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1. STRUCTURE

This service 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 judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.
This service manual mainly contains the necessary technical information for operations performed in a service workshop.
For ease of understanding, the manual is divided into the following sections.

SECTION 1 GENERAL
This section explains the safety hints and gives the specification of the machine and major components.

SECTION 2 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.

SECTION 3 HYDRAULIC SYSTEM
This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM
This section explains the electrical circuit, monitoring system and each component. It serves not only to give an understanding electrical system, but also serves as reference material for trouble shooting.

SECTION 5 TROUBLESHOOTING
This section explains the troubleshooting charts correlating problems to causes.

SECTION 6 MAINTENANCE STANDARD
This section gives the judgement standards when inspecting disassembled parts.

SECTION 7 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.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HD Hyundai Construction Equipment distributors.
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 shows how to read the page number.
   Example 1
   2 - 3
   Item number (2. Structure and Function)
   Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.
   10 - 4
   10 - 4 - 1
   10 - 4 - 2 Added pages
   10 - 5

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 contents page and section 1 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.
		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.

3. CONVERSION TABLE

Method of using the Conversion Table

The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

Example

1. **Method of using the Conversion Table to convert from millimeters to inches**

   Convert 55mm into inches.

   (1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.

   (2) Locate the number 5 in the row across the top, take this as ⓑ, then draw a perpendicular line down from ⓑ.

   (3) Take the point where the two lines cross as ⓒ. This point ⓒ gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.

2. Convert 550mm into inches.

   (1) The number 550 does not appear in the table, so divide by 10(Move the decimal point one place to the left) to convert it to 55 mm.

   (2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.

   (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (Move the decimal point one place to the right) to return to the original value.
   This gives 550 mm = 21.65 inches.

Millimeters to inches

ⓑ

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
ⓐ 50	1.969	2.008	2.047	2.087	2.126	ⓒ 2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0		2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.5.	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

	0	1	2	3	4	5	6	7	8	9
0		0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.6076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.631	25.625	25.889	26.153

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
0		0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.969	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgf · m to lbf · ft

1 kgf · m = 7.233 lbf · ft

	0	1	2	3	4	5	6	7	8	9
		7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	396.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	10005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

kgf/cm² to lbf/in²

1 kgf / cm² = 14.2233 lbf / in²

	0	1	2	3	4	5	6	7	8	9
		14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	2863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	5603	2617	2631	2646	2660	2674	2688
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

TEMPERATURE

Fahrenheit-Centigrade Conversion.

A simple way to convert a fahrenheit temperature reading into a centigrade temperature reading or vice verse is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

˚C		˚F	˚C		˚F	˚C		˚F	˚C		˚F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-26.1	-15	5.0	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-25.6	-14	6.8	-6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
-25.0	-13	8.6	-5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
-24.4	-12	10.4	-5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
-23.9	-11	12.2	-4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
-23.3	-10	14.0	-3.9	25	77.0	15.6	60	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	35	95.0	21.1	70	158.0	51.7	125	257.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	172	347.0

SECTION 1 GENERAL

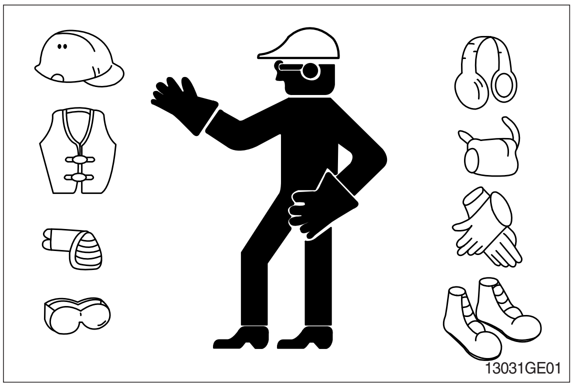
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

Unsafe work practices are dangerous. Understand service procedure before doing work; Do not attempt shortcuts.

WEAR PROTECTIVE CLOTHING

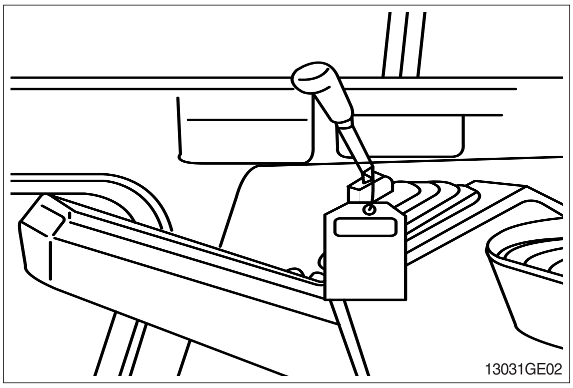
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

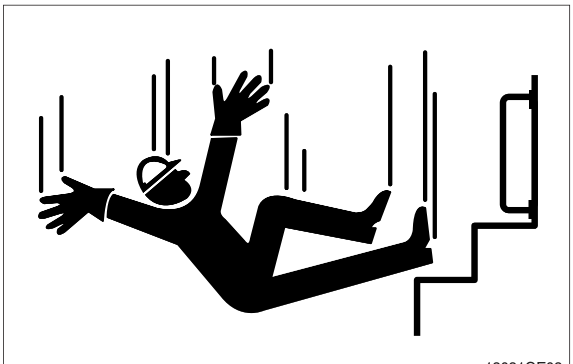
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a **Do Not Operate** tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.
When you get on and off the machine, always maintain a three point contact with the steps and handrails and face the machine. Do not use any controls as handholds.
Never jump on or off the machine. Never mount or dismount a moving machine.
Be careful of slippery conditions on platforms, steps, and handrails when leaving the machine.



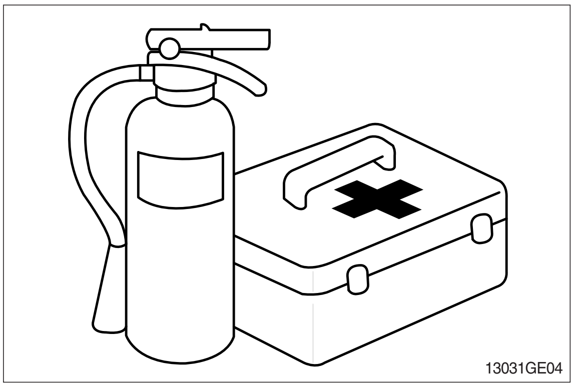
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

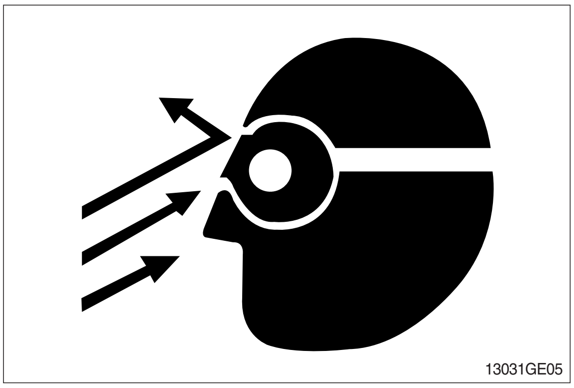
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.

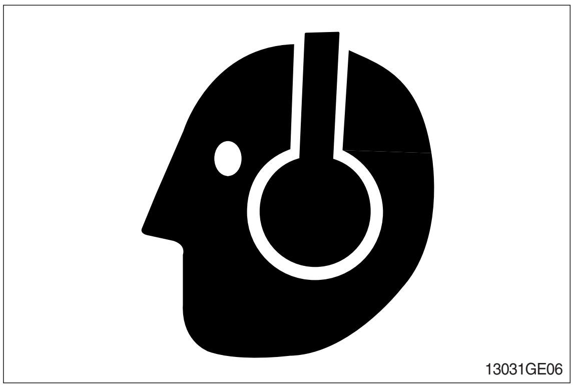


13031GE05

PROTECT AGAINST NOISE

Prolonged exposure to loud noise can cause impairment or loss of hearing.

Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

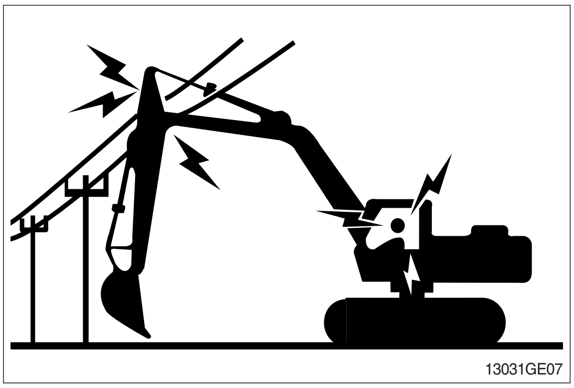


13031GE06

AVOID POWER LINES

Serious injury or death can result from contact with electric lines.

Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.

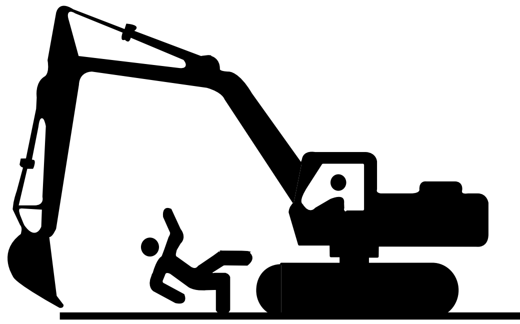


13031GE07

KEEP RIDERS OFF EXCAVATOR

Only allow the operator on the excavator. Keep riders off.

Riders on excavator are subject to injury such as being struck by foreign objects and being thrown off the excavator. Riders also obstruct the operator's view resulting in the excavator being operated in an unsafe manner.



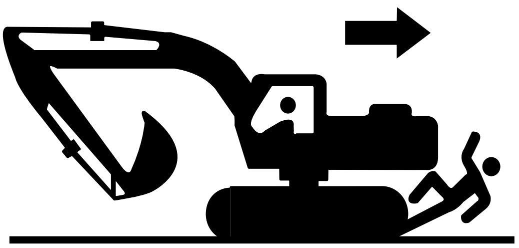
13031GE08

MOVE AND OPERATE MACHINE SAFELY

Bystanders can be run over. Know the location of bystanders before moving, swinging, or operating the machine.

Always keep the travel alarm in working condition. It warns people when the excavator starts to move.

Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.

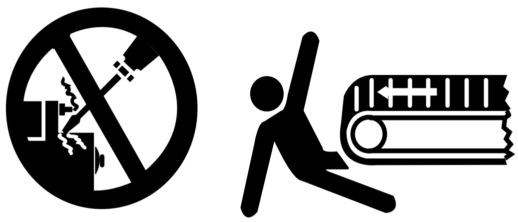


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

Avoid possible injury machine damage. Do not start engine by shorting across starter terminals.

NEVER start engine while standing on ground. Start engine only from operator's seat.



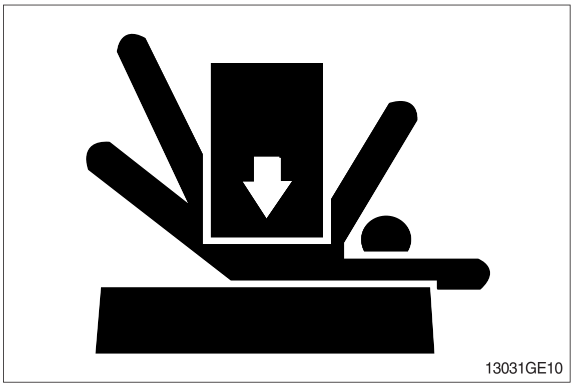
13031GE26

PARK MACHINE SAFELY

Before working on the machine:

·Park machine on a level surface.
·Lower bucket to the ground.
·Turn auto idle switch off.
·Run engine at 1/2 speed without load for 2 minutes.
  ·Turn key switch to OFF to stop engine.
  Remove key from switch.
·Move pilot control shutoff lever to locked position.
·Allow engine to cool.

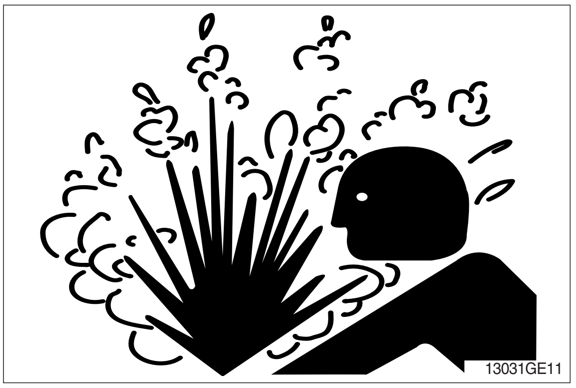
SUPPORT MACHINE PROPERLY


13031GE10

Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

SERVICE COOLING SYSTEM SAFELY


13031GE11

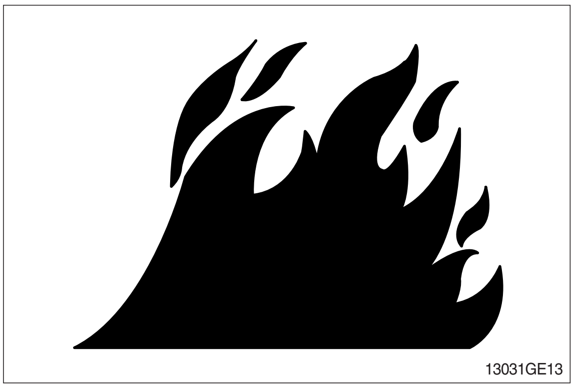
Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands.

HANDLE FLUIDS SAFELY-AVOID FIRES


13031GE12

Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.


13031GE13

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

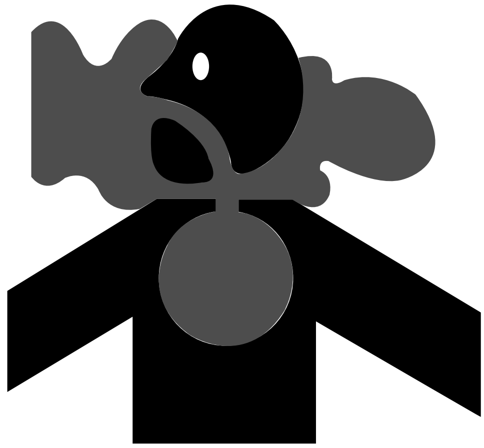
Make sure machine is clean of trash, grease, and debris.

Do not store oily rags; They can ignite and burn spontaneously.

BEWARE OF EXHAUST FUMES

Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

If you must operate in a building, be positive there is adequate ventilation. Either use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring enough outside air into the area.



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

·If you sand or grind paint, avoid breathing the dust. Wear an approved respirator.

·If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

ILLUMINATE WORK AREA SAFELY

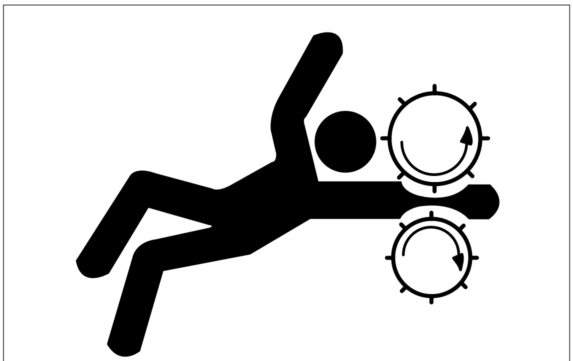
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.

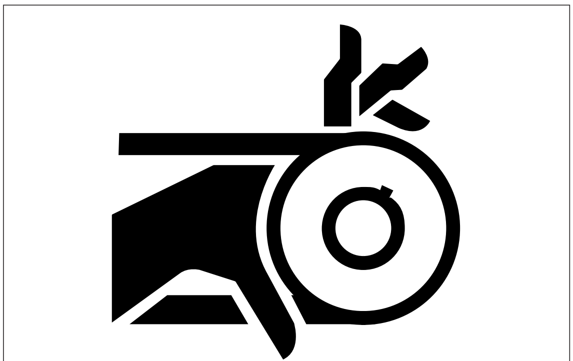


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

To prevent accidents, use care when working around rotating parts.



13031GE17

AVOID HIGH PRESSURE FLUIDS

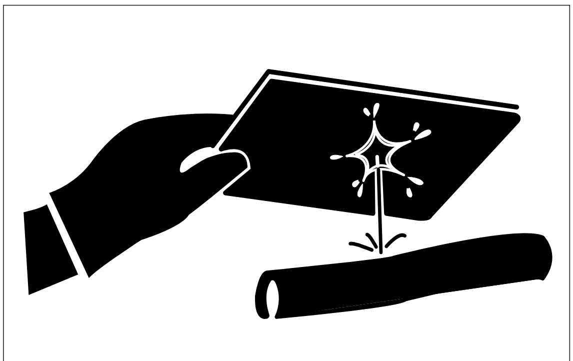
Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials.

Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area. Install fire resisting guards to protect hoses or other materials.

13031GE20

PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; It may explode. Warm battery to 16°C(60°F).

13031GE21

PREVENT ACID BURNS

Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

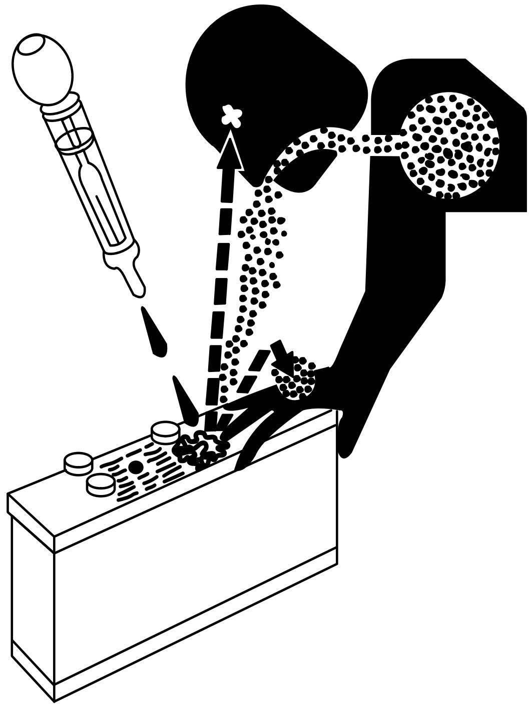
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10-15 minutes. Get medical attention immediately.

If acid is swallowed:

1. Drink large amounts of water or milk.
2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
3. Get medical attention immediately.



13031GE22

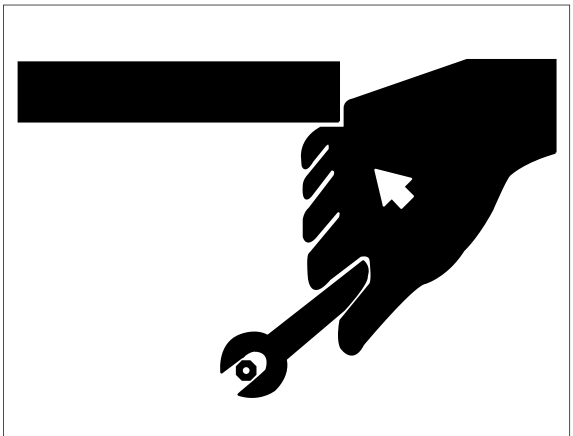
USE TOOLS PROPERLY

Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only recommended replacement parts. (See Parts catalogue.)



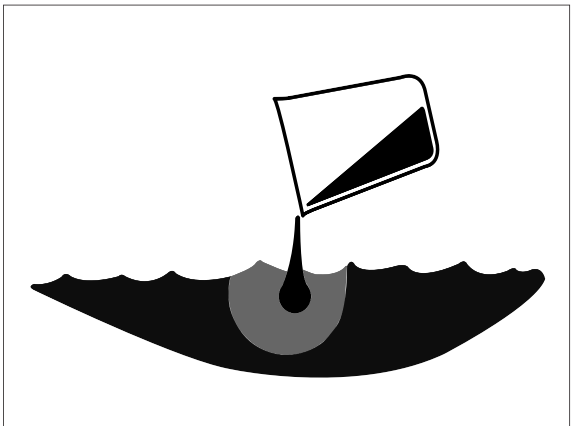
13031GE23

DISPOSE OF FLUIDS PROPERLY

Improperly disposing of fluids can harm the environment and ecology. Before draining any fluids, find out the proper way to dispose of waste from your local environmental agency.

Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

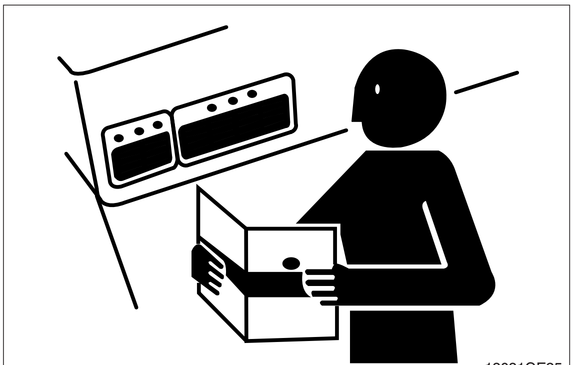
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



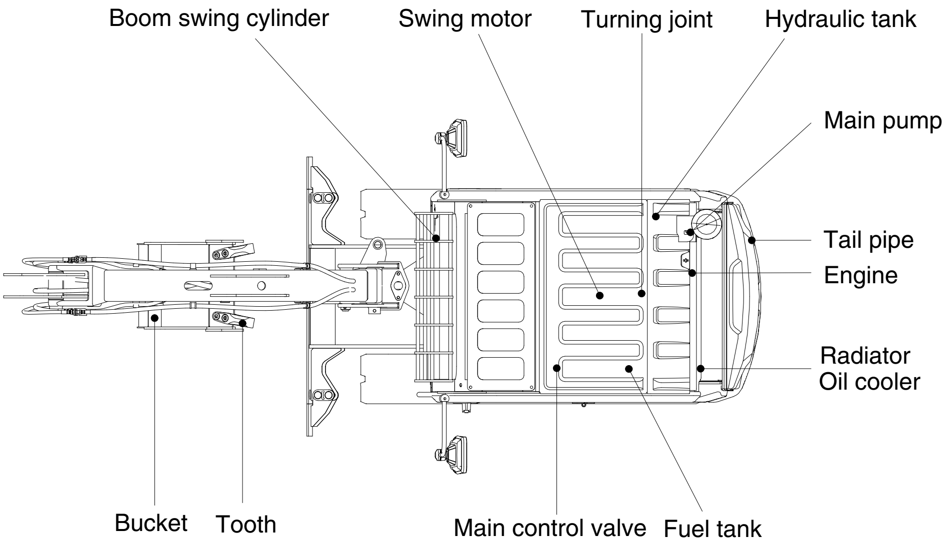
13031GE25

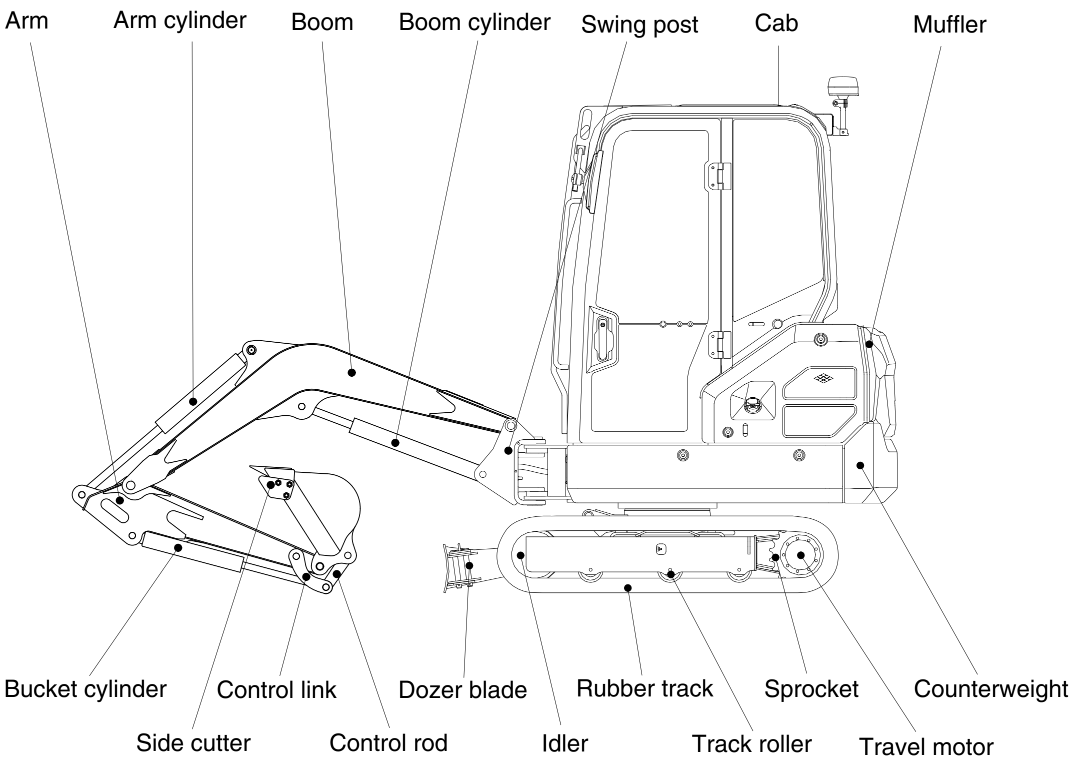
LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

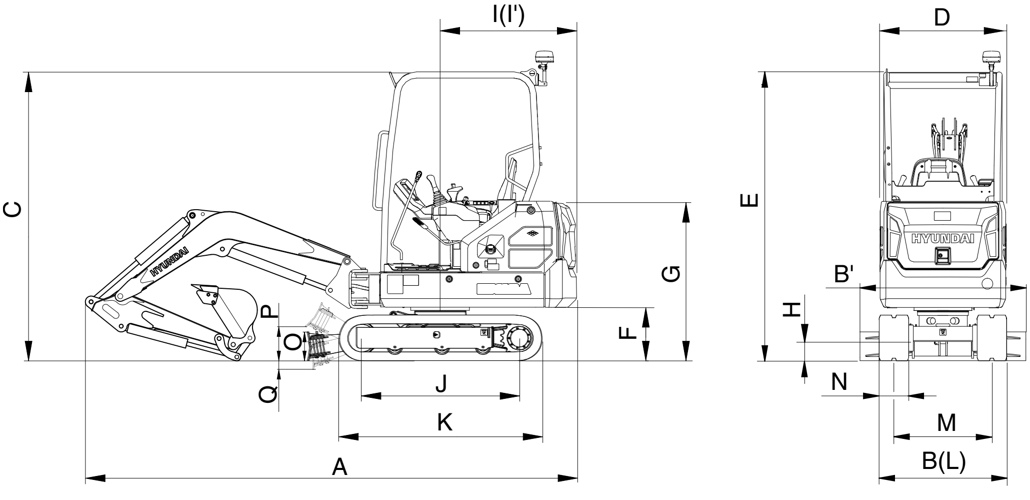




19A2SP01

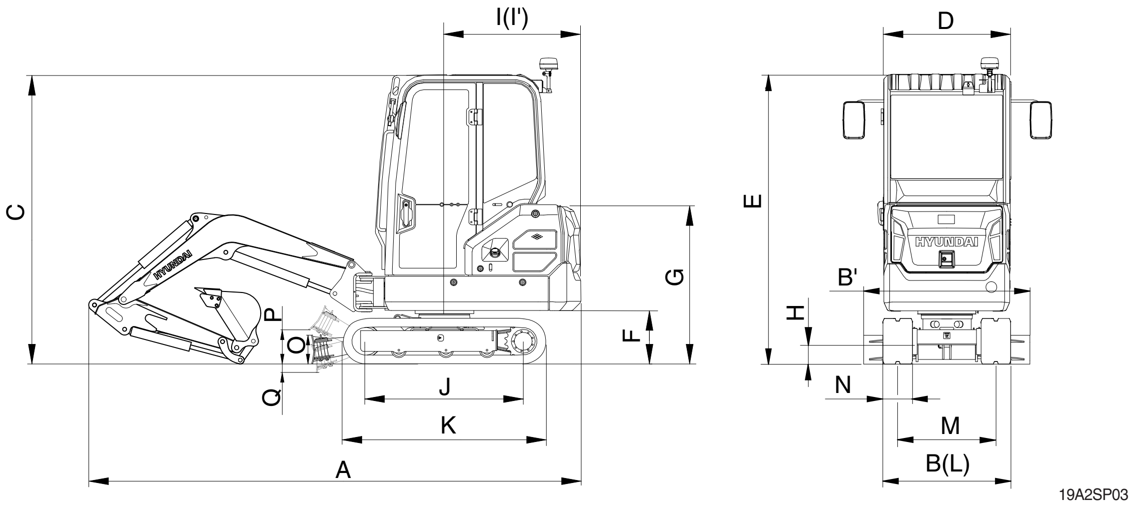
2. SPECIFICATIONS

1) 1.75 m (5' 9") MONO BOOM, 1.03 m (3' 5") ARM, WITH CANOPY



Description		Unit	Specification
Operating weight (canopy/cabin)		kg (lb)	1885 (4160)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.04 (0.05)
Overall length	A	mm (ft-in)	3837 (12' 7")
Overall width (extension crawler)	B		994~1290 (3' 3"~ 4' 3")
Overall width (dozer blade)	B'		1294 (4' 3")
Overall height	C		2275 (7' 6")
Overall width of upperstructure	D		980 (3' 3")
Overall height of canopy/cabin	E		2275 (7' 6")
Ground clearance of counterweight	F		415 (1' 4")
Overall height of engine hood	G		1240 (4' 1")
Minimum ground clearance	H		150 (0' 6")
Rear-end distance	I		1065 (3' 6")
Rear-end swing radius	I'		1065 (3' 6")
Distance between tumblers	J		1230 (4' 0")
Undercarriage length	K		1580 (5' 2")
Undercarriage width (extension crawler)	L		994~1290 (3' 3"~ 4' 3")
Track gauge (extension crawler)	M		764~1060 (2' 6"~ 3' 6")
Track shoe width, standard	N		230 (0' 9")
Height of blade	O		225 (0' 9")
Ground clearance of blade up	P		183 (0' 7")
Depth of blade down	Q		222 (0' 9")
Travel speed (low/high)		km/hr (mph)	2.06/3.73 (1.28/2.32)
Swing speed		rpm	9.21
Gradeability		Degree (%)	35 (70)
Ground pressure 230 mm rubber shoe (canopy/cabin)		kgf/cm^2 (psi)	0.31 (4.47)
Max traction force		kg (lb)	1441 (3180)

2) 1.75 m (5' 9") MONO BOOM, 1.23 m (4' 0") LONG ARM, WITH CAB

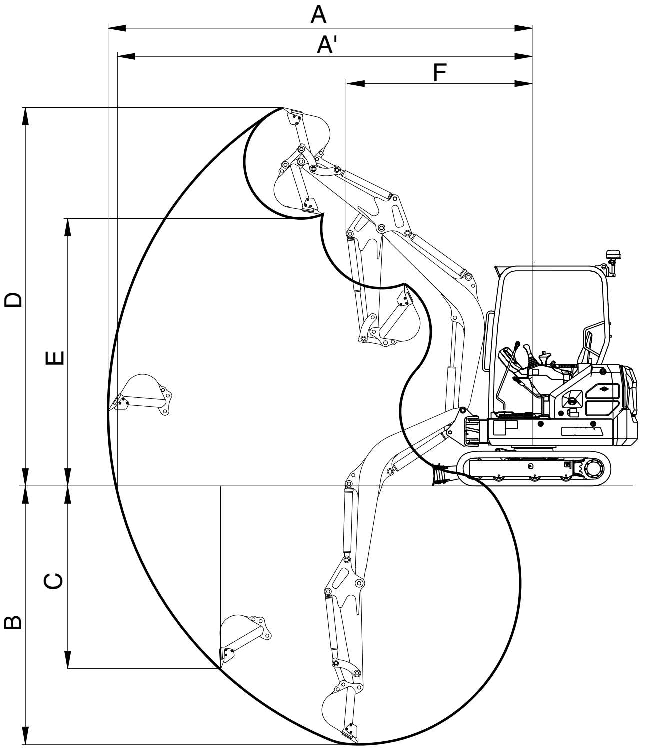


19A2SP03

Description		Unit	Specification
Operating weight (canopy/cabin)		kg (lb)	2020 (4450)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.04 (0.05)
Overall length	A		3835 (12' 7")
Overall width (extension crawler)	B		994~1290 (3' 3"~4' 3")
Overall width (dozer blade)	B'		1294 (4' 3")
Overall height	C		2270 (7' 5")
Overall width of upperstructure	D		980 (3' 3")
Overall height of canopy/cabin	E		2270 (7' 5")
Ground clearance of counterweight	F		415 (1' 4")
Overall height of engine hood	G		1240 (4' 1")
Minimum ground clearance	H		150 (0' 6")
Rear-end distance	I	mm (ft-in)	1065 (3' 6")
Rear-end swing radius	I'		1065 (3' 6")
Distance between tumblers	J		1230 (4' 0")
Undercarriage length	K		1580 (5' 2")
Undercarriage width (extension crawler)	L		994~1290 (3' 3"~4' 3")
Track gauge (extension crawler)	M		764~1060 (2' 6"~3' 6")
Track shoe width, standard	N		230 (0' 9")
Height of blade	O		225 (0' 9")
Ground clearance of blade up	P		183 (0' 7")
Depth of blade down	Q		222 (0' 9")
Travel speed (low/high)		km/hr (mph)	2.06/3.73 (1.28/2.32)
Swing speed		rpm	9.21
Gradeability		Degree (%)	35 (70)
Ground pressure 230 mm rubber shoe (canopy/cabin)		kgf/cm^2 (psi)	0.34 (4.78)
Max traction force		kg (lb)	1441 (3180)

3. WORKING RANGE

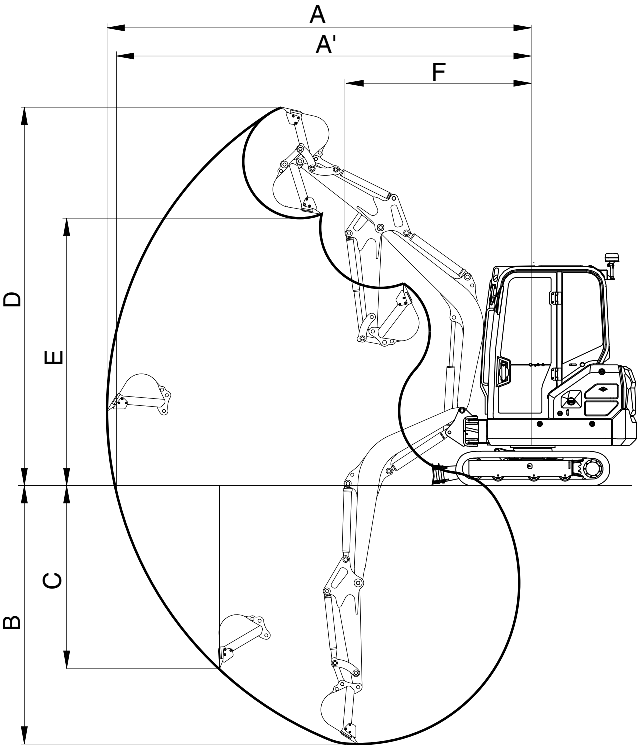
1) 1.75 m (5' 9") MONO BOOM, WITH CANOPY



19A2SP05

Description		1.03 m (3' 5") Arm
Max digging reach	A	3940 mm (12' 11")
Max digging reach on ground	A'	3850 mm (12' 8")
Max digging depth	B	2340 mm (7' 8")
Max digging depth (8 ft level)	B'	1740 mm (5' 9")
Max vertical wall digging depth	C	1840 mm (6' 0")
Max digging height	D	3470 mm (11' 5")
Max dumping height	E	2440 mm (8' 0")
Min swing radius	F	1725 mm (5' 8")
Boom swing radius (left/right)		55°/59°
Bucket digging force	SAE	14 kN
		1436 kgf
		3167 lbf
	ISO	16 kN
		1664 kgf
		3668 lbf
Arm crowd force	SAE	9 kN
		899 kgf
		1981 lbf
	ISO	9 kN
		933 kgf
		2057 lbf

2) 1.75 m (5' 9") MONO BOOM, WITH CAB



19A2SP06

Description		1.23 m (4' 0") Long arm
Max digging reach	A	4130 mm (13' 7")
Max digging reach on ground	A'	4040 mm (13' 3")
Max digging depth	B	2540 mm (8' 4")
Max digging depth (8 ft level)	B'	2000 mm (6' 7")
Max vertical wall digging depth	C	2020 mm (6' 8")
Max digging height	D	3585 mm (11' 9")
Max dumping height	E	2550 mm (8' 4")
Min swing radius	F	1760 mm (5' 9")
Boom swing radius (left/right)		55°/59°
Bucket digging force	SAE	14 kN
		1436 kgf
		3167 lbf
	ISO	16 kN
		1664 kgf
		3668 lbf
Arm crowd force	SAE	8 kN
		796 kgf
		1754 lbf
	ISO	8 kN
		822 kgf
		1812 lbf

4. WEIGHT

Item	kg	lb
Upperstructure assembly		
· Main frame weld assembly	248	547
· Engine assembly (including DPF)	75	165
· Main pump assembly	13	29
· Main control valve assembly	25	55
· Swing motor assembly	23	51
· Hydraulic oil tank wa	16	35
· Fuel tank wa	4	9
· Counterweight	65	143
· Cab assembly	364	802
Lower chassis assembly		
· Track frame weld assembly	206	454
· Dozer blade assembly	63	139
· Swing bearing	19	42
· Travel motor assembly	36	79
· Turning joint	14	31
· Sprocket	4	9
· Track recoil spring	11	24
· Idler	14	31
· Lower roller	5	11
· Track-chain assembly-rubber	71	157
Front attachment assembly		
· Boom assembly	72	159
· Arm assembly-1.03 m	37	83
· Arm assembly-1.03 m thumb bracket	40	88
· Arm assembly-1.23 m	47	104
· Arm assembly-1.23 m thumb bracket	49	109
· Bucket assembly	41	90
· Boom cylinder assembly	16	36
· Arm cylinder assembly	16	34
· Bucket cylinder assembly	12	25
· Dozer cylinder assembly	10	23
· Boom swing cylinder	10	22
· Extension cylinder	7	15
· Bucket control linkage total	12	27

※ This information is different with operating weight and transportation weight because it is not including harness, pipe, oil, fuel so on.

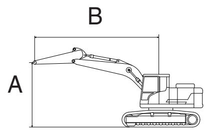
※ Refer to transportation for actual weight information and specifications for operating weight.

5. LIFTING CAPACITIES

1) CANOPY TYPE

Model	Type	Boom	Arm	Counterweight	Rubber shoe	Wheel	Dozer		Outtriger	
HX19A	Canopy	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		1750	1030	65	230	-	Up	-	-	-

· : Rating over-front · : Rating over-side or 360 degree



Load point height (A)		Load radius (B)						At max. reach		
		2.0 m (6.6 ft)		2.5 m (8.2 ft)		3.0 m (9.8 ft)		Capacity		Reach
										m (ft)
2.5 m	kg			*370	*370			*350	350	2.77
(8.2 ft)	lb			*820	*820			*770	770	(9.1)
2.0 m	kg			*380	*380	320	310	300	290	3.10
(6.6 ft)	lb			*840	*840	710	680	660	640	(10.2)
1.5 m	kg	*510	*510	420	400	320	300	270	260	3.30
(4.9 ft)	lb	*1120	*1120	930	880	710	660	600	570	(10.8)
1.0 m	kg	570	540	410	390	310	300	260	250	3.39
(3.3 ft)	lb	1260	1190	900	860	680	660	570	550	(11.1)
0.5 m	kg	550	510	400	380	300	290	250	240	3.39
(1.6 ft)	lb	1210	1120	880	840	660	640	550	530	(11.1)
0.0 m	kg	530	500	390	370	300	290	260	250	3.29
(0.0 ft)	lb	1170	1100	860	820	660	640	570	550	(10.8)
-0.5 m	kg	530	500	380	360	300	290	290	280	3.08
(-1.6 ft)	lb	1170	1100	840	790	660	640	640	620	(10.1)
-1.0 m	kg	540	510	390	370			340	330	2.73
(-3.3 ft)	lb	1190	1120	860	820			750	730	(9.0)
-1.5 m	kg	*500	*500					*430	*430	2.14
(-4.9 ft)	lb	*1100	*1100					*950	*950	(7.0)

Note
1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited by hydraulic capacity.

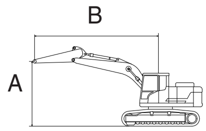
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult with your local HD Hyundai Construction Equipment dealer regarding the lifting capacities for specific work tools and attachments.

※ Please be aware of the local regulations and instructions for lifting operations.

⚠ Failure to comply to the rated load can cause serious injury, death, or property damage. Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Rubber shoe	Wheel	Dozer		Outtriger	
HX19A	Canopy	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		1750	1030	65	230	-	Down	-	-	-

· : Rating over-front · : Rating over-side or 360 degree



Load point height (A)		Load radius (B)						At max. reach		
		2.0 m (6.6 ft)		2.5 m (8.2 ft)		3.0 m (9.8 ft)		Capacity		Reach
										m (ft)
2.5 m	kg			*370	*370			*350	*350	2.77
(8.2 ft)	lb			*820	*820			*770	*770	(9.1)
2.0 m	kg			*380	*380	*390	330	*330	310	3.10
(6.6 ft)	lb			*840	*840	*860	730	*730	680	(10.2)
1.5 m	kg	*510	*510	*440	430	*410	320	*330	280	3.30
(4.9 ft)	lb	*1120	*1120	*970	950	*900	710	*730	620	(10.8)
1.0 m	kg	*700	580	*520	420	*440	320	*340	260	3.39
(3.3 ft)	lb	*1540	1280	*1150	930	*970	710	*750	570	(11.1)
0.5 m	kg	*850	550	*600	400	*480	310	*370	260	3.39
(1.6 ft)	lb	*1870	1210	*1320	880	*1060	680	*820	570	(11.1)
0.0 m	kg	*910	540	*640	390	*490	310	*410	270	3.29
(0.0 ft)	lb	*2010	1190	*1410	860	*1080	680	*900	600	(10.8)
-0.5 m	kg	*870	540	*630	390	*470	310	*440	300	3.08
(-1.6 ft)	lb	*1920	1190	*1390	860	*1040	680	*970	660	(10.1)
-1.0 m	kg	*760	540	*540	390			*450	350	2.73
(-3.3 ft)	lb	*1680	1190	*1190	860			*990	770	(9.0)
-1.5 m	kg	*500	*500					*430	*430	2.14
(-4.9 ft)	lb	*1100	*1100					*950	*950	(7.0)

Note 1. Lifting capacity are based on ISO 10567.
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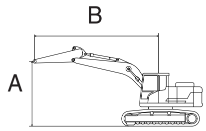
⚠ Failure to comply to the rated load can cause serious injury, death, or property damage. Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Rubber shoe	Wheel	Dozer		Outtriger	
HX19A	Canopy	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		1750	1230	65	230	-	Up	-	-	-

· : Rating over-front · : Rating over-side or 360 degree



Load point height (A)		Load radius (B)								At max. reach		
		2.0m (6.6ft)		2.5m (8.2ft)		3.0 m (9.8 ft)		3.5 m (11.5 ft)		Capacity		Reach
												m (ft)
3.0 m	kg			*350	*350					*320	*320	2.53
(9.8 ft)	lb			*770	*770					*710	*710	(8.3)
2.5 m	kg					*290	*290			*280	*280	3.01
(8.2 ft)	lb					*640	*640			*620	*620	(9.9)
2.0m	kg					320	310			*270	260	3.31
(6.6 ft)	lb					710	680			*600	570	(10.9)
1.5m	kg			*390	*390	320	300			250	240	3.50
(4.9 ft)	lb			*860	*860	710	660			550	530	(11.5)
1.0m	kg	580	540	410	390	310	300	240	230	230	220	3.58
(3.3 ft)	lb	1280	1190	900	860	680	660	530	510	510	490	(11.7)
0.5m	kg	550	510	390	370	300	290	240	230	230	220	3.58
(1.6 ft)	lb	1210	1120	860	820	660	640	530	510	510	490	(11.7)
0.0m	kg	530	500	380	360	290	280			240	230	3.48
(0.0 ft)	lb	1170	1100	840	790	640	620			530	510	(11.4)
-0.5m	kg	520	490	380	360	290	280			260	250	3.29
(-1.6 ft)	lb	1150	1080	840	790	640	620			570	550	(10.8)
-1.0m	kg	520	490	380	360					300	280	2.98
(-3.3 ft)	lb	1150	1080	840	790					660	620	(9.8)
-1.5m	kg	530	500							390	370	2.47
(-4.9 ft)	lb	1170	1100							860	820	(8.1)
-2.0m	kg									*290	*290	1.45
(-6.6 ft)	lb									*640	*640	(4.7)

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Model	Type	Boom	Arm	Counterweight	Rubber shoe	Wheel	Dozer		Outtriger	
HX19A	Canopy	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		1750	1230	65	230	-	Down	-	-	-

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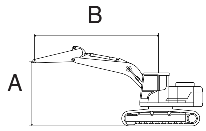

Load point height (A)		Load radius (B)								At max. reach		
		2.0m (6.6ft)		2.5m (8.2ft)		3.0 m (9.8 ft)		3.5 m (11.5 ft)		Capacity		Reach
												m (ft)
3.0 m	kg			*350	*350					*320	*320	2.53
(9.8 ft)	lb			*770	*770					*710	*710	(8.3)
2.5 m	kg					*290	*290			*280	*280	3.01
(8.2 ft)	lb					*640	*640			*620	*620	(9.9)
2.0m	kg					*340	330			*270	*270	3.31
(6.6 ft)	lb					*750	730			*600	*600	(10.9)
1.5m	kg			*390	*390	*370	320			*270	250	3.50
(4.9 ft)	lb			*860	*860	*820	710			*600	550	(11.5)
1.0m	kg	*620	580	*480	420	*410	320	*370	250	*270	240	3.58
(3.3 ft)	lb	*1370	1280	*1060	930	*900	710	*820	550	*600	530	(11.7)
0.5m	kg	*790	550	*560	400	*450	310	*390	250	*290	240	3.58
(1.6 ft)	lb	*1740	1210	*1230	880	*990	680	*860	550	*640	530	(11.7)
0.0m	kg	*880	540	*620	390	*480	300			*330	240	3.48
(0.0 ft)	lb	*1940	1190	*1370	860	*1060	660			*730	530	(11.4)
-0.5m	kg	*890	530	*630	380	*480	300			*390	260	3.29
(-1.6 ft)	lb	*1960	1170	*1390	840	*1060	660			*860	570	(10.8)
-1.0m	kg	*810	530	*580	380					*420	300	2.98
(-3.3 ft)	lb	*1790	1170	*1280	840					*930	660	(9.8)
-1.5m	kg	*620	540							*420	400	2.47
(-4.9 ft)	lb	*1370	1190							*930	880	(8.1)
-2.0m	kg									*290	*290	1.45
(-6.6 ft)	lb									*640	*640	(4.7)

Note 1. Lifting capacity are based on ISO 10567.
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2) CAB TYPE

Model	Type	Boom	Arm	Counterweight	Rubber shoe	Wheel	Dozer		Outtriger	
HX19A	Cab	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		1750	1030	65	230	-	Up	-	-	-

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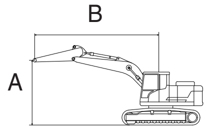

Load point height (A)		Load radius (B)						At max. reach		
		2.0 m (6.6 ft)		2.5 m (8.2 ft)		3.0 m (9.8 ft)		Capacity		Reach
										m (ft)
2.5 m (8.2 ft)	kg lb			*370 *820	*370 *820			*350 *770	*350 *770	2.77 (9.1)
2.0 m (6.6 ft)	kg lb			*380 *840	*380 *840	350 770	330 730	*330 *730	310 680	3.10 (10.2)
1.5 m (4.9 ft)	kg lb	*510 *1120	*510 *1120	*440 *970	430 950	350 770	330 730	300 660	280 620	3.30 (10.8)
1.0 m (3.3 ft)	kg lb	620 1370	580 1280	440 970	420 930	340 750	320 710	280 620	270 600	3.39 (11.1)
0.5 m (1.6 ft)	kg lb	590 1300	560 1230	430 950	410 900	330 730	320 710	280 620	270 600	3.39 (11.1)
0.0 m (0.0 ft)	kg lb	580 1280	550 1210	420 930	400 880	330 730	310 680	290 640	280 620	3.29 (10.8)
-0.5 m (-1.6 ft)	kg lb	580 1280	540 1190	420 930	400 880	330 730	310 680	320 710	300 660	3.08 (10.1)
-1.0 m (-3.3 ft)	kg lb	580 1280	550 1210	420 930	400 880			380 840	360 790	2.73 (9.0)
-1.5 m (-4.9 ft)	kg lb	*500 *1100	*500 *1100					*430 *950	*430 *950	2.14 (7.0)

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Model	Type	Boom	Arm	Counterweight	Rubber shoe	Wheel	Dozer		Outtriger	
HX19A	Cab	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		1750	1030	65	230	-	Down	-	-	-

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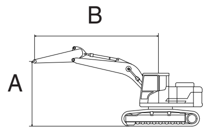

Load point height (A)		Load radius (B)						At max. reach		
		2.0 m (6.6 ft)		2.5 m (8.2 ft)		3.0 m (9.8 ft)		Capacity		Reach
										m (ft)
2.5 m	kg			*370	*370			*350	*350	2.77
(8.2 ft)	lb			*820	*820			*770	*770	(9.1)
2.0 m	kg			*380	*380	*390	350	*330	*330	3.10
(6.6 ft)	lb			*840	*840	*860	770	*730	*730	(10.2)
1.5 m	kg	*510	*510	*440	*440	*410	350	*330	300	3.30
(4.9 ft)	lb	*1120	*1120	*970	*970	*900	770	*730	660	(10.8)
1.0 m	kg	*700	620	*520	450	*440	340	*340	290	3.39
(3.3 ft)	lb	*1540	1370	*1150	990	*970	750	*750	640	(11.1)
0.5 m	kg	*850	600	*600	440	*480	340	*370	280	3.39
(1.6 ft)	lb	*1870	1320	*1320	970	*1060	750	*820	620	(11.1)
0.0 m	kg	*910	590	*640	430	*490	330	*410	290	3.29
(0.0 ft)	lb	*2010	1300	*1410	950	*1080	730	*900	640	(10.8)
-0.5 m	kg	*870	590	*630	430	*470	330	*440	320	3.08
(-1.6 ft)	lb	*1920	1300	*1390	950	*1040	730	*970	710	(10.1)
-1.0 m	kg	*760	590	*540	430			*450	380	2.73
(-3.3 ft)	lb	*1680	1300	*1190	950			*990	840	(9.0)
-1.5 m	kg	*500	*500					*430	*430	2.14
(-4.9 ft)	lb	*1100	*1100					*950	*950	(7.0)

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Model	Type	Boom	Arm	Counterweight	Rubber shoe	Wheel	Dozer		Outtriger	
HX19A	Cab	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		1750	1230	65	230	-	Up	-	-	-

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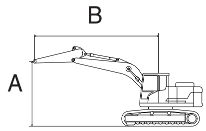

Load point height (A)		Load radius (B)								At max. reach		
		2.0m (6.6ft)		2.5m (8.2ft)		3.0 m (9.8 ft)		3.5 m (11.5 ft)		Capacity		Reach
												m (ft)
3.0 m	kg			*350	*350					*320	*320	2.53
(9.8 ft)	lb			*770	*770					*710	*710	(8.3)
2.5 m	kg					*290	*290			*280	*280	3.01
(8.2 ft)	lb					*640	*640			*620	*620	(9.9)
2.0m	kg					*340	330			*270	*270	3.31
(6.6 ft)	lb					*750	730			*600	*600	(10.9)
1.5m	kg			*390	*390	350	330			*270	260	3.50
(4.9 ft)	lb			*860	*860	770	730			*600	570	(11.5)
1.0m	kg	*620	590	440	420	340	320	270	250	260	240	3.58
(3.3 ft)	lb	*1370	1300	970	930	750	710	600	550	570	530	(11.7)
0.5m	kg	590	560	430	410	330	310	260	250	250	240	3.58
(1.6 ft)	lb	1300	1230	950	900	730	680	570	550	550	530	(11.7)
0.0m	kg	580	540	420	390	320	310			260	250	3.48
(0.0 ft)	lb	1280	1190	930	860	710	680			570	550	(11.4)
-0.5m	kg	570	530	410	390	320	300			280	270	3.29
(-1.6 ft)	lb	1260	1170	900	860	710	660			620	600	(10.8)
-1.0m	kg	570	540	410	390					330	310	2.98
(-3.3 ft)	lb	1260	1190	900	860					730	680	(9.8)
-1.5m	kg	580	550							*420	410	2.47
(-4.9 ft)	lb	1280	1210							*930	900	(8.1)
-2.0m	kg									*290	*290	1.45
(-6.6 ft)	lb									*640	*640	(4.7)

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Model	Type	Boom	Arm	Counterweight	Rubber shoe	Wheel	Dozer		Outtriger	
HX19A	Cab	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
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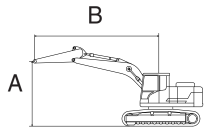

Load point height (A)		Load radius (B)								At max. reach		
		2.0m (6.6ft)		2.5m (8.2ft)		3.0 m (9.8 ft)		3.5 m (11.5 ft)		Capacity		Reach
												m (ft)
3.0 m	kg			*350	*350					*320	*320	2.53
(9.8 ft)	lb			*770	*770					*710	*710	(8.3)
2.5 m	kg					*290	*290			*280	*280	3.01
(8.2 ft)	lb					*640	*640			*620	*620	(9.9)
2.0m	kg					*340	*340			*270	*270	3.31
(6.6 ft)	lb					*750	*750			*600	*600	(10.9)
1.5m	kg			*390	*390	*370	350			*270	*270	3.50
(4.9 ft)	lb			*860	*860	*820	770			*600	*600	(11.5)
1.0m	kg	*620	*620	*480	450	*410	340	*370	270	*270	260	3.58
(3.3 ft)	lb	*1370	*1370	*1060	990	*900	750	*820	600	*600	570	(11.7)
0.5m	kg	*790	600	*560	430	*450	330	*390	270	*290	260	3.58
(1.6 ft)	lb	*1740	1320	*1230	950	*990	730	*860	600	*640	570	(11.7)
0.0m	kg	*880	580	*620	420	*480	330			*330	270	3.48
(0.0 ft)	lb	*1940	1280	*1370	930	*1060	730			*730	600	(11.4)
-0.5m	kg	*890	580	*630	420	*480	330			*390	290	3.29
(-1.6 ft)	lb	*1960	1280	*1390	930	*1060	730			*860	640	(10.8)
-1.0m	kg	*810	580	*580	420					*420	330	2.98
(-3.3 ft)	lb	*1790	1280	*1280	930					*930	730	(9.8)
-1.5m	kg	*620	590							*420	*420	2.47
(-4.9 ft)	lb	*1370	1300							*930	*930	(8.1)
-2.0m	kg									*290	*290	1.45
(-6.6 ft)	lb									*640	*640	(4.7)

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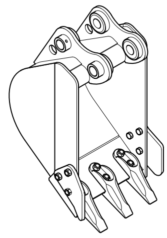
6. BUCKET SELECTION GUIDE



0.04 m³ SAE
heaped bucket

Capacity		Width		Weight	Recommendation	
					1.75 m (5' 9") boom	
SAE heaped	CECE heaped	Without side cutter	With side cutter		1.03 m (3' 5") arm	1.23 m (4' 0") arm
0.04 m^3 (0.05 yd^3)	0.035 m^3 (0.05 yd^3)	382 mm (15.0")	422 mm (16.6")	41 kg (90 lb)	●	●

● Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less

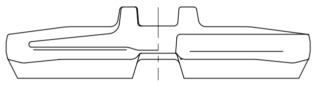
※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult with your local HD Hyundai Construction Equipment dealer for information on selecting the correct boom-arm-bucket combination.

7. UNDERCARRIAGE

1) TRACKS

X-leg type center frame is integrally welded with reinforced box-section track frames. The design includes dry tracks, lubricated rollers, idlers, sprockets, hydraulic track adjusters with shock absorbing springs and assembled track-type tractor shoes with triple grousers.

2) TYPES OF SHOES

Model	Shapes		Rubber track
			
HX19A	Shoe width	mm (in)	230 (9")
	Operating weight (canopy / cabin)	kg (lb)	1885 (4160)
	Ground pressure	kgf/cm² (psi)	0.31 (4.47)
	Overall width	mm (ft-in)	994~1290 (3' 3"~4' 3")

3) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

Confirm the category from the list of applications in **table 2**, then use **table 1** to select the shoe. Wide shoes (categories B and C) have limitations on applications. Before using wide shoes, check the precautions, then investigate and study the operating conditions to confirm if these shoes are suitable.

Select the narrowest shoe possible to meet the required flotation and ground pressure. Application of wider shoes than recommendations will cause unexpected problem such as bending of shoes, crack of link, breakage of pin, loosening of shoe bolts and the other various problems.

Table 1

Model	Track shoe	Specification	Category
HX19A	T/chain-rubber for rail interlocking (230 mm)	Standard	A

Table 2

Category	Applications	Precautions
A	Rocky ground, river beds, normal soil	· Travel at low speed on rough ground with large obstacles such as boulders or fallen trees or a wide range of general civil engineering work
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles
C	Extremely soft ground (swampy ground)	· Use the shoes only in the conditions that the machine sinks and it is impossible to use the shoes of category A or B · These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	KUBOTA D902-E4B
Type	4-cycle vertical, IDI diesel fuel
Cooling method	Water cooling
Number of cylinders and arrangement	3 cylinders, in-line
Firing order	1-2-3
Combustion chamber type	Spherical type
Cylinder bore × stroke	72.0 × 73.6 mm (2.83" × 2.90")
Piston displacement	898 cc (54.80 cu in)
Compression ratio	24 : 1
Gross power	16.2 hp (12.1 kW) at 2400 rpm
Net power	16.0 hp (11.9 kW) at 2400 rpm
Max. power	16.2 hp (12.1 kW) at 2400 rpm
Peak torque at 1900 rpm	5.57 kgf · m (40.3 lbf · ft)
Engine oil quantity	3.7 ℓ (1.0 U.S. gal)
Dry weight	75 kg (165 lb)
Starting motor	12V-1.2 kW
Alternator	12V-40 A

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Maximum pressure	210 kgf/cm^2 (2990 psi)
Capacity	2 × 7.5 cc/rev
Rated oil flow	2 × 17.3 ℓ/min (4.6 U.S. gpm / 3.8 U.K. gpm)
Rated speed	2300 rpm

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	4.5/2.7 cc/rev
Maximum pressure	190/35 kgf/cm^2 (2702/498 psi)
Rated oil flow	10.4/6.2 ℓ/min (2.7/1.6 U.S. gpm / 2.3/1.4 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	Sectional, 9 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	210 kgf/cm^2 (2990 psi)
Overload relief valve pressure	230 kgf/cm^2 (3270 psi)
2way (breaker piping) flow rate	27.7 ℓ/min (7.3 U.S. gpm / 6.1 U.K. gpm)

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	18.1 cc/rev
Relief pressure	165 kgf/cm^2 (2350 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	69.7 kgf·m (504 lbf·ft)
Brake release pressure	20~50 kgf/cm^2 (284~711 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Capacity	12.4/6.2 cc/rev
Relief pressure	210 kgf/cm^2 (2990 psi)
Reduction gear type	2-stage planetary

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	Ø60 × Ø40 × 465 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	Ø60 × Ø40 × 393 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	Ø55 × Ø35 × 345 mm
	Cushion	-
Boom swing cylinder	Bore dia × Rod dia × Stroke	Ø55 × Ø30 × 355 mm
	Cushion	-
Dozer cylinder	Bore dia × Rod dia × Stroke	Ø65 × Ø30 × 93 mm
	Cushion	-
Dozer cylinder-DPC	Bore dia × Rod dia × Stroke	Ø65 × Ø30 × 93 mm
	Cushion	-
Extension cylinder	Bore dia × Rod dia × Stroke	Ø50 × Ø25 × 300 mm
	Cushion	-

※ Discoloration of cylinder rod can occur when the friction reduction additive of lubrication oil spreads on the rod surface.

※ Discoloration does not cause any harmful effect on the cylinder performance.

9. RECOMMENDED OILS

HD Hyundai Construction Equipment genuine lubricating oils have been developed to offer the best performance and service life for your equipment. These oils have been tested according to the specifications of HD Hyundai Construction Equipment and, therefore, will meet the highest safety and quality requirements.

We recommend that you use only HD Hyundai Construction Equipment genuine lubricating oils and grease officially approved by HD Hyundai Construction Equipment.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C(°F): -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	3.7 (1.0)	SAE 10W SAE 20 SAE 30 SAE 10W-30 or 10W-40
Final drive	Gear oil	0.3×2 (0.1×2)	★SAE 75W-90 SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank: 20 (5.3)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO VG 46 ★3 ISO VG 68
Fuel tank	Diesel fuel★1	21.3 (5.6)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★2	5.4 (1.4)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

※ Using any lubricating oils other than HD Hyundai Construction Equipment genuine products may lead to a deterioration of performance and cause damage to major components.

※ Do not mix HD Hyundai Construction Equipment genuine oil with any other lubricating oil as it may result in damage to the systems of major components.

※ For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact your local HD Hyundai Construction Equipment dealer.

SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Material

★ : Cold region
Russia, CIS, Mongolia

★1 : Ultra low sulfur diesel
- sulfur content ≤ 10 ppm

★2 : Soft water
City water or distilled water

★3 : HD Hyundai Construction Equipment Bio Hydraulic Oil

SECTION 2 STRUCTURE AND FUNCTION

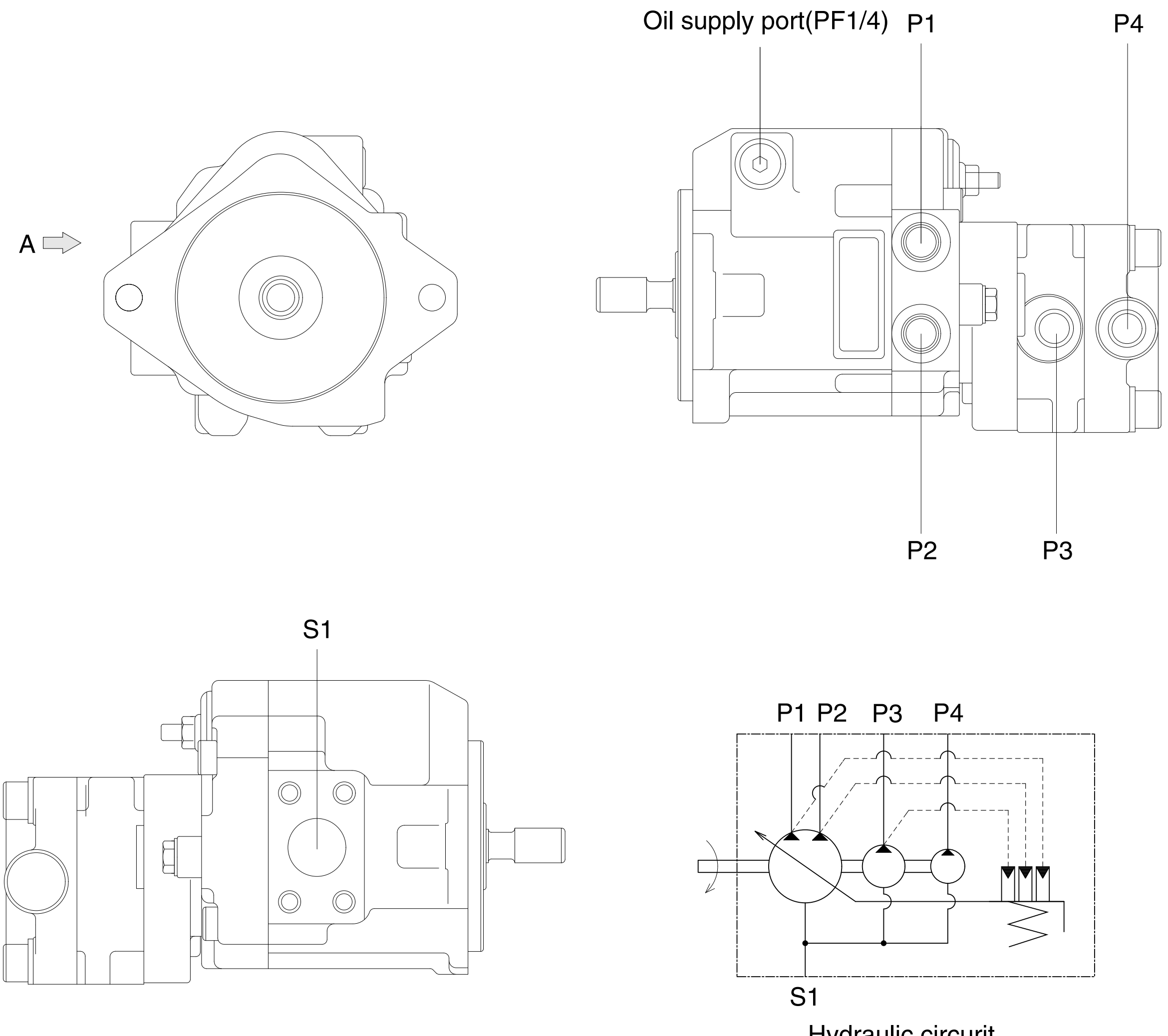
GROUP 1 HYDRAULIC PUMP

1. GENERAL

This is a variable displacement double-piston pump for discharge with equal displacements from one cylinder block. This pump is so compact as to appear a single pump though this is actually a double pump.

Because this pump has one swash plate, the tilting angle is the same for two pumps. Tilting of the pump changes in response to the total pressure of P1 + P2. Namely, the output is controlled to the constant value so that the relationship between the discharge pressure and flow rate Q becomes constant, (P1 + P2) * Q =Constant.

The third pump and pilot pump can be connected to the same shaft via a coupling.



VIEW A

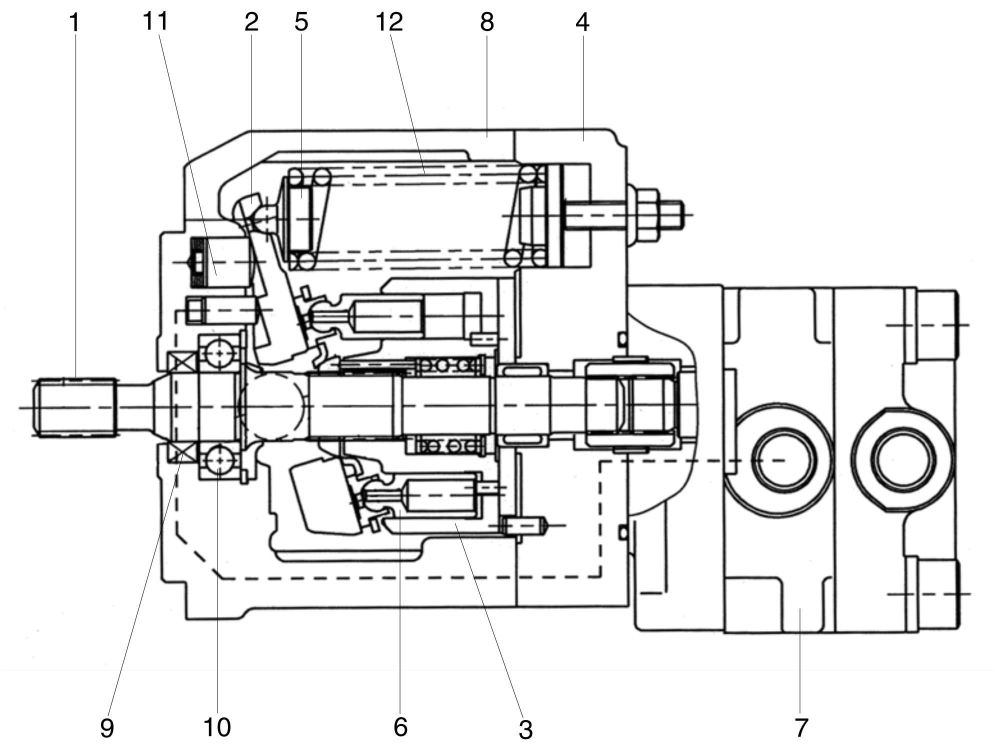
Hydraulic circuit

17AZ2MP01

Description of the ports

Port	Port name	Port size
S1	Suction port	SAE 1
P1, P2, P3, P4	Discharge port	PF 3/8

2. MAJOR COMPONENTS AND FUNCTIONS



17Z9A2MP02

1	Drive shaft assembly	7	Gear pump
2	Swash plate assembly	8	Body
3	Cylinder barrel	9	Oil seal
4	Port plate assembly	10	Bearing
5	Spring holder assembly	11	Stopper pin assembly
6	Piston	12	Spring

This is a variable displacement double-piston pump for discharge with two equal displacements from one cylinder block. Because this is one cylinder barrel, there is only one suction port.
The oil is divided into two equal flows by the control plate in the cover and directed to two discharge ports provided in the cover.
The discharge pressure directed to the piston tilts the hanger by overcoming the spring force.
Since the piston stroke changes according to the tilting angle of the hanger, the flow can be changed.
The simultaneous tilting angle constant-output control method is employed.
The pilot pump can be connected to the same shaft via a coupling.

1) PRINCIPLE OF OPERATION

(1) Function of pump

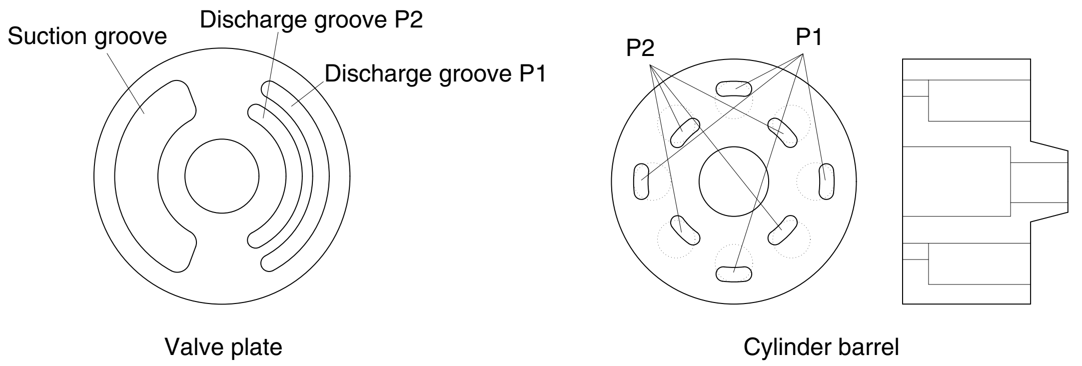


Figure 1 Working principle of PVD pump

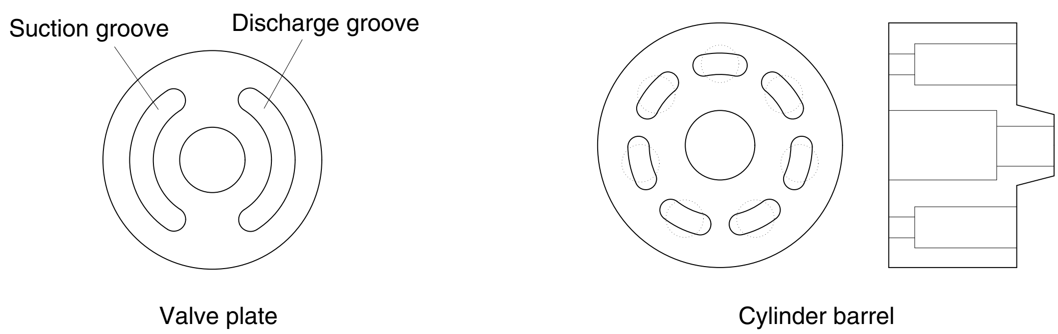


Figure 2 Working principle of Conventional type

R17Z9A2MP05

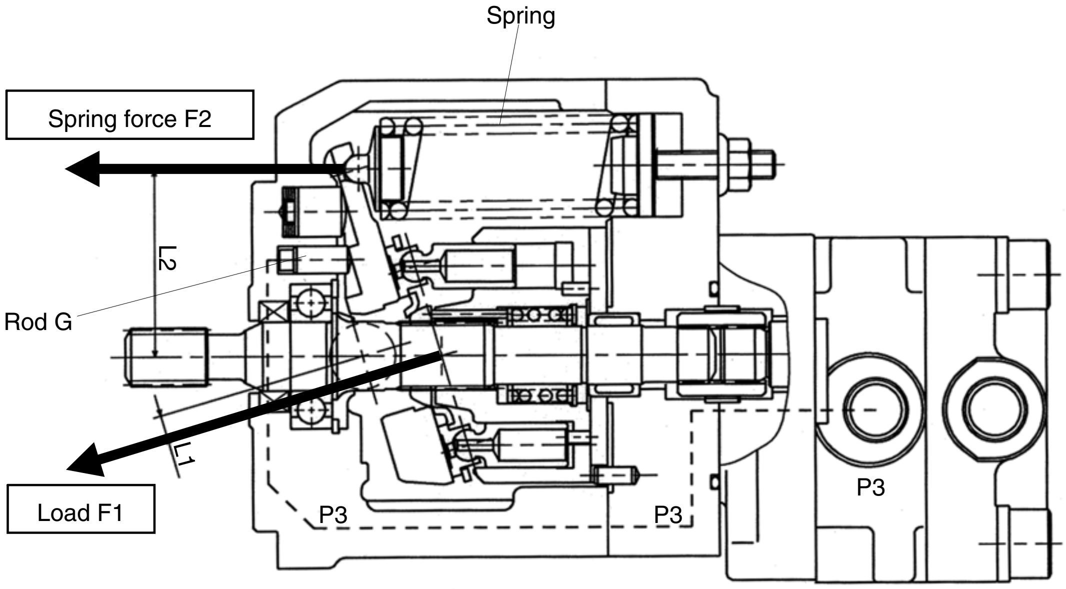
This pump adopts a new method using even numbered pistons to make functions of two same volume pumps available in one casing of a swash plate type variable volume piston pump.

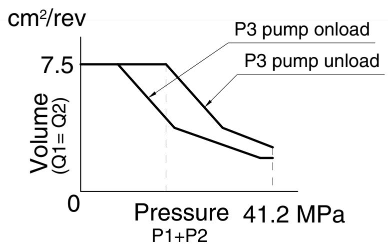
Conventional valve plate has one suction groove and one discharge groove respectively as shown in figure 2. But this method adopts one common suction groove and two discharge grooves on the outer side (P1) and the inner side (P2) as shown in figure 1, the piston room in the cylinder barrel opens to either the outer side (P1) or the inner side (P2) discharge groove of the valve plate alternately, and the discharges are performed independently on the inner side and the outer side.

Since this model has even numbered pistons, same No of pistons open to the outer side and the inner side of the valve plate. All pistons are of same swash plate, so the discharges from the outer side (P1) and the inner side (P2) are equal.

Also, since only one swash plate is used, the discharges from P1 and P2 ports changes equally when the swash plate angle of rake changes in variable controls. So, there is no difference between the two discharges.

2) CONTROL FUNCTIONS





P-Q characteristic

17AZ2MP04

(1) Constant horse power variable structure

The pump output flow rate is variable depending on an angle of the swash plate which is controlled according to the pump output pressure. This control enables the pump consumption horse power to be sustained at the maximum. The tilt point of the swash plate is the balls located behind the swash plate. The load F1 from the pistons is in the direction shown in the illustration and generates a clockwise moment against the swash plate. Against this force the spring (force F2) is located in the opposite direction to keep the horse power constant and set at the appointed load. As the pressure increases, the above clockwise moment increases, and when it overcomes the counter-clockwise moment created by the spring force, the spring is sagged and the swash plate angle gets smaller. Then the output flow rate is reduced to keep the horse power constant.

This prevents engine stall and the engine horse power can be utilized at the maximum.

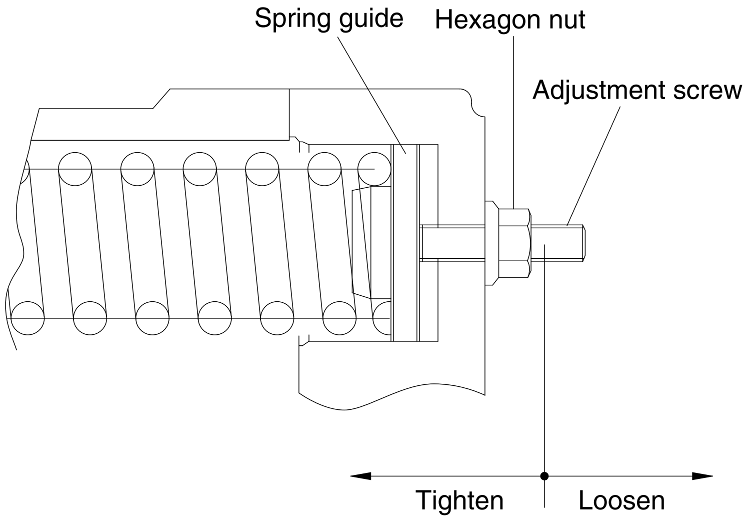
(2) Power shift mode (Reduced horse power control by P3 pressure)

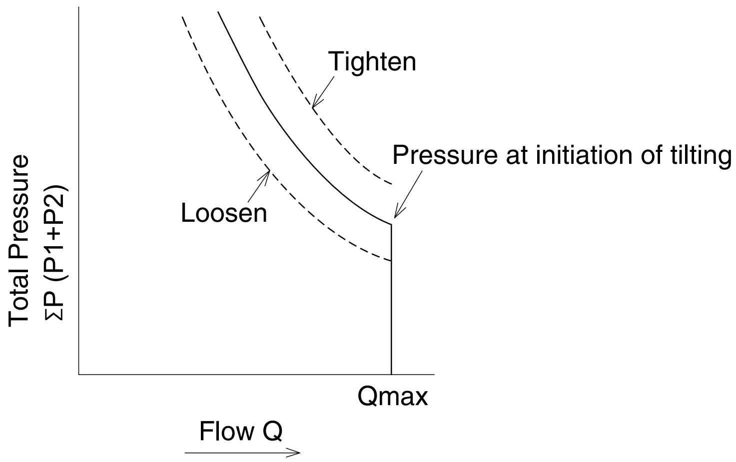
This control keeps the maximum value of the pump consumption horse power including the third pump (gear pump) constant. When the P3 (gear pump) pressure acts on the rod G, a clockwise moment proportion to the pressure acts on the swash plate and the P-Q characteristic shifts so that the total pump consumption horse power including the gear pump horse power is kept constant.

3) CONTROL / ADJUSTMENT PROCEDURE

(1) Loosen the hexagonal nut.

(2) Tighten or loosen the adjusting screw to set the power shifting line.

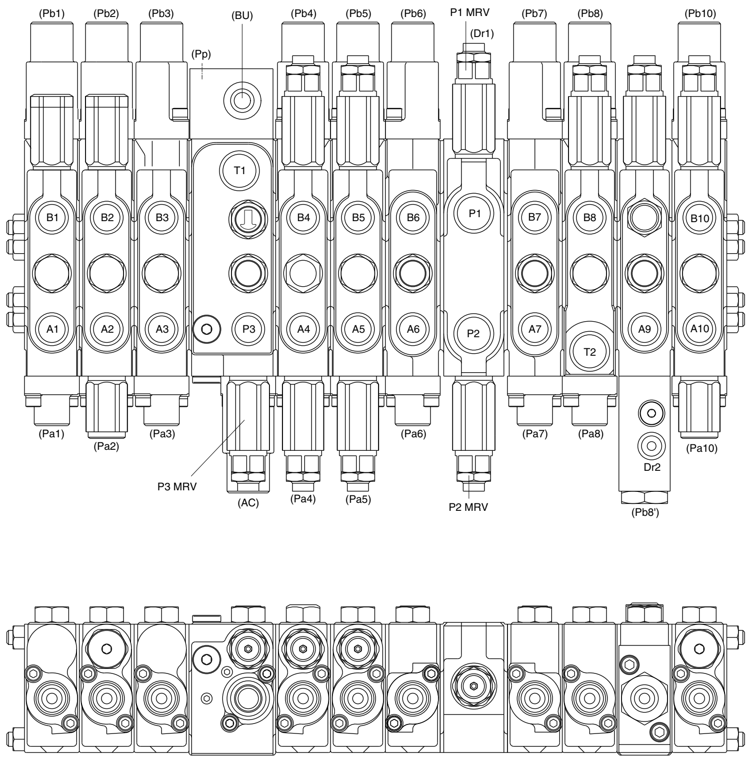




17Z9A2MP07

GROUP 2 MAIN CONTROL VALVE

1. OUTLINE

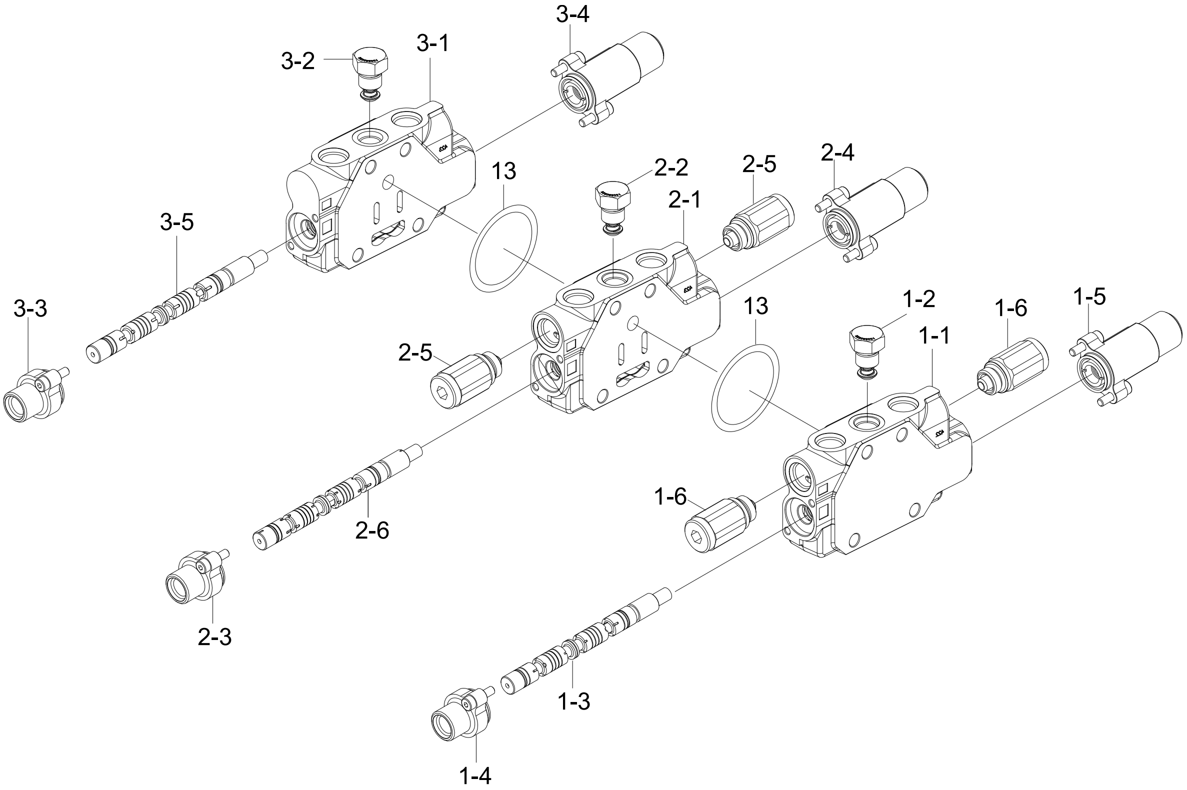


19A2MCV01

Mark	Port name	Port size	Tightening torque
P1	P1 pump port	PF 1/2	6~7 kgf · m
P2	P2 pump port		
T1	Tank return port		
T2	Tank return port		
P3	P3 pump port	PF 3/8	4.0~5.0 kgf · m
A1	Dozer		
B1	Dozer		
A2	Boom swing (RH) port		
B2	Boom swing (LH) port		
A3	Swing (LH) port		
B3	Swing (RH) port		
A4	Option port		
B4	Option port		
A5	Arm out port		
B5	Arm in port		
A6	Travel [LH/RR] port		
B6	Travel [LH/FW] port		
A7	Travel [RH/RR] port		
B7	Travel [RH/FW] port		
A9	Boom up port		
B8	Boom down port		
A10	Bucket out port	PF 3/8	4.0~5.0 kgf · m
B10	Bucket in port		

Mark	Port name	Port size	Tightening torque
Pa1	Dozer down pilot port	PF 1/4	2.5~3.0 kgf · m
Pb1	Dozer up pilot port		
Pa2	Boom swing (RH) pilot port		
Pb2	Boom swing (LH) pilot port		
Pa3	Swing (RH) pilot port		
Pb3	Swing (LH) pilot port		
Pa5	Arm out pilot port		
Pb5	Arm in pilot port		
Pa6	Travel [LH/RR] pilot port		
Pb6	Travel [LH/FW] pilot port		
Pa7	Travel [RH/RR] pilot port		
Pb7	Travel [RH/FW] pilot port		
Pa8	Boom up pilot port		
Pb8	Boom down pilot port		
Pa10	Bucket out pilot port		
Pb10	Bucket in pilot port		
Pp1	Travel signal input port		
Pb8	Boom lock valve release port		
Dr1	Travel drain port		
Dr2	Boom lock valve drain port		
Bu	Boom up pilot port		
Ac	Arm in pilot connecting port		
Pp1	Travel straight port		

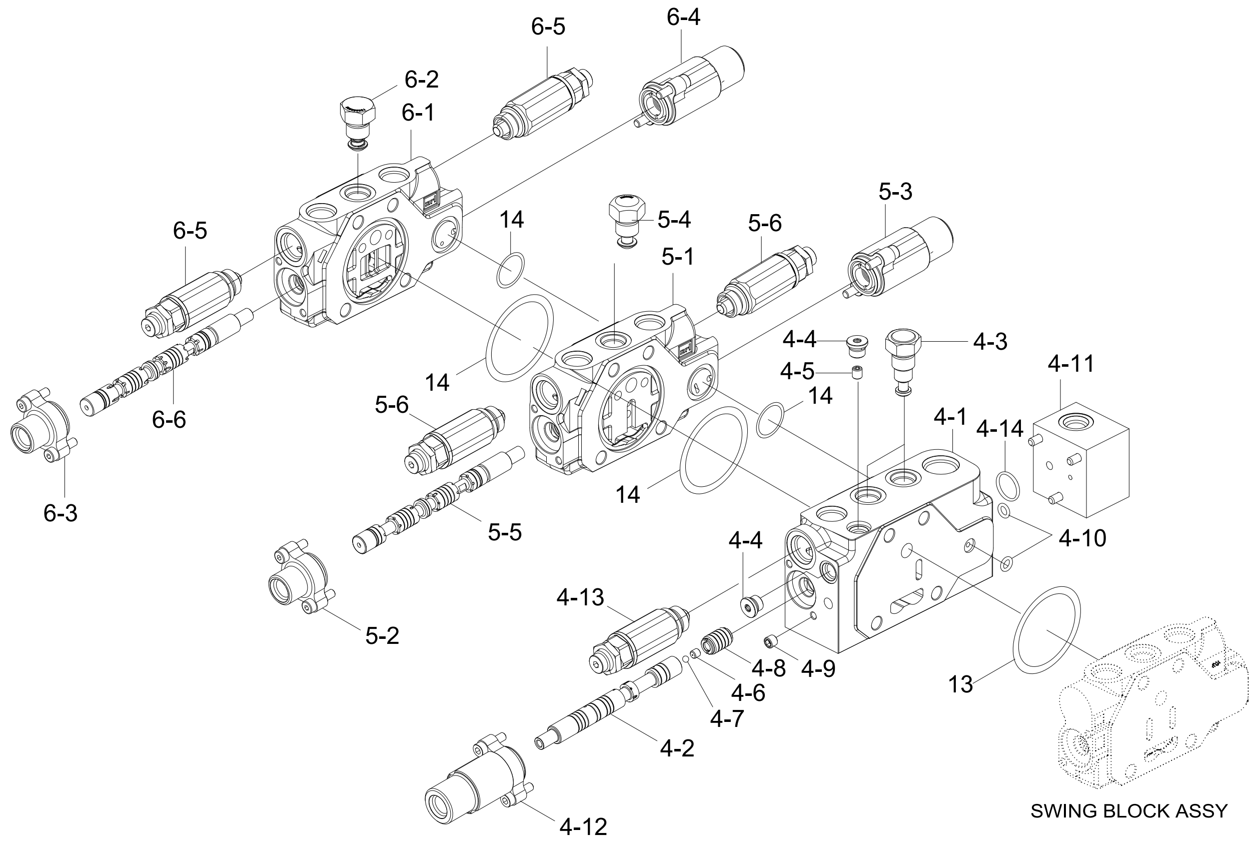
2. STRUCTURE (1/4)



19A2MCV02

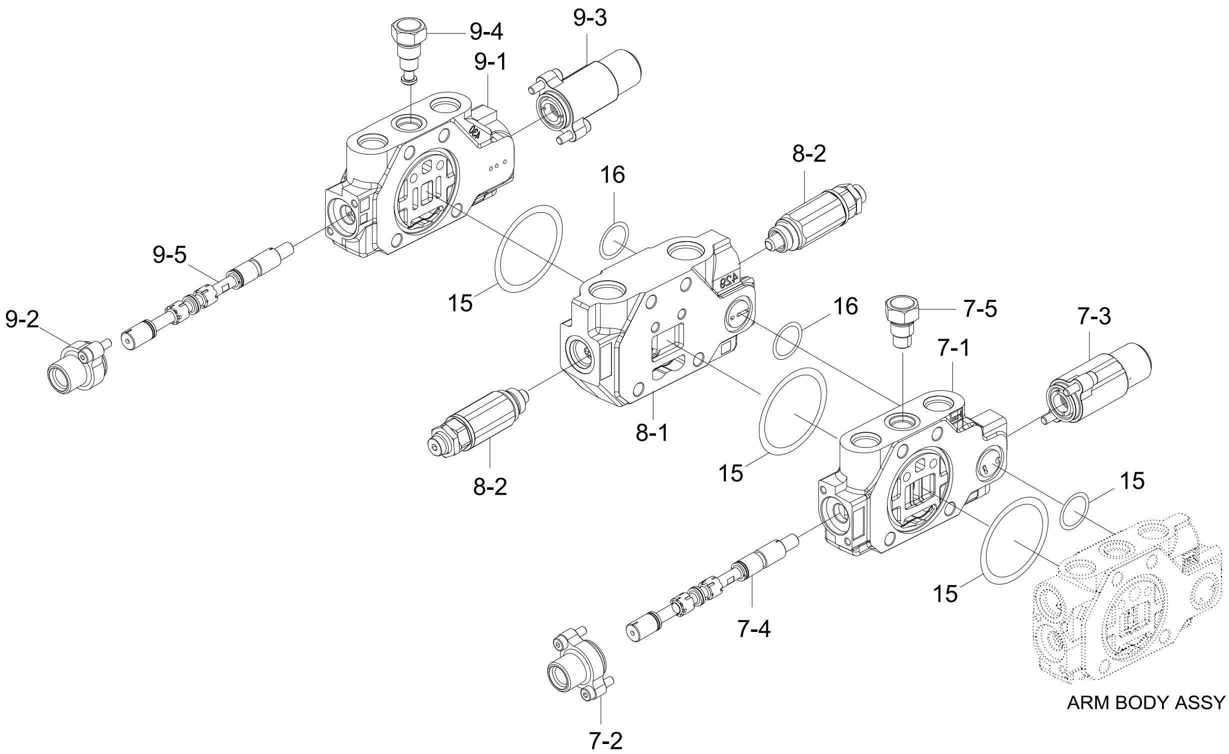
1-1	Dozer block assy	2-1	Boom swing body assy	3-1	Swing body assy
1-2	Plug	2-2	Plug	3-2	Plug
1-3	Dozer spool assy	2-3	Pilot cover	3-3	Pilot cover
1-4	Pilot cover	2-4	Pilot cover	3-4	Pilot cover
1-5	Pilot cover	2-5	Overload relief valve assy	3-5	Swing spool assy
1-6	Overload relief valve assy	2-6	Boom swing spool assy	13	O-ring

STRUCTURE (2/4)



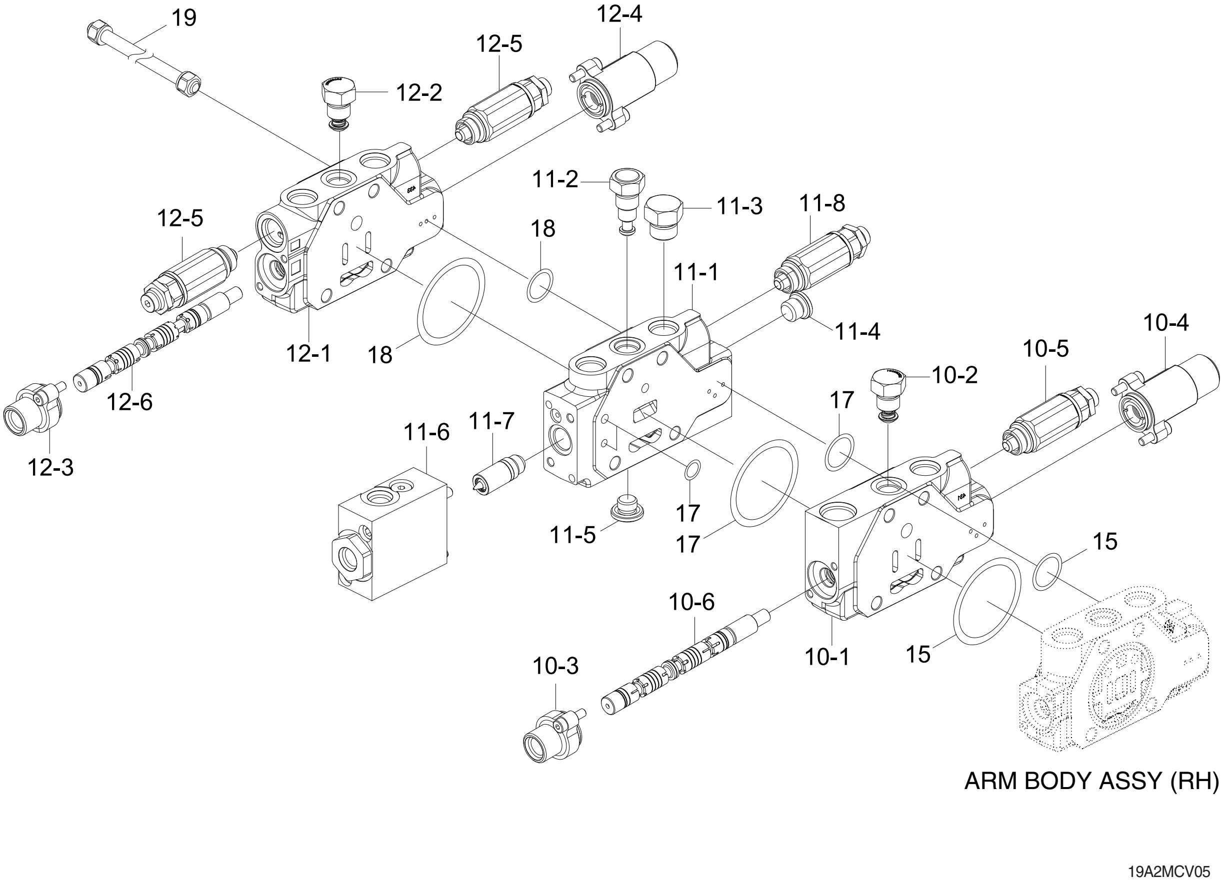
4-1	Conflux block assy	4-11	Pilot body	6-1	Arm block assy
4-2	Conflux spool assy	4-12	Pilot cover	6-2	Plug
4-3	Plug	4-13	Relief valve assy	6-3	Pilot cover
4-4	Plug	4-14	O-ring	6-4	Pilot cover
4-5	Piston	5-1	PTO block assy	6-5	Overload relief valve assy
4-6	Piston	5-2	Pilot cover	6-6	Arm spool assy
4-7	Ball	5-3	Pilot cover	13	O-ring
4-8	Spring	5-4	Plug	14	O-ring
4-9	Piston	5-5	PTO spool assy		
4-10	O-ring	5-6	Overload relief valve assy		

STRUCTURE (3/4)



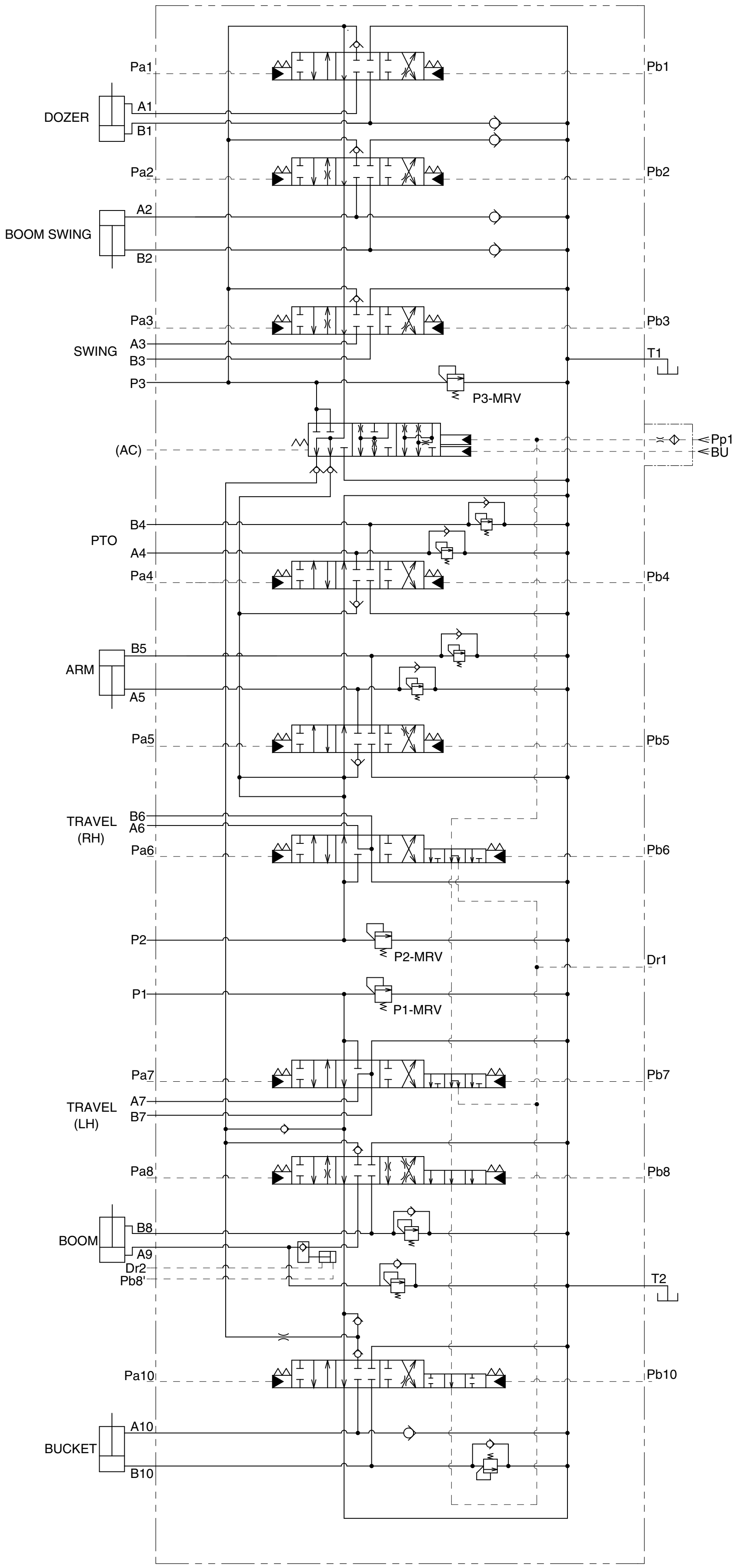
10-1	Boom block assy	11-3	Plug	12-3	Pilot cover
10-2	Plug	11-4	Plug	12-4	Pilot cover
10-3	Pilot cover	11-5	Plug	12-5	Overload relief valve assy
10-4	Pilot cover	11-6	Lock valve cover	12-6	Bucket spool assy
10-5	Overload relief valve assy	11-7	Lock valve cover	15	O-ring
10-6	Boom spool assy	11-8	Overload relief valve assy	17	O-ring
11-1	Boom lock block assy	12-1	Bucket block assy	18	O-ring
11-2	Plug	12-2	Plug	19	Socket bolt

STRUCTURE (4/4)



7-1	Travel body assy (LH)	8-1	Inlet block assy	9-4	Plug
7-2	Pilot cover	8-2	Relief valve assy	9-5	Travel spool assy
7-3	Pilot cover	9-1	Travel body assy (RH)	15	O-ring
7-4	Travel spool assy	9-2	Pilot cover	16	O-ring
7-5	Plug	9-3	Pilot cover		

3. HYDRAULIC CIRCUIT



19A2MCV06

4. FUNCTION

1) IN NEUTRAL (When all spools are in neutral position)

P1 : The oil discharged from the hydraulic pump flows into control valve P1 port, and then flows through P1 and P2 supply body the P1 side travel spool. The oil flows through the bypass passage in the direction of travel → boom → bucket spool, and then flows from the bypass passage to the tank passage in the bucket section.

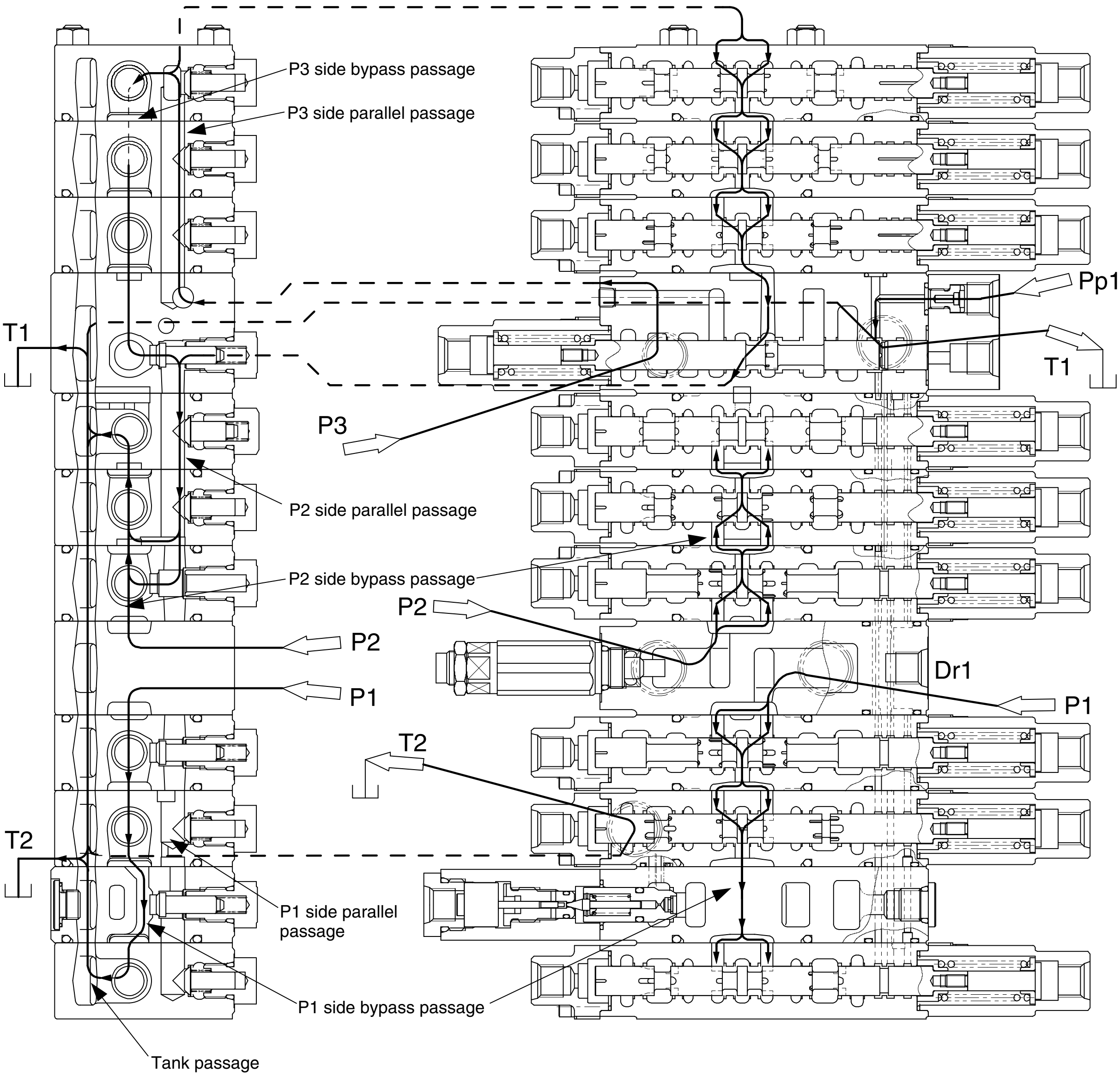
P2 : The oil discharged for the hydraulic pump flows into the control valve from P2 port, and then flows through P1 and P2 supply body to the P2 side travel spool. The oil flows through the bypass passage in the direction of travel → arm → PTO spool, and the flows from the bypass passage to the tank passage in the PTO section.

P3 : The oil discharged from the hydraulic pump flows into the control valve from P3 port, and then flows through the parallel passage of dozer, boom swing, and swing. The oil that has followed into the parallel passage flows through the bypass passage in the direction of dozer → Boom swing → swing spool, the connecting spool land, the P2 side parallel passage, the bypass passage from arm to PTO spool, the bypass passage in the PTO section, and then to the tank passage.

※ **Since each line (P1, P2, P3) is supplied with oil from the pump, the section is operatable; therefore, do not operate the control valve except the working time.**

· P1 line : Travel, boom, bucket
· P2 line : Travel, arm, PTO
· P3 line : Dozer, boom swing, arm, PTO, boom (up only)

P_P1 : When P_P1 port is applied with pilot pressure, the oil flows into the travel independent passage via an orifice.
With the spool in neutral, the oil flows into Dr1 port provided in the P1 and P2 supply body.



Hydraulic oil flow in neutral

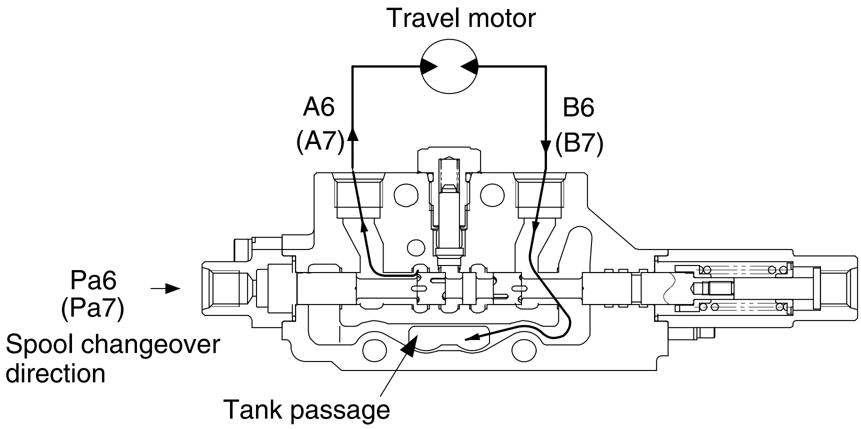
2) TRAVEL OPERATION

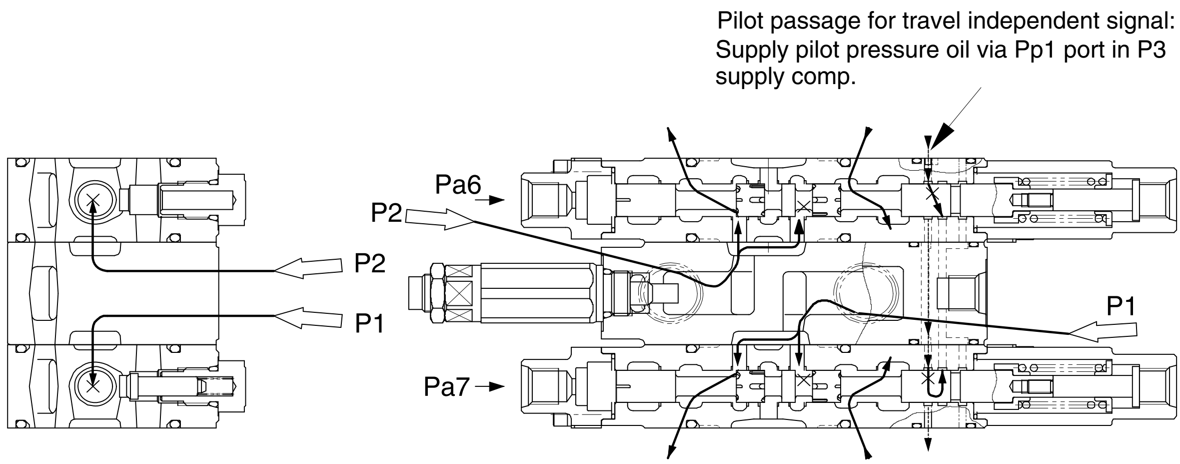
For the travel operation, both Pa pressurization and Pb pressurization are the same on operation so that only Pa pressurization is explained as follows.

When left (right) travel reverse is operated, the secondary pressure from the remote control valve is applied to Pa6 [Pa7] port to change over the travel spool. The oil flowed from P2 [P1] port flows through the supply body into the P2 [P1] side bypass passage. The oil flowed into the P2 [P1] side bypass passage flows through A6 [A7] port that has been opened by the spool changeover to the travel motor. On the other hand, the oil returned from the travel motor flows into the control valve from B6 [B7] port and then to the tank passage has been opened after the spool changeover.

The oil flowed from P_P1 port flows through the orifice passage provided in the P3 supply section into the travel independent signal passage.

Although the travel independent passage (see page 2-14) in the travel section that has been opened during neutral is blocked after the both travel spools changeover, the travel independent signal passage is connected to the drain port via the bucket section Accordingly, when the bucket section has not changed over, the connecting spool in the P3 supply section does not change over because the pressure in the travel independent signal passage is equal to the drain pressure.





Operation during travel(Forward)

R35Z72MCV12

3) BOOM OPERATION

Boom up operation

When the boom up operation is carried out, the secondary pressure from the remote control valve is applied to Pa8 port to change over the boom spool. Since Pa8 port is connected to boom up port through the piping, the pressure oil supplied to boom up port changes over the connecting spool through the connecting piston in the P3 supply section

Also, since the P1 side bypass passage is shut off at the boom section after the boom spool changeover, the oil flowed from P1 port flows through the check valve provided above the bypass passage in the travel section into the P1 side parallel passage.

On the other side, after the connecting spool changeover the oil flowed into P3 port.

① Flows through the internal passage in connecting spool and the check valve in the P3 supply section into the P1 side parallel passage.

② The oil flows through the P3 side parallel passage and P3 side bypass passage and then:

a. Flows through the check valve in the P3 supply section into the P1 side parallel passage.

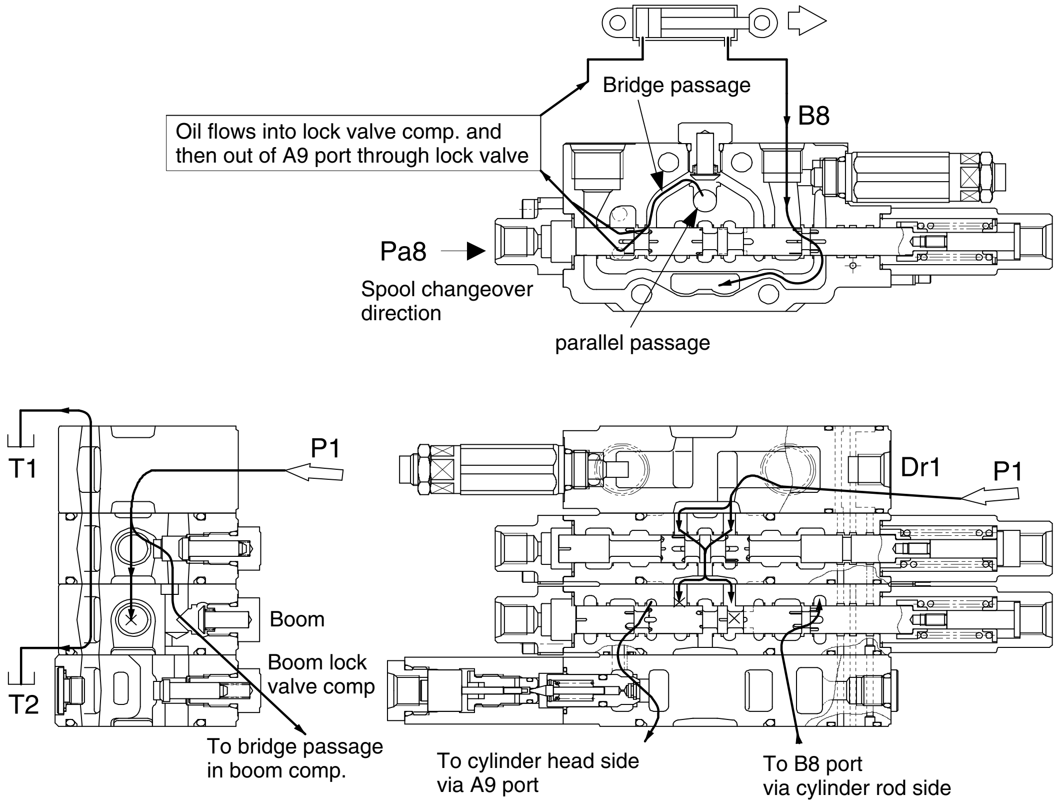
b. Some oil flows through the orifice passage provided in the connecting spool and the check valve in the P3 supply section into the P2 side parallel passage.

The oil flowed into the P1 side parallel passage is connected with the oil from P1 pump.
The oil flowed into the P2 side parallel passage flows through the bypass passages in the arm section and PTO section to the tank passage.

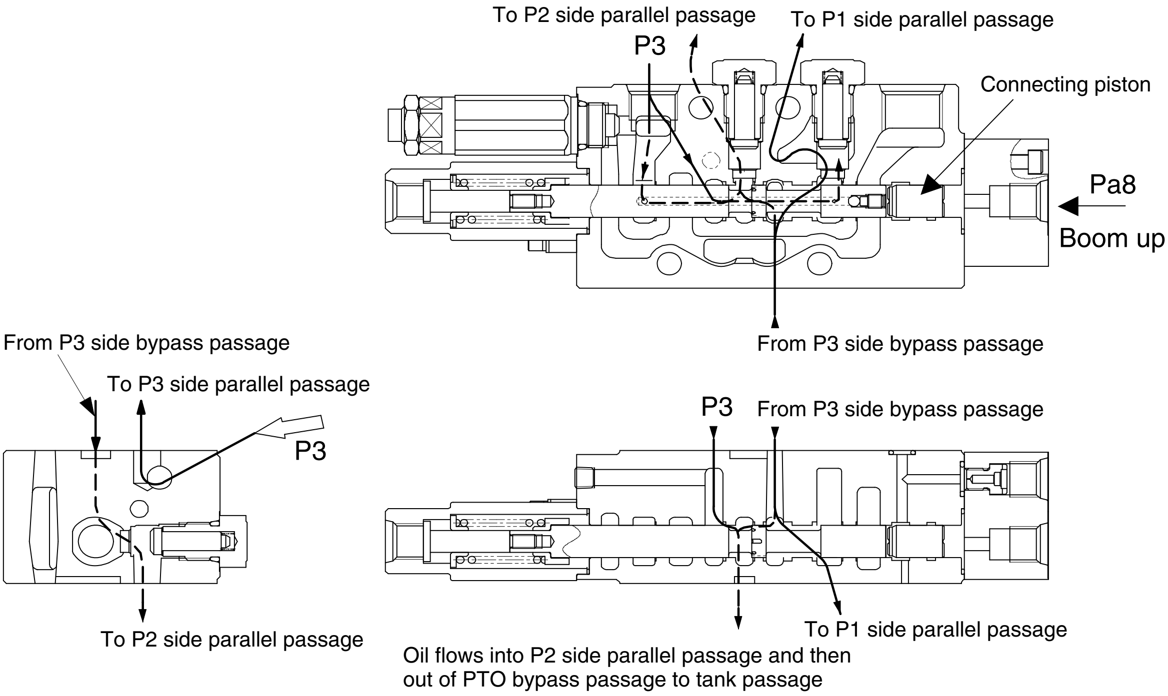
Since the passage connected to the boom lock valve and the bridge passage are opened after the boom spool changeover, the oil flowed into the P1 side parallel passage flows through the load check valve in the boom section and the bridge passage into the boom lock valve section
The oil flowed into the boom lock valve section opens the lock valve (free flow condition), flows into A9 port, and the to the head side of the boom cylinder.

On the other hand, the oil returned from the rod side of the boom cylinder flows into B8 port to the tank passage that has opened with the spool's notch after the spool changeover. Then, the boom cylinder extends to raise the boom.

P1 side circuit



P3 side (Connecting side) circuit



Boom up operation

R35Z72MCV13

Boom down operation

When the boom down operation is carried out, the secondary pressure from the remote control valve is applied to Pb8 port to change over the boom spool.

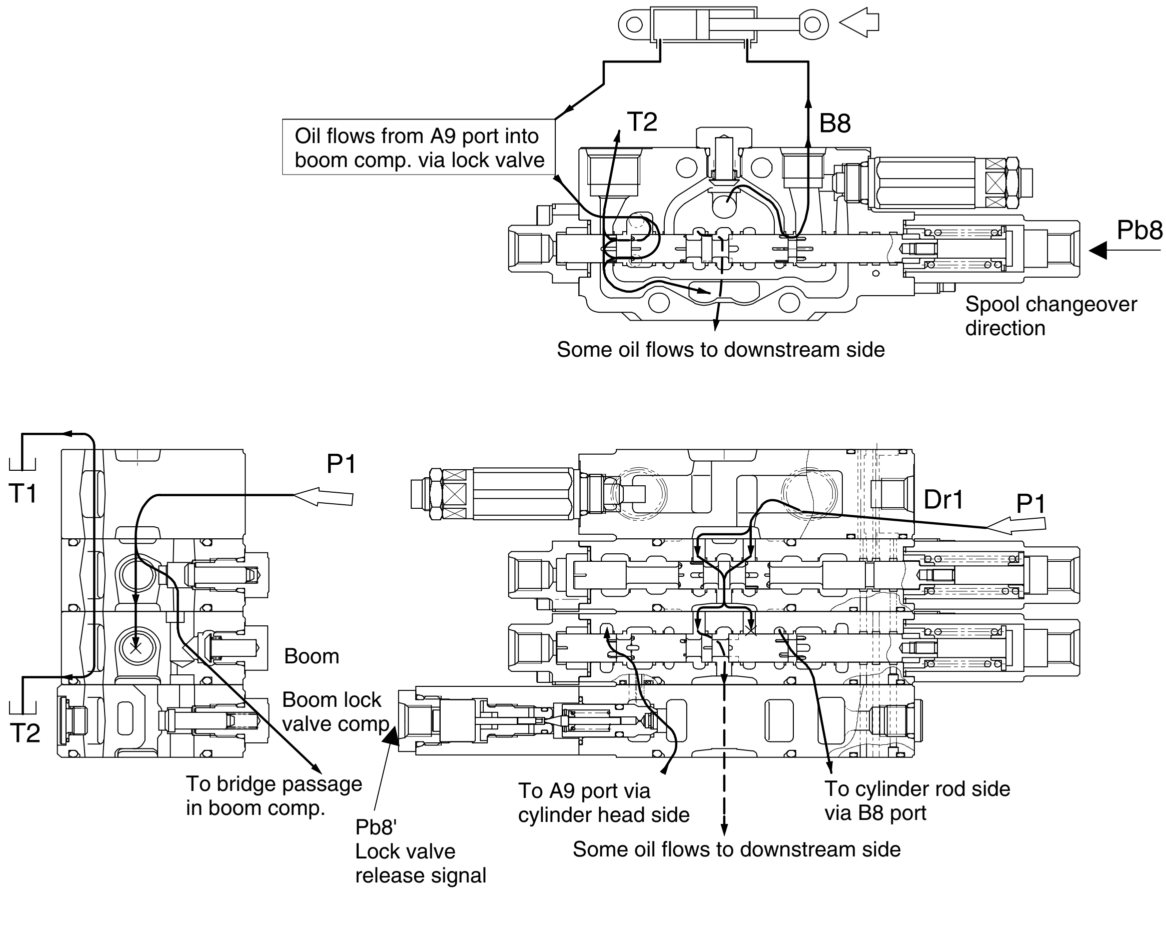
Since Pb8 port is connected to Pb8' port through the piping, the pressure is also applied to pb8' port (Boom lock valve release port) to release the boom lock valve.

(For the explanation of boom lock valve operation, see pages 2-19, 20)

Since the bypass passage is shut off at the boom section after the spool changeover (some oil flows through the orifice passage provided in the boom spool's bypass passage to the downstream side of the bypass passage), the oil flowed from P1 port flows through the check valve provided above the bypass passage in the travel section into the P1 side parallel passage.

Also, since a passage between B8 port and bridge passage is opened with the spool's notch after the spool changeover, the oil flowed into the P1 side parallel passage flows through the load check valve in the boom section into B8 port via the bridge passage and then into the rod side of the boom cylinder.

On the other side, the oil returned from the head side of the boom cylinder flows into A9 port to the tank passage that has been opened with the spool's notch after the spool changeover through the boom lock valve that has been released by Pb8' port pressure. Then, the boom cylinder retracts to lower the boom.



Boom down operation

R35Z72MCV14

4) Operation of boom lock valve

(1) Holding

In the boom spool neutral condition,

· The pilot piston chamber (a) is connected to the drain passage through the pilot port (Pb8') for releasing the boom lock valve.

· The piston chamber (b) is also connected to the drain passage through the drain port (Dr2).

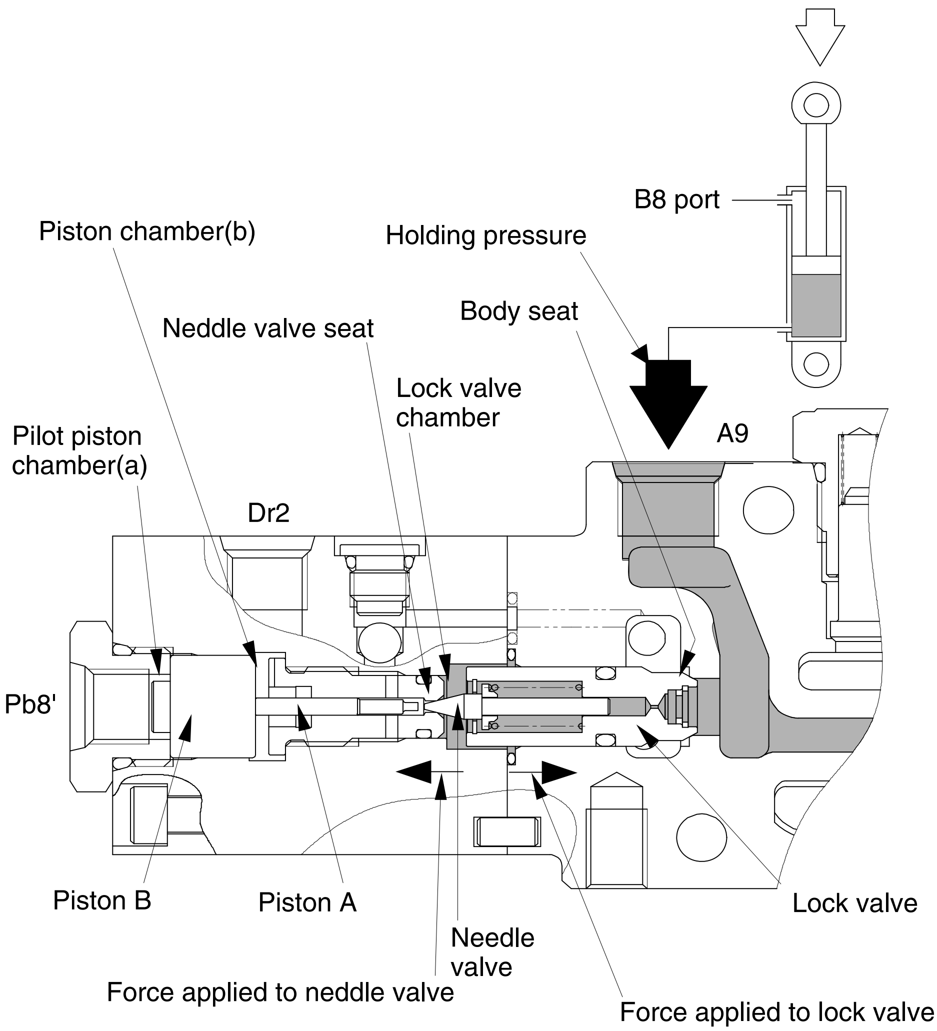
Therefore, the piston (B) maintains the condition shown in the figure.

The boom cylinder holding pressure (shown in half-tone dot meshing) is applied to the lock valve chamber as shown in the figure to :

· Press the needle valve against the needle valve seat.

· Press the lock valve against the body seat.

Then, oil leakage from the boom cylinder head side is prevented to stop the movement of the boom cylinder due to leakage.



Operation of boom lock valve (holding)

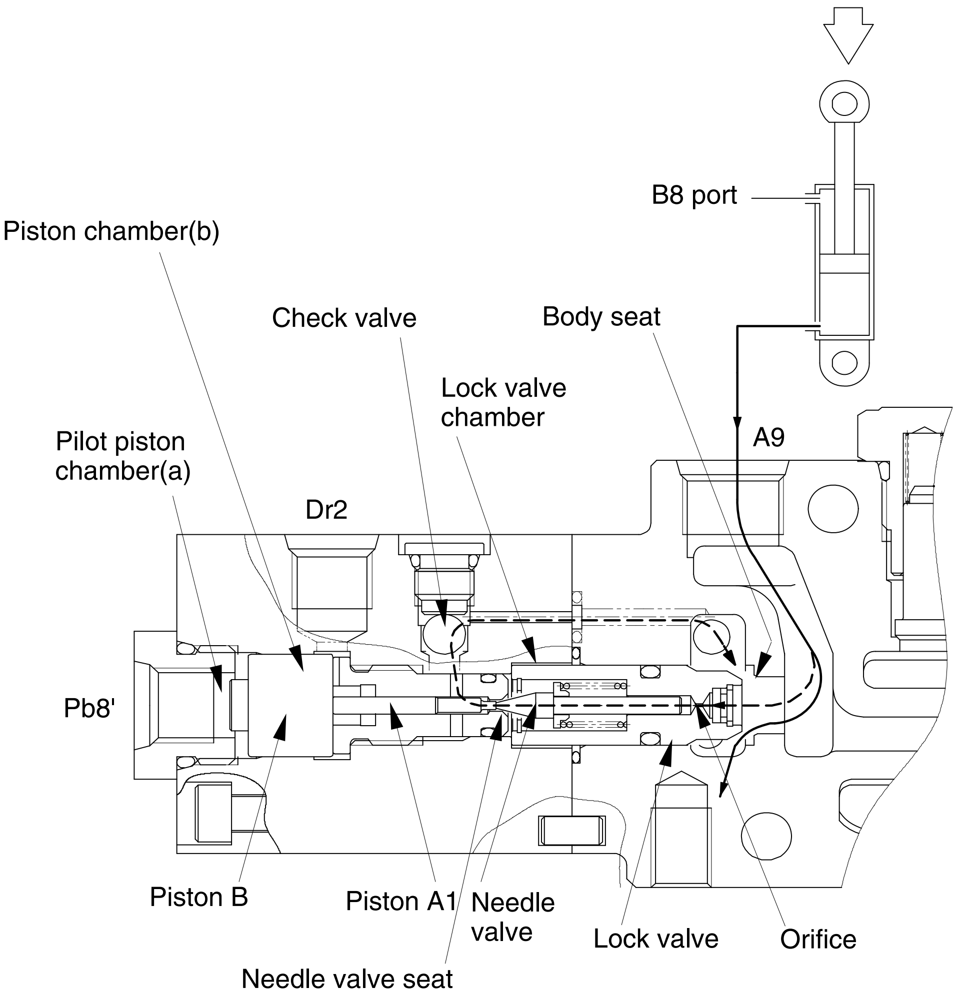
R35Z72MCV15

(2) Release

When the pilot pressure is applied to the pilot port (Pb8') for boom lock valve release, the piston (B) moves rightward to open the needle valve through the piston (A1).

Then, the oil returned from the boom cylinder flows through the passage in the direction of lock valve's orifice → lock valve chamber → needle valve seat → check valve into the lock valve's downstream side chamber (boom section).

When the lock valve's downstream chamber is connected to the tank passage after the boom spool changeover and the needle valve is released, the pressure in the lock valve chamber decreases to open the lock valve by the oil returned from the boom cylinder. The returned oil flows into the tank passage with the boom spool's notch to operate the cylinder.



Operation of boom lock valve (release)

R35Z72MCV16

5) BUCKET OPERATION

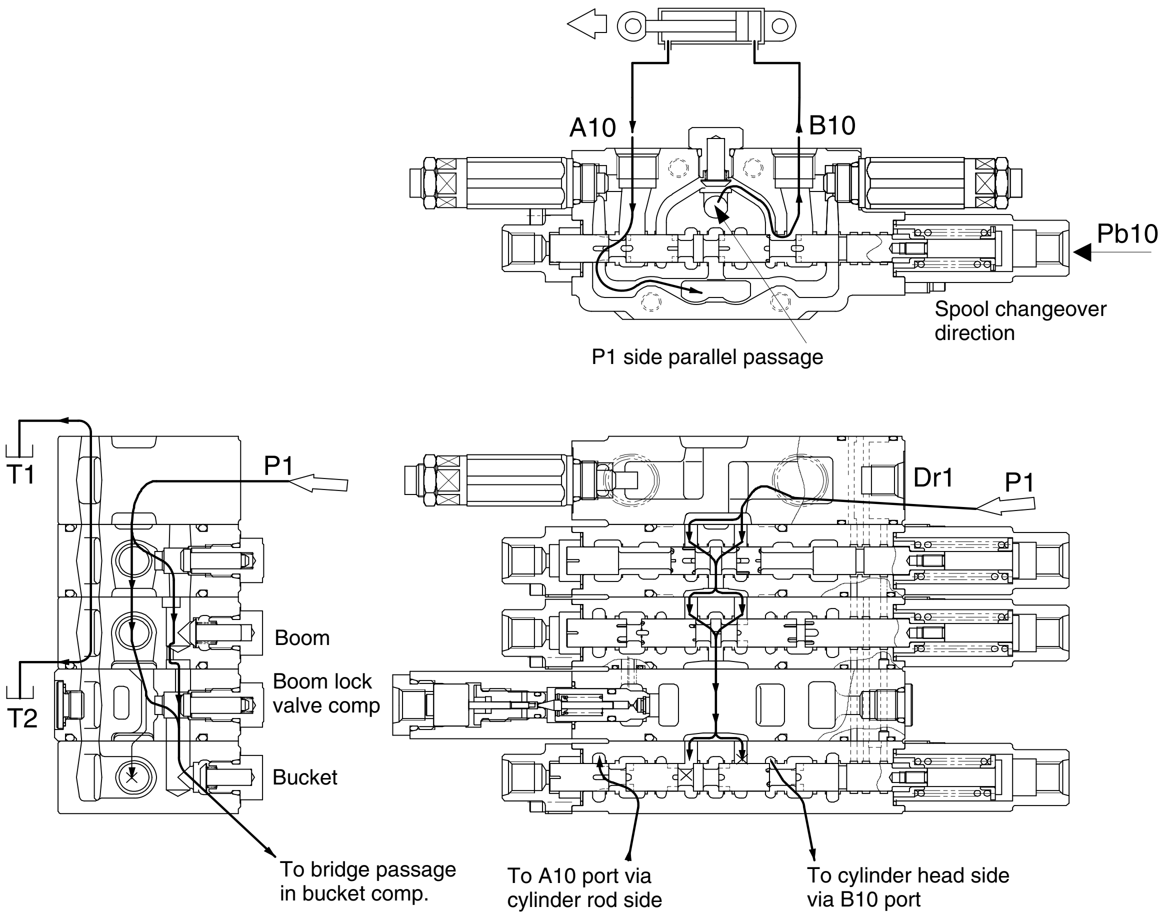
Bucket in operation

When the bucket in operation is carried out, the secondary pressure from the remote control valve flows into Pb10 port to change over the bucket spool.

Since the P1 side bypass passage is shut off at the bucket section after the bucket spool changeover, the oil flowed from P1 port flows through the check valve provided above the bypass passage in the travel section into the P1 side parallel passage.

Also, since a passage between B10 port and the bridge passage is opened after the spool changeover, the oil flowed into the P1 side parallel passage flows through the load check valve in the bucket section into B10 port via the bridge passage and then the head side of the bucket cylinder.

On the other hand, the oil returned from the rod side of the bucket cylinder flows into A10 port to the tank passage that has opened with the spool's notch after the spool changeover. Then, the bucket cylinder extends to make the bucket in.



Bucket in operation

R35Z72MCV17

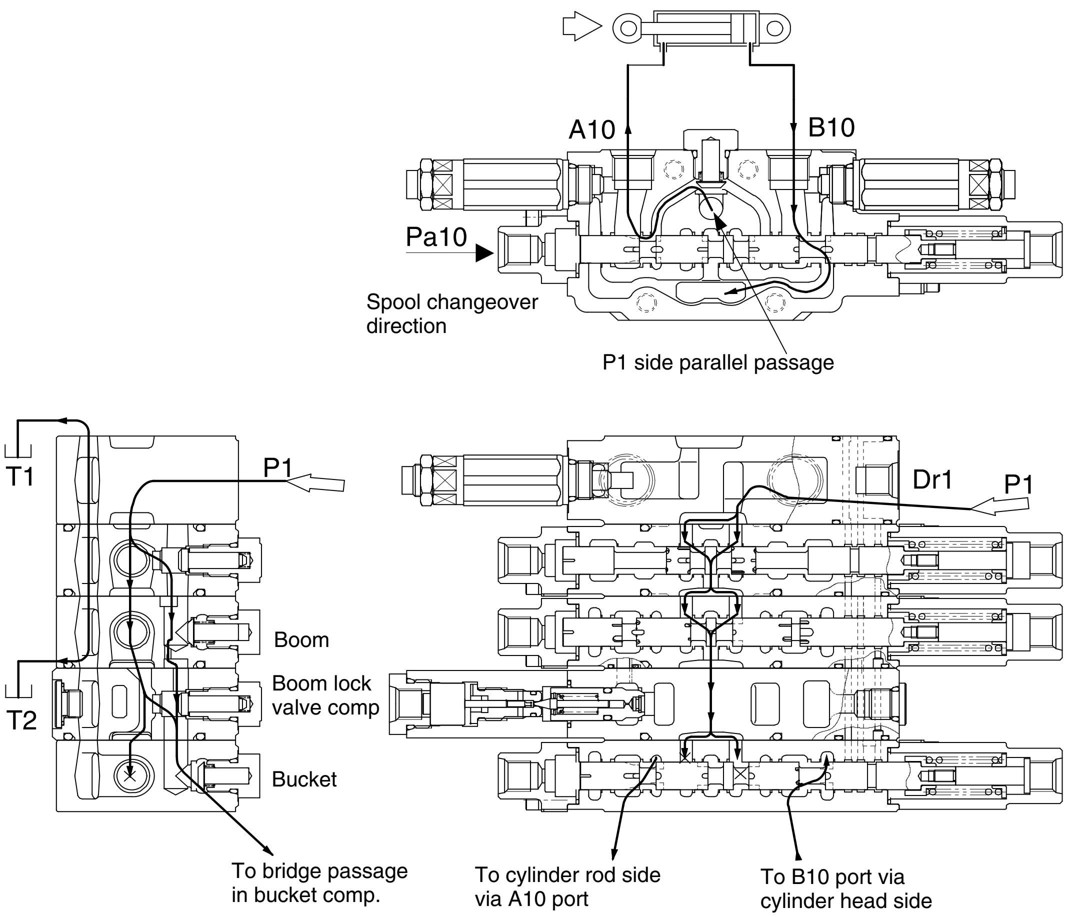
Bucket out operation

When the bucket out operation is carried out, the secondary pressure from the remote control valve flows into Pa10 port to change over the bucket spool.

Since the P1 side bypass passage is shut off at the bucket section after the bucket spool changeover, the oil flowed from P1 port flows through the check valve provided above the bypass passage in the travel section into the P1 side parallel passage.

Also, since a passage between A10 port and the bridge passage is opened after the spool changeover, the oil flowed into the P1 side parallel passage flows through the load check valve in the bucket section into A10 port via the bridge passage and then the rod side of the bucket cylinder.

On the other hand, the oil returned from the head side of the bucket cylinder flows into B10 port to the tank passage that has opened after the spool changeover.



Bucket out operation

6) ARM OPERATION

Arm in operation

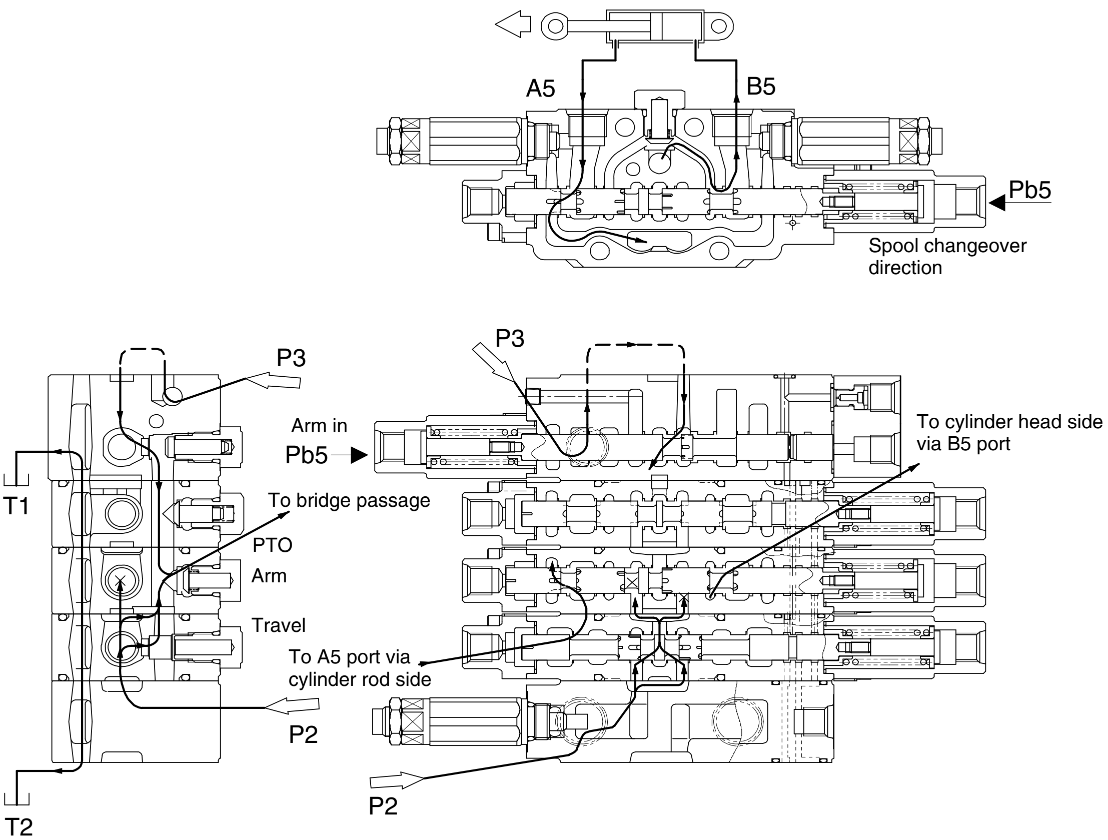
When the arm in operation is carried out, the secondary pressure from the remote control valve is applied to Pb5 port to change over the arm spool. The secondary pressure is also applied to the pilot chamber (arm in port) on the connecting section spring chamber side that has been connected through the piping. Therefore, when the operation is carried out together with the boom up operation at the same time, the connecting spool is hard to change over against the pilot pressure for arm in operation.

Since the P2 port bypass passage is shut off at the arm section after the arm spool change over, the oil flowed from P2 port flows through the travel section and a passage between travel section and arm section into the P2 side parallel passage.

Also, since the oil flowed from P3 port flows through the direction of dozer → boom swing → swing section and then into the P2 side parallel passage via the check valve in the P3 supply section, the connecting flow of P2 pump and P3 pump is supplied to the P2 side parallel passage. [Although the P3 side bypass passage is also connected to the P1 side parallel passage through the check valve in the P3 section, there is no oil flow into the P1 side as long as the P1 side sections (boom , bucket) are not operated.]

Since a passage between B5 port and the bridge passage is opened after the spool changeover, the oil flowed into the P2 side parallel passage flows through the load check valve in the arm section into B5 port via the bridge passage and then into the head side of the arm cylinder.

On the other hand, the oil returned from the rod side of the arm cylinder flows into A5 port to the tank passage that has opened with the spool's notch after the spool changeover. Then, the arm cylinder extends to make the arm in.



Arm in operation

R35Z72MCV19

Arm out operation

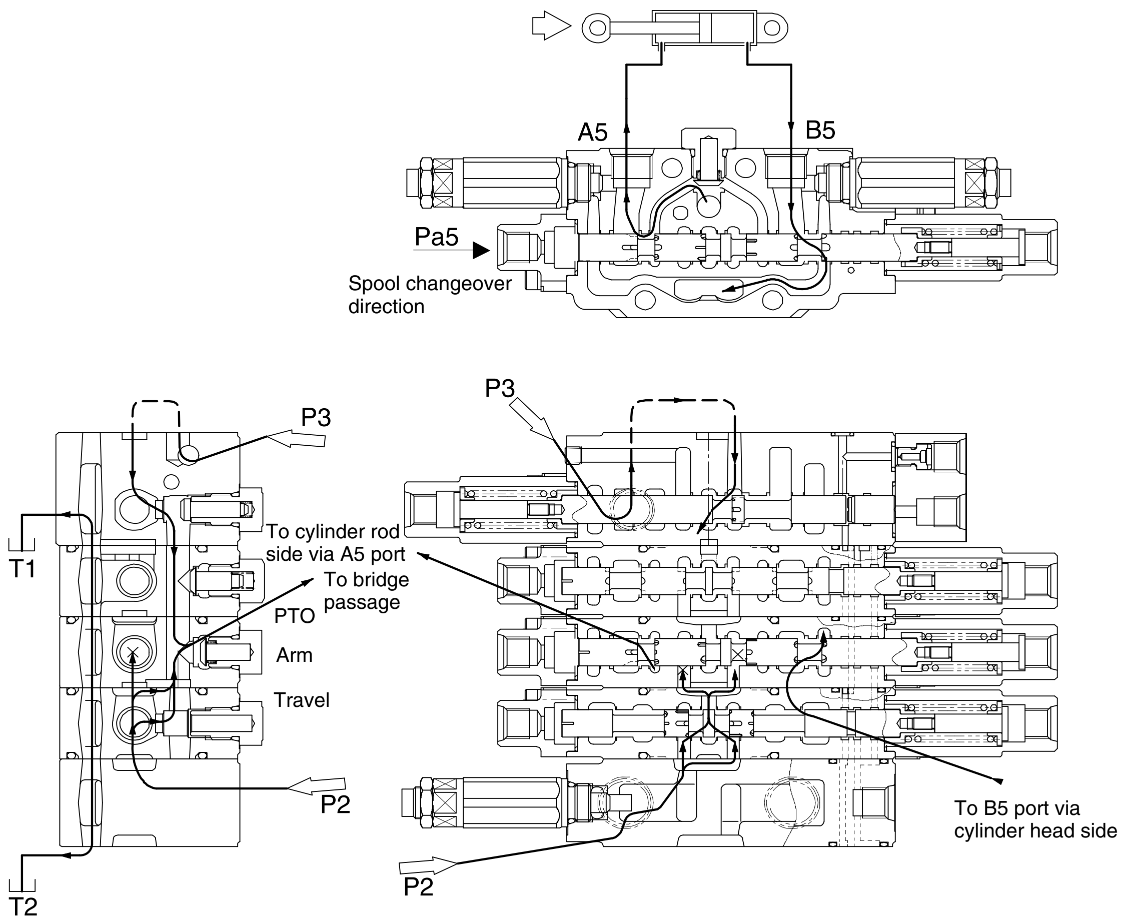
When the arm out operation is carried out, the secondary pressure from the remote control valve is applied to Pa5 port to change over the arm spool.

Since the P2 side bypass passage is shut off at the arm section after the arm spool changeover, the oil flowed from P2 port flows through the travel section and a passage between travel section and arm section into the P2 side parallel passage.

Also, since the oil flowed from P3 port flows through the direction of dozer → boom swing → swing section and then into the P2 side parallel passage via the check valve in the P3 supply section, the connecting flow of P2 pump and P3 pump is supplied to the P2 side parallel passage. [Although the P3 side bypass passage is also connected to the P1 side parallel passage through the check valve in the P3 section, there is no oil flow into the P1 side as long as the P1 side sections (boom , bucket) are not operated.]

Since a passage between A5 port and the bridge passage is opened after the spool changeover, the oil flowed into the P2 side parallel passage flows through the load check valve in the arm section into A5 port via the bridge passage and then into the rod side of the arm cylinder.

On the other hand, the oil returned from the head side of the arm cylinder flows into B5 port to the tank passage that has opened after the spool changeover. Then, the arm cylinder retracts to make the arm out.



Arm out operation

R35Z72MCV20

7) PTO OPERATION

For the PTO operation, both Pa pressurization and Pb pressurization are the same on operation so that only Pa pressurization is explained as follows.

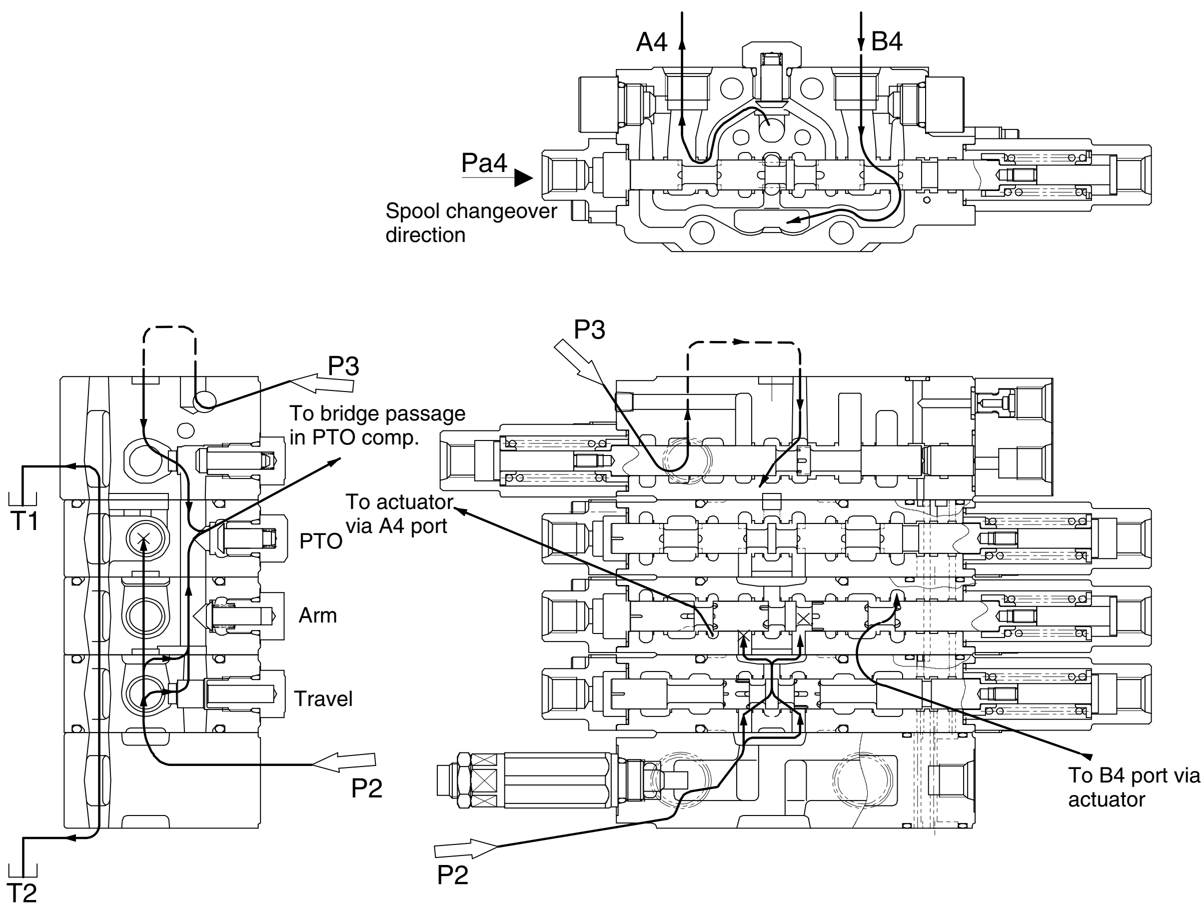
When the PTO operation (Pa4 pressurization) is carried out, the secondary pressure from the remote control valve is applied to Pa4 port to change over the PTO spool. Since the P2 side bypass passage is shut off at the PTO section after the PTO spool changeover, the oil flowed from P2 port flows through the travel section and a passage between travel section and arm section into the P2 side parallel passage.

Also, since the oil flowed from P3 port flows through the direction of dozer → boom swing → swing section and then into the P2 side parallel passage via the check valve in the P3 supply section, the connecting flow of P2 pump and P3 pump is supplied to the P2 parallel passage.

[Although the P3 side bypass passage is also connected to the P1 side parallel passage through the check valve in the P3 section, there is no oil flow into the P1 side as long as the P1 side sections (boom , bucket) are not operated.]

Since a passage between A4 port and the bridge passage is opened after the spool changeover, the oil flowed into the P2 side parallel passage flows through the load check valve in the PTO section into A4 port via the bridge passage and then into the actuator for PTO.

On the other hand, the oil returned from actuator for PTO flows into B4 port to the tank passage that has opened after the spool changeover.



PTO operation

R35Z72MCV21

8) DOZER OPERATION

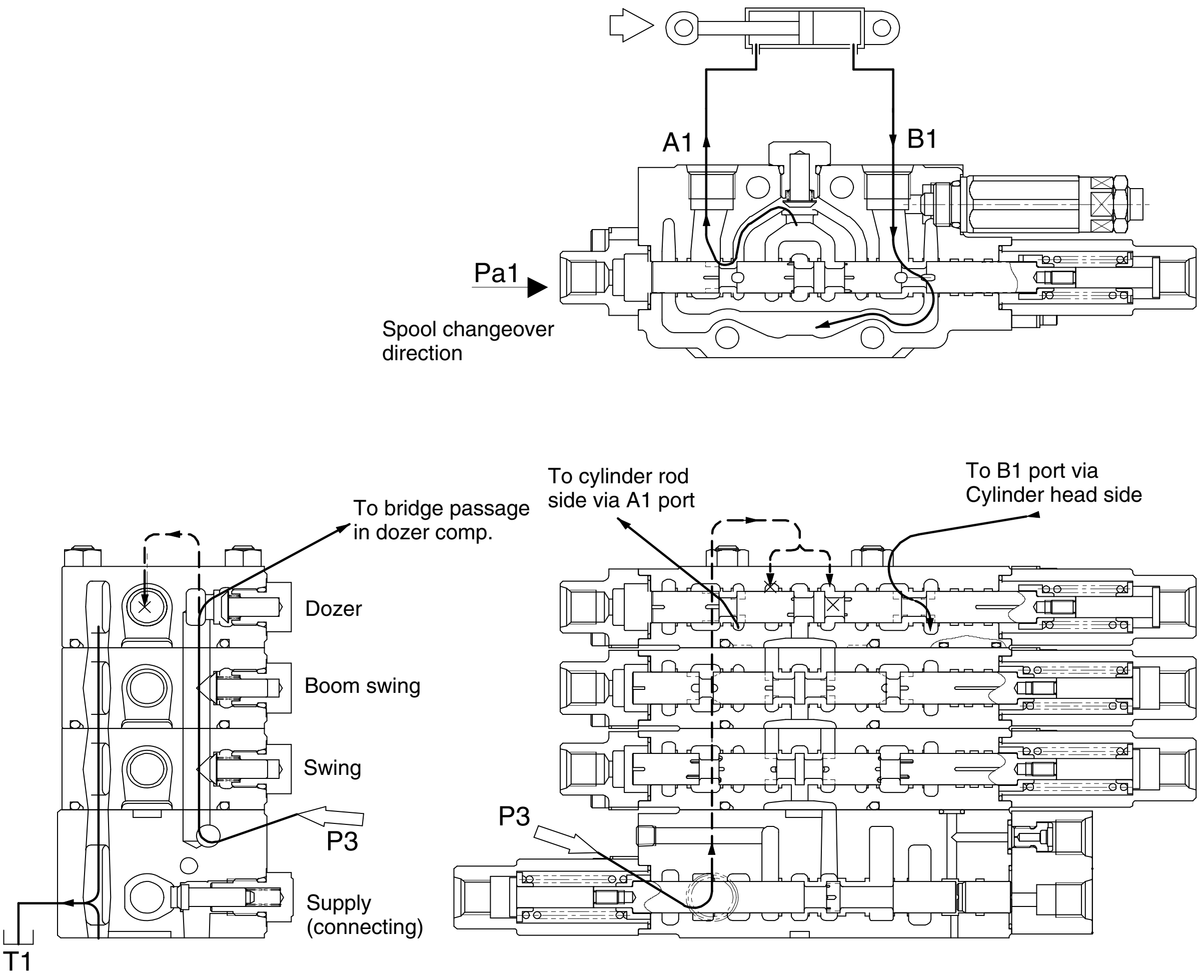
Dozer up operation

When the dozer up operation is carried out, the secondary pressure from the remote control valve is applied to Pa1 port to change over the dozer spool.

Since the P3 side bypass passage is shut off at the dozer section after the dozer spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into A1 port through the load check valve in the dozer section and the bridge passage since A1 port and the bridge passage have been opened after the spool changeover and then into the rod side of the dozer cylinder.

On the other hand, the oil returned from the head side of the dozer cylinder flows into B1 port to the tank passage that has opened after the spool changeover.

Then, the dozer cylinder retracts to raise the dozer.



Dozer up operation

R35Z72MCV22

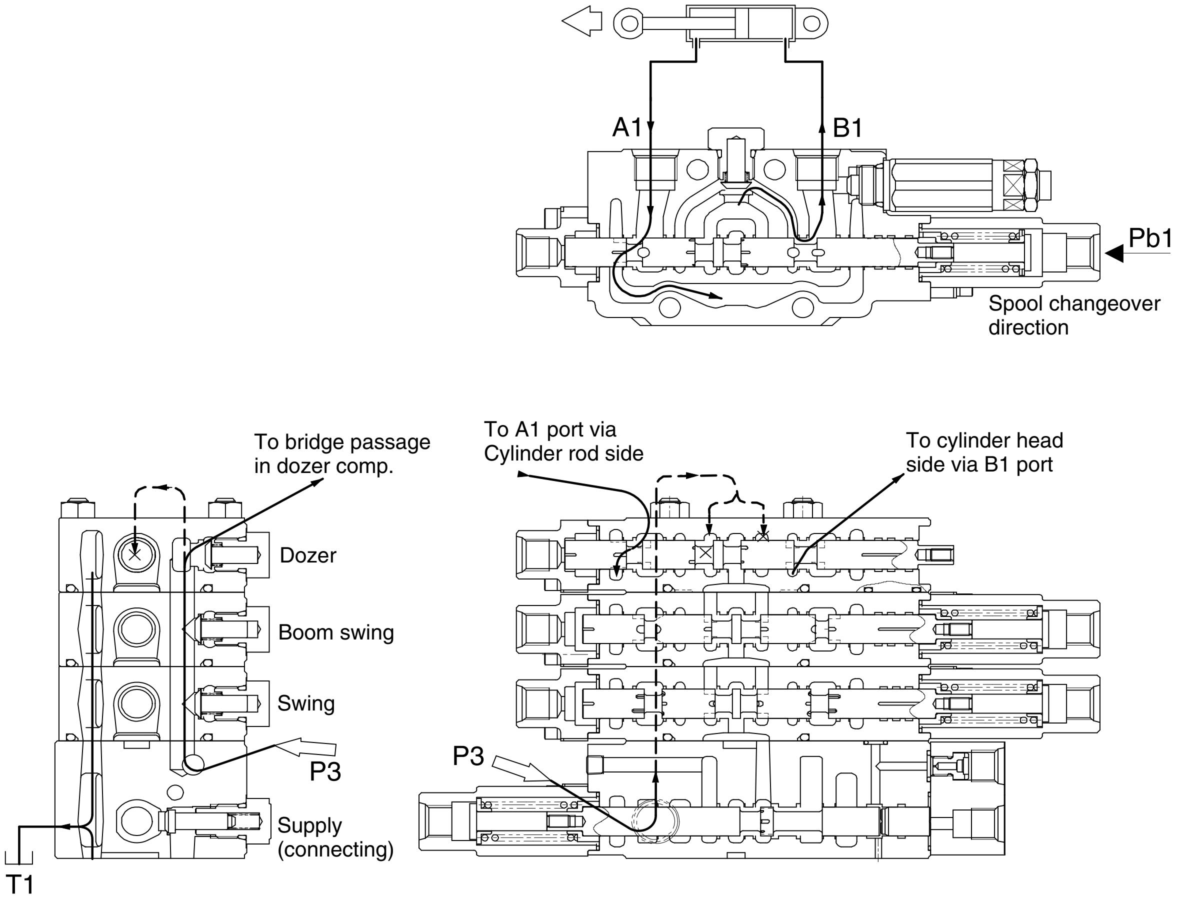
Dozer down operation

When the dozer down operation is carried out, the secondary pressure from the remote control valve is applied to Pb1 port to change over the dozer spool.

Since the P3 side bypass passage is shut off at the dozer section after the dozer spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into B1 port through the load check valve in the dozer section and the bridge passage since B1 port and the bridge passage have been opened after the spool changeover and then into the head side of the dozer cylinder.

On the other hand, the oil returned from the rod side of the dozer cylinder flows into A1 port to the tank passage that has opened with the spool's notch after the spool changeover.

Then, the dozer cylinder extends to lower the dozer.



Dozer down operation

R35Z72MCV23

9) BOOM SWING OPERATION

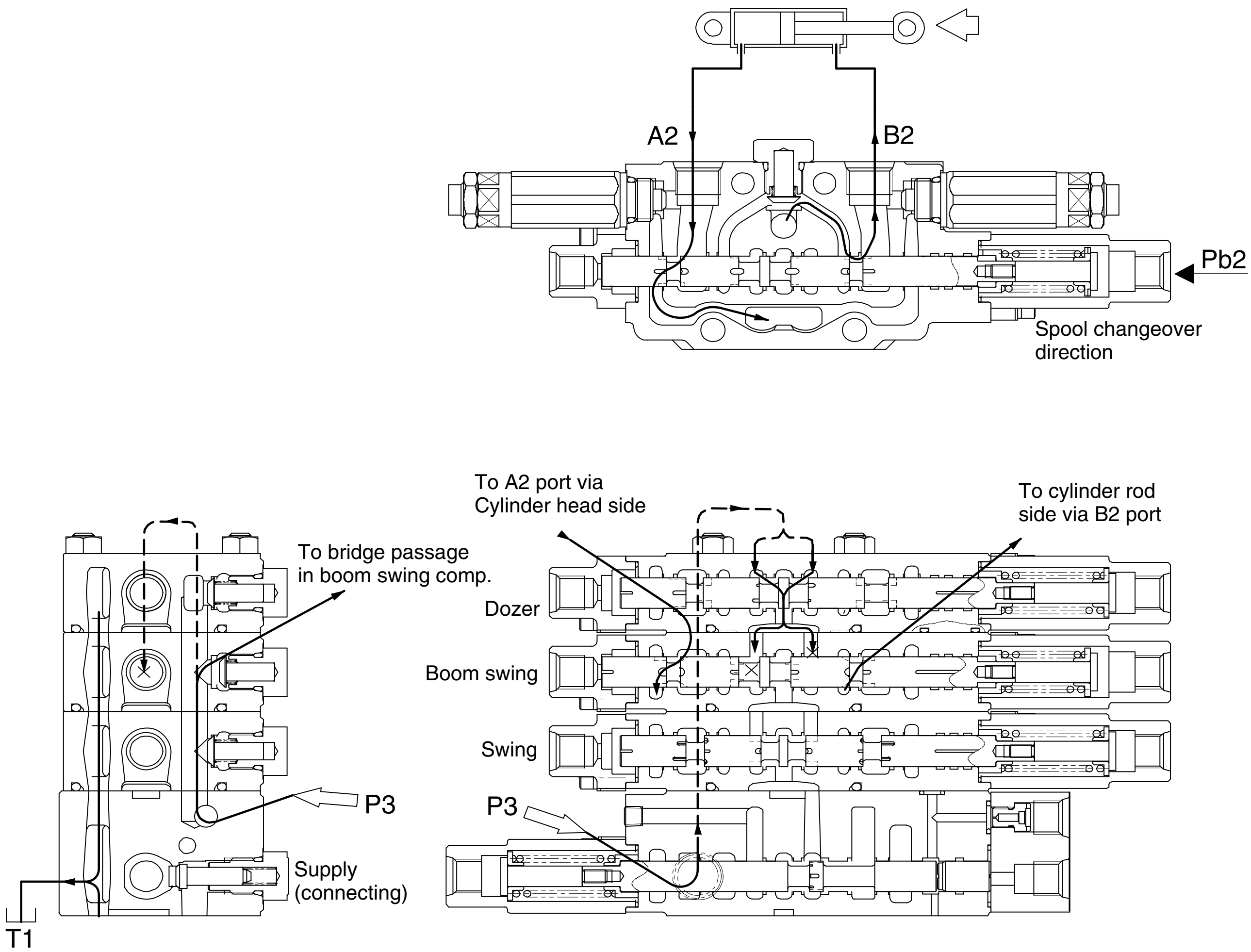
Boom left swing operation

When the boom left swing operation is carried out, the secondary pressure from the remote control valve is applied to Pb2 port to change over the boom swing spool.

Since the P3 side bypass passage is shut off at the boom swing section after the boom swing spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into B2 port through the load check valve in the boom swing section and the bridge passage since B2 port and the bridge passage have been opened after the spool changeover and then into the rod side of the boom swing cylinder.

On the other hand, the oil returned from the head side of the boom swing cylinder flows into A2 port to the tank passage that has opened with the spool's notch after the spool changeover.

Then, the boom swing cylinder retracts to swing the attachment left.



Boom left swing operation

R35Z72MCV24

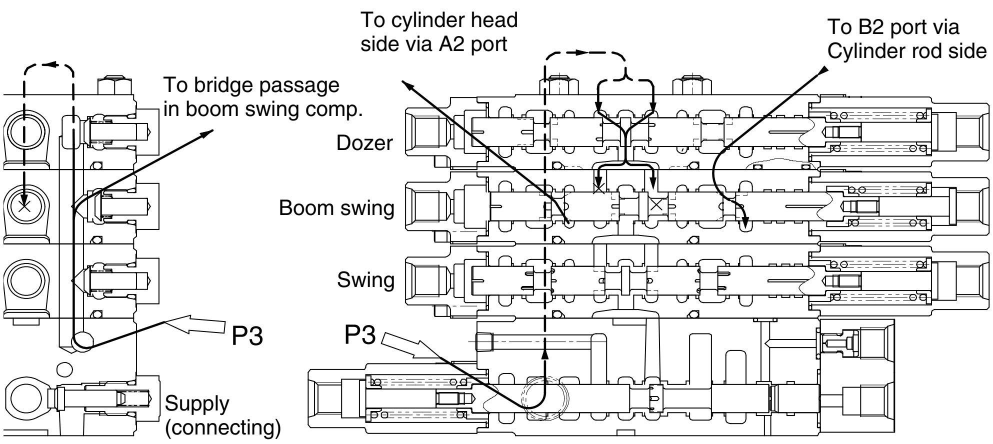
Boom right swing operation

When the boom right swing operation is carried out, the secondary pressure from the remote control valve is applied to Pa2 port to change over the boom swing spool.

Since the P3 side bypass passage is shut off at the boom swing section after the boom swing spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into A2 port through the load check valve in the boom swing section and the bridge passage since A2 port and the bridge passage have been opened after the spool changeover and then into the head side of the boom swing cylinder.

On the other hand, the oil returned from the rod side of the boom swing cylinder flows into B2 port to the tank passage that has opened with the spool's notch after the spool changeover.

Then, the boom swing cylinder extends to swing the attachment right.



Boom right swing operation

R35Z72MCV25

10) SWING OPERATION

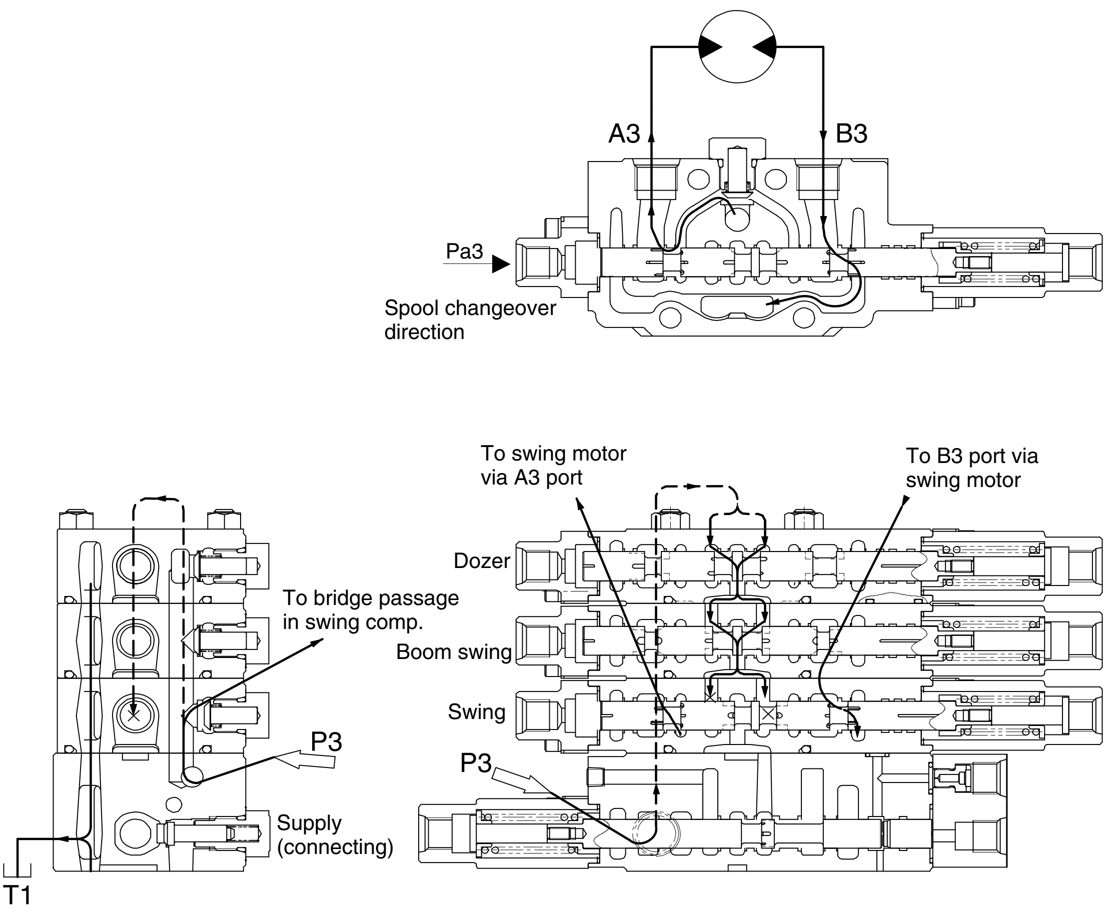
For the swing operation, both Pa pressurization and Pb pressurization are the same on operation so that only Pa pressurization is explained as follows.

When the right swing operation is carried out, the secondary pressure from the remote control valve is applied to Pa3 port to change over the swing spool.

Since the P3 side bypass passage is shut off at the swing section after the swing spool changeover, the oil flowed from P3 port through the P3 side parallel passage flows into A3 port through the load check valve in the swing section and the bridge passage since A3 port and the bridge passage have been opened after the spool changeover and then into the swing motor.

On the other hand, the oil returned from the swing motor flows into B3 port to the tank passage that has opened with the spool's notch after the spool changeover.

Then, the upper swing body swings right.



Right swing operation

R35Z72MCV26

11) COMBINED CONTROL OPERATION ①

Boom up + Arm in + bucket

When the above combined control is carried out, the secondary pressure from the remote control valve is applied to each spool to change over them. Since the secondary pressure for arm in operation is also applied to the pilot chamber on the connecting section spring chamber side according to the piping, the connecting spool operates against the secondary pressure developed from boom up operation and arm in operation.

(Boom up operation secondary pressure - Arm in operation secondary pressure =
connecting spool changeover pressure)

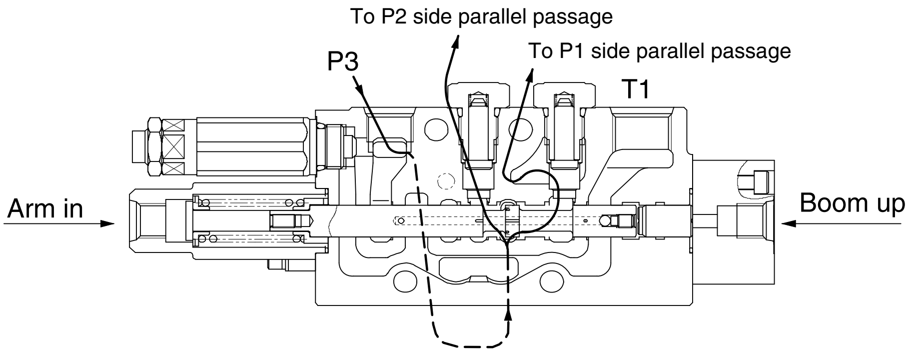
When all the above combined operations are carried out in full lever operation (full changeover), the oil supplied from P1 pump is supplied to the boom and bucket and the oil from P2 pump to the arm. Since the connecting spool changeover pressure becomes "0" as mentioned above, the connecting spool cannot change over and the oil from P3 pump flows to the P1 and P2 side parallel passages through the connecting section. Accordingly, much oil flows to the arm side normally because of its low working load.

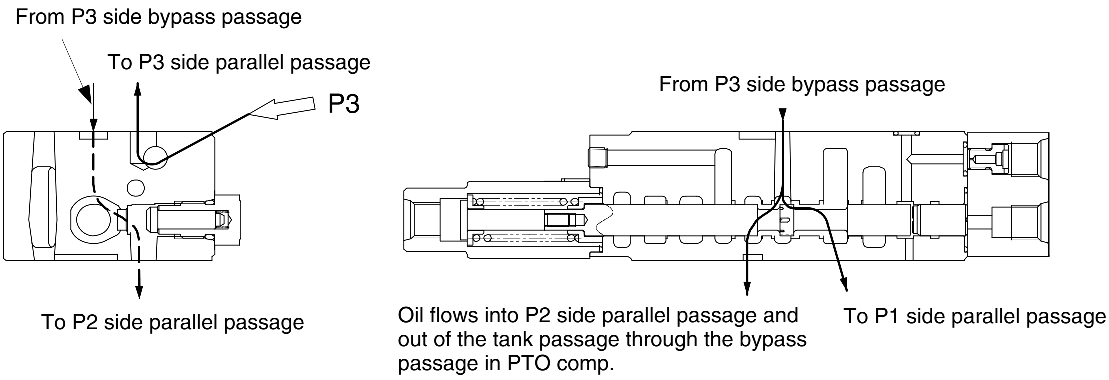
In this condition, since gradually restricting the arm in operation (returning the lever) causes the secondary pressure for arm in operation to decrease, the connecting spool changeover pressure to increase, the connecting spool to start changing over, and the passage to the arm side to be narrowed, the oil supplied from P3 pump flows abundantly into the P1 side (Boom, bucket).

As mentioned above, the oil supplied from P3 pump flows suitably into each attachment according to the control input during the above combined control, resulting in a well-balanced and efficient working speed.

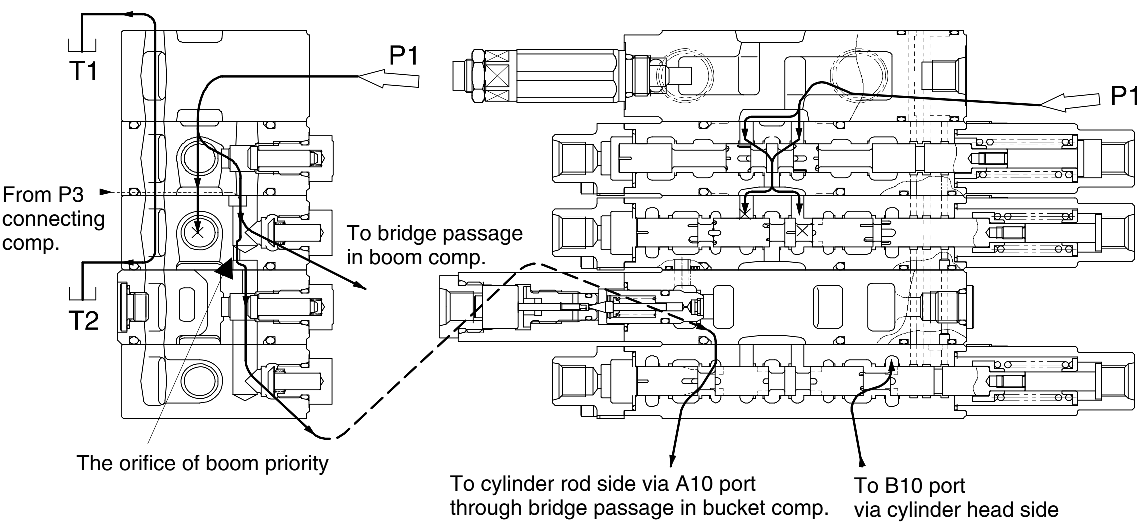
Besides, since the oil flow to the bucket whose working load is less than the boom is restricted with an orifice (the orifice of boom priority) provided before the bucket section in the P1 side parallel passage, much oil flows into the boom section. As a result, the working speed balance between both attachments is maintained during the combined operation of boom and bucket.

P3 side (connecting side) circuit





P1 side circuit (the orifice of boom priority)



Oil flow during combined operation

R35Z72MCV27

12) COMBINED CONTROL OPERATION ②

Both travels + bucket

When the both travels operation is carried out together with the bucket operation at the same time, the oil flowed from Pp1 port flows through the orifice passage and into the travel independent signal passage; both travels and the bucket spool changeover make a passage to the drain port shut off.

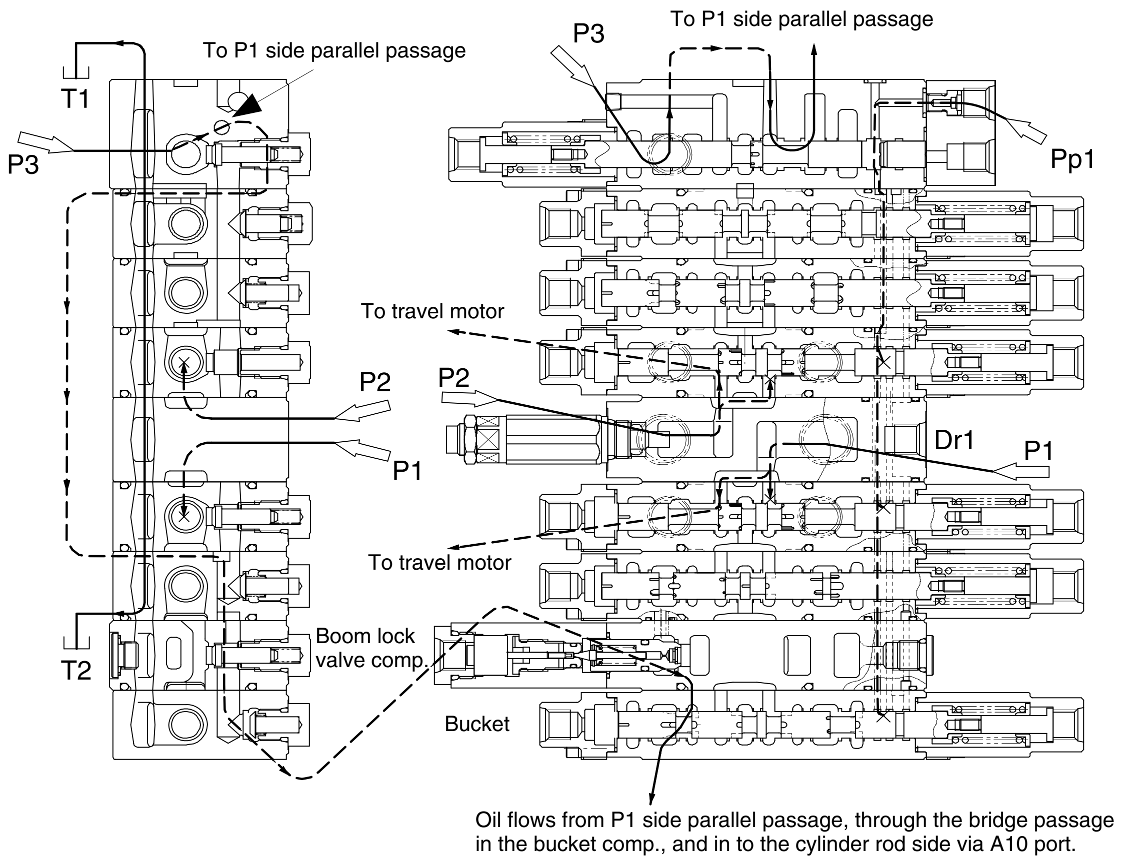
Then, the travel independent passage becomes the same pressure as Pp1 port pressure (pilot primary pressure).

When the travel independent passage becomes Pp1 pressure, the Pp1 pressure is applied to the connecting spool to change over the connecting spool.

Since the bypass passage from P3 to P2 side, which is a passage to the tank, in restricted, the oil from P3 side flows into the P1 side parallel passage that is connected through a check valve.

With his circuit arrangement, the bucket section is supplied with pressure oil from P3 during both travels operation, the simultaneous operation becomes possible.

Besides, since each of P1 and P2 is used independently during both travels and only P3 is used for bucket operation, stable travel is possible to continue even if there is change in the bucket load.



Travel independence operation

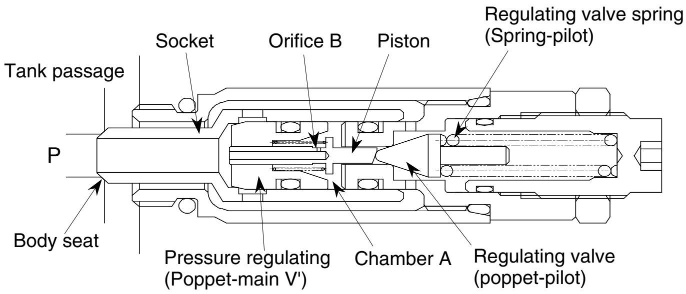
R35Z72MCV28

13) MAIN AND PORT RELIEF VALVE OPERATION

Main relief valve operation

Main relief valves (MRV) are different in the uses for P1/P2 and P3; however, their structures and operation are the same.

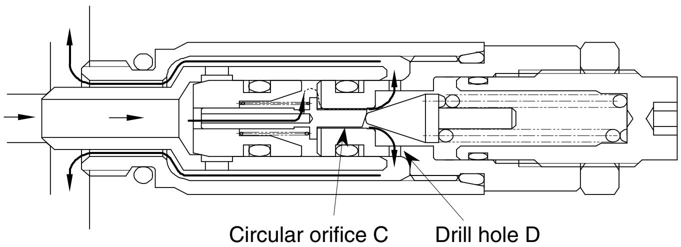
① Pressure oil flows through the inside of the piston built in the pressure regulating valve (poppet-main V') and the orifice B and then into the internal chamber A until it is filled up. The filled up pressure causes both of the pressure regulating valve and the socket and body seat to be seated securely.



MRV operation (1)

R35Z72MCV29

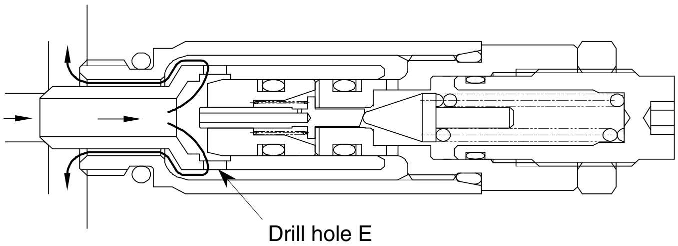
② When the oil pressure at port P increases up to the setting pressure of regulating valve spring, the pressure oil is applied to the regulating valve via the piston to open the regulating valve. Then, the pressure oil flows through a passage in the direction of piston inside → orifice B → chamber A → circular orifice C → Drill hole D and the external of socket and then into the tank passage.



MRV operation (2)

R35Z72MCV30

③ Since the pressure inside the chamber A decreases when the regulating valve is opened, which causes the pressure regulating valve to open to let the pressure oil port P flows into the tank passage through drill hole E.



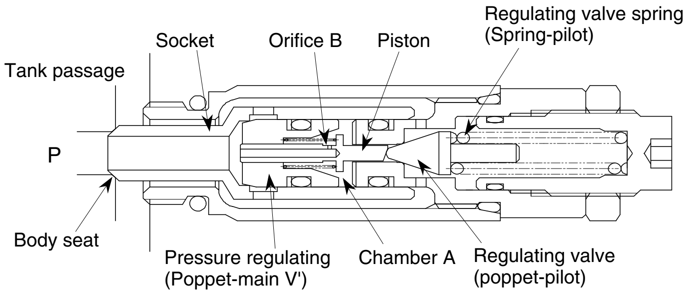
R35Z72MCV31

MRV operation (3)

④ Also, since the regulating valve is pressed to the seat by regulating valve spring when the pressure at port P decreases below the setting pressure of regulating valve spring, the pressure inside chamber A becomes the same as the pressure at port P to cause the pressure regulating valve to be pressed to the seat, resulting in the original condition (①).

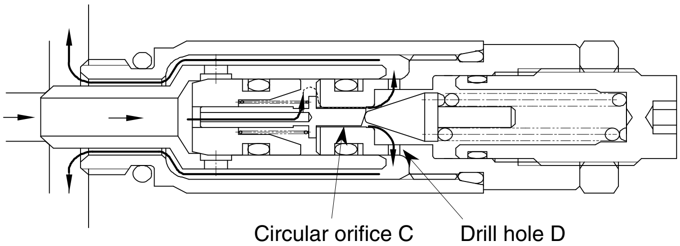
Overload relief valve (ORV) operation ①

① Pressure oil flows through the inside of the piston built in the pressure regulating valve (poppet-main V') and the orifice B and then into the internal chamber A until it is filled up. The filled up pressure causes both of the pressure regulating valve and socket and body seat to be seated securely.



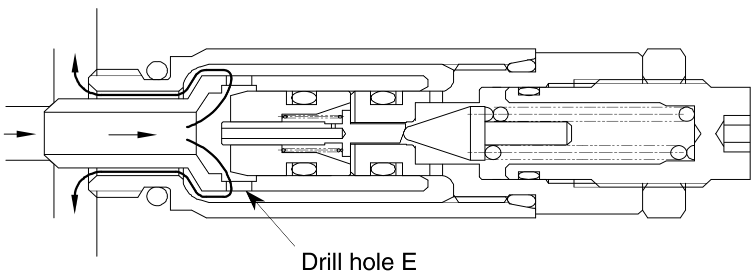
ORV operation (1) R35Z72MCV32

② When the oil pressure at port P increases up to the setting pressure of regulating valve spring, the pressure oil is applied to the regulating valve via the piston to open the regulating valve. Then, the pressure oil flows through a passage in the direction of piston inside → orifice B → chamber A → circular orifice C → Drill hole D and the external of socket and then into the tank passage.



ORV operation (2) R35Z72MCV33

③ Since the pressure inside the chamber A decreases when the regulating valve is opened, which causes the pressure regulating valve to open to let the pressure oil port P flows into the tank passage through drill hole E.

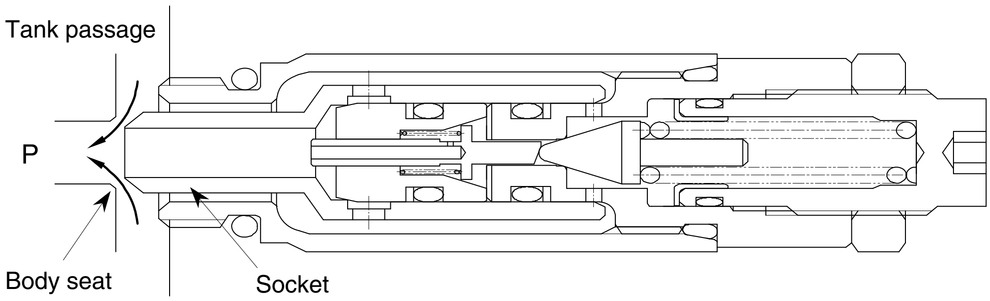


ORV operation (3) R35Z72MCV34

④ Also, since the regulating valve is pressed to the seat by regulating valve spring when the pressure at port P decreases below the setting pressure of regulating valve spring, the pressure inside chamber A becomes the same as the pressure at port P to cause the pressure regulating valve to be pressed to the seat, resulting in the original condition (①).

Overload relief valve (ORV) operation ② 【Operation during suction】

If there is negative pressure at port P (or the tank passage pressure is higher than P pressure), the socket is applied with press and open force. Then, the opening between body seat and socket increases to cause the oil to flow into port P from the tank passage, filling up the space.



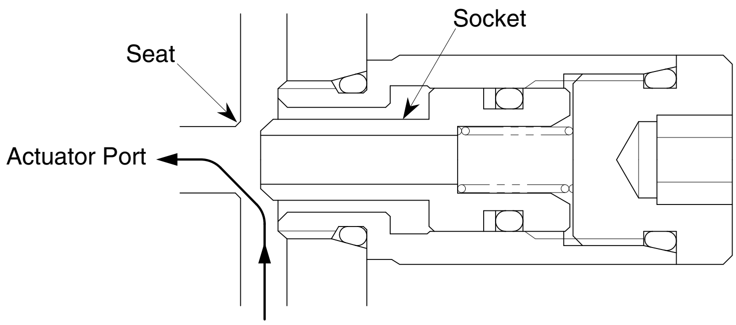
ORV operation (during suction)

R35Z72MCV35

Anti cavitation valve (ACV) operation

If there is negative pressure at actuator port, the tank pressure makes the socket pressed and opened.

Since the passage the seat and the socket is opened by the socket transfer, the oil discharged from the tank flows into the actuator port through this passage.



ACV operation

1692MC06

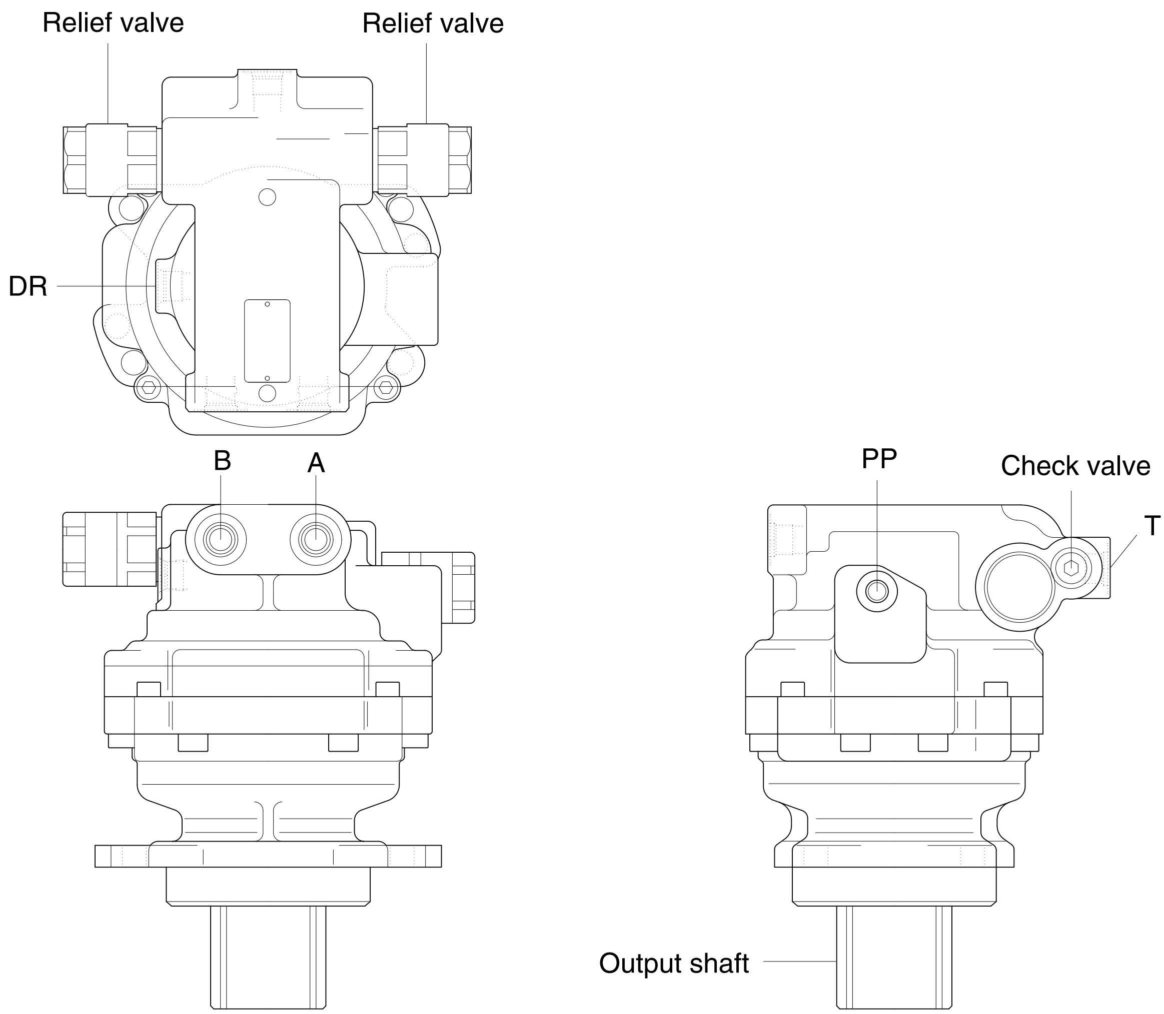
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor and swing reduction gear.

1) SWING MOTOR

Swing motor include mechanical relief valve, make up valve and check valve.



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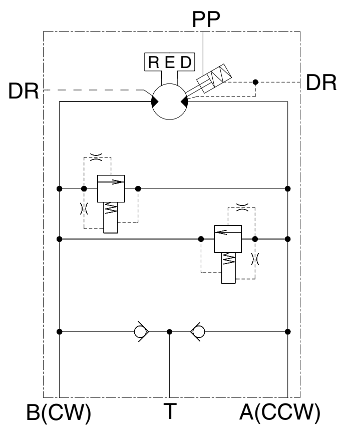
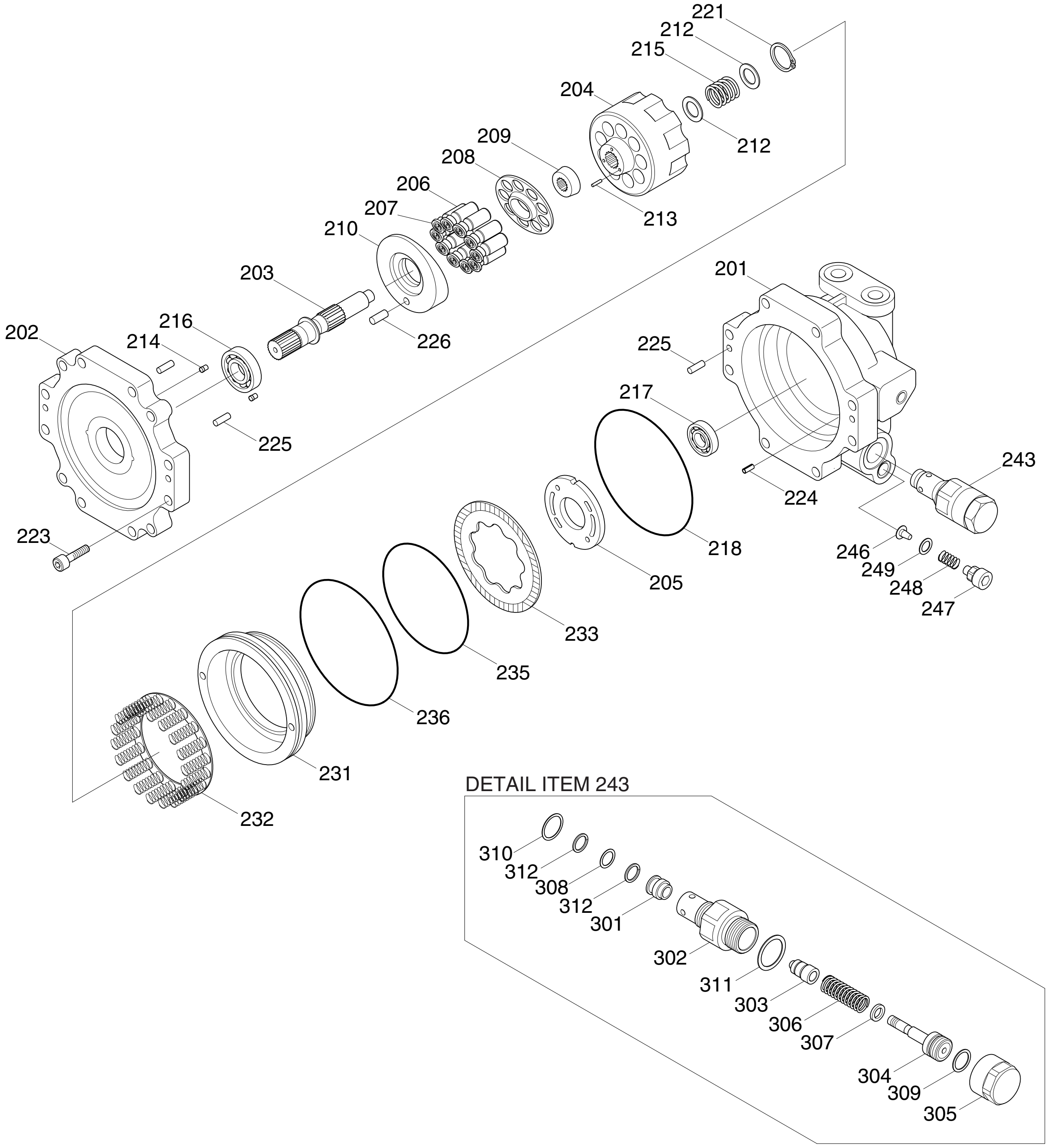


Hydraulic Circuit

Port	Port name	Port size
A	Main port	PF 3/8
B	Main port	PF 3/8
DR	Drain port	PF 3/8
PP	Parking brake port	PF 1/4
T	Make up port	PF 3/8

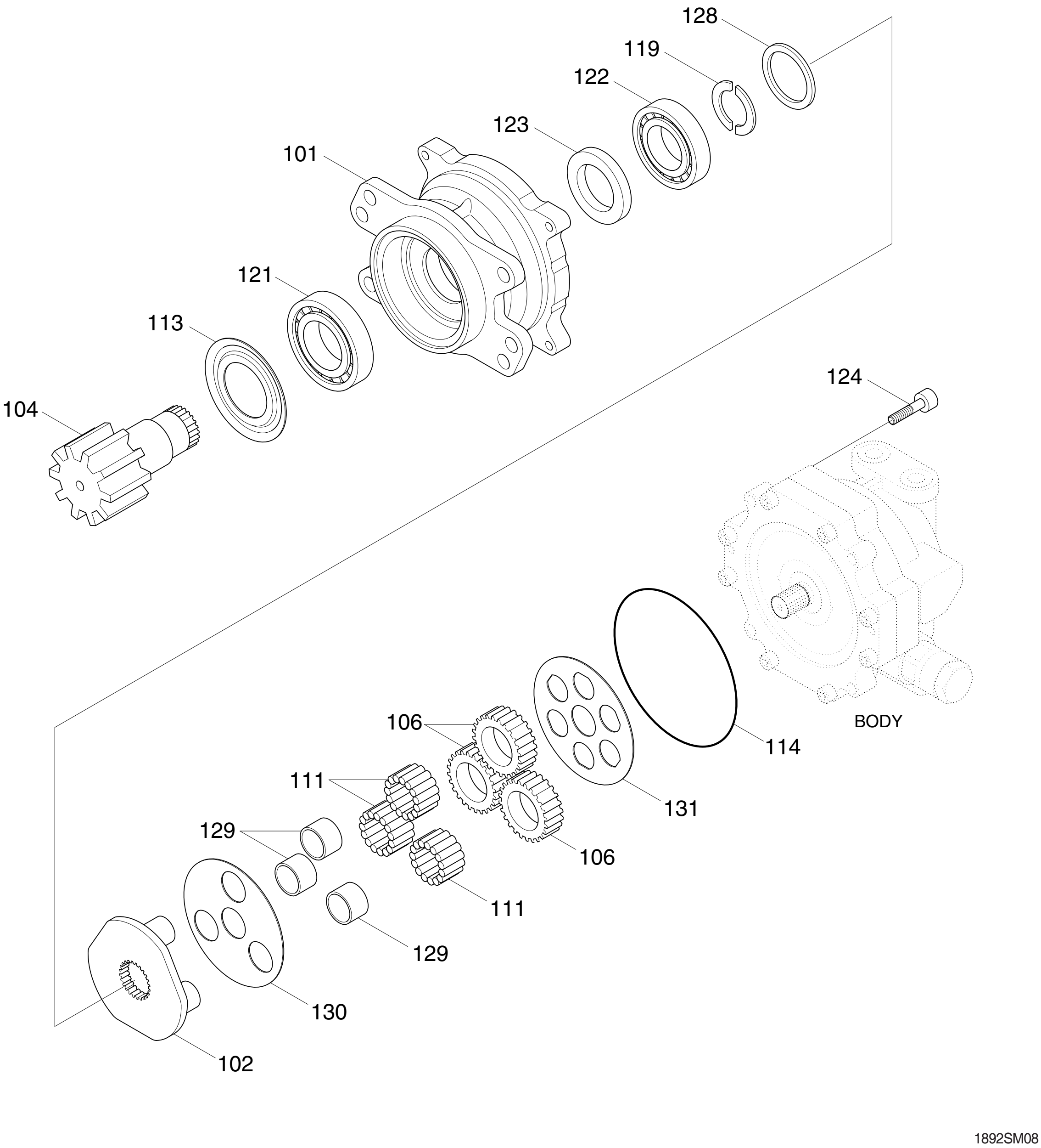
2) COMPONENTS (1/2)



1892SM06

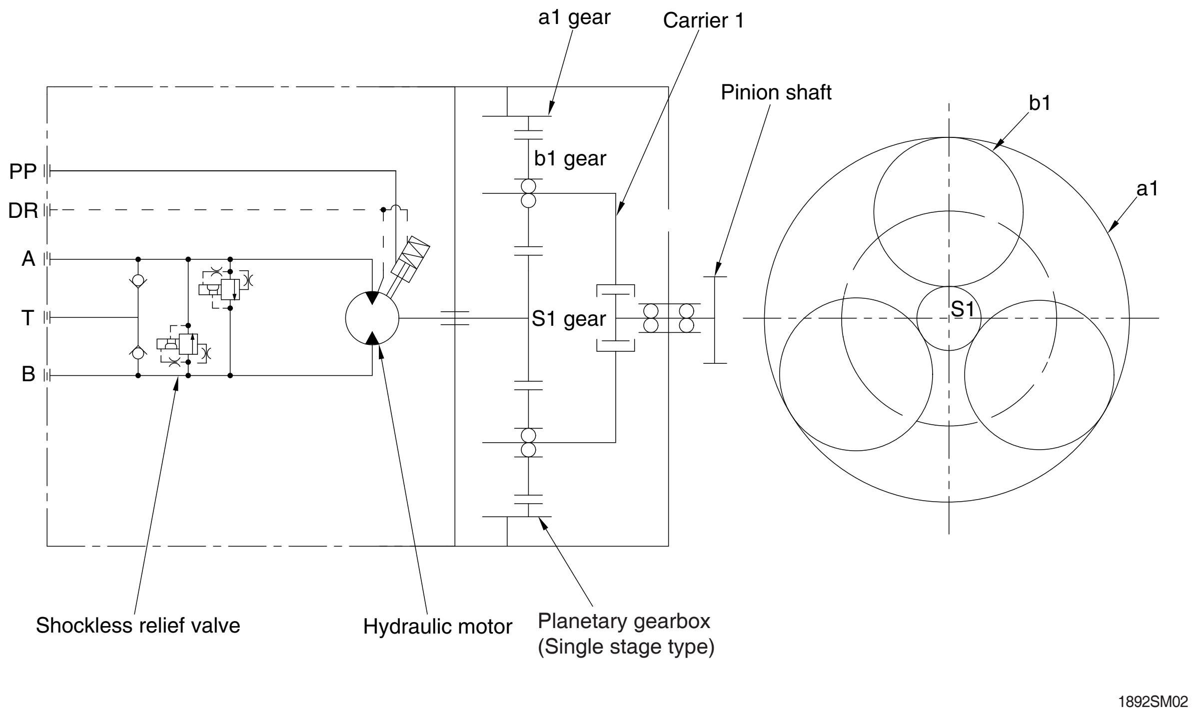
201	Body	213	Pin	231	Brake piston	302	Retainer
202	Plate	214	Filter	232	Spring assy	303	Poppet
203	Shaft	215	Spring C	233	Disk plate	304	Piston
204	Cylinder barrel	216	Bearing	235	O-ring	305	Cap
205	Valve plate	217	Bearing	236	O-ring	306	Spring
206	Piston	218	O-ring	243	Relief valve assy	307	Spacer
207	Shoe	221	Snap ring	246	Check valve	308	O-ring
208	Shoe holder	223	Screw	247	Plug	309	O-ring
209	Barrel holder	224	Spring pin	248	Spring	310	O-ring
210	Swash plate	225	Pin	249	O-ring	311	O-ring
212	Retainer	226	Pin	301	Seat	312	Back up-ring

COMPONENTS (2/2)



101	Body	114	O-ring	128	Ring
102	Carrier 1	119	Preload collar	129	Ring 1
104	Pinion shaft	121	Bearing	130	Thrust plate 1
106	Gear B1	122	Bearing	131	Thrust plate 2
111	Needle	123	Oil seal		
113	Seal ring	124	Screw		

2. OPERATION PRINCIPLE



3. OPERATION

The swing motor consists of a planetary gear speed reducer, a hydraulic motor and the hydraulic valves.

1) REDUCTION GEAR SECTION

(1) Function

The speed reducer of swing motor is a simple planetary gear type with single stage. The high output speed of the hydraulic motor is reduced to low speed with high torque and obtaining the pinion shaft rotation.

(2) Operation

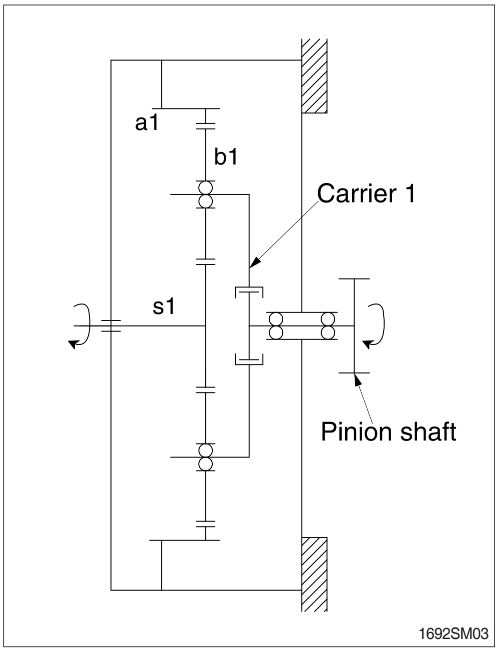
The s1 gear is attached to the hydraulic motor shaft, and the s1 output speed is reduced between the gears (s1, b1, a1).

This reduced output speed is transmitted to the pinion shaft, and drives the machine.

The gear ratio of single stages simple planetary speed reducer is calculated using the following formula.

$$R = \frac{Zs1}{Zs1+Za1}$$

※ Z ** : Number of gear teeth.



2) HYDRAULIC MOTOR SECTION

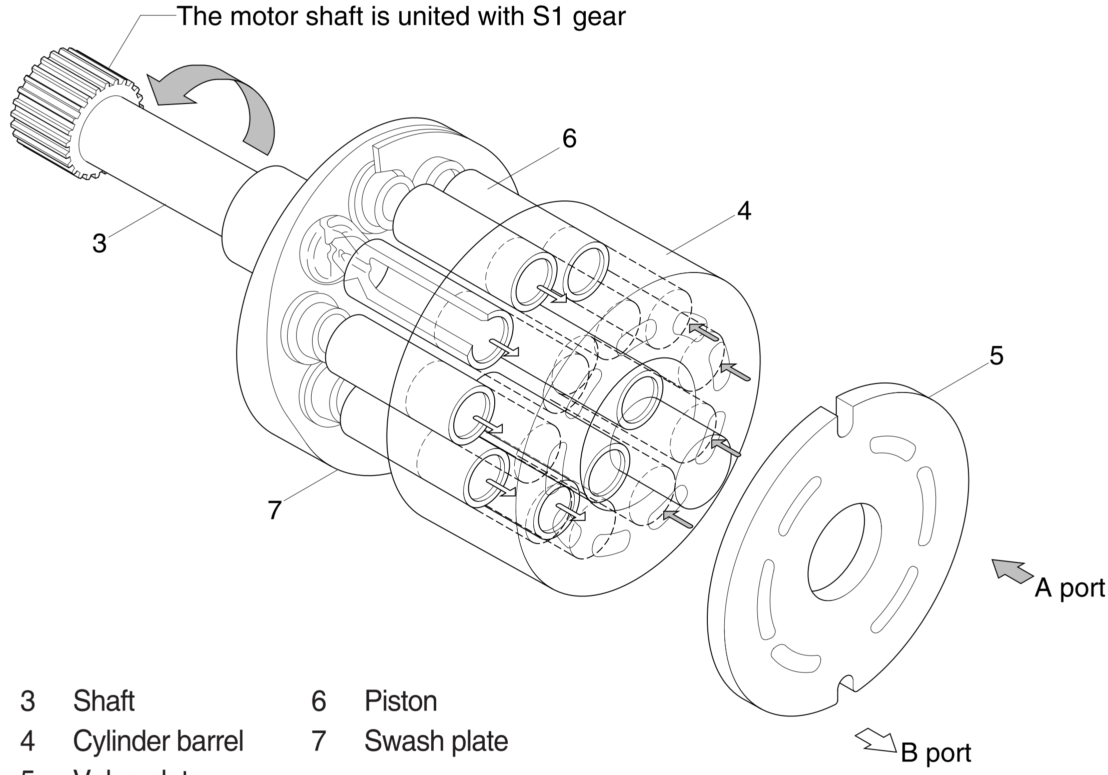
(1) Function

This hydraulic motor is an axial piston type, and changes the hydraulic energy supplied from the pump to the rotary motion.

(2) Structure

Through a hydraulic valve, the pressurized oil is supplied to the valve plate (5). When the pressurized oil is supplied to the A port, this pressurized oil pushes the piston (6) in the cylinder barrel (4). This pushing force is changed to the rotational power by the swash plate (7) and transmitted to the shaft (3) which is connected to the cylinder barrel (4) with the spline. The return flow from the cylinder port is going out through the B port of the valve plate (5).

To reverse rotation, pressurized oil is supplied to the B port and returning oil exits through the A port.



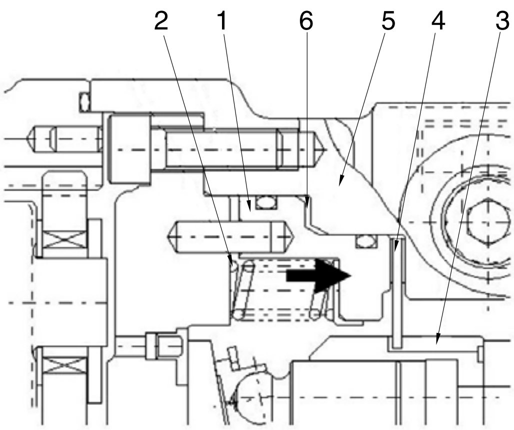
3	Shaft	6	Piston
4	Cylinder barrel	7	Swash plate
5	Valve plate		

1692SM04

(3) Parking brake

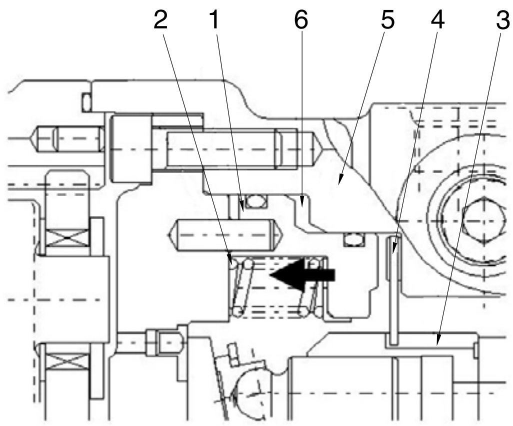
The parking brake fixes the output shaft of hydraulic motor mechanically while the swing motor is stopped.

When brake releasing pressure is not supplied, the brake piston (1) is pressed in the direction (shown as arrow in figure A) by the spring (2). Then the disk plate (4) which is fixed to the cylinder barrel (3) is held between the body (5) and the brake piston (1). As a result, with the friction of these parts, the cylinder barrel (3) and the hydraulic motor are unable to rotate.(figure A)



At the brake erleasing pressure OFF

Figure A



At the brake erleasing pressure ON

Figure B

1892SM07

When brake releasing pressure is supplied, the oil is lead to chamber (6) shown in figure B.

Then the brake piston (1) is moved to the direction (shown as arrow in figure B) against the force of spring (2). As a result, the disk plate (4) is released from the friction, and the cylinder barrel (3) can be rotated.(figure B)

3) HYDRAULIC VALVE SECTION

(1) Shockless relief valve

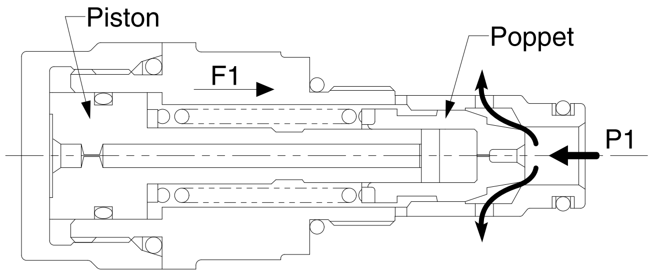
The shockless relief valve consists of the direct relief valve (poppet) and the piston for changing the spring force with two stages.

When the hydraulic motor is stopped, even after closing IN and OUT port of the hydraulic motor, the motor tries to run with inertia. Motor works as like a pump, and the pressure (brake pressure) is made on the OUT port side. The shockless relief valve releases this brake pressure with two stages of operation. This makes the shock smooth, and prevents the motor being damaged.

It also makes the start of the motor smooth.

① First stage

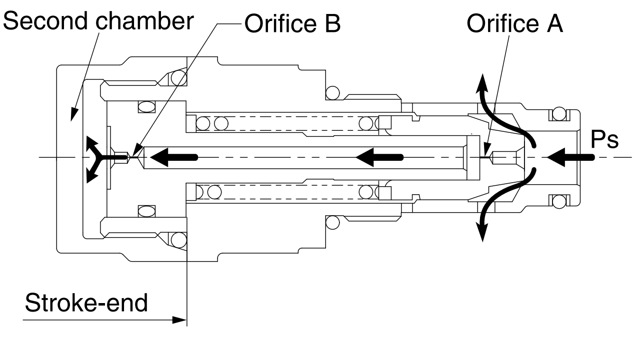
When the P1 pressure is going up, the poppet opens due to the pressure of the spring force F1.



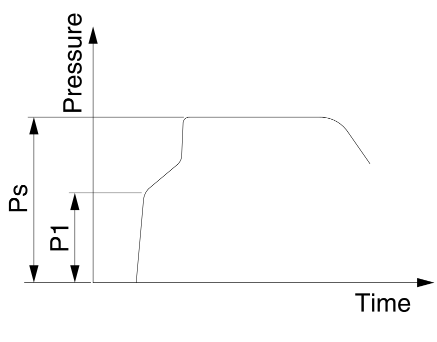
1692SM09

② Second stage

When P1 pressure enters the second chamber through the orifice A and B, the piston moves to its stroke-end. With this action, the spring is compressed, the spring force becomes stronger, and the P1 pressure is increased to the setting pressure Ps.



1692SM10



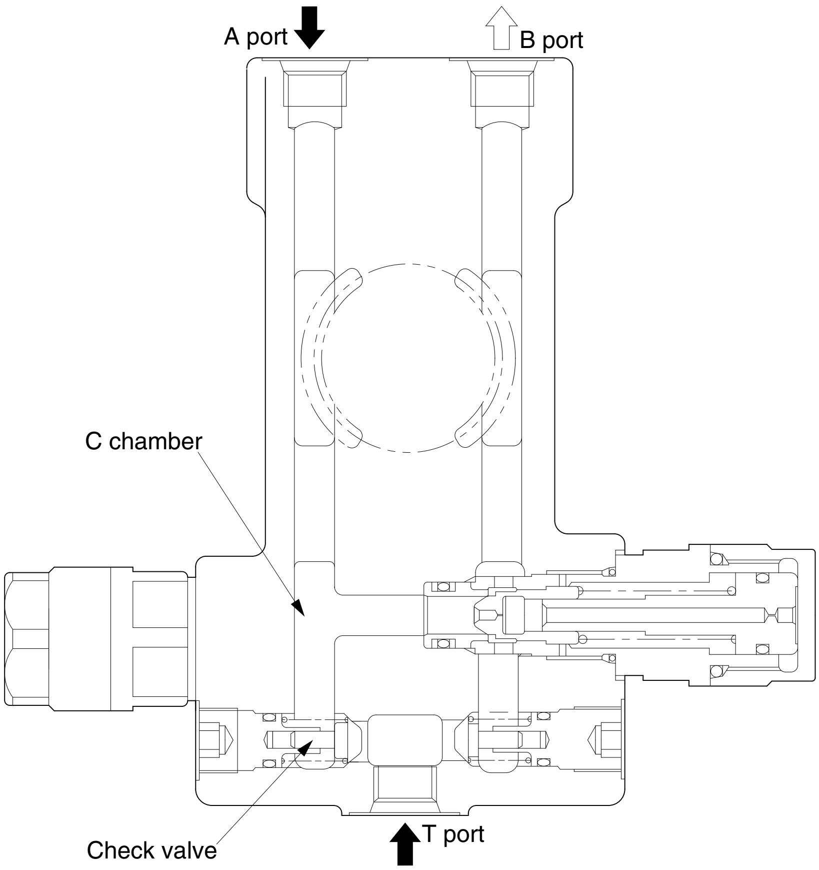
1692SM11

With the above two stages of operation, the motor starts and stops smoothly.

(2) Check valve

When the swing motor is decelerated by operating the control valve, it continues to be moved by the inertia of the machine. Then, it works as pump, and the pressure of C chamber tends to become negative. However, when B port pressure is below cracking pressure of the relief valve, all flow in A port goes out from B port through the motor.

Therefore, if C chamber can get flow only from the control valve, the flow will not be enough to prevent the negative pressure; as a result, cavitation could occur. The check valve works to supply the flow from T port to C chamber; and prevents cavitation.



1692SM05

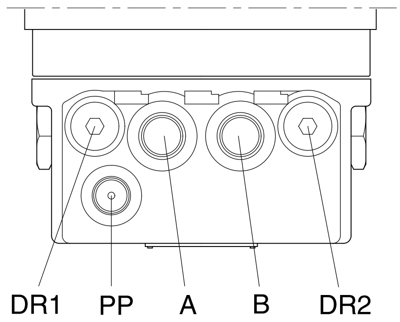
GROUP 4 TRAVEL DEVICE

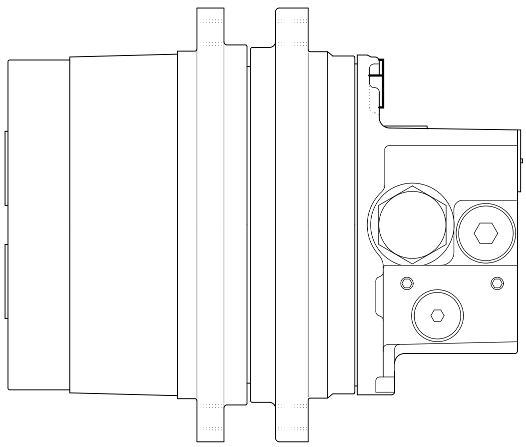
1. CONSTRUCTION

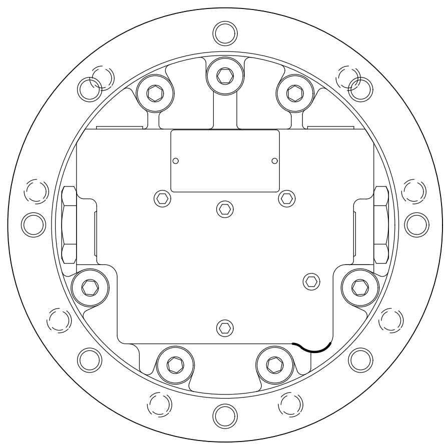
Travel device consists travel motor and gear box.

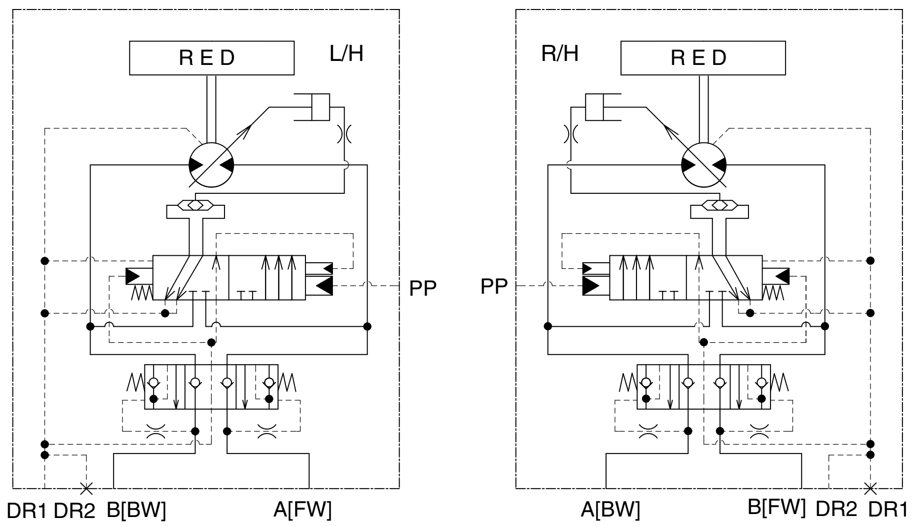
Travel motor includes counterbalance valve, parking brake and high/low speed changeover mechanism.

Port	Port name	Port size
A	Main port	PF 3/8
B	Main port	PF 3/8
DR1, DR2	Drain port	PF 1/4
PP	2 speed control port	PF 1/4





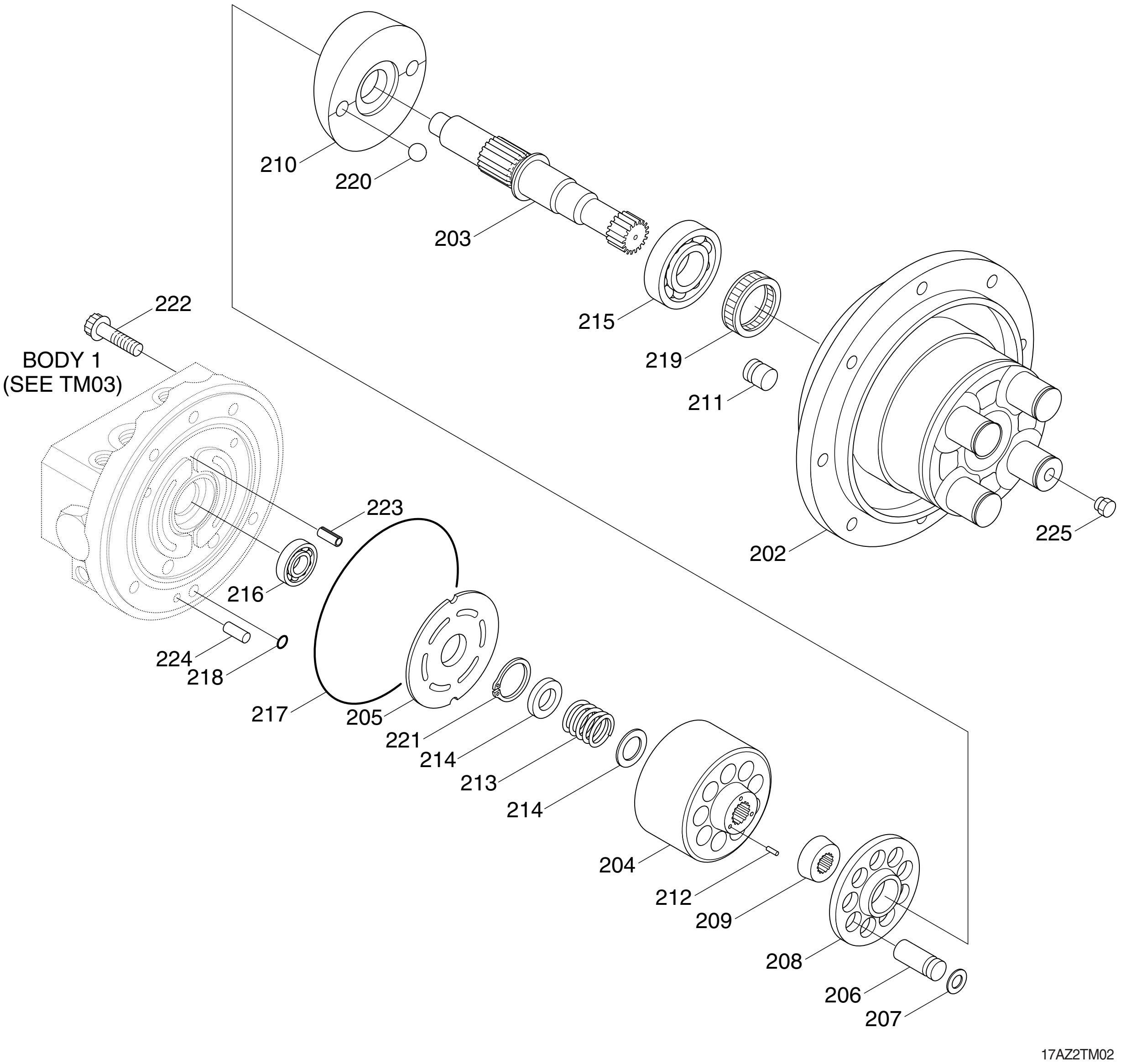




HYDRAULIC CIRCUIT

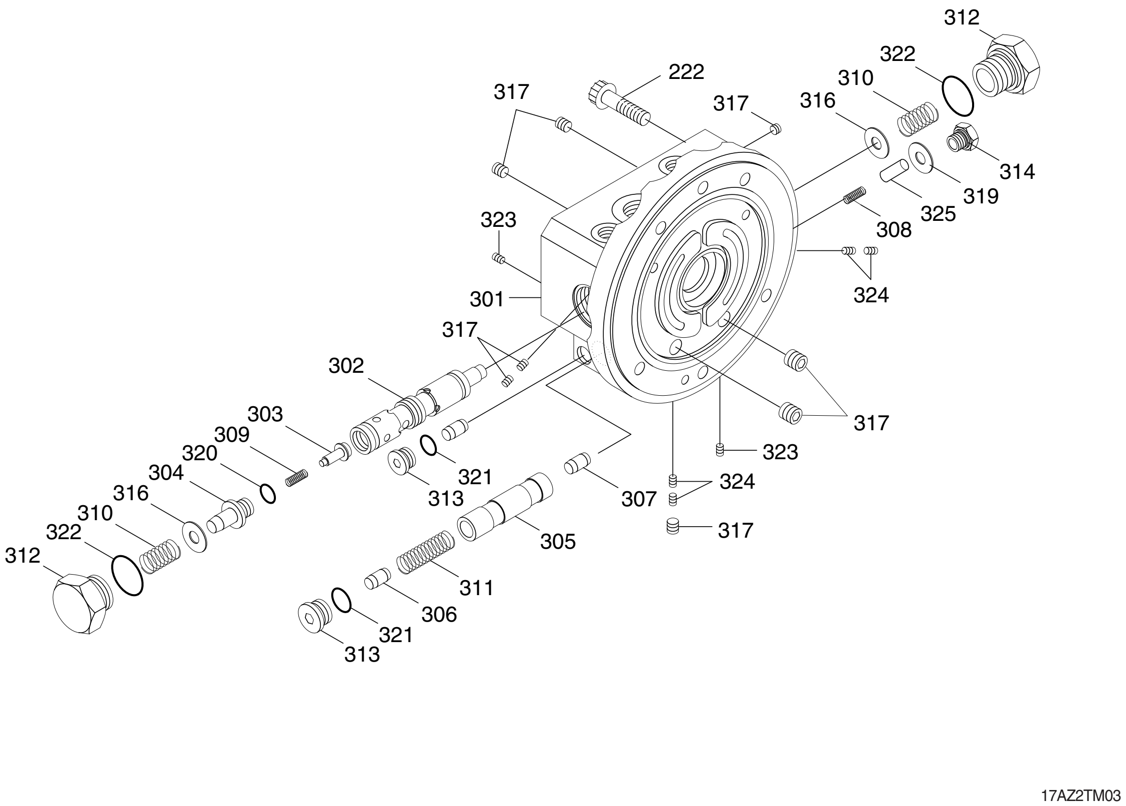
17AZ2TM01

2) STRUCTURE (1/3)



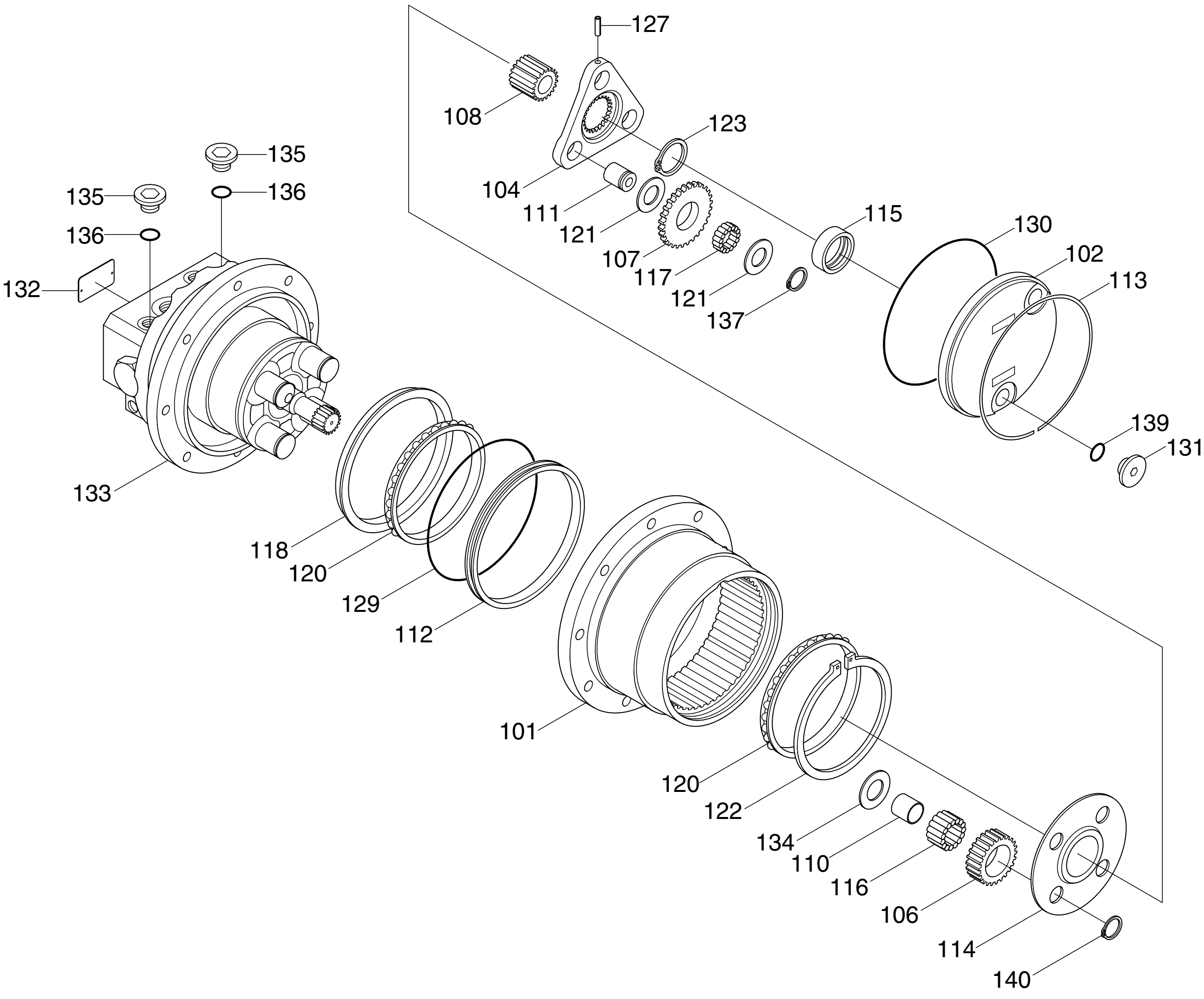
202	Body 2	210	Swash plate	218	O-ring
203	Shaft	211	Control piston	219	Oil seal
204	Cylinder barrel	212	Pin	220	Steel ball
205	Valve plate	213	Spring C	221	Snap ring
206	Piston	214	Retainer	222	Screw
207	Shoe	215	Bearing	223	Spring pin
208	Shoe holder	216	Bearing	224	Pin
209	Barrel holder	217	O-ring	225	Plug

STRUCTURE (2/3)



301	Body 1	309	Spring V1	319	O-ring
302	Spool	310	Spring V2	320	O-ring
303	Check valve	311	Spring V3	321	O-ring
304	Spring guide	312	Plug	322	O-ring
305	Spool	313	Plug	323	Chock
306	Spool B	314	Ring	324	Chock
307	Spool C	316	Plug	325	Pin
308	Shuttle spool	317	Plug		

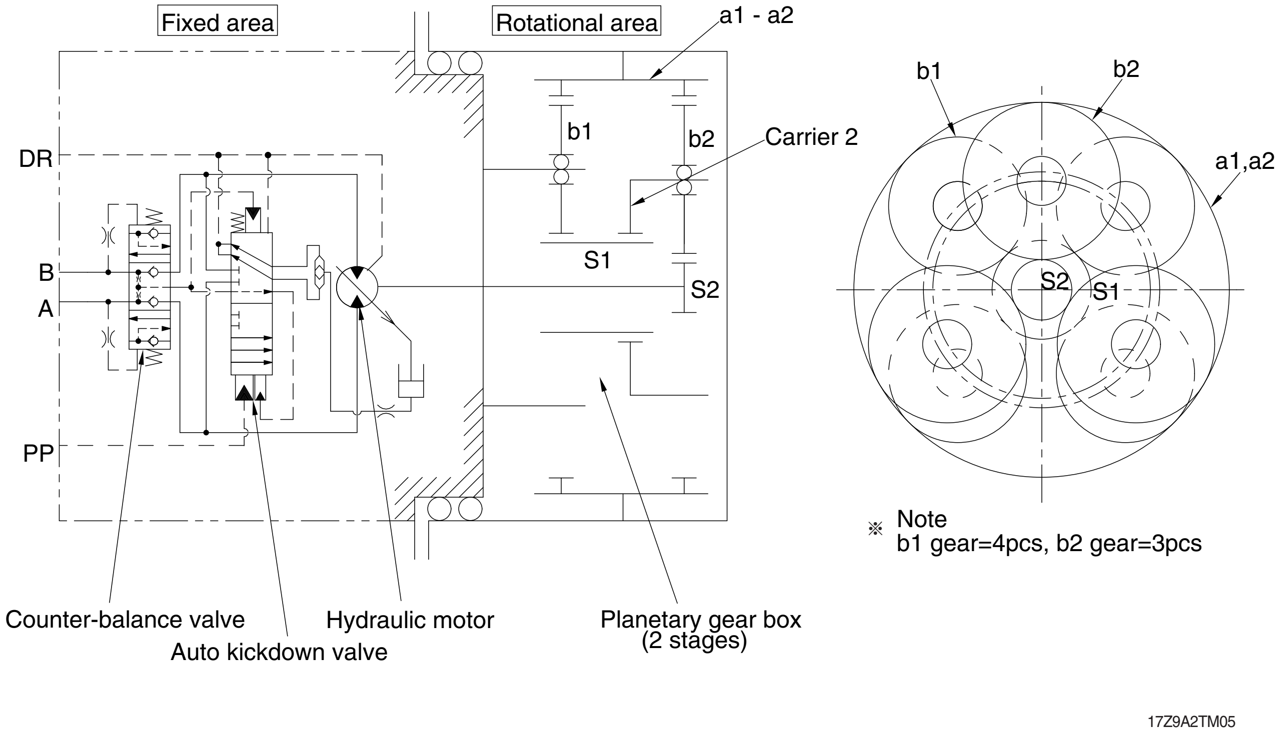
STRUCTURE (3/3)



17AZ2TM04

101	Body	112	Seal ring	121	Thrust washer	134	Thrust washer
102	Cover	113	Snap ring	122	Snap ring	135	Plug
104	Carrier 2	114	Thrust plate	123	Snap ring	136	O-ring
106	Gear B1	115	Slide ring	127	Spring pin	137	Snap ring
107	Gear B2	116	Needle bearing	129	O-ring	139	O-ring
108	Gear S1	117	Needle bearing	130	O-ring	140	Snap ring
110	Ring	118	Floating seat	131	Plug		
111	Pin B2	120	Bearing	133	Hydraulic motor		

2. DRAWING OF OPERATIONAL PRINCIPLE



3. OPERATION

Travel motor consists of a hydraulic motor "Fixed parts" and a planetary gear speed reducer "Rotating parts".

1) REDUCTION GEAR SECTION

(1) Function

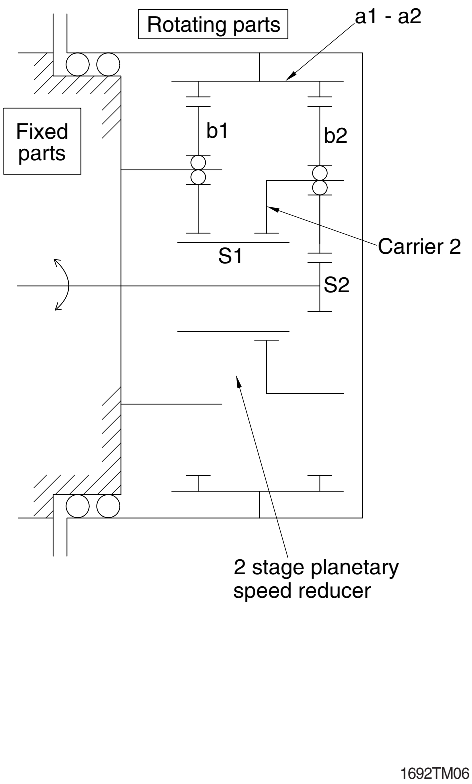
The speed reducer of travel motor is a simple planetary gear type with two stages. The high output speed of the hydraulic motor is reduced to low speed with high torque.

(2) Operation

The S2 gear is attached to the hydraulic motor shaft and the S2 output speed is reduced between the gears (s2, b2, a2) as a first stage speed reducer.

The reduced output speed of this first stage is reduced again between the gears (s1, b1, a1) which are connected to the carrier 2 with the spline.

This reduced output speed of the second stage is transmitted to the body case "rotating parts" through the inner gears (a1, a2) and drives the machine.



The gear ratio of 2 stage simple planetary speed reducer is calculated using the following formula.

$$R = \frac{Zs1}{Zs1+Za1} \times \frac{Zs2}{Zs2+Za2}$$

※ Z_{**} : Number of teeth

With the travel motor, the body case rotating, so the gear ratio is ;

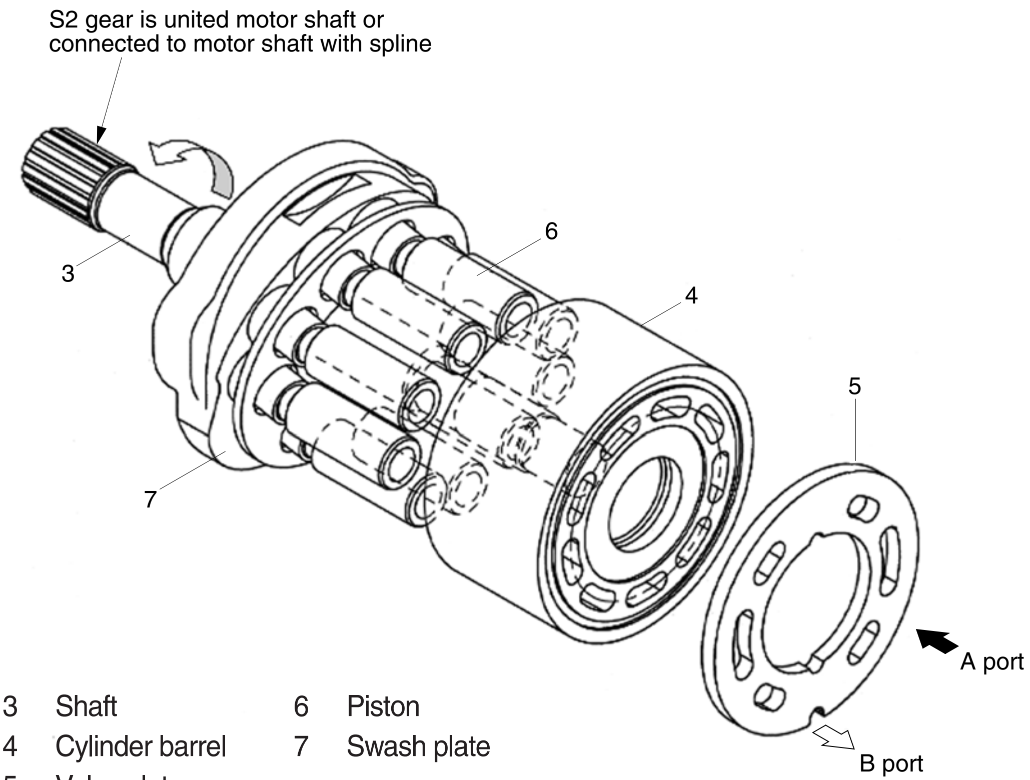
$$R' = \frac{1}{1-1/R}$$

2) HYDRAULIC MOTOR SECTION

(1) Function

This hydraulic motor is an axial piston type, and changes the hydraulic energy supplied from the pump to the rotary motion.

(2) Structure



3	Shaft	6	Piston
4	Cylinder barrel	7	Swash plate
5	Valve plate		

17Z9A2TM06

Through a hydraulic valve, the pressurized oil is supplied to the valve plate (5).
When the pressurized oil is supplied to the A port, this pressurized oil pushes the piston (6) in the clylinder barrel (4). This pushing force is changed to the rotational power by the swash plate (7) and transmitted to the shaft (3) which is connected to the cylinder barrel (4) with the spline. The return flow from the cylinder port is going out through the B port of the valve plate (5). To reverse rotation, pressurized oil is supplied to the B port and returning oil exits through the A port.

(3) 2 speed motor operation

The swash plate, which has surface Ⅰ and Ⅱ in the opposite side to the shoe sliding surface, is supported by the 2 balls which are fixed to the body 2.

Since the balls are located in the eccentric position, in the low speed range, the surface Ⅰ is faced to the body 2 by the oil pressure in the piston and the spring force in the cylinder barrel. The swash plate angle is α (max capacity).

When the pressurized oil is supplied to the (PP) port, the two-speed spool moves to the high position.

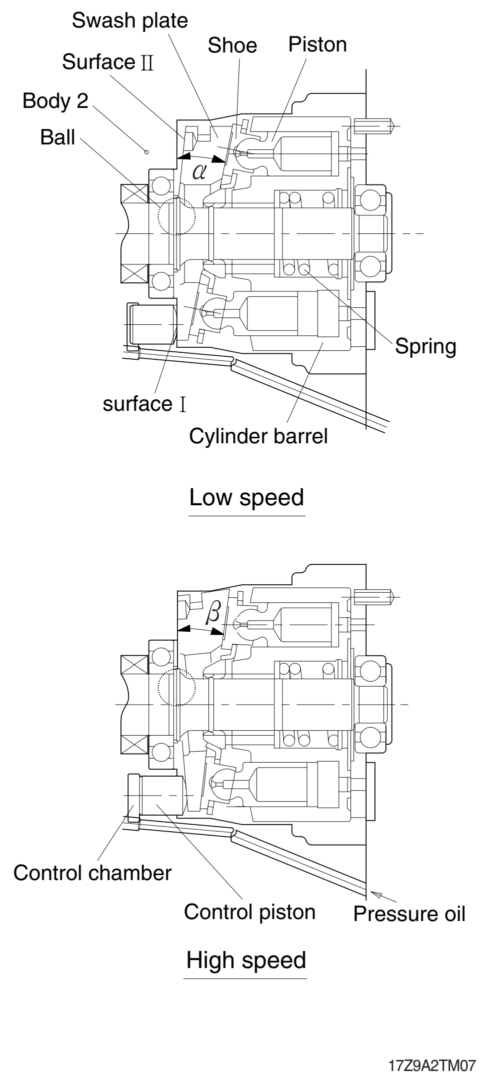
And the pressurized oil of inlet is led to the control chamber through the two-speed spool.

The control piston moves forward until the surface Ⅱ of the swash plate is in contact with the body 2, and the swash plate angle becomes β.

The capacity of the hydraulic motor is made small.

The pressurized oil of the (PP) port is shut off (or the engine is stopped), the two-speed spool moves to the low position.

And the control chamber is led to the tank port through the two-speed spool and the swash plate position comes to the low speed by the spring force.

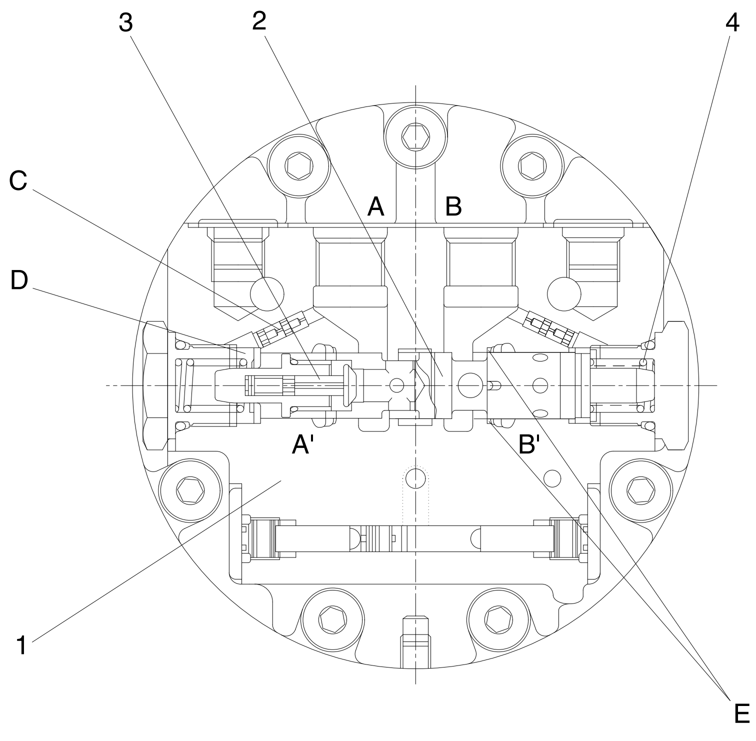


3) HYDRAULIC VALVE SECTION

(1) Counter-balance valve

When the pressurized oil is supplied from the A port, the pressurized oil opens the check valve (3) and flows into the hydraulic motor inlet A' port. At the same time, the pressurized oil goes through the orifice C into the chamber D, pushes the spring (4) and moves the spool (2) to right. Then the returned oil from the hydraulic motor flows into the B port, goes through area E and drives the hydraulic motor. When the pressurized oil is supplied from the B port, the hydraulic motor rotates in reverse.

Even the pressurized oil of the A port is shut off, the hydraulic motor tries to rotate by inertia force. When the pressurized oil from the A port is shut off, the spool (2) tries to return to left by the spring (4) force. At this time, the oil in the chamber D tries to go out to the A port through the orifice C, but due to the throttle effect of orifice C, the spool (2) speed is reduced. With the orifice and notches on the spool, the returned oil is controlled gradually and the hydraulic motor stops smoothly.



17Z9A2TM08

(2) Auto kick down valve

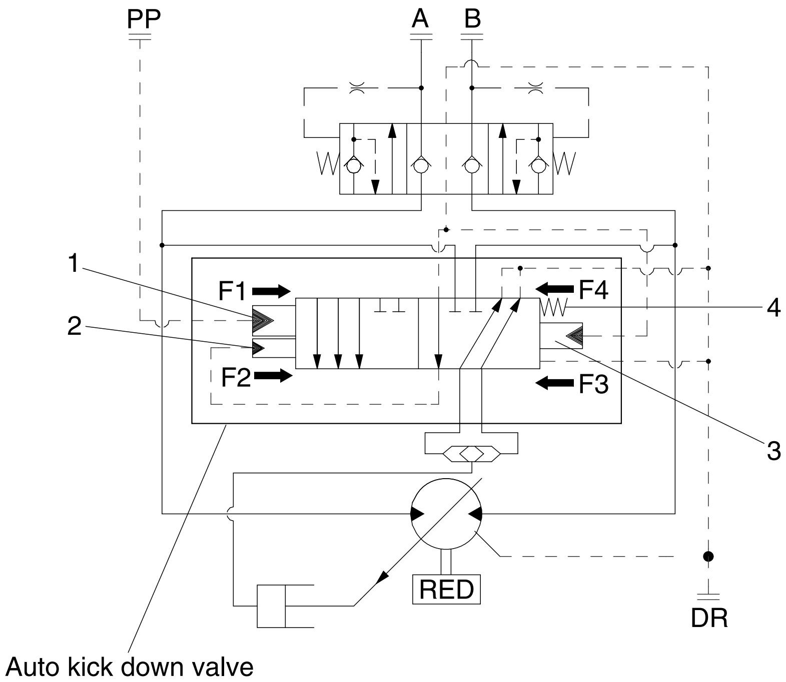
When the travel speed control switch for Hi speed mode is turned on, the pilot pressure for Hi speed mode comes from PP port to the hydraulic pilot (1), then the force F1 occurs. The auto kick down valve moves to the right direction because the F1 is larger than F4, which is by spring (4). Then the speed of track motor is changed to the Hi speed mode.

On the other hand, the operating pressure comes from A or B port to the hydraulic pilot (2) and (3), then the force F2 and F3 occur. The F3 is larger than F2 because the area of (3) is wider than the area of (2). Therefore, if the operating pressure increases, the difference between F2 and F3 also increases.

When the operating pressure is larger than the setting pressure of Hi speed to Lo speed, the right direction resultant of F1 and F2 is smaller than the left direction resultant of F3 and F4.

Therefore the auto kick down valve moves to the left direction, then the speed of track motor is changed to the Lo speed mode. When the operating pressure is smaller than the setting pressure of Lo speed to Hi speed, the right direction resultant of F1 and F2 is larger than the left direction resultant of F3 and F4.

Therefore the auto kick down valve moves to the right direction, then the speed of track motor is changed to the Hi speed mode.



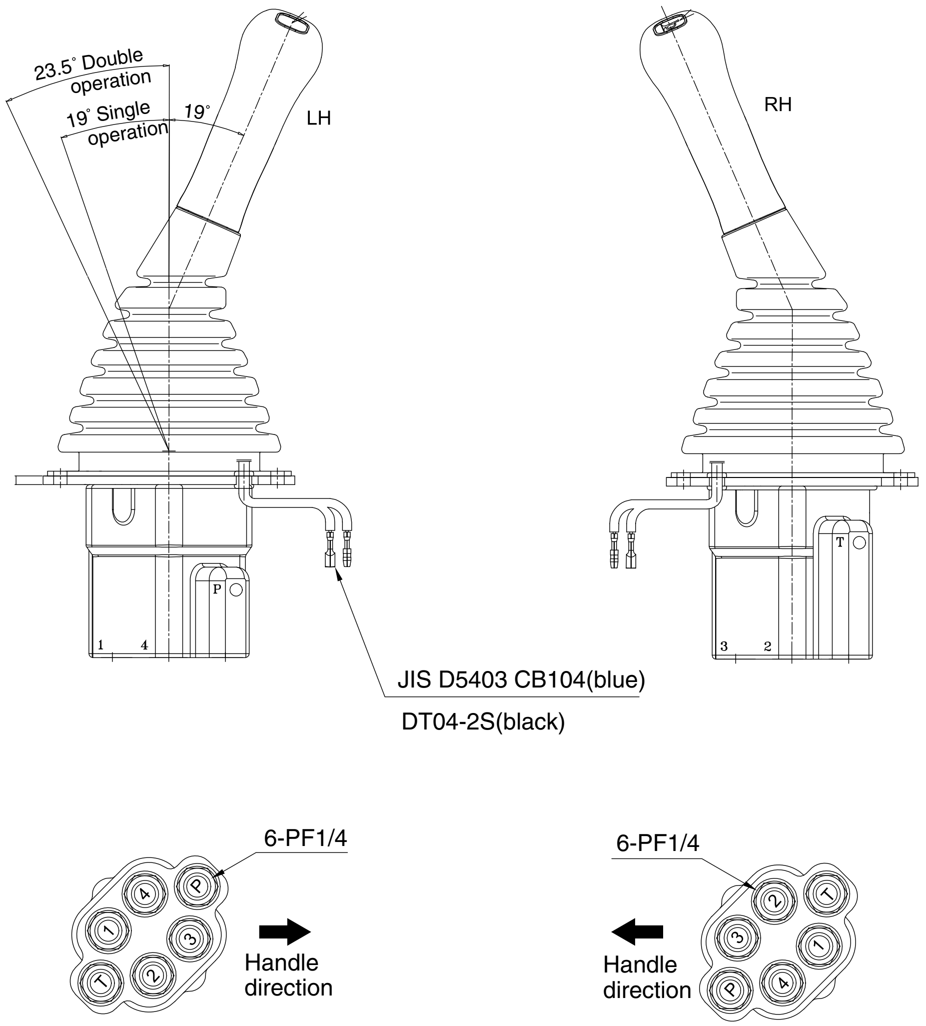
17AZ2TM10

GROUP 5 RCV LEVER

■ TYPE 1 (STANDARD)

1. STRUCTURE

The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1,2,3 and 4 provided at the bottom face.



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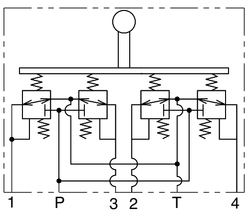


Hydraulic circuit

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm out port	Boom up port	
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	

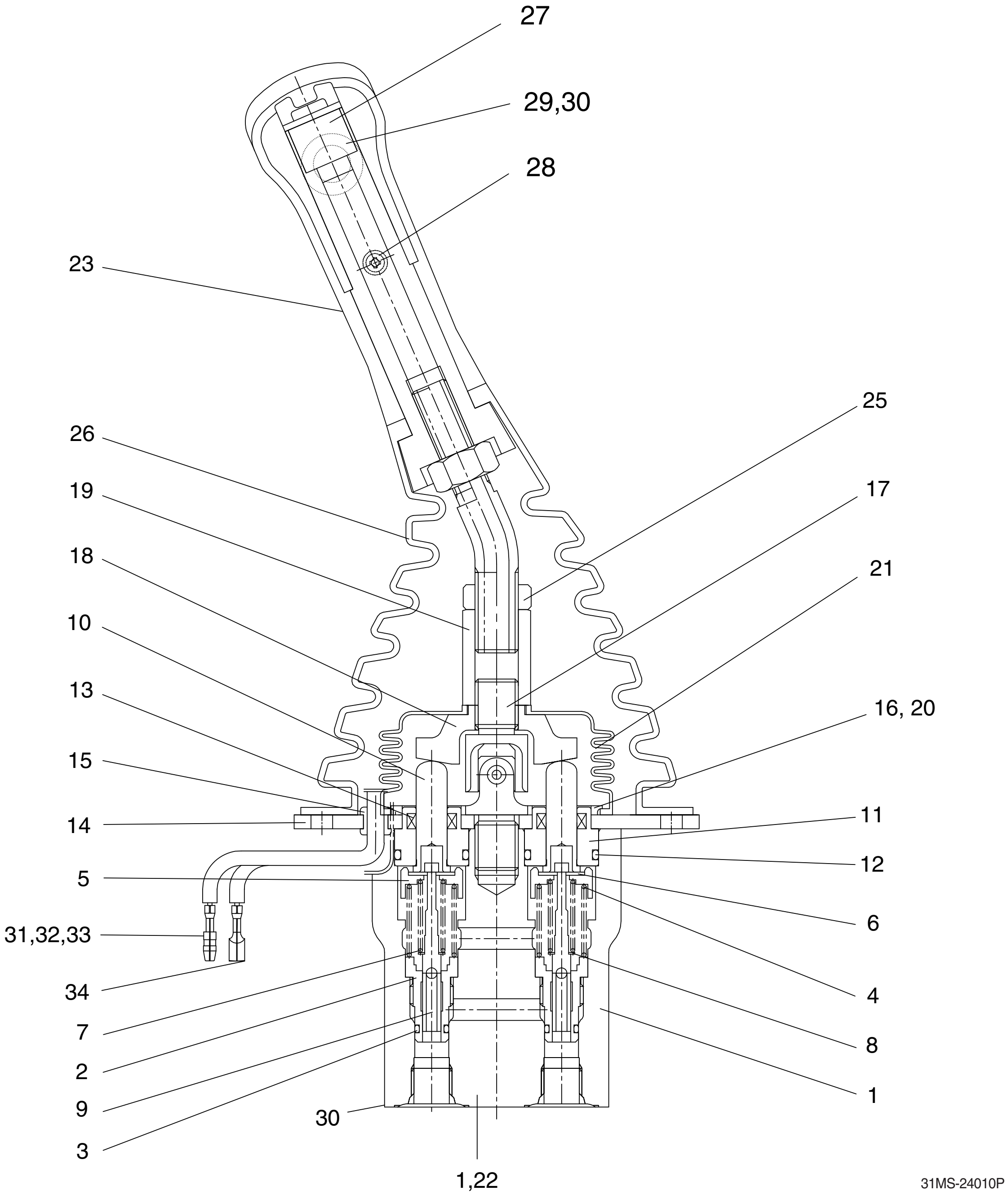
CROSS SECTION

The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (9), spring (7) for setting secondary pressure, return spring (4), stopper (6), spring seat (5) and shim (8). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5.5 to 20.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (10) by the return spring.

When the push rod is pushed down by tilting the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

CROSS SECTION

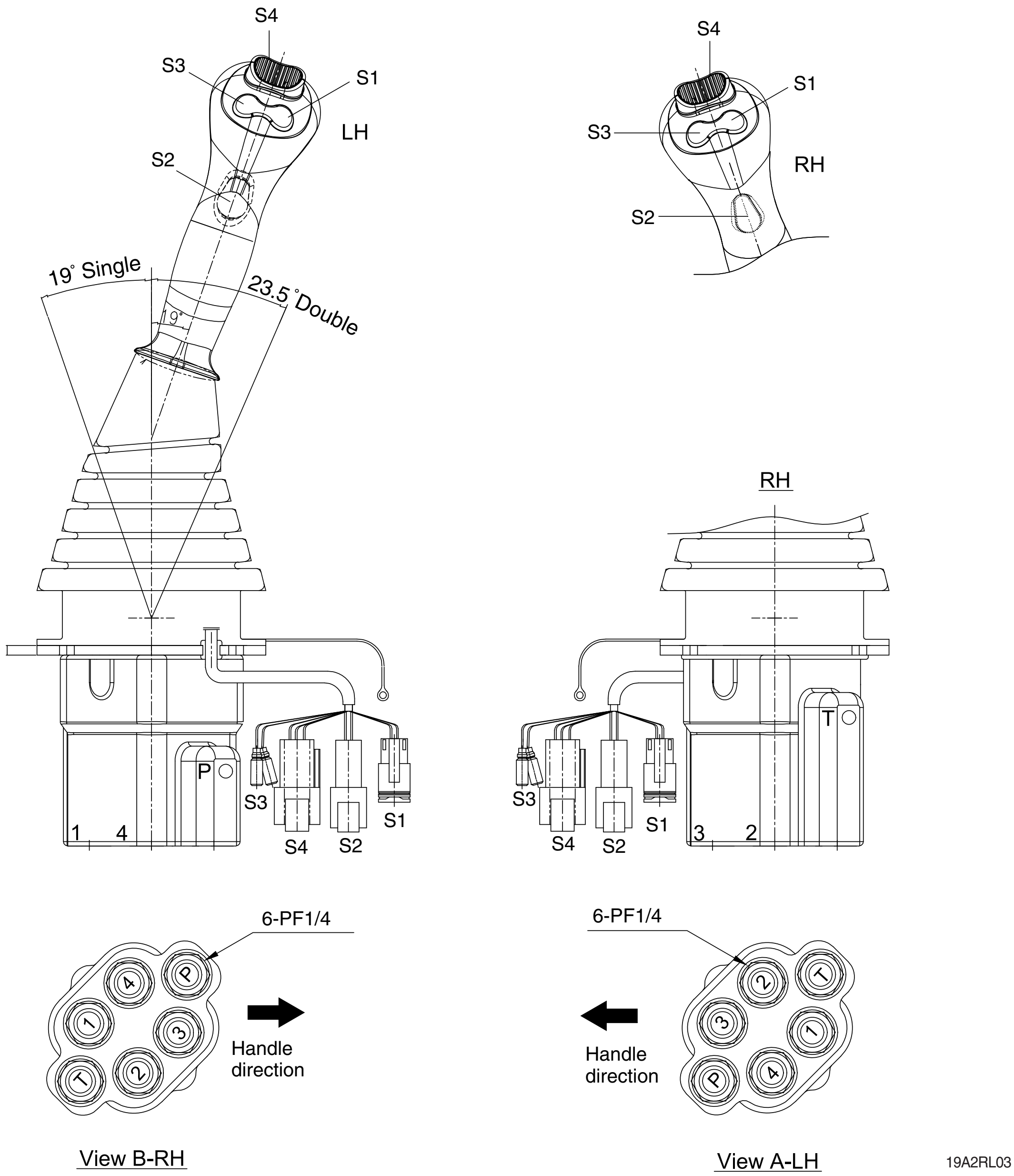


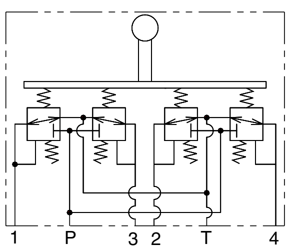
1	Body	13	Rod seal	25	Nut
2	Plug	14	Plate (A)	26	Boots
3	O-ring	15	Bushing	27	Switch 1
4	Spring	16	Machine screw	28	Screw
5	Spring seat	17	Joint assy	29	Switch 2
6	Stopper	18	Swash plate	30	Switch cover
7	Spring	19	Hex nut	31	Connector assy
8	Shim	20	Plate (B)	32	Terminal
9	Spool	21	Inner boots	33	Guide
10	Push rod	22	Plug	34	Connector
11	Plug	23	Handle assy (LH, RH)		
12	O-ring	24	Handle bar		

■ TYPE 2 (PROPORTIONAL, OPTION)

2. STRUCTURE

The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1,2,3 and 4 provided at the bottom face.





Hydraulic circuit

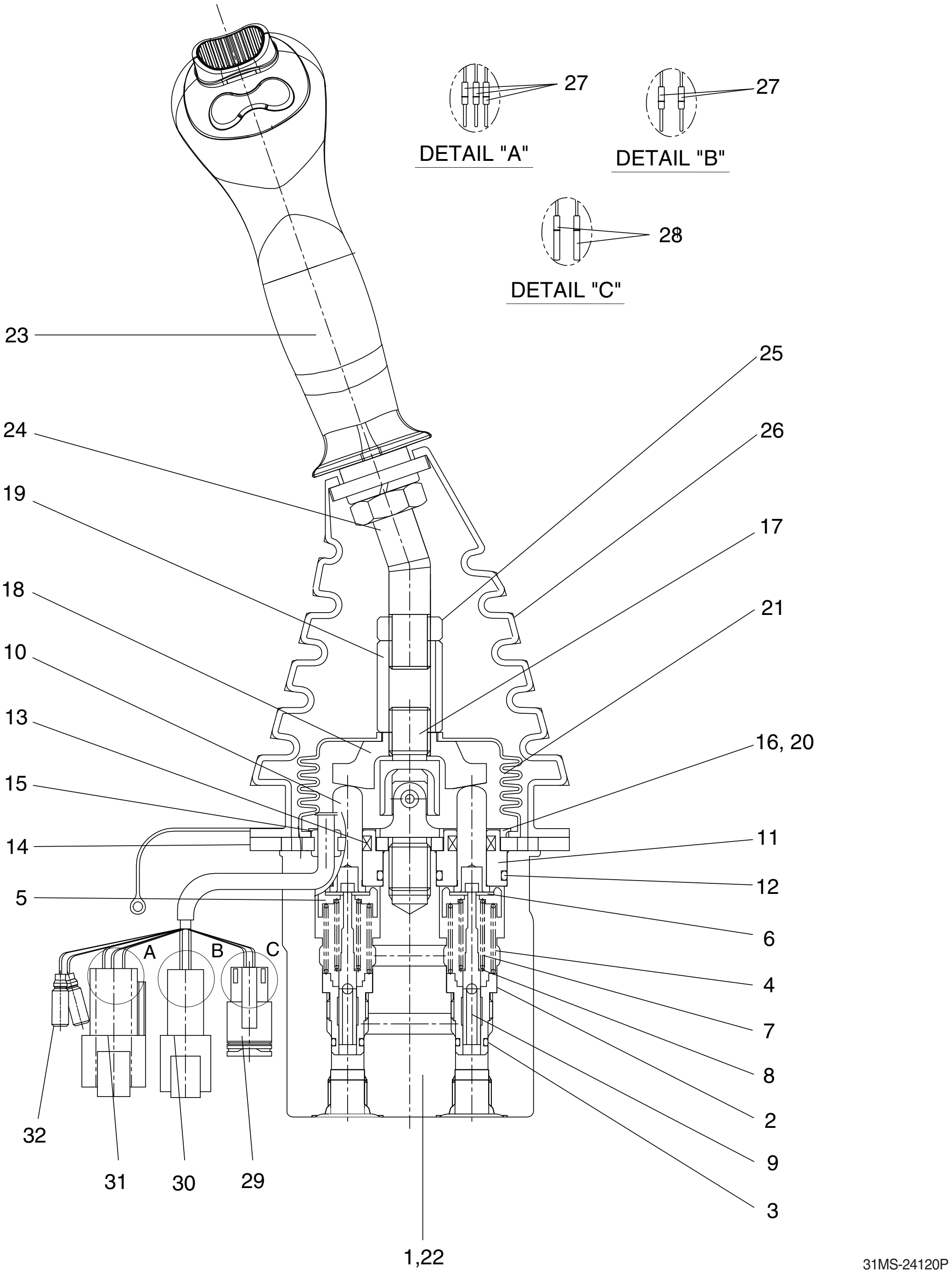
Port	LH	RH (with proportional)	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket in port	
2	Arm out port	Boom down port	
3	Right swing port	Bucket out port	
4	Arm in port	Boom up port	

CROSS SECTION

The structure of the remote control valve is as shown in the assembly. There is a vertical axial hole in the casing and the reduction valves are inserted into this.

The secondary pressure setting spring is set such that the secondary pressure is calculated as 5-5~20.5 kgf/cm^2. Spool (9) is pushed onto the push rod (10) by return spring (4).
Tilting the control handle pushes down push rod (10), the spring seat (5) also moves down and the setting of the secondary pressure setting spring is changed.
Port P, oil inlet (primary pressure) and port T outlet (tank) are in the casing.

CROSS SECTION

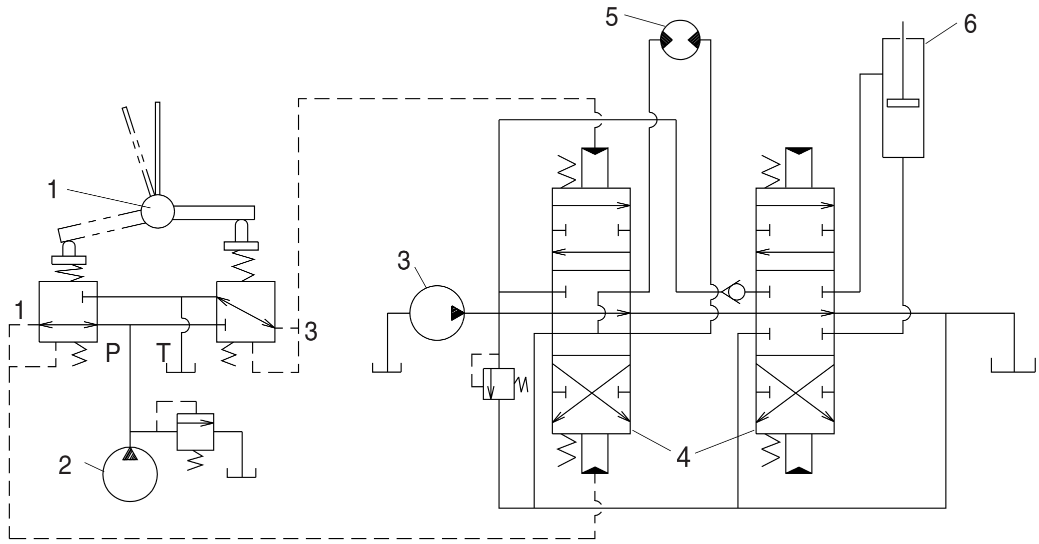


1	Body	12	O-ring	23	Handle assy (LH, RH)
2	Plug	13	Rod seal	24	Handle bar
3	O-ring	14	Plate (A)	25	Nut
4	Spring	15	Bushing	26	Boots
5	Spring seat	16	Machine screw	27	Connector pin male
6	Stopper	17	Joint assy	28	Connector pin female
7	Spring	18	Swash plate	29	Connector assy
8	Shim	19	Hex nut	30	Connector assy
9	Spool	20	Plate (B)	31	Connector assy
10	Push rod	21	Inner boots	32	Connector
11	Plug	22	Plug		

3. OPERATION

The operation of the remote control valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

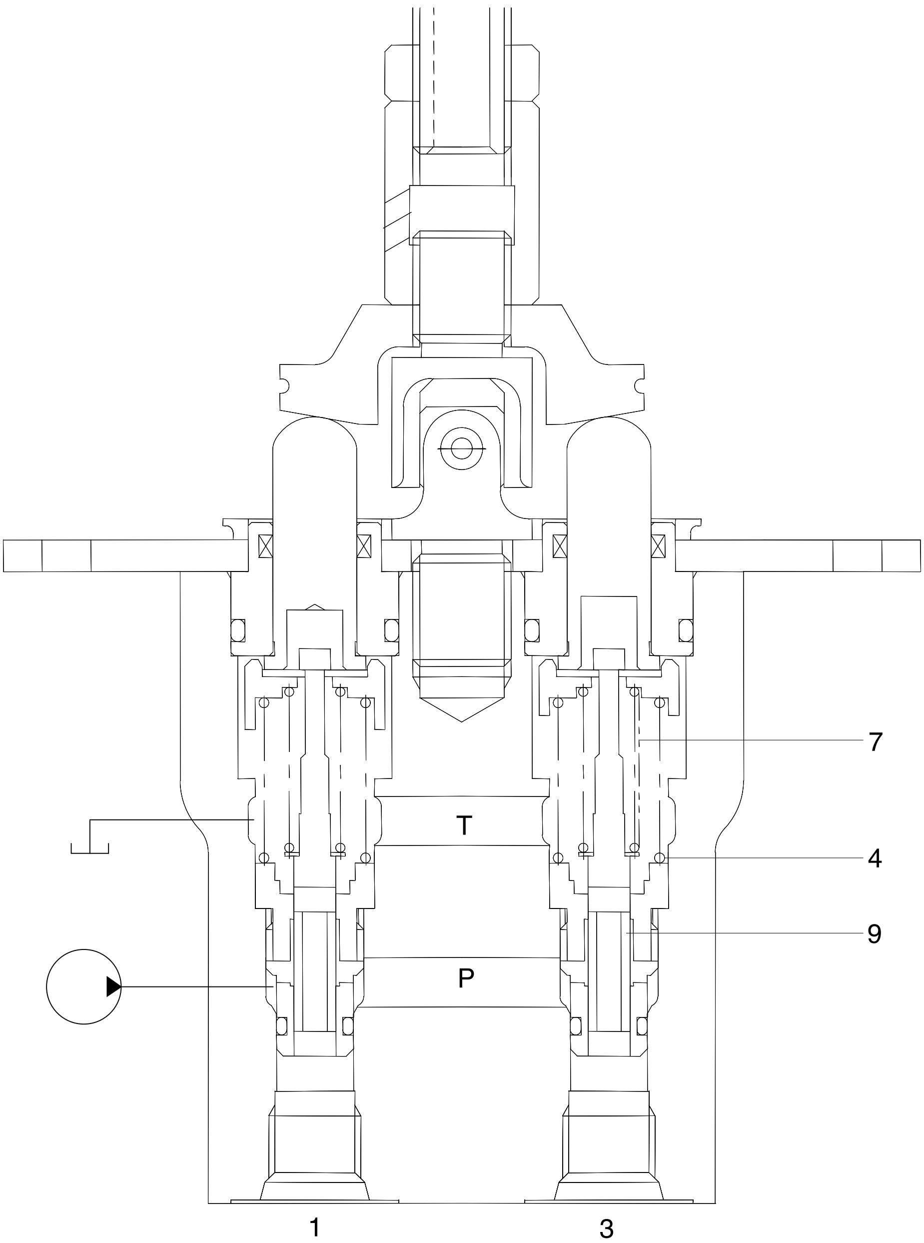
The diagram shown below is the typical application example of the remote control valve.



2-70 (140-7TIER)

1	Remote control valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

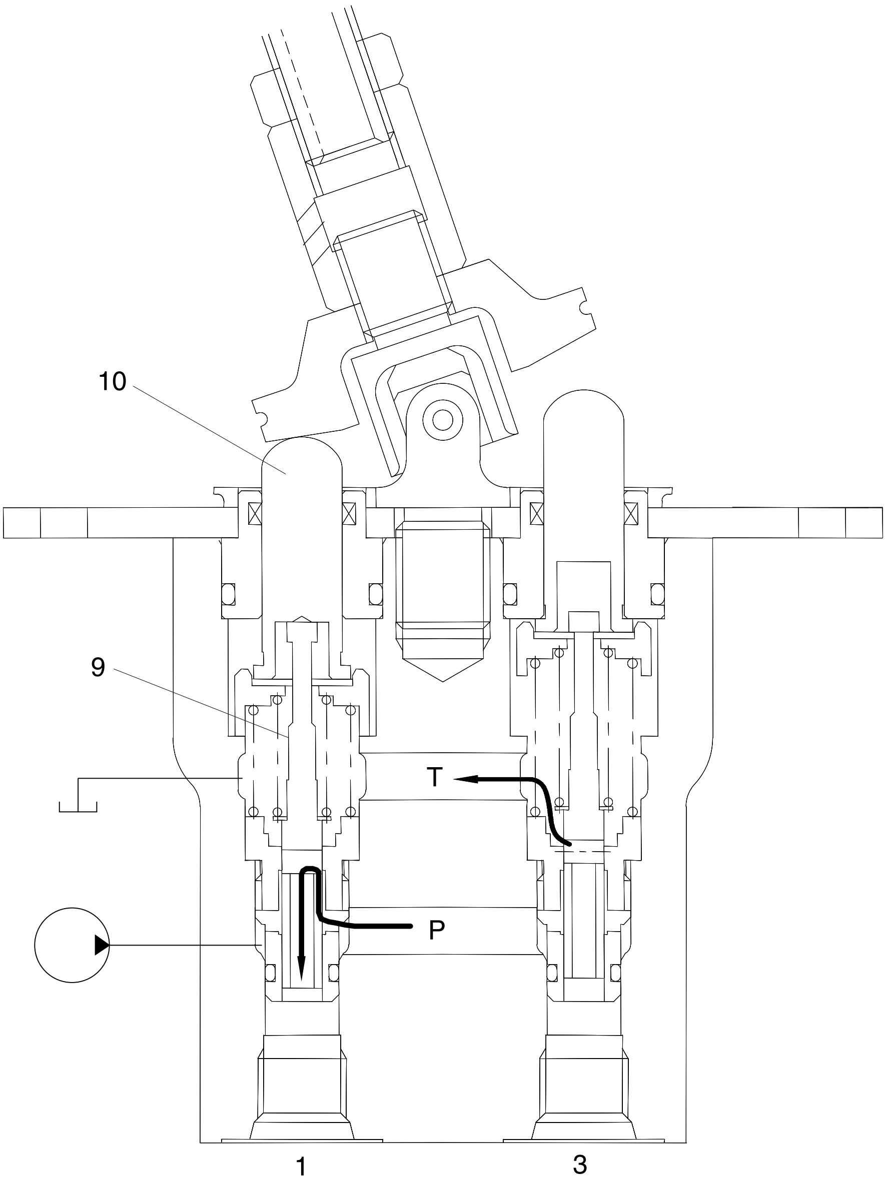
(1) Case where handle is in neutral position



R30Z9AK2RL03

The force of the spring (7) that determines the output pressure of the pilot valve is not applied to the spool (9). Therefore, the spool is pushed up by the spring (4) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted



R30Z9AK2RL04

When the push rod (10) is stroked, the spool (9) moves downwards.

Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.

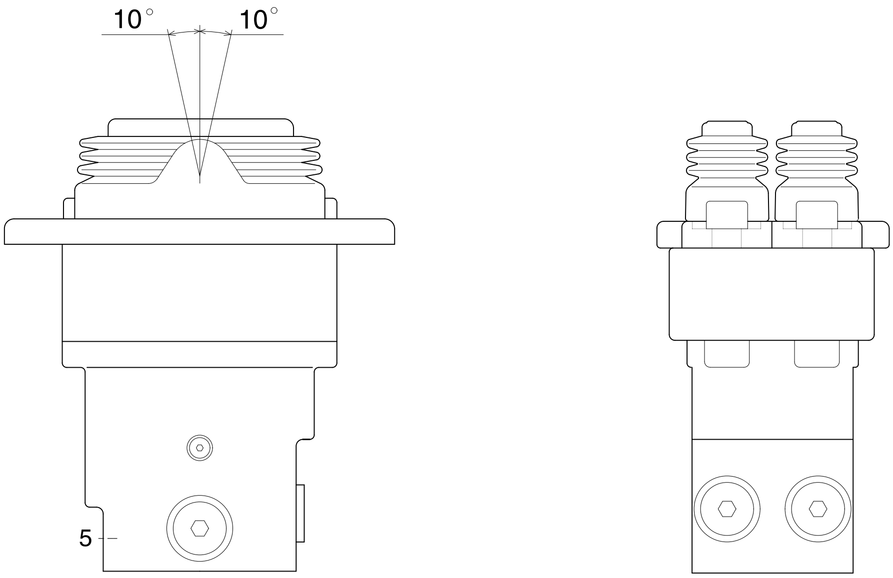
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port (1) increases higher than the set pressure, port P is disconnected from port (1) and port T is connected with port (1). If it decreases lower than the set pressure, port P is connected with port (1) and port T is disconnected from port 1.

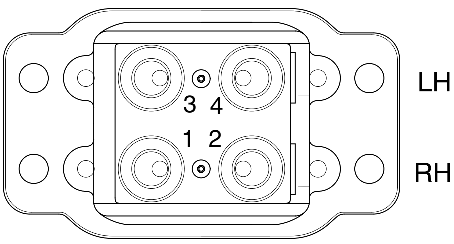
In this manner the secondary pressure is kept at the constant value.

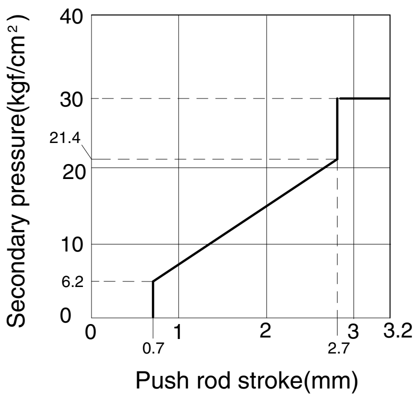
GROUP 6 RCV PEDAL

1. STRUCTURE

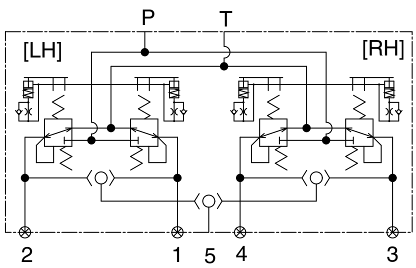
The casing has the oil inlet port P (primary pressure), and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.







35AZ2RCP01



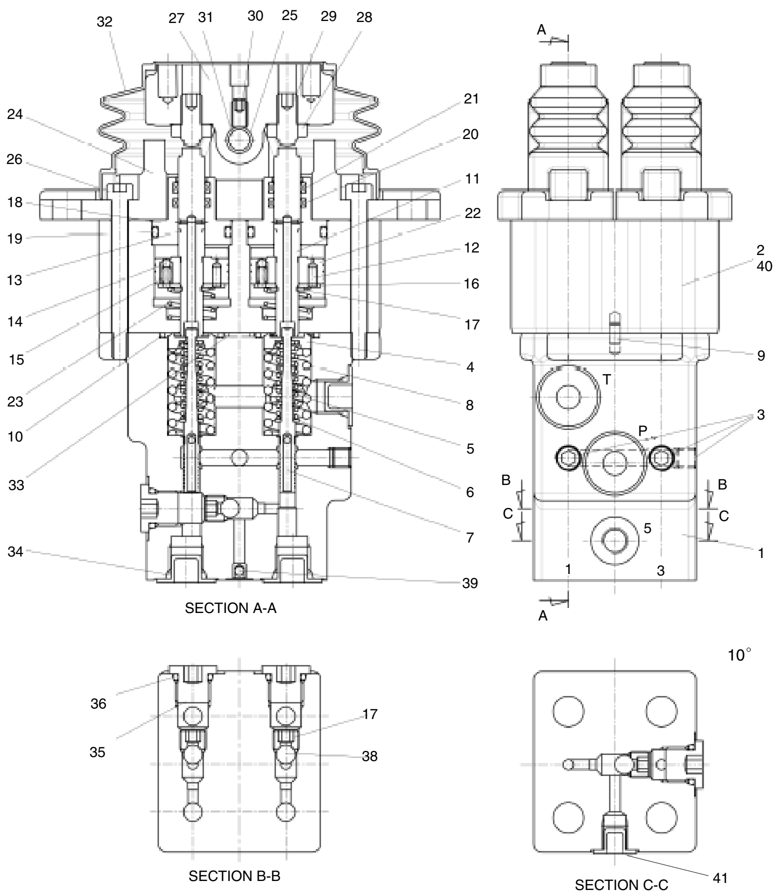
Port	Port name	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Travel (LH, backward)	
2	Travel (LH, forward)	
3	Travel (RH, backward)	
4	Travel (RH, forward)	
5	Travel alarm	PT 1/8

CROSS SECTION

The construction of the RCV pedal is shown in the below drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (7), spring (5) for setting secondary pressure, return spring (8), spring seat (4) and washer (6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 6.2 to 21.4 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (11) by the return spring.

When the push rod is pushed down by tilting pedal, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.



35AZ2RCP02

1	Body 1	15	Spring	29	Set screw
2	Body 2	16	Plate	30	Set screw
3	Plug	17	Snap ring	31	Hex nut
4	Spring seat	18	Plug	32	Bellows
5	Spring	19	O-ring	33	O-ring
6	Washer	20	Rod seal	34	Cap
7	Spool	21	Dust seal	35	Plug
8	Spring	22	Piston	36	O-ring
9	Spring pin	23	Spring	37	Check seat
10	O-ring	24	Cover	38	Steel ball
11	Push rod	25	Bushing	39	Expander
12	Spring pin	26	Wrench bolt	40	Name plate
13	Seal	27	Cam assy	41	Cap
14	Steel ball	28	Cam shaft		

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure (secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

(1) Inlet port (P) where oil is supplied from hydraulic pump.

(2) Output port (1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.

(3) Tank port (T) necessary to control the above output pressure.

(4) Spool to connect output port to inlet port tank port.

(5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (7) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output spool to determine the output pressure.

The spring (5) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (11) is inserted and can slide in the plug (18).

For the purpose of changing th displacement of the push rod through the cam (27) and cam shaft (28) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.

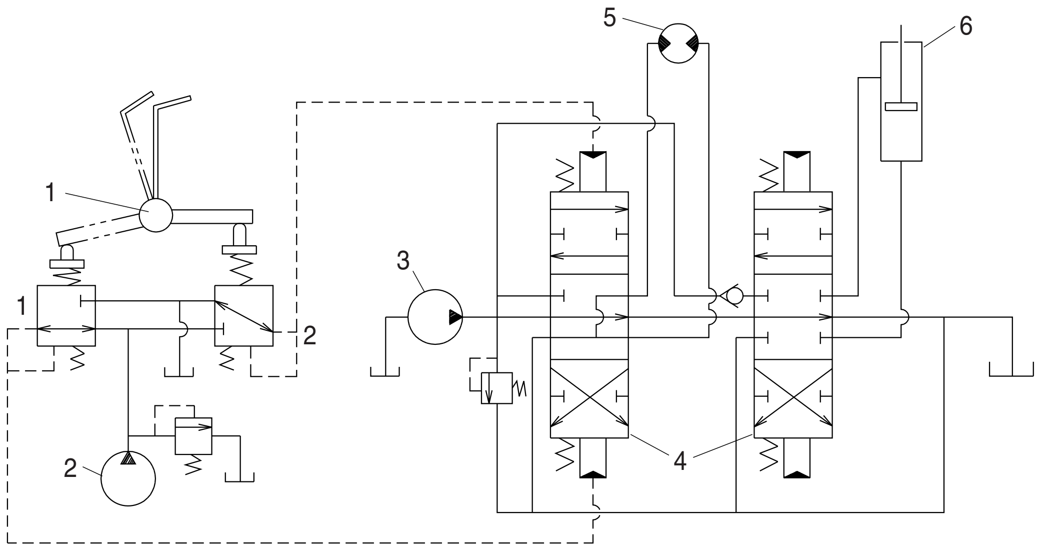
The spring (8) works on the casing (1) and washer (6) and tries to return the push rod (11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

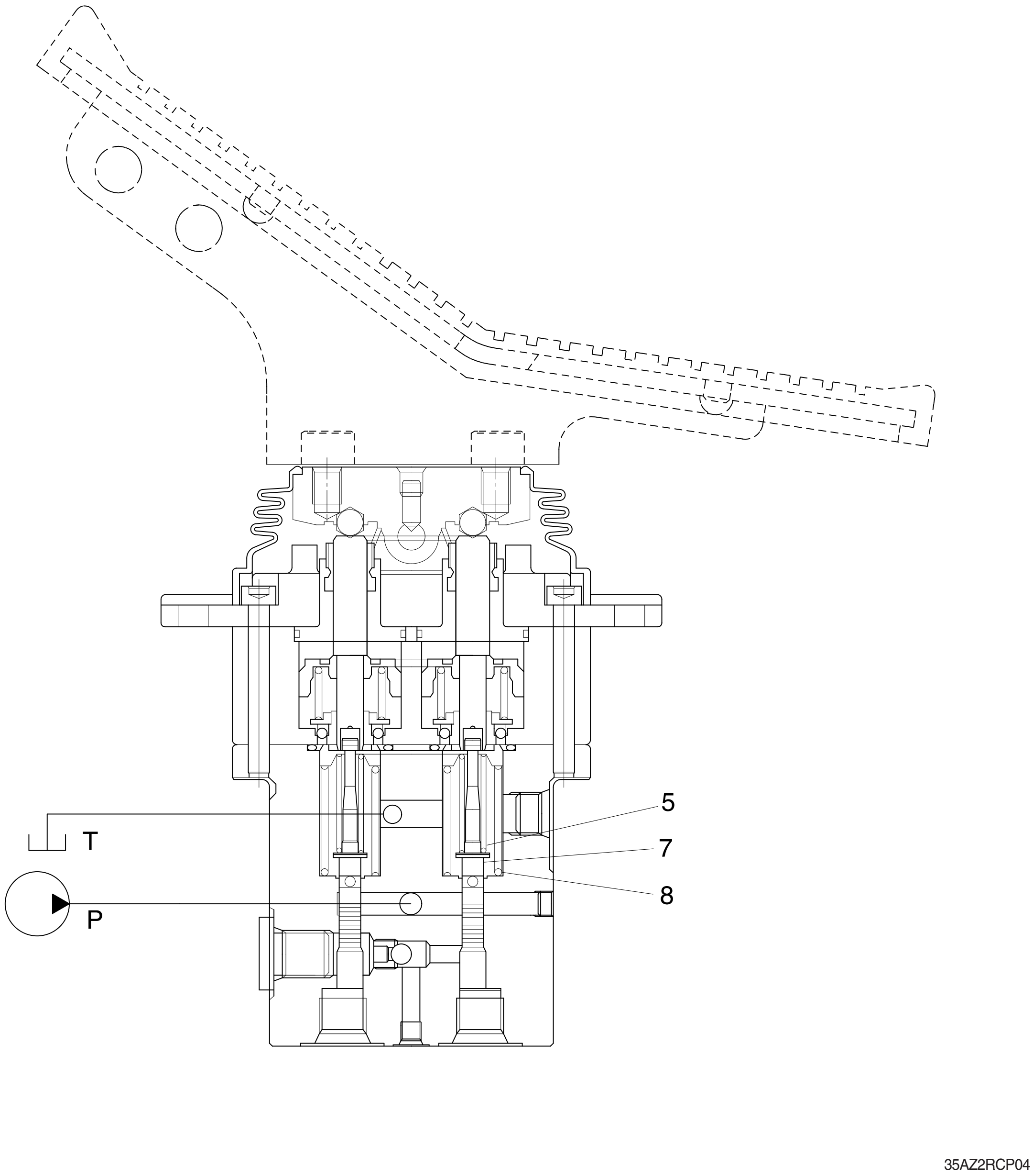
The diagram shown below is the typical application example of the pilot valve.



140LC-7 기타2-76

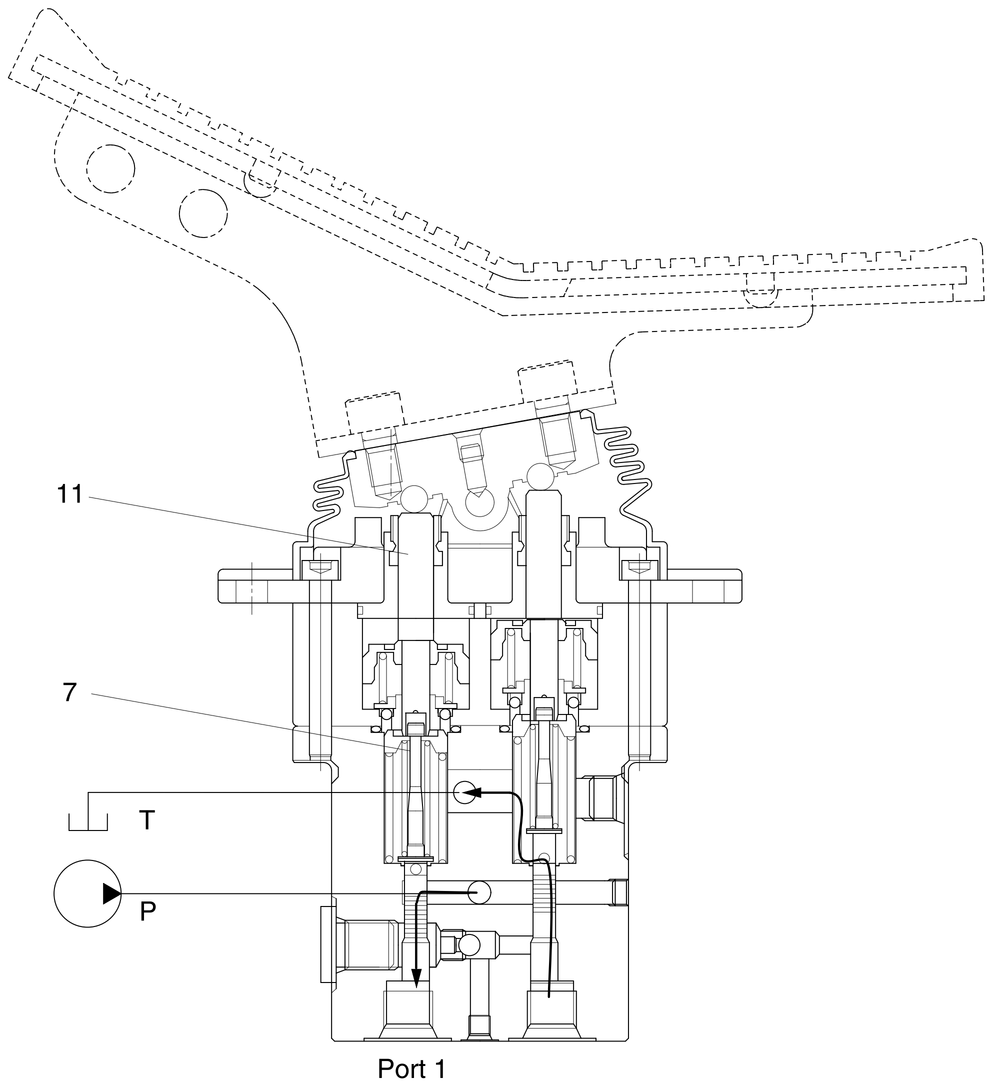
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (7). Therefore, the spool is pushed up by the spring (8) to the position of port 2 in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where pedal is tilted



35AZ2RCP05

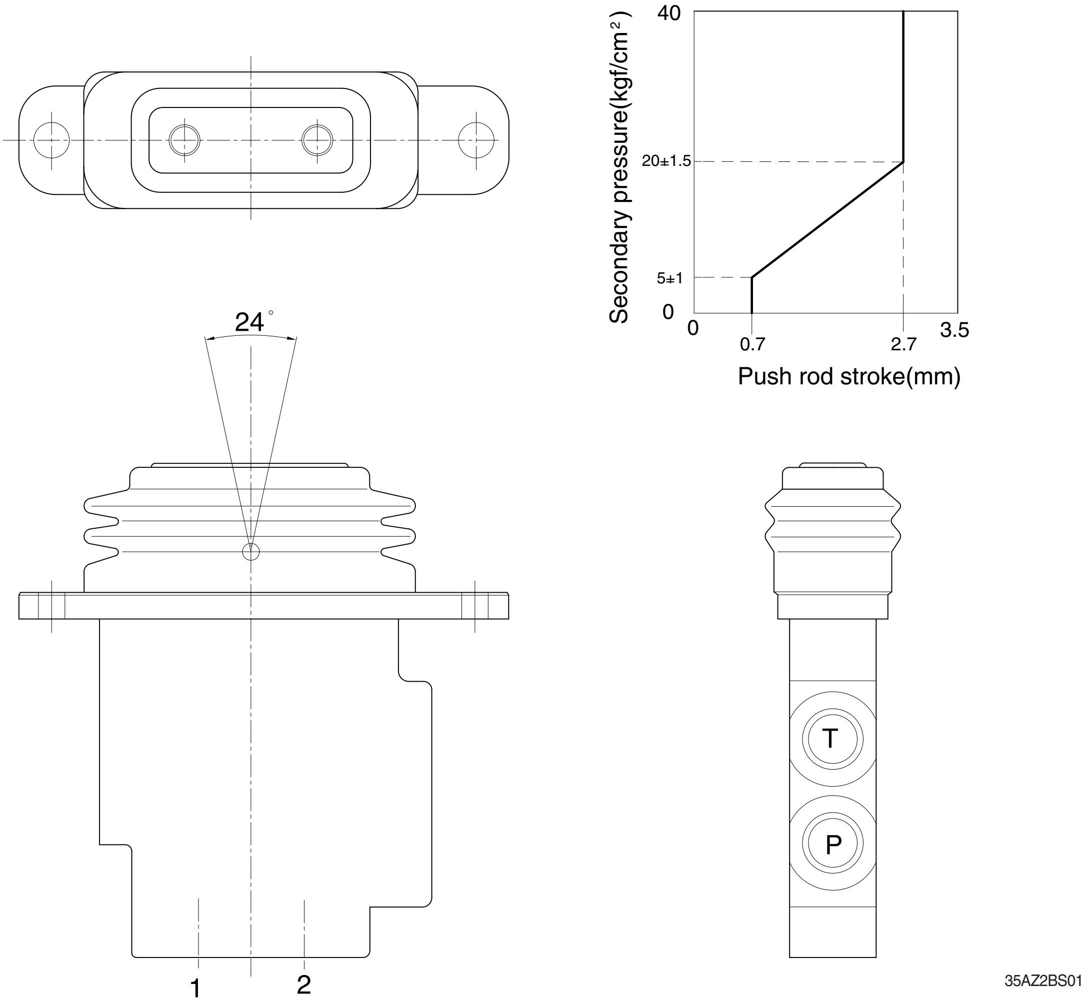
When the push rod (11) is stroked, the spool (7) moves downwards.
Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.

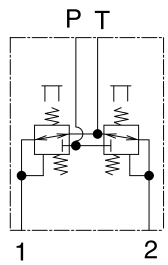
3. BOOM SWING PEDAL

1) STRUCTURE

The casing has the oil inlet P (primary pressure) and the oil return port (tank).

In addition the secondary pressure is taken out through port 1 and port 2 provided at the housing bottom face.

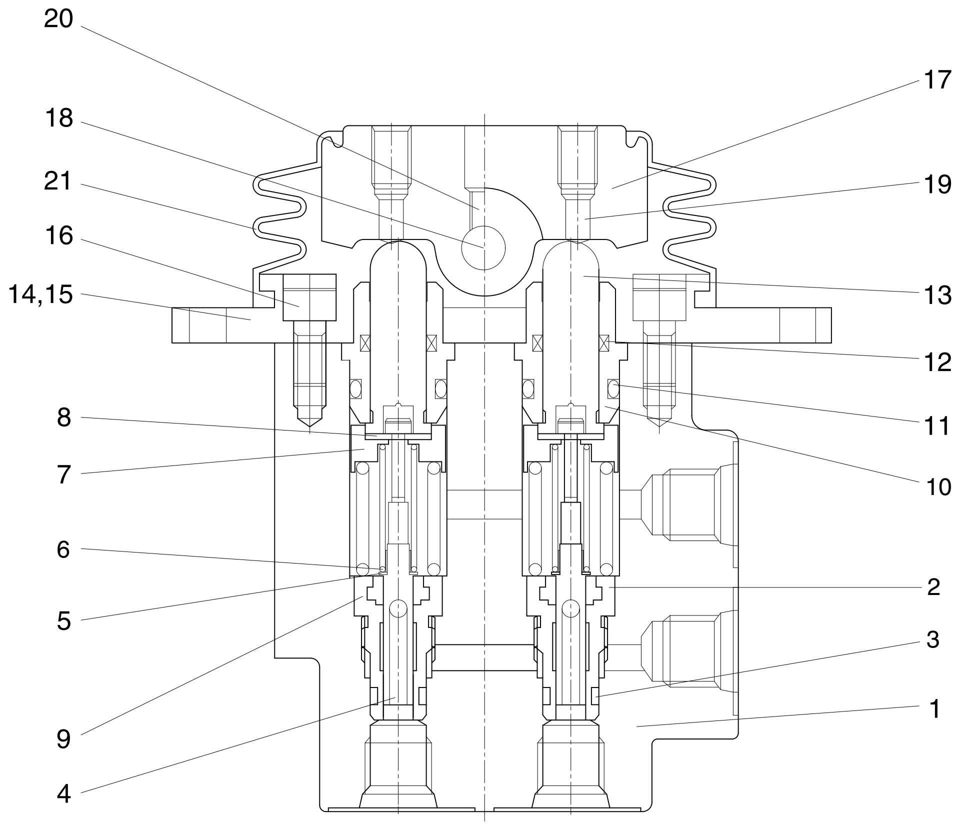




Hydraulic circuit

Port	Port name	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Boom swing (LH)	
2	Boom swing (RH)	

2) COMPONENT



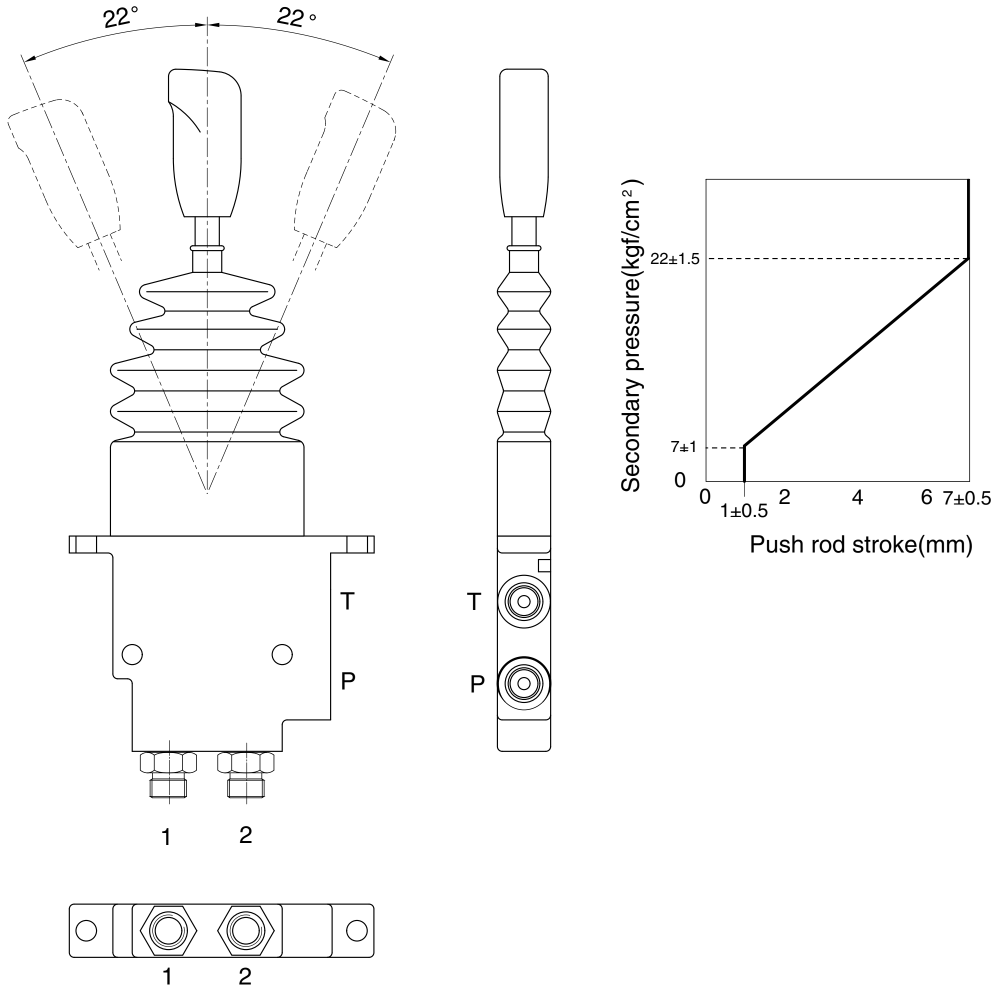
31MH-20050

1	Body	8	Stopper	15	DU bush
2	Plug	9	Spring	16	Wrench bolt
3	O-ring	10	Plug	17	Cam
4	Spool	11	O-ring	18	Pin
5	Spring seat	12	Rod seal	19	Adjust screw
6	Spring	13	Push rod	20	Socket bolt
7	Spring seat	14	Cover	21	Bellows

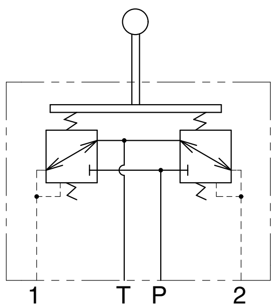
4. DOZER LEVER

1) STRUCTURE

The casing has the oil inlet P (primary pressure) and the oil return port (tank).
In addition the secondary pressure is taken out through port 1 and port 2 provided at the housing bottom face.



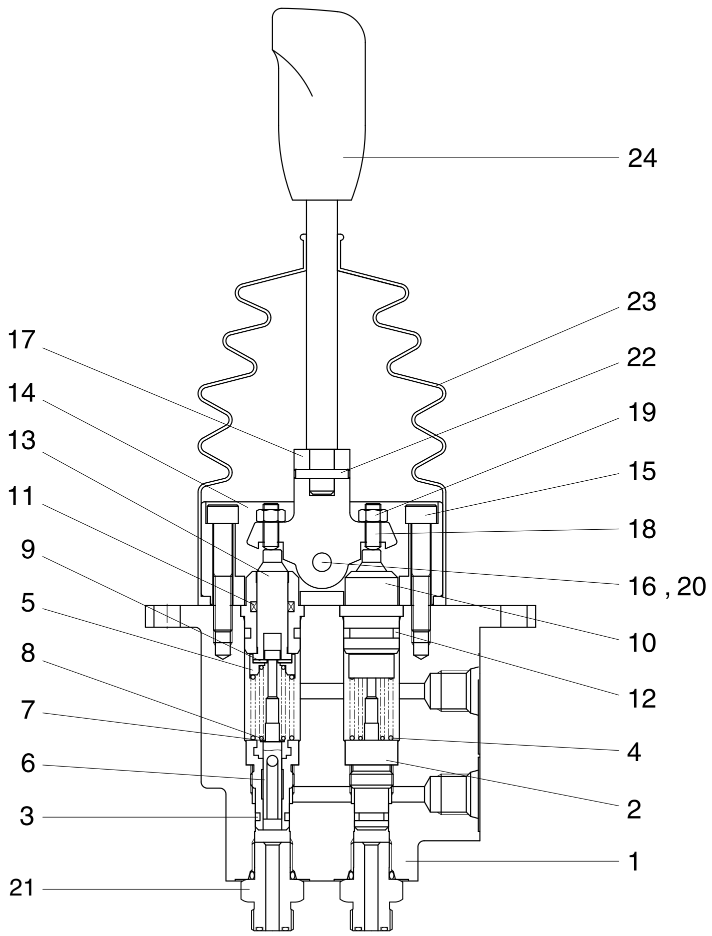
17AZ2DL01



Hydraulic circuit

Port	Port	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	PF 1/4
1	Dozer blade up port	9/16 UNF
2	Dozer blade down port	9/16 UNF

2) COMPONENT



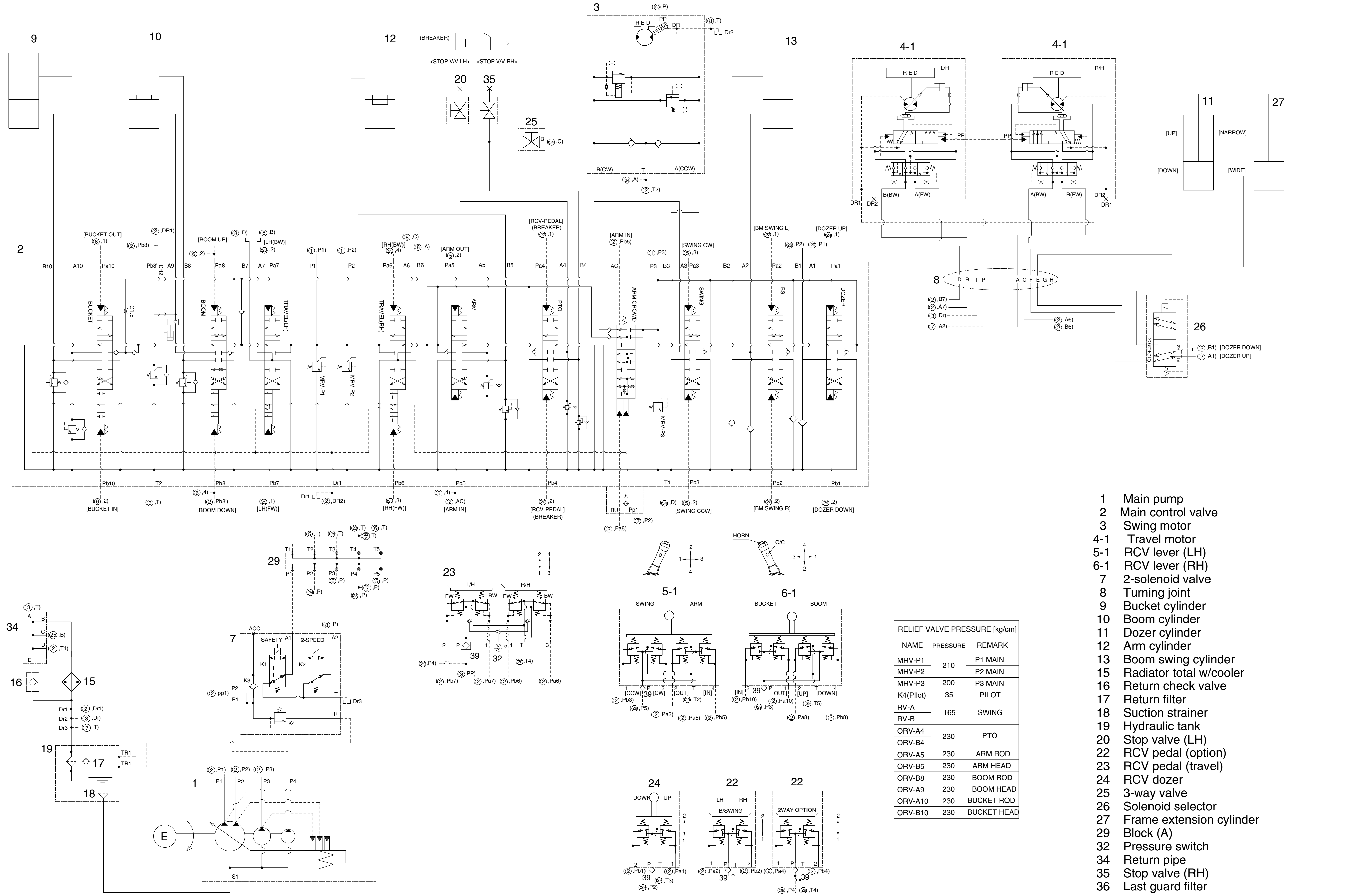
17AZ2DL02

1	Body	9	Stopper	17	Guide
2	Plug	10	Plug	18	Socket bolt
3	O-ring	11	Rod seal	19	Nut
4	Spring	12	O-ring	20	Snap ring
5	Spring seat	13	Push rod	21	Connector
6	Spool	14	Cover	22	Spring pin
7	Spring seat	15	Wrench bolt	23	Bellows
8	Spring	16	Pin	24	Lever

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

1. HYDRAULIC CIRCUIT (1/2)

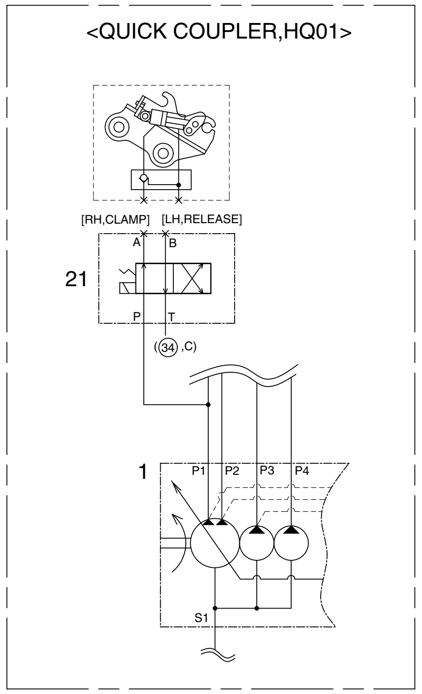


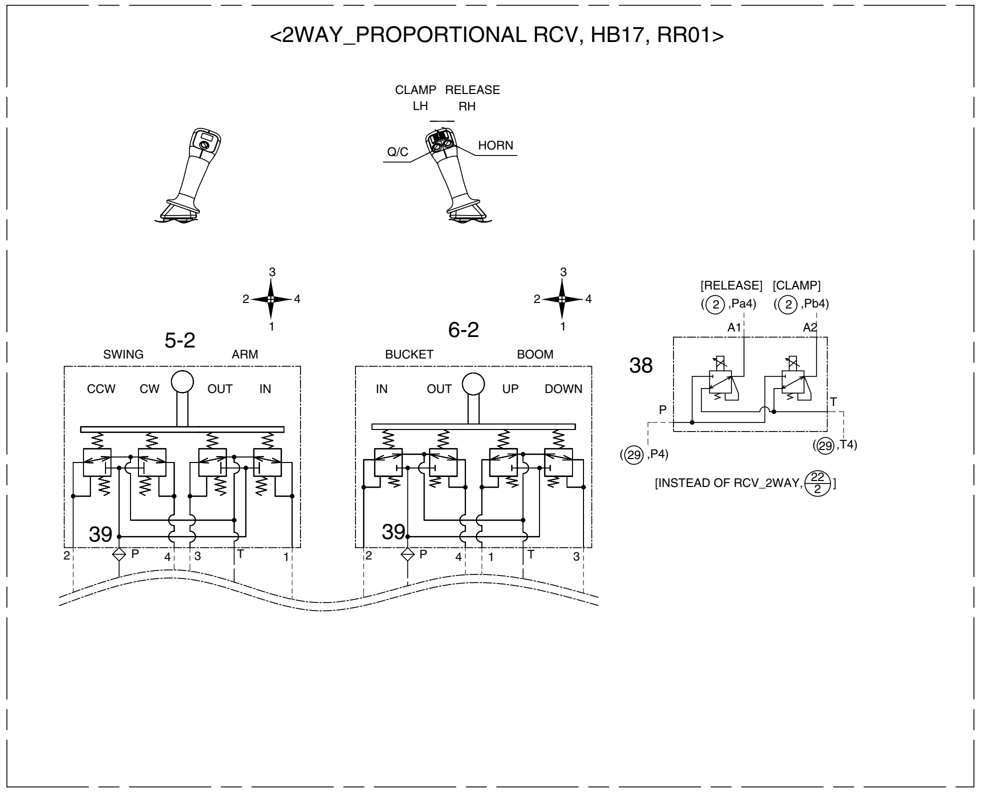
RELIEF VALVE PRESSURE [kg/cm]		
NAME	PRESSURE	REMARK
MRV-P1	210	P1 MAIN
MRV-P2		P2 MAIN
MRV-P3	200	P3 MAIN
K4(PIlot)	35	PILOT
RV-A	165	SWING
RV-B		
ORV-A4	230	PTO
ORV-B4		
ORV-A5	230	ARM ROD
ORV-B5	230	ARM HEAD
ORV-B8	230	BOOM ROD
ORV-A9	230	BOOM HEAD
ORV-A10	230	BUCKET ROD
ORV-B10	230	BUCKET HEAD

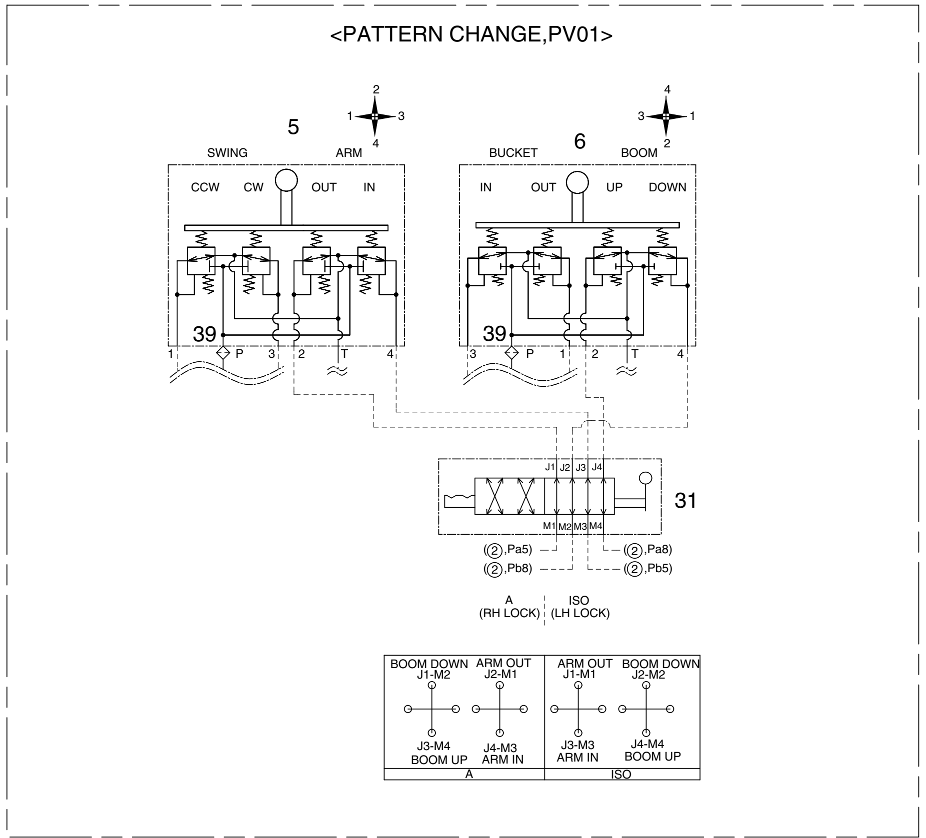
1 Main pump
2 Main control valve
3 Swing motor
4-1 Travel motor
5-1 RCV lever (LH)
6-1 RCV lever (RH)
7 2-solenoid valve
8 Turning joint
9 Bucket cylinder
10 Boom cylinder
11 Dozer cylinder
12 Arm cylinder
13 Boom swing cylinder
15 Radiator total w/cooler
16 Return check valve
17 Return filter
18 Suction strainer
19 Hydraulic tank
20 Stop valve (LH)
22 RCV pedal (option)
23 RCV pedal (travel)
24 RCV dozer
25 3-way valve
26 Solenoid selector
27 Frame extension cylinder
29 Block (A)
32 Pressure switch
34 Return pipe
35 Stop valve (RH)
36 Last guard filter

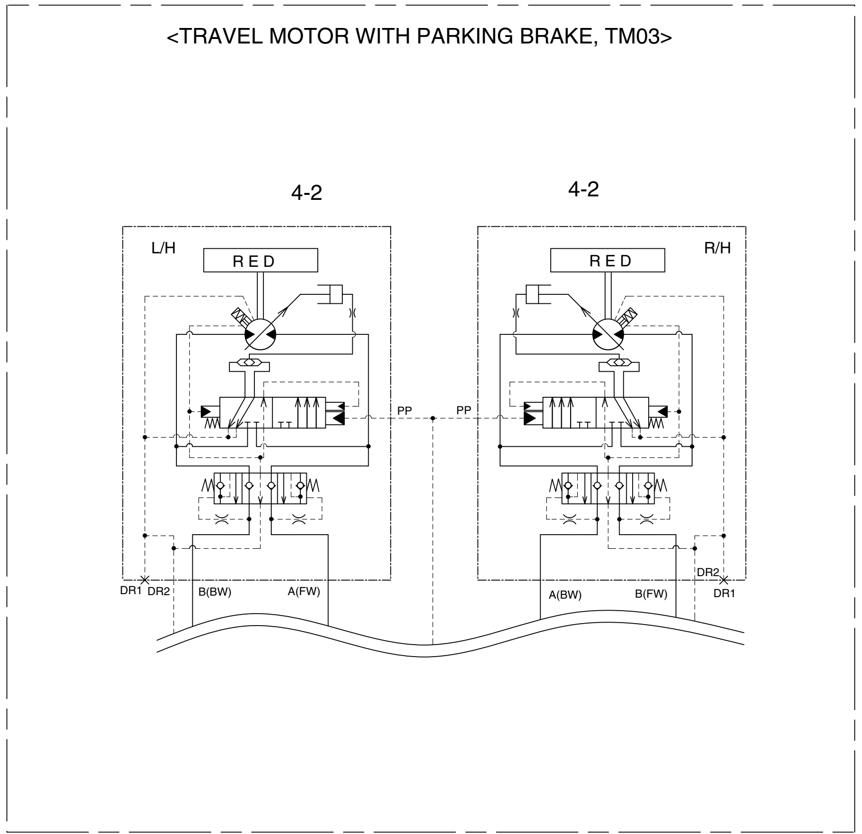
30MM-01000-01 1OF2

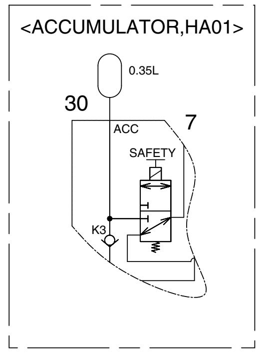
2. HYDRAULIC CIRCUIT (2/2)











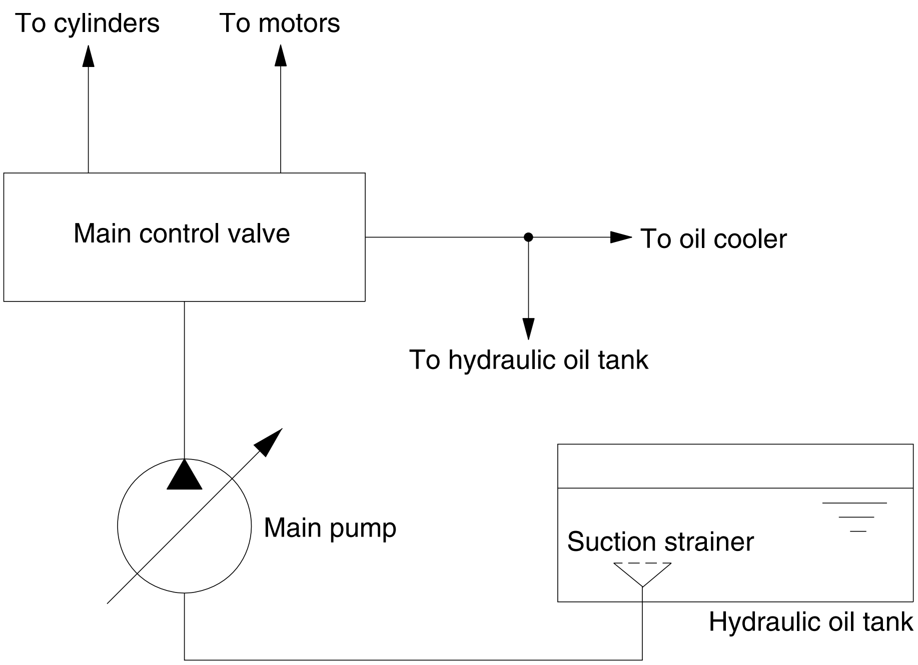
- 4-2 Travel motor
- 5-2 RCV (proportional, LH)
- 6-2 RCV (proportional, RH)
- 21 Splenoid valve
- 30 Accumulator
- 31 Selector valve
- 38 2-EPPR valve
- 39 Last guard filter

30MM-01000-01 2OF2

GROUP 2 MAIN CIRCUIT

The main hydraulic circuit consists of suction circuit, delivery circuit, return circuit and drain circuit.
The hydraulic system consists of one main pump, one control valve, one swing motor, four cylinders and two travel motors.
The swash plate type variable displacement axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

1. SUCTION AND DELIVERY CIRCUIT



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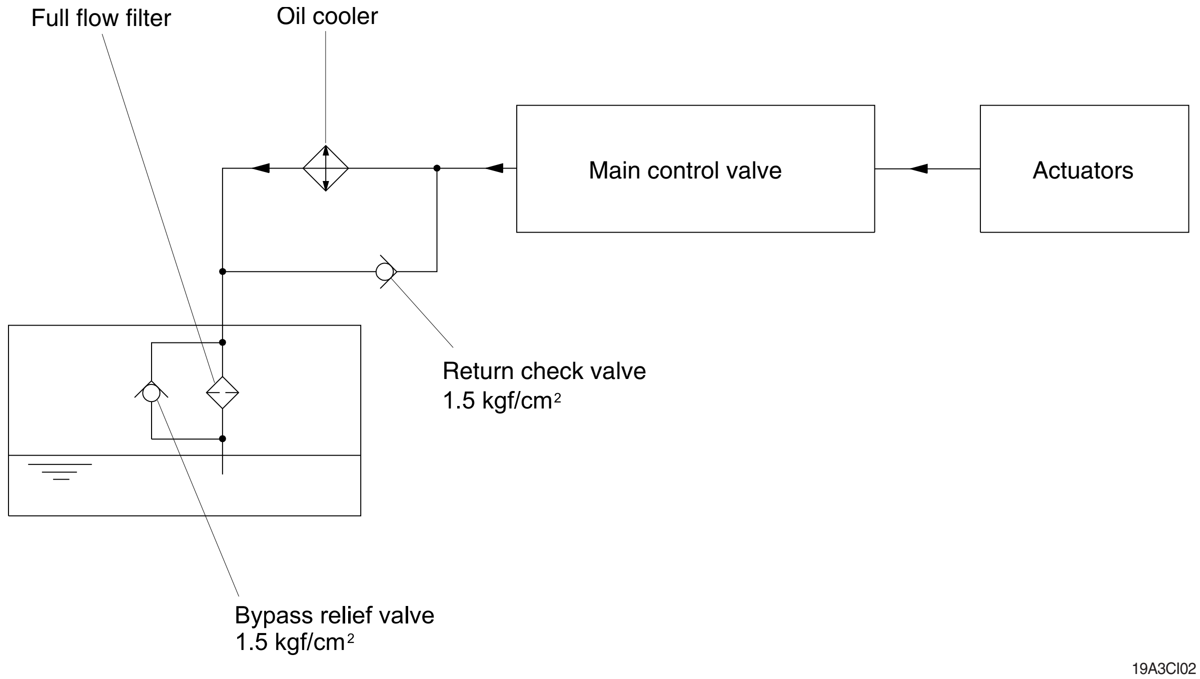
The pumps receive oil from the hydraulic tank through a suction strainer. The discharged oil from the pump flows into the main control valve and goes out the tank ports.
The oil discharged from the main pump flows to the actuators through the main control valve.
The main control valve controls the hydraulic functions.
The return oil from the actuators flows to the hydraulic tank through the main control valve and the oil cooler.

※ The circuit diagram may differ from the equipment, so please check before a repair.

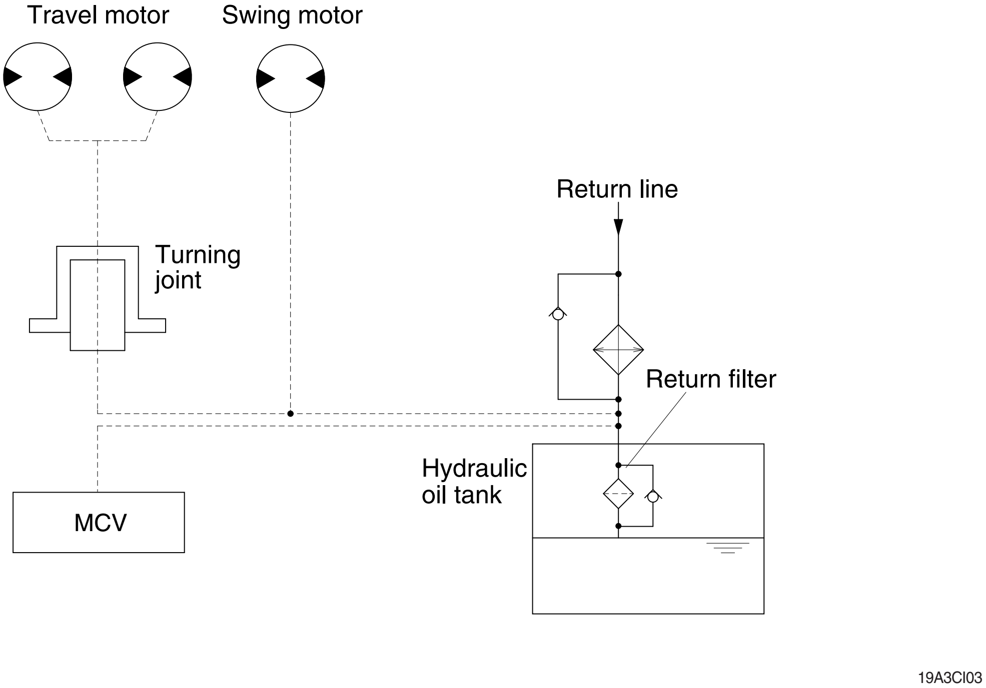
2. RETURN CIRCUIT



All oil returned from each actuator returns to the hydraulic tank through the control valve.
The bypass check valves are provided in the return circuit.
The setting pressure of return check valve is 1.5 kgf/cm^2 (21 psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.
When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. When the oil pressure exceeds 1.5 kgf/cm^2 (21 psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through return check valve.
The full-flow filter and bypass relief valve are provided in the hydraulic tank.
The oil returned from the main control valve filtered by the full-flow filter. A bypass relief valve is provided in the full-flow filter.
When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm^2 (21 psi) differential pressure.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3. DRAIN CIRCUIT



Besides internal leaks from the motors and main pump, the oil for lubrication circulates.

1) TRAVEL MOTOR DRAIN CIRCUIT

Oil leaked from the right and left travel motors comes out of the drain ports provided in the respective motor casing and join with each other. These oils pass through the turning joint and return to the hydraulic tank after being filtered by return filter.

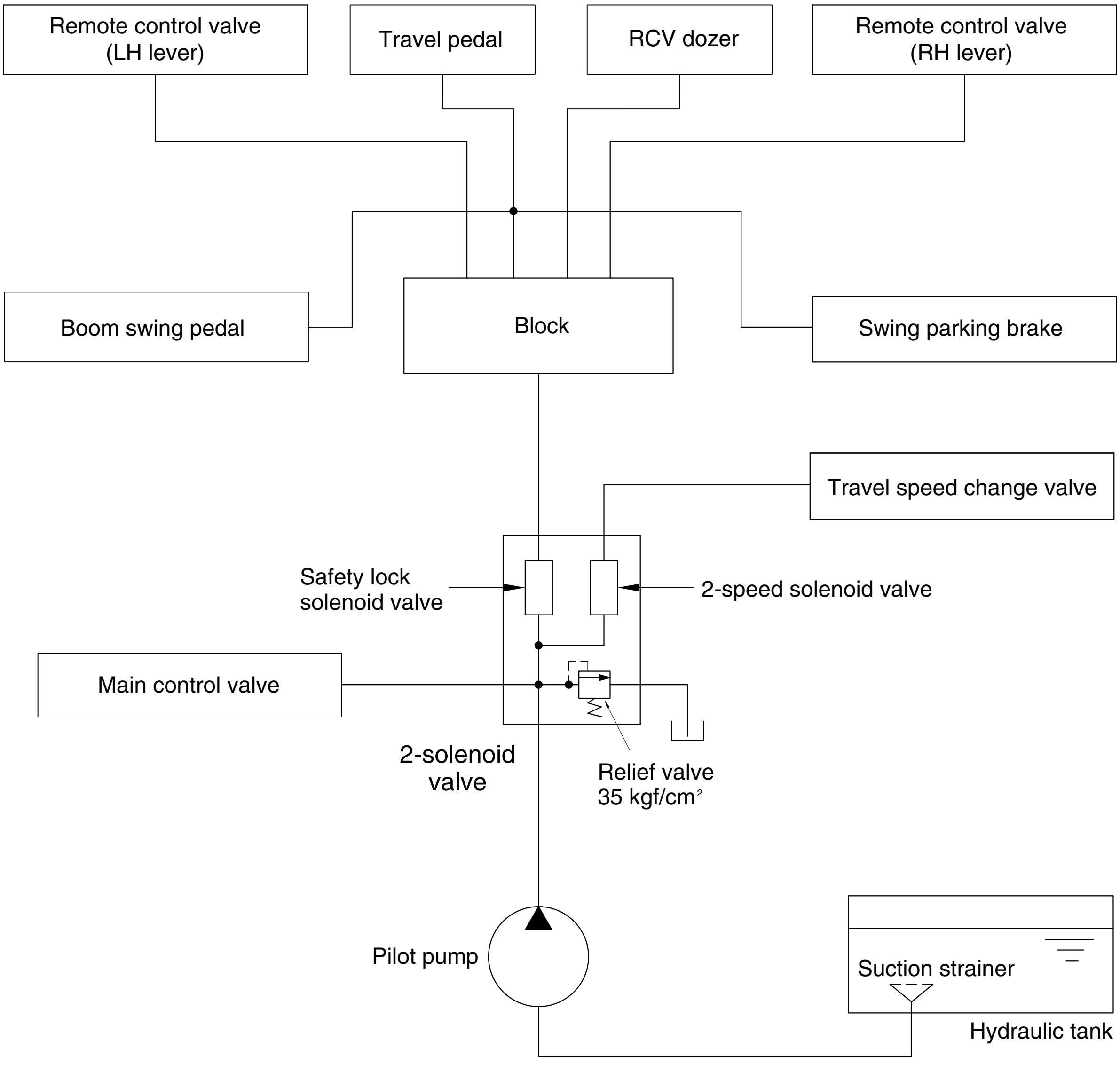
2) SWING MOTOR DRAIN CIRCUIT

Oil leaked from the swing motor returns to the hydraulic tank passing through a return filter with oil drained from the travel circuit .

3) MAIN CONTROL VALVE

Oil leaked from the main control valve returns to the hydraulic tank passing through a return filter.

※ The circuit diagram may differ from the equipment, so please check before a repair.

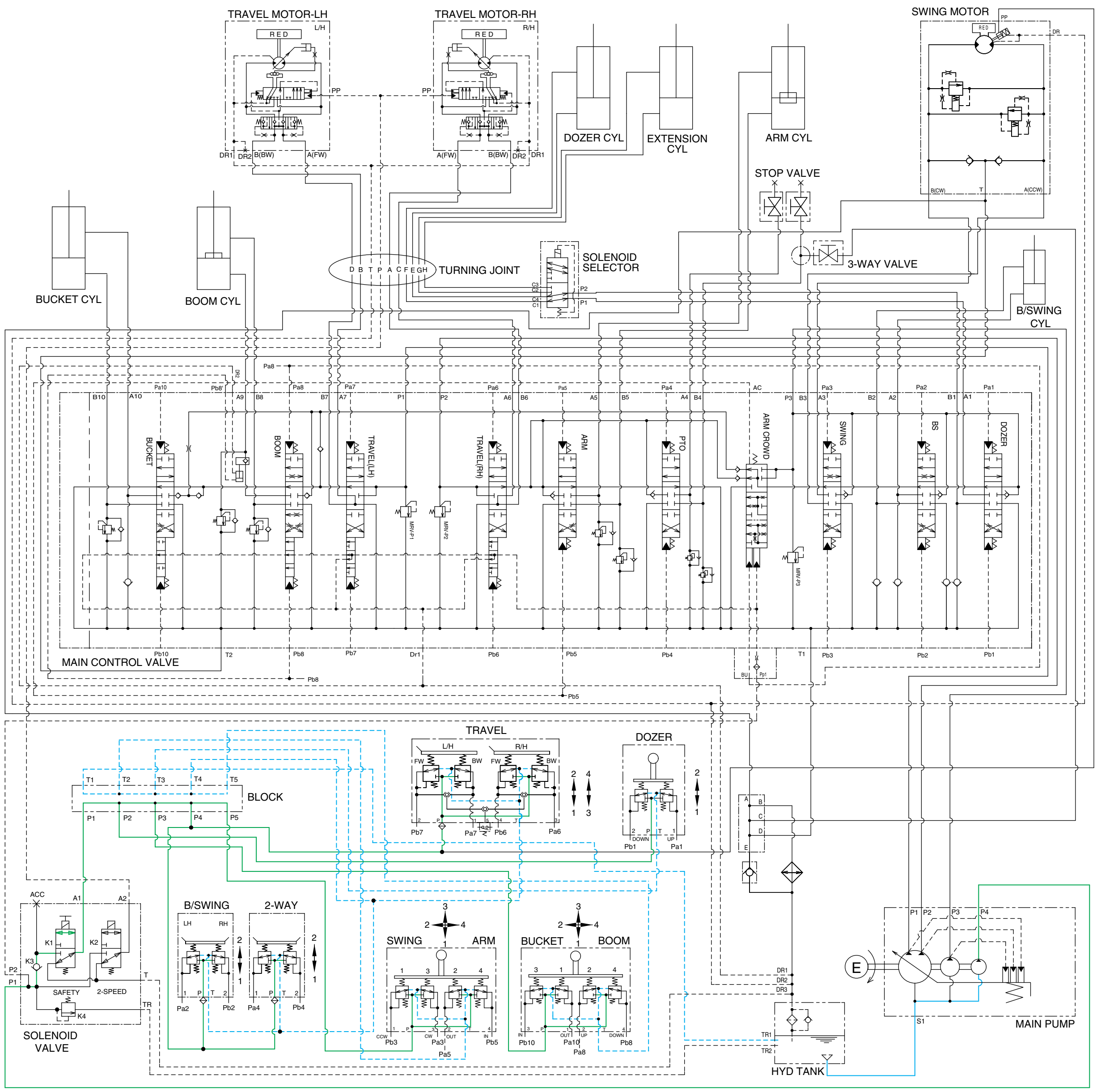


The pilot circuit consists of suction circuit, delivery circuit and return circuit.
The pilot pump is provided with relief valve, receives the oil from the hydraulic tank through the suction strainer.
The discharged oil from the pilot pump flows to the 2-solenoid valve and main control valve and provides oil to each control valve as below.

- RCV lever (LH & RH), RCV dozer, travel pedal, boom swing pedal and swing parking brake through the safety lock solenoid valve and block.
- Travel speed change valve through the 2-speed solenoid valve.

※ The circuit diagram may differ from the equipment, so please check before a repair.

1. SUCTION, DELIVERY AND RETURN CIRCUIT



19A3HC03

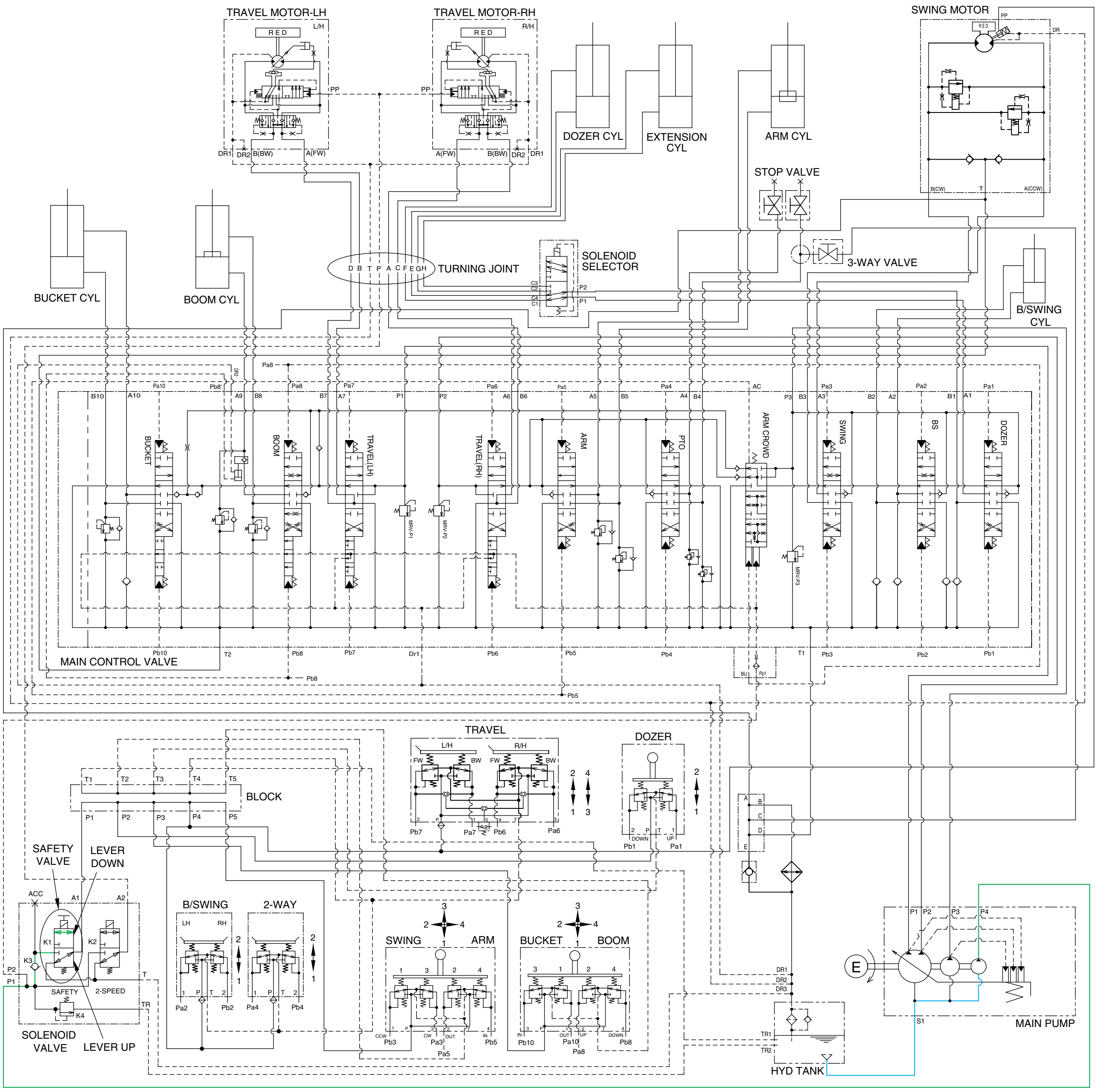
The pilot pump receives oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve. The pilot relief valve is provided in the solenoid valve for limiting the pilot circuit pressure.

The oil flows remote control valve, MCV and swing motor through safety solenoid valve.

The return oil flow into the hydraulic tank.

※ The circuit diagram may differ from the equipment, so please check before a repair.

2. SAFETY SOLENOID VALVE (SAFETY LEVER)



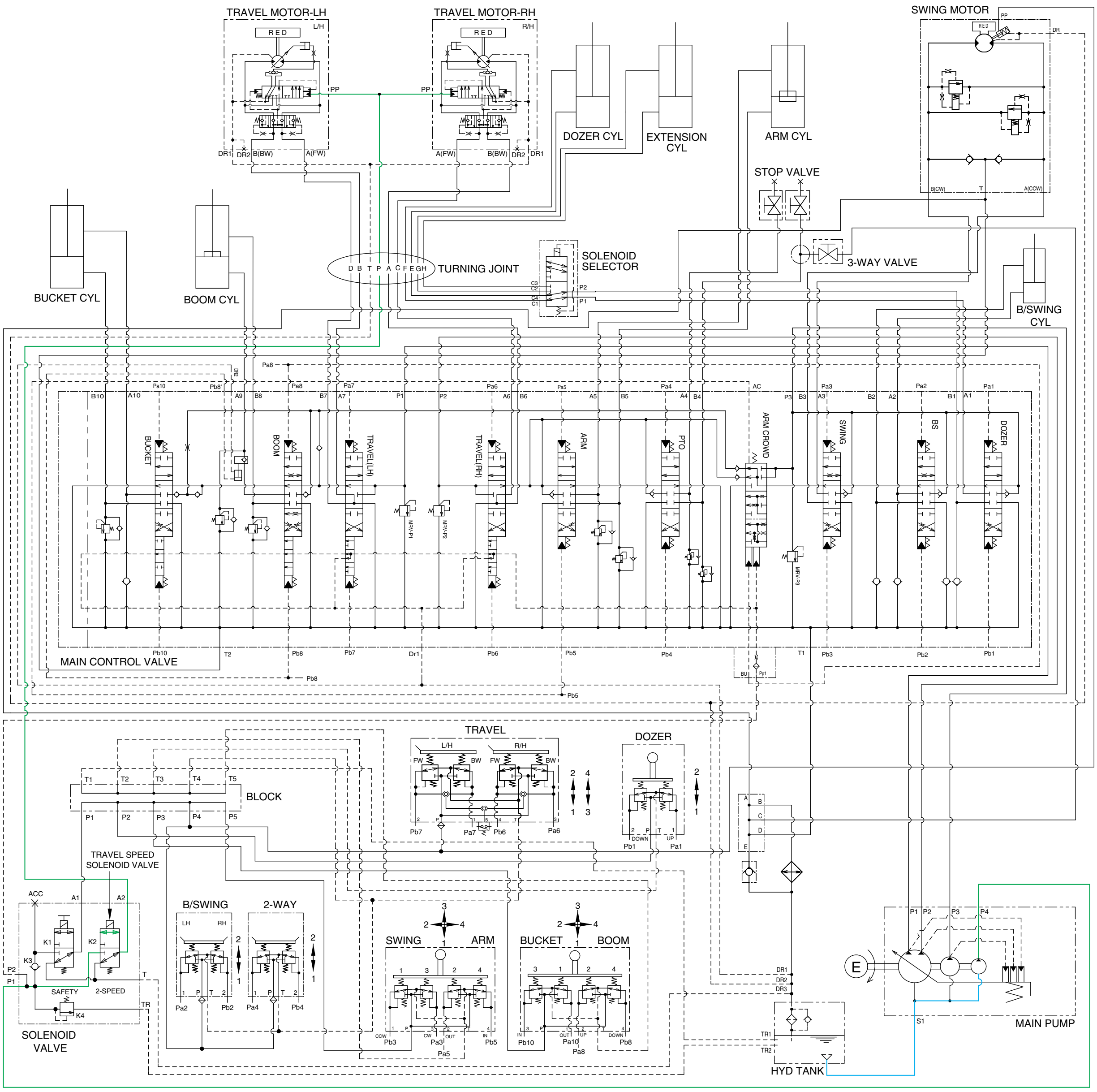
19A3HC04

When the lever of the safety solenoid valve is moved downward, oil flows into the remote control valve through safety solenoid valve.

When the lever of the safety solenoid valve is moved upward, oil does not flow into the remote control valve, because of the blocked port.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3. TRAVEL SPEED CONTROL SYSTEM



19A3HC05

When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the PP port of pilot valve in the travel motors.

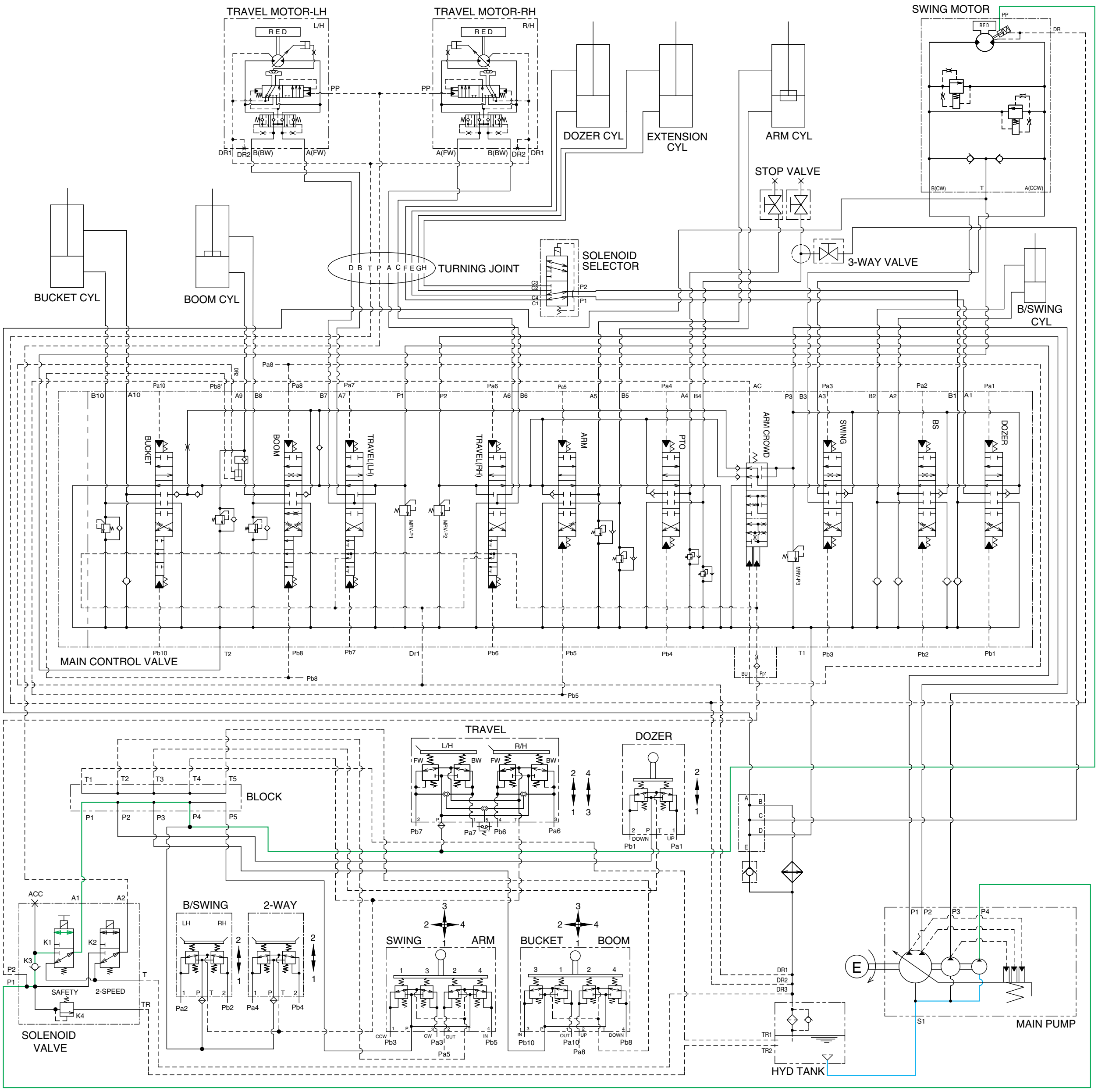
As a result, the control piston is pushed by the main oil flow, thus the displacement is minimized.

When the travel speed switch is pushed once more, the travel speed solenoid valve is return to original position by the force of spring, the hydraulic oil of PP port returns to the hydraulic tank.

As a result, the control piston is returned by the main oil flow, thus the displacement is maximized.

※ The circuit diagram may differ from the equipment, so please check before a repair.

4. SWING PARKING BRAKE RELEASE



19A3HC06

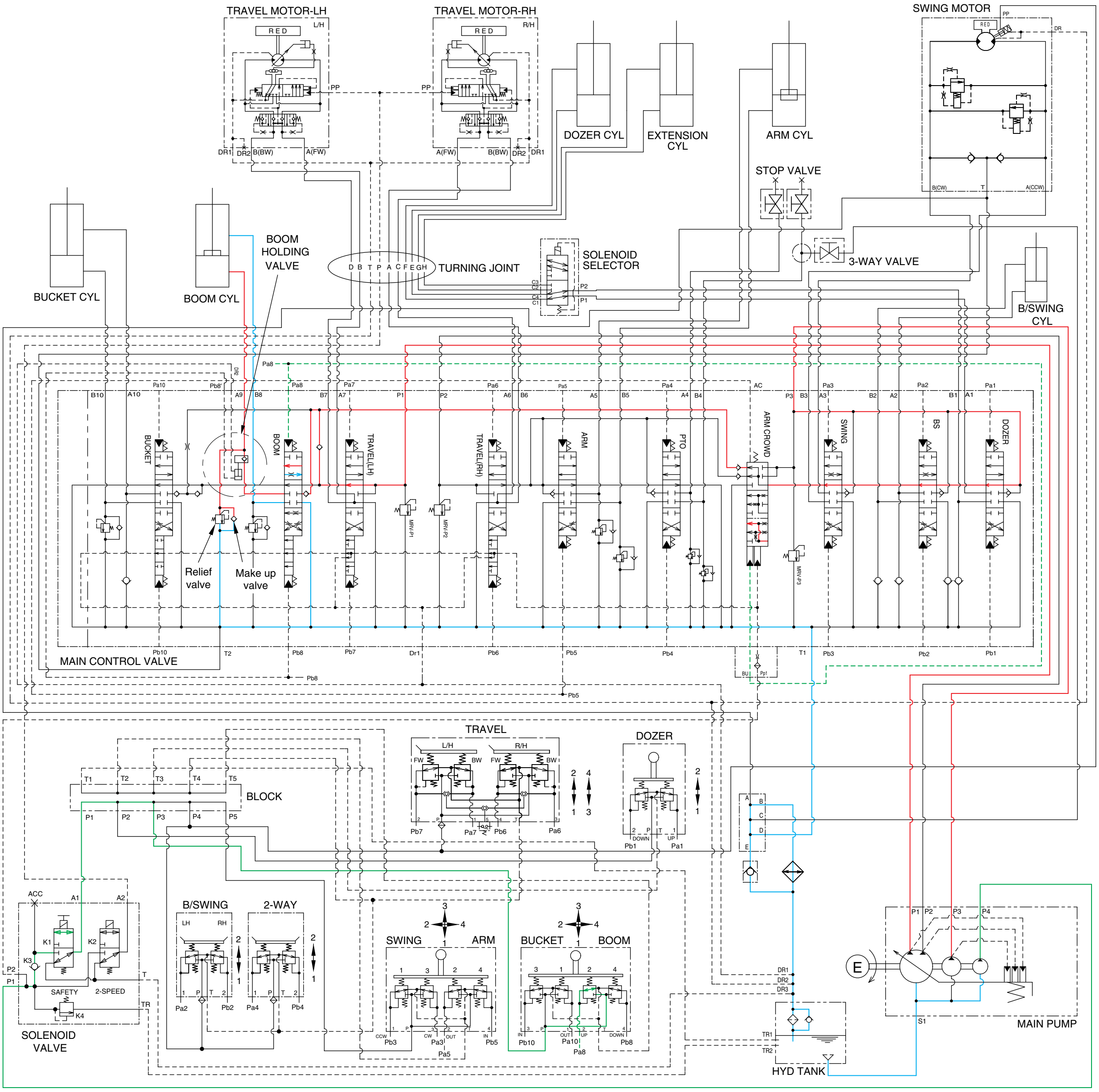
When the safety solenoid lever is moved downward, the pilot oil flow into PP port of the swing motor through solenoid valve. This pressure is applied to swing motor disc, thus the brake is released.

When the safety solenoid lever is moved to upward, oil in the swing motor disc cylinder is drained, thus the brake is applied.

※ The circuit diagram may differ from the equipment, so please check before a repair.

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



19A3HC10

When the right control lever is pulled back, the boom spool in the main control valve is moved to the up position by the pilot oil pressure (Pa8) from the remote control valve.

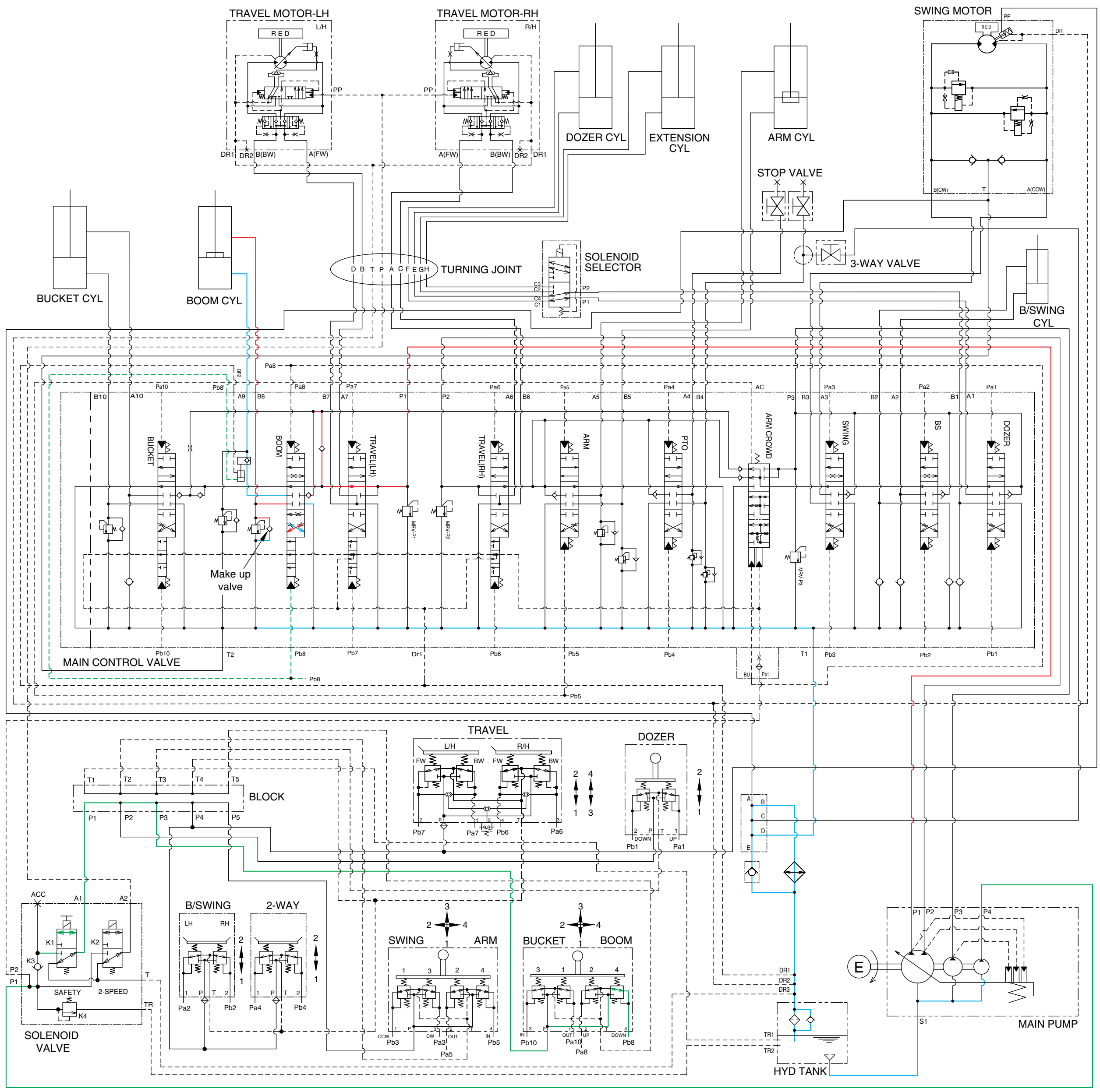
The oil from the P1 and P3 pump flows into the main control valve and then goes to the large chamber of boom cylinder. At the same time, the oil from the small chamber of boom cylinder returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up. The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve.

When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the bottom end of the boom cylinder is closed by the boom holding valve.

This prevents the hydraulic drift of boom cylinder.

※ The circuit diagram may differ from the equipment, so please check before a repair.

2. BOOM DOWN OPERATION



19A3HC11

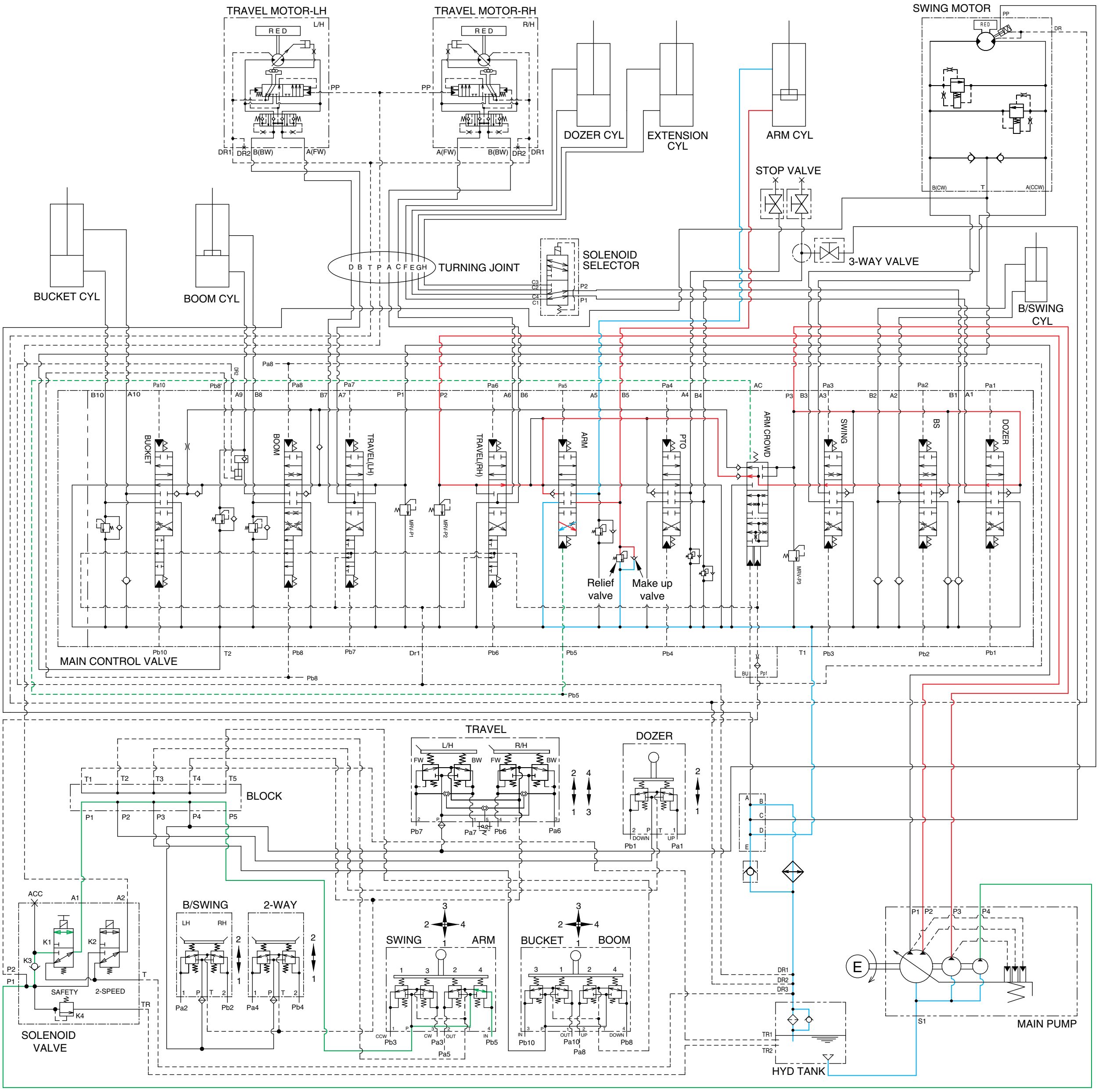
When the right control lever is pushed forward, the boom spool in the main control valve is moved to the down position by the pilot oil pressure (Pb8) from the remote control valve.

The oil from the P1 pump flows into the main control valve and then goes to the small chamber of boom cylinder. At the same time, the oil from the large chamber of boom cylinder returns to the hydraulic tank through the boom spool in the main control valve.

The cavitation in the boom cylinder rod end circuit is prevented by the make-up valve.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3. ARM ROLL IN OPERATION



19A3HC12

When the left control lever is pulled back, the arm spool in the main control valve is moved the to roll in position by the pilot oil pressure (Pb5) from the remote control valve.

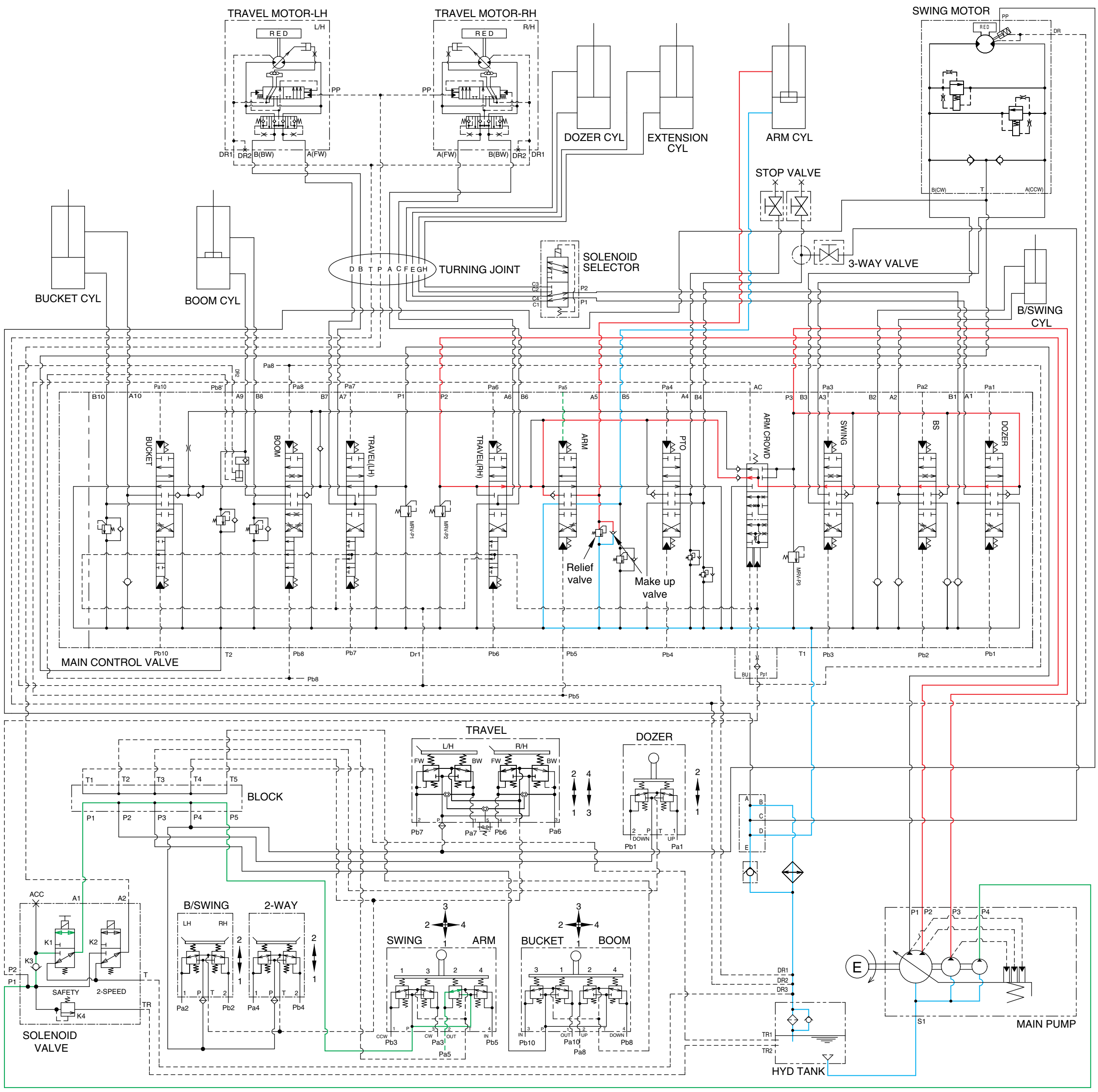
The oil from the P2 and P3 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls in.

The cavitation and excessive pressure in the bottom of the arm cylinder is also prevented by the make-up valve and the relief valve in the main control valve.

※ The circuit diagram may differ from the equipment, so please check before a repair.

4. ARM ROLL OUT OPERATION



19A3HC13

When the left control lever is pushed forward, the arm spool in the main control valve is moved to the roll out position by the pilot oil pressure (Pa5) from the remote control valve.

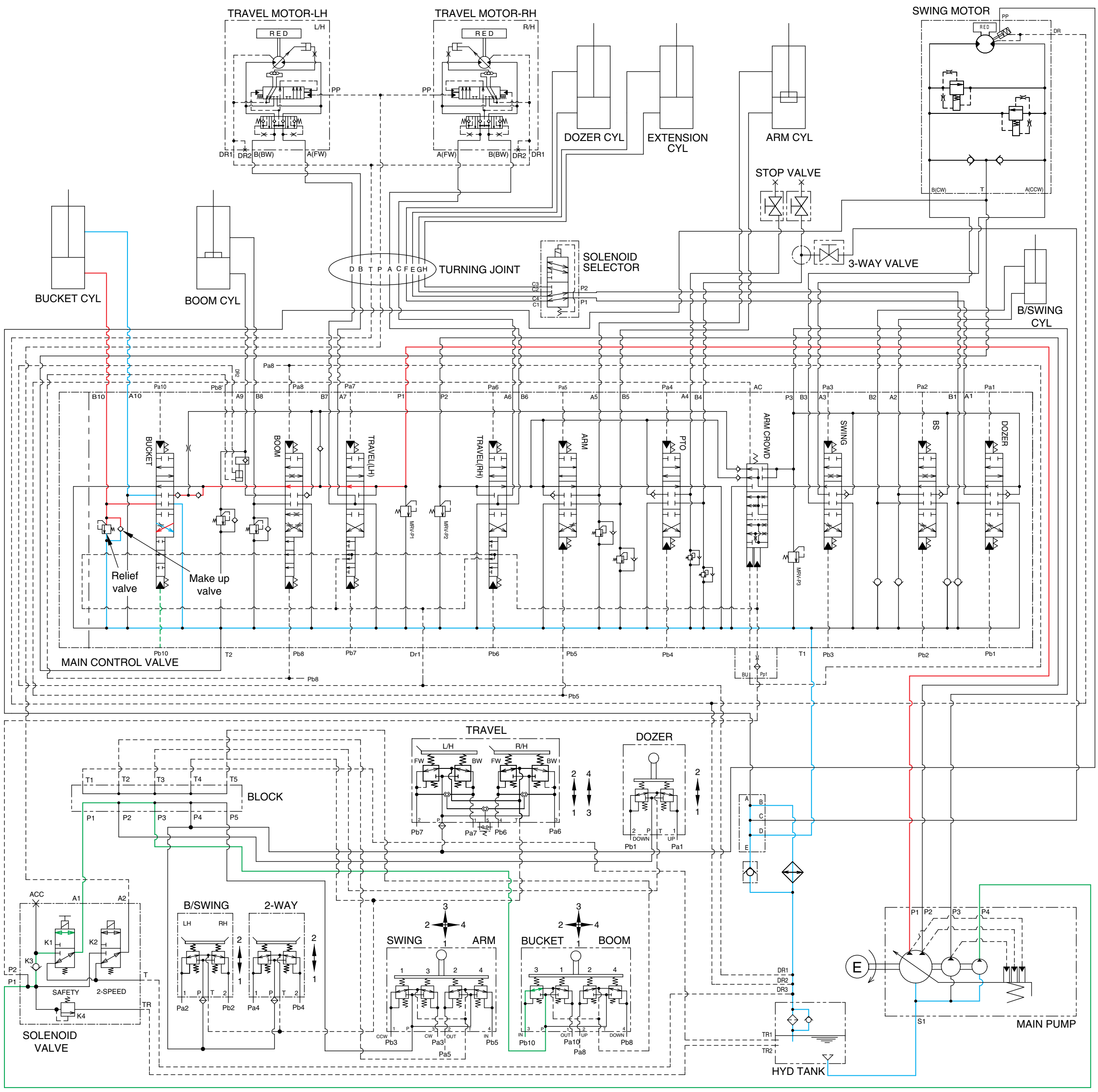
The oil from the P2 and P3 pump flows into the main control valve and then goes to the small chamber of arm cylinder.

At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls out.

The cavitation and excessive pressure in the rod of the arm cylinder is also prevented by the make-up valve and relief valve in the main control valve.

※ The circuit diagram may differ from the equipment, so please check before a repair.

5. BUCKET ROLL IN OPERATION



19A3HC14

When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure (Pb10) from the remote control valve.

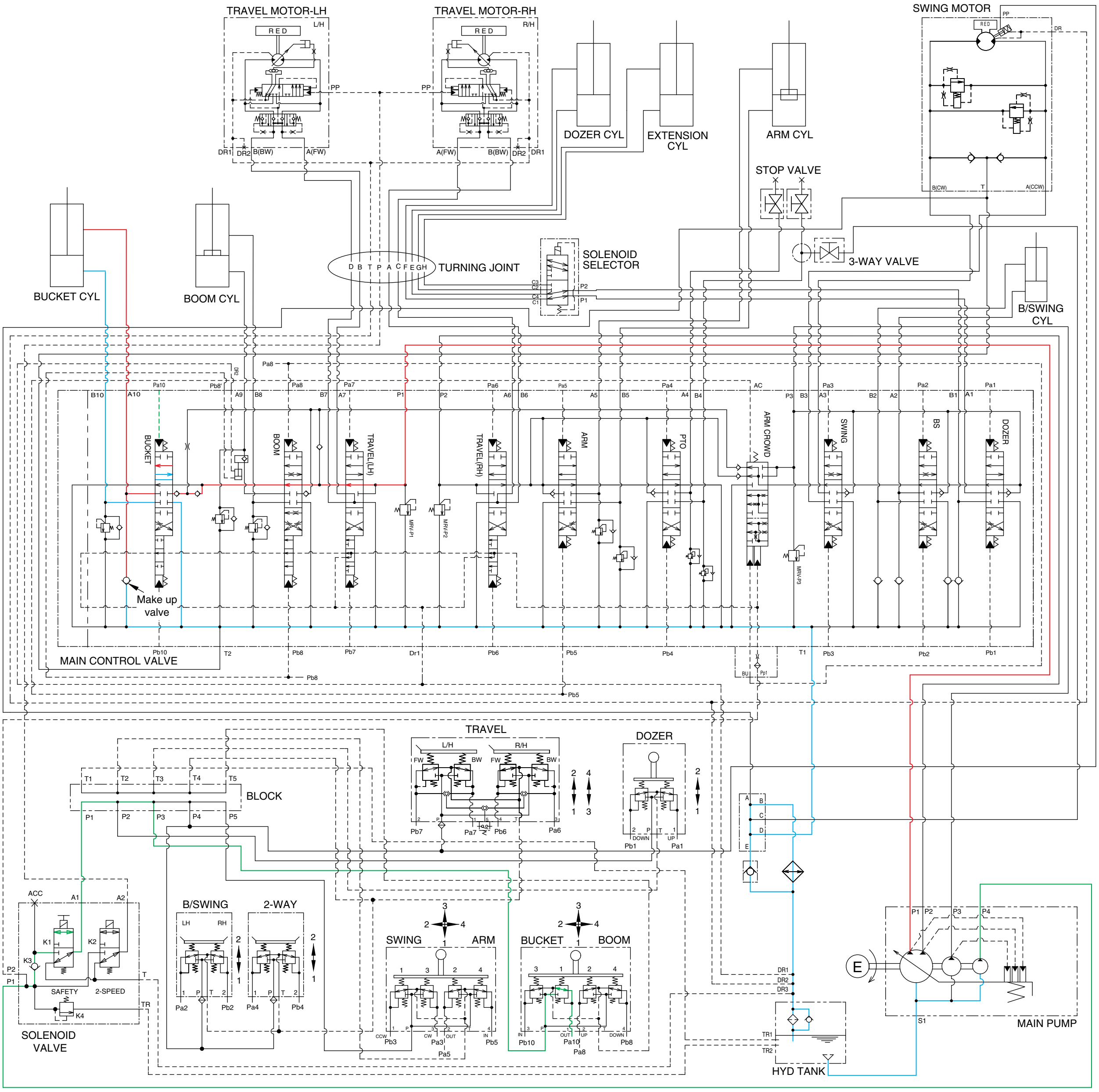
The oil from the P1 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

The cavitation and excessive pressure in the bottom of the bucket cylinder is also prevented by the make-up valve and relief valve in the main control valve.

※ The circuit diagram may differ from the equipment, so please check before a repair.

6. BUCKET ROLL OUT OPERATION

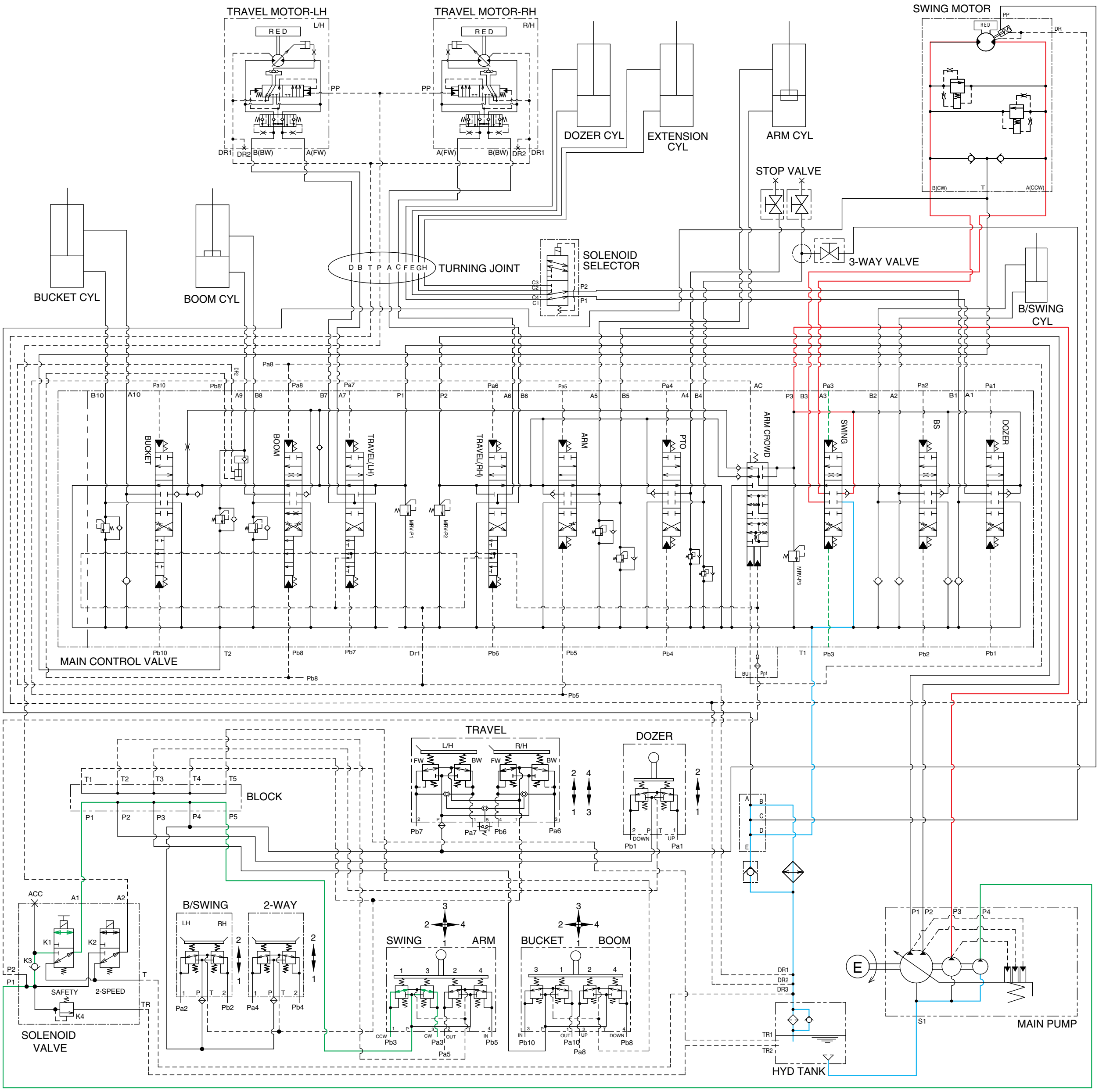


19A3HC15

When the right control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure (Pa10) from the remote control valve.
The oil from the P1 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.
The cavitation which will happen to the rod of the bucket cylinder is also prevented by the make-up valve in the main control valve.

※ The circuit diagram may differ from the equipment, so please check before a repair.

7. SWING OPERATION

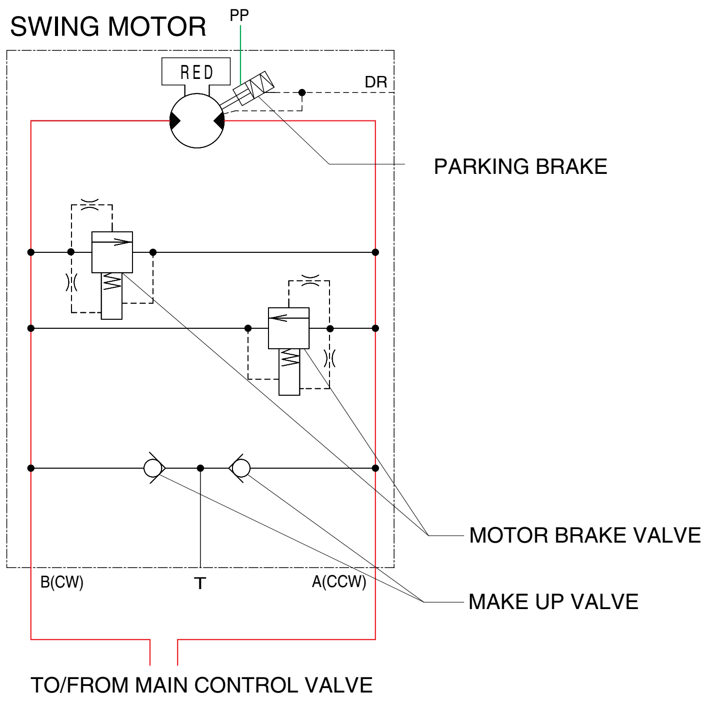


19A3HC16

When the left control lever is pushed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure (Pa3, Pb3) from the remote control valve.
The oil from the P3 pump flows into the main control valve and then goes to the swing motor.
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve. When this happens, the superstructure swings to the left or right. The make up valve and the overload relief valve are provided in the swing motor. The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

※ The circuit diagram may differ from the equipment, so please check before a repair.

SWING CIRCUIT OPERATION



189AK3HC20

1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation.

2) MAKE UP VALVE

The make up valves prevent cavitation by supplying return oil to the vacuum side of the motor.

3) PARKING BRAKE

PARKING BRAKE "ON" OPERATION

When the safety solenoid lever is moved to upward, the oil in the parking brake is drained to the tank. So, parking brake is applied.

PARKING BRAKE "OFF" OPERATION

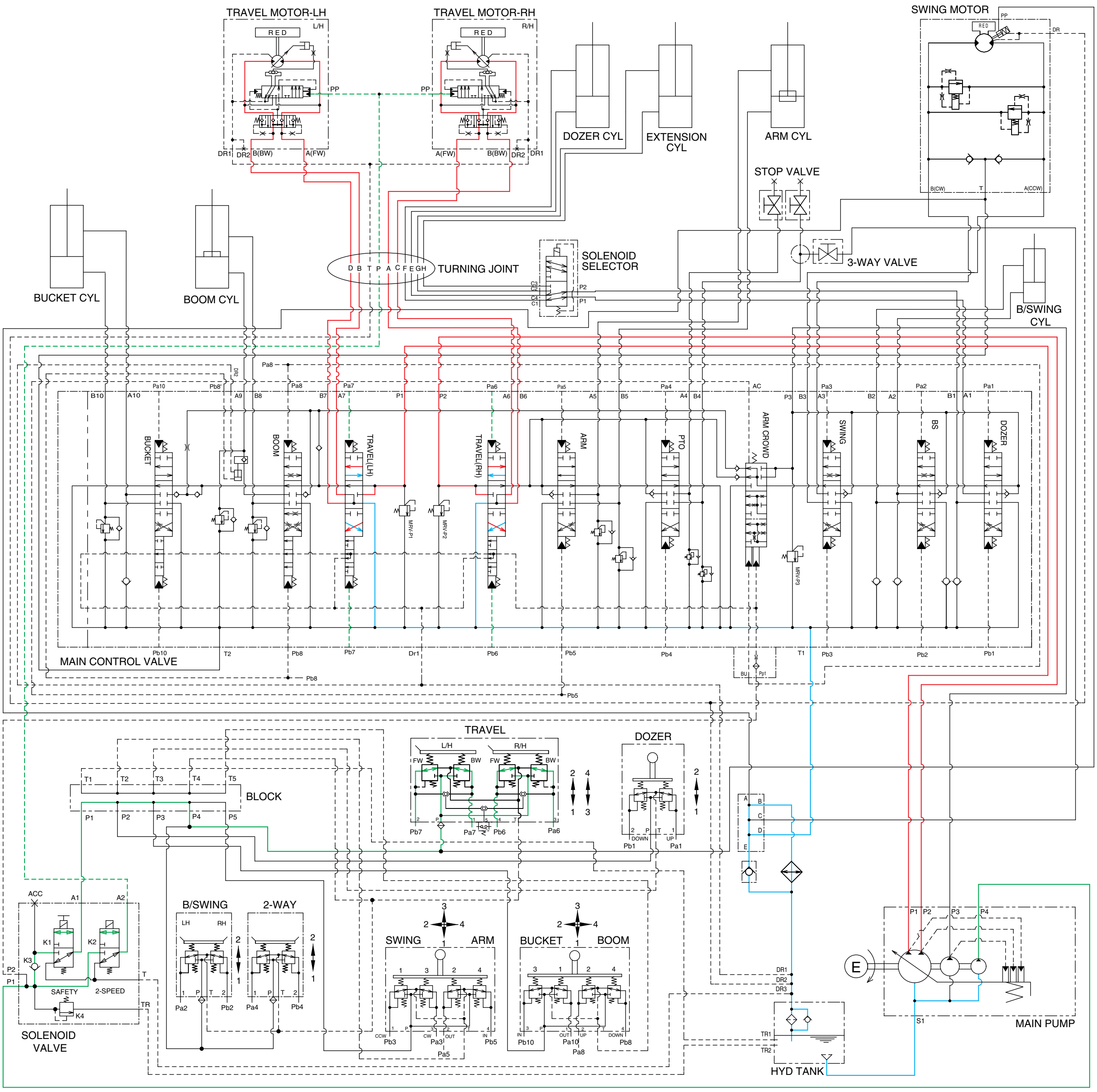
The parking brake is released by the pilot oil pressure (PP) from pilot pump.

When the safety solenoid lever is moved to downward, the pilot oil from the pilot pump (P4) is flow into parking brake through safety solenoid valve.

Then the pilot pressure lift the brake piston and release the parking brake.

※ The circuit diagram may differ from the equipment, so please check before a repair.

8. TRAVEL FORWARD AND REVERSE OPERATION

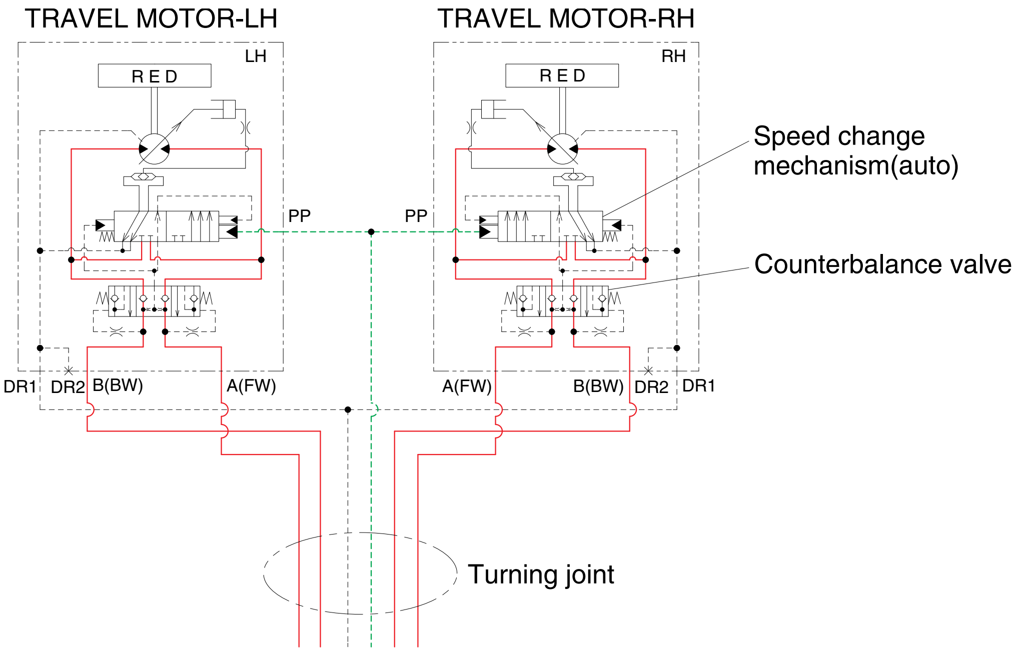


19A3HC17

When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by pilot pressure oil (Pa6, Pb6, Pa7, Pb7). The oil from the P1 and P2 pumps flows into the main control valve and then goes to the LH and RH travel motors through the turning joint. The return oil from both travel motors returns to the hydraulic oil tank through the turning joint and the travel spools in the main control valve. When this happens, the machine moves to the forward or reverse.

※ The circuit diagram may differ from the equipment, so please check before a repair.

TRAVEL CIRCUIT OPERATION



189AK3HC21

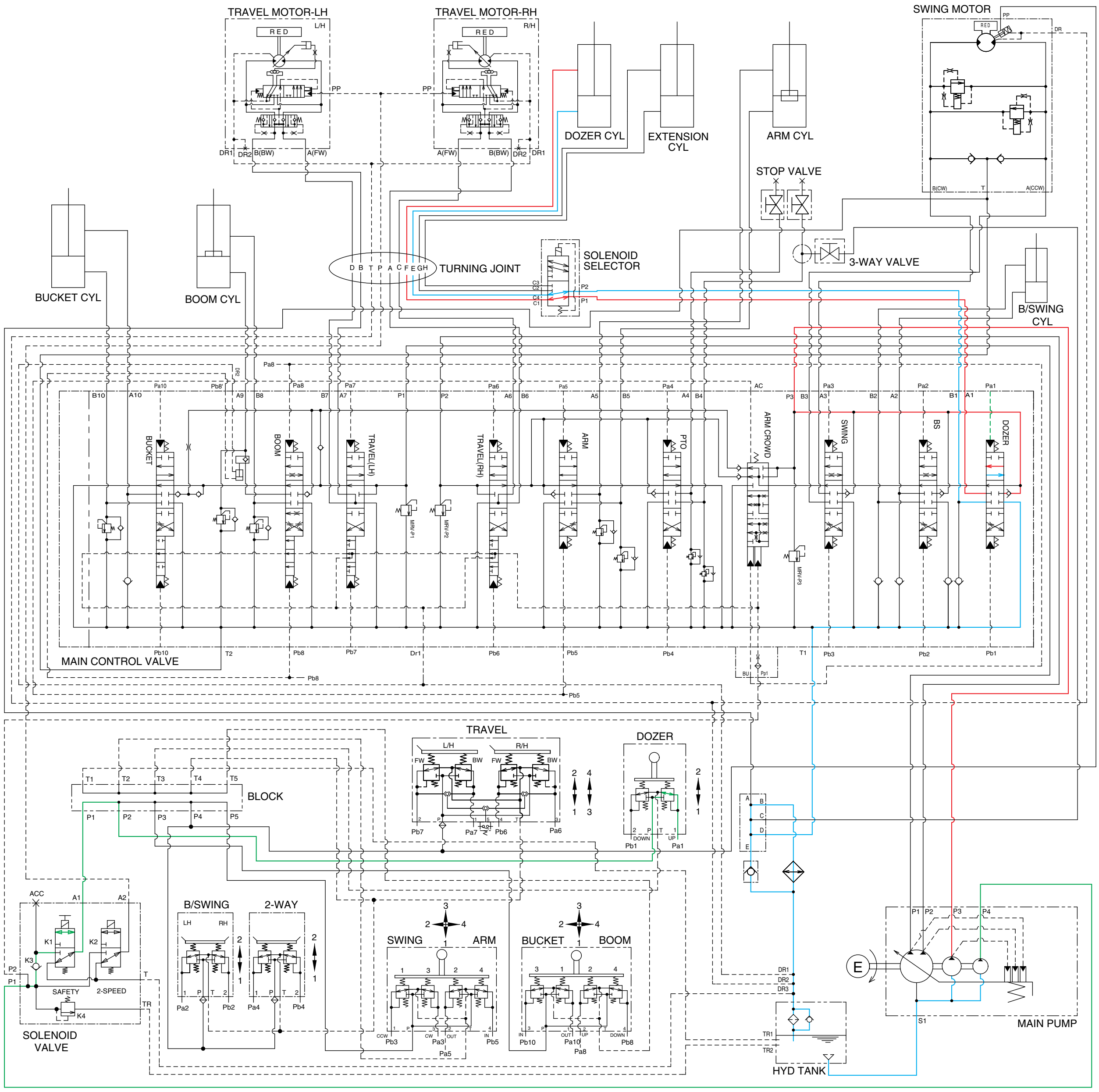
Valves are provided on travel motors to offer the following functions.

1) COUNTERBALANCE VALVE
   When stopping the motor of slope descending, this valve to prevent the motor over run.

2) SPEED CHANGE MECHANISM (auto)
   Auto two speed control mechanism consists of two spools and spring. This valve automatically changes motor displacement in portion to motor pressure.

※ The circuit diagram may differ from the equipment, so please check before a repair.

9. DOZER UP OPERATION



19A3HC18

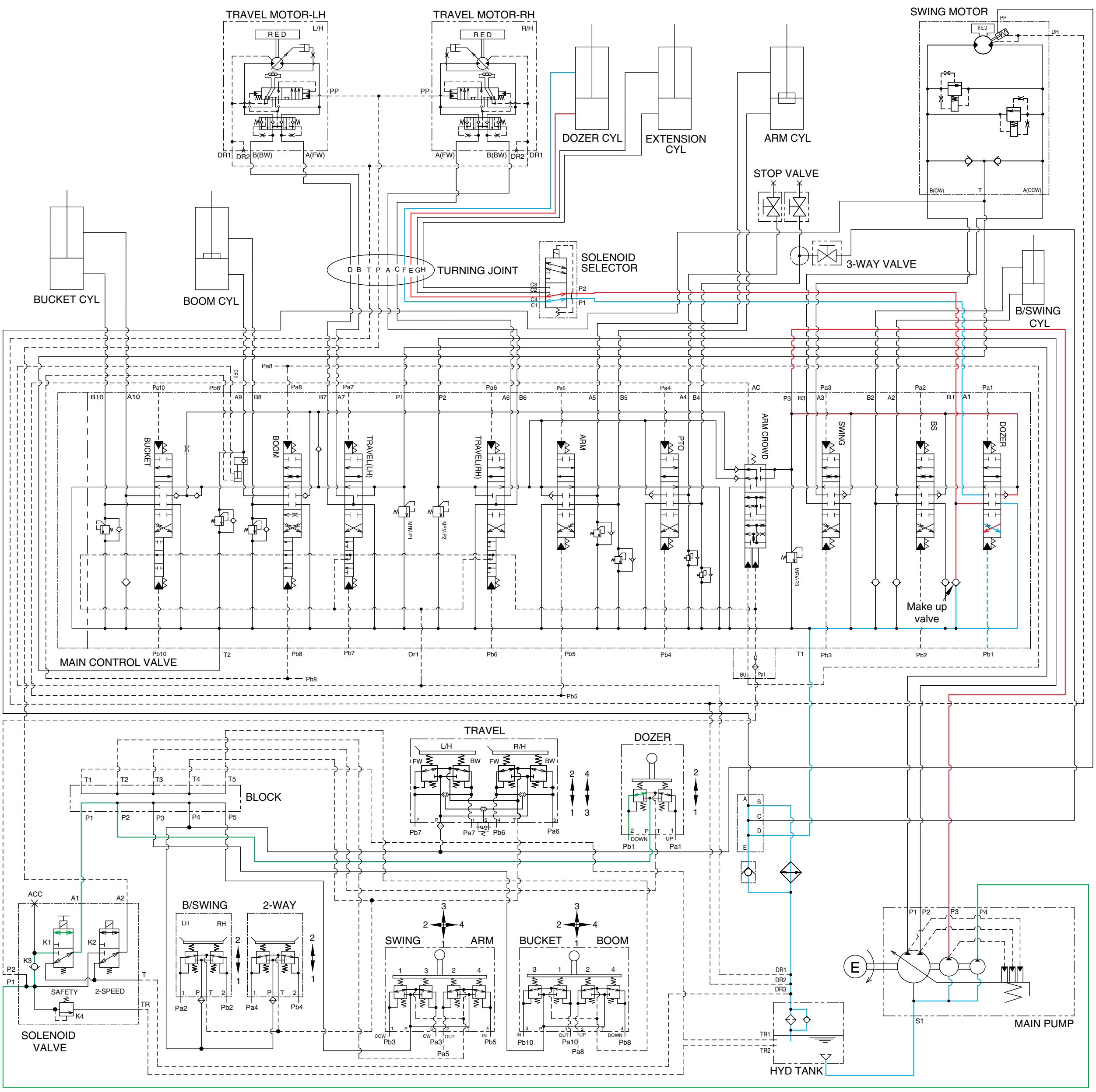
When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure (Pa1) from the remote control valve.

The oil from the P3 pump flows into the main control valve and then goes to the small chamber of dozer cylinder.

At the same time, the oil from the large chamber of dozer cylinder returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer goes up.

※ The circuit diagram may differ from the equipment, so please check before a repair.

10. DOZER DOWN OPERATION



19A3HC19

When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure (Pb1) from the remote control valve.

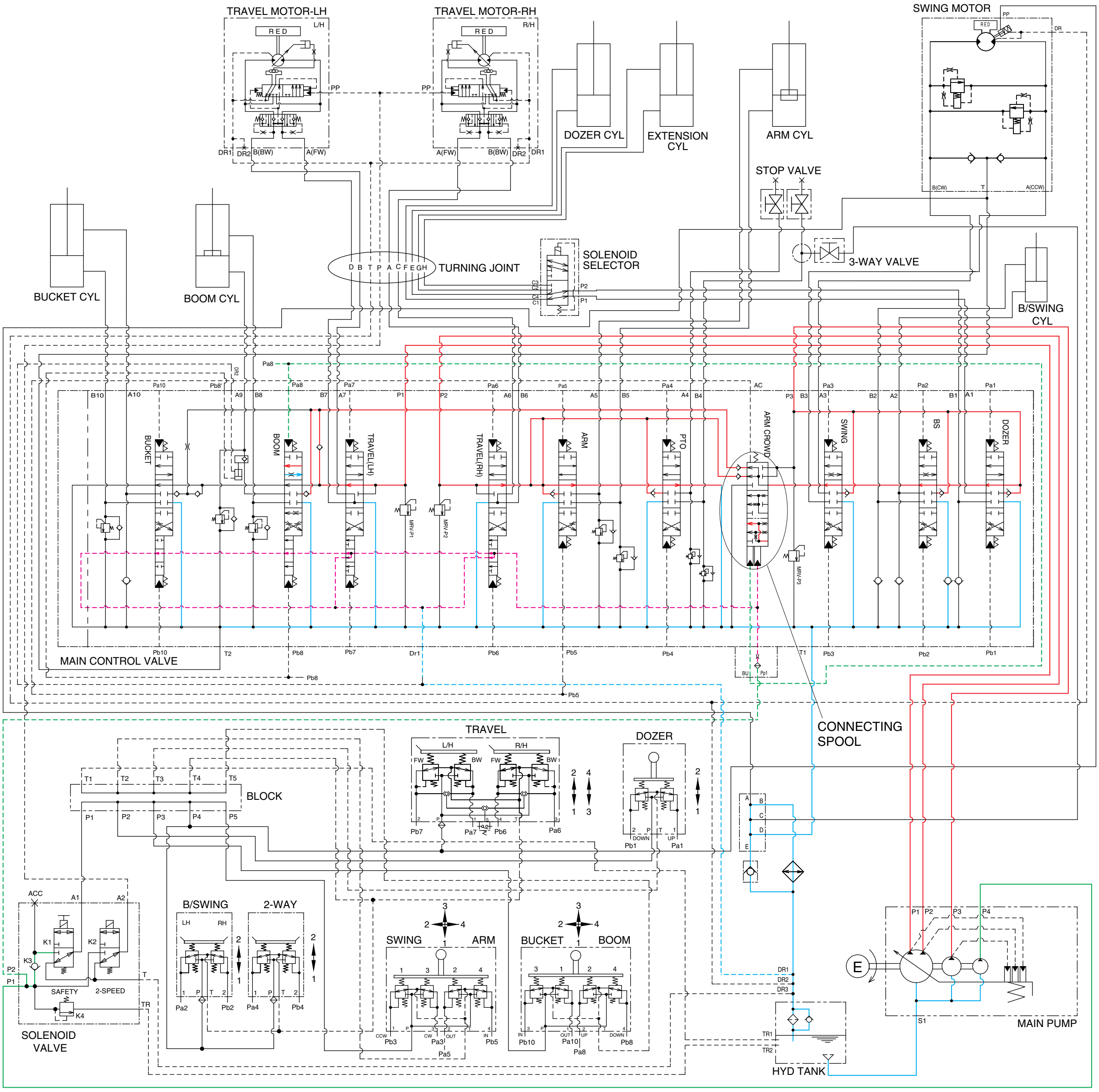
The oil from the P3 pump flows into the main control valve and then goes to the large chamber of dozer cylinder.

At the same time, the oil from the small chamber of dozer cylinder returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer blade is down.

※ The circuit diagram may differ from the equipment, so please check before a repair.

GROUP 5 COMBINED OPERATION

1. OUTLINE



19A3HC30

The oil from the P1, P2, P3 pump flows through the neutral oil passage, bypass oil passage and confluence oil passage in the main control valve. Then the oil goes to each actuator and operates them. Check valves and orifices are located on these oil passage in the main control valve. These control the oil from the main pumps so as to correspond to the operation of each actuator and smooth the combined operation.

INDEPENDENT TRAVEL SYSTEM

This independent travel system for straight travel is provided in the main control valve.

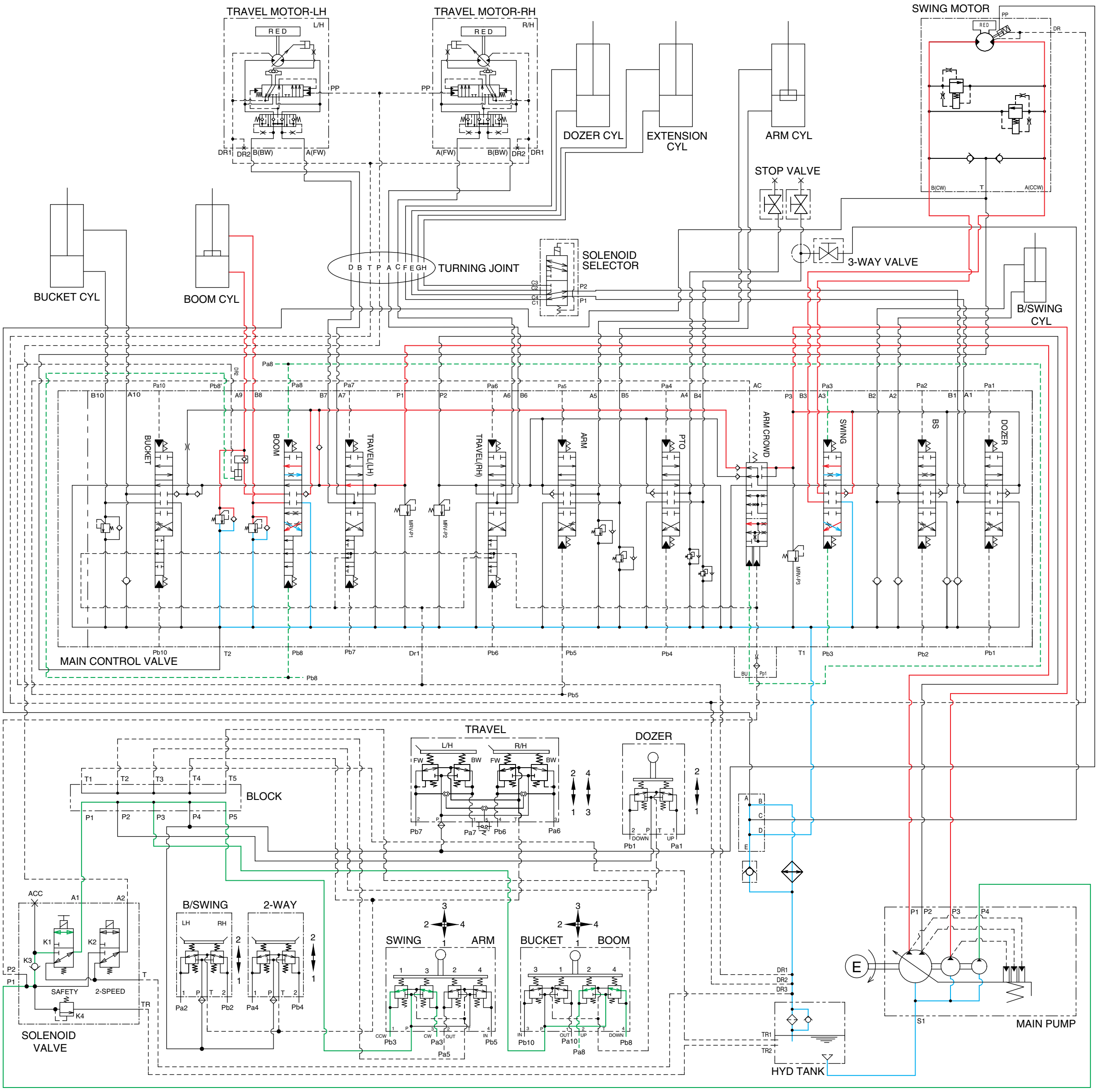
If any actuator(s) on P1 and P2 pump side is operated when traveling, the connecting spool is moved to the selected side by the pilot oil pressure (Pp1).

Consequently, the pressure oil from P1 and P2 pump are supplied to the right and left travel motor and oil from P3 pump flows into the other operated actuator.

This keeps the straight travel.

※ The circuit diagram may differ from the equipment, so please check before a repair.

2. COMBINED SWING AND BOOM OPERATION



19A3HC31

When the swing and boom functions are operated, simultaneously the selector spool, swing spool and boom spool in the main control valve are moved to the functional position by the pilot oil pressure (Pa3, Pb3, Pa8, Pb8) from the remote control valve.

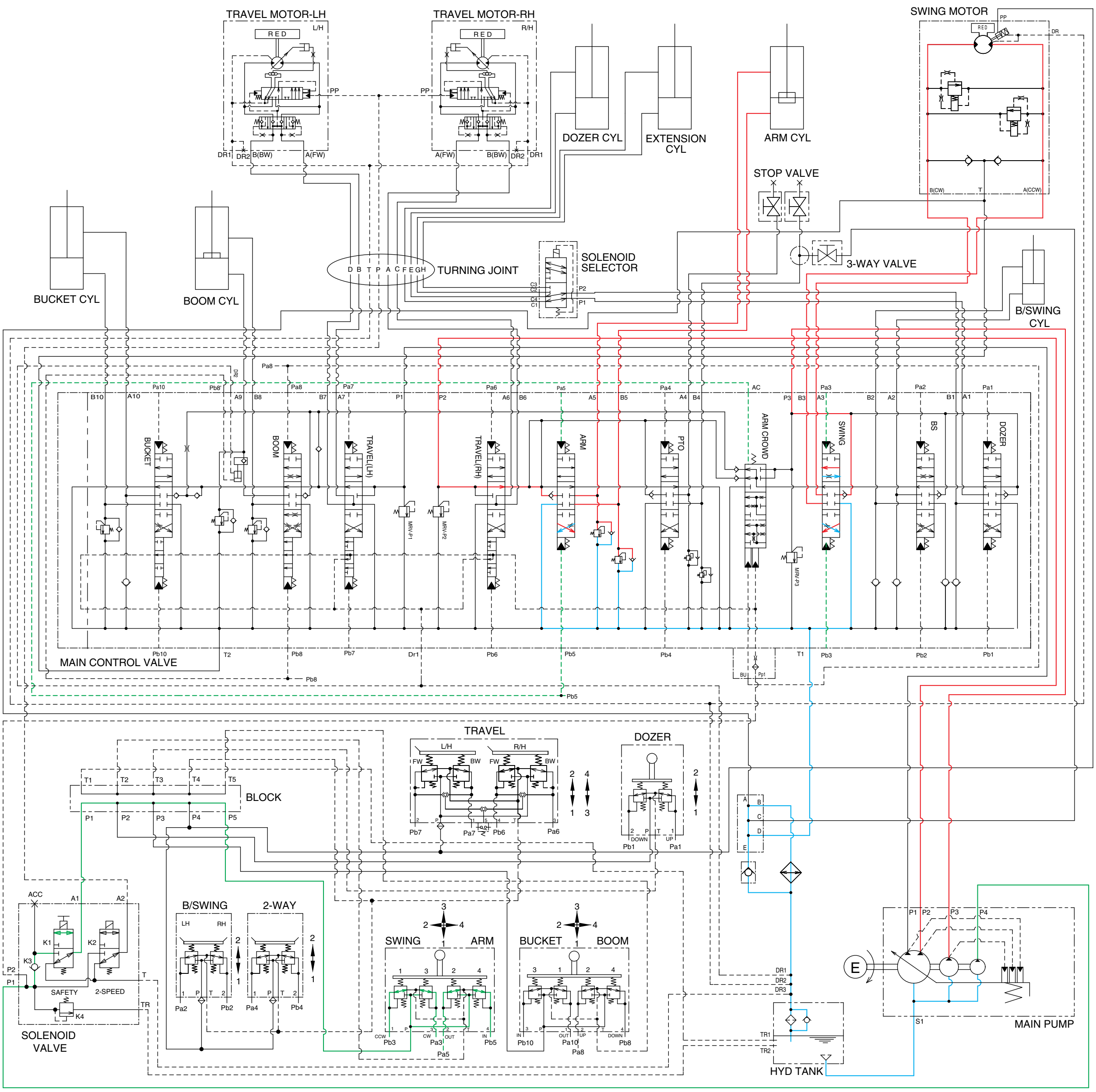
The oil from the P1 pump and some oil from the P3 pump flows into the boom cylinder through connecting spool (boom up only).

The oil from the P3 pump flows into the swing motor through the swing spool.

The superstructure swings and the boom is operated.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3. COMBINED SWING AND ARM OPERATION

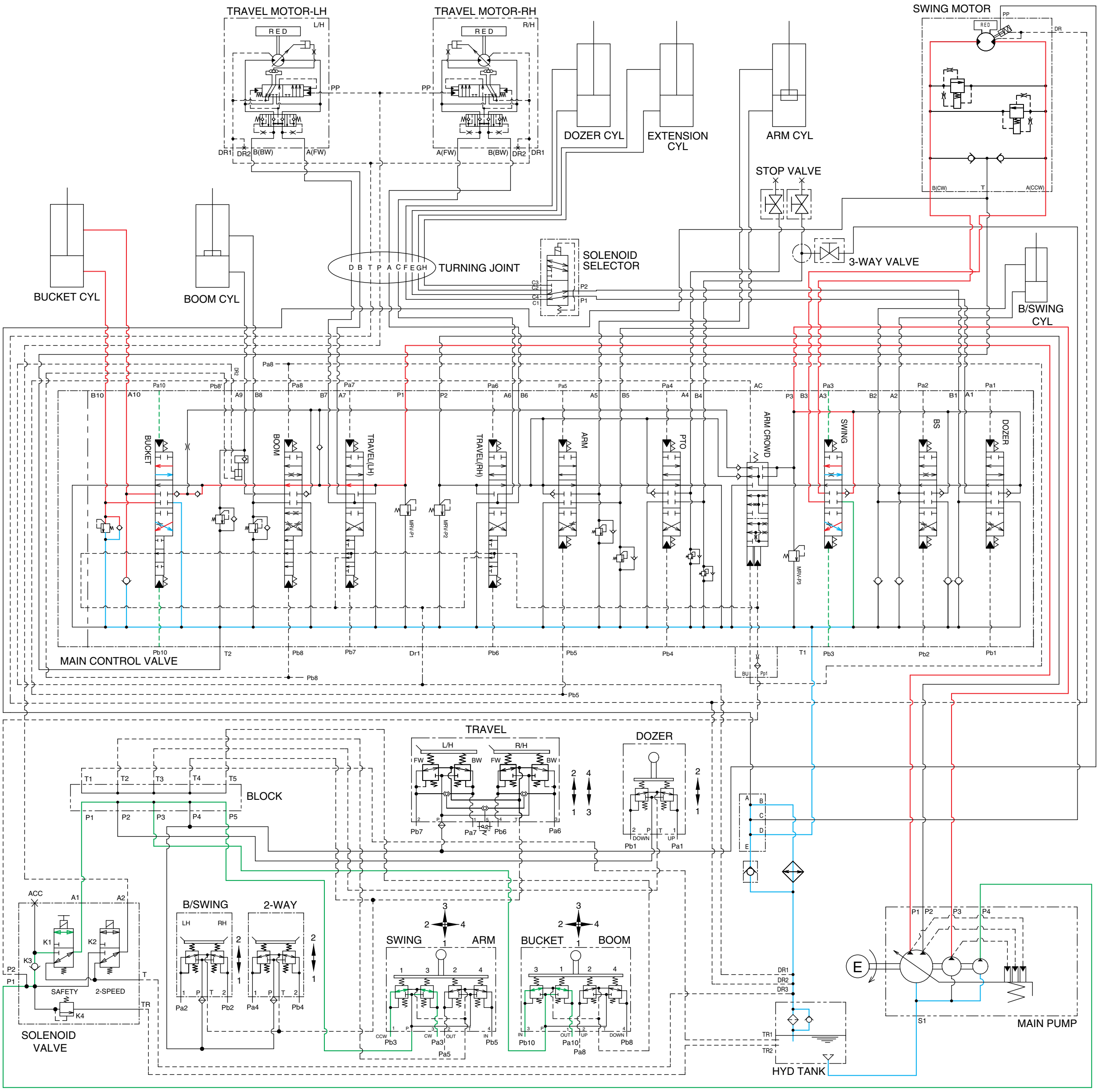


19A3HC32

When the swing and arm functions are operated, simultaneously the swing spool and arm spool in the main control valve are moved to the functional position by the pilot oil pressure (Pa3, Pb3, Pa5, Pb5) from the remote control valve.
The oil from the P3 pump flows into the swing motor through swing spool.
The oil from the P2 pump flows into the arm cylinder through the arm.
The superstructure swings and the arm is operated.

※ The circuit diagram may differ from the equipment, so please check before a repair.

4. COMBINED SWING AND BUCKET OPERATION



19A3HC33

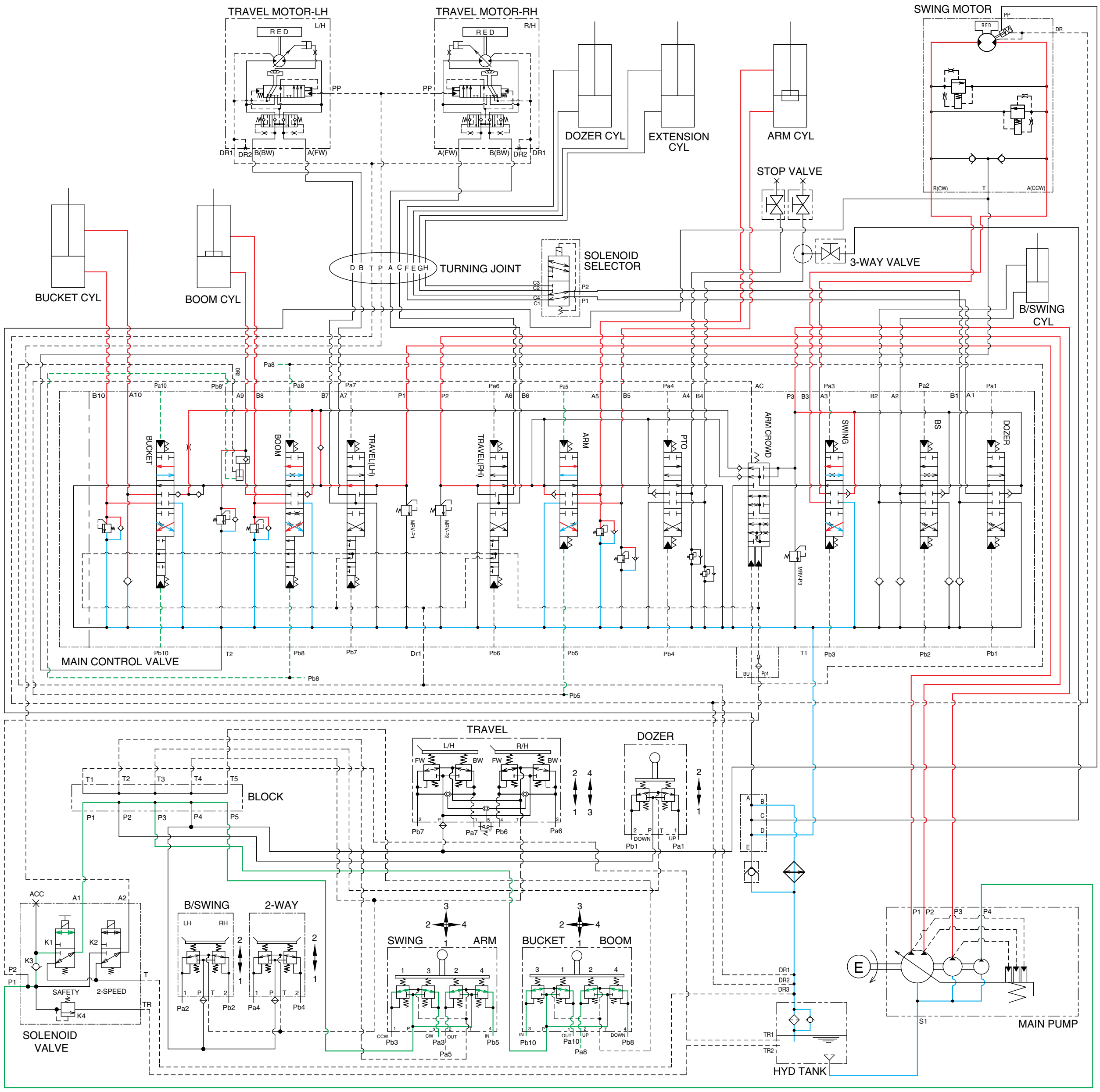
When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure (Pa3, Pb3, Pa10, Pb10) from the remote control valve.

The oil from the P3 pump flows into the swing motor through the swing spool.

The oil from the P1 pump flows into the bucket cylinder through the bucket spool.

※ The circuit diagram may differ from the equipment, so please check before a repair.

5. COMBINED SWING, BOOM, ARM AND BUCKET OPERATION



19A3HC34

When the swing, boom, arm and bucket functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure (Pa3, Pb3, Pa8, Pb8, Pa5, Pb5, Pa10, Pb10) from the remote control valve.

The oil from the P2 pump flows into the arm cylinder through, arm spool.

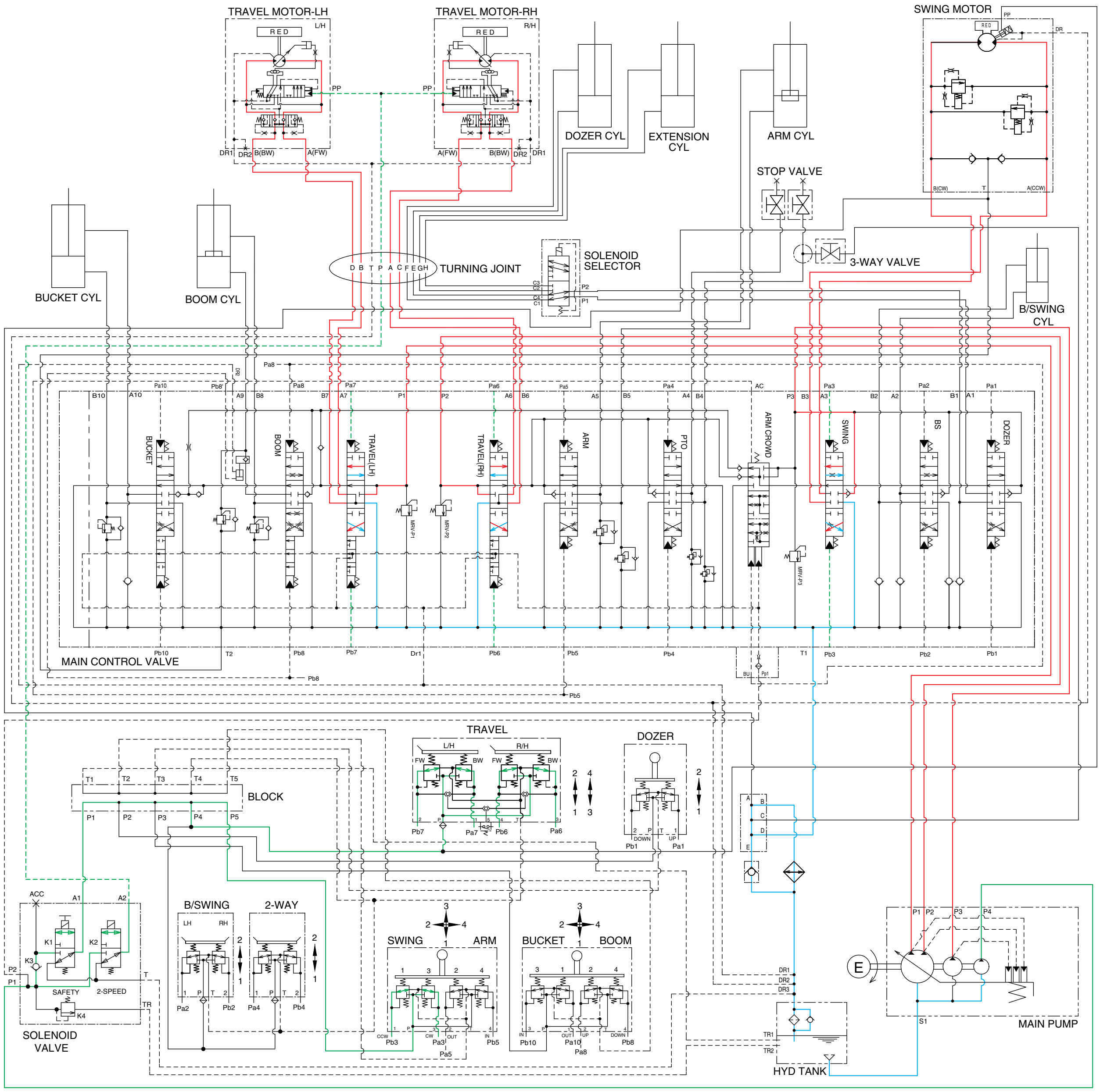
The oil from the P1 pump flows into the boom cylinder and bucket cylinder through the boom spool, bucket spool.

The oil from the P3 pump flows into the swing motor through the swing spool.

The superstructure swings and the boom, arm and bucket are operated.

※ The circuit diagram may differ from the equipment, so please check before a repair.

6. COMBINED SWING AND TRAVEL OPERATION



When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (Pa3, Pb3, Pa6, Pb6, Pa7, Pb7) from the remote control valve and the travel levers.

The oil from the P3 pump flows into the swing motor through the swing spool.

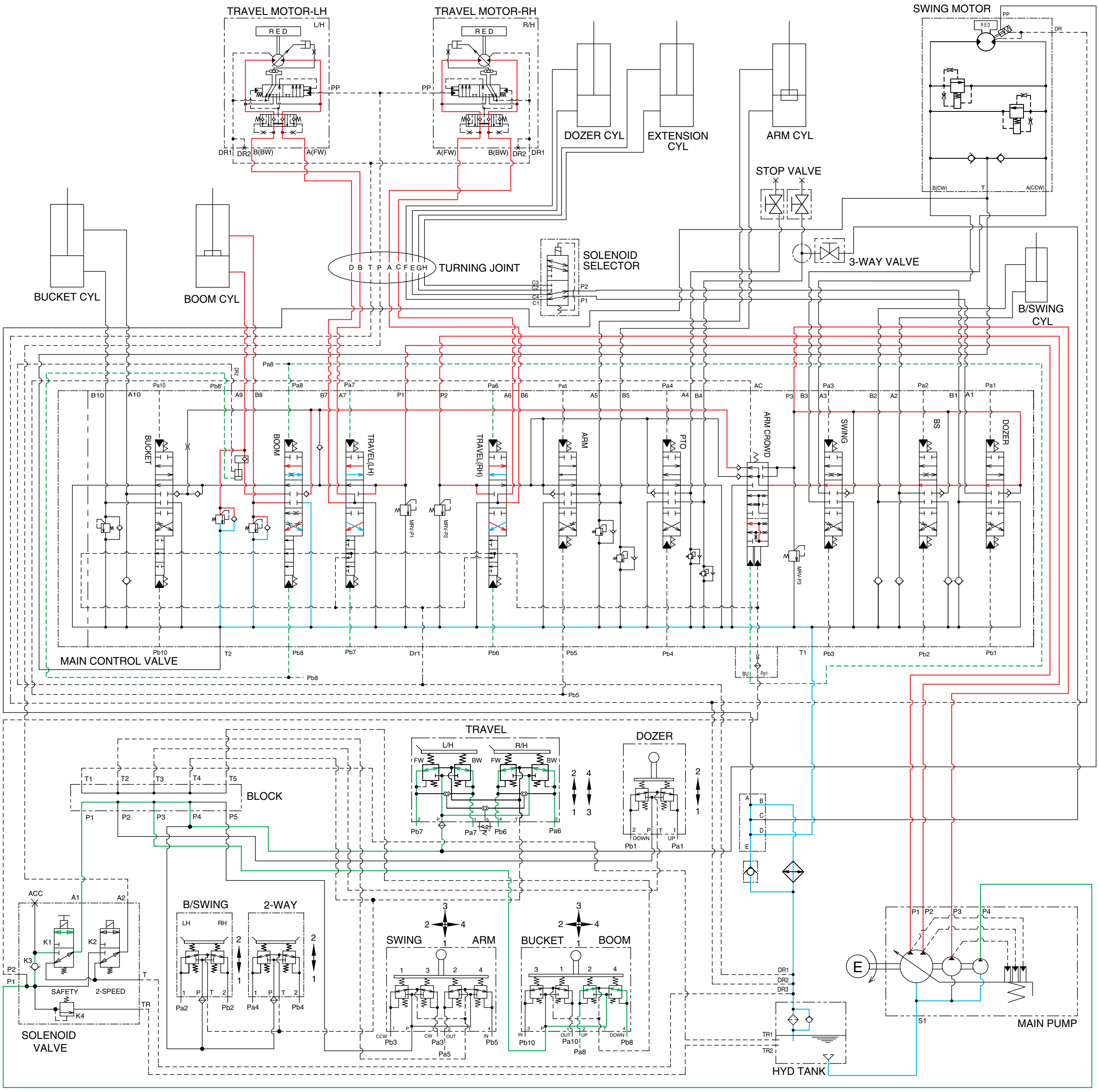
The oil from the P1 pump flows into the travel motor through the LH travel spool.

The oil from the P2 pump flows into the travel motor through the RH travel spool.

The superstructure swings and the machine travels straight.

※ The circuit diagram may differ from the equipment, so please check before a repair.

7. COMBINED BOOM AND TRAVEL OPERATION



19A3HC36

When the boom and travel functions are operated, simultaneously the boom spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (Pa8, Pb8, Pa6, Pb6, Pa7, Pb7) from the remote control valve.

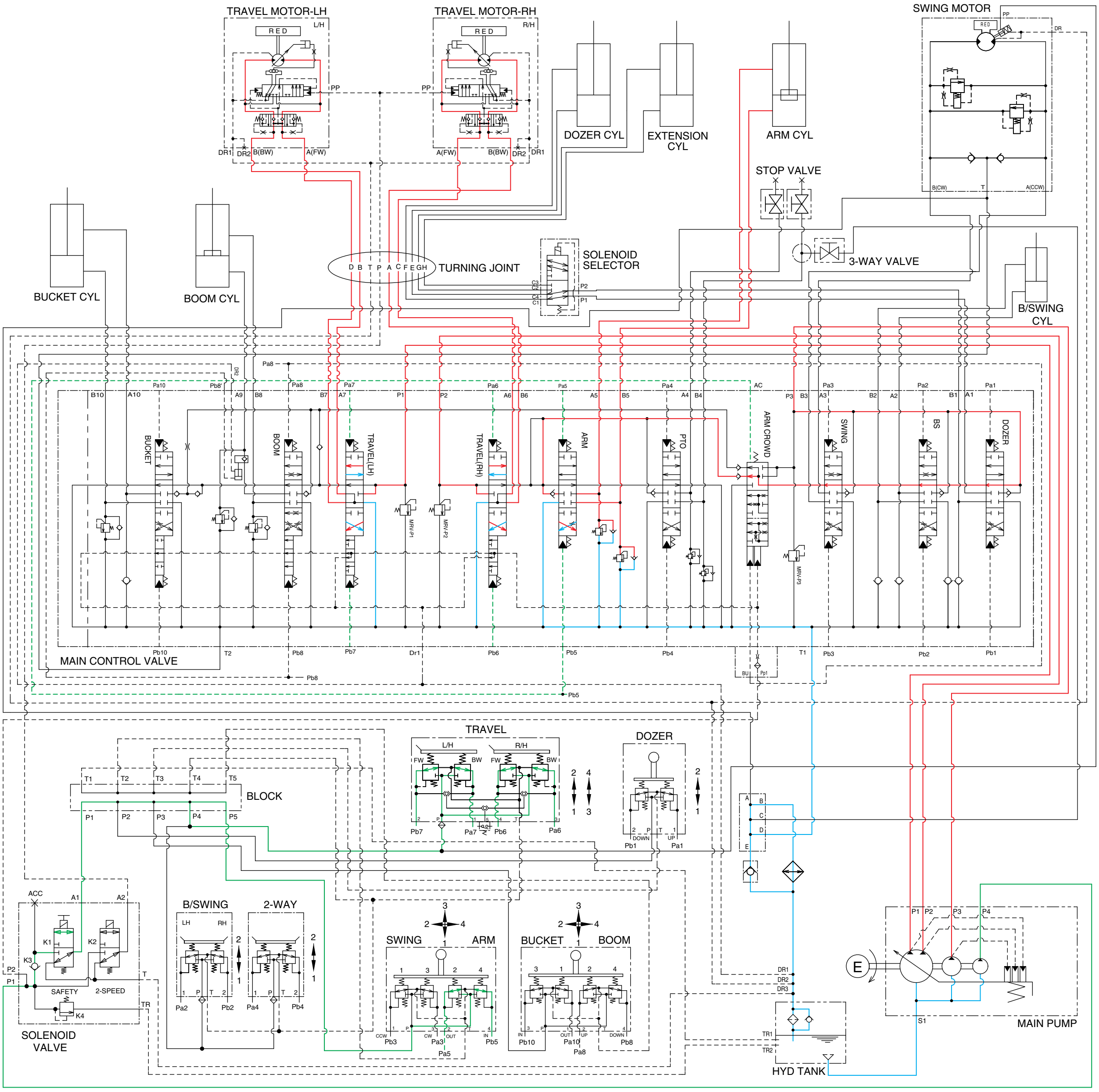
The oil from the P1 and P2 pumps flows into the travel motors through travel LH and travel RH spools.

The oil from the P3 pump flows into the boom cylinder through boom spool via the connecting spool.

The boom is operated and the machine travels straight.

※ The circuit diagram may differ from the equipment, so please check before a repair.

8. COMBINED ARM AND TRAVEL OPERATION



19A3HC37

When the arm and travel functions are operated, simultaneously the arm spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (Pa8, Pb8, Pa6, Pb6, Pa7, Pb7) from the remote control valve.

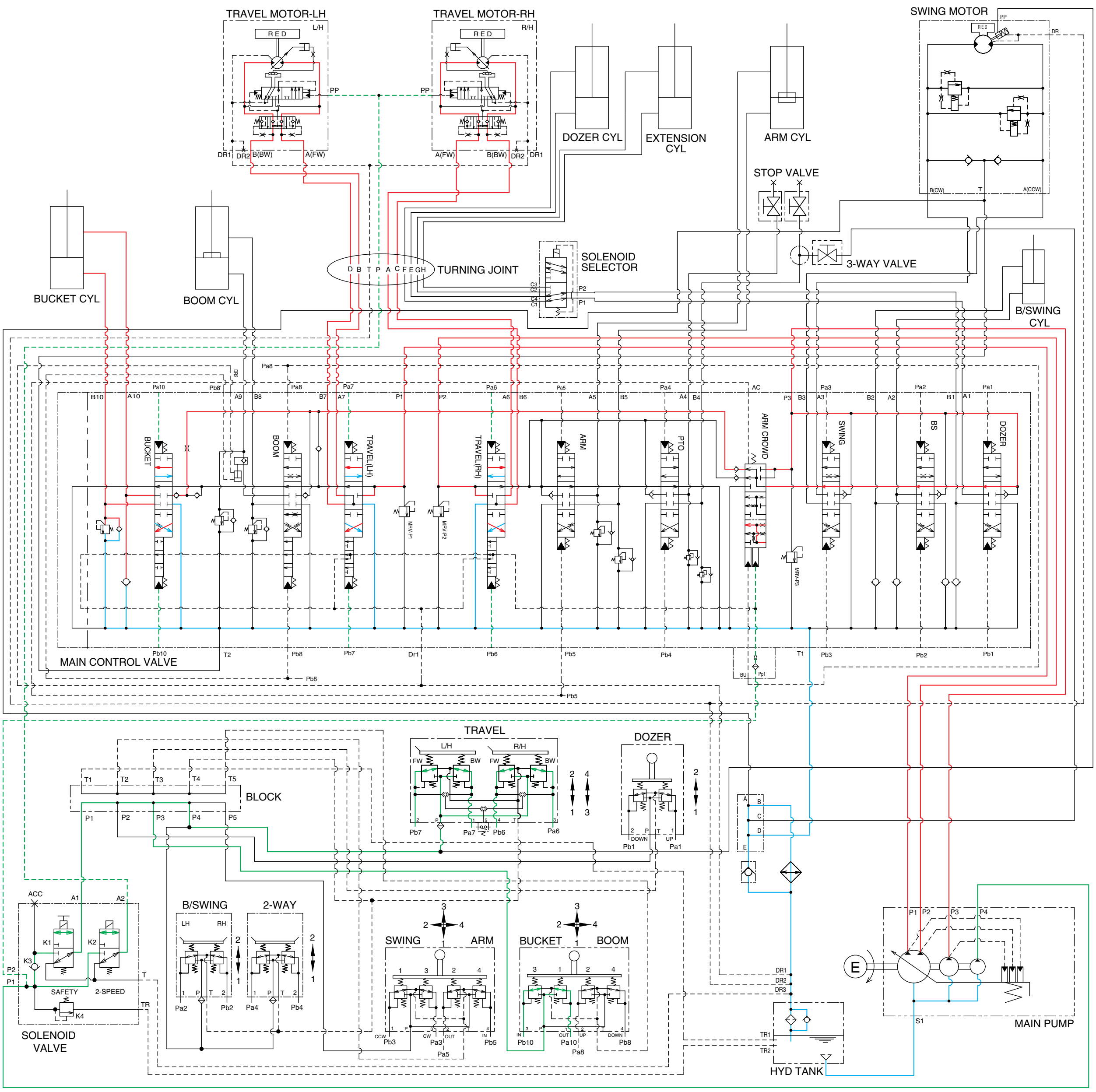
The oil from the P1 and P2 pumps flows into the travel motors through travel spools.

The oil from the P2 pump flows into the arm cylinder through arm spool via the connecting spool.

The arm is operated and the machine travels.

※ The circuit diagram may differ from the equipment, so please check before a repair.

9. COMBINED BUCKET AND TRAVEL OPERATION



19A3HC38

When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (Pa10, Pb10, Pa6, Pb6, Pa7, Pb7) from the remote control valve, and the travel selector spool is pushed to the up by the oil pressure from pilot pump. The oil from the P1 and P2 pumps flows into the travel motors.

The oil from the P3 pump flows into the bucket cylinder through bucket spool via the travel selector spool.

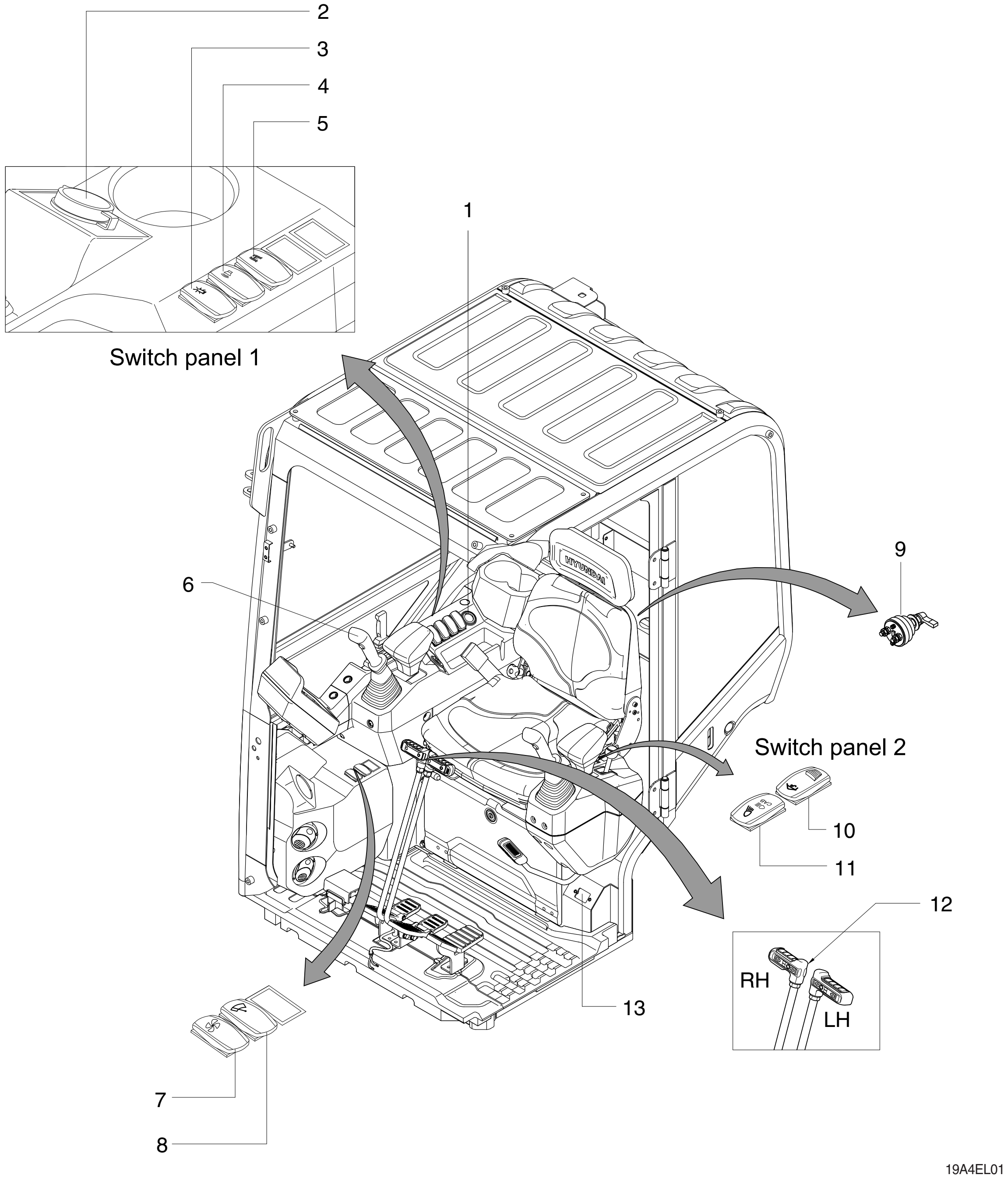
The bucket is operated and the machine travels straight.

※ The circuit diagram may differ from the equipment, so please check before a repair.

SECTION 4 ELECTRICAL SYSTEM

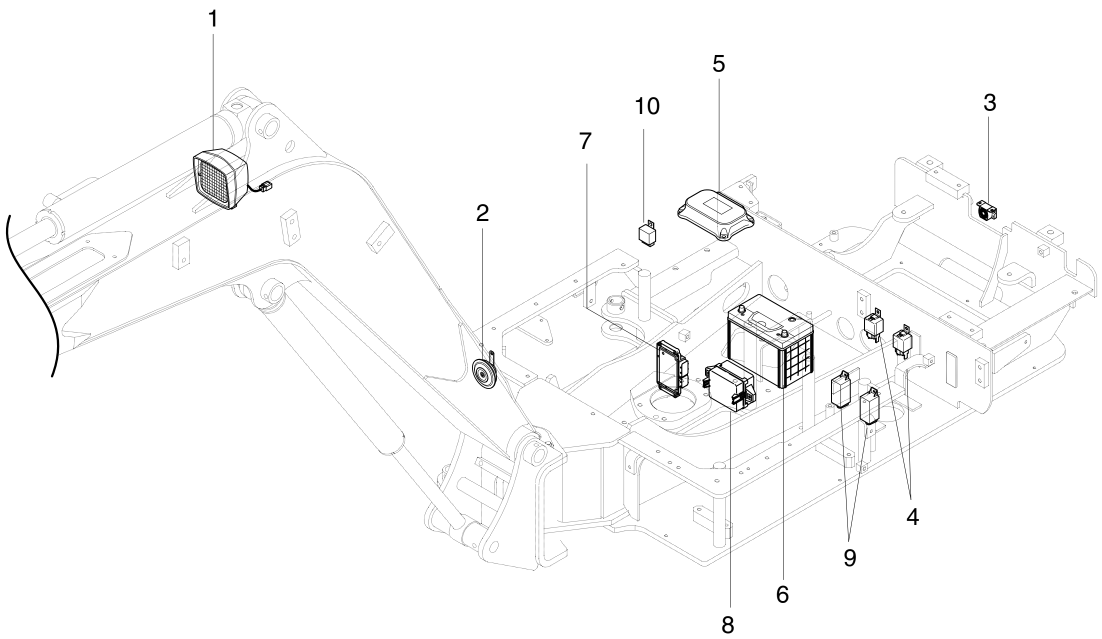
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



1	12V socket	6	Switch on RH RCV	7	Heater switch
2	Start switch		- Breaker switch	8	Washer/wiper switch
3	Beacon swich		- Horn switch	9	Master switch
4	Travel alarm switch		- Quick coupler switch	10	Quick coupler switch
5	Track extension switch		- 2-way switch	11	Work light switch
				12	Travel speed control switch
				13	Emergency stop switch

2. LOCATION 2



19A4EL01

1	Work lamp	5	RMCU	9	Micro 12V relay
2	Horn	6	Battery	10	Warning buzzer
3	Travel alarm buzzer	7	HCU assy		
4	Power relay	8	Fuse box		

GROUP 2 MONITORING SYSTEM

1. OUTLINE

The cluster consists of LCD and switches as shown below. The LCD is to warn the operator in case of abnormal machine operation or conditions for the appropriate operation and inspection.
The LCD is to display for monitoring, manage and display set with the switches.

※ The cluster installed on this machine does not entirely guarantee the condition of the machine. Daily inspection should be performed according to chapter 6, Maintenance.

※ When the cluster provides a warning, immediately check the problem and perform the required action.

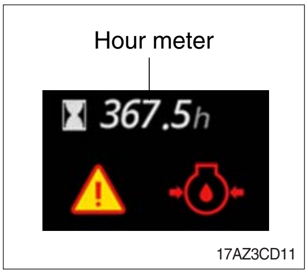
2. CLUSTER

1) MONITOR PANEL

19A4CD10

2) GAUGES AND DISPLAYS

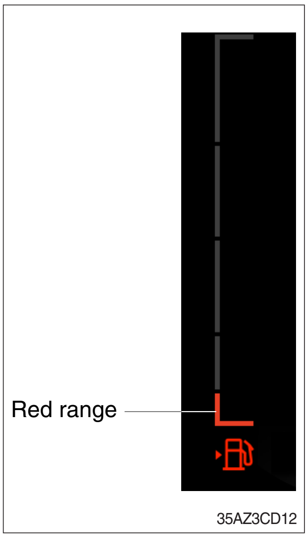
(1) Hour meter



① This meter shows the total operation hours of the machine.

② Always ensure the operating condition of the meter during the machine operation.
Inspect and service the machine based on hours as indicated the operator's manual in chapter 6, maintenance.

(2) Fuel gauge

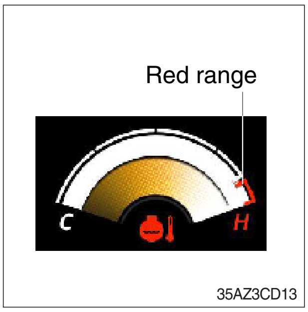


① This gauge indicates the amount of fuel in the fuel tank.

② Fill the fuel when in the red range or warning lamp ON.

※ If the gauge illuminates the red range or warning lamp ON even though the machine is in the normal condition range, check the electric device as this can be caused by poor connection of sensor.

(3) Engine coolant temperature gauge



① This indicates the temperature of coolant.
 · Red range : Above 105°C (221°F)

② When the red range pointed or warning lamp ON, engine do not abruptly stop but run it at medium speed to allow it to cool gradually, then stop it.
Check the radiator and engine.

※ If the engine is stopped without cooled down running, the temperature of engine parts will rise suddenly, this could cause severe engine trouble.

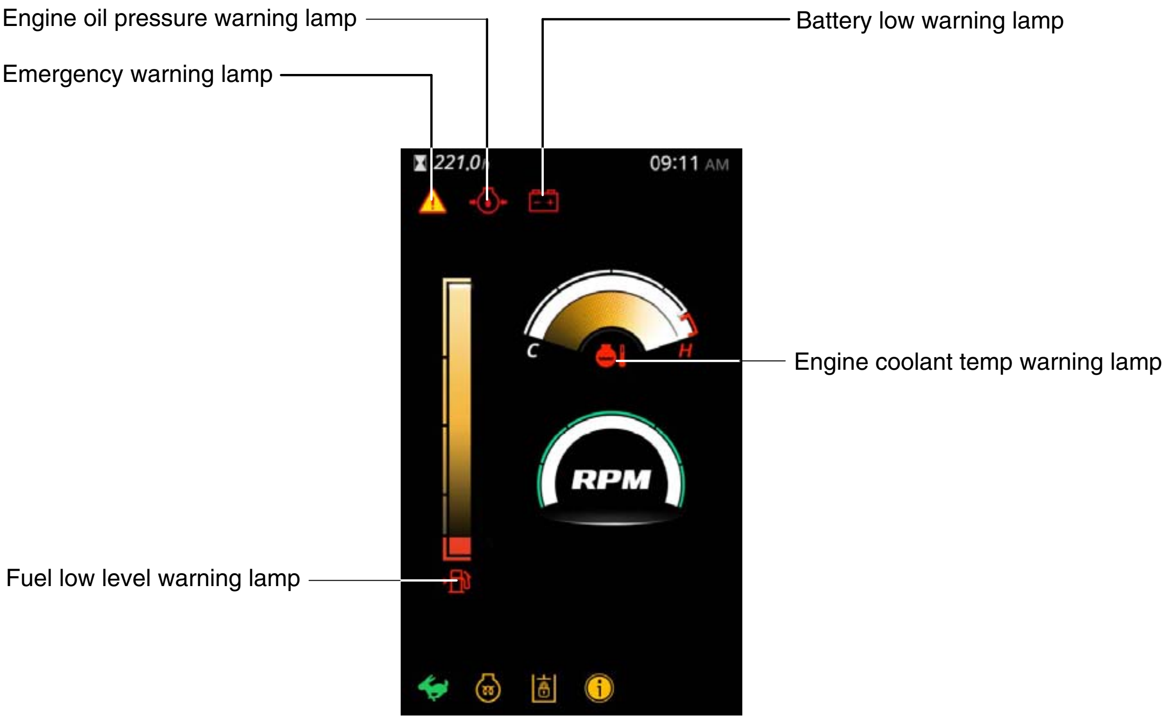
※ If the gauge indicates the red range or warning lamp ON in red even though the machine is in the normal condition range, check the electric device as this can be caused by poor connection of sensor.

(4) Engine rpm gauge

17AZ3CD15

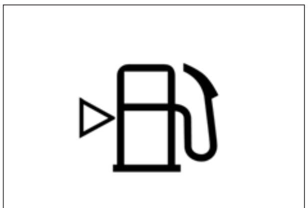
① This gauge indicates the engine speed.

3) WARNING LAMPS



17AZ3CD20

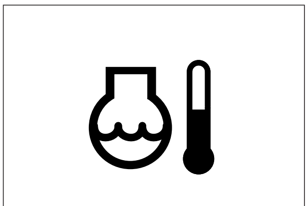
(1) Fuel low level warning lamp



35AZ3CD21

① This lamp lights up and buzzer sounds when the level of fuel is below 8.0 ℓ (2.1 U.S. gal).
② Fill the fuel immediately when the lamp ON.

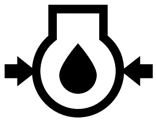
(2) Engine coolant temperature warning lamp



35AZ3CD22

① This lamp lights up and buzzer sounds when the temperature of coolant is over the normal temperature 105°C (221°F).
② Check the cooling system when the lamp ON.

(3) Engine oil pressure low warning lamp

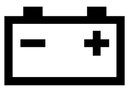


R5573CD13

① This lamp lights up and buzzer sounds after starting the engine because of the low oil pressure.

② If the lamp ON during engine operation, shut OFF engine immediately. Check oil level.

(4) Battery low warning lamp



R5573CD16

① This lamp lights up and buzzer sounds when the starting switch is ON, it is turned OFF after starting the engine.

② Check the battery charging circuit when this lamp does not turn off, or turns on or blinks during engine operation.

(5) Emergency warning lamp

290F3CD64

① This lamp pops up and the buzzer sounds when each of the below warnings occurs.

- Engine coolant temperature high warning lamp ON

※ **The pop-up warning lamp moves to the original position and lights up when the buzzer stop switch is pushed or pop-up is touched. The buzzer will stop.**

This is same as following warning lamps.

② When this warning lamp lights up, machine must be checked and serviced immediately.

4) PILOT LAMP

17AZ3CD30

(1) Travel mode pilot lamp

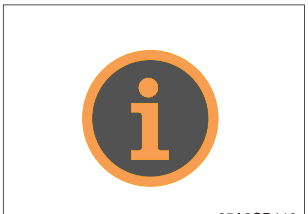
No	Mode	Pilot lamp	Selected mode
1	Travel mode		Low speed traveling High speed traveling

(2) Preheat pilot lamp


290F3CD79

① Turning the start key switch to the ON position starts preheating in cold weather.
② Start the engine after this lamp goes OFF.
※ Refer to the operator's manual page 4-4 for details.

(3) Maintenance pilot lamp


85A3CD110

① This lamp lights up when consumable parts are in need of replacement. It means that the change or replacement interval of parts is 30 hours from the required change interval.
② Check the message in maintenance information of main menu. Also, this lamp lights up for 3 minutes when the start switch is switched to the ON position.

(4) Manual safety lock pilot lamp

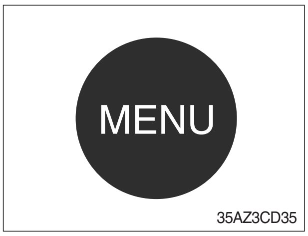

140WA3CD37

① This lamp lights up when the safety lever is set to the LOCK position.
※ Refer to the operator's manual page 3-29 for the safety lever.

5) SWITCHES

Sound short beep when each button is pressed.

(1) Menu button



35AZ3CD35

① Go into the menu screen.

※ Please refer to page 4-11.

(2) Left/up/(+)

17AZ3CD36

① Move left in sub menu.

② Move up in menu list

③ Increase input value in menu

(3) Right/down/(-) button

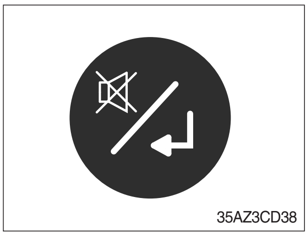
35AZ3CD37

① Move right in sub menu.

② Move down in menu list

③ Decrease input value in menu

(4) Enter and buzzer stop button

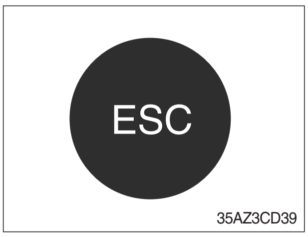


35AZ3CD38

① Select menu (enter).

② Stop buzzer sound when press this button immediately.

(5) ESC

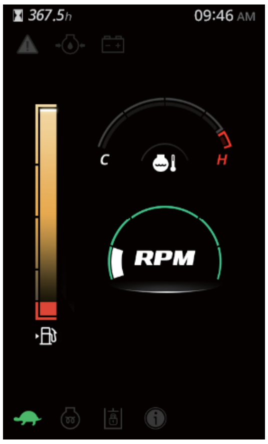


35AZ3CD39

① Escape in the menu.

6) MAIN MENU

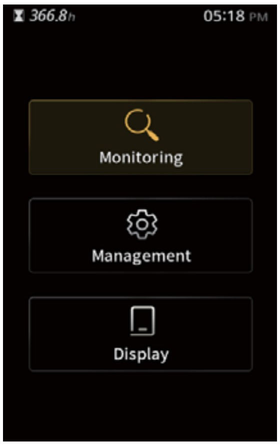
Operation screen



17AZ3CD100

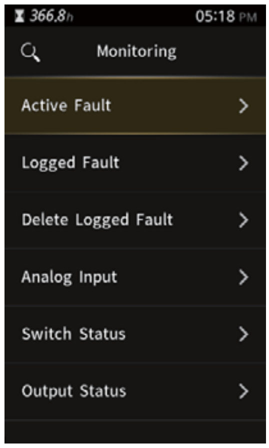
press
MENU
button

Main menu screen



17AZ3CD106

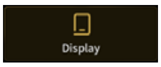
Sub menu screen



17AZ3CD110

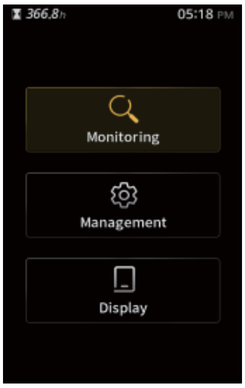
※ Please refer to the switches, page 4-10 for selection and change of menus and input values.
※ In the operation screen, press the menu button to access the sub-menu screen.

(1) Structure

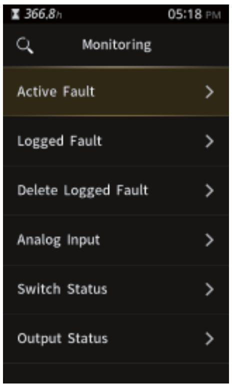
No	Main menu	Sub menu	Description
1	 Monitoring 17AZ3CD103	Active fault Logged fault Delete logged fault Analog input Switch status Output status	Active fault Logged fault Delete logged fault Coolant temp., Battery volt, Engine speed Safety lever, Quick coupler 1, Quick coupler 2, Travel speed Quick coupler solenoid, Start limit relay, Buzzer
2	 Manage 35AZ3CD104	Operating hours Maintenance ESL mode Change password Machine information A/S phone number	A day's operating hours Elapse, Interval, Replacement etc. Disabled, Enable (Always), Enable (Interval) Change password Machine, Engine, Cluster A/S phone number, A/S phone number change
3	 Display set 17AZ3CD105	Clock adjust Brightness Unit Language	12 hours, 24 hours Manual, Auto Temperature Korean, English, Turkish, etc (total 12 languages)

(2) Monitoring

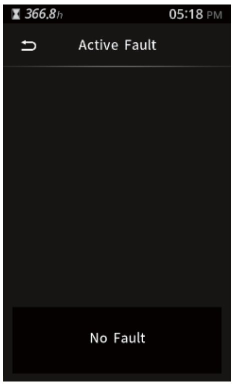
① Active fault



17AZ3CD106

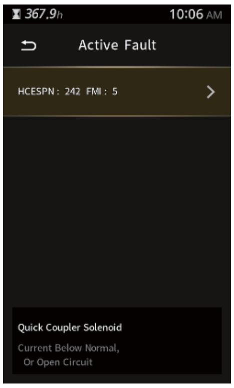


17AZ3CD110



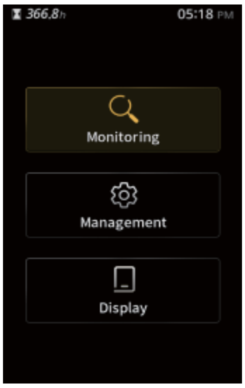
17AZ3CD111

- The active fault of the machine and engine can be checked by this menu.

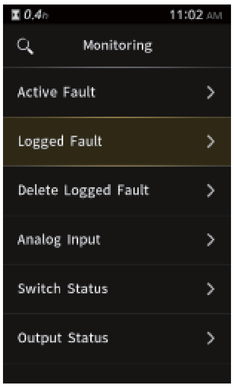


17AZ3CD112

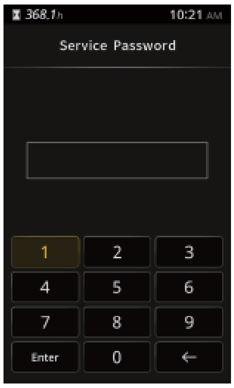
② Logged fault



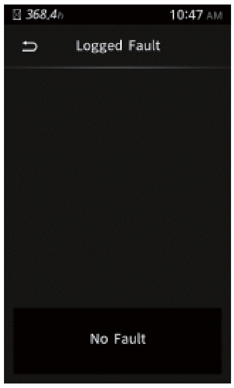
17AZ3CD106



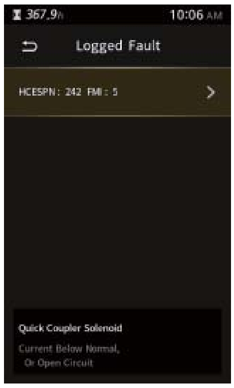
17AZ3CD113



17AZ3CD114



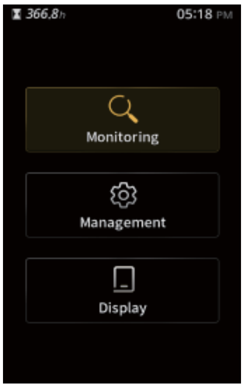
17AZ3CD115



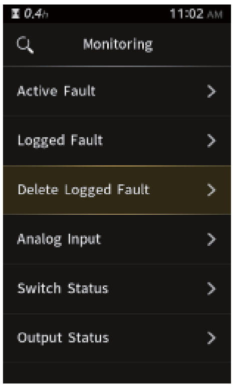
17AZ3CD116

- The logged fault of the machine and engine can be checked by this menu.
- · This menu can be used only HCE service man.

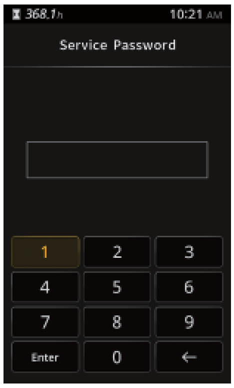
③ Delete logged fault



17AZ3CD106

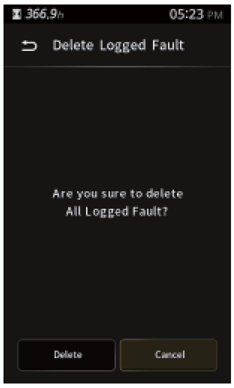


17AZ3CD117

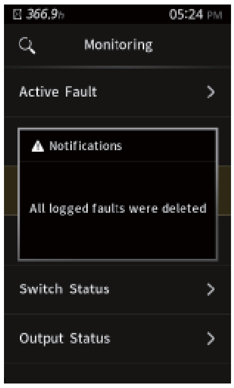


17AZ3CD118

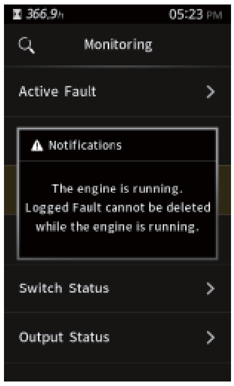
- The logged fault of the machine and engine can be deleted by this menu.
  (It is possible under the engine stop conditions)



17AZ3CD119

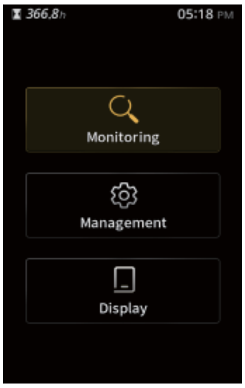


17AZ3CD120

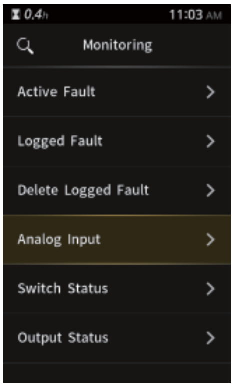


17AZ3CD121

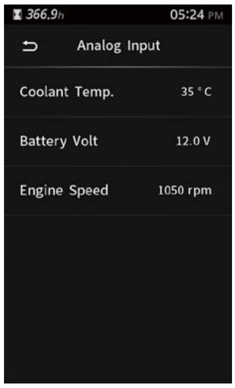
④ Analog input



17AZ3CD106



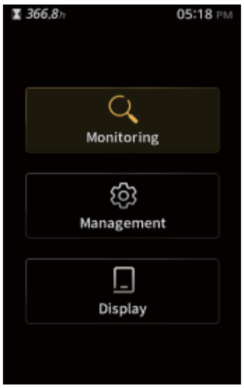
17AZ3CD122



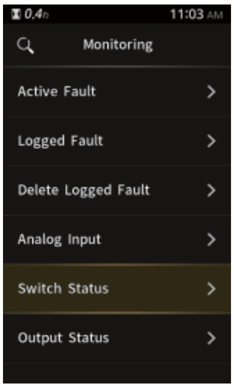
17AZ3CD123

- The machine status such as the engine speed, coolant temperature, battery voltage can be checked by this menu.

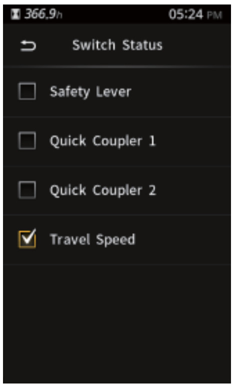
⑤ Switch status



17AZ3CD106



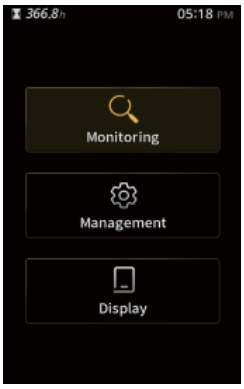
17AZ3CD124



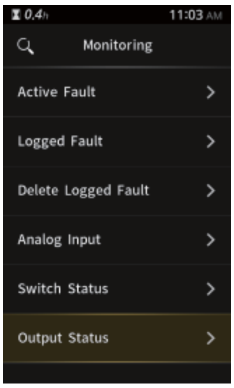
17AZ3CD125

- The switch input status can be checked by this menu.

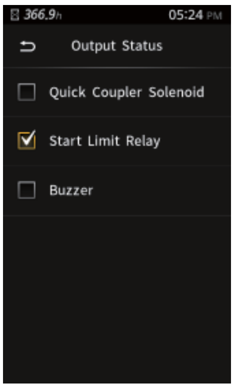
⑥ Output status



17AZ3CD106



17AZ3CD126



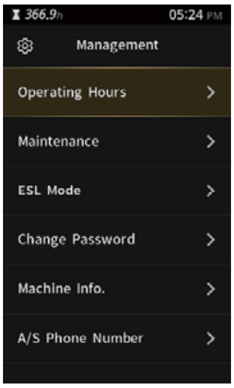
17AZ3CD127

- The output status can be confirmed by this menu.

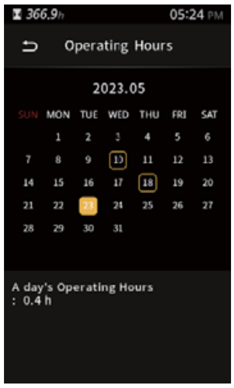
(3) Manage

① Operating hours

17AZ3CD107



17AZ3CD130

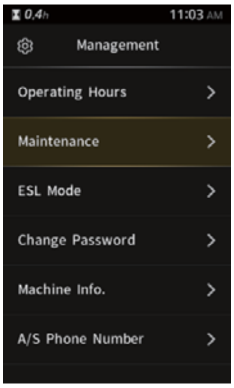


17AZ3CD131

- You can check the operating hours by this menu.

② Maintenance

17AZ3CD107



17AZ3CD132

17AZ3CD133

- Elapse : Maintenance elapsed time.
- Interval : The change intervals can be changed in hour increments of 50.
- History-Hourmeter : Display elapsed time.
- Replacement : The elapsed time will be reset to zero (0).

※ Refer to section, Maintenance chart for further information of maintenance interval.

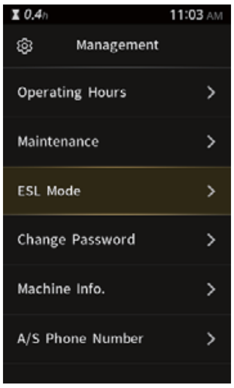
17AZ3CD134

17AZ3CD135

17AZ3CD136

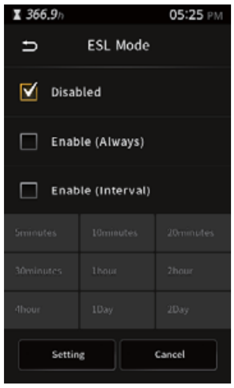
③ ESL mode

17AZ3CD107

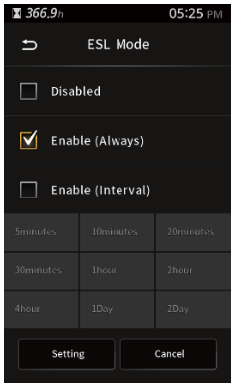


17AZ3CD137

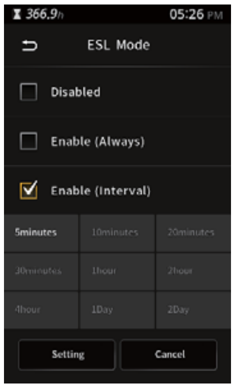
17AZ3CD138



17AZ3CD139



17AZ3CD140



17AZ3CD141

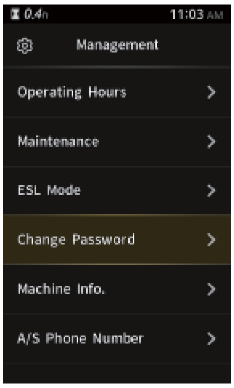
ESL mode setting

- ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
- When you Enable the ESL mode, the password will be required when the starting switch is turned to the on position.
- Machine security
  - · Disable : ESL function is disabled and password is not required to start engine.
  - · Enable (Always) : The password is required whenever the operator starts engine.
  - · Enable (Interval) : The password is required when the operator starts engine first. But the operator can restart the engine within the interval time without inputting the password. The interval time can be set to a maximum 2 days.

※ ESL : Engine Starting Limit

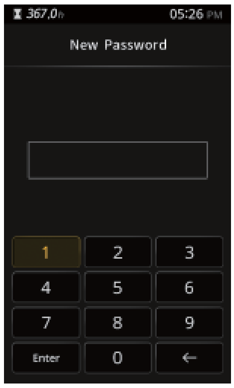
④ Change password

17AZ3CD107



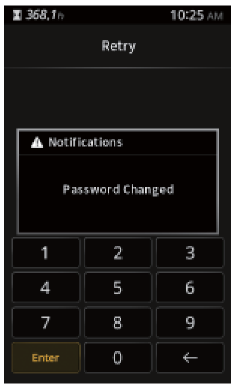
17AZ3CD142

17AZ3CD143



17AZ3CD144

17AZ3CD145



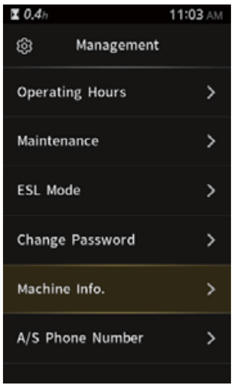
17AZ3CD146

- The password is 5~10 digits.

※ Before first use, please set user password and owner password in advance for machine security.

⑤ Machine information

17AZ3CD107



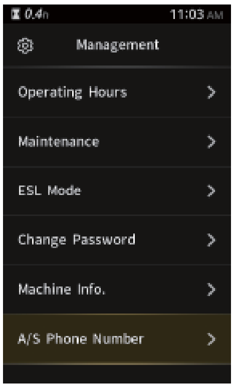
17AZ3CD147

17AZ3CD148

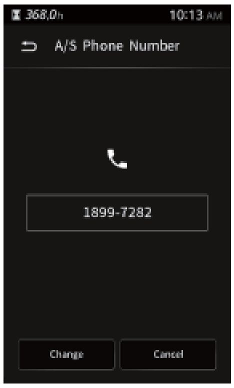
- This can confirm the identification of the machine, engine and cluster.

⑥ A/S phone number

17AZ3CD107



17AZ3CD149



17AZ3CD150

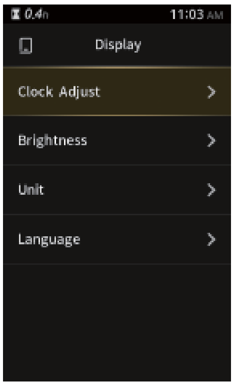
17AZ3CD151

- The A/S phone number can be checked and changed.

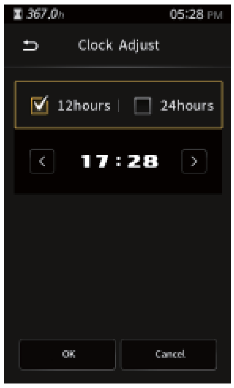
(4) Display set

① Clock adjust

17AZ3CD108



17AZ3CD160

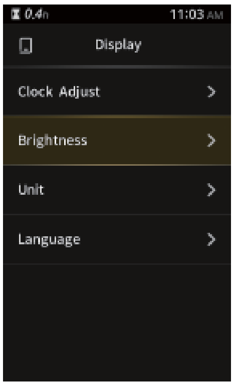


17AZ3CD161

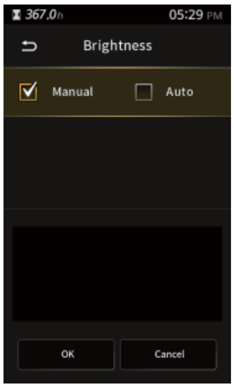
- Set the time (12 hours or 24 hours)

② Brightness

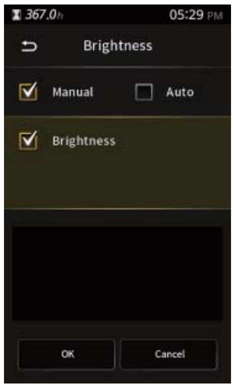
17AZ3CD108



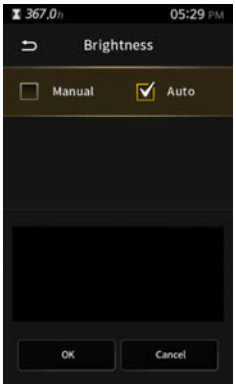
17AZ3CD162



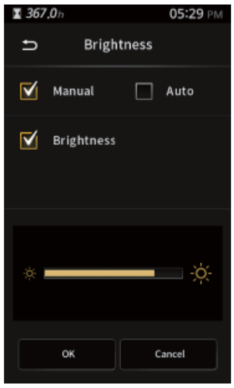
17AZ3CD163



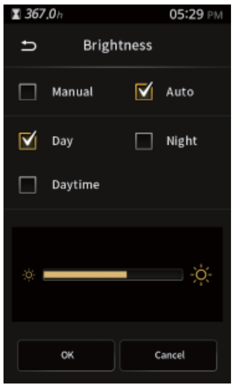
17AZ3CD164



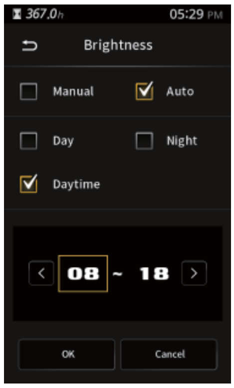
17AZ3CD166



17AZ3CD165



17AZ3CD167



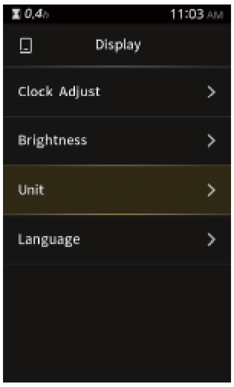
17AZ3CD168

- Manual : Manual setting for LCD brightness.
- Automatic : Automatic control of LCD brightness as set level of Day/Night.
- Setting day time : Set the time for daylight.

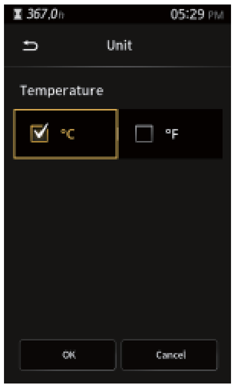
(in figure, black area represents night time while orange shows day time)

③ Unit

17AZ3CD108



17AZ3CD169

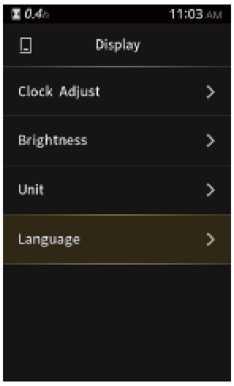


17AZ3CD170

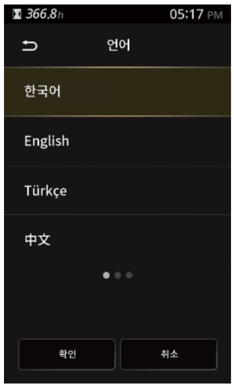
- Temperature : °C ↔ °F

④ Language

17AZ3CD108



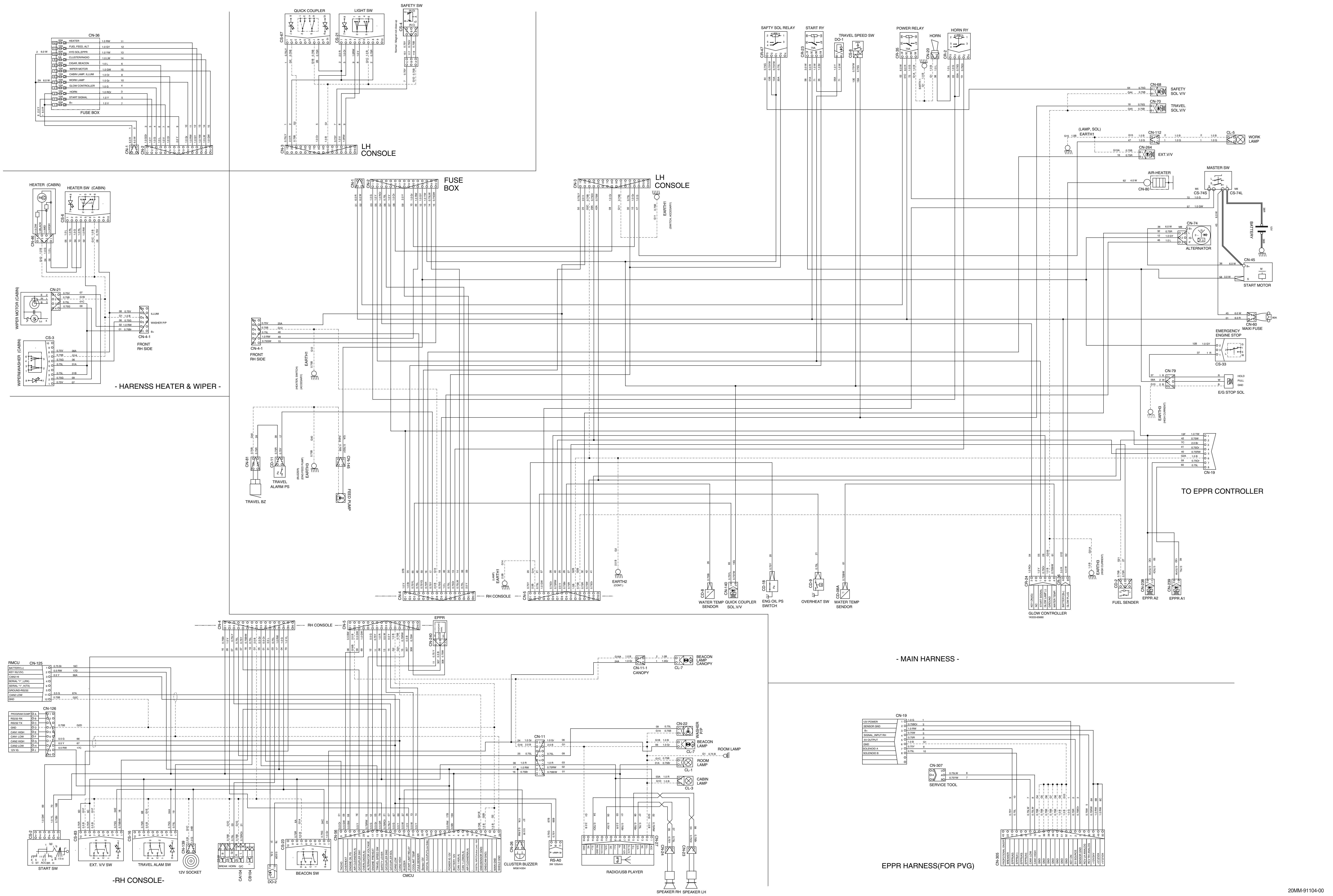
17AZ3CD171



17AZ3CD172

- User can select preferable language and all displays are changed to the selected language (한국어, English, Turkish, etc ; total 12 languages).

· ELECTRICAL CIRCUIT



MEMORANDUM

1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis directly.

When the start switch is in the OFF position, the current flows from the positive battery terminal as shown below.

1) OPERATING FLOW

Battery (B^+) → Master sw [CS-74 (L)] → Maxi puse [CN-60]

- → Start motor [CN-45 (B^+)] → Alternator (CN-74 (B^+))
- → I/conn [CN-1 (1)]
  - → I/conn [CN-2 (5)]
    - → I/conn [CN-4 (1)]
      - → RMCU [CN-125 (1)]
      - → Cluster [CN-56 (1)]
      - → I/conn [CN-11 (1)]
        - → Room lamp [CL-1 (2)]
        - → Radio and USB player [CN-27 (8)]
      - → Start switch [CS-2 (1)]
    - → To EPPR controller [CN-19 (3)]
  - → Horn relay [CR-2 (1, 3)]
- → Power relay [CR-35 (30)]
- → Start relay [CR-23 (30)]

※ I/conn : Intermediate connector

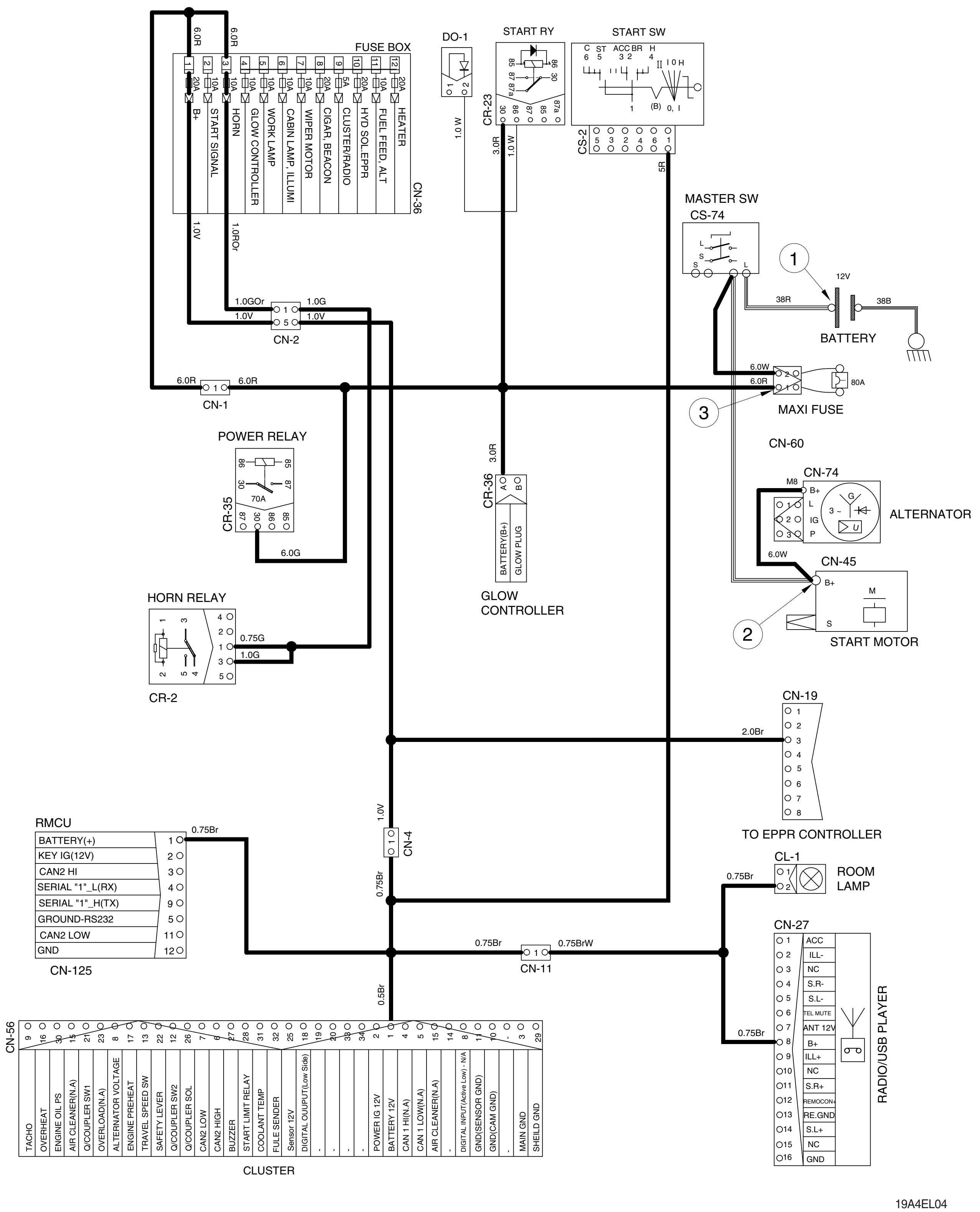
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	OFF	① - GND (Battery) ② - GND (Start motor B^+) ③ - GND (Maxi fuse)	10~12.5 V

※ GND : Ground

※ The circuit diagram may differ from the equipment, so please check before a repair.

POWER CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Master switch [CS-74] → Maxi fuse [CN-60]

→ I/conn [CN-1 (1)] → I/conn [CN-2 (5)] → I/conn [CN-4 (1)] → Start switch [CS-2 (1)]
→ Power relay [CR-35 (30)]
→ Start relay [CR-23 (30)]

(1) Start switch : ON

Start switch [CS-2 (2)] → I/conn [CN-5 (4)] → Master switch [CS-74]
→ Power relay [CR-35 (30) → (87)] → I/conn [CN-1 (2)]
→ Fuse box [all power is supplied with electric component)

(2) Start switch : START

Start switch [CS-2 (6)] → I/conn [CN-4 (15)] → I/conn [CN-2 (8) → Fuse box [No.2]
→ I/conn [CN-2 (2)] → Start relay [CR-23 (30) → (87)] → Start motor [CN-45 (S)]
→ Start motor operating
→ Glow controller [CR-24 (3)]

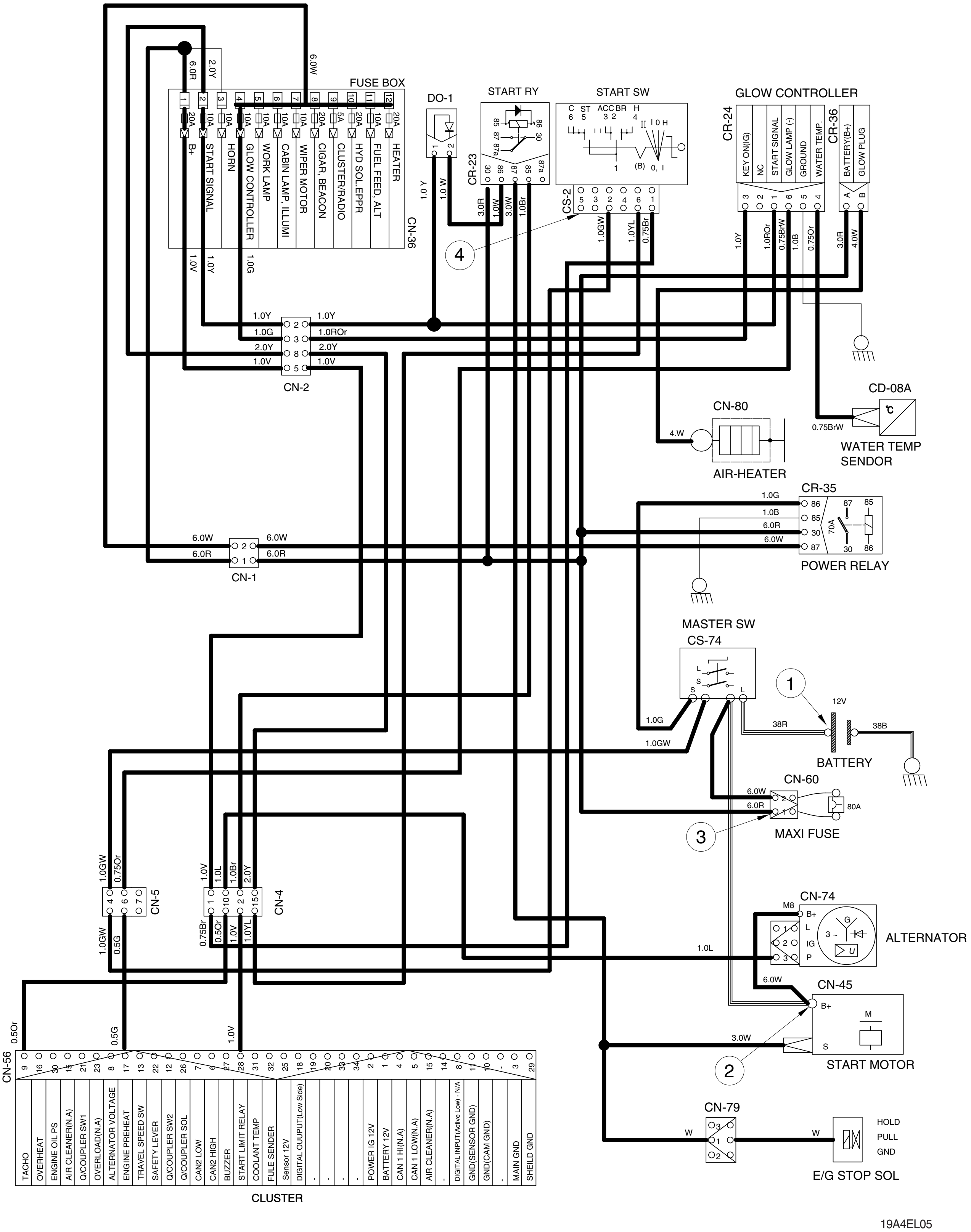
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Operating	START	① − GND (Battery) ② − GND (Start switch) ③ − GND (Start motor B^+) ④ − GND (Start motor S)	10~12.5 V

※ GND : Ground

※ The circuit diagram may differ from the equipment, so please check before a repair.

STARTING CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

3. CHARGING CIRCUIT

When the start motor is activated and the engine is started, the operator releases the start switch to the ON position.

Charging current generated by operating the alternator flows into the battery.

The current also flows from alternator to each electrical component and controller through the fuse box.

1) OPERATING FLOW

(1) Warning flow

Alternator terminal [CN-74 (1)] → I/conn [CN-5 (13)] → Cluster [CN-56 (8)]
→ Cluster warning lamp ON

(2) Charging flow

Alternator terminal [CN-74 (B^+)] → Start motor [CN-45 (B^+)] → Master switch [CS-74]
→ Battery(+) terminal
→ Maxi puse [CN-60] → I/conn [CN-1 (1)] → Fuse box [No. 1, 3]
→ Power relay [CR-35 (30) → (87)] → I/conn [CN-1 (2)]
→ Fuse box [No. 4~12]

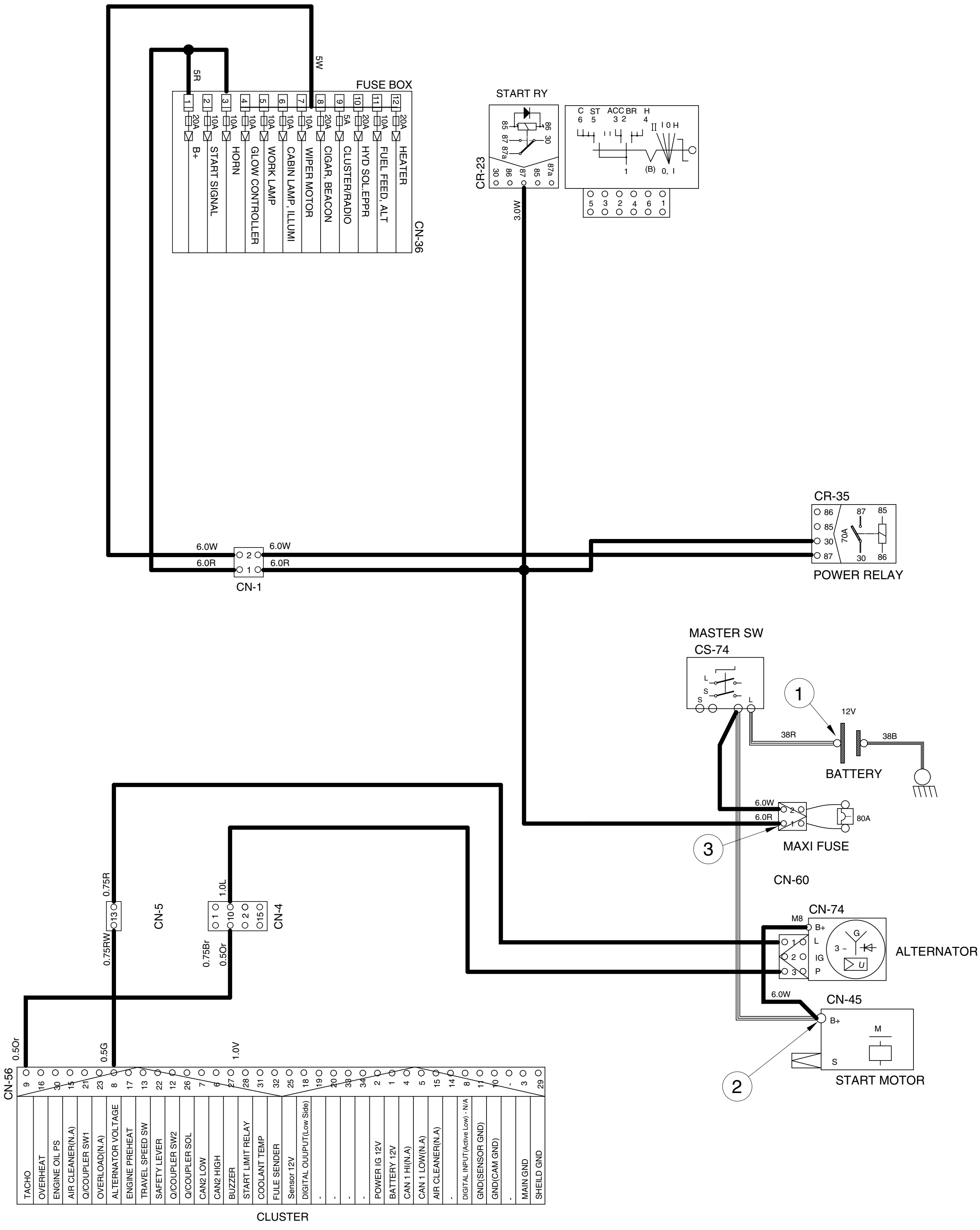
2) CHECK POINT

Engine	Start switch	Check point	Voltage
Operating	ON	① - GND (Battery voltage) ② - GND (Alternator B^+ terminal) ③ - GND (Cluster)	10~12.5 V

※ GND : Ground

※ The circuit diagram may differ from the equipment, so please check before a repair.

CHARGING CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

4. WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.6) → I/conn [CN-2 (6)] → I/conn [CN-3 (8)] → Light switch [CS-21 (2)]
Fuse box (No.5) → I/conn [CN-2 (10)] → I/conn [CN-3 (13)] → Light switch [CS-21 (5)]

(1) Main light switch ON : 1st step

Main light switch ON [CS-21 (2)]
→ Light switch illumination ON [CS-21 (8)]
→ I/conn [CN-3 (2)] → I/conn [CN-5 (8)]
→ I/conn [CN-11 (3)] → Cabin lamp [CL-3 (2)]
→ Radio/USB player [CN-27 (9)]
→ I/conn [CN-4-1 (5)] → Heater switch illumination ON [CS-6 (8)]
→ Wiper & washer illumination ON [CS-3 (8)]
→ Beacon switch illumination ON [CS-23 (8)]
→ Travel alarm switch illumination ON [CS-16 (8)]
→ Extension valve switch illumination ON [CS-83 (8)]

(2) Main light switch ON : 2nd step

Main light switch ON [CS-21 (4)] → I/conn [CN-3 (14)] → I/conn [CN-112 (2)]
→ Work light ON [CL-5 (2)]

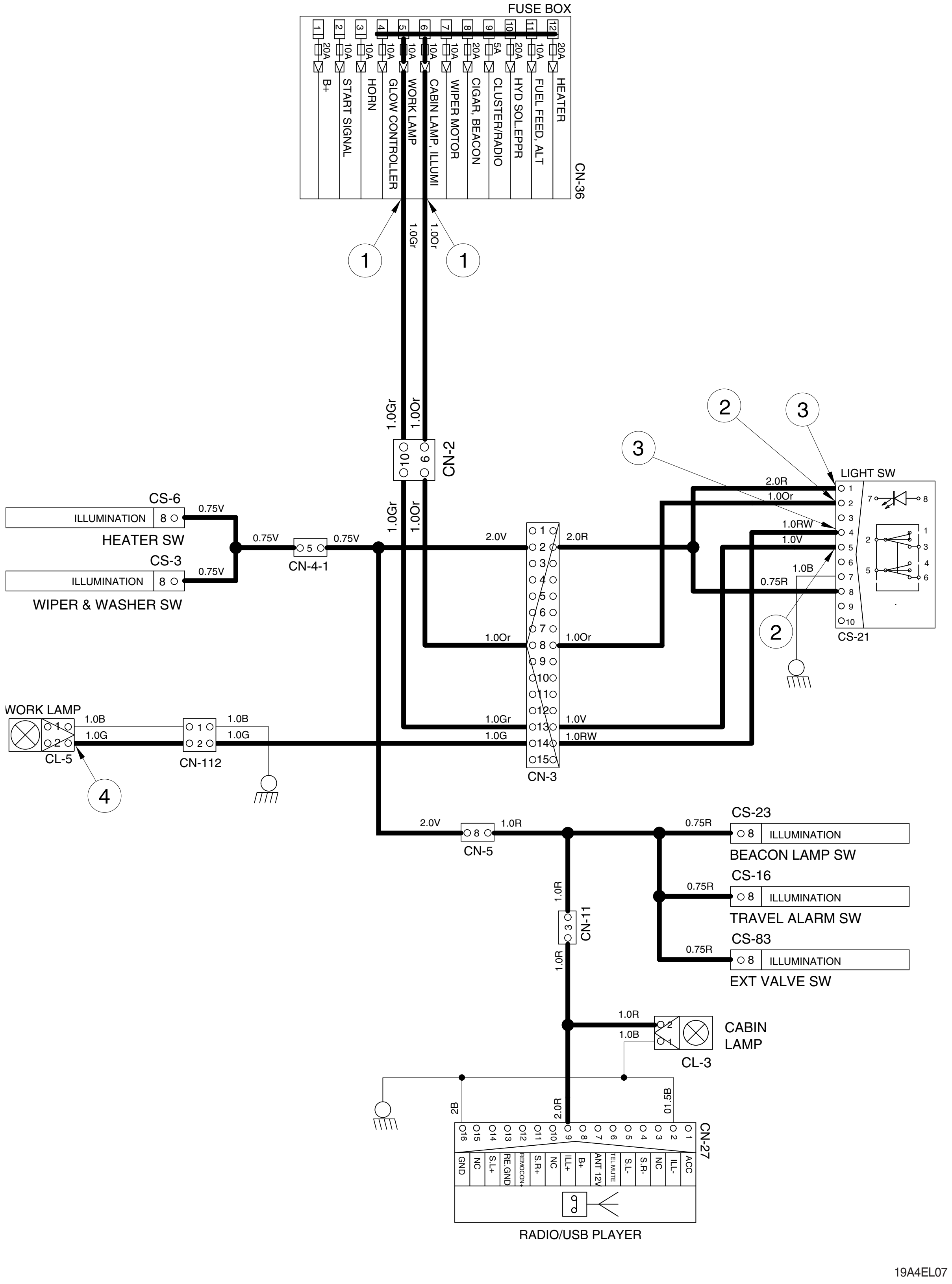
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① － GND (Fuse box) ② － GND (Switch power input) ③ － GND (Switch power output) ④ － GND (Work light)	10~12.5 V

※ GND : Ground

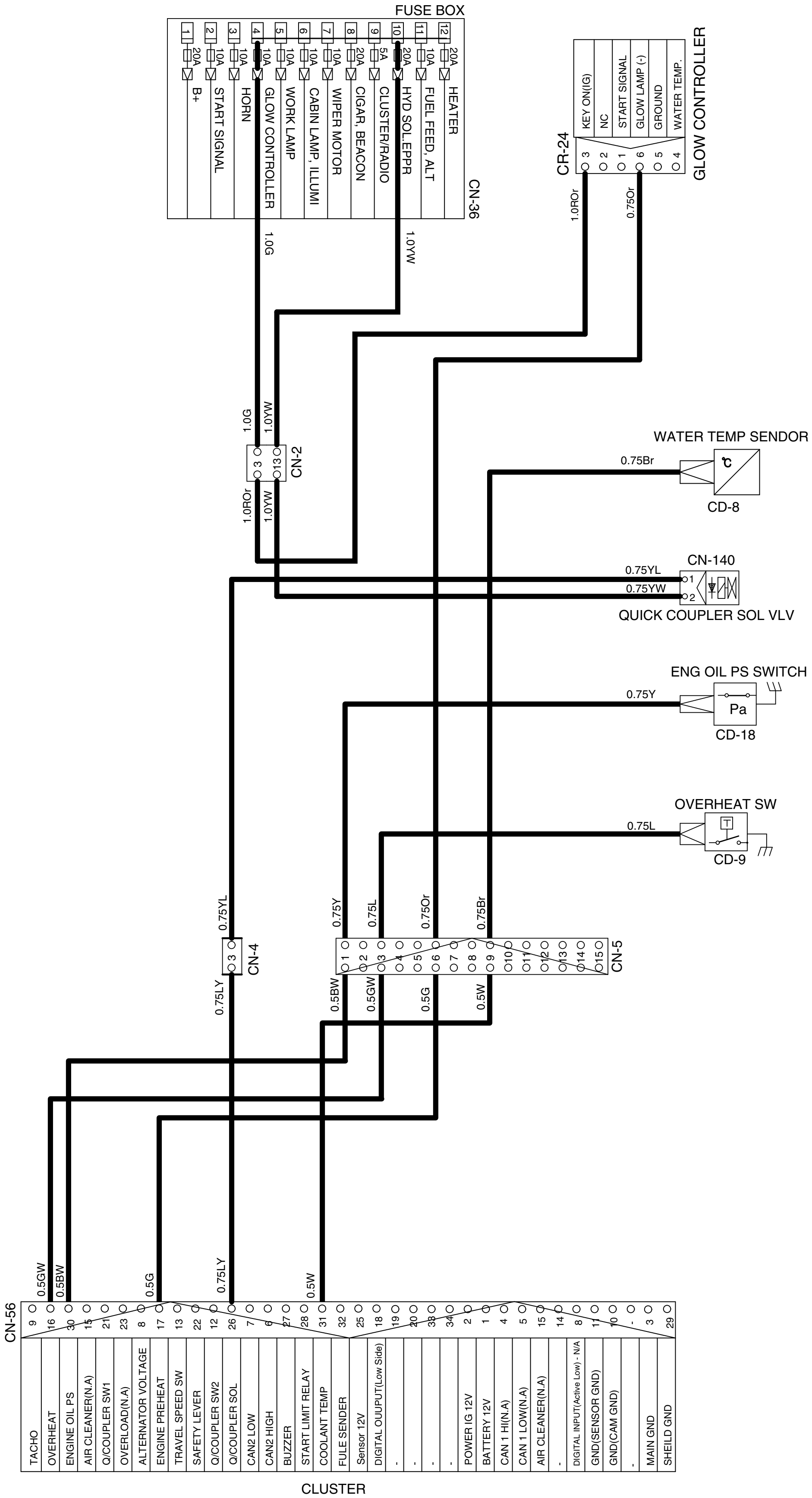
※ The circuit diagram may differ from the equipment, so please check before a repair.

WORK LAMP CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

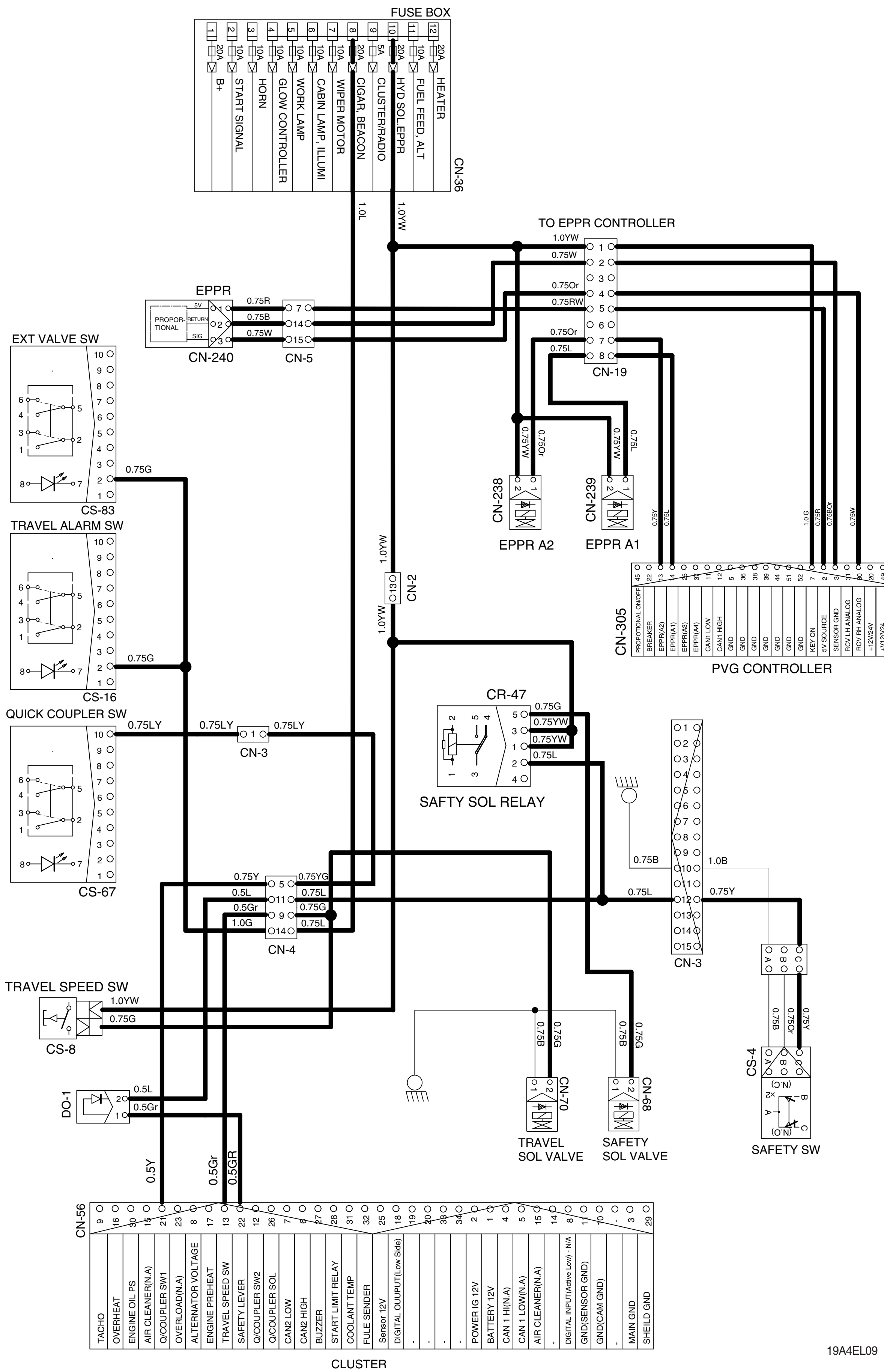
MONITORING CIRCUIT



19A4EL08

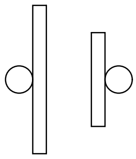
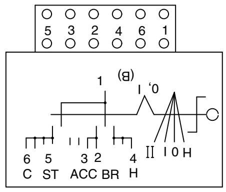
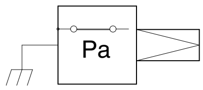
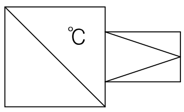
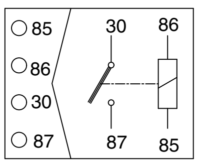
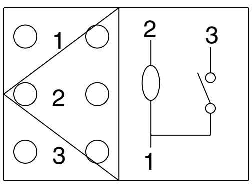
※ The circuit diagram may differ from the equipment, so please check before a repair.

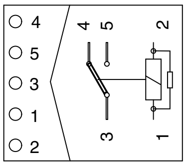
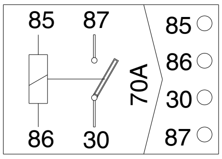
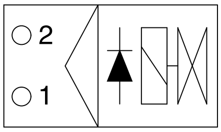
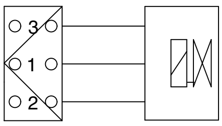
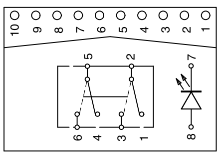
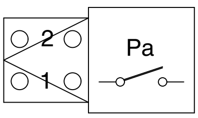
ELECTRIC CIRCUIT FOR HYDRAULIC

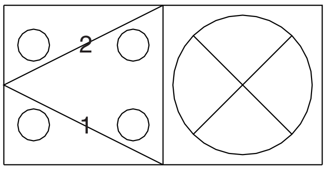
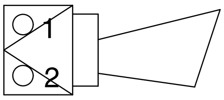
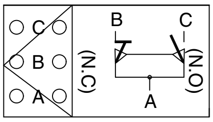
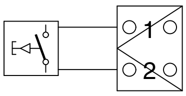
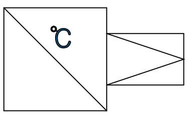
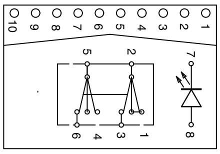


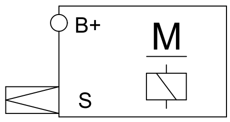
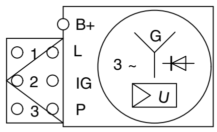
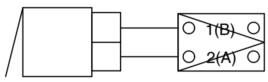
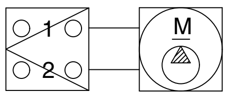
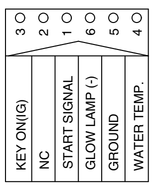
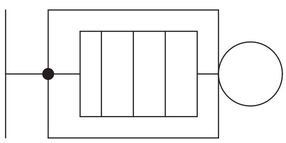
※ The circuit diagram may differ from the equipment, so please check before a repair.

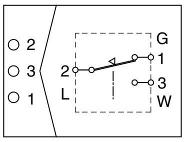
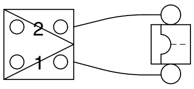
GROUP 4 ELECTRICAL COMPONENT SPECIFICATION

Part name	Symbol	Specification	Check
Battery		12V × 80Ah	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Start switch	 CS-2	12V	※Check contact OFF : ∞Ω (for each terminal) ON : 0Ω (for terminal 1-2) START : 0Ω (for terminal 1-6)
Pressure switch (for engine oil)	 CD-18	0.5 kgf/cm^2 (N.C TYPE)	※ Check resistance Normal : 0Ω (CLOSE)
Water temp sendor	 CD-08A	Pressure: 635 mmH_2O (N.O TYPE)	-
Start relay	 CR-23	12V 60A	※ Rated coil current 1.2±0.3A
Fuel sender	 CD-2	-	※ Check resistance Full : 30Ω Low : 100Ω Empty warning : 200Ω

Part name	Symbol	Specification	Check
Horn relay	 CR-2	12V 20A	※ Check resistance Normal : About 200Ω (for terminal 1-3) : 0Ω (for terminal 2-4)
Power relay	 CR-35	12V 70A	※ Rated coil current 1.2±0.3 A
Solenoid valve	 CN-68 CN-70 CN-140 CN-238 CN-239 CN-264	12V 1A	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
Solenoid valve (engine stop)	 CN-79	12V	※Coil resistance : 1.8Ω
Switch (looking type)	 CS-16 CS-23 CS-83	12V 16A	※ Check contact Normal OFF - ∞Ω (for terminal 2-1) - 0Ω (for terminal 2-3)
Pressure switch	 CD-11	10bar (N.O type)	※ Check contact Normal : 0.1Ω

Part name	Symbol	Specification	Check
Work lamp	 CL-5	12V 55W (H3 TYPE) 12V LED (opt)	※ Check disconnection Normal : 1.2Ω
Horn	 CN-20	12V 6A	132±5 dB
Safety switch	 CS-4	Micro 12V 15A	※ Check contact Normal : 0Ω Operating : ∞Ω
Horn switch	 CS-5	12V 10A	※ Check contact Normal : 0Ω
Water temp sender	 CD-8	-	※ Check contact 50°C : 0.748~0.904Ω 67°C : 0.538~0.650Ω 102°C : 0.185~0.167Ω 110°C : 0.143~0.130Ω 135°C : 0.076~0.100Ω
Light switch	 CS-21	12V 16A	※Check contact Normal : ∞Ω

Part name	Symbol	Specification	Check
Start motor	 CN-45	12V 1.2kW	※ Check contact Normal : 0.1Ω
Alternator	 CN-74	12V 40A	※ Check contact Normal : 0Ω (For terminal B^+-1) Normal : 10 ~ 12.5V
Travel alarm	 CN-81	12V	-
Fuel feed pump	 CN-145	12V	-
Glow controller	 CR-24	12V	-
Air-heater	 CN-80	12V 42A 500W	-

Part name	Symbol	Specification	Check
Emergency engine stop	 CS-33	12V	-
Maxi fuse	 CN-60	80A	-

GROUP 5 CONNECTORS

1. CONNECTOR DESTINATION

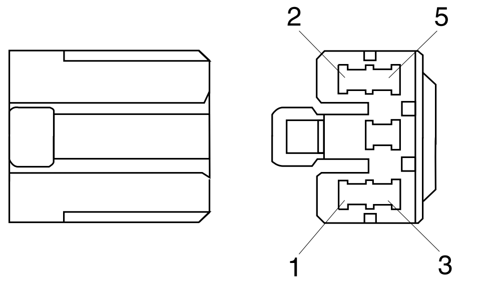
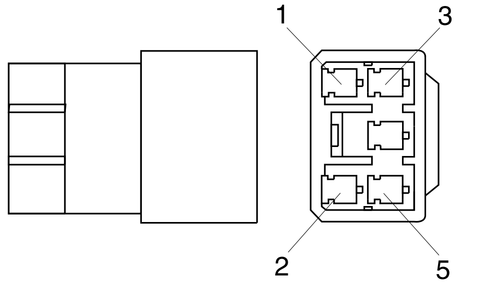
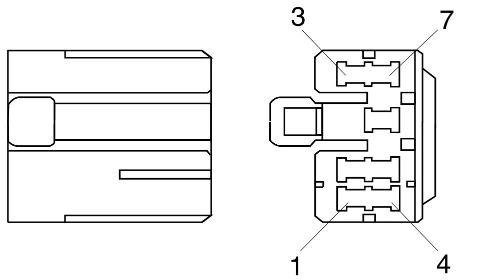
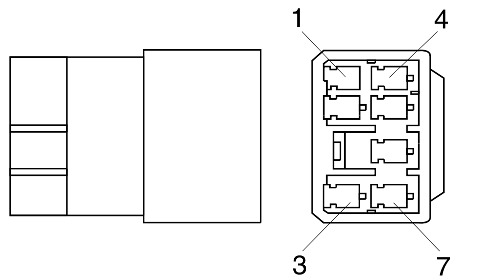
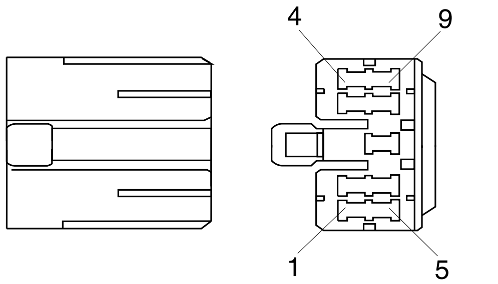
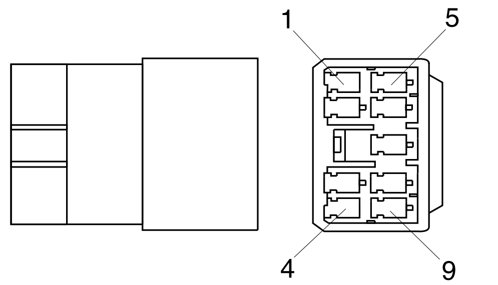
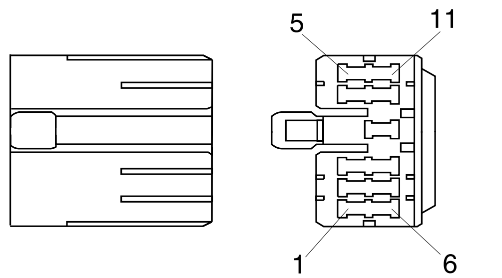
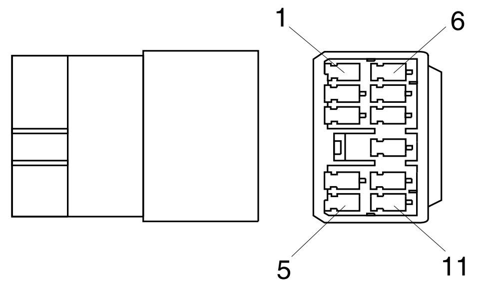
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	KET	1	I/conn (Main harness-fuse harness)	MG610557	MG620558
CN-2	AMP	15	I/conn (Main harness-fuse harness)	2-85262-1	368301-3
CN-3	AMP	16	I/conn (LH console harness-main harness)	368047-1	-
CN-4	AMP	16	I/conn (RH console harness-main harness)	368047-1	368050-1
CN-4-1	AMP	6	I/conn (Upper harness-washer harness)	174262-2	174264-2
CN-5	AMP	16	I/conn (Main harness-RH console harness)	368047-1	368050-1
CN-11	AMP	8	I/conn (RH console harness-cab harness)	174982-2	174984-2
CN-11-1	AMP	2	I/conn (Upper harness-beacon harness)	174352-2	174354-2
CN-19	TE	8	To EPPR harness	174982-2	174984-2
CN-20	DEUTSCH	2	Horn	DT06-2S	-
CN-21	AMP	4	Wiper moter	180900-0	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-26	KET	5	Buzzer	MG614354	-
CN-27	-	16	Radio & USB player	PK145-16017	-
CN-36	-	-	Fuse box	F12 890 010	-
CN-45	YAZAKI	1	Start motor	7123-2115	-
CN-45	KET	1	Start motor B+	S820-208000	-
CN-46	AMP	-	Heater	180900-0	-
CN-56	-	34	CMCU	4-1437290-0	-
CN-60	-	-	Maxi fuse	03.21000	03.01080
CN-68	DEUTSCH	2	Safety solenoid valve	DT06-2S	-
CN-70	DEUTSCH	2	Travel speed solenoid valve	DT06-2S	-
CN-74	SUMITOMO	3	Alternator	6189-0443	-
CN-74	KET	1	Alternator B+	S820-306000	-
CN-79	KET	3	Engine stop solenoid	MG610045	-
CN-80	KET	1	Air heater	S820-104000	-
CN-81	KET	2	Travel buzzer	MG610320	-
CN-112	DEUTSCH	2	I/conn (Upper harness-boom harness)	-	DT04-2P-E005
CN-112	DEUTSCH	2	To work lamp	DT06-2S	-
CN-116	-	1	Quick coupler switch	-	CA104
CN-125	DEUTSCH	12	GPS telematics	DT06-12S	-
CN-126	AMP	10	RS232 connect	174655-2	174657-2
CN-139	AMP	2	12V socket	172434-2	-

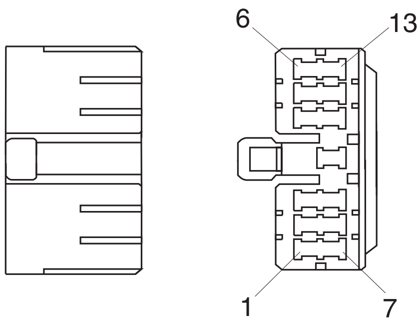
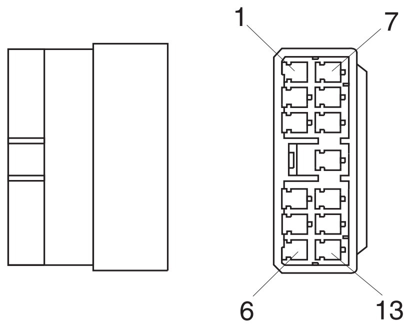
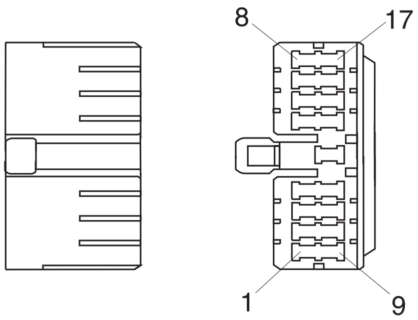
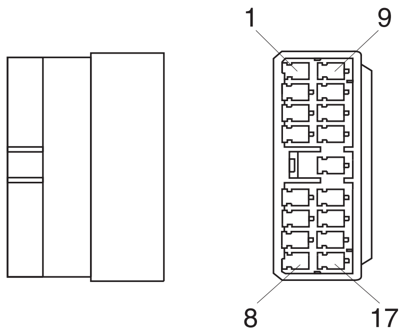
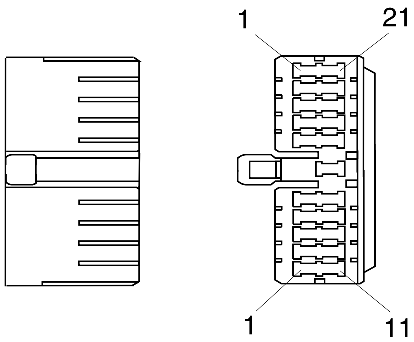
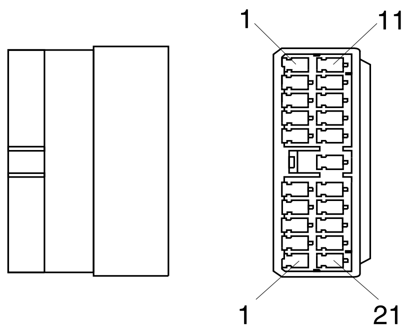
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-140	DEUTSCH	2	Quick coupler solenoid valve	DT06-2S	DT04-2P
CN-145	TE	2	Fuel feed pump	174198-1	-
CN-238	DEUTSCH	2	EPPR solenoid LH	DT06-2S	DT04-2P
CN-239	DEUTSCH	2	EPPR solenoid RH	DT06-2S	DT04-2P
CN-240	DEUTSCH	3	EPPR	DT06-3S-EP06	-
CN-264	DEUTSCH	2	Extention valve	DT06-2S	DT06-2P
CN-305	REXROTH	56	EPPR controller	1-928-405-16	-
CN-307	DEUTSCH	3	Service tool	DT06-3S	DT04-3P
LAMP					
CL-1	KET	2	Room lamp	MG610392	-
CL-2	AMP	3	Cigar	174200-1	-
CL-3	DEUTSCH	2	Cab lamp	DT06-2S	-
CL-5	DEUTSCH	1	Boom lamp	DT06-2S-EP06	-
CL-7	DEUTSCH	2	Beacon lamp	DT06-2S-EP06	-
RELAY					
CR-2	AMP	5	Horn relay	VCFM-1002	-
CR-23	KET	4	Start relay	MG612017-5	-
	YAZAKI			7323-2446	-
CR-24	SUMITOMO	6	Glow controller relay	6195-0021	-
CR-35	KET	4	Power relay	MG612017-5	-
CR-36	SUMITOMO	2	Glow controller	6195-0060	-
CR-47	AMP	5	Safety solenoid relay	VCFM1002	-
SENSOR					
CD-2	AMP	2	Fuel sender	17435942-2	-
CD-8	TE	1	Water temp sender	171809-2	-
CD-08A	TE	1	Water temp sender	171809-2	-
CD-9	TE	1	Overheat switch	172320-2	-
CD-11	KET	2	Travel alarm pressure switch	MG640795	-
CD-18	KET	1	Engine oil pressure switch	S820-104000	-
DO-01	-	2	Diode	21EA-50550	-
DO-02	-	2	Diode	21EA-50550	-
SWITCH					
CS-2	KET	6	Start switch	MG610335	-
CS-3	CARLING	10	Wiper & washer harness	21HN-56300	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E005
CS-6	CARLING	10	Heater switch	21HN-56300	-
CS-8	KET	1	Travel speed switch	CB104	CA104

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-16	SWF	10	Travel alarm switch	583757	-
CS-21	CARLING	10	Light switch	21HN-56300	-
CS-23	SWF	10	Beacon switch	583757	-
CS-33	TE	6	Emergency engine stop switch	174262-2	-
CS-67	CARLING	10	Quick coupler switch	21HN-56300	-
CS-74	KET	1	Mater switch-S	S820-306000	-
CS-74	KET	1	Mater switch-L	S820-210000	-
CS-83	SWF	10	Extention valve switch	583757	-

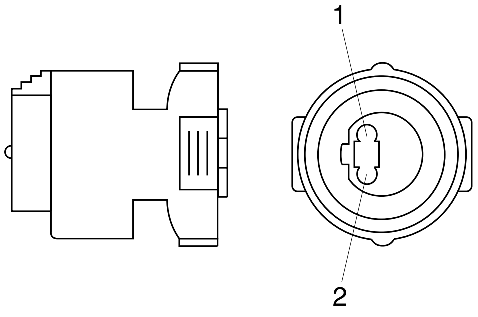
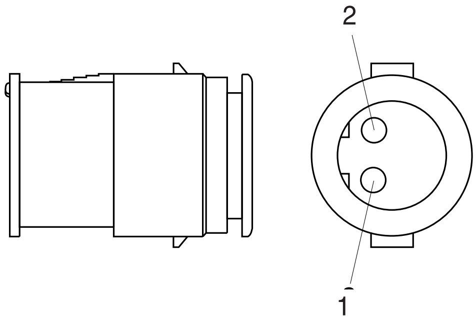
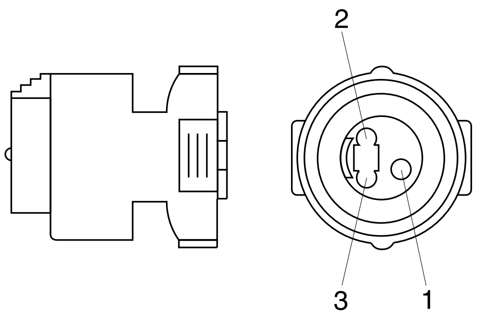
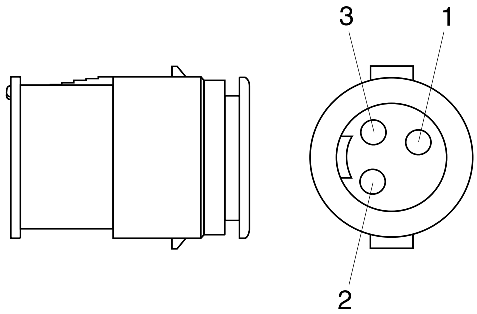
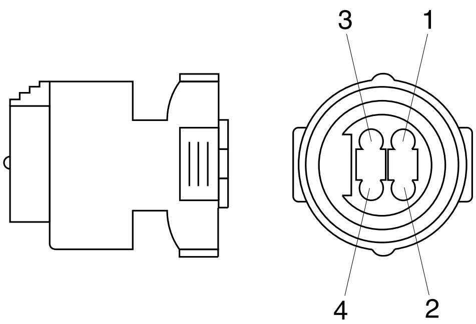
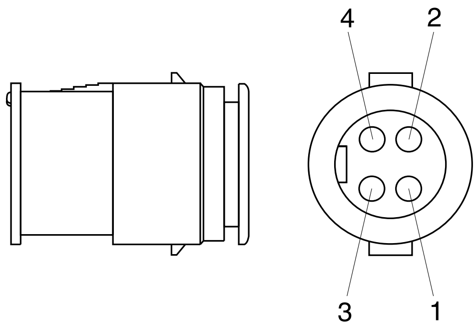
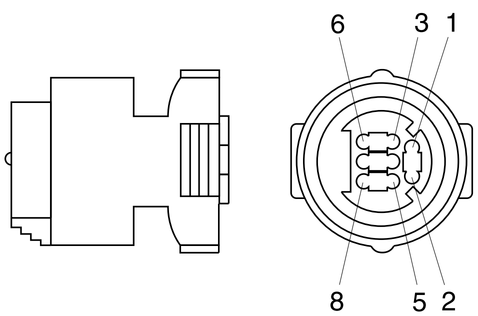
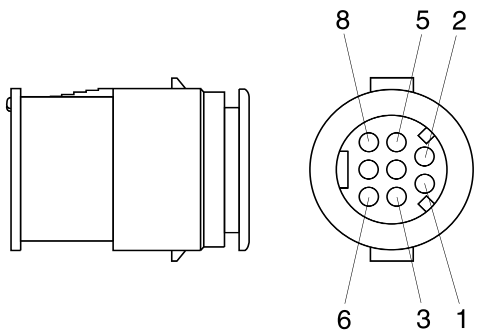
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

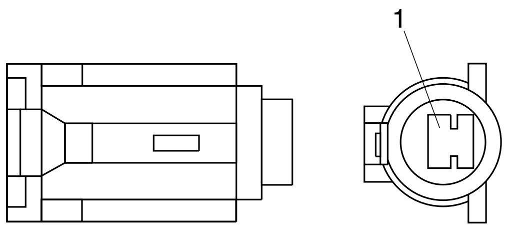
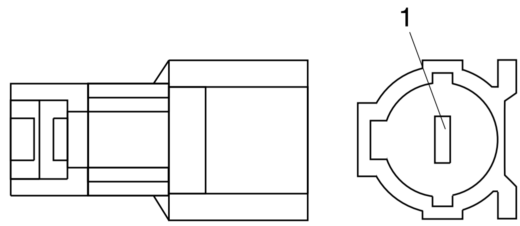
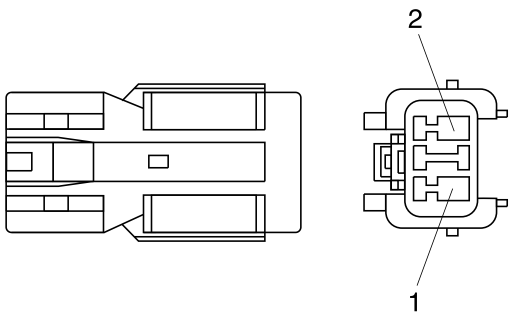
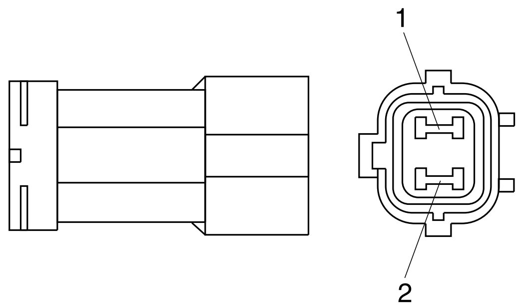
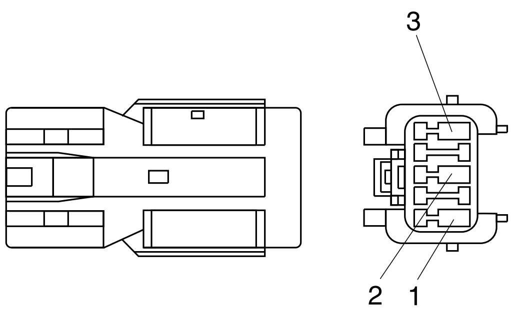
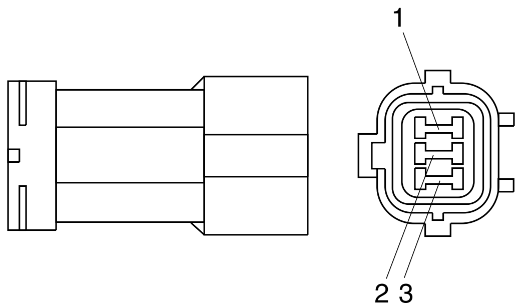
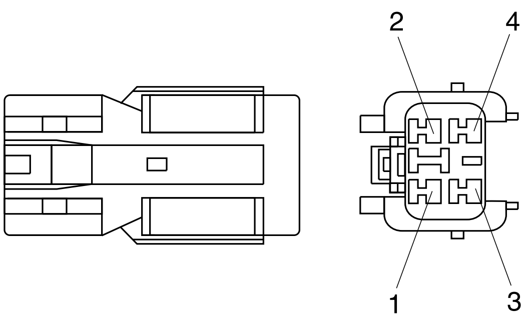
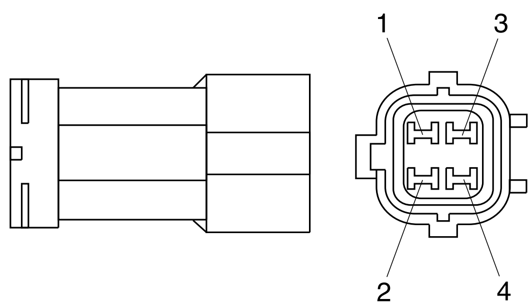
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

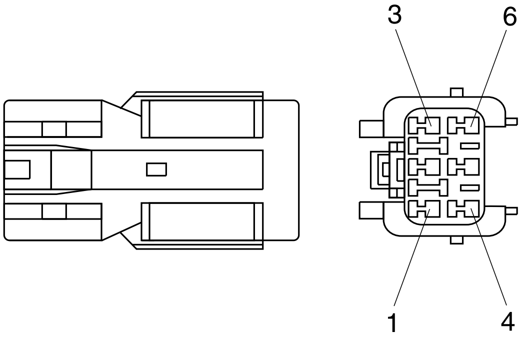
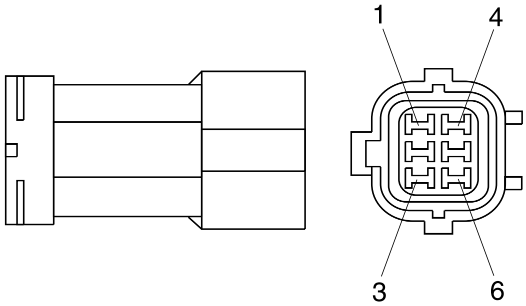
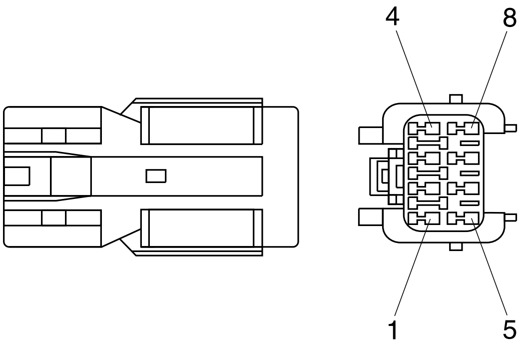
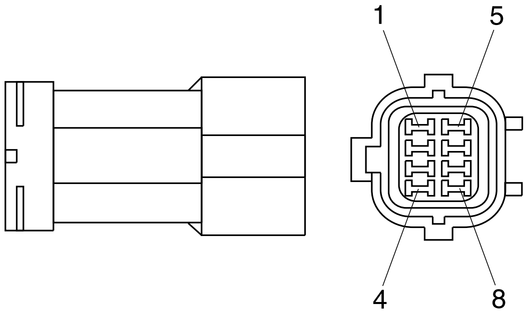
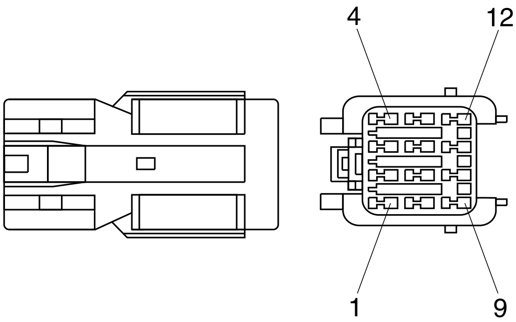
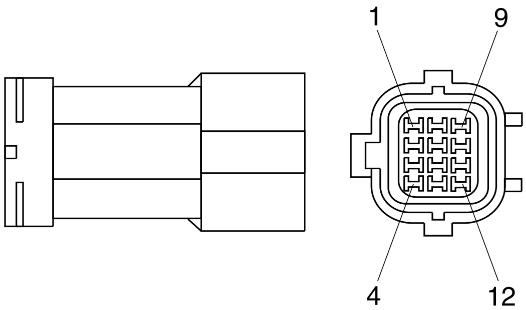
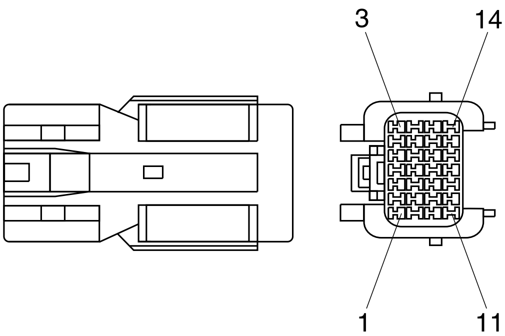
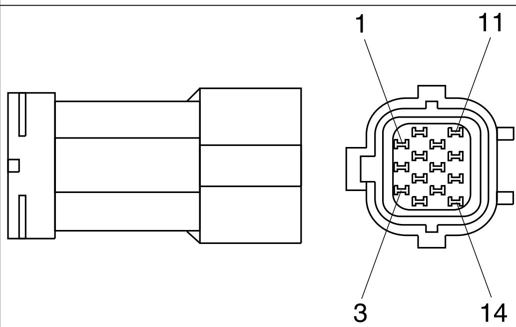
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

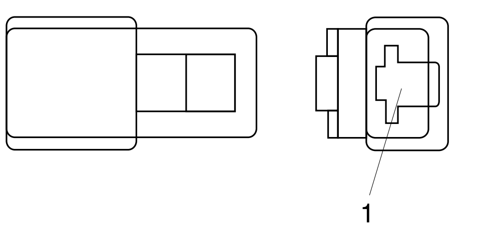
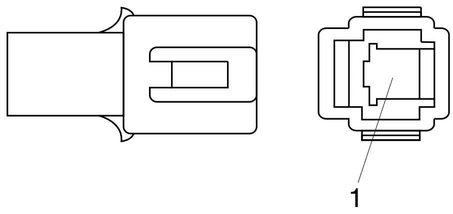
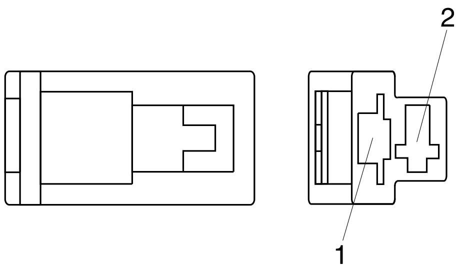
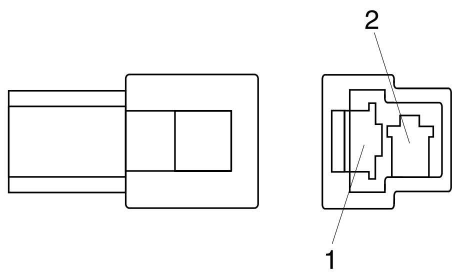
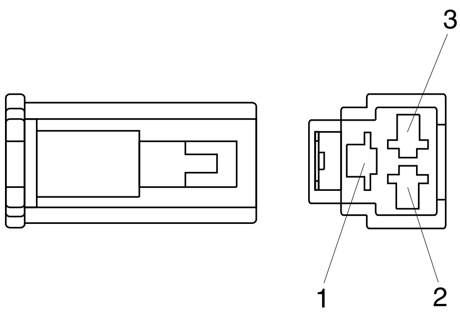
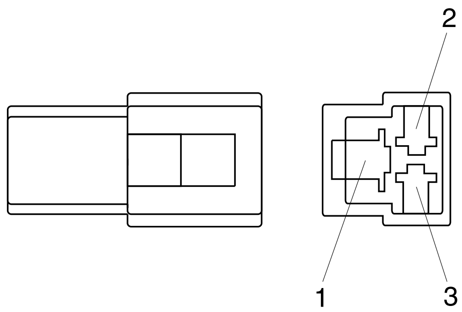
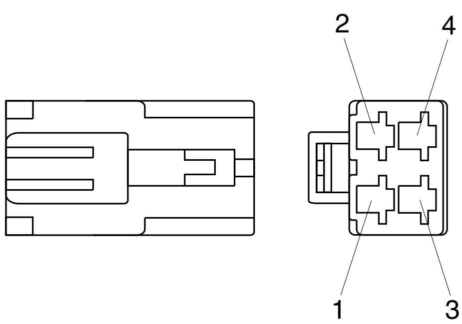
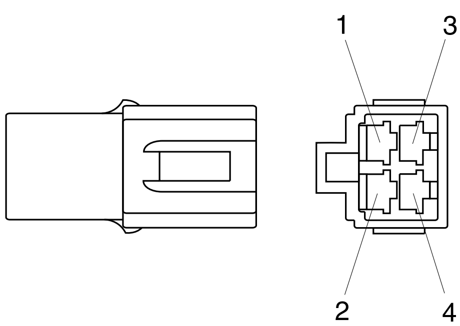
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

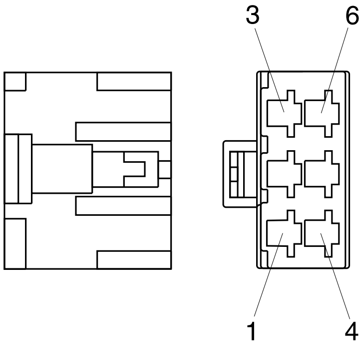
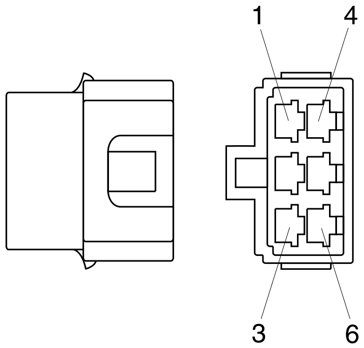
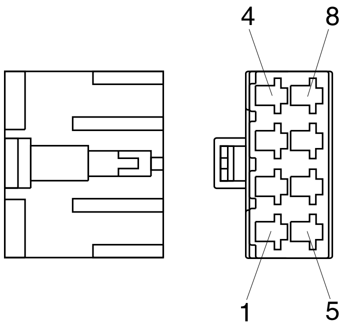
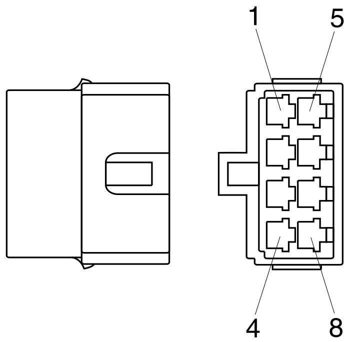
3) SWP TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S814-001000	 S814-101000
2	 S814-002000	 S814-102000
3	 S814-003000	 S814-103000
4	 S814-004000	 S814-104000

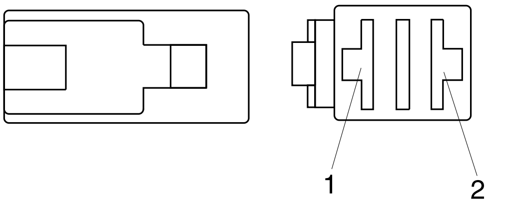
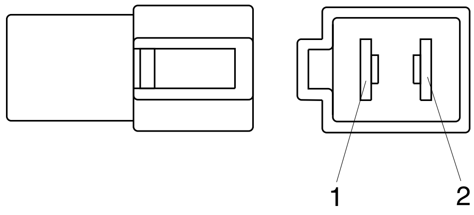
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

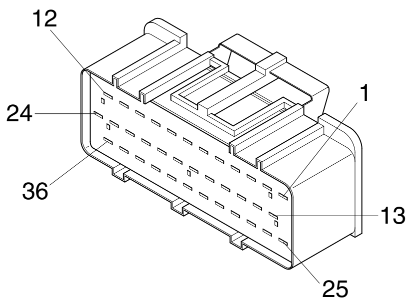
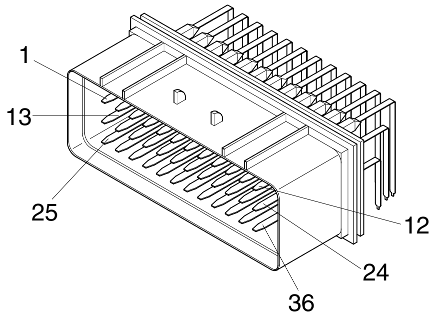
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S810-006202	 S810-106202
8	 S810-008202	 S810-108202

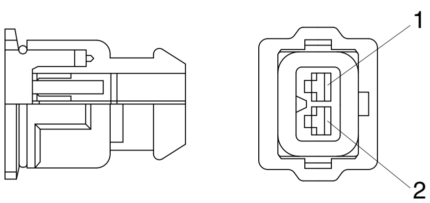
5) 375 FASTEN TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S810-002402	 S810-102402

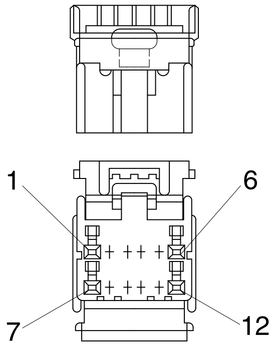
6) AMP ECONOSEAL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
36	 344111-1	 344108-1

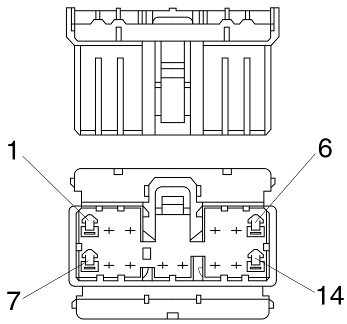
7) AMP TIMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 85202-1	

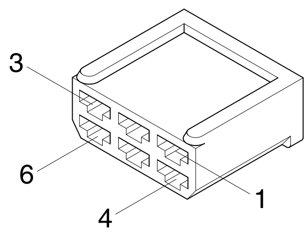
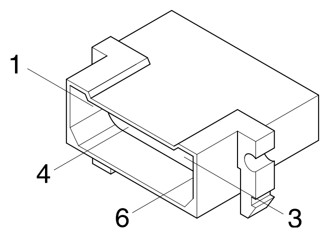
8) AMP 040 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
12	 174045-2	

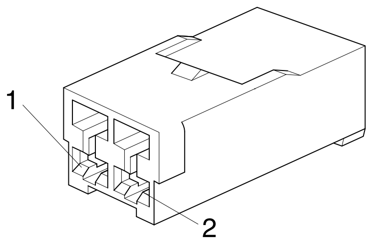
9) AMP 070 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
14	 173852	

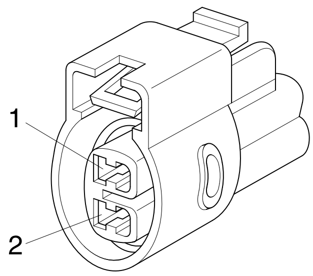
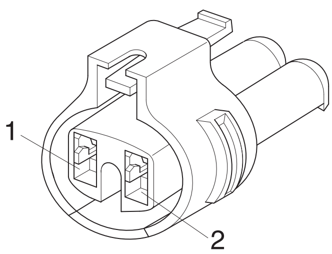
10) AMP FASTIN - FASTON CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 925276-0	 480003-9

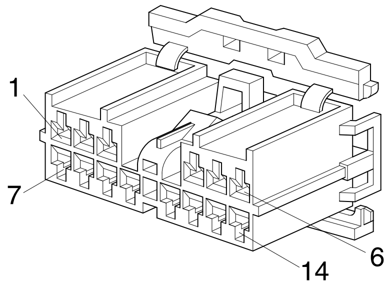
11) KET 090 CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 MG610070	

12) KET 090 WP CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 MG640605	
2	 MG640795	

13) KET SDL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
14	 MG610406	

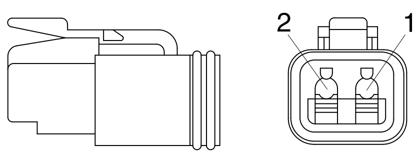
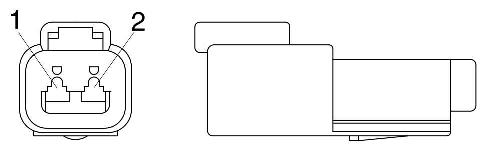
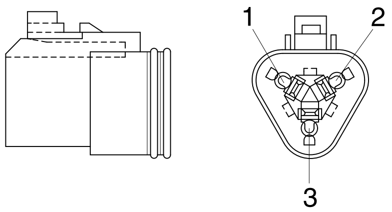
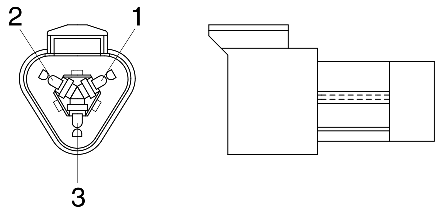
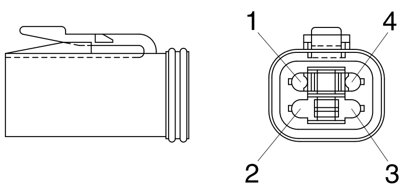
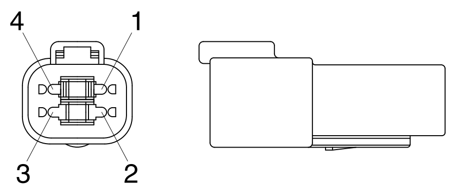
14) DEUTSCH DT CONNECTORS

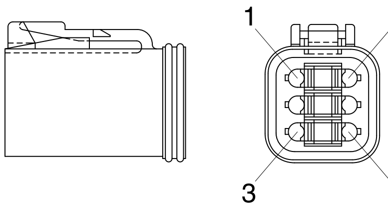
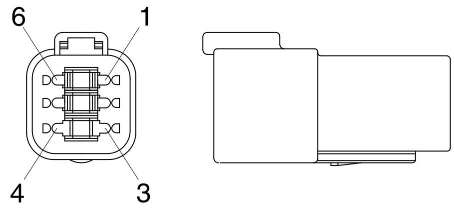
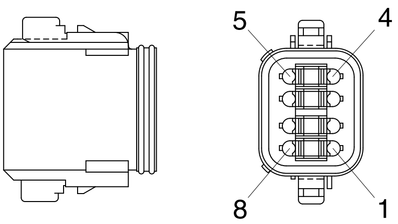
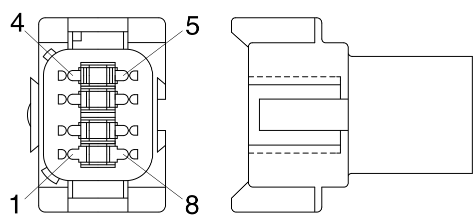
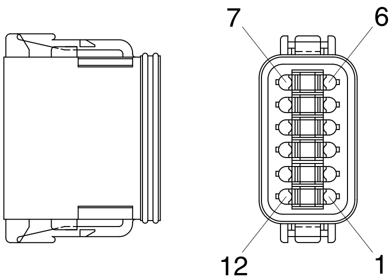
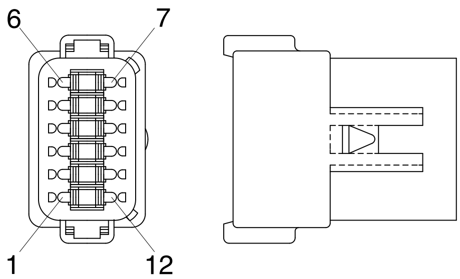
DT 06 - 3S - ★★★★

- ★★★★ : Modifications (See below)
- 3S : Number of contacts (P : Pin, S : Socket)
- 06 : 06 : Receptacle, 04 : Plug
- DT : Deutsch connectors

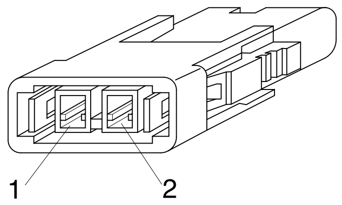
※ Modification

E003 : Standard end cap - gray
E004 : Color of connector to be black
E005 : Combination - E004 & E003
EP04 : End cap
EP06 : Combination P012 & EP04
P012 : Front seal enhancement - connectors color to black for 2, 3, 4 & 6pin

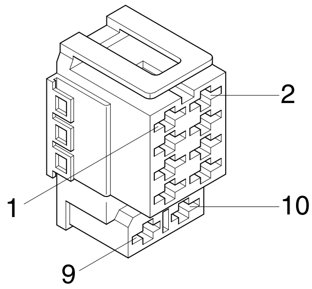
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 DT06-6S	 DT04-6P
8	 DT06-8S	 DT04-8P
12	 DT06-12S	 DT04-12P

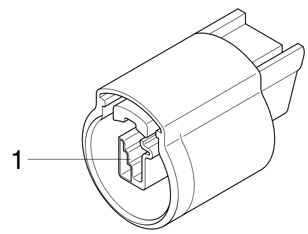
15) MOLEX 2CKTS CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 35215-0200	

16) ITT SWF CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

17) MWP NMWP CONNECTOR

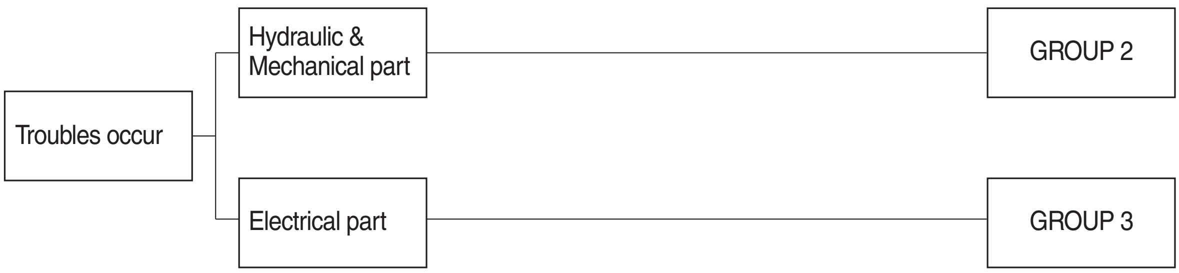
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 NMWP01F-B	

SECTION 5 TROUBLESHOOTING

GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

When a trouble is occurred in the machine, this section will help an operator to maintain the machine with easy.
The trouble of machine is parted Hydraulic & Mechanical system and Electrical system.
At each system part, an operator can check the machine according to the troubleshooting process diagram.

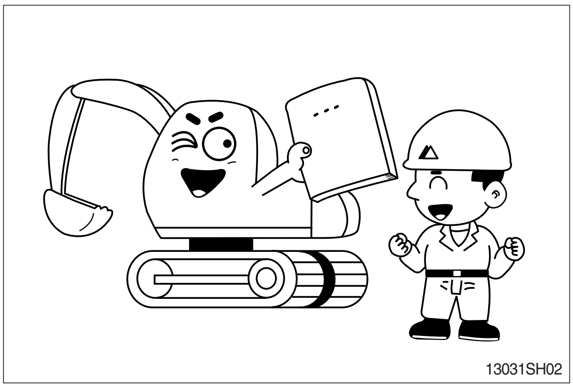


2. DIAGNOSING PROCEDURE

To carry out troubleshooting efficiently, the following steps must be observed.

STEP 1. Study the machine system

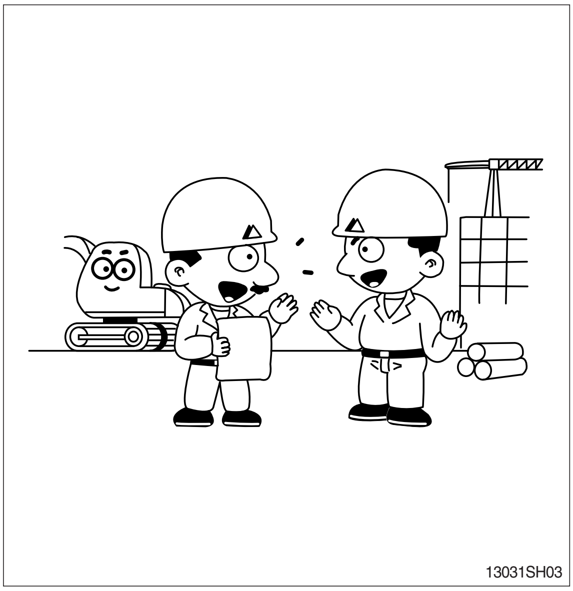
Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.
Especially, deepen the knowledge for the related parts of the trouble.



STEP 2. Ask the operator

Before inspecting, get the full story of malfunctions from a witness --- the operator.

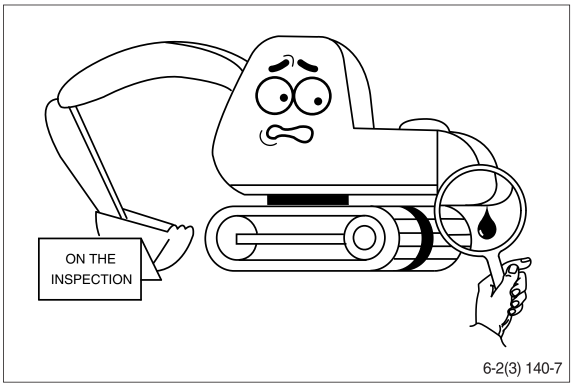
1) How the machine is used and when it is serviced?
2) When the trouble was noticed and what work the machine was doing at that time?
3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
4) Did the machine have any troubles previously? If so, which parts were repaired before.



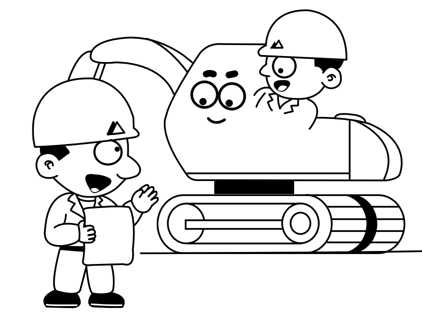
STEP 3. Inspect the machine

Before starting troubleshooting, check the machine for the daily maintenance points as shown in the operator's manual.

And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.

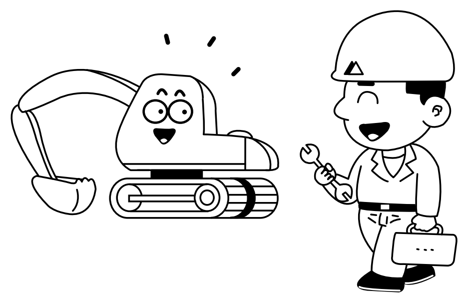


STEP 4. Inspect the trouble actually on the machine


6-3(1) 140-7

In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.

STEP 5. Perform troubleshooting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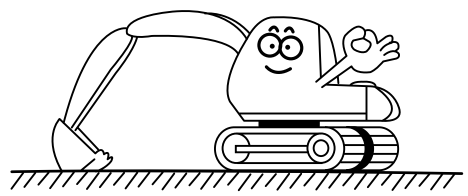
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.

STEP 6. Trace a cause


6-3(3) 140-7

Before reaching a conclusion, check the most suspectible causes again. Try to trace what the real cause of the trouble is.

Make a plan of the appropriate repairing procedure to avoid consequential malfunctions.

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

(1) If even a minor fault is left intact and operation is continued, a fatal failure may be caused, entailing a large sum of expenses and long hours of restoration.
Therefore when even a small trouble occurs, do not rely on your intuition and experience, but look for the cause based on the troubleshooting principle and perform maintenance and adjustment to prevent major failure from occurring. Keep in mind that a fault results from a combination of different causes.

(2) The following lists up commonly occurring faults and possible causes with this machine. For the troubleshooting of the engine, refer to the coming troubleshooting and repair.

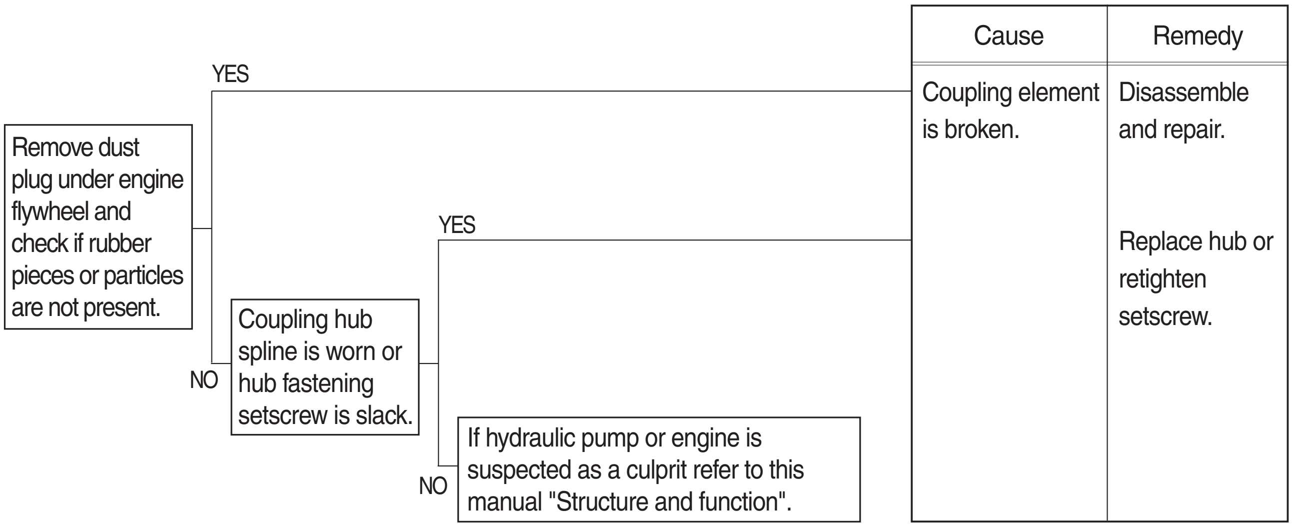
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(4) Ask user or operator the following.
① Was there any strange thing about machine before failure occurred?
② Under what conditions did the failure occur?
③ Have any repairs been carried out before the failure?

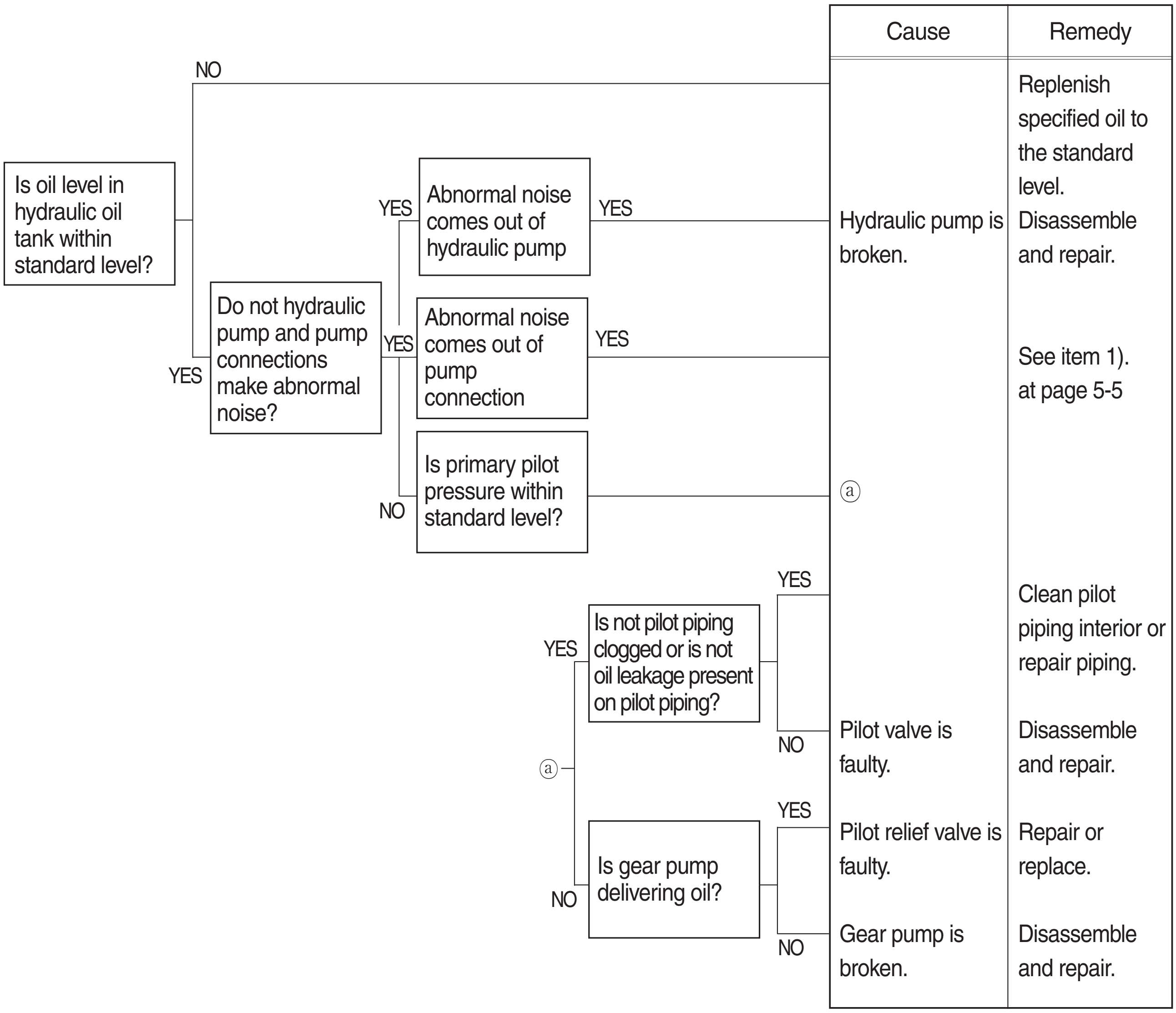
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

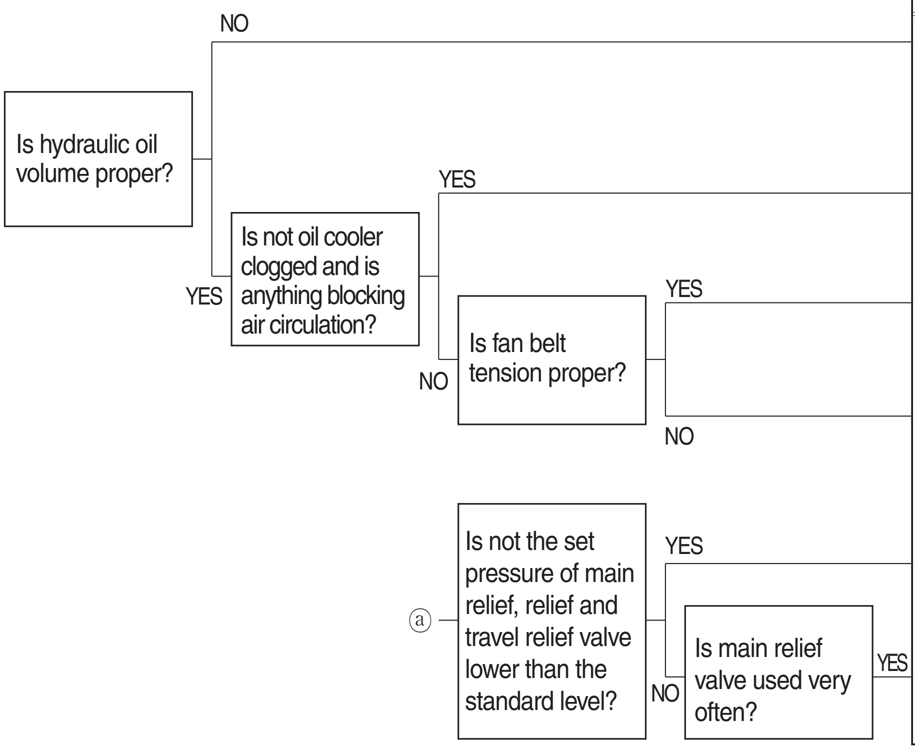


3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY

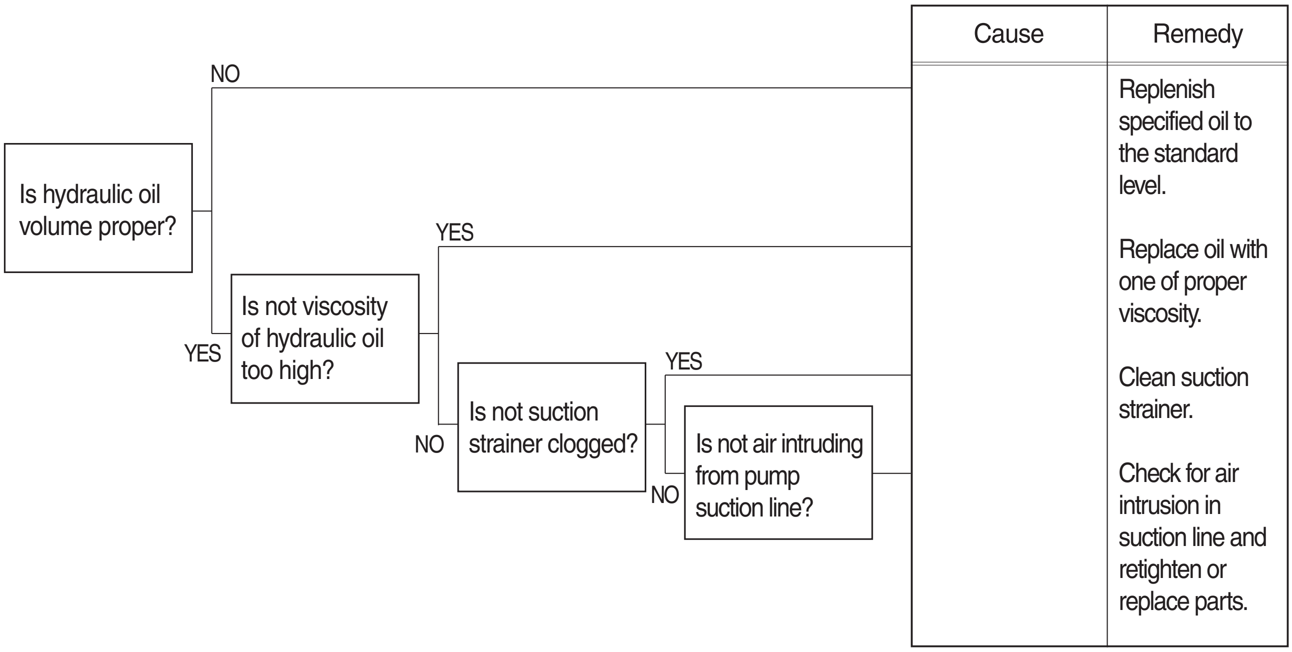
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY

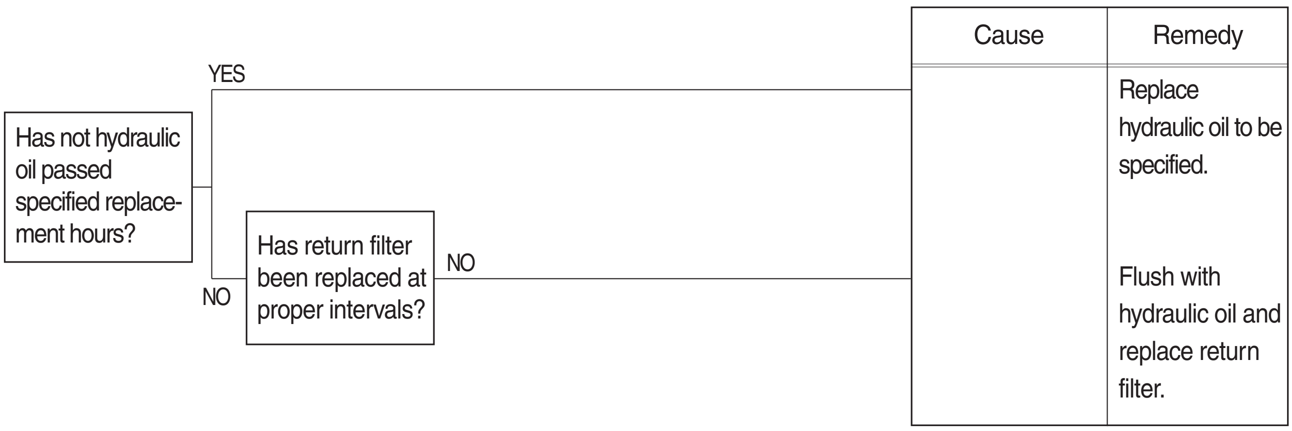


Cause	Remedy
	Replenish specified oil to the standard level.
	Clean oil cooler. Secure air circulation route.
ⓐ	
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

3) CAVITATION OCCURS WITH PUMP

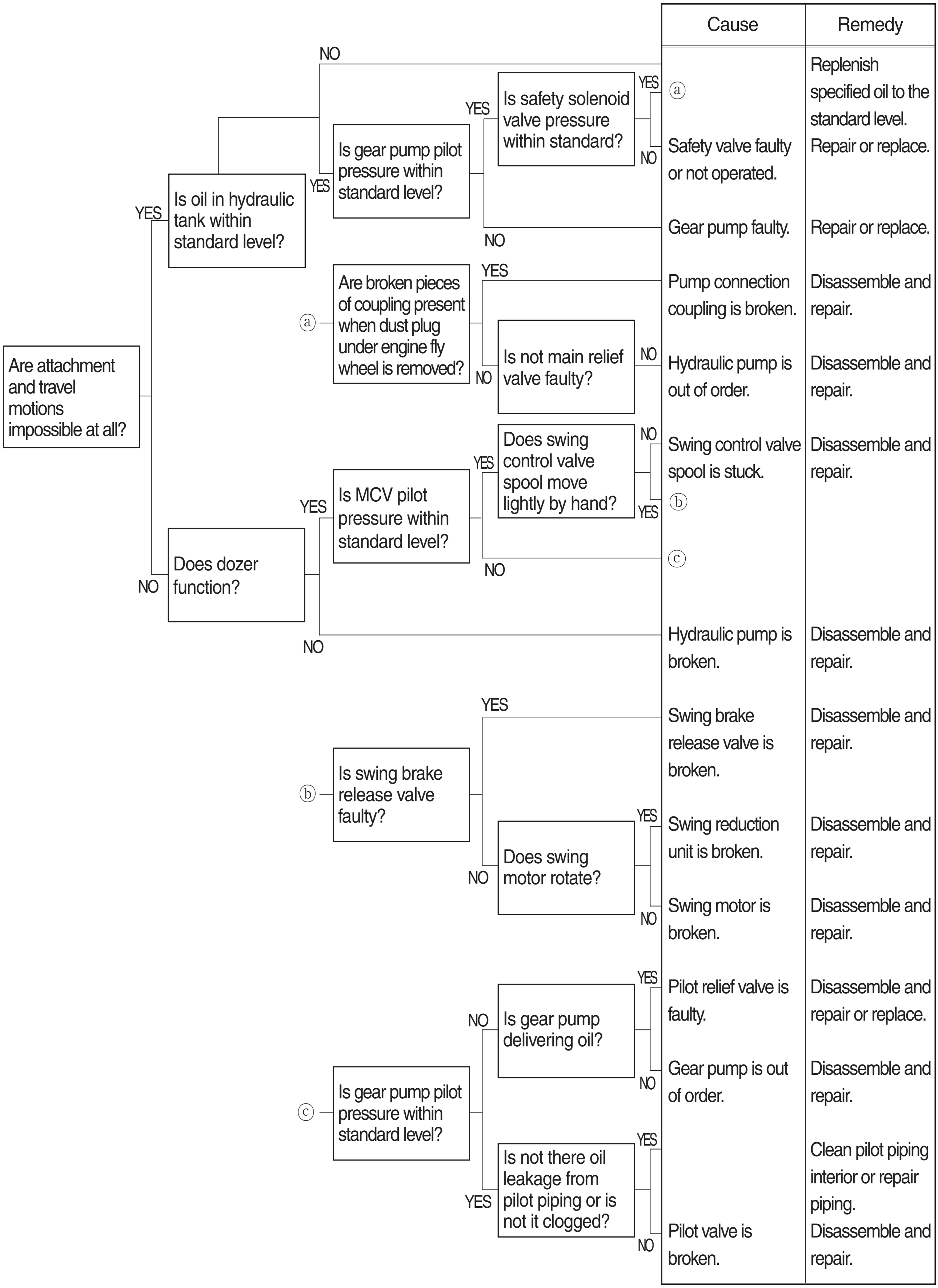


4) HYDRAULIC OIL IS CONTAMINATED

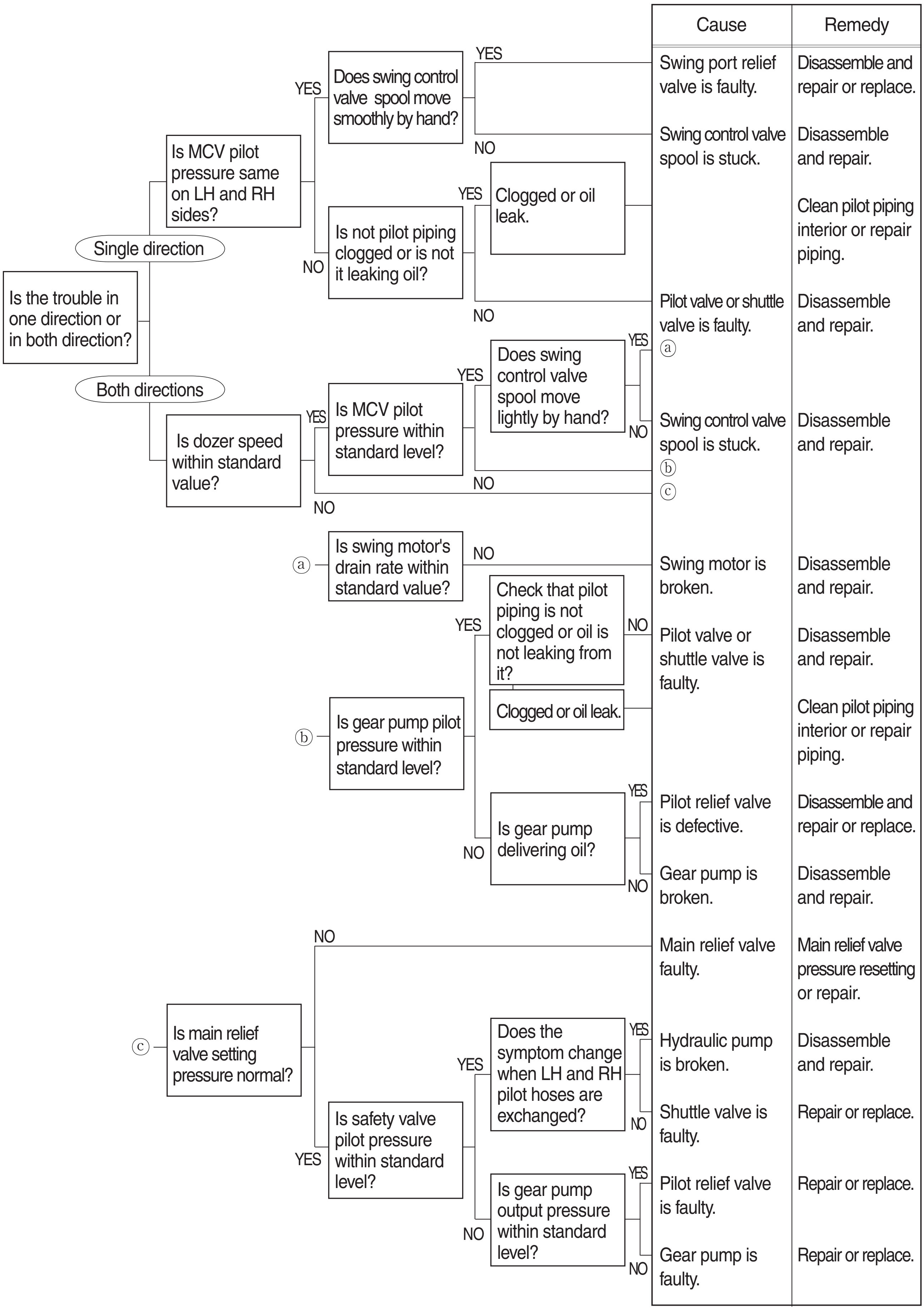


4. SWING SYSTEM

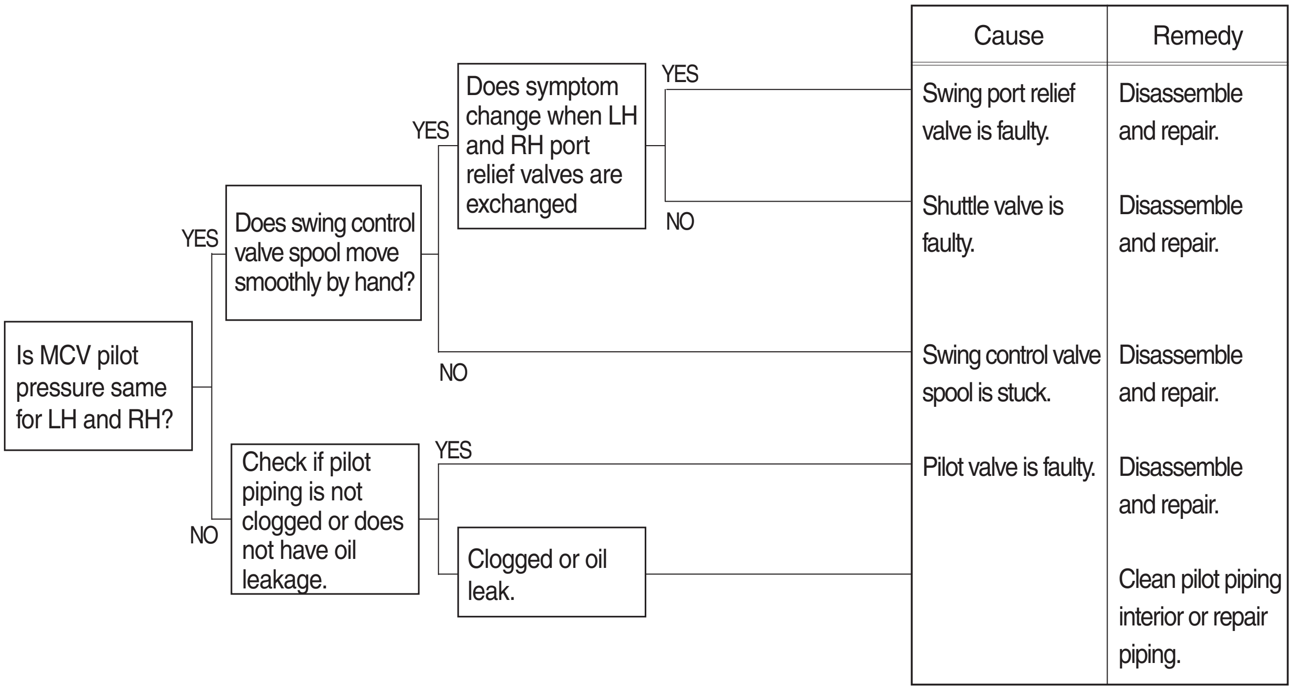
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



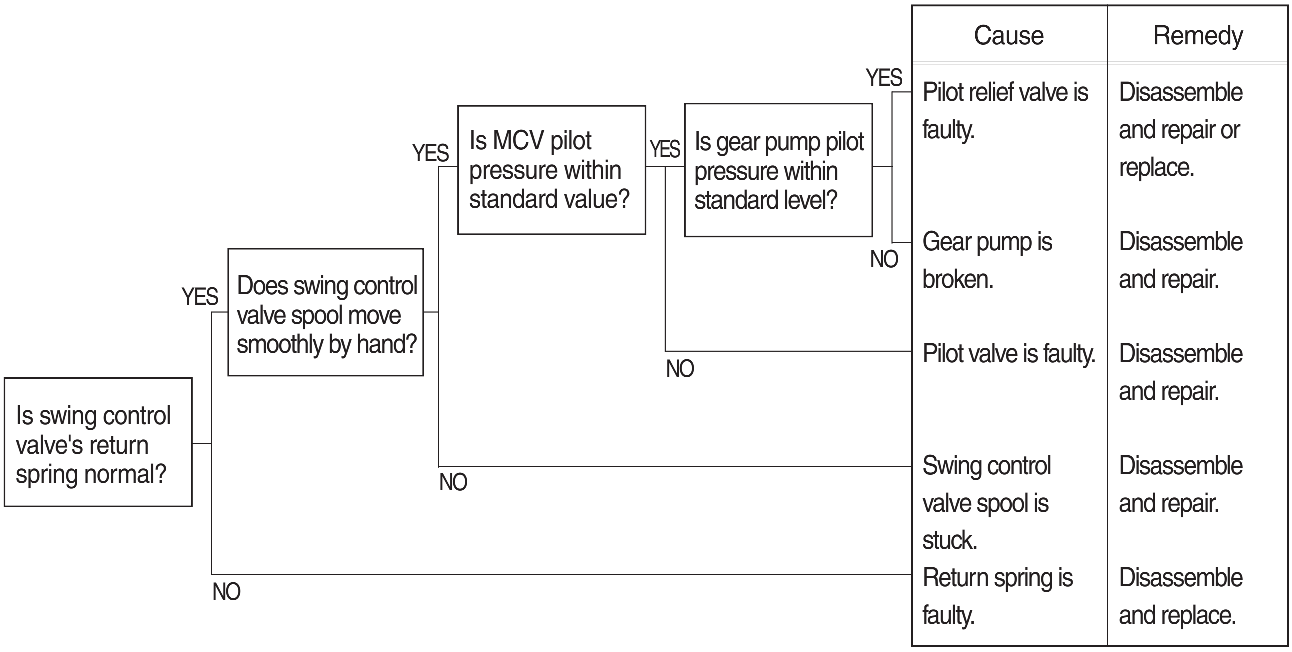
2) SWING SPEED IS LOW



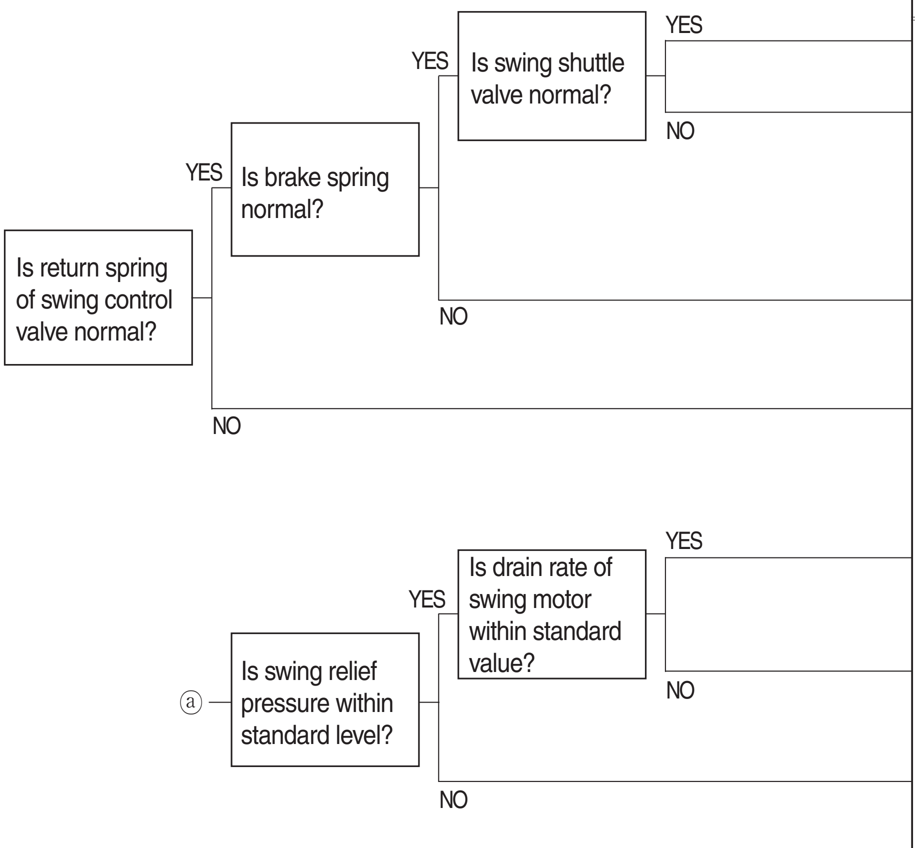
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP



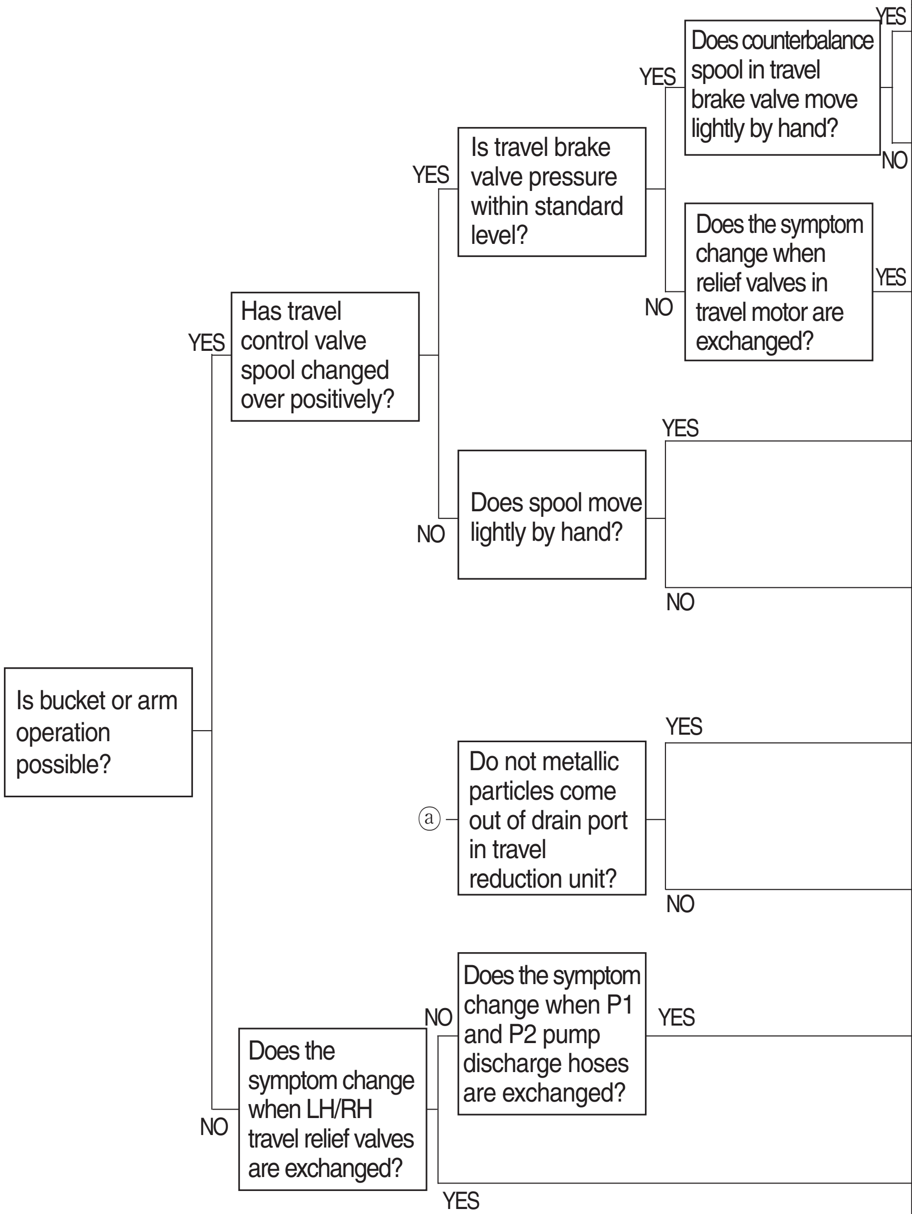
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.
	Adjust swing relief valve pressure or replace swing relief valve.

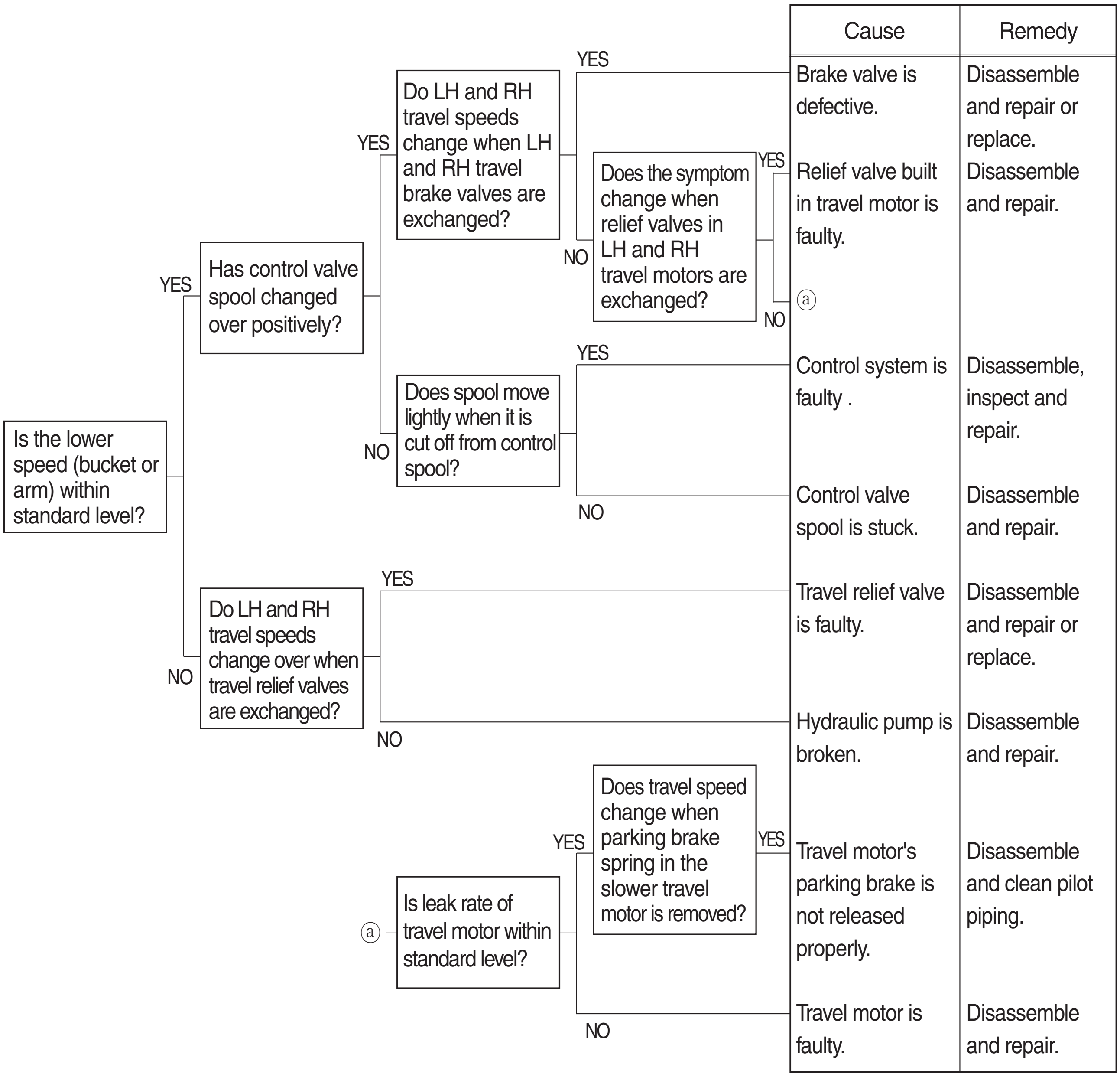
5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



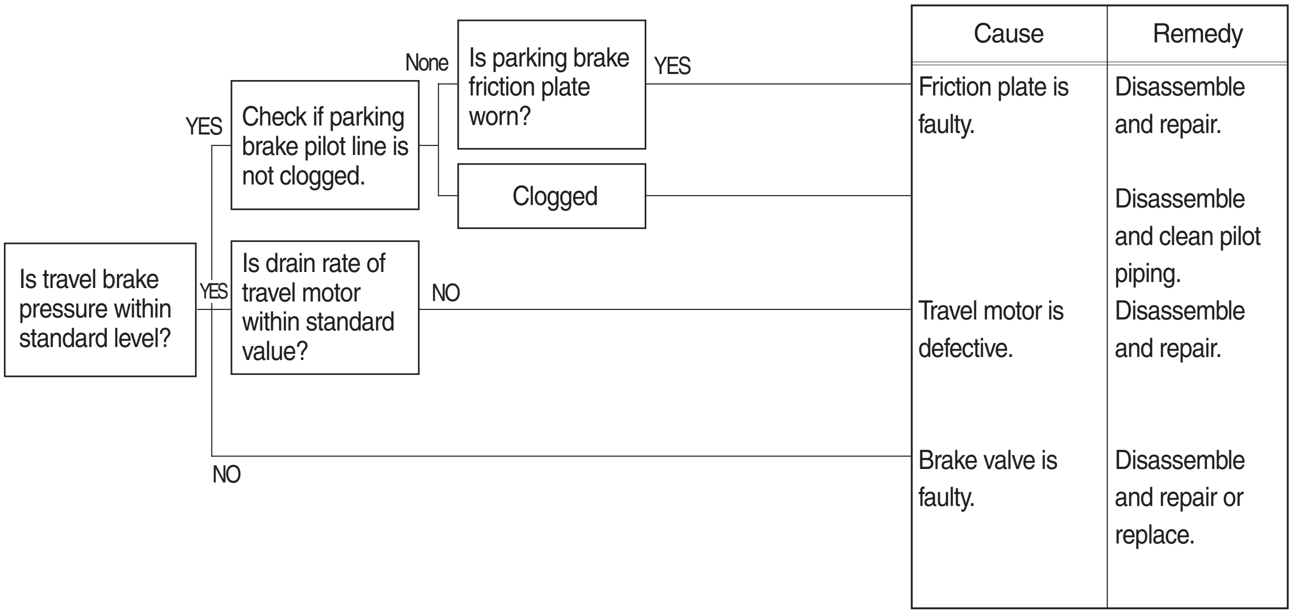
Cause	Remedy
ⓐ	
Counter spool in travel brake valve is stuck.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is defective.	Disassemble inspect and repair.
Travel control valve spool is stuck.	Disassemble and repair.
Travel reduction unit is faulty.	Disassemble and repair.
Travel motor is out of order.	Disassemble and repair.
Hydraulic pump is broken.	Disassemble and repair.
Travel relief valves are faulty.	Disassemble and repair or replace.

2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

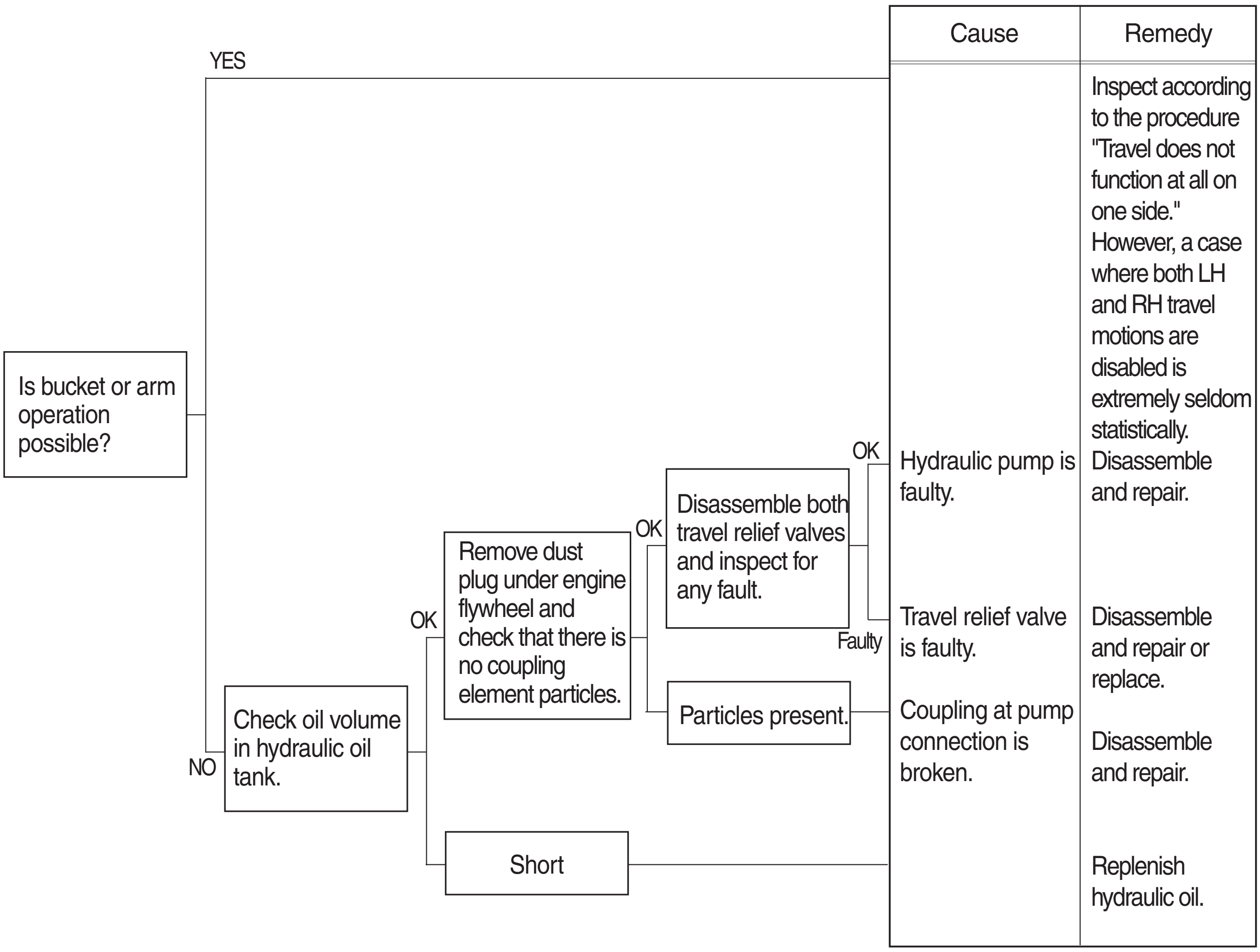


3) MACHINE DOES NOT STOP ON A SLOPE

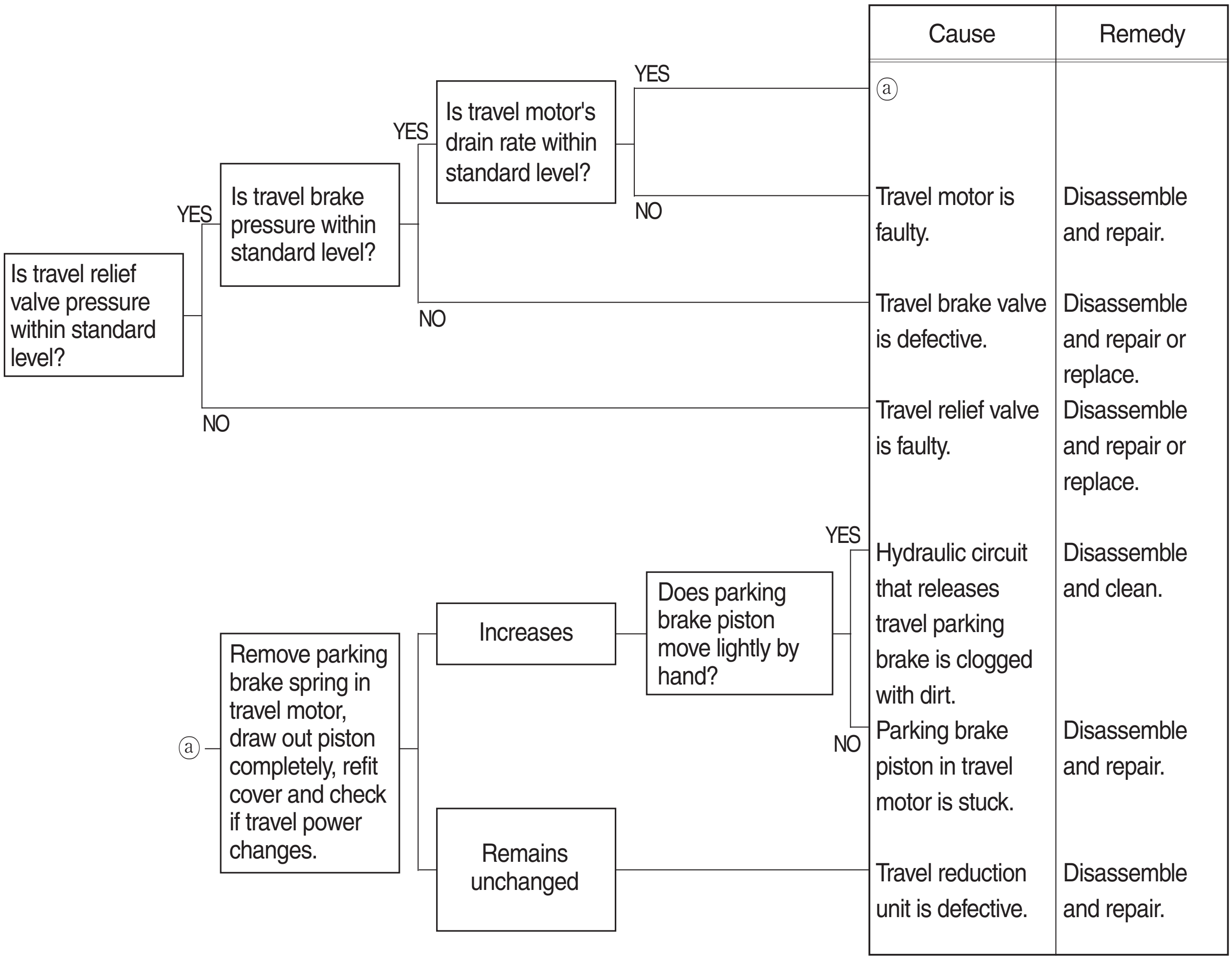
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

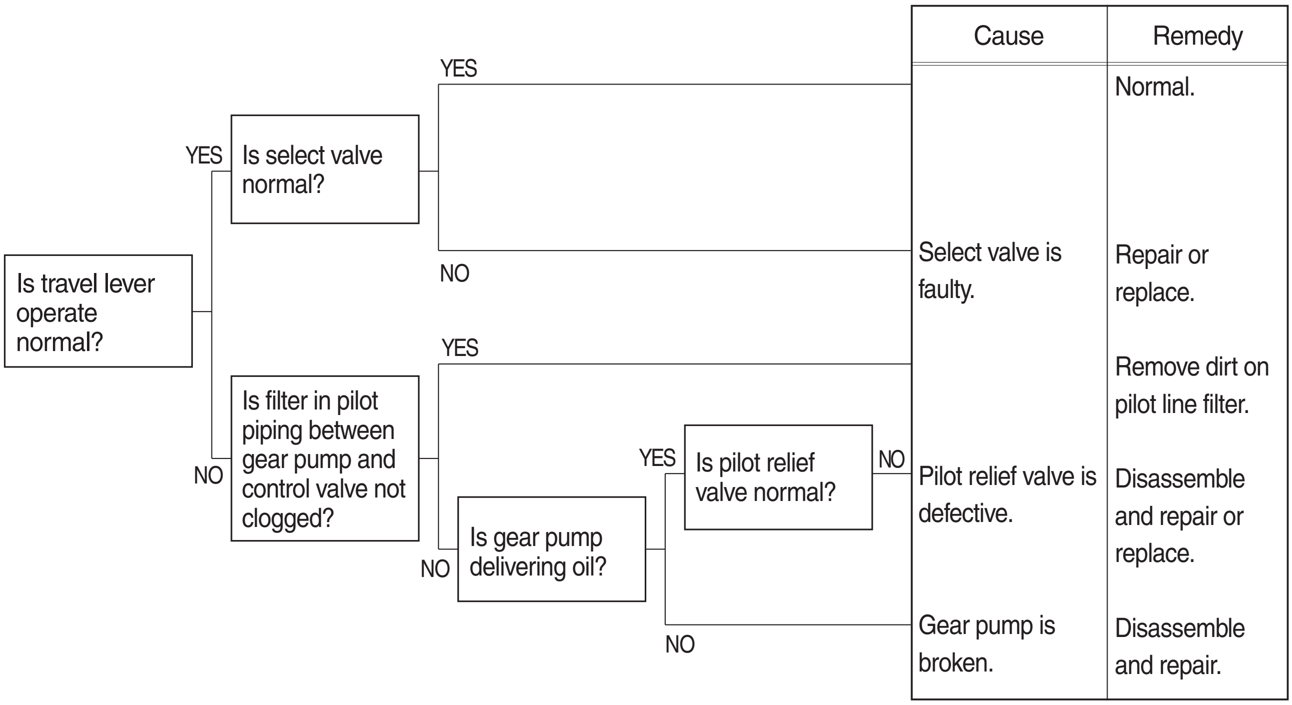


5) TRAVEL ACTION IS POWERLESS (travel only)



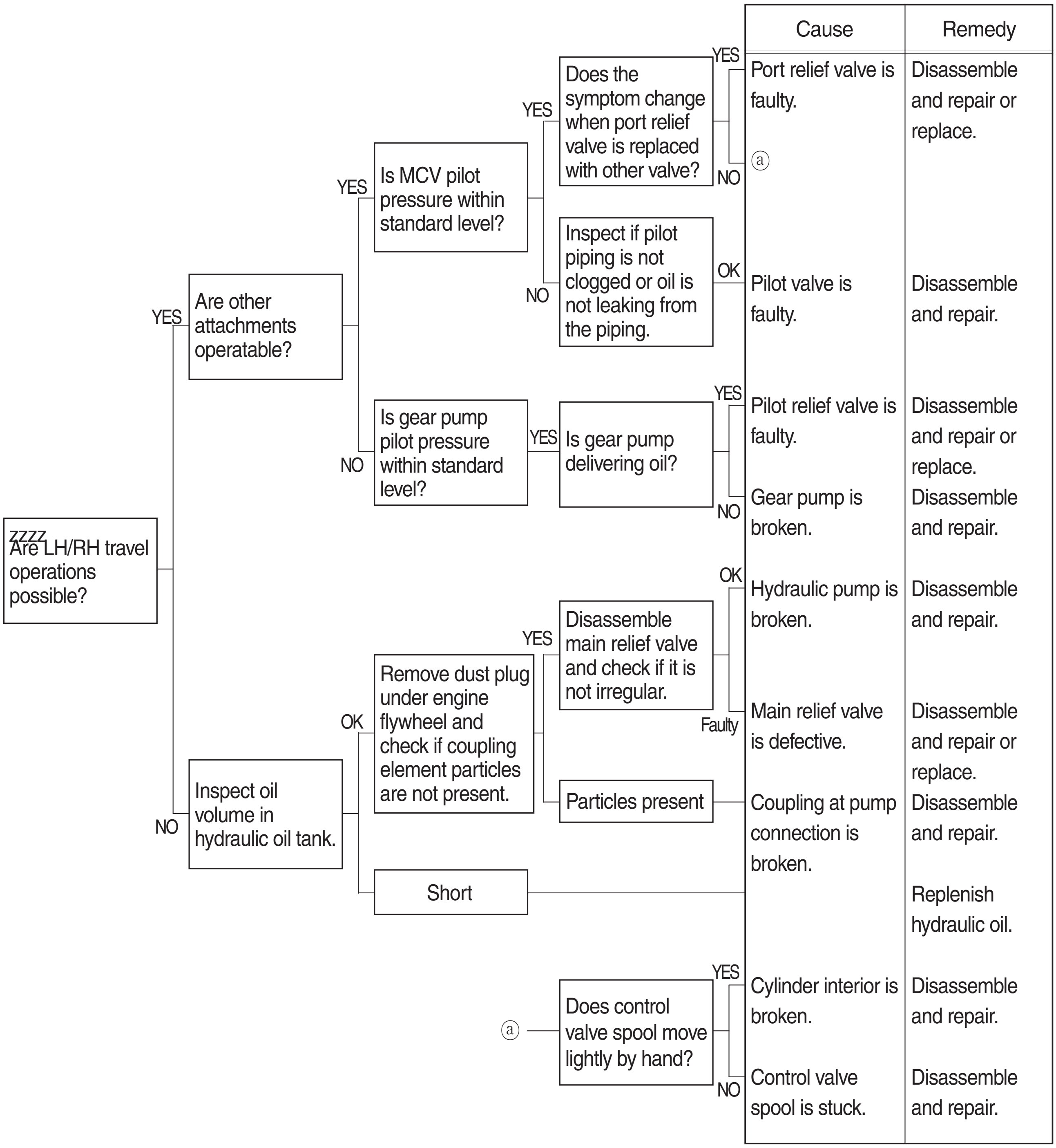
6) MACHINE RUNS RECKLESSLY ON A SLOPE

7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME

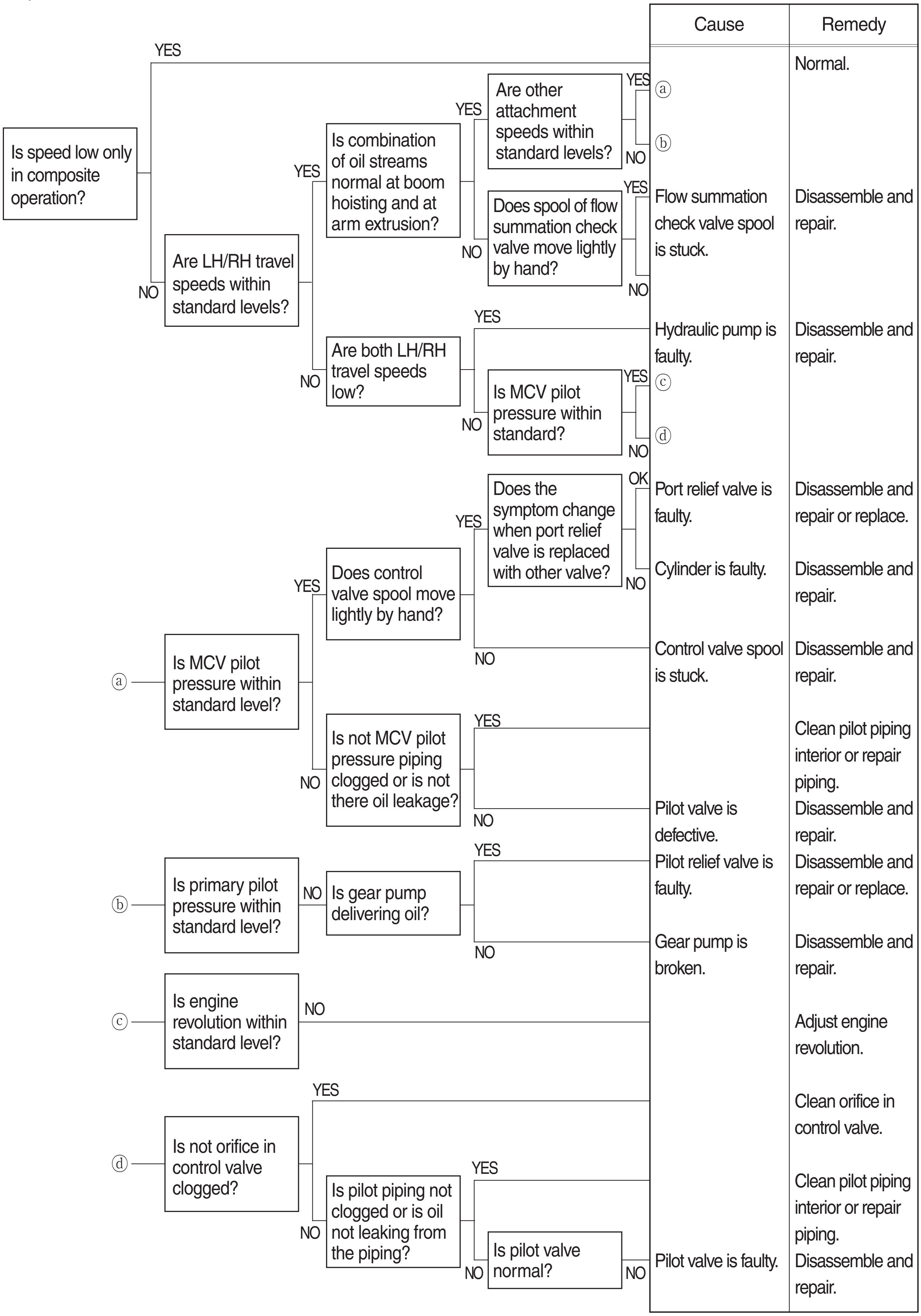


6. ATTACHMENT SYSTEM

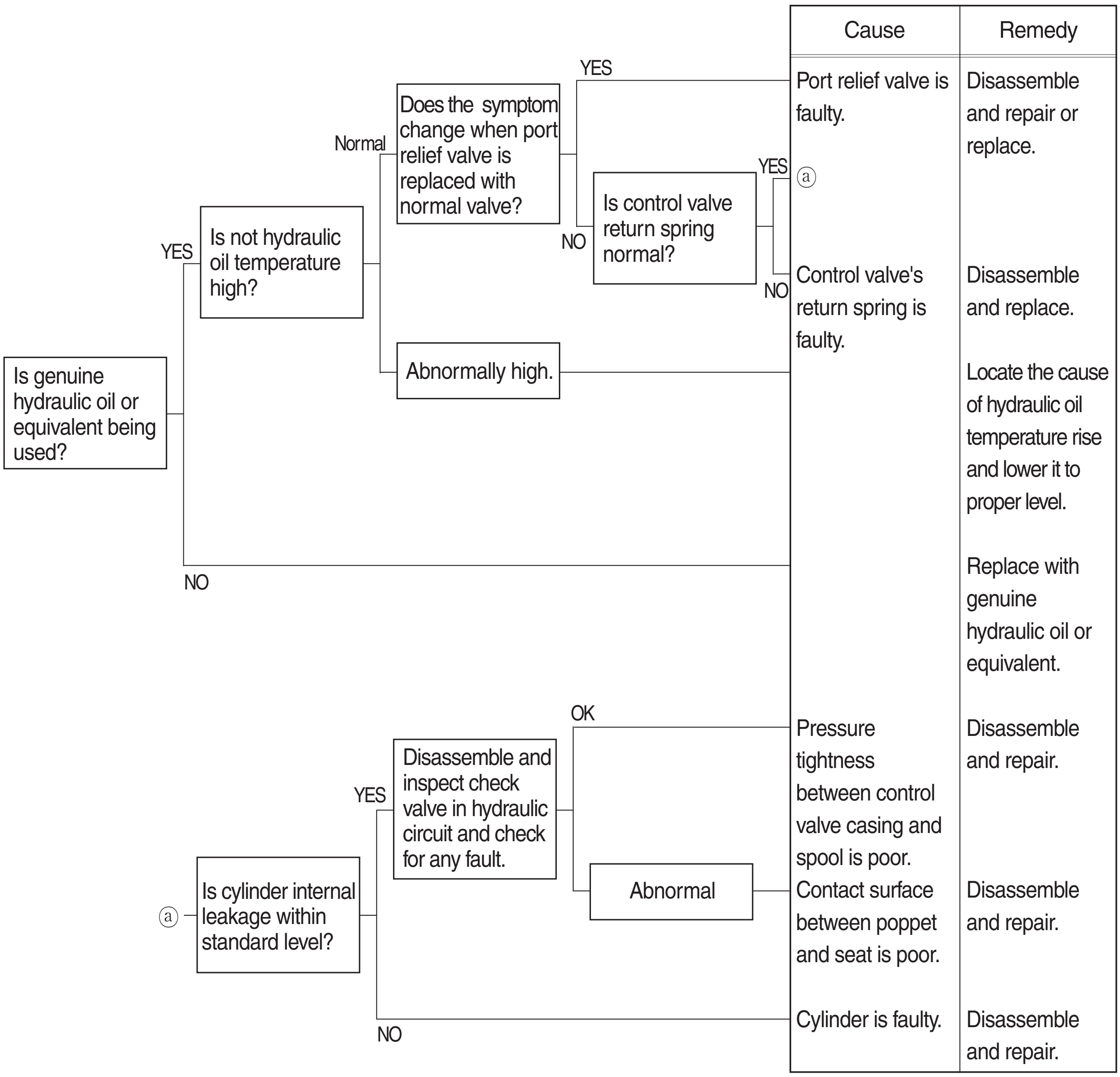
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



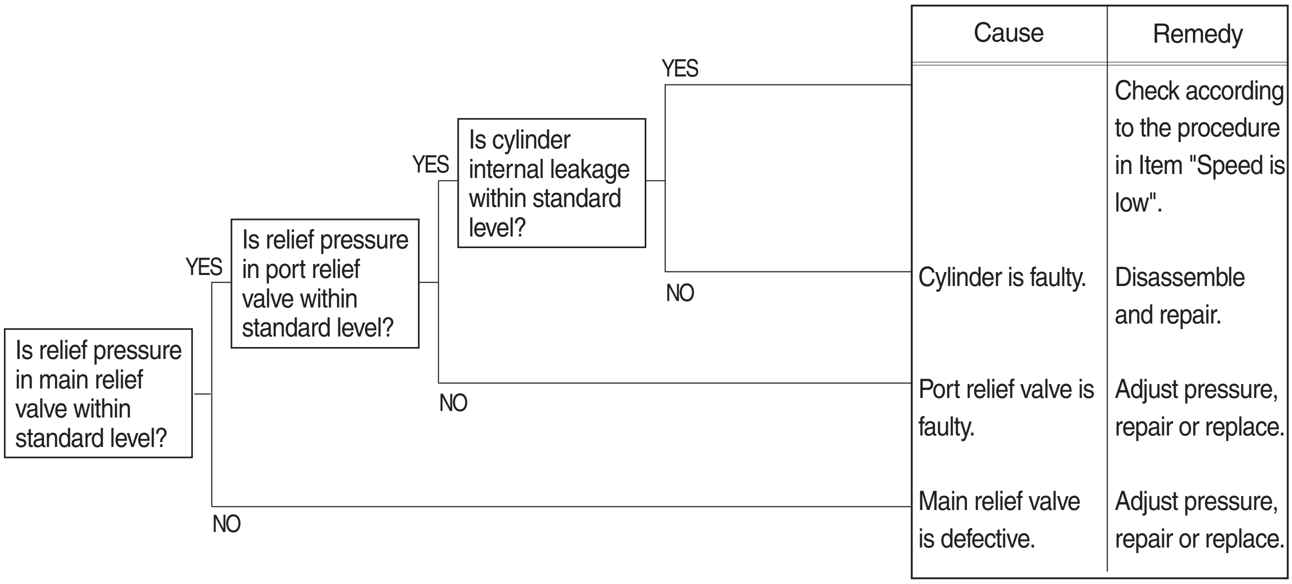
2) BOOM, ARM OR BUCKET SPEED IS LOW



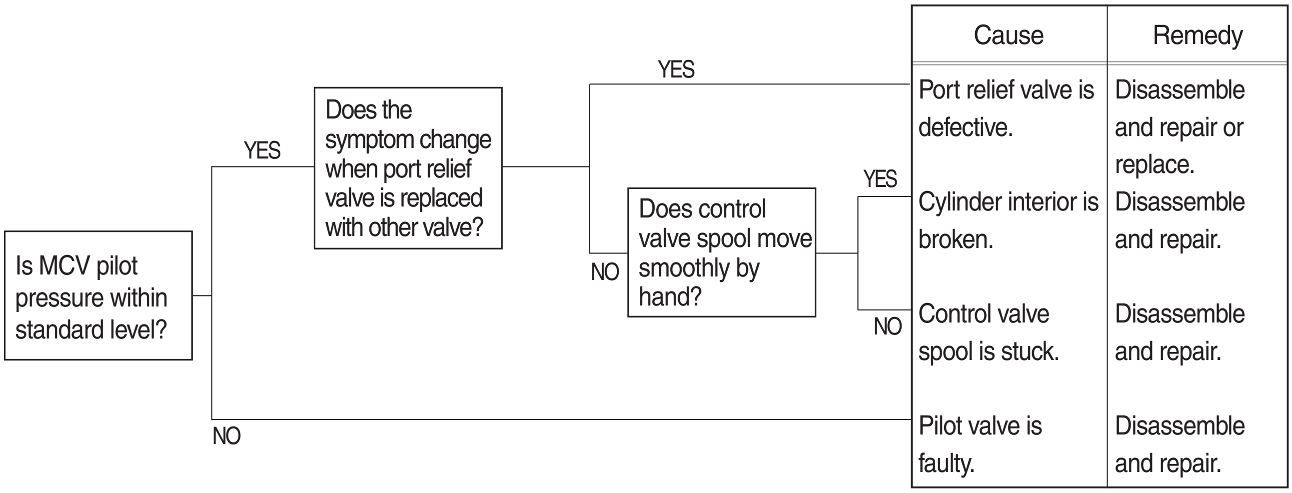
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

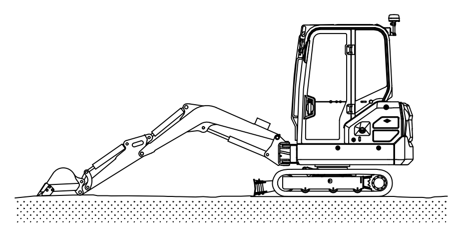


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

		Cause	Remedy
Is boom foot pin greased sufficiently?	YES		Frictional noise occurs between the sliding faces of boom cylinder's oil seal and boom proper. ※ Frictional noise will disappear if they are kept used.
	NO	Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in an initial stage, supply sufficient grease. If seizure is in a grown state, correct it by paper lapping or with an oil stone.

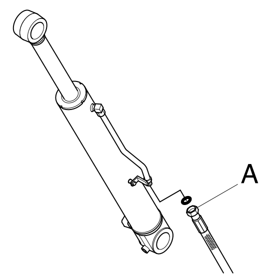
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

1. Lower the bucket teeth to the ground with bucket cylinder fully retracted and arm cylinder rod retracted almost in full.



19A5MA01

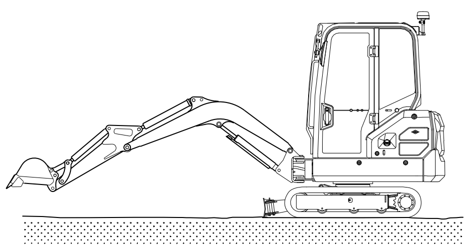
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (Put cups on piping and hose ends)



R5575BY02

3. Raise bucket OFF the ground by retracting the arm cylinder rod.

   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



19A5MA02

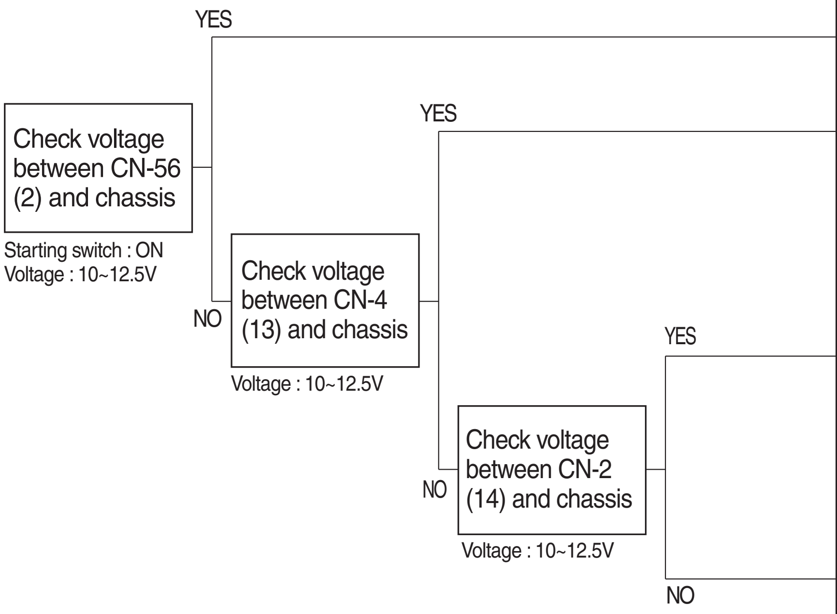
GROUP 3 ELECTRICAL SYSTEM

1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

· Before disconnecting the connector, always turn the starting switch OFF.

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.9.

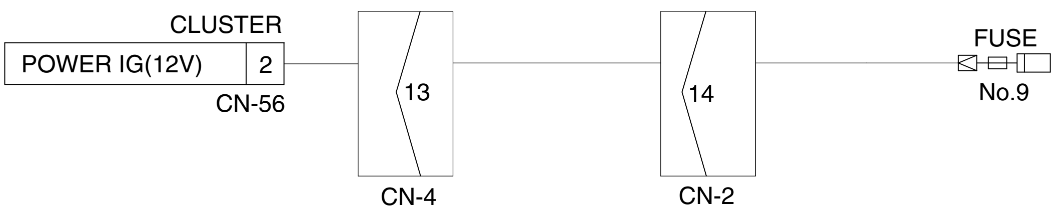
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56 (2) and CN-4 (13)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-4 (13) and CN-2 (3)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-2 (14) and fuse No.9	Repair or replace (after clean)

Check voltage

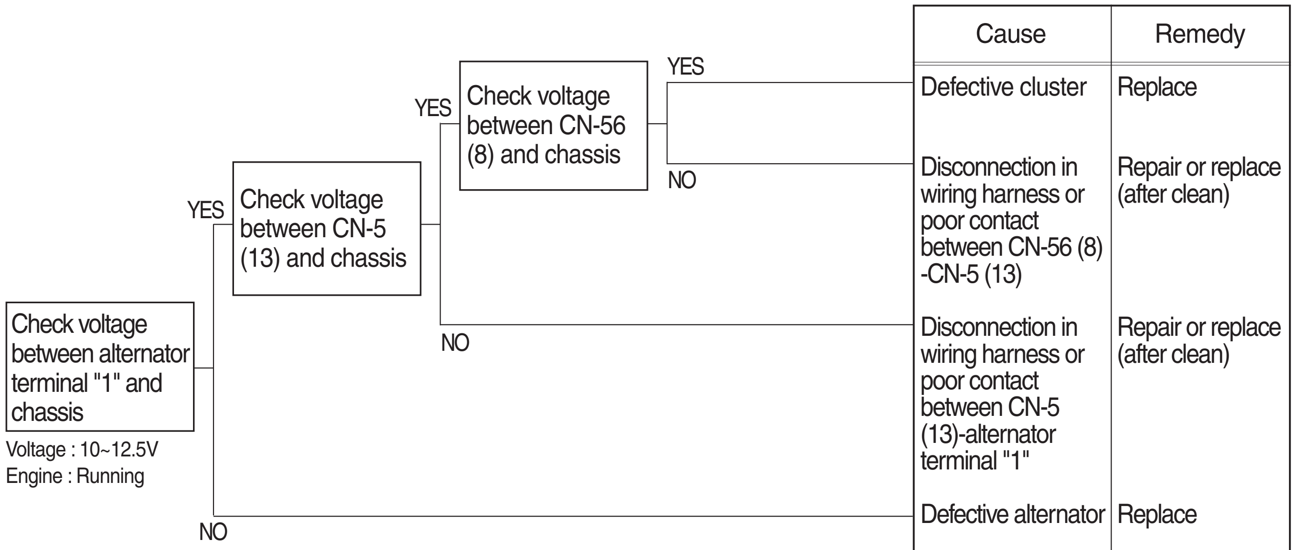
YES	10 ~ 12.5V
NO	0V



19A5TS02

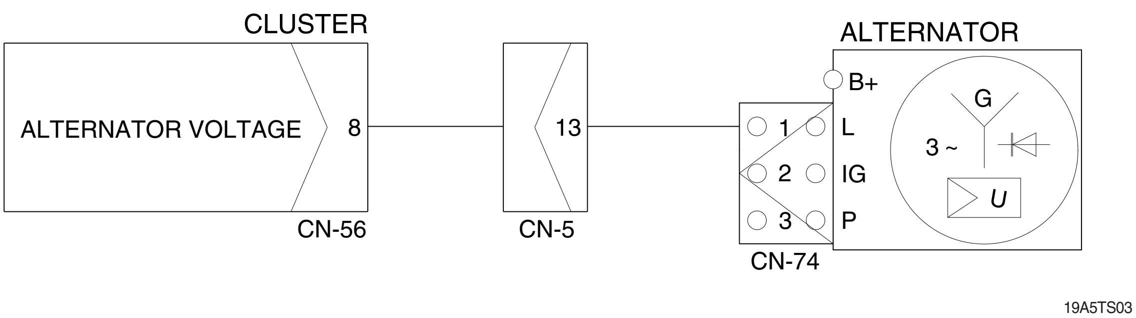
2. BATTERY CHARGING WARNING LAMP LIGHTS UP (starting switch : ON)

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



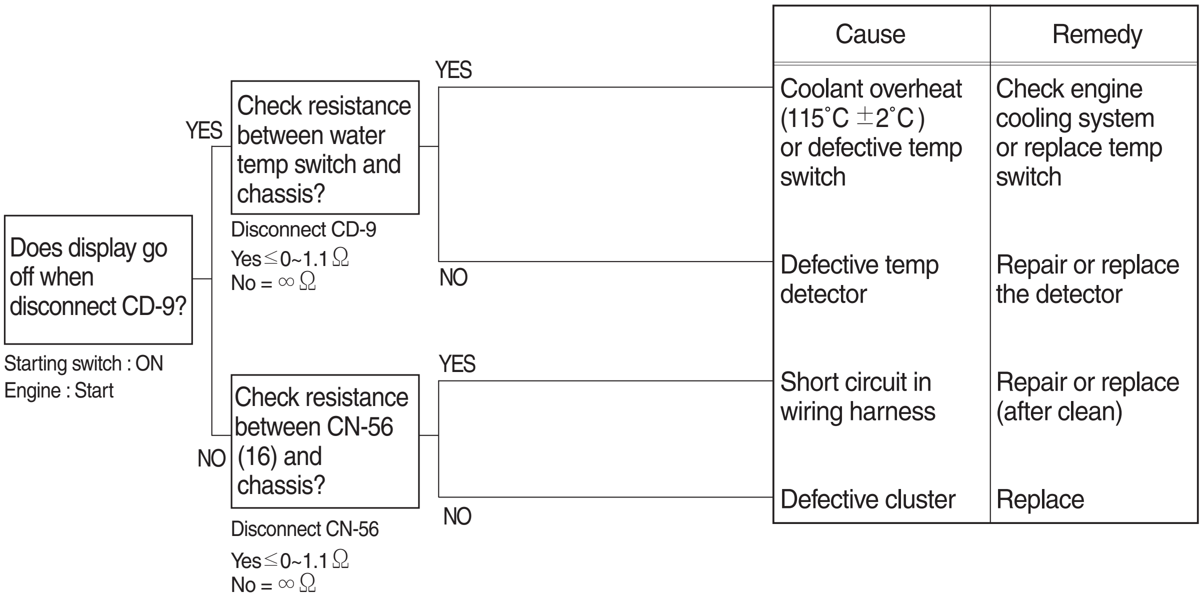
Check voltage

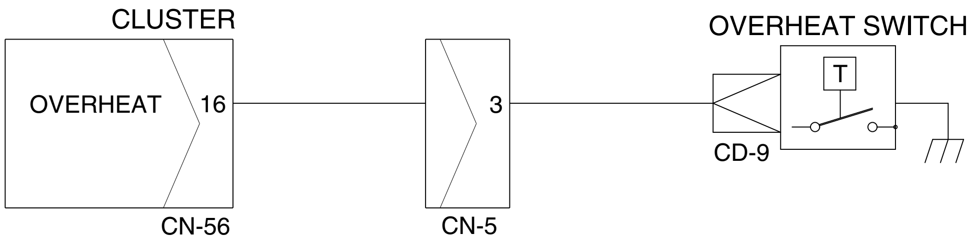
YES	10 ~ 12.5V
NO	0V



3. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (Engine is started)

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

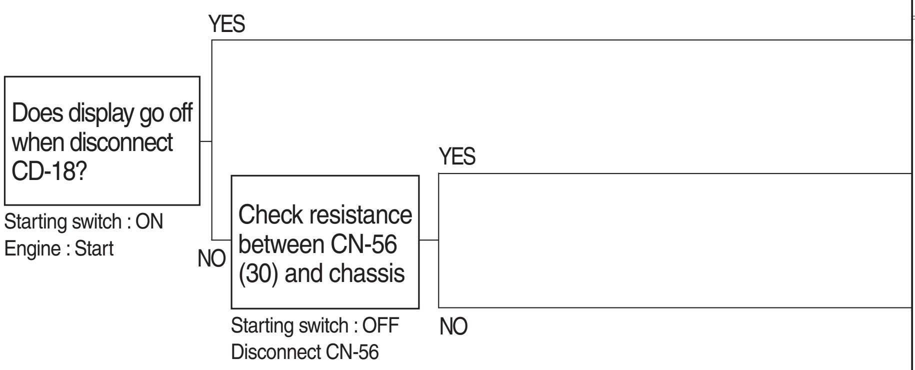




17AZ5TS04

4. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (Engine is started)

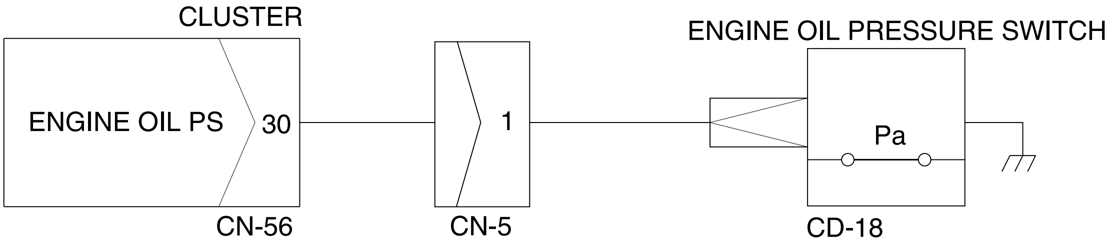
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Engine oil leakage, or defective switch	Check engine oil level or replace switch
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56 (30)-CD-18	Repair or replace (after clean)

Check resistance

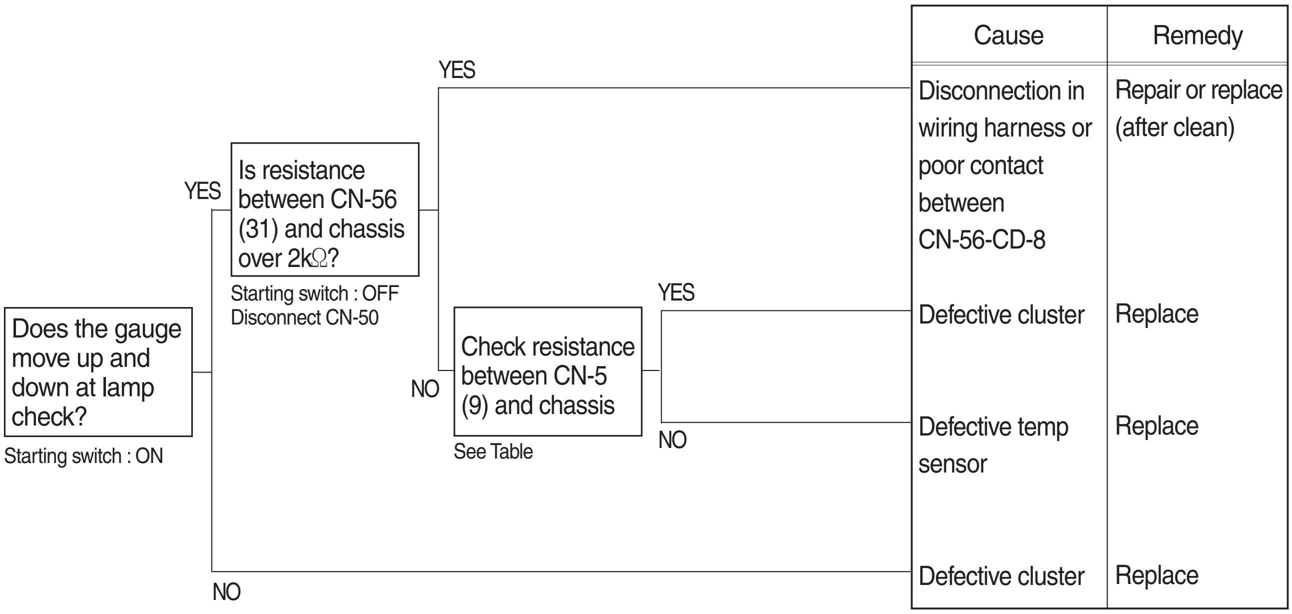
YES	MAX 1Ω
NO	MIN 1MΩ

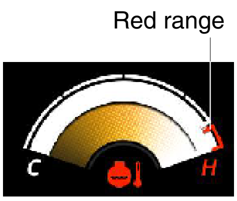


17AZ5TS06

5. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

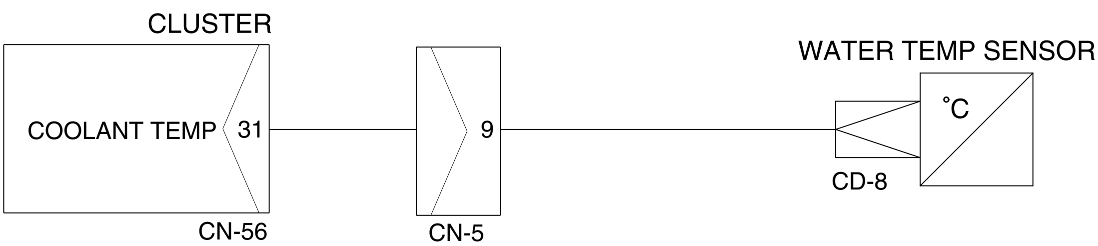
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

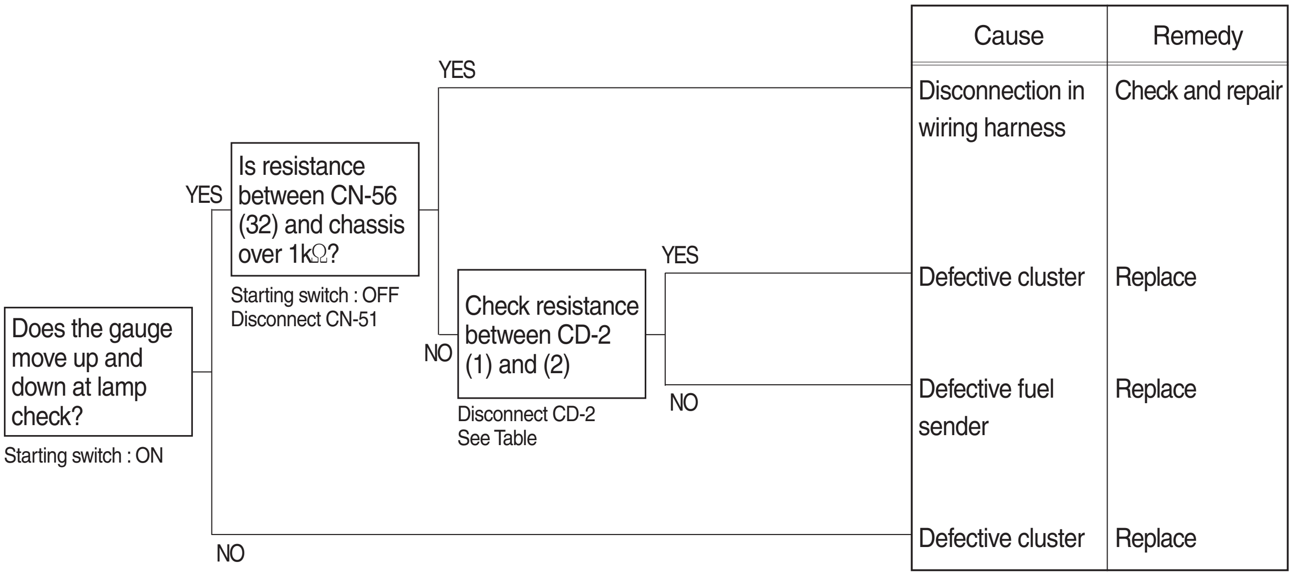
Item \ Temperature	50˚C	80˚C	100˚C	115˚C (red range)
Unit resistance (Ω)	350	118	63.5	36.2



19A5TS07

6. WHEN FUEL GAUGE DOES NOT OPERATE (Check warning lamp ON/OFF)

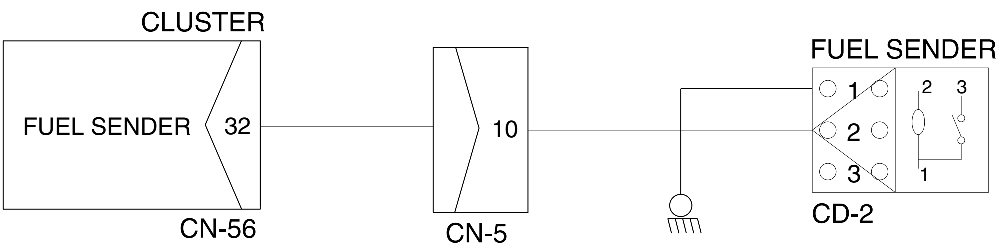
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Red range

Check Table

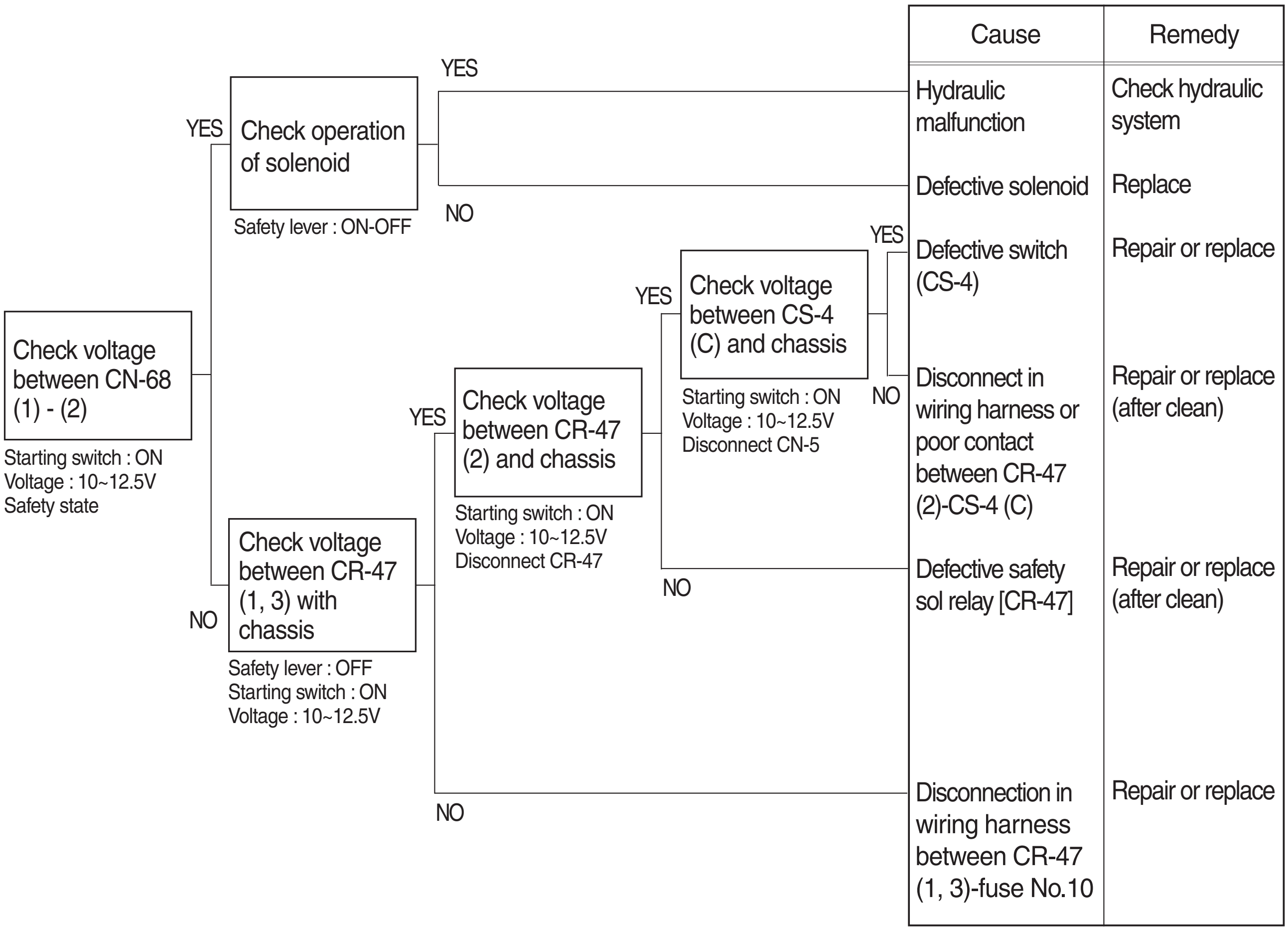
Item \ Temperature	Empty	1/2	Full
Unit resistance (Ω)	90	38	10

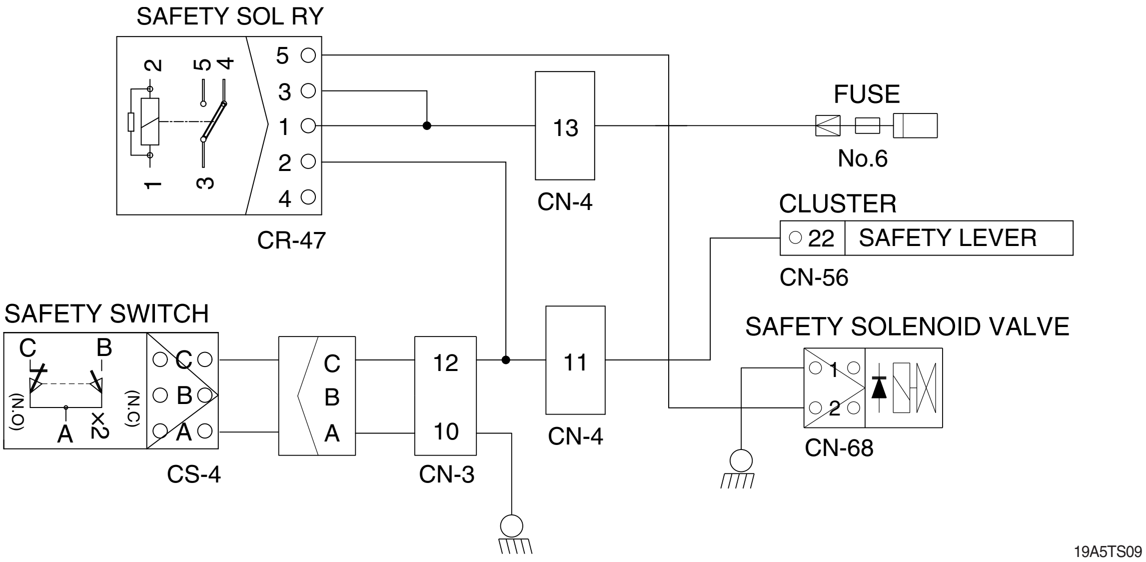


19A5TS08

7. WHEN SAFETY SOLENOID DOES NOT OPERATE

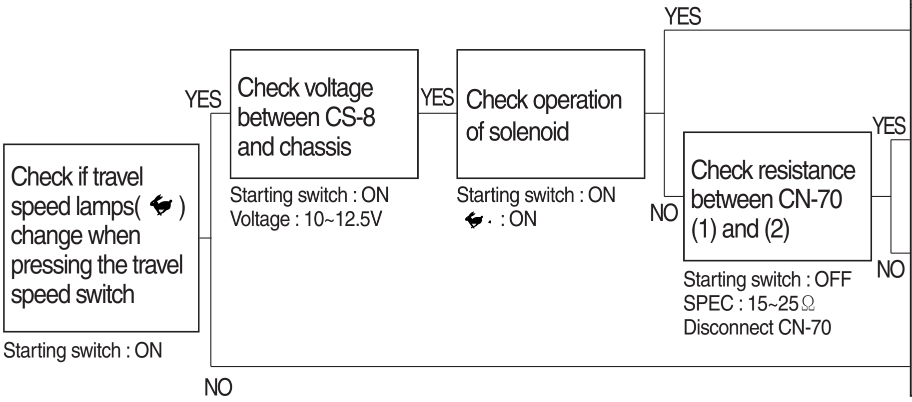
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.10.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



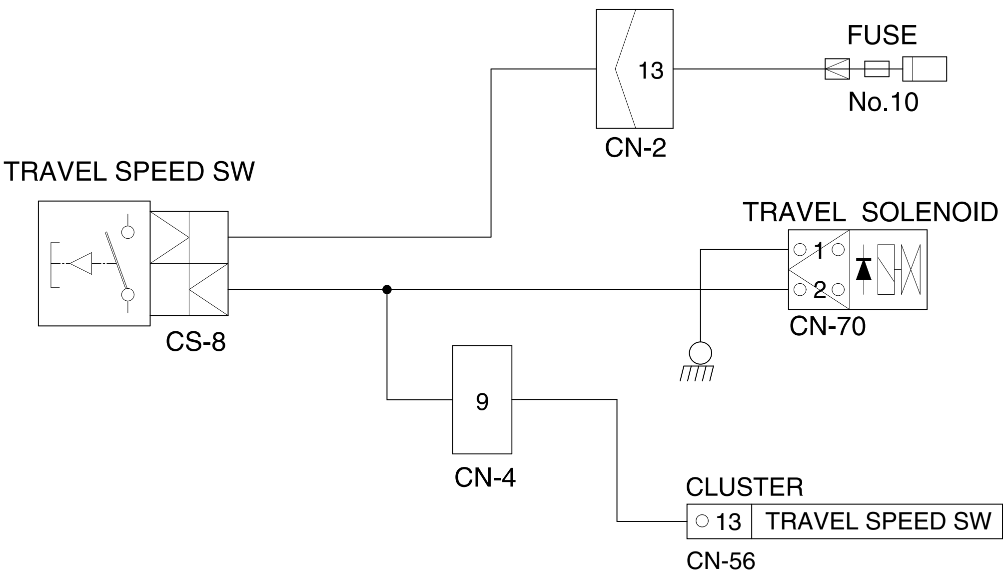


8. WHEN TRAVEL SPEED HIGH, LOW DOES NOT OPERATE

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.10.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



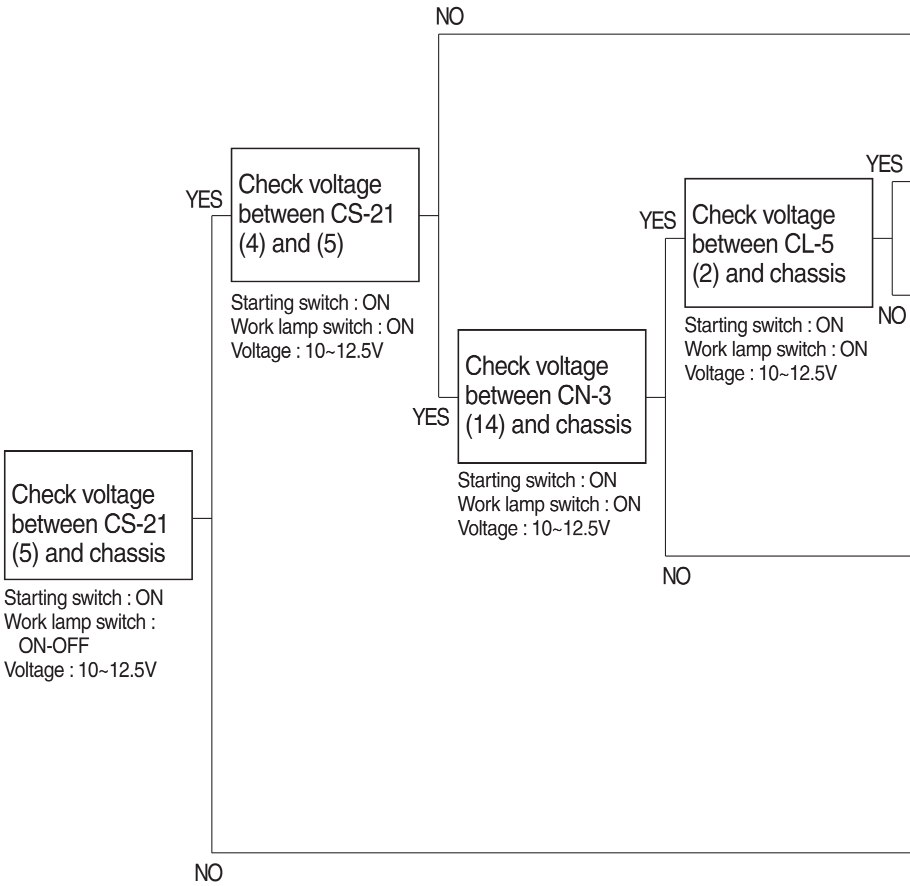
Cause	Remedy
Defective hydraulic system	Check hydraulic system
Defective cluster	Replace
Defective solenoid	Replace
Defective switch	Replace



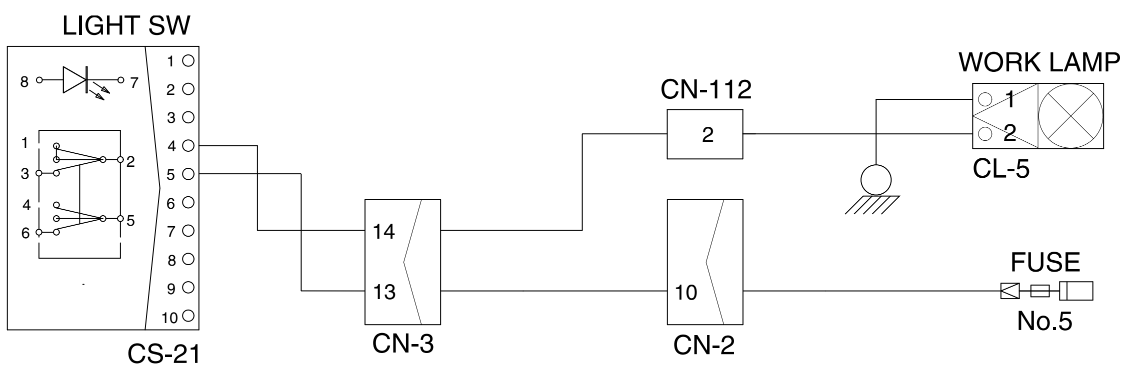
19A5TS10

9. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.5.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



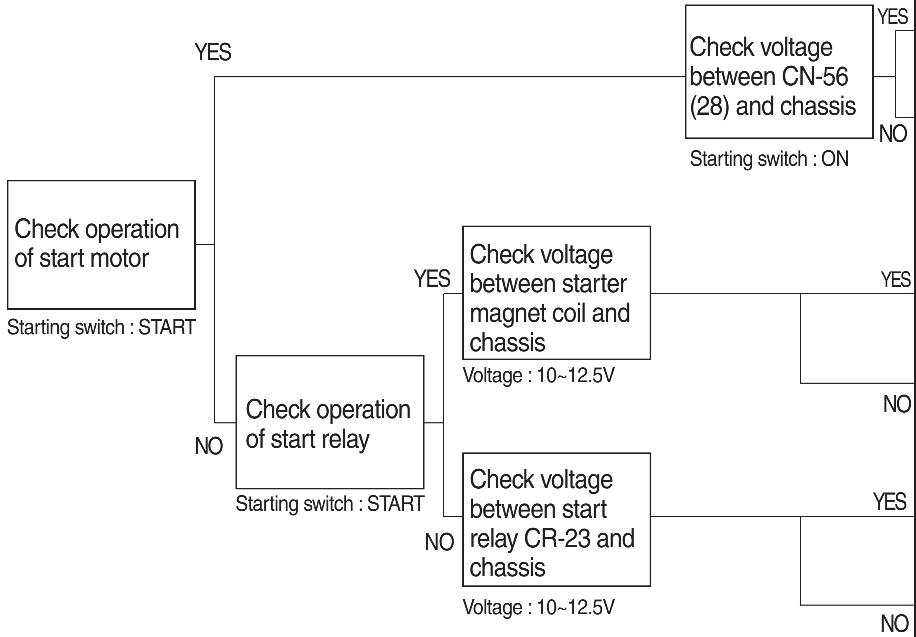
Cause	Remedy
Defective lamp switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-3 (14) and CL-5 (2)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-21 (4)-CN-3 (14)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-21 (5) and fuse No.5	Repair or replace (after clean)



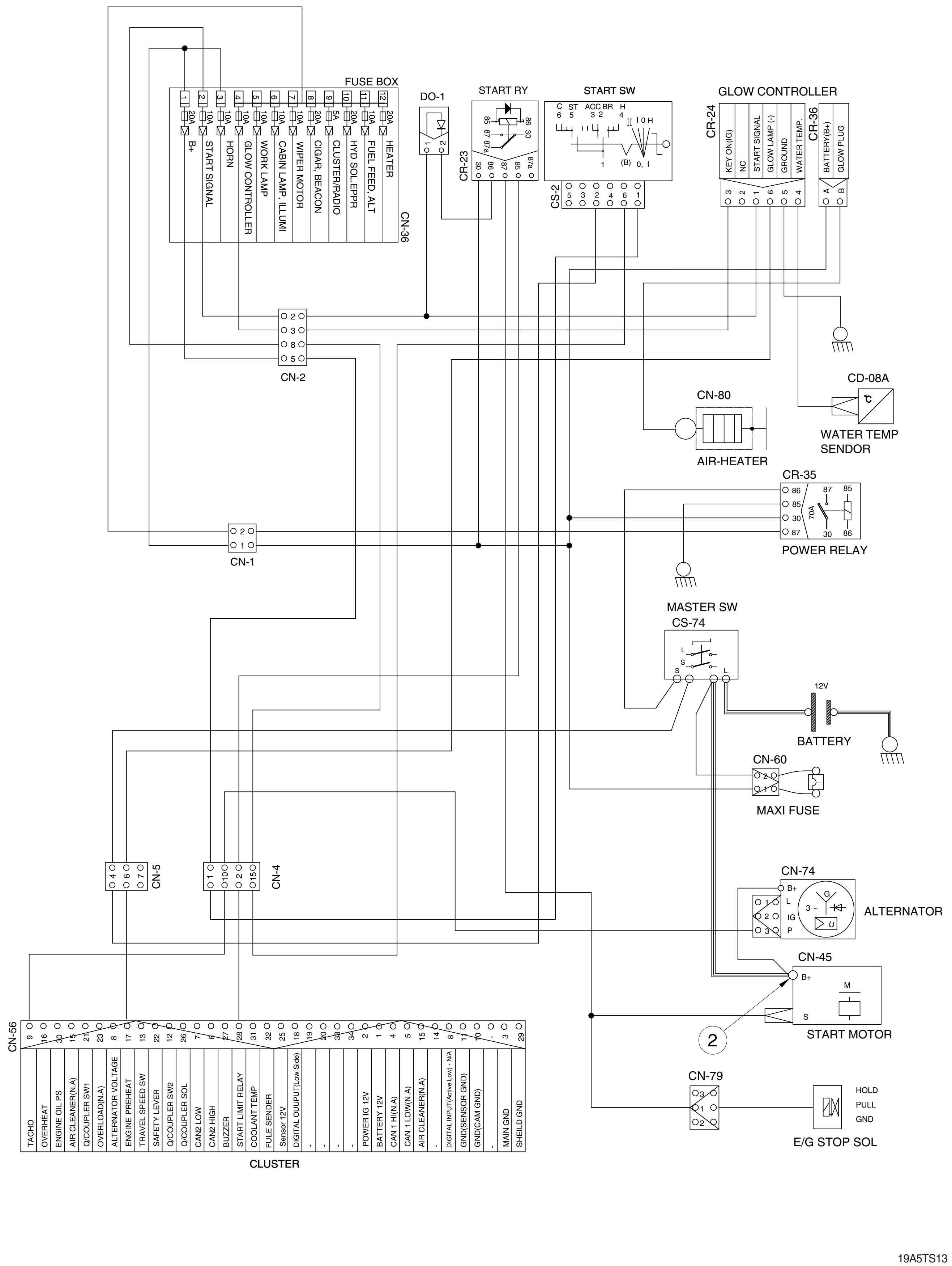
19A5TS12

10. WHEN ENGINE DOES NOT START

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

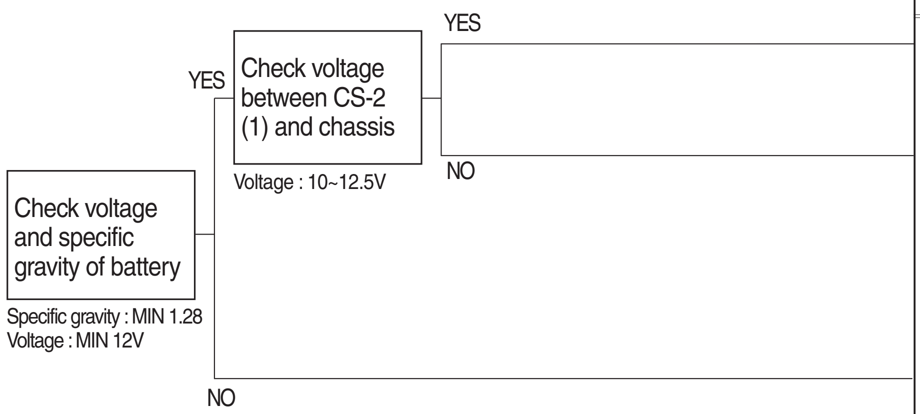


Cause	Remedy
Defective CMCU	Repair or replace CMCU
Disconnection in wiring harness or poor contact between CN-56 (28) and CS-2 (6)	Repair or replace fuel cut off relay or repair or replace (after clean)
Defective magnet of start motor	Repair or replace start motor
Defective start relay	Repair or replace start relay
Defective start relay	Repair or replace start relay
Disconnection in wiring harness or poor contact between CR-23 (86) and CS-2 (6)	Repair or replace (after clean)

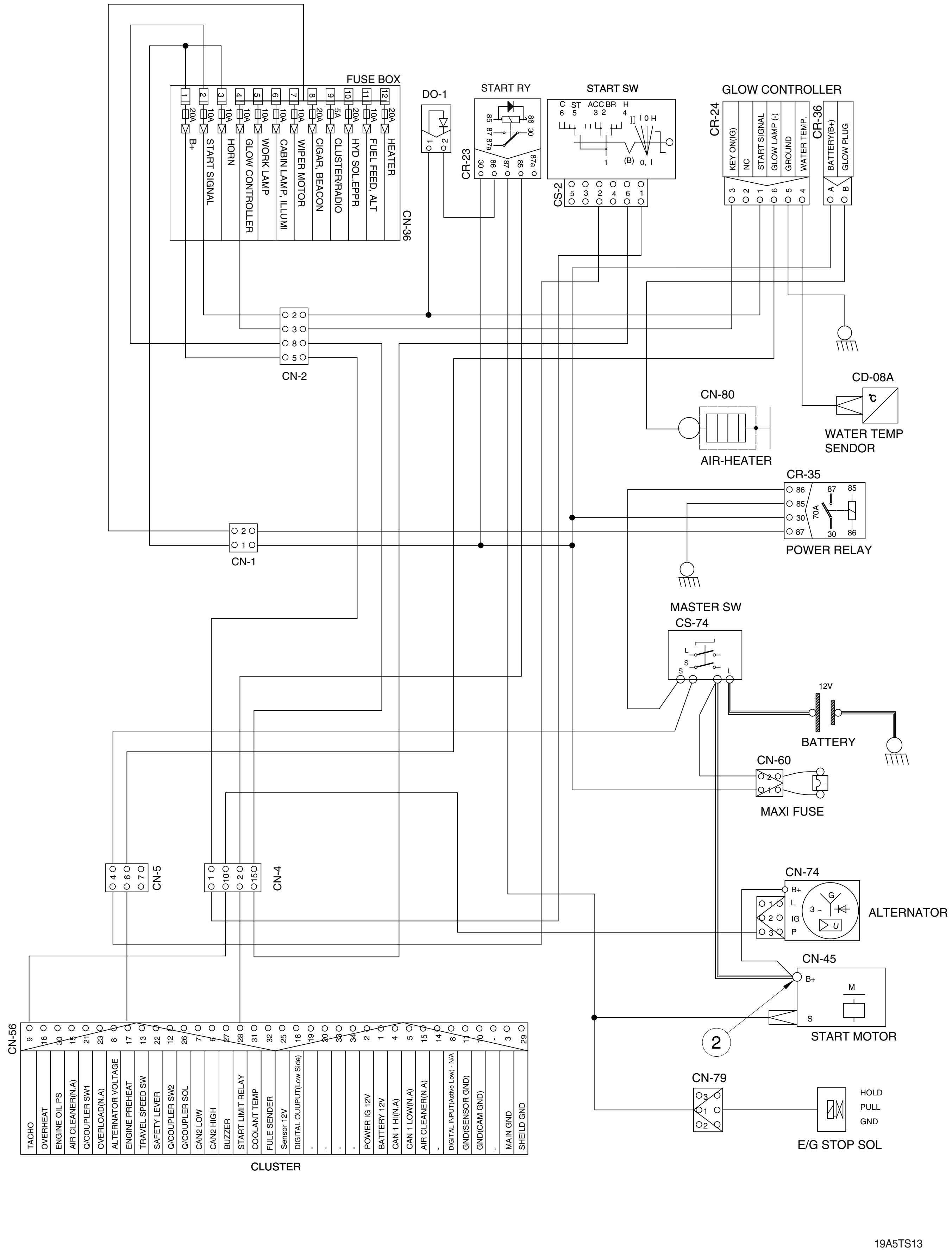


11. WHEN STARTING SWITCH ON DOES NOT OPERATE

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and master switch ON.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-Master switch	Replace
Battery capacity too low	Charge or replace (after clean)



SECTION 6 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

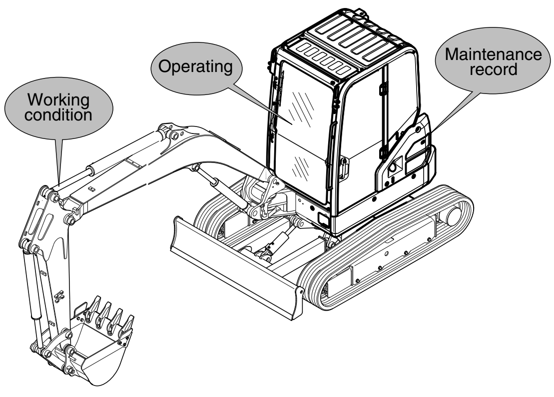
1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

Whenever a new machine is delivered in parts and reassembled at a customer's site, it must be tested to confirm that the operational performance of the machine meets HD Hyundai Construction Equipment spec.

2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

With the passage of time, the machine's operational performance deteriorates, so that the machine needs to be serviced periodically to restore it to its original performance level.

Before servicing the machine, conduct performance tests to check the extent of deterioration, and to decide what kind of service needs to be done (by referring to the "Service Limits" in this manual).



19A6MS01

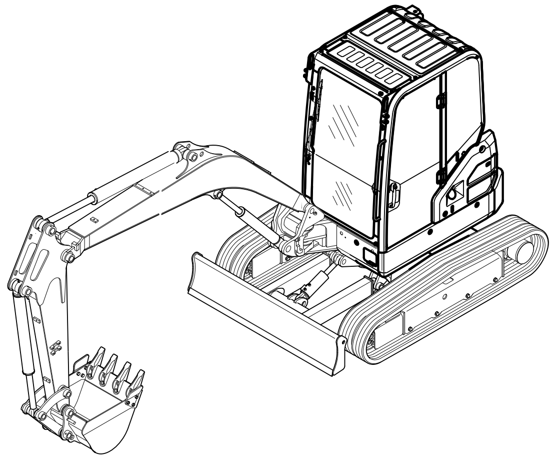
3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

After the machine is repaired or serviced, it must be tested to confirm that its operational performance was restored by the repair and/or service work done.

2. TERMINOLOGY

1) STANDARD

Specifications applied to the brand-new machine, components and parts.



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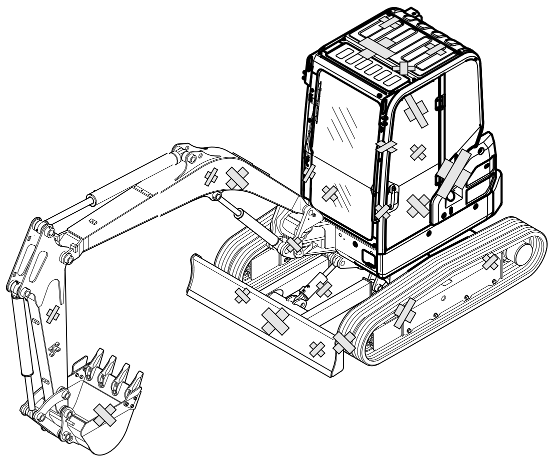
2) SERVICE LIMIT

The lowest acceptable performance level. When the performance level of the machine falls below this level, the machine must be removed from work and repaired. Necessary parts and components must be replaced.



19A6MS03

3. OPERATION FOR PERFORMANCE TESTS

1) Observe the following rules in order to carry out performance tests accurately and safely.

(1) The machine

Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(2) Test area

① Select a hard, flat surface.

② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.

③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions

① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.

② Operate the machine carefully and always give first priority to safety.

③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.

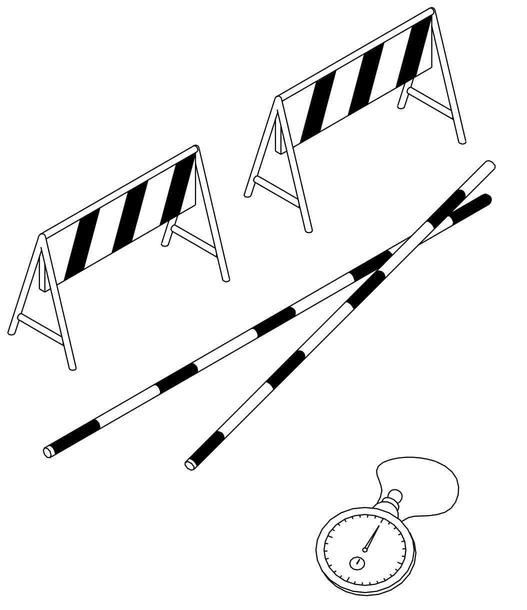
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

① Accurately calibrate test instruments in advance to obtain correct data.

② Carry out tests under the exact test conditions prescribed for each test item.

③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.



7-3 (140-7)

2) ENGINE SPEED

(1) Measure the engine speed at the maximum RPM.

※ The engine speed must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

(2) Preparation and measurement

① Warm up the machine, until the engine coolant temperature reaches 50°C or more, and the hydraulic oil is 50±5°C.

② Set the accel lever at the maximum stroke.

③ Measure the engine RPM.

(3) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

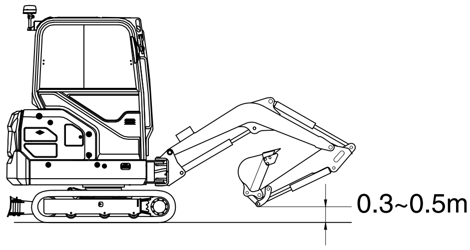
Model	Engine speed	Standard	Remarks
HX19A	Low idle	1450±50	
	High idle	2400±50	

3) TRAVEL SPEED

(1) Measure the time required for the excavator to travel a 20m test track.

(2) Preparation

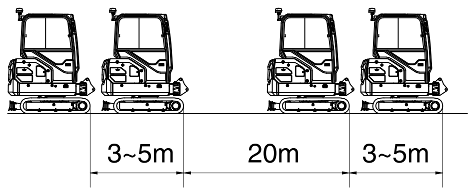
① Adjust the tension of both tracks to be equal.
② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5m on both ends for machine acceleration and deceleration.
③ Hold the bucket 0.3 to 0.5m above the ground with the arm and bucket rolled in.
④ Keep the hydraulic oil temperature at 50±5°C.



19A6MS04

(3) Measurement

① Measure both the low and high speeds of the machine.
② Before starting either the low or high speed tests, adjust the travel mode switch to the speed to be tested.
③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.
④ Measure the time required to travel 20m.
⑤ After measuring the forward travel speed, turn the upperstructure 180 ° and measure the reverse travel speed.
⑥ Repeat steps ④ and ⑤ three times in each direction and calculate the average values.



19A6MS05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

Model	Travel speed	Standard	Remarks
HX19A	1 Speed	34.8±2.0	
	2 Speed	18.8±1.0	

4) TRACK REVOLUTION SPEED

(1) Measure the track revolution cycle time with the track raised off ground.

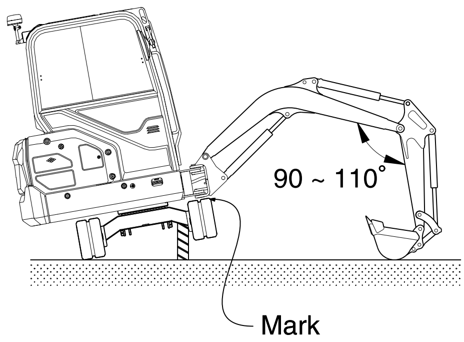
(2) Preparation

① Adjust the tension of both side tracks to be equal.

② On the track to be measured, mark one shoe with chalk.

③ Swing the upperstructure 90° and lower the bucket to raise the track off ground. Keep the boom-arm angle between 90 to 110° as shown. Place blocks under machine frame.

④ Keep the hydraulic oil temperature at 50±5°C.



19A6MS06

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed

② Operate the travel control lever of the raised track in full forward and reverse.

③ Rotate 1 turn, then measure time taken for next 3 revolutions.

④ Raise the other side of machine and repeat the procedure.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard	Remarks
HX19A	1 Speed	17.5±2.0	
	2 Speed	9.5±2.0	

5) TRAVEL DEVIATION

(1) Measure the deviation by the tracks from a 20m straight line.

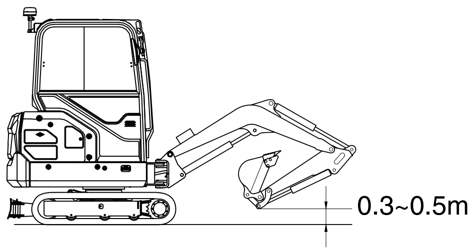
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Provide a flat, solid test yard 20 m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.

③ Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.

④ Keep the hydraulic oil temperature at 50±5°C.



19A6MS04

(3) Measurement

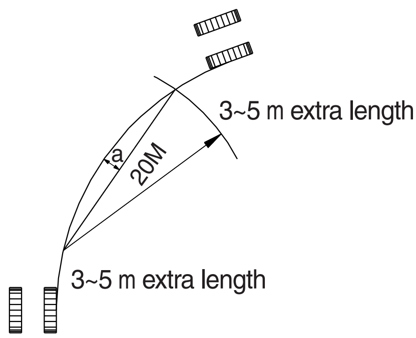
① Measure the amount of mistracking at high and low travel speeds.

② Start traveling the machine in the acceleration zone with the travel levers at full stroke.

③ Measure the distance between a straight 20m line and the track made by the machine. (Dimension a)

④ After measuring the tracking in forward travel, turn the upperstructure 180°and measure that in reverse travel.

⑤ Repeat steps ③ and ④ three times and calculate the average values.



7-7(2) 140-7

(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
HX19A	200 below	240	

6) SWING SPEED

(1) Measure the time required to swing three complete turns.

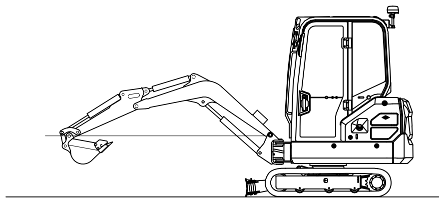
(2) Preparation

① Check the lubrication of the swing gear and swing bearing.

② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.

④ Keep the hydraulic oil temperature at 50±5°C.



19A6MS08

(3) Measurement

① Operate swing control lever fully.

② Swing 1 turn and measure time taken to swing next 2 revolutions.

③ Repeat steps ① and ② three time and calculate the average values.

(4) Evaluation

The time required for 2 swings should meet the following specifications.

Unit : Seconds / 2 revolutions

Model	Standard	Remarks
HX19A	13.0±1.0	

7) SWING FUNCTION DRIFT CHECK

(1) Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

(2) Preparation

① Check the lubrication of the swing gear and swing bearing.

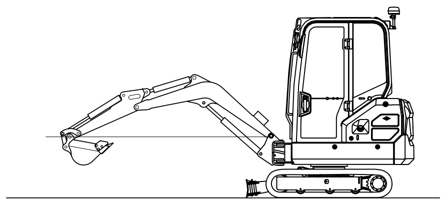
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.

④ Make two chalk marks: one on the swing bearing and one directly below it on the track frame.

⑤ Swing the upperstructure 360°.

⑥ Keep the hydraulic oil temperature at 50±5°C.



19A6MS08

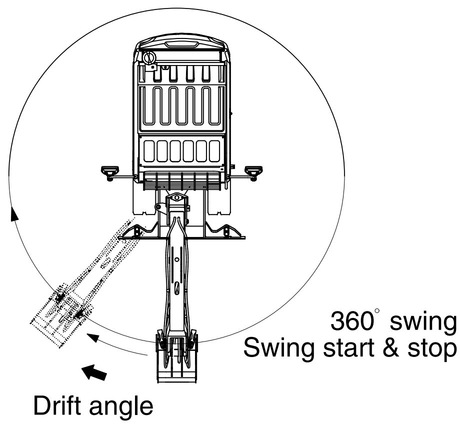
(3) Measurement

① Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360 °

② Measure the distance between the two marks.

③ Align the marks again, swing 360 °, then test the opposite direction.

④ Repeat steps ② and ③ three times each and calculate the average values.



19A6MS09

(4) Evaluation

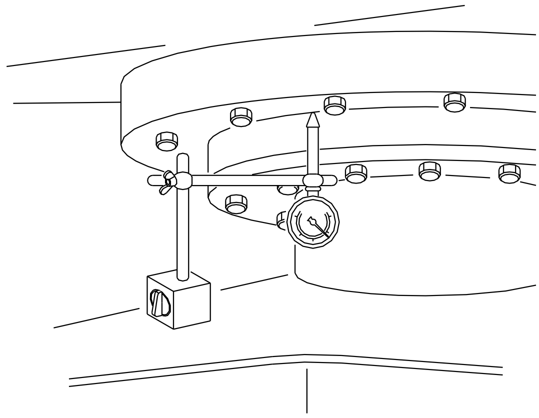
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Standard	Maximum allowable	Remarks
HX19A	40 below	50	

8) SWING BEARING PLAY

(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.



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(2) Preparation

① Check swing bearing mounting cap screws for loosening.

② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.

③ Install a dial gauge on the track frame as shown, using a magnetic base.

④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.

⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.

⑥ Bucket should be empty.

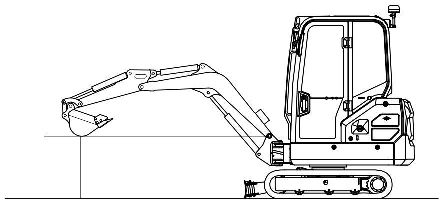
(3) Measurement

① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.
Record the dial gauge reading (h1).

② Lower the bucket to the ground and use it to raise the front idler 50 ㎝.
Record the dial gauge reading (h2).

③ Calculate bearing play (H) from this data (h1 and h2) as follows.
H=h2-h1

Measurement : h1



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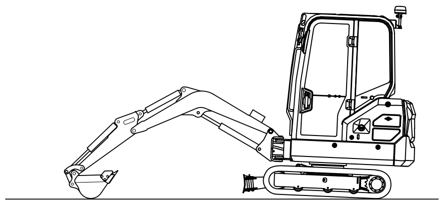
Measurement : h2



19A6MS11

(4) Evaluation

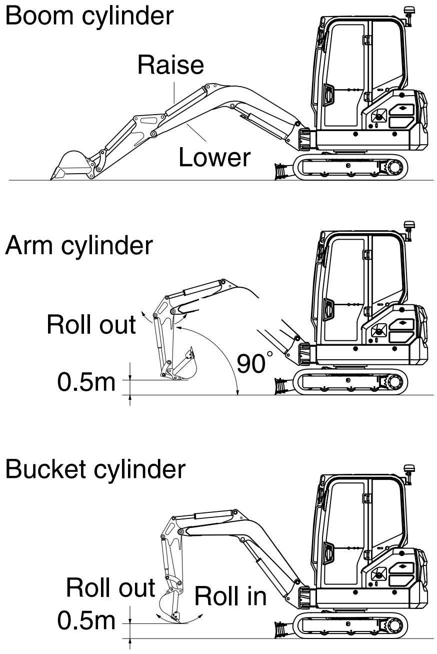
The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX19A	0.5 ~ 1.2	2.4	

9) HYDRAULIC CYLINDER CYCLE TIME

(1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.



(2) Preparation

① To measure the cycle time of the boom cylinders:
With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

② To measure the cycle time of the arm cylinder.
With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5m above the ground.

③ To measure the cycle time of the bucket cylinder.
The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

④ Keep the hydraulic oil temperature at 50±5°C.

(3) Measurement

① To measure cylinder cycle times.

- Boom cylinders
Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.

- Arm cylinder
Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

- **Bucket cylinders**
  Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.
- Repeat each measurement 3 times and calculate the average values.

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

Model	Function	Standard	Remarks
HX19A	Boom raise	2.3±0.4	
	Boom lower	1.7±0.4	
	Arm in	2.4±0.4	
	Arm out	1.6±0.4	
	Bucket load	2.9±0.4	
	Bucket dump	2.0±0.4	
	Boom swing (LH)	5.0±0.4	
	Boom swing (RH)	3.7±0.4	
	Dozer up (raise)	1.8±0.3	
	Dozer down (lower)	2.0±0.3	
	Angle dozer up (raise)	2.2±0.3	
	Angle dozer down (lower)	2.1±0.3	

10) DIG FUNCTION DRIFT CHECK

(1) Measure dig function drift, which can be caused by oil leakage in the control valve and boom, standard arm, and standard bucket cylinders, with the loaded bucket. When testing the dig function drift just after cylinder replacement, slowly operate each cylinder to its stroke end to purge air.

(2) Preparation

① Load bucket fully. Instead of loading the bucket, weight (W) of the following specification can be used.

· $W = M^3 \times 1.5$

Where :

M^3 = Bucket heaped capacity(m^3)

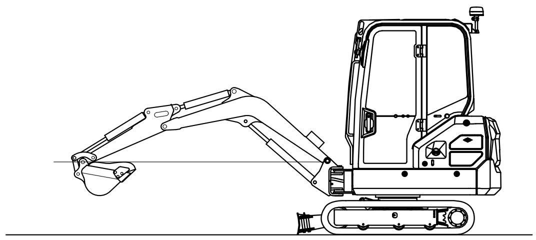
1.5= Soil specific gravity

② Position the arm cylinder with the rod 20 to 30 mm extended from the fully retracted position.

③ Position the bucket cylinder with the rod 20 to 30 mm retracted from the fully extended position.

④ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin.

⑤ Keep the hydraulic oil temperature at 50±5°C.



19A6MS13

(3) Measurement

① Stop the engine.

② Five minutes after the engine has been stopped, measure the changes in the positions of the boom, arm and bucket cylinders.

③ Repeat step ② three times and calculate the average values.

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX19A	Boom cylinder	10 below	20	
	Arm cylinder	20 below	30	
	Bucket cylinder	20 below	30	

11) CONTROL LEVER OPERATING FORCE

(1) Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

(2) Preparation

① Keep the hydraulic oil temperature at 50±5°C.

(3) Measurement

① Start the engine.

② Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.

③ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.

④ Repeat steps ② and ③ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX19A	Boom lever	1.8 or below	1.9	
	Arm lever	1.8 or below	1.9	
	Bucket lever	1.8 or below	1.9	
	Swing lever	1.8 or below	1.9	
	Travel lever	2.0 or below	2.5	

12) CONTROL LEVER STROKE

(1) Measure each lever stroke at the lever top using a ruler.

※ **When the lever has play, take a half of this value and add it to the measured stroke.**

(2) Preparation

Keep the hydraulic oil temperature at 50±5°C.

(3) Measurement

① Stop the engine.

② Measure each lever stroke at the lever top from neutral to the stroke end using a ruler.

③ Repeat step ② three times and calculate the average values.

(4) Evaluation

The measured drift should be within the following specifications.

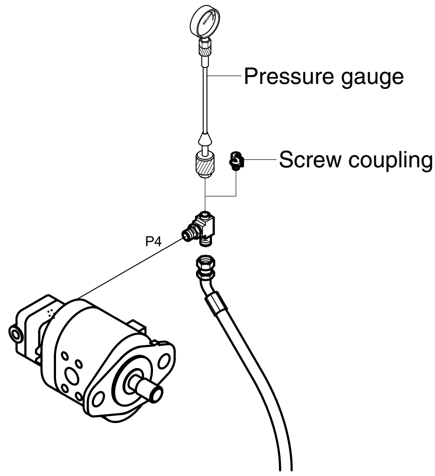
Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX19A	Boom lever	75±10	94	
	Arm lever	75±10	94	
	Bucket lever	75±10	94	
	Swing lever	75±10	94	
	Travel lever	133±10	166	

13) PILOT PRIMARY PRESSURE

(1) Preparation

① Stop the engine.
② Loosen the cap of screw coupling at the fitting near pilot pump and connect pressure gauge.
③ Start the engine and check for oil leakage from the port.
④ Keep the hydraulic oil temperature at 50±5˚C.



19A6MS14

(2) Measurement

① Measure the primary pilot pressure.

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm^2

Model	Standard	Remarks
HX19A	35±5	

14) FOR TRAVEL SPEED SELECTING PRESSURE

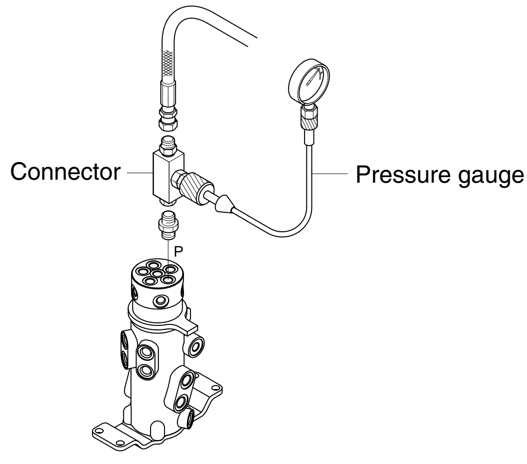
(1) Preparation

① Stop the engine.

② To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P2 port as shown.

③ Start the engine and check for on leakage from the adapter.

④ Keep the hydraulic oil temperature at 50±5°C.



19A6MS15

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed

② Measure the travel speed selecting pressure in the Hi or Lo mode.

③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.

④ Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX19A	1 Speed	0	-	
	2 Speed	35±5	-	

15) MAIN PUMP DELIVERY PRESSURE

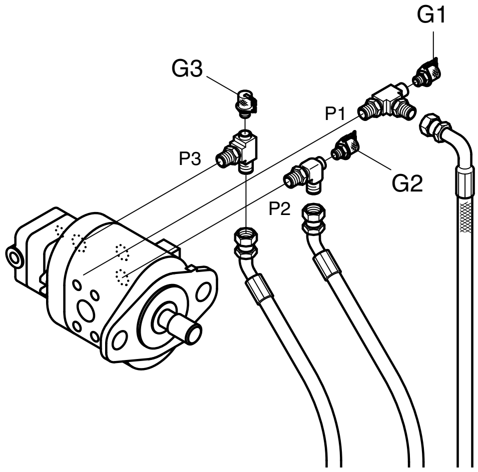
(1) Preparation

① Stop the engine.

② To measure the main pump pressure. Loosen the cap of screw coupling and connect pressure gauge to the main pump gauge port(G1, G2, G3) as shown.

③ Start the engine and check for oil leakage from the port.

④ Keep the hydraulic oil temperature at 50±5°C.



19A6MS16

(2) Measurement

① Measure the main pump delivery pressure at high idle.

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
HX19A	High idle	20±5	-	

16) SYSTEM PRESSURE REGULATOR RELIEF SETTING

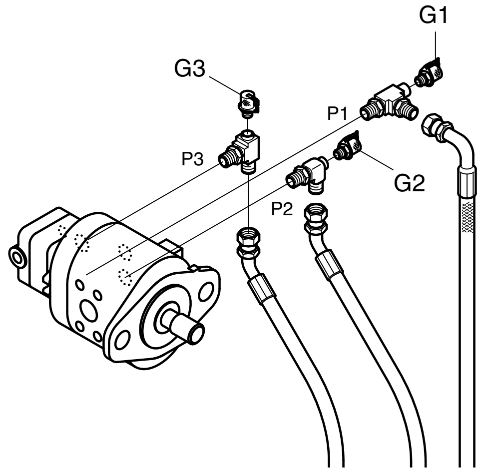
(1) Preparation

① Stop the engine.

② To measure the system relief pressure. Loosen the cap of screw coupling and connect pressure gauge to the main pump gauge port(G1, G2, G3) as shown.

③ Start the engine and check for oil leakage from the port.

④ Keep the hydraulic oil temperature at 50±5°C.



19A6MS16

(2) Measurement

① Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

② In the swing function, place bucket against an immovable object and measure the relief pressure.

③ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Function to be tested	Standard
HX19A	Boom, Arm, Bucket	210±10
	Travel	210±10
	Swing	200±10

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP

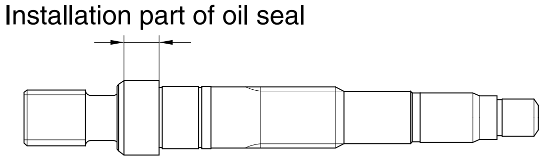
Before inspection, wash the parts well and dry them completely.

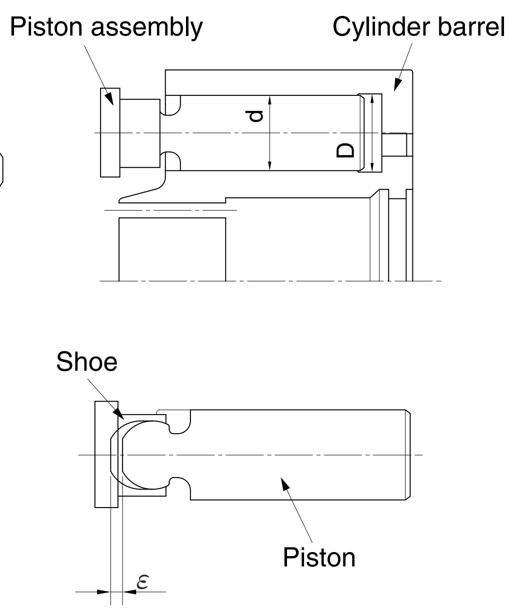
Inspect the principal parts with care and replace them with new parts when any abnormal wear exceeding the allowable limit or damage considered harmful is found.

Replace the seal also when any remarkable deformation and damage are found.

1) INSPECTION POINTS WHEN DISASSEMBLED

Part	Extent of the damage	Inspection standard	Action
Shaft	Excessive wear on the seal surface.	Worn depth : 0.025 mm or more	Replace the shaft.
Valve plate	Excessive wear or damages on the sliding surface.	Worn depth : 0.020 mm or more	Replace the cylinder barrel kit.
Cylinder barrel	Excessive wear or damages on the sliding surface.	Worn depth : 0.020 mm or more	Replace the cylinder barrel kit.
	Clearance between the pistons (D-d)	0.030 mm or more	Replace the cylinder barrel kit.
Piston and shoe	Wear of joint section	Check play (ε) between the shoe and the piston ε: 0.2 mm or more by hand operation.	Replace the cylinder barrel kit.
Seals (O-rings, gasket, etc.)	Damage, excessive rust	-	Replace each part.





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2) TROUBLESHOOTING AND COUNTERMEASURE

No.	Trouble	Possible cause	Countermeasure
1	Overload to engine	· Speed is higher than standard · Setting pressure is higher than specifications · Damage of internal parts of pump	· Readjust it as standard · Readjust it as spec · Repair or replace
2	Low pump flow or low pressure	· Speed down of engine · Wrong coupling · Damage of internal parts of pump	· Readjust of engine speed · Repair or replace · Repair or replace
3	Abnormal noise or abnormal vibration (cavitations)	· The level of oil in the tank is low · Air in the oil · Water in the oil · Clog of suction filter · High suction pressure · Damage of piston shoe · Installation condition is no good · Wrong coupling	· Replenish a tank with oil · Check piping Bleed the air in the hydraulic circuit · Replace oil · Clean or replace · Correction · Replace · Correction · Replace
4	Oil leakage	· Damage of O-ring or packing · Loosened plug · Leaking from oil seal	· Replace · Tight up · Replace Replace of oil seal

2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Block	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Seal section of port where O-ring contacts. - Seal section of each relief valve for main, travel, and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool in casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (Especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of poppet or spring · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & Anti cavitation valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

3. SWING MOTOR

Condition	Cause	Correction
Motor will not turn	· No oil · Pump broken · Relief valve stuck open or set too low	· Fill reservoir to proper oil level. · Replace pump. · Clean and free relief valve spool and adjust to proper setting.
Slow operation	· Low oil viscosity · Worn pump · Extremely high fluid temperatures · Relief setting too low	· Use proper viscosity oil. · Repair or replace pump. · Increase reservoir size or add oil cooler. · Set relief valve for proper pressure.
Erratic motor operation	· Relief setting too low · Air sucked in inlet side of pump	· Set relief valve for proper pressure. · Tighten pipe fitting on pump inlet side.
Motor turns in wrong direction	· Wrong piping · The valve timing is incorrect due to a disassembling error.	· Reverse the piping · Disassemble and reassemble the unit and correct valve timing.
Fluid leakage	· Loose bolts or plugs. · Scratched or abraded O-ring · Scratched or abraded X-ring	· Tighten bolts and plugs by the correct torque. · Replace the O-ring with a new one. · Replace the X-ring with a new one. Lower the drain pressure until it is within the allowable range.
Abnormal sound	· Air is remaining in the circuit and motor. · Pump cavitation.	· Bleed air completely. · Remove substance clogging the suction filter. Enlarge the diameter of the suction pipe of the pump. Raise the boost pump pressure.

※ In case of, caused from life, torque or revolution declined or increase of noise, repair the motor or replace for new one.

4. TRAVEL MOTOR

1) MAINTENANCE STANDARD FOR TRAVEL MOTOR

Travel motors basically don't require maintenance except changing the reducer lubricant. Don't disassemble the motor unless there are problem with it. Refer to the following standards for parts (kits) replacement.

(1) Reducer

No.	Part name	Point to be checked	Standard	Action
1	Body (internal gear)	Engaging tooth surface with B1 and B2 gears	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
2	Carrier 2	Spline tooth surface	No abnormal damage, wear	Replace whole carrier 2 kit
		Loose of B2 pins	No loose by hand	
3	B1 gears	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
		Needle rolling contact surface	No flaking and pitching	
4	B2 gears	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace whole carrier 2 kit
		Needle rolling contact surface	No flaking and pitching	
5	S1 gear	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace whole carrier 2 kit
6	S2 gear	Engaging tooth surface with B2 gears	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
		Spline tooth surface	No abnormal damage, wear	
7	B2 pins	Needle rolling contact surface	No flaking and pitching	Replace whole carrier 2 kit
8	Floating seals	Seat surface	No abnormal damage, wear	Replace
		O-ring surface	No damage, deformation, and hardening	
9	Angular ball bearings	Rolling contact surface	No abnormal damage, flaking	Replace
10	Needles	Rolling contact surface	No flaking and pitching	Replace whole carrier 2 kit
11	O-rings	Surface, hardness	No damage, deformation, and hardening	Replace

(2) Hydraulic valve and motor

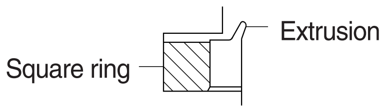
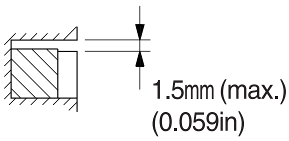
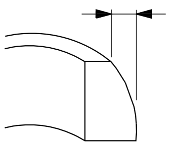
No.	Part name	Point to be checked	Standard	Action
12	Body 1	Spool sliding contact surface	No abnormal damage, wear	Relpace whole body 1 kit
13	Counter valve spool Two-speed spool Shuttle spool	Body 1 sliding contact surface	No abnormal damage, wear	Relpace whole body 1 kit
14	Body 2	Spline tooth surface	No abnormal damage, wear	Replace whole body 2 kit
		Control piston sliding contact surface	No abnormal damage, wear Clearance between piston and body 2 is 0.023 mm or smaller	
		Swash plate installaion surface	No abnormal damage, wear	
		Ball sliding contact surface	No abnormal damage, wear	
15	Shaft	Spline tooth surface	No abnormal damage, wear	Replace shaft kit
		Oil seal sliding contact surface	No abnormal damage, wear (0.025 mm or greater)	
16	Cylinder barrel	Piston sliding contact surface	No abnormal damage, wear Clearance between piston and cylinder barrel is 0.030 mm or smaller	Replace cylinder barrel kit
		Valve place sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
17	Valve plate	Cylinder barrel sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
18	Pistons Shoes	Cylinder barrel sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Replace cylinder barrel kit
		Swash plate sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
		Loose of shoe calking part	Loose is smaller than 0.3 mm	Replace cylinder barrel kit
19	Shoe holder	Barrel holder sliding contact surface	No abnormal damage, wear	Replace cylinder barrel kit
20	Barrel holder	Spline tooth surface	No abnormal damage, wear	Replace cylinder barrel kit
		Shoe holder sliding contact surface	No abnormal damage, wear	
21	Swash plate	Shoe sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace
		Ball sliding contact surface	No abnormal damage, wear	Replace
22	Control piston	Body 2 sliding contact surface	Clearance between piston and body 2 is 0.023 mm or smaller	Replace body 2 kit
23	Oil seal	Lip surface	No abnormal damage, wear and deformation	Replace
24	Ball bearing	Rolling contact surface	No abnormal damage, flaking	Replace
25	Springs	Surface	No crack	Replace
26	O-rings	Surface and hardness	No damage, deformation, and hardening	Replace

2) FAILURE DIAGNOSIS OF TRAVEL MOTOR

Failure detail	Major causes	Countermeasure
Doesn't start	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal working pressure is supplied to the motor inlet port.
	Defect in reducer - Damage of inner parts	 Replace the damaged part (kit).
	Defect in hydraulic motor - Oil leakage due to abnormal wear of the sliding parts - Damage of inner parts	 Replace the worn part (kit). Replace the damaged part (kit).
	Defect in hydraulic valve - Spool doesn't move Foreign object is caught in the spool sliding part. Choke is clogged	 Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object.
Doesn't stop or stop slowly	Defect in hydraulic valve - Spool doesn't return Foreign object is caught in the spool sliding part. Choke is clogged. Spring is damaged. - Check valve doesn't close due to foreign object being caught on the seat.	 Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object. Replace the body 1 kit. Remove the foreign object. In case of much leakage, replace the body 1 kit.
Rotating speed is slow	Prescribed flow rate is not supplied to the motor due to operating defect in the pump.	Inspect and repair or replace the pump.
	Volumetric efficiency declines due to defect in the motor. - Abnormal wear of sliding parts	 Replace the worn part (kit).
	Volumetric efficiency declines due to defect in the hydraulic valve. - Abnormal wear of main spool and two speed spool sliding part	 Replace body 1 kit.

Failure detail	Major causes	Countermeasure
Doesn't change to two speed	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal pressure is supplied to the pilot port.
	Defect in the hydraulic valve - Two speed spool doesn't move due to foreign object being caught in the spool sliding part. - Choke in the two speed pilot line is clogged.	 Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object.
	Defect in the hydraulic motor - Control piston doesn't move. Foreign object is caught in the piston sliding part. Oil leakage due to abnormal wear of the sliding part. Oil leakage due to damage of O-ring located between body 1 and body 2.	 Remove the foreign object. In case of much leakage, replace the body 2 kit. Replace the worn part (kit). Replace the O-ring.
Doesn't change to one speed	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal pressure is supplied to the pilot port.
	Defect in the hydraulic valve - Two speed spool doesn't move. Foreign object is caught in the spool sliding part. Damage of spring - Choke in the two speed pilot line is clogged.	 Remove the foreign object. In case of much leakage, replace the body 1 kit. Replace the body 1 kit. Remove the foreign object.
Tracking deviation	Same as No.3, 4 and 5	-
Oil leakage	Oil leakage due to damage of O-rings. - Damage of O-ring located in the reducer cover. - Damage of O-rings located between body 1 and body 2.	 Replace the O-ring. Replace the O-ring.
	Oil leakage from the floating seals - Abnormal wear of the seat surface or damage of the O-ring. - Pressure in the reducer casing rises due to damage of the oil seal.	 Replace the floating seal. Replace the oil seal.

5. TURNING JOINT

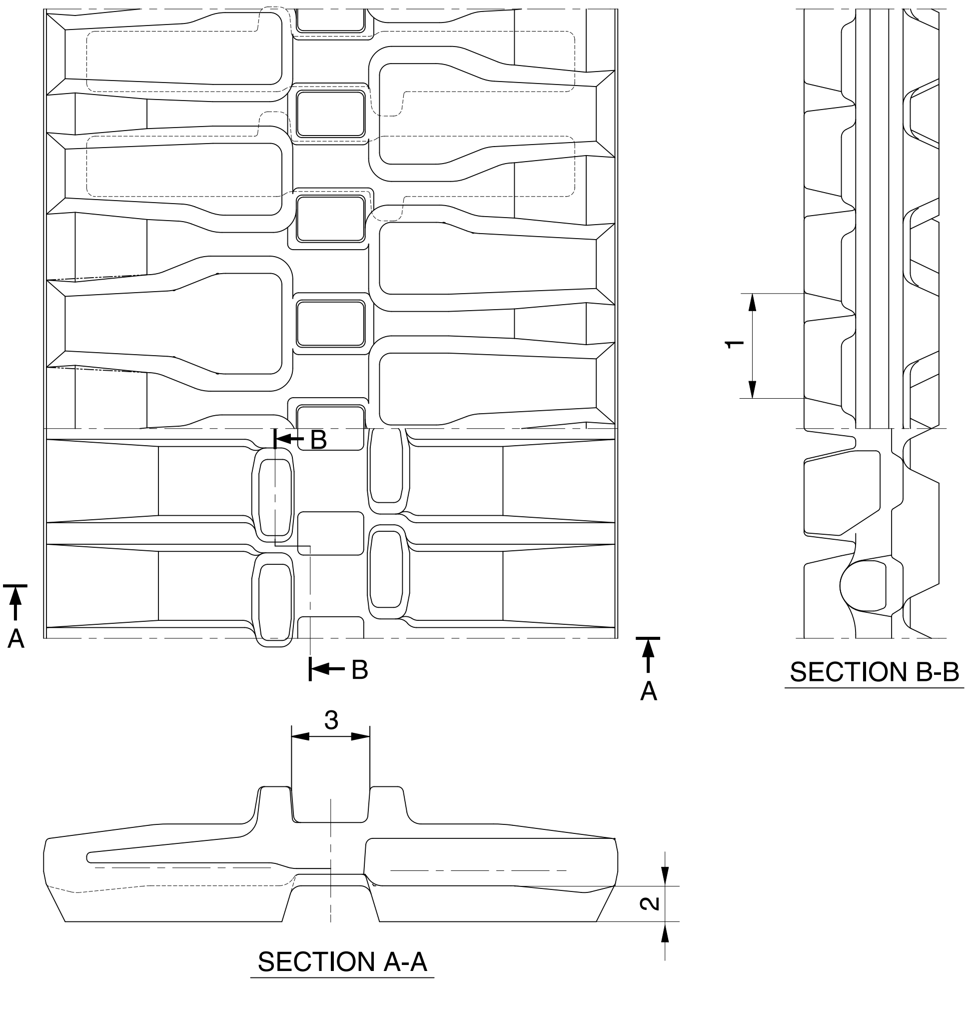
Parts Name		Check Points	Measures
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring. 	Replace
	-	· Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring. 	Replace
	-	· Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in) 	Replace

6. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached.	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal.	· Replace or replate
		· Rust is not present on plating.	· Replace or replate
		· Scratches are not present.	· Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
	· Bushing at mounting part	· Wear of I.D.	· Replace
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace
	· Weld on head	· Presence of crack	· Replace
	· Weld on hub	· Presence of crack	· Replace
	· Tube interior	· Presence of faults	· Replace if oil leak is seen
	· Bushing at mounting part	· Wear on inner surface	· Replace
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating

1. TRACK SHOE

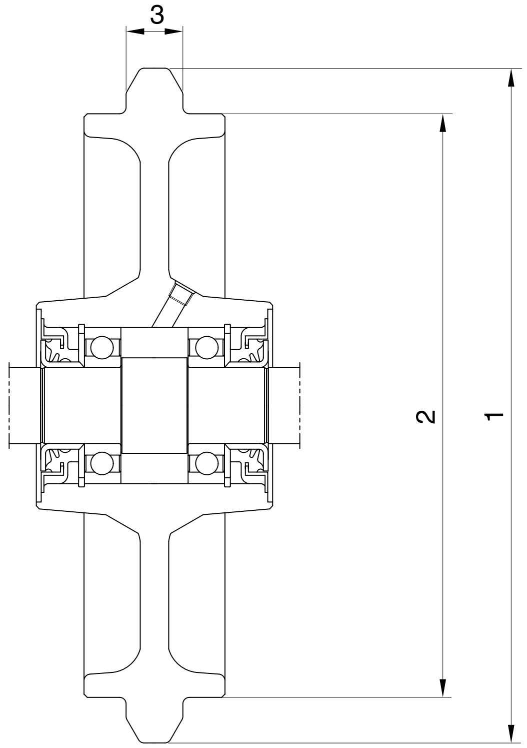
1) RUBBER SHOE SPEC



Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Link pitch	48	50	Replace
2	Height of grouser	20	5	
3	Width of link	34	44	

2. IDLER



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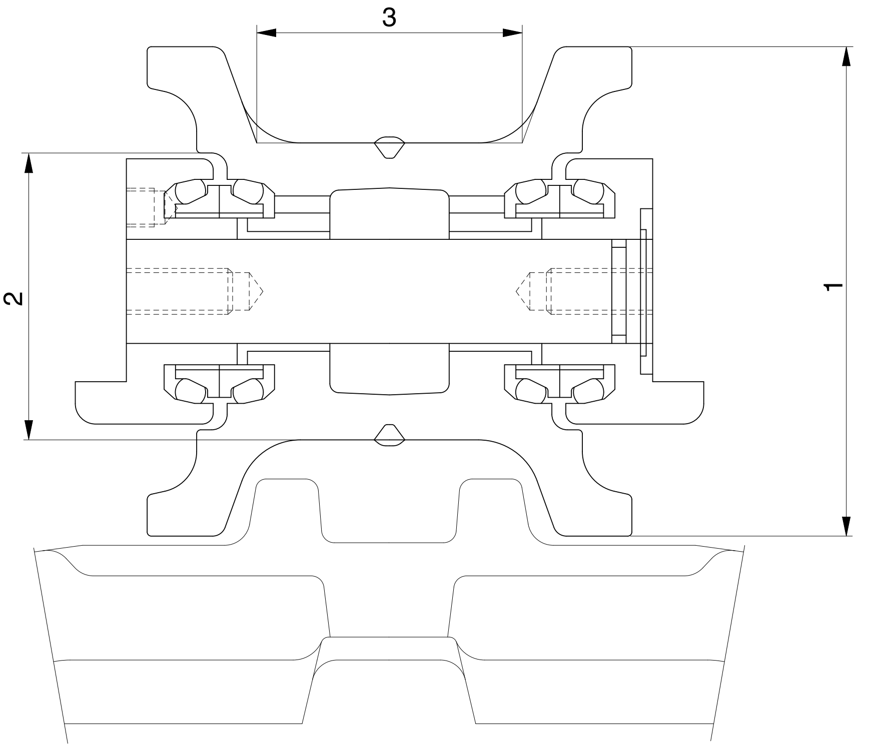
Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Rubber	249	-	Rebuild or replace
2	Outside diameter of thread	Rubber	216	210	
3	Width of flange		25	19	

3. TRACK ROLLER

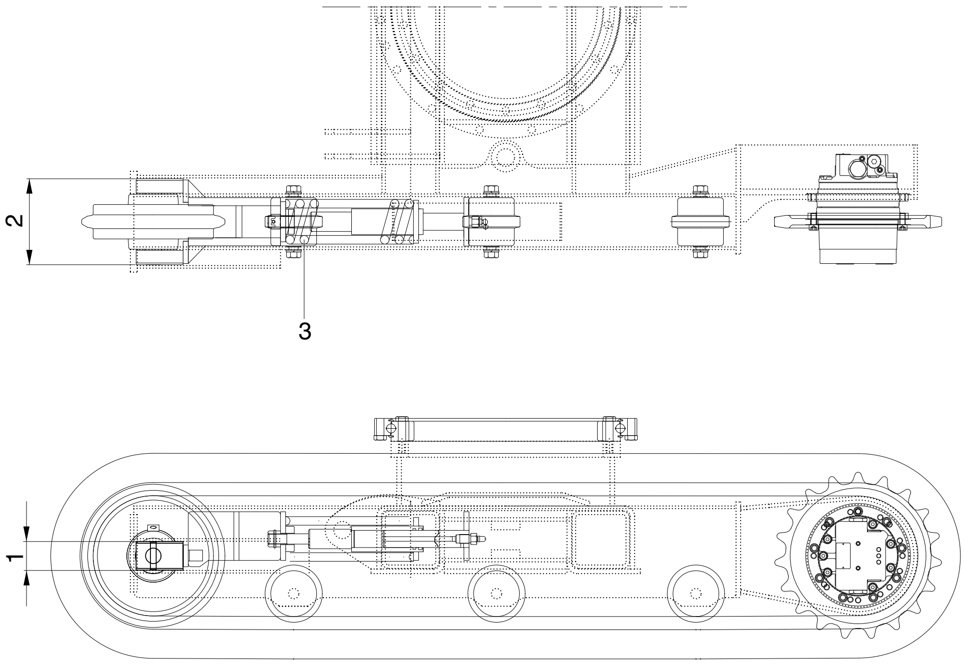


17Z9A6MC13

Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Rubber	118	112	Rebuild or replace
2	Outside diameter of thread	Rubber	72	-	
3	Width of flange		64	70	

4. TENSION CYLINDER

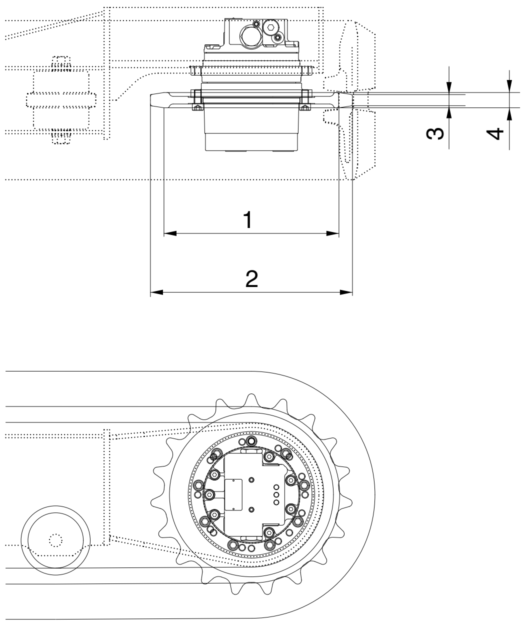


17Z9A6MC16

Unit : mm

<table>
<tr><th rowspan="2">No</th><th rowspan="2">Check item</th><th colspan="5">Criteria</th><th rowspan="2">Remedy</th></tr>
<tr><th></th><th colspan="2">Standard size</th><th colspan="2">Repair limit</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Vertical width of idler guide</td><td>Track frame</td><td colspan="2">51</td><td colspan="2">53</td><td>Rebuild</td></tr>
<tr><td>Idler support</td><td colspan="2">49</td><td colspan="2">47</td><td>Rebuild or replace</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td colspan="2">151</td><td colspan="2">155</td><td>Rebuild</td></tr>
<tr><td>Idler guide</td><td colspan="2">149</td><td colspan="2">145</td><td>Rebuild or replace</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Installed length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>261</td><td>188</td><td>1785 kg</td><td>-</td><td>1540 kg</td></tr>
</table>

5. SPROCKET

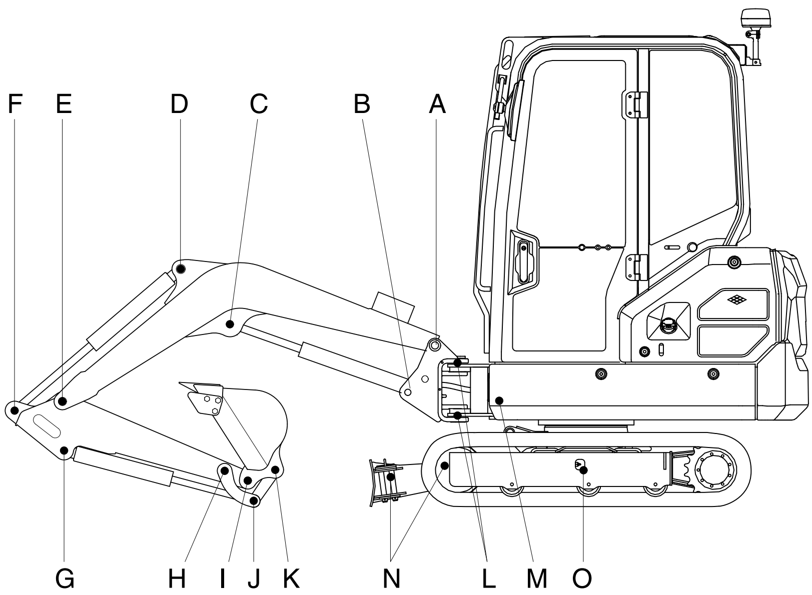


17Z9A6MC22

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Wear out of sprocket tooth lower side diameter	253	247	Rebuild or Replace
2	Wear out of sprocket tooth upper side diameter	292	-	
3	Wear out of sprocket tooth upper side width	16	-	
4	Wear out of sprocket tooth lower side width	22	16	

6. WORK EQUIPMENT



Unit : ㎜

Mark	Measuring point (Pin and Bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom rear	35	34	33.5	35.5	36	Replace
B	Boom cylinder head	30	29	28.5	30.5	31	〃
C	Boom cylinder rod	30	29	28.5	30.5	31	〃
D	Arm cylinder head	30	29	28.5	30.5	31	〃
E	Boom front	30	29	28.5	30.5	31	〃
F	Arm cylinder rod	30	29	28.5	30.5	31	〃
G	Bucket cylinder head	30	29	28.5	30.5	31	〃
H	Arm link	30	29	28.5	30.5	31	〃
I	Bucket and arm link	30	29	28.5	30.5	31	〃
J	Bucket cylinder rod	30	29	28.5	30.5	31	〃
K	Bucket link	30	29	28.5	30.5	31	〃
L	Boom swing post	45	44	43.5	45.5	46	〃
M	Boom swing cylinder	30	29	28.5	30.5	31	〃
N	Blade cylinder	30	29	28.5	30.5	31	〃
O	Blade and frame link	30	29	28.5	30.5	31	〃

SECTION 7 DISASSEMBLY AND ASSEMBLY

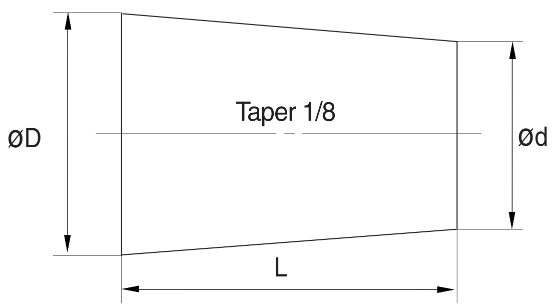
SECTION 7 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

1) Lower the work equipment completely to the ground.
   If the coolant contains antifreeze, dispose of it correctly.
2) After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
3) When draining oil, prepare a container of adequate size to catch the oil.
4) Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
5) To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.
6) Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
7) Check the number and thickness of the shims, and keep in a safe place.
8) When raising components, be sure to use lifting equipment of ample strength.
9) When using forcing screws to remove any components, tighten the forcing screws alternately.
10) Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.
11) When removing hydraulic equipment, first release the remaining pressure inside the hydraulic tank and the hydraulic piping.
12) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Dimensions		
	D	d	L
06	6	5	8
08	8	6.5	11
10	10	8.5	12
12	12	10	15
14	14	11.5	18
16	16	13.5	20
18	18	15	22
20	20	17	25
22	22	18.5	28
24	24	20	30
27	27	22.5	34



2. INSTALL WORK

1) Tighten all bolts and nuts (sleeve nuts) to the specified torque.
2) Install the hoses without twisting or interference.
3) Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
4) Bend the cotter pin or lock plate securely.
5) When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.
6) When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
7) Clean all parts, and correct any damage, dents, burrs, or rust.
8) Coat rotating parts and sliding parts with engine oil.
9) When press fitting parts, coat the surface with antifriction compound (LM-P).
10) After installing snap rings, check that the snap ring is fitted securely in the ring groove (Check that the snap ring moves in the direction of rotation).
11) When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
12) When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.
13) When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.
14) When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:
   (1) Start the engine and run at low idling.
   (2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100 mm before the end of the stroke.
   (3) Next, operate the piston rod to the end of its stroke to relieve the circuit. (The air bleed valve is actuated to bleed the air.)
   (4) After completing this operation, raise the engine speed to the normal operating condition.
   If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to the work equipment.
   Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

3. COMPLETING WORK

1) If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.

2) If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.

4) Add the specified amount of grease (Molybdenum disulphide grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket)	M10 × 1.25	5.35±0.35	38.7±2.5
2		Engine mounting bolt (bracket-frame)	M12 × 1.75	13.0±1.0	94±7.2
3		Radiator mounting bolt, nut	M12 × 1.75	12.8±3.0	92.6±21.7
4		Coupling mounting bolt	M10 × 1.5	5.2±0.3	37.6±2.2
5		Flywheel housing mounting bolt, nut	M 8 × 1.25	2.6±0.2	18.8±0.4
6		Fuel tank mounting bolt	M10 × 1.5	6.9±1.4	49.9±10.1
7	Hydraulic system	Main pump mounting bolt	M12 × 1.75	14.7±2.2	106±15.9
8		Main control valve mounting bolt	M10 × 1.5	6.9±1.4	49.9±10.1
9		Hydraulic oil tank mounting bolt	M10 × 1.5	6.9±1.4	49.9±10.1
10		Turning joint mounting bolt, nut	M10 × 1.5	6.9±1.4	49.9±10.1
11	Power train system	Swing motor mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7
12		Swing bearing upper mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7
13		Swing bearing lower mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7
14		Travel motor mounting bolt	M10 × 1.5	6.9±1.4	49.9±10.1
15		Sprocket mounting bolt	M10 × 1.5	6.9±0.7	49.9±10.1
16	Under carriage	Track roller mounting bolt	M12 × 1.75	12.3±1.2	89±8.7
17	Others	Counterweight mounting bolt	M16 × 2.0	29.7±4.5	215±32.5
18		Canopy/Cab mounting bolt, nut	M12 × 1.75	12.8±3.0	92.6±21.7
19		Operator's seat mounting bolt	M 8 × 1.25	1.17±0.1	8.5±0.7
20		Lower frame lower cover mounting bolt	M10 × 1.5	6.9±1.4	49.9±10.1
21		Travel motor cover mounting bolt	M10 × 1.5	6.9±1.4	49.9±10.1

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kgf·m	lbf·ft	kgf·m	lbf·ft
M 6×1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8×1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.7 ~ 4.1	19.5 ~ 29.7
M10×1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12×1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14×2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16×2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18×2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20×2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22×2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24×3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30×3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36×4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kgf·m	lbf·ft	kgf·m	lbf·ft
M 8×1.0	2.2 ~ 3.4	15.9 ~ 24.6	3.0 ~ 4.4	21.7 ~ 31.8
M10×1.2	4.5 ~ 6.7	32.5 ~ 48.5	5.9 ~ 8.9	42.7 ~ 64.4
M12×1.25	7.8 ~ 11.6	56.4 ~ 83.9	10.6 ~ 16.0	76.7 ~ 116
M14×1.5	13.3 ~ 18.1	96.2 ~ 131	17.9 ~ 24.1	130 ~ 174
M16×1.5	19.9 ~ 26.9	144 ~ 195	26.6 ~ 36.0	192 ~ 260
M18×1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20×1.5	40.0 ~ 54.0	289 ~ 391	53.4 ~ 72.2	386 ~ 522
M22×1.5	52.7 ~ 71.3	381 ~ 516	70.7 ~ 95.7	511 ~ 692
M24×2.0	67.9 ~ 91.9	491 ~ 665	90.9 ~ 123	658 ~ 890
M30×2.0	137 ~ 185	990 ~ 1339	182 ~ 248	1314 ~ 1796
M36×3.0	192 ~ 260	1390 ~ 1880	262 ~ 354	1894 ~ 2562

2) PIPE AND HOSE (FLARE type)

Thread size (PF)	Width across flat (mm)	kgf·m	lbf·ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

3) PIPE AND HOSE (ORFS type)

Thread size (UNF)	Width across flat (mm)	kgf·m	lbf·ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130
1-7/16-12	41	21	152
1-11/16-12	50	35	253

4) FITTING

Thread size	Width across flat (mm)	kgf·m	lbf·ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

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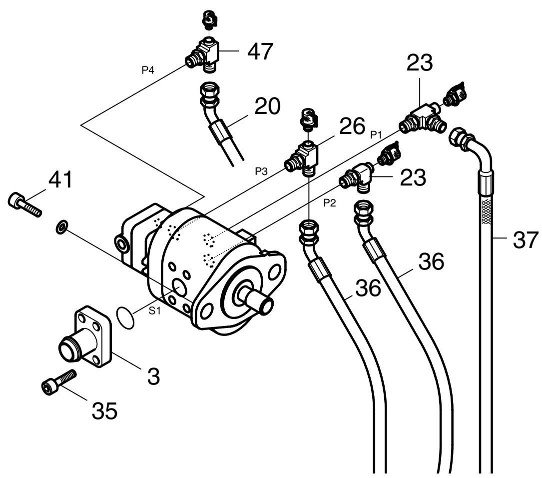
(4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.
· Hydraulic tank quantity : 12.1 ℓ (3.2 U.S.gal)

(5) Disconnect hoses (20) and remove connectors (47).

(6) Disconnect pilot line hoses (36, 37) and remove connectors (23, 26).

(7) Remove socket bolts (35) and disconnect pump suction tube (3).

※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.



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(8) Sling the pump assembly and remove the pump mounting bolts (41).
· Weight : 13 kg (29 lb)
· Tightening torque : 14.7±2.2 kgf·m (106±15.9 lbf·ft)

※ Pull out the pump assembly from housing. When removing the pump assembly, check that all the hoses have been disconnected.

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

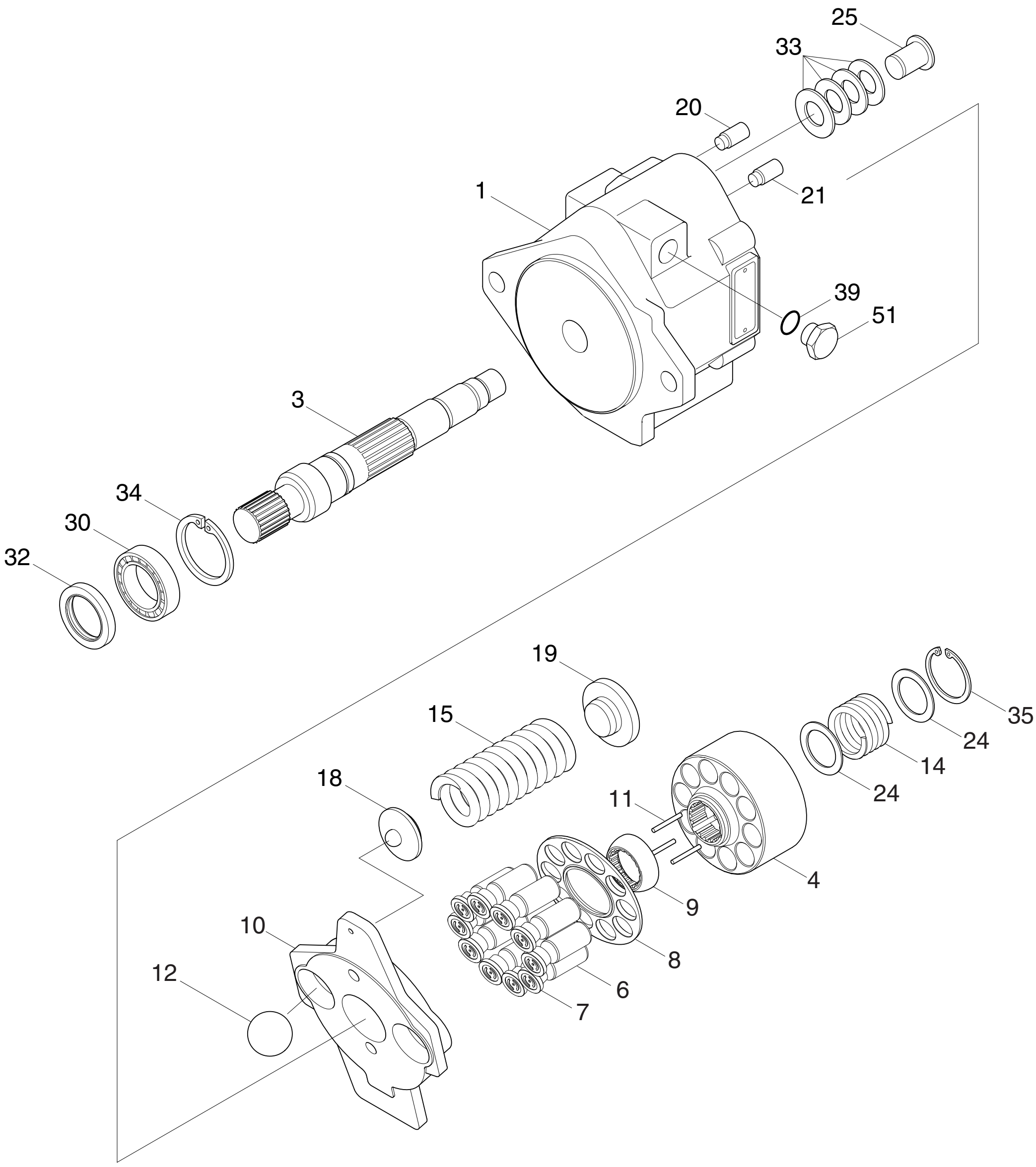
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (1EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

(8) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. MAIN PUMP

1) STRUCTURE (1/2)



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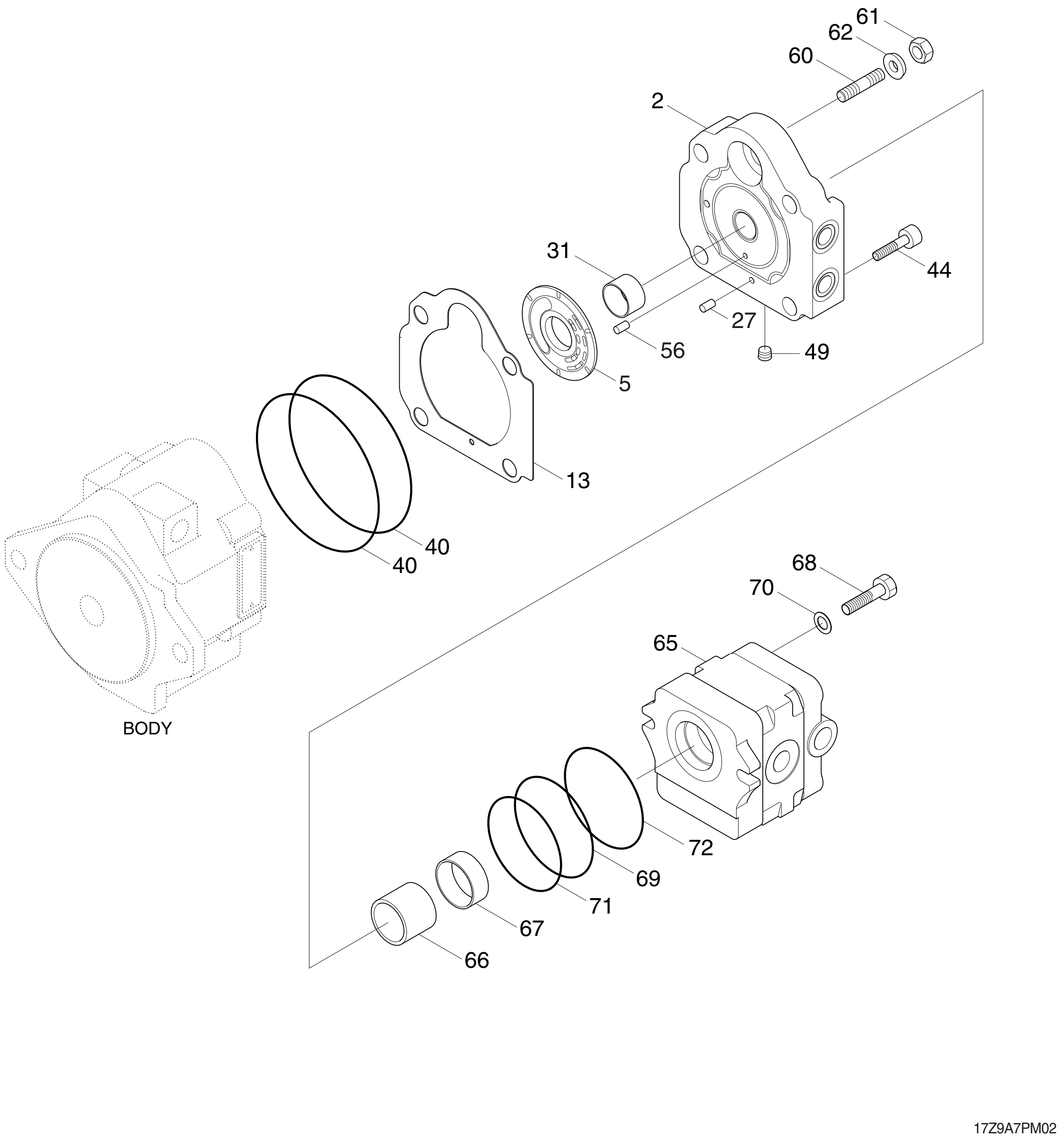
1	Body S	12	Ball	30	Ball bearing
3	Shaft	14	Spring C	32	Oil seal
4	Cylinder barrel	15	Spring T	33	Dish spring
6	Piston	18	Spring holder	34	Snap ring
7	Shoe	19	Spring guide	35	Snap ring
8	Shoe holder	20	Pin	36	Snap ring
9	Barrel holder	21	Rod G	39	O-ring
10	Swash plate	24	Retainer	51	Plug
11	Needle	25	Stopper pin A		

STRUCTURE (2/2)



2	Body H	49	Plug	67	Collar
5	Valve plate	56	Spring pin	68	Screw
13	Packing	60	Screw	69	O-ring
27	Pin	61	Nut	70	Washer
31	Needle bearing	62	Seal washer	71	O-ring
40	O-ring	65	Gear pump assy	72	O-ring
44	Screw	66	Coupling		

3. ASSEMBLE AND DISASSEMBLE

1) General precautions

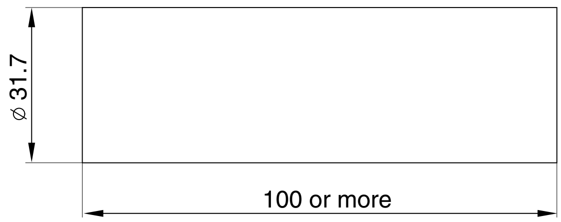
(1) Before disassembling, it is important to have fully understood the internal structure of the pump.

※ The gasket (13), oil seal (32) and O-rings will be probably damaged when you disassemble it, so be sure to have prepared spares.

(2) After having drained oil inside the pump, wash the pump and put it on a working bench covered with clean paper, cloth, or rubber mat for disassembling and assembling. Then, disassemble and assemble the pump slowly and carefully with necessary tools. Use care not to scratch even slightly, and take proper measures to prevent foreign matters from entering the assembly.

2) Tools

Tool name	Size	Quantity
Hexagon wrench	8 mm	1 each
Circlip player	For hole	1
Spanner wrench	13 mm	1
Torque wrench	45N (JIS B 4650) 90N (JIS B 4650)	1 1
Resin hammer	-	1
Special tooling for oil seal	See below	1
Seal kit	-	1 set
Grease	-	Small amount



Special tooling for oil seal

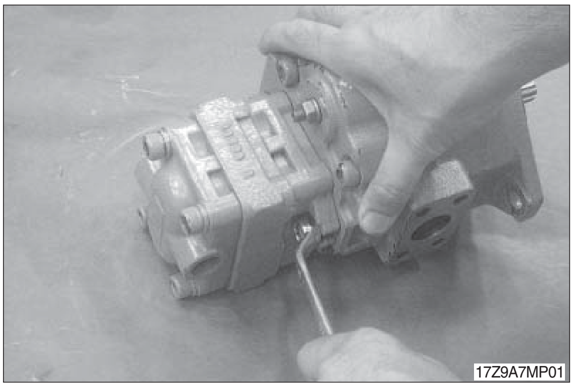
17Z9A7MP98

3) DISASSEMBLING

(1) Disassembling of gear pump

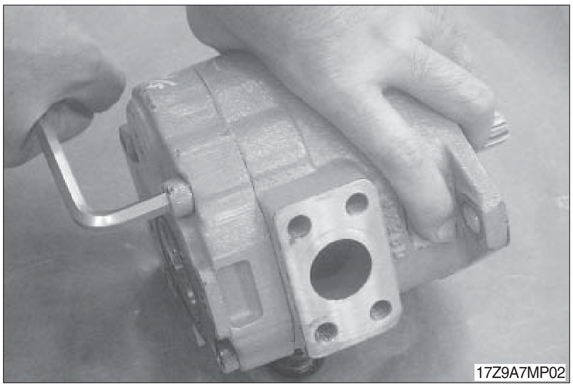
Remove two screws (68) with spanner wrench 13 mm, and after that remove two washer (70), gear pump (65), collar (67) and coupling (66).

※ Coupling (66) and collar (67) may be attached with gear pump kit (65).

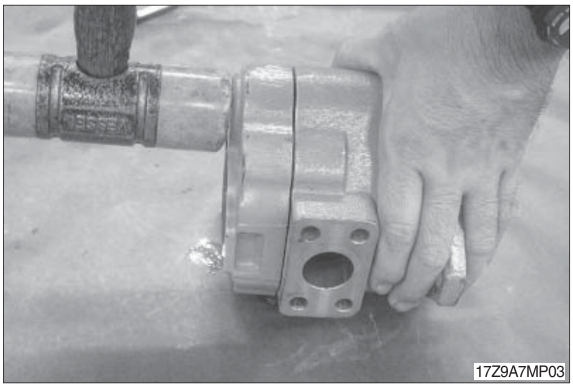


(2) Separation of body S and body H

Remove five screws (44) with hexagon wrench 8 mm.

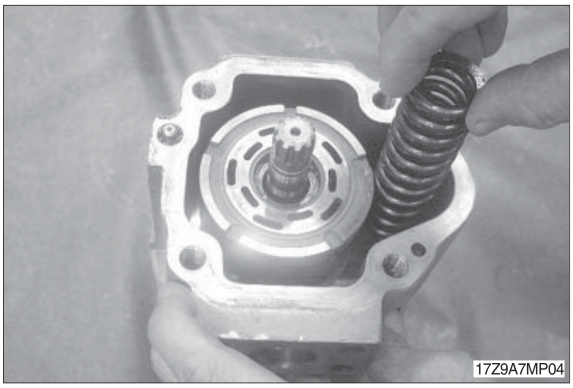


※ If you tap the part of inserted spring of body H with hummer softly, it is easy for separation.

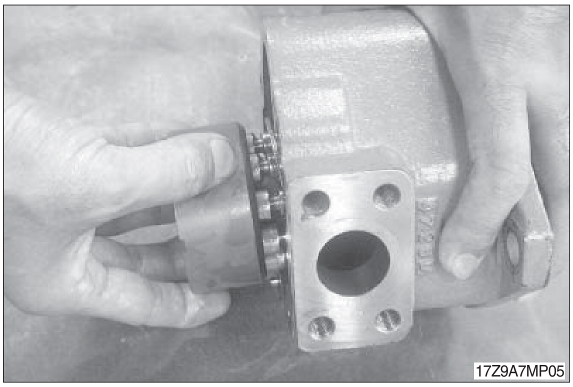


(3) Disassembling of body S kit

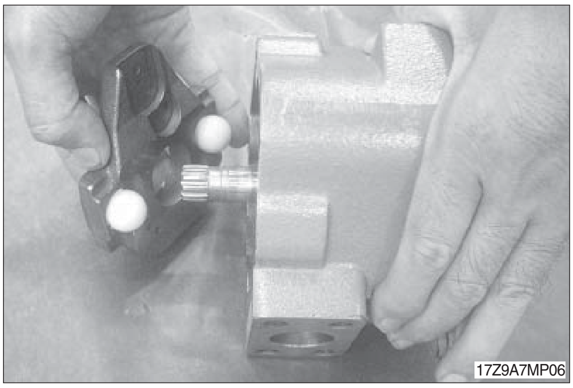
① Remove spring T (15) from body S kit, then take off spring holder (18).



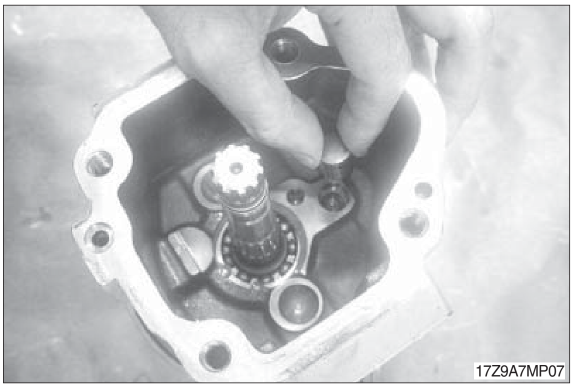
② Remove cylinder barrel kit.


17Z9A7MP05

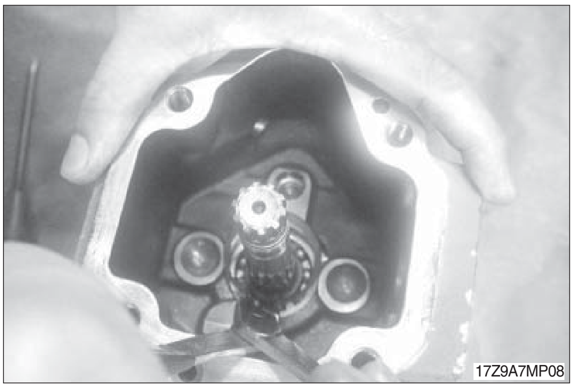
③ Remove swash plate (10) and two balls (12).


17Z9A7MP06

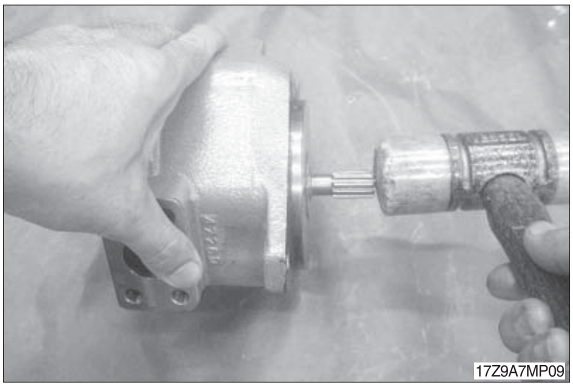
④ Remove stopper pin A (25), dish washers (33), rod G (21).


17Z9A7MP07

⑤ Remove snap ring (34) from body S (1).

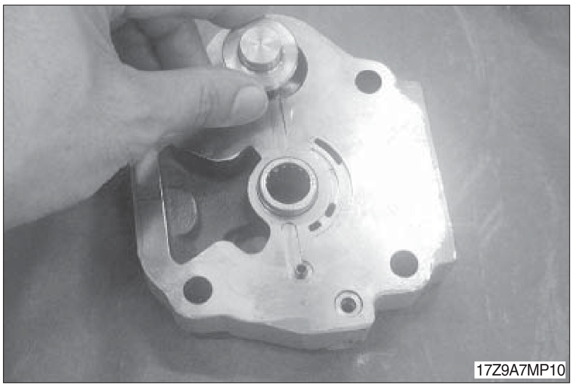

17Z9A7MP08

⑥ Tap the end of shaft (3) with hammer, then shaft with bearing (30) come off.


17Z9A7MP09

(4) Disassembling of body H kit

Remove spring guide (19) from body H.


17Z9A7MP10

4) ASSEMBLING

(1) Precautions during assembling

Reverse the above procedures for assembling.

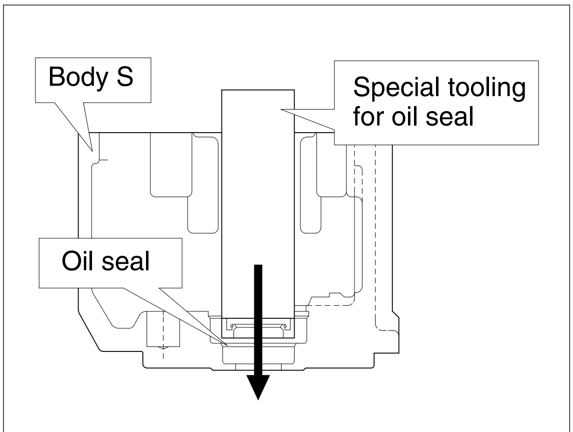
When assembling, be very careful to wash parts in clean oil, to prevent dusts and water from adhering to parts entering assemblies and not to scratch on the sliding surfaces of all parts.

※ Apply small quantity of grease to the periphery of O-rings to be set in socket and spigot joints to prevent the O-rings from being damaged.

(2) Assembling of body S kit

① Press-fit oil seal into body S (1).

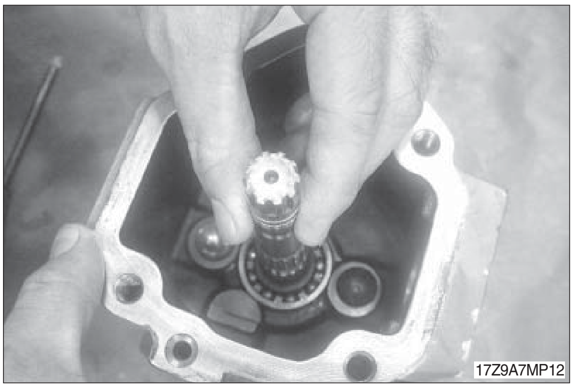
※ Use new oil seal for assembling. Before assembling, apply a small quantity of grease to the periphery of oil seal lip and tap it together with the following special tooling with hammer.



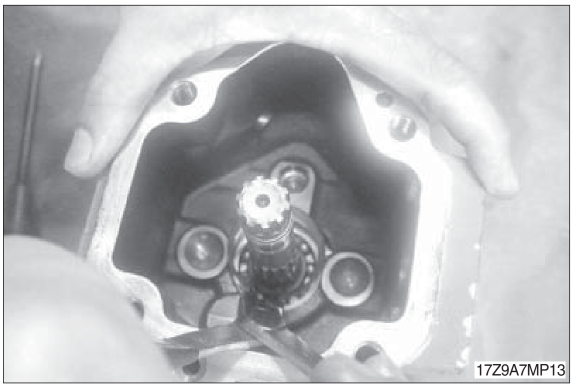
17Z9A7MP11

② Set shaft (3) with bearing (30) and snap ring (34) in this order into body S (1).

※ Pay attention not to damage the oil seal when assembling the shaft.



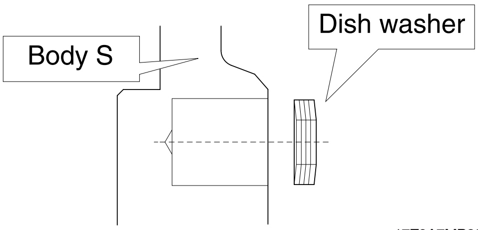
17Z9A7MP12



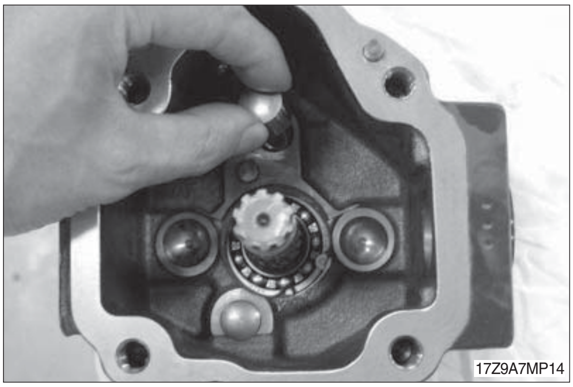
17Z9A7MP13

③ Set four dish springs (33), then set stopper pin A (25) and stopper pin B (26) into body S (1).

※ Pay attention to direction of the dish washer.

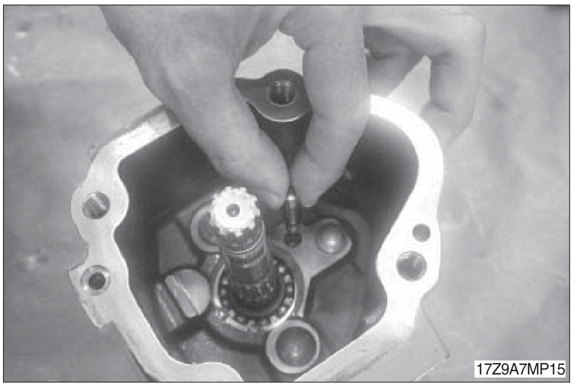


17Z9A7MP29



17Z9A7MP14

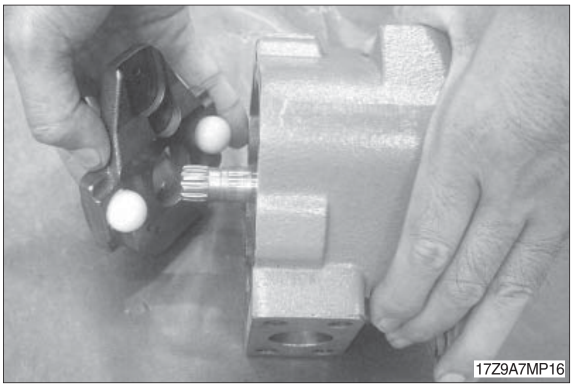
④ Set rod G (21) into body S (1).



17Z9A7MP15

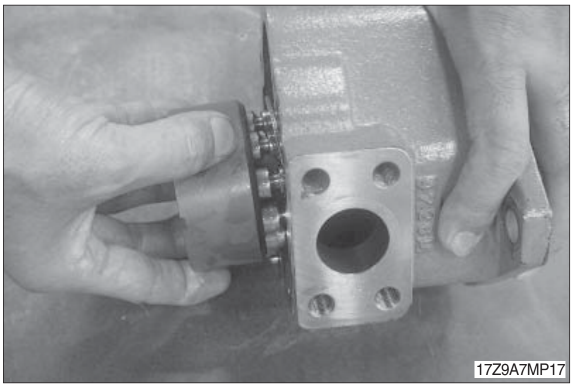
⑤ Put two balls (12) in the hole of swash plate (10) and install it in body S.

※ Apply grease on the balls if they drop out.



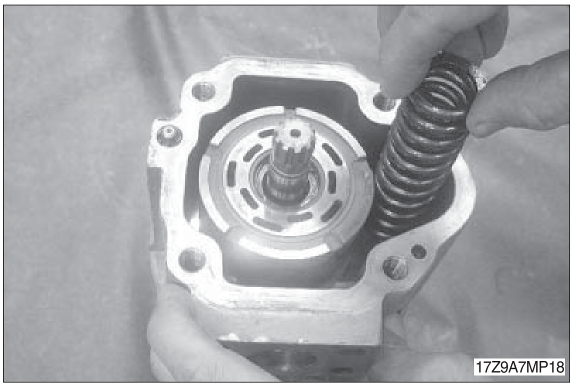
17Z9A7MP16

⑥ Assemble cylinder barrel kit into the body S (1).



17Z9A7MP17

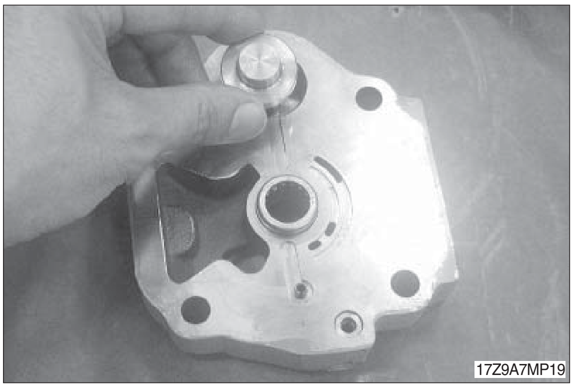
⑦ Set spring T (15) to spring holder (18), then set them together into the body S (1).



17Z9A7MP18

(3) Assembling of body H kit

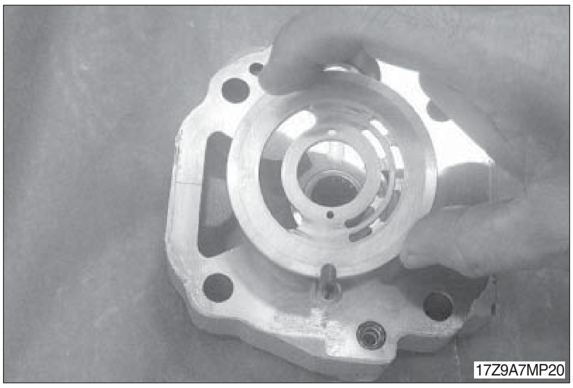
① Set spring guide (19) in body H (2).



17Z9A7MP19

② Place valve plate (5) slowly on body H (2) by positioning it with spring pin (56).

※ V notch copper alloy side of valve plate slides with cylinder barrel (4) and be careful not to set the valve plate to a wrong direction.



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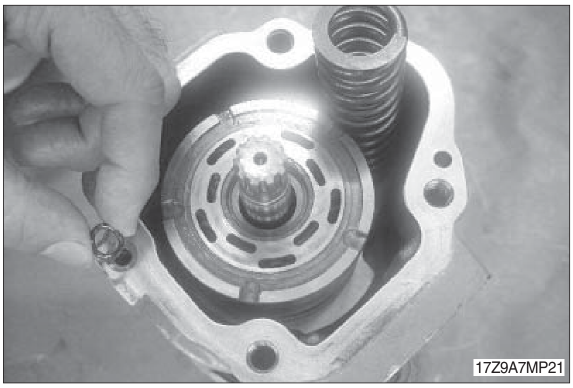
(4) Assembling of body S kit with body H kit

① Place O-ring (40) on body S.

※ Use new O-ring for assembling.



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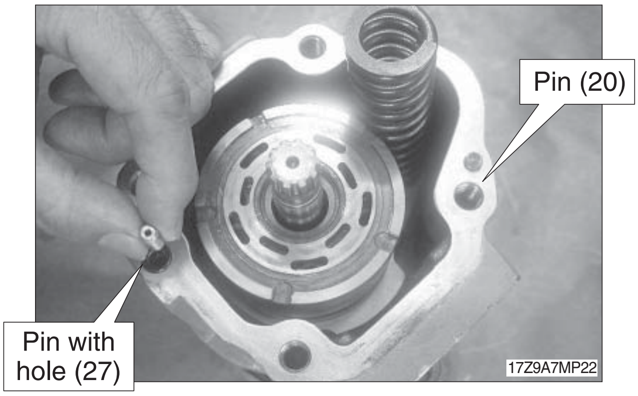
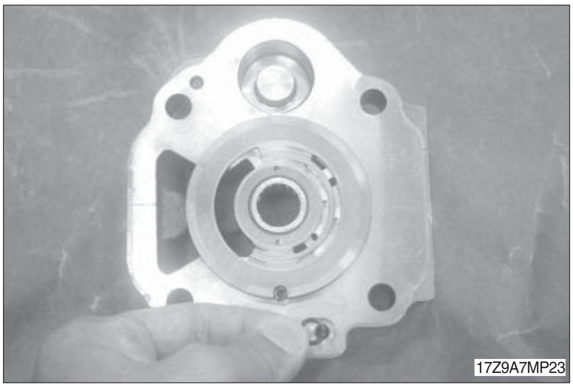
② Set pin (20) and pin (27) on body S.

※ Pay attention to the position of each pin. Pin (27) has a hole.



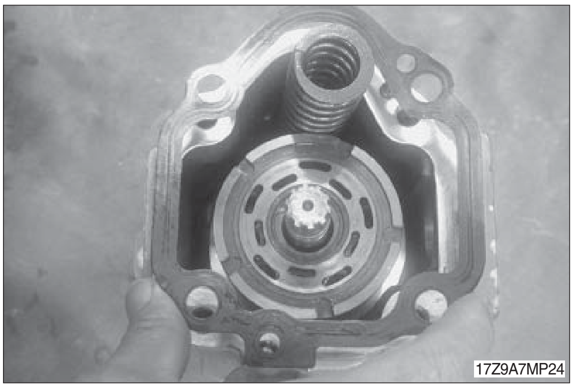
③ Place O-ring (40) on body S.

Use new O-ring for assembling.



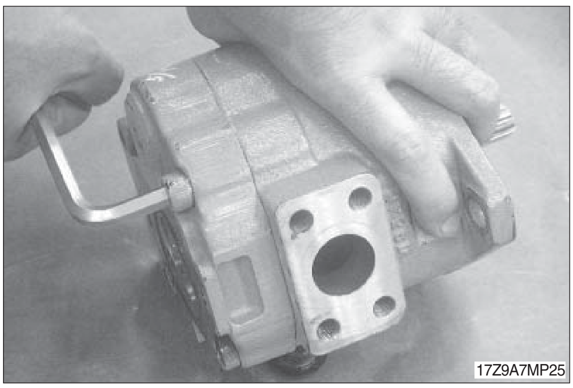
④ Place packing (13), position it with locating pin (20) on body S.

Use new gasket for assembling.



⑤ Set two screws (M10×65) into the upper side two screw holes, and tighten them until the distance between body S and body H comes to 5 to 10 mm.
Then set three screws (44, M10×40) into the lower side two screw holes, after that, replace the upper side two screws (M10×65) to the regular size screws (44, M10×40) and fix them.

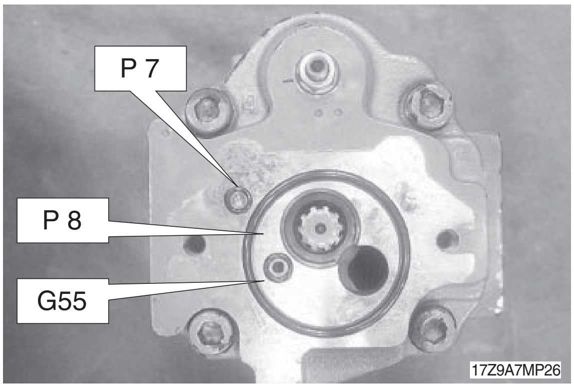
· Tightening torque : 5.2~6.6 kgf · m (37.6~47.7 lbf · ft)



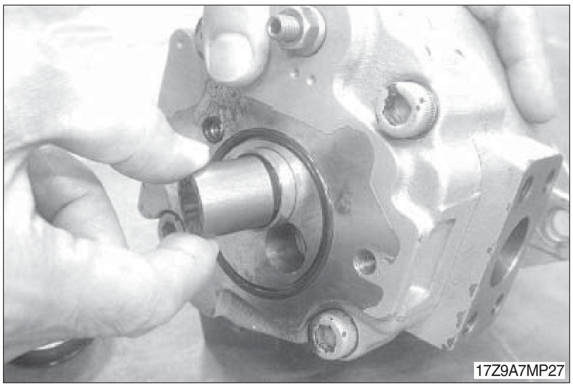
(5) Installation of gear pump kit

① Place O-ring (69, 71, 72) on the installation side of body H.

※ Use new O-ring for assembling.

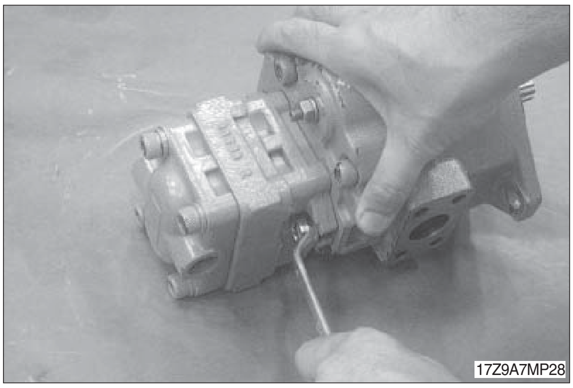


② Set collar (67), coupling (66).



③ Install gear pump kit (65) and fix it by two screws (68, M8×25) and washers (70) with spanner wrench 13 mm.

· Tightening torque : 2.0~2.4 kgf · m (14.5~17.4 lbf · ft)



(6) Inspection of assembling

After completed the assembling of pump, make sure that pump shaft rotates smoothly by hand.

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect hydraulic hose.

(5) Disconnect pilot line hoses.

(6) Sling the control valve assembly and remove the control valve mounting bolt.

· Weight : 25 kg (55 lb)

· Tightening torque : 6.9±1.4 kgf·m (106±15.9 lbf·ft)

(7) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.

① Cylinder (boom, arm, bucket)

② Swing motor

③ Travel motor

※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

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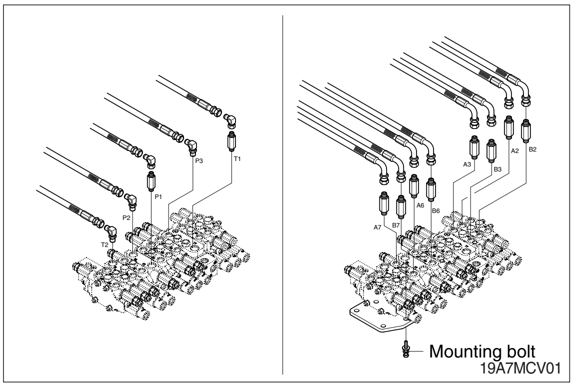

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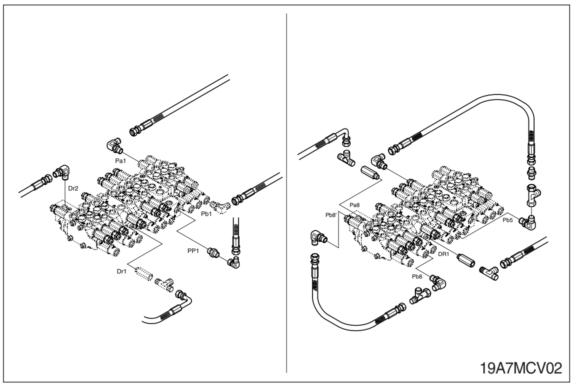

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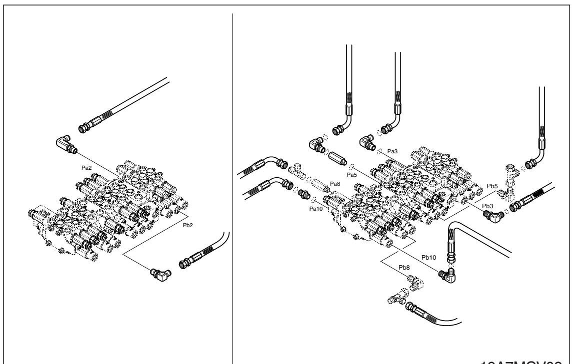
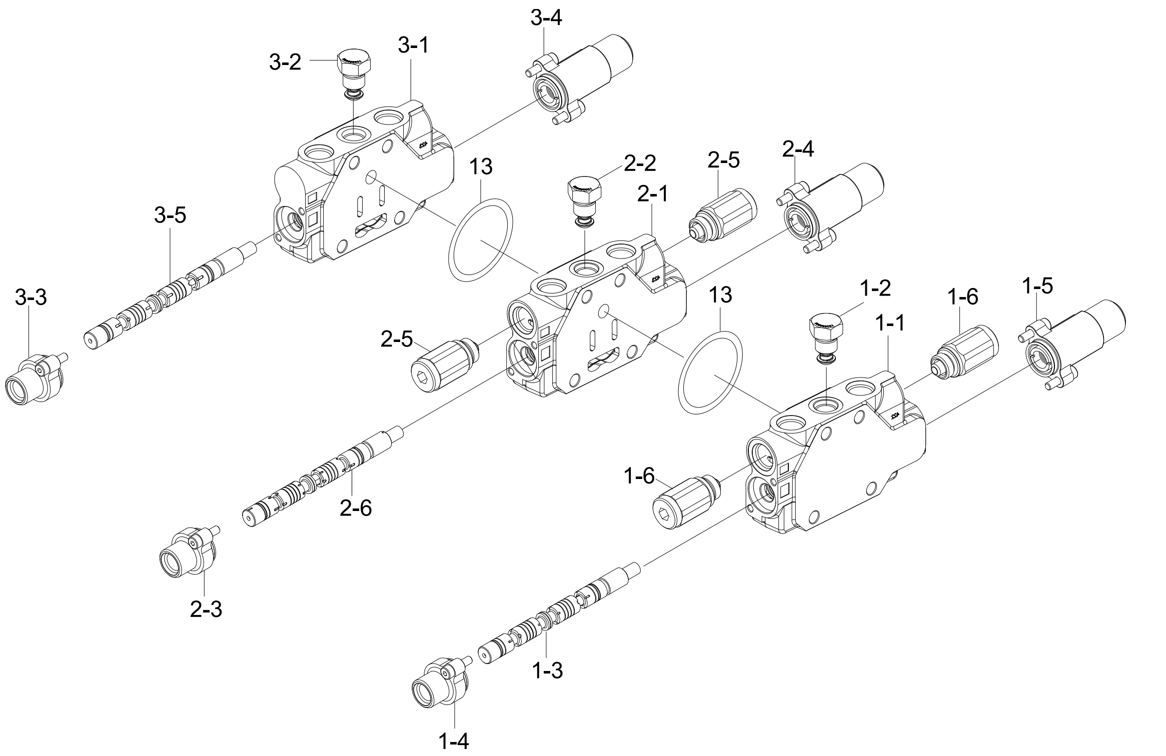


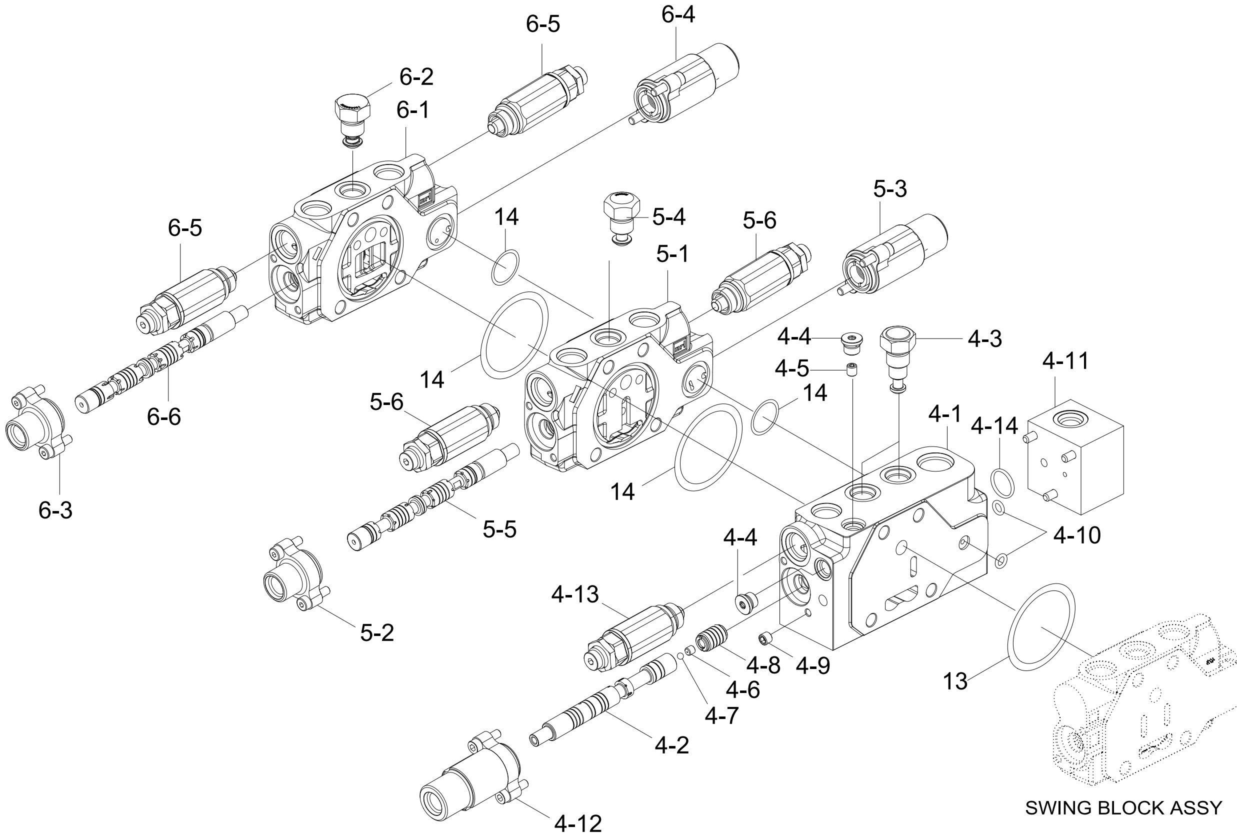
19A7MCV03

2. STRUCTURE (1/4)



1-1	Dozer block assy	2-1	Boom swing body assy	3-1	Swing body assy
1-2	Plug	2-2	Plug	3-2	Plug
1-3	Dozer spool assy	2-3	Pilot cover	3-3	Pilot cover
1-4	Pilot cover	2-4	Pilot cover	3-4	Pilot cover
1-5	Pilot cover	2-5	Overload relief valve assy	3-5	Swing spool assy
1-6	Overload relief valve assy	2-6	Boom swing spool assy	13	O-ring

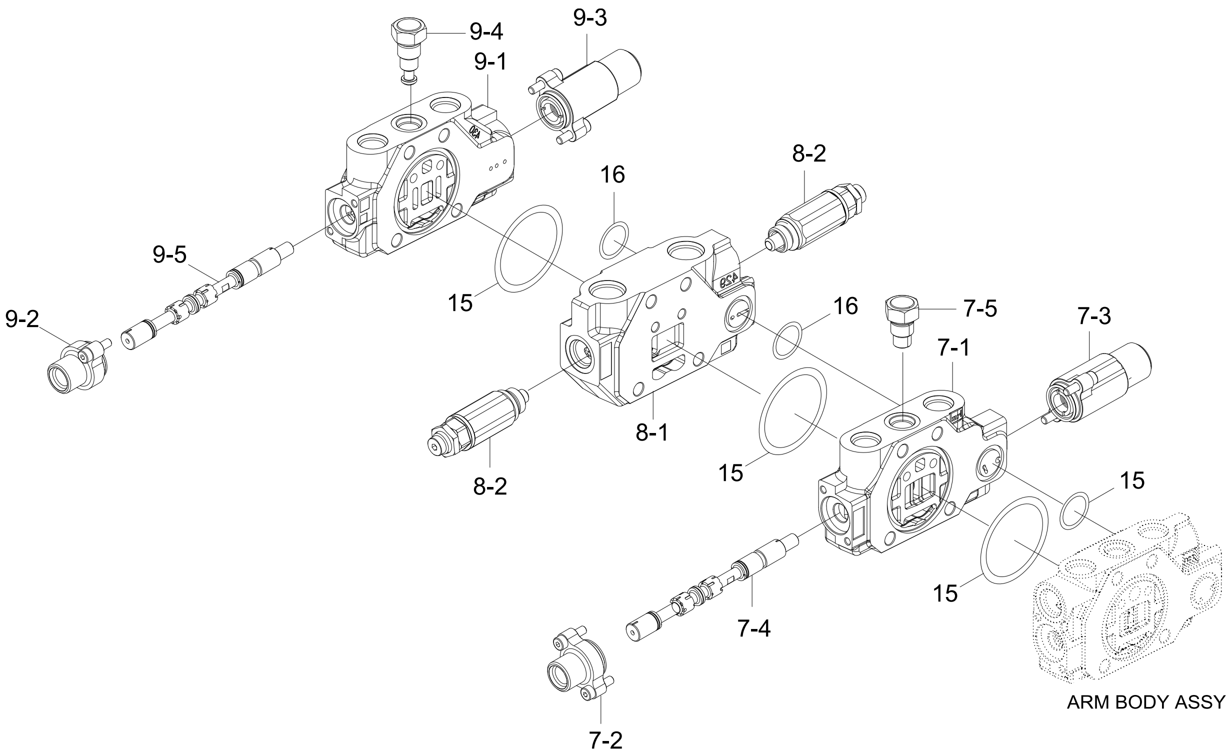
STRUCTURE (2/4)



19A2MCV03

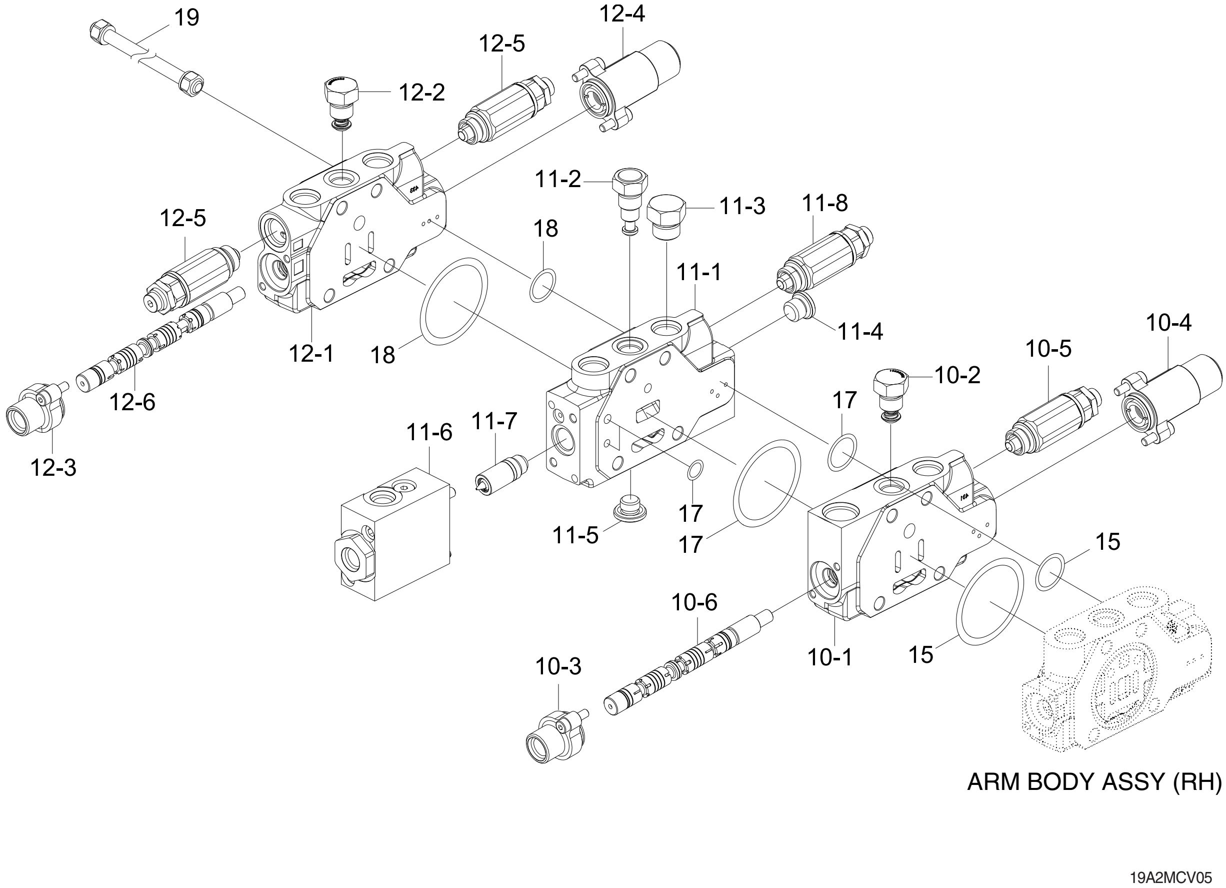
4-1	Conflux block assy	4-11	Pilot body	6-1	Arm block assy
4-2	Conflux spool assy	4-12	Pilot cover	6-2	Plug
4-3	Plug	4-13	Relief valve assy	6-3	Pilot cover
4-4	Plug	4-14	O-ring	6-4	Pilot cover
4-5	Piston	5-1	PTO block assy	6-5	Overload relief valve assy
4-6	Piston	5-2	Pilot cover	6-6	Arm spool assy
4-7	Ball	5-3	Pilot cover	13	O-ring
4-8	Spring	5-4	Plug	14	O-ring
4-9	Piston	5-5	PTO spool assy		
4-10	O-ring	5-6	Overload relief valve assy		

STRUCTURE (3/4)



10-1	Boom block assy	11-3	Plug	12-3	Pilot cover
10-2	Plug	11-4	Plug	12-4	Pilot cover
10-3	Pilot cover	11-5	Plug	12-5	Overload relief valve assy
10-4	Pilot cover	11-6	Lock valve cover	12-6	Bucket spool assy
10-5	Overload relief valve assy	11-7	Lock valve cover	15	O-ring
10-6	Boom spool assy	11-8	Overload relief valve assy	17	O-ring
11-1	Boom lock block assy	12-1	Bucket block assy	18	O-ring
11-2	Plug	12-2	Plug	19	Socket bolt

STRUCTURE (4/4)



7-1	Travel body assy (LH)	8-1	Inlet block assy	9-4	Plug
7-2	Pilot cover	8-2	Relief valve assy	9-5	Travel spool assy
7-3	Pilot cover	9-1	Travel body assy (RH)	15	O-ring
7-4	Travel spool assy	9-2	Pilot cover	16	O-ring
7-5	Plug	9-3	Pilot cover		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Hexagon wrench	Each 1 piece	5, 6, 10, 12 and 14
Socket wrench	Each 1 piece	5 and 6
Spanner	Each 1 piece	13, 21 and 30
Rod	1 piece	Less than 10×250

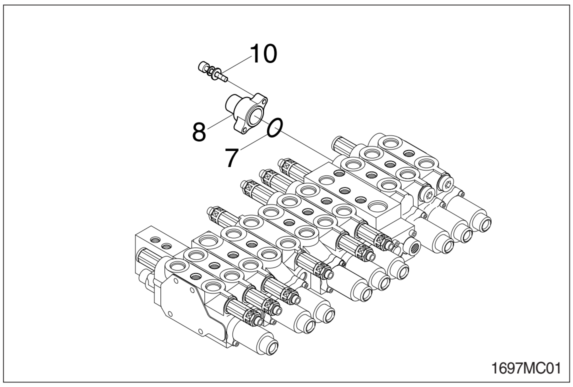
3) DISASSEMBLY

(1) Disassembly of spools (pilot type)

Loosen hexagon socket head bolts (10) with washer.
(Hexagon wrench : 5 mm)

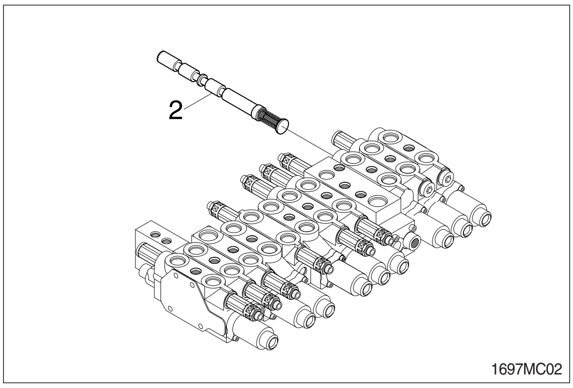
Remove the pilot cover (8).

Pay attention not to lose the O-ring (7) under the pilot cover.



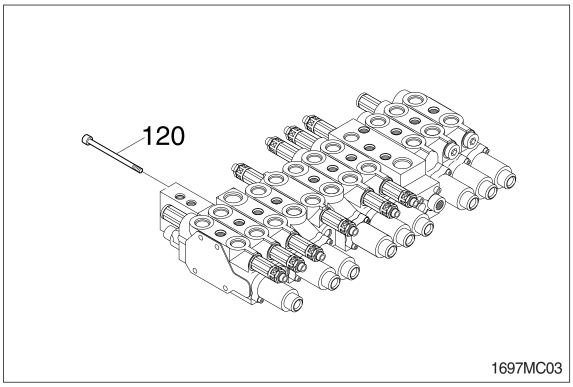
Remove the spool assembly (2) from the body by hand slightly.

When extracting each spool from its body, pay attention not to damage the body.
When extracting each spool assembly, it must be extracted from spring side only.
When any abnormal parts are found, replace it with completely new spool assembly.
When disassembled, tag the components for identification so that they can be reassembled correctly.



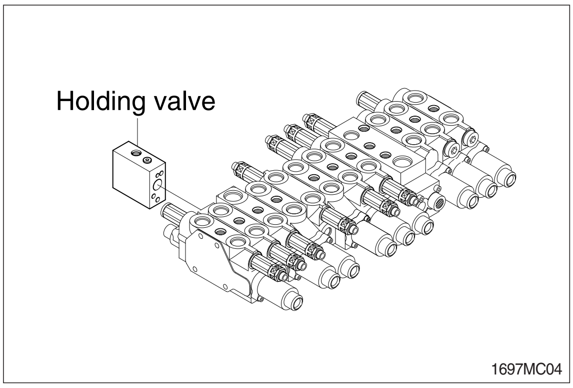
(2) Disassembly of holding valve (boom 1)

Loosen hexagon socket head bolts(120).
(Hexagon wrench : 5 mm)



Remove the holding valve.

Pay attention not to lose the O-ring and the poppet under the pilot cover.
Pay attention not to damage the "piston A" under pilot cover.
When any abnormal parts are found, replace it with completely new holding valve assembly.
When disassembled, tag the components for identification so that they can be reassembled correctly.



(3) Disassembly of the load check valve and the negative relief valve

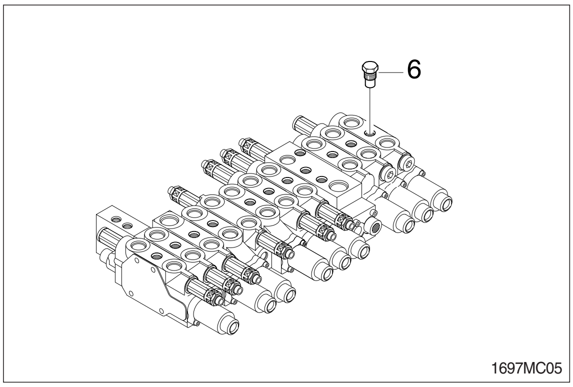
The load check valve

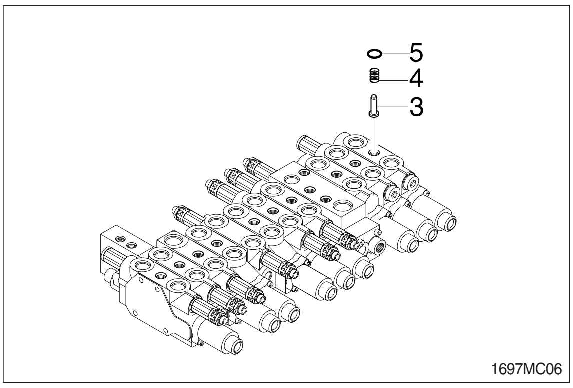
a. Fix the body to suitable work bench.

Pay attention not to damage the body.

b. Loosen the plug (6)
(Hexagon wrench : 10 mm).

c. Remove the O-ring (5), spring (4) and the load check valve (3) with pincers or magnet.





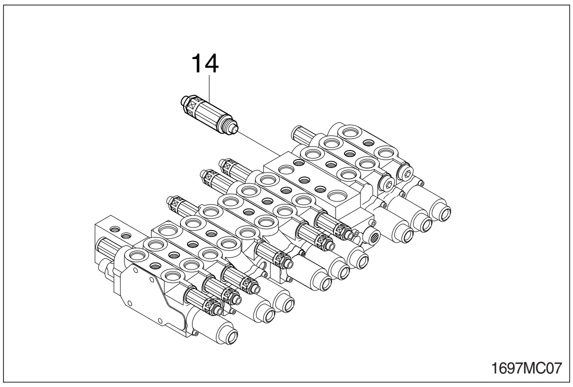
(4) Disassembly of the main and overload relief valve

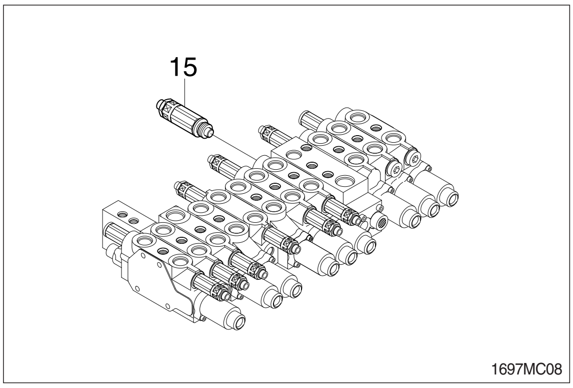
Fix the body to suitable work bench.

Remove the main relief valve (14). (Spanner : 30 mm)

Remove the overload relief valve (15). (Spanner : 22 mm)

When disassembled, tag the relief valve for identification so that they can be reassembled correctly.
Pay attention not to damage seat face.
When any abnormal parts are found, replace it with completely new relief valve assembly.

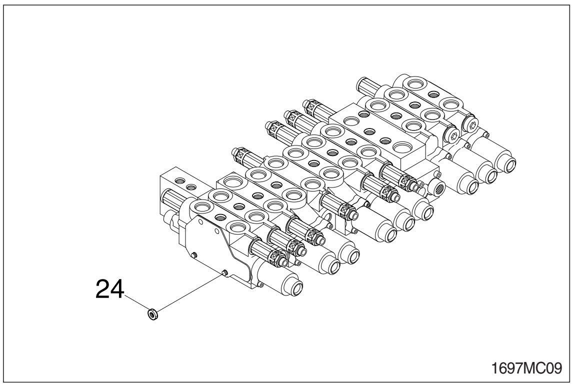




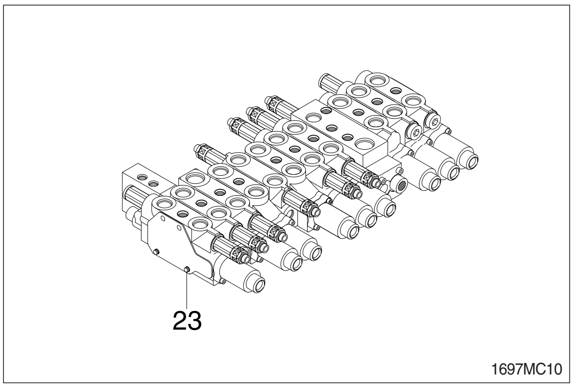
(5) Disassembly of the block assembly

Fix the body to suitable work bench.

Remove the nut (24).
(Spanner : 13 mm)



Do not removed the tie bolt (23).



(6) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that seal groove faces of body and block are smooth and free of dust, dent, rust etc.
c. Correct dents and damages and check seat faces within the body, if any, by lapping.
   Pay careful attention not to leave any lapping agent within the body.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and path's are free foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following it's the prescribed disassembly and assembly procedures.
g. Replace all seals and O-rings with new ones.

Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that springs are free from breakage, deformation, and wear.
e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
f. Replace all O-rings with new ones.
g. When any light damage is found in above inspections, correct it by lapping.
h. When any abnormal part is found, replace it with a completely new relief valve assembly.

4) ASSEMBLY

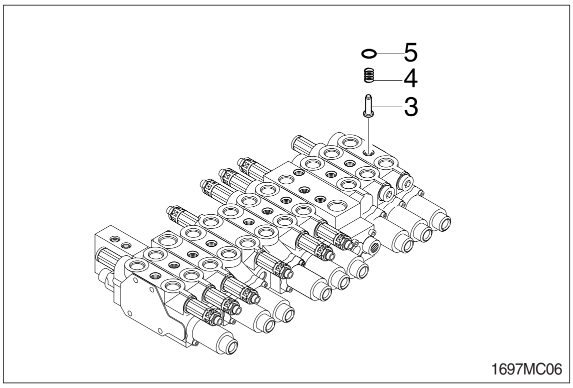
(1) General precaution

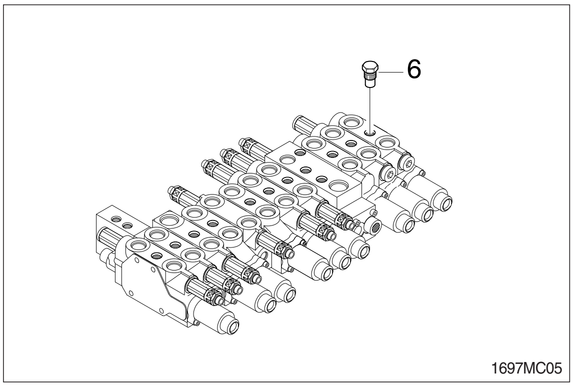
In this assembly section, explanation only is shown.
For further understanding, please refer to the figures shown in the previous structure & disassembly section.
Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.
Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly.
Do not stretch seals so much as to deform them permanently.
In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.
Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque.
Do not reuse removed O-rings and seals.

(2) Load check valve

Assemble the load check valve (3) and O-ring (5), spring (4).
Put O-rings on to plug (6).
Tighten plug to the specified torque.

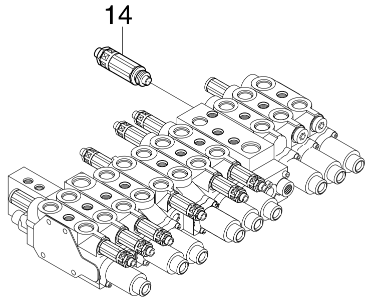
·Hexagon wrench : 8 mm
·Tightening torque : 3.7 kgf·m
(26.7 lbf·ft)





(3) Main relief, port relief valves

Install the main relief valve (14).
·Spanner : 30 mm
·Tightening torque : 6 kgf·m (43.4 lbf·ft)
Install the over load relief valve (15).
·Spanner : 22 mm
·Tightening torque : 4 kgf·m (28.9 lbf·ft)



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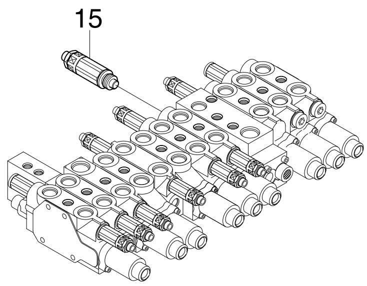
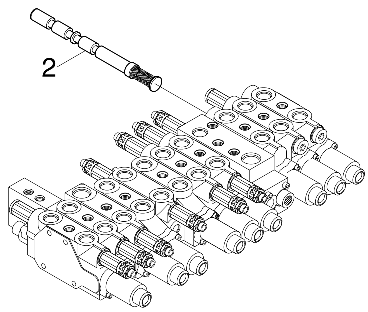


1697MC08

(4) Main spools

Carefully insert the previously assembled spool assemblies into their respective bores within of body.
Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.



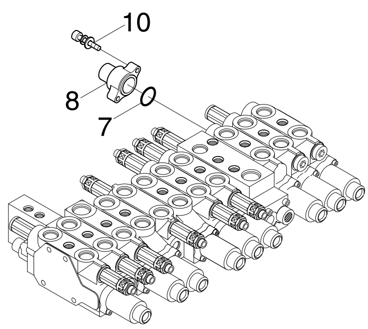
1697MC02

(5) Covers of pilot type

Fit spool covers (8) tighten the hexagonal socket head bolts (10) with washer to the specified torque.

·Hexagon wrench : 5mm
·Tightening torque : 1~1.1kgf·m (7.2~7.9lbf·ft)

Confirm that O-rings (7) have been fitted.

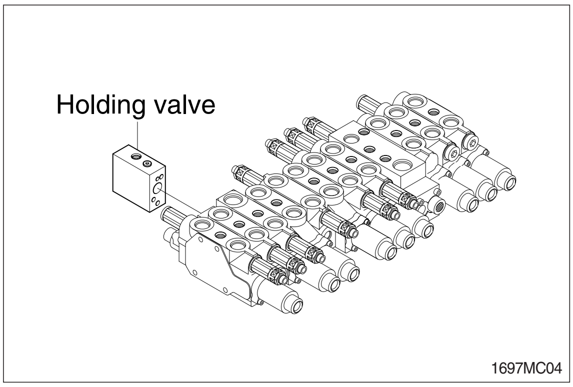


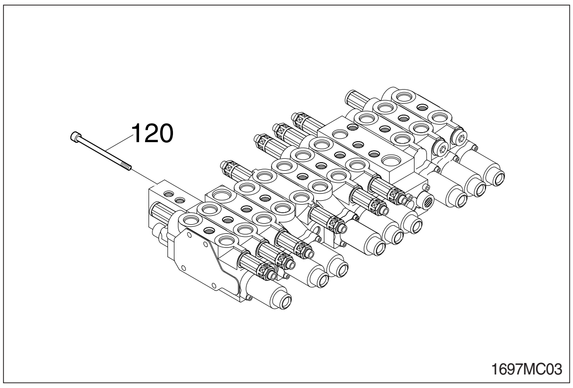
1697MC01

(6) Holding valve

Fit the holding valve to the body and tighten hexagon socket head bolt (120) to specified torque.

·Hexagon wrench : 5 mm
·Tightening torque :1.1 kgf·m (7.9 lbf·ft)





GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

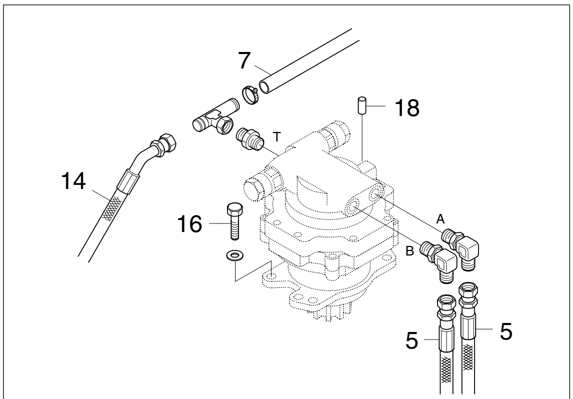
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**
When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.


13031GE18

(4) Disconnect hose assembly (5, 7, 14).

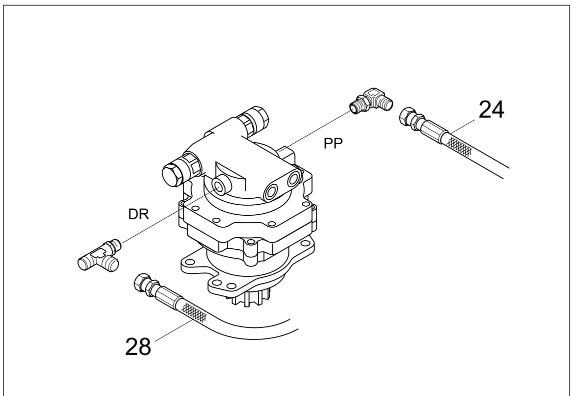
(5) Disconnect pilot line hoses (24, 28).

(6) Sling the swing motor assembly (1) and remove dowel pin (18) and the swing motor mounting bolts (16).
Motor device weight : 23 kg (51 lb)
· Tightening torque : 12.8±3.0 kgf·m (92.6±21.7 lbf·ft)



19A7SM01

(7) Remove the swing motor assembly.
When removing the swing motor assembly, check that all the piping have been disconnected.



19A7SM02

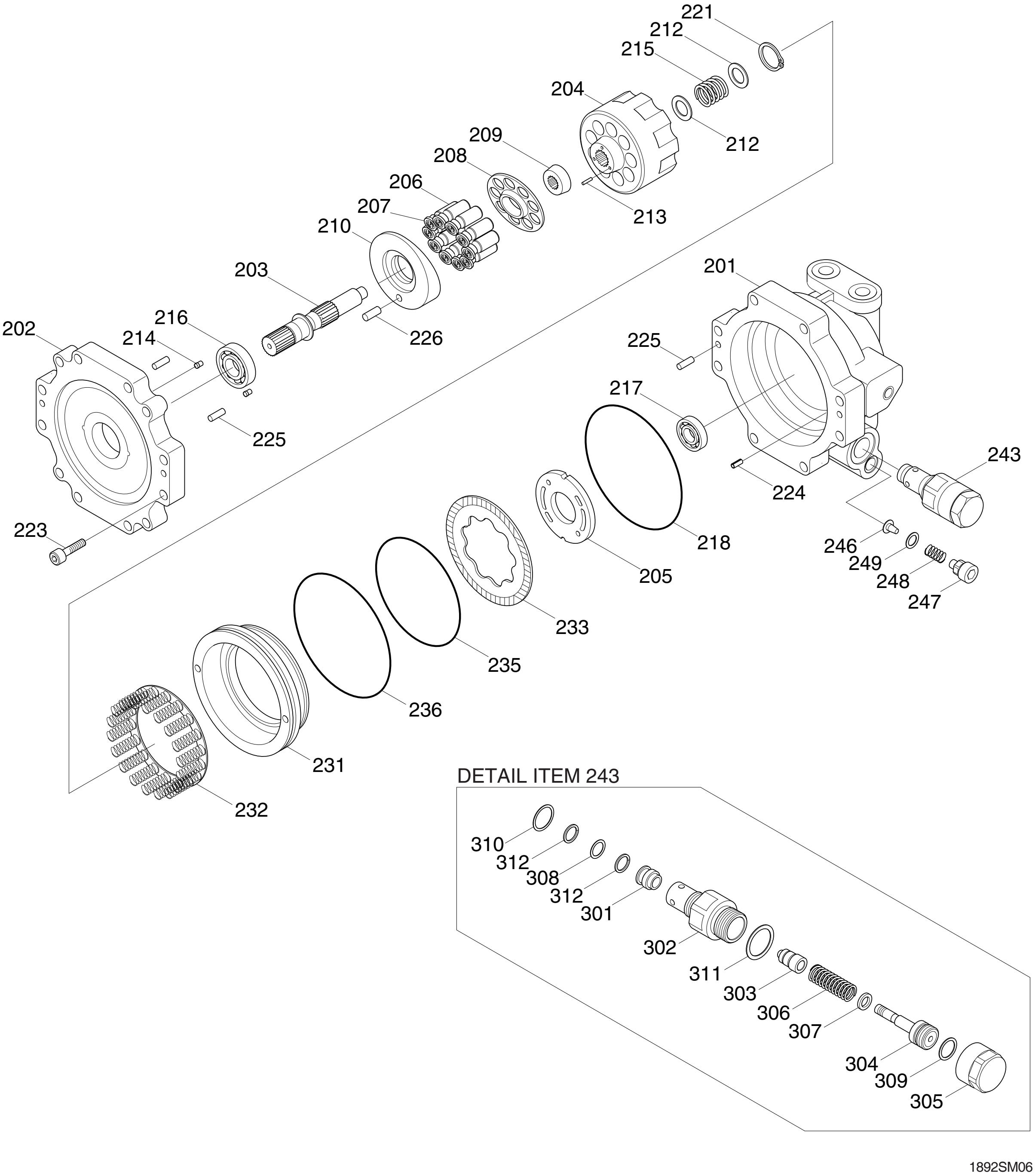
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.
Remove the air vent plug.
Pour in hydraulic oil until it overflows from the port.
Tighten plug lightly.
Start the engine, run at low idling and check oil come out from plug.
Tighten plug fully.

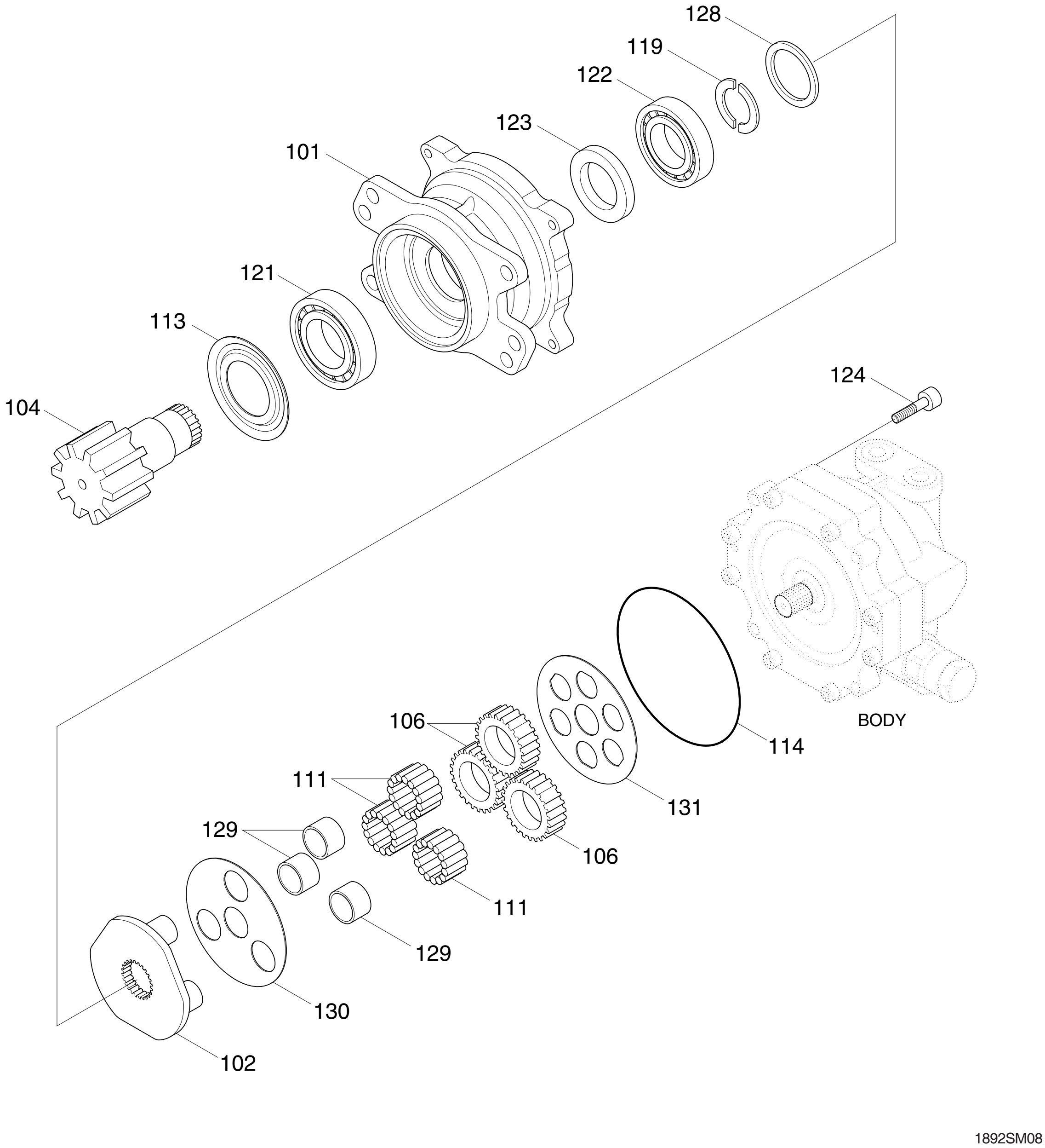
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) COMPONENTS (1/2)



201	Body	213	Pin	231	Brake piston	302	Retainer
202	Plate	214	Filter	232	Spring assy	303	Poppet
203	Shaft	215	Spring C	233	Disk plate	304	Piston
204	Cylinder barrel	216	Bearing	235	O-ring	305	Cap
205	Valve plate	217	Bearing	236	O-ring	306	Spring
206	Piston	218	O-ring	243	Relief valve assy	307	Spacer
207	Shoe	221	Snap ring	246	Check valve	308	O-ring
208	Shoe holder	223	Screw	247	Plug	309	O-ring
209	Barrel holder	224	Spring pin	248	Spring	310	O-ring
210	Swash plate	225	Pin	249	O-ring	311	O-ring
212	Retainer	226	Pin	301	Seat	312	Back up-ring

COMPONENTS (2/2)



101	Body	114	O-ring	128	Ring
102	Carrier 1	119	Preload collar	129	Ring 1
104	Pinion shaft	121	Bearing	130	Thrust plate 1
106	Gear B1	122	Bearing	131	Thrust plate 2
111	Needle	123	Oil seal		
113	Seal ring	124	Screw		

4) GENERAL ATTENTION

Please pay attention following points.

(1) Working should be done at the clean place and pay attention not to attach dust, paint cake and water. And prepare the clean box to put into the disassembled parts.

(2) Before disassembling, clean up the dust which is attached to the outside of the swing motor and take out paint which is attached to the binding parts by the wire brush.

(3) To make the original position when assembling, make a marking before disassembling.

(4) Give special care to protect parts from damage.

(5) Wash parts with washing oil sufficiently.

(6) Check parts whether there is friction loss or seize and take out burr with sand paper.

(7) Change the seals and snap rings to new ones.

5) DISASSEMBLY AND ASSEMBLY PROCEDURE

As the swing motor composes 2 blocks (hydraulic motor and reduction gear), explain each block disassembly and assembly procedure.

And please refer to the page 7-37~38.

6) TOOLS FOR DISASSEMBLY AND ASSEMBLY

No.	Tool	
1 2	Preset type hand torque wrench	45 N (JIS B4650) 90 N (JIS B4650)
4 5	Hexagon bar bit for above wrench	Two-plane width 6 Two-plane width 8
6	Single purpose type hand torque wrench	T = 15±1.5 kgf · m (108±10.8 lbf · ft) Two-plane 36
8 9	Hexagon bar wrench	Two-plane width 6 Two-plane width 8
10	Spanner	Two-plane width 36
11	Minus driver	Width 6~10
12	Snap ring pliers	Ø28 For hole
13	Hammer	-
14	Plastic hammer	-
15 16 17 18 19	Other	Grease (Oil designated hydraulic oil) Wire brush Sand paper Anti-loose adhesive (three bond #1305)

2. DISASSEMBLY

1) HYDRAULIC MOTOR

(1) Loose the hexagon socket head cap bolts (124), and take out the hydraulic motor assembly from the reduction gear body.

· Tools required :
Hexagon bar wrench : 6 mm

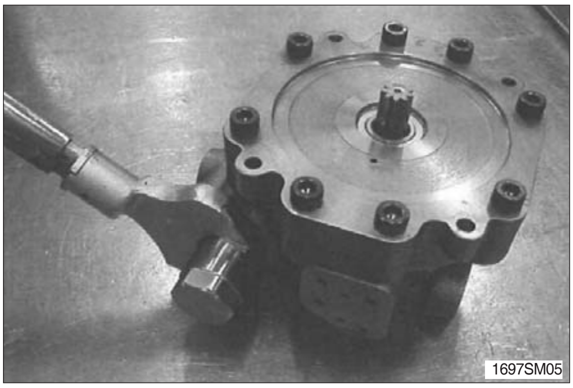
※ When taking out the hydraulic motor assembly from the reduction gear body, the drain port should be open.
When it is difficult to take out, insert the minus driver into the binding face to the body and take out the burr completely.


1897SM04

(2) Take out the relief valve assembly (243).

· Tools required :
Spanner : 36 mm

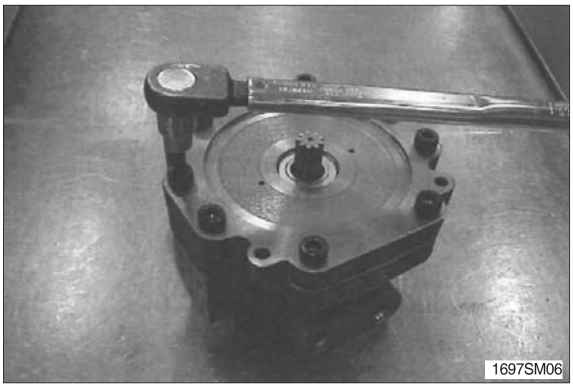
※ Do not disassemble the relief valve assembly, unless it is necessary.


1697SM05

(3) Loose the hexagon socket head cap bolts (223), and take out the plate S (202).

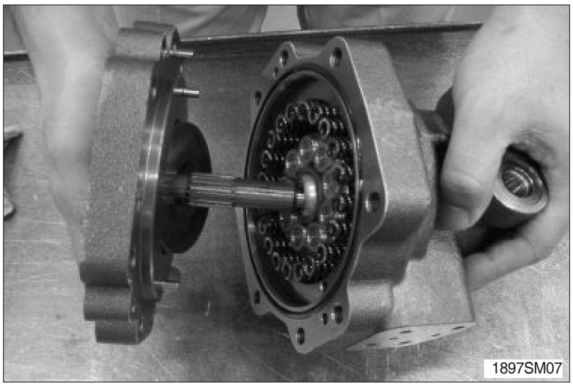
· Tools required :
Hexagon bar wrench : 8 mm

※ Pay attention not to drop out the swash plate (210).


1697SM06

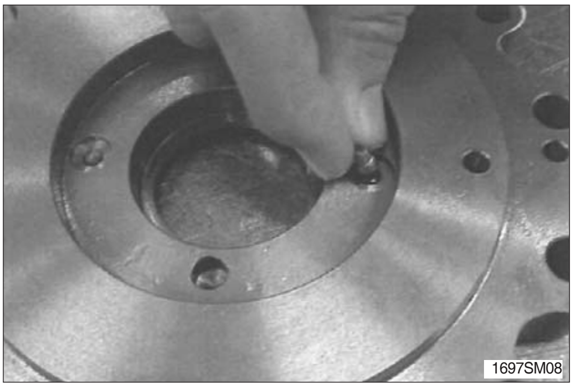
(4) Take out the swash plate (210) and the shaft kit from the plate S (202).

※ When it is difficult to take out the shaft, hit the opposite side slightly by the plastic hammer.
As the bearing (216) is pressed into the shaft, do not disassemble unless it is necessary to change the bearing.

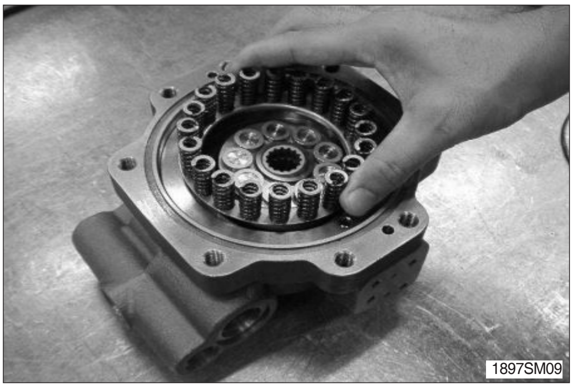

1897SM07

(5) Take out the filters (214) and the parallel pins (225) from the plate S (202).

- · Filter (214) : 2 pcs
- · Parallel pin (225) : 3 pcs

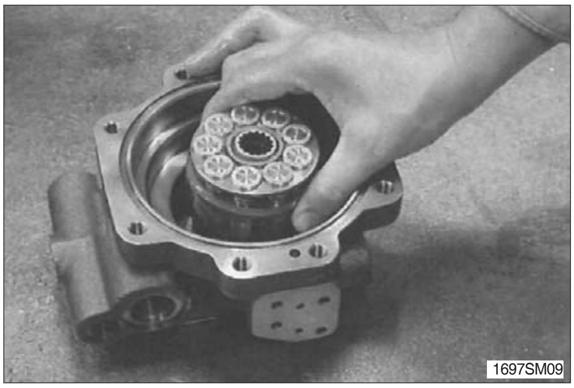

1697SM08

(6) Take out the O-ring (218) and the spring assemnbly (232) from the body H (201).

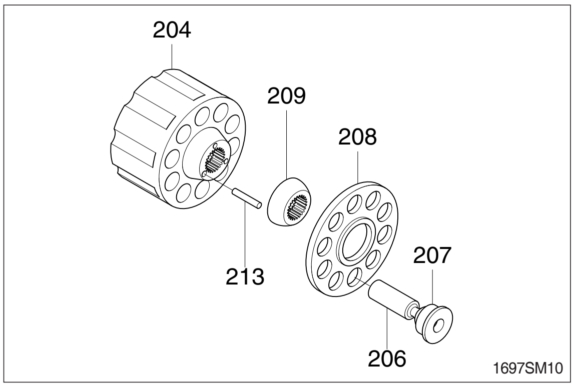

1897SM09

(7) Take out the cylinder barrel kit.

※ The small parts are easily dispersed, pay attention not to miss.
The valve plate (205) is sometime attached, pay attention not to drop out.

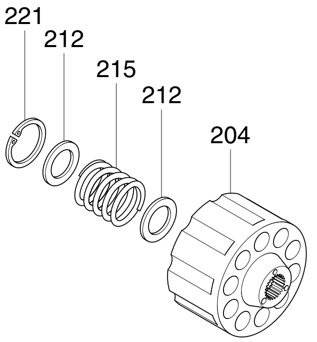

1697SM09

(8) Take out the piston (206) and the shoe (207) assembly, the shoe holder (208), the barrel holder (209) and the pin (213).

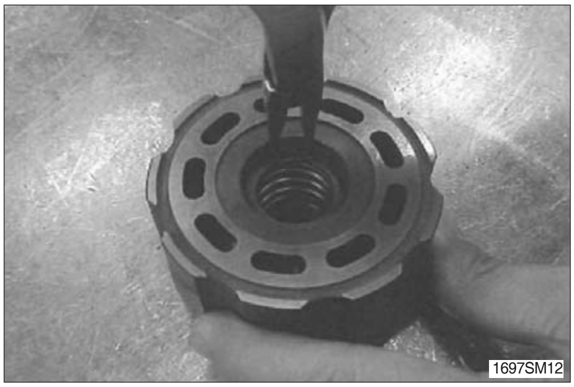


1697SM10

(9) Take out the snap ring (221), the retainer (212) and the spring C (215).

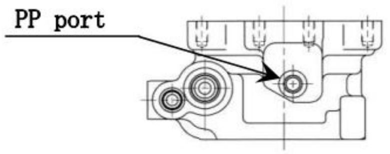


1697SM11



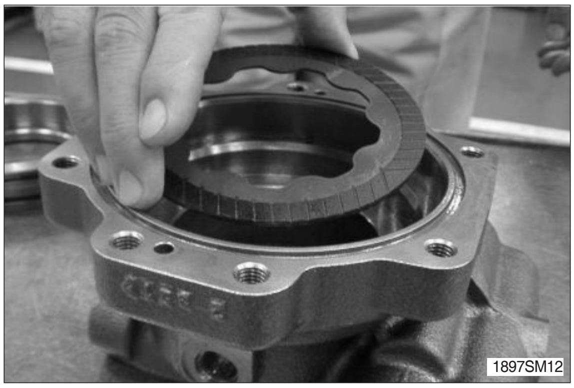
(10) Take out the brake piston (231) and the O-ring (235, 236).

※ The brake piston is drawn out bu the air blowing gradually from the PP port.
Pay attention not to draw out the brake piston rapidly.

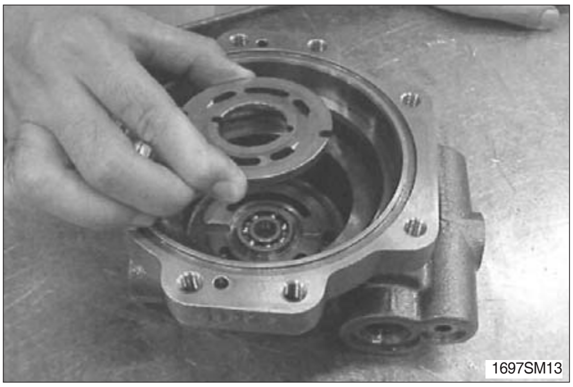


1897SM11

(11) Take out the disk plate (233).

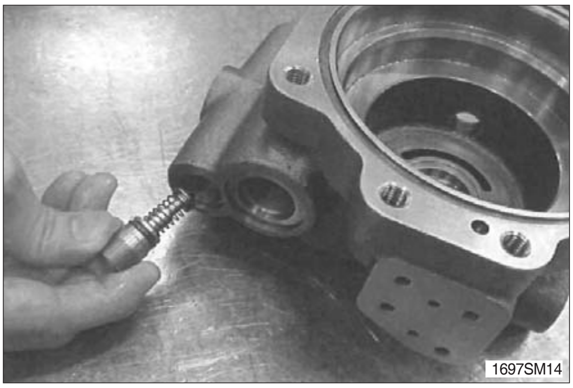


(12) Take out the valve plate (205).


1697SM13

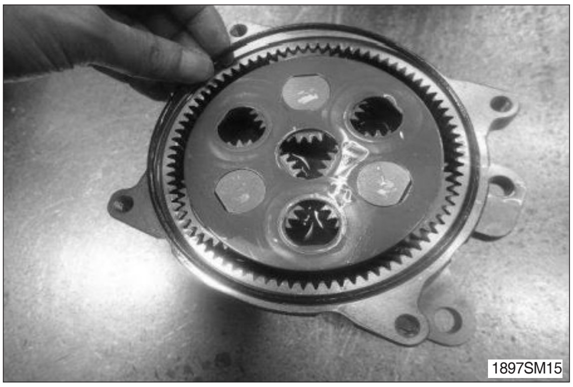
(13) Loose the plug (247), and take out the check valve (246) and the spring (248). (2 locations)

· Tools required :
Hexagon bar wrench : 8 mm

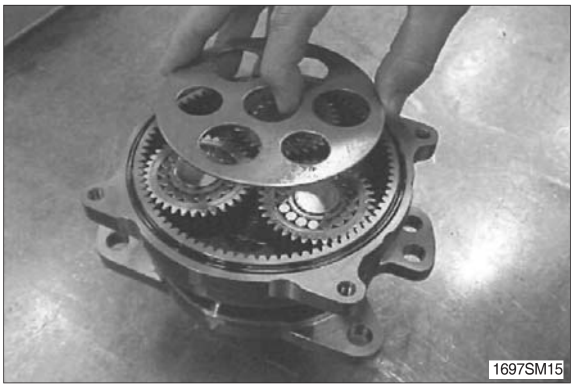

1697SM14

2) REDUCTION GEAR

(1) Take out the O-ring (114).



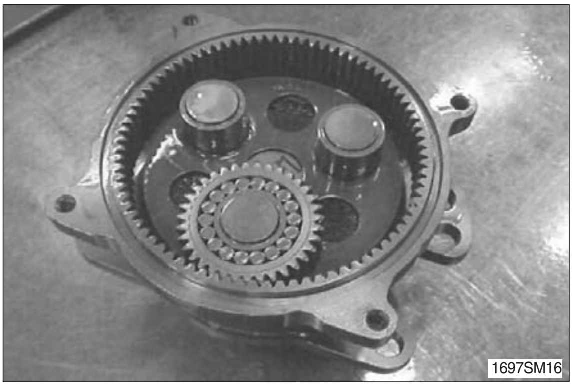
(2) Take out the thrust plate (131).



(3) Take out carrier 1 (102), the b1 gears (106), the needles (111) and the rings (129).

Needle (111) : 18 pcs / b1 gear 1pc
b1 gear (106) : 3 pcs
Ring (129) : 3 pcs

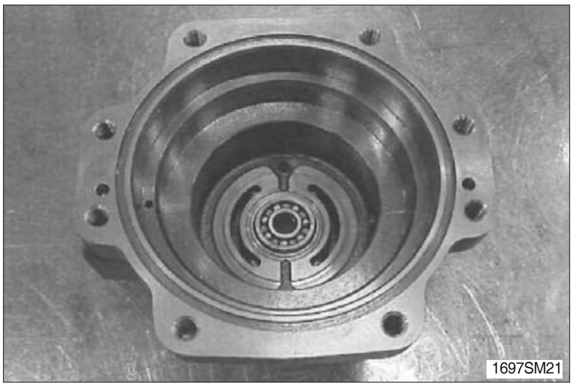
※ The small parts are easily dispersed. Pay attention not to miss.



3. ASSEMBLY

1) HYDRAULIC MOTOR SECTION

(1) Press-fit the bearing (217) and spring pin (224) into the body H (201).



1697SM21

(2) Insert the 2 check valves (246) (1 pc/side), 2 springs (248) (1 pc/side) and 2 plugs (247) (1 pc/side) with O-ring (249) in that order into the body H (201).

· Tools required :

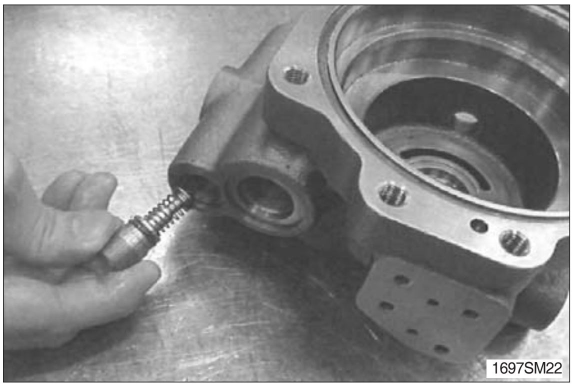
Hexagon bar wrench : 8 mm

Torque wrench

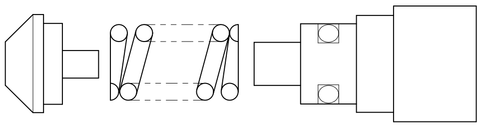
※ Apply grease slightly to the O-ring and assemble to pay attention not biting the seals.

· Plug tightening torque :

6 ± 0.3 kgf · m (43.4 ± 2.17 lbf · ft)



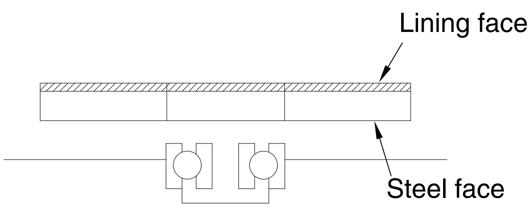
1697SM22



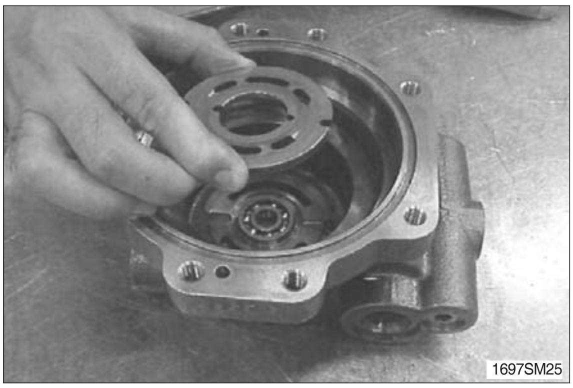
1697SM23

(3) Place the valve plate (205) onto the body H.

※ The steel face of the valve plate should be downside and assemble.

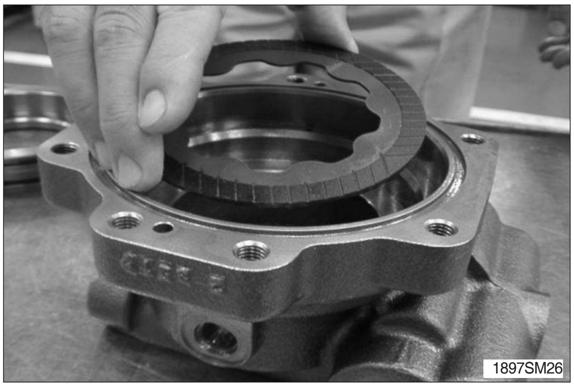


1697SM24



1697SM25

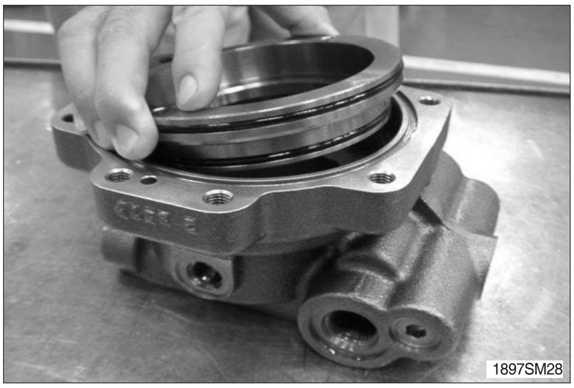
(4) Assemble the disk plate (233).



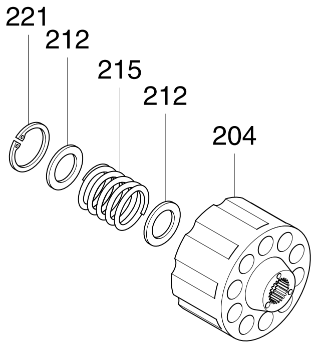
(5) Attach the O-ring (235, 236) to the brake piston (231), and make the brake piston assembly.

(6) Place the brake piston assembly onto the body H (201).

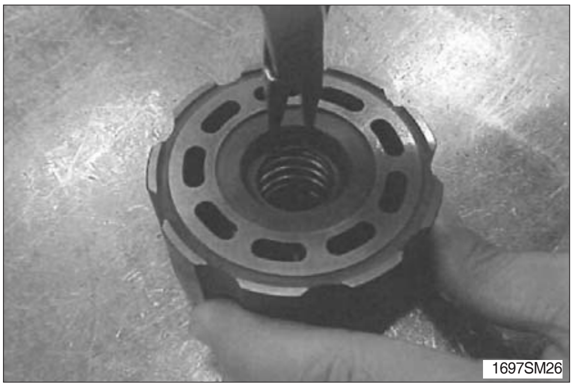
※ Set the brake piston assembly to the plate S which is attached 3 pcs of the parallel pins, and confirm there is no O-ring sticking out, flaw and dust, and assemble the brake piston assembly without inclination.
In case of the brake piston assembly dropping out, apply grease to the plate S side.
After assembled, take out the plate S.
Apply grease slightly to the O-ring and assemble to pay attention not biting the seals.



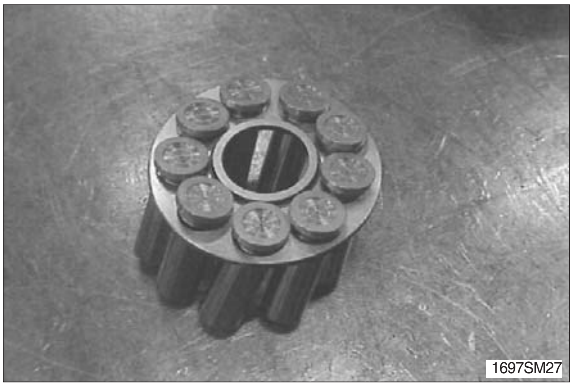
(7) Place the retainer (212), spring C (215) and retainer (212) in that order into the cylinder barrel (204), and then secure them with the snap ring (221).



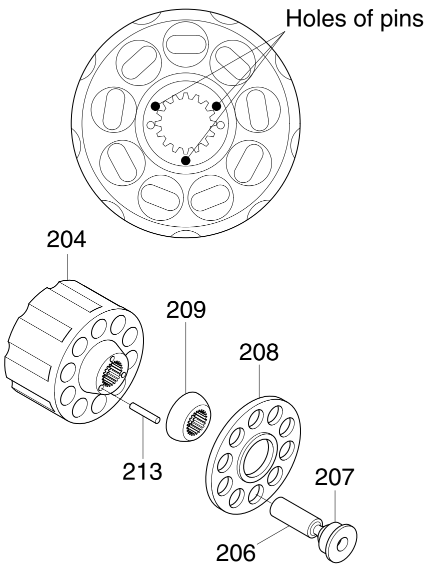
R27Z97SM38


1697SM26

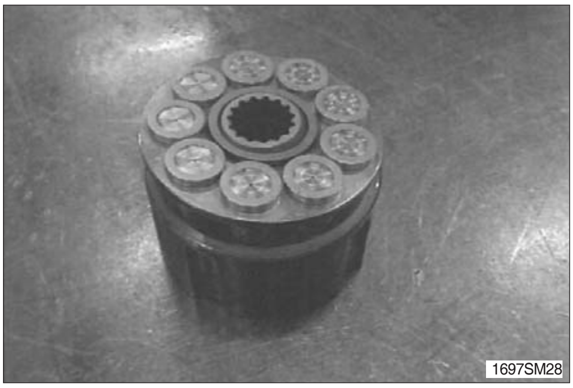
(8) Make the shoe holder assembly which has the 9 piston-shoe (206, 207) assemblies placed on the shoe holder (208).


1697SM27

(9) Place the 3 pins (213), barrel holder (209) and the shoe holder assembly onto the cylinder barrel (204) to make up a cylinder barrel assembly.

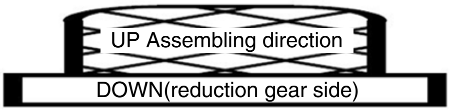


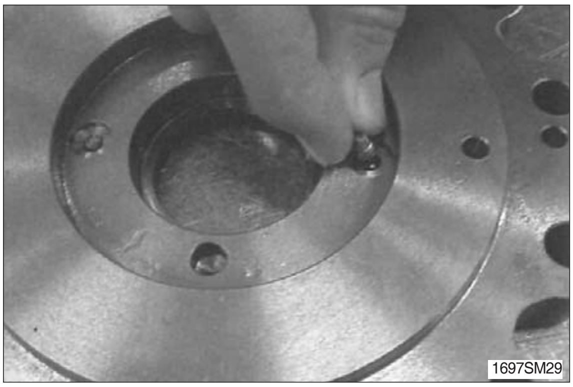
R27Z97SM41


1697SM28

(10) Place the filters (214) and the parallel pins (225) into the plate S.

Filter (214) : 2 pcs
Parallel pin (225) : 3 pcs

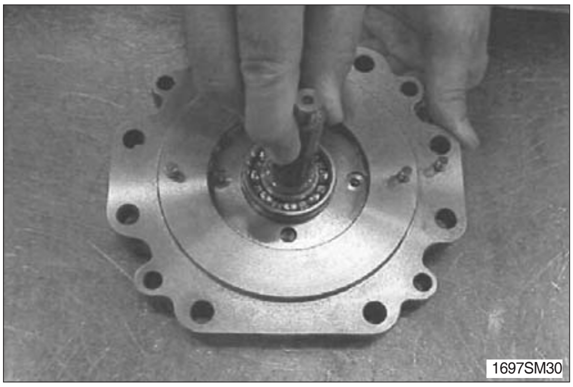




Use a plastic hammer when it is tight.

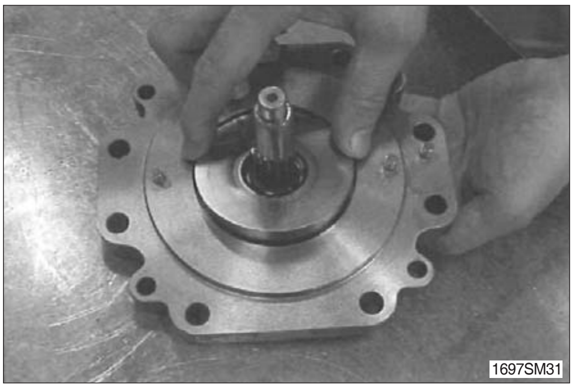
※ Pay attention height of pins are 8 mm from surface after installation.

(11) Place the shaft assembly into the plate S.



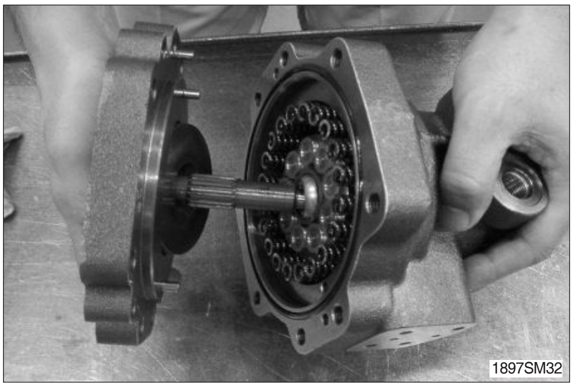
(12) Place the swash plate onto the plate S.

※ In case the swash plate drops out, apply grease to the plate S side of it.



(13) Join the body H and the plate S.

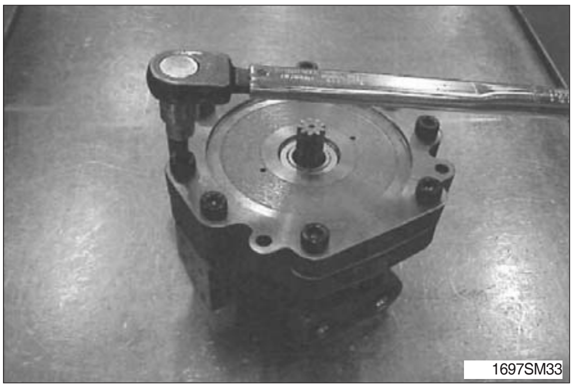
※ Align the serration of the shaft which is assembled to the plate S to the serration of the cylinder barrel assembly which is assembled to the body H.


1897SM32

(14) Bolt the plate S (202) together with the 8 hexagon socket head cap bolts (223).

· Tools required :
Hexagon bar wrench : 8 mm
Torque wrench

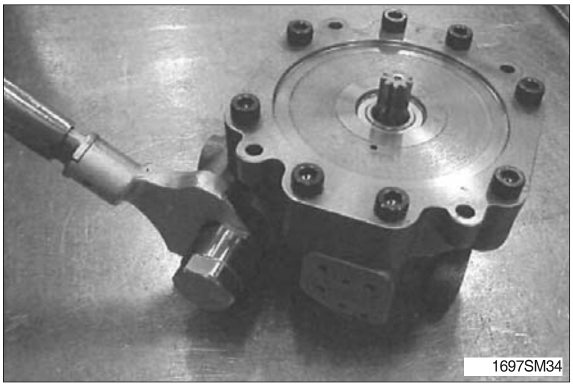
· Plug tightening torque :
6±0.3 kgf · m (43.4±2.17 lbf · ft)


1697SM33

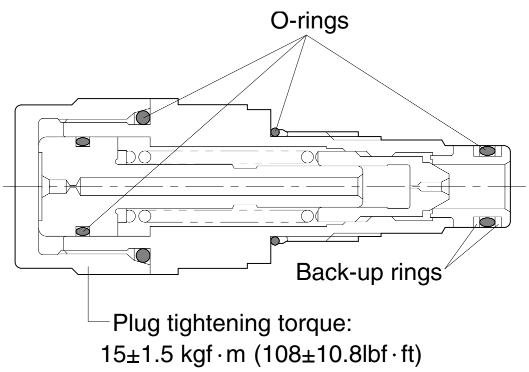
(15) Screw up the relief valve assembly (243). (both side)

· Tools required :
Spanner : 36 mm
Torque wrench

· Plug tightening torque :
15±1.5 kgf · m (108±10.8 lbf · ft)


1697SM34

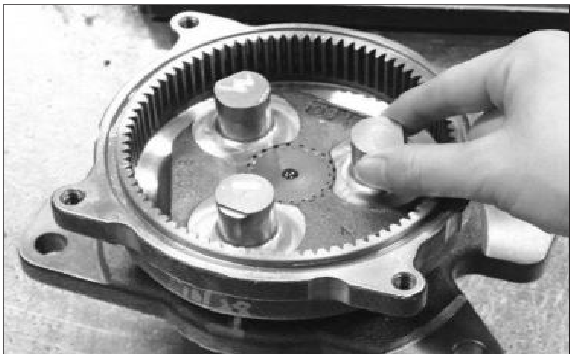
※ Once the relief valve is disassembled, replace the O-ring and the back up ring in the below, and screw the cap with the following torque.



R27Z97SM54

2) REDUCTION GEAR SECTION

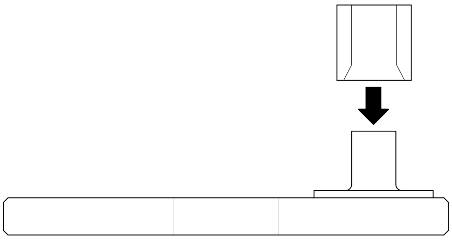
(1) Align the spline of the carrier 1 (102) to the pinion shaft (104) and place the carrier 1 (102) into the body.



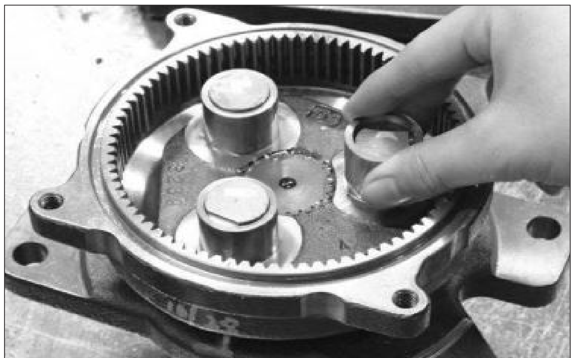
1897SM44

(2) Place the 3 rings (129) (1 pc/pin) onto the 3 pins of the carrier 1 (102).

※ Pay attention to direction of the ring. Beveling part of the ring should be down side.



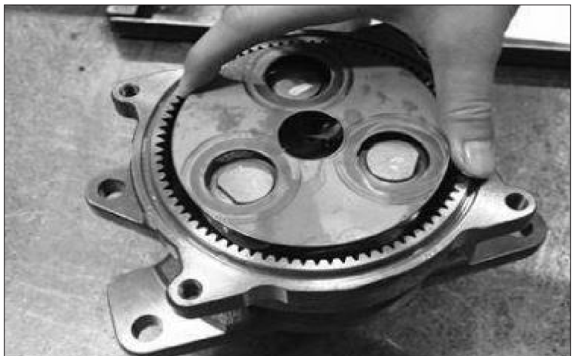
R27Z97SM61



1897SM45

(3) Place the thrust plate (130) onto the carrier 1.

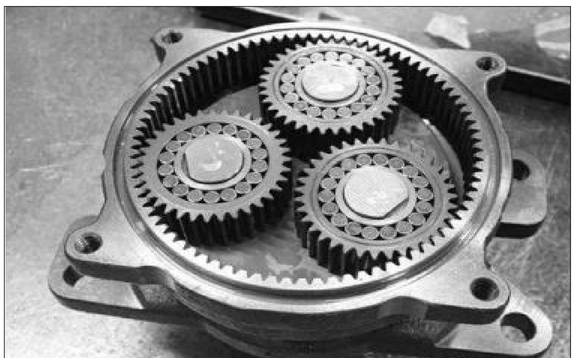
※ Larger size holes are aligned to the pins.



1897SM46

(4) Place the 3 b1 gears (106) (1 pc/pin) and 54 needles (111) (18 pc/pin) in that order onto the 3 pins of the carrier 1.

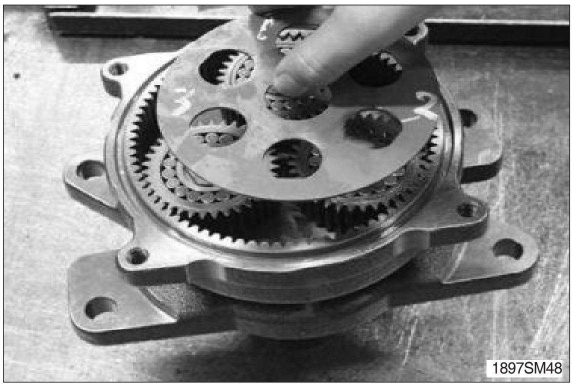
※ Pay attention not to drop the needles in the body.



1897SM47

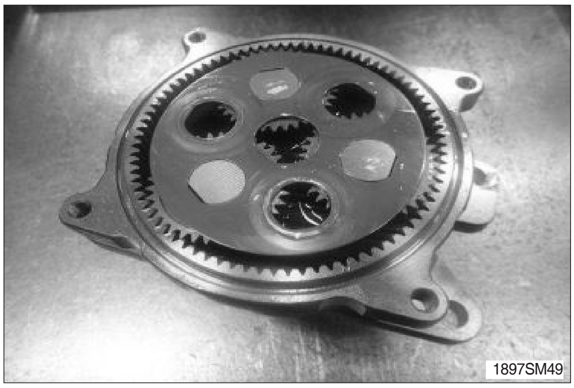
(5) Place the thrust plate (131) onto the carrier 1.

※ Smaller size holes are aligned to the pins.

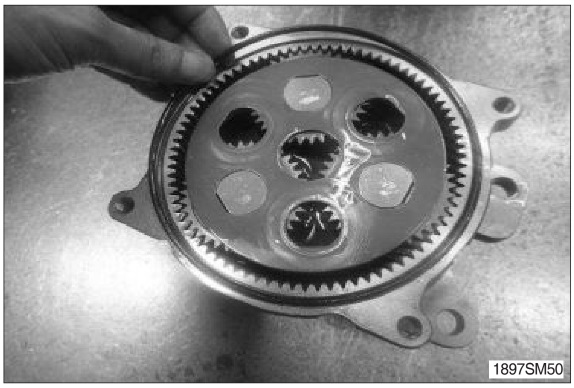


(6) Fill the body with hydraulic oil.

※ Oil : ISO VG 46 or equivalent
Oil amount : 3 to 4 mm below the top thrust plate
Wipe the oil off the flange surface if it is spilled.



(7) Place the O-ring (114) onto the body.



(8) Join the hydraulic motor and the body, and then bolt them together with the 4 hexagon socket head cap bolts.

· Tools required :
Hexagon bar wrench : 6 mm
Torque wrench

※ Align the shaft of the motor to the b1 gears. Apply anti-loose adhesive to the screws.

· Plug tightening torque :
3±0.3 kgf · m (21.7±2.17 lbf · ft)

GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90 and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

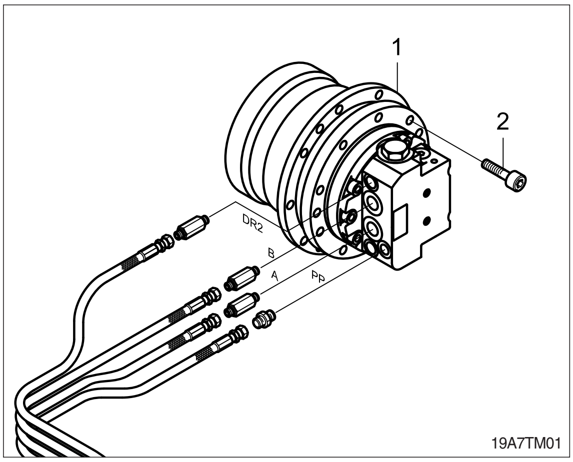
13031GE18

(4) Remove the track shoe assembly.
For details, see removal of track shoe assembly.

(5) Remove the cover.

(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.



19A7TM01

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.

· Weight : 18 kg (40 lb)

· Tightening torque : 6.9±1.4 kgf·m
(49.9±10.1 lbf·ft)

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the travel motor.

① Remove the air vent plug.

② Pour in hydraulic oil until it overflows from the port.

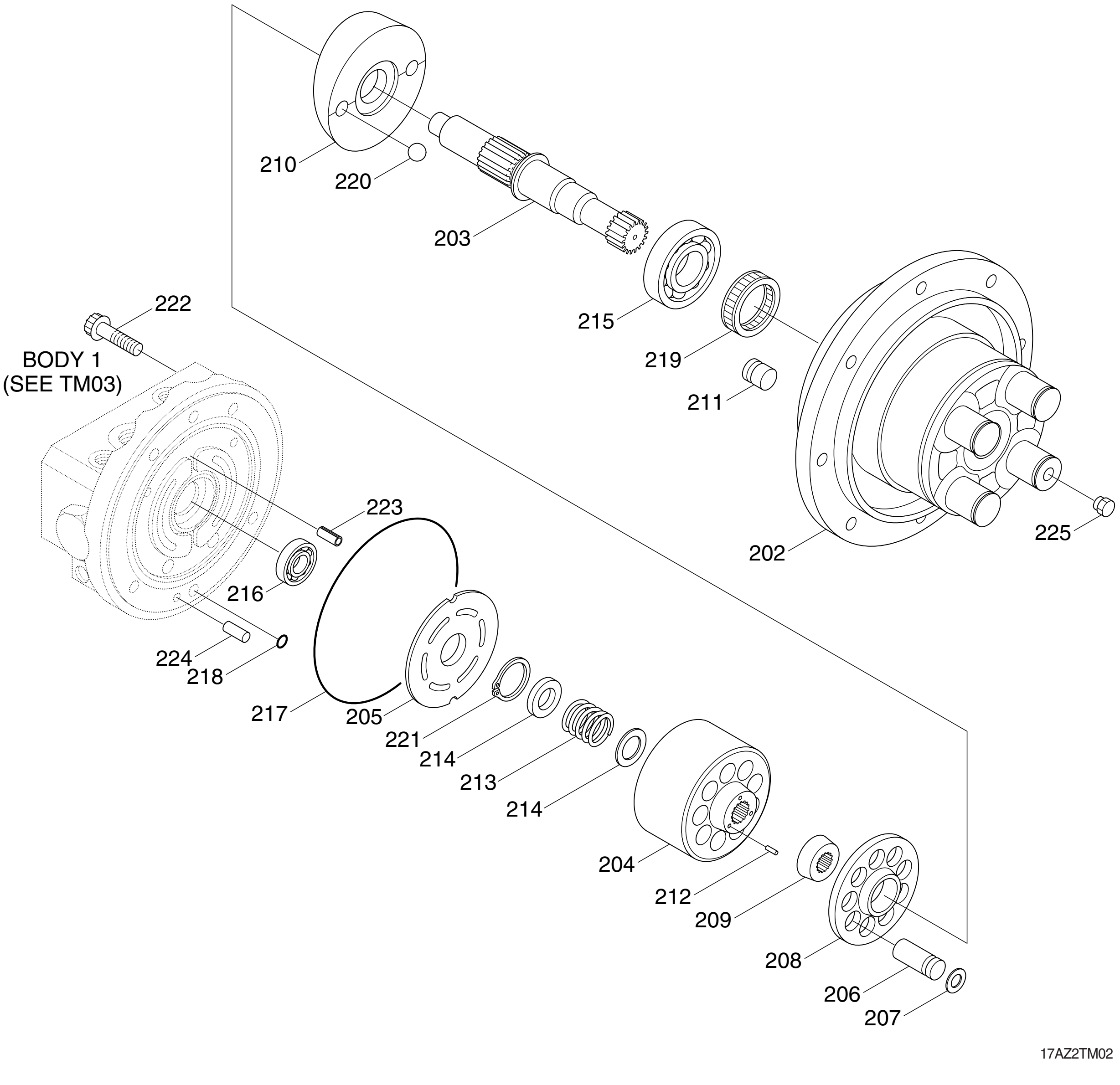
③ Tighten plug lightly.

④ Start the engine, run at low idling, and check oil come out from plug.

⑤ Tighten plug fully.

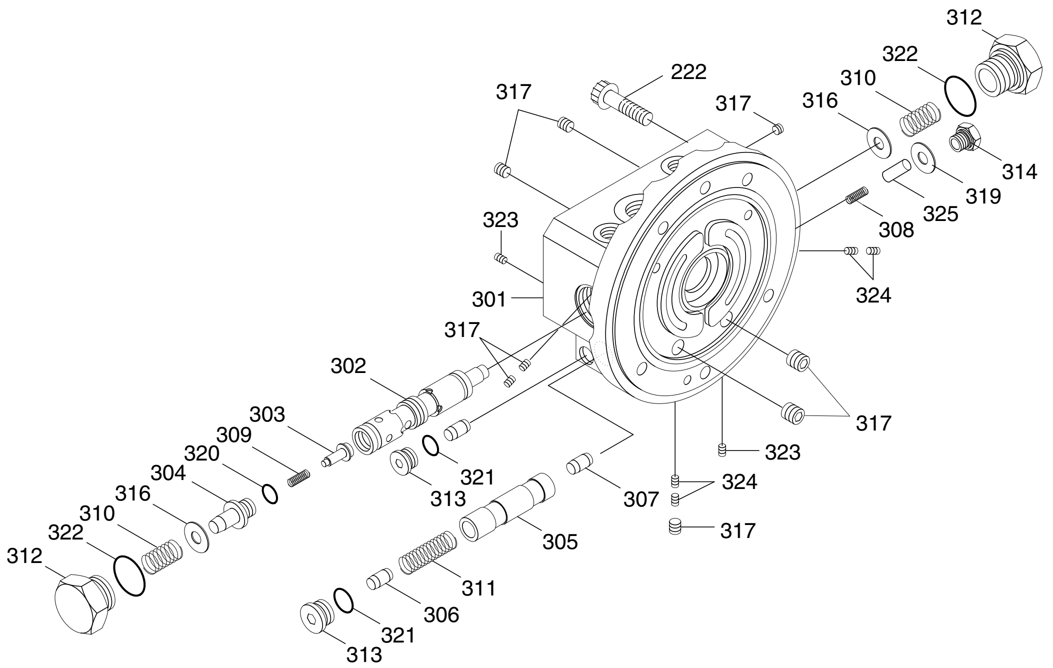
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) STRUCTURE (1/3)



202	Body 2	210	Swash plate	218	O-ring
203	Shaft	211	Control piston	219	Oil seal
204	Cylinder barrel	212	Pin	220	Steel ball
205	Valve plate	213	Spring C	221	Snap ring
206	Piston	214	Retainer	222	Screw
207	Shoe	215	Bearing	223	Spring pin
208	Shoe holder	216	Bearing	224	Pin
209	Barrel holder	217	O-ring	225	Plug

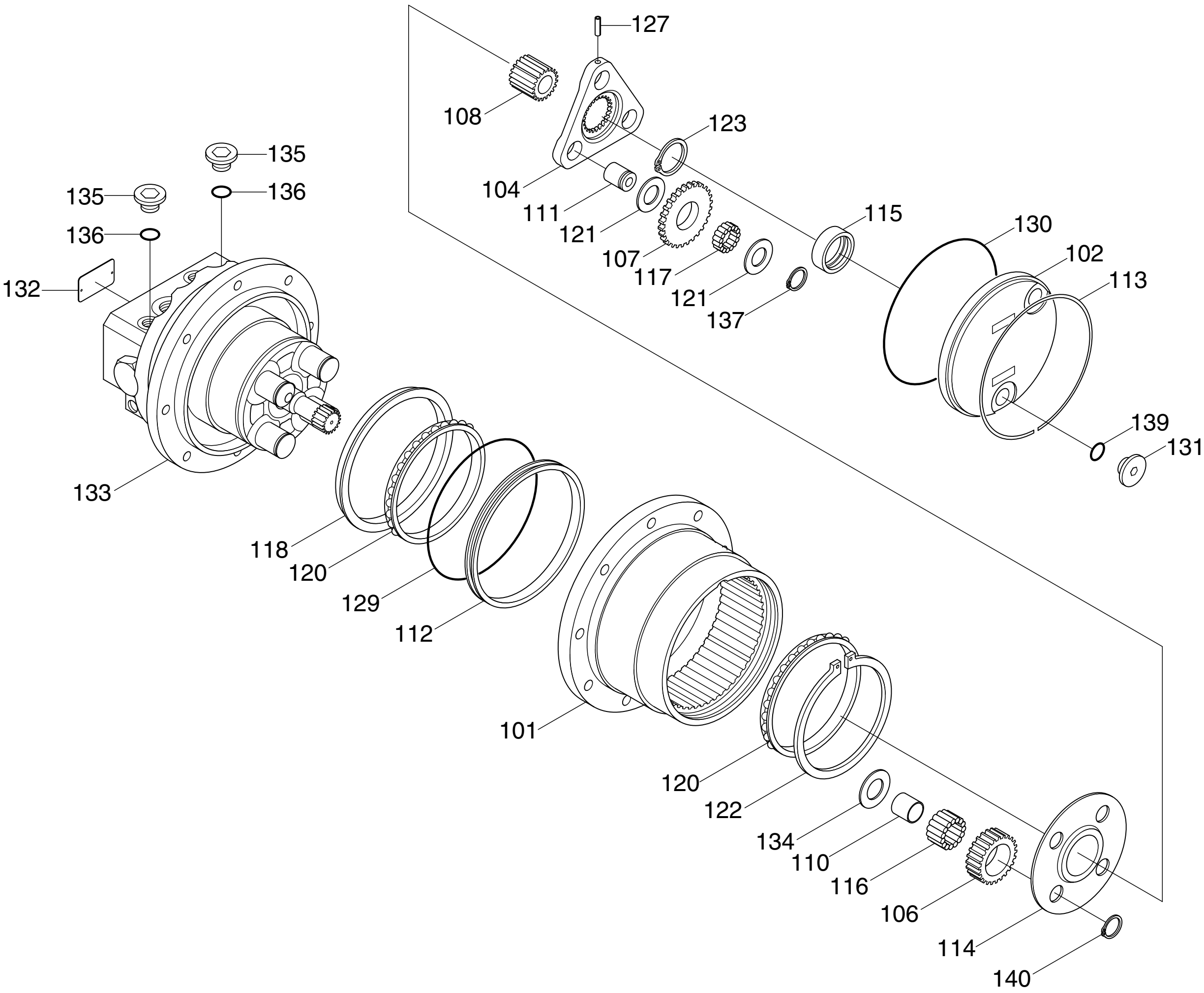
STRUCTURE (2/3)



17AZ2TM03

301	Body 1	309	Spring V1	319	O-ring
302	Spool	310	Spring V2	320	O-ring
303	Check valve	311	Spring V3	321	O-ring
304	Spring guide	312	Plug	322	O-ring
305	Spool	313	Plug	323	Chock
306	Spool B	314	Ring	324	Chock
307	Spool C	316	Plug	325	Pin
308	Shuttle spool	317	Plug		

STRUCTURE (3/3)



101	Body	112	Seal ring	121	Thrust washer	134	Thrust washer
102	Cover	113	Snap ring	122	Snap ring	135	Plug
104	Carrier 2	114	Thrust plate	123	Snap ring	136	O-ring
106	Gear B1	115	Slide ring	127	Spring pin	137	Snap ring
107	Gear B2	116	Needle bearing	129	O-ring	139	O-ring
108	Gear S1	117	Needle bearing	130	O-ring	140	Snap ring
110	Ring	118	Floating seat	131	Plug		
111	Pin B2	120	Bearing	133	Hydraulic motor		

4) MAINTENANCE INSTRUCTION

(1) Necessary tool to assemble

Tool name	Information
Torque wrench	12 N, 90 N and 180 N
Hexagon socket	Hexagon size : 5 mm, 6 mm and 8 mm
Socket wrenches	Hexagon size : 27 mm
Hexagon socket wrenches	Hexagon size : 5 mm, 6 mm and 8 mm
Screwdriver	Width : 6~10 mm
Snap ring pliers	Ø24 mm for hole Ø15 mm, Ø18 mm, Ø26 mm, Ø90 mm for shaft
Plastic hammer	-
Others	Grease, Oil, Sand paper and C-clamps

2. DISASSEMBLY

1) GENERAL PRECAUTIONS

(1) Work at the clean area, and pay attention to clean each part from rubbish, peace of paint and prepare the clean case for disassembled parts.

(2) Remove the rubbish from the outside of the track motor before disassembling, and remove of paint by wiring brush.

(3) Put a mark on each part before disassembling for keeping the correct position at assembling.

(4) Handle disassembled parts with special care.

(5) Clean each part with cleaning solvents.

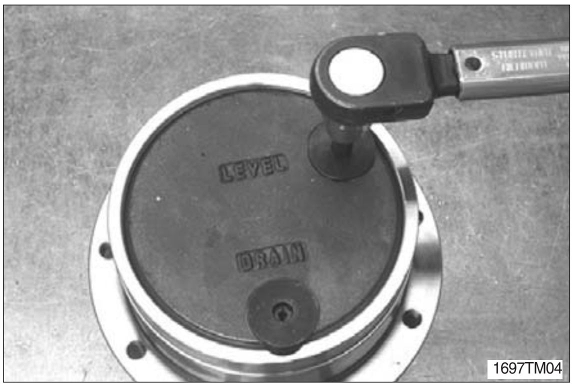
(6) Check disassembled parts with no damage, and removes any burrs.

(7) Use the new seal parts and snap rings.

(8) The press-fitting parts (for example, bearing and pin) can not be disassembled.

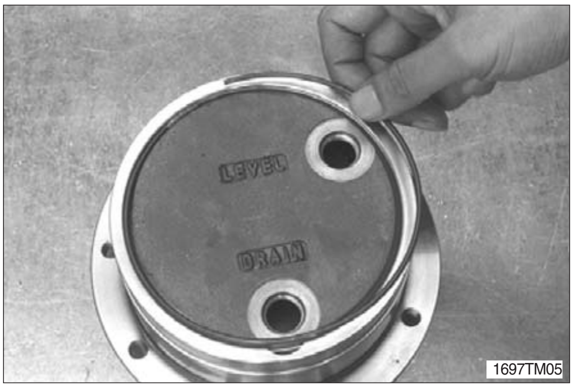
2) REDUCTION GEAR SECTION

(1) Remove the two plugs (PF3/8).
·Hexagon size : 8 mm
※ Remove the plug of "LEVEL" side first.



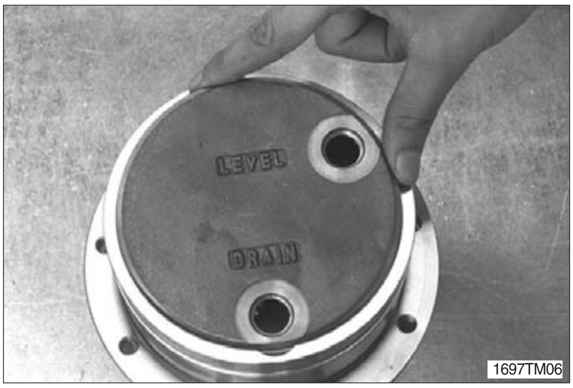
1697TM04

(2) Remove the snap ring.
※ Put the screwdriver into the notch of the body, and then pull the snap ring.



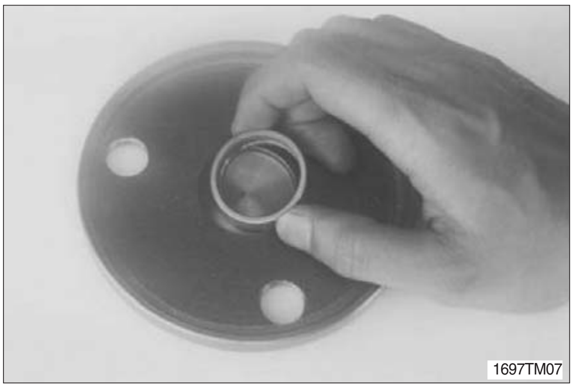
1697TM05

(3) Remove the cover.

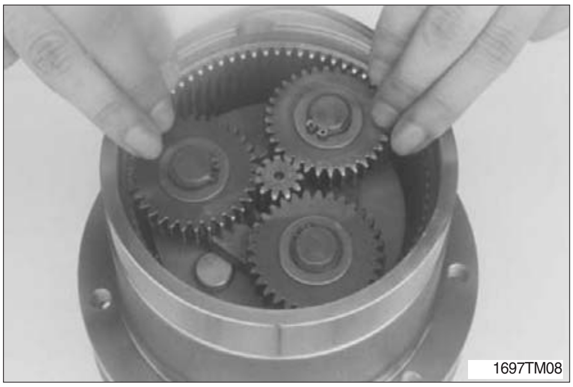


1697TM06

(4) Remove the slide ring from the cover.


1697TM07

(5) Remove the O-ring from the body.



1697TM08

(6) Remove the carrier 2 kit from the body.

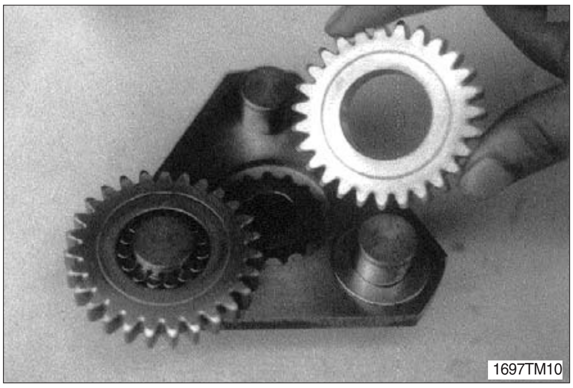
1697TM09

(7) Remove the three snap rings, three thrust washers, three b2 gears, thirty-nine needles and three thrust washers.

※ The thrust washers on both sides of the b2 gears are the same.

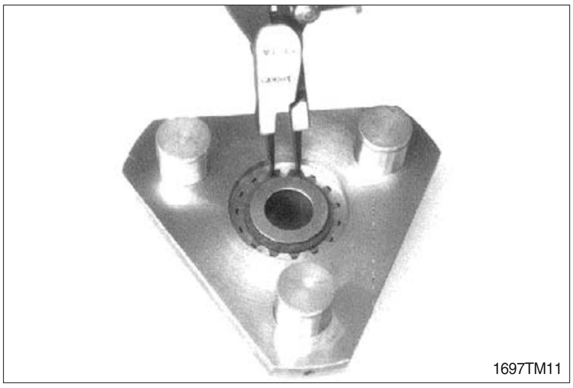
※ The b2 pins and spring pins are not able to disassemble, because they are press-fitted.

※ The needles are easily dispersed, pay attention not to lose.



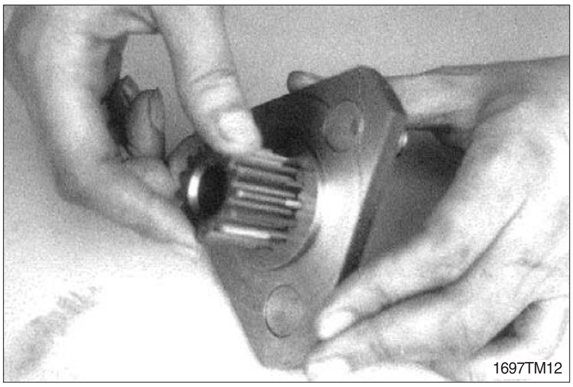
1697TM10

(8) Remove the snap ring from the carrier 2.



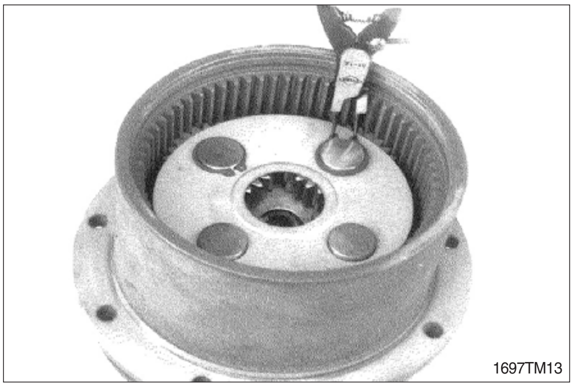
1697TM11

(9) Remove the s1 gear from the carrier 2.



1697TM12

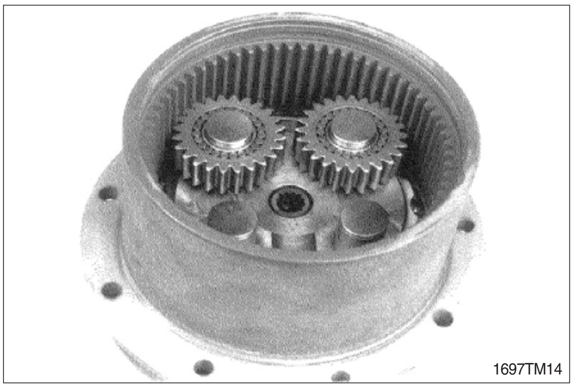
(10) Remove the four snap rings and the four thrust plates.



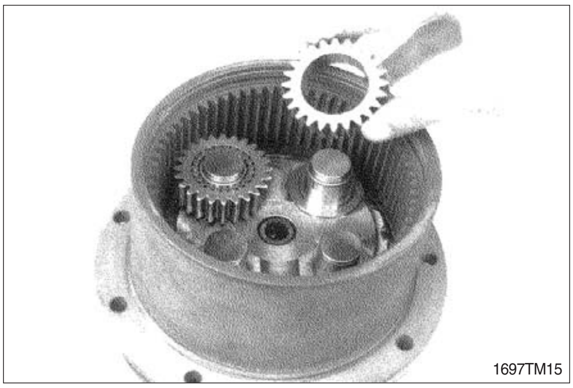
1697TM13

(11) Remove the four b1 gears, ninety-six needles, four thrust washers and four rings.

※ The needles are easily dispersed, pay attention not to lose.



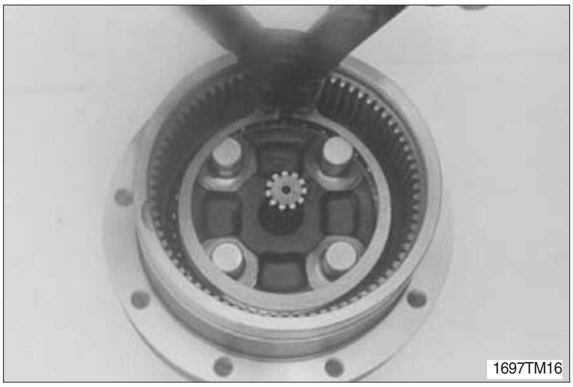
1697TM14

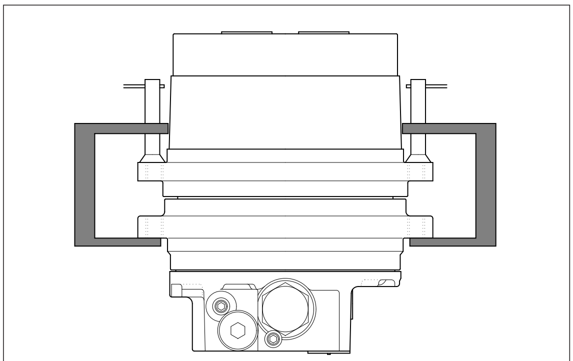


1697TM15

(12) Remove the snap ring.

※ Tighten the speed reducer flange and the motor flange with C-clamps or a hydraulic press (see the illustration) to make it easy.


1697TM16


1697TM17

(13) Remove the speed reducer with the iron balls with retainer and the internal ring of bearing.


1697TM18

(14) Remove the iron balls with retainer from the speed reducer.

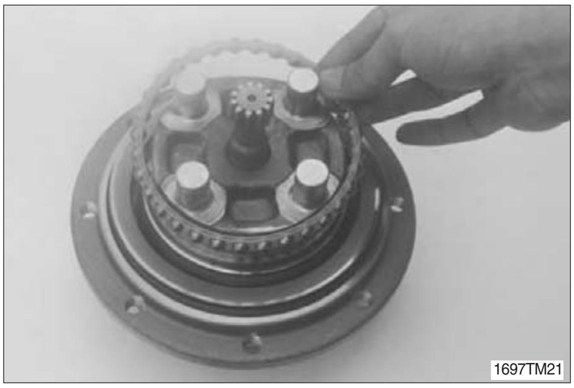
※ Pay attention not to lose the balls from retainer.

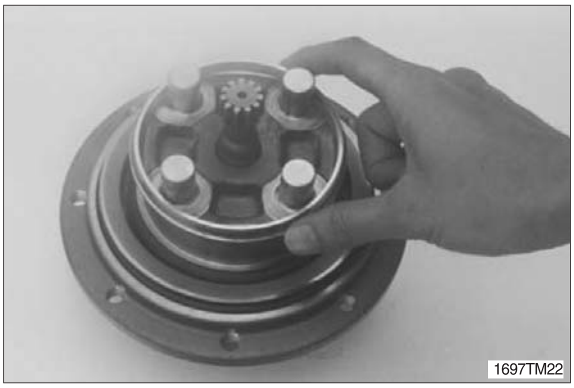

1697TM19

(15) Remove the seal ring from the speed reducer.

(16) Remove the iron balls with retainer and the internal ring of bearing from the hydraulic motor.

※ Pay attention not to lose the balls from retainer.



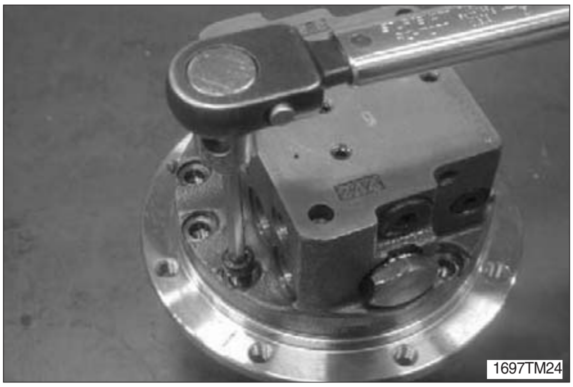


(17) Remove the floating seat with O-ring from the hydraulic motor.

3) HYDRAULIC MOTOR SECTION

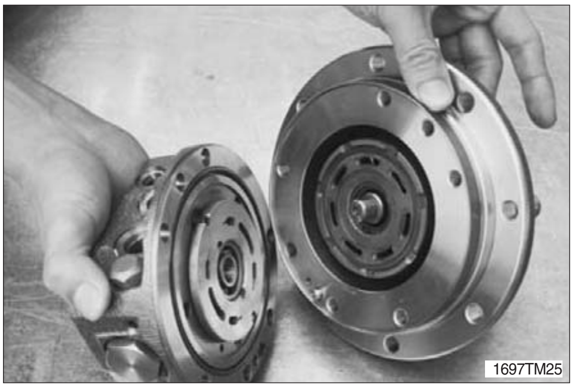
(1) Remove the seven hexagon socket head cap bolts.
·Hexagon size : 6 mm

※ If you fix the motor with a vice, protect it with aluminum plates or equivalent.

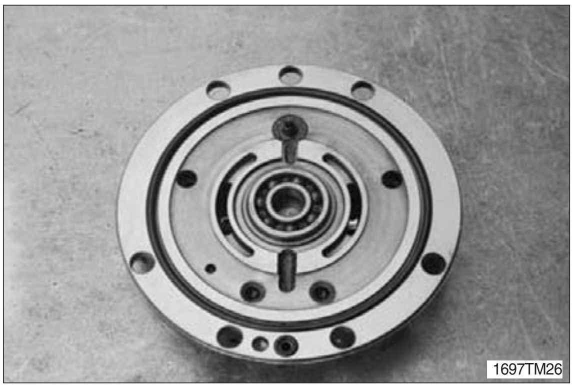

1697TM24

(2) Remove the body 1 from the body 2.

※ Pay attention not to come off and damage the valve plate.

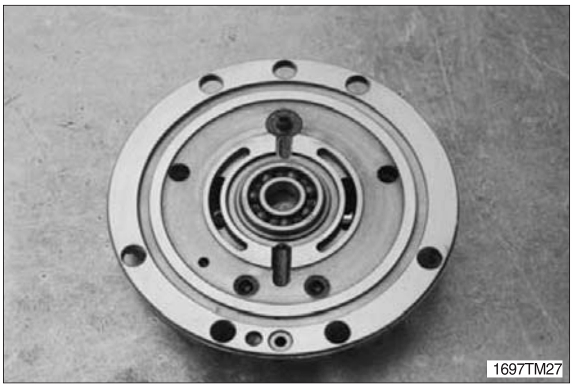

1697TM25

(3) Remove the valve plate.


1697TM26

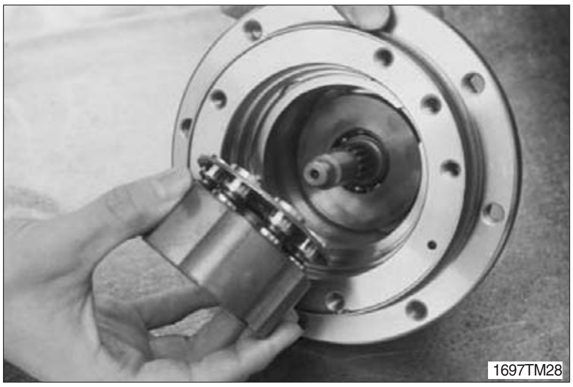
(4) Remove the two O-rings from the body 1.

※ The bearing and spring pins are not able to disassemble, because they are press-fitted.


1697TM27

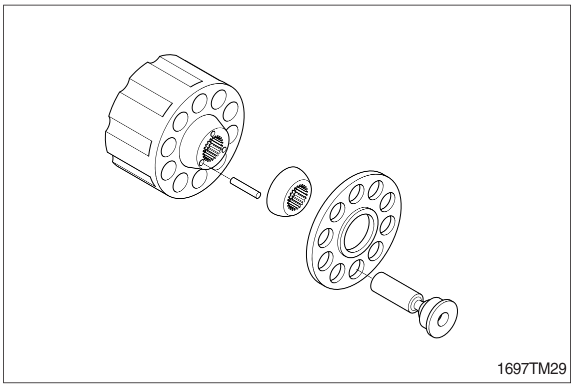
(5) Remove the cylinder barrel assembly from the body 2.

※ The small parts are easily dispersed, pay attention not to miss.



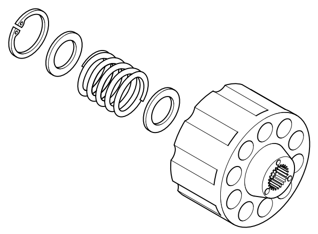
1697TM28

(6) Remove the seven piston-shoe assemblies, shoe holder, barrel holder, three pins.



1697TM29

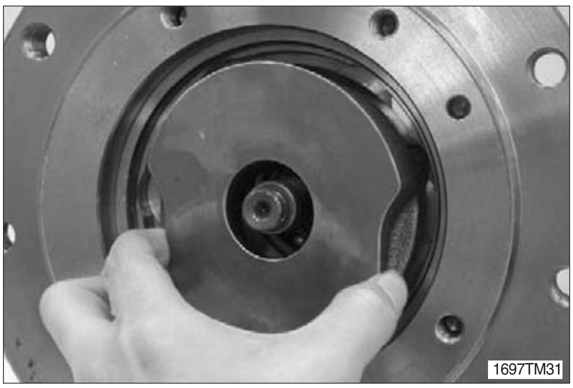
(7) Remove the snap ring, retainer, spring-C and retainer.



R27Z97TM28

1697TM30

(8) Remove the swash plate and two balls from the body 2.



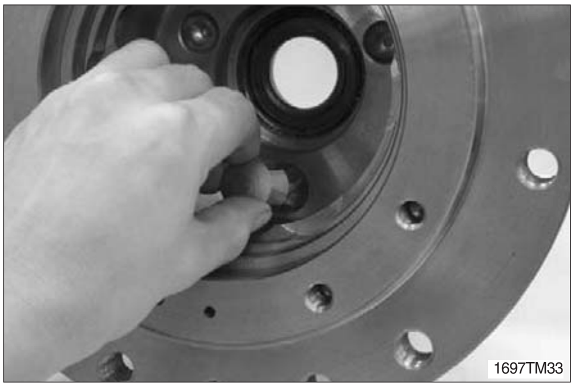
1697TM31

(9) Remove the shaft from the body 2.

※ The bearing is not able to disassemble, because they are press-fitted.

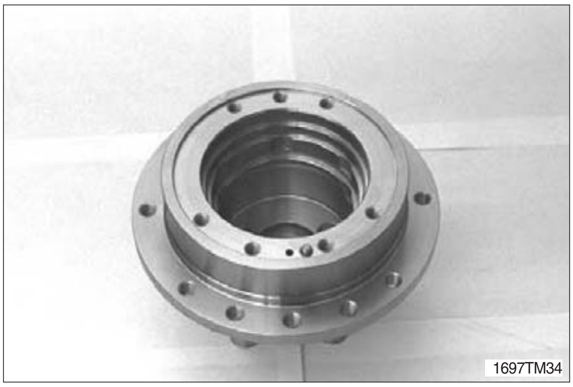

1697TM32

(10) Remove the control piston from the body 2.


1697TM33

(11) Remove the oil seal from the body 2.

(12) Remove the pin from the body 2.


1697TM34

(13) Remove the two plugs with O-rings from the body 1.

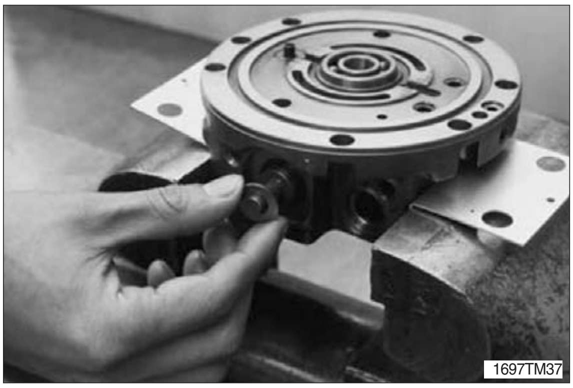
·Hexagon size : 27 mm

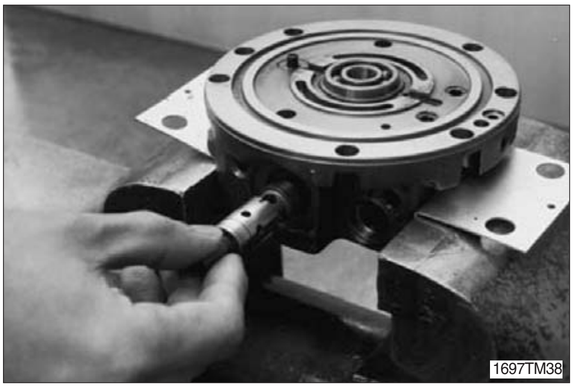

1697TM35

(14) Remove the two spring V2, two rings and spool assembly.

※ The spool assembly is not able to disassemble.

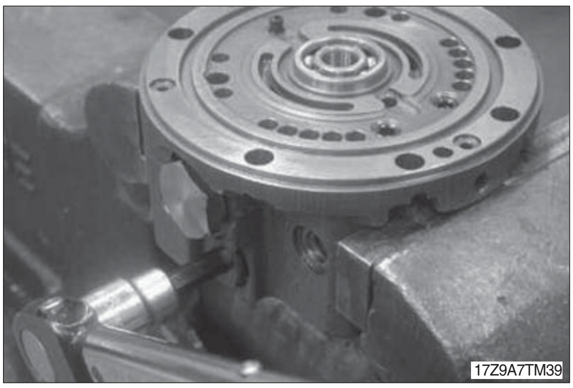

1697TM36


1697TM37


1697TM38

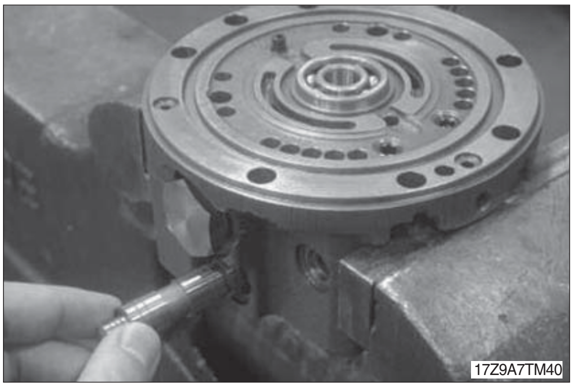
(15) Remove the two plugs with O-rings from the body 1.

·Hexagon size : 8 mm


17Z9A7TM39

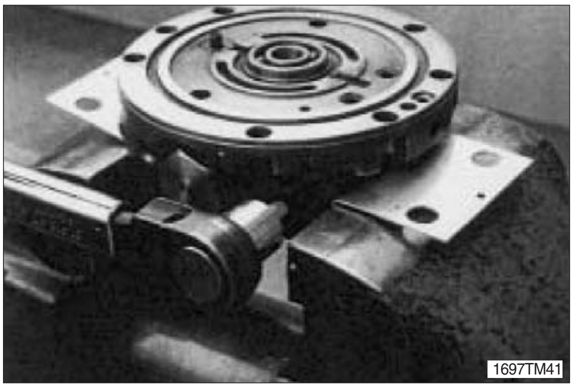
(16) Remove the spring V3, two speed spool, spool B and spool C.

※ The small parts are easily dispersed, pay attention not to miss.



(17) Remove the two plugs with O-ring from the body 1.

·Hexagon size : 5 ㎜

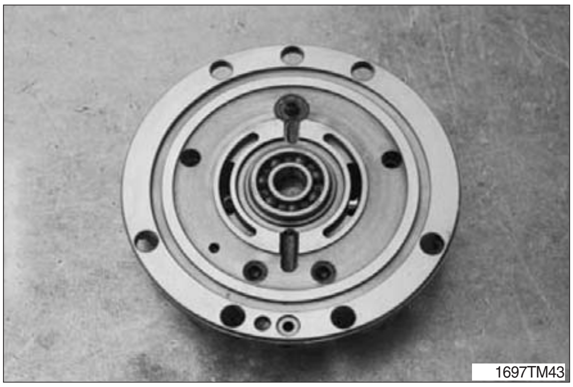


(18) Remove the two needles and shuttle spool.

3. ASSEMBLY

1) HYDRAULIC MOTOR SECTION

(1) Press-fit the bearing and the spring pin into the body 1.



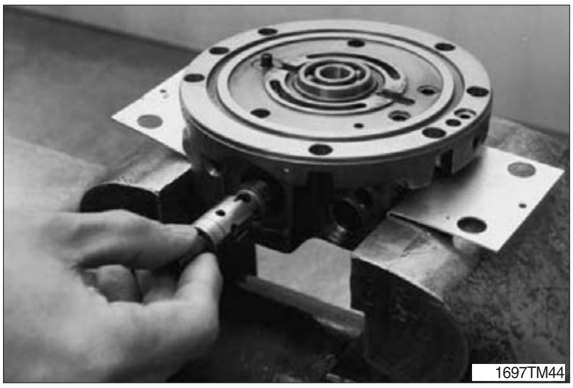
1697TM43

(2) Insert the spool assembly, two rings (1pc/side) and two springs (1pc/side) in that order into the body 1, and then screw the two plugs (1pc/side) with two O-rings (1pc/side).

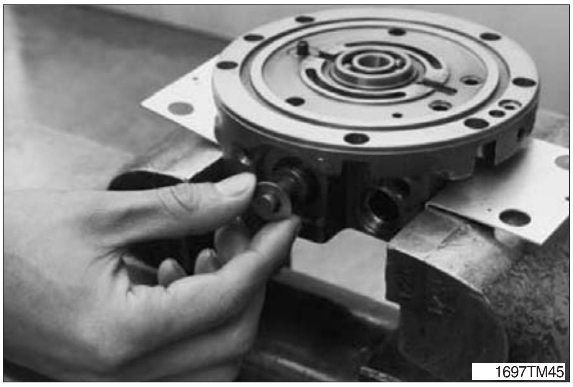
※ The spool assembly is not able to disassemble.

· Plugs tightening torque (both sides) :
13~17 kgf · m (94~123 lbf · ft)

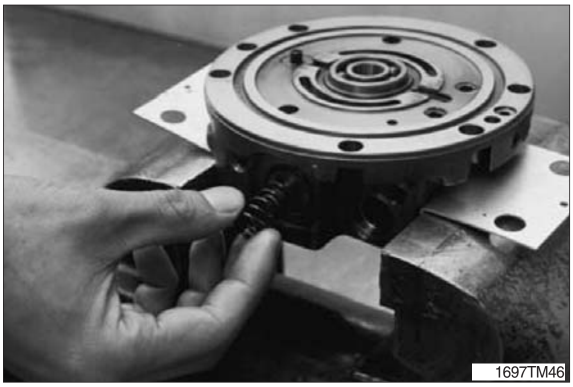
· Hexagon size : 27 mm



1697TM44



1697TM45

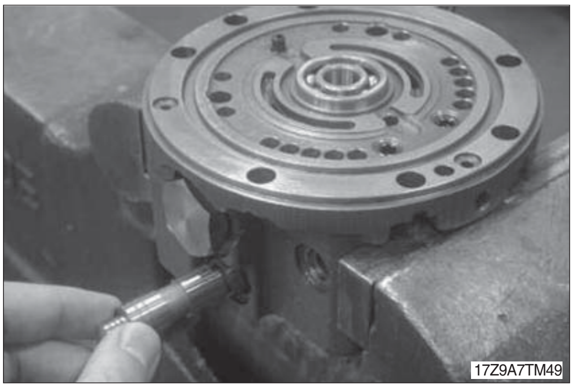


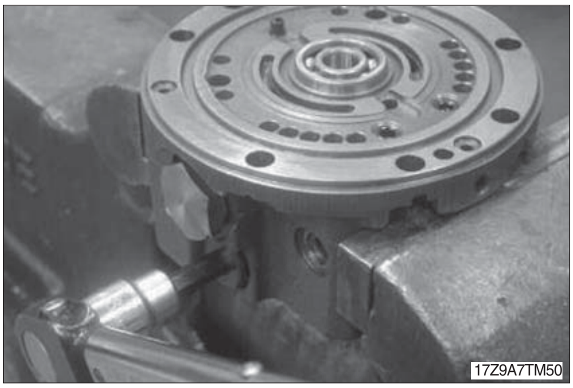
1697TM46

(3) Insert the spring V3, spool B and spool C into two speed spool. Insert its assembly into the body 1. Screw the two plugs (1pc/side) with two O-rings (1pc/side).

· Plugs tightening torque :
4.69~5.2 kgf · m (33.9~37.6 lbf · ft)
· Hexagon size : 8 mm

※ Pay attention to the direction of the spool. (See drawings for the direction, page 7-58~60).





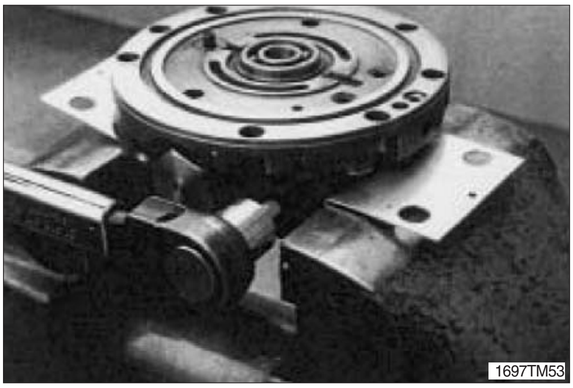
(4) Insert the shuttle spool and two needles (1pc/side) into the body 1, and then screw them in with the two plugs with O-rings (1pc/side).

· Plugs tightening torque :
1.2~1.8 kgf · m
(8.7~13.0 lbf · ft, both sides)

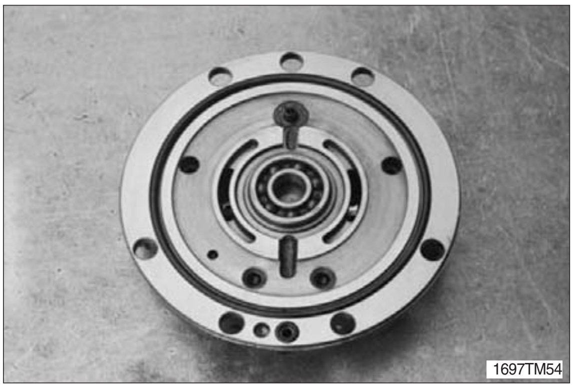
· Hexagon size : 5 mm


1697TM51


1697TM52


1697TM53

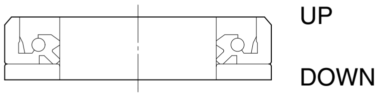
(5) Place two O-rings onto the body 1.


1697TM54

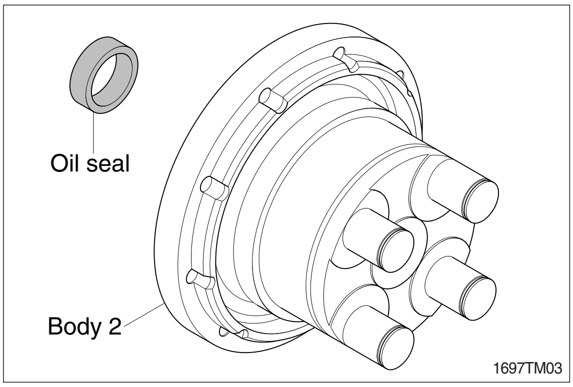
(6) Press-fit the oil seal into the body 2.

※ Apply grease to the periphery of the oil seal.

※ Pay attention to the direction of the oil seal, and do not slant it.



R27Z97TM52



1697TM03

(7) Place the pin into the body 2.

1697TM55

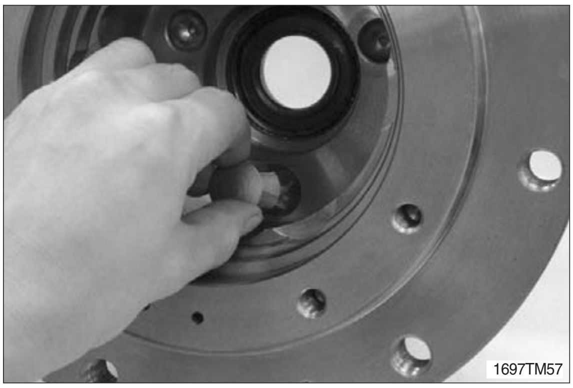
(8) Press-fit the bearing with the shaft.

1697TM56

(9) Insert the control piston into the body 2.

※ Pay attention to the direction of the control piston.

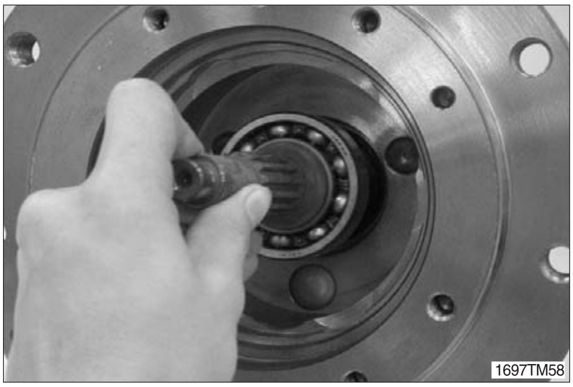
※ Assemble the control piston, which shoe surface should be upper side (see drawings for the direction, page 7-58~60).



1697TM57

(10) Place the shaft into the body 2.

※ Pay attention not to damage the oil seal with the shaft.
A oil which damaged should be replaced.

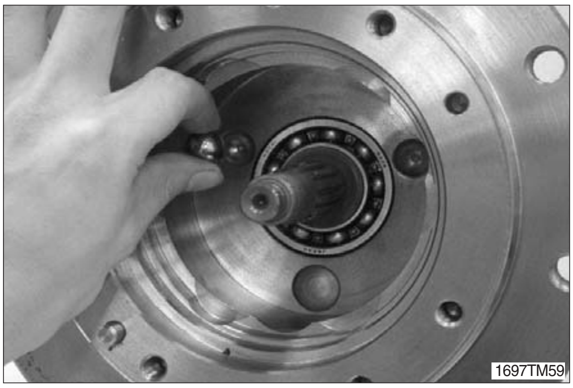


1697TM58

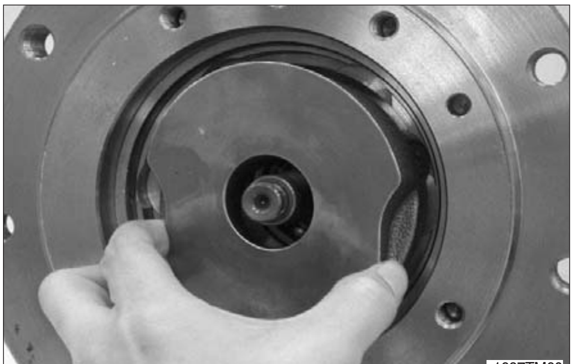
(11) Place the two balls and the swash plate onto the body 2.

※ Apply oil to the working face of the swash plate.

※ In case the swash plate drops out, apply grease to the back of it.



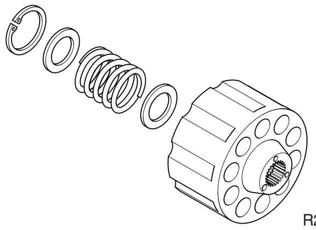
1697TM59



1697TM60

(12) Place the retainer, spring C and retainer in that order into the cylinder barrel, and then secure them with the snap ring.

※ Pay attention to the direction of the snap ring. The edge side should be uppermost.



R27Z97TM60

1697TM61

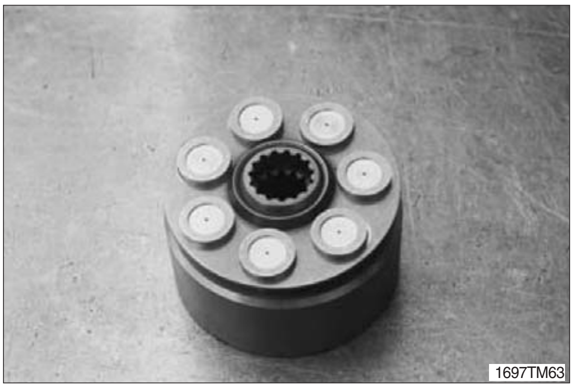
(13) Place the piston-shoe assemblies into the shoe holder.

1697TM62

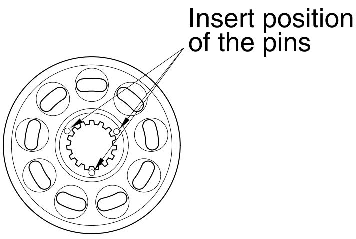
(14) Place the three pins, barrel holder and piston-shoe assemblies in that order into the cylinder barrel.

※ Apply oil to the inside of the cylinders, then lower the pistons into the cylinder barrel.

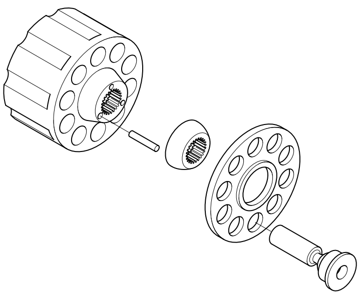
※ Pay attention to the order of pins, barrel holder and piston-shoe assemblies.
(See drawing for the order, page 7-58~60)



1697TM63



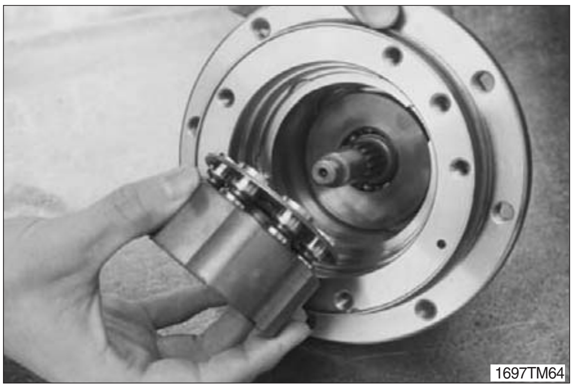
1697TM93



1697TM29

(15) Insert the cylinder barrel assembly into the body 2 so that the shoes contact the swash plate.

※ The small parts are easily dispersed, pay attention not to lose.



1697TM64

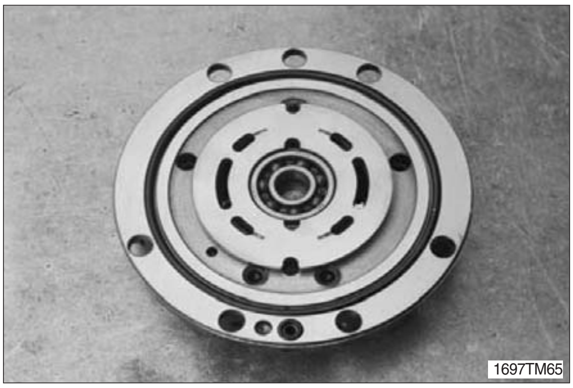
(16) Fill the body 2 with 0.1ℓ hydraulic oil for lubrication.

(17) Place the valve plate onto the body 1.

※ The copper face of the valve plate should be uppermost.

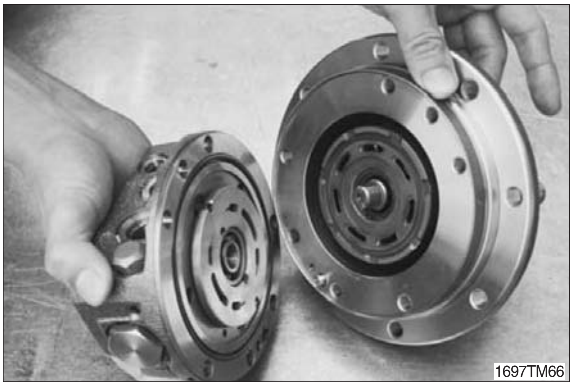
※ Apply oil to the copper face of the valve plate.

※ In case the valve plate drops out, apply grease to the steel face of it.


1697TM65

(18) Join the body 1 to the body 2.

※ The small parts are easily dispersed, pay attention not to miss.

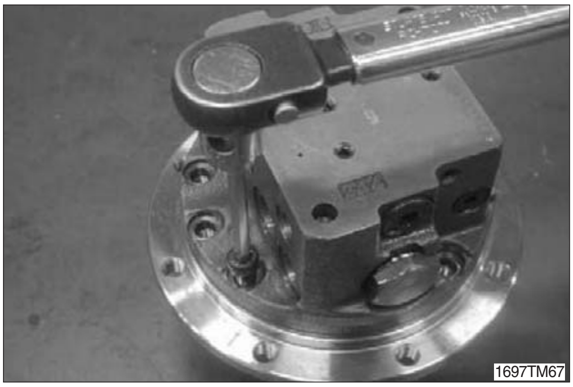

1697TM66

(19) Bolt them with seven hexagon socket head cap bolts.

· Bolt tightening torque :
2.9~3.1 kgf · m (21.0~22.4 lbf · ft)

· Hexagon size : 6 mm

※ If you fix the motor with a vice, protect it with aluminum plates or equivalent.


1697TM67

2) REDUCTION GEAR SECTION

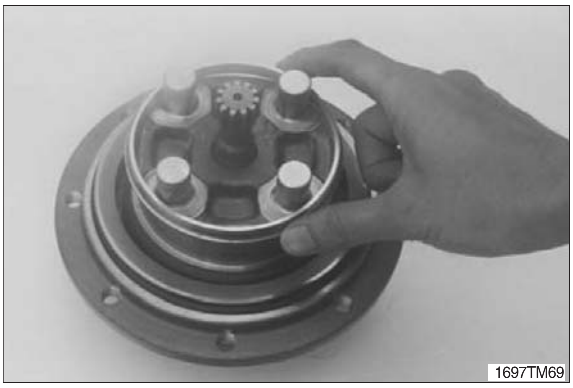
(1) Place the floating seal with O-ring into the hydraulic motor.

1697TM68

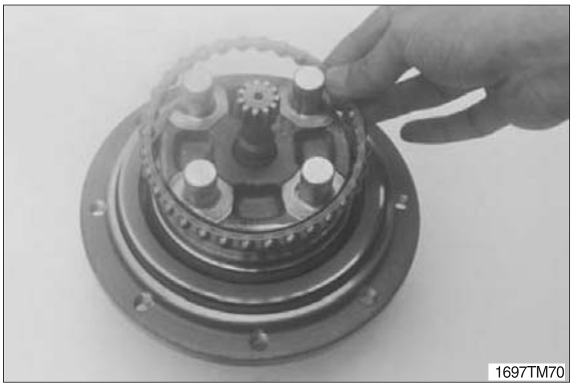
(2) Place inner ring, retainer with balls of the bearing in that order, onto the hydraulic motor.

※ Pay attention to the direction of the inner ring and the retainer.
(See drawings for the direction, page 7-58~60)

※ Pay attention not to disassemble the balls from the retainer.



1697TM69



1697TM70

(3) Put the seal ring with O-ring onto the body.

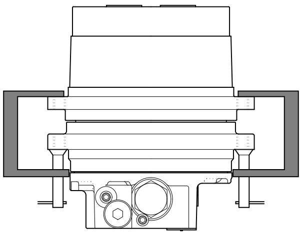
※ Apply grease to the O-ring to make it easy, and then wipe grease from the seal surface.

1697TM71

(4) Join the body to the motor.

※ Wipe grease from the seal surface.

※ Tighten the speed reducer flange and the motor flange with C-cramps or a hydraulic press.



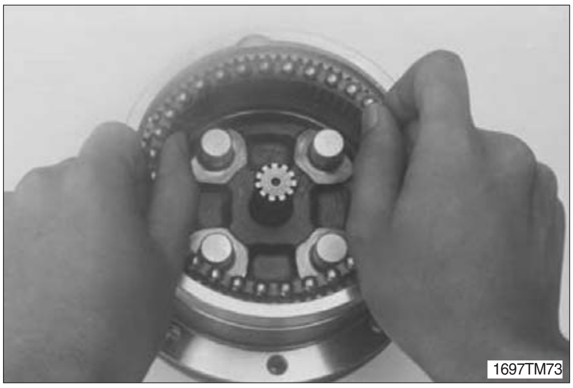
1697TM95

1697TM72

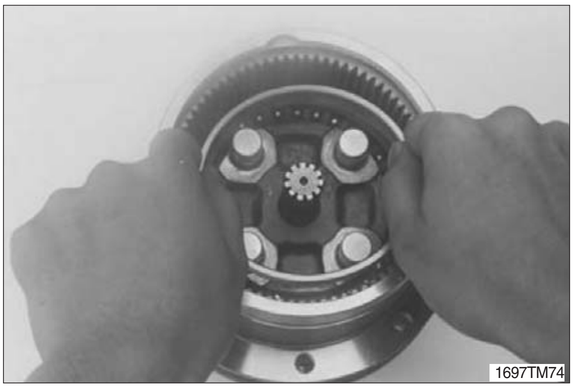
(5) Place retainer with balls, inner ring of the bearing in that order onto the hydraulic motor.

※ Pay attention to the direction of the inner ring and the retainer.

※ Pay attention not to disassemble the balls from retainer.
(See drawing for the direction.)



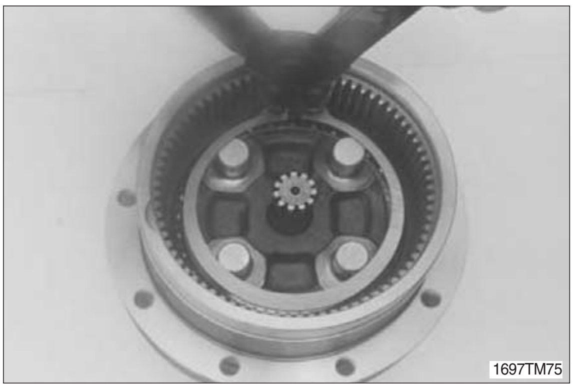
1697TM73



1697TM74

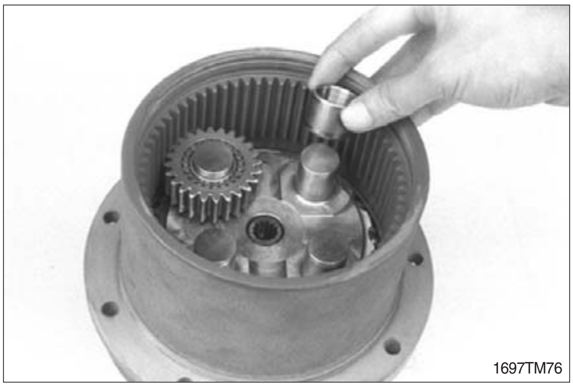
(6) Fix the bearing with the snap ring.

※ The pre-load for the bearings is adjusted by thickness of the snap ring.

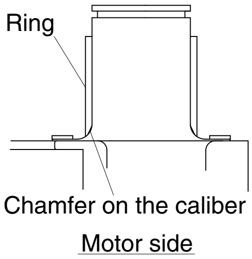


1697TM75

(7) Place the four rings (1pc/1pin), four thrust washers (1pc/1pin), four b1 gears (1pc/1pin) and ninety-six needles (24pcs/1pin) in that order onto the body 2.

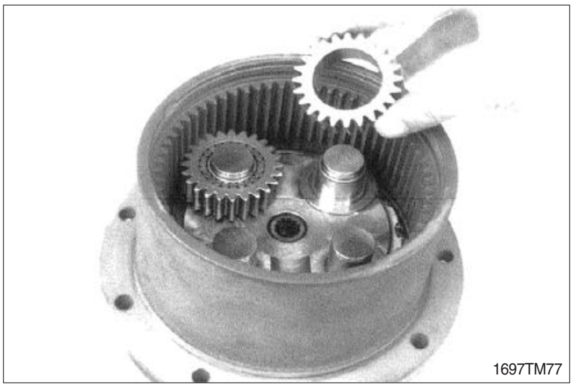

1697TM76

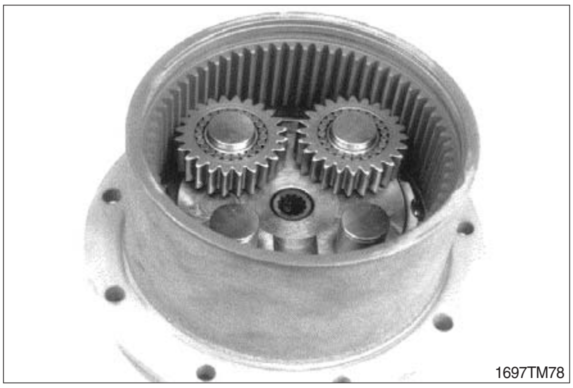
※ Pay attention to the direction of the ring. The chamfer on the caliber of the ring direction is motor side.



1697TM94

※ The needles are easily dispersed, pay attention not to lose.


1697TM77

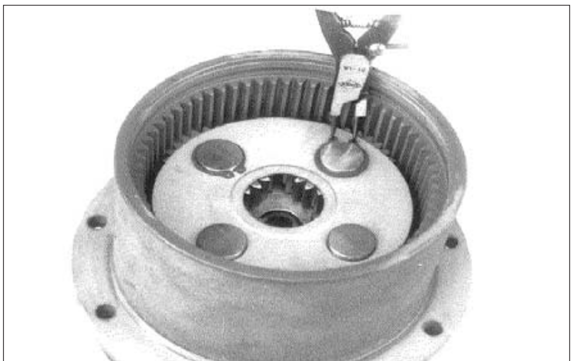

1697TM78

(8) Place thrust plate onto the gears and secure it with four snap rings.

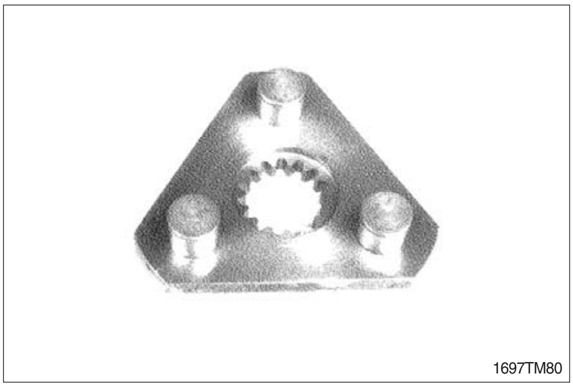
※ Pay attention to the direction of the thrust plate. The convex side should be uppermost. (see drawings for the direction, page 7-58~60).

※ Pay attention to the direction of the snap ring. The edge side should be uppermost.

※ Pay attention not to open the snap ring too much. A snap ring which loses tension should be replaced.


1697TM79

(9) Press-fit the three b2 pins and three spring pins (1pc/pin) into the carrier 2.

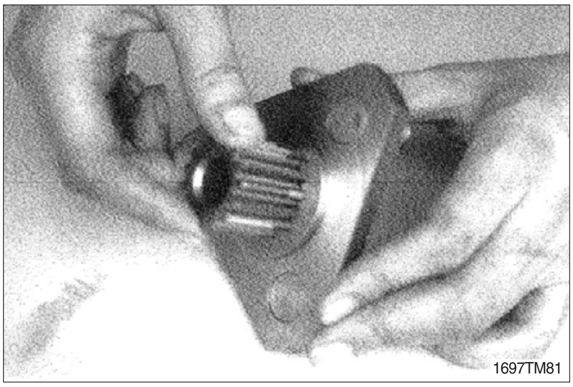


1697TM80

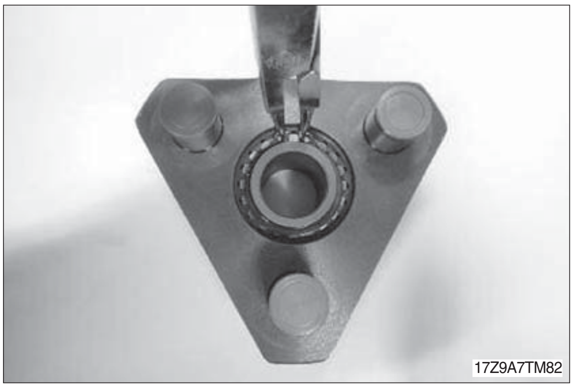
(10) Put the S1 gear to the carrier 2, and then secure them with the snap ring.

※ Pay attention to the direction of the snap ring. The edge side should be uppermost.

※ Pay attention not to open the snap ring too much. A snap ring which loses tension should be replaced.



1697TM81

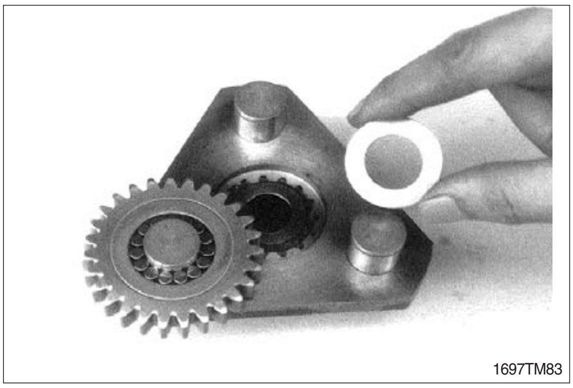


17Z9A7TM82

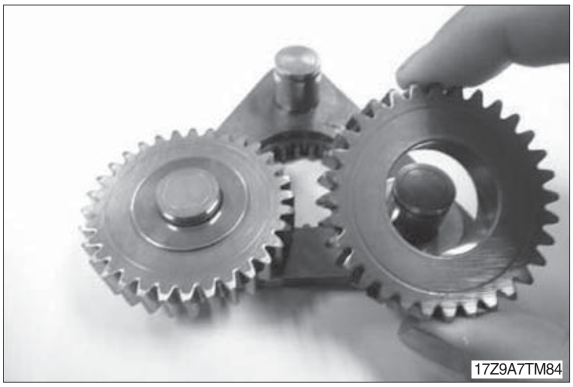
(11) Place the three thrust washers (1pc/1pin), three b2 gears (1pc/1pin), thirty-nine needles (13pcs/1pin) and the three thrust washers (1pc/1pin), in that order the carrier 2 and secure them with the three snap rings.

※ Pay attention to the direction of the snap ring. The edge side should be uppermost.

※ Pay attention not to open the snap ring too much. A snap ring which loses tension should be replaced.



1697TM83



17Z9A7TM84

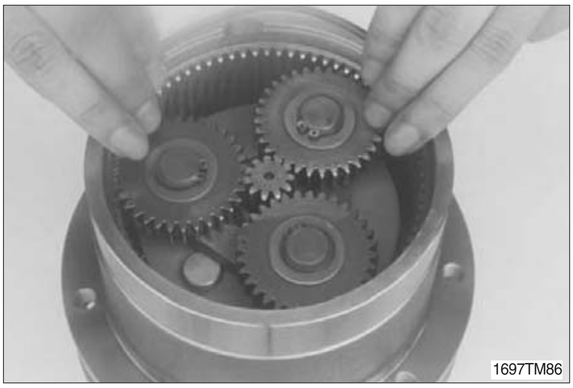
(12) Place the carrier 2 assembly into the body.

1697TM85

(13) Place the O-ring to the body.

※ Apply grease to the O-ring.

※ Pay attention not the rubbish in the O-ring groove.



1697TM86

(14) Place the slide ring onto the cover.

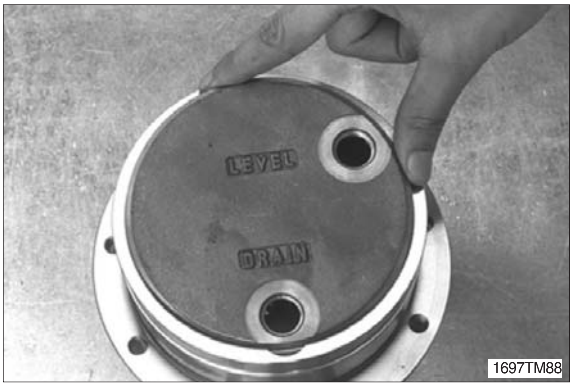
※ Apply grease to the slide ring to prevent it dropping out.

1697TM87

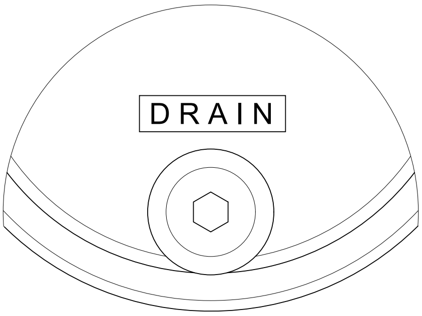
(15) Fill 0.33 ℓ gear oil in the body and insert cover.

※ Pay attention not to damage the O-ring.

※ The "DRAIN" side tapped hole should be aligned with notches of the body.



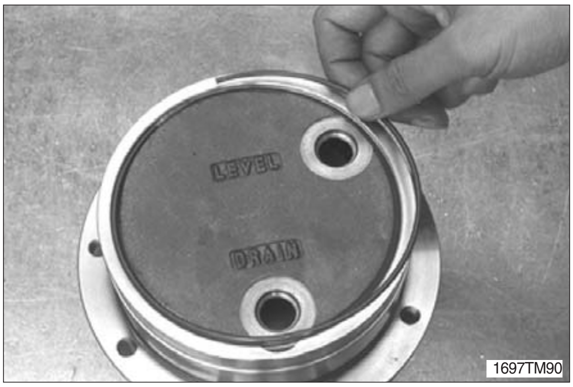
1697TM88



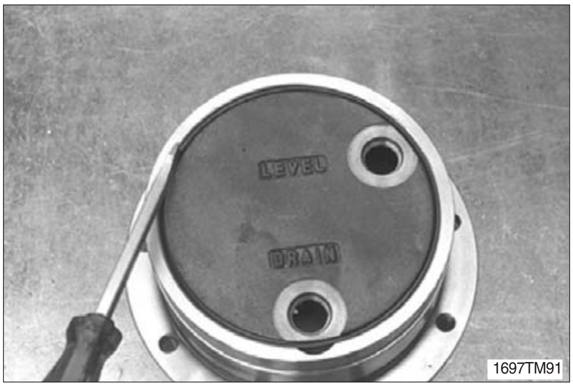
1697TM89

(16) Put the snap ring into the groove of the body to secure the cover.

※ Put the flat blade-flared tip screwdriver to the end of the snap ring, and tap it in the direction of the circumference.



1697TM90



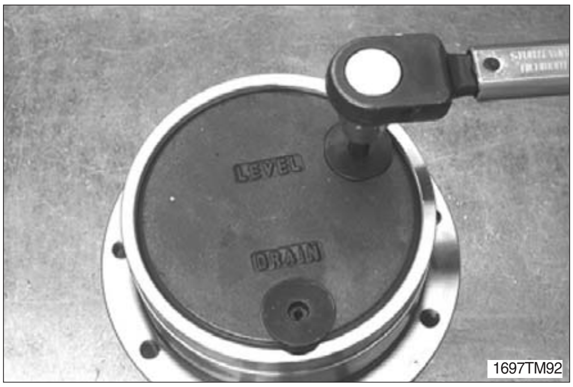
1697TM91

(17) Screw the two plugs (size : PF3/8) with O-rings (1pc/plug) to the cover.

· Plug tightening torque (PF3/8) :
4.69~5.2 kgf · m (33.9~37.6 lbf · ft)

· Hexagon size : 8 mm (PF3/8)

※ Screw the plug of "DRAIN" side first.



1697TM92

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

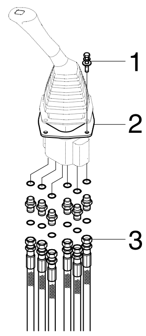
13031GE18

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**



17Z9A8DA06

(4) Loosen the with washer bolt (1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).
When removing the pilot valve assembly, check that all the hoses have been disconnected.

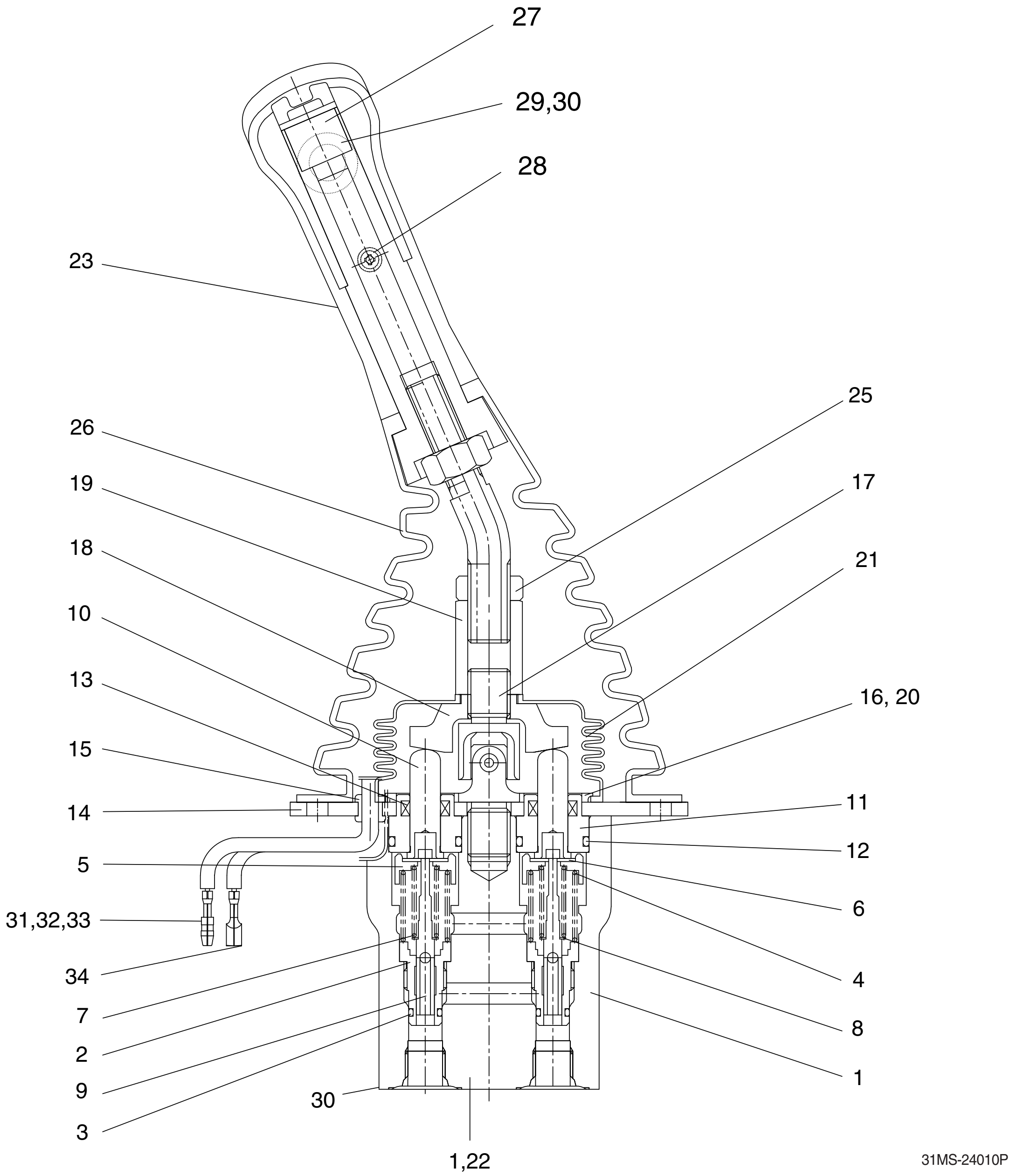
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

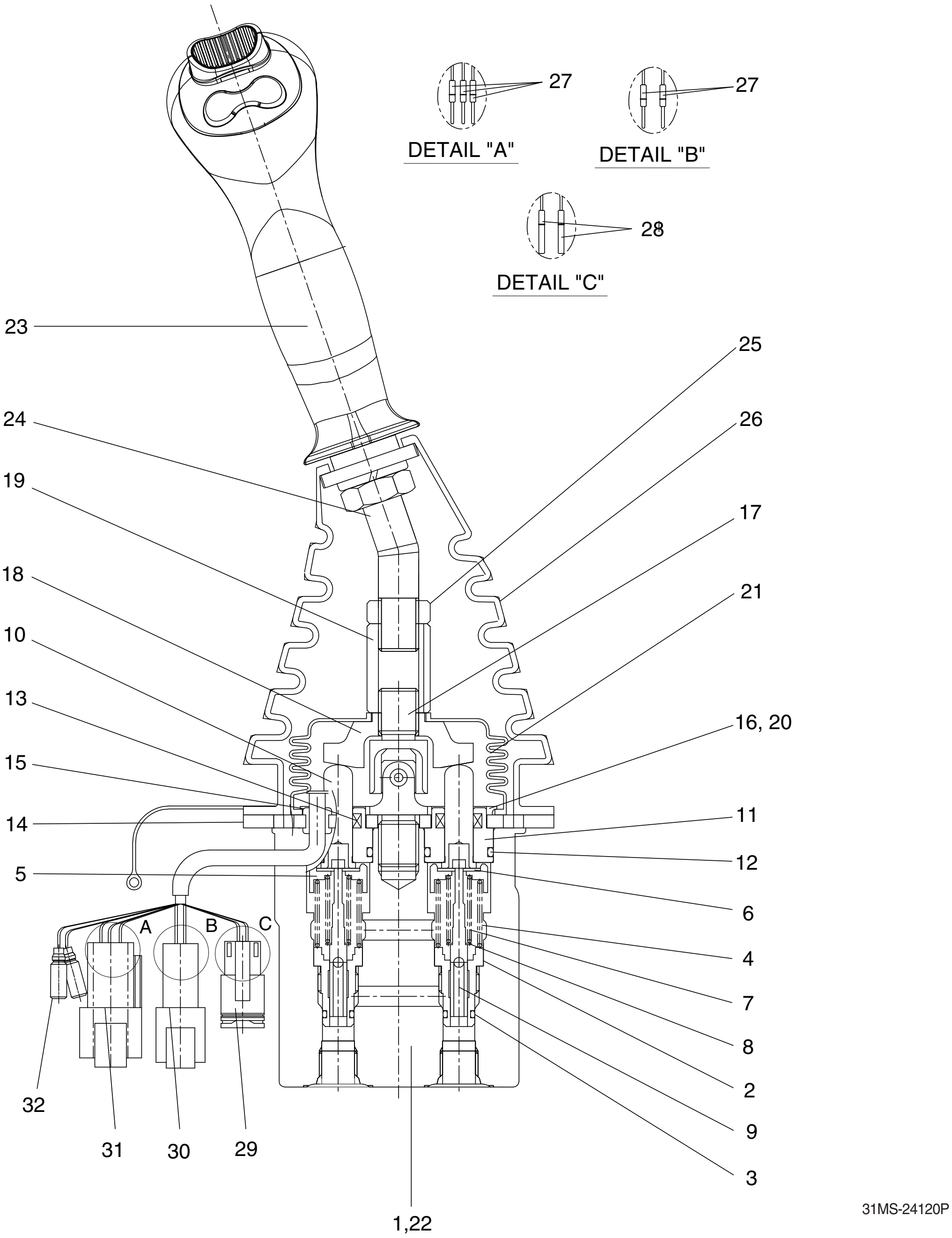
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE (STD)



1	Body	12	O-ring	23	Handle assy (LH, RH)
2	Plug	13	Rod seal	24	Handle bar
3	O-ring	14	Plate (A)	25	Nut
4	Spring	15	Bushing	26	Boots
5	Spring seat	16	Machine screw	27	Switch 1
6	Stopper	17	Joint assy	28	Screw
7	Spring	18	Swash plate	29	Switch 2
8	Shim	19	Hex nut	30	Switch cover
9	Spool	20	Plate (B)	31	Connector assy
10	Push rod	21	Inner boots	32	Terminal
11	Plug	22	Plug	33	Guide
				34	Connector

STRUCTURE (PROPORTIONAL, OPT)



1	Body	12	O-ring	23	Handle assy (LH, RH)
2	Plug	13	Rod seal	24	Handle bar
3	O-ring	14	Plate (A)	25	Nut
4	Spring	15	Bushing	26	Boots
5	Spring seat	16	Machine screw	27	Connector pin male
6	Stopper	17	Joint assy	28	Connector pin female
7	Spring	18	Swash plate	29	Connector assy
8	Shim	19	Hex nut	30	Connector assy
9	Spool	20	Plate (B)	31	Connector assy
10	Push rod	21	Inner boots	32	Connector
11	Plug	22	Plug	33	Cap

2) TOOLS

Tool name	Information
Torque wrench	22 mm
Spanner	22 & 27 mm
Long nose plier	-
Screwdriver	-
Plastic hammer	-
L-wrench	M10

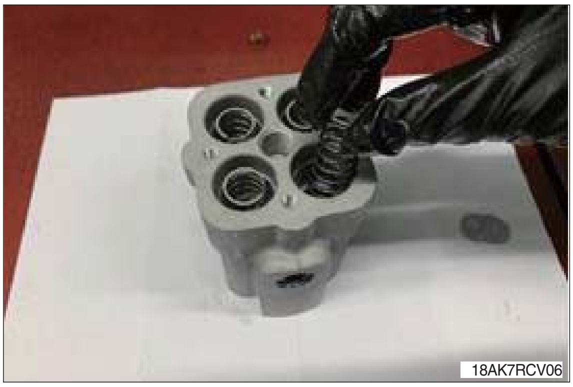
3) ASSEMBLY

(1) Prepare the body.
※ Secure the product on a flat table.

(2) Insert greased plugs into the respective ports.
※ Insert the spring while making sure that it is as close to the center as possible.

(3) Assemble plug.
※ 10 mm torque wrench, direction of assembly: clockwise
- Tightening torque : 3kgf·m (21.7 lbf·ft)

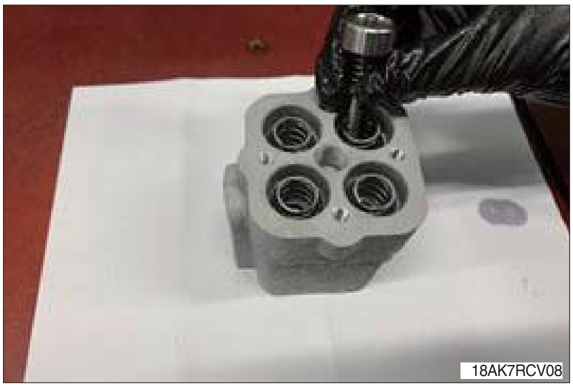
(4) Insert the op spring into the respective ports.



(5) Assemble the spool kit.
※ Assemble the spool, spring, spring seat, shim and stopper as shown in the photo.

18AK7RCV07

(6) Assemble the spool kit to the respective ports.

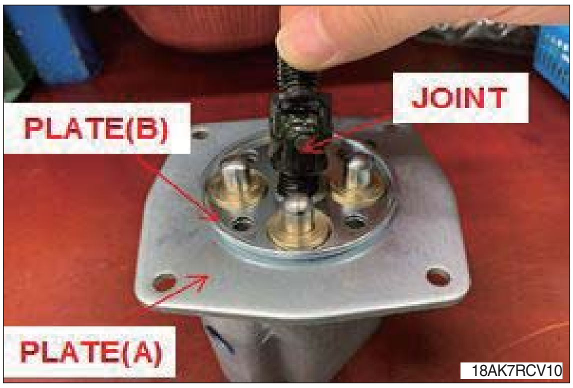


18AK7RCV08

(7) Place the plug kit over the spool kit.
※ Align the spool head part with the push rod hole.

18AK7RCV9

(8) Place plate (B) over plate (A) and assemble the joint with the wire hole facing toward port P.
※ Assemble the joint clockwise while pressing the plate.



18AK7RCV10

(9) Assemble the joint assy.
-Tightening torque : 3 kgf·m (21.7 lbf·ft)
※ Direction of assembly: clockwise
※ Lightly tap with a hammer in all four compass directions while making sure not to scratch the product, so that the plug can be inserted at the same time.

(10) Insert screws into the four holes.

(11) Fasten the screws with an electric driver. (Direction of assembly): clockwise

(12) Apply grease to the joint assy and push rod.
※ Grease spec: combi ep no.1 or equivalent

※ Apply grease to the rotating part of the joint and the upper surface of push rod.

(13) Assemble the swash plate.

※ Assemble the swash plate and push rod along the contact surface, and make sure that the push rod is not pressed.

※ Direction of assembly: clockwise.

18AK7RCV15

(14) Assemble the hex nut.

※ Direction of assembly: clockwise.

18AK7RCV16

(15) Assemble the hex nut with the torque wrench.

- Tightening torque : 8kgf·m (57.9 lbf·ft)

※ Direction of assembly of upper torque wrench: clockwise.

18AK7RCV17

(16) Assemble the inner boots.

※ Insert the boots between the plate and body.

18AK7RCV18

(17) Assemble the handle kit and fasten with a torque wrench.

-Tightening torque : 6kgf·m (43.4 lbf·ft)

※ When assembling, fasten according to the direction of the handle.

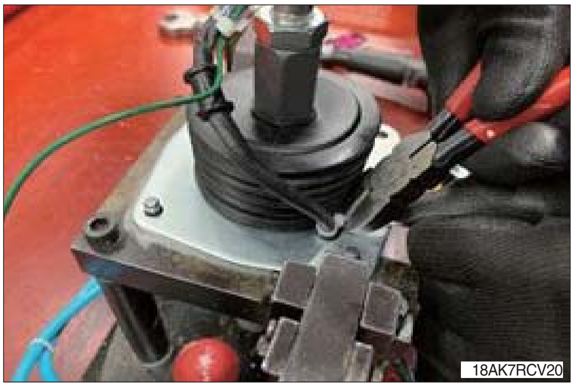
※ Assembly direction of the upper torque wrench: clockwise.

STD

PROPORTIONAL, OPT

(18) Insert wire into the bushing hole.

※ After inserting the wire, secure it with a cable tie.



(19) Insert the terminal into the respective wire.

STD

Insert the terminal into the respective wire.

SWITCH NUMBER	CONNECTOR SPECIFICATION	WIRE COLOR
1	DT06-2S-EP05	GRAY
2	DT04-2P-E005	BLACK
3	JIS D 5403 CB104	BLUE

(PUSH BUTTON SWITCH용)

SWITCH NUMBER	CONNECTOR SPECIFICATION	WIRE COLOR
4	DT04-3P-E004-1	RED
4	DT04-3P-E004-2	PURPLE
4	DT04-3P-E004-3	WHITE

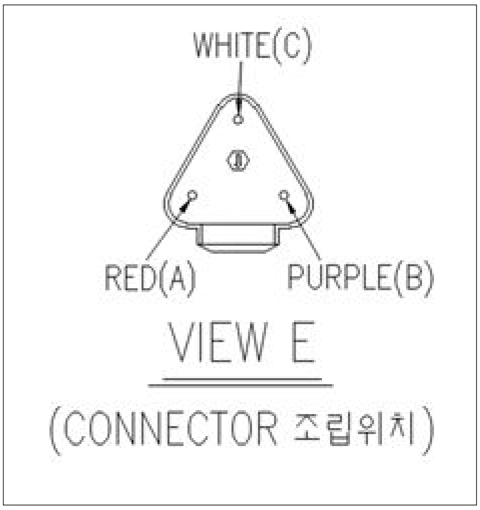
(PROPORTIONAL SWITCH용)

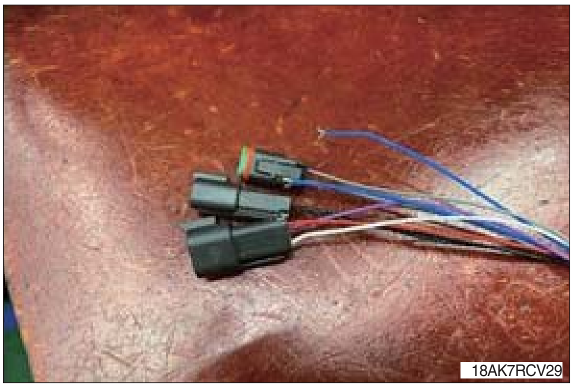
PROPORTIONAL, OPT

(20) Insert the female and male terminals.

STD

Insert the wire into the connector.





PROPORTIONAL, OPT

(21) Check the final status.

※ Check the exterior parts for irregularities as well as the connector specifications.

STD

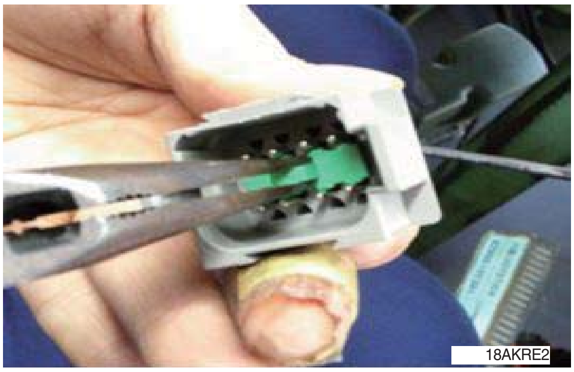
PROPORTIONAL, OPT

4) DISASSEMBLY

(1) 1. Prepare the joystick product.

※ Fix the product on a flat table.

(2) Dissemble the guide from the connector.



(3) Disassemble the wire from the connector.

※ Force the terminal holder to the opposite side and fix it.

(4) Pull out the terminal wire by moving the holder to the oppsite side.

(5) Pull out the wire from the bushing hole.


18AKRE5

(6) Disassemble the handle kit from the hex nut.

※ Disassembly direction: counterclockwise.


18AKRE6

(7) Disassemble the inner boots.


18AKRE7

(8) Disassemble the hex nut.

※ Disassembly direction: counterclockwise


18AKRE8

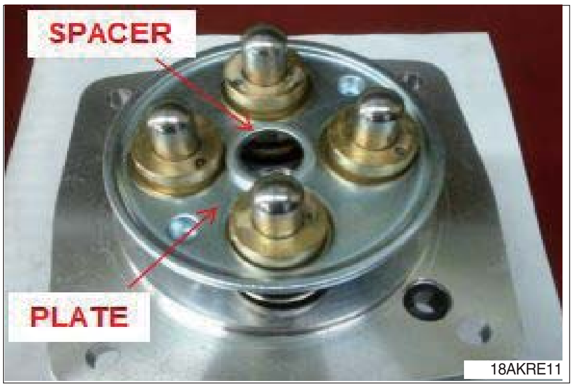
(9) Disassemble the swash plate.
※ Disassembly direction: counterclockwise.


18AKRE9

(10) Disassemble the joint assy.
※ Disassembly direction: counterclockwise.


18AKRE10

(11) Disassemble the plate and spacer.



18AKRE11

(12) Disassemble the plug kit from each port.

※ Fix the plug side using pliers and then force in the upper direction. take care not to damage the plug side.


18AKRE12

(13) Disassemble the bushing.
※ Extract the bushing using a screwdriver.

(14) Extract the spool kit from the body.

(15) Extract the op spting from the body.

(16) Check the final parts.

GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ Escaping fluid under pressure can penetrate the skin causing serious injury.

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

· Weight : 14 kg (31 lb)

· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

2) INSTALL

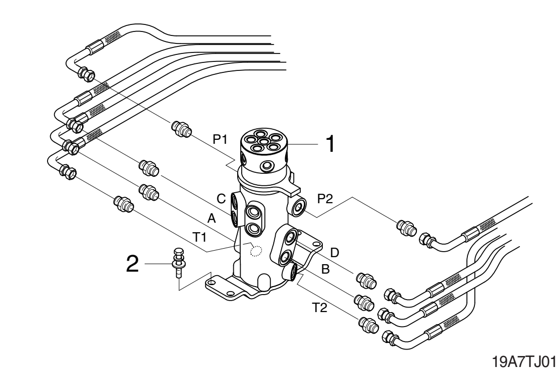
(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

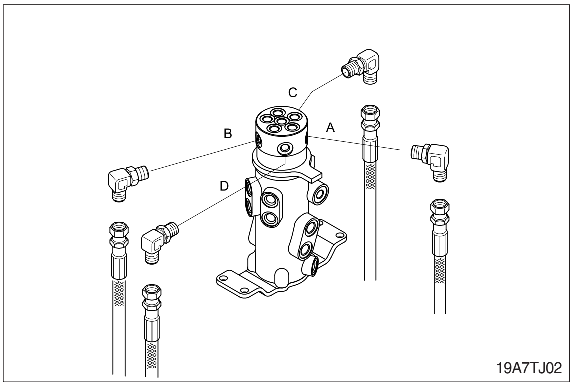
※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

13031GE18



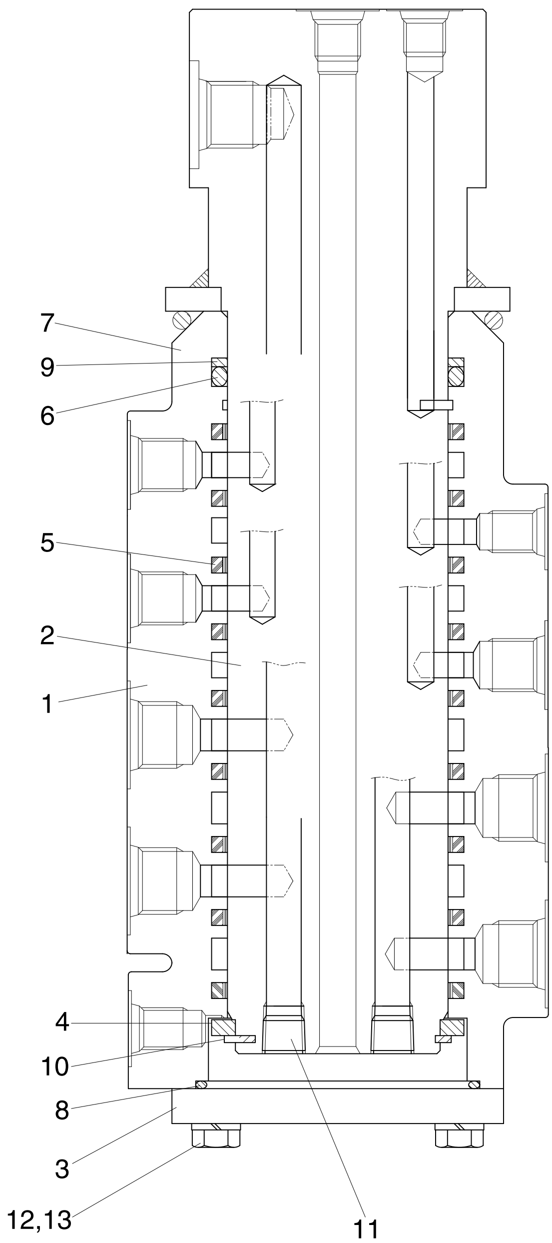
19A7TJ01



19A7TJ02

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



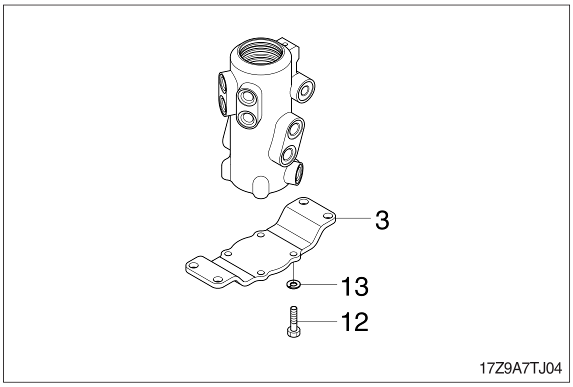
1697TJ02

1	Hub	6	O-ring	11	Plug
2	Shaft	7	O-ring	12	Hexagon bolt
3	Cover	8	O-ring	13	Spring washer
4	Spacer	9	Back-up ring		
5	Slipper seal	10	Retainer ring		

2) DISASSEMBLY

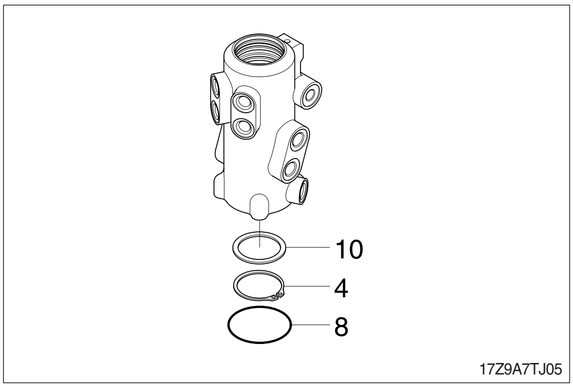
※ Before the disassembly, clean the turning joint.

(1) Loosen bolts (12), spring washer (13) and remove cover (3).



(2) Remove O-ring (8).

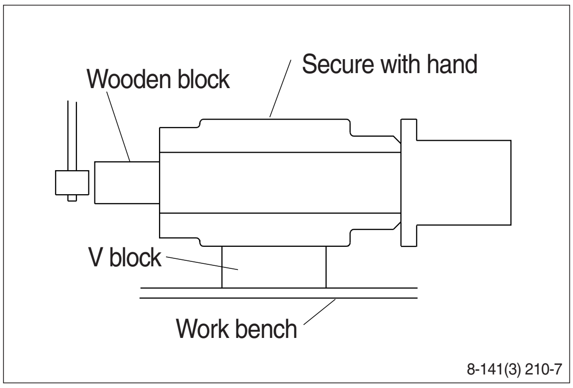
(3) Remove retainer ring (10) and spacer (4).



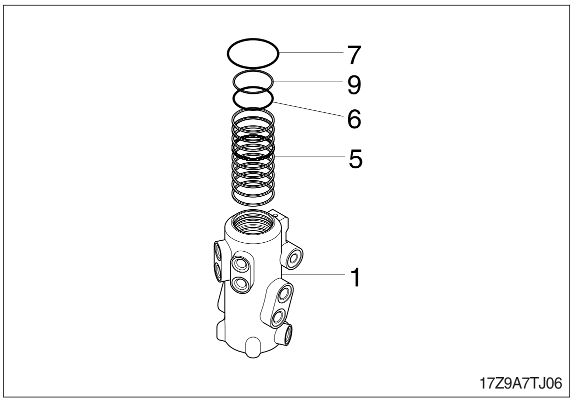
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



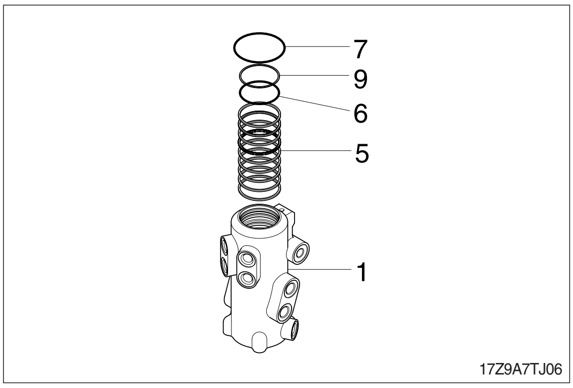
(5) Remove nine slipper seals (5), O-ring (7), back-up ring (9), and O-ring (6) from hub (1).



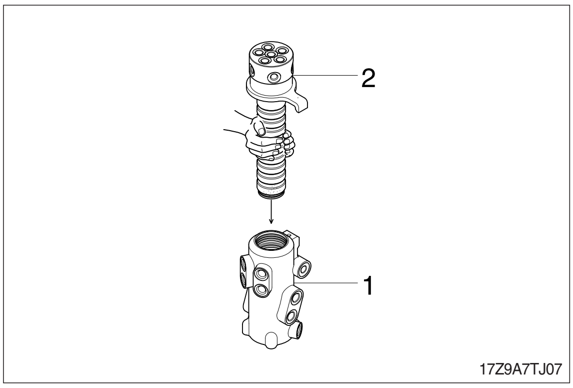
3) ASSEMBLY

※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix nine slipper seal (5) and O-ring (7), back-up ring (9) and O-ring (6) to hub (1).

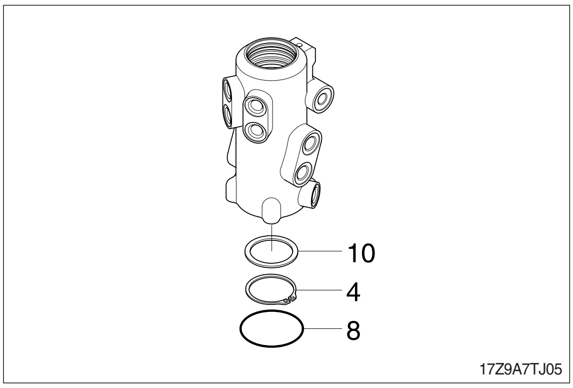


(2) Set hub (1) on block, install shaft (2) into hub (1) by hand.



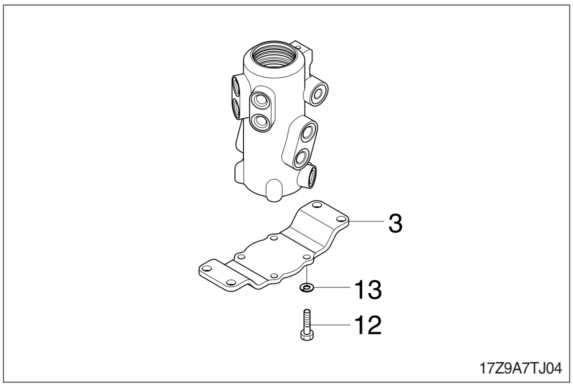
(3) Fit spacer (4) and retainer ring (10) to shaft (2).

(4) Fit O-ring (8) to hub (1).



(5) Install cover (3) to hub, tighten bolts (12) with spring washer (13).

· Tightening torque : 2.5~3.0 kgf·m
(18.1~21.7 lbf·ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDERS

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

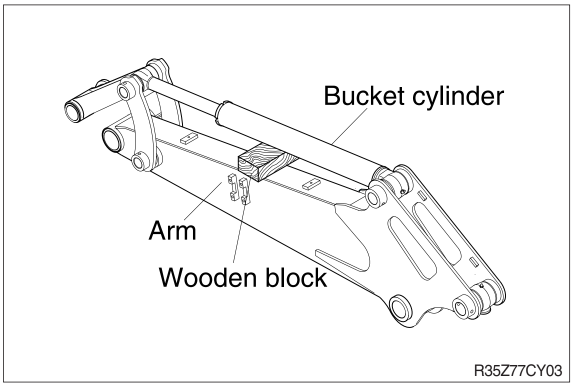
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

13031GE18

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank. Escaping fluid under pressure can penetrate the skin causing serious injury.

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between bucket cylinder and arm.

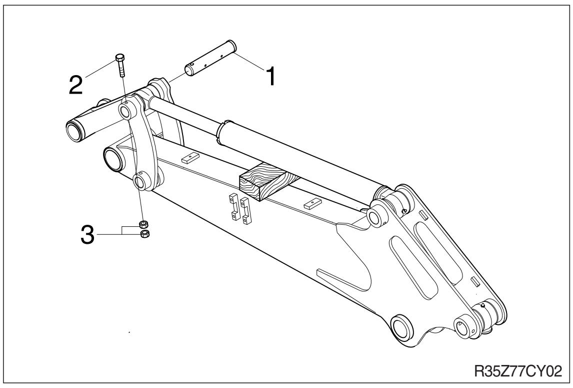


R35Z77CY03

② Remove bolt (2), nut (3) and pull out pin (1).

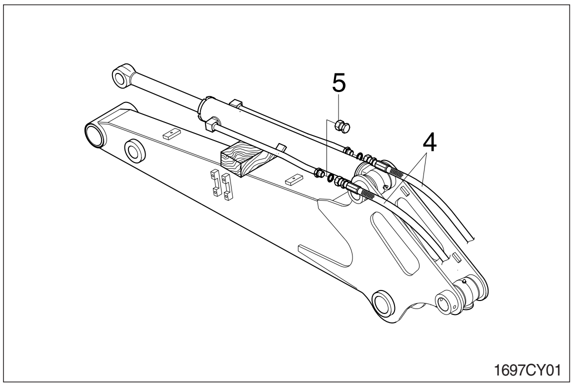
※ Tie the rod with wire to prevent it from coming out.

· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)



R35Z77CY02

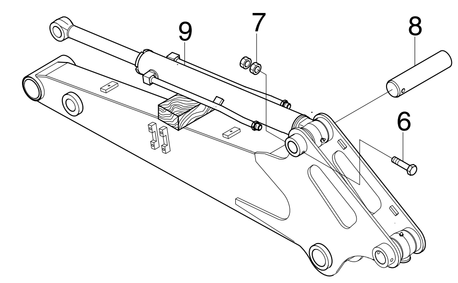
③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



1697CY01

④ Sling bucket cylinder assembly (9) and remove bolt (6) and nut (7) then pull out pin (8).

⑤ Remove bucket cylinder assembly (9).
- · Weight : 12 ㎏ (25 ℔)
- · Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)



1697CY02

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal


13031GE18

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

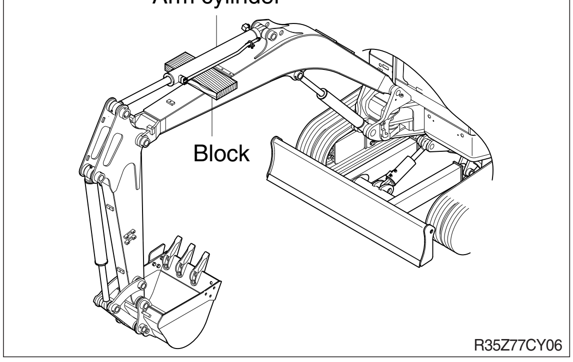
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ Escaping fluid under pressure can penetrate the skin causing serious injury.

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.

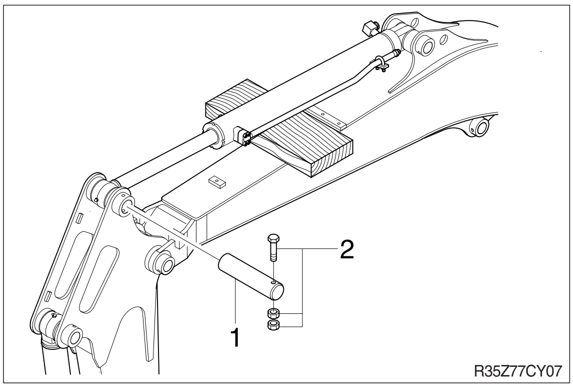


R35Z77CY06

② Remove bolt and nut (2) and pull out pin (1).

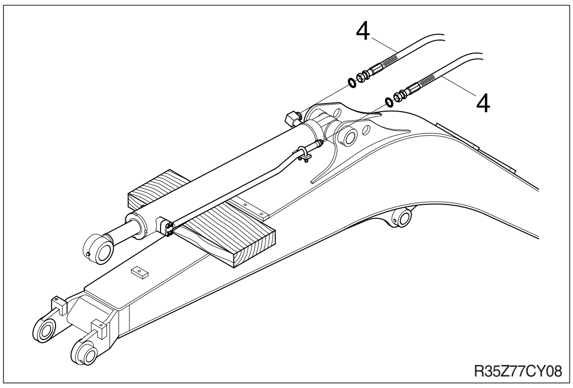
· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)

※ Tie the rod with wire to prevent it from coming out.



R35Z77CY07

③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.



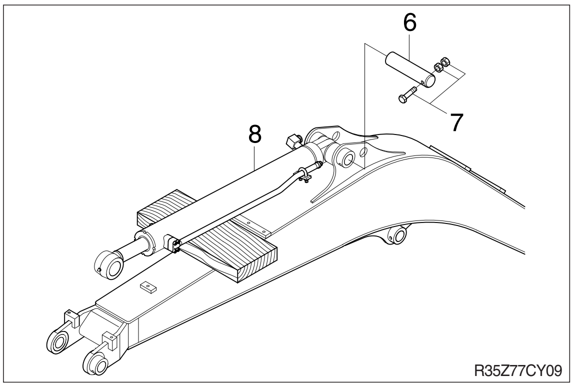
R35Z77CY08

⑤ Sling arm assembly (8) and remove bolt and nut (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 16 ㎏ (34 ℔)

· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the arm cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

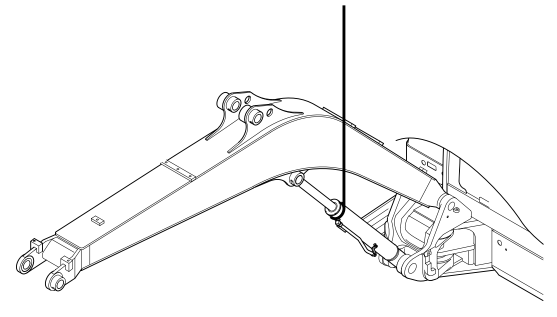
▲ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

▲ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.


13031GE18

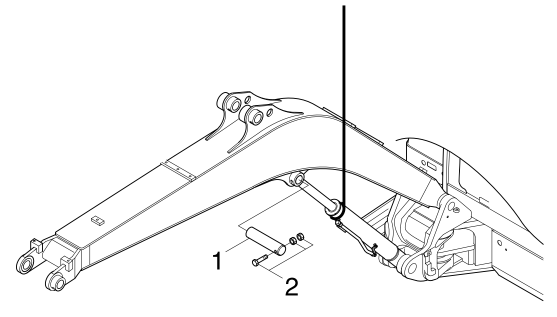
① Sling boom cylinder assembly.


R35Z77CY10

② Remove bolt and nut (2) and pull out pin (1).

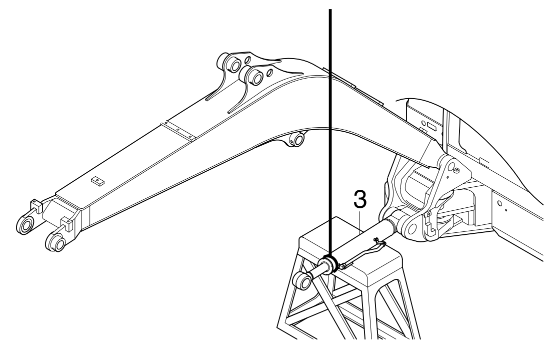
※ Tie the rod with wire to prevent it from coming out.

· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)



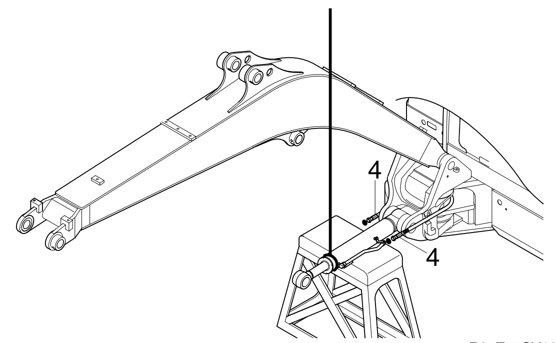
R35Z77CY11

③ Lower the boom cylinder assembly (3) on a stand.



R35Z77CY12

④ Disconnect boom cylinder hoses(4) and put plugs on cylinder pipe.



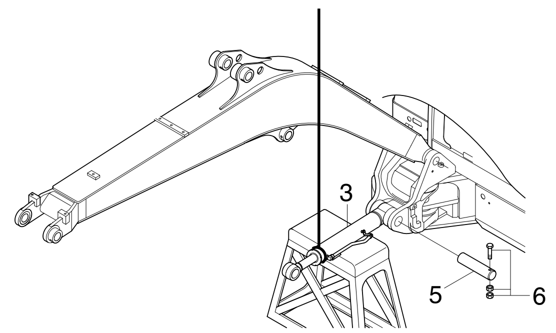
R35Z77CY13

⑤ Remove bolt (6) and pull out pin (5).

⑥ Remove boom cylinder assembly (3).

· Weight : 16 ㎏ (36 ℔)

· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)



R35Z77CY14

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

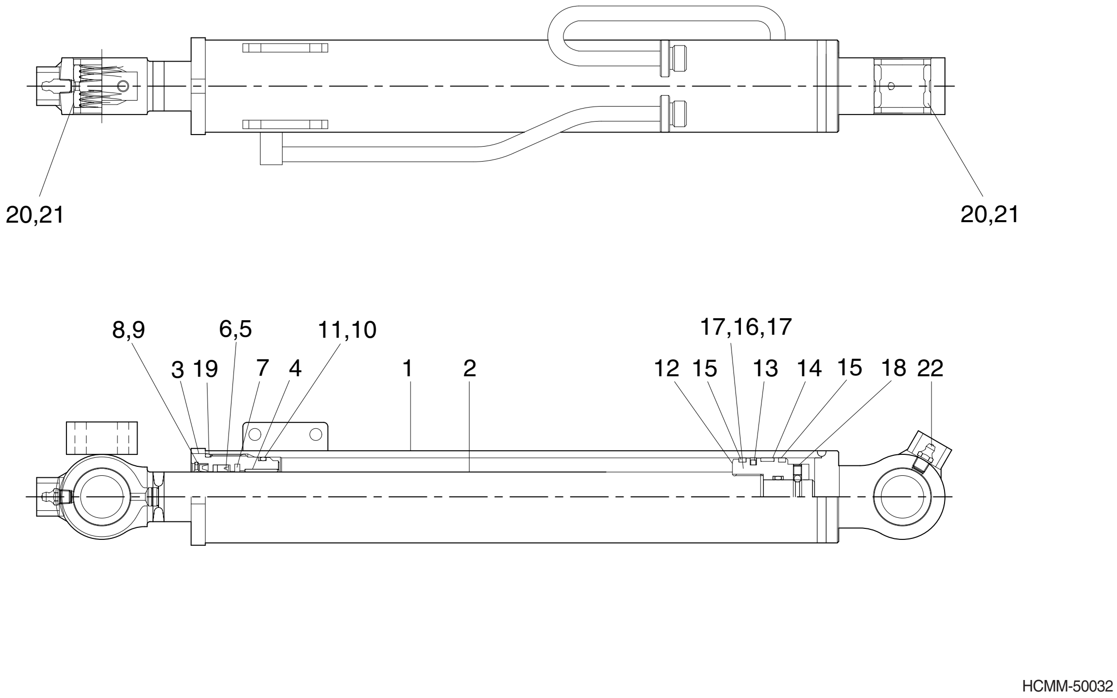
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

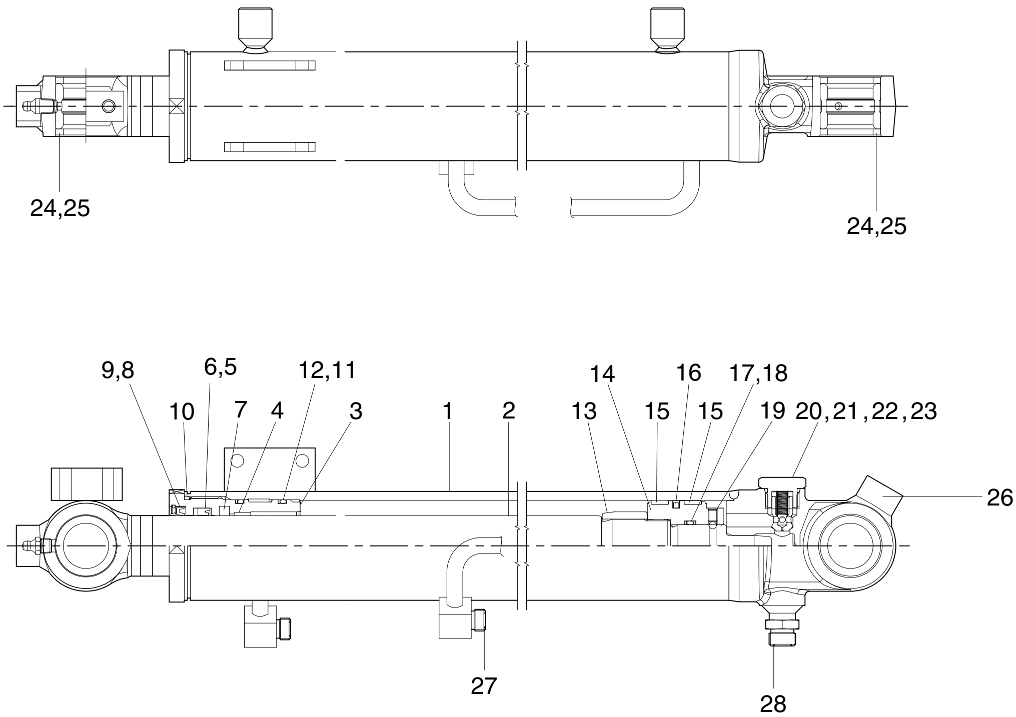
1) STRUCTURE

(1) Bucket cylinder



1	Tube assembly	9	Snap ring	17	Back up ring
2	Rod assembly	10	O-ring	18	Set screw
3	Gland	11	Back up ring	19	O-ring
4	DU bushing	12	Piston	20	Pin bushing
5	Rod seal	13	Piston seal	21	Dust seal
6	Back up ring	14	Wear ring	22	Grease nipple
7	Buffer ring	15	Dust ring	23	O-ring
8	Dust wiper	16	O-ring		

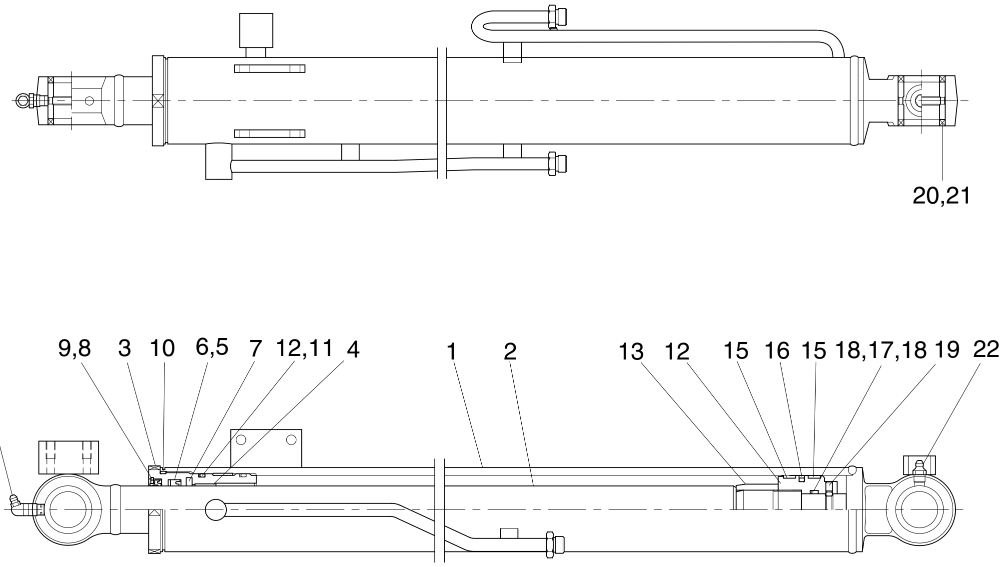
(2) Arm cylinder



HCMM-50022

1 Tube assembly
2 Rod assembly
3 Gland
4 DU bushing
5 Rod seal
6 Back up ring
7 Buffer ring
8 Dust wiper
9 Snap ring
10 O-ring
11 O-ring
12 Back up ring
13 Back up ring
14 Piston
15 Wear ring
16 Piston seal
17 O-ring
18 Back up ring
19 Set screw
20 Check valve
21 Coil spring
22 O-ring
23 Socket plug
24 Pin bushing
25 Dust seal
26 Grease nipple
27 O-ring
28 O-ring

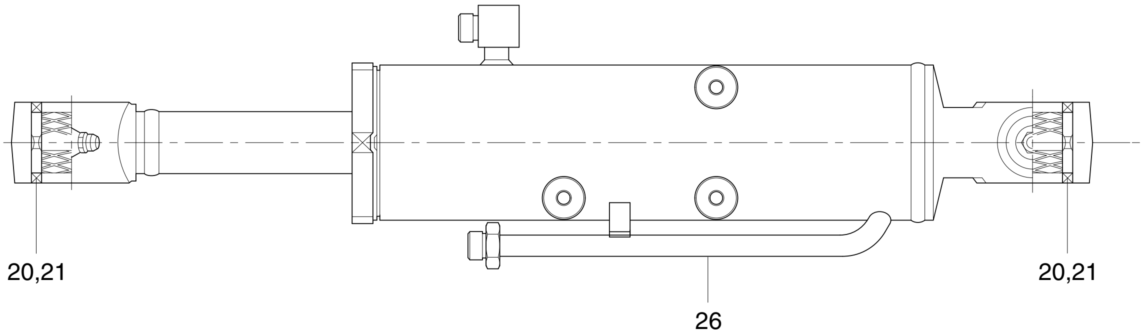
(3) Boom cylinder

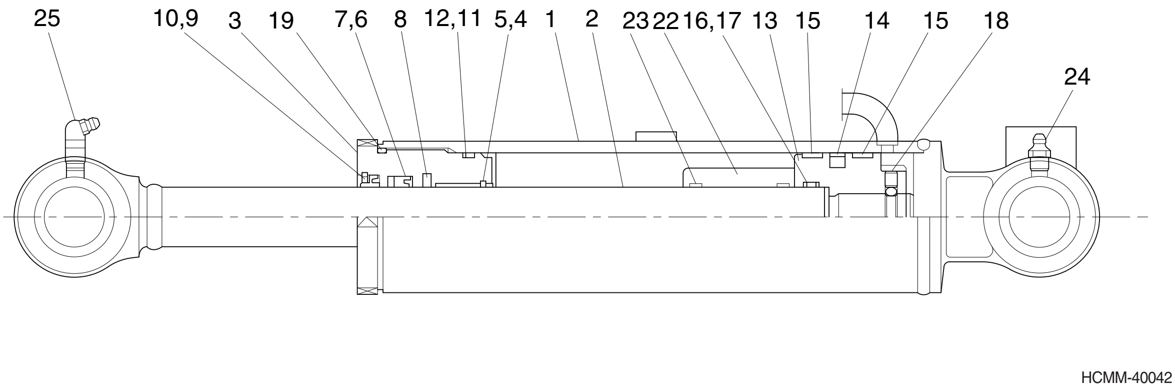


HCMM-50012

1	Tube assembly	9	Snap ring	17	O-ring
2	Rod assembly	10	O-ring	18	Back up ring
3	Gland	11	O-ring	19	Set screw
4	DU bushing	12	Back up ring	20	Pin bushing
5	Rod seal	13	Cushion ring	21	Dust seal
6	Back up ring	14	Piston	22	Grease nipple
7	Buffer ring	15	Wear ring	23	Grease nipple
8	Dust wiper	16	Piston seal	24	O-ring

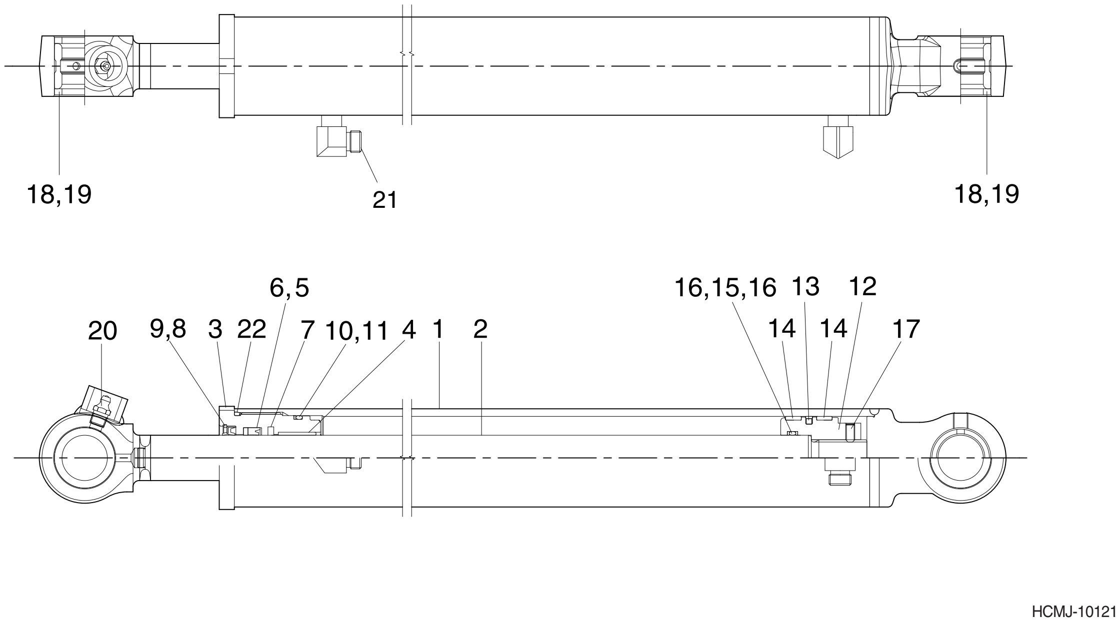
(4) Dozer cylinder





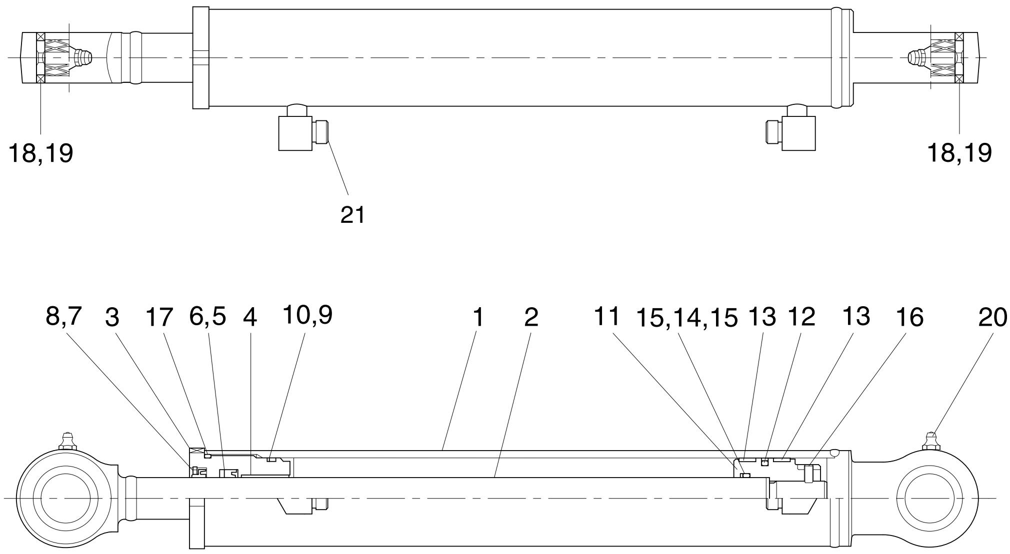
1	Tube assembly	10	Snap ring	19	O-ring
2	Rod assembly	11	O-ring	20	Pin bushing
3	Gland	12	Back up ring	21	Dust seal
4	DU bushing	13	Piston	22	Spacer
5	Snap ring	14	Piston seal	23	Wear ring
6	Rod seal	15	Wear ring	24	Grease nipple
7	Back up ring	16	O-ring	25	Grease nipple
8	Buffer ring	17	Back up ring	26	Pipe assy
9	Dust wiper	18	Set screw	27	O-ring

(5) Boom swing cylinder



1	Tube assembly	9	Snap ring	17	Set screw
2	Rod assembly	10	O-ring	18	Pin bushing
3	Gland	11	Back up ring	19	Dust seal
4	DU bushing	12	Piston	20	Grease nipple
5	Rod seal	13	Piston seal	21	O-ring
6	Back up ring	14	Wear ring	22	O-ring
7	Buffer ring	15	O-ring		
8	Dust wiper	16	Back up ring		

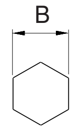
(6) Extension cylinder



1	Tube assembly	8	Snap ring	15	Back-up ring
2	Rod assembly	9	O-ring	16	Set screw
3	Gland	10	Back-up ring	17	O-ring
4	DU bushing	11	Piston	18	Pin bushing
5	Rod seal	12	Piston seal	19	Dust seal
6	Back-up ring	13	Wear ring	20	Grease nipple
7	Dust wiper	14	O-ring	21	O-ring

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	8	
	3	
Spanner	22	
Hook spanner	Suitable size (80~120 mm)	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf·m	lbf·ft
Gland	Boom cylinder	3	M60	90±9.0	651±65.1
	Arm cylinder	3	M60	60±6.0	434±43.4
	Bucket cylinder	3	M75	60±6.0	434±43.4
	Dozer cylinder	3	M70	70±7.0	506±65.1
	Boom swing cylinder	3	M60	48±4.8	347±34.7
	Extension cylinder	3	M55	44±4.5	318±32.5
Piston	Boom cylinder	14	M29	80±8.0	579±57.9
	Arm cylinder	14	M34	90±9.0	651±65.1
	Bucket cylinder	12	M29	70±7.0	506±65.1
	Dozer cylinder	13	M25	60±6.0	434±43.4
	Boom swing cylinder	12	M24	60±6.0	434±43.4
	Extension cylinder	11	M20	50±5.0	362±36.2
Set screw	Boom cylinder	19	M8	1.7±0.2	12.3±1.45
	Arm cylinder	19	M6	1.7±0.2	12.3±1.45
	Bucket cylinder	18	M8	1.7±0.2	12.3±1.45
	Dozer cylinder	18	M8	2.7±0.2	19.5±1.45
	Boom swing cylinder	17	M8	1.7±0.2	12.3±1.45
	Extension cylinder	16	M6	0.8±0.1	5.8±0.72

3) DISASSEMBLY

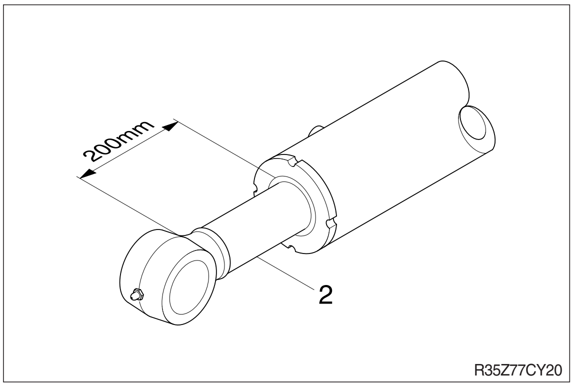
Procedures are based on the boom cylinder.

(1) Remove cylinder head and piston rod

① Hold the clevis section of the tube in a vise.

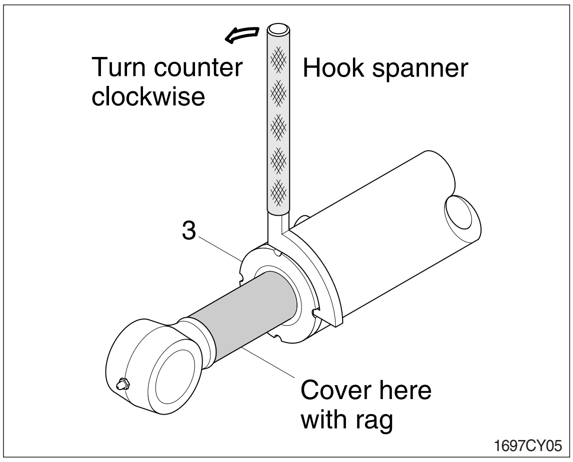
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 ㎜ (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



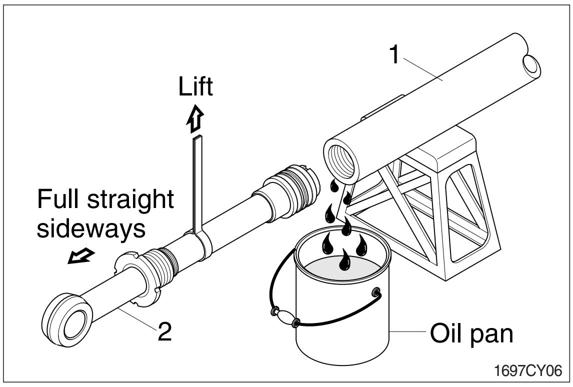
③ Loosen and remove the gland (3) by hook spanner.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



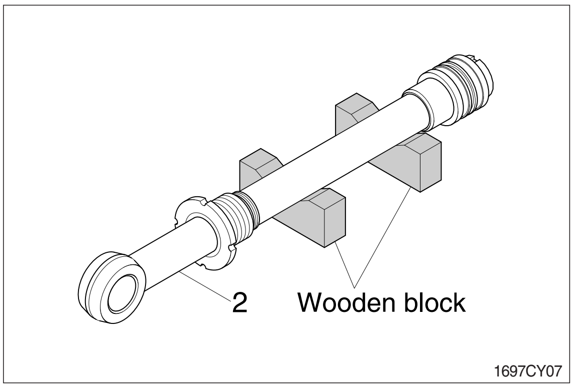
④ Draw out cylinder head and rod assembly together from tube assembly (1).

※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



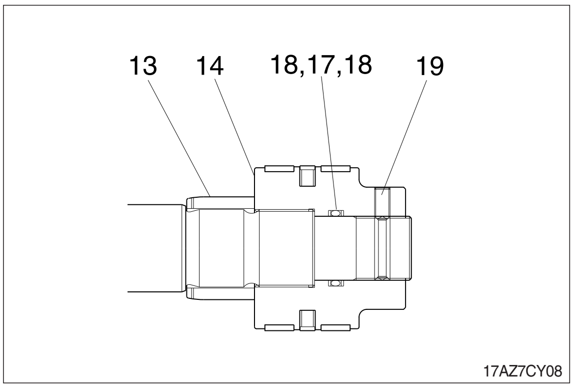
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly (2) on a wooden V-block that is set level.
※ Cover a V-block with soft rag.

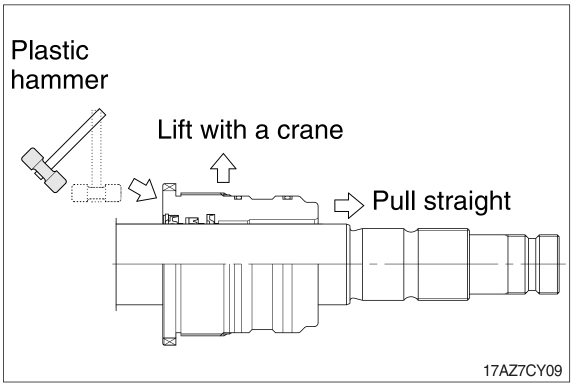


(2) Remove piston and gland

① Remove set screw (19).
② Remove piston assembly (14), back up ring (18), O-ring (17) and cushion ring (13).



③ Remove the gland assembly from rod assembly (2).
※ If it is too heavy to move, move it by striking the flanged part of gland with a plastic hammer.
※ Pull it straight with gland assembly lifted with a crane.
Exercise care so as not to damage the lip of packing (4, 5, 6, 7, 8, 9) by the threads of rod assembly (2).

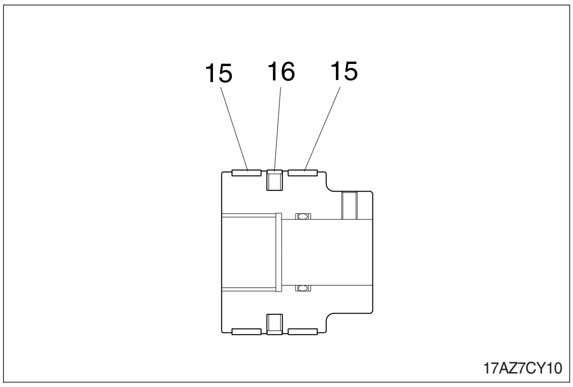


(3) Disassemble the piston assembly

① Remove wear ring (15).

② Remove wear ring (15) and piston seal (16).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble gland assembly

① Remove back-up ring (12) and O-ring (11).

② Remove snap ring (9), dust wiper (8).

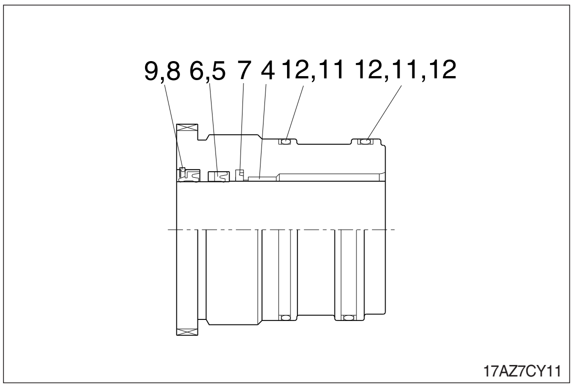
③ Remove back up ring (6), rod seal (5).

④ Remove buffer ring (7).

⑤ Remove the DU bushing (4).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

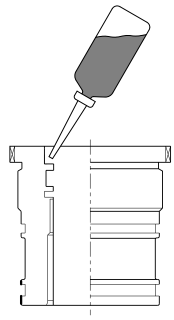


4) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

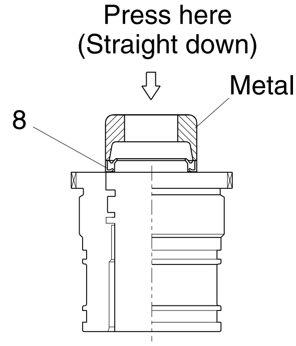
① Coat the inner face of gland (3) with hydraulic oil.



17AZ7CY12

② Coat dust wiper (8) with grease and fit dust wiper (4) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit retain ring (9) to the stop face.

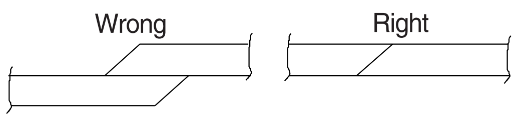


17AZ7CY13

④ Fit back up ring (6), rod seal (5) and buffer ring (7) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

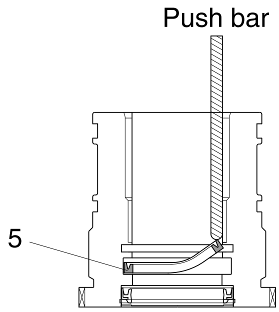
※ Insert the back up ring until one side of it is inserted into groove.



8-157(3) 210-7

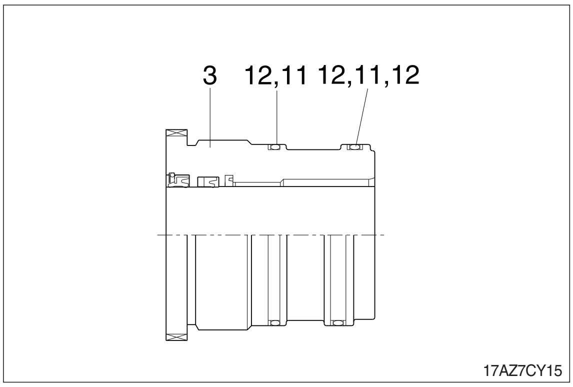
※ Rod seal (5) and buffer ring (7) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (5) and buffer ring (7) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



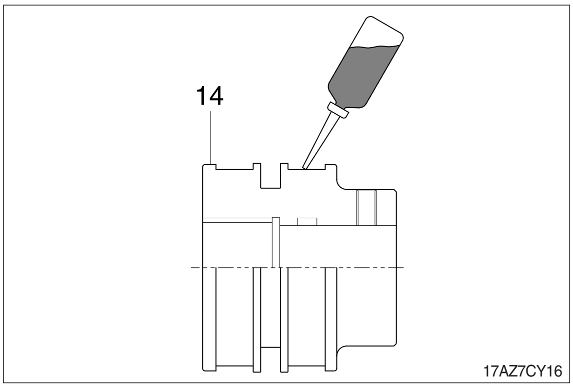
17AZ7CY14

⑥ Fit back up ring (12) to gland (3).
※ Put the backup ring in the warm water of 30~50°C .
⑦ Fit O-ring (11) to gland (3).

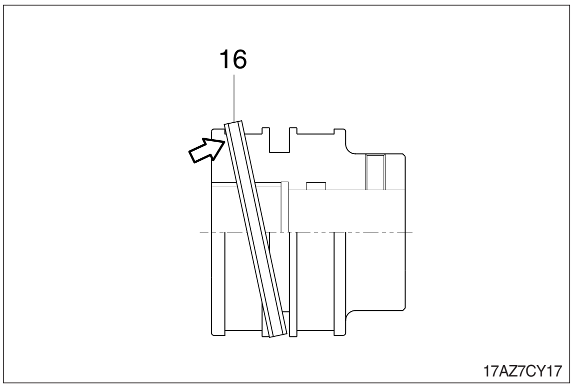


(2) Assemble piston assembly

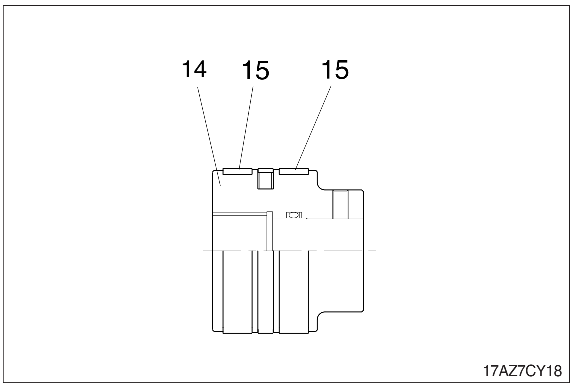
※ Check for scratches or rough surfaces. If found smooth with an oil stone.
① Coat the outer face of piston (14) with hydraulic oil.



② Fit piston seal (16) to piston.
※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.
※ After assembling the piston seal, press its outer diameter to fit in.



③ Fit wear ring (15) to piston (14).

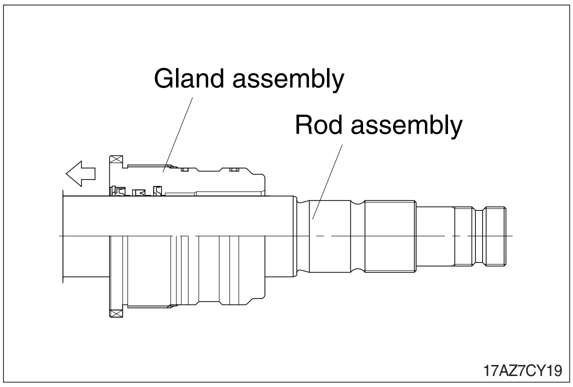


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

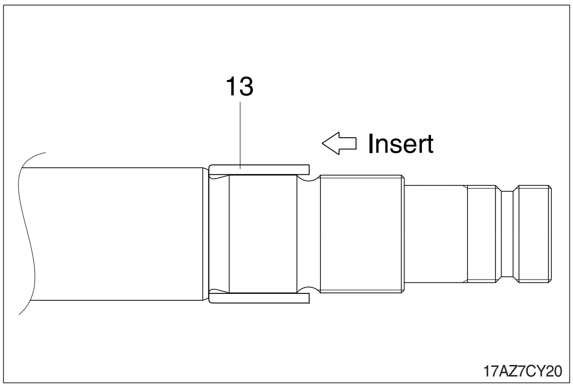
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and gland.

③ Insert gland assembly to rod assembly.

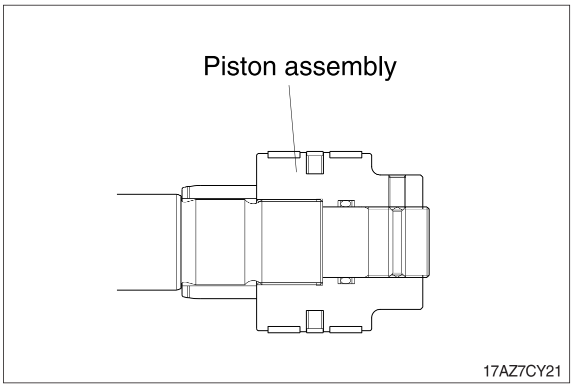


④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



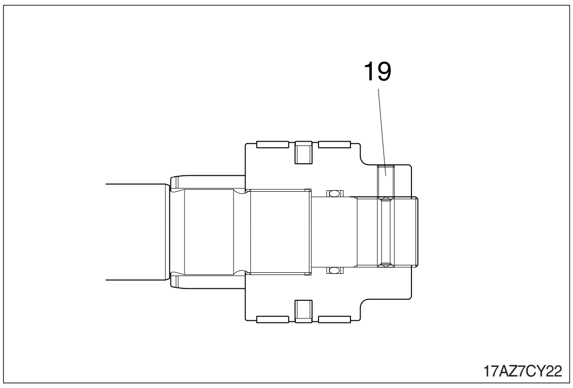
⑤ Fit piston assembly to rod assembly.



⑥ Fit set screw (19).

·Tightening torque :

1.7±0.2 kgf·m (12.3±1.45 lbf·ft)

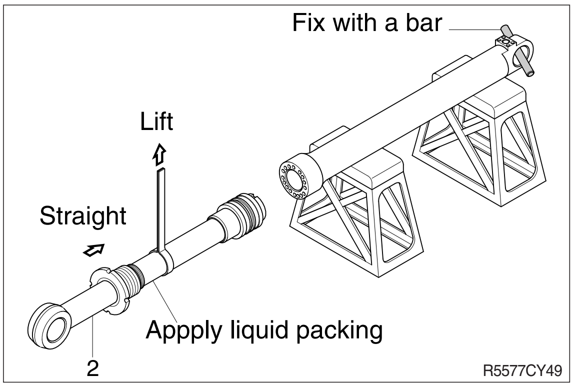


(4) Overall assemble

① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

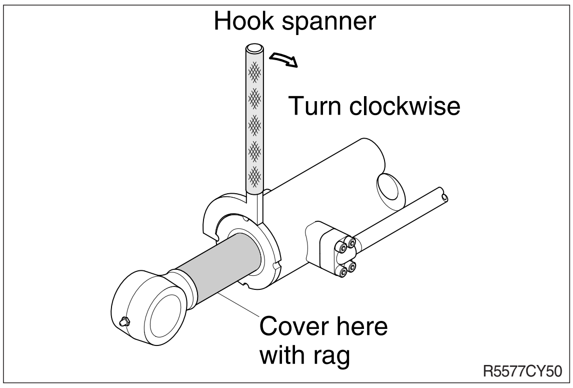
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly (2) with a crane.

※ Be careful not to damage piston seal (16) by thread of tube assembly (1).



③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.

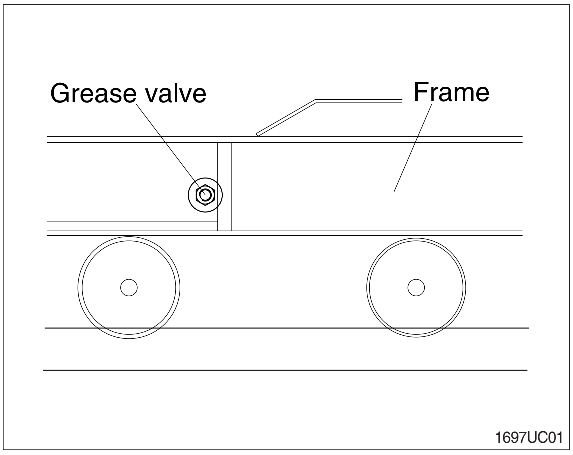


1. RUBBER TRACK

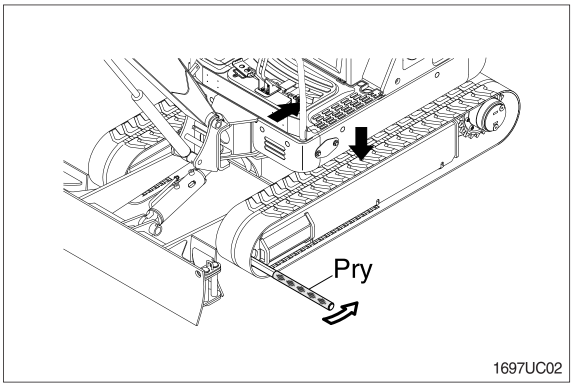
1) REMOVAL

(1) Loosen tension of the rubber track.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.



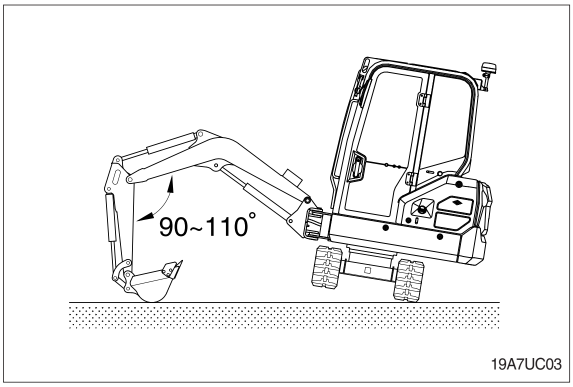
(2) Remove the rubber track from lower frame using pry.



2) INSTALL

(1) Carry out installation in the reverse order to removal.

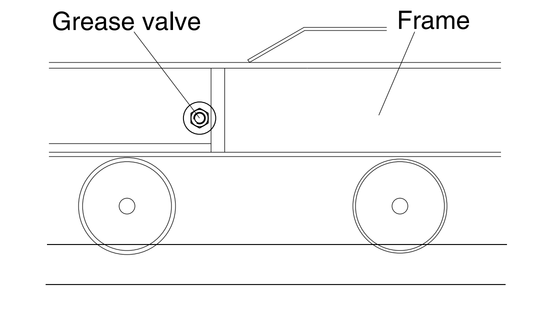
※ Adjust the tension of the rubber track.



2. TRACK ROLLER

1) REMOVAL

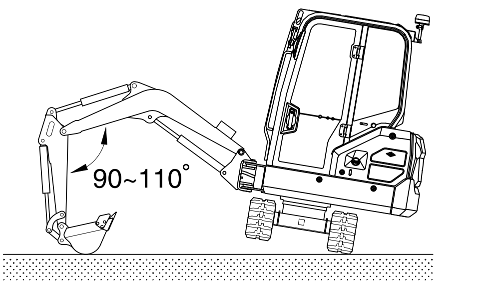
(1) Loosen tension of the rubber track.



1697UC01

(2) Using the work equipment, push up track frame on side which is to be removed.

※ After jack up the machine, set a block under the unit.

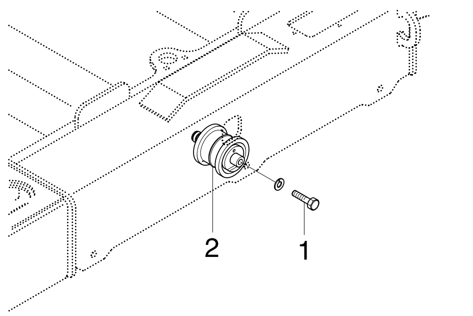


19A7UC03

(3) Remove the mounting bolt (1) and draw out the track roller (2).

·Weight : 5 kg (11 lb)

·Tightening torque : 12.3±1.2 kgf·m (89±8.7 lbf·ft)



17Z9A7UC04

2) INSTALL

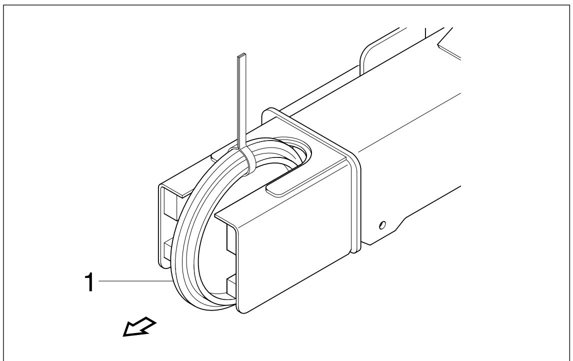
(1) Carry out installation in the reverse order to removal.

3. IDLER AND RECOIL SPRING

1) REMOVAL

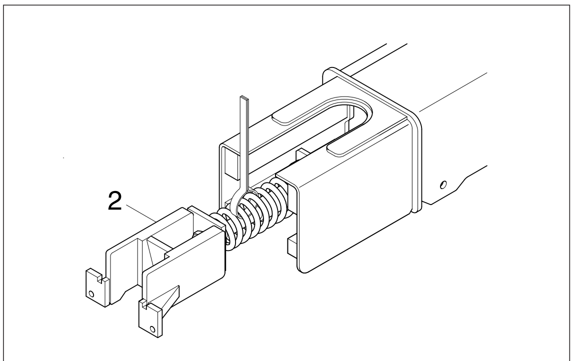
(1) Remove the track link.
For detail, see removal of track link.

(2) Sling the idler (1) and pull out idler and recoil spring assembly from track frame, using a pry.
·Weight : 14 ㎏ (32 ℔)



17Z9A7UC04

(3) Pull out yoke and spring weld assembly from track frame, using a pry.
·Weight : 11 ㎏ (24 ℔)

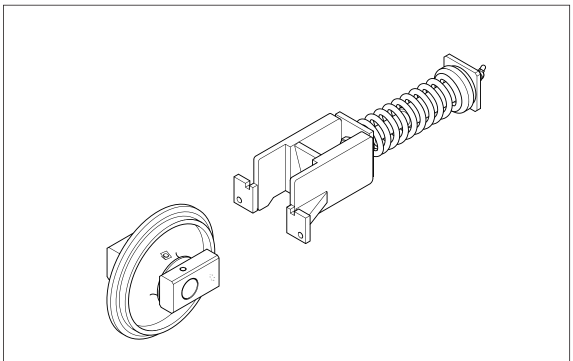


17Z9A7TR10

2) INSTALL

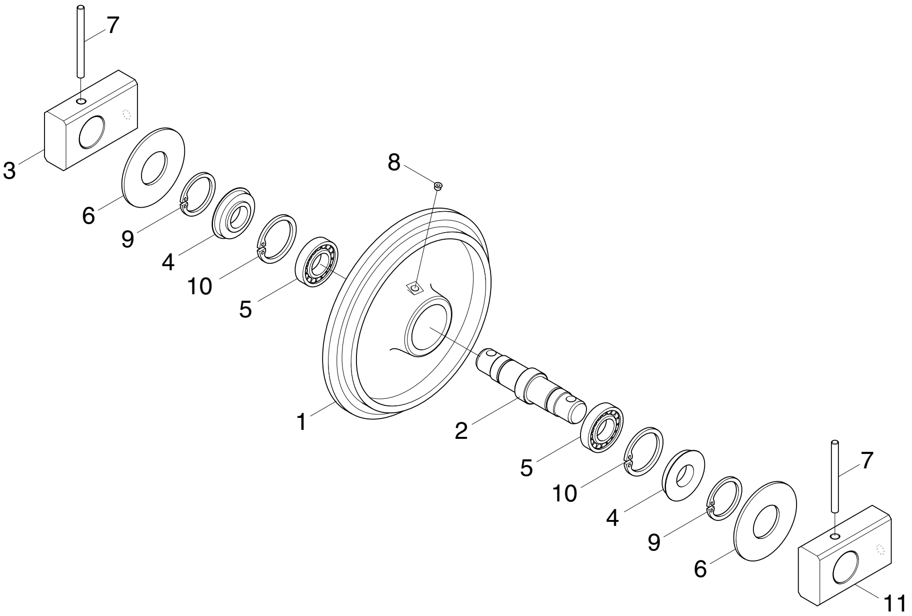
(1) Carry out installation in the reverse order to removal.

※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.


17Z9A7UC05

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



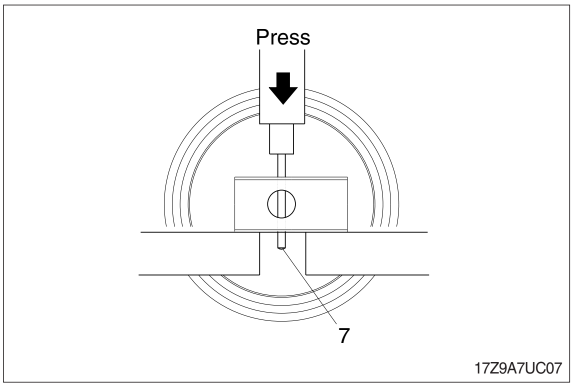
17Z9A7UC06

1	Idler shell	5	Ball bearing	9	Snap ring
2	Shaft	6	Lock plate	10	Snap ring
3	Collar-LH	7	Spring pin	11	Collar-RH
4	Oil seal	8	Plug		

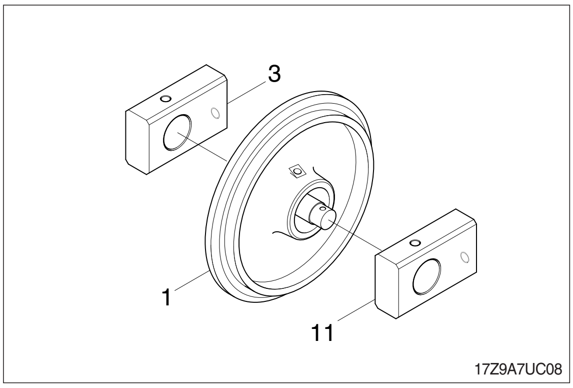
(2) Disassembly

① Remove plug and drain oil.

② Draw out the spring pin (7), using a press.



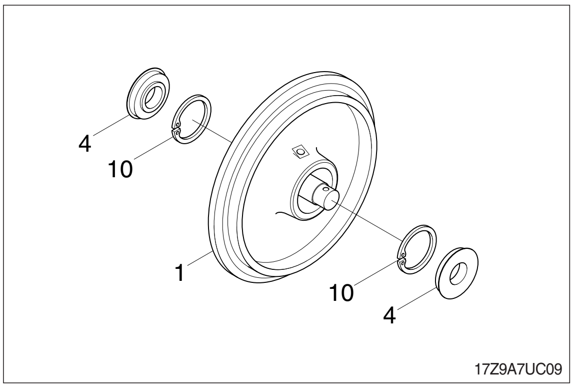
③ Remove collar (3, 11) from shaft.



④ Remove oil seal (4) from idler shell (1) by pry.

※ Do not reuse oil seal after removal.

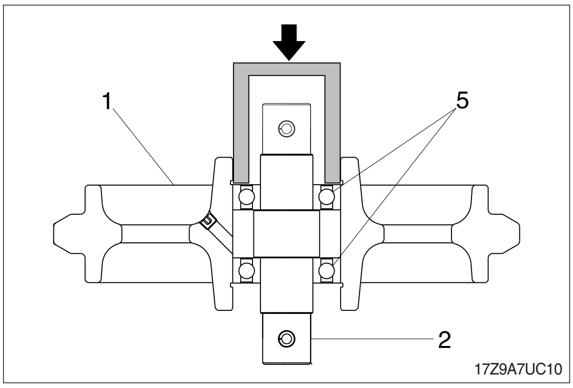
⑤ Remove snap ring (10) from idler shell (1)



⑥ Draw out the ball bearing (5) with shaft (2) using press.

⑦ Remove the ball bearing (5) from shaft, using a special tool.

※ Only remove ball bearing if replacement is necessity.

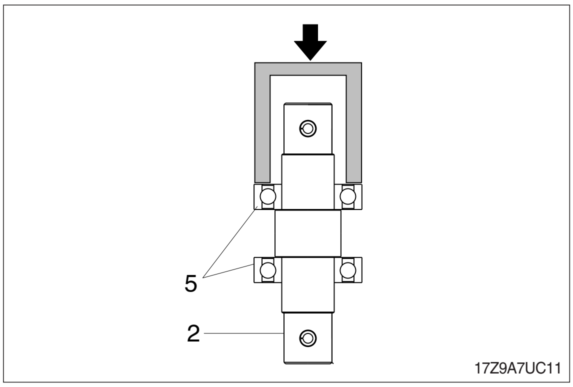


(3) Assembly

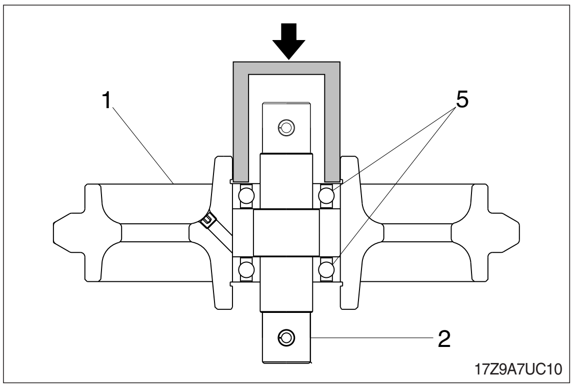
※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

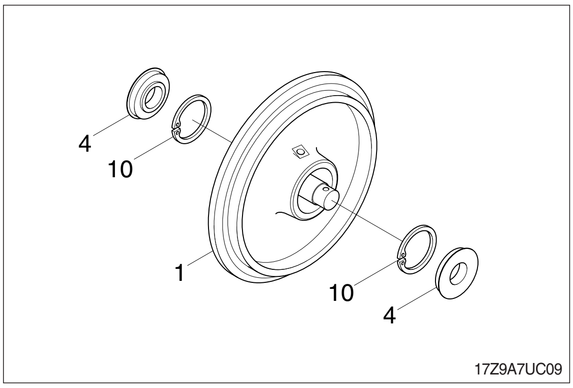
① Do not press it at the normal temperature, assemble ball bearing (5) to shaft (2) by press.



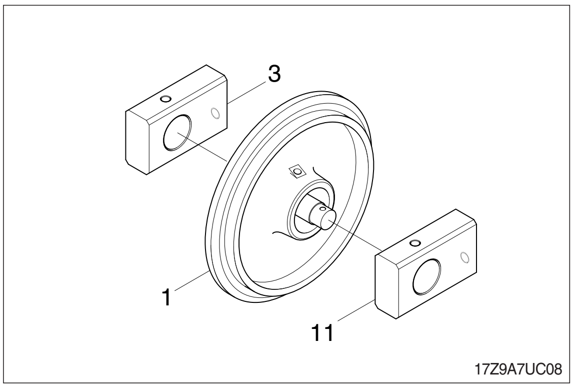
② Insert shaft (2) with ball bearing (5) assembly to idler shell (1).



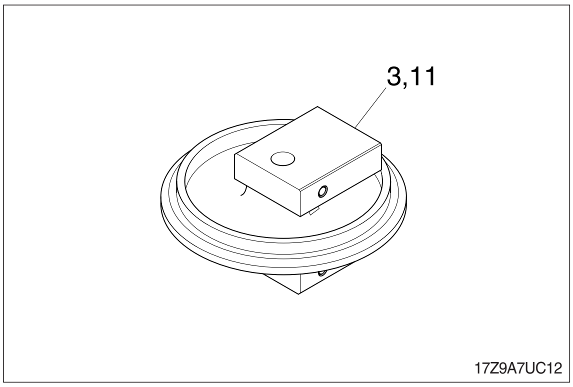
③ Assembly snap ring (10) and seal assembly (4).



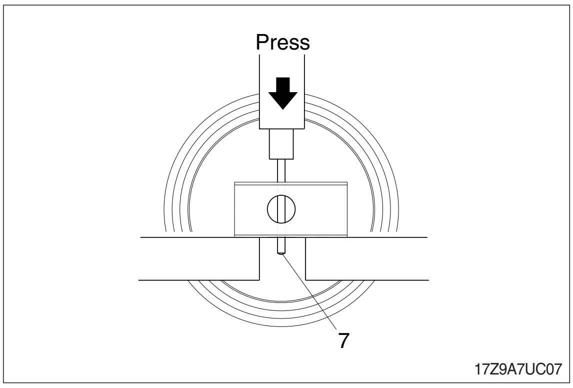
④ Assemble collar (3, 11) to idler shell (1).



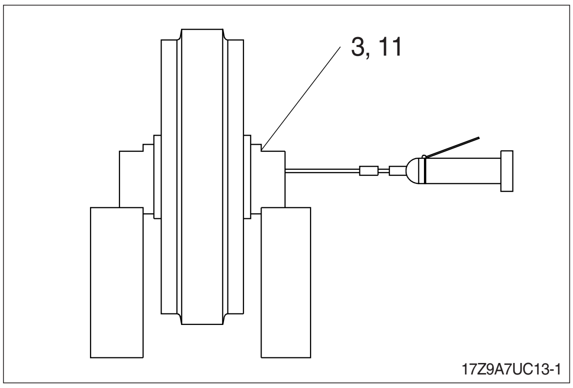
⑤ Install collar (3, 11) attached with oil seal (4).



⑥ Knock in the spring pin (7) with a hammer.

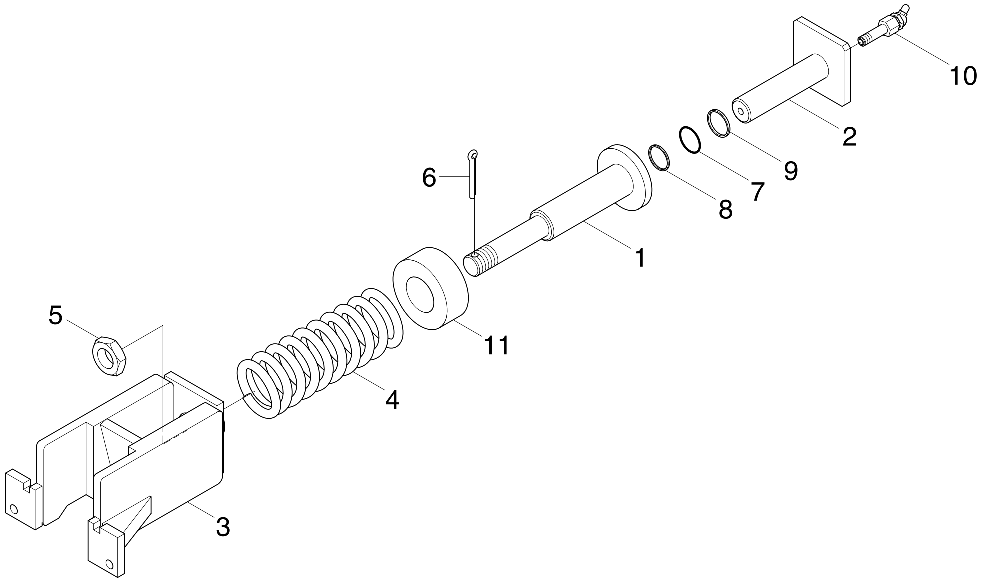


⑦ Lay collar (3, 11) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



17Z9A7UC13

1	Track tension body	5	Castle nut	9	Dust seal
2	Piston rod	6	Split pin	10	Valve assy
3	Bracket	7	O-ring	11	Spacer
4	Tension spring	8	Back-up ring		

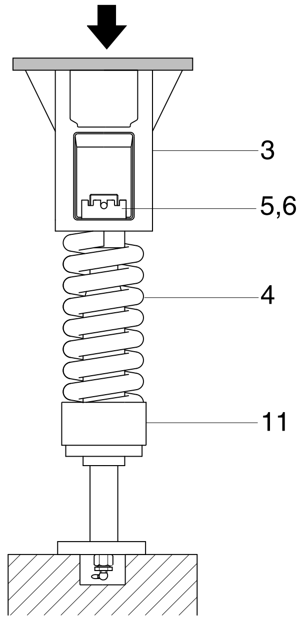
(2) Disassembly

① Apply pressure on bracket (3) with a press.
The spring is under a large installed load. This is dangerous, so be sure to set properly.
· Spring set load : 1785 ㎏ (3940 ㏏)

※ Remove split pin (6) and castle nut (5).

② Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

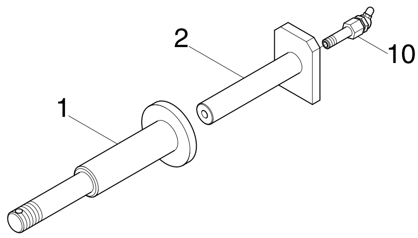
③ Lighten the press load slowly and remove bracket (3) and tension spring (4).



17Z9A7UC17

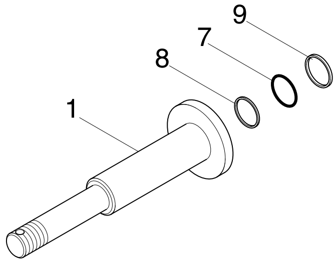
⑤ Remove piston rod (2) from track tension body (1).

⑥ Remove grease valve assy (10) from piston rod (2).



1697UC14

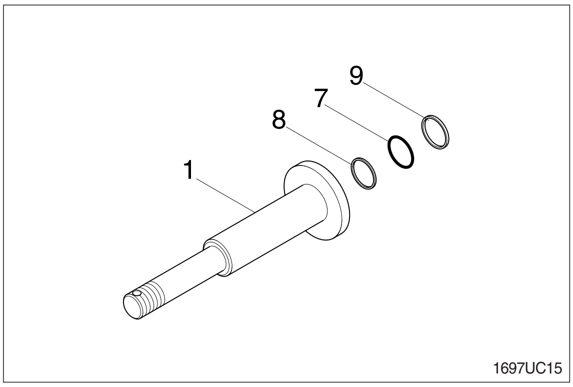
⑦ Remove dust seal (9), back-up ring (8) and O-ring (7) from track tension body (1).



1697UC15

(3) Assembly

① Install O-ring (7), back-up ring (8), and dust seal (9) to track tension body (1) .

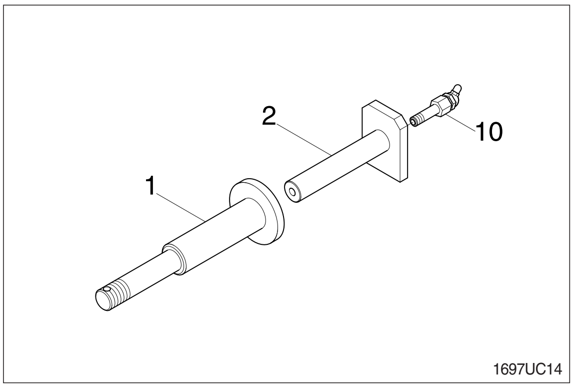


② Pour grease into track tension body (1), then push in piston rod (2) by hand.
After take grease out of grease valve mounting hole, let air out.

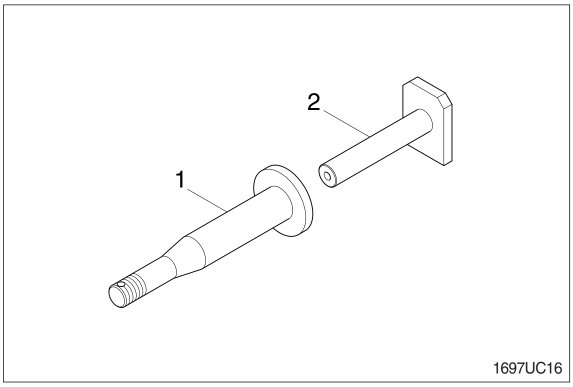
※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve assy (10) to piston rod (2).

· Tightening torque : 10±0.5 kgf · m
(72.4±3. 6 lbf · ft)



④ Install piston rod (2) to track tension body (1).

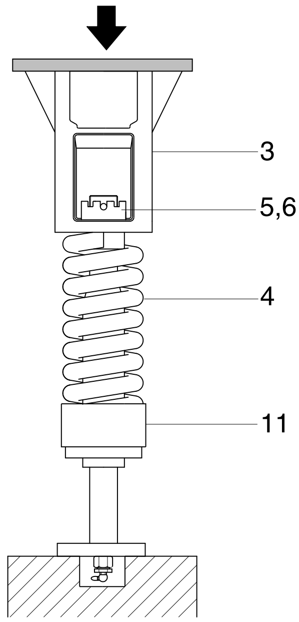


⑤ Install tension spring (4) and spacer (11) to track tension body (1).

⑥ Apply pressure to bracket (3) with a press and tighten nut (5).

※ During the operation, pay attention specially to prevent the press from slipping out.

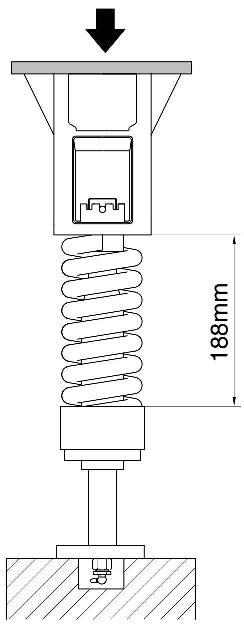
⑦ Tighten castle nut (5) and insert split pin (6).



17Z9A7UC17

⑧ Lighten the press load and confirm the set length of tension spring (4).

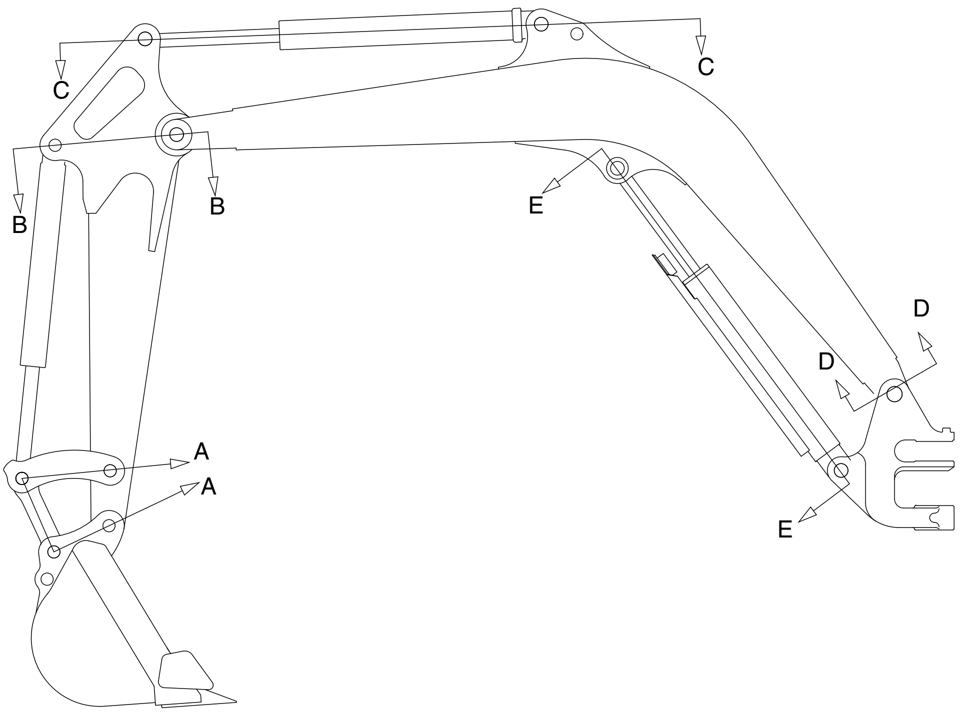
· Spring length : 188 ㎜ (7.4")

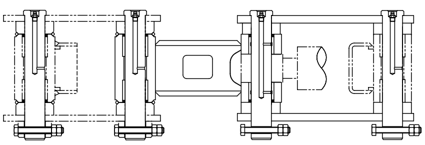


17Z9A7UC18

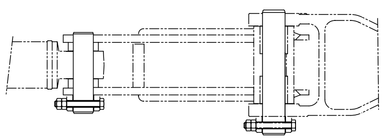
GROUP 11 WORK EQUIPMENT

1. STRUCTURE

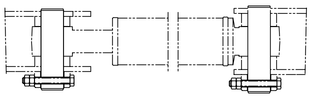




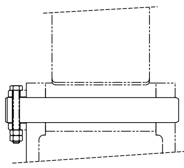
SECTION A-A



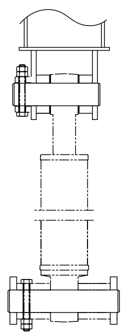
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

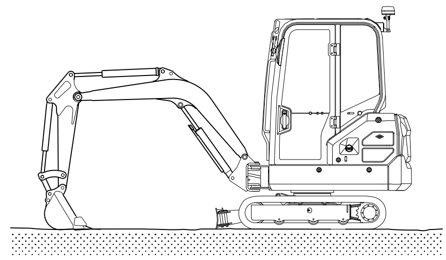
1697AT01

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

(1) Removal

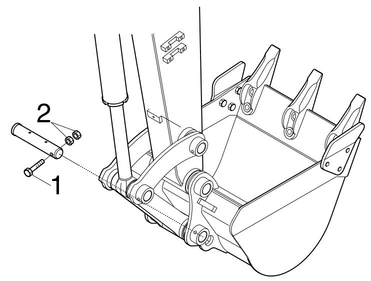
① Lower the work equipment completely to ground with back of bucket facing down.



19A4OP43

② Remove nut (1), bolt (2) and draw out the pin (4).

· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)

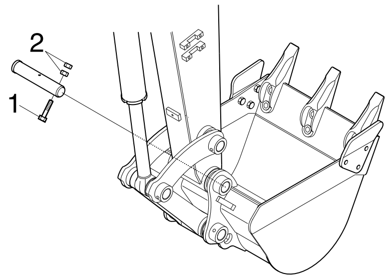


1697AT02

③ Remove nut (1), bolt (2) and draw out the pin (3) then remove the bucket assembly.

· Weight : 41 kg (90 lb)

· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)



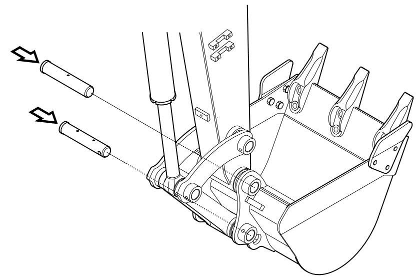
1697AT03

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Adjust the bucket clearance. For detail, see operator's manual.



1697AT04

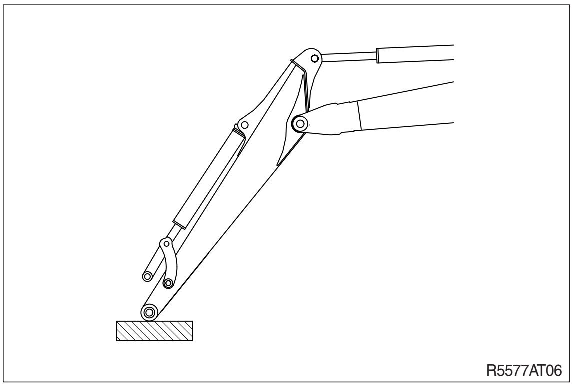
2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**

① Remove bucket assembly.
For details, see removal of bucket assembly.



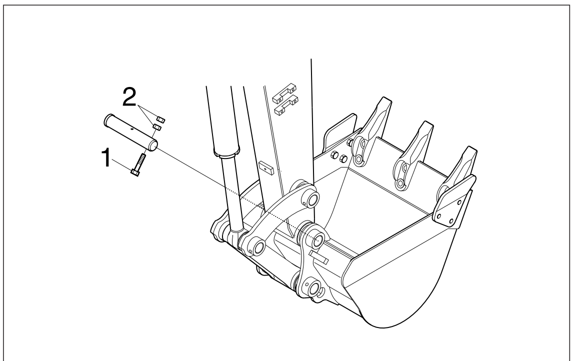
R5577AT06

② Disconnect bucket cylinder hose.

⚠ **Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

※ Tie the rod with wire to prevent it from coming out.



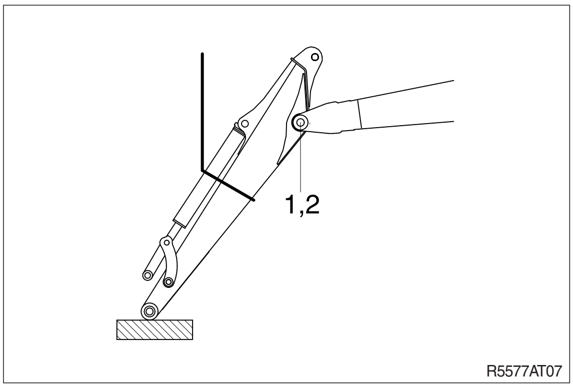
1697AT03

④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (1) and pull out the pin (2) then remove the arm assembly.

· Weight : 68 ㎏ (150 ℔)
· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)

※ When lifting the arm assembly, always lift the center of gravity.



R5577AT07

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

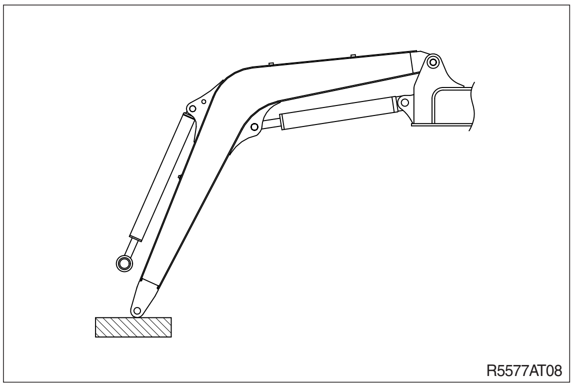
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(1) Removal

① Remove arm and bucket assembly.
For details, see removal of arm and bucket assembly.

② Remove boom cylinder assembly from boom.
For details, see removal of arm cylinder assembly.



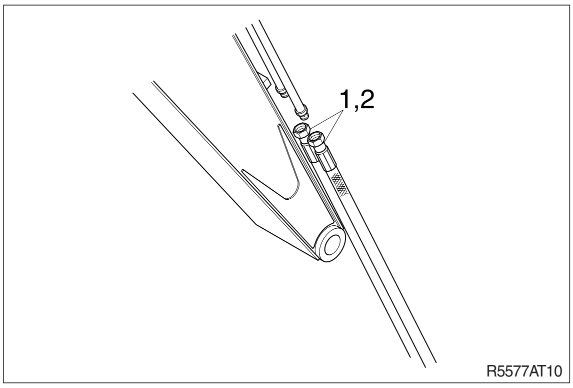
R5577AT08

③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

※ When the hose are disconnected, oil may spurt out.

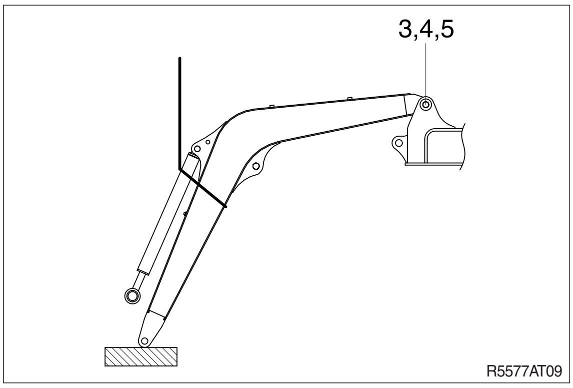
⑤ Sling boom assembly (3).



R5577AT10

⑥ Remove bolt (3), nut (4) and pull out the pin (5) then remove boom assembly.
· Weight : 105 kg (230 lb)
· Tightening torque : 6.9±1.4 kgf·m (49.9±10.1 lbf·ft)

※ When lifting the boom assembly always lift the center of gravity.



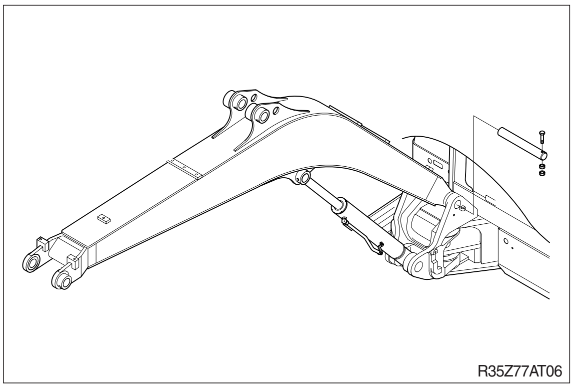
R5577AT09

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.



R35Z77AT06