376SHO5900

SHOP MANUAL

BL200-1 WHEEL LOADER

CEV STAGE IV
H SERIES ENGINE WITH AVTEC
TRANSMISSION ELECTRIC SHIFT

(APPL. EQPT. SL. NO. B10308 & UP)

IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine. The service and repair techniques recommended by BEML Ltd. and described in this manual are both effective and safe methods of operation.

To prevent injury to workers, the symbols and are used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

SAFETY

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
   - Always wear safety glasses when hitting parts with a hammer.
   - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, glasses, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out. Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.

12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned. Wait for the oil and water to cool before carrying out any work on the oil or water circuits.

13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (—) terminal first.

14. When raising heavy components, use a hoist or crane. Check that the wire rope, chains and hooks are free from damage. Always use lifting equipment which has ample capacity. Install the lifting equipment at the correct places. Use a hoist or crane and operate slowly to prevent the component from hitting any other part. Do not work with any part still raised by the hoist or crane.

15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, and then slowly loosen the bolts to remove.

16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.

17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.

18. As a general rule, do not use gasoline to wash parts. In particular, use only the mini mum of gasoline when washing electrical parts.

19. be sure to assemble all parts again in their original places. Replace any damaged parts with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.

20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely care full when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.

21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as, guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.

22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.

23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.

24. Take care when removing or installing the tracks of track-type machines. When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWORD

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgments. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into chapters for each main group of components; these chapters are further divided into the following sections.

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Troubleshooting charts correlating "Problems" to "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgment standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your BEML LTD distributor for the latest information.

For engine service details contact the nearesr M/s. Ashok Leyland dealer. The engine service details illustrated in this manual can be treated as minimal.

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

Chassis volume: Issued for every machine model
Engine volume: Issued for each engine series
Electrical volume : } Each issued as one volume to cover all models
Attachments volume : }

These various volumes are designed to avoid duplicating the same information. Therefore to deal with all repairs for any model, it is necessary that chassis, engine, electrical and attachment volumes are ready.

DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to BEML Ltd. distributers. Get the most up-to-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.
   Example 1 (Chassis volume):

   2 1 - 3
   - 2 — Unit number (2. Power train)
   - 1 — Item number (1. Structure and Function)
   - 3 — Consecutive page number for each item.

   Example 2 (Engine volume):

   1 2 - 4 1 0
   - 1 — Unit number (1. Engine)
   - 2 — Item number (2. Testing and Adjusting)
   - 4 — Group No. (4. Fuel system)
   - 10 — Consecutive page No. (Page 10 of Group 4)
3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   Example:

21-4		12-203
21-4-1	Added pages	12-203-1
21-4-2		12-203-2
21-5		12-204

REVISED EDITION MARK (①②③....)

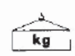
When a manual is revised, an edition mark is recorded on the bottom outside corner of the pages.

REVISIONS

Revised pages are shown at the LIST OF REVISED PAGES on the between the title page and SAFETY page.

SYMBOLS

So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

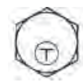
Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
	Safety	Extra special safety precautions are necessary when performing the work because it is under internal pressure.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

kgm

STANDARD TIGHTENING TORQUE

1. STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in sections of **"Disassembly and Assembly".**

Thread diameter of bolt (mm)	Width across flat (mm)		
		kgm	Nm
6	10	1.35 + 0.15	13.2 + 1.4
8	13	3.2 + 0.3	31.4±2.9
10	17	6.7±0.7	65.7 + 6.8
12	19	1 1.5 + 1.0	1 12 + 9.8
14	22	18.0 + 2.0	177 + 19
16	24	28.5 + 3	279 + 29
18	27	39+4	383±39
20	30	56±6	549 + 58
22	32	76 + 8	745 + 78
24	36	94.5 + 10	927±98
27	41	135 + 15	1320+140
30	46	175 + 20	1720±190
33	50	225±25	2210 + 240
36	55	280 + 30	2750 + 290
39	60	335 + 35	3280 + 340

This torque table does not apply to the bolts with which nylon packing or other non-ferrous metal washers are to be used, or which require tightening to otherwise specify torque.

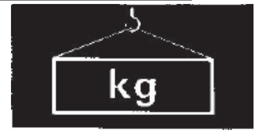
+ Nm (Newton meter}: 1Nm = 0.1kgm

2. TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

Thread diameter of bolt (mm)	Width across flats (mm)	Tightening torque	
		kgm	Nm
10 12 16	14 17 22	6.7 + 0.7 1 1.5 + 1 28.5 + 3	65.7 + 6.8 112 + 9.8 279±29

HOISTING INSTRUCTIONS



Heavy parts (25 kg or more) must be lifted with a hoist etc. In the **Disassembly and Assembly** section, every part weighing 25 kg or more is indicated clearly with the symbol kg

1. If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
   - Check for removal of all bolts fastening the part to the relative parts.
   - Check for existence of another part causing interference with the part to be removed.

2. Wire ropes

1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

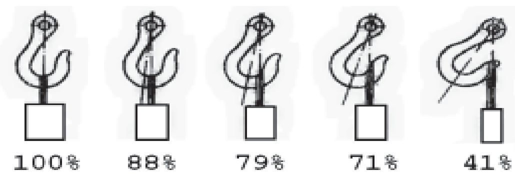
Wire ropes
(Standard "Z" or "S" twist ropes without galvanizing)

Rope diameter (mm)	Allowable load (tons)
10	1.0
11.2	1.4
12.5	1.6
14	2.2
16	2.8
18	3.6
20	4.4
22.4	5.6
30	10.0
40	18.0
50	28.0
60	40.0

The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook.

Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle



portion.

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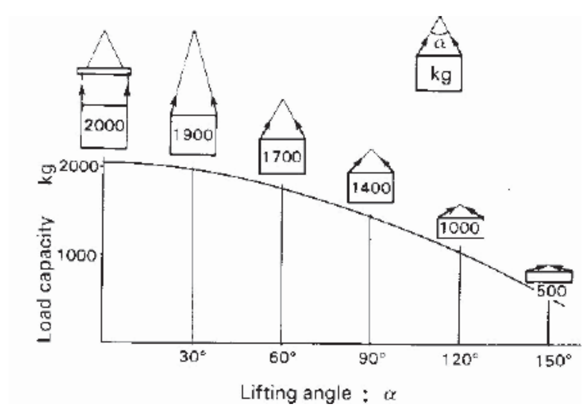
3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook. When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles.
When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 1 20° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 1 50°.



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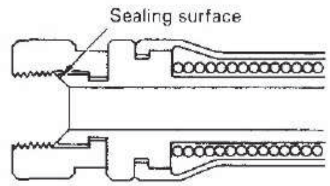


3. TIGHTENING TORQUE FOR NUTS OF FLARED

Use these torques for nut part of flared.

Thread diameter of nut part (mm)	Width across flats of nut part (mm)		Tightening torque	
		kgm		Nm
14	19	2.5 + 0.5		24.5+4.9
18	24	5±2		49±19.6
22	27	8±2		78.5+19.6
24	32	14 + 3		137.3 + 29.4
30	36	18±3		176.5 + 29.4
33	41	20 + 5		196.1 ±49
36	46	25±5		245.2±49
42	55	30±5		294.2 + 49

COATING MATERIALS

.	Applications
Adhesives	Used to apply rubber pads, rubber gaskets, and cork plugs.
	Used to apply resin, rubber, metallic and non-metallic parts when a fast, strong seal is needed.
	Preventing bolts, nuts and plugs from loosening and leaking oil.
	Provides an airtight, electrically insulating seal. Used for aluminum surfaces.
Liquid gasket	Used with gaskets and packing's to increase sealing effect.
	Heat-resistant gasket for pre combustion chambers and exhausts piping.
	Used by itself on mounting surfaces on the final drive and transmission cases. (Thickness after tightening: 0.07 - 0.08 mm)
	Used by itself to seal grease fittings, tapered screw fittings and tapered screw fittings in hydraulic circuits of less than 50 mm in diameter.
Antifriction compound (Lubricant including molybdenum disulfide)	Applied to bearings and taper shafts to facilitate press-fitting and to prevent sticking, burning or rusting.
Grease (Lithium grease)	Applied to bearings, sliding parts and oil seals for lubrication, rust prevention and facilitation of assembling work.
Vaseline	Used for protecting battery electrode terminals from corrosion.

ELECTRIC

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires. This wire code table will help you understand WIRING DIAGRAMS. Example: 05WB indicates a cable having a nominal number 05 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number strands	of strands (mm)	Cross section (mm-)			
01	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
02	26	0.32	2.09	3.1	20	Lighting, signal etc.
05	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	080	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

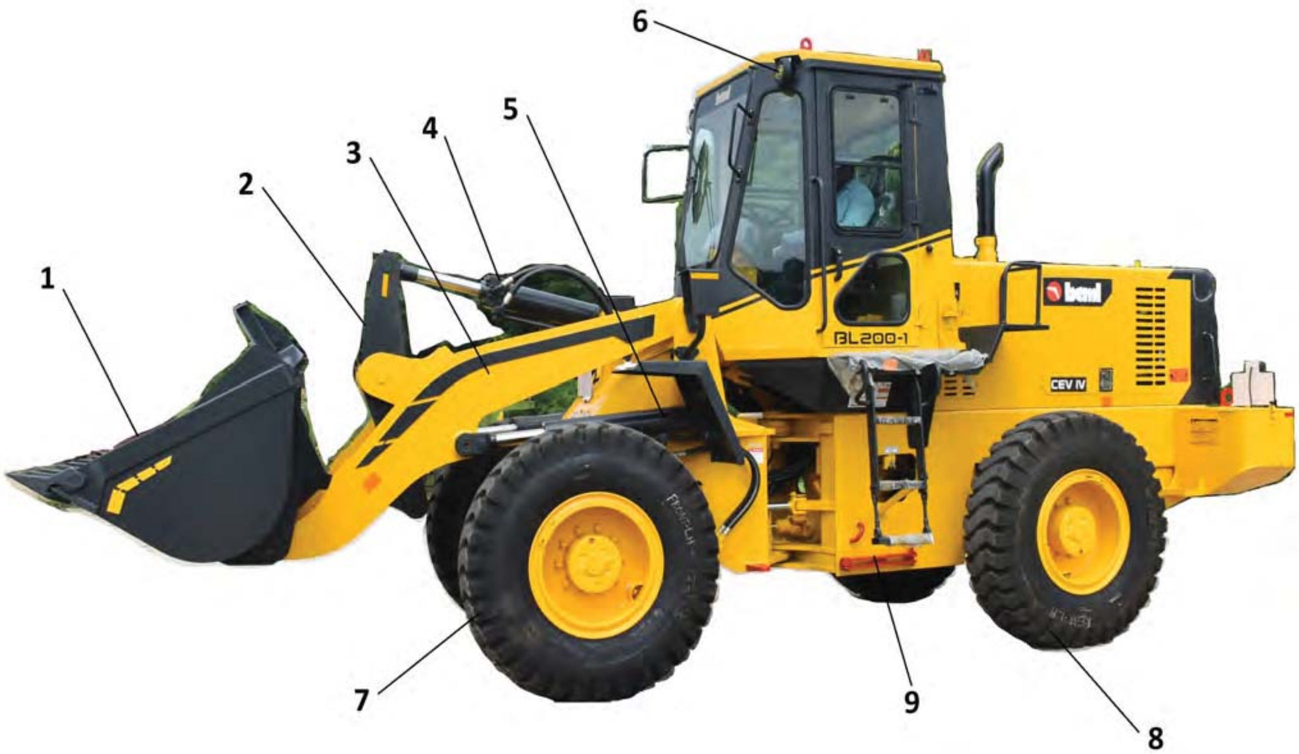
CLASSIFICATION BY COLOR AND CODE

Priority	Circuits Classification		Starting	Charging	Lighting	Signal	instrument	Other
1	Primary	Code	B	W	R	G	Y	L
		Color	Black	White	Red	Green	Yellow	Blue
2	Auxiliary	Code	BW	WR	RW	GW	YR	LW
		Color	Black & White	White & Red	Red Si White	Green & White	Yellow & Red	Blue & White
3		Code	BY	WB	RB	GR	YB	LR
		Color	Black & Yellow	White& Black	Red & Black	Green & Red	Yellow & Black	Blue & Red
4		Code	BR	WL	RY	GY	YG	LY
		Color	Black & Red	White & Blue	Red & Yellow	Green & Yellow	Yellow & Green	Blue & Yellow
5		Code	-	WY	RG	GB	YL	LB
		Color	-	White & Yellow	Red & Green	Green & Black	Yellow& Blue	Blue& Black
6		Code	-	WG	RL	GL	YW	
		Color	-	White & Green	Red & Blue	Green & Blue	Yellow & White	

CONTENTS

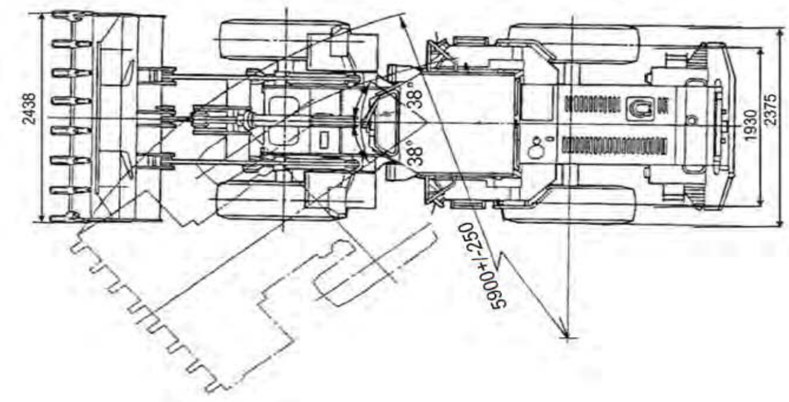
01 GENERAL

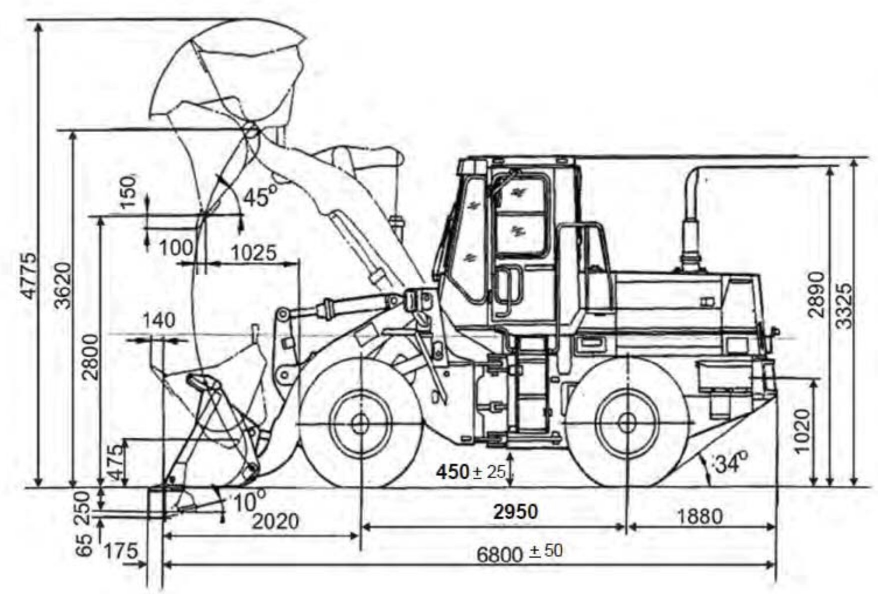
GENERAL VIEW



1) BUCKET	4) DUMP CYLINDER	7) FRONT WHEEL
2) BELLCRANK	5) LIFT CYLINDER	8) REAR WHEEL
3) LIFT ARM	6) HEAD LAMP	9) TRANSIT LOCK

GENERAL ASSEMBLY DRAWING





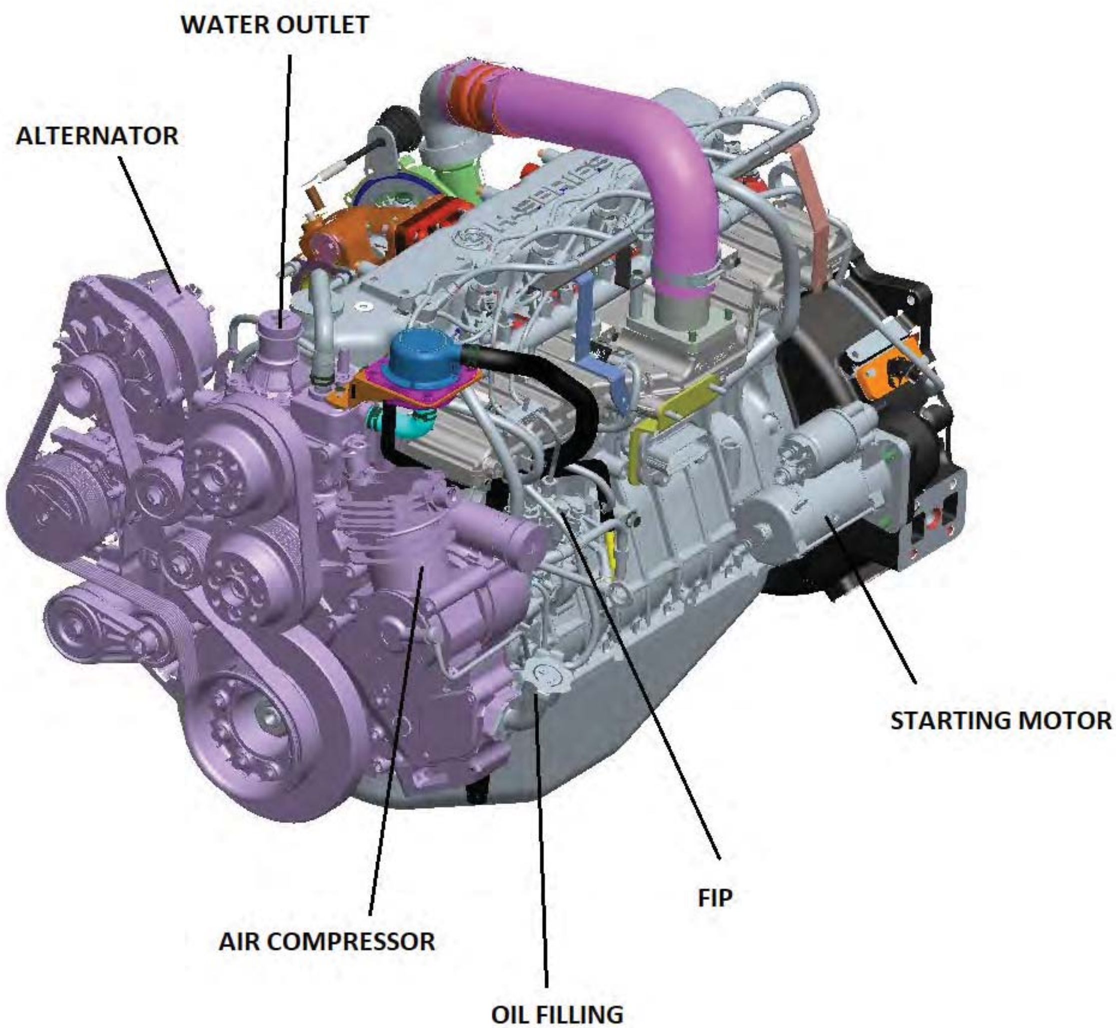
Unit: mm

SPECIFICATIONS

Machine model		BL200-1
Weight		
• Operating weight (with cab)	kg	10500±500
• Front wheel loading (with cab)	kg	4500
• Rear wheel loading (with cab)	kg	6000
Dimensions		
• Overall length (tooth length excluded)	mm	7125
• Overall width of machine	mm	2,375
• Overall width of bucket	mm	2,440
• Overall height (top edge of exhaust pipe)	mm	2,890
• Overall height (top of cab)	mm	3,325
• Overall height (turning bucket ascent)	mm	4,775
• Wheel base	mm	2950
• Tread	mm	1,930
• Bucket hinge pin height	mm	3,620
• Dumping clearance (bucket base)	mm	2,800
• Dumping reach (bucket base)	mm	1,025
• Bucket dumping angle	Degree	45
• Bucket tilt angle (traveling posture)	Degree	48
• Excavation depth (10° dump)	mm	250
• Minimum height above ground	mm	410
Performance		
• Bucket capacity	m^3	1.7
• Operating load	kg	3000
• Travel speed		
Forward 1 st speed	km/h	7
2nd speed	km/h	36
Reverse 1 st speed	km/h	16
• Maximum traction force	kg	9,880
• Gradeability	Degree	25
• Minimum turning radius		
• At outside of machine (with tooth)	mm	5900+/-250
• At center of outermost wheel	mm	5500+/-200

Machine model	BL200-1
Power train	
• Torque converter	Twin turbine type
• Transmission	DIRECT mounted, Full power shift, counter shaft type
• Reduction unit	Spiral bevel gear
• Differential	Straight bevel gear
• Final drive	Planetary gear
Axle shaft and wheel	
• Drive system	Four wheel drive
• Front axle	Fixed frame
• Rear axle	Center pin support, semi floating
• Tire	Tubeless14x 25 - 20 PR
Brake	
• Foot brake	4 Wheel, Wet multiple disc hydraulic actuated
Steering unit	
Hydraulic units	
• Work equipment and steering	155 lpm @ engine rated speed
pump discharge	
• Work equipment valve set pressure	210 kg/cm^2
• Steering valve set pressure	175 kg/cm^2
Cylinder	
(Number — Bore x Stroke)	
• Lift cylinder	2 - 120 mm x 700 mm
• Dump cylinder	1 - 130 mm x 474 mm
• Steering cylinder	2- 70 mm x 460 mm

ENGINE ASSEMBLY



ENGINE SPECIFICATIONS

Unit: mm

Model		**H6ETIC3U**
Type		Water Cooled, 6 Cylinder, Turbocharged, Direct Inject
No. of cylinders-bore x stroke	mm	6 Cylinders, 104X113
Piston displacement	cc	5760
Firing order		1-4-2-6-3-5
Dimensions		
• Overall length	mm	1145
• Overall width	mm	657
• Overall height	mm	861
Performance		
• Flywheel horsepower	HP	133HP
• Rated RPM	rpm	2300+/-50
• Maximum torque	N-m	475@17 00
• Fuel consumption ratio	g/HP.h	25
• High idling speed	rpm	2520+/- 50
• Low idling speed	rpm	850+/- 50
Dry weight	kg	530
Fuel pump		Inline type pump, make: MICO
Governor		Mechanical, all speeds
Starting motor		24V, 4.5kW
Alternator		24V, 55A
Battery		24V(12Vx2) - 150Ah

WEIGHT TABLE

⚠ This weight table is a guide for use when transporting or handling components.

(Unit: Kg-±5%)

Engine assembly	-
Torque converter assembly	-
Transmission	430
Front axle assembly	680
Rear axle assembly	680
Rear axle pivot	109
Hydraulic tank (dry)	110
Lift cylinder assembly {1 piece)	86
Dump cylinder assembly (1 piece)	77
Engine hood	150
Front frame (with accessory)	4500

Rear frame (with accessory)	5500
Lift arm with bushing	655
Bucket with teeth	625
Counterweight	700
Fuel tank (empty)	100.4
Cab	184
Floor frame	102

FUEL, COOLANT AND LUBRICANTS

RESERVOIR	KIND OF FLUID	BEML STDANDARD	AMBIENT TEMPERATURE -22 -4 14 32 50 68 86 104 122 (deg. F) -30 -20 -10 0 10 20 30 40 50 (deg. C)		CAPACITY (ltrs)	
					SPECIFIED	REFILL
ENGINE OIL	ENGINE OIL	———	SEE NOTE 2	API CK4 10W30	18	16
TRANSMISSION CASE	TM . OIL	C6002-12	C4 SAE30		30	25
HYD. SYSTEM	HYD. OIL	C6002-02	SAE 10W / EH-10CD		110	81
AXLE (FRONT AND REAR)	GEAR OIL	C6002-46		80W90 LS API-GL5	18	--
GREASE	LITHIUM BASE EP-2	C5003-04		NLGI-2	--	--
FUEL TANK	DIESEL	C6002-01	SEE NOTE 1	ASTM D975 NO.2	170	--
COOLING SYSTEM	PRE MIXED	———	SEE NOTE 3	LEY POWER COOLANT 5000	9+8 (INCL RADIATOR)	--
UDS TANK	PRE MIXED	———		ADBLUE	24	6% OF FUEL REFILLED

DETAILS ON COOLANT, OIL AND DIESEL FOR COLD START :

NOTE:

1. DIESEL : WINTER DIESEL (ATF + 0.4% No-NoX)
2. ENGINE OIL : GULF 10W30/ 5W30(SEMI / FULLY SYNTHETIC), ADDITIVE : NOT APPLICABLE
3. ENGINE COOLANT : GULF EURO COOL JIS K 2234 (CLASS 2) CONCENTRATION 50:50.

NOTE:

(1) When fuel sulphur content is less than 0.5%, change oil in the oil pan every periodic maintenance hours described in this manual. Change oil according to the following table if fuel sulphur content is above 0.5%.

Fuel sulphur content	Change interval of oil in engine oil pan
0.5 to 1.0%	1/2 of regular interval
Above 1.0%	1/4 of regular interval

(2) When starting the engine in an atmospheric temperature of tower than 0°C, be sure to use engine oil

APICK410W30 , even though an atmospheric temperature goes up to 10°C more or less in the daytime.

(3) For axle oil, use only recommended oil as follows.
SAE 85W-90/ SAE80W-90 for axle oil

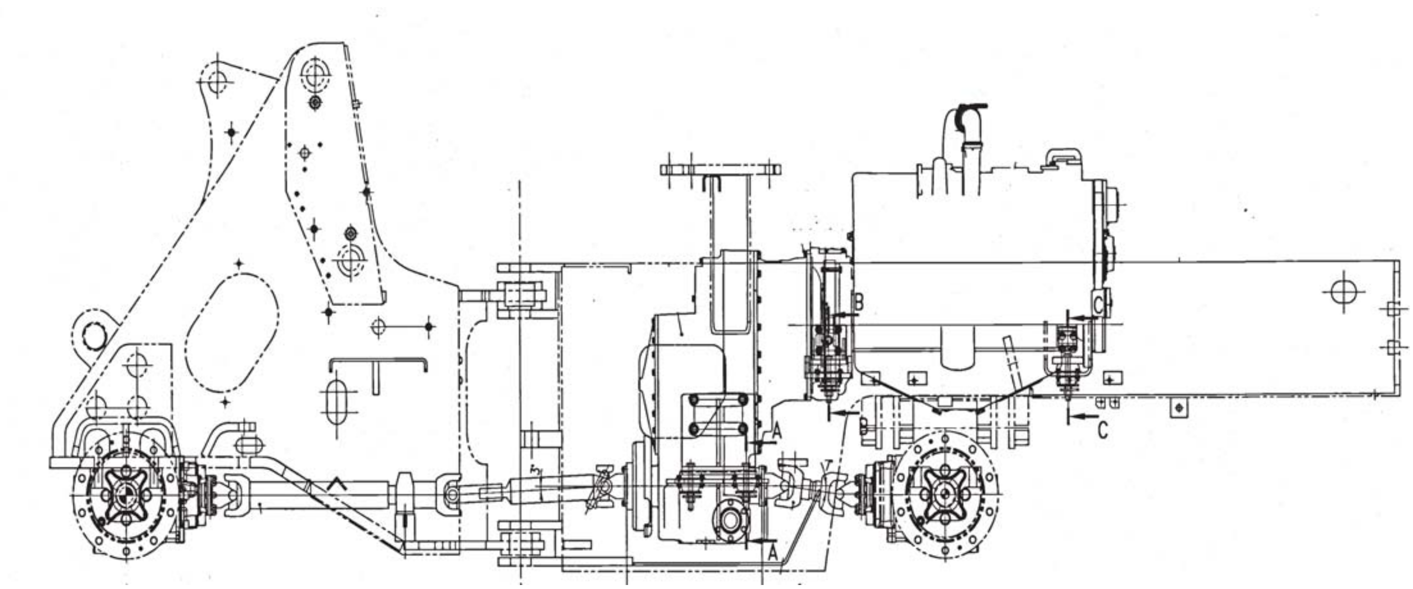
ENGINE
02 STRUCTURE AND FUNCTION

ENGINE MOUNT

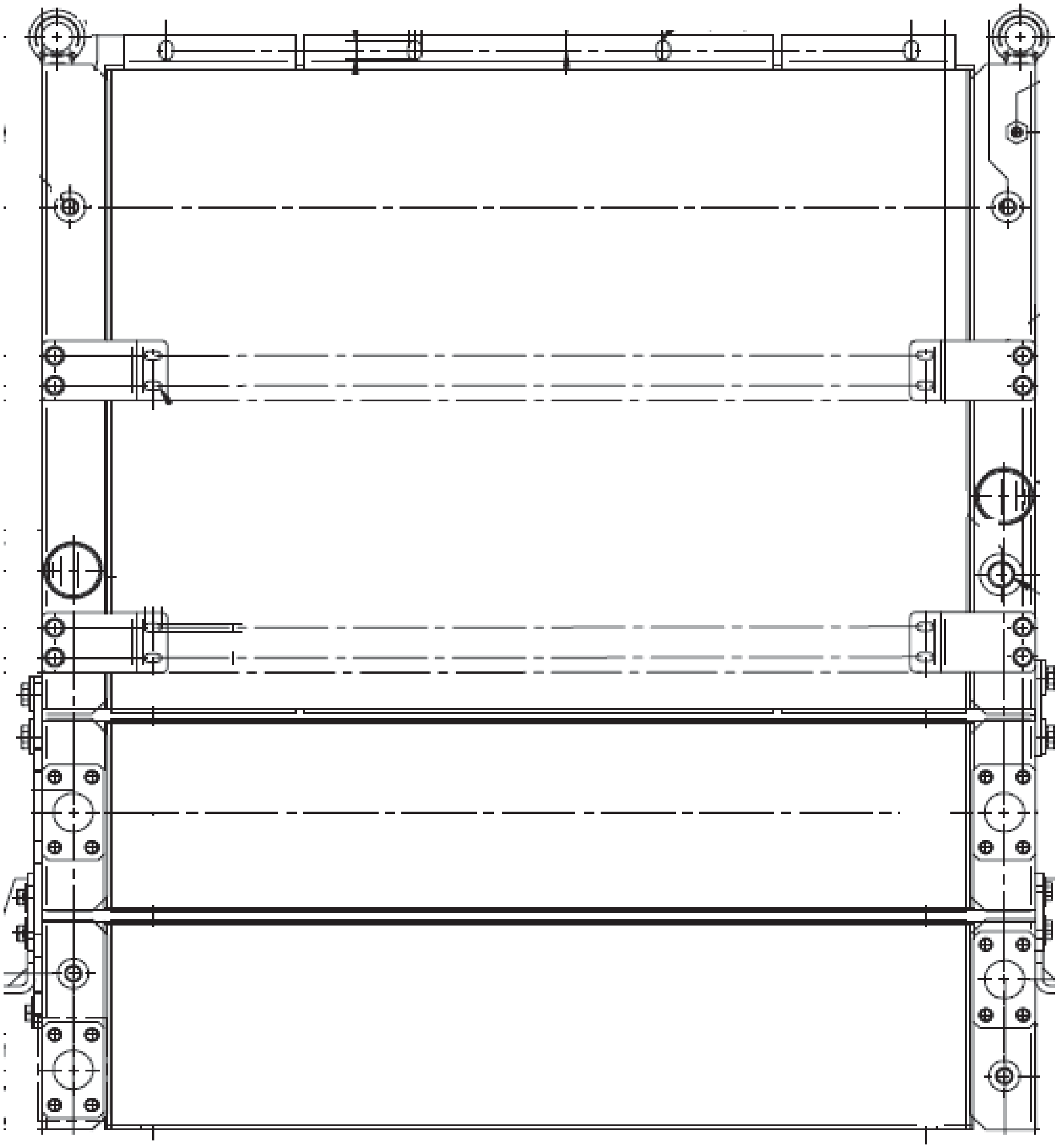
OUTLINE

ENGINE, TORQUE CONVERTER & TRANSMISSION ASSEMBLY

- The Torque converter is mounted on Engine.
- Engine assy is mounted with 4 rubber mounts.
- Transmission is coupled directly to engine and mounted on rubber cushions

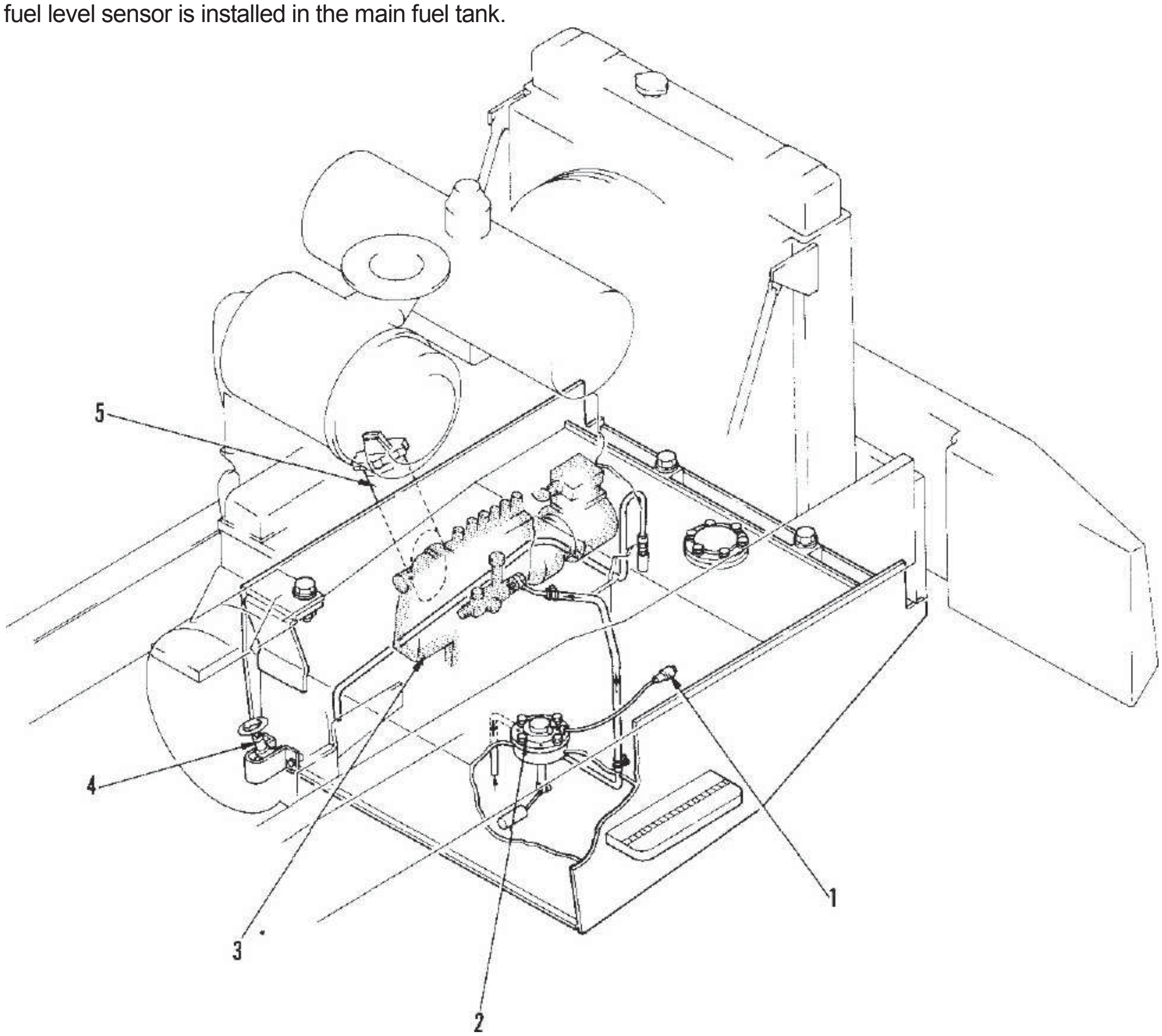


RADIATOR AND COOLER ASSY



FUEL TANK AND PIPING

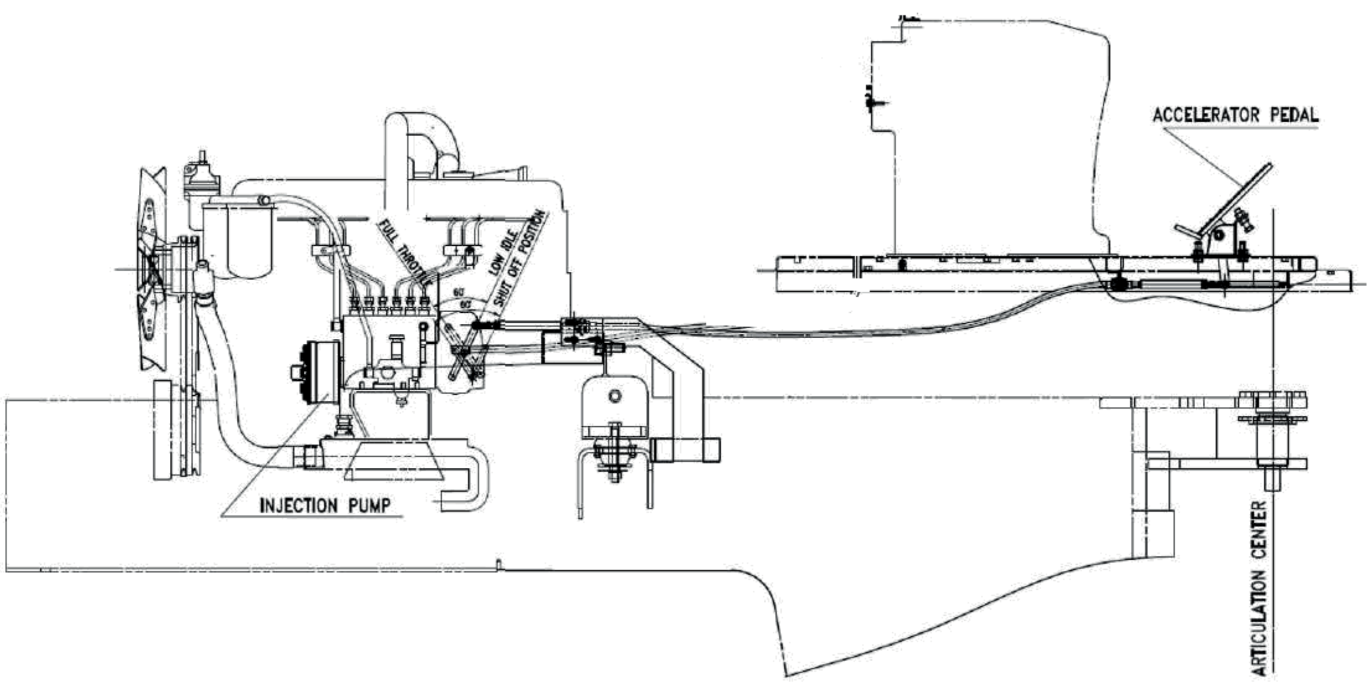
The fuel level sensor is installed in the main fuel tank.



1. Connector
2. Fuel level sensor
3. Injection pump
4. Drain valve
5. Fuel filler port

ENGINE CONTROL

The engine is accelerated with the help of accelerated pedal which is connected to the engine electically.
The engine is shut off by turning the starting key to off position.



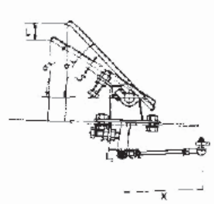
ENGINE

03 TESTING AND ADJUSTING

* The following precautions are necessary when using the Standard Value Tables to make judgments during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.
2. The standard values in these tables for judgment when troubleshooting are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgments.
3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make judgments.

STANDARD VALUE TABLE

Engine					
Category	Item	Condition	Unit	Standard value	Permissible value
Performance	Engine speed	High idling speed	rpm	2400	2500
		Low idling speed	rpm	850	800
	Necessary starting speed	0°C	rpm	Min 150	Min 150
		−20°C (using starting aid)	rpm	Min 100	Min 100
Intake and exhaust system	Intake resistance	All speed	mmH_2O	Max 300	Max 635
	Exhaust temperature	All speed (intake air temp.:20°C)	°C	Max 650	Max 650
	Exhaust gas color	Quick acceleration	Bosch index	Max 5	-
		At high idling	Bosch index	Max 2	
	Valve clearance (When engine is cold)	Intake valve	mm	Max 0.50	-
		Exhaust valve	mm	max 0.50	
Body	Compression pressure	Oil temperature 40 − 60°C (engine speed: 320 − 360 rpm)	kg/cm^2	Min 32.0	Min 22.0
	Blow-by pressure	At high idling, oil temperature min. 60°C	mmH_2O	Max 100	200
Lubrication system	Oil pressure (SAE30, min. 80°C)	At high idling	kg/cm^2	3.5 - 5.5	2.5
		At low idling	kg/cm^2	Min 1.5	0.7
	Oil temperature	Whole speed range (inside oil pan)	°C	80 - 110	120
	Oil consumption ration	At continuous rated horsepower (proportion of fuel consumption)	%	Max 0.5	1
Fuel system	Fuel injection pressure	Nozzle tester	kg/cm^2	225 + - 10	180
	Fuel injection timing	Before top dead center	Degree	20 + - 1	20+ - 1
Cooling system	Coolant temperature	Whole speed range (at engine outlet)	°C	70 - 80	100
	Thermostat function	Valve cracking temperature	°C	74.5	74.5-78.5
		Temperature when fully open	°C	90	90
		Lift when fully open	mm	9.5-10.5	9.5-10.5
	Fan belt tension (Alternator-Fan pulley)	Deflection when pushing with finger force approx. 6 kg	mm	10	5-15
Accelerator pedal	Operating force		kg	4-7	Max 10.5
	Operating angle α		Degree	45, 33	-
	Operating travel L		mm	42	-
	Stopper height L_1		mm	13.-23	-
	Stopper height L_2		mm	12 - 22	-
	Rod length X		mm	155 - 165	-

NOTE: Values are subjected to changes.

TOOL LIST FOR TESTING AND ADJUSTING

No.	Testing and measuring item	Tool	Remarks
1	Engine speed	Tachometer	Digital display 60 -19,999 rpm
2	Battery specific gravity	Battery coolant tester	1.100 - 1.300
3	Coolant freezing temperature		- 5 -------- 50°C
4	Water temperature, oil temperature, intake temperature	Thermistor temperature gauge	0 - 200°C
5	Exhaust temperature		0 - 1,000°C
6	Lubricating oil pressure	Engine pressure measuring kit	0 - 10 kg/cm^2
7	Fuel pressure		0 - 20 kg/cm^2
8	Intake pressure, exhaust pressure		0 - 1,500 mmHg
9	Blow-by pressure		0 - 1,000 $mmH_2 0$
10	Intake resistance		-1,000 - 0$mmH_2 0$
11	Compression pressure	Compression gauge Adapter	0-70 kg/cm^2
12	Blow-by pressure	Blow-by checker	0 - 500 mmB,0
13	Valve clearance	Feeler gauge	0.25 - 0.75
14	Exhaust gas color	Smoke meter	Discoloration % x 1/10 = Bosch index
15	Fuel or water mixed in oil	Engine oil checker	Water content 0.1 %, 0.2% in standard sample
16	Coolant quality	Water quality tester	PH, nitrous acid ion concentration
17	Leakage from cooling system	Cap tester	0 - 2 kg/cm^2
18	Fuel injection pressure Nozzle injection condition	Nozzle tester	0 - 300 kg/cm^2
~~19	Electrical circuit	Tester	Current, voltage, resistance
20	Accelerator pedal force	Push-pull scale	0 - 25 kg

⚠ When carrying out testing, adjusting or troubleshooting, stop the machine on level ground, install the safety bar on the frame, lower the bucket to the ground, and stop the engine. Then apply the parking brake and block the tires.

⚠ When working in groups use agreed signals and do not allow unauthorized persons near the machine.

⚠ When checking the water level in the radiator waits for the water to cool. Do not remove the radiator cap while the water is hot. Boiling water may spurt out.

⚠ Be careful not to get caught in rotating parts.

TESTING AND ADJUSTING FUEL INJECTION TIMING

REFER M/s. ASHOKLEYLAND MANUAL

ADJUSTING FUEL INJECTION TIMING BY DELIVERY CHECK

REFER M/s. ASHOKLEYLAND MANUAL

MEASURING ENGINE OIL PRESSURE AND TEMPERATURE

MEASURING ENGINE OIL PRESSURE

* Measurement condition **Unit: kg/cm^2**

• Coolant temperature: Inside operating range.

Item	Standard value	Permissible value
Oil pressure High idling	6 bar	6 bar
Low idling	2.5 bar	2.5 bar

The EOP is displayed in Digital Display.

MEASURING OIL TEMPERATURE

- Measurement condition
- Coolant temperature: Inside operating range.

Oil temp.	Standard value	Permissible value
Min.	80	80
Max.	120	120

The EOT is displayed in Digital Display.

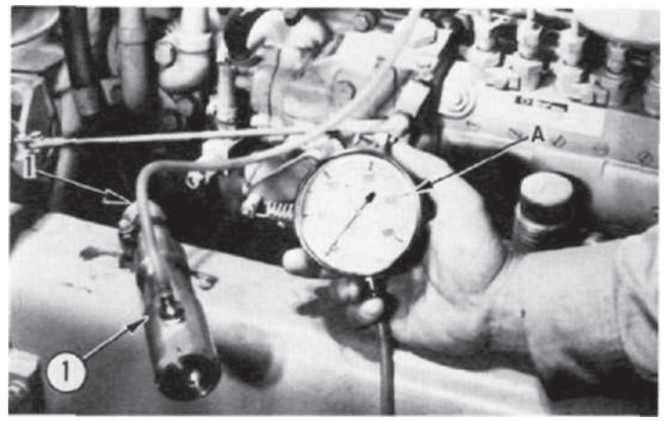
MEASURING BLOW-BY PR.

- Measurement condition
- Engine valve clearance: Standard value
- Coolant temperature: Inside operating range.

⚠ When taking measurements, be careful not to touch the exhaust manifold or muffler, or to get caught in rotating parts.

Unit: mmH_2O

Item	Standard value	Permissible value
Blow-by pressure	Max. 100	200



1. Measuring blow-by

1) When measuring the blow-by, warm the engine up thoroughly (oil temp: min. 60°C).
2) Stop engine and install adapter (T) of blow-by checker A on engine breather hose (1).
3) Connect adapter and pressure gauge A (0 — 1,000 mm H_20) with hose.
4) Run engine at high idling and measure blow-by pressure.

Precautions when measuring blow-by

* Blow-by may vary greatly according to the condition of the engine, so if there is any abnormality in the measured value, check for any problem related to defective blow-by, such as excessive oil consumption, defective exhaust gas color, or early deterioration or contamination of the oil.

TESTING AND ADJUSTING FAN BELT TENSION

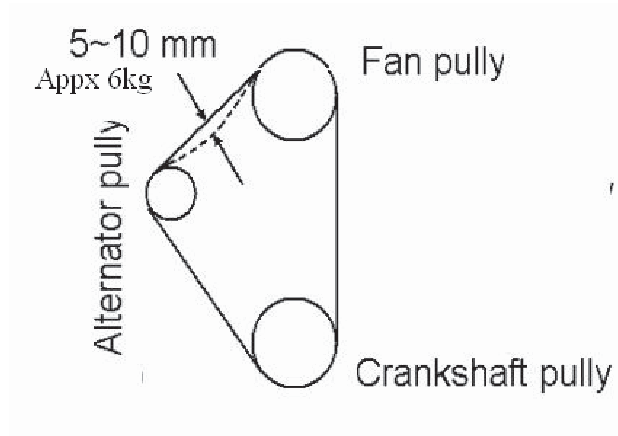
1. Measuring procedure

1) Push the V-belt with a force of 6 kg, at a point midway between the fan pulley and the alternator pulley.

2) Use a scale to measure the amount the V-belt deflects.

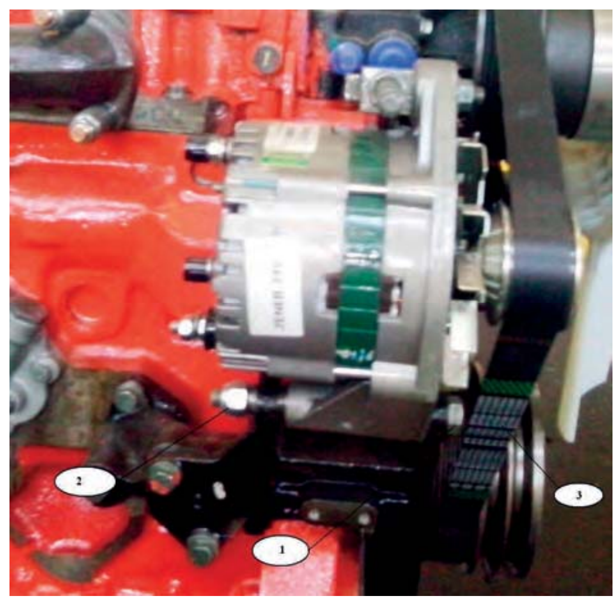
Unit : mm

Item	Standard value	Permissible value
Deflection of belt	10	5 - 15



2. Adjustment procedure

1) Loosen mounting bolt (1) of the alternator assembly and the mounting bolt (2) of adjustment plate.
2) Insert a stick or bar between the alternator mounting bolt and the cylinder block, then raise the alternator to the outside.
3) Adjust the belt (3) tension and temporarily tighten mounting bolt (2).
4) Check that the belt tension is correct then tighten all mounting bolts fully.

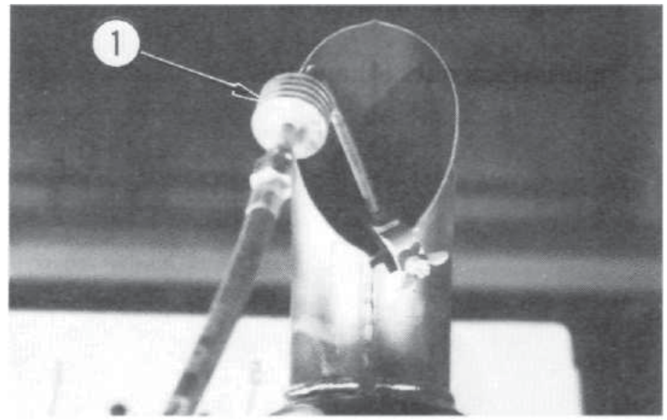


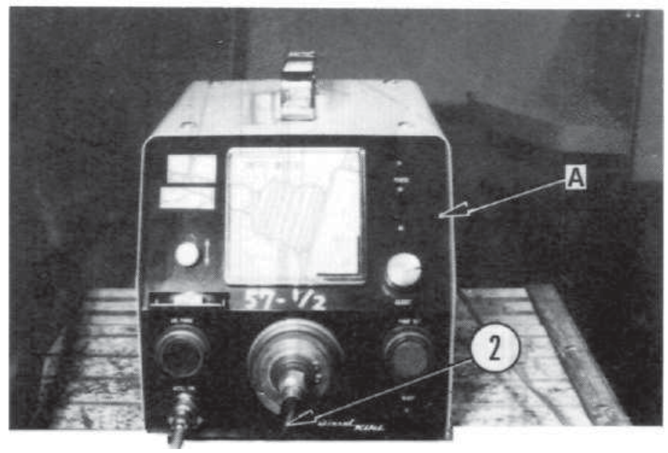
MEASURING EXHAUST GAS COLOR

- Measurement condition
- Coolant temperature: Inside operating range.
- Valve clearance:
- Standard value. **Unit: Bosch index**

Item		Standard value	Permissible value
Exhaust gas color	Acceleration	Max. 5.0	-
	High idling	Max. 2.0	-

⚠When measuring the exhaust color: be careful not to touched the exhaust pipe.





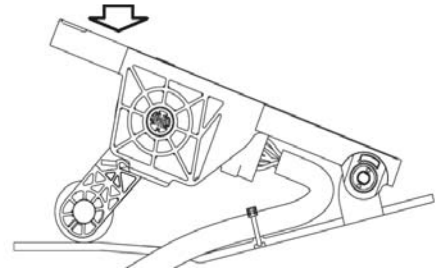
* When measuring exhaust gas color, warm engine up thoroughly. (Oil temp. min. 60°C)

1. Insert probe (1) in outlet of exhaust pipe (1) and secure to exhaust pipe with clip.
2. Connect probe hose, connector of accelerator switch and air hose *(2)* to smoke meter A.
   * The pressure of the air supply should be under 1 5 kg/cm^2.
3. Connect power cord to socket.
   * Check that the power switch is OFF before con necting the cord.
4. Loosen cap nut of "suction pump and insert filter paper.
   * Insert filter paper securely to prevent exhaust gas leakage
5. Turn power switch ON.
6. Accelerate engine suddenly. At the same time, depress accelerator pedal, operate relief valve and catch exhaust gas color on filter paper.
7. Lay filter paper used to catch exhaust gas color on top of unused filter papers (10 sheets or more) inside filter paper holder, and read indicated value.

MEASURING OPERATING FORCE AND OPERATING ANGLE OF ACCELERATOR PEDAL

* Measurement condition

- Coolant temperature: Inside operating range.



Unit: kg

Item	Standard value	Permissible value
Operating force of accelerator pedal	4 - 7	Max. 10.5

Special tools

	Part number	Part name	Quantity
A	7A0-262-0020	Push-pull scale	1
B	Commercially available	Angle gauge	1

OPERATING FORCE

1. Measuring procedure

1) Put push-pull scale A in contact with the accelerator pedal at point 150 mm from pedal fulcrum "a".

* The center of push-pull scale A must be in contact with a point 150 mm from the pedal fulcrum.

2) Start the engine, push the pedal in the direction of operation and measure the maximum value when pushing from idling to the end of the pedal travel (high idling).

2. Testing and adjusting

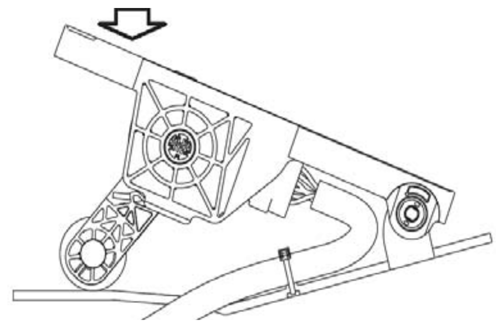
1) Stop the engine.
2) Disconnect the cable (2) at the bottom of the accelerator pedal,
3) Connect the cable at the bottom of the pedal, then disconnect at the connection for the injection pump, and check that the cable (2) moves smoothly.

* When carrying out this inspection, adjust or replace parts as necessary. Measure the operating force again and check that it is within the standard range.

OPERATING ANGLE

Unit: mm

Item		Standard value	Permissible value
Operating angle of accelerator pedal	$\alpha 1$	45°	Depends on engine throttle setup
	$\alpha 2$	33°	Depends on engine throttle setup
Installed height of accelerator pedal stopper (mm)	L1	13-23	Depends on engine throttle setup
	L_2	12-22	Depends on engine throttle setup



1. Measuring procedure

1) Stop the engine.

Measure the operating angle $\alpha_{1,}$ α_2 put the angle gauge B in contact with the accelerator pedal it is operated from low-idling and high idling.

ENGINE

04 DISASSEMBLY AND ASSEMBLY

* Take the following method for air bleeding when you start to operate hydraulic cylinders after reassembling cylinders, pumps and piping.

1. Start engine, keep idling.
2. Operate hydraulic cylinder 4 — 5 cycles, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 3 — 4 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

   NOTE: After long storage, same procedure is required.

REMOVAL OF STARTING MOTOR ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

REMOVAL OF ALTERNATOR ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

INSTALLATION OF
ALTERNATOR ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

REMOVAL OF ENGINE OIL COOLER ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

INSTALLATION OF ENGINE OIL COOLER ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

REMOVAL OF FUEL INJECTION PUMP ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

INSTALLATION OF FUEL INJECTIONPUMP ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

REMOVAL OF WATER PUMP ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

INSTALLATION OF WATER PUMP ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

REMOVAL OF CYL. HEAD ASSY.

REFER M/s. ASHOK LEYLAND MANUAL

INSTALLATION OF CYLINDER HEAD ASSEMBLY

REFER M/s. ASHOK LEYLAND MANUAL

2. Push Rod

REFER M/s. ASHOK LEYLAND MANUAL

REFER M/s. ASHOK LEYLAND MANUAL

REFER M/s. ASHOK LEYLAND MANUAL

REMOVAL OF RADIATOR

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

1. Draining Water

1) Loosen drain valve and drain coolant

Coolant : 18 Li

* If the cooling water contains antifreeze, dispose of it correctly.

2. Hood

1) Remove mounting bolts on engine hood.
Lift enginehood after removing electical connection to the lamp

2) Remove Tail pipe

3) Disconnect Radiator pipes with engine.

4) Disconnect the rear lamp connector .

3. Fan guard

Remove fan guard and radiator support .

4. Electric wiring

Disconnecting wiring of radiator water level sensor from connector.

5. Radiator hoses

1) Disconnect radiator hose from engine.
2) Disconnect radiator hose from both sides.
3) Disconnect radiator hoses from radiator.
4) Loosen lower hose clamp.

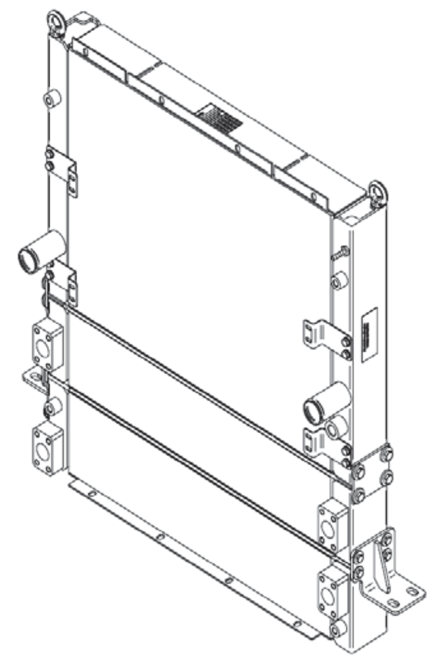
6. Cooler piping

Disconnect oil cooler hose.

7. Radiator

Sling radiator, remove mounting bolts and lift off radiator. When removing the radiator, move it towards the counterweight to prevent the radiator core from coming near fan.

INSTALLATION OF RADIATOR



1. Radiator

1) Sling radiator and place at mounting position. Tighten mounting bolts.

2) Insert radiator upper hose into radiator.

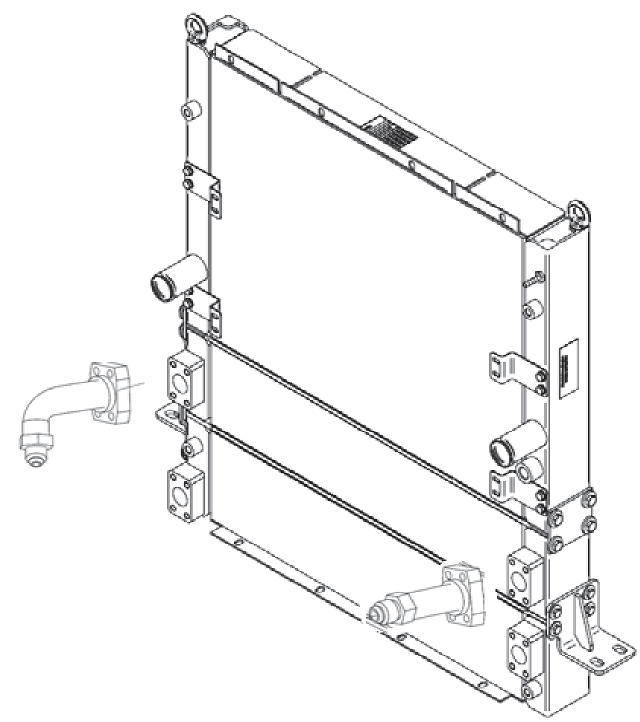
* Be careful not to damage the radiator core.

* Insert the radiator carefully from the counter weight side.

* Install so that the clearance from the fan is uniform.

* After connecting the hoses, tighten the clamps.

kgm Mounting bolt: **28.5** ± 3.0 **kgm**



2. Cooler piping

Connect oil cooler hoses and .

* Be careful not to twist hoses.

3. Radiator hoses

1) Connect radiator hoses and to radiator.

* Tighten lower hose clamp.

2) Connect radiator hose to engine and radiator.

3) Connect radiator hose to engine.

4. Electric wiring

Connect wiring of radiator water level sensor to connector.

1

5. Fan guard

NA

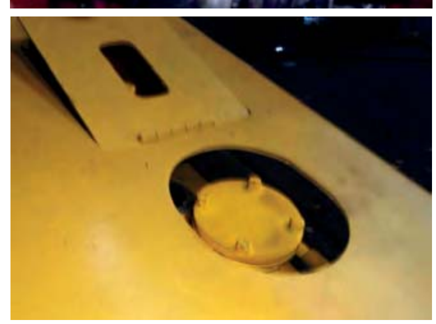
6. Hood

1) Set radiator guard (8) in position, and then temporarily tighten mounting bolts.
2) Install left and right engine side panels (7).
3) Close engine side hood (2), then adjust latch.
4) 4) Remove blocks (1); tighten mounting bolts of engine center hood (3), then install exhaust pipe (5).
5) * The final tightening of all mounting bolts is done.
6) * Connect rear lamp connector (9).

7. Refilling with water

Tighten drain valve and add water through water filler (21) to the specified level.

* Run the engine to circulate the water through the system. Then check the water level again.



REMOVAL OF ENGINE

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

⚠ Disconnect the lead from the (—) battery terminal.

1. Draining water

Loosen drain valve (1) and drain cooling water.

Cooling water: 8 lit + 9 lit coolant

* If the cooling water contains antifreeze, dispose of it correctly.

2. Hood and guard

1) Open engine side hood, remove engine side panels and exhaust pipe , and lift off engine center hood .

2) Sling radiator guard, remove mounting bolts, and liftoff radiator guard.

* Disconnect connector wiring.

3. Fan guard

NA

4. Electric wiring

Disconnect wiring (9) of radiator water level sensor from connector.

5. Radiator hoses

Disconnect radiator hoses (10), (11) and (12) from engine.

* Loosen lower hose clamps.

6. Cooler piping

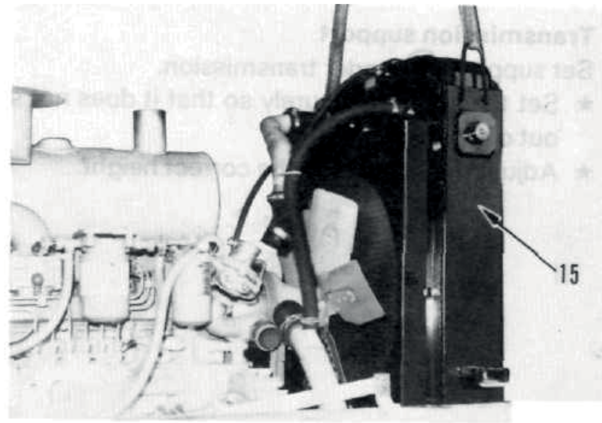
Disconnect cooler hoses (13) and (14).

7. Radiator

Remove radiator (15).

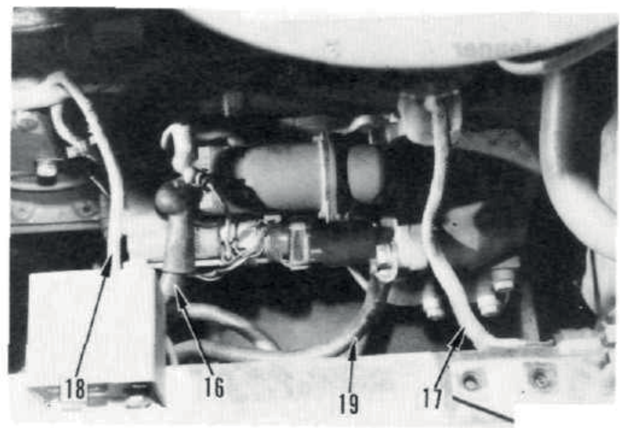
Radiator:

* When removing the radiator, move it towards the counter weight to prevent the radiator core from coming near the fan.



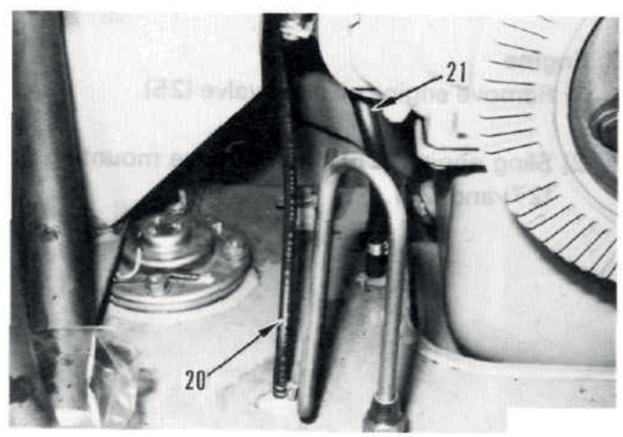
8. Electric wiring

Disconnect the following electric wiring.
*Disconnect cable (16) between starting motor and battery at starting motor end.
*Disconnect engine wiring (17) from connector.
*Disconnect main breaker wiring (1 8) from main breaker.
*Disconnect ground connection (19).
* Before removing the wiring, mark each wire with a tag to distinguish when installing.



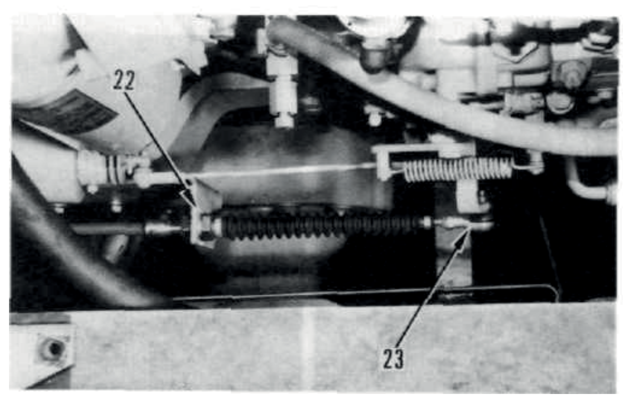
9. Fuel hoses

1) Disconnect hose (20) between fuel tank and fuel injection nozzle from fuel tank.
2) Disconnect hose (21) between fuel tank and fuel injection pump from fuel tank.



10. Fuel control cable

1) Remove fuel control cable bracket (22) mounting bolt, then remove fuel control cable bracket.
2) Disconnect fuel control cable (23) from engine.



11. Transmission support

Set support under transmission.

* Set the support securely so that it does not slip out of position.
* Adjust the support to the correct height.

12. Air cleaner

Remove Air cleaner .

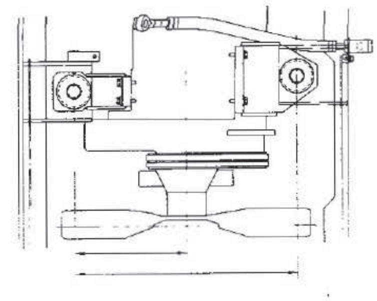
13. Engine

1) Remove engine oil drain valve.

2) Sling engine, then remove mounting bolts.

3) Remove connecting bolts of torque converter and then remove engine. When removing the engine, be careful of the contact face of the torque converter. Move out horizontally and when it comes completely free, raise the engine and remove. Also when removing the engine be careful that the engine oil drain hose does not interfere with the fuel tank.

INSTALLATION OF ENGINE



1. Engine

1) Set engine in mounting position, then tighten connecting bolts of torque converter.

O-ring circumference: Soapy water

* When connecting the engine to the torque converter, adjust the height so that the torque converter pilot goes in smoothly. Do not try to force it in.

2) Tighten rear mounting bolts.

* Fit rubber cushion securely in the bracket groove.
* Position the engine correctly.

Mounting bolt width across the flats: 32 mm

Mounting bolt: 76.0±8.5kgm

3) Install engine oil drain valve

2. Air cleaner

Set air cleaner in mounting position, then tighten mounting bolt and clamps.

3. Remove the transmission support.

4. Fuel control cable

1) Set fuel control cable in position to mount on engine, and then tighten mounting bolts.

Mounting bolt: 5.5 ± 2 **kgm**

2) Connect fuel control cable to engine.

Mounting bolt: 1.3±0.1kgm

5. Fuel hose

1) Connect hose between fuel tank and fuel injection pump at fuel tank end.

2) Connect hose between fuel tank and fuel injection nozzle at fuel tank end.

6. Fuel hose

Connect the following electric wiring.

1) Connect ground connection.

2)Connect main breaker wiring to main breaker.

3) Connect engine wiring at connector.

4) Connect cable between starting motor and battery at starting motor end.

7. Radiator

Set radiator in mounting position, then tighten mounting bolts.

* Be careful not to damage the radiator core. Insert the radiator carefully from the counter weight side.
* Raise radiator and stop 20 cm above mounting position, then first insert radiator hose.
* Install so that the clearance from the fan is uniform.

kgm Mounting bolt: **28.5 ± 3.0 kgm**

8. Cooler piping

Connect oil cooler hoses and to radiator .

* Install the hoses without twisting or interference.
* Hose nut width across flats: 41mm

9. Radiator hoses

Connect radiator hoses to engine.

* Tighten lower hose clamps.

10. Electric wiring

Connect wiring of radiator water level sensor to connector.

11. Fan guard

NA

12. ENGINE HOOD

1) Raise engine hood set in mounting position, and then tighten mounting bolts.

13. Refilling with water

Tighten drain valve and add water through water filter to the specified level.

* Run the engine to circulate the water though the system. Then check the water level again.

  Coolant:24lit.

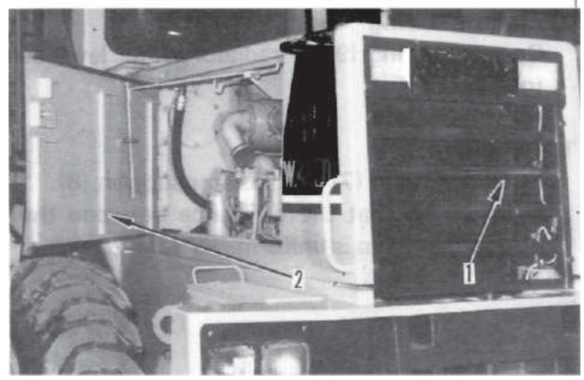
* Check that transmission oil level is the specified level.

REMOVAL OF FUEL TANK ASSEMBLY

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

1. Radiator grill

Remove radiator grill (1).

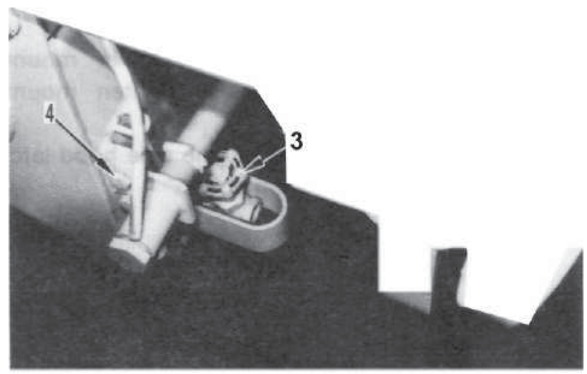


⚠ Open the engine side hood {2} and apply the lock.

2. Draining fuel

Loosen drain valve (3} and drain fuel.

Fuel: **170 lit**

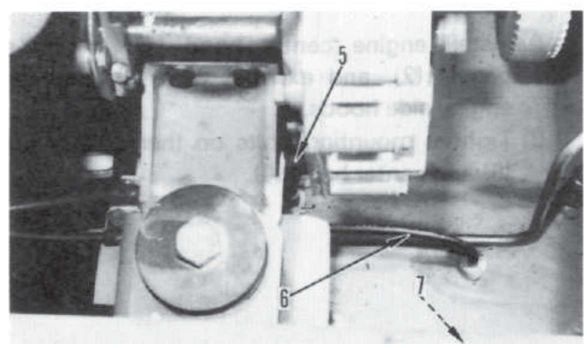


3. Drain valve

Remove engine oil drain valve (4) from fuel tank.

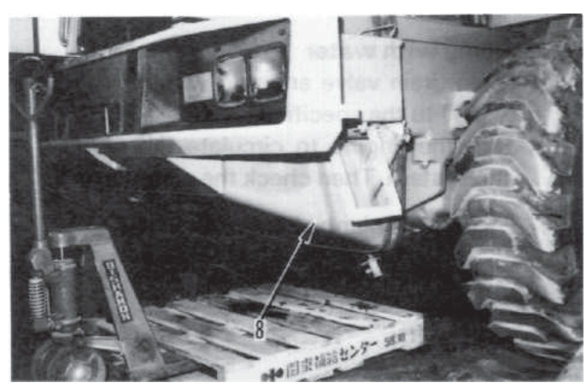
4. Fuel tubes and electrical wiring

1) Disconnect fuel tubes (5) and (6) from fuel tank.
2) Disconnect electrical wiring (7) for fuel unit from connector.



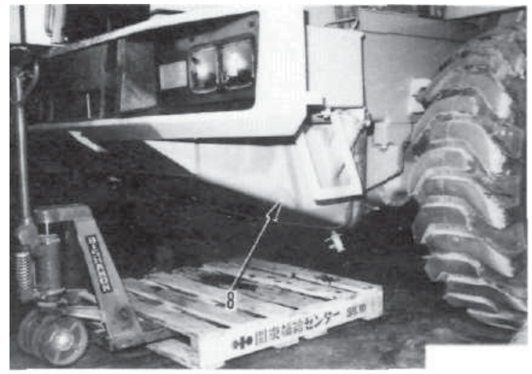
5. Fuel tank

1) Sling fuel tank (8), remove mounting bolts, and then lift off fuel tank.
   * Lay a pallet below the fuel tank, keep the tank balanced and lower slowly.
2) Pull fuel tank out from under machine.
   * Be careful not to let the breather tube hit the machine body.



INSTALLATION OF FUEL TANK ASSEMBLY

1. Fuel tank



1) Set fuel tank (8) on pallet, and then pull in to below mounting position.

* Be careful not to let the breather tube hit the machine body.

2) Raise fuel tank (8), set in mounting position, and then tighten mounting bolts.

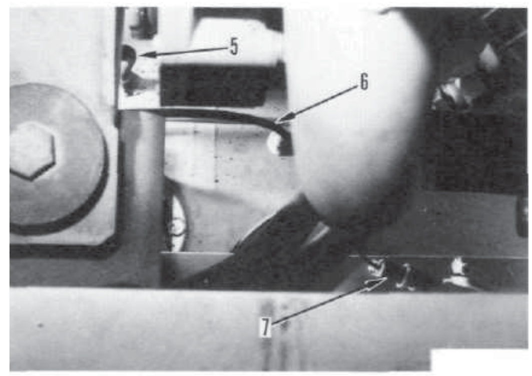
* When raising the fuel tank, keep it horizontal and set in the mounting position.

* Tighten the mounting bolts in the following order: Left, rear, right.

* Mounting bolt width across the flats: 30 mm

mounting bolt: **56±6kgm**

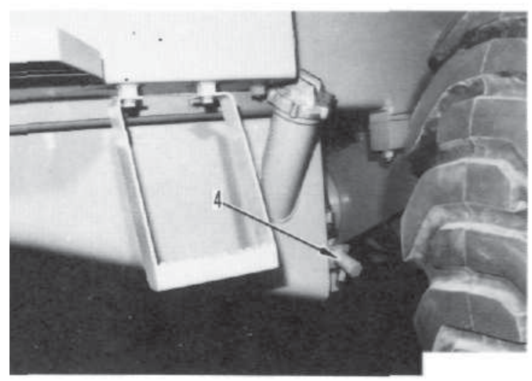
2. Fuel tubes, wiring



1) Connect wiring (7) for fuel unit to connector.

2) Connect fuel tubes (5) and (6) to fuel tank.

3. Drain valve



Install engine oil drain valve (4) to fuel tank.

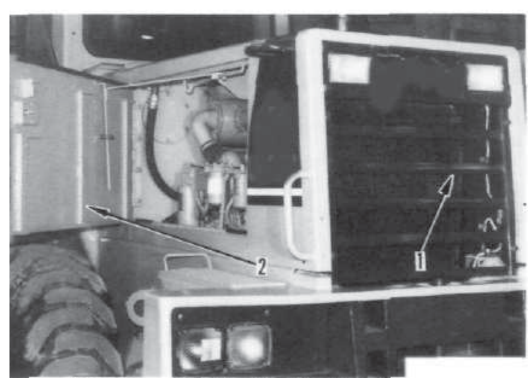
4. Hood

Release lock and close engine side hood (2).

5. Radiator grill

Install radiator grill **(1**).

6. Refilling with fuel

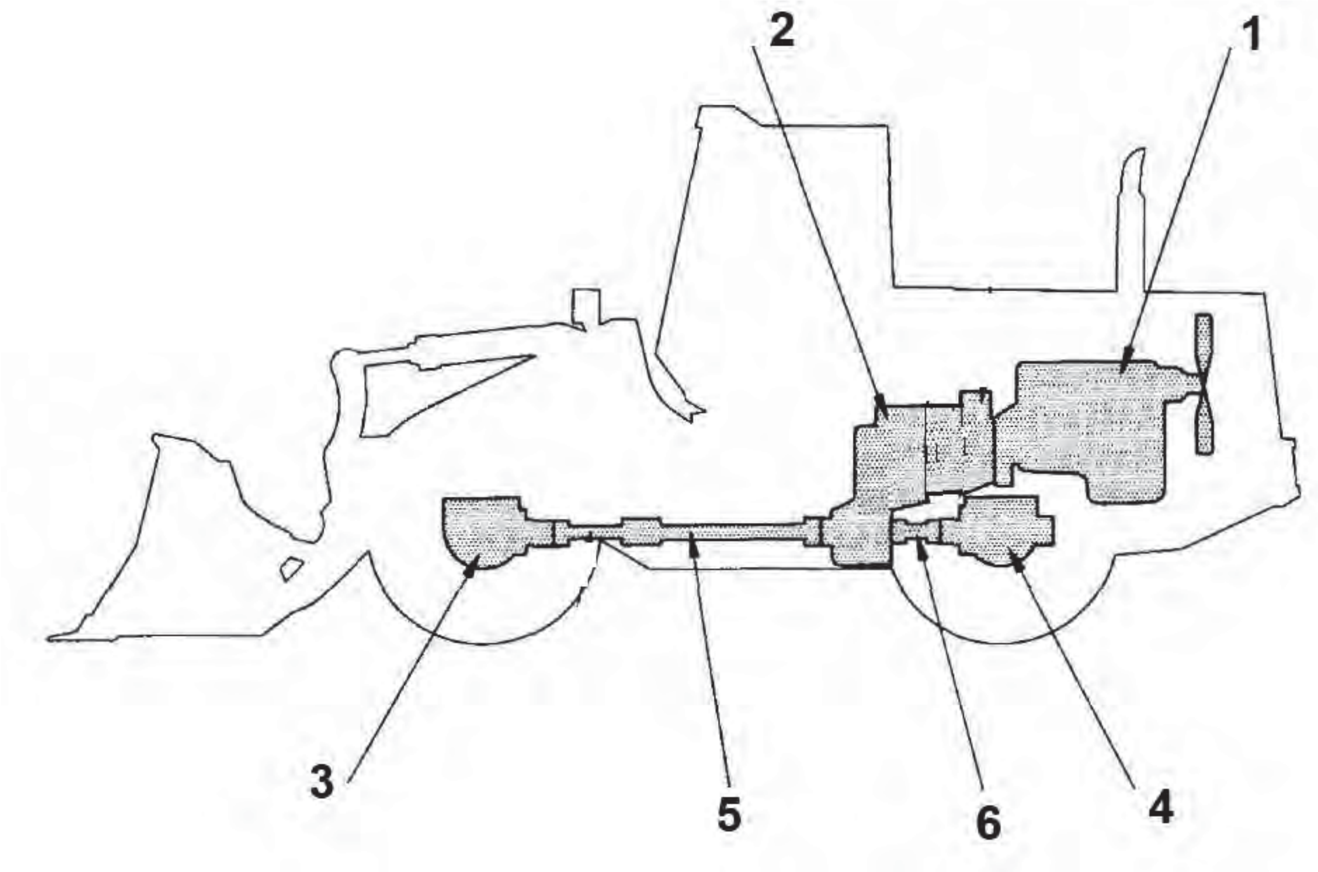


Tighten drain valve and add fuel through fuel filler (9).

Fuel: **170** lit

POWER TRAIN
05 STRUCTURES AND FUNCTION

GENERAL



OUTLINE

The Engine(1) develops the power and torque. This torque is transmissted to Torqueconvertor which is in built in Transmission(2).

The Torque Convertor cosists of 3 elements namely Pump, stator and Turbine. The Torque convertor magnifies the torque.

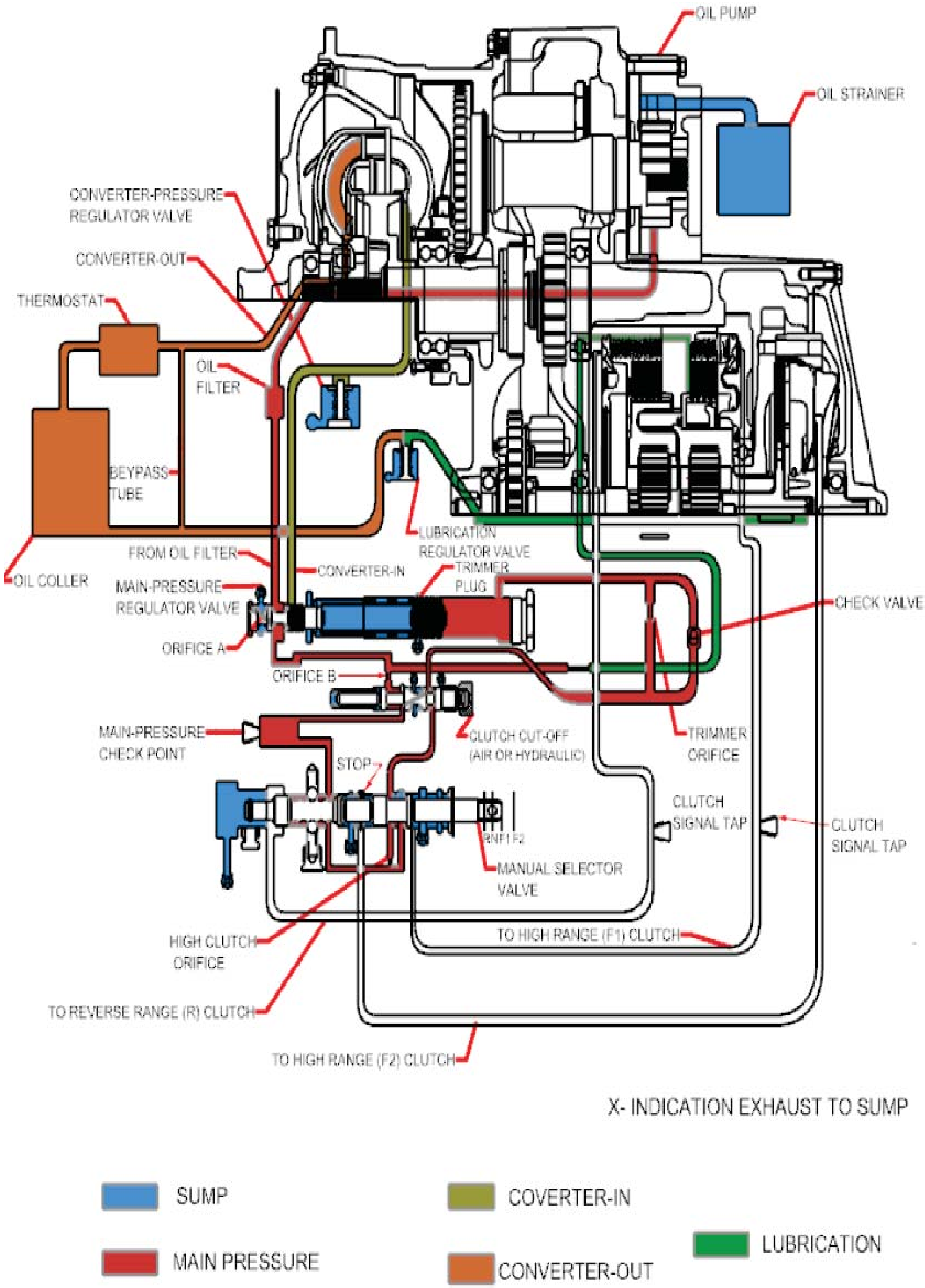
The Torque than transmitted to the Gear mechanism inside Transmission where the speed and direction of equipment is selected.

The Torque then transmitted to Front propeller shaft (5) and Rear propeller shaft (6).

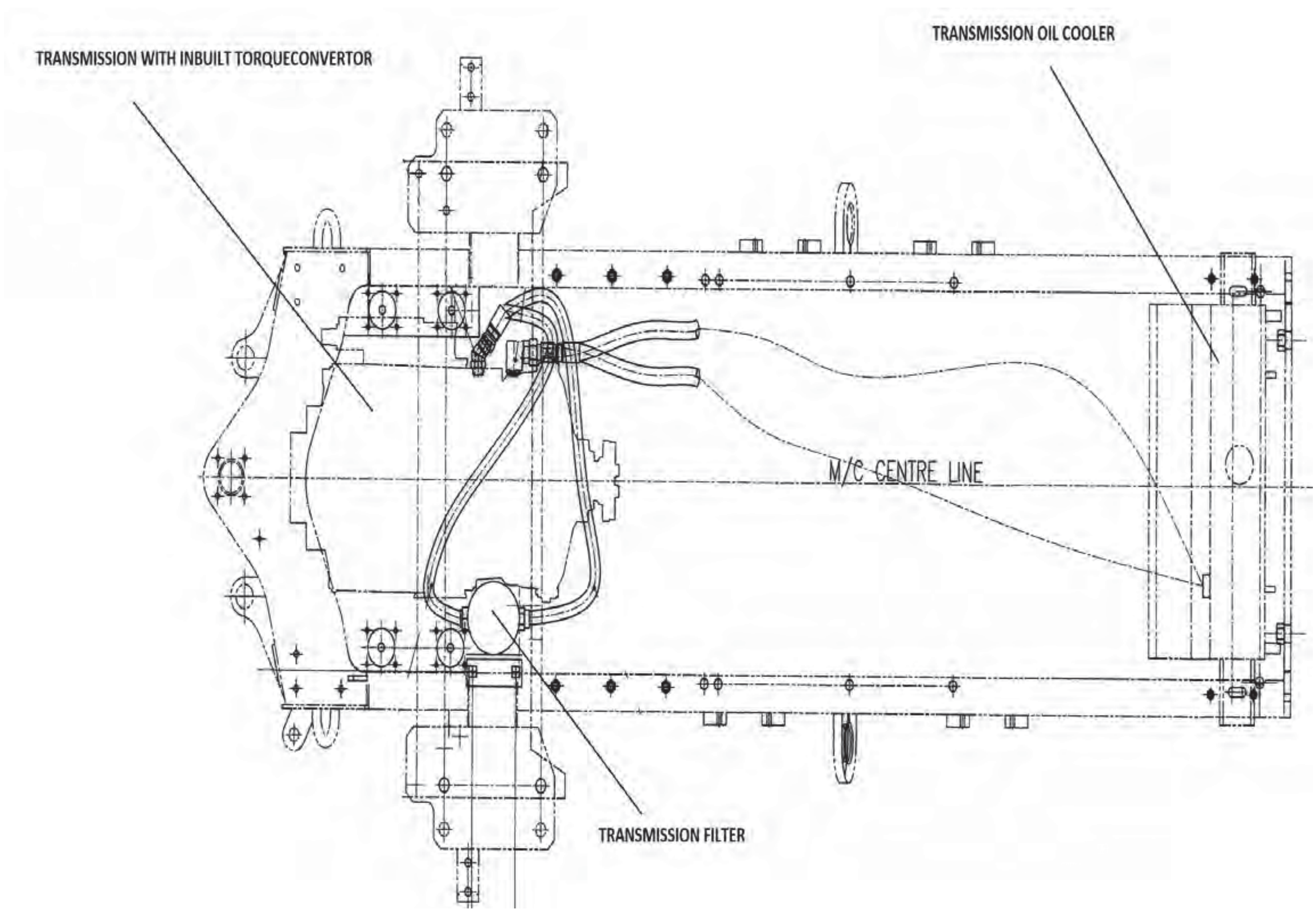
From Propeller shaft the torque is transmitted to Front Axle (3) and Rear Axle (4).

.

HYDRAULIC CIRCUIT FOR POWER TRAIN



TORQUE CONVERTER AND TRANSMISSION PIPING



TRANSMISSION PUMP

INBUILT OF TRANSMISSION

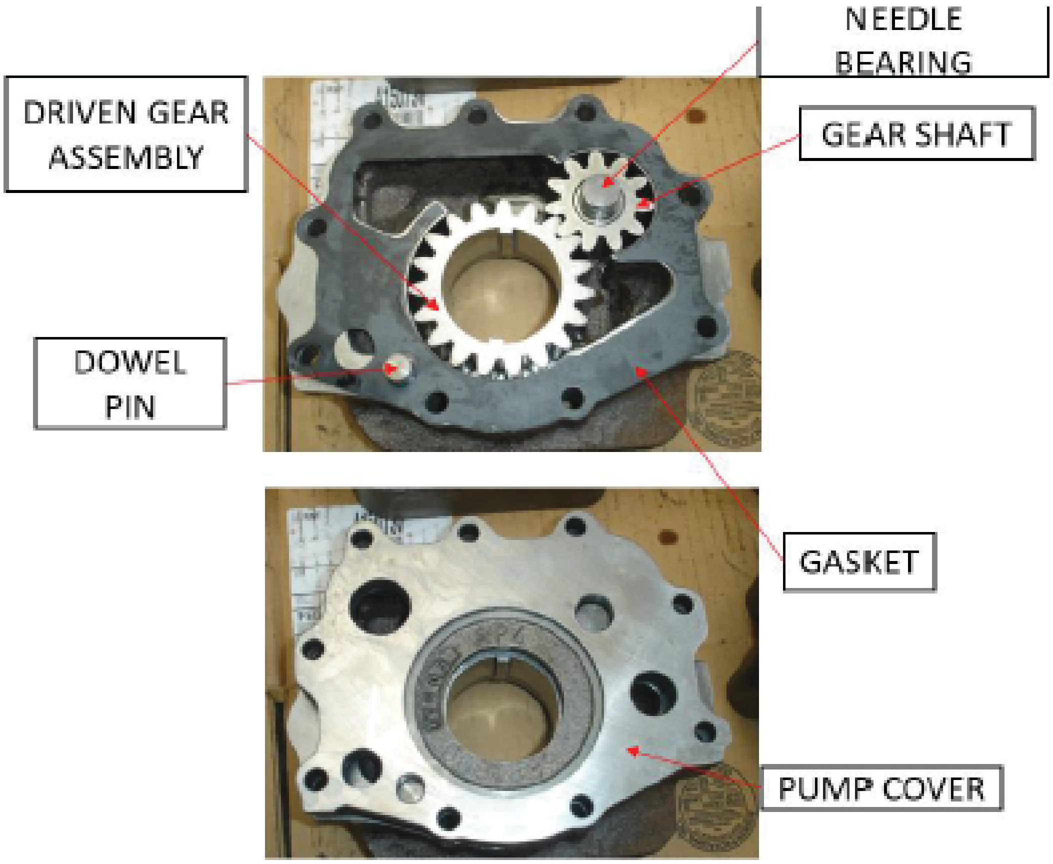
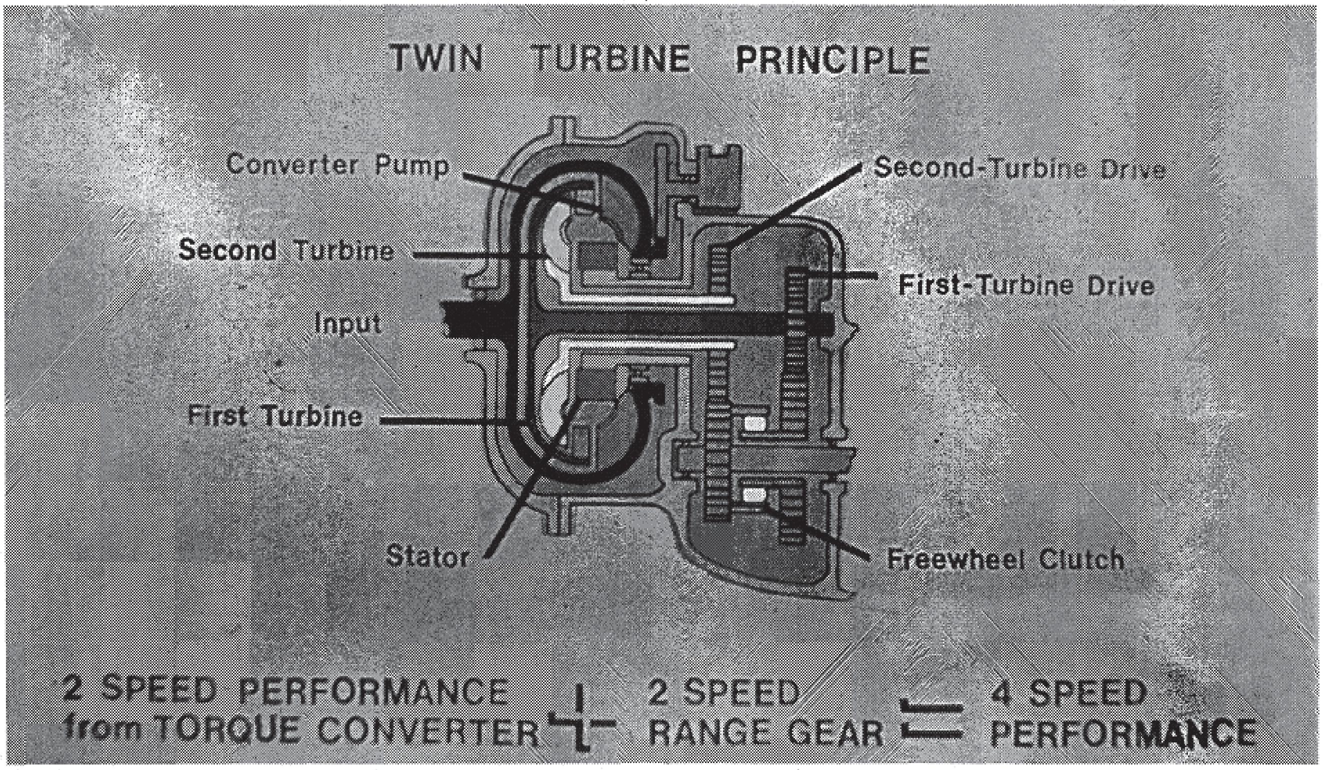


Fig – 19. CHARGING PUMP ASSEMBLY

TORQUE CONVERTER



The TT 2000 Series transmission contains a Twin Turbine Torque Converter .

Essentially this is a unit which has two turbines , One inside the Other.

Each turbine drives a different combining gear which in turn drives the Forward Reverse gears.

When the Load is started , oil flow within the converter causes the First turbine to turn, driving a low speed combining gear which in turn drives the range gears. As the load is reduced, due to increased vehicle movement , the higher velocity oil flow reaches the Second turbine AND CAUSES IT TO TURN. This drives the range gears through a higher speed combining gear. (The First turbine and its combining gear freewheel when the second turbine is operating at higher speeds)

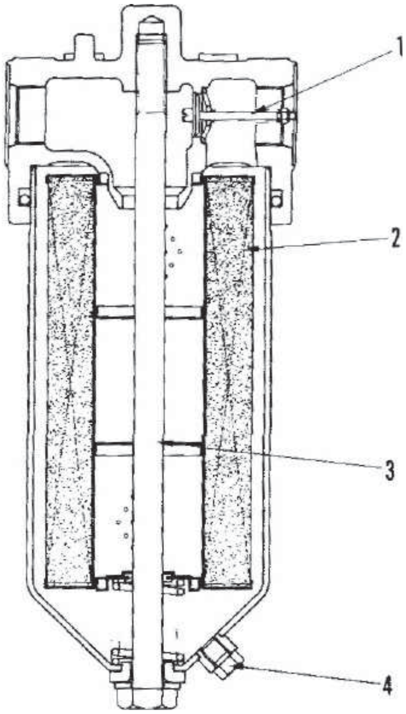
The result is Automatic Two Speed performance from the Torque Converter.

When this is combined with Two speeds in the range gearing , you get Four speed performance . Yet the operator has only Two Forward (and One OR Two Reverse) shift lever positions

TORQUE CONVERTER REGULATOR VALVE

REFER PAGE 05-4

TORQUE CONVERTER OIL FILTER



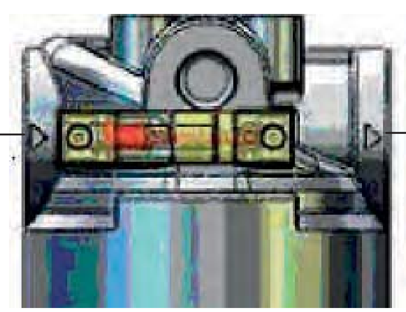
1. Relief valve
2. Element
3. Center bolt
4. Drain plug

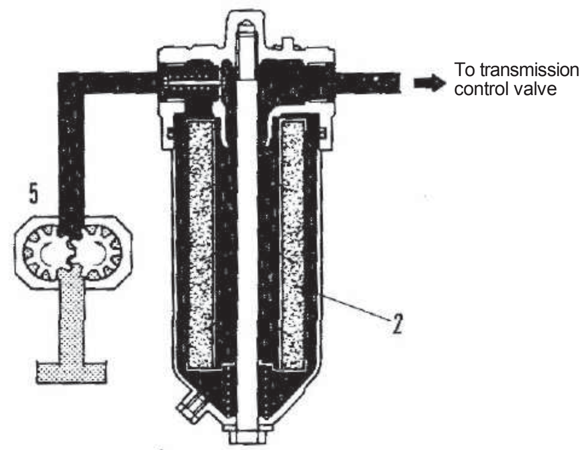
Filtration area: 8,900 cm-Relief pressure: 3.25 kg/sq.cm ;Rating:Absolute, Beta10>100

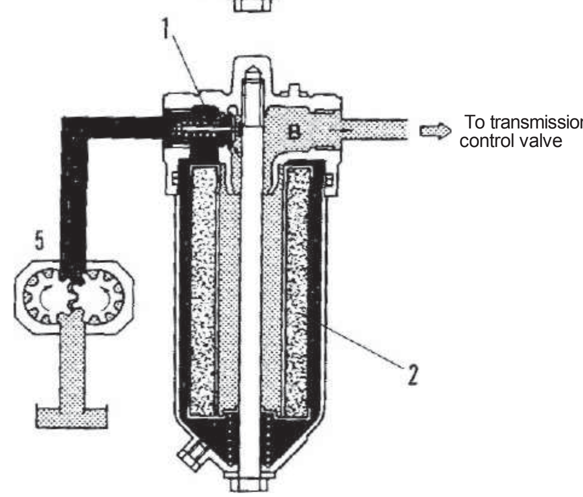
OPERATION

- The oil from the transmission pump (5) enters the filter inlet port A and passes from the outside of element (2) to the inside. It then flows to the outlet port B.
- If the element is clogged with dirt, or the oil temperature is low, the pressure at the inlet port rises. When this happens, the oil from the inlet port A opens relief valve (1) and flows directly to the outlet port. This prevents damage to the pump or filter (2) element
- While mounting ensure the direction of connectivity by checking the arrow mark on the filter casing.

INLET OUTLET







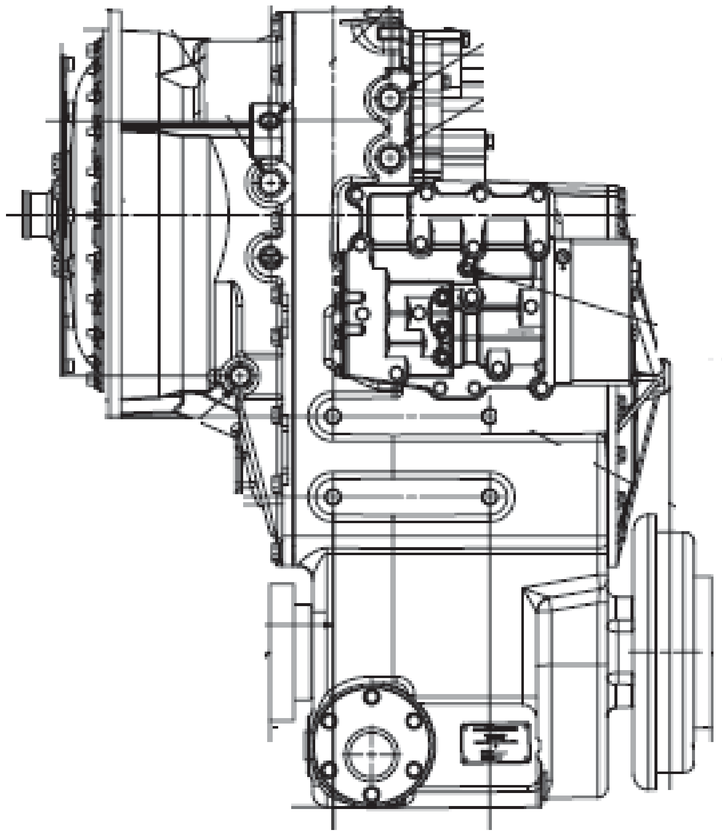
TORQUE CONVERTER OIL COOLER

OUTLINE

- The oil which comes out from the torque converter outlet port b is at a high temperature because of the energy used in transmitting the motive force. This torque converter oil passes through oil inlet port a and enters the oil cooler. Here it is cooled by air and cooled oil flows to transmission

POWERSHIFT TRANSMISSION

EXTERNAL VIEW OF TRANSMISSION



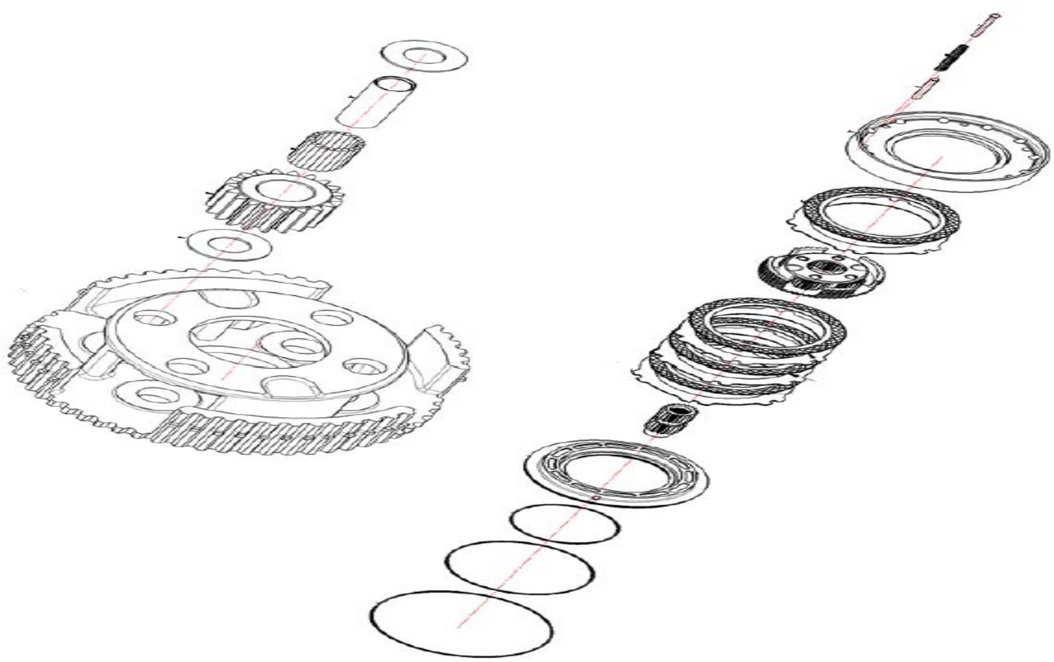
OUTLINE

- This is a Direct mount Transmission consisting of 2 Forward and 1 Reverse with hydraulically actuated clutches and dry shoe type parking brake on the front output shaft. The shifting is done through electric shifter which controls the operating of respective spools on transmission control valve for both Direction and Speed.

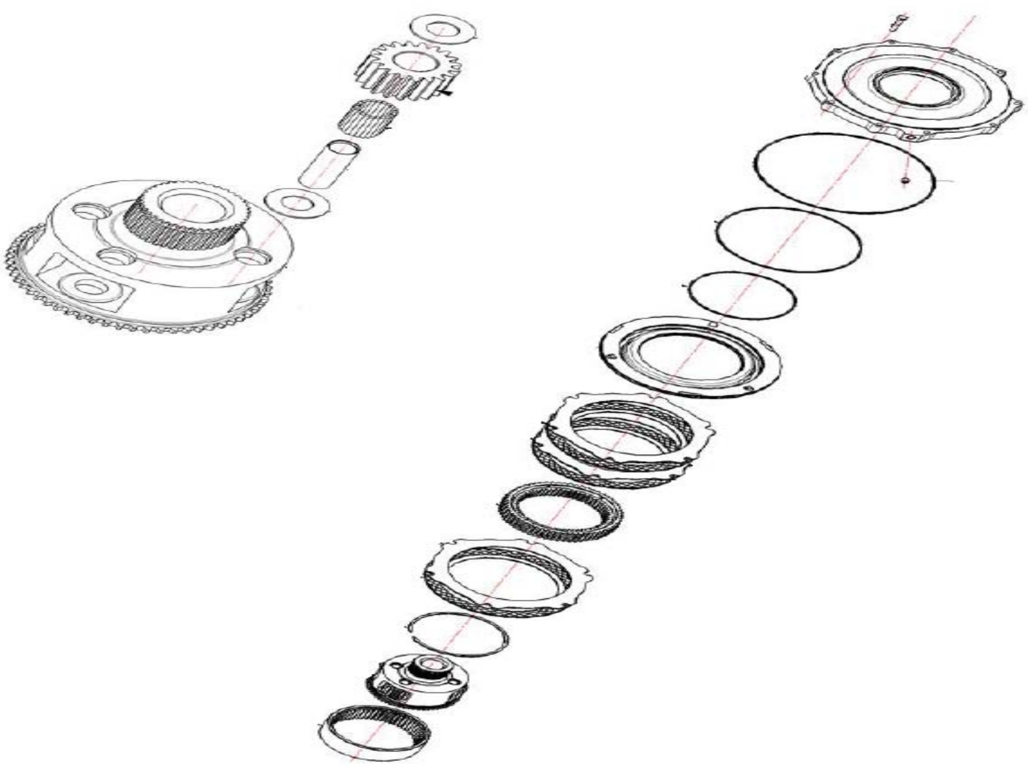
Travel Speed : F1 - 7 kmph
F2 -36kmph
R1 -16 kmph

CLUTCH PACK

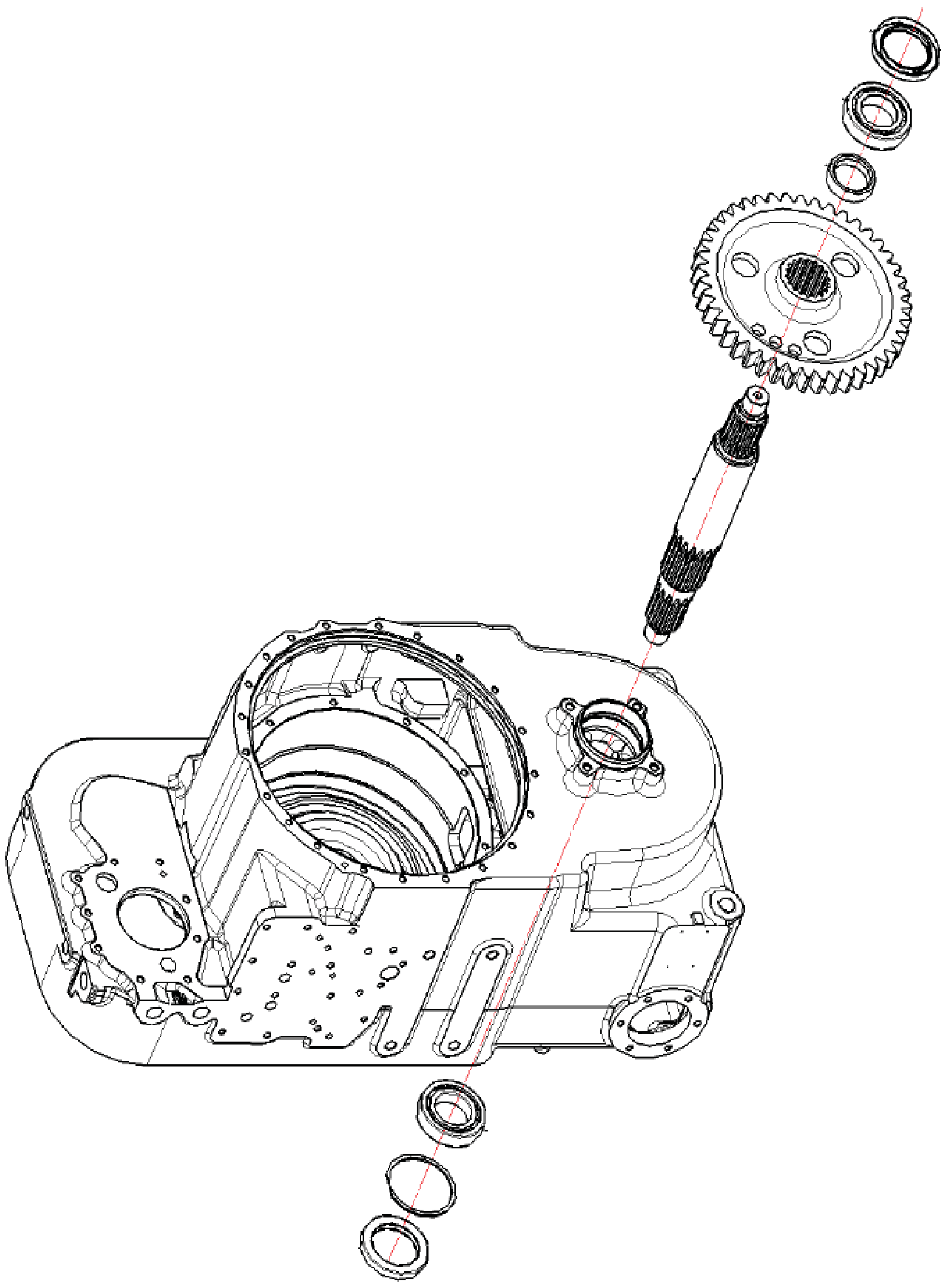
REVERSE CLUTCH



FOEWARD CLUTCH



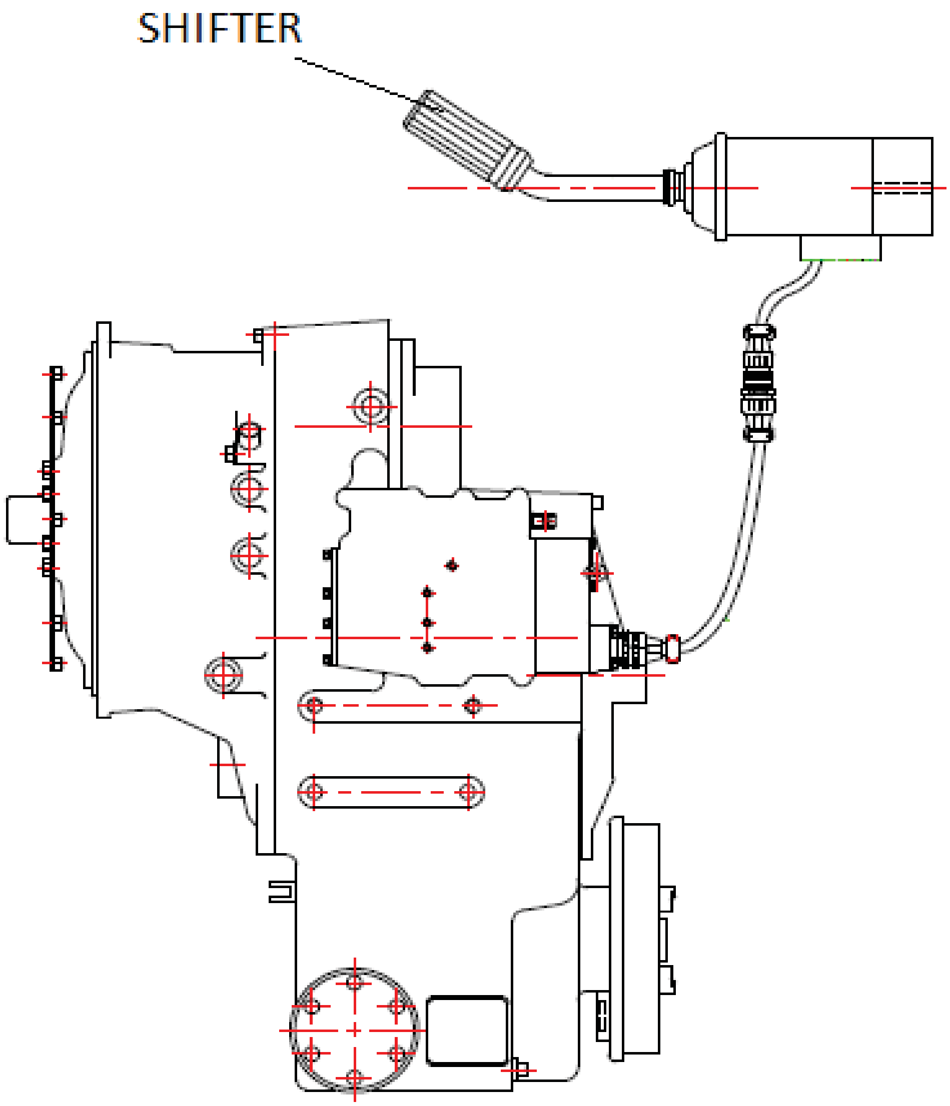
OUTPUT SHAFT ASSEMBLY



OPERATION OF CLUTCH

REFER M/s.AVTEC MANUAL

TRANSMISSION CONTROL



The transmission is electrically operated gear shift levers. The levers are in turn connected to the transmission control valve. The spool movement in the control valve results in changing of direction and adjusting speed of the vehicle.

PRIORITY VALVE, RELIEF VALVE

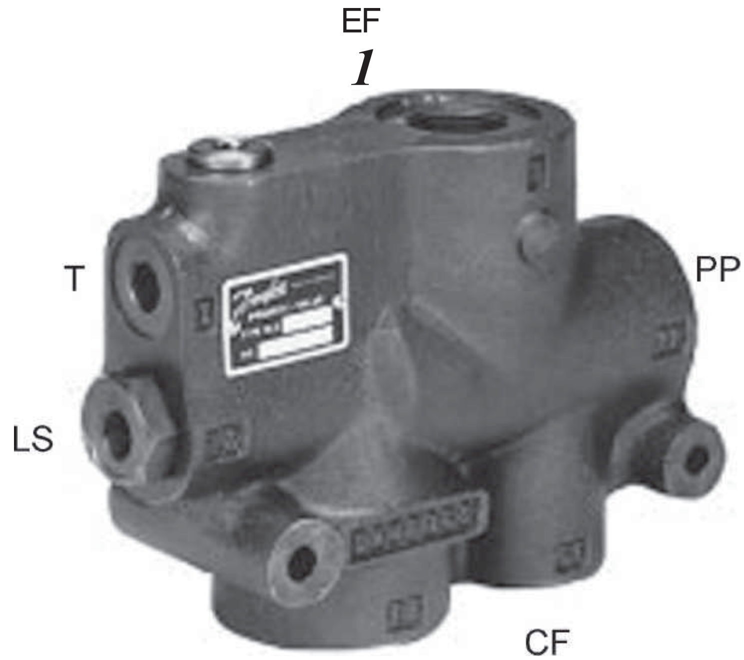
FUNCTION

- The priority valve gives priority to the oil sent to the pilot circuit of the lower valve. It also acts as a main relief valve to maintain the maximum pressure at the specified level.

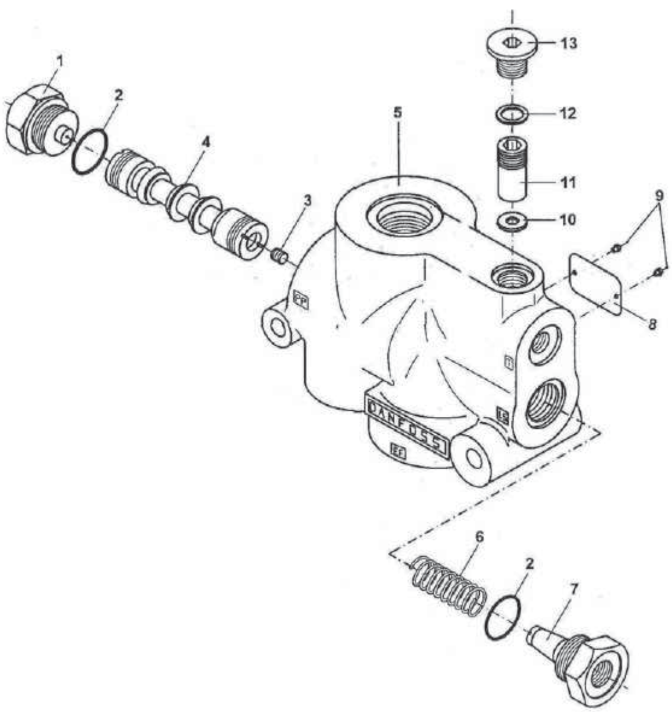
OPERATION

When the steering wheel is turned, the oil flow is distributed in the priority valve in such a way that the oil flow necessary for steering is led to the steering unit through the CF connection. The remaining oil flow is available for the working hydraulics through the EF connection. The distribution is controlled by the LS signal from the steering unit, so that the oil flow to the steering unit is always determined by the actual steering rate.

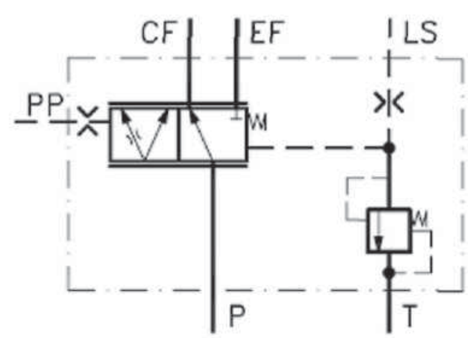
PRIORITY VALVE P



1 To steering unit
To working hydraulics



PRIORITY VALVE CIRCUIT

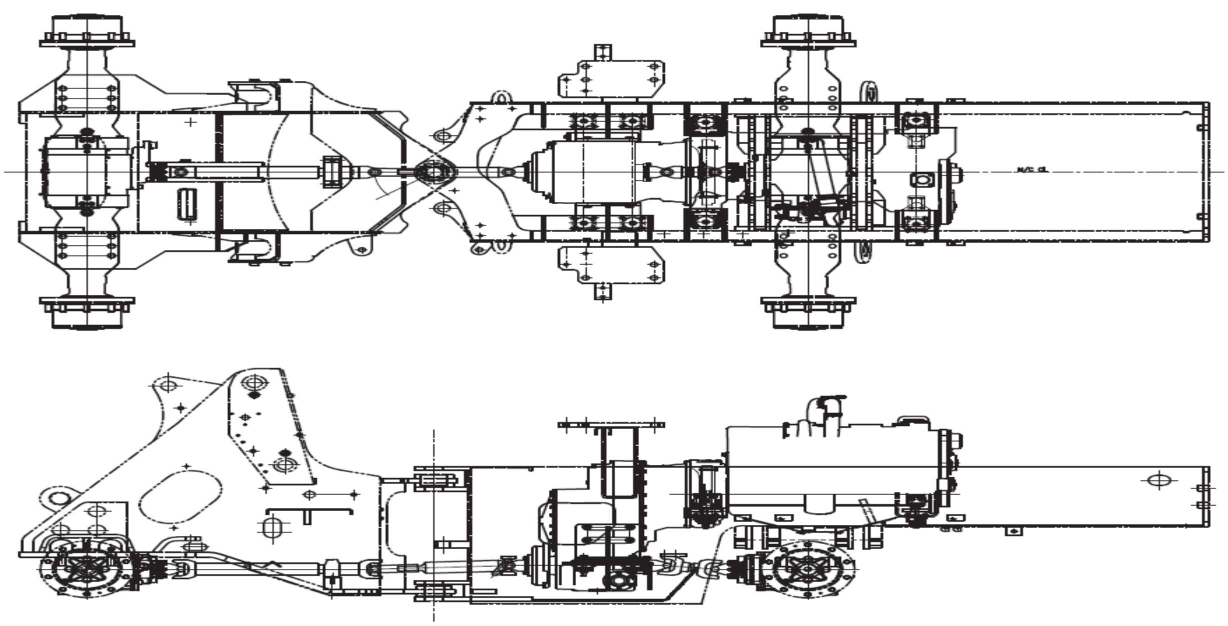


DRIVE SHAFT

OUTLINE

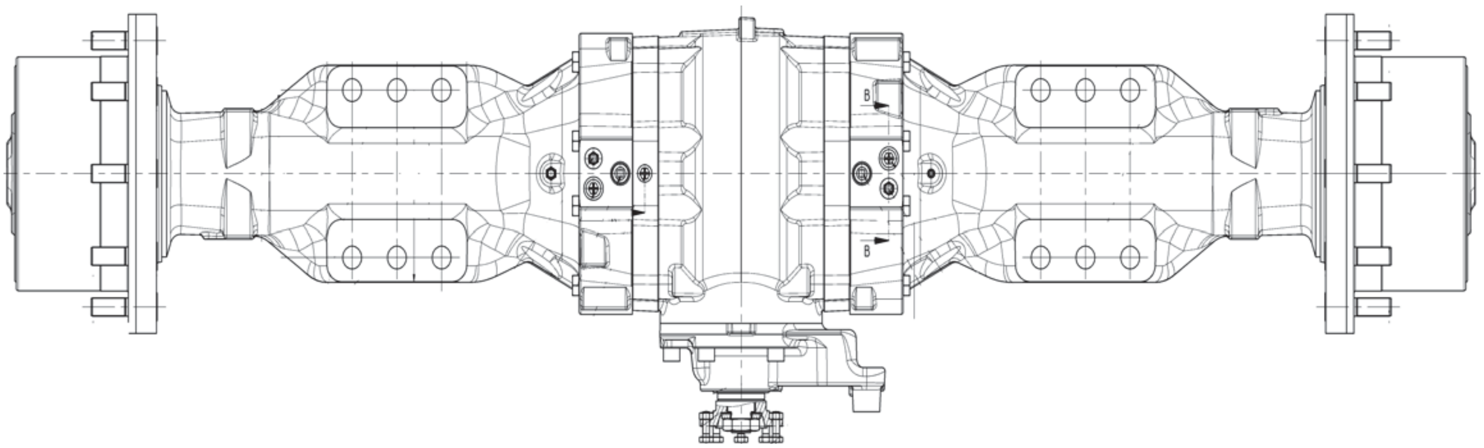
- The motive force from the engine passes through the torque converter, transmission and transfer. Part of this motive force passes through rear drive shaft (4) and goes to the rear axle; the rest of the motive force passes through center drive shaft (3), flanged bearing (2) and front drive shaft (1) and is sent to the front axle. In addition to transmitting the motive force, the drive shafts have the following purposes.

When the body is articulated, or when there is shock from the road surface during traveling, or when there is shock during operations, the axles in front and behind the engine and transmission change position.
To allow the motive force to be transmitted without damage to parts of the machine when there is shock or when the components move position, the drive shafts have a universal joint and a sliding joint. This allows them to handle changes in angle and length.



AXLE

FRONT

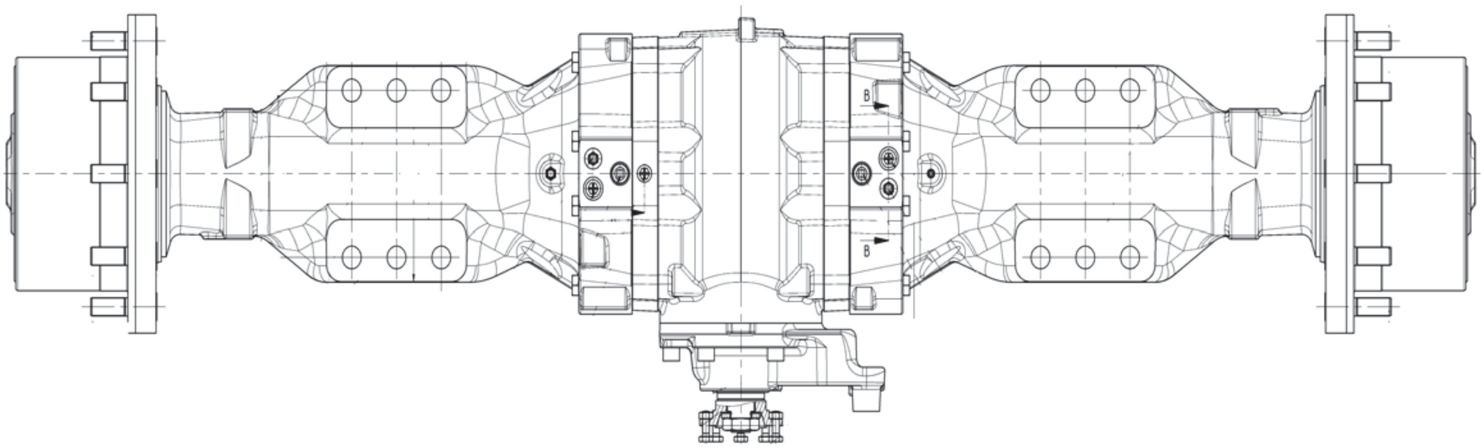


PLANETARY REDUCTION

OUTLINE

- The motive force from the engine passes through the torque converter transmission and drive shaft and is transmitted to the front and rear axles.
- Inside the axle, the motive force is transmitted from the pinion gear to the ring gear, and is sent at right angles. The speed is reduced and it passes through the differential and is transmitted to the sun gear shaft.
- The motive force of the sun gear is further reduced by the planetary-type final drive, and is transmitted to the axle shaft and wheel.

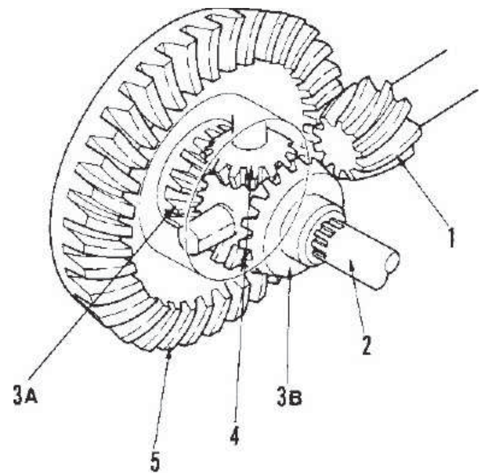
REAR



- Total reduction ratio: 22.69
- Brake operating pressure:20 bar
- Applicable for both front and rear axle

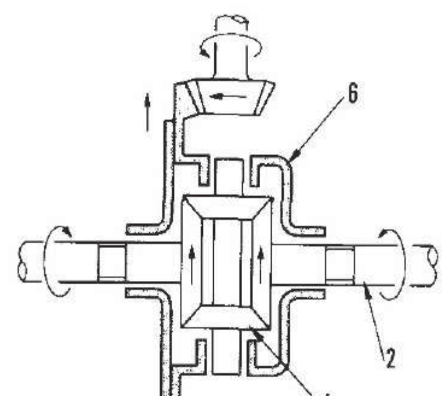
GENERAL

- Power from the engine is transmitted to the front and rear axles through the torque converter, transmission, and propeller shaft.
- In the rear axle, power is transmitted from pinion gear (1) to bevel gear (5). That is, the direction of power is changed 90° while reducing the gear speed and is transmitted to sun gear shaft (2) through differential (4).
- Power from the sun gear is transmitted to the axle shaft and wheels reducing the gear speed in the planetary gear type final drive.



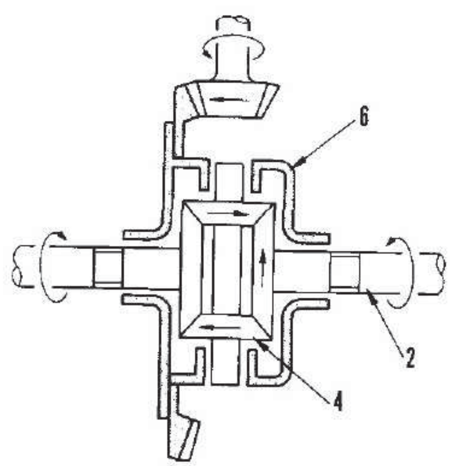
When driving straight forward

- When the machine is driven straight forward, the rotating speed of the left and right wheels is the same, so the pinion gear (4) inside the differential assembly does not rotate. The motive force of the carrier (6) is sent through the pinion gear (4) and the side gear (3) and is transmitted equally to the left and right sun gear shafts (2).



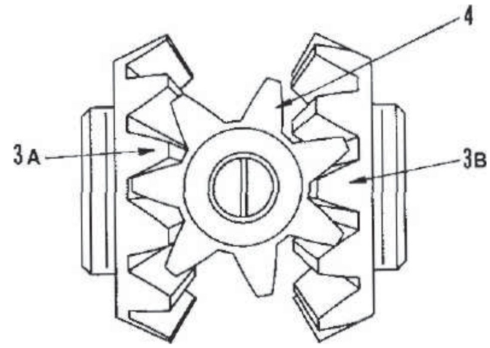
When turning

- When turning, the rotating speed of the left and right wheels is different, so the pinion gear (4) and side gear {3) inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels The motive force of the carrier (6) is then transmitted to the sun gear shafts (2).



FUNCTION

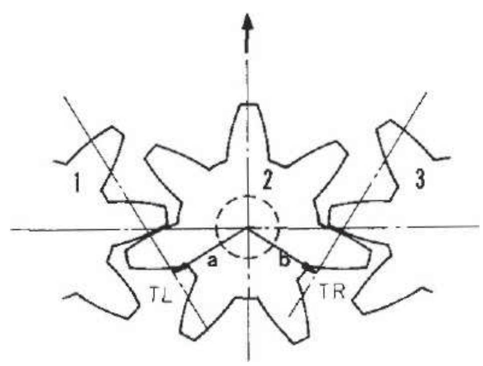
- Because of the nature of their work, 4-wheel-drive loaders have to work in places where the road surface is bad. In such places, if the tires slip, the ability to work as a loader is reduced, and also the life of the tire is reduced. The torque proportioning differential is installed to overcome this problem.
- In structure it resembles the differential of an automobile, but the differential pinion gear (4) has an odd number of teeth Because of the difference in the resistance from the road surface, the position of meshing of the pinion gear (4) and side gear (3A), (3B) changes, and this changes the reaction of the left and right tires.



OPERATION

When traveling straight (equal resistance from Road surface to left and right tires)

- If the resistance from the road surface to the left and right wheels is the same, the distance between the pinion gear and the mesh point "a" of the left side gear is the same as the distance between the pinion gear and meshing point "b" of right side gear (3B).
- Therefore the left side traction TL and the right side traction TR are balanced.



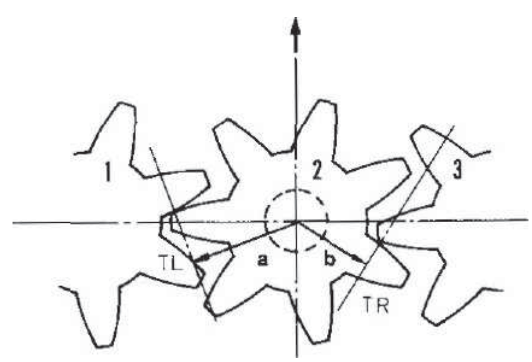
When traveling on soft ground (resistance from road surface to left and right tires is different)

- On soft ground, if the tire on one side slips, the side gear of the tire on the side which has least resistance from the road surface tries to rotate forward. Because of this rotation, the meshing of the pinion gear and side gear changes.
- If left side gear (3A) rotates slightly forward, the distance between the pinion gear and the meshing point "a" of the left side gear becomes longer than the distance between the pinion gear and the meshing port "b" of the right side gear. The position is balanced as follows.

  a x TL = b x TR

  The ratio between the distances to 'A" and "b" can change to 1:1.38.

  Therefore when the ratio of the distances to "a" and "b" is less than 1:1.38 (that is, the difference between the resistance from the road surface to the left and right tires is less than 38%), the pinion gear will not rotate freely, so drive force will be given to both side gears, and the tires will not slip. Because of this effect, the tire life can be increased by 20 — 30%, and at the same the operating efficiency is also increased.

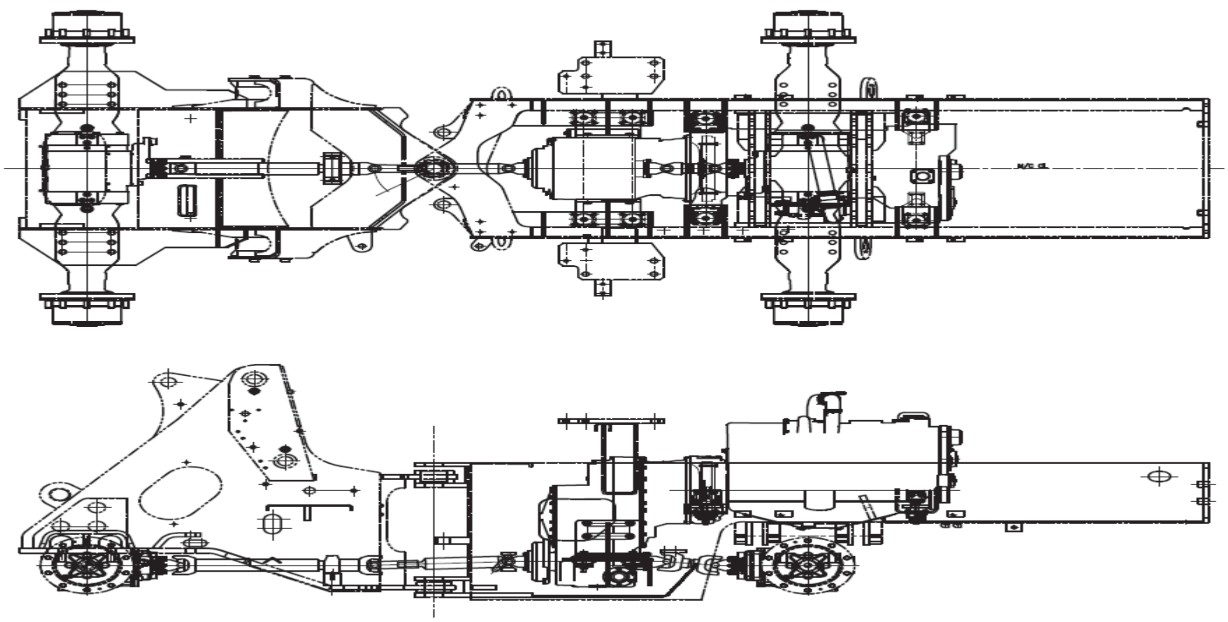


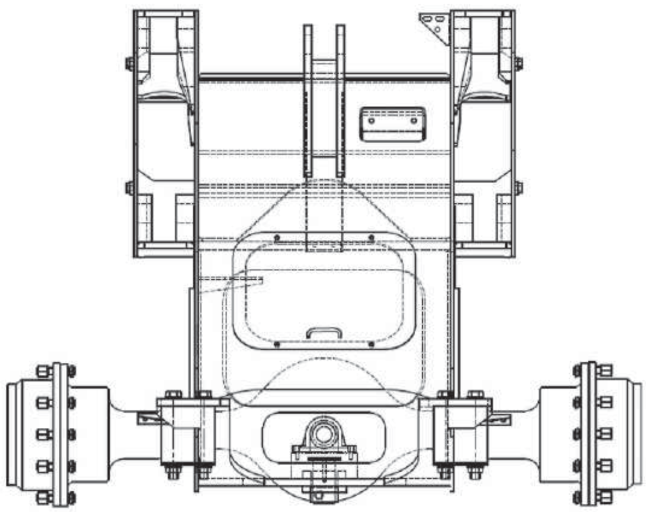
FINAL DRIVE

OUTLINE

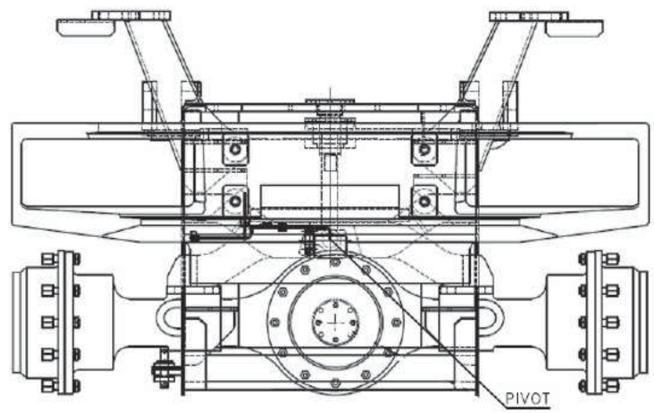
• The final drive makes the final reduction in speed of the motive force from the engine to increase the drive power. the motive force from the differential passes through sun gear shaft and enters the planetary gear system. Here the rotating speed is reduced and the drive power is increased. The increased drive power is then transmitted by planetary carrier and axle shaft to the wheels.

AXLE MOUNT





FRONT AXLE



REAR AXLE

Front axle

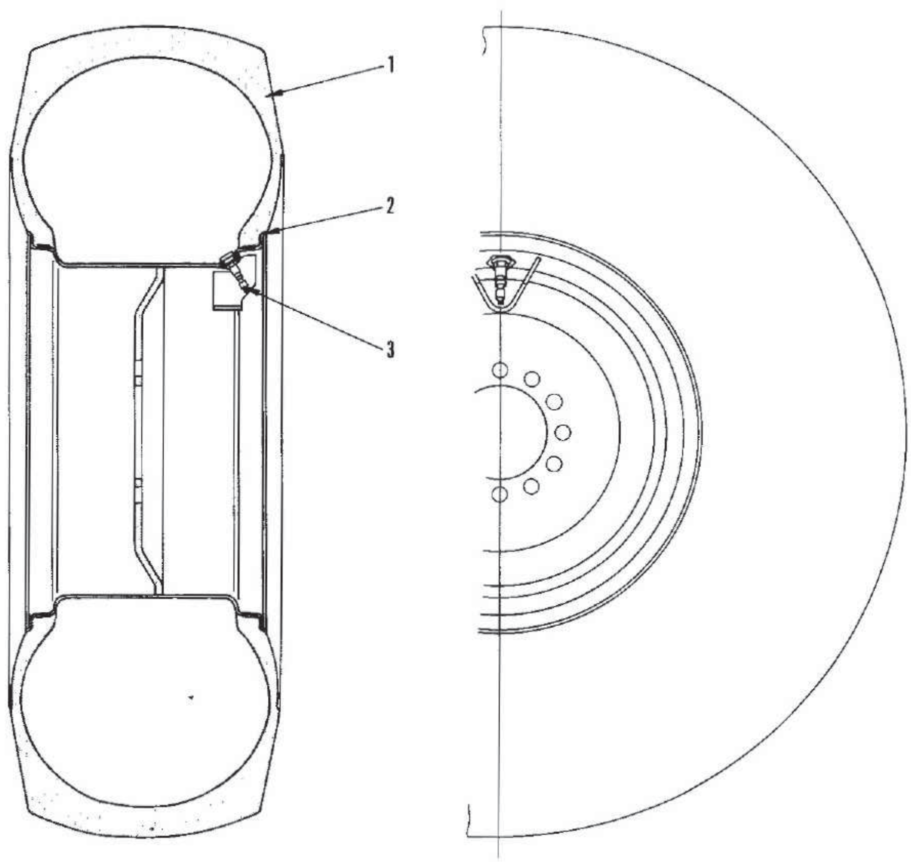
- The front axle receives the force directly during operations, so it is fixed directly to the front frame by tension bolts .

Rear axle

- The rear axle has a structure which allows the center of the rear axle to float, so that all tires can be in contact with the ground when traveling over soft ground.

TIRE AND WHEEL

- The tires act to absorb the shock from the ground surface to the machine, and at the same time they must rotate in contact with the ground to gain the power which drives the machine.
- Various types of tires are available to suit the purpose. Therefore it is very important to select the correct tires for the type of work and bucket capacity.



1. Tire
2. Rim
3. Air valve

Specification
Tire size: 14x25x20Ply (Tubeless)
TRA code: L3
Wheelsize: 10x25x1.5 Air
Pressure 5 bar

POWER TRAIN
06 TESTING AND ADJUSTING

* * The following precautions are necessary when using the Standard Value Tables to make judgments during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.
2. The standard values in these tables for judgment when troubleshooting are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgments.
3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgments.

STANDARD VALUE TABLE

Testing and measuring item	Measurement condition	Unit	Standard value	Permissible value
Engine stall speed	Coolant temperature:			
• Low idling	Inside operating range-	rpm	800	800±50
• High idling	Hydraulic temperature: 45 - 55°C	rpm	2450	2450 ±50
• Torque converter stall	Torque converter oil	rpm	2180	2180±5%
Shift lever operating force	• Torque converter oil			
and stroke	temperature: 60 - 80"C	kg		
• Directional lever operating force	• Engine speed: Low idling			
N-F		kg	3	3±5%
N-R		kg	3	3±5%
• Speed lever operating force				
1st-2nd		kg	3	3±5%
				_5%
♦ Directional lever travel		mm		
N-F		mm	12	12
N-R		mm	12	12
• Speed lever		mm		
1st-2nd			12+12	12+12
Oil pressure of torque converter	• Engine speed: High idling			
and transmission	• Coolant temperature:	bar		
	Inside operating range		15~17	
♦ Priority oil pressure	max	bar	210	210
• Pilot reducing pressure	max	bar	30	30
• All clutch oil pressure	• Torque converter oil	bar	18	16~19
	temperature: 60 - 80°C			
• Lubrication valve oil pressure		bar	2	1.5~2.5
• Torque converter outlet oil pressure		bar	2	1.5~2.5
Tire and wheel	Tire inflation pressure:	bar	5	4.5~5.5

MEASURING ENGINE STALL SPEED

- Measurement condition
- Coolant temperature: Inside operating range.
- Hydraulic oil temperature: 45 — 55°C
- Torque converter oil temperature: 60 — 80°C

Unit: rpm

Item		Standard value
Eng speed	Low idling	800±50
	High idling	2400±50
	Torque converter stall	2180±5%

* Check that the low idling and high idling speeds are within the standard value.
* Before measuring the stall speeds, install tachometer A to engine speed pick up (1) on the engine block.
* Check that the engine speeds are within the standard value. If any item is outside the permitted range, check for any looseness and play in the linkage.

⚠ Apply the parking brake and block the tires.

1. Measuring torque converter stall

1) Start engine and run at low idling.
2) Put the directional lever in FORWARD or REVERSE, and speed control lever in the highest. speed range.
3) Using the brake, stop the machine and measure the engine speed when the engine reaches high idling.
   * Turn the transmission cut-off valve switch to OFF, and use the left brake. (Check that the pilot lamp is OFF.)
   * Do not run at stall speed for more than 20 seconds, and do not let the torque converter oil temperature rise above 120°C

2. Measuring hydraulic stall

1) Start engine and run at high idling.
2) Operate the dump or lift lever to move the cylinder to the stroke end and actuate the relief valve of the main control valve.
3) Measure the engine speed at this point.
   * Do not run the engine at stall speed for more than 20 seconds, and operate the control lever quickly.

3. Measuring full stall

Measure the engine speed when torque converter Stall and hydraulic stall are reached at the same time.

* Measure full stall when both the torque converter and hydraulic stall speeds are normal. If either stall speed is abnormal, remove the abnormality and measure the stall speed again.

MEASURING OIL PRESSURE OF TC AND TRANSMISSION

- Measurement condition
- Coolant temperature: Inside operating range
- Torque converter oil temperature: 60 — 80°C

Unit: kg/cm^2

Item	Standard value	Permissible value
Relief Pressure	14	14
All clutch oil pressure	18	18

Apply the parking brake and block the tires.

1. Measuring procedure

* The following preparatory work is necessary before measuring any oil pressure.
  - Remove the covers on both sides of the rear frame.
  - Remove the plug from the measuring port of the transmission valve.
  - Install hydraulic tester to the measuring port, pull the gauge to the operator's compartment, then start the engine and measure the pressure.

* Check that there is no leakage of oil from any joints

2. Measuring priority pressure

1) Start the engine and measure the pressure at low idling and high idling.

3. Measuring pilot reducing pressure

1) Start the engine and measure the pressure at low idling and high idling.

4. Measuring all clutch pressure

1) Start the engine and measure the pressure when the directional and speed control levers are operated.

5. Measuring lubrication valve pressure

1) Start the engine and measure the pressure at high idling.

* The lubrication valve pressure is extremely low, so be careful when selecting the pressure gauge.

6. Measuring torque converter outlet pressure

1) Start the engine and measure the pressure at high idling.

MEASURING SHIFT LEVER

Unit: kg

Item			Standard value
Operating force	Directional lever	Neutral—Forward	3 kg
		Neutral—*Reverse	3 kg
	Speed lever	1st-2nd	3 kg
Travel	Directional lever	Neutral—Forward	12 mm
		Neutral—Reverse	12 mm
	Speed lever	In each range from 1 st to 2nd speeds	12 mm

⚠ Be sure to set chocks firmly against the tires.

1. Measuring the lever operating force

1) Stop the engine.
2) Attach push-pull scale A or a spring balancer to the lever knob at the center and measure the operating force required to pull it in the operating direction.

* The measurement should be made in each speed range.

2. Measuring the lever travel

1) Stop the engine.
2) Put mark "1" on the center of the control lever knob and measure the travel when the lever is moved in the operating direction.

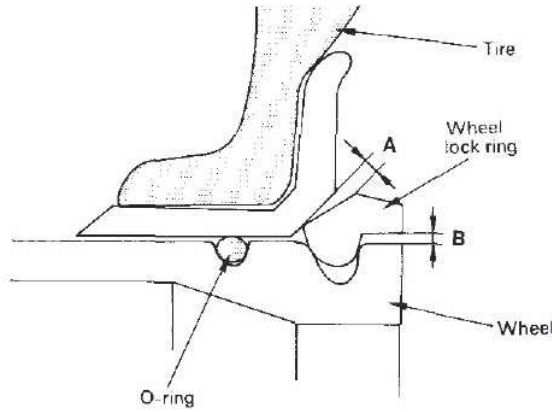
TIRE AND WHEEL

* Measurement condition

* Tire inflation pressure: Specified pressure

Unit: mm

Item	No.	Std value	Permissible value
Fitting of wheel lock ring	A	Max-2.5	Max. 2.5
	B	Max. 4.5	Max. 4.5
Clearance of wheel lock ring	C	2-12	2-12



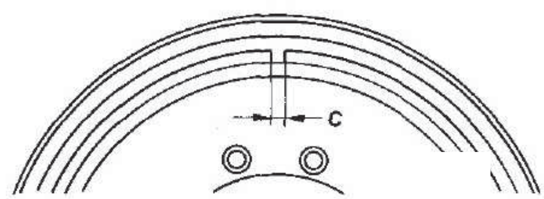
1. Measuring procedure

1) Fitting of wheel lock ring

Measure dimensions A and B with a feeler gauge.

2) Clearance of wheel lock ring

Measure dimension C.



TROUBLESHOOTING

PRECAUTIONS WHEN TROUBLESHOOTING

1. SAFETY

- Stop the machine on a level ground, and check that the safety pins and parking brake are correctly applied, and that the tires are blocked.
- When working in groups use agreed signals and do not allow unauthorized persons near the machine.
- Be careful not to get burned by hot parts or to get caught in rotating parts.
- Always disconnect the cable from the negative (—) terminal of the battery before disconnecting any wiring.
- Always release the pressure before removing the plugs or caps of any place under hydraulic or air pressure, and connect all measuring tools correctly.

2. METHODS FOR TROUBLESHOOTING

- Just because a failure occurs, do not immediately start to disassemble the machine.

If the machine is disassembled before making the proper checks,

- The machine may be disassembled in such a way that the problem cannot be located, so the cause of the problem will be unknown.
  As a result,
- The customer and operator will lose confidence in you.
- Time will be wasted, and unnecessary costs will be incurred for excess parts and greasing.

To avoid these problems, use the following procedure when troubleshooting.

1. Ask the customer and operator the following questions about the breakdown.

a. Have there been any other problems apart from the one reported?
b. Was there anything unusual before the machine broke down?
c. Did the breakdown occur suddenly, or had there been signs of trouble before?
d. What was the machine doing when the breakdown occurred?
e. Had the machine been repaired before the breakdown? If so, who carried out the repair, and when?
f. Had the same kind of failure occurred before?

2. Check the following items which can be checked simply by visual checks etc.

a. Check oil Level.
b. Check for leakage of oil from piping or hydraulic equipment.
c. Check travel of control levers.
d. Check stroke of spool in control valves.

3. Re-enact the failure and check the condition of the machine (particular conditions at the time of failure)

a. Ask the user or operator if the decision about the failure was made based on measured values, or by comparison, or by feeling.
b. Compare extent of failure with standard values.
   - Check safety before carrying out any check.
   - Did not make any check or measurement that will make the condition worse.

4. Try to locate the possible causes for the failure

The transmission system consists of the transmission itself, the transmission control valve, and the transmission electric control.
In particular, when trouble occurs in the transmission system, the probable location of the failure can be divided as follows.

- Transmission itself, or transmission control valve
- Transmission electric control

To decide which of these two is the location of the failure, go to page 22-1 7.

5. Carry out troubleshooting using the troubleshooting charts.

There are the following two types of troubleshooting charts.

1. TROUBLESHOOTING TABLE.…	POWER TRAIN, STEERING SYSTEM, BRAKE SYSTEM, WORK EQUIPMENT SYSTEM
2. TROUBLESHOOTING FLOW CHART..	ELECTRIC AND ELECTRONIC SYSTEM

The troubleshooting charts consist of:

1) Items which can be checked easily

2) Items which are likely to be the cause of such failures.

Follow these charts to carry out troubleshooting.

At the same time, do not forget the following points.

- Check related items.
- Check that there are no other failures or breakdowns.

6. Investigate causes of breakdown

- Even if the breakdown is repaired, if the original cause of the problem is not removed, the same breakdown will occur again. To investigate and remove the original cause, see "Actions to take to prevent failures from occurring again".

3. PRECAUTIONS WHEN REMOVING, INSTALLING, DISASSEMBLING OR ASSEMBLING PARTS DURING TROUBLESHOOTING

- If it is necessary to remove, install, disassemble or assemble parts for troubleshooting, remember the following points.
- Carry out the various testing and adjusting while observing the items on quality control given in "Testing and Adjusting".
- When removing parts, check their condition of mounting, and distinguish between front and rear, left and right, and top and bottom.
- Check the match marks, or make match marks to prevent mistakes when installing.
- If a part cannot be removed even when the nuts and bolts have been removed, do not use excessive force to remove it. Check the part to see if there is any problem with it, and remove the problem before trying to disassemble the part.
- When installing or assembling, clean off all dust and dirt and repair any scratches or dents.
- Remove all grease or oil before coating with gasket sealant.

METHOD OF READING TROUBLESHOOTING TABLE

DESCRIPTION OF SYMBOLS USED IN TROUBLESHOOTING TABLE

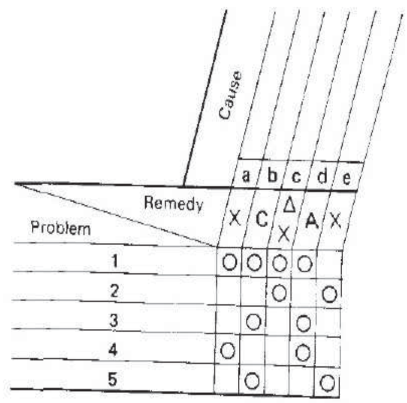
The following symbols are used in the "Remedy" column to indicate the method of eliminating the cause of a fault.

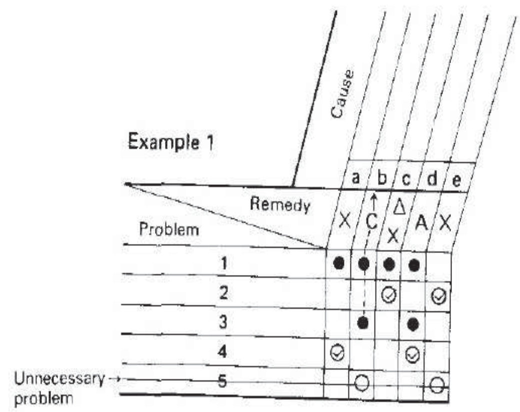
X: Replace; A; Repair
A: Adjusting; C: Clean

METHOD OF READING TROUBLESHOOTING TABLE

- The symbol o in the table is inserted only for causes which can be diagnosed- If a cause cannot be diagnosed, the corresponding box is left blank.

- If the result of problem 1 using the troubleshooting table shown at right is abnormal, the cause of the trouble can be assumed to lie between "a" and "d". Because it is not possible to make a problem regarding "e", it is necessary to perform the next problem (owing to the possibility of a multiple fault).
- If the result of problem 1 is normal, the cause of the fault does not lie between "a" and "d". In such a case, before diagnosing the cause as "e", however, carry out a check by means of problem 2 or 5
- If now the result of problem 1 is abnormal and the result of problem 2 normal, the cause is one of "a", "b" or "d". In addition, if the result of problem 3 is abnormal, the cause will be narrowed down to one of "b" or *"d".* To determine which of "b" or "d" the actual cause is, perform problem 4.
- If the result of problem is abnormal, blacken out the corresponding C in the table and then perform the next problem on these causes in order to narrow the likely causes.

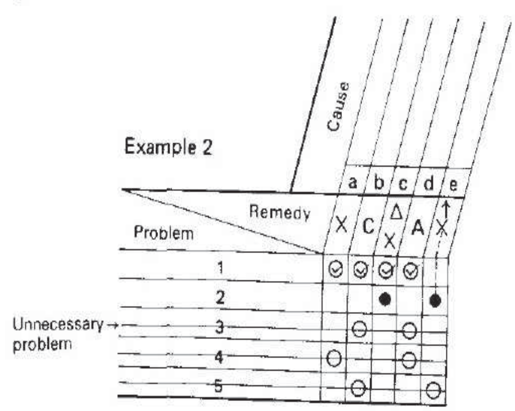




Example 1:

Problem 1— Abnormal
Problem 2—.Normal
Problem 3—'Abnormal
Problem 4—Normal

From the table of example 1, the cause of the fault is "b".



Example 2:

Problem 1 Normal
-Problem Abnormal

From the table of example 2, the cause of the fault is "e".

- In example 2, it is evident that the cause is "e" without carrying out problem 2; however problem 2 is performed by way of an additional check.

Example 3:

Problem 1→Abnormal
Problem 2→Normal
Problem 3→Normal

From the table of example 3, the cause is one of "a", "c" and "e".

Continue problems

Problem 4→Normal
Problem 5→Normal

From the table of example 3-1, the cause is "c".

Example 3

Problem \ Cause	a	b	c	d	e
Remedy	X	C	Δ X	A	X
1	●	●	●	●	
2			●		●
3		⊘		⊘	
4	○			○	
5		○			○

Example 3-1

Problem \ Cause	a	b	c	d	e
Remedy	X	C	Δ X	A	X
1	●	●	●	●	
2			●		●
3		⊘		⊘	
4	⊘			⊘	
5		⊘			⊘

Example 4:

Problem 1→Abnormal
Problem 2→Normal

From the table of example 4, the cause is one of "a", "b" or "d".

Continue problems

Problem 3→Abnormal
Problem 4→Abnormal
Problem 5→Normal

From the table of example 4-1, the cause is "a" or "d".

As can be seen from the above examples, it is not necessary to perform all of the problems.
Also, looking at a particular cause, no matter how many • marks there are in the column corresponding to that cause, it will cause to be an actual cause if there is even one ○ mark in the same column.

Example 4

Problem \ Cause	a	b	c	d	e
Remedy	X	C	Δ X	A	X
1	●	●	●	●	
2			⊘		⊘
3		○		○	
4	○			○	
5		○			○

Example 4-1

Problem \ Cause	a	b	c	d	e
Remedy	X	C	Δ X	A	X
1	●	●	●	●	
2			⊘		⊘
3		●		●	
4	●			●	
5		⊘			⊘

PREVENTING RECURRENCE OF TROUBLE

- The troubleshooting table is used to establish the direct cause of damage or breakdown of a part or piece of equipment. It is not able to establish the root cause of the damage or failure, however.
- Also, this table only describes the action to be taken with the particular part or piece of equipment. It does not mention what action should be taken to prevent a recurrence of the root cause.
- In order to remove the root cause of a fault so as to prevent a recurrence, carefully investigate the real cause while referring to the following items.
- Regarding the method of checking and adjusting each part or piece of equipment, refer to "Testing and adjusting" in the Shop Manual.

HYDRAULIC EQUIPMENT

1. Oil checks

- The fundamental cause of almost all faults occurring in hydraulic equipment is the inclusion of water, air or other foreign matter in the oil. Accordingly, it is necessary to check the oil to see whether or not it contains any of the above substances, and then take appropriate action.

1) Oil checks
   - Check for water ingress
     Check the oil for possible water ingress by means of a diesel engine oil checker or a hot plate.
   - Check for ingress of other foreign matter
     Remove the drain plug and filter, then check the bottom of the tank and also the filter to see if any foreign matter has collected there. Check the degree of contamination by means of a contamination checker.
   - Viscosity check
     Check the viscosity of the oil using a viscometer in order to confirm whether or not the oil is satisfactory.

2) Check of ingress point ,
   If, as a result of the above checks, it is discovered that the oil is contaminated by water or other foreign matter, it is necessary to find out where the contamination is occurring and also the take steps to prevent it.
   Water: Oil storage tank, breather, etc. Sand: Oil replenishing or replacing method, etc.
   Rubber: Cylinder packing, etc.
   Metal: Wear or damage to hydraulic equipment such as pump and motor, as well as transmission and torque converter, etc.

3) Oil cleaning and replacement
- If a large amount of metal particles or other foreign matter is discovered in the oil, either wash the oil using an oil refresher or replace it.
  * If the oil is contaminated by water, it is not possible to remove the water by means of an oil refresher.
  * When washing the oil, also wash or replace the strainer and replace the filter.

Cleaning fragments of damaged parts

If a part becomes damaged, fragments may pass into the oil line. It is thus necessary to wash the oil. In addition, disassemble and wash such parts as valves and cylinders which are liable to collect metal fragments and other foreign matter, thus helping to prevent a recurrence of faults due to such fragments becoming lodged in various parts of the engine or hydraulic equipment.

TROUBLESHOOTING TABLE T/C AND TRANSMISSION

1. Machine does not move off.

Ask the operator the following questions.

- Did the machine suddenly stop moving? —The seizure or damage to internal parts.
- Was an unusual noise emitted from machine? —• damaged parts

Checks before troubleshooting

- Is the machine monitor functioning normally?
- Is quantity of oil in transmission and also type of oil correct?
- Is the transmission filter or strainer clogged?
- Has oil in transmission deteriorated or does it emit a burnt smell?
- Is there any damage or oil leakage which can be discerned by viewing the exterior of the machine?
- Is the transmission drive shaft broken?
- Is wheel brake (including emergency brake) or parking brake locked?
- Is the electrical circuit in transmission normally?

.

No.	Cause	a	b	c	d	e	f	g	h	i	j
		Air being sucked into suction side of charging pump	Faulty charging pump	Charging pump not driven (faulty PTO)	Torque converter internally damaged (bearing, turbine, pump, stator, seal, etc.)	Torque converter relief valve malfunction	Transmission control valve internally damaged	Faulty pressure regulator valve for transmission clutch	Faulty operation of control valve (seizure due to foreign matter)	Faulty operation of solenoid valve	Blocked orifice on control valve
		Charging pump			Torque converter		Transmission control valve				
	Problem / Remedy	△ X	X	△ X	△ X	△ X	X	△ X	△ X	△ X	C
1	Machine does not move off in any speed position.	○	○	○	○	○	○	○	○	○	○
2	Machine only moves off in a certain speed position.						○		○	○	
3	Machine does not move off when oil temperature is high		○								
4	The torque converter stall speed does not drop to the correct value for any speed position.				○	○	○	○			○
5	The torque converter stall speed does not drop to the correct value for a certain speed position.										
6	The torque converter charging pressure does not rise.	○	○	○	○	○					
7	The transmission clutch pressure does not rise for any speed position.	○	○	○			○	○			○
8	The transmission clutch pressure does not rise for a certain speed position.										
9	Metal particles (aluminium, copper, steel, etc.) adhere to the filter and strainer.		○		○						

Note: Disassemble the solenoid valve only in a clean and dry work shop because dust and moisture can cause the solenoid valve to fail. Replace the solenoid valve as an assembled unit when making the repair in the field.

2. Machine speed is low, thrust is weak, and grade ability falls off.

Fault check

- Measure the machine speed during excavation work and also when it is on flat and sloping ground, respectively, in order to determine whether the machine is actually faulty or whether the operator simply feels that the machine lacks power.

Checks before troubleshooting

- Is quantity of oil in transmission and also type of oil correct?
- Is the transmission filter or strainer clogged?
- is there any leakage of oil from pipe or valve connections?
- Is wheel brake or parking brake dragging?
- Are tire pressure and tire treading satisfactory?
- Is the method of performing work correct?

	Cause	Charging/Pump		Torque converter			Transmission/control valve		
		Air being sucked into suction side of charging pump	Faulty charging pump	Faulty torque converter regulator valve	Oil leakage inside torque converter (seal ring, bushing, snap ring, bearing, etc.)	Damage inside torque converter (bearing, pump, turbine, stator, etc.)	Fault inside transmission control valve (worn or scratched spool)	Faulty operation of clutch pressure regulator of control valve	Blocked orifice of control valve
		a	b	c	d	e	f	g	h
No.	Problem / Remedy	△ ×	△ ×	△ ×	△ ×	×	△ ×	△ ×	C ×
1	Machine is faulty in all speed positions.	○	○	○	○	○		○	○
2	Machine is faulty in a certain speed position.						○		
3	Charging pump emits an unusual noise when the oil temperature is low.	○							
4	Oil in torque converter overheats.	○	○		○	○			
5	High idling and low idling speeds of engine are abnormal.					○			
6	Each stall engine speed is abnormal.		○	○	○	○			
7	Torque converter relief pressure is low.	○	○	○	○	○		○	
8	Transmission clutch pressure: Low at any speed range	○	○					○	○
9	Transmission clutch pressure: Becomes low for at a certain speed position.						○		
10	Transmission clutch pressure: Pointer of pressure gauge deflects by a large amount and in an unstable manner.	○							
11	Quantity of oil in transmission fluctuates.								
12	Metal particles adhere to the transmission strainer or torque converter filter.		○			○			

Oil leakage from seal ring of transmission clutch pack shaft	Oil leakage from piston seal of transmission clutch	Internal damage to transmission	Blocked transmission air breather	Blockage in torque converter cooler circuit	Oil leakage from the loader and steering circuit pump shaft seal	Faulty engine
Torque converter and transmission circuit					Other parts	
i	j	k	l	m	n	o
△ X	△ X	△ X	C △	△ X	△ X	△ X
		○	○	○	○	
	○	○				○
			○	○	○	○
		○	○			
						○
		○				
	○	○				○
			○	○	○	
		○				

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace A: Repair
A: Adjust C: Clean

3. Large shock when moving off or changing gear.

Fault check

Because it is difficult to determine whether shock is abnormally large or normal, consider it large in the following cases.

- When a shock occurs which is clearly larger than any that has occurred so far.
- When the shock is large compared to that occurring on other machines of the same type.

Check before troubleshooting

- Is the low-idling speed of the engine too high?
- Is there excessive play in each drive shaft?

	Cause	Control valve			Trans-mission		
		Faulty transmission clutch pressure regulating valve	Seizure of accumulator piston	Faulty modulation valve	Faulty quick retun valve	Faulty piston return due to broken or flattened return spring of clutch pack	Blocked oil drain hole in circumferential direction of clutch pack cylinder
		a	b	c	d	e	f
No.	Problem / Remedy	△ X	△ X	△ X	△ X	△ X	C △
1	Large shock in all speed positions.	○		○			
2	Large shock in a certain speed position.						○
3	Clutch pressure excessively high.	○					

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace A: Repair
A: Adjust C: Clean

4. Large time lag when moving off or changing gear.

Check the following items with the operator.

- If the time lag is large and also the machine speed, thrust force and grade ability are abnormal, refer to item 2 "Machine speed is low, thrust is weak, and grade ability falls off".

Checks before troubleshooting

- Is quantity of oil in transmission and also type of oil correct?
- Is there any leakage of oil from valve or pipe connections?

	Cause	a	b	c	d	e	f	g
		Faulty accumulator	Blocked orifice of transmission control valve	Faulty quick return valve	Oil leakage due to wear of piston spool or bore	Oil leakage from transmission clutch pack and piston seal	Oil leakage from transmission clutch pack and shaft seal ring	Oil leakage from O-ring between transmission housing and valve
		Transmission control valve				Transmission		
No.	Problem / Remedy	△ X	C △	△ X	△ X	△ X	△ X	△ X
1	Large time lag at all speed positions.	○	○	○	○			
2	Large timg lag at a certain speed position.						○	
3	Low clutch pressure at all speed positions.		○		○			
4	Clutch oil pressure is low at speed stages having a large time lag.				○		○	

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace a: Repair
A: Adjust C: Clean

5. Oil temperature in torque converter is high.

Ask the operator regarding the following points.

- **If** the oil temperature rises when the torque converter stalls and falls when it is unloaded. Select the correct speed position.
- If the oil temperature rises only when pushing soil uphill. —• improve the working method.

Checks before troubleshooting

- Radiator water level and fan belt tension.
- Is quantity of oil in transmission and also type of oil correct?
- Is the transmission filter or strainer clogged?

Fault check

- Measure the temperature of the oil in the torque converter. Check temperature is really high —► Faulty oil temperature gauge

Cause		Charging pump		Torque converter			Transmission		Torque converter and transmission circuits		Other parts	
		Air being sucked into suction side of charging pump	Faulty charging pump	Faulty torque converter regulator valve	Oil leakage in torque converter (seal ring, bushing, snap ring, bearing, etc.)	Damage inside torque converter (bearing, pump, turbine, stator, etc.)	Faulty transmission clutch pressure regulator valve	Damage inside transmission	Blockage in transmission air breather	Faulty air bleed from torque converter cooler or blocked circuit	Oil leakage from the loader and steering circuit pumps shaft seal	Faulty engine
		a	b	c	d	e	f	g	h	i	j	k
No.	Problem / Remedy	△ ×	△ ×	△ ×	△ ×	×	△ ×	×	C ×	△ ×	△ ×	△ ×
1	Charging pump emits unusual noise when oil temperature is low.	○										
2	High idling and low idling engine speeds are abnormal.					○		○	○			○
3	Each stall engine speed is abnormal.		○	○	○	○						○
4	Machine speed, thrust force and gradeability are abnormal at all speed positions.	○	○	○	○	○	○	○	○	○		○
5	Machine speed, thrust force and gradeability are abnormal at a certain speed position.							○				
6	Torque converter outlet pressure is low.	○	○	○	○	○						
7	Transmission clutch pressure: Low at any speed range	○	○				○	○				
8	Transmission clutch pressure: Becomes low for at a certain speed position.							○				
9	Transmission clutch pressure: Pointer of pressure gauge deflects by a large amount and in an unstable manner.	○										
10	Quantity of oil in transmission fluctuates.								○	○	○	
11	Metal particles adhere to the transmission strainer or torque converter filter.		○			○		○				

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace A: Repair
A: Adjust C: Clean

POWER TRAIN

07 DISASSEMBLY AND ASSEMBLY

* For repairs, remove hydraulic components and piping such as, hydraulic cylinders and pumps. Be sure to use the following method for air bleeding when starting to operate hydraulic cylinders after reassembling.

1. Start engine. Keep in low idle.
2. When moving the hydraulic cylinders by operating the control levers, move the hydraulic cylinders 4 — 5 times, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 3 — 4 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

   NOTE: After long storage, same procedure is required.

REFER M/s.AVTEC MANUAL

REMOVAL OF TORQUE CONVERTER, TRANSMISSION

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

⚠ Open the hood and fit the lock.

1, Draining off

Drain the hydraulic oil from Hydraulic tank by opening the plug below the Hydraulic tank

- Drain Transmission oil from Transmission sump

Transmission oil: 32 lit

2.Hydraulic piping

Disconnect the suction and delivery pipes from Hydraulic pump and transmission pump.

3.Removal of Torque converter

Hold the Torque converter in position with the help of proper fixture.

Remove the side cover of the Torque converter for removing the bolts of fly wheel adaptor plate.

Loosen the bolts of Flywheel adaptor plate which is used to connect the flywheel of the engine and toque converter rotor.

Loosen the bolts on the Torque converter casing.

4. Electric wiring

Disconnect the following wiring from the connector.

- Wires and for front frame.
- Wires and for rear frame.
- Wires and for transmission.
- Wire for cab.
- Ground connection and others and

* Before removing the harness, mark with a tag to distinguish when installing.

5. Main control valve

Remoe the wire harness from control valve

6. Parking brake cable

1) Remove clevis pin, then disconnect from caliper lever.

2) Remove cable bracket .

7. Cab, floor plate

Sling cab and floor support, remove mounting bolts, then lift off.

* The work equipment linkage contacts the hydraulic tank, so push the work equipment control lever to the rear. Be careful not to bend the rod.

* Be careful not to damage the cab window glass during the operation.

* After removing, put blocks under the floor support and lower to the ground.

* Check that hoses or electric wires are not caught, and lift off slowly.

8 . Hood, Exhaust pipe

Remove engine side hood , left and right side panels , exhaust pipe, and engine center hood.

9. Hydraulic piping

Disconnect the following hydraulic piping.

- Remove the tube support mounting bolts and hose between main control valve and hydraulic tank.
- Disconnect tube between hydraulic tank and main control valve at main control valve end.
- Disconnect hoses and between main control valve and lift cylinder at main control valve.

Disconnect tubes and between main control valve and dump cylinder at main control valve end.

- Loosen U-clamp nut for support for work equipment piping.
- Disconnect hose between steering valve and main control valve at steering valve and hydraulic tank end.
- Disconnect hose between steering valve and hydraulic tank at steering valve end.
- Loosen clamp of hose between hydraulic tank and pump at pump end.

10. Drive Shaft

Disconnect center drive and rear drive shaft from transmission. When disconnecting the center drive shaft, insert blocks between the frames.

11. Transmission piping

Disconnect hoses from cooler and transmission valve. Remove the tube between transmission strainer and torque converter charging pump. Move the work equipment piping to front of the chassis and secure with wire.

12. Torque converter, transmission

1) Set block between engine and axle housing, and adjust height.

2) Using eye bolts, sling torque converter and transmission, remove bracket mounting bolts, and then remove brackets.
   * Remove left side bracket first

3) Remove mounting bolts on engine, and then lift off torque converter and transmission.

* Be careful of the fitting of the pilot cover, and lift off slowly.

* Check that the piping does not interfere with other parts when lifting off the assembly.

INSTALLATION OF TORQUE CONVERTER, TRANSMISSION

1. Torque converter, transmission

1) Set torque converter and transmission in mounting position.
   * Check that there is an O-ring fitted to the torque converter housing.

   O-ring circumference: Soapy water

   * When installing the torque converter to the engine adjust the height of the pilot cover so that it enters the hole in the flywheel smoothly. Do not force it when installing.

2) Tighten connecting bolts to the engine.

3) Set left and right brackets and in mounting position, then temporarily tighten mounting bolts. After installing left and right brackets, tighten.
   * Install right side bracket first.

Mounting bolt of bracket: **28.5** ± 3.0 **kgm**

4) Use adjustment screw to set transmission in position, adjust clearance 'a' to the specified value, and then tighten mounting bolts and .
   - Do not use oil, grease or soapy water when installing rubber.
   - Clearance' a': 1 —3 **mm**
   - Mounting bolt width across the flats: 32 **mm**

Mounting bolt: **76.0±8.5kgm**

5) Remove block (T) at the bottom of the engine.

2. Hydraulic, steering pump

1) Install hoses regarding hydraulic pump and steering unit hydraulic and steering pump.

3. Transmission piping

1) Connect cooler hoses and to transmission valve.

• Hose nut width across the flat: **41mm**

2) Install tube between transmission strainer and torque converter charging pump.

• Tube cap, width across the flat: 32 **mm**

3) Return work equipment piping to rear of chassis.

4. Drive shafts

Connect center drive shaft and rear drive shaft to transmission.

* Be careful to install the coupling facing in the correct direction.

kgm Mounting bolt: **6.75±0.75 kgm**

5. Hood and exhaust pipe

Install engine side hood, left and right side panels, exhaust pipe and center hood.

7. Parking brake cable

1) Install cable bracket .
2) Connect clevis pin to caliper lever.

8. Fuel control cable

1) Set fuel control cable bracket in mounting position, then secure with lock nut .
2) Connect fuel control cable to fuel injection pump.

* Install the clamp at the bottom of the hydraulic tank.

9. Steering linkage

Connect steering linkage to center lever.

Mounting nut: **12.5±1.0kgm**

10. Cab, floor support

1) Raise cab and floor support, set in mounting position, then tighten mounting bolts.

2) The work equipment linkage contacts the hydraulic tank, so push the work equipment control lever to the rear, and mount the cab and floor support.

* Move the parking brake and fuel control cable towards the mounting position.

* Be careful not to interfere the electric wiring

12. Electric wiring

Connect the following wiring to the connector.

- Ground connection and others
- Wire for cab.
- Wires for transmission.
- Wires for rear frame.
- Wires for front frame.

  * Apply the connector lock securely.

15. Ladder

Using eye bolts raise left and right ladders, set in mounting position, and then tighten mounting bolts.

* Tighten the mounting bolts after fixing the ladder in position.

16. **Cover**

Install left and right covers.

17. Refilling with oil

1) Tighten drain valve and add oil through oil filler to the specified level.

   * Run the engine to circulate the oil through the system. Then check the oil level again.

    Transmission oil: SAE 10W

2) Tighten plug at top of hydraulic tank filter, and plugs of pump piping then add hydraulic oil through oil filler to the specified level.

18. Bleeding air, from brake line

Bleed air from the brake line**.**

REMOVAL OF TRANSMISSION CONTROL VALVE

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

⚠ Open the engine hood and lock it.

- Remove hydraulic tank side cover and transmission oil filler cover.

1. Draining oil

Loosen drain plug (1) and drain oil from transmission case.

Transmission oil: **32 L**

2. Hydraulic piping

1) Remove transmission oil supply tube .

3. Electric wiring

Disconnect wiring of transmission solenoid valve from connector.
* When removing the wiring connector, be careful not to damage or deform the thread case.

4. Transmission control valve

Sling transmission control valve, remove mounting bolts, then lower and remove from under the machine.

There is little space, so be careful when working.

* When installing the lifting tool, avoid the connectors and fit securely to the valve itself.

kg Transmission control valve: 48 kg approx.

INSTALLATION OF TRANSMISSION CONTROL VALVE

1. Transmission control valve

Set transmission control valve in mounting position, and then tighten mounting bolts.

2. Electric wiring

Connect wiring of transmission solenoid valve to connector.

* When installing the wiring connector be careful not to deform the thread case.

3. Hydraulic piping

1) Install all pipings

Oil

4. Refilling with oil

Tighten drain plug and add transmission oil through oil filler to the specified level.

Transmission oil: 32 lts

Install the hydraulic tank side cover and transmission oil filler cover.

Transmission valve mounting bolts

* Tighten the transmission valve bolts.

Mounting bolts 6

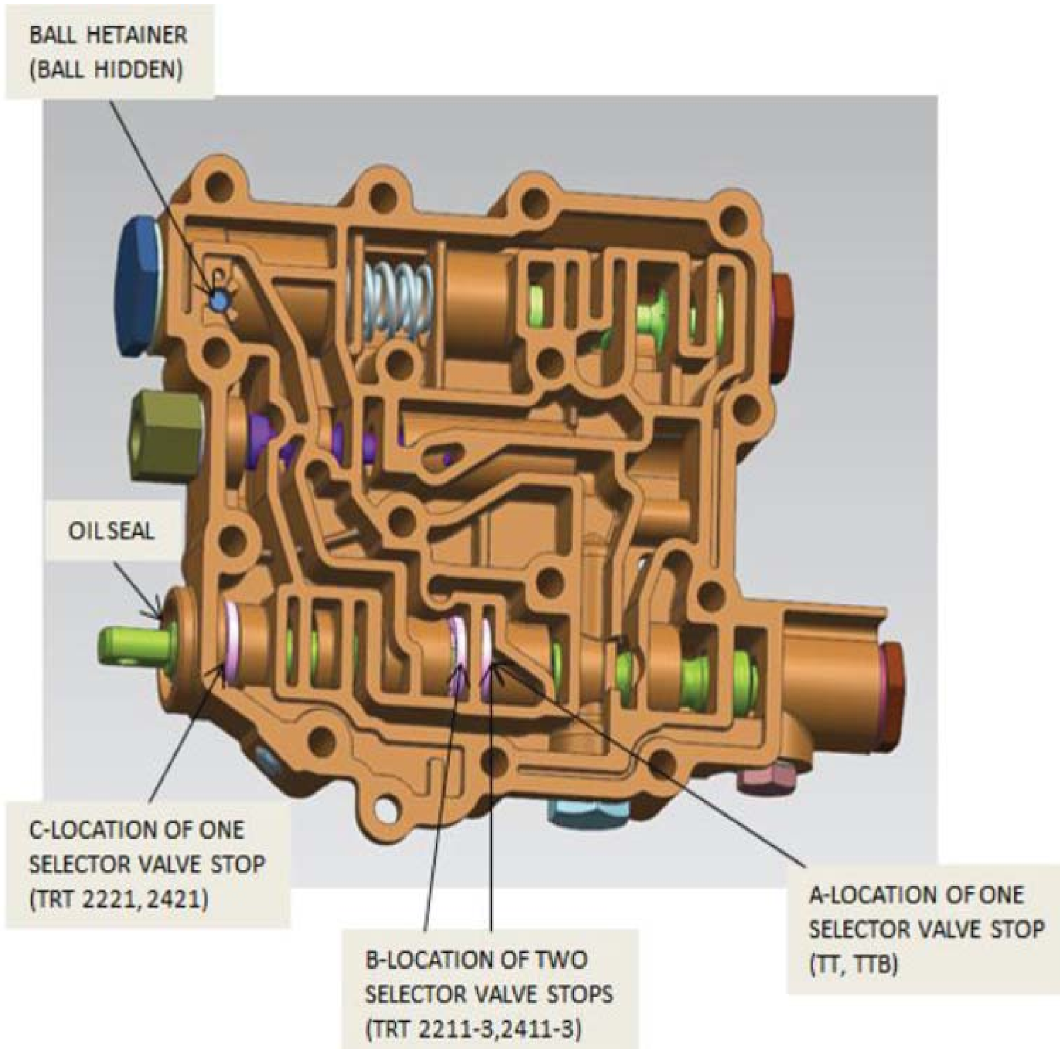
* Torque down by two steps. Adhesive (LT-2)

First step 1.5 ±0.5 **kgm**

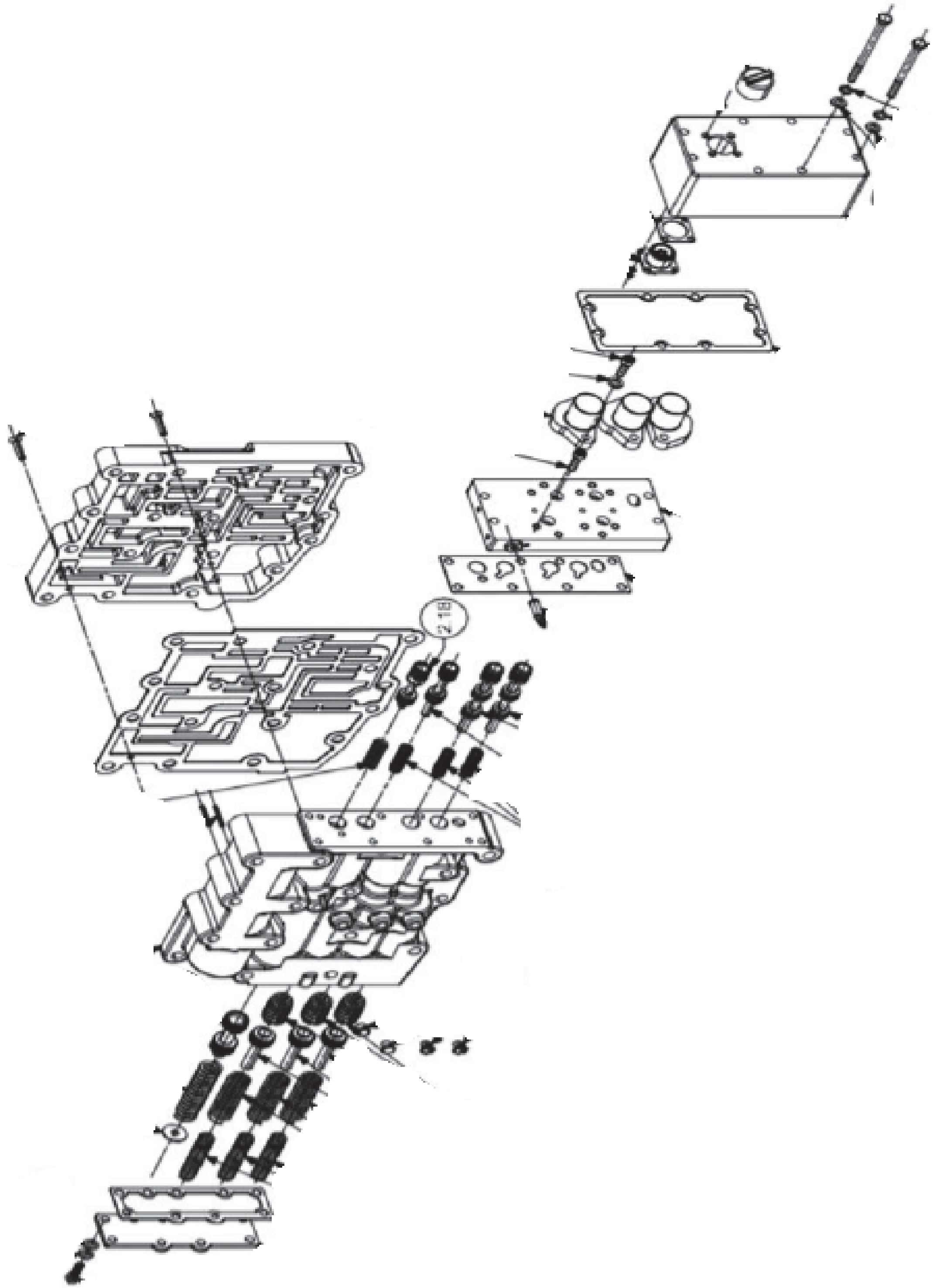
Second step 3.5 ±0.5 **kgm**

Adhesive (LT-2)

DISASSEMBLY & ASSEMBLY OF TRANSMISSION C.V.



The transmission control valve consists of 2 internal spools for direction and speed control. These can be remove for maintenance purpose by first disconnect all hoses, connector and adaptors. Then remove the mounting bolts shown in the figure above to separate the transmission control valve from the transmission housing. Then after servicing, place the transmission control vale on the housing and insert all the bolts and tighten. Then connect all the hoses to their respective locations as indicated in the figure above.


2.18

DISASSEMBLY OF DRIVE SHAFT

1. Front drive shaft

1) Remove coupling and tube.

* Make match marks "a" before removing so that the direction of the coupling does not change.

2) Loosen bolt , then remove coupling and retainer.

* Make match marks before removing so that the direction of the coupling does not change.

3) Using a press, remove flange bearing.

2. Center drive shaft, rear drive shaft

* Follow the procedure in **1**.

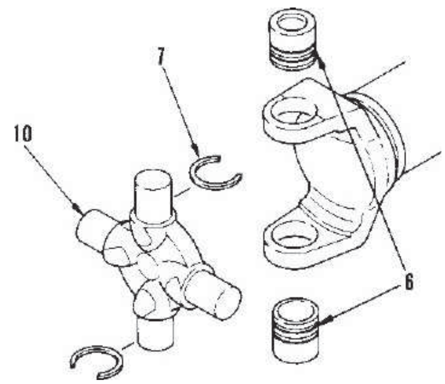
3. Spider Bearing

1) Remove seal and bearing caps .

2) Remove ring of spider and bearing , then tap with plastic hammer to remove spider and bearing.

* Repeat the same procedure for the front, center and rear drive shafts.

ASSEMBLY OF DRIVE SHAFT



1. Spider, bearing

1) Set spider (10) and bearing (6) in mounting position, assemble ring (7), then install.

* Assemble so that the grease nipples face in the same direction.
* Repeat the same procedure for the front, center and rear drive shafts.

2) Install bearing cap (5).

* Check that there is a bearing and Dealing washer inside the bearing cap.

Bearing cap: Grease (G2-LI)

* If the spider and bearing cap are worn, replace the spider and bearing.
* Heat will damage the bearing, so do not weld strap (8) of the cap.

2. Front drive shaft

1) Press fit flange bearing (4).

- Do not hit the flange bearing directly with a hammer.

2) Align match marks, install coupling (3) and retainer (9), then tighten mounting bolt (2).

* Tighten the bolts to the specified tightening torque after installing on the machine.

Spline: Grease (G2-LI)

kgm Mounting bolt: **28.5±3.0kgm**

3) Align match marks and install coupling and tube (1).

* Check that the couplings are facing in the same direction.
* If the spline is worn, replace the whole drive shaft assembly.

Spline: Grease (G2-LI)

3. Center drive shaft, rear drive shaft

* Follow the procedure in 1. Front drive shaft

REMOVAL OF FRONT AXLE

Stop the machine on level ground and install the safety bar on the frame. Lower the work equipment to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Jack up machine, and put blocks under front frame.

* Use the bucket to raise the front frame, and insert the block when the tires are slightly off the ground.

2. Tire, wheel

Sling tire and wheel , remove mounting bolts, then lift off.

kg Tire, wheel: **225** kg approx.

3. Front drive shaft

Disconnect front drive shaft .

Front drive shaft: **20 kg approx.**

4. Axle

1) Disconnect brake tube .

2) Using jack and hoist, sling axle , then remove mounting bolts and lower axle.

* Use the jack to adjust the height when removing the mounting bolts.

kg Axle: 460 kg approx.

3) Pull out axle assembly from machine. * Use the jack and hoist.

INSTALLATION OF FRONT AXLE

1. Axle

1. Insert axle under machine body.

♦ Use a hoist and jack to insert the axle.

2) Raise axle (4) with jack and hoist, set in mounting position, and tighten mounting bolts.

* Use the bolts as guides to align with the mounting position.

• Mounting bolt width across the flat: 36 **m**

kgm mounting bolt: **94.5 ± 10.5 kgm**

3) Connect brake tube .

* Be careful not to tighten the tube too much.

kgm Tightening torque of tube nut: 1.2 ± 0.3 kgm

2. Front drive shaft

Connect front drive shaft .

kgm Drive shaft: **6.75 ± 0.75 kgm**

3. Tire, wheel

Raise tire and wheel , set in mounting position, then tighten mounting bolts.

• Mounting bolt width across the flat: 36 mm

kgm Mounting bolt: 94.5 ± 10.5 kgm

4. Lowering machine to ground

Remove block under front frame, and lower machine to ground.

* Raise the front frame slightly with the bucket and remove the block .

5- Bleeding air from brakes

REMOVAL OF REAR AXLE

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

1. Raise machine

1) Put blocks between left and right rear axles and rear frame.

2) Put blocks under rear frame and jack up Machine.

* Use garage jack to raise the rear frame, and insert the blocks when the tires are slightly off the ground.

2. Tire, wheel

Sling tire and wheel , remove mounting bolts, then lift off.

kg Tire, wheel: **225** kg approx.

3. Rear drive shaft

Remove rear drive shaft .

* Make match marks to show the mounting position.

4. Brake hose, grease tubes

1) Disconnect brake hose

2) Remove grease tube .

5. Axle

1) Secure pivot to axle with wire.

*Fit the wire securely so that the pivot cannot move.

2) Sling one side of axle . Then, fit garage jack under other side of axle housing and remove mounting bolts.

* Adjust the height of garage jack when removing the mounting bolts.
* When removing the axle, the pivot side will drop, therefore, remove the axle carefully.

3) Pull out axle assembly from machine.

* Use a hoist and jack.
* After pulling the axle out from the machine body, remove wire.

INSTALLATION OF REAR AXLE

1. Axle

Raise axle with jack and hoist, set in mounting position, then tighten mounting bolts.

* Use the bolts as guides to align with the mounting position.

* Tighten the mounting bolts from the rear pivot end, and tighten in three stages.

* After installing the axle assembly, remove the wire.

* Mounting bolt width across the flat: 36 **mm**

kgm Mounting bolt: **56** ± **6 kgm**

2. Brake hose, grease tubes

1) Install grease tubes elbow .

2) Install grease tube

3) Connect brake hose (3).

* Do not tighten the brake tube too much.

Rear drive shaft Install rear drive shaft (2).

* Align match marks and be careful to install with the coupling facing in the correct direction.

kgm Mounting bolt: **6.75 ± 0.75 kgm**

Tire, wheel

Sling tire and wheel (1), set in mounting position, then tighten mounting bolts.

- Mounting bolt, width across the flat: 36 **mm**

kgm Mounting bolt: **94.5 ± 10.5 kgm**

3. Lowering machine to ground

1) Remove block under rear frame, and lower machine to ground.

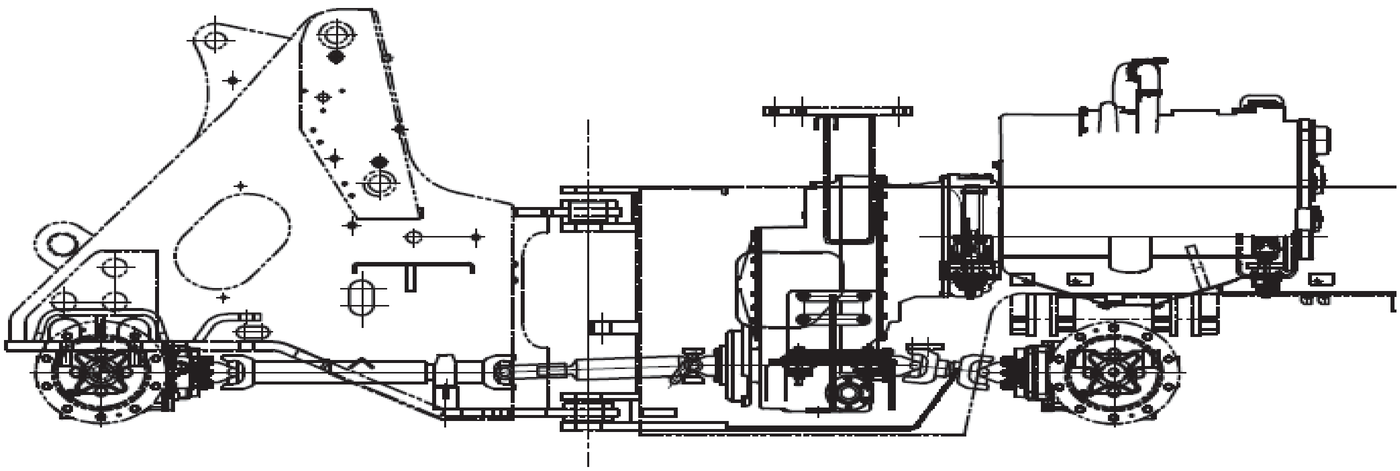
* Raise the rear frame slightly with a garage jack and remove the block.

2) Remove block between left and right axles and rear frame.

4. Bleeding air from brakes

POWER TRAIN
08 MAINTENANCE STANDARDS

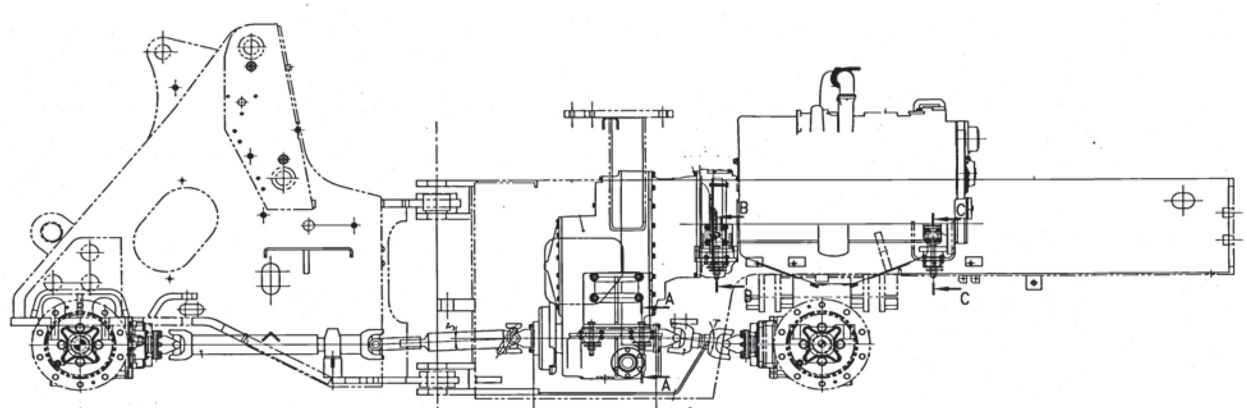
TRANSMISSION AND ENGINE MOUNT



Unit: mm

No.	Check item	Criteria	Remedy
1	Clearance between transmission bracket and adjustment bolt	1 - 3	
2	Tightening torque of mounting bolt	76.0 + 8.5 kgm	Retighten
3	Tightening torque of bracket mounting bolt	28.5 + 3.0 kgm	
4	Tightening torque of bracket mounting bolt	7.0+0.6 kgm	
5	Tightening torque of mounting bolt	76.0+8.5 kgm	
6	Tightening torque of clearance adjustment bolt	23.5 + 8.0 kgm	

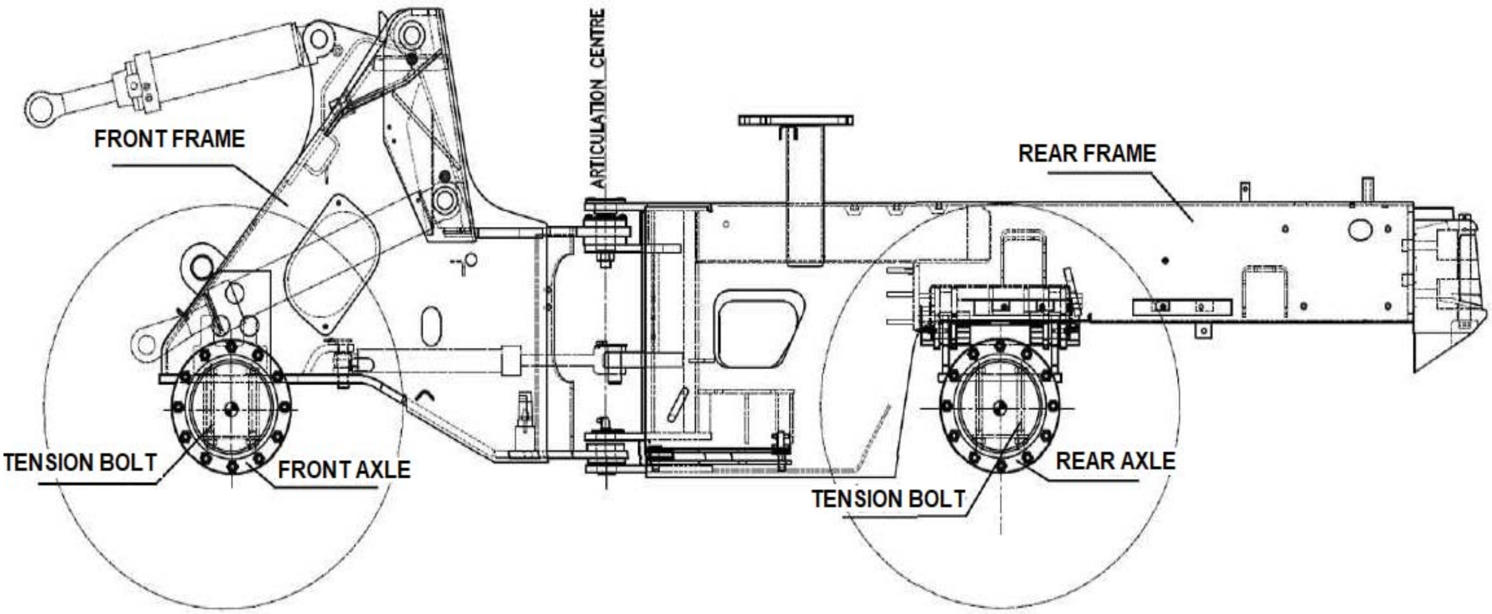
DRIVE SHAFT



Unit: mm

No.	Check item	Criteria	Remedy
1	Tightening torque of bolt	6.75 + 0.75 kgm	Retighten
2	Tightening torque of bolt	28.5±3.0kgm	
3	Tightening torque of bolt	6.75±0.75kgm	
4	Tightening torque of bolt	6.75 + 0.75 kgm	
5	Tightening torque of bolt	6.75 + 0.75 kgm	
6	Tightening torque of bolt	6.75 + 0.75 kgm	
7	Tightening torque of bolt	28.5 + 3 kgm	

AXLE MOUNT



Unit: mm

No.	Check item	Criteria					Remedy
1	Thickness of thrust plate	Standard size		Repair limit			Replace
		15.9		-			
2	Clearance between shaft and hole at front support side	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		170	-0-043 - 0-106	+ 0.550 + 0.050	-0.093 -- 0.656		
3	Clearance between shaft and hole at rear support side	170	-0.043 - 0-106	+ 0.550 + 0.050	-0.093 -- 0.656		
4	Thickness of axle mount shim	0.2 (Standard shim thickness}					-
5	Tightening torque of mounting bolt	11.5±1.0kgm					Retighten
6	Tightening torque of mounting bolt	11.5±1-0kgm					
7	Tightening torque of mounting bolt	56.0±6-0 kgm					
8	Tightening torque of axle mounting bolt	94.5+10.5 kgm					

STEERING SYSTEM

09 STRUCTURE AND FUNCTION

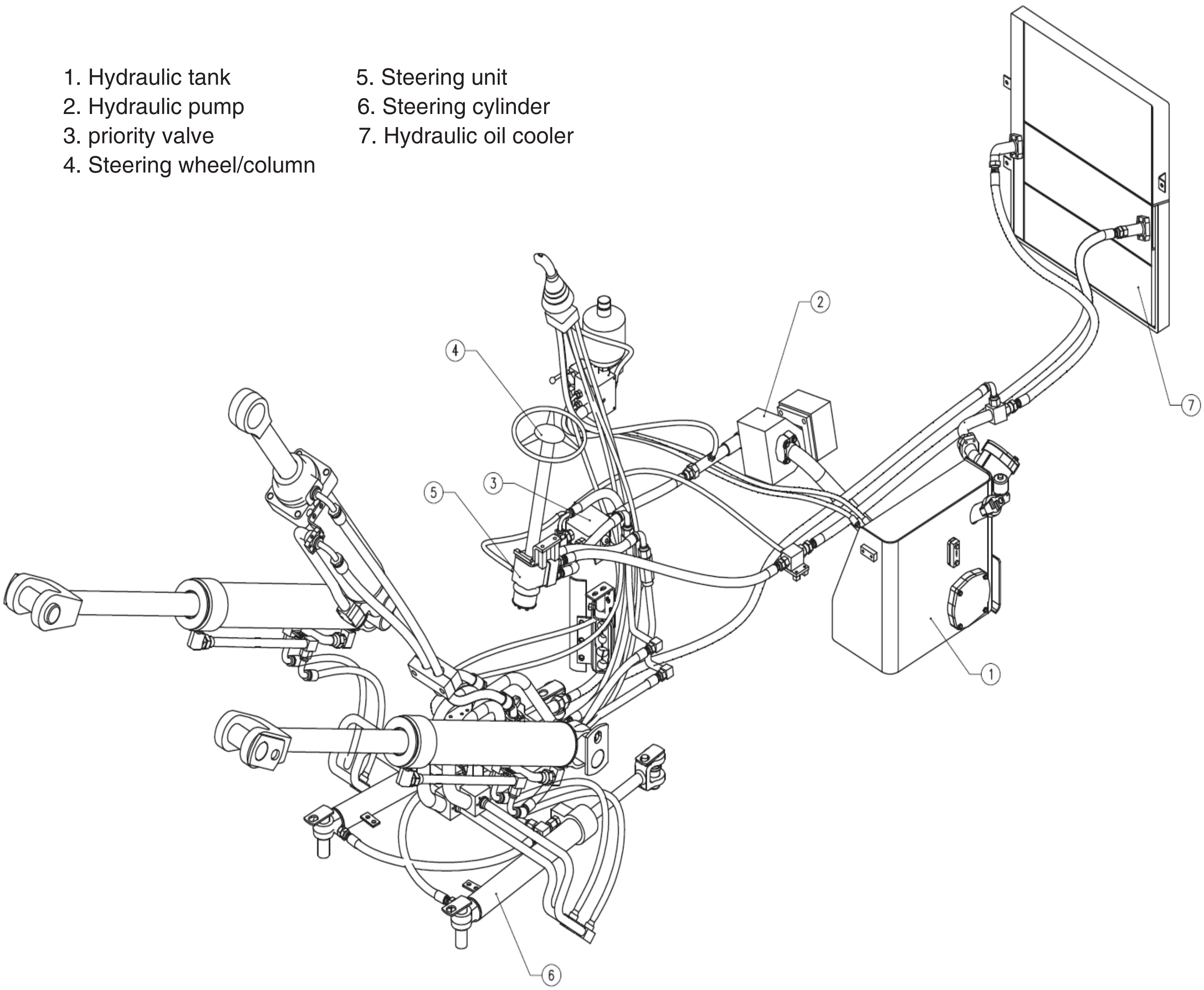
OUTLINE

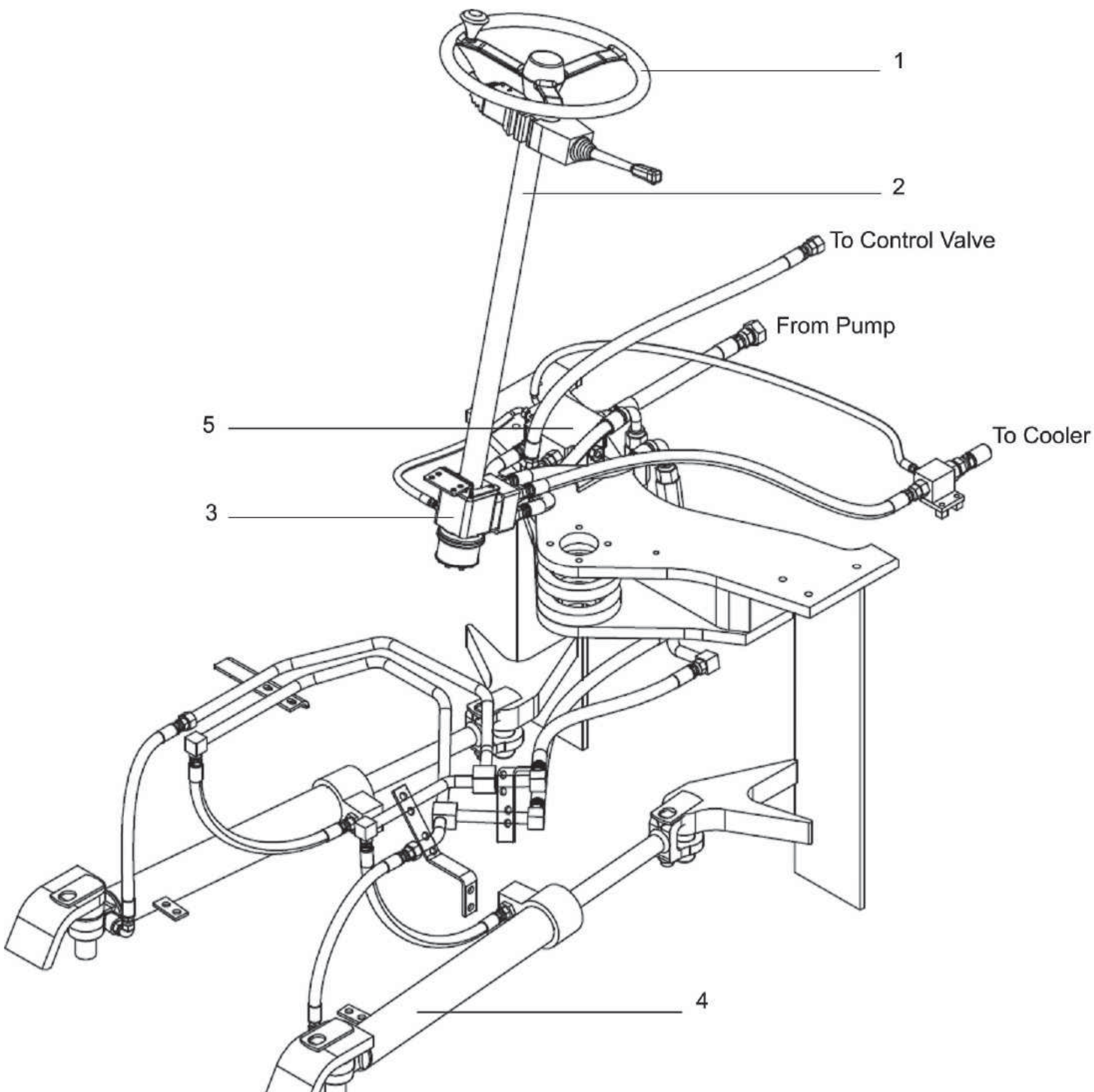
- The oil from hydraulic tank is sent to steering unit through priority valve by hydraulic pump
- When steering wheel is operated, the movement is transmitted by steering column, actuates steering unit

.

When steering unit is actuated, oil flows to steering cylinder and the steering is actuated. When steering wheel is not being operated, all the oil which enters steering unit flows to hydraulic control valve

1. Hydraulic tank
2. Hydraulic pump
3. priority valve
4. Steering wheel/column
5. Steering unit
6. Steering cylinder
7. Hydraulic oil cooler

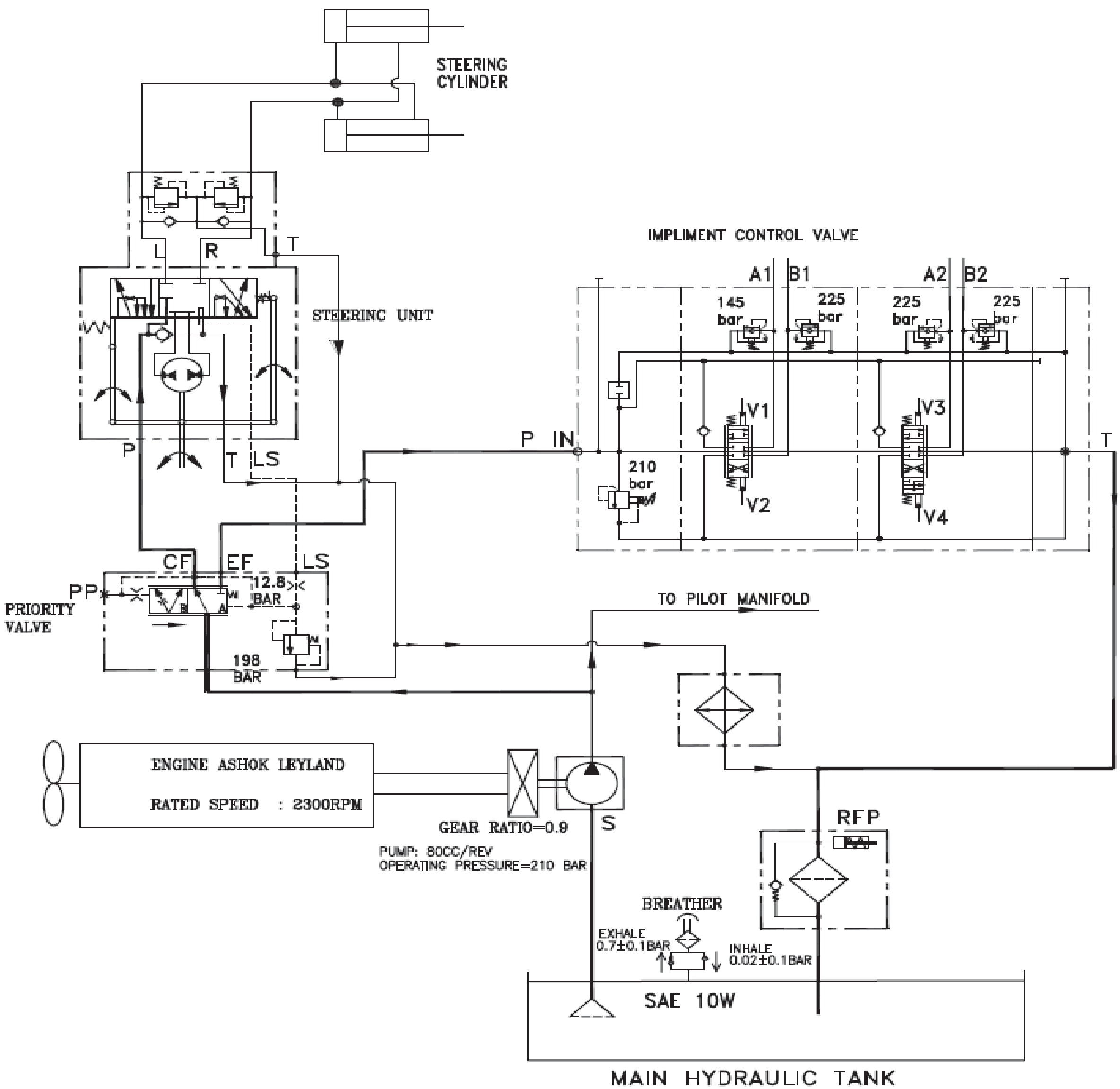




1. Steering wheel
2. Steering column
3. Steering unit
4. Steering cylinder
5. Priority valve

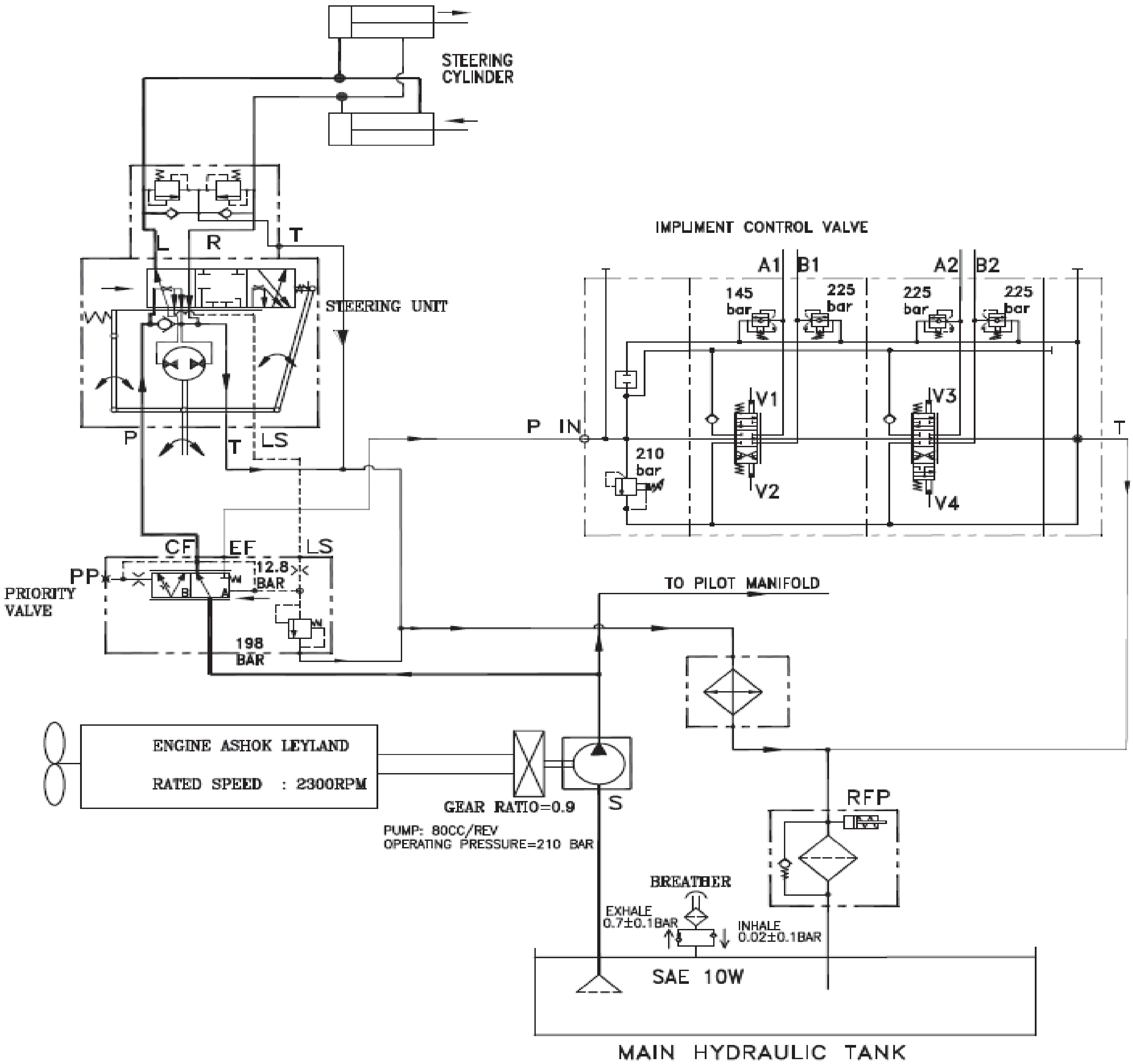
HYDRAULIC CIRCUIT

Neutral



The oil from the main pump enters to the steering unit through priority valve. when The steering wheel is not being operated, the steering spool does not move, so the pressure raises within the circuit and it pushes the priority valve to right ‘B’ position which connects the main implement circuit.
All hydraulic oil flows to the tank through main control valve in neutral position.

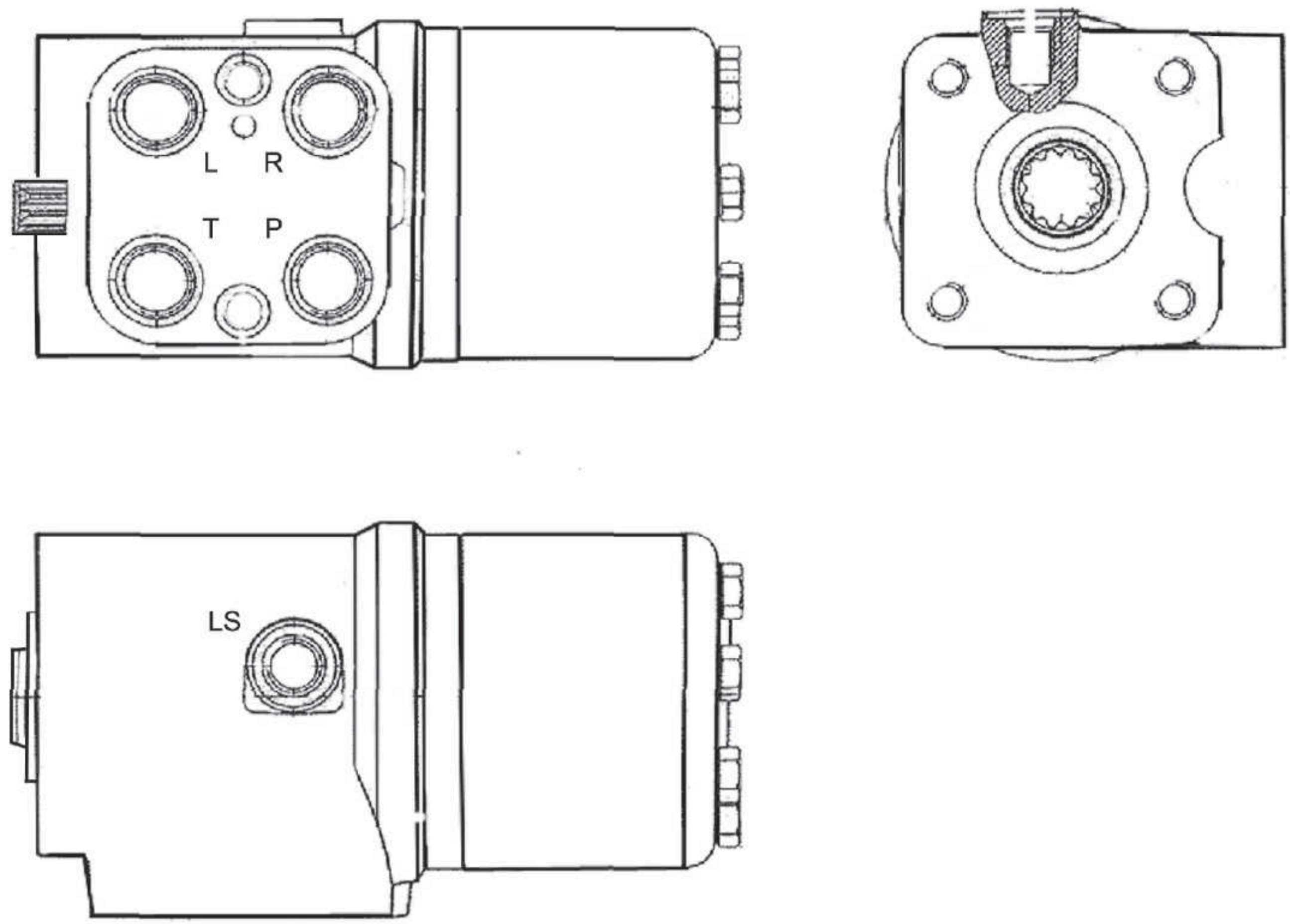
HYDRAULIC CIRCUIT DIAGRAM FOR STEERING



When the steering wheel is rotated, the control linkage actuated and steering spool moves either right or left based the rotation of the steering wheel.

The oil from the pump enters in to the steering cylinder through the priority valve and steering unit spool. In steering unit spool one line is also connects the LS line, which will pushes and holds the priority valve spool in the left position, so that continuous pressure oil will supply to the steering circuit only when it has been operated.

STEERING UNIT

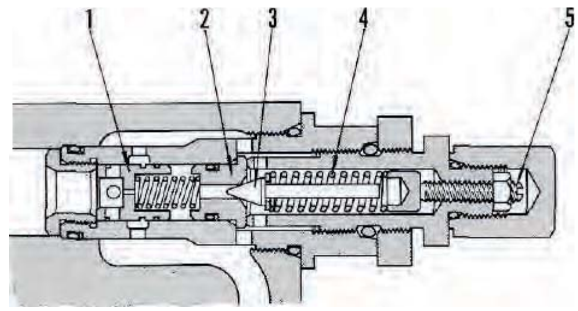


The steering unit OSPL 160 is hydrostatic. That is to say there is no mechanical connection between the steering column and the steered wheels. Instead there are hydraulic pipes and hoses between steering unit and steering cylinders. When the steering wheel is turned, the steering unit meters an oil volume proportional to the rate of rotation of the steering wheel. This volume of oil is directed to the appropriate side of the steering cylinder, while simultaneously the displaced oil is directed to tank.

Functionally the steering unit consists of rotary valve and a rotary meter. Via a steering column the steering unit is connected to the steering wheel of the vehicle. When steering wheel is turned, oil is directed from the steering system pump via the rotary valve and rotary meter to the cylinder ports L or R, depending on the direction of turn. the rotary meter meters the oil flow to the steering cylinder in proportion to the angular rotation of the steering wheel. If the oil flow from the steering system pump is too small, the steering unit can function as manual pump.

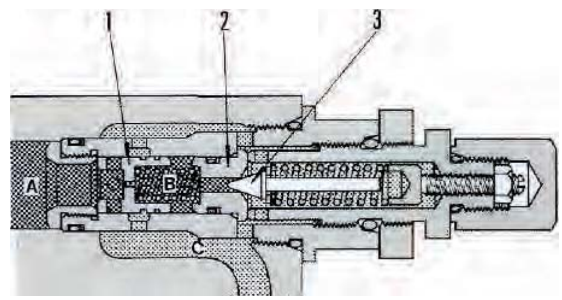
STEERING RELIEF VALVE

1. Main valve
2. Valve seat
3. Pilot poppet
4. Spring
5. Adjustment screw



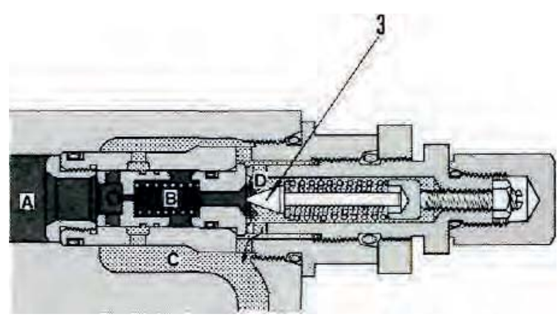
FUNCTION

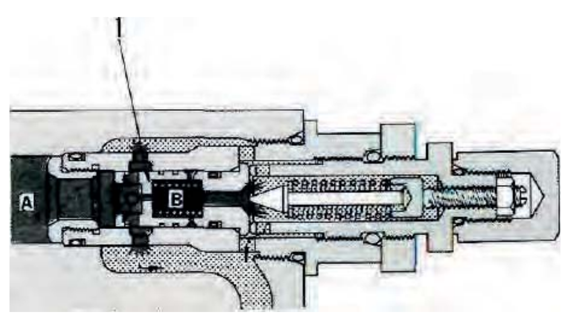
- The steering relief valve is inside the steering valve. When the steering cylinder reaches the end of its stroke and abnormal pressure is generated, the oil sent from the pump is relieved through this valve. This prevents damage to the pump or circuit.
  (The relief valve sets the maximum pressure of the circuit.)



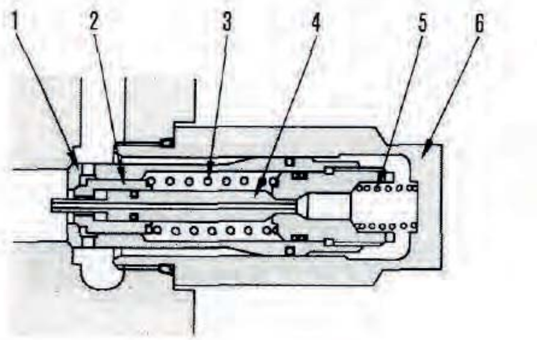
OPERATION

- Port A is connected to the pump circuit, and port C is connected to the drain circuit. The oil passes through the orifice in main valve (1) and fills port B. Pilot poppet (3) is in contact with valve seat (2).
  When the pressure inside port A and B reaches the pressure set by the poppet spring (set pressure), pilot poppet (3) opens and the hydraulic pressure at port B escapes from port D to port C. This lowers the pressure at port B. When the pressure at port B drops, the orifice of main valve (1) generates a difference in pressure between port A and port B. Main valve (1) is opened by the pressure at port A and the oil at port A is relieved.





SAFETY VALVE (with suction valve)



1. Suction valve
2. Main valve
3. Main valve spring
4. Pilot piston
5. Suction valve spring
6. Plug

FUNCTION

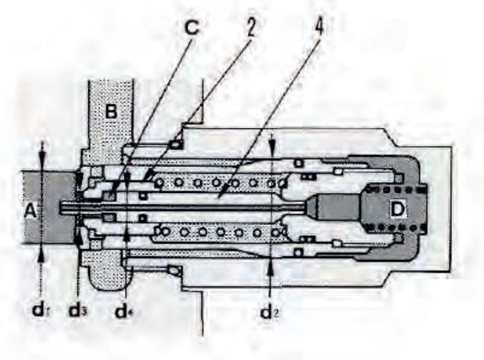
• The safety valve is in the steering cylinder circuit in the main valve. If shock causes any abnormally high pressure in the cylinder when the main valve is at neutral, the safety valve releases the abnormal pressure and protects cylinder from damage.

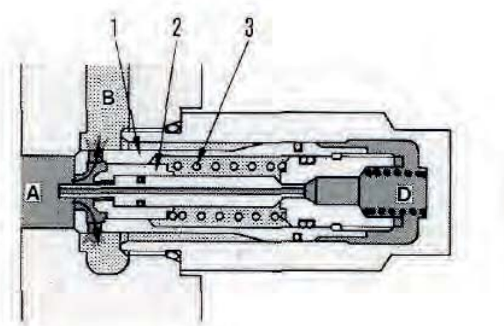
OPERATION

As a safety valve

- Port **A** is the cylinder circuit and port **B** is the drain circuit. The pressure oil in port **A** flows to port **D** through a hole in the pilot piston. It also flows to port **C** through an orifice consisting of the main valve (2) and the pilot piston (4).
  The pilot < piston :(4) is secured to the Suction valve by lock nut. The diameter of the cross section (cross-sectional area) gives a relationship of d_2 > **d,** > d_b > d_4.

  If abnormally high oil pressure occurs in port **A,** the suction valve (1) is not actuated because of the relationship $d_2 > d$.
  However, because of the relationship $d_b > d_4$ in port **A** and **C**, the hydraulic pressure on the main valve (2) is equivalent to the area difference between d_3 and d_4. If this pressure goes up to the main valve spring force (set pressure), the main valve (2) is actuated, and the oil in port **A** flows into port **B.**



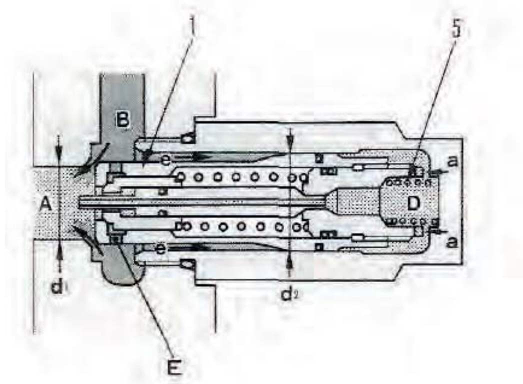


As a suction valve

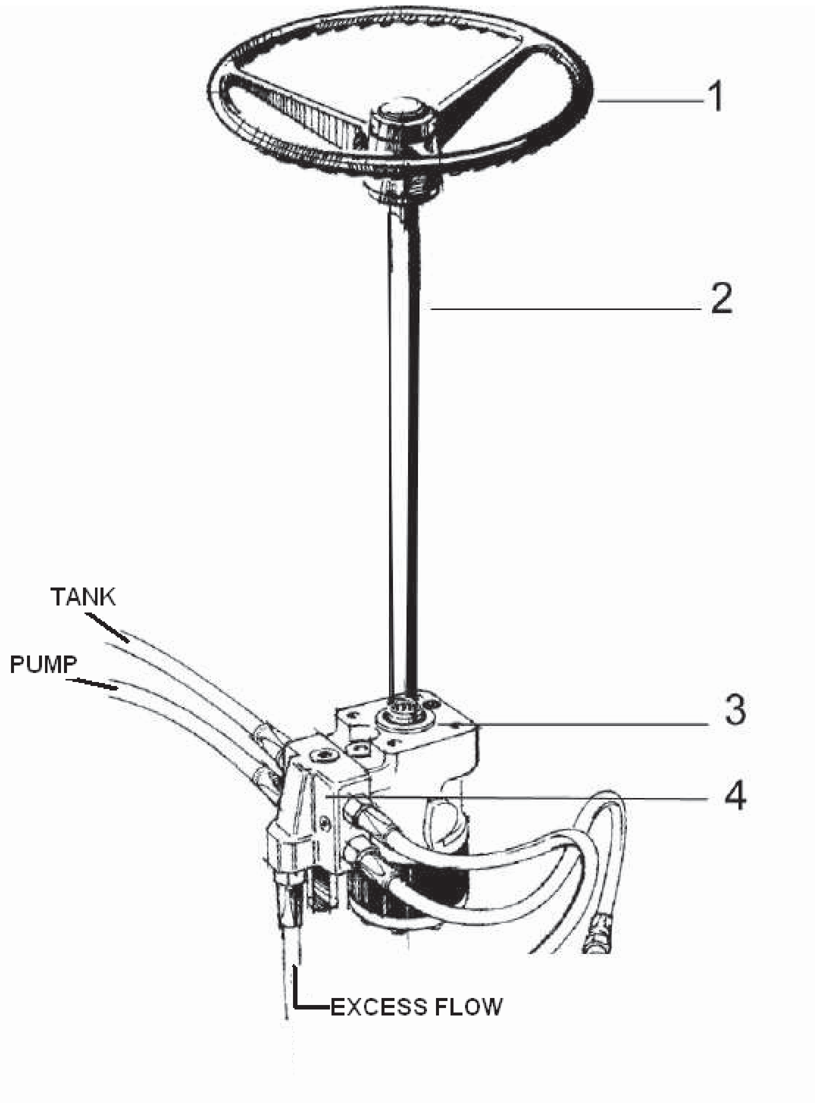
- If negative pressure is generated in port A, port D also has negative pressure, because port D and A are connected with each other. The tank pressure in port B is applied to port E.

  Hydraulic pressure "a" equivalent to the area difference between d_2 and d_1 is applied to the safety-valve because of the tank pressure in port E. Therefore, hydraulic pressure "e" acts to open the valve and hydraulic pressure "a" acts to close the suction valve (1).
- If the pressure in port A drops, (approaching negative pressure) hydraulic pressure "a" becomes smaller than oil pressure "e".

  When oil pressure "e" becomes larger than oil pressure "a" + valve spring (5) force, the suction valve (1) opens, causing the oil to flow from port B into port A- This prevents negative pressure from building up in port A.

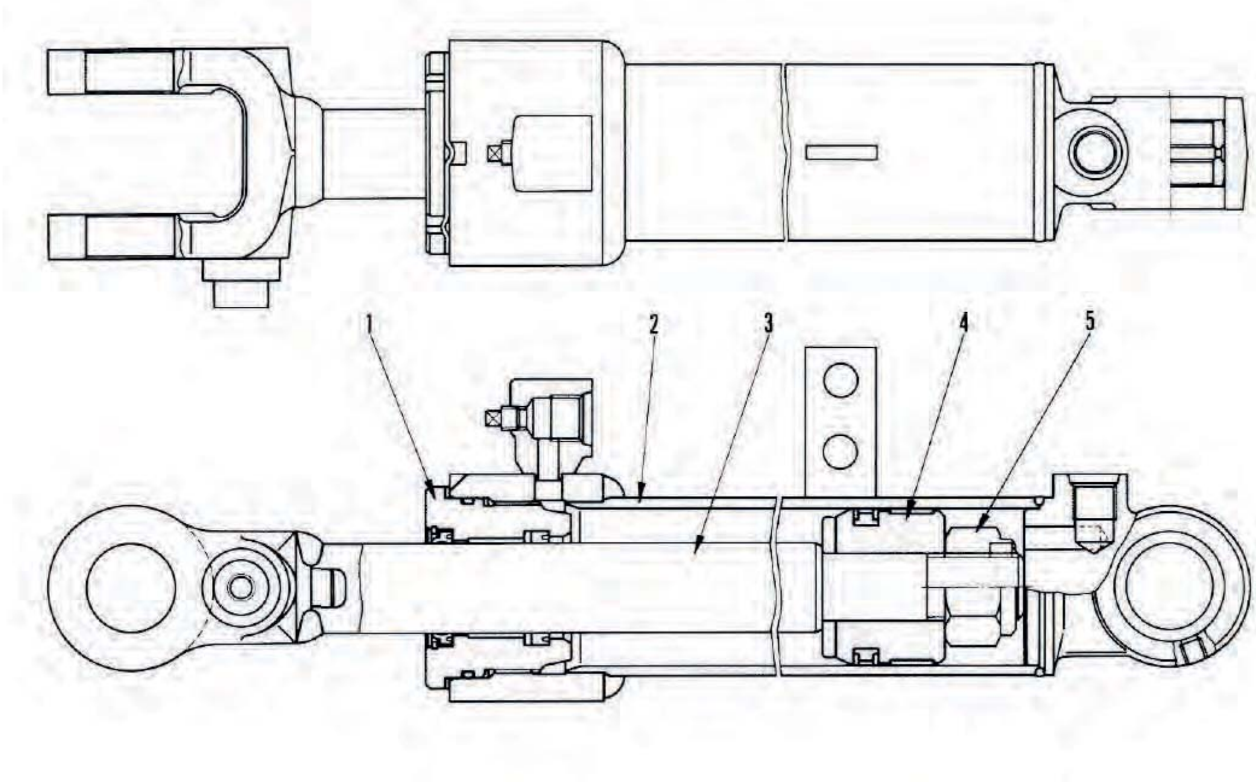


THE STEERING COLUMN ASSY



1. Steering Wheel
2. Steering Column
3. Steering Unit
4. Valve Block

STEERING CYLINDER - 2 - Ø70 Bore X 460 Stroke Unit in mm

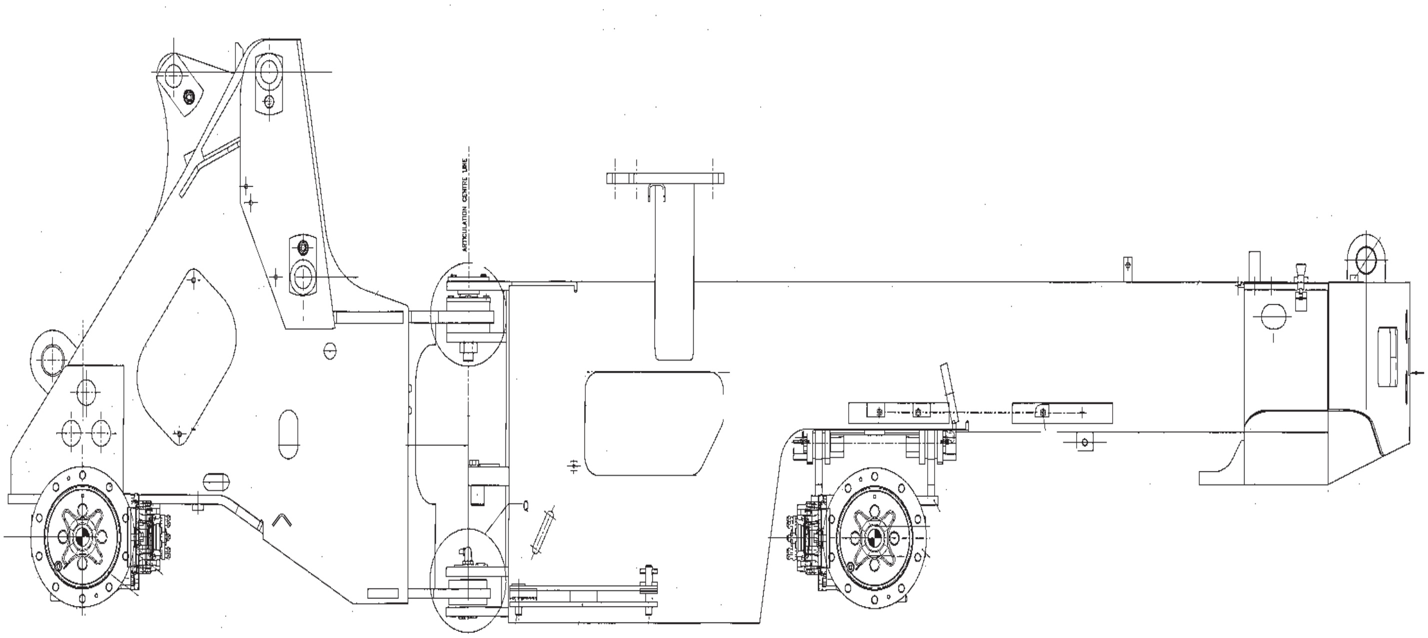


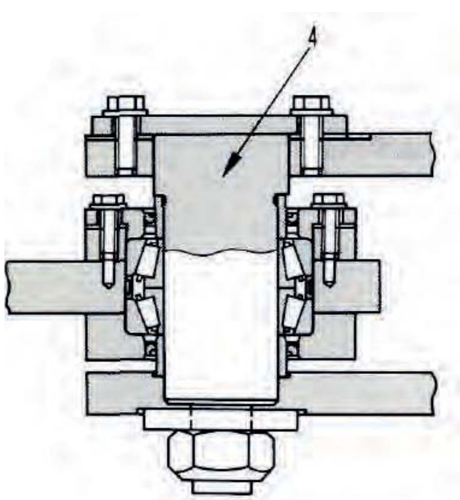
1. Cylinder head
2. Cylinder
3. Piston rod
4. Piston
5. Piston nut

CENTER HINGE PIN

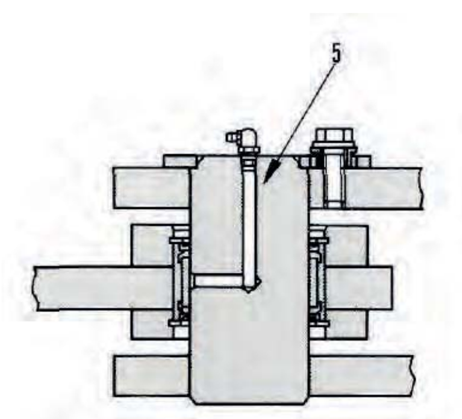
OUTLINE

• The front frame and rear frame are connected through a bearing by the center hinge pin. The steering cylinders are connected to the left and right front and rear frames, so when the cylinders Are operated, the frame bends at the middle to give the desired angle that is the desired turning radius.





Section C-C



Section D-D

1. Front frame
2. Rear frame
3. Steering cylinder
4. Upper hinge pin
5. Lower hinge pin

10 STEERING SYSTEM
TESTING AND ADJUSTING

The following precautions are necessary when using the Standard Value Tables to make judgments during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.
2. The standard values in these tables for judgment when troubleshooting are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgments.
3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgment

STANDARD VALUE TABLE

Testing and measuring item	Measurement condition	Unit	Standard value	Permissible value
Steering wheel • Steering wheel play • Steering wheel operating force • Operating time of steering wheel (Low idling) (High idling)	• Road surface: Flat, horizontal, dry, paved surface • Hydraulic temperature: 45 - 55°C • Machine posture: Facing straight	mm kg Sec.	20-70 2.0-2.5 2.5-3.5 ‘2.5-3.5	20-100 Max. 3.8 Max. 5.3 Max. 5.3
Steering linkage • Clearance between front frame and rear frame	Tire inflation pressure: Specified pressure	mm	10-20	-
Steering oil pressure • Steering relief oil pressure	Hydraulic temperature: 45 - 55°C	kg/cm^2	210+10	210±20

⚠ When carrying out testing, adjusting or troubleshooting, stop the machine on level ground, install the safety bar on the frame, lower the bucket to the ground, and stop the engine. Then apply the parking brake and block the tires.

⚠ When installing or removing gauges loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

⚠ When taking measurements, do not allow unauthorized persons near the machine.

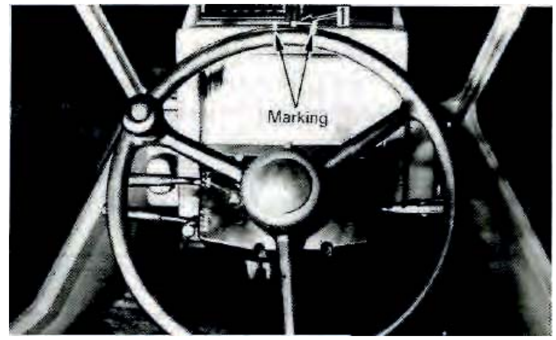
⚠ The oil in the circuit is hot, so be careful not to get burnt.

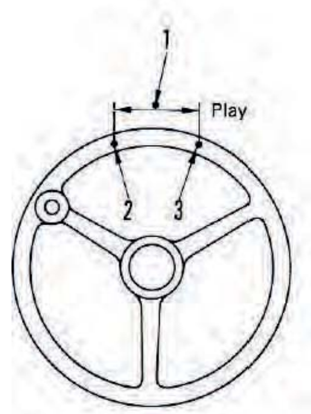
MEASURING STEERING WHEEL PLAY

- Measurement condition
- Engine speed: Low idling
- Machine posture: Facing straight

Unit: mm

Item	Standard value	Permissible value
Steering wheel play	20-70	20-100





1. Measuring procedure

1) Turn the steering wheel lightly clockwise and counterclockwise two or three times and confirm the neutral position of the steering mechanism. Put mark "1" on the outer frame of the vehicle monitor.

2) Turn the steering wheel clockwise. Align the position where the tires begin to move with mark "1", then put mark "2" on the steering wheel.

3) Turn the steering wheel counterclockwise. Align the position where the tires begin to move with mark "1", then put mark "3" on the steering wheel. Measure the distance of a straight line between mark "3" and mark "2".

MEASURING OPERATING FORCE OF STEERING WHEEL

Measurement condition:

Road surface: Flat, horizontal, dry, paved surface.

Coolant temperature: Inside operating range

Hydraulic oil temperature: 45 — 55°C

Tire inflation pressure: Specified pressure

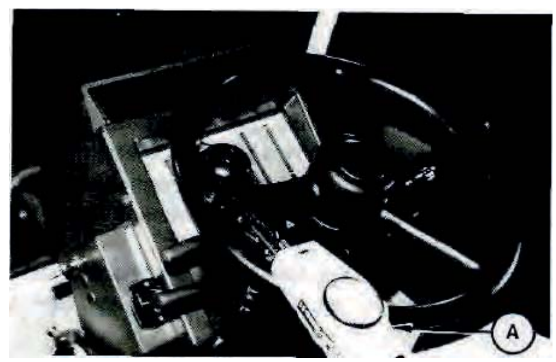
Engine speed: Low idling (bucket unload)

Unit: kg

Item	Standard value	Permissible value
Force of steering wheel	2.0-2.5	Max. 3.8

Measuring procedure

1. Hook push-pull scale A to the knob of the steering wheel.
   - Hock push-pull scale to center of knob.
2. Start the engine.
   - After starting the engine, raise the bucket about 400 mm and remove the safety bar.
3. Pull push-pull scale A at a tangent, and read the value when the steering wheel is moving smoothly.
   - Do not read the value at the time, the steering wheel starts to move.



OPERATING TIME OF STEERING WHEEL

Measurement condition:

Road surface: Flat, horizontal, dry, paved surface.

Coolant temperature: Inside operating range

Hydraulic oil temperature: 45 — 55°C

Tire inflation pressure: Specified pressure

Engine speed: Low idling (bucket unload)

Unit: sec

item		Standard value	Permissible value
Operating time of steering wheel	Low idling	2.5-3.5	Max. 5.3
	High idling	2.5-3.5	Max. 5.3

Measuring procedure

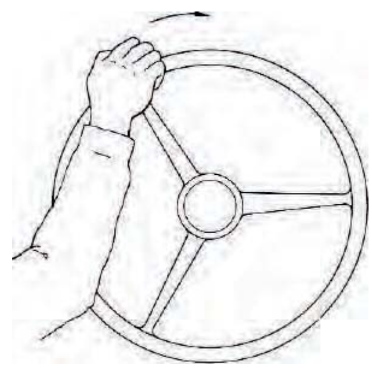
1. Start the engine.

   * After starting the engine, raise the bucket about 400 mm and remove the safety bar.

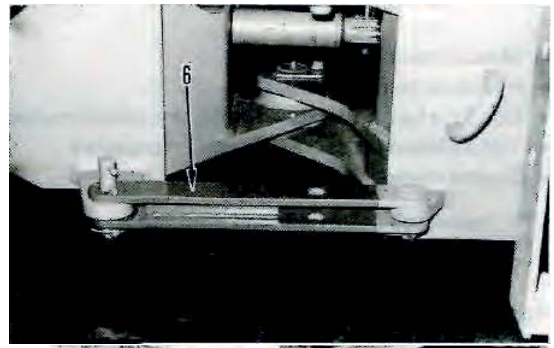
2. Turn steering wheel so that the machine is turned fully to the left or fully to the right

3. Measure the time taken for the steering wheel to be turned to the right (left) to the full lock position.

   * Turn the steering wheel as fast as possible without forcing it.
   * Measure at low idling and high idling, and when turning to the right and to the left.



STEERING OIL PRESSURE



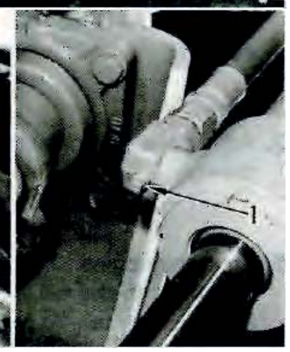
Measurement condition
- Hydraulic temperature: 45 — 55°C
- Engine speed: High idling

Unit: kg/cm^2

Item	Standard value	Permissible value
Steering relief oil pressure	210±10	210±20

1. Measuring main relief pressure

Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel several times to release the remaining pressure in the hydraulic piping.



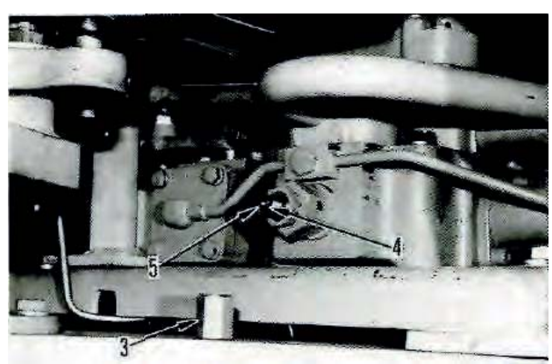
1) Fit safety bar (6) on the frame.
2) Remove plug (1) for measuring the right turn steering circuit.
3) Install hydraulic tester A to the measuring port.
4) Start the engine and run at high idling. Turn the steering wheel to the right and measure the pressure when the relief valve is actuated.

* When removing the plug (2) for the left turn steering circuit, turn the steering wheel to the left and measure.

2. Adjusting main relief pressure

Always stop the engine before adjusting the hydraulic pressure.

1) Stop the engine.
2) Remove cap nut (3) of the relief valve.
3) Loosen lock nut (4), then turn adjustment screw (5) to adjust.
   - * Amount of adjustment for 1 turn of adjustment screw.
     1 turn: **Approx. 24.8 kg/cm^2**
   - * Adjust the set pressure as follows.
     To INCREASE pressure, TIGHTEN screw. To DECREASE pressure, LOOSEN screw.
   - * If the relief pressure cannot be measured accurately, do not try to adjust the pressure.



TROUBLESHOOTING

* Before carrying out the troubleshooting in this section, read "PRECAUTIONS WHEN TROUBLESHOOTING" page 22-14, "METHOD OF READING TROUBLESHOOTING TABLE" page 22-16 and "PREVENTING RECURRENCE OF TROUBLE" page 22-18.

TROUBLESHOOTING TABLE

STEERING CIRCUIT

1. Steering wheel does not turn.

Ask the operator the following questions.

- Did the steering wheel suddenly cease to turn? — Damage to equipment in steering circuit.
- Did Steering wheel show signs of being sluggish for some time? — Worn parts in steering circuit or faulty seal.

Checks before troubleshooting

- Is oil level in hydraulic tank and type of oil satisfactory?
- Is there any damage to the steering gear box or the steering linkage?
- Has the safety bar been removed from the frame?
- Is the steering linkage properly adjusted?

	Cause	Hydraulic pump		Valve			Other parts	
		Faulty hydraulic pump	Faulty PTO	Steering relief valve (Internal damage to steering control valve)	Safety valve (Internal damage to steering control valve)	Demand spool (Internal damage to steering control valve)	Internally damaged steering gear box	Internal damage of steering cylinder (oil leakage from piston seal)
		a	b	c	d	e	f	g
No.	Problem / Remedy	△ X	△ X	△ X	△ X	△ X	△ X	△ X
1	Steering wheel cannot turn left or right.	○		○		○	○	○
2	Fault of item 1 and also work equipment does not operate normally.	○						
3	Steering wheel can only turn to either left or right.				○			○
4	Steering wheel is sluggish and does not turn properly	○		○		○	○	
5	Oil pressure in steering circuit does not rise at all.	○		○				

Because the steering circuit and the work equipment circuit are intimately related to each other, check the operation of the work equipment if the steering behaves abnormally.

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace A: Repair
A: Adjust C- Clean

2. Steering wheel is sluggish.

Ask the operator the following questions.

- Did the steering wheel suddenly become sluggish?
  Damage to equipment in steering circuit.
- Did the steering wheel show signs of being sluggish for some time? — Worn parts in steering circuit or faulty seal.

Checks before troubleshooting

- Is oil level in hydraulic tank and type oil satisfactory?
- Is there any abnormality in the steering gear box mounting part, steering column or linkage?
- Is the adjusting of the steering control lever stopper correct?
- Is there any oil leakage from the oil pressure hose, valves, cylinders, etc?
- Is there any seizure between the pin and bushing of the center hinge bearing and the steering
  Cylinder pin and bushing?
- Check tire pressure.

Fault check

- Measure the operating force of the steering wheel and also the operating time of steering wheel, then check the results against the standard value table to see whether or not there is any abnormality.

		Hydraulic pump		Valve			Other parts				
		Faulty steering pump	Faulty hydraulic pump	Steering relief valve	Internal fault in steering valve: Safety valve	Internal fault in steering valve: Demand spool	Internal fault in steering cylinder (oil leakage from piston seal)	Blockage in hydraulic oil return side filter or faulty bypass valve	Blockage in oil cooler	Incorrect adjustment of play in steering gear box	Internal fault in steering gear box (bearing and worm nut)
		a	b	c	d	e	f	g	h	i	j
No.	Problems \ Remedy	△ X	△ X	△A X	△ X	△ X	△ X	△ X	△ X	△ X	△ X
1	Steering wheel is sluggish in both left and right directions.	○		○		○	○			○	
2	Steering wheel is sluggish in one of left and right directions.				○		○				
3	Steering wheel is particularly sluggish at low engine speed.	○					○				
4	Boom lifting speed is insufficient when engine is at full throttle.		○								
5	Steering wheel is sluggish and jerky.	○	○								
6	Hydraulic oil overheats.								○		
7	Steering circuit pressure is low.	○	○	○	○	○	○				
8	Oil pressure in return side piping of steering cylinder rises.							○	○		

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace A: Repair
A: Adjust C: Clean

3. **Steering wheel moves unsteadily or is subjected to large shock.**

Checks before troubleshooting

- Is oil level in hydraulic tank and also oil type satisfactory?
- Is there any damage to the steering gear box mounting part, steering column or linkage?
- is there any play in the center pin hinge bearing or steering cylinder pin bushing?
- Does tire pressure fluctuate?

Fault check

Operate the wheel loader in a safe place and Check the conditions under which the steering Wheel becomes unsteady.

* If, in addition to the steering wheel being unsteady, there are other faults such as sluggishness, etc., refer to item 2 "Steering wheel is sluggish".

	Cause	Valve: Faulty steering valve: Safety valve	Valve: Faulty steering valve: Incorrect positioning of steering valve changeover spool	Valve: Faulty 2-way restricter valve	Internal fault in steering cylinder (inside surface of cylinder, piston seal, nut, bolt)
		a	b	c	d
No	Problem / Remedy	△A X	△ X	X	△ X
1	Machine body is unsteady when traveling on bumpy road surface.	○	○		○
2	Steering wheel becomes unsteady if suddenly turned when working or traveling.			○	○
3	Machine body becomes unsteady when traveling at high speed	○	○		○
4	Machine body becomes unsteady during engine starting.		○		

The following symbols are used to indicate the action to be taken when a cause of failure is located.
X: Replace A: Repair
A: Adjust C: Clean

4. Machine tends to turn naturally in one particular direction when traveling.

Cause: Faulty steering valve
- Incorrect positioning of spool.
- Faulty safety valve.
- Oil leakage in steering cylinder.
- Does tire pressure fluctuate?

5. Left and right turning radius are different.

Cause: Incorrectly adjusted steering linkage.
Left and right steering balance, lock position of stopper.
(Valve relief noise can be heard upon completion of turning.)

STEERING SYSTEM

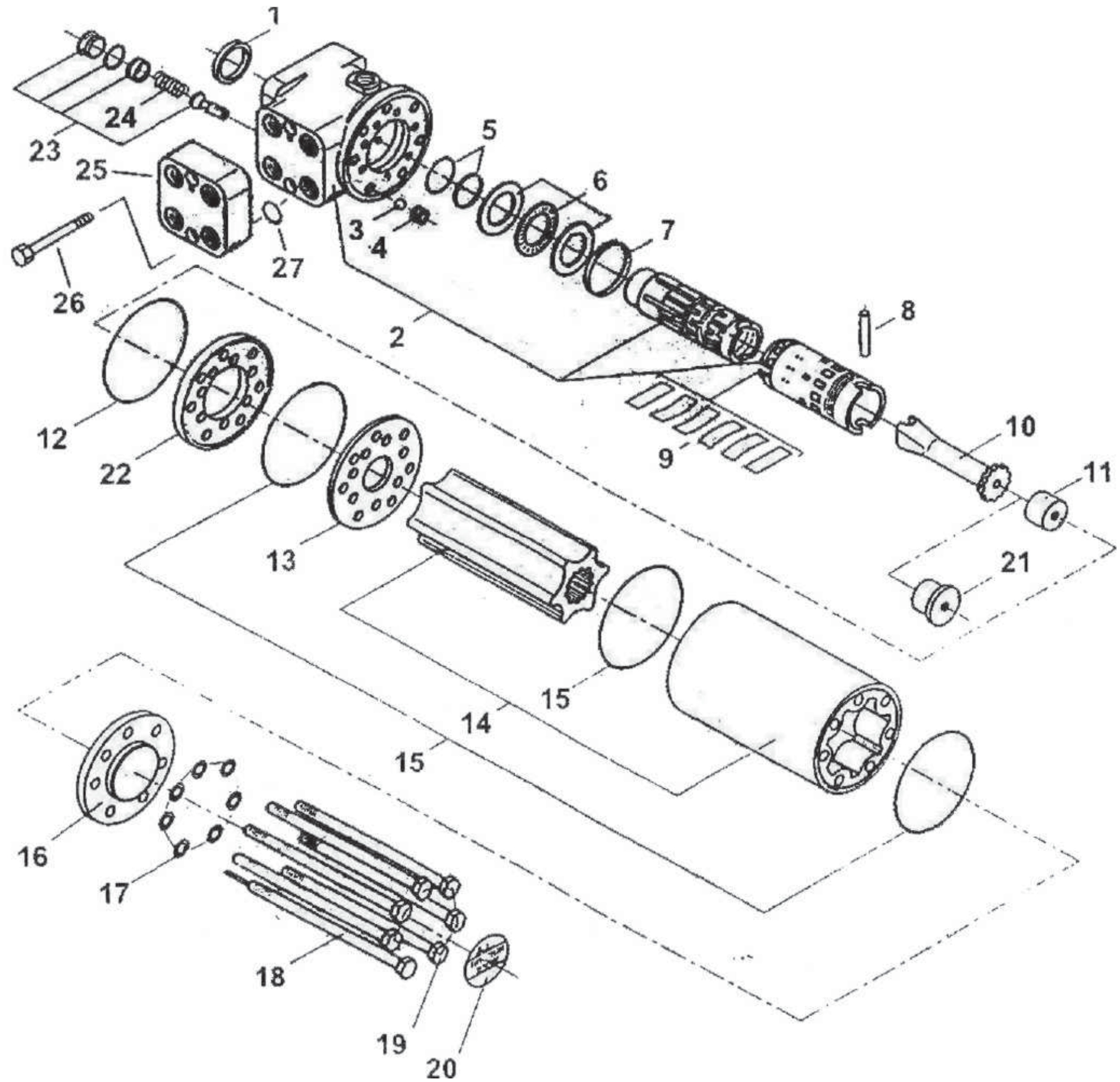
11 DISASSEMBLY AND ASSEMBLY

* For repairs, remove hydraulic cylinders, pumps and piping.
After re-assembling, when operating the cylinders for the first time, be sure to bleed air according to the following instructions:

1. Start engine and put in low idle.
2. Operate hydraulic cylinder 4 — 5 cycles, but do not exceed beyond 1 00 mm of stroke end.
3. Continue to operate cylinder 2 — 3 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

NOTE: After repairing and long storage, same procedure is required.

DISASSEMBLY AND ASSEMBLY OF STEERING VALVE



DISASSEMBLY

1. Remove tubes (1) and (2).

2. Remove main relief valve assembly (3) and safety valve assembly (4).

3. Case assembly

1) Remove case assembly (5), then remove collar (6).
2) Remove covers (26) and (27).
3) Remove dust seal (28).
4) Loosen bolt (30) of lever (29), then remove shaft (31).
5) Remove oil seal (32) and bearings (33) and (34).

4. Spool assembly

1) Remove case (7), then remove spool assembly (8).
2) Remove bolt (9), then remove retainer (10), spring (11) and retainer (10) from spool (12).
   * When loosening the bolt, loosen with the spool assembled in the body.

5. Remove plate (13), then remove valve (14).

6. Remove plate (13), then remove seat (15), spring (16) and valve (17).

7. Remove cover (18), then remove boss (1 9), spring (20), washer (21) and spool (22).

8. Remove plate (13), then remove seat (23), spring (24) and poppet (25).

ASSEMBLY

1. Assemble valve (25) and spring (24), fit O-ring and back-up ring, install seat (23), then install plate (13).
2. Assemble spool (22), washer (21), spring (20) and boss (19), then fit O-ring and install cover (18).
3. Assemble valve (17) and spring (16), fit O-ring and back-up ring, install seat (1 5), then install plate (13).
4. Fit O-ring and back-up ring, install valve (1 4), then install plate (13).

5. Spool assembly

1) Assemble retainer (10), spring (11) and retainer (10) to spool (12*),* then tighten bolt (9).
   * When tightening the bolt, tighten with the spool assembled in the body.
2) Assemble spool assembly (8) in body (35), then fit O-ring and install case (7).

6. Case assembly

1) Install bearings (33) and (34), and oil seal (32)
   Oil seal: Grease (G2-LU
2) Assemble key, then install shaft (31) to lever (29) and tighten bolt (30).
3) Install dust seal (28).
4) Fit O-rings and install covers (27) and (26).
5) Assemble collar (6), then fit O-ring and install case assembly (5).

7. Fit O-rings and install safety valve assembly (4) and main relief valve assembly (3).

   kgm Safety valve assembly: 4.5 ±0.5 **kgm**
   Main relief valve assembly: 8.5± 1.5 **kgm** 8.
   Fit O-rings and install tubes (2) and (1).

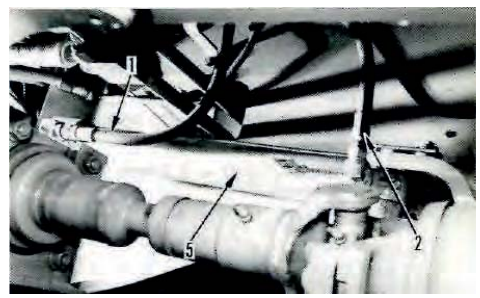
REMOVAL OF STEERING CYLINDER

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

⚠ Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

1. Hydraulic piping

Disconnect hoses (1) and (2) from cylinder.

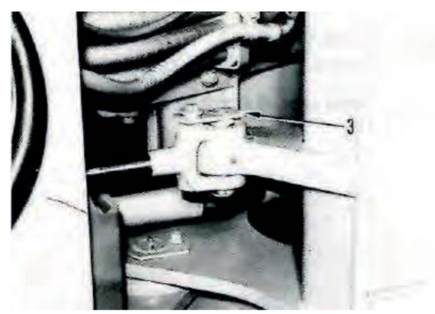


2. Steering cylinder

1) Remove bolt at rod end, then remove pin (3).

* If there are shim, check number and thickness of shim and keep in a safe place.

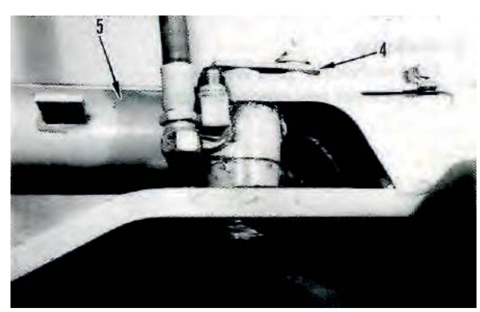
2) Remove bolt at bottom end, then remove pin (4).



3) Remove steering cylinder (5).

* This operation should be carried out by two workers. Be careful not to damage the cylinder rod.

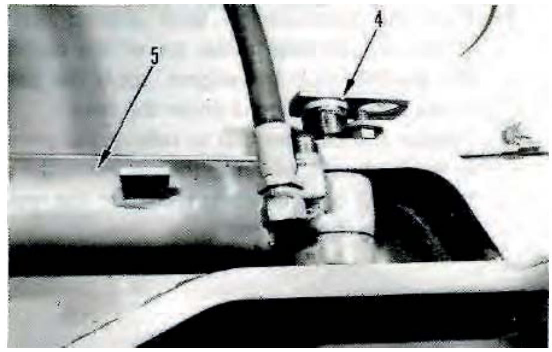
kg Steering cylinder: 20 kg



CHANGE THE PHOTOS

INSTALLATION OF STEERING CYLINDER

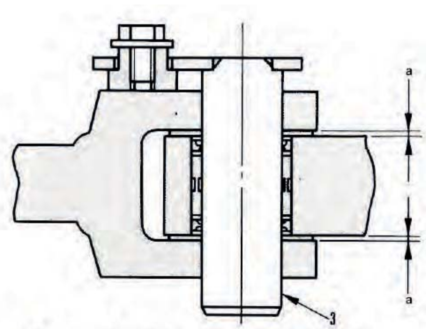
1. Steering cylinder



1) Set steering cylinder (5) in mounting position.

2) Install pin (4) at bottom end, then install bolt.

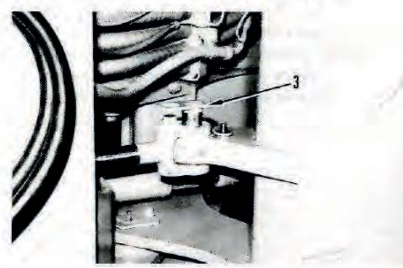
3) Install pin (3) at rod end, then install bolt.



⚠ Use a bar to align the pin holes.

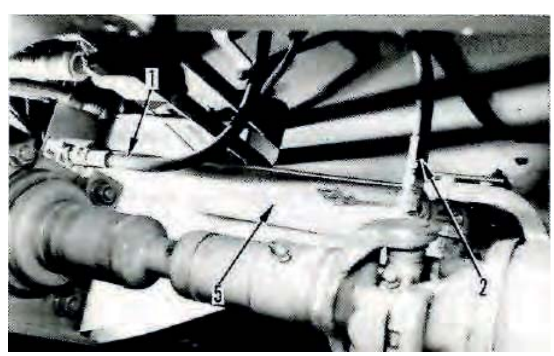
Never use your fingers.

***** Adjust with shims to give specified value for clearance 'a'.
Clearance 'a' = **0 — 1.0 mm**



2. Hydraulic piping
Connect hoses (1) and (2) to cylinder.

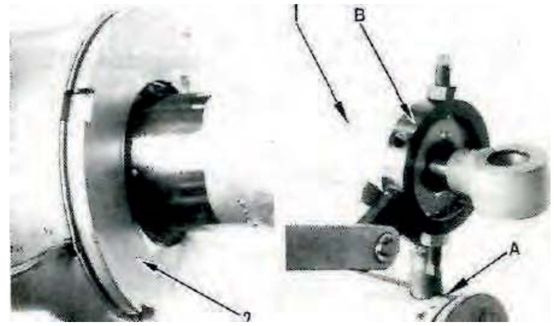
kgm Hose nut: **8.0±2 kgm**



3. Greasing
Grease cylinder pins well.
* Wipe off any grease which comes out.

DISASSEMBLY OF STEERING CYLINDER ASSEMBLY

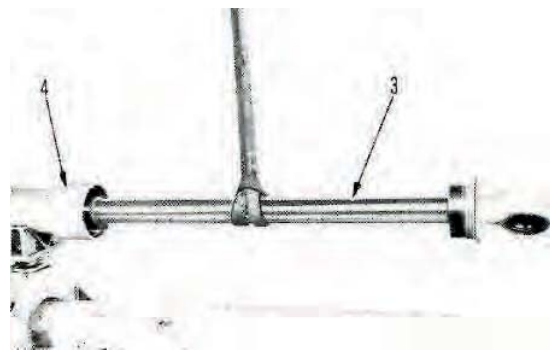
1. Set cylinder assembly (1) on tool **A.**



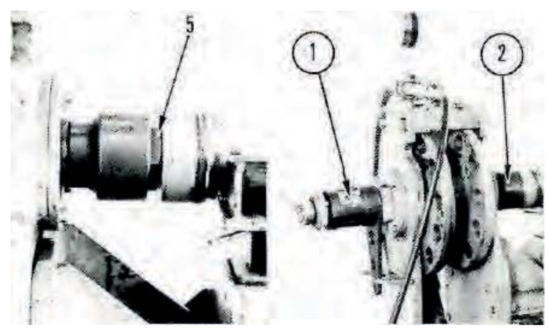
2. Straighten lock tab of cylinder head (2), then using too! **B**, remove cylinder head (2) from cylinder.

3. Pull cylinder head and piston rod assembly (3) from cylinder (4) and lift off.
   * Oil will come out when the piston rod assembly is removed from the cylinder, so have a container ready.

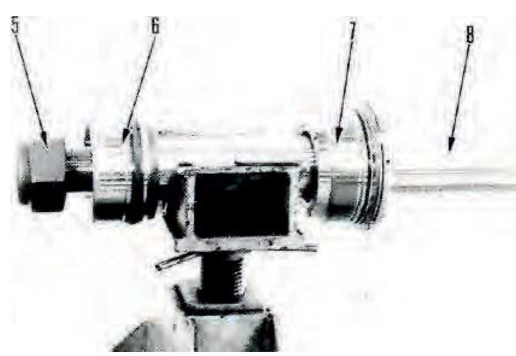
4. Remove cylinder (4) from tool **A.**



5. Set cylinder head and piston rod assembly on tool **A**, and loosen nut (5) with power wrench (1) and socket (2).
   ***** Power wrench: 16 times
   ***** Width across flats of socket *(T):* 46 mm



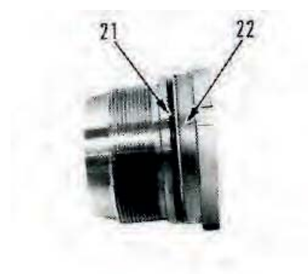
6. Remove nut (5), then remove piston assembly (6) and cylinder head assembly (7) from rod (8).



7. Disassemble piston assembly as follows;
   1) Remove wear ring (9).
   2) Remove piston ring (1 0) from piston (1,1).

Disassemble cylinder head assembly as follows;
1) Remove snap ring (16), then remove dust seal (17).
2) Remove rod packing (1 8).
3) Remove bushing (1 9) from cylinder head (20).

4) Remove O-ring (21) and back-up ring (22).

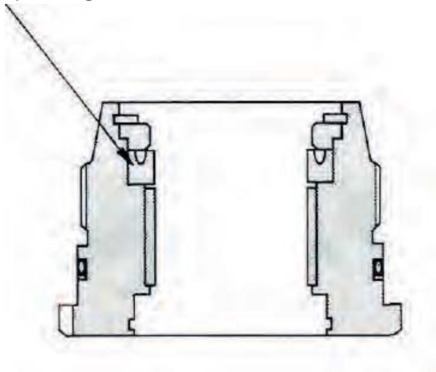


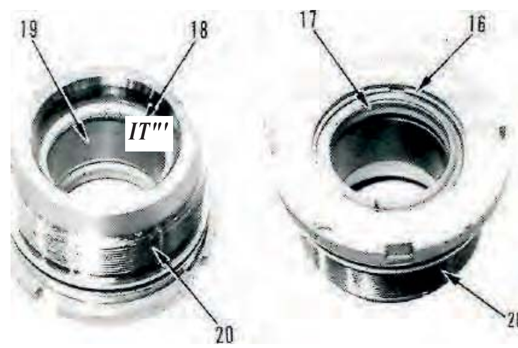
ASSEMBLY OF STEERING CYLINDER ASSEMBLY

* Coat the sliding surface of all parts with engine oil.
  Take care not to damage rod packing, dust seals or
  assembly (6) on rod, then install nut (5).

1. Assemble cylinder head assembly as follows;
   1) Using a push tool, press fit bushing (19) on cylinder head (20).
      * Take particular care not to deform the bushing when press fitting.
   2) Assemble rod packing (18).
      * Be careful to install the rod packing facing in the correct direction.

Rod packing





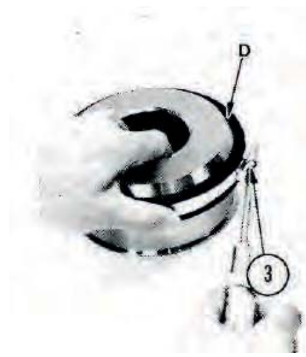
   3) Using a push tool, install dust seal (17) on head (20).
   4) Install snap ring (16).
   5) Install back-up ring (22) and O-ring (21).
      * Do not force back-up ring. Heat in hot water (50 - 6O°C) before inserting.

Assemble piston assembly as follows.

1) Using tool **C**, expand piston ring (1 0).
   * After setting the piston ring in tool **C**, rotate the handle 8 to 10 times to expand.

2) Remove piston ring (10) from tool **C** and
assemble on piston (11).

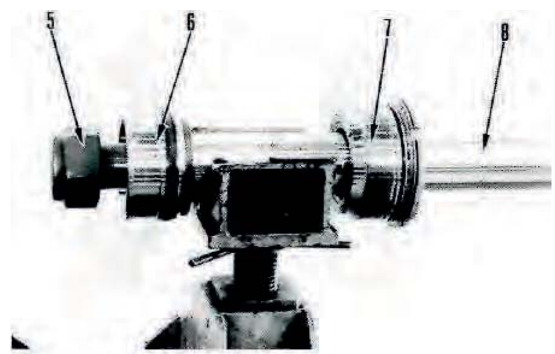
3) Fit tool **D** on piston ring and compress piston ring with clamp (3).
   * Parts No. of clamp
     (3) 07281-00909



4) Assemble wear ring (9).

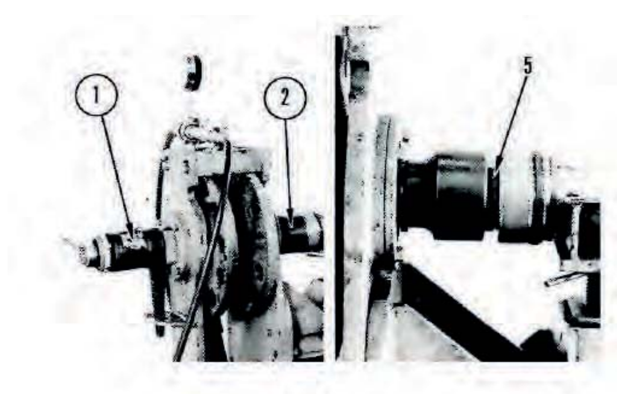
3. Set piston rod (8) in tool **A.**

4. Assemble cylinder head assembly (7) and piston assembly (6) on rod, then install nut (5).



5. Using power wrench *(1)* and socket 2 tighten nut (5) to the following specified torque;
   * Power wrench: **16 times**
   * Width across flats of nut (5): 46 **mm**

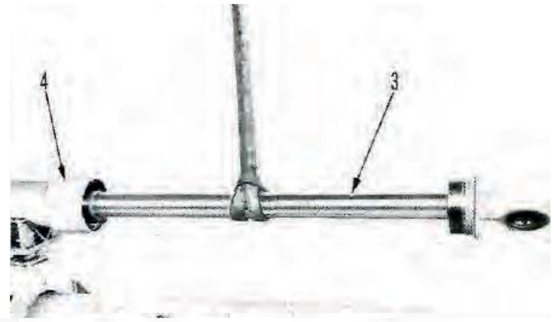
kgm Tightening torque of nut (5): **80±8 kgm**



6. Remove piston rod and cylinder head assembly from tool A.

7. Set cylinder (4) in tool A.

8. Sling piston rod and cylinder head assembly (3) and install in cylinder (4).

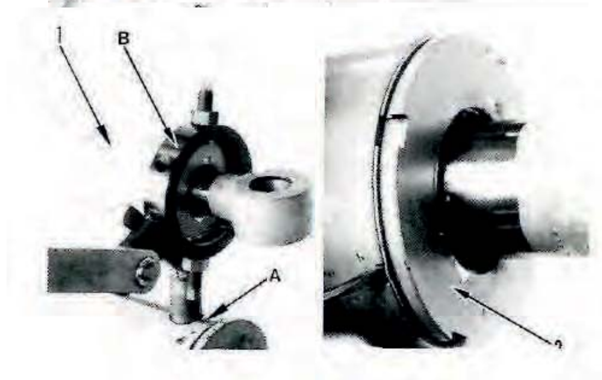


9. Using tool B, tighten cylinder head nut (2).

Cylinder head nut: **55±5.5kgm**

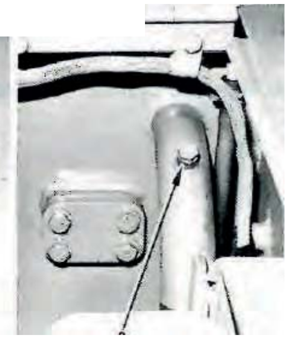
10. Bend lock into notch on cylinder.

11. Remove cylinder assembly from tool A.



REMOVAL OF CENTER HINGE PIN

* Remove the bucket before starting the operation.



⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires. Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

⚠ Loosen plug (1) at the top of the hydraulic tank filter, and plug (2} of the pump piping to prevent the oil inside the tank from flowing out.

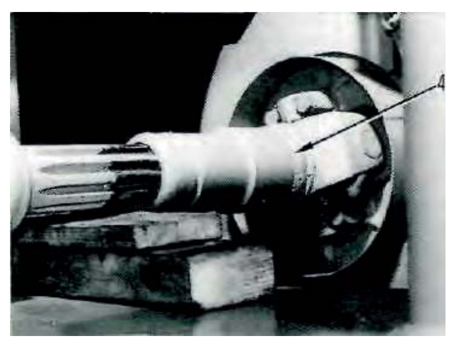
1. **Steering cylinder**

   Remove left and right rod pins (3) of steering cylinder.

   * If there are any shims, check the number and thickness of the shims, and keep in a safe place.

2. **Drive shaft**

   Disconnect center drive shaft (4). * Set a block under the drive shaft and dis-connect.

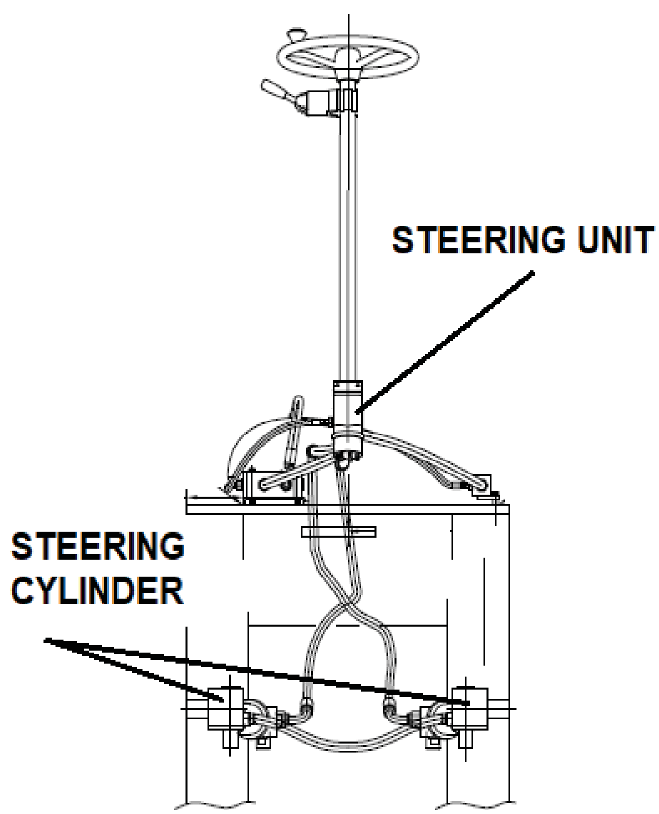


3. Electric wiring

Remove both the clamps (6) and (7) of wiring (5) at the front frame and rear frames.

4. Hydraulic piping

Disconnect the hydraulic hoses of steering unit and steering cylinder



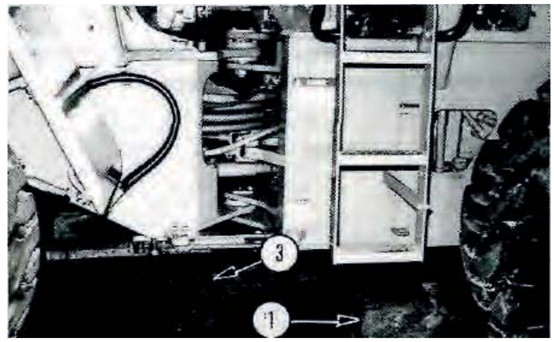
6. Frame support

1) Adjust height of rear frame and insert block *(1)*

2) Insert stands (2) under counterweight.

3) Adjust height of left and right front frame, then insert block (3).

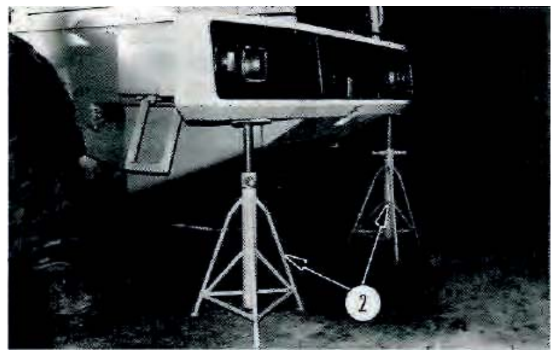
* Carefully adjust frame height.



7. Lower hinge pin

Remove lock bolt and take out lower hinge pin (18).

* Adjust the height carefully so that the pin can be removed easily by hand.

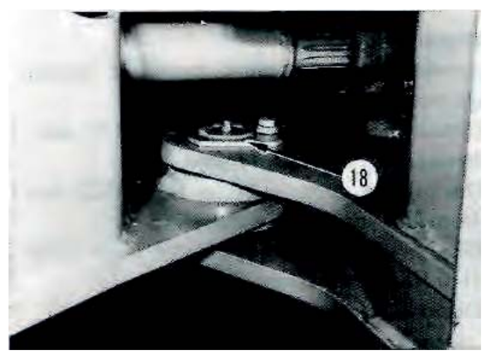


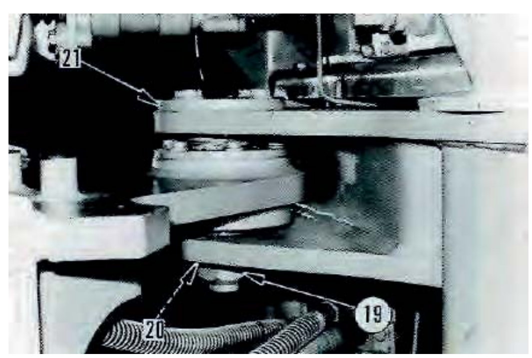
8. Upper hinge pin

1) Remove lock nut (1 9) and washer (20).

2) Remove pin mounting bolt, and take out upper hinge pin (21).

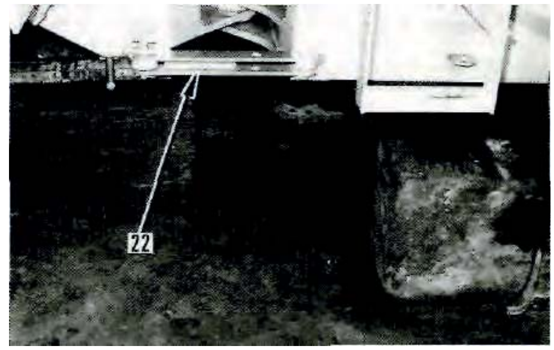
* Check the number of shims between the retainer and frame.

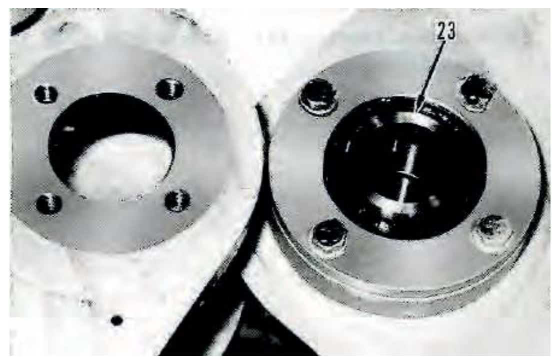




9. Disconnecting frame

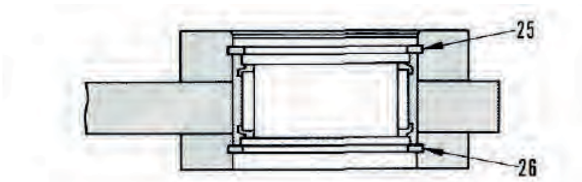
1) Remove safety bar (22) and jack up front differential, then pull out front frame to the front.
   * Be careful not to let the spacer at the bottom of the upper hinge get caught on the rear frame. Then, insert bar between rear frame and front frame, and disconnect while lifting front frame.
   * Carry out the operation carefully and be sure to keep the parts in balance.
2) After disconnecting frame, remove spacer (23).

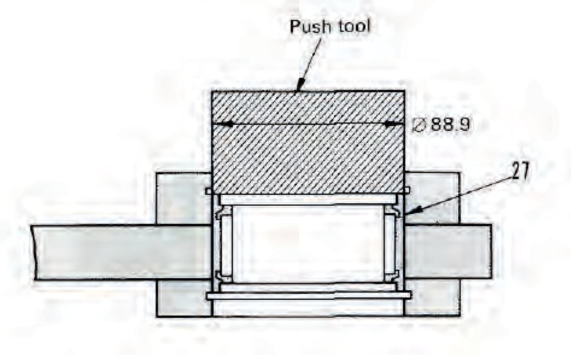


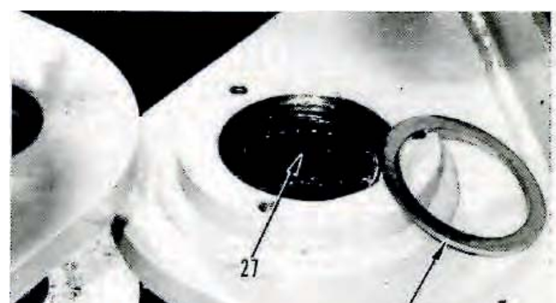


3. Lower hinge

1) Remove washer (24).
2) Remove snap rings (25) and (26) and take out
   bearing (27).

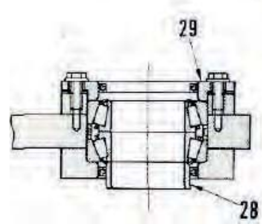




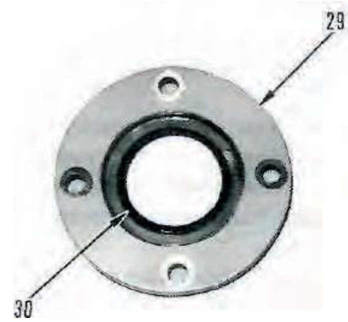


11. Upper hinge

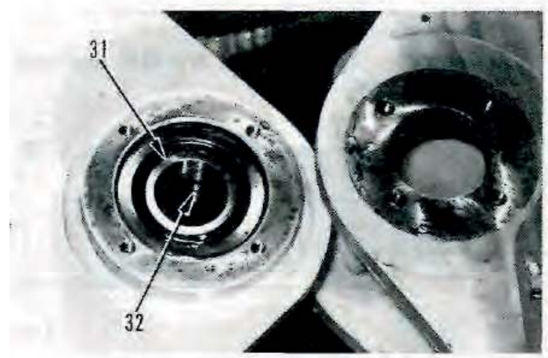
1) Remove spacer (28).
2) Remove mounting bolts, and remove retainer
   (29), then remove dust seal (30).
   * Check the number of shims between the retainer and frame.

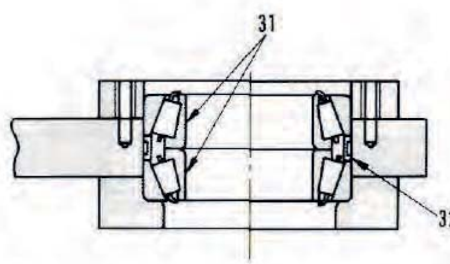


3) Remove dust seal (30) from retainer (29).



4) Remove bearing (31) and spacer (32) from front frame.





INSTALLATION OF CENTER HINGE PIN

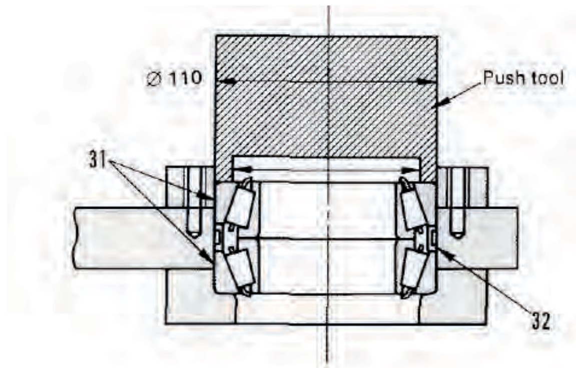
1. Upper hinge

1) Press fit bearing (31) and spacer (32) on front frame.

* The clearance of bearing and spacer are adjusted, so do not change the combination. If the bearing or spacer is replaced, change both parts as a set.

* Press fit the bearing and check that there is no clearance where contact surface of the frame.

Bearing: Grease (G2-LI)



2) Install dust seal (33) on front frame.

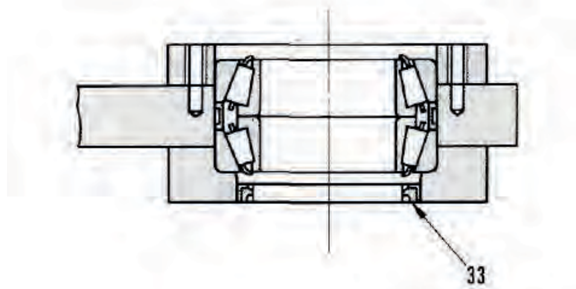
* Install lip on the outer side and be careful not to damage seal lip.

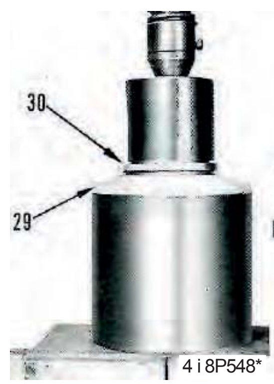
Seal lip: Grease (G2-LI)

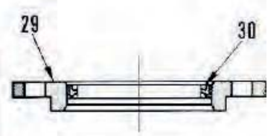
Inside circumference of spacer: Grease (G2-LI) 3) Press fit dust seal (30) on retainer (29).

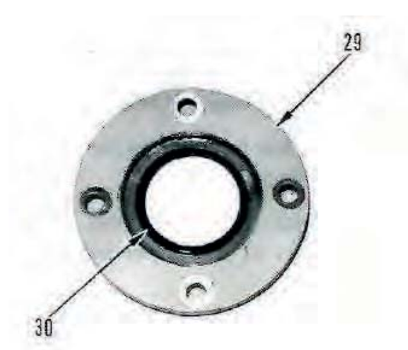
* Be careful to press fit dust seal so that the lip is faced outward.

Seal lip: Grease (G2-LI)



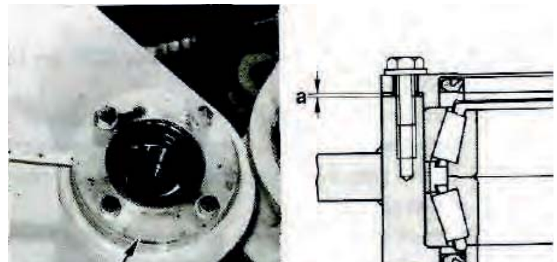


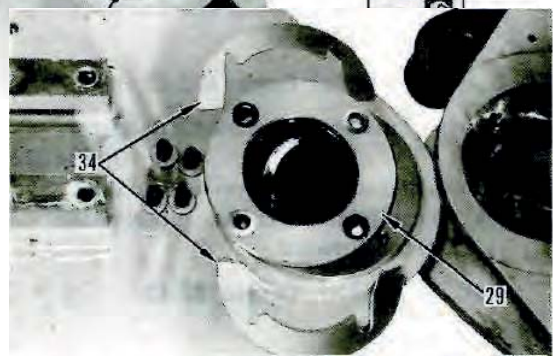




4) Tighten 4 mounting bolts of retainer (29) then select shims (34) to bring clearance 'a' between retainer and frame to specified value. Clearance' a': less than 0.1 mm

Mounting bolt: **1.5±0.15 kgm**
(When checking shims)
Mounting bolt: **6.75±0.75 kgm**

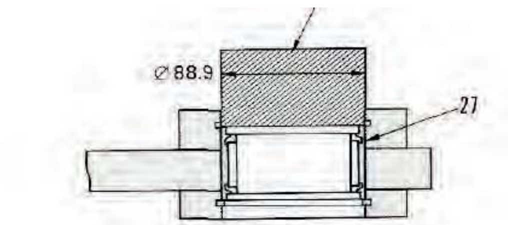




2. Lower hinge

1} Install snap ring (26), and press fit bearing (27). 2) Install snap ring (25) then install washer (24).

Push tool



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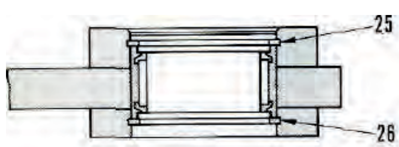
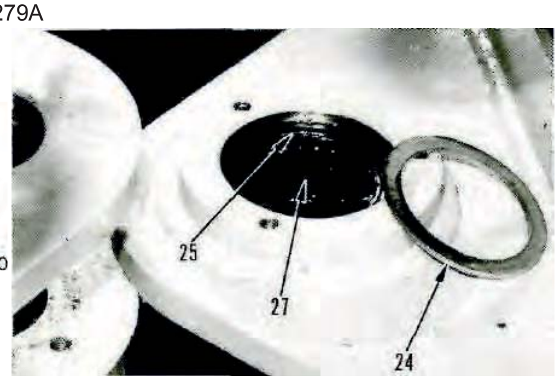


418F280



3. Connecting frame

1) Install spacers (28) and (23) on upper and lower front frame.
   * Install spacers so that larger chamfered side faces inward.
2) Jack up differential, move front frame towards rear frame, and align pin holes.

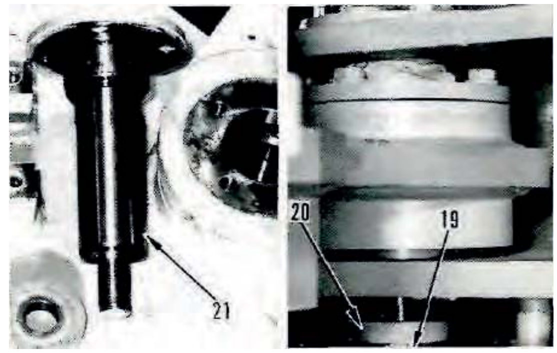
⚠ Use a bar to align the pin holes. Never use your fingers.

* Be careful to connect the spacers of the lower part of the upper hinge so that they match.
* Align the pin holes correctly.
* Connect safety bar.

4. Upper hinge pin

1) Insert upper hinge pin (21).

2) Tighten washer (20) and lock nut (1 9) to specified torque, then select shims to bring clearance 'b' between rear frame and pin to specified value.

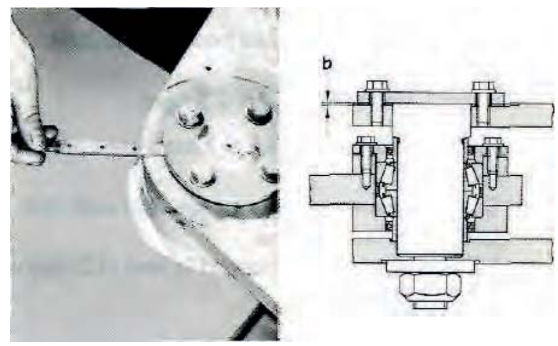


* Tighten the mounting bolts temporarily to act as stoppers when tightening the lock nut.

* Clearance V: less than 0.1 mm

kgm Lock nut: 58 ± 6 **kgm**

* Lock nut width across the flat: 55 **mm**

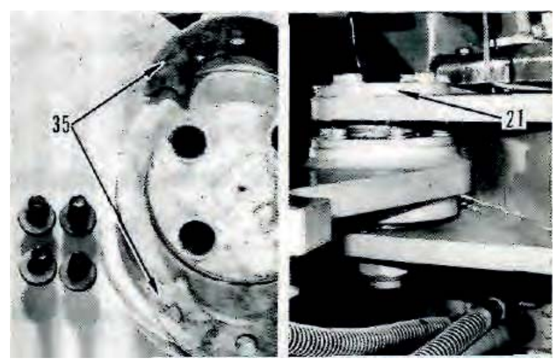


3) Install selected shims (35) and tighten pin mounting bolts.

• Tighten lock nut to specified torque again before tightening mounting bolts.

kgm Lock nut: 58±6kgm

kgm Mounting bolt: **11.5±1.0kgm**



5. Lower hinge pin

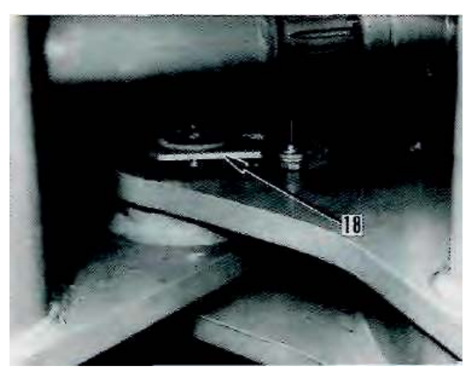
Insert lower hinge pin (18), and secure with lock bolt.

Hinge pin outside circumference:

Grease (G2-LI)

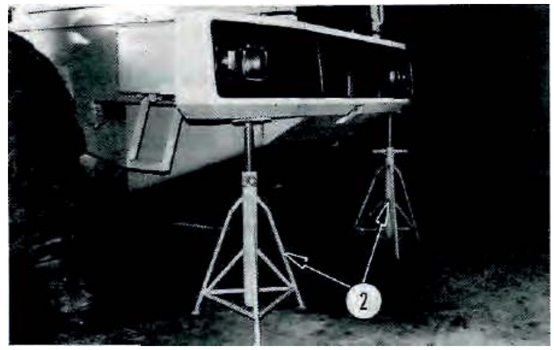
⚠ Use a bar to align the pin holes. Never use your fingers.

* Adjust height carefully so pin can easily be inserted by hand.



6. Frame support

1) Remove stands (*2)* from under counterweight.
2) Jack up rear frame and remove block (1).
3) Remove right and left blocks *(3)* from front frame.



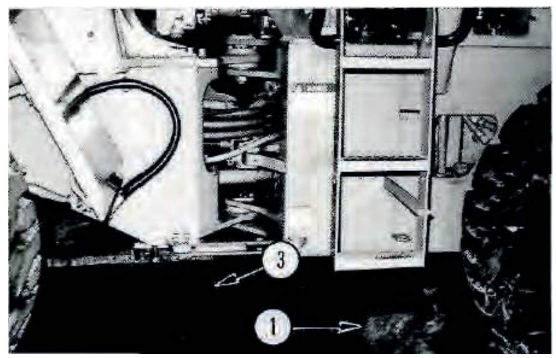
7. Hydraulic piping

Connect the following hydraulic piping and brake hose.

- Connect front axle brake hose (1 7) to joint.

Hose nut: **1.2±0.3 kgm**

- Connect steering cylinder hoses (15) and (16) to tube.
- Connect dump cylinder hoses (13) and (14) to joint inside front frame.
- Connect lift cylinder hose (1 1) and (1 *2)* to joint inside front frame.



8. **Steering linkage**

1) install steering linkage bracket (1 0) temporarily, then install center lever (9).
2) Connect steering linkage (8) to center lever.

kgm Lock nut: **28.5±3.0kgm**

kgm Mounting bolt: **18±2kgm**

Mounting bolt: Adhesive (Loctite 262)

kgm Mounting bolt: **12.5 + 1.0 kgm**

9. Electric wiring

Connect all electrical wirings

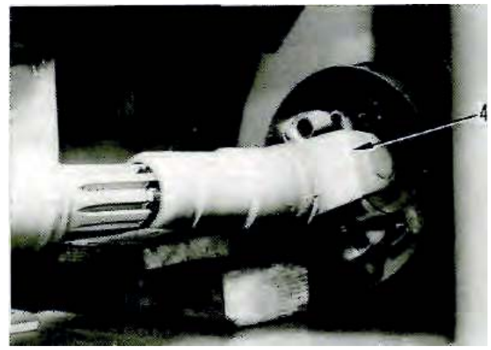
10. Drive shaft

Install center drive shaft (4).

* Be careful to install the coupling facing in the correct direction.

kgm Mounting bolt: **6.75±0.7B kgm**

* Remove block after connecting drive shaft.



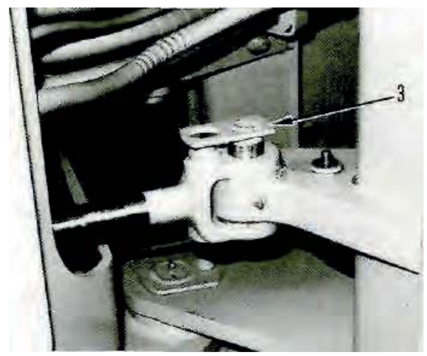
11. Steering cylinder

Install left and right pins (3) at steering cylinder rod end.

* Adjust with shims so that the clearance is within the specified range.

Clearance: less than 1.0 **mm**

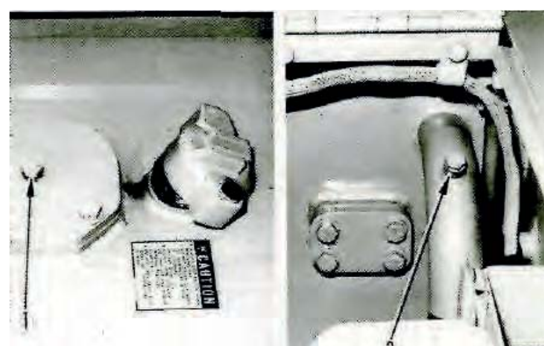
For details, see page 43-1 4.

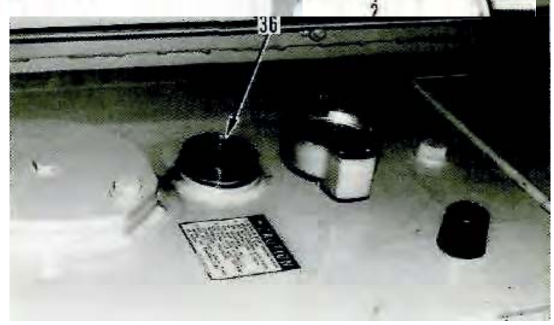


12. Refilling with oil

Tighten plug (1) at top of hydraulic tank filter, and plug (2} of pump piping, then add hydraulic oil through oil filler (36) to the specified level.

* Run the engine to circulate the oil through the system. Then check the oil level again.

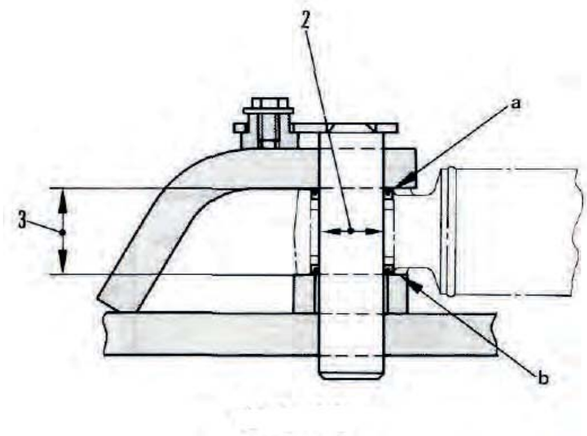




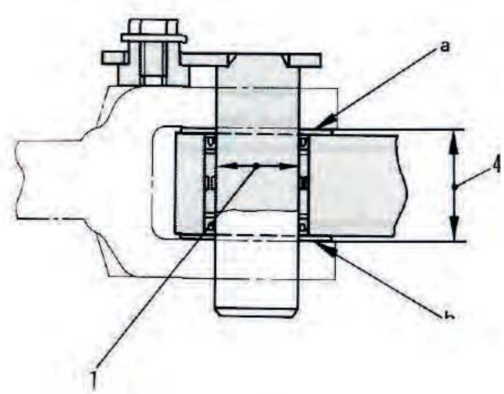
13. Bleeding air from brakes

STEERING SYSTEM
12 MAINTENANCE STANDARD

STEERING CYLINDER MOUNT



STEERING CYLINDER END IN FRONT FRAME

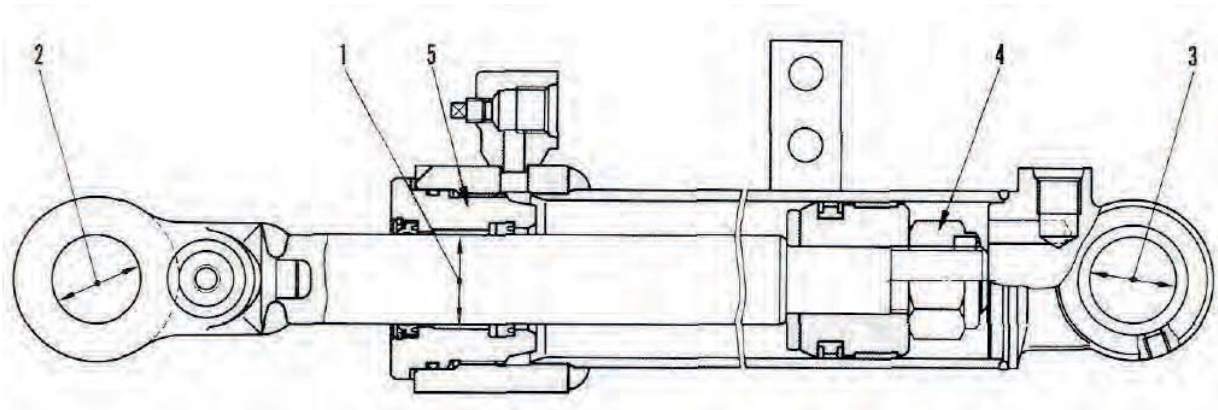


STEERING CYLINDER ROD END AT REAR FRAME

Unit: mm

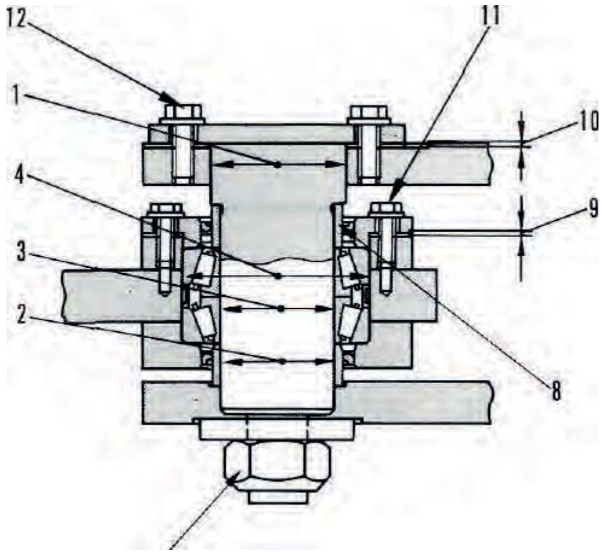
<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Clearance between mounting pin and bushing at connection of steering cylinder rod and</td><td rowspan="2">Standard
size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard
clearance</td><td rowspan="2">Clearance
limit</td><td rowspan="7">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>40</td><td>0 - 0.025</td><td>+ 0.142 + 0.080</td><td>0.080 - 0.167</td><td>–</td></tr>
<tr><td>2</td><td>Clearance between mounting pin and bushing at connection of steering cylinder bottom and frame</td><td>40</td><td>0 - 0.025</td><td>+ 0.142 + 0.080</td><td>0-080 - 0.167</td><td>-</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Connection of steering cylinder and front frame</td><td colspan="2">Width of boss</td><td colspan="2">Width of hinge</td><td>Standard clearance (clearance a + b)</td></tr>
<tr><td colspan="2">5O + 8^{8}</td><td colspan="2">53</td><td>After adjusting with shim: Less than —</td></tr>
<tr><td>4</td><td>Connection of steering cylinder and rear frame</td><td colspan="2">50</td><td colspan="2">54±0.8</td><td>After adjusting with shim: Less than 1</td></tr>
</table>

STEERING CYLINDER

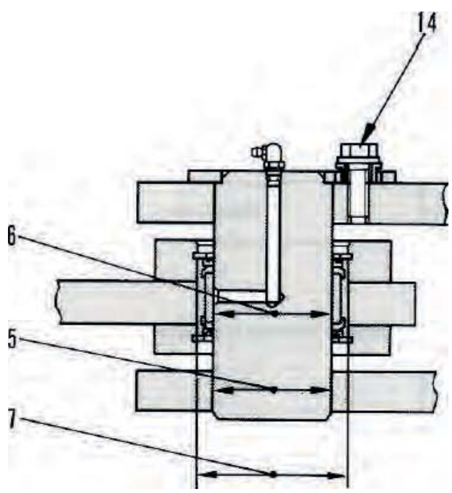


No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between rod and bushing	40	-0.080 -0.142	+ 0.132 + 0.006	0.086 -- 0.274	0.574	Replace
2	Clearance between piston rod mounting pin and diameter of hole	40	0 - 0.025	+ 0.142 + 0.080	0.080 -- 0-167		
3	Clearance between cylinder bottom mounting pin and bushing	40	0 - 0.025	+ 0.142 + 0.080	0.080 -- 0.167		
4	Tightening torque of piston nut	80±8 kgm (width across flats 46 mm]					Retighten
5	Tightening torque of cylinder head	55±5.5 kgm					

CENTER HINGE PIN



ARTICULATION TOP



ARTICULATION BOTTOM

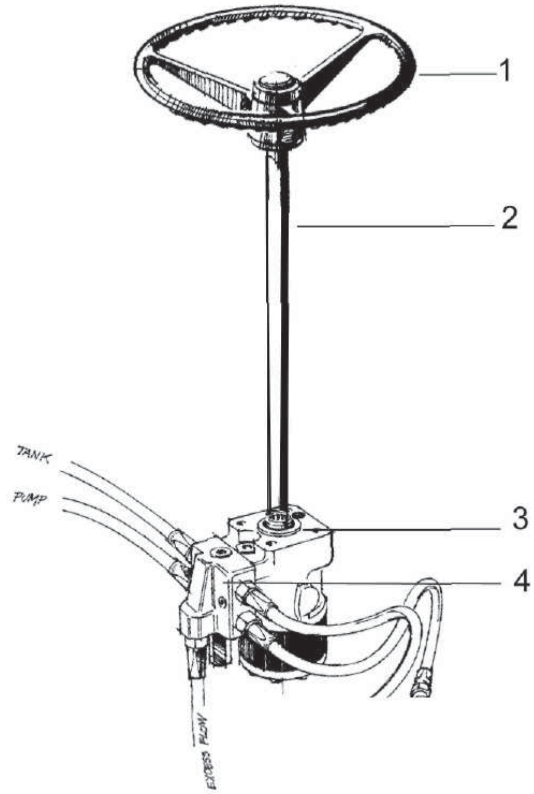
1

S

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between upper hinge pin and rear frame	80.5	-0.08 -0.18	±0.05	-0.03 -- 0.23	–	Replace
2	Clearance between upper hinge pin and spacer	65	-0.030 -0.049	+ 0.24 0	-0.030 - -0.073	-	
3	Clearance between upper hinge pin and bearing	65	-0.030 -0.049	0 - 0.015	-0.015 - -0.049	-	
4	Clearance between front frame and upper hinge bearing	110	0 - 0.02	-0.041 -0.076	-0.076 - -0.021	–	
5	Clearance between lower hinge pin and rear frame	70	-0.20 -0.21	-0.05 -0.15	0.05 - 0.16	-	
6	Clearance between lower hinge pin and bearing	70	-0.20 -0.21	-0.097 -0.122	0.078 - 0.113	-	
7	Clearance between front frame and lower hinge bearing	88.9	±0.05	0 - 0.020	0.07 - 0.05	–	
8	Height of upper hinge pin spacer	Standard size	Tolerance		Repair limit		Adjust
		26	0 - 0.25		-		
9	Thickness of standard shim between upper hinge and retainer	0-7					
10	Thickness of standard shim between upper hinge and retainer	1.5					
11	Tightening torque of upper hinge retainer mounting bolt	When adjusting with shim: 1.5 ±0.1 5 kgm					
		Final valve: 6.75 + 0.75 kgm					
12	Tightening torque of upper hinge retainer mounting bolt	11.5+1.0 kgm					Retighten
13	Tightening torque of upper hinge retainer mounting bolt	52 + 6 kgm					
14	Tightening torque of lower hinge retainer mounting bolt	11.5±1.0kgm					

STEERING COLUMN AND GEAR BOX

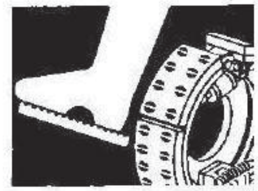


1. Steering Wheel
2. Steering Column
3. Steering Unit
4. Valve Block

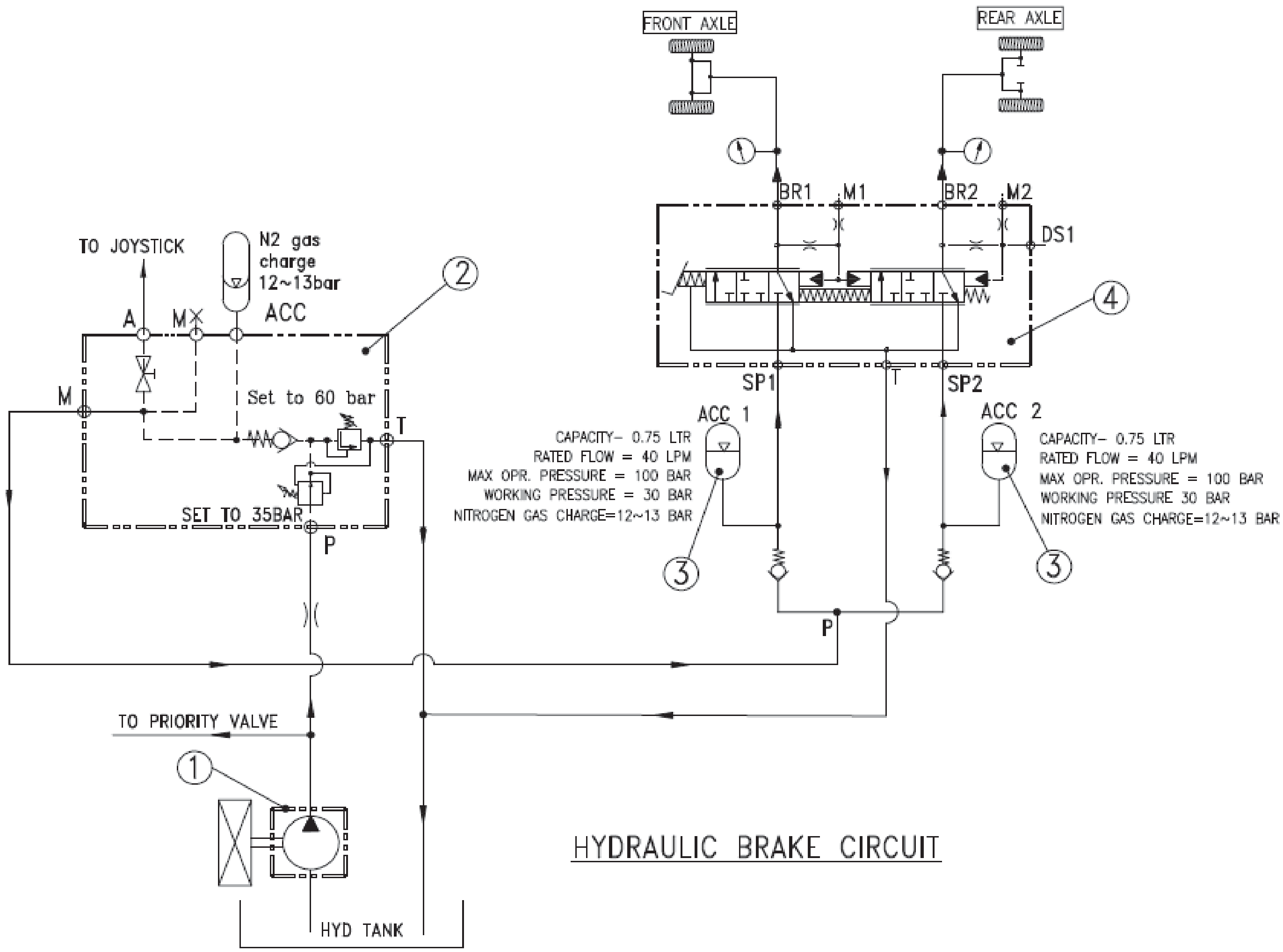
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between sector shaft and bushing	35	-0.009 -0.034	+ 0.025 0	0.009 - 0.059	-	Replace bushing
2	Clearance between sector shaft and bushing	30	-0.007 -0.028	+ 0.021 0	0.007 - 0.049		
3	Clearance between steering shaft and column bushing	19	0 - 0.08	+ 0.15 - 0.05	0.05 - 0.23	0.4	
4	Tightening torque of wheel mounting nut	3.0 + 0.3 kgm					Retighten
5	Tightening mounting bolt	5.7±0-7 kgm					

13 BRAKE SYSTEM STRUCTURE AND FUNCTION



GENERAL



1. Hydraulic pump
2. Pilot manifold
3. Brake accumulators
4. Brake valve

Hydraulic brake circuit

The Hydraulic Brake system consist of hydraulic pump (1), manifold block (2), brake accumulators(3) and brake valve(4).

Pressurized oil from the main pump (1) will enter in to the pilot manifold, in pilot manifold reducing valve will reduces the main pressure to 35 bar, and this pressure is sufficient to actuate the service brake in equipment.

From pilot manifold block M port is connected to brake valve (4) SP1 and SP2 ports, and parallelly fills the brake accumulators (3) in individual lines.

VE

GENERAL

Working of braking system

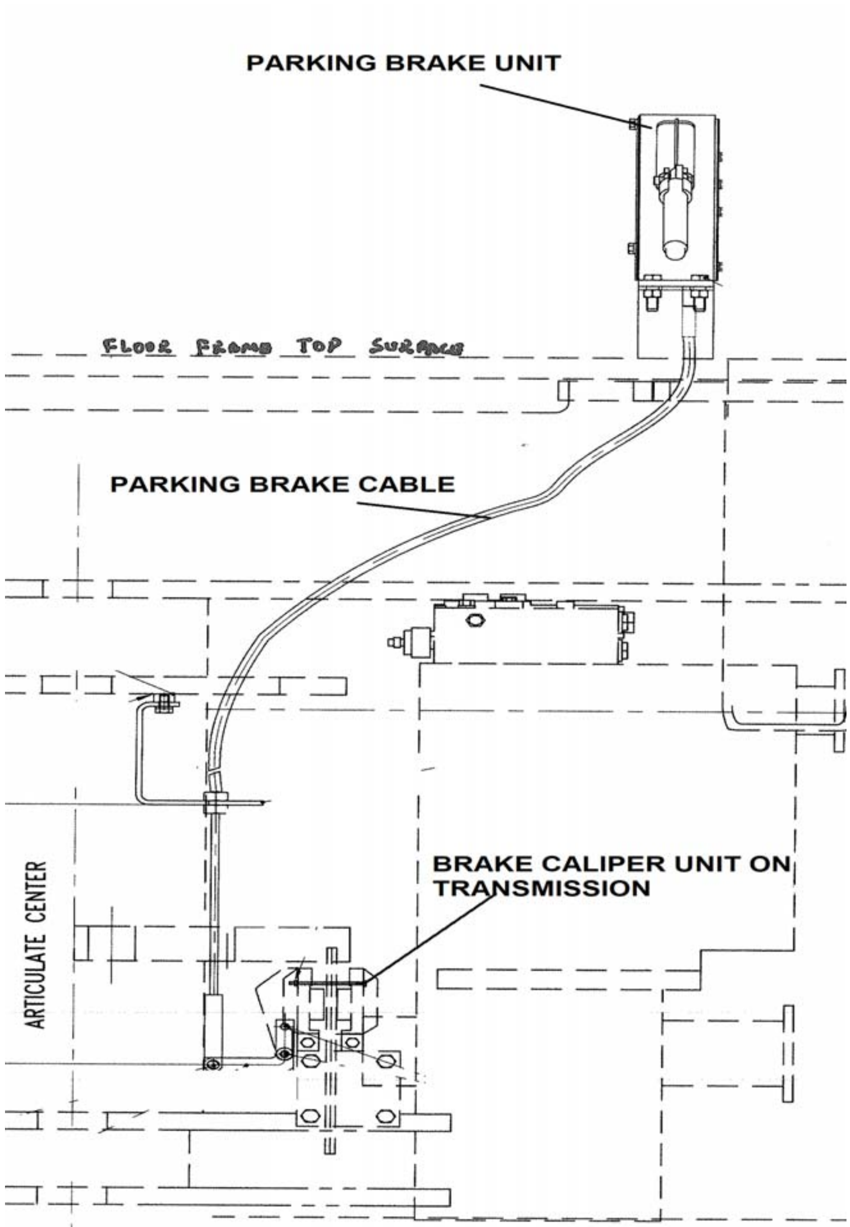
When the brake pedal is depressed, the brake valve spool will opens and connects pressure oil line to the brake housing on the axles, it acts on the brake housing of the axles with high pressure which in-turn acts on the rotating disc of the axles, thus braking will takes place.

Additional 2 brake accumulators are provided for individual front and rear axels, these accumulators are supplying the pressurized oil to the braking system in emergency condition i.e when the pump is not providing the pressurized oil or engine in off condition.

VE

PARKING BRAKE

- The parking brake is connected with a wire cable and is constructed to be applied or released mechanically.
- When the lever located inside the operator's cab is pulled upward, the lever will be locked in the BRAKE position by means of a ratchet. When the knob is pushed down, the ratchet will be unlocked and the brake will be released.



PARKING BRAKE

FUNCTION

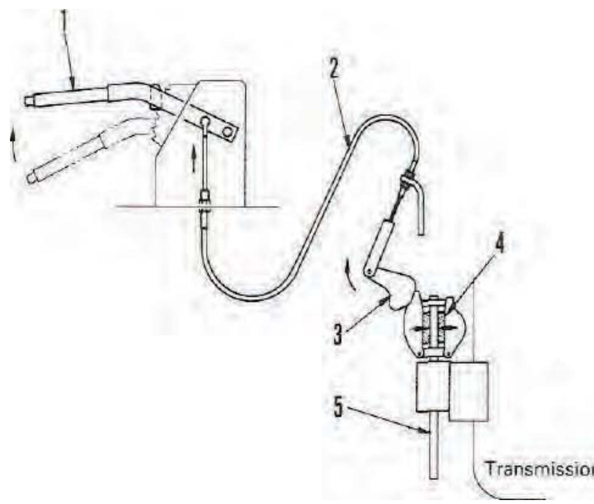
- The Parking brake is a Drum type brake and is installed to the transmission output coupling at the front.
- The lever and caliper are connected by wire cable . The force of brake can be controlled by the amount of lever pulled.

OPERATION OF PARKING BRAKE

1. Application of the parking brake

When parking brake lever (1) is pulled, the parking brake will work.

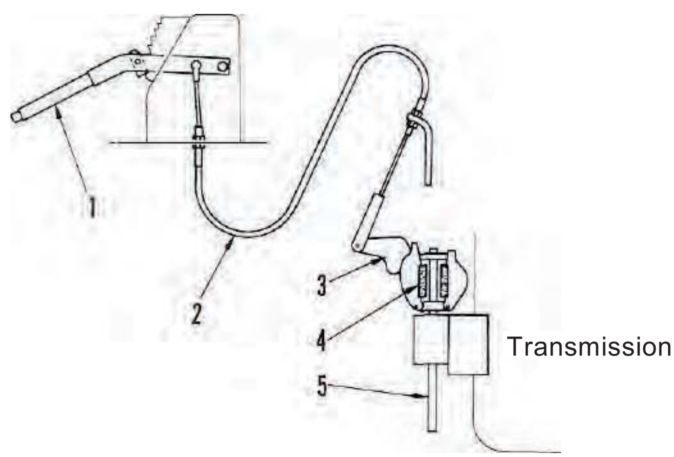
When parking brake lever (1) is pulled, wire (2) will pull up caliper lever (3), brake pad (4) will squeeze disc (5}, and the brake will work.



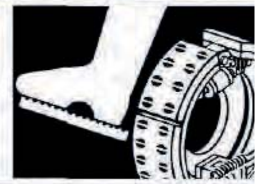
1. Parking brake lever
2. Wire
3. Caliper lever
4. Brake pad
5. Disc

2. Releasing of parking brake operation

When parking brake lever {1) is returned to OFF, the parking brake will be released. When parking brake lever (1) is returned, wire (2) will push down caliper lever (3), a clearance will be opened between brake pad {4} and disc (5), and the brake will be released.



BRAKE SYSTEM
14 TESTING AND ADJUSTING



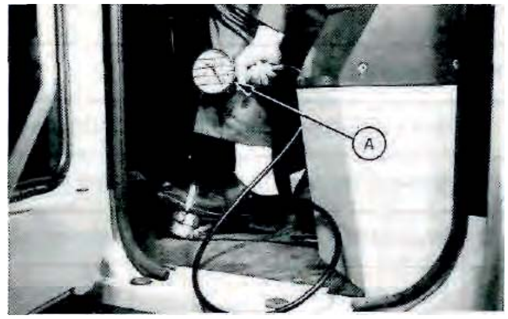
* The following precautions are necessary when using the Standard Value Tables to make judgments during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.
2. The standard values in these tables for judgment when troubleshooting are estimated values based on the
standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgments.
3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgments.

STANDARD VALUE TABLE

Testing and measuring item	Measurement condition	Unit	Standard Value	Permissible value
Brake pedal • Operating force • Travel • Play	• Coolant temperature: Inside operating range • Engine speed: Low idling	kg mm mm	30±3 70 - 90 10	Max. 43 Max. 120 Max. 13
Brake performance	• Road surface: Flat, horizontal, dry, paved surface • Speed when applying brakes: 32 km/h • Time lag when pressing the pedal: 0.1 sec. • Tire inflation pressure: Specified pressure • Pedal operating force: 38 kg	m	Max. 12.0	Max. 23.0
Drop in brake oil pressure	• Coolant temperature: Inside operating range • Test pressure 30 kg/cm² 5 min.	kg/cm²	Max. 3.5	Max. 3.5
Wear of brake disc	Coolant temperature: Inside operating range	mm	1.02-1.14	Min. 0.7
Parking brake performance	• Tire inflation pressure: Specified pressure • Road surface: Flat, dry, paved surface with 1/5 (1 1c20') gradient • Machine: In operating condition	—	Machine stopped	Machine stopped
WEAR LIMIT		mm		3.3
Parking brake lever • Travel	• Brake lever operating force: 25 kg	mm	170-210 (9-1 1 clicks)	170-210 (9-1 1 clicks)

MEASURING BRAKE PEDAL



★ Measurement condition

- Coolant temperature: Inside operating range
- Engine speed: Low idling

Item		Standard value	Permissible value
Brake pedal	Force	20 kg	-
	Travel	70-90 mm	Max. 120 mm
	Play	10 mm	Max. 1 3 mm

1. Measuring operating force of pedal

1) Fit push gauge A to the operator's foot.
   * Align the center of the push gauge with the center of the pedal.
2) Start the engine and run at low idling, then depress the pedal and measure the operating force.

2. Measuring travel of pedal

1) Fit push gauge A to the operator's foot.
   * Align the center of the push gauge with the center of the pedal.
2) Start the engine and run at low idling. Measure the travel of the pedal when it is operated with an operating force of 30 kg.

3. Measuring play of pedal

1) Start the engine and run at low idling. Measure the travel of pedal when it becomes too heavy with forced by hand.

CHECKING BRAKE PERFORMANCE

Measurement condition :

• Time lag when pressing the pedal: 0.1 sec.

• Pedal force: 20 kg

• Road surface: Flat, horizontal, straight, dry, paved surface.

• Machine speed: Speed when applying brakes: 37 km/h

• Tire inflation pressure: Specified pressure

Item	Standard value	Permissible value
Brake performance	Max. 12 m	Max. 12 m

Measuring procedure

1. Start the engine and then start the machine.

2. Place the speed control lever in the highest speed range and drive the machine.

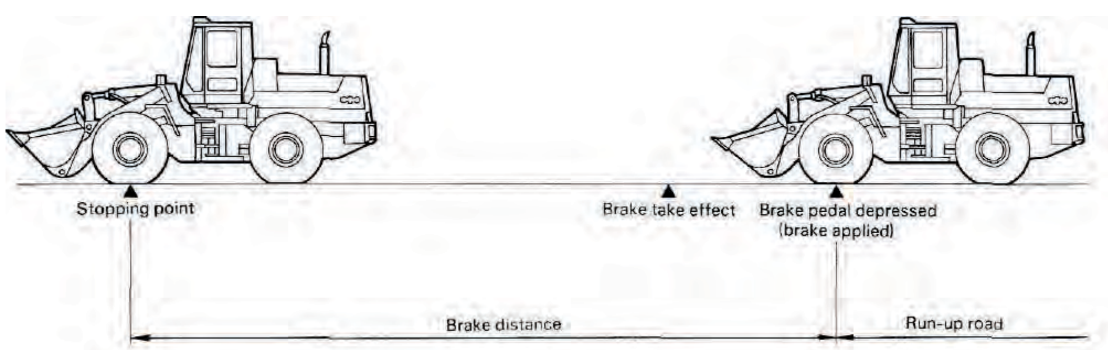
3. When the machine is traveling at 37 km/h in forward, depress the brake pedal with the specified operating force.

⋆ Decide the run-up road and point to; apply the brakes, and then apply the brakes when the braking point is reached.

⋆ Bring Transmission to neutral condition.

4. Measure the distance from the braking point to the point where the machine stops.

⋆ Carry out the test three times and take the average value.



CHECKING BRAKE OIL PRESSURE

Measurement condition :

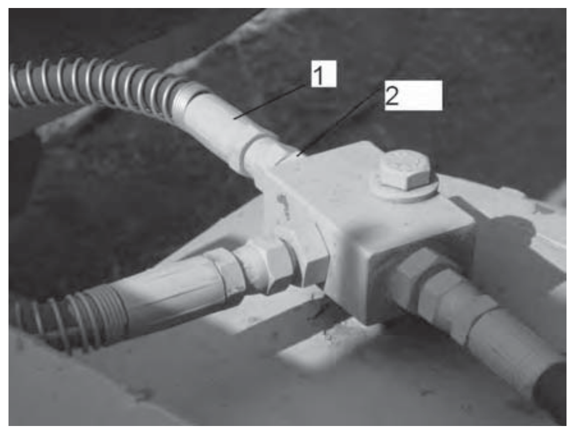
- Coolant temperature: Inside operating range
- Test pressure: 30 kg/cm²

Item	Standard value	Permissible value
Drop in pressure	Max. 3.5 kg/cm²	Max. 3.5 kg/cm²

Apply the parking brake and block the tires.

Measuring procedure

1. Raise the lift arm, put a support in position, and then remove front cover .
   ⋆ When leaving the operator's compartment, lock the control lever securely.
2. Stop the engine.
3. Remove brake tube (1) on the side to be measured, and then remove adapter (2).
4. Install hydraulic tester **A** after removing the adapter.
   ⋆ Connect the quick coupler of hydraulic tester **A**.
5. Loosen bleeder screw and bleed the air.
   ⋆ To bleed the air, operate pump .
6. Tighten the bleeder screw and operate pump to raise the pressure to 30 kg/cm², then tighten the stop valve **A**-1.
7. Leave for 5 minutes with the pressure applied, then check the drop in pressure.
   ⋆ Do not move the hose when measuring the pressure. If the hose is moved, the pressure will change.
   ⋆ When removing hydraulic tester **A** after testing, operate pump to lower the pressure in the hydraulic tester **A** before removing.
   ⋆ After completing inspection, install the brake tube and bleed the air from the brake circuit. For details, see AIR BLEEDING FROM BRAKE CIRCUIT.



MEASURING WEAR OF BRAKE DISC

Measurement condition :

- Coolant temperature: Inside operating range

item	Standard value	Permissible value
Disc wear (one side)	1.02-1.14	Min. 0.7

Unit: mm

Special tool

	Part number	Part name	Q'ty
	Commercially available	Feeler gauge	1

⚠ Apply the parking brake and block the tires.

Measuring

1. Loosen drain plug and drain the axle oil.

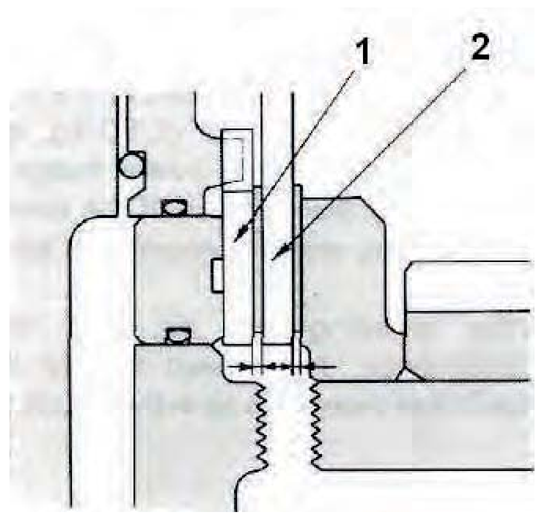
   Axle oil: **3.5 lit @ wheel end & 12 lit @ carriage**

2. Remove measuring plug .
3. Depress the brake pedal lightly.

   ★ Check that the piston is in close contact with the disc.

4. Insert a feeler gauge between disc (1) and plate
   (2), and measure the clearance.
5. Tighten the drain plug and measuring plug , and then add axle oil through the oil filler to the specified level.

   Axle oil : **3.5 lit @ wheel end & 12 lit @ carriage**



AIR BLEEDING FROM BRAKE CIRCUIT

1. Actuate brake carefully
2. Open bleeder
3. Close bleeder
4. Release brake
5. Repeat point 1 to 4 as often as no air bubbles occur

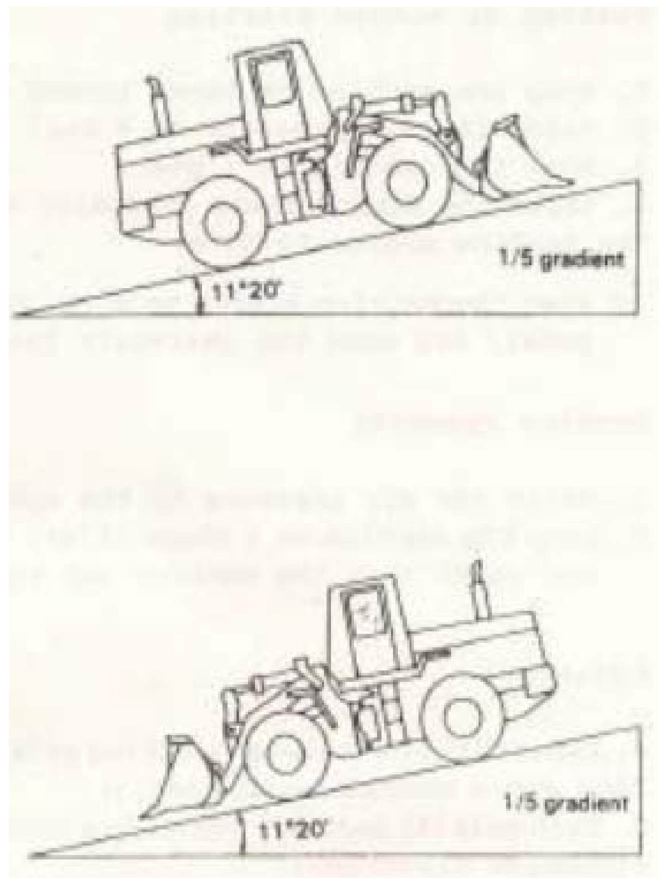
CHECKING PARKING BRAKE PERFORMANCE

★ **Measurement condition :**

- Tire inflation pressure: Specified pressure
- Road surface: Flat, dry, paved surface with 1/5 (11°20') gradient.
- Machine: In operating condition
- Parking lever operating force: Max 25 kg

Unit: kg/cm2

Item	Standard value	Permissible value
Parking Brake performance	Machine stopped on 1/5 (1 1°20'} gradient	



Measuring procedure

1. Start the engine and drive the machine straight up a 1 /5 gradient with the bucket unloaded.
2. Depress the brake, place the directional lever in neutral, and then stop the engine.
3. Pull the parking brake lever, then slowly release the brake pedal and keep the machine must be kept stopped.
   - The measurement must be made with the machine facing either up or down the slope.

CHECKING AND ADJUSTING PARKING BRAKE

Unit: mm

Item	Standard value	Permissible value
WEAR LIMIT		3.3

⚠ Block the tires securely.

1. Measuring pad

1) Stop the engine and operate the parking brake lever to release the brake.
2) Remove pad (1) from the caliper, and measure the thickness of the pad to the backing plate.
   If the measurement is not within the standard value, replace the two pads as a set.
   For details of replacing the pads, see DISASSEMBLY AND ASSEMBLY.

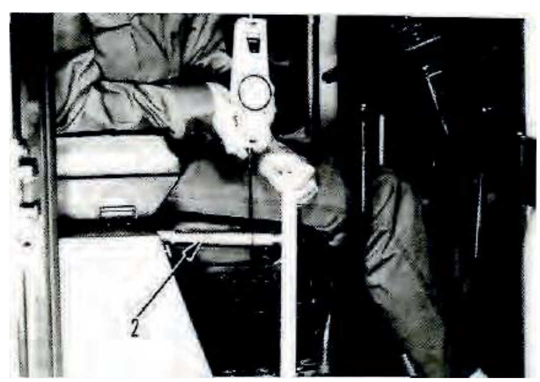
2. **Measuring lever**

★ Measurement condition

★ Lower operating force: 25 kg

Unit: mm

Item	Standard value	Permissible value
Travel	170-210mm(9-1 1 clicks)	

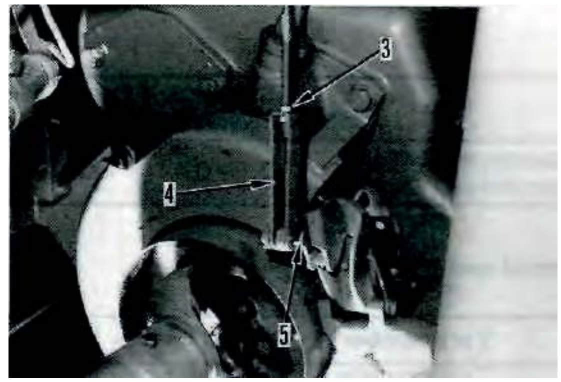


1) Install a push pull scale 50 mm from the tip of lever (2), and measure operating force.
2) Measure the movement of the lever tooth when the lever is operated at the standard value.

3. Adjusting

★ If the operating force is not within the standard value, check the linkage and cable.

1) Insert the lever tooth at the bottom.
2) Loosen lock nut (3) and pull out clevis pin (4).
3) Screw in clevis (5) to remove the lever play.
4) Assemble clevis pin (4) and tighten lock nut (3).



* The caliper should be completely released when the lever tooth is in the bottom groove.

MEASURING CLEARANCE OF PARKING BRAKE

Unit: mm

Item	Standard value	Permissible value
Clearance between disc and pad	0.1 -0.4	Max. 2.6

1. Measuring procedure

1) Move the parking brake back and release the brake.

2 Insert feeler gauge between shoe and cover (1), and measure the clearance (S) and (T).

* Measure the clearance at 4 points on the pad.

2. Adjusting

1) Move the parking brake Sever back to release the brake.

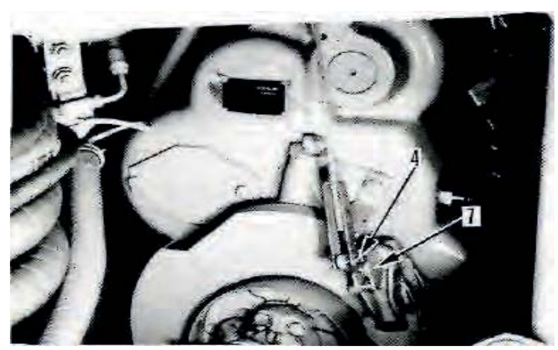
2) Remove clevis pin (4) and leave caliper lever (7) free.

3) Tighten adjustment bolt (8) and adjust the clearance to within the standard value.

⋆ Be careful not to tighten the adjustment bolt too far.

⋆ After adjusting, there should be no play of the adjustment bolt in the axial direction.

⋆ After adjusting, there should be clearance S and T.



4) Align the hole of caliper lever (7), and assemble clevis pin (4).

⋆ After making the adjustment, measure the operating force and travel of the parking brake lever. If it is not within the standard value, adjust the lever.

TROUBLESHOOTING

Troubleshooting table

★ Before carrying out the troubleshooting in this section, read "PRECAUTIONS WHEN TROUBLESHOOTING"

TROUBLE SHOOTING TABLE

1. Brake is ineffective or not very effective

Ask the operator the following questions.

- Did the brake suddenly cease to be effective?
  Damage in brake equipment.
- Did the brake gradually deteriorate? →
  Deterioration of seals, or wear of lining or discs.

Checks before troubleshooting

- Was the proper oil used for the master cylinder?
- Is the quantity of brake fluid correct?
- Is the play of brake pedal correct?
- Does oil leak from the brake tube or connectors? Is the brake tube damaged?
- Check the tire pressure and tire tread.

Check the abnormalities

Measure the braking force and check it against the standard value table to see whether or not braking performance is bad.

No.	Problem \ Cause	a: Internal damage brake unit	b: Defective brake piston seal in axle	c: Faulty operation of brake piston in axle	d: Defective brake section in axle	e: Wear or abnormality of brake lining in axle	f: Brake lining in axle is worn out and the disc plate contacts the piston or plate	g: Air in brake circuit	h: Internal damage of brake unit	i: Faulty operation of charging pump
	Remedy	△ X	△ X	△ X	△ X	△ X	△ X	△	△ X	△ X
1	Operating force of Brake pedal is too light.	○	○					○		
2	Operating force of Brake pedal is too heavy.	○							○	○
3	Too much pressing force is required to obtain the specified braking force.	○		○		○	○			○
4	When braking, abnormal noise comes from axle brake section.					○	○			
5	Machine does not travle normally (lacks traction)									○
6	With the four wheels jacked up, the axles plaud on blocks, and the gear speed at F1, if the brake is applied, only certain wheels rotate fast		○	○	○	○	○	○		
7	Air is released by bleeding the air, and the brake works normally after that.							○		
8	Brake fluid leaks abnormally.		○							
9	Too much metal powder is in the axle oil (as shown by oil clinic test)						○			

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

2. Brake cannot be released or drags.

Check before troubleshooting

- Is the play of the brake pedal proper?

Check for abnormalities

- Check the travel by inertia on a flat place smoothly.
- Check rotating resistance of the jacked-up wheels.

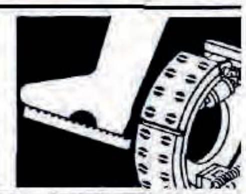
	Cause	Internal damage of brake unit	Internal damage of brake circuit	Faulty return of brake piston in axle	Defective brake section in axle (inner ring or other parts)
		a	b	c	d
No.	Problems / Remedy	△ X	△ X	△ X	△ X
1	If fluid is drained from the air bleeder in the pressure circuit of brake fluid, the pressure in the circuit will decrease and the brake will be released.	○	○		
2	With the four wheels placed on blocks the engine stopped and parking brake released, if the wheels are rotated by hand, only certain tires are heavy.			○	
3	With the four wheels placed on blocks, the engine stopped the parking brake released, and the gear speed in neutral, if the wheels are rotated by hand, they can be rotated easily. However they cannot be rotated if the engine is running.		○		

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace	△: Repair
A: Adjust	C: Clean

BRAKE SYSTEM

15 DISASSEMBLY AND ASSEMBLY



REMOVAL OF PARKING BRAKE

REFER M/S. AVTEC MANUAL

REFER M/S. AVTEC MANUAL

INSTALLATION OF PARKING BRAKE

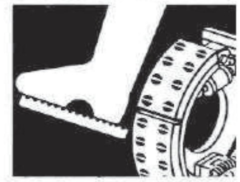
REFER M/S. AVTEC MANUAL

REFER M/S. AVTEC MANUAL

REMOVAL OF PARKING BRAKE PAD

REFER M/S. AVTEC MANUAL

BRAKE SYSTEM
16 MAINTENANCE STANDARD



BRAKE

Unit: mm

REFER M/S. AVTEC MANUAL

PARKING BRAKE

REFER M/S. AVTEC MANUAL

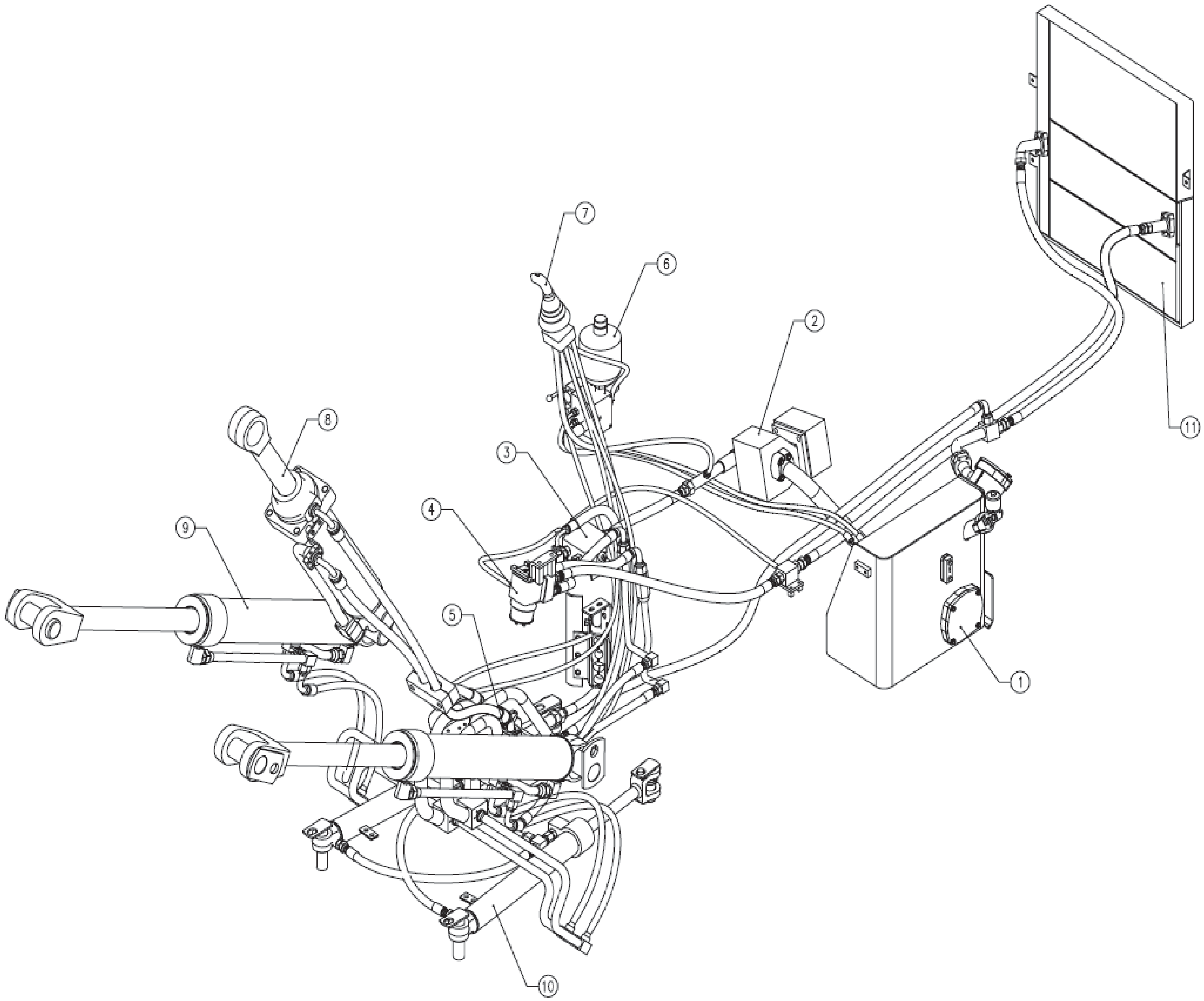
WORK EQUIPMENT SYSTEM
17 STRUCTURE AND FUNCTION

GENERAL

OUTLINE

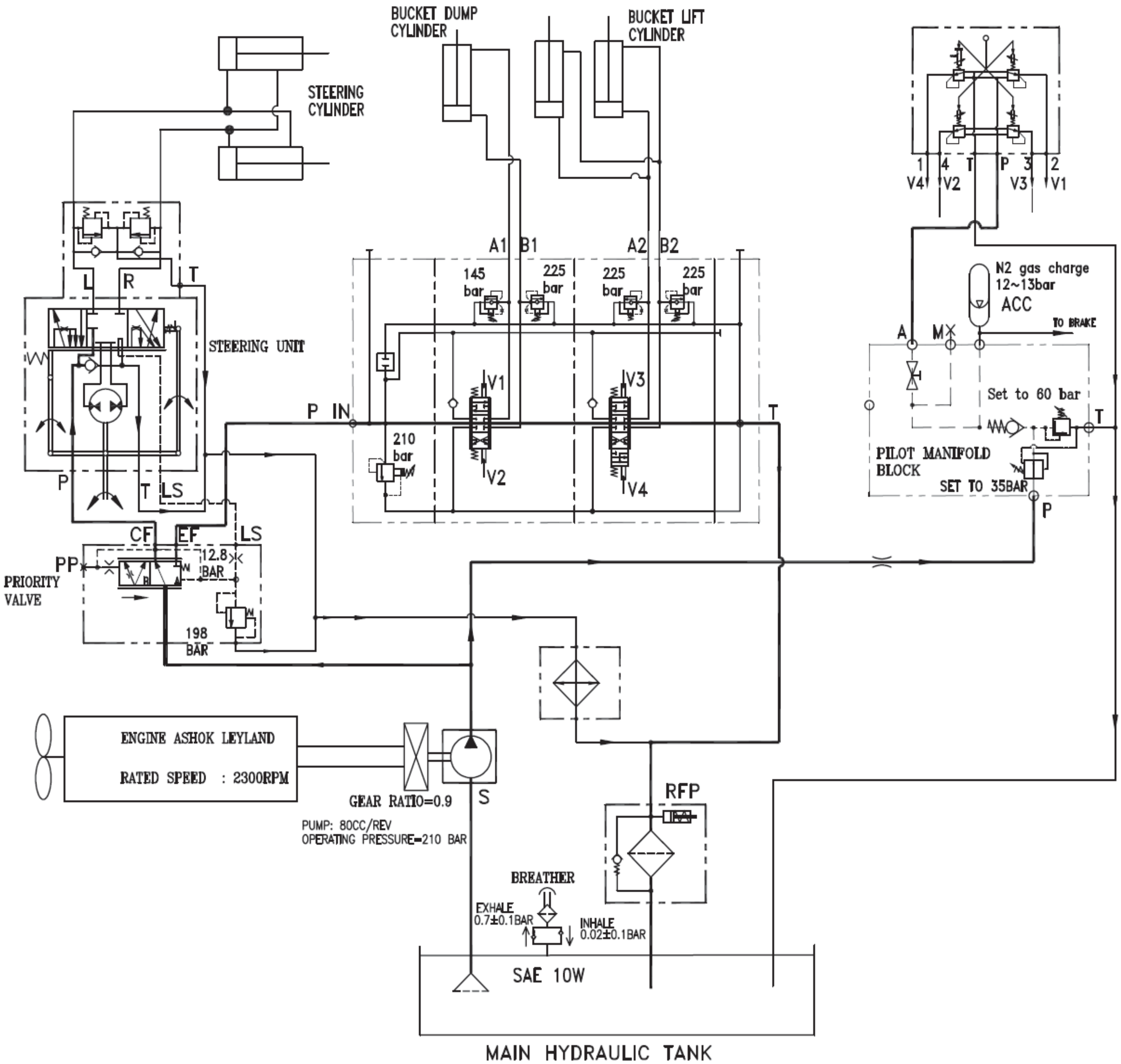
- The work equipment system consists of the hydraulic circuit and steering circuit. The hydraulic circuit controls the operation of the bucket.
- The oil in hydraulic tank (1) is sent to hydraulic pump (2) through strainer placed inside the tank. Further it is pumped to steering Priority valve. Further the oil flows to main control valve (7) through EF port of the Priority valve if steering is not operated. When the dump and lift spools of the main control valve are at neutral, the oil passes through the drain circuit of the main control valve back to tank line. It is then filtered by the filter in the hydraulic tank, and returns to the tank.
- When the Joystick is operated, the dump spool or lift spool in the main control valve moves accordingly, and oil flows from the main control valve to lift cylinder (3) or dump cylinder (4). The lift arm or bucket then moves.

The maximum pressure of the hydraulic circuit is regulated by the relief valve inside the main control valve. There is a safety valve (with suction valve) in both the lift and dump cylinders' circuit to protect the system. These safety valves come in operation whenever the valve is in closed position and the bucket is subjected to external loads (reaction loads). Hydraulic tank (1) is a pressurized, sealed type and has a breather with a relief valve. This acts to pressurize the tank and at the same time prevents negative pressure. This protects the pump from cavitations.

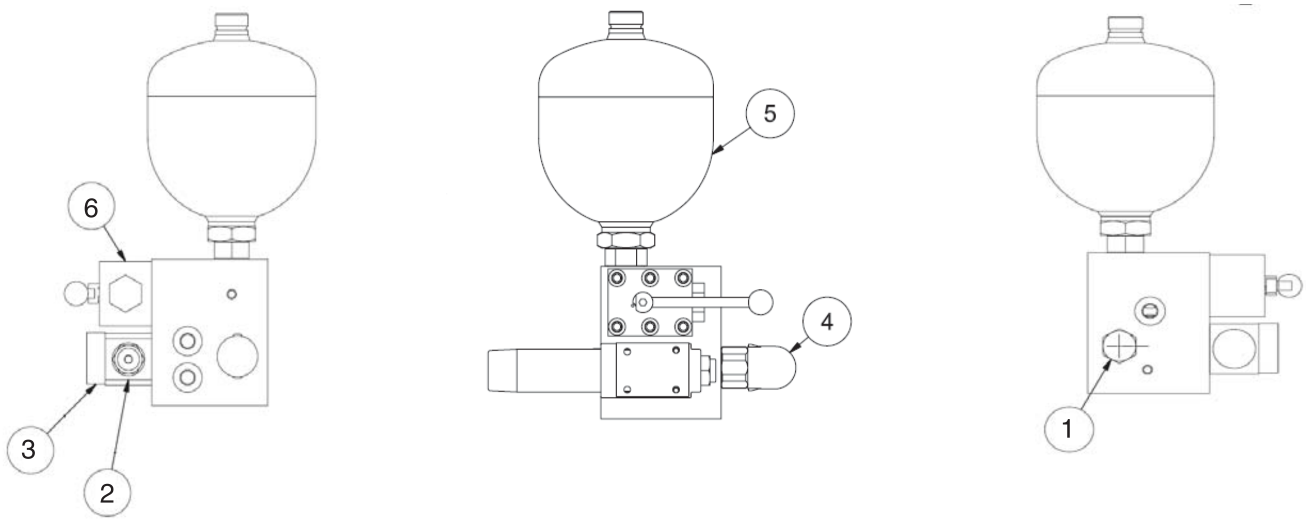


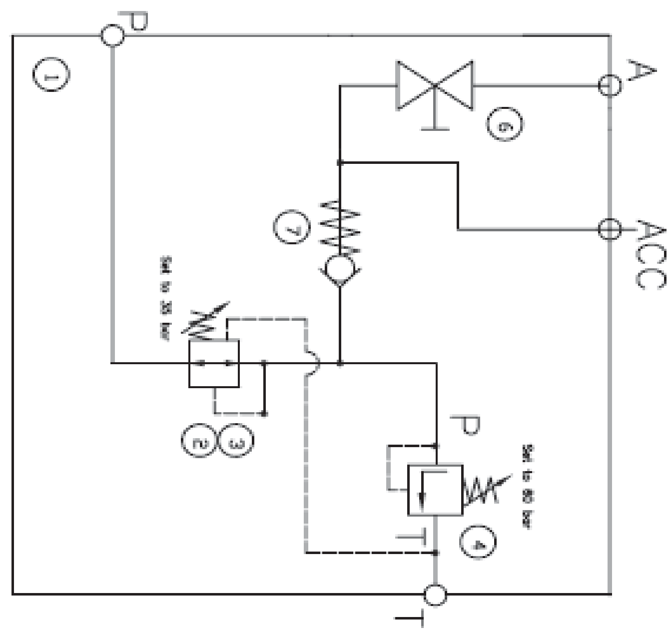
1. Hydraulic tank
2. Hydraulic pump
3. priority valve
4. Steering unit
5. Main control valve
6. Pilot manifold block
7. Hydraulic Joystick
8. Dump cylinder
9. Lift cylinder
10. Steering cylinder
11. Hydraulic oil cooler

HYDRAULIC CIRCUIT



MANIFOLD BLOCK





1) CHECK VALVE

2) PRESSURE REDUCING VALVE

3) ADAPTOR PLATE

4) PRESSURE RELIEF VALVE

5) ACCUMULATOR

6) PPC (SHUT OFF VALVE)

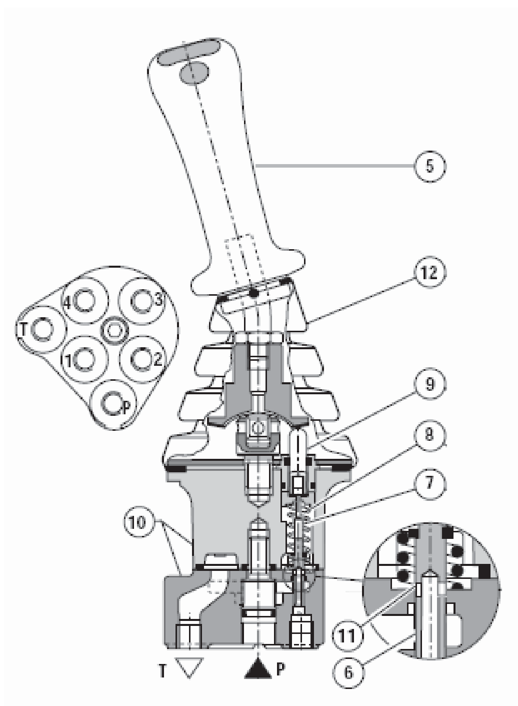
FUNCTION :

The function of the manifold is to protect the system during abnormal conditions & to supply regulated flow to the control valve to activate the corresponding spool.

JOYSTICK FOR WORK ATTACHMENT CONTROL

FUNCTION :

When not actuated the control lever is held in zero position by the four return springs (8). The control ports (1,2,3,4) were connected to the tank port T via the drilling (11).
With deflection of the control lever (5) the plunger (9) pushes against the return spring (8) and the control spring (7). The control spring moves the control spool (6) down allowing the flow to flow through the corresponding port and to the control to activate the corresponding spool in control valve
In this condition the T port is closed and the flow goes from supply part (P) to corresponding port via drilling (11).

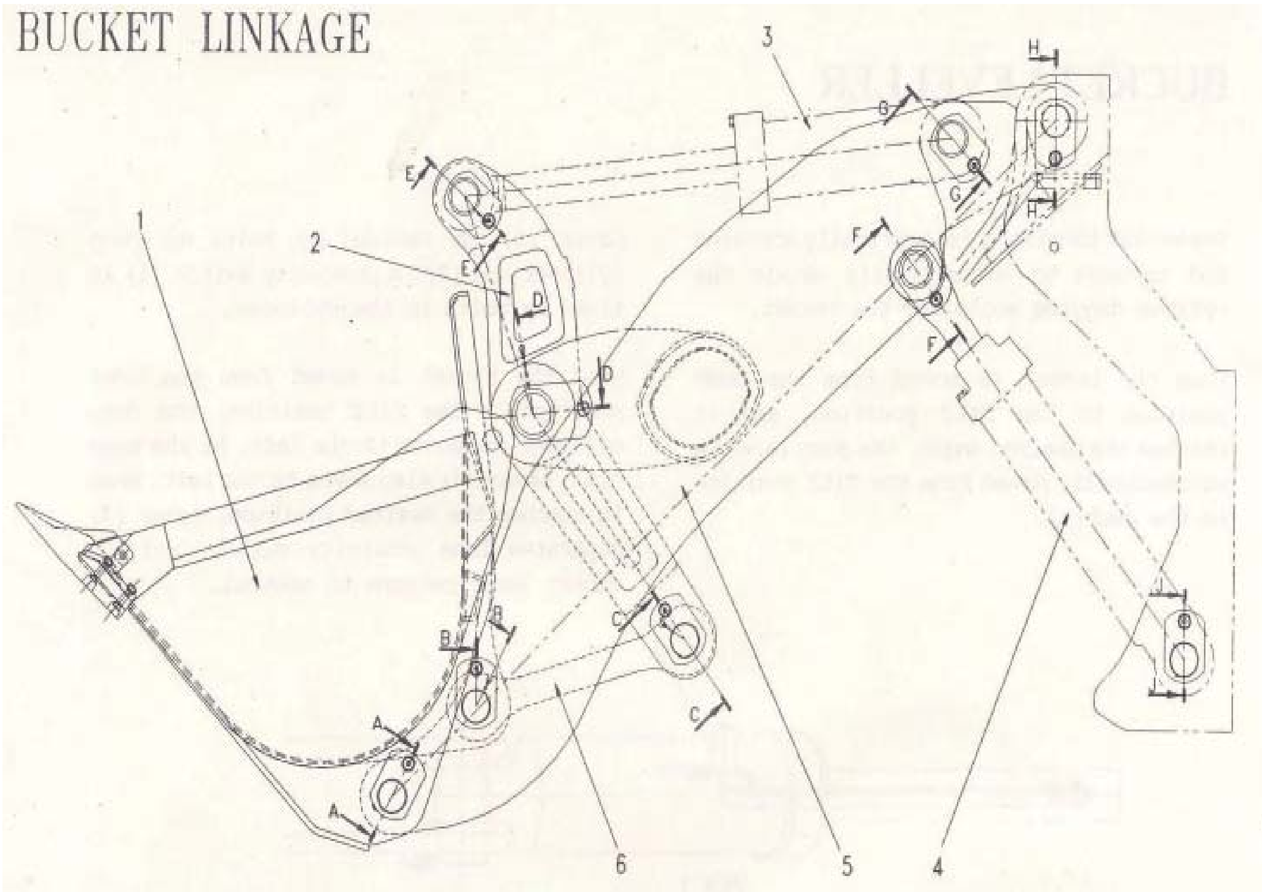


P- SUPPLY, T- TANK, 1,2,3,4- CONTROL PORTS, 5 – CONTROL LEVER, 6 – CONTROL SPOOL

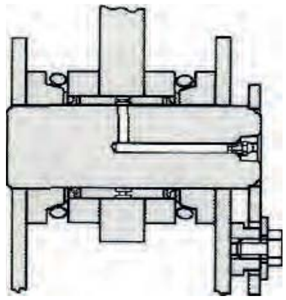
7 – CONTROL SPRING, 8 – RETURN SPRING, 9 – PLUNGER, 10 – HOUSING, 11 – DRILLING

12 – RUBBER BOOT

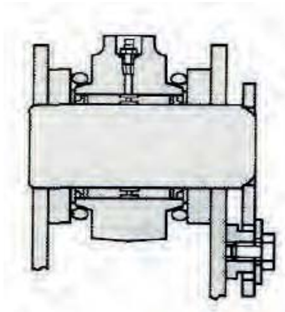
BUCKET LINKAGE



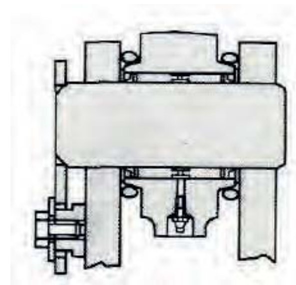
1. Bucket
2. Tilt lever
3. Dump cylinder
4. Lift cylinder
5. Lift arm
6. Bucket link



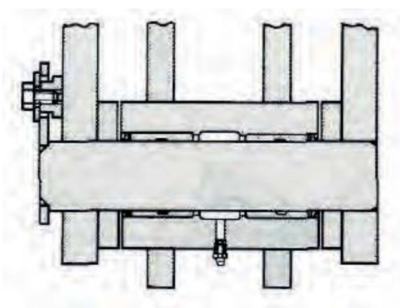
Section A-A



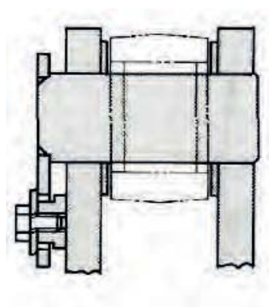
Section B-B



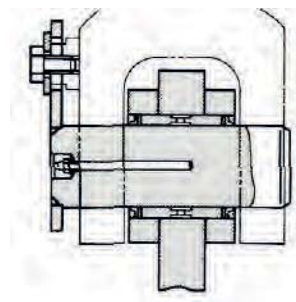
Section C-C



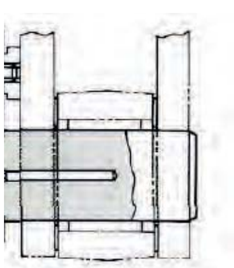
Section D-D



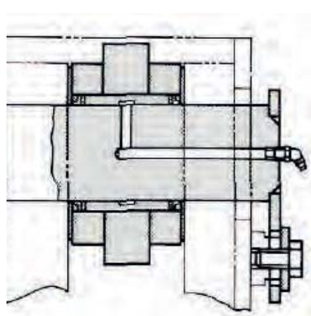
Section E-E



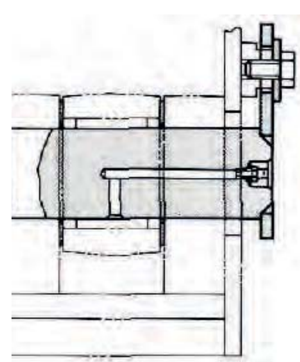
Section F-F



Section G-G



Section H-H



Section J-J

OIL FILTER BYPASS VALVE

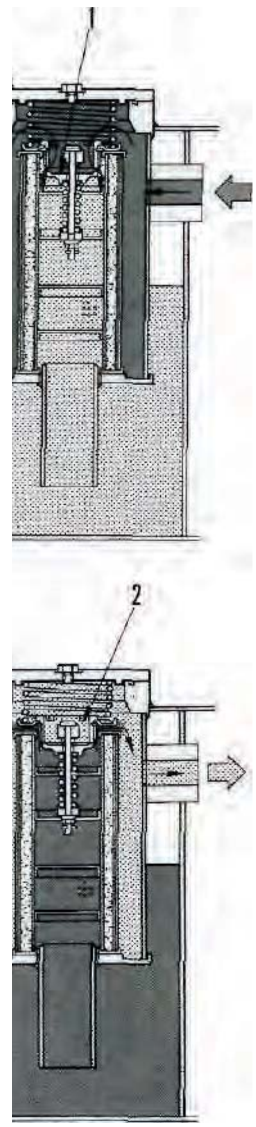
When the filter is clogged

Bypass valve (1) opens and the oil returns directly to the tank without passing through the filter. Bypass valve set pressure: 1.27 kg/cm2

When negative pressure is formed in the return circuit.

Valve (2) moves up and acts a check valve.

Check valve set pressure: 0.26 kg/cm2



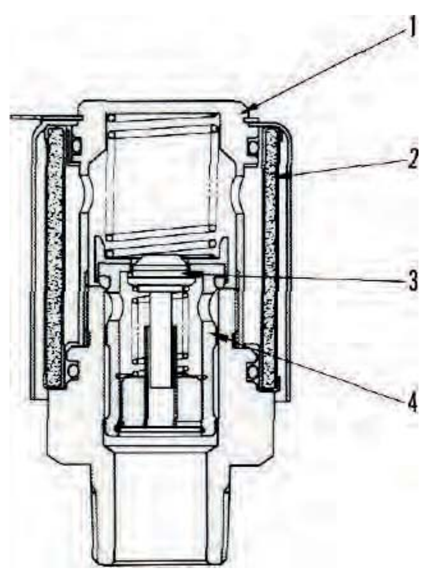
BREATHER

Preventing negative pressure inside the tank

The tank is a pressurized, sealed type, so negative pressure is formed inside the hydraulic tank when the oil level drops during operations. When this happens, the difference in pressure between the tank and the outside atmospheric pressure opens the poppet (3), and air from the outside is let into the tank to prevent negative pressure.

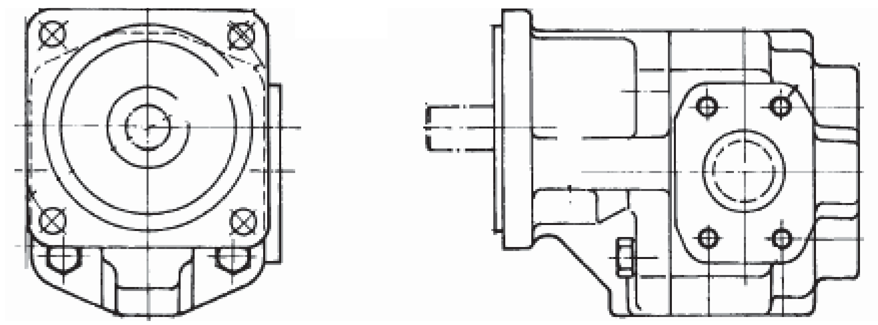
Preventing rise in pressure inside the tank

When the hydraulic cylinders are being used, the oil level in the hydraulic circuit changes and the temperature rises. If the hydraulic pressure rises above the set pressure, the breather is actuated to release the hydraulic pressure inside the tank.



1. Body
2. Filter element
3. Poppet
4. Sleeve

HYDRAULIC PUMP



Specification :

Type :- Gear pump

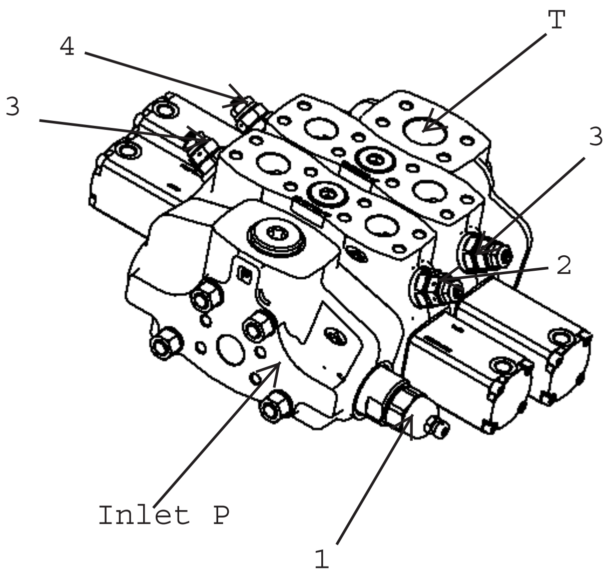
Make :- Rexroth

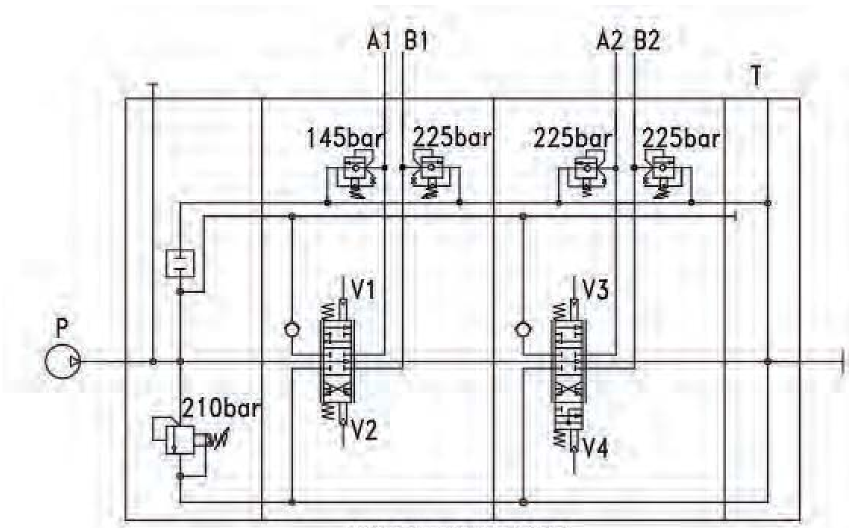
Displacement :- 80 CC

Max. Pressure :- 210 bar

Max. Pump speed ;- 2500 rpm

MAIN CONTROL VALVE





HYDRAULIC CIRCUIT

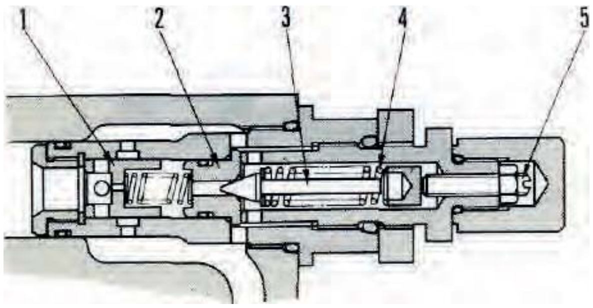
1. Pressure relief valve for P line
2. Pressure relief valve for B1 line
3. Pressure relief valve for B2 line
4. Pressure relief valve for A1 line
5 .Pressure relief valve for A2 line

OUTLINE

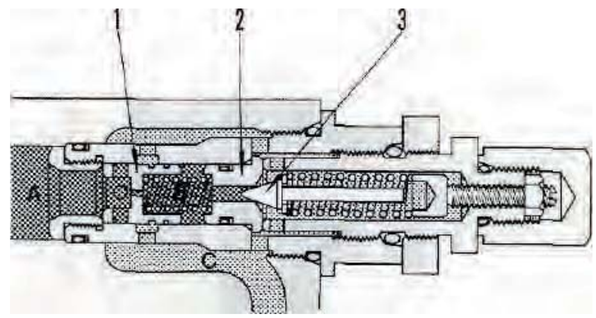
- The main control valve controls the actuation of the attachments and the buckets in the hydraulic system..
- The oil from the pump enters inlet port . The maximum pressure is set by the relief valve. The oil passes through the bypass circuit of dump spool and lift spool . It then flows from T port to the drain circuit, passes through the filter and re turns to the tank. If the dump and lift spools are actuated, the oil flows to the dump and lift cylinders.

The circuit consists of dump and lift spool. when operate joystick the dump and lift operations can be performed and ports are provided with port relief valves (with suction valves) to protect the circuit if abnormal pressure is generated in the bucket dump and arm lift circuit.

RELIEF VALVE



1. Main valve
2. Valve seat
3. Pilot poppet
4. Pilot poppet spring
5. Adjustment screw

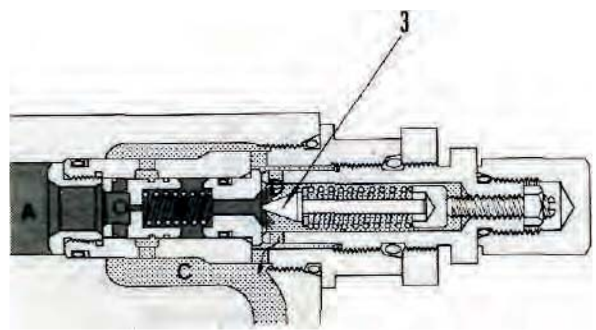


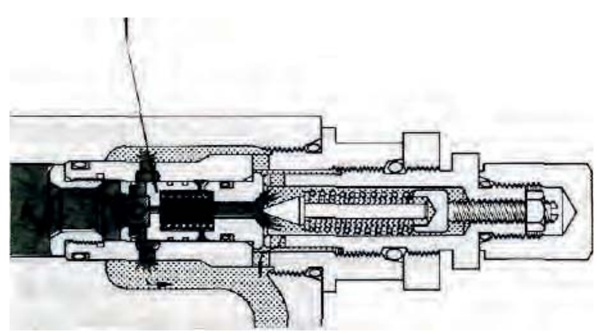
FUNCTION

- The relief valve is installed at the inlet of the main control valve. When the oil goes above the set pressure, the relief valve drains the oil to the tank-In this way; it sets the maximum pressure in the hydraulic circuit and protects the circuit

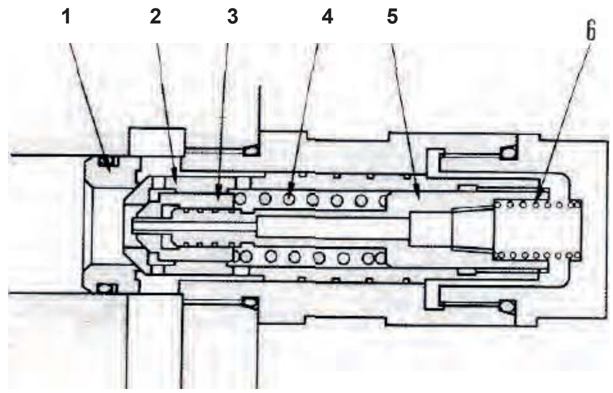
OPERATION

- Port A is connected to the pump circuit and port C is connected to the drain circuit. The oil passes through the orifice of main valve (1) and flows to port B. Pilot poppet (3) is in close contact with valve seat (2).
- When the hydraulic pressure in the circuit inside port A and port B reaches the set pressure of the pilot poppet spring (4), pilot poppet (3) opens, and the pressurized oil from port B flows from port D to port C, so the pressure at port B drops.
- When the pressure at port B drops, the orifice effect of main valve (1) generates a difference in pressure between port A and port B. The main valve is pushed open and the oil from port A passes through port C and flows to the drain circuit to release the abnormal pressure.
- The set pressure can be varied by changing the tension of pilot poppet spring (4). To change the set pressure, remove cap nut, loosen lock nut and turn adjustment screw (5) .





SAFETY VALVE (with suction valve)



1. Valve body
2. Suction valve
3. Main valve
4. Main valve spring
5. Pilot piston
6. Suction valve spring

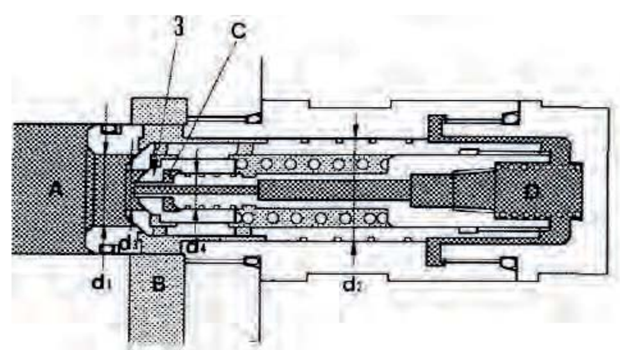
FUNCTION

- The safety valve (with suction valve) is in the dump cylinder circuit in the main control valve. If shock causes any abnormally high pressure in the cylinder when the main control valve is at neutral, the safety valve (with suction valve) relieves the abnormal pressure and protects the cylinder from damage.

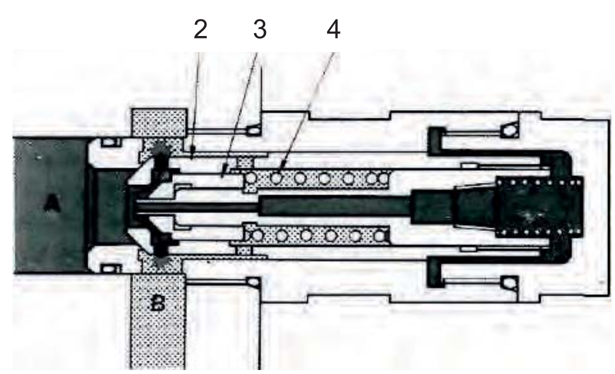
OPERATION

As a safety valve

- Port **A** is the cylinder circuit and port **B** is the drain circuit.
  The pressure oil in port **A** flows to port **D** through a hole in the pilot piston. It also flows to port **C** through an orifice consisting of the main valve (3) and the pilot piston (5).
  The pilot piston is secured to the safety valve by a lock nut. The diameter of the cross section (cross-sectional area) gives a relationship of **d2 > d1 > d3 > d4**

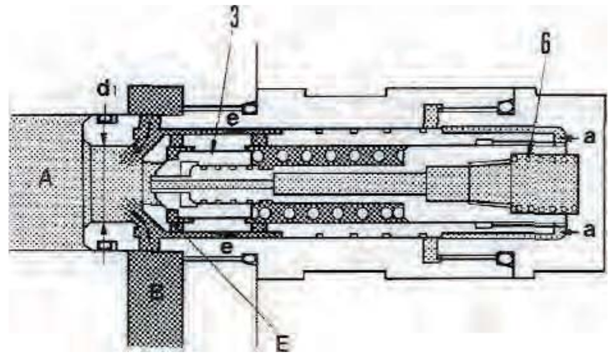


- If abnormally high oil pressure occurs in port **A**, the suction valve (2) is not actuated because of the relationship **d2 > d1**.
  However, because of the relationship **d3 > d4** in port **A** and **C**, the hydraulic pressure on the main valve (3) is equivalent to the area difference between **d3** and **d4**. If this pressure goes up to the poppet spring force (set pressure), the poppet is actuated, and the oil in port **A** flows into port **B**.

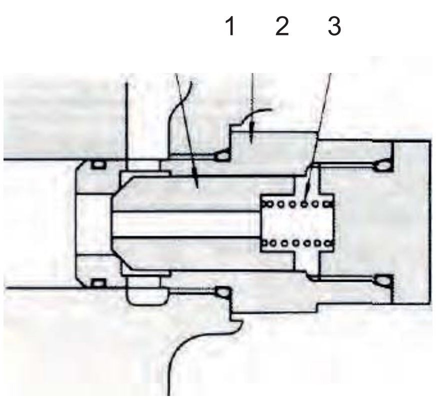


AS A SUCTION VALVE

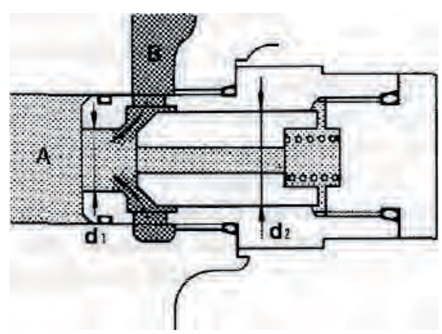
- If negative pressure is generated in port **A**, port **D** also has negative pressure, because port **D** and **A** are connected with each other. The tank pressure in port **B** is applied to port **E**. Hydraulic pressure "a" equivalent to the area difference between **d2** and **d1** is applied to the safety valve because of the tank pressure in port **E**. Therefore, hydraulic pressure "e" acts to open the valve and hydraulic pressure "a" acts to close the suction valve (2).
- If the pressure in port **A** drops, (approaching negative pressure) hydraulic pressure "a" becomes
  smaller than oil pressure "e".
  When oil pressure "e" becomes larger than oil pressure "a" + valve spring (6) force, the suction valve (2) opens, causing the oil to flow from port **B** into port **A**. This prevents negative pressure from building up in port **A**.



SUCTION VALVE



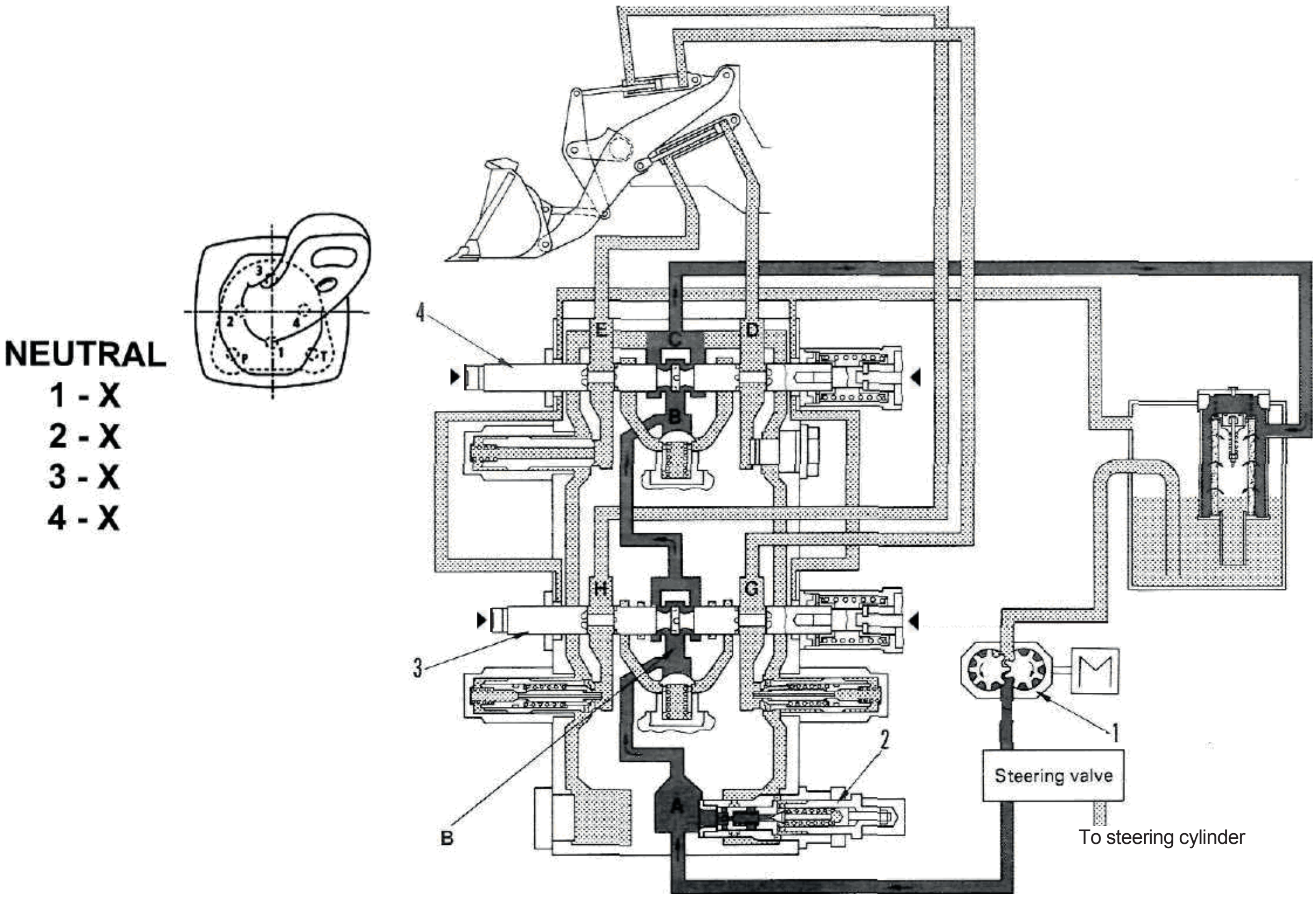
1. Main poppet
2. Sleeve
3.Spring



OPERATION

- If negative pressure is generated in port **A** (lift cylinder rod end) (if the pressure is lower than in port **B** in the tank circuit), the main poppet (1) opens because of the difference in area between **d1** and **d2**. Oil then flows from port C at the tank end to port A at the cylinder port end.

Lift and dump spools at "NEUTRAL position"

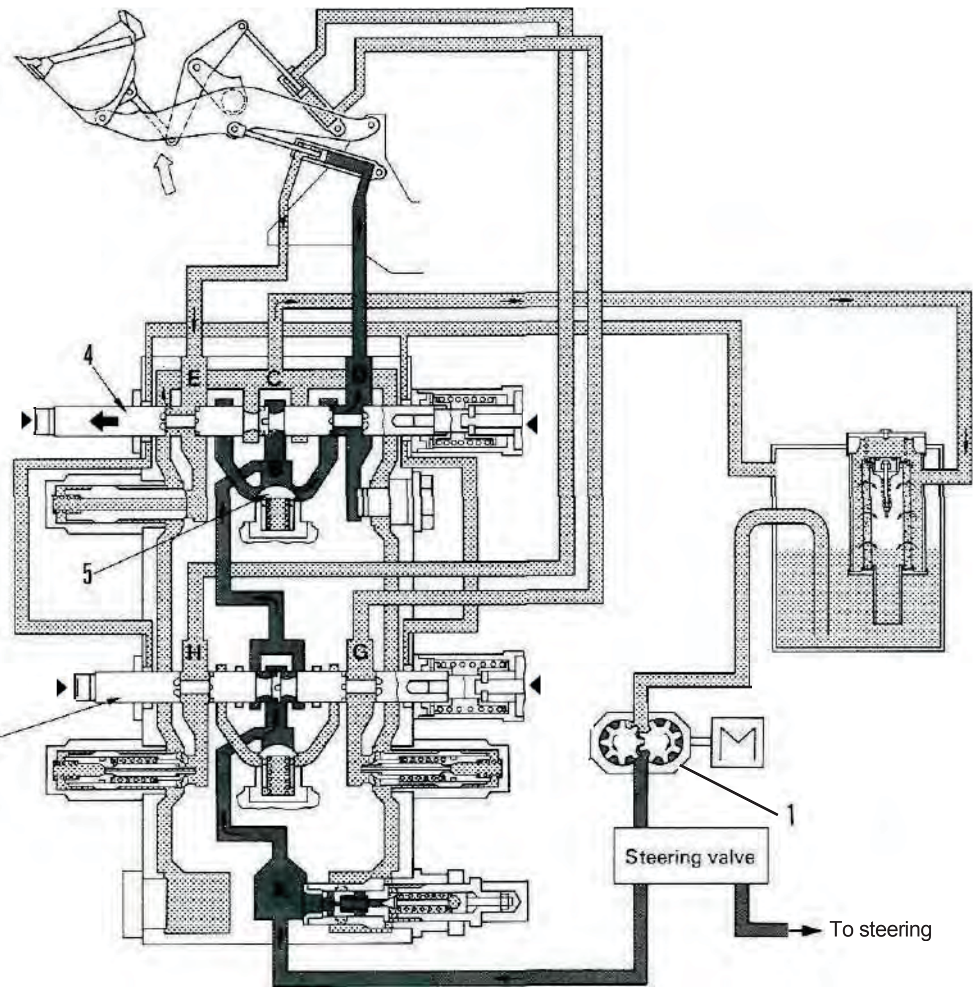


OPERATION

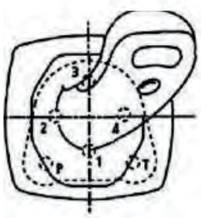
- The oil flows from pump (1) through the steering valve and enters port **A**.
- Dump spool (3) is at neutral, so the bypass circuit is open and the oil from port **A** passes around the spool and flows to port **B**.

The lift spool (4) is also at neutral, so the bypass circuit is open. The oil from port **B** passes around the spool, flows from the drain circuit through the oil cooler and filter, and goes back to the tank.

Lift spool at “RAISE position”



RAISE
1 -YES
2-X
3-X
4-X



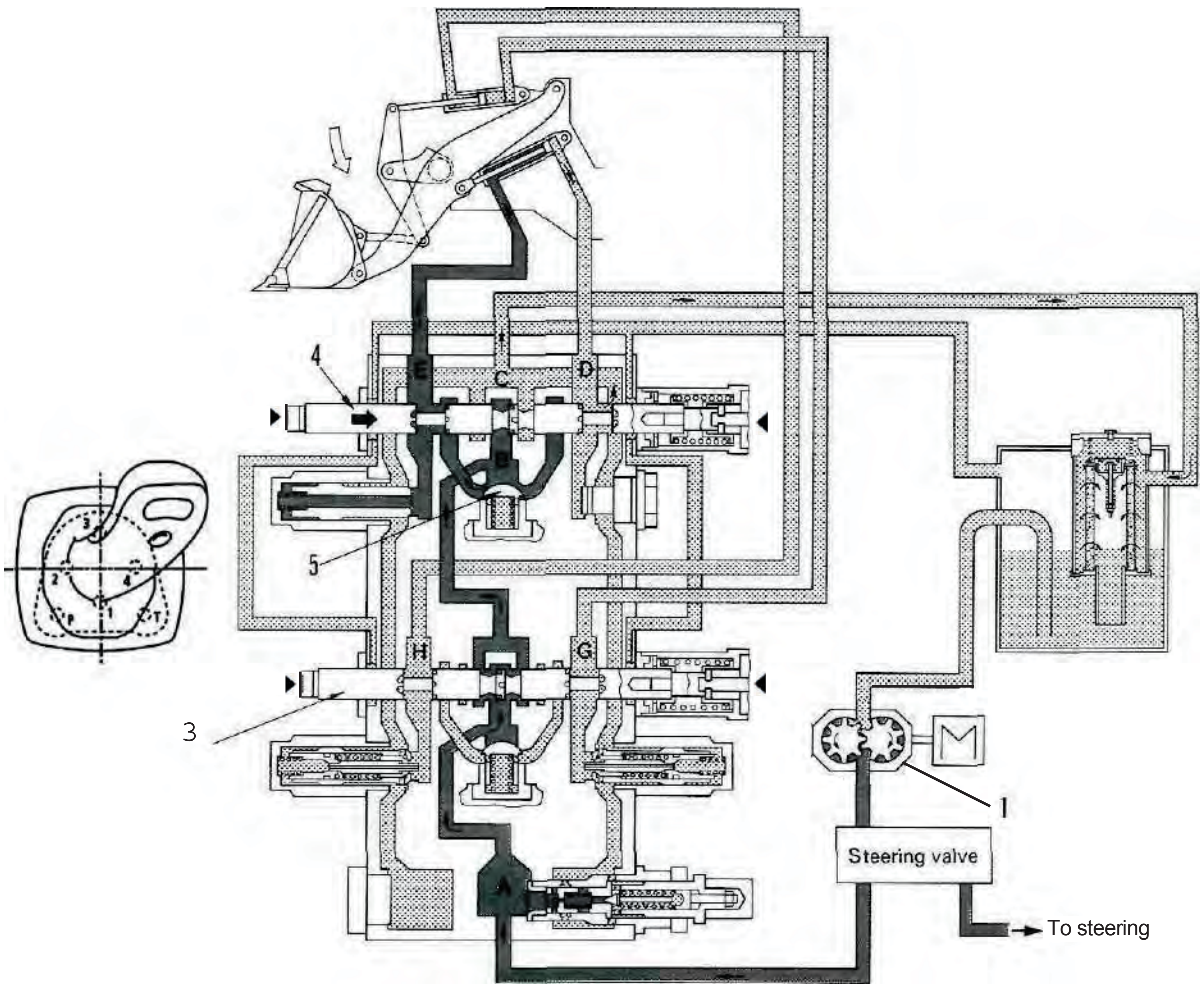
OPERATION

- When Joystick is pressed to 1, lift spool (4) is pulled in to the RAISE position.
- The oil flows from pump (1) through the control valve. It then passes through the bypass circuit of Dump spool (3) and flows to the bypass circuit of lift spool (4). The bypass circuit is closed by dump spool (4), so the oil pushes open check valve (5). The oil from check valve (5) flows to port D and enters the cylinder bottom.

At the same, the oil from the cylinder rod end flows from port E to drain port **C** and returns through the oil cooler to the tank. When this happens, the lift arm goes up.

Lift spool at "LOWER position"

LOWER
1 -X
2 -X
3 -YES
4 -X

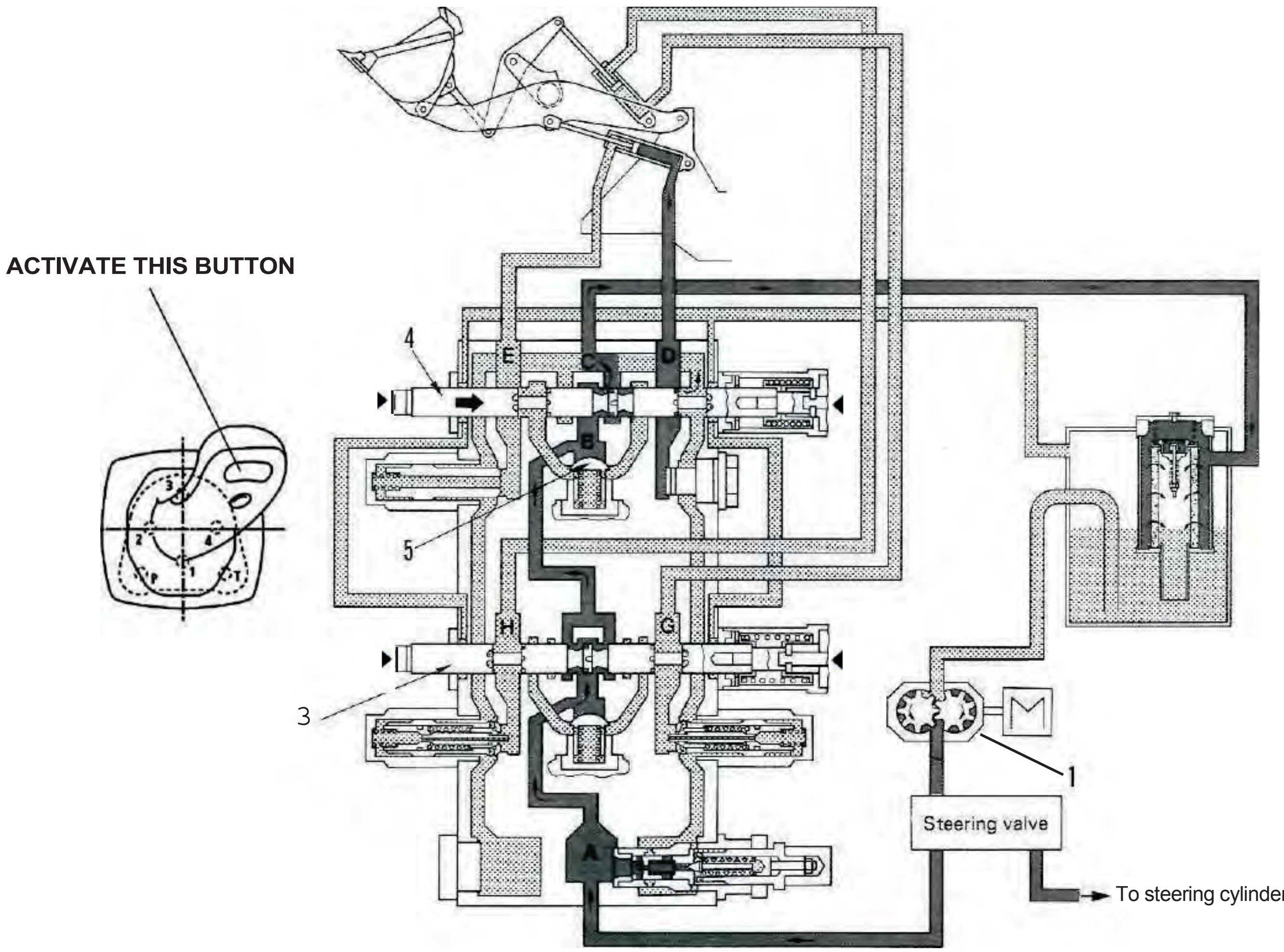


OPERATION

- When Joystick is pressed to position 3, lift spool is pushed out to the LOWER position.
- The oil flows from pump (1) through the control valve. It then passes through the bypass circuit of dump spool (3) and flows to the bypass circuit of lift spool (4). The bypass circuit is closed by lift spool (4), so the oil pushes open check valve (5).

The oil then flows from check valve (5) to port E and enters the rod end of cylinder. At the same time the oil from the cylinder bottom flows from port D and enters drain port **C**. It then passes through the oil cooler and return to the tank. When this happens, the lift arm goes down.

Lift spool at "FLOAT position"

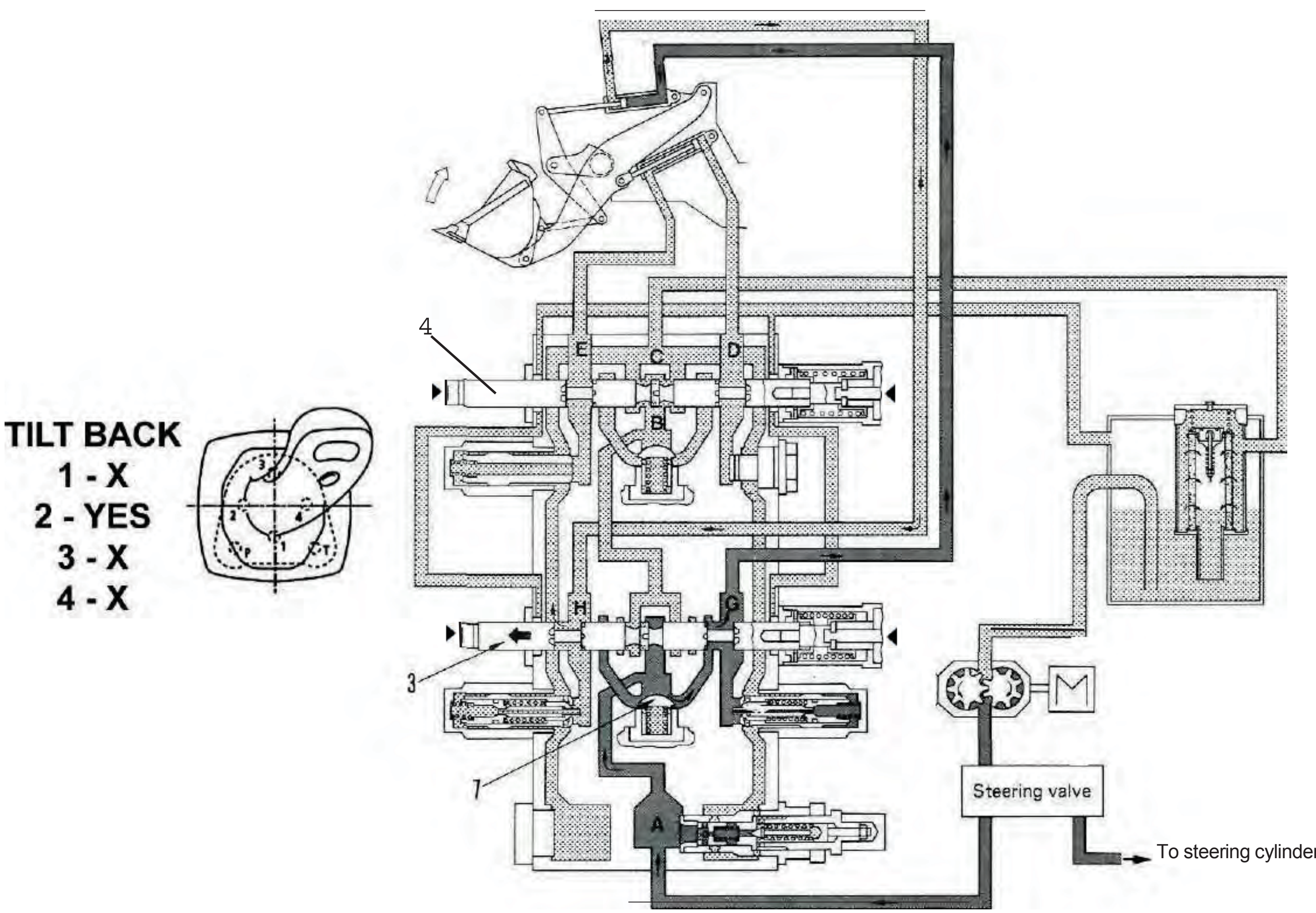


OPERATION

- When Joystick is pressed down further from the LOWER position, lift spool (4) is pushed in to the FLOAT position.
- The oil flows from pump (1) through the control valve. It then flows around the bypass circuit of dump spool (3) to the lift spool bypass circuit. The oil in the bypass circuit flows to the drain circuit because of the spool, but it cannot push open check valve (5).

In addition, RAISE circuit D and LOWER circuit E of the lift cylinder are connected to the drain circuit, so the lift arm goes down under its own weight-When the bucket is in contact with the ground, it can move up and down in accordance with the shape of the ground

Dump spool at "TILT back position"



OPERATION

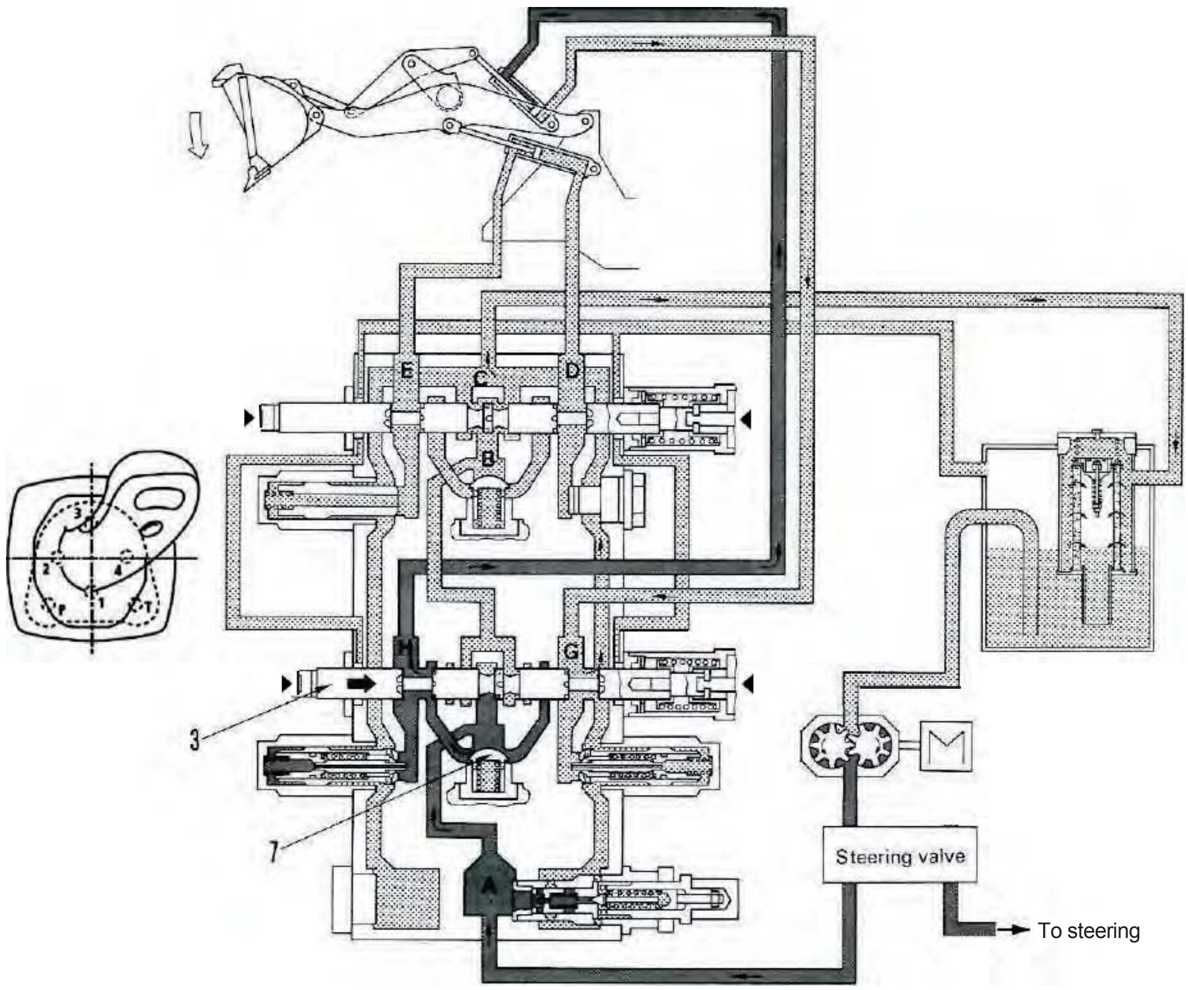
- When Joystick is pressed to position 2, dump spool (3) is pulled in to the tilt position.
- The bypass circuit is closed by dump spool (3), so oil from port **A** pushes open check valve (7).

The oil from port **A** flows from check valve (7) through port **G** to the cylinder bottom.

- At the same time, the oil at the cylinder rod end flows from port **H** to drain port **C**. It then passes through the oil cooler, and flows back to the tank. When this happens, the bucket tilt.

Dump spool at "DUMP"

DUMP
1 -X
2 -X
3 -X
4 -YES



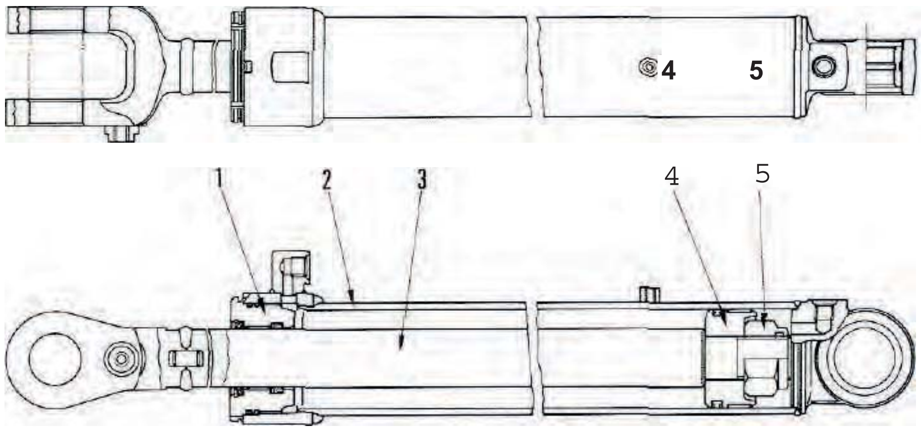
OPERATION

- When Joystick is pressed to position 4, dump spool (3) is pushed in to the DUMP position.
- The bypass circuit is closed by the dump spool (3), so the oil from port **A** pushes up check valve (7). The oil from port **A** flows from port **H** into the spool. It then flows to the cylinder rod end.

At the same time, the oil at the cylinder bottom end flows from port **G** to drain port **C** and then returns to the tank. As a result, the bucket is dumped.

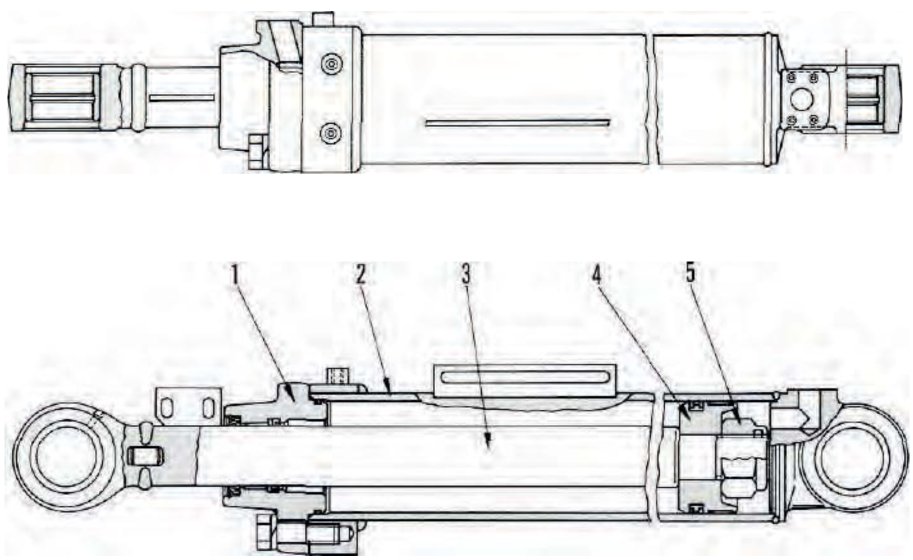
HYDRAULIC CYLINDER

LIFT CYLINDER



1. Cylinder head
2. Cylinder
3. Rod
4. Piston
5. Piston nut

DUMP CYLINDER



1. Cylinder head
2. Cylinder
3. Rod
4. Piston
5. Piston nut

	Lift cylinder	Dump cylinder
Cylinder I.D.	120 mm	130 mm
Rod dia.	70 mm	70 mm
Stroke	700 mm	474 mm
Cylinder max. length	1,940 mm	1,445 mm
Cylinder min. length	1,240 mm	971 mm

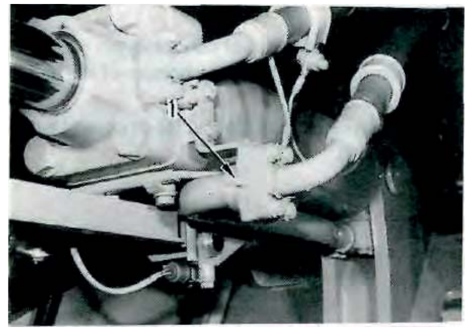
18 WORK EQUIPMENT SYSTEM TESTING AND ADJUSTING

* The following precautions are necessary when using the Standard Value Tables to make judgments' during troubleshooting or during testing and adjusting.

1. The values in these tables are based on the values for new machines leaving the plant, so they should be used as target values when repairing or when estimating wear after a period of use.
2. The standard values in these tables for judgments' when troubleshooting are estimated values based on the standard values for the machine when shipped from the plant, and on the results of various tests. Therefore, they should be used as reference in combination with repair and operating records when making judgments'.
3. These standard value tables must not be used for standard values when judging claims. In addition, do not use these values alone to make simple judgments'.

Testing and measuring item	Measurement condition	Unit	Standard value	Permissible value
Joystick • Lift lever operating force [Hold—Raise) (Raise—Hold) (Hold—-Lower) (Lower—'Hold) (Lower—'Float) (Float—Hold) • Dump lever operating force (Hold—Dump) (Hold—Tilt) (Tilt—Hold)	• Hydraulic temperature: 45 - 55°C • Engine speed: Low idling	kg	 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0	 Max. 1.0 Max. 1.0 Max. 1.0 Max. 1.0 Max. 1.0 Max. 1.0 Max. 1.0 Max. 1.0 Max. 1.0
Main control valve • Main relief oil pressure	• Hydraulic temperature: 45 - 55°C • Engine speed: High idling	kg/cm*	210 +8	210±20
Lift arm and bucket operating speed. • Lift arm lifting time • Lift arm lowering time • Bucket dumping time • Bucket tilt back time (Full stroke) • Bucket tilt back time (Horizontal position of bucket)	• Hydraulic temperature: 45 - 55°C • Engine speed: High idling • Steering position: Neutral • Coolant temperature: Inside operating range. • Bucket: unloaded	sec.	 5.5-6.1 2.5-3.5 0.9-1.5 2.0-2.6 0.9-1.5	 Max. 7.4 Max. 4.2 Max. 1.9 Max. 3.1 Max. 1.8
Hydraulic drift of lift arm and bucket • Retraction of lift cylinder rod • Retraction of dump cylinder rod	• Hydraulic temperature: 45 - 55°C • Coolant temperature: Inside operating range • Stop engine, leave for 5 minutes, then measure for next 15 minutes. • Lift arm horizontal • Bucket horizontal • Unloaded	mm	Max. 4.0 Max. 4.0	Max. 20 Max. 20
Bucket positioner • Clearance of switch Boom kick-out • Clearance of switch	Hydraulic temperature: 45 - 55°C	mm	5-8 5-8	5-8 5-8

MEASURING HYDRAULIC PRESSURE

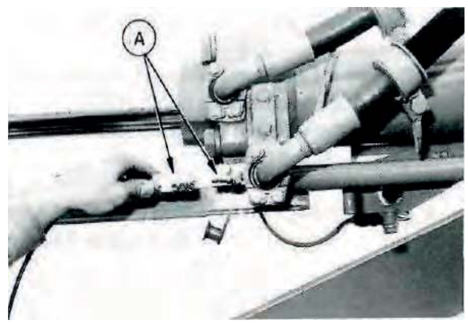


- Measurement condition
- Coolant temperature: Inside operating range
- Hydraulic oil temperature: 45 — 55°C
- Engine speed: High idling

Unit: kg/cm2

Item	Standard value	Permissible value
Main relief pressure	210+8 -0	210±20

1. Measuring procedure (Main relief valve)



Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

1) Remove plug (1) for measuring pressure of dump cylinder circuit.

2) Install hydraulic tester **A** to the measuring port.

★ Check that there is no oil leakage from any connection.

★ Use a hose which is long enough to reach the operator's compartment.

3) Start the engine, raise the lift arm 400 mm from the ground and operate the dump control lever (TILT). Measure the pressure when the relief valve is actuated.

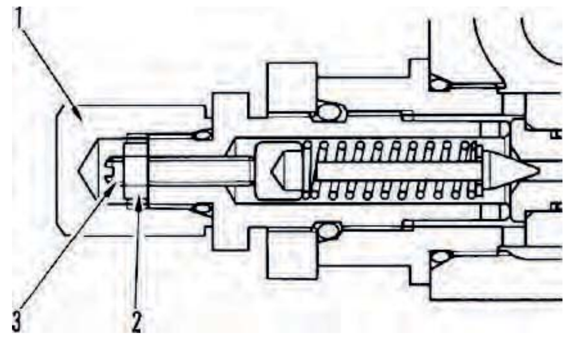
★ Be careful not to apply any sudden pressure to the pressure gauge.

When removing the hydraulic pressure gauge, release the pressure inside the circuit in the same way as when installing.

2. Adjusting

⚠ Always stop the engine before adjusting the hydraulic pressure.

1) Stop the engine; open the engine side hood
2) Remove cap nut (1) of the relief valve (5).
3) Loosen lock nut (2), and turn adjustment screw (3) to adjust.



- ⋆ Amount of adjustment for 1 turn of screw

  1 turn: **Approx. 35.7 kg/cm2**

- ⋆ Turn the adjustment screw as follows.
  To INCREASE pressure, TIGHTEN screw.
  To DECREASE pressure, LOOSEN screw.

⋆ If the relief pressure cannot be measured accurately, do not try to adjust the pressure.

MEASURING LIFT ARM AND BUCKET

Measurement condition :

- Coolant temperature: Inside operating range
- Steering position: Neutral
- Hydraulic temperature: 45 — 55°C
- Bucket: Unloaded
- Engine speed: High idling

Unit: sec

Item	Standard value	Permissible value
Lifting time of lift arm	5.5-6.1	Max. 7.4
Lowering time of lift arm	2.5-3.5	Max. 4.2
Dumping time of bucket	0.9-1.5	Max. 1.9
Tilt back time of bucket (Full stroke)	2.0-2.6	Max. 3.1
Tilt back time of bucket [From horizontal position of bucket)	0.9-1.5	Max. 1.8

Measuring procedure

1. Lifting time of lift arm

Set the bucket near the maximum tilt back position and at the lowest position on the ground. Raise the bucket and measure the time taken for bucket to reach the maximum height of the lift arm.

2. Lowering time of lift arm

Set the bucket horizontal with the lift arm at the maximum height, lower the bucket and measure the time taken for the bucket to reach the lowest position on the ground.

3. Dumping time of bucket

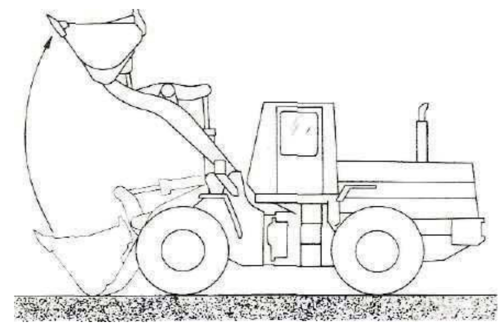
Raise the lift arm to the maximum height and measure the time taken for the bucket to move from the maximum tilt back position to the maximum dump position.

4. Tilt back time of bucket

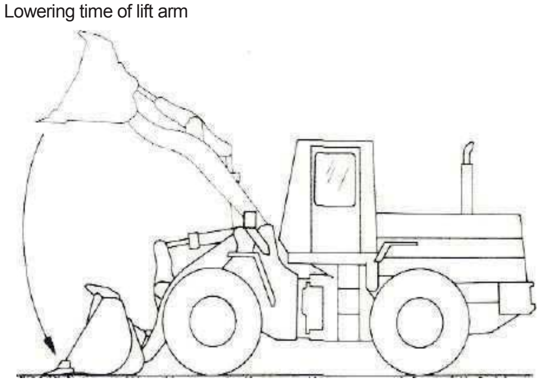
1) Raise the lift arm to the maximum height and measure the time taken for the bucket to reach the maximum tilt back position.

2) Set the bucket horizontal and measure the time taken for the bucket to move from the horizontal position to the maximum tilt back position.

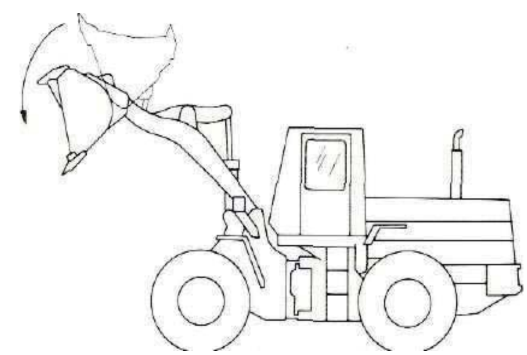
Lifting time of lift arm



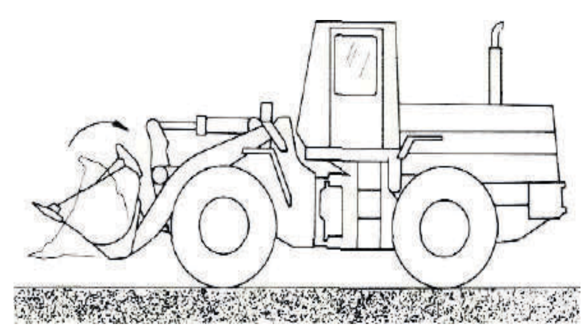
Lowering time of lift arm



Dumping time of bucket



Tilt back time of bucket



MEASURING HYDRAULIC DRIFT OF LIFT ARM AND BUCKET

★ Measurement condition

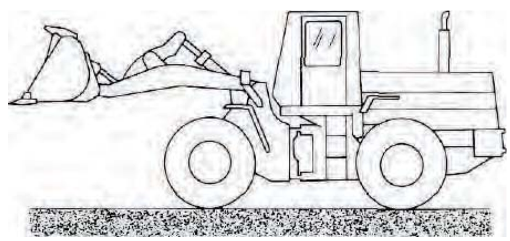
- Coolant temperature: Inside operating range
- Hydraulic temperature: 45 — 55°C
- Stop engine, leave for 5 minutes, then measure for next 1 5 minutes.
- Lift arm horizontal
- Bucket horizontal
- Unloaded

Unit: mm

Item	Standard value	Permissible value
Retraction of lift cylinder rod	Max. 4.0	Max. 20
Retraction of dump cylinder rod	Max. 4.0	Max. 20

⚠ Fit the safety locks on the control levers.

⚠ Do not go under the work equipment

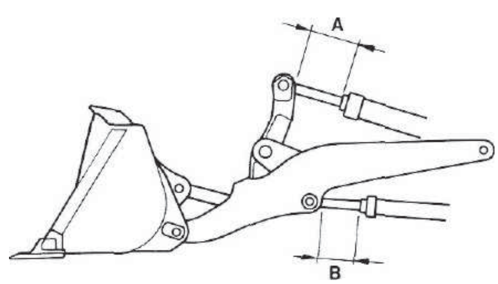


Measuring procedure

1. Set the lift arm and bucket horizontal, then stop
the engine.

2. Stop the engine, wait for 5 minutes, and then start
measuring.

3. Measure the amount the lift and dump cylinder rods retract during 15 minutes.



A. Retraction of dump cylinder rod
B. Retraction of lift cylinder r

TROUBLESHOOTING

* Before carrying out the troubleshooting in this section, read "PRECAUTIONS WHEN TROUBLESHOOTING", "METHOD OF READING TROUBLESHOOTING TABLE" and "PREVENTING RECURRENCE OF TROUBLE"

TROUBLESHOOTING TABLE

LOADER CIRCUIT

1. Lift arm does not rise.

Ask the operator the following questions.

- Did the lift arm suddenly fail to rise? → Seizure or damage to various units. Was an unusual noise produced? (Where did it emanate from?)
- Were there previous signs of the lift arm slowing down? → Wear of parts or flattening of spring.

Checks before troubleshooting

- Is oil level in hydraulic tank correct?
- Is travel of lift arm control lever and spool

	Cause	a	b	c	d	e	f	g
		Blockage on suction side of pump or excessive amount of air contained in oil	Pump PTO is not being driven	Faulty work equipment pump or steering pump	Faulty demand spool	Faulty main relief valve	Internal damage to valve body (lift spool)	Damaged lift cylinder piston seal
		Tank to pump			Demand valve	Control valve		Cylinder
No.	Problem / Remedy	C △	△ X	△ X	C X	△ X	X	X
1	Bucket cannot operate and lift arm is unable to rise.	○	○	○	○	○		
2	The machine body can be lifted up by the lift arm, however the lift arm is unable to rise. Or the bucket operates but the boom is unable to rise.						○	○
3	The lift arm can rise under no load but cannot rise under load	○		○		○		
4	The hydraulic pump produces an unusual noise.	○		○				
5	Lift cylinder has large amount of hydraulic drift.						○	○
6	When the engine is at high idling, steering action is light and excessively fast				○			
7	When the engine is at high idling, steering action is heavy and slow.	○		○				

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

2. Lift arm moves slowly or does not have sufficient lifting power.

Checks before troubleshooting

- Is the amount of oil in the hydraulic tank and also the type of oil correct?
- Is the travel of the lift arm control lever and also the spool of the main control valve correct?
- Seizure of work equipment linkage bushing.

Fault check

There is a strong relationship between faults involving lifting force and lifting speed. Such faults appear initially in the form of insufficient lifting speed. Measure the lifting speed of the lift arm when loaded and refer to the standard valuetable to determine whether or not there is a fault.

	Cause	Blockage on suction side of pump or excessive amount of air contained in oil.	Faulty work equipment pump	Faulty steering pump	Faulty demand spool	Faulty or improperly adjusted main relief valve	Worn or damaged valve body (lift arm spool)	Damaged lift arm cylinder piston seal
		Tank to pump			De-mand valve	Control valve		Cylin-der
		a	b	c	d	e	f	g
No.	Problem / Remedy	C △	△ X	△ X	△ X	A X	X	△ X
1	Bucket tilt back force and speed are abnormal and lift arm lifting speed is low.	○	○	○	○	○		
2	Bucket tilt back force and speed are normal but lift arm lifting speed is low.						○	○
3	Same as item 1 except that lift arm lifting speed becomes particularly low when oil temperature rises.		○	○				
4	Hydraulic pump emits unusual noise.	○	○	○				
5	When the engine is at high idling, steering action is light and excessively fast.				○			
6	When the engine is at high idling, steering action is heavy and slow.	○		○				
7	Lift arm cylinder has a large amount of hydraulic drift.						○	○
8	The relief pressure of maine relief valve is low					○	○	○

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair

A: Adjust C: Clean

3. Lift arm movement becomes slow after it reaches a certain height.

Check before troubleshooting

- External deformation of lift cylinder.

Cause

- Swollen or internally damaged lift cylinder tube.

★ Regarding other faults occurring during lift arm rise, refer to item 2 "Lift arm moves slowly or does not have sufficient lifting power".

4. Bucket cannot be held down with lift arm cylinder.

If the relief pressure in the circuit at the bottom of the lift cylinder is insufficient, refer to item 2 "Lift arm moves slowly or does not have sufficient lifting power".

Checks before troubleshooting

- Is level of oil in the hydraulic tank correct?
- Is travel of main control valve and lift arm spool correct?

Cause

- Faulty main control valve or suction valve seat on lift arm cylinder rod side.
- Oil leakage from lift arm cylinder piston seal.

5. Lift arm has large hydraulic drift.

Ask the operator the following questions.

- Did the hydraulic drift suddenly become large?
  → Dirt lodged in valve or damaged parts.
- Did the hydraulic drift gradually become large?
  → Worn parts.

Checks before troubleshooting

- Is the type and temperature of the oil in the hydraulic tank correct?
- Is the lift arm spool in the neutral position?
  →Seized link bushing, faulty spool detent

Problem and cause

- When measuring hydraulic drift, internal of lift cylinder produces oil leak noise → Damaged piston packing.

6. Lift arm movement is unsteady during work.

During excavation or ground leveling when the lift arm control lever is in the "Hold" position, the bucket and lift arm move up and down in accordance with the terrain.

Problem and cause

Check the amount of hydraulic drift and whether or not the machine body can be lifted up by the lift cylinder.

1. If the amount of hydraulic drift is greater than the standard value, refer to item 5 "Lift arm has large hydraulic drift".
2. If the machine body can not be lifted up by the lift cylinder, refer to item 4 "Bucket cannot be held down with lift cylinder".
3. If the amount of hydraulic drift is normal and the machine body can be lifted up by the lift cylinder after the lift arm is moved several times to cause the lift cylinder to move through its entire stroke — the trouble is due to the generation of a vacuum in the cylinder.
   ★ If a vacuum is generated frequently, → faulty suction valve on lift cylinder rod side.

7. Lift arm descends momentarily when control lever is shifted from "Hold" to "Raise".

The lift arm descends momentarily under its own weight when the lift arm control lever is gradually shifted from the "Hold" position to the "Raise" position white the engine is at low idling. When the control lever is put completely into the "Raise" position, the lift arm behaves normally.

Cause

- Faulty seating of main control valve or lift arm check valve.

8. Bucket does not tilt back.

Ask the operator the following questions.

- Did the bucket suddenly cease to move? — Seized or damaged equipment.
  Was any unusual noise emitted (where dit it emanate from)?
- Were there previous signs of the bucket slowing down? — Worn parts or flattened spring.

Checks before troubleshooting

- Is amount of oil in hydraulic tank satisfactory?
- Is the travel of the bucket control lever and spool correct?

No.	Cause	a	b	c	d	e	f	g	h
		Blockage on suction side of pump or excessive amount of air contained in oil	Pump PTO is not being driven	Faulty work equipment pump and steering pump	Faulty demand spool	Faulty main relief valve	Faulty safety valve on dump cylinder bottom side (with suction valve)	Internally damaged valve body (dump spool)	Damaged dump cylinder piston seal
		Tank to pump			Steering valve	Control valve			Cylinder
	Remedy	C X	△ X	△ X	X	A X	△ X	X	X
	Problem								
1	Lift arm cannot operate and bucket is unable to tilt back.	○	○	○	○	○			
2	The machine can be lifted up by the bucket but the bucket cannot tilt back. Or the lift arm operates but the bucket cannot tilt back.							○	○
3	The bucket can tilt back under no load but cannot excavate or scoop.	○		○					
4	The hydraulic pump produces an unusual noise.	○		○					
5	Bucket cylinder has large hydraulic drift.						○		○
6	Steering action is light and excessively fast when the engine is at high idling.				○				
7	Steering action is heavy and slow when the engine is at high idling.	○							

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace △: Repair
A: Adjust C: Clean

9. Bucket moves slowly or has insufficient tilt back power.

Checks before troubleshooting
- Is the oil qty. in the hyd. tank & the type of oil satisfactory?
- Is travel of bucket ctrl lever and the main CV
- spool correct?
- Seizure of bushing in work equipment linkage. (Was an unusual noise produced?)

Fault check
- Check the amount of deficient tilt back force by performing actual work.
- Measure op. speed of bkt. & check against the std. value table to det. whether or not it is normal.

Cause:
- a: Blockage on suction side of pump or excessive amount of air contained in oil
- b: Faulty work equipment pump
- c: Faulty steering pump
- d: Faulty demand spool
- e: Faulty or incorrectly adjusted main relief valve
- f: Faulty safety with suction valve on bottom of the bucket cylinder
- g: Internally worn or damaged valve body (dump spool)
- h: Damaged dump cylinder piston seal

No.	Problem	Tank to pump			Demand valve	Control valve			Cylinder
		a	b	c	d	e	f	g	h
	Remedy	C △	△ X	△ X	△ X	△A X	△ X	X	X
1	Lift arm lifting force and lifting speed are abnormal and also bucket tilt back force and tilt back speed are abnormal	○	○	○	○	○			
2	Lift arm lifting force and lifting speed are normal but bucket tilt back force and tilt back speed are abnormal.						○	○	○
3	Phenomena of item 1 become particularly bad when the oil temperature rise.		○	○					
4	The hydraulic pump emits an unusual noise.	○	○	○					
5	Steering action is light and excessively fast when the engine is at high idling.				○				
6	Steering action is heavy and slow when the engine is at high idling.	○		○					
7	The dump cylinder has a large amount of hydraulic drift.						○	○	○
8	The relief pressure of main relief valve is low when the engine is at high idling.					○	○	○	○
9	The discharge volume of the hydraulic pump is low		○	○					

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace	△: Repair
A: Adjust	C: Clean

11. Bucket movement becomes slow during tilt back.

Check before troubleshooting

- External deformation of dump cylinder.

Cause

- Swollen or internally damaged dump cylinder tube. Regarding other faults which occur when the bucket operates, refer to item 9 "Bucket moves slowly or has insufficient tilt back power".

12. Bucket cannot be held down by the bucket cylinder.

Refer to item 9 "Bucket moves slowly or has insufficient tilt back power".

Checks before troubleshooting

- Is oil level in the hydraulic tank satisfactory?
- Is the travel of the main control valve dump spool correct?

Cause

- Faulty seat of safety with suction valve of control valve for the bottom side of dump cylinder.
- Oil leakage from seal of dump cylinder piston.

13. Bucket has large hydraulic drift.

Ask the operator the following questions.

- Did the hydraulic drift suddenly become large? → Dirt lodged in valve or damaged parts.
- Did the hydraulic drift gradually become large? → Worn parts.

Checks before troubleshooting

- Is the type and temperature of the oil in the hydraulic tank correct?
- Is the dump spool in the neutral position?

→ Seized link bushing, faulty spool detent.

Fault check

- Use the standard value table to check whether or not the hydraulic drift of the bucket is actually large.

Cause

- Oil leakage in dump cylinder.
- Faulty seating of safety valve with suction valve on bottom side.
- Faulty oil sealing on spool of dump control valve.

13. Bucket moves unsteadily when machine travels under load. (Main control valve in “Hold”).

Checks before troubleshooting

- Is oil level in hydraulic tank and type of oil correct?
- Excessive play in pin and bushing of work equipment linkage.
  (Was an unusual noise produced?)

Cause

- Faulty piston seal of dump cylinder.
- Faulty safety valve with suction valve for the rod side of dump cylinder. If the above symptoms occur together with other symptoms, refer to the problem items corresponding to each fault.

14. Bucket dumps momentarily when control lever is shifted from "Hold" to "Tilt back".

The bucket dumps momentarily under its own weight when the dump control lever is gradually shifted from the "Hold" position to the "Tilt back" position while the engine is at low idling. When the control lever is put completely into the "Tilt back" position, the bucket behaves normally.

Cause

- Faulty seating of main control valve dump spool check valve.

15. Control levers of lift arm and bucket move stiffly and sluggishly.

Fault check
Using the standard value table, check whether the operating force of the lever is large or not.

No	Problem \ Cause	a	b	c	d	e	f	g
	Cause	Seizure of control lever or rotating parts of link	Distortion of valve body due to non-uniform tightening of valve mounting bolts	Bent main control valve spool	Sticking of detent of main control valve spool	Incorrect clearance between main control valve body and spool	Poor roundness of main control valve body and spool	Foreign matter lodged in main control valve spool
		Lever	Main control valve					
	Remedy	△ X	△ X	X	△ X	X	X	△ X
1	Movement of lift arm and bucket control levers becomes sluggish when load is applied and oil pressure increases.		○			○		
2	Movement of lift arm and bucket control levers becomes sluggish along with change in oil temperature		○			○		
3	Movement of lift arm and bucket control levers becomes generally sluggish irrespective of oil pressure and temperature.				○			
4	Movement of lift arm and bucket control levers becomes partially sluggish irrespective of oil pressure and temperature.	○	○	○				○
5	Movement of lift arm and bucket control levers does not become light even when the link of the control lever is disconnected at the valve connection part and the lever operated.	○						

The following symbols are used to indicate the action to be taken when a cause of failure is located.

X: Replace	△: Repair
A: Adjust	C: Clean

WORK EQUIPMENT SYSTEM

19 DISASSEMBLY AND ASSEMBLY

* For repairs, remove hydraulic cylinders, pumps and pilings after reassembling, when operating the cylinders for the first time; be sure to bleed air according to the following instructions.

1. Start engine and put in low gear.
2. Operate hydraulic cylinder 4 — 5 cycles, but do not exceed beyond 100 mm of stroke end.
3. Continue to operate cylinder 2 — 3 cycles until stroke end.
4. After finishing above steps, keep normal engine speed.

   NOTE: After repairing and long storage, same procedure is required.

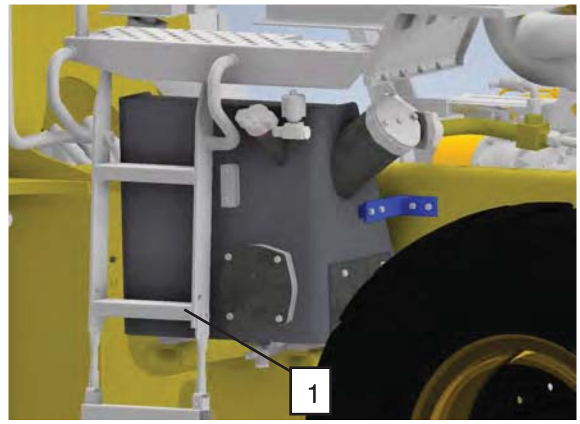
REMOVAL OF HYDRAULIC TANK

Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires

Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, and then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

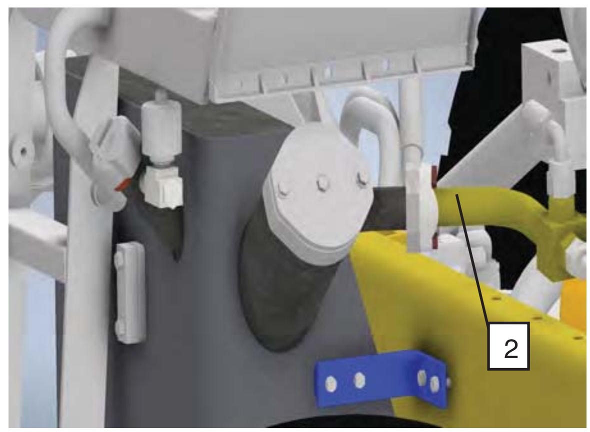
- Drain the oil in to a neat container

1. Remove ladder assembly (1)

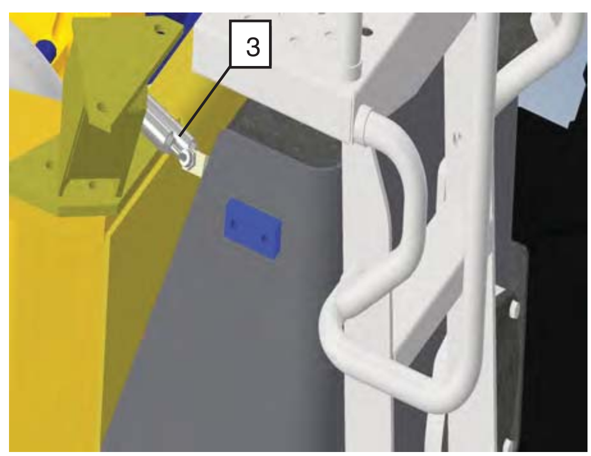


2. Disconnect all related hoses.

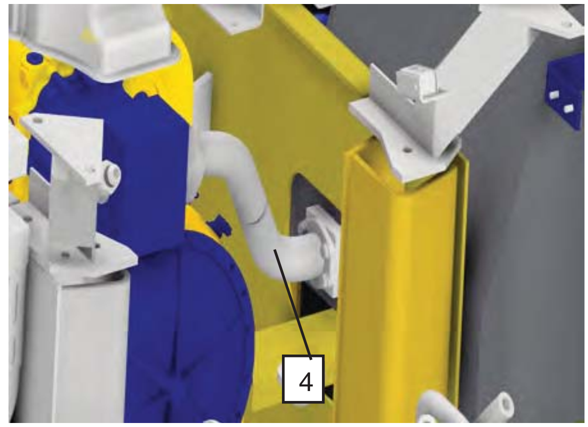
a. Disconnect cooler return line tube (2)



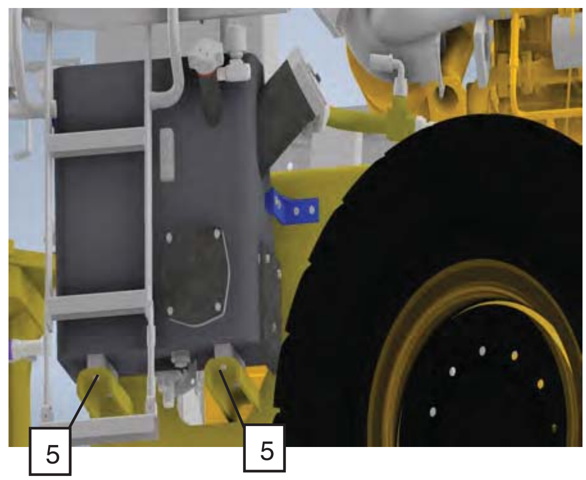
b. Disconnect all pilot hosses connected to tank (3)



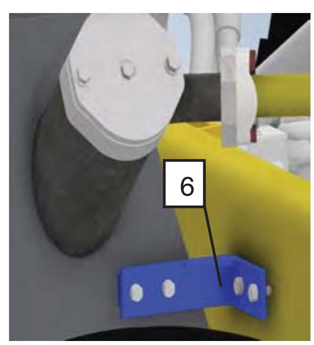
c. Disconnect suction tube (4)

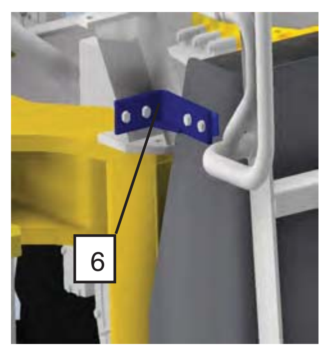


3. Remove hydraulic tank mounting bolts (5)



4. Remove hydraulic tank brackets (6)





5. Remove hydraulic tank slowly with crane or fork lift

* Support the tank with crane/fork lift before removing brackets

kg Hydraulic tank : 110 kg

INSTALLATION OF HYDRAULIC TANK

1. Hydraulic tank

1) Using lift or fork lift, raise hydraulic tank , set in mounting position, and then install mounting bolts (5).

* Tighten the mounting bolts with proper torque

2) Assemble hydraulic tank brackets (6)

3) Assemble suction tube (4).

4) Connect all related hoses
   a. Connect cooler return line tube (2) and its hoses
   b. Connect all pilot hoses (3) to the tank

5) Refilling with oil
   Tighten plug at top of hydraulic tank filter, then add hydraulic oil through oil filler to the specified level.

* Ensure the tightness of all tube and hoses connected to tank before starting the engine

* Run the engine to circulate the oil through the system. Then check the oil level again. if required fill the oil until the level reaches to the spefied level in the sight gauge

6) Assemble ladder assembly (1)

REMOVAL OF HYDRAULIC FILTER

Loosen the oil filler cap (1) slowly to release the pressure inside the hydraulic tank.

1. Cover

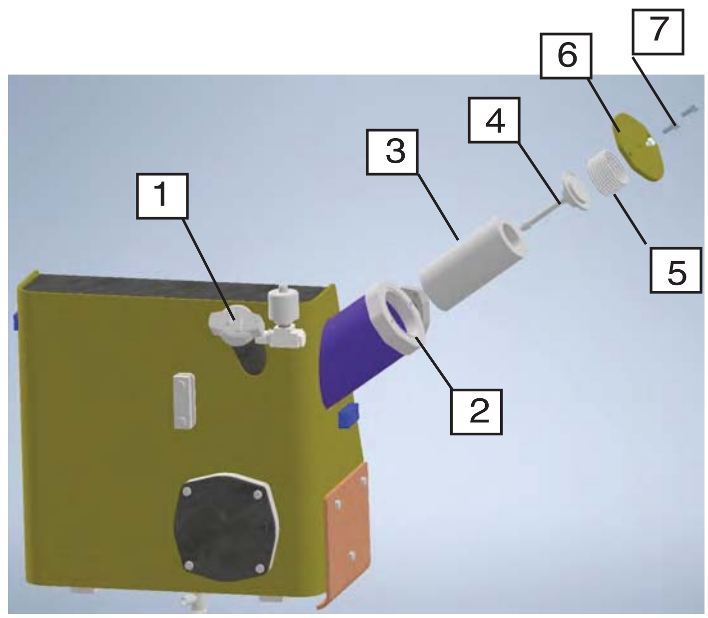
Remove mounting bolts (7), and then remove cover (6).

The tension of the spring is pushing the cover so be careful when removing.

★ Be careful not to damage O-ring (2) and the contact faces of the cover and tank.

2. Filter

Remove spring (5) and bypass valve (4), then remove filter (3).



INSTALLATION OF HYDRAULIC FILTER

1. Filter

Install filter (3), then install bypass valve (4) and spring (5).

2. Cover

Fit O-ring (2) in groove of cover, and then install cover (6) to tank.

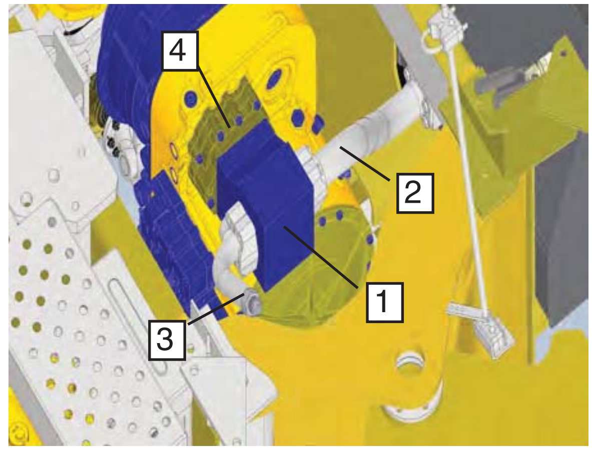
* Replace the O-ring with a new part.
* Fit the O-ring securely in the groove, and make sure that it does not get caught when installing.

2. Cover

Fit O-ring (2) in groove of cover, and then install cover (1) to tank.

★ Replace the O-ring with a new part.
★ Fit the O-ring securely in the groove, and make sure that it does not get caught when installing.

REMOVAL OF HYDRAULIC PUMP



Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, and thenoperate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

• Drain the oil in to a neat container

1. Hydraulic piping

1) Disconnect suction tube (2) between hydraulic tank and hydraulic pump at pump end.
2) Disconnect tube (3) between hydraulic pump and and Priority valve at pump end.

2. Hydraulic pump

Sling hydraulic pump (1), remove mounting bolts (4), and then remove pump.

* The removal of the pump should be carried out by two workers. Remove pump from lower inspection access port.
* There is little space to work, so be careful

INSTALLATION OF HYDRAULIC PUMP

1. Hydraulic pump

Set pump (1) in mounting position, then tighten mounting bolts (4).
*Check that there is an O-ring installed between the pump and housing.

* This operation should be carried out by two workers

* There is little space, so be careful when working

2. Hydraulic piping

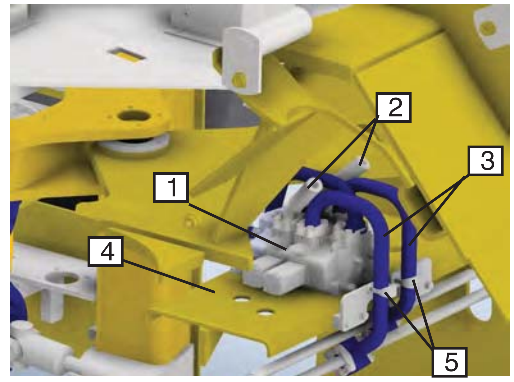
1) Connect the tube (3) between hydraulic pump and Priority valve at pump end.
2) Connect tube (2) between hydraulic tank and hydraulic pump at pump end.

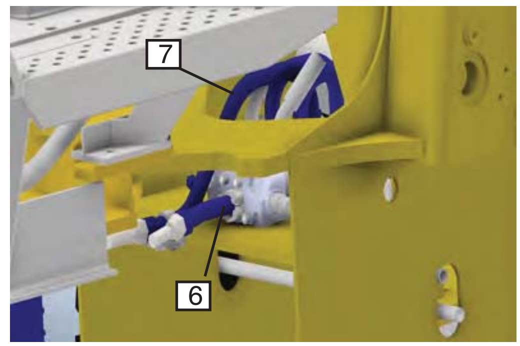
3. Refilling with oil

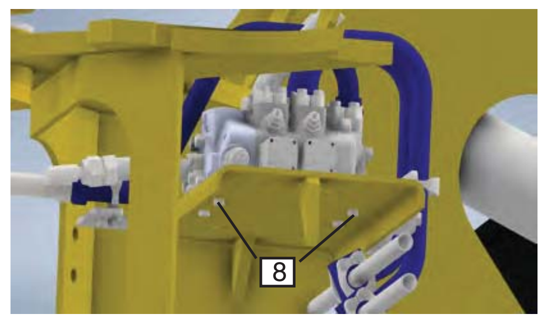
Tighten plug at top of hydraulic tank filter, then add hydraulic oil through oil filler (8) to the specified level.

* Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF MAIN CONTROL VALVE







Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, and then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

* Drain the oil to a safe container.

1. Hydraulic piping

Disconnect the following hydraulic piping.

a) Remove all pipe supported U clamps (5)

b) Disconnect lift cylinder tubes (3) from main control valve.

c) Disconnect dump cylinder hoses (2) from main control valve.

d) Disconnect return line tube (7) between main control valve and hydraulic tank

e) Disconnect P line tube (6) from priority valve

f) Disconnect all pilot hoses connected to lift and tilt spool. Sling main control valve (1),

2. Remove mounting bolts(8) and then lift off.

kg Main control valve: 48.6 kg

* Be careful not to let the lifting tool slip when raising the main control valve.

INSTALLATION OF MAIN CONTROL VALVE

1. Main control valve

Set main control valve (1) in mounting position, on the mounting plate (4) then tighten mounting bolts (8).

★ Tighten the mounting bolts (8) on diagonally opposite sides and be careful not to deform the valve.

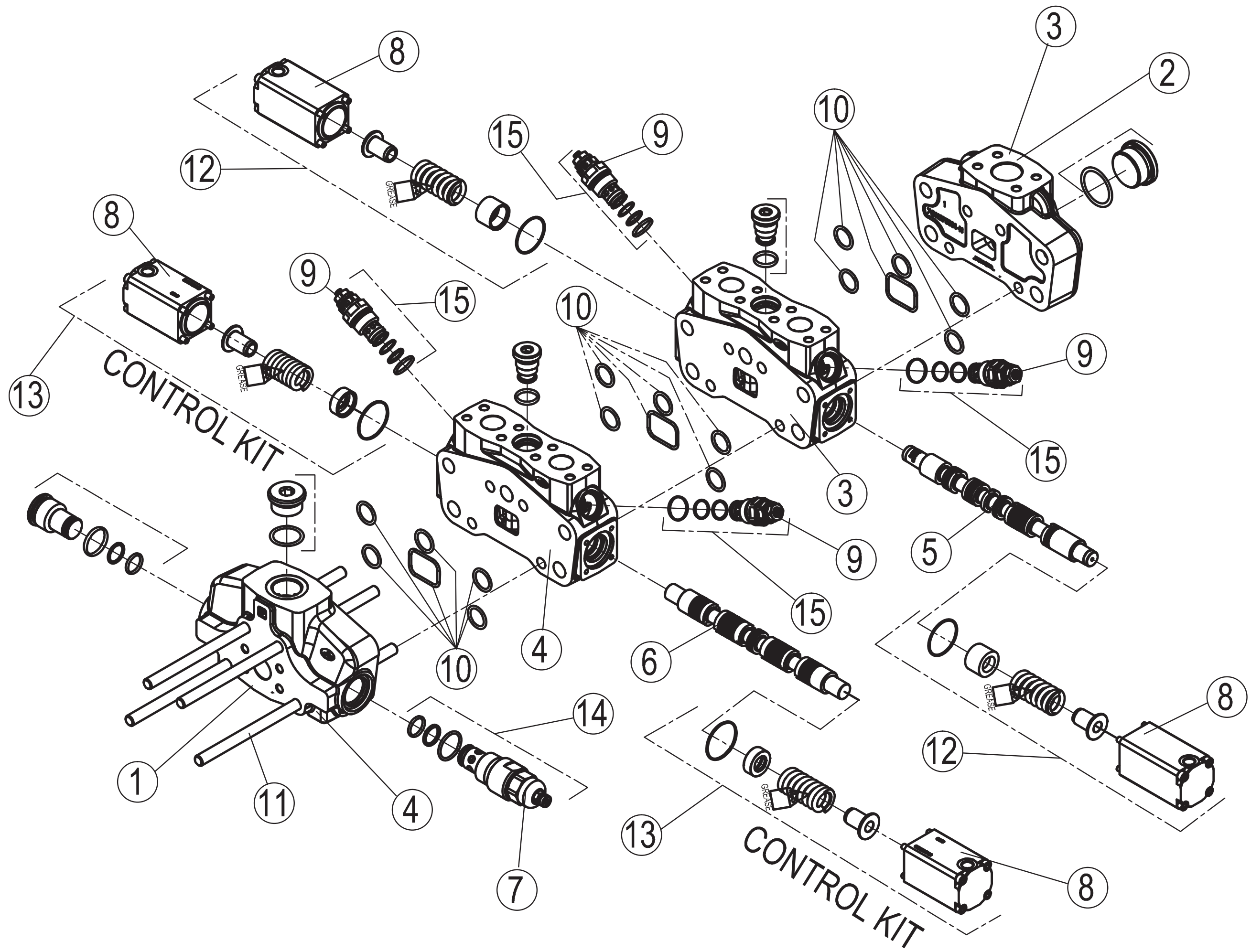
2. Hydraulic piping

Connect the following hydraulic piping.

a) Connect lift cylinder tubes (3) from main control valve.
b) Connect dump cylinder hoses (2) from main control valve.
c) Connect return line tube (7) between main control valve and hydraulic tank
d) Disconnect P line tube (6) from priority valve
e) Connect all pipe supported U clamps (5)
f) Connect all pilot hoses connected to lift and tilt spool.

3. Refilling with oil

Tighten plug at top of hydraulic tank filter, then add hydraulic oil through oil filler to the specified level.

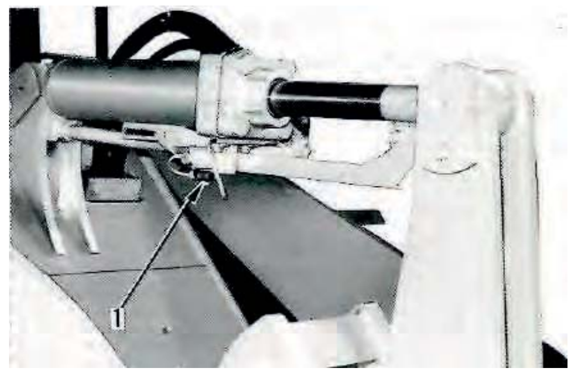


1) INLET BLOCK.
2) OUTLET BLOCK.
3) LIFT SECTION.
4) TILT SECTION.
5) LIFT SPOOL.
6) TILT SPOOL.
7) MAIN RELIEF VALVE.
8) END CAP.
9) PORT RELIEF VALVE.
10) SEAL KIT.
11) TIE ROD KIT.
12) CONTROL KIT LIFT.
13) CONTROL KIT TILT
14) MAIN RELIEF VALVE ASSY.
15) PORT RELIEF VALVE ASSY.

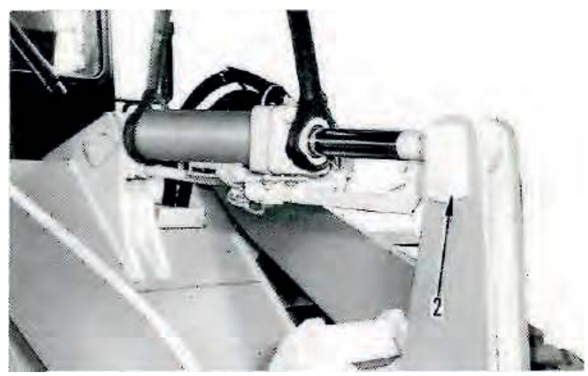
REMOVAL OF DUMP CYLINDER

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.
Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, and then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.

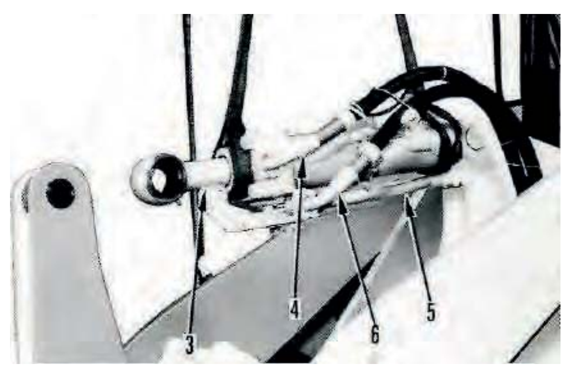
2. Rod pin



Sling cylinder, remove lock bolt, then remove pin (2).
★ When raising the cylinder, sling at two places and be careful to maintain the balance.



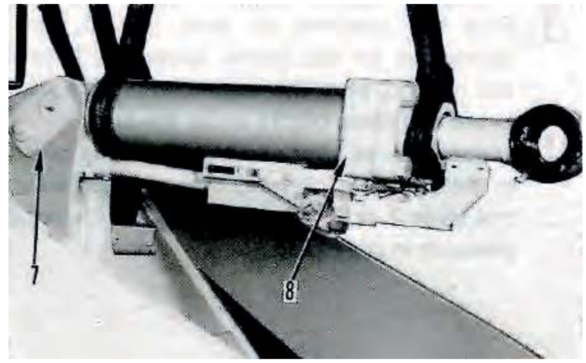
3. Hydraulic piping
1) Start engine, and operate control levers to re
tract cylinder rod (3).
★ Do not retract the rod fully. Stop about 20 mm from end of stroke.
2) Disconnect hose (4) at rod end from cylinder.
3) Disconnect tube (5) and hose (6) at bottom end from connection part.



4. Dump cylinder

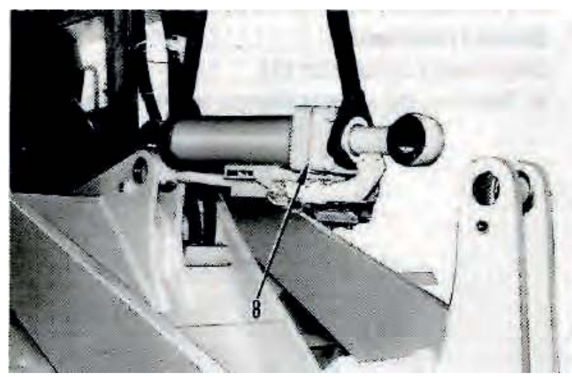
1) Remove lock bolt, then remove bottom pin (7).

★ When shims are installed, check the number and thickness of the shims, and keep in a safe place.



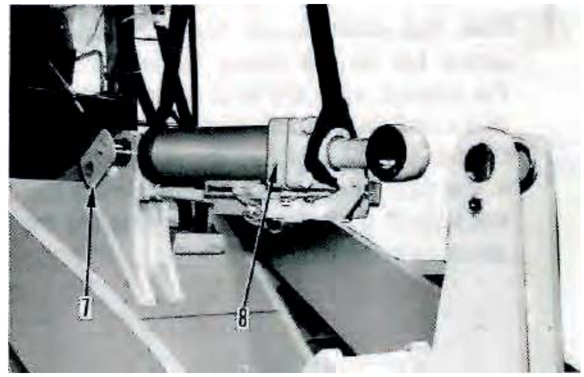
2) Lift off dump cylinder (8).

★ Be careful not to damage the cylinder rod.

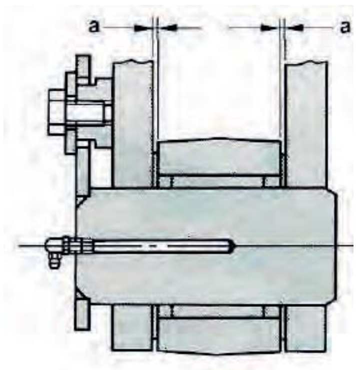


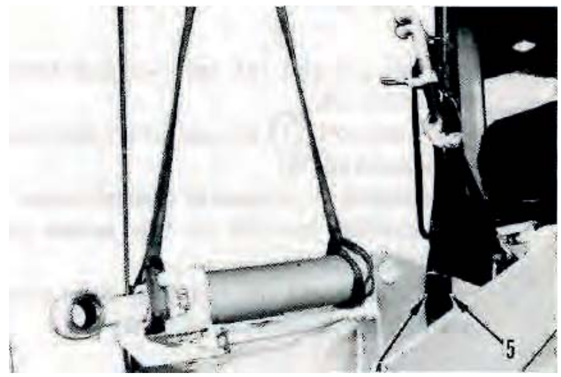
INSTALLATION OF DUMP CYLINDER

1. Dump cylinder

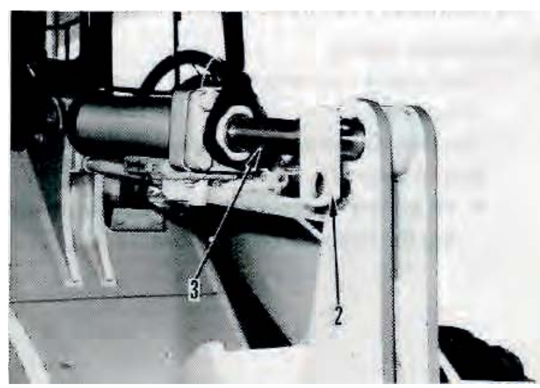


1) Raise dump cylinder (8) and set in mounting position.
2) Align pin hole at bottom end, assemble shim so that total clearance 'a' between cylinder and frame is within specified range, then install pin (7) and lock with bolt.
Clearance ‘a’: **less than 1.5 mm**





2. Hydraulic piping



1) Connect tube and hose (5) at bottom end.
2) Connect hose (4) at rod end.
- ★ Fit the O-rings securely in the grooves.
- ★ Install the hose without twisting or interference.

3) Start engine, and operate control levers to extend rod (3), then align pin hole.
4) Align pin hole, install pin {2}, then lock with bolt.

⚠ Use a bar to align the pin holes. Never use your-fingers.

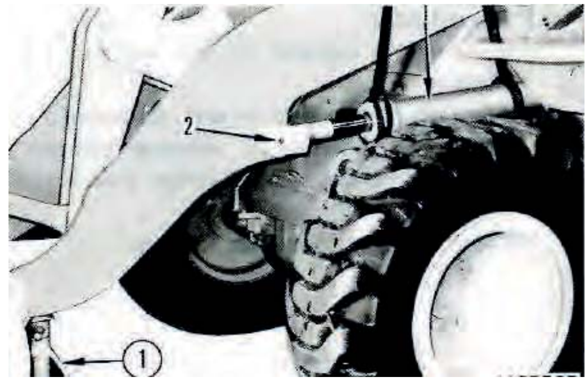
3. Bucket positioner (OPTIONAL)

Connect connector (1).
1) For details of adjusting bucket positioner, see
2) TESTING AND ADJUSTING.
3) Install wiring clamps and brackets.

REMOVAL OF LIFT CYLINDER

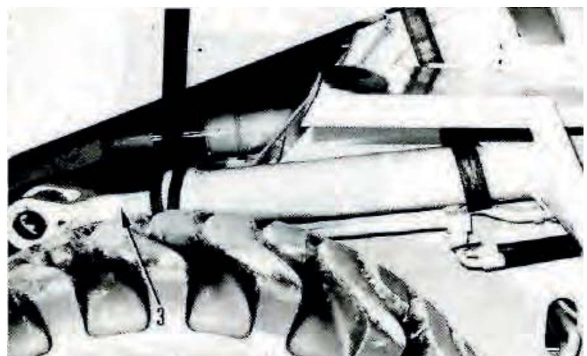
Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

Loosen the oil filler cap to relieve the pressure in the hydraulic oil tank, and then operate the control lever 2 or 3 times to eliminate the residual pressure in the piping.



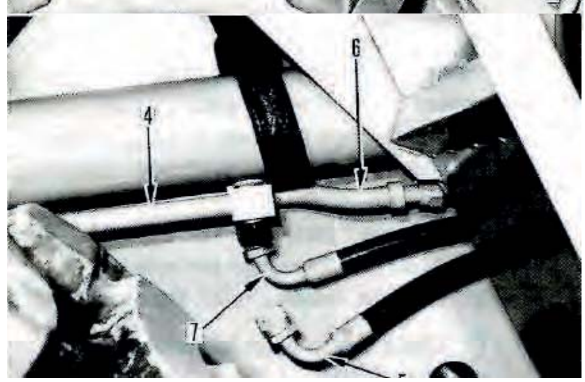
1. Rod pin

1) Sling lift cylinder (1), remove lock bolt, then remove pin (2). Set support (1) on end of lift arm that was removed pin (2).
2) Start engine, and operate control levers to retract cylinder rod (3) on side where pin has been removed. Do not retract the rod fully. Stop about 20 mm from the end of the stroke.



2. Hydraulic piping

1) Disconnect rod end tube (4) from connection of hose (5).
2) Disconnect bottom end tube (6) from connection of hose (7). Fit covers to prevent dirt or dust from entering the hoses or connections.



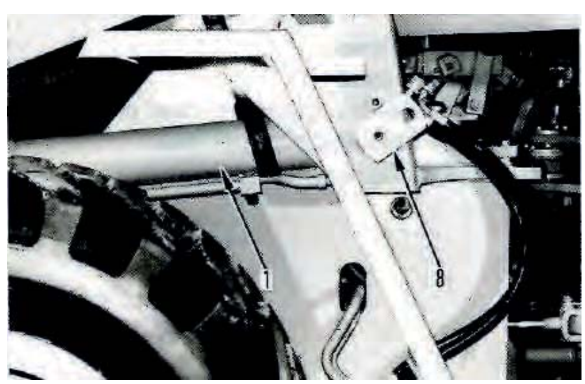
3. Lift cylinder

1) Remove lock bolt, then remove pin (8) at bottom end. When shims are installed, check the number and thickness of the shims, and keep in a safe place.
2) Liftoff left cylinder (1).

  ⋆ Be careful of the center of gravity, and remove slowly.

  ⋆ Be careful not to damage the cylinder rod.

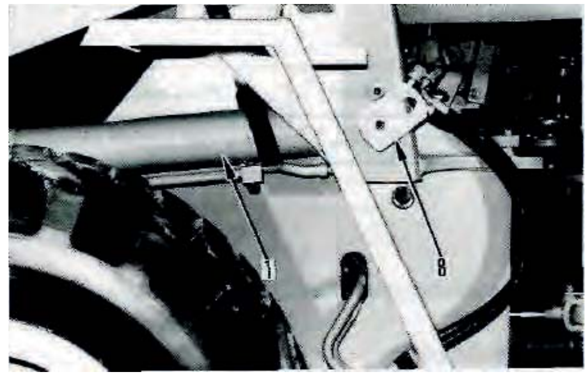
kg Lift cylinder: **80 kg**



INSTALLATION OF LIFT CYLINDER

1. Lift cylinder

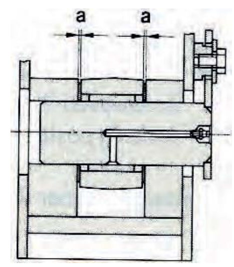
1) Sling lift cylinder (1) and set in mounting position.



2) Align pin hole at bottom end, assemble shim so that total clearance 'a' between cylinder and frame is within specified range, then install pin (8) and lock with bolt.

Use a bar to align the pin holes. Never use your fingers.

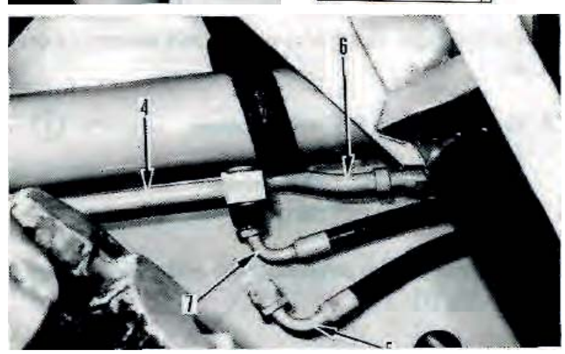
Clearance ‘a’: **less than 1.5 mm**



2. Hydraulic piping

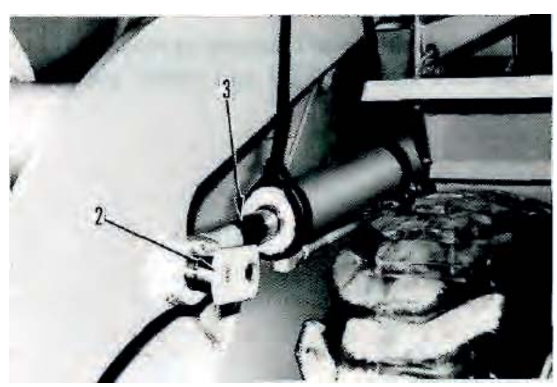
1) Connect tube (6) and hose (7) at bottom end.
2) Connect tube (4) and hose (5) at rod end.

- ⋆ Fit the O-rings securely in the grooves.
- ⋆ Install the hoses without twisting interference.
- ⋆ Hose nut width across the flat: **36 mm**



3. **Rod pin**

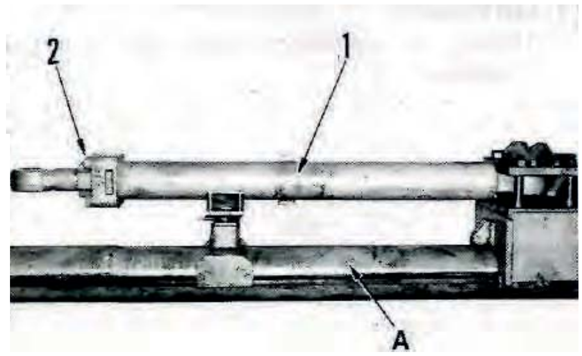
Start engine and operate control fevers to extend rod (3). Align pin hole, install pin (2), then lock with bolt.



DISASSEMBLY OF DUMP CYLINDER

Special tool

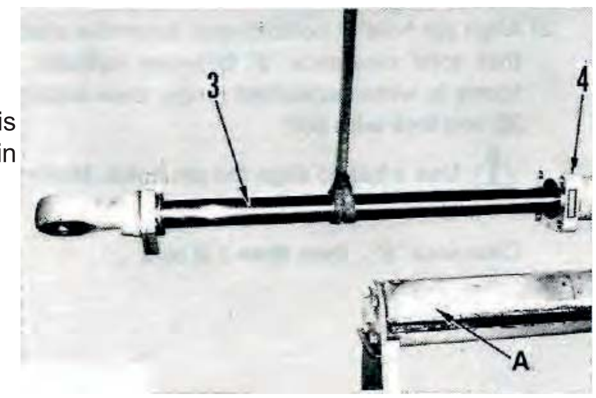
	Part number	Part name	Q'ty
A	790-502-1001	Cylinder repair stand	1



1. Set cylinder assembly (1) on tool **A**.

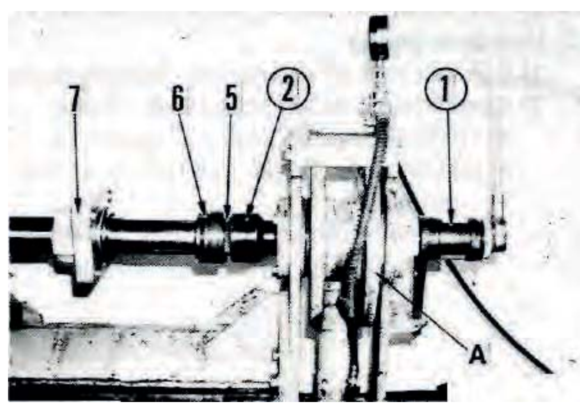
2. Remove piping.

3. Remove mounting bolts (2) of cylinder head.



4. Pull cylinder head and piston rod assembly (3} out of cylinder (4) and lift off.
- ⋆ Oil will come out when the piston rod assembly is removed from the cylinder, so place a container in position to catch the oil.

5. Remove cylinder (4) from tool **A**.



6. Set cylinder head and piston rod assembly on tool **A**.

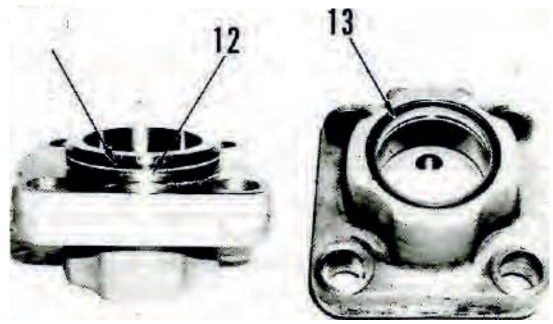
7. Remove nut (5) with power wrench (1) and socket (2).
- ⋆ Power wrench: **16 times**
- ⋆ Width across flats of socket: **80 mm**

8. Remove piston assembly (6) and cylinder head assembly (7).

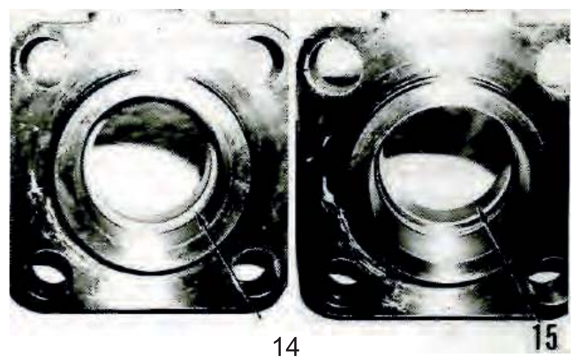
9. Disassemble piston assembly as follows:
Remove wear ring (8) and piston ring (9) from piston (10).

10. Disassemble cylinder head assembly as follows:

1) Remove O-ring (11) and backup ring (12).
2) Remove snap ring, then remove dust seal (13).



3) Remove rod packing (14).
4) Remove bushing (1 5).



ASSEMBLY OF DUMP CYLINDER

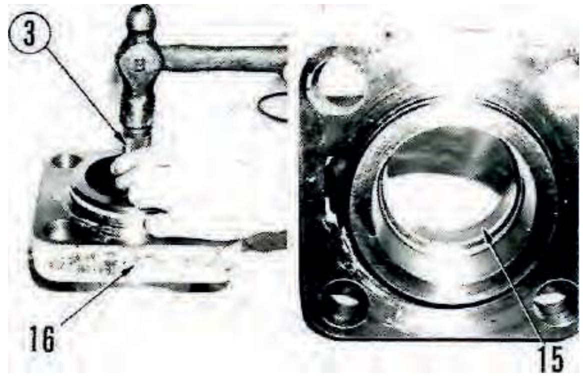
Special tools

	Part name	Q'ty
A	Cylinder repair stand	1
B	Expander	1
C	Ring	1

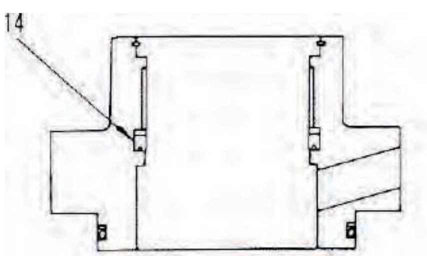
★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing. Be careful not to damage U-packing, dust seals or O-rings when installing.

1. Assemble cylinder head assembly as follows.

1) Using push tool (3), press fit bushing (15) on cylinder head (16).
   ★ Be careful not to deform the bushing when press fitting.



2) Assemble rod packing (14).
   ★ Be careful to install the rod packing facing in the right direction.



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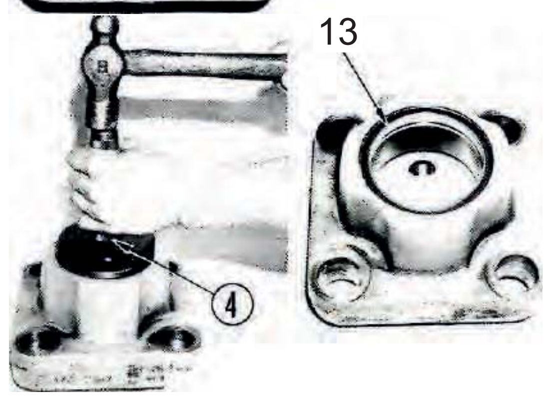
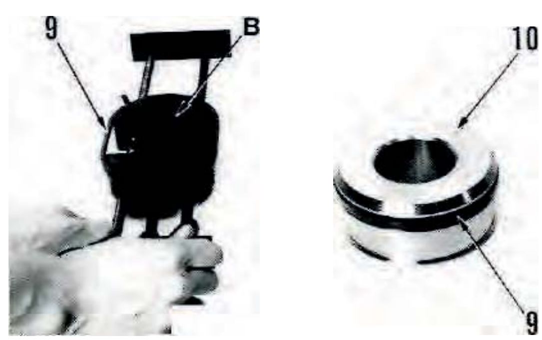
3) Install backup ring (12) first, then O-ring (11).
   ★ Do not try to force the backup ring into position. Warm it in warm water (50 to 60°C) before fitting it.

4) Using push tool (J), install dust seal (13) on cylinder head, then secure with snap ring.



2. Assemble piston assembly as follows.

1) **Using tool B**, expand piston ring (9).
   * Set the piston ring on the tool **C** and turn the handle 8 to 11 times to expand the ring.
2) Remove piston ring (9) from tool **B** and assemble on piston (10).
3) Fit tool **C** on piston ring and compress piston ring with clamp (5).
4) Assemble wear ring (8) on piston

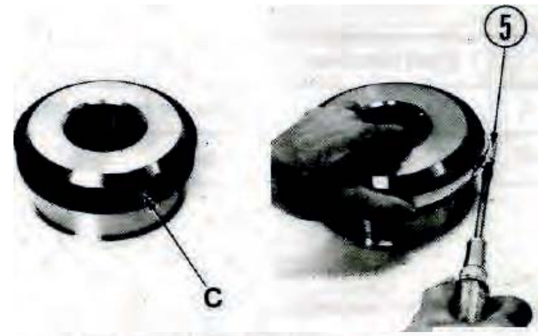


3. Set piston rod (17) in tool **A**.

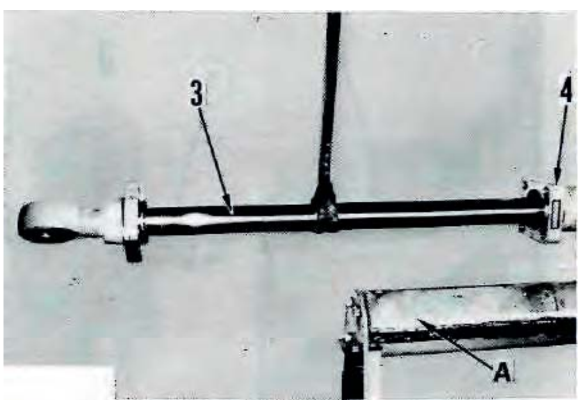
4. Assemble cylinder head assembly (7) and piston
assembly (6).

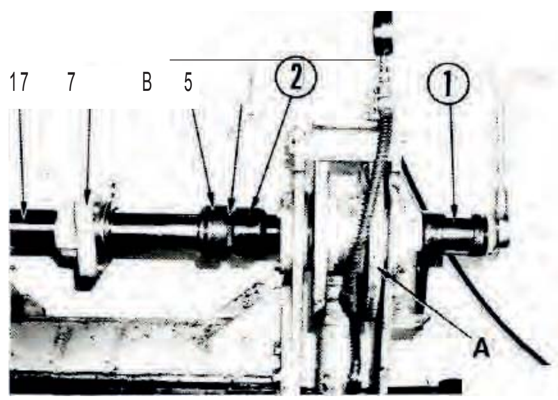
5. Using power wrench (1) and socket (2), tighten
nut (5).

★ Width across flats of socket: **80 mm** kgm Nut: **405+40.5 kgm**



6. Set cylinder (4) in tool **A**, then raise cylinder head and piston rod assembly (3) and install in cylinder (4).





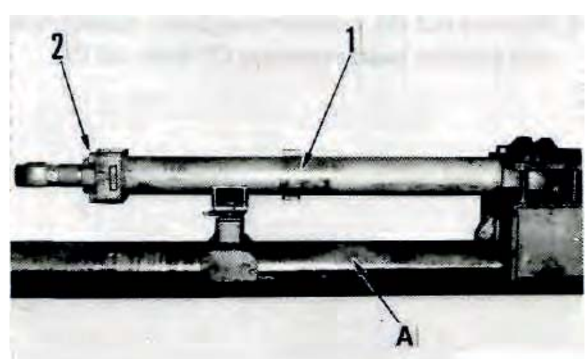
7. Tighten mounting bolt (2) of cylinder head.

kgm Cylinder head mounting bolt:

85±10kgm

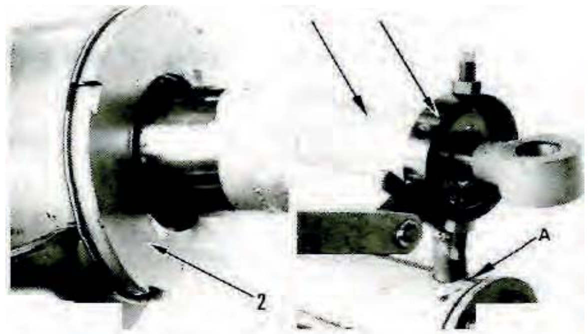
8. Fit O-ring and install piping.

9. Remove cylinder assembly (1) from tool **A**.



DISASSEMBLY OF LIFT CYLINDER

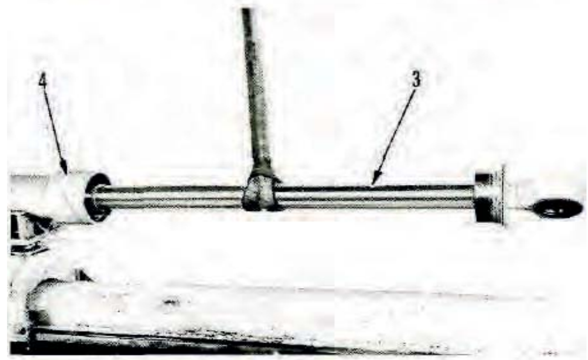
1. Set cylinder assembly (1) on tool **A**.
2. Straight lock tab of cylinder head (2), then using tool **B**, remove cylinder head (2} from cylinder.



3. Pull cylinder head and piston rod assembly (3) from cylinder (4) and lift off.

★ Oil will come out when the piston rod assembly is removed from the cylinder, so have a container ready.

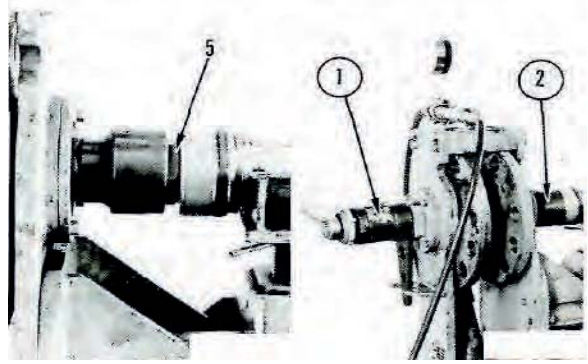
4. Remove cylinder (4) from tool **A**.



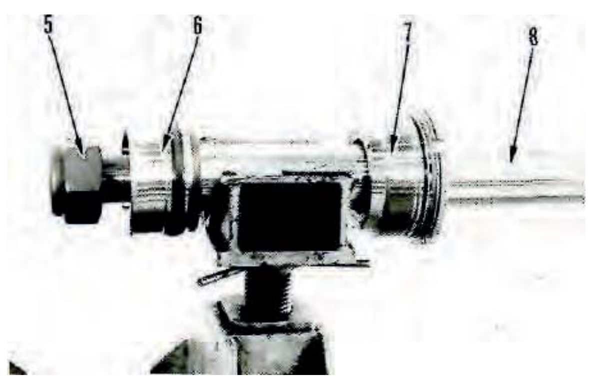
5. Set cylinder head and piston rod assembly (3) on tool **A**, and loosen nut (5) with power wrench (1) and socket (2).

★ Power wrench: **16 times**

★ Width across flats of socket (2): **80 mm**



6. Remove nut (5), then remove piston assembly (6) and cylinder head assembly (7) from rod (8).



7. Disassemble piston assembly as follows:

1) Remove wear ring (9).

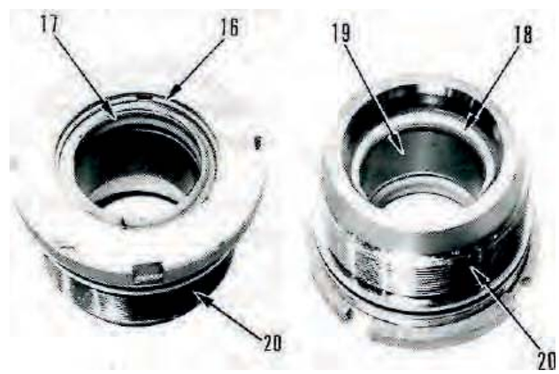
2) Remove piston ring (1 0) from piston (11).

8. Disassemble cylinder head assembly as follows:

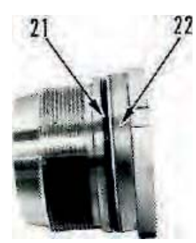
1) Remove snap ring (16), then remove dust seal (17).

2) Remove rod packing (18).

3) Remove bushing (19} from cylinder head (20).

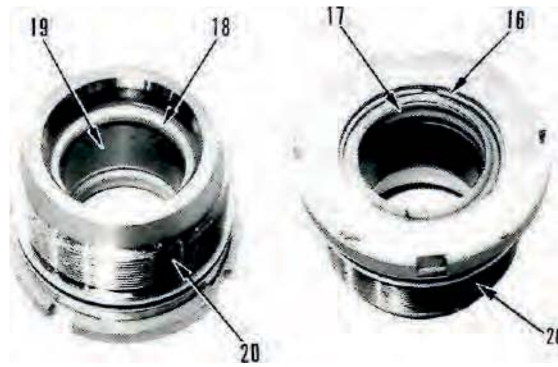


4) Remove O-ring (21) and backup ring (22).



ASSEMBLY OF LIFT CYLINDER

⋆ Coat the sliding surface of all parts with engine oil. Take care not to damage rod packings, dust seals or O-ring, then install nut.



1. Assemble cylinder head assembly as follows;

1) Using a push tool, press fit bushing (19) on cylinder head (20).

⋆ Take particular care not to deform the bushing when press fitting.

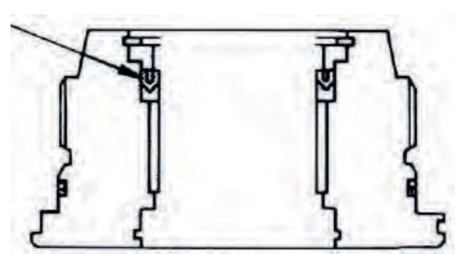
2) Assemble rod packing (18).

⋆ Be careful to install the rod packing facing in the correct direction.

3) Using a push tool, install dust seal (1 7) on head (20).

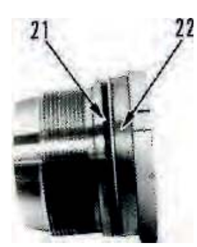
4) Install snap ring (16).

Rod packing



5) Install backup ring (22) and O-ring {21).

⋆ Do not force backup ring. Heat in hot water (50-60°C) before inserting.



2. Assemble piston assembly as follows;

1) Using tool **C**, expand piston ring (10).

★ After setting the piston ring in tool **C**, rotate the handle 8 to 10 times to expand.

2) Remove piston ring (10) from tool **C** and assemble on piston (11).

3) Fit tool **D** on piston ring and compress piston ring with clamp (3)

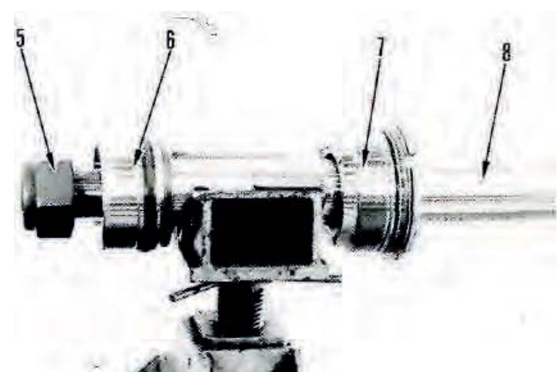
★ Parts No. of clamp (I) 07281-01589

4) Assemble wear ring (9).

10

3. Set piston rod (8) in tool **A**.

4. Assemble cylinder head assembly (7) and piston assembly (6) on rod, then install nut (5).

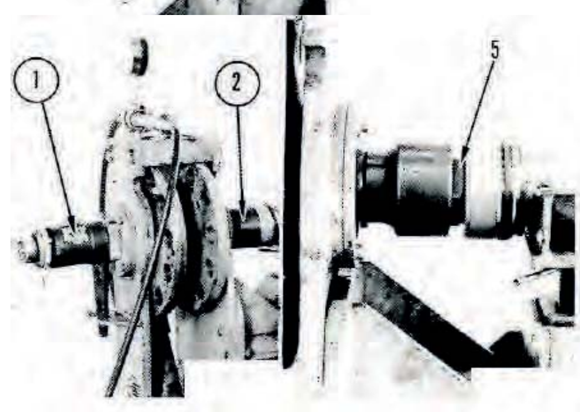


5. Using power wrench (1) and socket (2), tighten nut (5) to the following specified torque;

★ Power wrench: **16 times**

★ Width across flats of nut: **80 mm**

kgm Nut: **405±40.5kgm**



6. Remove piston rod and cylinder head assembly (3) from tool **A**.

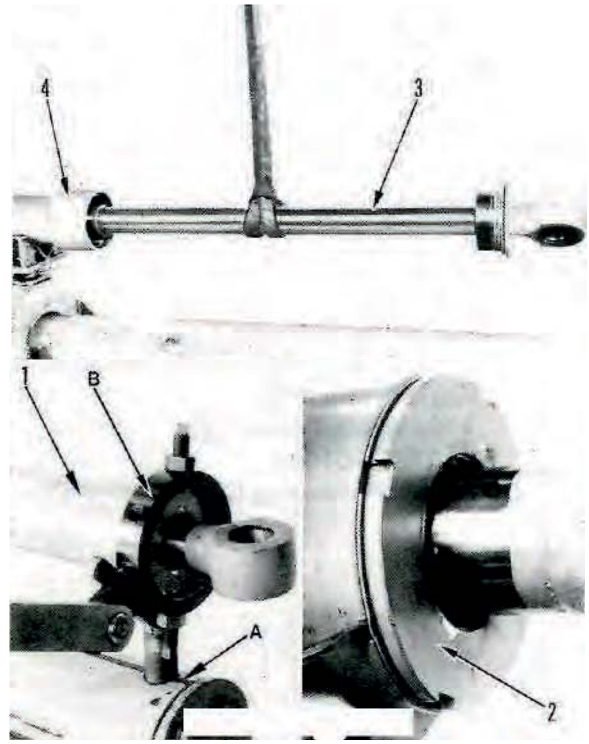
7. Set cylinder (4) in tool **A**.

8. Sling piston rod and cylinder head assembly (3) and install in cylinder (4).

9. Using tool **B**, tighten cylinder head (2).

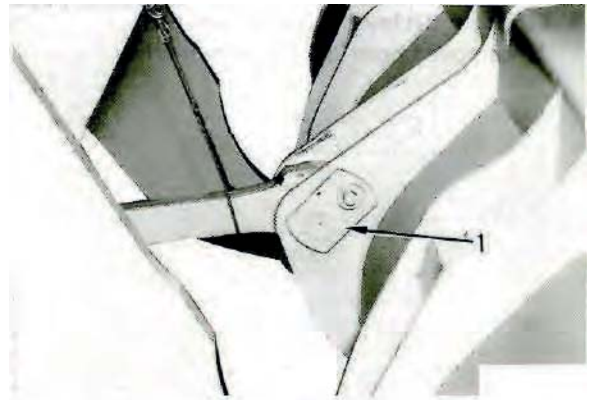
   kgm Cylinder head: **100±10kgm**

10. Bend lock into notch on cylinder.
11. Remove cylinder assembly (1) from tool **A**.



REMOVAL OF WORK EQUIPMENT

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.



1. Bucket link

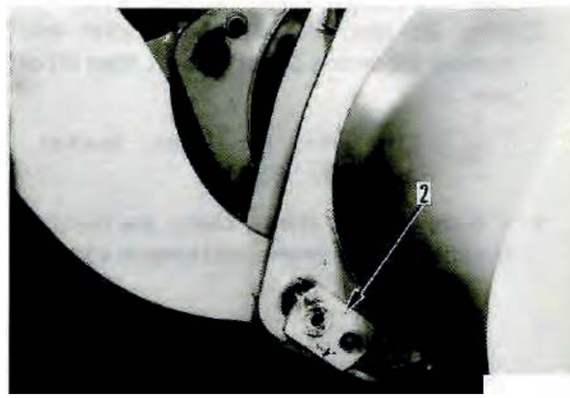
1) Remove mounting pin (1) of bucket link.

★ Tie the bucket link to the tilt lever with wire.

2) Remove mounting pins (2) of bucket hinge.

⚠ Do not put your fingers in the pin hole.

3) Drive machine in reverse to disconnect bucket.



2. Dump cylinder mounting pin

Sling dump cylinder (3), remove pin (4), then disconnect cylinder rod and tilt lever.

★ Insert a block *(J)* between the cylinder bottom and frame.

kg Dump cylinder: **77 kg**

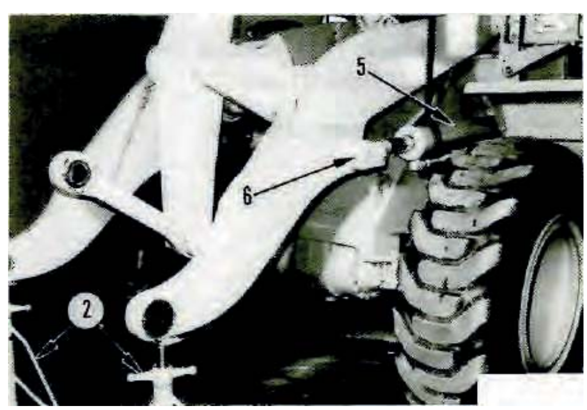
3. Lift cylinder pin

Sling lift cylinder (5), then remove mounting pin (6).

★ Place a support under the tip of the lift arm.

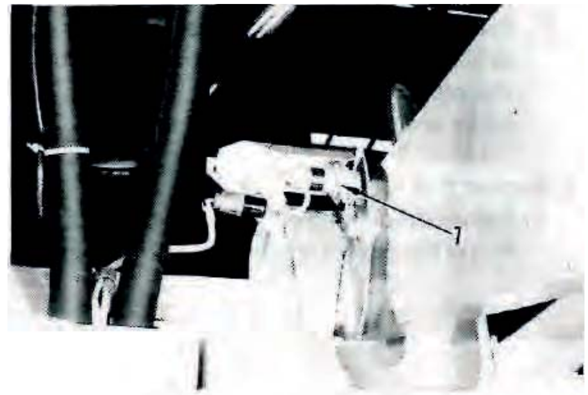
★ Place a block *(2)* on top of the axle, and lower the cylinder onto it.

kg Lift cylinder: **80 kg**



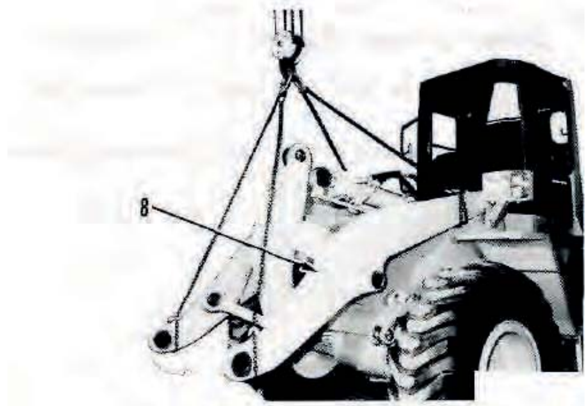
4. Lift arm, tilt lever, bucket link

1) Remove boom kick out switch (7) (if provided).



2) Sling lift arm, tilt lever and bucket link (8), remove mounting pin of lift arm, then lift off lift arm.

kg Lift arm, tilt lever, bucket link assembly: **833 kg**

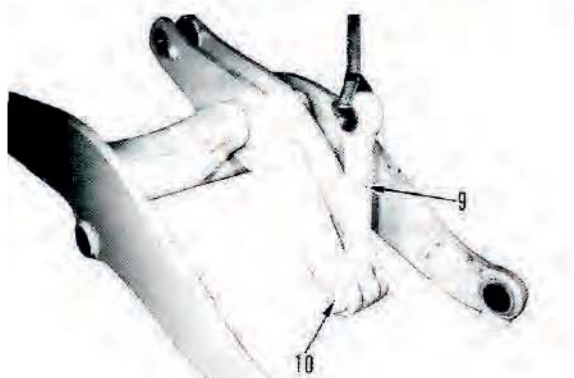


- If there are any shims, check the number and thickness of the shims, and keep in a safe place.

5. Tilt lever, bucket link

1) Sling bucket link (9), remove mounting pin (10), and then remove bucket link from tilt lever.

kg Bucket link: **35.5 kg**

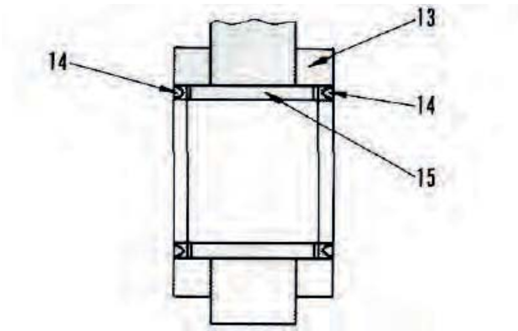


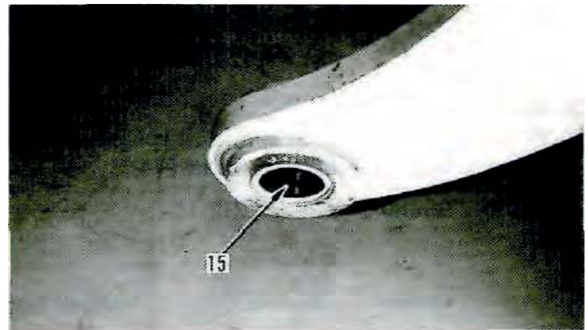
2) Sling tilt lever (11), remove mounting pin (12), and then lift off from lift arm.

kg Tilt lever: **150 kg**

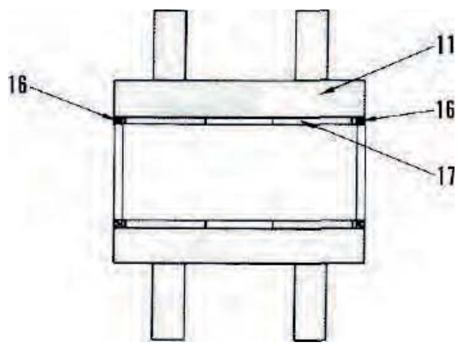
6. Dust seal, bushing

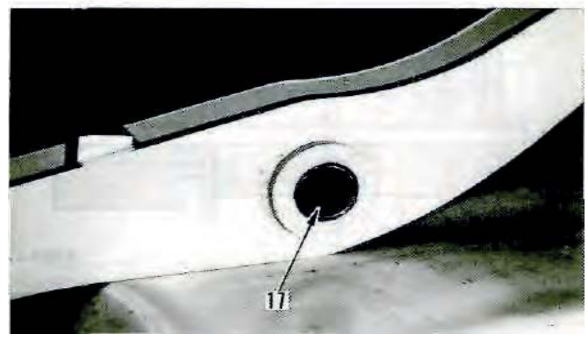
1) Remove dust seal (14) and bushing (15) from lift arm (13).



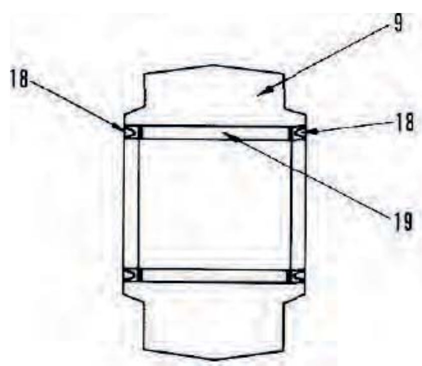


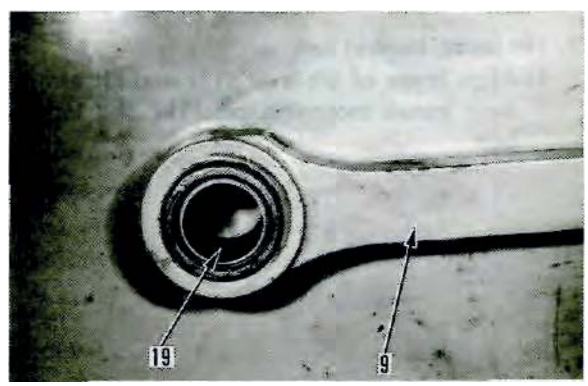
2) Remove dust seal (16) and bushing (17) from tilt lever (11).





3) Remove dust seal (18) and bushing (19) from bucket link (9).





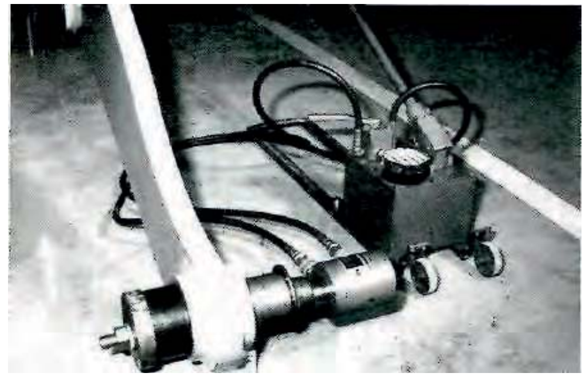
INSTALLATION OF WORK EQUIPMENT

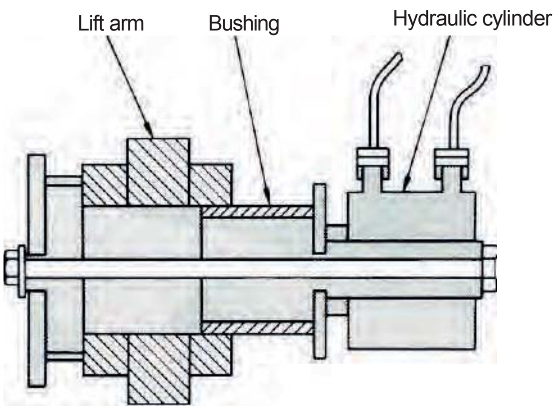
⚠ Use a bar to align the pin holes. Never use your fingers.

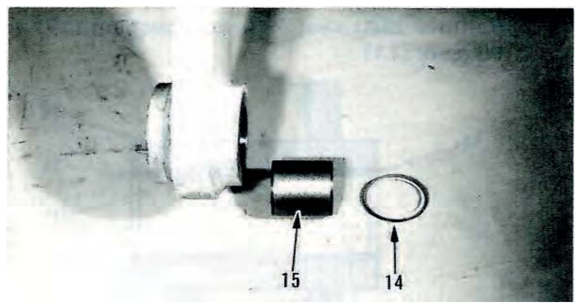
1. Dust seal, bushing

Press fit bushings (1 5) in bucket link, tilt lever, and lift arm, then assemble dust seal (14).

Bushing: Grease (G2-LI)

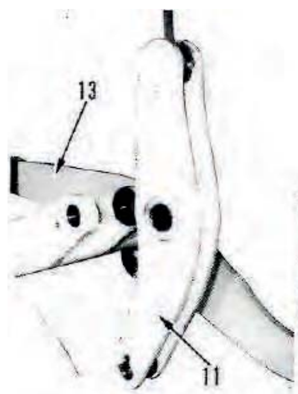






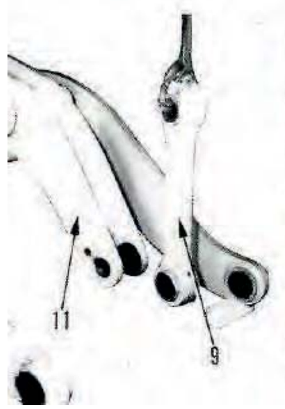
2. Tilt lever, bucket link

1) Align holes of tilt lever (11) and lift arm (13), then install mounting pin (12) and lock with bolt



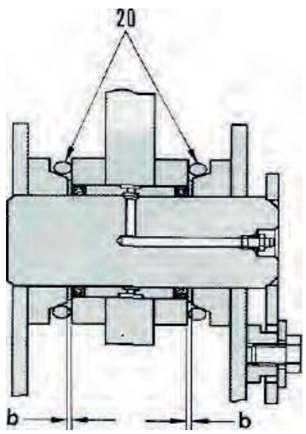
2) Assemble cord ring on bucket link (9), align holes of tilt lever (11), then install pin (10) and lock with bolt.

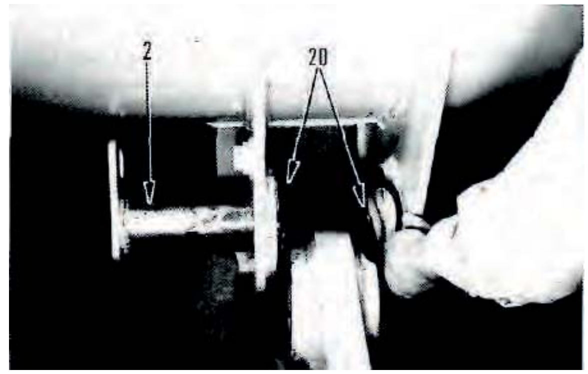
- ⋆ Tie the bucket link to the tilt lever with wire.
- ⋆ Be careful not to let the cord ring get caught when installing.



3. Bucket

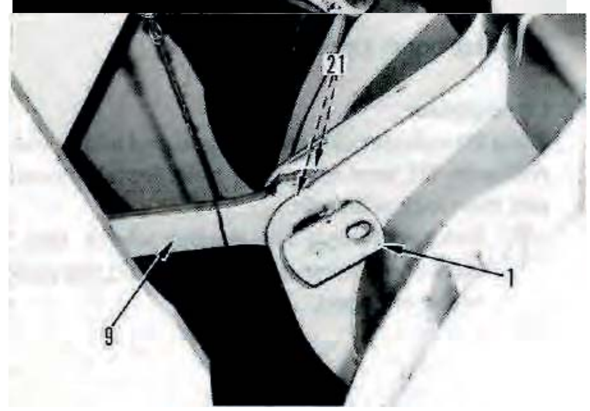
1) Operate control lever to align hole of bucket mounting pin (2). Install cord ring (20) and assemble shim so that clearance 'b' on left and right is equal, then install mounting pin and lock with bolt.
   - ⋆ Be careful not to let the cord ring get caught when installing.
   - ⋆ Clearance 'b': **less than 1.5 mm**

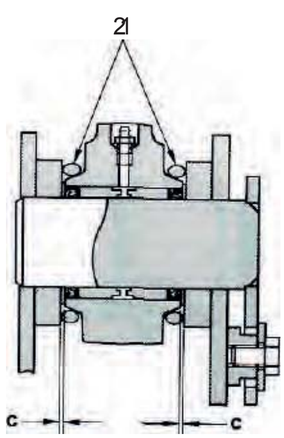




4. Bucket link

1) Align hole of mounting pin (1) of bucket link (9). Install cord ring (21) and assemble shim so that clearance 'c' on left and right is equal, then install mounting pin, and lock with bolt.
   - ⋆ Be careful not to let the cord ring get caught
     when installing.
   - ⋆ Clearance 'c': **Less than 1.5 mm**





5. Greasing

Grease all pins.

REMOVAL OF COUNTERWEIGHT

Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

1. Disconnect wiring connector , and remove light plate .

- ⋆ First remove grill.

2. Sling counterweight ,remove mounting bolts, and then lift off counterweight.

- ⋆ Be careful to maintain the balance when removing the counterweight.

kg Counterweight: 700 kg

- ⋆ Be careful not to damage the lamps when removing the counterweight.

INSTALLATION OF COUNTERWEIGHT

1. Counterweight

Raise counterweight , set in mounting position, and then tighten mounting bolts.

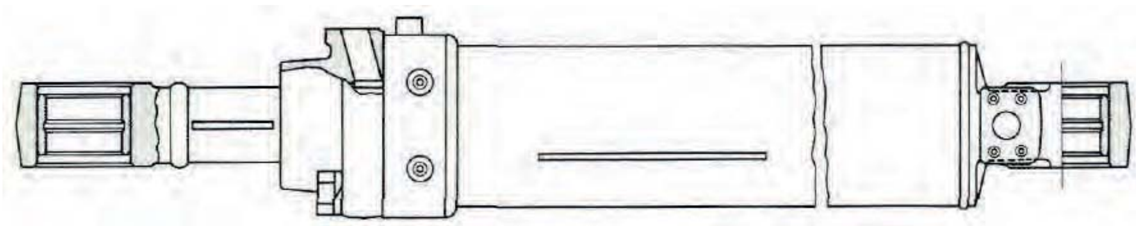
- ⋆ When setting in the mounting position, be care full not to damage the lamps.

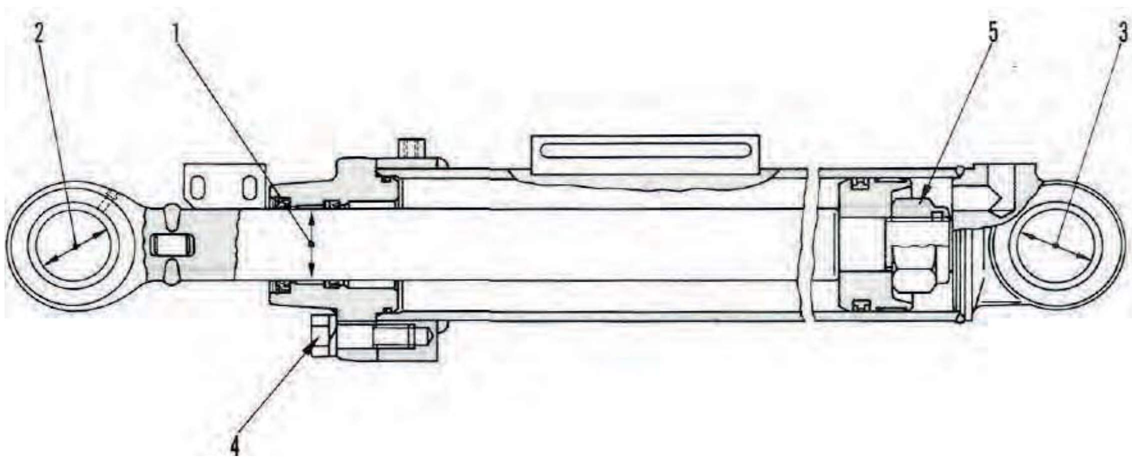
2. Set light plate in mounting position, connect wiring connector , and then secure light plate with mounting bolts

- ⋆ Mount grill (if provided).

20 WORK EQUIPMENT SYSTEM MAINTENANCE STANDARD

DUMP CYLINDER

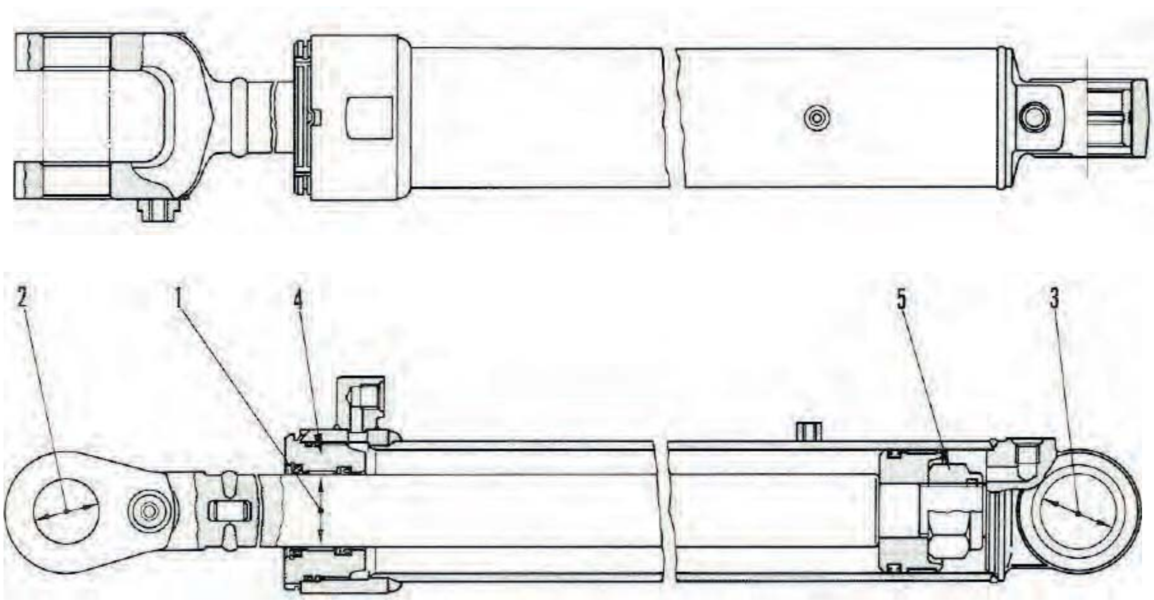




No.	Check item	Criteria					Remedy
1	Clearance between rod and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		70	-0.100 -0.174	+0.278 +0.061	0.445 - 0.161	0.745	
2	Clearance between piston rod mounting pin and bushing	70	-0.036 -0.090	+0.290 +0.100	0.130 - 0.366	1.0	
3	Clearance between cylinder bottom mounting pin and bushing	70	-0.036 -0.090	+0.290 +0.100	0.130 - 0.366	1.0	
4	Tightening torque of cylinder head mounting bolt	155 + 40 kgm					Retighten
5	Tightening torque of piston mounting bolt	405 + 40.5 kgm					

Unit: mm

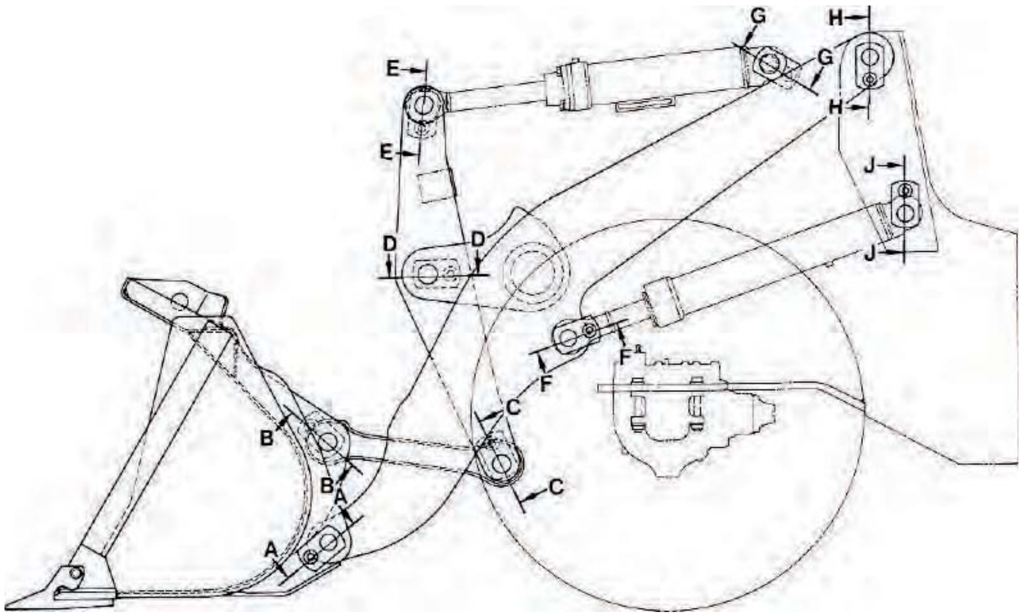
LIFT CYLINDER

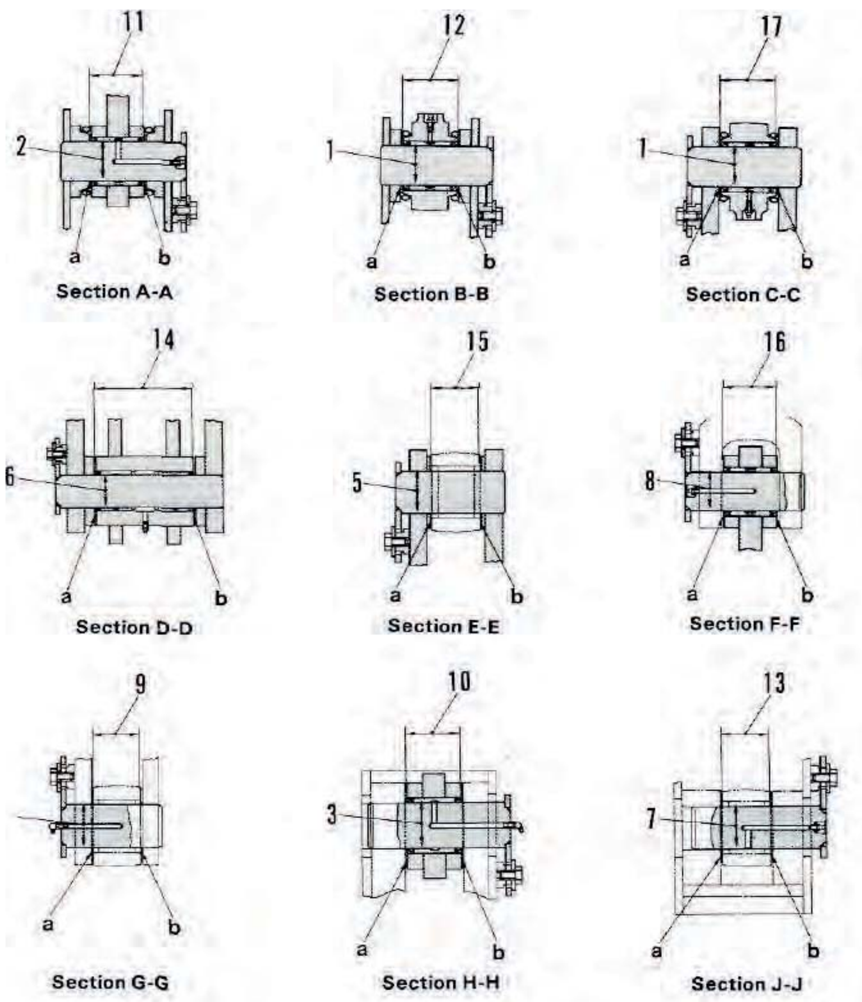


Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between rod and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		70	-0.100 - 0.174	+0.271 + 0.061	0.445 -0- 161	0.745	
2	Clearance between piston rod mounting pin and inside diameter of hole	65	-0.030 - 0.076	+0.174 + 0.100	0.130 - 0.250	1.0	Replace
3	Clearance between cylinder bottom mounting pin and bushing	70	-0.030 – 0.076	+0.290 + 0.100	0.130 - 0.366	1.0	Replace bushing
4	Tightening torque of cylinder head mounting bolt	100±10kgm					Retighten
5	Tightening torque of piston mounting bolt	405±40.5 kgm					

BUCKET LINKAGE





Unit: mm

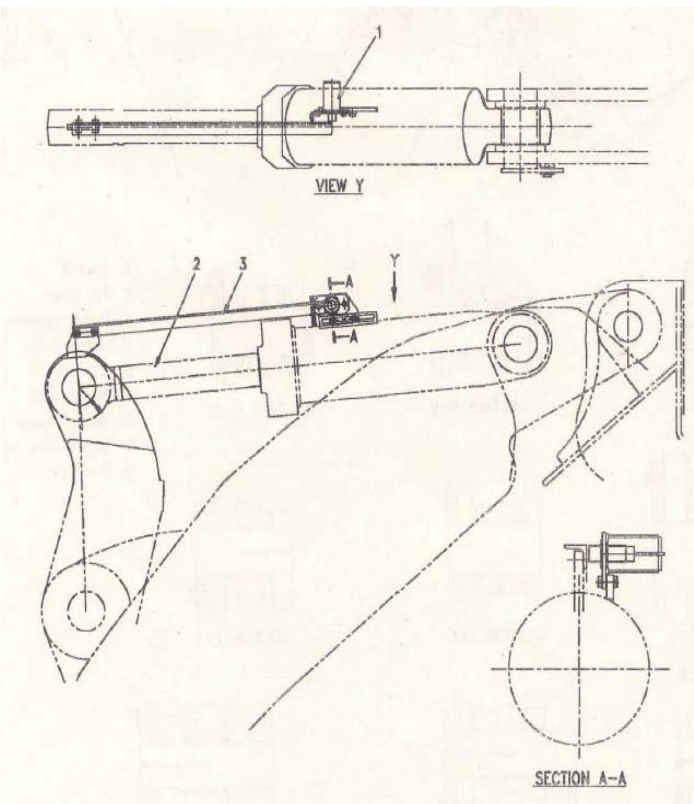
No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	learance limit	
			Shaft	Hole			
1	Clearance between pin and bushing at boss ends of bucket link	65	-0.030 - 0.076	+ 0.174 + 0.100	0.130 - 0.250	1.0	Replace also of other parts are
2	Clearance between pin and bushing at joint of lift arm and bucket	65	-0-030 - 0.076	+ 0.174 + 0.100	0.130 - 0.250	1.0	
3	Clearance between pin and bushing at joint of lift arm and frame	75	-0.036 - 0.090	+ 0-174 + 0.100	0.130 - 0.250	1.0	
4	Clearance between pin and bushing at joint of bucket cylinder bottom and frame	70	-0-036 - 0.090	+ 0.290 + 0.100	0.130 - 0.366	1.0	
5	Clearance between pin and bushing at joint of bucket cylinder rod and lever	70	-0.036 - 0.090	+ 0.290 + 0.100	0.130 - 0.366	1.0	
6	Clearance between pin and bushing at joint of tilt lever and lift arm	70	-0.036 - 0.090	+ 0.174 + 0.100	0.13 - 0.25	1.0	
7	Clearance between pin and bushing at joint of lift cylinder bottom and frame	70	-0.030 - 0.076	+ 0-290 + 0.100	0-130- 0.366	1.0	
8	Clearance between pin and bushing at joint of lift cylinder rod and lift arm	65	-0.030 - 0.076	+ 0.174 + 0.100	0.130- 0.250	1.0	

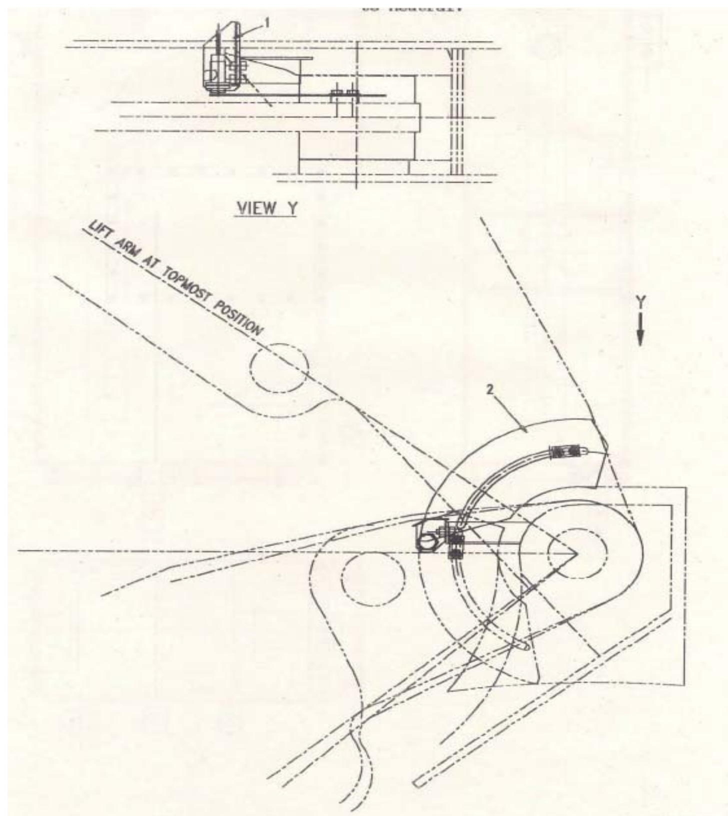
No.	Check item	Width between bosses	Width of hinge	Standard clearance (clearance a + b)	Remedy
9	Joint of bucket cylinder and frame	75 + 0.8 0	78+1.5	+ 0.7 - +4.5	Insert shims on both sides to make clearance on both left and right sides less than 1.5 mm
10	Joint of lift arm and frame	85+1.8	88 +J-5	+ 1.2 - +6.3	
11	Joint of lift arm and bucket	85+1.8	88 + 3	+ 1.2 - +7.8	
12	Joint of bucket link and bucket	85-0.8	88 +3 0	+ 0.2 - +6.8	
13	Joint of lift cylinder and frame		78+1.5 0	+ 2.2 - +4.5	
14	Joint of bell crank and lift arm		89.5+1-5	+ 0.2 - +6.8	
15	Joint of bucket cylinder and bucket lever	201+0.5	204+1.5	+ 1 - +5	
16	Joint of lift cylinder and lift arm	75+0.8 0	77.5+1.5	+ 0-2 - 4	
17	Joint of bell crank and bucket link	85+1.8	89 + 0.8	+ 1.4 - 6.6	

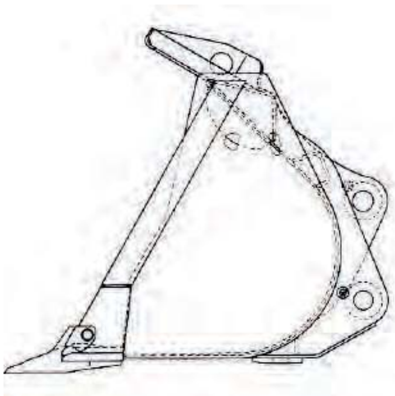
BUCKET POSITIONER AND BOOM KICK-OUT (OPTIONAL)

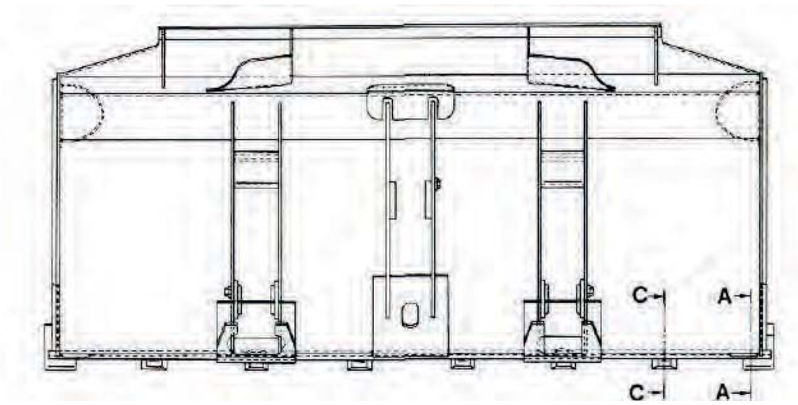
Unit: mm

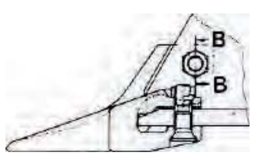
No.	Check item	Criteria	Remedy
1	Clearance of bucket positioner switch	5-8	Adjust
2	Clearance of boom kick-out switch	5-8	
3	Tightening torque of mounting bolt for adjuster	9.0±3 5 kgm	Retighten
4	Tightening torque of mounting bolt for bucket wear plate	1.8 + 0.2 kgm	





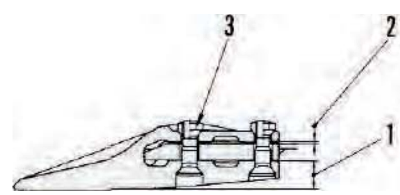






Section A-A

Section B-B

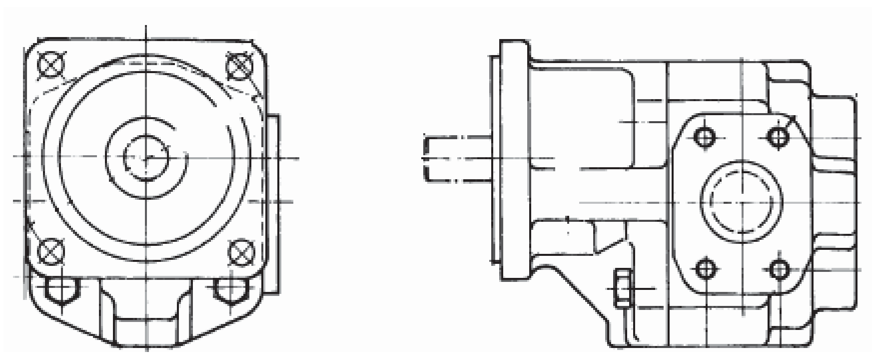


Section C-C

Unit: mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Wear of bucket tooth	35	13	Replace
2	Clearance of bucket tooth mounting part	Less than 0.5		Replace or adjust
3	Tightening torque of mounting bolt for bucket tooth	1 15±5 kgm		Retighten
4	Tightening torque of mounting bolt for bucket side tooth	115±5 kgm		

HYDRAULIC PUMP



Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td>1</td><td>Clearance between gear case and side plate, gear</td><td colspan="2">Model</td><td colspan="2">Standard clearance</td><td>Clearance limit</td><td>Replace</td></tr>
<tr><td></td><td></td><td colspan="2">GXP 10 COC 80
ABL-2X</td><td colspan="2">0.10-0.15</td><td>0.19</td><td></td></tr>
<tr><td>2</td><td>Clearance between inside diameter of plain bearing and gear shaft outside</td><td colspan="2"></td><td colspan="2">0.06 - 0.125</td><td>0.20</td><td></td></tr>
<tr><td>3</td><td>Insertion depth of pin</td><td colspan="5">1«-8.6</td><td></td></tr>
<tr><td>4</td><td>Rotating torque of spline shaft</td><td colspan="5">0.5 - 1.5 kgm</td><td>-</td></tr>
<tr><td>5</td><td>Tightening torque of bolt</td><td colspan="5">11.5±1.0kgm</td><td>Retighten</td></tr>
<tr><td rowspan="3"></td><td rowspan="3">Discharge Oil: EO-CD

Temperature: 45 — 55°C</td><td>Model</td><td colspan="2">Revolution (rpm)</td><td>Discharge pressure (kg/cm2)</td><td>Standard displacement (cc)</td><td>-</td></tr>
<tr><td>GXP 10
COC 80
ABL -2X</td><td colspan="2">2500</td><td>210</td><td>80</td><td></td></tr>
<tr><td></td><td colspan="2"></td><td></td><td></td><td></td></tr>
</table>

21 ELECTRIC AND ELECTRONIC SYSTEM
STRUCTURE AND FUNCTION

ELECTRIC AND ELECTRONIC SYSTEM

OUTLINE

The BL200-1 is equipped with electric and electronic systems as shown in Fig. 418F104 and Fig.419F150.

These systems can be broadly divided into the following two groups.

1. The “Electric system" which is found on most vehicles.
2. The "Electronic vehicle monitoring system", which detects and shown any abnormalities in the machine.

ENGINE STARTING CIRCUIT

OPERATION

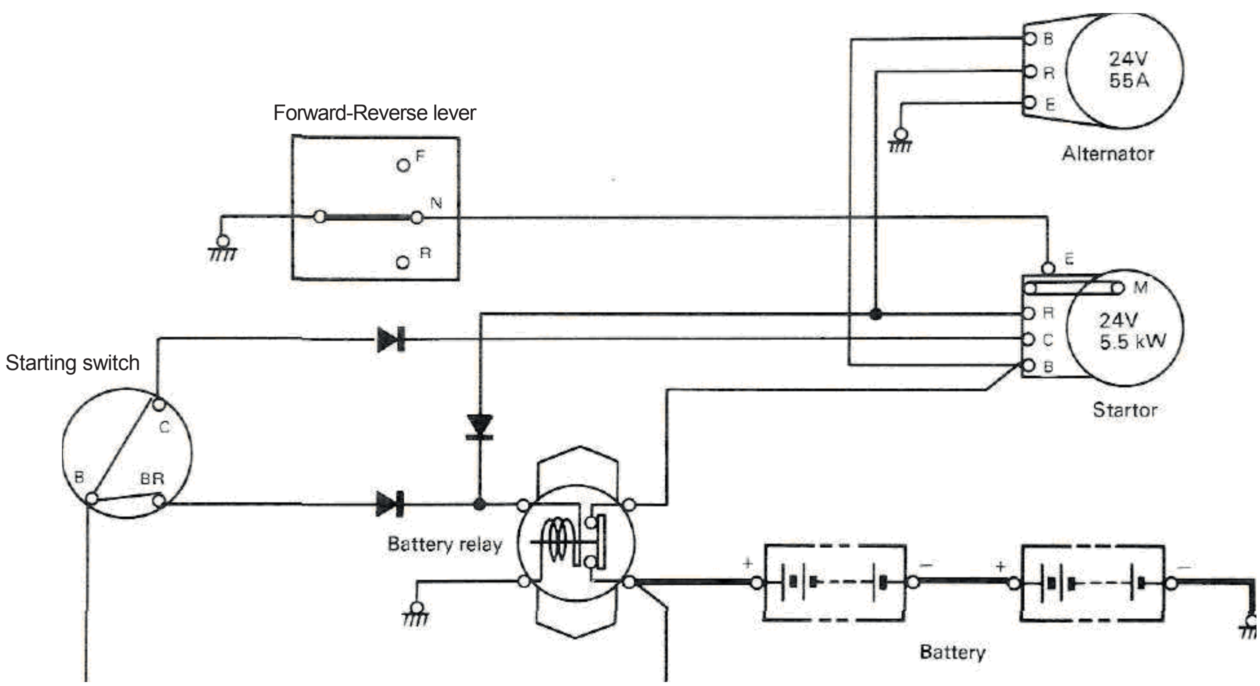
When the FORWARD-REVERSE lever is placed at **N** (neutral), the neutral contacts of the direction lever switch are closed. When this happens and the starting switch is turned to START, electric current flows in the following circuit.

(1) Battery (+) → Starting switch terminal **B** → starting switch terminal **C** → safety relay terminal **S** → safety relay terminal **E** → terminal **N** of direction lever switch → ground connection.

When this happens, the safety relay is actuated and following circuit is formed.

(2) Battery (+) → battery relay → starting motor terminal **B** → safety relay terminal **B** → safety relay terminal **C** → starting motor terminal **C**. The engine then starts.

If the FORWARD-REVERSE lever is any in position except **N** (neutral), the circuit in (1) is not formed, so the engine does not start.



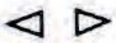
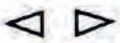
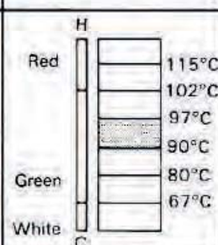
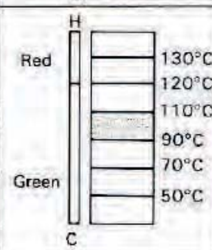
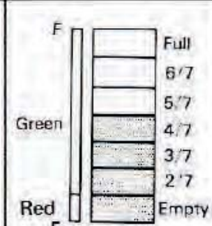
ENGINE STOP

To stop the engine the stop lever has to be pulled.

After pulling the stop lever, turn the switch to off position

INDICATION ON MONITOR PANEL

Category	Symbol	Indication item	Indication range	Description
CHECKS BEFORE STARTING		Brake oil level	Below low mark	Displayed when starting switch is turned to ON with engine stopped. Display goes out when normal Display flashes when abnormal
		Engine oil level	Below low mark	
		Coolant level	Below low mark	
CAUTION 1		Battery charge	When charging is defective	Emergency steering actuated when operated Displays when engine is running Display goes out when normal Display flashes when abnormal and lamps flash at same time
		Fuel level	Below low mark	
CAUTION 2		Engine oil pressure	Below specified pressure	Emergency steering actuated when operated Displays when engine is running Display goes out when normal Display flashes when abnormal and lamps flash at same time
		Coolant level	Below low mark	
		Coolant temperature	Above 102°C	Displays when engine is running Display goes out when normal Display flashes when abnormal; buzzer and lamp actuated
		Torque converter oil temperature	Above 102°C	
PILOT		Parking brake	When operated	Displays when starting switch is turned ON; Lights up when operated
		Work lamp	When operated	
		Transmission cut-off	When operated	
		PREHEAT	When preheating	Displays when starting switch is turned ON; lights up during preheating

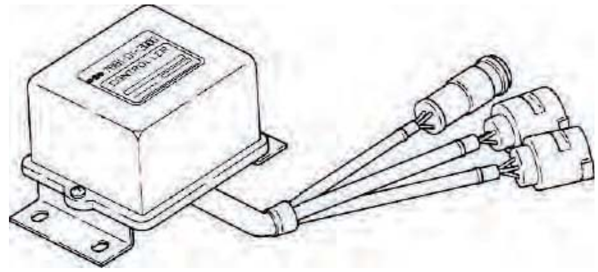
Category	Symbol	Indication item	Indication range	Description
SPEEDOMETER		Travel speed	0 — 100 km/h	Digital display
		High beam	When operated	Displays when starting switch is turned ON; Lights up when operated
		Winkers (right, left)	When operated	
		Hazard	When operated	Lights up when operated
SERVICE METER		Service meter	0 — 99999/h displayed	Actuated when engine oil pressure is normal Advances 1 for every hour of operation
		Service meter indicator		Flashes when service meter is operating
GAUGE		Coolant temperature		One lamp lights up to indicate level
		Torque converter oil temperature		One lamp lights up to indicate level
		Fuel level		All lamps light up below indicated level

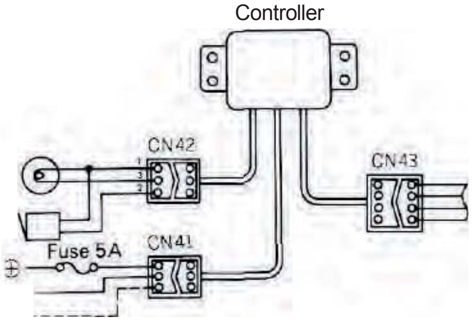
CONTROLLER (NOT APPLICABLE FOR THIS MODEL

FUNCTION

- The auxiliary controller acts as the power source box and provides electric power to the panel. The power source (battery, alternator) for the machine has a large difference in voltage, so the auxiliary controller converts this to a stable voltage and supplies it to the panel.

  Even if excessive voltage is generated by failure in the alternator or regulator, it is cut by the auxiliary controller.





SENSOR

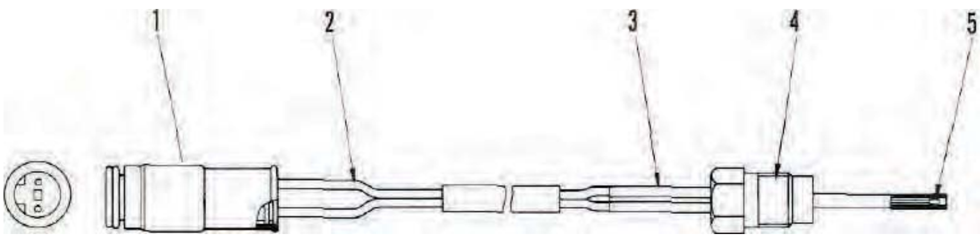
FUNCTION

- The signals from the sensors are directly input to the monitor panel. With contact type sensors, one side is always grounded to the chassis. When the contacts are closed, the panel recognizes the signal as a normal signal.

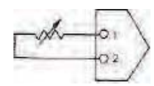
SENSOR ACTUATION TABLE

Check item	Sensor type	When normal	When abnormal
Brake oil level	Contact	OFF	ON
Fuel level	Resistor		
Engine oil pressure	Contact	OFF	ON
Coolant temperature	Resistor		
Torque converter oil temperature	Resistor		
Travel speed	GPS		

COOLANT TEMPERATURE, TORQUE CONVERTER OIL TEMPERATURE SENSOR



1. Connector
2. Wire
3. Tube
4. Plug
5. Thermistor (beat type)

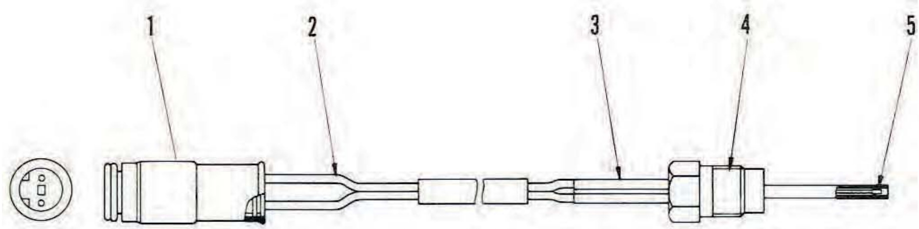


Circuit structure

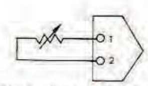
FUNCTION

- These sensors are installed on the engine thermostat housing and transmission case. They use a thermistor to detect the temperature, and when the temperature goes above the specified temperature, the machine monitor lamp flash to indicate the abnormality.

ENGINE OIL PRESSURE



1. Connector
2. Wire
3. Tube
4. Plug
5. Thermistor (beat type)



Circuit structure

FUNCTION

- These are installed on the engine block. The diaphragm detects the oil pressure, and when the pressure goes over the specified pressure, the machine monitor lamp lights up to indicate the abnormality, monitor lamp lights up to indicate the abnormality.

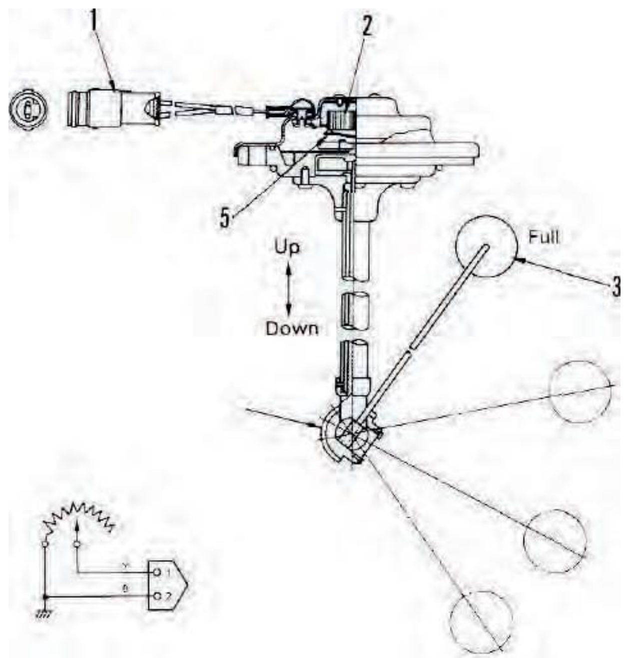
FUEL GAUGE SENSOR

FUNCTION

- The fuel gauge is installed on top of the fuel tank. The float moves up and down according to the fuel level. The movement of the float is sent through a gear to actuate a variable resistor. This sends a signal to the machine monitor to display the fuel level.

  When the display on the machine monitor drops to a certain level, a signal is generated between the modules inside the machine monitor, and the warning lamp flash.

  1. Connector
  2. Variable resistor
  3. Float
  4. Gear
  5. Contact



Circuit structure

Empty

CONTACT SWITCH (OPTIONAL)

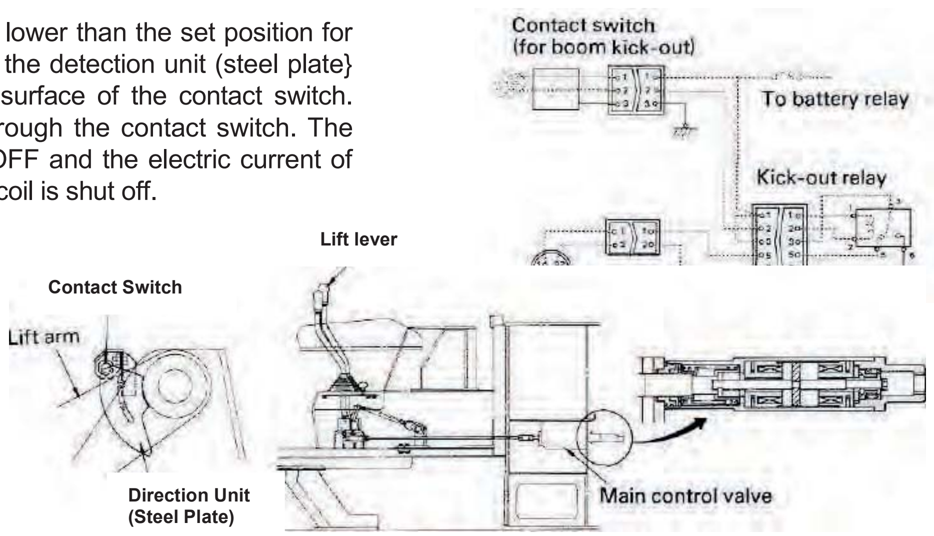
FUNCTION

- Contact switches are installed by a support to the lift and dump cylinders. The lift arm RAISE position and the TILT BACK position can be selected to match the operating conditions. When these positions are reached, a pulse is generated from the switch, the electric current flows to a magnet and the lift or dump lever is returned to the neutral position. When this happens, the main control valve is also returned to neutral and the movement of the lift arm or bucket stops.

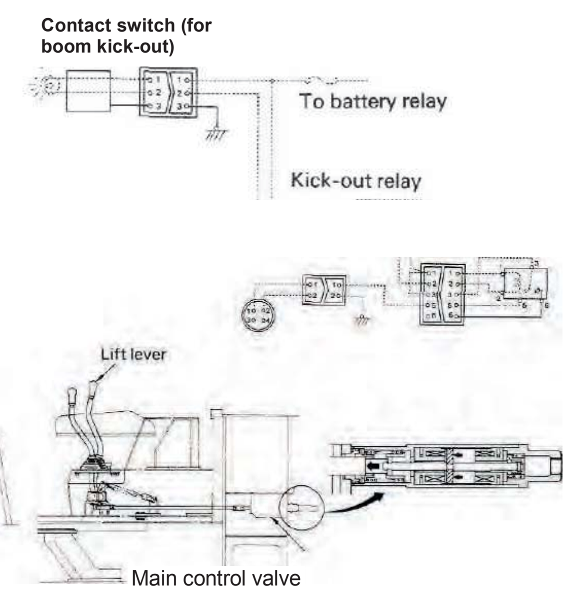
OPERATION

Lift arm RAISE

- When the lift arm is lower than the set position for the boom kick-out, the detection unit (steel plate} is on the sensing surface of the contact switch. Electricity flows through the contact switch. The relay switch is at OFF and the electric current of the magnet switch coil is shut off.

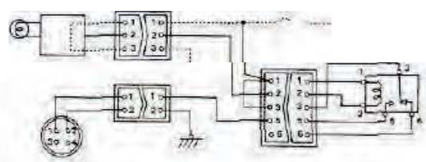


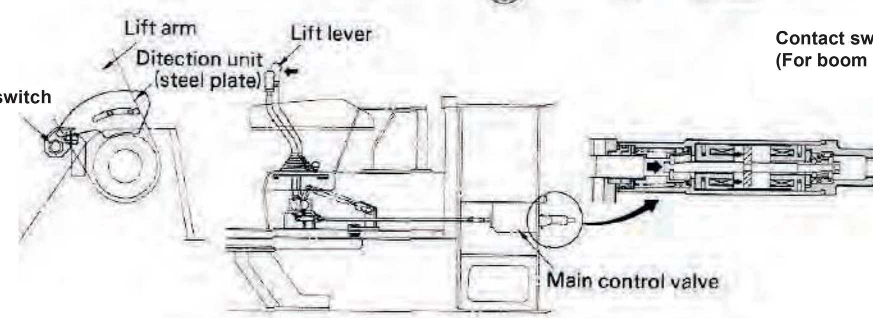
When the lift control lever is moved to the RAISE position, the lever cam and the cam follower keep the lift spool in the RAISE position, so the lift arm goes up.



- When the lift arm goes up and reaches the set position for the kick-out (that is, the detection unit (steel plate) is separated from the sensing surface of the contact switch), the contact switch and relay circuit act to send electric current to the magnet coil. This actuates the magnet, the cam is pulled out of the cam detent, and the lift spool is returned to the neutral position by the return spring.

Movement of contact switch

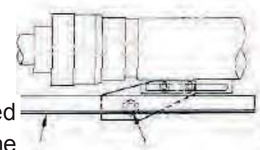


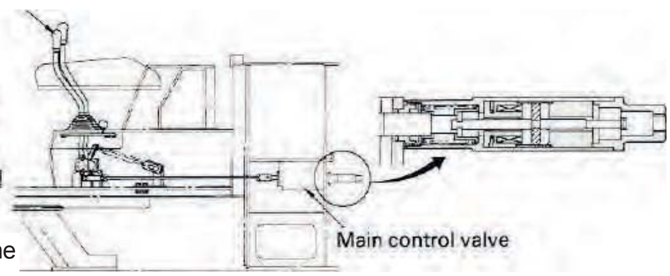


Position	Sensing surface of magnet switch is in contact with detection unit	Sensing surface of contact switch separated from detection unit
Magnet switch display	ON	OFF
Contact switch load circuit (relay switch circuit}	Current flows	Current shut off
Relay switch load circuit (magnet circuit)	Current shut off	Current flows

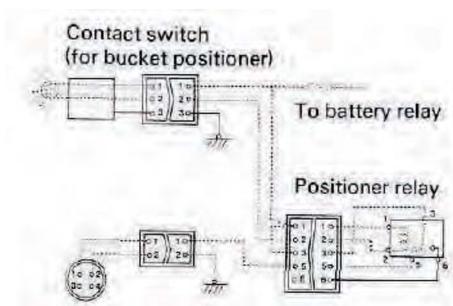
Bucket TILT

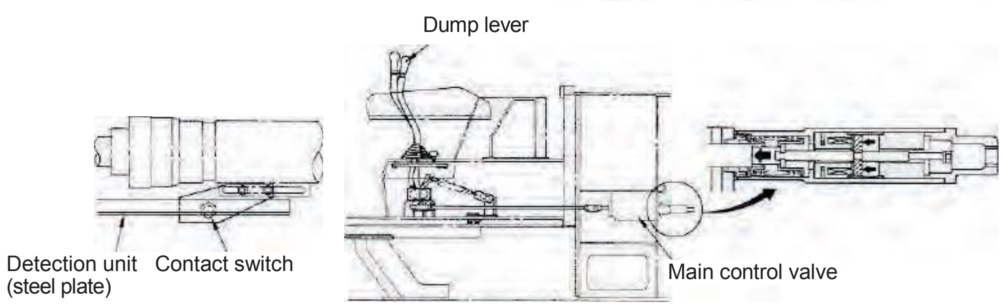
- When the bucket is lower than the set position for the bucket leveler, the detection unit (steel plate) is on the sensing surface of the contact switch. No electricity flows through the contact switch. The relay switch is at ON and the electric current from the battery flows through the magnet switch coil.



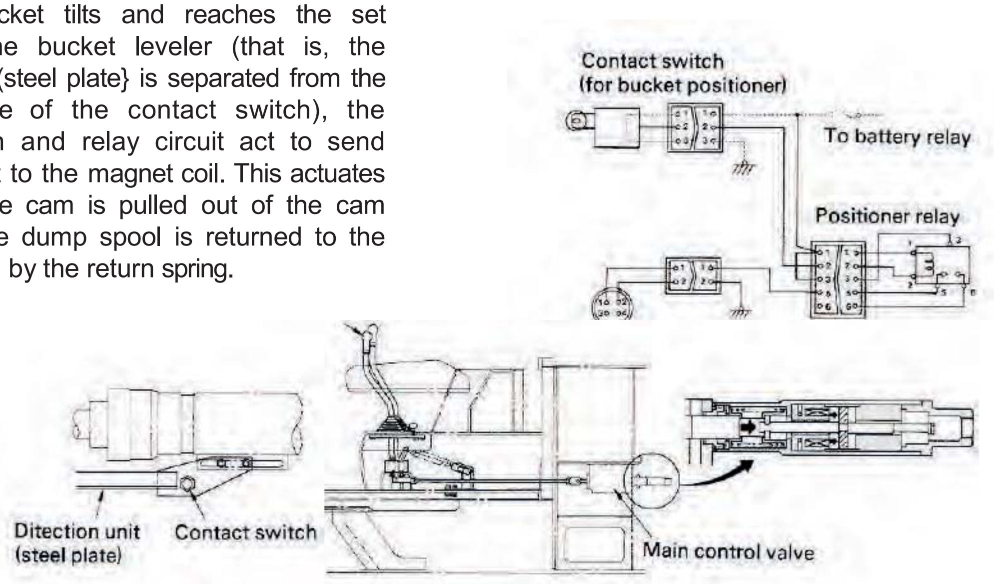


- When the bucket control lever is moved to the TILT position, the lever cam and the cam follower keep the dump spool in the TILT position, so the bucket tilts.

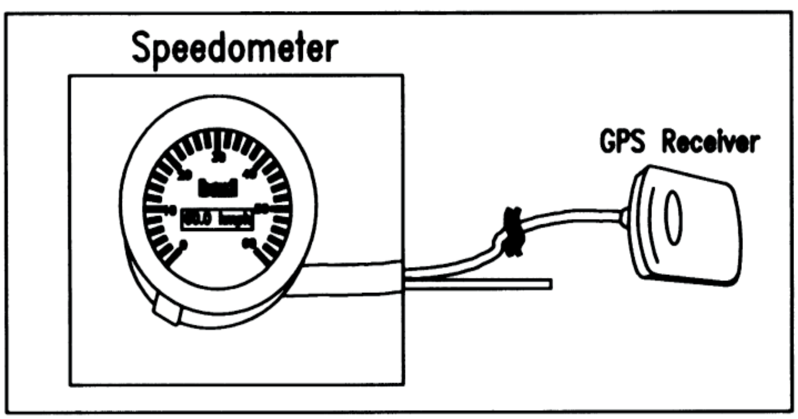




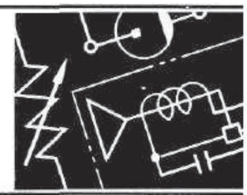
- When the bucket tilts and reaches the set position for the bucket leveler (that is, the detection unit (steel plate} is separated from the sensing surface of the contact switch), the contact switch and relay circuit act to send electric current to the magnet coil. This actuates the magnet, the cam is pulled out of the cam detent, and the dump spool is returned to the neutral position by the return spring.



SPEEDO METER



22 ELECTRIC AND ELECTRONIC SYSTEM TESTING AND ADJUSTING



METHOD OF USING YES-NO TROUBLESHOOTING FLOW CHART

The electric system can be broadly divided into the following two parts.

1. Starting system, transmission electrical control system, brake system.
2. ELECTRONIC VEHICLE MONITORING SYSTEM.
   The charts for these systems are marked as E-xx, and M-xx respectively.

Troubleshooting chart No.	Item
E-xx	Troubleshooting of starting system, transmission electrical control system brake system.
M-xx	Troubleshooting of electronic vehicle monitoring system.

1. Method for troubleshooting

- Check or measure the items inside the rectangle 

  According to the result, follow the YES arrow or the NO arrow and proceed to the next rectangle. (Note: The number given at the top right of the rectangle is a reference number. It does not indicate the order for troubleshooting.)
- If the result of the check or measurement leads directly to the CAUSE column, note the cause and take the action given in the REMEDY column.
- The value for the check and the measurement method is given inside the rectangle. If the value is correct, or the answer is yes, follow the YES arrow; if the value is not correct, or the answer is no, follow the NO arrow.
- Below the rectangle, there is a list giving preparatory work, methods of operating and handling, and judgment values needed for checking and measuring. If the preparatory work is ignored, or the wrong method of operating or handling is used, or the judgment is wrong, this could result in damage to the equipment. Therefore, always read the procedure carefully before starting the check or measurement, and carry out the operations in the order given.

2. Precautions when carrying out troubleshooting

The precautions to be followed when carrying out troubleshooting for each failure is marked. * under the description of the failure. Always follow these precautions when making measurements.

3. Tools needed for troubleshooting

The tools needed for troubleshooting for each problem are listed as follows.

Troubleshooting		

Prepare these tools before starting troubleshooting.

4. Place to install connectors, connector pin numbers

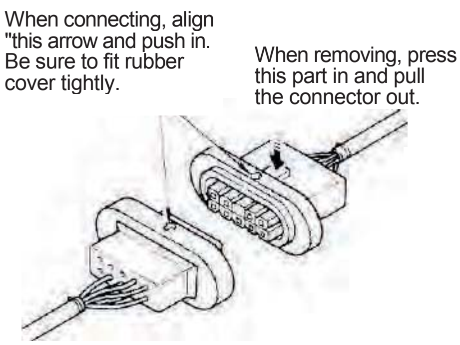
When troubleshooting some problems, measurements have to be made of continuity, voltage and resistance at each step during the troubleshooting procedure. The location for measurement at each step (location of connector, connector pin number) is shown in a photograph or diagram. For this reason, use these photographs together with the YES- NO type troubleshooting flow charts to carry out troubleshooting quickly and accurately.

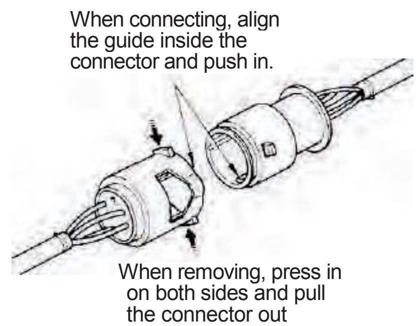
CHECKS BEFORE TROUBLESHOOTING

		Item	Standard value	Remedy
Checks before starting	Lubricating oil, cooling water	1. Check fuel level 2. Check for dirt or water in fuel 3. Check hydraulic oil level 4. Check hydraulic oil strainer 5. Check brake oil level 6. Check engine oil level (Level of oil in oil pan) 7. Check cooling water level 8. Check condition of dust indicator 9. Check air pressure in air reservoir	- - - - - - - - - -	Add fuel Clean, drain Add oil Clean, drain Add oil Add oil Add water Clean or replace See troubleshooting
Item	Electrical equipment	10. Check for loose or corroded battery terminals 11. Check for loose or corroded alternator terminals 12. Check for loose or corroded starting motor terminals	- - -	Tighten or replace Tighten or replace Tighten or replace
Other check items	Hydraulic, mechanical component	13. Check for abnormal noise or smell 14. Check for oil leakage 15. Bleed air from system	- - -	Repair Repair Bleed air
	Electrical components	16. Check battery voltage (engine stopped) 17. Check level of battery electrolyte 18. Check for discolored, burnt, or bare wiring 19. Check for missing wiring clamps, hanging wires 20. Checks for water leaking onto wiring (check carefully water leakage at connectors and terminals) 21. Check for broken or corroded fuses 22. Check alternator voltage (engine running at over half throttle) 23. Noise when battery relay is operated (switch starting switch from on to off)	20 – 30V - - - - - 27.5 – 29.5V -	Replace Add or replace Replace Repair Disconnect connector and dry connection Replace Replace Replace

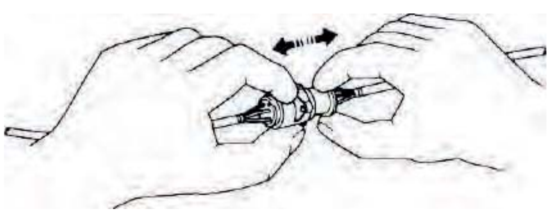
PRECAUTION WHEN HANDLING CONNECTOR

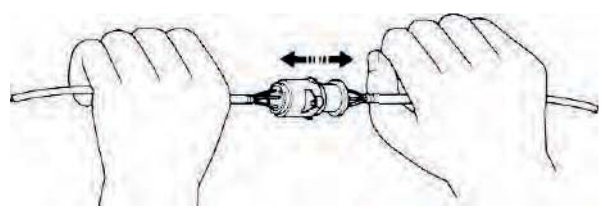
1. If the connector has a lock, always release the lock before disconnecting the connector.



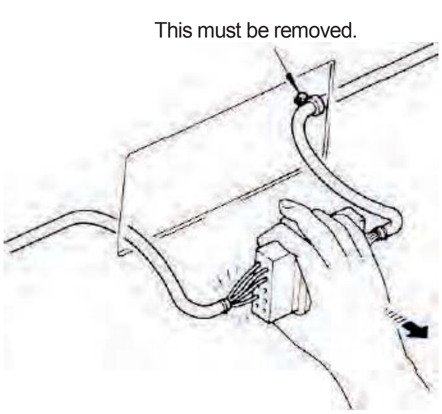


2. Never pull the cord to disconnect the connector.

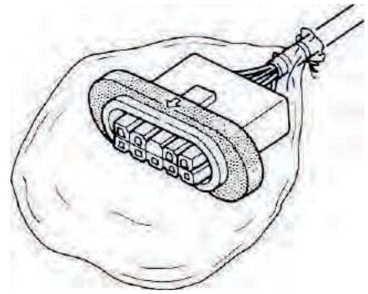




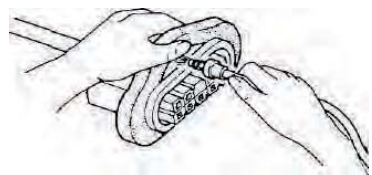
3. If the connector is difficult to disconnect, do not try to pull it out.
(If it is difficult to reach by hand, remove the clamp and move the wiring harness.)



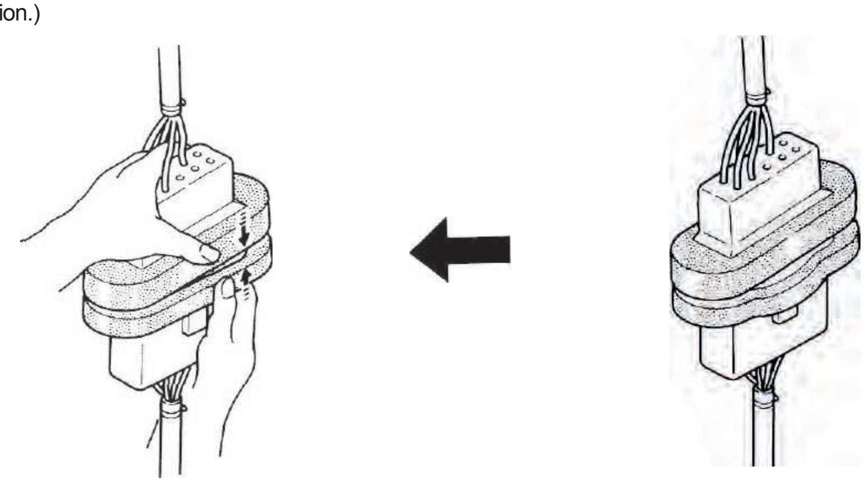
4. After pulling out the connector, cover with a vinyl bag to protect the contacts from dirt or oil.



5. When cleaning the connector, never use cleaning agents such as trichloroethane or trichloroethylene. If the connector is very dirty, use a neutral cleaning agent. After cleaning wash well and dry completely immediately. (Do not use any connector which has deposits left on it after drying.)
Coat with contact restorer.
(When drying, be particularly careful to dry the gaps in the rubber.)

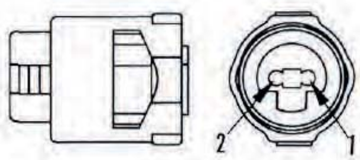
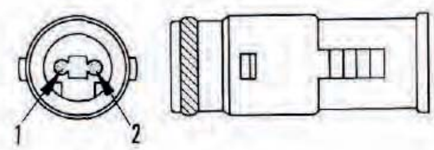
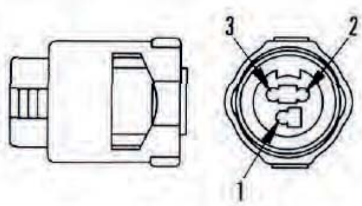
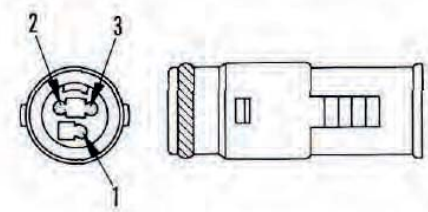
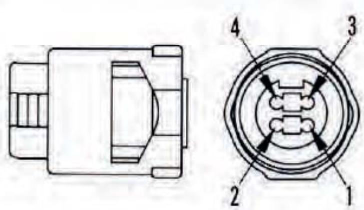
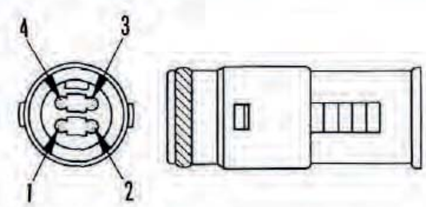
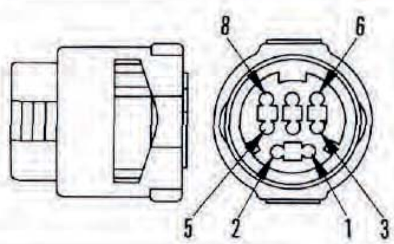
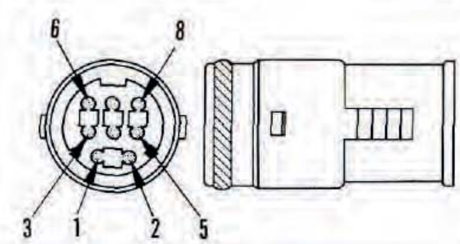
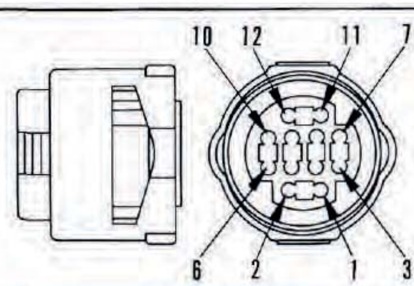
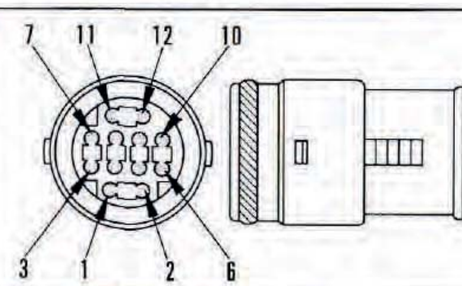


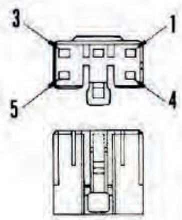
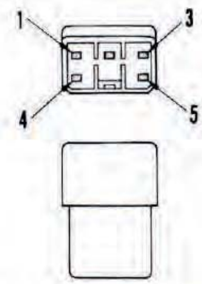
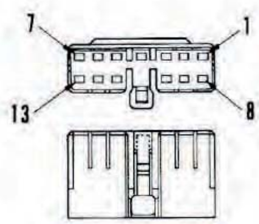
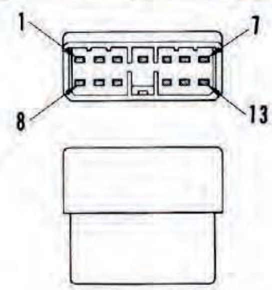
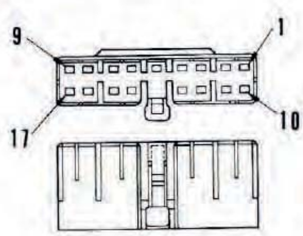
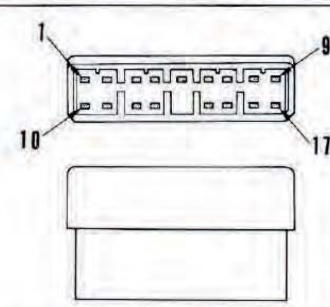
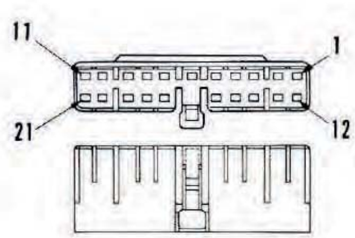
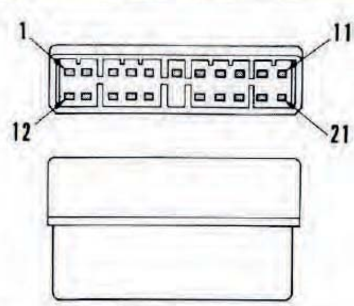
6. When assembling the connector, be sure to fit it correctly.
(For connectors with locks, it should be possible to hear the locks click as they fit completely into position.)

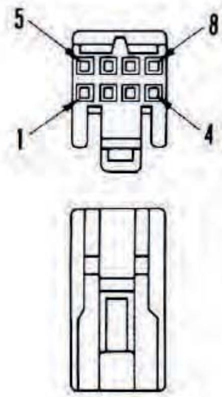
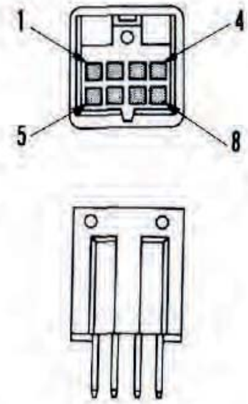
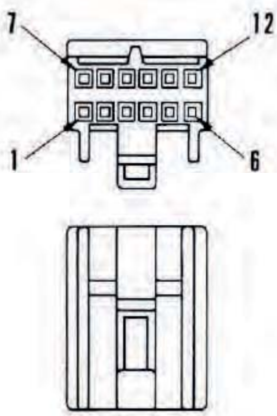
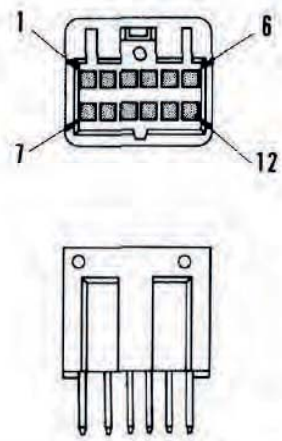
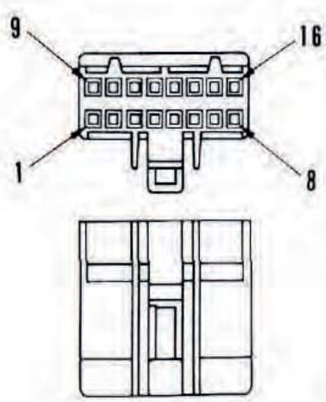
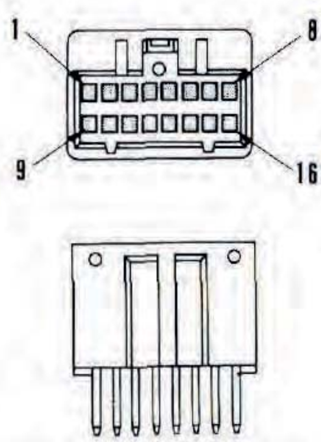


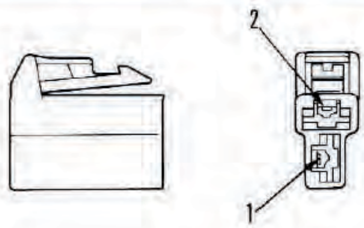
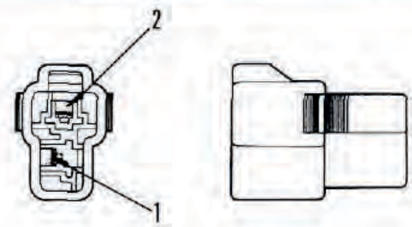
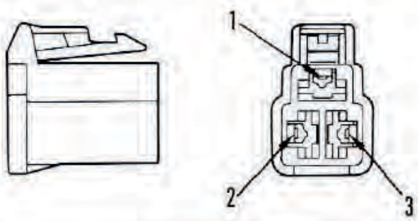
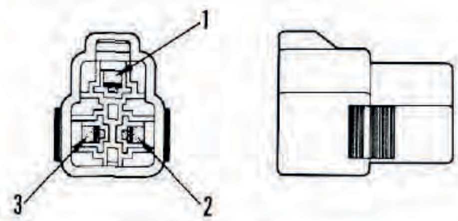
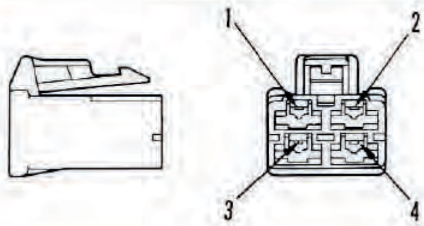
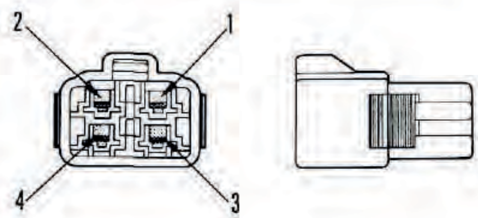
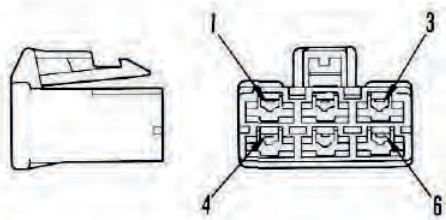
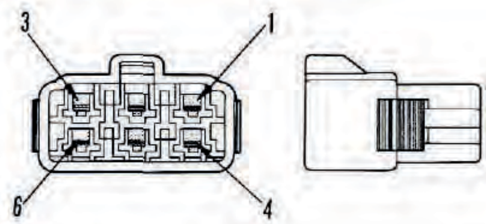
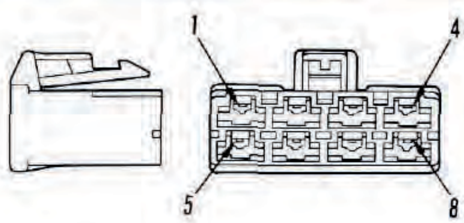
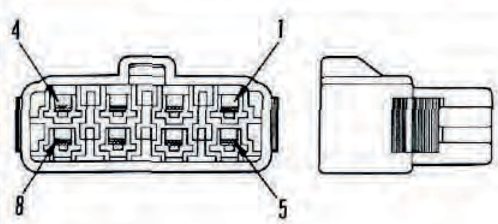
- Correct any protrusion of the boots.

CONNECTION TABLE FOR CONNECTOR PIN NUMBER

Total no. of pins	Econoseal connector	
	Female (socket for pin)	Male (pin protrudes)
2		
3		
4		
8		
12		

Total no. of pins	MIC connector	
	Female (socket for pin)	Male (pin protrudes)
5		
13		
17		
21		

Total no. of pins	DLI connector (for machine monitor panel)	
	Female (socket for pin)	Male (pin protrudes)
8		
12		
16		

Total no. of pins	N-SLC connector	
	Female (socket for pin)	Male (pin protrudes)
2		
3		
4		
6		
8		

ELECTRICAL CIRCUIT SYSTEM

1. ENGINE STARTING CIRCUIT SYSTEM

For detail of Engine start circuit refer electrical wiring diagram.

E1. ENGINE DOES NOT START

- Check the electrical connectivity from the battery to starting motor and rectify depending on the faults in starting motor and wiring.

EVEN WHEN ENGINE IS STOPPED,  **(BRAKE OIL LEVEL) FLASHES**

- Check the brake oil level in the Air booster chamber

WHEN ENGINE OIL PRESSURE LAMP IS ON WHEN ENGINE IS RUNNING

- Check the oil level

WHEN ENGINE IS RUNNING, EVEN THOUGH THERE IS NO ABNORMALITY IN MACHINE,  **(TORQUE CONVERTER OIL TEMPERATURE) SHOWING MAXIMUM VALUE**

- Check the sensor, gauge and wiring

TURN SIGNAL LAMPS, HIGH BEAM LIGHT UP OR DO NOT LIGHT UP

- Check the wiring

SPEEDOMETER DISPLAY DOES NOT WORK

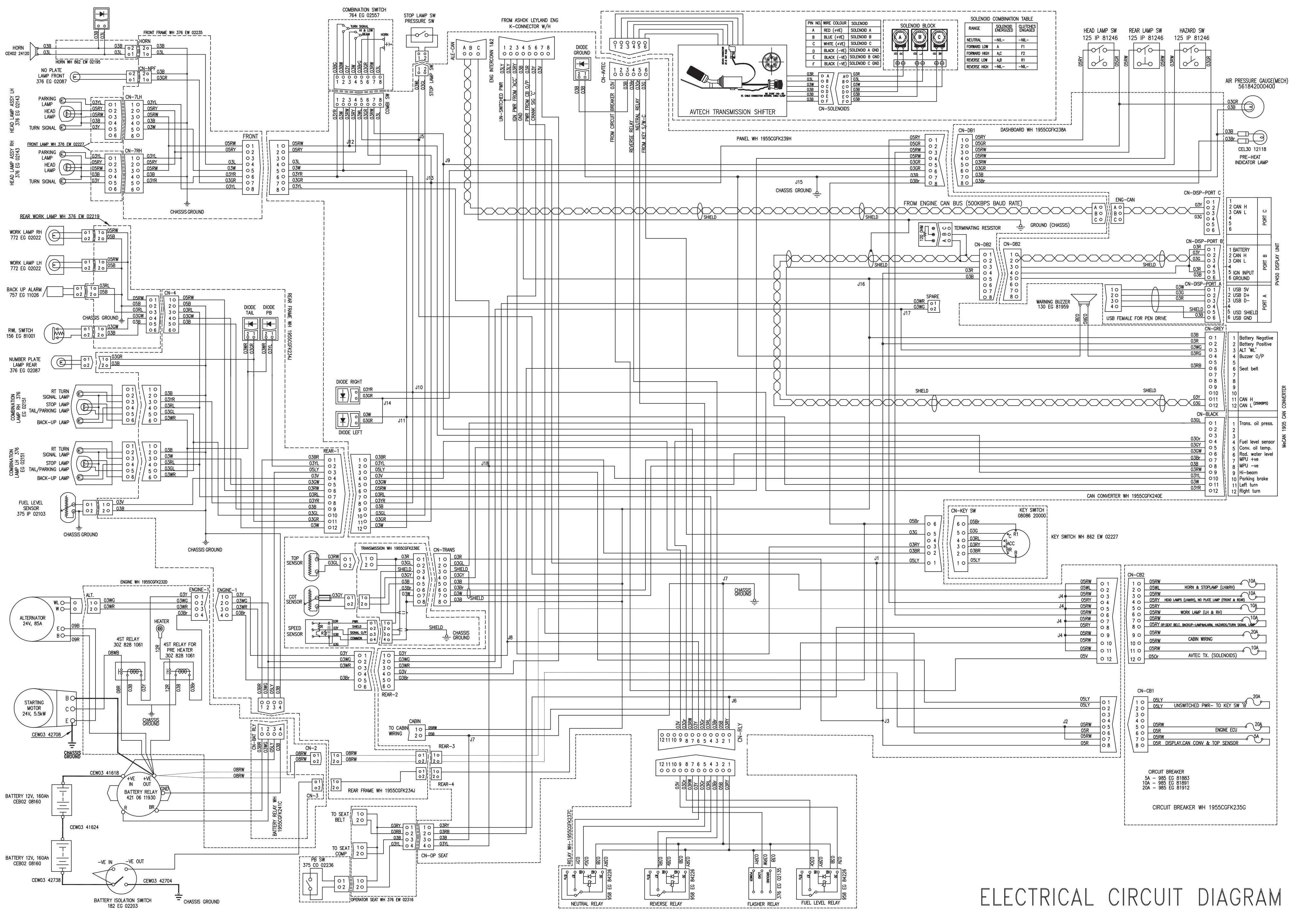
- Check the power supply
- Check the antenna connection

HOURMETER DOES NOT WORK

- Check the alternator connection

BATTERY CHARGE INDICATION LAMP IS ON WHEN ENGINE IS CRANKED.

- Check the alternator



PIN NO.	WIRE COLOUR	SOLENOID
A	RED (+VE)	SOLENOID A
B	BLUE (+VE)	SOLENOID B
C	WHITE (+VE)	SOLENOID C
D	BLACK (-VE)	SOLENOID A GND
E	BLACK (-VE)	SOLENOID B GND
F	BLACK (-VE)	SOLENOID C GND

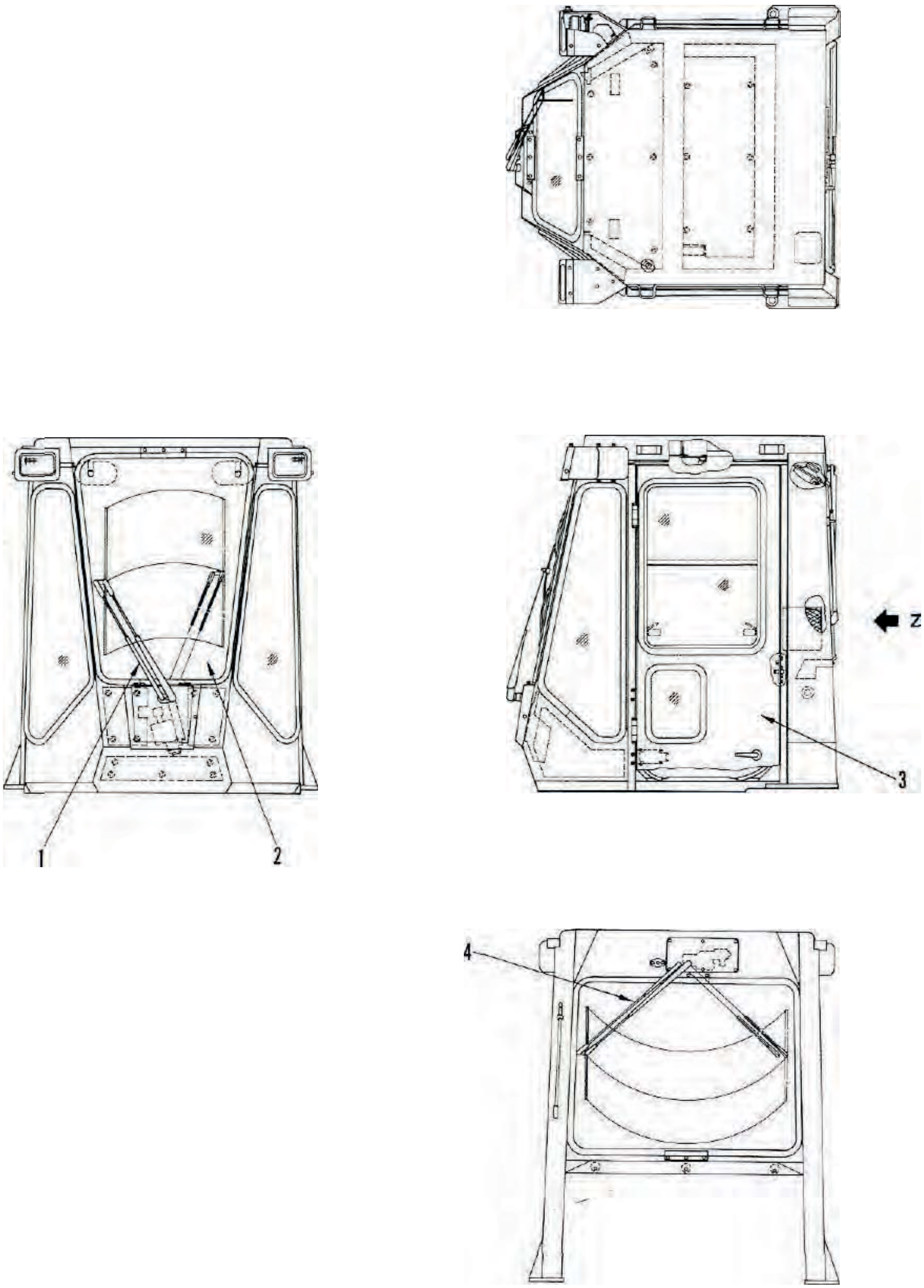
SOLENOID COMBINATION TABLE

RANGE	SOLENOID ENERGIZED	CLUTCHES ENGAGED
NEUTRAL	-NIL-	-NIL-
FORWARD LOW	A	F1
FORWARD HIGH	A,C	F2
REVERSE LOW	A,B	R1
REVERSE HIGH	-NIL-	-NIL-

ELECTRICAL CIRCUIT DIAGRAM

23 OTHERS
STRUCTURE AND FUNCTION

CAB



1. Front wiper
2. Front glass
3. Door
4. Rear wiper

OTHERS
24 DISASSEMBLY AND ASSEMBLY

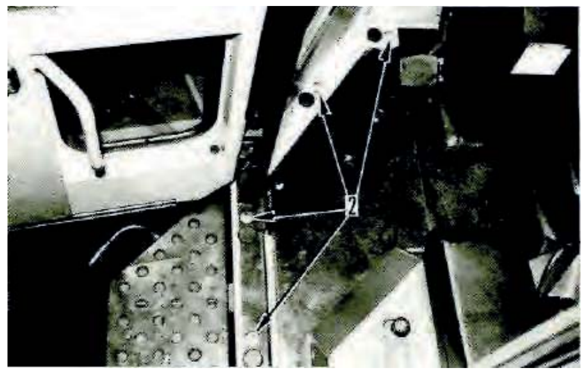
CAB

REMOVAL OF CAB

⚠ Park the machine on level ground, set the safety bar on the frame, lower the bucket to the ground, stop the engine, apply the parking brake and place blocks under the tires.

1. Electric wiring

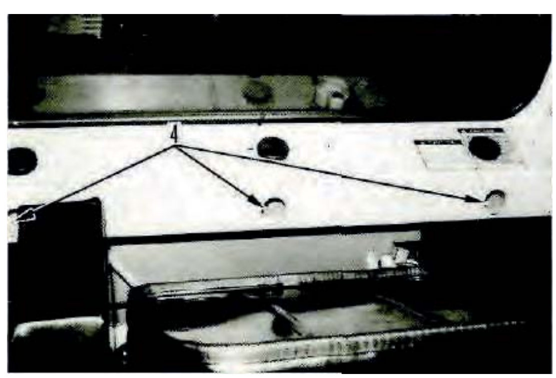
Disconnect electric wiring connector (1).



2. Cab

1) Raise floor mat, remove caps, then remove mounting bolts (2), {3} and (4).
2) Liftoff cab (5).
   ★ Lift off the cab slowly and horizontally.

kg Cab: **310 kg**



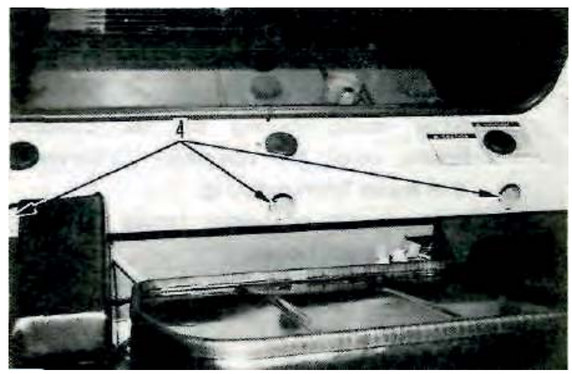
INSTALLATION OF CAB

1. Cab

1) Raise cab (5) and set in mounting position.

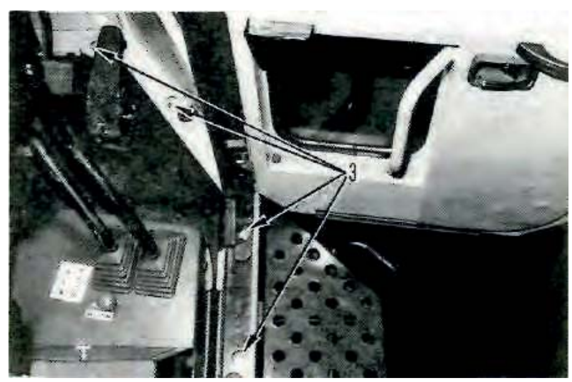
★ Coat all the seals evenly with gasket sealant.

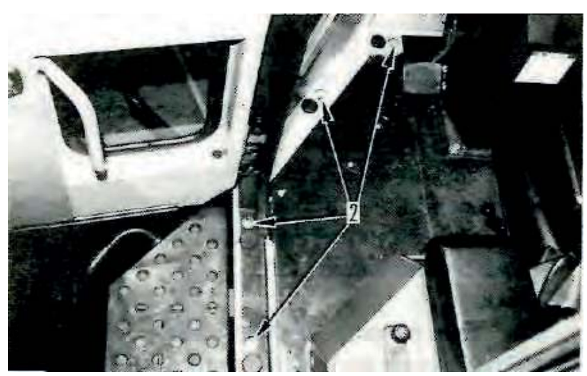
2) Tighten mounting bolts (4), (3) and (2), install caps, and return floor mat to original position.



2. Electric wiring

1) Connect electric wiring at connector (1).





25 GEAR PUMP
GENERAL

GENERAL

The hydraulic pump is a device which receives mechanical energy from a prime mover such as an engine, converts the energy into fluid energy, and functions as the source of energy in a hydraulic system.
The fluid energy can be divided into the energy of velocity, pressure, and potential. Almost all of the fluid energy used for hydraulic pressure is pressure energy.
The hydraulic pump receives and transmits the energy through the static pressure of a fluid, and easily produces a high pressure since its delivery is determined by the transfer of volumetric displacement enclosed by the fixed walls. Therefore, the pump delivery is not changed significantly with variations in the load.
It follows that the pump itself is a device which makes the oil flow, rather than a device to produce pressure.
The pump pressure is generated by the resistance (the load) against the oil flow. Therefore, when there is no resistance, no pressure is produced. Structurally, hydraulic pumps can be broadly classified into rotary pumps and reciprocating pumps. Functionally, they can be classified into fixed displacement pumps and variable displacement pumps. The hydraulic pumps used in construction machinery are external gear pumps and are classified as fixed displacement rotary pumps.
External gear pumps employ involute spur gears, and can be structurally classified into the following types.

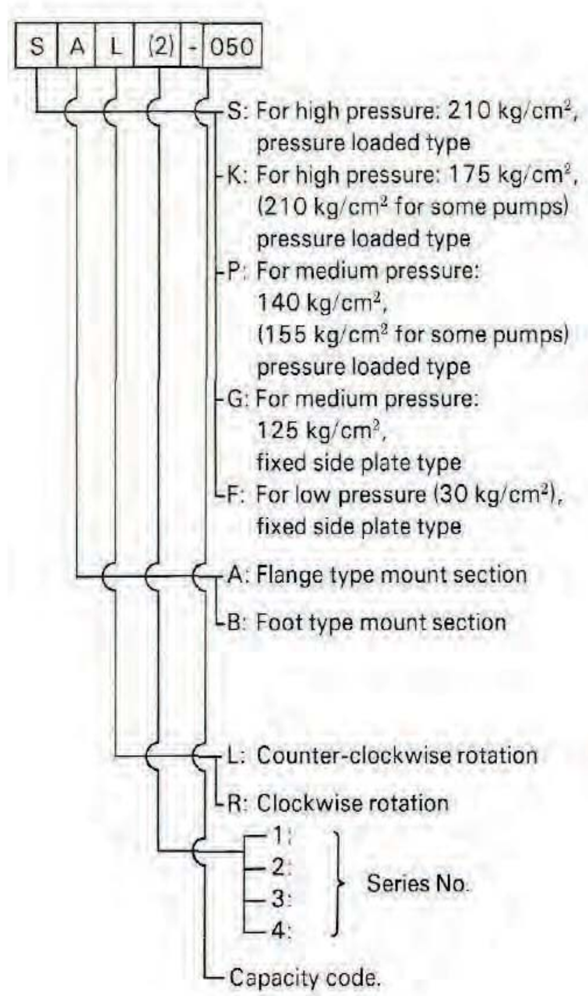
- Type of side plate adjustment

  1. Fixed side plate type (FAL, FAR)
     (GAL, GAR)
  2. Pressure loaded type (PAL, PAR)
     (KAL, KAR)
     (SAL, SAR)
  3. Pressure plate type

- Type of bearing

  Ball or roller bearing type
  Plain bearing type

Gear pumps installed on KOMATSU machines are called KOMATSU standard pumps. They are designated as follows.



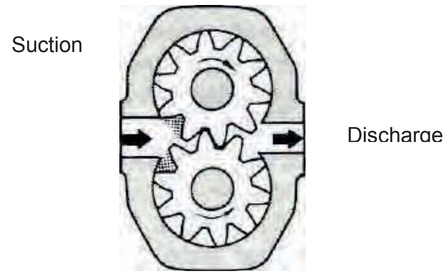
PRINCIPLE OF OPERATION

- **MECHANISM FOR DELIVERING OIL**

The drawing at right shows the operational principle of an external gear pump in which two gears are rotating in mesh. The oil entering through the suction port is trapped in the space between two gear teeth, and is delivered to the discharge port as the gear rotates .Except for the oil at the bottom of the gear teeth, the oil trapped between the gear teeth is prevented from returning to the suction side with the gears in mesh. Since the gears are constantly delivering oil, the oil delivered to the discharge port is forced out of the port.

The amount of discharge increases with the speed of rotation of the gear. If there is no resistance in the oil passage into which the discharged oil flows, the oil merely flows through the passage, producing no increase in pressure.

If, however, the oil passage is blocked with something like a hydraulic cylinder, there will be no other place for the oil to flow, so the oil pressure will rise. But the pressure which rises in this way will never go higher, once the hydraulic cylinder piston starts moving because of the oil pressure. As described earlier, the pump produces the oil flow, but not the oil pressure. We can therefore conclude that pressure is a consequence of load. In other words, the pressure depends on a counterpart.



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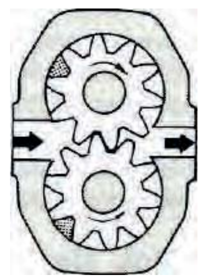
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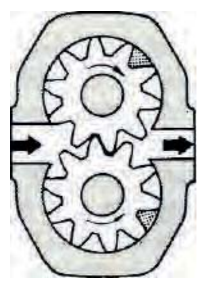
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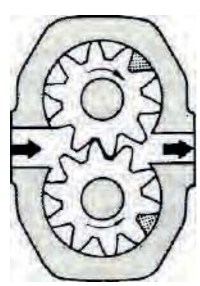
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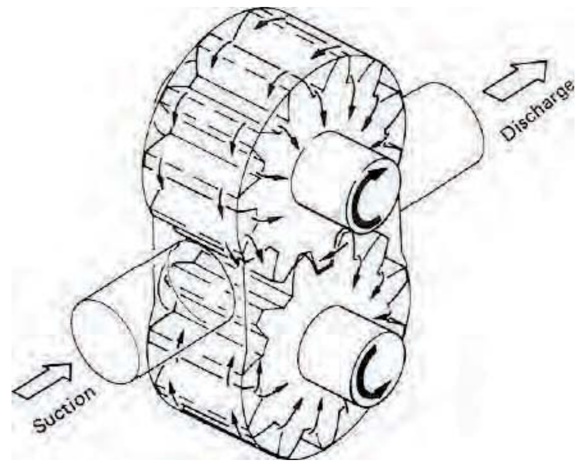
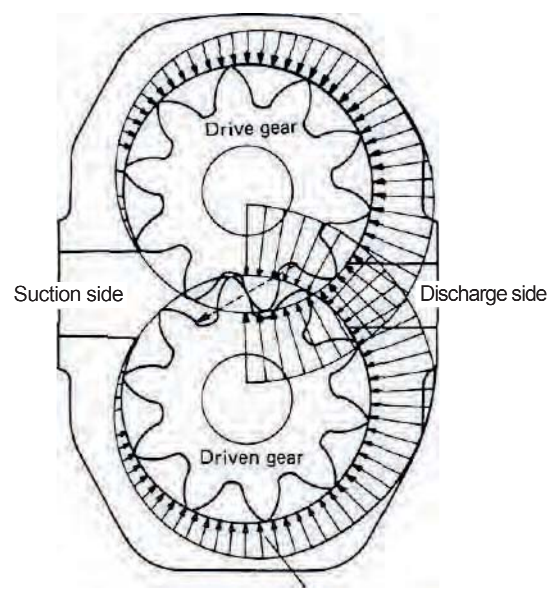
- **INTERNAL OIL LEAKAGE**
  Oil leaks from a place under higher pressure to a place under lower pressure, provided that a gap or a clearance exists in between. In the gear pump, small clearance are provided between the gear and the case and between the gear and the side plate to allow the oil to leak out and to serve as a lubricant so that the pump will be protected from seizure and binding. The drawing at right shows how the leaked oil flows in the pump. As such, there is always oil leakage in the pump from the discharge side (under higher pressure) to the suction side. The delivery of the pump is reduced by an amount equal to the pump discharge. In addition, the delivery of the pump will also decrease as the amount of oil leakage increases because of expanded radial clearance resulting from the wear of pump parts, the lower oil viscosity resulting from increases in the oil temperature, and the initial use of low viscosity oil.



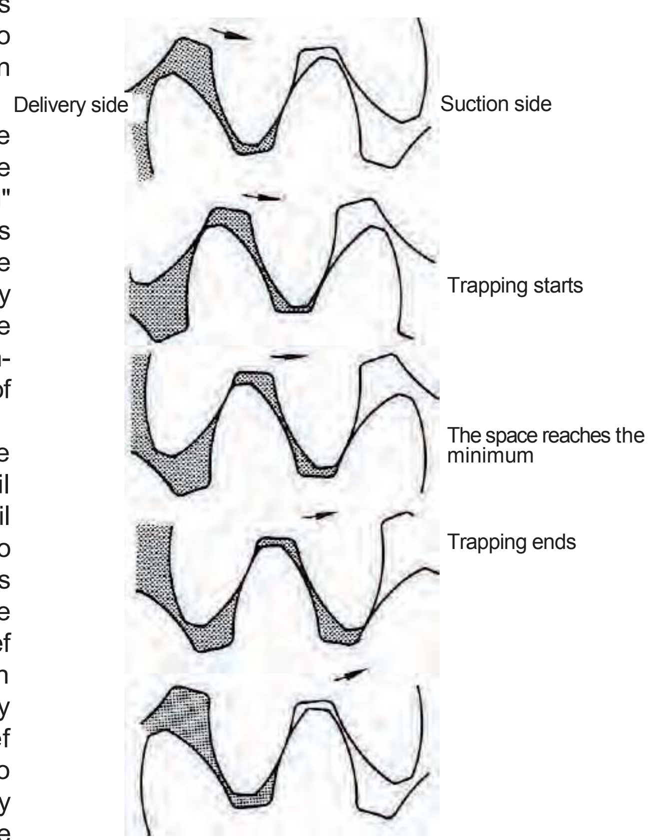
- **FORCES ACTING ON THE GEAR**
  The gear, whose outer surface is subjected to oil pressure, receives forces pointing towards its center.
  Due to the action of the delivery pressure, the oil pressure is higher on the delivery side of the pump, and, due to suction pressure, is lower on the suction side. In the intermediate section, the pressure will gradually lower as the position moves from the delivery side to the suction side. This phenomenon is shown in the drawing at right. In addition, the gears in mesh will receive interacting forces .These forces pushing the gears toward the suction side are received by the bearings. Since the gears are pressed toward the suction side by these forces, the radial clearance becomes smaller on the suction side in the case. In some pumps (PAL, PAR, KAL, KAR), the clearance may become zero, thus allowing the gear teeth and the case to come into light contact. For this reason, an excessive increase in the delivery pressure must be avoided, since it will produce a large force which will act on the gears, placing an overload on the bearings, and resulting in a shortened service life of the bearing or interference of the gear with the case.

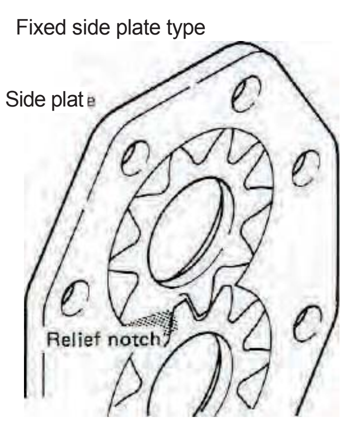


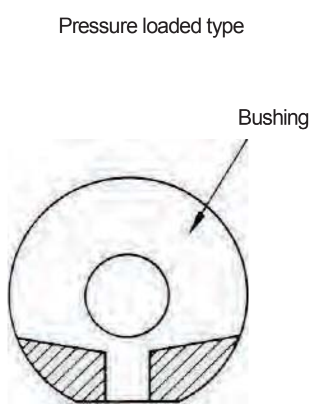
- **"TRAPPING" PHENOMENON OF THE OIL**

When a gear pump is rotating with the gears in mesh as shown in the drawing at right, in some instances two sets of gear teeth are in mesh while in other instances only one set of the gear teeth is in mesh. When two sets of the teeth are in mesh simultaneously, the oil in the space between the meshed gear teeth will be trapped inside — the front and rear exits will be completely shut. This is called the "trapping" phenomenon of oil. The space in which the oil is trapped moves from the suction side to the delivery side as the gears rotates. The volume of the space gradually decreases from the start of trapping until the space reaches the center section, and then gradually increases after leaving the center section until the end of trapping.

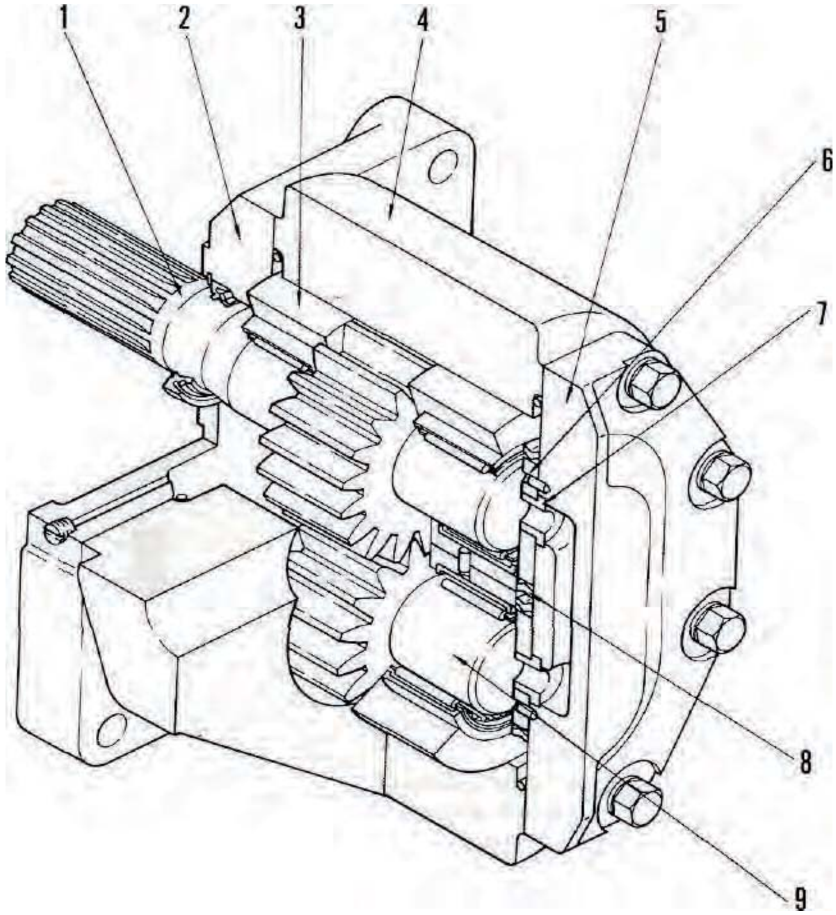
Since the oil itself is non-shrinkable, a reduction of the volume of space will greatly increase the oil pressure, unless some provision is made to relieve oil pressure. The high pressure oil will cause the pump to make noise and vibrate. To prevent this, relief notches are provided on the side plates to release the oil to the delivery side. As shown in the drawing below, the relief notches are provided in such a way that the oil can be relieved from the trapping space to the delivery side when the volume of the space is reduced. Relief notches are also provided on the suction side to prevent the formation of a vacuum in the space by allowing the oil to enter the space from the suction side when the space is expanded.







PRESSURE LOADED TYPE GEAR PUMP



GENERAL DESCRIPTION

Hydraulic pumps used for the work equipment hydraulic units on construction machinery are pressure loaded type gear pumps. Some gear pumps of this type have a maximum delivery pressure of 210 kg/cm^2 or higher.

The pressure loaded type gear pump is designed so that the clearance between the gear and the side plate can be automatically adjusted according to the delivery pressure. Therefore, the oil leakage from the side plate is less than that in the case of the fixed side plate type under a high discharge pressure. Consequently, no significant reduction of the pump delivery occurs, even when the pump is operated under high pressure

1. Drive gear
2. Bracket
3. Bushing
4. Gear case
5. Cover
6. Seal plate
7. Collar
8. Back-up ring
9. Driven gear

STRUCTURE AND OPERATION

In a pressure loaded type pump, two bushings acting as side plates are inserted into the pump case, and are pressed toward the sides of the gears. The oil leakage from the gear sides is thus minimized. Since the bushings are constantly pressed toward the gears by the oil pressure, there is no fear of an increase in oil leakage, even when the bushings are worn out and the clearances are expanded many hours of operation.

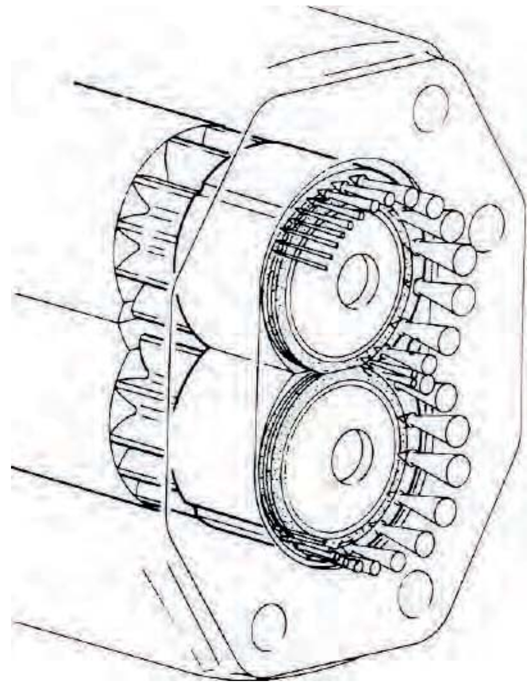
The bushings are pushed towards the gears from the cover side by the oil pressure, and they are pushed from the gear side by the pressure of oil trapped between the gear teeth and that which has leaked out from the clearance between the gear and the bushing.

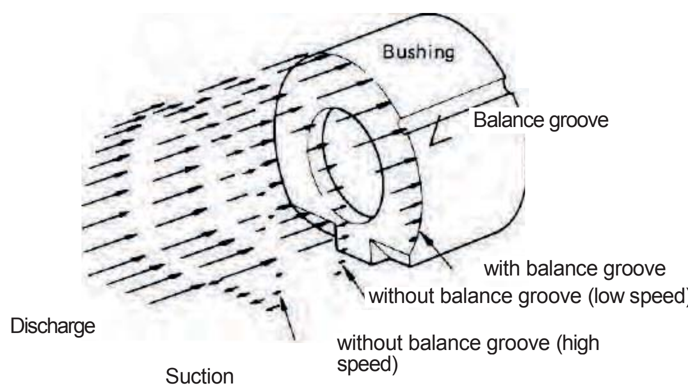
Since the oil pressure in the gears is higher on the pump delivery side and is lower on the suction side, provisions are made so that the pressing force acting on the bushings from the cover side is regulated in such a way that the delivery side is pressed harder and the suction side weaker to match the counter pressure.

More specifically, the area of the bushing on the discharge side is made larger than that on the suction side by partitioning the area of the bushing subjected to pressure on the cover side, with a backup ring installed to the seal plate as shown in the drawing at right

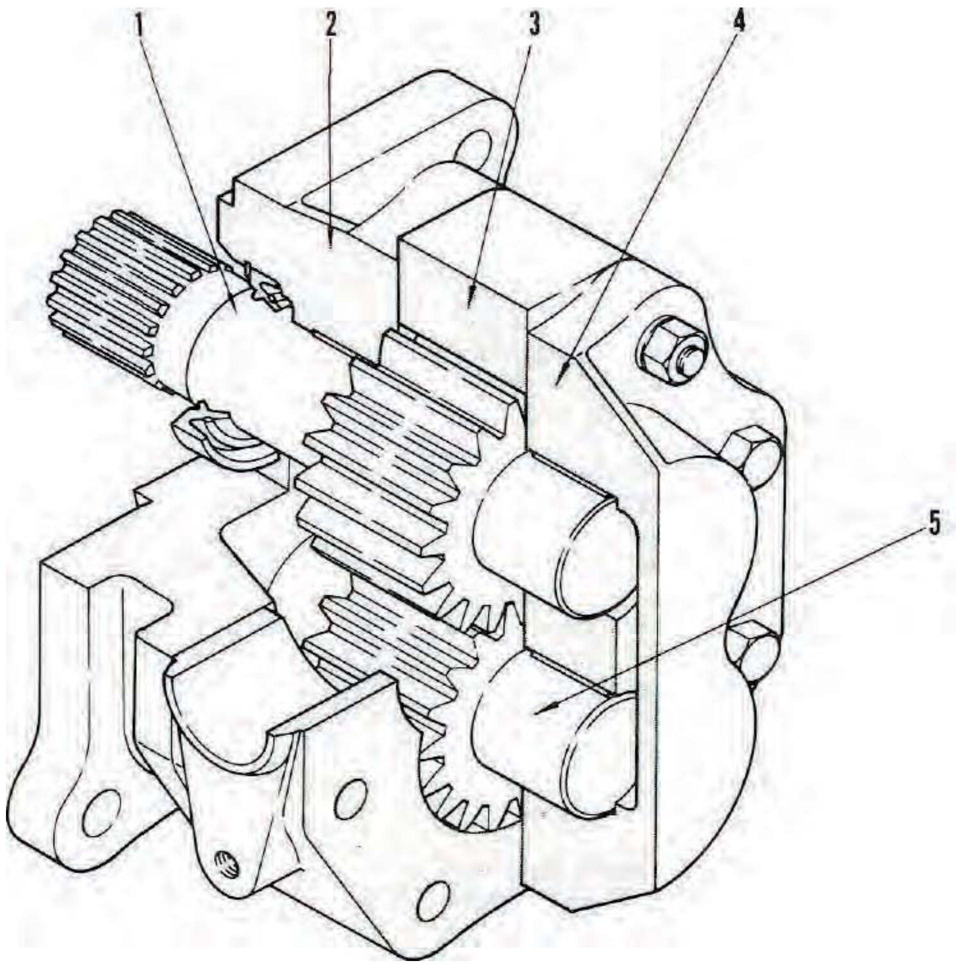
When the pump is operated at high speed, the pressure on the suction side is lowered and the distribution of pressure around the periphery of the gear will change into the state shown in the drawing at right below.

Pressure balance grooves are therefore provided on the bushings to keep the balance of the force on the cover side against the pressure acting on the bushing from the gear side that varies with the pump rotation and the pressure distribution. Thus the delivery pressure is led as shown in the drawing and the pressure distribution is stabilized at any rotational speed.





FIXED SIDE PLATE TYPE GEAR PUMP



GENERAL DESCRIPTION

Hydraulic pumps used for the main clutch, transmission, and steering system on bulldozers are fixed side plate type gear pumps which can be classified as follows: pumps generally called FAL or FAR pumps having a maximum delivery pressure of 30 kg/cm^2 and pumps generally called GAL or GAR pumps having a maximum delivery pressure of 1 25 kg/cm^2.

Since the bracket and the case cover serve as the side plates and the gear teeth bottom land is closer to the outer race of the bearing in the case of the fixed side plate type gear pump, oil leakage is liable to occur at the clearance between the gear and the side plate. However, this is only a small problem, as the pump is used for steering control which is operated at a low service pressure.

1. Drive gear
2. Bracket
3. Gear case
4. Cover
5. Driven gear

25 GEAR PUMP SA SERIES

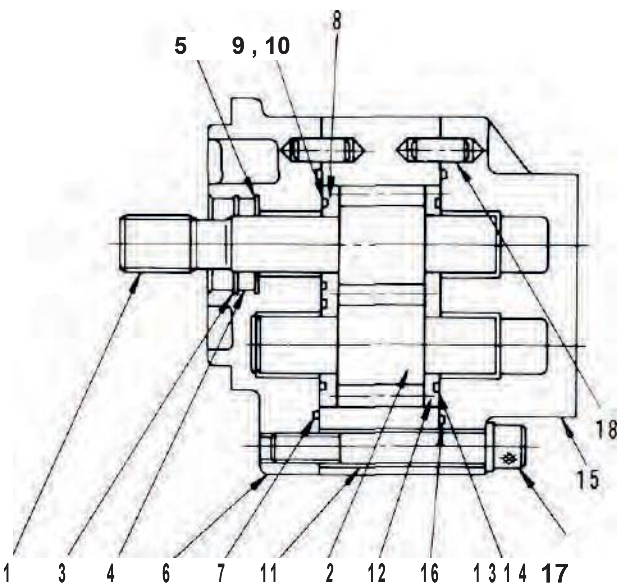
STRUCTURE

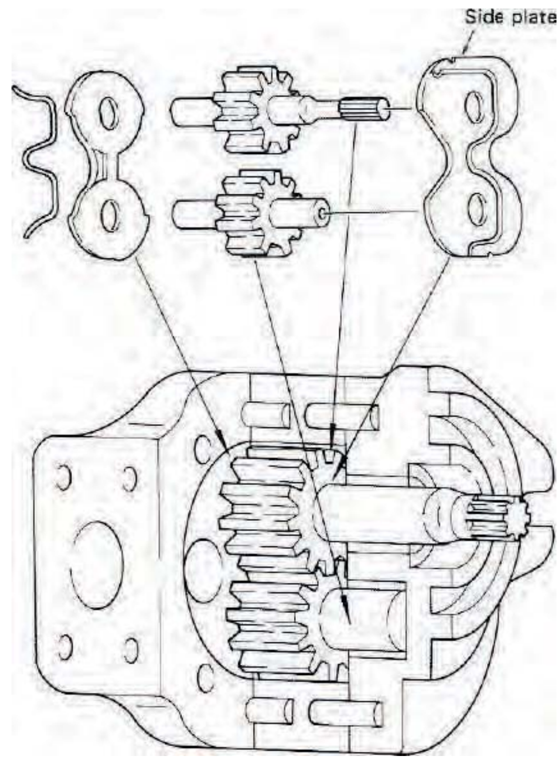
FEATURES

The gear pump is a high quality, reliable product that is specially designed for use in construction equipment which works under severe conditions.

- The side plate, given surface treatment to improve its matching characteristics with the special copper alloy, ensures minimum torque loss and excellent wear resistance.
- With the improved hydraulic balance mechanism, the pump offers stable performance and high durability.

STRUCTURE





1. Drive gear
2. Driven gear
3. Snap ring
4. Oil seal
5. Plate
6. Bracket
7. O-ring
8. Side plate
9. Backup ring
10. Sea! ring
11. Gear case
12. Side plate
13. Backup ring
14. Seal ring
15. Cover
16. O-ring
17. Bolt
18. Dowel pin

GEAR PUMP
25 GXP SERIES

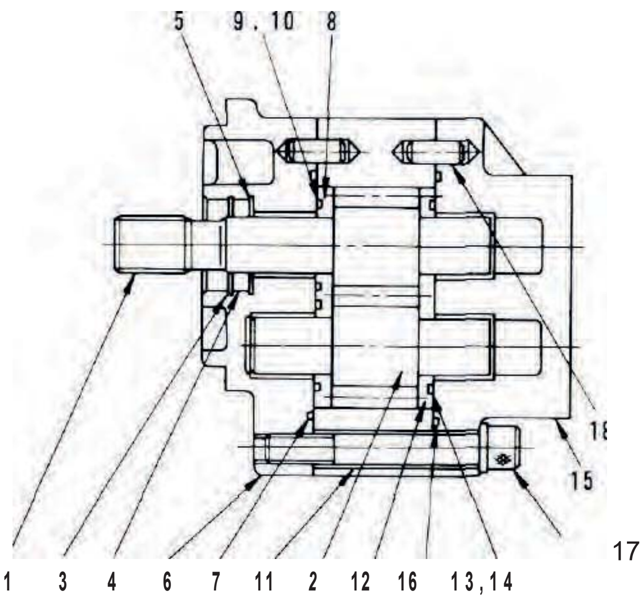
STRUCTURE

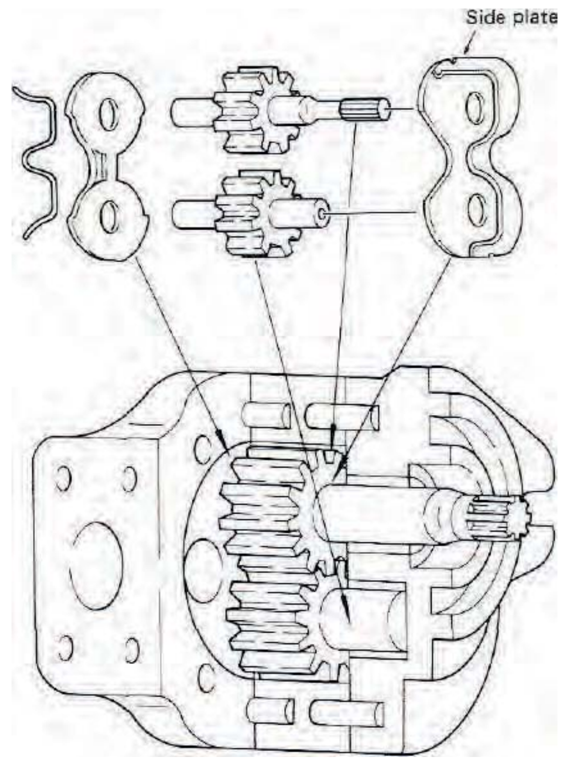
FEATURES

The gear pump is a high quality, reliable product that is specially designed for use in construction equipment which works under severe conditions.

- The side plate, given surface treatment to improve its matching characteristics with the special copper alloy, ensures minimum torque loss and excellent wear resistance.
- With the improved hydraulic balance mechanism, the pump offers stable performance and high durability.

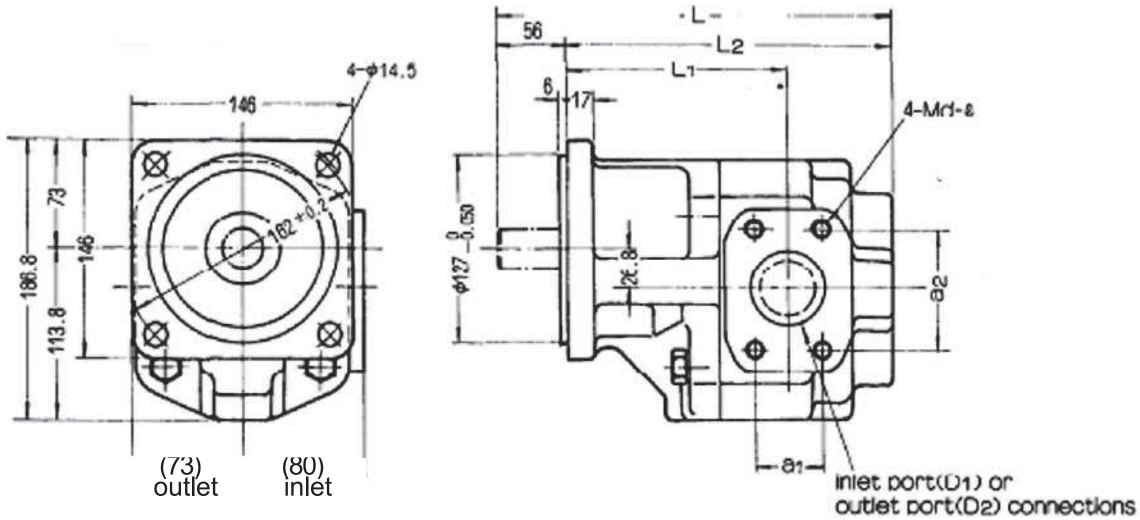
STRUCTURE





1. Drive gear
2. Driven gear
3. Snap ring
4. Oil seal
5. Plate
6. Bracket
7. O-ring
8. Side plate
9. Backup ring
10. Seal ring
11. Gear case
12. Side plate
13. Backup ring
14. Seal ring
15. Cover
16. O-ring
17. Bolt
18. Dowel pin

GXP Series Gear Pump



					Inlet Port			Outlet Pori		
model	size	L	L1	L2	D1	a1 x a2	D x l	D2	a1 x a2	D x l
10	80	267	143	211	51.0(2")	42.9x77.8	M12x22	38 (1 1/2")	35.7x69.8	M12x22

TESTING AND ADJUSTING

Measure the pump delivery with a test bench or flow meter kit (790-303-1001).
* See Note on page 97-1 07. The capacity codes marked • are for triple pumps.

No.	Check item	Series No.	Capacity code	Delivery pressure (kg/cm²!)	Standard		Repair limit	
					Rotation (rpm)	Delivery (liters; mm)	Rotation (rpm)	Delivery (liter/min)
1	Performance Hydraulic oil: E010-CD Oil temperature: 50=C	1	008 010 012 014 016 020 025	210	3500	25 32 38 47 52 66 83	3500	23 29 34 43 48 61 76
		2	*016 *020 *025 028 032 036 040 045 050	210	3000	44 55 67 77 88 100 111 121 138	3000	40 50 62 71 82 92 103 111 128
		3	*020 *025 *040 050 056 063 071 080 100	210	2500	45 55 90 112 129 145 158 184 231	2500	42 51 82 102 119 134 146 170 214
			112 125	140	2000	212 236	2000	192 213
		4	112 125 140 160	210	2200	233 253 287 328	2200	215 234 266 303
			180 200 224 250		2000	336 373 411 460	2000	310 345 385 425

For SA pumps operating at a service pressure of 50 kg/cm² or less, see the standard and the repair limit in Table, No. 2. (Examples: Pumps for power trainees and servo-hydraulic pumps for excavators)

No.	Check item	Series No.	Capacity code	Delivery pressure (kg/cm^2}	Standard Rotation (rpm)	Standard Delivery (liters/min)	Repair limit Rotation (rpm)	Repair limit Delivery (liters/min)
2	Performance	1	008	30	3500	27	3500	25
	Hydraulic oil:		010			33		30
	EO10-CD		012			40		37
	Oil temperature:		014			48		44
	50°C		016			54		50
			020			68		63
			025			86		79
		2	*008	30	3000	23	3000	21
			*016			47		43
			• 020			59		53
			*O25			72		66
			028			80		74
			032			92		84
			036			104		95
			040			115		106
			045			126		115
			050			144		132
		3	*020	30	2500	49	2500	44
			*025			60		55
			• 040			96		88
			*050			119		109
			056			134		123
			063			151		138
			071			164		150
			080			192		176
			100			241		221
			112	30	2000	217	2000	198
			125			240		220
		4	112	30	2200	242	2200	222
			125			264		242
			140			300		275
			160			342		314
			180		2000	350	2000	321
			200			389		357
			224			434		398
			250			480		440

Note 1) if it is impossible to raise the pump speed to the value shown in the table because of limitations of the test bench, calculate the allowance for the delivery from the following formula: we are seen

$$Q = Q_0 - \frac{(N_0 - N)\,Qth}{1000}$$

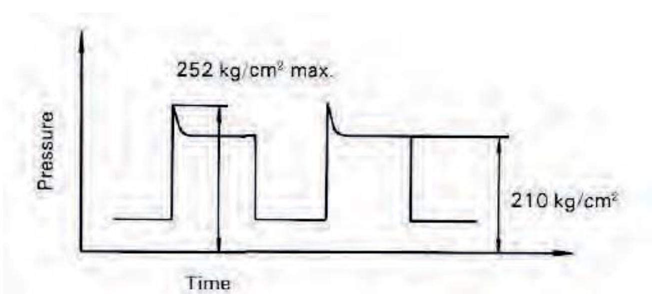
However, N>= 1 000 rpm
where, N: RPM of test bench
Q: Repair limit for delivery at N rpm (Liters/min)
N_0: RPM in the table (Liters/min)
Q_0,: Repair limit for delivery in the table
Qth: Capacity code

Note 2) if the test bench allows the pump to raise its delivery pressure above 140 kg/cm^2 but not above 210 kg/cm^2, use the repair limit for delivery given in Table, No. 1.

Note 3) for pumps whose service pressure exceeds 50 kg/cm^2 in operation, use Table, No. 1. (Do not use Table, No. 2}

Note 4) the volumetric efficiency of a pump decreases after the pump is reassembled. After reassembly, therefore, perform the following tests with a test bench or flowmeter kit (790-303-1001).

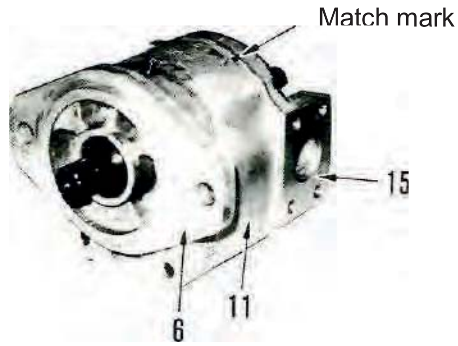
(1) Shock test
20 times



(2) Performance test (measure the delivery)

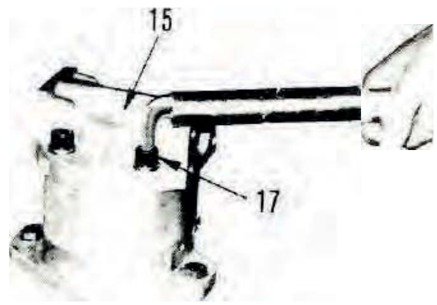
DISASSEMBLY

1. **Single pump**
   ★ Cautions before disassembly
   To avoid confusion in the reassembly, stamp match marks on connecting sections of bracket (6) to gear case (11) and to cover (15).



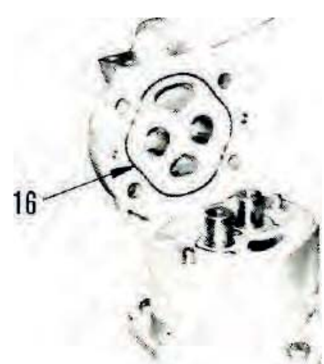
1) Put the pump assembly on a work bench with the bracket side facing down, and loosen mounting bolts (1 7) for cover (1 5).

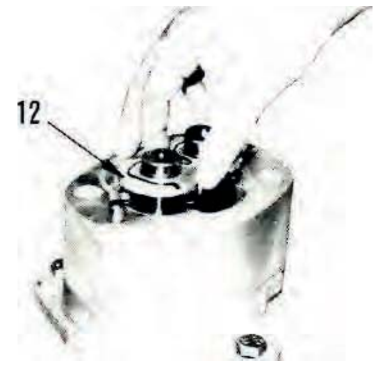
★ Use the bracket mounting bolt holes to secure the pump assembly.



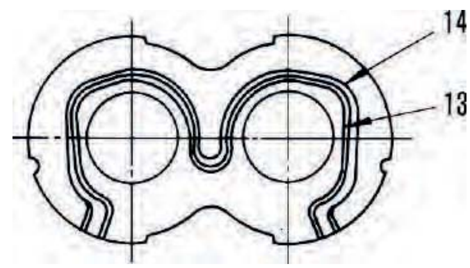
2) Remove cover assembly (5).
★ Place the internal parts in line in the order of removal, taking care not to damage the contacting surfaces or sliding surfaces of the parts.
★ Pull out cover assembly (1 5), taking care not to damage the hole for the dowel pin. Do not pry the cover.

3) Remove O-ring (16) from the cover.

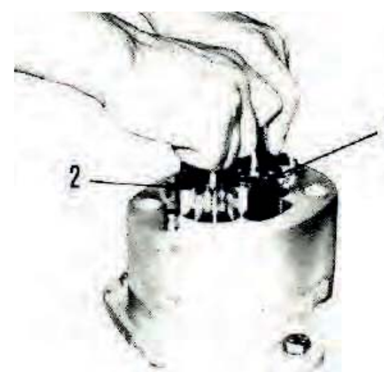




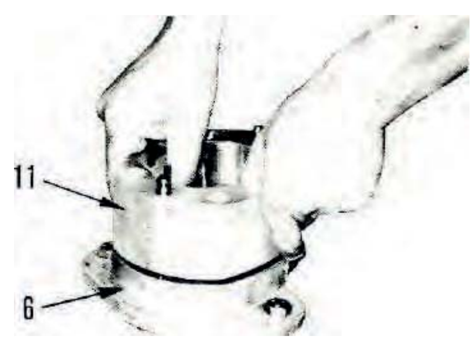
4) Pull out side plate (12) on the cover side.
5) Remove backup ring (13) and seal ring (14).



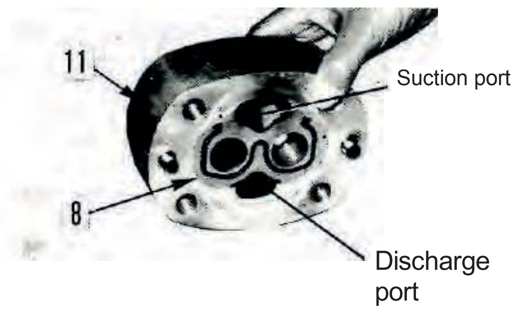
6) Remove drive gear (1) and driven gear (2).
- ⋆ Pull out the gears by hand. Do not use a hammer.
- ⋆ If the oil seal is not replaced, tape the drive gear and the spline section to protect the oil seal from damage.



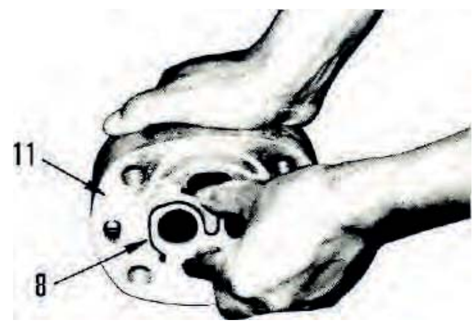
7) Remove bracket (6) from gear case (11).
- ⋆ When removing bracket (6) from gear case (11), take care not to let side plate (8) on the bracket side fall down and leave the side plate- installed as is to the gear case.
- ⋆ Do not hit the side plate surface.



8) Pull outside plate (8) from gear case (11}.

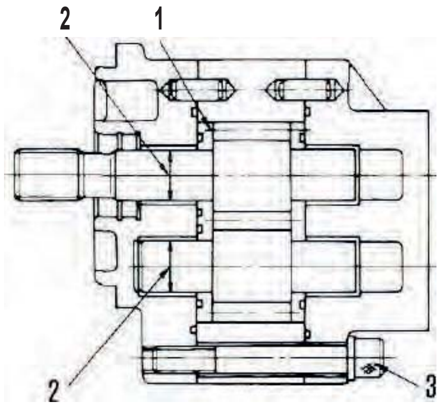


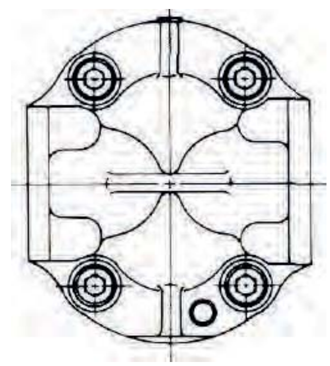
9) Remove backup ring (1 3} and seal ring (1 4).



10) Remove O-ring (7) from the bracket

MAINTENANCE STANDARD





Unit: mm

No.	Check item	Series No.	Criteria: Standard clearance	Criteria: Clearance limit	Remedy
1	Clearance between the gear case and the gear plus the side plate.	1 2	0.10 - 0.15	0.19	Replace the side plate or the pump assembly
		3	SALR020- 080 0.10 - 0.15	0.19	
			SALR100- 125 0.13 - 0.18	0.22	
		4	SALR112- 180 0.11 - 0.16	0.19	
			SALR200-250 0.14 -0.19	0.22	
2	Clearance between the I.D. of the plain bearing and the O.D. of the gear shaft.	1	SALR008- 014 0.06 -0.144	0.20	Replace
			SALR016- 025 0.06 -0.119		
		2	0.06- 0 125		
		3	0.06- 0.149		
		4	0.06- 0.140		
3	Tightening torque for the case mounting bolts.	1	10 -12.5 kgm		
		2	10 -12.5 kgm		
		3	23.5 - 27 kgm		
		4			