



SHOP MANUAL

E15 HYDRAULIC EXCAVATOR

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E15 SHOP MANUAL

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1.1 GENERAL SAFETY INFORMATION



WARNING: Do not operate or perform any maintenance on this machine until all instructions in the OPERATOR'S MANUAL and this MANUAL have been thoroughly read and understood.



WARNING: Improper operation or maintenance of this machine may cause accidents and could result in serious injury or death.



WARNING: Always keep the manual in storage.
If it is missing or damaged, place an order with an authorized Distributor for a replacement.
If you have any questions, please consult your dealer.

1. Most accidents, which occur during operation, are due to neglect of precautionary measures and safety rules. Sufficient care should be taken to avoid these accidents. Erroneous operation, lubrication or maintenance services are very dangerous and may cause injury or death of personnel. Therefore all precautionary measures, NOTES, DANGERS, WARNINGS and CAUTIONS contained in the manual and on the machine should be read and understood by all personnel before starting any work with or on the machine.
2. Operation, inspection, and maintenance should be carefully carried out, safety must be given the first priority. The safety information contained in the manual is intended only to supplement safety codes, insurance requirements, local laws, rules and regulations.

3. Messages of safety appear in the manual and on the machine:

All messages of safety are identified by either word of DANGER, WARNING, and CAUTION.



DANGER: Shows an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING: Shows a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION: Shows a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against possible damage to the machine and its components.

4. It is very difficult to foresee every danger that may occur during operation. However, safety can be ensured by fully understanding proper operating procedures for this machine according to methods recommended.
5. While operating the machine, be sure to perform work with great care, so no damage to the machine or accidents will occur.
6. Continue studying the manual until all Safety, Operation and Maintenance procedures are completely understood by all persons working with the machine.

2.3 SPECIFICATIONS AND PERFORMANCE

2.3.1 SPEED AND GRADABILITY

Item	Shoe Type	Rubber		Steel	
Slewing Speed	rpm	9.4			
Travel Speed	km/h (mph)	Low	High	Low	High
		2.2 (1.4)	4.0 (2.5)	2.0 (1.2)	3.7 (2.3)
Gradability		30°(58%)			

2.3.2 ENGINE

Model	3TNE72A-UYBB
Type	4-Cycle, vertical, water-cooled, 3-cylinder
Number of Cylinders- Bore×Stroke	3 - 72mm × 72mm (2.83in × 2.83in)
Total Displacement cc (cu.in)	879 (53.64)
Rated Output/Rotation Speed Ps/rpm	14.5/2,350
Maximum Torque/Rotation kgf·m (ft·lbs)/rpm	5.2 (38) /1,700
Starter	12V/1.0kW
Alternator	12V/20A

2.3.3 HYDRAULIC COMPONENTS

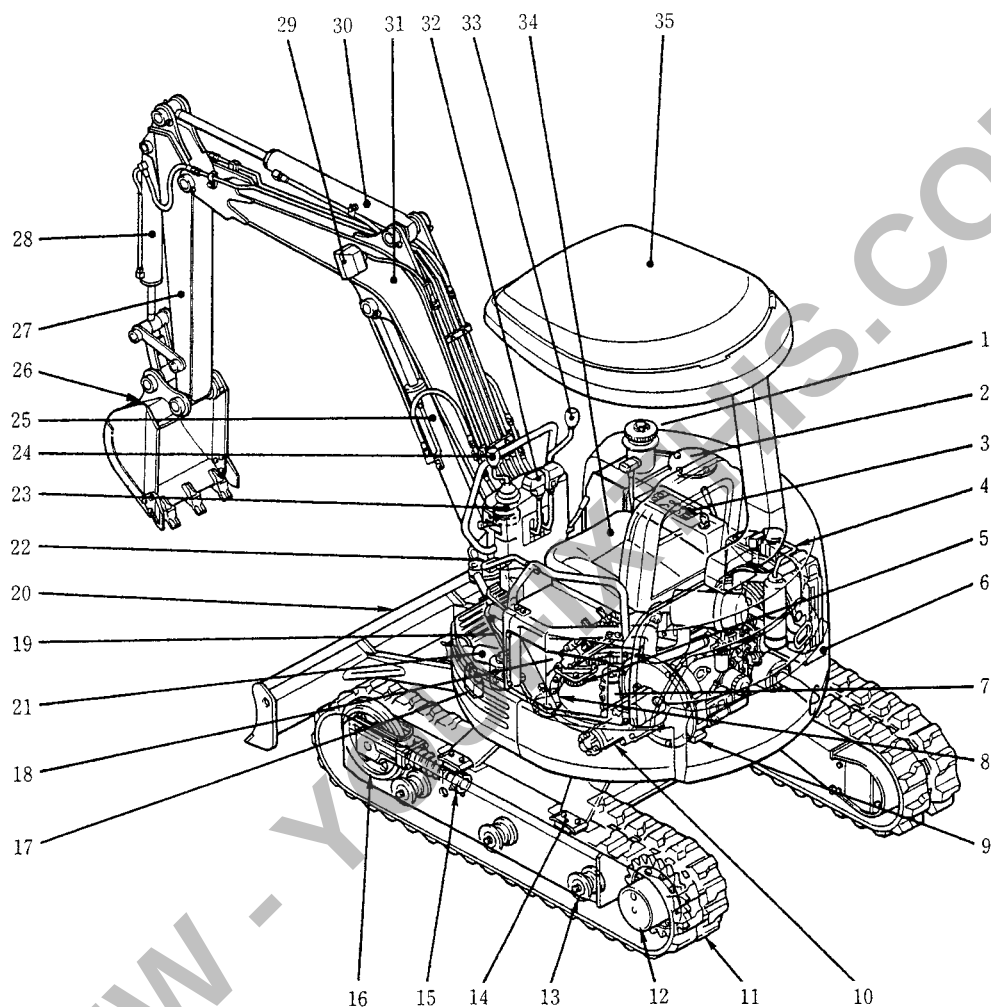
Hydraulic Pump	Gear pump
Hydraulic Motor (Slewing)	Orbit motor
Hydraulic Motor (Travel)	Axial piston, 2-speed motor
Control Valve	8-functions multiple control valve
Cylinder (Boom, Arm, Bucket, Swing, Dozer blade)	Double action cylinder
Return filter	Safety valve containing filter type (10 μ)

2.3.4 SIDE DIGGING

Type	Boom swing by hydraulic cylinder	
Boom Swing Angle	Canopy	55°(Right) / 85°(Left)
	Cab	55°(Right) / 70°(Left)

2.1 COMPONENTS

2.1.1 MACHINE COMPONENT NAMES



- | | | |
|--------------------|------------------------|-------------------------|
| ① FUEL TANK | ⑬ LOWER ROLLER | ⑳ BOOM CYLINDER |
| ② HYDRAULIC TANK | ⑭ SHOE SLIDE | ㉑ BUCKET |
| ③ INSTRUMENT PANEL | ⑮ TRACK ADJUSTER | ㉒ ARM |
| ④ RADIATOR | ⑯ IDLER | ㉓ BUCKET CYLINDER |
| ⑤ SLEWING MOTOR | ⑰ SOLENOID VALVE | ㉔ WORKING LIGHT |
| ⑥ BATTERY | ⑱ CONTROL VALVE | ㉕ ARM CYLINDER |
| ⑦ SWIVEL JOINT | ㉑ SWING CYLINDER | ㉖ BOOM |
| ⑧ SLEWING RING | ㉒ DOZER BLADE | ㉗ TRAVEL LEVER |
| ⑨ ENGINE | ㉓ DOZER BLADE CYLINDER | ㉘ RIGHT OPERATING LEVER |
| ⑩ HYDRAULIC PUMP | ㉔ SAFETY LEVER | ㉙ OPERATOR SEAT |
| ⑪ RUBBER SHOE | ㉕ PILOT VALVE | ㉚ CANOPY |
| ⑫ TRAVELING MOTOR | ㉖ LEFT OPERATING LEVER | |

2.8 ENGINE SPECIFICATIONS

2.8.1 SPECIFICATIONS TABLE

Engine Model	3TNA72L-UYBB		
Type	Diesel, 4-cycle water-cooled		
No. of cylinders – Dia × Stroke mm (in)	3 – 72 × 72 (2.83 × 2.83)		
Total displacement cc (cu.in)	879 (53.6)		
Compression ratio	22.3		
Output rating PS/rpm (kW/rpm)	14.5/2,350 (10.7/2,350)		
Max/ torque kgf-m/rpm (ft-lbs/rpm)	5.2/1,700 (37.6/1,700)		
High idling rpm	2,550 ± 25		
Low idling rpm	1,075 ± 25		
Injection start pressure kgf/cm ² (psi)	120 ⁺¹⁰ ₀ (1710 ⁺¹⁴⁰ ₀)		
Thermostat temperature °C (°F)	Valve opening 71 (160) Full open 85 (185)		
Ignition order	1 – 3 – 2 – 1		
Lube oil pressure kgf/cm ² (psi)	3.5 ± 0.5 (50 ± 7)		
Fuel injection timing (b.T.D.C.)	14° ± 1		
Valve clearance mm (in)	0.15~0.25 (0.006~0.018)		
valve action timing		Open	Close
	Suction valve	b.T.D.C. 7°~ 17°	a.B.D.C. 35°~ 45°
	Exhaust valve	b.B.D.C. 40°~ 50°	a.T.D.C. 8°~ 18°
Starter capacity V × kW	12 × 1.0		
Generator capacity V × A	12 × 20		
Cooling water capacity Engine/Radiator ℓ (gal)	1.1/2.0 (0.29/0.53)		
Engine oil volume Max/Effectiv ℓ (gal)	2.4/1.0 (0.63/0.26)		
Dry weight kg (lbs)	100 (221)		
Fuel consumption rate	Less than 200g/Psh		
Allowable tilting angles	Back and forth, left and right 25° (momentary 30°)		
Engine dimension L × W × H mm (in)	498 × 406 × 501 (19.6 × 16.0 × 19.7)		
Rotating direction	Counterclockwise as seen from flywheel side		

7.1 TORQUE SPECIFICATIONS FOR CAPSCREWS AND NUTS

7.1.1 TABLES 1 AND 2

Tables 1 and 2 indicate tightening torques applicable to cases where no special note is given.

Overtightening of bolts may result in a twist-off

and a fracture under load.

Insufficient tightening may lead to a loosening or loss of bolts. Always tighten bolts to proper torques.

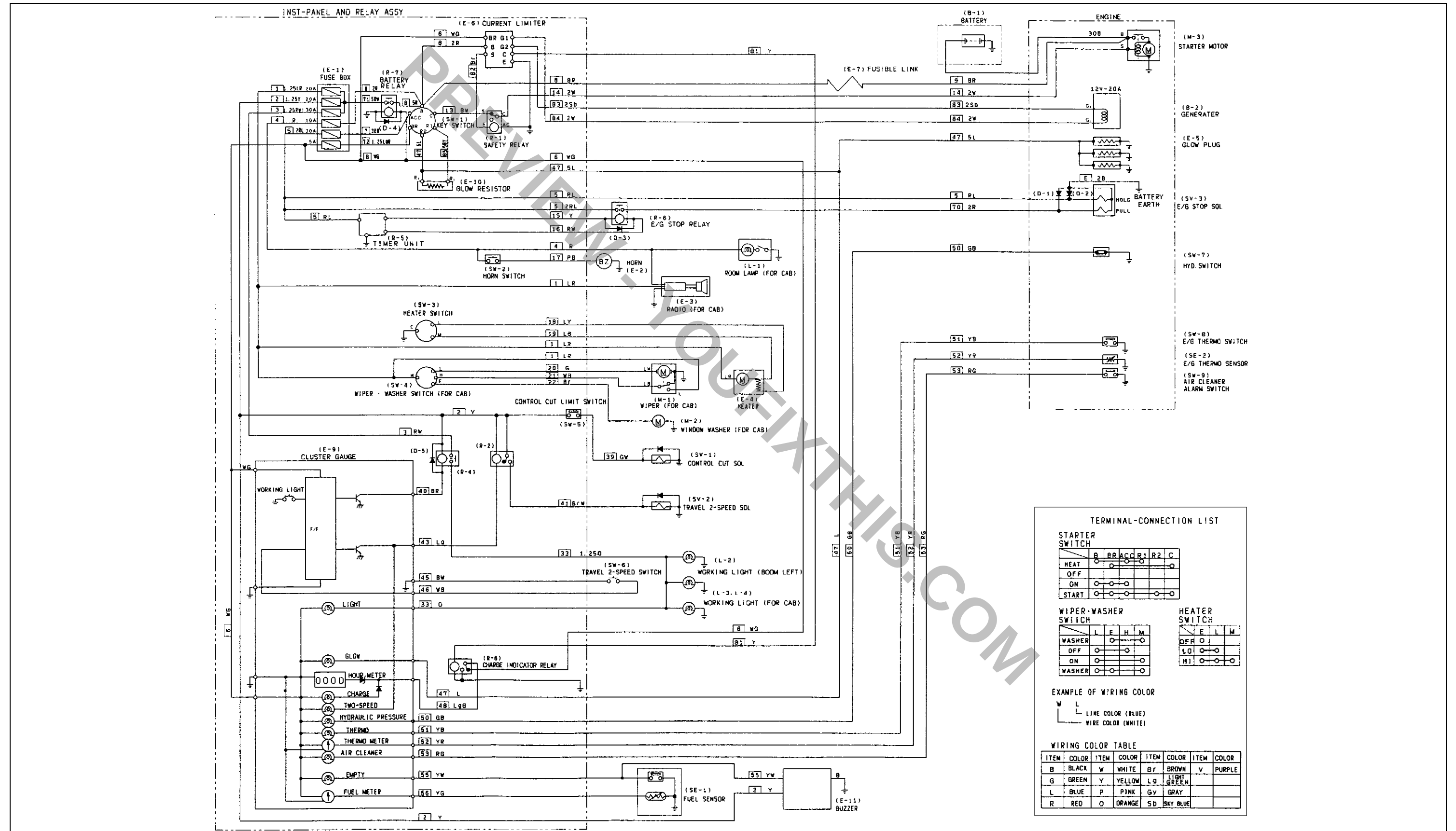
Table 1 Standard tightening torques for metric coarse screw threads unit: kgf·m (ft·lbs)

Classification Nominal size	4 T		7 T		10 T	
	No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M 6 P=1	0.45±0.05 (3.3±0.4)	0.38±0.04 (2.7±0.3)	0.98±0.1 (7.1±0.7)	0.83±0.08 (6.0±0.6)	1.77±0.18 (13±1)	1.5±0.15 (11±1)
M 8 P=1.25	1.09±0.11 (7.9±0.8)	0.92±0.09 (6.7±0.7)	2.4±0.2 (17±1)	2.0±0.2 (14±1)	4.3±0.4 (32±3)	3.6±0.4 (26±3)
M10 P=1.5	2.2±0.2 (16±1)	1.83±0.18 (13±1)	4.7±0.5 (34±4)	4.0±0.4 (29±3)	8.5±0.9 (61±7)	7.2±0.7 (52±5)
M12 P=1.75	3.7±0.4 (27±3)	3.2±0.3 (23±2)	8.1±0.8 (59±6)	6.8±0.7 (49±5)	14.6±1.5 (110±11)	12.3±1.2 (89±9)
M14 P=2	5.9±0.6 (43±4)	5.0±0.5 (36±4)	12.8±1.3 (93±9)	10.8±1.1 (78±8)	23±2 (170±14)	19.5±1.9 (140±14)
M16 P=2	9.0±0.9 (65±7)	7.6±0.7 (55±5)	19.5±2.0 (140±14)	16.4±1.6 (120±12)	35±4 (250±29)	29±3 (210±22)
M18 P=2.5	12.4±1.2 (90±9)	10.5±1.0 (76±7)	27±3 (200±22)	23±2 (170±14)	49±5 (350±36)	41±4 (300±29)
M20 P=2.5	17.5±1.7 (130±12)	14.7±1.4 (110±10)	38±4 (270±29)	32±3 (230±22)	68±7 (490±51)	57±6 (410±43)
M22 P=2.5	23±2 (170±14)	19.6±2.0 (140±14)	51±5 (370±36)	43±4 (310±29)	92±9 (670±65)	77±8 (560±58)
M24 P=3	30±3 (220±22)	24±3 (170±22)	65±7 (470±51)	53±5 (380±36)	118±12 (850±87)	96±10 (690±72)
M27 P=3	44±4 (320±29)	36±4 (260±29)	96±10 (690±72)	78±8 (560±58)	173±17 (1300±120)	140±14 (1000±100)
M30 P=3.5	60±6 (430±43)	50±5 (360±36)	131±13 (950±94)	110±11 (800±80)	235±24 (1700±170)	198±20 (1400±140)
M33 P=3.5	81±8 (590±58)	68±7 (490±51)	176±18 (1300±130)	148±15 (1100±110)	317±32 (2300±230)	266±27 (1900±200)
M36 P=4	105±10 (760±72)	88±9 (640±65)	227±23 (1600±170)	190±19 (1400±140)	409±41 (3000±300)	343±34 (2500±250)

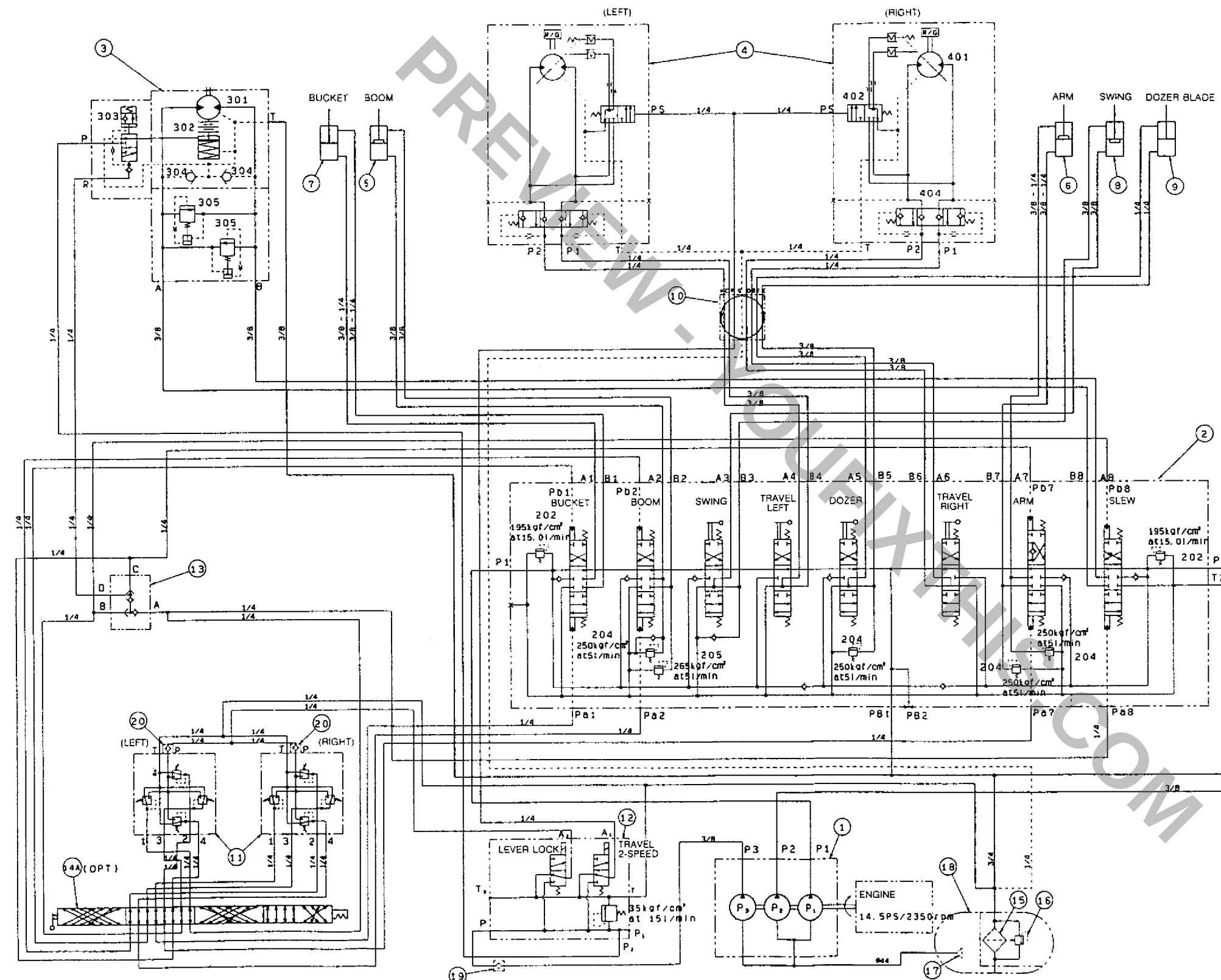
Table 2 Standard tightening torques for metric fine screw threads unit: kgf·m (ft·lbs)

Classification Nominal size	4 T		7 T		10 T	
	No lubrication	Oil lubrication	No lubrication	Oil lubrication	No lubrication	Oil lubrication
M 8 P=1	1.15±0.11 (8.3±0.8)	0.97±0.1 (7.0±0.7)	2.5±0.2 (18±1)	2.1±0.2 (15±1)	4.5±0.4 (33±3)	3.8±0.4 (27±3)
M10 P=1.25	2.3±0.2 (17±1)	1.91±0.19 (14±1)	4.9±0.5 (35±4)	4.2±0.4 (30±3)	8.9±0.9 (64±7)	7.5±0.7 (54±5)
M12 P=1.25	4.0±0.4 (29±3)	3.4±0.3 (25±2)	8.7±0.9 (63±7)	7.3±0.7 (53±5)	15.7±1.6 (110±12)	13.2±1.3 (95±9)
M16 P=1.5	9.4±0.9 (68±7)	7.9±0.8 (57±6)	20±2 (140±14)	17.2±1.7 (120±12)	37±4 (270±29)	31±3 (220±22)
M20 P=1.5	19±1.9 (140±14)	15.8±1.6 (110±12)	41±4 (300±29)	34±3 (250±22)	74±7 (540±51)	62±6 (450±43)
M24 P=2	32±3 (230±22)	27±3 (200±22)	70±7 (510±51)	58±6 (420±43)	126±12 (910±87)	105±10 (760±72)
M30 P=2	65±6 (470±43)	54±5 (390±36)	142±14 (1000±100)	118±12 (850±87)	255±26 (1800±190)	212±21 (1500±150)
M36 P=3	109±11 (790±80)	91±9 (660±65)	238±23 (1700±170)	198±20 (1400±140)	428±43 (3100±310)	357±36 (2600±260)

25.6.1 ELECTRICAL CIRCUIT DIAGRAM



12.2.1 STANDARD SPECIFICATION



No	NAME	MODEL No.
1	PUMP	KFP1161-61-30
2	CONTROL VALVE	KVS31-8
3	SLEW MOTOR	2PB20CO107-A
4	TRAVEL MOTOR	MAG10V-100-2
5	BOOM CYLINDER	$\phi 30 \times \phi 55 \times 435$
6	ARM CYLINDER	$\phi 30 \times \phi 55 \times 450$
7	BUCKET CYLINDER	$\phi 30 \times \phi 50 \times 340$
8	SWING CYLINDER	$\phi 35 \times \phi 65 \times 410$
9	DOZER BLADE CYLINDER	$\phi 35 \times \phi 70 \times 108$
10	SWIVEL JOINT	YV-7104
11	PILOT VALVE	TH40M
12	SOLENOID VALVE	2KWE5A-20
13	SHUTTLE VALVE	—
14A	MULTI CONTROL VALVE	K16AR6-11
15	RETURN FILTER	Y-464900
16	RELIEF VALVE	Y-148300
※ 17	SUCTION STRAINER	Y-1405
18	HYDRAULIC TANK	—
19	LINE FILTER	Y-410200
20	FILTER	—

No	PART NAME	No	PART NAME
202	MAIN RELIEF VALVE	304	CHECK VALVE
204	PORT RELIEF VALVE	305	RELIEF VALVE
205	PORT RELIEF VALVE	401	HYDRAULIC MOTOR
301	HYDRAULIC MOTOR	402	2-SPEED CONTROL VALVE
302	PARKING BRAKE	404	COUNTERBALANCE VALVE
303	TIME DELAY VALVE		

29.2 TROUBLESHOOTING CHART

29.2.1 DIAGNOSTICS TABLE AND ABBREVIATIONS TABLE

Class	Reference No.	Parts		Engine				Electric unit														Hydraulic unit													
				Fuel system	Cooling system	Lubrication system	Suction exhaust system and others	Power supply system				Power generation and stop system						Operation system and others				Pump			Valve							Actuator			
								Battery	Fusible link	Fuse	Key switch	Safety Relay	Starter motor	Alternator & Air heater	Battery relay	Timer unit	E/G Stop relay	E/G Stop SOL	Gauge cluster	Control cut Limit switch	Control cut SOL	Travel 1,2-speed SW&SOL	Travel lock motor & relay	Main pump	Trochoid pump	Gear pump	Travel & ATT main R/V	Main gear pump R/V	Ports R/V	Travel spool	ATT spool	Check valve	Shuttle valve	Slewing motor unit	Travel motor unit
Engine	1	Not start.	Starter doesn't rotate.	☐				☐	☐	☐	☐	☐	☐	☐																					
			Starter rotate.	☐					☐						☐	☐	☐																		
	2	Starts, but stops.		☐										☐		☐	☐																		
	3	Not stop.												☐	☐	☐																			
Pump	4	The engine malfunctions.		☐	☐		☐																												
	5	The engine revolution falls when loaded.																		☐															
Travel	6	The pump malfunctions.																	☐	☐	☐														
	7	Travel operations is unavailable.																☐	☐		☐											☐			
	8	Travel speed is slow.					☐											☐		☐	☐				☐								☐		
	9	Travel power is poor.																☐			☐		☐										☐		
Slewing	10	Travel motion deflects.																	☐														☐		
	11	Slewing operation unavailable.																☐	☐													☐			
	12	Slewing speed is slow.					☐													☐															
	13	Slewing power is poor.																				☐	☐									☐			
Attachment	14	Slewing operations is unavailable.																									☐					☐			
	15	Attachment is unoperatable.																☐	☐	☐					☐										
	16	Attachment speed is slow.					☐													☐							☐								☐
	17	Attachment power is poor.																				☐	☐												☐
	18	Attachment operation is unavailable.																								☐									☐

Table of Abbreviations

ATT	: ATTACHMENT
C/V	: CONTROL VALVE
E/G	: ENGINE
R/V	: RELIEF VALVE
SOL	: SOLENOID
SW	: SWITCH
V	: VALVE

(1) 3TNV82A

Engine name		Unit	3TNV82A									
Engine specification class		-	CL	VM								
Type		-	Vertical, in-line, 4-cycle, water-cooled diesel engine									
Combustion chamber		-	Direct injection									
Number of cylinders		-	3									
Cylinder bore×stroke		mm×mm	82×84									
Displacement		L	1.331									
Continuous rating	Revolving speed	Min ⁻¹	1500	1800	-							
	Output	kW (hp)	9.9 (13.5)	12.0 (16.3)	-							
Rated output	Revolving speed	Min ⁻¹	1500	1800	2000	2200	2400	2500	2600	2800	3000	
	Output	kW (hp)	11.0 (14.9)	13.2 (17.9)	14.6 (19.9)	16.0 (21.8)	17.5 (23.8)	18.2 (24.8)	19.0 (25.8)	20.4 (27.8)	21.9 (29.8)	
Max. no-load speed (±25)		min ⁻¹	1600	1895	2180	2375	2570	2675	2780	2995	3180	
Ignition order		-	1-3-2-1(No.1 cylinder on flywheel side)									
Power take off		-	Flywheel									
Direction of rotation		-	Counterclockwise (viewed from flywheel)									
Cooling system		-	Radiator									
Lubrication system		-	Forced lubrication with trochoid pump									
Starting system		-	Electric									
Applicable fuel		-	Diesel oil-ISO 8217 DMA, BS 2869 A1 or A2 (Cetane No.45 min.)									
Applicable lubricant		-	API grade class CD or CF									
Lubricant capacity (oil pan) *	Total	L	3.6							5.5		
	Effective	L	1.2							2.2		
Coolant water capacity (engine only)		L	1.8									
Engine Dimensions ** (with flyw Crankshaft V pulley diameter & heel housing)	Overall length	mm	553	528								
	Overall width	mm	489									
	Overall height	mm	565									
Engine mass (dry) ** (with flywheel housing)		kg	138	128								
Cooling fan (std.)		mm	335 mm O/D, 6 blades pusher type									
Fun V pulley diameter (std.)		mm	120×90	110×110								

* Engine oil capacity may differ from the above depending on an engine installed on a machine unit.

** Engine mass and dimensions without radiator

2. Inspection and Adjustment

2.1 Periodic Maintenance Schedule

The engine periodic inspection timing is hard to determine as it varies with the application, load status, qualities of the fuel and lubricating oils used and handling status. General rules are described here.

○: User-maintenance ◎: Parts replacement ●: Shop-inspection

Classification	Item	Daily	Maintenance period				
			Every 50 hours	Every 250 hours or 3 months	Every 500 hours or 6 months	Every 1000 hours or one year	Every 2000 hours or two years
Whole	Visual check around engine	○					
Fuel oil system	Fuel tank level check and fuel supply	○					
	Fuel tank draining		○				
	Water separator (Option) draining		○				
	Bleeding the fuel system		○				
	Water separator cleaning				○		
	Fuel filter element replacement				◎		
Lubricating oil system	Lube oil level check and replenishment	○					
	Lube oil replacement			◎			
	Lube oil filter replacement		1 st time ◎	2 nd time and thereafter			
Cooling water system	Coolant water level check and replenishment	○					
	Radiator fin cleaning			○			
	V-belt tension check		1 st time ○	2 nd time and thereafter			
	Coolant water replacement					◎	
	Coolant/water path flushing and maintenance						●
Rubber house	Fuel pipe and coolant water pipe inspection and maintenance	○					●
Governor	Inspection and adjustment of governor lever and accelerator	○		○			
Air intake system	Air cleaner cleaning and element replacement			○	◎		
	Diaphragm assy inspection					● (2 years)	
	Turbocharger blower cleaning*					●*	
Electrical system	Warning lamp & instruments function check	○					
	Battery electrolyte level check and battery recharging		○				
Cylinder head	Intake/exhaust valve head clearance adjustment					●	
	Intake/exhaust valve seat lapping						●
Fuel injection pump and nozzle	Fuel injection nozzle pressure inspection					●*	
	Fuel injection timing adjustment						
	Fuel injection pump inspection and adjustment						●*

*) EPA allows to maintain the emission related parts every 1,500 or 3,000 hours as shown in 1.6.3 of chapter1.

18.1 CRAWLER

18.1.1 PROCEDURE FOR REMOVING AND INSTALLING RUBBER CRAWLER

(1) Removing

- 1) Loosen grease nipple (1) for crawler adjuster to loosen tension of crawler.

④ : 19mm

⚠ Use care that high-pressured grease is not spouted or the nipple is not come out by turning nipple abruptly or overloosening.

⚠ One turn of grease nipple for adjuster is enough to discharge grease, however, if the discharge is poor, move the machine back and forth.

⚠ The rubber crawler is an endless type. When it is confirmed that grease has been discharged and that the rubber crawler has slackened, open the grease nipples and discharge the grease till the idler is pushed to the deepest end.

- 2) Lift the one side of machine with front attachment, as shown in Fig. 2, and place square timber or equivalent under lower frame to support machine.

⚠ When lifting up the body, adjust the angle of boom and arm to 90°~110°, and support the face of bucket bottom.

- 3) When the idler has been pushed to the deepest end, put an iron pipe in the rubber crawler, turn the sprocket backward slowly and when the rubber crawler has floated off the idler, slide it sideways and remove it.

Weight of rubber crawler (one side)

62kg(140lbs)

(2) Installing

- 1) Installing of the crawler is the reverse order of removing : Engage the crawler with the sprocket and mount them on the upper roller. Put an iron pipe in the rubber crawler, turn the sprocket slowly and then the rubber crawler has floated off the idler, engage it with the idler, using an iron pry or the like.

- 2) Check that rubber crawler retaining projection is matched with front idler, sprocket, lower roller respectively and completely, and then tighten grease nipple for crawler adjuster, and adjust the tension while applying grease.

④ : 19mm,

Tightening torque of grease nipple :

$6 \pm 1 \text{ kgf} \cdot \text{m}$ ($43 \pm 7 \text{ ft} \cdot \text{lbs}$)

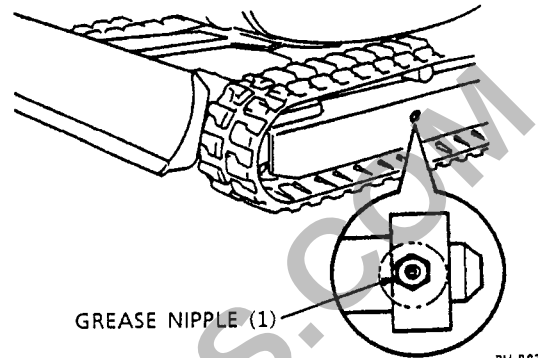


Fig. 1 Adjusting crawler tension

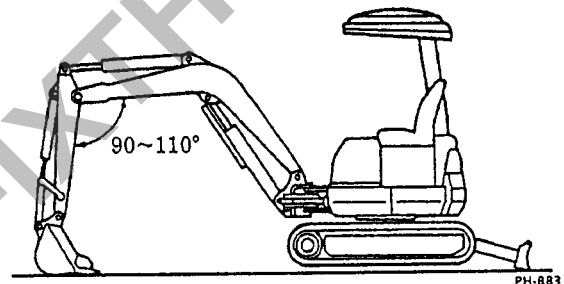


Fig. 2 Supporting machine

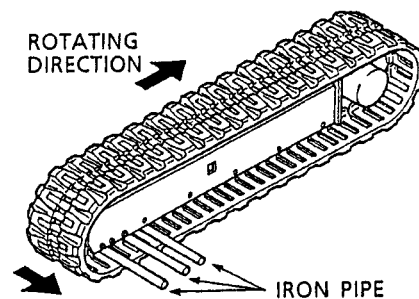


Fig. 3 Removing rubber crawler

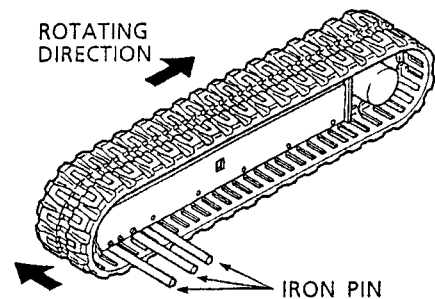


Fig. 4 Installing rubber crawler

22.1 OPERATOR'S CONTROLS

22.1.1 OPERATING LEVERS AND SWITCH LAYOUT

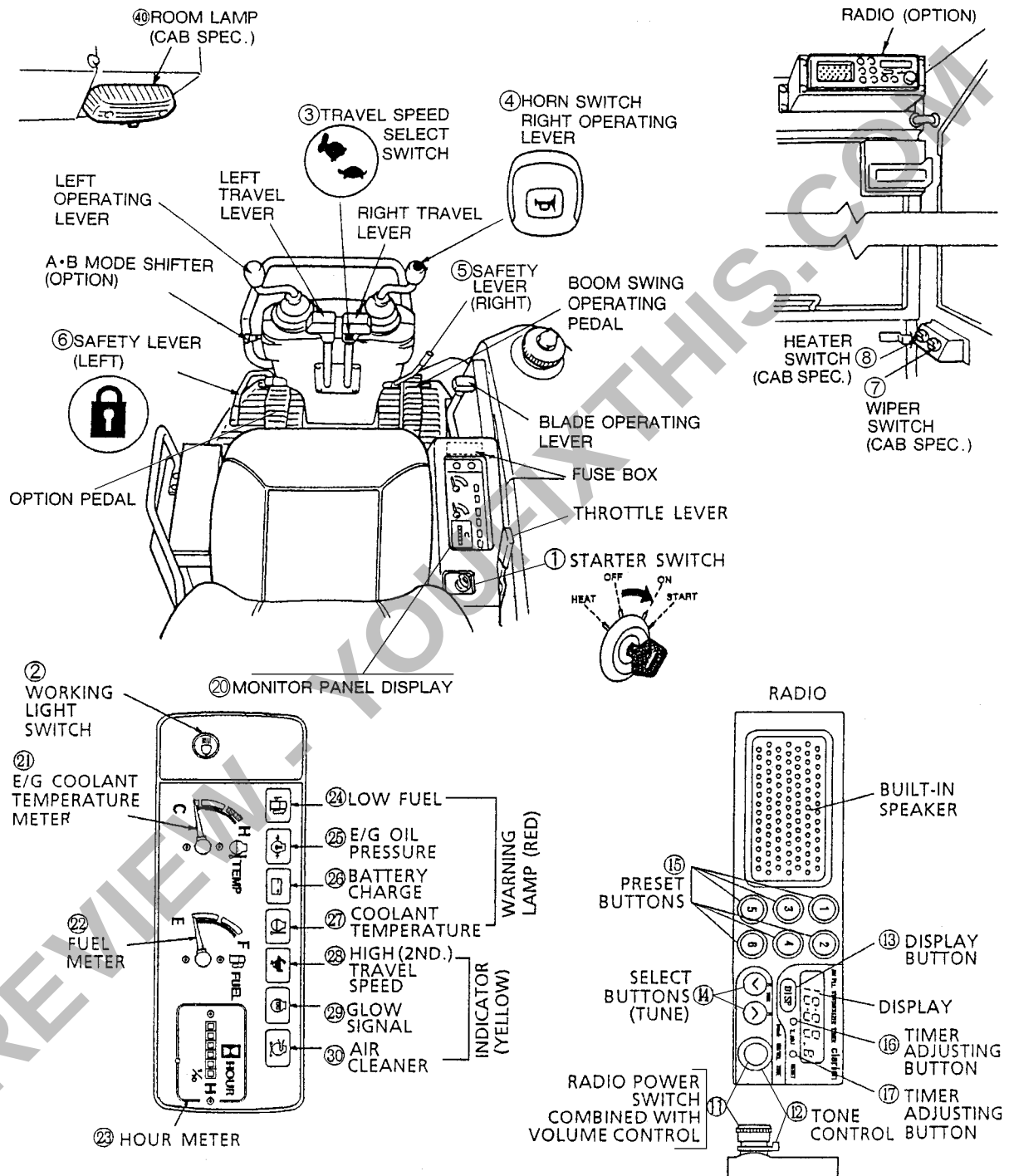


Fig. 1

21.1 BUCKET

21.1.1 REMOVAL AND INSTALLATION PROCEDURES

(1) Removal of Bucket

- 1) Operate the operating lever and bring the bucket down to the ground so the bucket and arm connecting pins are not loaded.
- 2) Remove the ring and the pin by means of a flat-bladed screwdriver and draw out pin (A), in order to remove pin (A) in the embossment of the bucket. (Fig. 1)

- If the pin is hard to come off, the pin is loaded. Adjust it by manipulating the operating lever.
- Exercise care so the dust seal between the arm and the bucket embossment is not scored.

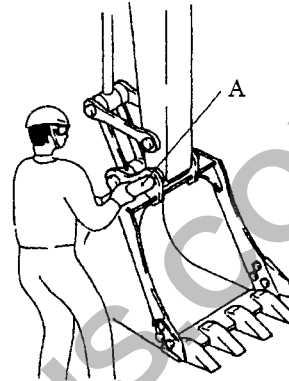


Fig. 1 Removing bucket pin

- 3) Adjust the bucket by manipulating the operating lever so the pin (B) between the bucket link and the bucket is not loaded.
- 4) Remove the pin securing ring and the pin in the bucket embossment, using a flat-bladed screwdriver and draw out pin (B). (See Fig. 2)

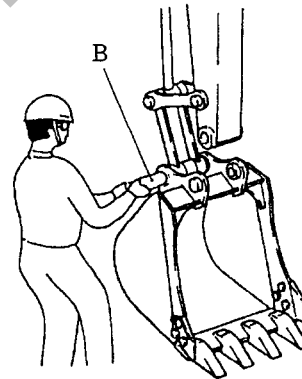


Fig. 2 Removing link pin

(2) Installation of Bucket (See Fig. 3)

Installation is performed in the reverse order of removal, including the following operations:

- 1) Clean the welds of the structures and check that there is no crack on the welds.
- 2) Check the bushing in the bucket embossment to see if it is not worn nor damaged, according to "Maintenance Standard" which will be explained later. Replace it where necessary.
- 3) Check that the dust seal is not scored and replace a faulty one if necessary.
- 4) When inserting the pin, coat the shaft with grease.

- The bucket can be mounted easily if the bucket link is installed in the beginning.
- When aligning the pin holes, do not put your finger in the pin holes in any circumstances, but align them visually.

- 5) Adjust the clearance between the bucket and the arm by referring to "Maintenance Standard" which will be dealt with later.

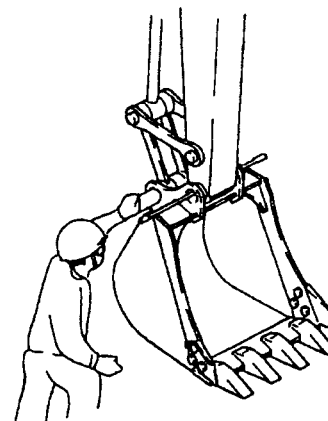
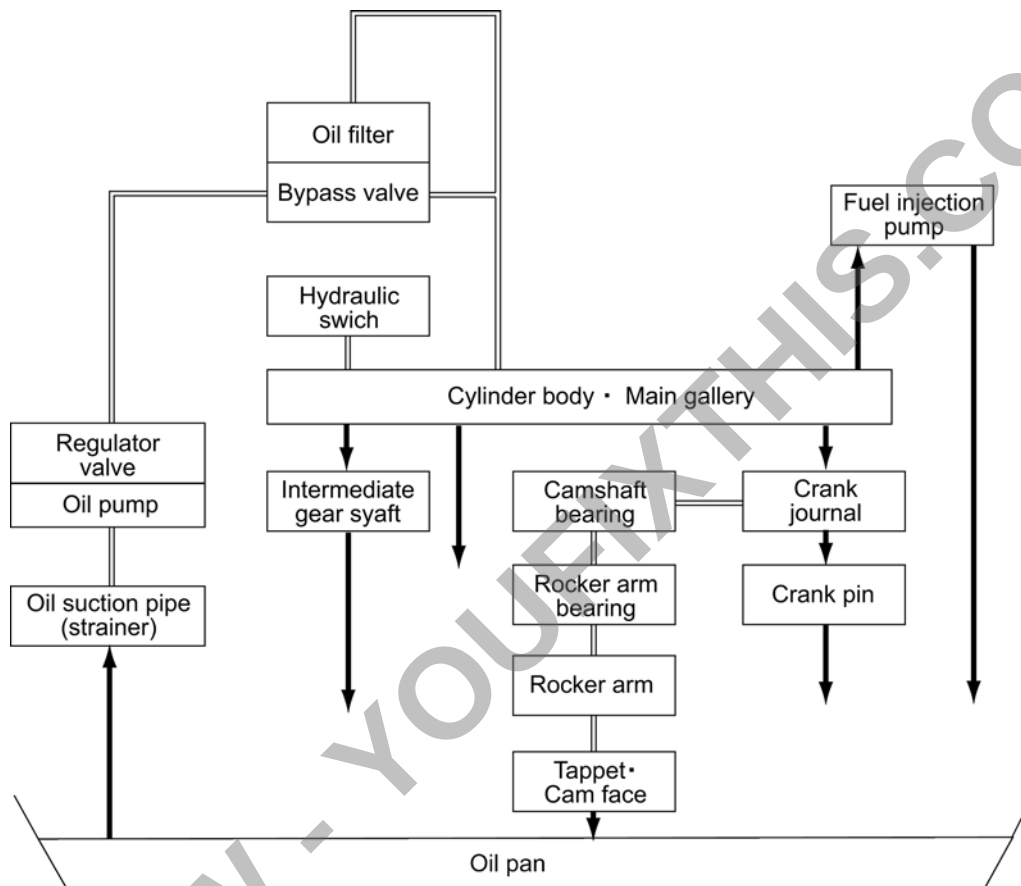


Fig. 3 Installing bucket

5. LUBRICATION SYSTEM

5.1 Lubrication System Diagram



Note: It varies in the specifications of each model whether Oil cooler and Piston cooling of the * mark are attached.

SECTION 3

COMPONENTS

Section Table of Contents	..I	Book/Form Number: 6-80320 NA
CHAPTER 31		
HYDRAULIC PUMP		
Table of Contents	31-1	Book/Form Number: 6-80330 NA
CHAPTER 33		
CONTROL VALVE		
Table of Contents	33-1	Book/Form Number: 6-80340 NA
CHAPTER 35		
PILOT VALVE (ATTACHMENT, STANDARD)		
Table of Contents	35-1	Book/Form Number: 6-80350 NA
CHAPTER 36		
PILOT VALVE (ATTACHMENT, AB SHIFTER)		
Table of Contents	36-1	Book/Form Number: 6-80360 NA
CHAPTER 37		
2-FUNCTION SOLENOID VALVE (WITH RELIEF VALVE)		
Table of Contents	37-1	Book/Form Number: 6-80370 NA
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SLEWING MOTOR UNIT		
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CHAPTER 39		
TRAVEL MOTOR UNIT		
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SYSTEM TROUBLESHOOTING

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SECTION 5

ENGINE

Section Table of Contents	..I	Book/Form Number: 6-80430 NA
CHAPTER 50		
GENERAL DISASSEMBLY AND ASSEMBLY		
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NOTES

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18.9.2.1 REMOVAL AND INSTALLATION

(1) Removing

- 1) Remove seal (5) fitted in the groove in the outer circumference under inner race (2) and seal (6) fitted in the groove in the inner circumference on top of outer race (1) and place them level on a square wooden block.
- 2) Remove taper pin (8), using a hammer and an extrusion rod.
- 3) Remove plug (9), using a puller inserted in the threaded hole in the center of the plug.
- 4) After removing plug (9) while rotating outer race (1) little by little, take out ball (3) and spacer (4) (4A) from the hole in sequence.

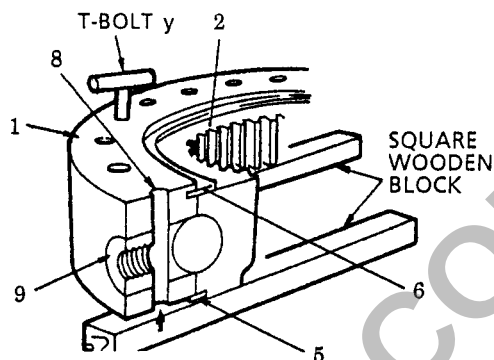


Fig. 73 Removing slewing bearing

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(2) Installing

- 1) Degrease thoroughly the groove for seal (6) located in the inner circumference of outer race (1) and the groove for seal (5) located in the outer circumference of inner race (2). Coat the grooves with adhesive Cyano Bond PO-1, fit seal (5), and place inner race (2) on a surface plate.
- 2) Lift and lower outer race (1) slowly till the top surface of inner race (2) matches the bottom of the sealing groove of outer race (1). Place an adjusting washer under outer race (1) so the track surface of ball (3) is aligned, in order to support the outer race.
- 3) Insert, through the hole for plug (9) in outer race (1), ball (3) and spacer (4) (4A) coated with grease (NLGI-2) alternately.

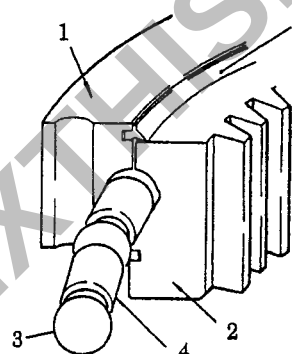


Fig. 74 Removing balls and spacer

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⚠ When inserting ball (3) spacer (4) (4A), the raceways must be aligned completely. To achieve it, outer race (1) should be adjusted. It is very dangerous to put your finger into the plug hole directly ; always use a push rod or a hooked rod.

- 4) Install plug (9) to outer race (1), confirming the direction and the position of the hole for taper pin (8).
- 5) Drive taper pin (8) and caulk the head of the taper pin with a punch.
- 6) Coat seal (6) with adhesive Cyano Bond PO-1 and fit it into outer race (1).
- 7) Confirm that grease nipple (7) is normal. Apply grease (NLGI-2) and confirm that the outer race rotates smoothly and that the lip of the seal is not scored.

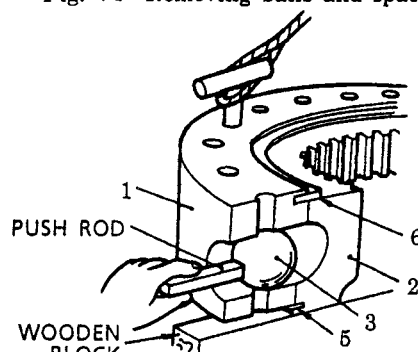


Fig. 75 Inserting balls

YN-874

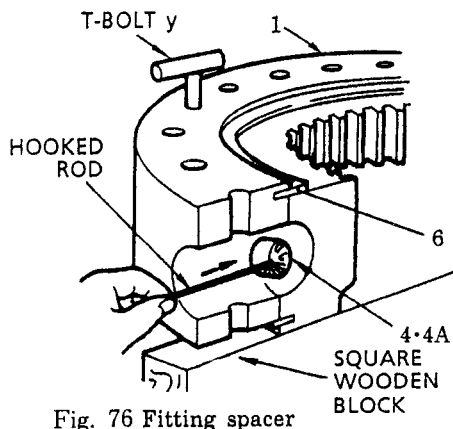


Fig. 76 Fitting spacer

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NOTES

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33.7.2 PORT RELIEF VALVE

7.2.1 Removal

(1) Combination Relief Valve

- 1) Remove the plug (2), and disassemble the wave washer (16), poppets (3) and (4), piston (5) and spring (7).
- 2) Loosen the nut (9) to remove the adjuster (9A), then disassemble the spring (8) and pilot poppet (6).

(2) Direct Relief Valve

- 1) Loosen the lock nut (5) to remove the adjuster (5A).
- 2) Remove the spring (4) and poppet (3) from the housing (1).

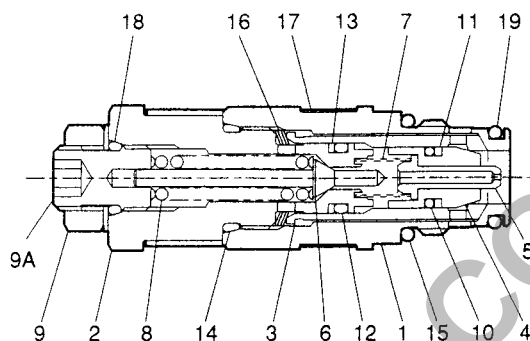


Fig. 35 Combination valve

7.2.2 Cleaning and Inspection

Make clean all the parts by clean mineral oil, and dry them up by dry compressed air, then inspect each part.

- 1) Any defects on the seat faces of each edge of poppet and sleeve are not allowable. And they must have even sealing effect.
- 2) A smooth sliding movement must be secured for the main poppet (4) and the sleeve (3). Neither scores nor other damages are allowable on the outer periphery of main poppet and the inner periphery of sleeve.
- 3) The spring must have no snapping off, distortion and wear.
- 4) The orifices on the main poppet and pilot seat must not be clogged by foreign matters.
- 5) No wear and distortion must exist on the O-ring and back-up ring.

Tiny scores found out through the inspection must be removed by lapping. If any defective parts are found, replace the valve assembly.

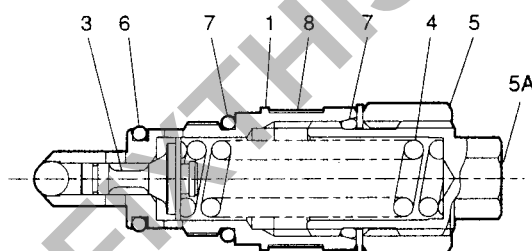


Fig. 36 Direct relief valve

7.2.3 Installation

(1) Combination relief valve

- 1) Insert the poppet (4) in which the O-ring (10) and back-up ring (11) are installed, into the poppet (3).
- 2) Insert the piston (5) and spring (7) into the poppet (4). (The assembled condition up to the above 1) and 2) is referred as the Assembly A.)
- 3) In the plug (2) in which the O-ring (12) and back-up ring (13) are assembled, insert the pilot poppet (6) and pilot spring (8). Screw this assembly into the plug (2) by the adjuster (9A), on which the O-ring (18) is attached.

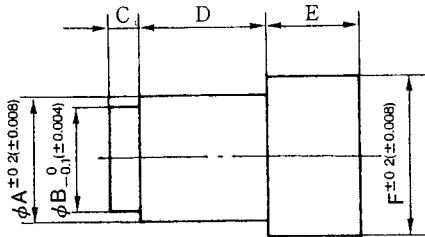
NOTES

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41.6 SPECIAL TOOLS

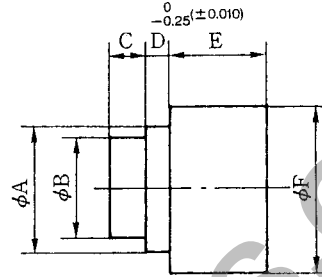
41.6.1 BUSHING AND SEAL RING JIGS

(1) Insertion Jig(A) : for Press-in Head Bush



Material : SS410 or equivalent

(2) Insertion Jig(B) : for Press-in Pin Bush

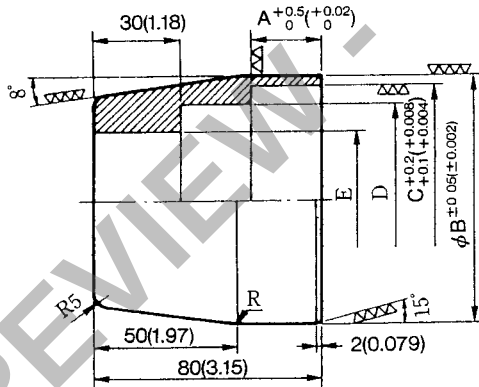


Material : SS410 or equivalent

Unit: mm(in)

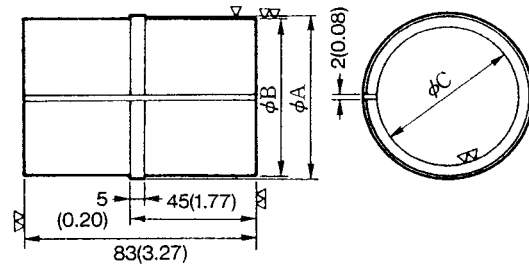
	Insertion Jig(A)						Insertion Jig(B)					
	A	B	C	D	E	F	A	B	C	D	E	F
Boom Cylinder	33.0(1.30)	29.5(1.16)	25.0(0.98)	42.0(1.65)	30.0(1.18)	50.0(1.97)						
Arm Cylinder	↑	↑	↑	15.0(0.59)	↑	↑	39.0(1.54)	29.5(1.16)	10.0(0.39)	5.0(0.20)	30.0(1.18)	50.0(1.97)
Bucket Cylinder	↑	↑	↑	2.0(0.08)	↑	↑						
Swing Cylinder	38 (1.50)	34.5(1.36)	↑	15.0(0.59)	↑	↑	44.0(1.73)	34.5(1.36)	↑	↑	↑	55.0(2.17)
Dozer Cylinder							54.0(2.13)	44.5(1.75)	↑	↑	↑	65.0(2.56)

(3) Insertion Jig(C) : for Piston Seal Ring



Material : STKM13C or equivalent

(4) Pushing Jig(D) : for Seal Ring



Material : Nylon

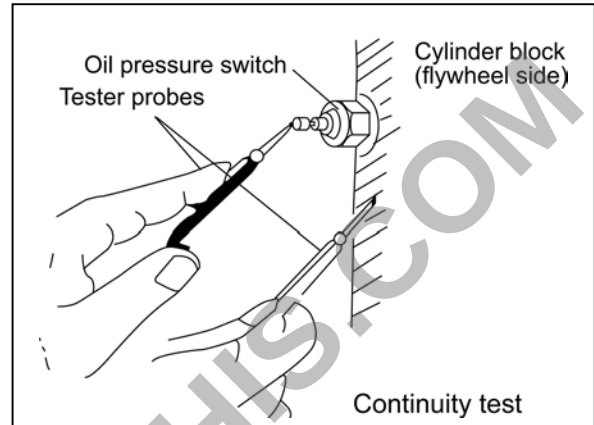
Unit: mm(in)

	Insertion Jig(C)					Pushing Jig(D)		
	A	B	C	D	E	A	B	C
Boom Cylinder	12.3(0.48)	55.5(2.19)	53.0(2.09)	35.0(1.38)	15.0(0.59)	60(2.36)	58(2.28)	50(1.97)
Arm Cylinder								
Bucket Cylinder	↑	50.5(1.99)	48.0(1.89)	30.0(1.18)	10.0(0.39)	55(2.17)	53(2.09)	45(1.77)
Swing Cylinder	15.7(0.62)	65.5(2.58)	63.0(2.48)	45.0(1.77)	25.0(0.98)	70(2.76)	68(2.68)	60(2.36)
Dozer Cylinder	20.0(0.79)	70.5(2.78)	68.0(2.68)	50.0(1.97)	30.0(1.18)	75(2.95)	73(2.87)	65(2.56)

2.4 Sensor Inspection

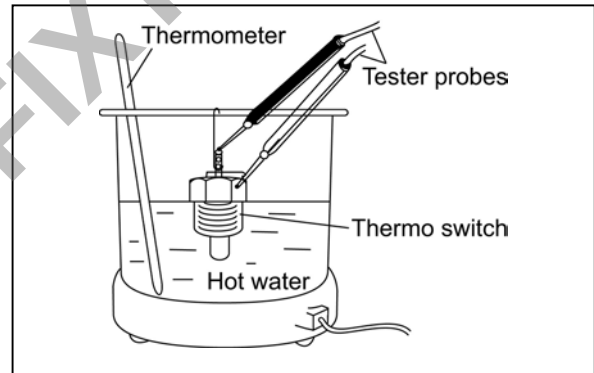
2.4.1 Oil pressure switch

Disconnect the connector from the oil pressure switch. Keep the voltammeter probes in contact with the switch terminal and cylinder block while operating the engine. It is abnormal if circuit is closed.



2.4.2 Thermo switch

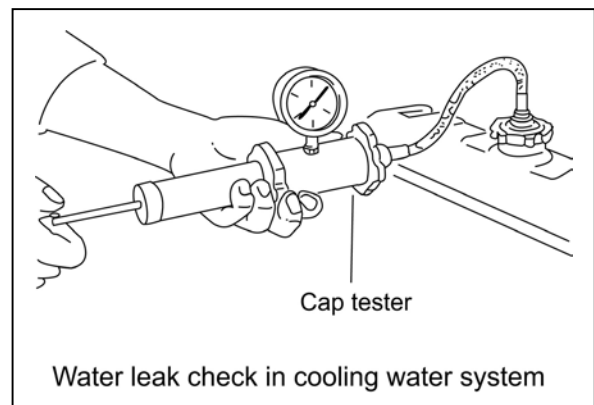
Place the thermo switch in a container filled with antifreeze or oil. Heat it while measuring the fluid temperature. The switch is normal if the voltammeter shows continuity when the fluid temperature is 107~113 deg C.



2.5 Water leak check in cooling water system

Check coolant water leakage from the cooling water system visually. If any problem is found, Inspect as follows.

- 1) Fill coolant water to the normal level in the radiator, and install the cap tester on the radiator.
- 2) Operate the manual pump to set the pressure to $0.09 \pm 0.015 \text{ MPa}$ ($0.9 \pm 0.15 \text{ kgf/cm}^2$). If the cap tester pressure gage reading drops then, water is leaking from the cooling water system. Check the water leaking point.



(2) RHB31/RHB51 type

Unit: mm

		Standard dimension		Wear limit	
		RHB31	RHB51	RHB31	RHB51
Turbine shaft	Turbine shaft journal outside diameter (A)	6.257~6.263	7.99~8.00	6.25	7.98
	Turbine shaft seal ring groove width (E)	1.038~1.062	1.25~1.28	1.07	1.29
	Compressor side seal ring groove width (G1)	1.02~1.03	1.22~1.23	1.04	1.31
	Compressor side seal ring groove width (G2)	0.82~0.83	1.02~1.03	0.84	1.11
	Turbine shaft run-out	0.002	0.002	0.005	0.011
Bearing	Journal bearing inside diameter (C)	6.275~6.285	8.01~8.03	6.29	8.04
	Journal bearing outside diameter (D)	9.940~9.946	12.32~12.33	9.93	12.31
	Bearing housing inside diameter (B)	9.995~10.005	12.40~12.41	10.01	12.42
Thrust bearing	Thrust bearing width (J)	3.59~3.61	3.99~4.01	3.58	3.98
	Thrust bushing groove dimension (K)	3.632~3.642	4.04~4.05	3.65	4.07
Seal ring fixing area	Turbine side (bearing housing)(F)	11.00~11.018	15.00~15.02	11.03	15.05
	Compressor side (seal ring)(H1)	9.987~10.025	12.40~12.42	10.04	12.45
	Compressor side (seal ring)(H2)	7.968~8.00	10.00~10.02	8.01	10.05
Rotor play in axial direction		0.022~0.053	0.03~0.06	0.07	0.09
Rotor play in radial direction		0.061~0.093	0.08~0.13	0.12	0.17

8.2.2 Tightening torque

(1) RHF5 type

N·m(kgf·cm)

Part	Thread diameter	Tightening torque
Turbine housing set bolt	M8	27~29 (275~295)
Compressor housing set bolt	M5	4.2~5.2 (43~53)
Thrust bearing set screw	M3	1.2~1.4 (12~14)
Seal plate set screw	M3	1.2~1.4 (12~14)
Blower impeller set nut (left-handed screw)	M5	1.8~2.2 (18~22)

(2) RHB31/ RHB51 type

N·m(kgf·cm)

Part	Thread diameter	Tightening torque	
		RHB31	RHB51
Waste gate actuator set bolt	M5	3.9~4.9 (40~50)	3.9~4.9 (40~50)
Lock plate set bolt	M6	11.8~12.8 (120~130)	11.8~12.8 (120~130)
	M8	11.8~12.8 (120~130)	27.0~28.9 (275~295)
Thrust bearing set screw	M3	1.2~1.4 (12~14)	1.2~1.4 (12~14)
Seal plate set screw	M3	1.2~1.4 (12~14)	1.2~1.4 (12~14)
Blower impeller set nut (left-handed screw)	M5	0.9~1.1 (9~11)	1.8~2.2 (18~22)

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