CONTENTS

SECTION 1 GENERAL

SECTION 2 STRUCTURE AND FUNCTION

SECTION 3 HYDRAULIC SYSTEM

SECTION 4 ELECTRICAL SYSTEM

SECTION 5 MECHATRONICS SYSTEM

SECTION 6 TROUBLESHOOTING

SECTION 7 MAINTENANCE STANDARD

SECTION 8 DISASSEMBLY AND ASSEMBLY

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 MECHATRONICS SYSTEM

This section explains the computer aided power optimization system and each component.

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 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.

   8 - 4
   8 - 4 - 1
   8 - 4 - 2 — Added pages
   8 - 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 55 mm into inches.
   (1) Locate the number 50 in 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 550 mm 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/cm^2 to lbf/in^2

1 kgf / cm^2 = 14.2233 lbf / in^2

	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

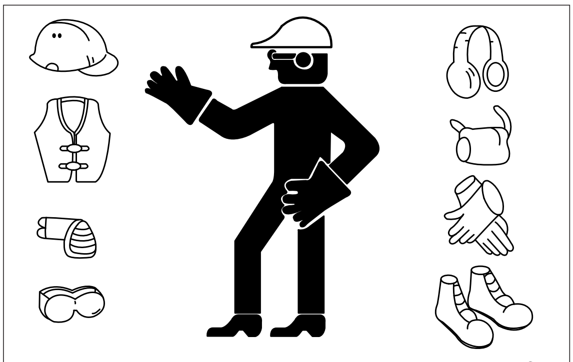
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

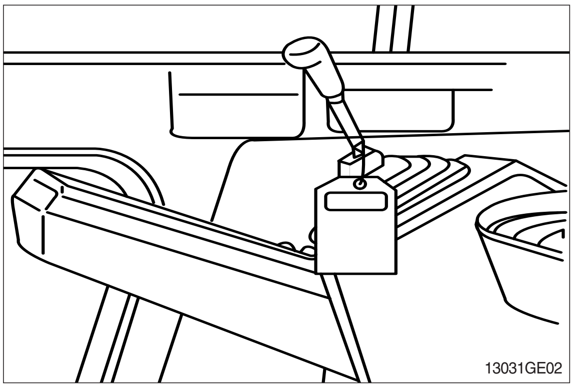
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

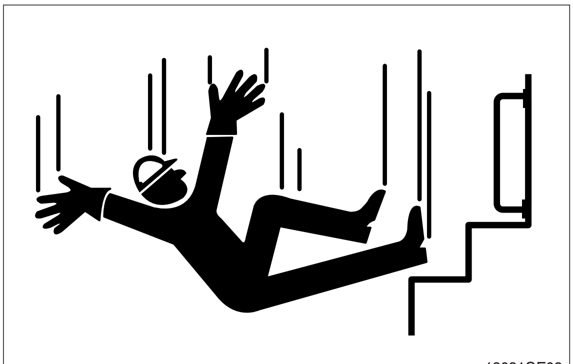
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「**Do Not Operate**」tag on the right side control lever.



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.



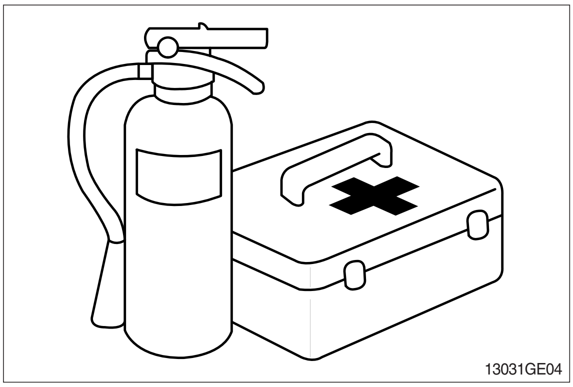
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

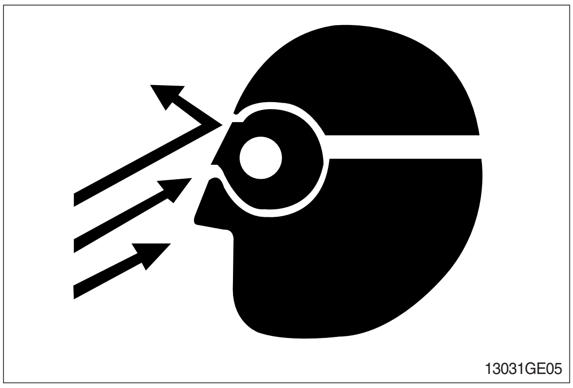
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

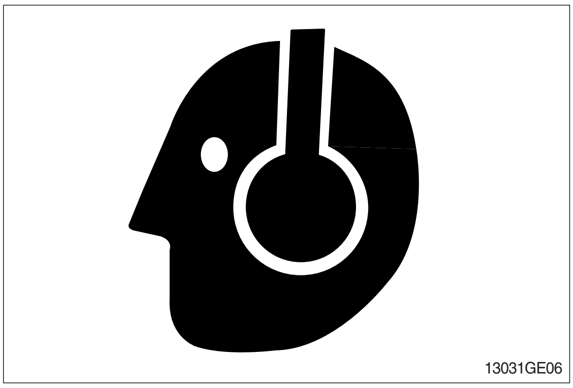


13031GE05

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.

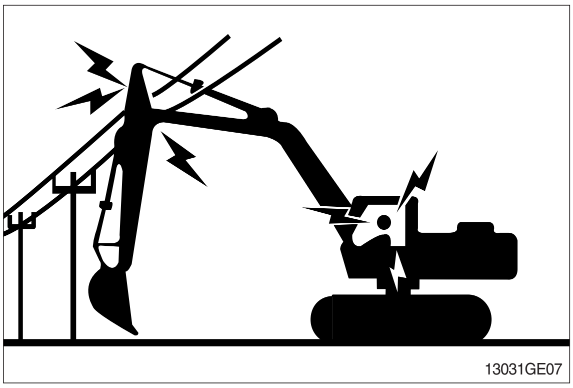


13031GE06

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.

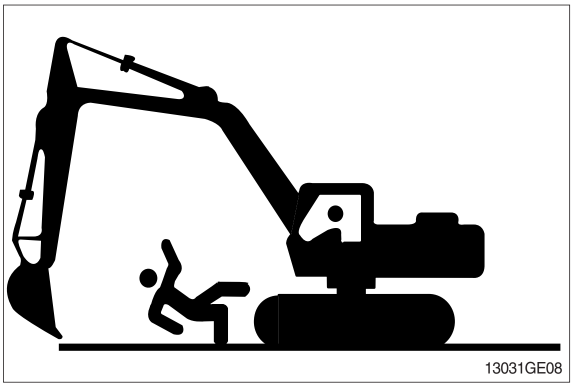


13031GE07

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.



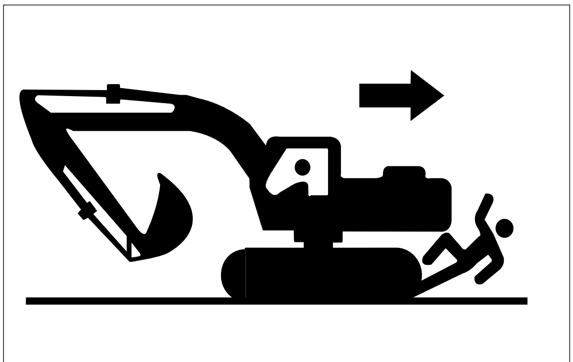
13031GE08

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

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.

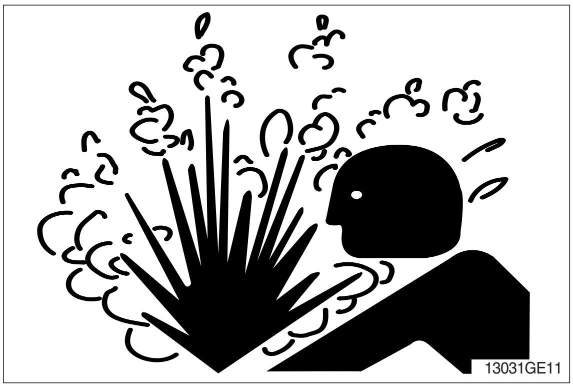
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

13031GE10

SERVICE COOLING SYSTEM SAFELY

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.



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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.

13031GE12

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

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

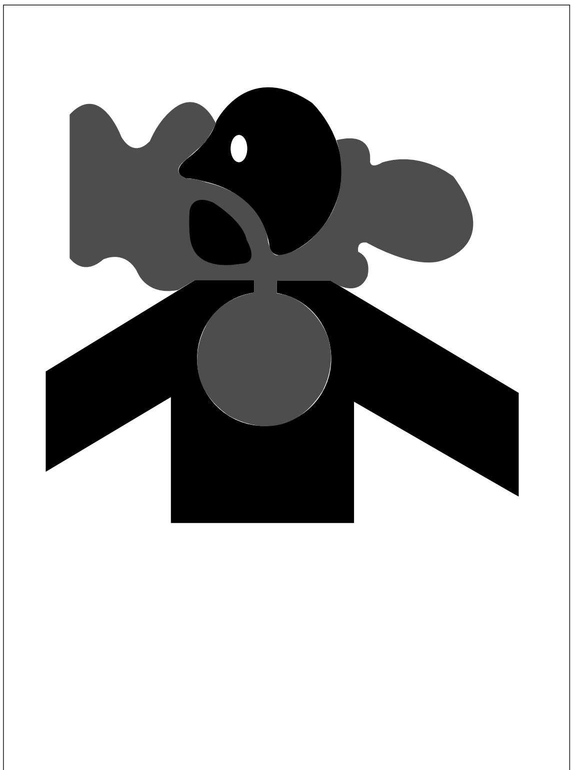
Do not store oily rags; They can ignite and burn spontaneously.

13031GE13

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

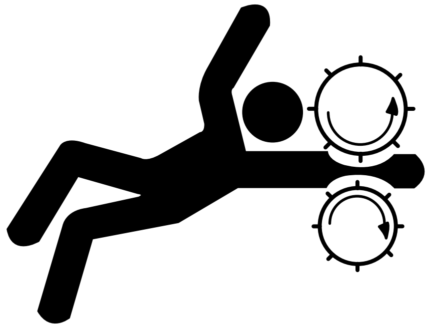
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

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.

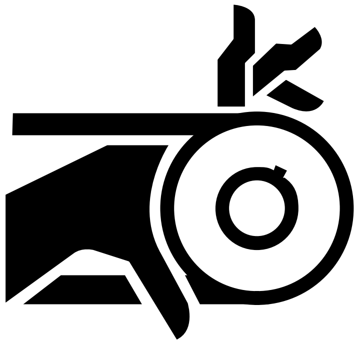


13031GE16

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

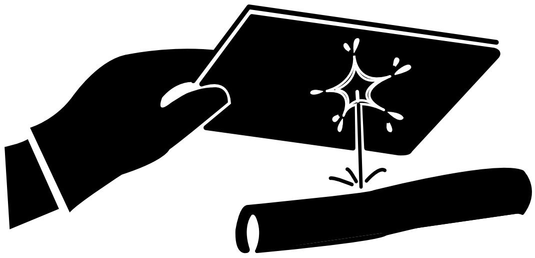
Escaping fluid under pressure can penetrate the skin causing serious injury.

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:

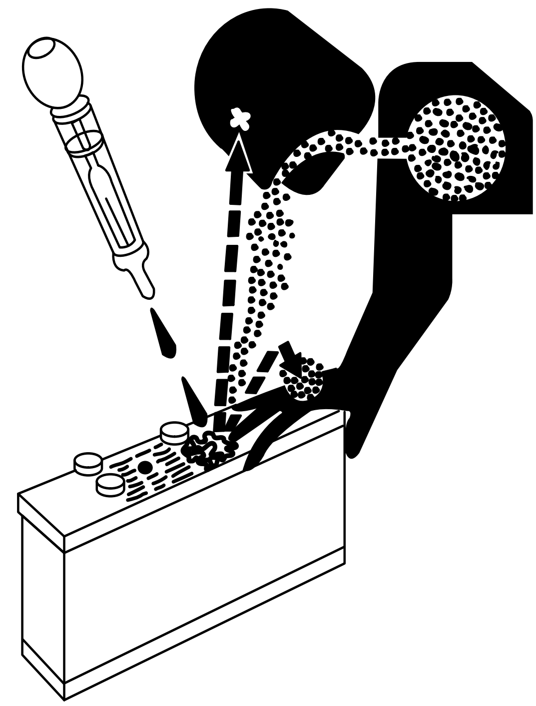
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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

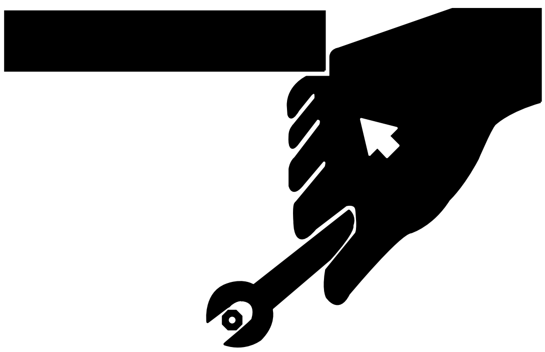
USE TOOLS PROPERLY

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.)



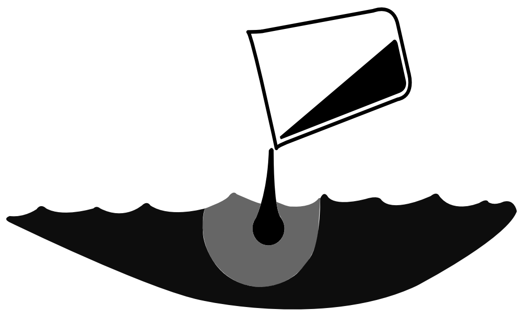
13031GE23

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.

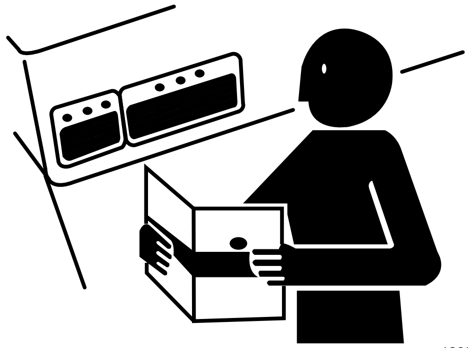
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



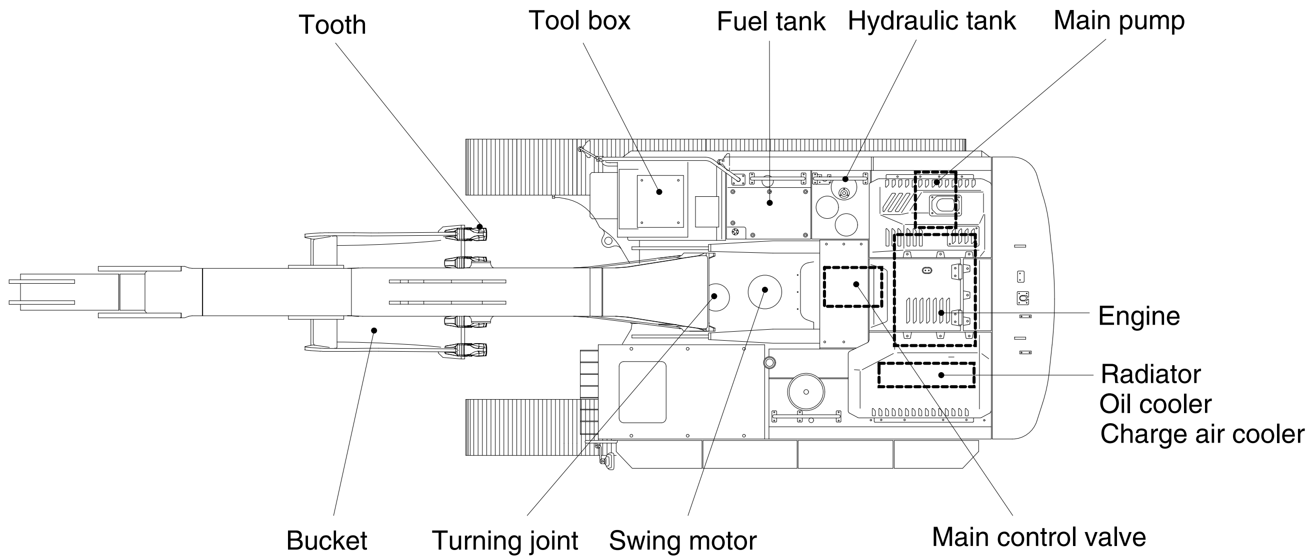
13031GE25

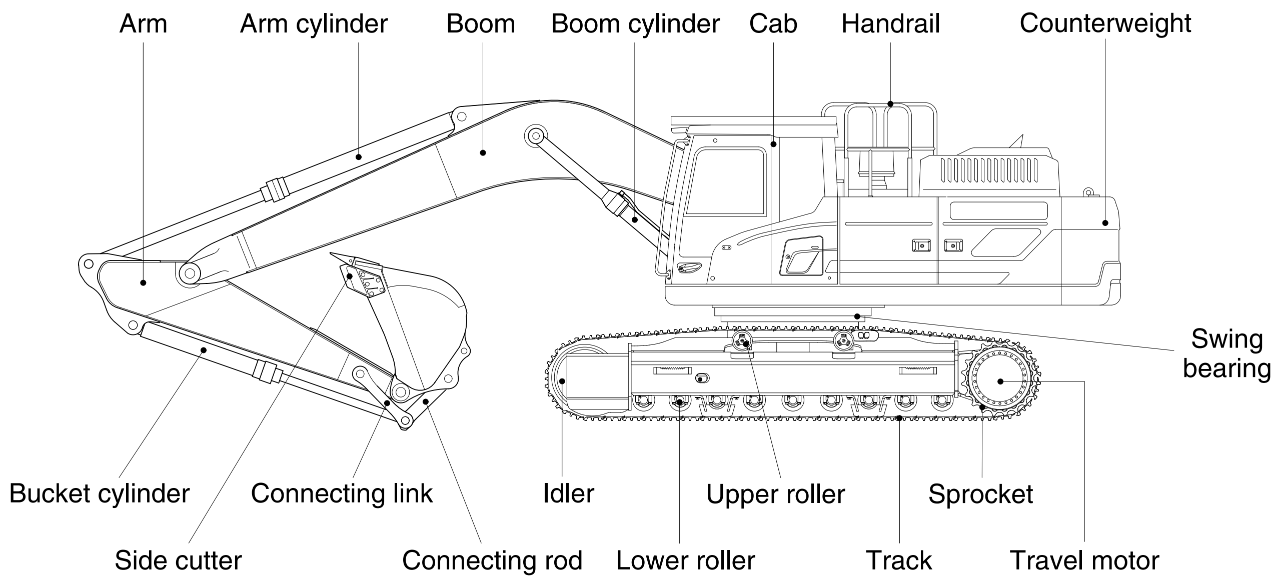
LIVE WITH SAFETY

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

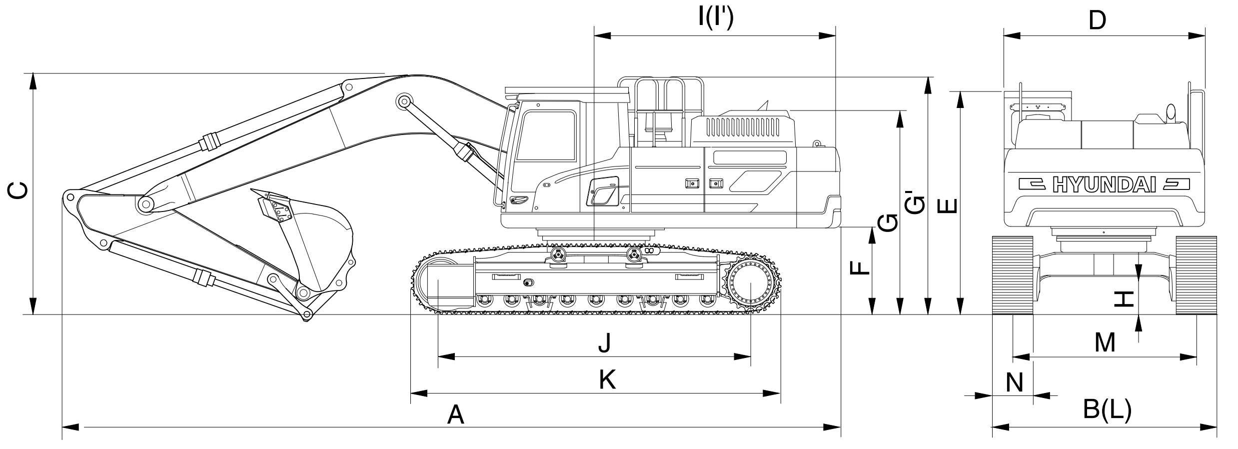




400SA2SP01

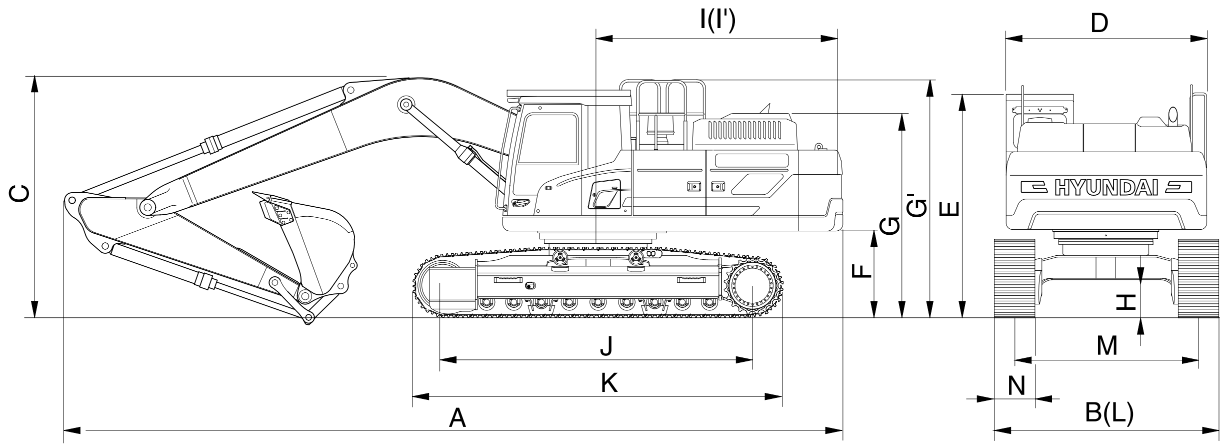
2. SPECIFICATIONS

1) HX400 LT3 (1/2)



Description		Unit		Specification			
		m (ft-in)	Boom	6.50 (21' 4")			
			Arm	2.55 (8' 4")	2.80 (9' 2")	3.20 (10' 6")	3.90 (12' 10")
		mm (in)	Shoe	600 (24)			
Operating weight		kg (lb)		38300 (84440)	38340 (84530)	38420 (84700)	38510 (84900)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.62 (2.12)	1.62 (2.12)	1.62 (2.12)	1.62 (2.12)
Overall length	A	mm (ft-in)		11430 (37' 6")	11430 (37' 6")	11410 (37' 5")	11400 (37' 5")
Overall width	B			3380 (11' 1")	3380 (11' 1")	3380 (11' 1")	3380 (11' 1")
Overall width with additional footboard	B'			3565 (11' 8")	3565 (11' 8")	3565 (11' 8")	3565 (11' 8")
Overall height of boom	C			3670 (12' 0")	3690 (12' 1")	3560 (11' 8")	3690 (12' 1")
Superstructure width (with catwalk)	D			3300 (10' 10")	3300 (10' 10")	3300 (10' 10")	3300 (10' 10")
Superstructure width (with protector)	D			3110 (10' 2")	3110 (10' 2")	3110 (10' 2")	3110 (10' 2")
Overall height of cab	E			3240 (10' 8")	3240 (10' 8")	3240 (10' 8")	3240 (10' 8")
Ground clearance of counterweight	F			1295 (4' 3")	1295 (4' 3")	1295 (4' 3")	1295 (4' 3")
Overall height of engine hood	G			2770 (9' 1")	2770 (9' 1")	2770 (9' 1")	2770 (9' 1")
Overall height of handrail	G'			3440 (11' 3")	3440 (11' 3")	3440 (11' 3")	3440 (11' 3")
Minimum ground clearance	H			555 (1' 10")	555 (1' 10")	555 (1' 10")	555 (1' 10")
Rear-end distance	I			3555 (11' 8")	3555 (11' 8")	3555 (11' 8")	3555 (11' 8")
Rear-end swing radius	I'			3620 (11' 11")	3620 (11' 11")	3620 (11' 11")	3620 (11' 11")
Distance between tumblers	J			4340 (14' 3")	4340 (14' 3")	4340 (14' 3")	4340 (14' 3")
Undercarriage length (without grouser)	K			5217 (17' 1")	5217 (17' 1")	5217 (17' 1")	5217 (17' 1")
Undercarriage length (with grouser)	K			5289 (17' 4")	5289 (17' 4")	5289 (17' 4")	5289 (17' 4")
Undercarriage width	L			3380 (11' 1")	3380 (11' 1")	3380 (11' 1")	3380 (11' 1")
Undercarriage width with additional footboard	L'			3565 (11' 8")	3565 (11' 8")	3565 (11' 8")	3565 (11' 8")
Track gauge	M			2740 (9' 0")	2740 (9' 0")	2740 (9' 0")	2740 (9' 0")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")	600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.2/5.3 (2.0/3.3)	3.2/5.3 (2.0/3.3)	3.2/5.3 (2.0/3.3)	3.2/5.3 (2.0/3.3)
Swing speed		rpm		9.1	9.1	9.1	9.1
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.69 (9.77)	0.69 (9.79)	0.69 (9.80)	0.69 (9.83)
Max traction force		kg (lb)		31613 (69694)	31613 (69694)	31613 (69694)	31613 (69694)

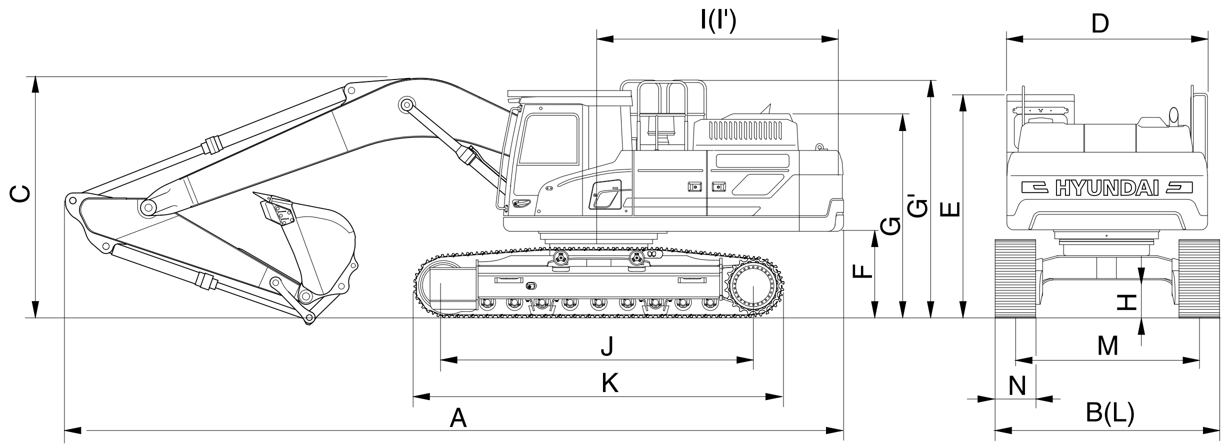
2) HX400 LT3 (2/2)



400SA2SP02

Description		Unit		Specification	
		m (ft-in)	Boom	6.15 (20' 2")	
			Arm	2.55 (8' 4")	2.80 (9' 2")
		mm (in)	Shoe	600 (24)	
Operating weight		kg (lb)		37500 (82670)	37540 (82760)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.62 (2.12)	1.62 (2.12)
Overall length	A	mm (ft-in)		11070 (36' 4")	11070 (36' 4")
Overall width	B			3380 (11' 1")	3380 (11' 1")
Overall width with additional footboard	B'			3565 (11' 8")	3565 (11' 8")
Overall height of boom	C			3710 (12' 2")	3720 (12' 2")
Superstructure width (with catwalk)	D			3300 (10' 10")	3300 (10' 10")
Superstructure width (with protector)	D			3110 (10' 2")	3110 (10' 2")
Overall height of cab	E			3240 (10' 8")	3240 (10' 8")
Ground clearance of counterweight	F			1295 (4' 3")	1295 (4' 3")
Overall height of engine hood	G			2770 (9' 1")	2770 (9' 1")
Overall height of handrail	G'			3440 (11' 3")	3440 (11' 3")
Minimum ground clearance	H			555 (1' 10")	555 (1' 10")
Rear-end distance	I			3555 (11' 8")	3555 (11' 8")
Rear-end swing radius	I'			3620 (11' 11")	3620 (11' 11")
Distance between tumblers	J			4340 (14' 3")	4340 (14' 3")
Undercarriage length (without grouser)	K			5217 (17' 1")	5217 (17' 1")
Undercarriage length (with grouser)	K			5289 (17' 4")	5289 (17' 4")
Undercarriage width	L			3380 (11' 1")	3380 (11' 1")
Undercarriage width with additional footboard	L'			3565 (11' 8")	3565 (11' 8")
Track gauge	M			2740 (9' 0")	2740 (9' 0")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.2/5.3 (2.0/3.3)	3.2/5.3 (2.0/3.3)
Swing speed		rpm		9.1	9.1
Gradeability		Degree (%)		35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.67 (9.56)	0.67 (9.57)
Max traction force		kg (lb)		31613 (69694)	31613 (69694)

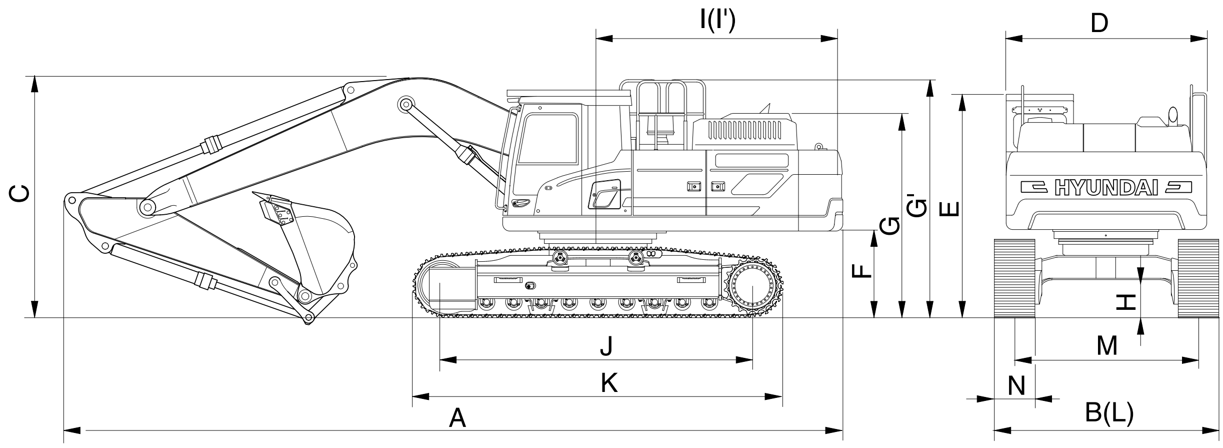
3) HX400 NLT3 (1/2)



400SA2SP02

Description		Unit		Specification			
		m (ft-in)	Boom	6.50 (21' 4")			
			Arm	2.55 (8' 4")	2.80 (9' 2")	3.20 (10' 6")	3.90 (12' 10")
		mm (in)	Shoe	600 (24)			
Operating weight		kg (lb)		38890 (85740)	38930 (85830)	39010 (86000)	39100 (86200)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.62 (2.12)	1.62 (2.12)	1.62 (2.12)	1.62 (2.12)
Overall length	A	mm (ft-in)		11430 (37' 6")	11430 (37' 6")	11410 (37' 5")	11400 (37' 5")
Overall width (with catwalk)	B			3300 (10' 10")	3300 (10' 10")	3300 (10' 10")	3300 (10' 10")
Overall width (with protector)	B'			3110 (10' 2")	3110 (10' 2")	3110 (10' 2")	3110 (10' 2")
Overall height of boom	C			3670 (12' 0")	3690 (12' 1")	3560 (11' 8")	3690 (12' 1")
Superstructure width (with catwalk)	D			3300 (10' 10")	3300 (10' 10")	3300 (10' 10")	3300 (10' 10")
Superstructure width (with protector)	D			3110 (10' 2")	3110 (10' 2")	3110 (10' 2")	3110 (10' 2")
Overall height of cab	E			3240 (10' 8")	3240 (10' 8")	3240 (10' 8")	3240 (10' 8")
Ground clearance of counterweight	F			1295 (4' 3")	1295 (4' 3")	1295 (4' 3")	1295 (4' 3")
Overall height of engine hood	G			2770 (9' 1")	2770 (9' 1")	2770 (9' 1")	2770 (9' 1")
Overall height of handrail	G'			3440 (11' 3")	3440 (11' 3")	3440 (11' 3")	3440 (11' 3")
Minimum ground clearance	H			555 (1' 10")	555 (1' 10")	555 (1' 10")	555 (1' 10")
Rear-end distance	I			3555 (11' 8")	3555 (11' 8")	3555 (11' 8")	3555 (11' 8")
Rear-end swing radius	I'			3620 (11' 11")	3620 (11' 11")	3620 (11' 11")	3620 (11' 11")
Distance between tumblers	J			4340 (14' 3")	4340 (14' 3")	4340 (14' 3")	4340 (14' 3")
Undercarriage length (without grouser)	K			5217 (17' 1")	5217 (17' 1")	5217 (17' 1")	5217 (17' 1")
Undercarriage length (with grouser)	K			5289 (17' 4")	5289 (17' 4")	5289 (17' 4")	5289 (17' 4")
Undercarriage width	L			3030 (9' 11")	3030 (9' 11")	3030 (9' 11")	3030 (9' 11")
Undercarriage width with additional footboard	L'			3030 (9' 11")	3030 (9' 11")	3030 (9' 11")	3030 (9' 11")
Track gauge	M			2390 (7' 10")	2390 (7' 10")	2390 (7' 10")	2390 (7' 10")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")	600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.3/5.3 (2.1/3.3)	3.3/5.3 (2.1/3.3)	3.3/5.3 (2.1/3.3)	3.3/5.3 (2.1/3.3)
Swing speed		rpm		8.6	8.6	8.6	8.6
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.70 (9.91)	0.70 (9.93)	0.70 (9.96)	0.70 (9.97)
Max traction force		kg (lb)		34100 (75180)	34100 (75180)	34100 (75180)	34100 (75180)

4) HX400 NLT3 (2/2)

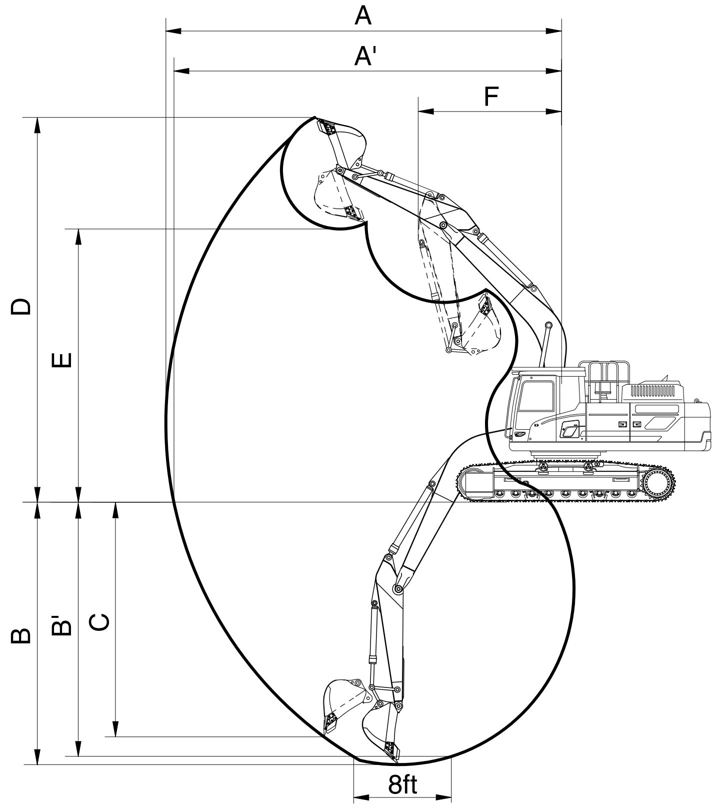


400SA2SP02

Description		Unit		Specification	
		m (ft-in)	Boom	6.15 (20' 2")	
			Arm	2.55 (8' 4")	2.80 (9' 2")
		mm (in)	Shoe	600 (24)	
Operating weight		kg (lb)		38940 (85850)	38980 (85940)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.62 (2.12)	1.62 (2.12)
Overall length	A	mm (ft-in)		11070 (36' 4")	11070 (36' 4")
Overall width (with catwalk)	B			3300 (10' 10")	3300 (10' 10")
Overall width (with protector)	B'			3110 (10' 2")	3110 (10' 2")
Overall height of boom	C			3710 (12' 2")	3720 (12' 2")
Superstructure width (with catwalk)	D			3300 (10' 10")	3300 (10' 10")
Superstructure width (with protector)	D			3110 (10' 2")	3110 (10' 2")
Overall height of cab	E			3240 (10' 8")	3240 (10' 8")
Ground clearance of counterweight	F			1295 (4' 3")	1295 (4' 3")
Overall height of engine hood	G			2770 (9' 1")	2770 (9' 1")
Overall height of handrail	G'			3440 (11' 3")	3440 (11' 3")
Minimum ground clearance	H			555 (1' 10")	555 (1' 10")
Rear-end distance	I			3555 (11' 8")	3555 (11' 8")
Rear-end swing radius	I'			3620 (11' 11")	3620 (11' 11")
Distance between tumblers	J			4340 (14' 3")	4340 (14' 3")
Undercarriage length (without grouser)	K			5217 (17' 1")	5217 (17' 1")
Undercarriage length (with grouser)	K			5289 (17' 4")	5289 (17' 4")
Undercarriage width	L			3030 (9' 11")	3030 (9' 11")
Undercarriage width with additional footboard	L'			3030 (9' 11")	3030 (9' 11")
Track gauge	M			2390 (7' 10")	2390 (7' 10")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.3/5.3 (2.1/3.3)	3.3/5.3 (2.1/3.3)
Swing speed		rpm		8.6	8.6
Gradeability		Degree (%)		35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.70 (9.93)	0.70 (9.94)
Max traction force		kg (lb)		34100 (75180)	34100 (75180)

3. WORKING RANGE AND DIGGING FORCE

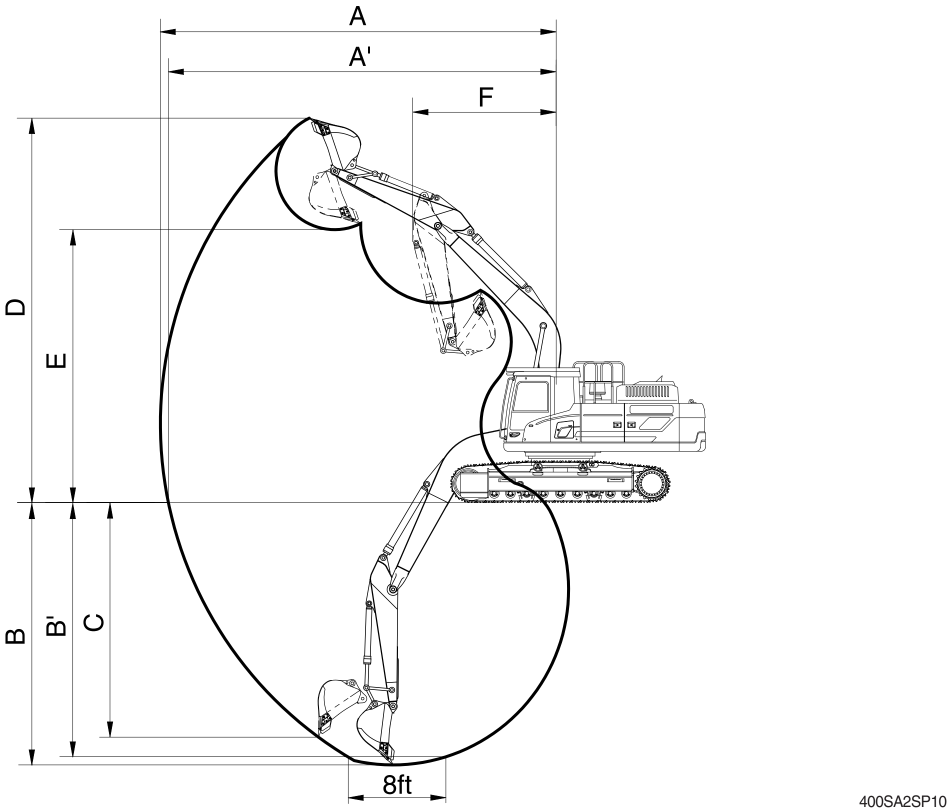
1) HX400 LT3/NLT3 (1/2)



400SA2SP10

Description	m (ft-in)	Boom	6.50 (21' 4")			
		Arm	2.55 (8' 4")	2.80 (9' 2")	3.20 (10' 6")	3.90 (12' 10")
Max digging reach	mm (ft-in)	A	10800 (35' 5")	11040 (36' 3")	11270 (37' 0")	11920 (39' 1")
Max digging reach on ground		A'	10580 (34' 9")	10820 (35' 6")	11050 (36' 3")	11710 (38' 5")
Max digging depth		B	6710 (22' 0")	6960 (22' 10")	7360 (24' 2")	8060 (26' 5")
Max digging depth (8 ft level)		B'	6530 (21' 5")	6780 (22' 3")	7180 (23' 7")	7880 (25' 10")
Max vertical wall digging depth		C	5020 (16' 6")	5230 (17' 2")	4870 (16' 0")	6010 (19' 9")
Max digging height		D	10800 (35' 5")	10940 (35' 11")	10680 (35' 0")	11080 (36' 4")
Max dumping height		E	7480 (24' 6")	7620 (25' 0")	7480 (24' 6")	7810 (25' 7")
Min swing radius		F	4250 (13' 11")	4280 (14' 1")	4310 (14' 2")	4070 (13' 4")
Bucket digging force	kN	SAE	211.8	211.8	211.8	211.8
	kgf		21600	21600	21600	21600
	lbf		47620	47620	47620	47620
	kN	ISO	242.2	242.2	242.2	242.2
	kgf		24700	24700	24700	24700
	lbf		54454	54454	54454	54454
Arm digging force	kN	SAE	197.1	186.3	170.6	146.1
	kgf		20100	19000	17400	14900
	lbf		44313	41888	38360	32849
	kN	ISO	205.0	193.2	176.5	150.0
	kgf		20900	19700	18000	15300
	lbf		46077	43431	39683	33731

2) HX400 LT3/NLT3 (2/2)



Description	m (ft-in)	Boom	6.15 (20' 2")	
		Arm	2.55 (8' 4")	2.80 (9' 2")
Max digging reach	mm (ft-in)	A	10430 (34' 3")	10660 (35' 0")
Max digging reach on ground		A'	10190 (33' 5")	10430 (34' 3")
Max digging depth		B	6460 (21' 2")	6710 (22' 0")
Max digging depth (8 ft level)		B'	6290 (20' 8")	6550 (21' 6")
Max vertical wall digging depth		C	4650 (15' 3")	4860 (15' 11")
Max digging height		D	10390 (34' 1")	10510 (34' 6")
Max dumping height		E	7100 (23' 4")	7230 (23' 9")
Min swing radius		F	4100 (13' 5")	4120 (13' 6")
Bucket digging force	kN	SAE	211.8	211.8
	kgf		21600	21600
	lbf		47620	47620
	kN	ISO	242.2	242.2
	kgf		24700	24700
	lbf		54454	54454
Arm digging force	kN	SAE	197.1	186.3
	kgf		20100	19000
	lbf		44313	41888
	kN	ISO	205.0	193.2
	kgf		20900	19700
	lbf		46077	43431

4. WEIGHT

Item	HX400 LT3	
	kg	lb
Upperstructure assembly		
· Main frame weld assembly	3191	7035
· Engine assembly	738	1627
· Main pump assembly	193	425
· Main control valve assembly	380	838
· Swing motor assembly	443	977
· Hydraulic oil tank WA	415	914
· Fuel tank WA	349	769
· Counterweight	6200	13669
· Cab assembly	495	1092
Lower chassis assembly		
· Track frame weld assembly	5236	11543
· Swing bearing	547	1206
· Travel motor assembly	380	838
· Turning joint	37	82
· Sprocket (2EA)	170	375
· Track recoil spring (2EA)	455	1003
· Idler (2EA)	522	1151
· Upper roller (4EA)	80	176
· Lower roller (18EA)	1431	3155
· Track-chain assembly (600 mm triple grouser shoe) (2EA)	5111	11268
· Track-chain assembly (600 mm double grouser shoe) (2EA)	4666	10287
· Track-chain assembly (700 mm triple grouser shoe) (2EA)	5116	11279
· Track-chain assembly (800 mm triple grouser shoe) (2EA)	5564	12266
· Track-chain assembly (900 mm triple grouser shoe) (2EA)	6014	13258
Front attachment assembly		
· 6.50 m boom assembly	3750	8267
· 3.20 m arm assembly	2080	4586
· 1.62 m^3 SAE heaped bucket	1500	3307
· Boom cylinder assembly (2EA)	357	787
· Arm cylinder assembly	447	985
· Bucket cylinder assembly	309	681
· Bucket control linkage total	280	617

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

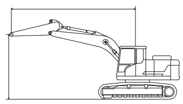
※ Refer to Transportation for actual weight information and Specifications for operating weight.

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX400LT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6150	2550	6200	600	-	-	-	-	-

· : Rating over-front

· : Rating over-side or 360 degree



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m	kg					*10350	*10350			*10350	8950	6.77
(24.6 ft)	lb					*22820	*22820			*22820	19730	(22.2)
6.0 m	kg					*10870	10850	*10290	7480	*9880	7060	7.74
(19.7 ft)	lb					*23960	23920	*22690	16490	*21780	15560	(25.4)
4.5 m	kg			*15550	*15550	*12260	10350	*10730	7300	*9870	6130	8.32
(14.8 ft)	lb			*34280	*34280	*27030	22820	*23660	16090	*21760	13510	(27.3)
3.0 m	kg			*19270	14810	*13940	9760	*11500	7020	9350	5680	8.60
(9.8 ft)	lb			*42480	32650	*30730	21520	*25350	15480	20610	12520	(28.2)
1.5 m	kg			*17690	14000	*15310	9280	11340	6770	9200	5550	8.61
(4.9 ft)	lb			*39000	30860	*33750	20460	25000	14930	20280	12240	(28.2)
0.0 m	kg			*21680	13760	15800	9020	11170	6620	9560	5730	8.34
(0.0 ft)	lb			*47800	30340	34830	19890	24630	14590	21080	12630	(27.4)
-1.5 m	kg	*14680	*14680	*20660	13800	*15560	8980	11170	6620	10610	6330	7.78
(-4.9 ft)	lb	*32360	*32360	*45550	30420	*34300	19800	24630	14590	23390	13960	(25.5)
-3.0 m	kg	*24210	*24210	*18310	14070	*13840	9150			*11480	7700	6.83
(-9.8 ft)	lb	*53370	*53370	*40370	31020	*30510	20170			*25310	16980	(22.4)
-4.5 m	kg			*13400	*13400					*10800	*10800	5.31
(-14.8 ft)	lb			*29540	*29540					*23810	*23810	(17.4)

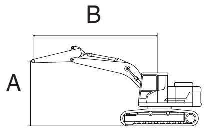
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

⚠ 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	Shoe	Wheel	Dozer		Outrigger	
HX400LT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6500	2550	6200	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
9.0 m (29.5 ft)	kg									*10560	*10560	5.83
	lb									*23280	*23280	(19.1)
7.5 m (24.6 ft)	kg					*9940	*9940			*9950	7930	7.25
	lb					*21910	*21910			*21940	17480	(23.8)
6.0 m (19.7 ft)	kg					*10710	*10710	*9850	7440	*9780	6400	8.16
	lb					*23610	*23610	*21720	16400	*21560	14110	(26.8)
4.5 m (14.8 ft)	kg			*16000	15740	*12200	10160	*10450	7200	9220	5610	8.71
	lb			*35270	34700	*26900	22400	*23040	15870	20330	12370	(28.6)
3.0 m (9.8 ft)	kg					*13890	9520	*11280	6890	8640	5220	8.98
	lb					*30620	20990	*24870	15190	19050	11510	(29.5)
1.5 m (4.9 ft)	kg					*15180	9040	11180	6620	8510	5100	8.99
	lb					*33470	19930	24650	14590	18760	11240	(29.5)
0.0 m (0.0 ft)	kg			*14960	13450	15550	8800	11000	6460	8810	5260	8.73
	lb			*32980	29650	34280	19400	24250	14240	19420	11600	(28.7)
-1.5 m (-4.9 ft)	kg			*20160	13530	*15340	8760	10980	6440	9690	5750	8.2
	lb			*44450	29830	*33820	19310	24210	14200	21360	12680	(26.9)
-3.0 m (-9.8 ft)	kg	*22990	*22990	*18020	13790	*13890	8920			*10660	6860	7.31
	lb	*50680	*50680	*39730	30400	*30620	19670			*23500	15120	(24.0)
-4.5 m (-14.8 ft)	kg			*13990	*13990					*10120	9610	5.92
	lb			*30840	*30840					*22310	21190	(19.4)

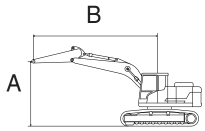
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

⚠ 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	Shoe	Wheel	Dozer		Outrigger	
HX400LT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6500	2800	6200	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
9.0 m	kg					*9920	*9920					*10030	*10030	6.18
(29.5 ft)	lb					*21870	*21870					*22110	*22110	(20.3)
7.5 m	kg							*9520	7560			*9240	7470	7.54
(24.6 ft)	lb							*20990	16670			*20370	16470	(24.8)
6.0 m	kg					*10320	*10320	*9520	7500			*8880	6100	8.42
(19.7 ft)	lb					*22750	*22750	*20990	16530			*19580	13450	(27.6)
4.5 m	kg			*15300	*15300	*11830	10240	*10190	7240			8840	5380	8.96
(14.8 ft)	lb			*33730	*33730	*26080	22580	*22470	15960			19490	11860	(29.4)
3.0 m	kg					*13580	9590	*11070	6910	8630	5210	8310	5010	9.22
(9.8 ft)	lb					*29940	21140	*24410	15230	19030	11490	18320	11050	(30.2)
1.5 m	kg					*14980	9080	11200	6630	8490	5080	8180	4900	9.22
(4.9 ft)	lb					*33030	20020	24690	14620	18720	11200	18030	10800	(30.3)
0.0 m	kg			*15760	13420	15550	8790	10990	6440			8450	5040	8.98
(0.0 ft)	lb			*34740	29590	34280	19380	24230	14200			18630	11110	(29.4)
-1.5 m	kg	*10800	*10800	*20480	13460	*15440	8720	10930	6400			9220	5480	8.45
(-4.9 ft)	lb	*23810	*23810	*45150	29670	*34040	19220	24100	14110			20330	12080	(27.7)
-3.0 m	kg	*21330	*21330	*18540	13690	*14200	8850	*10690	6550			*10420	6450	7.6
(-9.8 ft)	lb	*47020	*47020	*40870	30180	*31310	19510	*23570	14440			*22970	14220	(24.9)
-4.5 m	kg			*14890	14170	*10950	9250					*10090	8740	6.27
(-14.8 ft)	lb			*32830	31240	*24140	20390					*22240	19270	(20.6)

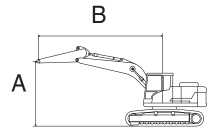
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

⚠ 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	Shoe	Wheel	Dozer		Outrigger	
HX400LT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6500	3200	6200	600	-	-	-	-	-

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



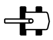
Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
9.0 m	kg											*8330	*8330	6.52
(29.5 ft)	lb											*18360	*18360	(21.4)
7.5 m	kg							*8790	7710			*7740	7130	7.82
(24.6 ft)	lb							*19380	17000			*17060	15720	(25.7)
6.0 m	kg					*9680	*9680	*9010	7590			*7570	5870	8.67
(19.7 ft)	lb					*21340	*21340	*19860	16730			*16690	12940	(28.4)
4.5 m	kg			*14200	*14200	*11230	10380	*9750	7310	8830	5390	*7670	5190	9.19
(14.8 ft)	lb			*31310	*31310	*24760	22880	*21500	16120	19470	11880	*16910	11440	(30.2)
3.0 m	kg			*18040	14800	*13050	9710	*10700	6960	8660	5230	8010	4830	9.44
(9.8 ft)	lb			*39770	32630	*28770	21410	*23590	15340	19090	11530	17660	10650	(31.0)
1.5 m	kg			*18170	13780	*14600	9140	11220	6650	8480	5070	7870	4710	9.45
(4.9 ft)	lb			*40060	30380	*32190	20150	24740	14660	18700	11180	17350	10380	(31.0)
0.0 m	kg			*19360	13400	*15470	8790	10970	6430	8370	4970	8090	4810	9.21
(0.0 ft)	lb			*42680	29540	*34110	19380	24180	14180	18450	10960	17840	10600	(30.2)
-1.5 m	kg	*12640	*12640	*20840	13360	15410	8670	10870	6340			8770	5190	8.70
(-4.9 ft)	lb	*27870	*27870	*45940	29450	33970	19110	23960	13980			19330	11440	(28.5)
-3.0 m	kg	*20920	*20920	*19230	13530	*14600	8740	10960	6410			10230	6030	7.87
(-9.8 ft)	lb	*46120	*46120	*42390	29830	*32190	19270	24160	14130			22550	13290	(25.8)
-4.5 m	kg	*21490	*21490	*16120	13950	*12130	9040					*10550	7940	6.60
(-14.8 ft)	lb	*47380	*47380	*35540	30750	*26740	19930					*23260	17500	(21.7)

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.

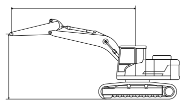
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult with your local HD Hyundai Construction Equipment dealer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

⚠ 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	Shoe	Wheel	Dozer		Outrigger	
HX400LT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6500	3900	6200	600	-	-	-	-	-

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

B

A 

Lift-point height (A)		Lift-point radius (B)												At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
																m (ft)
9.0 m	kg													*6170	*6170	7.44
(29.5 ft)	lb													*13600	*13600	(24.4)
7.5 m	kg									*7750	*7750			*5790	*5790	8.60
(24.6 ft)	lb									*17090	*17090			*12760	*12760	(28.2)
6.0 m	kg									*8140	7780	*7110	5640	*5670	5210	9.38
(19.7 ft)	lb									*17950	17150	*15670	12430	*12500	11490	(30.8)
4.5 m	kg							*10130	*10130	*8980	7470	*8340	5500	*5740	4660	9.86
(14.8 ft)	lb							*22330	*22330	*19800	16470	*18390	12130	*12650	10270	(32.4)
3.0 m	kg					*16220	15440	*12080	9970	*10040	7090	8750	5310	*5970	4360	10.10
(9.8 ft)	lb					*35760	34040	*26630	21980	*22130	15630	19290	11710	*13160	9610	(33.1)
1.5 m	kg					*19460	14160	*13870	9320	*11070	6730	8530	5110	*6390	4250	10.10
(4.9 ft)	lb					*42900	31220	*30580	20550	*24410	14840	18810	11270	*14090	9370	(33.1)
0.0 m	kg			*7130	*7130	*20850	13500	*15090	8870	11010	6450	8350	4950	*7080	4310	9.88
(0.0 ft)	lb			*15720	*15720	*45970	29760	*33270	19550	24270	14220	18410	10910	*15610	9500	(32.4)
-1.5 m	kg	*7910	*7910	*11810	*11810	*21200	13280	15400	8640	10840	6300	8270	4880	7770	4590	9.41
(-4.9 ft)	lb	*17440	*17440	*26040	*26040	*46740	29280	33950	19050	23900	13890	18230	10760	17130	10120	(30.9)
-3.0 m	kg	*12870	*12870	*17720	*17720	*20200	13340	*15100	8620	10830	6290			8810	5200	8.65
(-9.8 ft)	lb	*28370	*28370	*39070	*39070	*44530	29410	*33290	19000	23880	13870			19420	11460	(28.4)
-4.5 m	kg			*24910	*24910	*17880	13640	*13490	8800	*10030	6480			*9990	6470	7.52
(-14.8 ft)	lb			*54920	*54920	*39420	30070	*29740	19400	*22110	14290			*22020	14260	(24.7)
-6.0 m	kg					*13310	*13310							*9880	9810	5.78
(-19.7 ft)	lb					*29340	*29340							*21780	21630	(19.0)

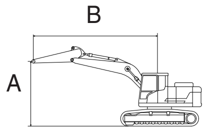
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

⚠ 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	Shoe	Wheel	Dozer		Outrigger	
HX400 NLT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6150	2550	7000	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m	kg					*10350	10180			*10350	8230	6.77
(24.6 ft)	lb					*22820	22440			*22820	18140	(22.2)
6.0 m	kg					*10870	9940	*10290	6880	*9880	6500	7.74
(19.7 ft)	lb					*23960	21910	*22690	15170	*21780	14330	(25.4)
4.5 m	kg			*15550	14560	*12260	9460	*10730	6710	*9870	5640	8.32
(14.8 ft)	lb			*34280	32100	*27030	20860	*23660	14790	*21760	12430	(27.3)
3.0 m	kg			*19270	13260	*13940	8890	*11500	6440	9780	5220	8.60
(9.8 ft)	lb			*42480	29230	*30730	19600	*25350	14200	21560	11510	(28.2)
1.5 m	kg			*17690	12490	*15310	8430	11870	6200	9640	5090	8.61
(4.9 ft)	lb			*39000	27540	*33750	18580	26170	13670	21250	11220	(28.2)
0.0 m	kg			*21680	12260	*15910	8180	11700	6050	10020	5250	8.34
(0.0 ft)	lb			*47800	27030	*35080	18030	25790	13340	22090	11570	(27.4)
-1.5 m	kg	*14680	*14680	*20660	12310	*15560	8140	11700	6050	11120	5790	7.78
(-4.9 ft)	lb	*32360	*32360	*45550	27140	*34300	17950	25790	13340	24520	12760	(25.5)
-3.0 m	kg	*24210	*24210	*18310	12560	*13840	8300			*11480	7030	6.83
(-9.8 ft)	lb	*53370	*53370	*40370	27690	*30510	18300			*25310	15500	(22.4)
-4.5 m	kg			*13400	13120					*10800	10390	5.31
(-14.8 ft)	lb			*29540	28920					*23810	22910	(17.4)

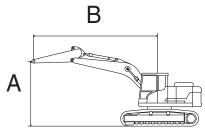
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

⚠ 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	Shoe	Wheel	Dozer		Outrigger	
HX400 NLT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6500	2550	7000	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
9.0 m	kg									*10560	10560	5.83
(29.5 ft)	lb									*23280	23280	(19.1)
7.5 m	kg					*9940	*9940			*9950	7300	7.25
(24.6 ft)	lb					*21910	*21910			*21940	16090	(23.8)
6.0 m	kg					*10710	9830	*9850	6850	*9780	5890	8.16
(19.7 ft)	lb					*23610	21670	*21720	15100	*21560	12990	(26.8)
4.5 m	kg			*16000	14130	*12200	9270	*10450	6610	9650	5160	8.71
(14.8 ft)	lb			*35270	31150	*26900	20440	*23040	14570	21270	11380	(28.6)
3.0 m	kg					*13890	8660	*11280	6310	9060	4790	8.98
(9.8 ft)	lb					*30620	19090	*24870	13910	19970	10560	(29.5)
1.5 m	kg					*15180	8200	11710	6050	8930	4680	8.99
(4.9 ft)	lb					*33470	18080	25820	13340	19690	10320	(29.5)
0.0 m	kg			*14960	11970	*15700	7960	11530	5890	9240	4810	8.73
(0.0 ft)	lb			*32980	26390	*34610	17550	25420	12990	20370	10600	(28.7)
-1.5 m	kg			*20160	12040	*15340	7930	11510	5870	10150	5260	8.20
(-4.9 ft)	lb			*44450	26540	*33820	17480	25380	12940	22380	11600	(26.9)
-3.0 m	kg	*22990	*22990	*18020	12290	*13890	8080			*10660	6260	7.31
(-9.8 ft)	lb	*50680	*50680	*39730	27090	*30620	17810			*23500	13800	(24.0)
-4.5 m	kg			*13990	12800					*10120	8720	5.92
(-14.8 ft)	lb			*30840	28220					*22310	19220	(19.4)

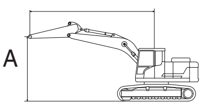
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

⚠ 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	Shoe	Wheel	Dozer		Outrigger	
HX400 NLT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6500	2800	7000	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
9.0 m	kg					*9920	*9920					*10030	9630	6.18
(29.5 ft)	lb					*21870	*21870					*22110	21230	(20.3)
7.5 m	kg							*9520	6960			*9240	6880	7.54
(24.6 ft)	lb							*20990	15340			*20370	15170	(24.8)
6.0 m	kg					*10320	9910	*9520	6900			*8880	5620	8.42
(19.7 ft)	lb					*22750	21850	*20990	15210			*19580	12390	(27.6)
4.5 m	kg			*15300	14350	*11830	9350	*10190	6650			*8860	4940	8.96
(14.8 ft)	lb			*33730	31640	*26080	20610	*22470	14660			*19530	10890	(29.4)
3.0 m	kg					*13580	8720	*11070	6330	9040	4780	8710	4600	9.22
(9.8 ft)	lb					*29940	19220	*24410	13960	19930	10540	19200	10140	(30.2)
1.5 m	kg					*14980	8230	11720	6050	8900	4660	8580	4490	9.22
(4.9 ft)	lb					*33030	18140	25840	13340	19620	10270	18920	9900	(30.3)
0.0 m	kg			*15760	11940	*15630	7960	11520	5870			8860	4610	8.98
(0.0 ft)	lb			*34740	26320	*34460	17550	25400	12940			19530	10160	(29.4)
-1.5 m	kg	*10800	*10800	*20480	11980	*15440	7890	11460	5830			9670	5010	8.45
(-4.9 ft)	lb	*23810	*23810	*45150	26410	*34040	17390	25260	12850			21320	11050	(27.7)
-3.0 m	kg	*21330	*21330	*18540	12190	*14200	8010	*10690	5980			*10420	5890	7.60
(-9.8 ft)	lb	*47020	*47020	*40870	26870	*31310	17660	*23570	13180			*22970	12990	(24.9)
-4.5 m	kg			*14890	12650	*10950	8400					*10090	7950	6.27
(-14.8 ft)	lb			*32830	27890	*24140	18520					*22240	17530	(20.6)

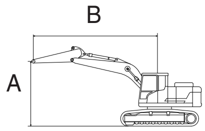
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

⚠ 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	Shoe	Wheel	Dozer		Outrigger	
HX400 NLT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6500	3200	7000	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)										At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
														m (ft)
9.0 m	kg											*8330	*8330	6.52
(29.5 ft)	lb											*18360	*18360	(21.4)
7.5 m	kg							*8790	7100			*7740	6570	7.82
(24.6 ft)	lb							*19380	15650			*17060	14480	(25.7)
6.0 m	kg					*9680	*9680	*9010	6990			*7570	5410	8.67
(19.7 ft)	lb					*21340	*21340	*19860	15410			*16690	11930	(28.4)
4.5 m	kg			*14200	*14200	*11230	9480	*9750	6710	*8980	4950	*7670	4770	9.19
(14.8 ft)	lb			*31310	*31310	*24760	20900	*21500	14790	*19800	10910	*16910	10520	(30.2)
3.0 m	kg			*18040	13240	*13050	8830	*10700	6380	9070	4800	*8020	4430	9.44
(9.8 ft)	lb			*39770	29190	*28770	19470	*23590	14070	20000	10580	*17680	9770	(31.0)
1.5 m	kg			*18170	12280	*14600	8280	*11580	6070	8900	4650	8260	4310	9.45
(4.9 ft)	lb			*40060	27070	*32190	18250	*25530	13380	19620	10250	18210	9500	(31.0)
0.0 m	kg			*19360	11910	*15470	7950	11500	5860	8780	4540	8490	4400	9.21
(0.0 ft)	lb			*42680	26260	*34110	17530	25350	12920	19360	10010	18720	9700	(30.2)
-1.5 m	kg	*12640	*12640	*20840	11870	*15510	7830	11400	5770			9200	4740	8.70
(-4.9 ft)	lb	*27870	*27870	*45940	26170	*34190	17260	25130	12720			20280	10450	(28.5)
-3.0 m	kg	*20920	*20920	*19230	12040	*14600	7900	*11250	5840			*10440	5500	7.87
(-9.8 ft)	lb	*46120	*46120	*42390	26540	*32190	17420	*24800	12870			*23020	12130	(25.8)
-4.5 m	kg	*21490	*21490	*16120	12430	*12130	8190					*10550	7230	6.60
(-14.8 ft)	lb	*47380	*47380	*35540	27400	*26740	18060					*23260	15940	(21.7)

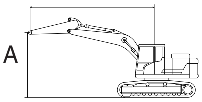
Note
1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

▲ 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	Shoe	Wheel	Dozer		Outrigger	
HX400 NLT3	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6500	3900	7000	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)												At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
																m (ft)
9.0 m	kg													*6170	*6170	7.44
(29.5 ft)	lb													*13600	*13600	(24.4)
7.5 m	kg									*7750	7330			*5790	5680	8.60
(24.6 ft)	lb									*17090	16160			*12760	12520	(28.2)
6.0 m	kg									*8140	7170	*7110	5190	*5670	4790	9.38
(19.7 ft)	lb									*17950	15810	*15670	11440	*12500	10560	(30.8)
4.5 m	kg							*10130	9780	*8980	6870	*8340	5060	*5740	4280	9.86
(14.8 ft)	lb							*22330	21560	*19800	15150	*18390	11160	*12650	9440	(32.4)
3.0 m	kg					*16220	13840	*12080	9090	*10040	6500	*8890	4870	*5970	4000	10.10
(9.8 ft)	lb					*35760	30510	*26630	20040	*22130	14330	*19600	10740	*13160	8820	(33.1)
1.5 m	kg					*19460	12630	*13870	8460	*11070	6150	8940	4680	*6390	3890	10.10
(4.9 ft)	lb					*42900	27840	*30580	18650	*24410	13560	19710	10320	*14090	8580	(33.1)
0.0 m	kg			*7130	*7130	*20850	12000	*15090	8020	11540	5880	8770	4520	*7080	3940	9.88
(0.0 ft)	lb			*15720	*15720	*45970	26460	*33270	17680	25440	12960	19330	9960	*15610	8690	(32.4)
-1.5 m	kg	*7910	*7910	*11810	*11810	*21200	11800	*15530	7800	11370	5730	8690	4450	8160	4190	9.41
(-4.9 ft)	lb	*17440	*17440	*26040	*26040	*46740	26010	*34240	17200	25070	12630	19160	9810	17990	9240	(30.9)
-3.0 m	kg	*12870	*12870	*17720	*17720	*20200	11860	*15100	7780	11360	5720			9250	4740	8.65
(-9.8 ft)	lb	*28370	*28370	*39070	*39070	*44530	26150	*33290	17150	25040	12610			20390	10450	(28.4)
-4.5 m	kg			*24910	24030	*17880	12140	*13490	7960	*10030	5910			*9990	5890	7.52
(-14.8 ft)	lb			*54920	52980	*39420	26760	*29740	17550	*22110	13030			*22020	12990	(24.7)
-6.0 m	kg					*13310	12720							*9880	8890	5.78
(-19.7 ft)	lb					*29340	28040							*21780	19600	(19.0)

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.

⚠ 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.

6. BUCKET SELECTION GUIDE

1) HX400 LT3

(1) 6200 kg counterweight

General bucket

Heavy duty
(with side cutter)

Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO				
						Recommendation mm (ft-in)				
	SAE Heaped	CECE heaped	w/o side cutter			6.15 m (20' 2")	6.50 m (21' 4")			
	m³ (yd³)	m³ (yd³)	mm (in)	kg (lb)	EA	2.55 m (8' 4")	2.55 m (8' 4")	2.80 m (9' 2")	3.20 m (10' 6")	3.90 m (12' 10")
General bucket	1.46 (1.91)	1.28 (1.67)	1305 (51)	1400 (3,090)	4	●	●	●	●	◐
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1500 (3,310)	5	●	●	●	◐	■
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1610 (3,550)	5	●	◐	◐	■	▲
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1690 (3,730)	5	◐	■	■	■	▲
	2.32 (3.03)	2.02 (2.64)	1885 (74)	1800 (3,970)	6	■	■	▲	▲	X
Heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1560 (3,440)	4	●	●	●	●	◐
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1660 (3,660)	5	●	●	●	◐	■
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1790 (3,950)	5	●	◐	■	■	▲
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1880 (4,140)	5	◐	■	■	■	▲
	2.5 (3.27)	2.22 (2.90)	1750 (69)	2020 (4,450)	5	■	▲	▲	▲	X
Rock heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1750 (3,860)	4	●	●	●	●	–
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1850 (4,080)	5	●	●	◐	◐	–
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1990 (4,390)	5	◐	◐	■	■	–
	2.1 (2.75)	1.84 (2.41)	1735 (68)	2090 (4,610)	5	◐	■	■	▲	–

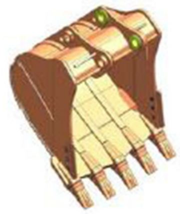
●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
■	Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less
▲	Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less
X	Not recommended
-	Not available

※ 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.

(2) 7000 kg counterweight

General bucket

Heavy duty
(with side cutter)



Rock heavy duty

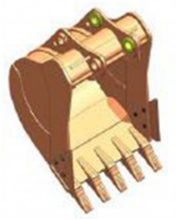
Type	Capacity		Width	Weight	Tooth	MONO				
						Recommendation mm (ft-in)				
	SAE Heaped	CECE heaped	w/o side cutter			6.15 m (20' 2")	6.50 m (21' 4")			
	m³ (yd³)	m³ (yd³)	mm (in)	kg (lb)	EA	2.55 m (8' 4")	2.55 m (8' 4")	2.80 m (9' 2")	3.20 m (10' 6")	3.90 m (12' 10")
General bucket	1.46 (1.91)	1.28 (1.67)	1305 (51)	1400 (3,090)	4	●	●	●	●	●
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1500 (3,310)	5	●	●	●	●	◐
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1610 (3,550)	5	●	●	◐	◐	■
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1690 (3,730)	5	●	◐	■	■	▲
	2.32 (3.03)	2.02 (2.64)	1885 (74)	1800 (3,970)	6	◐	■	■	■	▲
Heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1560 (3,440)	4	●	●	●	●	●
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1660 (3,660)	5	●	●	●	●	◐
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1790 (3,950)	5	●	◐	◐	◐	■
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1880 (4,140)	5	◐	◐	■	■	▲
	2.5 (3.27)	2.22 (2.90)	1750 (69)	2020 (4,450)	5	■	■	▲	▲	X
Rock heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1750 (3,860)	4	●	●	●	●	–
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1850 (4,080)	5	●	●	●	●	–
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1990 (4,390)	5	●	◐	◐	■	–
	2.1 (2.75)	1.84 (2.41)	1735 (68)	2090 (4,610)	5	◐	■	■	■	–

●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
■	Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less
▲	Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less
X	Not recommended
-	Not available

※ 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.

(3) 7500 kg counterweight

General bucket



Heavy duty
(with side cutter)

Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO				
						Recommendation mm (ft-in)				
	SAE Heaped	CECE heaped	w/o side cutter			6.15 m (20' 2")	6.50 m (21' 4")			
	m³ (yd³)	m³ (yd³)	mm (in)	kg (lb)	EA	2.55 m (8' 4")	2.55 m (8' 4")	2.80 m (9' 2")	3.20 m (10' 6")	3.90 m (12' 10")
General bucket	1.46 (1.91)	1.28 (1.67)	1305 (51)	1400 (3,090)	4	●	●	●	●	●
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1500 (3,310)	5	●	●	●	●	◐
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1610 (3,550)	5	●	●	●	◐	■
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1690 (3,730)	5	●	◐	◐	◐	■
	2.32 (3.03)	2.02 (2.64)	1885 (74)	1800 (3,970)	6	◐	■	■	■	▲
Heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1560 (3,440)	4	●	●	●	●	●
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1660 (3,660)	5	●	●	●	●	◐
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1790 (3,950)	5	●	●	◐	◐	■
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1880 (4,140)	5	●	◐	◐	■	▲
	2.5 (3.27)	2.22 (2.90)	1750 (69)	2020 (4,450)	5	■	■	▲	▲	▲
Rock heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1750 (3,860)	4	●	●	●	●	–
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1850 (4,080)	5	●	●	●	●	–
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1990 (4,390)	5	●	◐	◐	◐	–
	2.1 (2.75)	1.84 (2.41)	1735 (68)	2090 (4,610)	5	◐	◐	■	■	–

●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
■	Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less
▲	Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less
X	Not recommended
-	Not available

※ 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.

(4) 8100 kg counterweight

General bucket

Heavy duty
(with side cutter)

Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO				
						Recommendation mm (ft-in)				
	SAE Heaped	CECE heaped	w/o side cutter			6.15 m (20' 2")	6.50 m (21' 4")			
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	kg (lb)	EA	2.55 m (8' 4")	2.55 m (8' 4")	2.80 m (9' 2")	3.20 m (10' 6")	3.90 m (12' 10")
General bucket	1.46 (1.91)	1.28 (1.67)	1305 (51)	1400 (3,090)	4	●	●	●	●	●
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1500 (3,310)	5	●	●	●	●	●
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1610 (3,550)	5	●	●	●	●	◐
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1690 (3,730)	5	●	●	◐	◐	■
	2.32 (3.03)	2.02 (2.64)	1885 (74)	1800 (3,970)	6	◐	◐	■	■	▲
Heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1560 (3,440)	4	●	●	●	●	●
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1660 (3,660)	5	●	●	●	●	●
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1790 (3,950)	5	●	●	●	◐	■
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1880 (4,140)	5	●	◐	◐	◐	■
	2.5 (3.27)	2.22 (2.90)	1750 (69)	2020 (4,450)	5	◐	■	■	■	▲
Rock heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1750 (3,860)	4	●	●	●	●	–
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1850 (4,080)	5	●	●	●	●	–
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1990 (4,390)	5	●	●	●	◐	–
	2.1 (2.75)	1.84 (2.41)	1735 (68)	2090 (4,610)	5	●	◐	◐	■	–

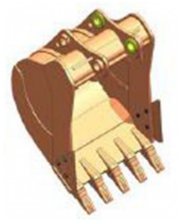
●	Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less
◐	Applicable for materials with density of 1800 kg/m^3 (3000 lb/yd^3) or less
■	Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less
▲	Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3) or less
X	Not recommended
-	Not available

※ 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.

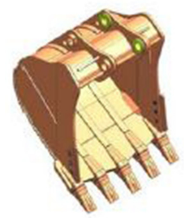
2) HX400 NLT3

(1) 7000 kg counterweight

General bucket



Heavy duty
(with side cutter)



Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO				
						Recommendation mm (ft-in)				
	SAE Heaped	CECE heaped	w/o side cutter			6.15 m (20' 2")	6.50 m (21' 4")			
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	kg (lb)	EA	2.55 m (8' 4")	2.55 m (8' 4")	2.80 m (9' 2")	3.20 m (10' 6")	3.90 m (12' 10")
General bucket	1.46 (1.91)	1.28 (1.67)	1305 (51)	1400 (3,090)	4	●	●	●	●	◐
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1500 (3,310)	5	●	◐	◐	◐	■
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1610 (3,550)	5	◐	■	■	■	▲
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1690 (3,730)	5	■	■	▲	▲	X
	2.32 (3.03)	2.02 (2.64)	1885 (74)	1800 (3,970)	6	■	▲	▲	▲	X
Heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1560 (3,440)	4	●	●	●	◐	■
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1660 (3,660)	5	●	◐	◐	◐	■
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1790 (3,950)	5	◐	■	■	▲	▲
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1880 (4,140)	5	■	▲	▲	▲	X
	2.5 (3.27)	2.22 (2.90)	1750 (69)	2020 (4,450)	5	▲	▲	X	X	X
Rock heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1750 (3,860)	4	●	●	◐	◐	–
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1850 (4,080)	5	●	◐	◐	■	–
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1990 (4,390)	5	◐	■	■	▲	–
	2.1 (2.75)	1.84 (2.41)	1735 (68)	2090 (4,610)	5	■	▲	▲	▲	–

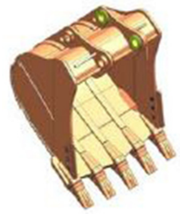
●	Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less
◐	Applicable for materials with density of 1800 kg/m^3 (3000 lb/yd^3) or less
■	Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less
▲	Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3) or less
X	Not recommended
-	Not available

※ 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.

(2) 7500 kg counterweight

General bucket

Heavy duty
(with side cutter)



Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO				
						Recommendation mm (ft-in)				
	SAE Heaped	CECE heaped	w/o side cutter			6.15 m (20' 2")	6.50 m (21' 4")			
	m³ (yd³)	m³ (yd³)	mm (in)	kg (lb)	EA	2.55 m (8' 4")	2.55 m (8' 4")	2.80 m (9' 2")	3.20 m (10' 6")	3.90 m (12' 10")
General bucket	1.46 (1.91)	1.28 (1.67)	1305 (51)	1400 (3,090)	4	●	●	●	●	◐
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1500 (3,310)	5	●	●	◐	◐	■
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1610 (3,550)	5	◐	◐	■	■	▲
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1690 (3,730)	5	◐	■	■	▲	▲
	2.32 (3.03)	2.02 (2.64)	1885 (74)	1800 (3,970)	6	■	▲	▲	▲	X
Heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1560 (3,440)	4	●	●	●	●	◐
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1660 (3,660)	5	●	●	◐	◐	■
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1790 (3,950)	5	◐	■	■	■	▲
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1880 (4,140)	5	■	■	▲	▲	X
	2.5 (3.27)	2.22 (2.90)	1750 (69)	2020 (4,450)	5	▲	▲	▲	X	X
Rock heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1750 (3,860)	4	●	●	●	◐	–
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1850 (4,080)	5	●	◐	◐	◐	–
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1990 (4,390)	5	◐	■	■	■	–
	2.1 (2.75)	1.84 (2.41)	1735 (68)	2090 (4,610)	5	■	■	▲	▲	–

●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
■	Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less
▲	Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less
X	Not recommended
-	Not available

※ 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.

(3) 8100 kg counterweight


General bucket


Heavy duty
(with side cutter)


Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO				
						Recommendation mm (ft-in)				
	SAE Heaped	CECE heaped	w/o side cutter			6.15 m (20' 2")	6.50 m (21' 4")			
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	kg (lb)	EA	2.55 m (8' 4")	2.55 m (8' 4")	2.80 m (9' 2")	3.20 m (10' 6")	3.90 m (12' 10")
General bucket	1.46 (1.91)	1.28 (1.67)	1305 (51)	1400 (3,090)	4	●	●	●	●	◐
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1500 (3,310)	5	●	●	●	●	◐
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1610 (3,550)	5	●	◐	◐	■	■
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1690 (3,730)	5	◐	■	■	■	▲
	2.32 (3.03)	2.02 (2.64)	1885 (74)	1800 (3,970)	6	■	■	▲	▲	X
Heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1560 (3,440)	4	●	●	●	●	◐
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1660 (3,660)	5	●	●	●	◐	■
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1790 (3,950)	5	●	◐	■	■	▲
	2.1 (2.75)	1.84 (2.41)	1735 (68)	1880 (4,140)	5	◐	■	■	■	▲
	2.5 (3.27)	2.22 (2.90)	1750 (69)	2020 (4,450)	5	■	▲	▲	▲	X
Rock heavy duty	1.46 (1.91)	1.28 (1.67)	1305 (51)	1750 (3,860)	4	●	●	●	●	–
	1.62 (2.12)	1.42 (1.86)	1415 (56)	1850 (4,080)	5	●	●	◐	◐	–
	1.9 (2.49)	1.65 (2.16)	1600 (63)	1990 (4,390)	5	◐	◐	■	■	–
	2.1 (2.75)	1.84 (2.41)	1735 (68)	2090 (4,610)	5	◐	■	■	▲	–

●	Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less
◐	Applicable for materials with density of 1800 kg/m^3 (3000 lb/yd^3) or less
■	Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less
▲	Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3) or less
X	Not recommended
-	Not available

※ 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) TYPES OF SHOES

Model	Description	Unit		Triple grouser								Double grouser	
	width	mm	(in)	600	(24)	700	(28)	800	(32)	900	(36)	700	(28)
HX400 LT3	Operating weight	kg	(lb)	38420	84700	38870	85690	39320	86690	39780	87700	38360	84570
	Ground pressure	kgf/cm²	(psi)	0.69	9.80	0.60	8.49	0.53	7.52	0.48	6.77	0.69	9.79
	Overall width	mm	(ft-in)	3180	(10' 5")	3180	(10' 5")	3180	(10' 5")	3180	(10' 5")	3180	(10' 5")
	Link quantity	EA		51		51		51		51		51	
HX400 T3	Operating weight	kg	(lb)	39510	87100							39450	86970
	Ground pressure	kgf/cm²	(psi)	0.71	10.08							0.71	10.06
	Overall width	mm	(ft-in)	3180	(10' 5")							3180	(10' 5")
	Link quantity	EA		51								51	

2) 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

Track shoe	Specification	Category
600 mm triple grouser	Standard	A
700 mm triple grouser	Option	B
800 mm triple grouser	Option	C
900 mm triple grouser	Option	C
600 mm double grouser	Option	C

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
Maker / Model	HD Hyundai Construction Equipment / HE8.9
Type	4-cycle, turbocharged, charge air cooled, electronic controlled diesel engine
Cooling method	Water cooled
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	114 × 145 mm (4.49" × 5.69")
Displacement	8.9 ℓ (543 cu in)
Compression ratio	17.8 : 1
Gross power	280 Hp (209 kW) at 2000 rpm
Net power	275 Hp (205 kW) at 2200 rpm
Max. power	310 Hp (231 kW) at 1700 rpm
Peak Torque	1451 N·m (1070 lbf·ft) at 1400 rpm
Engine oil quantity	30 ℓ (7.9 U.S. gal)
Wet weight	738 kg (1627 lb)
Starter motor	24 V-7.8 kW
Alternator	24 V-95 A

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 185 cc/rev
Maximum pressure	350 kgf/cm² (4980 psi)
Rated oil flow	2 × 315 ℓ/min (83.2 U.S. gpm / 69.3 U.K. gpm)

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm^2 (569 psi)
Rated oil flow	25.5 ℓ/min (6.7 U.S. gpm/5.6 U.K. gpm)

4) MAIN CONTROL VALVE

Item		Specification
Type		9 spools three-block
Operating method		Hydraulic pilot system
Main relief valve pressure		350 kgf/cm^2 (4980 psi)
Port relief valve pressure	Boom	400 kgf/cm^2 (5690 psi)
	Arm	400 kgf/cm^2 (5690 psi)
	Bucket	400 kgf/cm^2 (5690 psi)

5) SWING MOTOR

Item		Specification
Type		Two fixed displacement axial piston motor
Capacity		240 cc/rev
Relief pressure		290 kgf/cm^2 (4125 psi)
Braking system		Automatic, spring applied hydraulic released
Braking torque		137 kgf · m (991 lbf · ft) over
Brake release pressure	Cracking	9 kgf/cm^2 (128 psi)
	Full stroke	26 kgf/cm^2 (370 psi)
Reduction gear type		2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Capacity	185/114 cc/rev
Relief pressure	350 kgf/cm^2 (4980 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	57.1 kgf · m (413 lbf · ft)
Brake release pressure	10.6 kgf/cm^2 (150 psi)
Reduction gear type	2-stage planetary

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Stroke	Ø160 × 1500 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Stroke	Ø170 × 1750 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Stroke	Ø150 × 1285 mm
	Cushion	Extend only

※ 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	30 (7.9)	★SAE 0W-30 SAE 5W-30 SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	7.4 (1.96)	★SAE 75W-90
Final drive	Gear oil	5.5×2 (1.45×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank 210 (55.3) System 414 (109)	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	600 (159)	★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★1	33 (8.7)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

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 : Soft water
City water or distilled water

※ **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.**

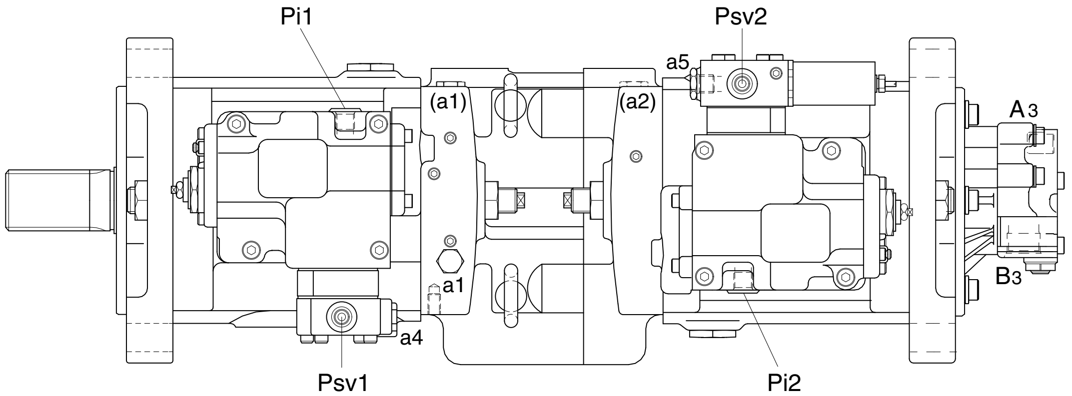
※ **For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact your local HD Hyundai Construction Equipment dealer.**

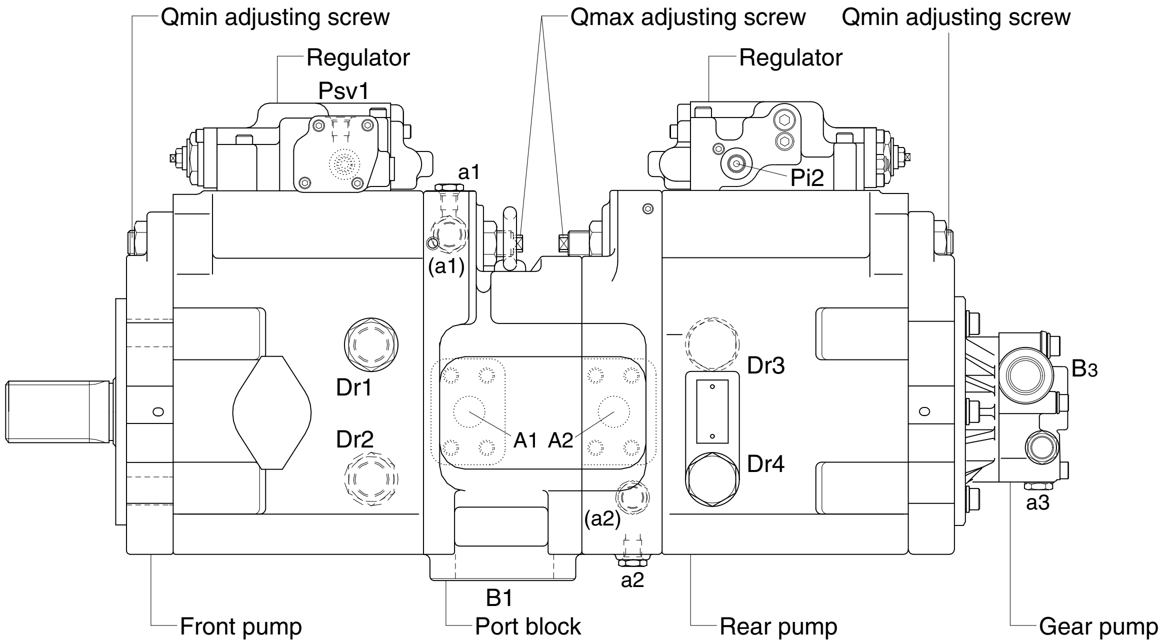
SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

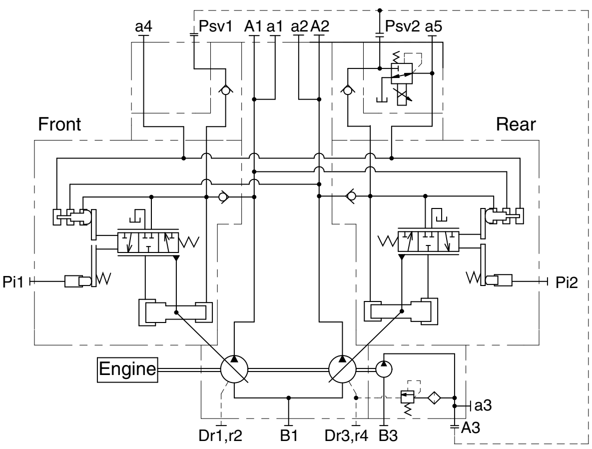
1. STRUCTURE

The pump device consists of main pump, regulator and gear pump.





Port	Port name	Port size
A1, 2	Delivery port	SAE 6000 psi 1"
B1	Suction port	SAE 2500 psi 3"
Dr	Drain port	PF 3/4 - 23
Pi1, i2	Pilot port	PF 1/4 - 15
Psv1, sv2	Servo assist port	PF 1/4 - 15
a1, 2, 4, 5	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4 - 14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

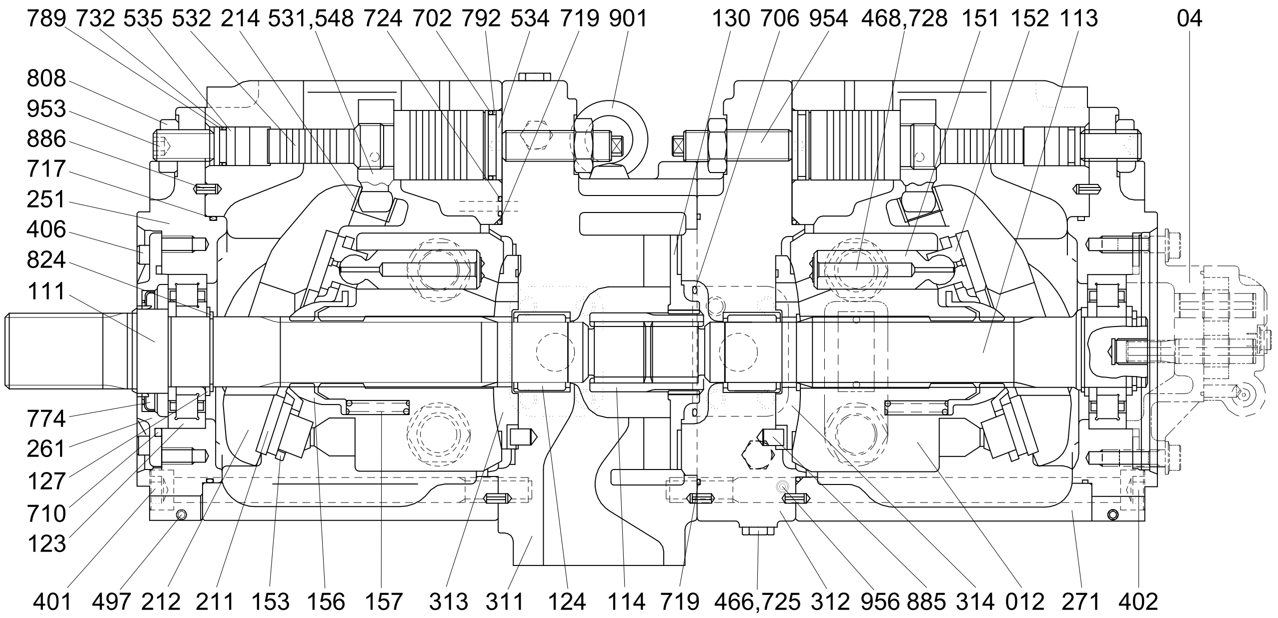


Hydraulic circuit

400SA2MP01

1) MAIN PUMP (1/2)

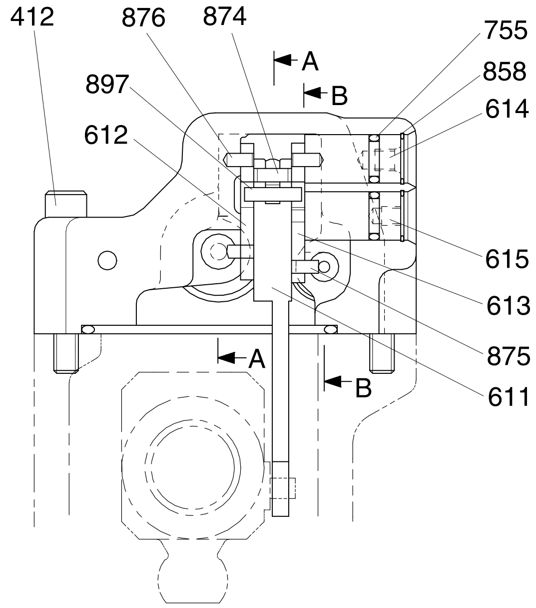
The main pump consists of two piston pumps (front & rear) and valve cover.

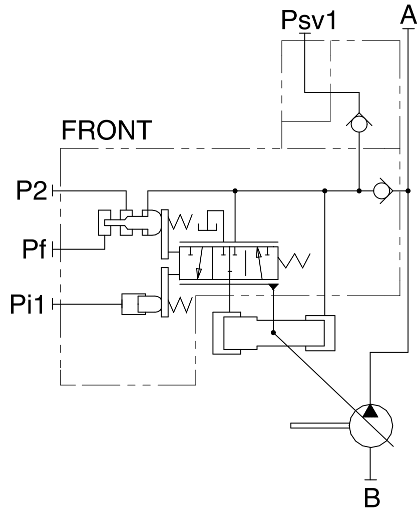


400SA2MP02

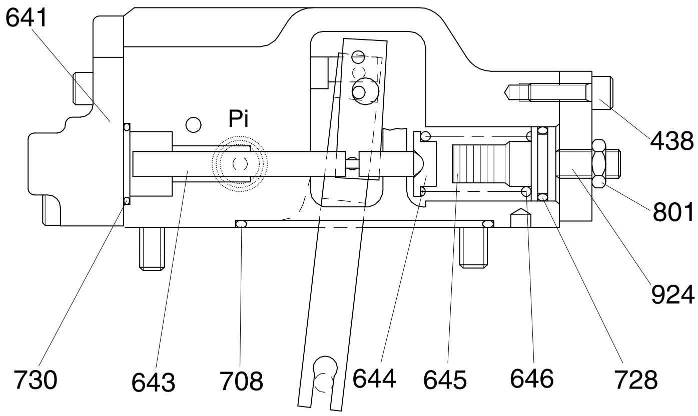
04	Gear pump
111	Drive shaft (F)
113	Drive shaft (R)
114	Spline coupling
123	Roller bearing
124	Needle bearing
127	Bearing spacer
130	Booster
012	Cylinder block
151	Piston
152	Shoe
153	Set plate
156	Bushing
157	Cylinder spring
211	Shoe plate
212	Swash plate
214	Bushing
251	Support plate
261	Seal cover (F)
271	Pump casing
311	Valve cover (F)
312	Valve cover (R)
313	Valve plate (R)
314	Valve plate (L)
401	Hexagon socket bolt
402	Hexagon socket bolt
406	Hexagon socket bolt
466	Plug
468	Plug
497	MH Plug
531	Tilting pin
532	Servo piston
534	Stopper (L)
535	Stopper (S)
548	Feedback pin
702	O-ring
706	O-ring
710	O-ring
717	O-ring
719	O-ring
724	Square ring
725	O-ring
728	O-ring
732	O-ring
774	Oil seal
789	Back up ring
792	Back up ring
808	Hexagon head nut
824	Snap ring
885	Pin
886	Spring pin
901	Eye bolt
953	Set screw
954	Set screw
956	Set screw

2) FRONT REGULATOR (1/2)

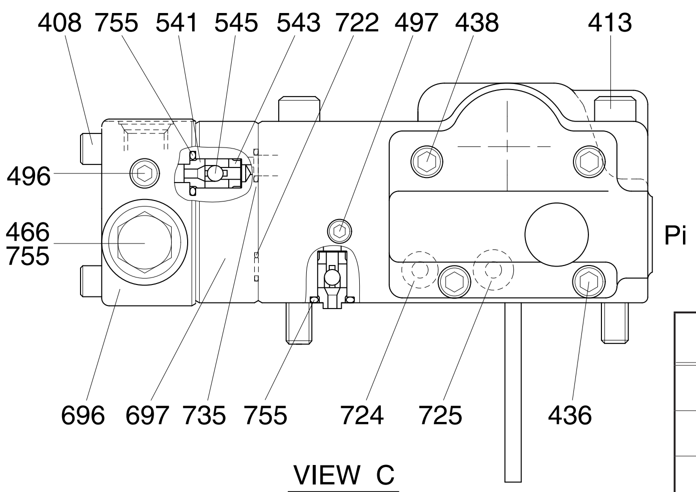




Hydraulic circuit



SECTION B-B

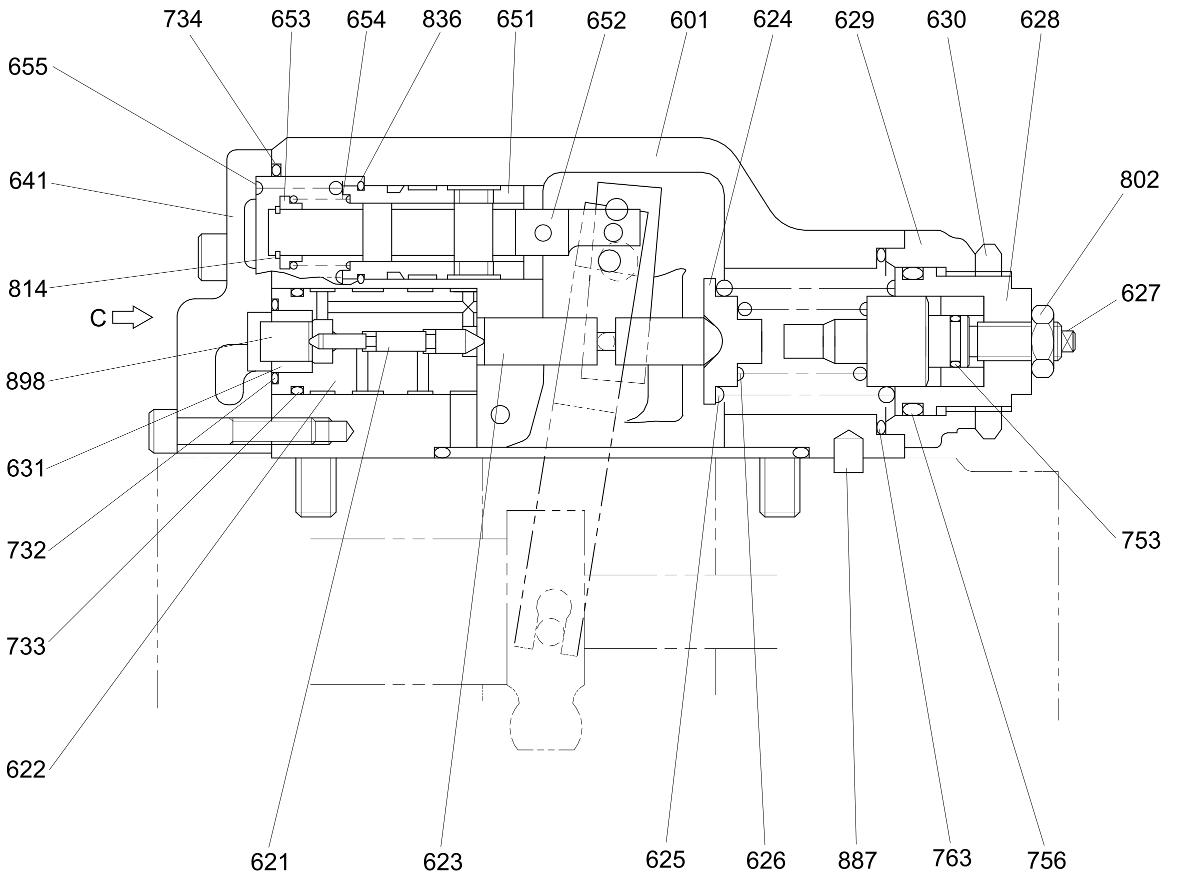


VIEW C

400SA2RG01

Port	Port name	Port size
Pi1	Pilot port	PF 1/4-15
Psv1	Servo assist port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

FRONT REGULATOR (2/2)

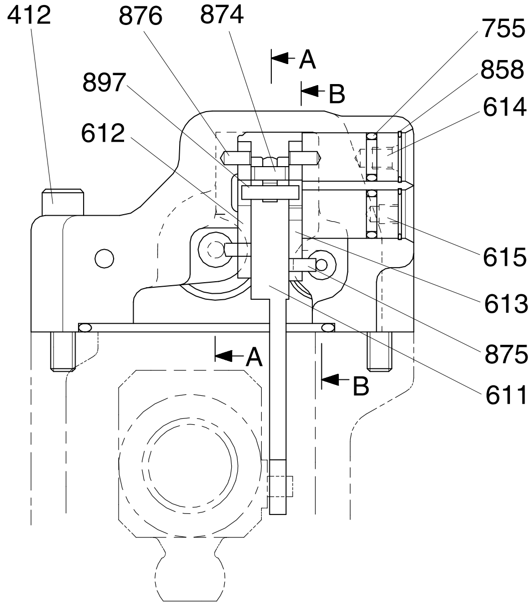


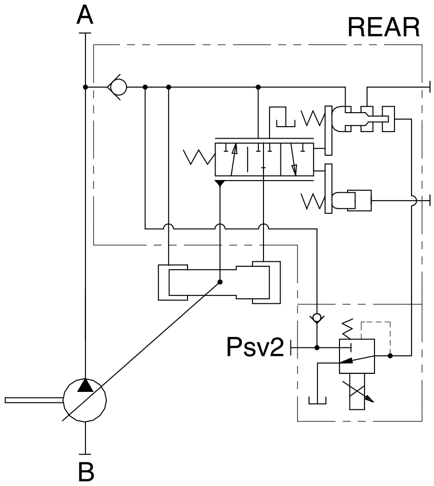
SECTION A-A

400SA2RG03

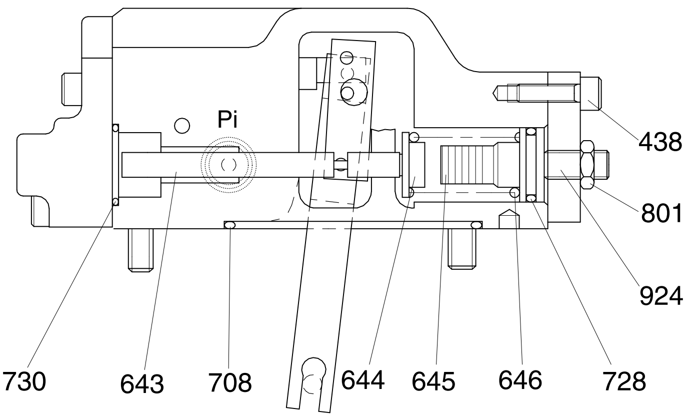
408 Hexagon socket bolt
412 Hexagon socket bolt
413 Hexagon socket bolt
436 Hexagon socket bolt
438 Hexagon socket bolt
466 Plug
496 Plug
497 Plug
541 Seat
543 Stopper
545 Steel ball
601 Casing
611 Feedback lever
612 Lever(1)
613 Lever(2)
614 Center plug
615 Adjust plug
621 Compensator piston
622 Piston case
623 Compensator rod
624 Spring seat (C)
625 Outer spring
626 Inner spring
627 Adjust stem (C)
628 Adjust screw (C)
629 Cover (C)
630 Lock nut
631 Sleeve, pf
641 Pilot cover
643 Pilot piston
644 Spring seat (Q)
645 Adjust stem (Q)
646 Pilot spring
651 Sleeve
652 Spool
653 Spring seat
654 Return spring
655 Set spring
696 Port cover
697 Check valve plate
708 O-ring
722 O-ring
724 Square ring
725 O-ring
728 O-ring
730 O-ring
732 O-ring
733 O-ring
734 O-ring
735 O-ring
753 O-ring
755 O-ring
756 O-ring
763 O-ring
801 Hexagon nut
802 Hexagon nut
814 Snap ring
836 Stop ring
858 Snap ring
874 Pin
875 Pin
876 Pin
887 Pin
897 Pin
898 Pin
924 Set screw

3) REAR REGULATOR (1/2)

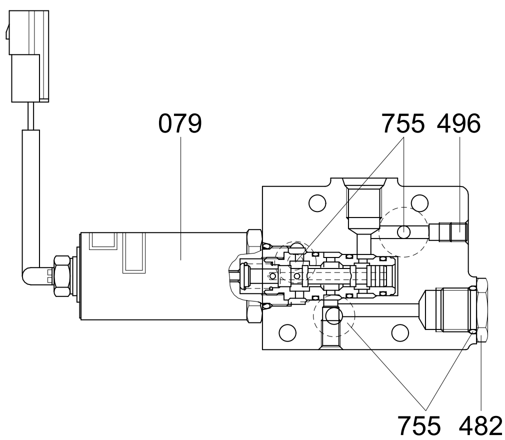




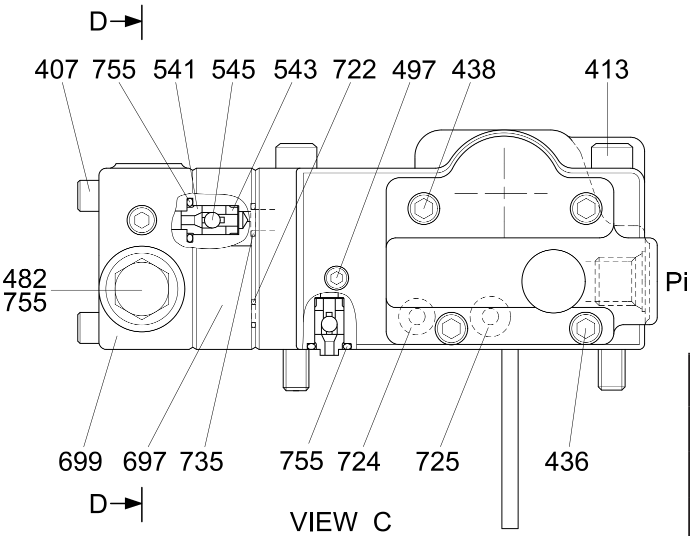
Hydraulic circuit



SECTION B-B



SECTION D-D

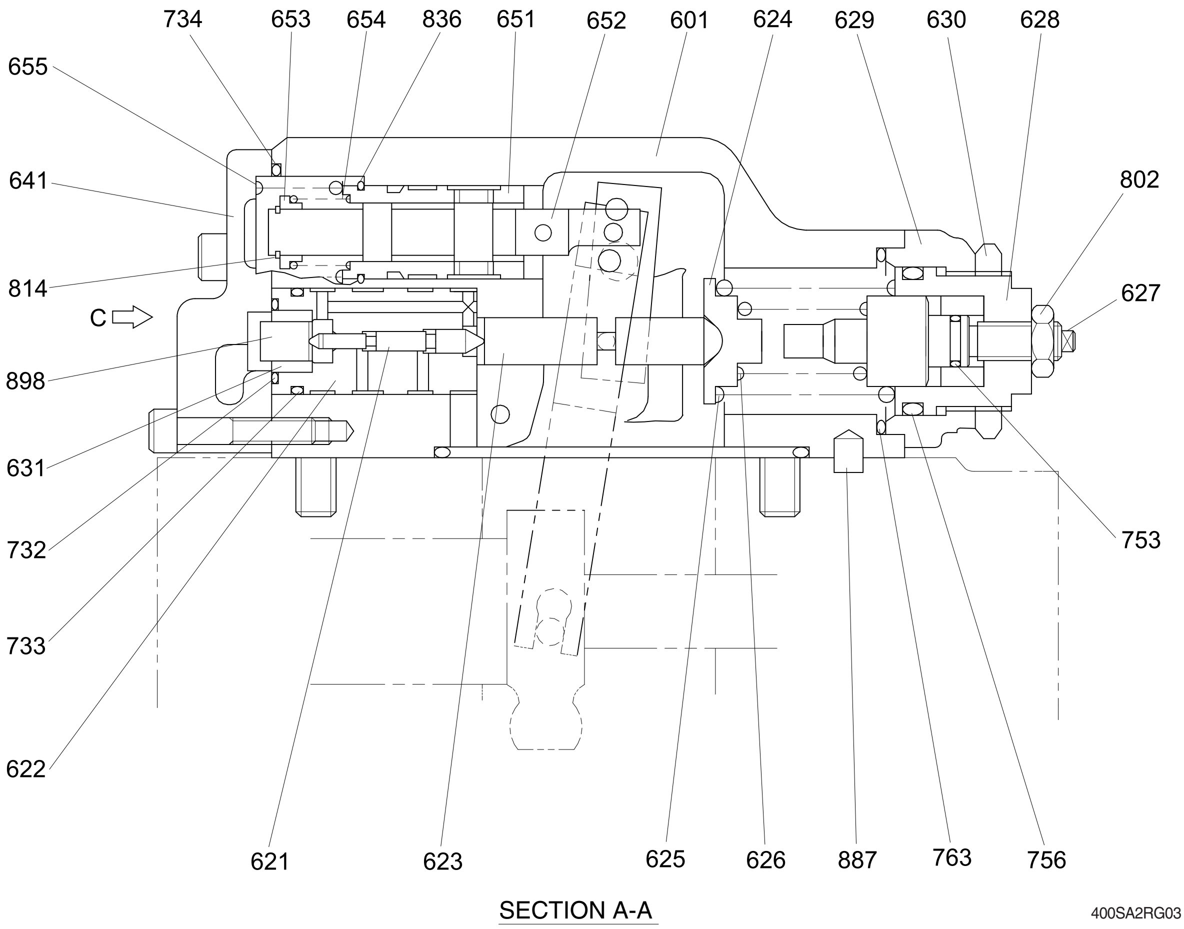


VIEW C

400SA2RG02

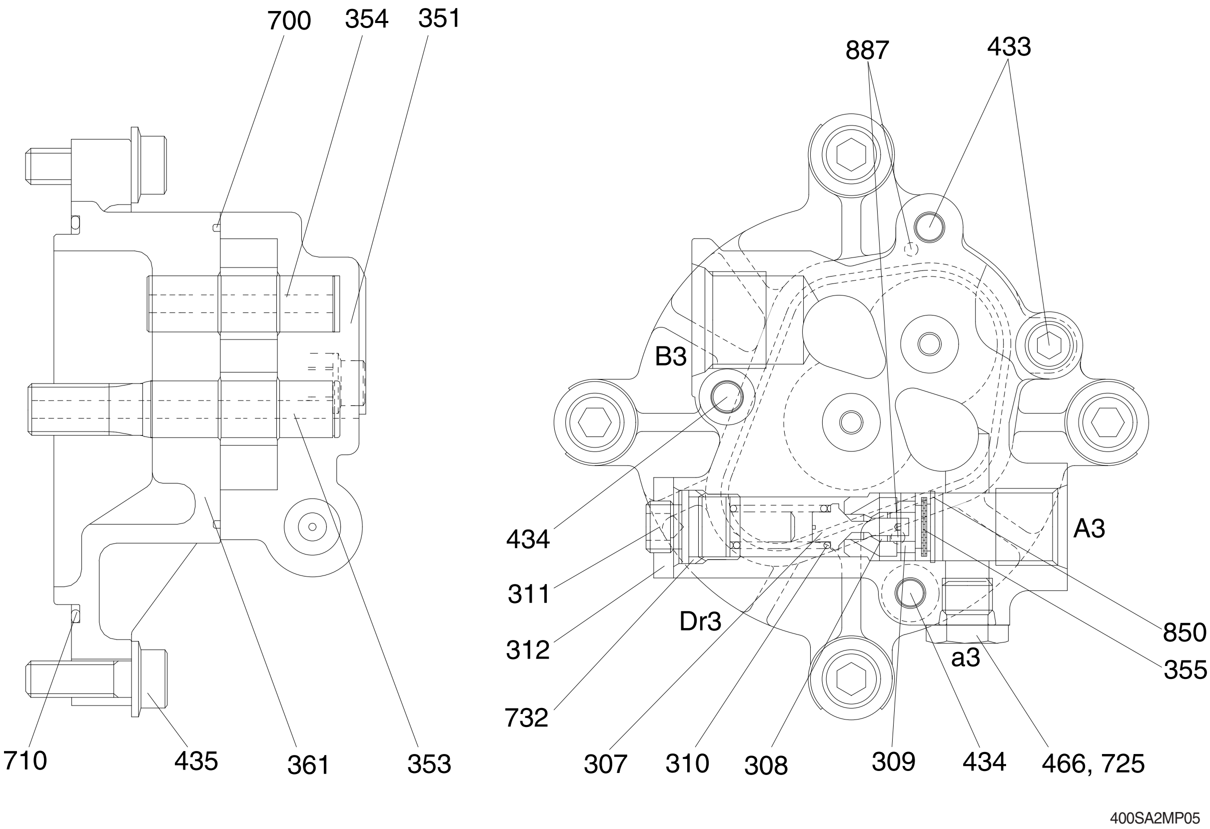
Port	Port name	Port size
Pi1	Pilot port	PF 1/4-15
Psv1	Servo assist port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

REAR REGULATOR (2/2)



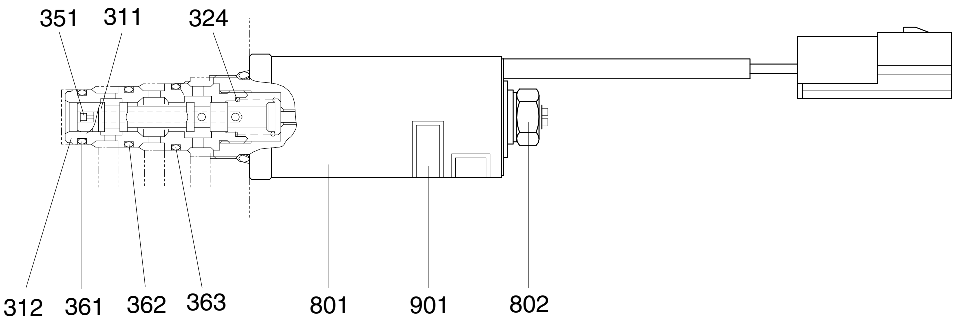
407	Hexagon socket bolt	626	Inner spring	728	O-ring
412	Hexagon socket bolt	627	Adjust stem (C)	730	O-ring
413	Hexagon socket bolt	628	Adjust screw (C)	732	O-ring
436	Hexagon socket bolt	629	Cover (C)	733	O-ring
438	Hexagon socket bolt	630	Lock nut	734	O-ring
482	Plug	631	Sleeve, pf	735	O-ring
496	Plug	641	Pilot cover	753	O-ring
497	Plug	643	Pilot piston	755	O-ring
541	Seat	644	Spring seat (Q)	756	O-ring
543	Stopper	645	Adjust stem (Q)	763	O-ring
545	Steel ball	646	Pilot spring	801	Hexagon nut
601	Casing	651	Sleeve	802	Hexagon nut
611	Feedback lever	652	Spool	814	Snap ring
612	Lever(1)	653	Spring seat	836	Stop ring
613	Lever(2)	654	Return spring	858	Snap ring
614	Center plug	655	Set spring	874	Pin
615	Adjust plug	697	Check valve plate	875	Pin
621	Compensator piston	699	Valve casing	876	Pin
622	Piston case	708	O-ring	887	Pin
623	Compensator rod	722	O-ring	897	Pin
624	Spring seat (C)	724	Square ring	898	Pin
625	Outer spring	725	O-ring	924	Set screw

4) GEAR PUMP



307	Poppet	353	Drive gear	466	Plug
308	Seat	354	Driven gear	700	Ring
309	Ring	355	Filter	710	O-ring
310	Spring	361	Front case	725	O-ring
311	Screw	433	Flange socket	732	O-ring
312	Nut	434	Flange socket	850	Snap ring
351	Gear case	435	Flange socket	887	Pin

5) EPPR VALVE ASSY



311	Spool	361	O-ring	802	Hexagon nut
312	Sleeve	362	O-ring	901	Name plate
324	Spring	363	O-ring		
351	Orifice	801	Solenoid		

2. FUNCTION

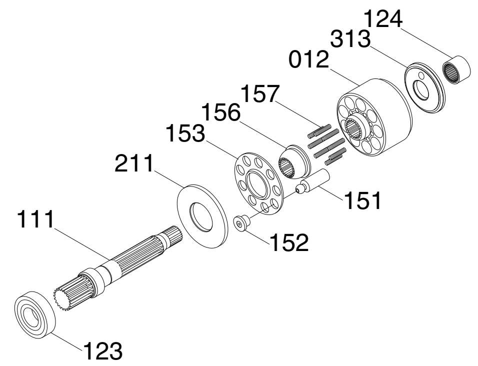
1) MAIN PUMP

The pumps may classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

(1) Rotary group

The rotary group consists of drive shaft (F)(111), cylinder block (012), piston shoes (151,152), set plate (153), spherical bush (156) and cylinder spring (157). The drive shaft is supported by bearing (123,124) at its both ends.

The shoe is caulked to the piston to from a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and the take hydraulic balance so that it slides lightly over the shoe plate (211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush. Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.



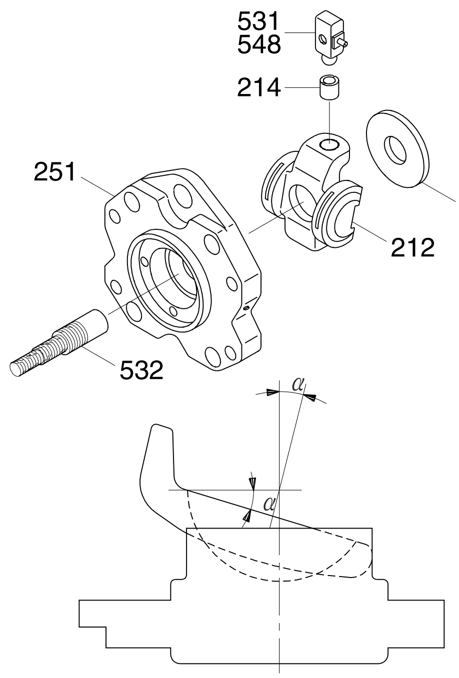
32092MP03

(2) Swash plate group

The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

If the servo piston moves to the right and left as hydraulic force controlled by the regulator is admitted to hydraulic chamber located on both sides of the servo piston, the swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle (α)



3607A2MP10

(3) Valve block group

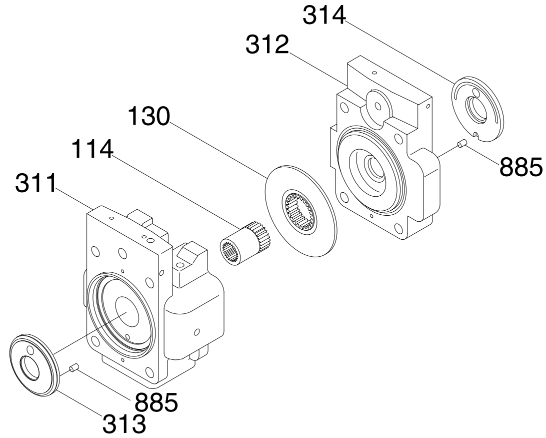
The valve block group consists of valve cover (F, 311), valve cover (F, 312), valve plate (313, 314), spline coupling (114), booster (130) and valve plate pin (885).

The valve plate having two melon-shaped ports is fixed to the valve block and feeds and collects oil to and from the cylinder block.

The oil changed over by the valve plate is connected to an external pipeline by way of the valve block.

Now, if the drive shaft is driven by a prime mover (electric motor, engine, etc), it rotates the cylinder block via a spline linkage at the same time. If the swash plate is tilted as in Fig (previous page) the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block.

If you pay attention to a single piston, it performs a motion away from the valve plate (oil sucking process) within 180 degrees, and makes a motion towards the valve plate (or oil discharging process) in the rest of 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.



38092MP04

2) REGULATOR

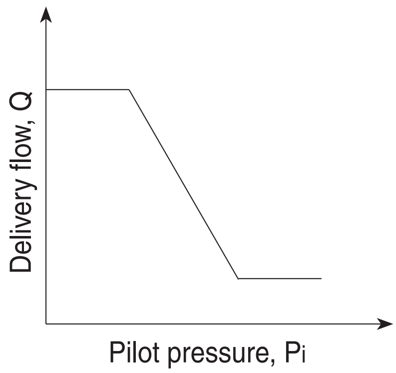
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

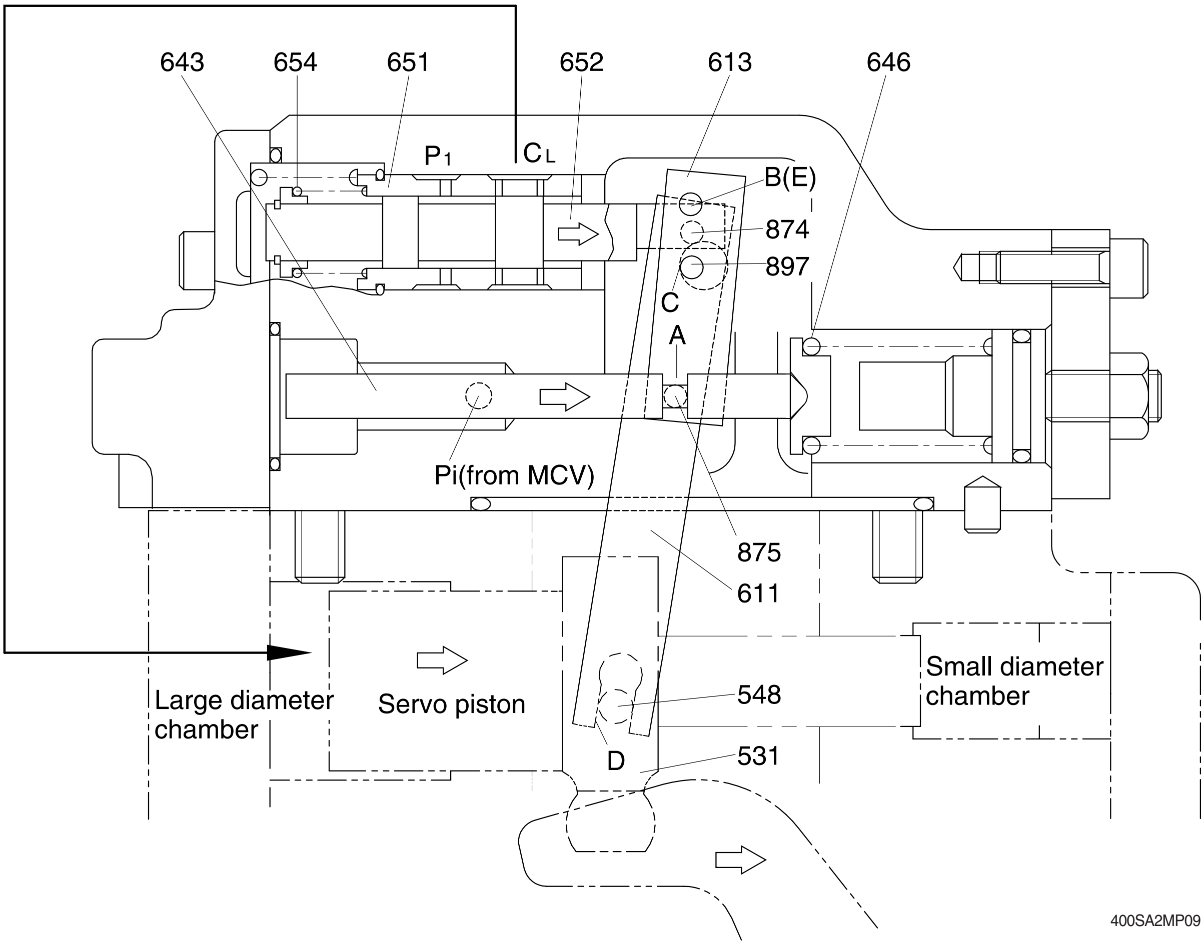
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

This regulator is of the negative flow control in which the delivery flow Q decreases as the pilot pressure Pi rises.

With this mechanism, when the pilot pressure corresponding to the flow required for the work is commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.



① Flow reducing function



As the pilot pressure Pi rises, the pilot piston (643) moves to the right to a position where the force of the pilot spring (646) balances with the hydraulic force.

The groove (A) in the pilot piston is fitted with the pin (875) that is fixed to lever 2 (613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B [Fixed by the fulcrum plug (614) and pin (875)]. Since the large hole section (C) of lever 2 contains a protruding pin (897) fixed to the feedback lever (611), the pin (897) moves to the right as lever 2 rotates. Since the opposing-flat section (D) of the feedback lever is fitted with the pin (548) fixed by the tilting pin (531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin (897) moves.

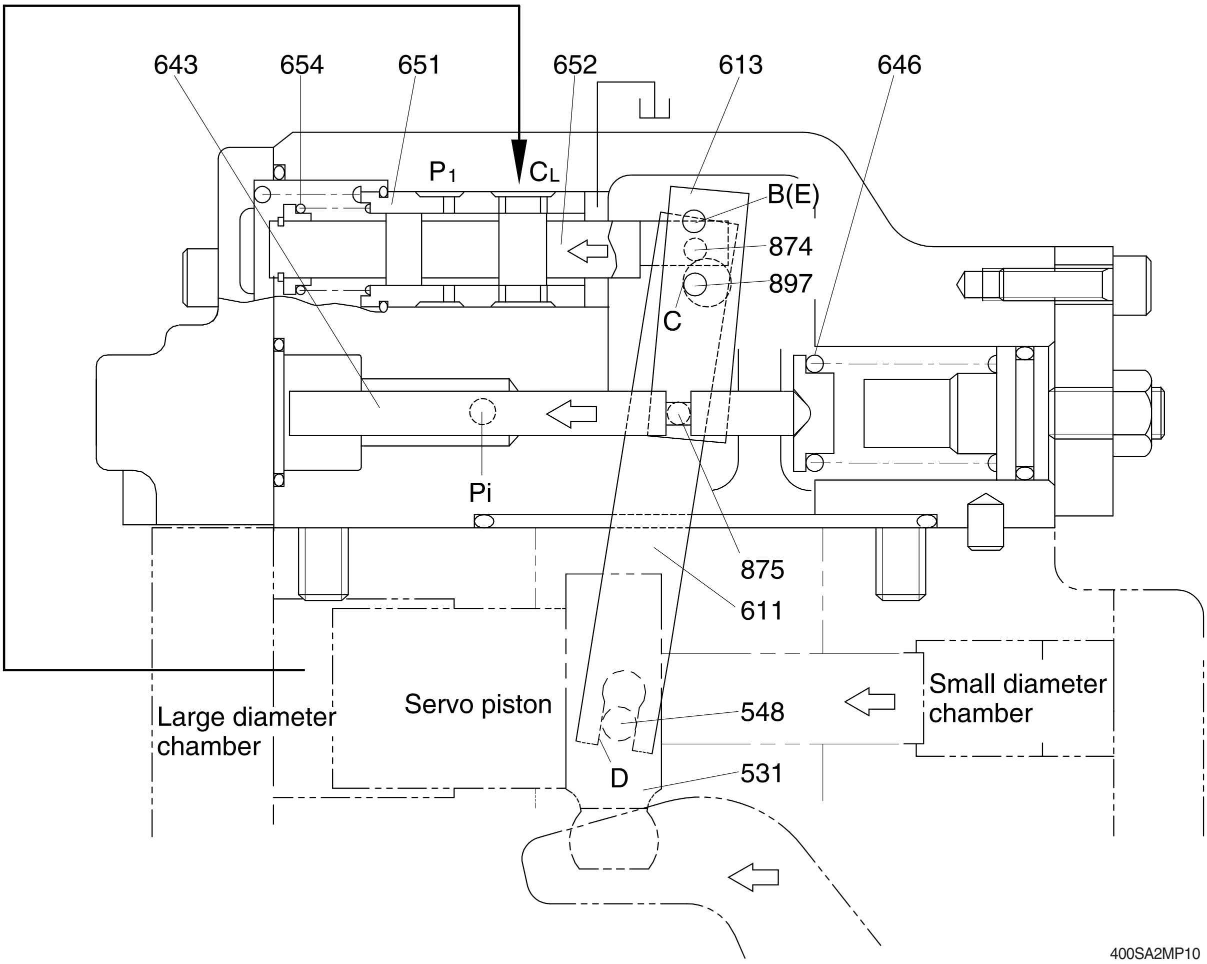
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

The movement of the spool causes the delivery pressure P1 to connect to port CL through the spool and to be admitted to the large diameter section of the servo piston. The delivery pressure P1 that is constantly admitted to the small diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.

When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring (654) and is tensioned to the left at all times, and so the pin (897) is pressed against the large hole section (C) of lever 2.

Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve (651) and spool (652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

② Flow increasing function



As the pilot pressure Pi decreases, the pilot piston (643) moves to the left by the action of the pilot spring (646) and causes lever 2 (613) to rotate around the fulcrum of point B. Since the pin (897) is pressed against the large hole section (C) of lever 2 by the action of the return spring (654) via the spool (652), pin (874), and feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 2 rotates, and shifts the spool to the left. Port CL opens a way to the tank port as the spool moves. This deprives the large diameter section of the servo piston of pressure, and shifts the servo piston to the left by the discharge pressure P1 in the small diameter section, resulting in an increase in the flow rate.

As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

③ Adjustment of flow control characteristic

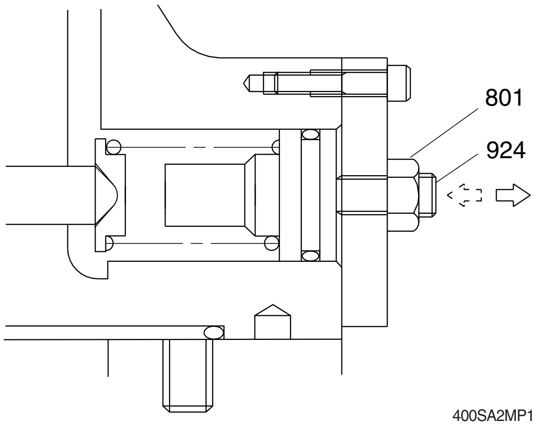
The flow control characteristic can be adjusted with the adjusting screw.

Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

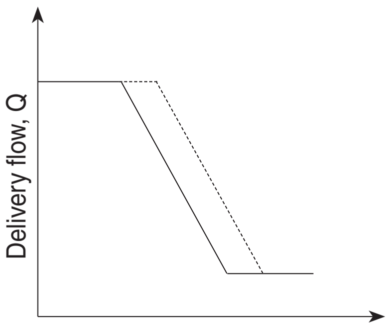
Tightening the screw shifts the control chart to the right as shown in the figure.

※ Adjusting values are shown in table.

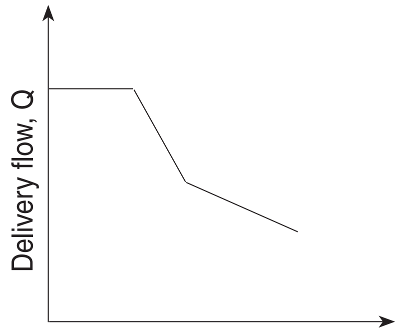
Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(ℓ /min)
1800	+1/4	+1.0	+18.9



400SA2MP11



(2) Total horsepower control



The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.

(The input horsepower is constant when the speed is constant.)

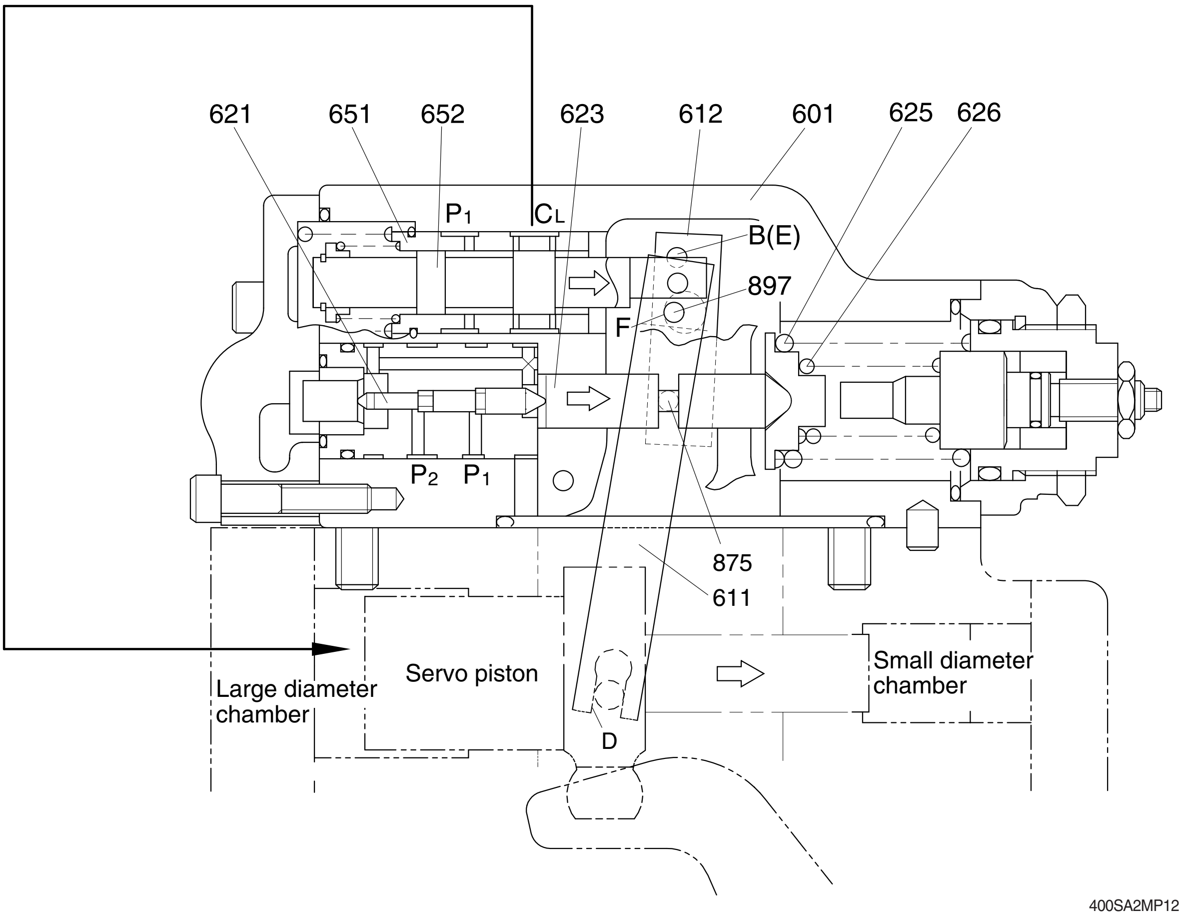
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.

Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation :

$$Tin = P1 \times q / 2\pi + P2 \times q / 2\pi$$
$$= (P1+P2) \times q / 2\pi$$

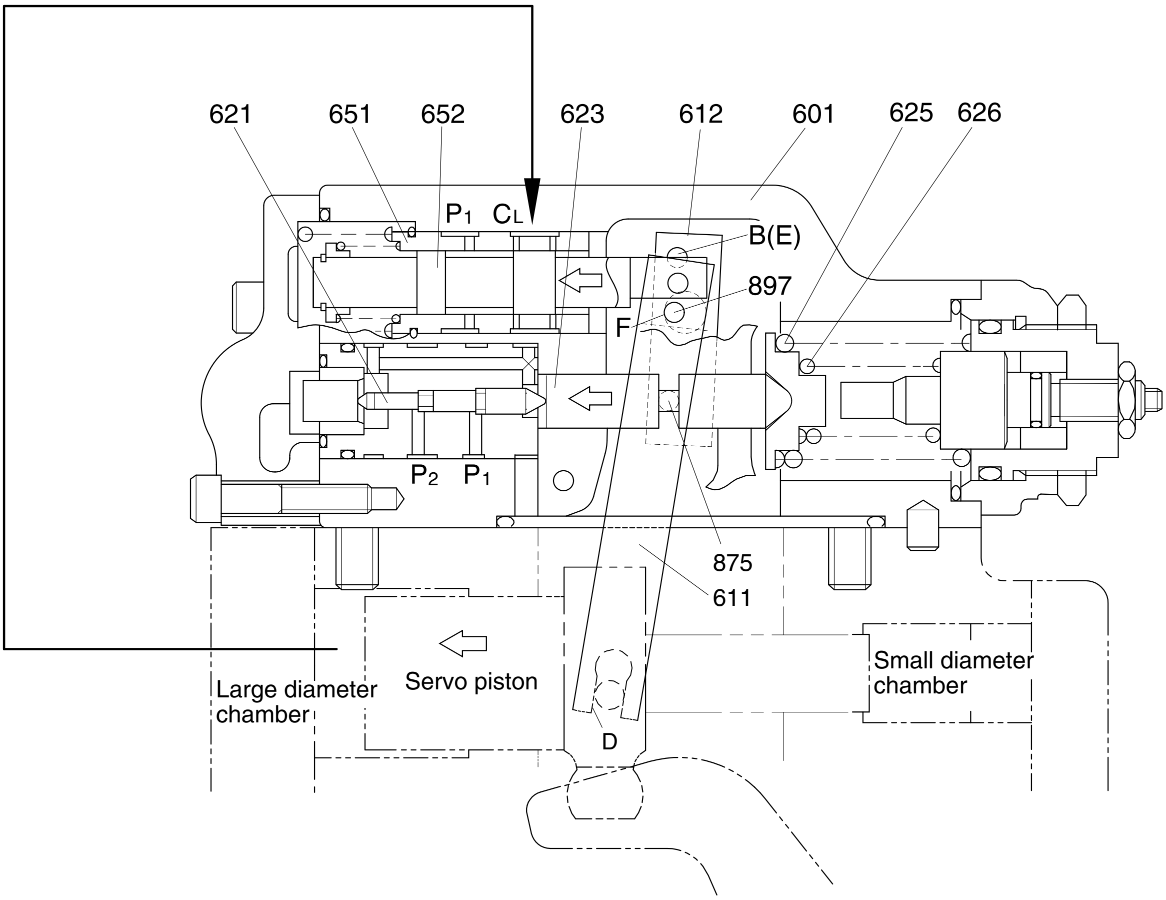
The horsepower control function is the same as the flow control function and is summarized in the following. (for detailed behaviors of respective parts, refer to the section of flow control).

① Overload preventive function



When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force. The movement of the compensating rod is transmitted to lever 1 via pin (875).
Lever 1 rotates around the pin (875) (E) fixed to the casing (601).
Since the large hole section (F) of lever 1 contains a protruding pin (897) fixed to the feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 1 rotates, and then the spool (652) is shifted to the right. As the spool moves, the delivery pressure P1 is admitted to the large diameter section of the servo piston via port CL, causes the servo piston move to the right, reduces the pump delivery flow rate, and prevents the prime mover from being overloaded.
The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool (652) and sleeve (651) is closed.

② Flow reset function



As the self pump delivery pressure P1 or the companion pump delivery pressure P2 decreases, the compensating rod (623) is pushed back by the action of the springs (625 & 626) to rotate lever 1 (612) around point E. Rotating of lever 1 causes the feedback lever (611) to rotate around the fulcrum of point D and then the spool (652) to move to the left. As a result, port CL opens a way to the tank port.

This causes the servo piston to move to the left and the pump's delivery rate to increase.

The movement of the servo piston is transmitted to the spool by the action of the feedback mechanism to move it till the opening between the spool and sleeve is closed.

③ **Low tilting angle (low flow) command preferential function**

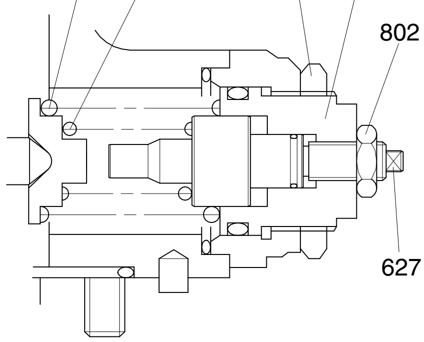
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (Ø4) protruding from the large hole (Ø8), only the lever lessening the tilting angle contacts the pin (897) ; the hole (Ø8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

④ **Adjustment of input horsepower**

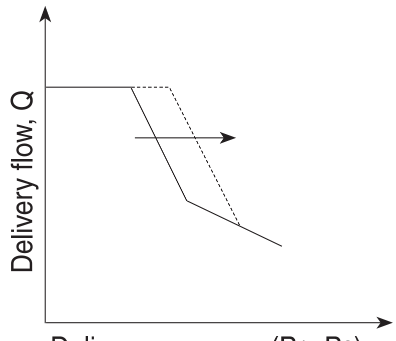
Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one pump is loaded.

a. **Adjustment of outer spring**

Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting screw QI (627) by N×A turns at first. (A=1.48)



400SA2MP14



※ **Adjusting values are shown in table.**

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw (C) (628)	Compensating control starting pressure change amount	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
1800	+1/4	+15.9	+6.6

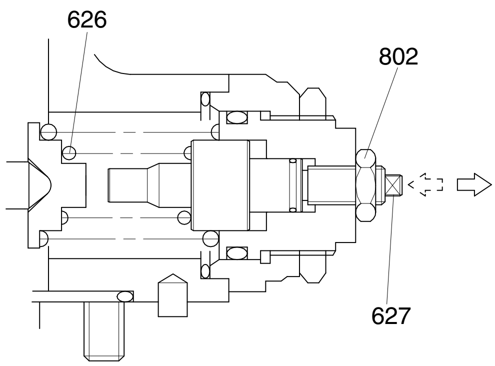
b. Adjustment of inner spring

Adjust it by loosening the hexagon nut (802) and by tightening (or loosening) the adjusting screw QI (627).

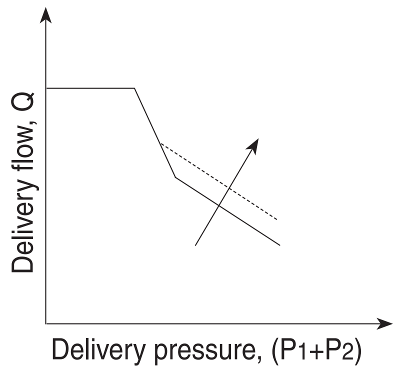
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valves are shown in table.

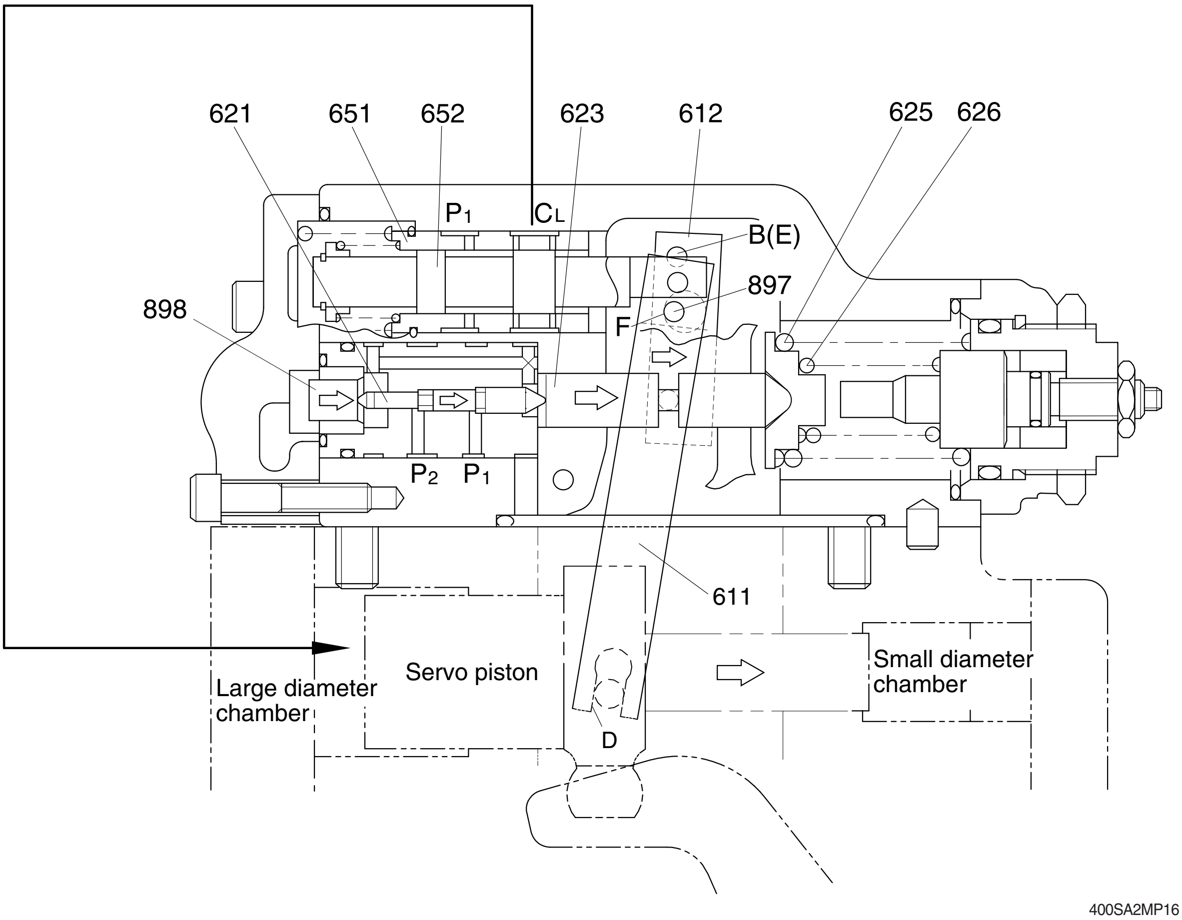
Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw (QI) (627)	Flow change amount	Input torque change amount
(min $^{-1}$)	(Turn)	(lpm)	(kgf · m)
1800	+1/4	+17.4	+7.7

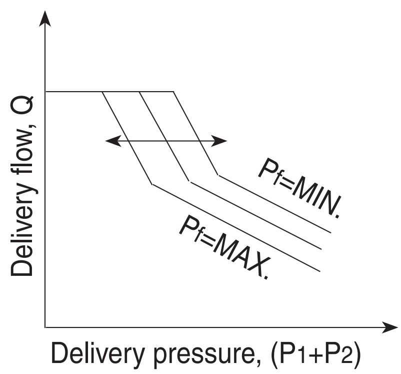


400SA2MP15



(3) Power shift control





The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided.

However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level.

This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.

The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.

As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).

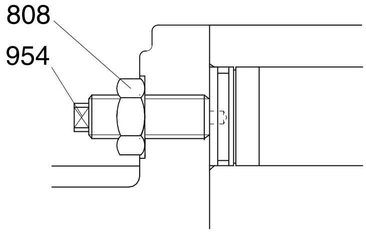
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

① **Adjustment of maximum flow**

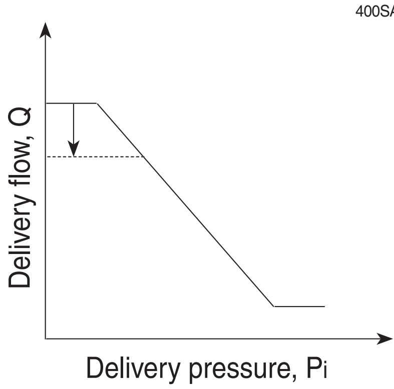
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

The maximum flow only is adjusted without changing other control characteristics.



400SA2MP17

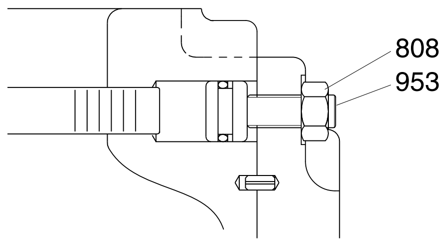
Speed	Adjustment of max flow spring	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(ℓ/min)
1800	+1/4	-6.9



② **Adjustment of minimum flow**

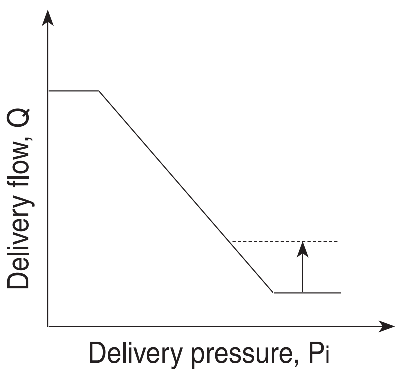
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

However, remember that, if tightened too much, the required horsepower during the maximum delivery pressure (or during relieving) may increase.

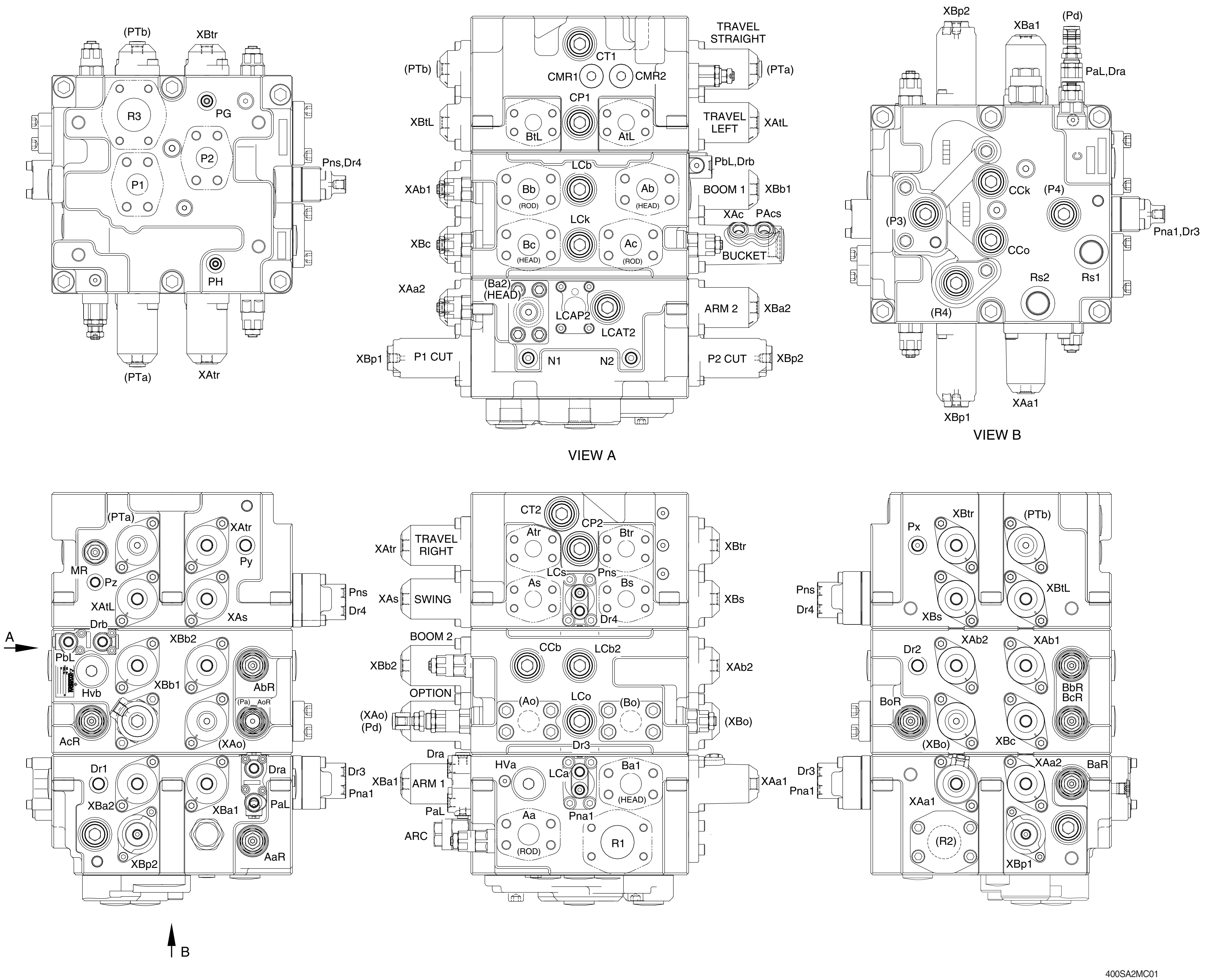


400SA2MP18

Speed	Adjustment of min flow spring	
	Tightening amount of adjusting screw (953)	Flow change amount
(min^{-1})	(Turn)	(ℓ/min)
1800	+1/4	+6.9

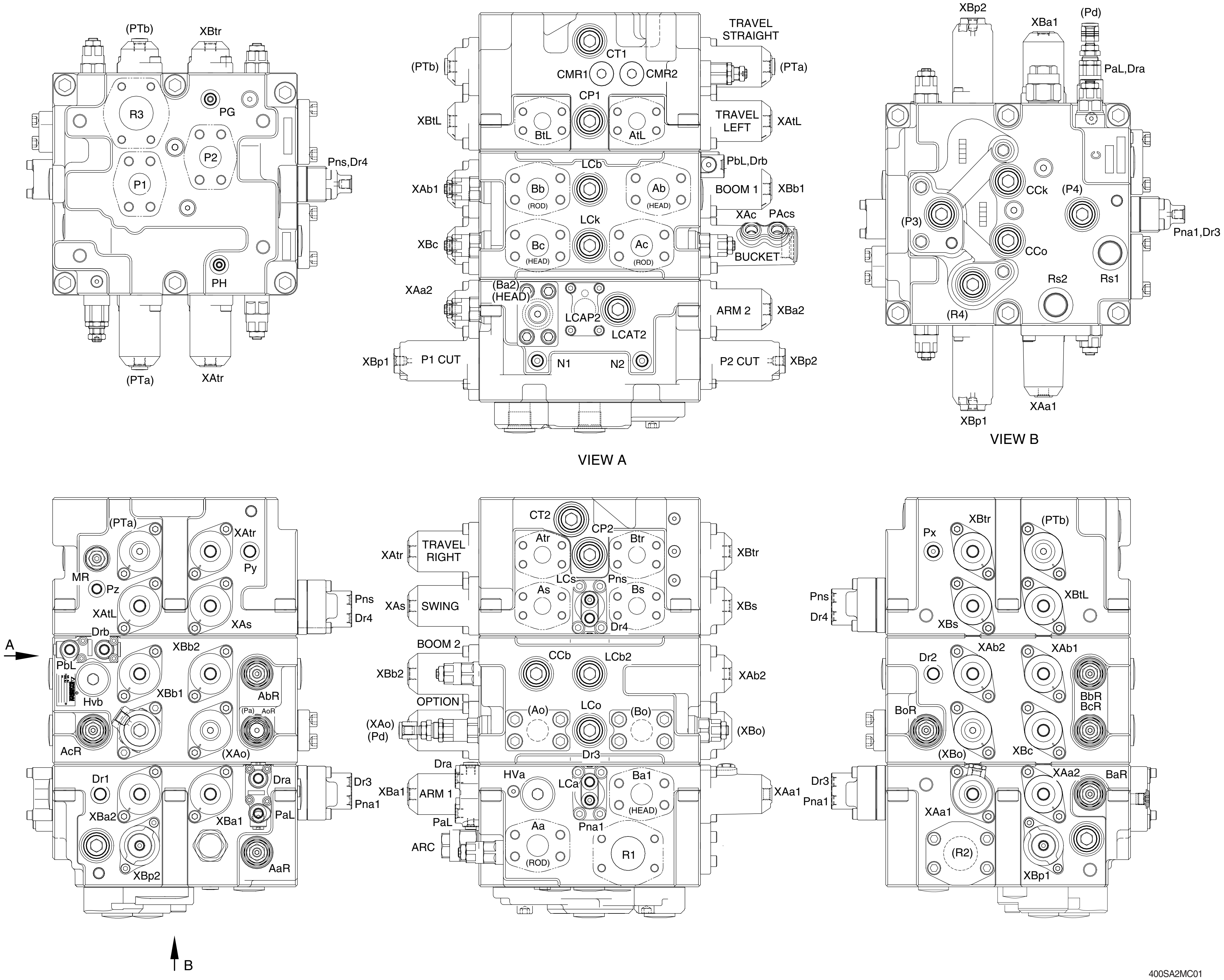


1. STRUCTURE (1/2)



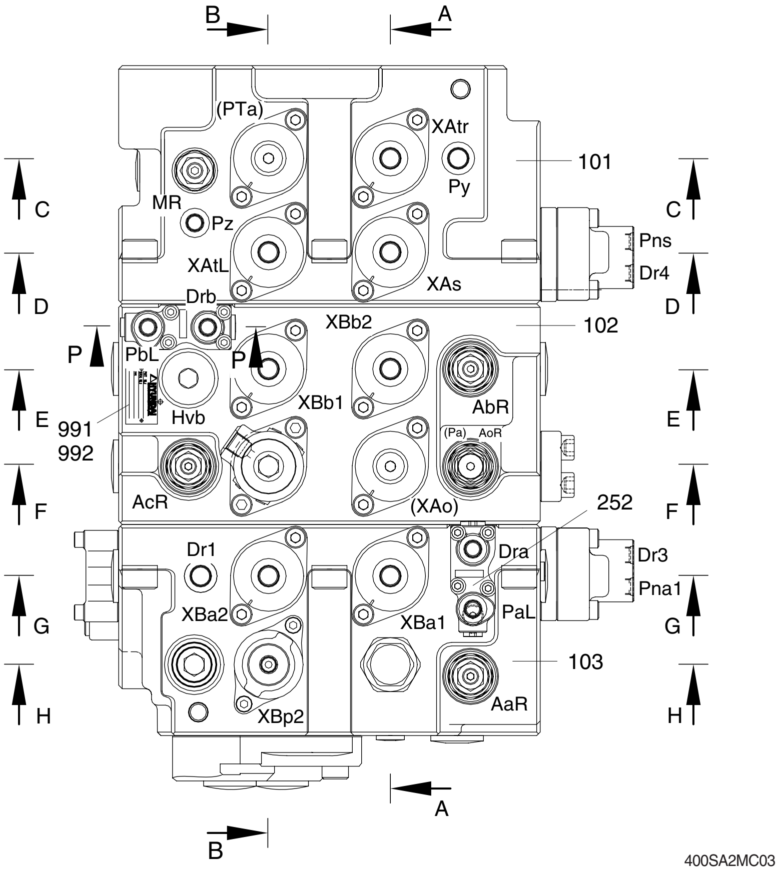
Mark	Port name	Port size	Tightening torque
(P3)	-	PF1	20.4~25.5 kgf · m (148~184 lbf · ft)
(P4)	-		
(R4)	-		
Rs1	Make up port		
Rs2	Make up port		
XAtr	Travel left (forward) pilot port	PF3/8	7.0~8.0 kgf · m (50.6~57.9 lbf · ft)
XBtr	Travel left (reverse) pilot port		
(XAo)	Optional pilot port		
(XBo)	Optional pilot port		
XAc	Bucket out pilot port		
XBc	Bucket in pilot port		
XAb1	Boom up pilot port		
XBb1	Boom down pilot port		
XAb2	Boom up pilot port		
XBb2	Boom down pilot port		
XAa2	Arm out confluence pilot port		
XBa2	Arm in confluence pilot port		
XAtL	Travel right (forward) pilot port		
XBtL	Travel right (reverse) pilot port		
XAs	Swing right pilot port		
XBs	Swing left pilot port		
XAa1	Arm out pilot port		
XBa1	Arm in pilot port		
Dr1	Drain port		
Dr2	Drain port		
(PTa)	-		
(PTb)	-		
PAcs	Bucket in stroke limit pilot port		
N1	Nega-con pressure pilot port (P1 side)		
N2	Nega-con pressure pilot port (P2 side)		
PG	Pilot port		
PH	Pilot port		
Px	Pressure port for attachment		
Py	Pressure port for travel		

STRUCTURE (2/2)



Mark	Port name	Port size	Tightening torque
XBp1	Bypass cut spool pilot port (P1 side)	PF1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
XBp2	Bypass cut spool pilot port (P2 side)		
PaL	Lock valve pilot port (arm rod side)		
PbL	Lock valve pilot port (boom head side)		
Dra	Drain port		
Drb	Drain port		
Pna1	Arm regeneration cut pilot port		
Pns	Swing priority pilot port		
Dr3	Drain port		
Dr4	Drain port		
Pz	Main relief pilot pressure port		
(Pd)	Option relief pilot pressure port		
Atr	Travel motor left side (reverse) port	M12	8.5~11.2 kgf · m (61.5~81.0 lbf · ft)
Btr	Travel motor left side (forward) port		
As	Swing motor right port		
Bs	Swing motor left port		
AtL	Travel motor right side (reverse) port		
BtL	Travel motor right side (forward) port		
R1	Return port		
(R2)	-		
R3	Return port		
P1	Pump port (A2 side)	M14	14.3~18.4 kgf · m (103~133 lbf · ft)
P2	Pump port (A1 side)		
(Ao)	Optional port		
(Bo)	Optional port		
Aa	Arm out port		
Ba1	Arm in port		
Ab	Boom up port		
Bb	Boom down port		
Ac	Bucket out port		
Bc	Bucket in port		
(Ba2)	-		

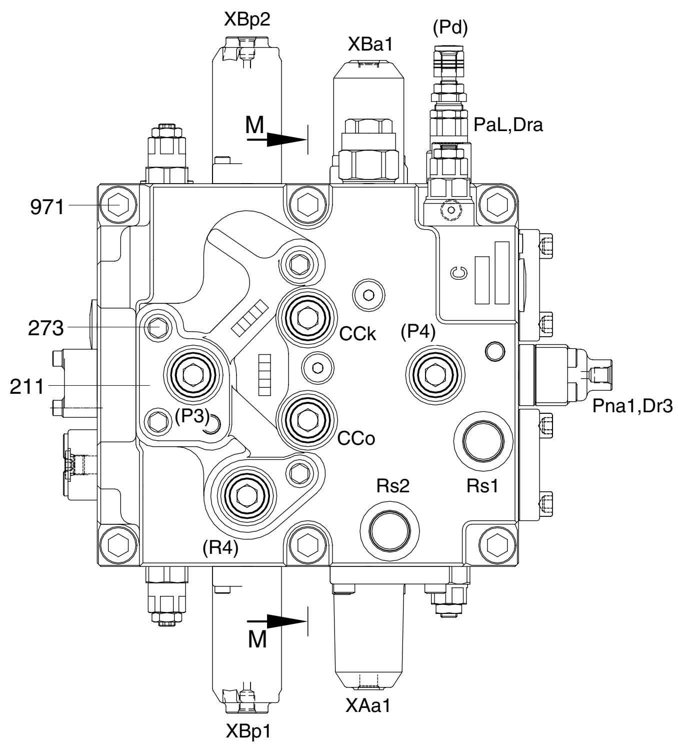
1) RELIEF VALVE SIDE VIEW



400SA2MC03

101 Casing A
102 Casing B
103 Casing C
252 Lock valve selector sub assy
991 Name plate
992 Pin

2) BACK SIDE VIEW

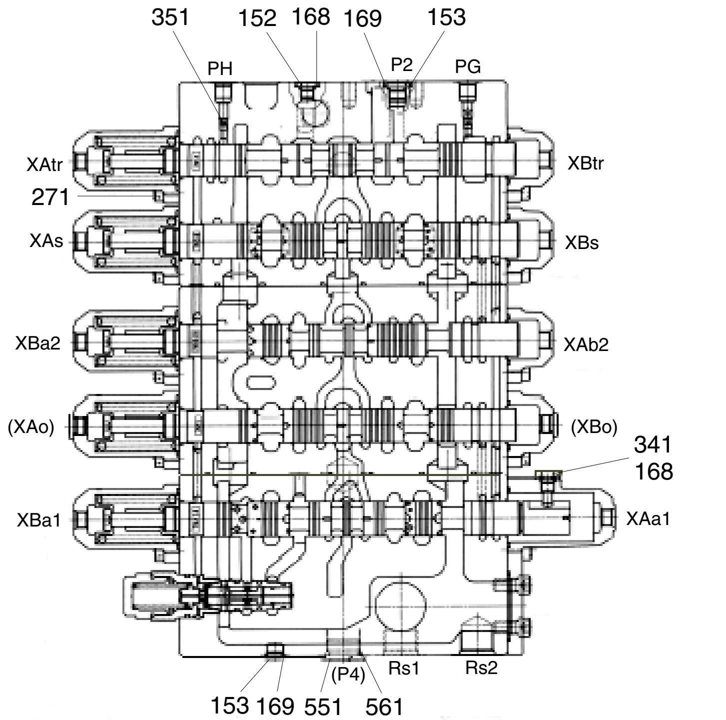


VIEW B

400SA2MC04

211 Plate
273 Hexagon socket screw
971 Hexagon socket screw

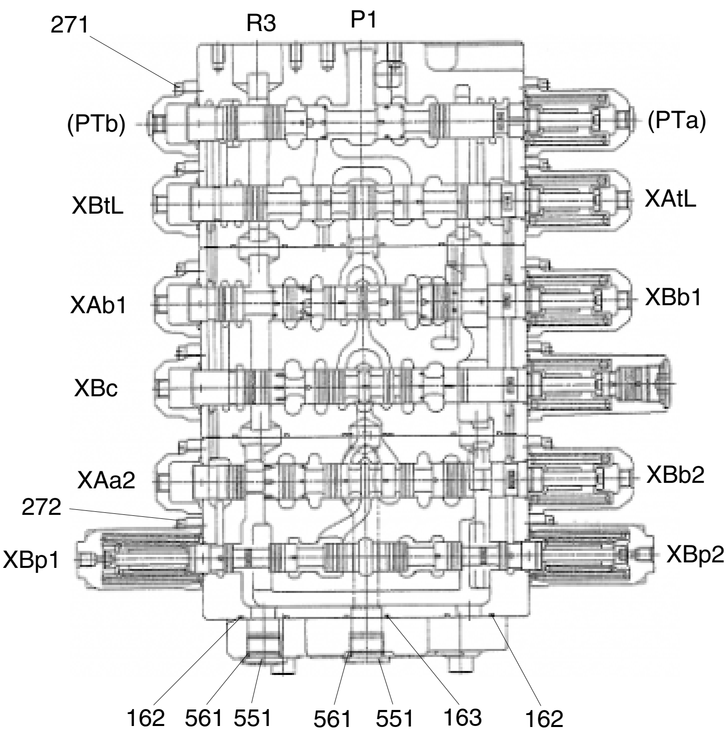
3) P2 SPOOL SECTION



400SA2MC05

152 ROH plug
153 ROH plug
168 O-ring
169 O-ring
271 Hexagon socket screw
341 Plug
351 Orifice
551 Plug
561 O-ring

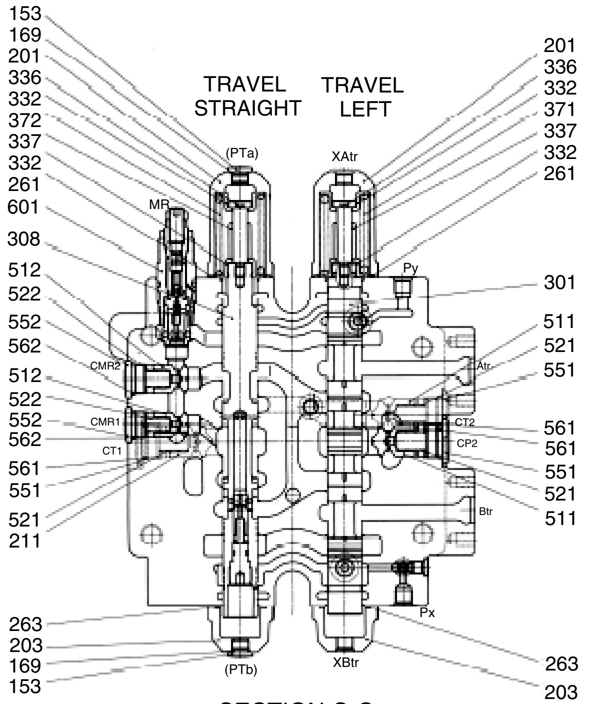
4) P1 SPOOL SECTION



400SA2MC06

162 O-ring
163 O-ring
271 Hexagon socket screw
272 Hexagon socket screw
551 Plug
561 O-ring

5) TRAVEL LEFT AND TRAVEL STRAIGHT SECTION

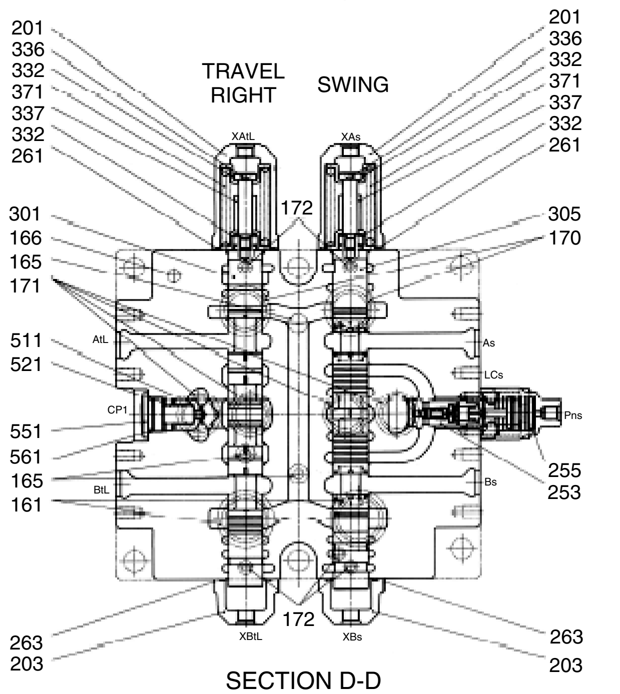


SECTION C-C

400SA2MC07

153 ROH plug
169 O-ring
201 Spring cover
203 Spool cover
261 O-ring
263 O-ring
301 Travel spool
308 Straight travel spool sub assy
332 Spring seat
336 Spacer bolt
337 Stopper
371 Spring
372 Spring
511 Poppet
512 Poppet
521 Spring
522 Spring
551 Plug
552 Plug
561 O-ring
562 O-ring
601 Main relief valve assy

6) TRAVEL RIGHT AND SWING SECTION

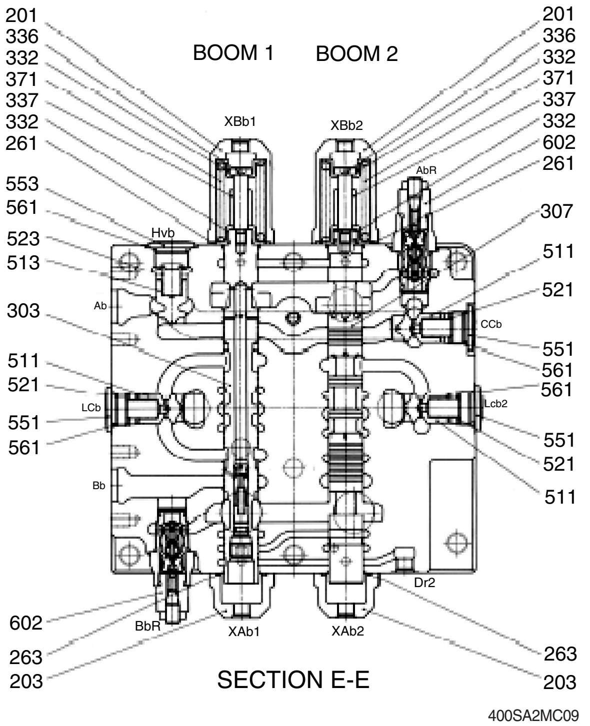


SECTION D-D

400SA2MC08

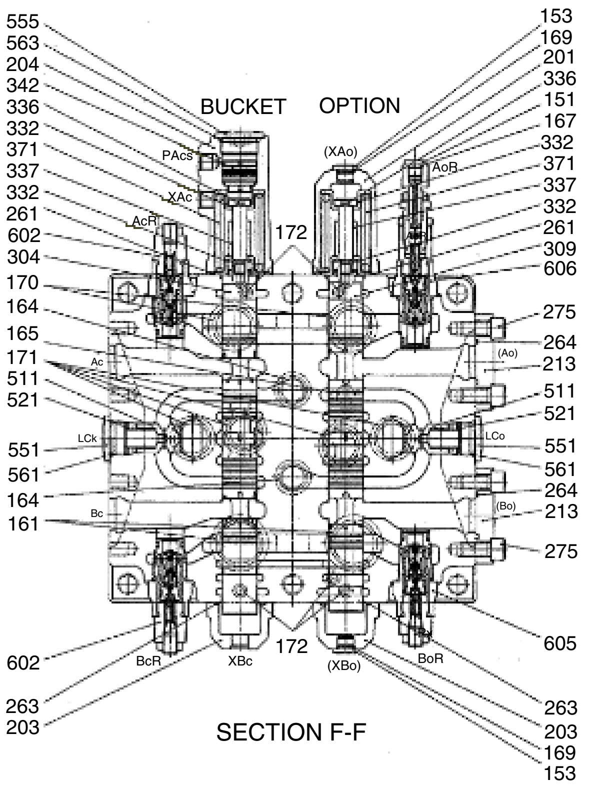
161 O-ring
165 O-ring
166 O-ring
170 O-ring
171 O-ring
172 O-ring
201 Spring cover
203 Spool cover
253 Logic poppet assy
255 Logic control valve assy
261 O-ring
263 O-ring
301 Travel spool
305 Swing spool
332 Spring seat
336 Spacer bolt
337 Stopper
371 Spring
511 Poppet
521 Spring
551 Plug
561 O-ring

7) BOOM 1 AND BOOM 2 SECTION



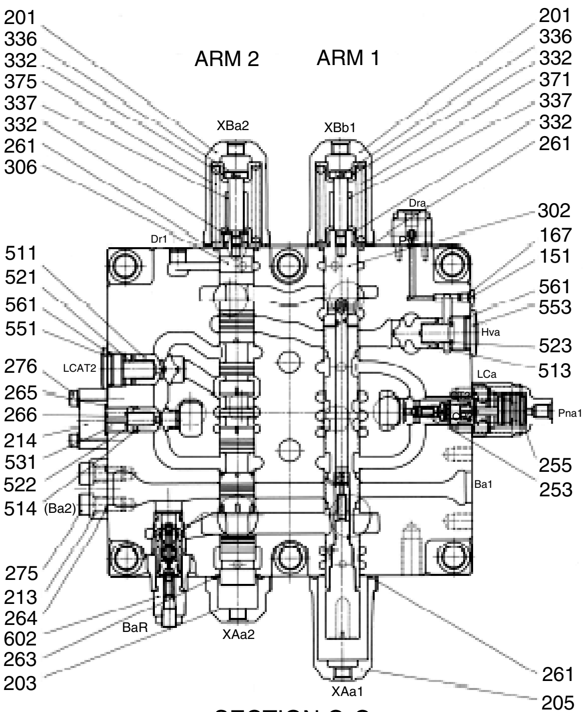
201 Spring cover
203 Spool cover
261 O-ring
263 O-ring
303 Boom 1 spool sub assy
307 Boom 2 spool
332 Spring seat
336 Spacer bolt
337 Stopper
371 Spring
511 Poppet
513 Poppet
521 Spring
523 Spring
551 Plug
553 Plug
561 O-ring
602 Port relief valve assy

8) BUCKET AND OPTION SECTION



151 ROH plug
153 ROH plug
161 O-ring
164 O-ring
165 O-ring
167 O-ring
169 O-ring
170 O-ring
171 O-ring
172 O-ring
201 Spring cover
203 Spool cover
204 Spring cover
213 Flange
261 O-ring
263 O-ring
264 Square ring
275 Hexagon socket screw
304 Bucket spool
309 Option spool
332 Spring seat
336 Spacer bolt
337 Stopper
371 Spring
511 Poppet
521 Spring
551 Plug
555 Plug
561 O-ring
562 O-ring
563 O-ring
602 Port relief valve assy
605 Port relief valve assy
606 Port relief valve assy

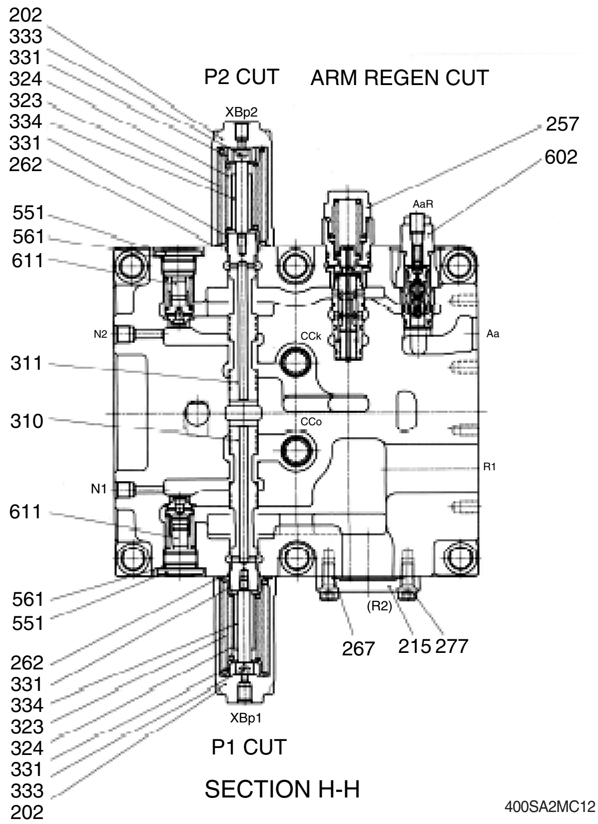
9) ARM 1 AND ARM 2 SECTION



SECTION G-G

151 ROH plug
167 O-ring
201 Spring cover
203 Spool cover
263 O-ring
205 Spool cover
213 Flange
214 Load check cover
253 Logic poppet assy
255 Logic control valve assy
261 O-ring
264 Square ring
265 O-ring
266 Square ring
275 Hexagon socket screw
276 Hexagon socket screw
302 Arm 1 spool sub assy
306 Arm 2 spool
332 Spring seat
336 Spacer bolt
337 Stopper
371 Spring
375 Spring
511 Poppet
513 Poppet
514 Poppet
521 Spring
522 Spring
523 Spring
531 Spring seat
551 Plug
553 Plug
561 O-ring
602 Port relief valve assy

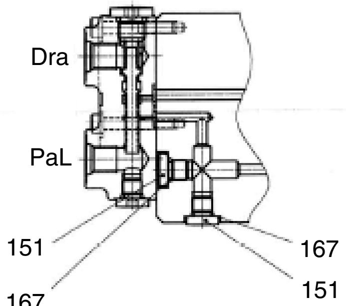
10) BYPASS CUT (P1 & P2)



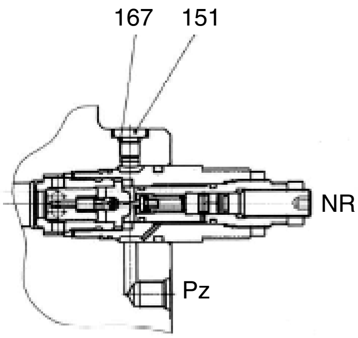
SECTION H-H

202 Spring cover
215 Blank flange
257 Arm regen cut sub assy
262 O-ring
267 O-ring
277 Hexagon socket screw
310 Bypass-cut assy
311 Bypass-cut assy
323 Spring
324 Spring
331 Spring seat
333 Spacer bolt
334 Stopper
551 Plug
561 O-ring
602 Hexagon socket screw
611 Nega-con relief valve assy

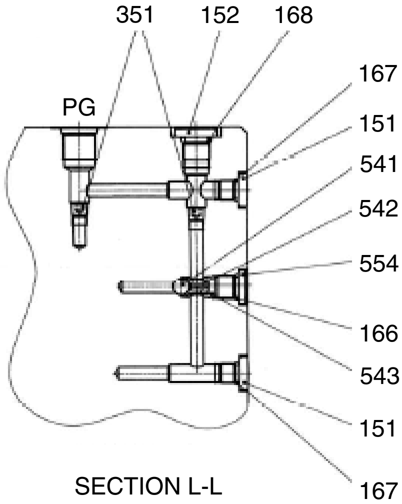
11) OTHER SECTION



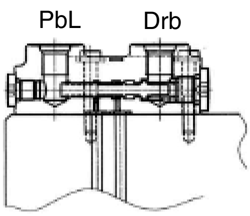
SECTION Q-Q



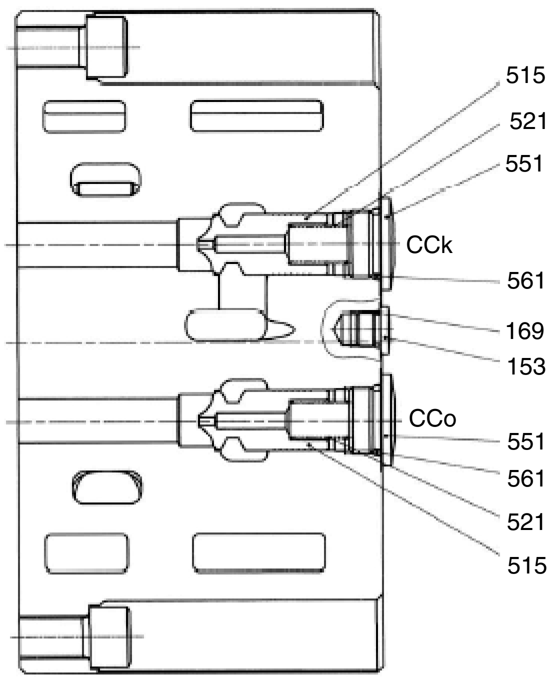
SECTION N-N



SECTION L-L



SECTION P-P

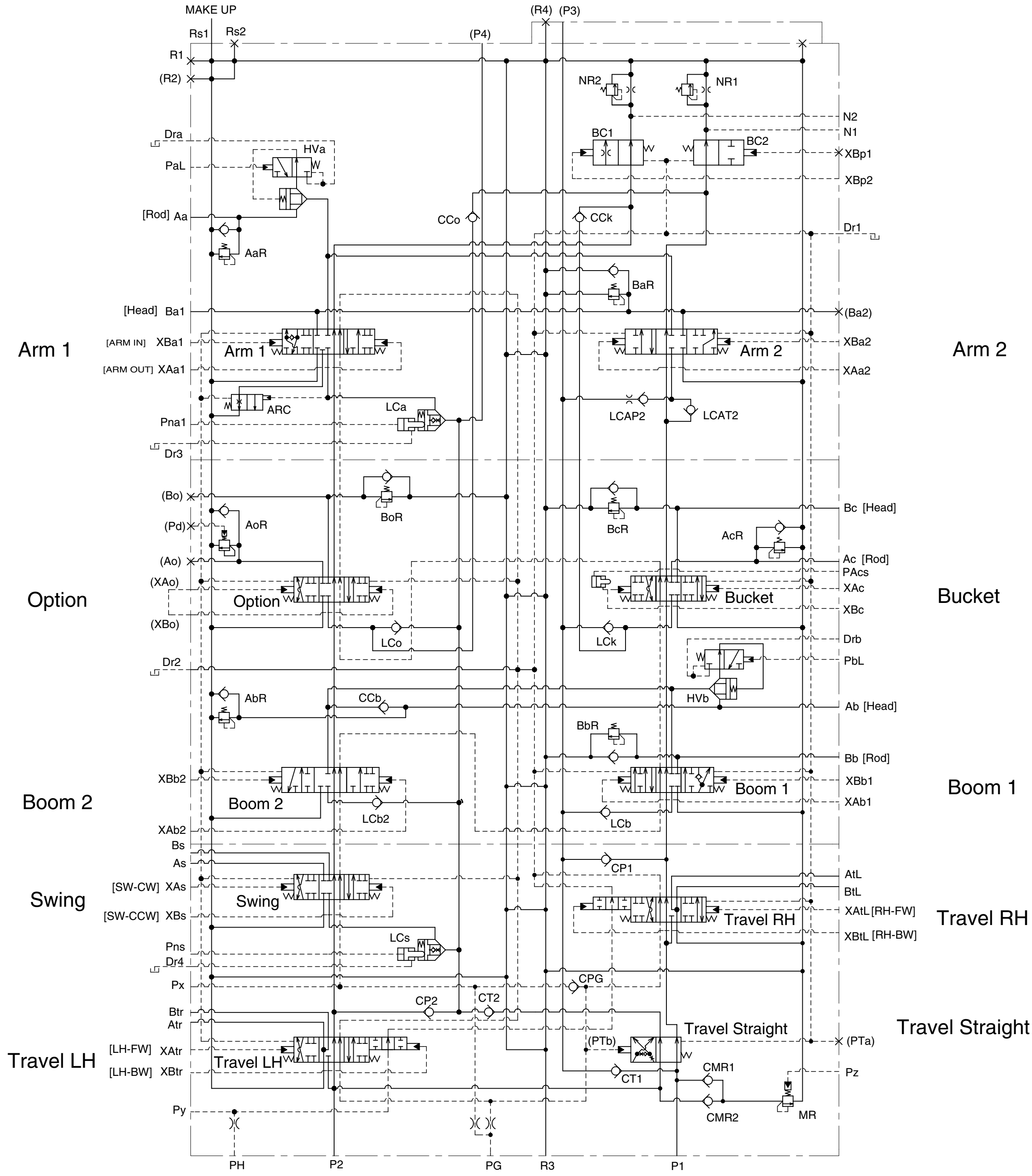


SECTION M-M

380A2MC13

151	ROH plug	169	O-ring	543	Spring
152	ROH plug	351	Orifice	551	Plug
153	ROH plug	515	Poppet	554	Plug
166	O-ring	521	Spring	561	O-ring
167	O-ring	541	Steel ball		
168	O-ring	542	Spring seat		

2. HYDRAULIC CIRCUIT



400SA2MC14

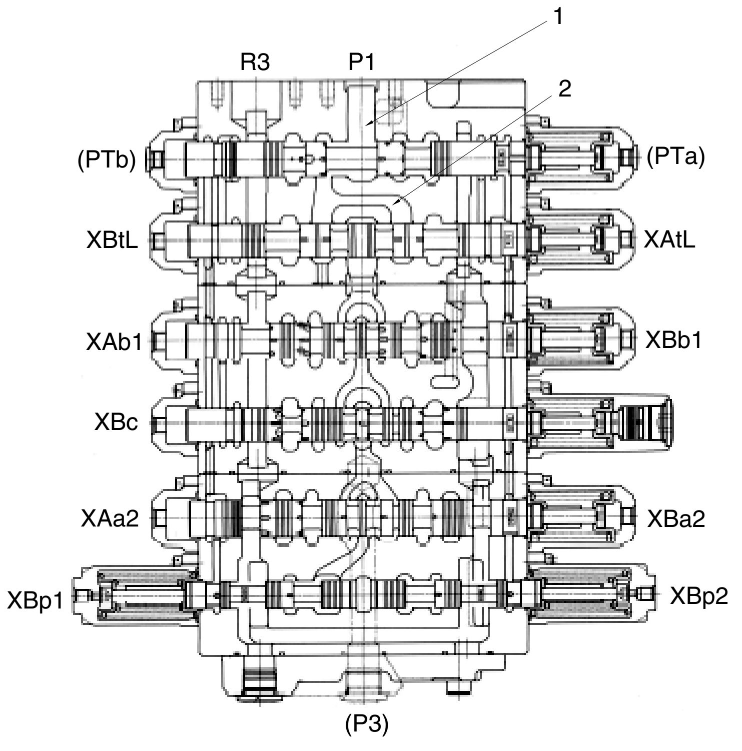
3. OPERATION

1) NEUTRAL POSITIONS OF SPOOLS

(1) P1 HOUSING SIDE

When all spools are in the neutral positions, the pressurized oil discharged from the hydraulic pump (A1) passes through port P1, the main path (1), the bypass circuit (2) passing the spools for travel straight (308), travel left (301) , boom 1 (303), bucket (304), arm 2 (306) and boom 1 side negative control orifice, and returns to the hydraulic oil tank through the return port (R1), (R3).

The negative control signal pressure of the boom 1 side negative control relief valve (611) is led from port N1 to the regulator on the hydraulic pump (A1) side, and controls the pump discharge flow rate to its minimum value.

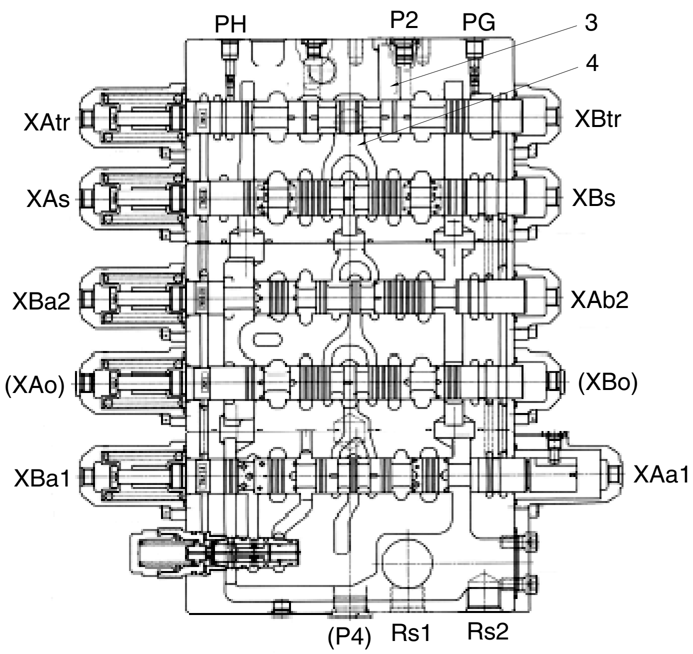


(2) P2 housing side

The oil discharged from the hydraulic pump (A2) passes through port P2, the main path (3), the bypass circuit (4) passing the spools for travel right (301), swing (305), boom 2 (307), option (309), arm 1 (302) and arm 1 side negative control orifice, and returns to the hydraulic oil tank through the return port (R1), (R3).

The negative control signal pressure of the arm 1 side negative control relief valve (611) is led from port N2 to the regulator on the hydraulic pump (A2) side, and controls the pump discharge flow rate to its minimum value.

When any of nine main spools is changed over, the bypass circuit (2) or (4) is cut off and the control signal pressure at port N1 or N2 in the negative control circuit is changed tank pressure, and controls the pump discharge flow rate to its maximum value.



380A2MC16

2) TRAVEL OPERATION

(1) Pilot circuit

Since any of the travel spools (301) on the left or right transfers and shuts off the side-bypass path, the pressure at port Py (pressure port for travel) increases.

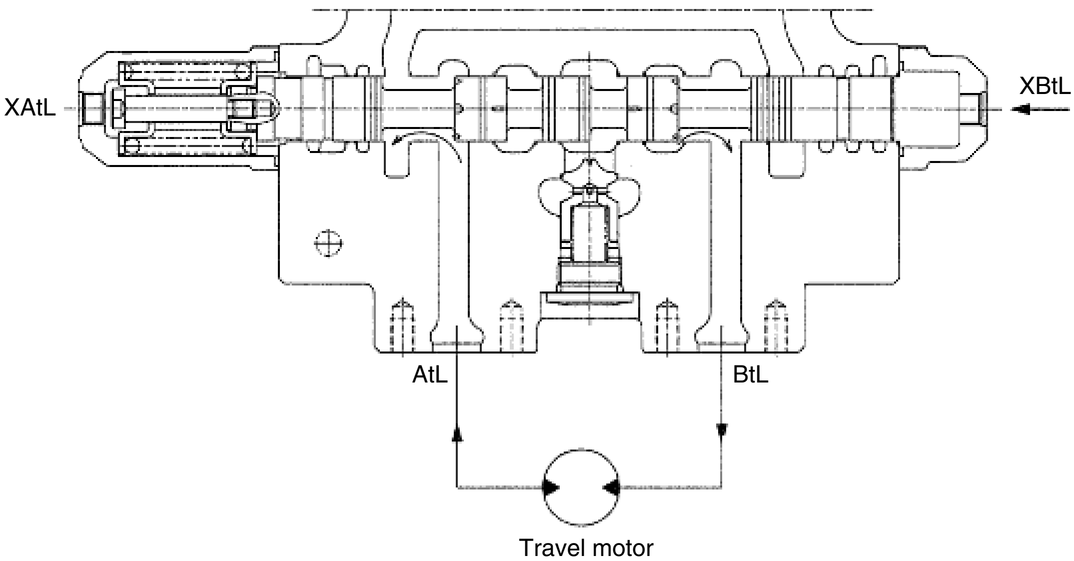
(2) Main circuit

When pilot port XBtL of the travel left spool (301) is pressurized, the bypass circuit (2) in the boom 1 side is shut off and pressurized oil from port P1 passes through port BtL and flows to the travel left motor.

When pilot port XBtr of the travel right spool (301) is pressurized, the bypass circuit (4) in the arm 1 side is shut off and pressurized oil from port P2 passes through port Btr and flows to the travel right motor.

On the other hand, the return oil from the travel left(right) motor passes through port AtL(Atr) and travel left (right) spool , and returns to the hydraulic oil tank through the tank port (R1), (R3).

In the case of the opposite operation (when the pilot pressure is applied to ports XAtL and XAtr of the control valve), the operation is similar.



380A2MC17

3) ARM OPERATION

(1) Arm stretching operation

① Pilot circuit

Since the arm 1 spool (302) transfers and shuts off the side-bypass path, the pressure at port Px increases.

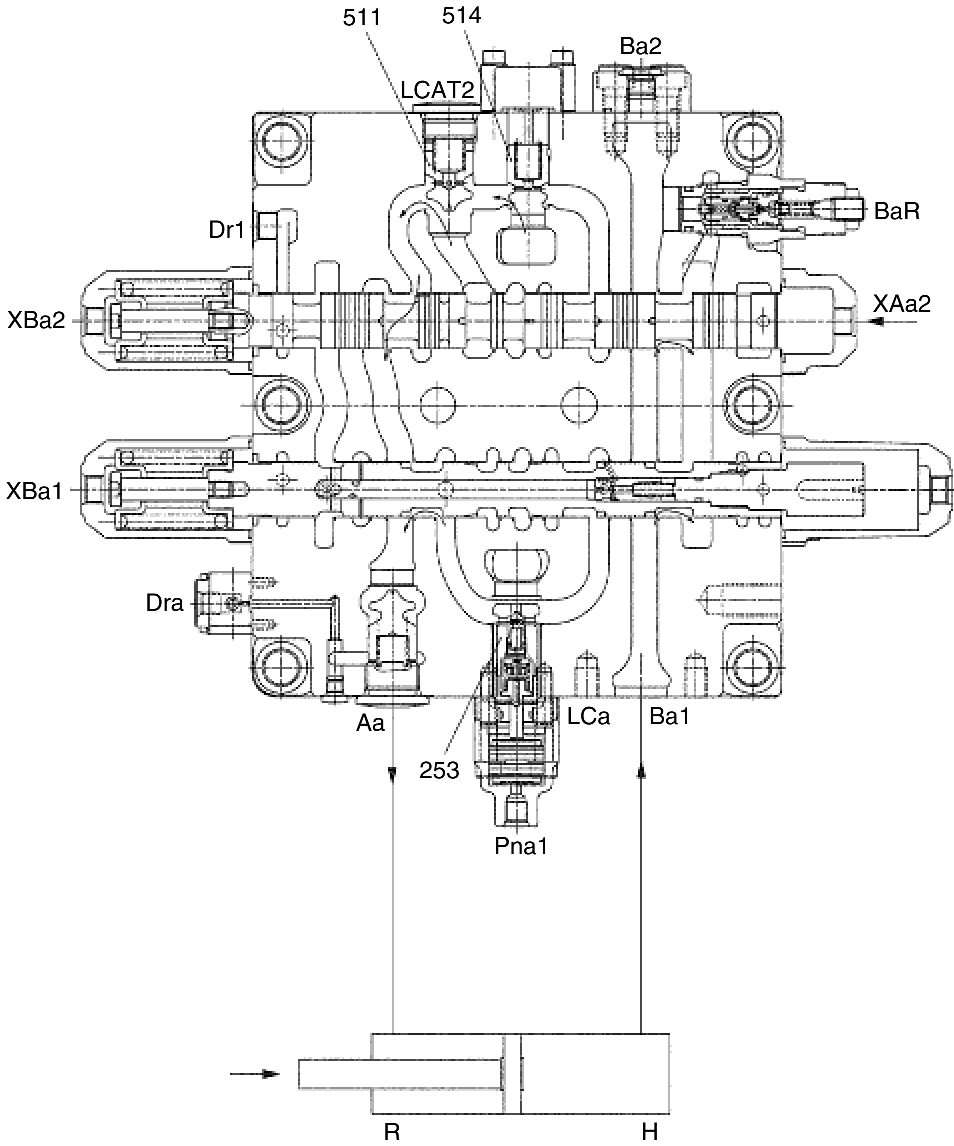
② Main circuit

During the arm stretching operation, the pilot pressure enters through ports XAa1 and XAa2.

When the pressure enters through ports XAa1 and XAa2, the arm 1 and arm 2 spools transfer in the left direction in figure. The hydraulic oil entering through port P2 passes through the main path (3) and flows to the bypass circuit (4), but the bypass circuit is shut off due to transfer of the arm 1 spool (302).Therefore, the hydraulic oil from the parallel circuit pushes open the logic poppet (253) and flows through the U-shaped path to the arm 1 spool (302).Then, it flows around the periphery of the arm 1 spool (302) to port Aa, and is supplied to the arm cylinder rod side (R).

On the other hand, the oil entering through port P1 passes in the main path (1), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (306). The hydraulic oil from the parallel circuit pushes open the check valve (514) and oil from the bypass circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (306). Then, it flows around the periphery of arm 2 spool (306) and joins into port Aa through the inside path.

Besides, the return oil from the arm cylinder head side (H) passes through port Ba1, flows into tank line in arm 1 side and in arm 2 side and returns to the hydraulic oil tank through the tank ports (R1), (R3).


511
514
Ba2
LCAT2
BaR
Dr1
XBa2
XAa2
XBa1
XAa1
Dra
Aa
LCa
Ba1
253
Pna1
R
H

380A2MC18

(2) Arm excavating operation

① Pilot circuit

Since the arm 1 spool (302) transfers and shuts off the side-bypass path, the pressure at port Px (pressure port for attachment) increases. Then, the pressure enters also through port PaL and the release signal is sent to the lock valve selector (252).

② Main circuit

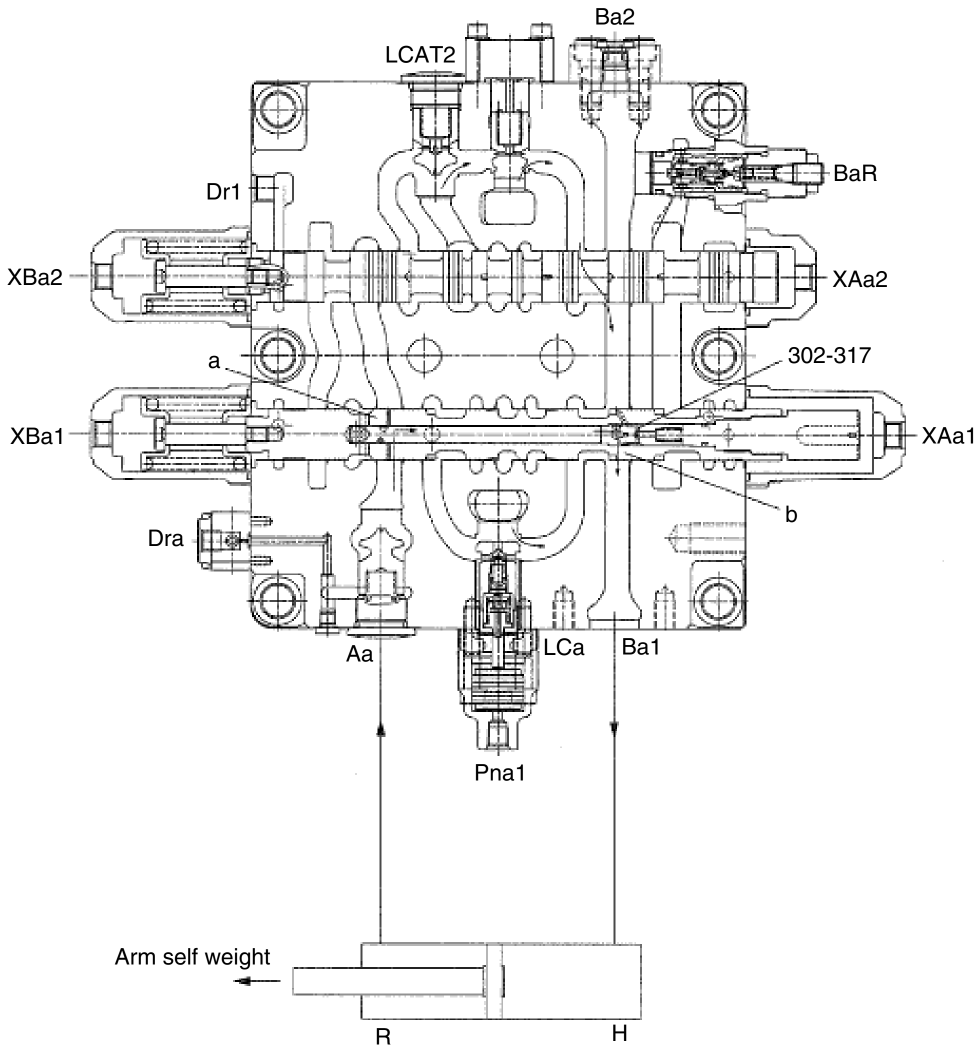
During the arm excavating operation, the pilot pressure enters through ports XBa1 and XBa2. When the pressure enters through ports XBa1 and XBa2, the arm 1 and arm 2 spools transfer in the right direction in figure. The hydraulic oil entering through port P2 passes through the main path (3) and flows to the bypass circuit (4), but the bypass circuit is shut off due to transfer of the arm 1 (302) spool. Therefore, the hydraulic oil from the parallel circuit pushes open the logic poppet (253) and flows through the U-shaped path to the arm 1 spool (302). Then, it flows around the periphery of the arm 1 spool (302) to port Ba1, and is supplied to the arm cylinder head side (H).

On the other hand, the hydraulic oil entering through port P1 passes in the main path (1), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (306). The hydraulic oil from the parallel circuit pushes open the check valve (514) and oil from the bypass circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (306). Then, it flows around the periphery of arm 2 spool (306) and joins into port Ba1 through the inside path.

On the other hand, the return oil from the arm cylinder rod side (R) is pressurized by self-weight of the arms and so on, and returns to port Aa. The pressurized oil returning to port Aa enters into the spool through the outside hole (a) of the arm 1 spool (302). During a light load only, it pushes open the sleeve check valve (302-317) and joins into port Ba from the spool hole (b). This is called the arm regeneration function.

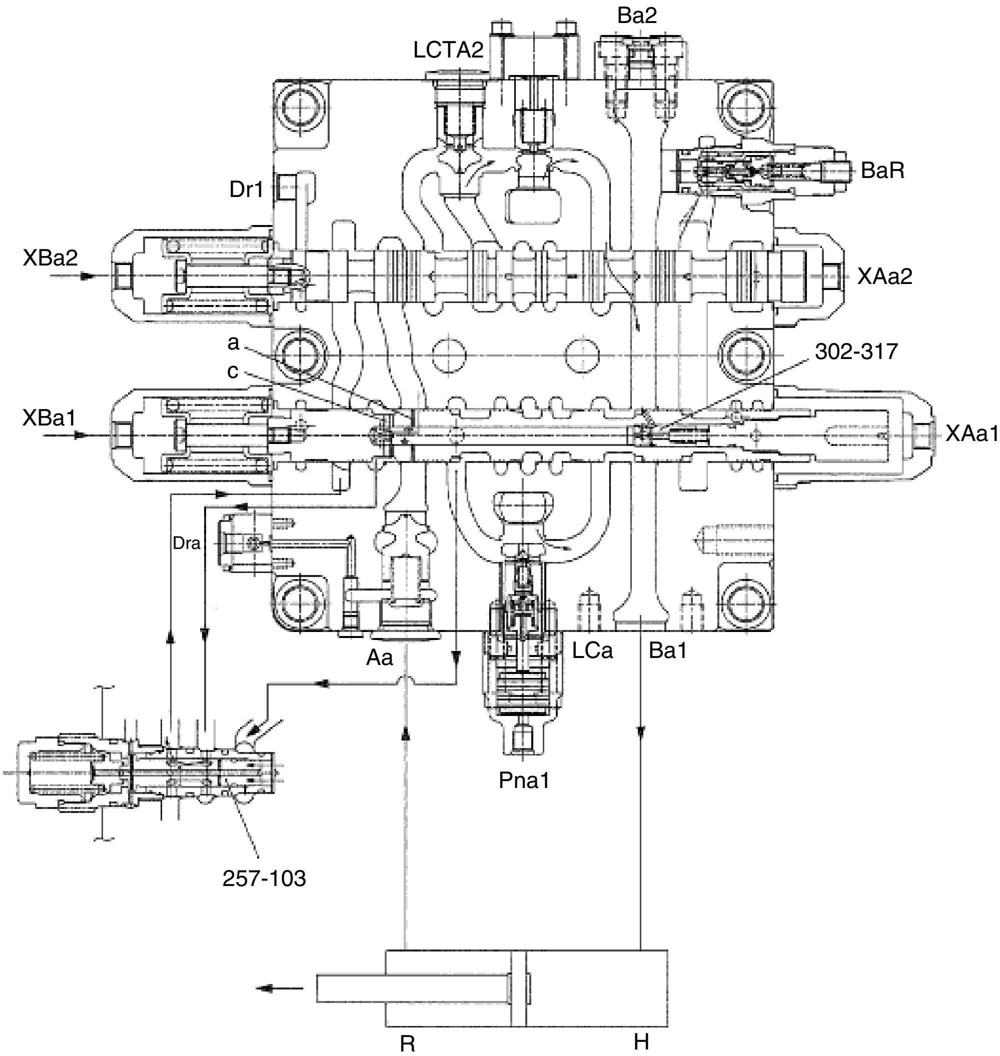
When the pressure in the arm cylinder head side (H) and the U-shaped path increases, the arm regeneration cut spool (257-103) is transferred in the left direction in Fig. ***, and at the same time the check valve (302-317) is closed by its backpressure.
This shuts off the arm regeneration function, and the return oil from the arm cylinder rod side (R) enters from port Aa through the periphery hole (a) of the arm 1 spool (302) into the spool, flows to the arm regeneration cut valve (257) through the periphery hole (c) of the arm 1 spool (302), and returns through the tank port (R1), (R3) to the hydraulic oil tank.

· During light load only



380A2MC19

· In case the pressure in the arm cylinder head side (H) increases.



4) BOOM OPERATION

(1) Boom hoisting operation

① Pilot circuit

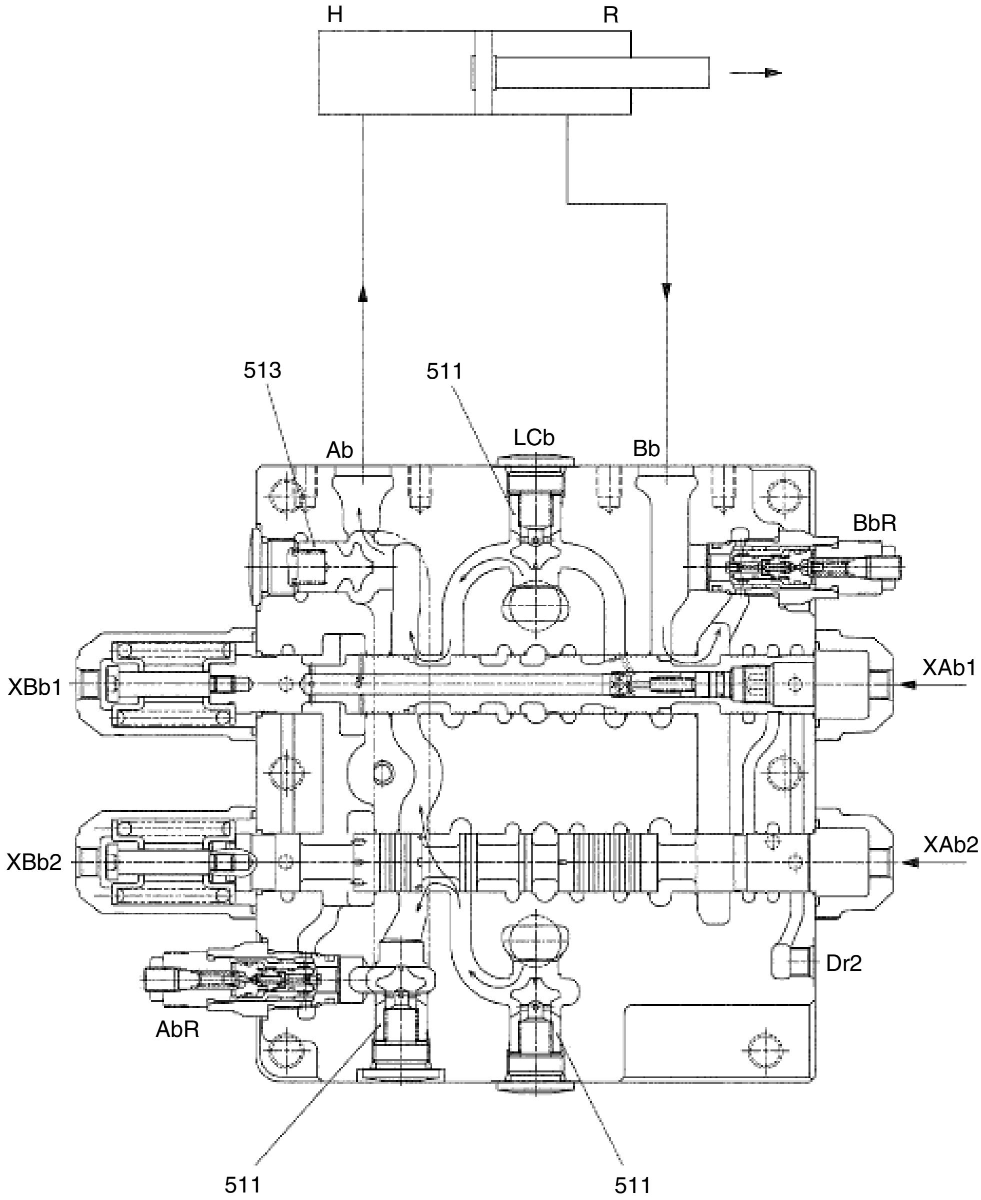
Since the boom 2 spool (307) transfers and shuts off the side-bypass path, the pressure at port Px (Pressure port for attachment) increases.

② Main circuit

During the boom hoisting operation, the pilot pressure enters through port XAb1 and transfers the boom 1 spool (303) in the left direction in figure. The pressurized oil entering through port P1 passes through the main path (1) and flows to the bypass circuit (2), but the bypass circuit is shut off due to transfer of the boom 1 spool (303). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through U-shaped path to the boom 1 spool (303). Then, it flows around the periphery of the boom 1 spool (303) to port Ab, and is supplied to the boom cylinder head side (H).

At the same time, the pilot pressure enters also through port XAb2 to transfer the boom 2 spool (307) in the left direction in figure. Though the pressurized oil enters into port P2, the bypass circuit is shut off due to transfer of the boom 2 spool (307). Therefore, the oil flows in the parallel circuit and flows through the U-shaped path to the boom 2 spool (307). Then, the oil passes through the periphery of the boom 2 spool, pushes open the check valve (511), joins into port Ab through the inside path, and is supplied to the boom cylinder head side (H). (boom confluent flow)

On the other hand, the return oil from the boom cylinder rod side (R) enters through port Bb, passes around the periphery of the boom 1 spool (303), and returns to the hydraulic oil tank through the tank ports (R1), (R3).



380A2MC21

(2) Boom lowering operation

① Pilot circuit

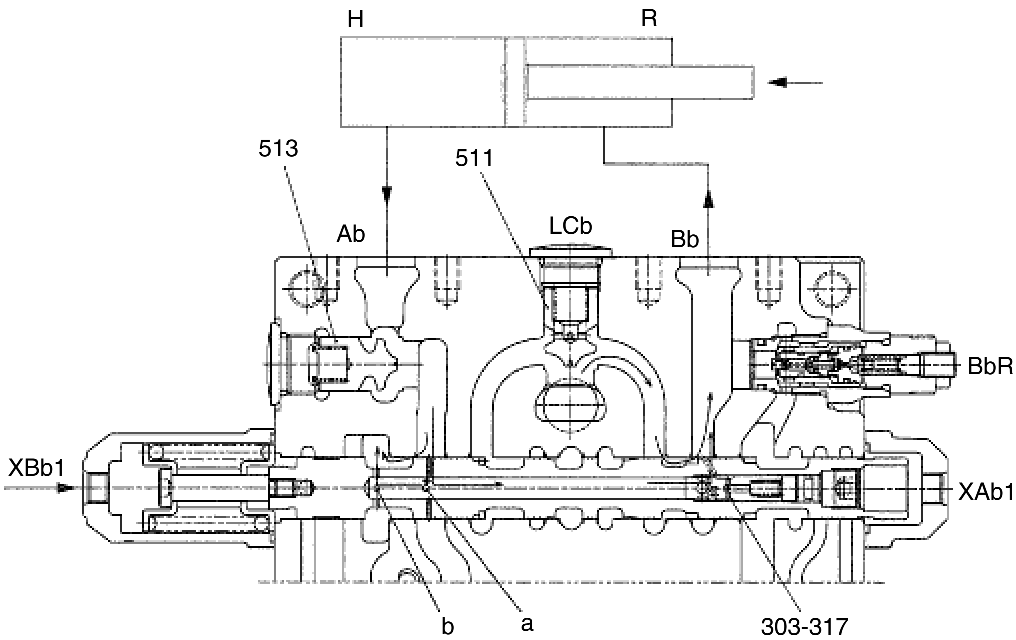
Since the boom 2 spool (307) transfers and shuts off the side-bypass path, the pressure at port Px increases. Then, the pressure enters also through port PbL and the release signal is sent to the lock valve selector (252).

② Main circuit

During the boom lowering operation, the pilot pressure enters through port XBb1 and transfers the boom 1 spool (303) in the right direction in figure. The pressurized oil entering through port P1 passes through the main path (1) and flows to the bypass circuit (2), but the bypass circuit is shut off due to transfer of the boom 1 spool (303). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the boom 1 spool (303). Then, it flows around the periphery of the boom 1 spool (303) to port Bb and is supplied to the boom cylinder rod side (R).

On the other hand, the return oil from the boom cylinder head side (H) passes through the periphery hole (a) and the periphery of the boom 1 spool (303).

Since this return oil has a sufficient pressure caused by the weight of the boom, it passes through the path inside the spool, pushes the poppet (303-317) in the spool in the right direction shown in the figure. flows around the outside of the spool. Then, it is supplied again to the boom cylinder rod side (R) as hydraulic oil to lower the boom. (boom regeneration function)
Besides, a part of the return oil from the boom cylinder flows from the hole (b) into the tank.



380A2MC22

5) BUCKET OPERATION

(1) Bucket excavating operation

① Pilot circuit

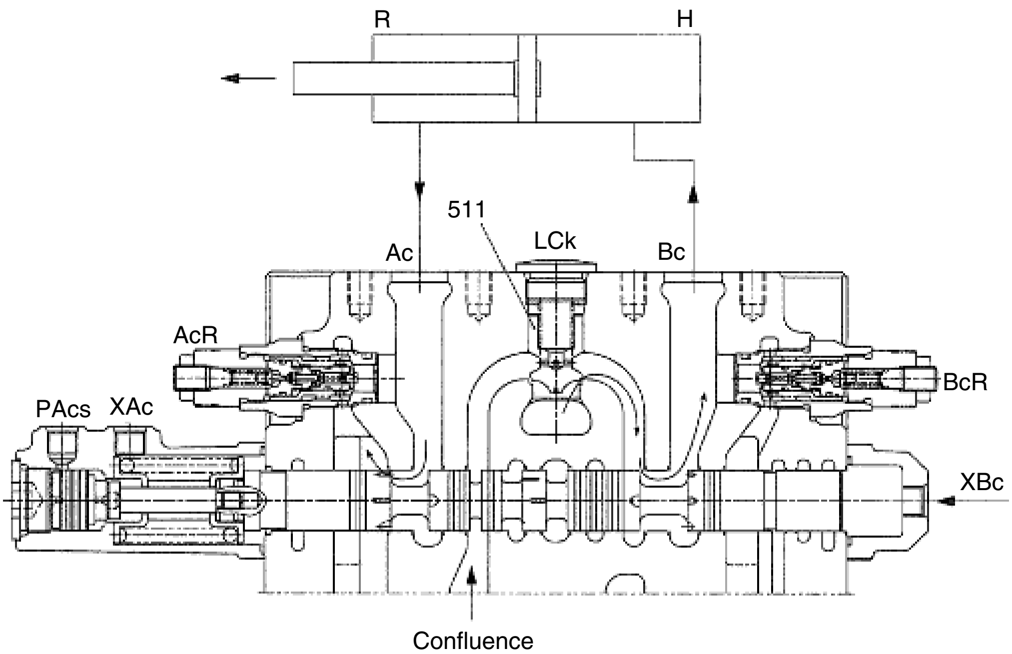
Since the bucket spool (304) transfers and shuts off the side-bypass path, the pressure at port Px increases. Then, the pressure enters also through port XBp2.

② Main circuit

During the bucket excavating operation, the pilot pressure enters through port XBc and transfers the bucket spool (304) in the left direction in figure. The pressurized oil entering through port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit is shut off due to transfer of the bucket spool (304). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the bucket spool (304). Then, it flows through the periphery of the bucket spool (304) to port Bc and is supplied to the bucket cylinder head side (H).

On the other hand, the return oil from the bucket cylinder rod side (R) enters through port Ac, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank ports (R1) and (R3).

During both the boom hoisting operation and bucket excavating operation, the pilot pressure enters through port PAcs and the bucket spool transfers in the half stroke not full stroke. Therefore, the pressurized oil entering through port P1 flows to the boom 1 spool (303) preferentially to the bucket spool (304) to make the boom hoisting operation most preferential.



380A2MC23

(2) Bucket releasing operation

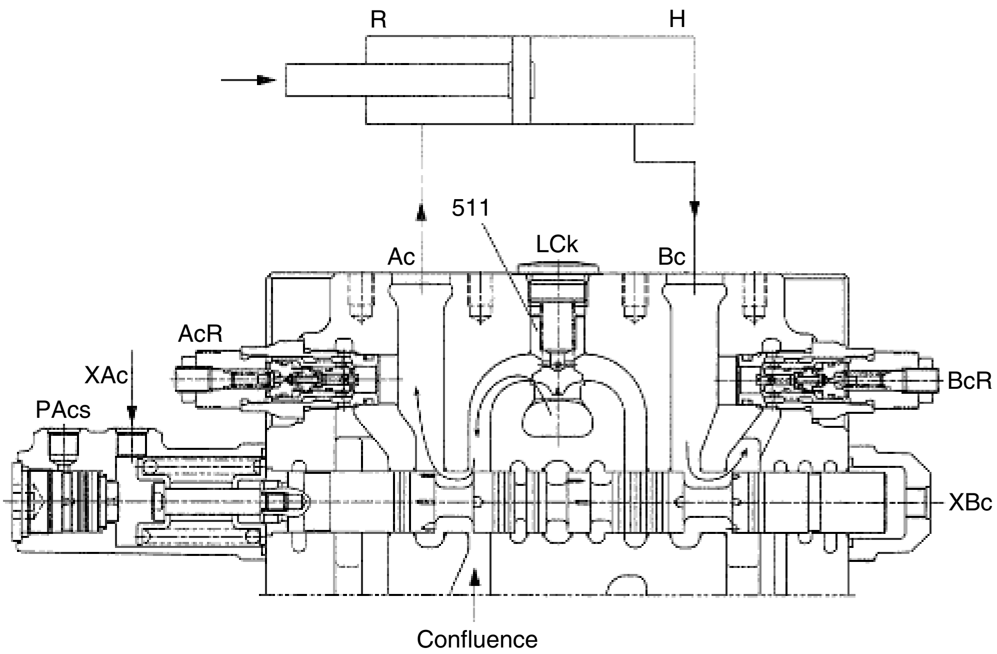
① Pilot circuit

Since the bucket spool (304) transfers and shuts off the side-bypass path, the pressure at port Px increases. Then, the pressure enters also through port XBp2.

② Main circuit

During the bucket releasing operation, the pilot pressure enters through port XAc and transfers the bucket spool (304) in the right direction in figure. The pressurized oil entering through port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit is shut off due to transfer of the bucket spool (304). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the bucket spool (304). Then, it flows through the periphery of the bucket spool (304) to port Ac and is supplied to the bucket cylinder rod side (R).

On the other hand, the return oil from the bucket cylinder head side (H) enters through port Bc, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank ports (R1), (R3).



380A2MC24

③ Bucket confluence

During the bucket excavating or releasing operation, the pilot pressure enters also through port XBp2 and transfers the bypass-cut spool (310). The pressurized oil entering through port P2 passes through the main path (3) and flows through the bypass circuit (4), but the bypass circuit is shut off due to transfer of the bypass-cut spool (310). Therefore, the pressurized oil pushes open the check valve (515), and flows through inside path and the U-shaped path to the bucket spool (304).

6) SWING OPERATION

(1) Independent swing operation

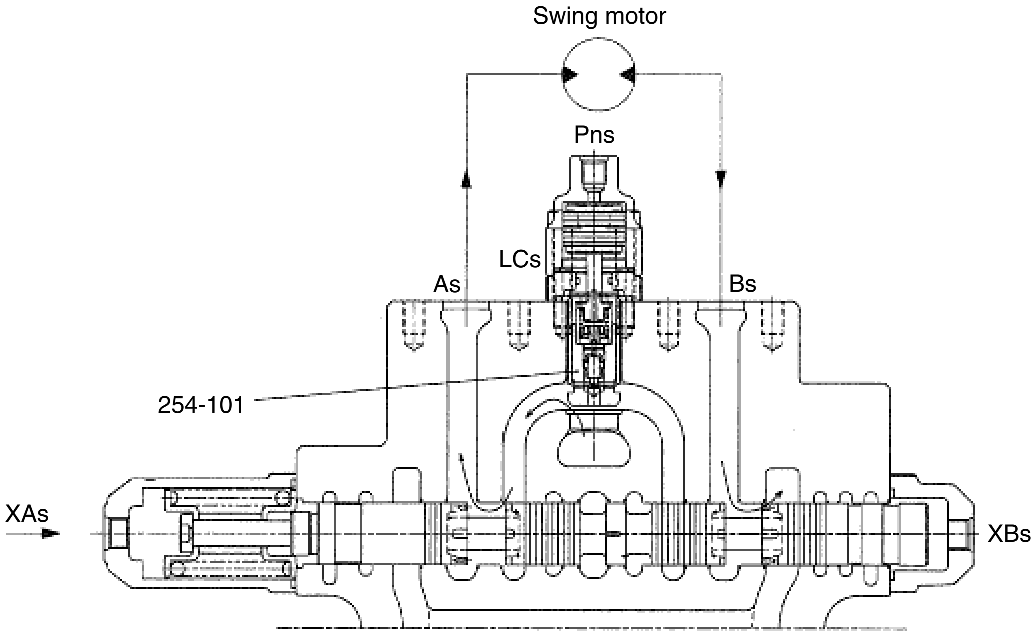
① Pilot circuit

Since the swing spool (305) transfers and shuts off the side-bypass path, the pressure at port Px increases.

② Main circuit

During the swing operation, the pilot pressure enters through port XAs (or XBs) and transfers the swing spool (305). The pressurized oil entering through port P2 passes through the main path (3) and flows through the bypass circuit (4), but the bypass circuit (4) is shut off due to transfer of the swing spool (305). Therefore, the pressurized oil flows into the parallel circuit, pushes open the logic poppet (254-101), and flows through the U-shaped path to the swing spool (305). Then, it flows through the periphery of the spool to port As (or Bs) and is supplied to the swing motor.

On the other hand, the return oil from the swing motor enters port Bs (or As) and returns to the hydraulic oil tank through the tank ports (R1), (R3).



380A2MC25

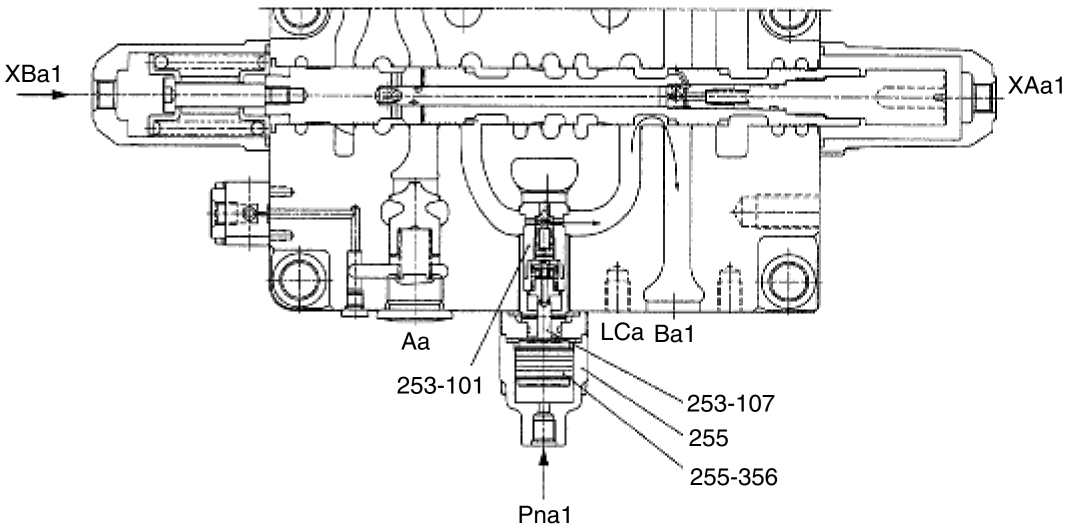
(2) Swing priority function

The following is the case of making the swing operation prior to the arm excavating operation.

① Main circuit

During both the arm excavating operation and the swing operation, the swing pilot pressure enters through ports Pna1 of the logic poppet (255), and transfers the piston (255-356) and the spool (253-107) upward in figure. Therefore, the lift of the poppet (253-101) is limited, and the passage from the parallel circuit to the U-shaped path is restricted. As a result, the pressurized oil flows to the swing spool preferentially to the arm 1 spool to make the swing operation prior.

Similarly, in case the pilot pressure is applied to port Pns of the logic poppet (255), the lift of the poppet (254-101) is limited, and the boom hoisting operation is made prior to the swing operation.



380A2MC26

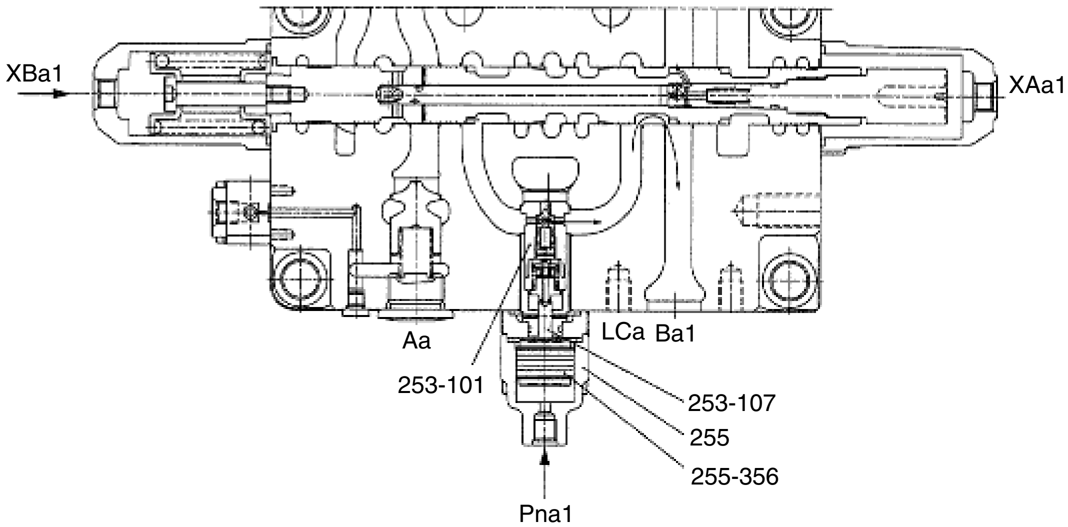
(2) Swing priority function

The following is the case of making the swing operation prior to the arm excavating operation.

① Main circuit

During both the arm excavating operation and the swing operation, the swing pilot pressure enters through ports Pna1 of the logic poppet (255), and transfers the piston (255-356) and the spool (253-107) upward in figure. Therefore, the lift of the poppet (253-101) is limited, and the passage from the parallel circuit to the U-shaped path is restricted. As a result, the pressurized oil flows to the swing spool preferentially to the arm 1 spool to make the swing operation prior.

Similarly, in case the pilot pressure is applied to port Pns of the logic poppet (255), the lift of the poppet (254-101) is limited, and the boom hoisting operation is made prior to the swing operation.



380A2MC26

7) OPTION OPERATION

This spool is used for controlling the optional attachments like a nibbler.

(1) Option operation

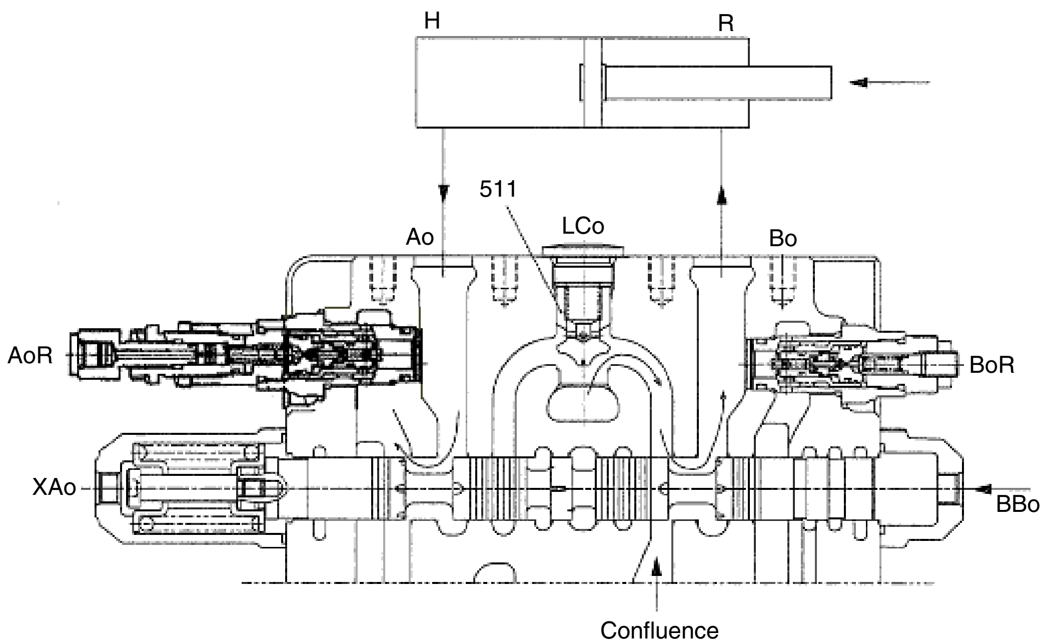
① Pilot circuit

Since the side bypass sections of both travel spools (301) shut off and the side bypass section of the downstream-side of swing spool shuts off, the pilot pressure from the port PG enters through the port PTb to transfer the travel straight spool (308).

② Main circuit

During the swing operation, the pilot pressure enters through port XAs (or XBs) and transfers the swing spool (305). The pressurized oil entering through port P2 passes through the main path (3) and flows through the bypass circuit (4), but the bypass circuit (4) is shut off due to transfer of the swing spool (305). Therefore, the pressurized oil flows into the parallel circuit, pushes open the logic poppet (254-101), and flows through the U-shaped path to the swing spool (305). Then, it flows through the periphery of the spool to port As (or Bs) and is supplied to the swing motor.

On the other hand, the return oil from the swing motor enters port Bs (or As) and returns to the hydraulic oil tank through the tank ports (R1), (R3).



400SA2MC27

(2) Option confluence

In order to use the option confluence, the pilot pressure enters through port XBp1 and transfers the bypass-cut spool (310). The pressurized oil entering through port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bypass-cut spool (310). Therefore the pressurized oil pushes open the check valve (515), and flows through the inside path and the U-shaped path to the option spool (309).

8) TRAVEL STRAIGHT OPERATION

Simultaneous operating of both travel spools (301) and other spool makes the operation useful. The following is the case where both travel spools (301) and swing spool (305) are changed over. (the pilot ports XAtL, XAtr and XAs are pressurized.)

① Pilot circuit

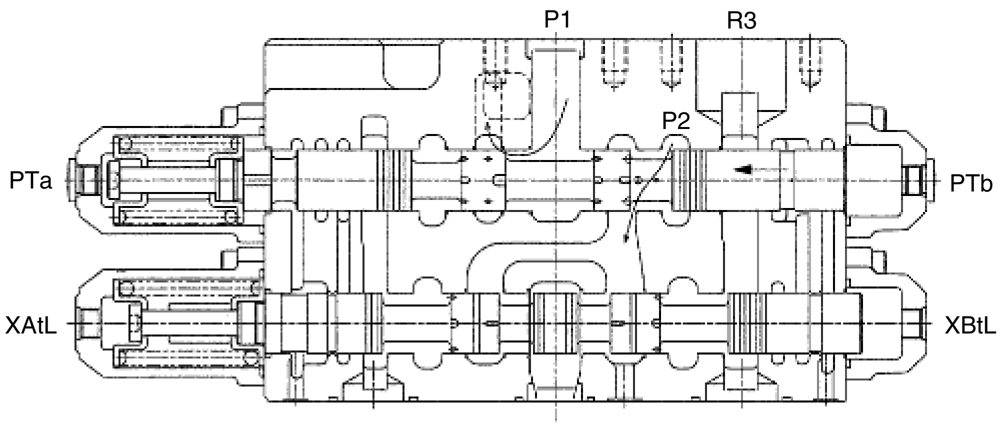
Since the side bypass sections of both travel spools (301) shut off and the side bypass section of the downstream-side of swing spool shuts off, the pilot pressure from the port PG enters through the port PTb to transfer the travel straight spool (308).

② Main circuit

After changeover of the travel straight spool (308), the port P2 and both travel spools (301) are connected preferentially and the port P1 and the parallel paths of swing, boom 2, option and arm 1 / boom 1, bucket and arm 2 are connected preferentially. Therefore, the pressurized oil entering through port P2 passes through mainly ports AtL and Atr, and flows to both travel motors separately.

On the other hand, the pressurized oil entering through port P1 flows to port As and is supplied to the swing motor.

When the pressure of port P2 is lower than the pressure of port P1, the part of oil entering through port P1 flows into Port P2 side. Therefore, it prevents the rapid slowdown of travel.



380A2MC28

9) FUNCTION OF LOCK VALVE

The lock valve (252) is installed between the arm cylinder rod side (R) and the arm 1 spool (302). It decreases the leakage by the pressure of the cylinder.

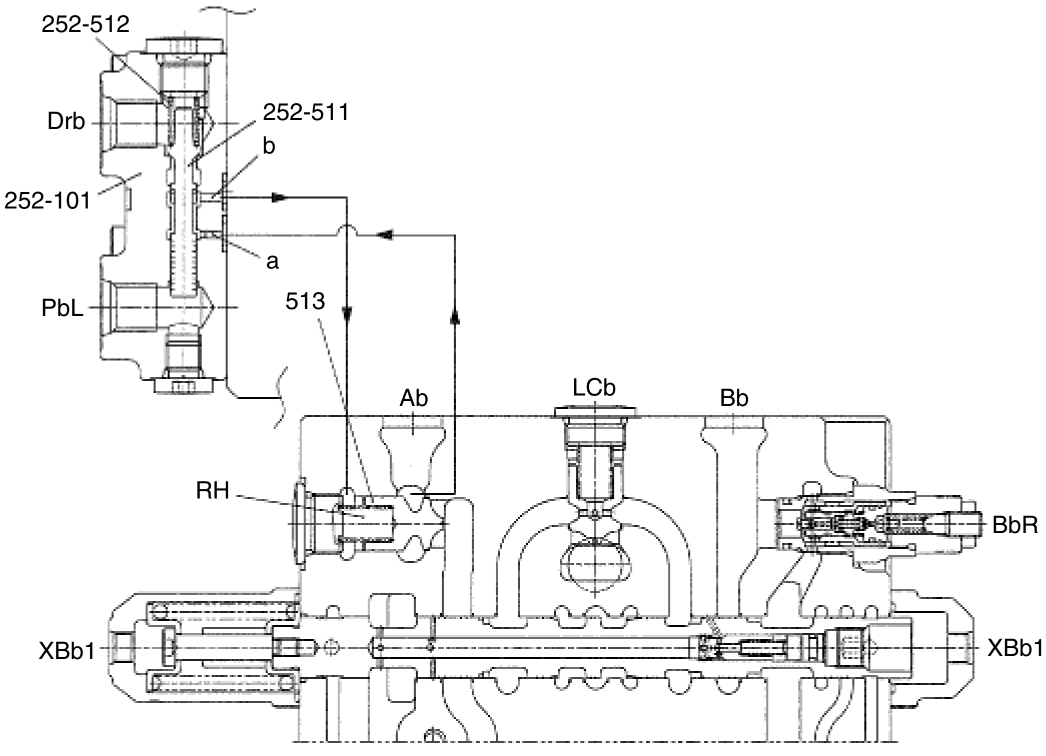
Similarly, another lock valve (252) is installed between the boom cylinder head side (H) and the boom 1 spool (303) and decreases the leakage by the pressure of the cylinder.
The following is the case of the boom cylinder head side (H).

(the case of the arm cylinder rod side (R) is in the same way.)

(1) Neutral positions of spools

During the boom 1 spool (303), boom 2 spool (307) are in the neutral position, the spool (252-511) in the lock valve is kept in the position shown in figure by the force of the spring (252-512). The spool (252-511) is pushed to the seat of the lock valve (252-101).

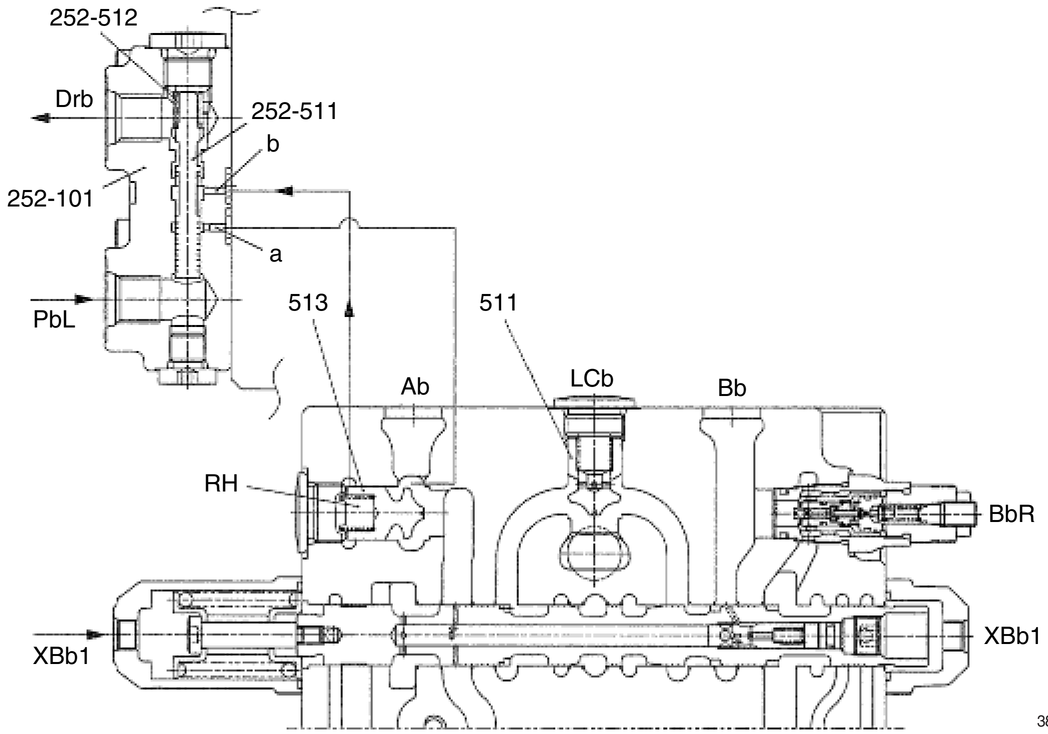
In this position, pressurized oil from the boom cylinder head side (H) enters through hole (a), the periphery of the spool (252-511) in the lock valve and hole (b), and it pushes the poppet (513) to the casing seat, and the leakage is decreased.



380A2MC29

(2) Boom lowering operation

During the boom lowering operation, pilot pressure enters through port PbL, XBb1 and XBb2. Pilot pressure transfers the spool (252-511) in the lock valve in the top direction in figure. By the transfer of the spool (252-511), firstly the hole (a) is blocked and pressurized oil from the boom cylinder head side (H) does not enter to spring chamber (RH). Secondly, the oil in spring chamber (RH) enters through hole (b) and flows to drain circuit. Therefore, the poppet (513) is lifted by the pressure of the boom cylinder head side (H) and the function of the lock valve (252) is released.



380A2MC30

(3) Boom hoisting operation

During the boom hoisting operation, the pilot pressure enters through ports XAb1, XAb2. The oil flowing from the boom 1 spool (303) and the boom 2 spool (307) pushes open the poppet (513) and flows to port Ab.

10) FUNCTION OF MAIN RELIEF VALVEN

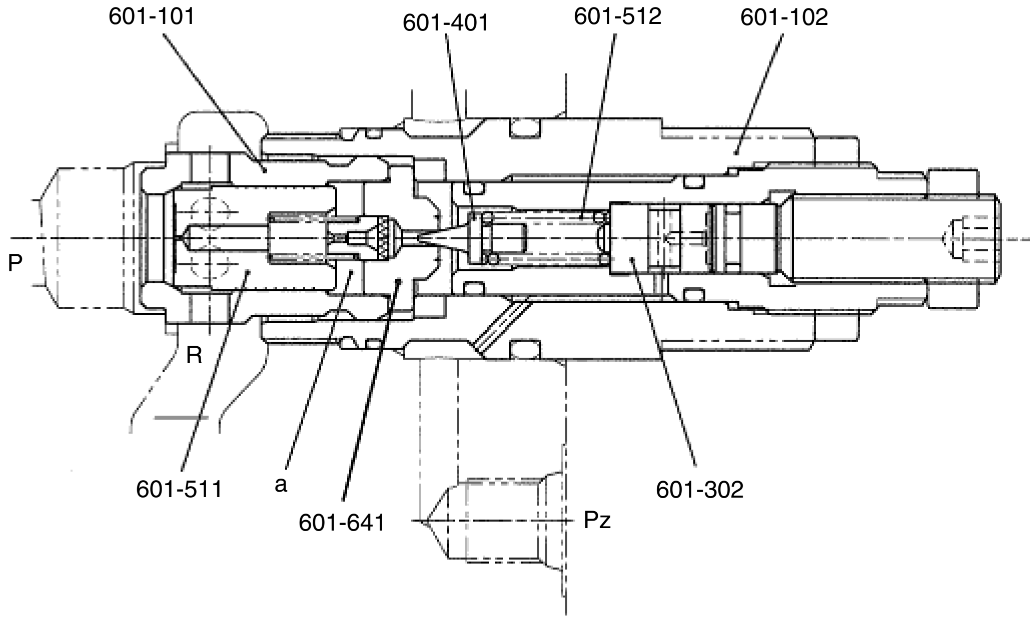
The main relief valve (601) is fitted in the casing A (101) and functions as follows.

(1) The hydraulic oil is filled up in the inside space chamber (a) from the path (P) through a hole of the body (601-101) and a restriction of the plunger (601-511), and seats the plunger (601-511) against body (601-101) securely.

(2) When the pressure in the path (P) becomes equal to the set load of the spring (601-512), the poppet (601-401) opens to make the hydraulic oil flow through a hole of the seat (601-641), around the poppet (601-401) and into the low pressure path (R).

(3) Opening of the poppet (601-401) causes the pressure in the chamber (a) to fall and the plunger (601-511) to open. As the result the pressurized oil in the path (P) runs into the low pressure path (R) directly.

(4) When the pressurized oil higher than pressure 3MPa enters through the port Pz, it pushes the piston (601-302) to change the relief set pressure of the spring (601-512) to the high pressure.



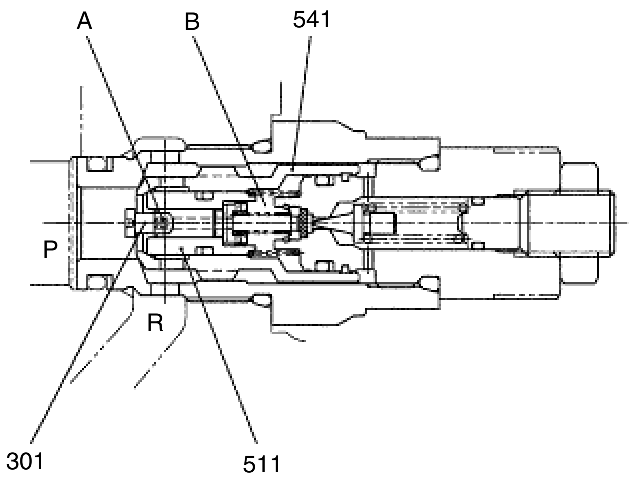
380A2MC31

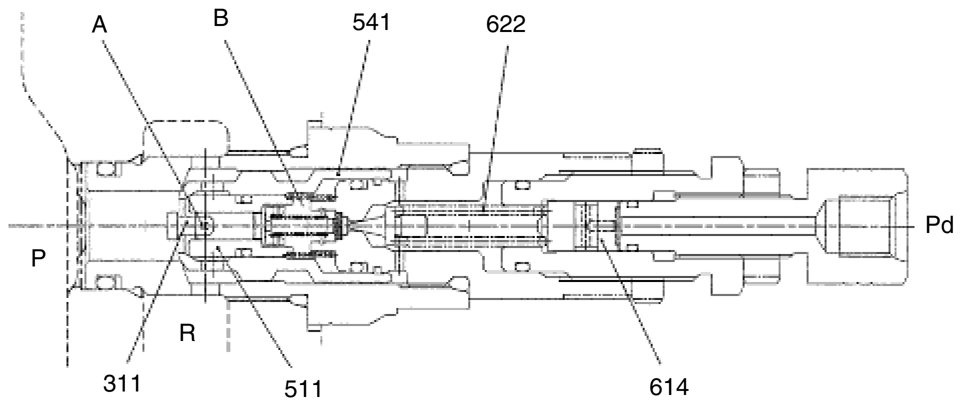
11) FUNCTION OF PORT RELIEF VALVE

The port relief valve is fitted between the cylinder port and low-pressure path. In addition to the relief valve, this serves also as an anti-cavitation check valve, and functions as follows:

(1) Function as relief valve

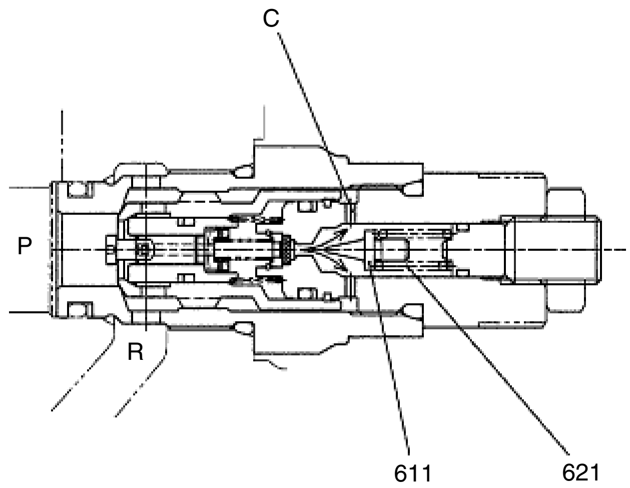
① The pressurized oil passes through Hole A of the piston (301), is filled up in chamber B of the inside space, and seat the plunger (511) against the seat (541) securely.





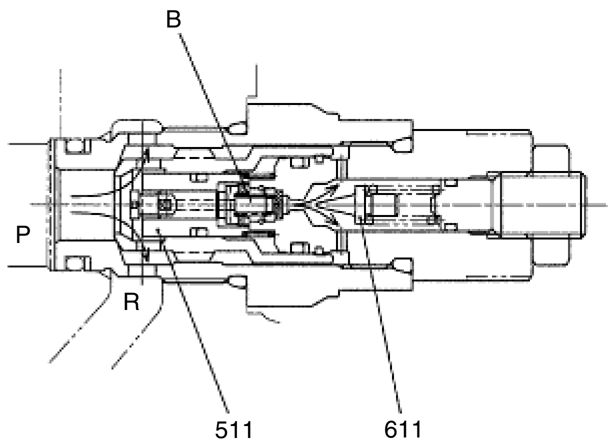
380A2MC32

② When the pressure in the path (P) becomes equal to the set pressure of the spring (621), the pressurized oil pushes open the poppet (611), flows around it, and flows to the low pressure path (R) through hole C.



380A2MC33

③ Opening of the poppet (611) causes the pressure in chamber B to fall and the plunger (511) to open. As the result the pressurized oil in the path (P) runs into the low pressure path (R) directly.

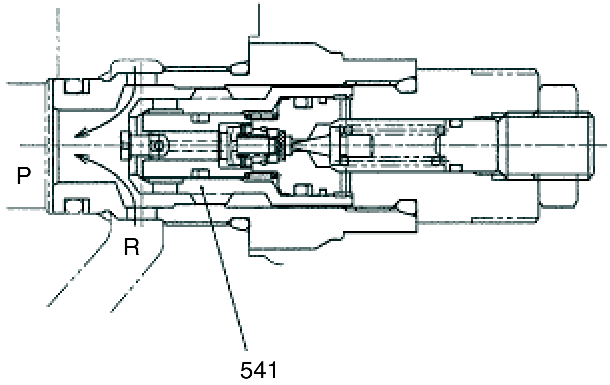


380A2MC34

(2) Function as anti-cavitation check valve

When any negative pressure exists in the path (P), the oil is supplied through the path (R). When the pressure at (R) becomes higher than that in the path (P), the seat (541) moves in the right direction.

Then, sufficient oil passes around the seat (541) from the path (R) to the path (P) and prevents cavitation.



380A2MC35

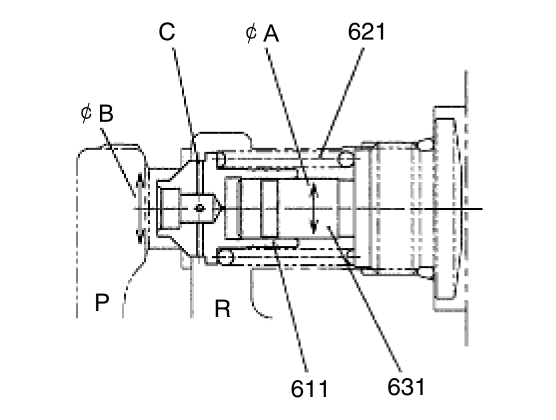
(12) FUNCTION OF NEGATIVE CONTROL RELIEF VALVE

The negative control relief valve is fitted between the downstream of the center bypass path and low-pressure path, and functions as follows:

① When the pressure in the path (P) falls below the set level of the spring (621),the poppet (611) is in the condition shown in the figure.

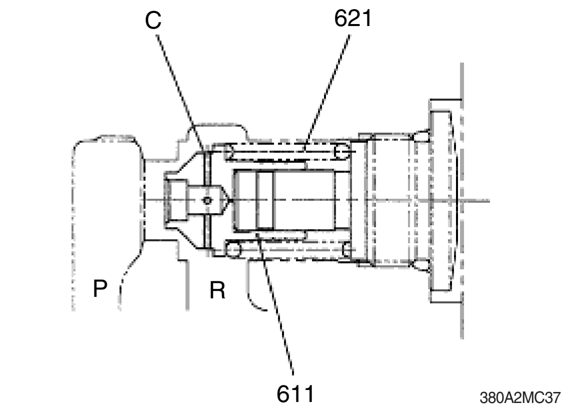
The pressure acting area of the poppet (611) is reduced to (ØB-ØA), as the area ØB is cancelled by the area ØA of the damping rod (631).

In this condition, the pressurized oil in the path (P) runs out to the path (R) through the orifice (C).



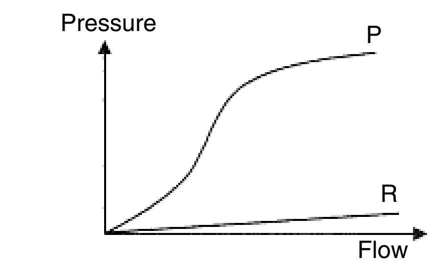
380A2MC36

② When the pressure in the path (P) goes over the set pressure of the spring (621), the poppet (611) opens as shown in the figure. Then, the pressurized oil in the port P passes around the outside of the poppet (611) and flows to the low-pressure path (R).



380A2MC37

The relation between the flow rate Q and pressure P of the hydraulic oil that flows from the path (P) to the low-pressure path (R) is as shown in figure.



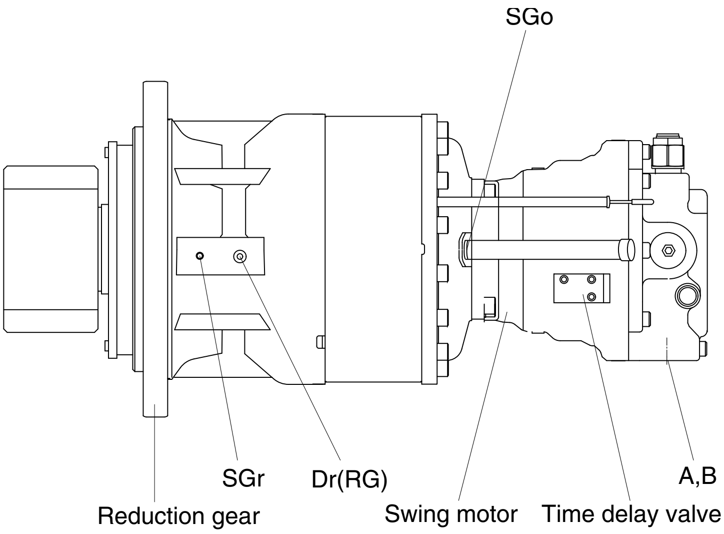
380A2MC38

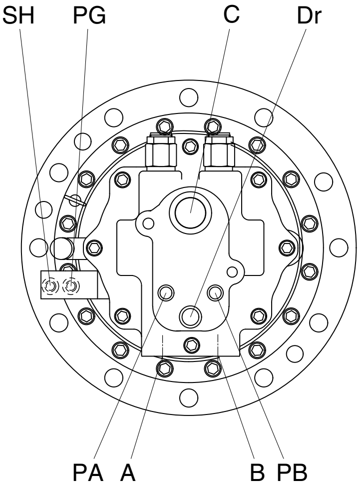
GROUP 3 SWING DEVICE

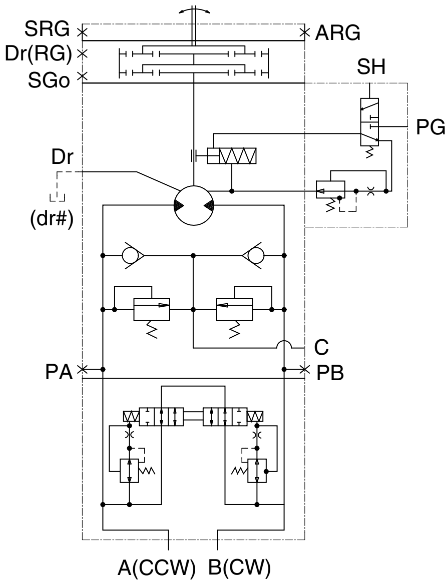
1. STRUCTURE (TYPE 1)

Swing device consists swing motor, swing reduction gear.

Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.





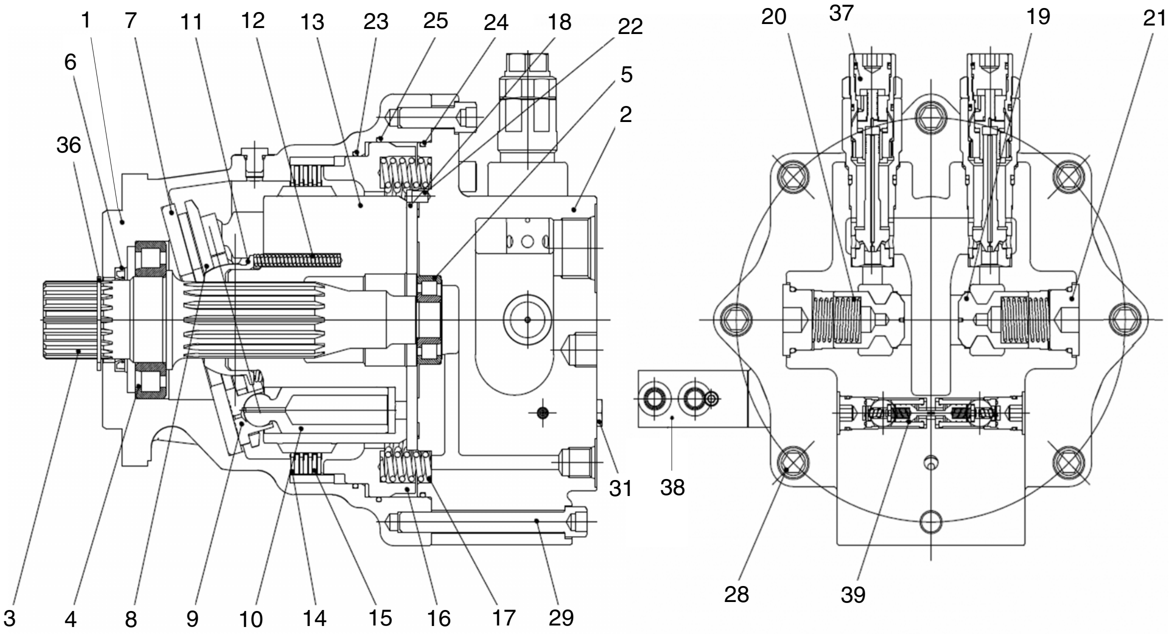


Hydraulic circuit

Port	Port name	Port size
A	Main port	SAE 1"
B	Main port	SAE 1"
DB	Drain port	PF 1/2
C	Make up port	PF 1 1/4
SH	Brake release pilot port	PF 1/4
PG	Brake release stand by port	PF 1/4
PA, PB	Gauge port	PF 1/4
SGr	Grease filling port	PT 1/8
Dr (R/G)	Gear oil drain port	PT 1/2
SGo	Gear oil filling port	PT 3/4

380A2SM01

1) SWING MOTOR (TYPE 1)



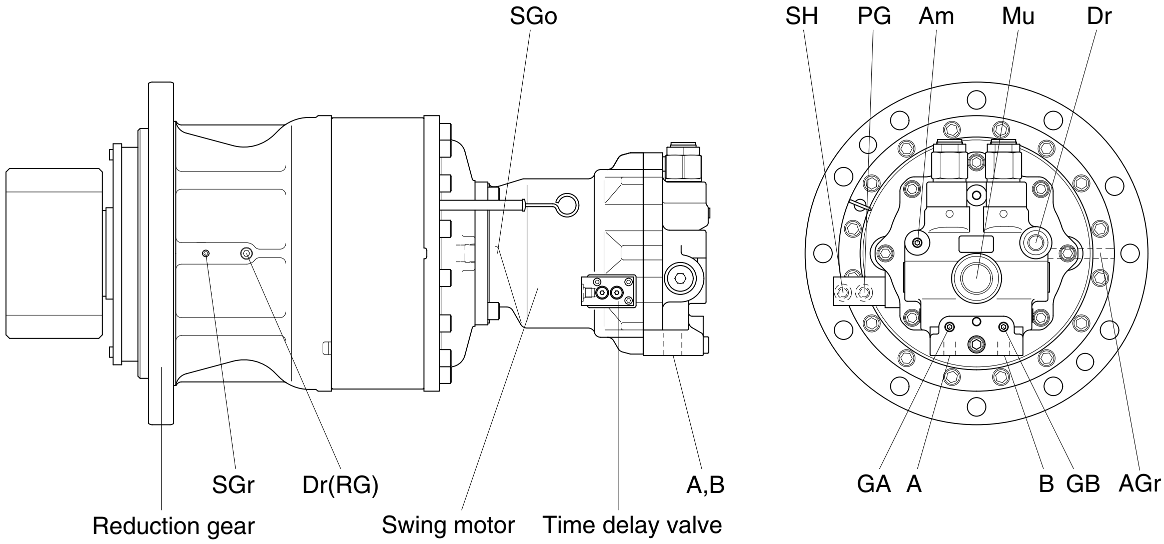
380A8SM05

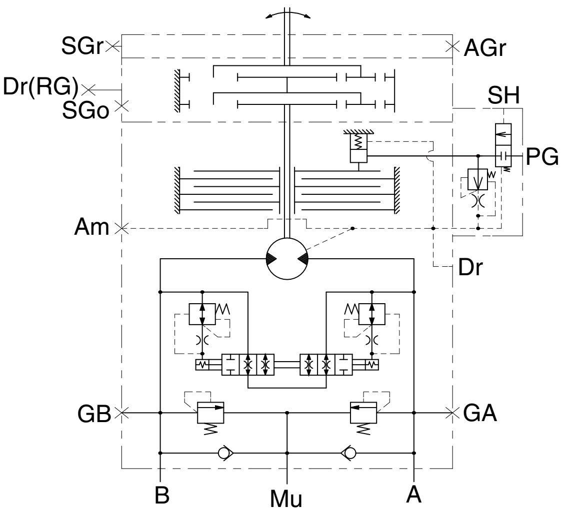
1 Casing
2 Valve casing
3 Drive shaft
4 Roller bearing
5 Roller bearing
6 Oil seal
7 Shoe plate
8 Retainer plate
9 Shoe
10 Piston
11 Thrust ball
12 Cylinder spring
13 Cylinder block
14 Friction plate
15 Separation plate
16 Brake piston
17 Brake spring
18 Valve plate
19 Plunger
20 Check spring
21 RO plug assy
22 Pin
23 O-ring
24 O-ring
25 O-ring
28 Socket bolt
29 Socket bolt
30 Socket bolt
31 VP plug assy
36 Snap ring
37 Relief valve
38 Brake valve
39 Reactionless valve

STRUCTURE (TYPE 2)

Swing device consists swing motor, swing reduction gear.

Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.



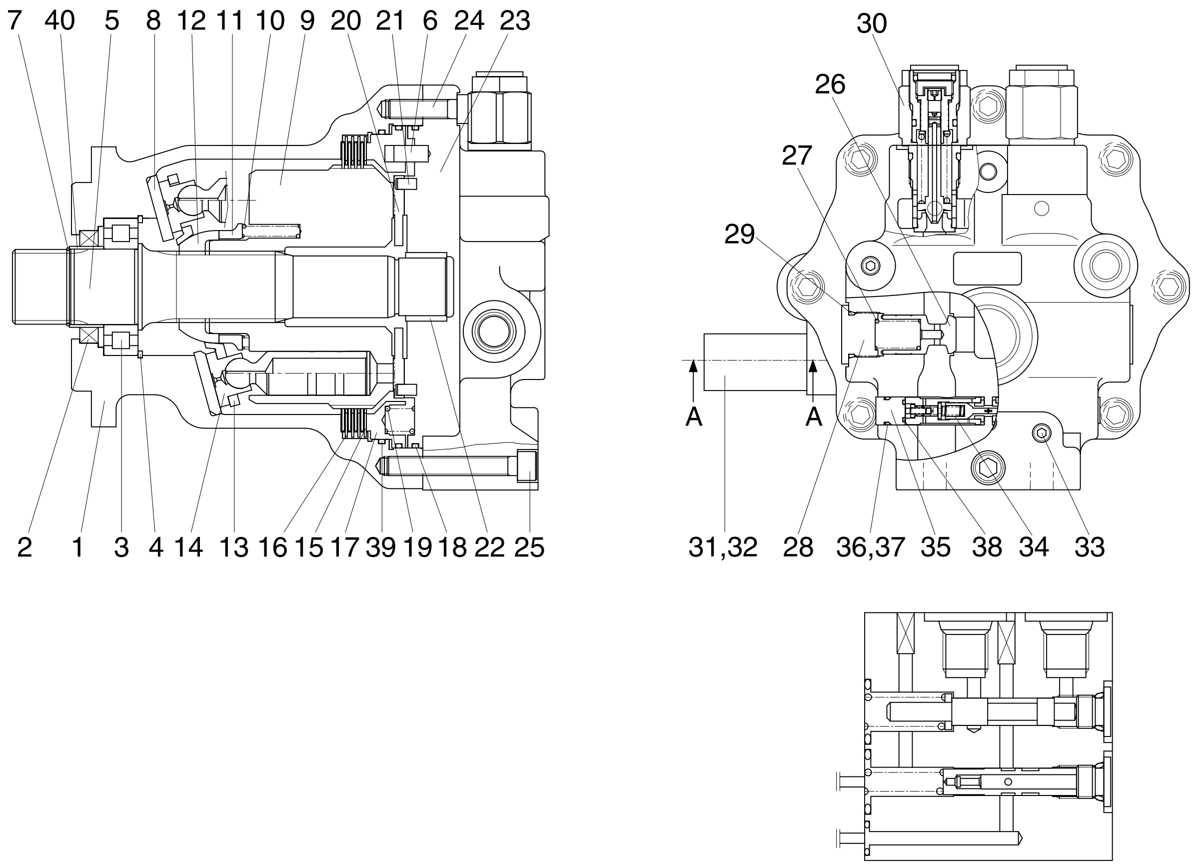


Hydraulic circuit

Port	Port name	Port size
A	Main port	SAE 1"
B	Main port	SAE 1"
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1 1/4
SH	Brake release pilot port	PF 1/4
PG	Brake release stand by port	PF 1/4
GA, GB	Gauge port	PF 1/4
Am	Motor air bleed port	PF 1/4
AGr	R/G air bleed port	PT 1/8
SGr	Grease filling port	PT 1/8
Dr(R/G)	Gear oil drain port	PT 1/2
SGo	Gear oil filling port	PT 3/4

38092SM01A

1) SWING MOTOR (TYPE 2)

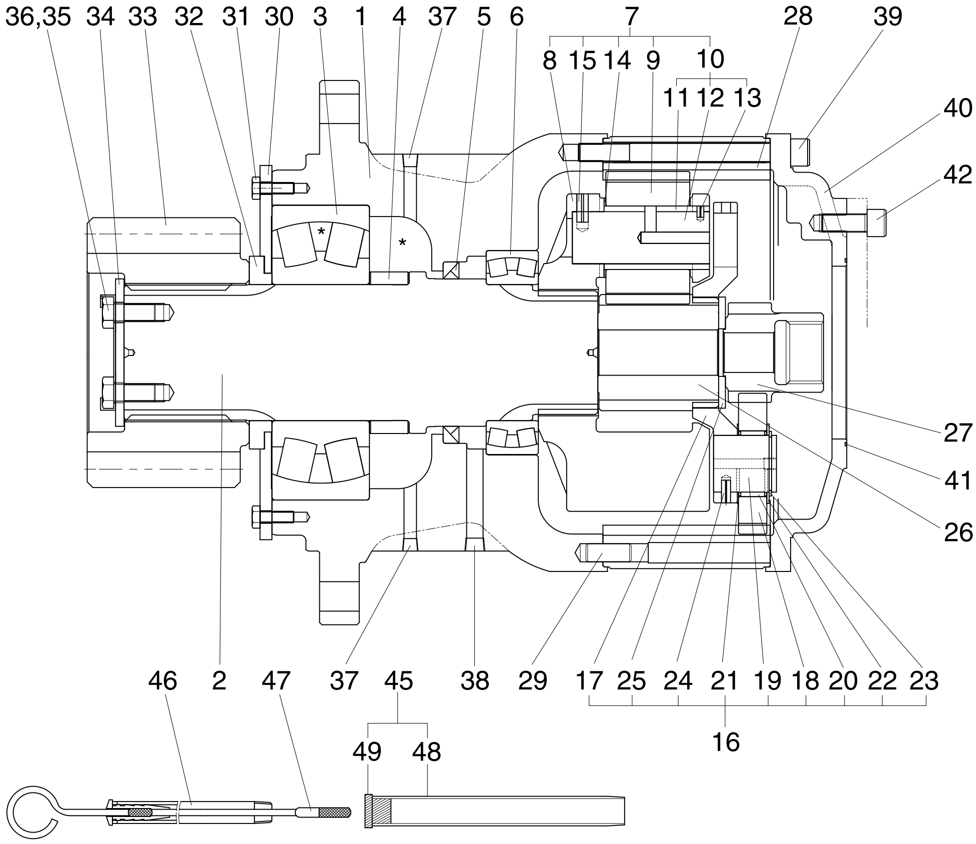


SECTION A-A

38092SM02

1	Body
2	Oil seal
3	Roller bearing
4	Snap ring
5	Shaft
6	Pin
7	Stop ring
8	Shoe plate
9	Cylinder block
10	Spring
11	Ball guide seat
12	Ball guide
13	Set plate
14	Piston assy
15	Friction plate
16	Plate
17	Brake piston
18	O-ring
19	Spring
20	Valve plate
21	Pin
22	Needle bearing
23	Rear cover
24	Wrench bolt
25	Wrench bolt
26	Poppet
27	Spring
28	Plug
29	O-ring
30	Relief valve assy
31	Time delay valve
32	Wrench bolt
33	Plug
34	Swing reactionless valve assy
35	Plug
36	O-ring
37	Back up ring
38	O-ring
39	O-ring
40	Bushing

2) REDUCTION GEAR



380A2SM03

1	Casing	17	Carrier 1	33	Pinion gear
2	Drive shaft	18	Planetary gear 1	34	Lock plate
3	Taper roller bearing	19	Pin 1	35	Hexagon bolt
4	Spacer ring	20	Needle cage	36	Lock washer
5	Oil seal	21	Side plate 1	37	Plug
6	Taper roller bearing	22	Side plate 2	38	Plug
7	Carrier assy 2	23	Stop ring	39	Socket bolt
8	Carrier 2 assy	24	Spring pin	40	Cover
9	Planetary gear 2	25	Thrust ring	41	O-ring
10	Pin assy 2	26	Sun gear 2	42	Hexagon socket bolt
11	Pin 2 assy	27	Sun gear 1	45	Air breather assy
12	Bushing 2	28	Ring gear	46	Gauge pipe
13	Spring pin	29	Knock pin	47	Gauge bar
14	Thrust washer	30	Cover plate	48	Air breather post
15	Spring pin	31	Hexagon bolt	49	Air breather cap
16	Carrier assy 1	32	Spacer		

2. FUNCTION

1) ROTARY PART

When high pressurized oil enters a cylinder through port (a), which is the inlet of valve plate (1), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston (2) upon the retainer plate (3) which acts upon the shoe plate (4) via an hydrostatic bearing. Force F1 perpendicular to shoe plate (4) and force F2 perpendicular to cylinder center.

Being transferred to the cylinder block (5) through piston, force F2 causes rotational moment at surroundings of cylinder.

Since cylinder block has 9 equidistantly arrayed pistons, rotational torque is transmitted to cylinder shaft in order by several pistons connected to the inlet port of high pressurized oil. When the direction of oil flow is reversed, rotational direction of cylinder is also reversed. Output torque is given by the equation.

$$T=\frac{p \times q}{2\pi}\ ,\ q=Z \cdot A \cdot PCD \cdot \tan\theta\ ,\ F_1=\frac{F}{\cos\theta}\ ,\ F_2=F\tan\theta\ ,\ S=PCD \times \tan\theta$$

Where p : Effective difference of pressure (kgf/cm^2)

q : Displacement (cc/rev)

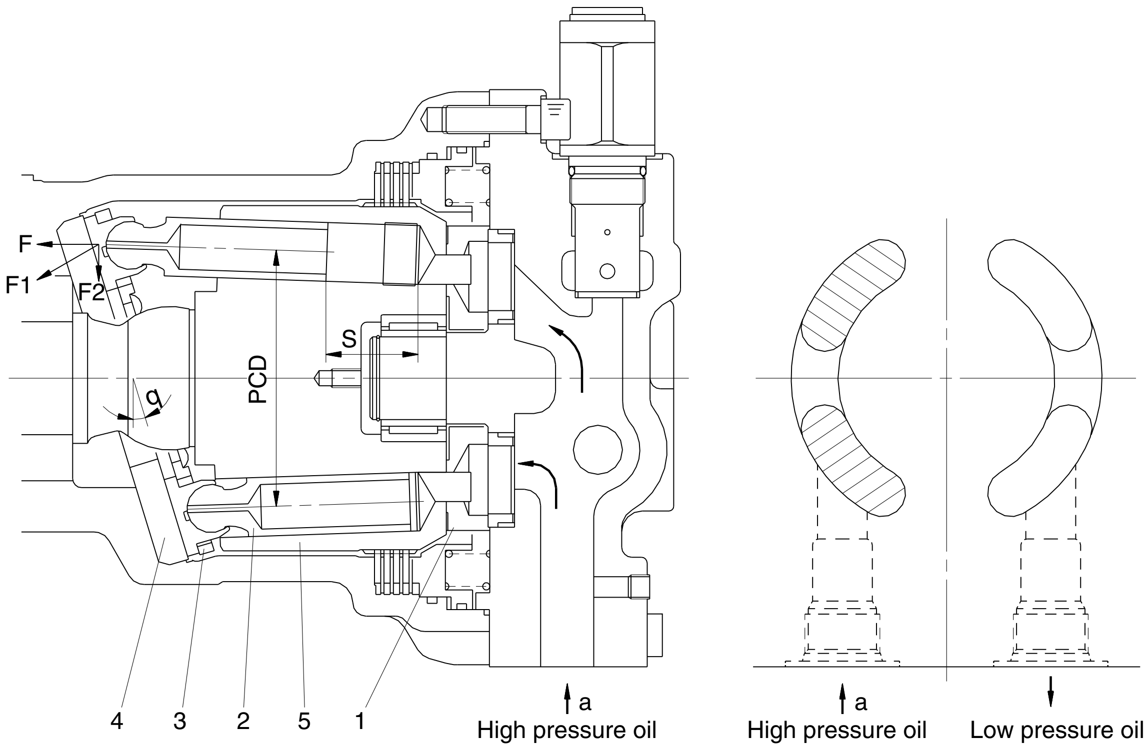
T : Output torque (kgf · cm)

Z : Piston number

A : Piston area (cm^2)

θ : Tilting angle of shoe plate (degree)

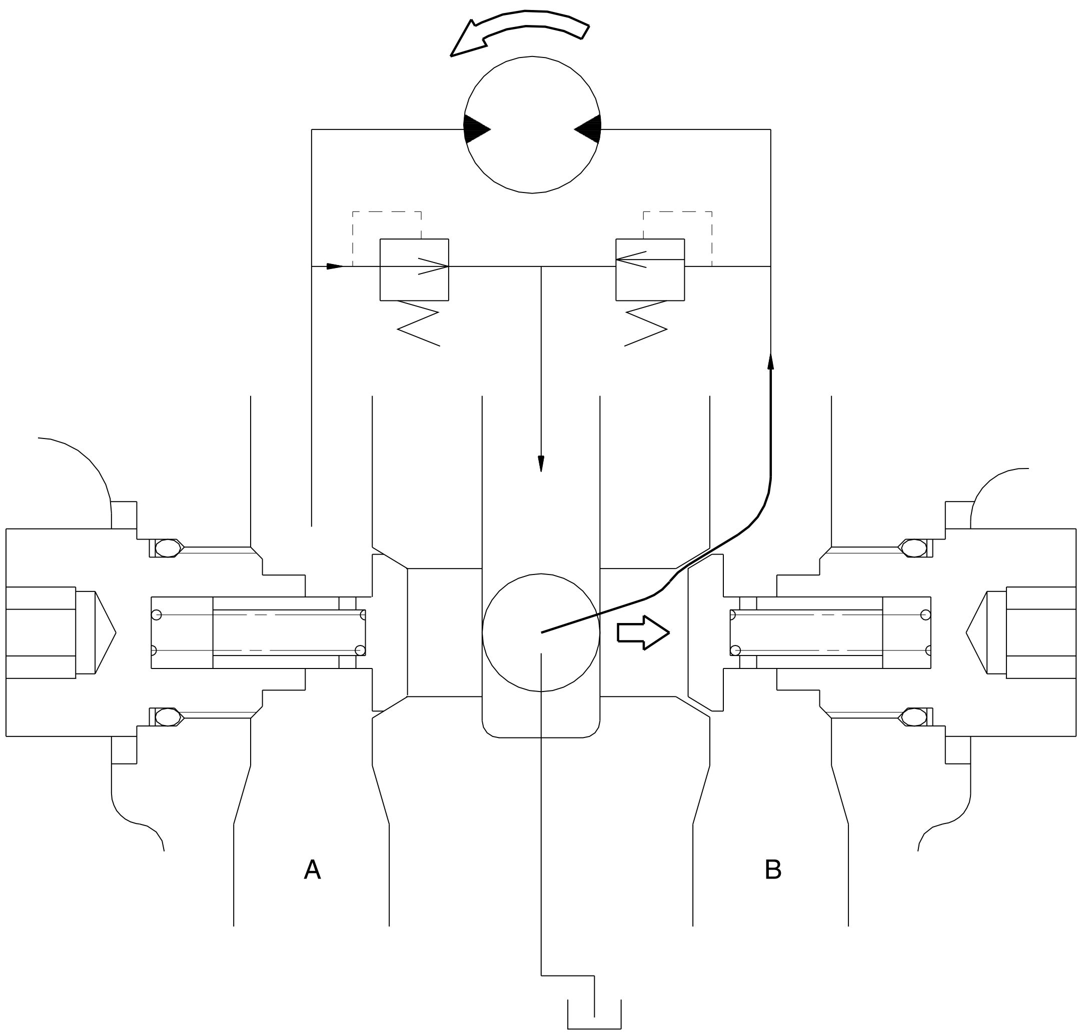
S : Piston stroke (cm)



36072SM04A

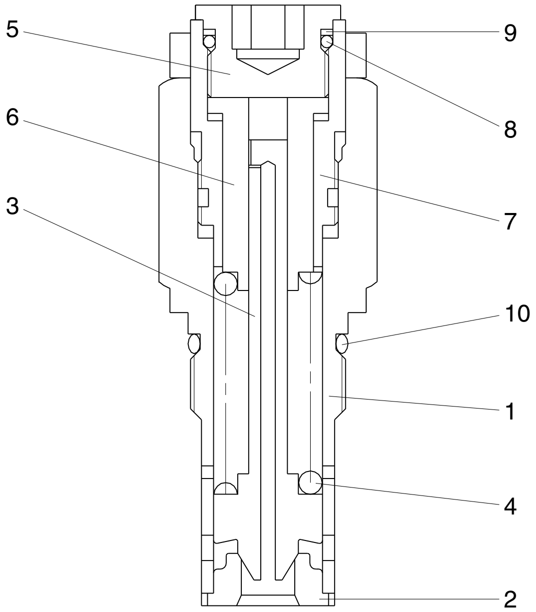
2) MAKE UP VALVE

In the system using this type of motor, there is no counter balance functioning valve and there happens the case of revolution exceeding hydraulic supply of motor. To prevent the cavitation caused by insufficient oil flow there is a make up valve to fill up the oil insufficiency.
A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.
Pressurized oil into the port B, the motor rotate counterclockwise.
If the plunger of MCV moves neutral position, the drain oil from Mu port run into motor via right make up valve, which prevent the cavitation of motor.



36072SM05

3) RELIEF VALVE



36072SM06

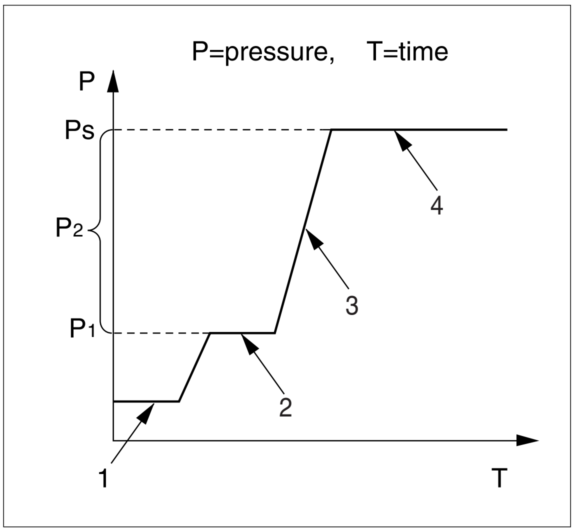
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Sleeve
8	O-ring
9	Back up ring
10	O-ring

(1) Construction of relief valve

The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

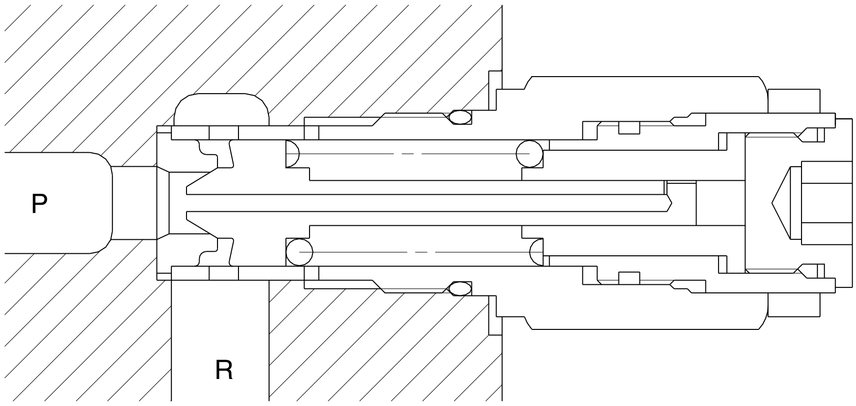
(2) Function of relief valve

Figure illustrates how the pressure acting on the relief valve is related to its rising process. Here is given the function, referring to the figure following page.



2-51(2) [360-7]

① Ports (P, R) at tank pressure.

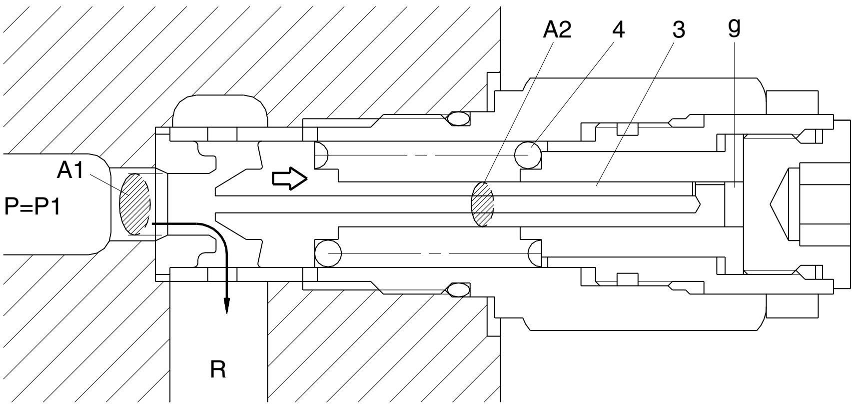


36072SM07

② When hydraulic oil pressure (P × A1) reaches the preset force (F_{SP}) of spring (4), the plunger (3) moves to the right as shown.

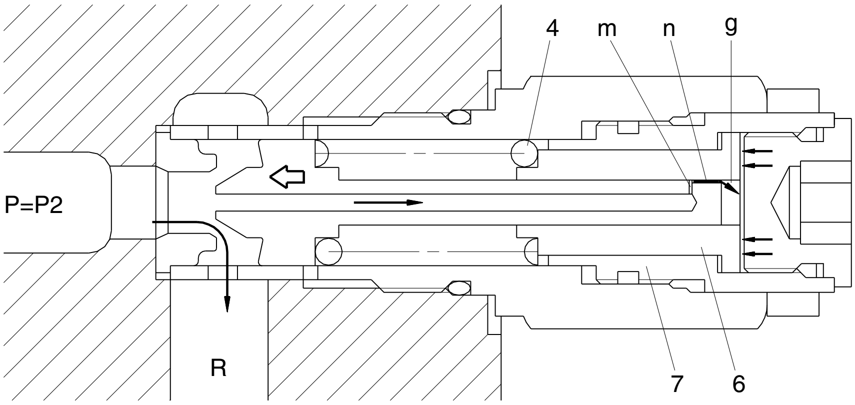
$P_1 \times A_1 = F_{SP} + Pg \times A_2$

$$P1 = \frac{Fsp + Pg \times A2}{A1}$$



36072SM08

③ The oil flow chamber g via orifice m and n. When the pressure chamber g reaches the preset force (Fsp) of spring (4), the piston (6) moves left and stop the piston (6) hits the bottom of sleeve (7).

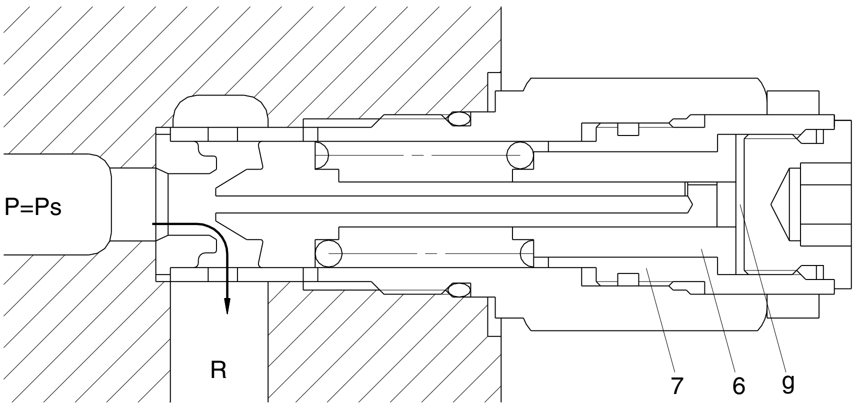


36072SM09

④ When piston (6) hits the end of sleeve (7), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

$P_S \times A_1 = F_{SP} + P_S \times A_2$

$$PS = \frac{Fsp}{A1-A2}$$



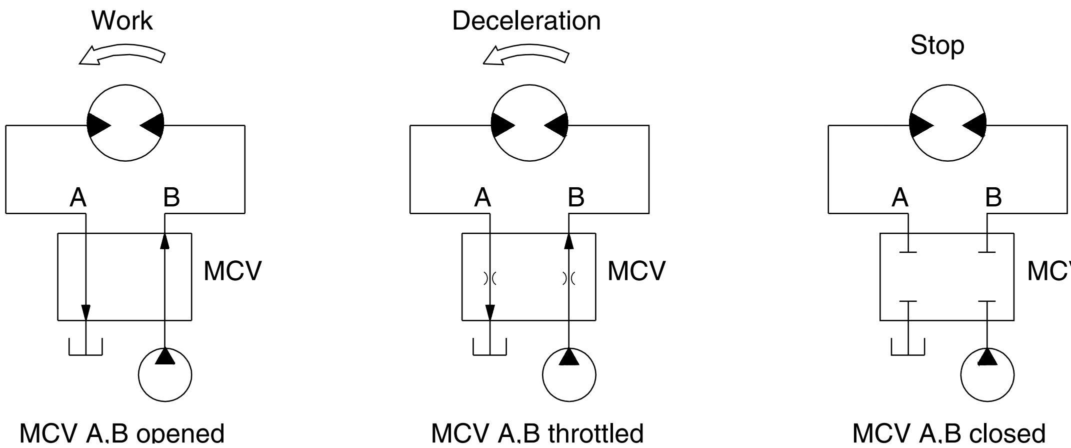
36072SM10

4) BRAKE SYSTEM

(1) Control valve swing brake system

This is the brake system to stop the swing motion of the excavator for during operation.

In this system, the hydraulic circuit is throttled by the swing control valve, and the resistance created by this throttling works as a brake force to slow down the swing motion.



R130SM05

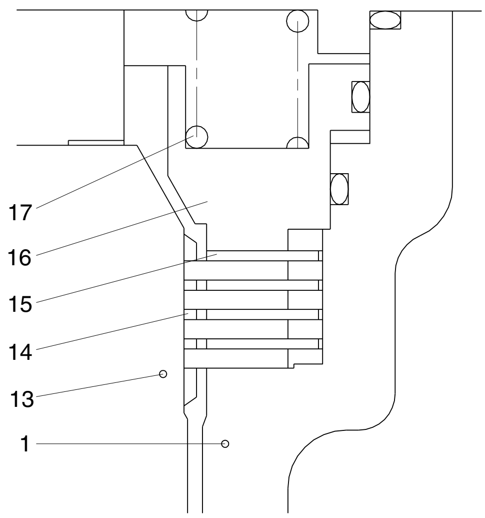
(2) Mechanical swing parking brake system

The mechanical swing parking brake system is installed to prevent the upper structure from swinging downhill because of its own weight when the excavator is parked on a slope since it completely eliminates the hydraulic drift of swing motion while the excavator is on a slop, work can be done more easily and safely.

① Brake assembly

Circumferential rotation of separate plate (15) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (17) through friction plate (14), separate plate (15) and brake piston (16), friction force occurs there.

Cylinder block (13) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

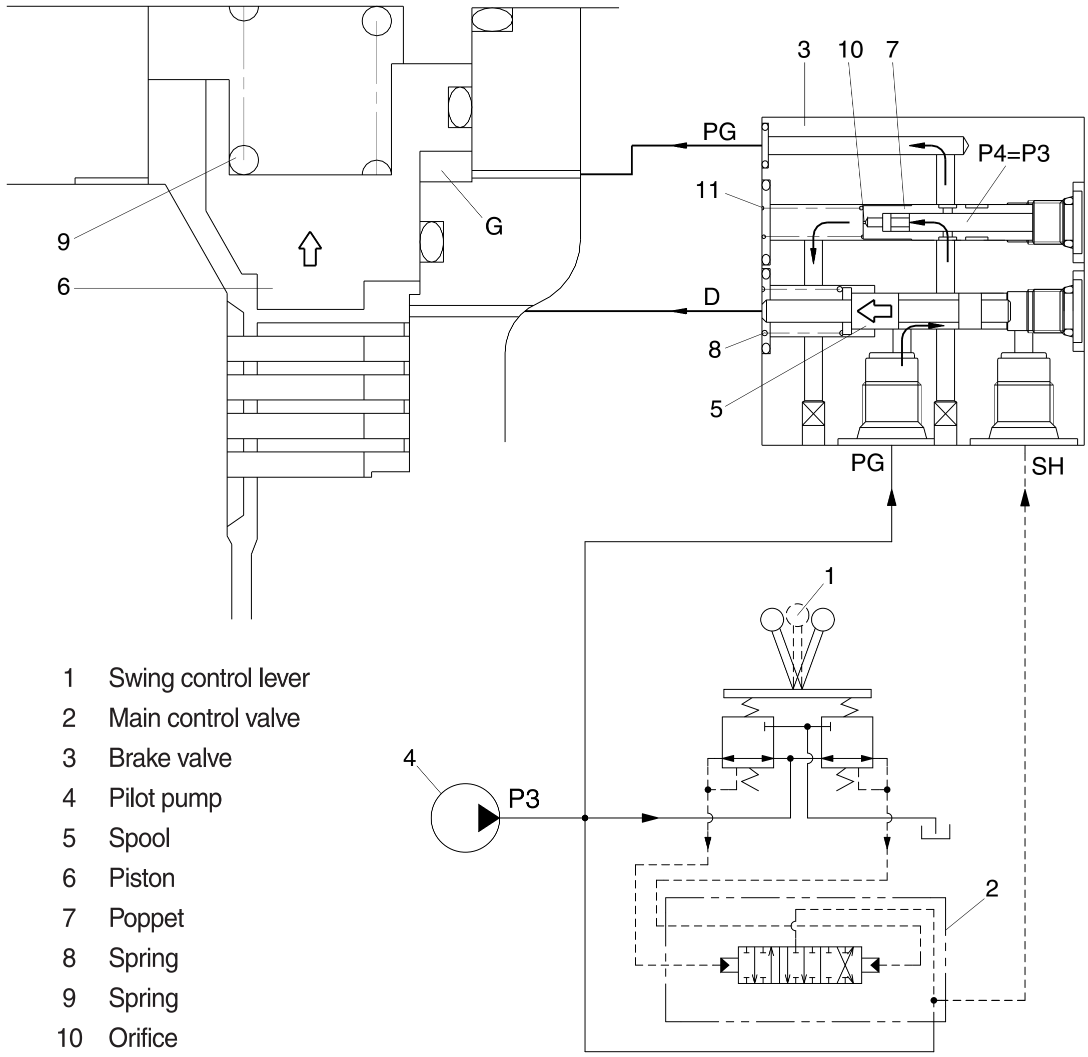


36072SM11

1	Casing	15	Separate plate
13	Cylinder block	16	Brake piston
14	Friction plate	17	Brake spring

② Operating principle

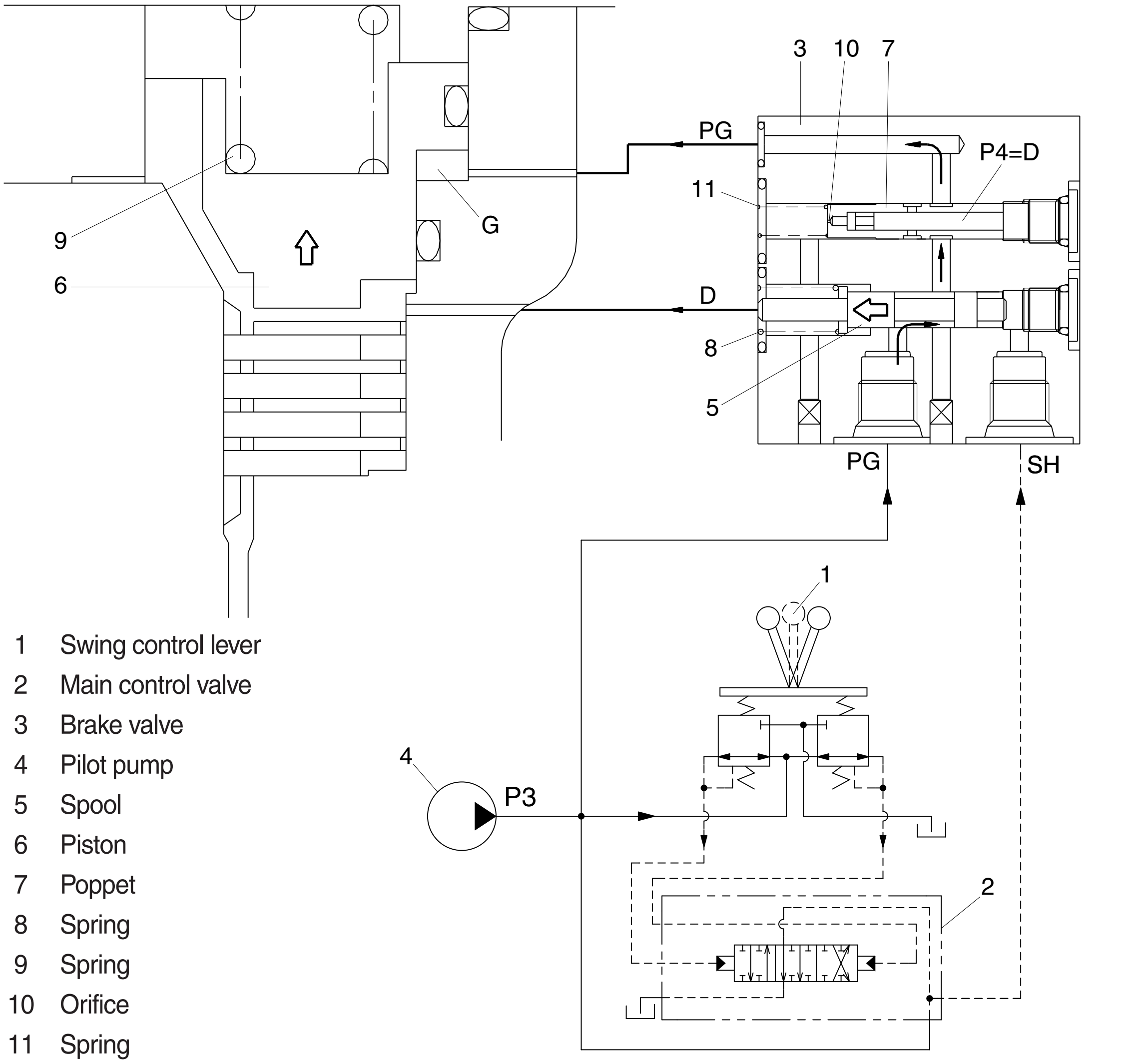
a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the brake valve (3).
This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the piston (6) to the upward against the force of the spring (9). Thus, it releases the brake force.



1 Swing control lever
2 Main control valve
3 Brake valve
4 Pilot pump
5 Spool
6 Piston
7 Poppet
8 Spring
9 Spring
10 Orifice
11 Spring

36072SM12

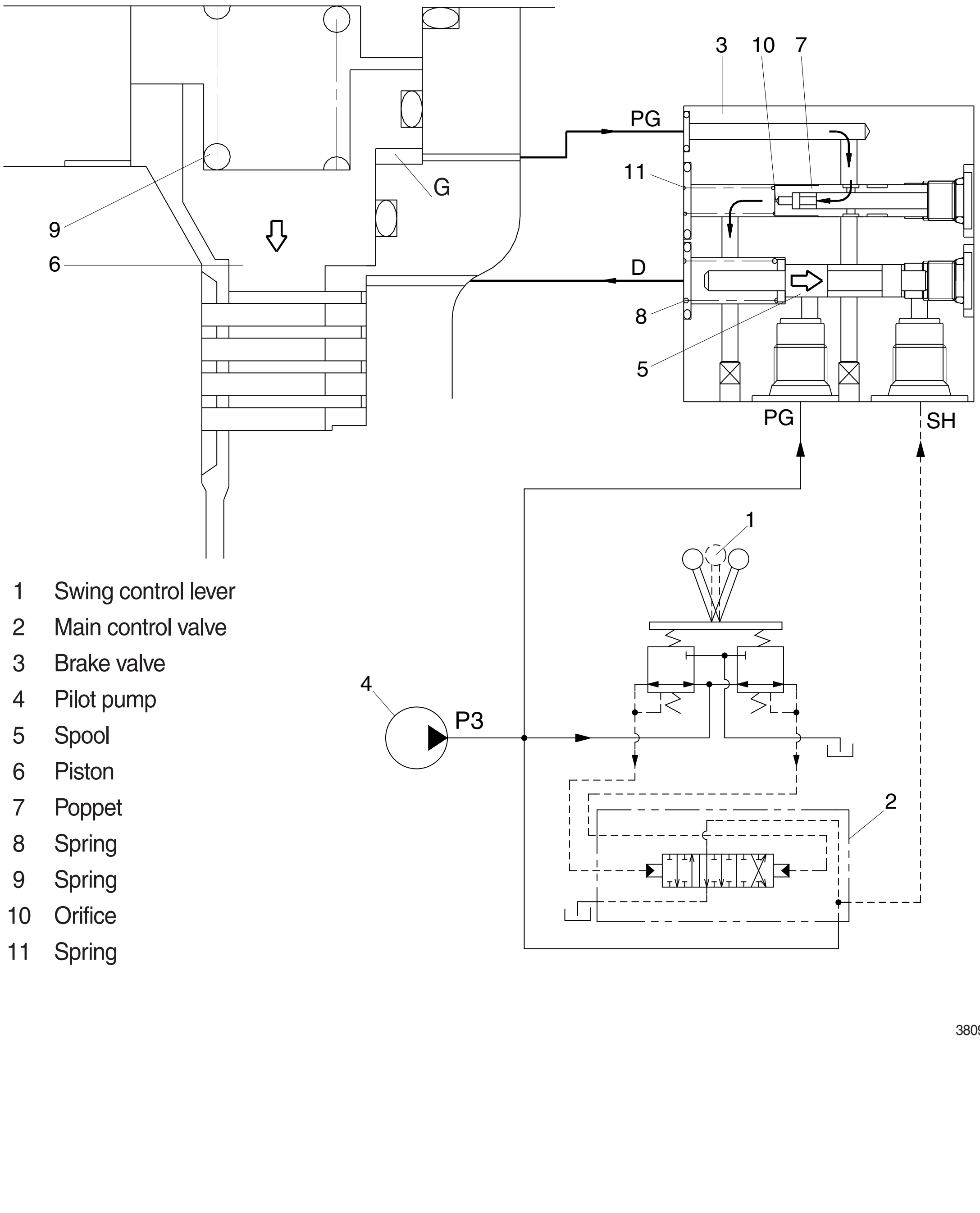
b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
   Then, the piston (6) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
   At this time, the brake works.



1 Swing control lever
2 Main control valve
3 Brake valve
4 Pilot pump
5 Spool
6 Piston
7 Poppet
8 Spring
9 Spring
10 Orifice
11 Spring

36072SM13A

c. When the swing control (1) lever is set the neutral position the spool (5) returns right in the brake valve (3).
   Then, the piston (6) is moved lower by spring force and the return and the return oil from the chamber G flows back to D-port through orifice (10) of the poppet (7).
   At this time, the poppet (7) works to make a time lag for 5 seconds.



1 Swing control lever
2 Main control valve
3 Brake valve
4 Pilot pump
5 Spool
6 Piston
7 Poppet
8 Spring
9 Spring
10 Orifice
11 Spring

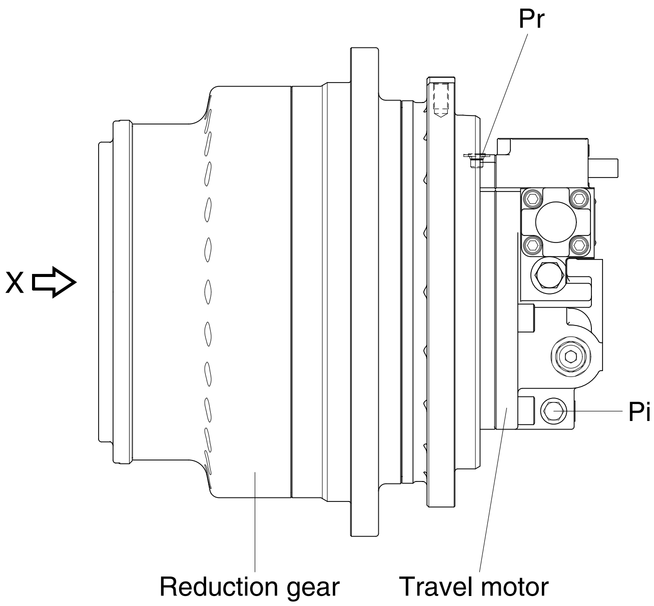
38092SM04

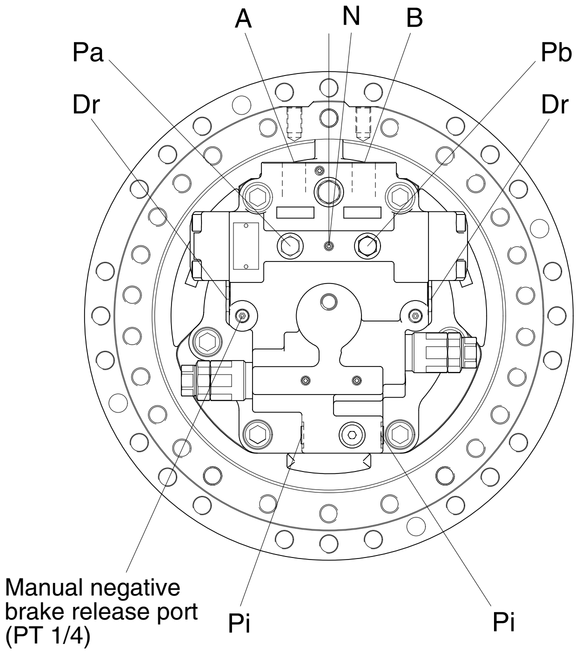
GROUP 4 TRAVEL DEVICE

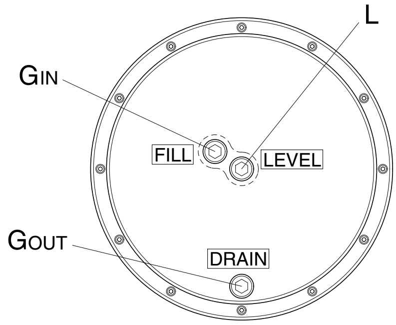
1. CONSTRUCTION

Travel device consists travel motor and reduction gear.

Travel motor include counterbalance valve, cross over relief valve.

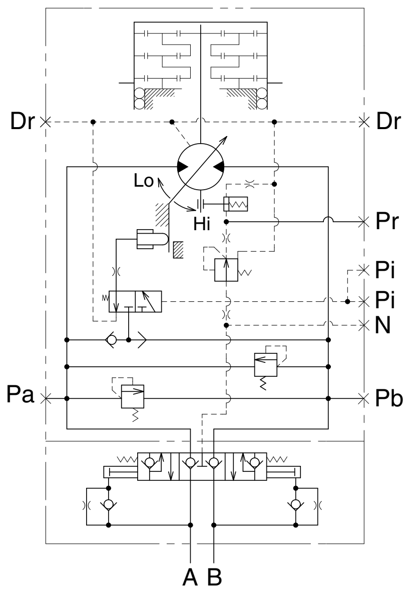






VIEW X

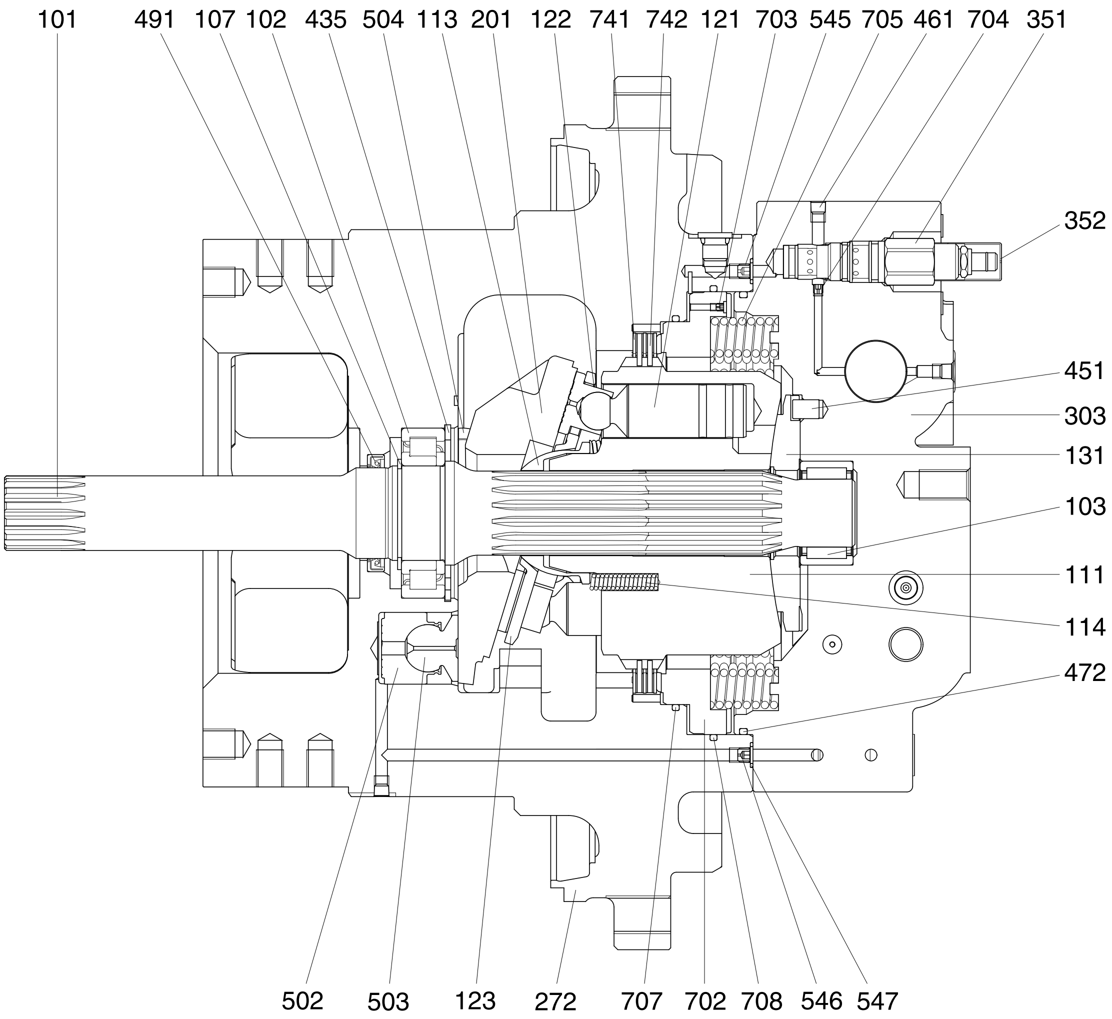
3809A2TM01



Hydraulic circuit

Port	Port name	Port size
A	Main port	SAE 6000 psi 1"
B	Main port	SAE 6000 psi 1"
Pi	Pilot port	PF 1/4
Dr	Drain port	PF 1/2
N	Negative brake release port	NPTF 1/16
Pa, Pb	Pressure gauge port	PF 1/4
Pr	Brake release pressure gauge port	PF 1/4
L	Level gauge	PF 1/2
GIN	Gear oil inlet port	PF 1/2
GOUT	Gear oil outlet port	PF 1/2

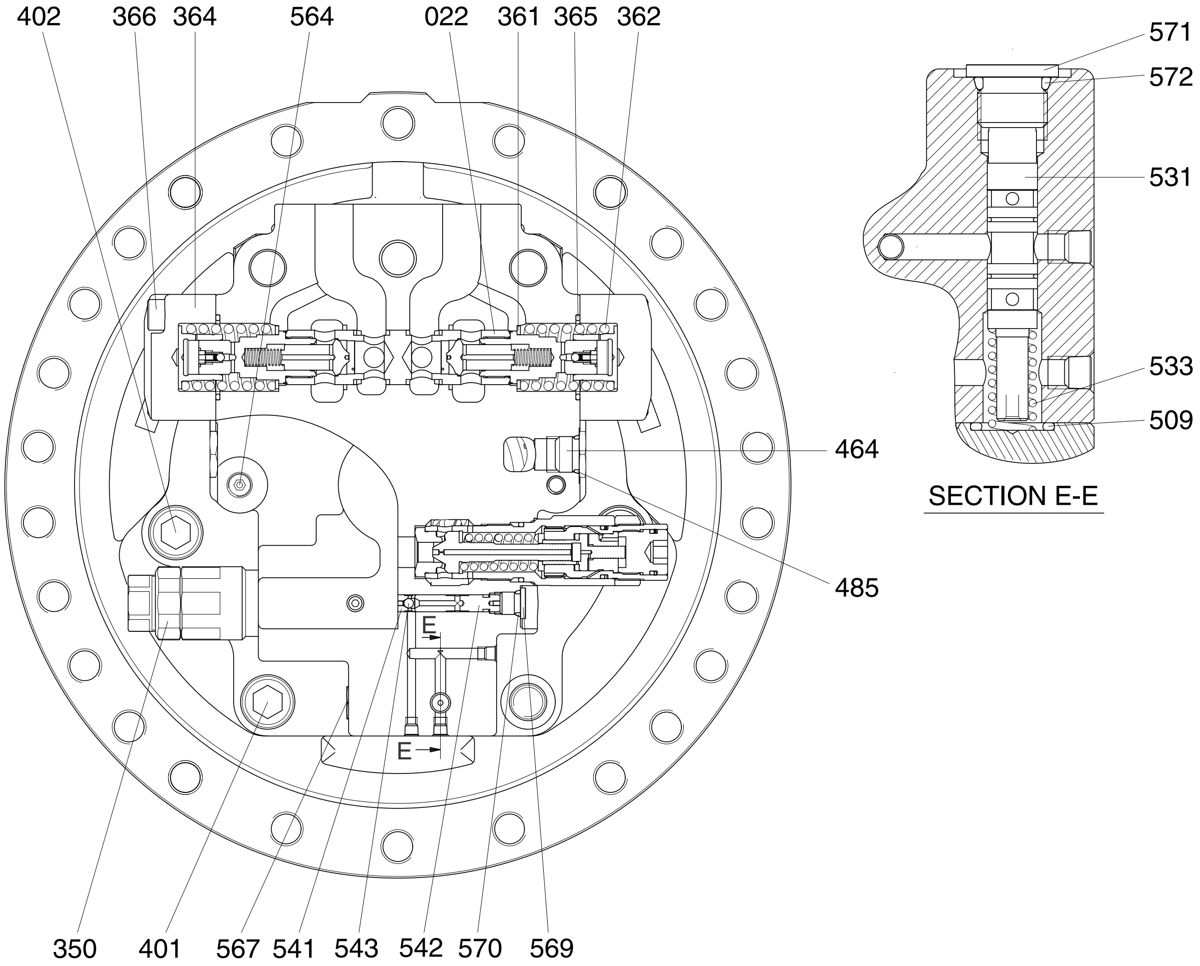
1) TRAVEL MOTOR (1/2)



3809A2TM02

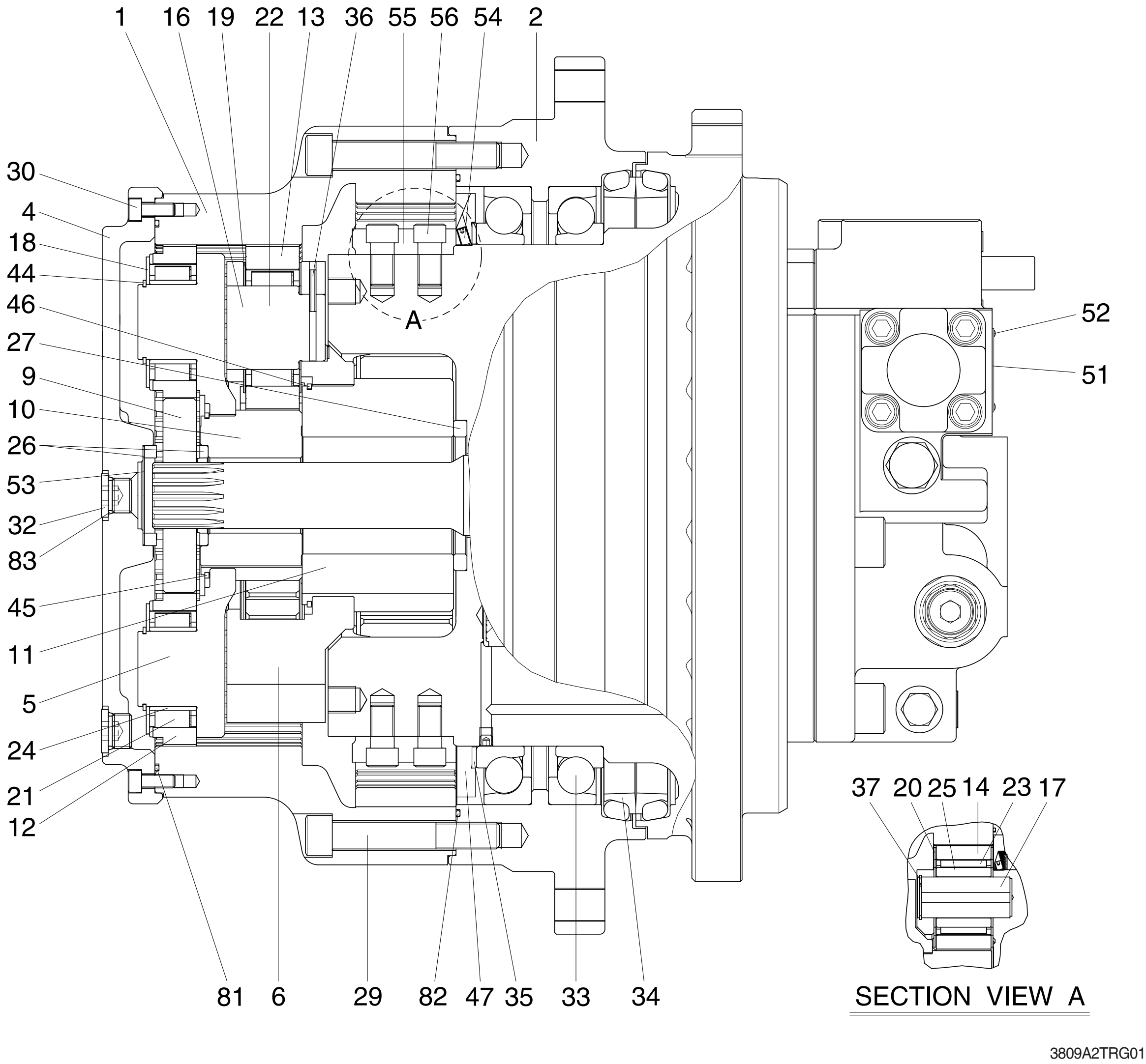
101	Drive shaft	272	Shaft casing	545	Orifice
102	Roller bearing	303	Valve casing	546	Orifice
103	Needle bearing	351	Reducing valve	547	O-ring
107	Snap ring	352	Cover	702	Brake piston
111	Cylinder block	435	Snap ring	703	Orifice
113	Spherical bushing	451	Pin	704	Orifice
114	Cylinder spring	461	Plug	705	Brake spring
121	Piston	472	O-ring	707	O-ring
122	Shoe	491	Oil seal	708	O-ring
123	Set plate	502	Piston	741	Separation plate
131	Valve plate	503	Shoe	742	Friction plate
201	Swash plate	504	Pivot ball		

TRAVEL MOTOR (2/2)



022	Counterbalance spool	402	Hex socket bolt	543	Steel ball
350	Relief valve	464	VP plug	564	Plug
361	Washer	485	O-ring	567	VP plug
362	Counterbalance spring	509	O-ring	569	RO plug
364	Counterbalance cover	531	Tilting spool	570	O-ring
365	O-ring	533	Tilting spring	571	RO plug
366	Hex socket bolt	541	Seat	572	O-ring
401	Hex socket bolt	542	Stopper		

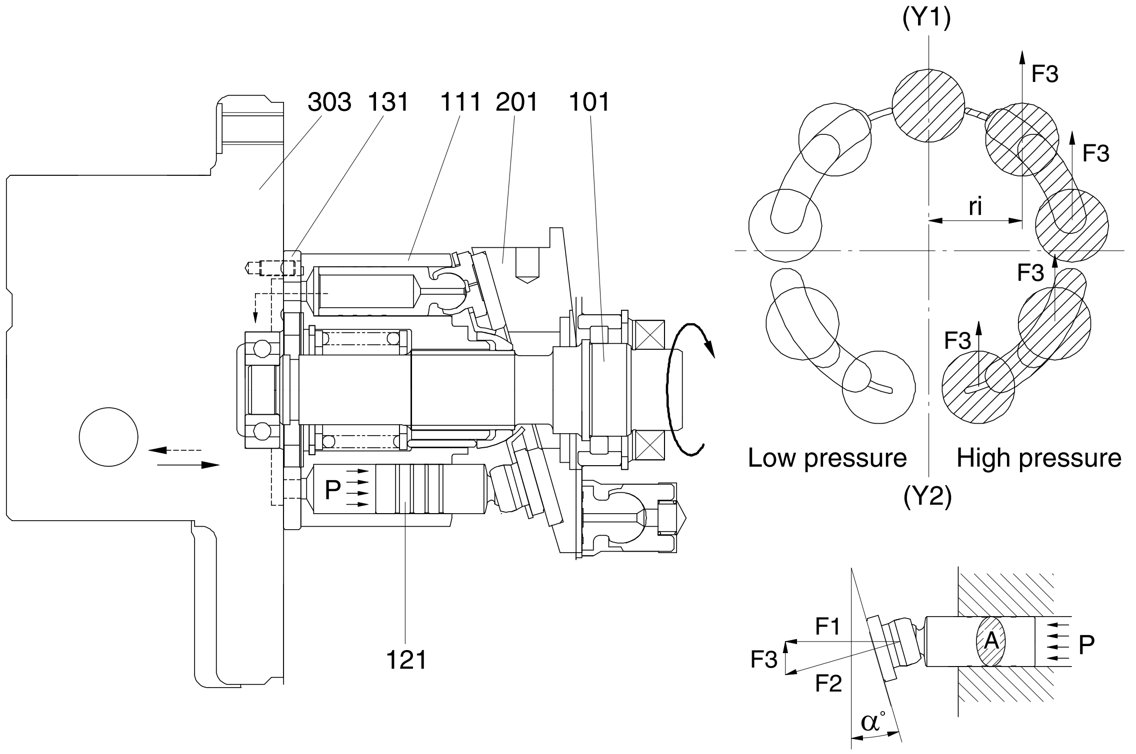
2) REDUCTION GEAR



1	Ring gear	20	Side plate	37	Snap ring
2	Housing	21	Needle cage	44	Snap ring
4	Side cover	22	Needle cage	45	Clip
5	Carrier 1	23	Needle cage	46	W clip
6	Carrier 2	24	Inner ring	47	Nutring
9	Sun gear 1	25	Floating bushing	51	Name plate
10	Sun gear 2	26	Thrust ring	52	Rivet
11	Sun gear 3	27	Thrust ring	53	Washer
12	Planetary gear 1	29	Socket bolt	54	Set screw
13	Planetary gear 2	30	Socket bolt	55	Nutring stopper
14	Planetary gear 3	32	RO plug	56	Hex socket bolt
16	Pin 2	33	Angular bearing	81	O-ring
17	Pin 3	34	Floating seal	82	O-ring
18	Side plate	35	Shim	83	O-ring
19	Side plate	36	Spring pin		

2. FUNCTION

1) GENERATION OF TORQUE



3607A2TRG02

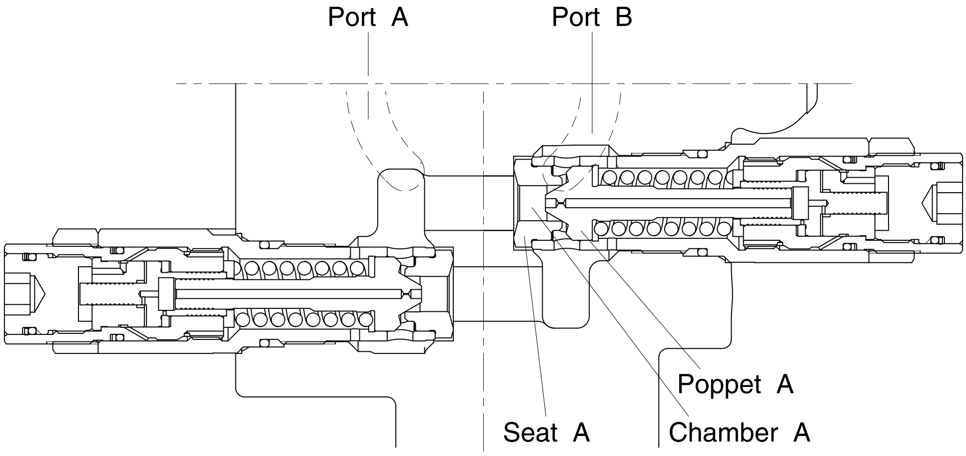
The pressurized oil delivered from the hydraulic pump flows to valve casing (303) of the motor, passes through the brake valve mechanism, and is introduced into cylinder block (111) via valve plate (131). This oil constructively introduced only to one side of (Y1)- (Y2) connecting the upper and lower dead points of stroke of piston (121). The pressurized oil led to one side in cylinder block (111) pushes each piston (121) four or five and generates a forec [F (kgf) = P (kgf/cm^2) ×A (cm^2)].
This force acts on swash plate (201), and is resolves into components (F2 and F3) because swash plate (201) is fixed at an angle (α) with the axis of drive shaft (101).
Radial component (F3) generates respective torques (T=F3×ri) for (Y1)- (Y2). This residual of torque [T=S (F3×ri)] rotates cylinder block (111) via piston (121).
Since the cylinder block (111) is spline coupled with drive shaft (101).
So the drive shaft (101) rotates and the torque is transmitted.

2) RELIEF VALVE

The relief valve mainly has the following two functions :

(1) To keep the starting pressure of the hydraulic motor at a constant value and bypass to the return line excessive oil generated at the motor inlet depending upon the acceleration speed of the driven inertia.

(2) To generate a brake pressure at the outlet during stopping of the driven inertia, and stop it forcedly.

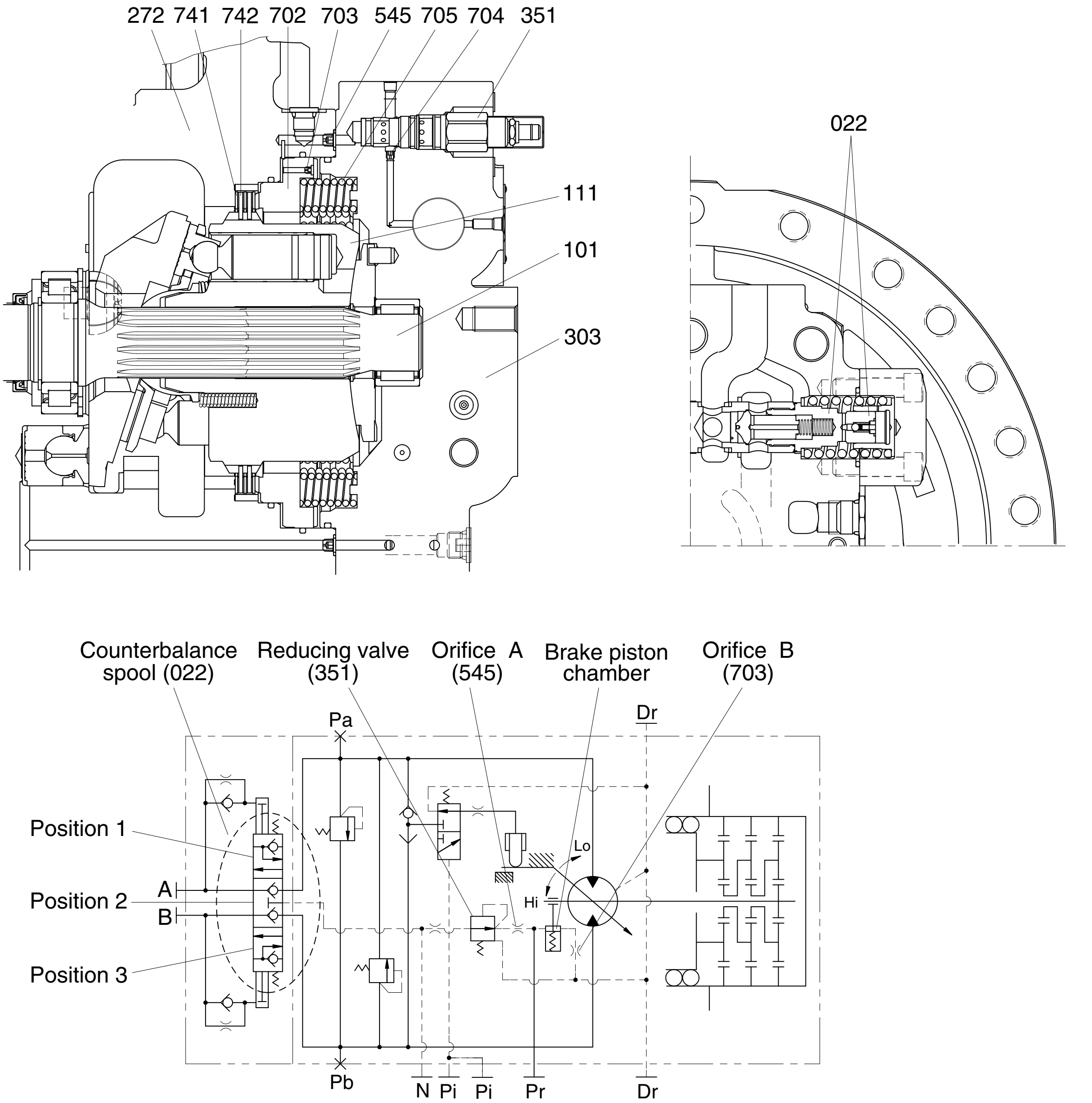


3607A2TM06

The chamber A is always connected to the port A of the motor.
When the pressure at port A increases and the force pushing poppet A is higher than the set pressure of the spring, then poppet A is pushed up from the contact surface of seat A, and oil flows from chamber A to port B.

3) NEGATIVE BRAKE

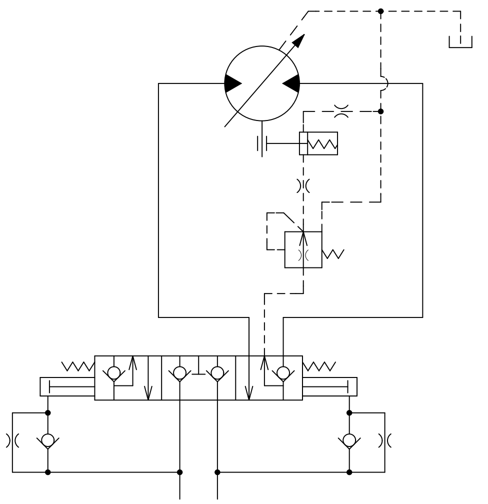
The negative brake is released applying to the brake piston (702) the pressure led through the built-in counterbalance spool sub-assembly (022).
With no pressure working, the brake force is always ensured.



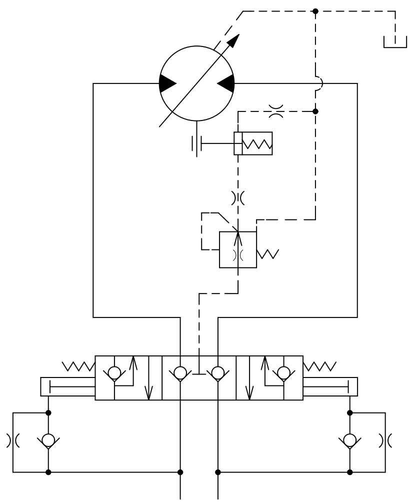
3607A2TM07

The brake force is the friction force generated on the surfaces of the friction plates (742) spline-coupled with the cylinder block (111), when their rotation is restricted by the shaft casing (272), separation plate (741), and brake piston (702).
Without pressure being applied to the brake piston, the brake piston is pushed by fourteen brake springs (705), and the friction plate and separation plate are held between the brake and shaft casing. This holding force functions as the friction force. This friction force restrains the shaft (101) spline-coupled with the cylinder block, and this function is the brake.

4) PRESSURE RELEASE VALVE (Flow control valve)



During running



During stop

3607A2TM08A

This brake is of a backpressure-insensitive type. In other words, since the counterbalance spool used be overlapped at the neutral position, the pressure release valve prevents the circuit backpressure from working into the brake chamber when the machine stops traveling and works, and so the specified brake torque is available even on a slope.

During normal traveling, the pressure coming through the counterbalance valve is applied to the brake chamber to release the break, and is also applied to the pressure release valve section.

This pressure release valve is of a constant differential pressure type, and irrespective of the working pressure, the passing flow is constant and approximately 1 to 2 ℓ / min.

When the condition changes from traveling to stop, the counterbalance spool returns to its neutral position. The brake piston is pushed by the brake spring, and the oil in the brake chamber flow to the motor drain line via the pressure release valve. Then the brake torque is generated.

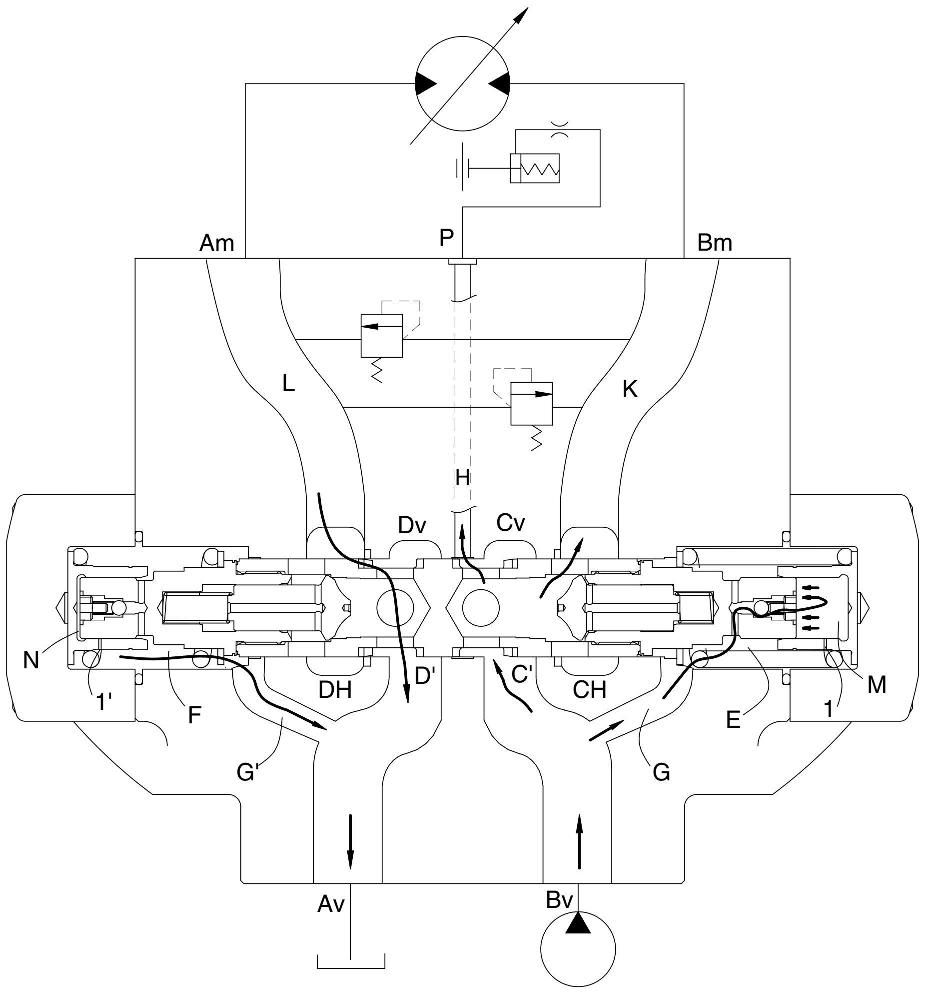
5) RELEASING METHOD OF NEGATIVE BRAKE

In releasing the negative brake without applying the brake releasing pressure, follow the procedures shown below.

Details of work	Tools
Remove two plugs (564) from the valve casing (303). (For their position, see the attached installation dimension) Tighten an M10 screw of 135 mm in length into a tapped hole of the brake piston (702). Then the condition having the brake release pressure is attained and the brake is released.	Socket wrench 6 mm 8 mm

Note : Even with the negative brake released, the hydraulic motor will not turn. When it is difficult to generate the working pressure due to failure of the pump or so, and the whole machine is to be pulled for transportation without removing the hydraulic motor, connect pressure measurement ports P_a and P_b with a short hose or something. Then the machine can be pulled slowly.

6) COUNTERBALANCE VALVE



3607A2TRG03

Suppose port Bv is connected to the hydraulic pump and Port Av, to the tank. The oil supplied from the hydraulic pump passes through Bv, Cv and C' in sequence, pushes up the poppet of the check valve, passes through K to Port Bm, and is supplied to the hydraulic motor to turn it.

Therefore, the pump discharge oil pressure increases, and the pressure is led via passage G to spring room E and via the ball check valve to dumping room M. When the pressure in rooms E and M exceeds the value equivalent to the force of the spring which holds the spool at its neutral position, the spool begins to move left. Since the working oil in room N flows into room F via throttle 1' and that in room F is discharged via passage G' through port Av to the tank, the spool moves left to have passage L-DH-D'-Dv composed. In addition, passage Cv-H-P is also composed, and the pump discharge pressure in port Bv is led to port P.

Because of the throttle or clearance provided for the working oil flow from room N, this changeover motion of the spool is comparatively slow.

When the pump discharge pressure is higher, the spool movement is larger and the above opening area of the spool is larger.

When the pump discharge pressure falls, pressures in rooms E and M fall and the spool will move right due to the spring on the room F side.

Since working oil in room M flows to room E via throttle 1 and that in room E, to port Bv via passage G, the spool moves right.

When the pressure at port Bv falls down to the tank pressure, the pressure in room E also falls to the tank pressure and becomes equal to that in room F, and so the spool returns to its neutral position.

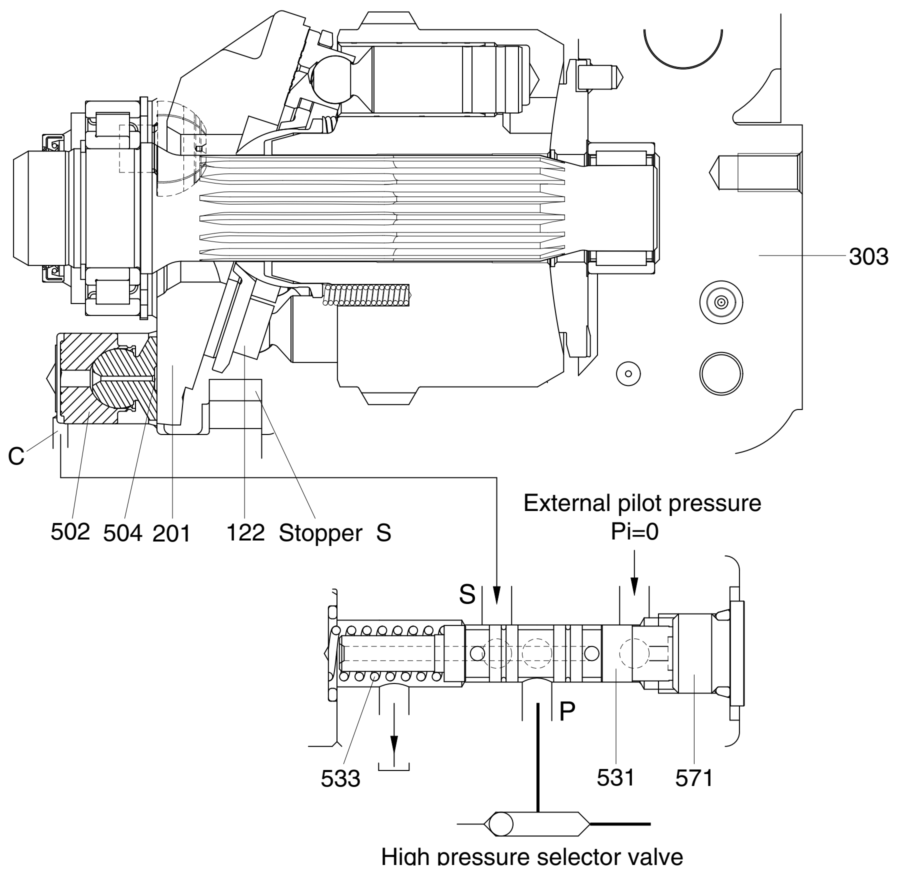
7) DISPLACEMENT CHANGEOVER SECTION

As a supporting mechanism for the swash plate (201) on which the shoes (122) slide, the pillar system is adopted to support the load with semi-cylindrical sliding bearings provided at both ends of the mechanism.

The capacity is changed by changing the tilting angle of this swash plate.

This is a mechanism that swash plate was pushed by tilting position, and the tilting angle of the swash plate is decided in two positions (large and small) by controlling the flows to and from these piston rooms with the displacement changeover valve section.

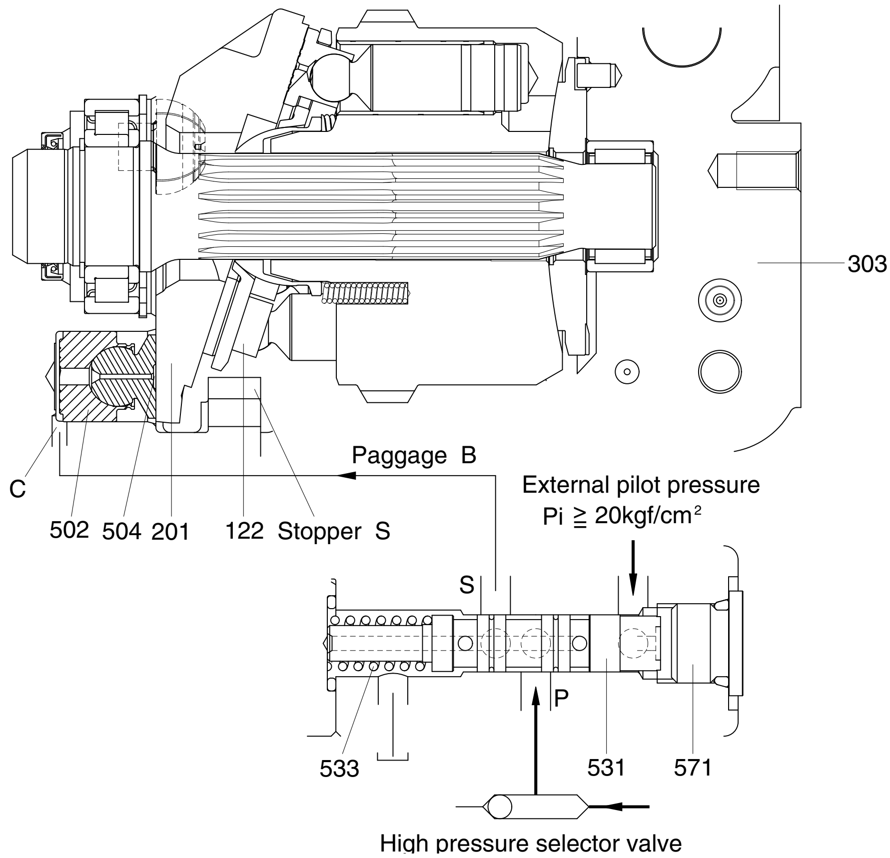
(1) **External pilot pressure** : $P_i = 0$ ············ Large displacement



3607A2TM04

By means of the built-in high pressure selector mechanism in the valve casing (303), the high pressure oil working on the motor functions to port P of the displacement-changeover valve. This pressure becomes the servo pressure. Since the spool (531) assembled in the displacement changeover valve is pressed to plug (571) by thy spring (533), the high pressure oil at port P is enclosed.

(2) **External pilot pressure** : Pi ≧ 20 kgf/cm² ——— small displacement



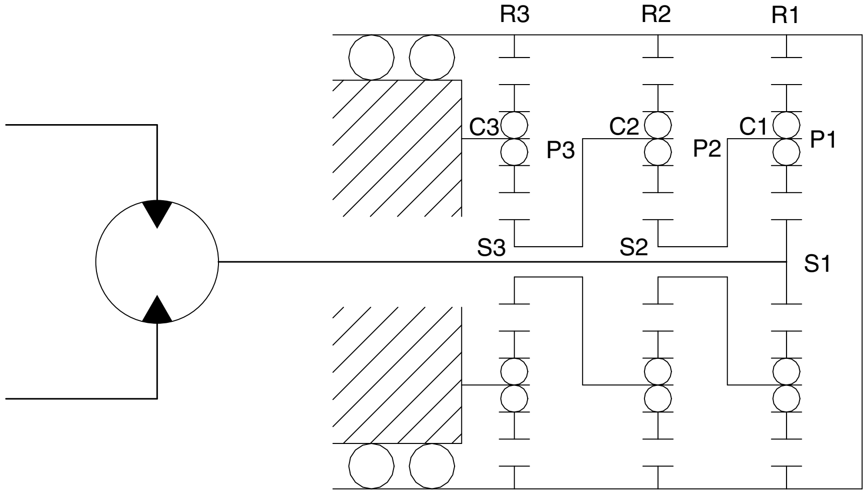
3607A2TM05

The force working on the spool (531) of the displacement-changeover valve becomes higher than that of the spring (533), and the spool moves left. The high pressure oil flows from port P of the displacement-changeover valve through port S and passage B to room C where it works.

The displacement changeover piston (502) is pushed light by the high pressure oil and the swash plate moves in the arrowed direction. The swash plate moves until it touched stopper S, and then is fixed there.

8) REDUCTION GEAR

The reduction gear is composed of a three-stage planetary gear mechanism shown in the following figure. Since the sun gear is designed to have a floating mechanism, errors of the gears and carrier pin hole pitches will not affect the gears' lives heavily.



3607A2TRG04

The input rotation of the hydraulic motor is transmitted to No. 1 sun gear (S1) and this drives No. 1 planetary gears (P1). This No. 1 planetary gears (P1) drive No.1 ring gear (R1) with the same force as the meshing tangential force with No. 1 sun gear (S1), and also No. 1 carrier (C1) with the same force as the meshing reaction force. In other words, No. 1 planetary gears (P1) revolve rotating. This rotation of No. 1 carrier (C1) becomes the output of the 1st stage, and is transmitted directly to No. 2 sun gear (S2).

(No. 1 carrier is spline-coupled with No. 2 sun gear.) Similarly the revolution of No. 2 planetary gear (P2) are transmitted via No.2 carrier (C2) to No. 3 sun gear (S3). Since No. 3 carrier (C3) supporting No. 3 planetary gears (P3) are fixed, No. 3 planetary gears (P3) do not revolve, but rotates to drive No. 3 ring gear (R3).

Therefore, the rotating case is driven by the overall driving torque of No1, 2 and 3 ring gears.

This reduction ratio is expressed as shown below:

$$i = \frac{(Z_{S1} + Z_{R1})(Z_{S2} + Z_{R2})(Z_{S3} + Z_{R3})}{Z_{S1} \cdot Z_{S2} \cdot Z_{S3}} - 1$$

where Z : Number of teeth of each gear

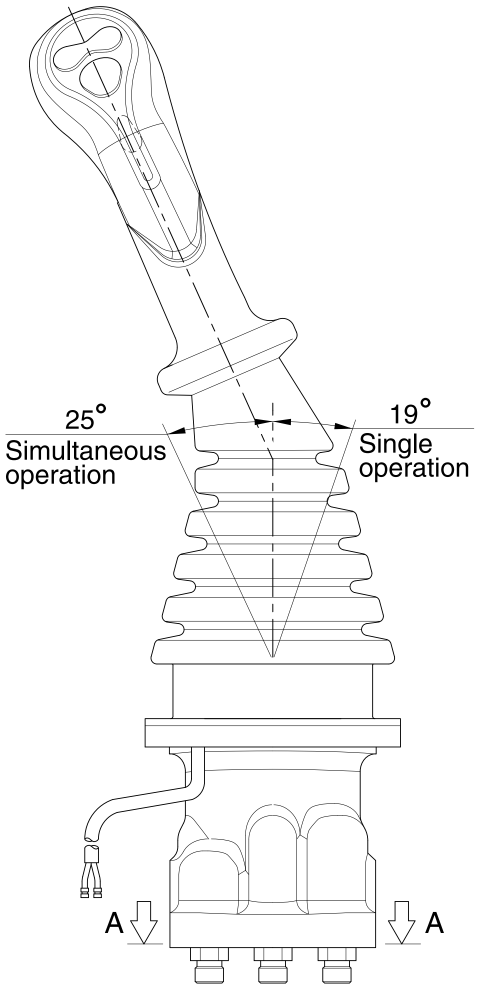
The direction of rotation is reverse to that of the input shaft.

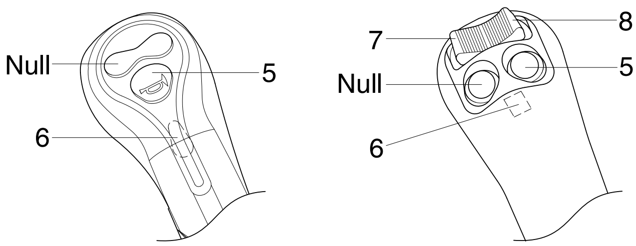
1. STRUCTURE

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.

※ **Refer to the parts manual for the types of the RCV lever.**

1) TYPE M1, M10



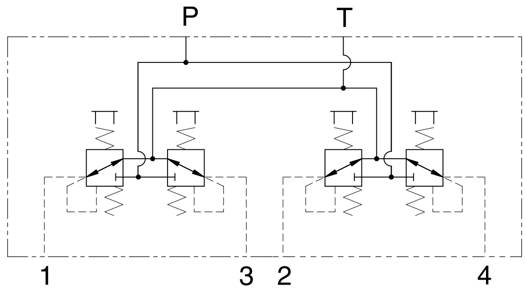


TYPE M1, M10 NONE

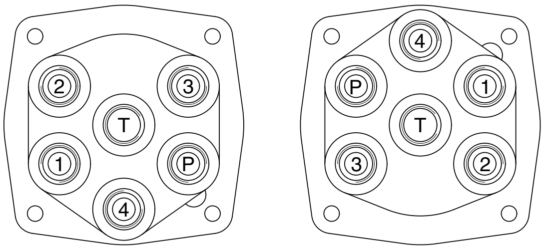
Switches

Type	No.	LH	RH
M1, M10	5	One touch decel	Horn
	6	Power boost	Breaker
None	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

※ Number 7 and 8 : Option attachment



Hydraulic circuit



LH RH

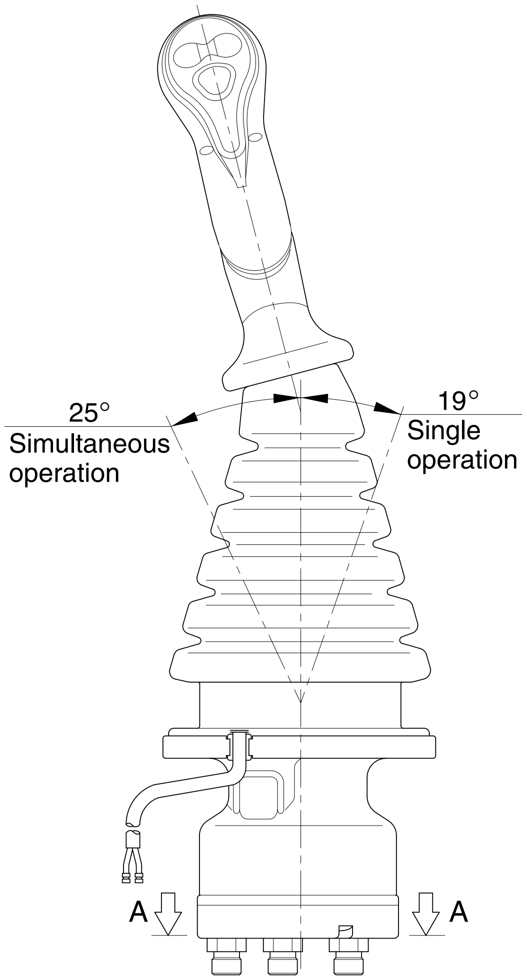
VIEW A-A

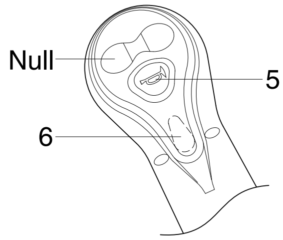
Pilot ports

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 3/8
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	

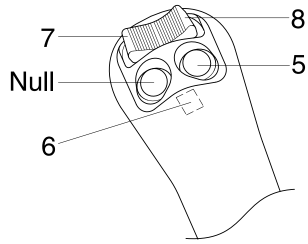
480A2RL01

2) TYPE M11, M12





TYPE M12

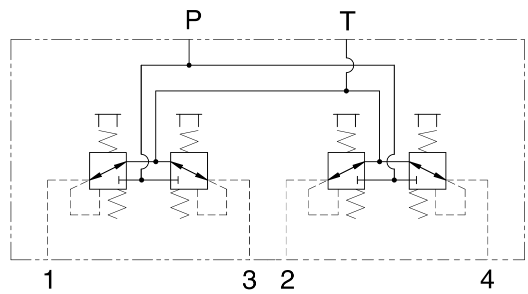


TYPE M11

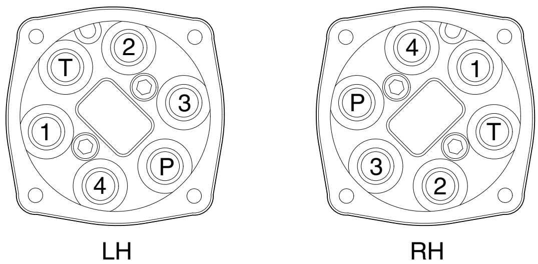
Switches

Type	No.	LH	RH
M12	5	One touch decel	Horn
	6	Power boost	Breaker
M11	5	One touch decel	Horn
	6	Power boost	Null
	7	CCW rotation	Close
	8	CW rotation	Open

※ Number 7 and 8 : Option attachment



Hydraulic circuit



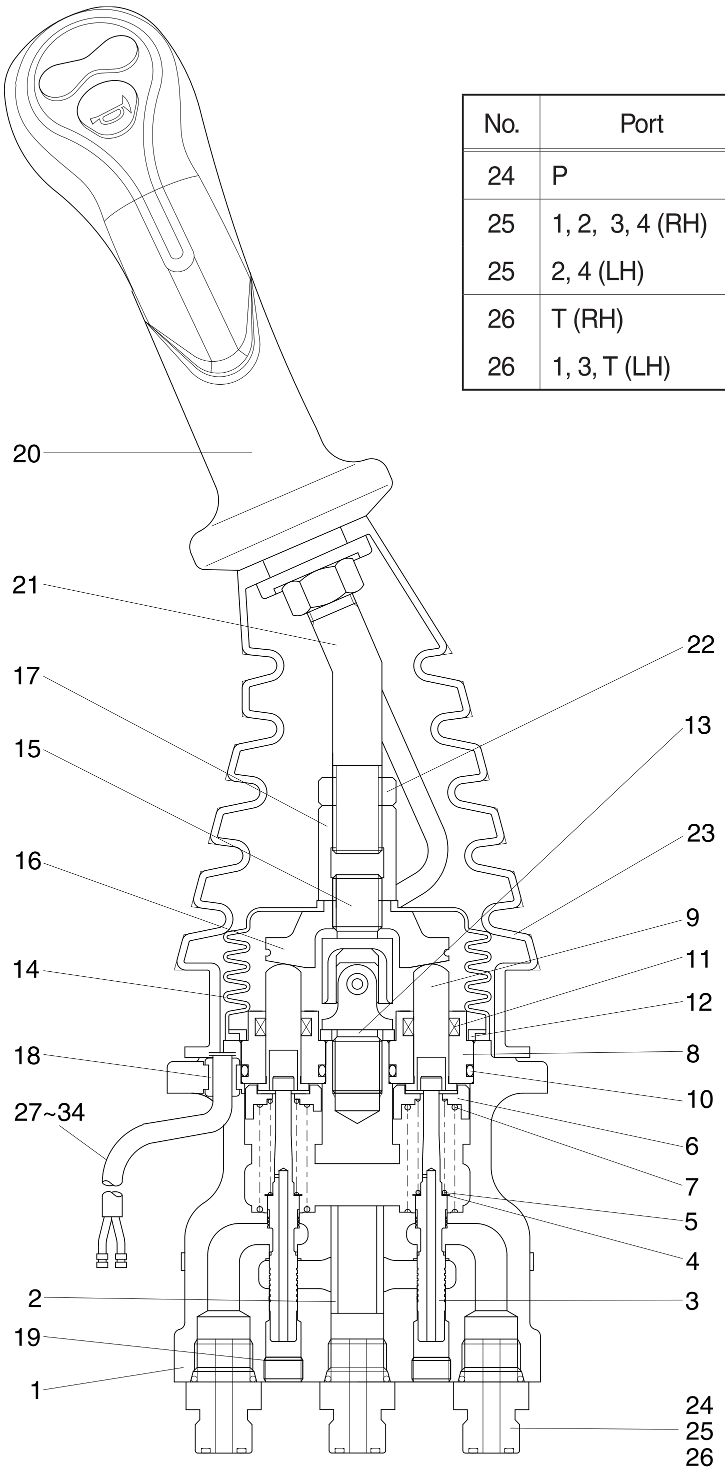
VIEW A-A

Pilot ports

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 3/8
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	

480A2RL05

3) CROSS SECTION



No.	Port
24	P
25	1, 2, 3, 4 (RH)
25	2, 4 (LH)
26	T (RH)
26	1, 3, T (LH)

1 Case
2 Bushing
3 Spool
4 Shim
5 Spring
6 Spring seat
7 Spring
8 Plug
9 Push rod
10 O-ring
11 Rod seal
12 Spacer
13 Spacer
14 Boot
15 Joint assembly
16 Swash plate
17 Adjusting nut
18 Bushing
19 Plug
20 Handle assembly
21 Handle bar
22 Nut
23 Boot
24 Last guard filter
25 Connector
26 Connector
27 Connector pin
28 Connector pin
29 Connector pin
30 Connector pin
32 Connector
34 Connector

210S2RL06

Item numbers are based on the type M1.

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

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve that 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 ports (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 or tank port.

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

2) FUNCTIONS OF MAJOR SECTIONS

Item numbers are based on the type M1.

The functions of the spool (3) 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 port pressure oil to tank port T.

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

The change the deflection of this spring, the push rod (9) is inserted and can slide in the plug (8).

For the purpose of changing the displacement of the push rod through the swash plate (16) and adjusting nut (17) are provided the handle assy (20) that can be tilted in any direction around the fulcrum of the universal joint (15) center.

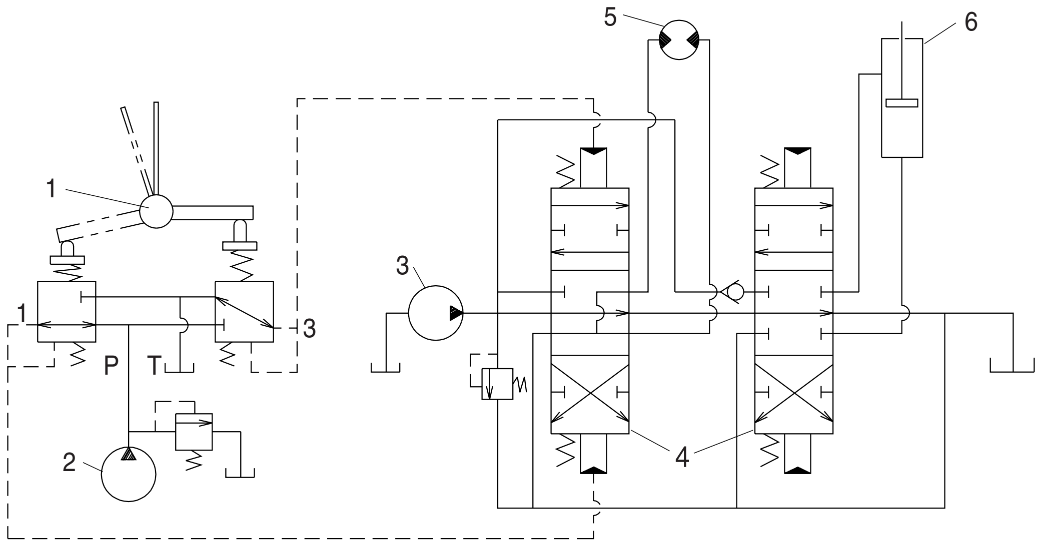
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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 and the attached operation explanation drawing.

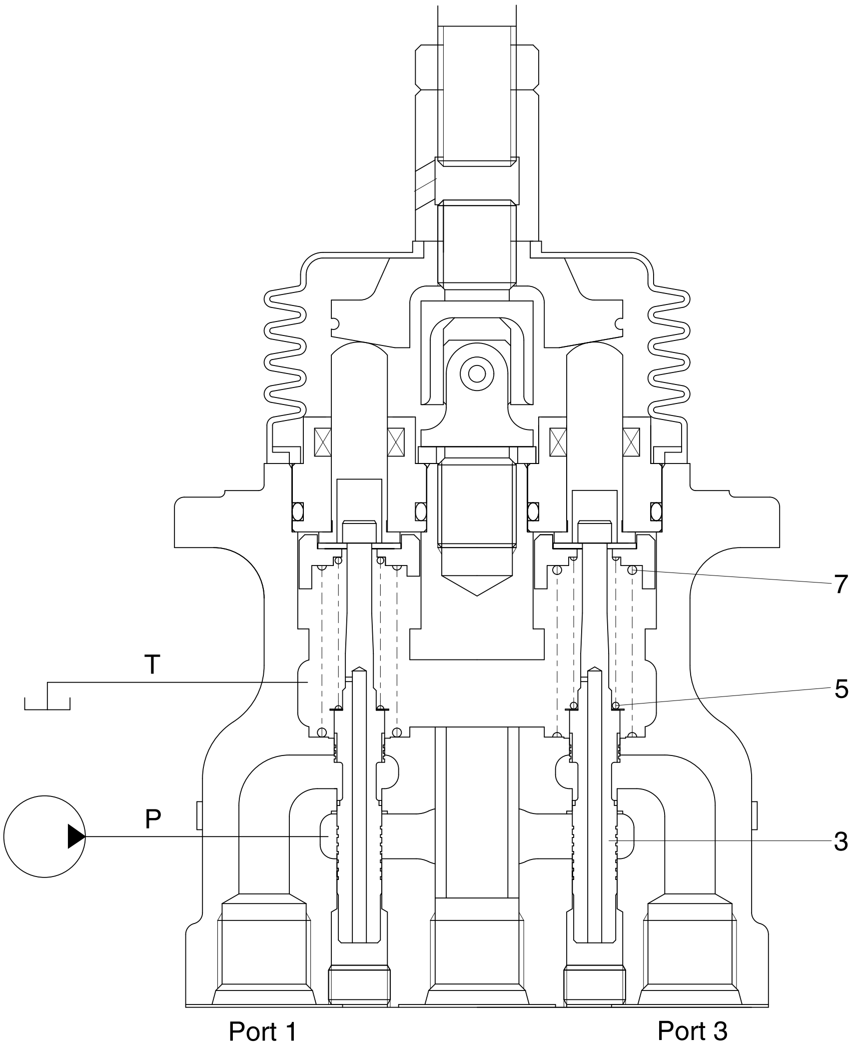
The diagram shown below is the typical application example of the pilot valve.



2-70

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

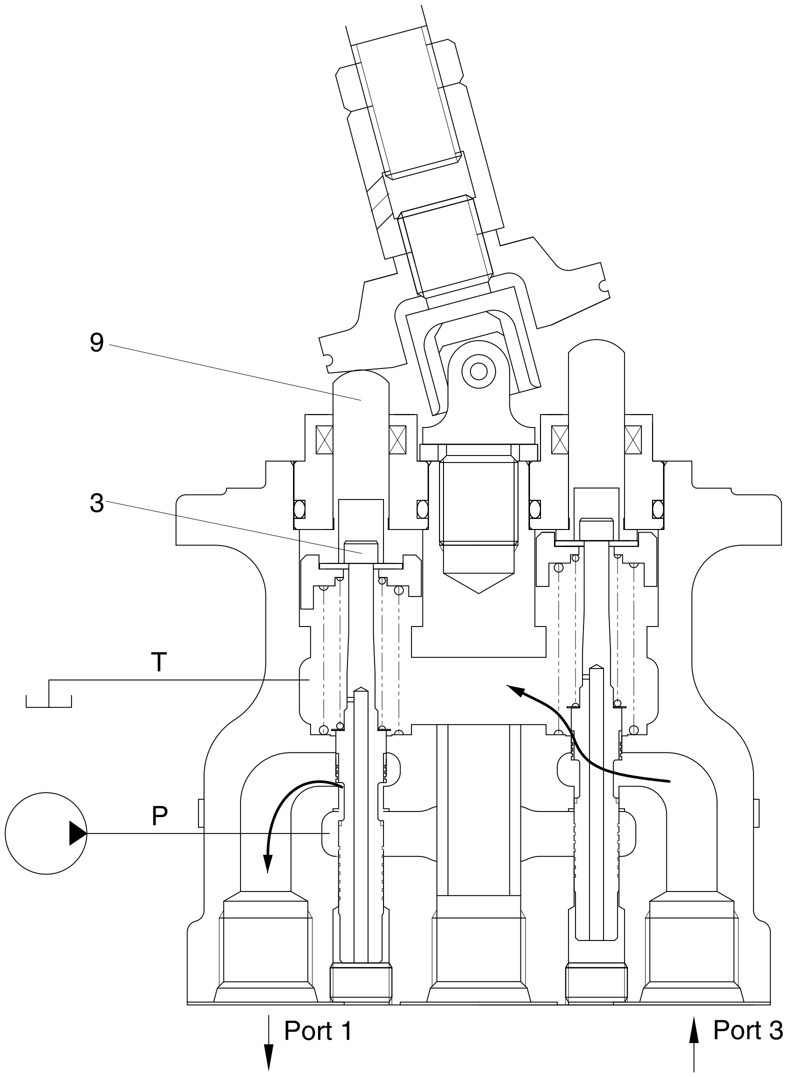
(1) Case where handle is in neutral position



300L2RL03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (3). Therefore, the spool is pushed up by the spring (7) 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



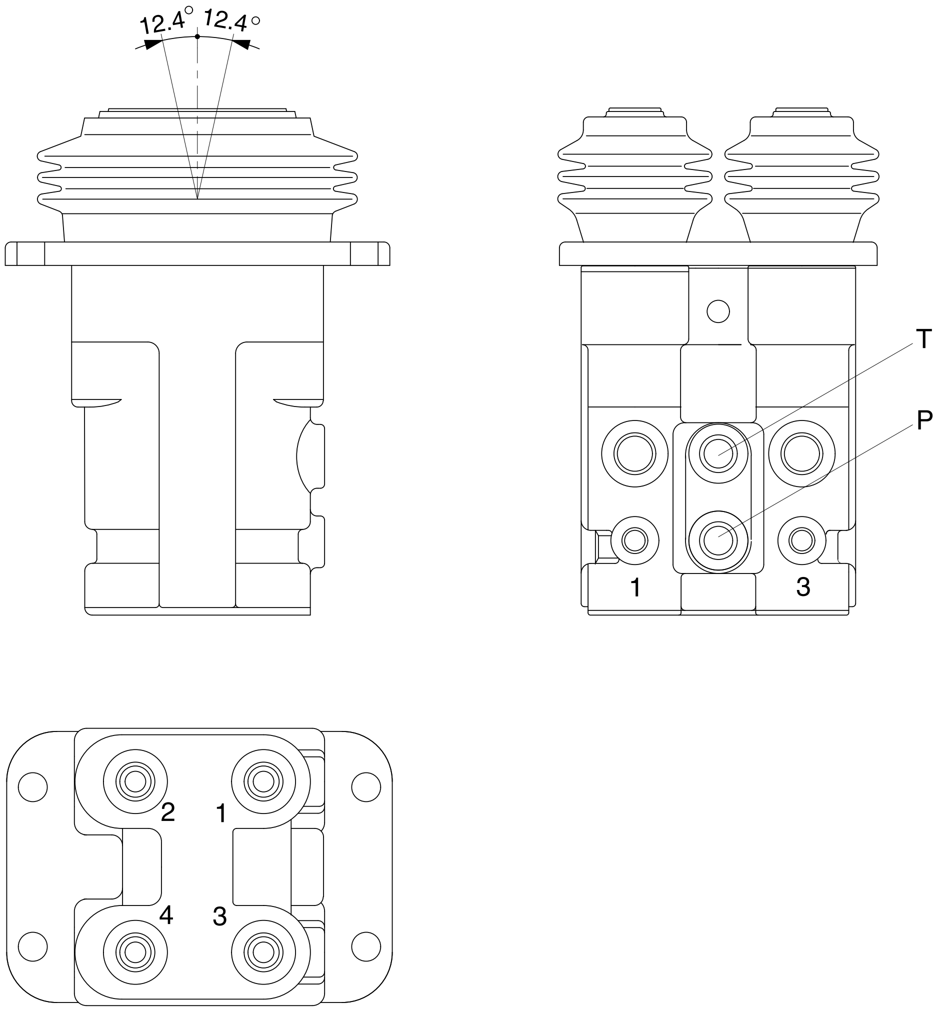
300L2RL04

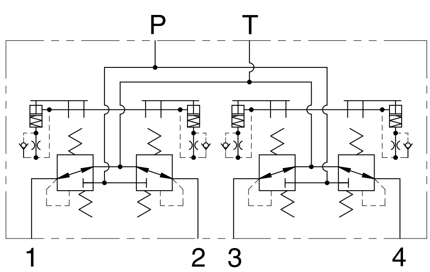
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, 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.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

GROUP 6 RCV PEDAL

1. STRUCTURE

The casing (spacer) 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	Port	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Travel (LH, Forward)	
2	Travel (LH, Backward)	
3	Travel (RH, Forward)	
4	Travel (RH, Backward)	

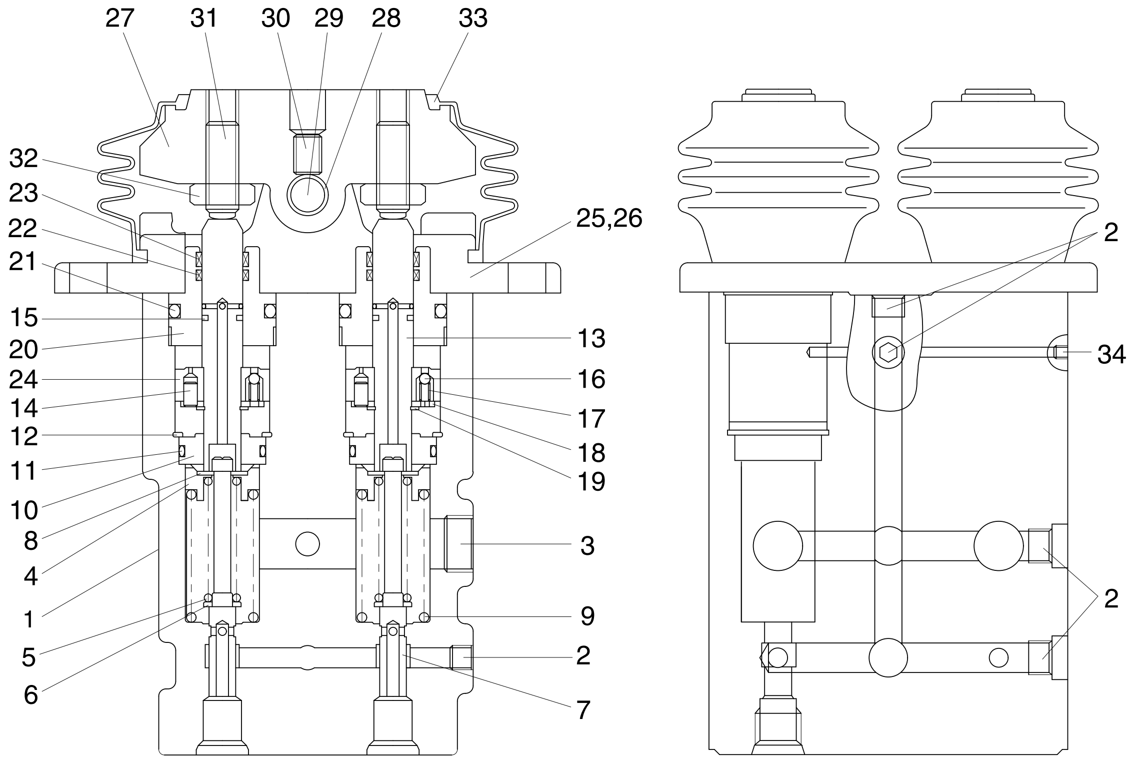
480A2RP01

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 kit (7), spring (5) for setting secondary pressure, return spring (9), stopper (8), and spring seat (6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 6.3±1 to 24.9±1.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (13) 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.



480A2RP02

1	Body	13	Push rod	25	Cover
2	Plug	14	Spring pin	26	Socket bolt
3	Plug	15	Seal	27	Cam
4	Spring seat	16	Steel ball	28	Bushing
5	Spring	17	Spring	29	Cam shaft
6	Spring seat	18	Plate	30	Set screw
7	Spool kit	19	Snap ring	31	Set screw
8	Stopper	20	Plug	32	Hex nut
9	Spring	21	O-ring	33	Bellows
10	Rod guide	22	Oil seal	34	Expand
11	O-ring	23	Dust seal	36	Cap
12	Snap ring	24	Piston		

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 (13) is inserted and can slide in the plug (20).

For the purpose of changing th displacement of the push rod through the cam (27) and adjusting nut (32) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.

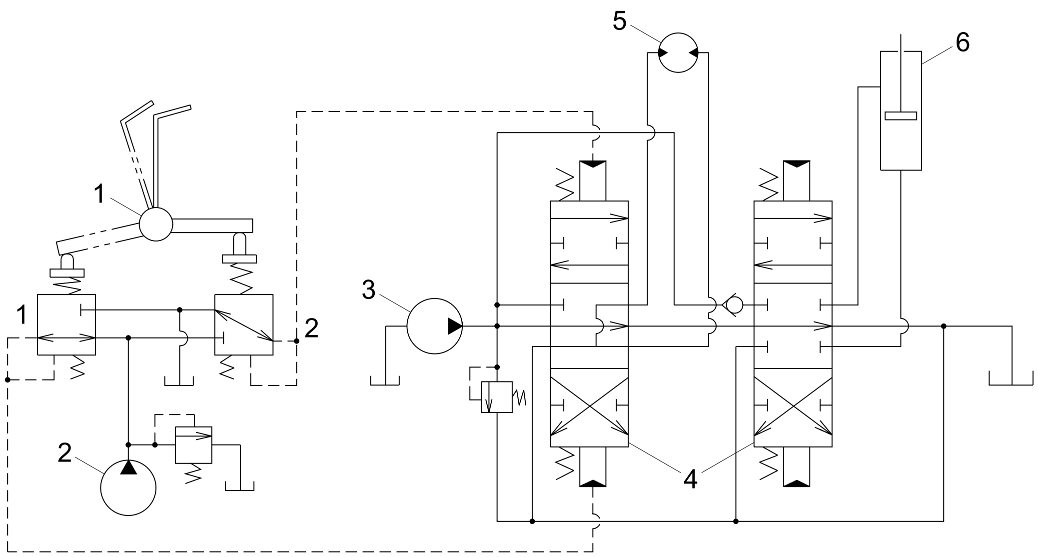
The spring (9) works on the body (1) and spring seat (6) and tries to return the push rod (13) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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 and the attached operation explanation drawing.

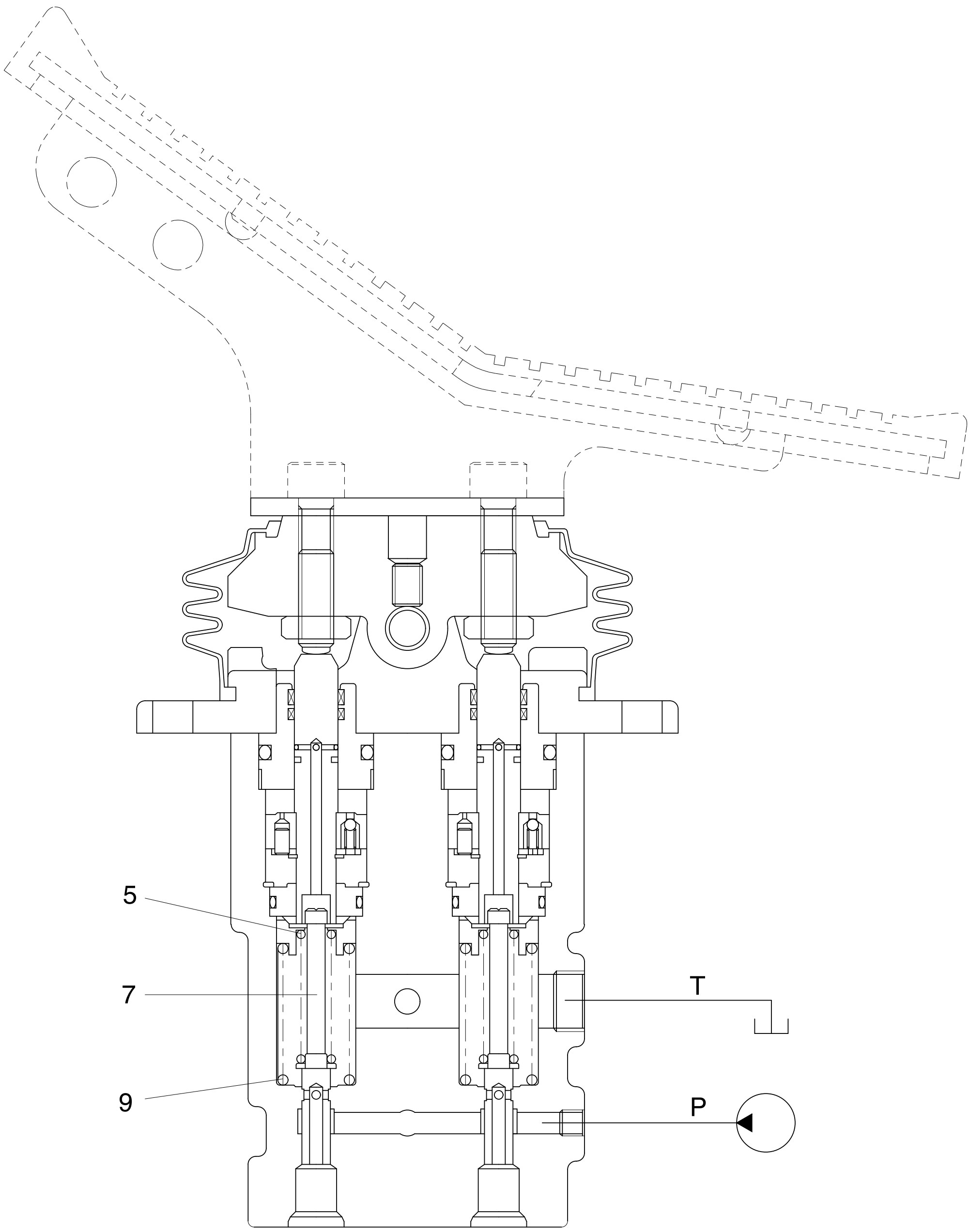
The diagram shown below is the typical application example of the pilot valve.



36072SF01

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

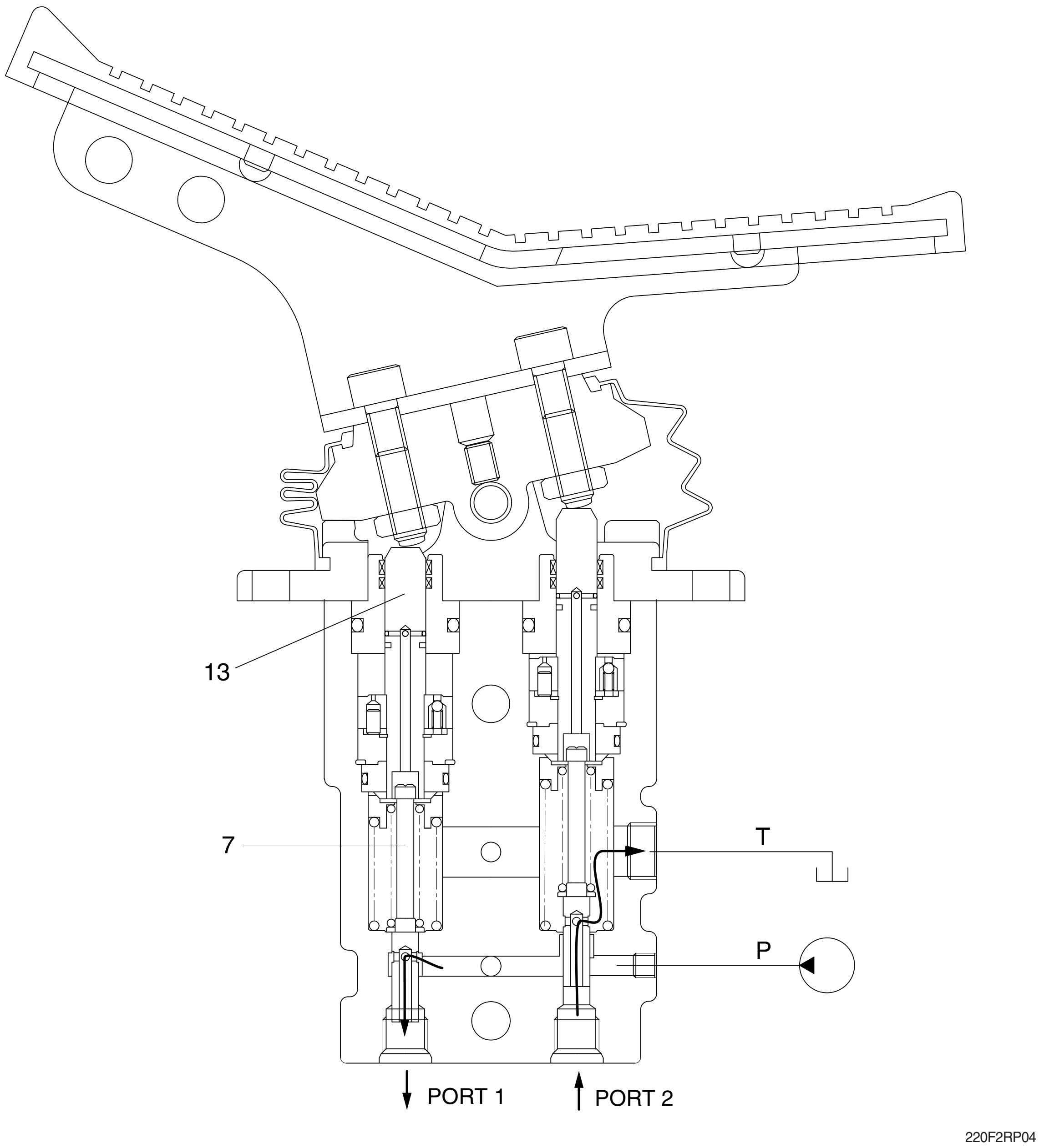
(1) Case where pedal is in neutral position



130ZF2RP03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool kit (7). Therefore, the spool is pushed up by the spring (9) to the position of 1 and port 2. 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



When the push rod (13) is stroked, the spool kit (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.

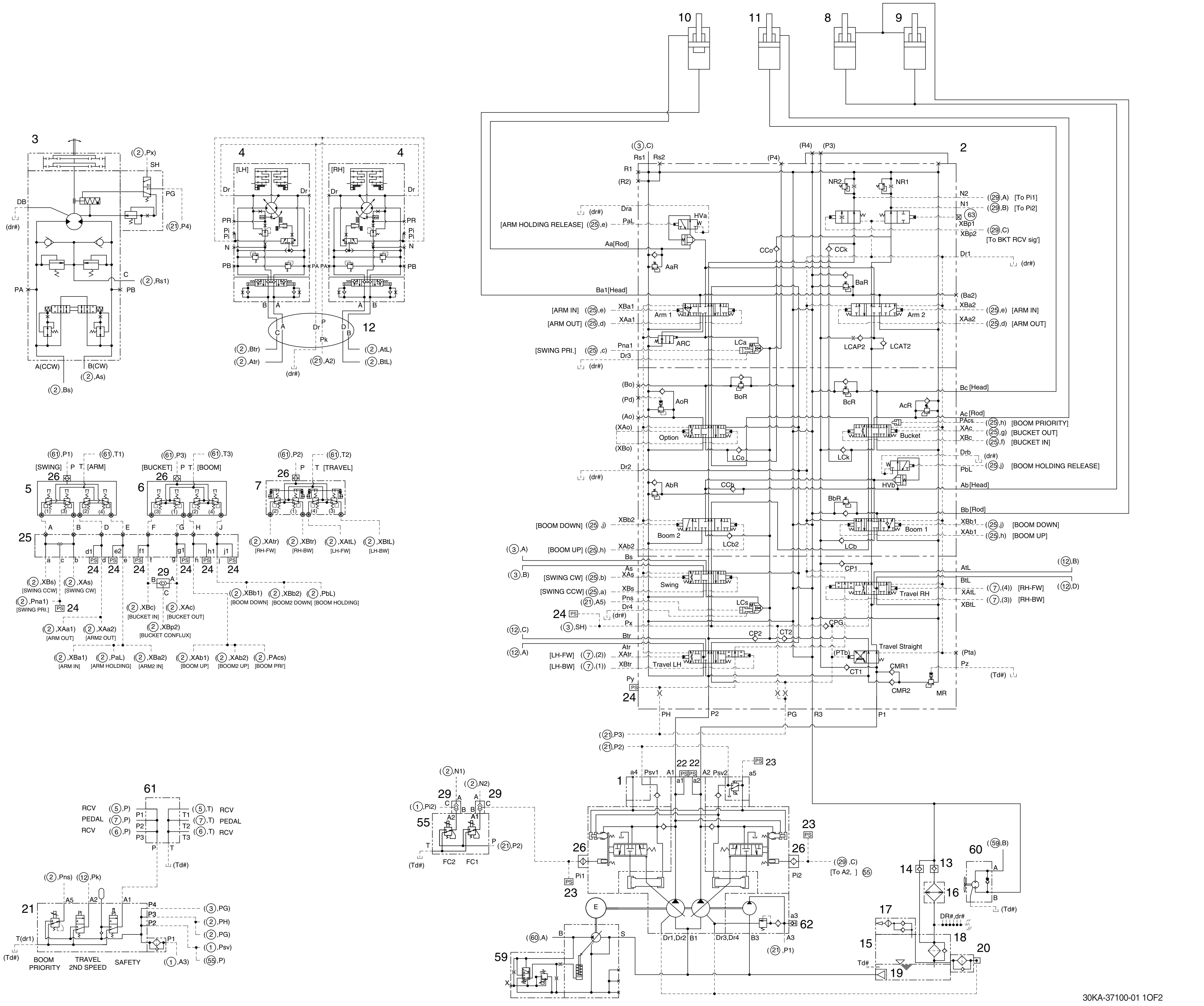
In this manner the secondary pressure is kept at the constant value.

Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

1. HYDRAULIC CIRCUIT (1/2)

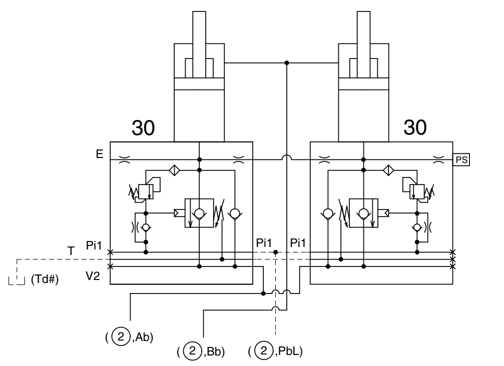


1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Drain check valve
14 Drain check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Return filter w/bypass valve
19 Strainer
20 Drain filter
21 3-cartridge valve
22 Pressure sensor
23 Pressure sensor
24 Pressure sensor
25 Terminal block
26 Last guard filter
29 Tee shuttle
55 2 EPPR cartridge valve
59 Fan pump
60 Fan motor
61 Cross assy
62 Screw coupling
63 Plug

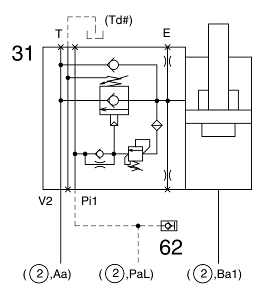
30KA-37100-01 1OF2

2. HYDRAULIC CIRCUIT (2/2)

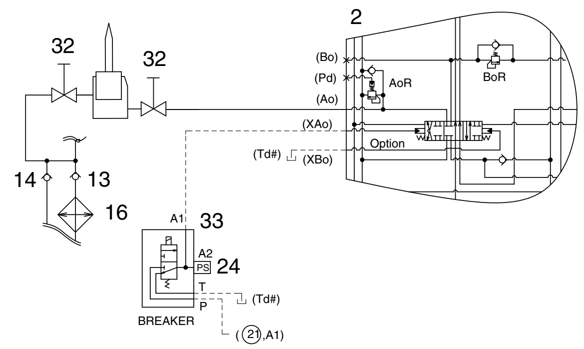
<BOOM SAFETY LOCK VALVE>



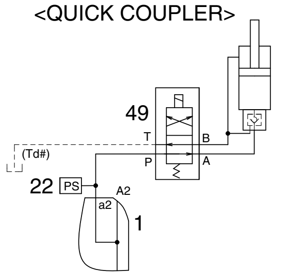
<ARM SAFETY LOCK VALVE>



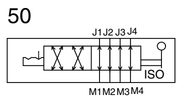
<SINGLE ACTING>



<QUICK COUPLER>

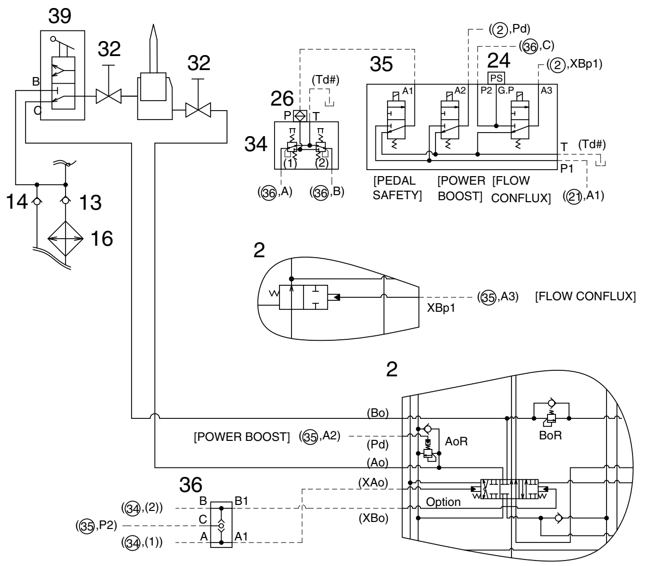


<PATTERN CHANGE>

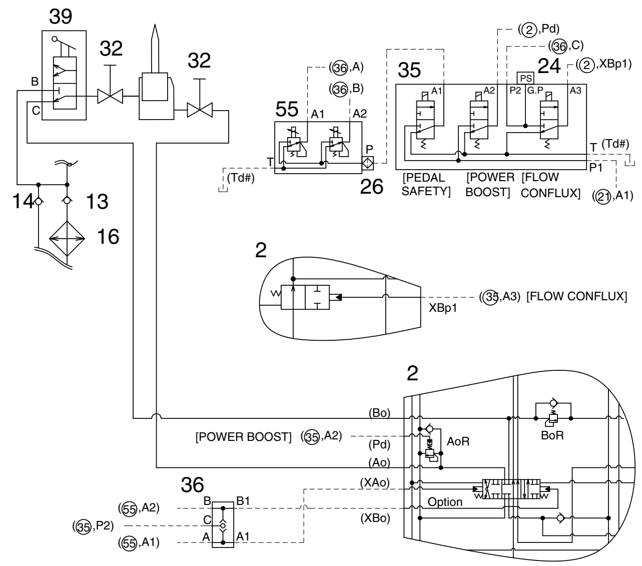


FROM		TO	
ITEM	PORT	ITEM	PORT
5	2	50	J1
	4		J3
6	2		J4
	4		J2
50	M1	25	D
	M2		J
	M3		E
	M4		H

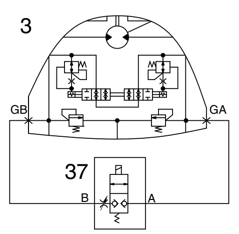
<DOUBLE ACTING WITH PEDAL>



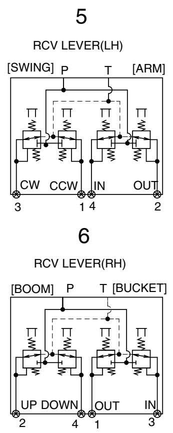
<DOUBLE ACTING WITH PROPORTIONAL RCV>



<FINE SWING CONTROL>

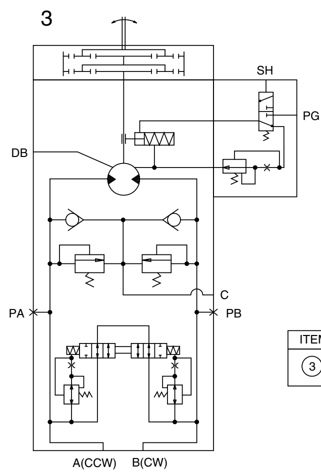


<RCV LEVER(LH/RH)>



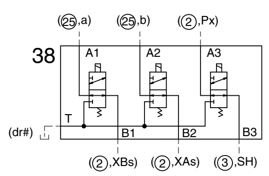
ITEM	OPT(1)	OPT(2)	PART NO.	NOTE
5 / 6	ERR00	EJA01	31K9-21011/21	19Âº,EATON
		EJA21	31K9-21410/20	19Âº,DAEHYUN
	ERR01	EJA01	31K9-21131/41	19Âº,EATON
		EJA21	31K9-21430/40	19Âº,DAEHYUN

<SWING MOTOR ASS'Y>



ITEM	OPT	PART NO.	NOTE
3	ESW02	3SAA-01000	MOTTROL
	ESW03	31QA-10153SG8	EATON

<SWING PARKING BY FORCE>



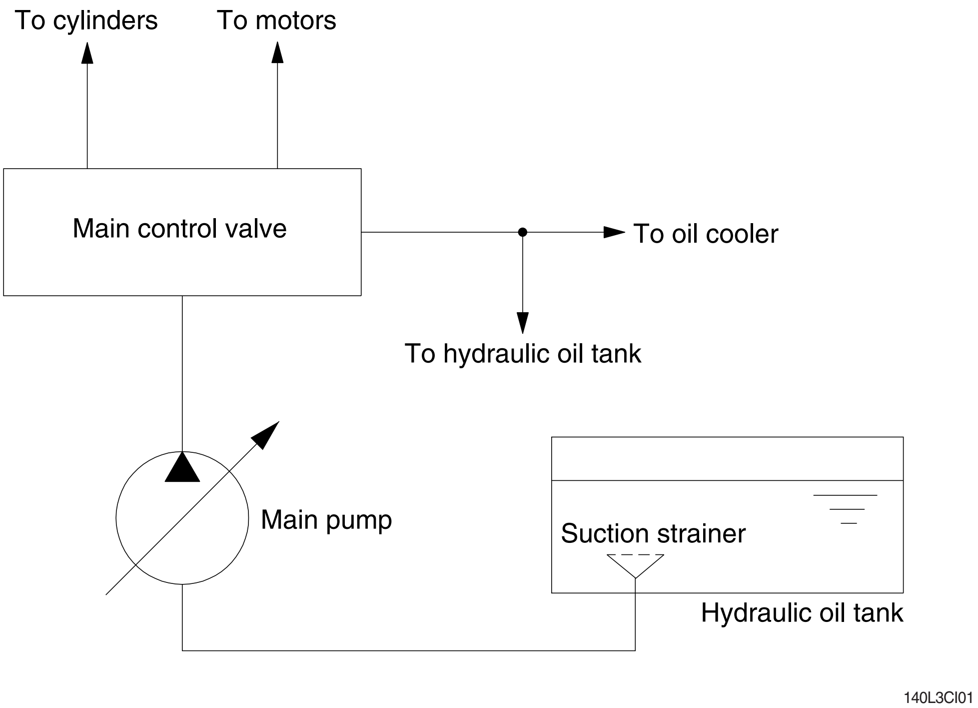
1 Main pump
2 Main control valve
3 Swing motor
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
13 Check valve
14 Check valve
16 Oil cooler
24 Pressure sensor
30 Boom safety valve(option)
31 Arm safety valve(option)
32 Stop valve(option)
34 2-way pedal(option)
35 Solenoid valve(option)
36 5-shuttle
37 Solenoid valve(option)
38 Solenoid valve(option)
39 3 way pedal(option)
49 Solenoid valve(option)
50 Pattern change valve(option)
55 2-EPPR valve(option)
62 Screw coupling(option)

30KA-37100-01 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 tandem axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

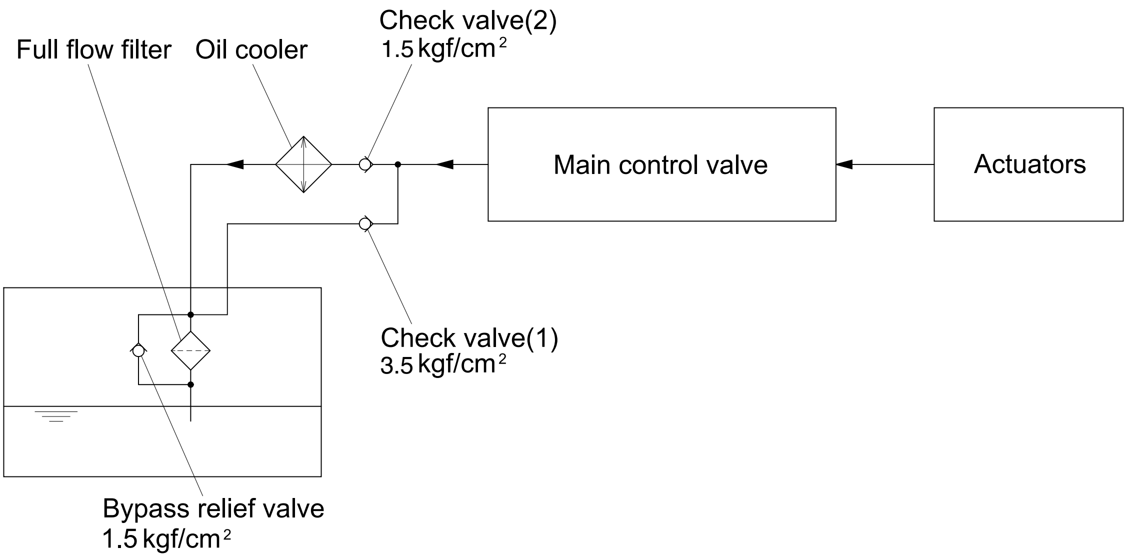
1. SUCTION AND DELIVERY CIRCUIT



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

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

2. RETURN CIRCUIT



400SA3CI02

All oil 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 bypass check valves are 1.5 kgf/cm^2 (21 psi) and 3.5 kgf/cm^2 (50 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. The oil pressure exceeds 3.5 kgf/cm^2 (50 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 bypass check valve (1).

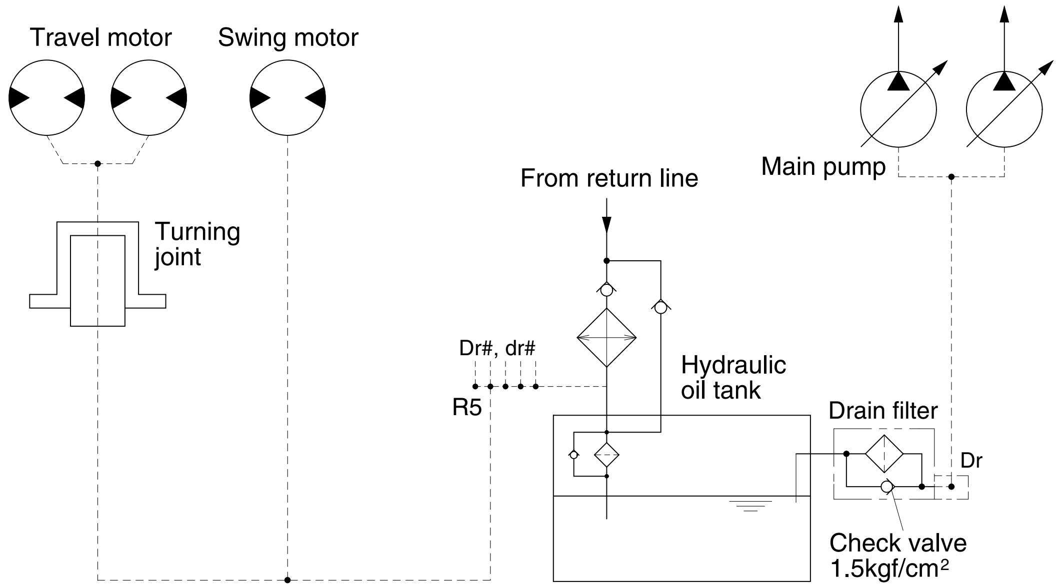
The full-flow filter and bypass relief valve are provided in the hydraulic tank.

The oil from right and left side of control valve is combined and filtered by the return 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



380A3CI03

Besides internal leaks from the motors and main pump, the oil for lubrication circulates. These oil have to be fed to the hydraulic tank passing through drain filter and full flow filter in the hydraulic tank. When the drain oil pressure exceed 1.5 kgf/cm^2 (21 psi), the oil returns to the hydraulic tank directly.

1) TRAVEL MOTOR AND SWING MOTOR DRAIN CIRCUIT

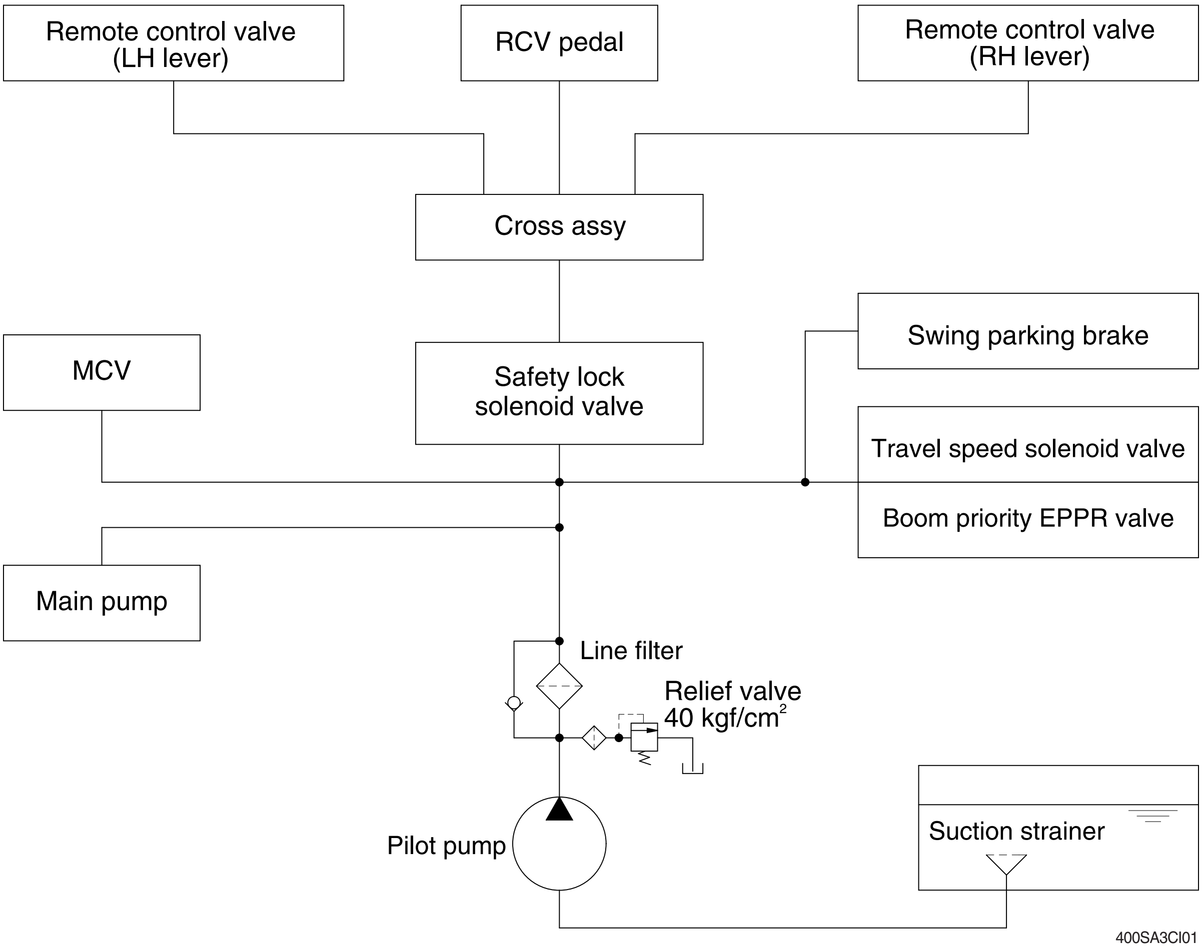
Oil leaking from the right and left travel motors comes out of the drain ports provided in the respective motor casing and join with each other. These oils pass through the turning joint and join with oil leak line of the swing motor and return to the hydraulic tank after being filtered by return filter.

2) MAIN PUMP DRAIN CIRCUIT

Oil leaking from main pump come out and return to the hydraulic tank passing through drain filter.

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

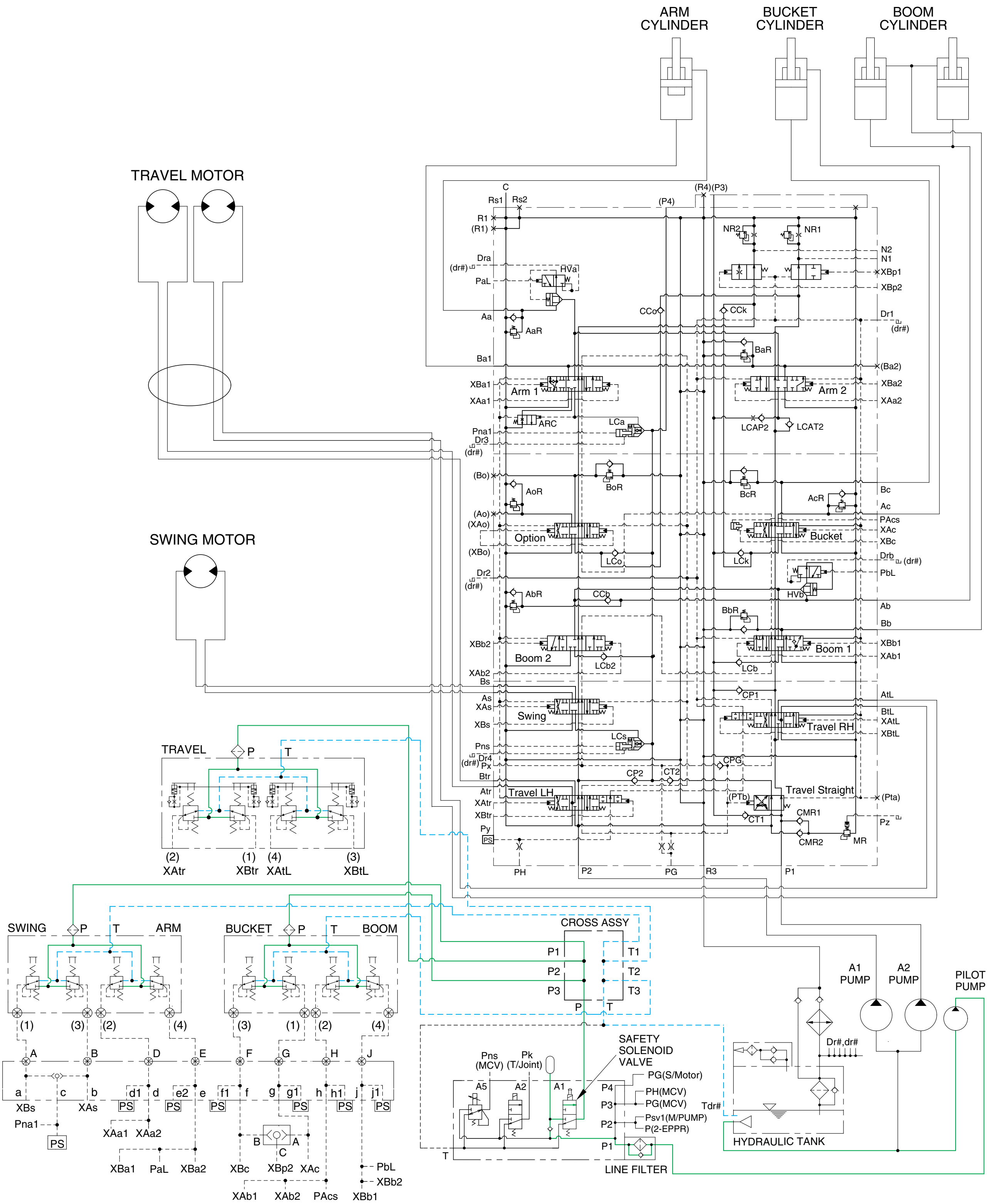
GROUP 3 PILOT CIRCUIT



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 remote control valve through line filter, EPPR valve, solenoid valve assemblies, swing parking brake, main control valve and safety lock solenoid valve.

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT



400SA3HC02

The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

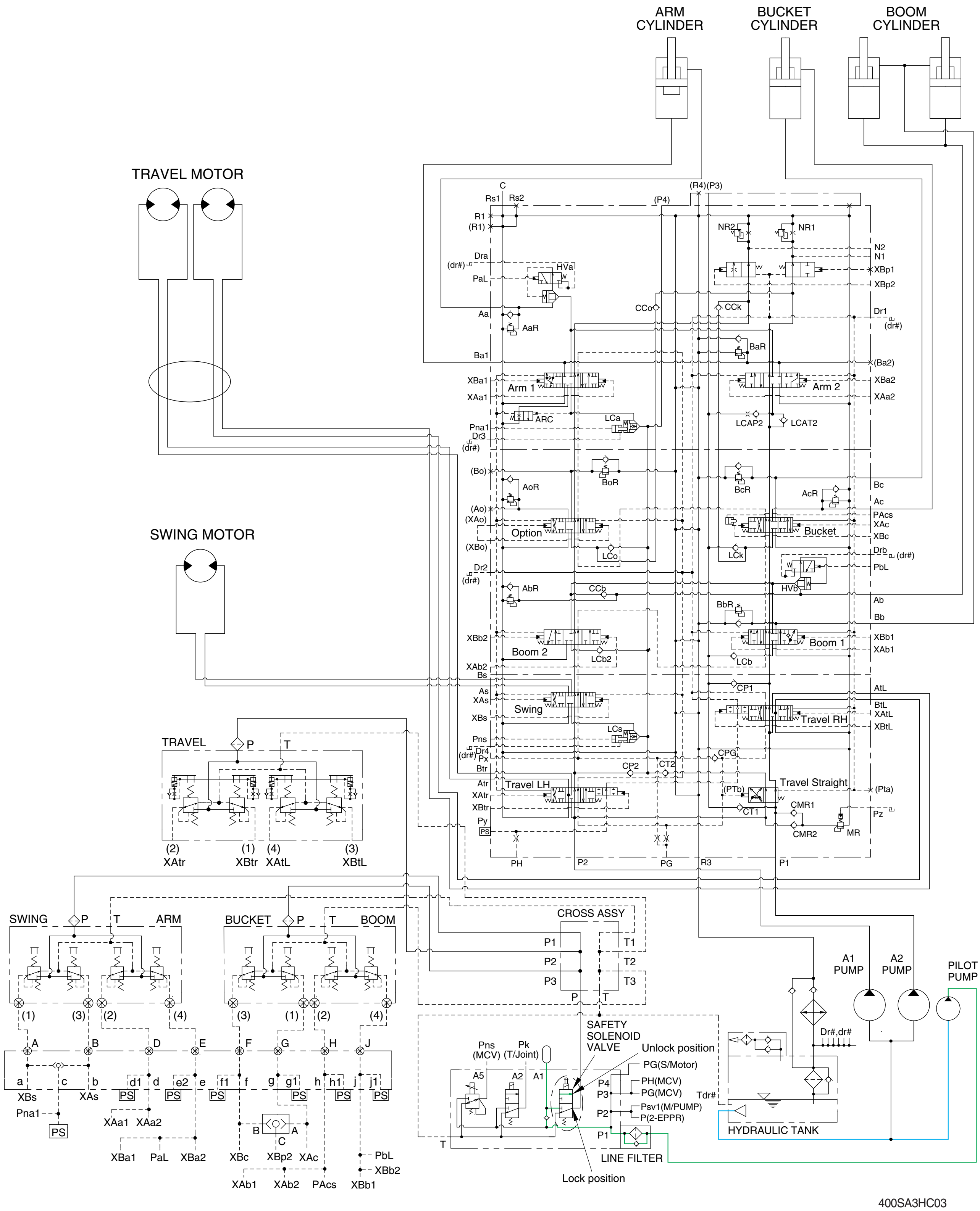
The oil filtered by line filter flows remote control valve through safety solenoid valve and cross assy.

Also, the oil flows 3-cartridge valve, main pump, main control valve, swing motor and flow control 2-EPPR valve.

The return oil from remote control valve returned to hydraulic tank thought cross assy.

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

2. SAFETY SOLENOID VALVE (SAFETY KNOB)

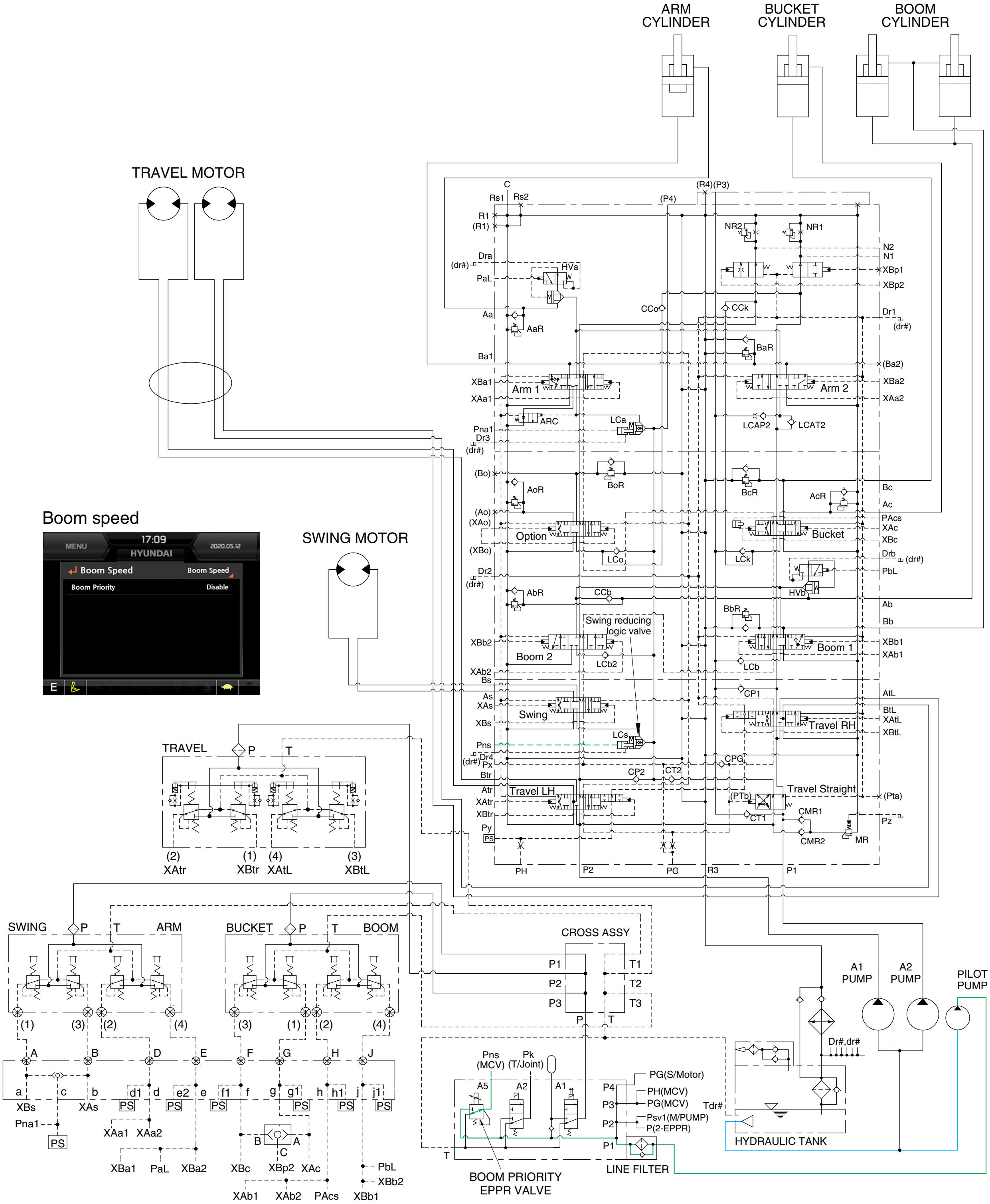


When the knob of the safety solenoid valve is turned to the unlock position, oil flows into the remote control valve through line filter, safety solenoid valve and cross assy.

When the knob of the safety solenoid valve is turned to the lock position, oil does not flows into the remote control valve, because of blocked by the spool.

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

3. BOOM PRIORITY SYSTEM

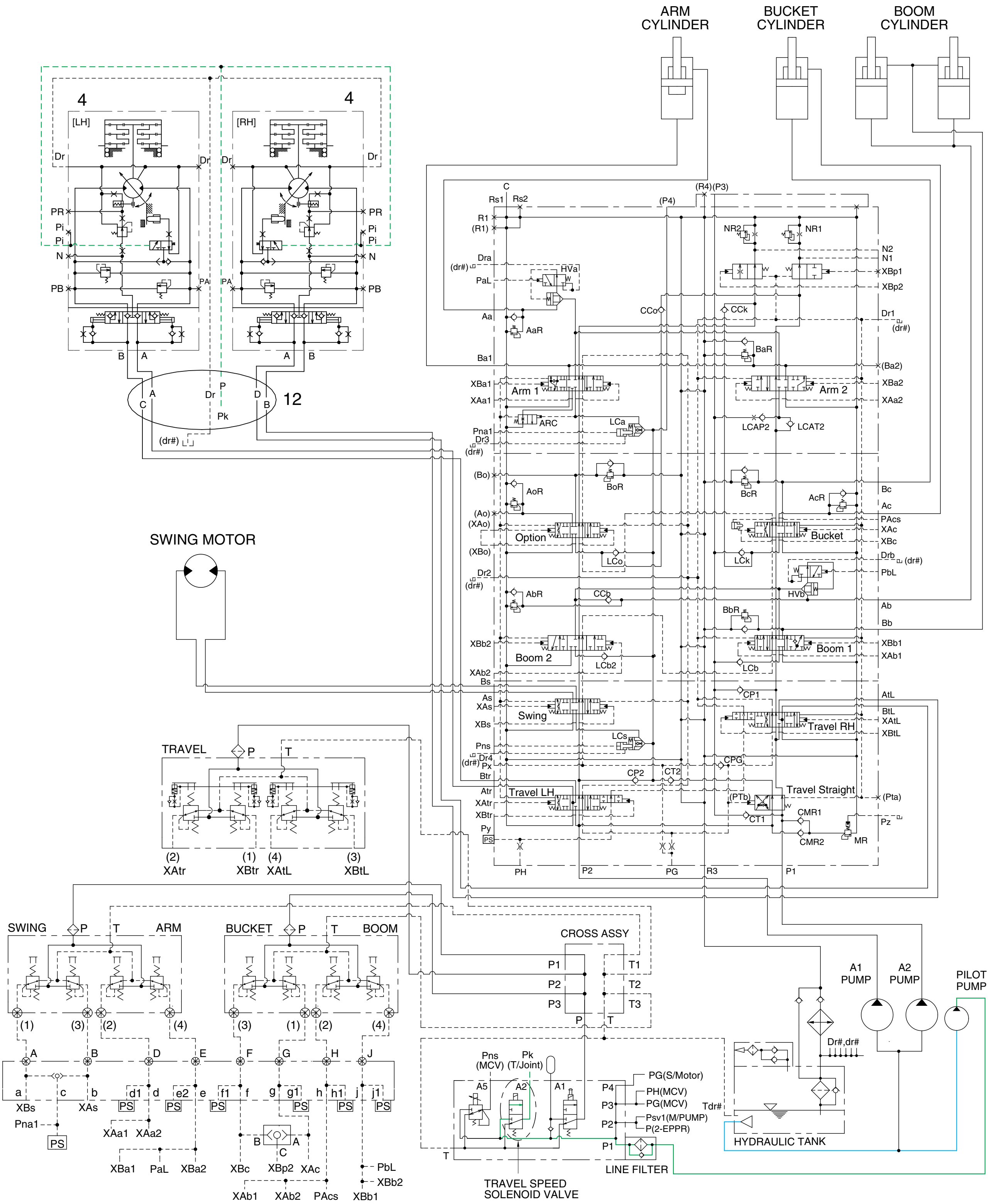


400SA3HC04

When carrying out the combined operation of swing and boom up, the boom up operating speed is lowered then normal operation.
To increase working efficiency, swing speed reducing system is used.
The pilot oil from pilot pump flow into Pns port in main control valve through boom EPPR valve. Pns oil pressure moves swing reducing logic valve to upper position and oil flow rate to the swing motor decreased.
Then, the boom up speed is increased. This is called the boom priority system.
The boom up speed can be adjusted by the cluster. Refer to page 3-19 of the operator's manual.

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

4. TRAVEL SPEED CONTROL SYSTEM



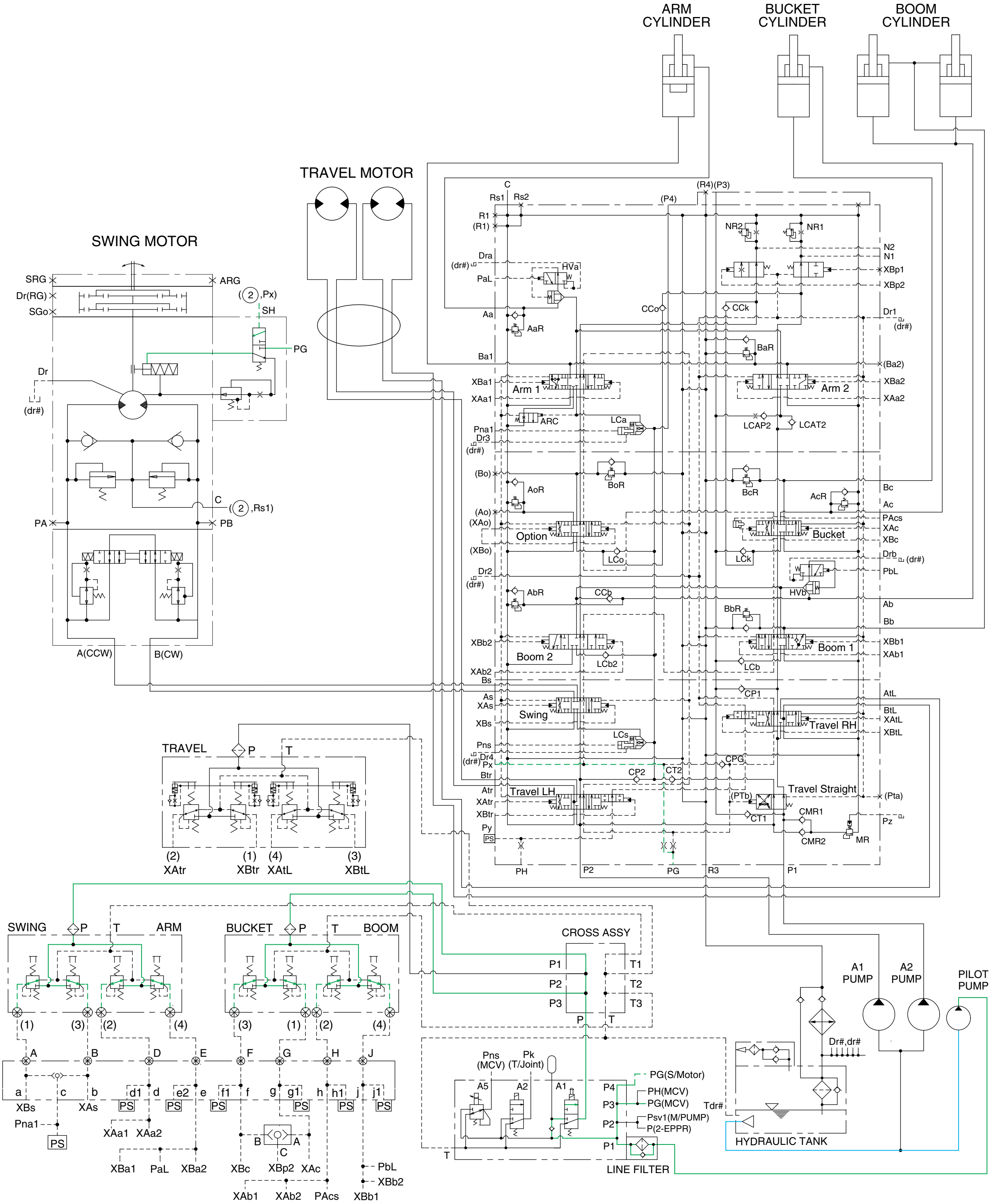
400SA3HC05

When the travel speed solenoid valve was placed in the Hi position, the pressure oil from pilot pump through line filter flows to port Pi of travel speed change over valve, and the control piston is pushed left (RH) and right (LH), thus minimizing the displacement.

When the travel speed solenoid valve was placed in the Lo position, the oil of Pi port return to the tank and the control piston is returned, thus maximizing the displacement.

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

5. SWING PARKING BRAKE RELEASE



400SA3HC07

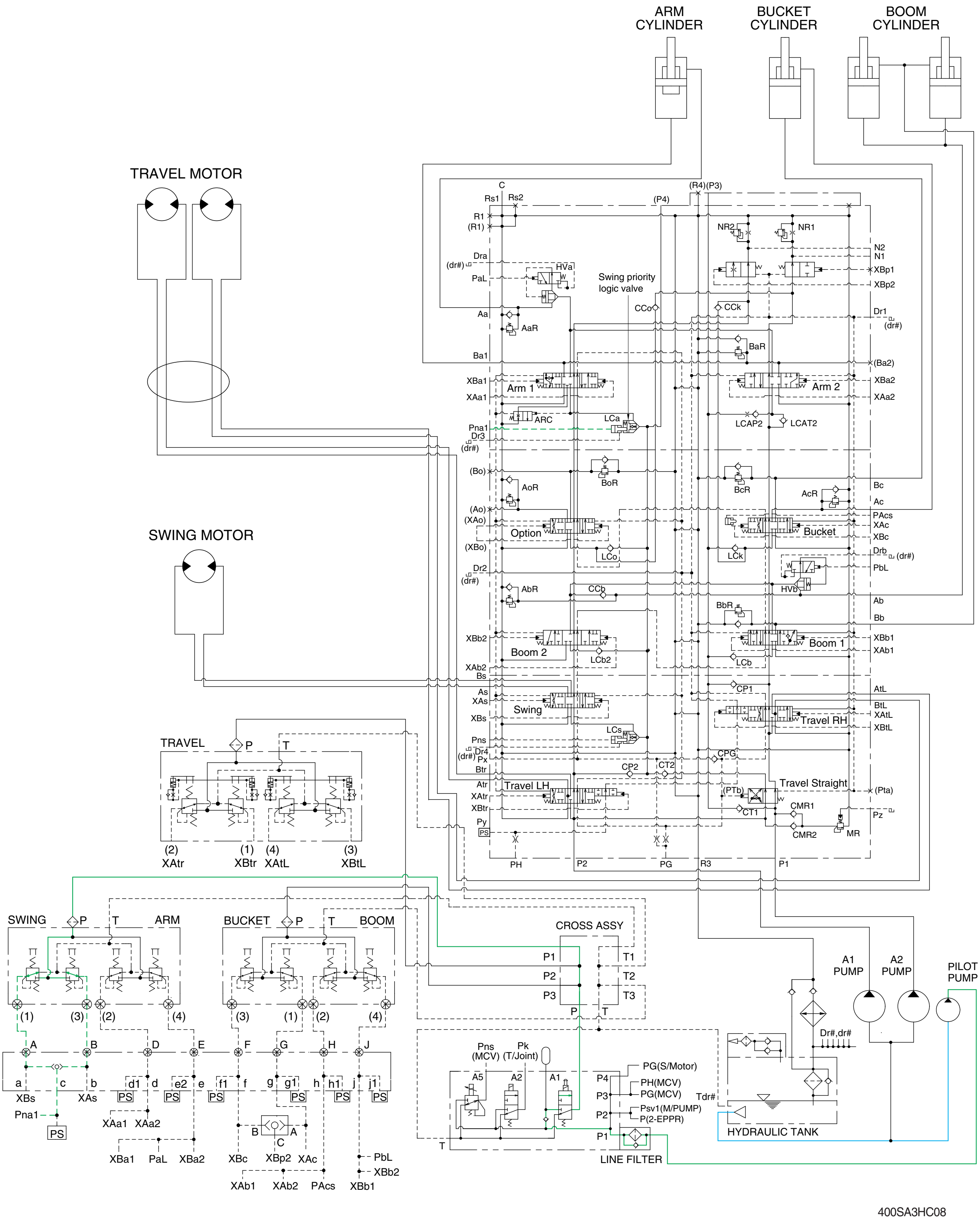
When one of the RCV lever (except travel lever) is tilted, the pilot oil flows into SH port through main control valve (Px).

This pressure moves spool of the time delay valve so, discharged oil from pilot valve flows to swing motor PG port. This pressure is applied to swing motor disc, thus the brake is released.

When all of the RCV lever are set in the neutral position, 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.

6. SWING PRIORITY SYSTEM



When carrying out the combined operation of swing and arm of the left control valve, the swing speed can be lowered than operating speed of arm.

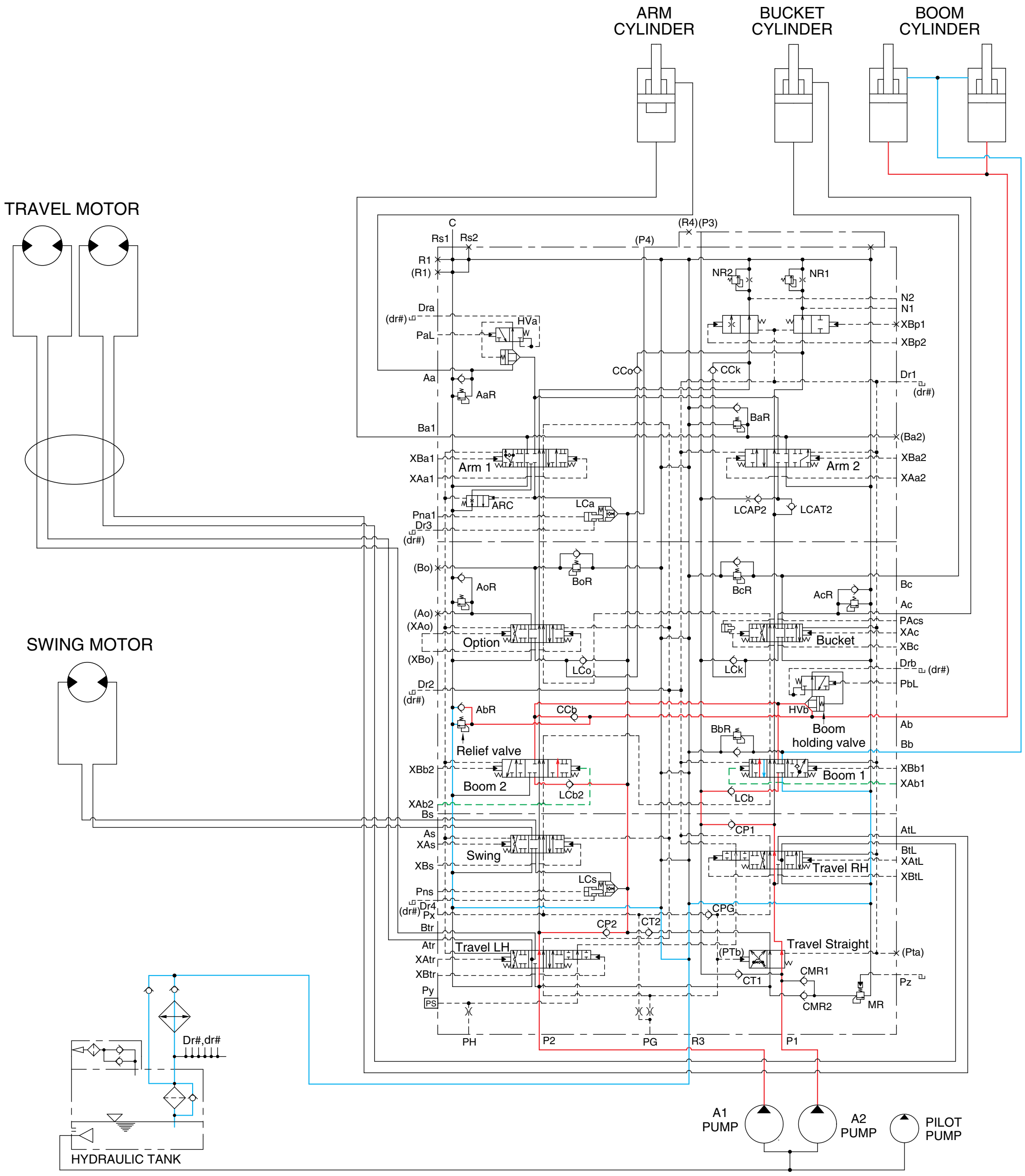
Pna1 pressure from the swing shuttle block change the swing priority logic valve and decreases the oil flow rate to the next section to make the swing operation more preferential.

This is called the swing priority system. For details, refer to page 2-45.

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

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



400SA3HC10

When the RH control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure (XAb1, XAb2) from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinders.

At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom 1 spool in the main control valve. When this happens, the boom goes up.

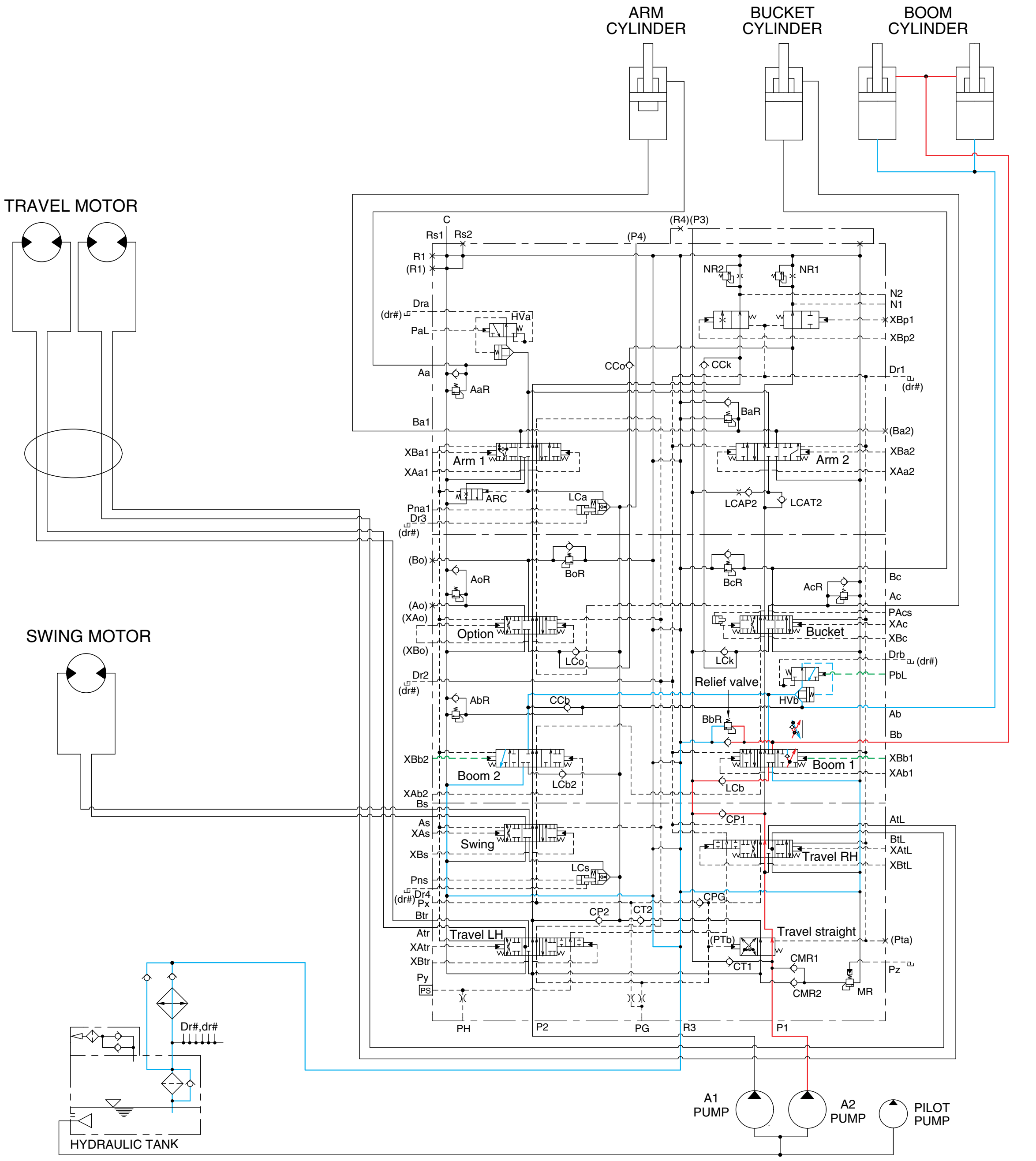
The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve.

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 cylinders.

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

2. BOOM DOWN OPERATION



400SA3HC11

When the RH control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure (XBb1, XBb2) from the remote control valve.

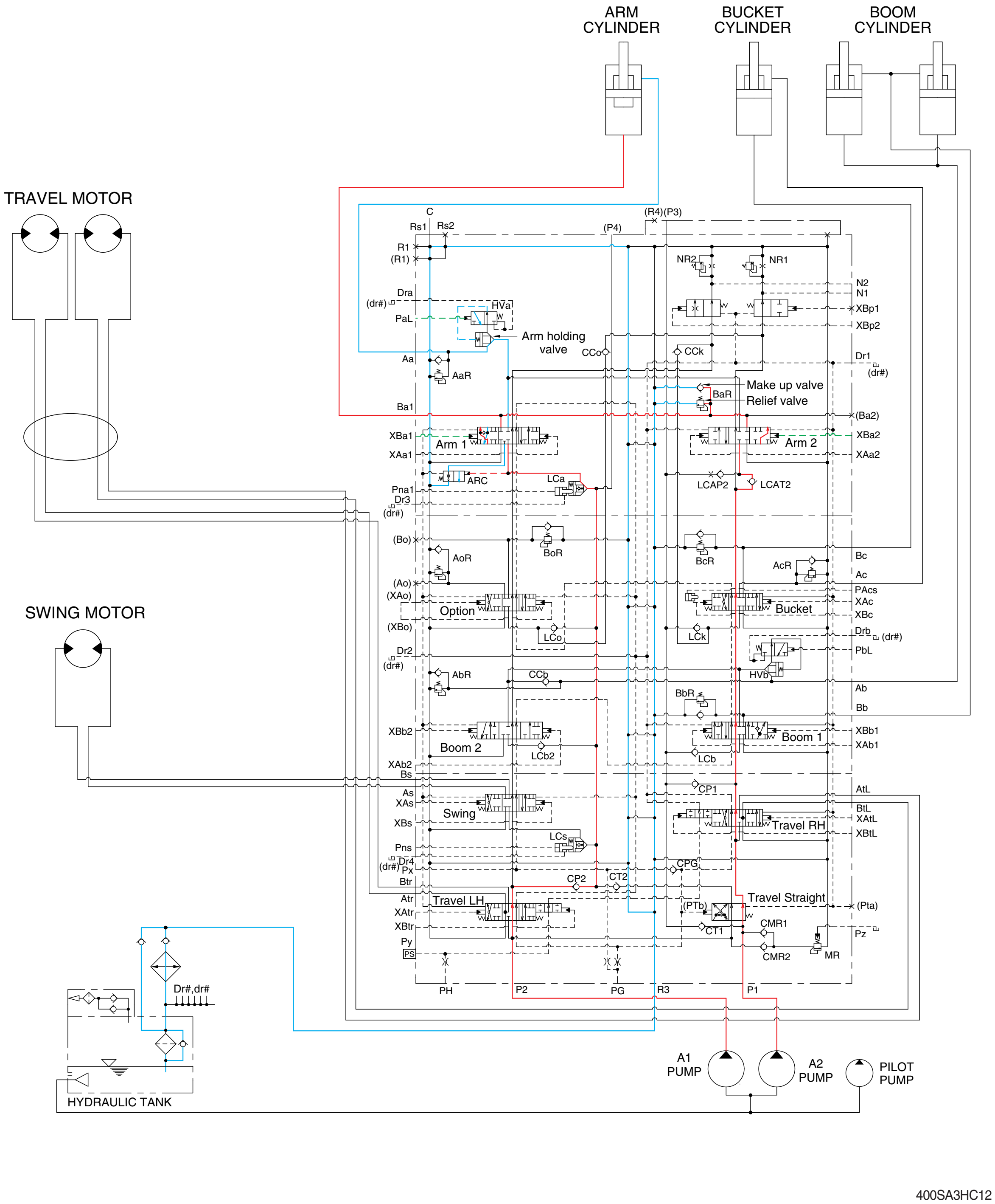
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 2 spool in the main control valve.

When the down speed of boom is faster, the oil returned from the large chamber of boom cylinders combines with the oil from the A2 pump, and flows into the small chamber of the boom cylinders.

This prevents cylinder cavitation by the negative pressure when the A2 pump flow can not match the boom down speed. And the excessive pressure in the boom cylinder rod end circuit is prevented by the relief valve.

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

3. ARM IN OPERATION



When the LH control lever is pulled back, the arm spools in the main control valve are moved the to roll in position by the pilot oil pressure (XBa1, XBa2) from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

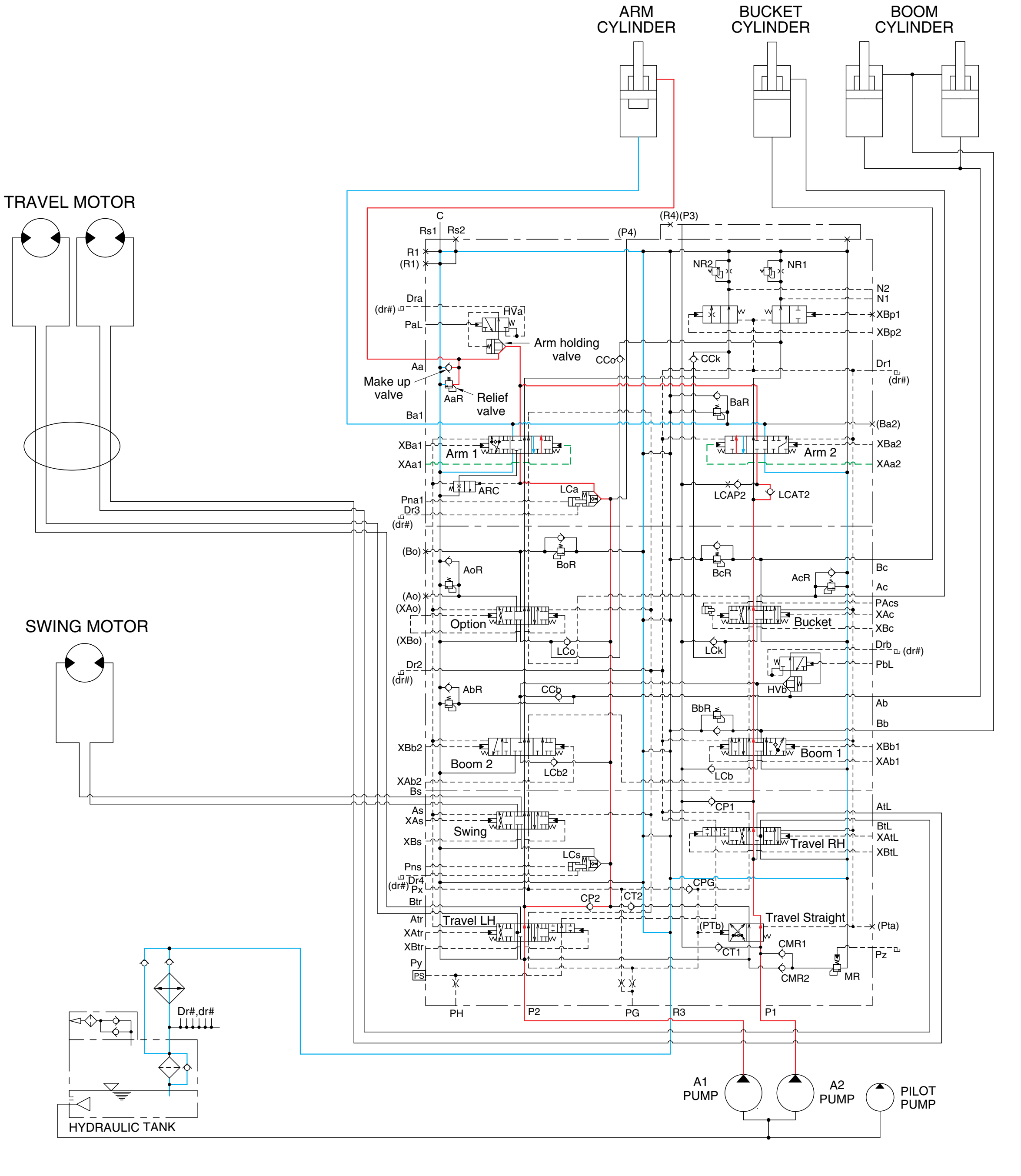
At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 1 spool in the main control valve. When this happens, the arm rolls in.

The excessive pressure in the arm cylinder head side is prevented by relief valve.

The cavitation which will happen to the head side of the arm 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.

4. ARM OUT OPERATION



400SA3HC13

When the LH control lever is pushed forward, the arm spools in the main control valve are moved to the roll out position by the pilot oil pressure (XAa1, XAa2) from the remote control valve.

The oil from the A1 and A2 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 spools in the main control valve. When this happens, the arm rolls out.

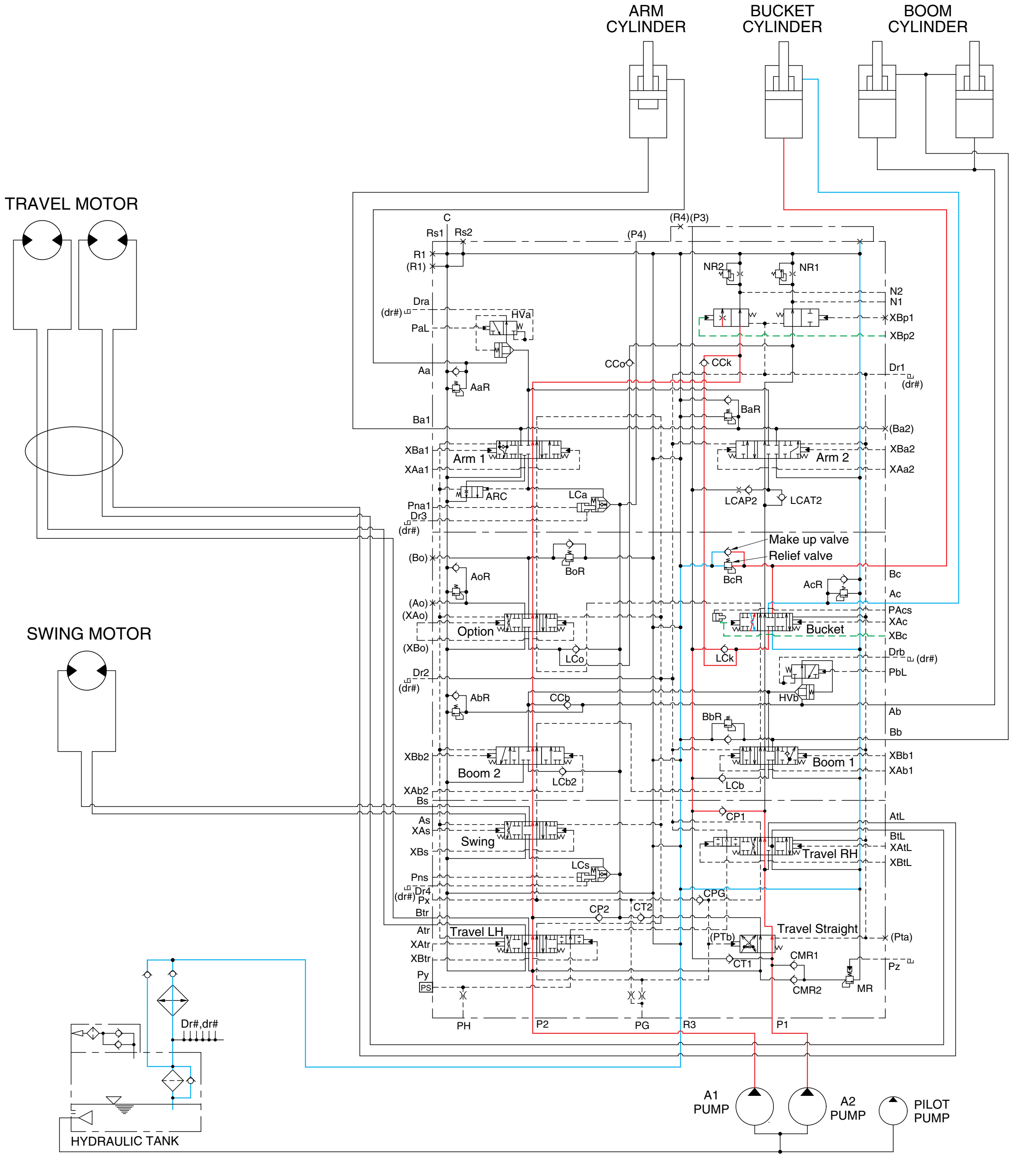
The excessive pressure in the arm cylinder rod side is prevented by relief valve.

When the arm is roll out and the control lever is returned to neutral position, the circuit for the holding pressure at the rod side of the arm cylinder is closed by the arm holding valve.

The cavitation which will happen to the rod side of the arm 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.

5. BUCKET IN OPERATION



400SA3HC14

When the RH 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 (XBc) from the remote control valve.

The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder. The oil from the A1 pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (XBp2).

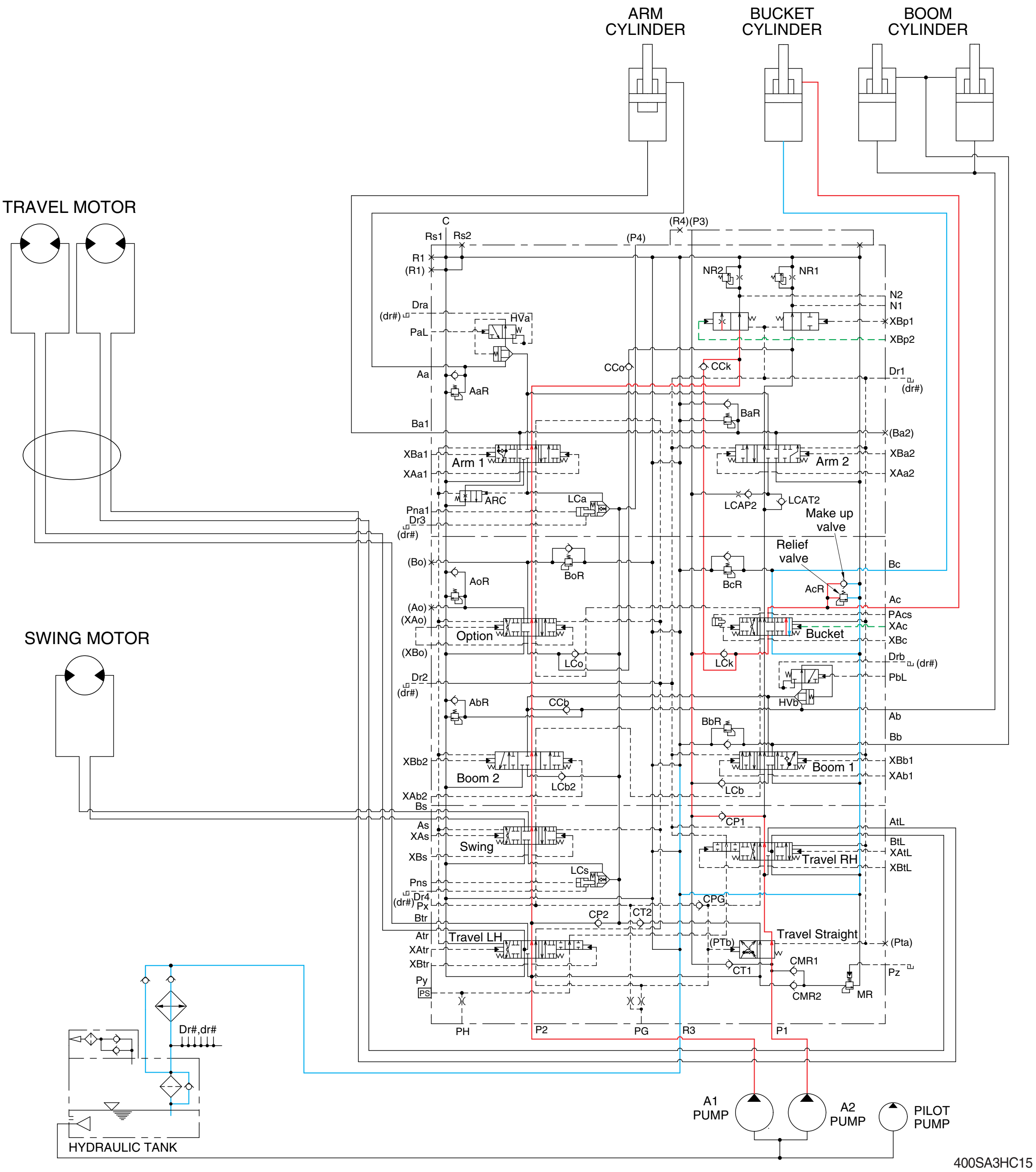
At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

The excessive pressure in the bucket cylinder head side is prevented by relief valve.

The cavitation which will happen to the head side 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.

6. BUCKET OUT OPERATION



When the RH 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 (XAc) from the remote control valve.

The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder. The oil from the A1 pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (XBp2).

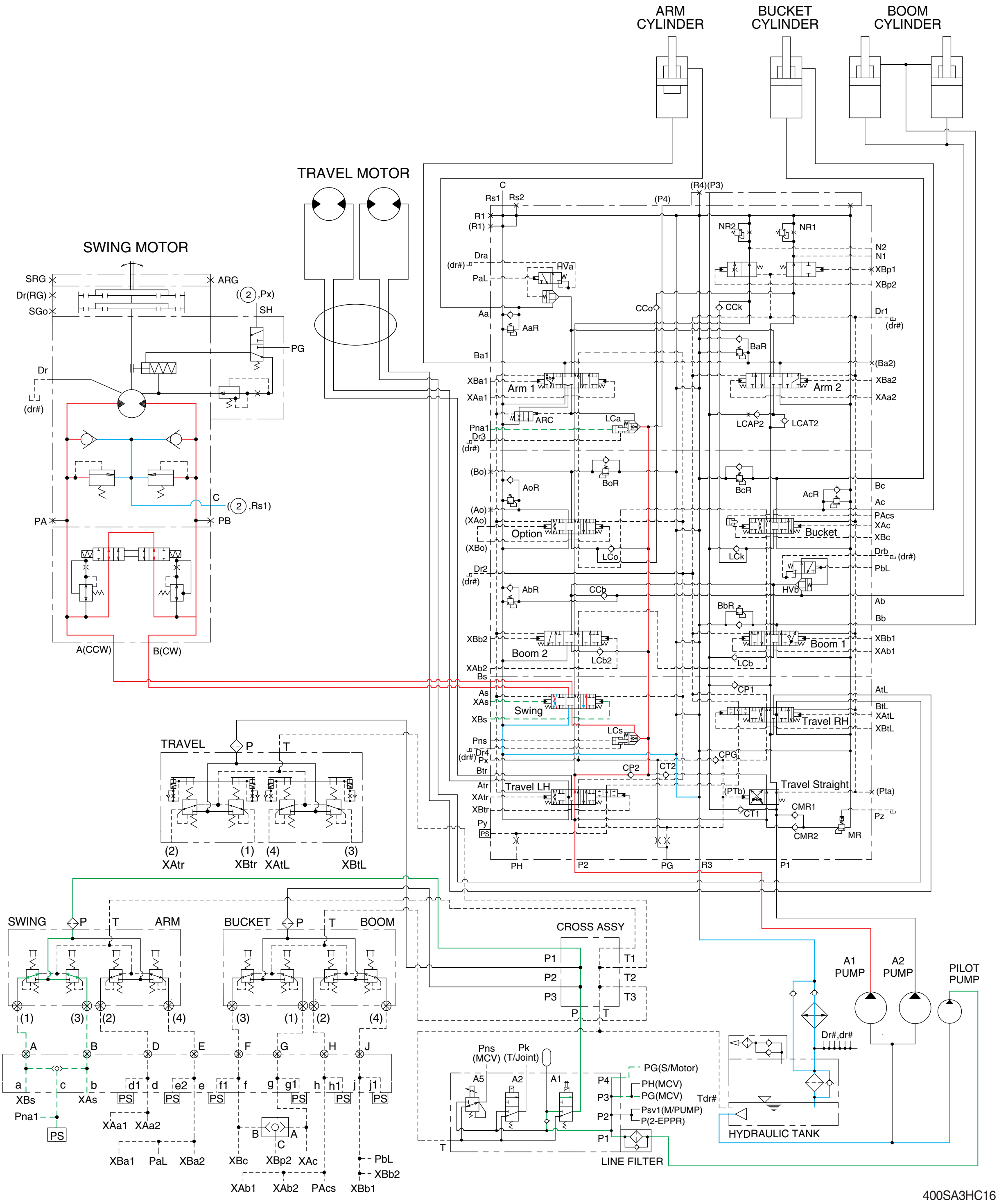
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.

The excessive pressure in the bucket cylinder rod side is prevented by relief valve.

The cavitation which will happen to the rod side 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



400SA3HC16

When the LH 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 (XAs, XBs) from the remote control valve.

The oil from the A1 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.

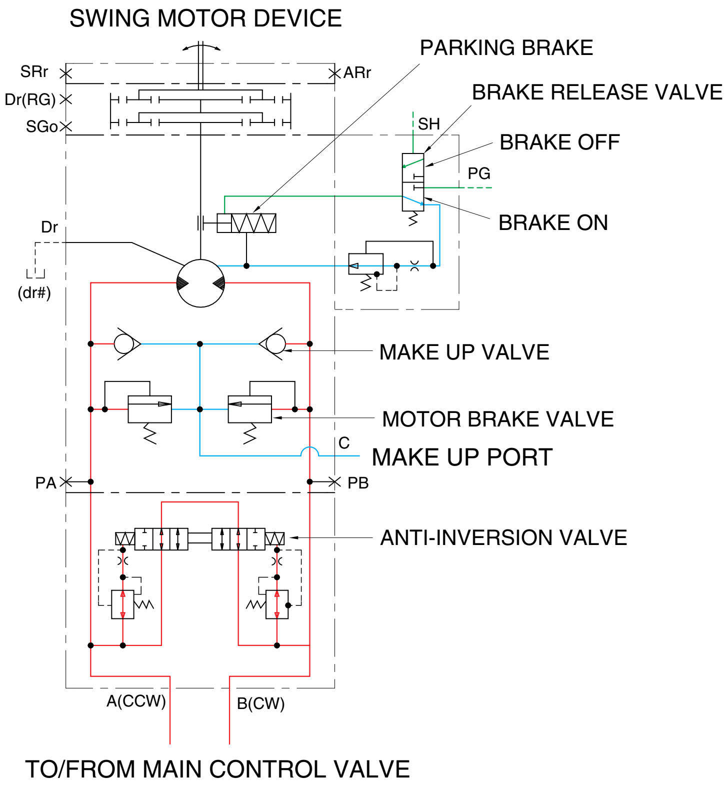
When this happens, the upper structure swings to the left or right.

The swing parking brake, make up valve and the motor brake 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. Also the swing operation preference function is operated by the pilot pressure **Pna1** (refer to page 3-12).

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

SWING CIRCUIT OPERATION



1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

This is function as a parking brake only when all of the RCV lever (except travel pedal) are not operated.

PARKING BRAKE "OFF" OPERATION

The parking brake is released by the pilot pressure oil from the pilot pump.
When one of the RCV lever (except travel lever) placed in the operating position, the pilot oil flows into SH port through the MCV. This pressure transferred to the brake release valve and the brake release valve is change over. Then the pilot oil pressure PG lift the brake piston and release the parking brake.

PARKING BRAKE "ON" OPERATION

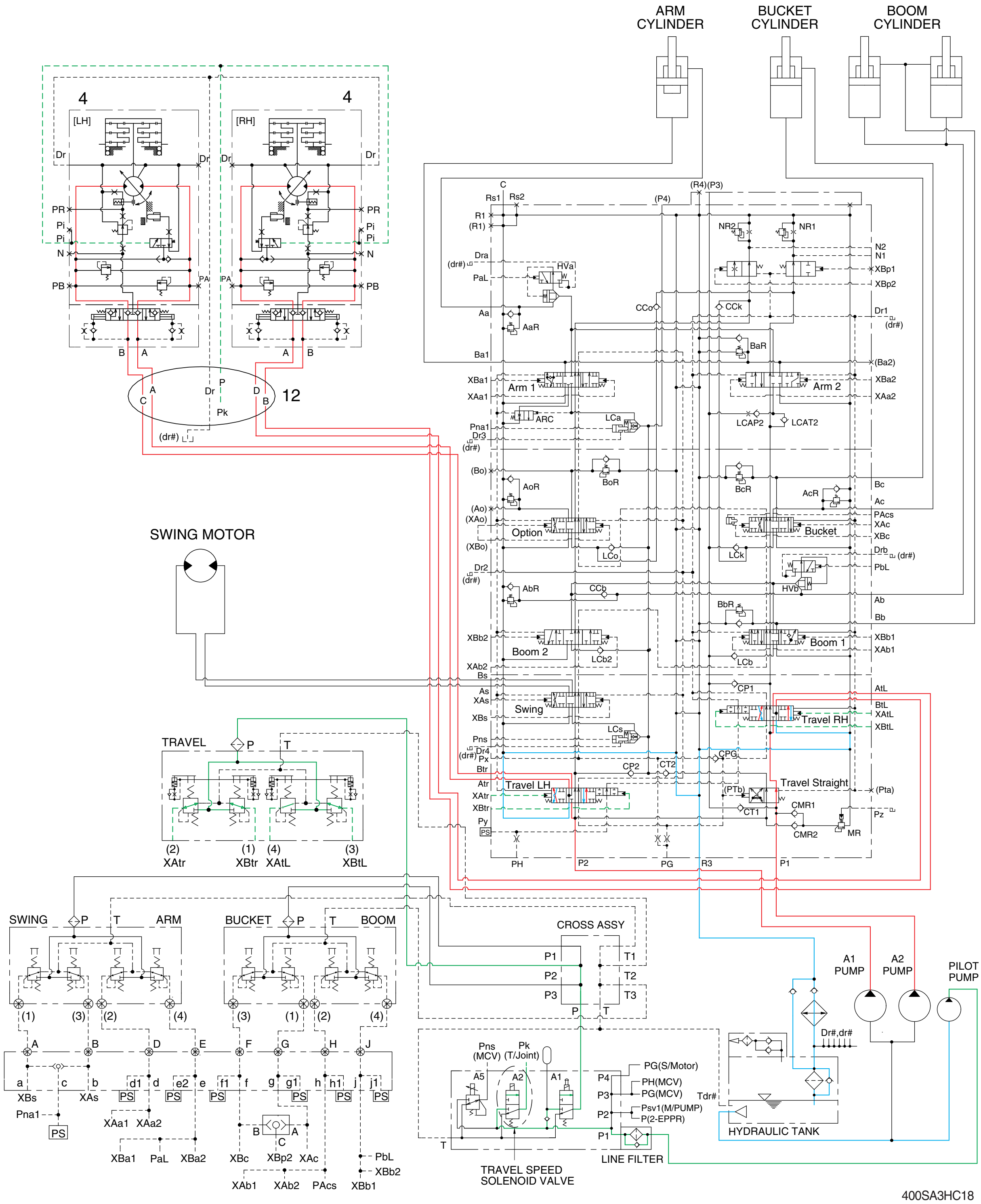
When all of the RCV lever placed in the neutral position, the pressure of the pilot oil passage down. Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the tank. And the brake is set to 'ON".

4) ANTI-INVERSION VALVE

This anti-inversion valve absorbs shocks produced as swing motion stops and reduced oscillation cause by swing motion.

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

8. TRAVEL FORWARD AND REVERSE OPERATION



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 the pilot oil pressure (XAtr, XBtr, XAtL, XBtL) from the remote control valve.

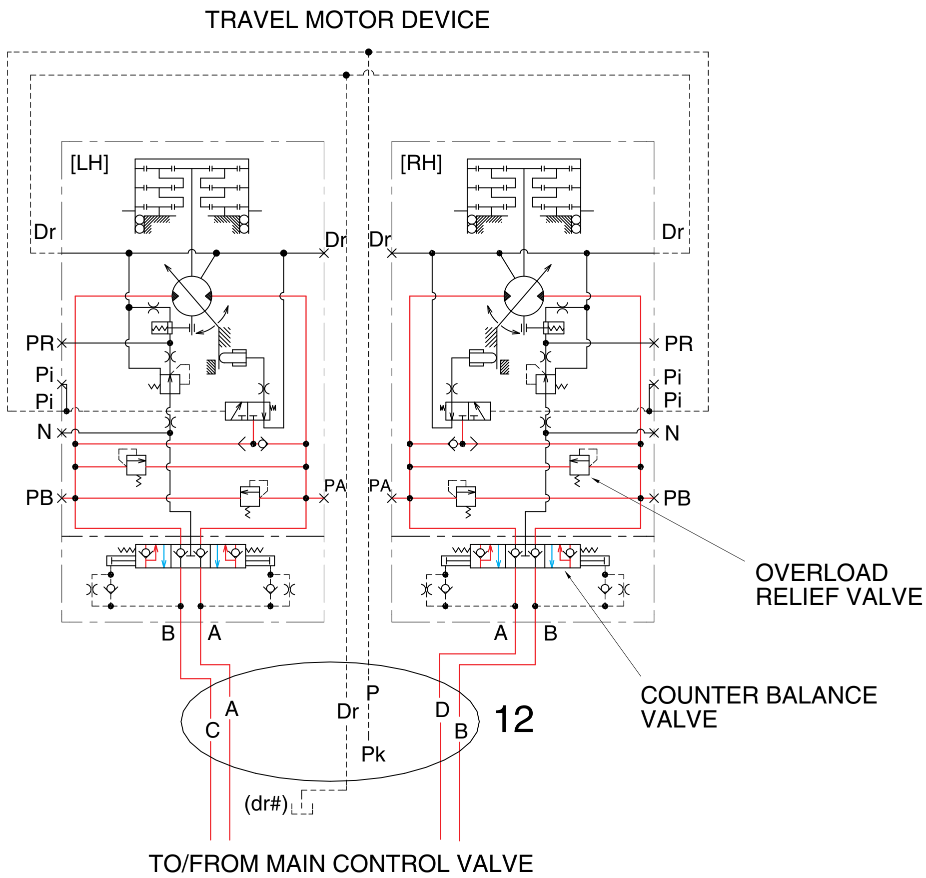
The oil from the each pump flows into the main control valve and then goes to the each travel motor through the turning joint.

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



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

1) COUNTER BALANCE VALVE

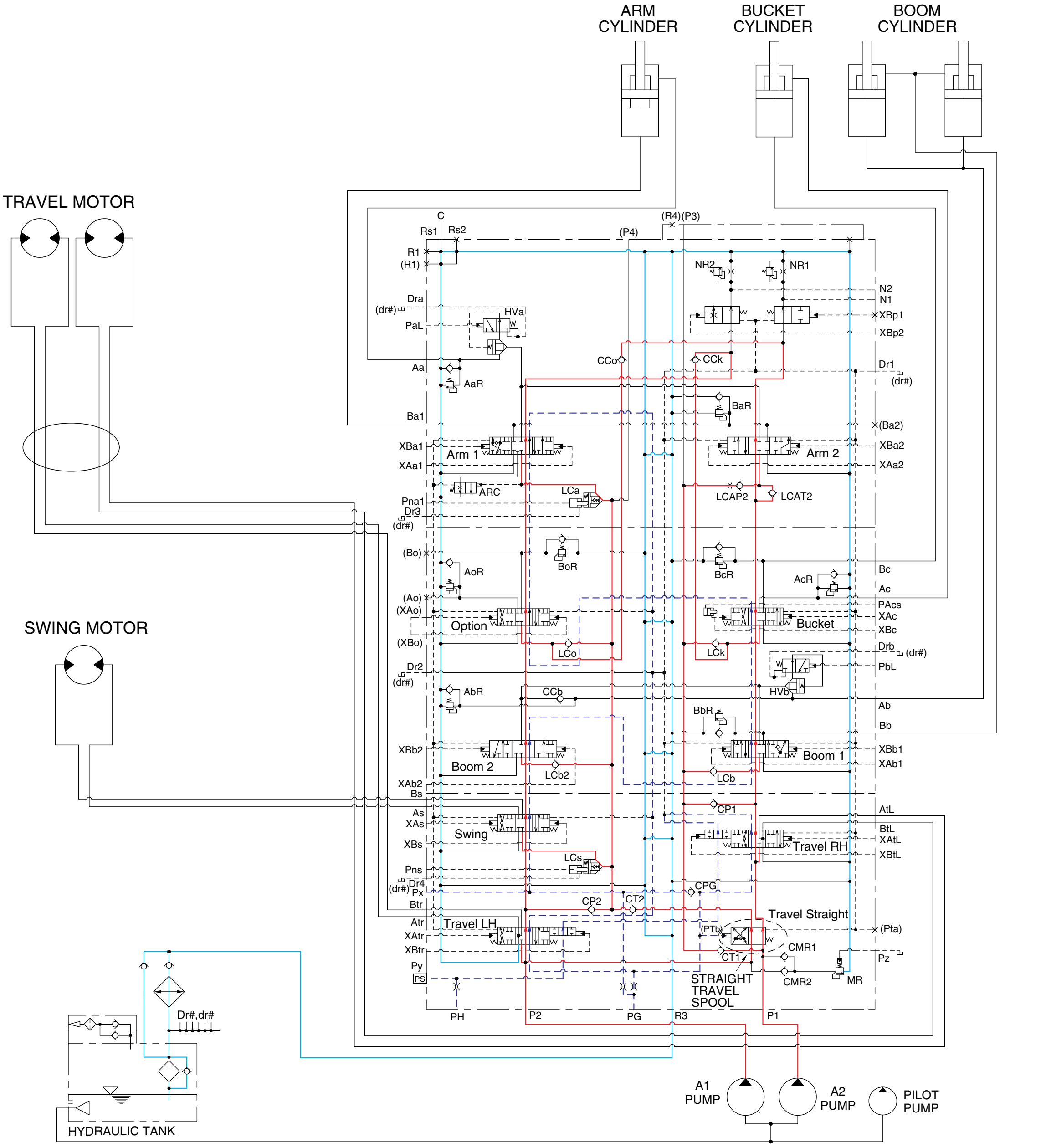
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 350 kgf/cm^2 (4980 psi) to prevent high pressure generated at a time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

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

1. OUTLINE



400SA3HC20

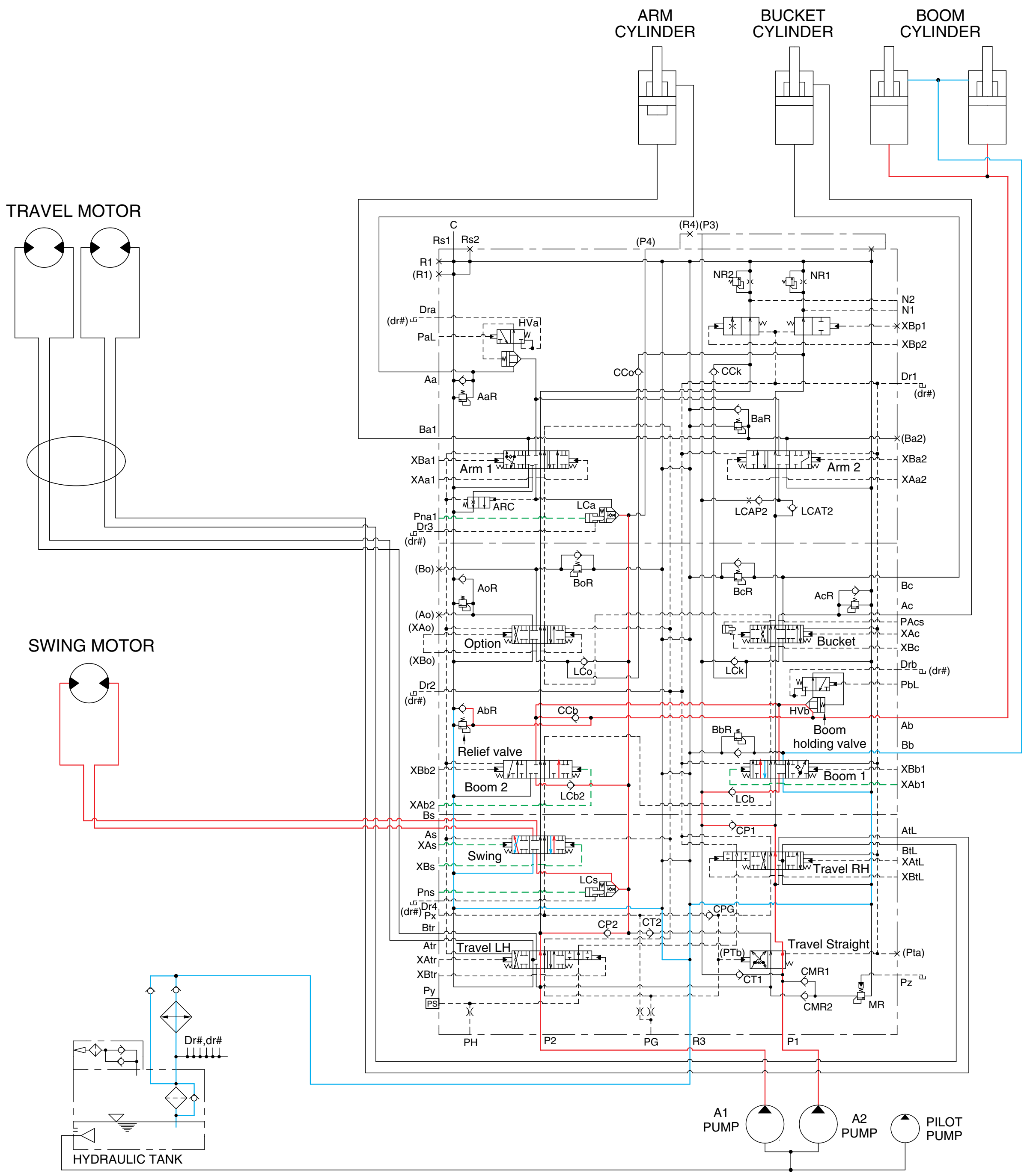
The oil from the A1 and A2 pump flows through the neutral oil passage, bypass oil passage and confluence oil passage in the main control valve. Then the oil goes to each actuator and operates them. Check valves and orifices are located on these oil passage in the main control valve. These control the oil from the main pumps so as to correspond to the operation of each actuator and smooth the combined operation.

STRAIGHT TRAVEL SPOOL

This straight travel spool is provided in the main control valve.
If any actuator is operated when traveling, the straight travel spool is pushed to the right by the pilot oil pressure from the pilot pump.
Consequently, the left and right travel oil supply passage are connected, and equivalent amount of oil flows into the left and right travel motors. This keeps the straight travel.

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

2. COMBINED SWING AND BOOM UP OPERATION



400SA3HC21

When the swing and boom up functions are operated simultaneously, the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure (XAs, XBs, XAb1, XAb2) from the remote control valve.

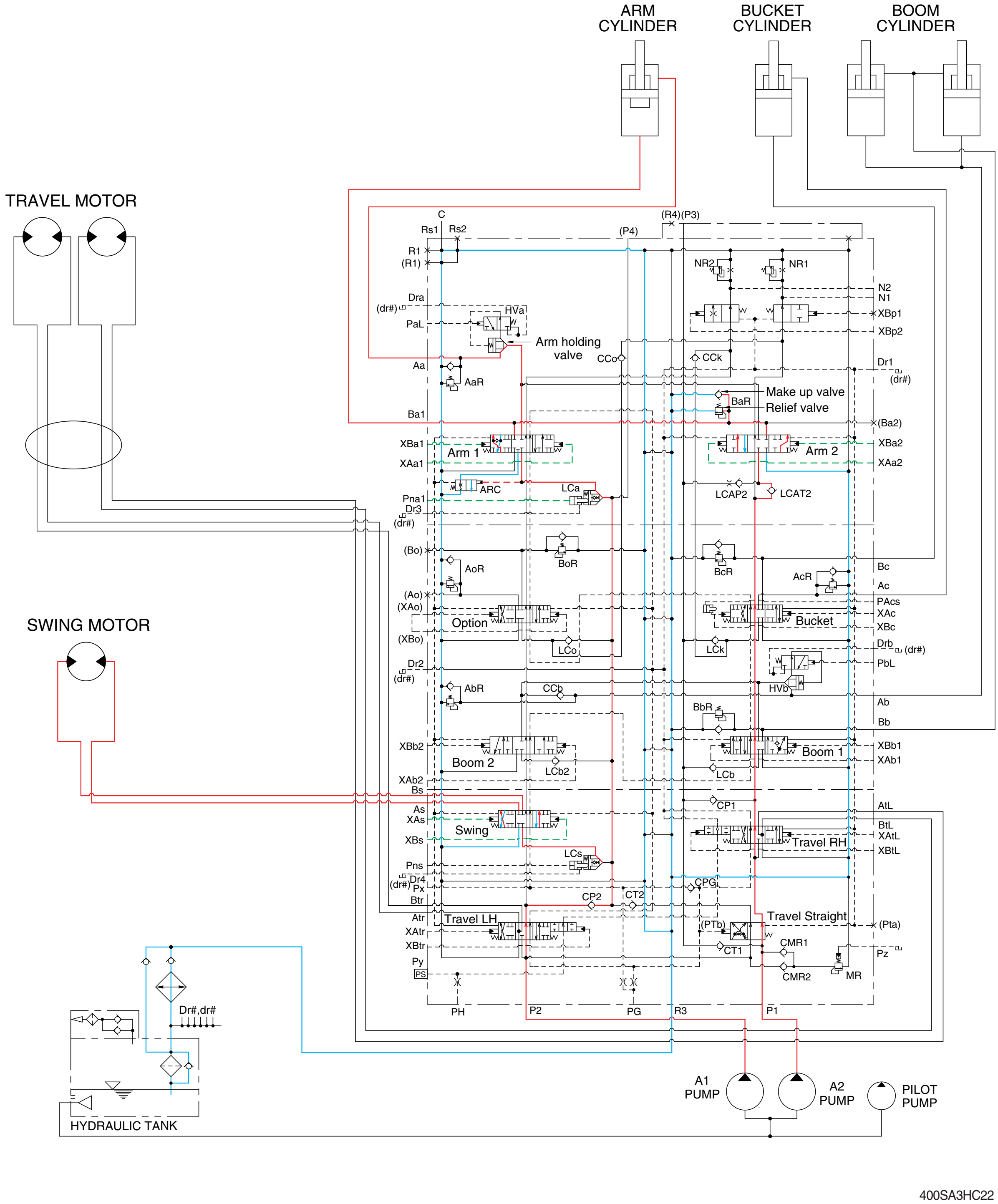
The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

The oil from the A2 pump flows into the boom cylinders through the boom 1 spool in the P1 housing side of the main control valve. The upper structure swings and the boom is operated.

Refer to page 3-9 for the boom priority system.

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

3. COMBINED SWING AND ARM OPERATION



When the swing and arm functions are operated simultaneously, the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure (XAs, XBs, XAa1, XAa2, XBa1, XBa2) from the remote control valve.

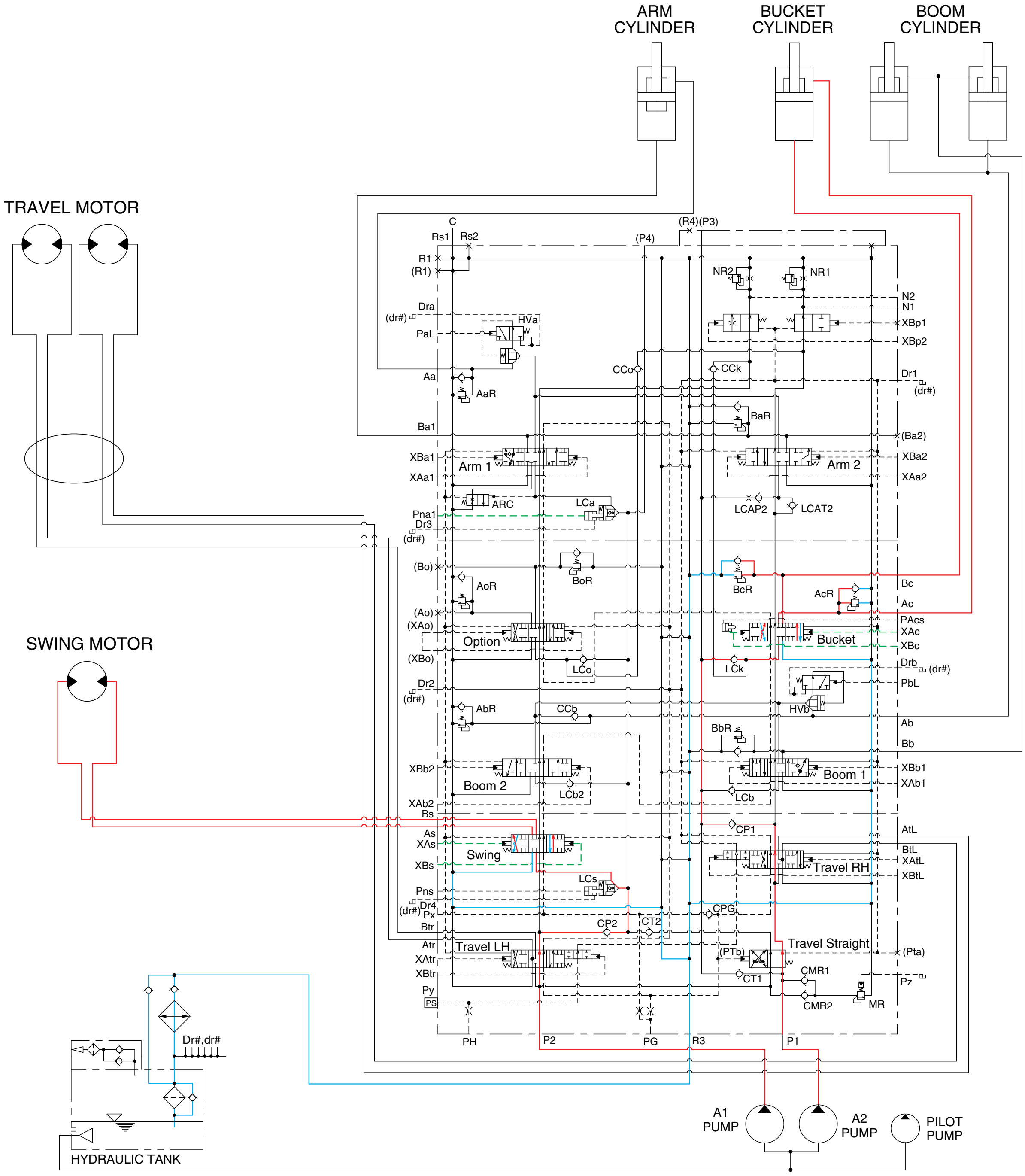
The oil from the A1 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

The oil from the A2 pump flows into the arm cylinder through the arm 2 spool of the P1 housing side of the main control valve. The upper structure swings and the arm is operated.

Refer to page 2-45 for the swing operation preference function.

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

4. COMBINED SWING AND BUCKET OPERATION



400SA3HC23

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 (XAs, XBs, XAc, XBc) from the remote control valve.

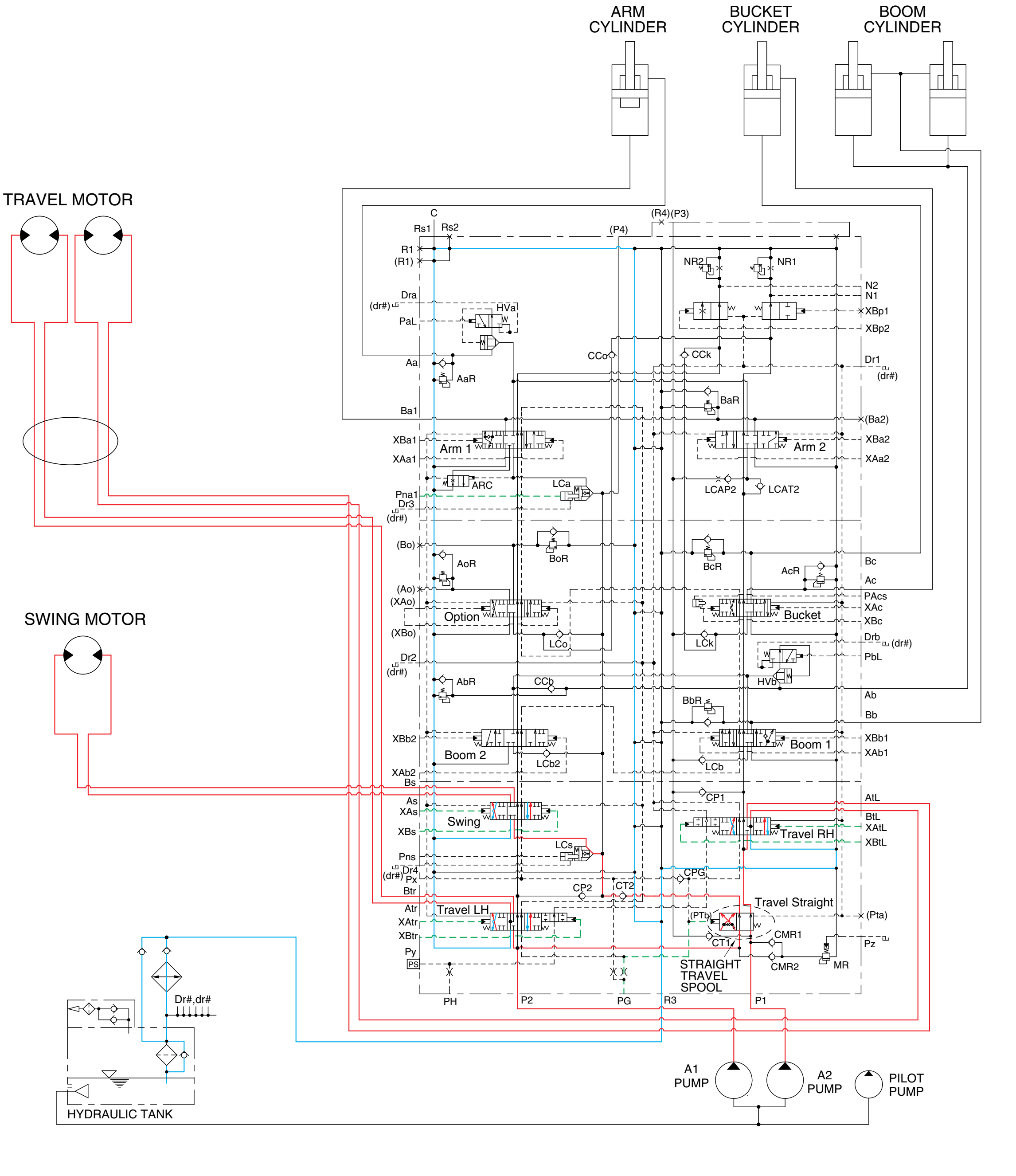
The oil from the A1 pump flows into the swing motor through the swing spool in the P2 housing side of the main control valve.

The oil from the A2 pump flows into the bucket cylinder through the bucket spool in the P1 housing side of the main control valve.

The upper structure swings and the bucket is operated.

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

5. COMBINED SWING AND TRAVEL OPERATION



400SA3HC24

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 (XAs, XBs, XAtr, XBtr, XAtL, XBtL) from the remote control valve and straight travel spool is pushed to the right by the pilot oil pressure from the pilot pump.

The oil from the A1 pump flows into the travel motors through the RH travel spool of the P2 housing side and the LH travel spool of the P1 housing side via the straight travel spool.

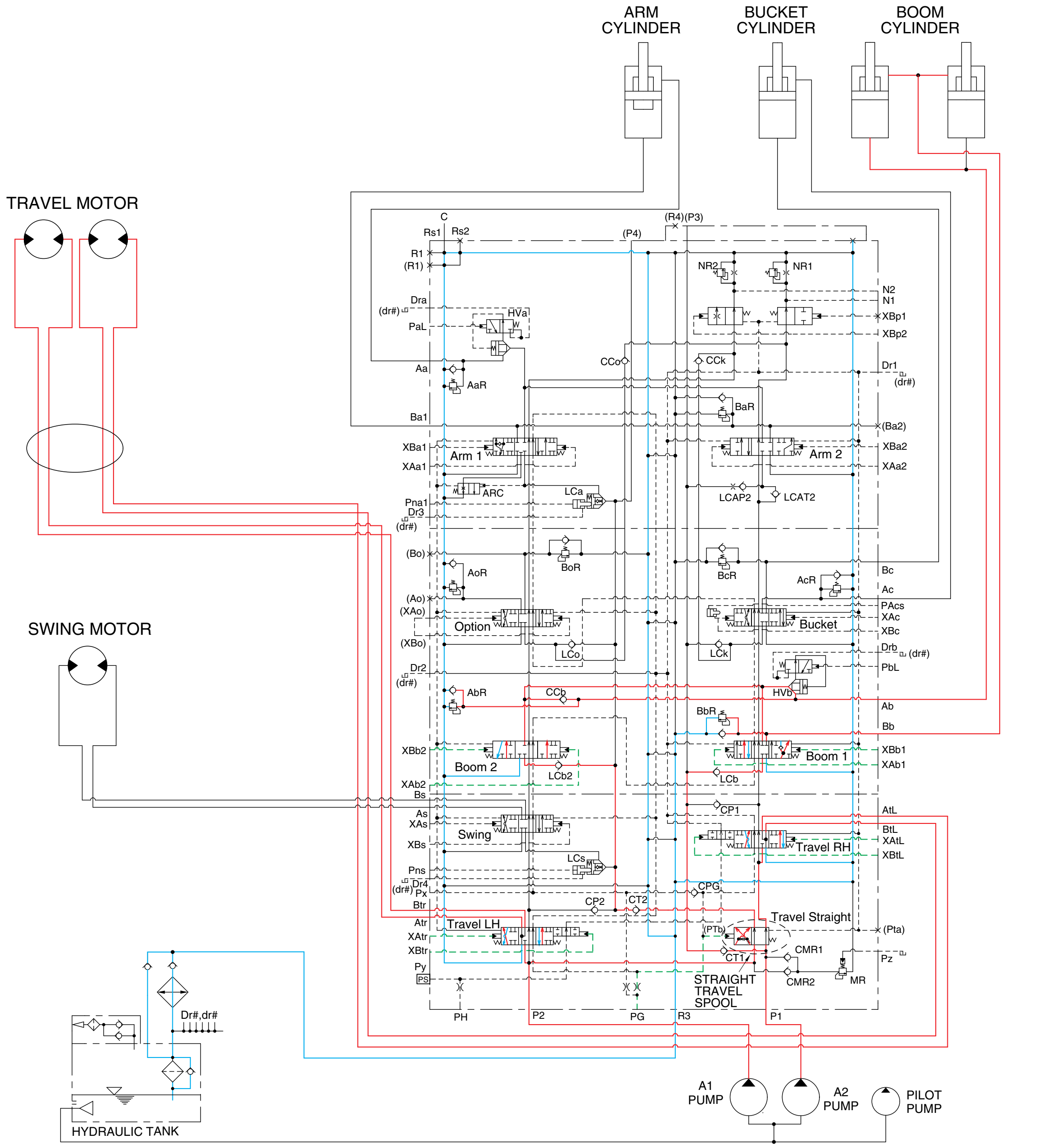
The oil from the A2 pump flows into the swing motor through the swing spool via the straight travel spool.

When the pressure of the travel motors is lower than the pressure of the swing motor, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The upper structure swings and the machine travels straight.

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

6. COMBINED BOOM AND TRAVEL OPERATION



400SA3HC25

When the boom and travel functions are operated simultaneously, the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (XAs, XBs, XAb1, XAb2, XBb1, XBb2) from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

The oil from the A1 pump flows into the travel motors through the RH travel spool of the P2 housing side and the LH travel spool of the P1 housing side via the straight travel spool.

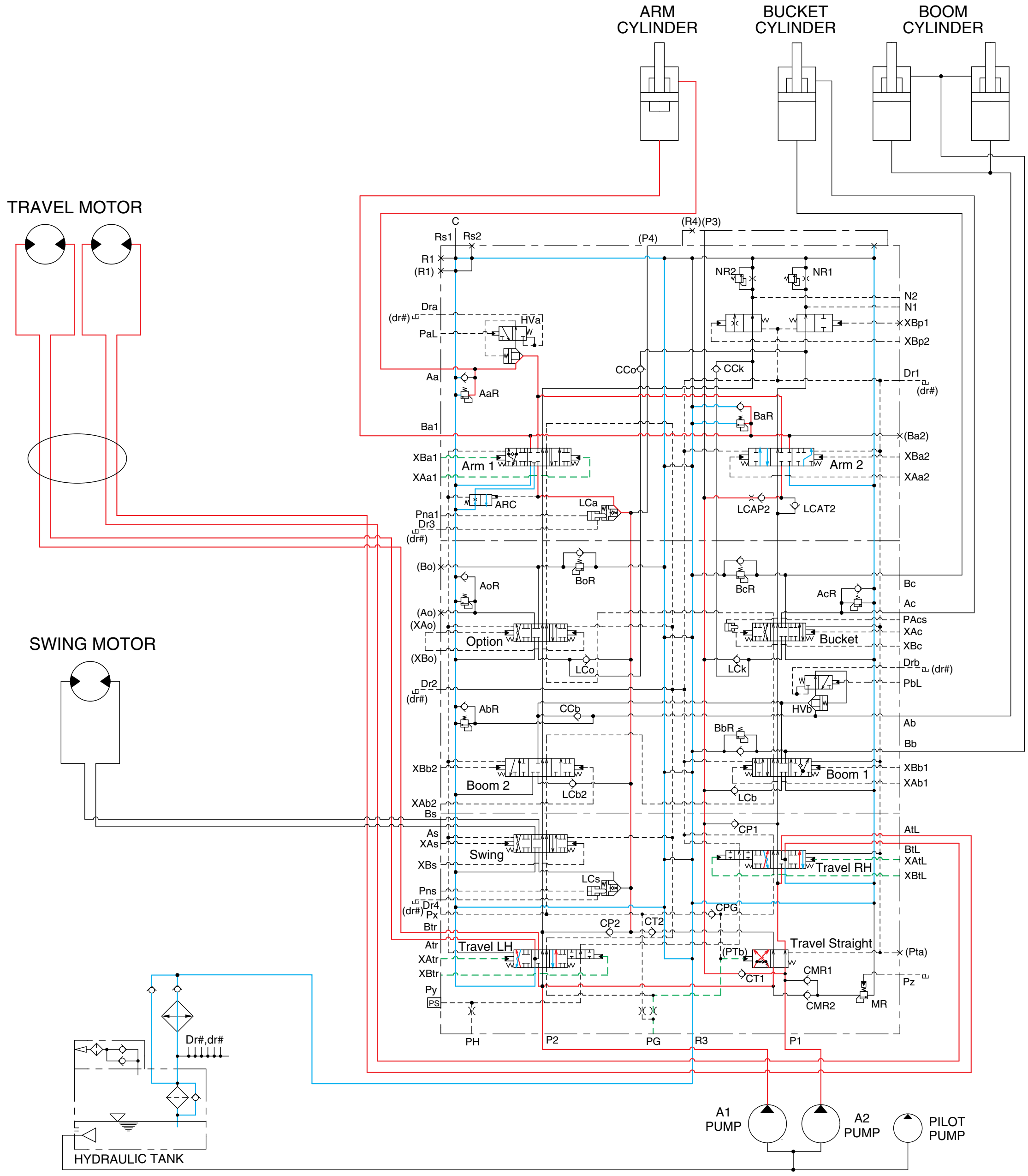
The oil from the A2 pump flows into the boom cylinders through the boom 2 spool and boom 1 spool via the parallel and confluence oil passage in case boom up operation.

When the pressure of the travel motors is lower than the pressure of the boom cylinders, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The boom is operated and the machine travels straight.

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

7. COMBINED ARM AND TRAVEL OPERATION



400SA3HC26

When the arm and travel functions are operated simultaneously, the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (XAs, XBs, XAa1, XAa2, XBa1, XBa2) from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

The oil from the A1 pump flows into the travel motors through the RH travel spool of the P2 housing side and the LH travel spool of the P1 housing side via the straight travel spool.

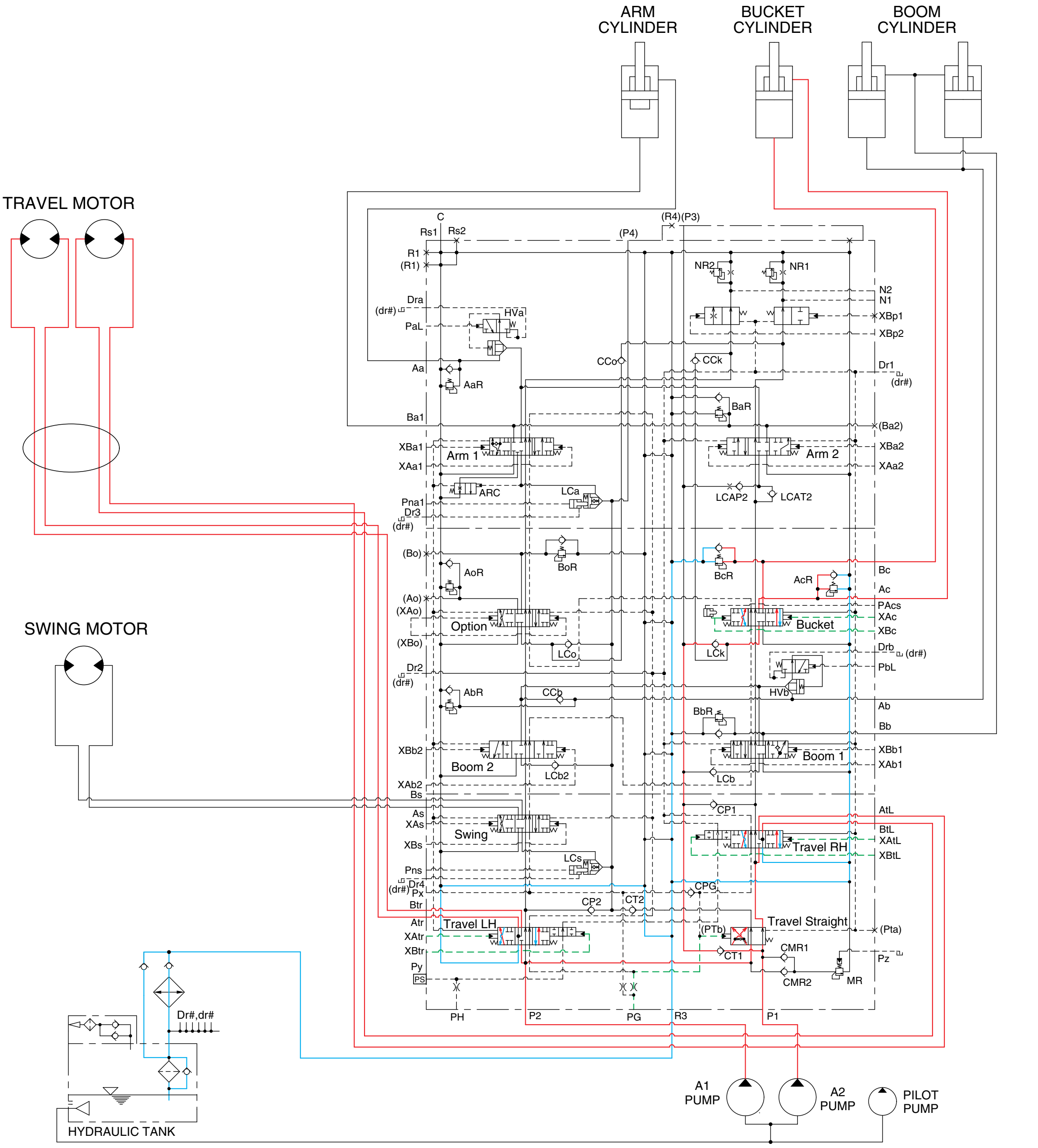
The oil from the A2 pump flows into the arm cylinder through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage.

When the pressure of the travel motors is lower than the pressure of the arm cylinder, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The arm is operated and the machine travels straight.

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

8. COMBINED BUCKET AND TRAVEL OPERATION



400SA3HC27

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 (XAs, XBs, XAc, XBc) from the remote control valve, and the straight travel spool is pushed to the right by the oil pressure from pilot pump. The oil from the A1 pump flows into the travel motors through the RH travel spool of the P2 housing side and the LH travel spool of the P1 housing side via the straight travel spool of the control valve.

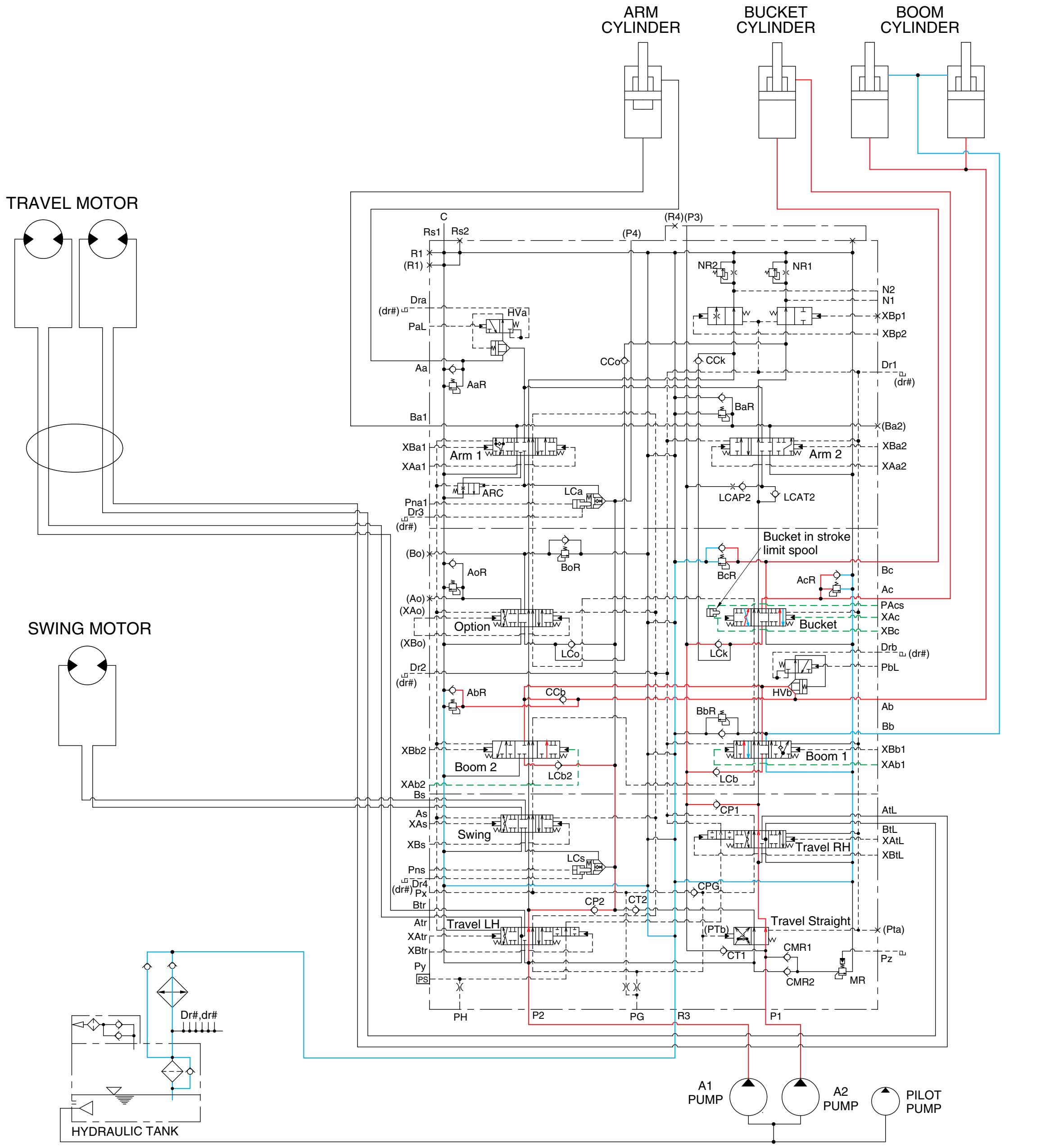
The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage.

When the pressure of the travel motors is lower than the pressure of the bucket cylinder, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The bucket is operated and the machine travels straight.

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

9. COMBINED BOOM UP AND BUCKET OPERATION



400SA3HC28

When the boom up and bucket functions are operated simultaneously, each spool in the main control valve is moved to the functional position by the pilot oil pressure (XAb1, XAb2, XAc, XBc) from the remote control valve.

The oil from the A1 pump flows into the boom cylinders through the boom 2 spool in the P2 housing side. The oil from the A2 pump flows into the boom cylinders and bucket cylinder through the boom 1 spool, bucket spool and the parallel and confluence oil passage in the P1 housing side.

Also, when the boom up and bucket in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure PAcs and then the bucket spool transfers in the half stroke not full stroke (Refer to page 2-42). Therefore, the most of pressurized oil flows into boom 1 spool than the bucket spool to make the boom up operation more preferential.

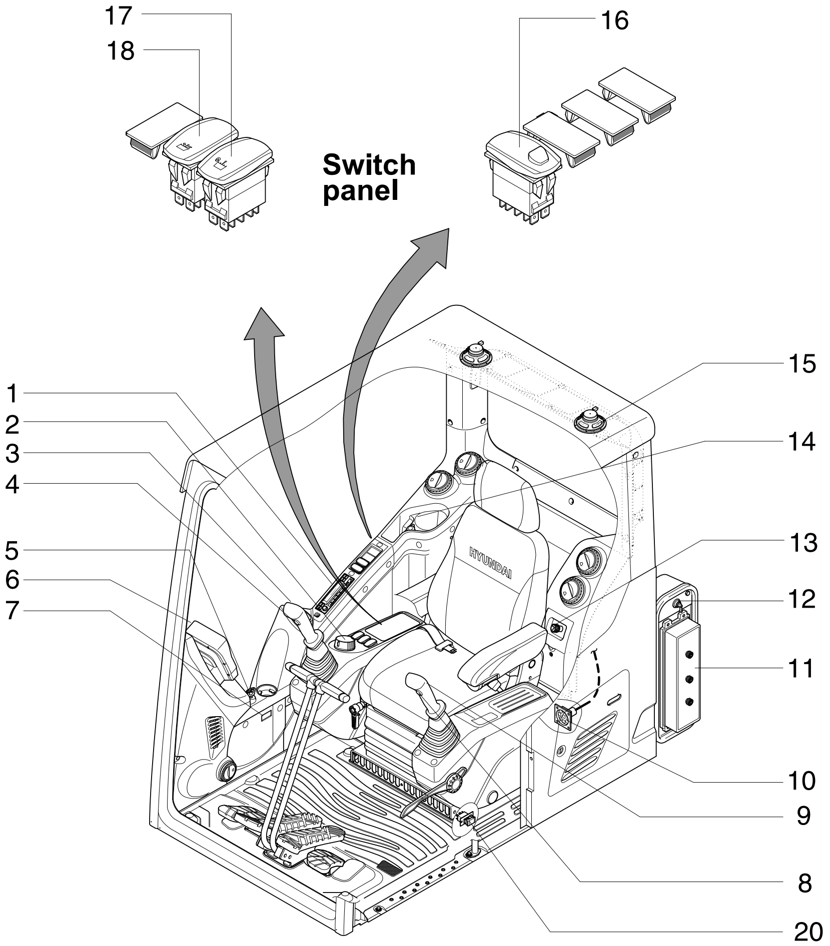
The boom and bucket are operated.

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

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

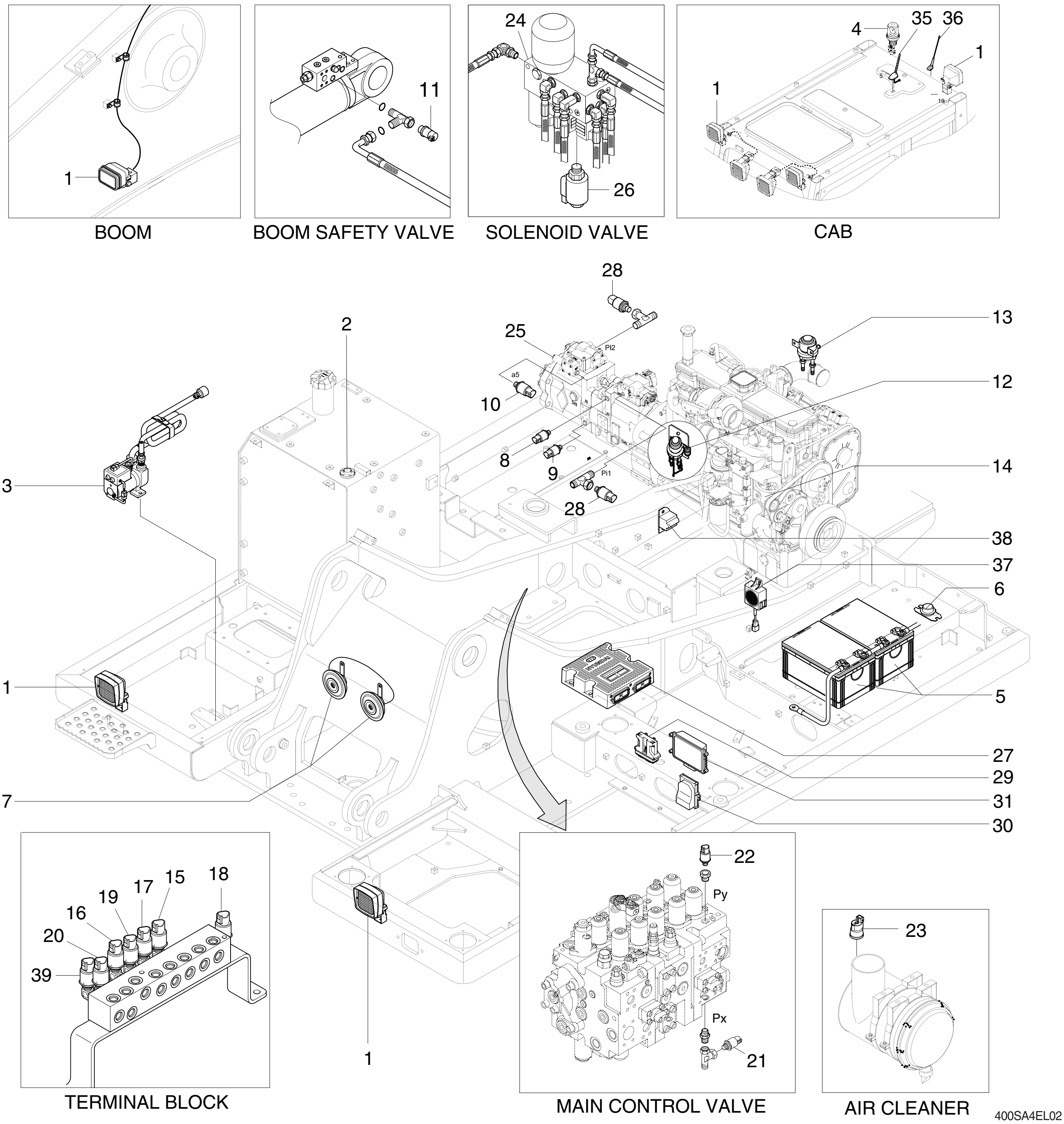
1. LOCATION 1



400SA4EL01

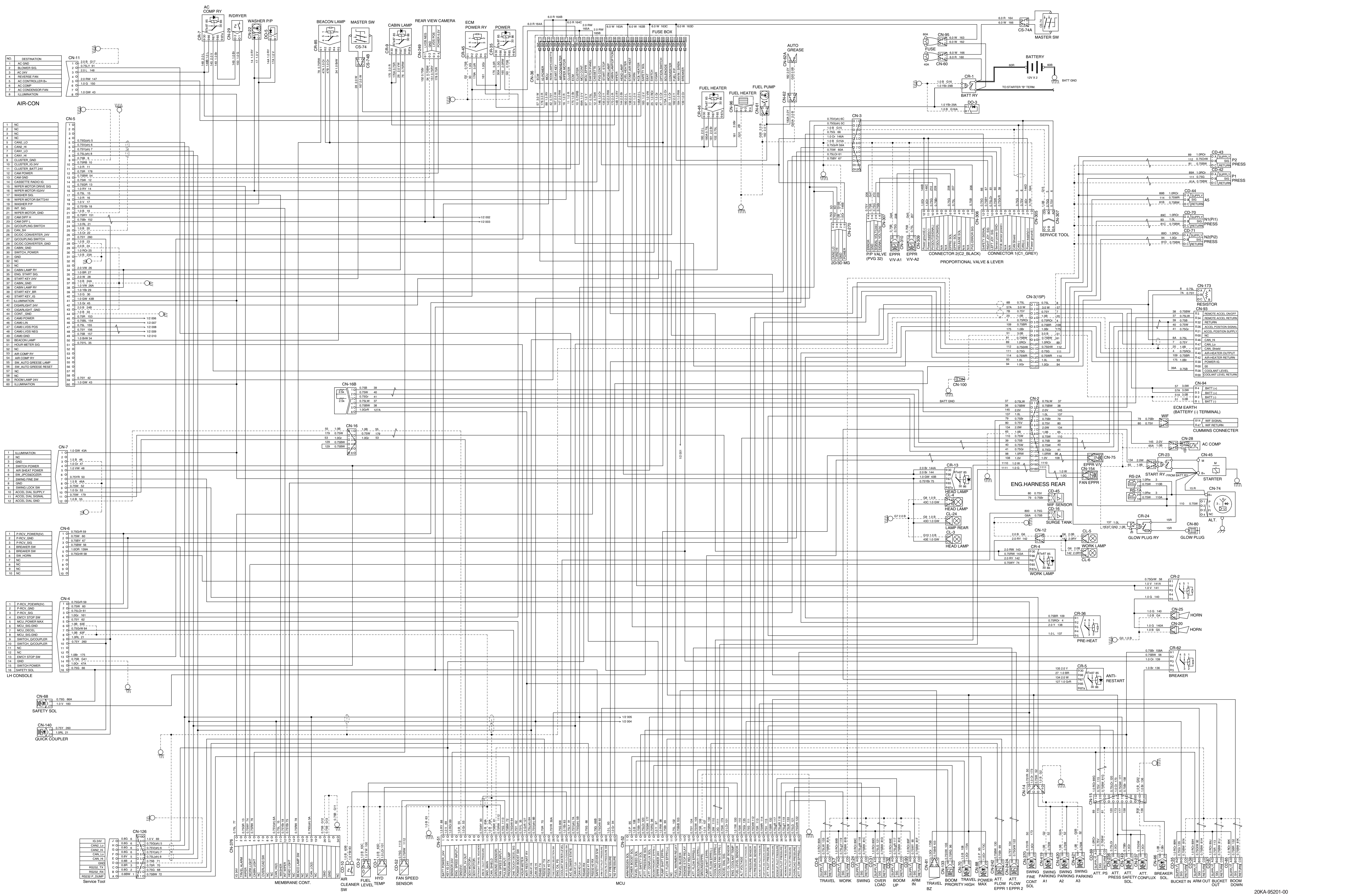
1	Radio & USB player	8	Power max switch (null)	15	Speaker
2	Accel dial	9	One touch decel switch	16	Quick clamp switch
3	Horn switch	10	RS232 service socket	17	Swing lock switch
4	Breaker operation switch	11	Fuse & relay box	18	Fine swing switch
5	Starting switch	12	Master switch	19	Emergency engine stop switch
6	Cluster	13	Cigar lighter		
7	Service meter	14	12V socket		

2. LOCATION 2

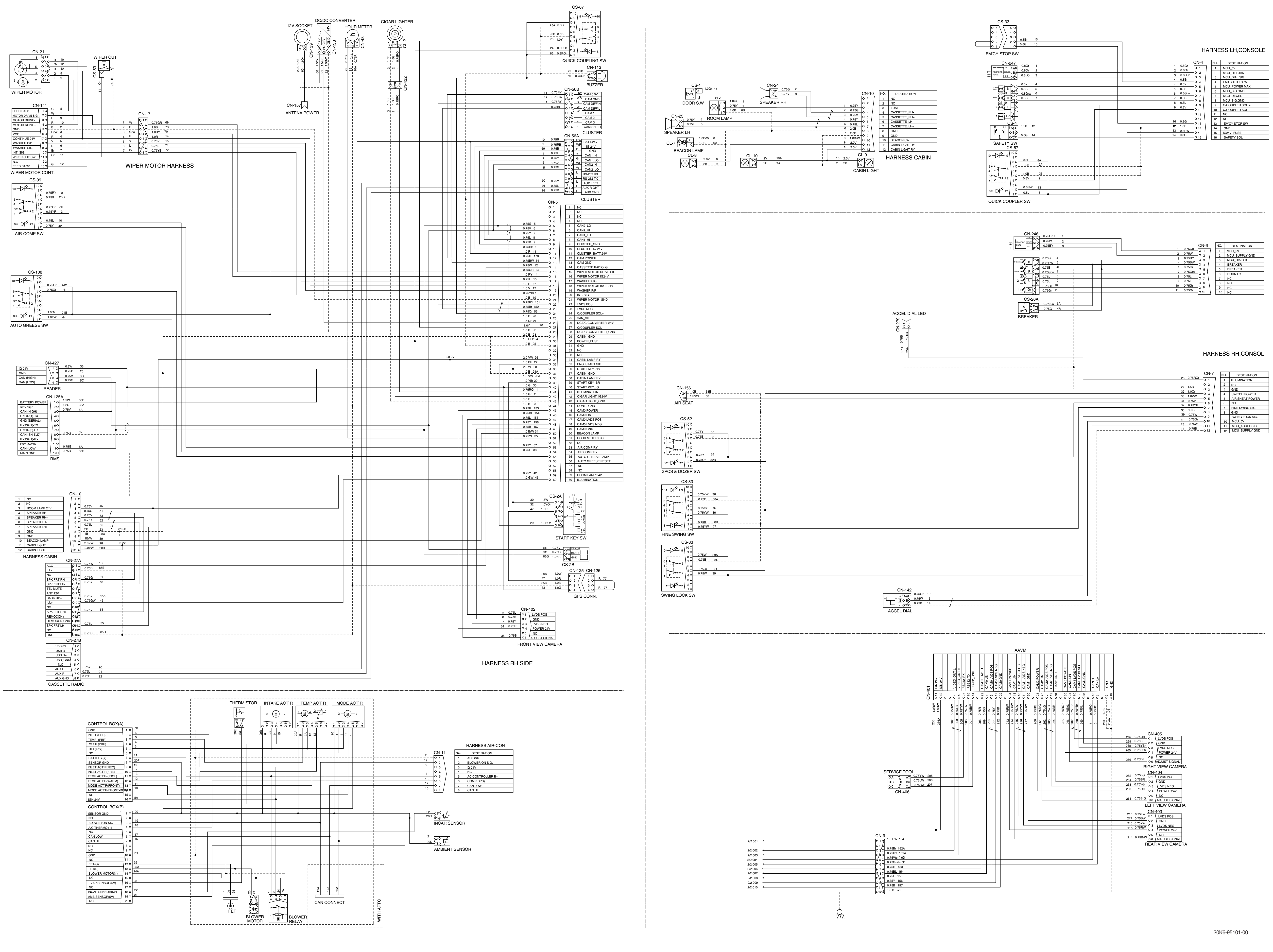


1 Lamp
2 Fuel sender
3 Fuel filler pump
4 Beacon lamp
5 Battery
6 Battery relay
7 Horn
8 A1 pump pressure sensor
9 A2 pump pressure sensor
10 EPPR pressure sensor
11 Overload pressure sensor
12 Start relay
13 Heater relay
14 Alternator
15 Bucket out pressure sensor
16 Arm out pressure sensor
17 Boom up pressure sensor
18 Swing pressure sensor
19 Boom down pressure sensor
20 Arm in pressure sensor
21 Attach pressure sensor
22 Travel pressure sensor
23 Air cleaner sensor
24 3 cartridge valve
25 Pump EPPR valve
26 Boom priority EPPR valve
27 MCU
28 Pliot pressure sensor
29 PVG32 controller
30 Relay drive unit
31 Around view controller
35 Integrated antenna
36 Satellite antenna
37 Warning buzzer
38 Travel alarm buzzer
39 Bucket in pressure sensor

· ELECTRICAL CIRCUIT (1/2)



· ELECTRICAL CIRCUIT (2/2)



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 → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A]

- → Fuse box [No.1] → I/conn [CN-2 (8)] → ECM [CN-94 (3, 4)]
- → Fuse box [No.2] → Power relay [CR-35 (30)]
  - → ECM power relay [CR-45 (3)]
- → Fuse box [No.3] → MCU [CN-51 (1)]
- → Fuse box [No.4] → I/conn [CN-5 (59)] → I/conn [CN-10 (3)] → Room lamp [CL-1 (2)]
  - → Door switch [CS-1]
  - → Radio & USB player [CN-27A (8)]
- → Fuse box [No.5] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]
  - → RMS [CN-125A (1)]
  - → GPS connection [CN-125 (1)]
- → Fuse box [No.6] → I/conn [CN-11 (5)] → AC & Heater controller box (A)
  - → Blower relay (4)
- → Fuse box [No.7] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)] → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.8] → I/conn [CN - 5 (11)] → Cluster [CN -56A (1)]
  - → Hour meter [CN-48 (1)]

※ I/conn : Intermediate connector

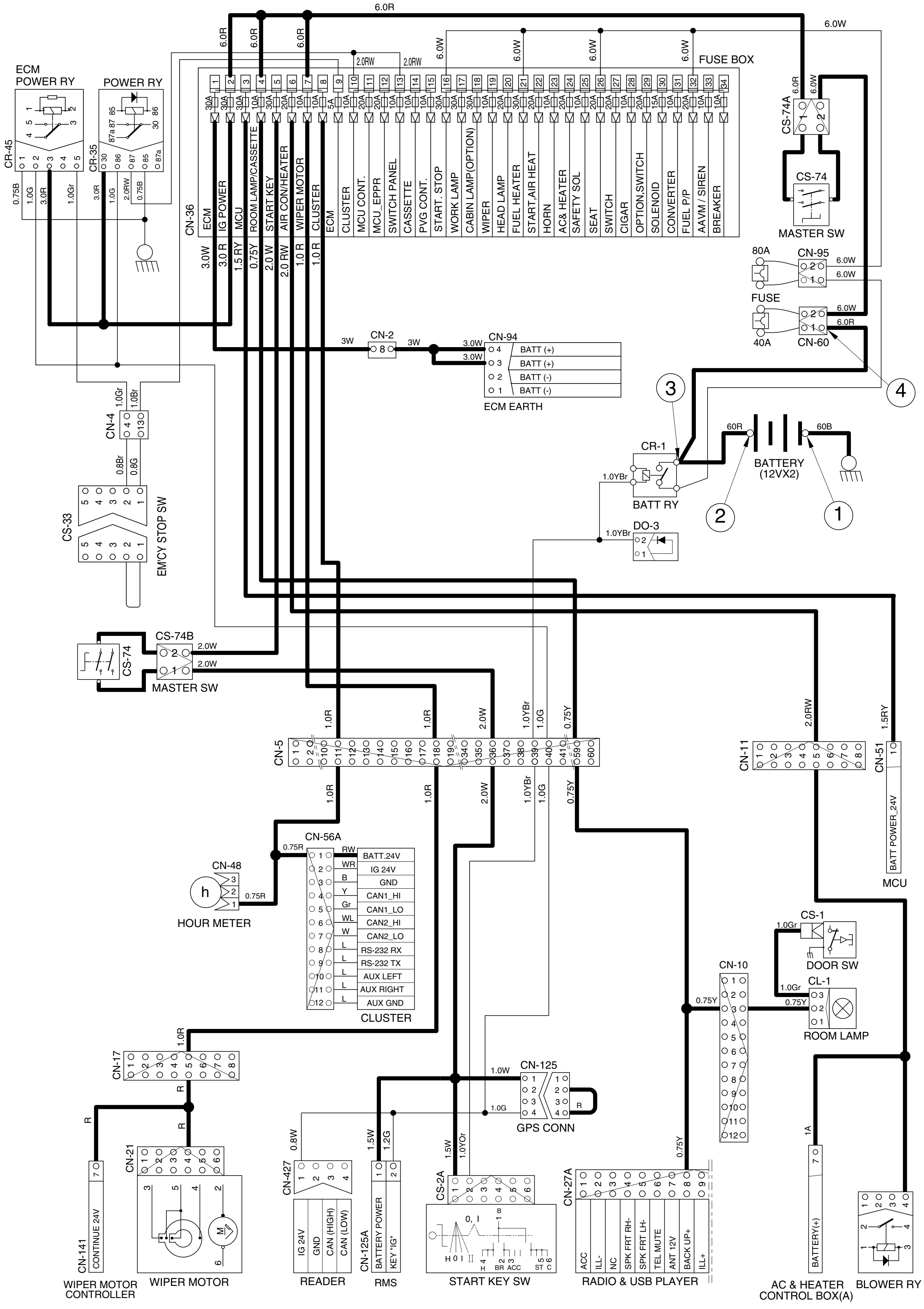
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	OFF	① - GND (battery 1EA)	10~12.5V
		② - GND (battery 2EA)	20~25V
		③ - GND (battery relay)	20~25V
		④ - GND (circuit breaker)	20~25V

※ GND : Ground

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

POWER CIRCUIT



400SA4EL05

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

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A]
→ Fuse box [No.5] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]
→ Fuse box [No.2] → Power relay [CR-35 (30)]
→ ECM power relay [CR-45 (3)]

(1) When start switch is in ON position

→ Start switch ON [CS-2A (2)] → I/conn [CN-5 (39)]
→ Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)
→ Start switch ON [CS-2A (3)] → GPS conn [CN-125 (2) → (4)]
→ I/conn [CN-5 (40)] → Power relay [CR-35 (86) → (87)]
→ Fuse box [No.11] → MCU [CN-51 (2)]
→ ECM Power relay [CR-45 (2) → (5)] → I/conn [CN-4 (4)]
→ Emergency engine stop sw [CS-33 (2)→(1)] → I/conn [CN-4 (13)]
→ Fuse box [No. 9] → I/conn [CN-2 (15)]
→ Engine ECM [CN-93 (39)]
→ Reader [CN-427 (1)]
→ RMS [CN-125A (2)]

(2) When start switch is in START position

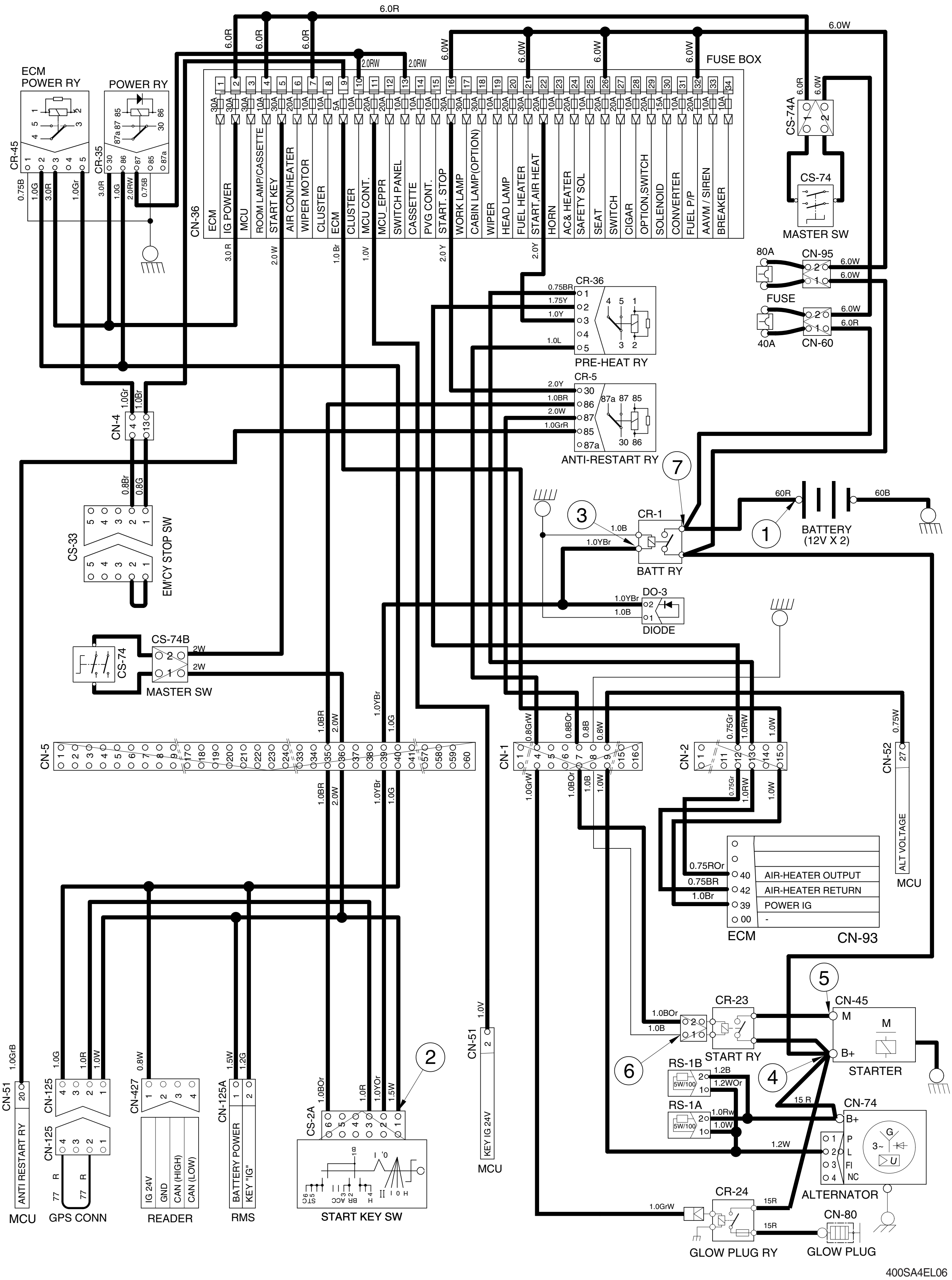
Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (86) → (87)]
→ I/conn CN-1 (7) → Start relay [CR-23 (2)] → Starter motor operating

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OPERATING	START	① - GND (battery) ② - GND (start switch) ③ - GND (battery relay M4) ④ - GND (starter B^+) ⑤ - GND (starter M) ⑥ - GND (start relay) ⑦ - GND (battery relay M8)	20~25V

※ 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 starter is activated and the engine is started, the operator releases the start switch to the ON position.

Charging current generated by operating alternator flows into the battery through the battery relay [CR-1].

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

1) OPERATING FLOW

(1) Warning flow

Alternator [CN-74 (2)] → I/conn [CN-1 (9)] → MCU alternator voltage [CN-52 (27)]
→ Cluster charging warning lamp (Via CANbus interface)

(2) Charging flow

Alternator [CN-74 (B^+)] → Start motor [CR-45 (B^+)] → Battery relay (CR-1)
→ Battery (+) terminal
→ Fuse [CN-60] → Master switch [CS-74A] → Fuse box [No.1~8]
→ Fuse [CN-95] → Fuse box [No.16~34]

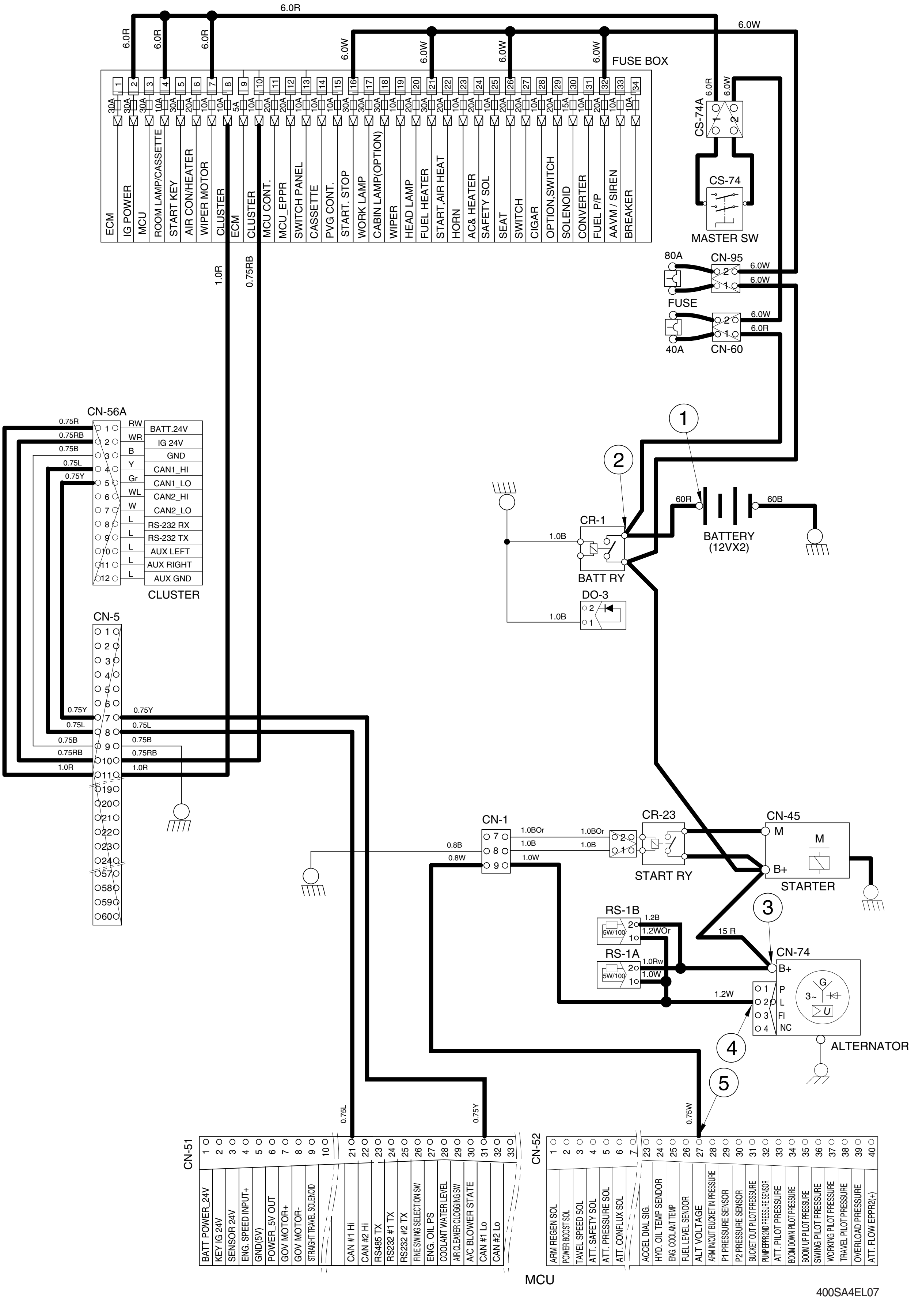
2) CHECK POINT

Engine	Start switch	Check point	Voltage
RUN	ON	① - GND (battery voltage) ② - GND (battery relay) ③ - GND (alternator B^+ terminal) ④ - GND (alternator 2 terminal) ⑤ - GND (MCU)	20~25V

※ 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. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.20) → Head light relay [CR-13 (30, 86)]
Fuse box (No.17) → Work light relay [CR-4 (30, 86)]
Fuse box (No.13) → Membrane controller [CN-376 (1)]

(1) Head light switch ON

Head light switch ON [CN-376 (13)] → Head light relay [CR-13 (85) → (87)]
→ Head light ON [CL-3 (2), CL-4 (1), CL-24 (2)]
→ I/conn [CN-5 (41)] → I/conn [CN-432 (1)] → Cigar lighter [CL-2]
→ I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]
→ I/conn [CN-7 (1)] → Accel dial LED [CN-279 (2)]

(2) Work light switch ON

Work light switch ON [CN-376 (4)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (2)] → Work light ON [CL-5 (2), CL-6 (2)]

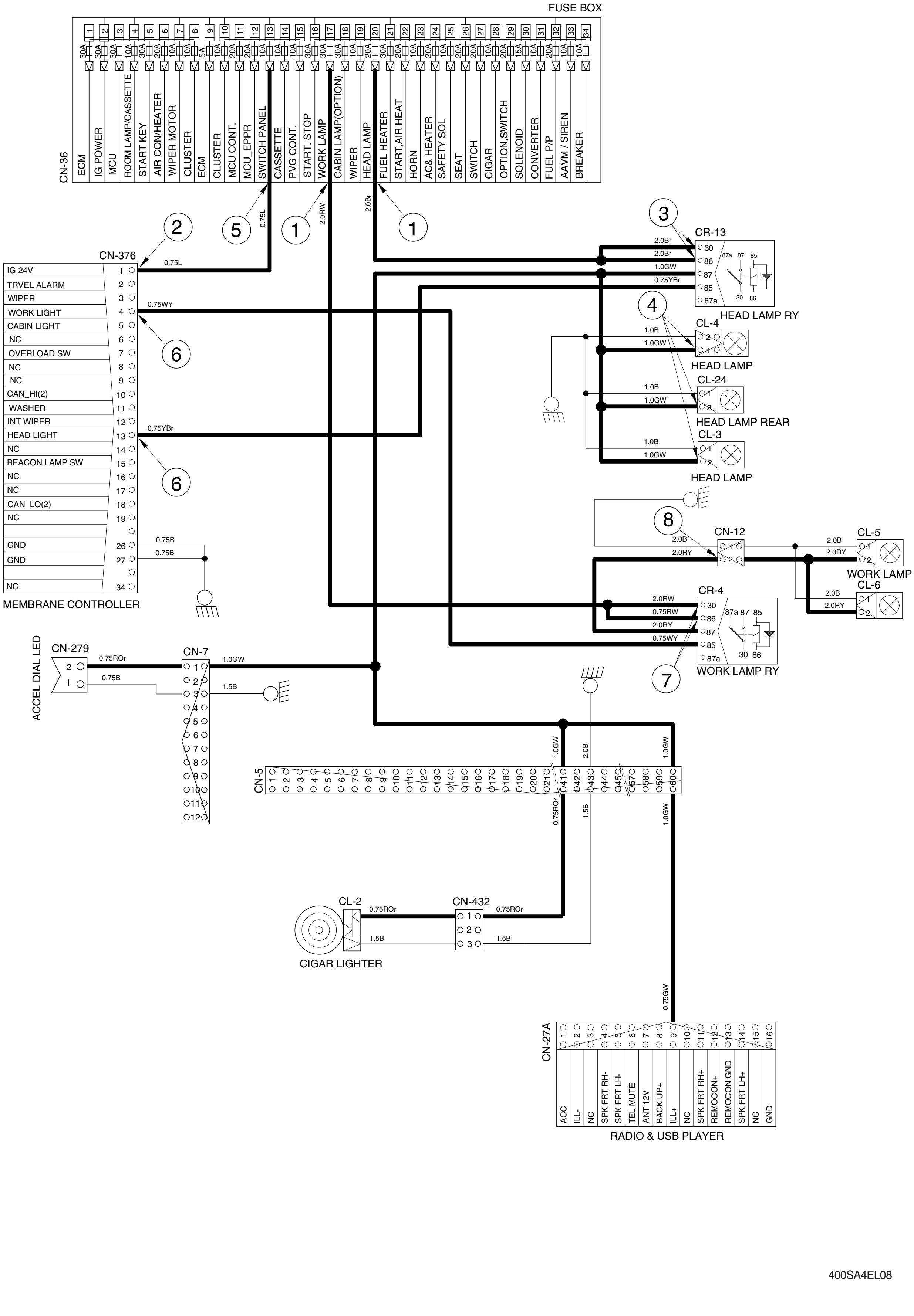
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input) ③ - GND (head light relay) ④ - GND (head light) ⑤ - GND (fuse box) ⑥ - GND (switch power output) ⑦ - GND (work light relay) ⑧ - GND (work light)	20~25V

※ GND : Ground

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

HEAD AND WORK LIGHT CIRCUIT



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

5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.29) → Beacon lamp relay [CR-85 (2, 3)]
Fuse box (No.18) → Cab light relay [CR-9 (30, 86)]
Fuse box (No.13) → Membrane controller [CN-376 (1)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CN-376 (15)] → Beacon lamp relay [CR-85 (1)→(5)]
→ I/conn [CN-5 (50)] → I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]

(2) Cab light switch ON

Cab light switch ON [CN-376 (5)] → Cab lamp relay [CR-9 (85)→(87)]
→ I/conn [CN-5 (34, 38)] → I/conn [CN-10 (11)] → Cab light ON [CL-8 (2)]
→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2), CL-10 (2)]

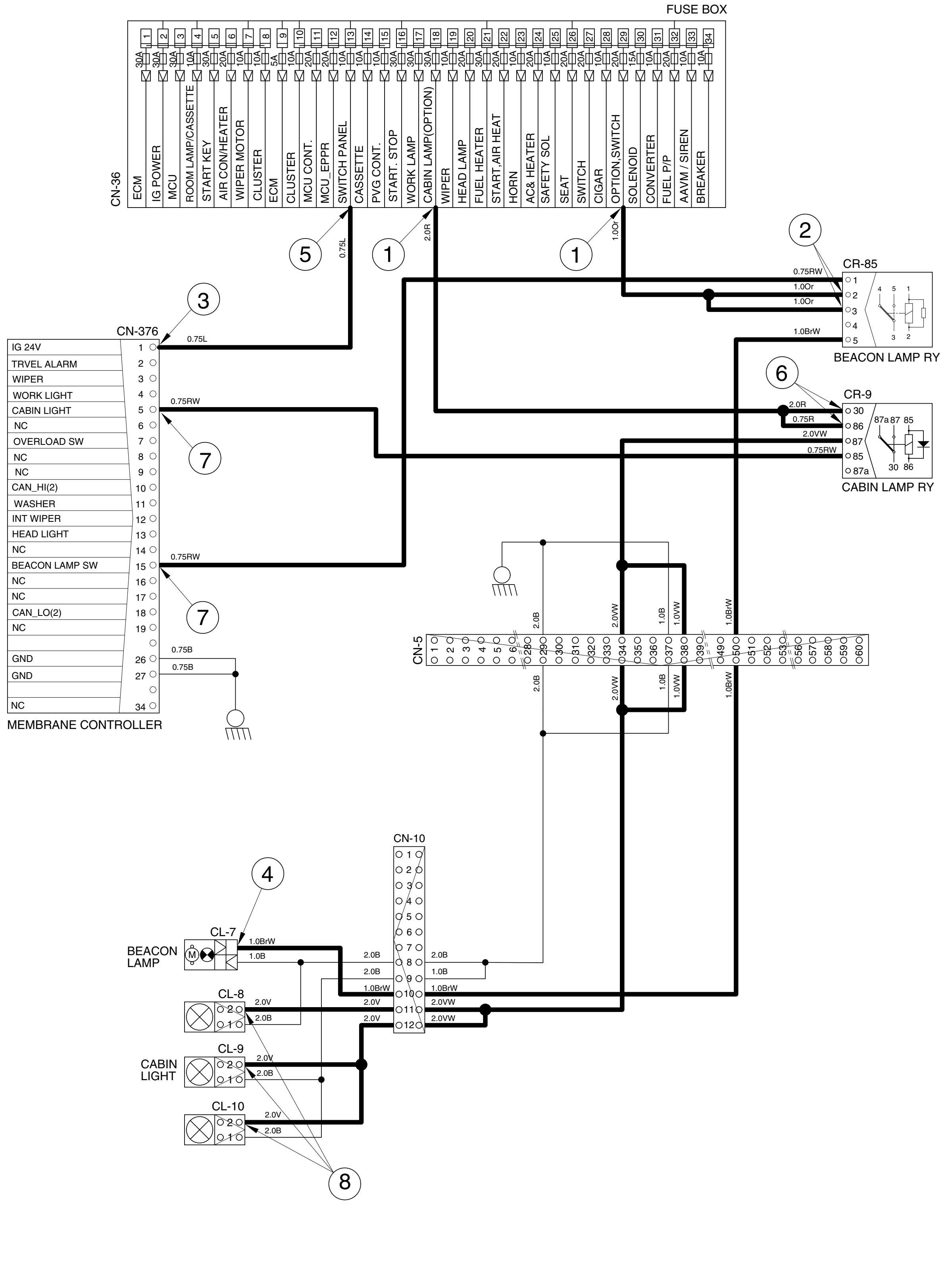
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (beacon lamp relay) ③ - GND (switch power input) ④ - GND (beacon lamp) ⑤ - GND (fuse box) ⑥ - GND (cabin light relay) ⑦ - GND (switch power output) ⑧ - GND (cab light)	20~25V

※ GND : Ground

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

BEACON LAMP AND CAB LIGHT CIRCUIT



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

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Start switch ON

Fuse box (No.13) → RDU membrance controller [CN-376 (1)]

Fuse box (No.7) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] → Wiper motor controller [CN-141 (7)]
→ Wiper motor [CN-21 (4)]

Fuse box (No.19) → I/conn [CN-5 (16)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
→ Wiper pump [CN-22 (2)]

(2) Wiper switch ON (Intermittent)

Wiper switch ON [CN-376 (12)] → I/conn [CN-5 (20)] → I/conn [CN-17 (8)]
→ Wiper motor controller [CN-141 (10)→(3)] → Wiper motor [CN-21 (6)] → Intermittently operating

(3) Wiper switch ON (continual)

Wiper switch ON [CN-376 (3)] → I/conn[CN-5 (15)] → I/conn[CN-17 (2)]
→ Wiper motor controller [CN-141 (2) → (4)] → Wiper motor [CN-21 (2)] → Continual operating

(4) Washer switch ON

Washer switch ON [CN-376 (11)] → I/conn [CN-5 (17)] → I/conn [CN-17 (7)]
→ Wiper motor controller [CN-141 (9) → (8)] → I/conn [CN-17 (6)] → I/conn [CN-5 (19)]
→ Washer pump [CN-22 (1)] → Washer operating
Wiper switch ON [CN-376 (3)] → I/conn[CN-5 (15)] → I/conn[CN-17 (2)]
→ Wiper motor controller [CN-141 (2) → (4)] → Wiper motor [CN-21 (2)] → Continual operating

(5) Auto parking (when switch OFF)

Switch OFF [CN-376 (3)] → Wiper motor parking position by wiper motor controller

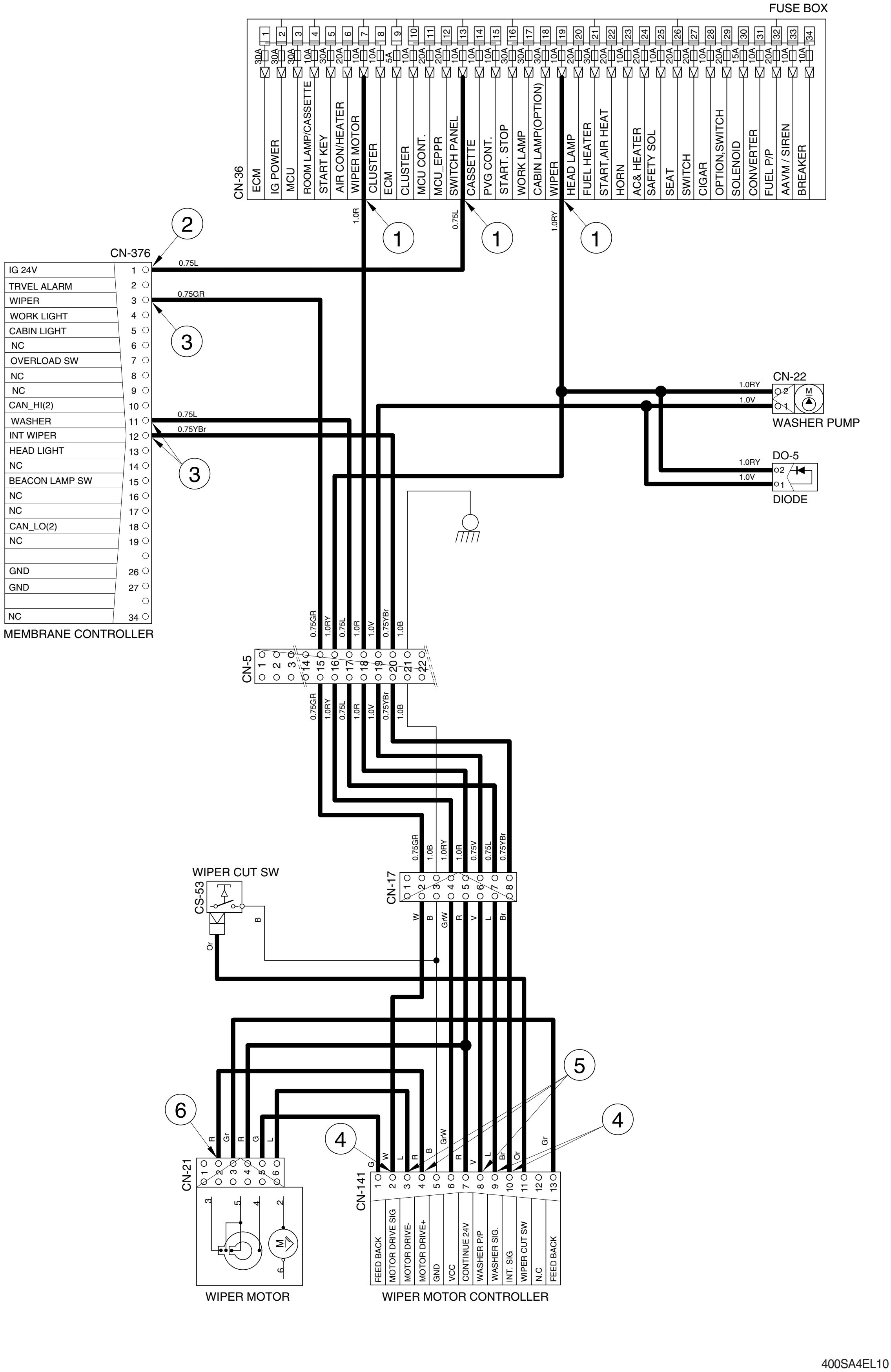
3) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	20~25V
		③ - GND (switch power output) ④ - GND (wiper switch power input)	0 ~ 5V
		⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

※ GND : Ground

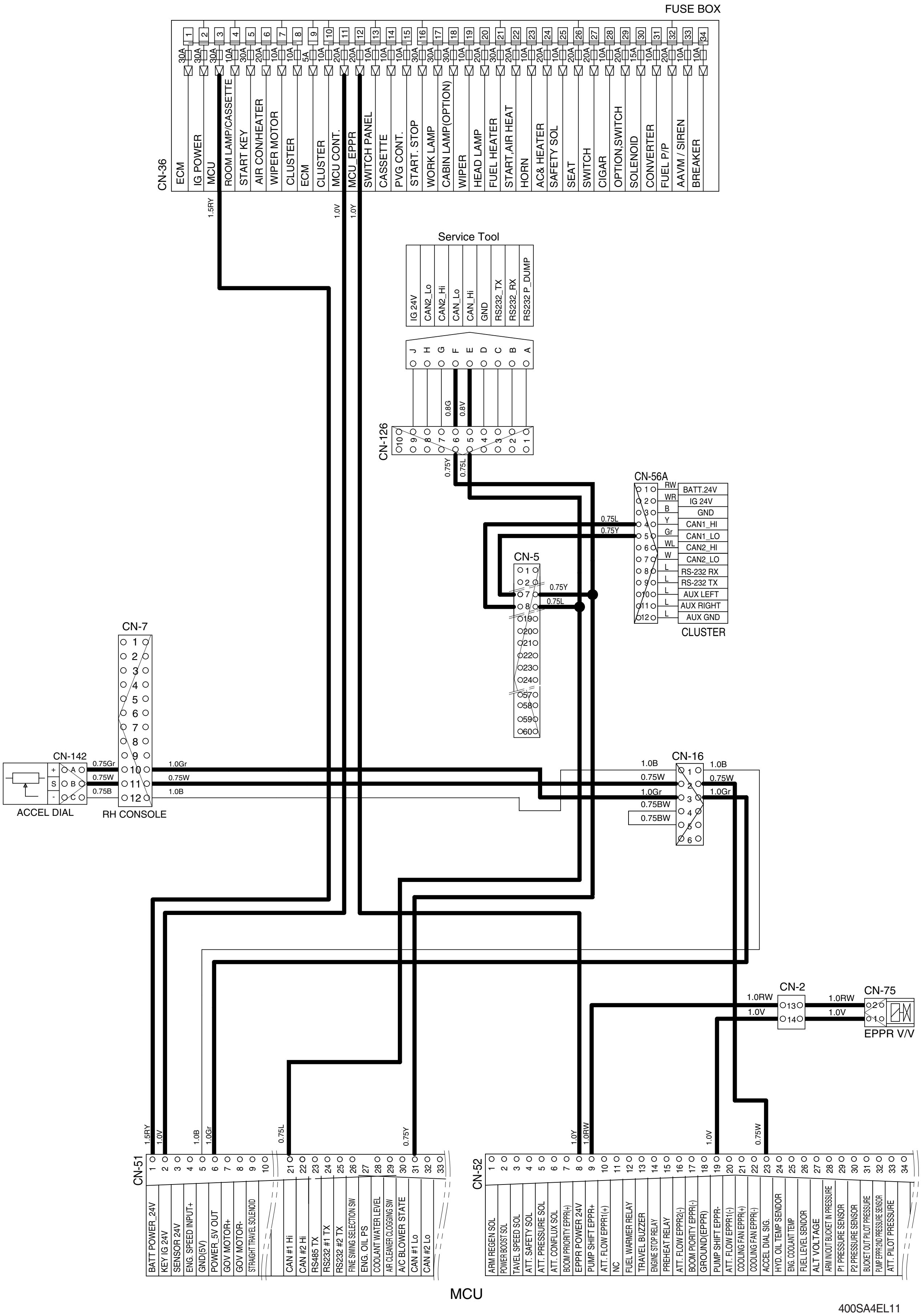
※ The circuit diagram may differ from the equipment, so please check before a repair.

WIPER AND WASHER CIRCUIT



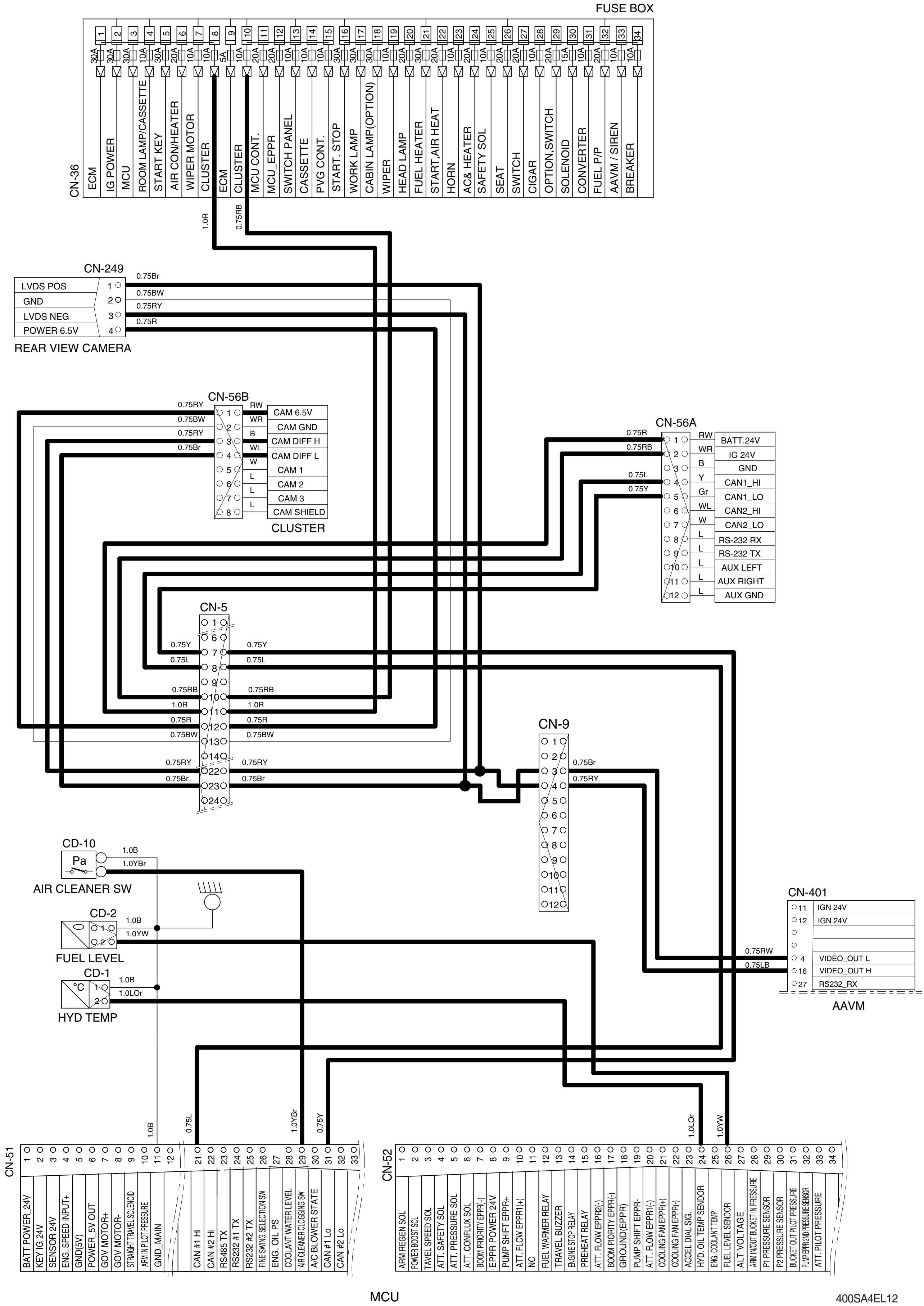
※ The circuit diagram may differ from the equipment, so please check before a repair.

CONTROLLER CIRCUIT



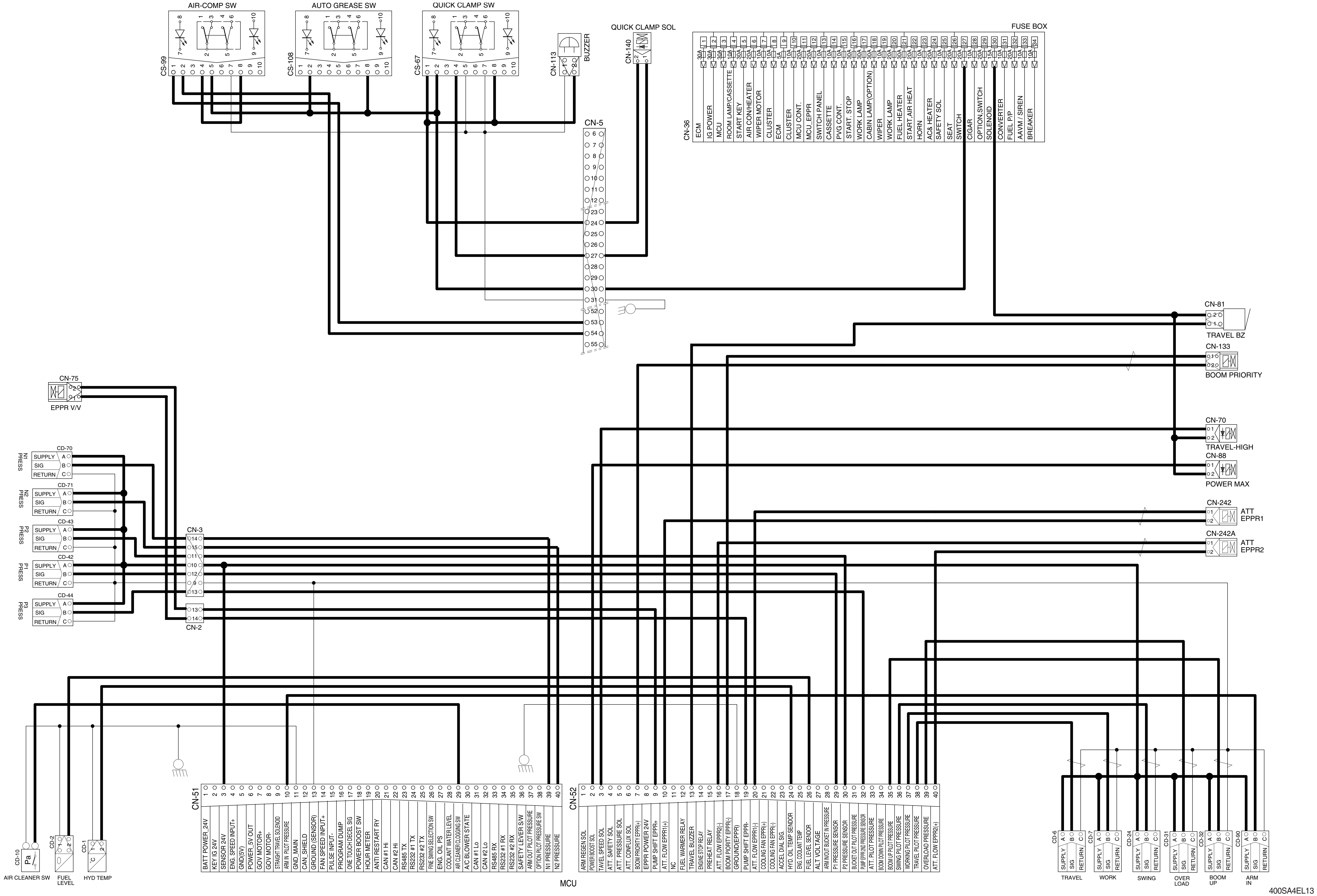
※ The circuit diagram may differ from the equipment, so please check before a repair.

MONITORING CIRCUIT



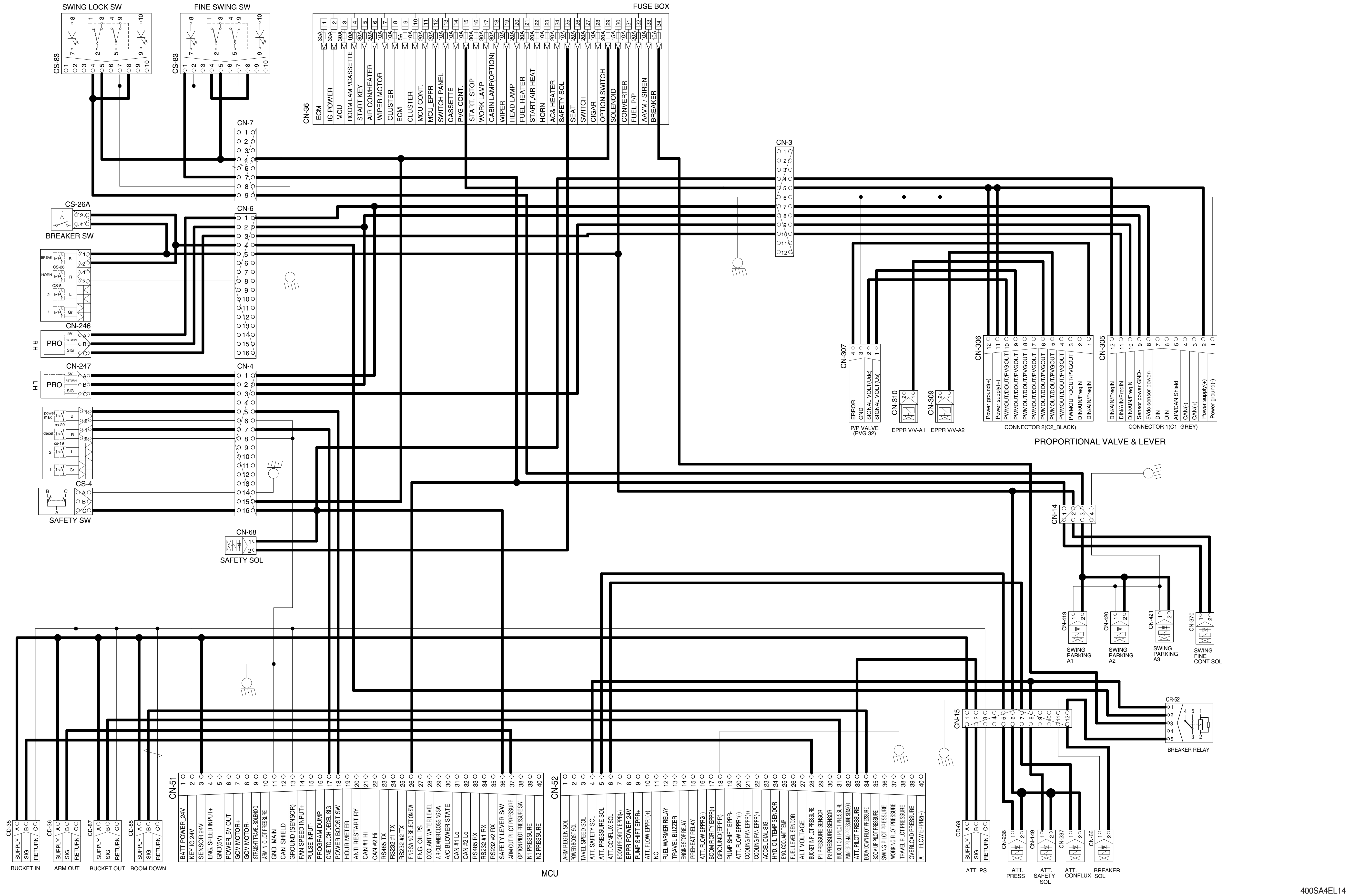
※ The circuit diagram may differ from the equipment, so please check before a repair.

ELECTRIC CIRCUIT FOR HYDRAULIC (1/2)



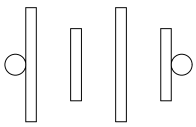
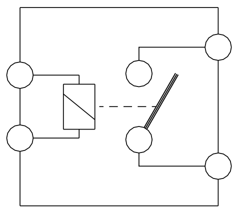
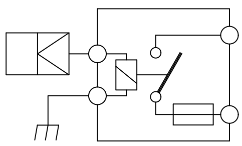
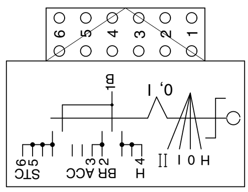
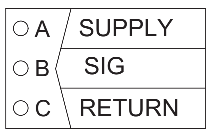
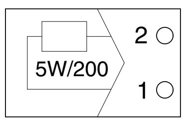
※ The circuit diagram may differ from the equipment, so please check before a repair.

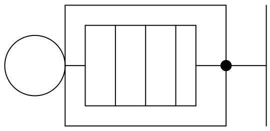
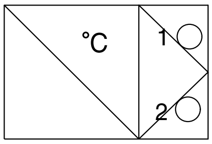
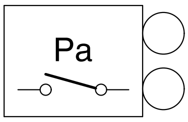
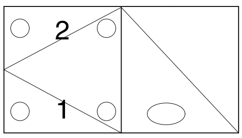
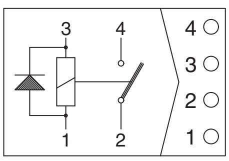
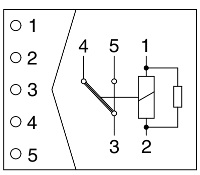
ELECTRIC CIRCUIT FOR HYDRAULIC (2/2)

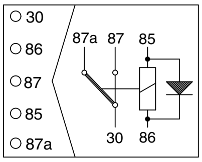
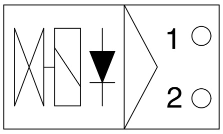
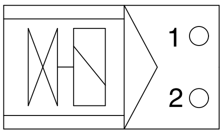
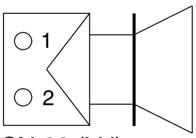
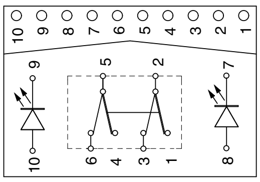
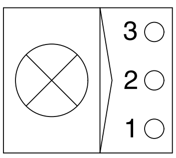


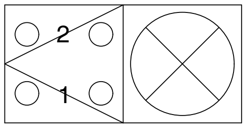
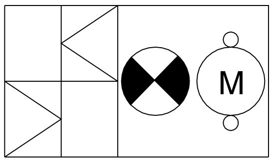
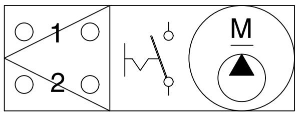
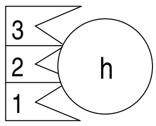
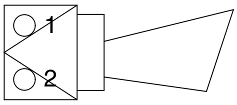
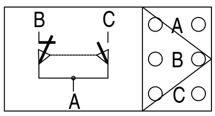
※ The circuit diagram may differ from the equipment, so please check before a repair.

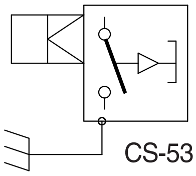
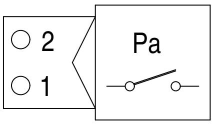
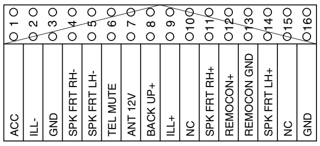
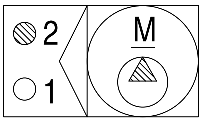
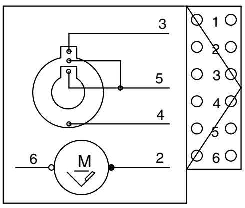
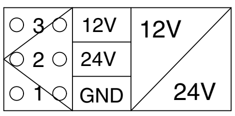
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

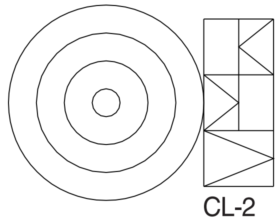
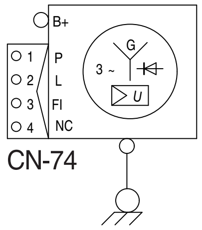
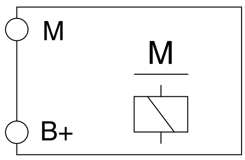
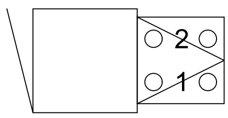
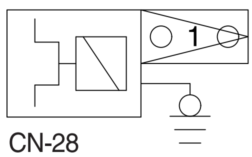
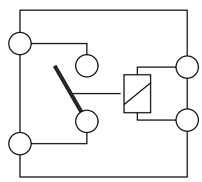
Part name	Symbol	Specifications	Check
Battery		12V×160Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942Ω (For terminal 1-GND)
Start switch	 CS-2A	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞Ω (for each terminal) ON : 0Ω (for terminal 1-3 and 1-2) START : 0Ω (for terminal 1-6)
Pressure sensor	 CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-36 CD-42 CD-43 CD-44 CD-69 CD-70 CD-71 CD-85 CD-87 CD-90	8~30V	※ Check contact Normal : 0.1Ω
Resistor	 RS-1A RS-2A	5W 200Ω	※ Check resistance Normal : 200Ω (For terminal 1-2)

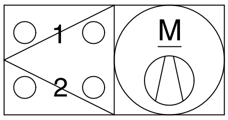
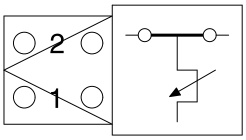
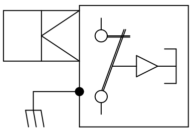
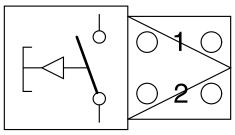
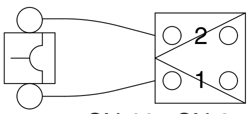
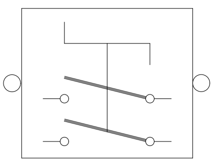
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12Ω
Temperature sensor (hydraulic, fan speed)	 CD-1 CD-52	-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω
Air cleaner pressure switch	 CD-10	N.O TYPE	※ Check contact High level : ∞Ω Low level : 0Ω
Fuel level sender	 CD-2	-	※ Check resistance Full : 50Ω 6/12 : 350Ω 11/12 : 100Ω 5/12 : 400Ω 10/12 : 150Ω 4/12 : 450Ω 9/12 : 200Ω 3/12 : 500Ω 8/12 : 250Ω 2/12 : 550Ω 7/12 : 300Ω 1/12 : 600Ω Empty warning : 700Ω
Relay (air con blower)		24V 20A	※ Check resistance Normal : About 200Ω (for terminal 1-3) ∞Ω (for terminal 2-4)
Relay	 CR-2 CR-36 CR-45 CR-62 CR-85	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0Ω (for terminal 3-4) ∞Ω (for terminal 3-5)

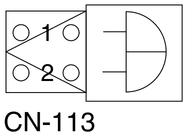
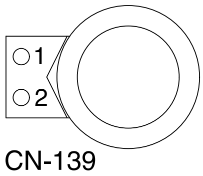
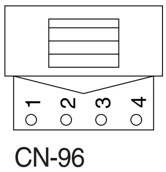
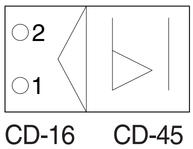
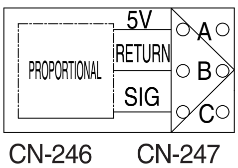
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-140 CN-149 CN-236 CN-237 CN-370 CN-419 CN-420 CN-421	24V 1A	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-154 CN-242 CN-242A CN-309 CN-310	700mA	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
Speaker	 CN-23 (LH) CN-24 (RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-52 CS-67 CS-83 CS-99 CS-108	24V 8A	※ Check contact Normal ON : 0 Ω (for terminal 2-3, 5-6) ∞ Ω (for terminal 1-2, 4-5) OFF : ∞ Ω (for terminal 2-3, 5-6) 0 Ω (for terminal 1-2, 4-5)
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0Ω ON : 0Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0Ω (For terminal 1-3)

Part name	Symbol	Specifications	Check
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※ Check disconnection Normal : A fewΩ
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※ Check resistance Normal : 1.0Ω
Hour meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※ Check operation Supply power(24V) to each terminal and connect ground.
Safety switch	 CS-4	24V 15A (N.C TYPE)	※ Check contact Normal : 0Ω(for terminal A-B) ∞Ω(for terminal A-C) Operating : ∞Ω(for terminal A-B) 0Ω(for terminal A-C)

Part name	Symbol	Specifications	Check
Wiper cut switch	 CS-53	24V (N.O TYPE)	※ Check contact Normal : 0Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : ∞Ω
Radio & USB player	 CN-27A	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※ Check contact Normal : 10.7Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※ Check disconnection Normal : 7Ω (for terminal 2-6)
DC/DC Converter	 CN-138	12V 3A	※ Check voltage 24V (for terminal 1-2) 12V (for terminal 1-3)

Part name	Symbol	Specifications	Check
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞Ω Operating time : 5~15sec
Alternator	 CN-74	Denso 24V 95A	※ Check contact Normal : 0Ω (for terminal B^+-L) Normal : 24~27.5V
Starter	 CN-45	24V 7.8kW	※ Check contact Normal : 0.1Ω
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2Ω
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94Ω(for terminal 1-2)

Part name	Symbol	Specifications	Check
Blower motor		24V 9.5A	※ Check resistance Normal : 2.5Ω (for terminal 1-2)
Thermistor		1˚C OFF 4˚C ON	※ Check resistance Normal : 0Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※ Check resistance Normal : About 5MΩ
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※ Check resistance Normal : ∞Ω
Fuse	 CN-60 CN-95	CN-60 : 40A CN-95 : 80A	※ Check disconnection Normal : 0Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74	6-36V	※ Check disconnection Normal : 0.1Ω

Part name	Symbol	Specifications	Check
Quick clamp buzzer		24V 200mA 107±4dB	-
Socket		12V 10A	-
Fuel heater		-	-
sensor (WIF, surge tank)		-	-
Proportional valve sensor		-	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-2	TE/AMP	16	I/conn (Frame harness-Engine harness)	1-368047-1	368050-1
CN-3	AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-3	TYCO	12	I/conn (Frame harness-Pro vlv harness)	174661-2	368537-1
CN-4	AMP/TE	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-6	AMP	10	I/conn (Console harness RH-Frame harness)	S816-010002	174655-2
CN-7	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-9	DEUTSCH	12	I/conn (Frame harness-AAVM harness)	DT06-12SA-P021	DT04-12PA-P021
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12PA-P021
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-14	TE	4	I/conn (Fream harness-Swing parking & fine control)	174257-2	174259-2
CN-15	AMP	12	I/conn (Frame harness-Breaker sol)	2-85262-1	S816-112002
CN-16	TYCO	6	Emergency engine start & speed control	-	174264-2
CN-16A	-	6	Emergency engine start & speed control	174262	-
CN-16B	-	6	Emergency engine start & speed control	174262	-
CN-17	AMP	8	I/conn (Side harness RH-Wiper harness)	S816-008002	S816-108002
CN-20	DEUTSCH	2	Horn	DT06-2S-EP06	-
CN-21	AMP	6	Wiper motor	S810-006202	-
CN-22	KET	2	Washer tank 1	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	Radio & USB player	-	174984-2
CN-28	KET	2	Aircon compressor	MG610320-5	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-20510	-
CN-45	RING-TERM	-	Starter motor B^+	S820-108000	-
CN-48	KET	3	Hour meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC23-40PA	-
CN-52	DEUTSCH	40	MCU	DRC23-40PA	-
CN-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	R/TERM/-	2	Fuse	ST710285-2	21K9-03270
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	DT04-2P-E005

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-62	DEUTSCH	2	Auto grease	DT06-2S-EP06	DT04-2P-E005
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	-	4	Alternator terminal	1218 6568	-
CN-75	AMP	2	Pump EPPR	174352-2	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-93	DEUTSCH	50	ECM	DRC26-50S-04	-
CN-94	DEUTSCH	4	ECM earth	DTP06-4S-EP06	-
CN-95	R/TERM/-	2	Fuse	ST710285-2	21K9-03270
CN-96	AMP	4	Fuel warmer	-	2-967402-2
CN-96A	AMP	3	Fuel warmer	368523-1	-
CN-96B	AMP	4	Fuel warmer	2-967325-2	-
CN-100	KET	1	ECM earth	MG640944-5	-
CN-113	KET	2	Buzzer	MG651205-5	-
CN-125	Econoseal J	4	RMS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	RMS	DT06-12S-P021	DT04-12PA-P021
CN-126	AMP	10	Service tool	174259-2	S816-110002
CN-133	DEUTSCH	2	Boom priority solenoid	DT06-2S-EP06	-
CN-138	FASTEN	3	DC/DC Converter	S810-003202	-
CN-139	FASTEN	2	12V socket	172434-2	-
CN-140	DEUTSCH	2	Quick clamp solenoid	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	-
CN-142	DEUTSCH	3	Accel dial switch	DT06-3S	-
CN-147	AMP	4	Fuel heater	2-967325-1	965687-1
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-154	DEUTSCH	2	Fam EPPR	DT06-2S	-
CN-156	DEUTSCH	2	Seat heat	DT06-2S-EP06	DT04-2P
CN-157	AMP	1	Antena power	S822-014002	-
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	-
CN-236	DEUTSCH	2	Attach pressure solenoid	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach EPPR 1 (A1)	DT06-2S-EP06	DT04-2P-E0005
CN-242A	DEUTSCH	2	Attach EPPR 2 (A2)	DT06-2S-EP06	DT04-2P-E0005
CN-246	DEUTSCH	3	Proportional valve-RH	DT06-3S	DT04-3P
CN-247	DEUTSCH	3	Proportional valve-LH	DT06-3S	DT04-3P
CN-249	DEUTSCH	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005

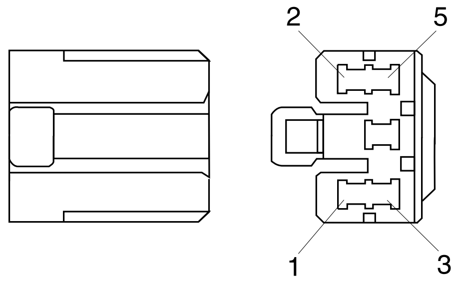
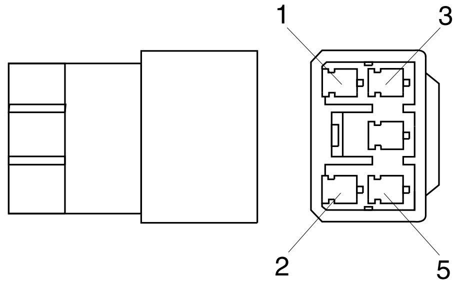
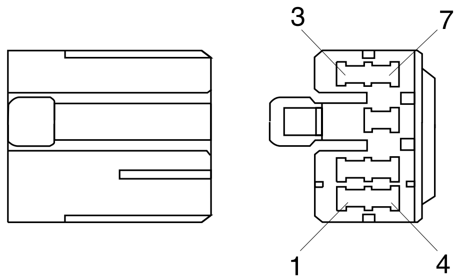
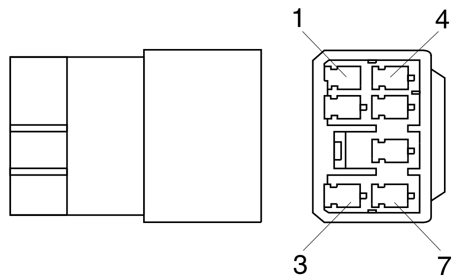
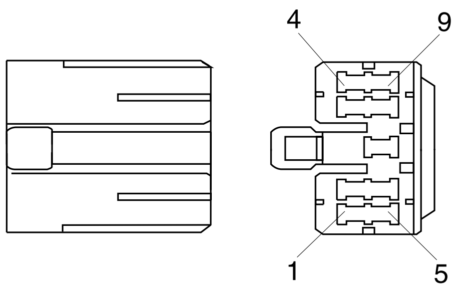
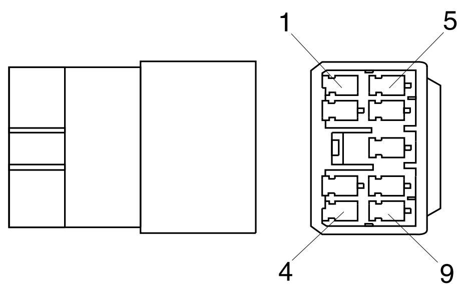
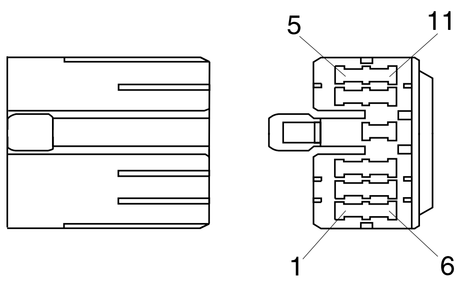
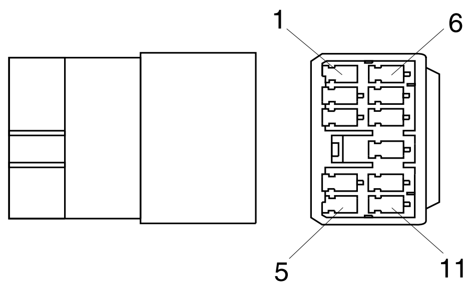
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-279	AMP	2	Accel dial LED	S816-002002	-
CN-305	DEUTSCH	12	Proportional-connector 1	DTM06-12SA	-
CN-306	DEUTSCH	12	Proportional-connector 2	DTM06-12SB	-
CN-307	DEUTSCH	3	Proportional-Service tool	DT06-3S-EP06	DT04-3P-E005
CN-307	DEUTSCH	4	Proportional-PVG32	DT06-4S	DT04-4P-E005
CN-309	DEUTSCH	2	Proportional-EPPR valve A1	DT06-2S-EP06	-
CN-310	DEUTSCH	2	Proportional-EPPR valve A2	DT06-2S-EP06	-
CN-370	DEUTSCH	2	Swing fine control solenoid	DT06-2S-EP06	-
CN-376	TYCO	34	Membrane controller	4-1437290-1	-
CN-401	TE	35	AAVM controller	776164-1	-
CN-402	DEUTSCH	6	Front view camera	DT06-6S-P021	DT04-6P-P021
CN-403	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P-EP14
CN-404	DEUTSCH	6	LH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-405	DEUTSCH	6	RH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-406	DEUTSCH	3	RS 232	DT06-3S-EP06	DT04-3P-E005
CN-419	DEUTSCH	2	Swing parking-A1	DT06-2S-EP06	-
CN-420	DEUTSCH	2	Swing parking-A2	DT06-2S-EP06	-
CN-421	DEUTSCH	2	Swing parking-A3	DT06-2S-EP06	-
CN-427	MOLEX	4	Reader-RMS	039012040	026013096
CN-432	AMP	3	Cigar lighter	174357-2	174359-2
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710289-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Cabin lamp relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-23	KET	2	Start relay	MG610320	S814-102001
CR-24	RING TERM	1	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-45	-	5	ECM power relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
CR-85	-	5	Beacon lamp relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2A	WP	6	Start key switch	S814-006100	-

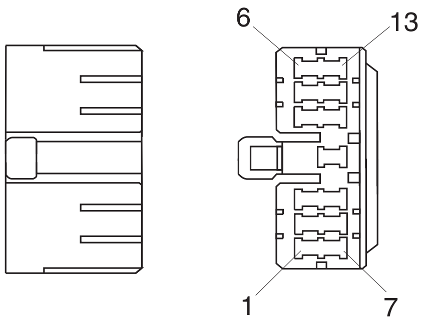
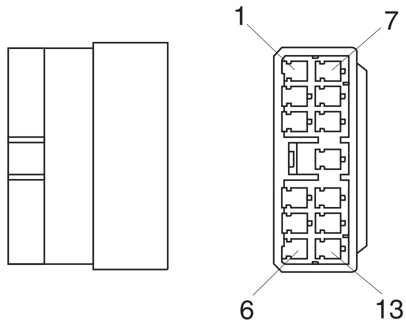
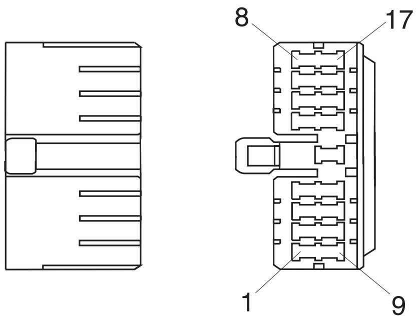
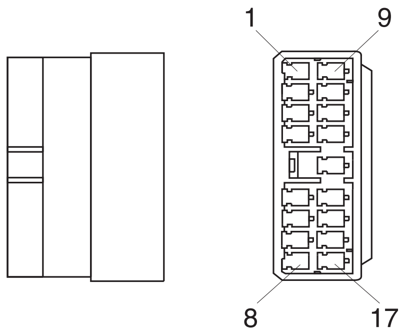
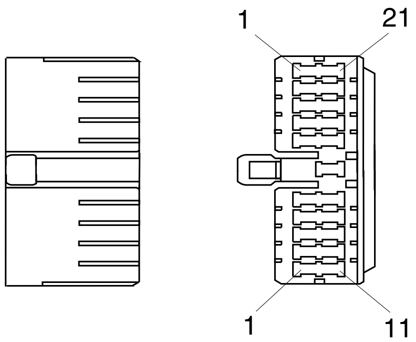
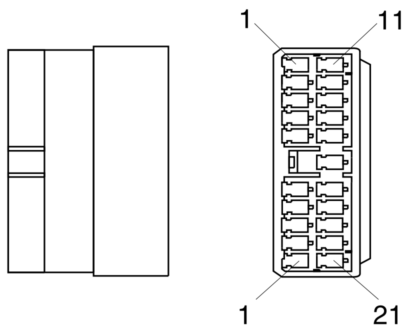
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-2B	DEUTSCH	3	BKCU	DT06-3S-EP06	DT04-3P-E005
CS-4	DEUTSCH	3	Safety switch	DT06-3S	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P
CS-26	DEUTSCH	2	Breaker switch	DT06-2S	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S	-
CS-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002
CS-52	CARLING	10	2 pcs and dozer switch	VC2-01	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	CARLING	10	Quick clamp switch	VC2-01	-
CS-73	CARLING	10	Fine swing switch	VC2-01	-
CS-74A	KET	2	Master switch	MG610557-5	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-83	CARLING	10	Swing lock switch	VC2-01	-
CS-99	CARLING	10	Air compressor switch	VC2-01	-
CS-108	CARLING	10	Auto grease switch	VC2-01	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	-
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	-
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	-
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	-
CL-7	DEUTSCH	2	Beacon lamp	DT06-2S-EP06	DT04-2P
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab lighter	DT06-2S-EP06	DT04-2P
CL-24	DEUTSCH	2	Head lamp-rear	DT06-2S-EP06	DT04-2P-E005
CL-36	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	-
CL-37	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	-
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	-
CD-10	AMP	2	Air cleaner switch	85202-1	-
CD-24	DEUTSCH	3	Swing pressure sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT04-3P-E005

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CD-32	DEUTSCH	3	Boom up pressure sensor	DT06-3S-EP06	-
CD-35	DEUTSCH	3	Bucket in pressure sensor	DT06-3S-EP06	-
CD-36	DEUTSCH	3	Arm out pressure sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	P1 pump pressure sensor	DT06-3S-EP06	-
CD-43	DEUTSCH	3	P2 pump pressure sensor	DT06-3S-EP06	-
CD-44	DEUTSCH	3	A5 pump pressure sensor	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	DT04-2P-E005
CD-52	AMP	2	Fan speed sensor	174352-2	-
CD-69	DEUTSCH	3	Attach pressure sensor	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-
CD-85	DEUTSCH	3	Boom down pressure sensor	DT06-3S-EP06	-
CD-87	DEUTSCH	3	Bucket out pressure sensor	DT06-3S-EP06	-
CD-90	DEUTSCH	3	Arm in pressure sensor	DT06-3S-EP06	-

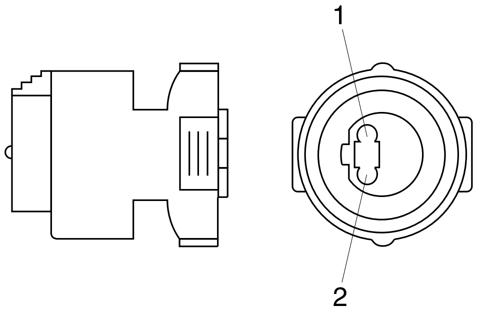
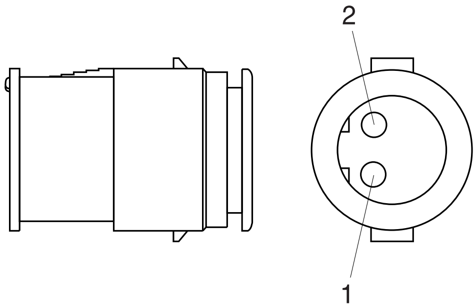
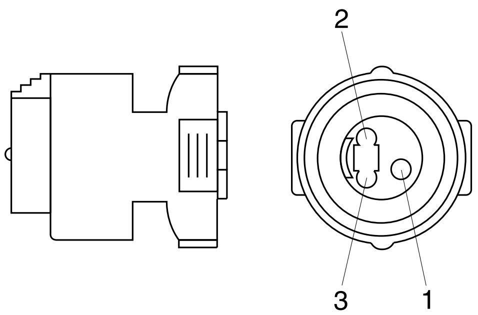
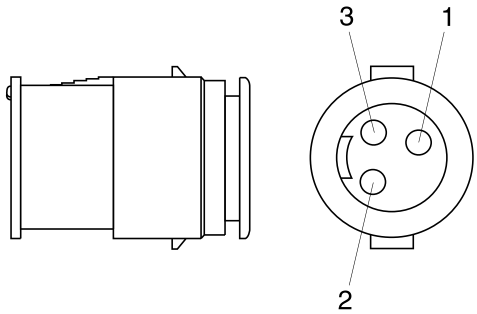
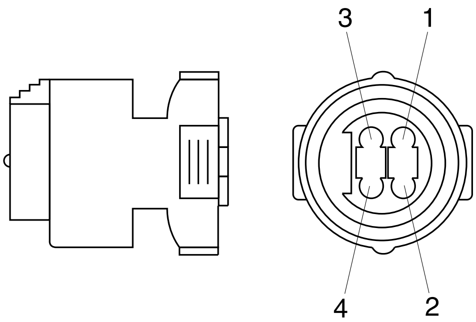
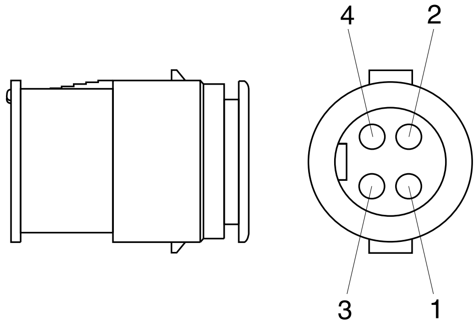
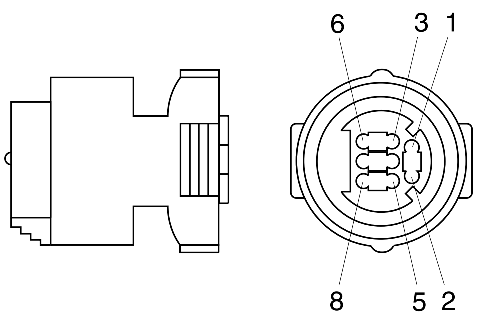
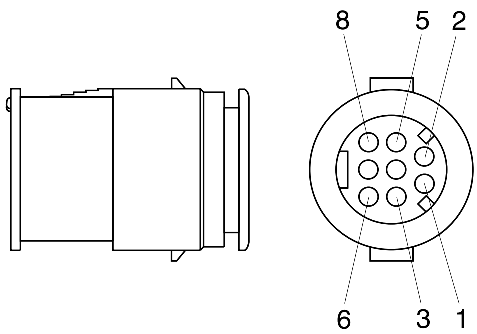
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

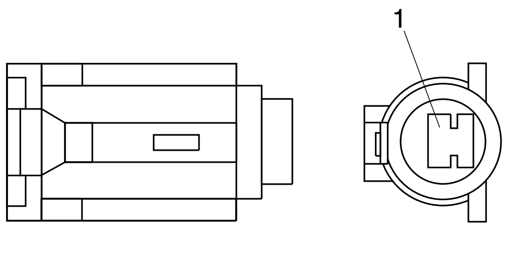
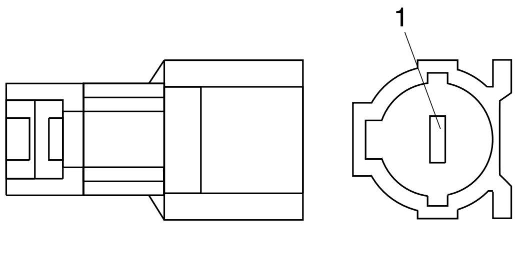
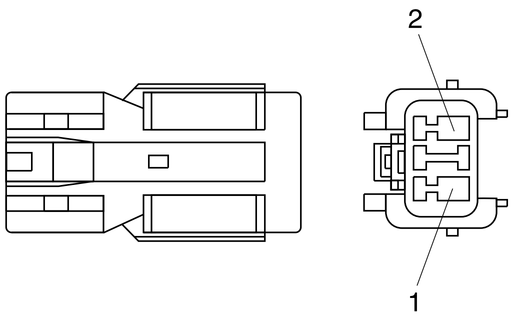
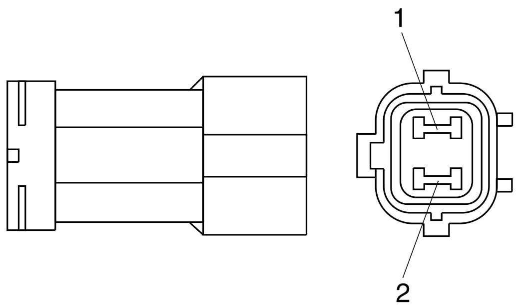
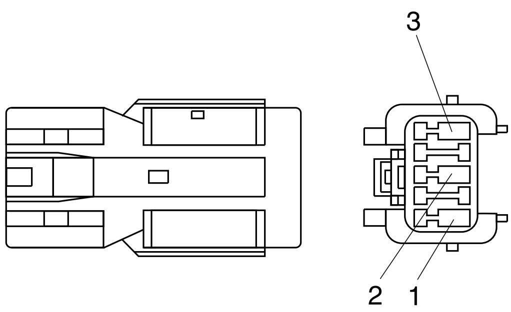
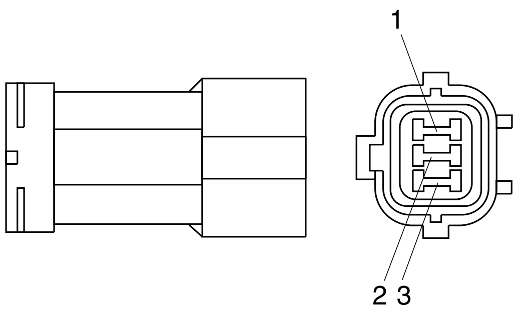
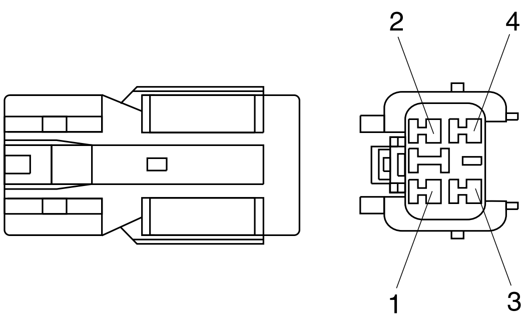
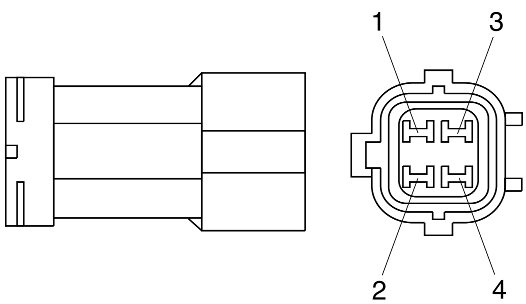
<table>
<tr><th>No. of pin</th><th>Receptacle connector (female)</th><th>Plug connector (male)</th></tr>
<tr><td>5</td><td>
S811-005002</td><td>
S811-105002</td></tr>
<tr><td>7</td><td>
S811-007002</td><td>
S811-107002</td></tr>
<tr><td>9</td><td>
S811-009002</td><td>
3S811-109002</td></tr>
<tr><td>11</td><td>
S811-011002</td><td>
S811-111002</td></tr>
</table>

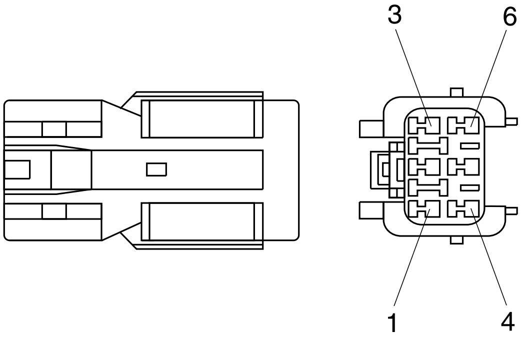
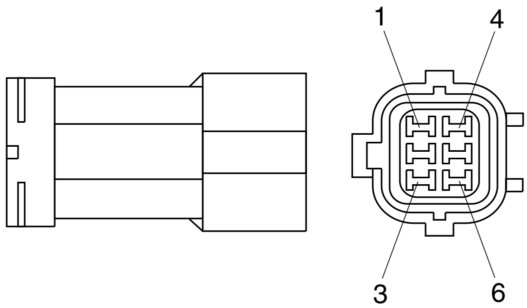
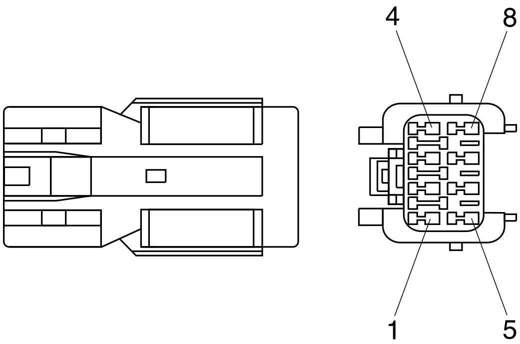
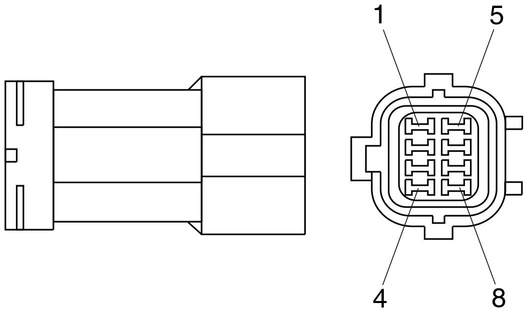
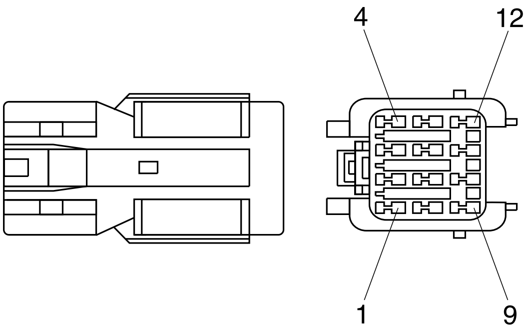
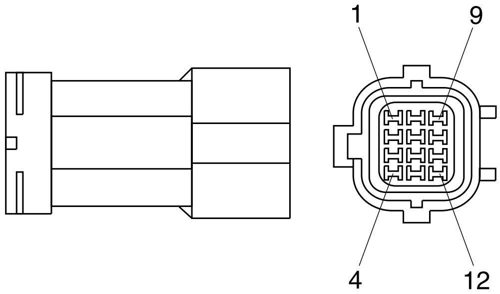
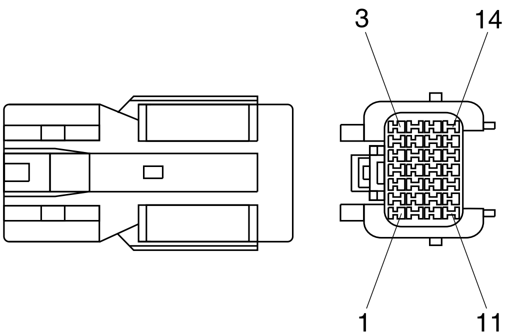
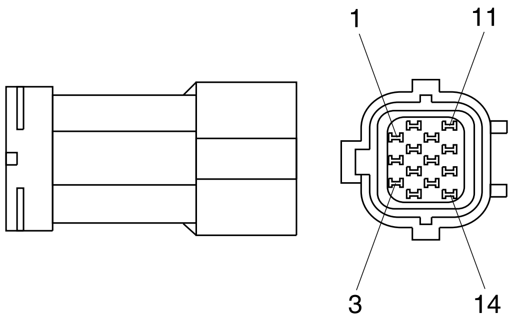
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

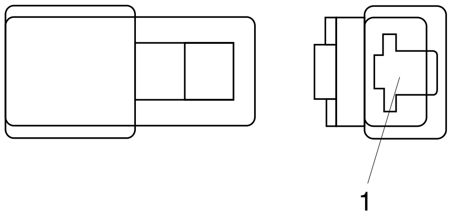
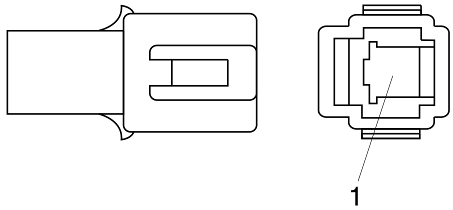
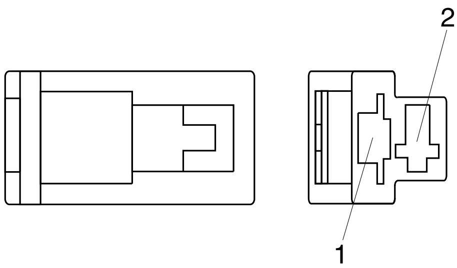
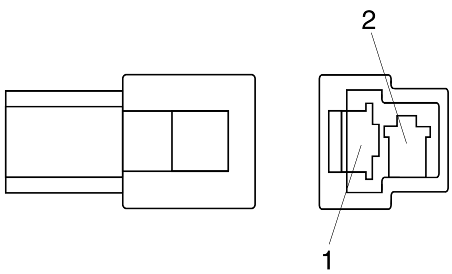
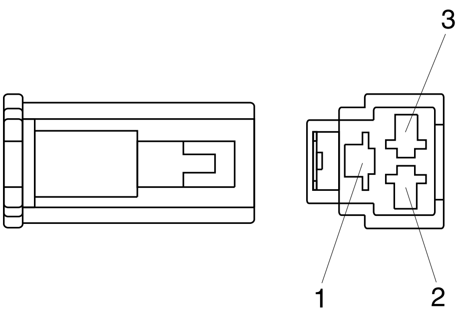
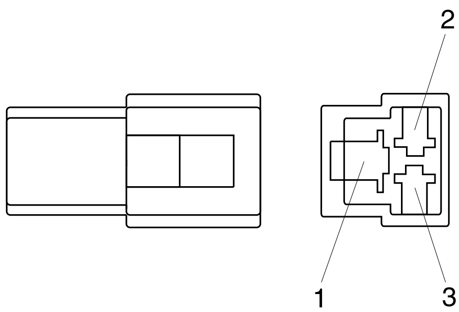
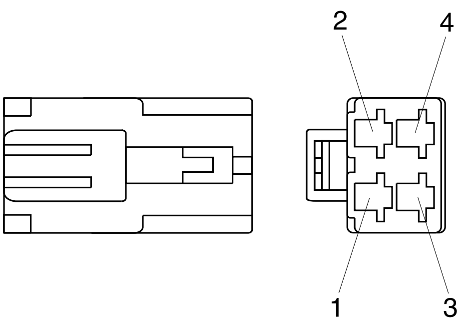
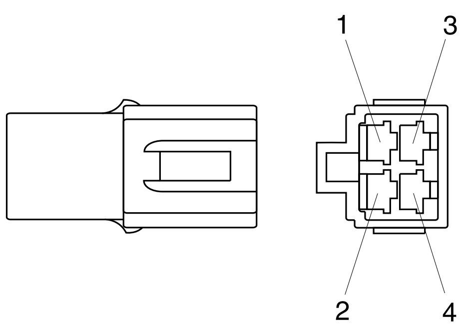
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

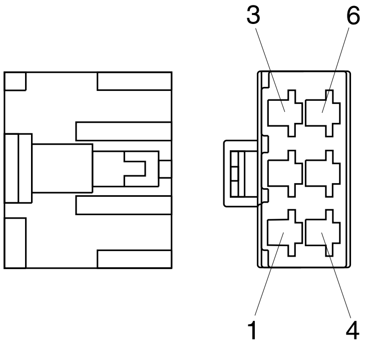
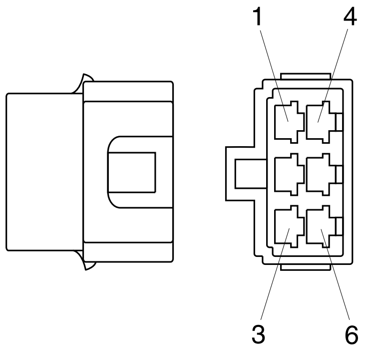
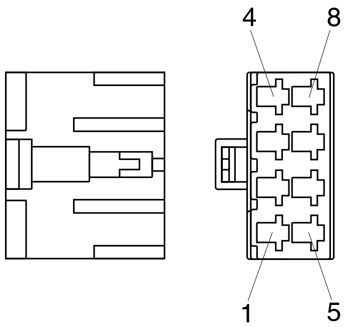
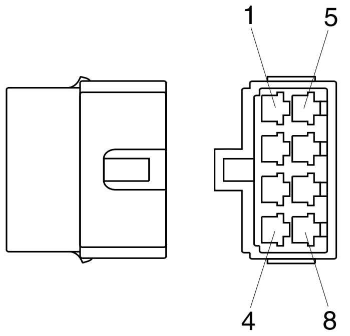
3) SWP TYPE CONNECTOR

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

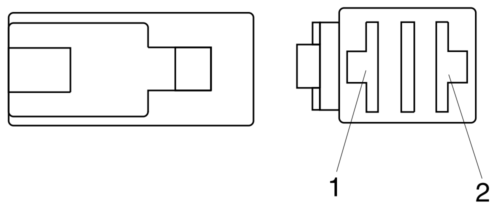
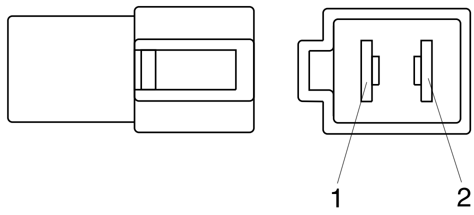
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

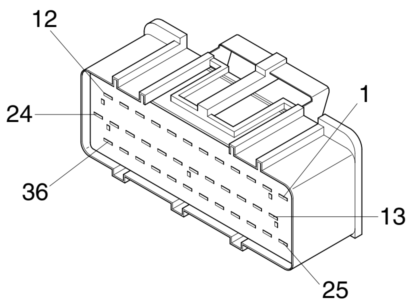
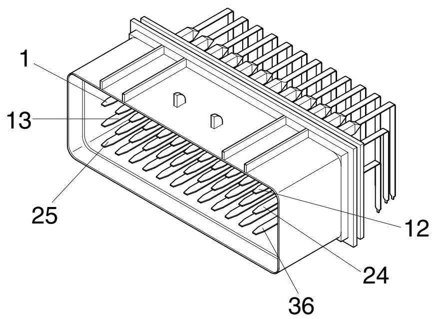
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

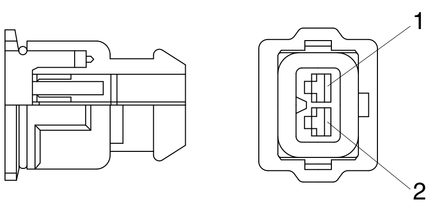
5) 375 FASTEN TYPE CONNECTOR

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

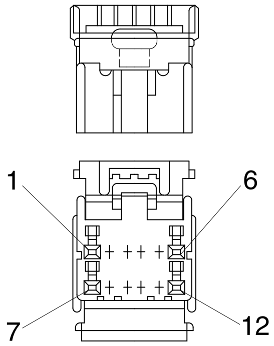
6) AMP ECONOSEAL CONNECTOR

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

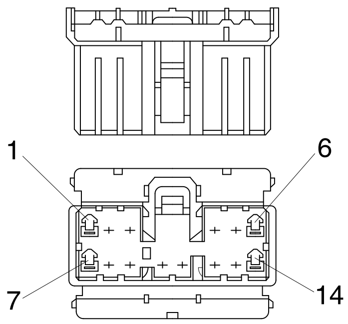
7) AMP TIMER CONNECTOR

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

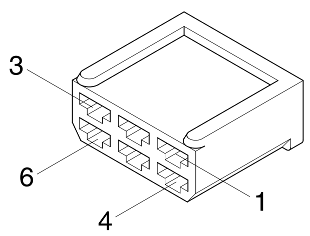
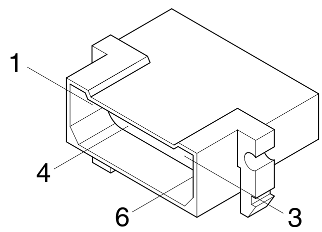
8) AMP 040 MULTILOCK CONNECTOR

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

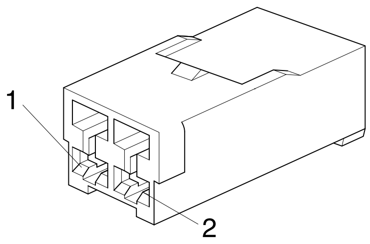
9) AMP 070 MULTILOCK CONNECTOR

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

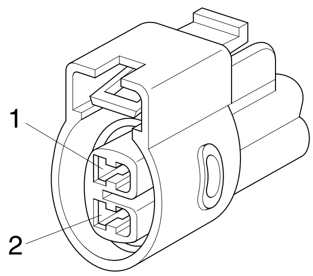
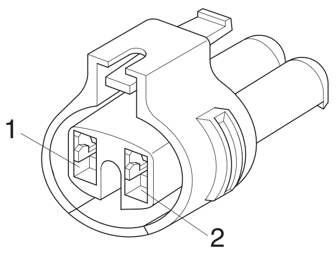
10) AMP FASTIN - FASTON CONNECTOR

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

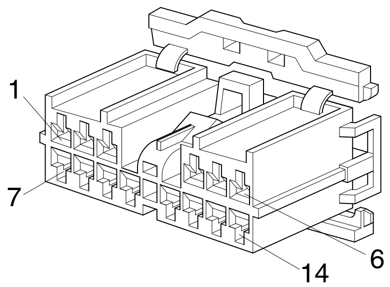
11) KET 090 CONNECTOR

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	

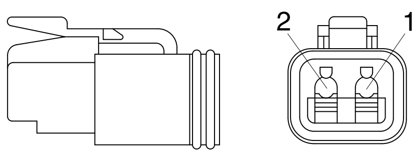
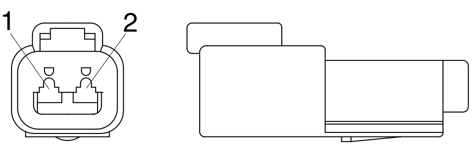
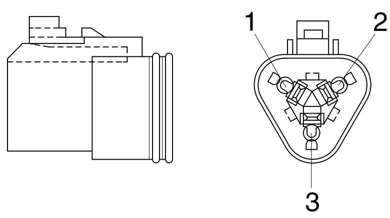
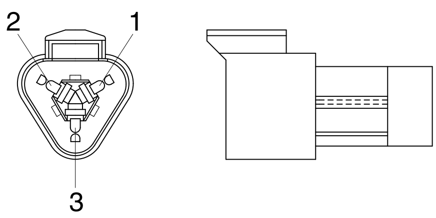
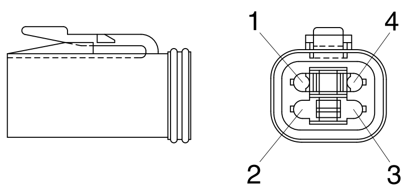
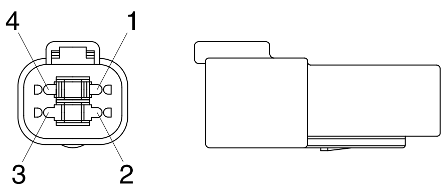
14) DEUTSCH DT CONNECTORS

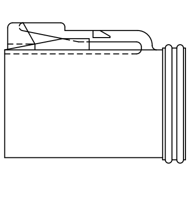
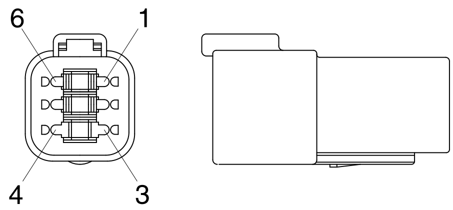
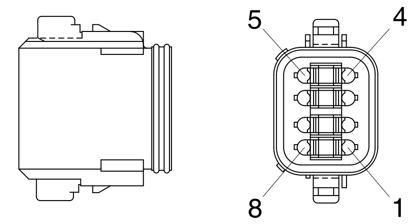
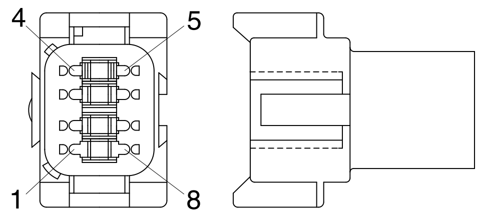
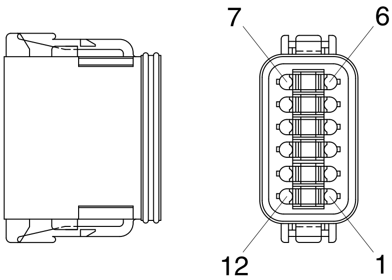
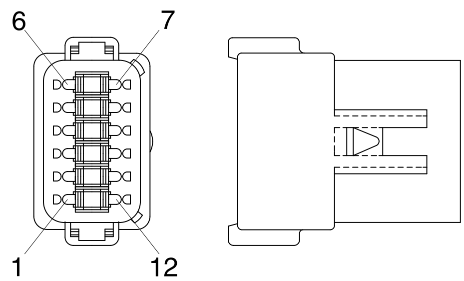
DT 06 - 3S - ★★★★

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

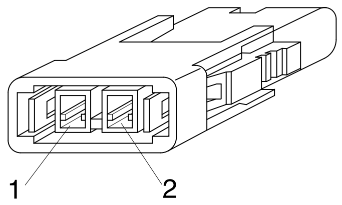
※ Modification

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

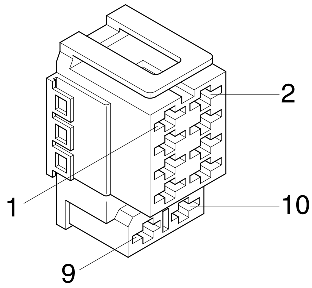
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

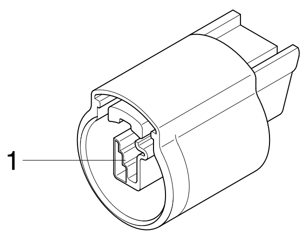
15) MOLEX 2CKTS CONNECTOR

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

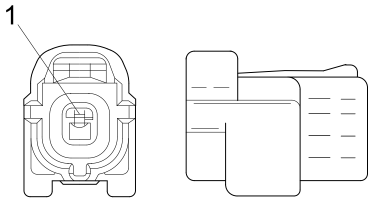
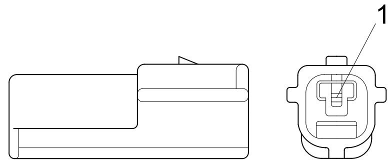
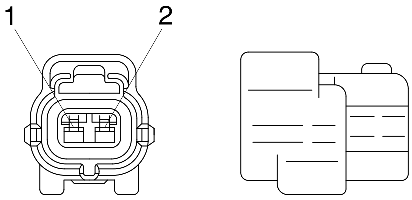
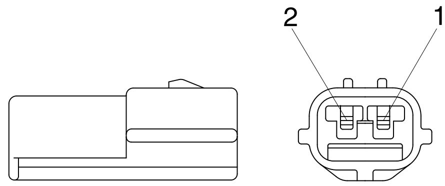
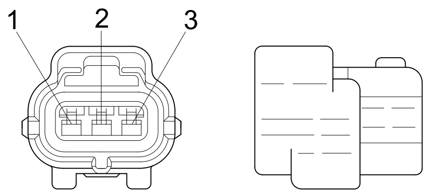
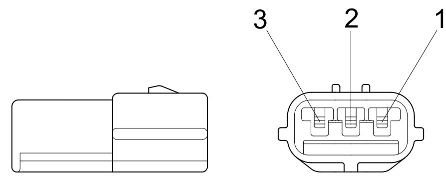
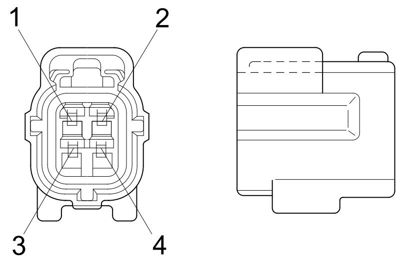
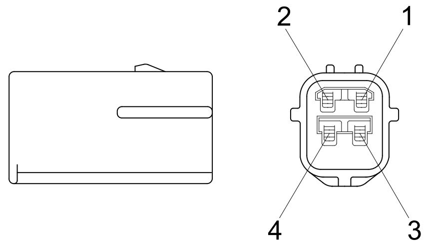
16) ITT SWF CONNECTOR

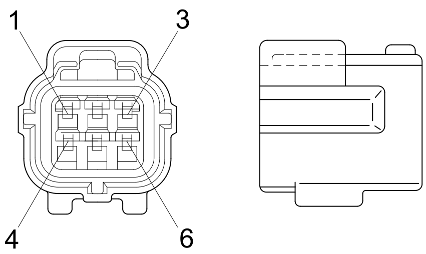
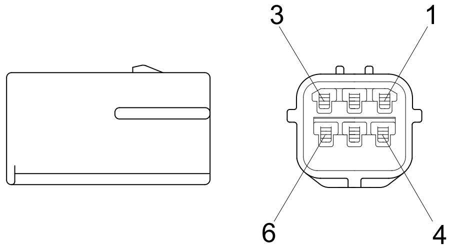
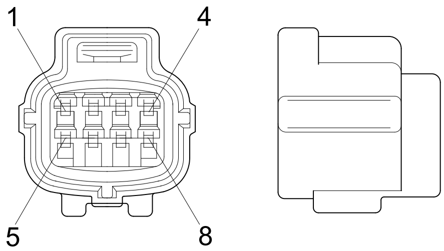
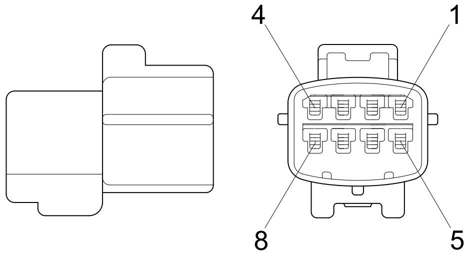
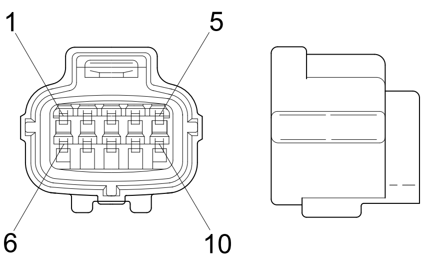
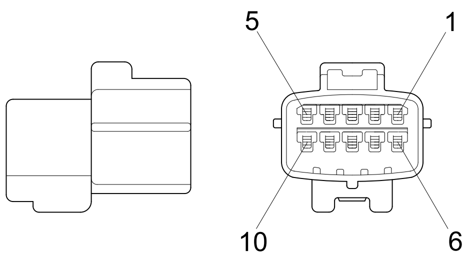
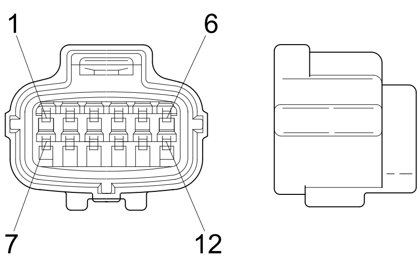
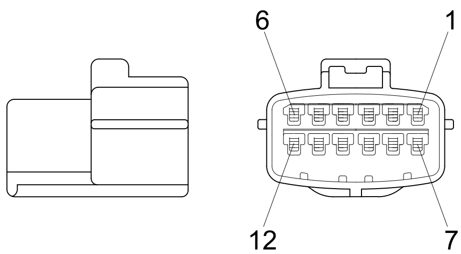
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

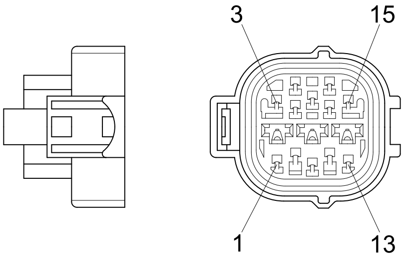
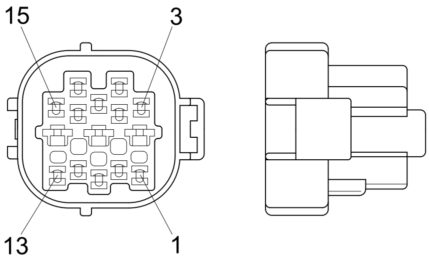
17) MWP NMWP CONNECTOR

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

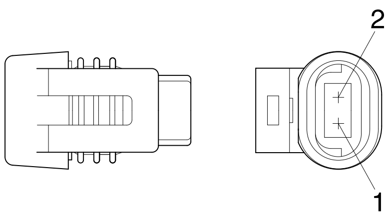
18) ECONOSEAL J TYPE CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S816-001002	 S816-101002
2	 S816-002002	 S816-102002
3	 S816-003002	 S816-103002
4	 S816-004002	 S816-104002

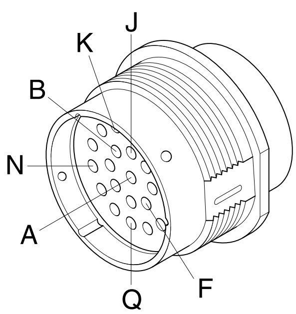
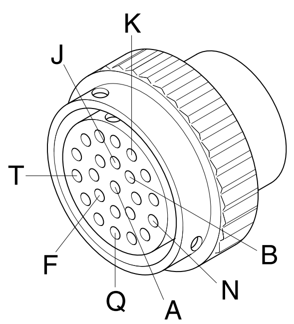
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

No. of pin	Receptacle connector (female)	Plug connector (male)
15	 368301-1	 2-85262-1

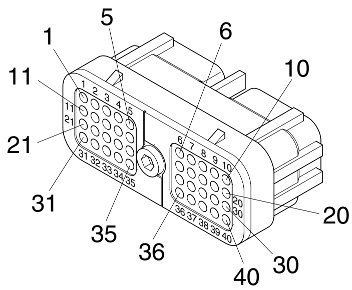
19) METRI-PACK TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 12040753	

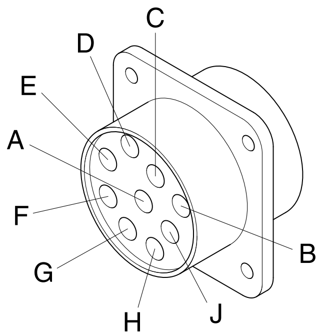
20) DEUTSCH HD30 CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
23	 HD36-24-23SN	 HD34-24-23PN

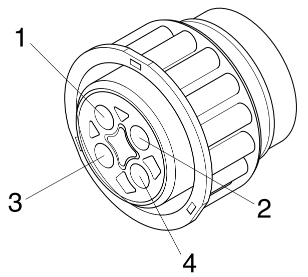
21) DEUTSCH MCU CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
40	 DRC26-40SA/B	

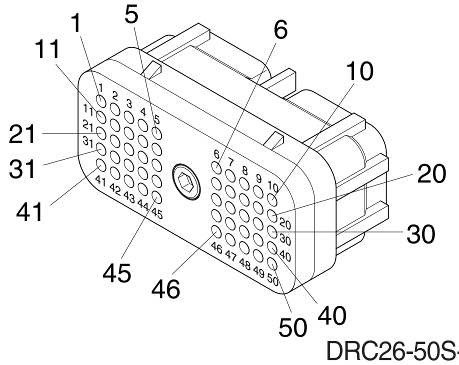
22) DEUTSCH SERVICE TOOL CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
9	 HD10-9-96P	

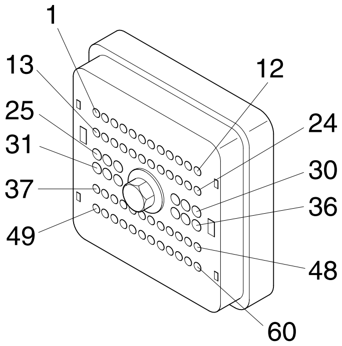
23) AMP FUEL WARMER CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
4	 2-967325-3	

24) DEUTSCH ENGINE ECM CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
50	 DRC26-50S-04	

25) DEUTSCH INTERMEDIATE CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
60	 DRB16-60SAE-L018	

SECTION 5 MECHATRONICS SYSTEM

SECTION 5 MECHATRONICS SYSTEM

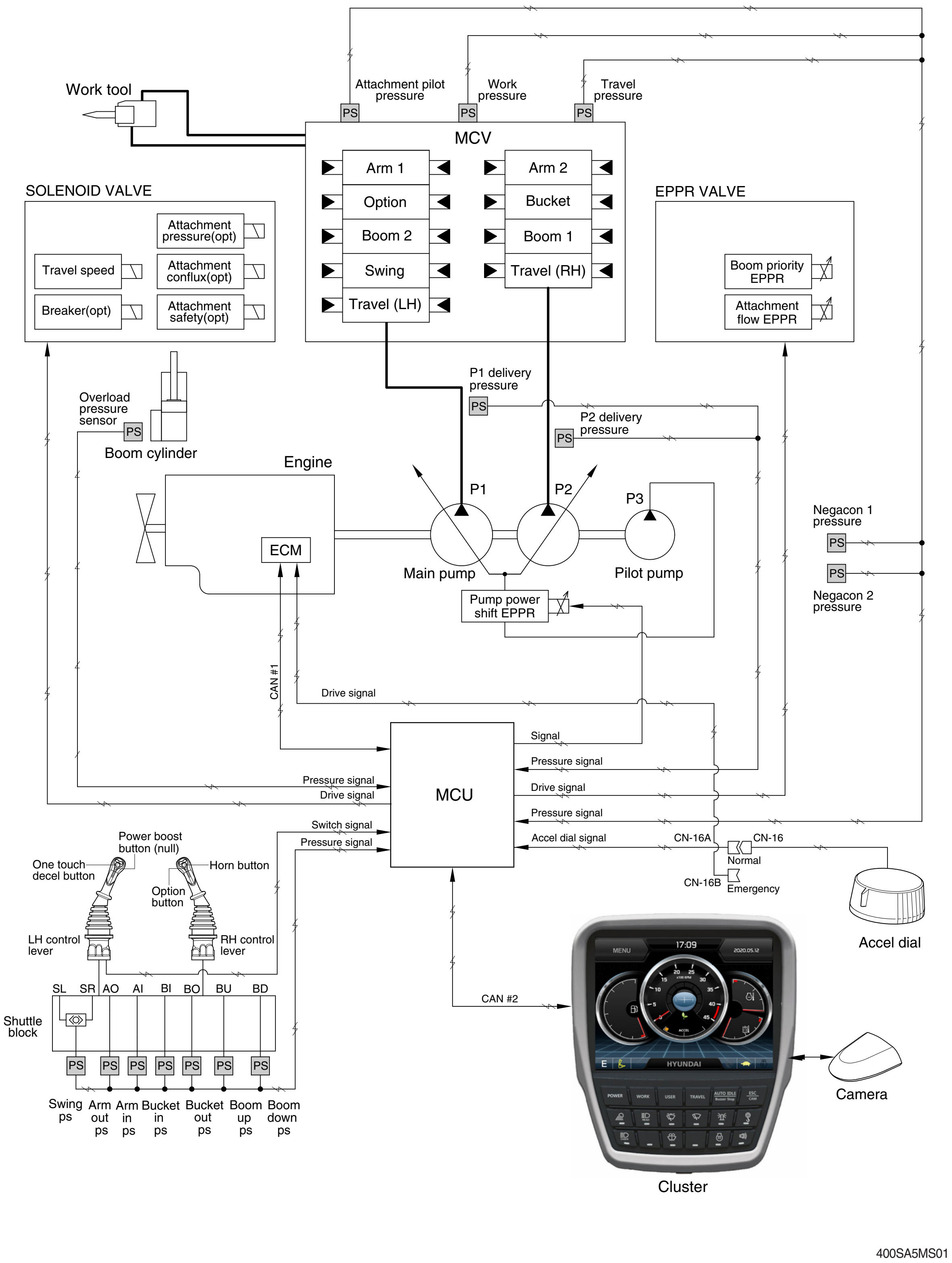
GROUP 1 OUTLINE

The ADVANCED CAPO (Computer Aided Power Optimization) system controls engine and pump mutual power at an optimum and less fuel consuming state for the selected work by mode selection, auto-deceleration, power boost function, etc. It monitors machine conditions, for instance, engine speed, coolant temperature, hydraulic oil temperature, and hydraulic oil pressure, etc.

It consists of a MCU, a cluster, an ECM, EPPR valves, and other components. The MCU and the cluster protect themselves from over-current and high voltage input, and diagnose malfunctions caused by short or open circuit in electric system, and display error codes on the cluster.

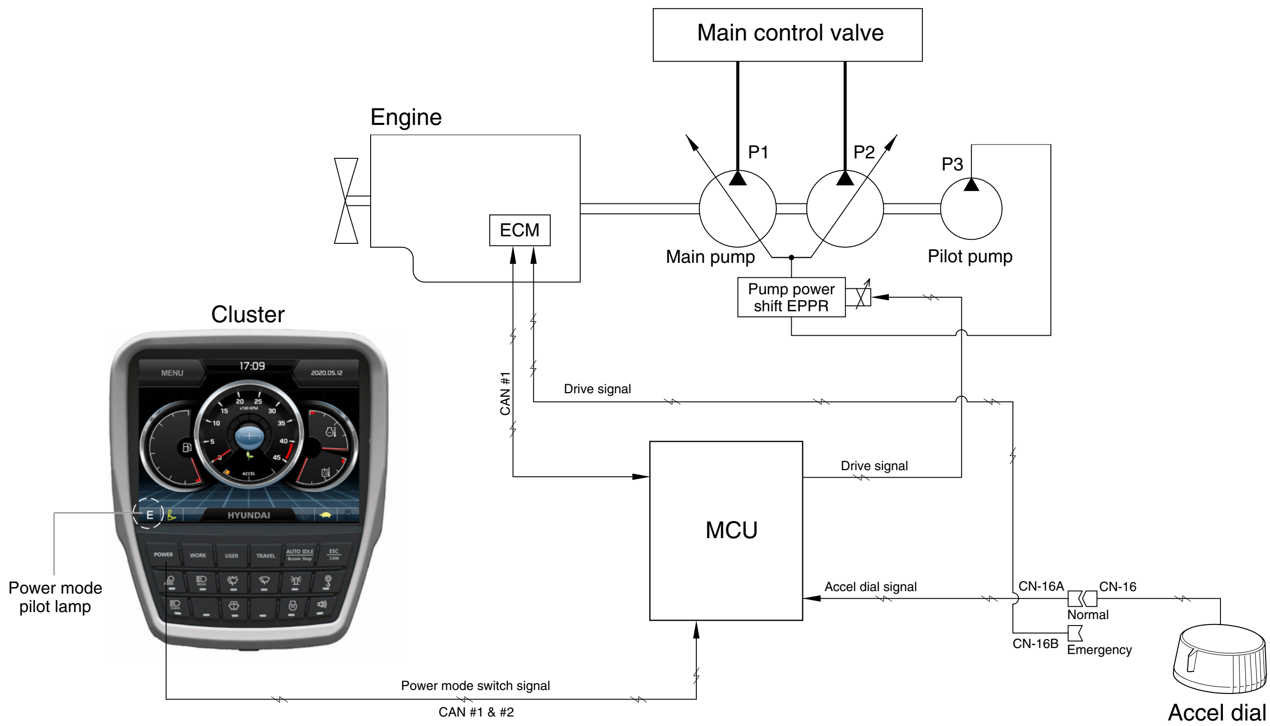
- ADVANCED CAPO SYSTEM
  - Mode selection system
    - Power mode selection (P, S, E)
    - Work mode selection
    - User mode system (U)
  - Auto deceleration system
  - Travel speed control system
  - Automatic warming up system
  - Engine overheat prevention system
  - Variable power control system
  - Attachment flow control system
  - Intelligent power control system
  - Anti-restart system
  - Self-diagnostic system
    - MCU & cluster protection
    - Open-short diagnosis & error code display
    - Machine error code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system

SYSTEM DIAGRAM



GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



400SA5MS02

Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

The combination of 3 power modes (P, S, E) and acceleration mode (10 set) of haptic controller makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

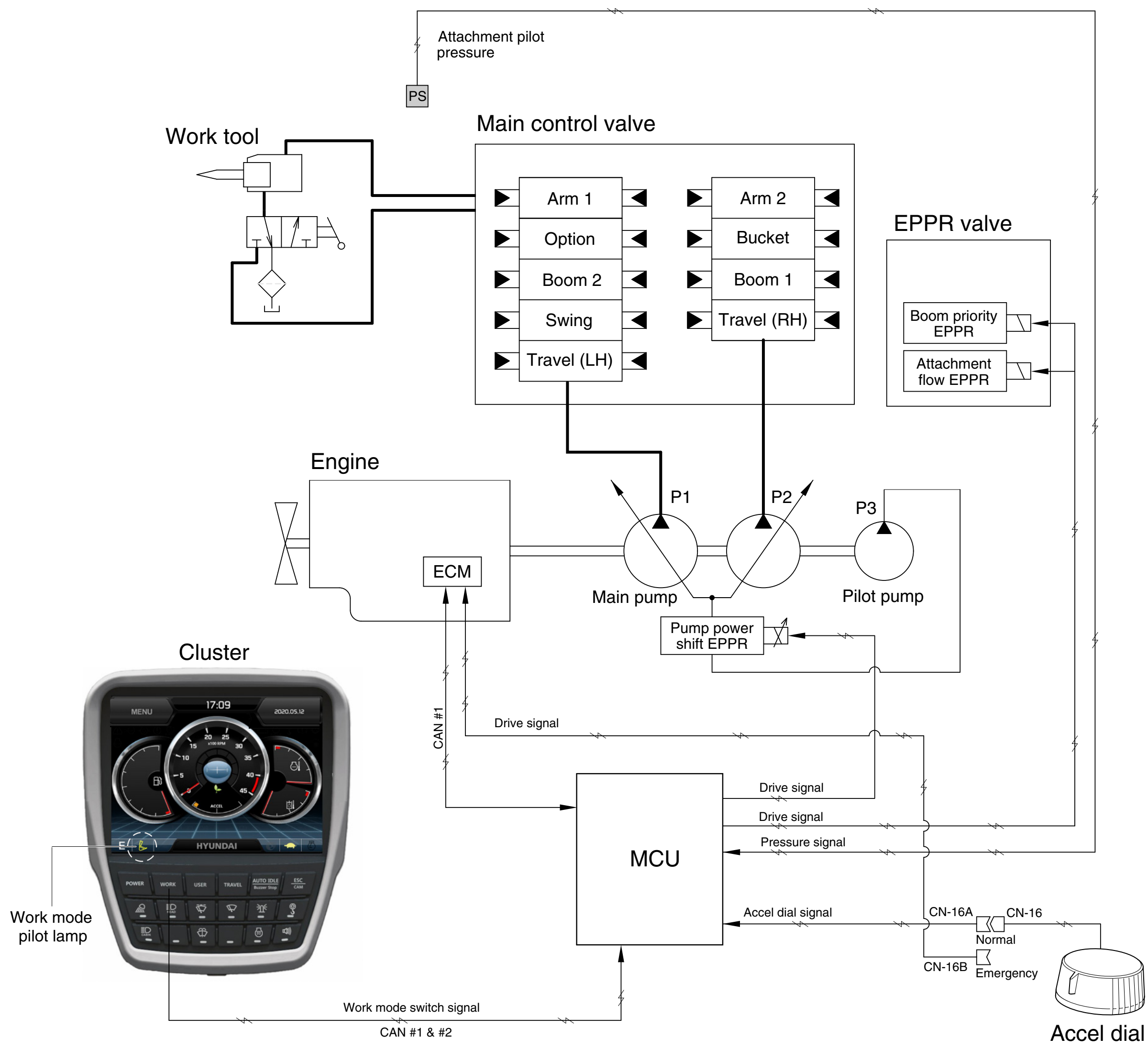
Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1700	1700	1700	1700	340	10 (7)	300	7 (7)
S	Standard power	1600	1600	1600	1600	350	11 (8)	310	8 (8)
E	Economy operation	1500	1600	1600	1600	400	15 (12)	360	12 (12)
AUTO DECEL	Engine deceleration	1000	-	1000	-	700	38	700	38
One touch decel	Engine quick deceleration	900	-	900	-	700	38	700	38
KEY START	Key switch start position	900	-	900	-	700	38	700	38

※ Power shift (Standard/Option) can be changed by "Service menu" in "Management" on the cluster.

※ ( ) : Load

2. WORK MODE SELECTION SYSTEM

Work mode consists of the general operation (bucket) and the optional attachment (breaker, crusher).



400SA5MS03

1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

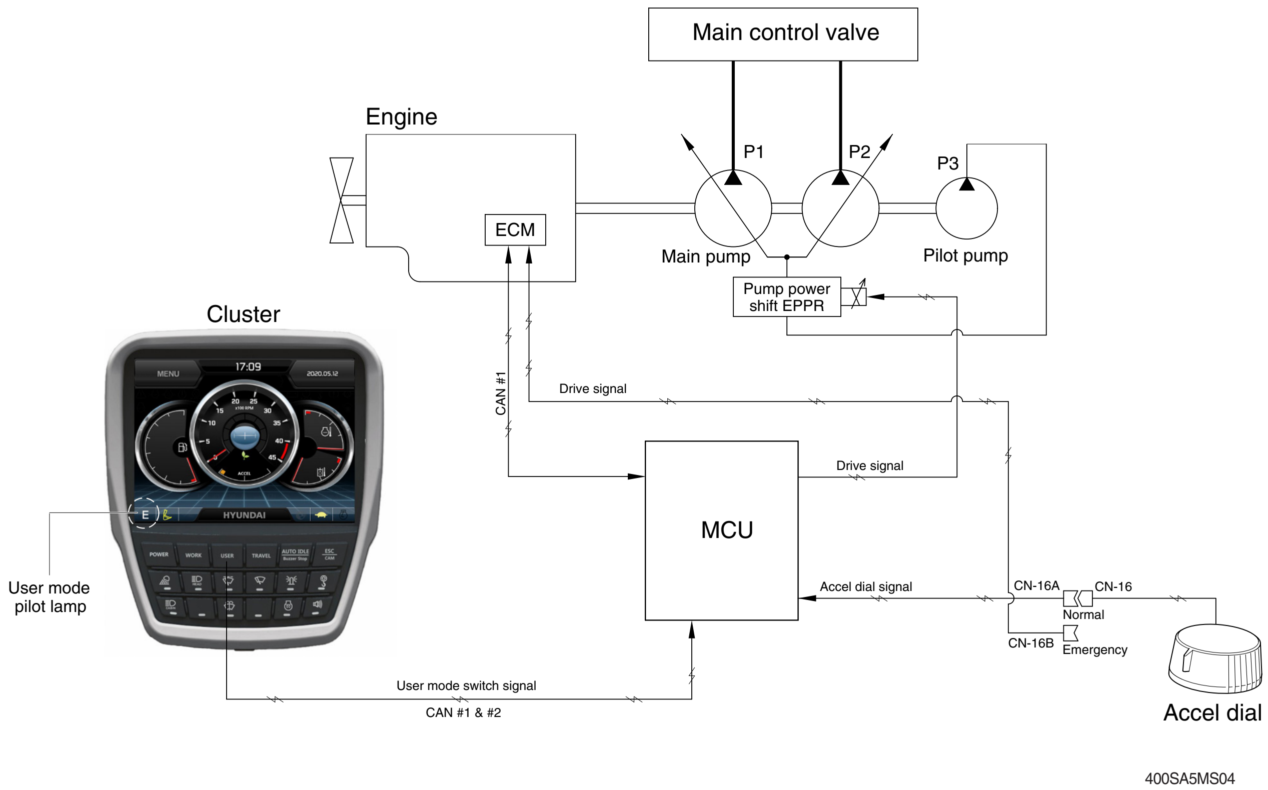
2) ATT WORK MODE (breaker, crusher)

It controls the pump flow and system pressure according to the operation of breaker or crusher.

Description	General mode	Work tool	
	Bucket	Breaker	Crusher
Attachment safety solenoid	OFF	-	ON
Attachment conflux solenoid	OFF	ON/OFF	ON/OFF
Attachment flow EPPR current	100 mA	100~700 mA	100~700 mA
Breaker solenoid★	OFF	ON	-

★ When breaker operating button is pushed.

3. USER MODE SELECTION SYSTEM

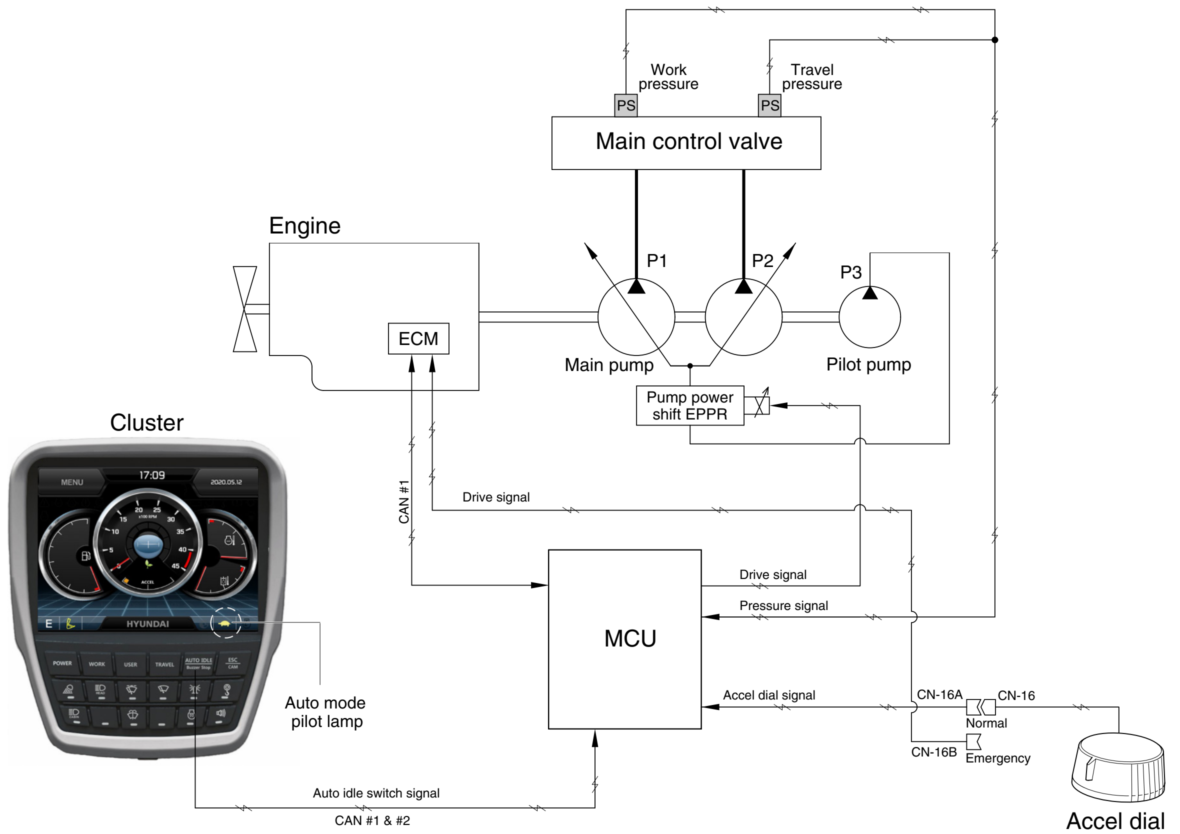


1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1350	800	0
2	1400	850	3
3	1450	900	6
4	1500	950	9
5	1550	1000 (auto decel)	12
6	1600	1050	16
7	1650	1100	20
8	1700	1150	26
9	1750	1200	32
10	1800	1250	38

GROUP 3 AUTOMATIC DECELERATION SYSTEM

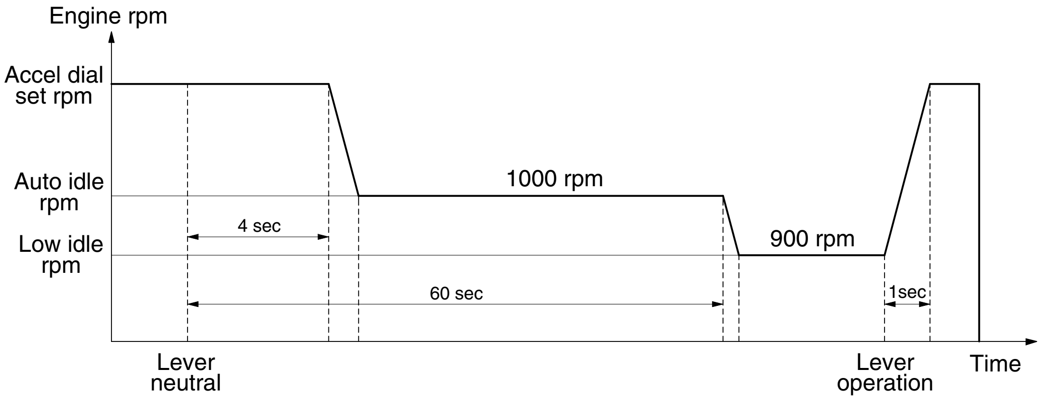


400SA5MS05

1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU drive the governor moter to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 900 rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

When the auto idle pilot lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed before deceleration in a second.



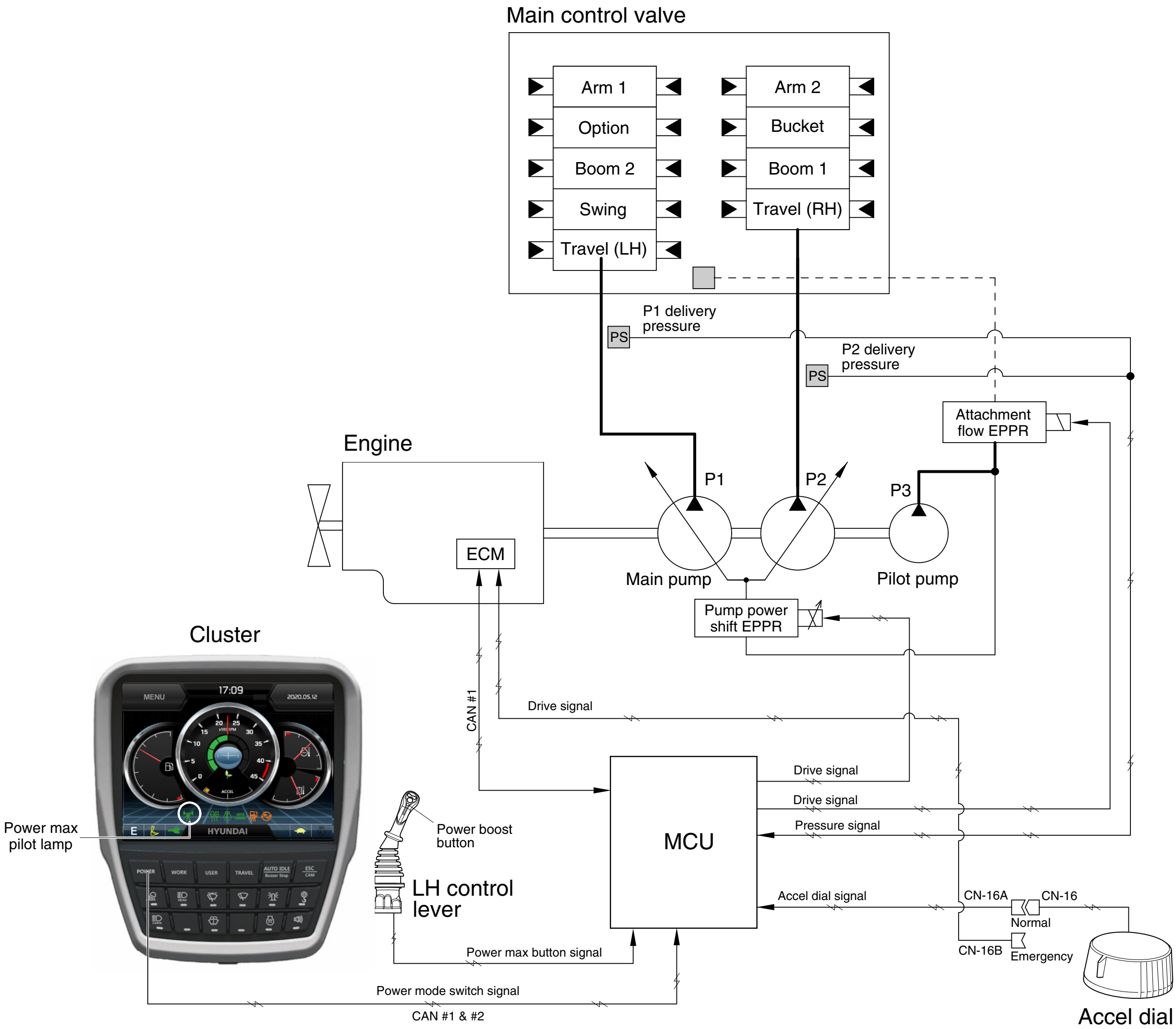
350SA5MS56

2. WHEN AUTO IDLE PILOT LAMP OFF

The engine speed can be set as desired using the accel dial switch, and even if the control levers are neutral, the engine speed is not reduced.

※ Auto idle function can be activated when accel dial position is over 4.

GROUP 4 POWER BOOST SYSTEM (NULL)



400SA5MS06

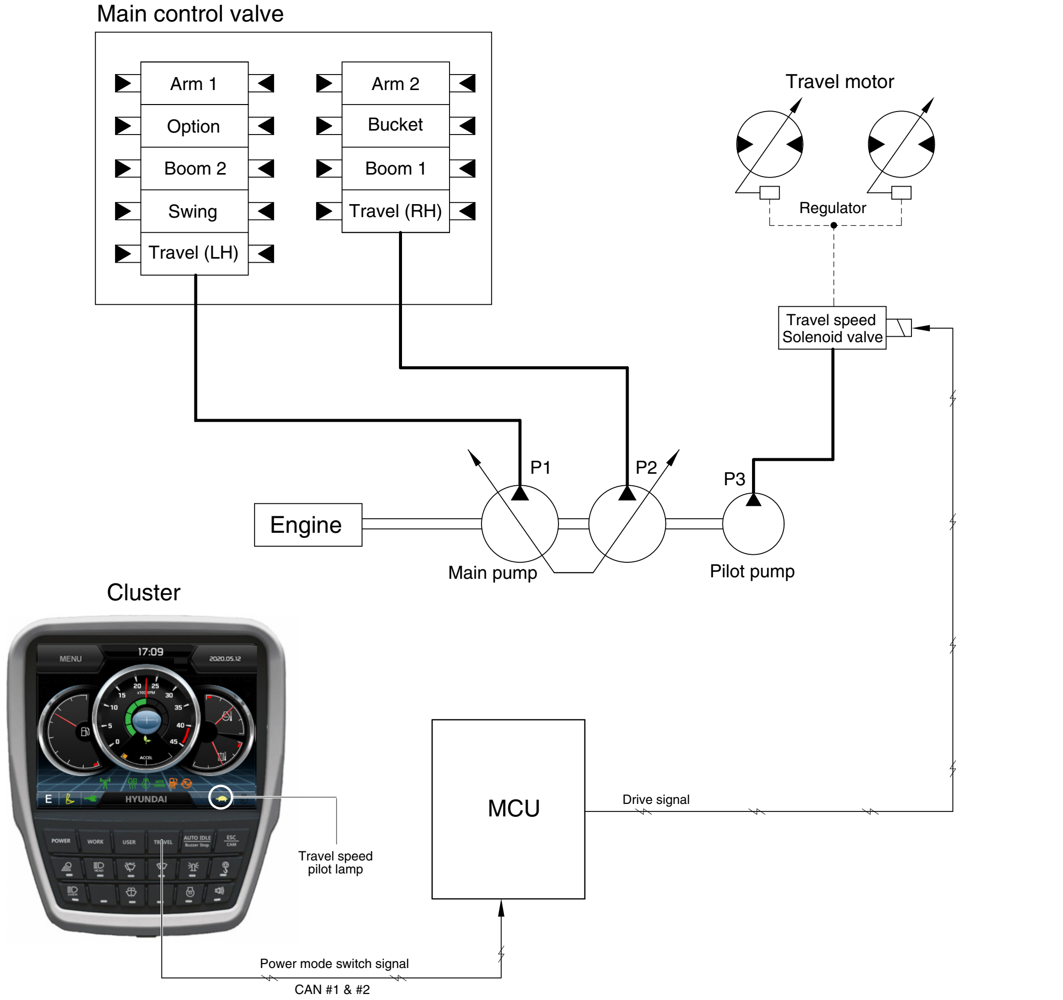
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

· When the power boost function is activated, the power boost solenoid valve pilot pressure raises the set pressure of the main relief valve to increase the digging power.

Description	Condition	Function
Activated	Power boost switch : ON Multimodal dial : over 8	- Power mode : P - Multimodal dial power : 9 - Power boost solenoid : ON - Power boost pilot lmap : ON - Operating time : max 8 seconds
Canceled	Power boost switch : OFF	- Pre-set power mode - Power boost solenoid : OFF - Power boost pilot lamp : OFF

※ When the auto power boost is set to enable and power mode is set to P mode on the cluster, the digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds.

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



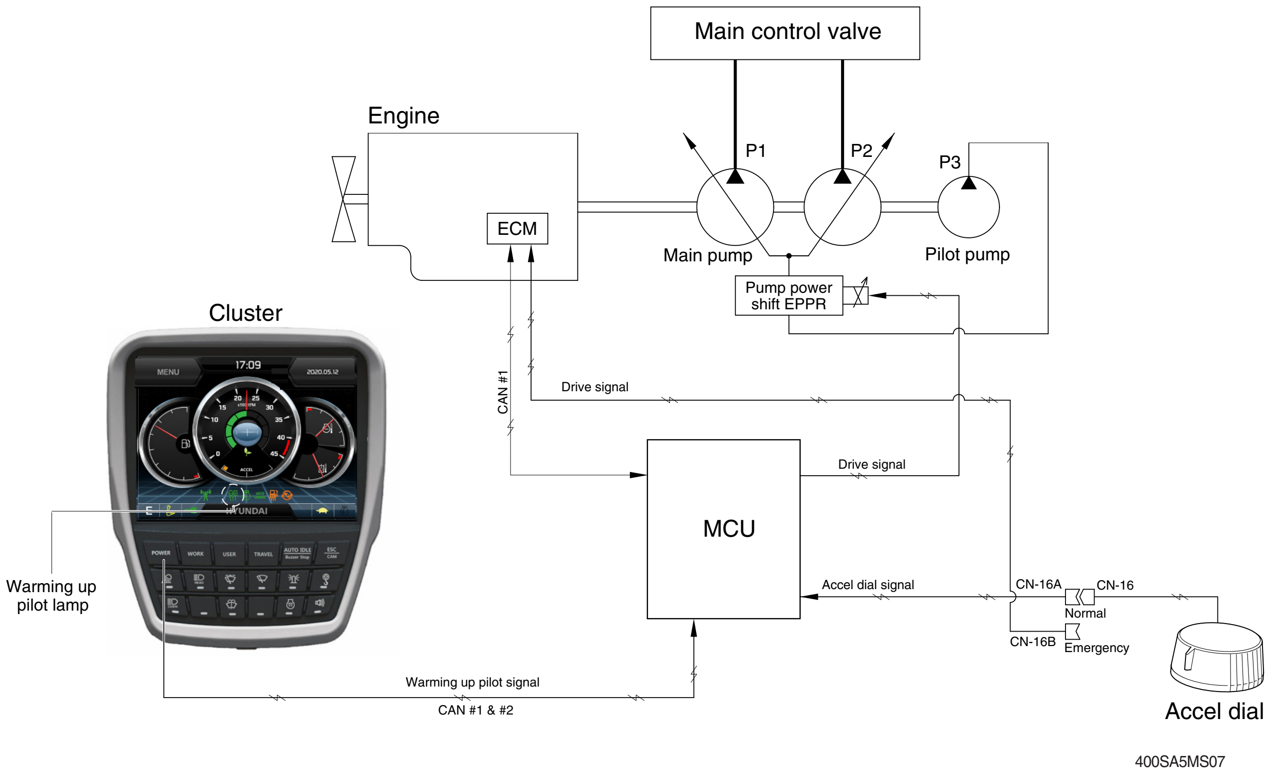
400SA5MS10

Travel speed can be switched manually by pressing the travel speed switch on the cluster.

Speed	Travel speed solenoid valve	Lamp on cluster	Operation
Low	OFF	Turtle	Low speed, high driving torque in the travel motor
High	ON	Rabbit	High speed, low driving torque in the travel motor

※ Default : Turtle (Low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



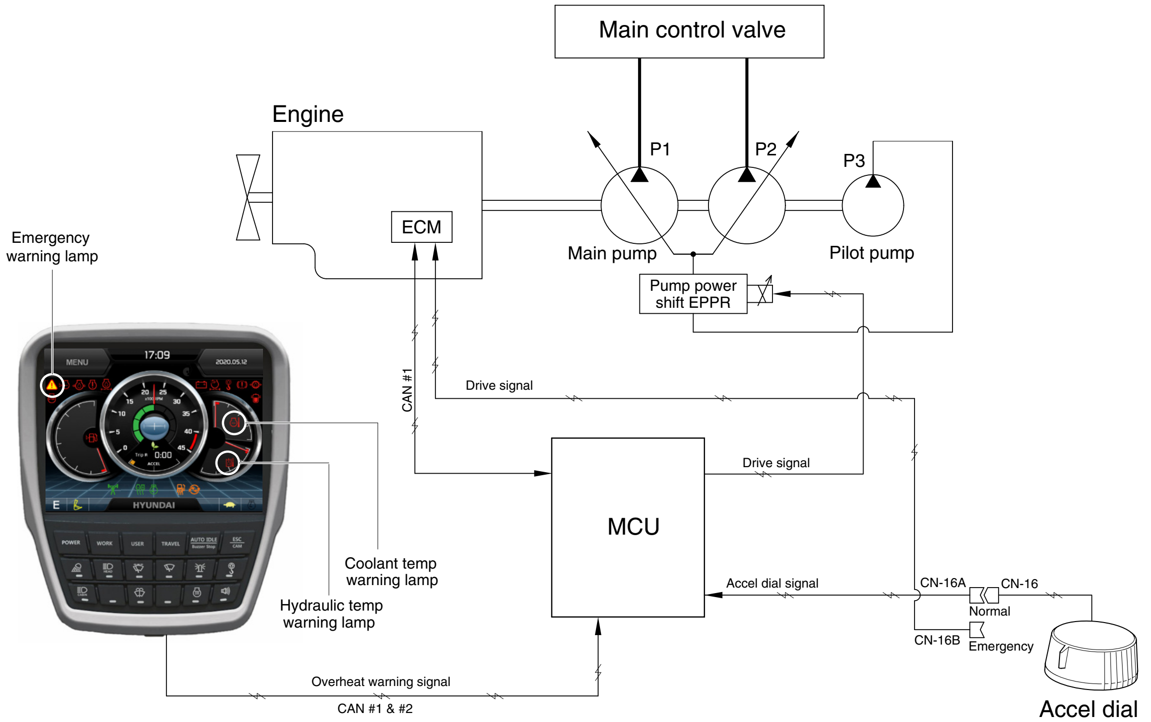
1. The MCU receives the engine coolant temperature thought the temperature sensor, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1000 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

2. In case of the coolant temperature increases up to 30˚C, the engine speed is decreased to key start speed. And if an operator changes power mode set during the warming up function, the MCU cancels the automatic warming up function.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : below 30˚C (after engine run)	- Power mode : Default (E mode) - Warming up time : 10 minutes (max) - Warming up pilot lamp : ON
Canceled	- Coolant temperature : Above 30˚C - Warming up time : Above 10 minutes - Changed power mode set by operator - RCV lever or pedal operating - Auto idle cancel ※ If any of the above conditions is applicable, the automatic warming up function is canceled	- Power mode : set mode - Warming up pilot lamp : OFF

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM



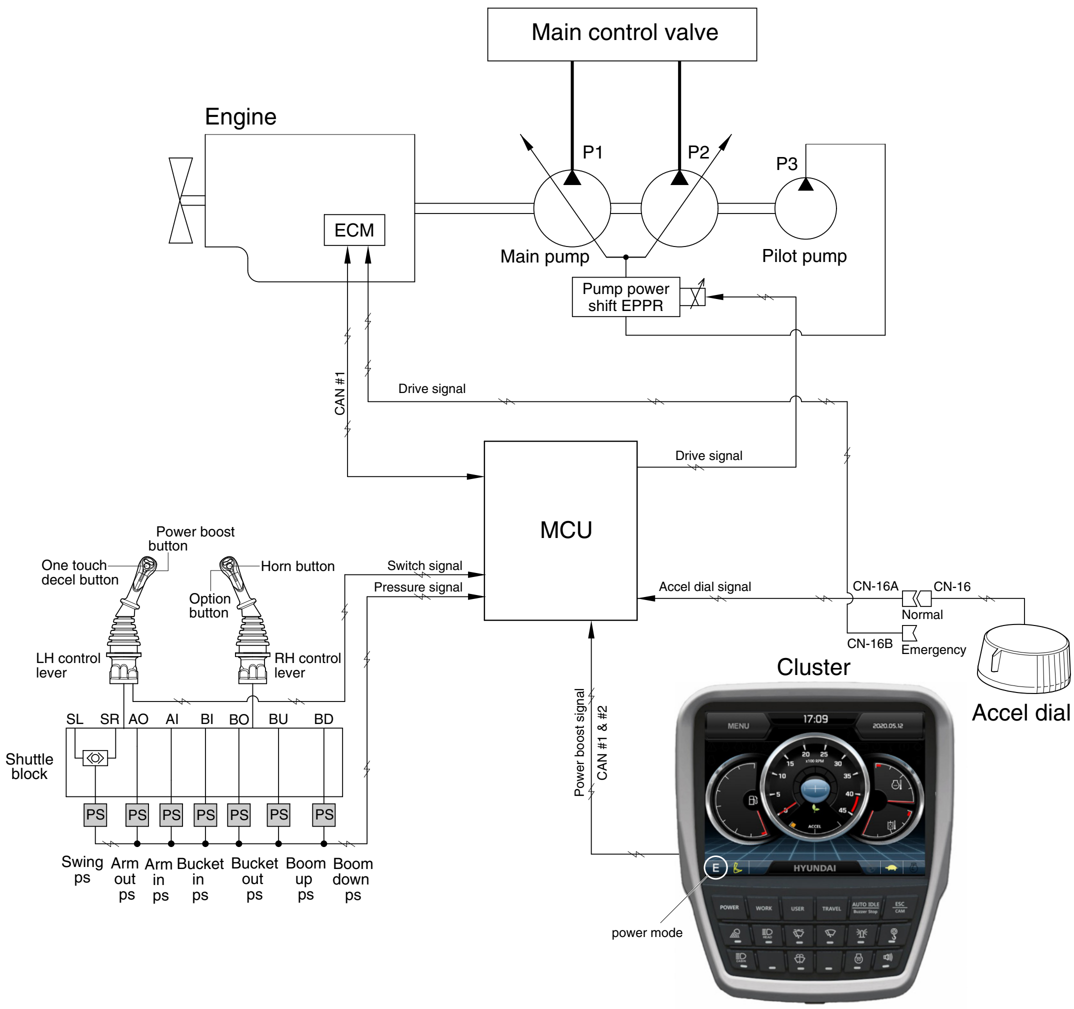
400SA5MS08

1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 100˚C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant temperature : Above 107˚C - Hydraulic oil temperature : Above 100˚C	- Warning lamp : ON , buzzer : OFF - Pump input torque is reduced. - Warning lamp & buzzer : ON - Pump input torque is reduced.
	Canceled	- Coolant temperature : Less than 107˚C - Hydraulic oil temperature : Less than 100˚C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant temperature : Above 113˚C - Hydraulic oil temperature : Above 105˚C	- Emergency warning lamp pops up on the center of LCD and the buzzer sounds. - Engine speed is reduced after 10 seconds.
	Canceled	- Coolant temperature : Less than 107˚C - Hydraulic oil temperature : Less than 100˚C	- Return to pre-set the engine speed. - Hold pump absorption torque on the first step warning.

GROUP 8 VARIABLE POWER CONTROL SYSTEM



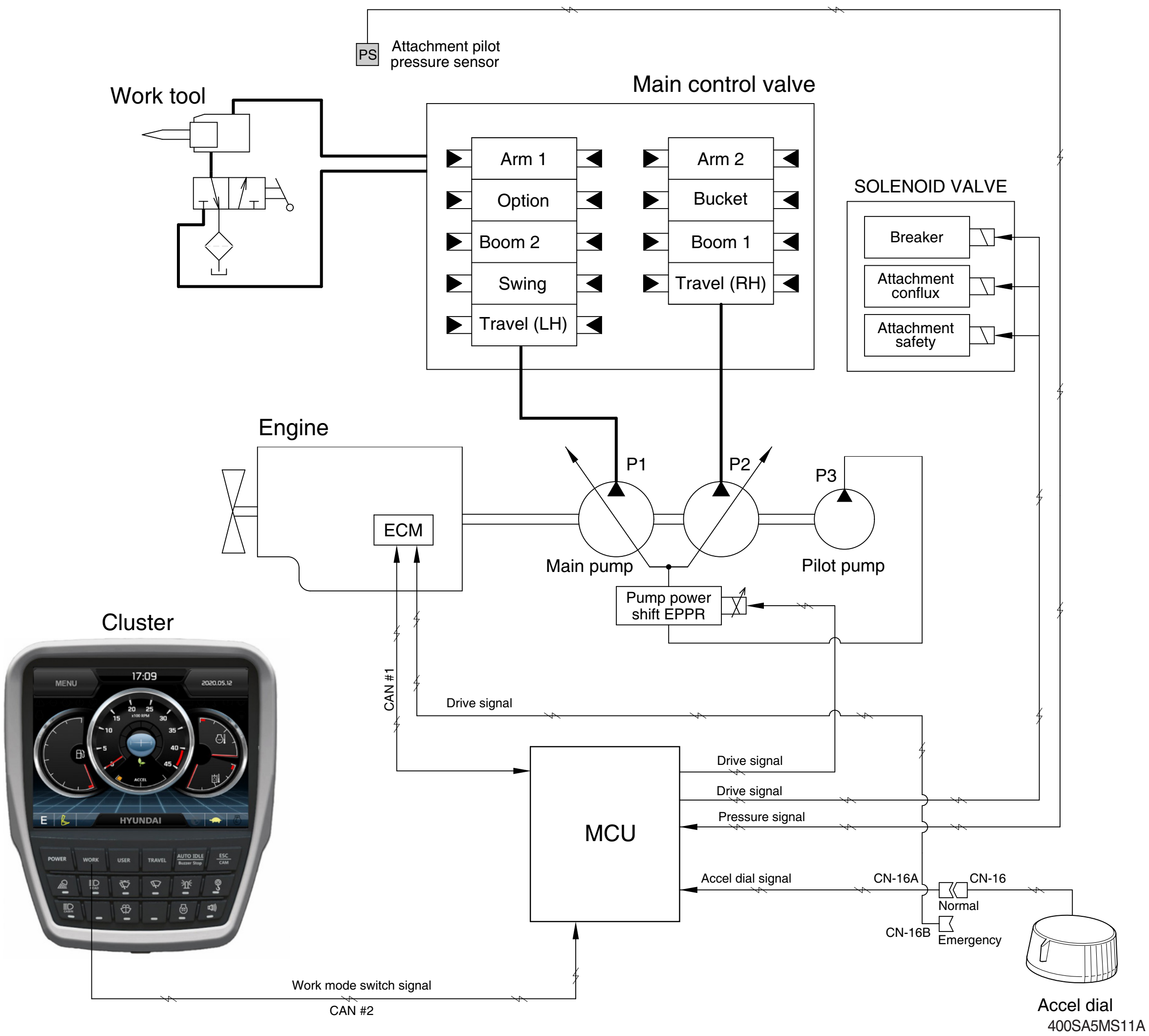
400SA5MS09

· The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.
It makes fuel saving and smooth control at precise work.

Description	Working condition
Power mode	P, S, E
Work mode	General (bucket)
Pressure sensor	Normal

※ The variable power control function can be activated when the power mode is set to all power mode.

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



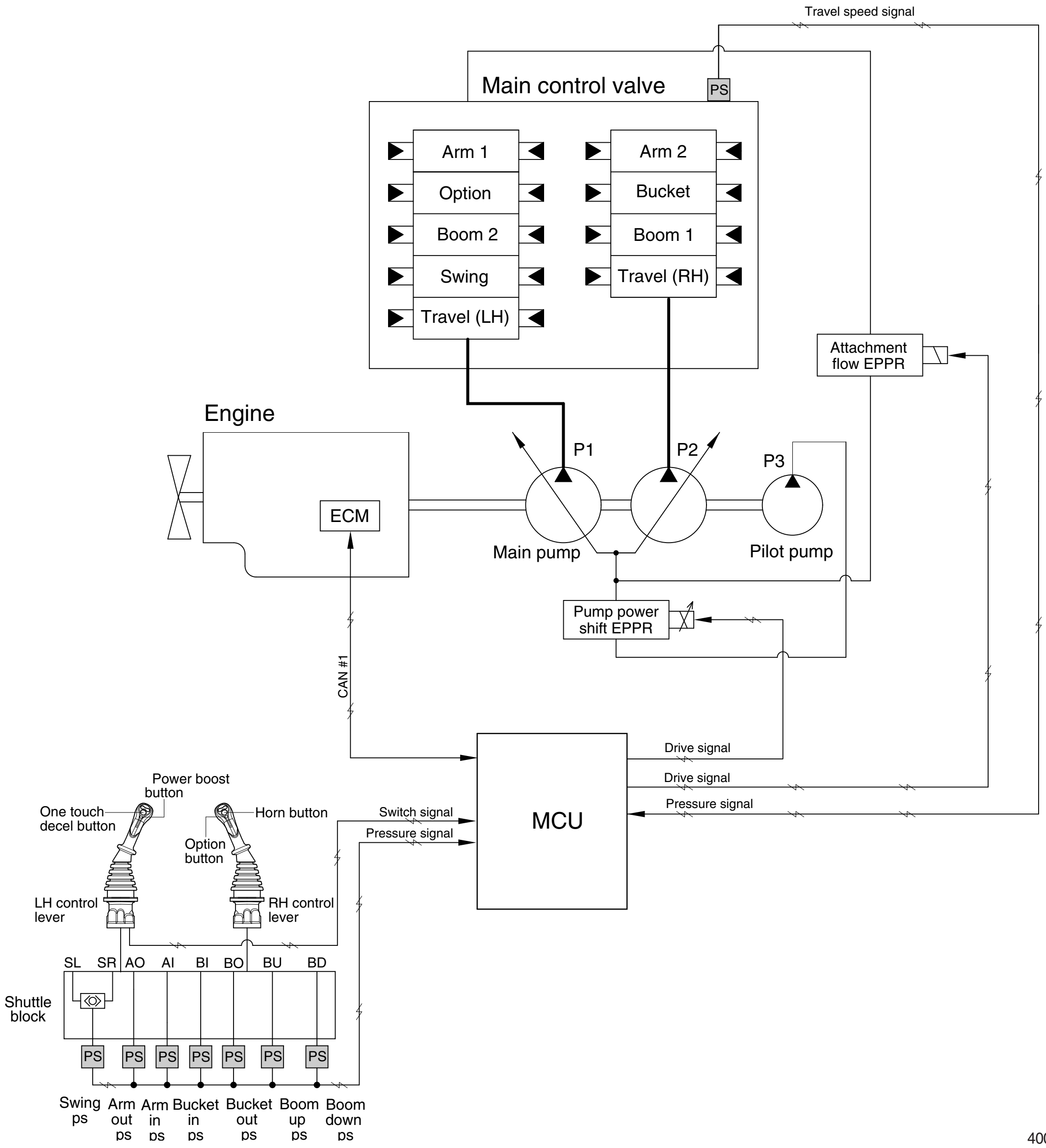
· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool	
	Breaker	Crusher
Flow level	100 ~ 250 lpm	100 ~ 580 lpm
Attach safety solenoid	-	ON
Attach conflux solenoid	-	ON/OFF
Breaker solenoid★	ON	-

※ Refer to the page 5-75 for the attachment kinds and max flow.

★ When breaker operating button is pushed.

GROUP 10 INTELLIGENT POWER CONTROL SYSTEM



400SA5MS12

1. When the requirement of pump flow rate is low, IPC mode controls pump flow rate to improve fuel efficiency.

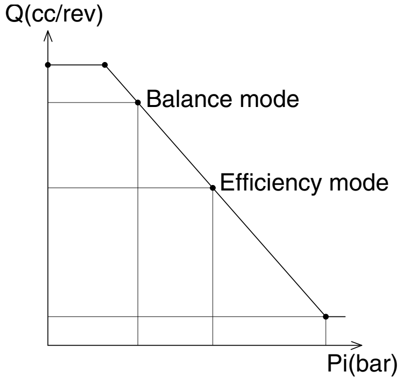
Condition★1	Function
IPC mode : ON★2 Boom up Arm in Not travel motion Not swing motion	Limitation of pump flow rate : Activated
None of upper condition	Limitation of pump flow rate : Canceled

★1 AND condition

★2 IPC mode ON/OFF is selected at "Mode setup > IPC mode". See next page.

2. IPC MODE SELECTION

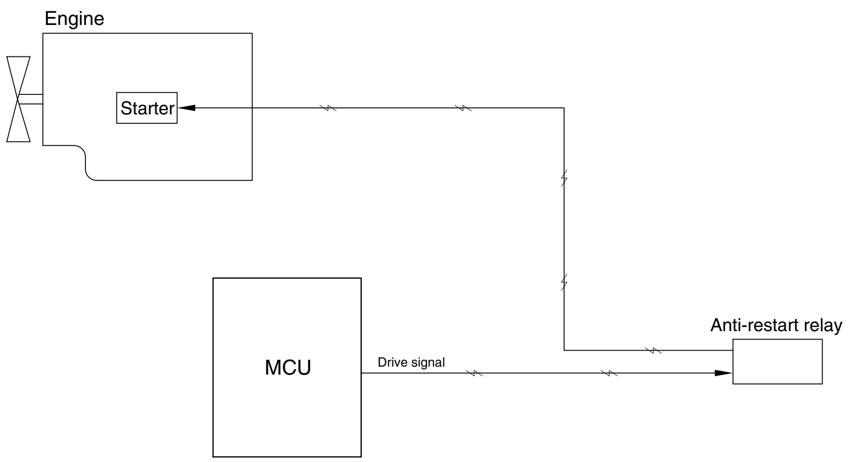
IPC mode ON/OFF and the levels of flow rate limit can be selected at "Mode setup > IPC mode"



145SA5MS19

IPC mode	Description
Balance mode (default)	IPC mode ON, limit level 1
Efficiency mode	IPC mode ON, limit level 2
Speed mode	IPC mode OFF

GROUP 11 ANTI-RESTART SYSTEM



220S5MS18

1. ANTI-RESTART FUNCTION

After a few seconds from the engine starts to run, MCU turns off the anti-start relay to protect the starter from inadvertent restarting.

1. OUTLINE

When any abnormality occurs in the ADVANCED CAPO system caused by electric parts malfunction and by open or short circuit, the MCU diagnoses the problem and sends the error codes to the cluster and also stores them in the memory.

2. MONITORING

1) Active fault

220S3CD120A

220S3CD125A

· The active faults of the MCU can be checked by this menu.

2) Logged fault

220S3CD128A

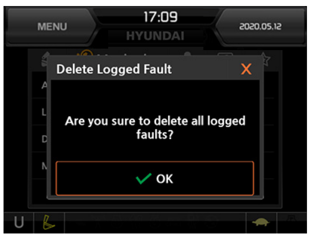
220S3CD124A

· The logged faults of the MCU can be checked by this menu.

3) Delete logged fault

220S3CD134A

220S3CD126A



220S3CD127A

· The logged faults of the MCU can be deleted by this menu.

3. MACHINE ERROR CODES TABLE

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
101	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Hydraulic oil temperature display failure 2. Control Function – Fan revolutions control failure (Checking list) 1. CD-1 (#2) – CN-52 (#24) Checking Open/Short 2. CD-1 (#1) – CN-51 (#11) Checking Open/Short			
105	0	10 seconds continuous, Working Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Working Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Working Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Working Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure (Checking list) 1. CD-7 (#B) – CN-52 (#37) Checking Open/Short 2. CD-7 (#A) – CN-51 (#3) Checking Open/Short 3. CD-7 (#C) – CN-51 (#13) Checking Open/Short			
108	0	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage > 5.2V		●	
	1	10 seconds continuous, 0.3V ≤ Travel Oil Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Travel Oil Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Travel Oil Press. display failure 2. Control Function – Auto Idle operation failure, Engine variable horse power control operation failure, IPC operation failure, Driving alarm operation failure (Checking list) 1. CD-6 (#B) – CN-52 (#38) Checking Open/Short 2. CD-6 (#A) – CN-51 (#3) Checking Open/Short 3. CD-6 (#C) – CN-51 (#13) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">120</td><td>0</td><td>10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V ≤ Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Main Pump 1 (P1) Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Main Pump 1 (P1) Press. display failure
2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure
(Checking list)
1. CD-42 (#B) – CN-52 (#29) Checking Open/Short
2. CD-42 (#A) – CN-51 (#3) Checking Open/Short
3. CD-42 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">121</td><td>0</td><td>10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Main Pump 2 (P2) Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Main Pump 2 (P2) Press. display failure
2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure
(Checking list)
1. CD-43 (#B) – CN-52 (#30) Checking Open/Short
2. CD-43 (#A) – CN-51 (#3) Checking Open/Short
3. CD-43 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">122</td><td>1</td><td>(when you had conditions mounting pressure sensor)
10 seconds continuous, 0.3V ≤ Overload Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(when you had conditions mounting pressure sensor)
10 seconds continuous, Overload Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Overload Press. display failure
2. Control Function – Overload warning alarm failure
(Checking list)
1. CD-31 (#B) – CN-52 (#39) Checking Open/Short
2. CD-31 (#A) – CN-51 (#3) Checking Open/Short
3. CD-31 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
123	0	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Negative 1 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 1 Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Negative 1 Press. display failure 2. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CD-70 (#B) – CN-51 (#39) Checking Open/Short 2. CD-70 (#A) – CN-51 (#3) Checking Open/Short 3. CD-70 (#C) – CN-51 (#13) Checking Open/Short			
124	0	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Negative 2 Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Negative 2 Press. Sensor Measurement Voltage < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Negative 2 Press. display failure 2. Control Function – Option attachment flow control operation failure (Checking list) 1. CD-71 (#B) – CN-51 (#40) Checking Open/Short 2. CD-71 (#A) – CN-51 (#3) Checking Open/Short 3. CD-71 (#C) – CN-51 (#13) Checking Open/Short			
127	0	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Boom Up Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Boom Up Pilot Press. Sensor Measurement < 0.3V	●		
		(Results / Symptoms) 1. Monitor – Boom Up Pilot Press. display failure 2. Control Function – Engine/Pump variable horse power control operation failure, IPC operation failure, Boom first operation failure (Checking list) 1. CD-32 (#B) – CN-52 (#35) Checking Open/Short 2. CD-32 (#A) – CN-51 (#3) Checking Open/Short 3. CD-32 (#C) – CN-5 1(#13) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
128	0	(when you had conditions mounting pressure sensor) 10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	(when you had conditions mounting pressure sensor) 10 seconds continuous, 0.3V≤ Boom Down Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Boom Down Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom Down Pilot Press. display failure 2. Control Function – Boom floating operation failure (Checking list) 1. CD-85 (#B) – CN-52 (#34) Checking Open/Short 2. CD-85 (#A) – CN-51 (#3) Checking Open/Short 3. CD-85 (#C) – CN-51 (#13) Checking Open/Short				
129	0	10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage > 4.8V	●		
	1	10 seconds continuous, 0.3V≤ Arm In Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Arm In Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Arm In Pilot Press. display failure 2. Control Function – IPC operation failure (Checking list) 1. CD-90 (#B) – CN-51 (#10) Checking Open/Short 2. CD-90 (#A) – CN-51 (#3) Checking Open/Short 3. CD-90 (#C) – CN-51 (#13) Checking Open/Short				
133	0	10 seconds continuous, Bucket in Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Bucket in Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Bucket in Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Bucket in Pilot Press. display failure 2. Control Function – Engine variable horse power control operation failure (Checking list) 1. CD-35 (#B) – CN-52 (#28) Checking Open/Short 2. CD-35 (#A) – CN-51 (#3) Checking Open/Short 3. CD-35 (#C) – CN-51 (#13) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">135</td><td>0</td><td>10 seconds continuous, Swing Pilot Press. Sensor
Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Swing Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Swing Pilot Press. Sensor
Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Swing Pilot Press. display failure
2. Control Function – IPC operation, Boom first operation failure
(Checking list)
1. CD-24 (#B) – CN-52 (#36) Checking Open/Short
2. CD-24 (#A) – CN-51 (#3) Checking Open/Short
3. CD-24 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="4">138</td><td>0</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, 0.3V≤ Attachment Pilot Press. Sensor Measurement Voltage < 0.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>Monitor – Select Attachment(breaker / crusher)
10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Attachment Pilot Press. display failure
2. Control Function – Option attachment flow control operation failure
(Checking list)
1. CD-69 (#B) – CN-52 (#33) Checking Open/Short
2. CD-69 (#A) – CN-51 (#3) Checking Open/Short
3. CD-69 (#C) – CN-51 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">139
(NA)</td><td>1</td><td>10 seconds continuous, 0.3V≤ Option Pilot Press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td>●</td></tr>
<tr><td>4</td><td>10 seconds continuous, Option Pilot Press. Sensor
Measurement Voltage < 0.3V</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Option Pilot Press. display failure
2. Control Function – Auto Idle operation failure
(Checking list)
1. CD-100 (#B) – CN-52 (#21) Checking Open/Short
2. CD-100 (#A) – CN-51 (#3) Checking Open/Short
3. CD-100 (#C) – CN-1 (#6) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General　　C : Crawler Type　　W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">140</td><td>5</td><td>(Detection)
(When Pump EPPR Current is more than 10 mA)
10 seconds continuous, Pump EPPR drive current < 0 mA
(Cancellation)
(When Pump EPPR Current is more than 10 mA)
3 seconds continuous, Pump EPPR drive current ≥10 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Pump EPPR drive current > 1.0A
(Cancellation)
3 seconds continuous, Pump EPPR drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Pump horse power setting specification difference
(Fuel efficiency/speed specification failure)
(Checking list)
1. CN-75 (#2) – CN-52 (#9) Checking Open/Short
2. CN-75 (#1) – CN-52 (#19) Checking Open/Short</td></tr>
<tr><td rowspan="3">141</td><td>5</td><td>(Model Parameter) mounting Boom Priority EPPR
(Detection)
(When Boom Priority EPPR Current is more than 10 mA)
10 seconds continuous, Boom Priority EPPR drive current < 0 mA
(Cancellation)
(When Boom Priority EPPR Current is more than 10 mA)
3 seconds continuous, Boom Priority EPPR drive current ≥ 10 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Boom Priority EPPR drive current > 1.0 A
(Cancellation)
3 seconds continuous, Boom Priority EPPR drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Boom first control operation failure
(Checking list)
1. CN-133 (#2) – CN-52 (#7) Checking Open/Short
2. CN-133 (#1) – CN-52 (#17) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">143
(NA)</td><td>5</td><td>(Detection)
(When Travel EPPR Current is more than 10 mA)
10 seconds continuous, Travel EPPR drive current = 0 mA
(Cancellation)
(When Travel EPPR Current is more than 100 mA)
3 seconds continuous, Travel EPPR drive current ≥ 10 mA</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Travel EPPR drive current > 1.0 A
(Cancellation)
3 seconds continuous, Travel EPPR drive current ≤ 1.0 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – cruise control operation failure
(Checking list)
1. CN-246 (#2) – CN-54 (#39) Checking Open/Short
2. CN-246 (#1) – CN-51 (#40) Checking Open/Short</td></tr>
<tr><td rowspan="3">145
(NA)</td><td>5</td><td>(Model Parameter) mounting Remote Cooling Fan EPPR
(Detection)
(When Remote Cooling Fan EPPR Current is more than 10 mA)
10 seconds continuous, Remote Cooling Fan EPPR drive current = 0 mA
(Cancellation)
(When Remote Cooling Fan EPPR Current is more than 10 mA)
3 seconds continuous, Remote Cooling Fan EPPR drive current ≥ 10 mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, Remote Cooling Fan EPPR drive current > 1.0 A
(Cancellation)
3 seconds continuous, Remote Cooling Fan EPPR drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Remote fan control operation failure
(Checking list)
1. CD-385 (#3) – CN-51 (#9) Checking Open/Short
2. CD-385 (#1) – CN-51 (#14) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General　　C : Crawler Type　　W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">164
(NA)</td><td>4</td><td>(Detection)
(When Working Cutoff Relay is Off)
10 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Working Cutoff Relay is Off)
3 seconds continuous, Working Cutoff Relay drive unit Measurement Voltage > 3.0V</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
(When Working Cutoff Relay is On)
10 seconds continuous, Working Cutoff Relay drive current > 6.5 A
(Cancellation)
(When Working Cutoff Relay is On)
3 seconds continuous, Working Cutoff Relay drive current ≤ 6.5 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – (Wheel Excavator) In driving mode, attachment hydraulic pilot pressure cut off failure
(Checking list)
1. CR-47 (#85) – CN-54 (#9) Checking Open/Short
2. CR-47 (#30, #86) – Fuse box (#28) Checking Open/Short</td></tr>
<tr><td rowspan="3">166</td><td>4</td><td>(Detection)
(When Power Max Solenoid is Off)
10 seconds continuous, Power Max Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Power Max Solenoid is Off)
3 seconds continuous, Power Max Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Power Max Solenoid is On)
5 seconds continuous, Power Max Solenoid drive current > 4.5 A
(Cancellation)
(When Power Max Solenoid is On)
3 seconds continuous, Power Max Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Voltage increase operation failure
(Checking list)
1. CN-88 (#1) – CN-52 (#2) Checking Open/Short
2. CN-88 (#2) – Fuse box (#30) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
167	4	(Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V		●	
		(When Parking mode is not) (Detection) (When Travel Speed Solenoid is Off) 10 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel Speed Solenoid is Off) 3 seconds continuous, Travel Speed Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Travel Speed Solenoid is On) 10 seconds continuous, Travel Speed Solenoid drive current > 4.5 A (Cancellation) (When Travel Speed Solenoid is On) 3 seconds continuous, Travel Speed Solenoid drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – driving in 1/2 transmission operation failure (Checking list) 1. CN-70 (#1) – CN-52 (#3) Checking Open/Short 2. CN-70 (#2) – Fuse box (#30) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">169</td><td>4</td><td>Monitor – Selecting attachment(breaker / crusher)
(Detection)
(When Attachment Conflux Solenoid is Off)
10 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Attachment Conflux Solenoid is Off)
3 seconds continuous, Attachment Conflux Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Attachment Conflux Solenoid is On)
10 seconds continuous, Attachment Conflux Solenoid drive Current > 6.5 A
(Cancellation)
(When Attachment Conflux Solenoid is On)
3 seconds continuous, Attachment Conflux Solenoid drive Current ≤ 6.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / symptoms)
1. Control Function – Option attachment flow control – Joining operation failure
(Eco breaker mode, crusher mode)
(Checking list)
1. CN-237 (#1) – CN-52 (#6) Checking Open/Short
2. CN-237 (#2) – Fuse box (#30) Checking Open/Short</td></tr>
<tr><td rowspan="3">170
(NA)</td><td>4</td><td>(Model Parameter) mounting Arm Regenerating Solenoid
(Detection)
(When Arm Regeneration Solenoid is Off)
10 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Arm Regeneration Solenoid is Off)
3 seconds continuous, Arm Regeneration Solenoid drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Arm Regeneration Solenoid is On)
10 seconds continuous, Arm Regeneration Solenoid drive current > 4.5 A
(Cancellation)
(When Arm Regeneration Solenoid is On)
3 seconds continuous, Arm Regeneration Solenoid drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / symptoms)
1. Control Function – Arm regeneration operation failure
(Checking list)
1. CN-135 (#1) – CN-52 (#1) Checking Open/Short
2. CN-135 (#2) – Fuse box (#28) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
171	4	Monitor – Selecting attachment(crusher) (Detection) (When Attachment Safety Solenoid is Off) 10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Attachment Safety Solenoid is Off) 3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Attachment Safety Solenoid is On) 10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A (Cancellation) (When Attachment Safety Solenoid is On) 3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – Option spool pilot pressure cut off failure (crusher mode) (Checking list) 1. CN-149 (#1) – CN-52 (#4) Checking Open/Short 2. CN-149 (#2) – Fuse box (#30) Checking Open/Short				
179	4	Monitor – Selecting attachment(breaker / crusher) (Detection) (When Breaker Operating Solenoid is Off) 10 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Breaker Operating Solenoid is Off) 3 seconds continuous, Attachment Safety Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Breaker Operating Solenoid is On) 10 seconds continuous, Attachment Safety Solenoid drive current > 6.5 A (Cancellation) (When Breaker Operating Solenoid is On) 3 seconds continuous, Attachment Safety Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – Breaker operation failure (breaker mode) (Checking list) 1. CN-66 (#1) – CN-15 (#11) Checking Open/Short 2. CN-66 (#2) – CR-62 (#5) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
181 (NA)	4	(Model Parameter) mounting Reverse Cooling Fan Solenoid (Detection) (When Reverse Cooling Fan Solenoid is Off) 10 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Reverse Cooling Fan Solenoid is Off) 3 seconds continuous, Reverse Cooling Fan Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Reverse Cooling Fan Solenoid is On) 10 seconds continuous, Reverse Cooling Fan Solenoid drive current > 4.5 A (Cancellation) (When Reverse Cooling Fan Solenoid is On) 3 seconds continuous, Reverse Cooling Fan Solenoid drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Cooling Fan reverse control operation failure (not applicable)				
188	5	(Detection) (When Attachment Flow EPPR 1 current is equal or more than 300 mA) 10 seconds continuous, Attachment Flow EPPR drive current < 100 mA (Cancellation) (When Attachment Flow EPPR 1 current is equal or more than 300 mA) 3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 1 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 1 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – IPC operation failure, Option attachment flow control operation failure (Checking list) 1. CN-242 (#2) – CN-52 (#10) Checking Open/Short 2. CN-242 (#1) – CN-52 (#20) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
189	5	(Detection) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 10 seconds continuous, Attachment Flow EPPR drive current < 100 mA (Cancellation) (When Attachment Flow EPPR 2 current is equal or more than 300 mA) 3 seconds continuous, Attachment Flow EPPR drive current ≥ 100 mA	●		
	6	(Detection) 10 seconds continuous, Attachment Flow EPPR 2 drive current > 1.0 A (Cancellation) 3 seconds continuous, Attachment Flow EPPR 2 drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control operation failure (Checking list) 1. CN-242A (#2) – CN-52 (#40) Checking Open/Short 2. CN-242A (#1) – CN-52 (#16) Checking Open/Short				
196 (NA)	0	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage > 5.2V			
	1	HW145 10 seconds continuous, 0.3V≤ Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.8V			
	4	HW145 10 seconds continuous, Attachment flow control EPPR 1 press. Sensor Measurement Voltage < 0.3V			
	(Results / Symptoms) 1. Control Function – Driving second pump joining function operation failure (Checking list) 1. CD-93 (#B) – CN-52 (#34) Checking Open/Short 2. CD-93 (#A) – CN-51 (#32) Checking Open/Short 3. CD-93 (#C) – CN-51 (#31) Checking Open/Short				
200	0	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Pump EPPR Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Pump EPPR Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Pump EPPR Press. display failure 2. Control Function – Pump input horse power control failure, Overload at compensation control operation failure (Fuel efficiency/speed performance failure) (Checking list) 1. CD-44 (#B) – CN-52 (#32) Checking Open/Short 2. CD-44 (#A) – CN-51 (#3) Checking Open/Short 3. CD-44 (#C) – CN-51 (#13) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
205 (NA)	0	(Mounting pressure sensor) 10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage > 5.2V	●		
	1	(Mounting pressure sensor) 10 seconds continuous, 0.3V≤ Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.8V	●		
	4	(Mounting pressure sensor) 10 seconds continuous, Boom Cylinder Rod Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom Cylinder Rod Press. display failure 2. Control Function – Boom floating control operation failure (Checking list) 1. CD-124 (#B) – CN-53 (#5) Checking Open/Short 2. CD-124 (#A) – CN-53 (#3) Checking Open/Short 3. CD-124 (#C) – CN-53 (#13) Checking Open/Short				
218 (NA)	4	Mounting pressure sensor (HCESPN128 or HCESPN 205) (Detection) (When Boom Up Floating Solenoid is Off) 10 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Boom Up Floating Solenoid is Off) 3 seconds continuous, Boom Up Floating Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Boom Up Floating Solenoid is On) 10 seconds continuous, Boom Up Floating Solenoid drive current > 6.5 A (Cancellation) (When Boom Up Floating Solenoid is On) 3 seconds continuous, Boom Up Floating Solenoid drive current ≤ 6.5 A	●		
	(Results / Symptoms) 1. Control Function – Boom floating control operation failure (Checking list) 1. CN-368 (#1) – CN-53 (#20) Checking Open/Short 2. CN-368 (#2) – Fuse box (#17) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
220 (NA)	4	Mounting pressure sensor (HCESPN 128 or 205) (Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is Off) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 10 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current > 6.5 A (Cancellation) (When Boom Down Pilot Pressure Cutoff Solenoid is On) 3 seconds continuous, Boom Down Pilot Pressure Cutoff Solenoid drive current ≤ 6.5 A	●		
		(Results / Symptoms) 1. Control Function – Boom floating control operation failure (Checking list) 1. CN-369 (#1) – CN-53 (#35) Checking Open/Short 2. CN-369 (#2) – Fuse box (#17) Checking Open/Short			
221 (NA)	5	Monitor – Selecting attachment(breaker / crusher) (Detection) (When ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current = 0 mA (Cancellation) ATT Relief Setting EPPR 1 Current is equal or more than 10 mA) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current ≥ 10 mA	●		
	6	(Detection) 10 seconds continuous, ATT Relief Setting EPPR 1 drive current > 1.0 A (Cancellation) 3 seconds continuous, ATT Relief Setting EPPR 1 drive current ≤ 1.0 A	●		
		(Results / Symptoms) 1. Control Function – Option attachment flow control – P1 relief pressure setting failure (Checking list) 1. CN-365 (#2) – CN-53 (#39) Checking Open/Short 2. CN-365 (#1) – CN-53 (#40) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">222
(NA)</td><td>5</td><td>Monitor – Selecting attachment(crusher)
(Detection)
(When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA)
10 seconds continuous, ATT Relief Setting EPPR 2 drive current = 0 mA
(Cancellation)
(When ATT Relief Setting EPPR 2 Current is equal or more than 10 mA)
3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≥ 10mA</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
10 seconds continuous, ATT Relief Setting EPPR 2 drive current > 1.0 A
(Cancellation)
3 seconds continuous, ATT Relief Setting EPPR 2 drive current ≤ 1.0 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Option attachment flow control – P2 relief pressure setting failure
(Checking list)
1. CN-366 (#2) – CN-53 (#32) Checking Open/Short
2. CN-366 (#1) – CN-53 (#33) Checking Open/Short</td></tr>
<tr><td rowspan="3">301</td><td>3</td><td>10 seconds continuous, Fuel Level Measurement Voltage > 3.8V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Fuel Level Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Fuel remaining display failure
(Checking list)
1. CD-2 (#2) – CN-52 (#26) Checking Open/Short
2. CD-2 (#1) – CN-51 (#11) Checking Open/Short</td></tr>
<tr><td rowspan="3">325</td><td>4</td><td>(Model Parameter) mounting Fuel Heater Relay
(Detection)
(When Fuel Heater Relay is Off)
10 seconds continuous, Fuel Heater Relay drive unit
Measurement Voltage ≤ 3.0V
(Cancellation)
(When Fuel Heater Relay is Off)
3 seconds continuous, Fuel Heater Relay drive unit
Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Fuel Heater Relay is On)
10 seconds continuous, Fuel Heater Relay drive current > 4.5 A
(Cancellation)
(When Fuel Heater Relay is On)
3 seconds continuous, Fuel Heater Relay drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Fuel heater operation failure
(Checking list)
1. CR-46 (#85) – CN-52 (#12) Checking Open/Short
2. CR-46 (#30, #86) – Fuse box (#21) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
501 (NA)	0	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Transmission Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Transmission Oil Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Transmission Oil Press. display failure, Transmission Oil low pressure warning failure (Checking list) 1. CD-5 (#B) – CN-54 (#27) Checking Open/Short 2. CD-5 (#A) – CN-54 (#3) Checking Open/Short 3. CD-5 (#C) – CN-54 (#13) Checking Open/Short				
503 (NA)	0	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Brake Oil Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Brake Oil Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Brake Oil Press. display failure, Brake Oil low pressure warning failure (Checking list) 1. CD-3 (#B) – CN-54 (#4) Checking Open/Short 2. CD-3 (#A) – CN-54 (#3) Checking Open/Short 3. CD-3 (#C) – CN-54 (#13) Checking Open/Short				
505 (NA)	0	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Working Brake Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Working Brake Press. Sensor Measurement Voltage < 0.3V			●
	(Results / Symptoms) 1. Monitor – Working Brake Oil Press. display failure, Working Brake Oil low pressure warning failure (Checking list) 1. CD-38 (#B) – CN-54 (#5) Checking Open/Short 2. CD-38 (#A) – CN-54 (#3) Checking Open/Short 3. CD-38 (#C) – CN-54 (#13) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
514 (NA)	4	(Detection) (When Parking Relay is Off) 10 seconds continuous, Parking Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Parking Relay is Off) 3 seconds continuous, Parking Relay drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Parking Relay is On) 10 seconds continuous, Parking Relay drive current > 6.5 A (Cancellation) (When Parking Relay is On) 3 seconds continuous, Parking Relay drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Parking Relay operation failure (Checking list) 1. CR-66 (#1) – CN-54 (#20) Checking Open/Short 2. CR-66 (#2) – Fuse box (#30) Checking Open/Short				
517 (NA)	4	(Detection) (When Traveling Cutoff Relay is Off) 10 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Traveling Cutoff Relay is Off) 3 seconds continuous, Traveling Cutoff Relay drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Traveling Cutoff Relay is On) 10 seconds continuous, Traveling Cutoff Relay drive current > 6.5 A (Cancellation) (When Traveling Cutoff Relay is On) 3 seconds continuous, Traveling Cutoff Relay drive current ≤ 6.5 A			●
	(Results / Symptoms) 1. Control Function – Traveling Cutoff Relay operation failure (Checking list) 1. CR-47 (#85) – CN-54 (#9) Checking Open/Short 2. CR-47 (#86) – Fuse box (#28) Checking Open/Short				

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">525
(NA)</td><td>4</td><td>(Detection)
(When Ram Lock Solenoid is Off)
10 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Ram Lock Solenoid is Off)
3 seconds continuous, Ram Lock Solenoid drive unit Measurement Voltage > 3.0V</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
(When Ram Lock Solenoid is On)
10 seconds continuous, Ram Lock Solenoid drive current > 6.5 A
(Cancellation)
(When Ram Lock Solenoid is On)
3 seconds continuous, Ram Lock Solenoid drive current ≤ 6.5 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Ram lock control operation failure
(Checking list)
1. CN-69 (#1) – CN-54 (#8) Checking Open/Short
2. CN-69 (#2) – Fuse box (#33) Checking Open/Short</td></tr>
<tr><td rowspan="3">527
(NA)</td><td>4</td><td>(Detection)
(When Creep Solenoid is Off)
10 seconds continuous, Creep Solenoid drive unit
Measurement Voltage ≤ 3.0V
(Cancellation)
(When Creep Solenoid is Off)
3 seconds continuous, Creep Solenoid drive unit
Measurement Voltage > 3.0V</td><td></td><td></td><td>●</td></tr>
<tr><td>6</td><td>(Detection)
(When Creep Solenoid is On)
10 seconds continuous, Creep Solenoid drive current > 6.5 A
(Cancellation)
(When Creep Solenoid is On)
3 seconds continuous, Creep Solenoid drive current ≤ 6.5 A</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Creep mode operation failure
(Checking list)
1. CN-206 (#1) – CN-54 (#7) Checking Open/Short
2. CN-206 (#2) – Fuse box (#30) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="4">530
(NA)</td><td>0</td><td>10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage > 5.2V</td><td></td><td></td><td>●</td></tr>
<tr><td>1</td><td>10 seconds continuous, 0.3V≤ Travel Forward Press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td>●</td></tr>
<tr><td>4</td><td>10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage < 0.3V</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Travel Forward Press. display failure
2. Control Function – Driving interoperability power control operation failure
(Checking list)
1. CD-73 (#B) – CN-54 (#6) Checking Open/Short
2. CD-73 (#A) – CN-54 (#3) Checking Open/Short
3. CD-73 (#C) – CN-54 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">531
(NA)</td><td>1</td><td>10 seconds continuous, 0.3V≤ Travel Reverse Press. Sensor Measurement Voltage < 0.8V</td><td></td><td></td><td>●</td></tr>
<tr><td>4</td><td>10 seconds continuous, Travel Reverse Press. Sensor Measurement Voltage < 0.3V</td><td></td><td></td><td>●</td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Travel Reverse Press. display failure
2. Control Function – Driving interoperability power control operation failure
(Checking list)
1. CD-74 (#B) – CN-54 (#23) Checking Open/Short
2. CD-74 (#A) – CN-54 (#3) Checking Open/Short
3. CD-74 (#C) – CN-54 (#13) Checking Open/Short</td></tr>
<tr><td rowspan="3">705</td><td>0</td><td>10 seconds continuous, Battery input Voltage > 35V</td><td>●</td><td></td><td></td></tr>
<tr><td>1</td><td>10 seconds continuous, Battery input Voltage < 18V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Startup impossibility
(Checking list)
1. CS-74A (#1) – CN-51 (#1) Checking Open/Short</td></tr>
<tr><td rowspan="2">707</td><td>1</td><td>(When Engine is equal or more than 400 rpm) 10 seconds continuous, Alternator Node I Measurement Voltage < 18V
(In case 12v goods, Alternator Node I Measurement Voltage < 9V)</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Battery charging circuit failure
(Checking list)
1. CS-74A (#1) – CN-51 (#2) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General　　C : Crawler Type　　W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="3">714</td><td>3</td><td>(Model Parameter) Mounting Acc. Dial
10 seconds continuous, Acc. Dial Measurement Voltage > 5.2V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>(Model Parameter) Mounting Acc. Dial
10 seconds continuous, Acc. Dial Measurement Voltage < 0.3V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Monitor – Acc. Dial Voltage display failure
2. Control Function – Engine rpm control failure
(Checking list)
1. CN-142 (#B) – CN-52 (#23) Checking Open/Short</td></tr>
<tr><td rowspan="3">722</td><td>4</td><td>(Detection)
(When Travel Alarm (Buzzer) Sound is Off)
10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage ≤ 3.0V
(Cancellation)
(When Travel Alarm (Buzzer) Sound Relay is Off)
3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive unit Measurement Voltage > 3.0V</td><td>●</td><td></td><td></td></tr>
<tr><td>6</td><td>(Detection)
(When Travel Alarm (Buzzer) Sound is On)
10 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current > 4.5 A
(Cancellation)
(When Travel Alarm (Buzzer) Sound is On)
3 seconds continuous, Travel Alarm (Buzzer) Sound Relay drive current ≤ 4.5 A</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Driving alarm operation failure
(Checking list)
1. CN-81 (#1) – CN-52 (#13) Checking Open/Short
2. CN-81 (#2) – Fuse box (#30) Checking Open/Short</td></tr>
<tr><td rowspan="2">831</td><td>2</td><td>(When mounting the A/C Controller)
60 seconds continuous, A/C Controller Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – A/C Controller operation failure
(Checking list)
1. CN-11 (#8) – CN-51 (#22) Checking Open/Short
2. CN-11 (#7) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">840</td><td>2</td><td>60 seconds continuous, Cluster Communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Cluster operation failure
(Checking list)
1. CN-56A (#7) – CN-51 (#32) Checking Open/Short
2. CN-56A (#6) – CN-51 (#22) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
841 (NA)	2	10 seconds continuous, ECM Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – ECM operation failure (Checking list) 1. CN-93 (#17) – CN-51 (#21) Checking Open/Short 2. CN-93 (#18) – CN-51 (#31) Checking Open/Short			
845 (NA)	2	(When mounting the I/O Controller 1) 60 seconds continuous, I/O Controller 1 Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – I/O Controller 1 operation failure (Checking list) 1. CN-53 (#21) – CN-51 (#23) Checking Open/Short 2. CN-53 (#31) – CN-51 (#33) Checking Open/Short			
848 (NA)	2	(When mounting the Haptic Controller) 60 seconds continuous, Haptic Controller Communication Data Error	●		
		(Results / Symptoms) 1. Control Function – Haptic Controller operation failure (Checking list) 1. CN-8 (#2) – CN-51 (#22) Checking Open/Short 2. CN-8 (#3) – CN-51 (#32) Checking Open/Short			
850	2	(When mounting the RMCU) 60 seconds continuous, RMCU communication Data Error	●		
		(Resuluts / Symptoms) 1. Control Function – RMCU operation failure (Checking list) 1. CN-125A (#3) – CN-51 (#22) Checking Open/Short 2. CN-125A (#11) – CN-51 (#32) Checking Open/Short			
861 (NA)	2	(When mounting the I/O Controller 2) 60 seconds continuous, I/O Controller 2 communication Data Error	●		
		(Results / Symptoms) 1. Control Function – I/O Controller 2 operation failure (Checking list) 1. CN-53 (#21) – CN-51 (#23) Checking Open/Short 2. CN-53 (#31) – CN-51 (#33) Checking Open/Short			

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>W</th></tr>
<tr><td rowspan="2">866</td><td>2</td><td>(When mounting the AAVM)
60 seconds continuous, AAVM communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – AAVM operation failure
(Checking list)
1. CN-401 (#15) – CN-51 (#22) Checking Open/Short
2. CN-401 (#3) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">867</td><td>2</td><td>60 seconds continuous, RDU communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – RDU operation failure
(Checking list)
1. CN-376 (#10) – CN-51 (#22) Checking Open/Short
2. CN-376 (#18) – CN-51 (#32) Checking Open/Short</td></tr>
<tr><td rowspan="2">868</td><td>2</td><td>60 seconds continuous, Switch Controller communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – Switch Controller operation failure
(Checking list)
1. CN-56A (#7) – CN-51 (#32) Checking Open/Short
2. CN-56A (#6) – CN-51 (#22) Checking Open/Short</td></tr>
<tr><td rowspan="2">869</td><td>2</td><td>(When mounting the BKCU)
60 seconds continuous, BKCU communication Data Error</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(Results / Symptoms)
1. Control Function – BKCU operation failure
(Checking list)
1. CS-2B (#A) – CN-51 (#22) Checking Open/Short
2. CS-2B (#B) – CN-51 (#32) Checking Open/Short</td></tr>
</table>

※ Some error codes are not applied to this machine.

G : General C : Crawler Type W : Wheel Type

4. ENGINE FAULT CODE

Fault code	J1939 SPN	J1939 FMI	Item	Description
111	629	12	Controller #1	Engine control module critical internal failure - bad intelligent device or component
115	612	2	System diagnostic code # 2	Engine speed/position sensor circuit lost both of two signals from the magnetic pickup sensor - data erratic, intermittent, or incorrect
122	102	3	Boost pressure	Intake manifold pressure sensor circuit – voltage above normal, or shorted to high source
123	102	4	Boost pressure	Intake manifold pressure sensor circuit – voltage below normal, or shorted to low source
124	102	16	Boost pressure	Intake manifold 1 pressure - data valid but above normal operational range - moderately severe level
131	91	3	Accelerator pedal position	Accelerator pedal or lever position sensor circuit - voltage above normal, or shorted to high source
132	91	4	Accelerator pedal position	Accelerator pedal or lever position sensor circuit - voltage below normal, or shorted to low source
133	974	3	Remote accelerator	Remote accelerator pedal or lever position sensor circuit – voltage above normal, or shorted to high source
134	974	4	Remote accelerator	Remote accelerator pedal or lever position sensor circuit – voltage below normal, or shorted to low source
135	100	3	Engine oil pressure	Oil pressure sensor circuit - voltage above normal, or shorted to high source
141	100	4	Engine oil pressure	Oil pressure sensor circuit - voltage below normal, or shorted to low source
143	100	18	Engine oil pressure	Oil pressure low – data valid but below normal operational range - moderately severe level
144	110	3	Engine coolant temperature	Coolant temperature sensor circuit – voltage above normal, or shorted to high source
145	110	4	Engine coolant temperature	Coolant temperature sensor circuit – voltage below normal, or shorted to low source
146	110	16	Engine coolant temperature	Coolant temperature high - data valid but above normal operational range - moderately severe level
147	91	1	Accelerator pedal position	Accelerator pedal or lever position sensor circuit – abnormal frequency, pulse width, or period
148	91	0	Accelerator pedal position	Accelerator pedal or lever position sensor circuit – abnormal frequency, pulse width, or period
151	110	0	Engine coolant temperature	Coolant temperature high - data valid but above normal operational range - most severe level
153	105	3	Intake manifold #1 temp	Intake manifold air temperature sensor circuit - voltage above normal, or shorted to high source
154	105	4	Intake manifold #1 temp	Intake manifold air temperature sensor circuit - voltage below normal, or shorted to low source
155	105	0	Intake manifold #1 temp	Intake manifold air temperature high – data valid but above normal operational range - most severe level

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
187	3510	4	5 Volts dc supply	Sensor supply voltage #2 circuit – voltage below normal, or shorted to low source
193	520199	3	Cruise control	Cruise control (resistive) signal circuit - voltage above normal, or shorted to high source
194	520199	4	Cruise control	Cruise control (resistive) signal circuit - voltage below normal, or shorted to low source
195	111	3	Coolant level	Coolant level sensor circuit - voltage above normal, or shorted to high source
196	111	4	Coolant level	Coolant level sensor circuit - voltage below normal, or shorted to low source
197	111	18	Coolant level	Coolant level - data valid but below normal operational range - moderately severe level
199	1661	4	Engine automatic start lamp	Engine automatic start lamp driver circuit - voltage above normal, or shorted to high source
211	1484	31	J1939 error	Additional auxiliary diagnostic codes logged - condition exists
212	175	3	Oil temperature	Engine oil temperature sensor 1 circuit - voltage above normal, or shorted to high source
213	175	4	Oil temperature	Engine oil temperature sensor 1 circuit - voltage below normal, or shorted to low source
214	175	0	Oil temperature	Engine oil temperature - data valid but above normal operational range - most severe level
221	108	3	Barometric pressure	Barometric pressure sensor circuit – voltage above normal, or shorted to high source
222	108	4	Barometric pressure	Barometric pressure sensor circuit – voltage below normal, or shorted to low source
227	3510	3	5 Volts dc supply	Sensor supply voltage #2 circuit – voltage above normal, or shorted to high source
231	109	3	Coolant pressure	Coolant pressure sensor circuit - voltage above normal, or shorted to high source
232	109	4	Coolant pressure	Coolant pressure sensor circuit - voltage below normal, or shorted to low source
233	109	18	Coolant pressure	Coolant pressure - data valid but below normal operational range - moderately severe level
234	190	0	Engine speed	Engine speed high - data valid but above normal operational range - most severe level
235	111	1	Coolant level	Coolant level low - data valid but below normal operational range - most severe level
237	644	2	External speed input	External speed input (multiple unit synchronization) - data erratic, intermittent, or incorrect
238	3511	4	System diagnostic code # 1	Sensor supply voltage #3 circuit – voltage below normal, or shorted to low source
239	3511	3	System diagnostic code #2	Sensor supply voltage #3 circuit - voltage above normal, or shorted to high source
241	84	2	Wheel-based vehicle speed	Vehicle speed sensor circuit - data erratic, intermittent, or incorrect
242	84	10	Wheel-based vehicle speed	Vehicle speed sensor circuit tampering has been detected – abnormal rate of change

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
244	623	4	Red stop lamp	Red stop lamp driver circuit - voltage below normal, or shorted to low source
245	647	4	Fan clutch output device driver	Fan control circuit - voltage below normal, or shorted to low source
249	171	3	Ambient air temperature	Ambient air temperature sensor circuit - voltage above normal, or shorted to high source
256	171	4	Ambient air temperature	Ambient air temperature sensor circuit - voltage below normal, or shorted to low source
261	174	16	Fuel temperature	Engine fuel temperature - data valid but above normal operational range - moderately severe level
263	174	3	Fuel temperature	Engine fuel temperature sensor 1 circuit - voltage above normal, or shorted to high source
265	174	4	Fuel temperature	Engine fuel temperature sensor 1 circuit - voltage below normal, or shorted to low source
268	94	2	Fuel delivery pressure	Fuel pressure sensor circuit - data erratic, intermittent, or incorrect
271	1347	4	Fuel pump pressurizing assembly #1	High fuel pressure solenoid valve circuit – voltage below normal, or shorted to low source
272	1347	3	Fuel pump pressurizing assembly #1	High fuel pressure solenoid valve circuit – voltage above normal, or shorted to high source
281	1347	7	Fuel pump pressurizing assembly #1	High fuel pressure solenoid valve #1 – mechanical system not responding properly or out of adjustment
285	639	9	Sae J1939 datalink	SAE J1939 multiplexing pgn timeout error - abnormal update rate
286	639	13	Sae J1939 datalink	SAE J1939 multiplexing configuration error – out of calibration
287	91	19	Accelerator pedal position	SAE J1939 multiplexing accelerator pedal or lever sensor system error - received network data in error
288	974	19	Remote accelerator	SAE J1939 multiplexing remote accelerator pedal or lever data error - received network data in error
292	441	14	Auxiliary temperature 1	Auxiliary temperature sensor input 1 - special instructions
293	441	3	OEM Temperature	Auxiliary temperature sensor input # 1 circuit - voltage above normal, or shorted to high source
294	441	4	OEM Temperature	Auxiliary temperature sensor input # 1 circuit - voltage below normal, or shorted to low source
295	108	2	Barometric pressure	Barometric pressure sensor circuit - data erratic, intermittent, or incorrect
296	1388	14	Auxiliary pressure	Auxiliary pressure sensor input 1 - special instructions
297	1388	3	Auxiliary pressure	Auxiliary pressure sensor input # 2 circuit - voltage above normal, or shorted to high source
298	1388	4	Auxiliary pressure	Auxiliary pressure sensor input # 2 circuit - voltage below normal, or shorted to low source
319	251	2	Real time clock power	Real time clock power interrupt - data erratic, intermittent, or incorrect

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
322	651	5	Injector cylinder #01	Injector solenoid cylinder #1 circuit – current below normal, or open circuit
323	655	5	Injector cylinder #05	Injector solenoid cylinder #5 circuit – current below normal, or open circuit
324	653	5	Injector cylinder #03	Injector solenoid cylinder #3 circuit – current below normal, or open circuit
325	656	5	Injector cylinder #06	Injector solenoid cylinder #6 circuit – current below normal, or open circuit
331	652	5	Injector cylinder #02	Injector solenoid cylinder #2 circuit – current below normal, or open circuit
332	654	5	Injector cylinder #04	Injector solenoid cylinder #4 circuit – current below normal, or open circuit
334	110	2	Engine coolant temperature	Coolant temperature sensor circuit – data erratic, intermittent, or incorrect
338	1267	3	Vehicle accessories relay driver	Idle shutdown vehicle accessories relay driver circuit - voltage above normal, or shorted to high source
339	1267	4	Vehicle accessories relay driver	Idle shutdown vehicle accessories relay driver circuit - voltage below normal, or shorted to low source
342	630	13	Calibration memory	Electronic calibration code incompatibility - out of calibration
343	629	12	Controller #1	Engine control module warning internal hardware failure - bad intelligent device or component
349	191	16	Transmission output shaft speed	Transmission output shaft speed - data valid but above normal operational range - moderately severe level
351	3597	12	Controller #1	Injector power supply - bad intelligent device or component
352	3509	4	5 volts DC supply	Sensor supply voltage #1 circuit – voltage below normal, or shorted to low source
386	3509	3	5 volts DC supply	Sensor supply voltage #1 circuit – voltage above normal, or shorted to high source
415	100	1	Engine oil pressure	Oil pressure low – data valid but below normal operational range - most severe level
418	97	15	Water in fuel indicator	Water in fuel indicator high - data valid but above normal operational range – least severe level
422	111	2	Coolant level	Coolant level - data erratic, intermittent, or incorrect
425	175	2	Oil temperature	Engine oil temperature - data erratic, intermittent, or incorrect
428	97	3	Water in fuel indicator	Water in fuel sensor circuit - voltage above normal, or shorted to high source
429	97	4	Water in fuel indicator	Water in fuel sensor circuit - voltage below normal, or shorted to low source
431	558	2	Accelerator pedal low idle switch	Accelerator pedal or lever idle validation circuit - data erratic, intermittent, or incorrect
432	558	13	Accelerator pedal low idle switch	Accelerator pedal or lever idle validation circuit - out of calibration

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
435	100	2	Engine oil pressure	Oil pressure sensor circuit - data erratic, intermittent, or incorrect
441	168	18	Electrical potential (voltage)	Battery #1 voltage low - data valid but below normal operational range – moderately severe level
442	168	16	Electrical potential (voltage)	Battery #1 voltage high - data valid but above normal operational range – moderately severe level
449	157	0	Injector metering rail 1 pressure	Fuel pressure high - data valid but above normal operational range – moderately severe level
451	157	3	Injector metering rail 1 pressure	Injector metering rail #1 pressure sensor circuit - voltage above normal, or shorted to high source
452	157	4	Injector metering rail 1 pressure	Injector metering rail #1 pressure sensor circuit - voltage below normal, or shorted to low source
488	105	16	Intake manifold	Intake manifold 1 temperature - data valid but above normal operational range - moderately severe level
489	191	18	Transmission output shaft speed	Transmission output shaft speed - data valid but below normal operational range - moderately severe level
497	1377	2	Switch circuit	Multiple unit synchronization switch circuit - data erratic, intermittent, or incorrect
523	611	2	System diagnostic code # 1	OEM Intermediate (PTO) speed switch validation - data erratic, intermittent, or incorrect
527	702	3	Circuit - voltage	Auxiliary input/output 2 circuit - voltage above normal, or shorted to high source
528	93	2	Switch - data	Auxiliary alternate torque validation switch - data erratic, intermittent, or incorrect
529	703	3	Circuit - voltage	Auxiliary input/output 3 circuit - voltage above normal, or shorted to high source
546	94	3	Fuel delivery pressure	Fuel delivery pressure sensor circuit - voltage above normal, or shorted to high source
547	94	4	Fuel delivery pressure	Fuel delivery pressure sensor circuit - voltage below normal, or shorted to low source
551	558	4	Accelerator pedal low idle switch	Accelerator pedal or lever idle validation circuit - voltage below normal, or shorted to low source
553	157	16	Injector metering rail 1 pressure	Injector metering rail #1 pressure high – data valid but above normal operational range - moderately severe level
554	157	2	Injector metering rail 1 pressure	Fuel pressure sensor error - data erratic, intermittent, or incorrect
559	157	18	Injector metering rail 1 pressure	Injector metering rail #1 pressure low – data valid but below normal operational range - moderately severe level
584	677	3	Starter solenoid lockout relay driver circuit	Starter relay circuit - voltage above normal, or shorted to high source
585	677	4	Starter solenoid lockout relay driver circuit	Starter relay circuit - voltage below normal, or shorted to low source
595	103	16	Turbocharger 1 speed	Turbocharger #1 speed high - data valid but above normal operational range – moderately severe level

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
596	167	16	Alternate potential (voltage)	Electrical charging system voltage high – data valid but above normal operational range - moderately severe level
597	167	18	Alternate potential (voltage)	Electrical charging system voltage low – data valid but below normal operational range - moderately severe level
598	167	1	Alternate potential (voltage)	Electrical charging system voltage low – data valid but below normal operational range - most severe level
599	640	14	Engine external protection input	Auxiliary commanded dual output shutdown - special instructions
649	1378	31	Engine oil change interval	Change lubricating oil and filter – condition exists
687	103	18	Turbocharger 1 speed	Turbocharger #1 speed low - data valid but below normal operational range – moderately severe level
689	190	2	Engine speed	Primary engine speed sensor error – data erratic, intermittent, or incorrect
691	1172	3	Turbocharger #1compressor inlet temperature	Turbocharger #1 compressor inlet temperature sensor circuit – voltage above normal, or shorted to high source
692	1172	4	Turbocharger #1compressor inlet temperature	Turbocharger #1 compressor inlet temperature sensor circuit – voltage below normal, or shorted to low source
697	1136	3	Sensor circuit - voltage	ECM internal temperature sensor circuit - voltage above normal, or shorted to high source
698	1136	4	Sensor circuit - voltage	Ecm internal temperature sensor circuit - voltage below normal, or shorted to low source
719	22	3	Crankcase pressure	Extended crankcase blow-by pressure circuit - voltage above normal, or shorted to high source
729	22	4	Crankcase pressure	Extended crankcase blow-by pressure circuit - voltage below normal, or shorted to low source
731	723	7	Engine speed sensor #2	Engine speed/position #2 mechanical misalignment between camshaft and crankshaft sensors - mechanical system not responding properly or out of adjustment
757	2802	31	Electronic control module	Electronic control module data lost - condition exists
778	723	2	Engine speed sensor #2	Engine speed sensor (camshaft) error – data erratic, intermittent, or incorrect
779	703	11	Auxiliary equipment sensor input	Warning auxiliary equipment sensor input # 3 (OEM switch) - root cause not known
951	166	2	Cylinder power	Cylinder power imbalance between cylinders - data erratic, intermittent, or incorrect
1117	3597	2	Power supply	Power lost with ignition on - data erratic, intermittent, or incorrect
1139	651	7	Injector cylinder # 01	Injector cylinder #1 - mechanical system not responding properly or out of adjustment
1141	652	7	Injector cylinder # 02	Injector cylinder #2 - mechanical system not responding properly or out of adjustment
1142	653	7	Injector cylinder # 03	Injector cylinder #3 - mechanical system not responding properly or out of adjustment

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
1143	654	7	Injector cylinder # 04	Injector cylinder #4 - mechanical system not responding properly or out of adjustment
1144	655	7	Injector cylinder # 05	Injector cylinder #5 - mechanical system not responding properly or out of adjustment
1145	656	7	Injector cylinder # 06	Injector cylinder #6 - mechanical system not responding properly or out of adjustment
1239	2623	3	Accelerator pedal position	Accelerator pedal or lever position sensor 2 circuit - voltage above normal, or shorted to high source
1241	2623	4	Accelerator pedal position	Accelerator pedal or lever position sensor 2 circuit - voltage below normal, or shorted to low source
1242	91	2	Accelerator pedal position	Accelerator pedal or lever position sensor 1 and 2 - data erratic, intermittent, or incorrect
1256	1563	2	Control module identification input state	Control module identification input state error - data erratic, intermittent, or incorrect
1257	1563	2	Control module identification input state	Control module identification input state error - data erratic, intermittent, or incorrect
1852	97	16	Water in fuel indicator	Water in fuel indicator - data valid but above normal operational range - moderately severe level
1911	157	0	Injector metering rail	Injector metering rail 1 pressure - data valid but above normal operational range - most severe level
2111	52	3	Coolant temperature	Coolant temperature 2 sensor circuit - voltage above normal, or shorted to high source
2112	52	4	Coolant temperature	Coolant temperature 2 sensor circuit - voltage below normal, or shorted to low source
2113	52	16	Coolant temperature	Coolant temperature 2 - data valid but above normal operational range - moderately severe level
2114	52	0	Coolant temperature	Coolant temperature 2 - data valid but above normal operational range - most severe level
2115	2981	3	Coolant pressure	Coolant pressure 2 circuit - voltage above normal, or shorted to high source
2116	2981	4	Coolant pressure	Coolant pressure 2 circuit - voltage below normal, or shorted to low source
2117	2981	18	Coolant pressure	Coolant pressure 2 - data valid but below normal operational range - moderately severe level
2182	1072	3	Engine brake output # 1	Engine brake actuator driver 1 circuit - voltage above normal, or shorted to high source
2183	1072	4	Engine brake output # 1	Engine brake actuator driver 1 circuit - voltage below normal, or shorted to low source
2185	3512	3	System diagnostic code # 1	Sensor supply voltage #4 circuit – voltage above normal, or shorted to high source
2186	3512	4	System diagnostic code # 1	Sensor supply voltage #4 circuit – voltage below normal, or shorted to low source
2195	703	14	Auxiliary equipment sensor	Auxiliary equipment sensor input 3 engine protection critical - special instructions
2215	94	18	Fuel delivery pressure	Fuel pump delivery pressure - data valid but below normal operational range - moderately severe level
2216	94	16	Fuel delivery pressure	Fuel pump delivery pressure - data valid but above normal operational range – moderately severe level

※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
2217	630	31	Calibration memory	ECM program memory (RAM) corruption - condition exists
2249	157	1	Injector metering rail 1 pressure	Injector metering rail 1 pressure - data valid but below normal operational range - most severe level
2261	94	15	Fuel delivery pressure	Fuel pump delivery pressure - data valid but above normal operational range - least severe level
2262	94	17	Fuel delivery pressure	Fuel pump delivery pressure - data valid but below normal operational range - least severe level
2263	1800	16	Battery temperature	Battery temperature - data valid but above normal operational range - moderately severe level
2264	1800	18	Battery temperature	Battery temperature - data valid but below normal operational range - moderately severe level
2265	1075	3	Electric lift pump for engine fuel	Fuel priming pump control signal circuit – voltage above normal, or shorted to high source
2266	1075	4	Electric lift pump for engine fuel	Fuel priming pump control signal circuit – voltage below normal, or shorted to low source
2292	611	16	Fuel inlet meter device	Fuel inlet meter device - data valid but above normal operational range - moderately severe level
2293	611	18	Fuel inlet meter device	Fuel inlet meter device flow demand lower than expected - data valid but below normal operational range - moderately severe level
2311	633	31	Fuel control valve #1	Fueling actuator #1 circuit error – condition exists
2321	190	2	Engine speed	Engine speed / position sensor #1 - data erratic, intermittent, or incorrect
2322	723	2	Engine speed sensor #2	Engine speed / position sensor #2 - data erratic, intermittent, or incorrect
2345	103	10	Turbocharger 1 speed	Turbocharger speed invalid rate of change detected - abnormal rate of change
2346	2789	15	System diagnostic code #1	Turbocharger turbine inlet temperature (calculated) - data valid but above normal operational range – least severe level
2347	2629	15	System diagnostic code #1	Turbocharger compressor outlet temperature (calculated) - data valid but above normal operational range – least severe level
2363	1073	4	Engine compression brake output # 2	Engine brake actuator circuit #2 – voltage below normal, or shorted to low source
2365	1112	4	Engine brake output # 3	Engine brake actuator driver output 3 circuit - voltage below normal, or shorted to low source
2367	1073	3	Engine compression brake output # 2	Engine brake actuator circuit #2 – voltage above normal, or shorted to high source
2368	1112	3	Engine brake output # 3	Engine brake actuator driver 3 circuit - voltage above normal, or shorted to high source
2372	95	16	Engine fuel filter differential pressure	Fuel filter differential pressure - data valid but above normal operational range - moderately severe level
2373	1209	3	Exhaust gas pressure	Exhaust gas pressure sensor circuit - voltage above normal, or shorted to high source
2374	1209	4	Exhaust gas pressure	Exhaust gas pressure sensor circuit - voltage below normal, or shorted to low source

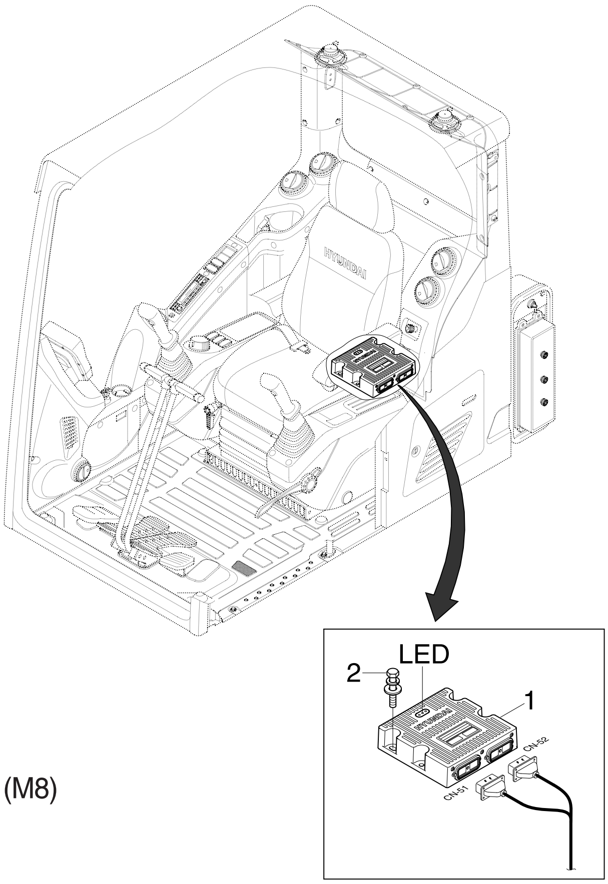
※ Some fault codes are not applied to this machine.

Fault code	J1939 SPN	J1939 FMI	Item	Description
2375	412	3	Exhaust gas recirculation temperature	Exhaust gas recirculation temperature sensor circuit - voltage above normal, or shorted to high source
2376	412	4	Exhaust gas recirculation temperature	Exhaust gas recirculation temperature sensor circuit - voltage below normal, or shorted to low source
2377	647	3	Fan clutch output device driver	Fan control circuit - voltage above normal, or shorted to high source
2425	730	4	Intake air heater # 2	Intake air heater 2 circuit - voltage below normal, or shorted to low source
2426	730	3	Intake air heater # 2	Intake air heater 2 circuit - voltage above normal, or shorted to high source
2448	111	17	Coolant level	Coolant level - data valid but below normal operating range - least severe level
2555	729	3	Inlet air heater driver #1	Intake air heater #1 circuit - voltage above normal, or shorted to high source
2556	729	4	Inlet air heater driver #1	Intake air heater #1 circuit - voltage below normal, or shorted to low source
2557	697	3	Auxiliary PWM driver #1	Auxiliary PWM driver #1 - voltage above normal, or shorted to high source
2558	697	4	Auxiliary PWM driver #1	Auxiliary PWM driver #1 - voltage below normal, or shorted to low source
2963	110	15	Engine coolant temperature	Engine coolant temperature high - data valid but above normal operational range - least severe level
2973	102	2	Boost pressure	Intake manifold pressure sensor circuit - data erratic, intermittent, or incorrect

※ Some fault codes are not applied to this machine.

GROUP 13 ENGINE CONTROL SYSTEM

1. MCU (Machine Control Unit)



1 MCU
2 Mounting bolt (M8)

220S5MS13

2. MCU ASSEMBLY

1) To match the pump absorption torque with the engine torque, MCU varies EPPR valve output pressure, which control pump discharge amount whenever feedbacked engine speed drops under the reference rpm of each mode set.

2) Three LED lamps on the MCU display as below.

LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on MCU	· Change the MCU
G and Y are turned ON	Trouble on serial communication line	· Check if serial communication lines between MCU and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	· Check if the input power wire (24 V, GND) of MCU is disconnected · Check the fuse

G : green, R : red, Y : yellow

GROUP 14 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

EPPR (Electro Proportional Pressure Reducing) valve consists of electro magnet and spool valve installed at main pump.

(1) Electro magnet valve

Receive electric current from MCU and move the spool proportionally according to the specific amount of electric current value.

(2) Spool valve

Is the two way direction control valve for pilot pressure to reduce main pump flow.
When the electro magnet valve is activated, pilot pressure enters into flow regulator of main pump.

(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm^2	psi		
Standard (Stage : 1.0)	P	10	142	340	1700
	S	11	156	350	1600
	E	15	213	400	1500
Option (Stage : 2.0)	P	7	100	300	1700
	S	8	114	310	1600
	E	12	171	360	1600

2) HOW TO SWITCH THE STAGE (1.0 ↔ 2.0) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the stage (1.0↔2.0).

- Management
  · Service menu

220S3CD149A

→

Enter the password 220S3CD150B

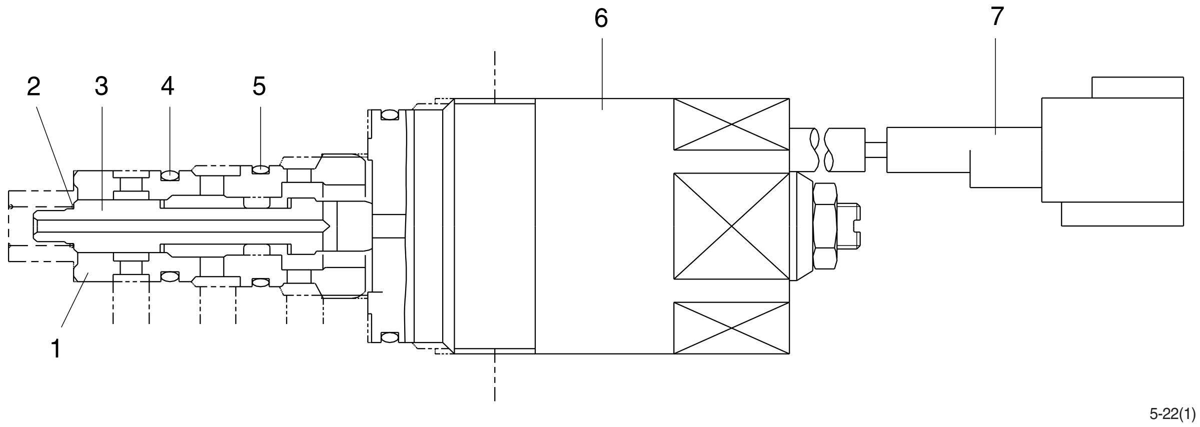
→

220S3CD251A

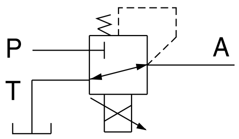
· Power shift (standard/option) : Power shift pressure can be set by option menu.

3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



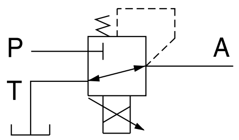
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

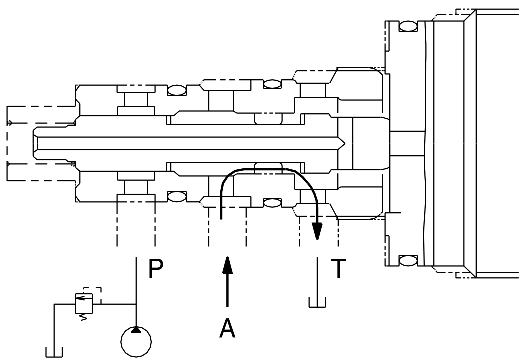


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

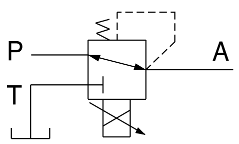
Pressure line is blocked and A oil returns to tank.

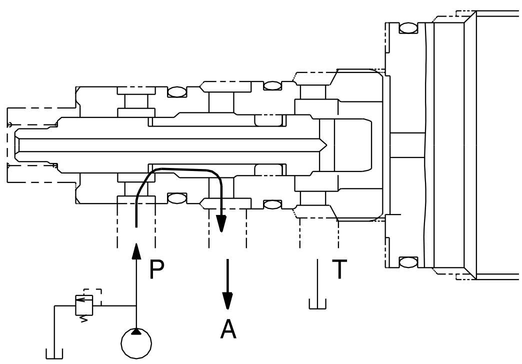




(3) Operating

Secondary pressure enters into A.





4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-75 from EPPR valve.

② Insert the adapter to CN-75 and install multimeter as figure.

③ Start engine.

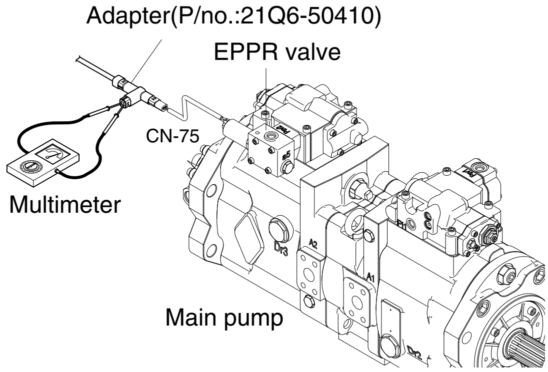
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1600±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA



400SA5MS21

(2) Check pressure at EPPR valve

① Start engine.

② Set S-mode and cancel auto decel mode.

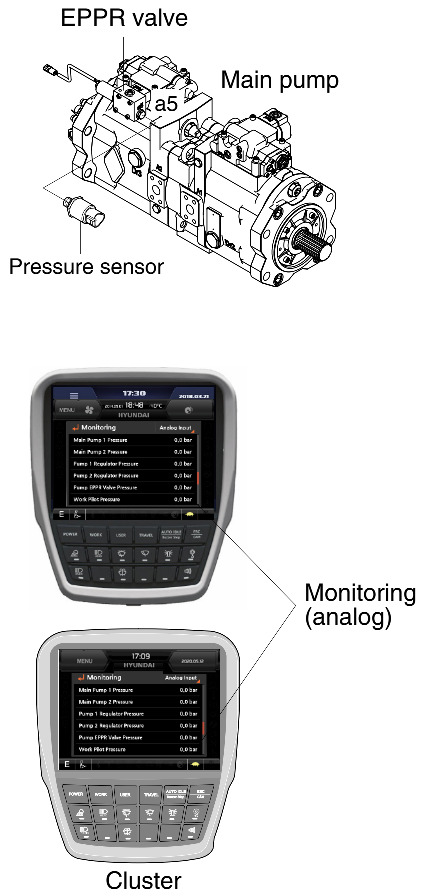
③ Position the accel dial at 10.

④ Slowly operate control lever of bucket functions at full stroke over relief and measure the EPPR valve pressure by the the monitoring menu of the cluster.

⑤ If pressure is not correct, adjust it.

⑥ After adjust, test the machine.

Spec : 2~25 kgf/cm^2 (30~350 psi)



400SA5MS22

2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

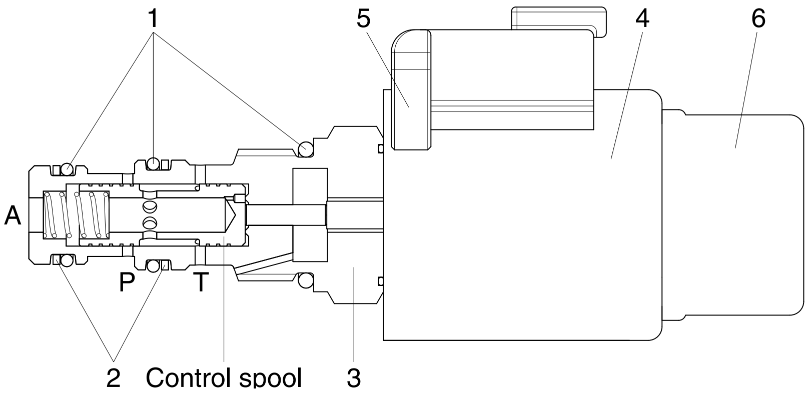
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

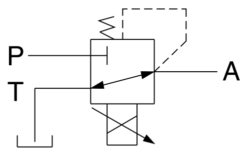
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

3) OPERATING PRINCIPLE

(1) Structure



21095MS14



P : Pilot supply line
T : Return to tank
A : Secondary pressure to flow MCV

1	O-ring	3	Valve body	5	Connector
2	Support ring	4	Coil	6	Cover cap

(2) Operation

In de-energized mode the inlet port (P) is closed and the outlet port (A) is connected to tank port (T).

In energized mode the solenoid armature presses onto the control spool with a force corresponding to the amount of current. This will set a reduced pressure at port A. The setting is proportional to the amount of current applied.

(3) Maximum pressure relief

If a pressure from outside is applied on port A the valve may directly switch to tank port (T) and protect the system before overload.

2) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-133 from EPPR valve.

② Insert the adapter to CN-133 and install multimeter as figure.

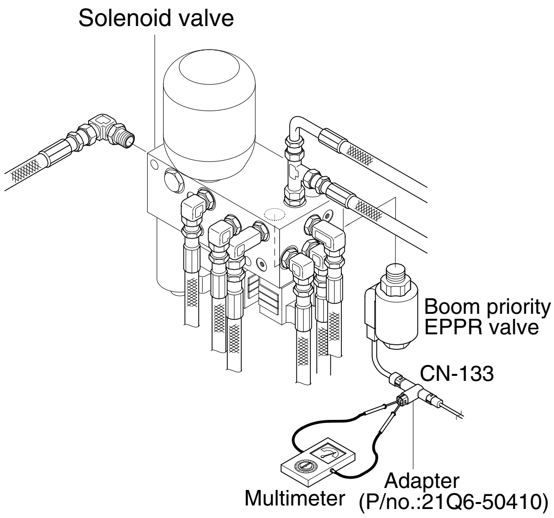
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ If rpm display approx 1600 rpm disconnect one wire harness from EPPR valve.

⑥ Check electric current in case of combined boom up and swing operation.

Spec : 400~600 mA
(combined boom up and swing operation)



400SA5MS15

(2) Check pressure at EPPR valve

① Remove hose from A5 port and connect pressure gauge as figure.
- Gauge capacity : 0 to 50 kgf/cm^2 (0 to 725 psi)

② Start engine.

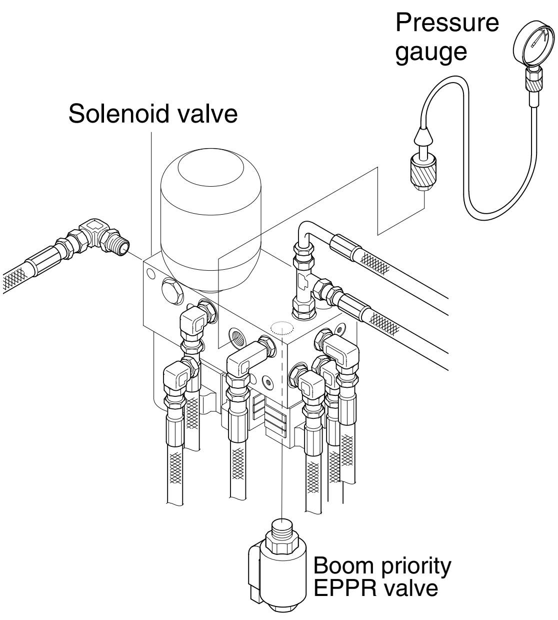
③ Set S-mode and cancel auto decel mode.

④ If rpm display approx 1600 rpm check pressure (In case of combined boom up and swing operation).

⑤ If pressure is not correct, adjust it.

⑥ After adjust, test the machine.

Spec : 12~37 kgf/cm^2 (170~530 psi)
(combined boom up and swing operation)



400SA5MS16

GROUP 15 MONITORING SYSTEM

1. OUTLINE

Monitoring system consists of the monitor part and switch part.

The monitor part gives warnings when any abnormality occurs in the machine and informs the condition of the machine.

Various select switches are built into the monitor panel, which act as the control portion of the machine control system.

2. CLUSTER

1) MONITOR PANEL

Normal type

300SA3CD50A

Premium type

300SA3CD51A

※ The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem. The warning lamp blinks until the problem is cleared. Refer to page 5-62 for details.

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

a. Buzzer sounding for 4 seconds with HYUNDAI logo on cluster.

※ If the ESL mode is set to the enable, enter the password to start engine.

② After initialization of cluster, the operating screen is displayed on the LCD. Also, self diagnostic function is carried out.

a. Engine rpm display : 0 rpm

b. Engine coolant temperature gauge : White range

c. Hydraulic oil temperature gauge : White range

d. Fuel level gauge : White range

③ Indicating lamp state

a. Power mode pilot lamp : E mode or U mode

b. Work mode pilot lamp : General operation mode (bucket)

c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display indicates at present rpm

b. Gauge and warning lamp : Indicate at present condition.

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work

d. Power mode selection : E mode or U mode

e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON

b. After engine started, engine speed increases to 1000 rpm.

※ Others same as above.

③ When abnormal condition

a. The warning lamp lights up and the buzzer sounds.

b. If BUZZER STOP switch is pressed, buzzer sound is canceled but the lamp warning lights up until normal condition.

※ The pop-up warning lamp moves to the original position and blink when the buzzer stop switch is pushed. Also the buzzer stops.

3. CLUSTER CONNECTOR

1) NORMAL TYPE

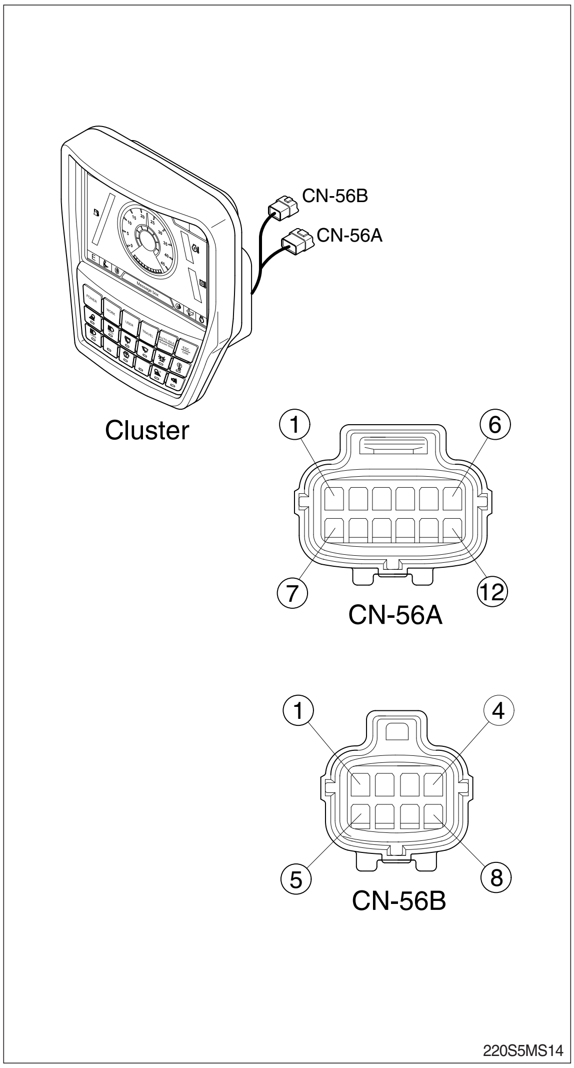
(1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32Vdc
2	Power IG {24V}	20~32Vdc
3	GND	-
4	N.C	-
5	N.C	-
6	CAN 2 (H)	0~5Vdc
7	CAN 2 (L)	20~32Vdc
8	N.C	-
9	N.C	-
10	N.C	-
11	N.C	-
12	N.C	-

(2) CN-56B

No.	Name	Signal
1	CAM + 6.5V	6.3~6.7Vdc
2	CAM GND	-
3	CAM DIFF (H)	0~5Vdc
4	CAM DIFF (L)	0~5Vdc
5	CAM 1	NTSC signal
6	CAM 2	NTSC signal
7	CAM 3	NTSC signal
8	CAM shield	0~5Vdc

NTSC : National Television System Committee



2) PREMIUM TYPE

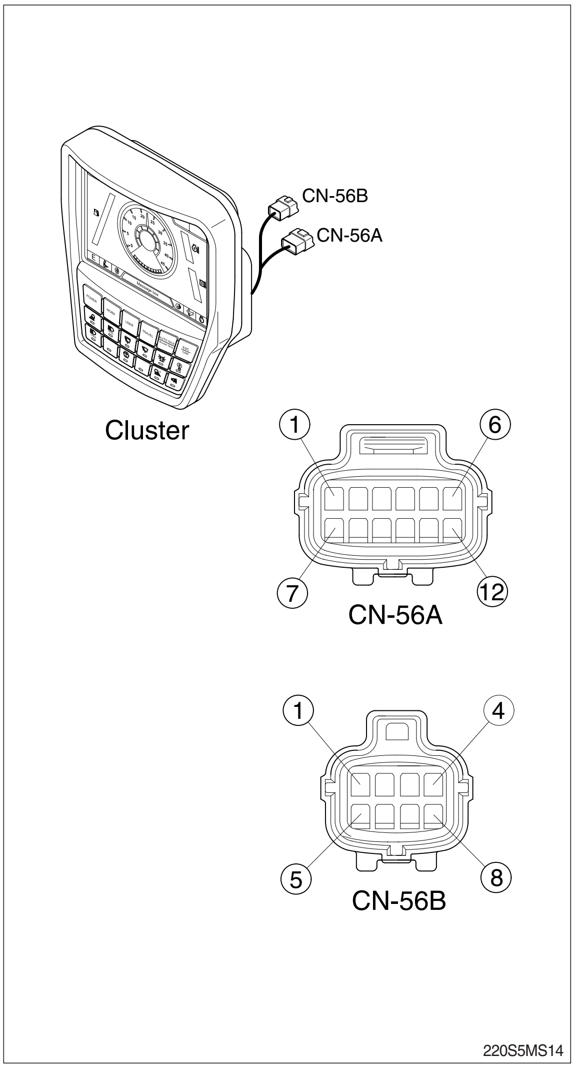
(1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32Vdc
2	Power IG {24V}	20~32Vdc
3	GND	-
4	N.C	-
5	N.C	-
6	CAN 2 (H)	0~5Vdc
7	CAN 2 (L)	20~32Vdc
8	N.C	-
9	N.C	-
10	N.C	-
11	N.C	-
12	N.C	-

(2) CN-56B

No.	Name	Signal
1	CAM + 6.5V	6.3~6.7Vdc
2	CAM GND	-
3	CAM DIFF (H)	0~5V
4	CAM DIFF (L)	0~5V
5	CAM 1	NTSC signal
6	CAM 2	NTSC signal
7	CAM 3	NTSC signal
8	CAM shield	0~5Vdc

NTSC : National Television System Committee



3) GAUGE

(1) Operation screen

When you first turn starting switch ON, the operation screen will appear.

Normal type

220S3CD551A

Premium type

Default

Option

220S3CD151A

1 RPM / Speed gauge
2 Engine coolant temperature gauge
3 Hydraulic oil temperature gauge
4 Fuel level gauge
5 Tripmeter display
6 Eco guage
7 Accel dial gauge

※ Operation screen type can be set by the screen type menu of the display (premium type). Refer to page 5-86 for details.

(2) RPM / Speed gauge

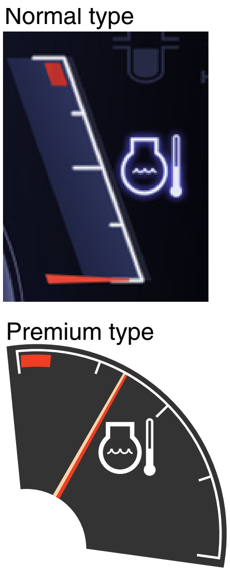
Normal type

Premium type

220S3CD549

① This displays the engine speed.

(3) Engine coolant temperature gauge



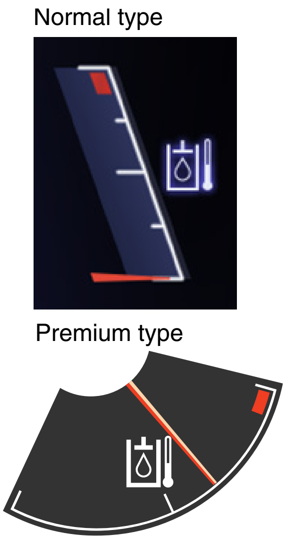
220S3CD553

① This gauge indicates the temperature of coolant.
  · White range : 40-113˚C (104-212˚F)
  · Red range : Above 113˚C (212˚F)

② If the indicator is in the red range or lamp pops up and the buzzer sounds, turn OFF the engine and check the engine cooling system.

※ If the gauge indicates the red range or lamp blinks 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) Hydraulic oil temperature gauge



220S3CD554

① This gauge indicates the temperature of hydraulic oil.
  · White range : 40-100˚C (104-235˚F)
  · Red range : Above 100˚C (235˚F)

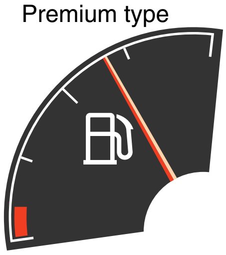
② If the indicator is in the red range or lamp pops up and the buzzer sounds reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.

※ If the gauge indicates the red range or lamp blinks 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 electricity or sensor.

(5) Fuel level gauge

Normal type

Premium type



220S3CD555

① This gauge indicates the amount of fuel in the fuel tank.
② Fill the fuel when in the red range, or lamp pops up and the buzzer sounds.
※ If the gauge indicates the red range or lamp blinks in red even though the machine is on the normal condition range, check the electric device as this can be caused by poor connection of electricity or sensor.

(6) Tripmeter display

290F3CD56

① This displays the engine the tripmeter.
※ Refer to page 5-87 for details.

(7) Eco gauge

290F3CD58

① This gauge indicates the fuel consumption rate and machine load status so that the operators can operate the machine efficient in regards to fuel consumption.
② Fuel consumption rate or machine load is higher if the number of segments are increased.
③ The color of Eco gauge indicates operation status.
 · White : Idle operation
 · Green : Economy operation
 · Yellow : Non-economy operation at a medium level.
 · Red : Non-economy operation at a high level.

(8) Accel dial gauge

290F3CD59

① This gauge indicates the level of accel dial.

4) WARNING LAMPS

Normal type

400SA3CD503

Premium type

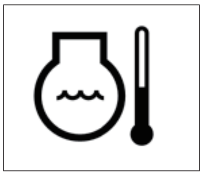
400SA3CD03

※ Warning lamps and buzzer

Warnings	When error happened	Lamps and buzzer
All warning lamps except below	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position, blinks and the buzzer stops when; - the buzzer stop switch [AUTO IDLE Buzzer Stop] is pushed - the lamp of the LCD is touched
COMM ERROR	Warning lamp pops up on the center of the LCD and the buzzer sounds	· Cluster displays this pop-up when it has communication error with MCU. · If communication with MCU become normal state, it will disappear automatically.
	Warning lamp pops up on the center of the LCD and the buzzer sounds	※ **Refer to page 5-63 for details.**

※ Refer to page 5-69 for the buzzer stop switch [AUTO IDLE Buzzer Stop] .

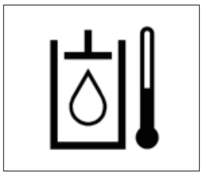
(1) Engine coolant temperature warning lamp



290F3CD61

① Engine coolant temperature warning is indicated in 2 steps.
  – 100˚C over : The lamp pops up and the buzzer sounds.
  – 107˚C over : The lamp pops up and the buzzer sounds.
② The pop-up , lamps move to the original position and blinks when the buzzer stop switch is pushed. The buzzer will stop and , lamps will blink.
③ Check the cooling system when the lamps keep blink.

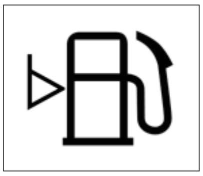
(2) Hydraulic oil temperature warning lamp



290F3CD62

① Hydraulic oil temperature warning is indicated in 2 steps.
  – 100˚C over : The lamp pops up and the buzzer sounds.
  – 105˚C over : The lamp pops up and the buzzer sounds.
② The pop-up , lamps move to the original position and blinks when the buzzer stop switch is pushed. The buzzer will stop and , lamps will blink.
③ Check the hydraulic oil level and hydraulic cooling system.

(3) Fuel level warning lamp



290F3CD63

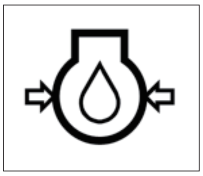
① This warning lamp pops up and the buzzer sounds when the fuel level is below 31 ℓ (8.2 U.S. gal).
② Fill the fuel immediately after the lamp blinks.

(4) Emergency warning lamp

290F3CD64

① This warning lamp pops up and the buzzer sounds when each of the below warnings occurs.
  – Engine coolant overheating (over 107˚C)
  – Hydraulic oil overheating (over 105˚C)
  – MCU input voltage abnormal
  – Cluster communication data error
  – Engine ECM communication data error
※ **The pop-up warning lamp moves to the original position and blinks when the buzzer stop switch is pushed. The buzzer will stop.**
② When this warning lamp blinks, machine must be checked and serviced immediately.

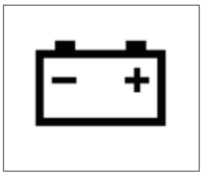
(5) Engine oil pressure warning lamp



290F3CD65

① This warning lamp pops up and the buzzer sounds when the engine oil pressure is low.
② If the lamp blinks, shut OFF the engine immediately. Check oil level.

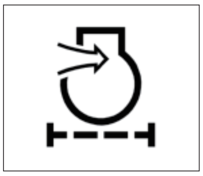
(6) Battery charging warning lamp



290F3CD67

① This warning lamp pops up and the buzzer sounds when the battery charging voltage is low.
② Check the battery charging circuit when this lamp blinks.

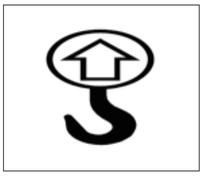
(7) Air cleaner warning lamp



290F3CD68

① This warning lamp pops up and the buzzer sounds when the air cleaner is clogged.
② Check, clean or replace filter.

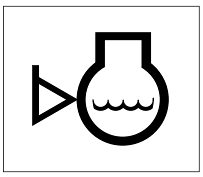
(8) Overload warning lamp (opt)



290F3CD69

① When the machine is overloaded, the overload warning lamp pops up and the buzzer sounds when the overload switch is ON. (if equipped)
② Reduce the machine load.

(9) Coolant level warning lamp



760F3CD58

① This warning lamp indicates lack of coolant.
② Check and refill coolant.

5) PILOT LAMPS

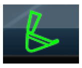
Normal type

400SA3CD574

Premium type

400SA3CD74

(1) Mode pilot lamps

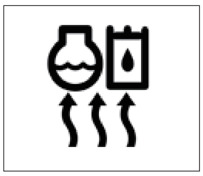
No	Mode	Pilot lamp	Selected mode
1	Power mode	P	Heavy duty power work mode
		S	Standard power mode
		E	Economy power mode
2	User mode	U	User preferable power mode
3	Work tool mode		General operation - IPC speed mode
			General operation - IPC balance mode
			General operation - IPC efficiency mode
			Breaker operation mode
			Crusher operation mode
4	Travel mode		Low speed traveling
			High speed traveling
5	Auto idle mode		Auto idle

(2) Power max pilot lamp (null)

290F3CD78

① The lamp will be ON when pushing power max switch on the LH RCV lever.
② The power max function operates for a max period of 8 seconds.
※ **Refer to the operator's manual page 3-36 for power max function.**

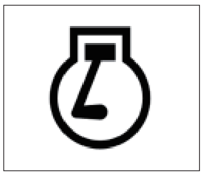
(3) Warming up pilot lamp



290F3CD80

① This lamp lights up when the coolant temperature is below 30˚C (86˚F).
② The automatic warming up is cancelled when the engine coolant temperature is above 30˚C (86˚F), or when 10 minutes have passed since starting the engine.

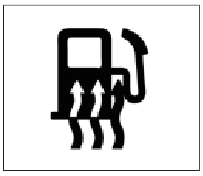
(4) Decel pilot lamp



290F3CD81

① Operating one touch decel switch on the RCV lever makes the lamp light up.
② Also, the lamp will light up. And engine speed will be reduced automatically to save fuel when all levers and pedals are in the neutral position, and the auto idle function is selected.
※ One touch decel is not available when the auto idle pilot lamp is turned ON.
※ Refer to the page operator's manual 3-36.

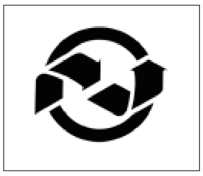
(5) Fuel warmer pilot lamp



290F3CD82

① This lamp lights up when the coolant temperature is below 10˚C (50˚F) or the hydraulic oil temperature 20˚C (68˚F).
② The automatic fuel warming is cancelled when the engine coolant temperature is above 60˚C (140˚F), and the hydraulic oil temperature is above 45˚C (113˚F) since the start switch was ON position.

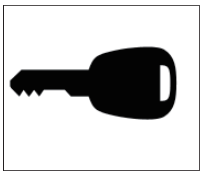
(6) Maintenance pilot lamp



290F3CD83

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.
※ Refer to the page 5-80.

(7) Smart key pilot lamp (premium type, opt)



290F3CD214

① This lamp lights up when the engine is started by the start button.
② This lamp is red when the a authentication fails, it will be green when it authentication is successful.
※ Refer to the page 5-81.

(8) Auto engine shutdown pilot lamp (premium type, opt)

220A3CD202A

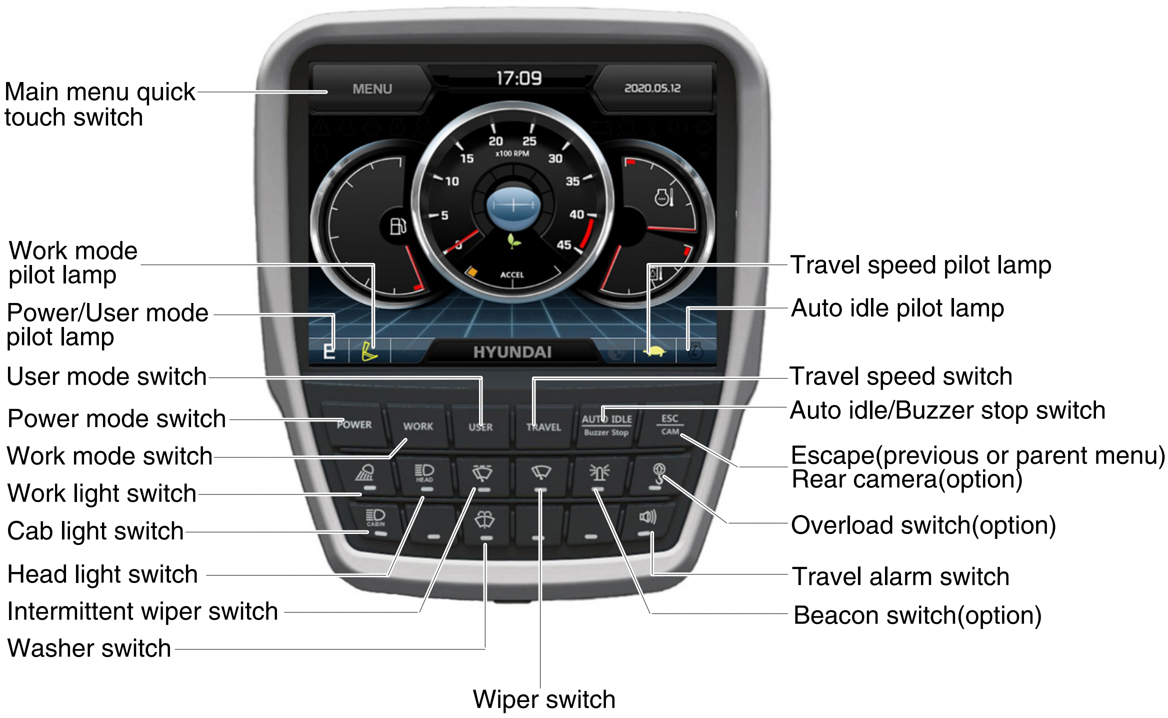
① This lamp lights up when the auto engine shutdown is activated
※ Refer to the page 5-77.

6) SWITCHES

Normal type

220S3CD586A

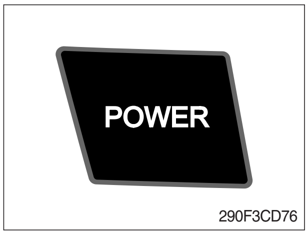
Premium type



220S3CD86B

※ When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 6-65 for details.

(1) Power mode switch



290F3CD76

① This switch is to select the machine power mode and when pressed, the power mode pilot lamp will be displayed on the section of the monitor.
- · P : Heavy duty power work.
- · S : Standard power work.

② · E : Economy power work.
The pilot lamp changes E → S → P → E in this order.

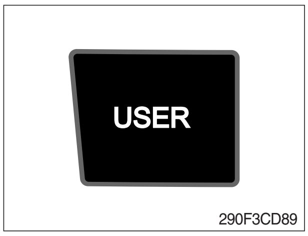
(2) Work mode switch

290F3CD88

① This switch is to select the machine work mode, which shifts from general operation mode to optional attachment operation mode.
- · : General operation mode
- · : Breaker operation mode (if equipped)
- · : Crusher operation mode (if equipped)
- · Not installed : Breaker or crusher is not installed.

※ Refer to the page operator's manual 2-7 for details.

(3) User mode switch



290F3CD89

① This switch is used to select between user mode and general power mode.
- U : User mode
- P/S/E : General power mode

② Refer to the page 5-75 for another set of user mode.

(4) Travel speed switch

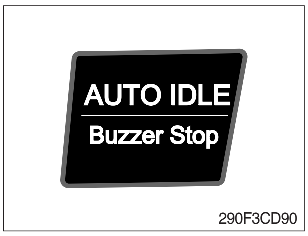
290F3CD91

① This switch is used to select the travel speed alternatively.
- · : Low speed
- · : High speed

※ Do not change the setting of the travel speed switch while machine is moving. Machine stability may be adversely affected

⚠ Serious injury or death can result from sudden changes in machine stability.

(5) Auto idle/ buzzer stop switch



290F3CD90

① This switch is used to activate or cancel the auto idle function.
- · Pilot lamp ON : Auto idle function is activated.
- · Pilot lamp OFF : Auto idle function is cancelled.

② The buzzer sounds when the machine has a problem.
In this case, push this switch and buzzer stops, but the warning lamp blinks until the problem is cleared.

(6) Escape/Camera switch

290F3CD92

① This switch is used to return to the previous menu or parent menu.
② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-87 for the camera.
③ If the camera is not installed, this switch is used only ESC function.

(7) Work light switch


290F3CD93

① This switch is used to operate the work light.
② The pilot lamp lights up when this switch is pressed.

(8) Head light switch

290F3CD94

① This switch is used to operate the head light.
② The pilot lamp lights up when this switch is pressed.

(9) Intermittent wiper switch


290F3CD95

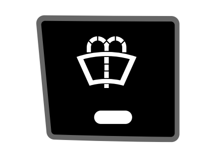
① This switch is used to wipe operates intermittently.
② The pilot lamp lights up when this switch is pressed.

(10) Wiper switch


290F3CD96

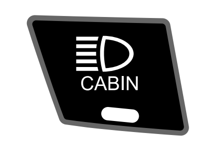
① This switch is used to operate the wiper.
② Note that the wiper will self-park when switched off.
③ The pilot lamp lights up when this switch is pressed.
※ If the wiper does not operate with the switch in ON position, turn the switch OFF immediately. Check the cause.
If the switch remains ON, motor failure can result.

(11) Washer switch


290F3CD100

① Washer liquid is sprayed and the wiper is operated only when this switch is pressed.
② The pilot lamp lights up when this switch is pressed.

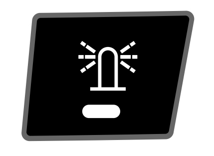
(12) Cab light switch



290F3CD99

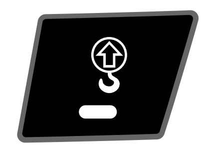
① This switch turns on the cab light.
② The pilot lamp lights up when this switch is pressed.

(13) Beacon switch


290F3CD97

① This switch activates the rotary light on the cab.
② The pilot lamp lights up when this switch is pressed.

(14) Overload switch


290F3CD98

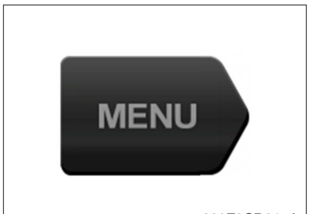
① When this switch is activated, buzzer makes sound and overload warning lamp lights up in the event that the machine is or becomes in an overloaded situation.
② When the switch is inactivated, buzzer stops and warning lamp goes off.
⚠ **Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard could result in serious injury or death. Always activate the overload warning device before you handle or lift objects.**

(15) Travel alarm switch


290F3CD101

① This switch is to activate travel alarm function surrounding when the machine travels.
· ON : The travel alarm function is activated.
· OFF : The travel alarm function is not activated.

(16) Main menu quick touch switch



290F3CD217A

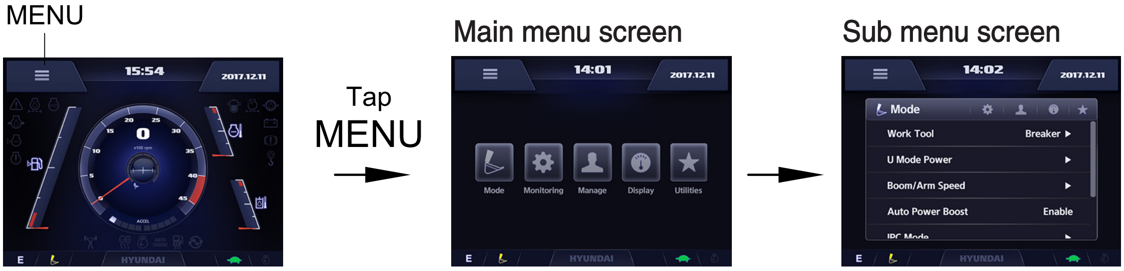
① This switch is to activate the main menu in the cluster.

※ Refer to the page 5-73.

7) MAIN MENU

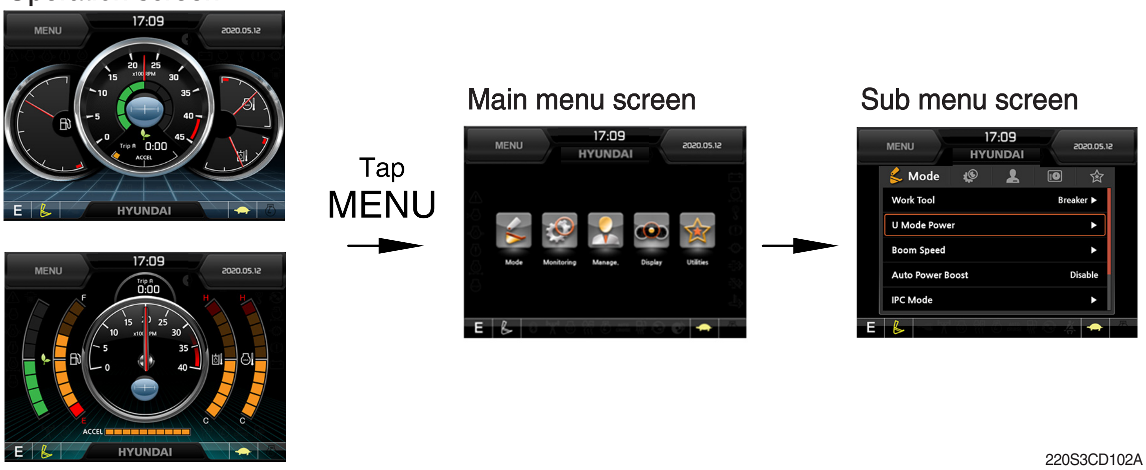
※ On the operation screen, tap MENU to access the main menu screen.
On the sub menu screen, you can tap the menu bar to access functions or applications.

Normal type
Operation screen



220S3CD502A

Premium type
Operation screen



220S3CD102A

(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 220S3CD103	Work mode U mode power Boom/Arm speed Auto power boost (null) IPC mode Auto engine shutdown (opt) Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Boom speed Enable, Disable Speed mode, Balance mode, Efficiency mode One time, Always, Disable Key on initial mode / initial work mode Switch function
2	 Monitoring 220S3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU, AAVM (opt) MCU, AAVM (opt) All logged fault delete, Initialization canceled Machine information, Switch status, Output status,
3	 Management 220S3CD105	Fuel rate information Maintenance information Machine security Machine information Contact Service menu Clinometer Update	General record, Hourly, Daily, Mode record Replacement, Change interval oils and filters ESL mode setting, Password change Model, MCU, Monitor RMCU, Relay drive unit, AAVM (opt) A/S phone number, A/S phone number change Power shift, Operating hour, Breaker mode pump acting, EPPR current level, Overload pressure Clinometer setting Cluster, ETC device
4	 Display 220S3CD106	Display item Clock Brightness Unit setup Language selection Screen type★	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Distance, Date format Korean, English, Chinese, ETC A type, B type
5	 Utilities 220S3CD107	Tripmeter Camera setting AUX Manual	3 kinds (A, B, C) Number of active, Display order, AAVM (opt)★

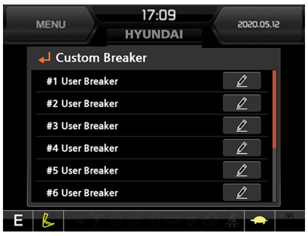
★ : premium type

(2) Mode setup

※ Illustrations are based on the premium type cluster.

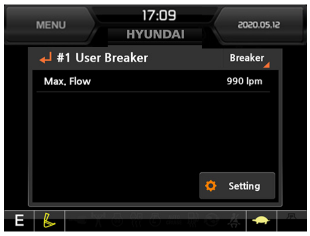
① Work mode

220S3CD108A



220S3CD253A

A



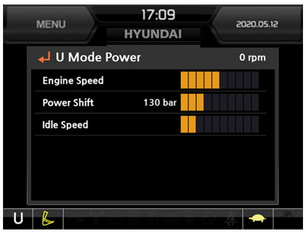
220S3CD254A

B

· Select installed optional attachment
  - A : It can set the user's attachment.
    It is available in setting #1~#10.
  - B : Max flow - Set the maximum flow for the attachment.

② U mode power

220S3CD111A



220S3CD112A

· Engine high idle rpm, auto idle rpm and pump torque (power shift) can be modulated and memorized separately in U-mode.

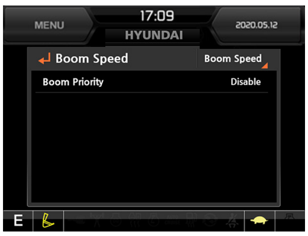
· U-mode can be activated by user mode switch.

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1350	800	0
2	1400	850	3
3	1450	900	6
4	1500	950	9
5	1550	1000 (auto decel)	12
6	1600	1050	16
7	1650	1100	20
8	1700	1150	26
9	1750	1200	32
10	1800	1250	38

※One touch decel & low idle : 900 rpm

③ Boom speed

220S3CD113A



220S3CD115A

· Boom speed
  - Boom priority function can be activated or cancelled
    Enable - Boom up speed is automatically adjusted as working conditions by the MCU.
    Disable - Normal operation

④ Auto power boost (null)

220S3CD118A

220S3CD117A

· The power boost function can be activated or cancelled.
Enable - The digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds, then goes off for a period or 1 second and then activates again for 8 seconds and continues this cycle.
Disable - Not operated.

⑤ IPC mode

220S3CD310A

220S3CD311A

220S3CD304A

220S3CD312A

220S3CD305A

220S3CD313A

220S3CD306A

· The IPC mode can be selected by this menu.
- Speed mode
- Balance mode (default)
- Efficiency mode

⑥ Automatic engine shutdown (option)

220S3CD91A

220S3CD92A

220S3CD93A

· The automatic engine shutdown function can be set by this menu.
  - One time
  - Always
  - Disable
  - Wait time setting : Max 40 minutes, min 2 minutes

⑦ Initial mode

220S3CD122A

220S3CD119A

· Key on initial mode
  - Selected the power mode is activated when the engine is started.

Key on initial work mode
  - Not installed
  - Last setting
  - Work mode

⑧ Emergency mode

220S3CD248A

220S3CD249A

· This mode can be used when the switches are abnormal on the cluster.
· The cluster switches can be selected by touching each icon.

(3) Monitoring

① Active fault

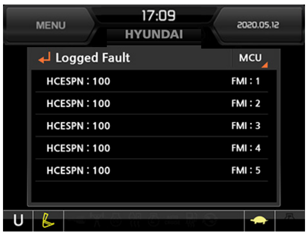
220S3CD120A

220S3CD125A

· The active faults of the MCU can be checked by this menu.

② Logged fault

220S3CD128A

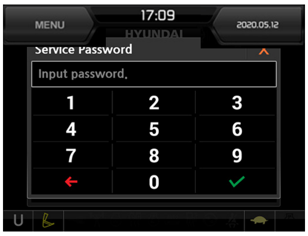


220S3CD124A

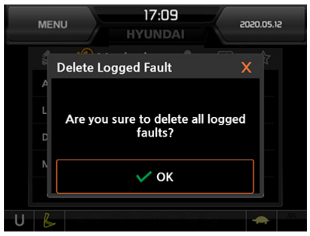
· The logged faults of the MCU can be checked by this menu.

③ Delete logged fault

220S3CD134A



220S3CD126A

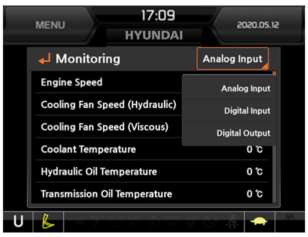


220S3CD127A

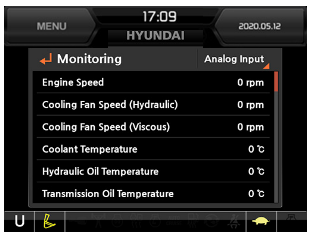
· The logged faults of the MCU can be deleted by this menu.

④ Monitoring

220S3CD172A



220S3CD188A



220S3CD189A

· The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu (Analog input).

· The switch status or output status can be confirmed by this menu (Digital input & Digital output).

· The activated switch or output pilot lamps ● will light up.

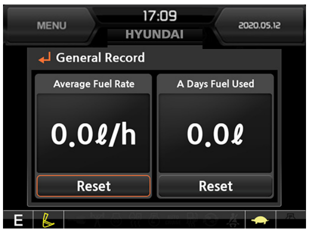
(4) Management

① Fuel rate information

220S3CD14A

220S3CD15A

A



220S3CD16A

· General record (A)
- Average fuel rate (left) (from "Reset" to now)
  Fuel consumption divided by engine run time (service meter time).
- A days fuel used (right)
  Fuel consumption from 24:00 (or "Reset" time) to now (MCU real time).

B

220S3CD17A

· Hourly record (B)
- Hourly fuel rates for past 12 hours (service meter time).
- No record during key-off time.
- One step shift to the right for every one hour.
- Automatic deletion of data from 12 hours and earlier.
- "Reset" deletes all hourly records.

C

220S3CD18A

· Daily record (C)
- Daily fuel consumption for past seven days (MCU real time).
- No record during key-off time.
- One step shift to the right at 24:00 for every day.
- Automatically deletes data from 7 days and earlier.
- All daily records deletion by "Reset".

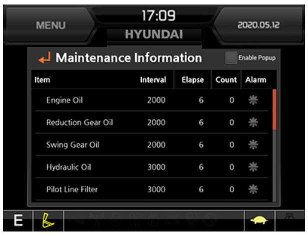
D

220S3CD19A

· Mode record (D)
- Average fuel rate for each power mode/accel dial (at least 7) from "Reset" till present.
- No record during idle.
- All records can be deleted by "Reset".

② Maintenance information

220S3CD131A



220S3CD132A

220S3CD133A

· Alarm lamp (●) is ON when oil or filter needs to be changed or replaced.
· Replacement : The elapsed time will be reset to zero (0).
· Change interval : The change intervals can be changed in hour increments of 50.
※ Refer to section, Maintenance chart for further information of maintenance interval.

③ Machine security

220S3CD190A

220S3CD135A

220S3CD136A

220S3CD137A

220S3CD138A

· ESL mode setting

- ESL : Engine Starting Limit
- ESL mode is desingned 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.
- 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 4 hours.

  ※Default password : 00000 + ☑

  ※Password length : (5~10 digits) + ☑
- Smart key (option) : Refer to next page.

· Password change

- The password is 5~10 digits.

220S3CD190A

220S3CD140A

220S3CD135A

Enter the current password

220S3CD142A

Enter the new password

220S3CD143A

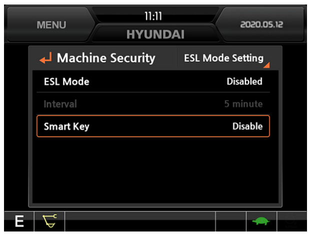
Enter the new password again

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

- Smart key

220S3CD190A

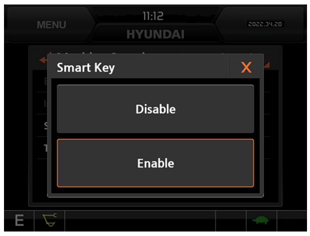
220S3CD135A



235F3CD001

· Smart key is registered when equipped with optional smart key. If smart key is not inside of the cabin, authentication process fails and the password is needed.

· Tag management menu is activated when the Smart key menu is Enabled.
You can register and delete the tags.

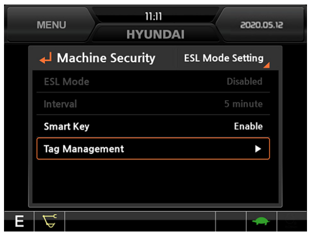


235F3CD002

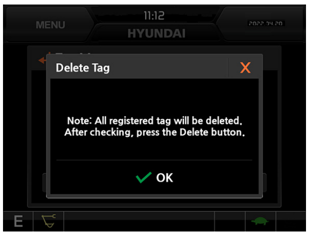
- Tag management

· When registering a tag : Only the tag you want to register must be in the cabin.

· When deleting a tag : All registered tags are deleted.

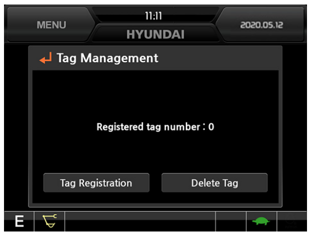


235F3CD003



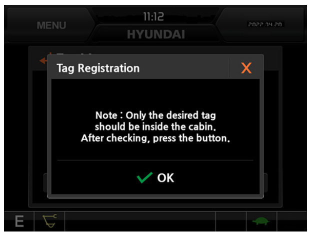
235F3CD006

Deleting



235F3CD004

Registering



235F3CD005

※ Engine Starting Condition

Case	ESL Mode	Smart Key	Condition
1	Disable	Disable	- With registered tag : Engine can be started without password input. - Without registered tag : Engine can be started without password input.
2	Disable	Enable	If Smart Key is enabled, ESL Mode is automatically enabled. This Case 2 work the same as the Case 4.
3	Enable	Disable	- With registered tag : Engine can be started with password input. - Without registered tag : Engine can be started with password input.
4	Enable	Enable	- With registered tag : Engine can be started without password input. - Without registered tag : Engine can be started with password input.

④Machine Information

220S3CD144A

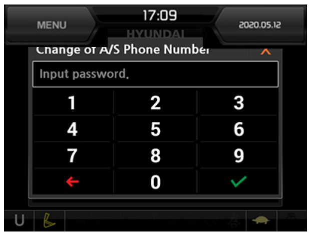
220S3CD145A

· This can confirm the identification of the model information (ECU), MCU, monitor, switch controller, RMCU, relay driver unit, AAVM (opt).

⑤ Contact (A/S phone number)

220S3CD146A

220S3CD147A



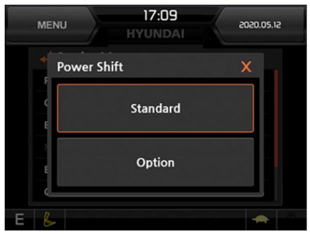
220S3CD148A

Enter the new A/S phone number

⑥ Service menu

220S3CD149A

220S3CD150B



220S3CD251A

※ This menu can be used only HCE service man and can not be accessible by the owner and the operator.

· Power shift (standard/option) : Power shift pressure can be set by option menu.
· Operating hours : Operating hours since the machine line out can be checked by this menu.
· Breaker mode pump acting (null)
· EPPR current level (attach flow EPPR 1 & 2)
· Overload pressure : 100 ~ 350 bar

⑦ Clinometer

220S3CD152A

220S3CD153A

· When the machine is on the flatland, if you touch "initialization" on cluster, the values of X, Y will reset to "O".
· You can confirm tilt of machine in cluster's operating screen.

⑧ Update (cluster & ETC devices)

220S3CD67A

220S3CD135A

220S3CD280A

· ETC devices and cluster can be updated through CAN 2 network.

· Insert USB memory stick or SD card which includes program files, start download.

220S3CD290A

220S3CD281A

220S3CD291A

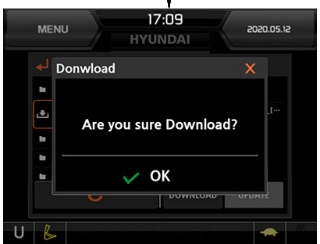
220S3CD282A

220S3CD299A

220S3CD292A

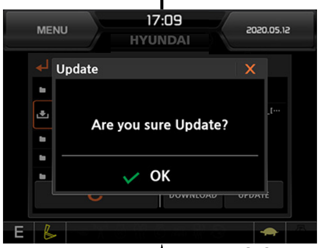
220S3CD283A

220S3CD298A



220S3CD293A

220S3CD284A

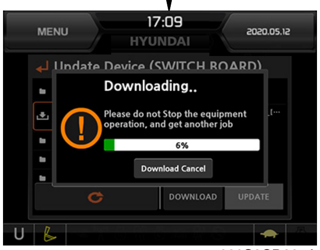


220S3CD297A

220S3CD294A

220S3CD285A

220S3CD296A



220S3CD295A

(5) Display

① Display item

220S3CD154A

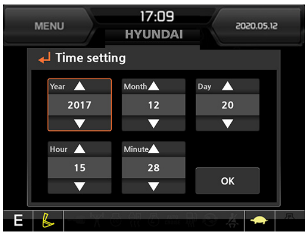
220S3CD155A

220S3CD156A

· The center display type of the LCD can be selected by this menu.
· The engine speed or the tripmeter menu (A,B,C) is displayed on the center display.

② Clock

220S3CD157A

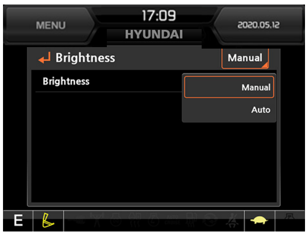


220S3CD158A

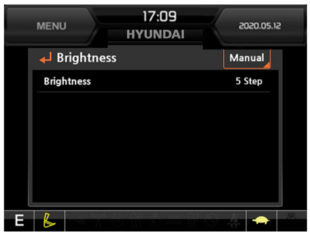
· The first row of boxes indicate Year/Month/Day.
· The second row shows the current time. (0:00~23:59)

③ Brightness

220S3CD159A

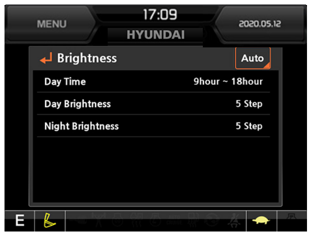


220S3CD160A



220S3CD139A

220S3CD141A



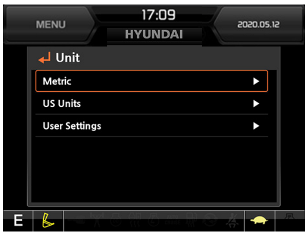
220S3CD191A

220S3CD192A

· If "Auto" is chosen, brightness for day and night can be set accordingly. Also by using the bar in lower side, users can define which an operation interval belongs to day and night. (in bar figure, white area represents night time while orange shows day time)

④ Unit

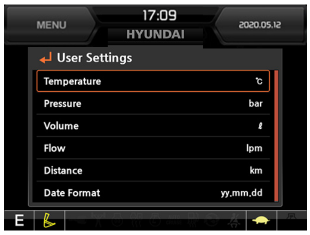
220S3CD161A



220S3CD182A

220S3CD183A

220S3CD186A



220S3CD162A

220F3CD193A

- Temperature : ˚C ↔ ˚F
- Pressure : bar ↔ MPa ↔ kgf/cm^2
- Volume : ℓ ↔ gal
- Flow : lpm ↔ gpm
- Distance : km ↔ mile
- Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-mm-yy

⑤ Language

220S3CD163A

220S3CD164A

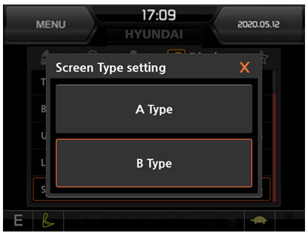
- User can select preferable language and all displays are changed to the selected language.

⑥ Screen type (premium type)

220S3CD165A

A Type (Default) 220S3CD166A

220S3CD156A



B Type (Option) 220S3CD174A

220S3CD167A

(6) Utilites

① Tripmeter

220S3CD168A

220S3CD169A

· A maximum of 3 kinds of tripmeters can be used at the same time.

· Each tripmeter can be turned on by choosing "Start". it also can be turned off by choosing "Stop".

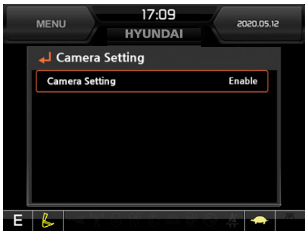
· If the tripmeter icon is activated in the operation screen, it can be controlled directly there.

② Camera setting

· If the rear camera is not installed on the machine, set disable.

· If the rear camera is installed on the machine, set enable.

220S3CD225A



220S3CD255A

220S3CD256A

· In the operation screen, rear camera screen shows up when ESC/CAM switch is pushed.

220S3CD222A

290F3CD221

③ AAVM (Advanced Around View Monitoring, premium type, opt)

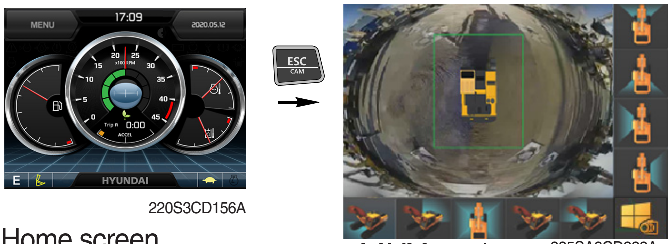
· The AAVM switches of the cluster consist of ESC/CAM and AUTO IDLE/Buzzer stop.

220S3CD244A

- Escape switch

· Activates AAVM mode from the beginning if AAVM is installed.

· While in the AAVM mode, select the ESC switch to return to the home screen.



220S3CD156A

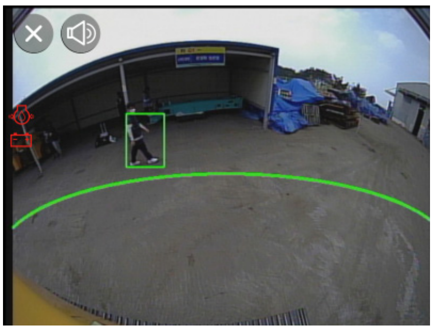
Home screen

AAVM mode 235SA3CD222A

- Buzzer stop switch

· AAVM mode detects surrounding pedestrians or objects and the warning buzzer sounds.

· User can turn OFF the warning sound by pressing buzzer stop switch.



220A3CD246

· When a worker/pedestrian reaches the green line, which is an external danger area equipped on the cluster, warning buzzer sounds and it displays a green rectangular box recognizing the worker/pedestrian.

Stop work immediately. Stop the buzzer by pressing the buzzer stop switch. Then resume work after you confi rm that the area is safe and clear of workers/objects.

220A3CD247

· When a worker/pedestrian reaches the green line, which is an external danger area equipped on the cluster, warning buzzer sounds and it displays a red rectangular box recognizing the worker/pedestrian.

Stop work immediately. Stop the buzzer by pressing the buzzer stop switch. Then resume work after you confirm that the area is safe and clear of workers/objects.

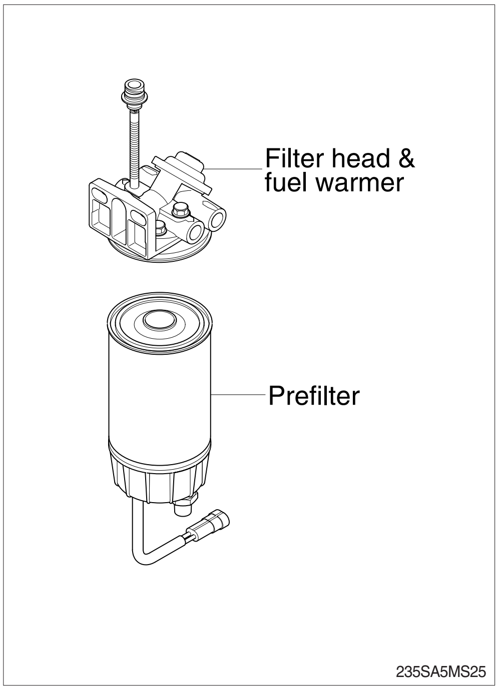
⚠ Failure to comply may result in serious injury or death.

※ In AAVM mode, a touch screen of the LCD is available only. The multimodal dial of the haptic controller is not available.

GROUP 16 FUEL WARMER SYSTEM

1. SPECIFICATION

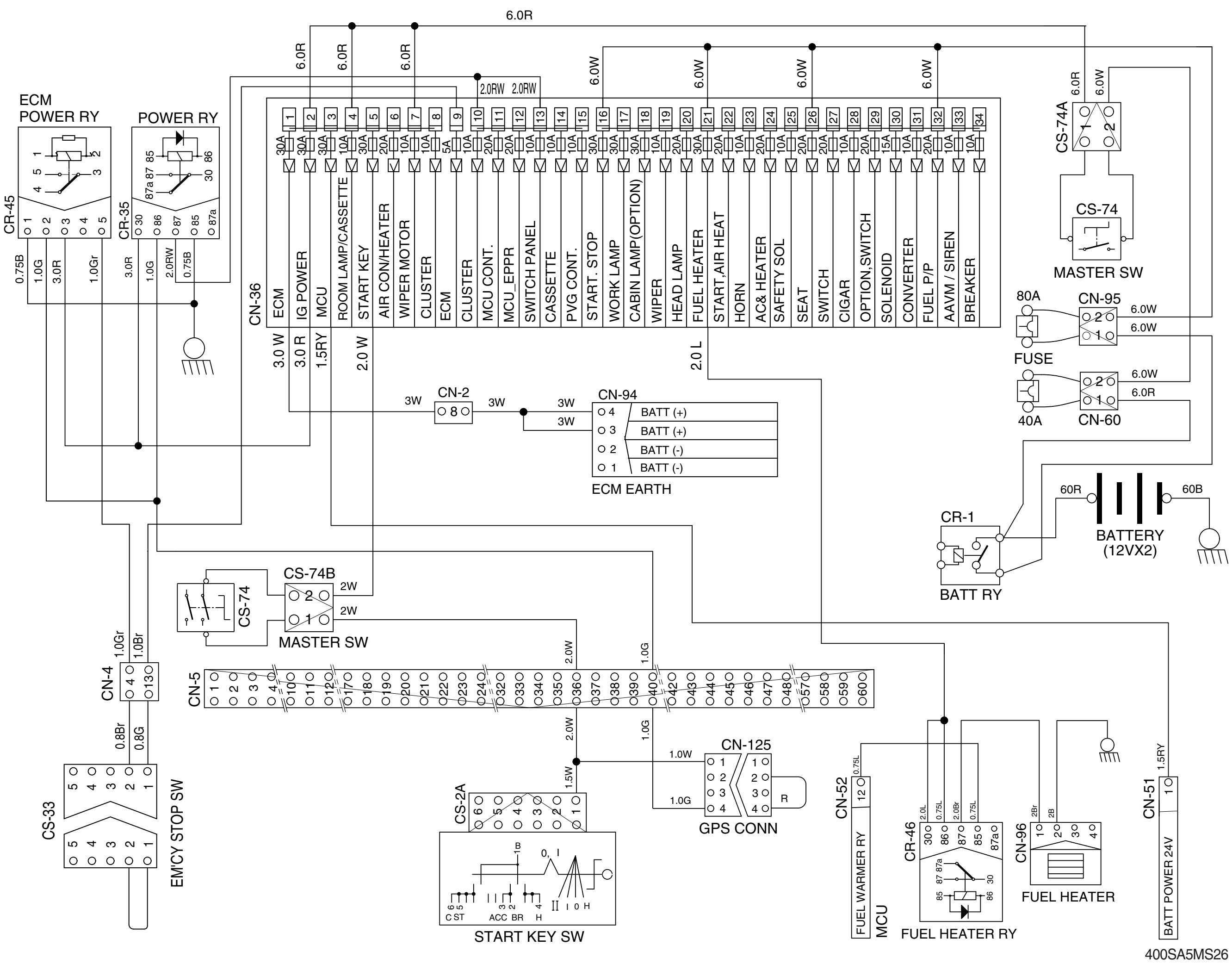
1) Operating voltage : 24$\pm$4 V
2) Power : 350$\pm$50 W
3) Current : 15 A



2. OPERATION

1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
2) At the first state, the 15 A current flows to the fuel warmer and engine may be started in 1~2 minutes.
3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5 A.
So, fuel is protected from overheating by this mechanism.

3. ELECTRIC CIRCUIT



SECTION 6 TROUBLESHOOTING

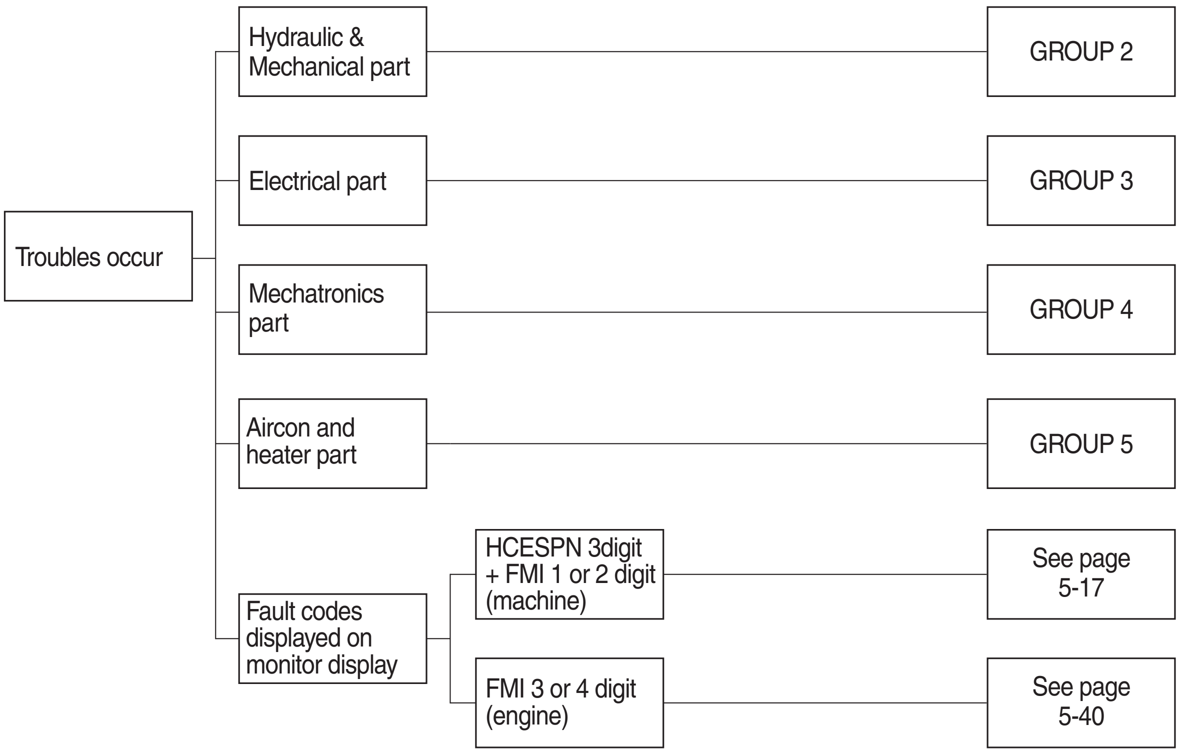
GROUP 1 BEFORE TROUBLESHOOTING

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, Electrical system, Mechatronics system and Air conditioner and heater system. At each system part, an operator can check the machine according to the troubleshooting process diagram.

※ **Before carring out troubleshooting procedure, check monitoring menu in the cluster.**

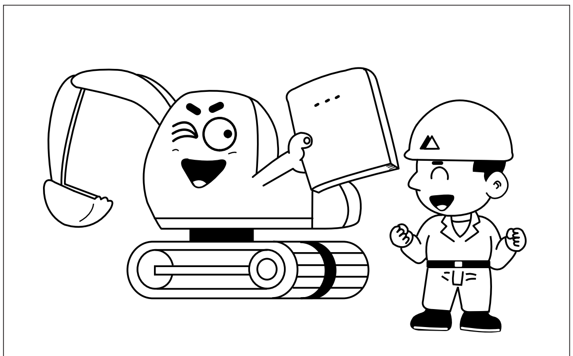


2. DIAGNOSING PROCEDURE

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.

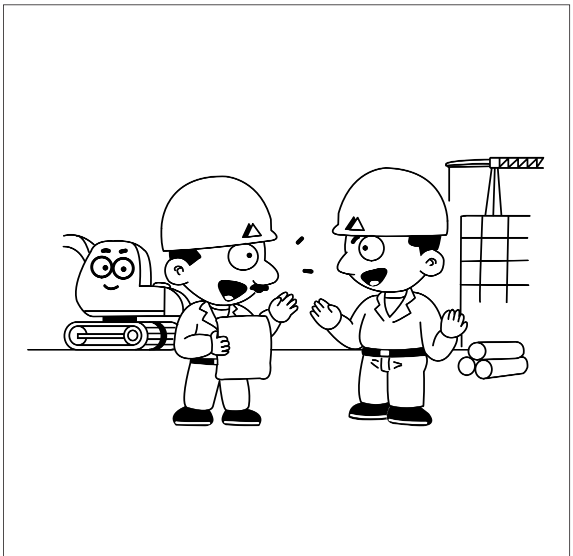


13031SH02

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.

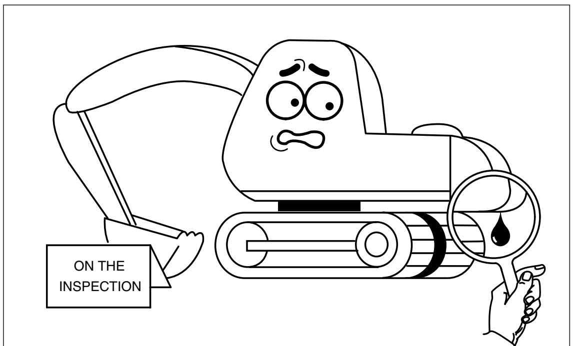


13031SH03

STEP 3. Inspect the machine

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

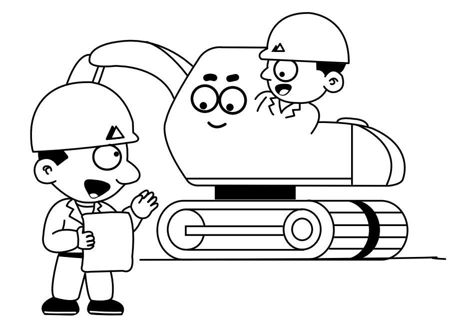
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

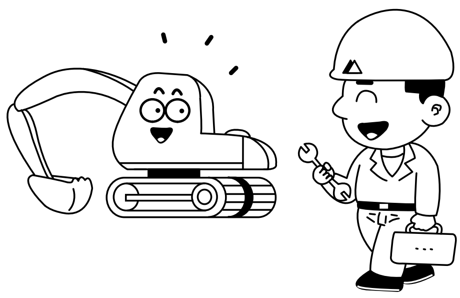
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 6-3(1)

STEP 5. Perform troubleshooting

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.

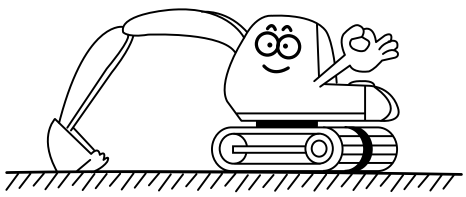


13031SH05

STEP 6. Trace a cause

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.



(210-7) 6-3(3)

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.

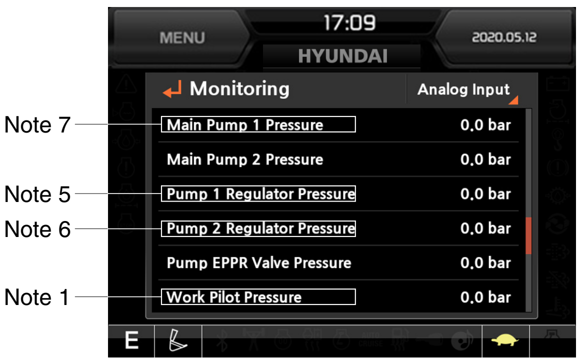
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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?

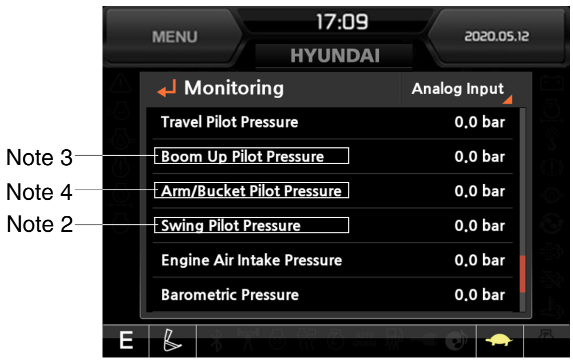
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2) MACHINE STATUS MONITORING ON THE CLUSTER

(1) The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu.



Analog 1



Analog 2

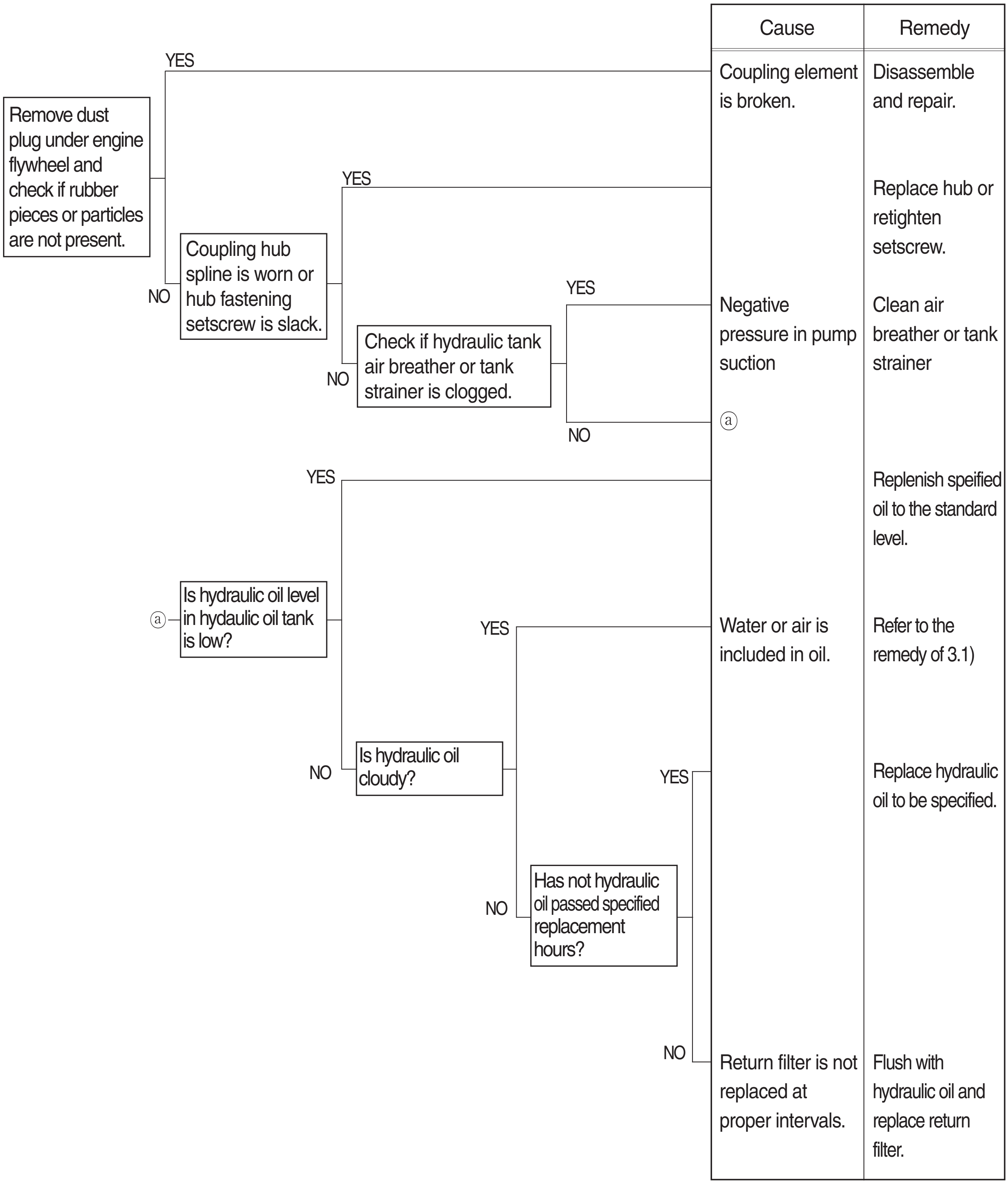
145SA6HS01

(2) Specification

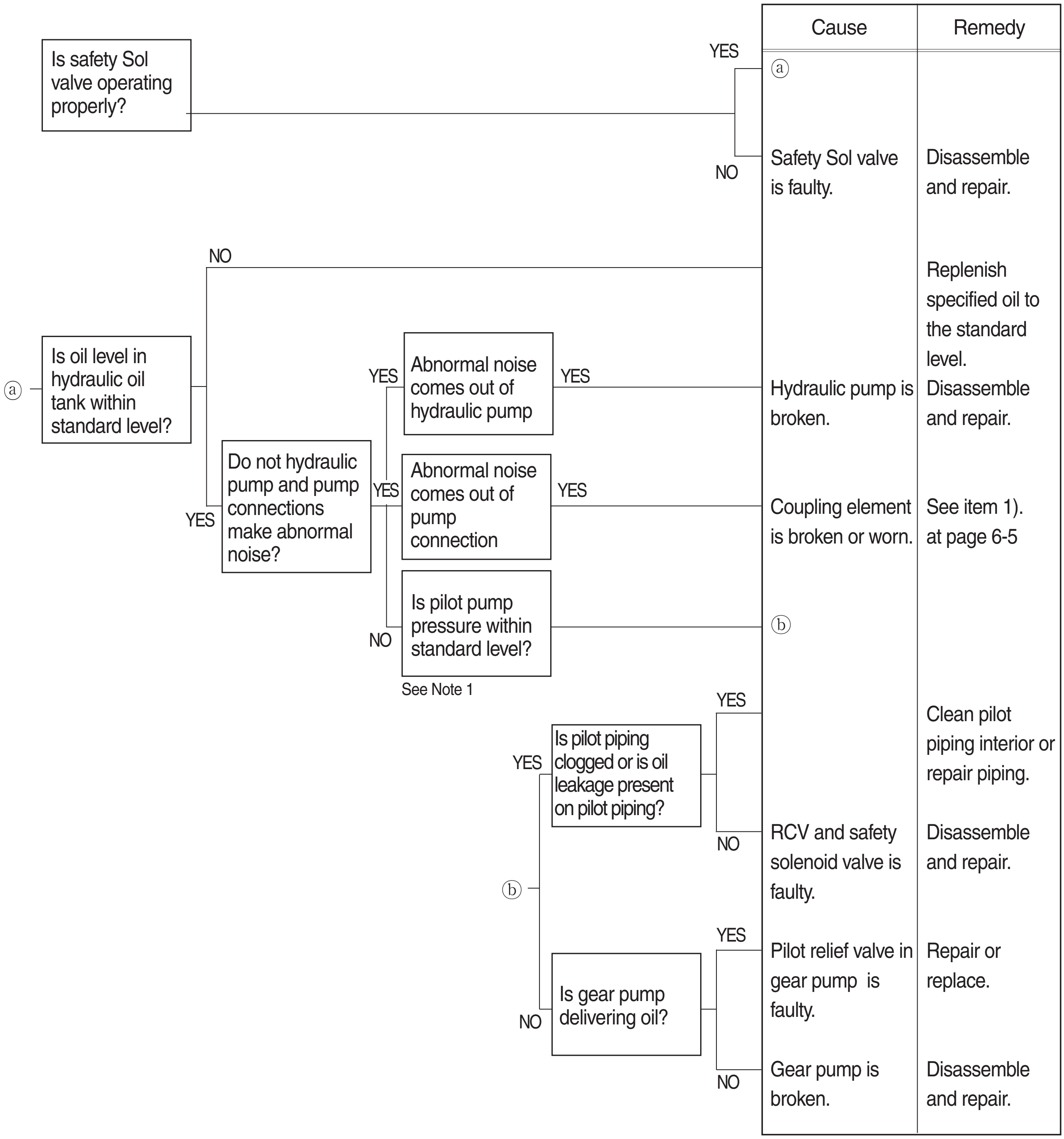
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

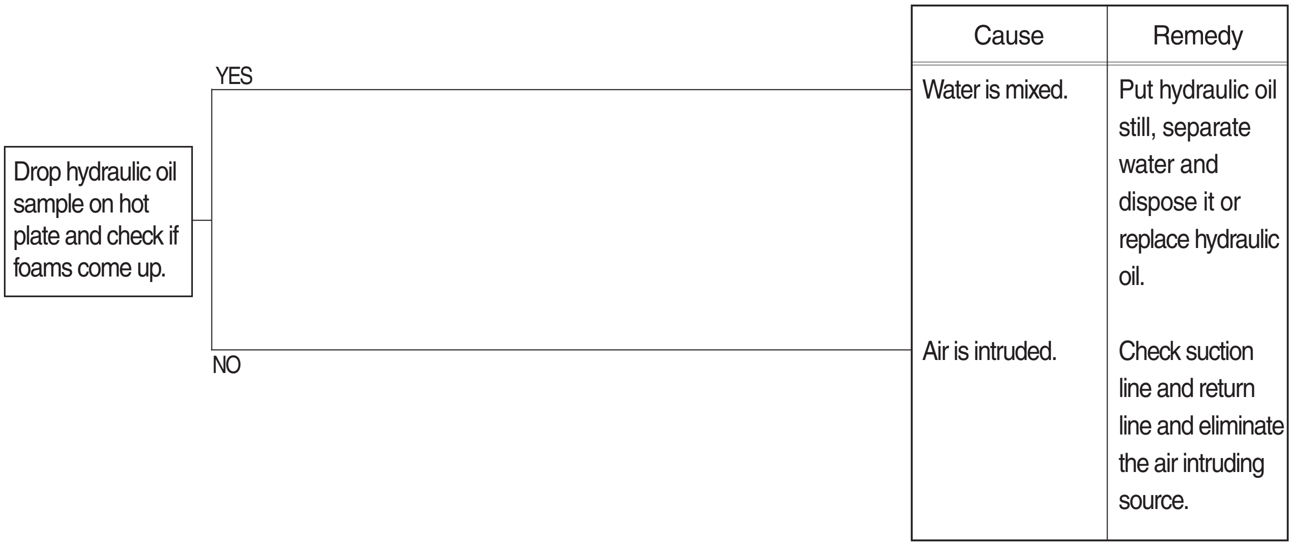


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

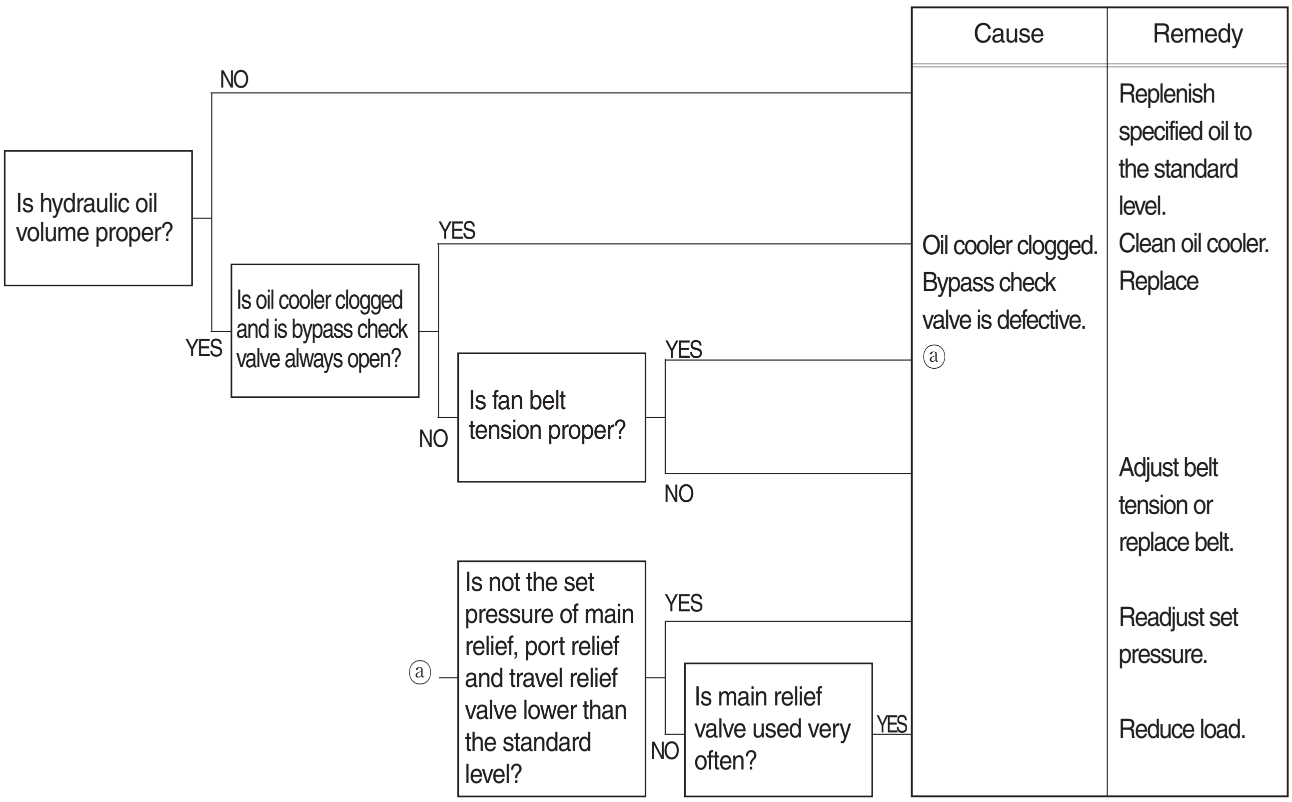


3. HYDRAULIC SYSTEM

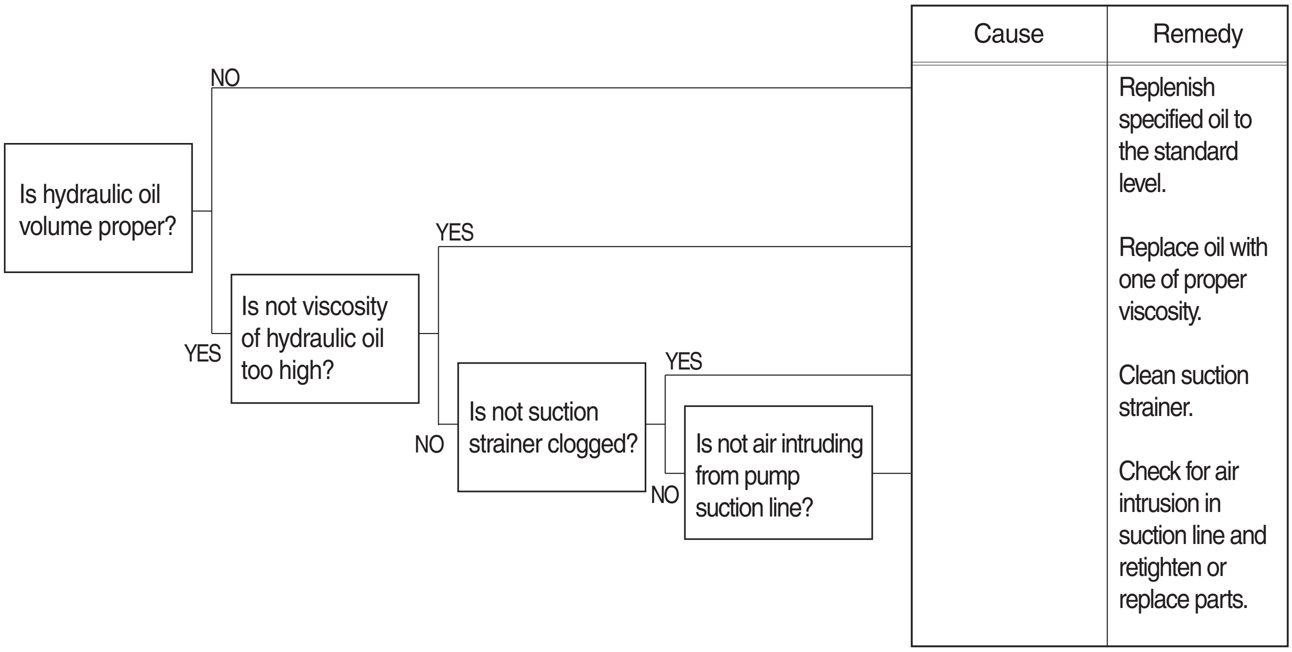
1) HYDRAULIC OIL IS CLOUDY



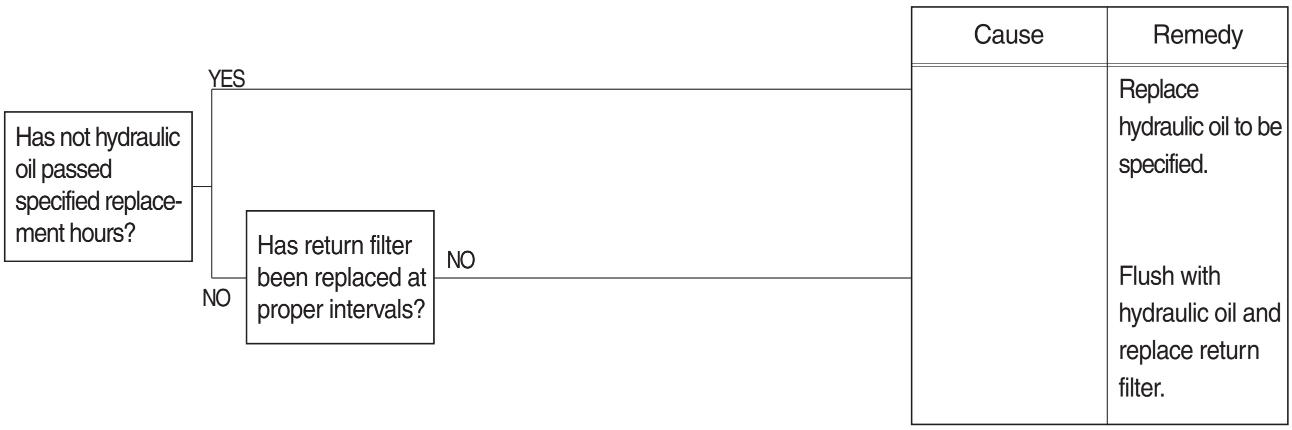
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

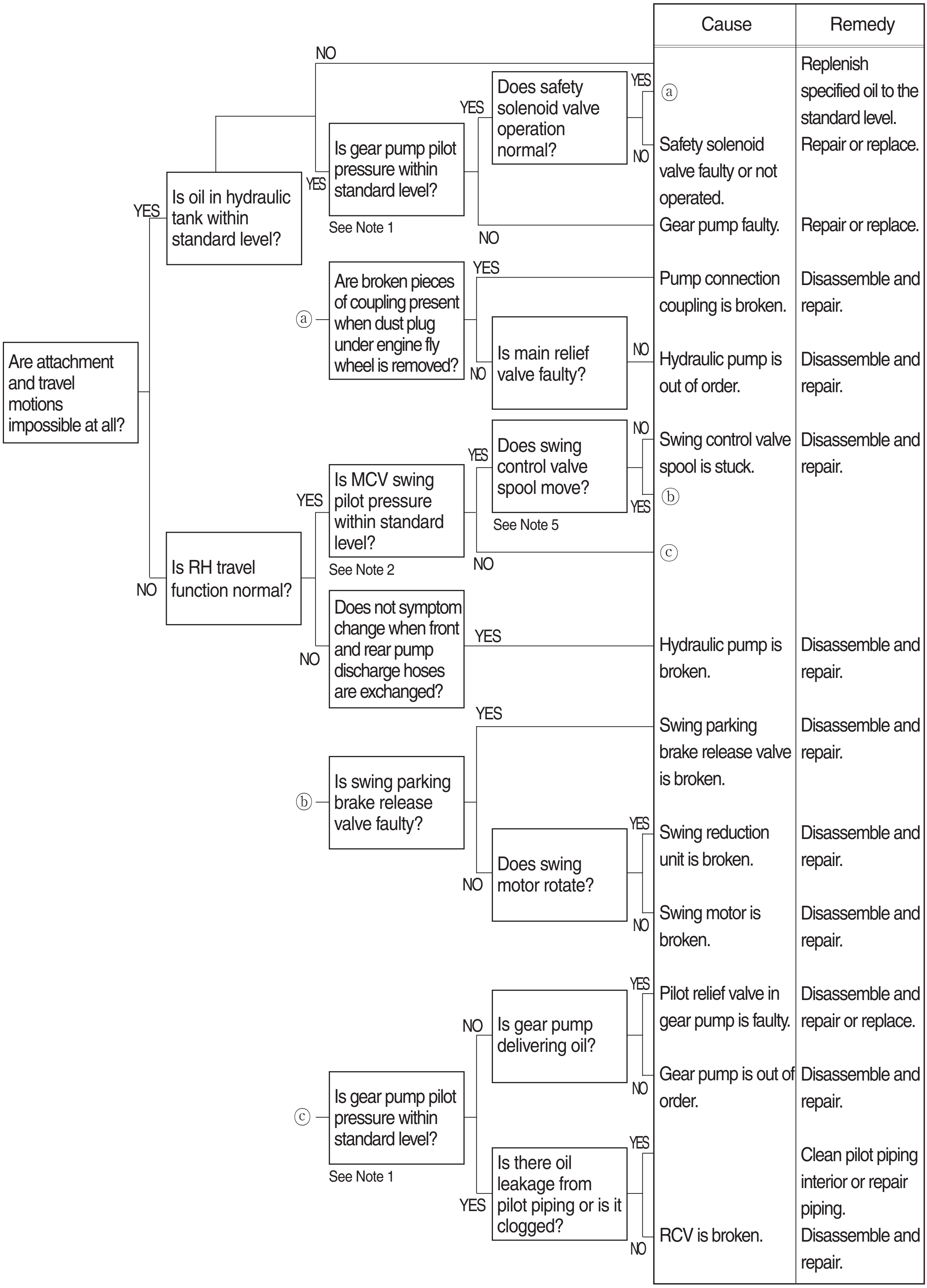


4) HYDRAULIC OIL IS CONTAMINATED

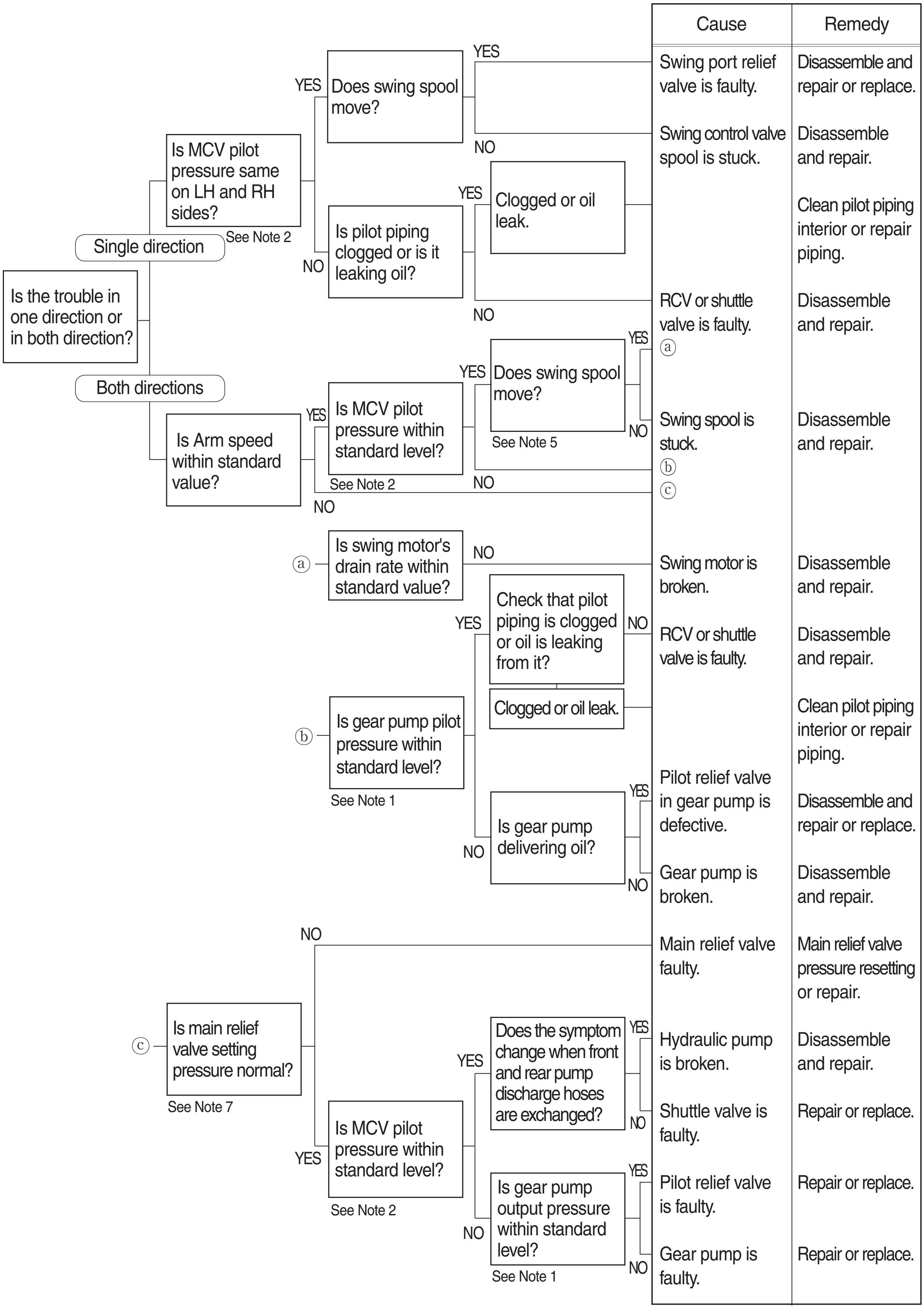


4. SWING SYSTEM

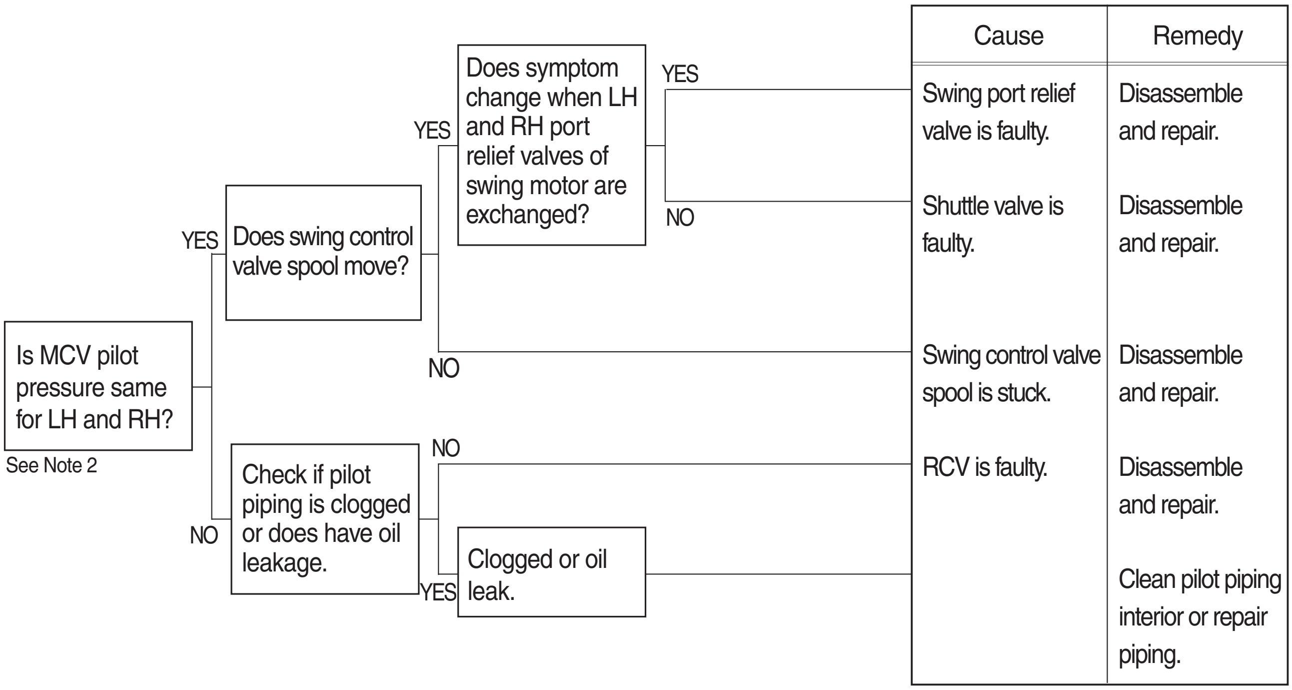
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



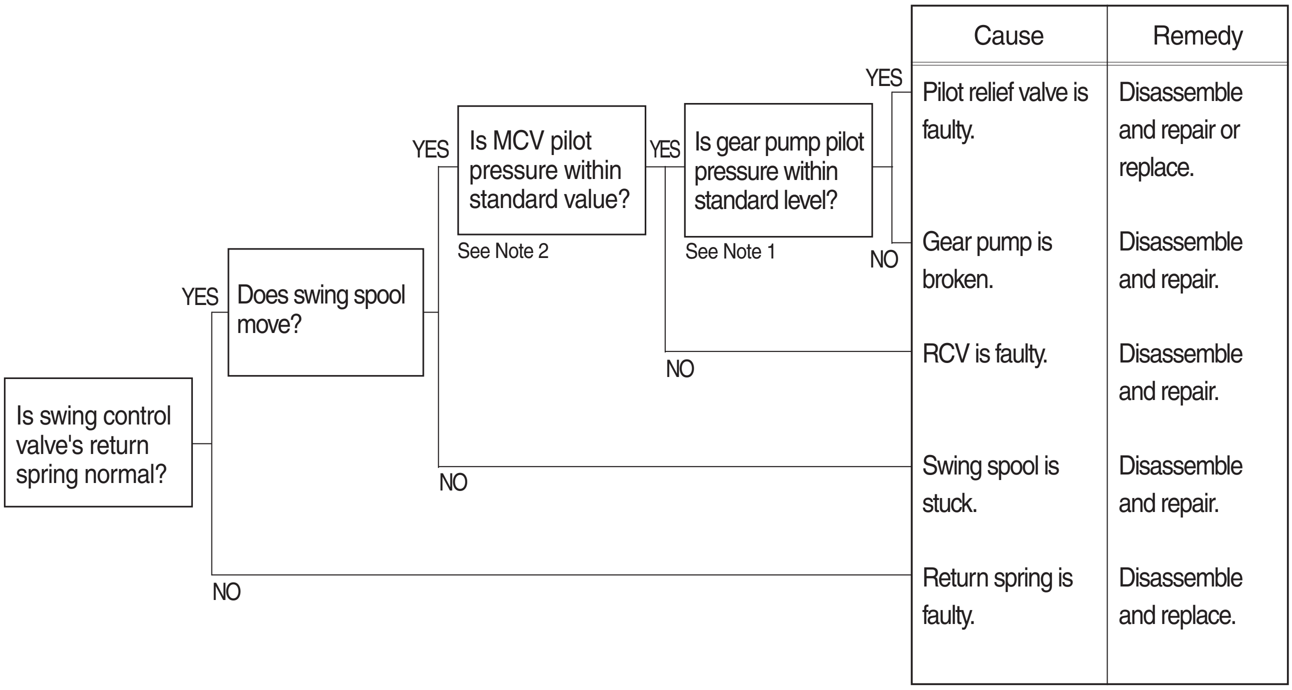
2) SWING SPEED IS LOW



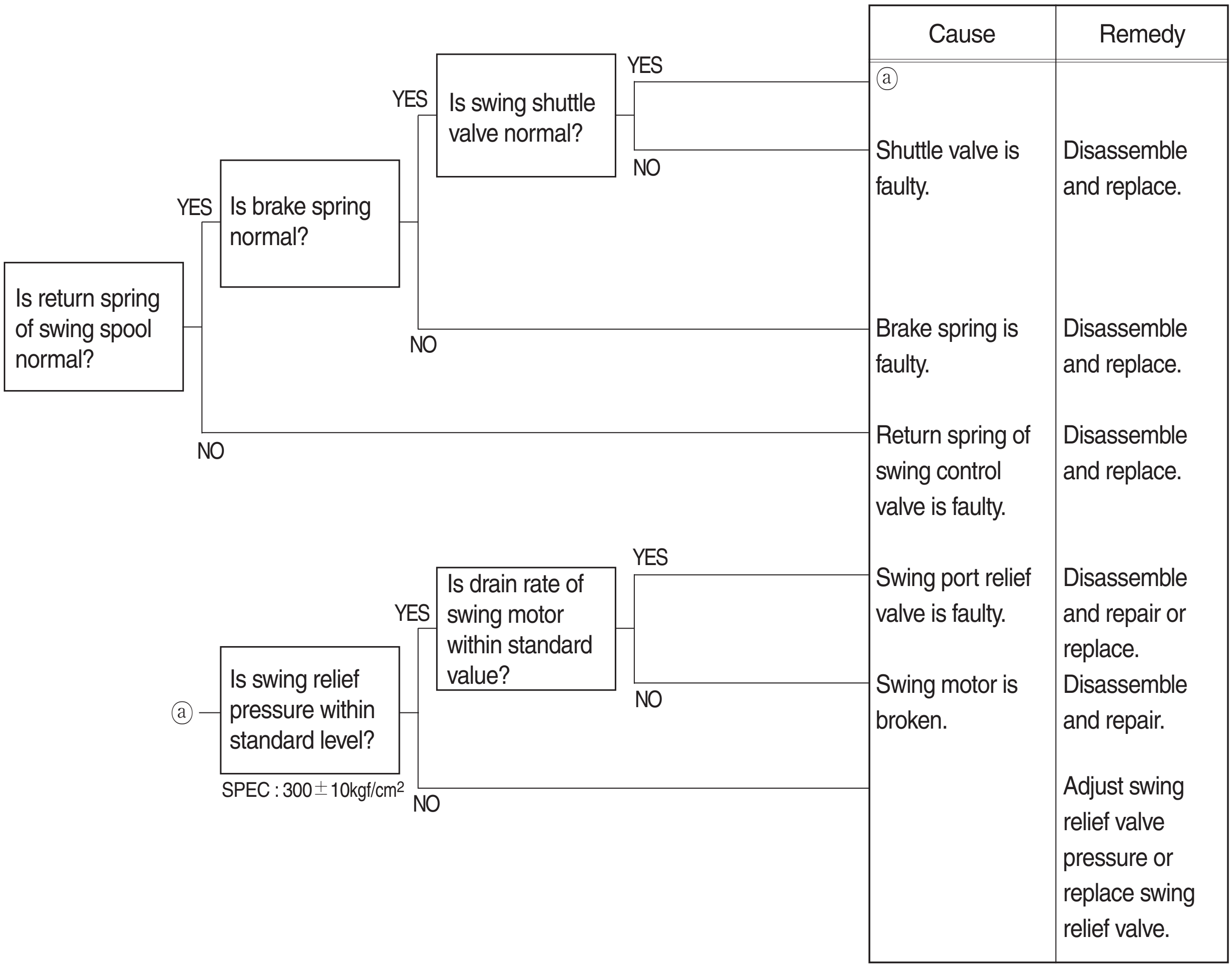
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



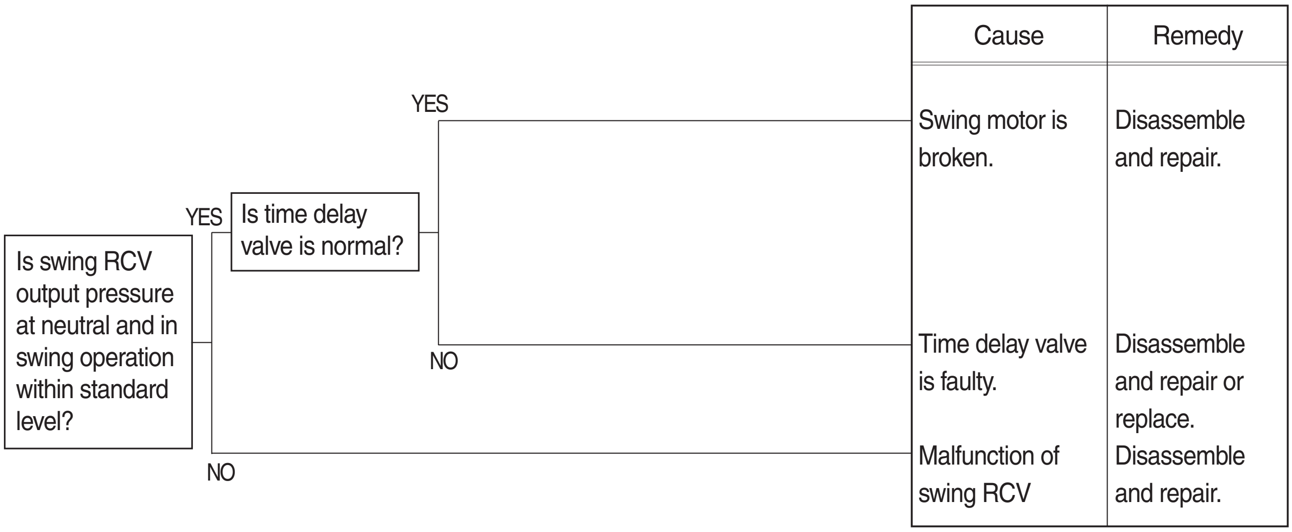
4) MACHINE SWINGS BUT DOES NOT STOP



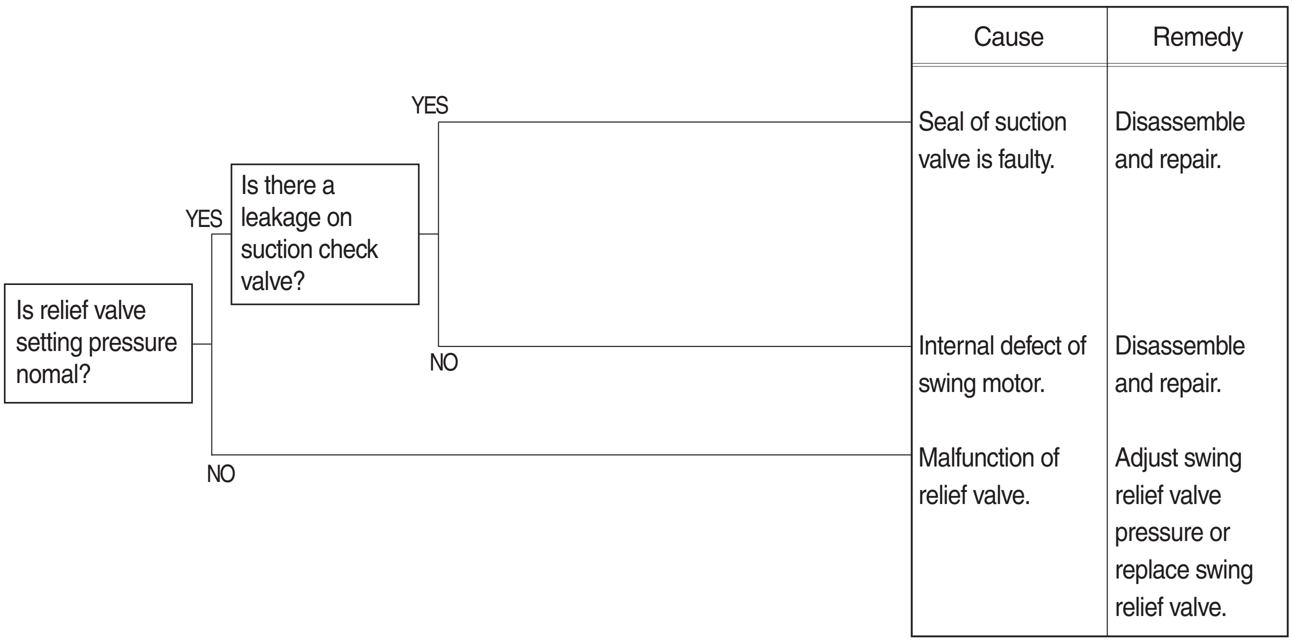
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



6) LARGE SHOCK OCCURS WHEN STOP SWINGING

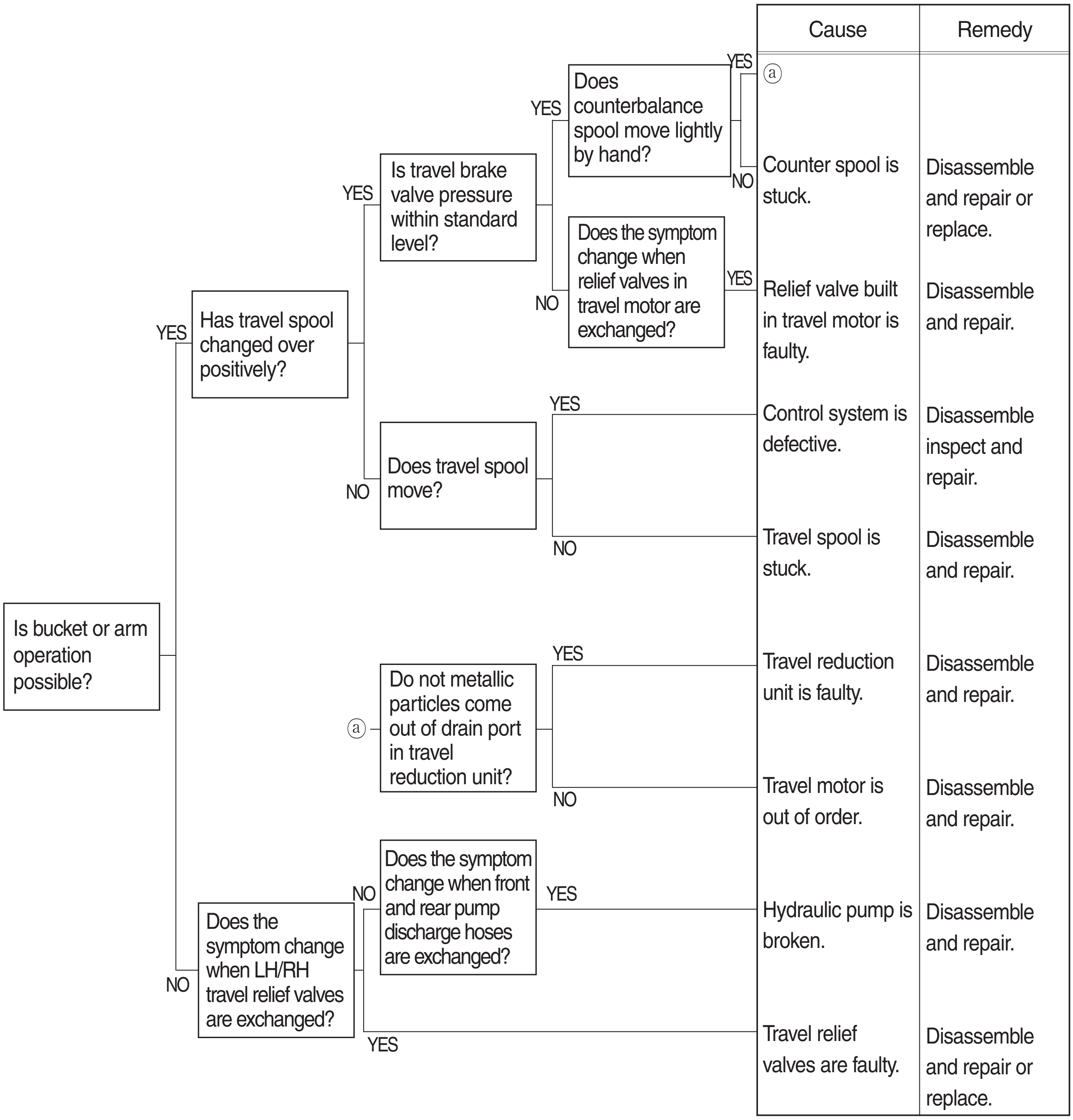


7) LARGE SOUND OCCURS WHEN STOP SWINGING

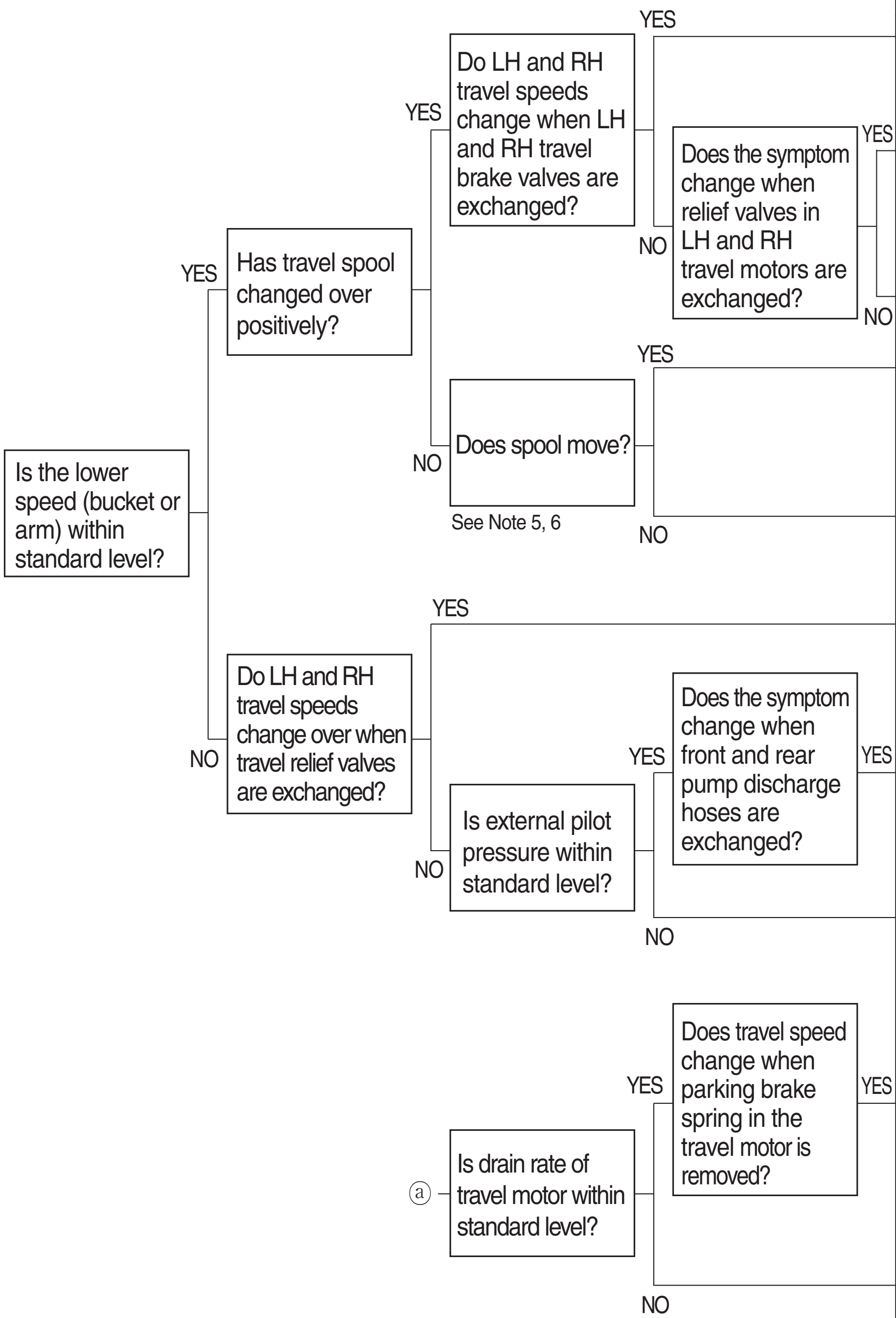


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



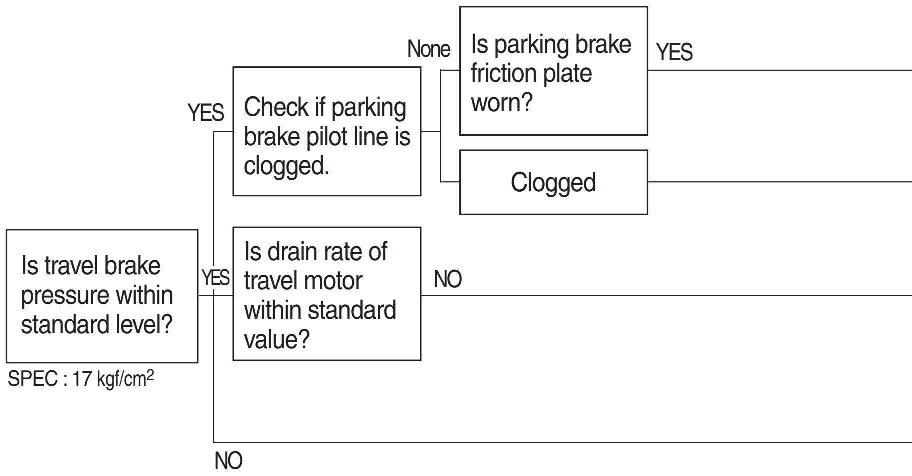
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic pump is broken.	Disassemble and repair.
External pilot piping is clogged or oil is leaking from it.	Disassemble and clean.
Travel motor's parking brake is not released properly.	Disassemble and clean pilot piping.
Travel motor is faulty.	Disassemble and repair.

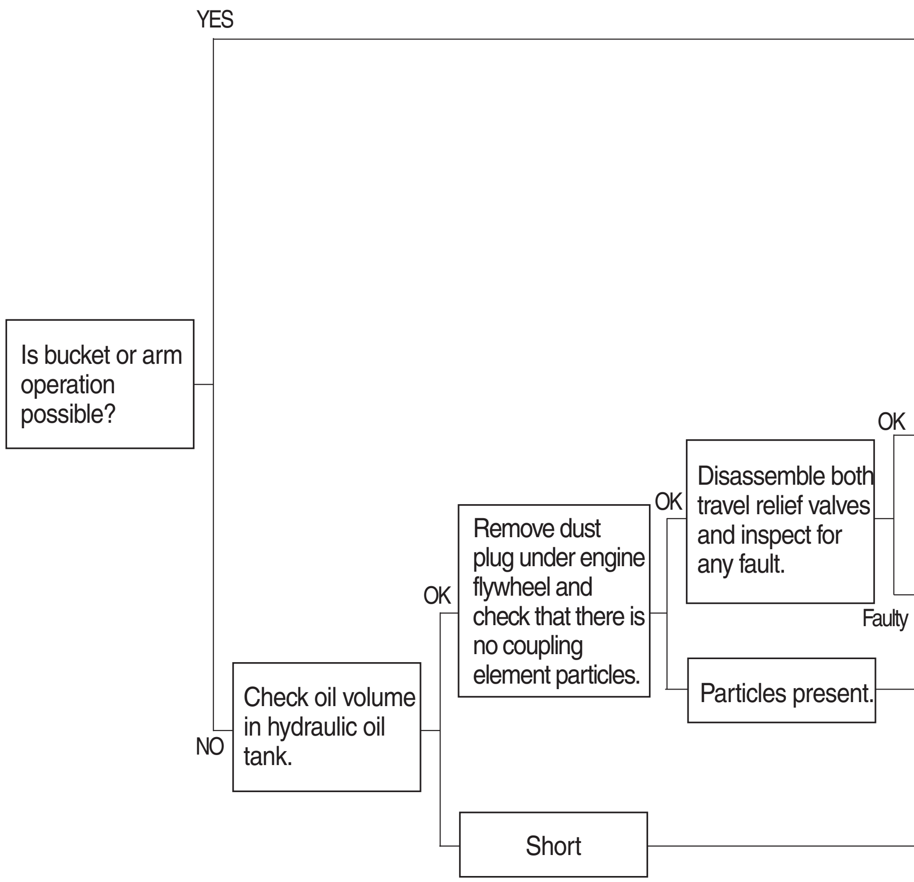
3) MACHINE DOES NOT STOP ON A SLOPE

Machine is pulled forward as sprocket rotates during digging operation.



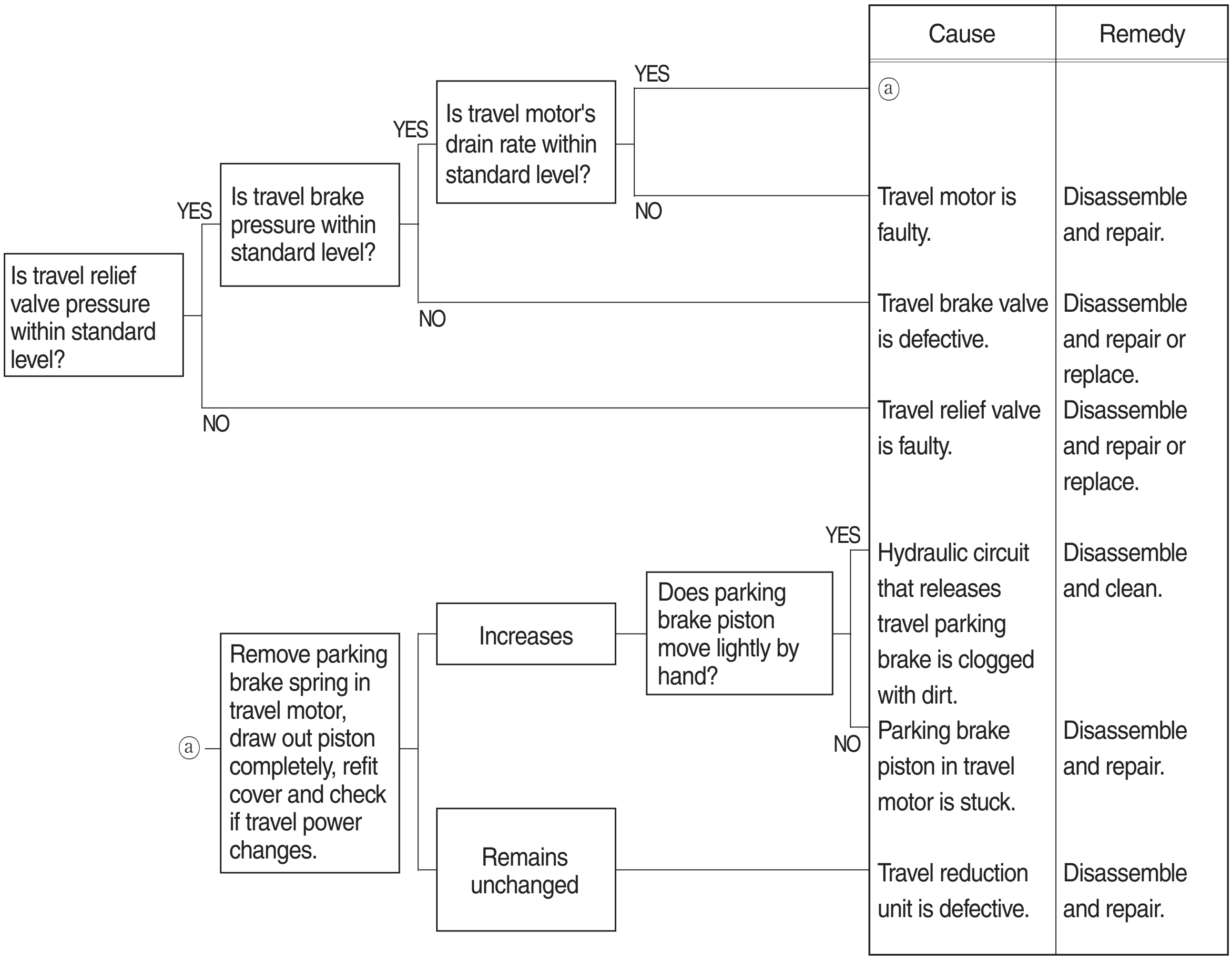
Cause	Remedy
Friction plate is faulty.	Disassemble and repair.
	Disassemble and clean pilot piping.
Travel motor is defective.	Disassemble and repair.
Brake valve is faulty.	Disassemble and repair or replace.

4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



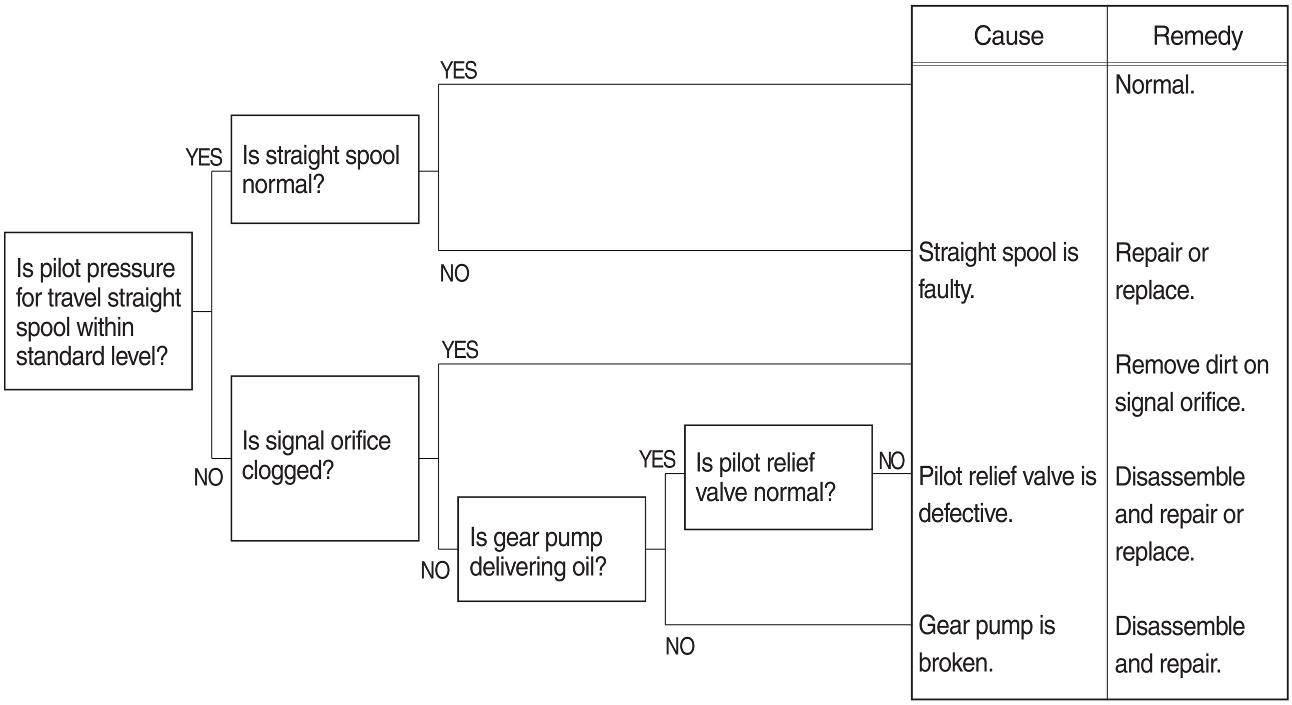
Cause	Remedy
	Inspect according to the procedure "Travel does not function at all on one side." However, a case where both LH and RH travel motions are disabled is extremely seldom statistically.
Hydraulic pump is faulty.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble and repair or replace.
Coupling at pump connection is broken.	Disassemble and repair.
	Replenish hydraulic oil.

5) TRAVEL ACTION IS POWERLESS (travel only)



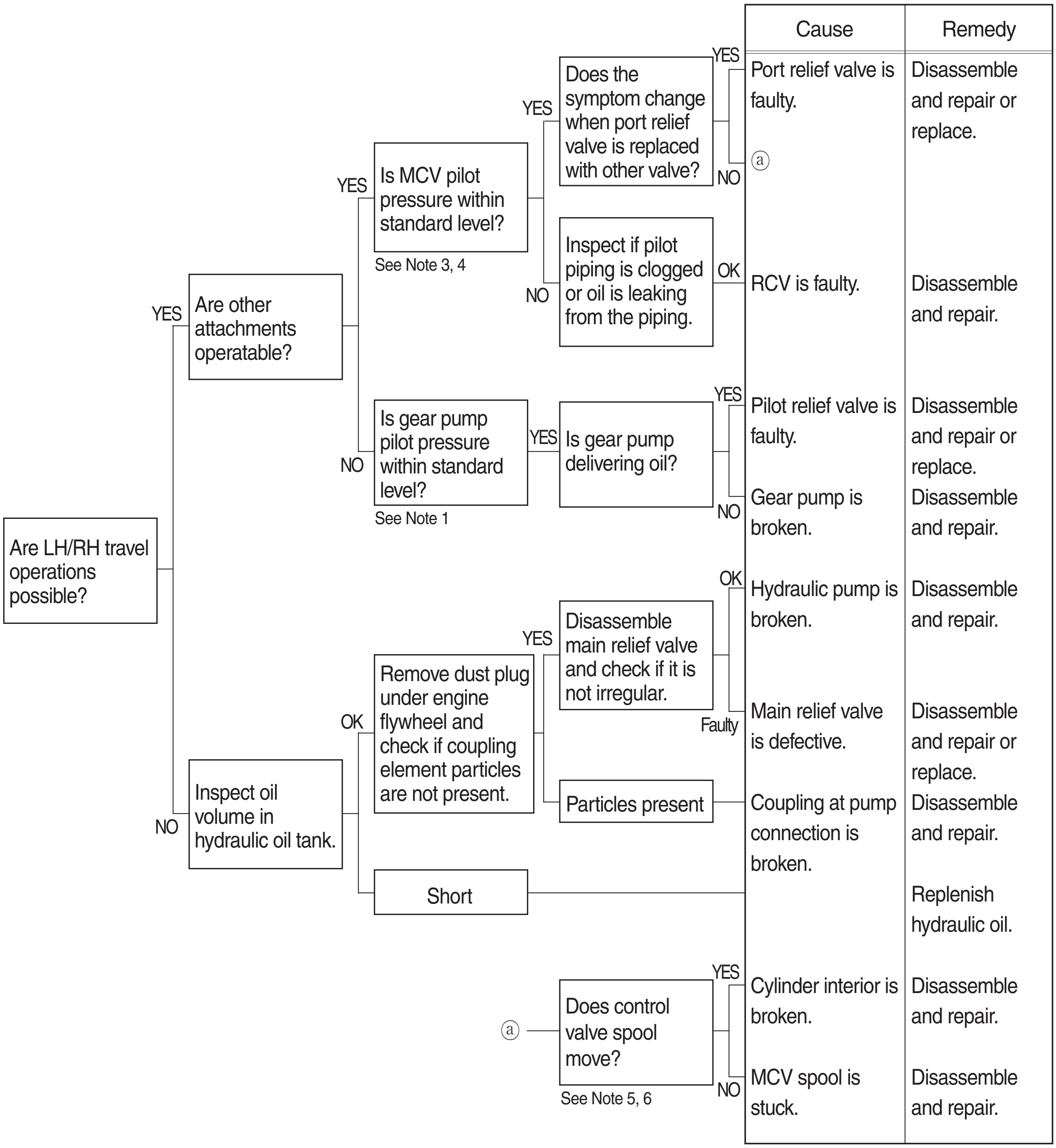
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

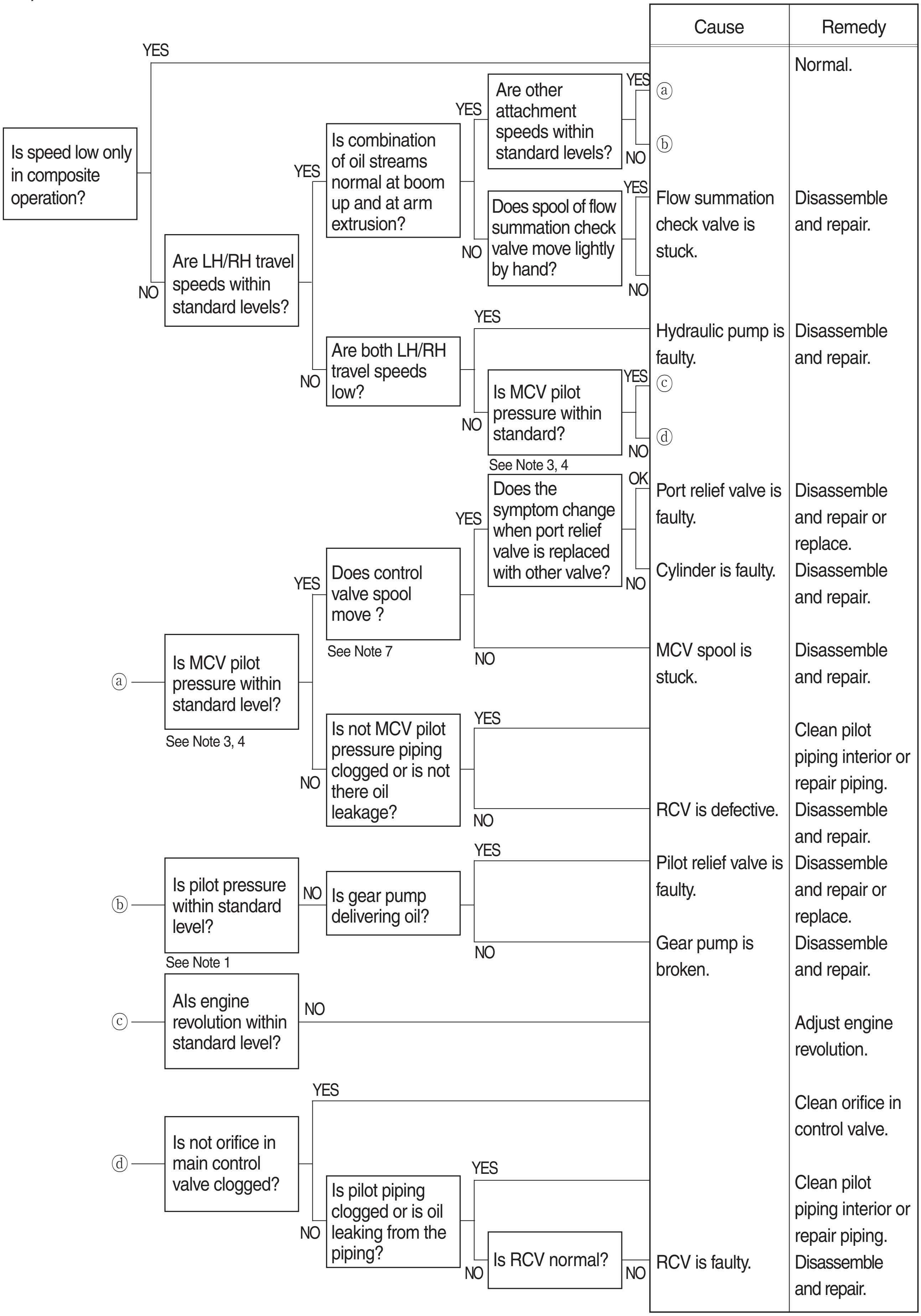


6. ATTACHMENT SYSTEM

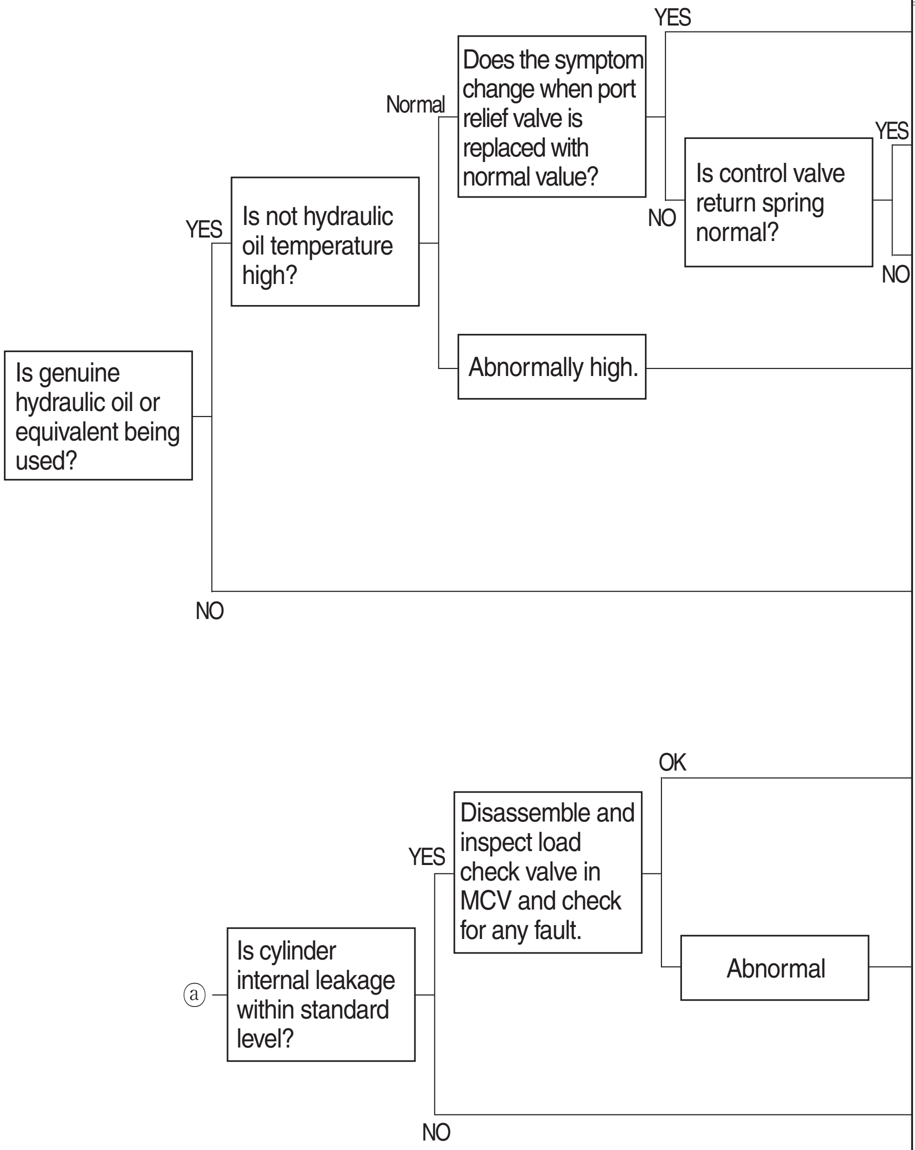
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

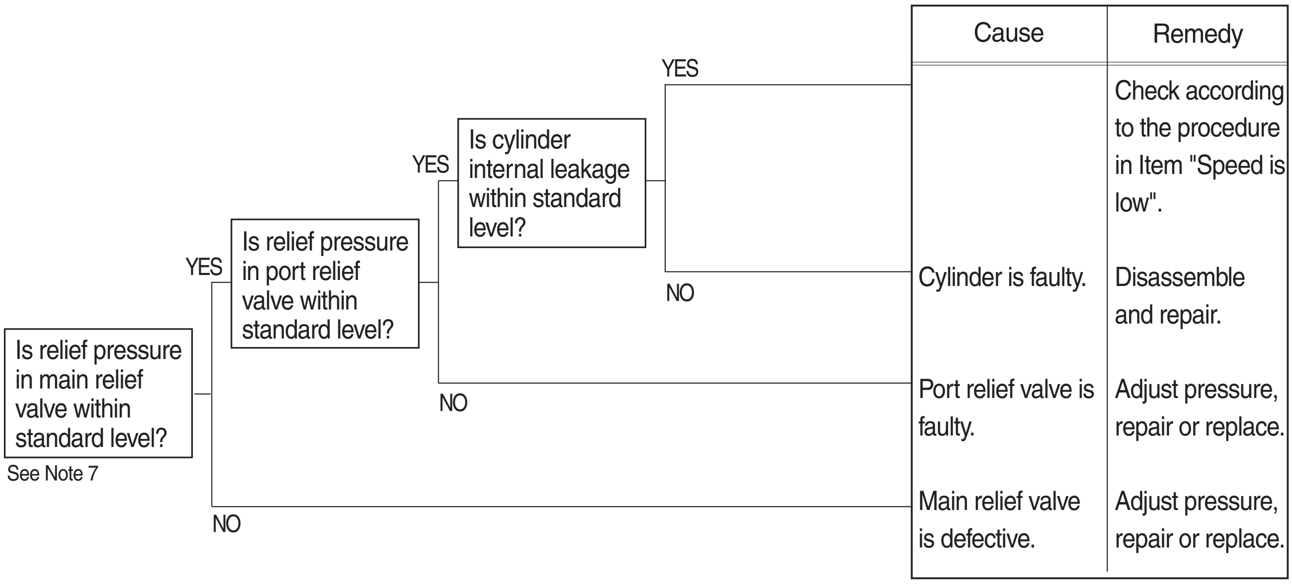


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

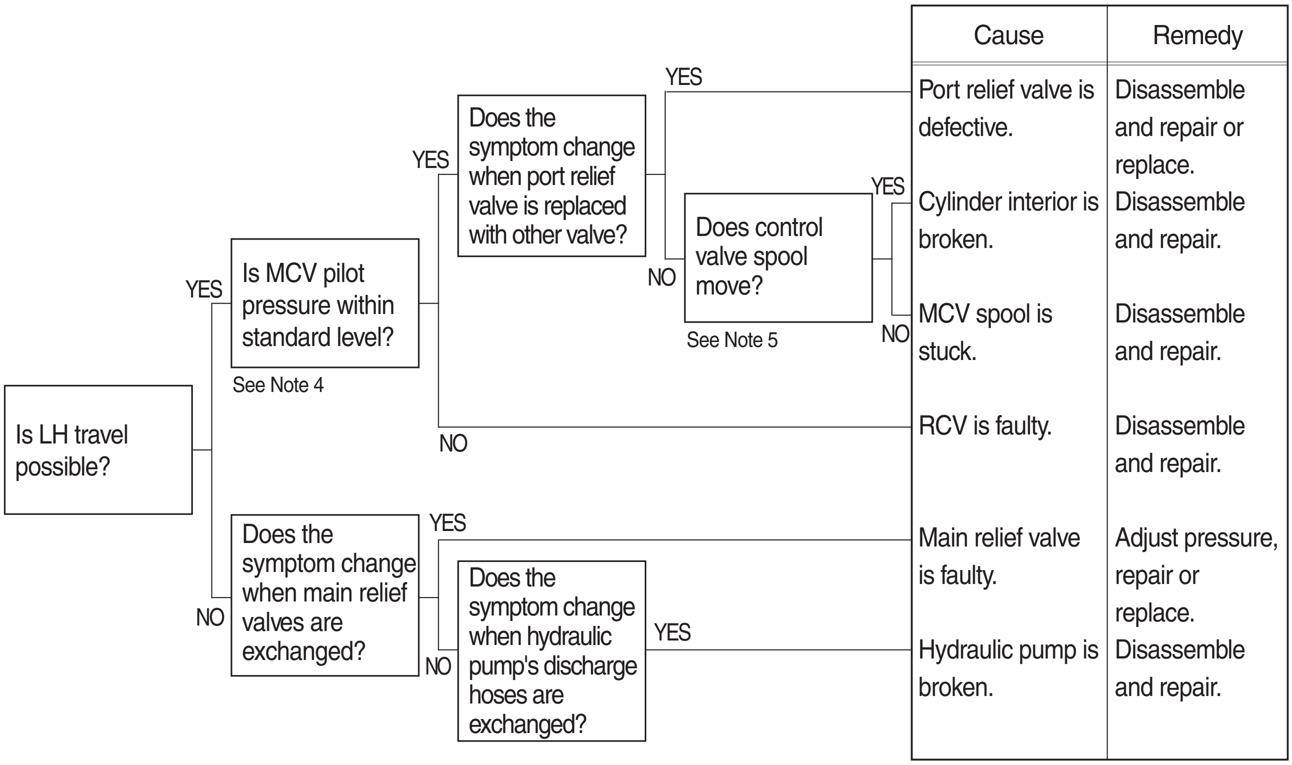


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between control valve casing and spool is poor.	Disassemble and repair.
Contact surface between poppet and seat is poor.	Disassemble and repair.
Cylinder is faulty.	Disassemble and repair.

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

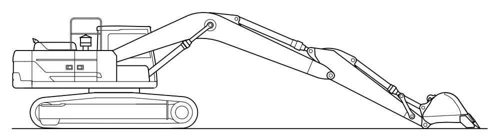
Check		Cause	Remedy
Is boom foot pin greased sufficiently?	YES		Frictional noise occurs between the sliding faces of boom cylinder's oil seal and boom proper. ※ Frictional noise will disappear if they are kept used.
	NO	Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in an initial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

7) TIME LAG OF MACHINE WORKING IS LARGE.

Check		Cause	Remedy
Is overload relief valve for each spool working properly?	YES		Refer to 2)
	NO	Overload relief valve is faulty.	Disassemble and repair.

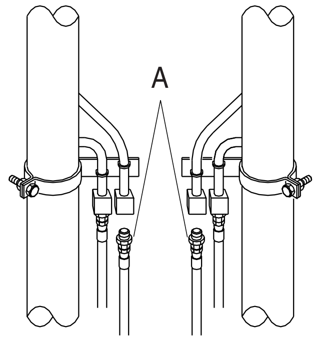
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



300L6TS01

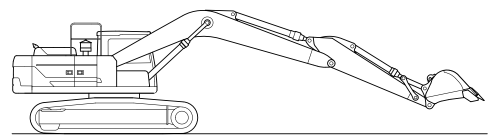
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(210-7) 6-20(2)

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

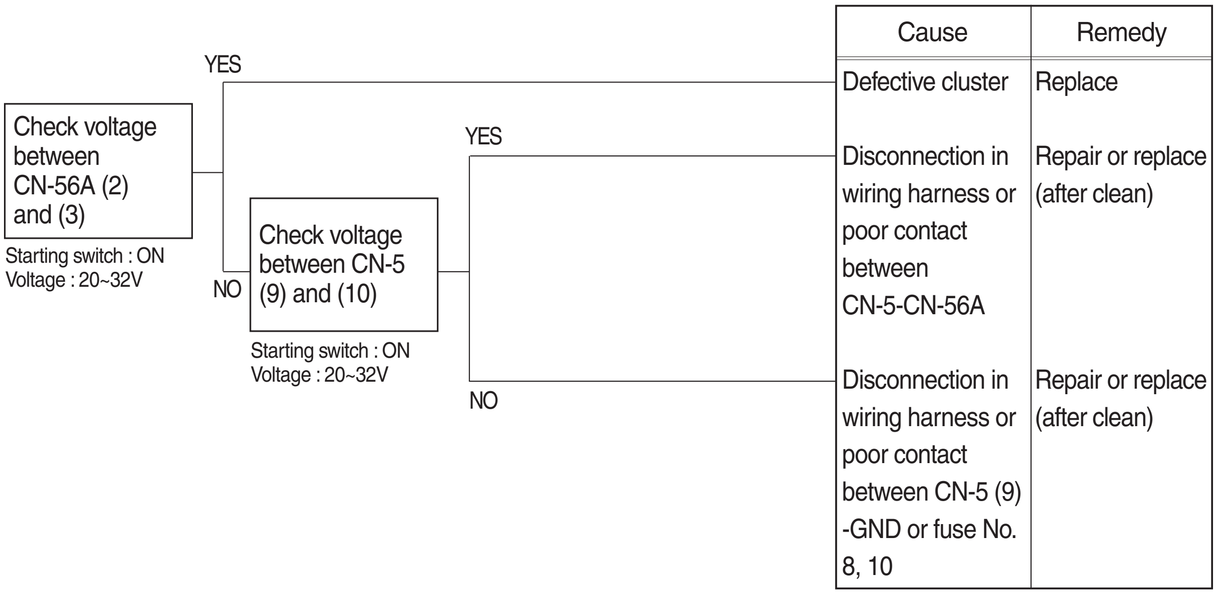
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



300L6TS02

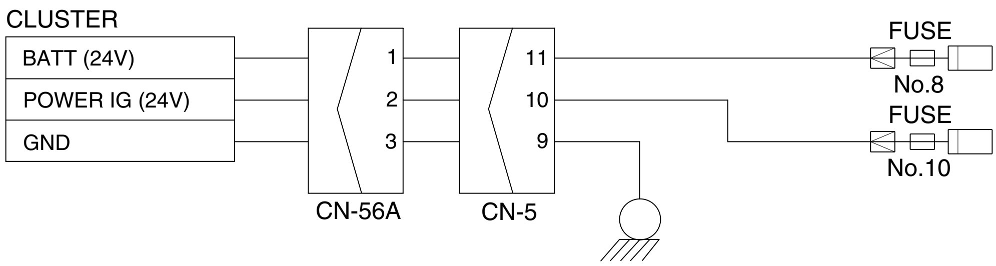
1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

· 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. 8, 10.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check voltage

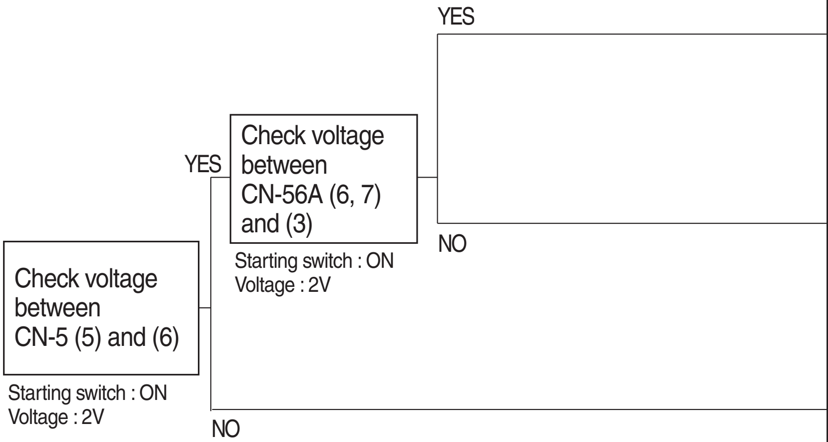
YES	20~32V
NO	0V



220S6ES01

2. ⚠ COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

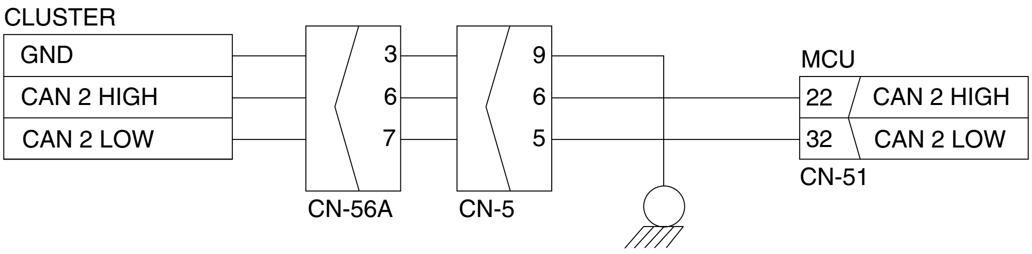
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56A (6, 7)-CN-5 (5, 6)	Repair or replace (after clean)
Defective MCU Disconnection in wiring harness or poor contact between CN-5 (5, 6)- CN-51(22, 32)	Replace Repair or replace (after clean)

Check voltage

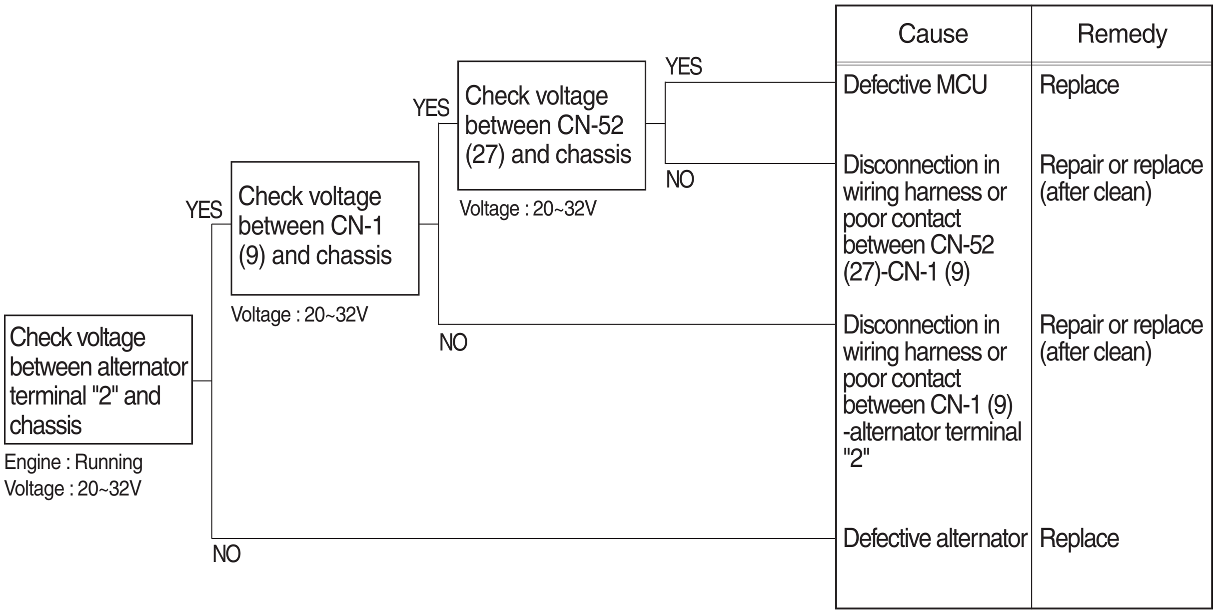
YES	2V
NO	0V



300L6ES02

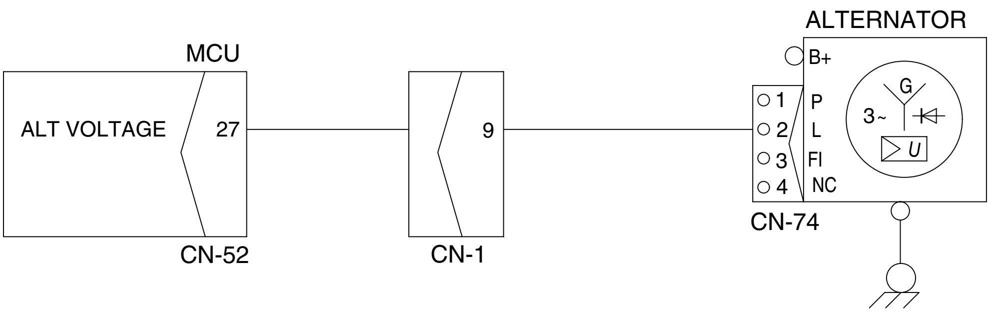
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

· 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	20~32V
NO	0V



220SA6ES03

4. 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.

Check resistance between temp sensor (A)-(B)

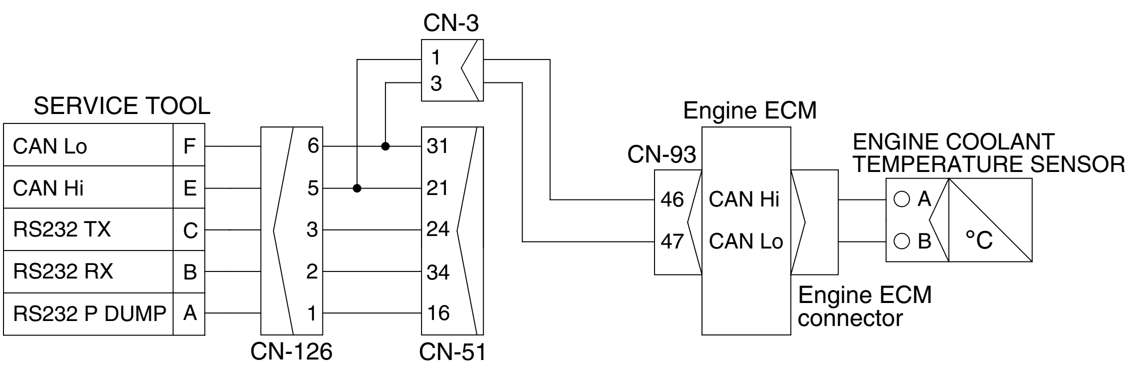
Starting switch : OFF
Spec : 180Ω~160 kΩ
See table

- YES → Check resistance between engine ECM connectors
  Spec : 180Ω~160 kΩ
  - YES → Cause: Check use HRDT — Remedy: Check or replace
  - NO → Cause: Disconnection in wiring harness or poor contact between temp sensor-engine ECM connectors — Remedy: Repair or replace (after clean)
- NO → Cause: Defective coolant temp sensor — Remedy: Replace

Cause	Remedy
Check use HRDT	Check or replace
Disconnection in wiring harness or poor contact between temp sensor-engine ECM connectors	Repair or replace (after clean)
Defective coolant temp sensor	Replace

Check Table

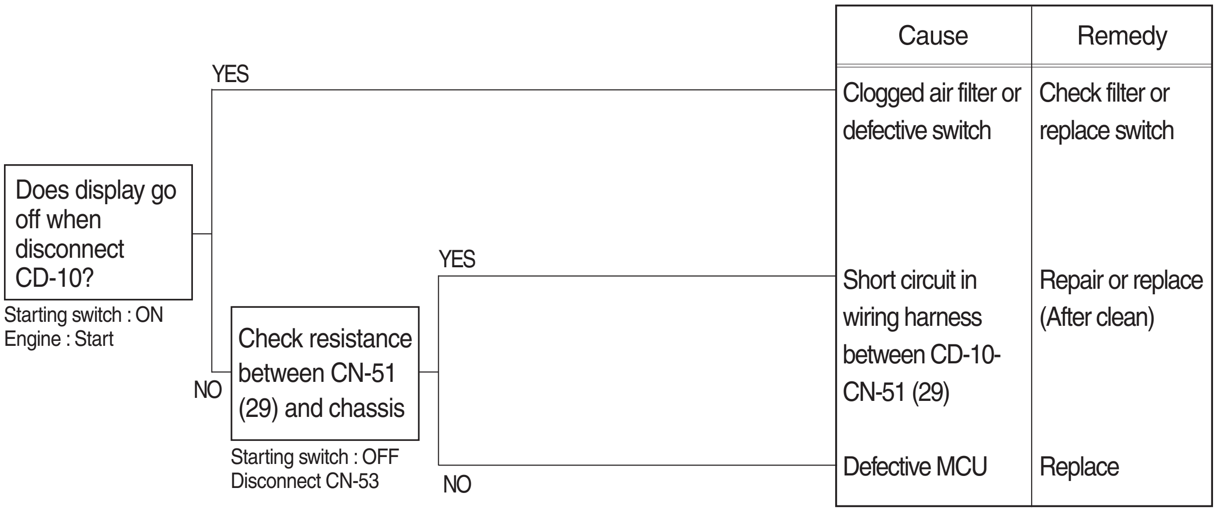
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



400SA6ES04

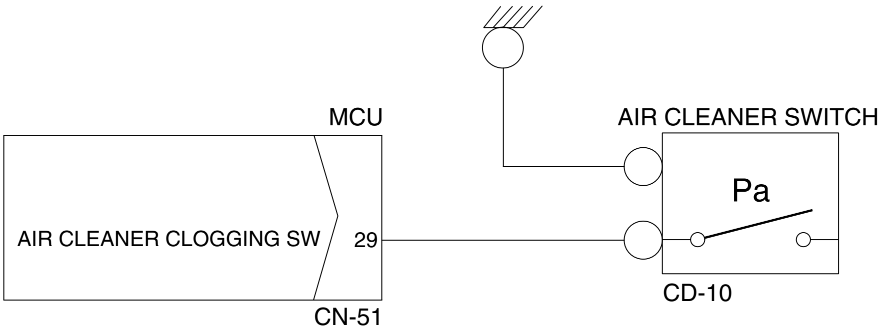
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

· 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.



Check resistance

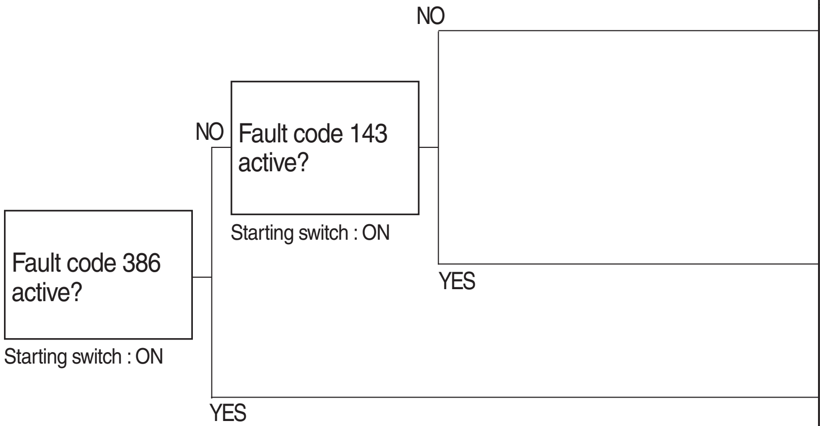
YES	MAX 1Ω
NO	MIN 1MΩ



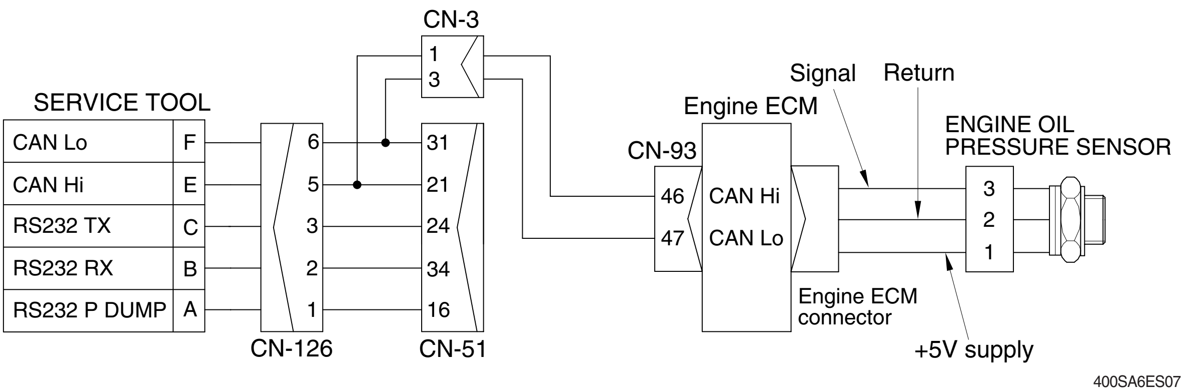
220S6ES05

6. 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.

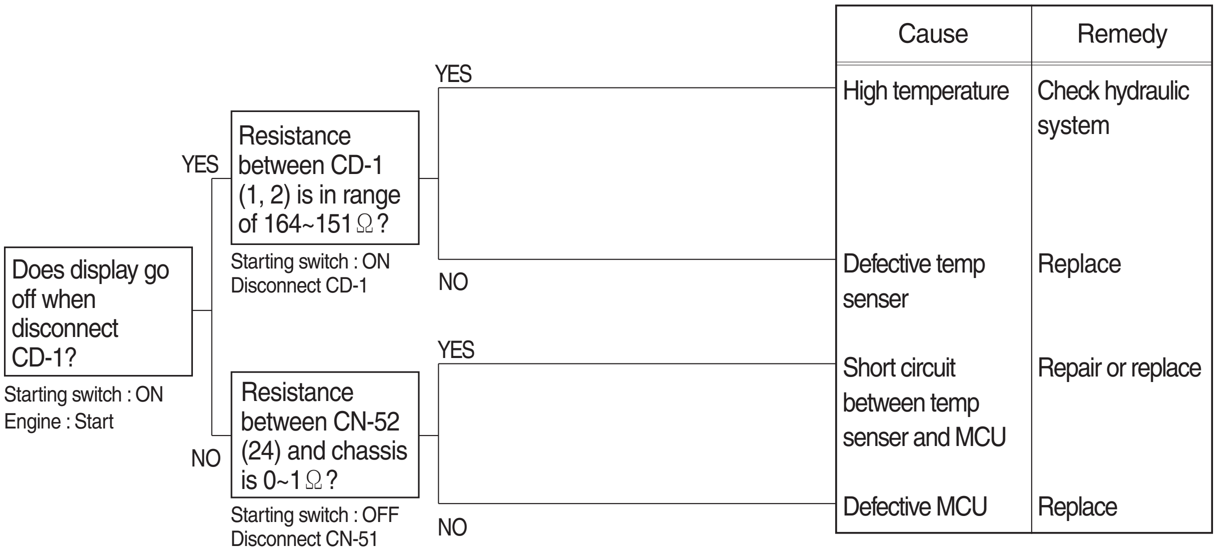


Cause	Remedy
Defective circuit, sensor or ECM.	Contact Cummins.
Voltage above normal or shorted to high source	Refer to engine fault code 143
Voltage above normal or shorted to high source	Refer to engine fault code 386



7. WHEN HYDRAULIC OIL TEMPERATURE 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.

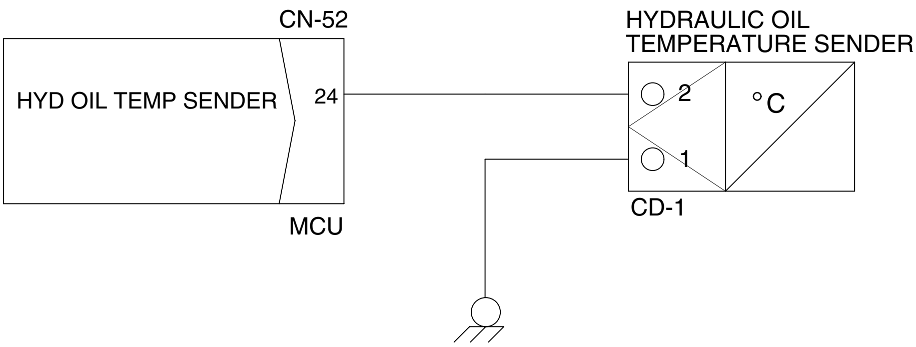


Normal type

Premium type

Check Table

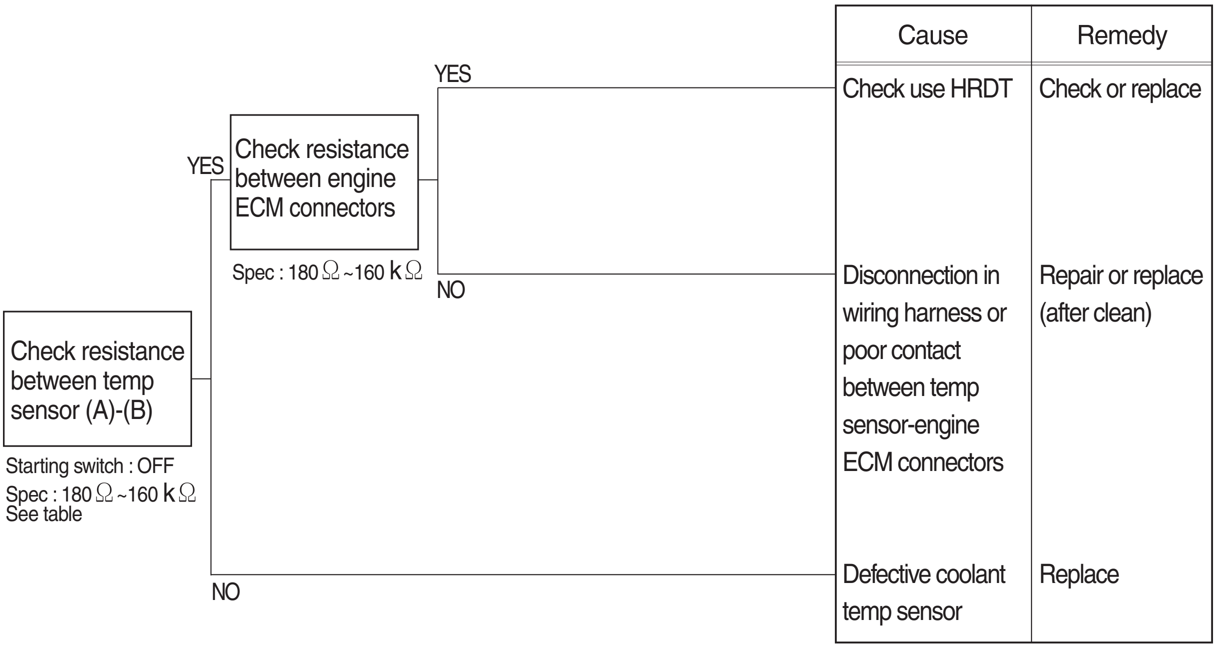
Temperature (°C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



220SA6ES08

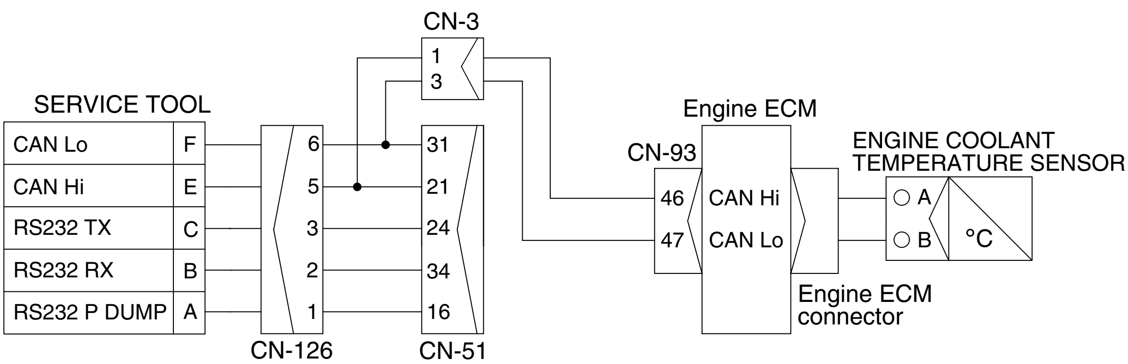
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE (HCESPN 304, FMI 3 or 4) GAUGE DOES NOT OPERATE

· 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

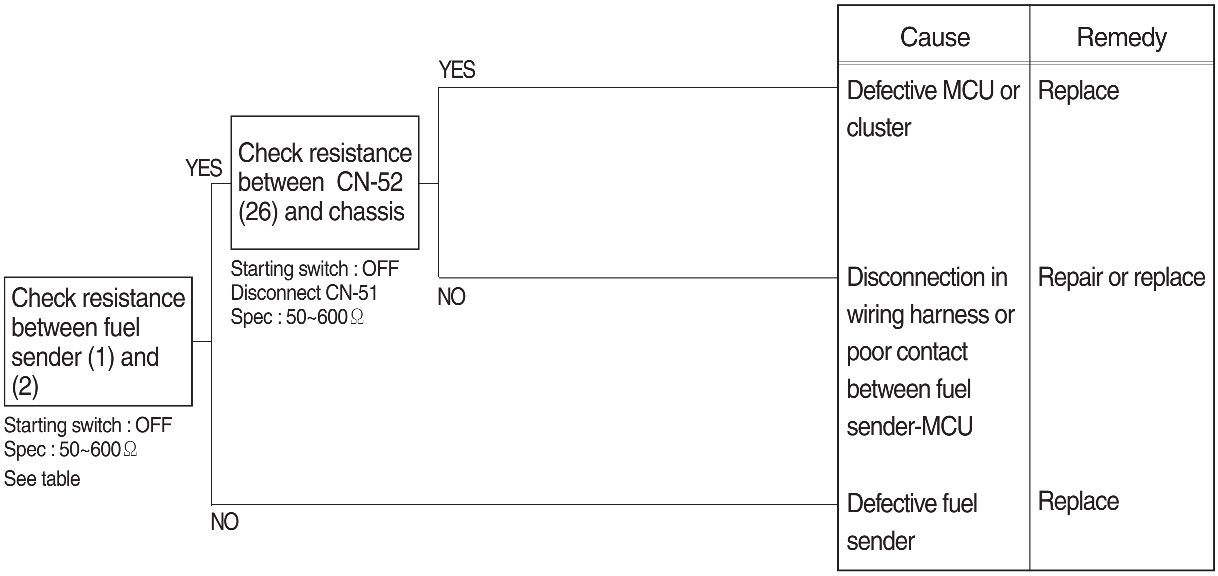
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



400SA6ES04

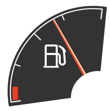
9. WHEN FUEL GAUGE DOES NOT OPERATE (HCESPN 301, FMI 3 or 4)

· 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.



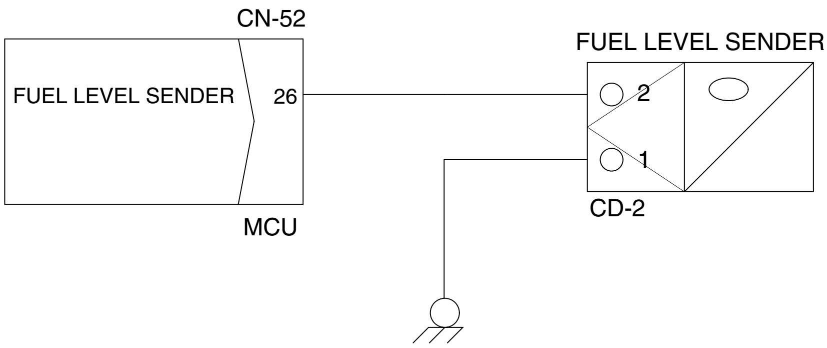
Normal type

Premium type



Check Table

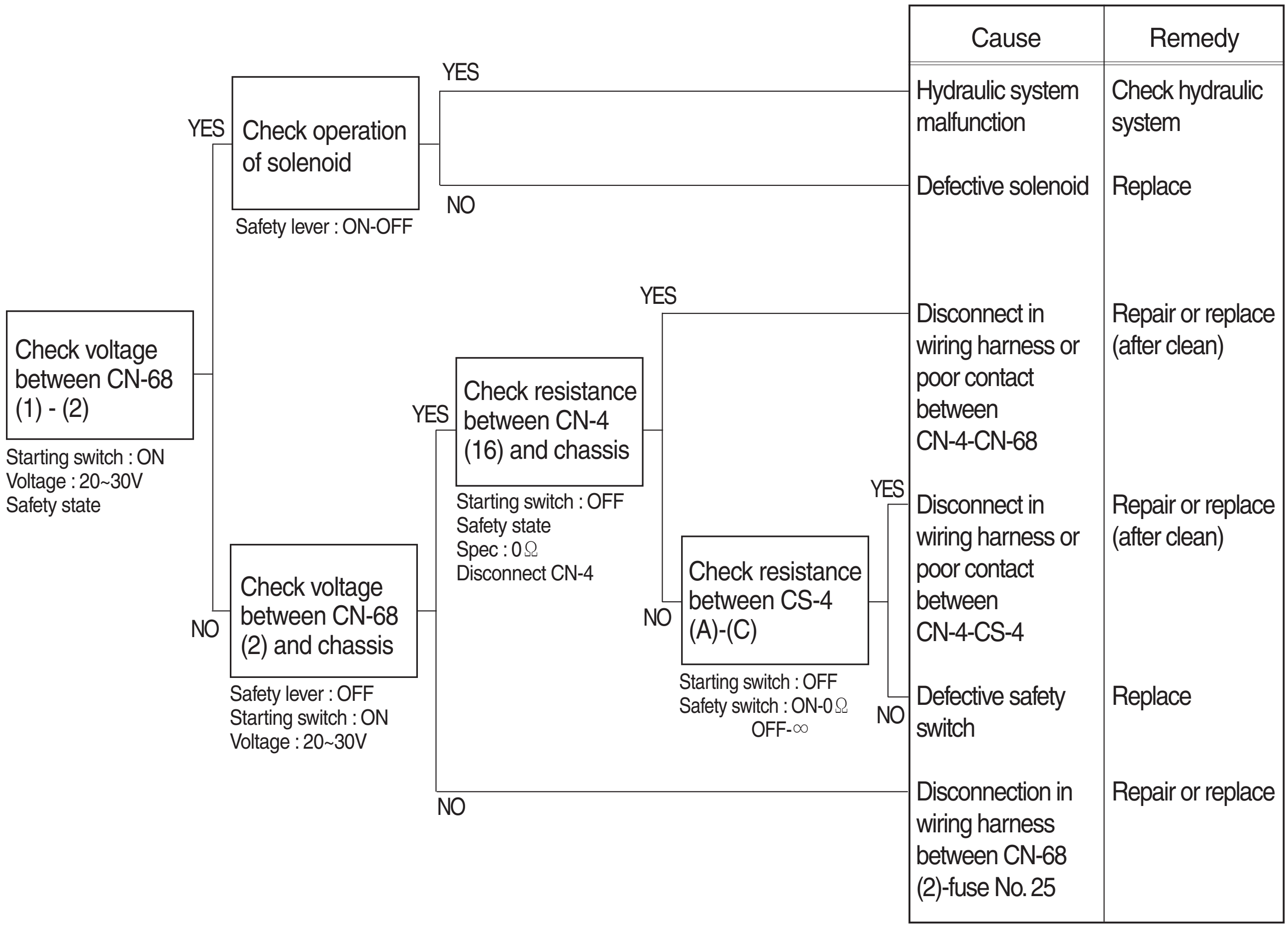
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

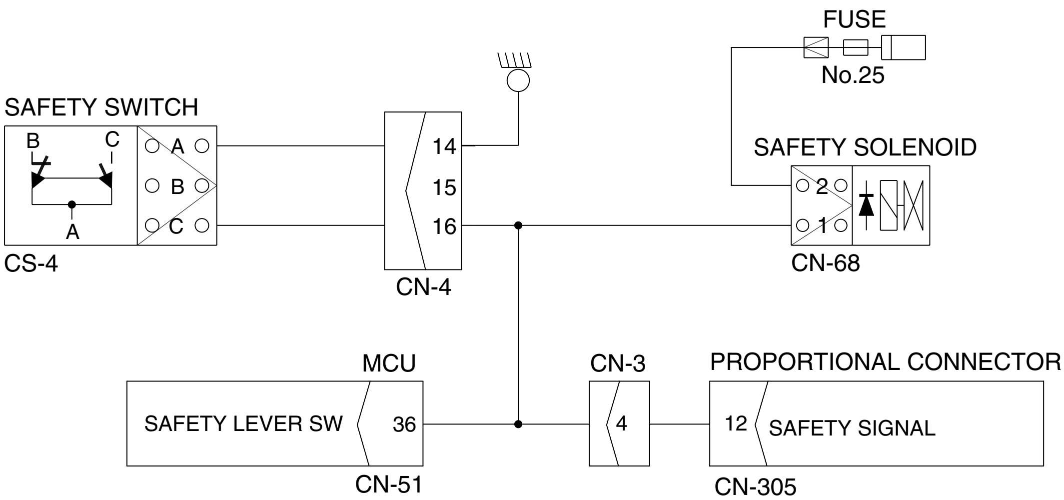


220SA6ES10

10. 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. 25.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





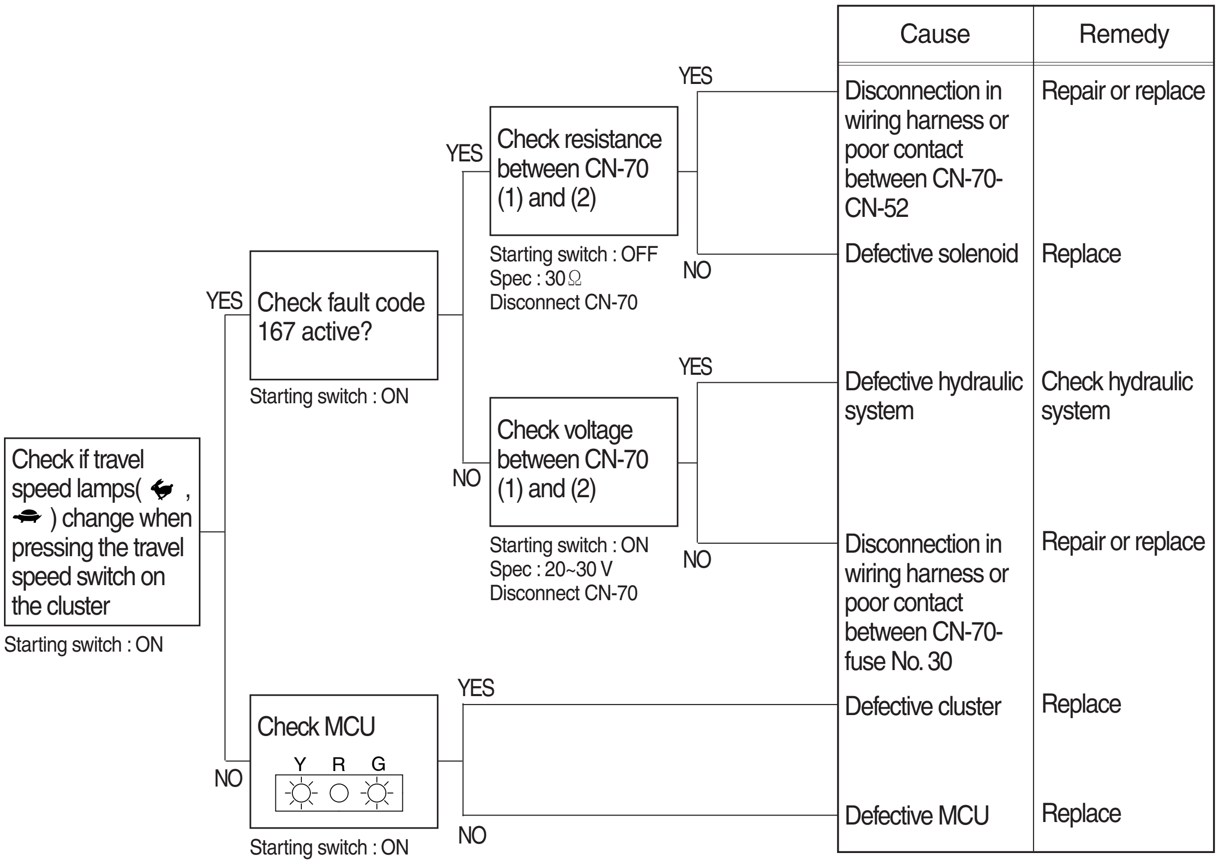
220SA6ES12

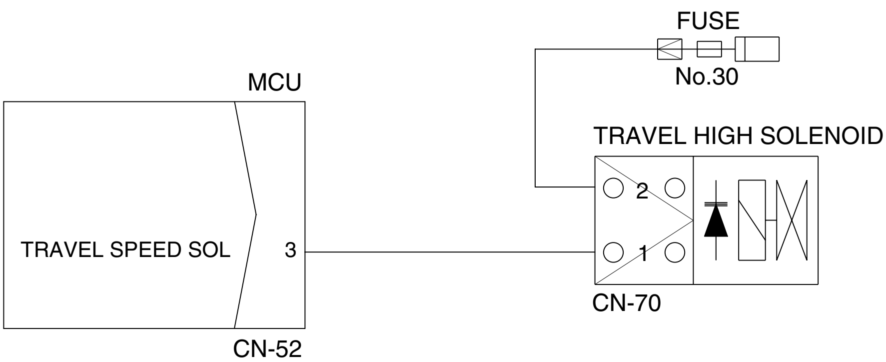
11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 4 or 6)

· 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. 30.

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





220S6ES13

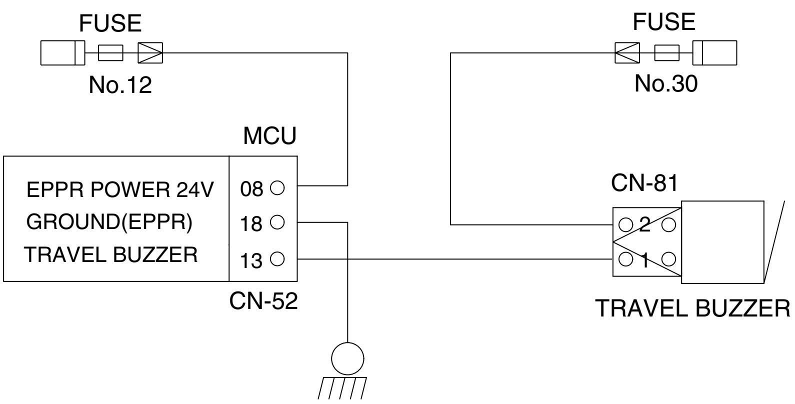
12. TRAVEL ALARM DOES NOT SOUND OR DOES NOT STOP SOUNDING

Check the fuse for travel alarm inside fuse box whether fuse is blown or not

- YES → The fuse is blown
- NO → Check the signal of MCU's pin for back buzzer whether ground signal (DO) generate or not when machine travel mode.
  - YES → The travel alarm signal of united MCU is defective
  - NO → * Prepare with starting switch OFF, then turn start engine and carry out troubleshooting : Between CN-81 (2) - chassis ground : 20-30 voltage . Between CN-81 (1) - chassis ground : Max 1 Ω (resistance) Is the above value normal?

    ** Note : Since voltage value , connector number and pin number varies with each model, should refer to the electric circuit of each model.
    - YES → The travel buzzer is defective
    - NO → * Prepare with starting switch OFF, then carry out trouble-shooting without turning starting switch ON : 1. Disconnection in wiring or defective contact in connector between CN-81 (2) inline connector-end connector : Max 1 Ω (resistance) 2. Short circuit with ground circuit between CN-81 (2) inline connector-end connector - chassis ground : Min 1MΩ (resistance)
      - NO → In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit

Cause	Remedy
The fuse is blown	Replace the fuse
The travel alarm signal of united MCU is defective	Check the united MCU program
The travel buzzer is defective	Replace the travel buzzer
In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit	Replace connector Connect the wire



220SA6ES25

13. HORN DOES NOT SOUND

Check the fuse for horn inside fuse box whether fuse is blown or not

YES → The fuse is blown → Replace the fuse

NO → After replacing the relay for horn, check the horn operate

YES → The relay is broken → Replace the relay

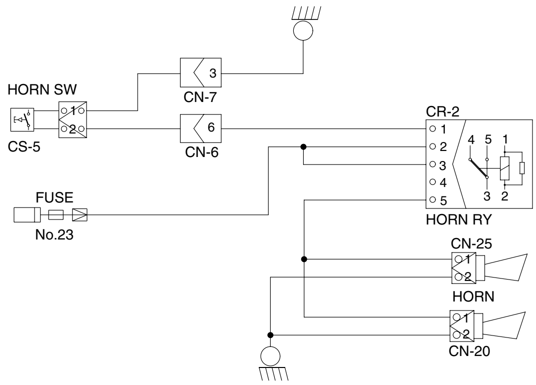
NO → * Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting : Between CN-20 (1) or CN-25 (1) - chassis ground (with horn switch turned ON) : 20-30 voltage
* Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON : Between CN-20 (2) or CN-25 (2)- chassis ground : Max 1 Ω (resistance)
Is the above value normal?
** Note : Since voltage value , connector number and pin number varies with each model, should refer to the wiring diagram of each model.
<CN-20 (1)/ CN-25 (1) : Horn connector (+) terminal CN-20 (2) /CN-25 (2) : Horn connector (-) terminal>

YES → The horn is defective → Replace the horn

NO → * Prepare with starting switch OFF, then carry out trouble-shooting without turning starting switch ON :
1. Disconnection in wiring or defective contact in connector between CN-20 (1) or CN-25 (1) - inline connector-end connector : Max 1 Ω (resistance)
2. Short circuit with ground circuit between CN-20 (1) or CN-25 (1) - inline connector-end connector - chassis ground : Min 1M Ω (resistance)

NO → In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit → Replace connector. Connect the wire

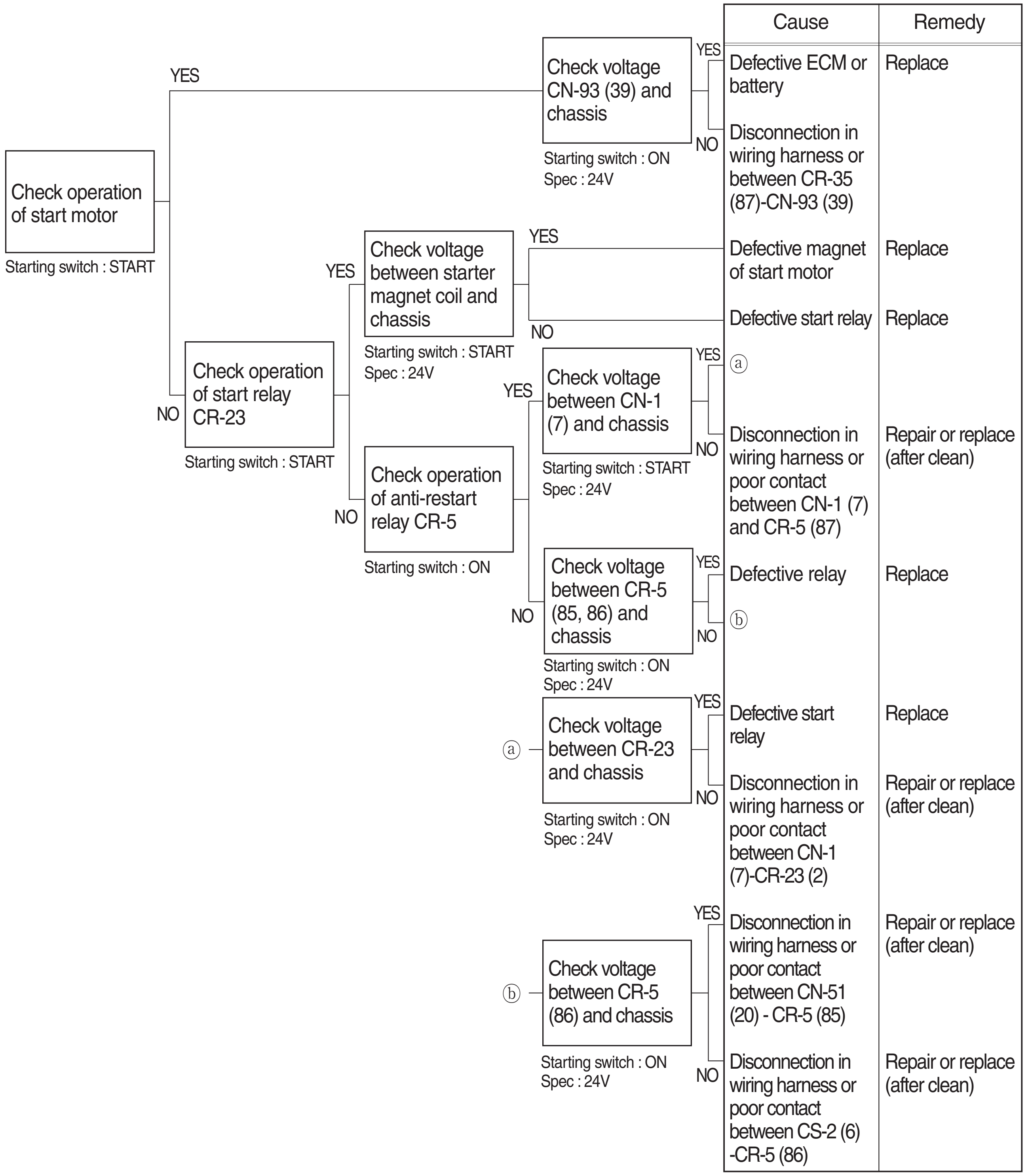
Cause	Remedy
The fuse is blown	Replace the fuse
The relay is broken	Replace the relay
The horn is defective	Replace the horn
In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit	Replace connector. Connect the wire

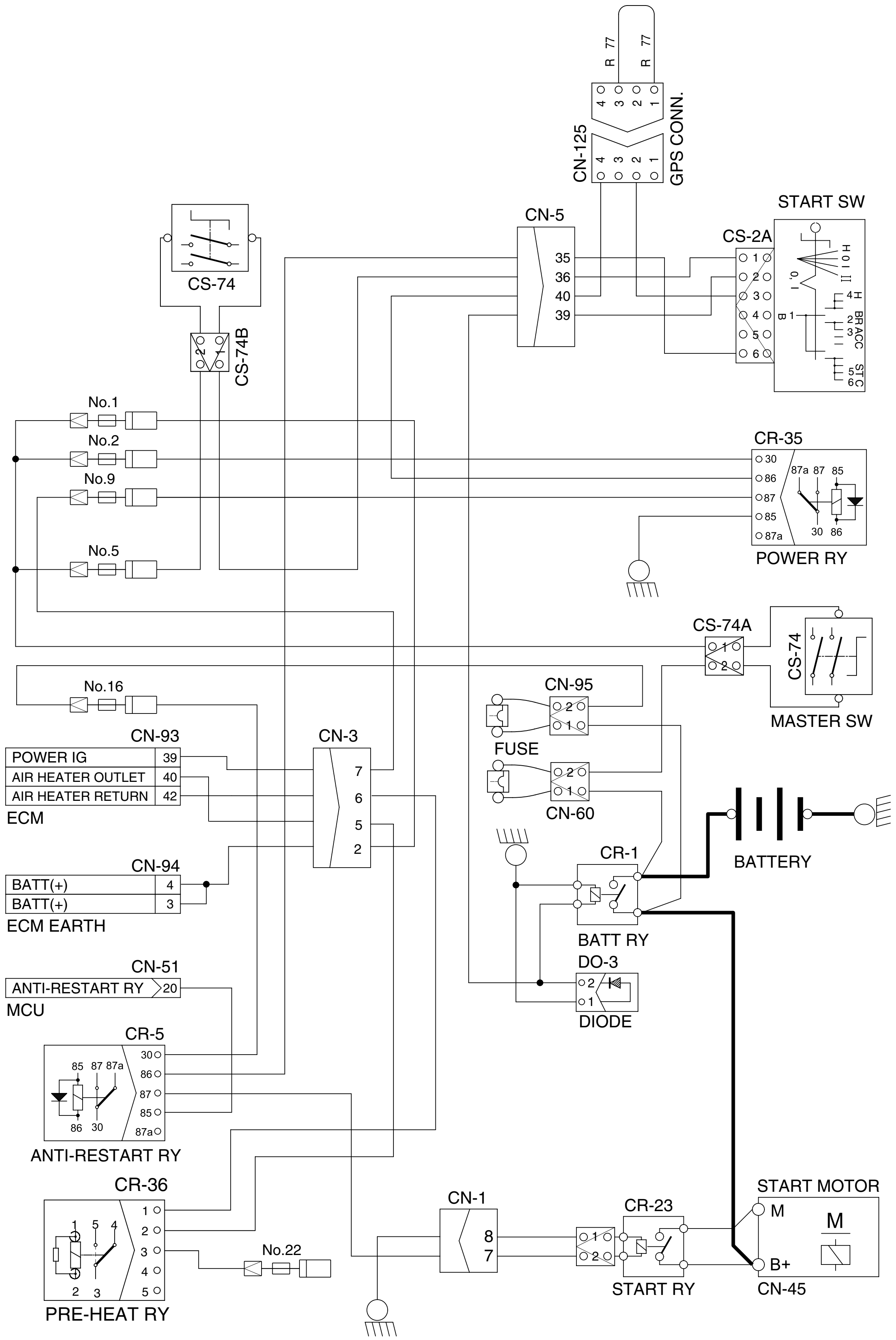


400SA6ES26

14. WHEN ENGINE DOES NOT START ([battery symbol: - +] lights up condition)

· Check supply of the power at engine stop solenoid while starting switch is ON.
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 1, 2, 5, 9 and 16 burnt out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

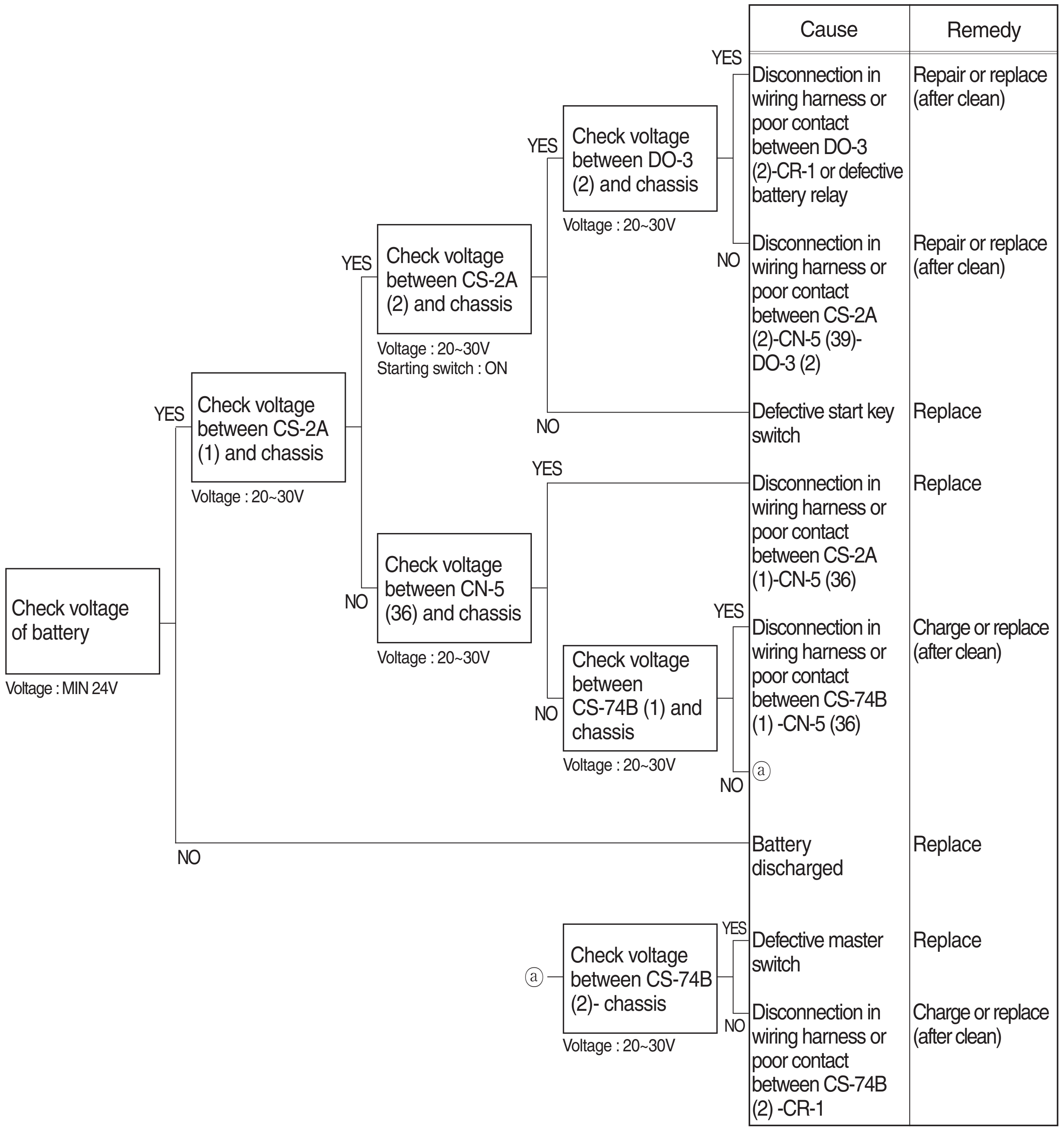


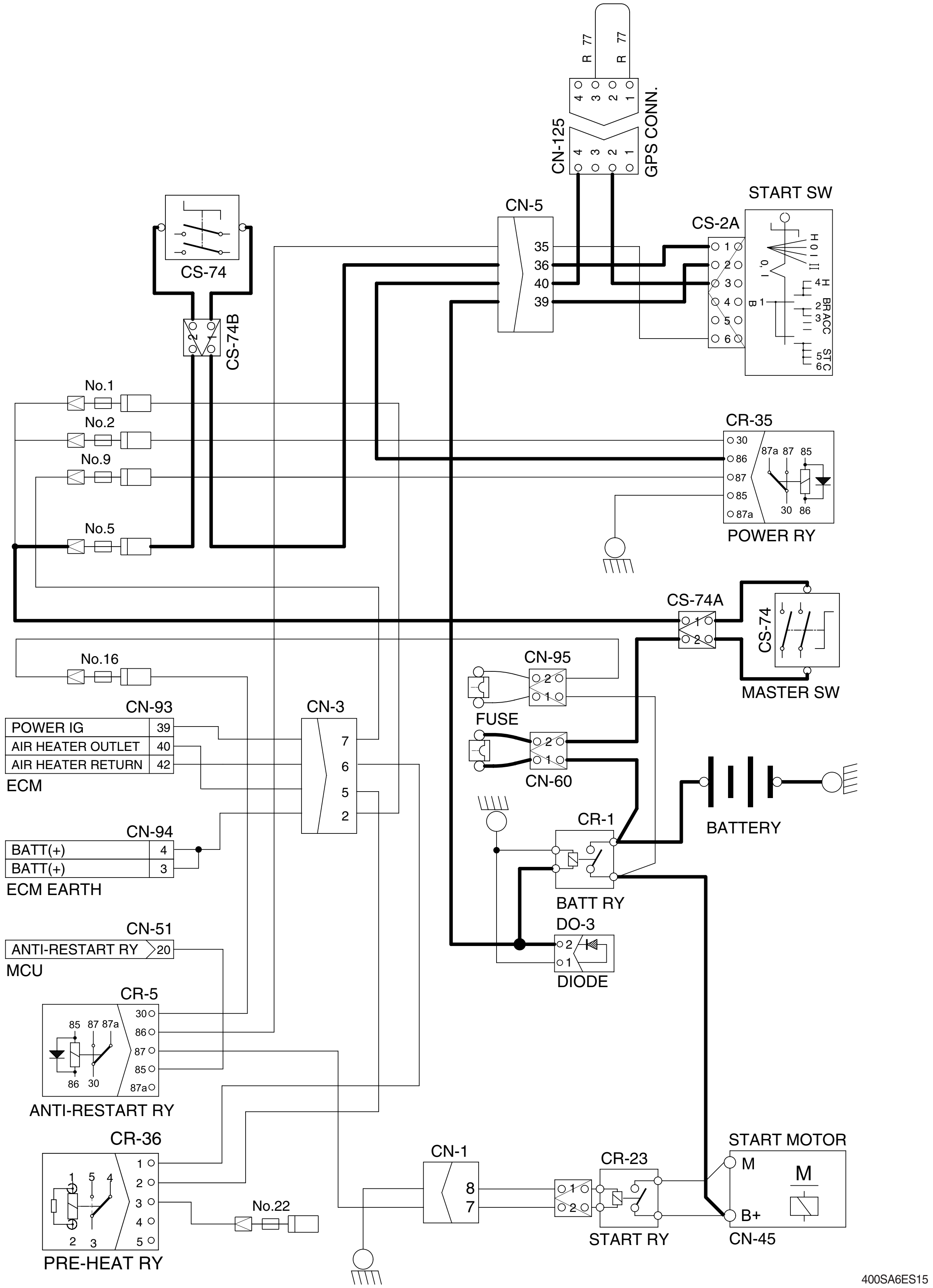


400SA6ES14

15. WHEN STARTING SWITCH ON DOES NOT OPERATE

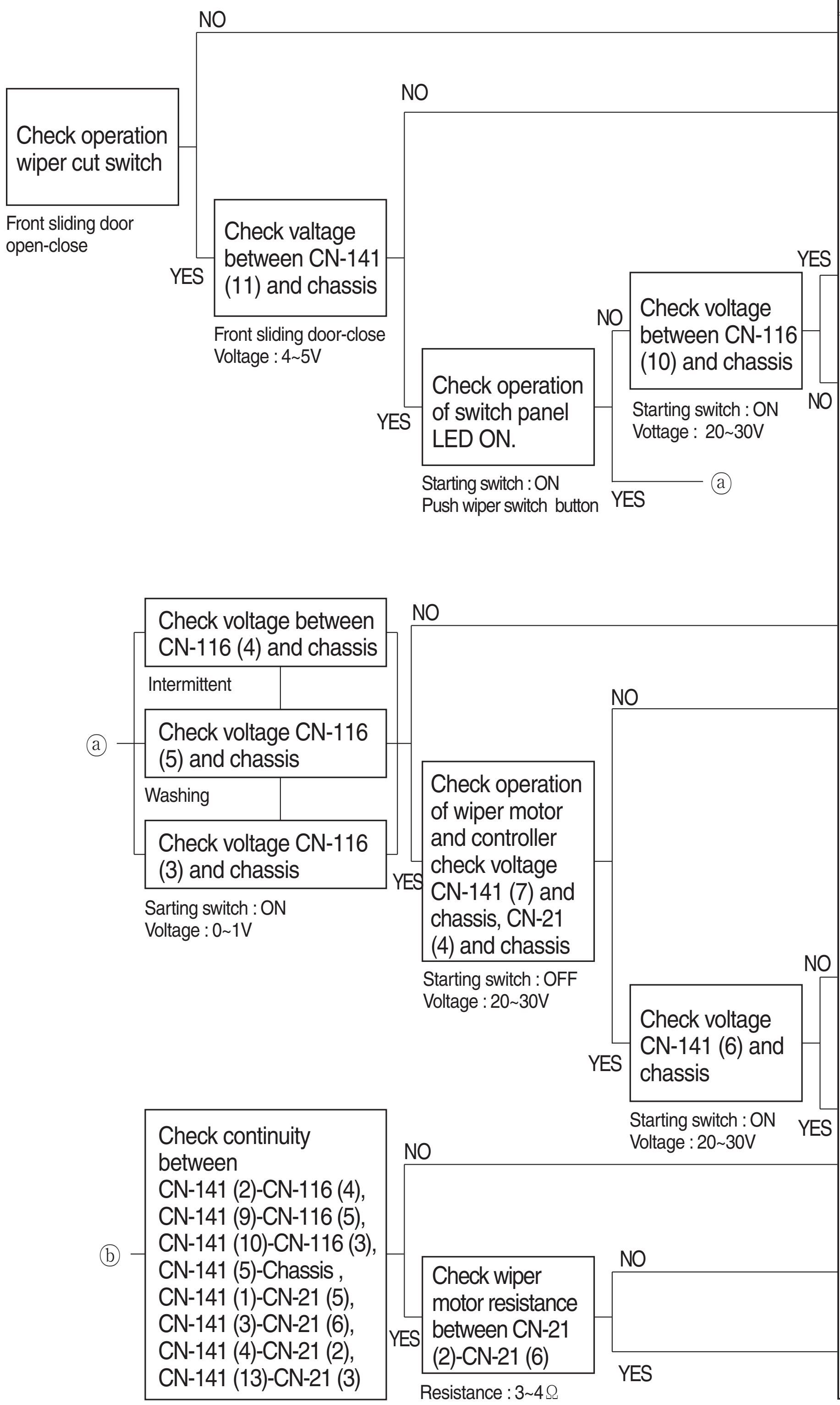
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check blown out of the fuse (CN-60).
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



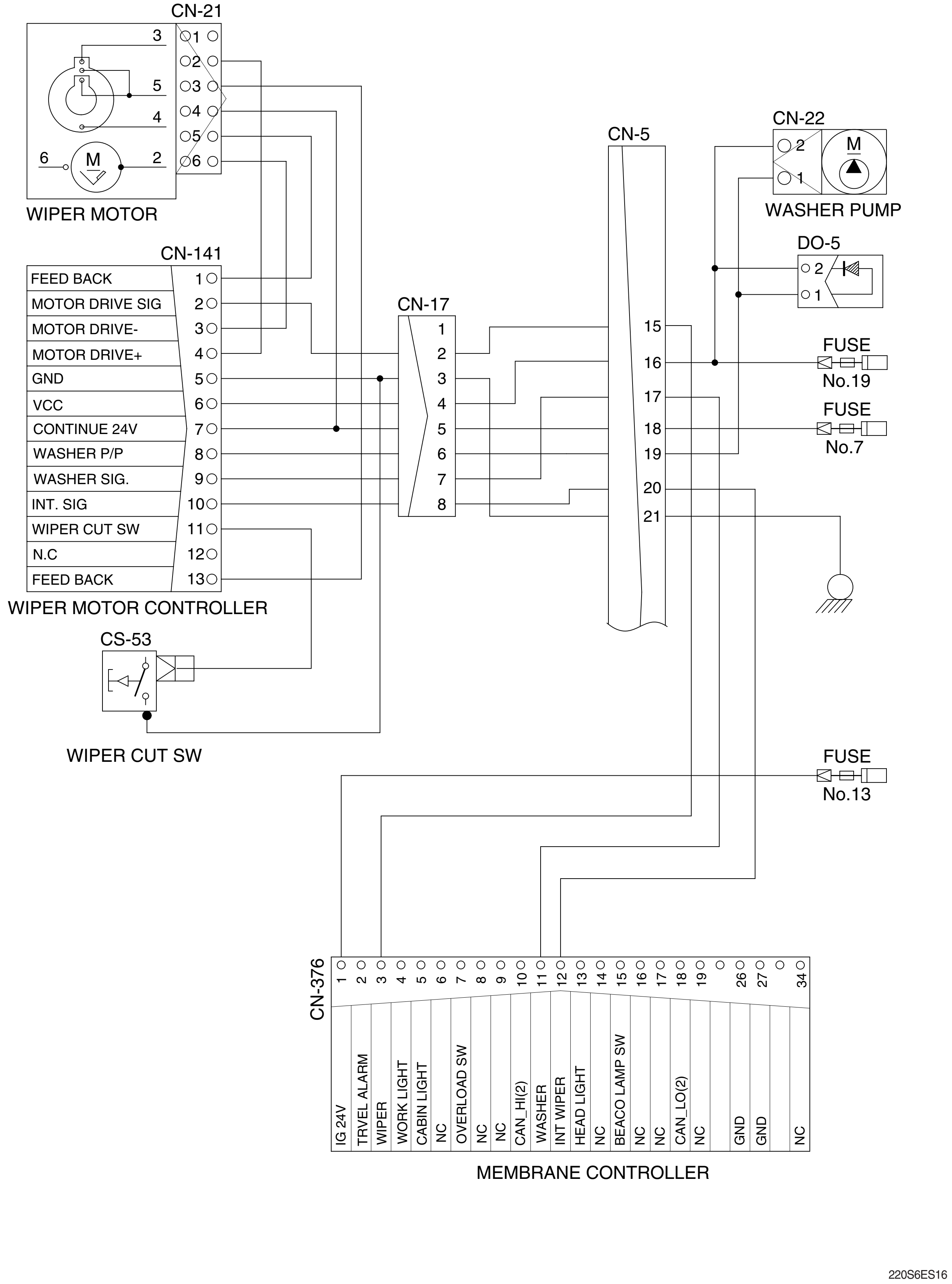


16. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 7, 13 and 19 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

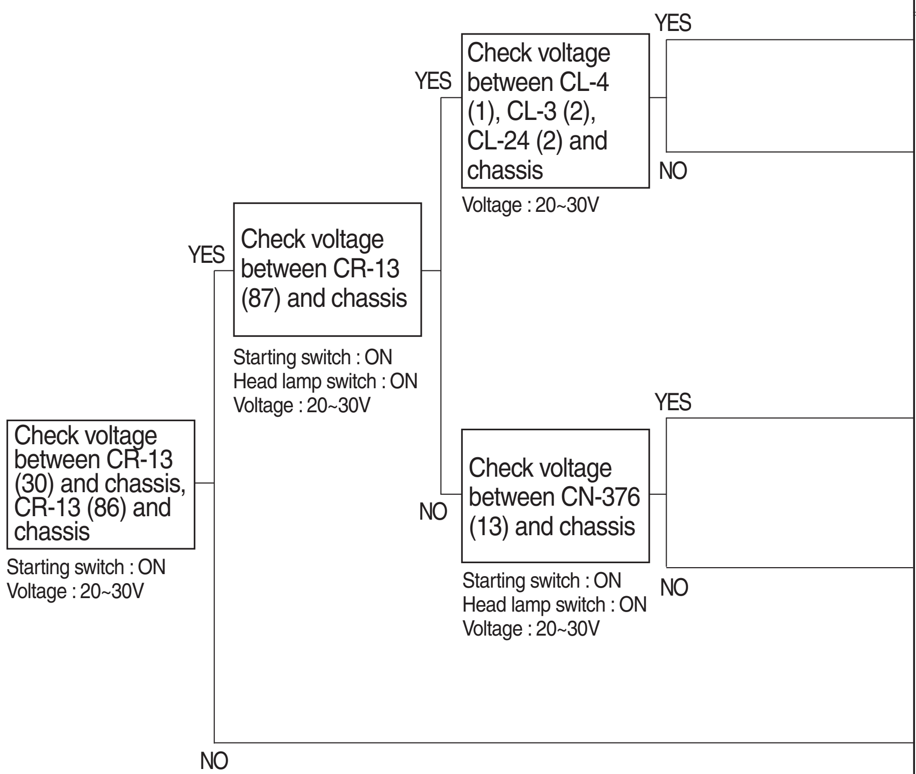


Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective switch panel	Replace
1)Recheck fuse No.13 2)Disconnection in wiring harness or poor contact between CN-376 (1)-Fuse No.13	Replace Repair or replace (after clean)
Defective switch panel	Replace
1) Recheck fuse No.7 2) Disconnection in wiring harness or poor contact between CN-141(7)-Fuse No.7, CN-21 (4)-Fuse No.7	Replace Repair or replace (after clean)
1) Recheck fuse No.19 2) Disconnection CN-141(6)-Fuse No.19 ⓑ	Replace Repair or replace (after clean)
Disconnection in wiring harness or poor contact	Repair or replace (after clean)
Defective wiper motor	Replace
Defective wiper motor controller	Replace

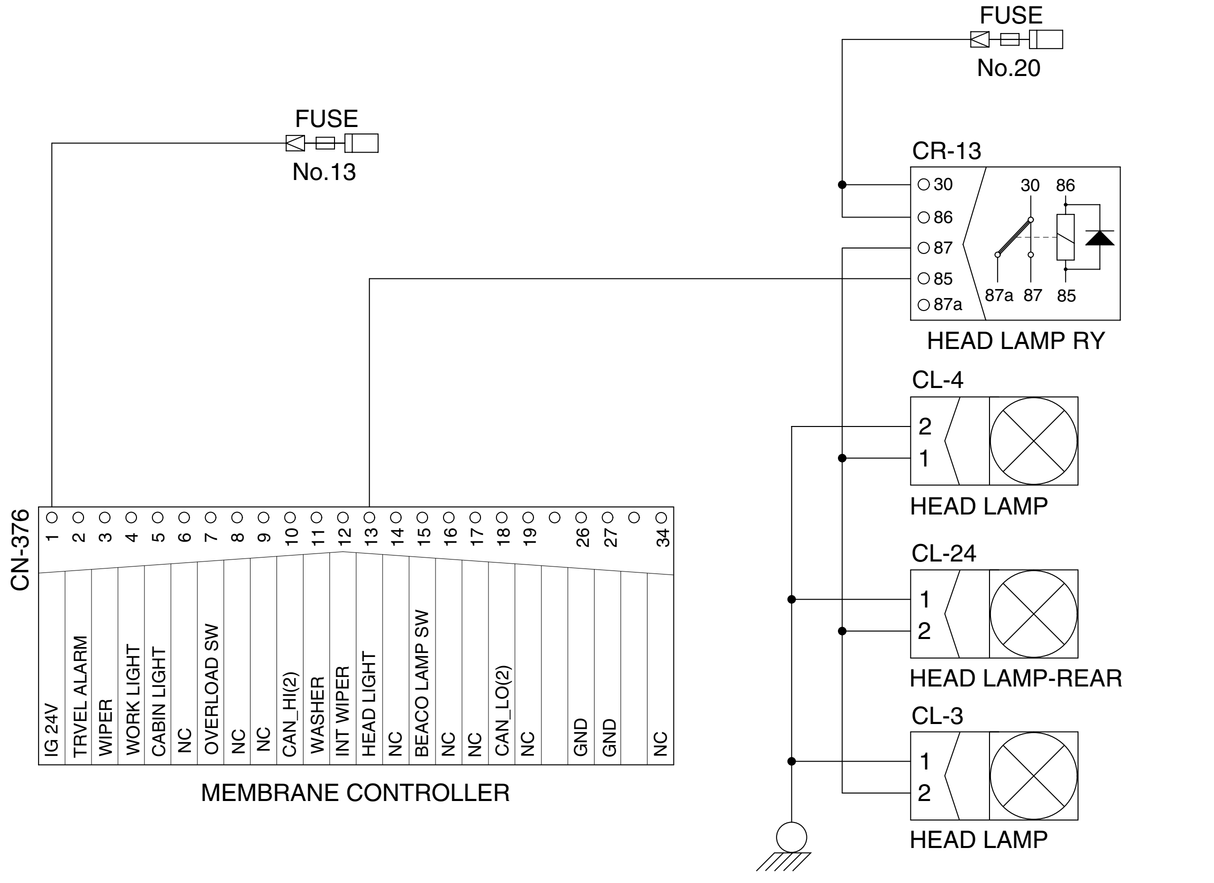


17. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

· 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.13 and 20.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



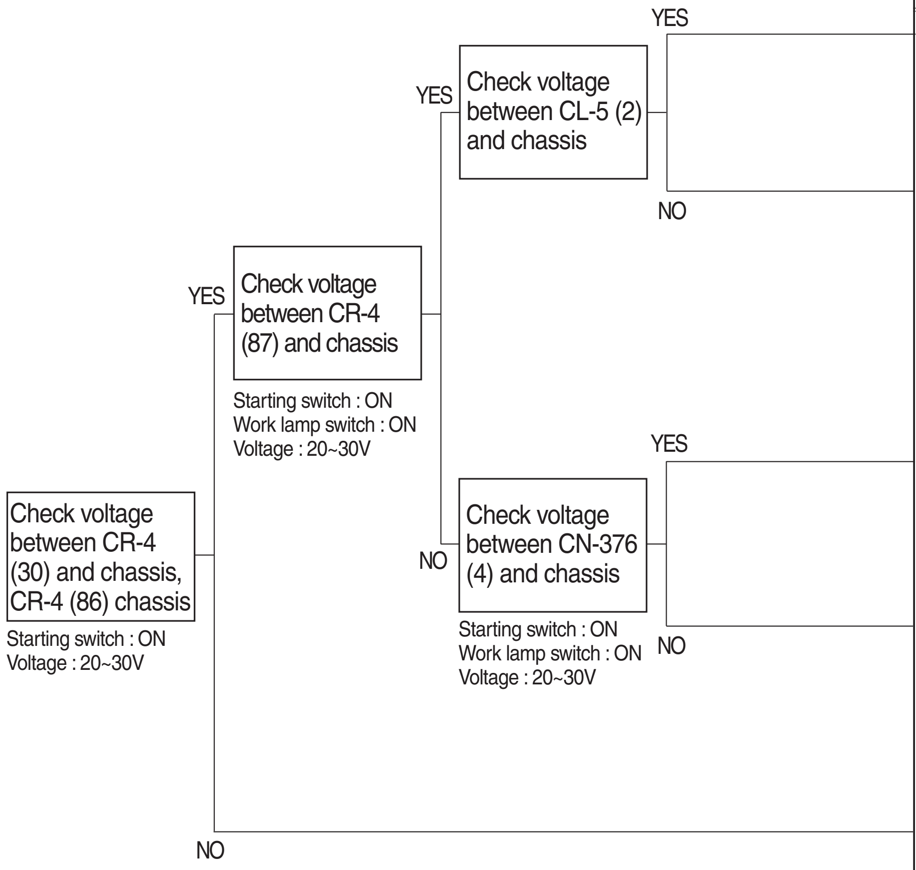
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13 (87)-CL-3 (2) or CR-13 (87)-CL-24 (2)	Repair or replace (after clean)
Defective membrance controller	Replace
Disconnection in wiring harness or poor contact between CN-376 (13)-CR-13 (85)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (30) and fuse No.20 or CR-13 (86) - fuse No.20	Repair or replace (after clean)
Recheck fuse No. 20	Replace



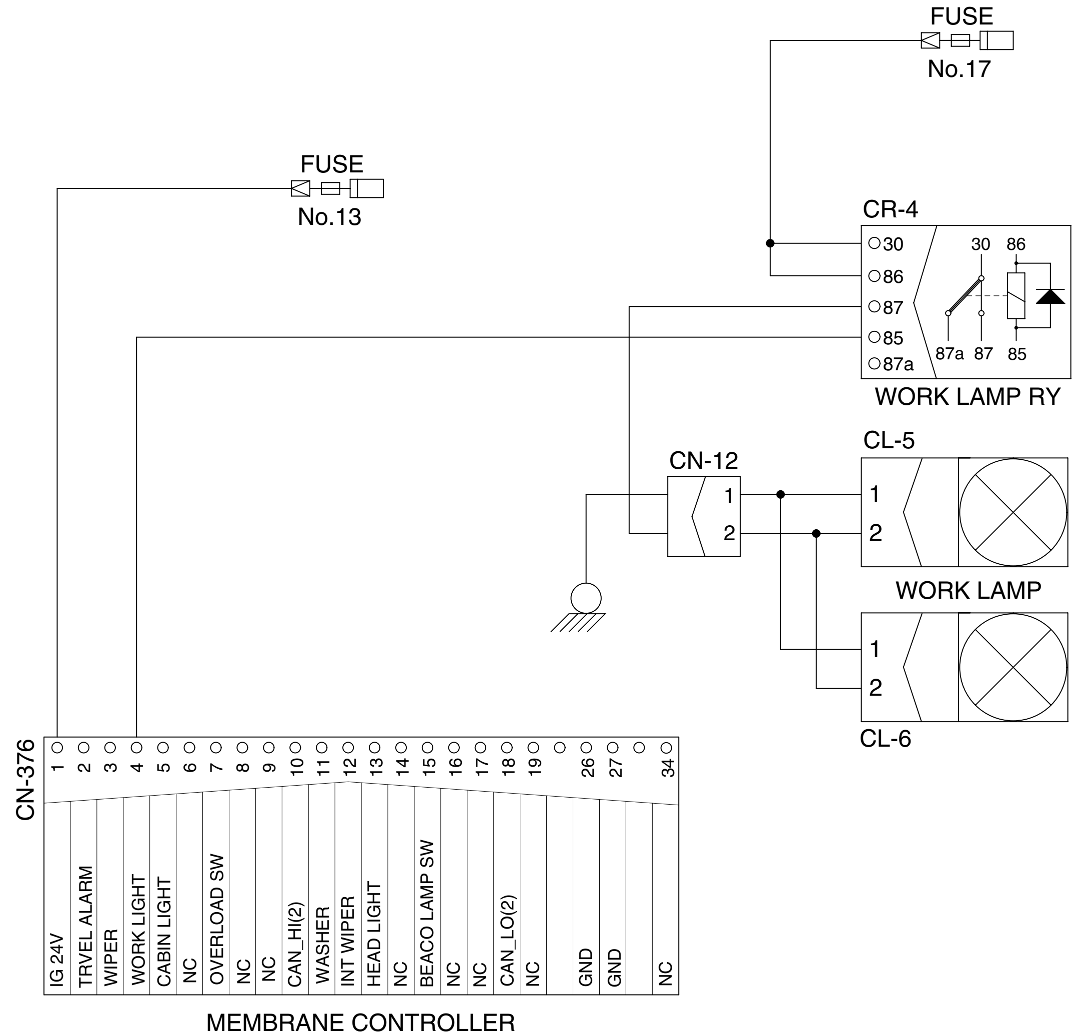
220S6ES17

18. 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 13 and 17.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-4 (87)-CL-5 (2)	Repair or replace (after clean)
Defective membrance controller	Replace
Disconnection in wiring harness or poor contact between CR-4 (85)-CN-376 (4)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-4 (30) and fuse No.17 or CR-4 (86) and fuse No.17	Repair or replace (after clean)
Recheck fuse No.17	Replace



220S6ES18

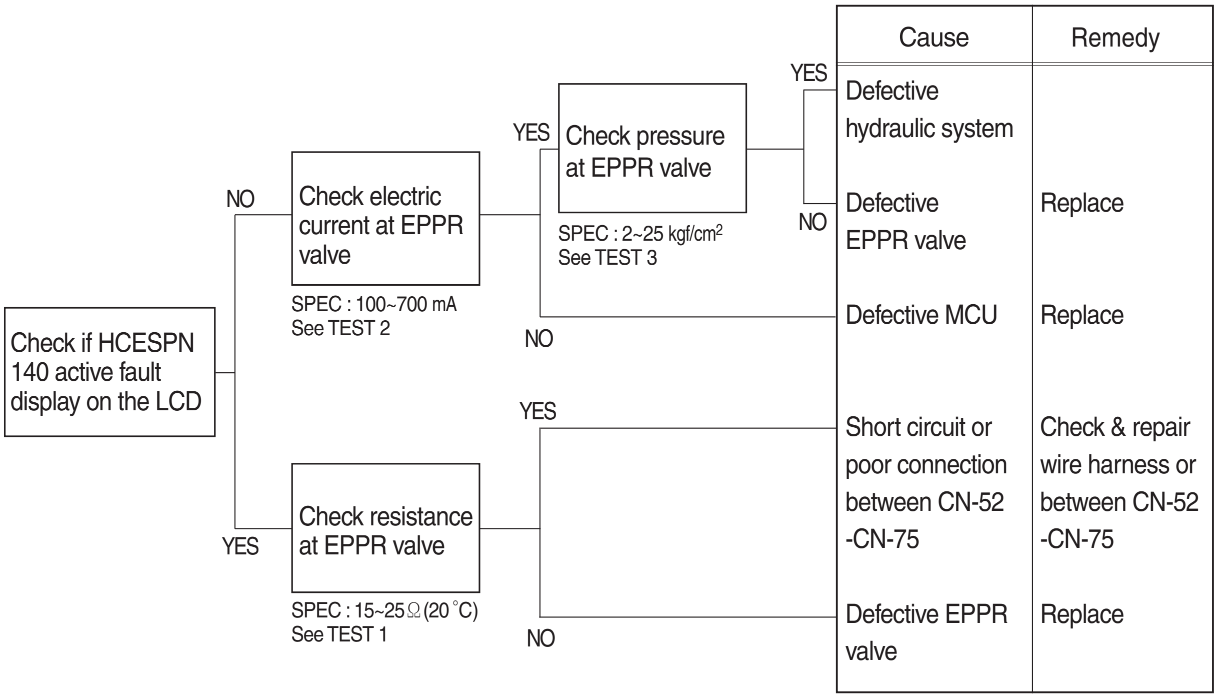
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.

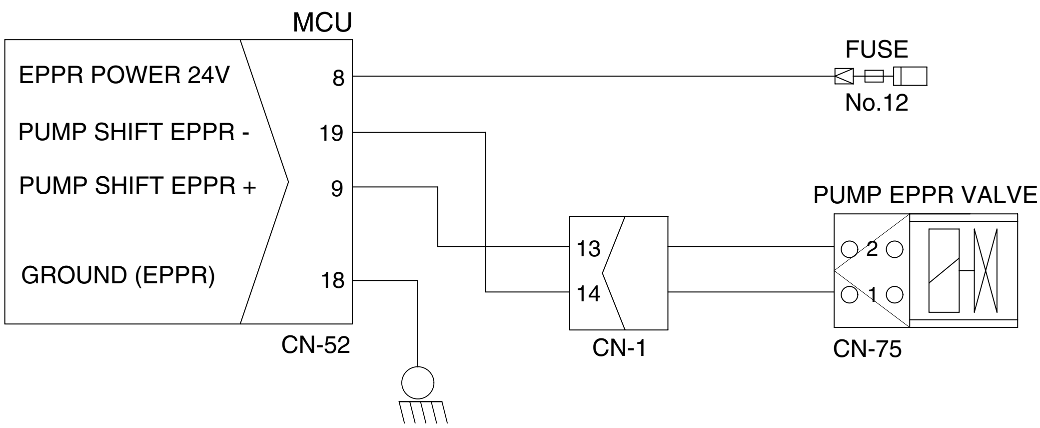
※ Spec : P-mode 1650 ± 50 rpm S -mode 1550 ± 50 rpm E-mode 1450 ± 50 rpm

※ Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE



Wiring diagram



220SA6MS01

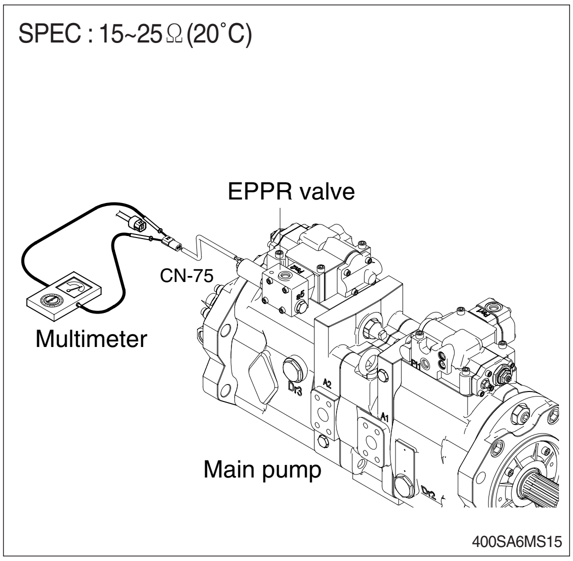
2) TEST PROCEDURE

(1) Test 1 : Check resistance at connector CN-75.

① Starting key OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.



(2) Test 2 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.

② Insert the adapter to CN-75 and install multimeter as figure.

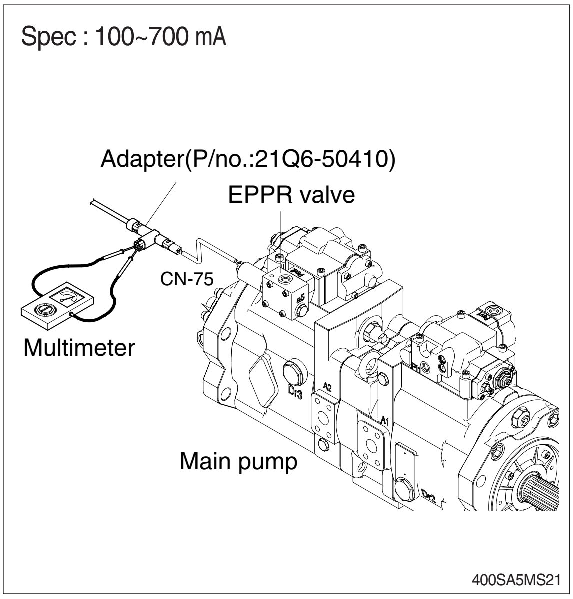
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If tachometer show approx 1600±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.



(3) **Test 3** : Check pressure at EPPR valve.

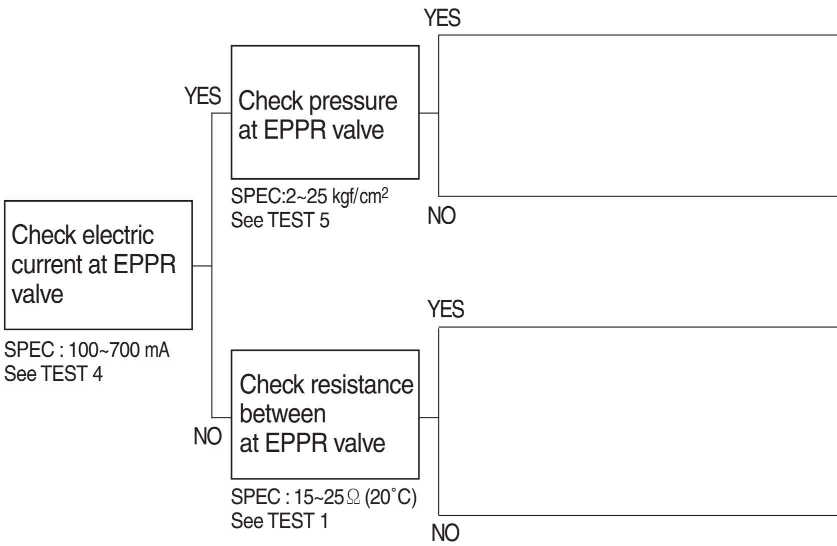
① Start engine.
② Set S-mode and cancel auto decel mode.
③ Position the accel dial at 10.
④ Slowly operate control lever of bucket functions at full stroke over relief and measure the EPPR valve pressure by the the monitoring menu of the cluster.
⑤ If pressure is not correct, adjust it.
⑥ After adjust, test the machine.

400SA5MS22

2. ENGINE STALL

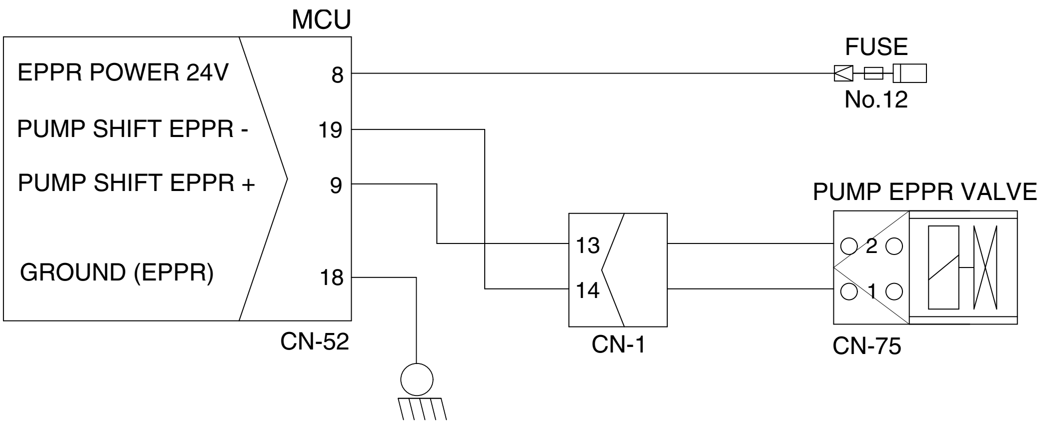
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Not enough engine power	Check engine fault Contact HD Hyundai Construction Equipment dealer
Defective EPPR valve	Replace
Short circuit or poor connection between CN-52 - CN-75	Check and repair wire harness
Defective EPPR valve	Replace

Wiring diagram



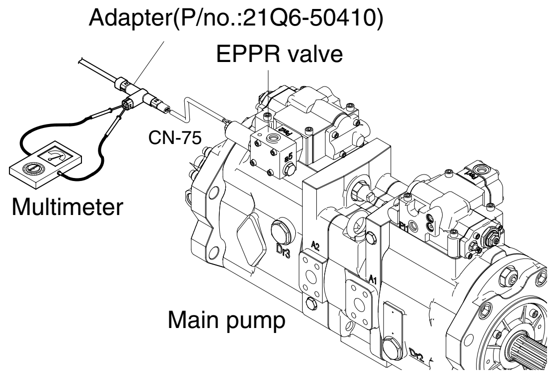
220SA6MS01

2) TEST PROCEDURE

(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set S-mode and cancel auto decel mode.
⑤ Position the accel dial at 10.
⑥ If rpm show approx 1600±50 rpm disconnect one wire harness from EPPR valve.
⑦ Check electric current at bucket circuit relief position.

Spec : 100~700 mA

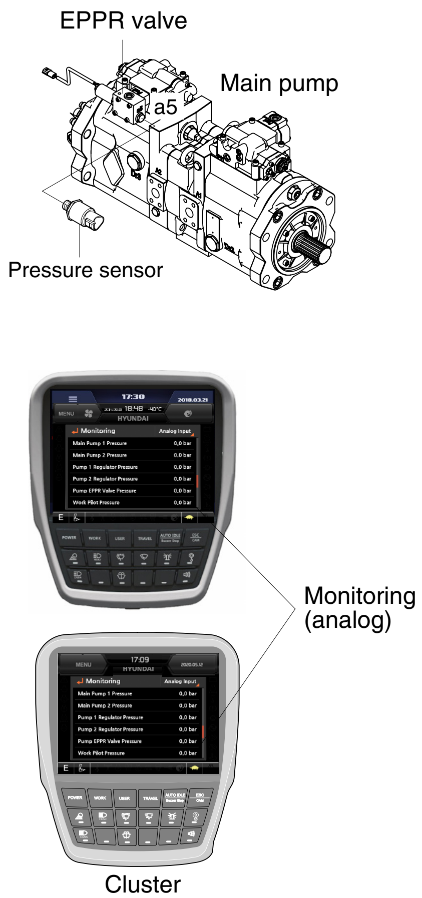


400SA5MS21

(2) Test 5 : Check pressure at EPPR valve.

① Start engine.
② Set S-mode and cancel auto decel mode.
③ Position the accel dial at 10.
④ Slowly operate control lever of bucket functions at full stroke over relief and measure the EPPR valve pressure by the the monitoring menu of the cluster.
⑤ If pressure is not correct, adjust it.
⑥ After adjust, test the machine.

SPEC : 2~25 kgf/cm² (30~350 psi)

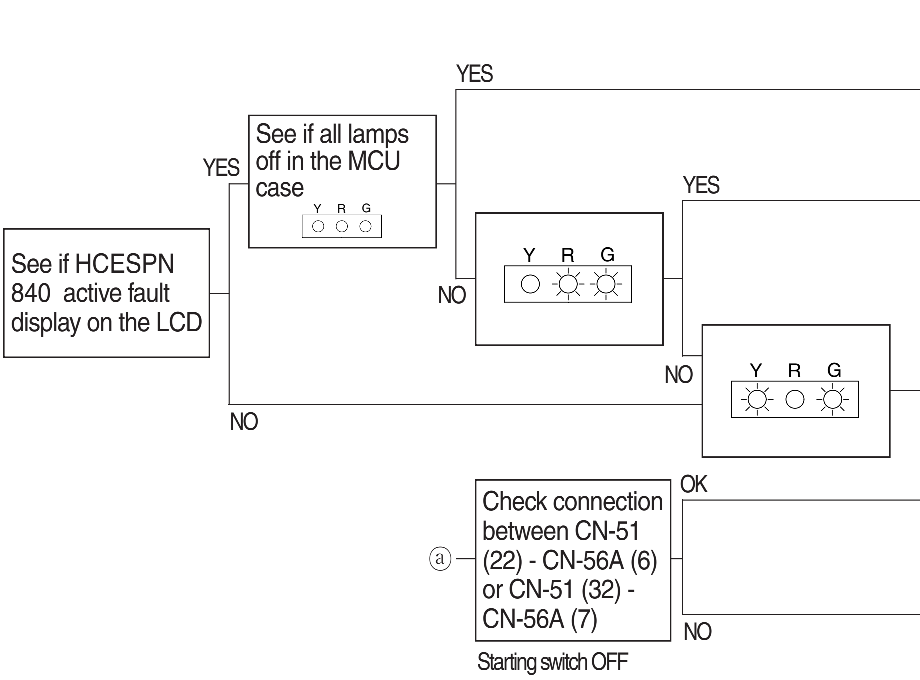


400SA5MS22

3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

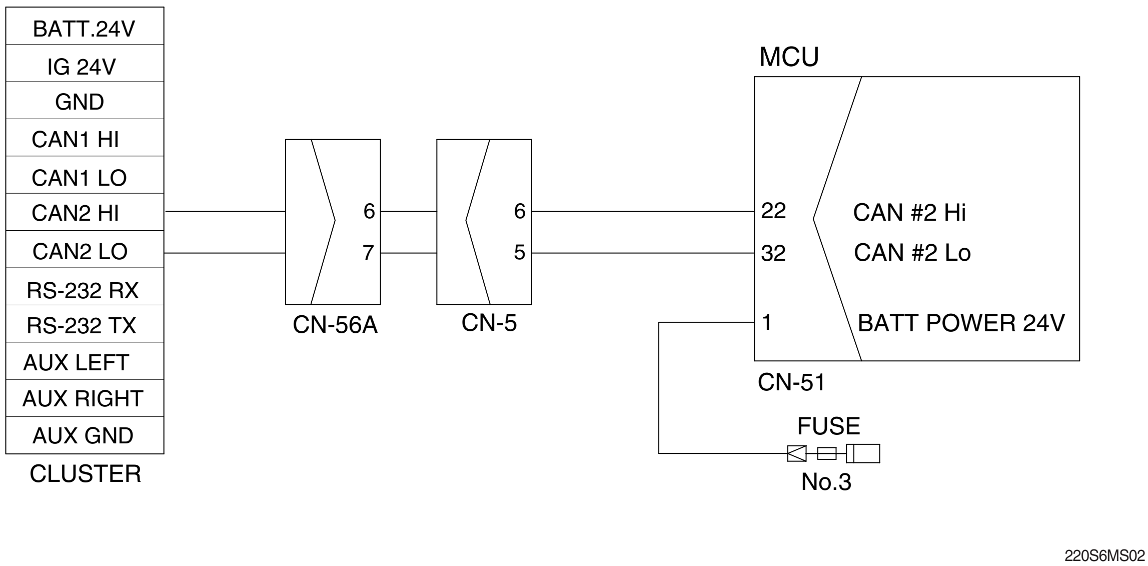
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
No power supply to the MCU	Check fuse No.3
MCU failure	Replace
ⓐ	
Cluster failure	Replace
No connection	Check and repair

Wiring diagram

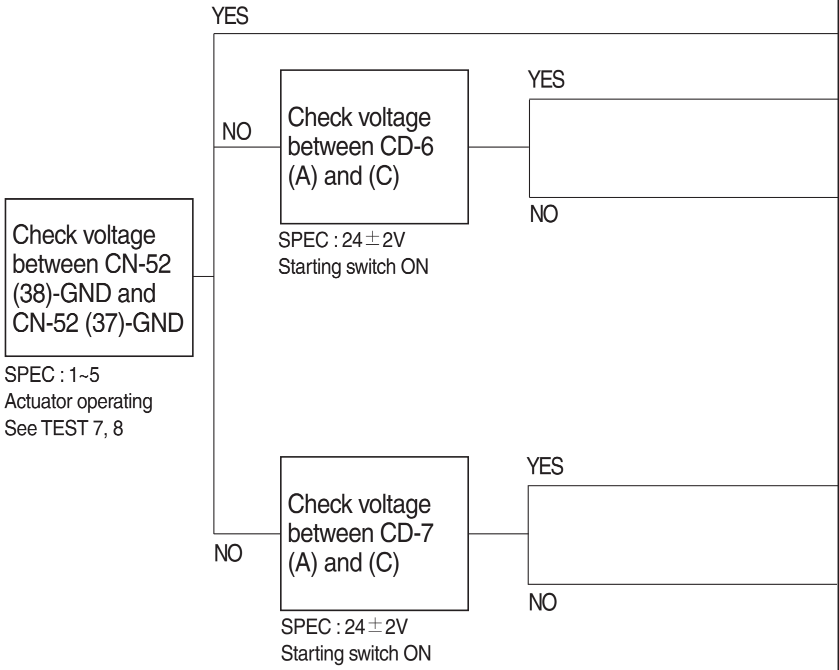


4. AUTO DECEL SYSTEM DOES NOT WORK

· Fault code : HCESPN 105, FMI 0~4 (work pressure sensor)
HCESPN 108, FMI 0~4 (travel oil pressure sensor)

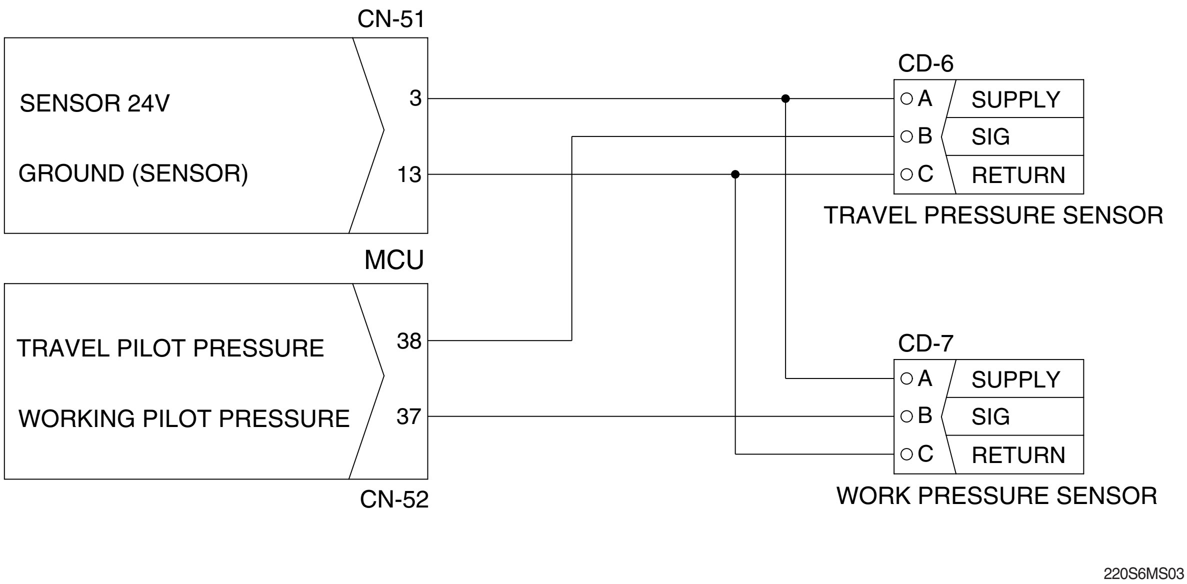
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure sensor	Replace
Short circuit or poor connection between CN-51 (3)-CD-6 (A) and / or CN-51 (13)-CD-6 (C) (fault code 108 displayed)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51 (3)-CD-7 (A) and / or CN-51 (13)-CD-7 (C) (fault code 105 displayed)	Replace or repair

Wiring diagram



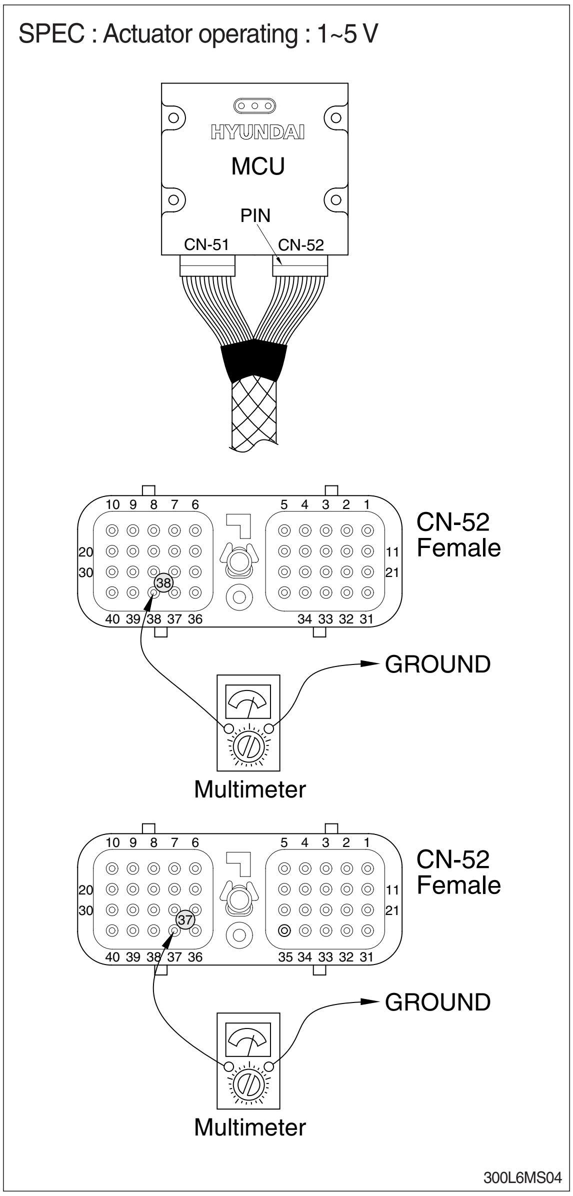
2) TEST PROCEDURE

(1) Test 7 : Check voltage at CN-52 (38) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (38) of CN-52.
③ Starting switch key ON.
④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52 (37) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper
② Insert prepared pin to rear side of connectors : One pin to (37) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

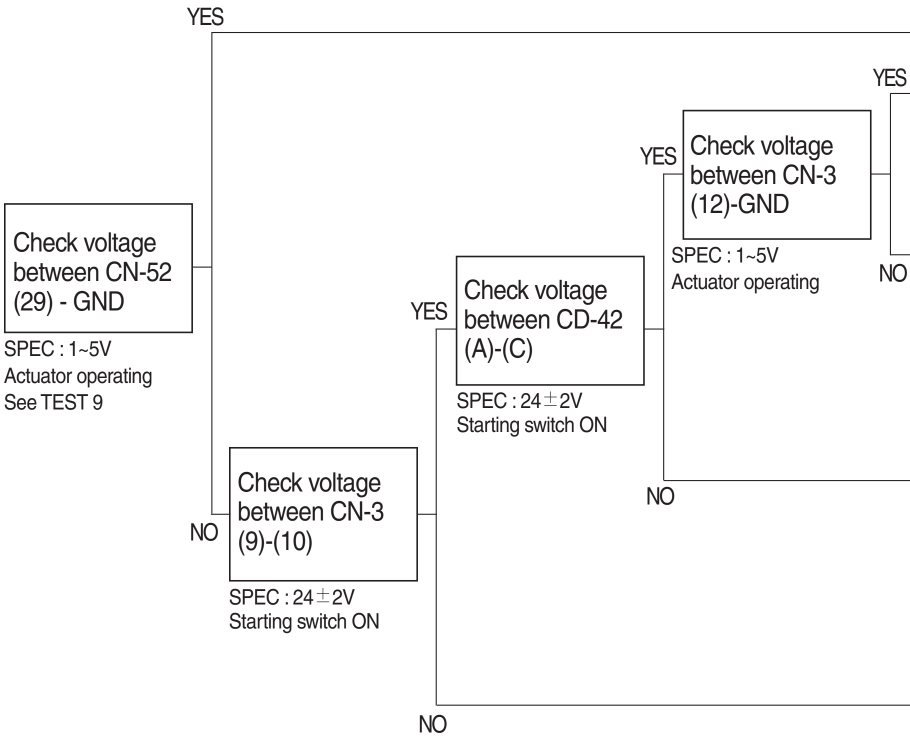


5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

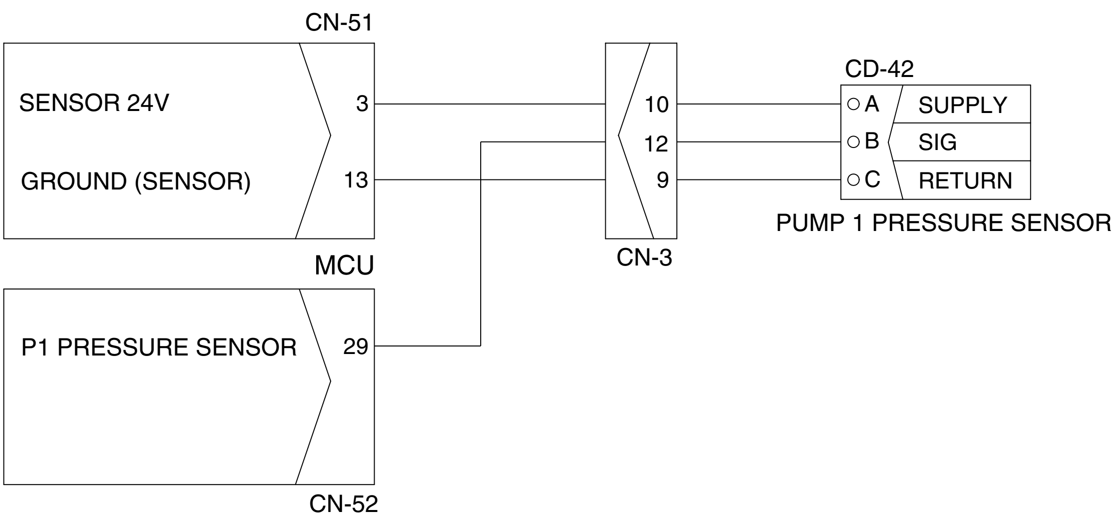
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(29)-CN-3 (12)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-3 (12)-CD-42 (B)	Replace or repair
Short circuit or poor connection between CD-42 (A)-CN-3 (10) or CD-42 (C)-CN-3 (9)	Replace or repair
Short circuit or poor connection between CN-3 (10)-CN-51 (3) or CN-3 (9) - CN-51 (13)	Replace or repair

Wiring diagram



400SA6MS05

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-52 (29) and ground.

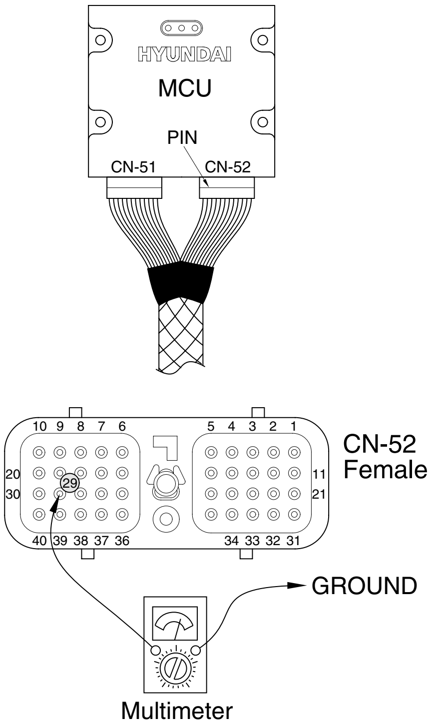
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (29) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



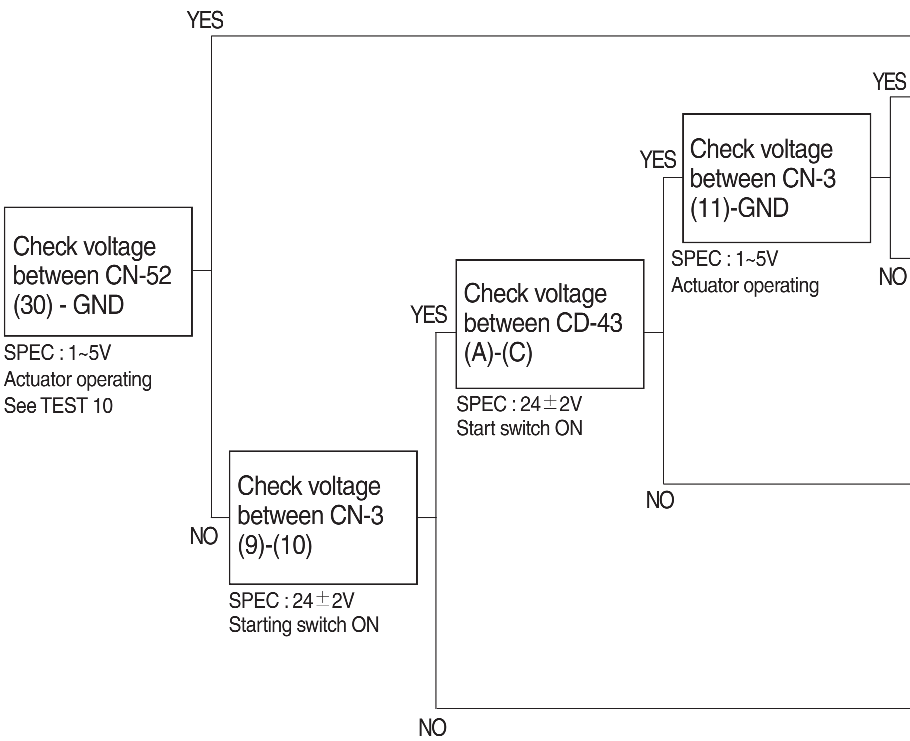
300L6MS06

6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

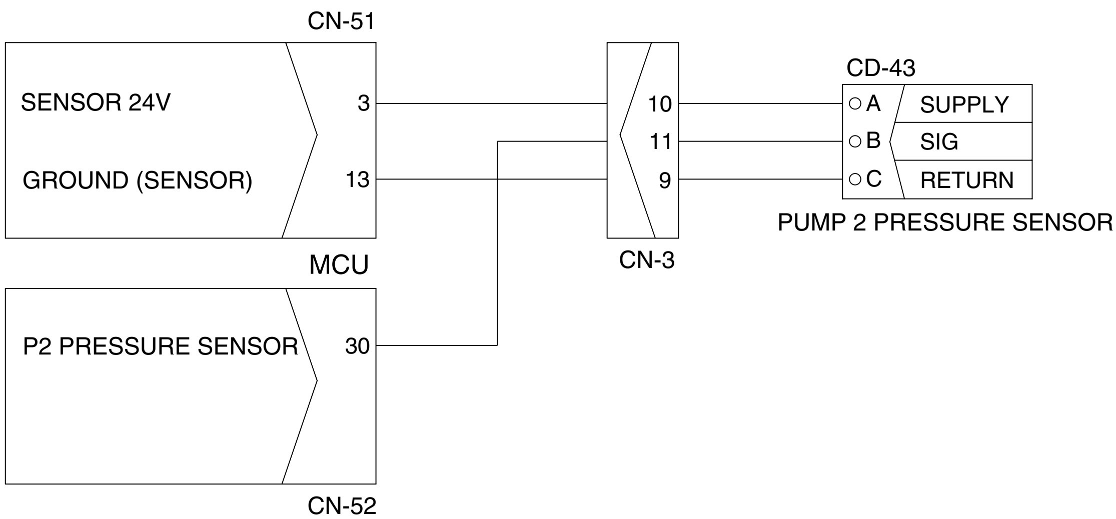
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(30)-CN-3 (11)	Replace or repair
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-3 (11) -CD-43 (B)	Replace or repair
Short circuit or poor connection between CD-43 (A)-CN-3 (10) or CD-43 (C)-CN-3 (9)	Replace or repair
Short circuit or poor connection between CN-2 (10)-CN-51 (3) or CN-3 (9) - CN-51 (13)	Replace or repair

Wiring diagram



400SA6MS07

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52 (30) and ground.

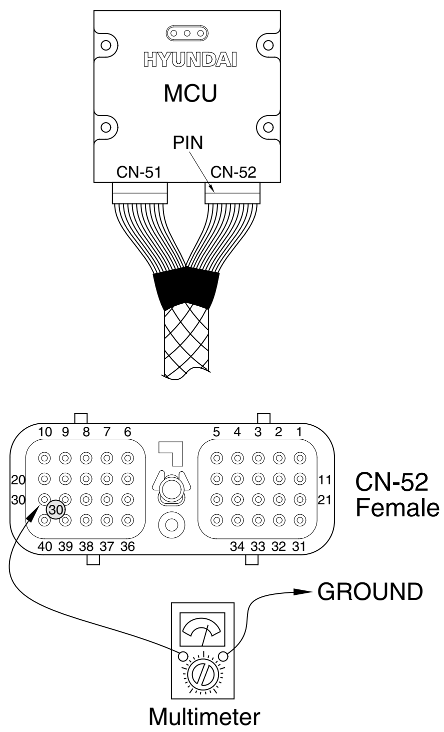
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (30) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



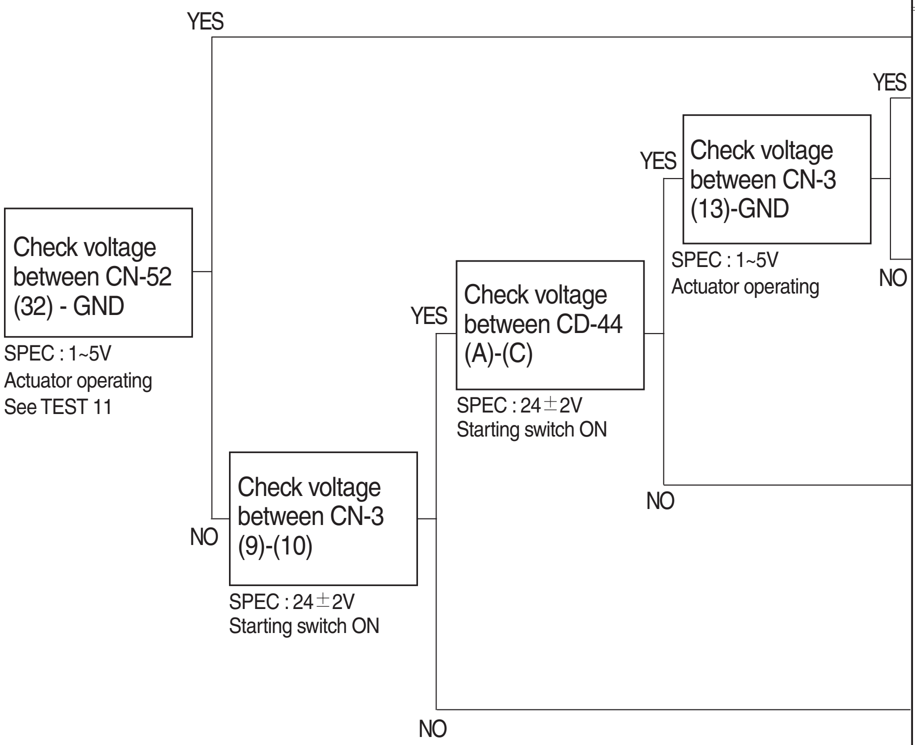
220S6MS08

7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

· Fault code : HCESPN 125, FMI 0~4

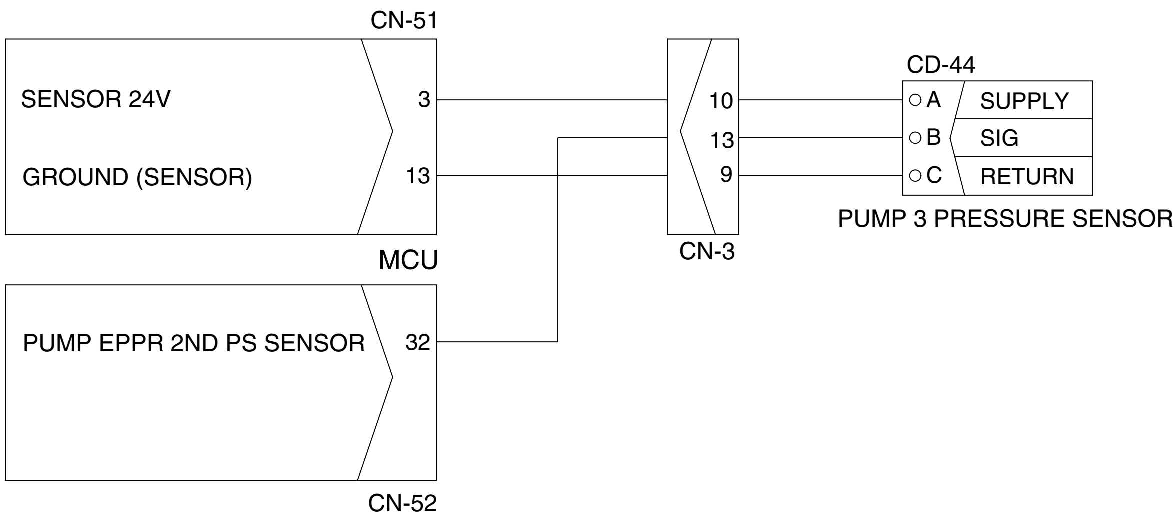
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(32)-CN-3 (13)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-3 (13) -CD-44 (B)	Replace or repair
Short circuit or poor connection between CD-44 (A)-CN-3 (10) or CD-44 (C)-CN-3 (9)	Replace or repair
Short circuit or poor connection between CN-2 (10)-CN-51 (3) or CN-3 (9) - CN-51 (13)	Replace or repair

Wiring diagram



400SA6MS09

2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-52 (32) and ground.

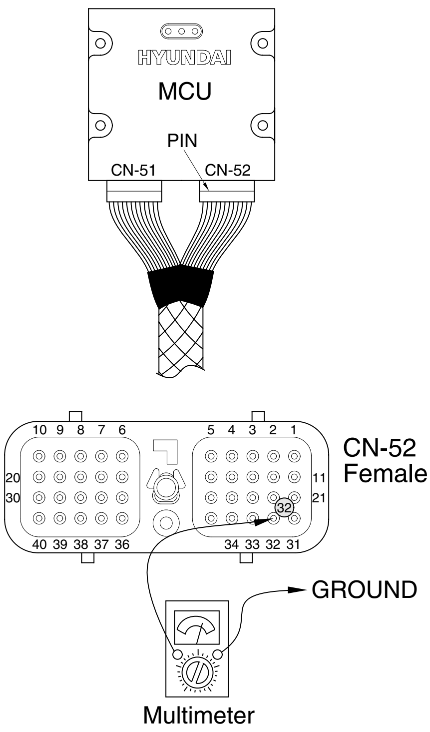
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (32) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



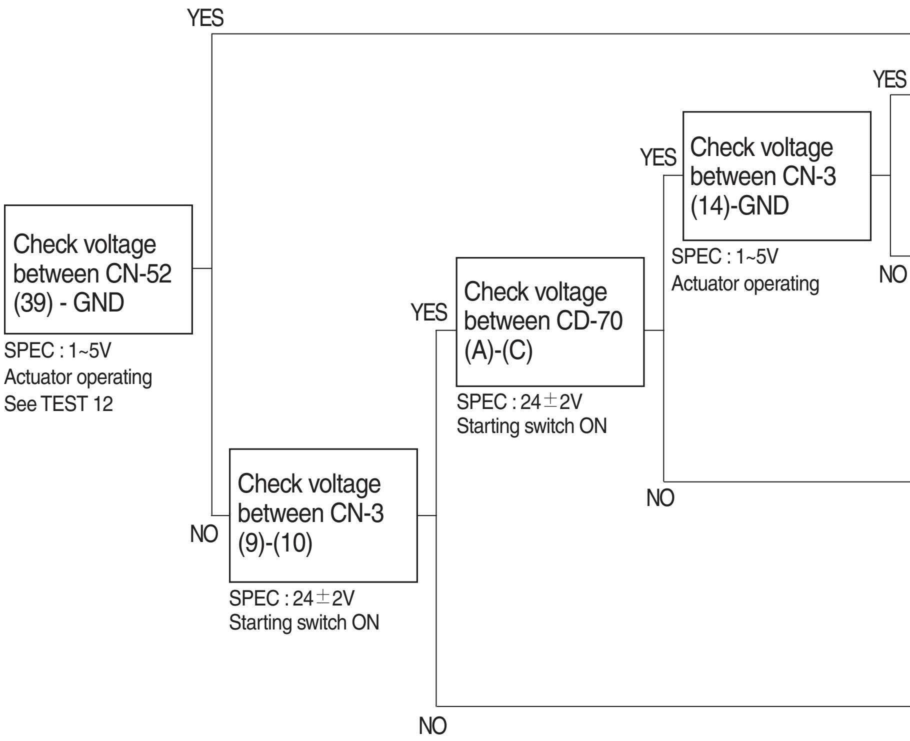
300L6MS10

8. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

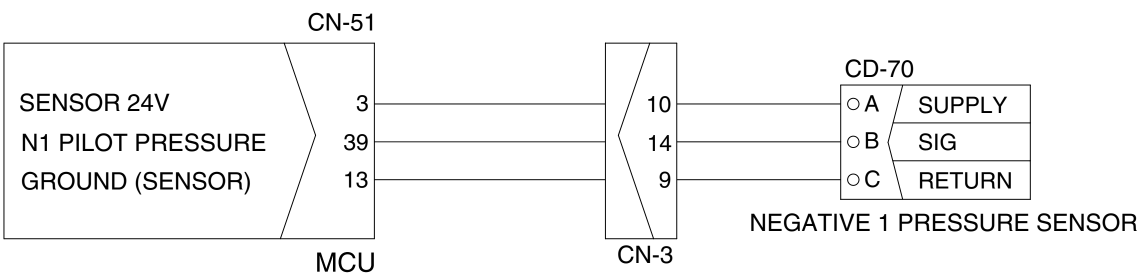
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(39)-CN-3 (14)	Replace or repair
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-3 (14) -CD-70 (B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-3 (10) or CD-70 (C)-CN-3 (9)	Replace or repair
Short circuit or poor connection between CN-2 (10)-CN-51 (3) or CN-3 (9) - CN-51 (13)	Replace or repair

Wiring diagram



400SA6MS11

2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52 (39) and ground.

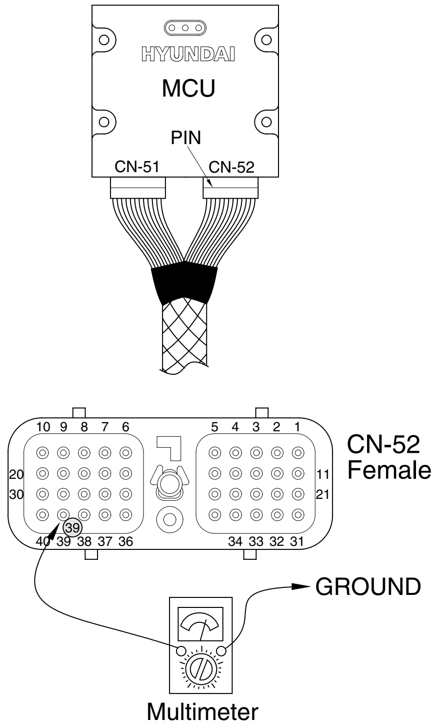
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (39) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



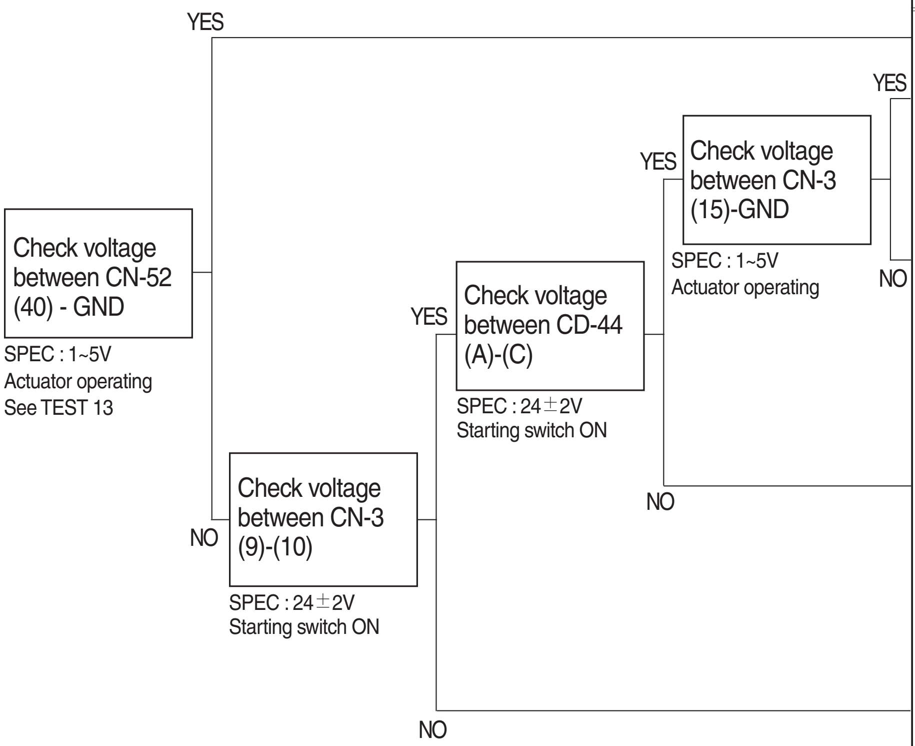
220S6MS12

9. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

· Fault code : HCESPN 124, FMI 0~4

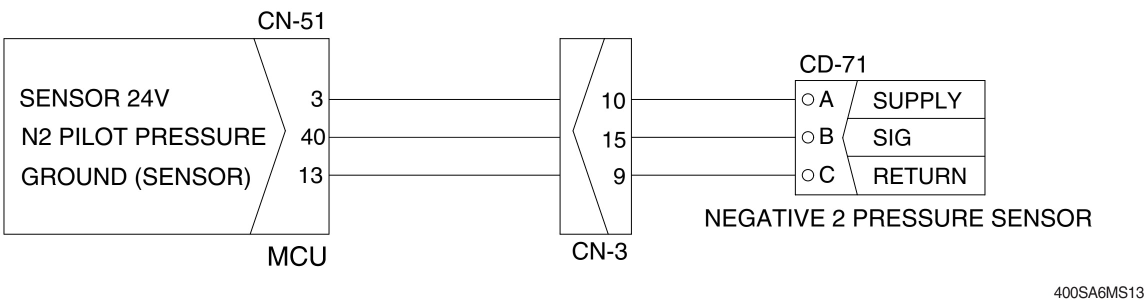
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(40)-CN-3 (15)	Replace or repair
Detective N2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-3 (15) -CD-44 (B)	Replace or repair
Short circuit or poor connection between CD-71 (A)-CN-3 (10) or CD-71 (C)-CN-3 (9)	Replace or repair
Short circuit or poor connection between CN-2 (10)-CN-51 (3) or CN-3 (9) - CN-51 (13)	Replace or repair

Wiring diagram

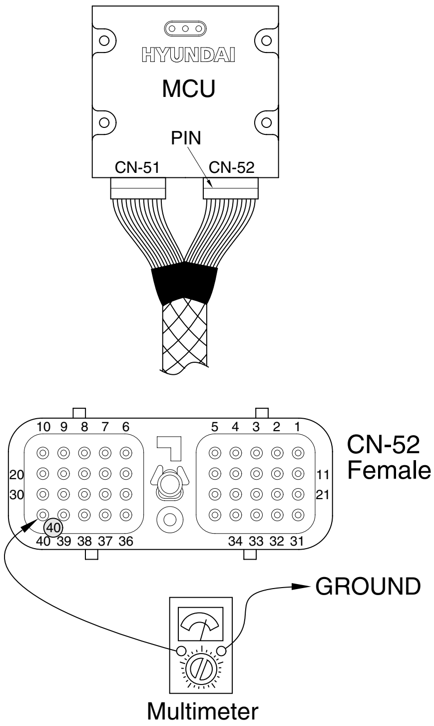


2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52 (40) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (40) of CN-52.
③ Starting switch ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



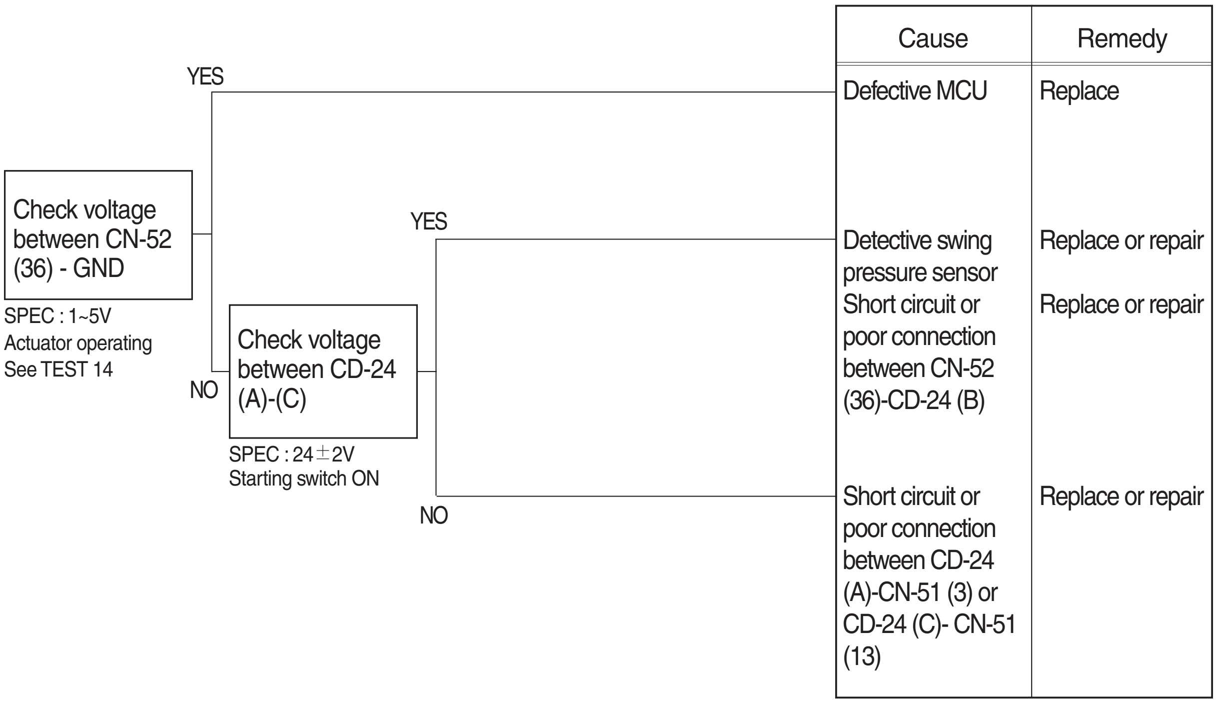
220S6MS14

10. MALFUNCTION OF SWING PRESSURE SENSOR

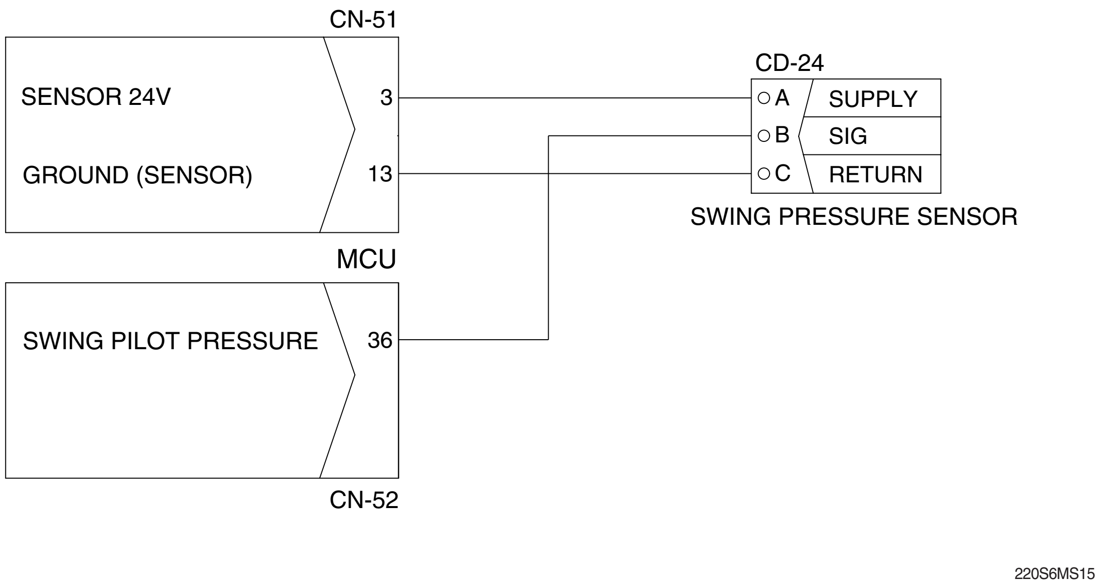
· Fault code : HCESPN 135, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

(1) Test 14 : Check voltage at CN-52 (36) and ground.

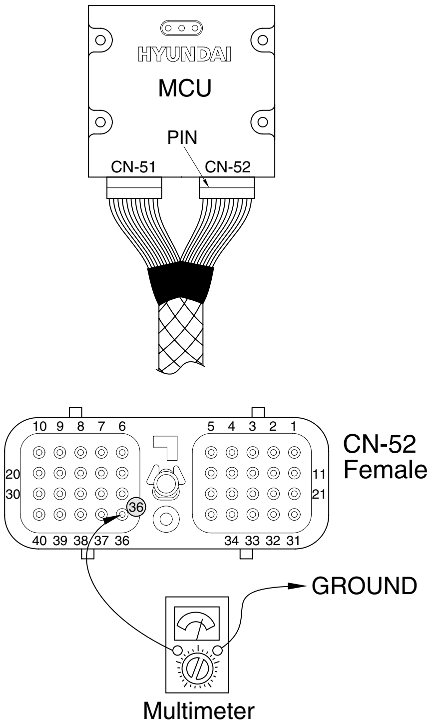
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (36) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



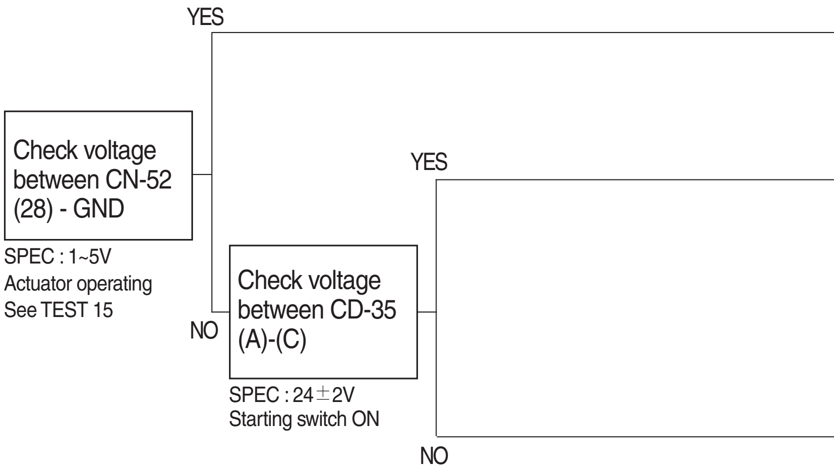
300L6MS16

11. MALFUNCTION OF BUCKET IN PRESSURE SENSOR

· Fault code : HCESPN 133, FMI 0~4

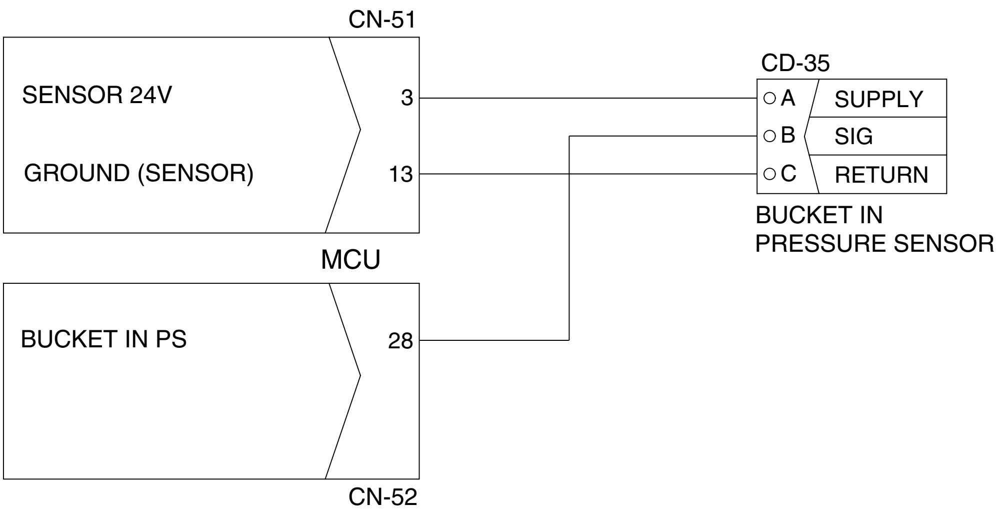
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective bucket in pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (35)-CD-35 (B)	Replace or repair
Short circuit or poor connection between CD-35 (A)-CN-51 (3) or CD-35 (C)- CN-51 (13)	Replace or repair

Wiring diagram



400SA6MS17

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52 (28) and ground.

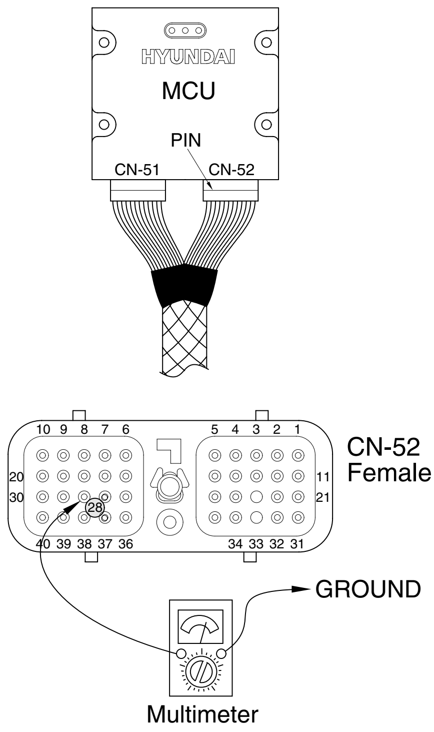
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (28) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



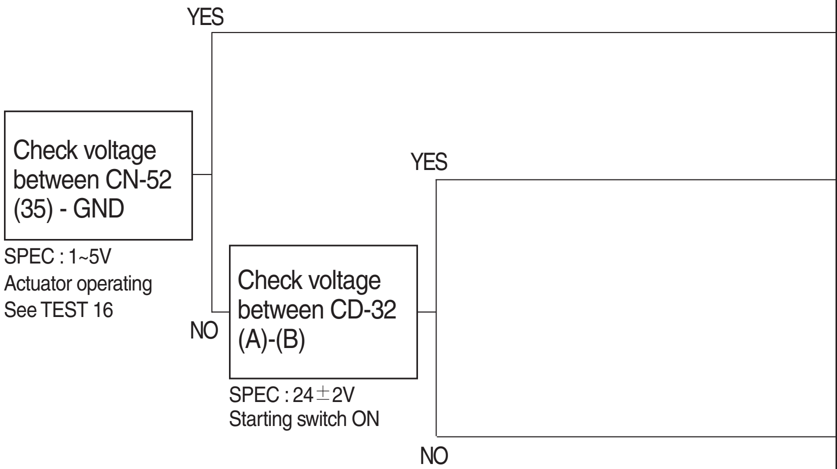
220S6MS18

12. MALFUNCTION OF BOOM UP PRESSURE SENSOR

· Fault code : HCESPN 127, FMI 0~4

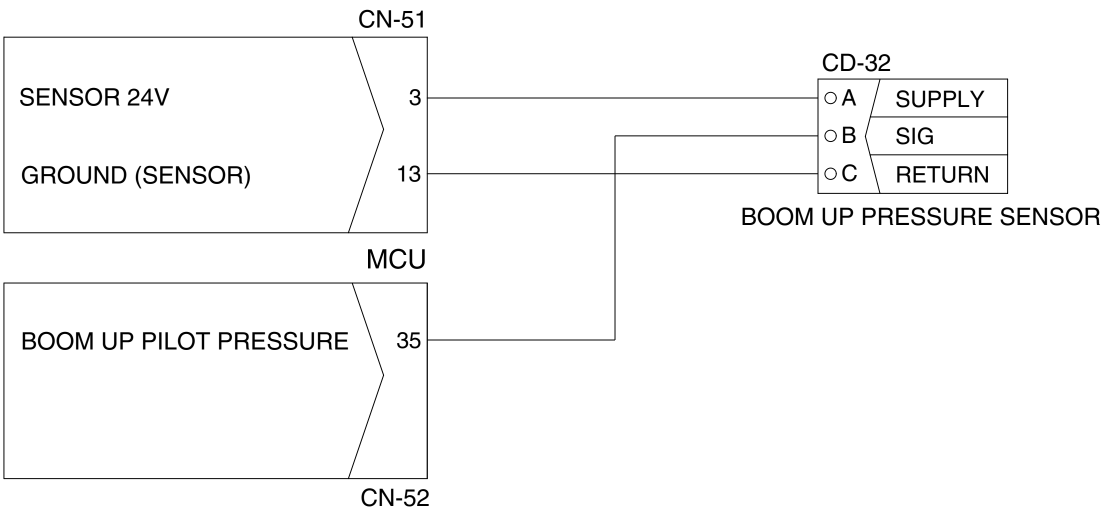
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (35)-CD-32 (B)	Replace or repair
Short circuit or poor connection between CD-32 (A)-CN-51 (3) or CD-32 (C)- CN-51 (13)	Replace or repair

Wiring diagram



220S6MS19

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (35) and ground.

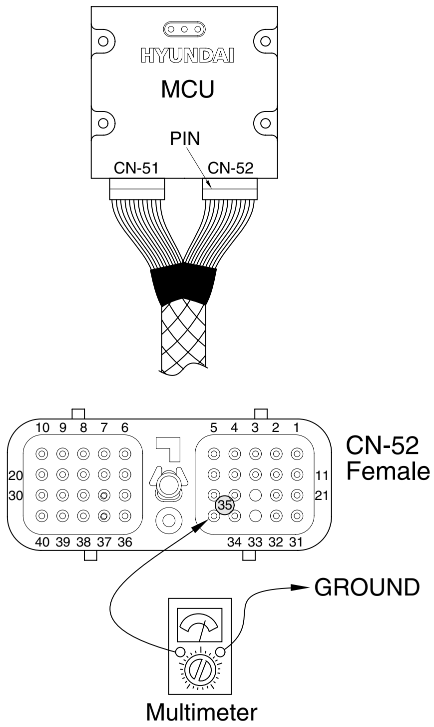
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (35) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



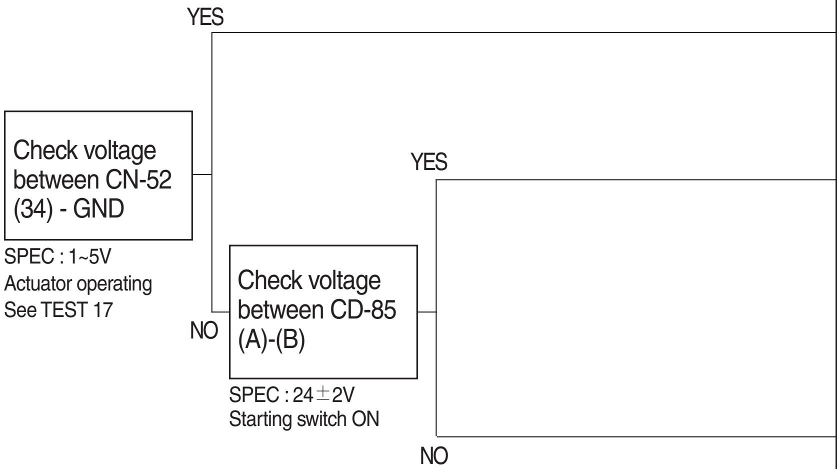
220S6MS20

13. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

· Fault code : HCESPN 128, FMI 0~4

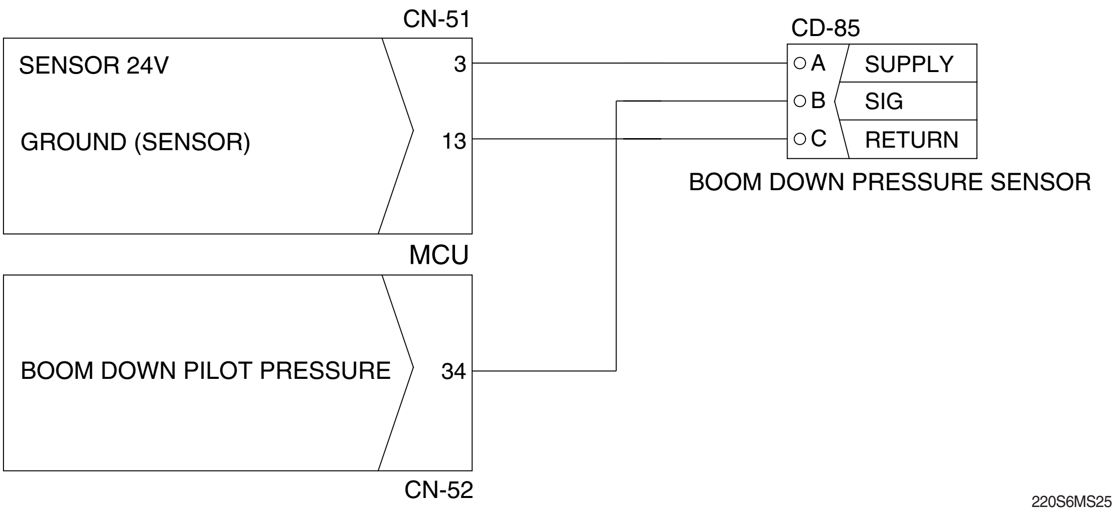
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (34)-CD-85 (B)	Replace or repair
Short circuit or poor connection between CD-85 (A)-CN-51 (3) or CD-85 (C)- CN-51 (13)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-52 (34) and ground.

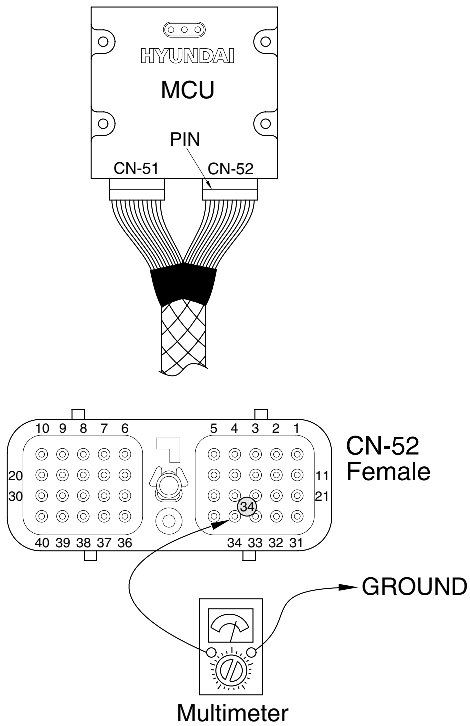
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (34) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



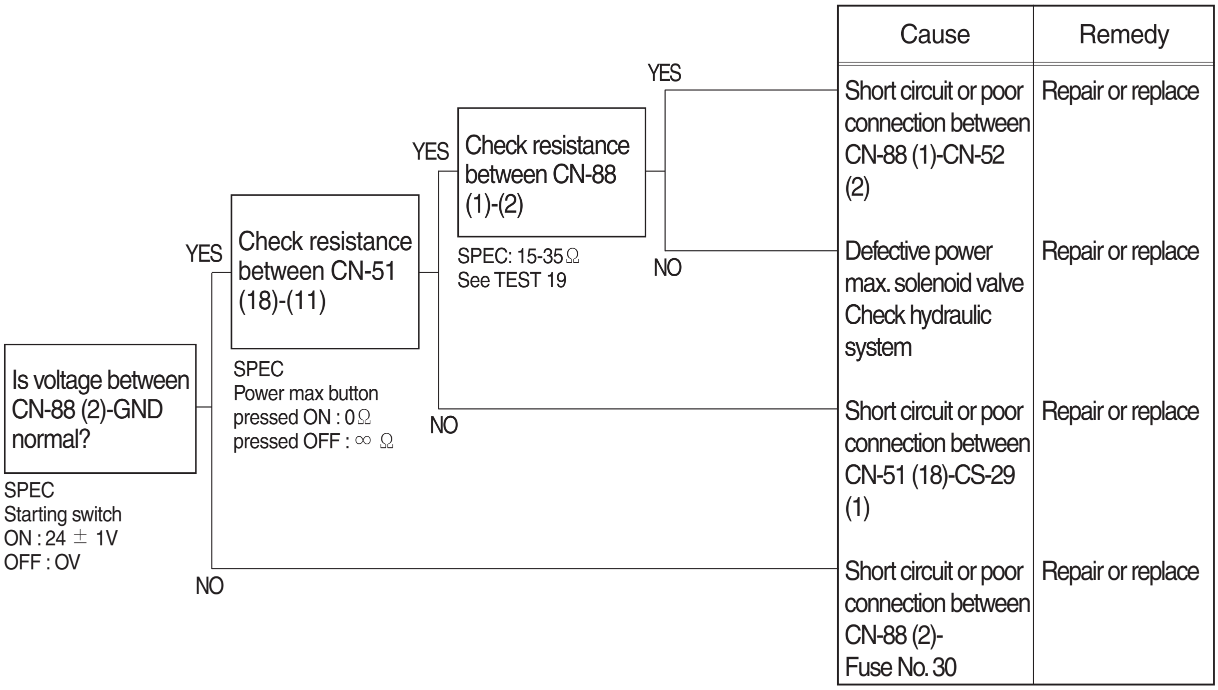
220S6MS26

14. MALFUNCTION OF POWER MAX (NULL)

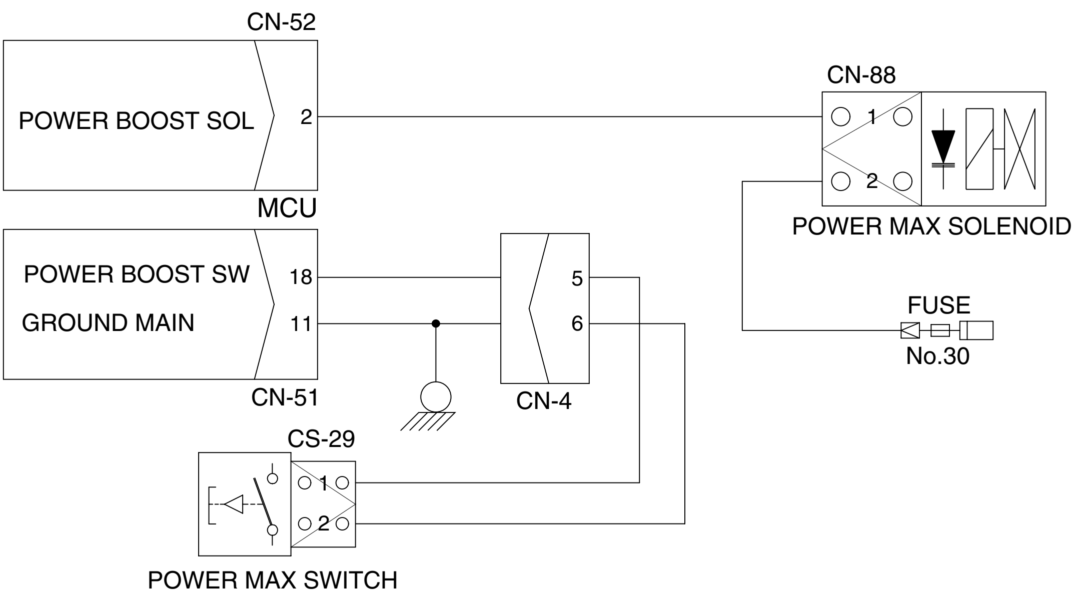
· Fault code : HCESPN 166, FMI 4 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



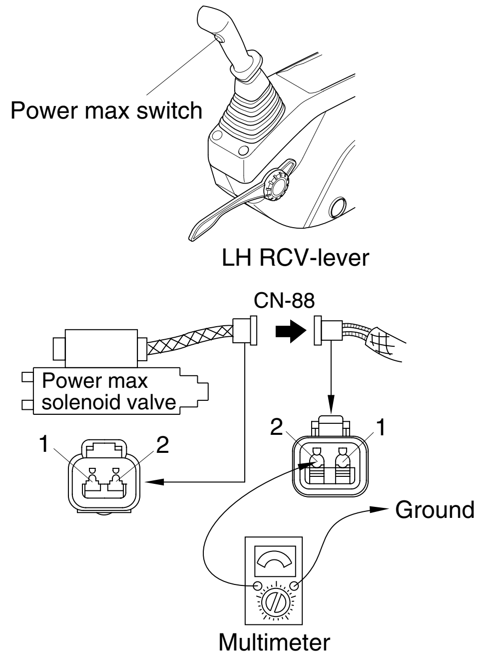
220S6MS21

2) TEST PROCEDURE

(1) Test 18: Check voltage between connector CN-88 (2) - GND.

① Disconnect connector CN-88 from power max solenoid valve.
② Start switch ON.
③ Check voltage as figure.

SPEC : Starting switch ON : 24±1V
Starting switch OFF : 0V

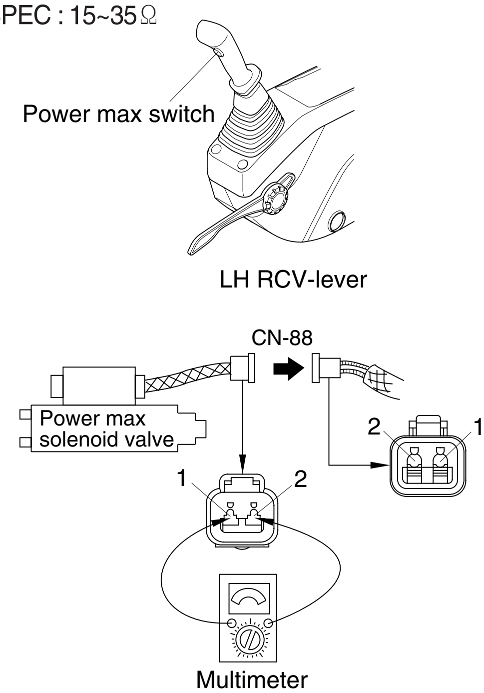


140L6MS123

(2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).

① Starting switch OFF.
② Disconnect connector CN-88 from power max solenoid valve.
③ Check resistance as figure.

SPEC : 15~35Ω



140L6MS124

15. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

· Fault code : HCESPN 141, FMI 5 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

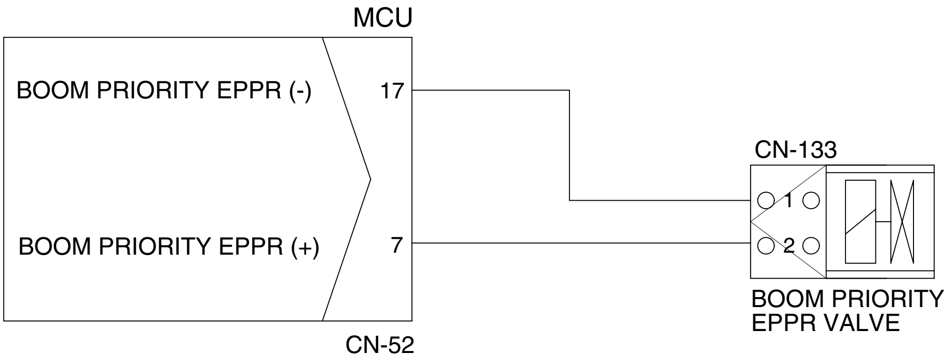
1) INSPECTION PROCEDURE

Check resistance between CN-133 (1)-(2)

SPEC : 20~30V
Starting switch : ON

	Cause	Remedy
YES	Short circuit or poor connection between CN-52 (17)-CN-133 (1) or CN-52 (7)-CN-133 (2)	Repair or replace
NO	Defective EPPR valve	Repair or replace

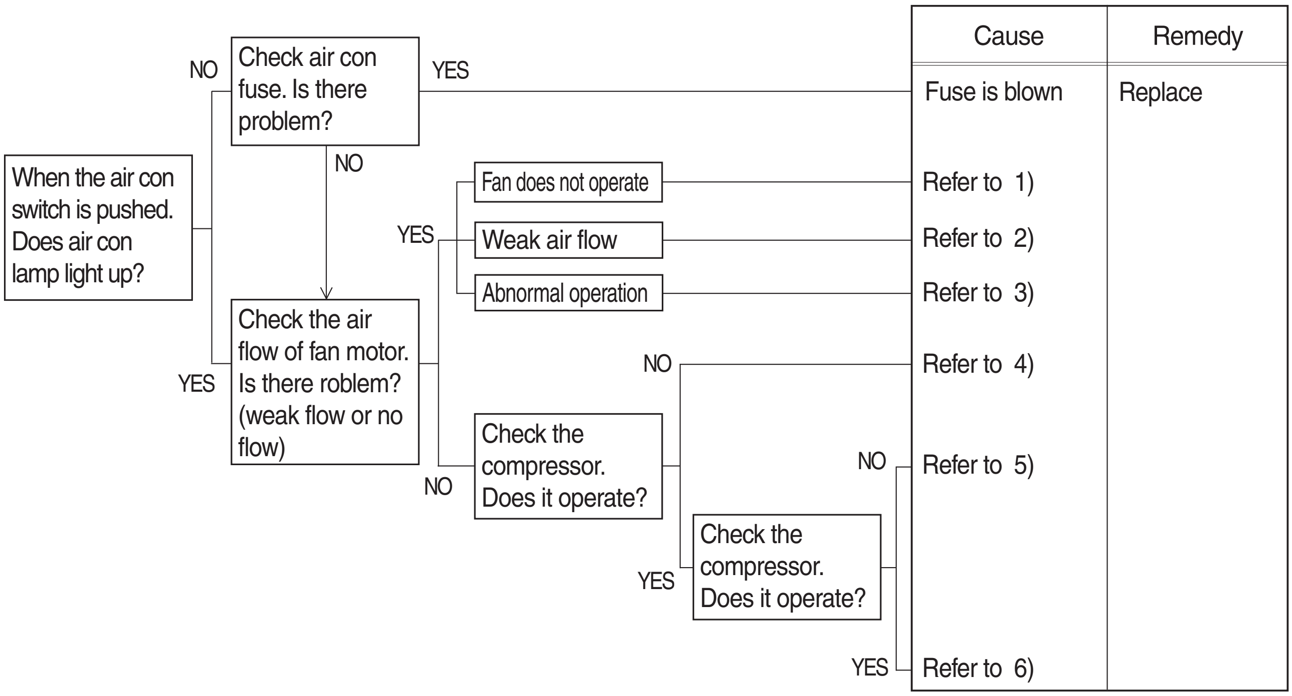
Wiring diagram



220S6MS23

GROUP 5 AIR CONDITIONER AND HEATER SYSTEM

1. AIR CONDITIONER DOES NOT OPERATE



1) FAN DOES NOT OPERATE

Cause	Check	Remedy
Fuse is blown or abnormal relay operation	* Fuse * Does relay normally operate?	Replace
Harness short or poor contact	Check any harness short or abnormal contact of connnector	Repair shortage
Fan motor failure	Supply 24V to 2 lead wire from motor and check the operation	Replace
Resistor is broken	Check current flow of resistor with tester	Replace
Fan switch failure	Push fan switch by turn and check the operation	Replace

2) WEAK AIR FLOW FROM FAN MOTOR

Cause	Check	Remedy
Clogged evaporator or obstacles around air inlet	Check if evaporator is contaminated	Clean
Leakage of air flow	Check HVAC case assembly	Adjust
Duct sensor failure	Check if evaporator is frozen	Replace

3) ABNORMAL OPERATION OF FAN MOTOR

Cause	Check	Remedy
Abnormal operation of each step of control	4 step only operate	Replace resistor
	1 or 2 step does not operate	Replace control
	3 or 4 step does not operate	Replace relay

4) COMPRESSOR DOES NOT ROTATE OR HARDLY ROTATE

Cause	Check	Remedy
Loose belt	Belt shaking is severe	Adjust tension
Failure of compressor itself	Belt slip	Repair or Replace
Low voltage of battery	Slip when rotate	Charge battery
Fieldcoil short	Slip when rotate	Replace magnetic clutch
Oily clutch face	Contamination around clutch	Replace magnetic clutch, clean
Fieldcoil is broken	Magnetic clutch does not operate or "∞" resistance	Replace compressor
Leakage of refrigerant or oil inside	Check if wet with oil	Replace compressor Charge refrigerant

5) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

Cause	Check	Remedy
Shortage of refrigerant	When air con operate during 5~10 min small temperature difference between high and low pressure pipes.	Repair leakage joint Charge refrigerant
Overcharge of refrigerant	*Magnetic clutch on/off rapidly *High pressure over specification *Lukewarm air from nozzle	Recharge refrigerant following specification
Lower pressure than normal condition at low side	Shortage of refrigerant	Make up refrigerant
	Clogged receive dryer	Replace receive dryer
	Clogged expansion valve	Replace expansion valve
	Clogged or crushed pipe	Replace pipe or clean
	Failure of duct sensor	Replace duct sensor

6) COMPRESSOR OPERATE NORMALLY AND AIR FLOW IS NORMAL

Cause	Check	Remedy
Lower pressure than normal condition at low side	Failure of duct sensor Magnetic clutch off before air temperature sufficiently down	Replace duct sensor or adjust location
	Defective compressor gasket When compressor off, high and low pressure balance immediatly	Repair compressor or Replace
Higher pressure than normal condition at high side	Failure of condensing Contamination on condenser or insufficient air flow from fan	Clean the condenser Repair fan
	Overcharge of refrigerant	Adjust refrigerant
	Entrained air	Vacuum and recharge
Lower pressure than normal condition at high side	Shortage of refrigerant	Make up refrigerant

SECTION 7 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.

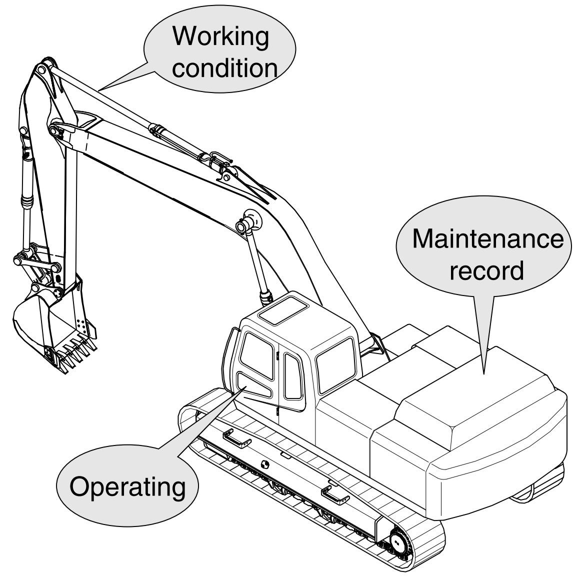
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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).

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.

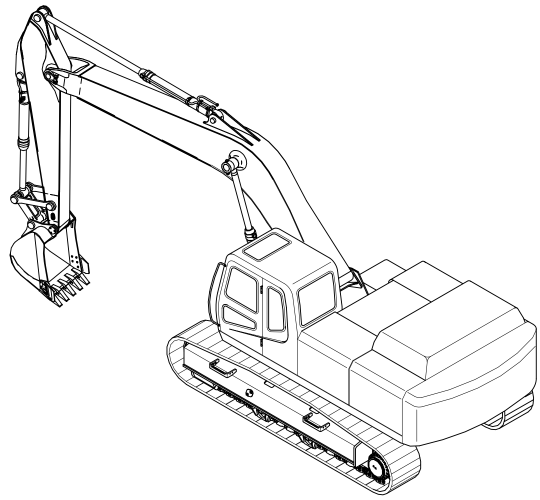


21077MS01

2. TERMINOLOGY

1) STANDARD

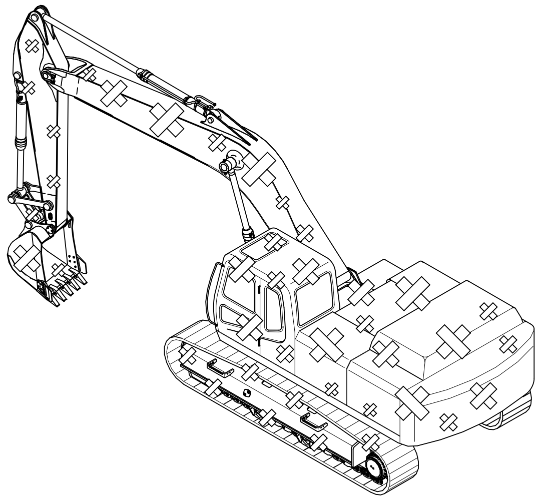
Specifications applied to the brand-new machine, components and parts.



21077MS02

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.



21077MS03

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 20 m, 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.

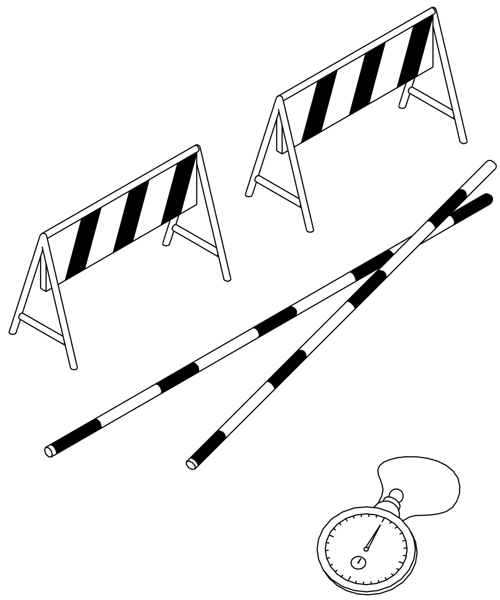
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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.



(210-7) 7-3

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

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

(2) Preparation

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 dial at 10 (Max) position.

③ Measure the engine RPM.

(3) Measurement

① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

② Measure and record the engine speed at each mode (P, S, E).

③ Select the P-mode.

④ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.

⑤ Measure and record the auto deceleration speed.

400SA7MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HX400LT3	Start idle	900±100	
	P mode	1700±50	
	S mode	1600±50	
	E mode	1500±50	
	Auto decel	1000±100	
	One touch decel	900±100	

Condition : Set the accel dial at 10 (Max) position.

3) TRAVEL SPEED

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

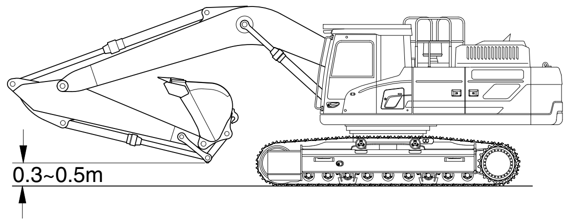
(2) Preparation

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 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.



400SA7MS02

(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, then select the following switch positions.

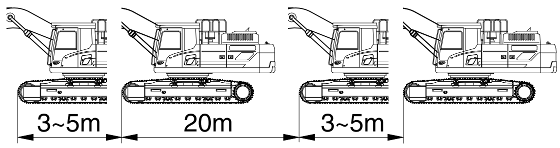
· Power mode switch : P mode

③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.

④ Measure the time required to travel 20 m.

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.



400SA7MS03

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX400LT3	1 Speed	22.5±2.0	26.1	
	2 Speed	13.6±1.0	15.6	

4) TRACK REVOLUTION SPEED

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

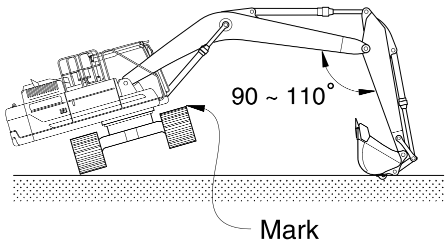
(2) Preparation

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.



400SA7MS04

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed

· Power mode switch : P mode

· Auto idle switch : OFF

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.

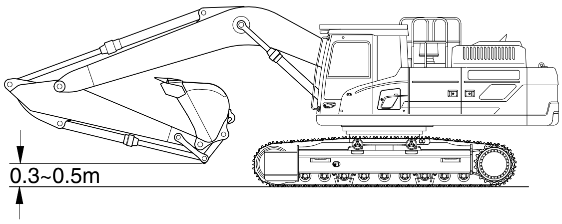
Unit : Seconds / 3 revolutions

Model	Travel speed	Standard	Maximum allowable
HX400LT3	1 Speed	35.5±2.0	45
	2 Speed	22.3±2.0	22.3

5) TRAVEL DEVIATION

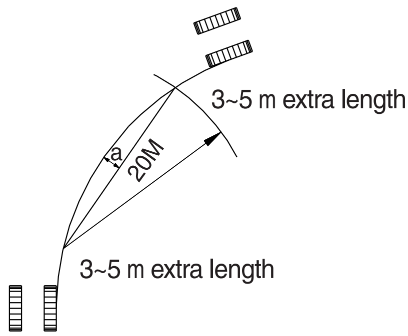
(1) Measure the deviation by the tracks from a 20 ㎧ straight line.

(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.



400SA7MS02

(3) Measurement
① Measure the amount of mistracking at high and low travel speeds.
② Before beginning each test, select the following switch positions.
· Power mode switch : P mode
③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.
④ Measure the distance between a straight 20 m line and the track made by the machine. (Dimension a)
⑤ After measuring the tracking in forward travel, turn the upperstructure 180 °and measure that in reverse travel.
⑥ Repeat steps ④ and ⑤ three times and calculate the average values.



(210-7) 7-7(2)

(4) Evaluation
Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
HX400LT3	200 below	250	-

6) SWING SPEED

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

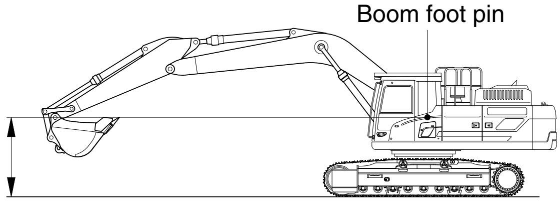
(2) Preparation

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.



400SA7MS05

(3) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Operate swing control lever fully.

③ Swing 1 turn and measure time taken to swing next 3 revolutions.

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

(4) Evaluation

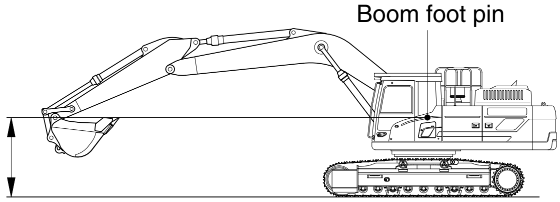
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
HX400LT3	P mode	18.9±1.5	23.8

7) SWING FUNCTION DRIFT CHECK

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



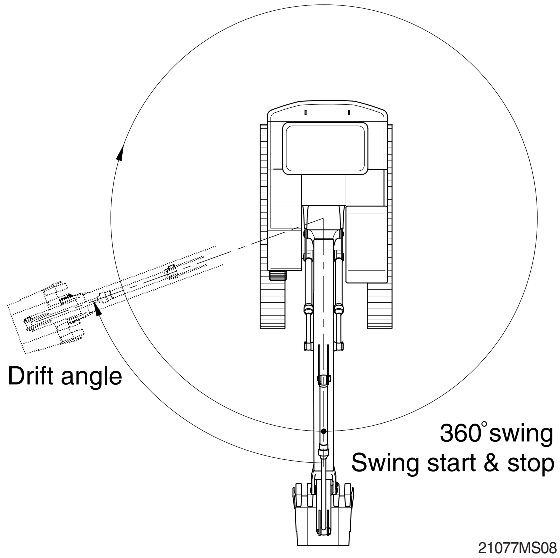
400SA7MS05

(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.

(3) Measurement

① Conduct this test in the M mode.
② Select the following switch positions.
· Power mode switch : P mode
③ 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 ˚
④ Measure the distance between the two marks.
⑤ Align the marks again, swing 360 ˚, then test the opposite direction.
⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



21077MS08

(4) Evaluation

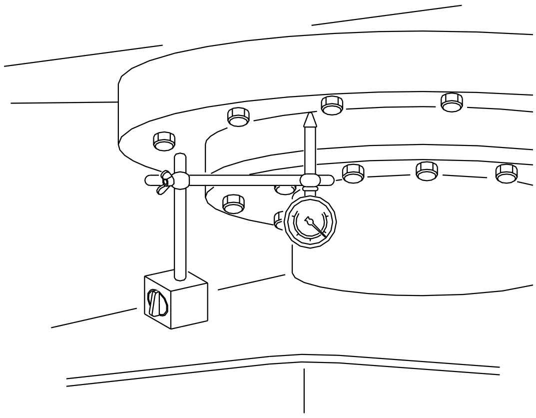
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX400LT3	P mode	90 below	112.5	

8) SWING BEARING PLAY

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



(210-7) 7-10(1)

(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.

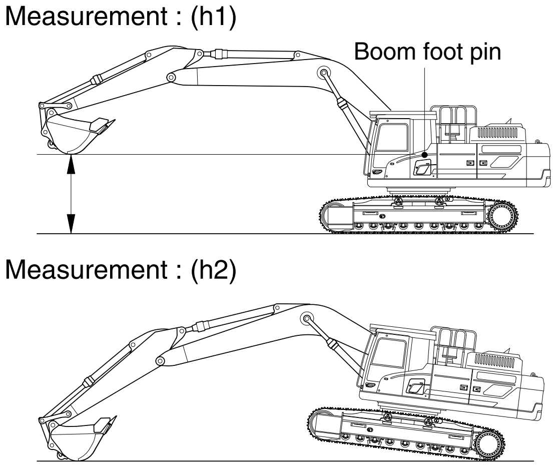
⑥ Bucket should be empty.

(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



400SA7MS06

(4) Evaluation
The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX400LT3	0.5 ~ 1.5	3.0	

9) HYDRAULIC CYLINDER CYCLE TIME

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

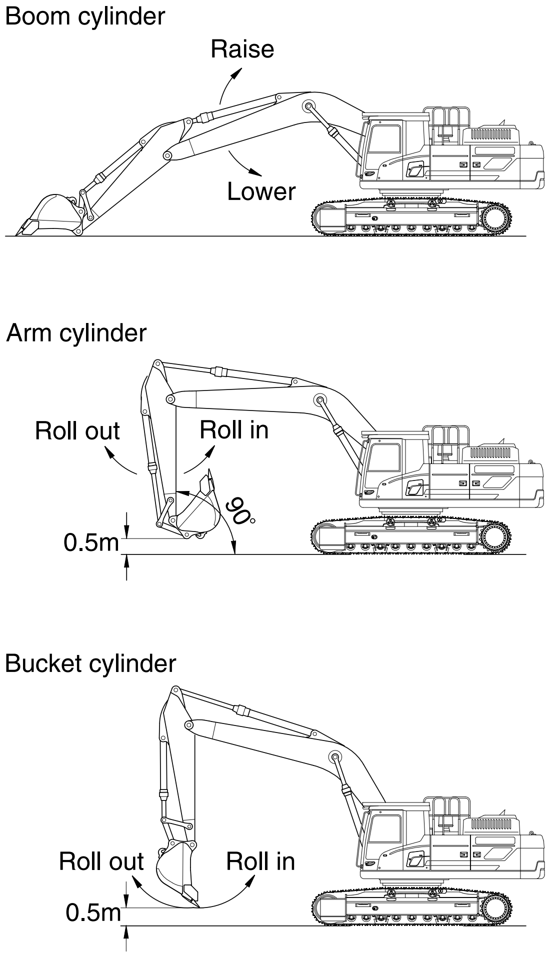
(2) Preparation

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 0.5 m 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.



400SA7MS07

(3) Measurement

① Select the following switch positions.
· Power mode switch : P mode

② 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	Maximum allowable	Remarks
HX400LT3	Boom raise		4.4±0.4	5.3	
	Boom lower		2.9±0.4	4.0	
	Arm in	Regen ON	3.5±0.4	4.2	
	Arm out		3.1±0.3	3.4	
	Bucket load		2.9±0.4	3.7	
	Bucket dump		2.4±0.3	3.5	

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.

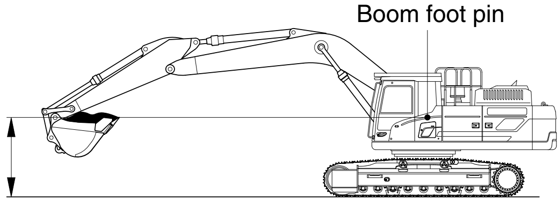
· $W=M^3 \times 1.5$
Where :
M^3 = Bucket heaped capacity (m^3)
1.5 = Soil specific gravity

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.



400SA7MS08

(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) The measured drift should be within the following specifications.

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX400LT3	Boom cylinder	10 below	15	
	Arm cylinder	10 below	15	
	Bucket cylinder	40 below	50	

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 Select the following switch positions.

· Power mode switch : P mode

③ Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.

④ 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.

⑤ Repeat steps ③ and ④ 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
HX400LT3	Boom lever	1.3 or below	1.7	
	Arm lever	1.3 or below	1.7	
	Bucket lever	1.3 or below	1.7	
	Swing lever	1.3 or below	1.7	
	Travel lever	2.1 or below	3.15	

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
HX400LT3	Boom lever	90±10	115	
	Arm lever	90±10	115	
	Bucket lever	90±10	115	
	Swing lever	90±10	115	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

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

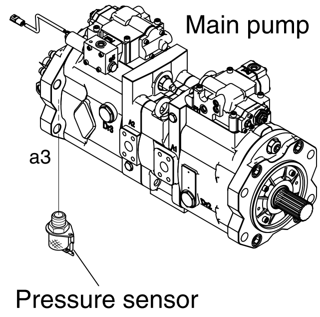
(2) Measurement

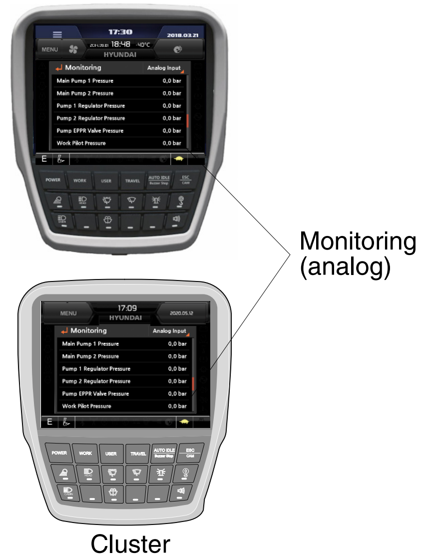
① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

② Measure the primary pilot pressure by the monitoring menu of the cluster.





400SA7MS13

(3) Evaluation

The average measured pressure should meet the following specifications:

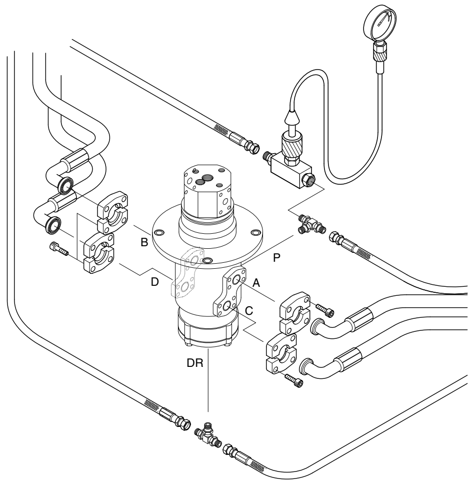
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX400LT3	P mode	40^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.
④ Start the engine and check for on leakage from the adapter.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



400SA7MS14

(2) Measurement

① Select the following switch positions.
· Power mode switch : P mode
· 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.

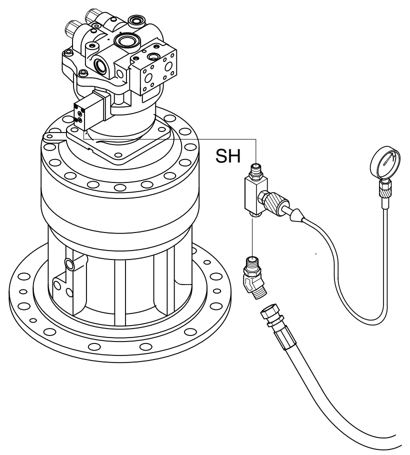
Unit : kgf / cm²

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX400LT3	1 Speed	0	-	
	2 Speed	40±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ The pressure release L wrench to bleed air.
④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
⑤ Start the engine and check for oil leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5˚C.



400SA7MS15

(2) Measurement

① Select the following switch positions.
· Power mode switch : P mode
② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Description	Standard	Allowable limits	Remarks
HX400LT3	Brake disengaged	40	-	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

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

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Measure the main pump delivery pressure in the P mode (high idle).

400SA7MS16

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
HX400LT3	High idle	Under 10	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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

(2) Measurement

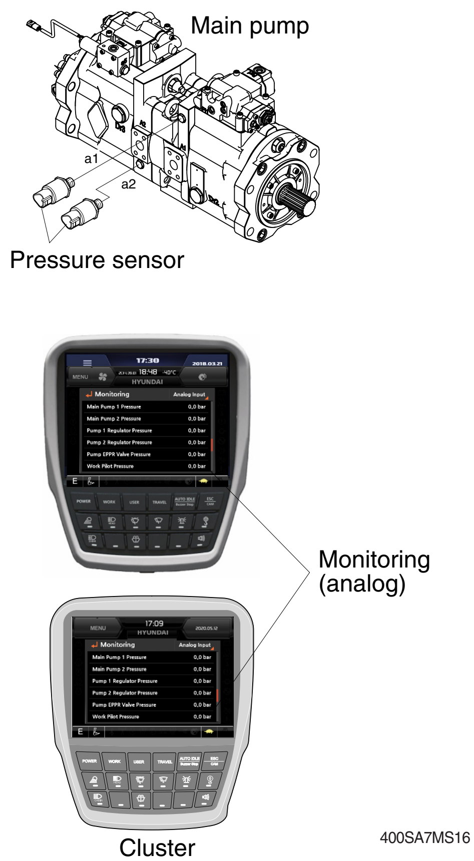
① Select the following switch positions.

· Power mode switch : P mode

② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

③ In the swing function, place bucket against an immovable object and measure the relief pressure.

④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.



(3) Evaluation

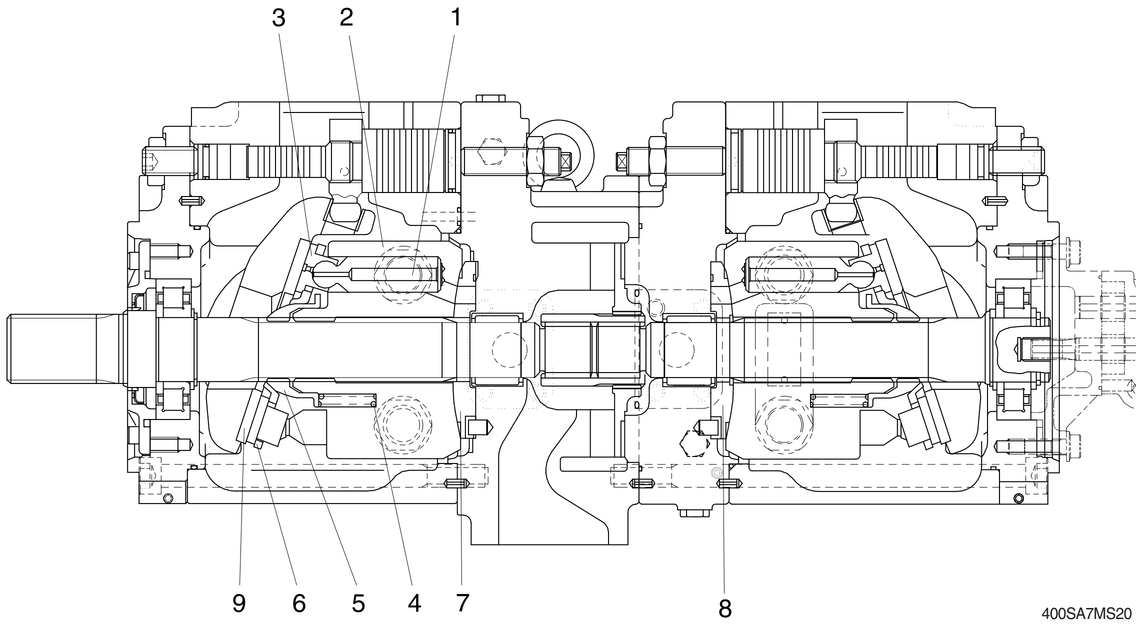
The average measured pressure should be within the following specifications.

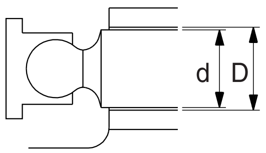
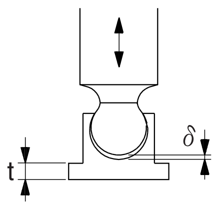
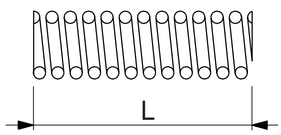
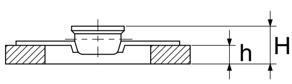
Unit : kgf / cm²

Model	Function to be tested	Standard	Port relief setting
HX400LT3	Boom, Arm, Bucket	350±10	390±10
	Travel	350±10	-
	Swing	290±10	-

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston(1) & cylinder bore(2) (D-d)		0.0375	0.078	Replace piston or cylinder.
Play between piston(1) & shoe caulking section(3) (δ)		0-0.1	0.35	Replace assembly of piston & shoe.
Thickness of shoe (t)		5.4	5.0	
Free height of cylinder spring(4) (L)		40.9	40.1	Replace cylinder spring.
Combined height of set plate(5) & spherical bushing(6) (H-h)		23.8	22.8	Replace retainer or set plate.
Surface roughness for valve plate (sliding face) (7,8), swash plate (shoe plate area) (9), & cylinder(2) (sliding face)	Surface roughness necessary to be corrected	Ra 3.2		Lapping
	Standard surface roughness (corrected value)	0.4z or lower		

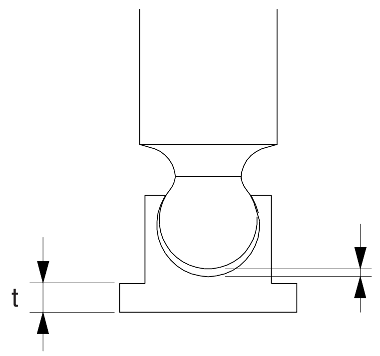
2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratches, rust or corrosion.	· In case of damage in following section, replace casing. - Sliding sections of casing hole and spool, especially land sections applied with held pressure. - Seal pocket section where spool is inserted. - Sealing section of port where O-ring contacts. - Sealing section of each relief valve for main and port. - Sealing section of plug. - Other damages that may damage normal function.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool into 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 spring · Damage of poppet · Insert poppet into casing and function it.	· Replacement. · Correction or replacement when sealing is incomplete. · Normal when it can function lightly and smoothly without sticking.
Spring and related parts	· Rusting, corrosion, deformation or breakage 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 & negative control valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · O-rings and back up rings.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement in principle.

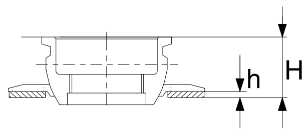
3. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.041	0.060	Replace piston or cylinder block
Thickness of valve plate	6	5.88	Replace
Play between piston and shoe caulking section (δ)	0.025	0.1	Replace assembly of piston and shoe
Thickness of shoe (t)	6.6	6.5	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	17.6	17.3	Replace set of retainer plate and sperical bushing
Thickness of friction plate	2.94	2.7	Replace



140W77MS12



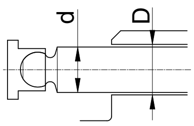
2609A7MS01

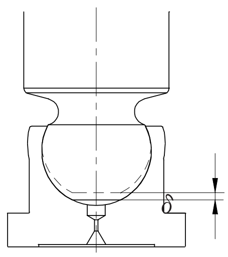
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	Rmax=1S (Ra=0.2a) (LAPPING)	4S (Ra=0.1a)	
Shoe plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Cylinder	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Valve plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	2S (Ra=0.5a)	

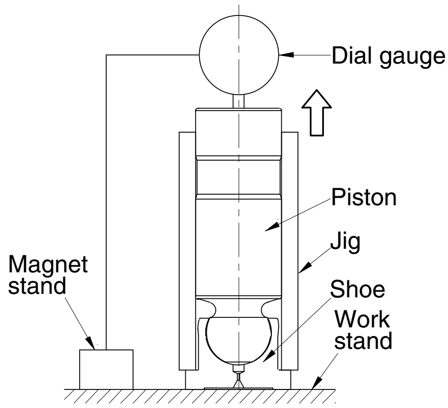
4. TRAVEL MOTOR

The followings are the general maintenance standards. However, it is the most important to determine which parts should be replaced, depending on the characteristics before disassembling, damages and discoloration of exterior view, the purpose of disassembling, the expected remaining service life. etc..

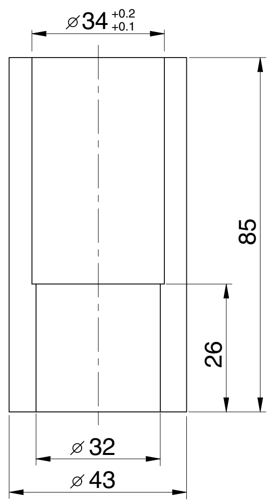
Check item		Measuring method	Criteria	Allowable	Remedy
Sliding surface of cylinder block, valve plate and swash plate	Surface roughness of cylinder block, valve plate and swas plate	Measure the surface roughness by rough-ness tester	Below 0.4 Zμ	Below 3.0 Zμ	Replace or repair ※ Lap together the surfaces of both cylinder block and valve plate to remedy their roughness (# 1200 power)
	Swash plate - hardness of sliding surface	Measure the surface hardness of swash plate by hardness tes-ter	Over HS78	HS74	Replace
Clearance between piston and cylinder block  Measurement position	Outer dia of piston d max - d min	Measure outer dia of piston and bore of cylinder block at least 3 places in the longitudinal direction with microme-ter and obtain : max outer dia = d max min outer dia = d min max inner dia = D max min inner dia = D min	0.01 mm	0.05 mm	Replace piston or cylinder block ※ In exchanging pistons, replace all of nine pis-tons at the same time
	Inner dia of cylinder bore D max - D min		0.01 mm	0.022 mm	
	Clearance D-d		0.037~ 0.047 mm	0.065 mm	
Play between pis-ton and shoe	Play between calked piston and shoe (δ)	With the jig, hold down the shoe on work stand and pull up the piston vertical direction to measure the play between piston and shoe	0~0.1 mm	0.3 mm	Replace piston



Play



Method



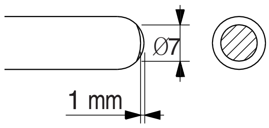
Jig for measuring play

29097MS10

Check item	Measuring method	Criteria	Allowable	Remedy
Parking brake torque	After completion of assembly, set the torque wrench on the shaft end, and measure the braking torque generated when the shaft starts to rotate	92.6 kgf · m (670 lbf · ft)	82.8 kgf · m (599 lbf · ft)	Replace all of separator, friction plates and springs
Standard of replacing friction and separating plate. When measuring parking brake torque, it needs to disassemble traveling unit to motor and reduction gear portion, and it's so hard. The right allowable value is a standard of replacing friction and separating plate. If it is impossible to disassemble traveling unit, refer to the right value.	Measure the total thickness of 4 pieces of friction plate and 5 pieces of separating plate.	22.76 mm	Thickness : 21.3 mm	Replace all separating and friction plates and springs.

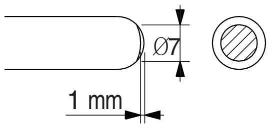
Check item	Measuring method	Judging criteria and remedy
Shaft	Measure the wear at contacting surface of oil seal (3) with the surface roughness tester	If the depth of shaft wear is less than 0.05 mm, the shaft is reusable. ※ In case of replacing the shaft (9), replace oil seal (3) at the same time.
Bearings	Replace bearings (10, 51) after decided hours	Replace bearings (10, 51) before hour meter of host machine indicates 10,000 hours. ※ In case replacing the bearings (10, 51), replace both inner and outer races at the same time. ※ Also the bearing shims (52) must be readjusted when replaced shaft (9) and/or bearings (10, 51). Contact dealers for jigs and tools required.
Splines	Replace if the wear of splines exceeds the allowable value	If the wear of splines is less than 0.3 mm, the spline is reusable.
Overload relief valve	Do not try to adjust the valve, since special hydraulic test bench is required for inspecting and adjusting the pressure	Replace relief valve part as an assembly each time the host machine works for 10,000 hours.

5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000 cc/m at neutral handle position, or more than 2000 cc/m during operation.	Conditions : Primary pressure : 40 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

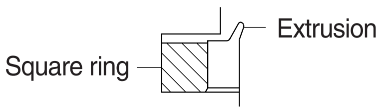
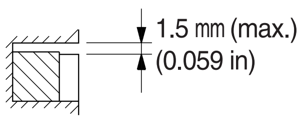
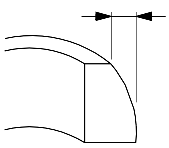
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

6. RCV PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	Conditions : Primary pressure : 40 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

7. TURNING JOINT

Part name		Maintenance standards	Remedy
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

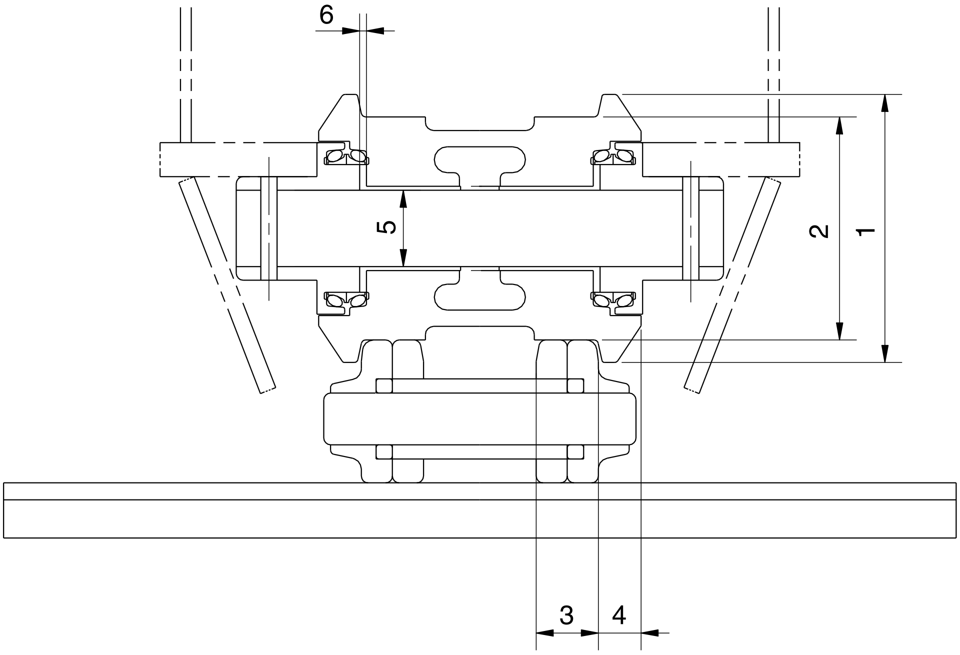
8. CYLINDER

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

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) LOWER ROLLER

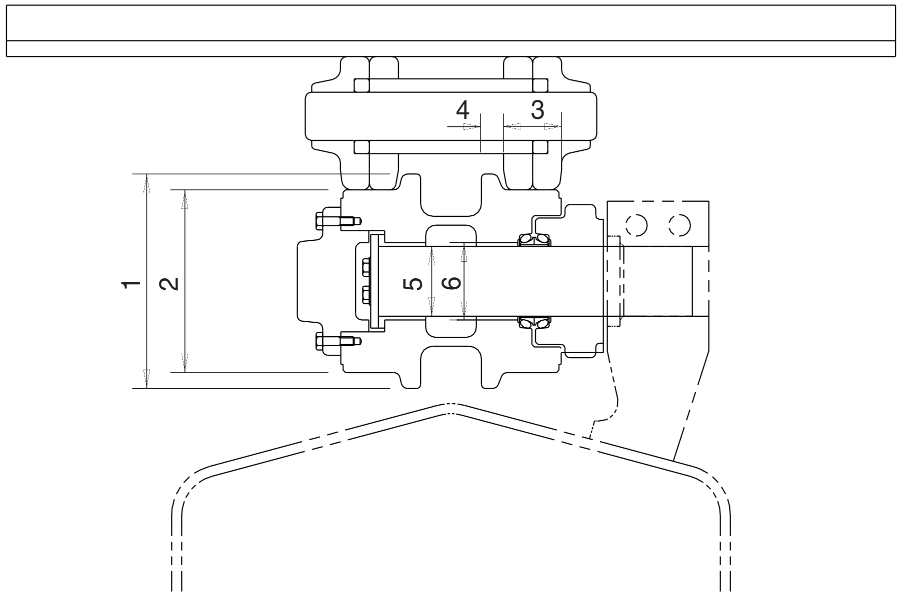


21037MS01

Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø250</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø200</td><td colspan="2">Ø188</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">54.6</td><td colspan="2">60.6</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">39.9</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>$Ø85\ ^{0}_{-0.035}$</td><td>$Ø85.3\ ^{+0.05}_{0}$</td><td>0.37 ~ 0.455</td><td>2.0</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Side clearance of roller (both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">0.36~1.14</td><td colspan="2">2.0</td></tr>
</table>

2) UPPER ROLLER

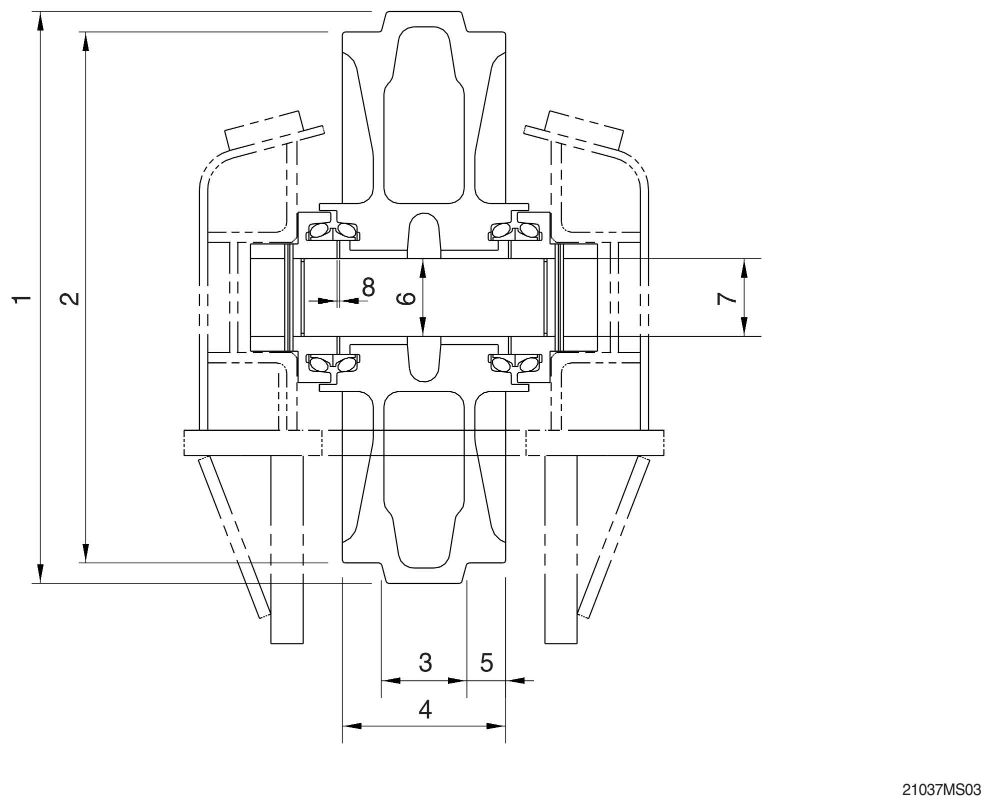


32037MA37

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø220		–		
2	Outside diameter of tread	Ø191		Ø181		
3	Width of tread	51		56		
4	Width of flange	20		–		
5	Clearance between shaft and support	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø57.15 $^{0}_{-0.1}$	Ø57.15 $^{+0.3}_{+0.1}$	0.1~0.4	1.2	

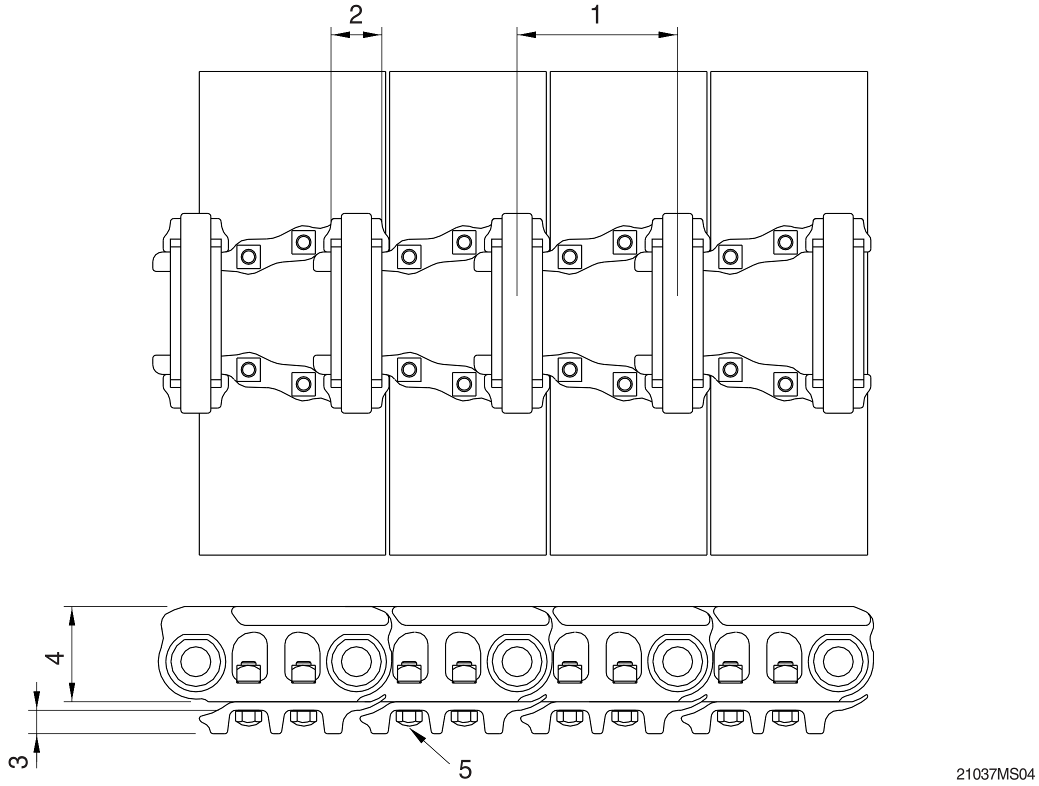
3) IDLER



Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protrusion</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø646</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø594</td><td colspan="2">Ø580</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">102</td><td colspan="2">–</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">203</td><td colspan="2">–</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">50.5</td><td colspan="2">57.5</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>Ø95 $^{0}_{-0.035}$</td><td>Ø95 $^{+0.40}_{+0.35}$</td><td>0.35~0.435</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>Ø95 $^{0}_{-0.035}$</td><td>Ø95 $^{+0.09}_{+0.036}$</td><td>0.36~1.25</td><td>1.2</td><td>Replace</td></tr>
<tr><td>8</td><td>Side clearance of idler (both side)</td><td colspan="2">Standard clearance
0.51~1.46</td><td colspan="2">Clearance limit
2.0</td><td>Replace</td></tr>
</table>

4) TRACK



Unit : ㎜

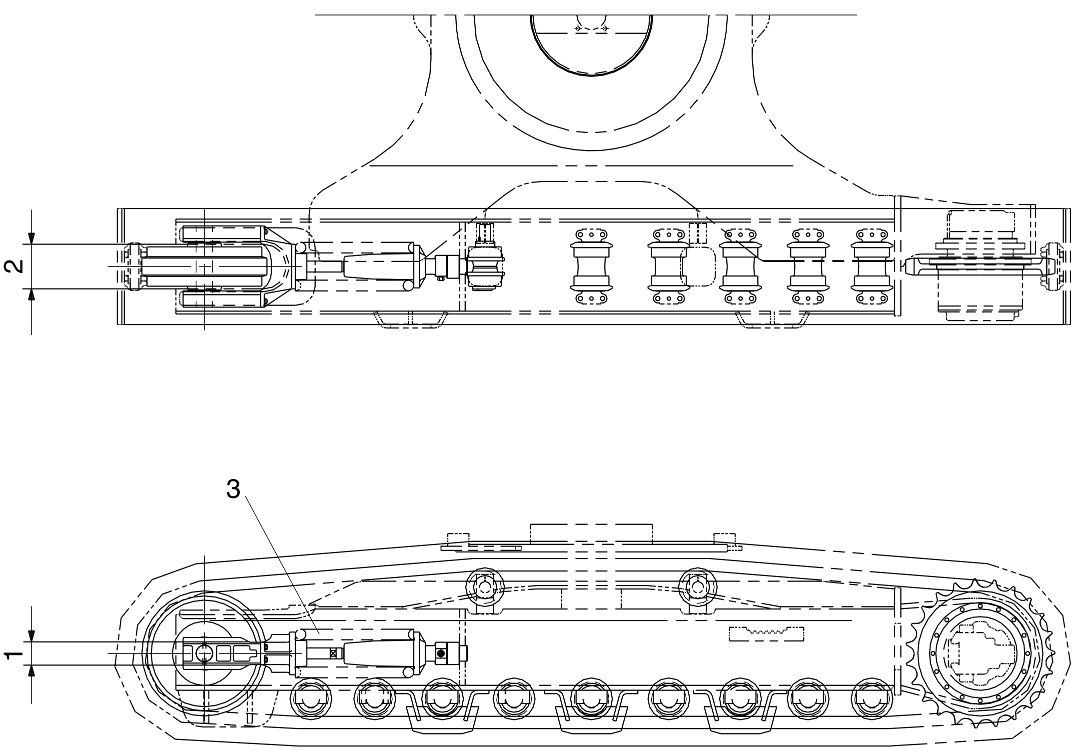
No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		215.9	220.9	
2	Outside diameter of bushing	Ø71	Ø62	Rebuild or replace
3	Height of grouser	36	26	
4	Height of link	129	121	
5	Tightening torque	Initial tightening torque : 140±5 kgf · m		Retighten

(Mahcine Serial No. : #0069-)

Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		215.9	220.9	
2	Outside diameter of bushing	Ø71	Ø62	Rebuild or replace
3	Height of grouser	49	34	
4	Height of link	129	121	
5	Tightening torque (Tightening angle method)	Initial tightening torque : 50±5 kgf · m Additional tightening angle : 120±10˚		Retighten

5) TRACK FRAME AND RECOIL SPRING



21037MS05

Unit : ㎜

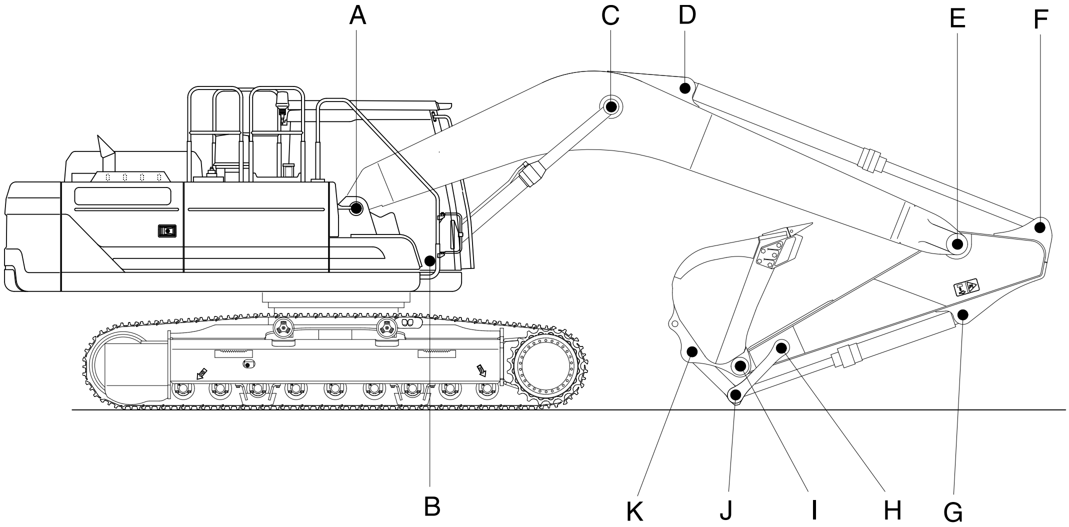
No.	Check item	Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit	Rebuild or replace
		Track frame		123	2.0 -1.0	127	
		Idler support		130	0 -1.5	126	
2	Horizontal width of idler guide	Track frame		292	2.0 -1.0	296	
		Idler support		420	–	417	
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		740	595	24500 ㎏	–	19600 ㎏	

(Mahcine Serial No. : #0069-)

Unit : ㎜

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit	Rebuild or replace
		Track frame		133	2.0 0	137	
		Idler support		130	0.5 -0.5	126	
2	Horizontal width of idler guide	Track frame		292	–	296	
		Idler support		290	0.5 -0.5	287	
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		857	707	24375 ㎏	–	19600 ㎏	

2. WORK EQUIPMENT



Unit : mm

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	120	119	118.5	120.5	121	Replace
B	Boom Cylinder Head	100	99	98.5	100.5	101	Replace
C	Boom Cylinder Rod	110	109	108.5	110.5	111	Replace
D	Arm Cylinder Head	110	109	108.5	110.5	111	Replace
E	Boom Front	110	109	108.5	110.5	111	Replace
F	Arm Cylinder Rod	110	109	108.5	110.5	111	Replace
G	Bucket Cylinder Head	90	89	88.5	90.5	91	Replace
H	Arm Link	90	89	88.5	90.5	91	Replace
I	Bucket and Arm Link	100	99	98.5	100.5	101	Replace
J	Bucket Cylinder Rod	90	89	88.5	90.5	91	Replace
K	Bucket Link	100	99	98.5	100.5	101	Replace

SECTION 8 DISASSEMBLY AND ASSEMBLY

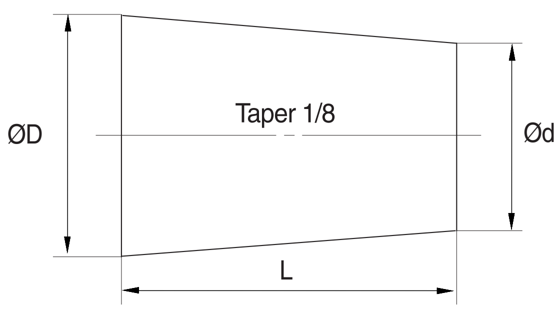
SECTION 8 DISASSEMBLY AND ASSEMBLY

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 100mm 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 disulphied 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)	M12 × 1.75	11.5 ± 1.0	83.2 ± 7.2
2		Engine mounting bolt (bracket-frame)	M24 × 3.0	90 ± 9.0	651 ± 65
3		Radiator, oil cooler mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
4		Coupling mounting socket bolt	M20 × 2.5	46.5 ±2.5	336 ±18.1
5		Fuel tank mounting bolt	M20 × 2.5	57.8 ±5.8	418 ± 42.0
6	Hydraulic system	Main pump housing mounting bolt	M10 × 1.5	6.5 ± 0.7	47.0 ± 5.1
7		Main pump mounting socket bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
8		Main control valve mounting nut	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
9		Hydraulic oil tank mounting bolt	M20 × 2.5	57.9 ± 5.8	419 ± 42
10		Turning joint mounting bolt, nut	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
11	Power train system	Swing motor mounting bolt	M24 × 3.0	97.8 ± 15	707 ± 108
12		Swing bearing upper part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
13		Swing bearing lower part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
14		Travel motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
15		Sprocket mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
16	Under carriage	Upper roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
17		Lower roller mounting bolt	M24 × 3.0	100 ± 10.0	723 ± 72.3
18		Track tension cylinder mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
19		Track shoe mounting bolt, nut	M22 × 1.5	123 ± 6.0	890 ± 43.4
20		Track guard mounting bolt	M24 × 3.0	100 ± 15	723 ± 108
21	Others	Counterweight mounting bolt	M36 × 3.0	337 ± 33	2440 ± 239
22		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
23		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8
24		Under cover mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7

※ For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6×1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8×1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10×1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12×1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14×2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16×2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18×2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20×2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22×2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24×3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30×3.5	120 ~161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8×1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10×1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12×1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14×1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16×1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18×1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20×1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22×1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24×2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30×2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

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	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

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	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

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	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

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.**

(4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 210 ℓ (55.5 U.S. gal)

(5) Remove socket bolts (5) and disconnect pipes (1, 2).

(6) Disconnect pilot line hoses (6, 7, 8, 9, 10, 11, 12, 13).

(7) Remove socket bolts (4) 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.

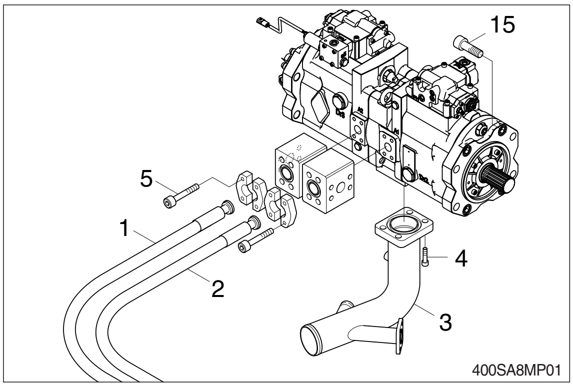
(8) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 193 kg (425 lb)

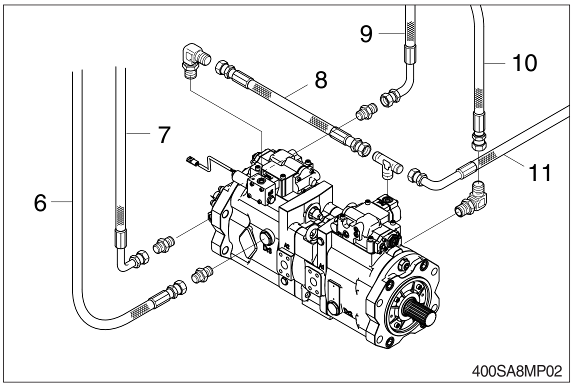
· Tightening torque : 57.9±8.7 kgf · m (419±62.9 lbf · ft)

※ Pull out the pump assembly from housing. When removing the pump assembly, check that all the hoses have been disconnected.

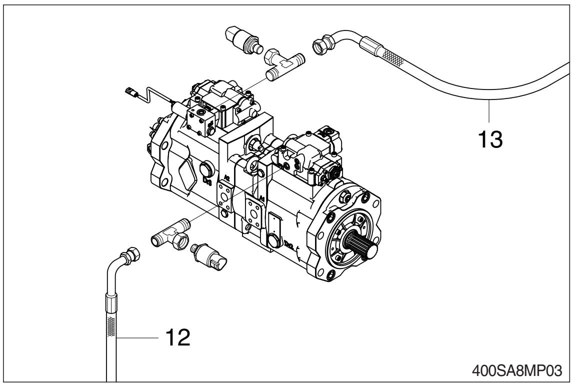
13031GE18



400SA8MP01



400SA8MP02



400SA8MP03

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.

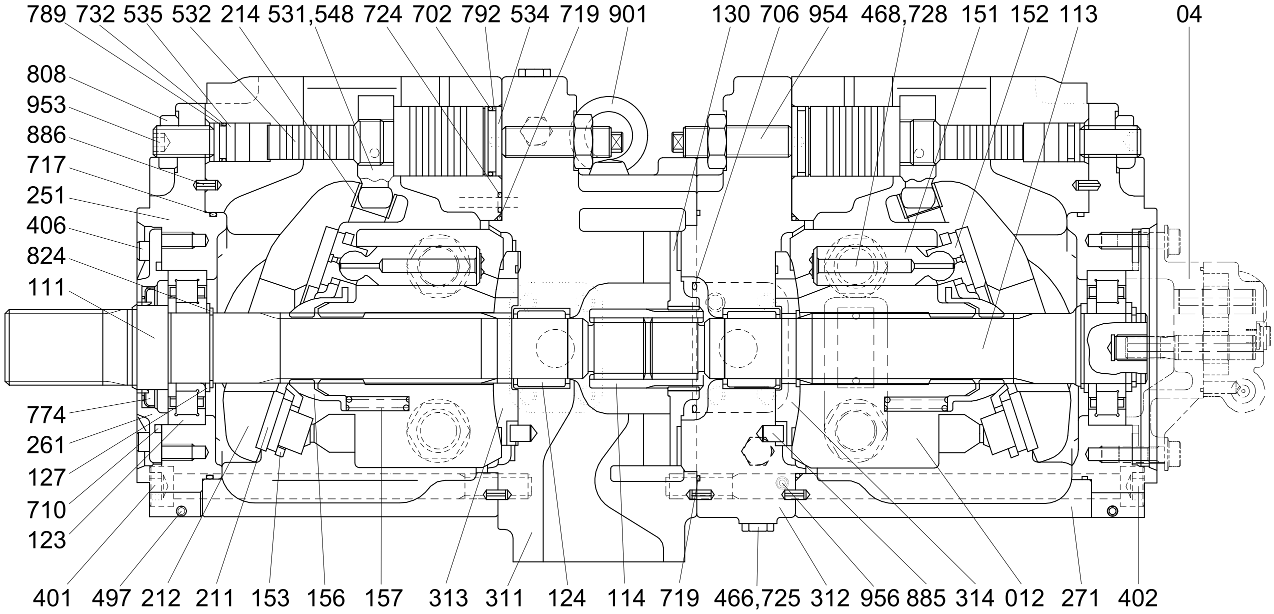
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(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



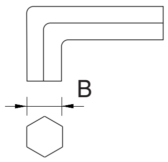
400SA2MP02

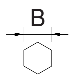
04	Gear pump	271	Pump casing	717	O-ring
111	Drive shaft (F)	311	Valve cover (F)	719	O-ring
113	Drive shaft (R)	312	Valve cover (R)	724	Square ring
114	Spline coupling	313	Valve plate (R)	725	O-ring
123	Roller bearing	314	Valve plate (L)	728	O-ring
124	Needle bearing	401	Hexagon socket bolt	732	O-ring
127	Bearing spacer	402	Hexagon socket bolt	774	Oil seal
130	Booster	406	Hexagon socket bolt	789	Back up ring
012	Cylinder block	466	Plug	792	Back up ring
151	Piston	468	Plug	808	Hexagon head nut
152	Shoe	497	MH Plug	824	Snap ring
153	Set plate	531	Tilting pin	885	Pin
156	Bushing	532	Servo piston	886	Spring pin
157	Cylinder spring	534	Stopper (L)	901	Eye bolt
211	Shoe plate	535	Stopper (S)	953	Set screw
212	Swash plate	548	Feedback pin	954	Set screw
214	Bushing	702	O-ring	956	Set screw
251	Support plate	706	O-ring		
261	Seal cover (F)	710	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Tool name & size	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
Allen wrench 	4	M 5	BP-1/16	-	M 8
	5	M 6	BP1/ 8	-	M10
	6	M 8	BP-1/ 4	PO-1/4	M12, M14
	8	M10	BP-3/ 8	PO-3/8	M16, M18
	17	M20, M22	BP-1	PO-1, 1 1/4, 1 1/2	-

Tool name & size	B	Hexagon head bolt	Hexagon head bolt	VP plug (PF thread)
Double ring spanner, socket wrench, double (single) open end spanner 	19	M12	M12	VP-1/4
	24	M16	M16	-
	27	M18	M18	VP-1/2
	30	M20	M20	-
	36	-	-	VP-3/4

Tool name & size	Part name
Adjustable angle wrench	Medium size, 1 set
Screw driver	Minus type screw driver, Medium size, 2 sets
Hammer	Plastic hammer, 1 set
Pliers	For snap ring, TSR-160
Steel bar	Steel bar of key material approx. 10×8×200
Torque wrench	Capable of tightening with the specified torques

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT plug (material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF plug (material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

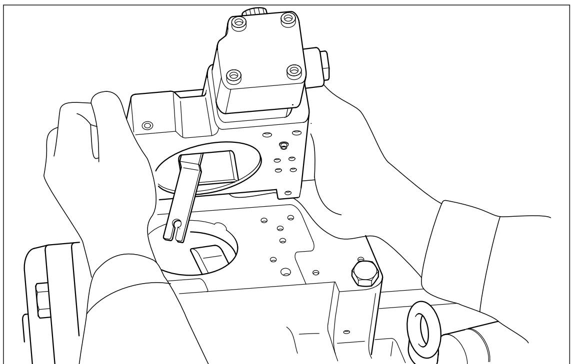
3) DISASSEMBLY

(1) Select place suitable to disassembling.
※ Select clean place.
※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing (front and rear pump).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.

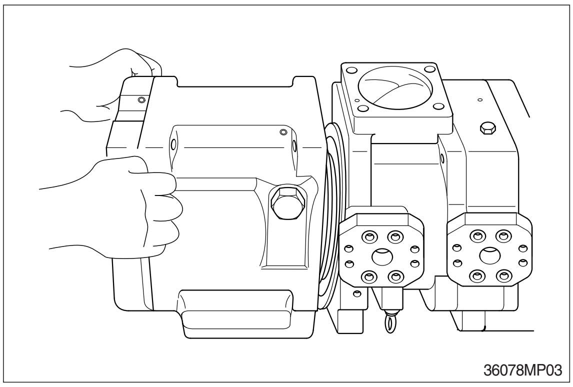

36078MP02

(5) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve cover (F, 311).
※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

(6) Loosen hexagon socket head bolts (402) which tighten swash plate support (251), pump casing (271) and valve cover (R, 312).

(7) Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve cover (F, 311).

※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.

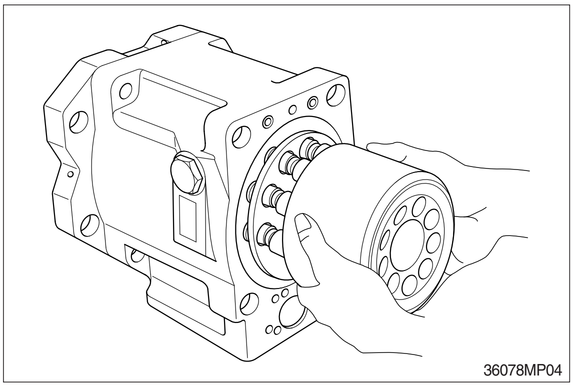


36078MP03

(8) Separate valve cover (F, 311) from valve cover (R, 312) and pull out booster (130), spline coupling (114).

(9) Separate valve cover (R, 312) from pump casing and then pull out the cylinder block (012) of pump casing (271) straightly over drive shaft(R, 113). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

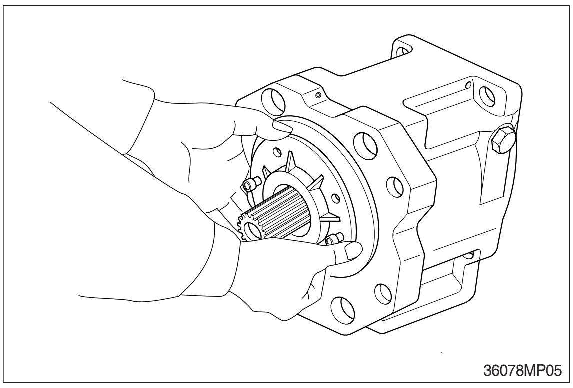


36078MP04

(10) Remove hexagon socket head bolts (406) and then seal cover (F, 261).

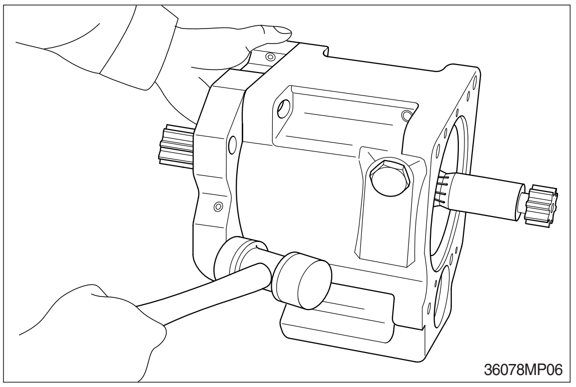
※ Fit bolt into pulling-out tapped hole of seal cover (F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover (F), take care not to damage it when removing cover.

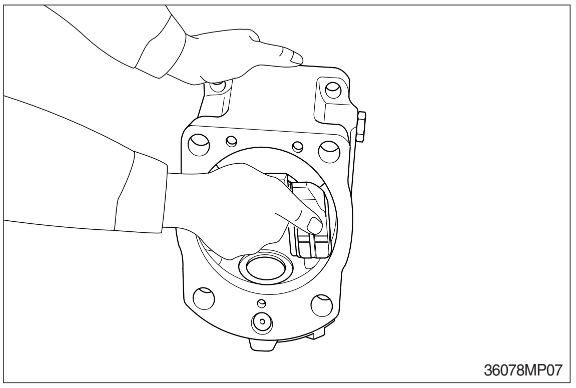


36078MP05

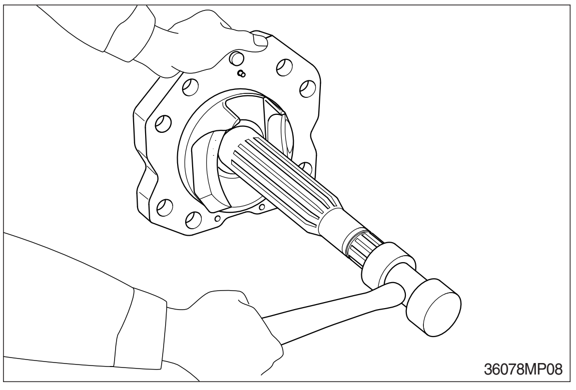
(11) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



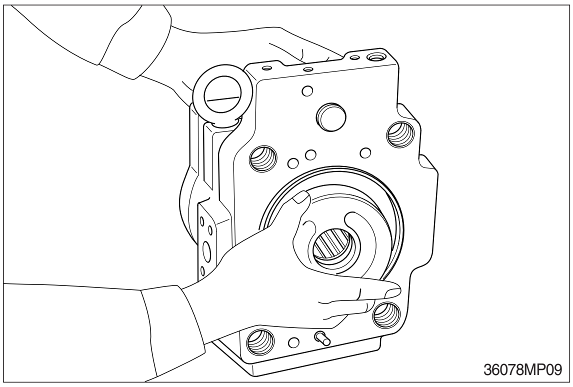
(12) Remove shoe plate (211) and swash plate (212) from pump casing (271).



(13) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



(14) Remove valve plates (313, 314) from valve cover (311, 312).
※ These may be removed in work 7, 9.


36078MP09

(15) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) from valve cover (311, 312).
※ In removing tilting pin, use a protector to prevent pin head from being damaged.
※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.
※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.
※ Do not loosen hexagon nuts of valve cover and swash plate support.
If loosened, flow setting will be changed.

(16) This is the end of disassembling procedures.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

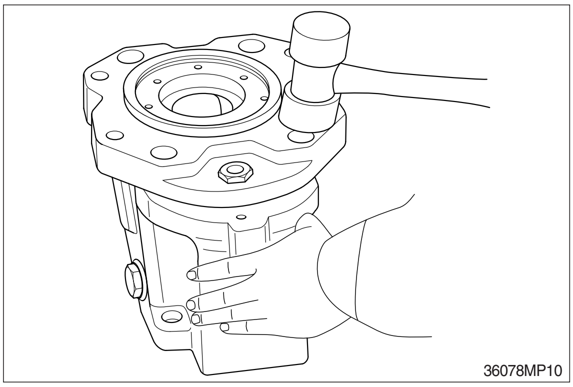
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-10, 11.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.

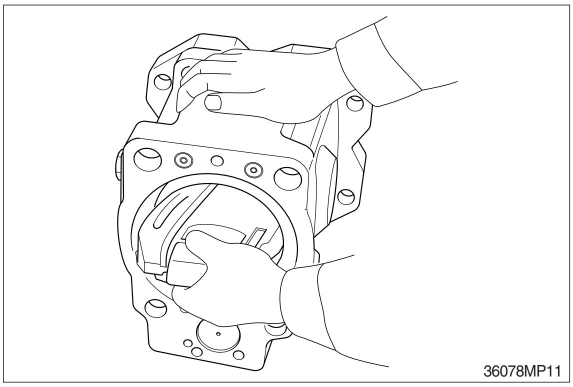
※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (medium strength) to their threaded sections.

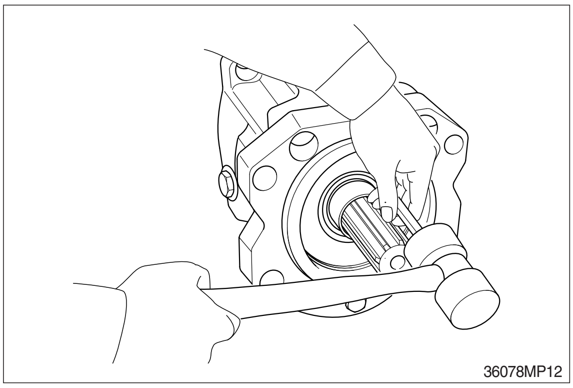


36078MP10

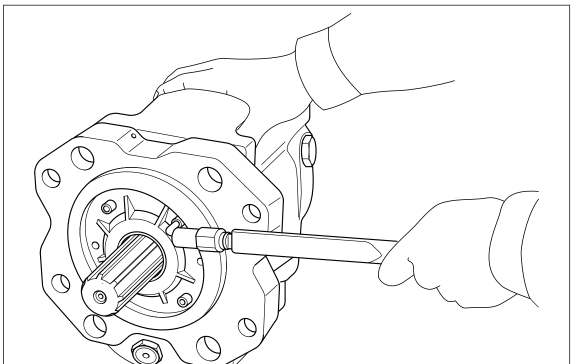
(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.
※ Confirm with fingers of both hands that swash plate can be removed smoothly.
※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.


36078MP11

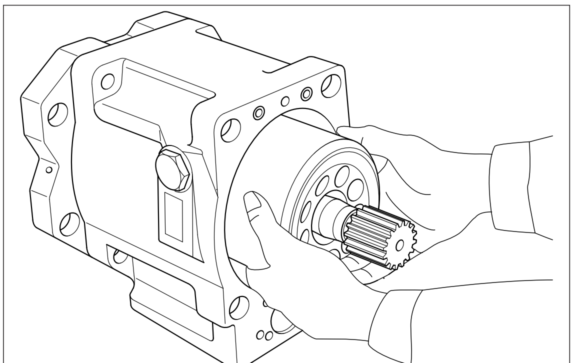
(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).
※ Do not tap drive shaft with hammer or so on.
※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.
Fit them fully, using steel bar or so on.


36078MP12

(5) Assemble seal cover(F, 261) to pump casing(271) and fix it with hexagon socket head bolts(406).
※ Apply grease lightly to oil seal in seal cover(F).
※ Assemble oil seal, taking full care not to damage it.
※ For tandem type pump, fit rear cover(263) and seal cover(262) similarly.

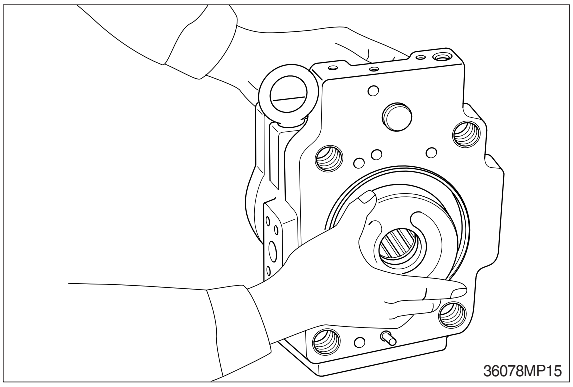

36078MP13

(6) Assemble piston cylinder subassembly [cylinder block (012), piston subassembly (151, 152), set plate (153), spherical bushing (156) and cylinder spring (157)].
Fit spline phases of retainer and cylinder.
Then, insert piston cylinder subassembly into pump casing (271).


36078MP14

(7) Fit valve plate (313) to valve cover (F, 311), and fit valve plate (314) to valve cover (R, 312), entering pin into pin hole.

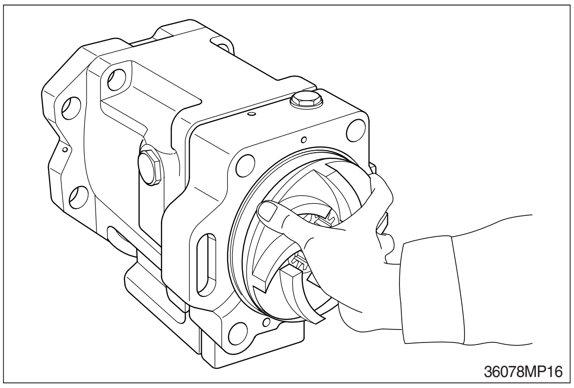
※ Take care not to mistake suction / delivery directions of valve plate.


36078MP15

(8) Fit valve block (R, 312) to pump casing (271) and fit spline coupling (114) and booster(130) to shaft (R, 113).

※ Take care not to mistake direction of valve cover.

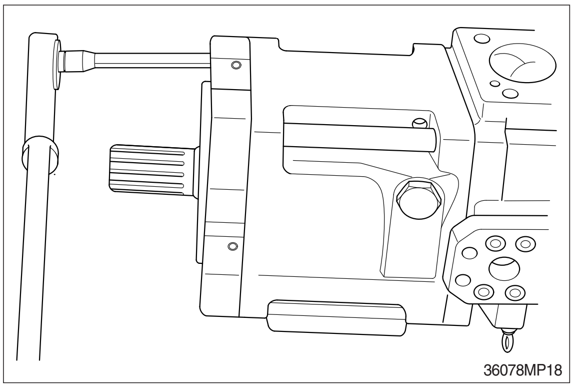
※ Fit valve cover with regulator up and with delivery flange left, viewed from front side. Take care not to mistake direction of booster (130).
(Refer to the sectional drawing)


36078MP16

(9) Fit valve cover (F, 311) to valve cover (R) and tighten hexagon socket head bolts (402).

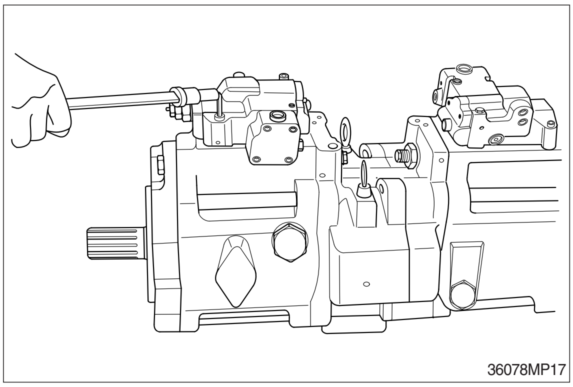
(10) Fit pump casing (271) with shaft (F, 111) to valve cover (F, 311) and tighten hexagon socket head bolts (401).

※ Mate spline phases of shaft (F) and spline coupling, with shaft (F) been rotating.


36078MP18

(11) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412,413).

※ Take care not to mistake regulator of front pump for that of rear pump.

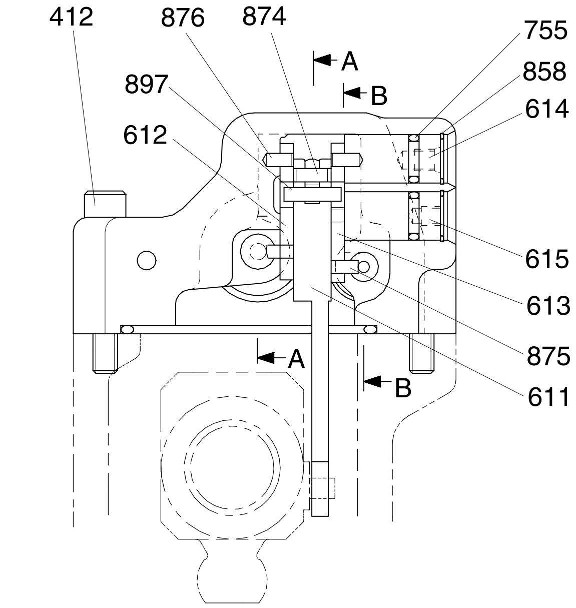


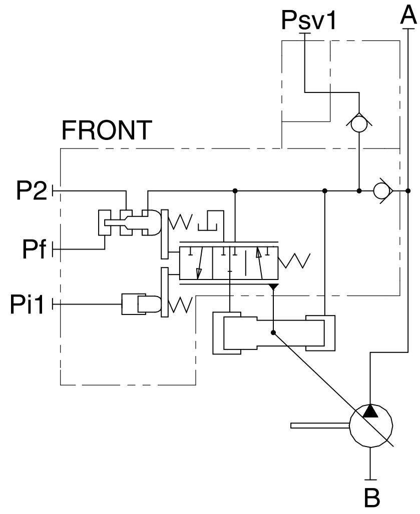
(12) Fit drain port plug (468).

This is the end of reassembling procedures.

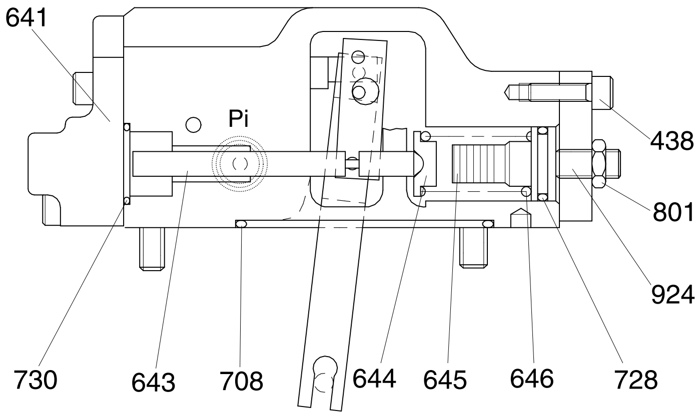
3. REGULATOR

1) FRONT REGULATOR (1/2)

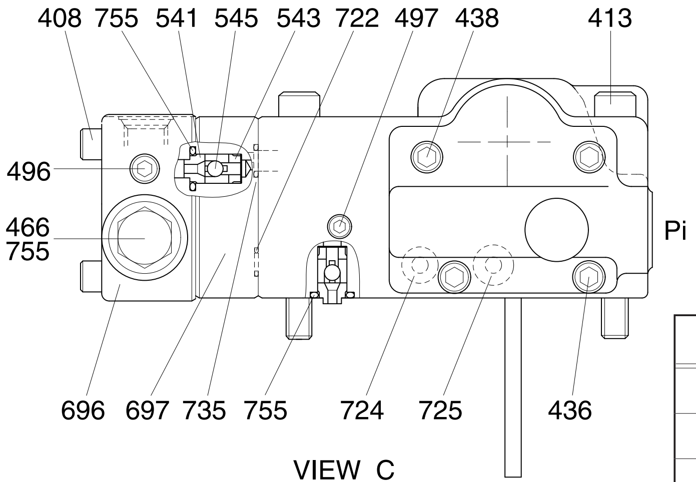




Hydraulic circuit



SECTION B-B

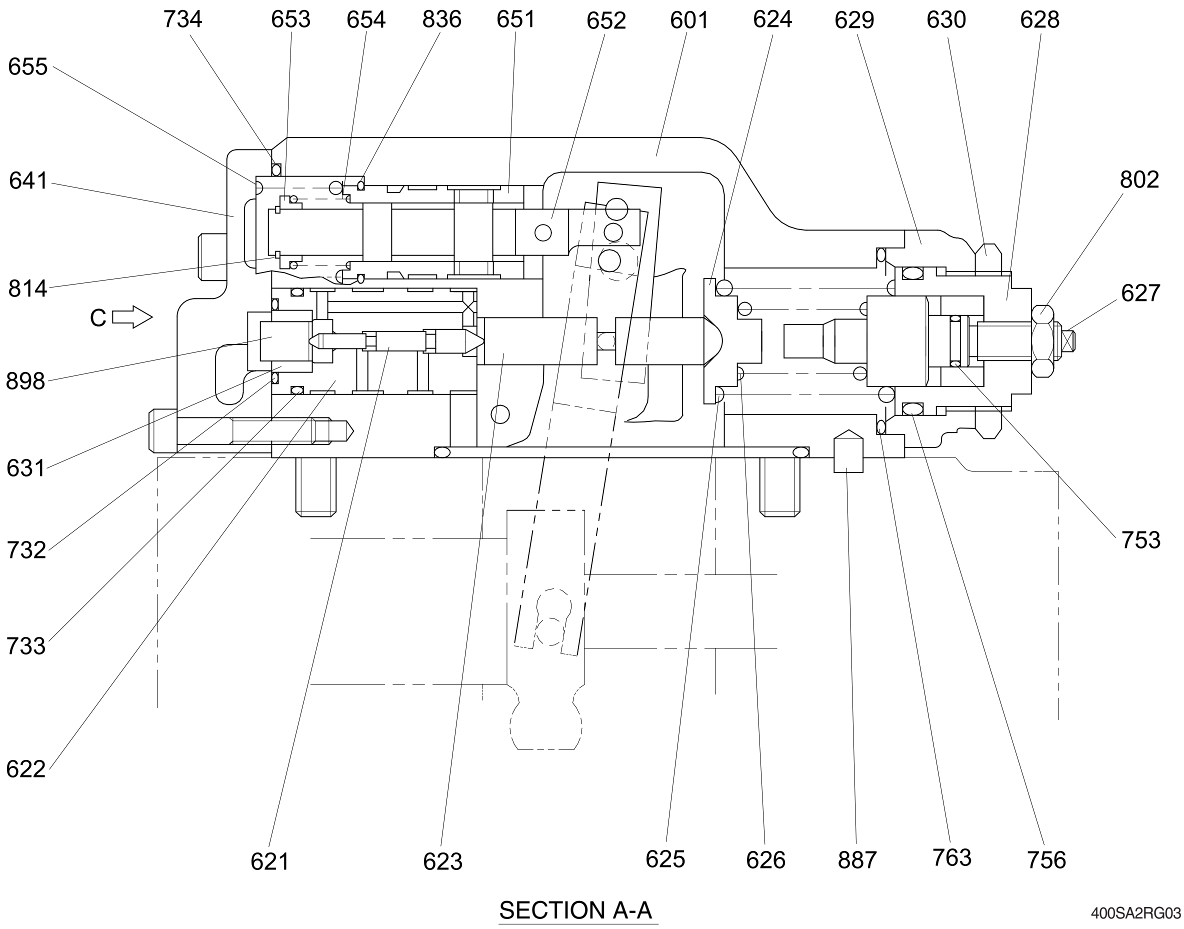


VIEW C

Port	Port name	Port size
Pi1	Pilot port	PF 1/4-15
Psv1	Servo assist port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

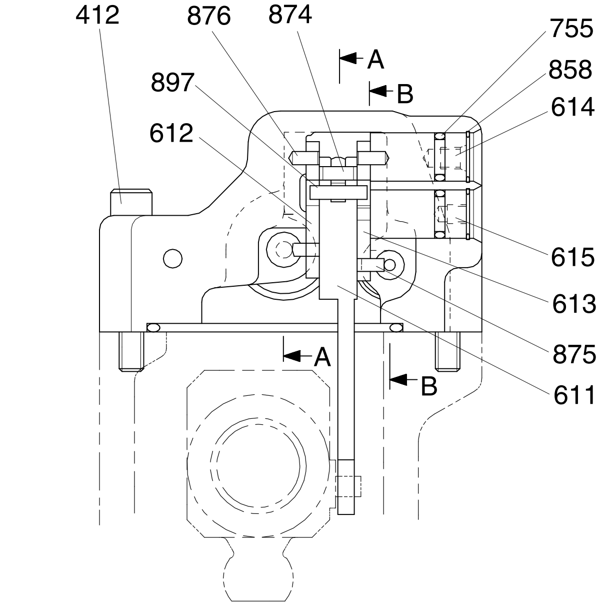
400SA2RG01

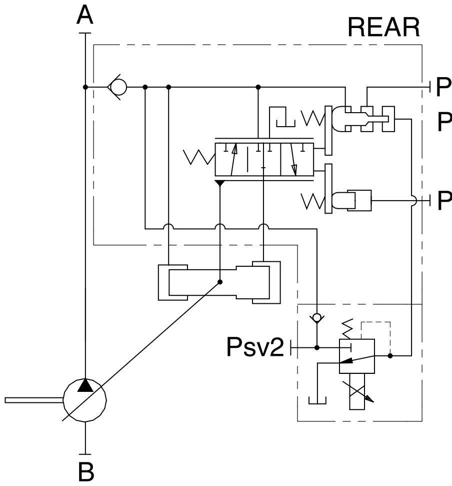
FRONT REGULATOR (2/2)



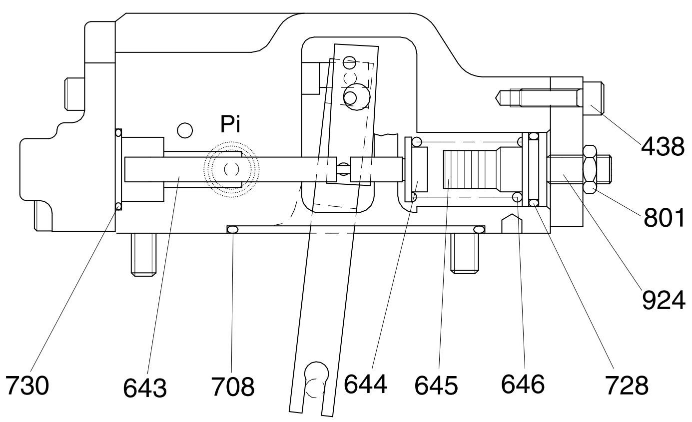
408	Hexagon socket bolt	626	Inner spring	728	O-ring
412	Hexagon socket bolt	627	Adjust stem (C)	730	O-ring
413	Hexagon socket bolt	628	Adjust screw (C)	732	O-ring
436	Hexagon socket bolt	629	Cover (C)	733	O-ring
438	Hexagon socket bolt	630	Lock nut	734	O-ring
466	Plug	631	Sleeve, pf	735	O-ring
496	Plug	641	Pilot cover	753	O-ring
497	Plug	643	Pilot piston	755	O-ring
541	Seat	644	Spring seat (Q)	756	O-ring
543	Stopper	645	Adjust stem (Q)	763	O-ring
545	Steel ball	646	Pilot spring	801	Hexagon nut
601	Casing	651	Sleeve	802	Hexagon nut
611	Feedback lever	652	Spool	814	Snap ring
612	Lever(1)	653	Spring seat	836	Stop ring
613	Lever(2)	654	Return spring	858	Snap ring
614	Center plug	655	Set spring	874	Pin
615	Adjust plug	696	Port cover	875	Pin
621	Compensator piston	697	Check valve plate	876	Pin
622	Piston case	708	O-ring	887	Pin
623	Compensator rod	722	O-ring	897	Pin
624	Spring seat (C)	724	Square ring	898	Pin
625	Outer spring	725	O-ring	924	Set screw

2) REAR REGULATOR (1/2)

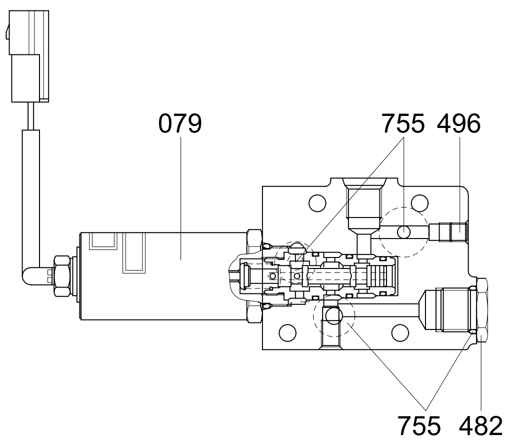




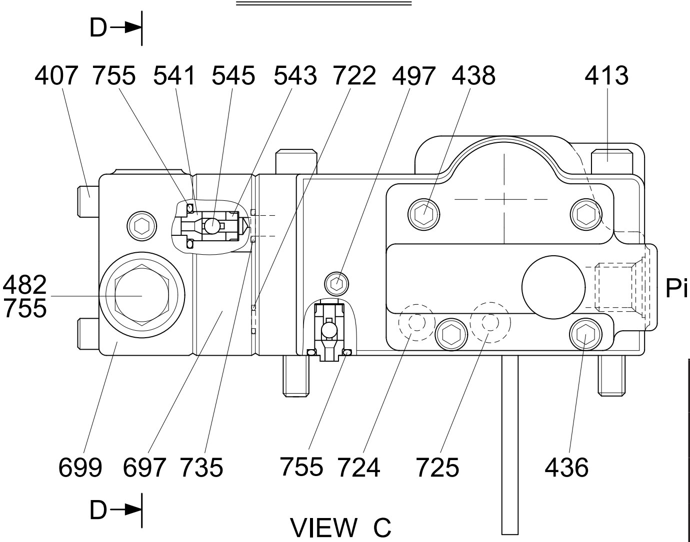
Hydraulic circuit



SECTION B-B



SECTION D-D

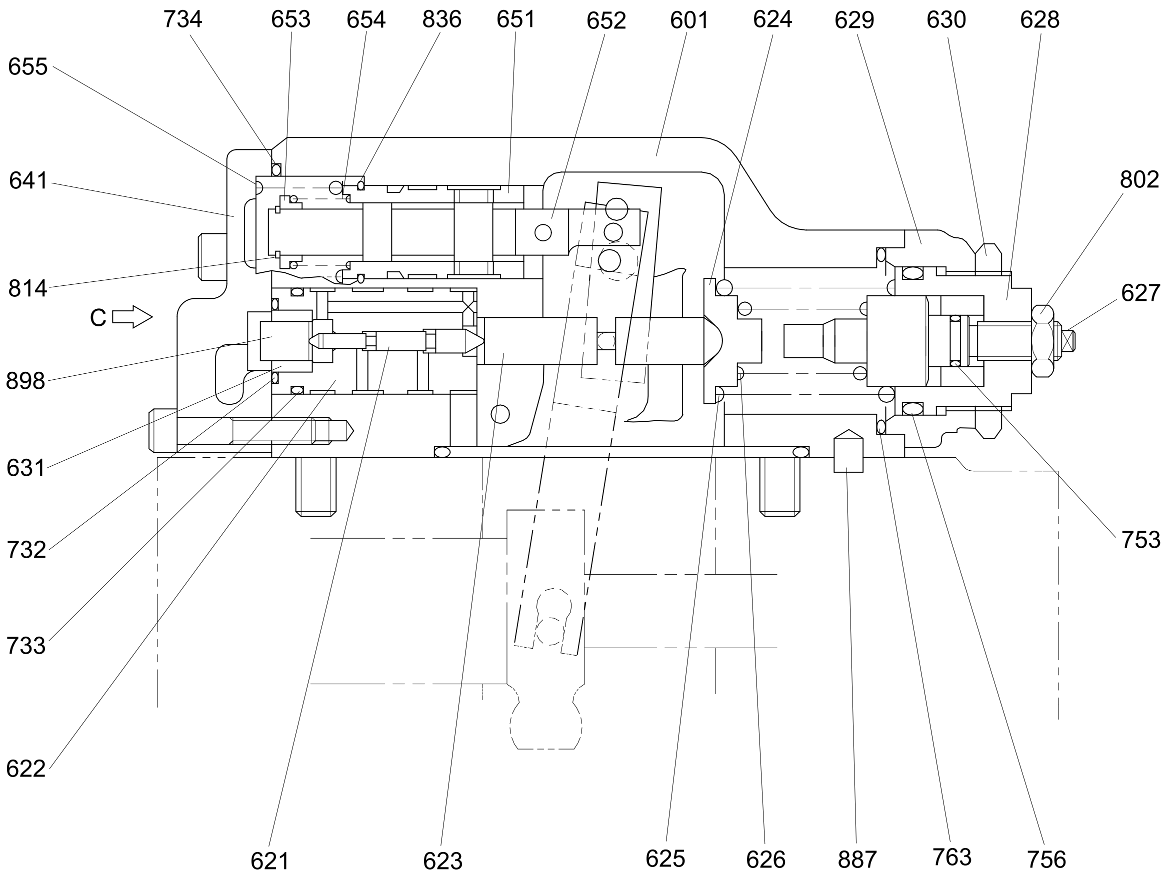


VIEW C

Port	Port name	Port size
Pi1	Pilot port	PF 1/4-15
Psv1	Servo assist port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

400SA2RG02

REAR REGULATOR (2/2)



SECTION A-A

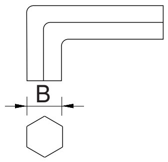
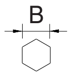
400SA2RG03

407	Hexagon socket bolt	626	Inner spring	728	O-ring
412	Hexagon socket bolt	627	Adjust stem (C)	730	O-ring
413	Hexagon socket bolt	628	Adjust screw (C)	732	O-ring
436	Hexagon socket bolt	629	Cover (C)	733	O-ring
438	Hexagon socket bolt	630	Lock nut	734	O-ring
482	Plug	631	Sleeve, pf	735	O-ring
496	Plug	641	Pilot cover	753	O-ring
497	Plug	643	Pilot piston	755	O-ring
541	Seat	644	Spring seat (Q)	756	O-ring
543	Stopper	645	Adjust stem (Q)	763	O-ring
545	Steel ball	646	Pilot spring	801	Hexagon nut
601	Casing	651	Sleeve	802	Hexagon nut
611	Feedback lever	652	Spool	814	Snap ring
612	Lever(1)	653	Spring seat	836	Stop ring
613	Lever(2)	654	Return spring	858	Snap ring
614	Center plug	655	Set spring	874	Pin
615	Adjust plug	697	Check valve plate	875	Pin
621	Compensator piston	699	Valve casing	876	Pin
622	Piston case	708	O-ring	887	Pin
623	Compensator rod	722	O-ring	897	Pin
624	Spring seat (C)	724	Square ring	898	Pin
625	Outer spring	725	O-ring	924	Set screw

3) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><th colspan="2">Tool name & size</th><th colspan="12">Part name</th></tr>
<tr><td rowspan="4">Allen wrench
</td><td>B</td><td colspan="3">Hexagon socket head bolt</td><td colspan="3">PT plug (PT thread)</td><td colspan="3">PO plug (PF thread)</td><td colspan="3">Hexagon socket head setscrew</td></tr>
<tr><td>4</td><td colspan="3">M 5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M 6</td><td colspan="3">BP1/ 8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M 8</td><td colspan="3">BP-1/ 4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double (single) open end spanner
</td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon head nut</td><td colspan="4">VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="4">M8</td><td colspan="4">M8</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Small size, Max 36 mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="12">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="12">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="12">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="12">4×100 mm</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="12">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="12">M4, Length : 50mm</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT plug (material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF plug (material : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

4) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

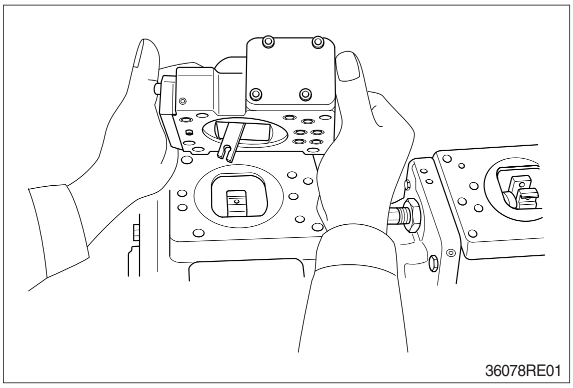
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.



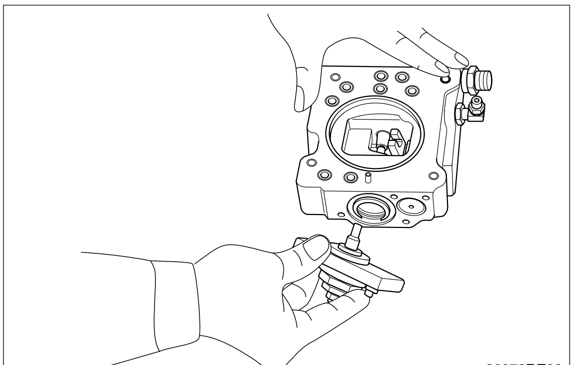
36078RE01

(4) Remove hexagon socket head screw (438) and remove cover (C,629)

※ Cover (C) is fitted with adjusting screw (C,QI) (628), adjusting stem (C, 627), lock nut (630), hexagon nut (801) and set screw (924).

Do not loosen these screws and nuts.

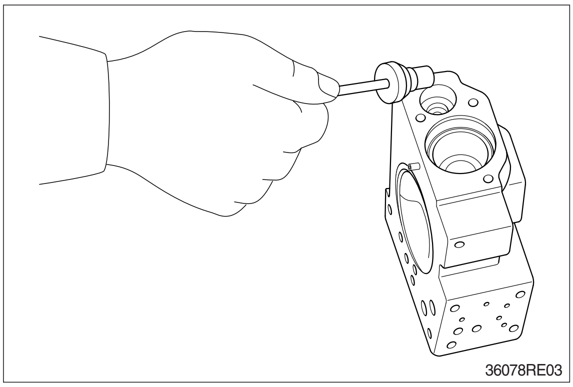
If they are loosened, adjusted pressure-flow setting will vary.



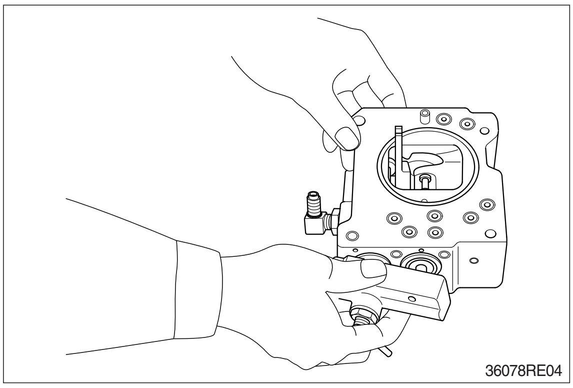
36078RE02

(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting stem (Q, 645), pilot spring (646) and spring seat (644) from pilot section.

※ Adjusting stem (Q,645) can easily be drawn out with M4 bolt.


36078RE03

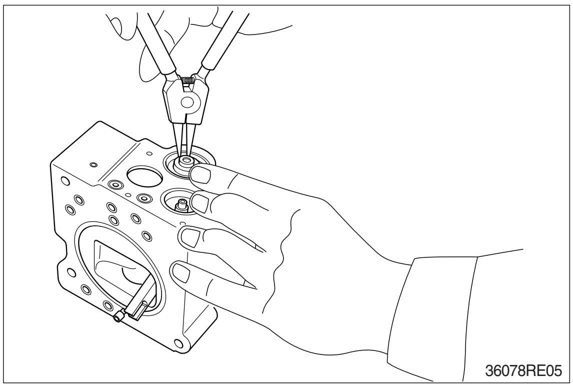
(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.


36078RE04

(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
Sleeve (651) is fitted with snap ring (836).

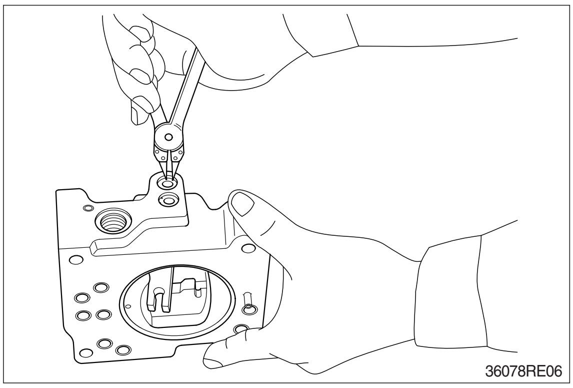
※ When removing snap ring (814), return spring (654) may pop out.

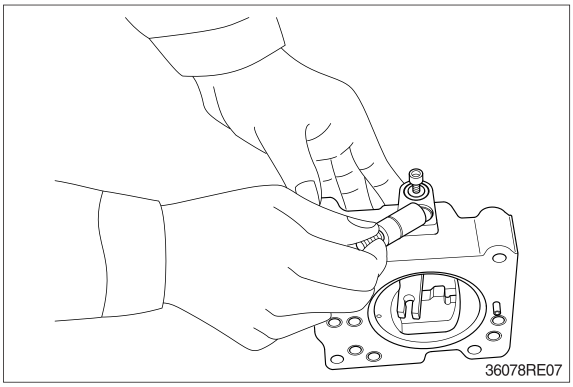
※ Take care not to lose it.


36078RE05

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).

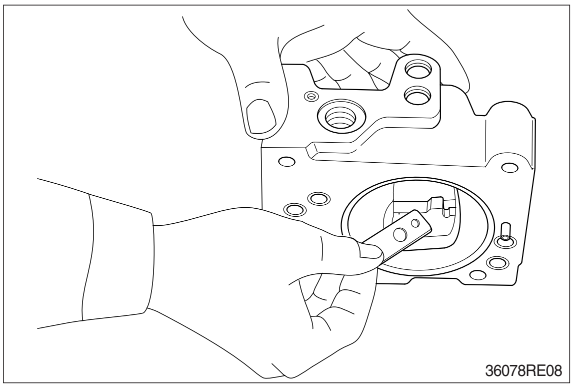
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.


36078RE06



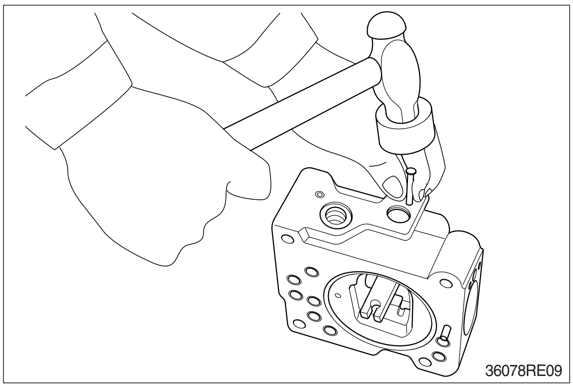
(9) Remove lever2 (613). Do not draw out pin (875).

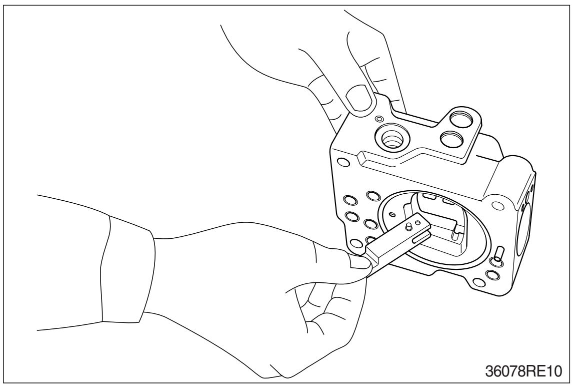
※ Work will be promoted by using pincers or so on.



(10) Draw out pin (874) and remove feedback lever (611).

※ Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever1 (612).





(11) Remove lever1 (612). Do not draw out pin (875).

(12) Draw out pilot piston (643) and spool (652).

(13) Draw out piston case (622), compensating piston (621) and compensating rod (623).

※ Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand.
Mixing of foreign matter will cause malfunction.

③ Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

④ Always tighten bolts, plugs, etc. to their specified torques.

⑤ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.
Replace seals such as O-ring with new ones as a rule.

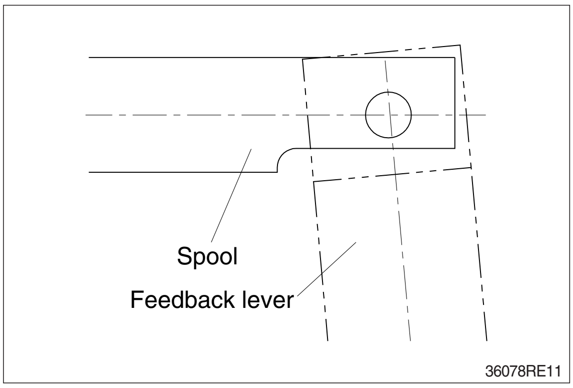
(2) Put compensating rod (623) into compensating hole of casing(601).

(3) Put pin force-fitted in lever1 (612) into groove of compensating rod and fit lever 1 to pin force-fitted in casing.

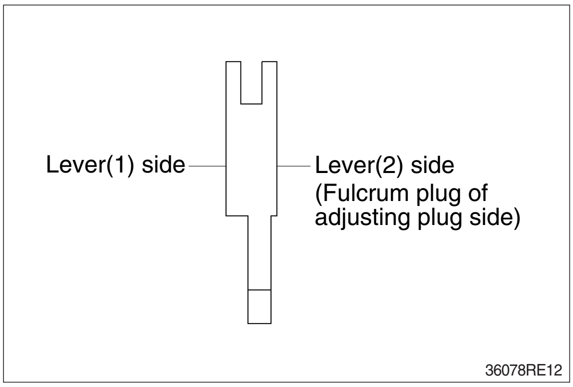
(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



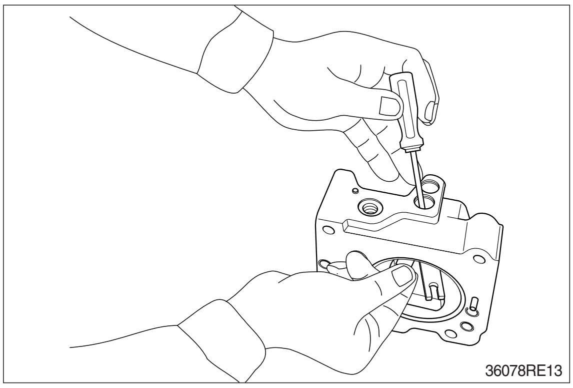
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



36078RE12

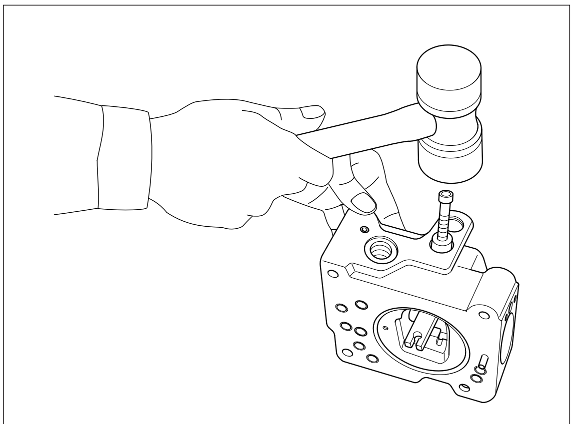
(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

(7) Put pin force-fitted in lever2 (613) into groove of pilot piston.
Then fix lever (2).

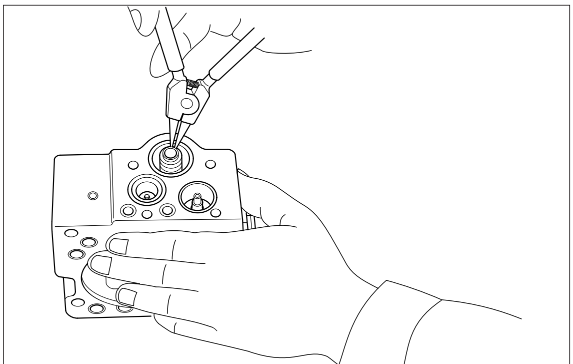

36078RE13

(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever (2).
Then fix locking ring (858).

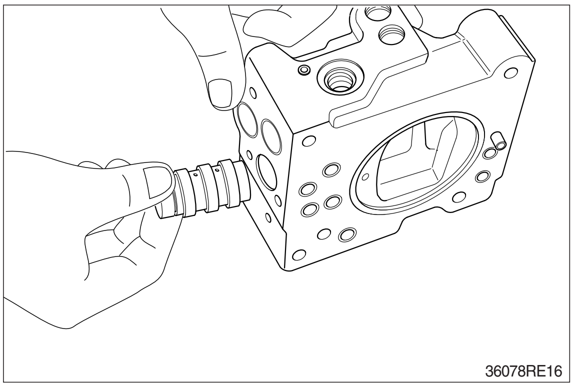
(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


36078RE14

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).

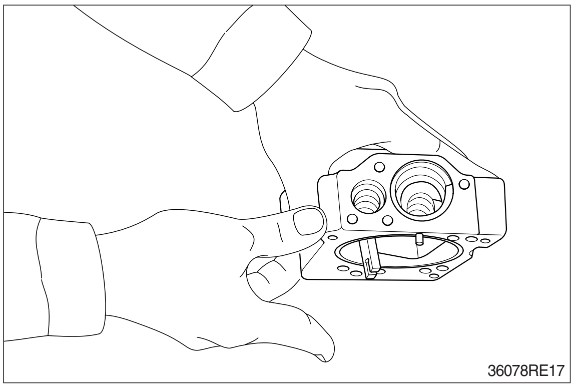

36078RE15

(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).



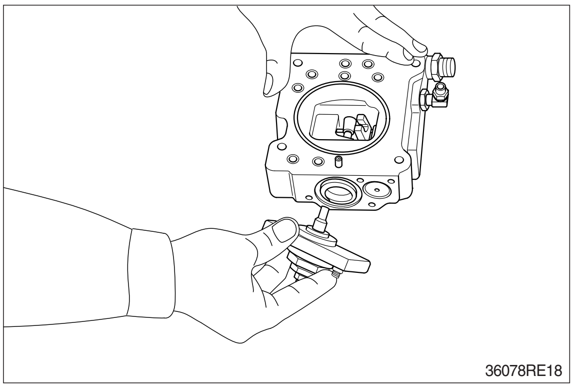
(12) Put spring seat (644), pilot spring (646) and adjusting stem (Q, 645) into pilot hole. Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

※ When fitting spring seat, take care not to mistake direction of spring seat.



(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting stem (C, 627), lock nut (630), hexagon nut (802) and set screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.



GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL

1) REMOVAL

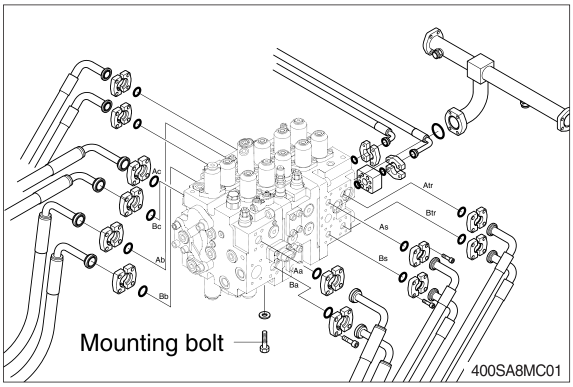
(1) Lower the work equipment to the ground and stop the engine.

(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.



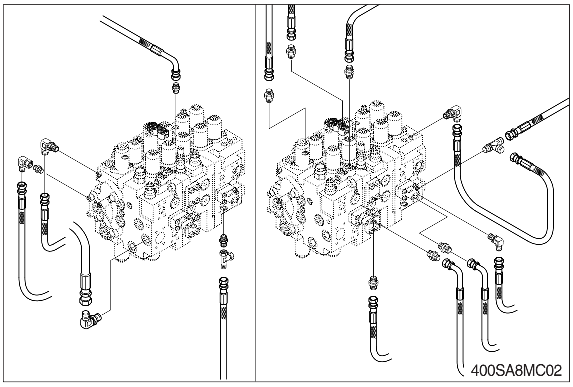
(4) Remove bolts and disconnect pipes.

(5) Disconnect pilot line hoses.

(6) Disconnect pilot pipes.

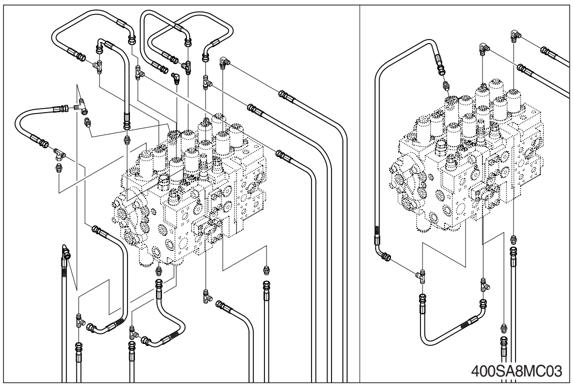
(7) Sling the control valve assembly and remove the control valve mounting bolts.

- · Weight : 380 kg (838 lb)
- · Tightening torque : 57.9±8.7 kgf · m (419±62.9 lbf · ft)



(8) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

2) INSTALL



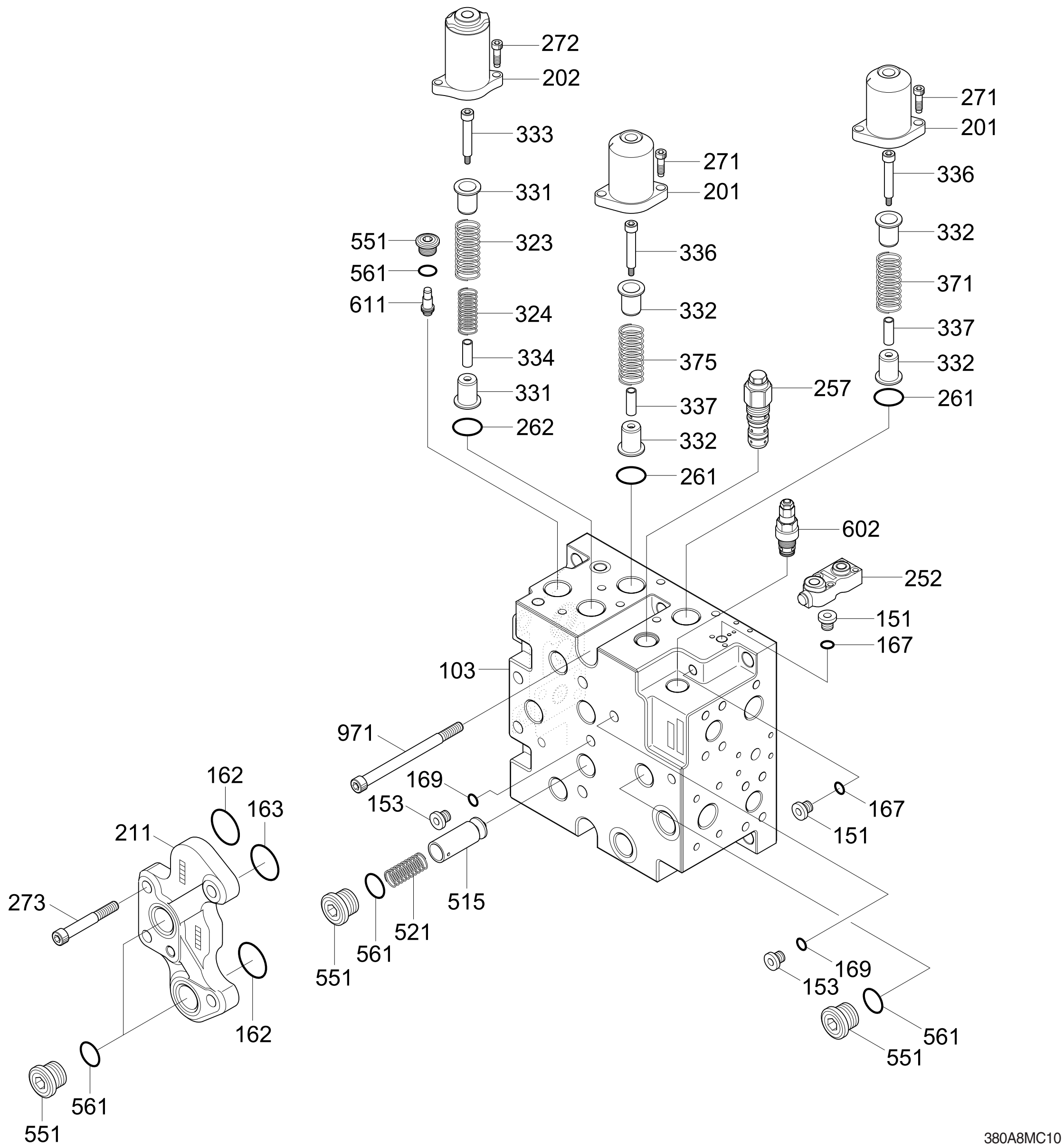
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.

① Cylinder (Boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.

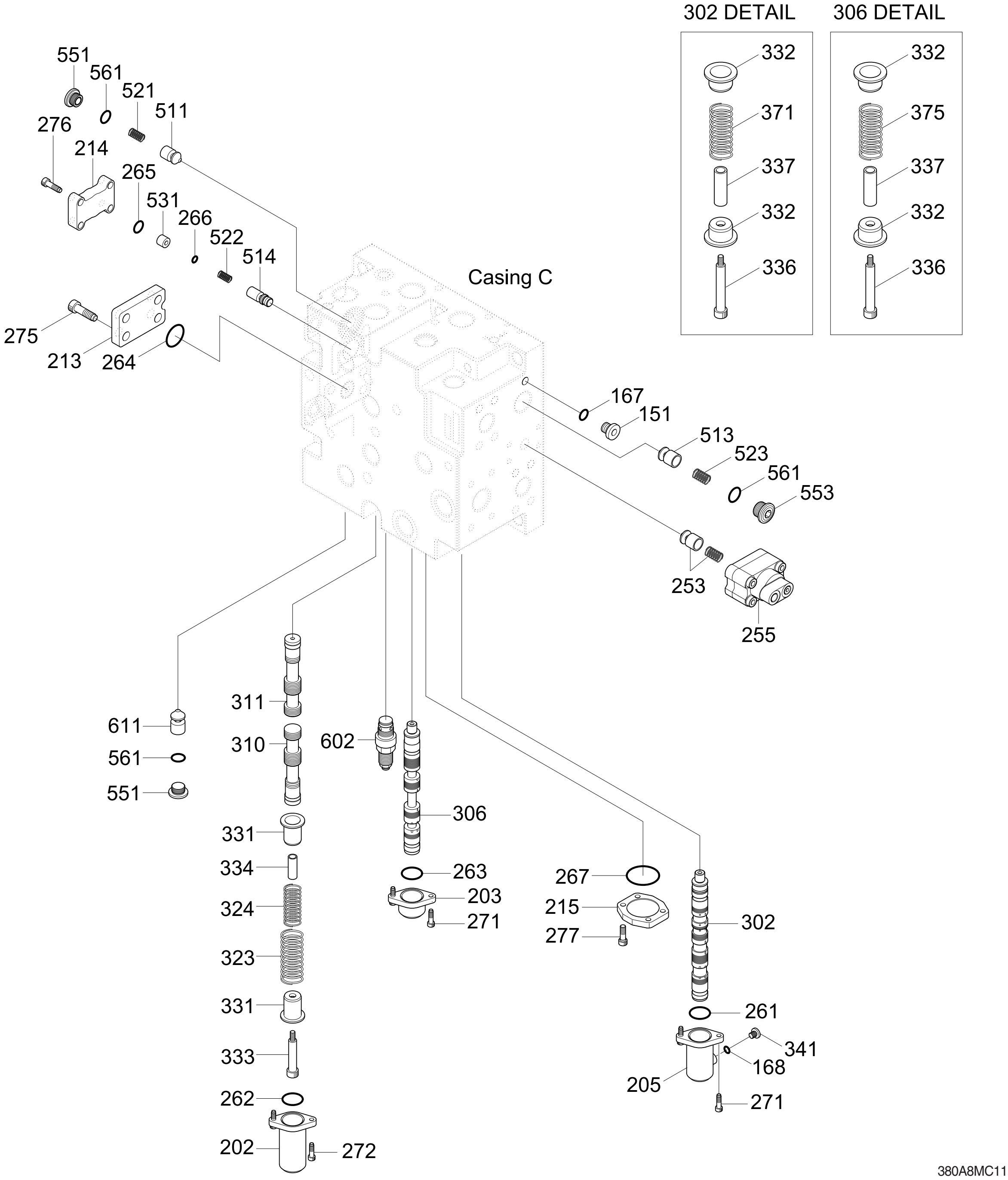
(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

2. STRUCTURE (1/4)



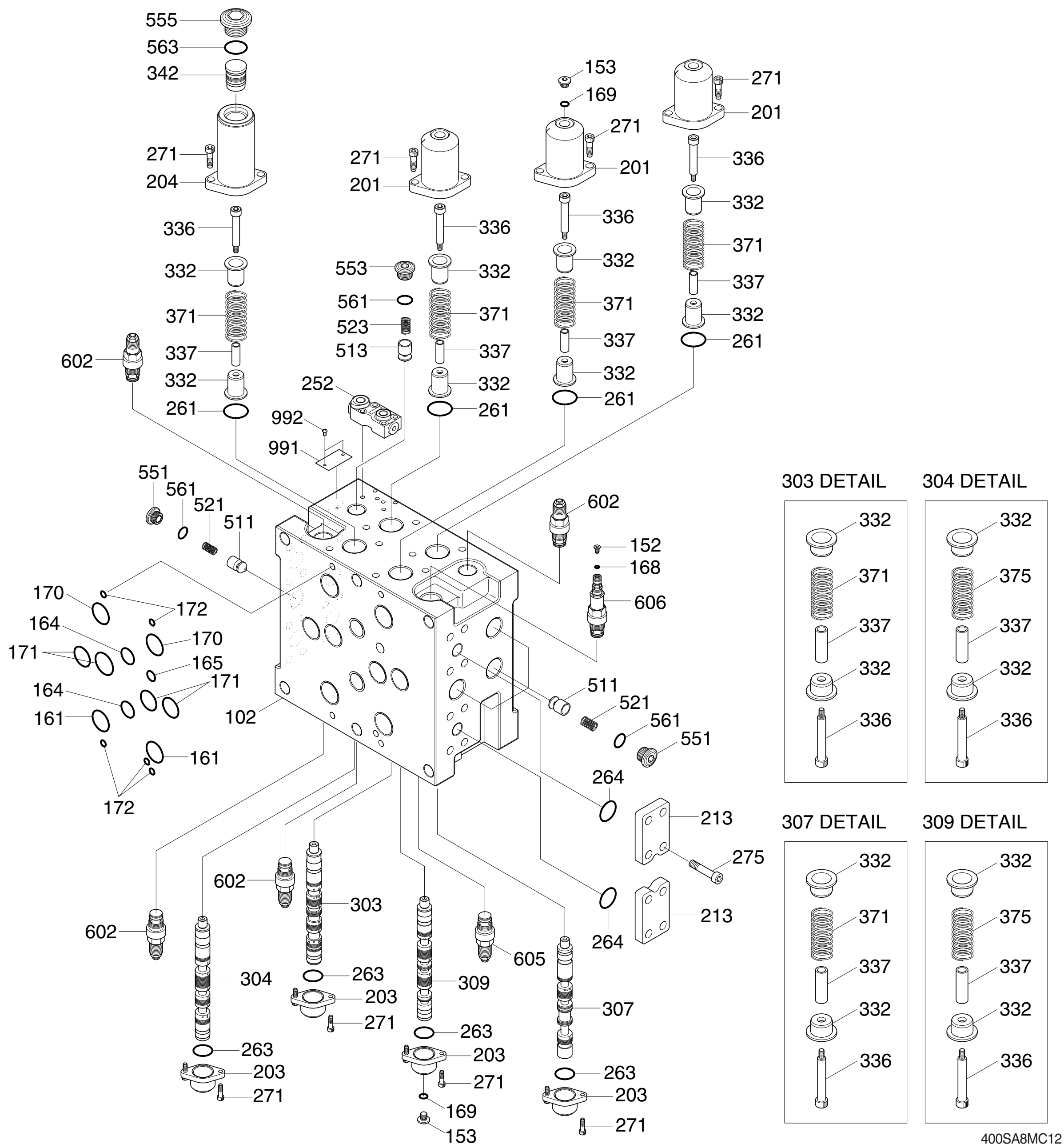
103	Casing C	252	Lock valve	371	Spring
151	Plug	257	Arm relief valve assy	375	Spring
153	Plug	261	O-ring	515	Poppet
162	O-ring	271	Hexagon socket bolt	521	Spring
163	O-ring	273	Hexagon socket screw	551	Plug
167	O-ring	331	Seat	561	O-ring
169	O-ring	332	Spring seat	602	Relief valve assy
201	Spring cover	333	Spacer bolt	611	Nega-con relief valve assy
202	Spring cover	336	Spacer bolt	971	Hexagon socket screw
211	Plate	337	Stopper		

STRUCTURE (2/4)



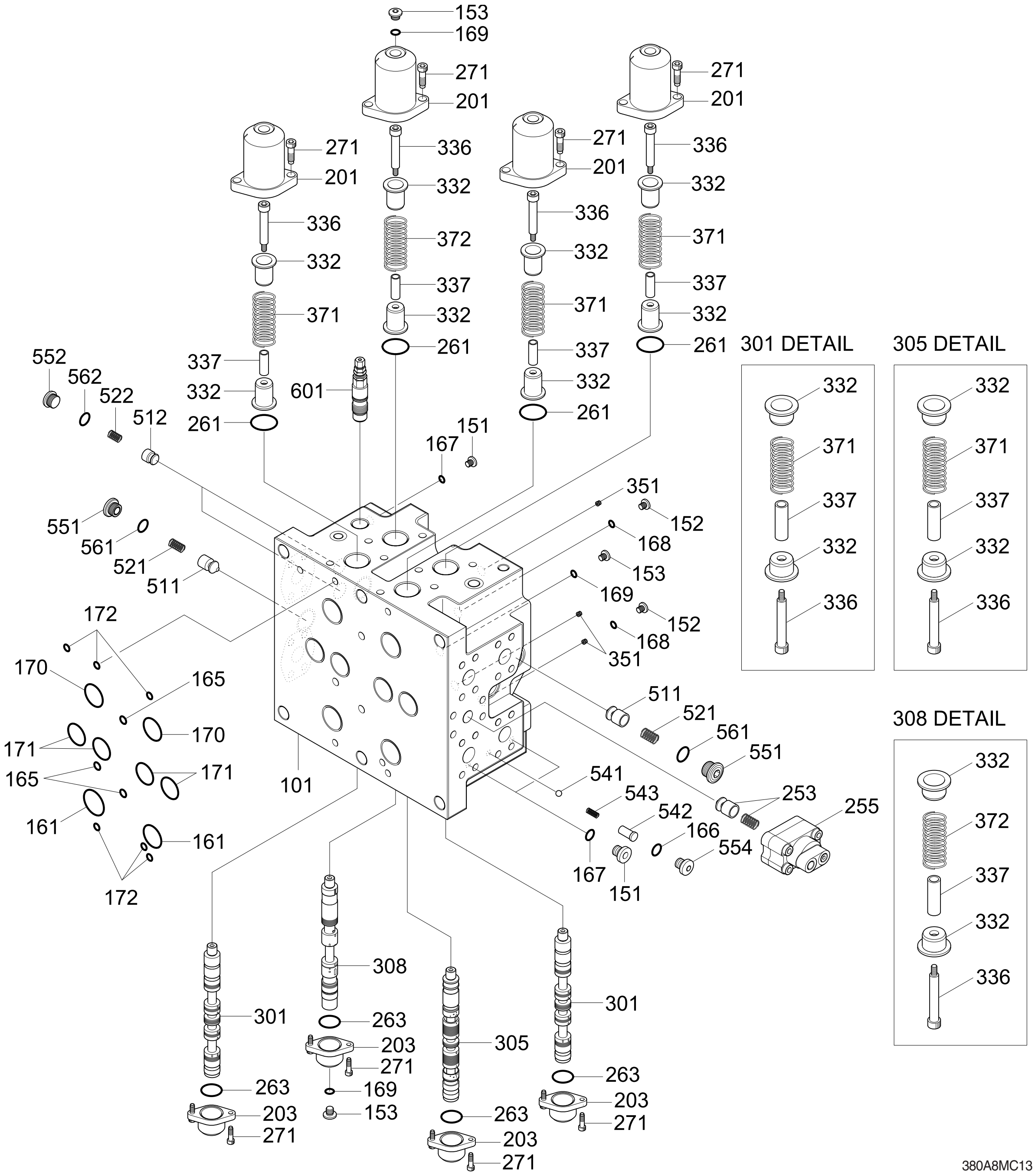
151	Plug	265	O-ring	333	Spacer bolt
167	O-ring	266	O-ring	334	Stopper
168	O-ring	267	O-ring	341	Plug
202	Spring cover	271	Hexagon socket screw	511	Poppet
203	Spool cover	272	Hexagon socket screw	513	Poppet
205	Spool cover	275	Hexagon socket screw	514	Poppet
213	Flange	276	Hexagon socket screw	521	Spring
214	Load check cover	277	Hexagon socket screw	522	Spring
215	Blank flange	302	Arm 1 spool kit	523	Spring
253	Logic control valve assy	306	Arm 2 spool kit	531	Spring seat
255	Logic control valve assy	310	Bypass spool kit	551	Plug
261	O-ring	311	Bypass spool kit	553	Plug
262	O-ring	323	Spring	561	O-ring
263	O-ring	324	Spring	602	Relief valve assy
264	Square ring	331	Seat	611	Nega-con relief valve assy

STRUCTURE (3/4)



102	Casing B
152	Plug
153	Plug
161	O-ring
164	O-ring
165	O-ring
168	O-ring
169	O-ring
170	O-ring
171	O-ring
172	O-ring
201	Spring cover
203	Spool cover
204	Spring cover
213	Flange
252	Lock valve
261	O-ring
263	O-ring
264	Square ring
271	Hexagon socket screw
275	Hexagon socket screw
303	Boom 1 spool kit
304	Bucket spool kit
307	Boom 2 spool kit
309	Option spool kit
332	Spring seat
336	Spacer bolt
337	Stopper
342	Valve piston
371	Spring
375	Spring
511	Poppet
513	Poppet
521	Spring
523	Spring
551	Plug
553	Plug
555	Plug
561	O-ring
563	O-ring
602	Relief valve assy
605	Relief valve assy
991	Name plate
992	Rivet screw

STRUCTURE (4/4)



101	Casing A	203	Spool cover	372	Spring
151	Plug	253	Logic control valve assy	511	Poppet
152	Plug	255	Logic control valve assy	512	Poppet
153	Plug	261	O-ring	521	Spring
161	O-ring	263	O-ring	522	Spring
165	O-ring	271	Hexagon socket screw	541	Steel ball
166	O-ring	301	Travel spool kit	542	Spring seat
167	O-ring	305	Swing spool kit	543	Spring
169	O-ring	308	Travel spool kit	551	Plug
168	O-ring	332	Spring seat	552	Plug
170	O-ring	336	Spacer bolt	554	Plug
171	O-ring	337	Stopper	561	O-ring
172	O-ring	351	Orifice	562	O-ring
201	Spring cover	371	Spring	601	Relief valve assy

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components must be worked with precision working. Then, 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 removed from the machine, apply caps and masking seals to all ports. Before disassembling the valve, re-check that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working, spread a paper or rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully in carrying, transferring and so on of the control valve. Do not support the lever, exposed spool, end cover section or so on without fail.

(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 the hydraulic test equipment is necessary to these tests.
Therefore, even when its disassembling can be carried out technically, do not disassemble such component that cannot be tested, adjusted, and so on.
Besides, 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)
Vise bench	1 unit	-
Box wrench	Each 1 piece	36, 46
Hexagon key wrench	Each 1 piece	5, 6, 8, 10, 12, 14, 17
Loctite #262	1 piece	-
Spanner	Each 1 piece	32 (main relief valve, 601) 36 (port relief valve, 602, 605)

3) DISASSEMBLING

The figure in ( ) shown after the part name in the explanation sentence shows its number in the construction figures.

(1) Place control valve on working bench.

※ Disassemble it in clean place and pay attention not to damage flange face.

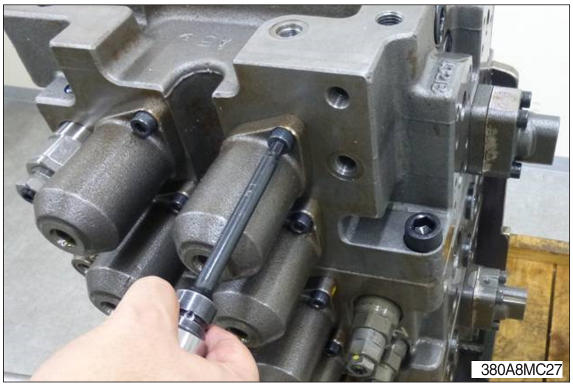

380A8MC26

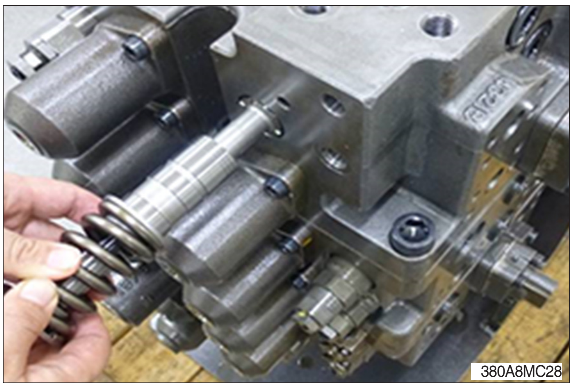
(2) Disassembling of main spool (travel (301), bucket (304), swing (305), option (309), arm 2 (306), boom 2 (307))

① Loosen the hexagon the socket head bolts (271), and remove the spring cover (201 or 204) and the O-ring (261). (hexagon key wrench 8 mm)

② Pull out spool, spring, spring seats (332), stopper (337) and spacer bolt (336) in spool assembly condition from casing.

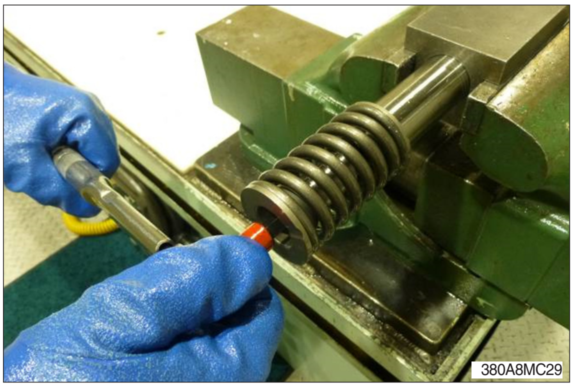
※ When pulling out spool assembly from casing, pay attention not to damage casing.


380A8MC27


380A8MC28

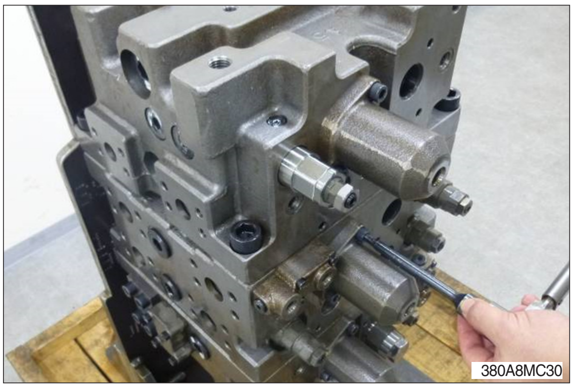
③ Hold the spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove spacer bolt (336) and disassemble spring, stopper (337) and spring seats (332).
(hexagon key wrench 8 mm)

Loosen plug (555) before removing bucket spring cover (204) from casing B (102). Then, pull out piston (342).
(hexagon key wrench 17 mm)


380A8MC29

(3) Disassembling of the boom1 spool (303)

① Loosen the hexagon socket head bolts (271) and remove the spring cover (201) and O-ring (261).
(hexagon key wrench 8 mm)


380A8MC30

② Pull out the boom1 spool (303), spring (371), spring seat (332), stopper (337) and spacer bolt (336) in the spool assembly condition from the casing B (102).

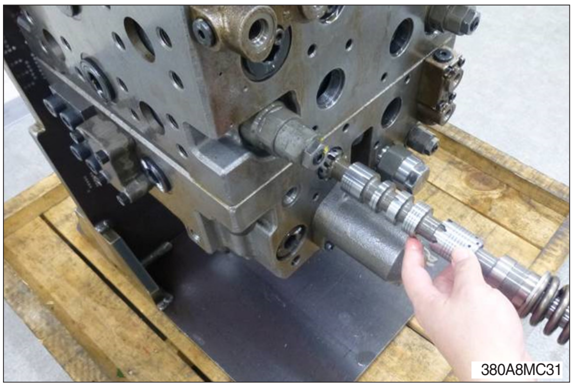
※ When pulling out the spool assembly from casing B (102), pay attention not to damage the casing.

③ Hold the boom1 spool (303) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336) and disassemble spring (371), stopper (337) and spring seats (332).
(hexagon key wrench 8 mm)

④ Do not disassemble the boom1 spool (303) more than these conditions.

(4) Disassembling of the arm 1 spool (302)

① Loosen the hexagon socket head bolts (271) and remove the spring cover (201) and O-ring (261).
(hexagon key wrench 8 mm)


380A8MC31

② Pull out the arm1 spool (302), spring (371), spring seat (332), stopper (337) and spacer bolt (336) in the spool assembly condition from casing C (103).

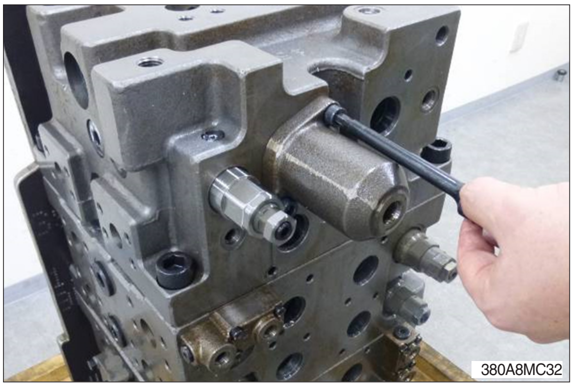
※ When pulling out the spool assembly from casing C (103), pay attention not to damage the casing.

③ Hold the arm1 spool (302) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove spacer bolt (336) and disassemble spring (371), stopper (337) and spring seats (332).
(hexagon key wrench 8 mm)

④ Do not disassemble the arm1 spool (302) more than these conditions.

(6) Disassembling of the travel straight spool (308)

① Loosen hexagon socket head bolts (271) and remove the spring cover (201) and O-ring (261).
(hexagon key wrench 8 mm)


380A8MC32

② Remove travel the straight spool (308), spring (372), spring seat (332), stopper (337) and spacer bolt (336) in the spool assembly condition from the casing A (101).

③ Hold the travel straight spool (308) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove spacer bolt (336) and disassemble spring (372), stopper (337) and spring seats (332).
(hexagon key wrench 8 mm)

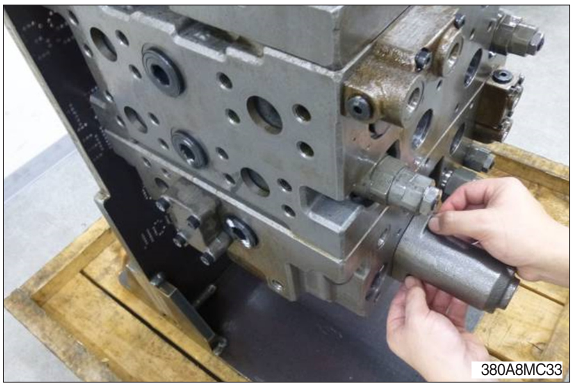
④ Do not disassemble the travel straight spool (308) more than these conditions.

(6) Disassembling of the bypass cut spool (310)

① Loosen hexagon socket head bolts (272) and remove the spring cover (202) and O-ring (262).
(hexagon key wrench 6 mm)

② Pull out the bypass cut spool (310), spring (323, 324), spring seats (331), stopper (334) and spacer bolt (333) in the spool assembly condition from casing C (103).

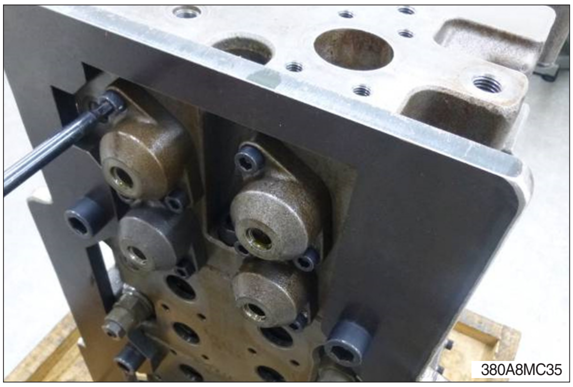
※ When pulling out the spool assembly from casing C (103), pay attention not to damage the casing.



③ Hold the travel spool (310) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove spacer bolt (333) and disassemble spring (323, 324), stopper (334) and spring seats (331).
(hexagon key wrench 10 mm)

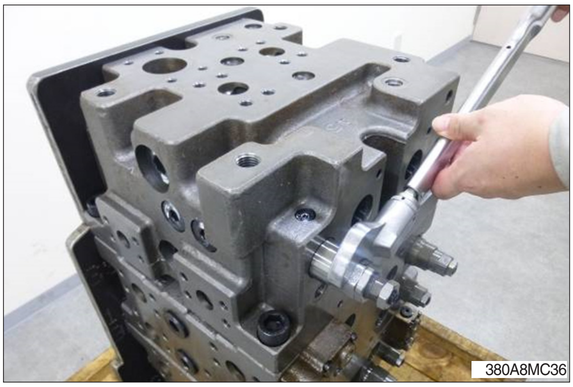
(7) Disassembly of spool covers (203, 205)

Loosen hexagon socket head bolts (271), and remove the spool cover (203, 205) and O-ring (261, 263).
(hexagon key wrench 8 mm)

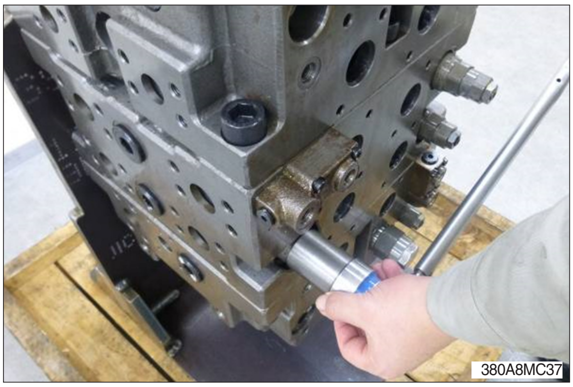


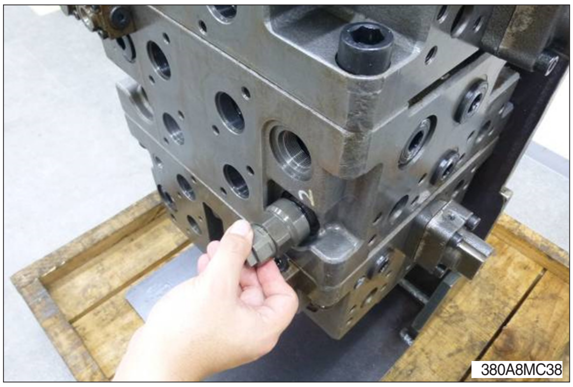
(8) Removal of the main relief valve (601) and the port relief valves (602, 605,606).
Remove the main relief valve (601) and the port relief valve (602, 605,606) from the casing.

Main relief valve (601) : spanner 32 mm
Port relief valve (602) : box wrench or spanner 36 mm
Port relief valve (605) : box wrench or spanner 36 mm
Port relief valve (606) : spanner 36 mm



※ Do not disassemble the relief valves more after.

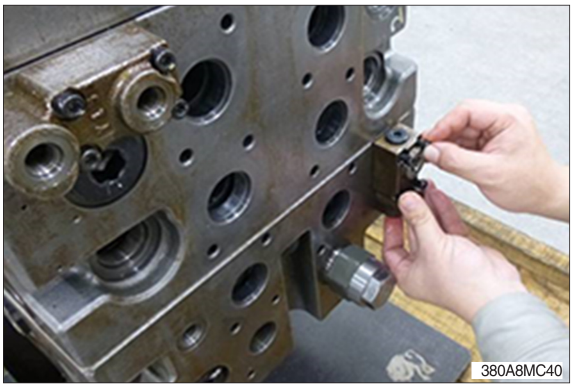


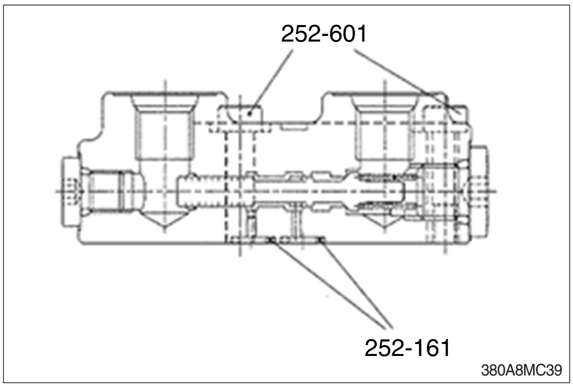


(9) Removal of the lock valve selector (252)

Loosen hexagon socket head bolts (252-601) and remove the lock valve selector (252) and O-ring (252-161).
(hexagon key wrench 5 mm)

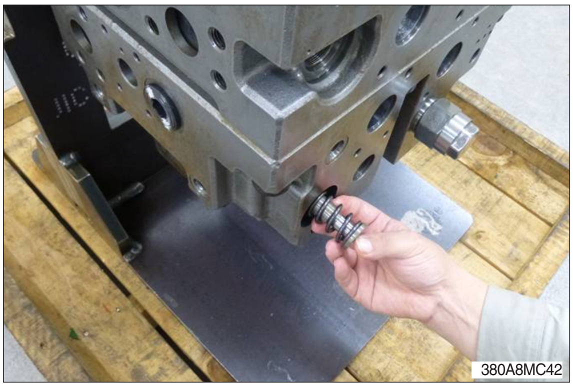
Do not disassemble the lock valve selector (252) more than these conditions.

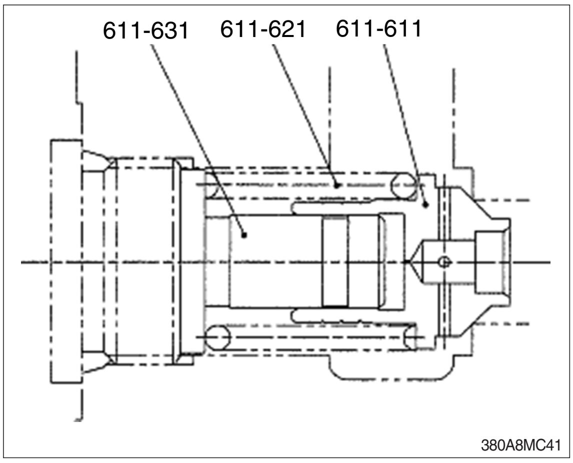




(10) Removal of the negative control relief valve (611)

Remove the plug (551) from the casing C (103). Pull out poppet (611-611), spring (611-621) and damping rod (611-631).
(hexagon key wrench 17 mm)

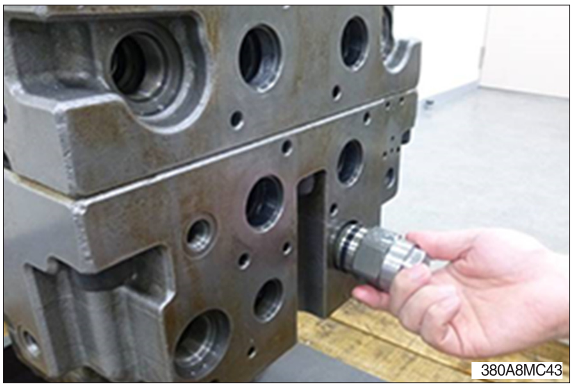

380A8MC42

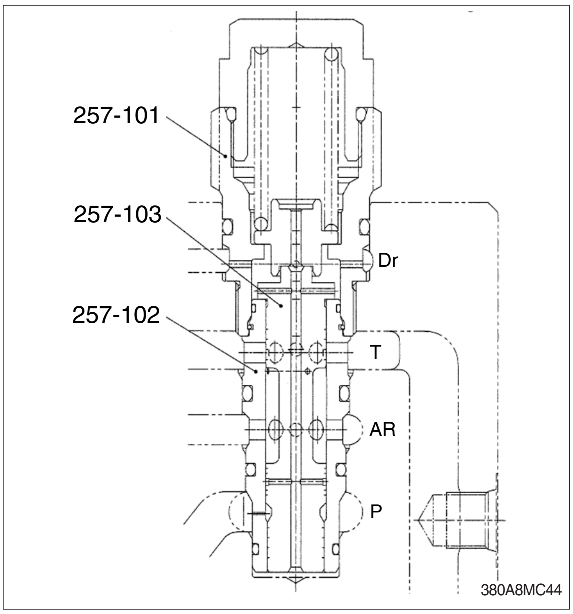


380A8MC41

(11) Removal of the arm regeneration cut valve (257)

Remove the body (257-101), the spool (257-103) and sleeve (257-102) from the casing C (103).
(box key wrench 46 mm)


380A8MC43



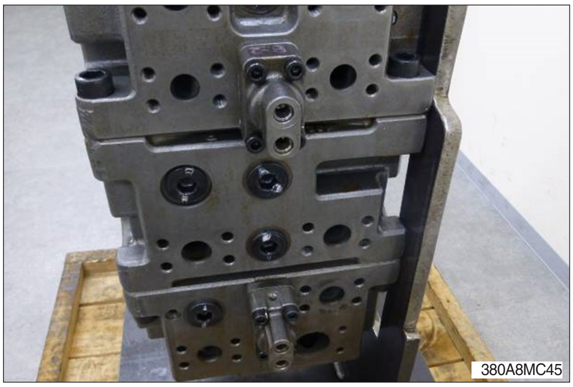
380A8MC44

(12) Disassembly of the logic control valve (255), the swing logic valve assembly (254) and the arm 1 logic valve assembly (253)

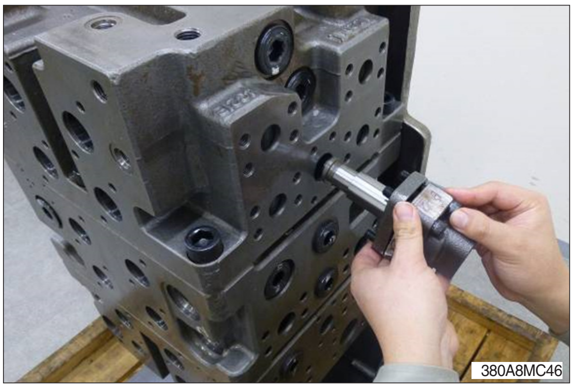
① Loosen hexagon socket head bolts (255-276) and remove the logic control valve (255) and O-ring (255-264).
(hexagon key wrench 8 mm)

② Pull out the swing logic valve (254) and the arm 1 logic valve (253) in the assembly condition from casing.

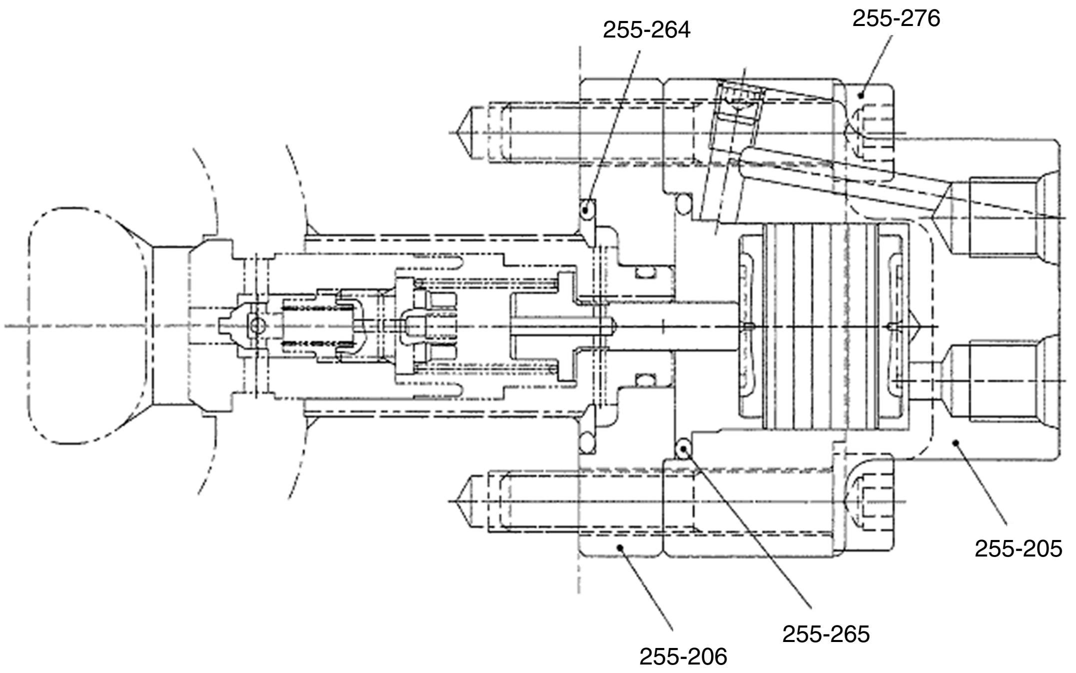
③ Do not disassemble the logic poppet and the logic valve assy (253, 254) more than these conditions.



380A8MC45



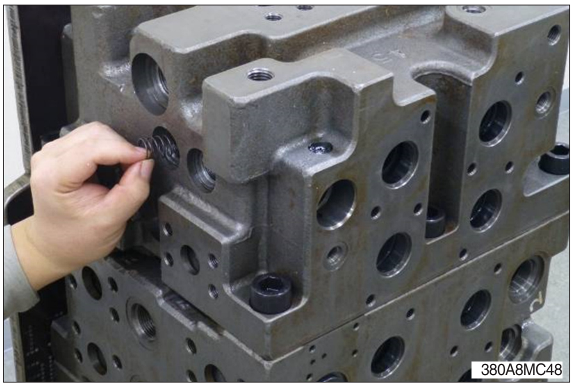
380A8MC46



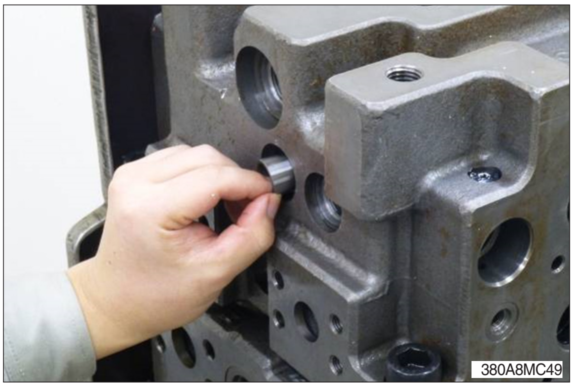
380A8MC47

(13) Disassembly of the check valve

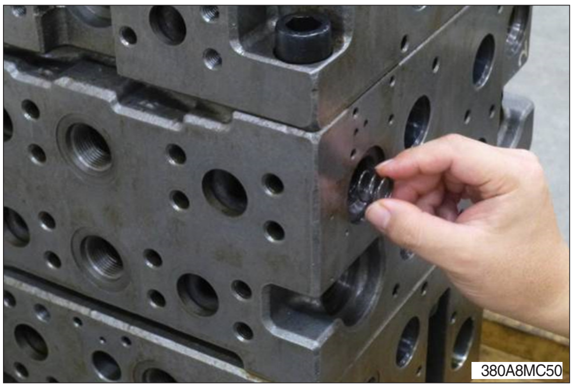
① CT1, CT2, CP1, CP2, LCb, LCb2, CCb, LCk, LCo, LCAT2
Remove the plug (551) and take out poppet (511) and spring (521).
(hexagon key wrench 17 mm)



② CMR1, CMR2
Remove the plug (552) and take out poppet (512) and spring (522).
(hexagon key wrench 12 mm)



③ Hva, Hvb
Remove the plug (553) and take out poppet (513) and spring (523).
(hexagon key wrench 17 mm)



④ CCk, CCo
Remove the plug (551) and take out poppet (515) and spring (521).
(hexagon key wrench 17 mm)

⑤ Remove the plug (554) and take out steel ball (541), spring (543) and spring seat (542).
(hexagon key wrench 6 mm)

(14) Disassembly of the flanges (213)
Loosen hexagon socket head bolts (275) and remove the flange (213) and O-ring (264).
(hexagon key wrench 12 mm)

(15) Disassembly of the plate (211)

Loosen hexagon socket head bolts (273) and remove the plate (211) and O-ring (162, 163).
(hexagon key wrench 14 mm)

(16) Disassembly of the orifices for signal line

Do not disassemble the plug (152) and the orifice (351) unless required specifically.

(17) Disassembly of the casing:

① Except when required specially, do not disassemble tie bolts of the casing A (101) and C (103).

② Since the plugs not described in above disassembling procedures are the blind plugs for sacrifice holes and blind plugs for casing sanitation, do not disassemble them as far as not required specially.


380A8MC51

(18) Inspection after disassembling

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.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.

b. Confirm that seal groove faces of casing and covers are smooth and free of dust, dent, rust etc.

c. Correct dents and damages on check seat faces of casing and block, if any, by lapping.

※ Pay attention not to leave lapping agent in casing and block.

d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from foreign matter.

e. If any spring is broken or deformed, replace it with new one.

f. When relief valve do not function properly, repair it, following its disassembling assembling procedures.

g. Replace all seats and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and are uniform 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 breaking, 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 relief valve assembly.

4) ASSEMBLING

(1) In this assembling section, explanation only is shown. Refer to figures and photographs shown in disassembling section.

(2) Figure in ( ) shown after part name in explanation sentence shows number in construction figure.

(3) Cautions in assembling seals

① Pay attention to keep seals free from defects in its forming and damages in its handling.

② Apply grease, hydraulic oil or so on to seals and seal-fitting sections for full lubrication.

③ Do not stretch seals so much to deform them permanently.

④ In fitting O-ring, pay attention not to roll it into its position. In addition, twisted O-ring cannot remove its twisting naturally with ease after being fitted, and causes oil leakage.

⑤ Tighten fitting bolts at all sections with torque wrench to their respective tightening torques shown in "Maintenance standards".

(4) Assembly of check valve

① Assemble poppets (511, 512, 513, 515) and springs (521, 522, 523).
② Put O-rings (561, 562) onto the plugs (551, 552, 553).
③ Tighten the plugs (551, 552, 553) with their specified torques.

※ Use poppets, springs and plugs in following groups.

Poppet	Spring	Plug	Remark
511	521	551	511 in 10 positions
512	522	552	512 in 2 positions
513	523	553	513 in 2 positions
515	521	551	515 in 2 positions

Tightening torque

Plug no.	Hex wrench	Tightening torque	
		kgf · m	lbf · ft
551	17 mm	37.7~41.8	273~302
552	12 mm	23.5~26.5	170~192
553	17 mm	37.7~41.8	273~302

(5) **Assembly of the plate (211)**

Fit O-rings (162, 163) to the casing C (103), and tighten hexagon socket head bolts (273) with specified torque.
(box wrench 14 mm)
· Tightening torque : 21.4~26.5 kgf · m (155~192 lbf · ft)
So turn the control valve that the plate face may be directed downward.

(6) **Assembly of the flange (213)**

Fit O-rings (264) to the flange (213), and tighten hexagon socket head bolts (275) with specified torque.
(box wrench 12 mm)
· Tightening torque : 14.3~18.4 kgf · m (103~133 lbf · ft)

(7) **Assembly of the logic control valve (255) and the swing logic valve assembly (254)**

① Assemble the swing logic valve ass'y (254) into the casing A (101).
② Fit the O-rings (255-264) to the plate (255-206). Fit the O-rings (255-265) to the cover (255-205), and tighten the hexagon socket head bolts (255-276) with specified torque.
(box wrench 8 mm)
· Tightening torque : 5.3~6.3 kgf · m (38.4~45.7 lbf · ft)

(8) **Assembly of the logic control valve (255) and the arm 1 logic valve assembly (253)**

① Assemble the arm 1 logic valve ass'y (253) into the casing C (103).
② Fit the O-rings (255-264) to the plate (255-206). Fit the O-rings (255-265) to the cover (255-205), and tighten the hexagon socket head bolts (255-276) with specified torque.
(box wrench 8mm)
· Tightening torque : 5.3~6.3 kgf · m (38.4~45.7 lbf · ft)

(9) **Assembly of the negative control relief valve (611)**

Assemble poppet (611-611), spring (611-621) and damping rod (611-631) into the casing C (103).
Put O-ring (561) onto the plug (511) and tighten the plug (511) with its specified torque.
(box wrench 17 mm)
· Tightening torque : 37.7~41.8 kgf · m (273~302 lbf · ft)

(10) **Assembly of the arm regeneration cut valve (257)**

Assemble the sleeve (257-102), spool (257-103), and body (257-101) into the casing C (103).
Tighten it with specified torque.
(box wrench 46mm)
· Tightening torque : 14.3~16.3 kgf · m (103~118 lbf · ft)

(11) **Assembly of the lock valve selector (252)**

Fit the O-rings (252-161) to the lock valve selector (252) and tighten the hexagon socket head bolts (252-601) with specified torque.
(box wrench 5 mm)
· Tightening torque : 1.0~1.4 kgf · m (7.2~10.3 lbf · ft)

(12) **Assembling of the main relief valve (601) and the port relief valve (602, 605, 606)**

Assemble the main relief valve (601) and the port relief valves (602, 605,606) to the casing and tighten it with specified torque.

Item	Size	Tightening torque	
		kgf · m	lbf · ft
Main relief valve (601)	Spanner 32 mm	12.2~14.3	88.2~103
Port relief valve (602, 605)	Spanner 36 mm Box wrench 36 mm	12.2~14.3	88.2~103
Port relief valve (606)	Spanner 36 mm	12.2~14.3	88.2~103

(13) **Assembling of the travel straight spool (308) :**

① Hold the middle of the travel straight spool (308) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Set spring seat (332), stopper (337) and spring (372), and tighten spacer bolt (336) with specified torque.
※ Before tightening spacer bolt (336), apply loctite #262 to it.
(box wrench 8 mm)
· Tightening torque : 3.8~4.2 kgf · m (22.8~30.2 lbf · ft)
Pay attention not to fasten the vise excessively to the shape of the travel straight spool (308) is deformed.

② Insert the spool assemblies of Items ① above into the casing A (101).
※ Fit the spool assemblies into casing A (101) carefully and slowly.
Do not push them forcibly without fail.

(14) **Assembling of the boom1 spool (303)**

① Hold the middle of the boom1 spool (303) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Set spring seat (332), spring (371) and stopper (337), and tighten spacer bolt (336) with specified torque.
※ Before tightening spacer bolt (336), apply Loctite #262 to them.
(box wrench 8 mm)
· Tightening torque : 3.8~4.2 kgf · m (22.8~30.2 lbf · ft)
Pay attention not to fasten the vise excessively to the shape of the boom 1 spool (303) is deformed.
② Insert the spool assemblies of Items ① above into the casing B (102).
※ Fit the spool assemblies into the casing B (102) carefully and slowly.
Do not push them forcibly without fail.

(15) Assembling of the arm 1 spool (302)

① Hold the middle of the arm 1 spool (302) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Set spring seats(332), spring (371) and stopper (337), and tighten spacer bolt (336) with specified torque.

※ Before tightening spacer bolt (336), apply Loctite #262 to it.
(box wrench 8 mm)
· Tightening torque : 3.8~4.2 kgf · m (22.8~30.2 lbf · ft)
Pay attention not to fasten the vise excessively to the shape of the arm1 spool (302) is deformed.

② Insert the spool assemblies of Items ① above into the casing C (103).

※ Fit the spool assemblies into the casing C (103) carefully and slowly.
Do not push them forcibly without fail.

(16) Assembling of the main spool (travel (301), bucket (304), swing (305), option (309), arm 2 (306), boom 2 (307))

① Hold the middle of each spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Set spring seats (332), springs and stopper (337), and tighten spacer bolt (336) with specified torque.

※ Before tightening spacer bolt (336), apply loctite #262 to it.
(hexagon key wrench 8 mm)
· Tightening torque 3.8~4.2 kgf · m (22.8~30.2 lbf · ft)
Pay attention not to fasten the vise excessively to the shape of spool is deformed.

② Insert spool assemblies of Items ① above into the casing A (101), B (102) and C (103).

※ Fit spool assemblies into the casing A (101), B (102) and C (103) carefully and slowly. Do not push them forcibly without fail.

(17) Assembly of the bypass cut spool (310)

① Hold the middle of the bypass cut spool (310) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Set spring seats(331), spring (323, 324) and stopper (334), and tighten spacer bolt (333) with specified torque.

※ Before tightening spacer bolt (333), apply loctite #262 to it.
(box wrench 10 mm)
· Tightening torque : 1.6~1.8 kgf · m (11.8~13.3 lbf · ft)
Pay attention not to fasten the vise excessively to the shape of the bypass cut spool (310) spool is deformed.

② Insert the spool assemblies of Items ① above into the casing C (103).

※ Fit the spool assemblies into the casing C (103) carefully and slowly. Do not push them forcibly without fail.

(18) Assembling of the covers

① Fit the spool covers (203, 205) to sides reverse to spring sides of spools, and tighten hexagon socket head bolts (271) with specified torque.
(box wrench 8 mm)
· Tightening torque : 5.3~6.3 kgf · m (38.4~45.7 lbf · ft)

※ Confirm that O-rings (261, 263) have been fitted to spool cover (203, 205).

② Bucket the spring cover (204):
Assemble piston (342) into the bucket spring cover (204). Put O-ring (563) onto the plug (555) and tighten it with specified torque.
(box wrench 17 mm)
· Tightening torque : 22.4~26.5 kgf · m (162~192 lbf · ft)

③ Fit the spring covers (201, 202, 204) to spring sides of spools, and tighten hexagon socket head bolts (271, 272) with specified torque.

(271 : Hexagon key wrench 8mm, tightening torque 5.3~6.3 kgf · m (38.4~45.7 lbf · ft)
(272 : Hexagon key wrench 6mm, tightening torque 2.5~3.5 kgf · m (18.4~25.1 lbf · ft)

※ Confirm that O-rings (261) have been fitted to spring covers (201, 202, 204).

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.

(4) Disconnect hoses (2, 3, 4, 5, 6, 7, 8, 9, 10).

(5) Sling the swing motor assembly (1) and remove the swing motor mounting bolts (11).
· Motor device weight : 443 kg (977 lb)
· Tightening torque : 97.8 ± 15 kgf·m
(707 ± 108 lbf·ft)

(6) Remove the swing motor assembly.
※ When removing the swing motor assembly, check that all the piping have been disconnected.

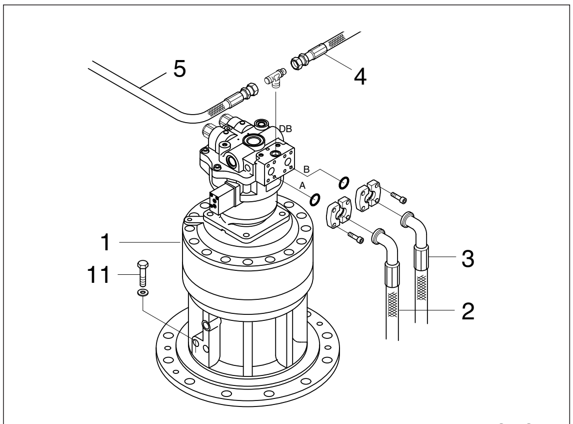
2) INSTALL

(1) Carry out installation in the reverse order to removal.

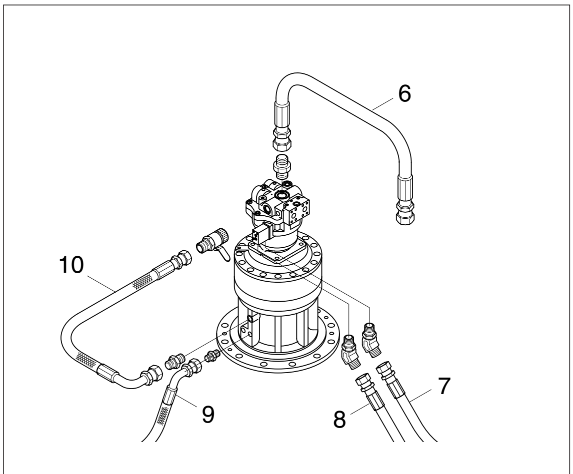
(2) Bleed the air from the swing motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it over flows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

(3) Confirmed the hydraulic oil level and check the hydraulic oil leak or not.


13031GE18



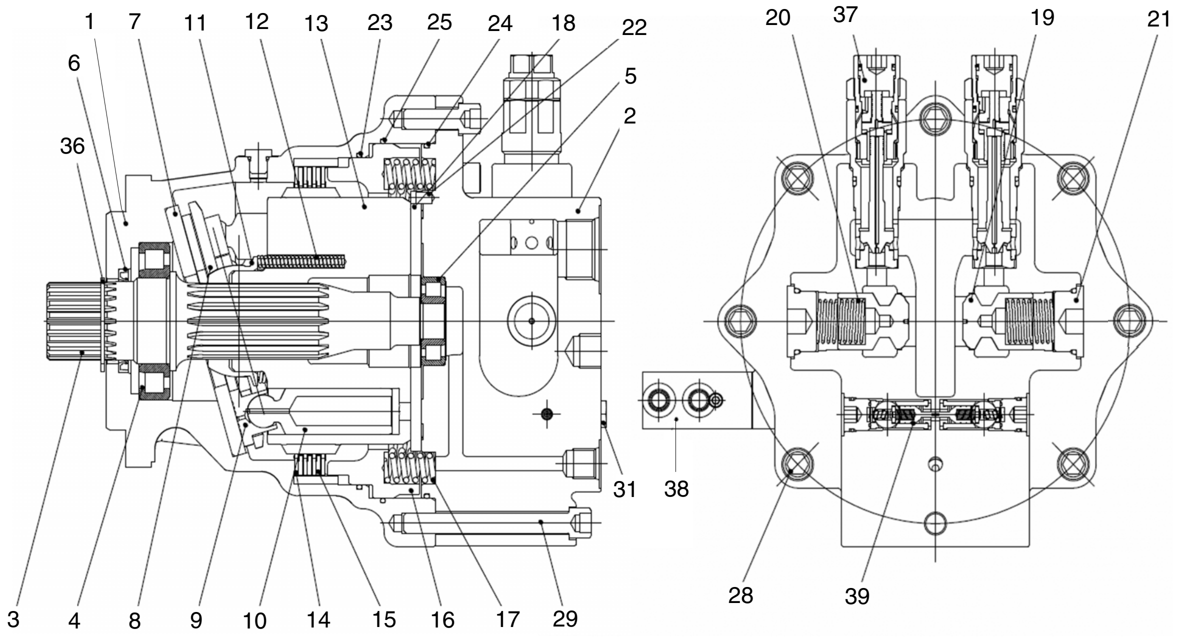
400SA8SM01



400SA8SM02

2. SWING MOTOR (TYPE 1)

1) STRUCTURE

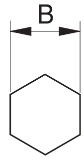


380A8SM05

1	Casing	12	Cylinder spring	23	O-ring
2	Valve casing	13	Cylinder block	24	O-ring
3	Drive shaft	14	Friction plate	25	O-ring
4	Roller bearing	15	Separation plate	28	Socket bolt
5	Roller bearing	16	Brake piston	29	Socket bolt
6	Oil seal	17	Brake spring	30	Socket bolt
7	Shoe plate	18	Valve plate	31	VP plug assy
8	Retainer plate	19	Plunger	36	Snap ring
9	Shoe	20	Check spring	37	Relief valve
10	Piston	21	RO plug assy	38	Brake valve
11	Thrust ball	22	Pin	39	Reactionless valve

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	17	
Socket for socket wrench, spanner	5	
	19	
	36	
Plier (for stop ring)	For shaft Φ 45 mm	
Plier (for lock ring)	For hole Φ 100 mm For hole Φ 45 mm	
Driver	(-) type, 2EA	
Steel rod	10x8x200 mm, 1EA	
Hammer	Plastic hammer, steel hammer, each 1EA	
Torque wrench (adjust range)	1.0~4.5 kgf·m (7.2~32.5 lbf·ft) 4.0~18 kgf·m (28.9~130 lbf·ft) 12~48 kgf·m (86.8~347 lbf·ft)	
Slide hammer bearing plier	-	
Brake piston subtract jig	-	

(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	mm	inch
Socket bolt	30	M6	1.2±0.2	8.7±1.4	5	0.20
Socket bolt	28, 29	M14	11.3±1.1	81.7±8.0	17	0.67
Relief valve	37	M33	18±1.0	130±7.2	19	0.75
Plug	31	PF 1/4	3.7±0.2	26.8±1.4	36	1.42

3) DISASSEMBLING

※ The disassembling procedures are as following.

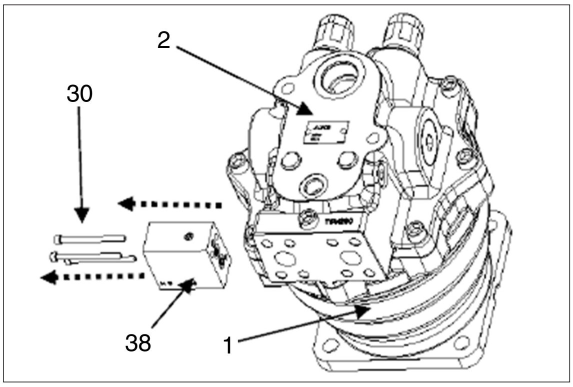
※ Figure in ( ) shown after part name in explanation sentence shows number in construction figure.

(1) Bind the circumference of the motor and lift up by crane.
Clean the motor with cleaning oil and dry it with compressed air.

(2) Drain the oil from the casing (1) through the drain port.

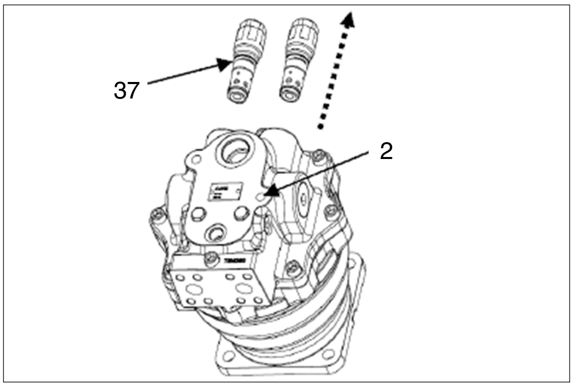
(3) Place the drive shaft (3) with the shaft side with down ward and fix it on a work table for easy disassembling.

(4) Put a fitting mark on the casing (1) and valve casing (2) and loosen the socket bolt (30) and remove the brake valve (38) form the swing motor.



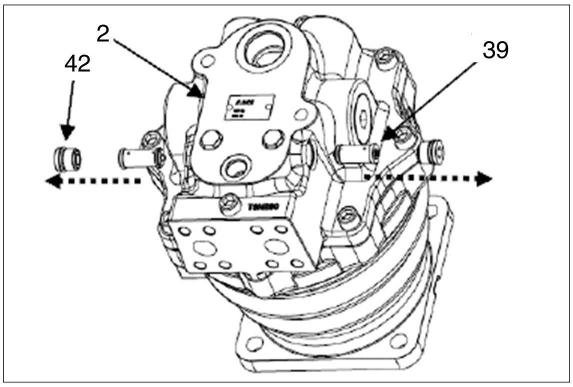
380A8SM06

(5) Loosen the relief valve (37) and take off it from the valve casing (2).



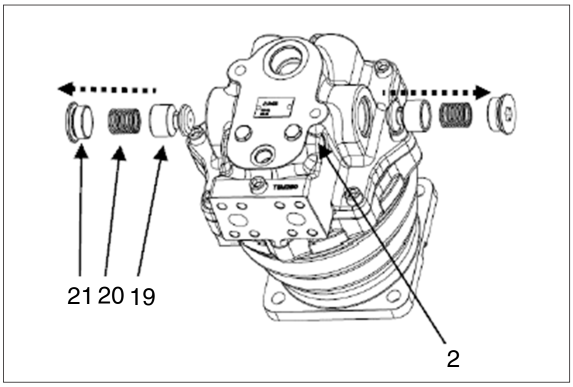
380A8SM07

(6) Remove the RO plug (42) from the valve casing (2) and pull out the reactionless valve (39).



380A8SM08

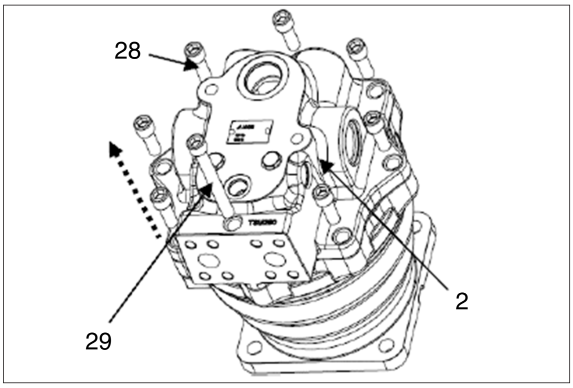
(7) Loosen the RO plug (21) from the valve casing (2) and pull out the spring (20) and plunger (19).



380A8SM09

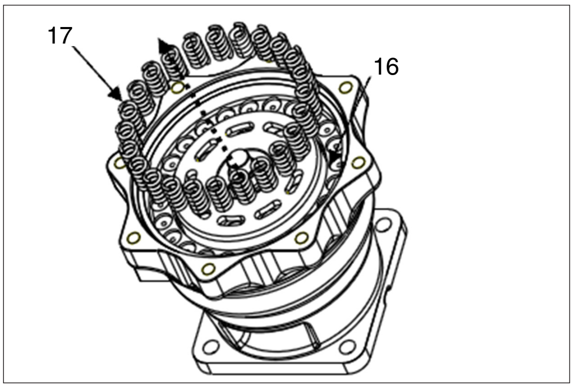
(8) Loosen the socket bolt (28, 29) and take off the valve casing (2).

※ The valve casing (2) is separated from the casing (1) automatically by the brake spring (17) force when the socket bolt (28, 29) is loosened.



380A8SM10

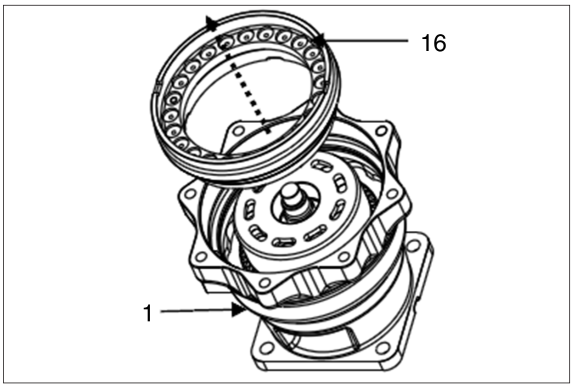
(9) Pull out the brake spring (17) from the brake piston (16).



380A8SM11

(10) The brake piston (16) from the casing (1) by using a jig.

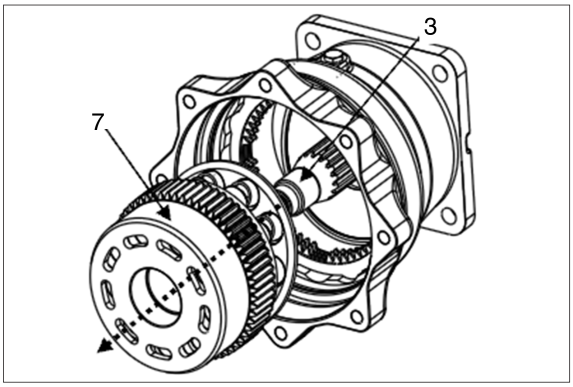
※ Pull the brake piston (16) straight up when using the bolt hole of the brake piston (16).



380A8SM12

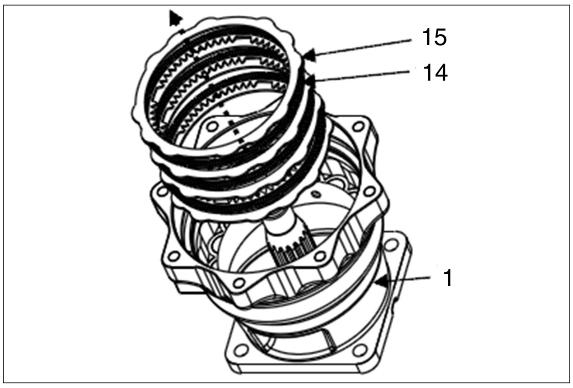
(11) Put the motor horizontally and pull out the cylinder block (13) from the drive shaft (3). And the piston assy (9, 10), retainer (8), thrust ball (11) and shoe plate (7).

※ Take care not to damage sliding face of the cylinder block (13), thrust ball (11) and shoe (9) when pull out the cylinder block (13).



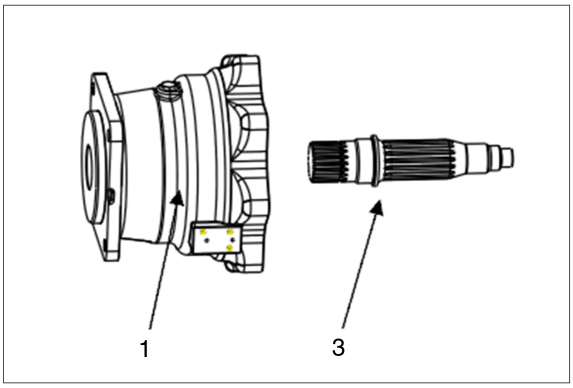
380A8SM13

(12) Take off the friction plate (14) and separation plate (15) from the casing (1).



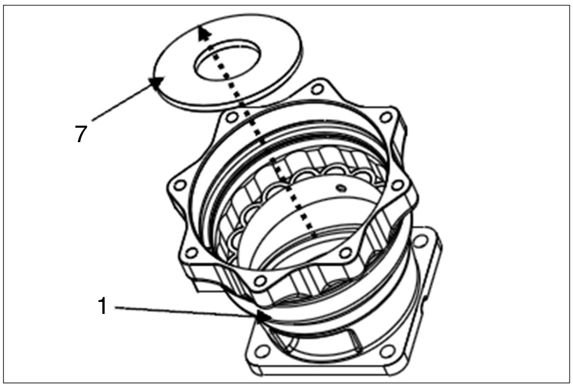
380A8SM14

(13) Separate drive shaft (3) from the casing (1).



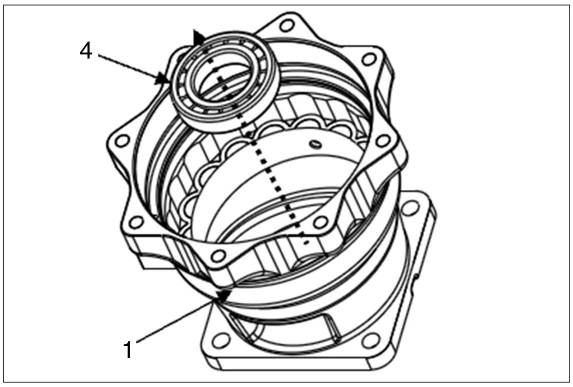
380A8SM15

(14) Pull the shoe plate (7) from the casing (1) by tapping lightly the cylinderical roller bearing (4) side with a plastic hammer.



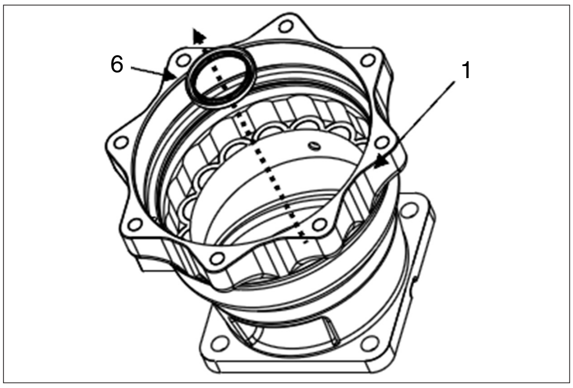
380A8SM16

(15) Pull the roller bearing (4) from the casing (1) by tapping lightly with a steel rod.
※ Take care not to damage the bearing by tapping the inner race of the cylinderical roller bearing evenly with a steel rod.
※ Do not reuse the dissembled bearing.



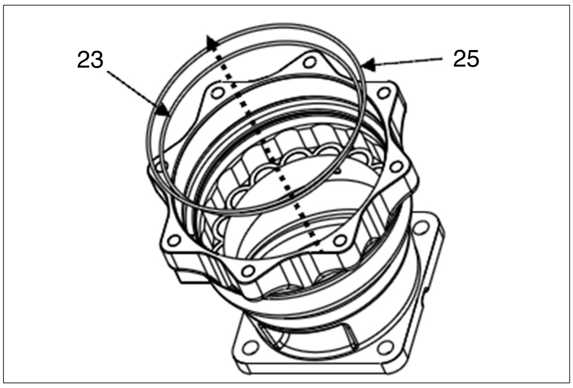
380A8SM17

※ Following works perform if necessary.
(16) Disassemble the oil seal (6) from the casing (1).
※ Disassemble the oil seal (6) by tapping bottom side of the oil seal with a steel rod.



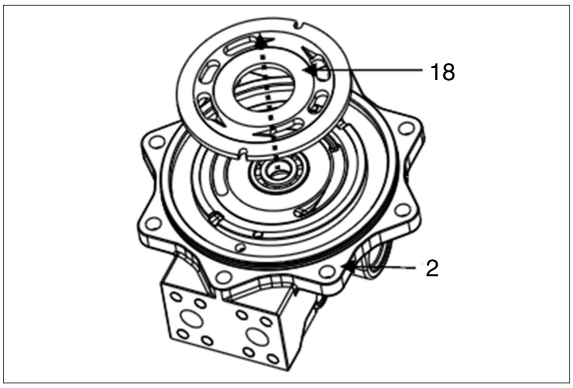
380A8SM18

(17) Disassemble the O-ring (23, 25) from the casing (1).



380A8SM19

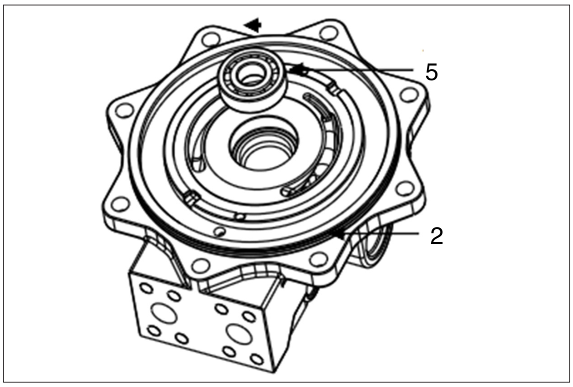
(18) Disassemble the valve (18) from the valve casing (2).



380A8SM20

(19) Disassemble the roller bearing (5) from the valve casing (2) with a plastic hammer.

※ Do not reuse the dissembled bearing.



380A8SM21

(20) This is the end of disassembling procedures.

※ Check every part for any abnormals.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

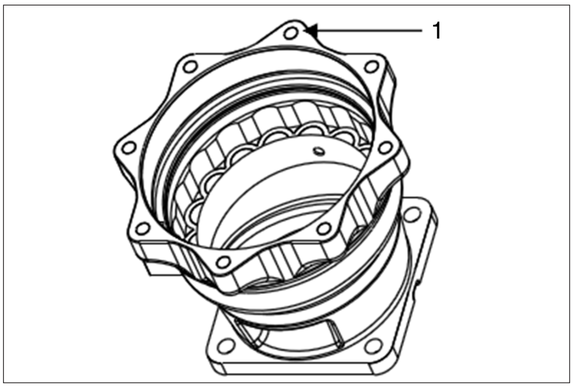
② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

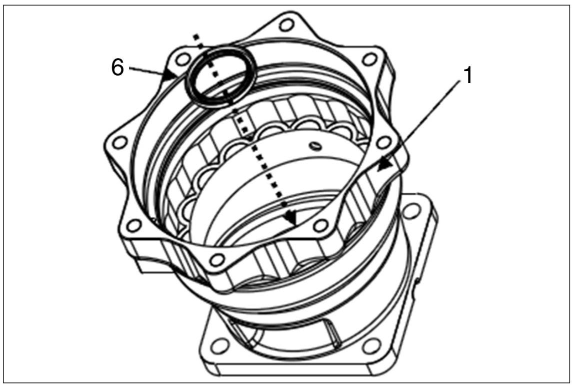
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-62-2.

(2) Place the casting (1) on a suitable place.



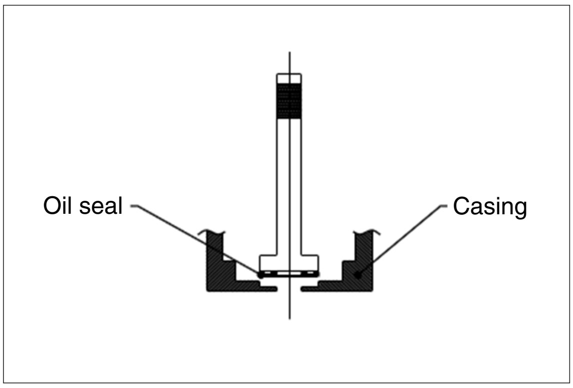
380A8SM22

(3) Assemble the oil seal (6) on the casting (1).



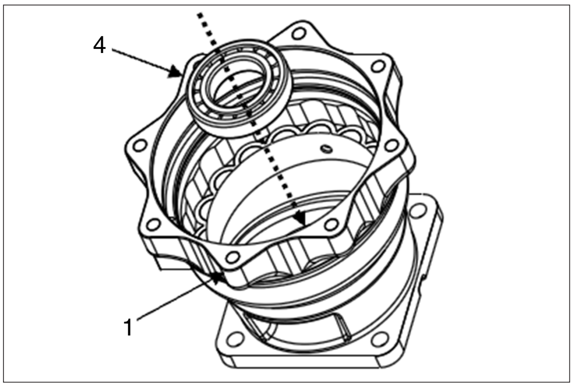
380A8SM23

(4) Assemble the oil seal with a jig when assembling it and take care not to damage the lip of the oil seal (6).



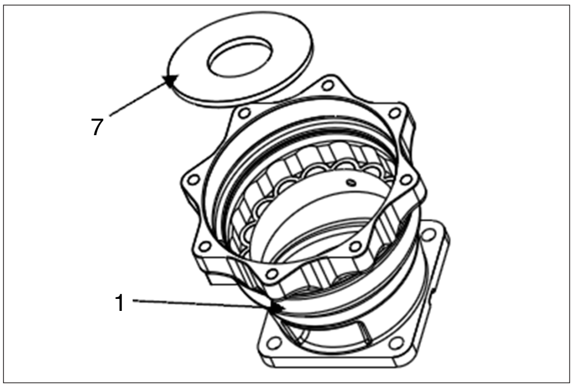
380A8SM24

(5) Using a jig, assemble the roller bearing (4) on the casting (1) by tapping the roller bearing (4) lightly.
※ Take care not to damage the bearing by tapping the inner race of the cylinderical roller bearing evenly with a steel rod.
※ Do not reuse the dissembled bearing.



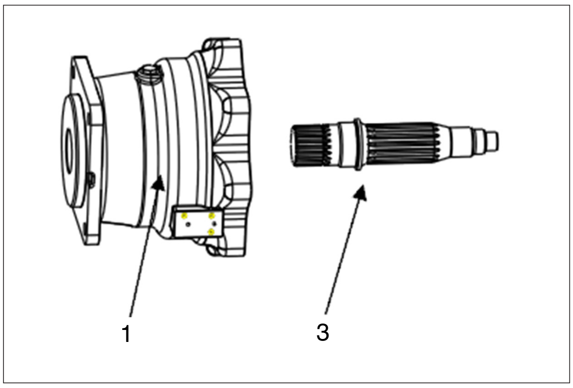
380A8SM25

(6) Apply some grease to the back side of the show plate (7) and assemble it on the swash plate of the casing (1).
※ Take care not to mistake front and rear side of the shoe plate (7).



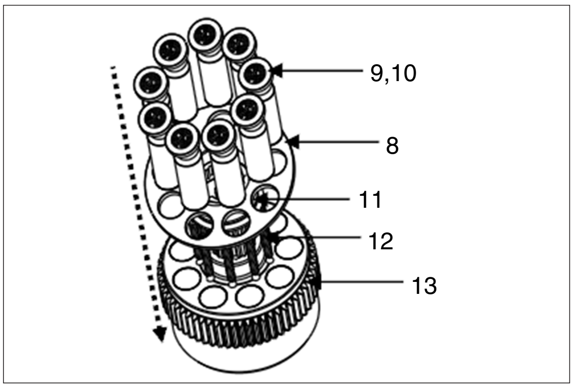
380A8SM26

(7) Assemble the drive shaft (3) into the casing (1).



380A8SM27

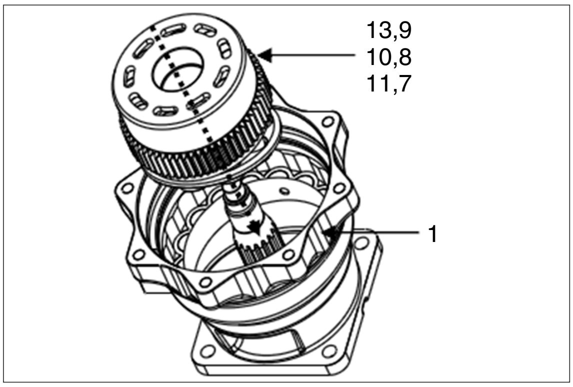
(8) Insert the nine cylinder block springs (12) into the cylinder block (13).
(9) Confirm the assembling of the springs and put the thrust ball (11) on the springs.
(10) Assemble the retainer (8) and piston assy (9, 10) after assembling thrust ball (11).



380A8SM28

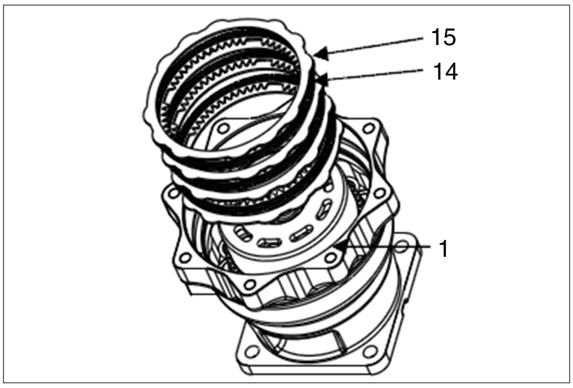
(11) Place the motor horizontally and assemble the cylinder block (13), piston assy (9, 10), retainer (8), thrust ball (11) and shoe plate (7) into the drive shaft (3).

※ Take care not to sliding face of the thrust ball (11) and shoe (9).



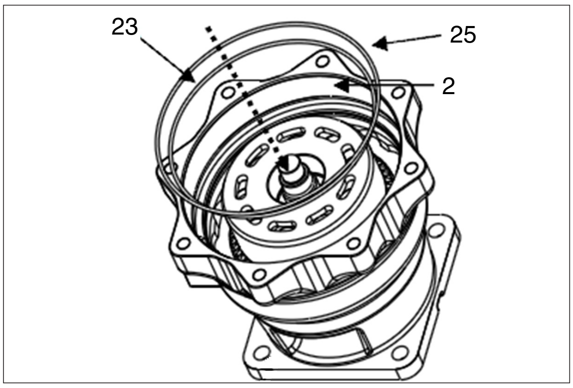
380A8SM29

(12) Assemble the three friction plates (14) and four separation plates into the casing (1).



380A8SM30

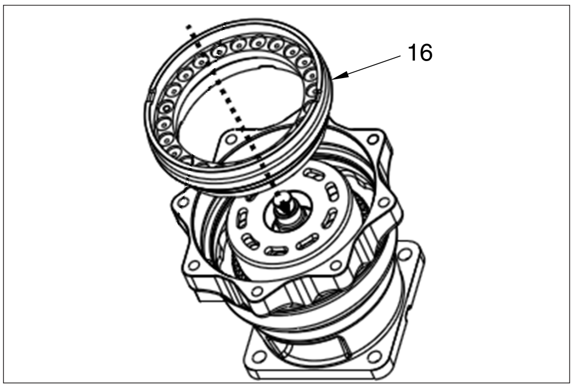
(13) Apply some grease to the O-ring (23, 25) and assemble them on the valve casing (2).



380A8SM31

(14) Assemble the brake piston (16) into casing (1).

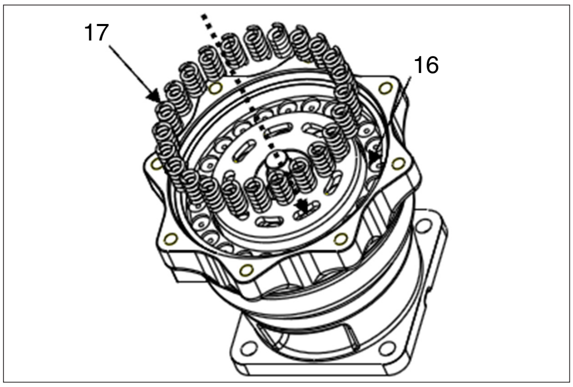
※ Assemble the brake piston (16) by tapping lightly with a plastic hammer when assembling it.



380A8SM32

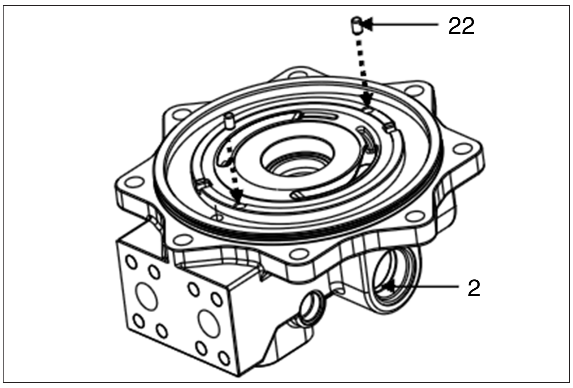
(15) Put the twenty four brakes springs (17) on the brake piston (16).

※ Take care not to slip down brake springs (17) when assembling them.



380A8SM33

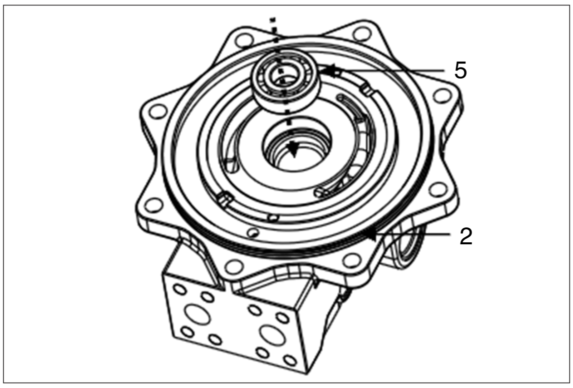
(16) Insert the pin (22) into the valve casing (1) by using a jig.



380A8SM34

(17) Assemble the cylinderical roller bearing (5) into the valve casing (2) by using a plastic hammer.

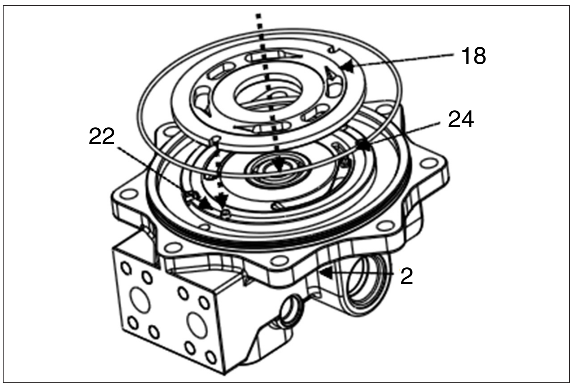
※ Tap the bearing with a hammer lightly when assembling them.



380A8SM35

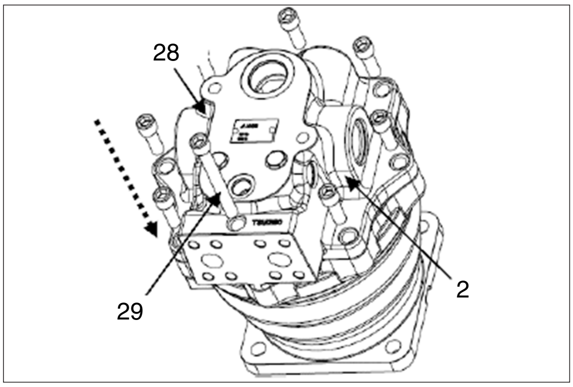
(18) Apply some grease to the back side of the valve plate (18) and align the hole of the pin (22) and assemble it on the valve casing (2).

And assemble the O-ring into the hole of the O-ring.



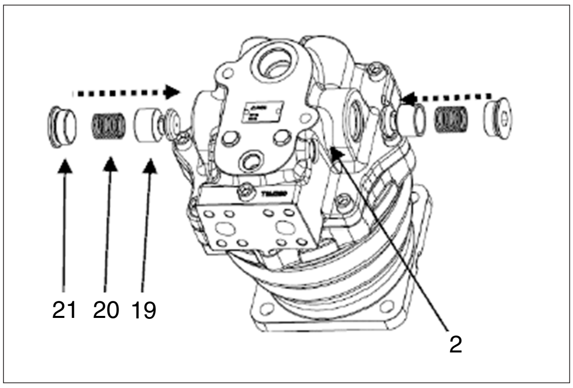
380A8SM36

(19) Align the bolt hole of the valve casing (2) and casing (1) and tightening the socket bolt (28, 29) as specification torques.
※ Take care not to damage the bearing when assembling it.



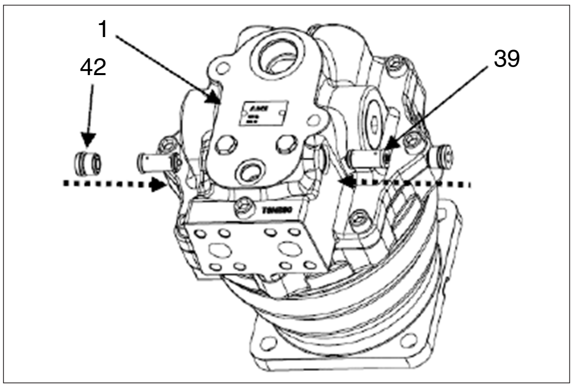
380A8SM37

(20) Assemble the spring (20) and RO plug (21) into the valve casing (2) after seat making the plunger (19) on the valve casing (2) two or three times.



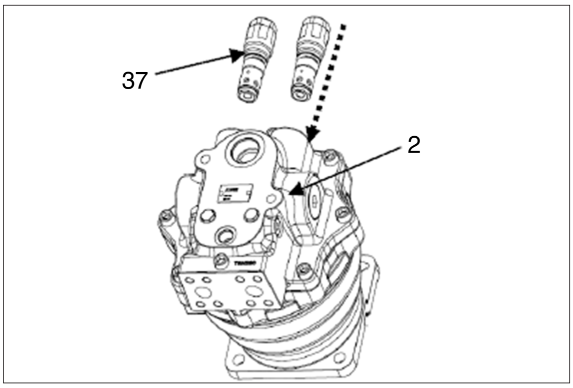
380A8SM38

(21) Assemble the reactionless valve (39) into the valve casing (2) and assemble the RO plug (42) by using L-wrench.



380A8SM39

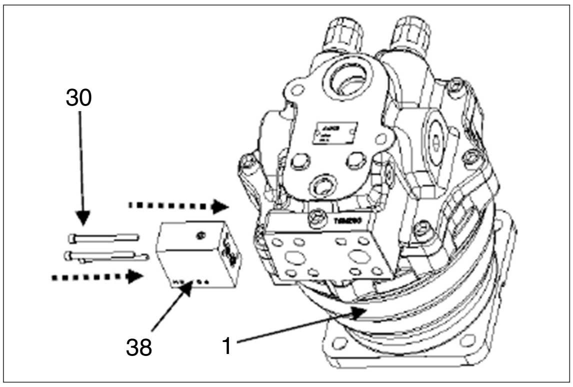
(22) Assemble the relief valve (37) into the valve casing (2).
※ Apply some grease to O-ring of the relief valve when assembling it.
※ Tighten with a specified torque when tightening.



380A8SM40

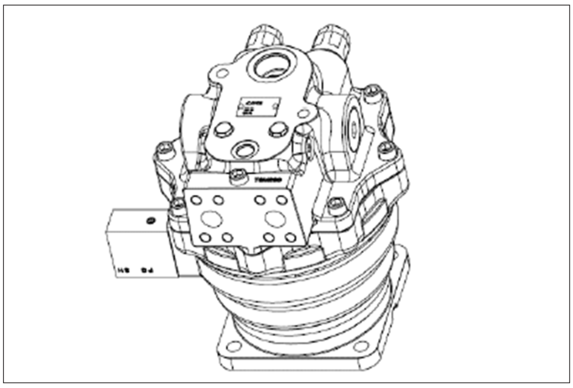
(23) Assemble the brake valve (38) on the casing (1) with the socket bolts (30).

※ Take care not to miss the O-ring of the brake valve when assembling.



380A8SM41

(24) Clean the face of the motor to the reduction gear with cleaning oil and dry it by compressed air.

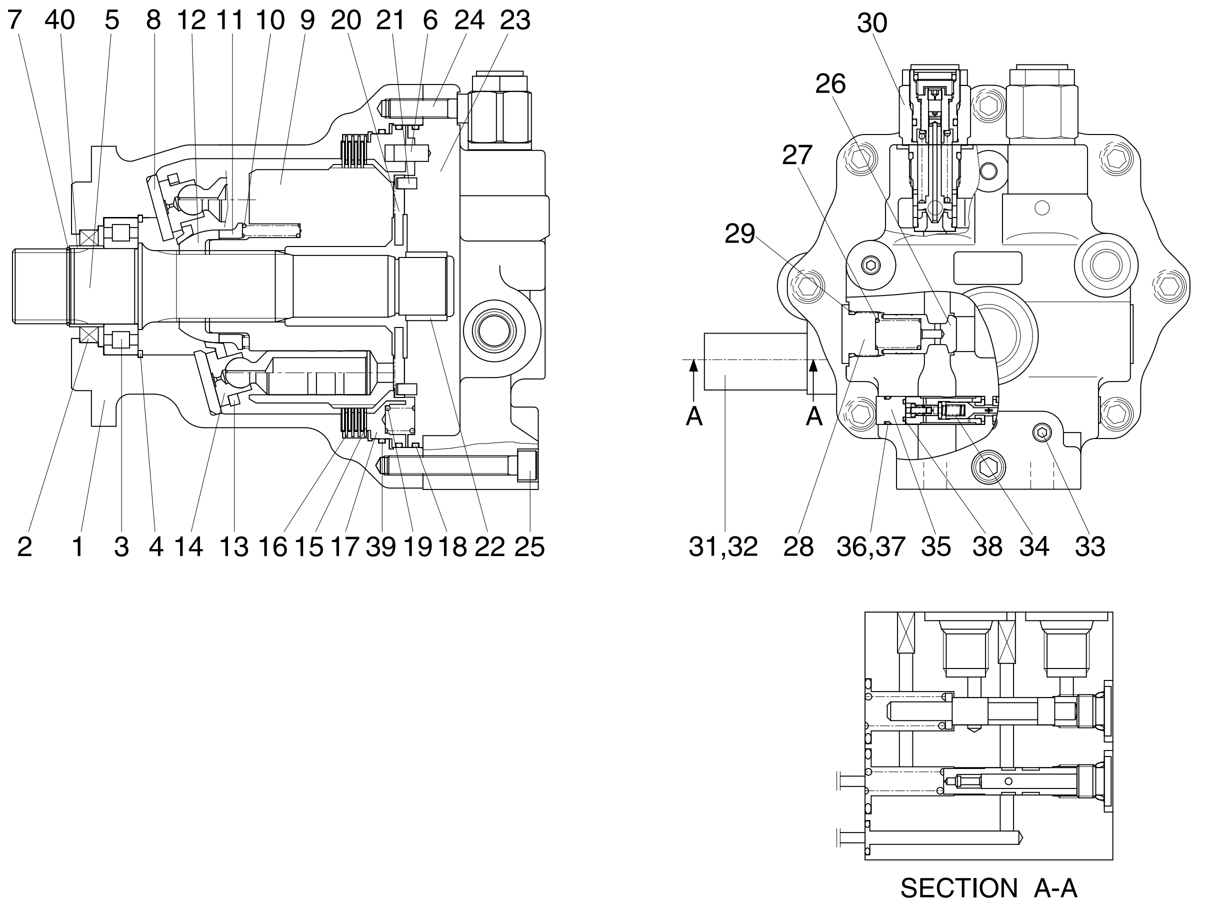


380A8SM42

(25) This is the end of assembling procedures.

SWING MOTOR (TYPE 2)

1) STRUCTURE

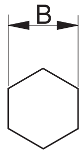


38092SM02

1	Body	15	Friction plate	29	O-ring
2	Oil seal	16	Plate	30	Relief valve assy
3	Roller bearing	17	Brake piston	31	Time delay valve
4	Snap ring	18	O-ring	32	Wrench bolt
5	Shaft	19	Spring	33	Plug
6	Pin	20	Valve plate	34	Swing reactionless valve assy
7	Stop ring	21	Pin	35	Plug
8	Shoe plate	22	Needle bearing	36	O-ring
9	Cylinder block	23	Rear cover	37	Back up ring
10	Spring	24	Wrench bolt	38	O-ring
11	Ball guide seat	25	Wrench bolt	39	O-ring
12	Ball guide	26	Poppet	40	Bushing
13	Set plate	27	Spring		
14	Piston assy	28	Plug		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	5	
	6	
	12	
	17	
Socket for socket wrench, spanner	36	
Torque wrench	Capable of tightening with the specified torques	
Snap ring plier(for holes, axis)	Snap ring(4)	
Solder hammer	Needle bearing(22), pin(6, 21)	
Oil seal inserting jig	Oil seal(2)	
Induction heating apparatus for bearing	Roller bearing(3)	

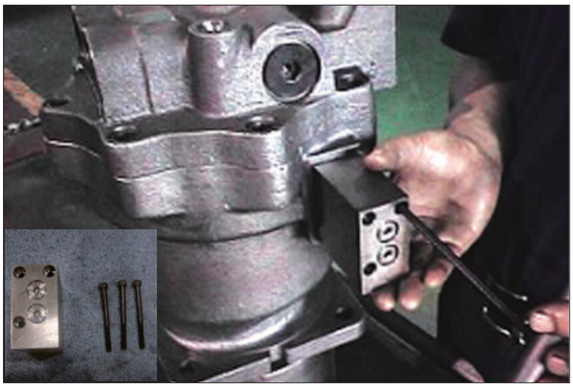
(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	in	mm
Wrench bolt	24	M14	20.9	151.2	0.47	12
Wrench bolt	25	M14	20.9	151.2	0.47	12
Relief valve	30	M33	18.0	130.2	1.42	36
Wrench bolt	32	PF 1/4	6.9	49.9	0.20	5
Plug	33	PF 1/4	20.9	151.2	0.24	6

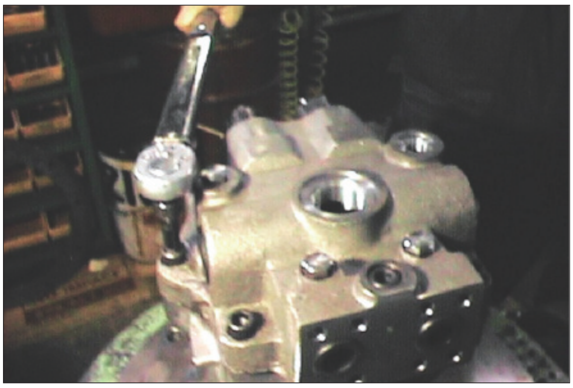
2) DISASSEMBLING

(1) Disassemble the sub of a TURNING AXIS

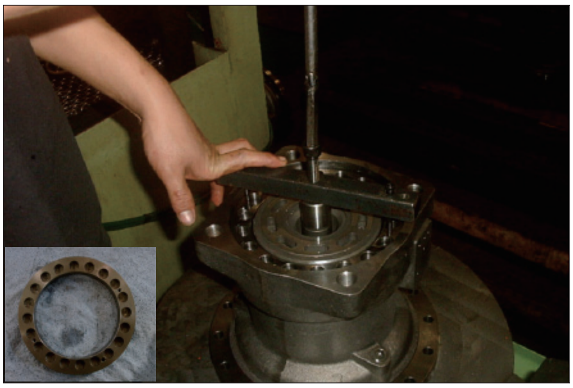
① Unloosing wrench bolt (32) and disassemble time delay valve assy (31) from rear cover (23)


3607A8SM01/01A

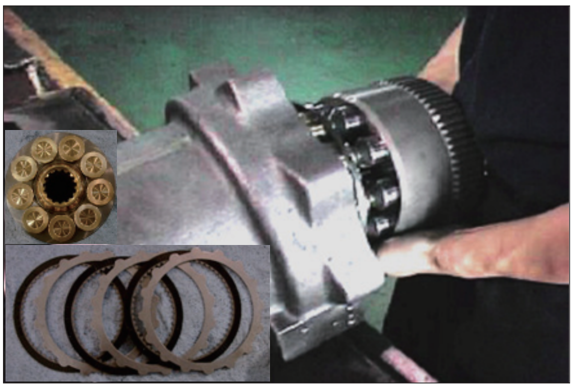
② Hang rear cover (23) on hoist, unloose wrench bolt (24, 25) and disassemble from body (1).


3607A8SM02

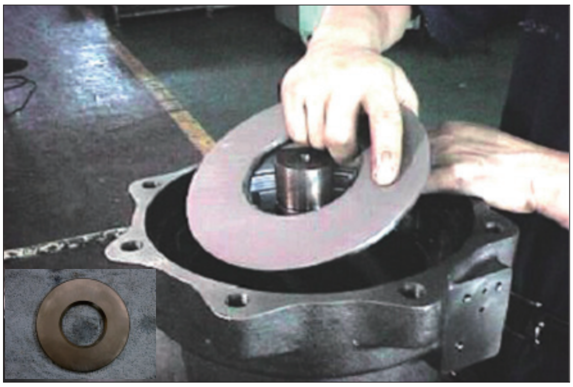
③ Using a jig, disassemble break piston (17) from body (1).


3607A8SM03

④ Disassemble respectively cylinder block assy, fricktion plate (15), plate (16) from body (1).


3607A8SM04

⑤ Disassemble shoe plate (8) from body (1).



3607A8SM05

⑥ Using a plier jig, disassemble snap ring (4) and shaft assy (5).

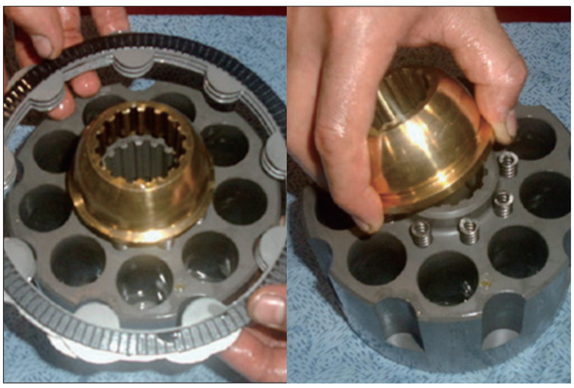
3607A8SM06/06A

(2) Disassemble cylinder block assy sub

① Disassemble pistion assy (14), set plate (13) from cylinder block assy.

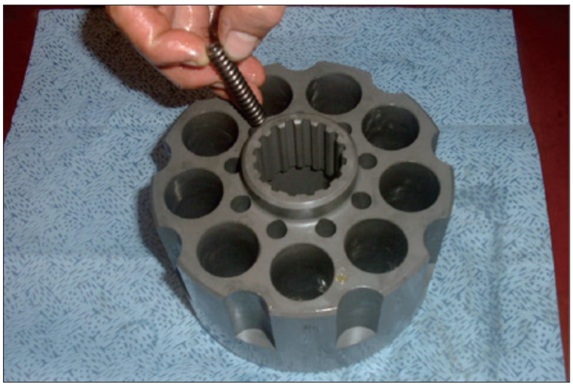
3607A8SM07

② Disassemble ball guide (12), friction plate (15), plate (16) and ball guide seat (11) from cylinder block (9).



3607A8SM08A/08B

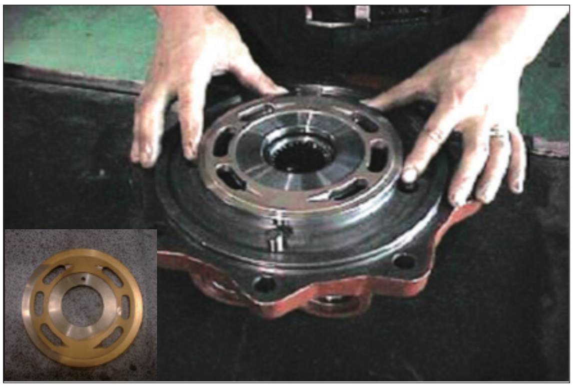
③ Disassemble spring (10) from cylinder block (9).



3607A8SM09

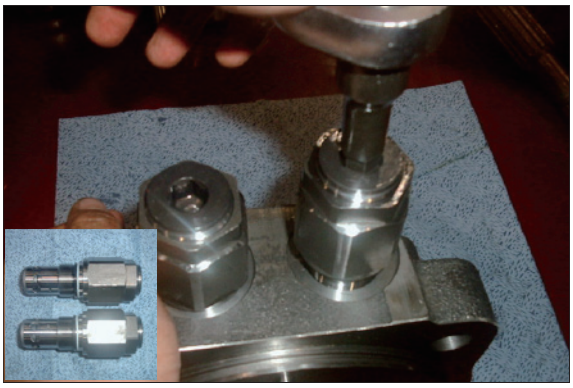
(3) Disassemble rear cover assy sub

① Disassemble pin (6, 21) and valve plate (20) from rear cover (23).



3607A8SM10/10A

② Using a torque wrench, disassemble relief valve assy (30) 2 set from rear cover (23).



3607A8SM11/11A

③ Disassemble make up check valve assy with a torque wrench from rear cover (23).

3607A8SM12/12A

4) ASSEMBLING

(1) Assemble the sub of a turning axls

① Put roller bearing (3) on preheater and provide heat to inner wheel (compress ing temp : 290˚C for 2 minutes)

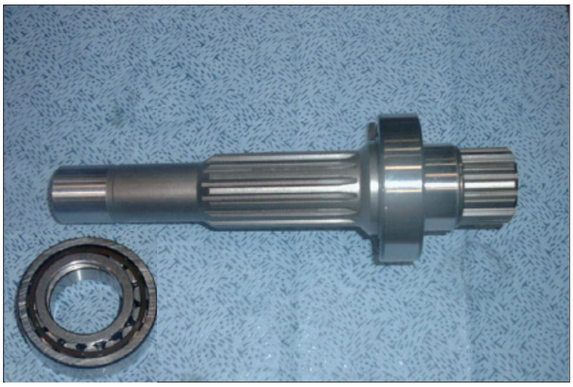
· Roller bearing ×1EA

3607A8SM21

② After assembling and compressing preheated roller bearing (3), stop ring (7) into shaft (5).

· Stop ring ×1EA

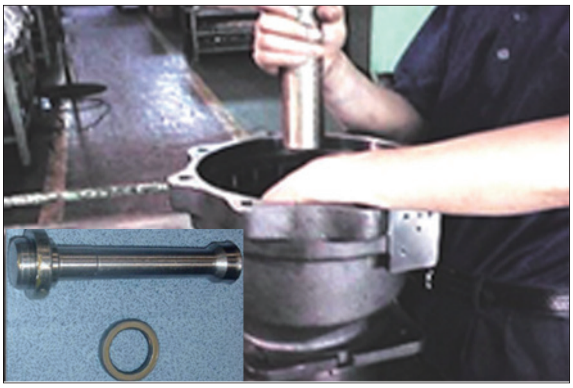
· Shaft× 1EA



3607A8SM22/22A

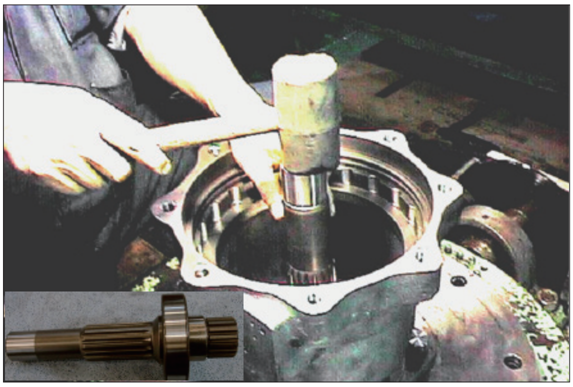
③ Using a compressing tool and steel stick, assemble oil seal (2) into body (1).

· Oil seal ×1EA



3607A8SM23/23A

④ Insert above shaft sub into body (1) and assemble it with a hammer.

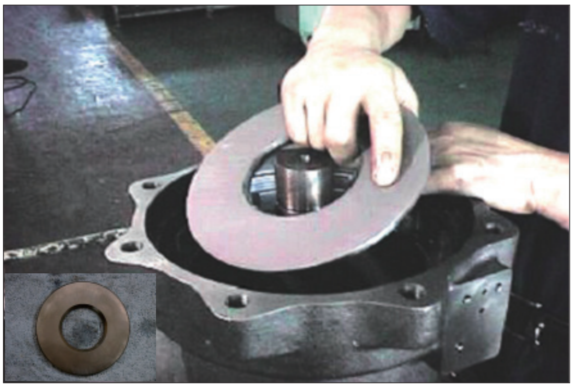


3607A8SM24

⑤ Fix snap ring (4) to shaft with a plier jig.
  · Snap ring ×1EA

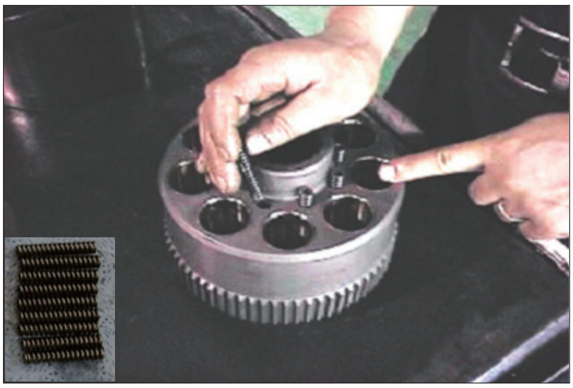

3607A8SM06

⑥ Spread grease on shoe plate (8) and assemble on the body.
  · Shoe plate ×1EA

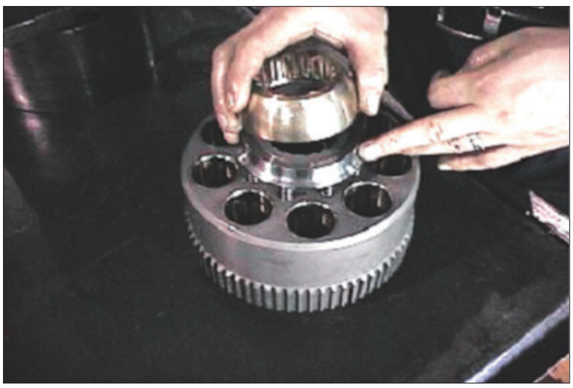

3607A8SM05

(2) Assemble the sub of cylinder block assy

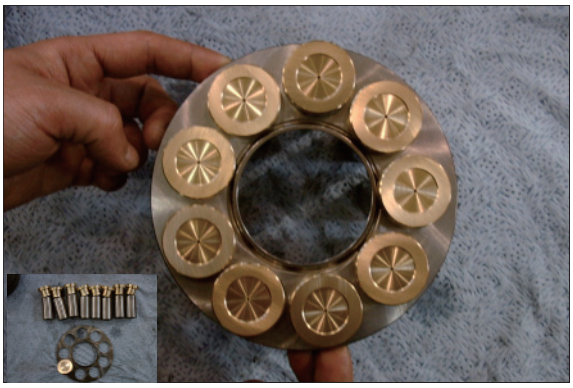
① Assemble spring (10) 9 set into cylinder block (9).
  · Spring ×9EA


3607A8SM25

② Assemble ball guide (12) and ball guide seat (11) into cylinder block (9).
  · Ball guide ×1EA


3607A8SM26

③ Assemble piston assy (14) 9 set into set plate (13).
· Piston assy ×9EA
· Set plate ×1EA


3607A8SM27

④ Assemble above item ② and ③.


3607A8SM28

⑤ Assemble cylinder block assy into body (1).


3607A8SM04

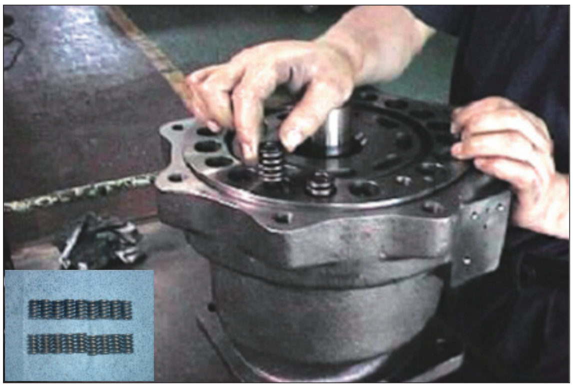
⑥ Assemble 4 set of lining plate (16), friction plate (15) respectively into body.
· Lining plate ×4EA
· Friction plate ×4EA


3607A8SM29

⑦ Assemble O-ring (18) into break piston (17).
· O-ring ×2EA

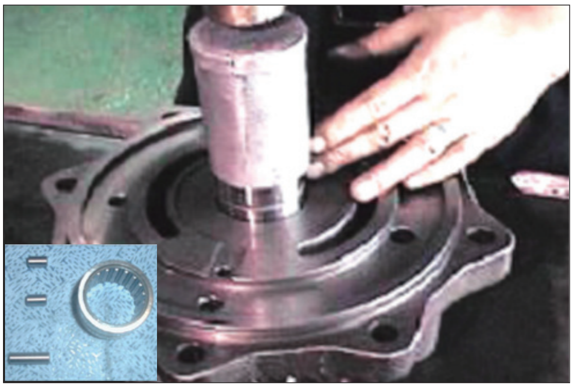

3607A8SM30

⑧ Insert break piston assy into body (1) and assemble spring (19) into break piston (17).
· Spring×19EA

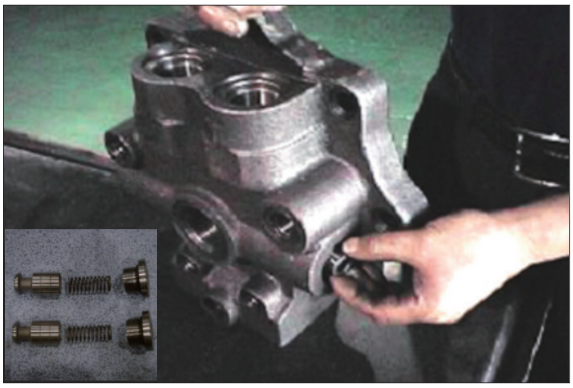

3607A8SM31/31A

(3) Assemble the sub of rear cover assy sub

① After assembling needle bearing (22) into rear cover (23), with a hammer assemble pin (6, 21).


3607A8SM32/32A

② Assemble respectively make up check valve assy spring (27), poppet (26), plug (28) into rear cover (23) after then screw it torque wrench.
· Make up check sub ×2set
· Spring ×2EA
· Check ×3EA


3607A8SM33/12A

③ Assemble relief valve assy (30) 2set into rear cover (23) with a torque wrench.

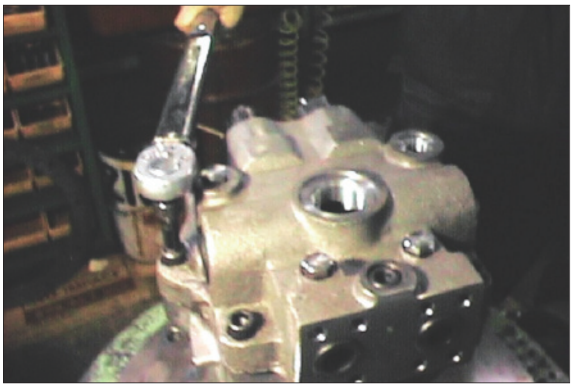
3607A8SM34/11A

④ Spreading grease on valve plate (20), assemble into rear cover (23).

· Valve plate×1EA

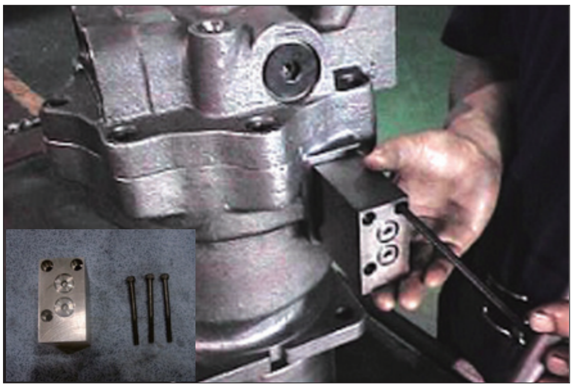
3607A8SM10/10A

⑤ Lift up rear cover assy on body (1) by a crane and assemble it with a wrench bolt (24, 25).



3607A8SM02

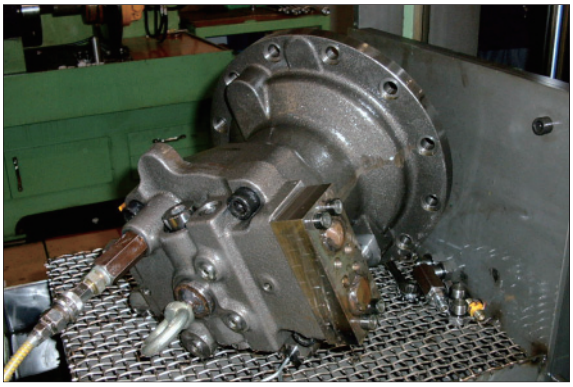
⑥ Assemble time delay valve assy (31) into rear cover (23) with a wrench bolt (32).



3607A8SM01/01A

(4) Air pressing test

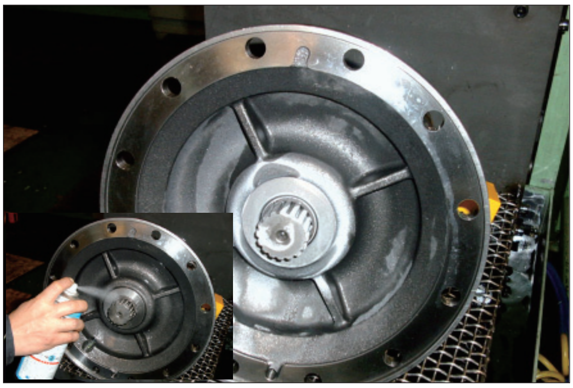
Be sure of leakage, after press air into assembled motor.



14078SM232

(5) Leakage check

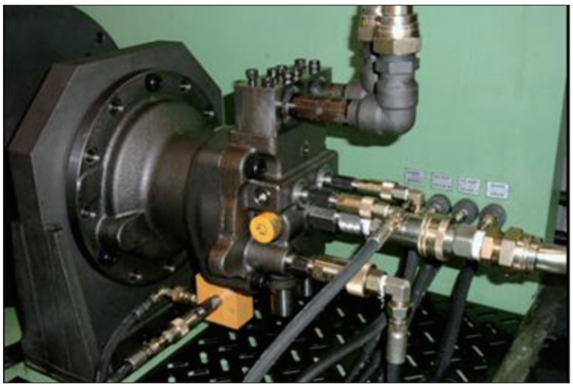
After cleaning motor by color check No.1, paint No.3 and be sure of leakage.



14078SM233/233A

(6) Mount test bench

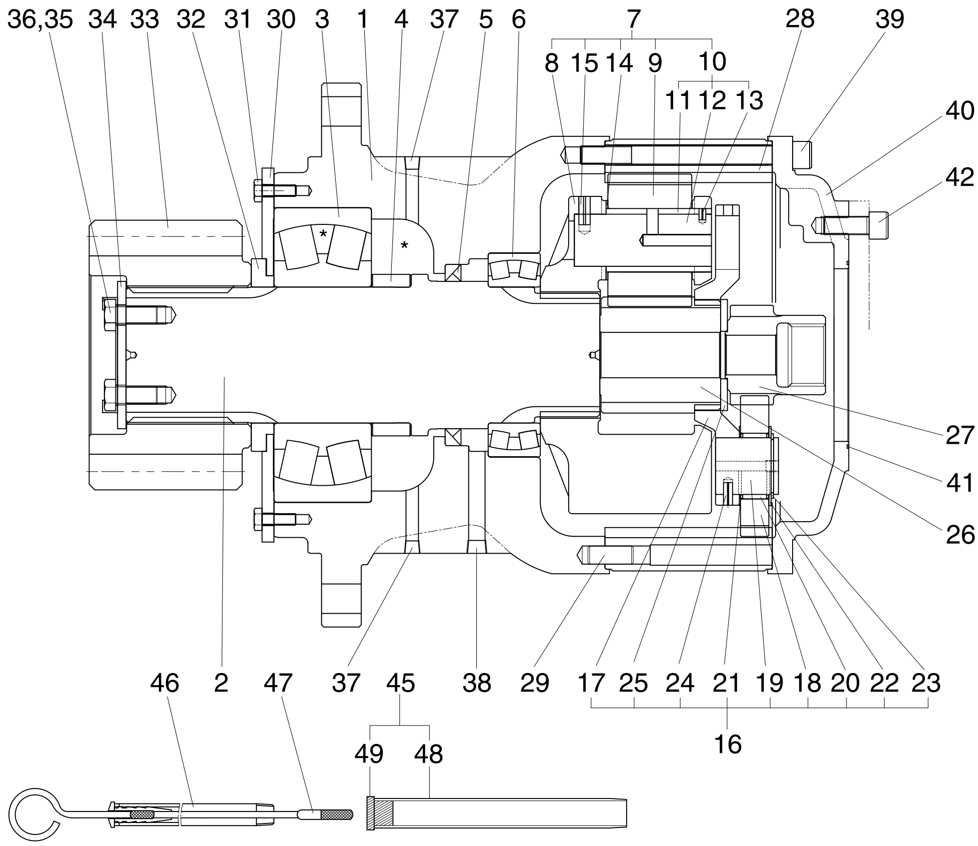
Mounting motor test bench, test the availability of each part.



220078SM14

3. REDUCTION GEAR (TYPE 1, 2)

1) STRUCTURE



380A2SM03

1	Casing	17	Carrier 1	33	Pinion gear
2	Drive shaft	18	Planetary gear 1	34	Lock plate
3	Taper roller bearing	19	Pin 1	35	Hexagon bolt
4	Spacer ring	20	Needle cage	36	Lock washer
5	Oil seal	21	Side plate 1	37	Plug
6	Taper roller bearing	22	Side plate 2	38	Plug
7	Carrier 2 assy	23	Stop ring	39	Socket bolt
8	Carrier 2	24	Spring pin	40	Cover
9	Planetary gear 2	25	Thrust ring	41	O-ring
10	Pin 2 assy	26	Sun gear 2	42	Hexagon socket bolt
11	Pin 2	27	Sun gear 1	43	Plug
12	Bushing 2	28	Ring gear	45	Air breather assy
13	Spring pin	29	Knock pin	46	Gauge pipe
14	Thrust washer	30	Cover plate	47	Gauge bar
15	Spring pin	31	Hexagon bolt	48	Air breather post
16	Carrier 1 assy	32	Spacer	49	Air breather cap

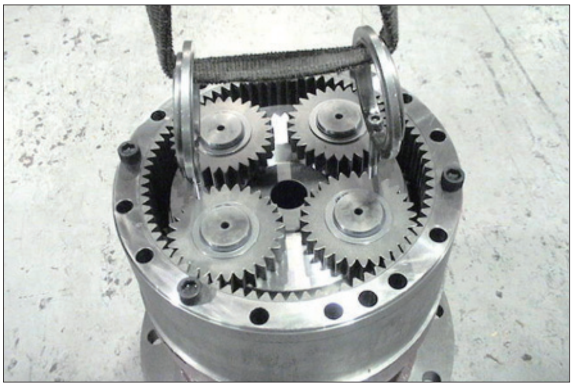
2) DISASSEMBLY

(1) Removal of cover

※ Loosen the socket bolt (39) with 16mm hexagonal socket and remove the cover (40).

(2) Removal of carrier 1 assembly assembly

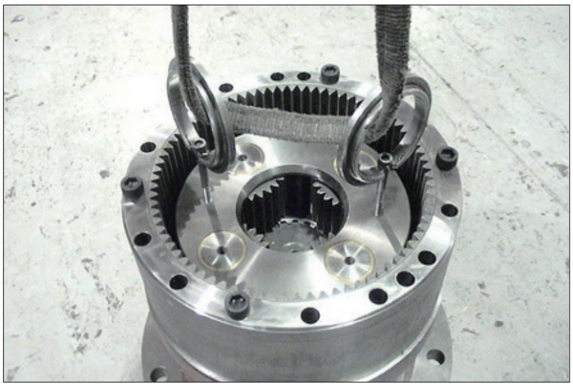
Remove sun gear 1 (27) and thrust ring (25), install eye bolt to tap hole (M10) and remove carrier 1 assembly (16) itself.



3607A8SR03

(3) Removal of carrier 2 assembly

Remove sun gear 2 (26), install eye bolt to tap (M10) of carrier 2 (8) and remove carrier 2 assembly (7) itself.

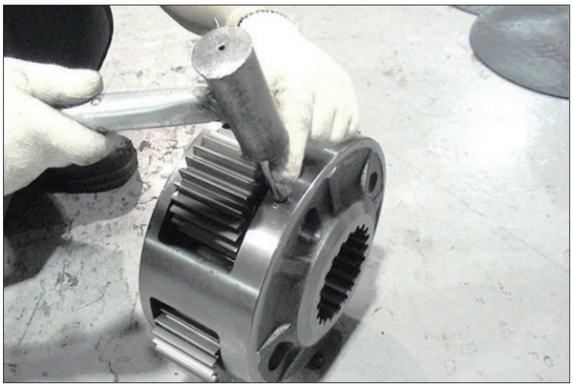


3607A8SR04

(4) Disassembly of carrier 2 assembly

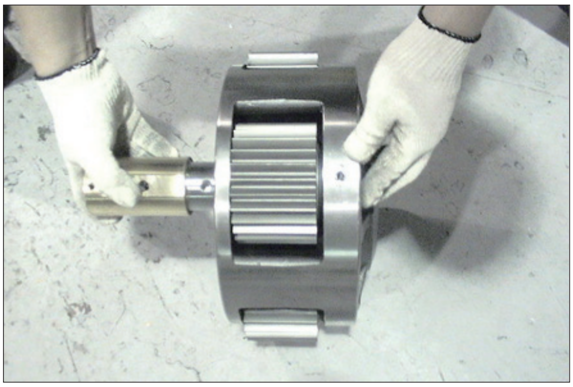
① Insert spring pin (15) into pin 2 (11) by hammering.

※ Do not reuse spring pin after removal.



3607A8SR05

② Remove pin 2 (11), planetary gear 2 (9) and thrust washer (14) from carrier 2 (8) with hands.

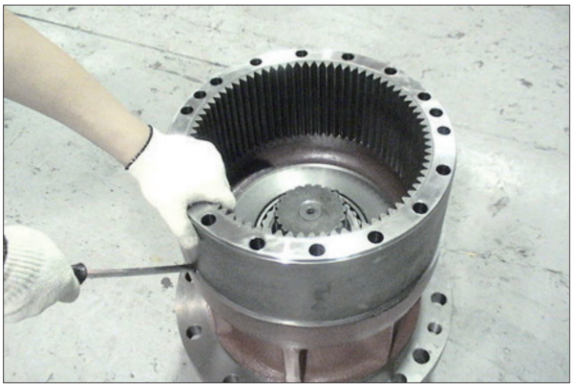


3607A8SR06

(5) Removal of ring gear

Remove ring gear (28) from casing (1).

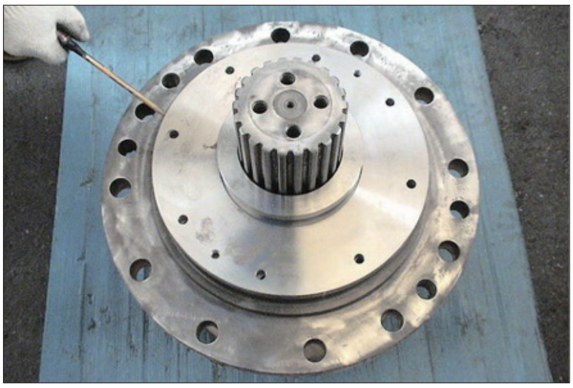
※ Fluid packing is applied on contacting face of ring gear and gear casing. Therefore, remove ring gear from casing by minus screw driver.



3607A8SR07

(6) Removal of drive shaft (2) assembly

① Spread off the corners of spacer (32), and loosen hex bolt (31) with a tool and remove cover plate (30).



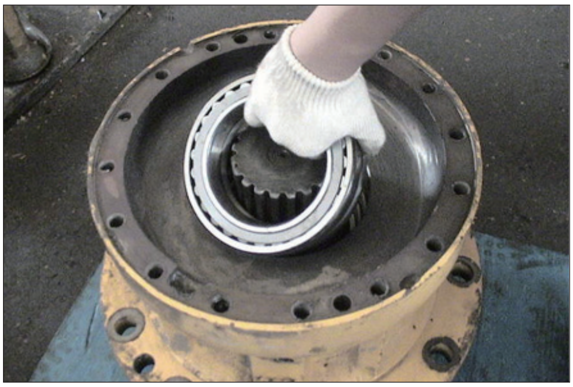
3607A8SR08

② Install hydraulic press at the end face of shaft, and remove drive shaft (2), spacer ring (4), and taper roller bearing (3) as assembly.

※ Do not reuse oil seal after removal.

3607A8SR09

③ Remove taper roller bearing (6) from gear casing (1).



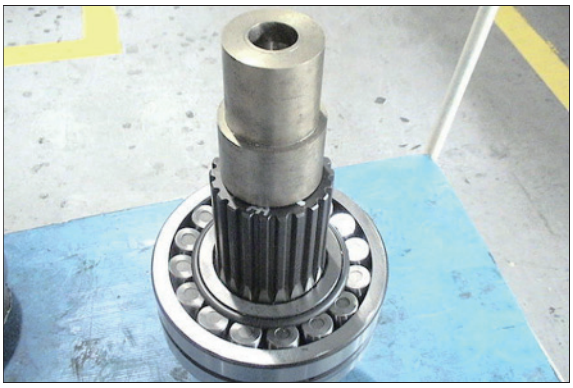
3607A8SR10

④ Remove oil seal (5) from gear casing (1).

3607A8SR11

(7) Disassembly of shaft assembly

Insert motor side of shaft (2) into steel tube (inner dia : Ø145 mm) and push the end of output shaft side with hydraulic press and then remove taper roller bearing (3), and spacer ring (4) as assembly from drive shaft (2).



3607A8SR12

3) ASSEMBLY

(1) Assembly of drive shaft assembly

① After heat taper roller bearing (3) up to 50˚C plus surrounding temperature and assemble it to shaft with hydraulic press and then assemble spacer ring (4) in this order.

※ Pay attention to the assembling direction of cover plate (30).

3607A8SR13

(2) Installation of oil seal

Remove oil from assembled face of oil seal of gear casing (1) and oil seal (5).

Apply fluid packing (three bond of white color) on outer face of oil seal and assemble at pressing jig of gear casing.

After inserting with press, lubricate oil seal with grease.

3607A8SR14

(3) Install of drive shaft assembly

① Be careful lest oil seal lip damage by spline of drive shaft (2).
Assemble drive shaft assembly by using seal guide.

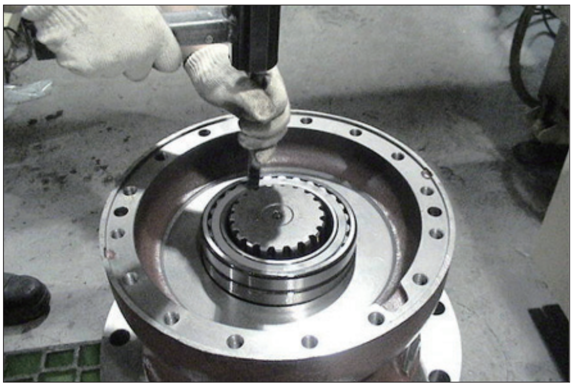
② Put drive shaft of gear casing (1) upward.
Assemble drive shaft assembly to gear casing by tightening eye bolt into tap hole (M16) of output side of drive shaft (2).

※ Place support (approx 150 mm) below of gear case (1) for seal protector contact with work table.

3607A8SR15

(4) Install of taper roller bearing

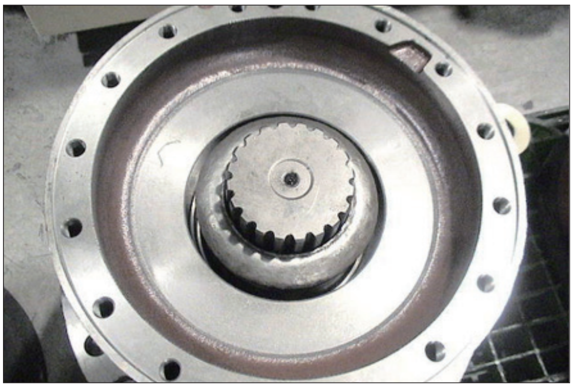
Put gear casing under output shaft and heat taper roller bearing (6) up to 50˚C plus surrounding temperature and then assemble it to the shaft (2).



3607A8SR16

(5) Assembly of ring gear

① Remove oil from mating faces between gear casing (1) and ring gear (28), and knock pin (29). Assemble collar of gear casing and apply fluid packing (three bond of grey color).



3607A8SR17

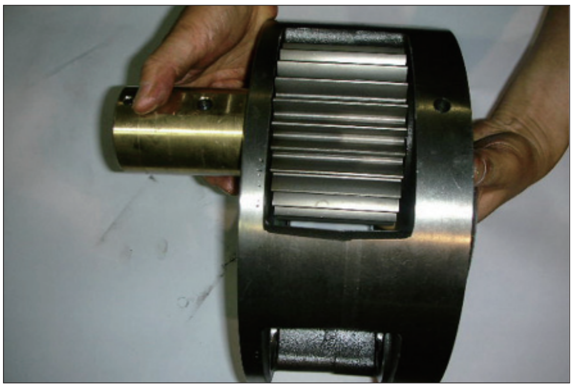
② Assemble ring gear (28).

36078SR18

(6) Assembly of carrier 2 assembly

① Assemble planetary gear 2 (9) to carrier 2 (8) with thrust washer (14) and insert pin 2 (11).

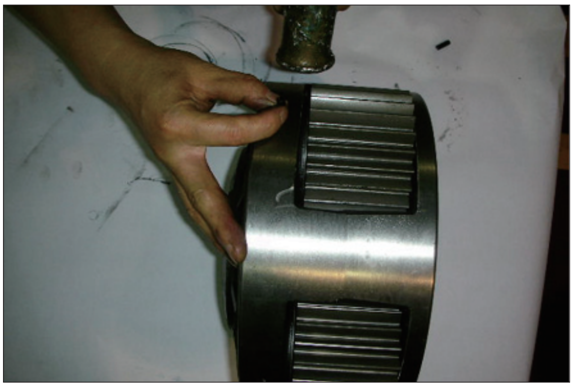
※ Lubricate gear oil to inside of gear and outside of shaft.



3607A8SR19

② Insert spring pin (15) by hammering.

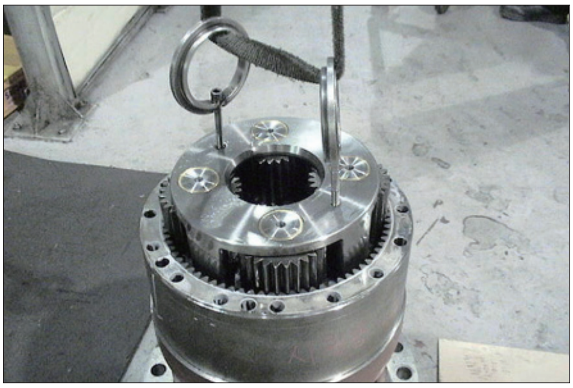
※ Insert as the clearance between spring pins toward planetary gear 2 (9).



3607A8SR20

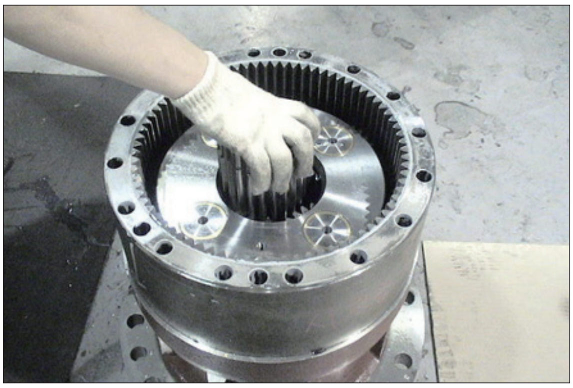
(7) **Assembly of carrier 2 assembly and sun gear 2**

① Mount eye bolt into tap hole (M10) of carrier 2 (8) and lift carrier assembly and then insert carrier assembly being engaged with internal teeth of ring gear (28). Rotate carrier assembly lightly so that splines of drive shaft (2) are engaged.



3607A8SR21

② Insert sun gear 2 (26) to planetary gear 2 (9).

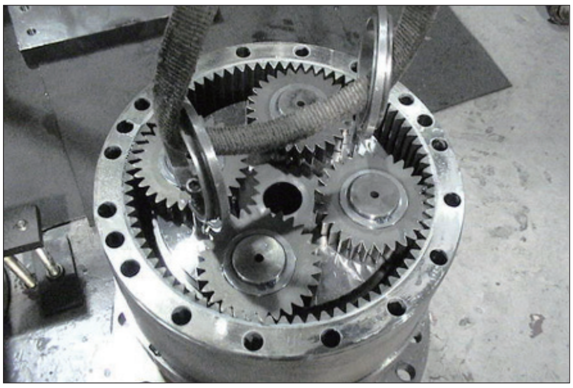


3607A8SR22

(8) **Assembly of sun gear 1, carrier 1 assembly**

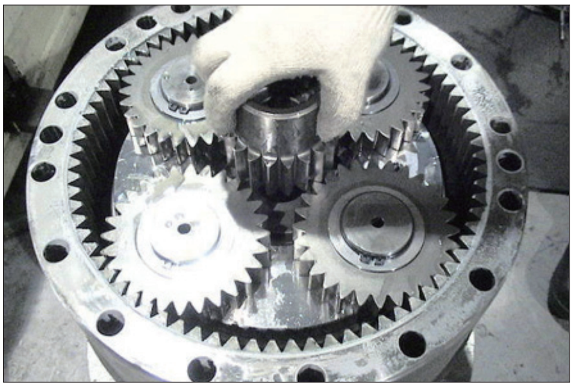
① Mount eye bolt into tap hole (M10) of carrier 1 (17) and lift carrier assembly and then insert carrier assembly being engaged with internal teeth of ring gear (28).

Rotate holder assembly lightly so that sun gear 2 (26) is engaged with teeth of carrier 1 (17).



3607A8SR23

② Insert sun gear 1 (27) to planetary gear 1 (18).



3607A8SR24

(9) Check rotation of sun gear 1 (27) by turning plunge part of gear casing with hands.

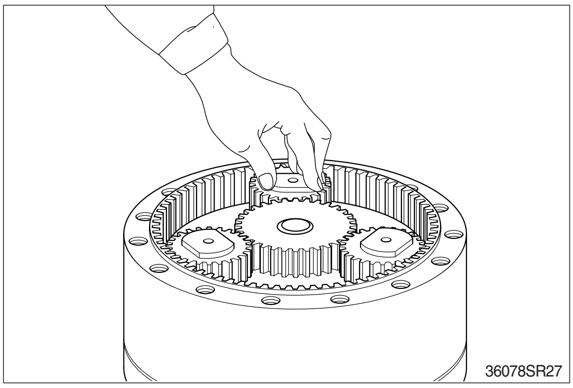
(10) Assembly of cover

Remove oil from mating faces between ring gear (28) and cover (40) and apply fluid packing.

Assemble cover (40) and tighten socket bolt (39) with 16 mm hexagonal socket.

Tightening torque : 28.5±3.0 kgf · m
(206±21.7lbf · ft)

This completes assembly



36078SR27

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.

13031GE18

⚠ 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) Remove the track shoe assembly.
For details, see removal of track shoe assembly.

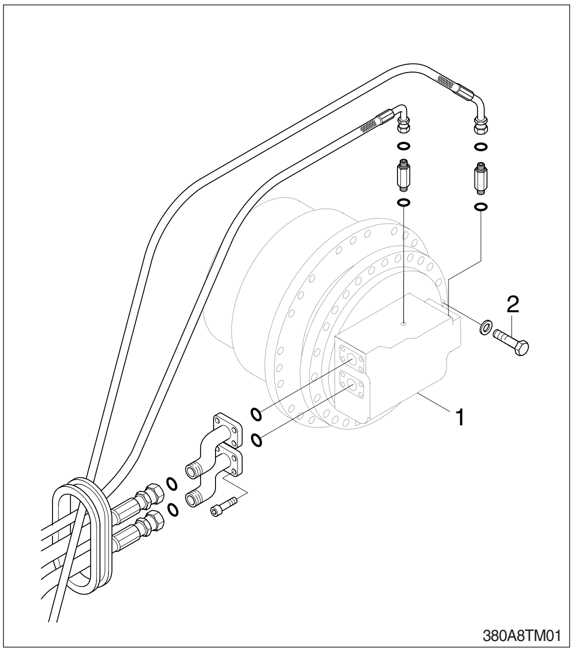
(5) Remove the cover.

(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(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 : 380 kg (838 lb)
· Tightening torque : 57.9 ± 8.7 kgf·m
(419 ± 62.9 lbf·ft)



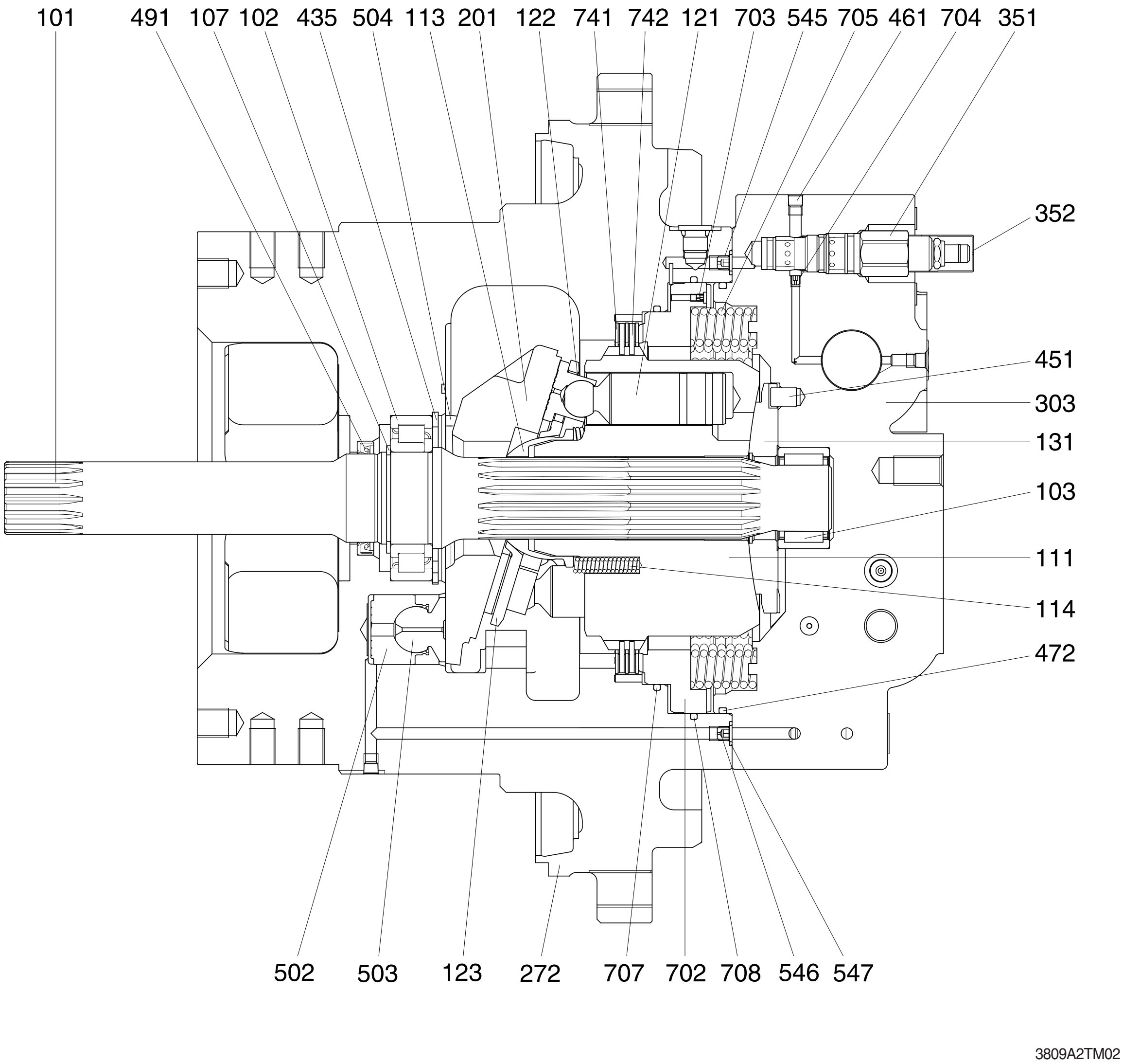
380A8TM01

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.

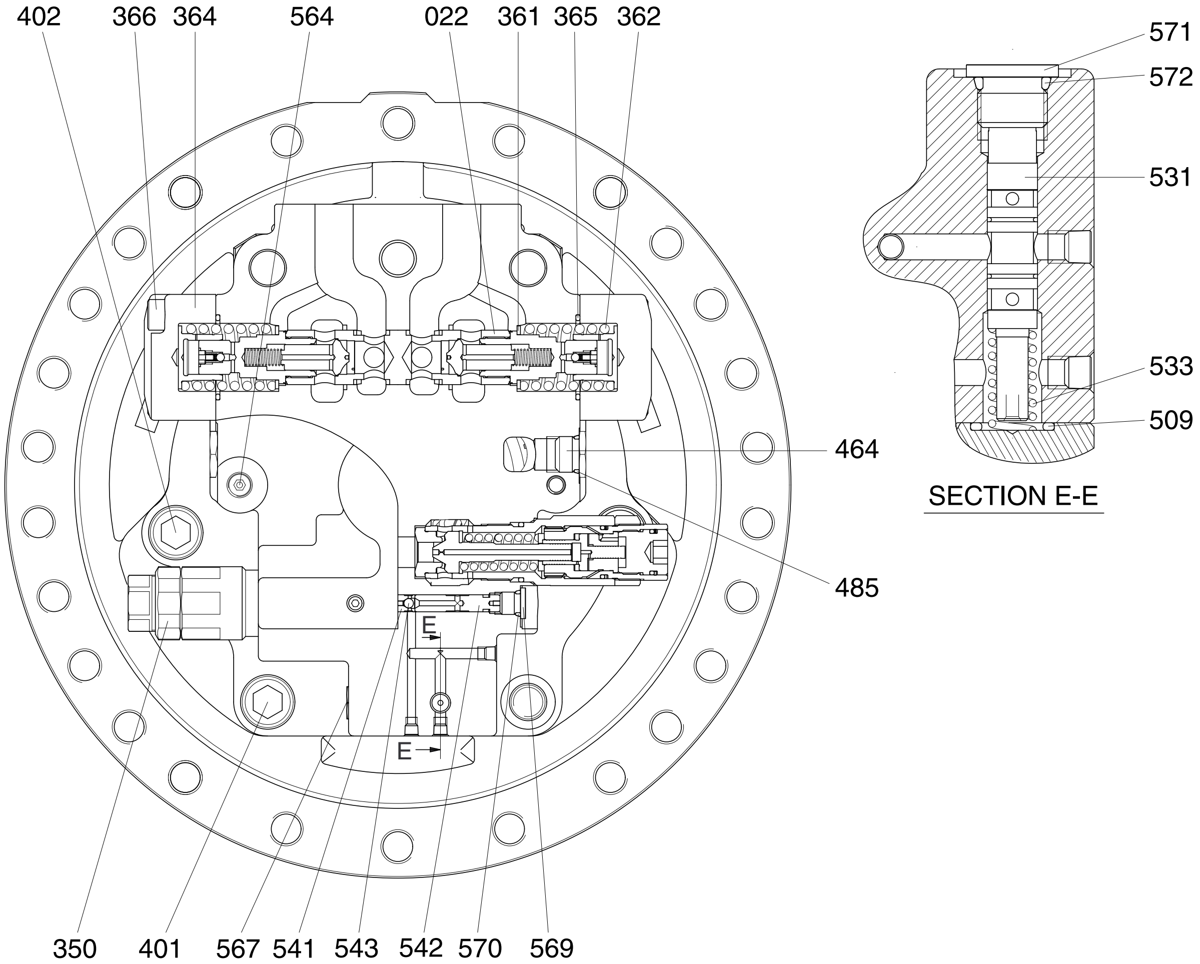
2. TRAVEL MOTOR

1) STRUCTURE (1/2)



101	Drive shaft	272	Shaft casing	545	Orifice
102	Roller bearing	303	Valve casing	546	Orifice
103	Needle bearing	351	Reducing valve	547	O-ring
107	Snap ring	352	Cover	702	Brake piston
111	Cylinder block	435	Snap ring	703	Orifice
113	Spherical bushing	451	Pin	704	Orifice
114	Cylinder spring	461	Plug	705	Brake spring
121	Piston	472	O-ring	707	O-ring
122	Shoe	491	Oil seal	708	O-ring
123	Set plate	502	Piston	741	Separation plate
131	Valve plate	503	Shoe	742	Friction plate
201	Swash plate	504	Pivot ball		

STRUCTURE (2/2)

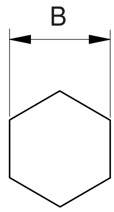


3607A2TM03

022	Counterbalance spool	402	Hex socket bolt	543	Steel ball
350	Relief valve	464	VP plug	564	Plug
361	Washer	485	O-ring	567	VP plug
362	Counterbalance spring	509	O-ring	569	RO plug
364	Counterbalance cover	531	Tilting spool	570	O-ring
365	O-ring	533	Tilting spring	571	RO plug
366	Hex socket	541	Seat	572	O-ring
401	Hex socket	542	Stopper		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

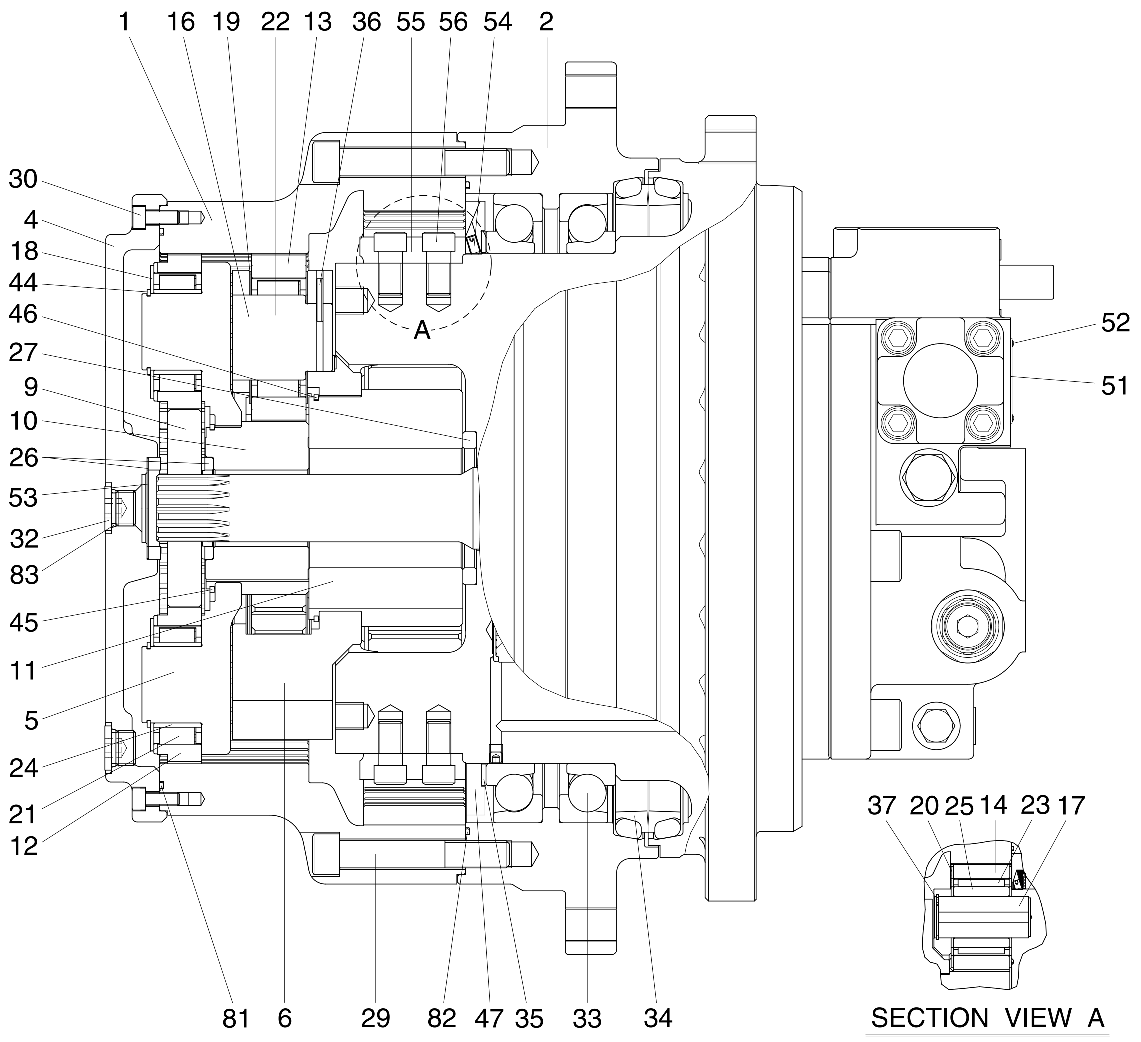
Tool name	Remark	
Allen wrench	2	
	2.5	
	4	
	6	
	8	
	10	
	17	
Socket for socket wrench, spanner	19	
	22.4	
	27	
	42	
Torque wrench	Capable of tightening with the specified torques.	
Plier (For hole, TPR-90)	For snap ring (435)	
Plier (For shaft)	For snap ring (107)	
(-) Driver	-	
Plastic hammer	Wooden hammer allowed. Nominal 1 or so	
Steel rod approx	7×7×200mm, Bearing (102, 103)	
Monkey wrench	-	
Oil seal inserting jig	-	
Bearing plier	-	
Seal tape	-	

(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	in	mm
Socket bolt	366	M12×45	10	72.3	0.39	10
Socket bolt	401	M20×100	44	318	0.67	17
Socket bolt	402	M20×50	44	318	0.67	17
Plug	461	NPTF 1/16	0.9	6.5	0.16	4
VP Plug	464	PF 1/4	11	79.6	1.06	27
Orifice	545, 546	NPTF 1/16	0.7	5.1	0.16	4
Plug	564	PT 1/2	2.2	15.9	0.24	6
VP Plug	567	PF 1/4	3.7	26.8	0.75	19
Plug	569	PF 1/4	3.7	26.8	0.24	6
Plug	571	PF 3/8	7.5	54.2	0.31	8
Orifice	703	M4×0.7	0.35	2.5	0.08	2
Orifice	704	M5×0.8	0.7	5.1	0.1	2.5

3. TRAVEL REDUCTION GEAR

1) STRUCTURE

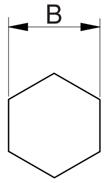


3809A2TRG01

1	Ring gear	20	Side plate	37	Snap ring
2	Housing	21	Needle cage	44	Snap ring
4	Side cover	22	Needle cage	45	Clip
5	Carrier 1	23	Needle cage	46	W clip
6	Carrier 2	24	Inner ring	47	Nutring
9	Sun gear 1	25	Floating bushing	51	Name plate
10	Sun gear 2	26	Thrust ring	52	Rivet
11	Sun gear 3	27	Thrust ring	53	Washer
12	Planetary gear 1	29	Socket bolt	54	Set screw
13	Planetary gear 2	30	Socket bolt	55	Nutring stopper
14	Planetary gear 3	32	RO plug	56	Hex socket bolt
16	Pin 2	33	Angular bearing	81	O-ring
17	Pin 3	34	Floating seal	82	O-ring
18	Side plate	35	Shim	83	O-ring
19	Side plate	36	Spring pin		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	4	
	8	
	10	
	14	
Spanner	27	
Torque wrench	Capable of tightening with the specified torques.	
Plier (for shaft)	Snap ring (037, 044)	
(-) Driver	For removing floating seal	
Plastic hammer	Wooden hammer allowed	
Eye bolt	M8, M10, M16, M20, For lifting-up	
Press (1 ton)	Angular bearing (033)	
Depth gauge straight edge	100mm depth, for adjusting shins (053)	
Tap M16	For removing screw lock in tapped holes	
Oil stone	For finishing mating faces	
Punch	For preventing spring pin from coming out	
Loctite (three bond 1373B)	Set screw (054)	
Loctite	Socket bolt (029)	
Nut ring inserting jig	Nut ring (047)	

(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	in	mm
Socket bolt	29	M16×100	30	217	0.55	14
	30	M8×20	3.5	25.3	0.24	6
Plug	32	PF 1/2	11	79.6	0.39	10
Set screw	54	M8×16	1.0	7.2	0.24	6

4. DISASSEMBLING

1) GENERAL PRECAUTIONS

(1) Pay attention to not damaging contact surfaces for O-rings, oil seals, etc. and contact/sliding surfaces for gears, pins, bearings, etc.

(2) This motor can be disassembled even in a state on the reduction gear.
However, in that case, pay full attention to preventing mud, dust, etc. from entering in it.

(3) The numerical in parentheses following each part name indicates its part number shown in the attached **assembly drawings.**

(4) The piping side of the motor is referred to as the rear side, and the output side as the front side.

2) DISASSEMBLY OF REDUCTION GEAR

(1) Select a disassembling place.
※ Select a clean place.
※ Spread rubber sheet or cloth on work bench to prevent parts from being damaged.

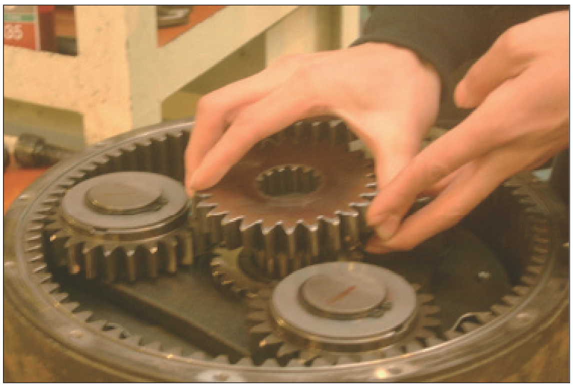
(2) Remove dust, mud, etc. from reduction gear surfaces with washing oil or so.

(3) Place reduction gear with its gear oil drain port or level gauge at the lowest position, and drain reduction gear oil.
※ Receive gear oil with clean vessel and check it for abnormalities.
Renew gear oil.

(4) Place reduction gear with its side cover (4) upward, and remove socket bolt (30), and remove side cover (4) and O-ring (81).


370078TM01

(5) Remove sun gear 1 (9).


370078TM02

(6) Remove carrier 1 (5), together with planetary gears 1 (12), sun gear 2 (10), etc. fitted.

370078TM03

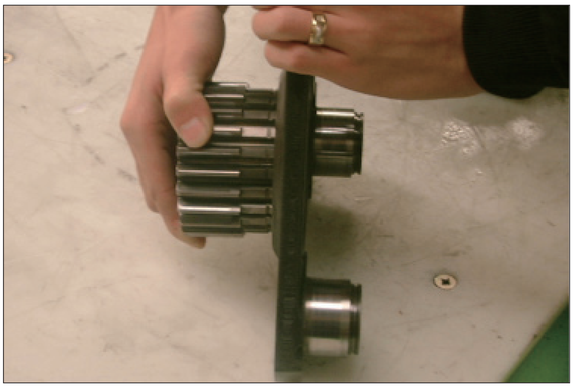
(7) Disassembling of carrier 1 sub-assembly

① Remove snap ring (44), and then remove side plate (18), planetary gear 1 (12), needle cage (21) and side plate (18).

※ If flaking is observed on the inner ring surface replace inner ring. In this case, replace planetary gear 1 and needle cage simultaneously.

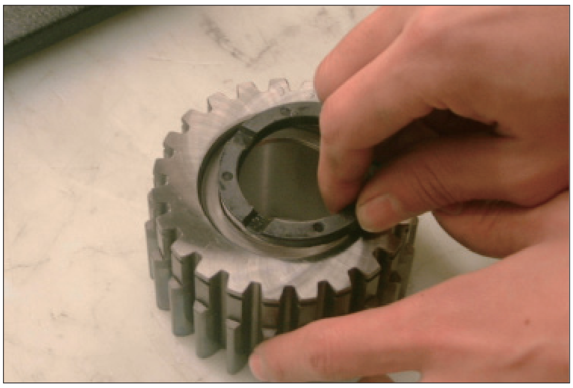
370078TM04

② Remove circlip (45), and then remove carrier 1 (5) from sun gear 2 (10).



370078TM05

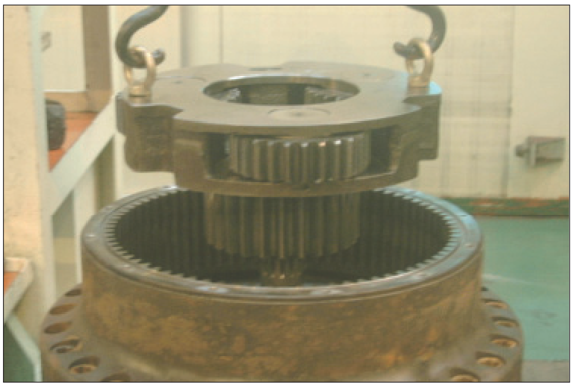
③ Remove thrust ring (26).



370078TM06

(8) Remove carrier 2 (6), with planetary gears 2 (13), sun gear 3 (11), etc. fitted.

※ Use M10 eyebolt. In this case, thrust ring (26) is removed simultaneously.



370078TM07

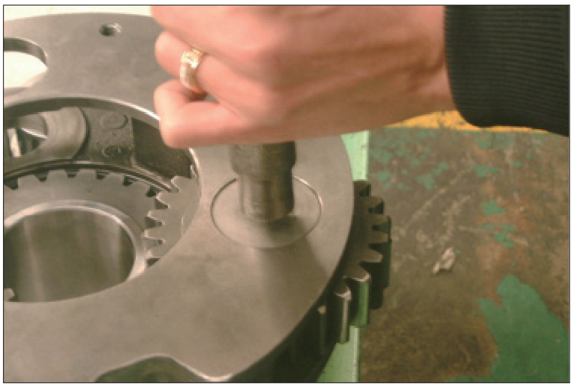
(9) Disassembling of carrier 2 sub-assembly

① Push in spring pin (36), and remove pin 2 (16), from carrier 2.

※ Carry out the following check in advance. If any abnormality should be found, carry out disassembling.

· Is there any crevice, crack or pitting on tooth surface of planetary gear?

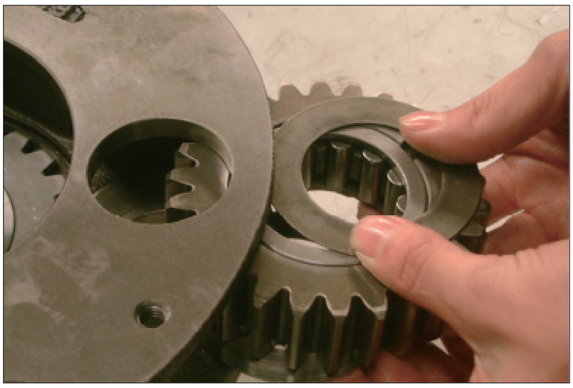
· When turning planetary gear lightly, is there any abnormal noise or eccentric clearance? Carry out check similarly to the above for carrier 3.



370078TM08

② Remove side plate (20), planetary gear 2 (13), and needle bearing (22) from carrier 2.

③ Remove thrust ring (26).



370078TM09

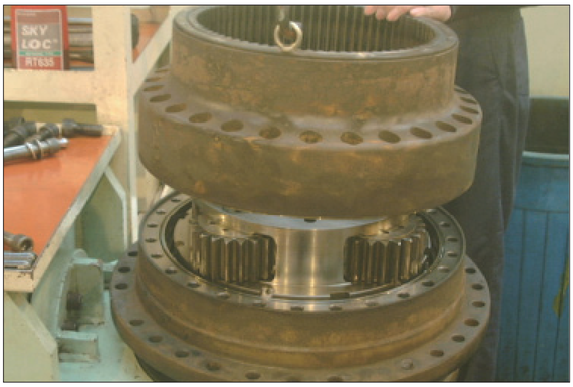
④ Remove snap ring (46), and remove carrier 2 (6) from sun gear 3 (11).

⑤ Remove thrust ring (27) from sun gear 3 (11).

370078TM10

(10) Remove socket bolt (29), and then screw two M8 eyebolts on front side of ring gear (1), lift up ring gear with crane, and remove O-ring (82) from housing (2).

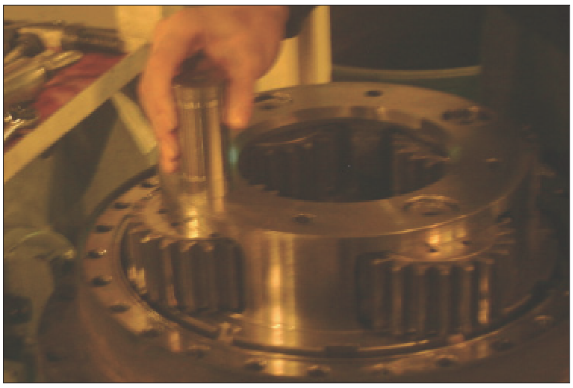
※ It is difficult to separate them, because it is assembled by LOCTITE.
In this case, if you can use wrench and pipe, it is easy to separate them.



370078TM11

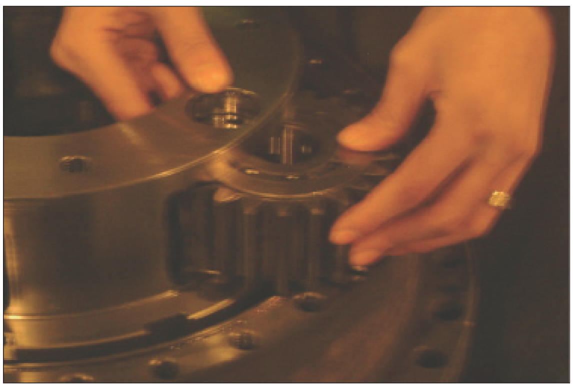
(11) Remove snap ring (37) and then remove pin 3 (17) from shaft casing (272).

370078TM12



370078TM13

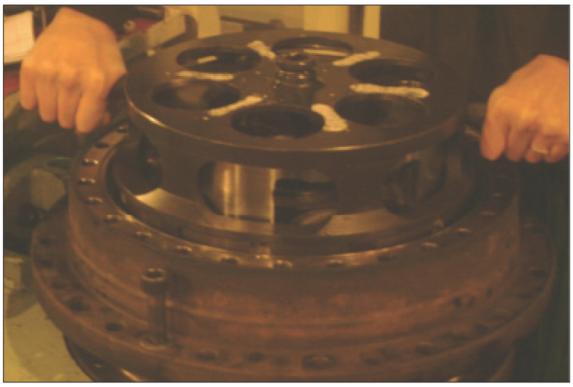
(12) Remove side plate (20), planetary gear 3 (14), needle cage (23), floating bushing (25) from shaft casing (272).



370078TM14

(13) Remove set screw (54) from nut ring (47), and then remove nut ring (47) from shaft casing (272).

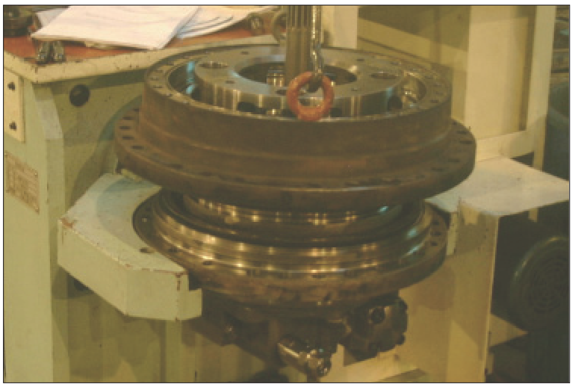
※ When disassembling nut ring, remove dust, mud, etc. from set screw hole by blasting compressed air.
And remove the nut ring by using the special tool for removing the nut ring.



370078TM15

(14) Remove housing (2), angular bearing (33), floating seal (34) from shaft casing (272).

※ Screw two M16 eye bolts on front side of housing (2).
Lift up housing (2) with crane.



370078TM17

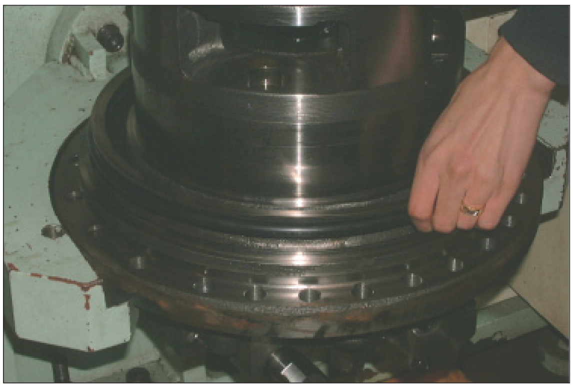
(15) Remove floating seal (34) from housing (2), paying attention to not damaging it.

※ Pay attention to O-ring and sheet faces.

370078TM18

(16) Remove floating seal (34) from casing (272), pay attention to not damaging it.

※ Pay attention to O-ring and sheet faces.



370078TM19

(17) Remove angular bearing (33) from housing (2).

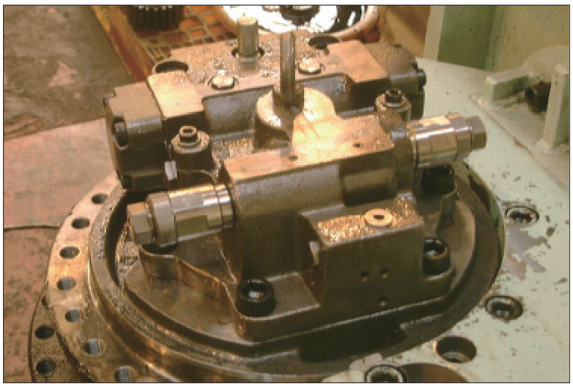
※ Bearing should be renewed once it is removed.

370078TM20

3) DISASSEMBLY OF MOTOR

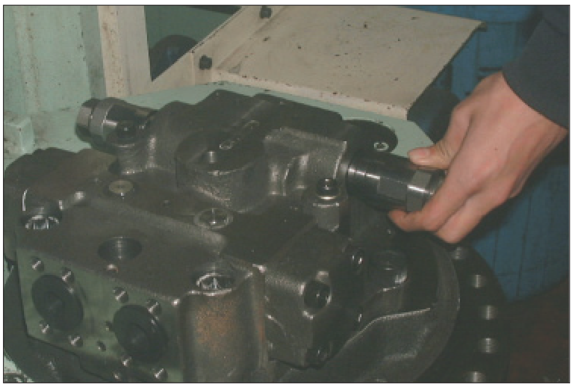
(1) Disassembling of motor main body

① Place hydraulic motor on bench with its output shaft down.

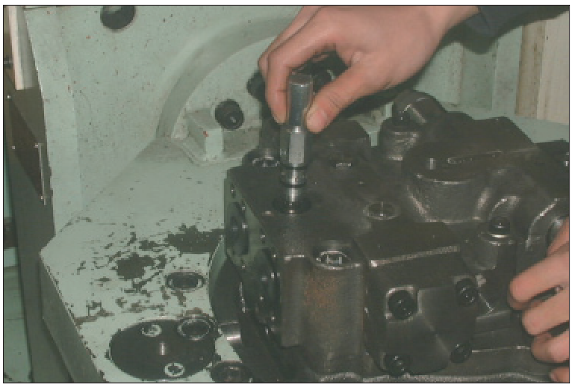


370078TM21

② Loosen relief valve (350), reducing valve (351), cover (352), plug, etc.
They are fitted to valve casing (303).

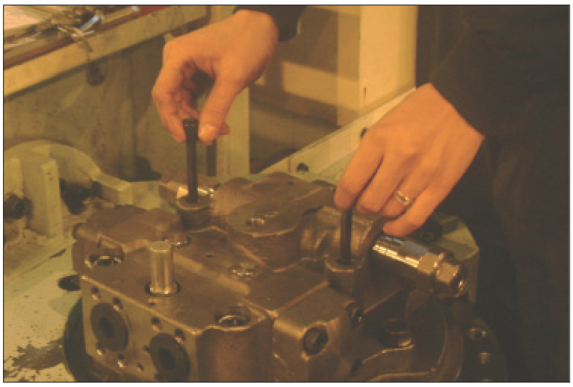


370078TM22



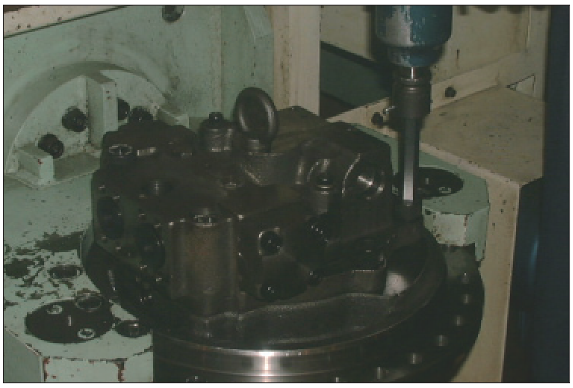
370078TM23

③ Remove plug (564) from valve casing (303). And then screw two M10×135 bolts on the holes of compelling brake release. Sub assembly (valve casing & brake piston)



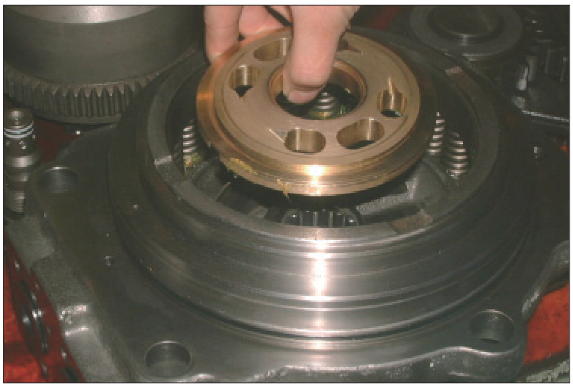
370078TM24

④ Remove socket bolts (401, 402) that assemble valve casing (303).



370078TM25

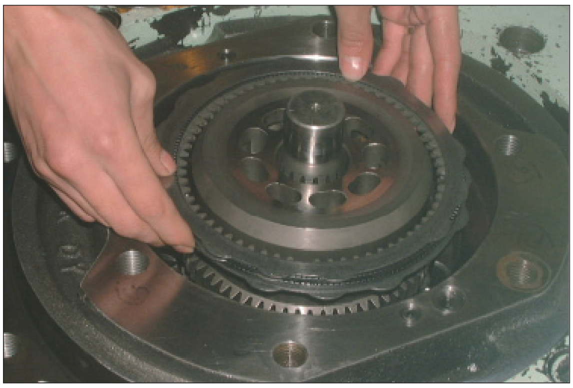
⑤ Remove the above socket bolt, and then separate valve casing sub-assembly and remove valve plate (131).



370078TM26

⑥ Pull out friction plate (742) and separation plate (741) from cylinder block (111).

※ In this case, motor should be located in horizontally.

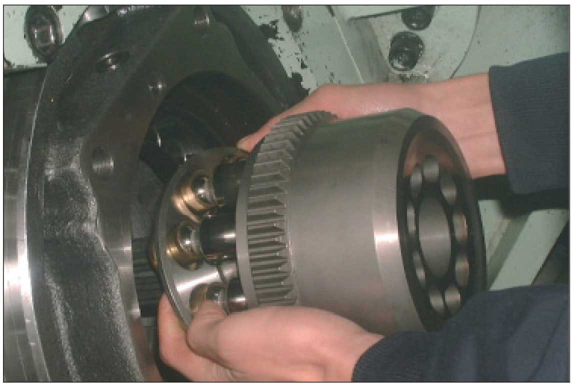


370078TM27

⑦ Pull out cylinder block and piston sub-assembly.

※ After placing the motor horizontally, take out cylinder block from casing.

※ Be careful not to damage the sliding parts of the cylinder block, spherical bushing and shoe.

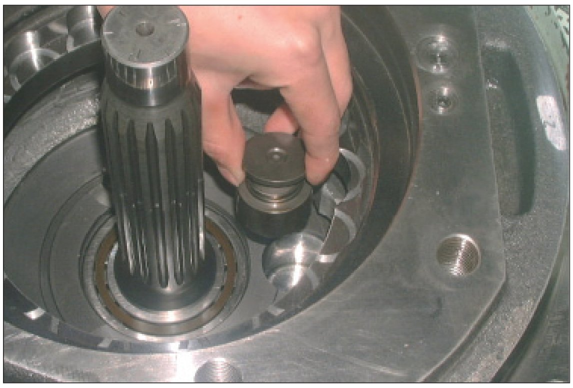


370078TM28

⑧ Remove swash plate (201).

370078TM29

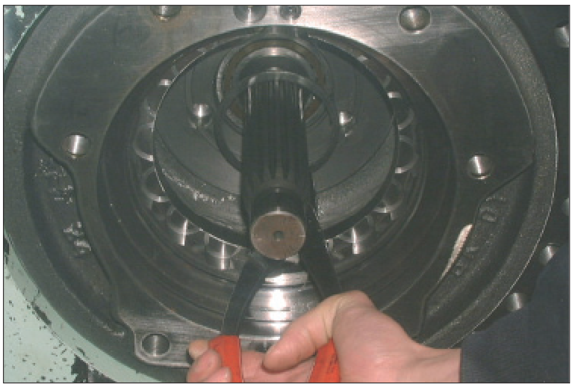
⑨ Remove pivot ball (504) and tilting piston sub assembly.



370078TM30

⑩ Take out snap ring (435), and then hit front side end face of shaft (101) lightly with plastic hammer or so to remove from casing (272).

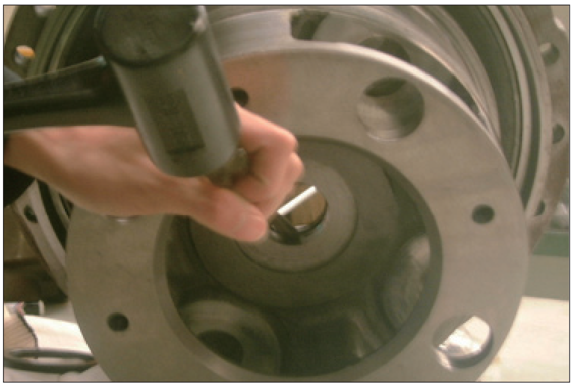
※ Do not remove cylinderical roller bearing (102) as far as it remains normal.



370078TM31

⑪ Take out oil seal (491) from shaft casing (272).

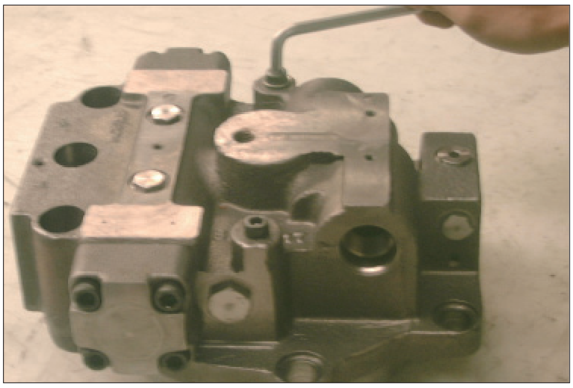
※ Do not reuse the disassembling oil seal (491).



370078TM32

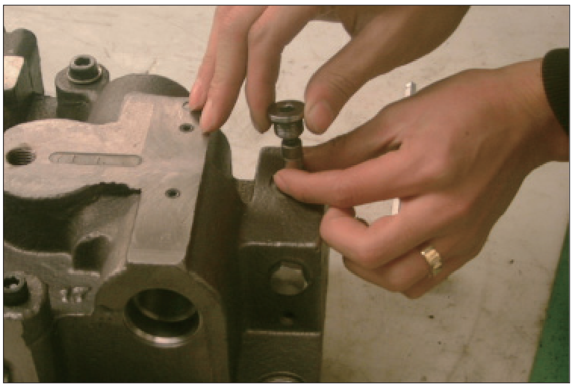
(2) Disassembling of valve casing sub-assembly

① Remove two M10×135 bolts for compelling brake release. Disassemble brake piston from valve casing.



370078TM33

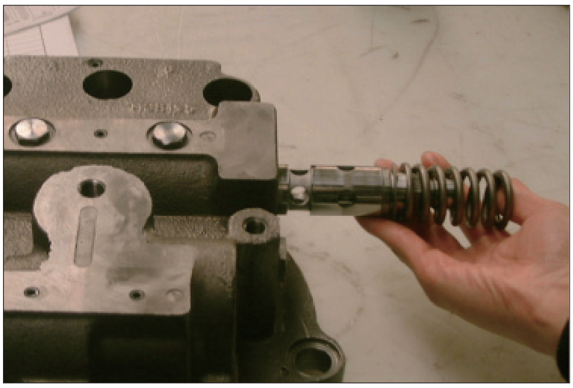
② Remove plug (571), tilting spring (533), and tilting spool (531) from valve casing.



370078TM34

③ Remove socket bolts (366), counterbalance cover (364), and counterbalance spool assembly.

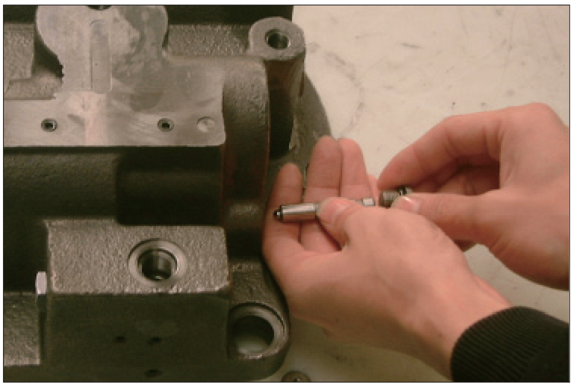
※ When any abnormality is found in counterbalance spool, counterbalance spring, etc. replace with the counter balance spool sub assembly as a set.



370078TM35

④ Remove plug (569), stopper (542), steel ball (543) and seat (541).

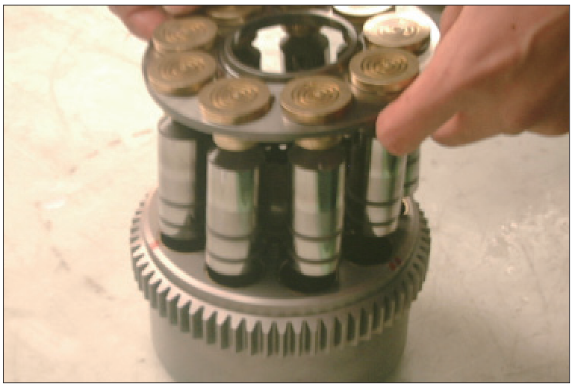
※ When no abnormality is found in displacement changeover, it is not necessary to overhaul it specifically.
And don't remove needle bearing (103) as far as it remains normal.



370078TM36

(3) Disassembling of cylinder sub-assembly

① Pull out set plate (123), piston (121), and shoe (122) sub-assembly.



370078TM37

② Remove spherical bush (113) and cylinder spring (114).
That is all of the disassembling work.
The pins (451) force-fitted to the valve casing cannot be removed.

370078TM38

5. ASSEMBLING

1) GENERAL CAUTIONS

(1) Clean each part fully with washing oil and dry it by blasting compressed air. It is better not to use waste cloths as much as possible.
However, if they are to be used, use clean ones, and pay attention to not leaving lint and so on.
Don't clean the friction plate with washing oil without fail.

(2) Use the torque wrench in tightening fitting screws and plugs to their respective torque shown in page 8-90, 8-92.

(3) When hammering is required, use the plastic hammer and try to hit parts lightly.

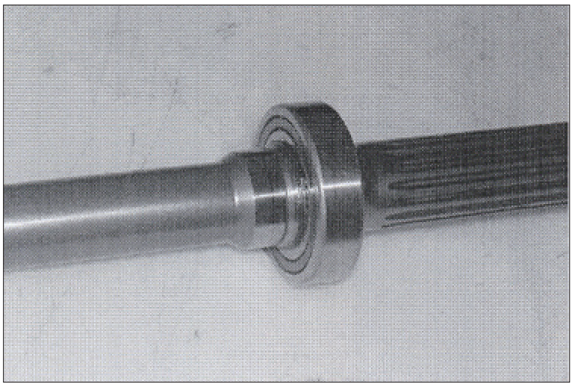
(4) Similarly to the disassembling procedures, the numeral in parentheses following each part name indicates its item number shown in the attached assembly drawings.

2) ASSEMBLY OF MOTOR

(1) Assembling driving shaft sub-assembly

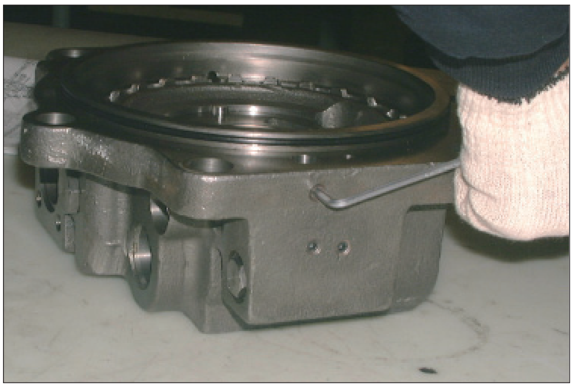
① Put roller bearing (102) on drive shaft (101), and assemble snap ring (107) by using the plier.

※ Roller bearing is press fit by the heat to drive shaft.
※ Pay attention to not damaging oil seal sliding area of driving shaft.
※ Pay attention to not fitting snap ring the other way around.

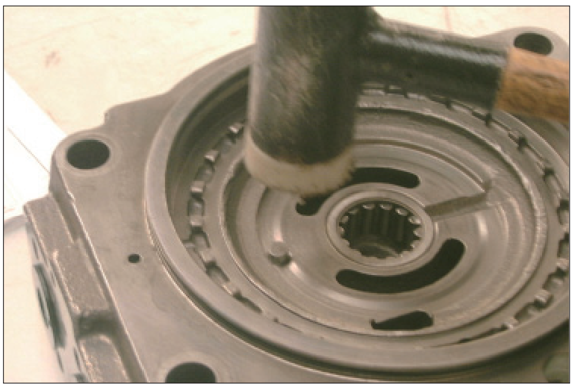

370078TM39

(2) Assembling of valve casing sub-assembly

① Tighten plugs (461, 564) into valve casing (303) with specified torque.
· Plug(461) : 0.9 kgf · m (6.5 lbf · ft)
· Plug(564) : 2.2 kgf · m (15.9 lbf · ft)


370078TM40

② Interference-fit pin (451).


370078TM41

③ Interference-fit needle bearing (103).

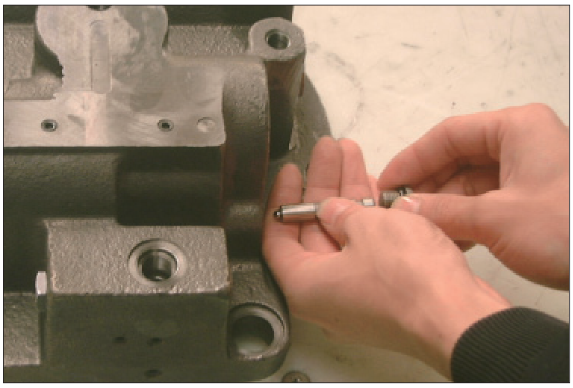
※ It is necessary when needle bearing was disassembled from the valve casing.

370078TM42

④ Assemble seat (541), steel ball (543), stopper (542) and RO plug (569) in the order named.

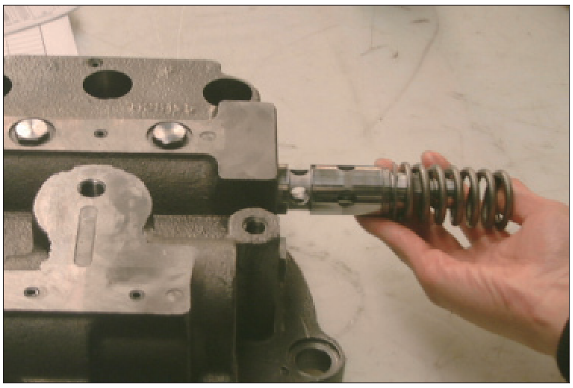
· Tightening torque : 3.7 kgf · m (26.8 lbf · ft)

※ Pay attention to not assembling seat and stopper the other way around.



370078TM43

⑤ Assemble counterbalance spool (360), washer (361), spring (362) in the order named.

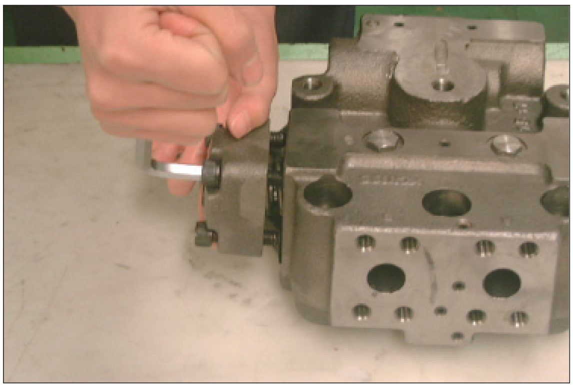


370078TM44

⑥ Fit counterbalance cover (364) by tightening socket bolt (366).

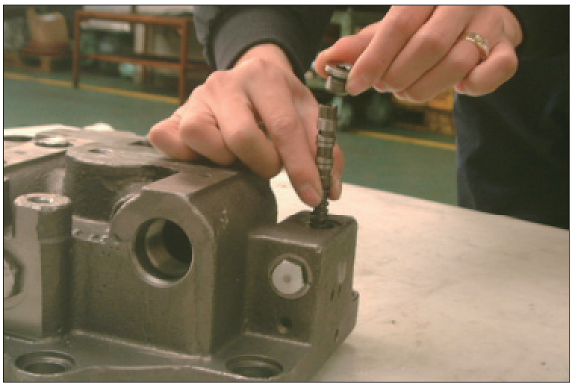
· Tightening torque : 10 kgf · m (72.3 lbf · ft)

※ Confirm that O-ring (365) has been inserted in cover.



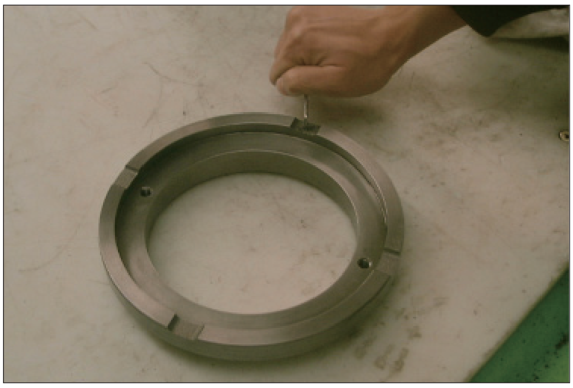
370078TM45

⑦ Assemble tilting spool (531), tilting spring (533) and plug (571) in the order named.
· Tightening torque : 7.5 kgf · m (54.2 lbf · ft)



370078TM46

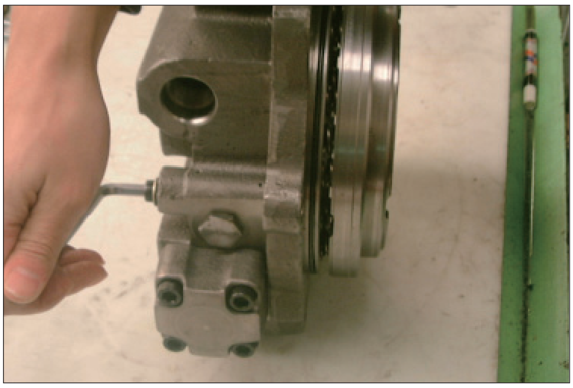
⑧ Assemble orifice (703) and tighten them into brake piston (702) to specified torque.
· Tightening torque : 0.35 kgf · m (2.5 lbf · ft)



370078TM47

⑨ Assemble brake spring (705) in brake piston (702). And then screw two M10×135 bolts on the holes for compelling brake release.
Sub-assembly (valve casing & brake piston)

※ After finishing assembly, two M10×135 bolts will be removed.



370078TM48

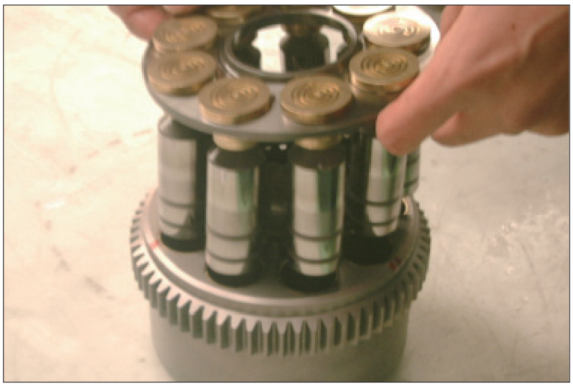
(3) Assembling of cylinder sub-assembly

① Fit cylinder spring (114) and spherical bush (113) to cylinder block (111).

※ Match spline phase of cylinder block (111) to that of spherical bush.

370078TM49

② Put piston (121), shoe (122) sub-assembly in set plate (123) and then assemble them to cylinder block (111).



370078TM50

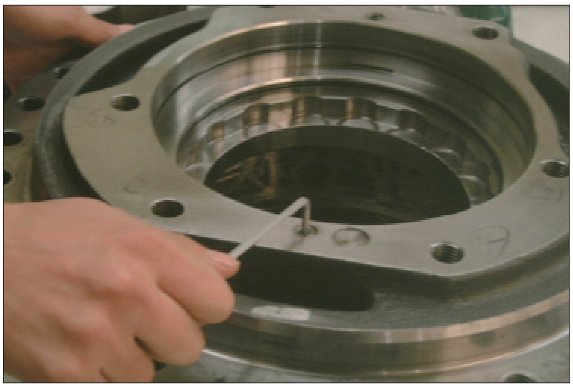
(4) Assembling of motor main body

① Tighten plug (461) and orifice (545, 546) into shaft casing (272) to specified torque.

· Plug (461) : 0.9 kgf · m (6.5 lbf · ft)

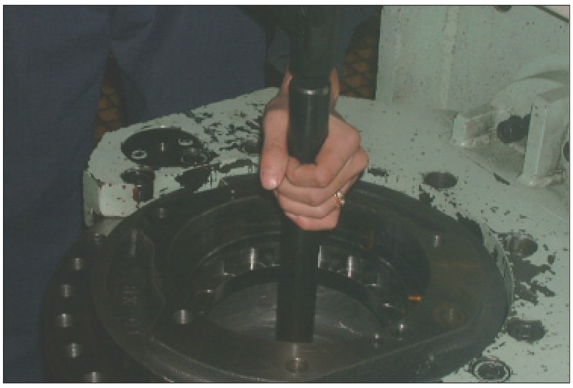
· Plug (545, 546) : 0.7 kgf · m (5.1 lbf · ft)

370078TM51



370078TM51A

② Interference-fit oil seal (491) into shaft casing (272) by special tool.

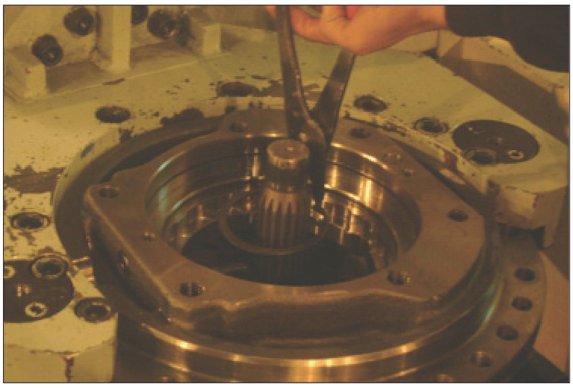


370078TM52

③ Interference-fit the shaft sub-assembly. And then assemble snap ring (435).

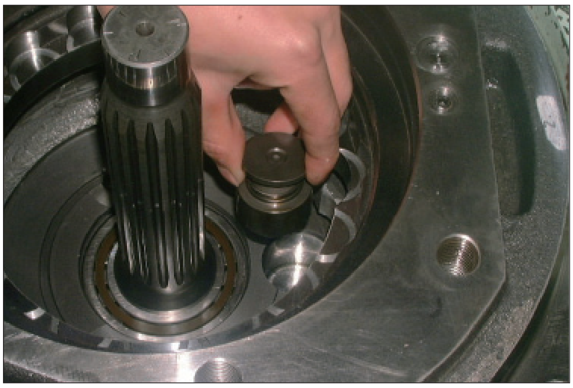
※ Interference-fit outer race of cylindrical roller bearing (102) by hitting lightly with hammer, utilizing key.

370078TM53

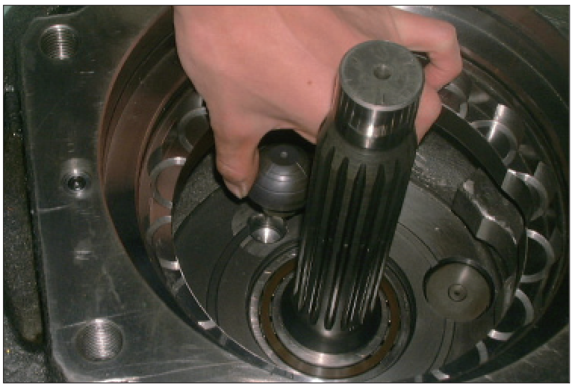


370078TM54A

④ Assemble tilting piston sub-assembly and pivot ball (504) into shaft casing (272).



370078TM54



370078TM54A

⑤ Assemble swash plate (201) onto pivot ball (504).

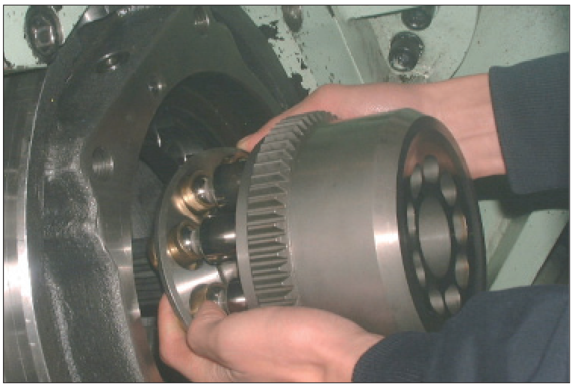
※ Apply grease on sliding area of swash plate rear surface.

※ Confirm with finger tips of both hands if swash plate moves smoothly.

370078TM55

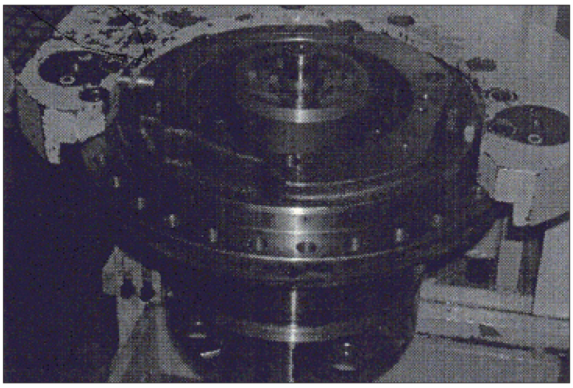
⑥ Change position of shaft casing (272) from vertical one to horizontal one.
And then mount cylinder block sub-assembly.

※ Pay attention to not dropping swash plate.



370078TM56

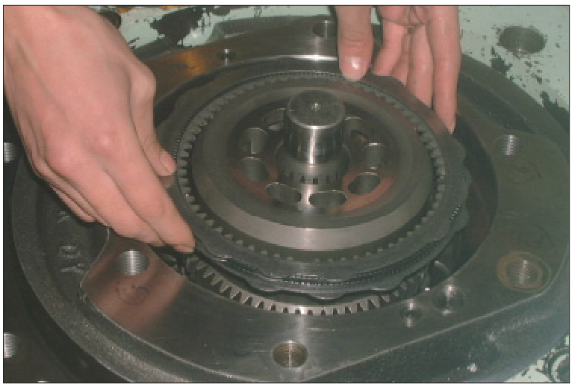
⑦ Change position of shaft casing (272) from horizontal one to vertical one.



370078TM57

⑧ Fit separation plate (741) and friction plate (742) into cylinder block (111).

※ Mate hole of separation plate each other.

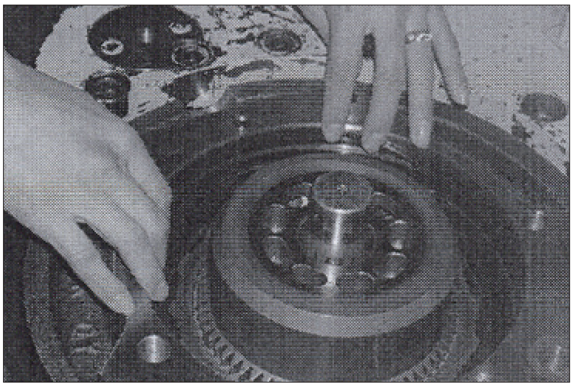


370078TM27

⑨ Assemble O-ring (707, 708) into shaft casing (272).

※ Do not reuse the disassembling O-ring (707, 708).

※ Coat the O-ring with grease.
(O-ring can be protected by grease)



370078TM59

⑩ Fit valve plate (131) to valve casing (303) sub-assembly. Assemble them to casing, and then tighten them with socket bolt (401, 402).

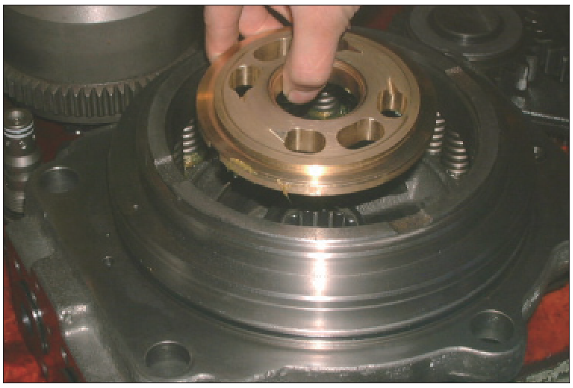
· Socket bolt (401, 402) Tightening torque : 44 kgf · m (318 lbf · ft)

※ Apply grease on valve plate rear surface and pay attention to not dropping valve plate.

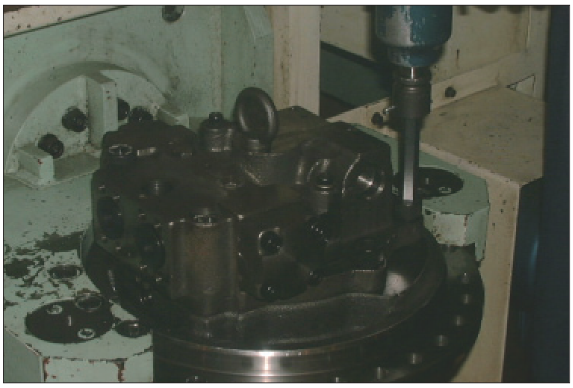
※ Use guide bolt.

※ Apply grease on roller of needle bearing and pay attention to easy to assemble with driving shaft.

※ Use crane in assembling valve casing to shaft casing.



370078TM60

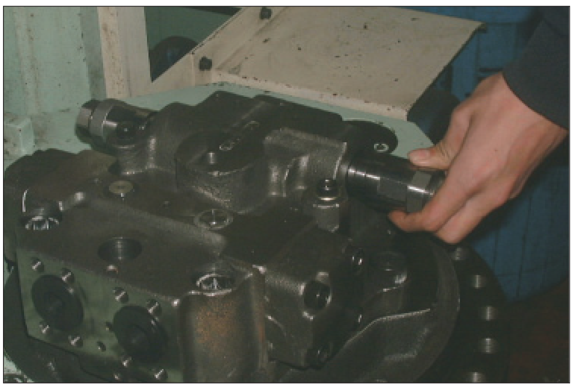


370078TM60A

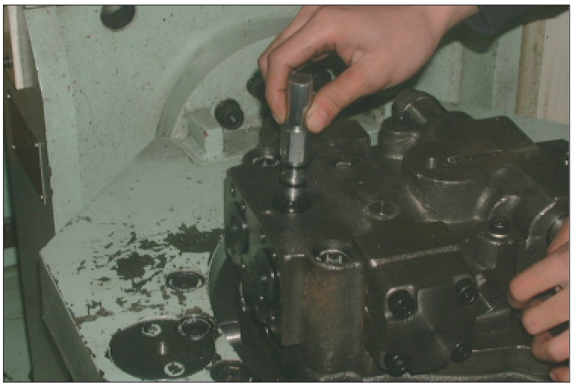
⑪ Tighten to specified torque plugs, relief valve (350), reducing valve (351), etc. fitted to valve casing sub-assembly.

· Tightening torque :

- Relief valve (350) : 18 kgf · m (130 lbf · ft)
- Reducing valve (351) : 4.5 kgf · m (32.5 lbf · ft)

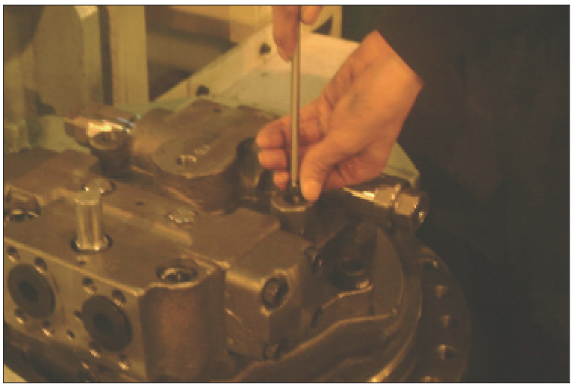


370078TM61



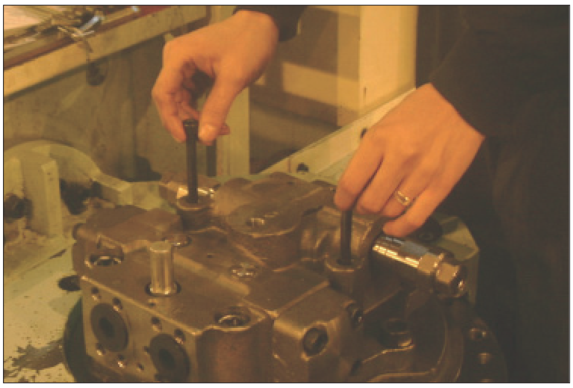
370078TM61A

⑫ Mount cover (352).



370078TM63

⑬ Disassemble two M10×135 bolts on the holes for compelling brake release.
And then assemble plug (564).
· Tightening torque : 2.2 kgf · m (15.9 lbf · ft)



370078TM24

3) ASSEMBLY OF REDUCTION GEAR

(1) Place housing (2) with its front side up, and fit angular bearings (33) with their back faces mated.

※ Fit angular bearings one by one with press or key hammer.

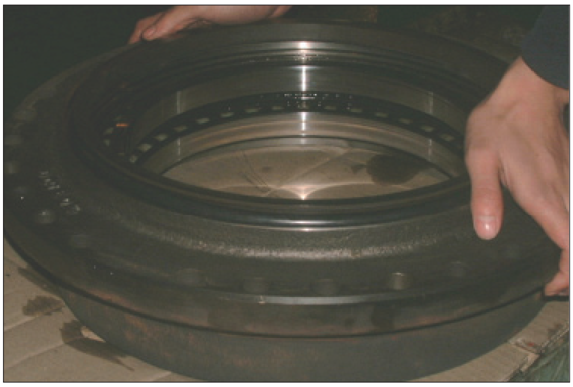
※ When housing is to be reused, remove screw lock of its tapped holes with M16 tap.

370078TM64

(2) Fit O-ring to floating seal (34) without twisting it, and then to housing (2).

※ Apply grease to O-ring thinly.

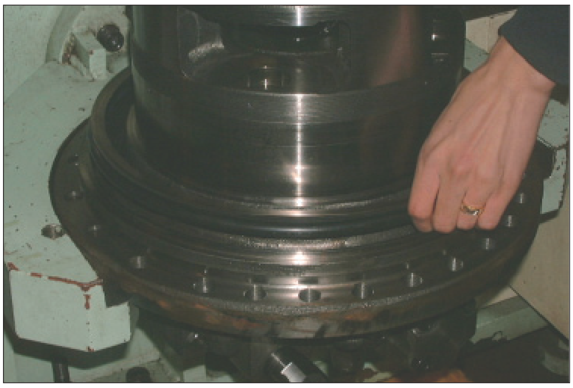
※ Do not reuse the disassembling O-ring.



370078TM65

(3) Similarly, fit floating seal to shaft casing (272) of hydraulic motor.

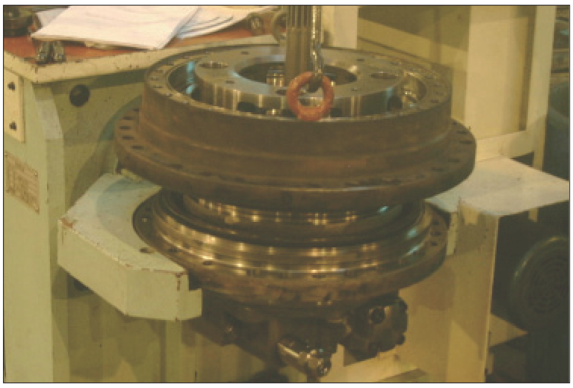
※ Do not reuse the disassembling O-ring.



370078TM66

(4) Lift up housing sub-assembly with its floating seal side down, and put inner diameter of angular bearing on outer diameter of shaft casing.

※ Pay attention to not damaging sliding faces of floating seal.



370078TM67

(5) Assemble shim (35) to nut ring (47).

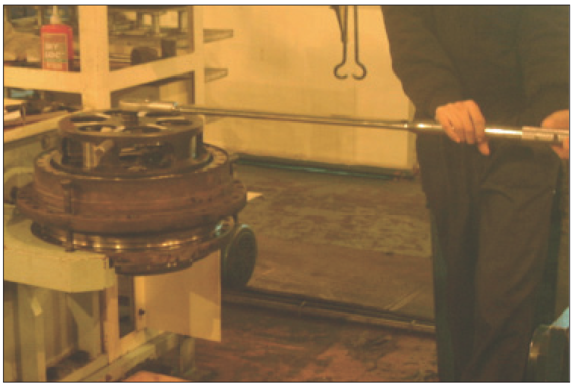
※ Apply grease between shim and nut ring.

370078TM68

(6) Insert nut ring assembled shim to shaft casing, and then tighten it to specified torque, utilizing special tool.

※ After tighten it to maximum torque and then disassemble, and then tighten it to specified torque.

· Tightening torque : 60 kgf · m (434 lbf · ft)



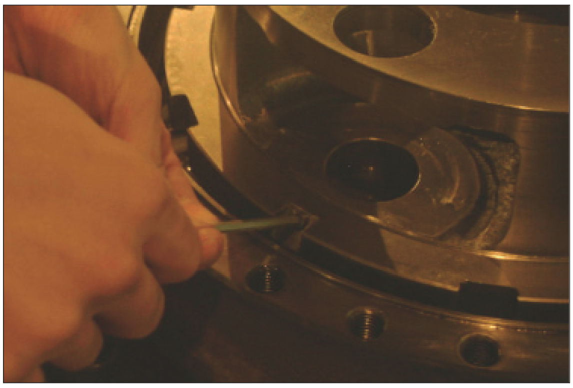
370078TM70

(7) After assemble set screw (54) affixed LOCTITE, and punch at hole to lock it. Pay attention to not be lifted nut ring (47).

※ Screw the set screw, until upper side of set screw is lower than tilting side of nut ring.

· Loctite specifications : Three bond 1373B

· Tightening torque : 1 kgf · m (7.2 lbf · ft)



370078TM71

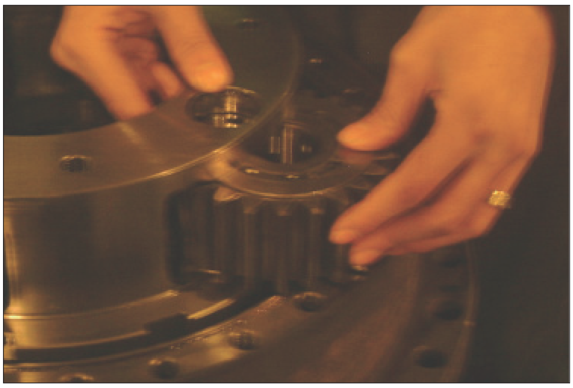
(8) Assemble thrust ring (27) into shaft casing (272).

※ Pay attention to not assembling thrust ring (27) the other way around.
(Oil groove is located upside.)

370078TM72

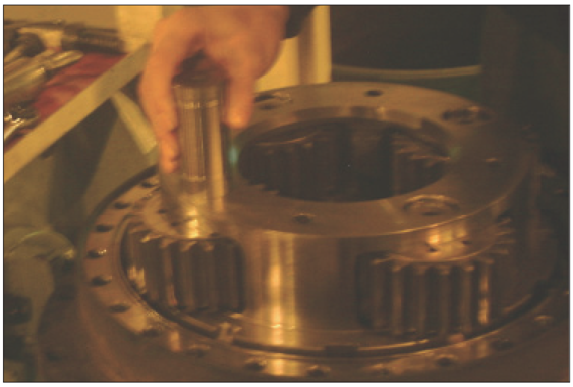
(9) Put needle cage (23) into inside of planetary gears 3 (14), and insert them into shaft casing, holding them between side plates (20).

※ Mate pin hole of shaft casing with center of planetary gear.



370078TM73

(10) Insert pin 3 (17) into shaft casing, and then assemble snap ring (37).



370078TM74

370078TM74A

(11) Assemble O-ring (82) to housing (2), and then assemble ring gear (1).
Pay attention to its meshing planetary gear 3 (14) and ring gear (1), utilizing crane.

※ Applying grease to O-ring thinly.
※ Do not reuse the disassembling O-ring.

370078TM75

(12) Assemble ring gear (1) and housing (29).
(Screw socket bolt (29), and tighten it to specified torque, with torque wrench.)
· Tightening torque : 30 kgf · m (217 lbf · ft)
· Loctite specifications : #636

370078TM76

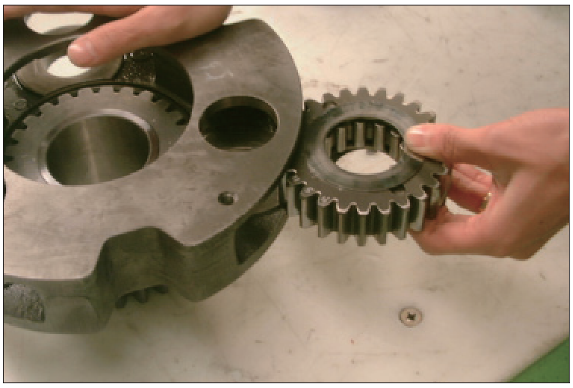
(13) Assembling carrier 2 sub-assembly

① Assemble carrier 2 (6) to sun gear 3 (11), and fit clip (46).

② Place carrier 2 with sun gear 3 up.

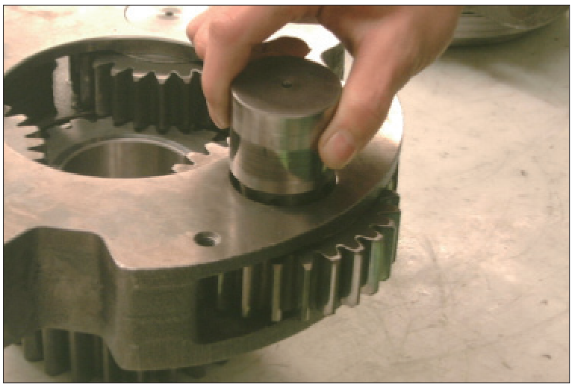
370078TM77

③ Put needle cage (22) into inside of planetary gear 2 (13), and insert them into carrier 2, holding them between side plates (19).



370078TM78

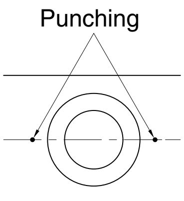
④ Insert pins 2 (16) into carrier 2.

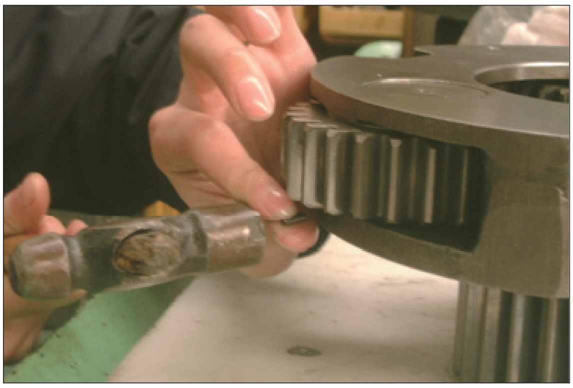


370078TM78A

⑤ Insert spring pin (36) into pin holes of carrier 2 and pin 2, and punch at two points as figure to lock it.

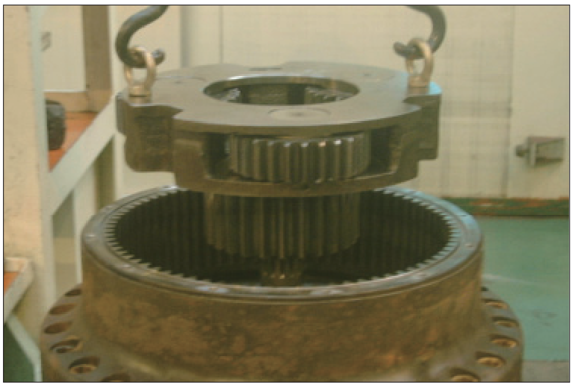
※ Mate pin hole of carrier 2 with center of planetary gear.





370078TM79

(14) Screw two M10 eyebolts into carrier 2 sub-assembly, and assemble it with crane, paying attention to its meshing with planetary gear 2 and ring gear.

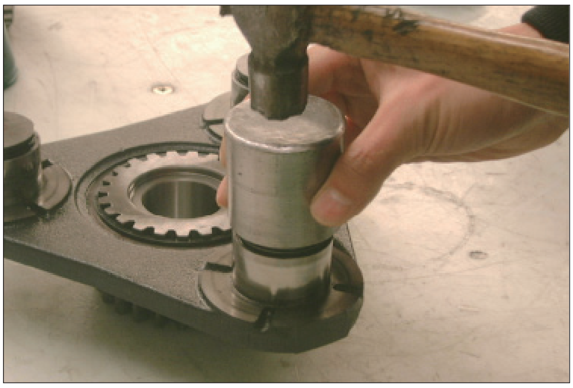


370078TM80

(15) Assembling of carrier 1 sub-assembly

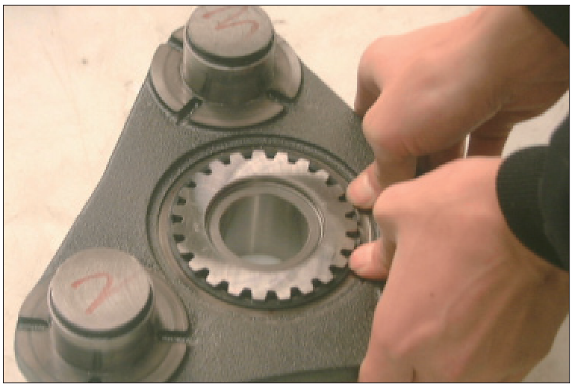
① Interference-fit inner ring (24) to carrier 1 (5).

※ Inner ring is press-fit by the heat to carrier 1 (5).



370078TM81

② Assemble carrier 1 (5) to sun gear 2 (10), and fit clip (45).



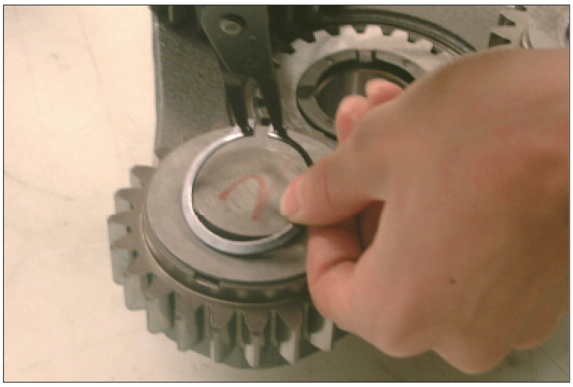
370078TM82

③ Assemble thrust ring (26) to sun gear 2 (10).

※ Pay attention to not assembling thrust ring (26) the other way around. (Oil groove is located upside.)

370078TM83

④ Put needle cage (21) into inside of planetary gear 1 (12), and assemble them, holding them between side plates (18). Then fit snap ring (44) on them.

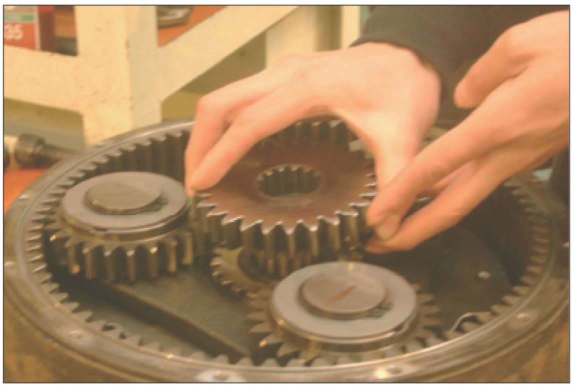


370078TM84

(16) Assemble carrier 1 (5) sub-assembly to ring gear (1).
Paying attention to its meshing with carrier 1 sub-assembly and ring gear (1).

370078TM85

(17) Assemble sun gear 1 (9) to drive shaft (101) paying attention to its meshing with sungear and drive shaft (101).

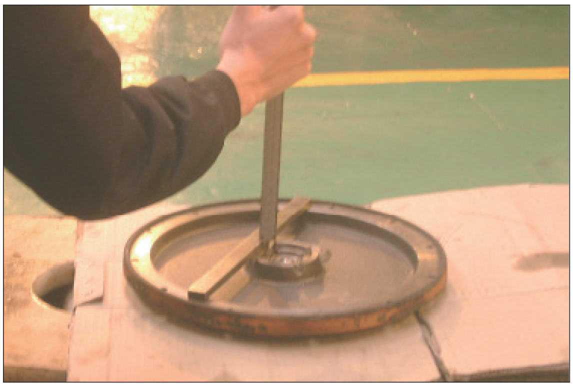


370078TM86

(18) Measure height "A" from sun gear 1 end face to ring gear (1) mating face with straight edge and depth gage.

370078TM87

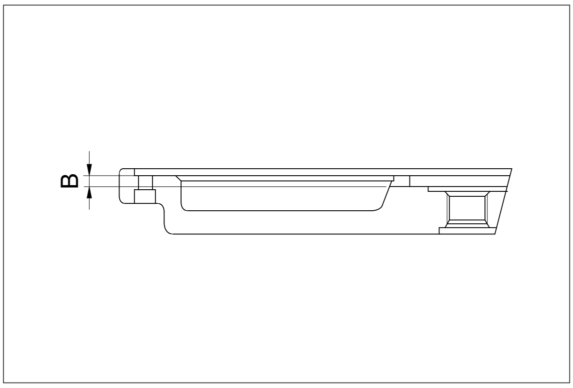
(19) Measure height "B" from side cover (4) mating face to center hold bottom with straight edge and depth gage.



370078TM88

(20) Obtain optimum thickness with the following formula.
1.5~2.0 = (B+A)
- (Thickness of thrust ring + thickness of washer)

※ Keep axial clearance between sun gear and washer 1.5~2.0 mm.



370078TM89

(21) Place washer (53) of above-selected thickness and thrust ring (26) to center of side cover (4).

※ Pay attention to not assembling thrust ring (26) the other way around and punch it (Oil groove is located upside)

370078TM90

(22) Assemble O-ring (81) into ring gear. And degrease and dry mating faces of side cover & ring gear. Then lift side cover(4) up, and place it on ring gear. And tighten socket bolt (30) to specified torque to fix side cover.
· Tightening torque : 3.5 kgf · m (25.3 lbf · ft)

370078TM91

(23) Tighten plug (32) to specified torque at side cover (4).
 · Tightening torque : 11.0 kgf · m (79.6 lbf · ft)

That is all of the assembling work. After fitting the motor this reduction gear, supply oil until overflows from the level gauge.


370078TM92

4) CHECKING FACTS AFTER ASSEMBLY

(1) Air test of reduction gear
Disassemble plug (32) of reduction gear part.
When compressed air(0.3 kgf/cm^2) is inserted that in water during the 2 minutes, it should be not happened air bubble.
 · Gear oil : 5.5 ℓ / 1.5 U.S. gal (SAE 85W-140, API GL-5 or better)

(2) Air test of hydraulic motor
One port should be opened, the others port should be closed.
When compressed air (3 kgf/cm^2) is inserted opened port in water during the 2 minutes, it should be not happened air bubble.
 · Working fluid : 1.5 liter (0.33 U.S. gal)

GROUP 7 RCV LEVER

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.**

13031GE18

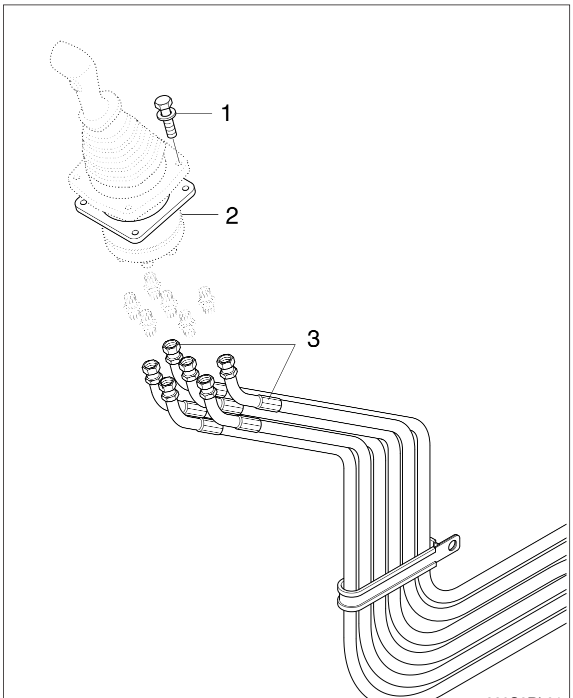
(4) Loosen the socket bolt (1).
Tightening torque : 1.05 ± 0.2 kgf · m
(7.6 ± 1.45 lbf · ft)

(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.



220S8RL01

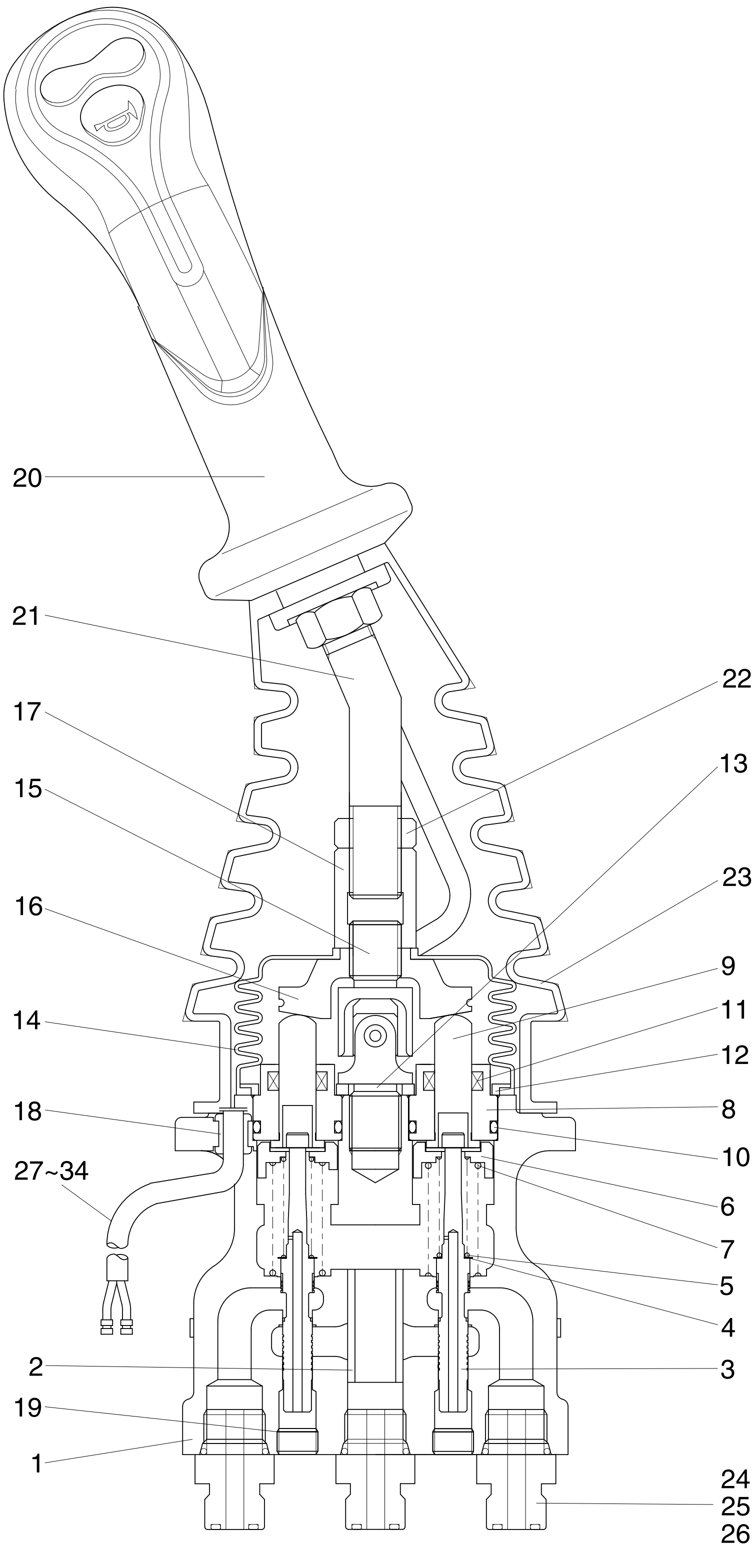
2) INSTALL

(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

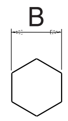


210S2RL06

1	Case
2	Bushing
3	Spool
4	Shim
5	Spring
6	Spring seat
7	Spring
8	Plug
9	Push rod
10	O-ring
11	Rod seal
12	Spacer
13	Spacer
14	Boot
15	Joint assembly
16	Swash plate
17	Adjusting nut
18	Bushing
19	Plug
20	Handle assembly
21	Handle bar
22	Nut
23	Boot
24	Last guard filter
25	Connector
26	Connector
27	Connector
28	Connector pin
27	Connector pin
29	Connector pin
30	Connector pin
32	Connector
34	Connector

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanne	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Joint	15	M14	3.8	27.5
Swash plate	16	M14	7.0±0.40	50.6±2.9
Adjusting nut	17	M14	7.0±0.40	50.6±2.9
Lock nut	22	M14	5.0±0.35	36.2±2.5

3) DISASSEMBLY

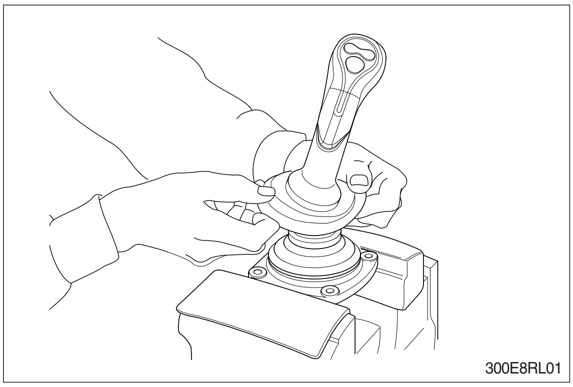
※ Procedures are based on the type M1.

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

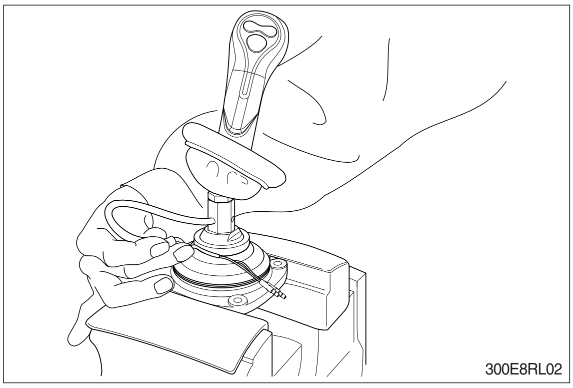
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



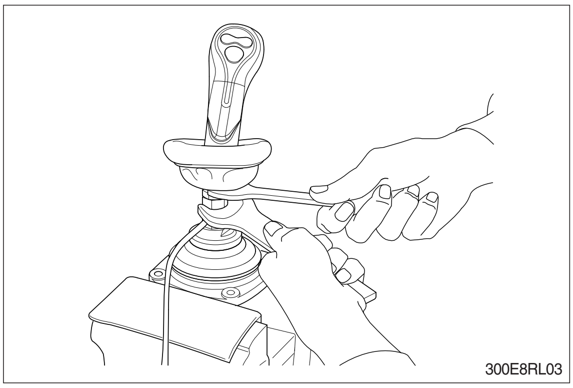
300E8RL01

※ For valve with switch, remove cord also through hole of casing.



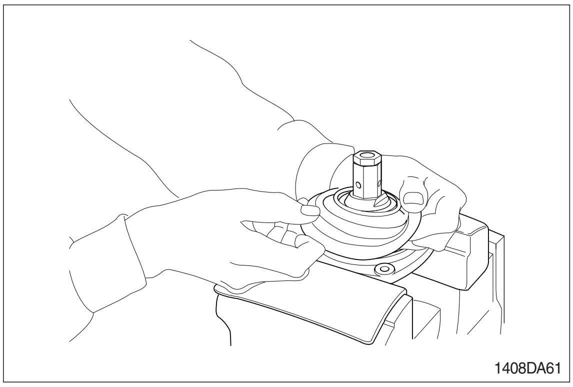
300E8RL02

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



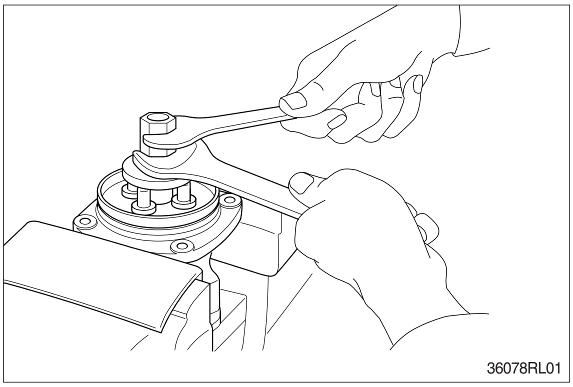
300E8RL03

(5) Remove the boot (14).

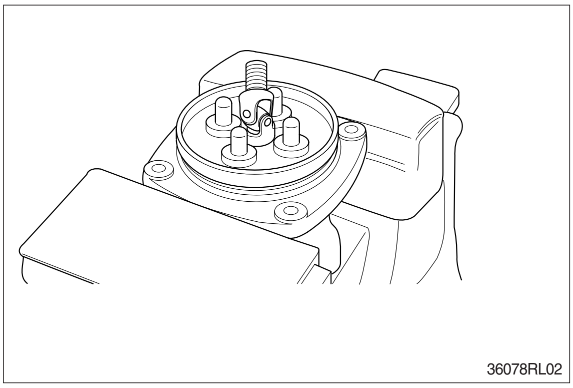


1408DA61

(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.



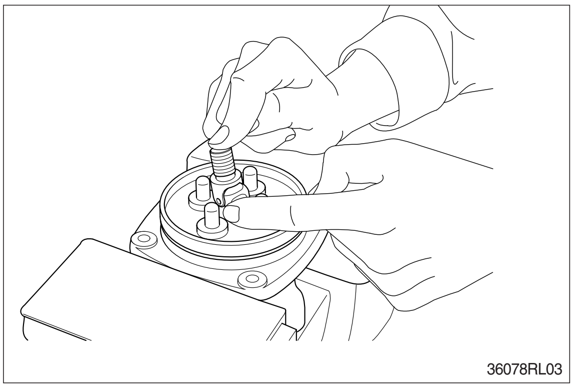
36078RL01



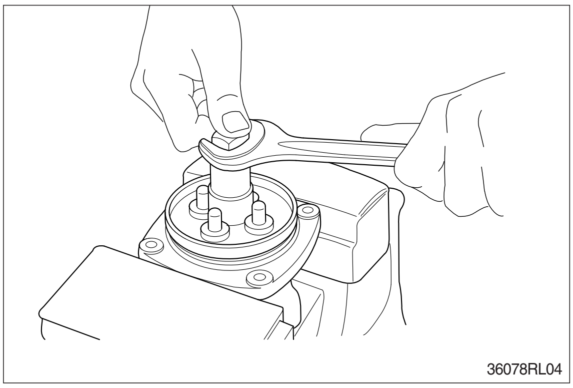
36078RL02

(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
Pay attention to this.

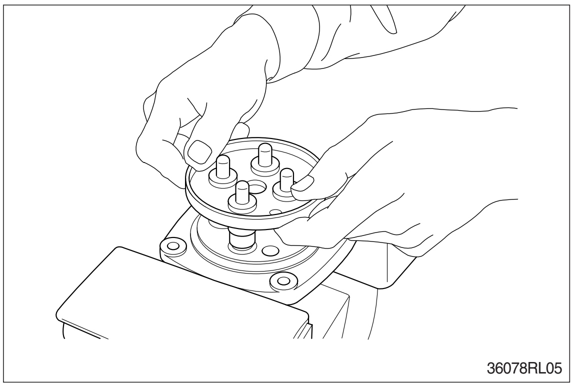


36078RL03



36078RL04

(8) Remove plate (12).

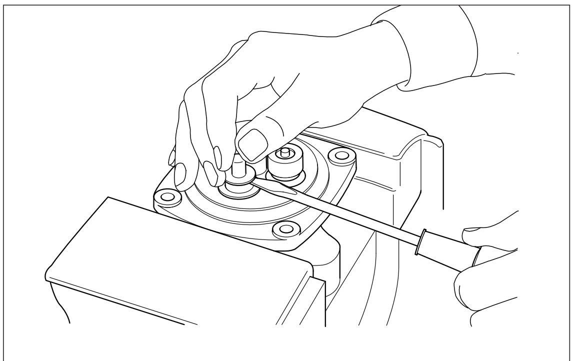


36078RL05

(9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.

※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

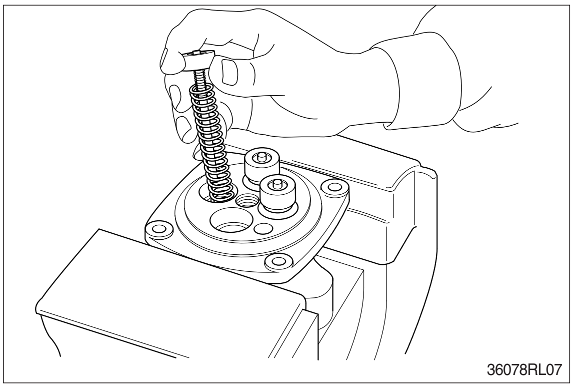
※ During taking out, plug may jump up due to return spring (7) force.
Pay attention to this.



36078RL06

(10) Remove reducing valve subassembly and return spring (7) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



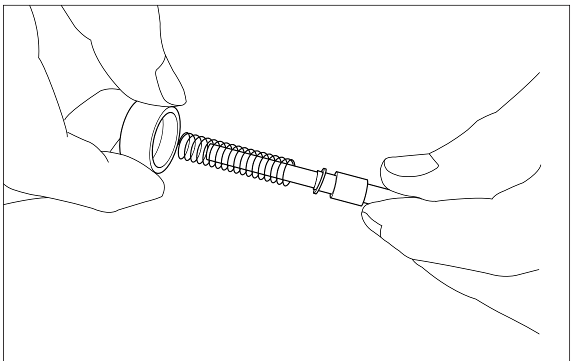
36078RL07

(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.

※ Pay attention not to damage spool surface.

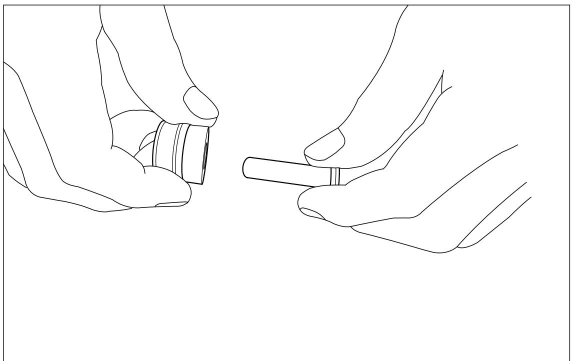
※ Record original position of spring seat (6).

※ Until being assembled, they should be handled as one subassembly group.



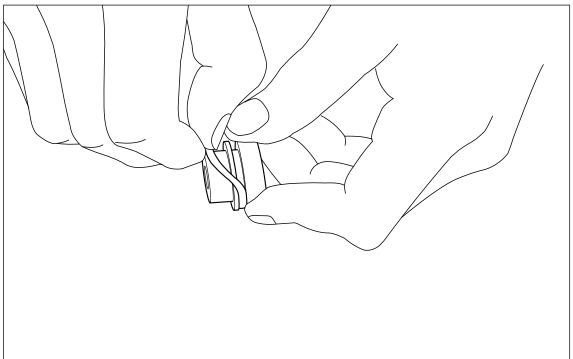
36078RL10

(12) Take push rod (9) out of plug (8).

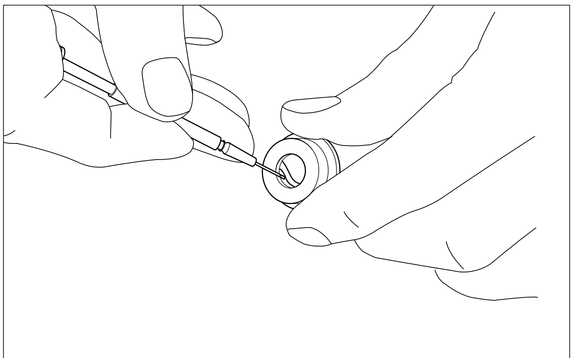


36078RL11

(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.

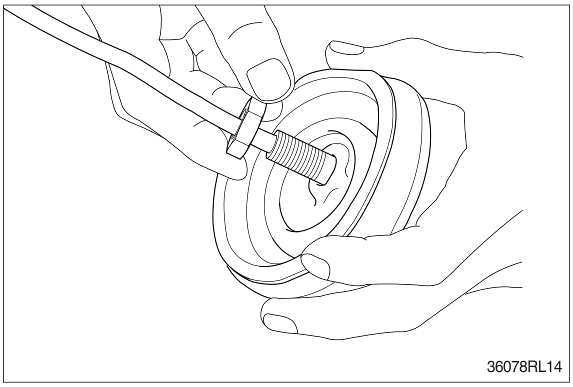


36078RL12

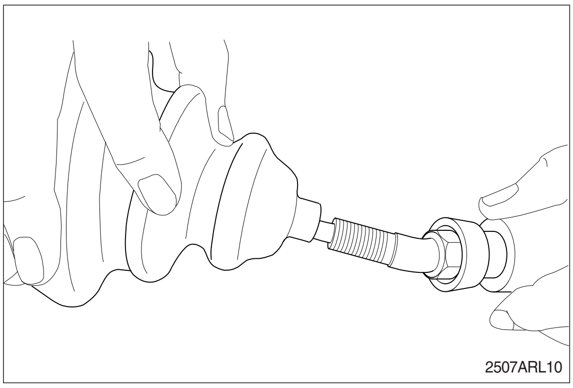


36078RL13

(14) Remove lock nut (22) and then boot (23).



36078RL14



2507ARL10

(15) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

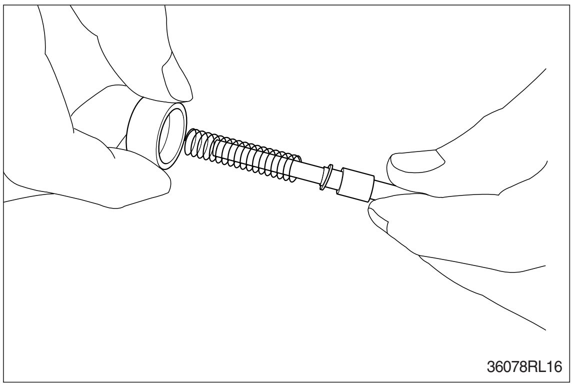
(16) Rust prevention of parts

Apply rust-preventives to all parts.

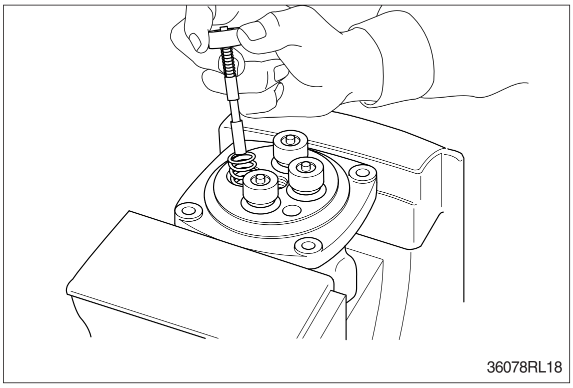
※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

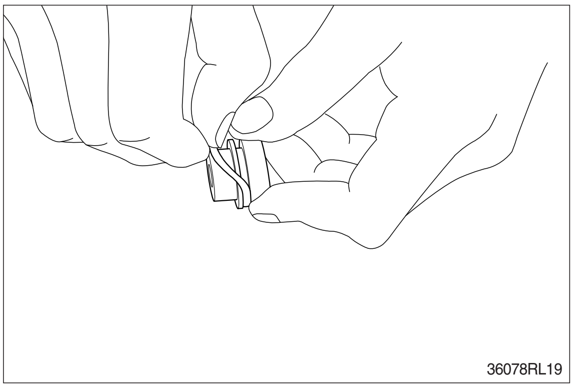
(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



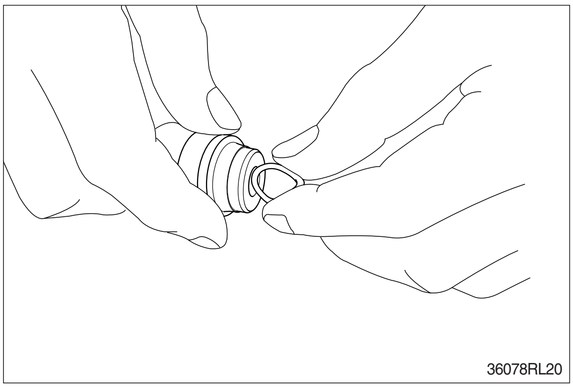
(2) Assemble spring (7) into casing (1). Assemble reducing valve subassembly into casing.
※ Assemble them to their original positions.



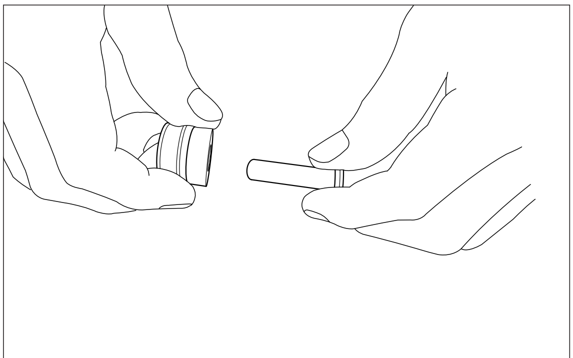
(3) Assemble O-ring (10) onto plug (8).



(4) Assemble seal (11) to plug (8).
※ Assemble seal in such lip direction as shown below.

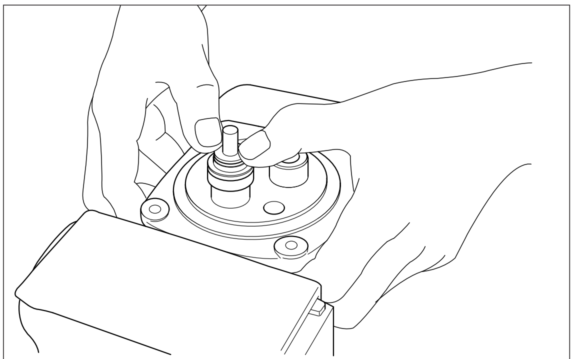


(5) Assemble push rod (9) to plug (8).
※ Apply working oil on push-rod surface.



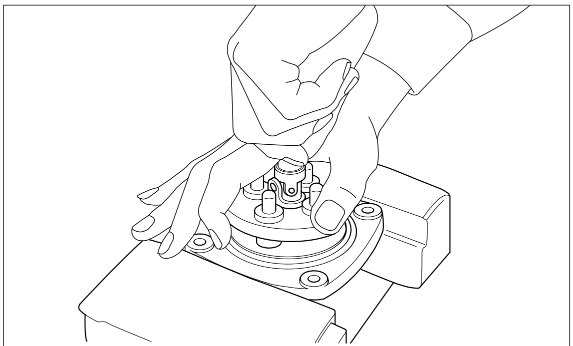
36078RL21

(6) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.



36078RL22

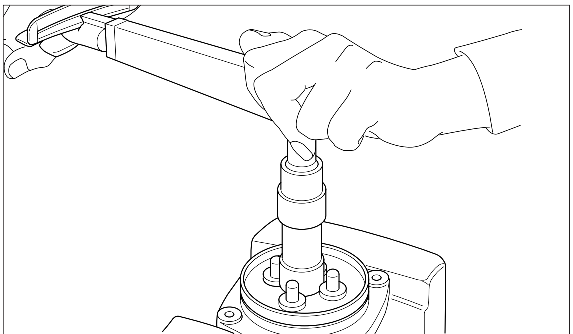
(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.



36078RL23

(8) Fit plate (12).

(9) Tighten joint (15) with the specified torque to casing, utilizing jig.

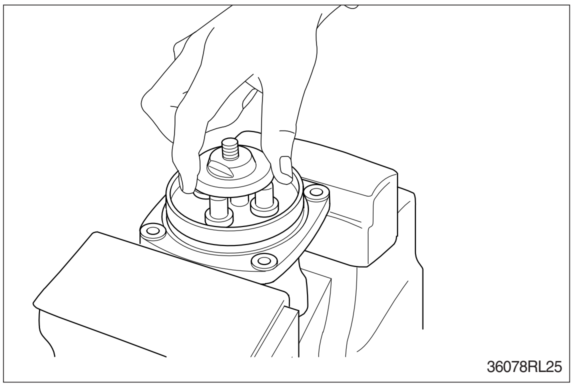


36078RL24

(10) Assemble swash plate (16) to joint (15).

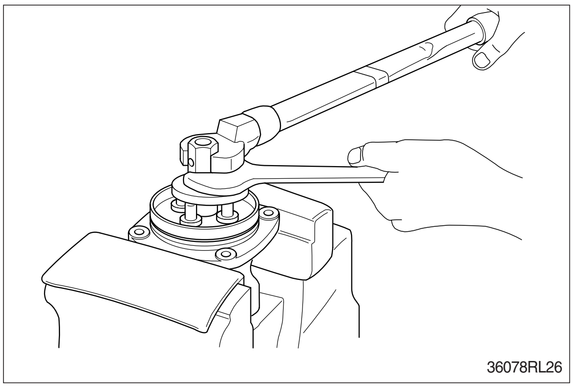
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

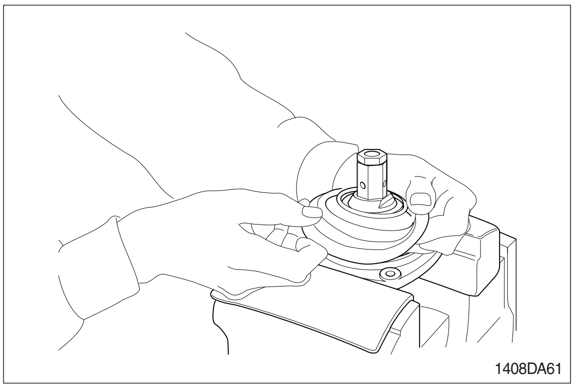


(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.

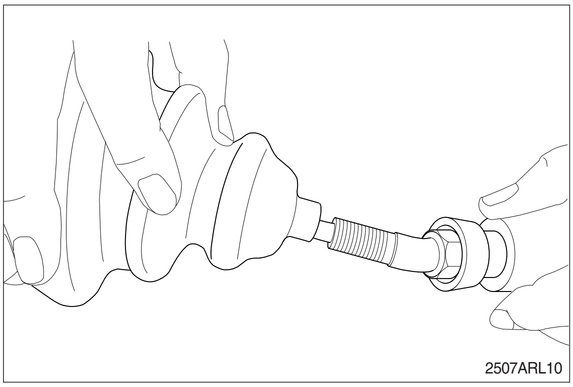
※ During tightening, do not change position of disk.

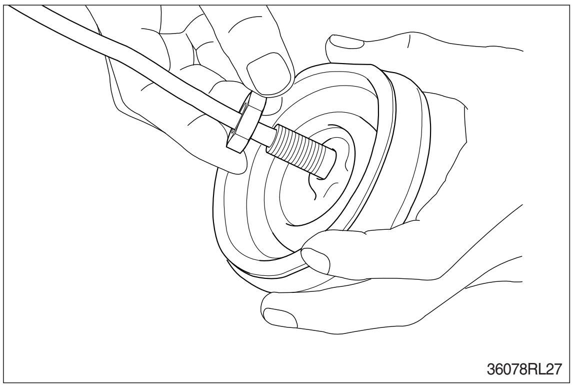


(12) Fit boot (14) to plate.

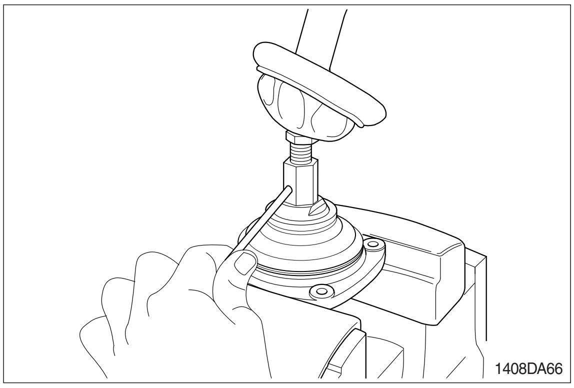


(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.



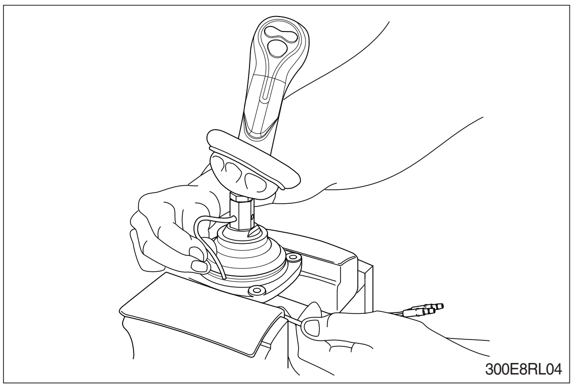


(14) Pull out cord and tube through adjusting nut hole provided in direction 60 °to 120 °from casing hole.

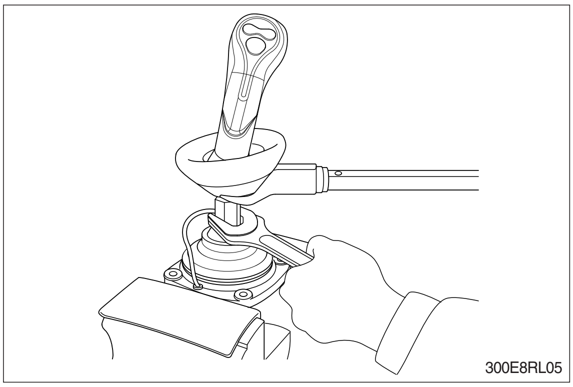


(15) Assemble bushing (18) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.

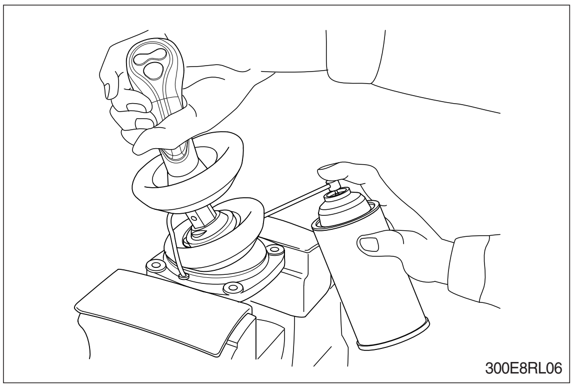


(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



300E8RL05

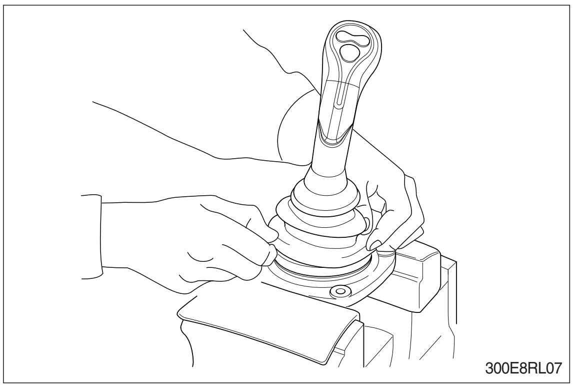
(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



300E8RL06

(18) Assemble lower end of bellows to casing.

(19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



300E8RL07

GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

13031GE18

(1) Lower the work equipment to the ground and stop the engine.

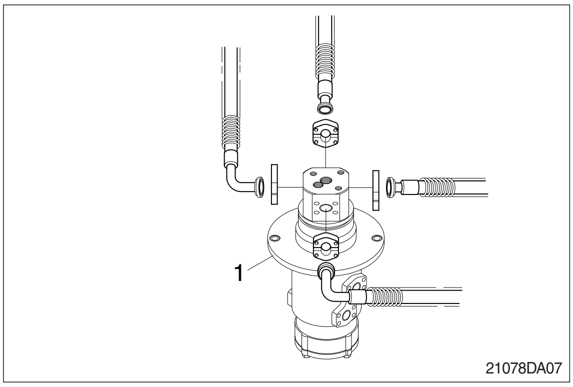
(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect all hoses.

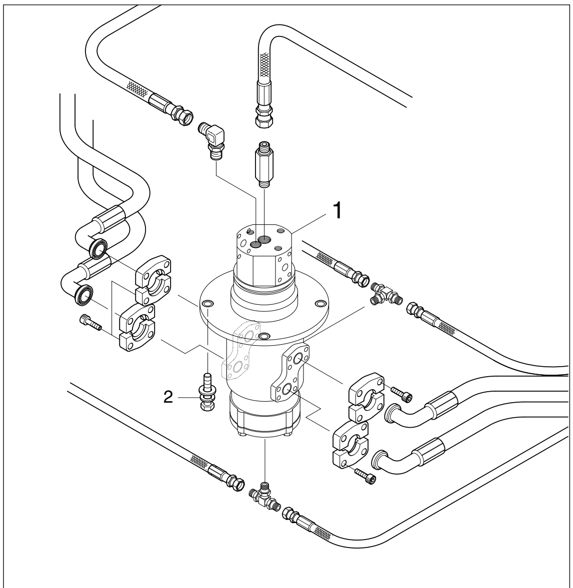


21078DA07

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).
Weight : 37 kg (82 lb)
Tightening torque : 12.8±3.0 kgf · m
(92.6±21.7 lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.



400SA8DA08

2) INSTALL

(1) Carry out installation in the reverse order to removal.

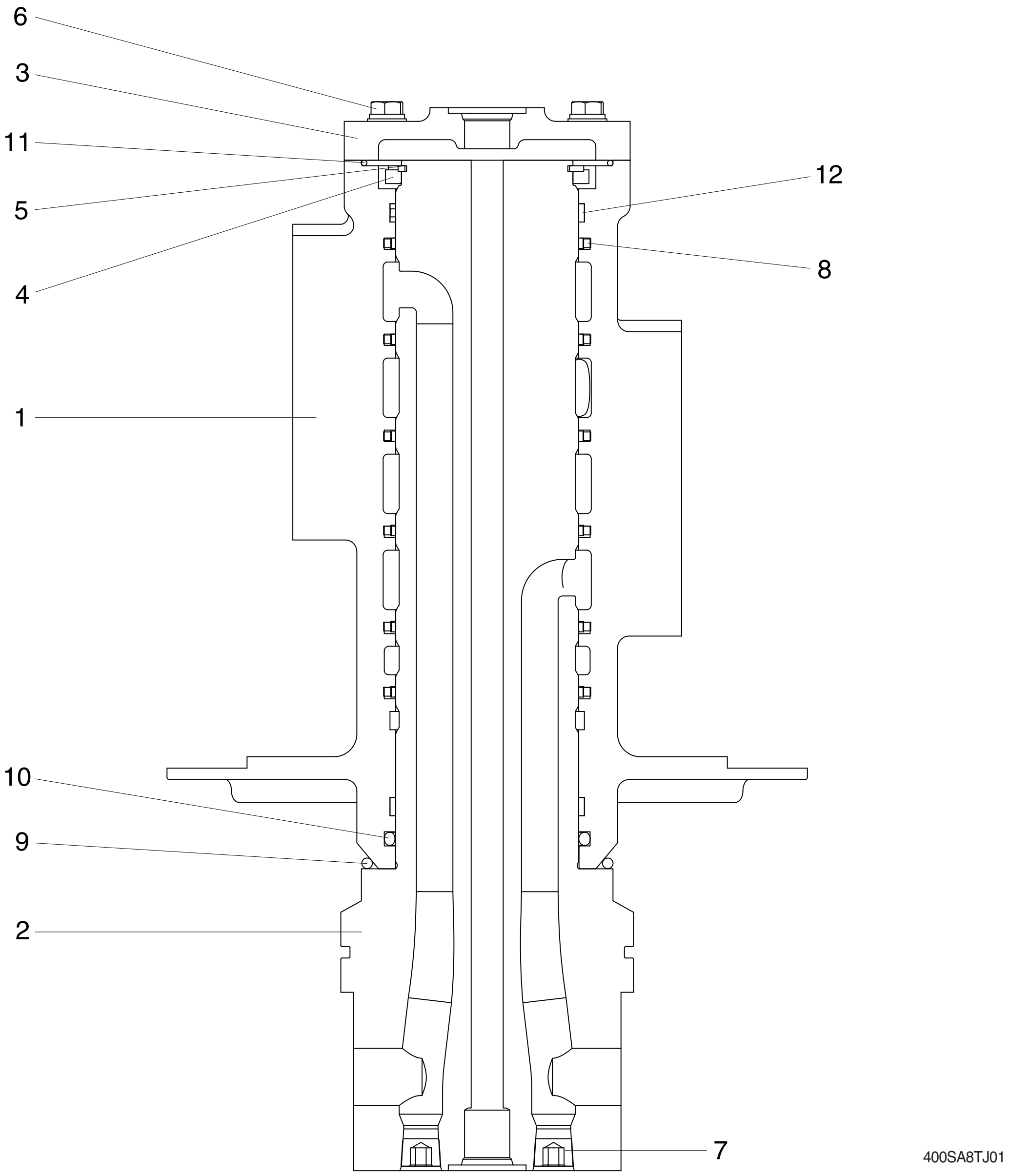
※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

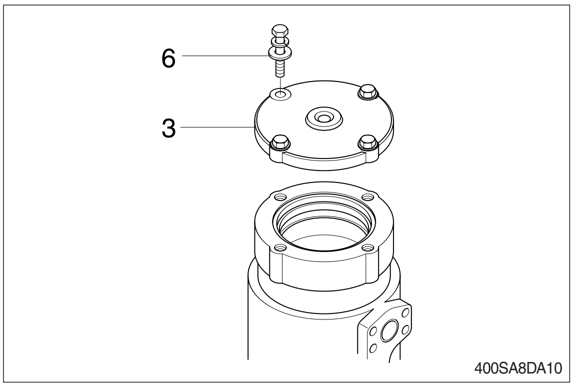


1	Hub	5	Retainer ring	9	O-ring
2	Shaft	6	Bolt with washer	10	O-ring
3	Cover	7	Socket plug	11	O-ring
4	Ring	8	Slipper seal	12	Wear ring

2) DISASSEMBLY

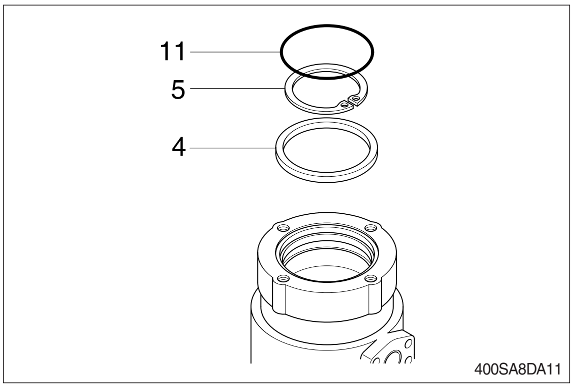
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (6) and cover (3).



(2) Remove O-ring (11).

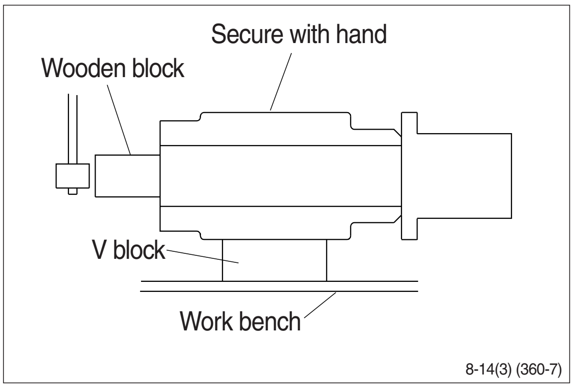
(3) Remove retainer ring (5) and ring (4).



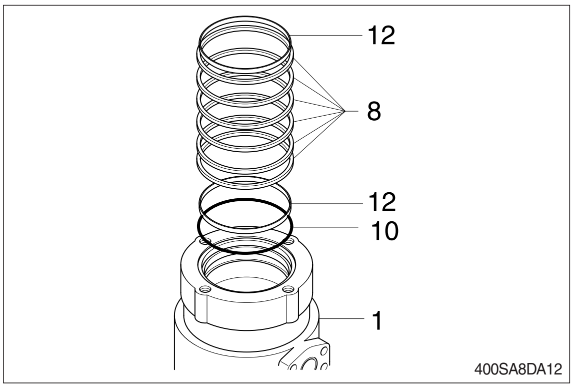
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ 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 six slipper seals (8) and O-ring (10), two wear ring (12) from hub (1).



3) ASSEMBLY

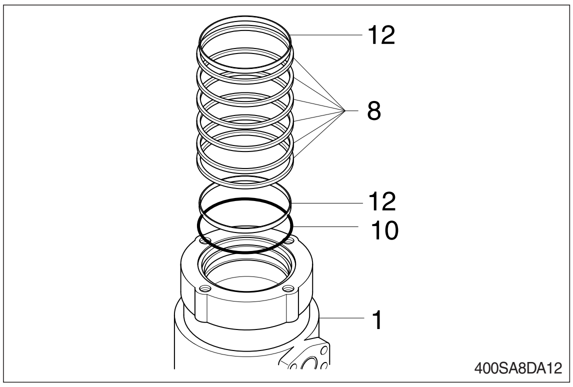
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

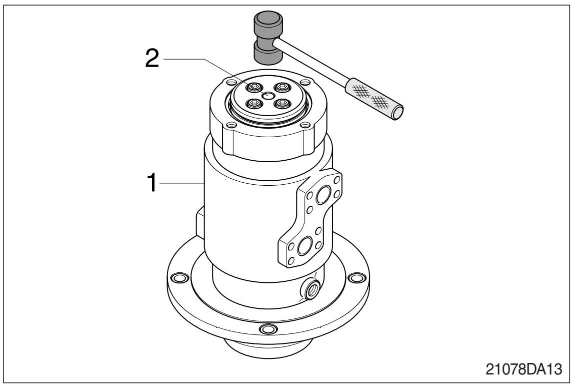
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal (8) and O-ring (10), two wear ring (12) to hub (1).

(2) Fit O-ring (9) to shaft (2).

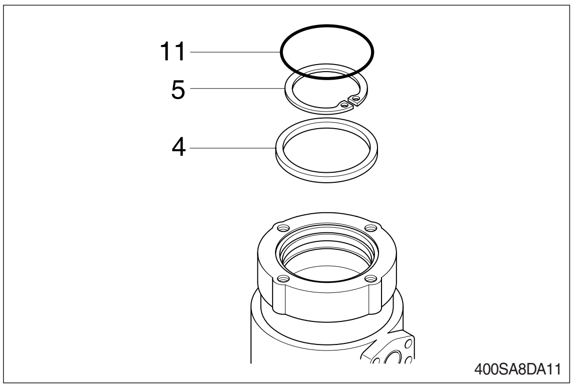


(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

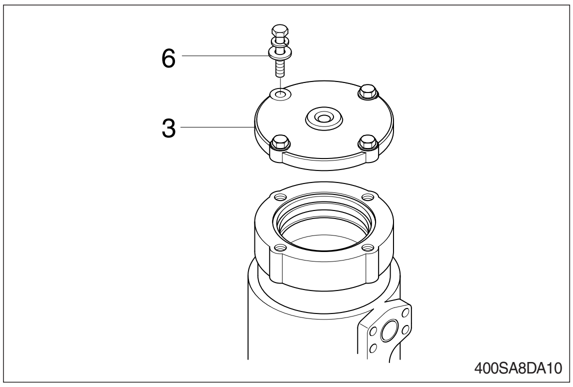


(4) Fit ring (4) and retainer ring (5) to shaft (2).

(5) Fit O-ring (11) to hub (1).



(7) Install cover (3) to body (1) and tighten bolts (6).
Torque : 2.5 ± 0.3 kgf · m
(18.1 ± 2.2 lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

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.

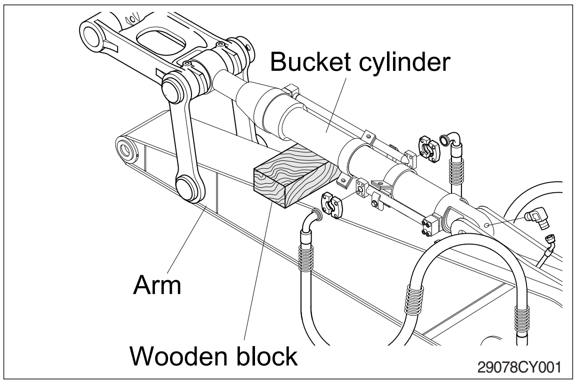
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ 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 Set block between bucket cylinder and arm.

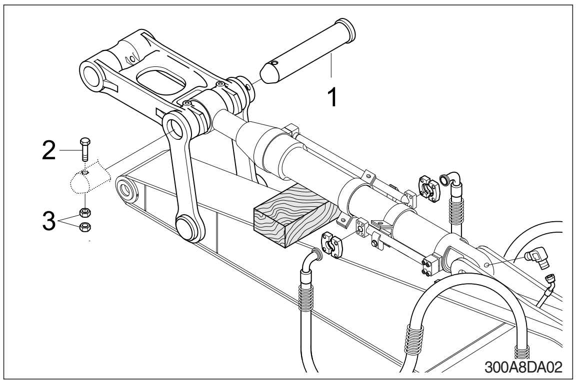


29078CY001

② Remove bolt (2), nut (3) and pull out pin (1).

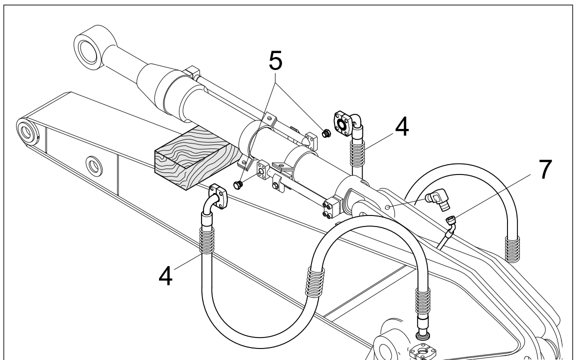
※ Tie the rod with wire to prevent it from coming out.

· Tightening torque : 57.9 ± 8.7 kgf·m (419 ± 62.9 lbf·ft)



300A8DA02

③ Disconnect bucket cylinder hoses (4), grease line hose (7) and put plugs (5) on cylinder pipe.



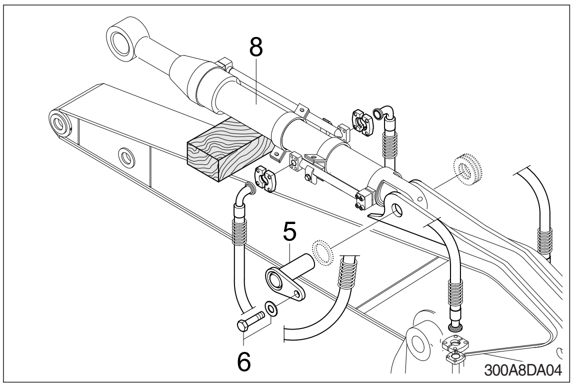
300A8DA03

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 309 ㎏ (681 ℔)

· Tightening torque : 57.9 ± 8.7 kgf·m
(419 ± 62.9 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 bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

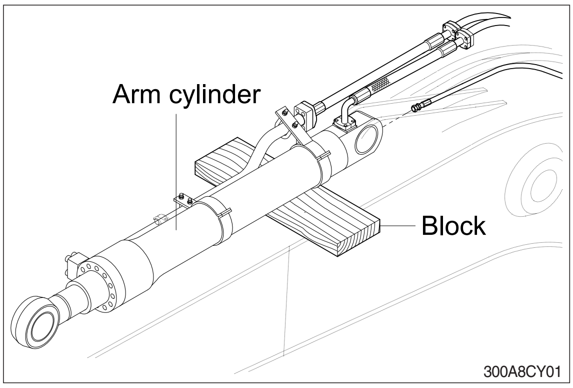
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **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.

① Set block between arm cylinder and boom.


13031GE18



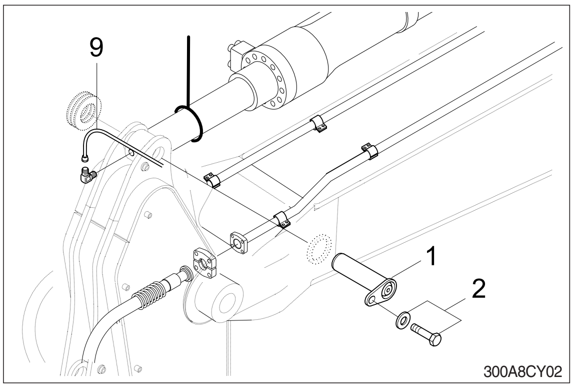
300A8CY01

② Disconnect grease line hose (9).

③ Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.

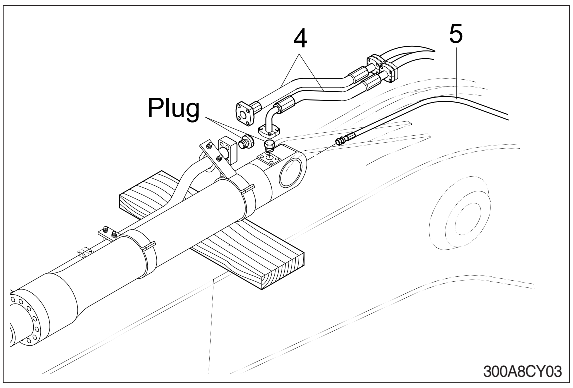
· Tightening torque : 57.9 ± 8.7 kgf·m (419 ± 62.9 lbf·ft)



300A8CY02

④ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

⑤ Disconnect greasing pipings (5).



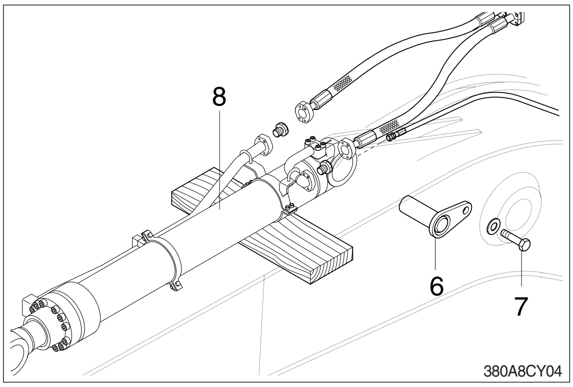
300A8CY03

⑥ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).

⑦ Remove arm cylinder assembly (8).

· Weight : 447 ㎏ (985 ㏈)

· Tightening torque : 57.9 ± 8.7 kgf·m (419 ± 62.9 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.

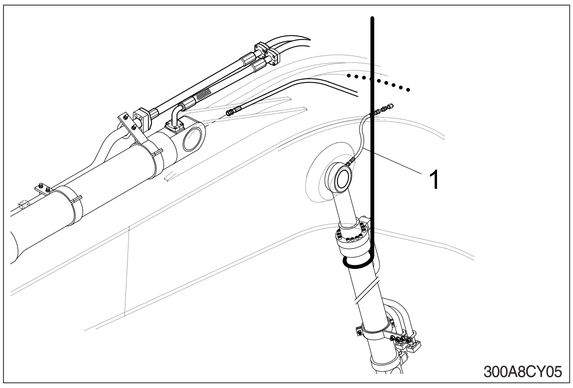
⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

※ 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.

① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

13031GE18

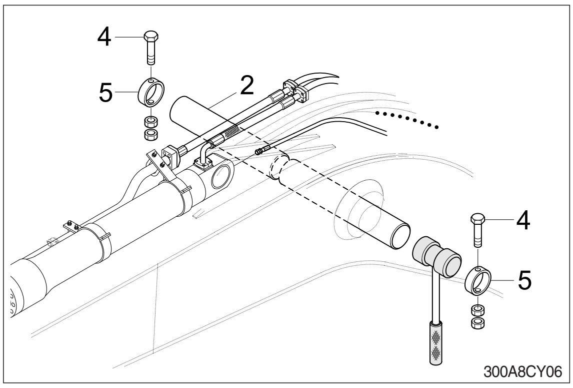


300A8CY05

③ Remove bolt (4), pin stopper (5) and pull out pin (2).

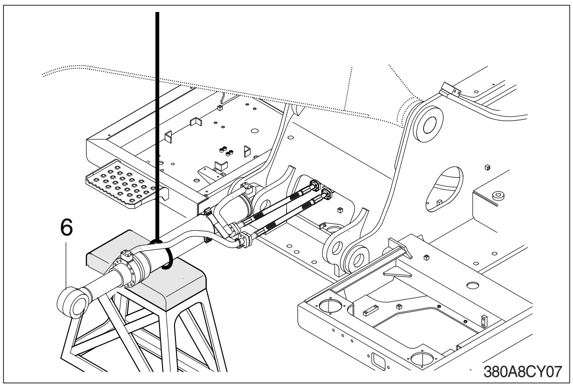
※ Tie the rod with wire to prevent it from coming out.

· Tightening torque : 100 ± 15 kgf·m (723 ± 108 lbf·ft)



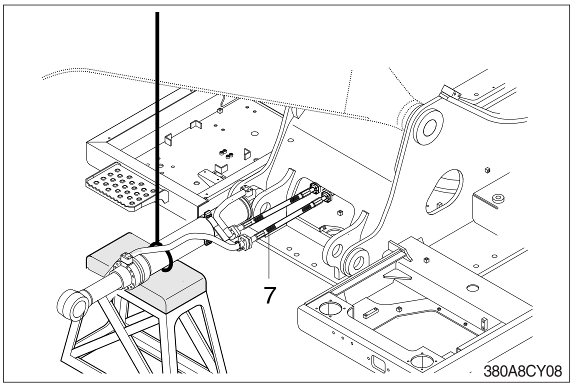
300A8CY06

④ Lower the boom cylinder assembly (6) on a stand.



380A8CY07

⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.

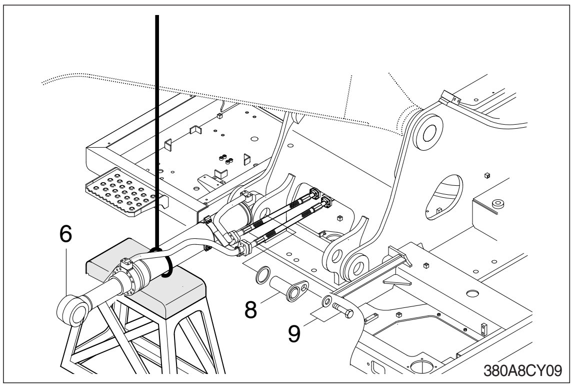


⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 397 kg (787 lb)

· Tightening torque : 57.9 ± 8.7 kgf · m (419 ± 62.9 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.**

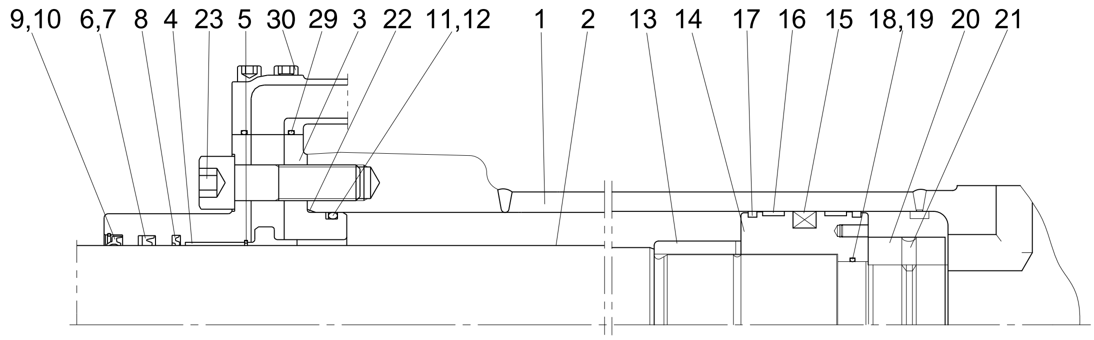
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

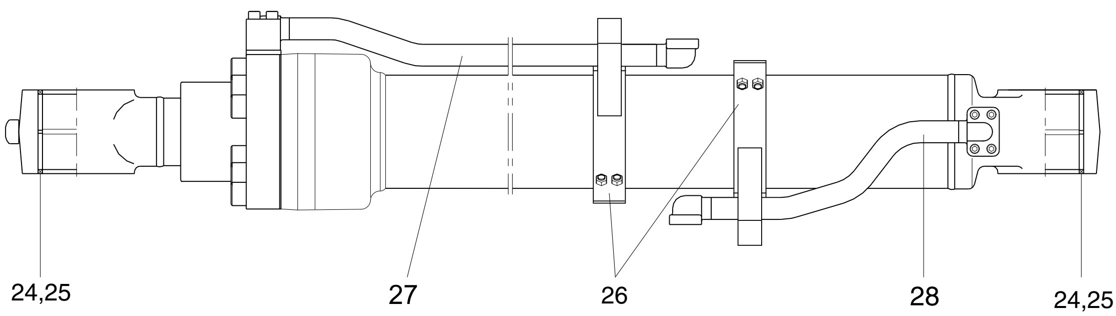
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder (CHANGZHOU)



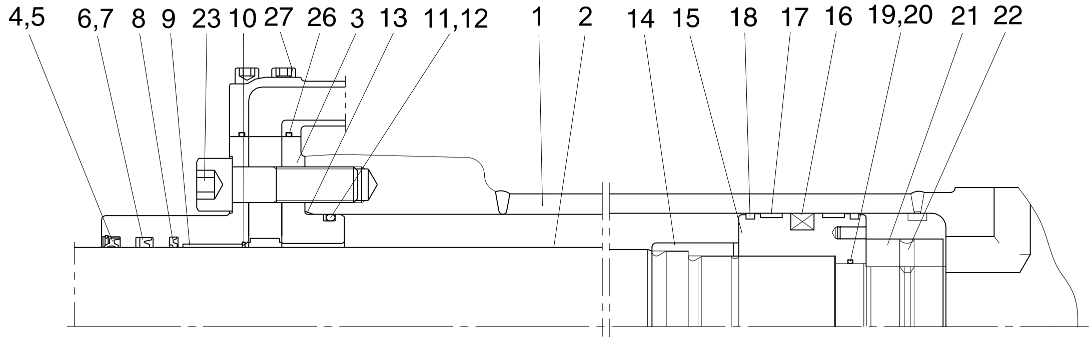
Internal detail



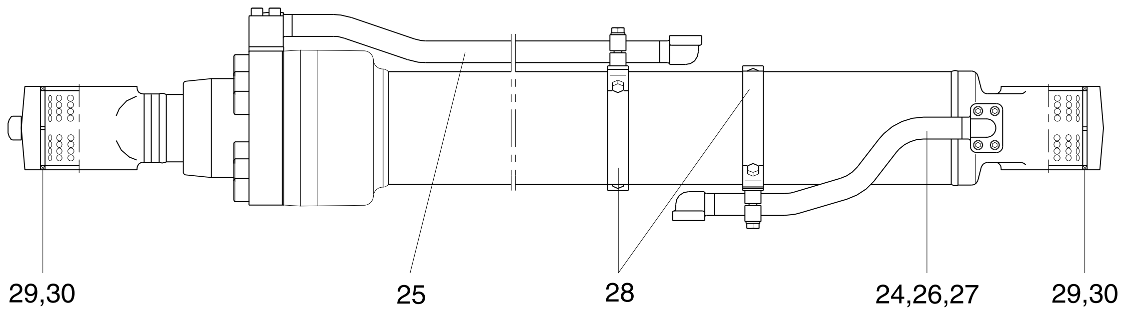
3BQA-60120CGG

1	Tube assembly	11	O-ring	21	Set screw
2	Rod assembly	12	Back up ring	22	O-ring
3	Gland	13	Cushion ring	23	Hexagon socket head bolt
4	DD2 bushing	14	Piston	24	Dimple bushing
5	Snap ring	15	Piston seal	25	Dust seal
6	Rod seal	16	Wear ring	26	Band assembly
7	Back up ring	17	Dust ring	27	Pipe assembly-R
8	Buffer ring	18	O-ring	28	Pipe assembly-B
9	Dust wiper	19	Back up ring	29	O-ring
10	Snap ring	20	Lock nut	30	Hexagon socket head bolt

Bucket cylinder (SHPAC)

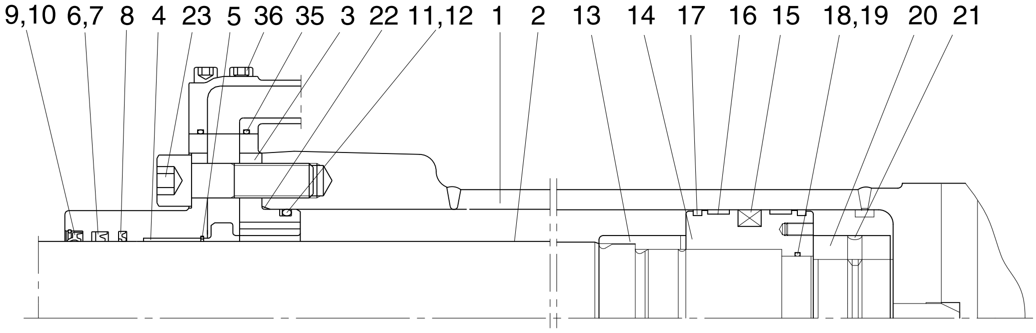


Internal detail

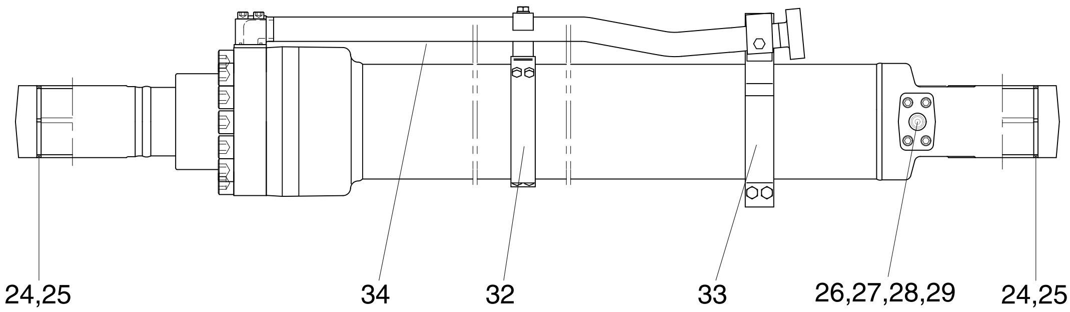


1	Tube assembly	11	O-ring	21	Lock nut
2	Rod assembly	12	Back up ring	22	Hexagon socket set screw
3	Gland	13	O-ring	23	Hexagon socket head bolt
4	Dust wiper	14	Cushion ring	24	Pipe assembly-B
5	Retaining ring	15	Piston	25	Pipe assembly-R
6	Rod seal	16	Piston seal	26	O-ring
7	Back up ring	17	Wear ring	27	Hexagon socket head bolt
8	Buffer ring	18	Dust ring	28	Band assembly
9	Dry bearing	19	O-ring	29	Dimple bushing
10	Retaining ring	20	Back up ring	30	Dust seal

(2) Arm cylinder (CHANGZHOU)



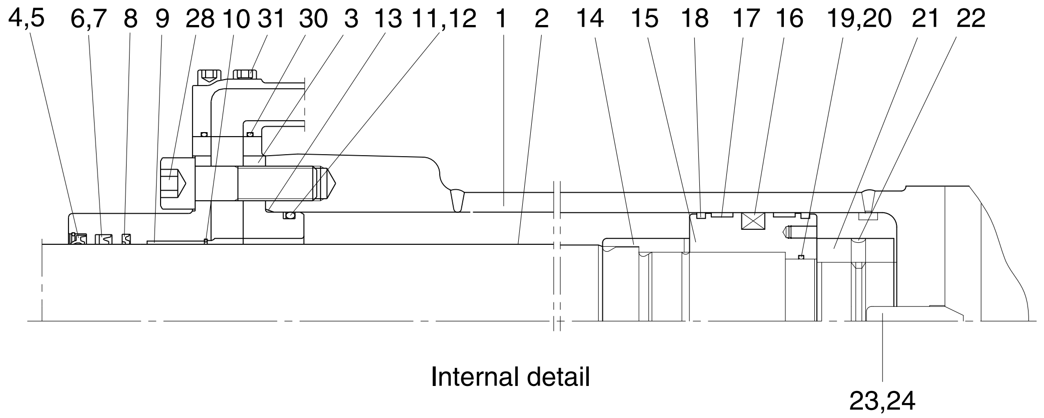
Internal detail

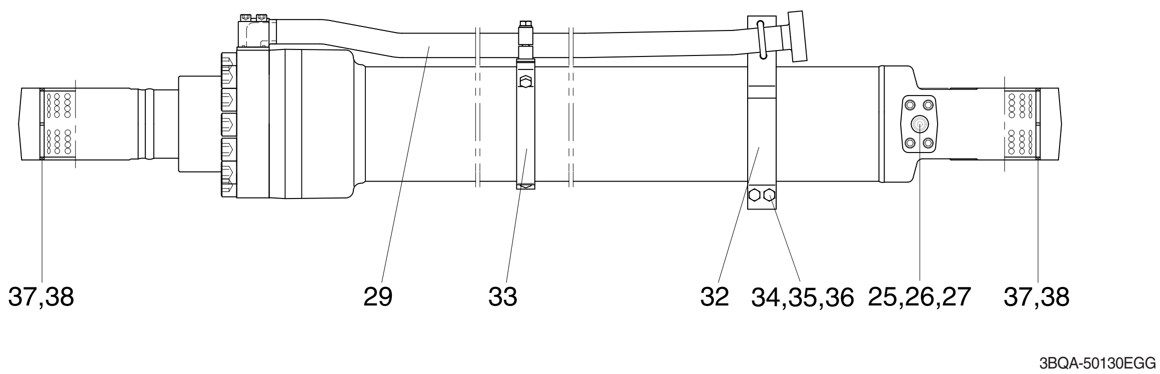


3BQA-50130CGG

1	Tube assembly	13	Cushion ring	25	Dust seal
2	Rod assembly	14	Piston	26	Check valve
3	Gland	15	Piston seal	27	Coil spring
4	DU bushing	16	Wear ring	28	O-ring
5	Snap ring	17	Dust ring	29	Plug
6	Rod seal	18	O-ring	32	Band assembly (R)
7	Back up ring	19	Back up ring	33	Band assembly (B)
8	Buffer ring	20	Lock nut	34	Pipe assembly (R)
9	Dust wiper	21	Set screw	35	O-ring
10	Snap ring	22	O-ring	36	Hexagon socket head bolt
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Dimple bushing		

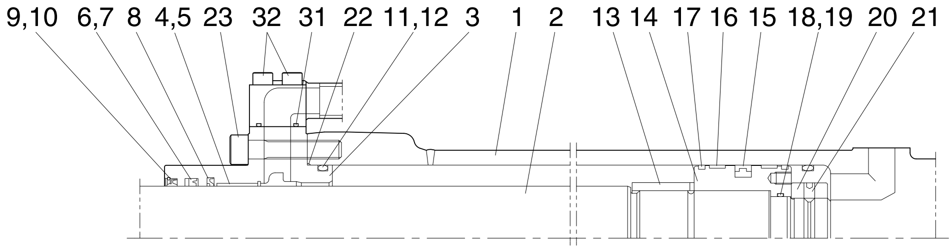
Arm cylinder (SHPAC)



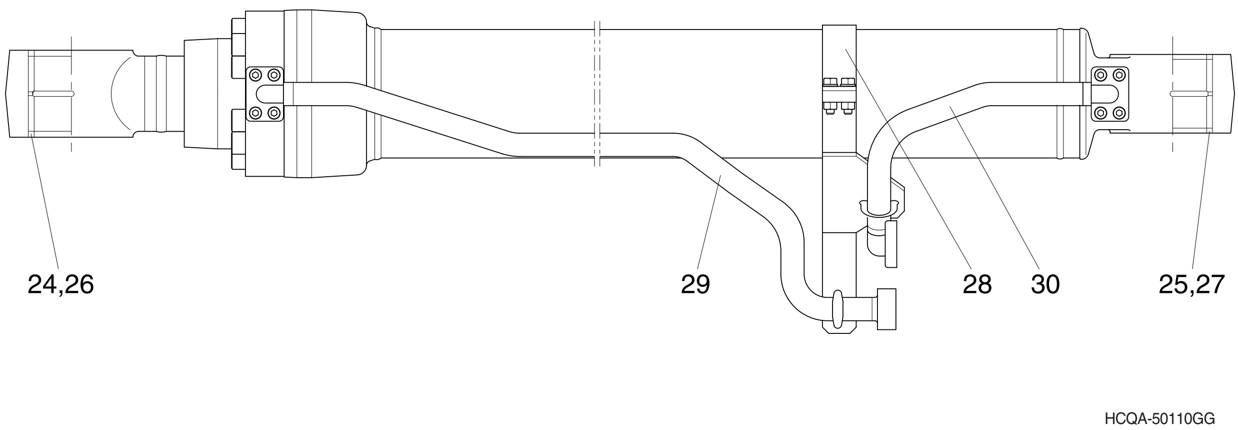


1	Tube assembly	14	Cushion ring	27	Hexagon plug
2	Rod assembly	15	Piston	28	Hexagon socket head bolt
3	Gland	16	Piston seal	29	Pipe assembly-R
4	Dust wiper	17	Wear ring	30	O-ring
5	Retaining ring	18	Dust ring	31	Hexagon socket head bolt
6	Rod seal	19	O-ring	32	Band assembly-B
7	Back up ring	20	Back up ring	33	Band assembly-R
8	Buffer ring	21	Lock nut	34	U-bolt
9	Dry bearing	22	Hexagon socket set screw	35	Hexagon nut
10	Retaining ring	23	Cushion plunger	36	Spring washer
11	O-ring	24	Stop ring	37	Dimple bushing
12	Back up ring	25	Check valve	38	Dust seal
13	O-ring	26	Coil spring		

(3) Boom cylinder (CHANGZHOU)

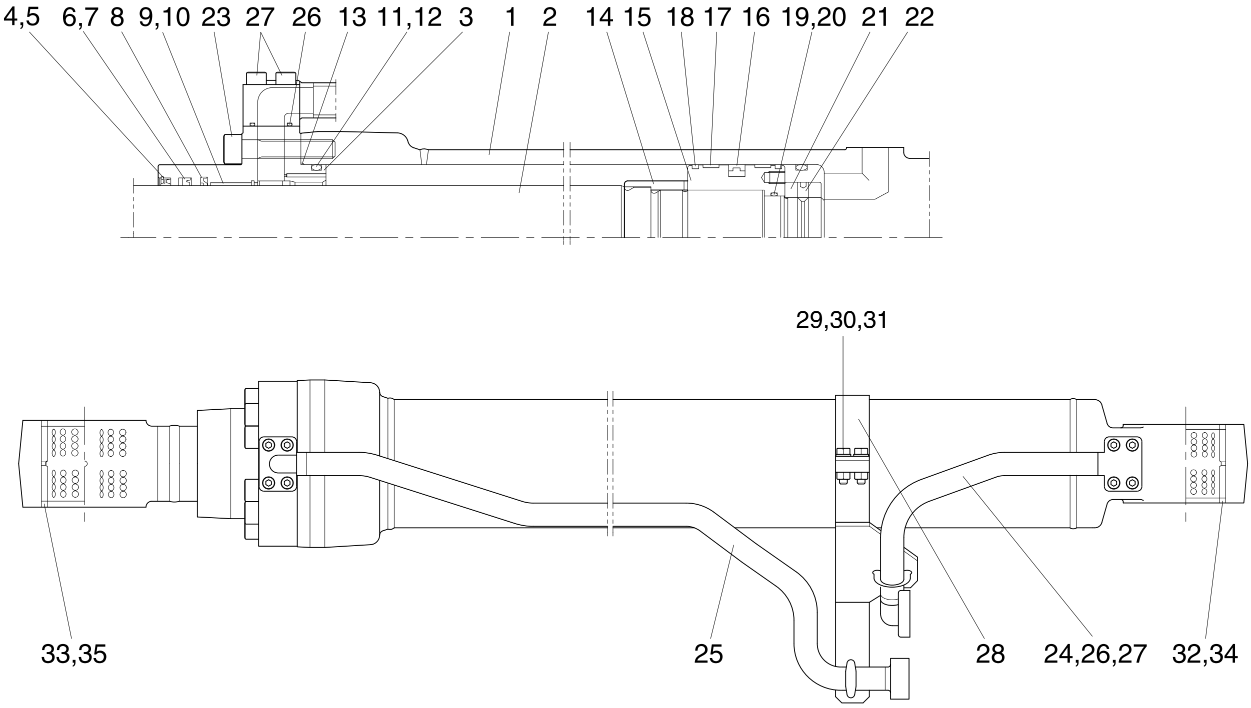


Internal detail



1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DU bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Dust seal
6	Rod seal	17	Dust ring	28	Band assembly
7	Back up ring	18	O-ring	29	Pipe assembly (R)
8	Buffer ring	19	Back up ring	30	Pipe assembly (B)
9	Dust wiper	20	Lock nut	31	O-ring
10	Snap ring	21	Set screw	32	Hexagon socket head bolt
11	O-ring	22	O-ring		

Boom cylinder (SHPAC)

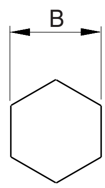


3BQA-50110GG

1	Tube assembly	13	O-ring	25	Pipe assembly-R
2	Rod assembly	14	Cushion ring	26	O-ring
3	Gland	15	Piston	27	Hexagon socket head bolt
4	Dust wiper	16	Piston seal	28	Band assembly
5	Retaining ring	17	Wear ring	29	U-bolt
6	Rod seal	18	Dust ring	30	Hexagon nut
7	Back up ring	19	O-ring	31	Spring washer
8	Buffer ring	20	Back up ring	32	Dimple bushing
9	Dry bearing	22	Lock nut	33	Dimple bushing
10	Retaining ring	22	Hexagon socket set screw	34	Dust seal
11	O-ring	23	Hexagon socket head bolt	35	Dust seal
12	Back up ring	24	Pipe assembly-B		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tools	Remark	
Allen wrench	6	
	8	
	10	
	12	
	14	
	17	
Spanner	7	
	8	
(-) 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
Socket head bolt	Bucket cylinder	23★1★3	M20	46.0±5.0	333±36.2
		23★1★4	M20	52.2±5.2	378±37.6
		30★3	M12	9.4±1.0	68.0±7.2
		27★4	M12	11.3±1.1	81.7±8.0
	Boom cylinder	23★1★3	M22	63.0±6.0	456±45.6
		23★1★4	M22	69.4±6.9	502±49.9
		32★3	M12	9.4±1.0	68.0±7.2
		27★4	M12	11.3±1.1	81.7±8.0
	Arm cylinder	23★1★3	M22	63.0±6.0	456±43.4
		28★1★4	M22	69.4±6.9	502±49.9
		36★3	M12	9.4±1.0	68.0±7.2
		31★4	M12	11.3±1.1	81.7±8.0

★1 : Apply loctite #243 on the thread of bolt.
★3 : CHANGZHOU
★4 : SHPAC

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Lock nut	Bucket cylinder	20★3 21★4	- M82	100±10.0 100±10.0	723±72.3 723±72.3
	Boom cylinder	20★3 21★4	- M80	150±15.0 150±15.0	1085±108 1085±108
	Arm cylinder	20★3 21★4	- M90	200±20.0 150±15.0	1447±145 1085±108
Piston	Bucket cylinder	14★3 15★4	- M95	150±15.0 150±15.0	1085±108 1085±108
	Boom cylinder	14★3 15★4	- M100	200±20.0 200±20.0	1447±145 1447±145
	Arm cylinder	14★3 15★4	- M110	200±20.0 200±20.0	1447±145 1447±145
Set screw	Bucket cylinder	21★3 22★4	M10 M10	5.4±0.5 2.5±0.3	39.1±3.6 18.1±2.2
	Boom cylinder	21★3 22★4	M10 M10	5.4±0.5 2.5±0.3	39.1±3.6 18.1±2.2
	Arm cylinder	21★3 22★4	M10 M10	5.4±0.5 2.5±0.3	39.1±3.6 18.1±2.2

★1 : Apply loctite #243 on the thread of bolt.

★3 : CHANGZHOU

★4 : SHPAC

3) DISASSEMBLY

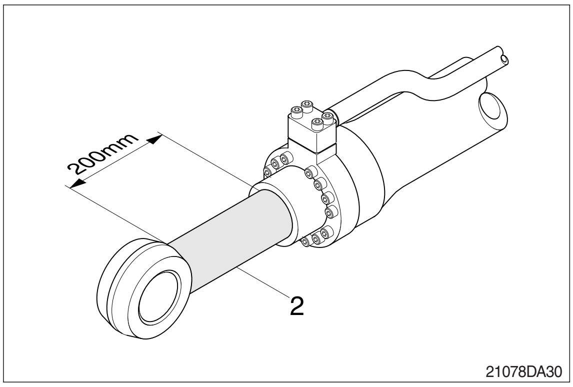
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder (CHANGZHOU type).

① Hold the clevis section of the tube in a vise.

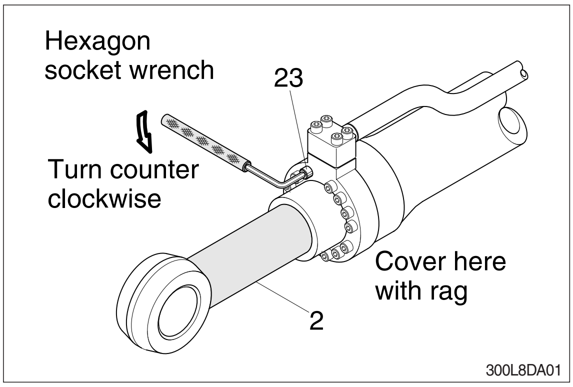
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 mm (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



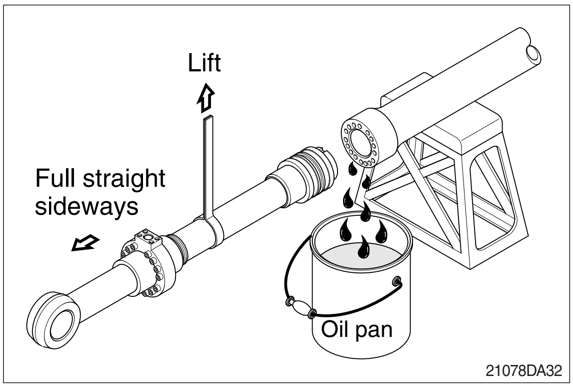
③ Loosen and remove socket bolts (23) of the gland in sequence.

※ 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).

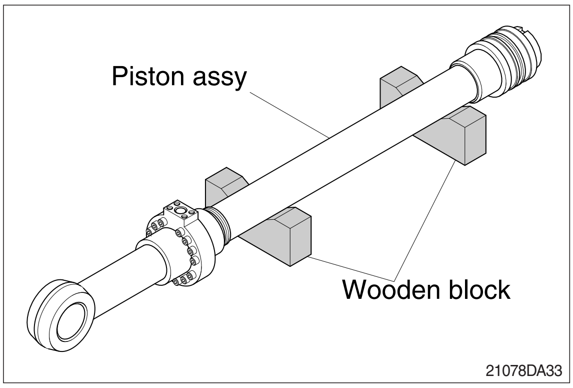
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



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 on a wooden V-block that is set level.

※ Cover a V-block with soft rag.

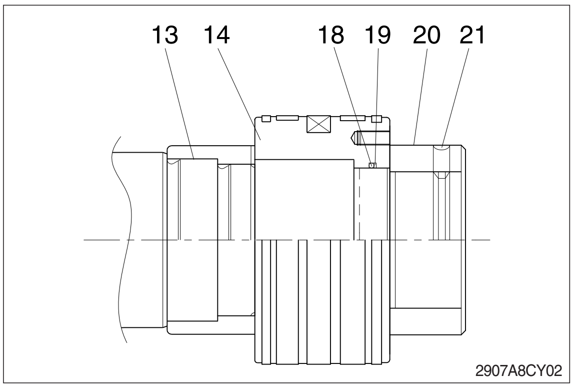


(2) Remove piston and cylinder head

① Remove set screw (21).

※ Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the set screw (21) lock nut (20).

② Remove piston assembly (14), back up ring (19), and O-ring (18).

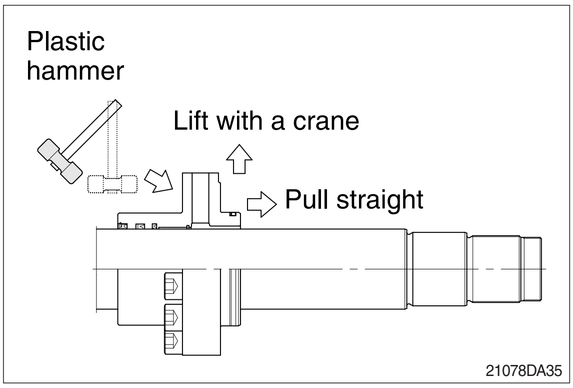


③ Remove the cylinder head assembly from rod assembly (2).

※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.

※ Pull it straight with cylinder head assembly lifted with a crane.

Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

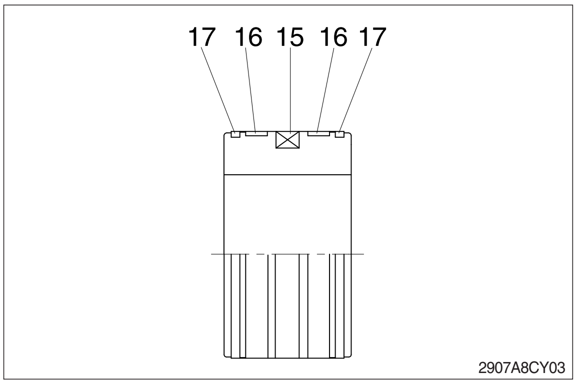


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

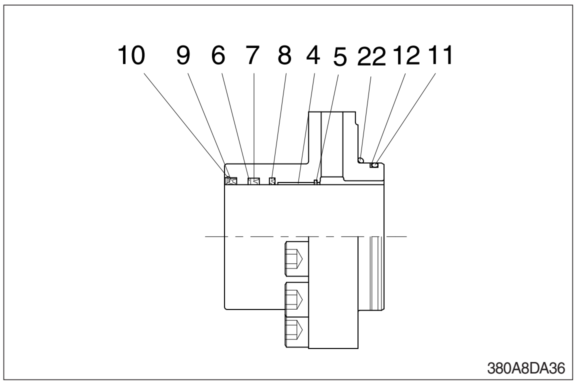
① Remove back up ring (12) and O-ring (11) and O-ring (22).

② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

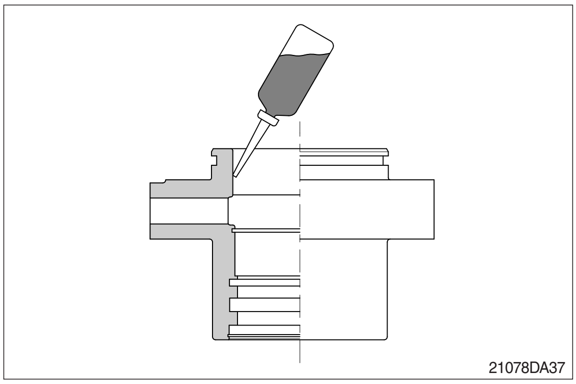


3) ASSEMBLY

(1) Assemble cylinder head assembly

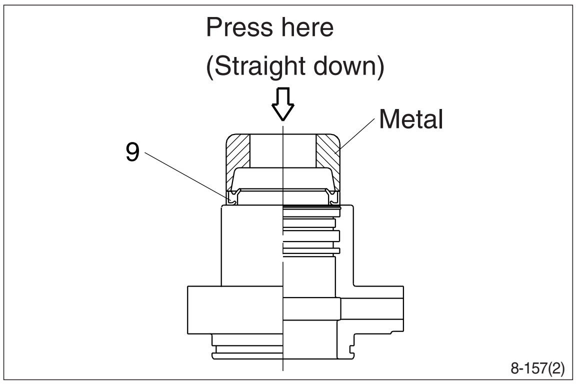
※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of gland (3) with hydraulic oil.



② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

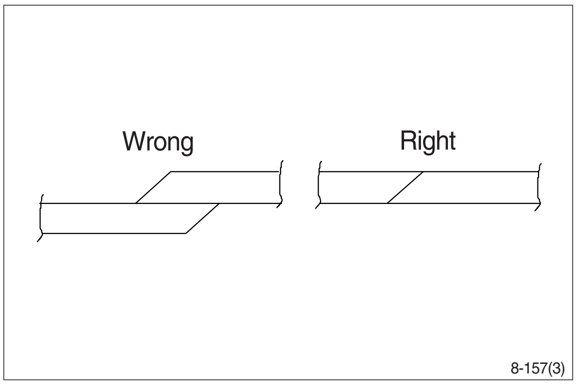
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

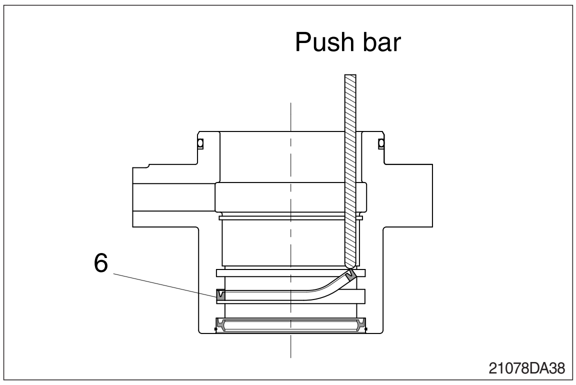
※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until one side of it is inserted into groove.



※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

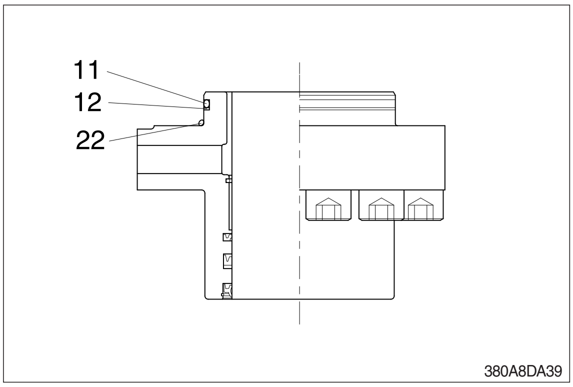
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

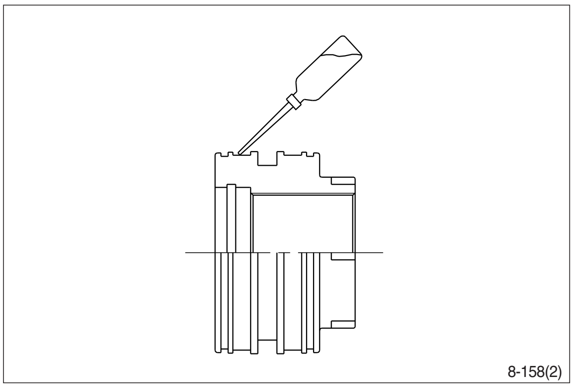
⑥ Fit O-ring (11) and O-ring (22) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

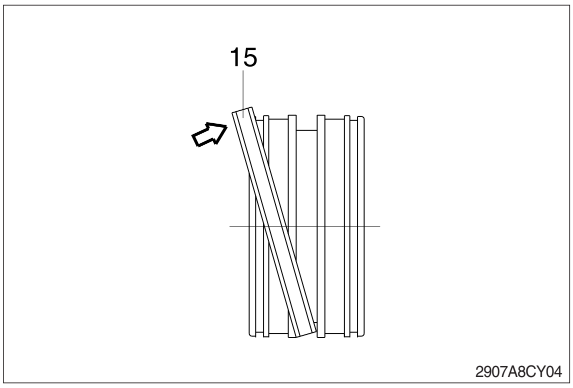
① Coat the outer face of piston (14) with hydraulic oil.



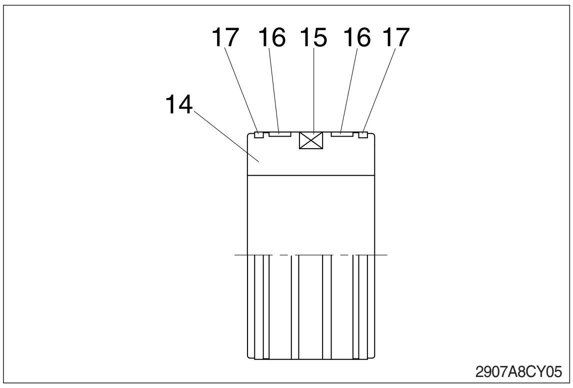
② Fit piston seal (15) to piston.

※ 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 (16) and dust ring (17) to piston (14).

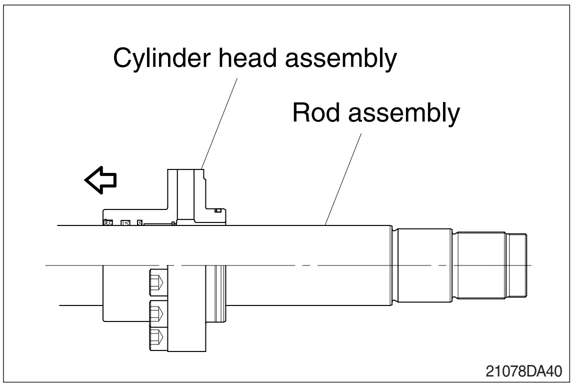


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

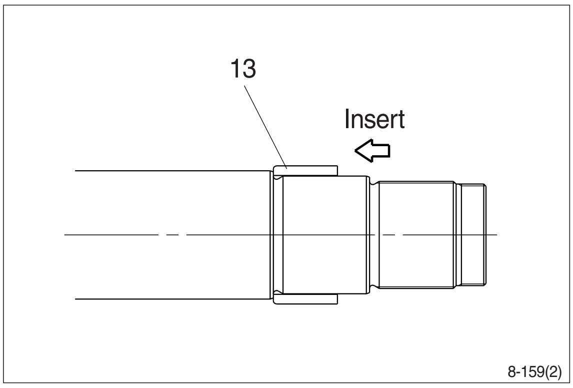
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring (13) to rod assembly.

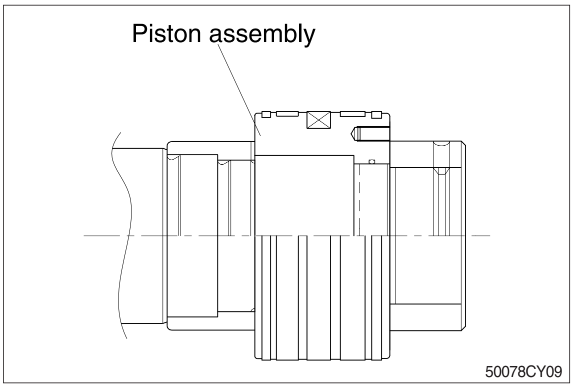
※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

· Tightening torque : 150±15.0 kgf · m (1085±108 lbf · ft)

※ Refer to page 8-138.



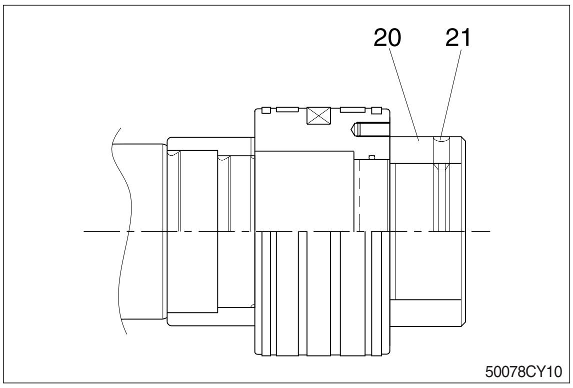
⑥ Fit lock nut (20) and tighten the screw (21).

· Tightening torque :

Item 20 : 100±10.0 kgf·m (723±72.3 lbf·ft)

Item 21 : 5.4±0.5 kgf·m (39.1±3.6 lbf·ft)

※ Refer to page 8-138.



(3) Overall assemble

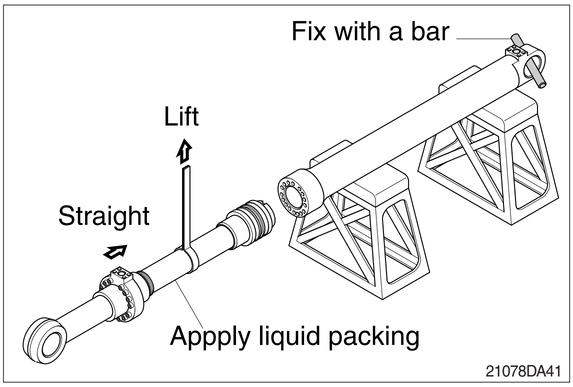
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

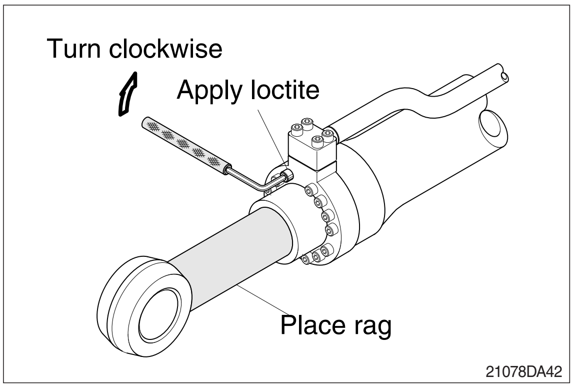
※ Be careful not to damage piston seal by thread of tube assembly.

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.



21078DA41



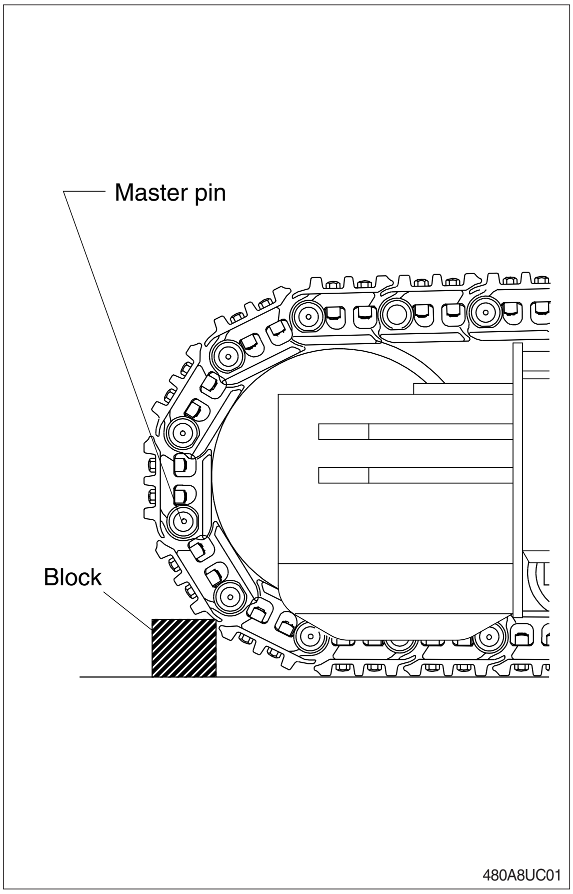
21078DA42

GROUP 10 UNDERCARRIAGE

1. TRACK LINK

1) REMOVAL

(1) Move track link until master pin is over front idler in the position put wooden block as shown.



(2) Loosen tension of the track link.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.

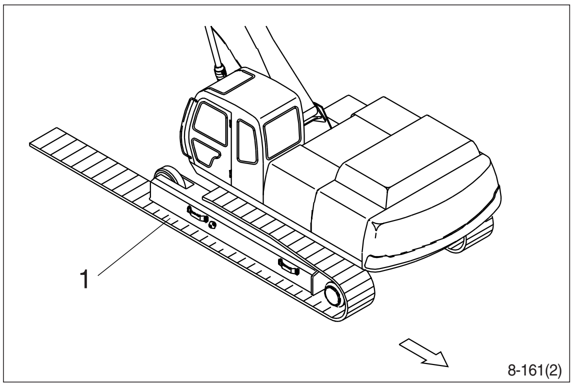
※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease nipple can be suddenly popped out by pressurized grease.

(3) Push out master pin by using a suitable tool.

(4) Move the machine slowly in reverse, and lay out track link assembly (1).

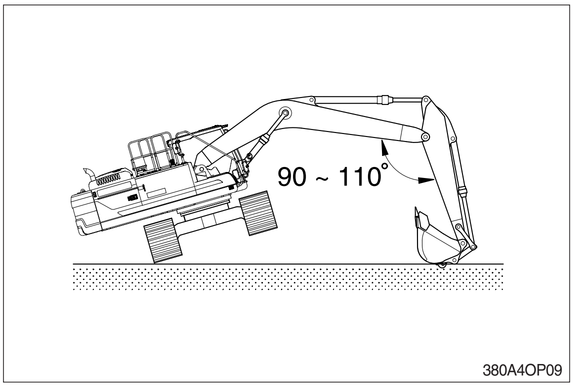
※ Jack up the machine and put wooden block under the machine.

※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.



2) INSTALL

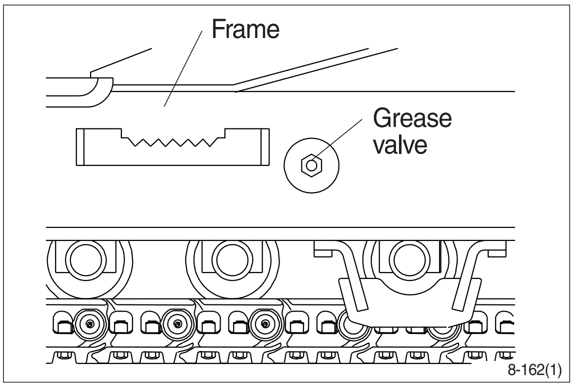
(1) Carry out installation in the reverse order to removal.
Adjust the tension of the track link.



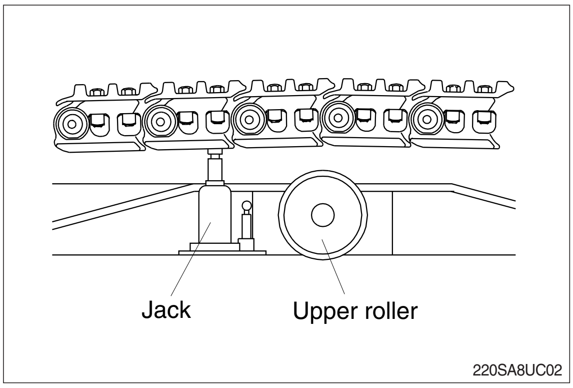
2. UPPER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.

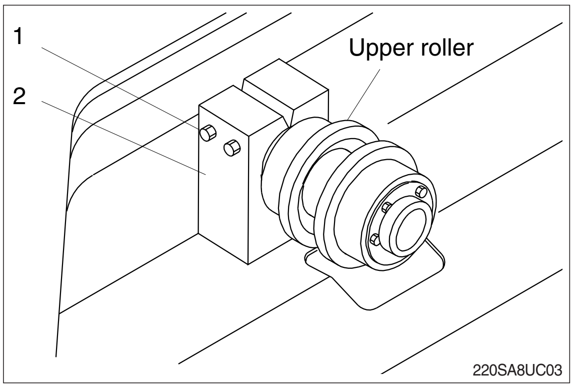


(2) Jack up the track link height enough to permit upper roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket (2) with a screwdriver, push out from inside, and remove upper roller assembly.
  · Weight
    General : 80 kg (176 lb)
  · Tightening torque : 29.7±3.0 kgf·m
    (215±21.7 lbf·ft)



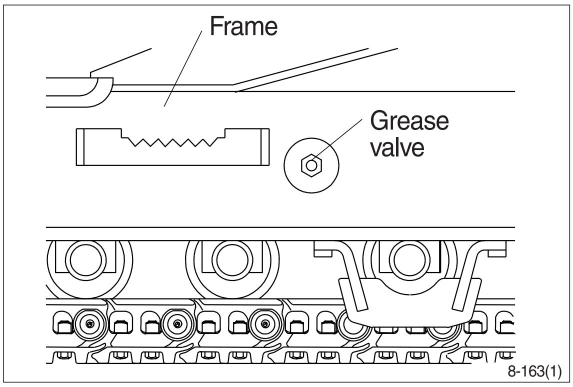
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. LOWER ROLLER

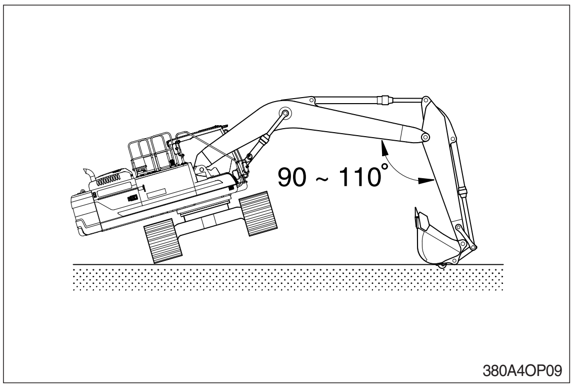
1) REMOVAL

(1) Loosen tension of the track link.



(2) Using the work equipment, push up track frame on side which is to be removed.

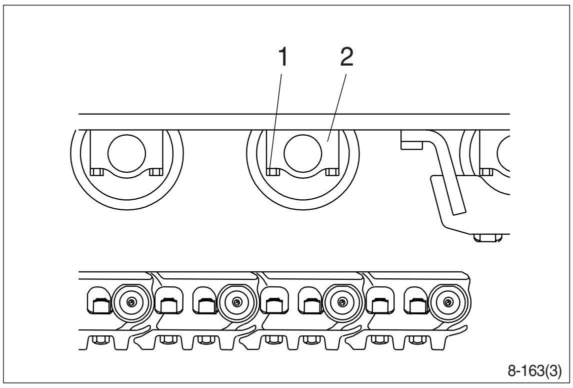
※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt (1) and draw out the lower roller (2).

· Weight : 79.5 kg (175 lb)

· Tightening torque : 100±10.0 kgf·m (723±72.3 lbf·ft)



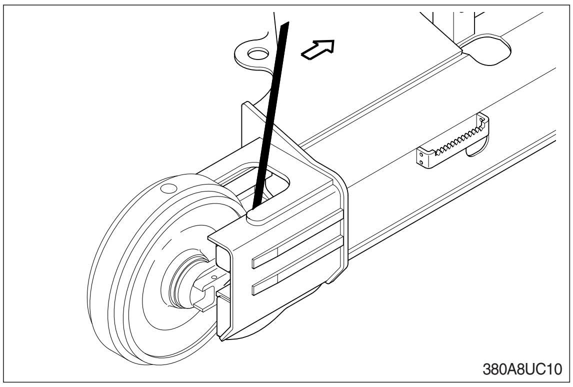
2) INSTALL

(1) Carry out installation in the reverse order to removal.

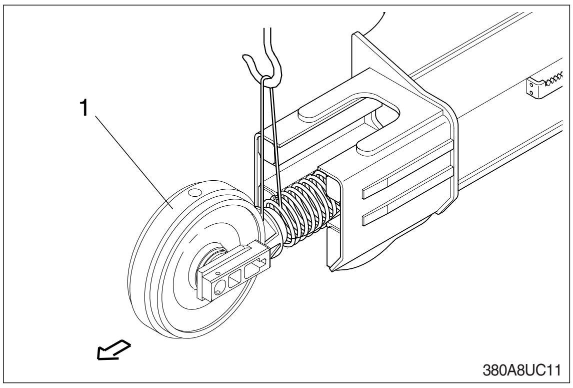
4. IDLER AND RECOIL SPRING

1) REMOVAL

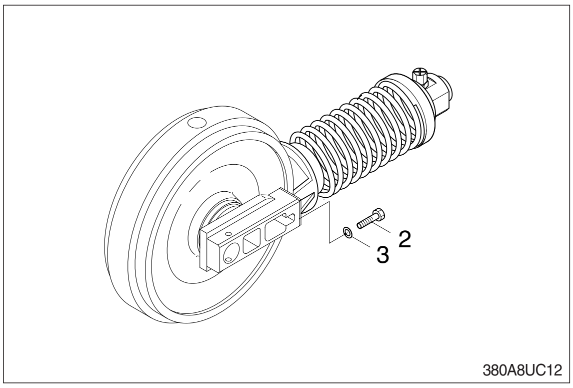
(1) Remove the track link.
For detail, see removal of track link.



(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 489 kg (1078 lb)

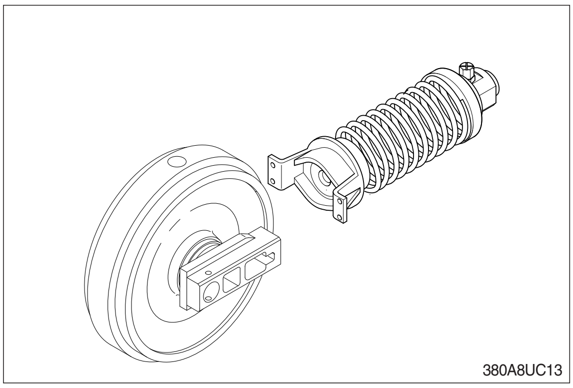


(3) Remove the bolts (2), washers (3) and separate idler from recoil spring.
· Tightening torque : 29.7±4.5 kgf·m
(215±32.5 lbf·ft)



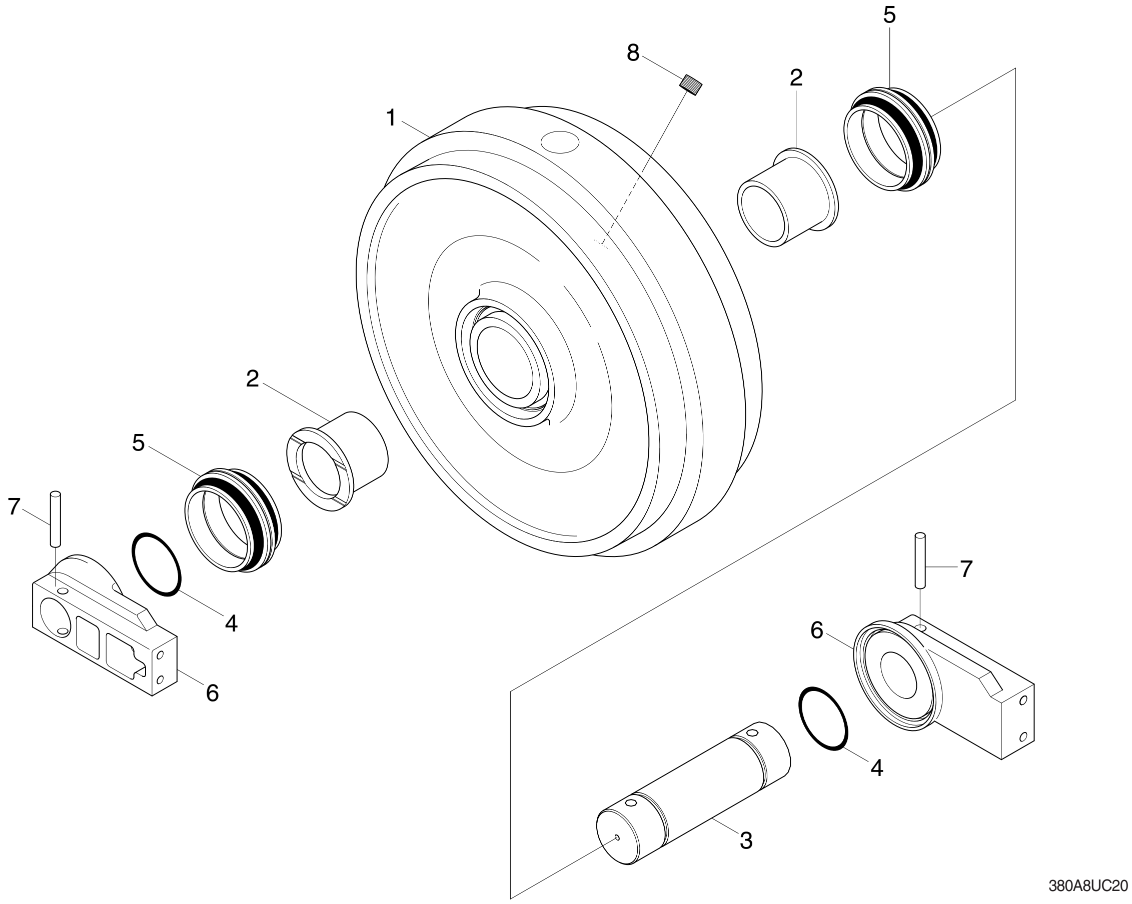
2) INSTALL

(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.



3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

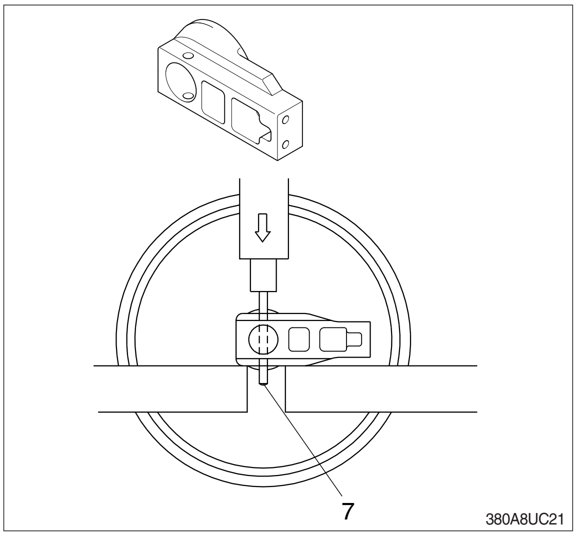


1	Shell	4	O-ring	7	Spring pin
2	Bushing	5	Seal assembly	8	Plug
3	Shaft	6	Bracket		

(2) Disassembly

① Remove plug and drain oil.

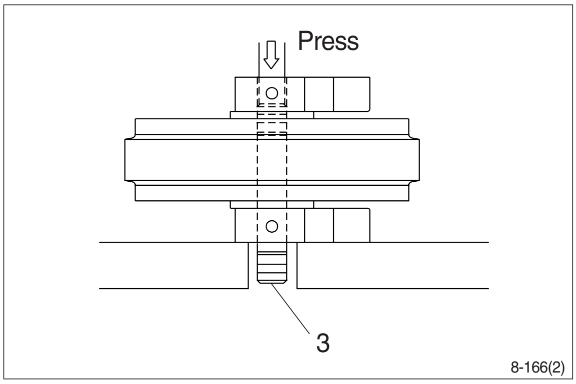
② Draw out the spring pin (7), using a press.



③ Pull out the shaft (2) with a press.

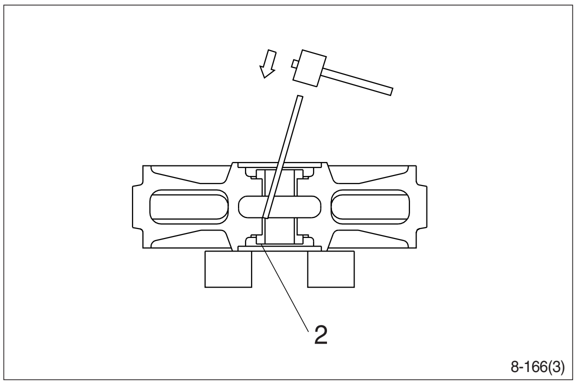
④ Remove seal (5) from shell (1) and bracket (6).

⑤ Remove O-ring (4) from shaft.



⑥ Remove the bushing (2) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.

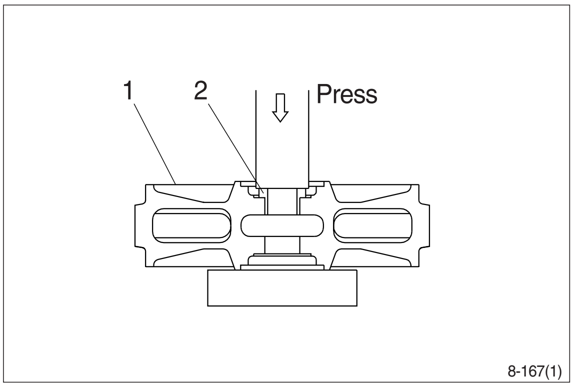


(3) Assembly

※ Before assembly, clean the parts.

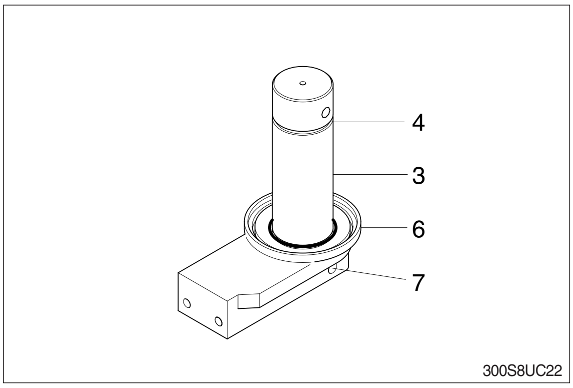
※ Coat the sliding surfaces of all parts with oil.

① Cool up bushing (2) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.

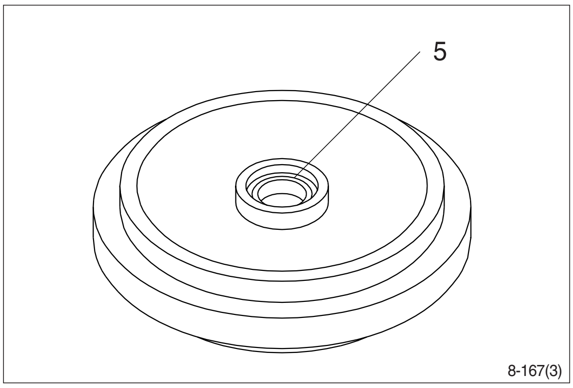


② Coat O-ring (4) with grease thinly, and install it to shaft (3).

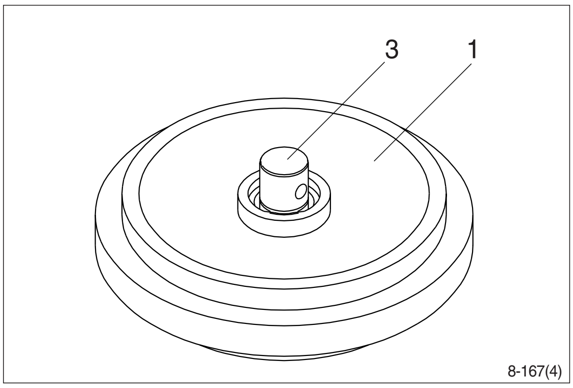
③ Insert shaft (3) into bracket (6) and drive in the spring pin (7).



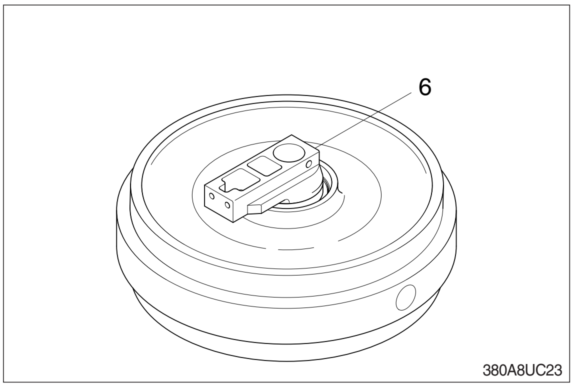
④ Install seal (5) to shell (1) and bracket (6).



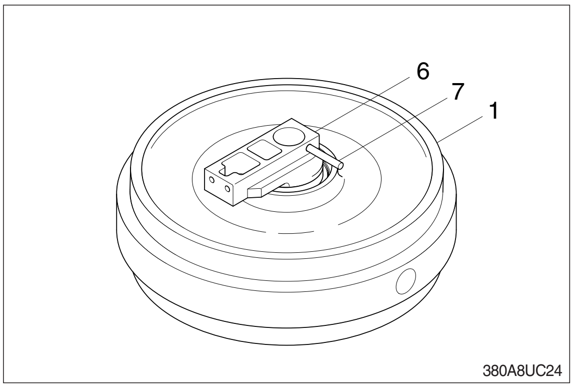
⑤ Install shaft (3) to shell (1).



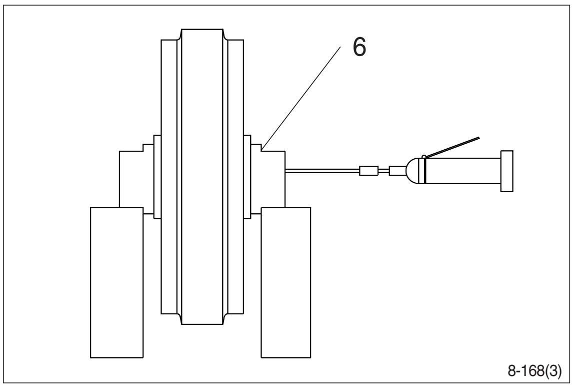
⑥ Install bracket (6) attached with seal (5).



⑦ Knock in the spring pin (7) with a hammer.

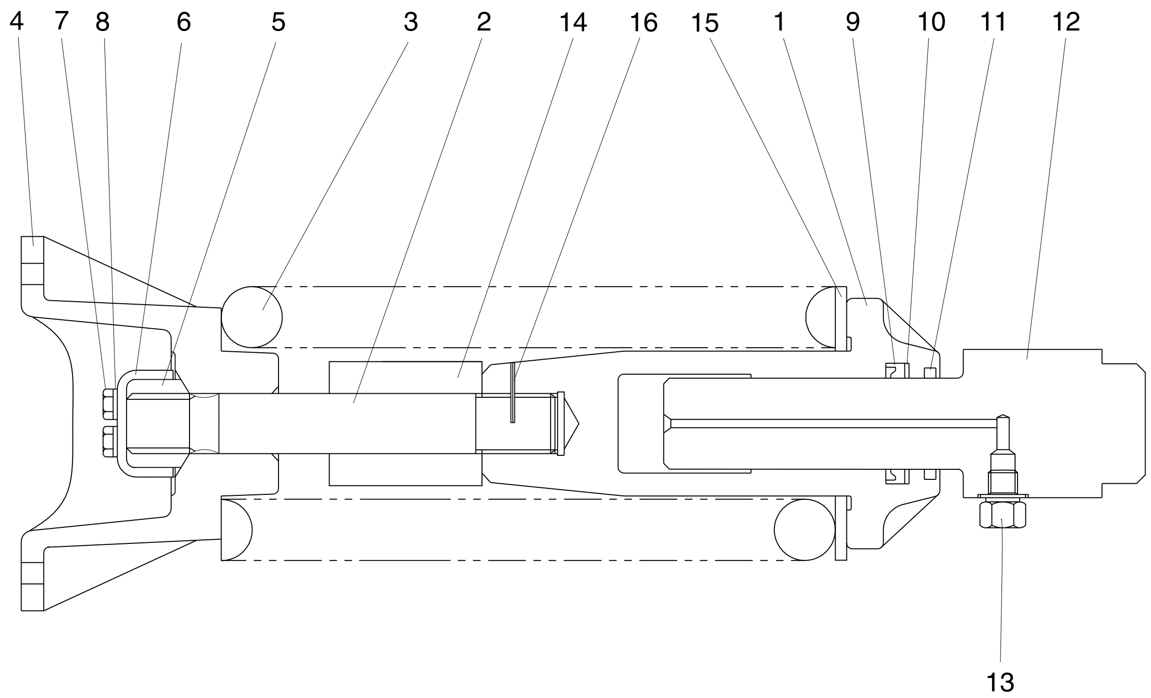


⑧ Lay bracket (6) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



81QA-14015

1	Body	7	Bolt	13	Grease valve
2	Tie bar	8	Spring washer	14	Stopper tube
3	Spring	9	Rod packing	15	Spacer
4	Bracket	10	Back up ring	16	Spring pin
5	Lock nut	11	Dust seal		
6	Lock plate	12	Adjust rod		

(2) Disassembly

※ The illustrations are base on the type 1.

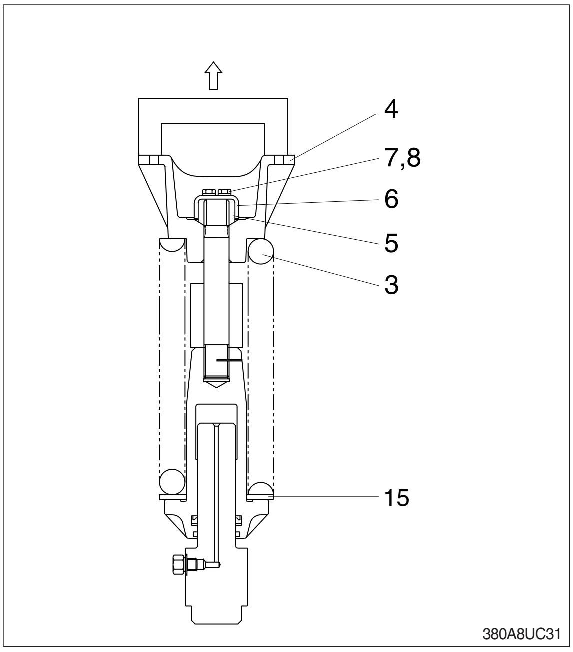
① Apply pressure on spring (3) with a press.

※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

② Remove bolt (7), spring washer (8) and lock plate (6).

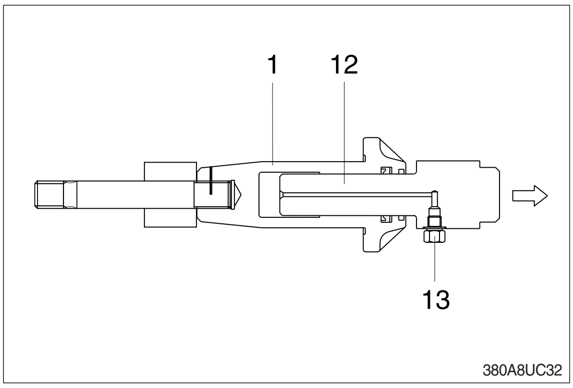
③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket (4), spring (3) and spacer (15).

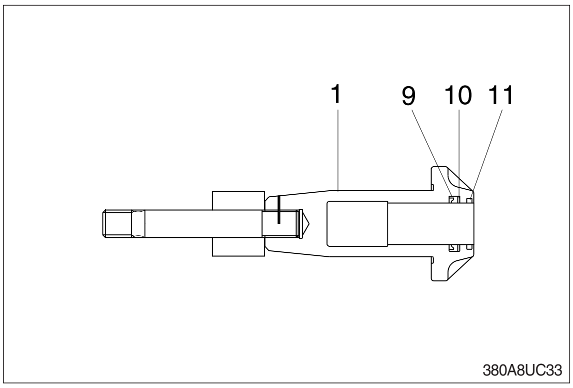


⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



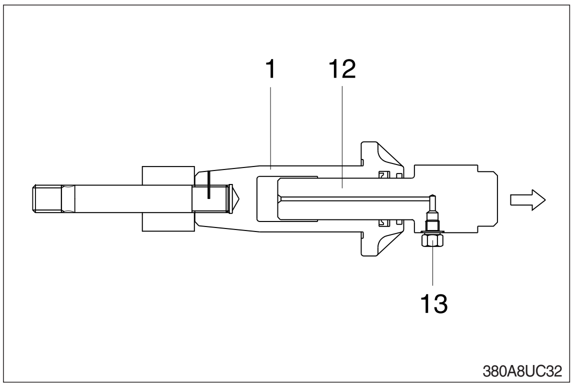
⑦ Remove rod seal (9), back up ring (10) and dust seal (11).



(3) Assembly

① Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

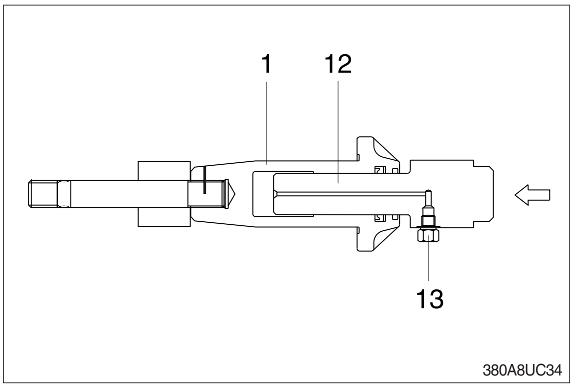
※ When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



② Pour grease into body (1), then push in rod (12) 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 (13) to rod (12).
· Tightening torque : 13.0±1.0 kgf · m
(94±7.2 lbf · ft)

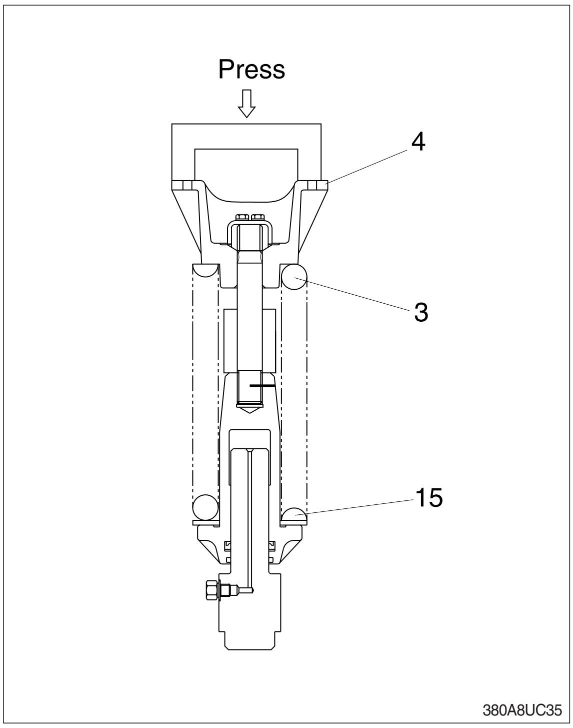


④ Install spacer (15), spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).
· Spring set load
24500 kg (54010 lb)

※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.

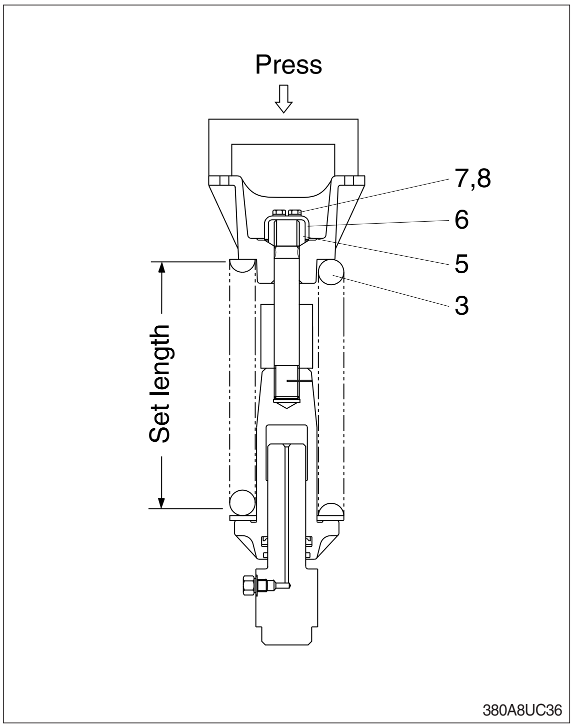


⑥ Lighten the press load and confirm the set length of spring (3).

·Set length : 610±1.5 mm

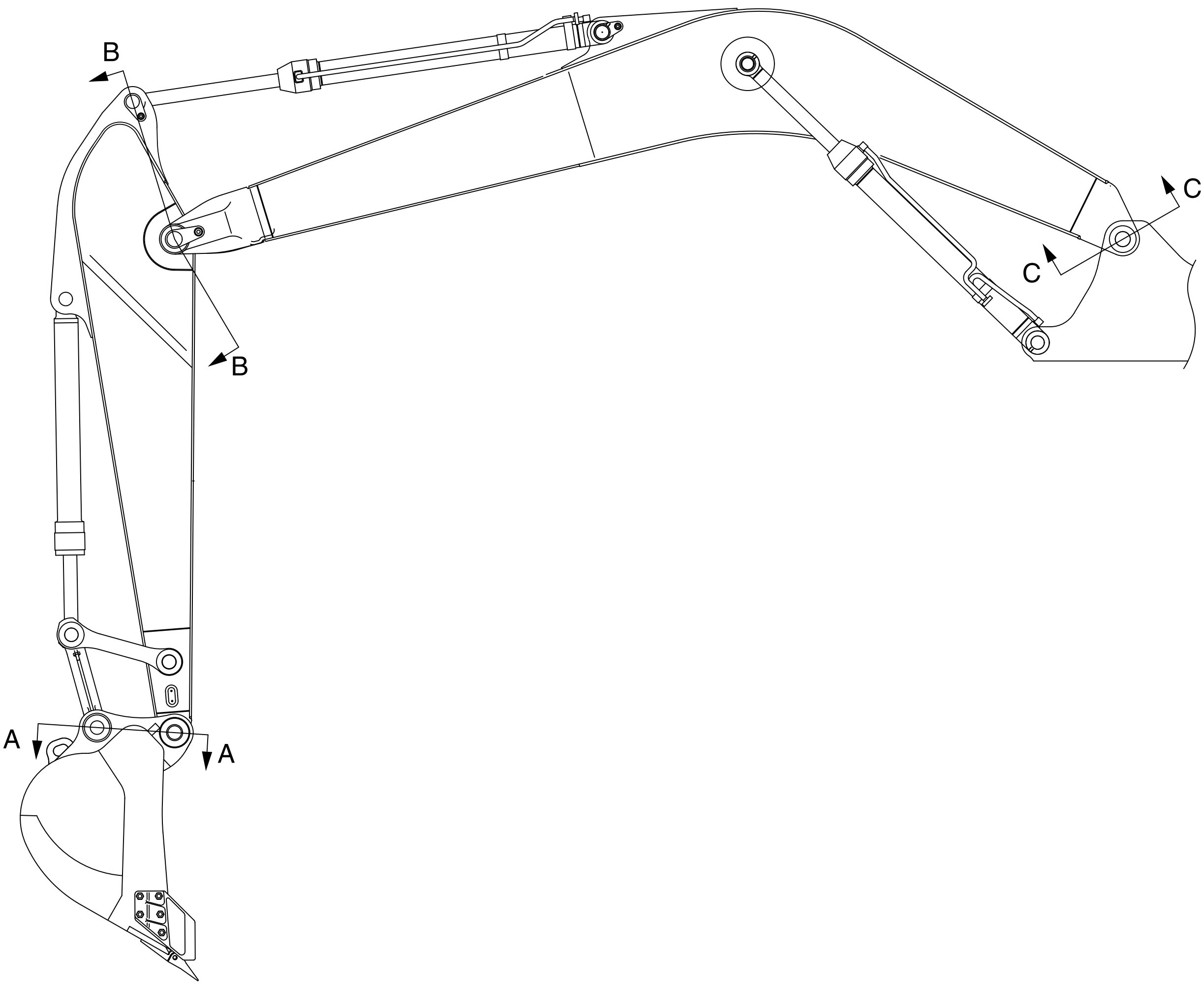
⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).

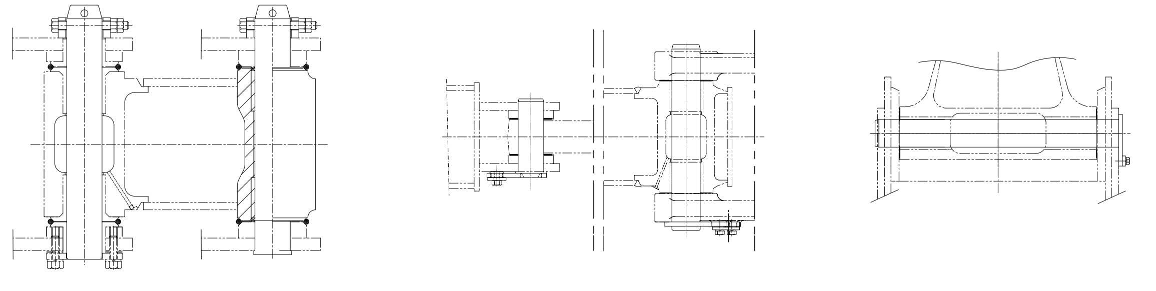
·Tightening torque : 13.3±2.7 kgf·m
(96.2±19.5 lbf·ft)



GROUP 11 WORK EQUIPMENT

1. STRUCTURE





SECTION A SECTION B SECTION C

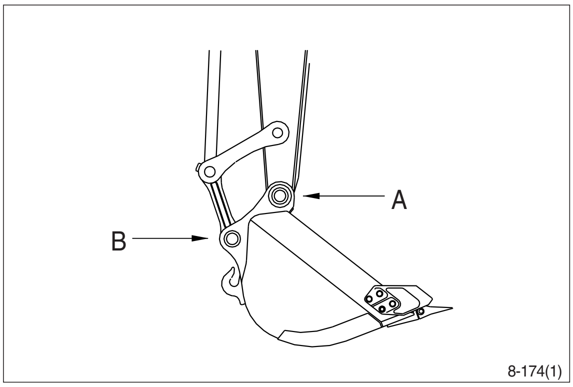
380A8WE01

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

(1) Removal

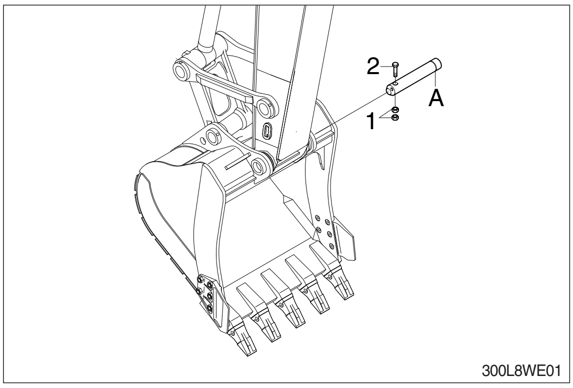
① Lower the work equipment completely to ground with back of bucket facing down.



8-174(1)

② Remove nut (1), bolt (2) and draw out the pin (A).

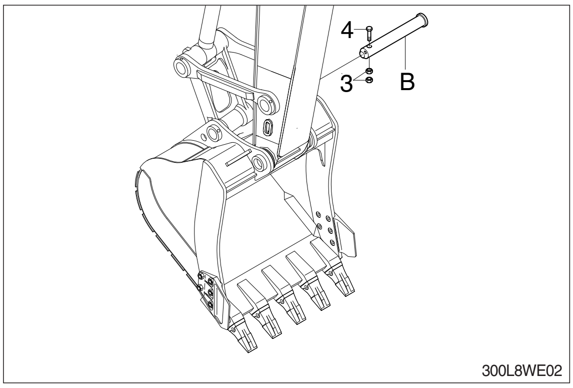
· Tightening torque : 57.9±8.7 kgf·m (419±62.9 lbf·ft)



300L8WE01

③ Remove nut (3), bolt (4) and draw out the pin (B).

· Tightening torque : 57.9±8.7 kgf·m (419±62.9 lbf·ft)



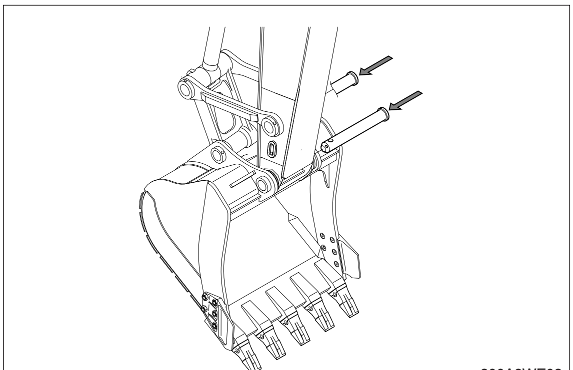
300L8WE02

(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 **operation manual.**



300A8WE03

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.**

② Disconnect bucket cylinder hose (1).

⚠ **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.

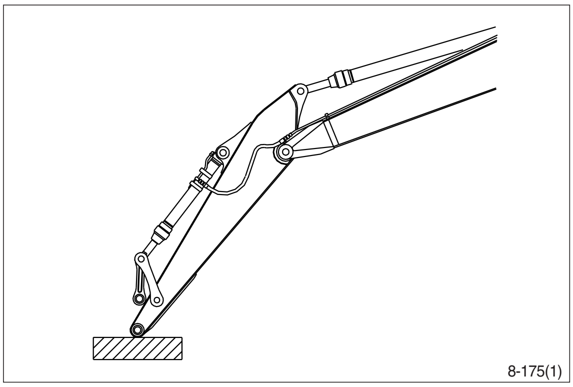
④ For details, see **removal of arm cylinder assembly.**
Place a wooden block under the cylinder and bring the cylinder down to it.

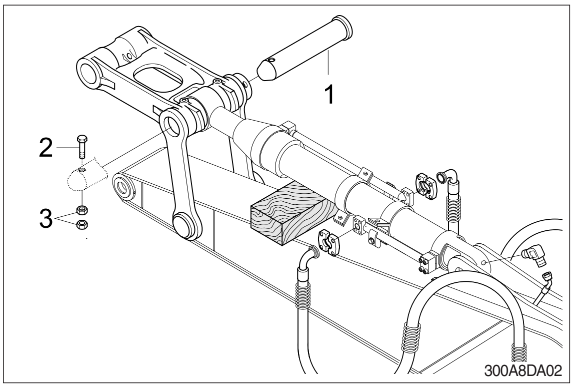
⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

· Weight : 2000 ㎏ (4410 ℔)

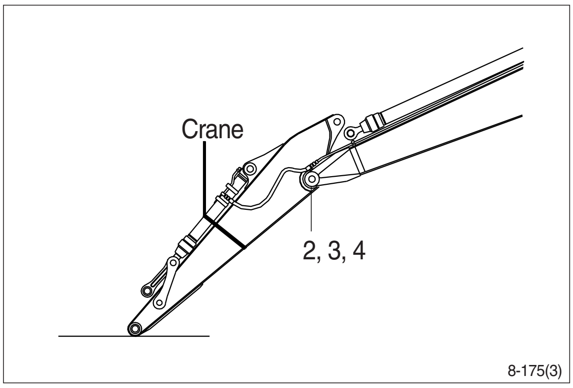
· Tightening torque (2) : 57.9±8.7 kgf·m (419±62.9 lbf·ft)

※ When lifting the arm assembly, always lift the center of gravity.


8-175(1)



300A8DA02



8-175(3)

(2) Install

① Carry out installation in the reverse order to removal.
When lifting the arm assembly, always lift the center of gravity.

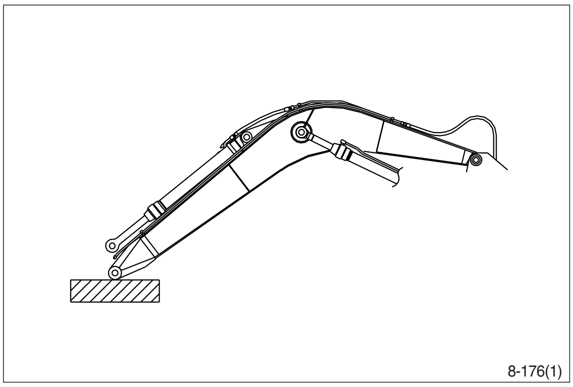
※ Bleed the air from the cylinder.

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.**



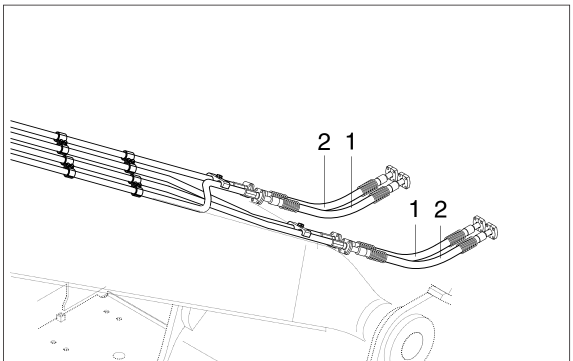
8-176(1)

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.

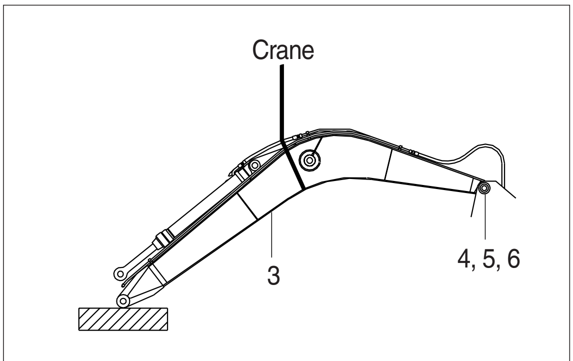
⑤ Sling boom assembly (3).



380A8DA45

⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight : 3750 ㎏ (8270 ℔)

※ When lifting the boom assembly always lift the center of gravity.
· Tightening torque : 57.9±6.0 kgf·m (419±43.4 lbf·ft)



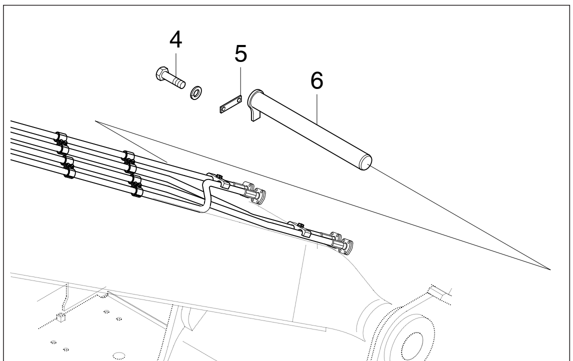
8-176(3)

(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.



380A8DA46