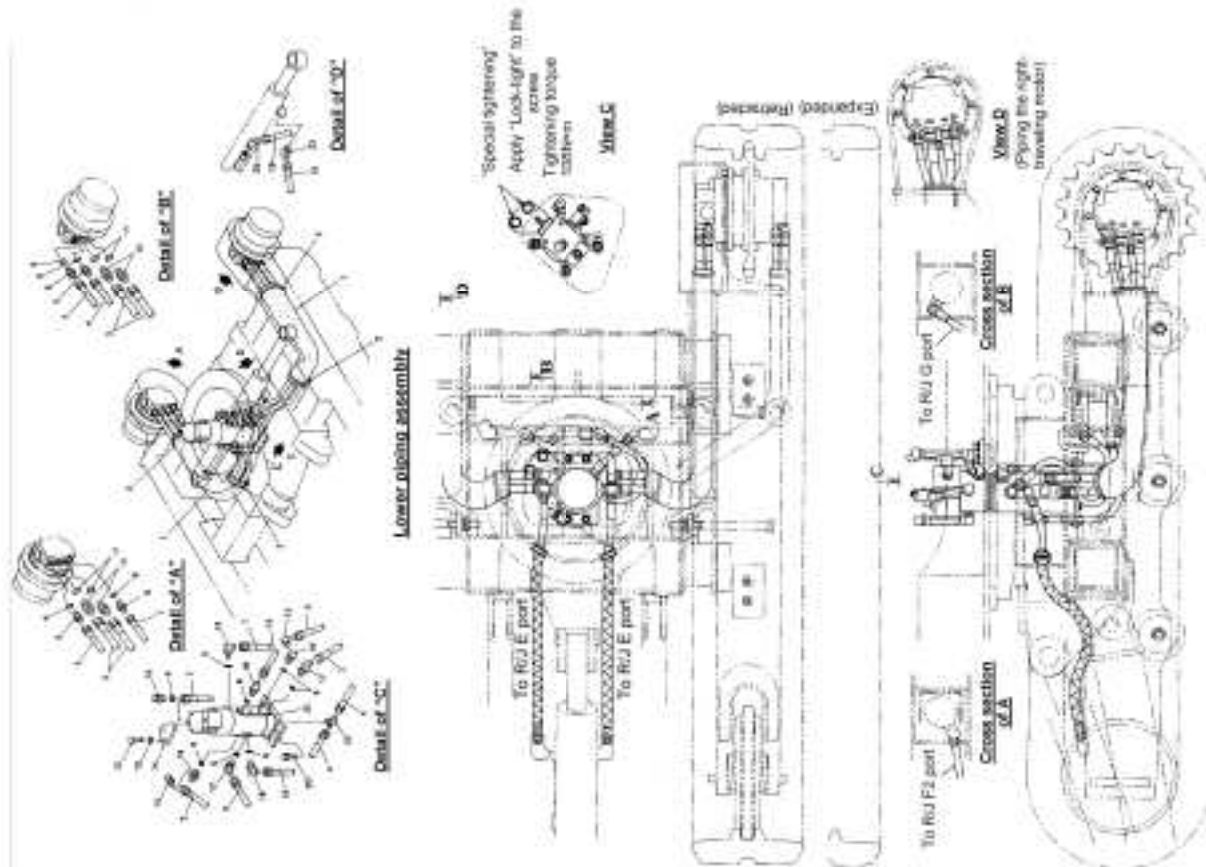
Parking brake	Release pressure (Theoretical)	1.50 MPa
Relief valve	Set pressure	15.2 MPa at 10 L/min
Timer valve	Set pressure (Theoretical)	1.37 ± 0.2 MPa
	Timer time	4 ± 2 sec (at VG-45-45°C)

STRUCTURE

17V93

ROTARY JOINT & LOWER PIPING ASSEMBLY

Rotary joint assembly
Weight: 14 kg



Refer to the Parts Catalog
for the names and No. of
parts

NOTE
Apply coat grease on the
shaft and shaft surfaces
when assembling

STRUCTURE

17VX3

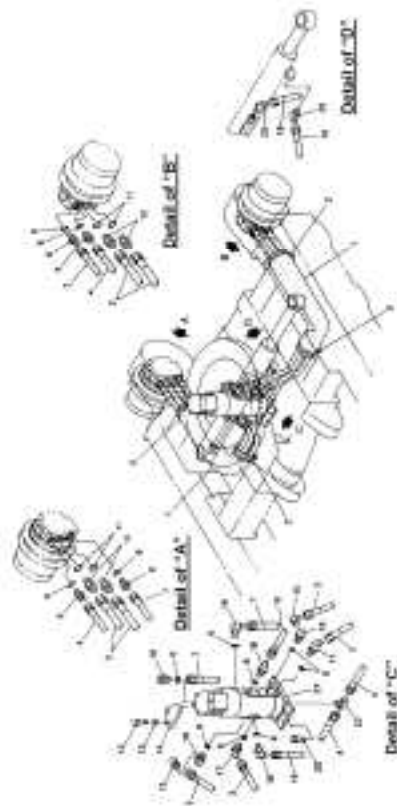
ROTARY JOINT & LOWER PIPING ASSEMBLY

Rotary joint assembly
Weight: 14 kg

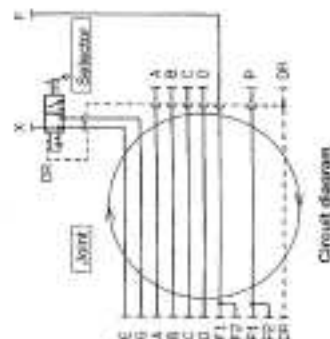
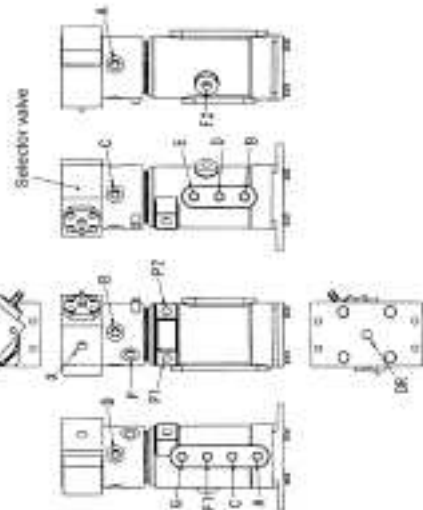
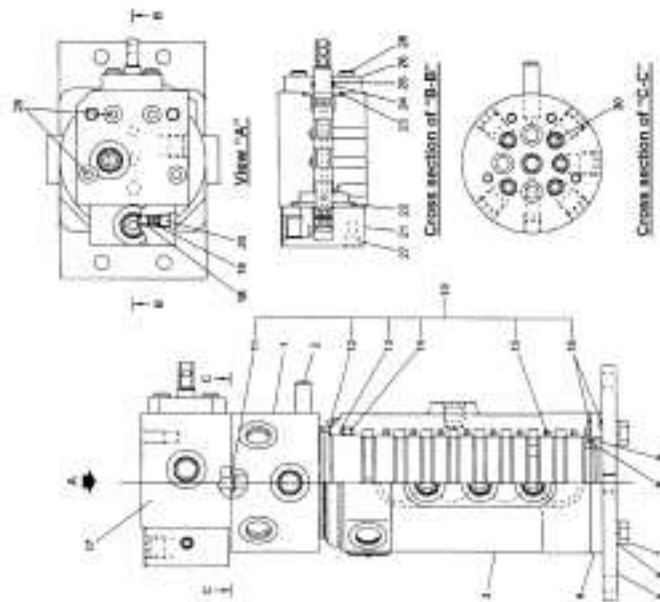
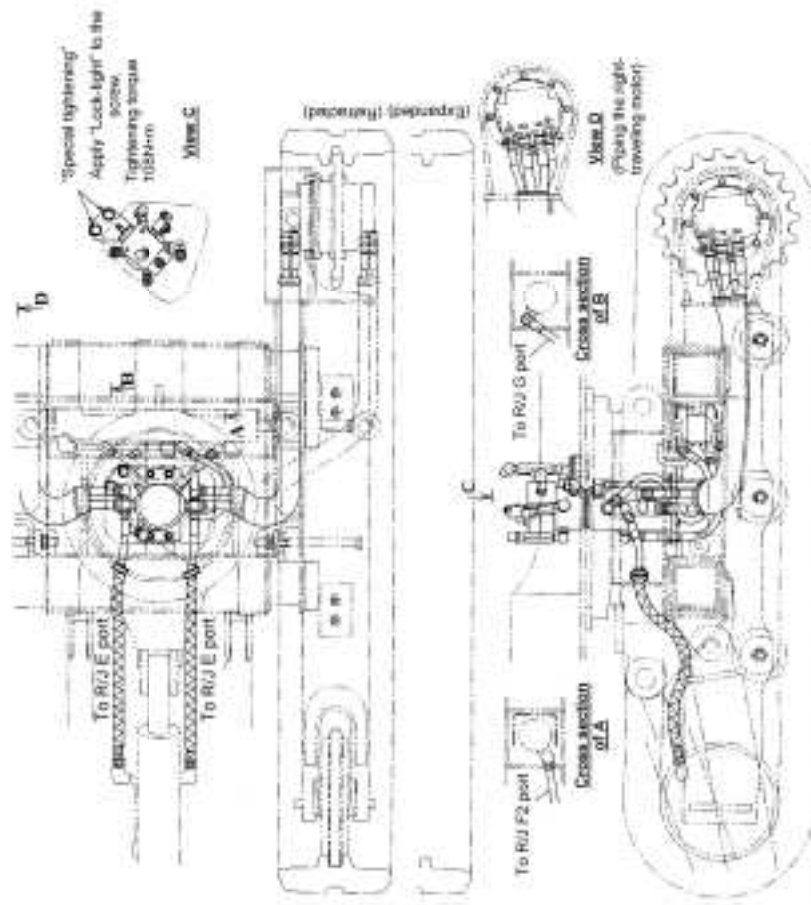
Refer to the Parts Catalog
for the names and No. of
parts.

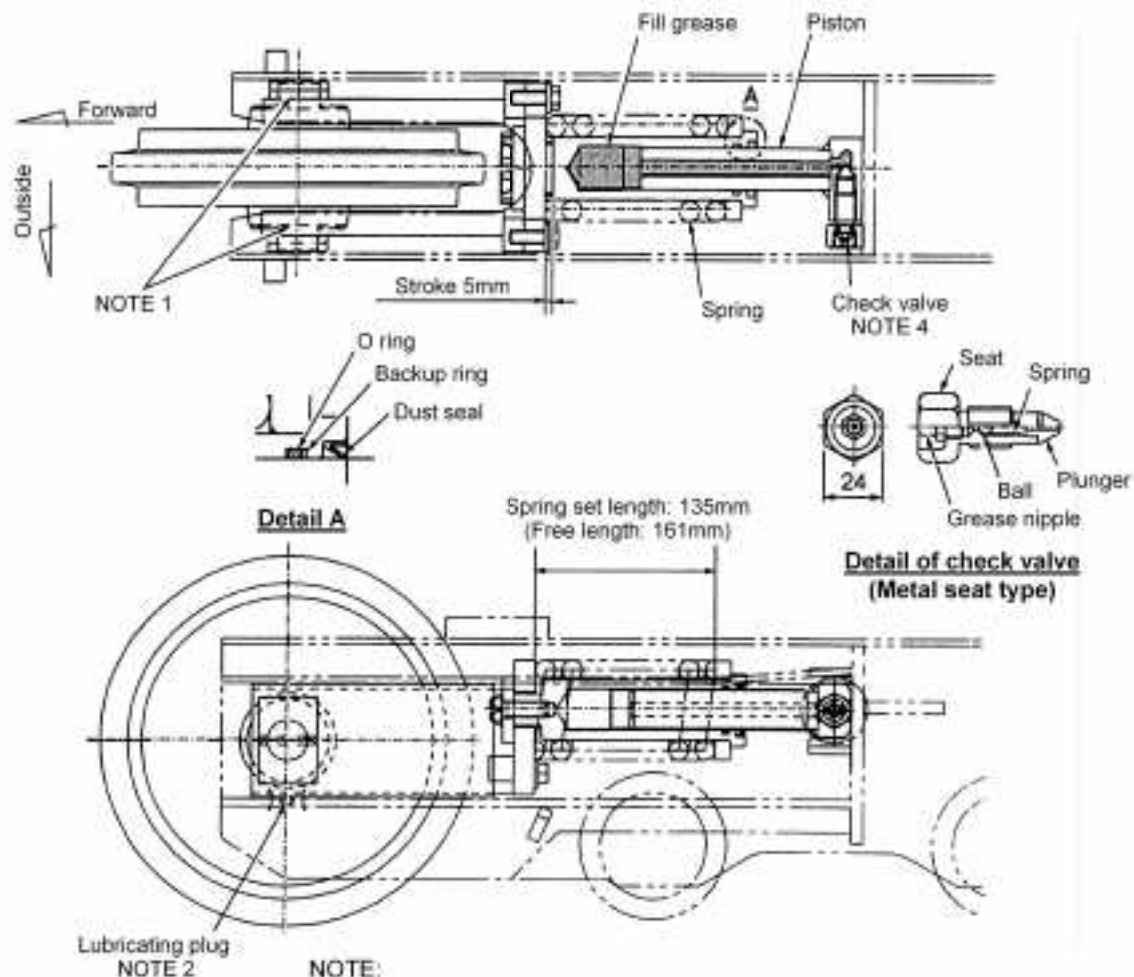
NOTE:

Apply cool grease on the
seals and shaft surfaces
when assembling.



Lower piping assembly



CRAWLER SHOE ADJUSTING DEVICE**NOTE:**

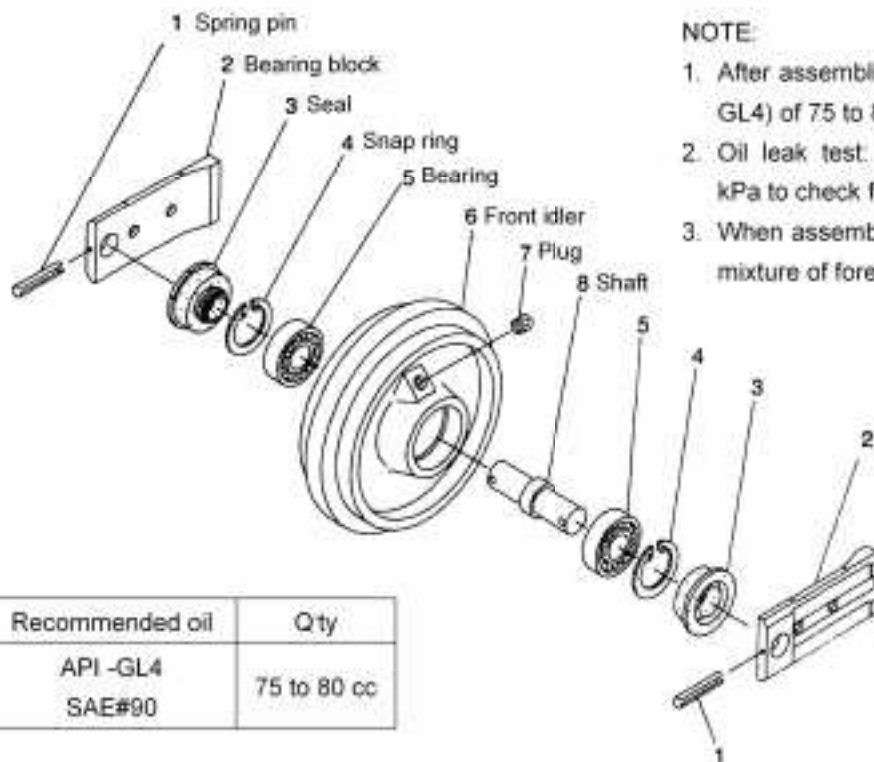
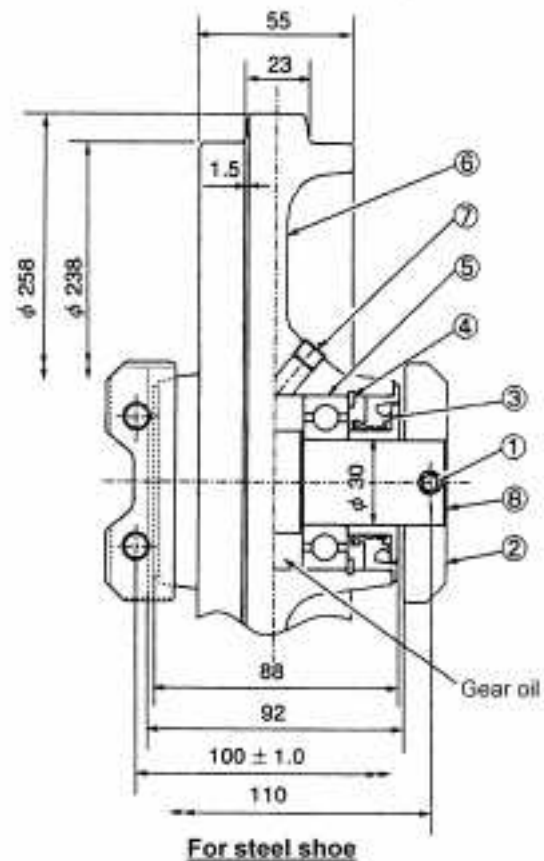
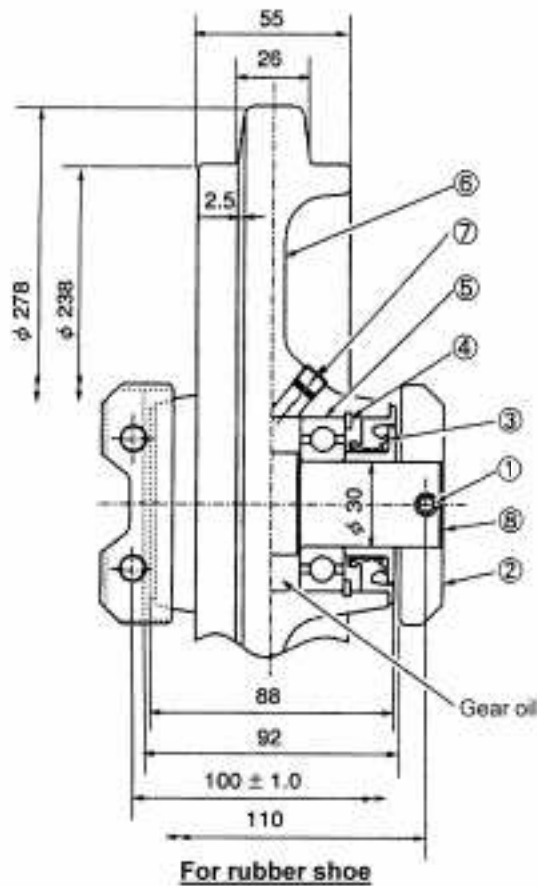
1. Before assembling the idler ass'y bearing block lubricate their side way to the frame with grease.
2. Position the lubricating plug side outward when assembling the idler ass'y to the frame.
3. Install the grease cylinder to position the oil fill pod outward.
4. Keep tightening torque to the check valve 55.8 to 68.6 N•m to prevent breaking it.
5. This figure shows the left side frame. Assemble the right side symmetrically.

WARNING

- When the tension of the shoe is high, the grease cylinder internal pressure becomes considerably high.
- The grease can gush out of the cylinder under high pressure. NEVER remove the grease nipple.
- While adjusting, do not move your face or hands closer to the check valves.
- Relieve pressure by opening check valve gradually by 1 turn at maximum.

FRONT IDLER ASSEMBLY

Weight: 21 kg



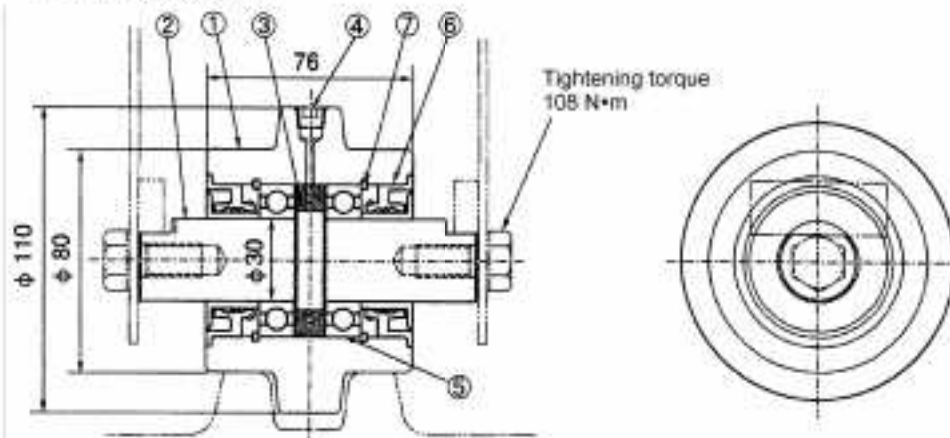
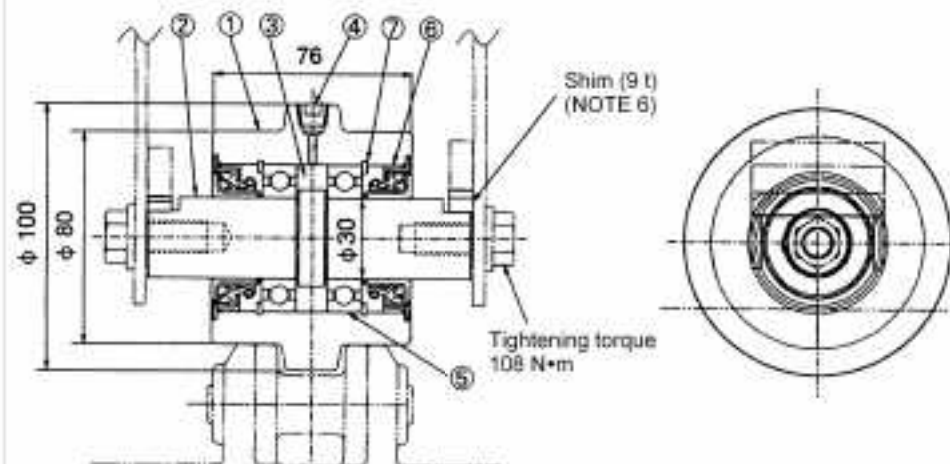
NOTE:

1. After assembling, fill gear oil (SAE#90•API-GL4) of 75 to 80 cc and assemble plug ⑦.
2. Oil leak test: Apply pressurized air of 98 kPa to check for any oil leak.
3. When assembling, take care to prevent any mixture of foreign matter.

Recommended oil	Qty
API -GL4 SAE#90	75 to 80 cc

LOWER ROLLER ASSEMBLY

Weight: 2.7 kg

1. For Rubber Shoe:**2. For Steel Shoe:****NOTE :**

1. Clean the roller, collar and shaft inside before assembling to prevent mixture of foreign matter.
2. After assembling snap ring ⑦, place the roller vertically and fill gear oil (SAE#90•API-GL4) of 25cc and install oil seal ⑥.
3. Perform the leak test after assembling. Apply pressurized air of 98 kPa to the oil fill port ④.
4. Wind a seal tape around plug ④ and install it on the roller.
5. Perform bolting with the crawler frame and lower roller mounting face in close contact with each other.
6. In the case of steel shoe, insert a shim (9mm thick) between the frame and shaft so as to allow bolting with the mounting faces in absolute contact.

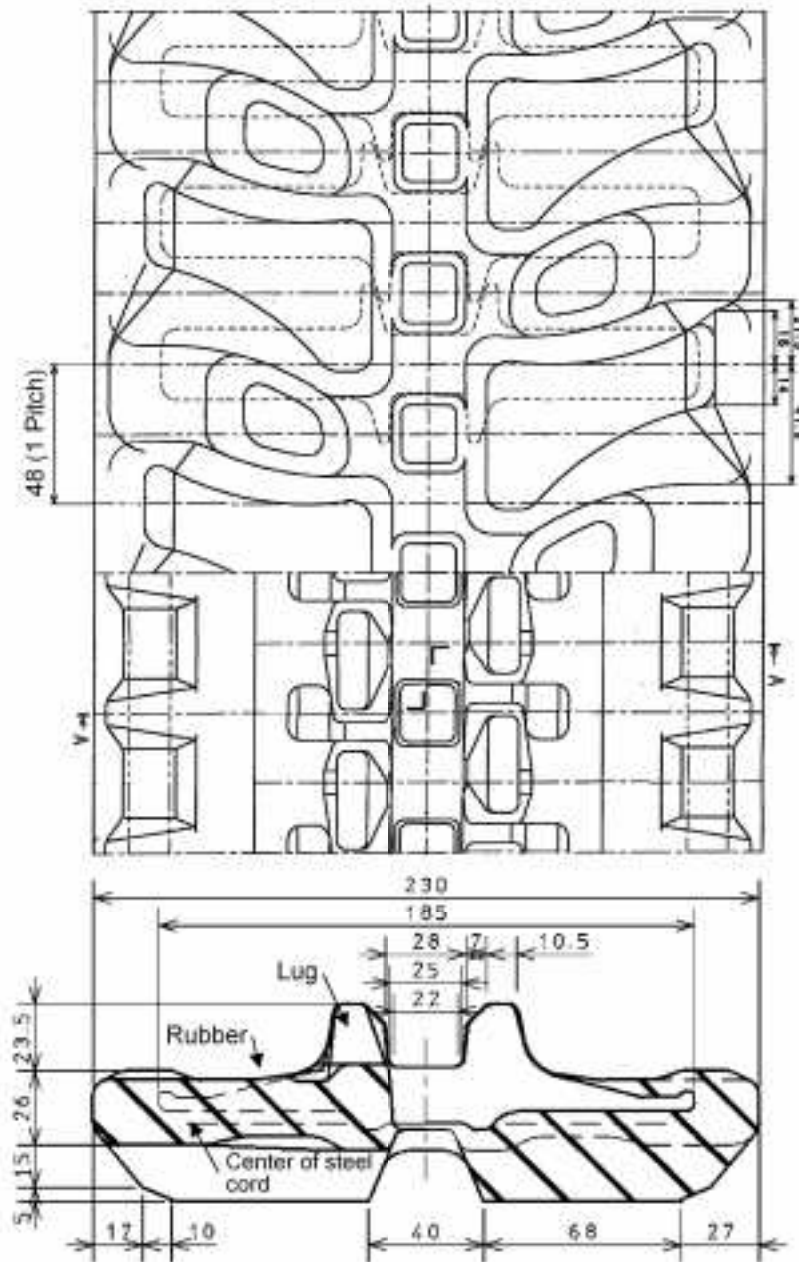
No.	Description	Qty	Remarks
1	Guide Roller	1	
2	Shaft	1	
3	Gear Oil	→	25 cc
4	Plug	1	1/8
5	Bearing	2	
6	Oil Seal	2	
7	Snap Ring	2	

Recommended oil	Qty
API -GL4 SAE#90	25 cc

CRAWLER SHOE ASSEMBLY (RUBBER SHOE)

Weight: 57 kg

The figure below shows the shape and cross section of rubber shoe.

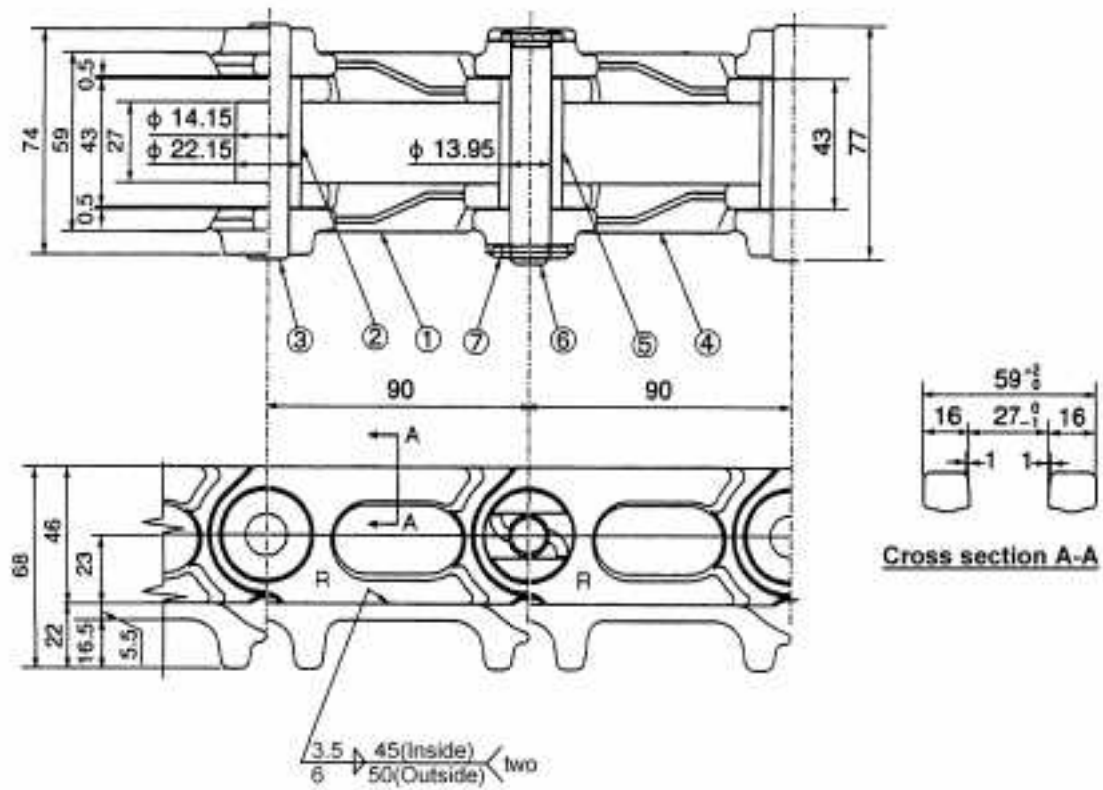


Cross section of rubber shoe

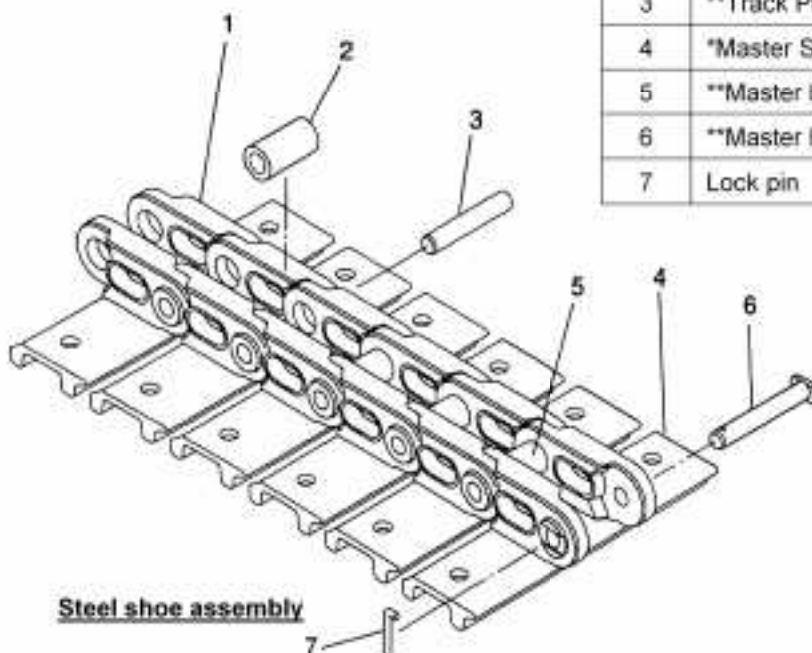
70 Link

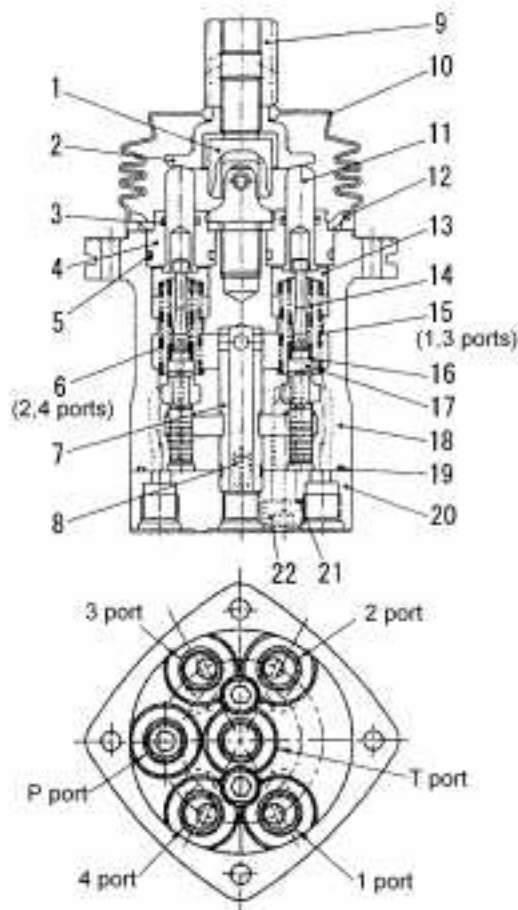
CRAWLER SHOE ASSEMBLY (Steel Shoe)

Weight: 83.2 kg



Key	Description	Qty
1	*Track Shoe Complete	35
2	**Track bushing	35
3	**Track Pin	35
4	*Master Shoe Complete	1
5	**Master bushing	1
6	**Master Pin	1
7	Lock pin	1

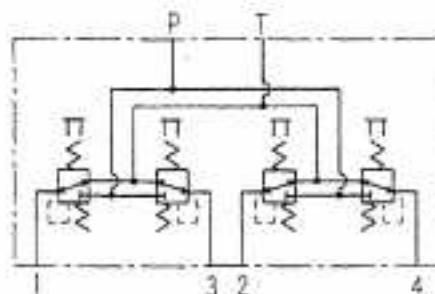
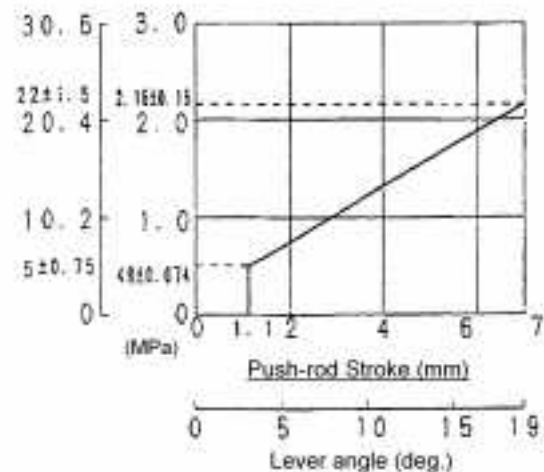


REMOTE CONTROL VALVE ASSEMBLY**Standard**

No.	Parts name	Qty
1	Joint	1
2	Cam	1
3	Seal	4
4	Plug	4
5	O ring	4
6	Spring	2
7	Bushing	1
8	Spring pin	1
9	Adjusting nut	1
10	Boots	1
11	Push rod	4
12	plate	1
13	Spring washer	4
14	Spring	4
15	Spring	2
16	Washer	4
17	Spool	4
18	Casing	1
19	O ring	1
20	Port plate	1
21	Seal washer	2
22	Hex. Socket bolt	2

NOTE:

1. Apply coat grease to center of the joint ① when assembling.
2. Apply coat grease to the cam ② and the push rod ③ contact areas.
3. Apply coat locktight #242 to the adj. nut ④, and the joint ⑤ when assembling.

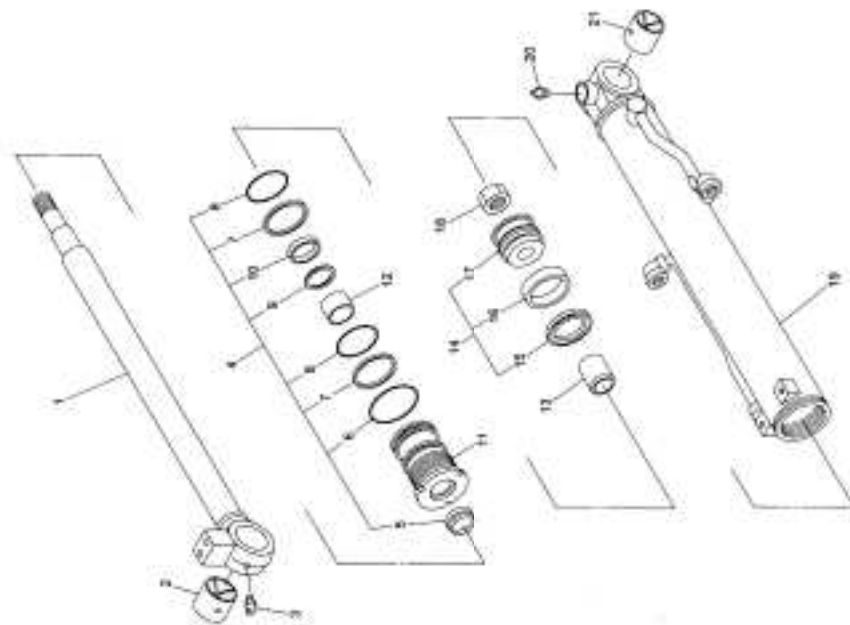
**Hyd. symbol****Control Diagram**

STRUCTURE

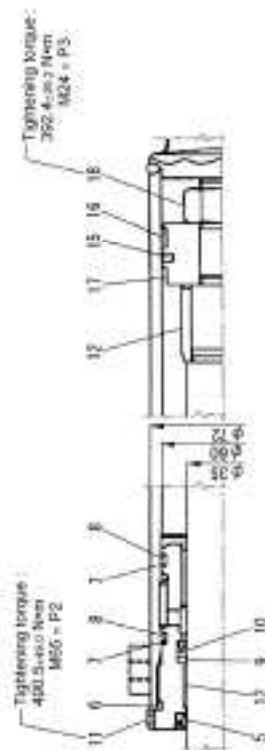
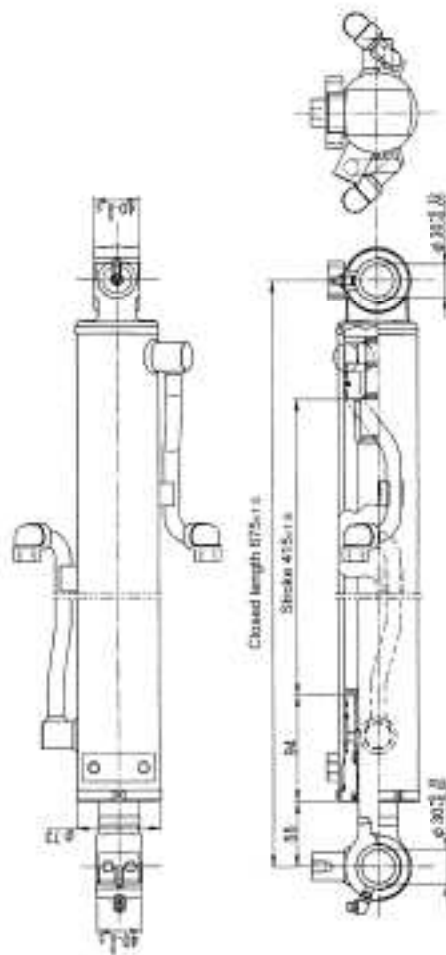
17VX3

BOOM CYLINDER ASSEMBLY

Weight: 14.0kg



No.	Parts name	Qty
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	2
9	Back up ring	1
10	U ring	1
11	Cylinder head	1
12	Bushing	1
13	Cushion bearing	1
14	Piston ass'y	1
15	Seal ring ass'y	1
16	Side ring	1
17	Piston	1
18	H.T. nut	1
19	Cylinder tube ass'y	1
20	Grease nipple	1
21	Bushing	1



Detail of Cylinder Head

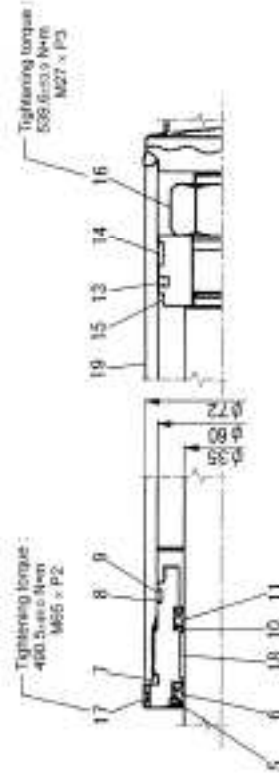
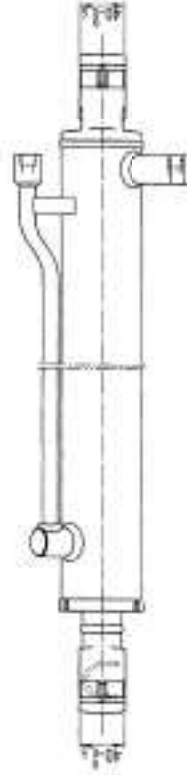
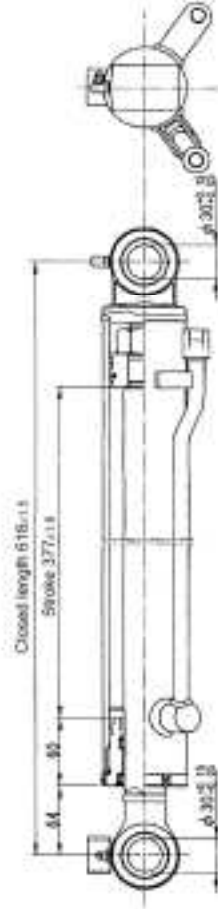
Detail of Piston

STRUCTURE

1/1x3

ARM CYLINDER ASSEMBLY

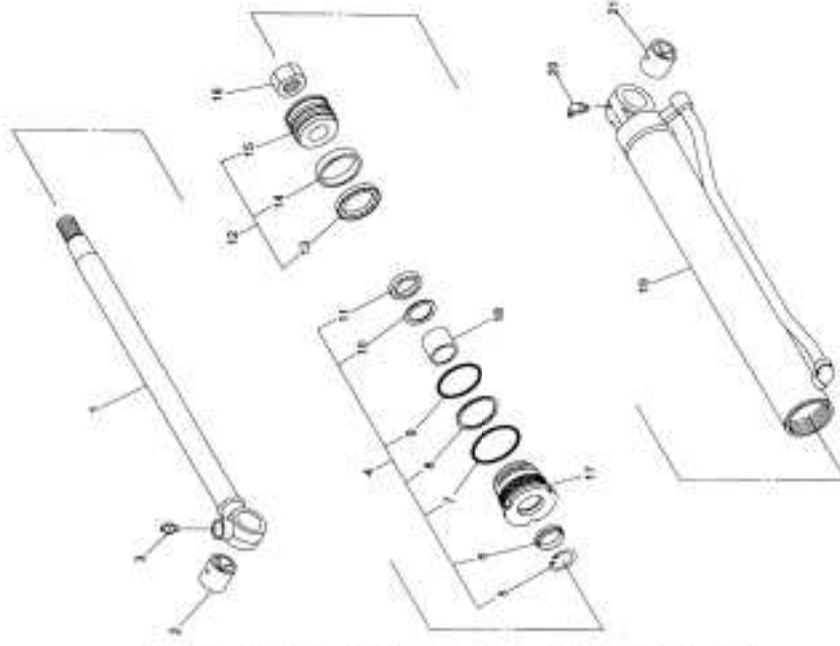
Weight: 14.5kg



Detail of Cylinder Head

Detail of Piston

No.	Parts name	Qty
1	Piston rod ass'y	1
2	Bushing	1
3	Grease nipple	1
4	Seal kit	1
5	Snap ring	1
6	Dust seal	1
7	O ring	1
8	Back up ring	1
9	O ring	1
10	Back up ring	1
11	U ring	1
12	Piston ass'y	1
13	Seal ring ass'y	1
14	Slide ring	1
15	Piston	1
16	H.T nut	1
17	Cylinder head	1
18	Bushing	1
19	Cylinder tube ass'y	1
20	Grease nipple	1
21	Bushing	1

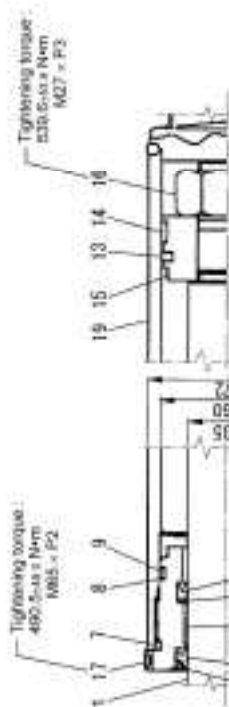
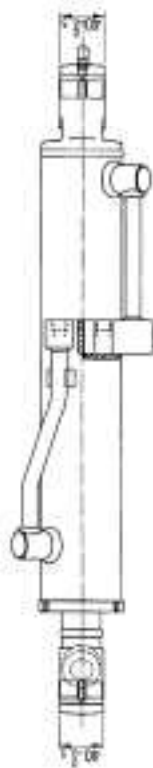
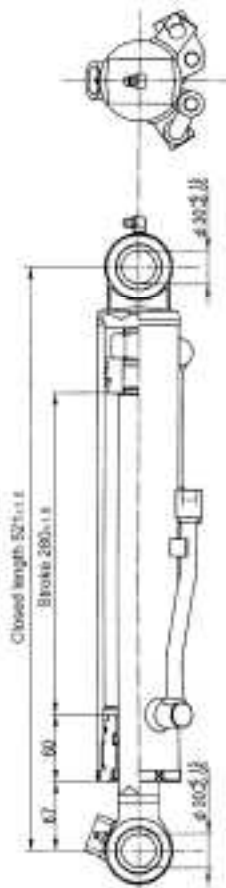


STRUCTURE

17VX3

BUCKET CYLINDER ASSEMBLY

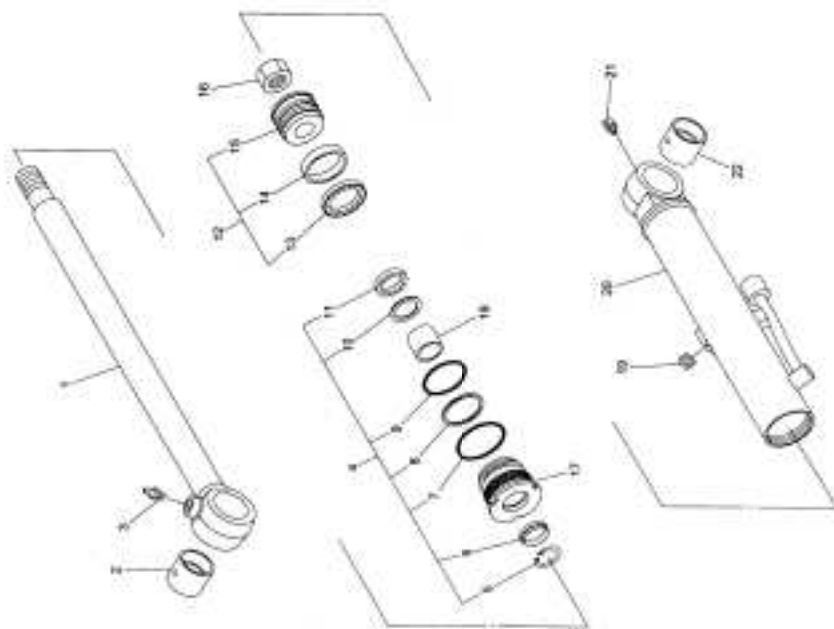
Weight: 12.4kg



Detail of Cylinder Head

Detail of Piston

No.	Parts name	Qty
1	Piston rod ass'y	1
2	Bushing	1
3	Grease nipple	1
4	Seal kit	1
5	Seal ring	1
6	Dust seal	1
7	O ring	1
8	Back up ring	1
9	O ring	1
10	Back up ring	1
11	U ring	1
12	Piston ass'y	1
13	Seal ring ass'y	1
14	Slide ring	1
15	Piston	1
16	H.T. nut	1
17	Cylinder head	1
18	Bushing	1
19	Plug	1
20	Cylinder tube ass'y	1
21	Grease nipple	1
22	Bushing	1

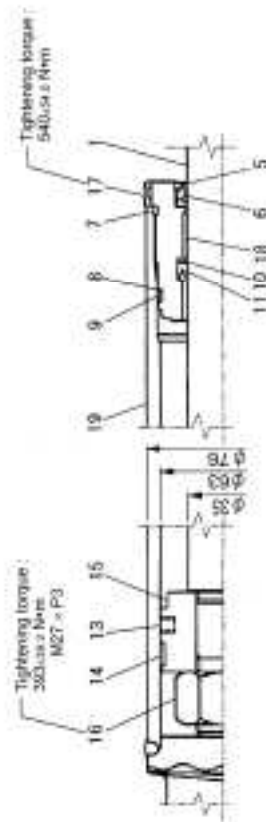
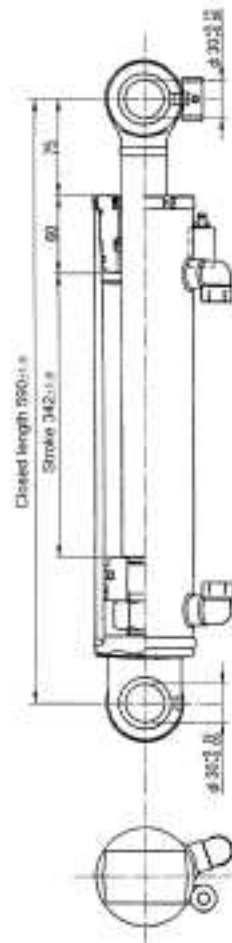
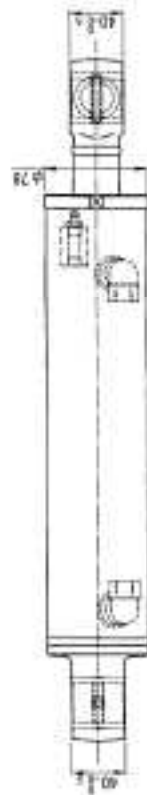


STRUCTURE

17VX3

SWING CYLINDER ASSEMBLY

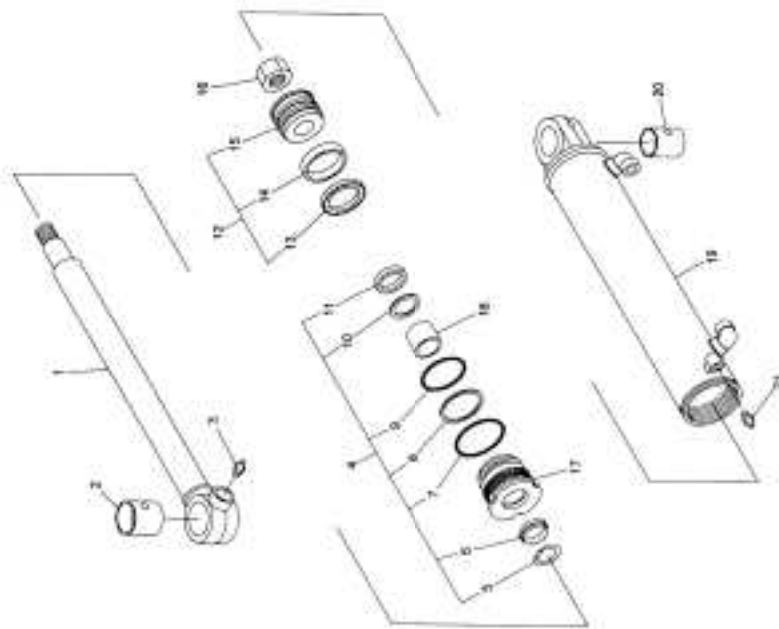
Weight: 14.2kg



Detail of Piston

Detail of Cylinder Head

No.	Parts name	Qty
1	Piston rod ass'y	1
2	Bushing	1
3	Grease nipple	1
4	Seal kit	1
5	Snap ring	1
6	Dust seal	1
7	O ring	1
8	Back up ring	1
9	O ring	1
10	Back up ring	1
11	U ring	1
12	Piston ass'y	1
13	Seal ring ass'y	1
14	Slide ring	1
15	Piston	1
16	H.T. nut	1
17	Cylinder head	1
18	Bushing	1
19	Cylinder tube ass'y	1
20	Bushing	1
21	Grease nipple	1

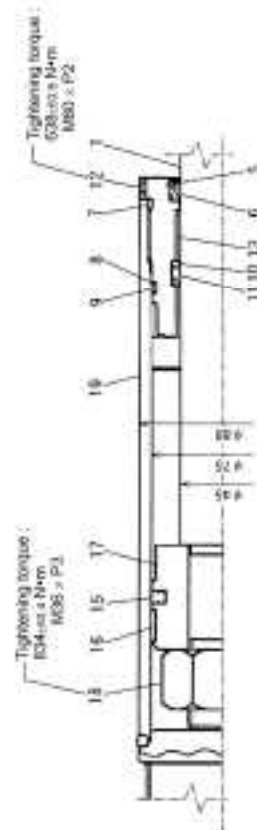
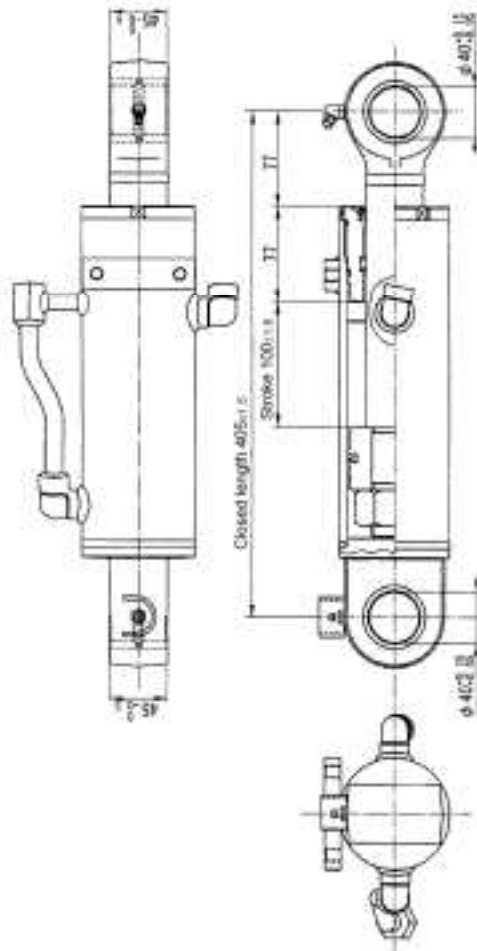


STRUCTURE

17VX3

BLADE CYLINDER ASSEMBLY

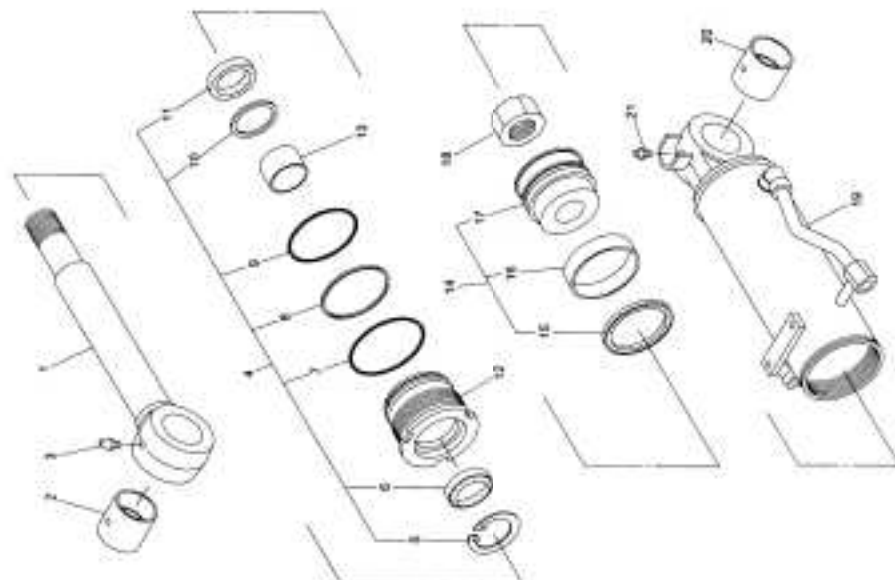
Weight: 13.9kg



Detail of Piston

Detail of Cylinder Head

No.	Parts name	Qty
1	Piston rod ass'y	1
2	Bushing	1
3	Grease nipple	1
4	Seal kit	1
5	Snap ring	1
6	Dust seal	1
7	O ring	1
8	Back up ring	1
9	O ring	1
10	Back up ring	1
11	U ring	1
12	Cylinder head	1
13	Bushing	1
14	Piston ass'y	1
15	Seal ring ass'y	1
16	Slide ring	1
17	Piston	1
18	Hexagon socket nut (smaller diameter)	1
19	Cylinder tube ass'y	1
20	Bushing	1
21	Grease nipple	1

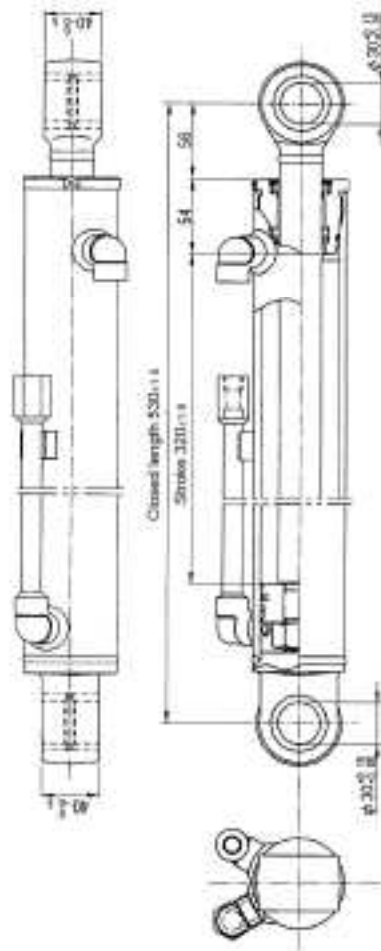


STRUCTURE

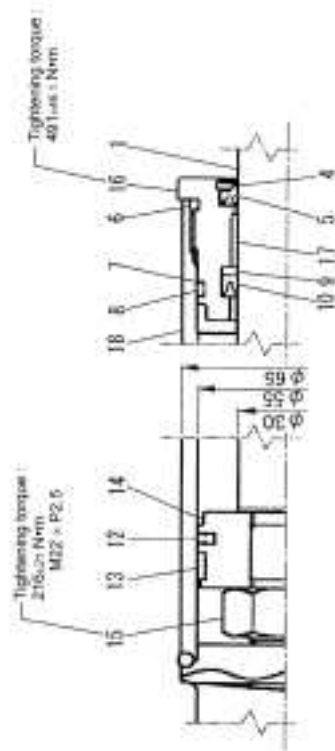
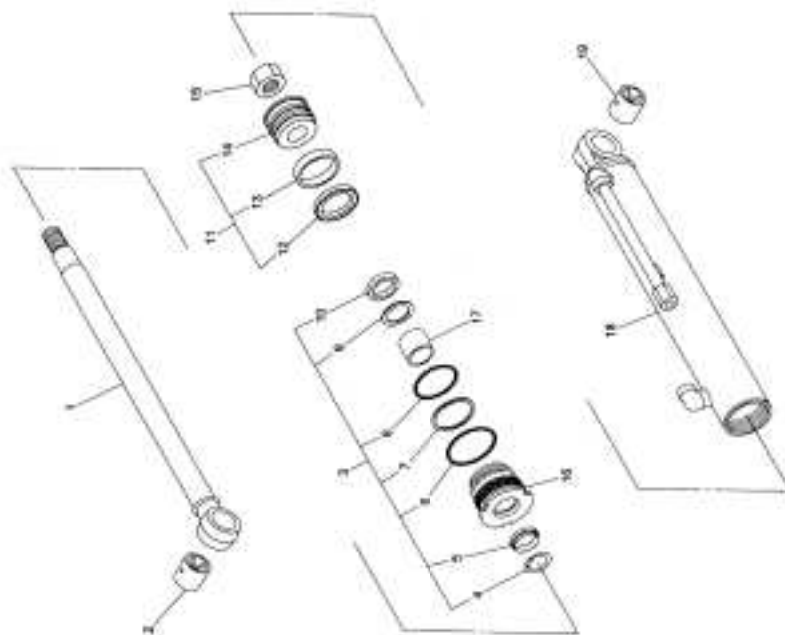
17VX3

SPANNER CYLINDER ASSEMBLY

Weight: 0.2kg



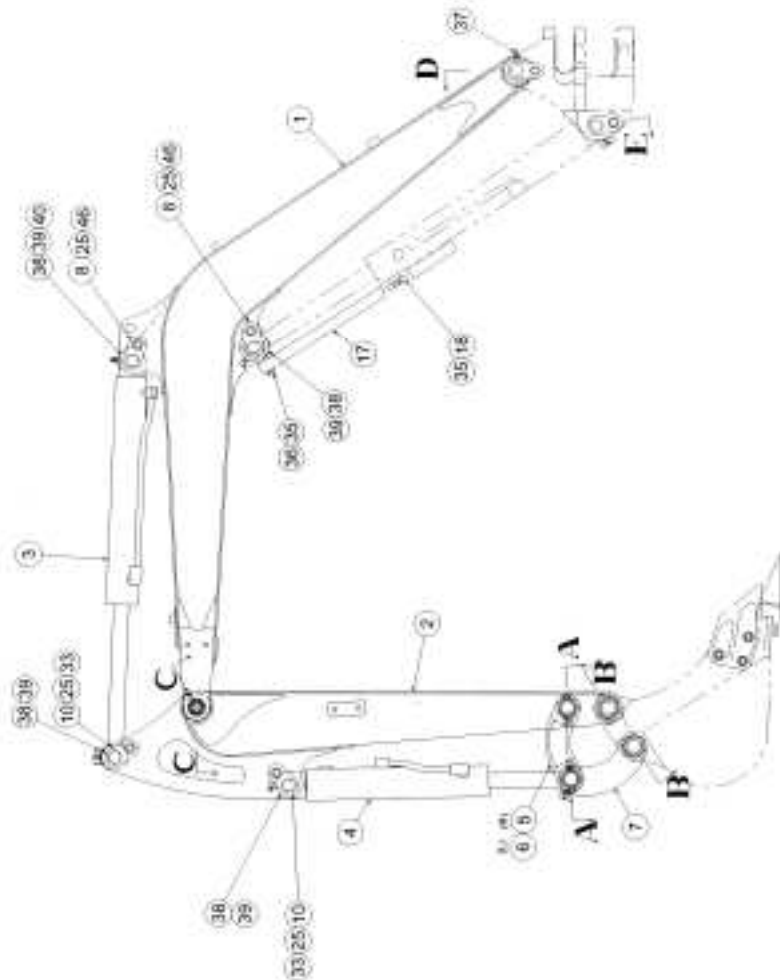
No.	Parts name	Qty
1	Piston rod ass'y	1
2	Bushing	1
3	Seal kit	1
4	Snap ring	1
5	Dust seal	1
6	O Ring	1
7	Back up ring	1
8	O ring	1
9	Back up ring	1
10	U ring	1
11	Piston ass'y	1
12	Seal ring ass'y	1
13	Slide ring	1
14	Piston	1
15	H.T. nut	1
16	Cylinder head	1
17	Bushing	1
18	Cylinder tube ass'y	1
19	Bushing	1



Detail of Piston

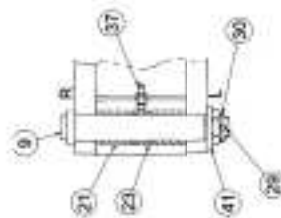
Detail of Cylinder Head

ATTACHMENT ASSEMBLY

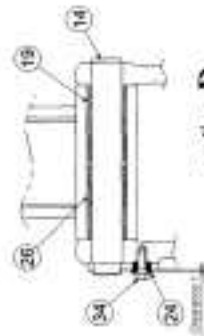


Note:

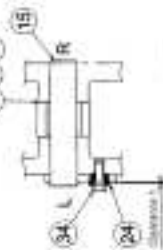
1. Double-nuts tightening clearance should be 0.5 mm to 1 mm.
2. When assembling bushing No. 19 and 20, direct inward the side where the groove extends from the end face.
3. Apply molybdenum disulfide grease at three places, the boom foot, boom pin and arm pin when assembling. EP2 grease can be applied at other places.
4. Adjust the pin tightening section using washers No. 38 to 40 and No. 42 to 44 so that the clearance will be 1.2 mm or less. Use washers No. 38 to 40 and No. 42 to 44 to adjust the play at the pin connection section. The number of washers is thus for reference only. For installation, the number of washers required should be determined according to the machine used.



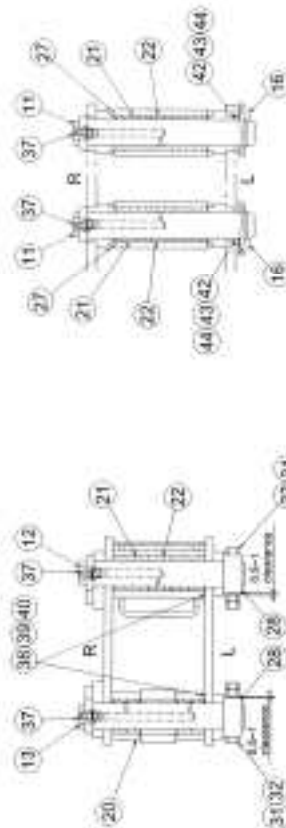
section C-C



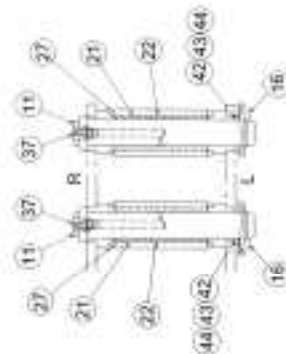
section D



E



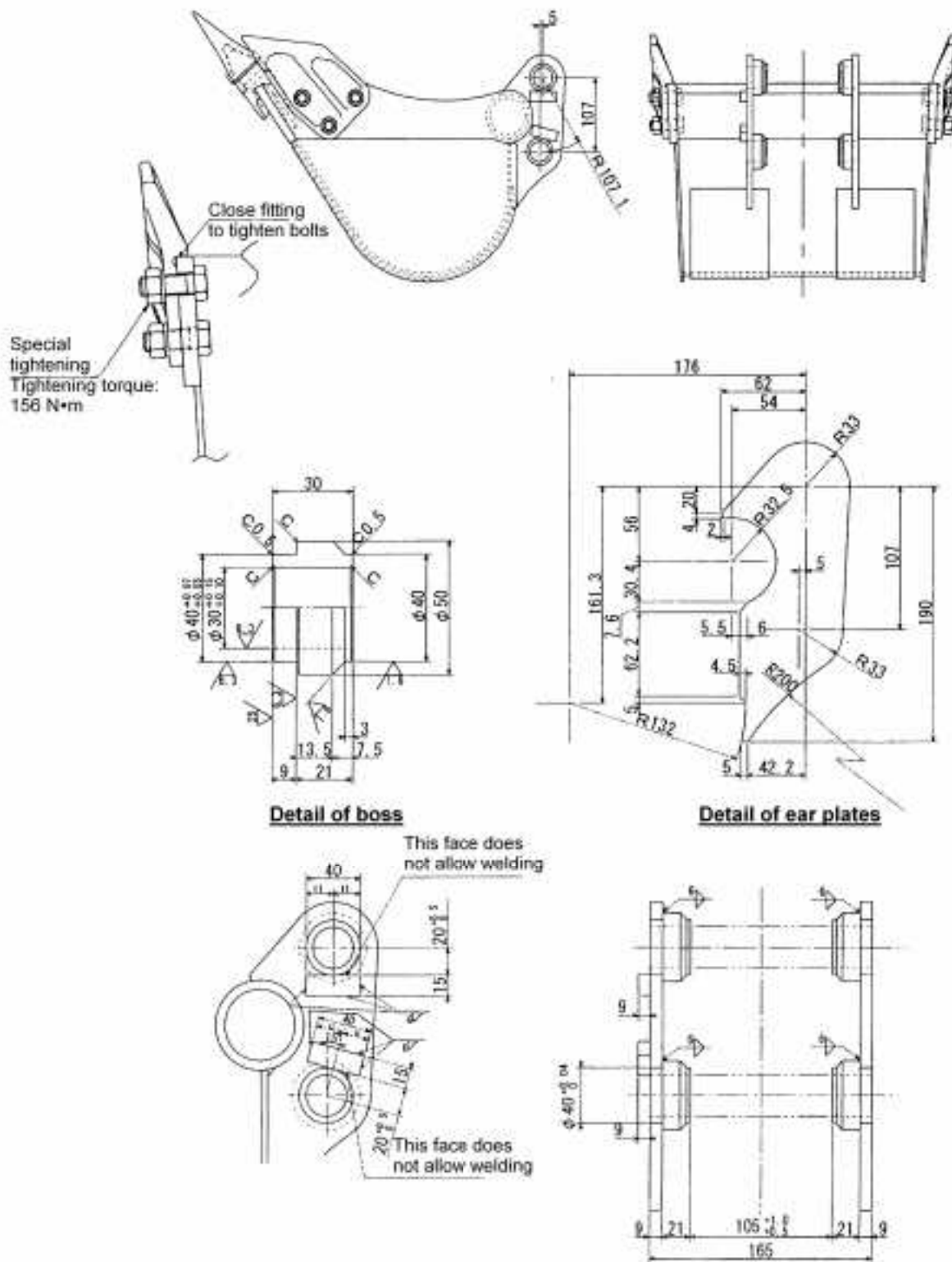
section A-A



section B-B

Item	Parts name	Qty
1	Boom	50 kg
2	Arm STD.	27 kg
3	Arm LONG	36 kg
4	Arm cylinder	1
5	Bucket cylinder	1
6	Arm link (R, L)	1
7	Arm link (L, R)	1
8	Bucket link	1
9	Wing pin	2
10	Head pin	1
11	Wing pin	2
12	Head pin	2
13	Head pin	1
14	Wing pin	1
15	Wing pin	1
16	Ring pin	2
17	Cover	1
18	Slay	1
19	Steering bushing	2
20	Steel bushing	2
21	Steering bushing	8
22	Spacer	3
23	Spacer	1
24	Bushing	2
25	Bushing	4
26	Spacer	1
27	Ching	4
28	Collar	2
29	Collar pin	1
30	Coiler nut	1
31	F. HT (S) nut	4
32	F. HT (S) bolt	2
33	F. HT (S) bolt	2
34	HT (S) bolt	2
35	HT (S) bolt	4
36	Spring washer	2
37	Grease fitting	6
38	Resin washer	7
39	Resin washer	7
40	Resin washer	4
41	Washer	1
42	Washer	2
43	Washer	2
44	Washer	2
45	HT (S) bolt	2

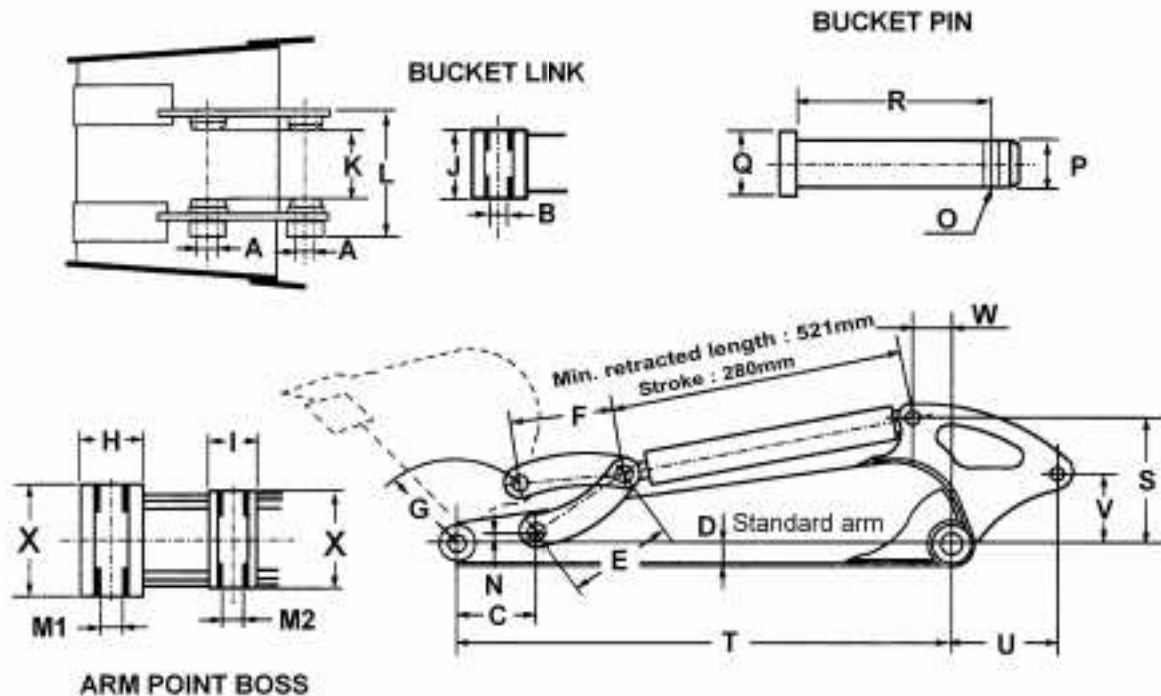
BUCKET ASSEMBLY
(Dimension of ear plates)



Detail of installation part

ATTACHMENT DATA

HYDRAULIC BREAKER INSTALLATION DATA



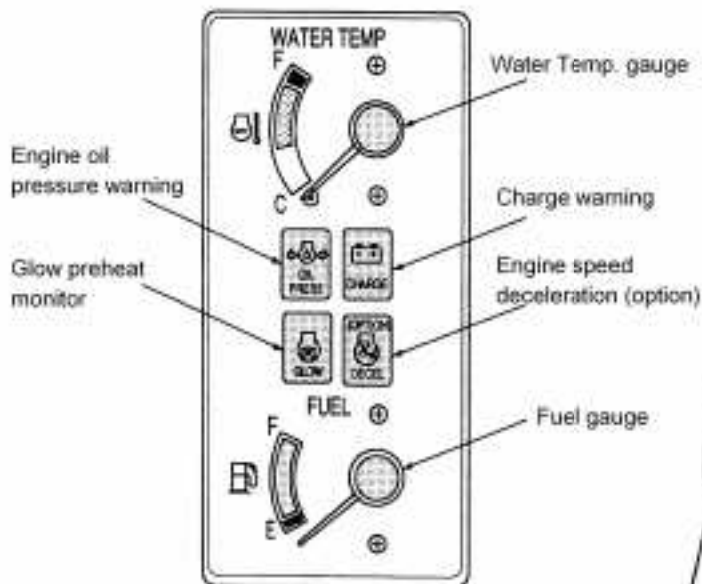
Key	A	B	C	D	E	F	G	H	I
Dimension (mm)	φ 30	φ 30	95	37	165	165	107	φ 65	φ 54

Key	J	K	L	M1	M2	N	O	P	Q
Dimension (mm)	105	105	165	φ 30	φ 30	0	φ 8	φ 30	40×50

Key	R	S	T	U	V	W	X
Dimension (mm)	174	180	950	186	116	211	105

HYDRAULIC SYSTEM

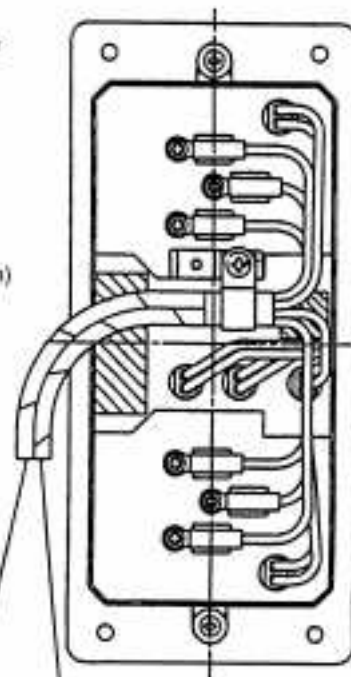
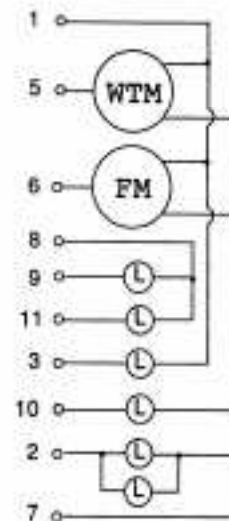
1	Type of pump	Variable plunger
2	Maximum flow	29.2 L/min
3	Relief valve set pressure	20.6 (210) MPa(kgf/cm ²)
4	Hydraulic oil tank	Enclosed type
5	Hydraulic oil cooler	Air cooled type
6	Service port	Standard equipped

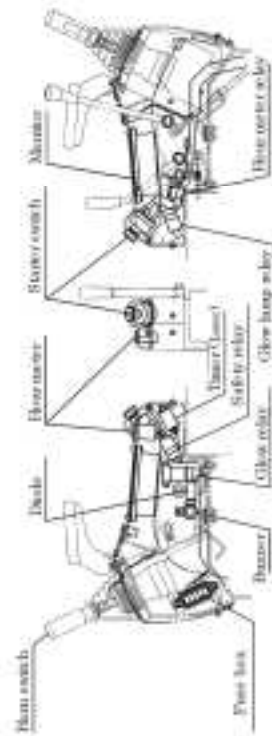
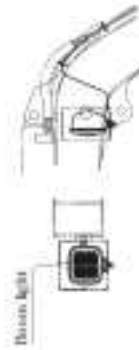
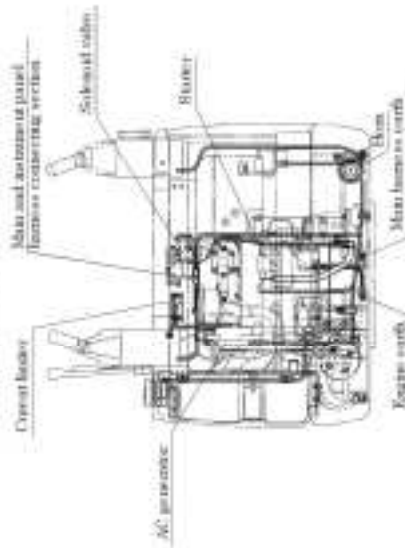
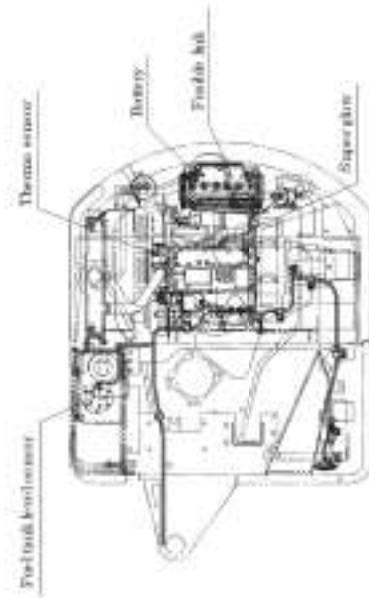
MONITOR ASSEMBLY**Fig.-1 Monitor panel**

METER	FUEL	WATER TEMP.
DIAL		
Measurement point	E F	67°C 105°C
Std. Resistance	80Ω 10Ω	49.8Ω 15.5Ω
Allowance	Initial	0 -5° +9° +2° ±5° ±3°
	After	±6° ±7°

Table - 1 Indicator Standards

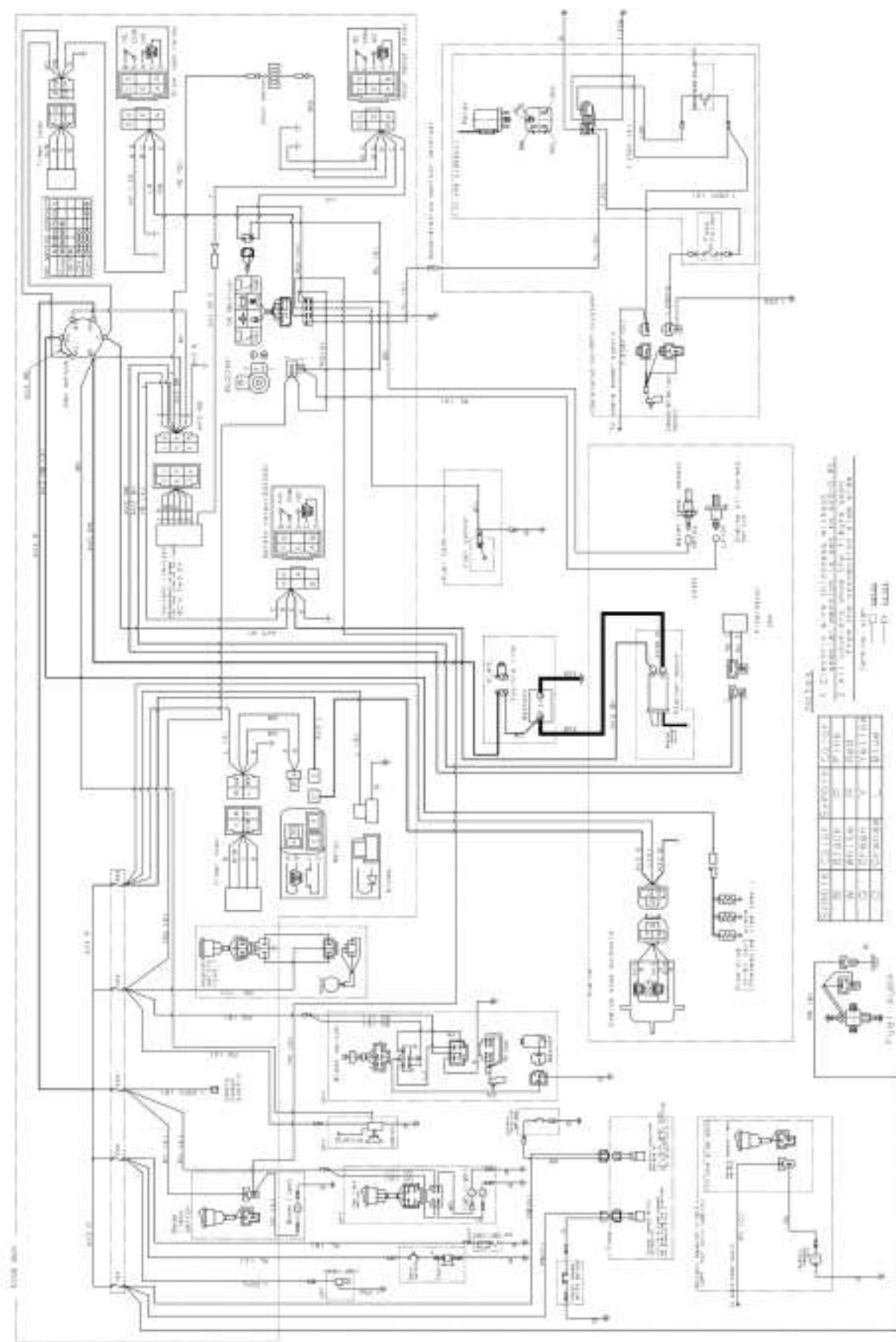
No.	To connect	Wire dia.	Color
1	12V	AV50.5	R
2	Light		Y
3	Glow		Y/G
4	Option		P
5	Water temp. sensor		L/W
6	Fuel sensor		W/L
7	Earth		B
8	12V		G/W
9	Charge		L/R
10	Decel.		G/R
11	Engine oil press.	AV50.5	L

Table - 2 Connection of connectors**Fig.-2 Monitor reverse side****Fig.-3 Electrical circuit in monitor**

ELECTRICAL WIRING ASSEMBLY**Detail of side box****View from machine rear****Detail of boom light****View from machine front****View from machine top****View from machine left side**

Electrical wiring and device names / arrangement are shown below

ELECTRICAL WIRING SYSTEM DIAGRAM

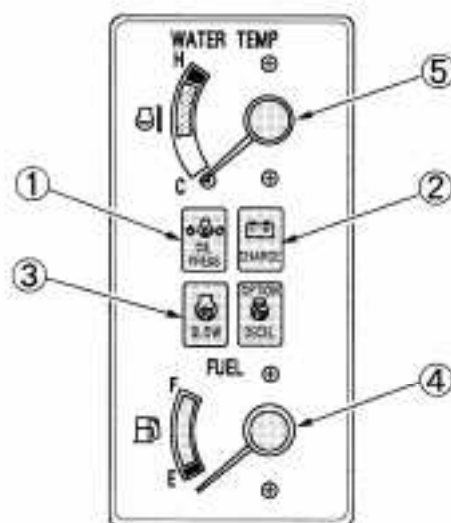
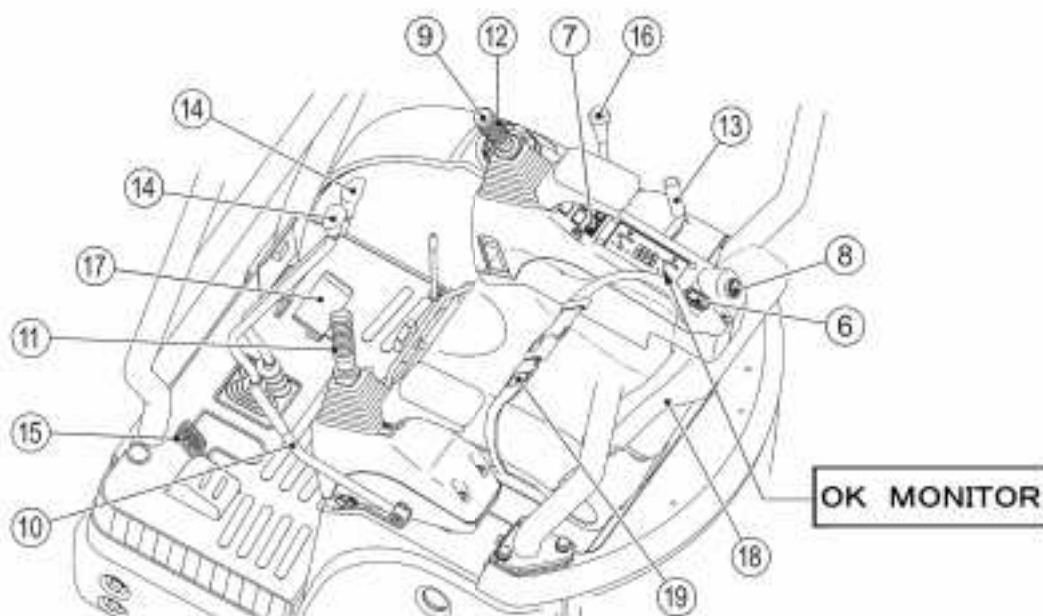


SECTION 3 OPERATION

TABLE OF CONTENTS

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Controls and Instruments	3 - 1 - 1
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"Break-in" Operation	3 - 5 - 1
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Travelling the Machine	3 - 8 - 1
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Loading and Unloading the Machine	3 - 12 - 1
Precaution on Use Rubber Track Shoe	3 - 13 - 1
Boom Lowering with the Engine Stopped	3 - 14 - 1
Parking the Machine	3 - 15 - 1
Emergency Engine Stop	3 - 15 - 1

CONTROLS AND INSTRUMENTS



- | | | |
|--------------------------------------|-----------------------------|------------------------------|
| (1) Engine Oil Pressure Warning Lamp | (7) Light Switch | (14) Travel Lever |
| (2) Charge Warning Lamp | (8) Engine Start Switch | (15) High Speed Travel Pedal |
| (3) Heat Indicate Lamp | (9) Horn Switch | (16) Blade Lever |
| (4) Fuel Level Gauge | (10) Control Shut-Off Lever | (17) Boom Swing Pedal |
| (5) Water Temp. Gauge | (11) Left Operating Lever | (18) Operator's Seat |
| (6) Service Hour Meter | (12) Right Operating Lever | (19) Seat Belt |
| | (13) Engine Throttle Lever | |

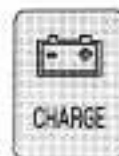
1. MONITOR LAMPS**① Engine Oil Pressure Warning Lamp**

When warning lamp comes on and the action alarm sounds with the engine running, stop the engine. This indicates insufficient oil pressure.

Check the engine oil level and have any necessary repairs made before starting the engine.

**② Charge Warning Lamp**

This indicates a malfunction in the electrical charging system. If the light comes on while the engine is running, check the electrical system.

**③ Heat Indicate Lamp**

Hold the engine start switch in the HEAT position for approximately 4 seconds. The heater is activated and the indicator comes on.



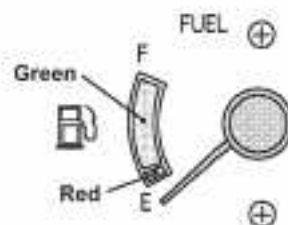
2. GAUGES and METER

④ Fuel Level Gauge

It indicates the amount of in the fuel tank. Add fuel immediately when the gauge indicates the level is in the E range.

F : The fuel tank is full.

E : Fuel level is too low.



⑤ Water Temperature Gauge

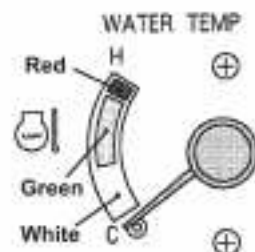
This indicates the engine coolant temperature.

Upon start-up, the lowest "White" range indicates. While running the engine, with out load and low idling warming up.

The "Green" range is the normal operating temperature.

The "Red" range indicates overheating.

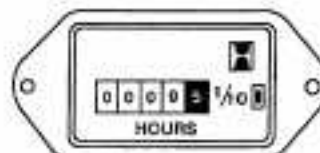
If the gauge indicate red range, reduce machine operating speed and keep the engine at low idle until the engine is cooled down. Stop the engine. Check the coolant. Check the fan drive belt. Have any necessary repair made.



⑥ Service Hour Meter

Indicates the total operating hours of the machine.

It should be used to determine service hour maintenance intervals.



3. SWITCHES

⑦ 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.

LIGHT



⑧ Engine Start Switch

CAUTION

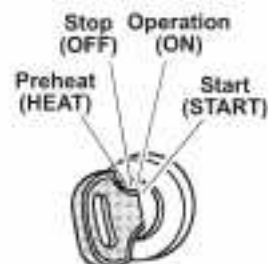
If the engine does not start after 10 seconds, return the key to **OFF** and wait for two minutes before returning it to **START**.

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.

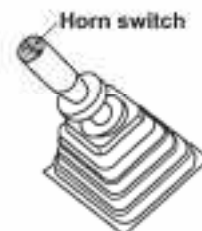
HEAT : If the engine is hard to start in cold weather, hold the switch in the **HEAT** position to preheat the engine intake air. After approximately 4 seconds the heater indicator on the monitor will turn off.



Engine Start Switch

⑨ Horn switch

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



Right operating lever

4. MACHINE CONTROLS

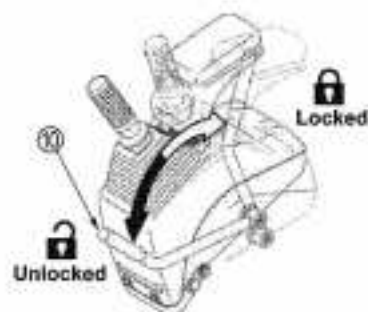
- ⑩ **Control Shut-off Lever (Left Lever)**
(for all hydraulic activation controls)

CAUTION

To mounting and dismounting the machine, be sure to put the shut-off lever in the LOCKED position.
If the lever is in the UNLOCKED position, upper structure can swing and can result personal injury.

Locked : Move the lever back to the locked position. This makes all hydraulic activation controls inoperable.

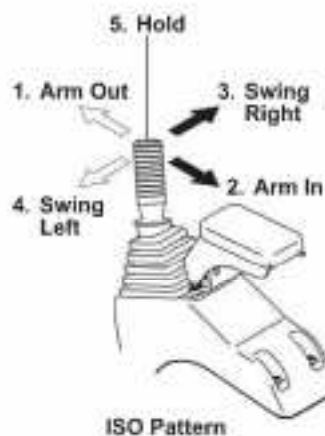
Unlocked : Move the lever forward to the unlocked position. This makes all hydraulic activation controls operable.



- ⑪ **Left Operating Lever**

[Swing and arm controls]

1. **Arm Out:**
Move the lever forward to move the arm out.
2. **Arm In:**
Move the lever back to move the arm in.
3. **Swing Right :**
Move the lever right to swing the upper structure to the right.
4. **Swing Left :**
Move the lever left to swing the upper structure to the left.
5. **Hold :**
When the lever released from any position, the lever will return to hold (center position). Arm or swing movement will stop.



Two Functions may be performed at the same time by moving the lever diagonally.

⑫ Right Operating Lever**[Bucket and boom controls]****1. Boom Lower:**

Move the lever forward to lower the boom.

2. Boom Raise:

Move the lever rear to raise the boom.

3. Bucket Dump :

Move the lever right to dump the bucket.

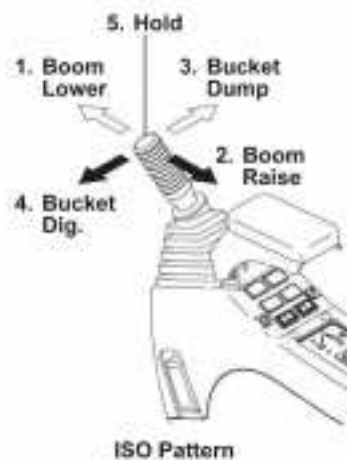
4. Bucket Dig. :

Move the lever left to close the bucket.

5. Hold :

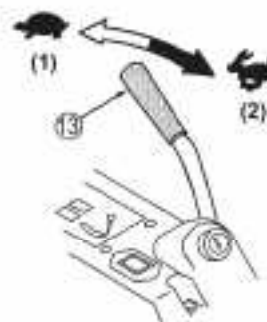
When the lever released from any position, the lever will return to hold(center position) . Boom or bucket movement will stop.

Two Functions may be performed at the same time by moving the lever diagonally.

**⑬ Engine Throttle Lever**

Decrease (1) : Move the lever to forward to decrease the engine speed.

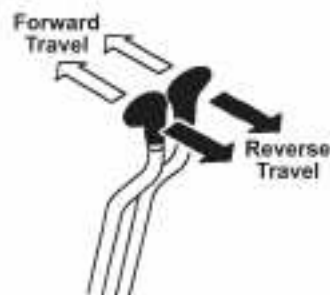
Increase (2) : Move the lever to the rear to increase the engine speed.



14 Travel Lever

CAUTION

- * Normal traveling is when the drive sprocket are under the rear of the machine. Blade are under the front of the cab. Reverse traveling is when the cab is over the sprockets. Both the directional and traveling functions will be reversed.
- * Always travel with sprockets under the rear of the machine.



Forward Direction Travel :

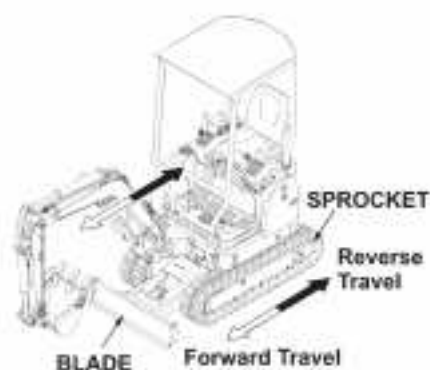
Move the both travel levers forward to move the machine forward direction.

Stop :

Release the travel levers to stop the machine and apply the brakes.

Reverse Direction Travel :

Move the both travel levers rear to move the machine reverse direction.



Refer to Traveling the Machine section of this manual.

15 High Speed Travel Pedal

CAUTION

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

Low Speed Travel

Release the pedal to low speed travel. Select the **LOW** speed travel when driving on rough or soft surface. Low is also recommended for loading or unloading from a truck.

High Speed Travel

During push down the pedal to shift the high speed travel. Select the **HIGH** speed travel when driving on a hard even surface.

15 High Speed Travel (push down)



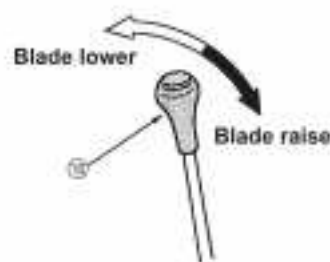
⑫ Blade Lever

CAUTION

The blade falls with its self-weight if pushing this lever to forward when the engine stops. Be careful.

Blade raise : Move the lever back to raise the blade.

Blade lower : Move the lever forward to lower the blade.



⑬ Boom Swing Pedal

CAUTION

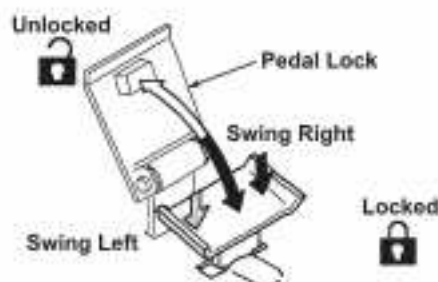
ALWAYS locked pedal when is not in use.

Boom swing right :

Push down right on the pedal to swing the boom to the right.

Boom swing left :

Push down left on the pedal to swing the boom to the left.



⑭ Operator's Seat

CAUTION

- * Seat adjustment should be checked at the beginning of each shift or when changing operator.
- * Lower the bucket on the ground, stop the engine and then make adjustment.

Seat Adjustment

Seat position can be adjusted forward or backward and seat back tilt. Select the desired position to allow full pedal and lever travel.

To Adjust the Seat Forward or Backward.

Pull up and hold lever ① and move the seat to the desired position. Release the lever to hold the seat in the selected position.

To Adjust the Seat Back Tilt.

Pull up and hold lever ② and tilt the seat back to the desired position. Release the lever to hold the seat in the selected position.

To Adjust the Seat Suspension.

Turning nob ③ clockwise increases suspension stiffness and turning it counterclockwise decreases suspension stiffness.



19 SEAT BELT**⚠ CAUTION**

ALWAYS fasten the seat belt while operating the machine.

Before operating the machine, be sure to inspect the seat belt and mounting for excessive wear and damaged. Replace if damaged.

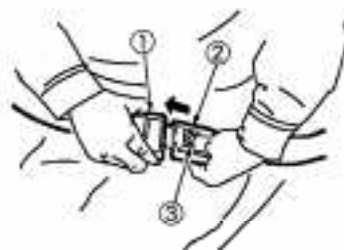
1. Confirm that the seat belt (1) is not twisted and put it into the buckle (2) securely.



2. Adjust the seat belt length according to your body size. Slightly pull the belt and confirm the belt (1) is locked.



3. Press the button (3) of the buckle (2) and unfasten seat belt.



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.

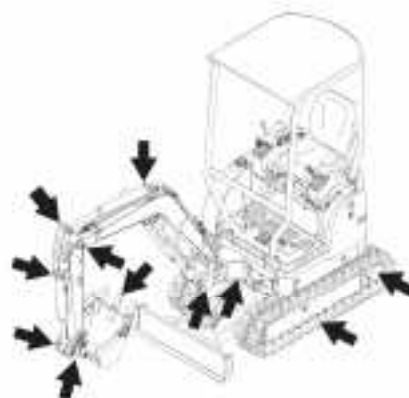
Refer to the Daily in the Maintenance Section for more detailed information.

■ Seat and Seat Belt Checks

Adjust the seat to allow full travel of the levers and pedals when the operator is seated against the seat back.

Inspect the belt mounting hardware. Replace any damaged or worn hardware. Keep the mounting bolt tight.

Fasten the seat belt before starting the engine.



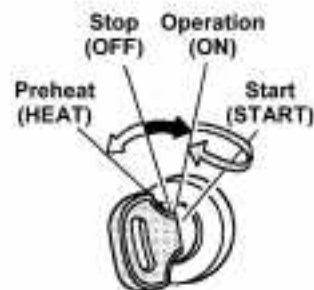
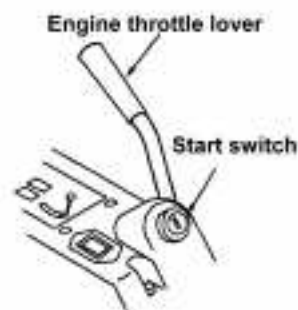
STARTING ENGINE

Once the pre-start inspection has been completed, the engine may be started.

Starting at Normal Temperature**CAUTION**

If the engine does not start after 15 seconds, return the key to **OFF** and wait for 15 seconds before returning it to **START**.

1. Move Control shut-off lever to the **LOCKED** position.
2. Move all Controls to the **HOLD** position.
3. Move the engine throttle lever above the low to medium position (advance about one-third to one-half).
4. Insert key ① into the switch and turn the switch to the **ON** position.
5. Turn the switch to the **START** position.
Do not crank the engine for more than 15 seconds.
Allow the starter to cool for seconds before cranking again.
6. Release the switch key after the engine starts.
7. Move the engine throttle lever to position **LOW** to allow the engine to warm.

**Starting In Cold Weather****WARNING**

This engine has an inlet manifold heater for cold weather starting. Do not use other types of starting aids such as ether. Such use could result in an explosion and personal injury.

1. Repeat steps 1 through 4 in Starting At Normal Temperature.
2. Hold the switch in the **HEAT** position to preheat the engine intake air. After approximately 4 seconds the heater indicator on the monitor will turn off.
This indicates that the engine is ready to start.
3. Repeat steps 5 through 7 in Starting At Normal Temperature.



Heater indicator

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) and **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) and **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

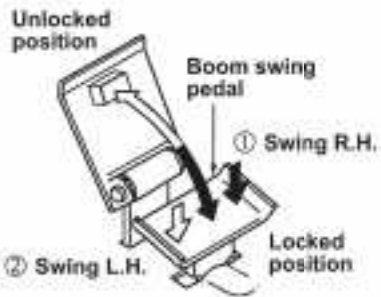
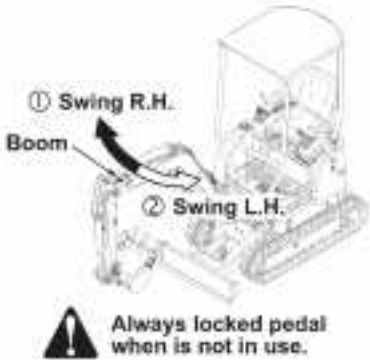

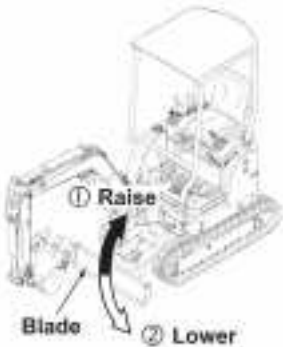
BACKHOE OPERATION

Shown lever pattern A (ISO) type operations.

OPERATIONS	DIRECTION OF LEVER	DIRECTION OF MACHINE
BOOM		
BUCKET		
ARM		
SWING		



When leaving the operator's seat, stop the engine, lower the bucket and the blade on the ground.

OPERATIONS	DIRECTION OF LEVER	DIRECTION OF MACHINE
<p>BOOM SWING</p>	 <p>Unlocked position</p> <p>Boom swing pedal</p> <p>① Swing R.H.</p> <p>② Swing L.H.</p> <p>Locked position</p>	 <p>① Swing R.H.</p> <p>Boom</p> <p>② Swing L.H.</p> <p>⚠ Always locked pedal when is not in use.</p>
<p>BLADE</p>	 <p>② Lower</p> <p>① Raise</p> <p>Blade lever</p>	 <p>① Raise</p> <p>Blade</p> <p>② Lower</p>

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.

Precautions on use of special attachment and 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.
- When a special attachment and an actuator are mounted, the machine specifications such as stability, working radius, transport height, etc., should be altered. Before starting operation, confirm each specification to ensure safety of workers and the machine.

1. SINGLE ACTION OPERATION**Hydraulic Breaker and Others Controls****CAUTION**

If the marked (—) of the valve is set in horizontal position, the pressure of returned oil becomes higher and the breaker does not function efficiently.

ALWAYS set the marked (|) in vertical position.

Switching the attachment hydraulic circuit.

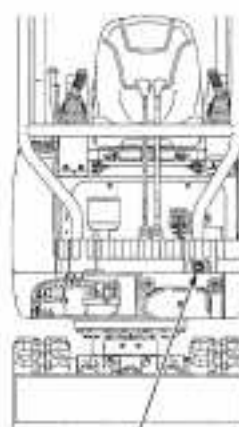
Check the marked position on the shift valve ① Turn the valve with a wrench and set the marked (|) in vertical position, if necessary.

- 1) Fold the pedal ② into double layers.
- 2) Move the lock lever ③ to the unlocked position.

Breaker ON : Push down the pedal ② to activate the breaker.

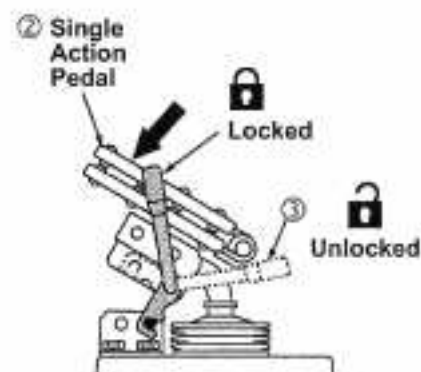
Breaker OFF: Release the pedal ② to deactivate the breaker.

NOTE: When no breaker operation is needed, be sure to lock the pedal ② by lock lever ③ to the **LOCKED** position.



Set the mark (|) in vertical position

① Shift Valve



2. DOUBLE ACTION OPERATION

Wrench Fork and Others Controls

CAUTION

ALWAYS set the marked (—) in horizontal position. If the marked (I) of the valve is set in vertical position, the B port of the double action does not function efficiently.

Switching the attachment hydraulic circuit.

Check the marked position on the shift valve ①. Turn the valve with a wrench and set the marked (—) in horizontal position, if necessary.

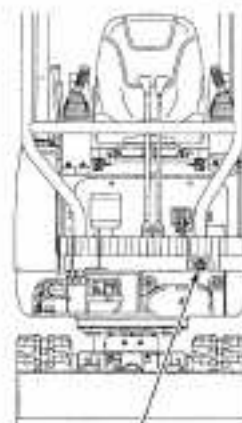
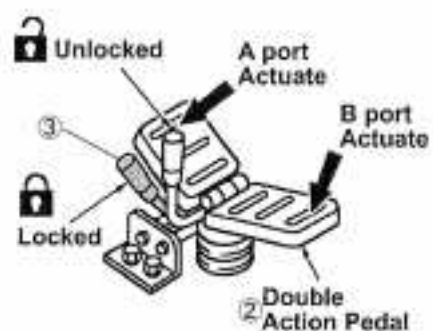
- 1) Unfold the pedal ② into two pedal plates.
- 2) Move the lock lever ③ to the unlocked position.

To actuate the port A :

Push down on the front of the pedal ② to actuate the port A.

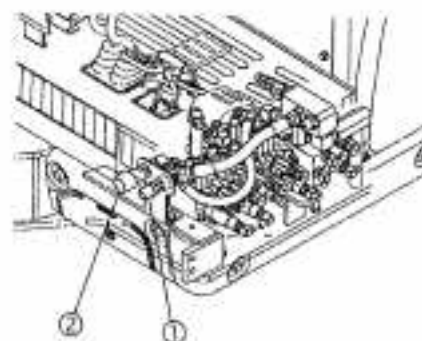
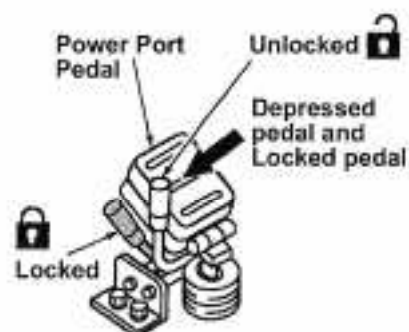
To actuate the port B :

Push down on the rear of the pedal ② to actuate the port B.



Set the mark (—) in horizontal position

① Shift Valve



3. SINGLE ACTION OPERATION

USED : FOR POWER PORT WORKS

CAUTION

The engine cannot be started if the power port is **ON** (locked status with the pedal depressed).

Be sure to set the pedal at the neutral position before starting the engine.

- 1) Fold the pedal into double layers.
- 2) Turn the pedal lock lever to the unlocked position and release the pedal lock.
- 3) Push down the pedal and turn the pedal lock lever to the locked position.

This makes it possible to supply the hydraulic pressure to the high-pressure line of the power port.

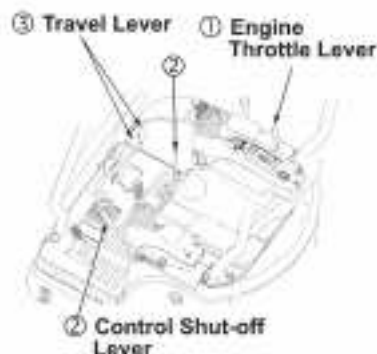
The actuator can be operated by the actuator's control valve.

- 4) When the power port is out of service, **ALWAYS** set the pedal back to the neutral position and pedal lock lever to the locked position.

TRAVELING THE MACHINE**STRAIGHT TRAVEL****⚠ WARNING**

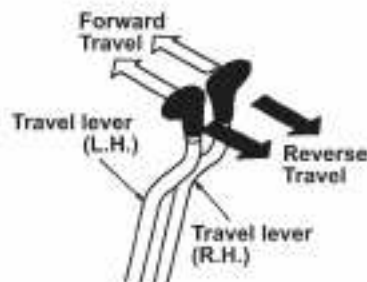
- * Be sure no one is working on or near the machine to prevent injury.
Keep the machine under control at all times to prevent injury.
- * Before control levers, confirm which direction the track frame faces.
- * Always travel with sprockets under the rear of the machine.

1. Move engine throttle lever ① to the operating range.
2. Move the control shut-off lever ② to the unlocked position.
3. Raise the boom and the blade enough to provide sufficient ground clearance.
4. Control right and left travel levers ③ as follows.

**Forward Direction Travel**

Move the both travel levers ③ forward to move the machine forward.

The machine will always travel toward the **BLADE**.

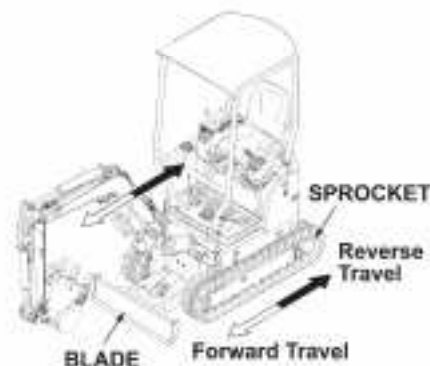
**Stop**

Slowly move both the travel levers ③ to the stop position to stop the machine and apply the brakes.

Reverse Direction Travel

Move the both travel levers ③ rear to move the machine reverse.

The machine will always travel toward the **SPROCKETS**.



STEERING CONTRTROL

⚠ WARNING

- Be sure no one is working on or near the machine to prevent injury. Keep the machine under control at all times to prevent injury.
- Before control levers, confirm which direction the track frame faces.
- Always travel with sprockets under the rear of the machine.

1. Move engine throttle lever ① to the operating range.
2. Move the travel lever lock and control shut-off lever to the unlocked position.
3. Raise the boom and the blade enough to provide sufficient ground clearance.

STEERING

To make turns, control the travel levers.
Control the two travel levers as follows:

Pivot Left Turn

Move the right lever ① forward to travel forward and left, and move it rear to travel reverse and left, pivoting on the left track.

Pivot Right Turn

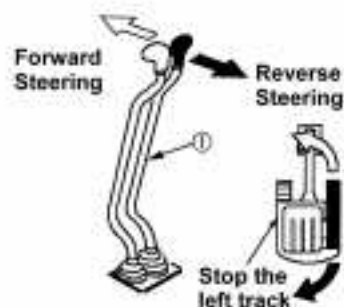
Move the left lever ② forward to travel forward and right, and move it rear to travel reverse and right, pivoting on the right track.

SPOT TURN**Spot Left Turn**

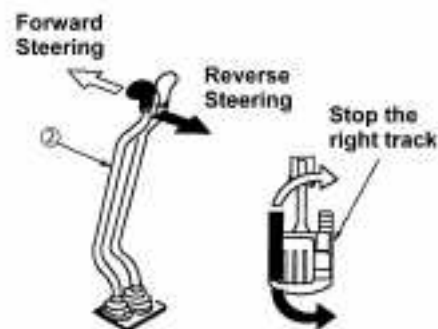
Move the left travel lever ② rear and move the right lever ① forward at the same time. This allows a quick left turn.

Spot Right Turn

Move the right travel lever ① rear and move the left lever ② forward at the same time, allowing a quick right turn.



PIVOT LEFT TURN



PIVOT RIGHT TURN



SPOT LEFT TURN

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 ① shift to the high speed travel.

When released pedal, shift to the low speed travel.

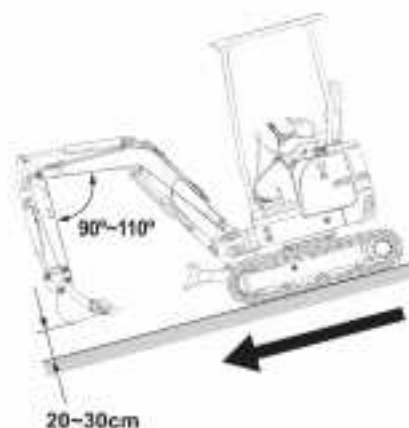
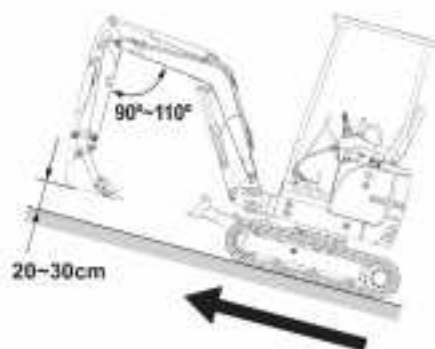
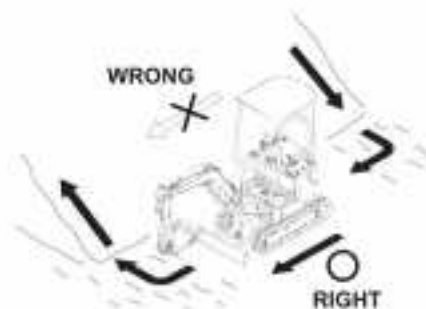


CAUTION ON TRAVEL ON A GRADE

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 is equipped with the spanner mechanism (crawler extension / retraction mechanism). Take the following procedure.

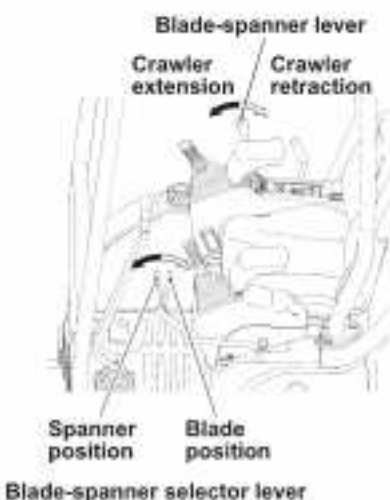
1. Jack up the main unit.

Set the blade to the rear and jack up the main unit with the working device and blade cylinder till the crawler is off from the ground to extend or retract the crawler easily.



2. Lever selection

Set the selector lever to the spanner position.



3. Crawler extension / retraction

Set the engine speed at medium or higher.

Move the blade - spanner lever (blade lever) forward or backward.

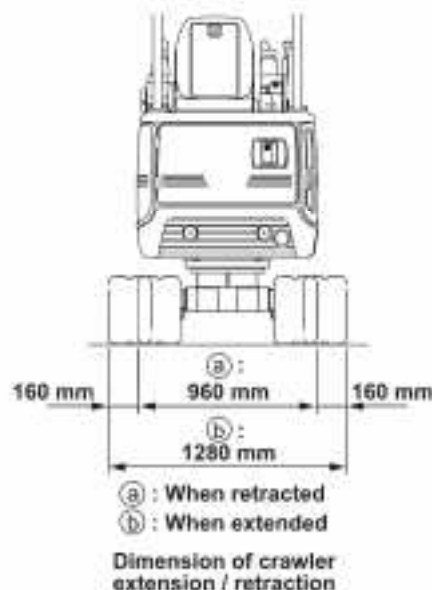
- **Crawler extension** : Push the lever forward.
- **Crawler retraction** : Pull the lever backward.

CAUTION

Extend or retract the crawler on a level ground without an obstacle.

Extension or retraction is possible without jacking up the main unit.

If there is an obstacle on the ground beside the crawler, the resistance is larger and extension or retraction is sometimes impossible.



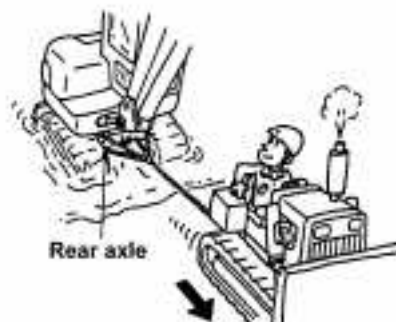
TOWING**⚠ WARNING**

- 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.

1. 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 must 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.



2. Use of the towing hook

The towing hook is used to tow for lightweight material. The maximum allowable towed weight is 500 kg.

NEVER tow the machine with the towing hook, which may damage the towing hook and cause a personal injury.



LIFTING THE MACHINE**⚠ WARNING**

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

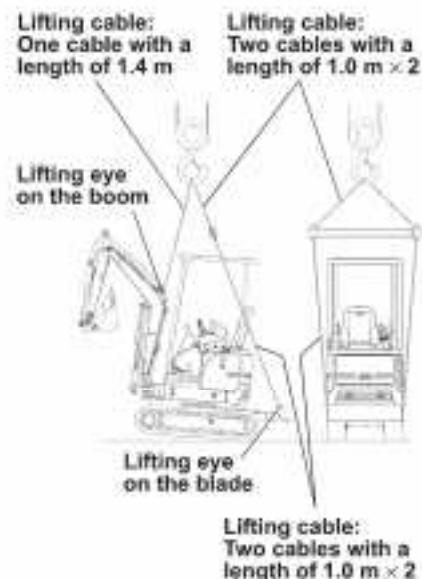
- Use proper rated cables and slings for lifting. Lifting cables should have sufficient length to prevent contact with machine.
- Position crane for level machine lift.
- **NEVER** lift the machine loaded with any personnel.
- Use guide or tag lines to prevent the machine from swinging or turning.
- Be sure to use wire ropes with breaking force of greater than 10 tons.

Lifting Procedures

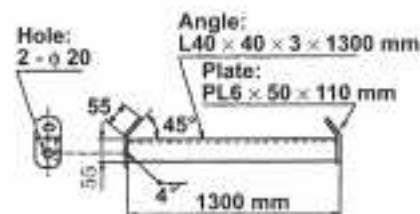
1. Start the engine and swing the machine to position the blade to rear.
2. Position the machine on the level ground with the boom, arm and bucket cylinders fully extended.
3. Position the boom at the center of the machine with the boom swing pedal.
4. Stop the engine.
5. Install the cables to the two lifting eyes on the blade with shackles.
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

Selection of the lifting cables: Be sure to use wire ropes with breaking force of greater than 4 tons.



Machine mass (kg)		
Shoe type	STD	ADD Weight
Rubber shoe	1,520	1,620
Steel shoe	1,590	1,690



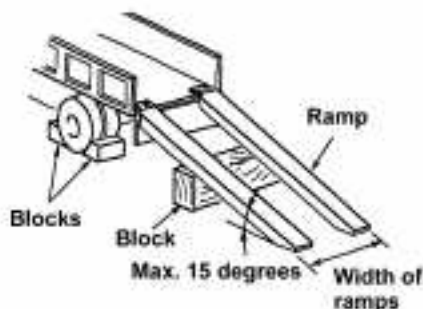
Details of a lifting jig

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.

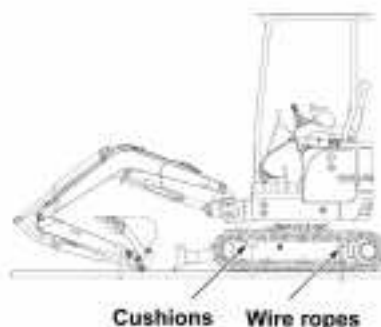
MACHINE LOADING ONTO A TRUCK.

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**

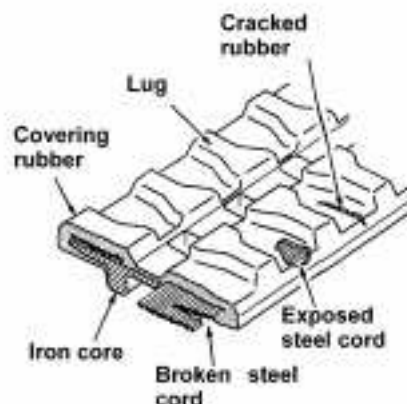
The rubber track shoe may be damaged or worn faster depending on working conditions. Perform working operation properly according to working site conditions and machine operation.

■ 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 fire
 - Travel in contact with concrete path or wall
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.

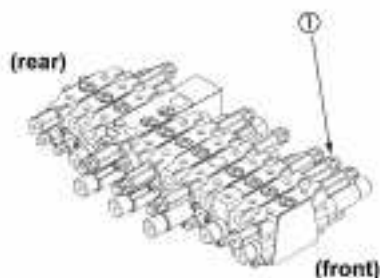
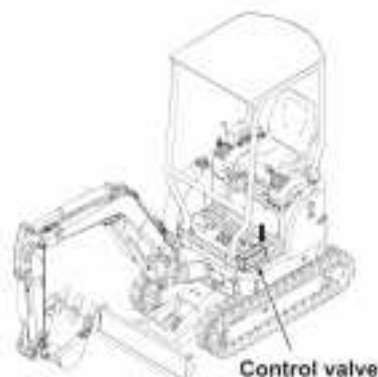
BOOM LOWERING WITH THE ENGINE STOPPED**■ Method of Boom Lowering When Engine Damaged****⚠ WARNING**

Be sure no one is under or the front implements before manually lowering the boom.
Keep all personnel away from the boom area when lowering the boom with engine stopped.

Use the following procedure when it is necessary to lower the boom while engine is shut down or the hydraulic system disabled.

1. Remove the floor cover under the operator's station floor.
2. Remove the lock nut ② of the boom raise relief valve located inside the control valve ①.
3. Slowly loosen adjusting screw ③ until boom start lower. The boom will start to lower slowly.
4. After making sure that the front implement has lowered completely on to the ground, install the lock nut ②.
5. Make any necessary repairs placing the excavator back into service.

NOTE: For further information, contact your IHI dealer.



Boom raise relief valve

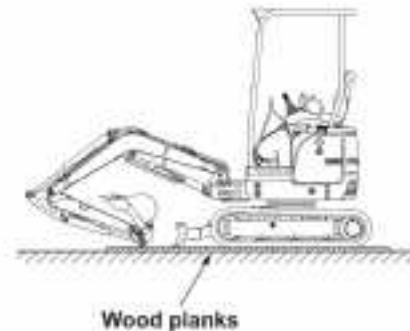
PARKING THE MACHINE

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.



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.
3. Close and lock the doors.

EMERGENCY ENGINE STOP

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

SECTION 4 MAINTENANCE

TABLE OF CONTENTS

Subject	Page
Maintenance Intervals	4 - 1 - 1
Lubrication Chart Maintenance and Checks	4 - 2 - 1
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250 hours Maintenance and Checks	4 - 7 - 1
500 hours Maintenance and Checks	4 - 8 - 1
1000 hours Maintenance and Checks	4 - 9 - 1
2 years hours Maintenance and Checks	4 - 10 - 1
Unusual Operating Conditions	4 - 11 - 1
Long Term Storage	4 - 12 - 1
Hydraulic System Pressure Settings	4 - 13 - 1

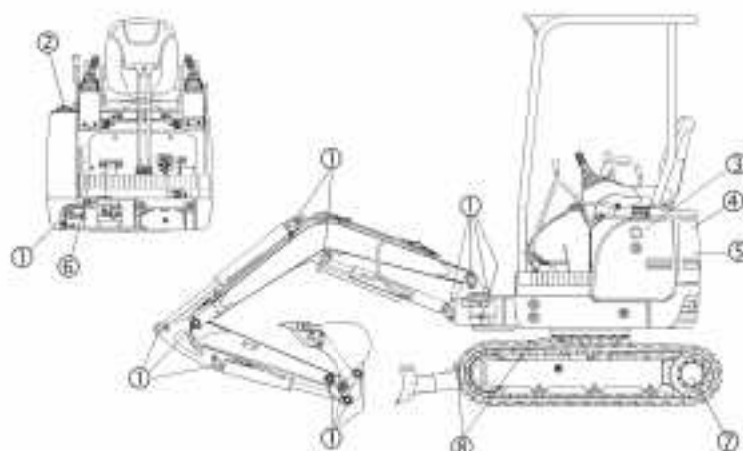
MAINTENANCE INTERVALS

Check Point	Item	Page
When Required		
Tracks	Check and Adjust Tension	4 - 4 - 1
Tracks	Check Rubber Shoes	4 - 4 - 2
Fuses	Replace	4 - 4 - 3
Fusible Link	Replace	4 - 4 - 3
Battery	Clean and Check Electrolyte Level	4 - 4 - 4
Bucket	Change Bucket	4 - 4 - 5
Daily Check (8 Service hours)		
Engine Oil	Check Oil Level	4 - 5 - 1
Engine Coolant	Check Coolant Level	4 - 5 - 1
Hydraulic Tank	Check Hydraulic Oil Level	4 - 5 - 2
Fuel Tank	Check Fuel Level	4 - 5 - 2
Air Cleaner	Check Service Signal	4 - 5 - 2
Water Sedimenter	Check Level and Drain Water	4 - 5 - 3
Every 50 Service Hours (First perform previous service hour items)		
Fuel Tank	Drain Water and Sediment	4 - 6 - 1
Attachment Pins	Lubricate Fitting with Grease	4 - 2 - 1
Swing Bearing	Lubricate Fitting with Grease	4 - 2 - 1
Engine Oil	Change Oil and Filter *	4 - 7 - 1
Hydraulic System	Change Return Filter *	4 - 8 - 2
Every 250 Service Hours (First perform previous service hour items)		
Engine Oil	Change Oil and Filter	4 - 7 - 1
Air Cleaner	Clean or Change Filter Elements	4 - 7 - 2
Fuel Filter	Clean Filter Element	4 - 7 - 5
Fan Belt	Inspect and Adjust	4 - 7 - 6
Engine Coolant	Change Coolant (When not used L.L.C)	4 - 10 - 1
Every 500 Service Hours (First perform previous service hour items)		
Tighten Bolts	Retightening Bolt	4 - 8 - 1
Return Filter	Change Return Filter	4 - 8 - 2
Fuel Filter	Change Filter Element	4 - 8 - 3
Travel Drive	Check Oil Level	4 - 8 - 3
Every 1000 Service Hours (First perform previous service hour items)		
Travel Drive	Change Gear Case Oil	4 - 9 - 1
Hydraulic Tank	Change Hydraulic Oil and Clean Strainer	4 - 9 - 2
Every 2 years Service Hours		
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 hour meter.
It should be shortened in service operating conditions.



Check points	Check items	Check Interval						
		Initial period of use After 50 hours	Daily	Every 50 hours	Every 250 hours	Every 500 hours	Every 1000 hours	Every 2 years hours
① Attachment pins	Lubricate with grease "G"			○				
② Fuel Tank	Drain water and Sediment			○				
③ Hydraulic Tank	Oil level "H"		○				●	
	Drain water and sediment Wash and clean strainer			○			○	
④ Return filter	Filter	●				●		
⑤ Engine	Engine oil "E"	●	○		●	●		
	Fuel filter				○	●		
	Oil filter	●			●			
	Coolant level "W"		○					●
⑥ Swing bearing	Bearing lubricate with grease "G"			○				
	Ring gear lubricate with grease "G"					○		
⑦ Travel drive	Check oil level and change oil "L"	○				○	●	
⑧ Blade	Lubricate with grease "G"			○				

Symbol	G	L	H	E	W	○	●
Remarks	Grease	Gear oil	Hydraulic fluid	Engine oil	Coolant	Check / Maintenance / Supply	Change
	EP-2 Lithium grease	API-GL-4, ISO-VG320	Wear-proof hydraulic fluid ISO-VG46	API-CD SAE10W30			

RECOMMENDED LUBRICATION TABLE

LOCATION	REFILL CAPACITIES (APPROXIMATE)	CHANGE INTERVALS	USE	LUBRICANT VISCOSITIES
Diesel Engine	Max. 3.8 liter	250 Hrs.	Cold Regions	API, Class CD SAE20
	Min. 2.1 liter	Initial oil change 50 hours	General	API, Class CD SAE30
			Tropical Regions	API, Class CD SAE40
Hydraulic Oil	Total Amount 23 liter	1000 Hrs. (500 Hrs. when breaker used)	Ambient Temperature -5°C	Wear Proof Hydraulic Fluid ISO - VG46
	Tank Capacity 19 liter		Ambient Temperature Below -5°C	Wear Proof Hydraulic Fluid ISO - VG32
Track Rollers	0.025 liter (Each)	Upon occasion	—	API, GL-4 ISO-VG320 (SAE90) Gear Oil
Front Idlers	0.07 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.

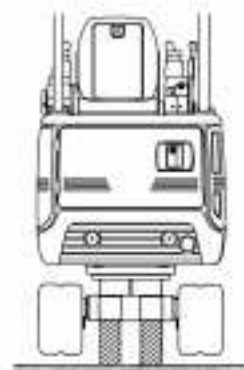
WHEN REQUIRED MAINTENANCE AND CHECKS

WHEN REQUIRED

TRACKS CHECK / ADJUST

⚠ WARNING

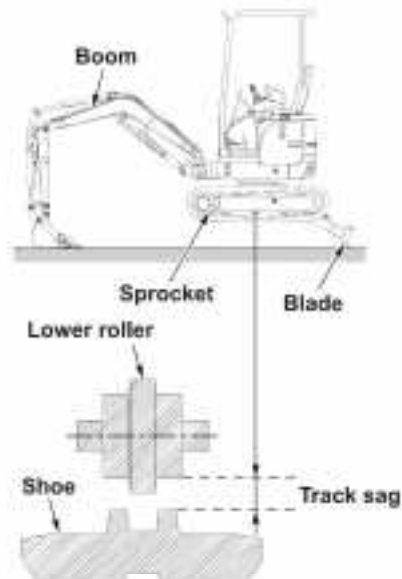
- * Grease is under high pressure.
- * **NEVER** remove the grease fitting.
- * Grease coming out of the check valve under pressure can penetrate the body causing injury or death.
- * **DO NOT** watch the check valve to see if grease is escaping. Watch the track or track adjustment cylinder to see if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



Supported the machine

■ **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. In case of steel shoes, approximately 30 to 50 mm.



Rubber shoes: 10 to 20 mm
Steel shoes: 30 to 50 mm

■ **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 (6 to 7 kgf·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.



WHEN REQUIRED

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

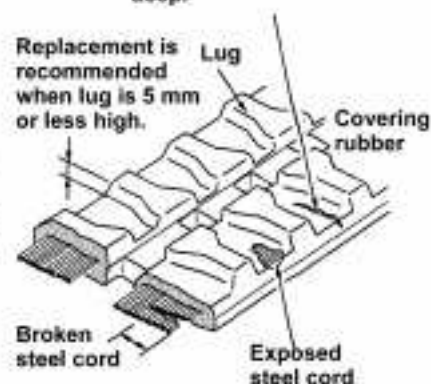
When break of steel cord is detected, replace it immediately. If you leave it as it is, the rubber track shoe can be break without expectation, which causes a serious accident.

4. Crack of Covering Rubber

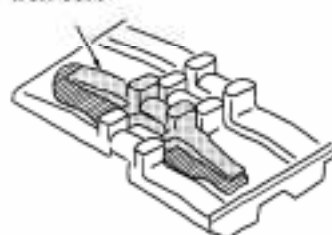
If a crack is 30 mm or more long and 8 mm or more deep, repair the cover immediately. If steel cord appears even if a crack is small, repair it immediately.

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

Repair is necessary when a crack is 30 mm or more deep.



Removed iron core



FUSES

The fuse box is located on the front of the instrument panel. Fuses will protect the electrical system from damage caused by overloaded circuits.

Replace fuses with the same type and size only. Otherwise, electrical damage can result. Change a fuse, have the circuit checked and repaired.

■ Replace

1. Pull the latch and remove the cover for fuse access.
2. Change the damaged fuse to new one.

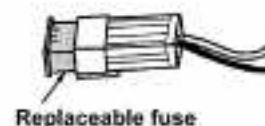
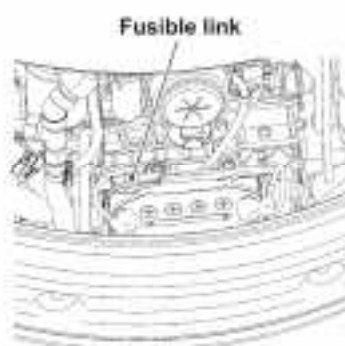
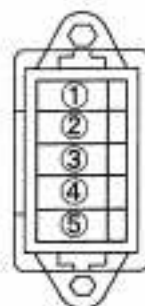
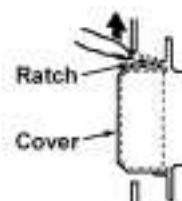
The following circuit protected by each fuse includes the fuse amperage.

- ① Fuel pump, Control shut-off and Travel speed shift solenoid - 10 amps
- ② Horn, Cigarette lighter and Cab dome light - 20 amps
- ③ Front light - 20 amps
- ④ Monitor, Radio, Heater and Wiper - 20 amps
- ⑤ Engine stop - 30 amps

FUSIBLE LINK

The fusible link is provided between the positive terminal of the battery and the starter switch to prevent electrical circuit wires from being burned because of short circuit. When the power is turned off by short circuit, check the fusible link. When it is blown out, replace it with new one after repairing the wires.

WHEN REQUIRED

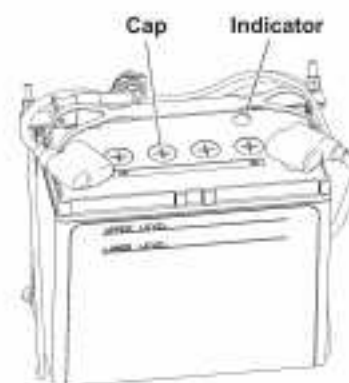


WHEN REQUIRED

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.

WHEN REQUIRED

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.

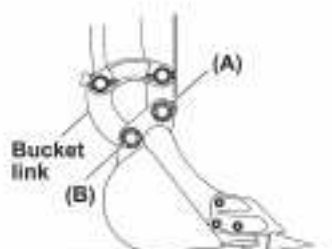
Movement of O-ring



Bucket boss

■ **Install the Bucket**

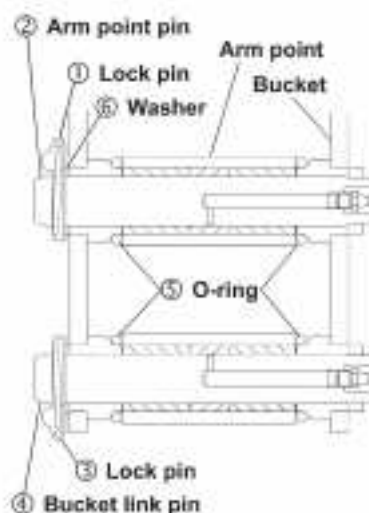
1. Clean the removed pins and pin holes and apply coat the grease to them surface.
2. Place a new bucket in a stable position as illustrated.
3. Connect the arm into the hole A, and the link into the hole B with pins.
4. Install a stopper bolt to each pin securely.
5. Adjust the bucket clearance.
6.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



■ **Bucket Clearance (If Equipped with a Bucket Capable of Shim Adjustment)**

If the bucket installed clearance becomes excessive, adjust clearance to 0.1 to 0.8 mm by remove appropriate number of shims.

1. Stop the engine.
2. To remove shims, remove bolts, washers and flange.
3. After correct number of shim have been removed, install flange washers and bolt. Tighten bolts.
4. After installation, make sure that clearance is still correct.



REPLACE THE TEETH AND SIDE CUTTERS

WARNING

- * Personal injury or death can result from bucket falling
- * Block the bucket before changing bucket tooth or side cutter.

■ Replacement Period of Tooth

Replace the bucket tooth when a wear hole appears.

■ Replacement of Tooth

1. Drive the lock pin from the worn tooth.
Remove the tooth.
2. Clean the adaptor and pin hole.
3. Install the new rubber pin into the tooth.
4. Install the new tooth over the adaptor.
5. Drive the lock pin through the tooth, until the pin is flush with the tooth surface.

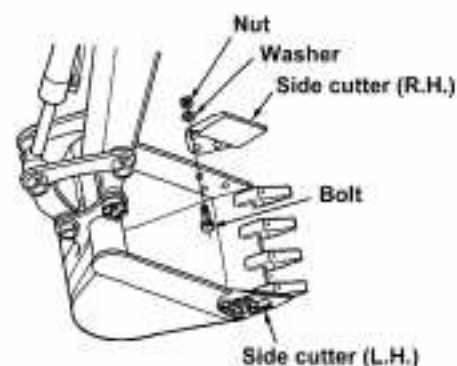
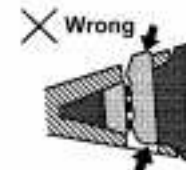
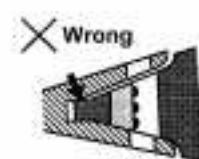
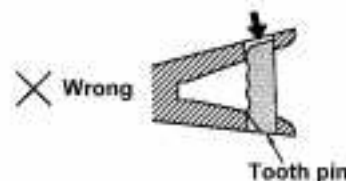
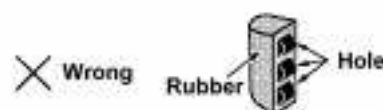
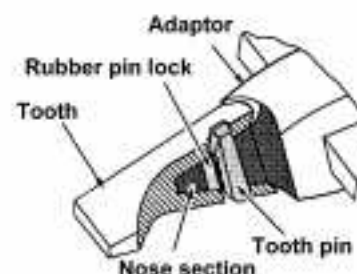
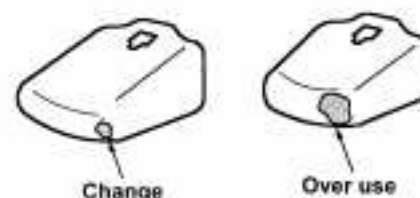
NOTICE:

After driving the lock pin, make sure the lock pin fits snugly into the hole of the tooth.

■ Replacement of Side Cutters

1. Remove the mounting bolts and remove the side cutters.
2. Clean the mounting surfaces. Install the new side cutters.

WHEN REQUIRED



DAILY MAINTENANCE AND CHECKS

DAILY

■ Check the Engine Oil Level

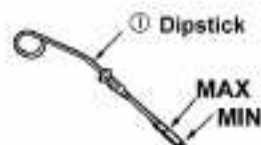
CAUTION

- * 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 Oil level gauge ② Fill plug

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.

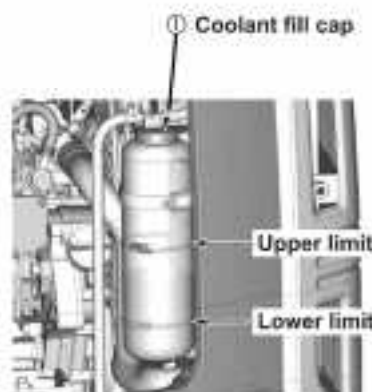


■ Check the Coolant Level

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.



Reserve tank level

DAILY

■ Hydraulic Oil Level

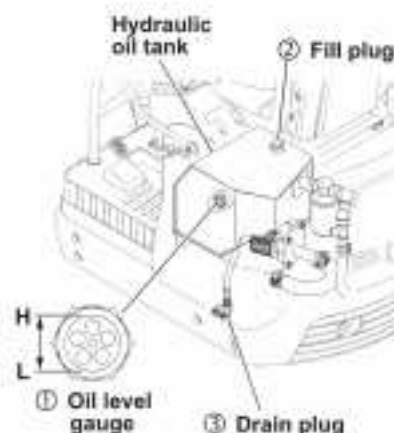
CAUTION

- * 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.



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

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 any 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.



■ 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 lock the fuel tank cap to protect against vandalism.

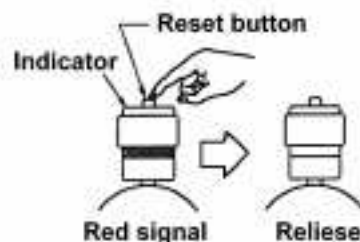


■ Dust Indicator

Check the air filter dust indicator. If the indicator is in the red zone, clean or replace the element.

See Service the Filter Elements.

After servicing, reset the dust indicator pushing in the reset button.



DAILY

■ **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.

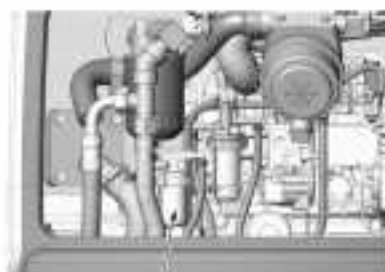
1. Stop the engine.
2. Turn the fuel stop lever to the "closed" position.
3. Loosen the ring nut ① and remove the bowl ② and the filter ③
4. Drain water and sediment into suitable container.

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

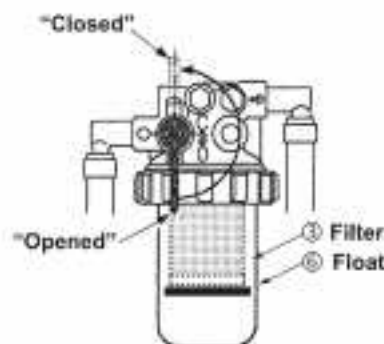
5. Clean the inside surfaces of the body ④ and bowl ②
6. Clean the filter ③
7. Inspect the O ring ④ on bowl Replace them if they are worn or damaged.
8. Install a filter ③ to the body. Install a spring ⑤ and float ⑥ into the bowl. Install the bowl to the body. Tighten ring nut ①
9. Turn the fuel stop 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

DAILY

■ **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**

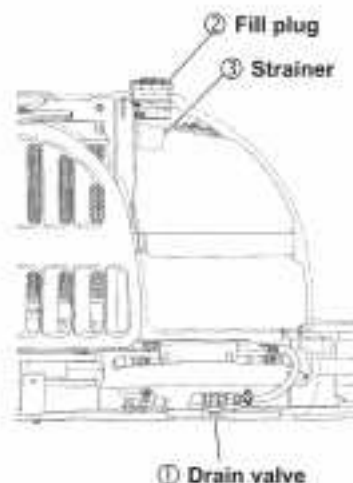
NOTE: Before draining the water and sediment, be sure to fill the tank with fuel.

The drain valve located under the fuel tank.

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

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

3. Close the drain valve.

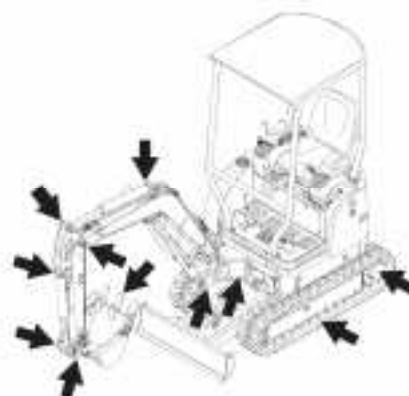


■ **Lubrication**

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.



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.

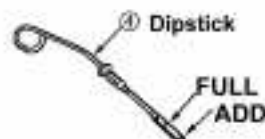


① Drain plug

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.

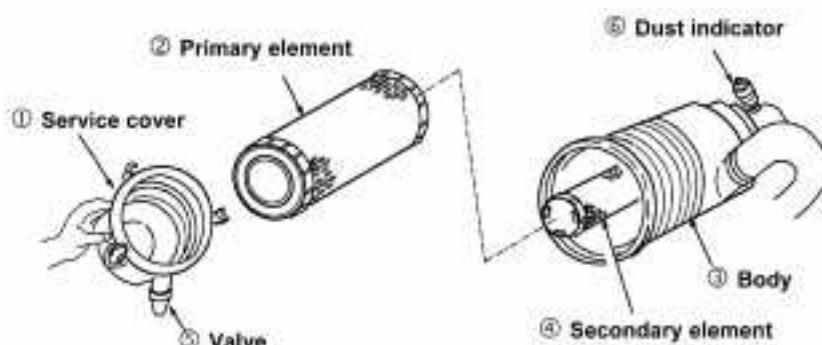
3. Open the engine cover on the rear of machine.
4. Remove the used filter ② by the filter wrench. Clean the filter housing base.
5. Apply a light coat of engine oil to the gasket of the new filter.
6. Install the new filter by hand. When the seal contacts the base, tighten the filter 3/4 turn more by 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 dipstick 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.



■ Service the Filter Elements

CAUTION

- * Service the air cleaner if indicated the red signal in the dust indicator with the engine running at high idle.
- * 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.



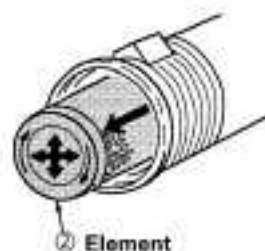
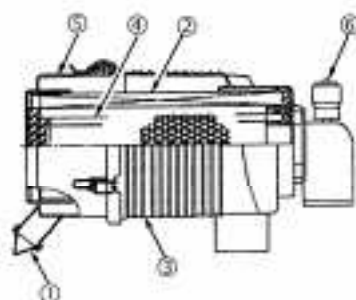
Service the Primary Element

Cleaning : Every 250 hours or when indicated the red signal in the dust indicator.

Replacement : After cleaning five times, after one year or damaged pleats or seals.

1. Stop the engine.
2. Release the three latches and remove the service cover ①.
3. Remove the primary element ② from the air cleaner housing ③. Do not remove the secondary element ④, when service the primary element ② only.

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.



250 HOURS

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. Primary element ② can be cleaned with compressed air 200 kPa 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.

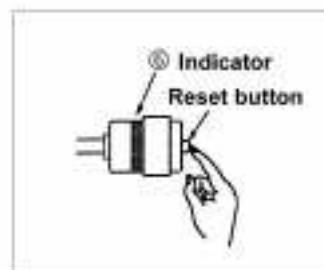
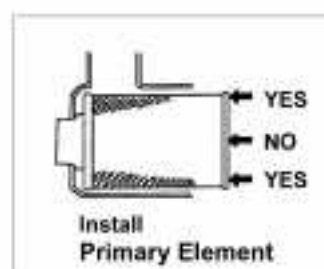
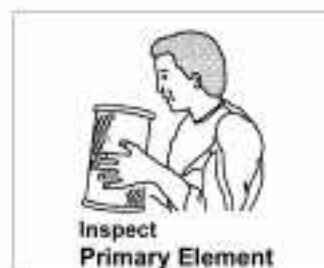
NOTE: The used element may be useful to find a foreign substance on the seal surface of the filter element, which can cause leak. If the striped dust is seen on the seal surface, it is a symptom of dust leak. If such dust seen, inspect if there are foreign substances, on the inside and outside of the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

7. Install a clean primary element ②. Install and secure the service cover ① with the valve ⑤ at the bottom.

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.

8. Reset the dust indicator ⑥ by pushing in the reset button.
9. If the dust indicator indicated the red signal after starting the engine, change to new element.

NOTE: Normally a filter can be cleaned up to five times. Replace after five cleanings maximum.



250 HOURS

Change the Secondary Element

CAUTION

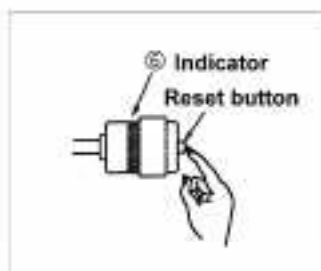
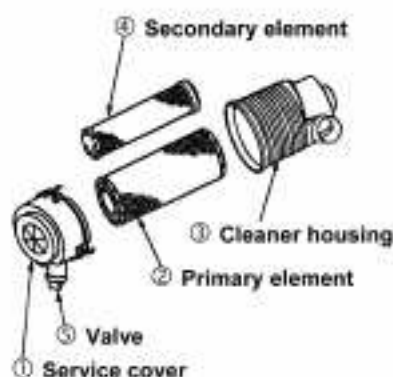
- * Always replace the secondary filter element.
NEVER attempt to reuse it by cleaning.
- * The secondary filter element should be replaced at the time the primary element is serviced for five time.

Replacement: When replaced the primary element with the secondary element.

1. Remove the service cover ① and the primary element ② from the air cleaner housing ③.
2. Remove the secondary element ④ from the air cleaner housing ③. Cover the engine intake opening.
3. Clean the inside of the air cleaner housing ③ and service cover ①. Remove the covering from the intake opening.

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

4. Install the new secondary element ④.
5. Install the primary element ② secure the service cover ①.
6. Reset the dust indicator ⑥ by pushing in the reset button.



250 HOURS

■ 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.



Fuel filter

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

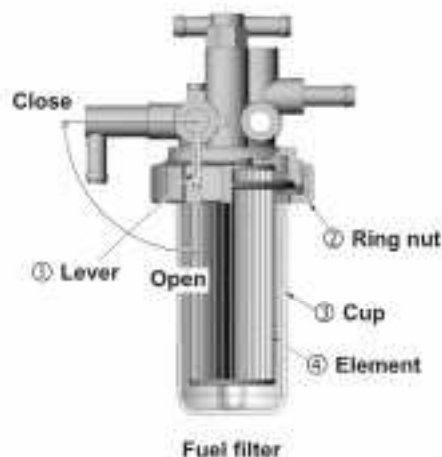
There should be enough fuel in the system to allow the engine to start. Keep the engine start switch key at ON for a period of 20 seconds, which operates the fuel pump and priming automatically.

■ 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.



250 HOURS

■ Fan and Alternator Belt

⚠ WARNING

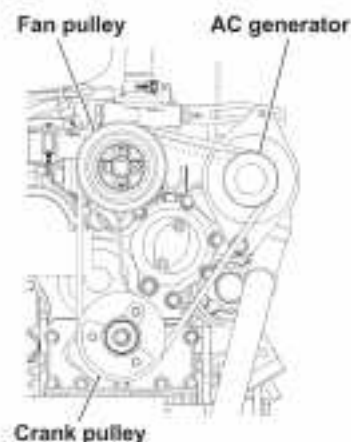
- * Hot components can cause personal injury.
- * Stop the engine and remove the start switch key.

Inspect

Stop the engine. Inspect the belt for wear and cracking. To check the belt tension, Push the belt inward by hand apply 98N 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

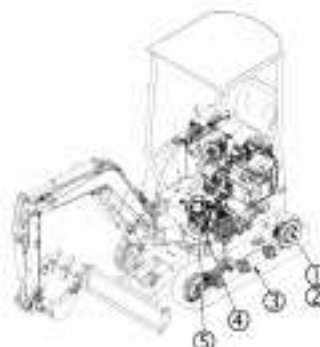
First perform previous service hour hems

■ **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 (mm)	Tighten Torque (N•m)
①	Travel drive	Bar 8	M10	55
②	Sprocket	Bar 8	M10	55
③	Lower roller	19	M12	108
④	Swing bearing	19	M12	108
⑤	Swing motor	Bar 10	M12	108

Newton meter (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.	Metric fine H.T. bolt
		N • m	N • m
M8	13	23	25
M10	17	47	50
M12	19	83	91
M14	22	134	135
M16	24	206	220
M20	30	412	450
M24	36	715	813

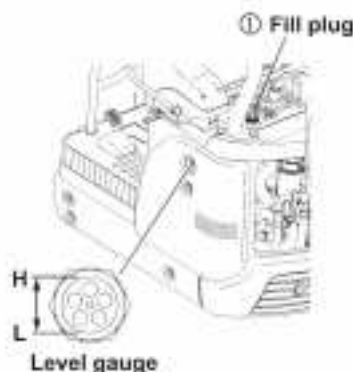
High pressure-hose union nut	
Hose Size (inch)	Tighten torque N•m
1/4"	25
3/8"	49
1/2"	59
3/4"	118
1"	137
1-1/4"	167

500 HOURS

■ Change the Return Filter

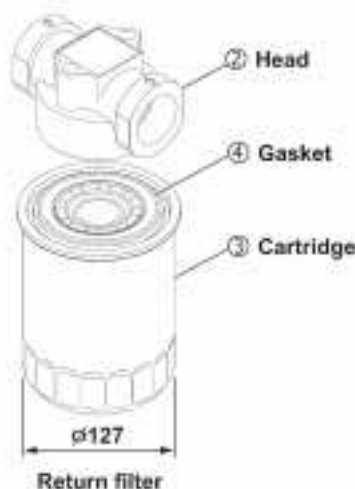
CAUTION

- * 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 ③ only after the engine has been stopped and the return filter is cool enough to touch with your bare hand.



1. Lower the bucket on the ground and stop the engine.
2. Relieve the internal pressure from the hydraulic tank by loosening oil fill plug ①.
3. Clean the area to keep dirt out of the filter base ②.
4. Remove the used filter ③ by filter wrench. Clean the filter base ②.

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



5. Coat the gasket ④ of new filter with clean hydraulic oil.
6. Install the new filter ③ by hand. When the seal contacts the base. Tighten an additional 3/4 turn by filter wrench.
7. 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.
8. 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.
9. Start and operate the engine. Inspect for leaks on the oil filter ③.

☆ 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.

500 HOURS

■ 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.

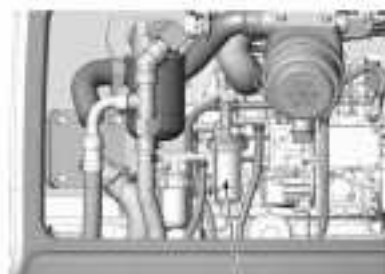
1. Stop the engine
2. Turn the fuel stop lever ① to the "closed"(OFF) position. Loosen the ring nut ②.
3. Remove the cup ③ and the element ④.
4. Drain water and sediment into a suitable container.

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

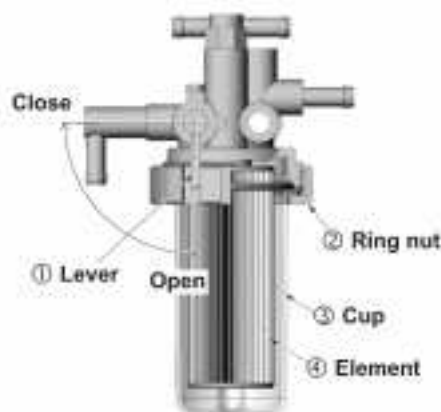
5. Clean the inside surface of the cup.
6. Install the new element ④.
7. Install cup ③. Tighten ring nut ②.
8. Turn the fuel stop lever ① to the "opened" (ON) position.

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

9. 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.



Fuel filter



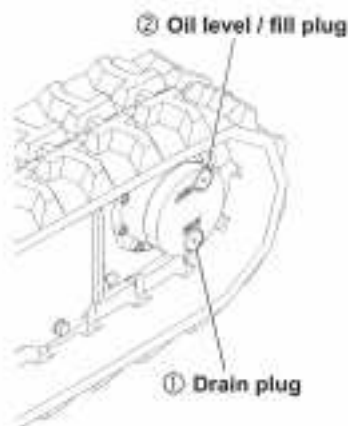
Fuel filter

■ Check the Travel Drives Oil Level

WARNING

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 • 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**

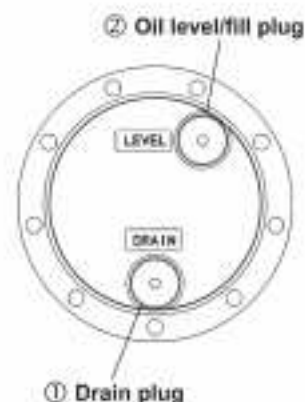
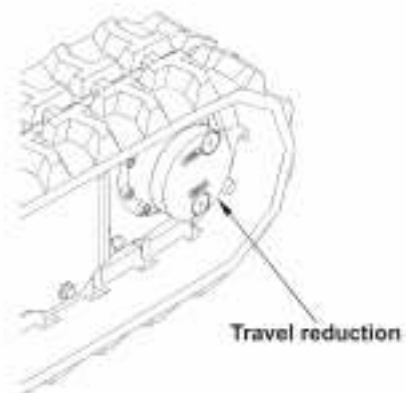
1. Position one travel drive with drain plug ① at the bottom.
2. Remove drain plug ① and oil level/fill plug ②. Allow the oil to drain into a container.

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.



■ 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.

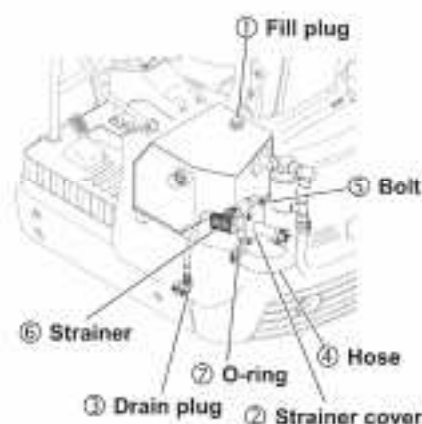
1. Place the machine on level ground, with the arm and bucket cylinder fully retracted and attachments lowered, as shown. Stop the engine.
2. Relieve the internal pressure from the hydraulic tank by loosening the fill plug ①.
3. Clean area thoroughly to keep dirt out of strainer cover unit ② and fill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



Bucket position at the time of drain the hydraulic oil.

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

5. Remove the suction hoses ④. Remove the bolts ⑤ and the strainer cover unit ② /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 ②/ strainer ⑥ and the suction hoses ④.
9. Clean and install the drain plug ③.



1000 HOURS

10. Fill the hydraulic tank with oil. See Recommended Lubricant Table.

11. Start and operate the engine at idling speed for five minutes.

12. Operate the control levers to allow the hydraulic oil to circulate through all hydraulic circuits.

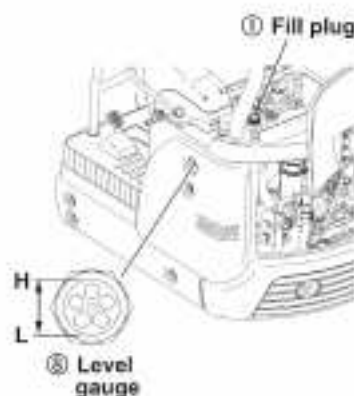
13. Lower the bucket to the ground with the arm and bucket cylinder fully retracted and stop the engine.

14. Maintain the oil level between **FULL** and **ADD** marks on the level gauge.

15. Pressurize the hydraulic tank.

Raise the boom with the arm, boom and bucket cylinder fully extended. Remove the fill plug ① and then install fill plug again.

16. 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

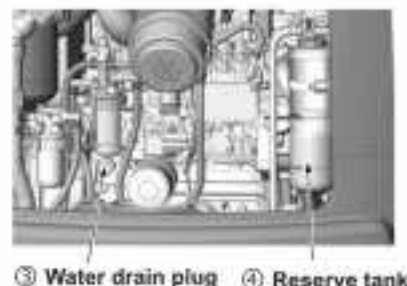
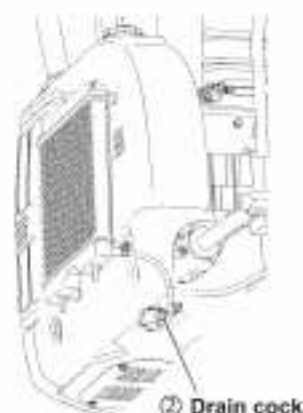
⚠ WARNING

- * 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 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 drain valve ④ 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 drain valve ④ 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.



2 YEARS

12. Maintain the coolant level to the fill port neck.
13. Replace the cap gasket if the gasket is damaged. Install the radiator cap ②.
14. Maintain the coolant level between the MAX and MIN marks on the reserve tank.

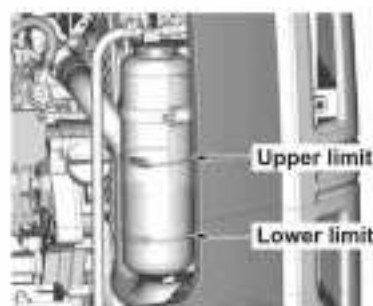
■ **Clean the Outside of the Radiator Core**

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.



Reserve tank level

■ **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 Rate of Long-Life-Coolant**

The mixing ratio 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)	1.1	1.4	1.8
Quantity of water (L)	2.5	2.2	1.8
Coolant total amount: 3.6L	Engine proper: 0.9 L Radiator and other proper : 1.9 L Reserve tank : 0.8 L		

UNUSUAL

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.



BEFORE attempting any working operations, warm up the hydraulic oil as described in "After Starting the Engine".

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.

UNUSUAL

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.
1. Make frequent inspections for rust and corrosions 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.

■ 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.

LONG TERM

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.

■ 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.



Bucket position at the time of long term storage.

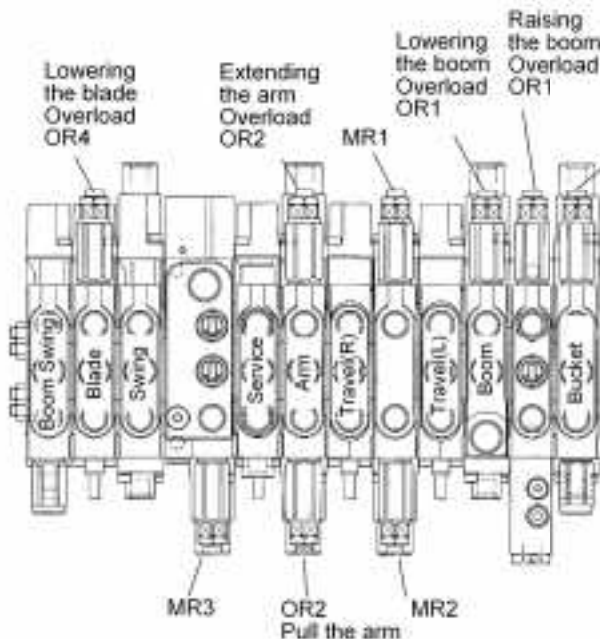
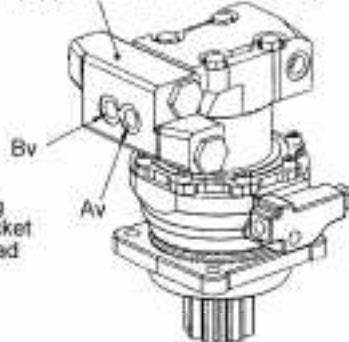
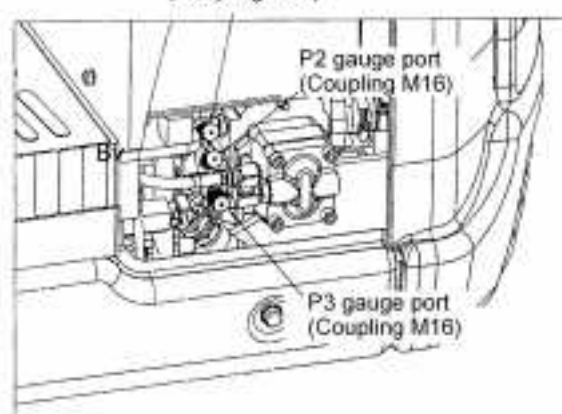
HYDRAULIC SYSTEM PRESSURE SETTINGS

1. SET PRESSURE

Hyd. Oil Temp.: 50 ± 5 °C

Relief Valves		Gauge Ports	Valve Location	Maintenance Std.	Note
				MPa	
Main	Boom Bucket Travel (R.H)	P1	MR1	20.6 $\begin{smallmatrix} +0.40 \\ 0 \end{smallmatrix}$	Max. Engine RPM
	Arm Travel (LH) Service	P2	MR2	20.6 $\begin{smallmatrix} +0.40 \\ 0 \end{smallmatrix}$	Max. Engine RPM
	Swing, Blade Boom Swing	P3	MR3	18.1 $\begin{smallmatrix} +0.40 \\ 0 \end{smallmatrix}$	Max. Engine RPM
Over load	Boom (Raise)	P1	OR1	24.5 $\begin{smallmatrix} +0.40 \\ 0 \end{smallmatrix}$ at 5L / min	Min. Engine RPM
	Boom (Lower)		OR1		
	Arm (In)	P2	OR2		
	Arm (Out)		OR2		
	Bucket (Dig)	P1	OR3	20.6 $\begin{smallmatrix} +0.40 \\ 0 \end{smallmatrix}$ at 5L / min	
	Blade (Lower)	P3	OR4		
Brake	Swing	P3	SWR	15.2	Min. Engine RPM
	Travel	P1 (LH) P2(RH)	Not Equipped		
Remote Control		P4	PP	2.94 $\begin{smallmatrix} +0.2 \\ 0 \end{smallmatrix}$	Max. Engine RPM

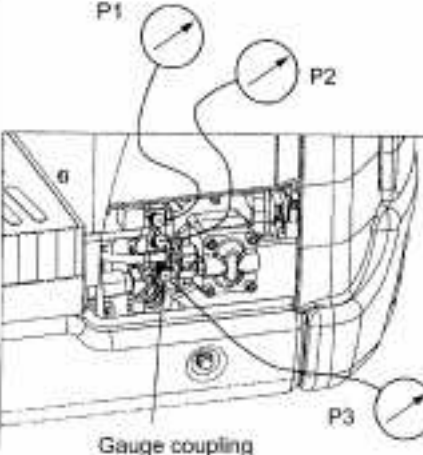
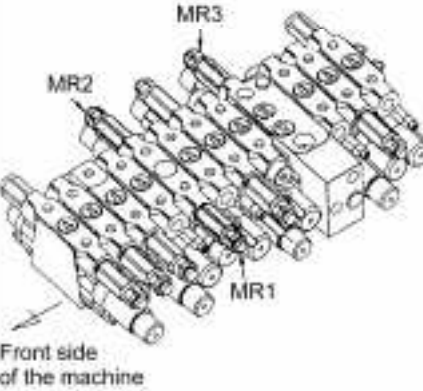
2. GAUGE PORTS & RELIEF VALVE LOCATIONS


SWR relief valve
(Upper Av side; lower Bv side)

P1 gauge port
(Coupling M16)

P2 gauge port
(Coupling M16)

P3 gauge port
(Coupling M16)

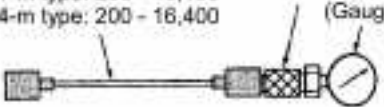
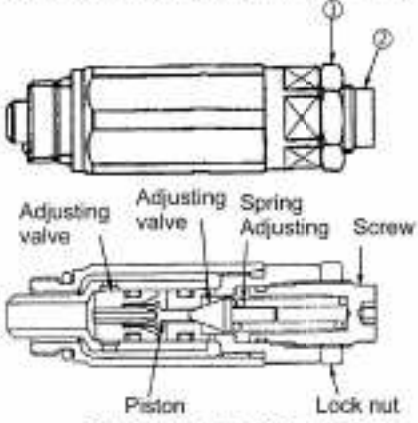
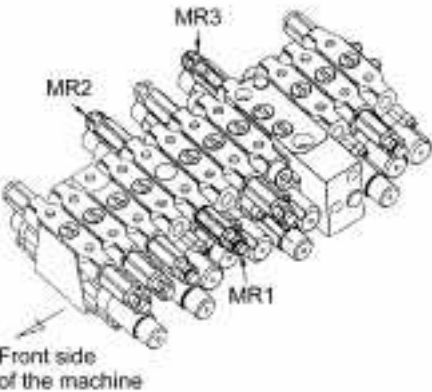
3. Main Relief Valve.

3-1 Measuring Procedures.

Conditions	Procedures	Note
	<ol style="list-style-type: none"> 1. Engine speed: Maximum 2. Oil temperature: $50 \pm 5^{\circ}\text{C}$ 3. Installation of a gauge: Remove the cap for the coupling assembly, and install a gauge coupling. For the gauge coupling, see page 4-13-4. <ul style="list-style-type: none"> • When no gauge coupling is available, stop the engine to release the pressurized air from the hydraulic tank. Then remove the coupling assembly and mount the gauge. After installation of the gauge, pressurize the air in the hydraulic tank. 	<div data-bbox="1089 369 1252 401" style="border: 1px solid black; padding: 2px; text-align: center;">WARNING</div> <p>Do not remove the gauge port plug until air pressure has been relieved in hydraulic tank.</p>
Measuring procedures	<p>A. MR1 (P1) Main relief valve</p> <ol style="list-style-type: none"> 1. Start the engine and move the boom or bucket cylinder to the stroke end. 2. Set the engine speed to the maximum. 3. Operate the boom or bucket cylinder at the full stroke and hold it there. 4. Read out the pressure indicated on the gauge during air release. <p>* If the pressure is 20.6 MPa or lower, pressure adjustment is required.</p> <p>B. MR2 (P2) Main relief valve</p> <ol style="list-style-type: none"> 1. Start the engine and move the arm cylinder to the stroke end. 2. Set the engine speed to the maximum. 3. Operate the arm lever at the full stroke and hold it there. 4. Read out the pressure indicated on the gauge during air release. <p>* If the pressure is 20.6 MPa or lower, pressure adjustment is required.</p> <p>C. MR3 (P3) Main relief valve</p> <ol style="list-style-type: none"> 1. Start the engine and move the boom swing cylinder to the stroke end. 2. Run the engine at the maximum speed. 3. Operate the boom swing pedal at the full stroke and hold it there. 4. Read out the pressure indicated on the gauge during air release. <p>* If the pressure is 18.1 MPa or lower, pressure adjustment is required.</p> <p>[Caution] If the cylinder internal leakage is severe, the relief pressure will decline. In such a case, release the air at the both sides of the cylinder. Also check other cylinders. (P1 for the boom and bucket; P2 for the arm; and P3 for the blade or swing).</p>	 <p>P1, P2, P3, Gauge coupling</p>  <p>MR3, MR2, MR1, Front side of the machine</p>

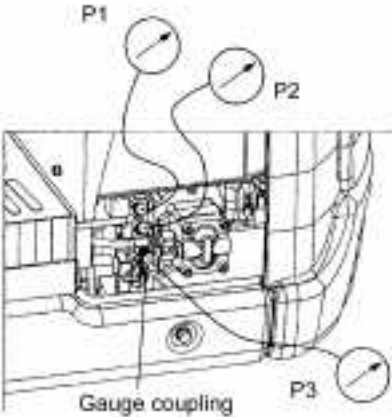
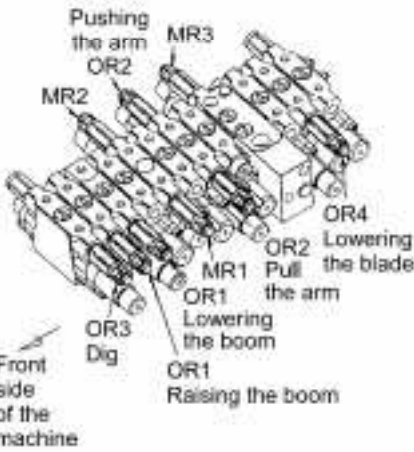
3. Main Relief Valve.

3-2 Adjusting Procedures.

Conditions	Procedures	Note
<p>1. Engine speed: Maximum</p> <p>2. Oil temperature: $50 \pm 5^{\circ}\text{C}$</p> <p>3. Installation of a gauge: For coupling assembly M16, a sheet-type adaptor is used. For pressure measurement, the parts shown on the right column are required.</p> <p>• When no gauge coupling is available, stop the engine to release the pressurized air from the hydraulic tank. Then, remove the coupling assembly and mount the gauge.</p>	<p>Take the same adjusting procedures for MR1, MR3, and MR3.</p> <ol style="list-style-type: none"> Loosen Lock Nut ①. Turn adjusting screw ② using a hexagon wrench to adjust the screw. <ul style="list-style-type: none"> When the screw is tightened: the pressure will increase. When the screw is loosened: the pressure will decrease. <p>(The amount of pressure change for one turn of the adjusting screw: approx. 9.8 MPa)</p> Fix adjusting screw ② using a hexagon wrench and tighten lock nut ①. Measure the pressure. <p>Take the above procedures 1 to 4 until the specified pressure is obtained.</p> <p>* When there is no change in the pressure even after adjustment:</p> <ol style="list-style-type: none"> This is caused not by the wear-out of the spring, but by the biased wear of the adjusting valve and the pressure regulating valve, the inclusion of dust or clogging. Therefore, remove the valve to disassemble and check it. 	<p>WARNING</p> <p>Do not remove the gauge port plug until air pressure has been relieved in hydraulic tank.</p> <p>Hose (Gauge coupling) : 300 - 42,000 1-m type: 200 - 16,100 4-m type: 200 - 16,400</p> <p>Gauge connector (Gauge)</p>  <p>The parts for gauge connection shown above are handled as parts</p>  <p>Cross section of the relief</p>  <p>MR3 MR2 MR1 Front side of the machine</p>

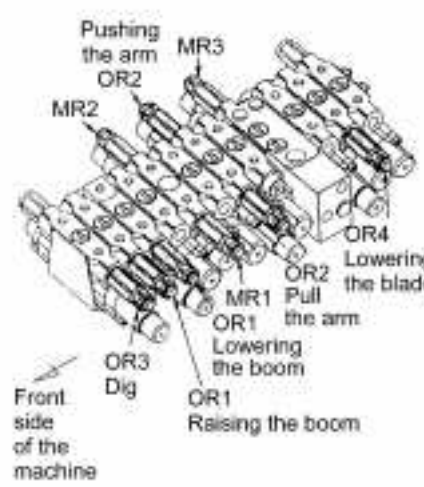
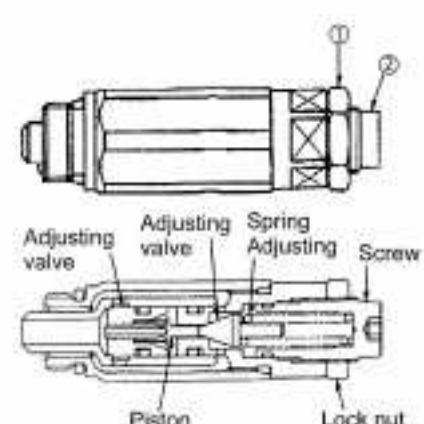
4. Over load Relief Valve.

4-1 Measuring Procedures.

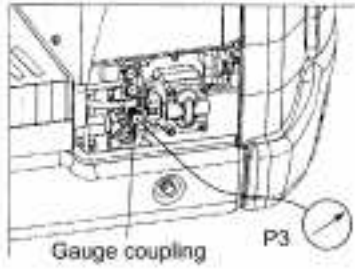

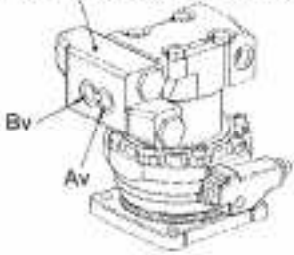
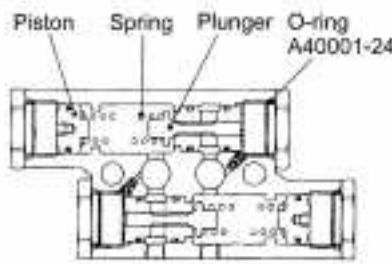
	Procedures	Note
Conditions	<ol style="list-style-type: none"> 1. Engine speed: Low idling The set flow rate of this valve is 5 liters/min. and the flow rate becomes higher than the set value at a high engine speed, in which case higher pressures are indicated. Be sure to run the engine at a low speed. 2. Oil temperature: $50 \pm 5^{\circ}\text{C}$ 3. Installation of a gauge: Remove the cap for the coupling assembly, and install a gauge coupling. <ul style="list-style-type: none"> • When no gauge coupling is available, stop the engine to release the pressurized air from the hydraulic tank. Then, remove the coupling assembly and mount the gauge. After installation of the gauge, pressurize the air in the hydraulic tank. 4. Set pressures: See the table for the set pressures. 5. Set the main relief pressure temporarily. The overload relief pressure is set higher than the main relief pressure. Therefore, the main relief pressure needs to be set higher than the overload relief pressure. <p>Temporary setting of the main relief pressure</p> <ol style="list-style-type: none"> 1) Loosen the lock nut for main relief pressure and tighten the adjusting screw by 180° to tighten the tightening lock nut. 2) After adjusting the overload relief pressure, loosen the lock nut for main relief pressure, loosen the adjusting screw by 180° or more. Return the pressure to the set value or less and thereafter make adjustments at the tightening side. 	<p>WARNING</p> <p>Do not remove the gauge port plug until air pressure has been relieved in hydraulic tank.</p> 
Measuring procedures	<p>Overload relief for raising the boom (OR1) is explained below. Take the same procedures also for other valves.</p> <ol style="list-style-type: none"> 1. Set the main relief pressure temporarily. 2. Start the engine and run it at a low speed. 3. Raise the boom to the stroke end of the cylinder and operate the control lever at the full stroke. Hold the lever with the pressure relieved and read the gauge. 4. When the pressure is 22.6 MPa or lower, pressure adjustment is required. (See the next page) <ul style="list-style-type: none"> • The pressure is 24.5 MPa only for the bucket. 5. When the pressure is normal, return the main relief pressure to the set value. (For the adjusting procedures, see the above-mentioned item for Conditions.) 6. Remove the gauge coupling, and fix the cap on the coupling assembly. <ul style="list-style-type: none"> • In the case of a gauge adaptor, stop the engine and remove the pressurized air from the hydraulic tank. Remove the gauge adaptor and wind a seal tape around the thread portion of the coupling assembly. After installation, pressurize the air in the hydraulic tank. (See Page 4-8-2.) 	

4. Over load Relief Valve.

4-2 Adjusting Procedures.

	Procedures	Note
Adjusting procedures	<ol style="list-style-type: none"> 1. Set the main relief pressure temporarily. 2. Start the engine and run it at a low speed. 3. Operate the control lever of the valve to be measured at the full stroke. Hold the lever when the cylinder comes to the stroke end (relief). 4. Loosen lock nut ① of the overload relief valve. Using a hexagon spanner, adjust adjusting screw ② to the set pressure at the tightening side (the pressure increasing side). If the pressure is higher than the set value, or when the adjusting screw is tightened more than the set pressure, loosen it until the pressure becomes the set value or lower. Then, adjust it again at the tightening side. 5. After adjustment, fixing adjusting screw ② by a hexagon spanner, tighten the lock nut. 6. After locking, check the pressure. 7. Repeat the procedures starting from item 3 above until the set pressure is obtained. 8. When the pressure is normal, return the main relief pressure to the set value. (For the adjusting procedures, see the item for Conditions.) 9. Remove the gauge coupling and fix the cap to the coupling assembly. <ul style="list-style-type: none"> • In the case of gauge adaptor, stop the engine and remove the pressurized air from the hydraulic tank. Remove the gauge adaptor and wind a seal tape around the thread portion of the coupling assembly. After installation, pressurize the air in the hydraulic tank. 	<p>WARNING</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 the relief</p>

5. Swing Relief Valve pressure Measuring & Adjusting Procedures.

Conditions	Procedures	Note
<p>1. Engine speed: Low</p> <p>2. Oil temperature: $50 \pm 5^{\circ}\text{C}$</p> <p>3. Installation of a gauge: Remove the cap for the coupling assembly P3, and install a gauge coupling.</p> <ul style="list-style-type: none"> When no gauge coupling is available, stop the engine to release the pressurized air from the hydraulic tank. Then, remove the coupling assembly and mount the gauge. After installation of the gauge, pressurize the air in the hydraulic tank. 		<p>⚠ WARNING</p> <p>Upper structure movement can cause personal injury or death. To prevent structure movement.</p> <p>Do not remove the gauge port plug until air pressure has been relieved in hydraulic tank.</p>  <p>Gauge coupling P3</p> <p>Make the bucket dig into the ground to stop and relieve the swing pressure.</p>  <p>Posture taken when the swing pressure is being measured</p>
Measuring procedures	<p>1. Make the bucket dig into the ground in the posture shown in the right column. Then, operating the swing lever slowly, relieve the pressure and hold it.</p> <p>Make measurements by performing right or left swing.</p> <p>[Notes]</p> <p>1. Confirm beforehand that the pressure of the main relief valve is normal.</p> <p>2. The pressure changes depending on the engine speed.</p> <ul style="list-style-type: none"> When the engine runs idling: the pressure is nearly the set value. When the engine runs at the maximum speed: a pressure higher by 0.5 to 1.5 MPa is detected. (This also differs depending on the oil temperature.) 	
Adjusting procedures	<p>1. Any occurrence of biased wear of the plunger, inclusion of dust, or clogging of the holes will lead to a decline in the pressure. Disassembling and checking are therefore required.</p> <p>2. When the pressure is still lower, replace the relief valve assembly with a new one.</p>	<p>Relief valve (Upper AV side; Lower BV side)</p>  <p>Relief valve position</p>  <p>Piston Spring Plunger O-ring A40001-24</p> <p>Relief valve assembly</p>

SECTION 6 PERFORMANCE STANDARDS

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Performance Judgment 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 judgment 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 judgment 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

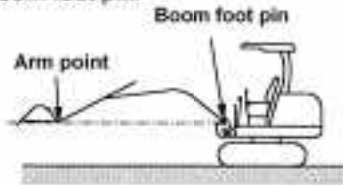
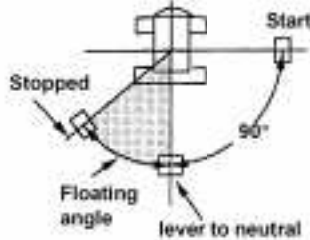
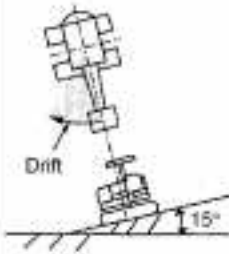
3. Perform the measurement under the conditions specified.

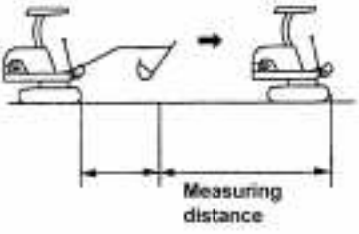
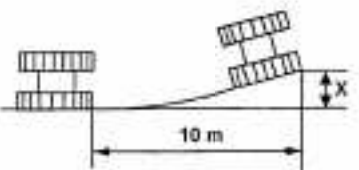

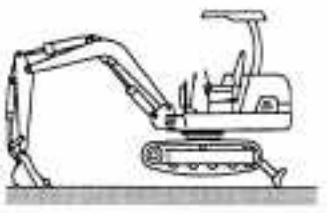
If measurement conditions change, then measured values will in turn change, greatly. If the specified conditions are not followed, record the actual conditions.


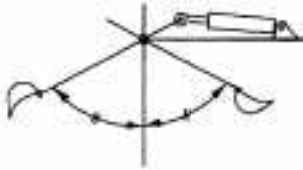
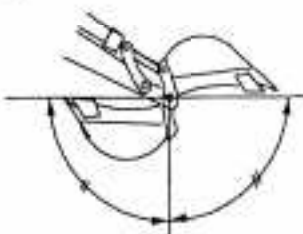
- (1) If the manufacturer is to be consulted because of trouble, report the measurement conditions; in particular, oil temperature and engine speed (max. speed without load, single pump relief, double pump relief)
- (2) The standard values are set under the condition of bucket without load (empty). However 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.


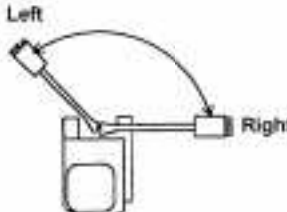
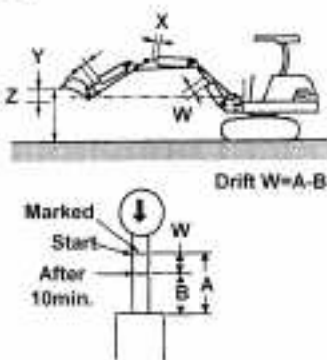
4. If any measured value greatly differs from the standard:
 - (1) Check that the measurement conditions and methods have been appropriate. (Engine speed, oil pressure, oil temperature, ground for measurement, bucket load)
 - (2) Performance has been greatly degraded. In that case the performance will 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 ⁻¹	2300	-	
	Rated Output	kw	10.5	-5%	
	Max. Torque	N•m	51.8	-5%	
	High Idle (No load)	min ⁻¹	2460 ⁺⁰ ₋₅₀	2460±50	
	Low Idle (No load)	min ⁻¹	1250 ⁺⁰ ₋₃₀	1250±50	
HYDRAULIC PRESSURE	Boom	MPa	20.6 ^{+0.0} ₋₀	20.6 ^{+0.5} _{-1.0}	<ul style="list-style-type: none"> At hydraulic temperature 50±5°C
	Arm		↑	↑	
	Bucket		↑	↑	
	Swing		15.2 ^{+0.5} ₋₀	15.2 ^{+0.5} _{-1.0}	
	Travel		20.6 ^{+0.5} ₋₀	20.6 ^{+0.5} _{-1.0}	
	Boom Swing		18.1 ^{+0.5} ₋₀	18.1 ^{+0.5} _{-1.0}	
	Blade		↑	↑	
LEVER FORCE	Boom: Raise/Lower	kg	1.2±0.3	1.2±0.5	<ul style="list-style-type: none"> At engine stopped
	Arm: In/Out		1.2±0.3	1.2±0.5	
	Bucket		1.0±0.3	1.0±0.5	
	Swing: Right/Left		1.0±0.3	1.0±0.5	
	Travel: Forward/Reverse		1.8±0.4	1.8±0.7	
	Boom Swing: Right/Left		9.0±0.5	9.0±1.0	
	Blade: Raise/Lower		2.3±0.4	2.3±1.0	
	Throttle		4.0±0.4	4.0±1.0	
SPOOL STROKE	Boom	mm	7.0	←	<ul style="list-style-type: none"> Measurement from the outside is not allowable due to the hydraulic remote control type. (For measurement, remove the spool case.)
	Arm				
	Bucket				
	Swing				
	Boom Swing		7.0	←	<ul style="list-style-type: none"> Mechanical type Check and adjust the control lever beforehand.
	Travel				
	Service				
	Blade				

Item	CONDITION	STANDARD	ALLOW
SWING Upper floats when swing operation is stopped. (Brake working angle)	<p>Engine : Rated R.P.M. Oil temp. : $50 \pm 5^{\circ}\text{C}$</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 90° with no load. Measure floating angle after stop the machine.</p> 	<p>$20 \pm 10^{\circ}$</p>	<p>Below 35°</p>
Swing Operating Speed	<p>Engine : Rated R.P.M. Oil temp. : $50 \pm 5^{\circ}\text{C}$</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>$12.6 \text{ sec} \pm 0.5^{\circ} \text{ sec}$</p>	<p>Below 14 sec</p>
Natural Drift	<p>Engine : Low idling Oil temp. : $50 \pm 5^{\circ}\text{C}$ Incline angle : 15° Fully retracted bucket cylinder and arm cylinder. Arm point pin positioned to be horizontal with boom foot pin. Slant surface crosswise. Measure drift angle after 5 minutes.</p> 	<p>Below 0</p>	<p>Below 0</p>

Item	CONDITION	STANDARD	ALLOW
TRAVEL Travel Speed	Engine : Rated R.P.M Oil temp. : $50 \pm 5^{\circ}\text{C}$ Level solid ground Time required for 10 m travel after 5 m take off. 	Rubber shoe	
		High Speed 9.3 sec ± 1.0 sec Low Speed 17.0 sec ± 1.0 sec	High Speed below 11 sec Low Speed below 19 sec
		Steel shoe	
		High Speed 9.3 sec ± 1.0 sec Low Speed 17.5 sec ± 1.0 sec	High Speed below 11 sec Low Speed below 20 sec
Travel Alignment	Engine : Rated R.P.M Oil temp. : $50 \pm 5^{\circ}\text{C}$ Measure turning distance (x) after 10m travel. 	Below 500 mm	Below 700 mm
Natural Drift 	Engine : Low idling Oil temp. : $50 \pm 5^{\circ}\text{C}$ Measure drift gravity in 5 minutes.	100 mm /5 min	300 mm /5 min
Time for Crawler belt	Engine : Rated R.P.M Oil temp. : $50 \pm 5^{\circ}\text{C}$ Measure time required for five turns after one turn. 	High Speed 15.0 sec ± 1.0 sec Low Speed 28.5 sec ± 1.0 sec	High Speed below 18.0 sec Low Speed below 32.0 sec

Item	CONDITION	STANDARD	ALLOW
BOOM CYLINDER SPEED	<p>Engine : Rated R.P.M Oil temp. : $50 \pm 5^{\circ}\text{C}$</p>  <p>Arm and bucket cylinder fully retracted. Without measure cushion stroke.</p> <ol style="list-style-type: none"> 1. Measure time to raise boom from ground level to maximum height. 2. Measure time to lower boom from maximum height to ground level. 	with canopy	
		<p>Raise 2.8 sec ± 0.5 sec</p> <p>Lower 2.6 sec ± 0.5 sec</p>	<p>Below 3.5 sec</p> <p>Below 3.3 sec</p>
		with canopy	
ARM CYLINDER SPEED	<p>Engine : Rated R.P.M Oil temp. : $50 \pm 5^{\circ}\text{C}$</p>  <p>Divided Equally</p> <p>Measure time for full extension or retraction of cylinder. Without measure cushion stroke.</p>	with canopy	
		<p>Arm In 2.5 sec ± 0.5 sec</p>	<p>Below 3.4 sec</p>
		<p>Arm Out 2.5 sec ± 0.5 sec</p>	<p>Below 3.4 sec</p>
BUCKET CYLINDER SPEED	<p>Engine : Rated R.P.M Oil temp. : $50 \pm 5^{\circ}\text{C}$</p>  <p>Divided Equally</p> <p>Measure time for full extension or retraction of cylinder.</p>	with canopy	
		<p>Dig 2.8 sec ± 0.3 sec</p>	<p>Below 3.5 sec</p>
		<p>Dig 2.1 sec ± 0.3 sec</p>	<p>Below 2.6 sec</p>

Item	CONDITION	STANDARD	ALLOW
BLADE CYLINDER SPEED	<p>Engine : Rated R.P.M Oil temp. : $50 \pm 5^{\circ}\text{C}$</p>  <p>Measure time for full</p>	<p>Hoist 1.8 sec ± 0.5 sec</p> <p>Lower 2.5 sec ± 0.5 sec</p>	<p>Below 2.4 sec</p> <p>Below 3.1 sec</p>
BOOM SWING CYLINDER SPEED	<p>Engine : Rated R.P.M Oil temp. : $50 \pm 5^{\circ}\text{C}$</p>  <p>Measure time for full extension or retraction of cylinder. Without measure cushion stroke.</p>	<p>Left 5.3 sec ± 0.6 sec</p> <p>Right 4.0 sec ± 0.6 sec</p>	<p>Below 6.4 sec</p> <p>Below 5.1 sec</p>
CYLINDER DRIFT	<p>Engine : Stopped Oil temp. : $50 \pm 5^{\circ}\text{C}$</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 10mm</p> <p>Arm Cylinder: below 10mm</p> <p>Bucket Cylinder: below 5mm</p> <p>Bucket Tooth Point: below 200mm</p>	<p>Below 20 mm</p> <p>Below 20 mm</p> <p>Below 10 mm</p> <p>Below 300 mm</p>