2.3 SPECIFICATIONS AND PERFORMANCE

SPEED AND GRADEABILITY

Model		SK50SR-3			
Applicable Machines		PJ04-03001~			
Shoe Type		Rubber shoe		Iron shoe (OPT)	
Slewing Speed	min^{-1} {rpm}	8.8 {8.8}			
Travel Speed	km/h (mph)	Low (1st)	High (2nd)	Low (1st)	High (2nd)
		2.8	4.6	2.8	4.6
Gradeability	% (degree)	58(30)			

ENGINE

Model (YANMAR)		4TNV88-XYB
Type		Water-cooled, 4-cycle type Swirl chamber type diesel engine
Number of cylinders-Bore × Stroke		4 - ø88 mm × 90 mm (3.46 in × 3.54 in)
Total Displacement	L	2.189 (134 cu•in)
Output Rating	kW/min^{-1} {PS/rpm}	30.4/2,400 {41.3/2,400}
Maximum Torque	N•m/min^{-1} (lbf•ft/rpm)	139/1,440 (103/1,440)
Starting Motor	V × kW	12 × 2.3
Generator	V × A	12 × 55

HYDRAULIC COMPONENTS

Hydraulic Pump	Variable displacement axial piston + gear pump
Hydraulic Motor	Axial piston
Hydraulic Motor w/Reducer (Travel)	2-Axial piston, 2-Speed motor
Control Valve	11-spool multiple control valve
Cylinder (Boom, Arm, Swing, Bucket, Dozer)	Double action cylinder
Return Filter	Safety valve containing/Filter Type (30μ)

SIDE DIGGING & DOZER

Type		Boom swing by hydraulic cylinder
Boom Swing Angle	Right	60°
	Left	70°
Stroke of Dozer (above/below)	mm (in)	495 / 375 (19.5/14.8)

WEIGHT

Machine Weight	kg (lb)	Rubber shoe	Iron shoe
		4,660 (10,300)	4,760 (10,500)
Upper slewing body	kg (lb)	2,310 (5,100)	←
Travel system	kg (lb)	1,720 (3,790)	1,820 (4,010)
Attachment (Boom+STD Arm+STD Bucket)	kg (lb)	535 (1,180)	
Oil & Water	kg (lb)	95 (209)	

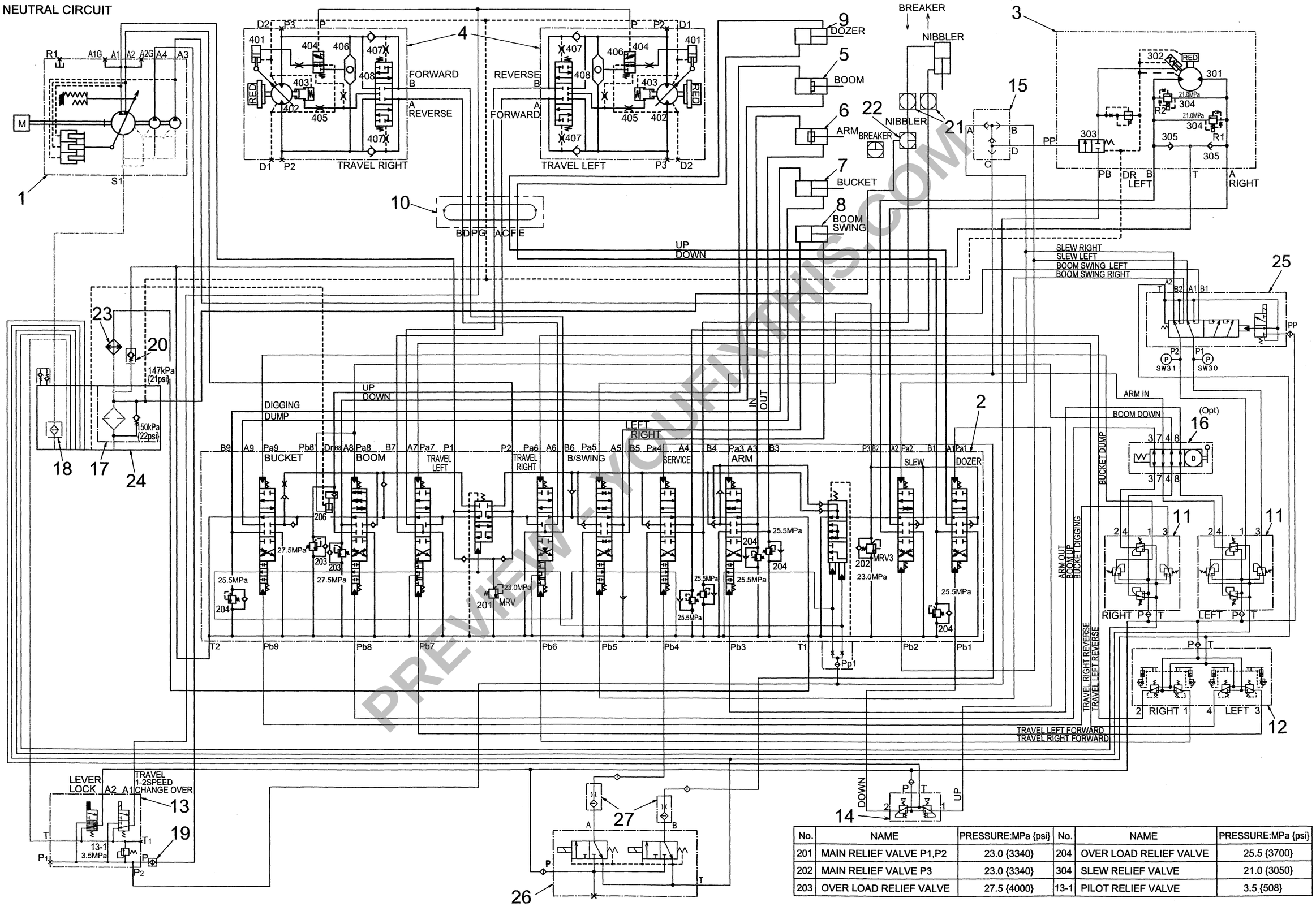
Note : This figure is calculated with Japanese standard bucket.

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71.1.2 HYDRAULIC CIRCUIT OPERATION

(1) NEUTRAL CIRCUIT



No.	NAME	PRESSURE:MPa {psi}	No.	NAME	PRESSURE:MPa {psi}
201	MAIN RELIEF VALVE P1,P2	23.0 {3340}	204	OVER LOAD RELIEF VALVE	25.5 {3700}
202	MAIN RELIEF VALVE P3	23.0 {3340}	304	SLEW RELIEF VALVE	21.0 {3050}
203	OVER LOAD RELIEF VALVE	27.5 {4000}	13-1	PILOT RELIEF VALVE	3.5 {508}

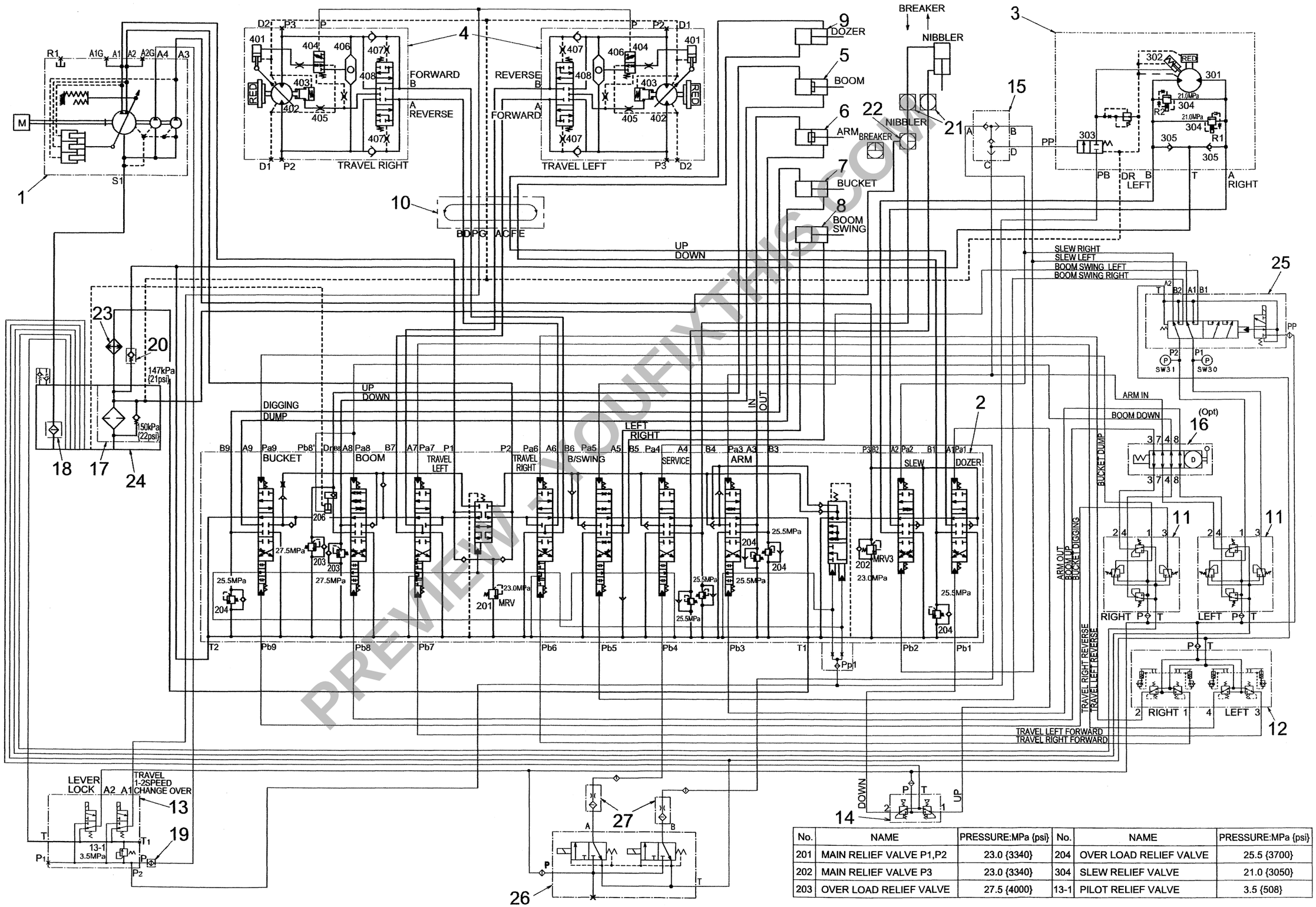
Fig. 71-2

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71.1 HYDRAULIC CIRCUIT DIAGRAM

71.1.1 STANDARD SPECIFICATION



No.	NAME	PRESSURE:MPa {psi}	No.	NAME	PRESSURE:MPa {psi}
201	MAIN RELIEF VALVE P1,P2	23.0 {3340}	204	OVER LOAD RELIEF VALVE	25.5 {3700}
202	MAIN RELIEF VALVE P3	23.0 {3340}	304	SLEW RELIEF VALVE	21.0 {3050}
203	OVER LOAD RELIEF VALVE	27.5 {4000}	13-1	PILOT RELIEF VALVE	3.5 {508}

Fig. 71-1

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32.1.2 BUCKET

32.1.2.1 REMOVAL OF BUCKET

(1) Operate the operating lever and place the bucket on the ground, so the bucket and arm connecting pins are not loaded.

(2) Move the O-rings (3) toward the bucket bosses using a spatula.

(3) In order to remove pin (K) which links arm and bucket, remove the ring (2) and the pin (3) by means of straight driver, and draw out pin (K).

- If the pin does not come off easily, the pin is loaded. Take off the load by manipulating the operating lever.
- Take care so the dust seal between the arm and the bucket bosses is not damaged.

(4) Adjust the bucket by manipulating the operating lever so the pin (J) between the bucket link and the bucket is not loaded.

(5) Remove the ring (2) and pin (1) then pull out the pin (J).

(6) Remove bucket assembly.
Weight :
112kg (247 lbs) — SK50SR-3

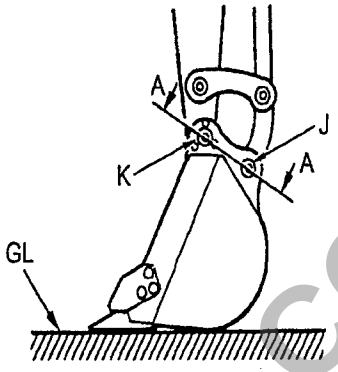


Fig. 32-2 To place Bucket on ground

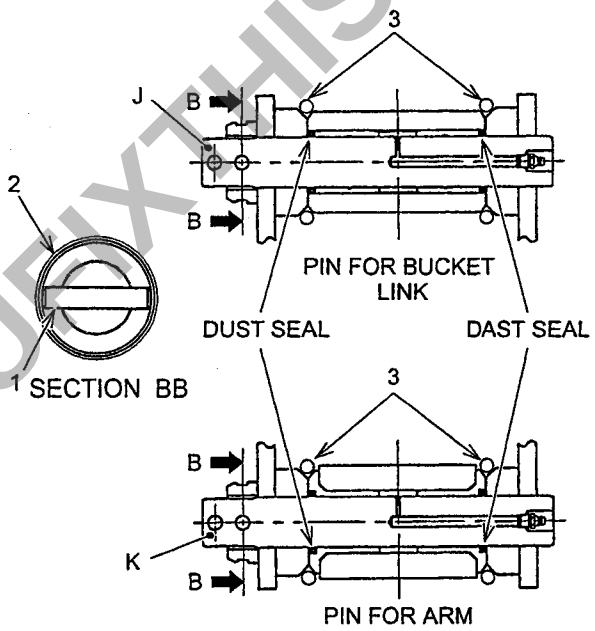


Fig. 32-3 Assembly of pin (SECTION A-A)

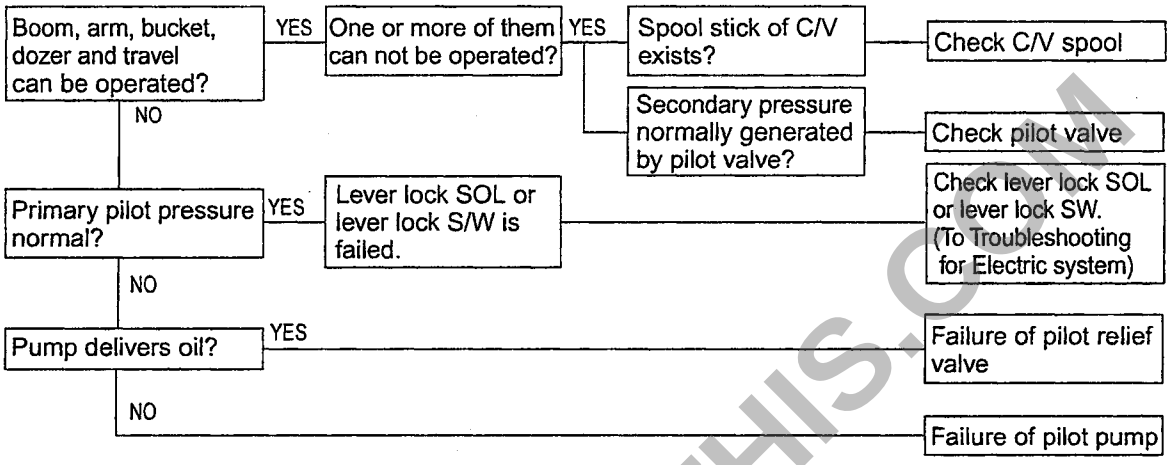
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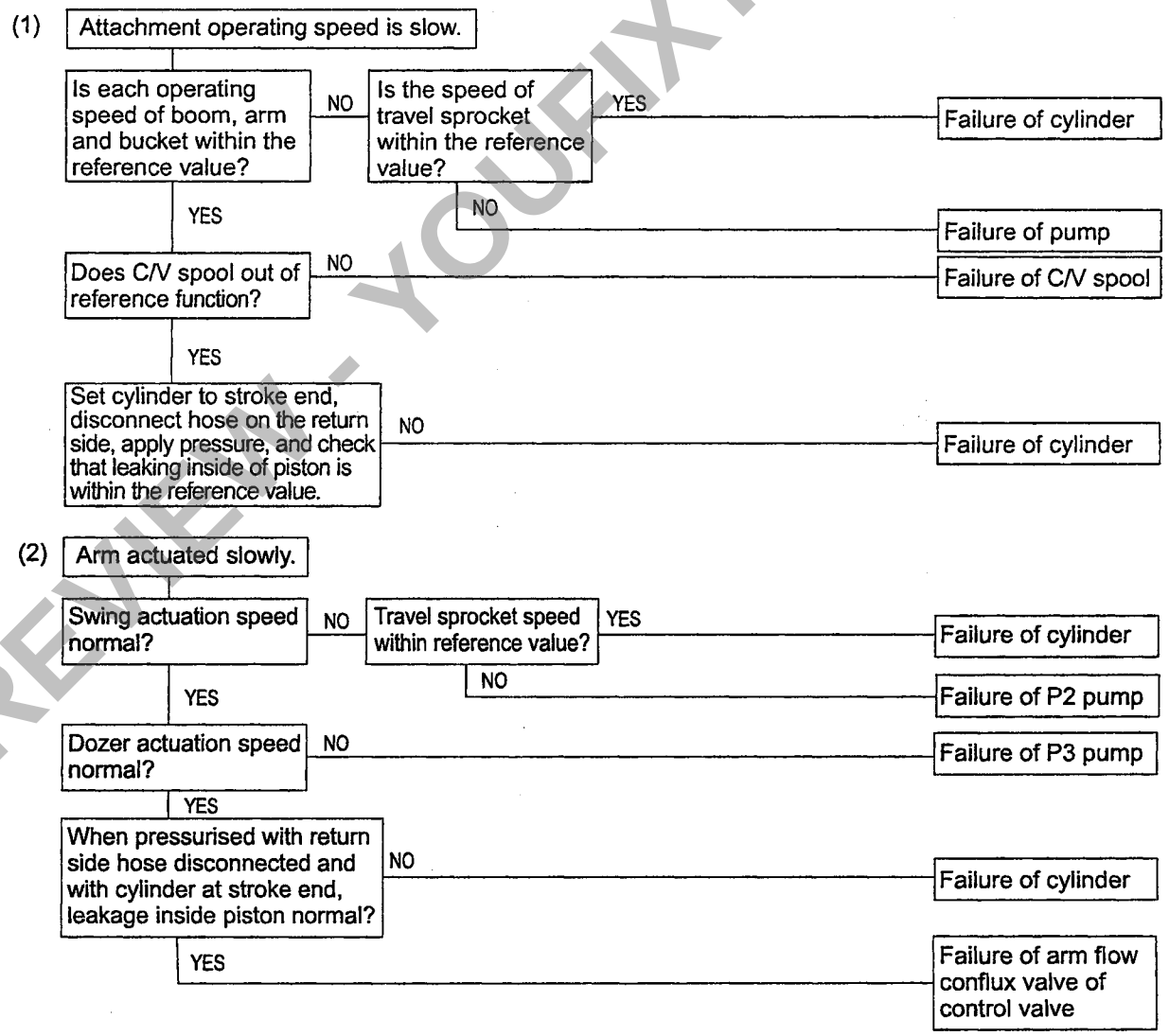
42.3 TROUBLESHOOTING

42.3.1 Attachment

42.3.1.1 Attachment operational failure (Excluding swing operations)



42.3.1.2 Attachment speed is slow



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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		◎ 1st time	◎ 2nd time and thereafter			
	Lube oil filter replacement						
Cooling water system	Coolant water level check and replenishment	○					
	Radiator fin cleaning			○			
	V-belt tension check		○ 1st time	○ 2nd 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.

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HYDRAULIC EXCAVATOR

SHOP MANUAL model SK50SR-3

INDEX

1	SPECIFICATIONS
2	MAINTENANCE
3	SYSTEM
4	DISASSEMBLING
5	TROUBLESHOOTING
6	ENGINE
7	INSTALLATION PROCEDURES FOR OPTIONAL ATTACHMENT
8	SUPPORTING DATA

KOBELCO

Book Code No.S5PJ0009E01

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GENERAL SAFETY INFORMATION

⚠WARNING

Do not operate or perform any maintenance on this machine until all instructions found in the OPERATOR'S MANUAL and this MANUAL have been thoroughly read and understood.
Improper operation or maintenance of this machine may cause accidents and could result in serious injury or death.
Always keep the manual in storage.
If it is missing or damaged, place an order with an authorized our Distributor for a replacement.
If you have any questions, please consult an authorized our Distributor.

(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, and safety must be given the first priority. Messages of safety are indicated with marks. 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".

1) **DANGER-** Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury and is represented as follows:

⚠DANGER

2) **WARNING-** Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury and is represented as follows:

⚠WARNING

3) **CAUTION-** Indicates 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 and is represented as follows:

⚠CAUTION

(4) It is very difficult to forecast 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 by Manufacturer.

(5) While operating the machine, be sure to perform work with great care, so as not to damage the machine, or allow accidents to occur.

(6) Continue studying the manual until all Safety, Operation and Maintenance procedures are completely understood by all persons working with the machine.

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SAFETY PRECAUTIONS

⚠WARNING

The proper and safe lubrication and maintenance for this machine, recommended by Manufacturer, are outlined in the OPERATOR'S MANUAL for the machine.
Improper performance of lubrication or maintenance procedures are dangerous and could result in injury or death. Read and understand the MANUAL before performing any lubrication or maintenance.

The serviceman or mechanic may be unfamiliar with many of the systems on this machine. This makes it important to use caution when performing service work. A knowledge of the system and or components is important before the removal or disassembly of any component.

Because of the size of some of the machine components, the serviceman or mechanic should check the weights noted in this manual. Use proper lifting procedures when removing any components. Weight of components table is shown in the section ; SPECIFICATIONS.

The following is a list of basic precautions that must always be observed.

(1) Read and understand all Warning plates and decal on the machine before Operating, Maintaining or Repairing this machine.

(2) Always wear protective glasses and protective shoes when working around machines. In particular, wear protective glasses when using hammers, punches or drifts on any part of the machine or attachments. Use welders gloves, hood/goggles, apron and the protective clothing appropriate to the welding job being performed. Do not wear loose fitting or torn clothing. Remove all rings from fingers, loose jewelry, confine long hair and loose clothing before working on this machinery.

(3) Disconnect the battery and hang a "Do Not Operate" tag in the Operators Compartment. Remove ignition keys.

(4) If possible, make all repairs with the machine parked on a level, hard surface. Block the machine so it does not roll while working on or under the machine. Hang a "Do Not Operate" tag in the Operators Compartment.

(5) Do not work on any machine that is supported only by lift, jacks or a hoist. Always use blocks or jack stands, capable of supporting the machine, before performing any disassembly.

⚠WARNING

Do not operate this machine unless you have read and understand the instructions in the OPERATOR'S MANUAL. Improper machine operation is dangerous and could result in injury or death.

(6) Relieve all pressure in air, oil or water systems before any lines, fittings or related items are disconnected or removed. Always make sure all raised components are blocked correctly and be alert for possible pressure when disconnecting any device from a system that utilizes pressure.

(7) Lower the bucket, dozer, or other attachments to the ground before performing any work on the machine. If this cannot be done, make sure the bucket, dozer, ripper or other attachment is blocked correctly to prevent it from dropping unexpectedly.

(8) Use steps and grab handles when mounting or dismounting a machine. Clean any mud or debris from steps, walkways or work platforms before using. Always face to the machine when using steps, ladders and walkways. When it is not possible to use the designed access system, provide ladders, scaffolds, or work platforms to perform safe repair operations.

(9) To avoid back injury, use a hoist when lifting components which weigh 20kg (45lbs) or more. Make sure all chains, hooks, slings, etc., are in good condition and are the correct capacity. Be sure hooks are positioned correctly. Lifting eyes are not to be side loaded during a lifting operation.

(10) To avoid burns, be alert for hot parts on machines which have just been stopped and hot fluids in lines, tubes and compartments.

(11) Be careful when removing cover plates. Gradually back off the last two capscrews or nuts located at opposite ends of the cover or device and carefully pry cover loose to relieve any spring or other pressure, before removing the last two capscrews or nuts completely.

(12) Be careful when removing filler caps, breathers and plugs on the machine. Hold a rag over the cap or plug to prevent being sprayed or splashed by liquids under pressure. The danger is even greater if the machine has just been stopped because fluids can be hot.

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3.4.2 DOZER MAINTENANCE STANDARDS

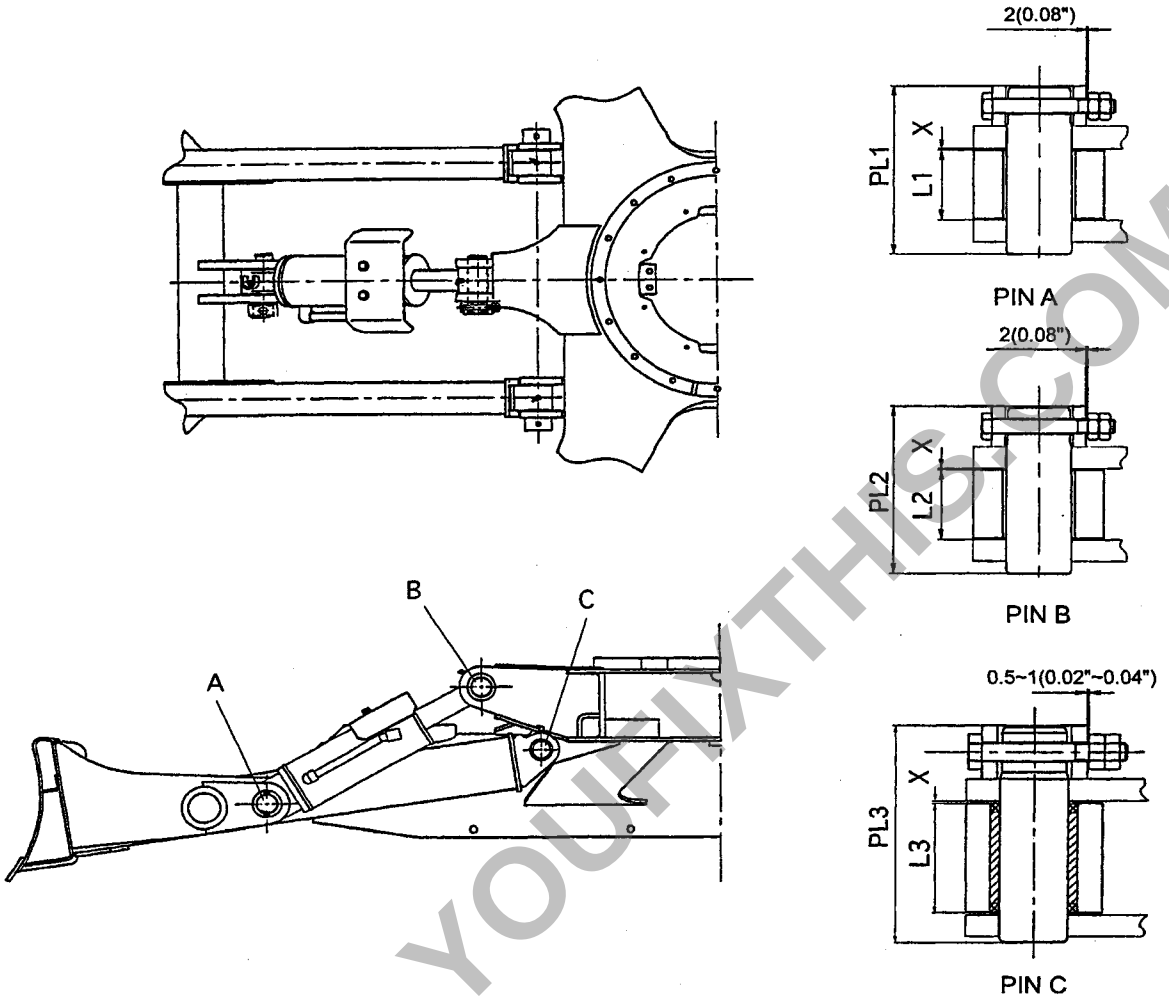


Fig. 3-11 Dozer maintenance standards

(1) Clearance of pin and bushing

Table 3-11

Unit : mm (in)

Pos.	Item	Pin part No.	Standard dimension			Clearance			Remedy
			Pin dia.	Tolerance on pin dia.	Tolerance on bushing bore dia.	Standard value	Standard value for repair	Service-ability limit	
A	Dozer blade cylinder (Head side)	YJ51B01009P1	ø55 (2.17)	–0.15 –0.21 (-0.0059) (-0.0083)	+0.25 +0.05 (+0.0098) (+0.0020)	0.20~ 0.46 (0.0079~ 0.0181)	1.5 (0.059)	2.0 (0.079)	Replace bushing or pin
B	Dozer blade cylinder (Rod side)								
C	Dozer blade foot	PH51B01001P1	ø40 (1.57)	–0.06 –0.09 (-0.0024) (-0.0035)	+0.215 +0.115 (+0.0085) (+0.0045)	0.175~ 0.305 (0.0069~ 0.0120)			

(Note)

- The tolerance for bushing inside diameter means the dimension after fitting of it into place.
- The part number for pins may be changed owing to improvement, use them only for reference.

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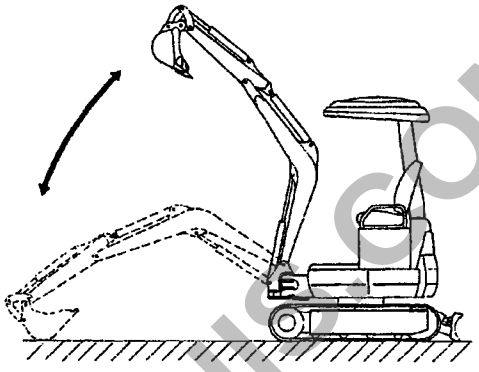
13.7 MEASURING ATTACHMENT OPERATING PERFORMANCES

- **TEST PROCEDURES**
  Measure 3-time each.
  Apply average data of the above for judgement.

13.7.1 Cylinder Speed

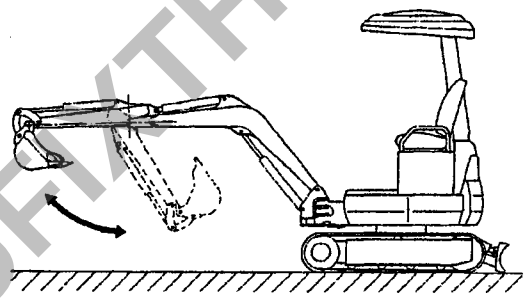
(1) Boom Cylinder Speed

- Engine : High Idle
- Hydraulic Oil Temp. : 50 ~ 60 °C(122 ~ 140 °F)
- Measurement Posture : Completely retract the arm cylinder, fully extend the bucket cylinder and place the dozer blade on the ground.
- Then measure the time required for the bucket to reach its highest point (lowest point) from its lowest point (highest point) placing on the ground. (Do not include the cushioning time.)



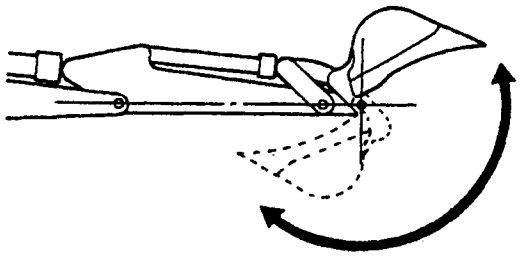
(2) Arm Cylinder Speed

- Engine : High Idle
- Hydraulic Oil Temp. : 50 ~ 60 °C(122 ~ 140 °F)
- Measurement Posture : Completely retract the arm cylinder, fully extend the bucket cylinder, position the arm horizontally and place the dozer blade on the ground.
- Then measure the time required for the arm cylinder to completely retract (extend) from a fully extended state (retracted state).



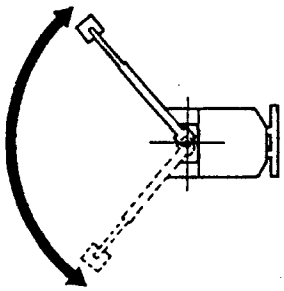
(3) Bucket Cylinder Speed

- Engine : High Idle
- Hydraulic Oil Temp. : 50 ~ 60 °C(122 ~ 140 °F)
- Measurement Posture : Completely retract the arm cylinder, position the arm horizontally and place the dozer blade on the ground.
- Then measure the time required for the bucket cylinder to completely retract (extend) from a fully extended state (retracted state).



(4) Swing Cylinder Speed

- Engine : High Idle
- Hydraulic Oil Temp. : 50 ~ 60 °C(122 ~ 140 °F)
- Measurement Posture : Same as that for measuring slew time.
- While swinging the boom left (right) to right (left), measure the time required for a full stroke each way.



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23.2.4 DETAIL OF HARNESS & CABLE

23.2.4.1 Inst • Main Harness (No. H-1)

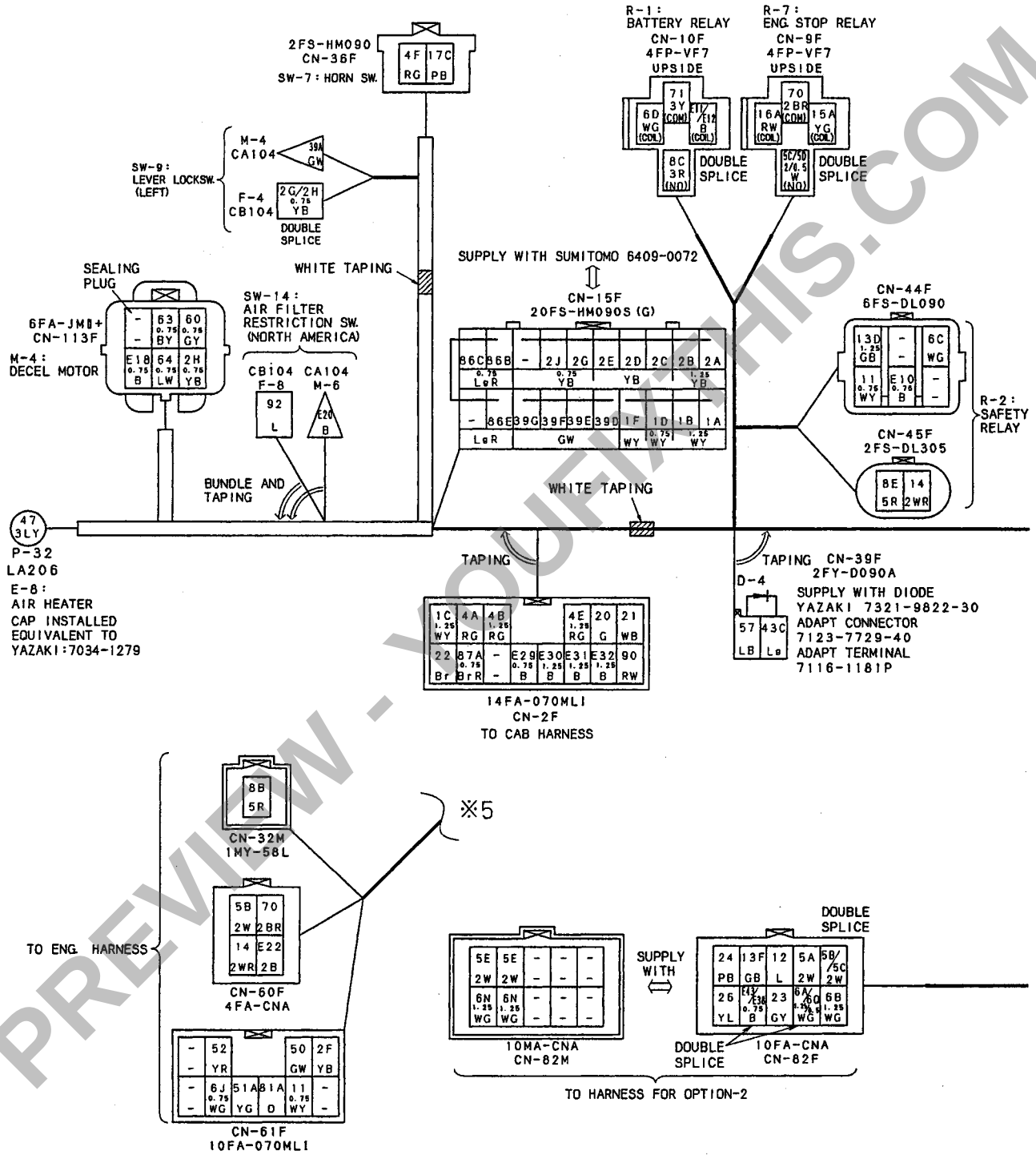
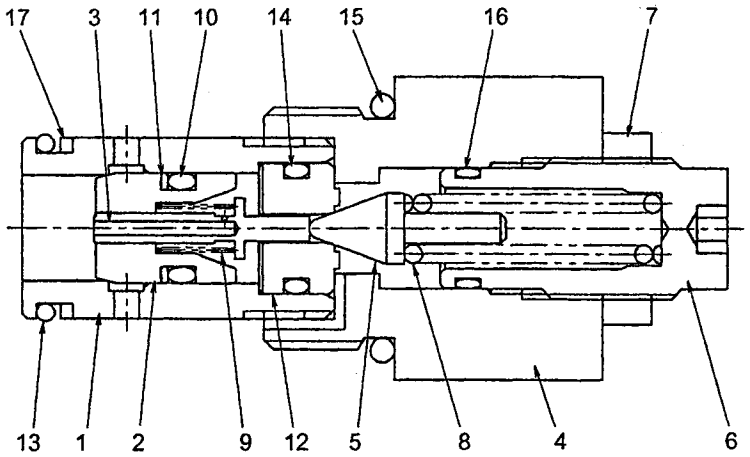


Fig. 23-18 Inst • Main Harness (No. H-1) — (1/8)

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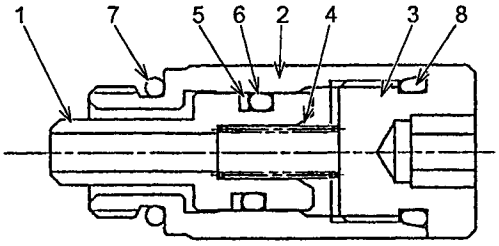
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3) Main relief valve (P1, P2)



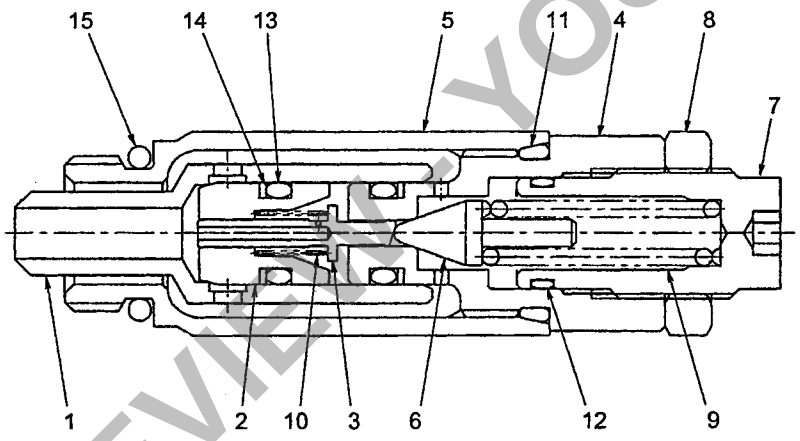
Item	NAME	Q'ty
1	Socket	1
2	Pressure regulating valve	1
3	Piston	1
4	Body	1
5	Poppet	1
6	Adjust screw	1
7	Lock nut M14	1
8	Spring (Adjust valve)	1
9	Spring (Pressure regulating)	1
10	O-ring 1A P7	1
11	Back up ring	1
12	Seat (adjust section)	1
13	O-ring AS 1B 15	1
14	O-ring 1B P10	1
15	O-ring 1B P22	1
16	O-ring 1B S10	1
17	Back up ring	1

4) Anti cavitation valve



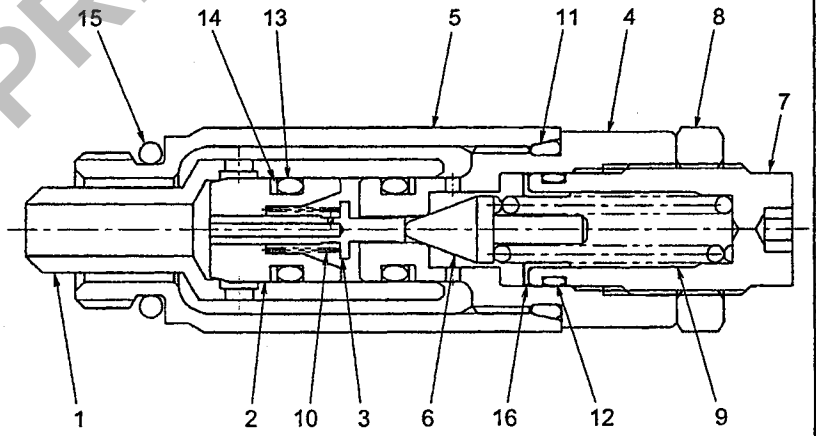
No.	NAME	Q'ty
1	Anti cavitation valve	1
2	Body	1
3	Plug	1
4	Spring	1
5	Back up ring	1
6	O-ring 1A P10A	1
7	O-ring 1B P14	1
8	O-ring 1B P15	1

5) Main relief valve (P3)



Item	NAME	Q'ty
1	Socket	1
2	Pressure regulating valve	1
3	Piston	1
4	Plug	1
5	Body	1
6	Poppet	1
7	Adjust screw	1
8	Lock nut M14	1
9	Spring (Adjust valve)	1
10	Spring (Pressure regulating)	1
11	O-ring 1B P15	1
12	O-ring 1B S10	1
13	O-ring 1A P7	2
14	Back up ring	2
15	O-ring 1B P14	1

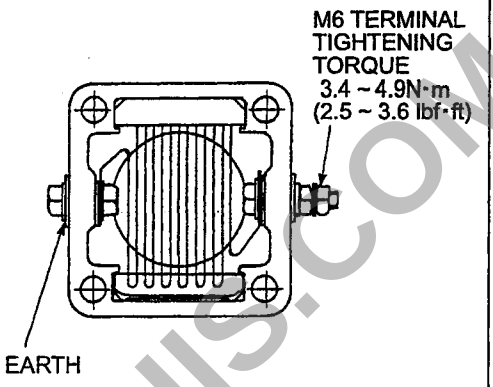
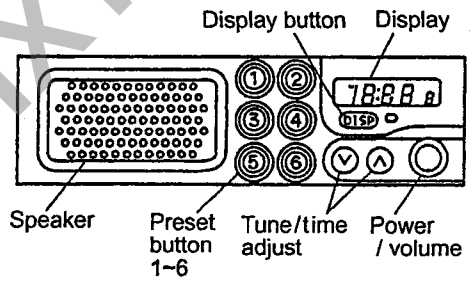
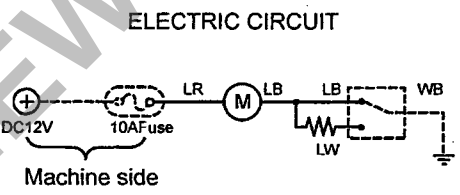
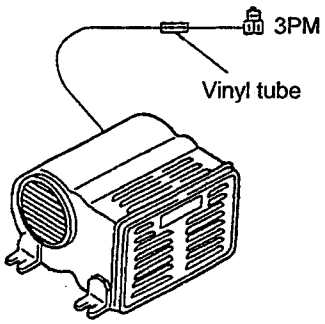
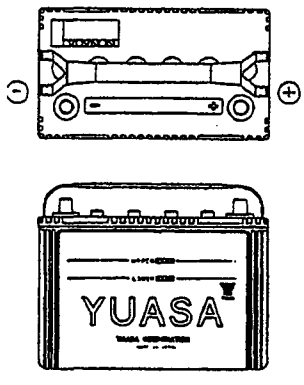
6) Overload relief valve



Item	NAME	Q'ty
1	Socket	1
2	Pressure regulating valve	1
3	Piston	1
4	Plug	1
5	Body	1
6	Poppet	1
7	Adjust screw	1
8	Lock nut M14	1
9	Spring (Adjust valve)	1
10	Spring (Pressure regulating)	1
11	O-ring 1B P15	1
12	O-ring 1B S10	1
13	O-ring 1A P7	2
14	O-ring 1B P14	2
15	Back up ring	1
16	Spring guide	1

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Code No. Parts Name Parts No. Use Applicable Machine	Specifications	Description
E-8 Air heater 129100-77501 E/G starter PH05-03501~ PJ04-03001~	YANMAR Part No. 129100-77501 Rated voltage DC11V Rated current 36.5A Rated output 400W Insulation resistance 3MΩor more / 500V megger	
E-10 Tuner PY54S00001P1 Radio (OPT) PW08-20001~ PX09-08001~ PW10-22001~ PX11-08901~ PW11-30001~ PX12-11001~ PH05-03501~ PJ04-03001~	Maker CLARION Voltage 12V	
E-12 Heater PM21M00005F1 Heating (OPT) PW10-22001~ PX11-08901~ PW11-30001~ PX12-11001~ PH05-03501~ PJ04-03001~		
E-13 Battery YJ72S00001P1 Power source PH05-03501~ PJ04-03001~	Type 115D31L Rated voltage DC12V Capacity 72Ah/5HR Amount of electrolyte 5.0L Weight 21.0kg (46lb)	

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(5) Inspection after installation

1) Unloaded performance test

a. Put the cylinder horizontally at unloaded condition.

b. Apply pressure slowly and alternately through the ports at both ends to operate the piston rod 5 or 6 times.

c. Check that the cylinder operates normally.

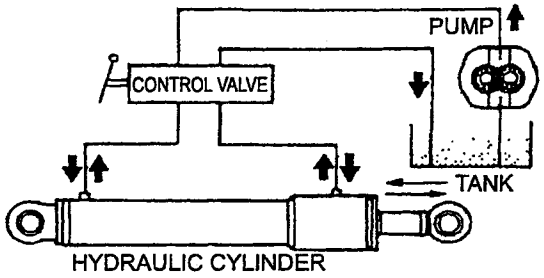


Fig. 32-43 Unloaded test

2) Leakage test

- External leakage

a. Apply test pressure for 3 minutes each to the rod retraction side and to the rod extension side of the cylinder.

b. Confirm that rod seals, cylinder head tightening part, and each weld are free from abnormalities, such as external leakage and permanent deformation.

- Internal leakage

a. Disconnect the hose from the rod extension side of the cylinder.

b. Apply test pressure to the rod retraction side of the cylinder for 3 minutes.

c. Measure the leakage from the rod extension side.

- Leakage should be below 1 cc (0.06 cu•in) / 3 min.

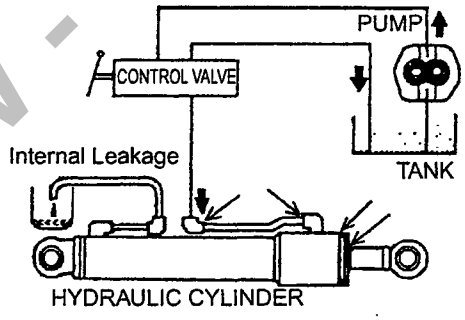


Fig. 32-44 Leakage test

(6) Bleeding air from hydraulic cylinder

Bleed air from the cylinder after removing or installing it, or after disconnecting a hydraulic pipe.

1) Start the engine, and let it idling for about 5 minutes.

2) Repeat the step of extending and retracting the cylinder 4 or 5 times at slow speed of engine.

- Move the piston rod 100 mm (4 in) short of its stroke end.
  Do not extend or retract the rod until the end to prevent the relief condition.

3) Perform the above 2) procedures at high idling speed, then move the piston rod to its stroke end at low idling speed to reach the relief condition.

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33.1.21 SWIVEL JOINT

33.1.21.1 REMOVAL PREPARATION

(1) Lift the machine by approx. 30 cm (1 foot) and insert support blocks at four places of the crawler shoes, namely, front, rear, right and left, to secure working space under the machine.

(2) Remove the cover (2) of the floor plate (See Section 33.1.3.1).

(3) Loosen four M10×25 capscrews (A5) to remove the under cover (A4).

: 17 mm

(4) Release the residual pressure in the circuit and the hydraulic tank.

(5) Disconnect the hose of the slewing motor (See Section 33.1.20).

- Remove the canopy to facilitate to remove the swivel joints.

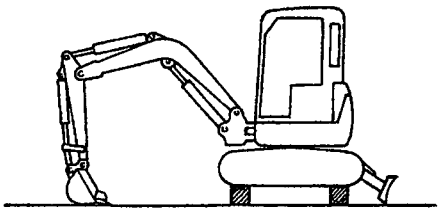


Fig. 33-68 Lifting machine

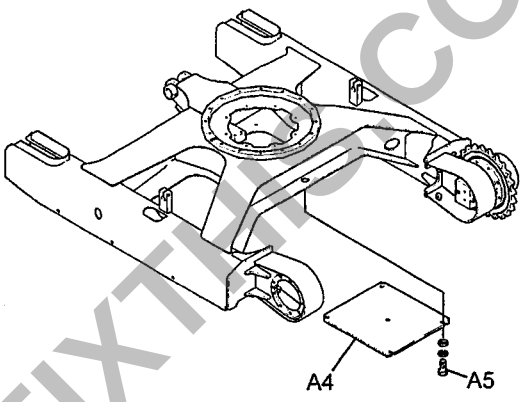


Fig. 33-69 Undercover removal

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6) Assembling relief valve and overload relief valve
The relief valve is essential for the performance and safety, and it is very difficult to reset the pressure. Therefore, in case of the abnormality, replace it with a new assembly.
The assembling procedures described below are only for reference after disassembling to investigate the cause for abnormality.
The figures in parentheses following the part names in the description are the item numbers in the cross-sectional drawing (Fig. 33-83).
First, place spring guide (16) in adjusting screw (7) and then place spring (9) in.
Then, shake the adjusting screw lightly and be sure that the interference of spring guide (16) and spring (9) is sufficiently ensured. If the interference is insufficient, spring (9) pops out or the protrusion from adjusting screw (7) becomes larger. Thereafter fit poppet (6) in plug (4) and tighten adjusting screw (7) {spring guide (16), spring (9) are already fitted.} lightly.
At that time, tighten lock nut M14 (8) lightly. And place spring (10) and piston (3) in poppet (2), and place it in socket (1). And tighten body (5) and plug (4) to the specified torque after checking that piston (3) is inserted in the hole of the top end of plug (4).
T=58.8 N•m (43 lbf•ft)
And adjust the pressure by adjusting screw (7) with Allen wrench of 4 mm, and tighten lock nut M14 (8) to the specified torque.
T=19.6N•m (14 lbf•ft)
Assemble the relief valves in the reverse procedure of the disassembly paying attention to the direction and order and observing the specified torque. Failure to do so may result in oil leakage or breakage.

7) Assembling anticavitation valve
The anticavitation valve is essential for the performance and safety, so in case of abnormality replace it with a assembly.
For reference, the procedure for disassembly and assembly is shown below.
The figures in parentheses following the part names in the description are the item numbers in the cross-sectional drawing (Fig. 33-84).
First, place anti cavitation valve (1) in body (2), and place spring (4) in it. Then tighten the plug to the specified torque.
T=58.8 N•m (43 lbf•ft)
Assemble the anti cavitation valve by the reverse procedure of the disassembly paying attention to the direction and order and observing the specified torque.
Failure to do so may result in oil leakage or breakage.

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34.1.11.2 CONSTRUCTION

No.	NAME	Q'TY	No.	NAME	Q'TY
1	INNER RACE	1	6	PLUG	1
2	OUTER RACE	1	7	TAPER PIN	1
3	BALL	95	8	SEAL A	1
4	SPACER	70	9	SEAL B	1
5	SPACER(ADJUSTING)	25	10	GREASE NIPPLE	1

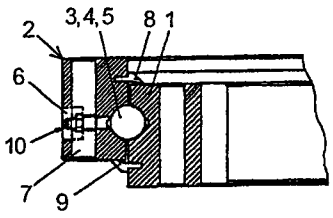


Fig. 34-87 Cross-section of slewing bearing

34.1.11.3 DISASSEMBLY AND ASSEMBLY

34.1.11.3.1 Disassembling

(1) Remove seal A (8) fitted in the groove in the inner circumference on top of outer race (2) and seal B (9) fitted in the groove in the outer circumference under inner race (1), from the bearing, and place the bearing level on wood block.

(2) Remove taper pin (7), using a hammer and a push rod.

(3) Remove plug (6) with an puller bolt making use of the threaded bore in the center of the plug (6).

(4) After removing plug (6), take out balls (3) and spacers (4) (5) from the bore in order, while rotating outer race (2) slightly.

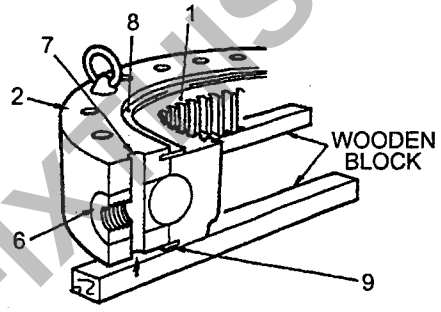


Fig. 34-88 Disassembling slewing bearing

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Issue	Data of Issue	Applicable Machines	Remarks
First Edition	August, 2004	SK30SR–3 : PW11–30001~ SK35SR–3 : PX12–11001~	S5PW4209E01 (KCM North America) KE
↑	↑	SK50SR-3 : PJ04–03001~	↑ KE

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- Contents omitted in this manual
  Though the following jobs are omitted in the explanation in this manual, they should be conducted in actual work:
  3) Jacking up and lifting
  4) Cleaning and washing of removed parts as required
  5) Visual inspection

(3) Definition of Terms

[NOTICE]: Instruction whose negligence is very likely to cause an accident. Always observe it.

Standard: Allowable range for inspection and adjustment.

Limit: The maximum or minimum value that must be satisfied during inspection or adjustment.

(4) Abbreviations

Abbreviation	Meaning	Abbreviation	Meaning
Assy	assembly	T.D.C.	top dead center
Sub-Assy	sub-assembly	B.D.C.	bottom dead center
a.T.D.C	after top dead center	OS	oversize
b.T.D.C	before top dead center	US	undersize
STD	Standard	Min^{-1}	revolutions per minute
IN	Intake	PS	Output (metric horsepower)
EX	Exhaust	T	Bolt/nut tightening torque

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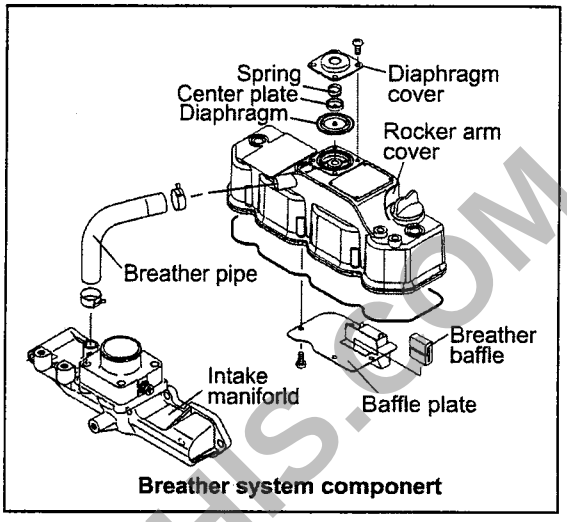
(2) Diaphragm assy inspection

Inspect the diaphragm assy on the rocker arm cover every 1000 hours or **2 years**. Refer to 4.2.4 point 6 for the function of the diaphragm.

1) Loosen screws, and remove a diaphragm assy, and check whether oil and so on doesn't enter between the diaphragm and the cover. If oil and so on enters into the diaphragm assy, the diaphragm doesn't work well.
2) Check the damages of the diaphragm rubber and the spring. If necessary, replace with new ones.

[NOTICE]

- When a diaphragm is damaged, pressure control inside the crankcase becomes insufficient, and troubles such as combustion defect and so on occur.
- At lubricating oil replacement or lubricating oil supply, the amount of lubricating oil isn't to be beyond the standard upper limit. If the lubricating oil quantity is beyond the upper limit or an engine is operated beyond the allowable maximum angle of an engine, the amount of oil mist may be inducted in the combustion chamber and the oil hammer sometimes may occur.



Breather system componert

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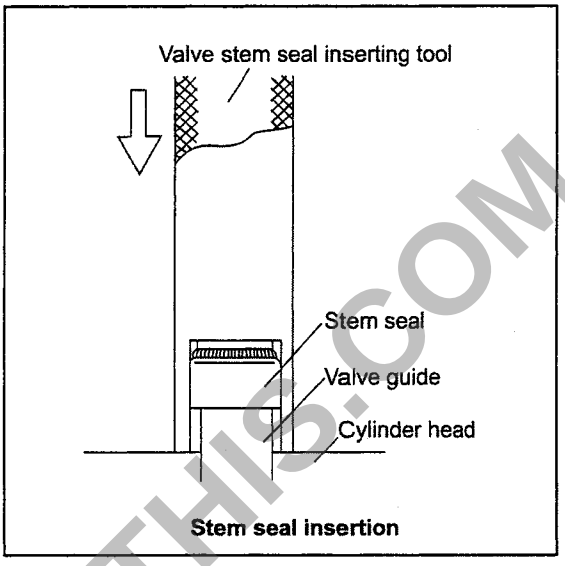
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4.2.8 Valve stem seal replacement

Always use a new seal after the intake/exhaust valve is disassembled. Since the one for the exhaust valve is marked with yellow paint, do not confuse the intake and exhaust valves.

1) Apply engine oil to the lip.

2) Push with the inserting tool (Refer to No.5 of 4.1.2 in Chapter 4) for installation.

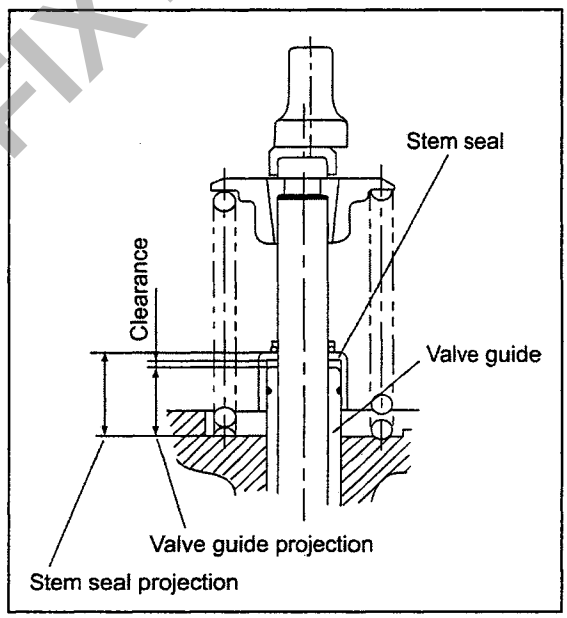


Stem seal insertion

3) Measure and check the projection of valve stem seal to keep proper clearance between valve guide and stem seal.

mm

Model	Number of valves	Projection
3TNV82A	2 valves	15.7~16.0
4TNV84 3TNV84(T) 4TNV88		18.7~19.0
4TNV84T	4 valves	9.9~10.2
4TNV94L 4TNV98(T)		11.7~12.0
4TNE106(T)		15.4~15.6

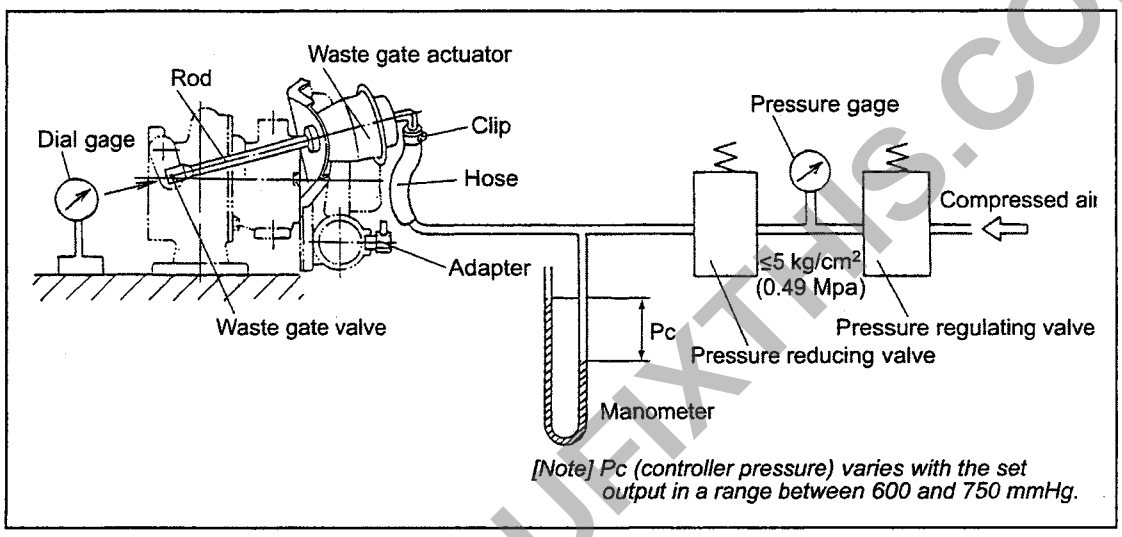


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(b) Measuring instruments and devices

Dial gage	Capable of measuring 0 to 10 mm (A flat head type is recommendable.)
Manometer	Mercury column or electrical type (capable of measuring 0 to 1500 mmHg)
Pressure regulating valve	Allowing gradual adjustment in a range between 0 and 2 kgf/cm^2 (0.196 Mpa)
Pressure reducing valve	Used for suppressing the air supply pressure at 5 kgf/cm^2 (0.49 Mpa) or less.
Pressure gage	Bourdon tube pressure gage (0 to 10 kgf/cm^2 (0.98 Mpa))



(c) Check method

1) Set the manometer control pressure (Pc) applied to the waste gate actuator to 0 and set the dial gage to the zero point.
2) Gradually open the pressure regulating valve and measure the Pc value when the actuator rod is operated by 2 mm.
3) For the hysteresis, let the rod move to 3 mm first. The gradually close the pressure regulating valve, measure the pressure when the rod is moved to 2mm and obtain the difference from the pressure measured in b. above.
4) Precautions

- Set the dial gage on the extension line of the actuator rod.
- The piping and joints shall completely be free from leak.
- Fix the turbocharger and dial gage securely.
- If an electric manometer is used, it shall have sufficient precision.
- Even when an electric manometer is used, use of a mercury column type manometer in combination is recommended for calibration and daily check.
- The speed for increasing/decreasing Pc by means of the pressure regulating valve shall be very slow near the measuring point. If the mm position is exceeded, restart from the beginning.
- Do not apply over 0.49 MPa (5 kgf/cm^2) to the actuator.

(2) Waste gate actuator leak test

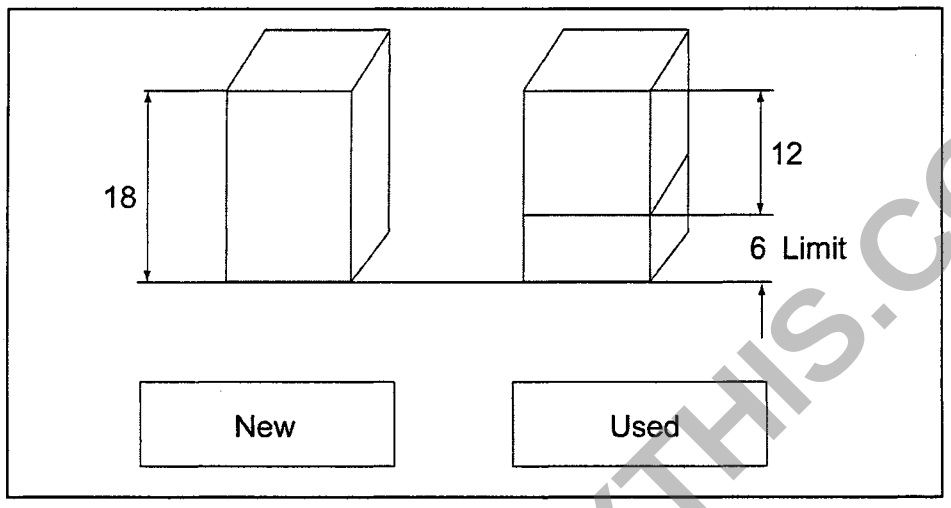
Apply 0.12 Mpa (1.2kgf/cm^2) to the actuator and hold the state for minute. The actuator is good if the pressure then is 0.11 Mpa (1.1kgf/cm^2) or above.

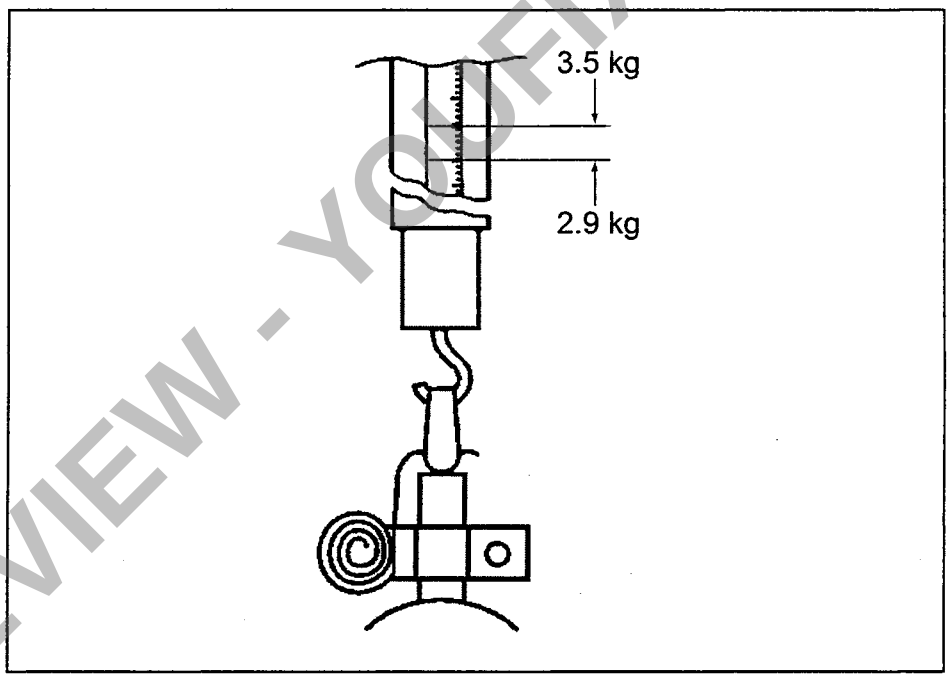
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(3) Brush

1) Check wear of the brush and the brush spring force.





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