CONTENTS

SECTION 1 GENERAL

Group 1 Safety Hints 1-1
Group 2 Specifications 1-10

SECTION 2 STRUCTURE AND FUNCTION

Group 1 Pump Device 2-1
Group 2 Main Control Valve 2-15
Group 3 Swing Device 2-49
Group 4 Travel Device 2-60
Group 5 RCV Lever 2-74
Group 6 RCV Pedal 2-81

SECTION 3 HYDRAULIC SYSTEM

Group 1 Hydraulic Circuit 3-1
Group 2 Main Circuit 3-3
Group 3 Pilot Circuit 3-6
Group 4 Single Operation 3-17
Group 5 Combined Operation 3-27

SECTION 4 ELECTRICAL SYSTEM

Group 1 Component Location 4-1
Group 2 Electrical Circuit 4-3
Group 3 Electrical Component Specification 4-23
Group 4 Connectors 4-36

SECTION 5 MECHATRONICS SYSTEM

Group 1 Outline 5-1
Group 2 Mode selection System 5-3
Group 3 Automatic Deceleration System 5-6
Group 4 Power Boost System 5-7
Group 5 Travel Speed Control System 5-8
Group 6 Automatic Warming Up Function 5-9
Group 7 Engine Overheat Prevention Function 5-10
Group 8 Variable Power Control System 5-11

Group 9 Attachment Flow Control System ····· 5-12
Group 10 Boom Floating Control System ····· 5-13
Group 11 Intelligent Power Control System ····· 5-14
Group 12 Anti-Restart System ····· 5-16
Group 13 Self-Diagnostic System ····· 5-17
Group 14 Engine Control System ····· 5-63
Group 15 EPPR (Electro Proportional Pressure Reducing) Valve ····· 5-64
Group 16 Monitoring System ····· 5-69
Group 17 Fuel Warmer System ····· 5-110
Group 18 1 or 2-Way Optional Piping Pressure Removal System ····· 5-111
Group 19 2DMG+ System ····· 5-112

SECTION 6 TROUBLESHOOTING

Group 1 Before Troubleshooting ····· 6-1
Group 2 Hydraulic and Mechanical System ····· 6-4
Group 3 Electrical System ····· 6-25
Group 4 Mechatronics System ····· 6-43
Group 5 Air conditioner and heater System ····· 6-71

SECTION 7 MAINTENANCE STANDARD

Group 1 Operational Performance Test ····· 7-1
Group 2 Major Components ····· 7-21
Group 3 Track and Work Equipment ····· 7-30

SECTION 8 DISASSEMBLY AND ASSEMBLY

Group 1 Precaution ····· 8-1
Group 2 Tightening Torque ····· 8-4
Group 3 Pump Device ····· 8-7
Group 4 Main Control Valve ····· 8-33
Group 5 Swing Device ····· 8-57
Group 6 Travel Device ····· 8-87
Group 7 RCV Lever ····· 8-119
Group 8 Turning Joint ····· 8-133
Group 9 Boom, Arm and Bucket Cylinder ····· 8-138
Group 10 Undercarriage ····· 8-163
Group 11 Work Equipment ····· 8-176

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

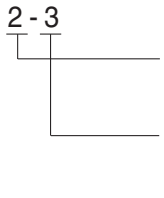
Distribution and updating

Any additions, amendments or other changes will be sent to HD Hyundai Construction Equipment distributors.

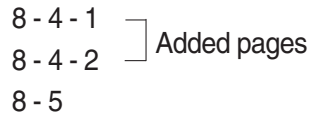
Get the most up-to-date information before you start any work.

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



3. Additional pages : Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.



Revised edition mark (①②③…)

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

Revisions

Revised pages are shown at the list of revised pages on the between the contents page and section 1 page.

Symbols

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

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

Convert 55mm into inches.

(1) Locate the number 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

1mm = 0.03937in

	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

1kg = 2.2046lb

	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

1kgf · m = 7.233lbf · ft

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

kgf/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

Group 1 Safety Hints 1-1
Group 2 Specifications 1-10

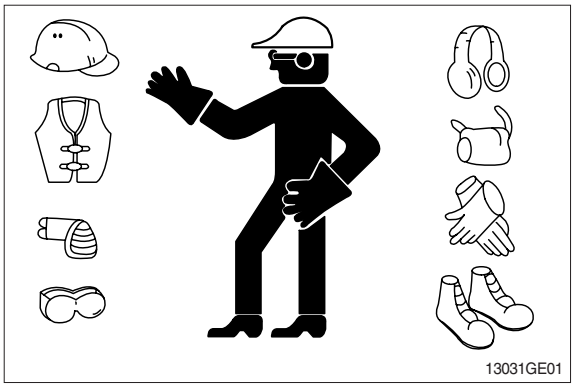
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

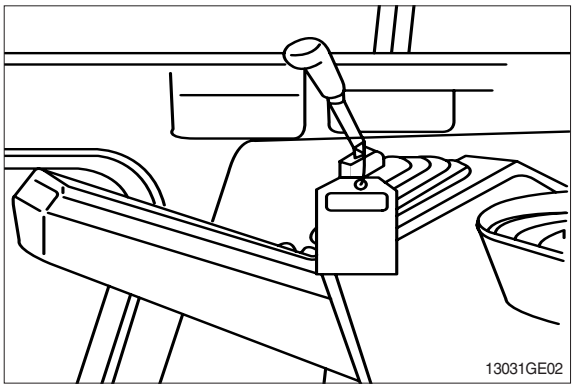
WEAR PROTECTIVE CLOTHING

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



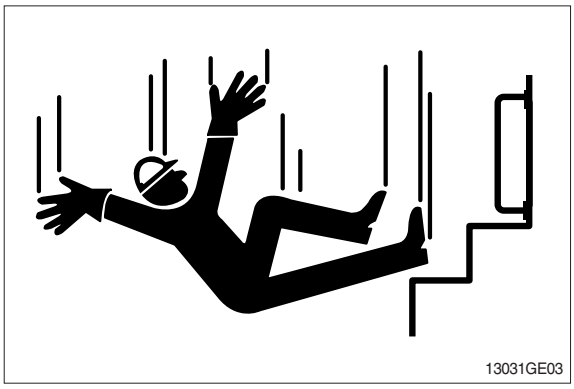
WARN OTHERS OF SERVICE WORK

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.



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.

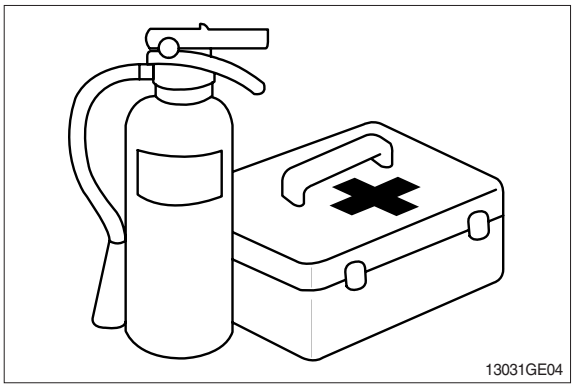


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

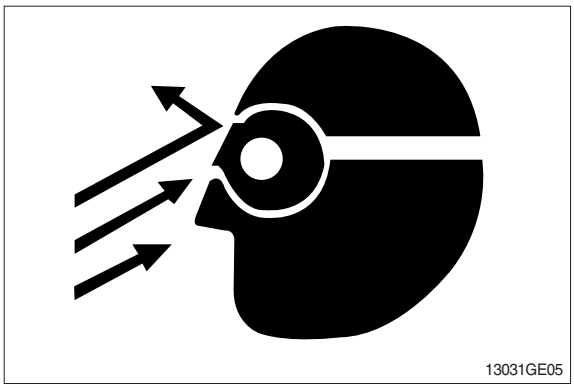
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

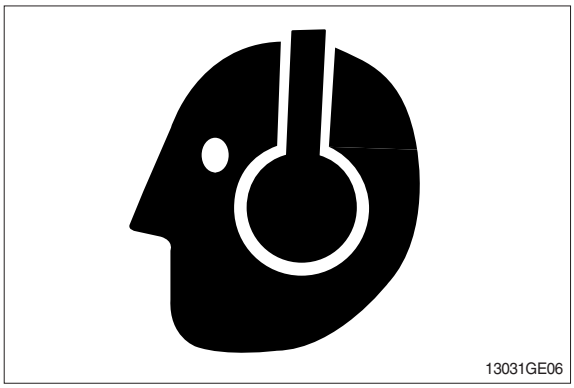
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

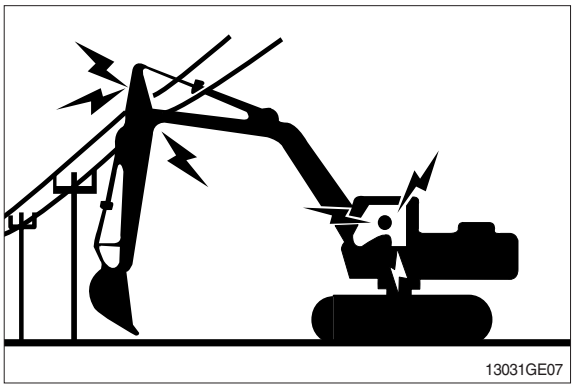
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

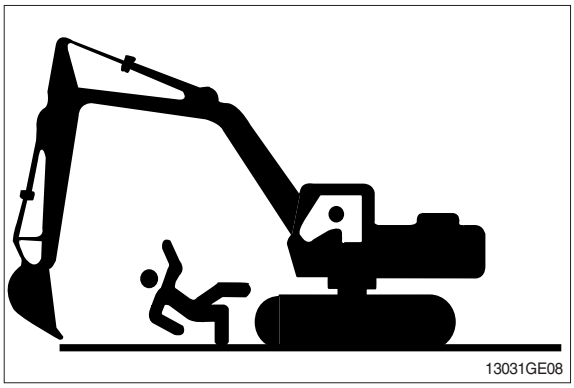
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



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.

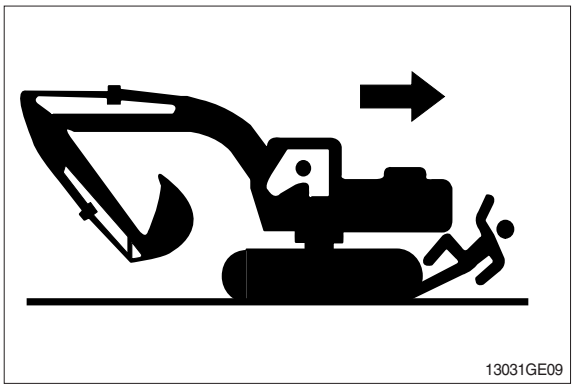

13031GE08

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.

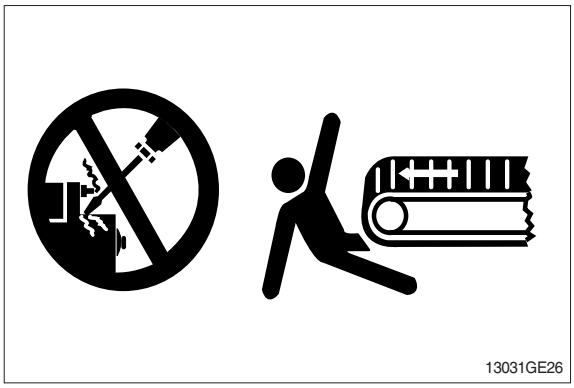
Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.


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

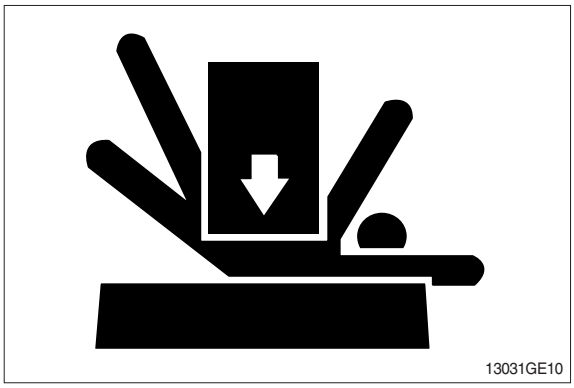
Before working on the machine:

- 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.

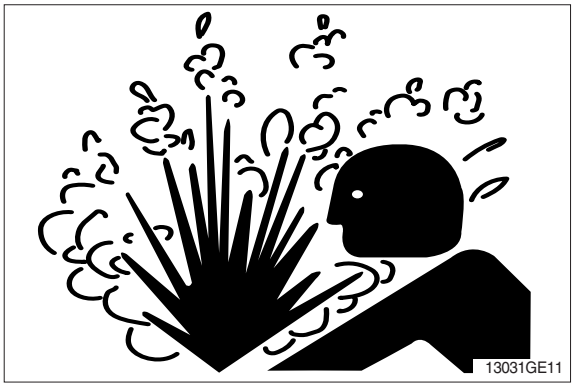
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.


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

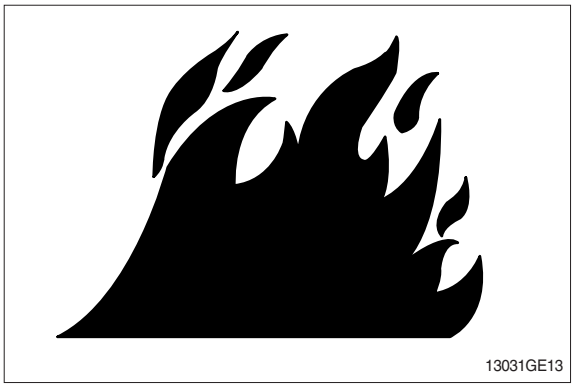
Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.


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.

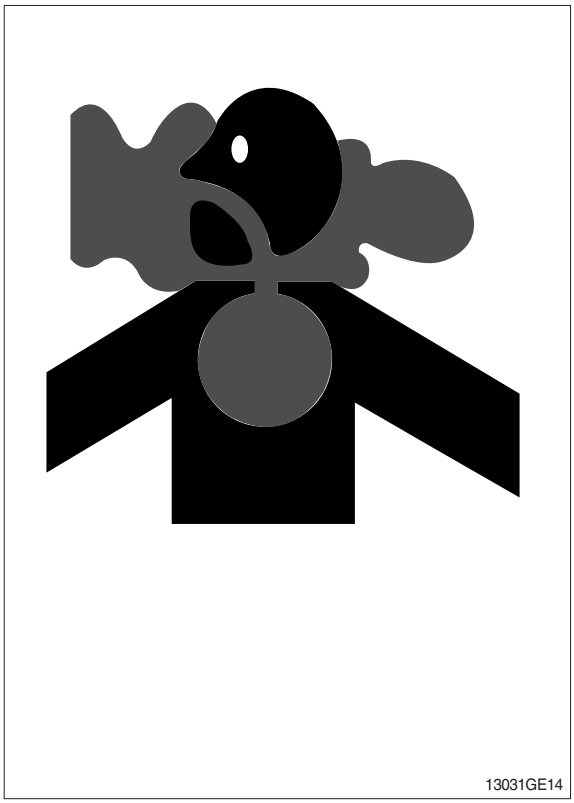
Do not store oily rags; They can ignite and burn spontaneously.


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.

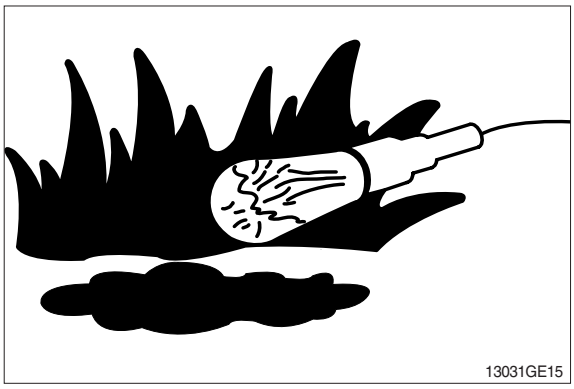
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

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

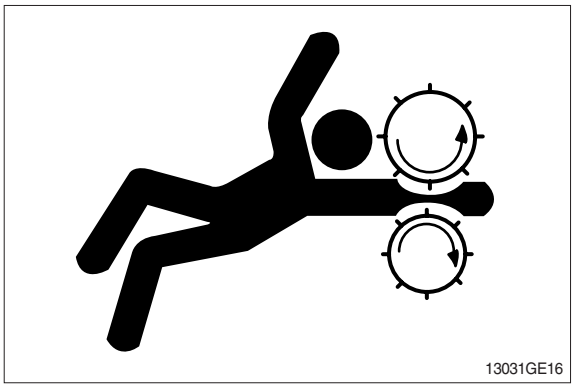
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.


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.

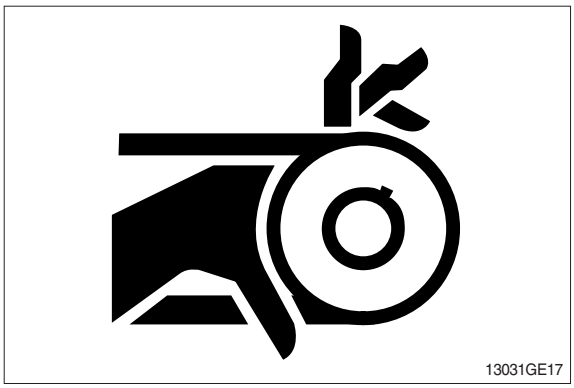
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



AVOID HIGH PRESSURE FLUIDS

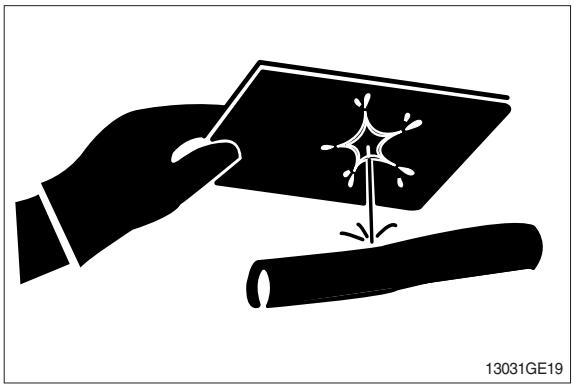
Escaping fluid under pressure can penetrate the skin causing serious injury.

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.





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 do not charge a frozen battery; It may explode. Warm battery to 16 ℃ (60 ℉).


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:

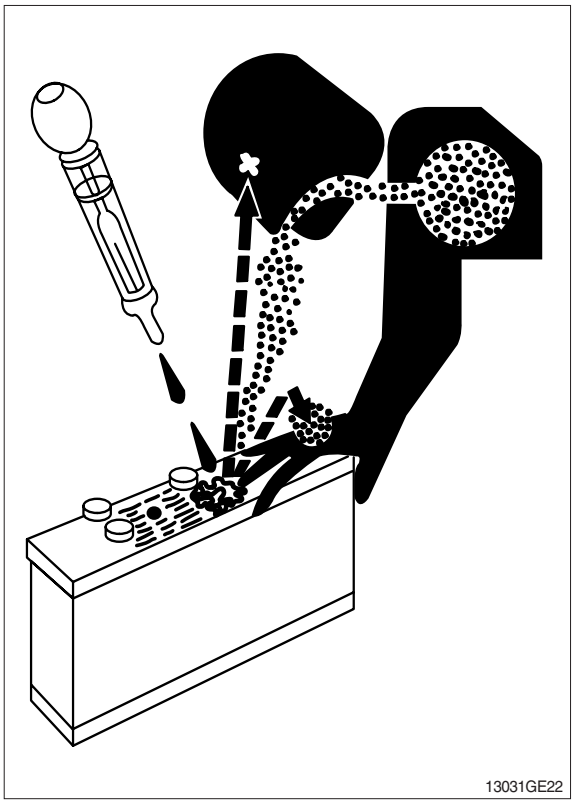
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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.



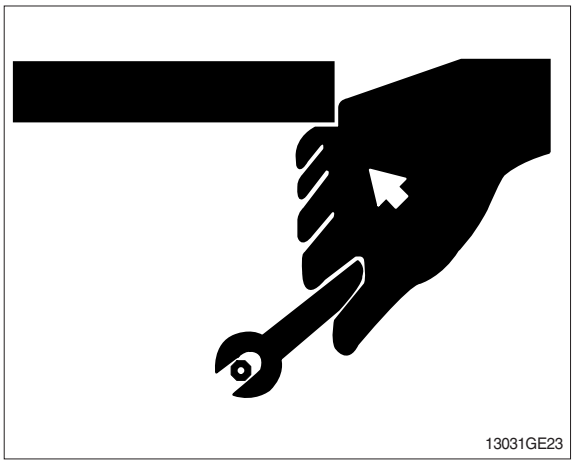
USE TOOLS PROPERLY

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 manual.)

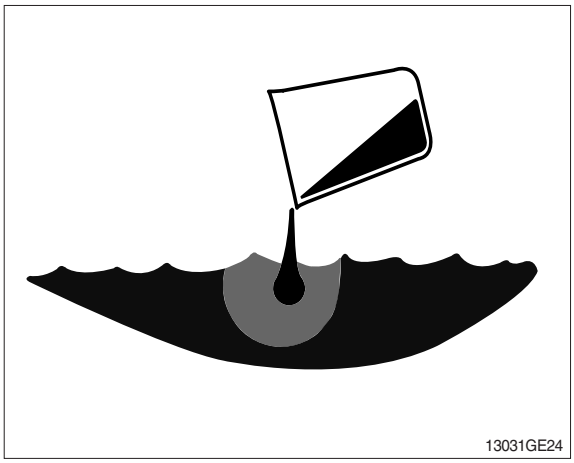


DISPOSE OF FLUIDS PROPERLY

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.

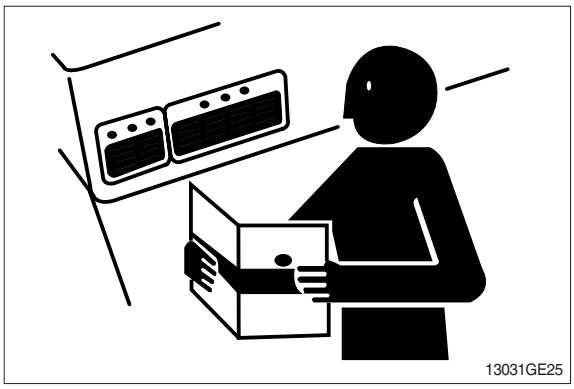
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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.

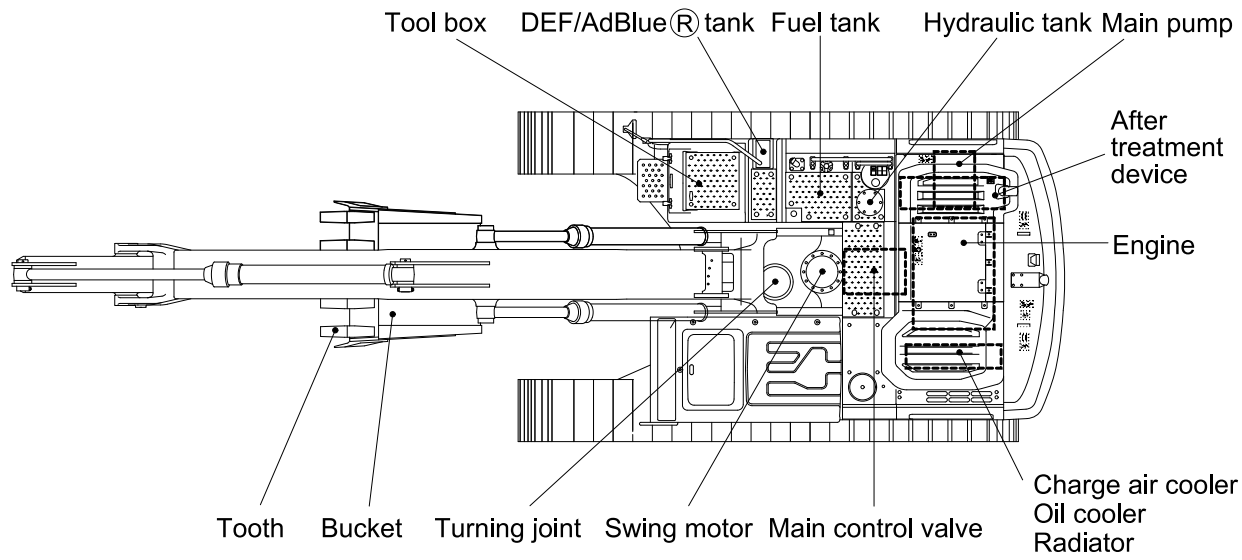

13031GE25

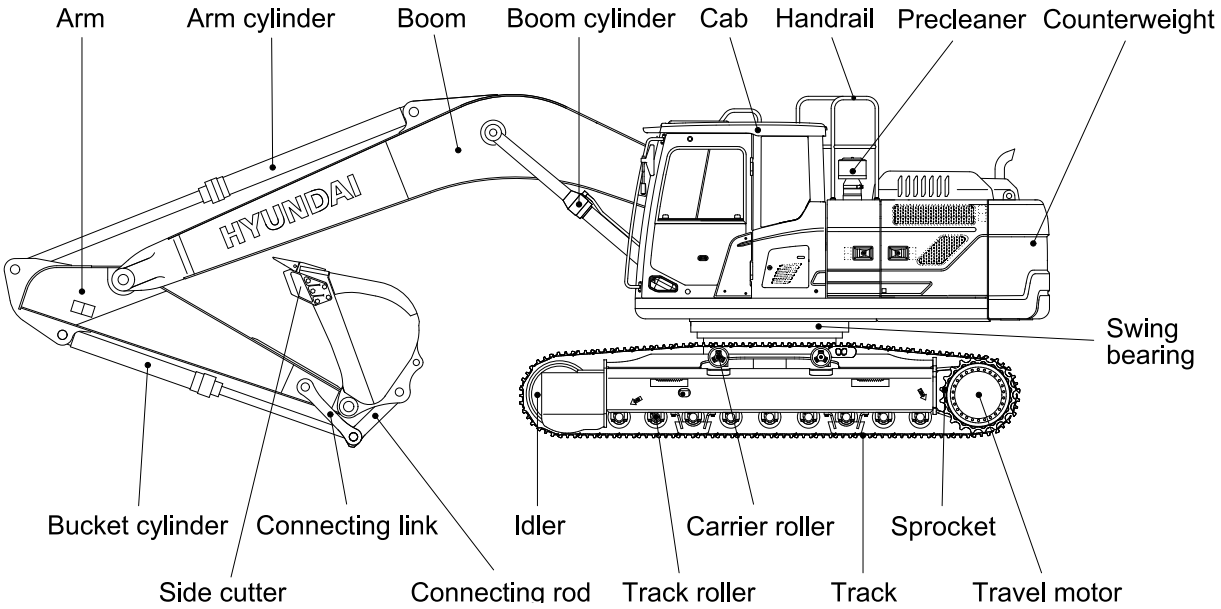
LIVE WITH SAFETY

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

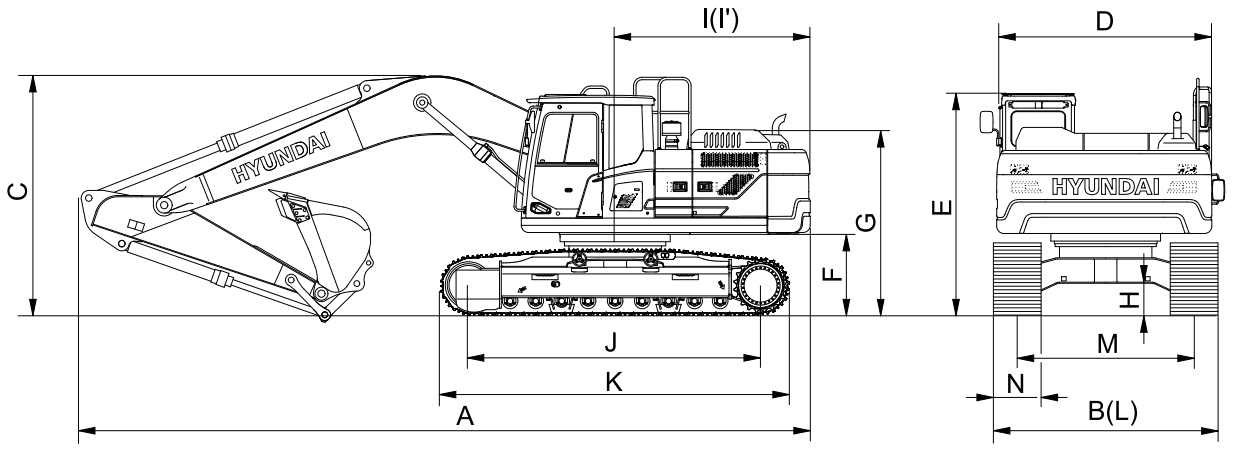




220A2SP01

2. SPECIFICATIONS

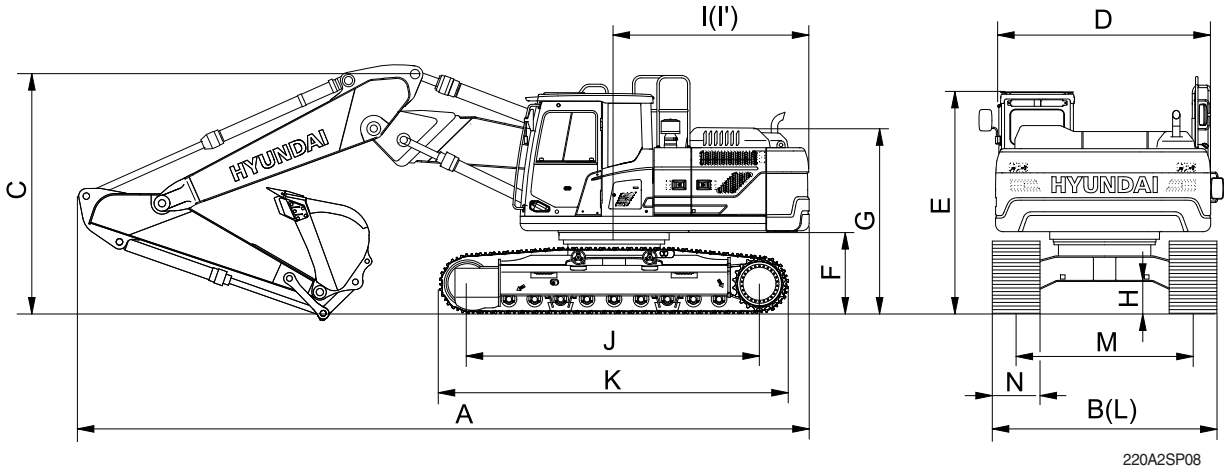
1) HX220A L, MONO BOOM



220A2SP02

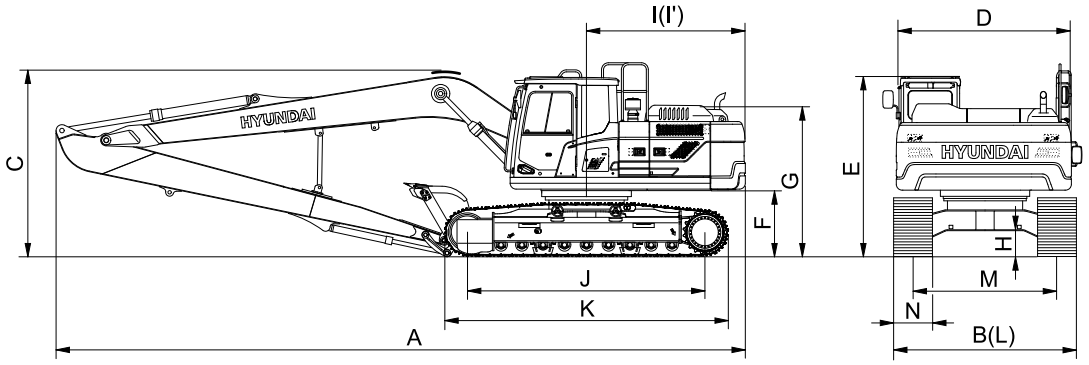
Description		Unit		Specification			
		m (ft-in)	Boom	5.70 (18' 8")			
			Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")	3.50 (11' 6")
		mm (in)	Shoe	600 (24)			
Operating weight		kg (lb)		22280 (49120)	22130 (48790)	22190 (48920)	22510 (49630)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.92 (1.2)	0.92 (1.2)	0.92 (1.2)	0.92 (1.2)
Overall length	A	mm (ft-in)		9550 (31' 4")	9620 (31' 7")	9575 (31' 5")	9560 (31' 4")
Overall width	B			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Overall height of boom	C			2960 (9' 9")	3115 (10' 3")	3020 (9' 11")	3320 (10' 11")
Superstructure width	D			2740 (9' 0")	2740 (9' 0")	2740 (9' 0")	2740 (9' 0")
Overall height of cab	E			3035 (9' 11")	3035 (9' 11")	3035 (9' 11")	3035 (9' 11")
Ground clearance of counterweight	F			1115 (3' 8")	1115 (3' 8")	1115 (3' 8")	1115 (3' 8")
Overall height of engine hood	G			2520 (8' 3")	2520 (8' 3")	2520 (8' 3")	2520 (8' 3")
Overall height of guardrail	G'			3245 (10' 8")	3245 (10' 8")	3245 (10' 8")	3245 (10' 8")
Minimum ground clearance	H			475 (1' 7")	475 (1' 7")	475 (1' 7")	475 (1' 7")
Rear-end distance	I			2770 (9' 1")	2770 (9' 1")	2770 (9' 1")	2770 (9' 1")
Rear-end swing radius	I'			2890 (9' 6")	2890 (9' 6")	2890 (9' 6")	2890 (9' 6")
Distance between tumblers	J			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Undercarriage length	K			4395 (14' 5")	4395 (14' 5")	4395 (14' 5")	4395 (14' 5")
Undercarriage width	L			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Track gauge	M			2390 (7' 10")	2390 (7' 10")	2390 (7' 10")	2390 (7' 10")
Track shoe width, standard	N			600 (24")	600 (24")	600 (24")	600 (24")
Travel speed (low/high)		km/hr (mph)		3.5/5.4 (2.2/3.4)	3.5/5.4 (2.2/3.4)	3.5/5.4 (2.2/3.4)	3.5/5.4 (2.2/3.4)
Swing speed		rpm		11.4	11.4	11.4	11.4
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.48 (6.76)	0.47 (6.72)	0.47 (6.74)	0.48 (6.83)
Max traction force		kg (lb)		20830 (45922)	20830 (45922)	20830 (45922)	20830 (45922)

2) HX220A L, 2-PIECE BOOM



Description		Unit		Specification		
		m (ft-in)	Boom	5.87 (19' 3")		
			Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")
		mm (in)	Shoe	600 (24)	600 (24)	600 (24)
Operating weight		kg (lb)		22990 (50680)	22840 (50350)	22900 (50490)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.92 (1.2)	0.92 (1.2)	0.92 (1.2)
Overall length	A	mm (ft-in)		9715 (31' 10")	9750 (32' 0")	9725 (31' 11")
Overall width	B			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Overall height of boom	C			3035 (9' 11")	3010 (9' 11")	3015 (9' 11")
Superstructure width	D			2740 (9' 0")	2740 (9' 0")	2740 (9' 0")
Overall height of cab	E			3035 (9' 11")	3035 (9' 11")	3035 (9' 11")
Ground clearance of counterweight	F			1115 (3' 8")	1115 (3' 8")	1115 (3' 8")
Overall height of engine hood	G			2520 (8' 3")	2520 (8' 3")	2520 (8' 3")
Overall height of guardrail	G'			3245 (10' 6")	3245 (10' 6")	3245 (10' 6")
Minimum ground clearance	H			475 (1' 7")	475 (1' 7")	475 (1' 7")
Rear-end distance	I			2770 (9' 1")	2770 (9' 1")	2770 (9' 1")
Rear-end swing radius	I'			2890 (9' 6")	2890 (9' 6")	2890 (9' 6")
Distance between tumblers	J			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Undercarriage length	K			1395 (14' 5")	1395 (14' 5")	1395 (14' 5")
Undercarriage width	L			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Track gauge	M			2390 (7' 10")	2390 (7' 10")	2390 (7' 10")
Track shoe width, standard	N			600 (24")	600 (24")	600 (24")
Travel speed (low/high)		km/hr (mph)		3.5/5.4 (2.2/3.4)	3.5/5.4 (2.2/3.4)	3.5/5.4 (2.2/3.4)
Swing speed		rpm		11.2	11.2	11.2
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.49 (6.98)	0.49 (6.98)	0.49 (6.98)
Max traction force		kg (lb)		20830 (45922)	20830 (45922)	20830 (45922)

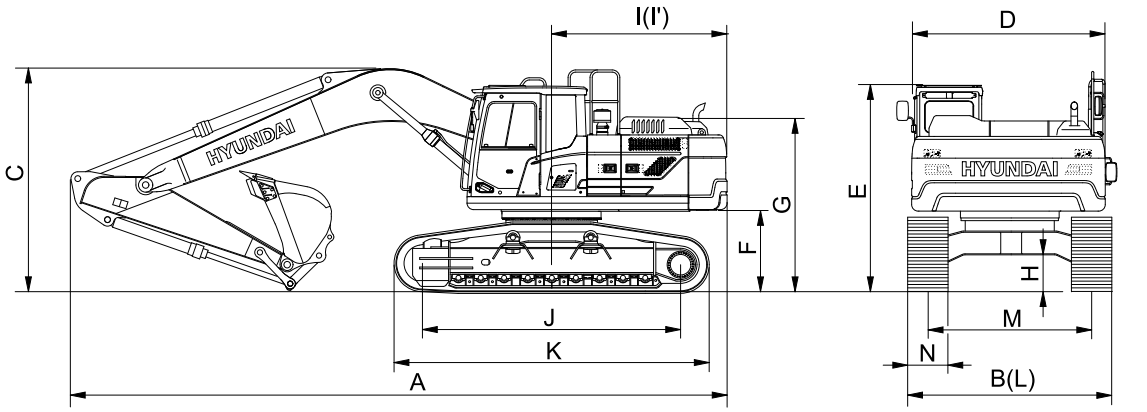
3) HX220A LR



220A2SP03

Description		Unit		Specification
		m (ft-in)	Boom	8.50 (27' 11")
			Arm	6.20 (20' 4")
		mm (in)	Shoe	800 (32)
Operating weight		kg (lb)		25420 (56040)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.92 (1.2)
Overall length	A	mm (ft-in)		12345 (40' 6")
Overall width	B			3190 (10' 6")
Overall height of boom	C			3365 (11' 0")
Superstructure width	D			2740 (9' 0")
Overall height of cab	E			3035 (9' 11")
Ground clearance of counterweight	F			1115 (3' 8")
Overall height of engine hood	G			2520 (8' 3")
Overall height of guardrail	G'			3245 (10' 8")
Minimum ground clearance	H			475 (1' 7")
Rear-end distance	I			2770 (9' 1")
Rear-end swing radius	I'			2890 (9' 6")
Distance between tumblers	J			3650 (12' 0")
Undercarriage length	K			4395 (14' 5")
Undercarriage width	L			3190 (10' 6")
Track gauge	M			2390 (7' 10")
Track shoe width, standard	N			800 (32")
Travel speed (low/high)		km/hr (mph)		3.5/5.4 (2.2/3.4)
Swing speed		rpm		11.4
Gradeability		Degree (%)		35 (70)
Ground pressure		kgf/cm^2 (psi)		0.41 (5.79)
Max traction force		kg (lb)		20830 (45922)

4) HX220A HW, MONO BOOM

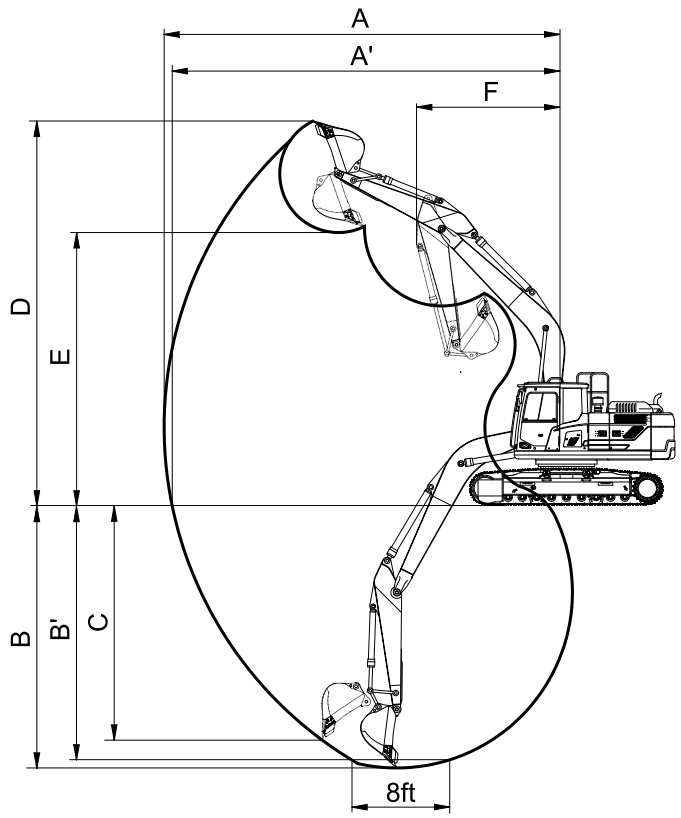


220A2SP04

Description		Unit		Specification			
		m (ft-in)	Boom	5.70 (18' 8")			
			Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")	3.50 (11' 6")
		mm (in)	Shoe	600 (24)			
Operating weight		kg (lb)		24410 (53820)	24250 (53460)	24320 (53610)	24640 (54320)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.92 (1.2)	0.92 (1.2)	0.92 (1.2)	0.92 (1.2)
Overall length	A	mm (ft-in)		9515 (31' 3")	9625 (31' 7")	9560 (31' 4")	9575 (31' 5")
Overall width	B			3395 (11' 2")	3395 (11' 2")	3395 (11' 2")	3395 (11' 2")
Overall height of boom	C			2975 (9' 9")	3195 (10' 6")	3090 (10' 2")	3275 (10' 9")
Superstructure width	D			2740 (9' 0")	2740 (9' 0")	2740 (9' 0")	2740 (9' 0")
Overall height of cab	E			3200 (10' 6")	3200 (10' 6")	3200 (10' 6")	3200 (10' 6")
Ground clearance of counterweight	F			1260 (4' 2")	1260 (4' 2")	1260 (4' 2")	1260 (4' 2")
Overall height of engine hood	G			2720 (8' 11")	2720 (8' 11")	2720 (8' 11")	2720 (8' 11")
Overall height of guardrail	G'			3410 (11' 2")	3410 (11' 2")	3410 (11' 2")	3410 (11' 2")
Minimum ground clearance	H			660 (2' 2")	660 (2' 2")	660 (2' 2")	660 (2' 2")
Rear-end distance	I			2770 (9' 1")	2770 (9' 1")	2770 (9' 1")	2770 (9' 1")
Rear-end swing radius	I'			2890 (9' 6")	2890 (9' 6")	2890 (9' 6")	2890 (9' 6")
Distance between tumblers	J			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Undercarriage length	K			4404 (14' 5")	4404 (14' 5")	4404 (14' 5")	4404 (14' 5")
Undercarriage width	L			3395 (11' 2")	3395 (11' 2")	3395 (11' 2")	3395 (11' 2")
Track gauge	M			2795 (9' 2")	2795 (9' 2")	2795 (9' 2")	2795 (9' 2")
Track shoe width, standard	N			600 (24")	600 (24")	600 (24")	600 (24")
Travel speed (low/high)		km/hr (mph)		2.9 (5.1)	2.9 (5.1)	2.9 (5.1)	2.9 (5.1)
Swing speed		rpm		11.4	11.4	11.4	11.4
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.50 (7.15)	0.50 (7.11)	0.50 (7.13)	0.51 (7.22)
Max traction force		kg (lb)		22190 (48921)	22190 (48921)	22190 (48921)	22190 (48921)

3. WORKING RANGE AND DIGGING FORCE

1) HX220A L, MONO BOOM

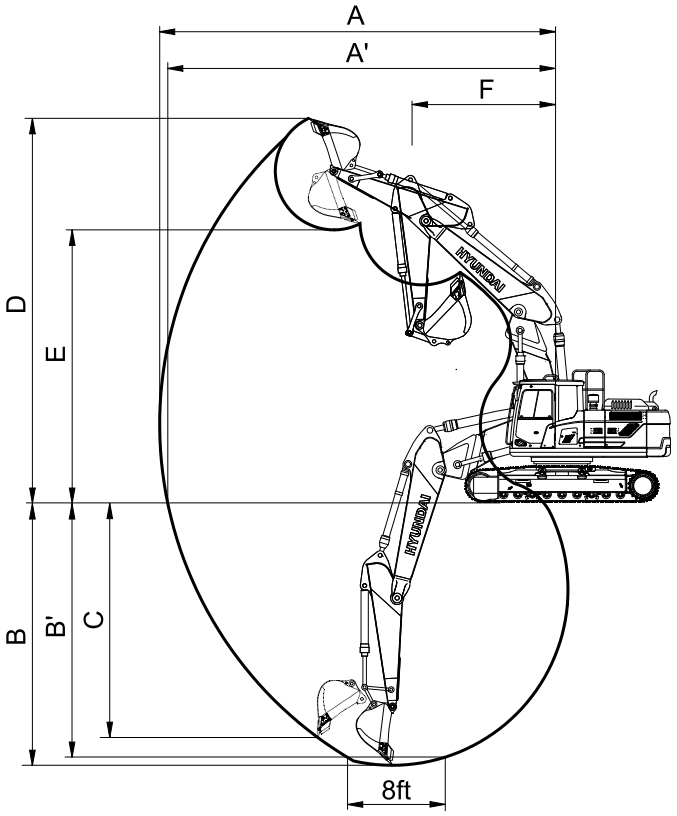


220A2SP05

Description	m (ft-in)	Boom	5.70 (18' 8")			
		Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")	3.50 (11' 6")
Max digging reach	mm (ft-in)	A	9945 (32' 8")	9145 (30' 0")	9525 (31' 3")	10450 (34' 3")
Max digging reach on ground		A'	9780 (32' 1")	8960 (29' 5")	9355 (30' 8")	10290 (33' 9")
Max digging depth		B	6500 (21' 4")	5585 (18' 4")	5990 (19' 8")	7090 (23' 3")
Max digging depth (8 ft level)		B'	6315 (20' 9")	5360 (17' 7")	5790 (19' 0")	6935 (22' 9")
Max vertical wall digging depth		C	5960 (19' 7")	5070 (16' 8")	5445 (17' 10")	6330 (20' 9")
Max digging height		D	9750 (32' 0")	9370 (30' 9")	9625 (31' 7")	9890 (32' 5")
Max dumping height		E	6990 (22' 11")	6580 (21' 7")	6380 (22' 5")	7160 (23' 6")
Min swing radius		F	3425 (11' 3")	3715 (12' 2")	3400 (11' 2")	3445 (11' 4")
Bucket digging force	kN	SAE	130.4 [141.6]	130.4 [141.6]	130.4 [141.6]	130.4 [141.6]
	kgf		13300 [14440]	13300 [14440]	13300 [14440]	13300 [14440]
	lbf		29320 [31830]	29320 [31830]	29320 [31830]	29320 [31830]
	kN	ISO	152.3 [165.3]	152.3 [165.3]	152.3 [165.3]	152.3 [165.3]
	kgf		15530 [16860]	15530 [16860]	15530 [16860]	15530 [16860]
	lbf		34240 [37170]	34240 [37170]	34240 [37170]	34240 [37170]
Arm digging force	kN	SAE	102.8 [111.6]	144.3 [156.6]	119.3 [129.4]	92.2 [100.1]
	kgf		10480 [11380]	14710 [15970]	12160 [13200]	9400 [10210]
	lbf		23100 [25090]	32430 [35210]	26810 [29100]	20720 [22510]
	kN	ISO	106.9 [116.0]	152.0 [165.0]	124.7 [135.4]	95.4 [103.6]
	kgf		10900 [11830]	15500 [16830]	12720 [13810]	9730 [10560]
	lbf		24030 [26080]	34170 [37100]	28040 [30450]	21450 [23280]

[ ] : Power boost

2) HX220A L, 2-PIECE BOOM

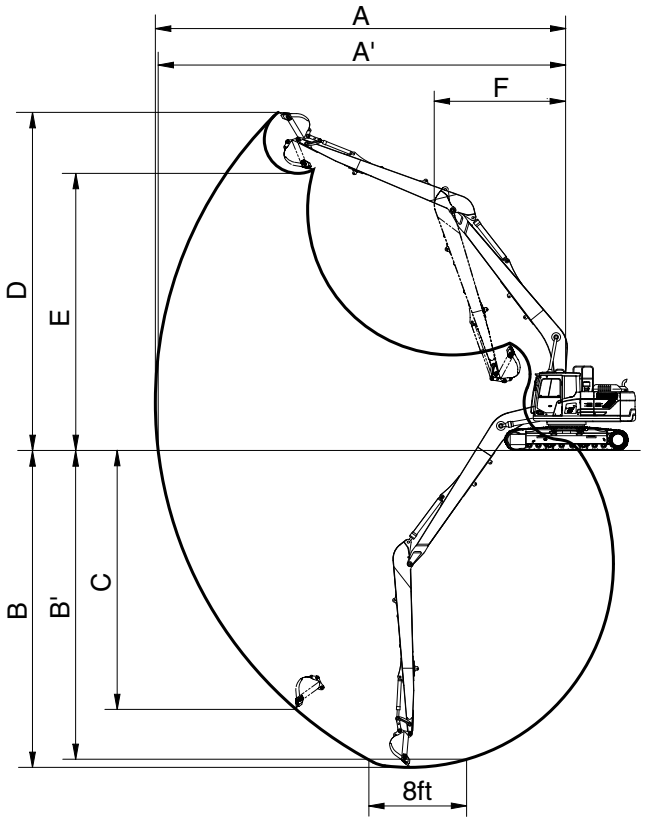


220A2SP10

Description	m (ft-in)	Boom	5.87 (19' 3")		
		Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")
Max digging reach	mm (ft-in)	A	10215 (33' 6")	9380 (30' 9")	9775 (32' 1")
Max digging reach on ground		A'	10055 (33' 0")	9205 (30' 2")	9605 (31' 6")
Max digging depth		B	6410 (21' 0")	5535 (18' 2")	5940 (19' 6")
Max digging depth (8 ft level)		B'	6305 (20' 8")	5415 (17' 9")	5825 (19' 1")
Max vertical wall digging depth		C	4160 (13' 8")	3405 (11' 2")	3690 (12' 1")
Max digging height		D	11430 (37' 6")	10730 (35' 2")	11090 (36' 5")
Max dumping height		E	8500 (27' 11")	7800 (25' 7")	8160 (26' 9")
Min swing radius		F	2610 (8' 7")	2820 (9' 3")	2700 (8' 10")
Bucket digging force	kN	SAE	130.4 [141.6]	130.4 [141.6]	130.4 [141.6]
	kgf		13300 [14440]	13300 [14440]	13300 [14440]
	lbf		29320 [31830]	29320 [31830]	29320 [31830]
	kN	ISO	152.3 [165.3]	152.3 [165.3]	152.3 [165.3]
	kgf		15530 [16860]	15530 [16860]	15530 [16860]
	lbf		34240 [37170]	34240 [37170]	34240 [37170]
Arm digging force	kN	SAE	102.8 [111.6]	144.3 [156.6]	119.3 [129.4]
	kgf		10480 [11380]	14710 [15970]	12160 [13200]
	lbf		23100 [25090]	32430 [35210]	26810 [29100]
	kN	ISO	106.9 [116.0]	152.0 [165.0]	124.7 [135.4]
	kgf		10900 [11830]	15500 [16830]	12720 [13810]
	lbf		24030 [26080]	34170 [37100]	28040 [30450]

[ ] : Power boost

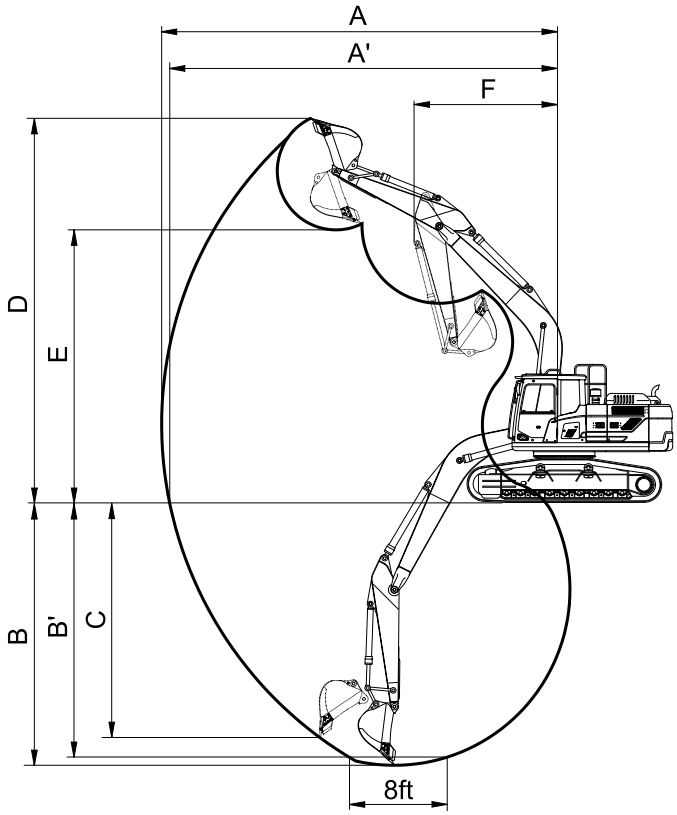
3) HX220A LR



220A2SP06A

Description	m (ft-in)	Boom	8.50 (27' 11")
		Arm	6.20 (20' 4")
Max digging reach	mm (ft-in)	A	15425 (50' 7")
Max digging reach on ground		A'	15320 (50' 3")
Max digging depth		B	11500 (37' 9")
Max digging depth (8 ft level)		B'	11355 (37' 3")
Max vertical wall digging depth		C	10265 (33' 8")
Max digging height		D	13445 (44' 1")
Max dumping height		E	11200 (36' 9")
Min swing radius		F	4705 (15' 5")
Bucket digging force	kN	SAE	68.0
	kgf		6930
	lbf		15280
	kN	ISO	80.3
	kgf		8190
	lbf		18060
Arm digging force	kN	SAE	49.5
	kgf		5050
	lbf		11130
	kN	ISO	111.3
	kgf		11350
	lbf		25020

4) HX220A HW



220A2SP07

Description	m (ft-in)	Boom	5.70 (18' 8")			
		Arm	2.90 (9' 6")	2.00 (6' 7")	2.40 (7' 10")	3.50 (11' 6")
Max digging reach	mm (ft-in)	A	9945 (32' 8")	9145 (30' 0")	9525 (31' 3")	10450 (34' 3")
Max digging reach on ground		A'	9740 (31' 11")	8920 (29' 3")	9310 (30' 7")	10255 (33' 8")
Max digging depth		B	6290 (20' 8")	5385 (17' 8")	5785 (19' 0")	6890 (22' 7")
Max digging depth (8 ft level)		B'	6115 (20' 1")	5160 (16' 11")	5590 (18' 4")	6735 (22' 1")
Max vertical wall digging depth		C	5760 (18' 11")	4870 (16' 0")	5245 (17' 2")	6130 (20' 1")
Max digging height		D	9950 (32' 8")	9570 (31' 5")	9825 (32' 3")	10090 (33' 1")
Max dumping height		E	7190 (23' 7")	6780 (22' 3")	7030 (23' 1")	7360 (24' 2")
Min swing radius		F	3425 (11' 3")	3715 (12' 2")	3340 (10' 11")	3445 (11' 4")
Bucket digging force	kN	SAE	130.4 [141.6]	130.4 [141.6]	130.4 [141.6]	130.4 [141.6]
	kgf		13300 [14440]	13300 [14440]	13300 [14440]	13300 [14440]
	lbf		29320 [31830]	29320 [31830]	29320 [31830]	29320 [31830]
	kN	ISO	152.3 [165.3]	152.3 [165.3]	152.3 [165.3]	152.3 [165.3]
	kgf		15530 [16860]	15530 [16860]	15530 [16860]	15530 [16860]
	lbf		34240 [37170]	34240 [37170]	34240 [37170]	34240 [37170]
Arm digging force	kN	SAE	102.8 [111.6]	144.3 [156.6]	119.3 [129.4]	92.2 [100.1]
	kgf		10480 [11380]	14710 [15970]	12160 [13200]	9400 [10210]
	lbf		23100 [25090]	32430 [35210]	26810 [29100]	20720 [22510]
	kN	ISO	106.9 [116.0]	152.0 [165.0]	124.7 [135.4]	95.4 [103.6]
	kgf		10900 [11830]	15500 [16830]	12720 [13810]	9730 [10560]
	lbf		24030 [26080]	34170 [37100]	28040 [30450]	21450 [23280]

[ ] : Power boost

4. WEIGHT

Item	HX220A L		HX220A LR		HX220A HW	
	kg	lb	kg	lb	kg	lb
Upperstructure assembly						
· Main frame weld assembly	1,890	4,170	1,890	4,170	1,930	4,260
· Engine assembly	583	1,285	583	1,285	583	1,285
· Aftertreatment assembly	74	162	74	162	74	162
· Main pump assembly	140	309	140	309	140	309
· Main control valve assembly	220	485	220	485	220	485
· Swing motor assembly	240	529	240	529	240	529
· Hydraulic oil tank WA	220	485	220	485	220	485
· Fuel tank WA	210	463	210	463	210	463
· Counterweight	3,800	8,380	5,300	11,680	3,800	8,380
· Cab assembly	490	1,080	490	1,080	490	1,080
Lower chassis assembly						
· Track frame weld assembly	2,530	5,580	2,530	5,580	3,605	7,950
· Swing bearing	280	620	280	620	299	660
· Travel motor assembly (2EA)	609	1,340	609	1,340	609	1,340
· Turning joint	57	130	57	130	57	130
· Sprocket (2EA)	112	247	112	247	103	227
· Track recoil spring (2EA)	279	615	279	615	326	719
· Idler (2EA)	301	664	301	664	301	664
· Upper roller (2EA)	93	205	93	205	177	390
· Lower roller (18EA)	797	1,757	797	1,757	797	1,757
· Track-chain assembly (600 mm triple grouser shoe) (2EA)	2,712	5,979	-	-	2,902	6,398
· Track-chain assembly (700 mm triple grouser shoe) (2EA)	3,184	7,020	-	-	3,184	7,020
· Track-chain assembly (800 mm triple grouser shoe) (2EA)	3,468	7,646	3,468	7,646	3,468	7,646
· Track-chain assembly (900 mm triple grouser shoe) (2EA)	3,750	8,267	-	-	3,750	8,267
· Track-chain assembly (700 mm double grouser shoe) (2EA)	3,458	7,624	-	-	3,458	7,624
Front attachment assembly						
· 5.68 m boom assembly	1,520	3,351	-	-	1,520	3,351
· 2.92 m arm assembly	760	1,676	-	-	760	1,676
· 0.92 m^3 SAE heaped bucket	820	1,808	-	-	820	1,808
· 8.2 m boom assembly	-	-	2,110	4,652	-	-
· 6.3 m arm assembly	-	-	1,100	2,425	-	-
· 0.52 m^3 SAE heaped bucket	-	-	470	1,036	-	-
· Boom cylinder assembly (2EA)	180	397	180	397	180	397
· Arm cylinder assembly	280	617	270	595	280	617
· Bucket cylinder assembly	170	375	100	220	170	375
· Bucket control linkage total	200	441	170	375	200	441

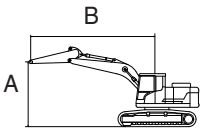
※ This information is different with operating and transportation weight because it is not including harness, pipe, oil, fuel so on.

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

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5700	2900	3800	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)		Capacity		Reach
														m (ft)
7.5 m (24.6 ft)	kg							*4920	*4920			*4330	*4330	6.21
	lb							*10850	*10850			*9550	*9550	(20.4)
6.0 m (19.7 ft)	kg							*4830	*4830			*4030	3980	7.34
	lb							*10650	*10650			*8880	8770	(24.1)
4.5 m (14.8 ft)	kg					*6130	*6130	*5330	*5330	*4960	3800	*3960	3390	8.03
	lb					*13510	*13510	*11750	*11750	*10930	8380	*8730	7470	(26.3)
3.0 m (9.8 ft)	kg					*7880	7870	*6120	5150	*5300	3700	*4060	3100	8.39
	lb					*17370	17350	*13490	11350	*11680	8160	*8950	6830	(27.5)
1.5 m (4.9 ft)	kg					*9500	7350	*6940	4910	5540	3580	*4320	2990	8.48
	lb					*20940	16200	*15300	10820	12210	7890	*9520	6590	(27.8)
0.0 m (0.0 ft)	kg			*4930	*4930	*10340	7080	*7510	4740	5450	3490	4730	3050	8.28
	lb			*10870	*10870	*22800	15610	*16560	10450	12020	7690	10430	6720	(27.2)
-1.5 m (-4.9 ft)	kg	*5620	*5620	*9410	*9410	*10370	7000	7470	4660	5410	3460	5130	3290	7.80
	lb	*12390	*12390	*20750	*20750	*22860	15430	16470	10270	11930	7630	11310	7250	(25.6)
-3.0 m (-9.8 ft)	kg			*13620	*13620	*9630	7060	*7140	4700			*5810	3880	6.96
	lb			*30030	*30030	*21230	15560	*15740	10360			*12810	8550	(22.8)
-4.5 m (-14.8 ft)	kg			*10720	*10720	*7730	7280					*5820	5370	5.60
	lb			*23630	*23630	*17040	16050					*12830	11840	(18.4)

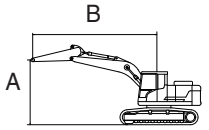
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5700	2000	3800	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 (24.6 ft)	kg									*6130	*6130	5.05
	lb									*13510	*13510	(16.6)
6.0 m (19.7 ft)	kg			*6180	*6180	*5780	5450			*5810	4910	6.39
	lb			*13620	*13620	*12740	12020			*12810	10820	(21.0)
4.5 m (14.8 ft)	kg			*7370	*7370	*6130	5330			*5780	4040	7.17
	lb			*16250	*16250	*13510	11750			*12740	8910	(23.5)
3.0 m (9.8 ft)	kg					*6820	5110	5670	3700	5570	3640	7.58
	lb					*15040	11270	12500	8160	12280	8020	(24.9)
1.5 m (4.9 ft)	kg					*7480	4920	5580	3630	5400	3520	7.67
	lb					*16490	10850	12300	8000	11900	7760	(25.2)
0.0 m (0.0 ft)	kg			*10600	7160	7620	4810			5580	3610	7.46
	lb			*23370	15790	16800	10600			12300	7960	(24.5)
-1.5 m (-4.9 ft)	kg			*10130	7180	*7580	4800			6220	4000	6.92
	lb			*22330	15830	*16710	10580			13710	8820	(22.7)
-3.0 m (-9.8 ft)	kg	*11600	*11600	*8810	7310					*6360	4990	5.95
	lb	*25570	*25570	*19420	16120					*14020	11000	(19.5)

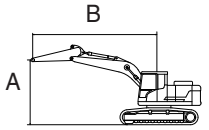
Note 1. Lifting capacity are based on ISO 10567.
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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5700	2400	3800	600	-	-	-	-	-

· : 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 (24.6 ft)	kg									*5580	*5580	5.62
	lb									*12300	*12300	(18.4)
6.0 m (19.7 ft)	kg					*5340	*5340			*5390	4420	6.85
	lb					*11770	*11770			*11880	9740	(22.5)
4.5 m (14.8 ft)	kg			*6830	*6830	*5770	5350	*5380	3770	*5320	3700	7.58
	lb			*15060	*15060	*12720	11790	*11860	8310	*11730	8160	(24.9)
3.0 m (9.8 ft)	kg			*8560	7740	*6520	5120	*5610	3700	5160	3370	7.97
	lb			*18870	17060	*14370	11290	*12370	8160	11380	7430	(26.1)
1.5 m (4.9 ft)	kg			*9990	7300	*7250	4910	5560	3600	5000	3250	8.06
	lb			*22020	16090	*15980	10820	12260	7940	11020	7170	(26.4)
0.0 m (0.0 ft)	kg			*10530	7110	7580	4770	5490	3530	5150	3330	7.85
	lb			*23210	15670	16710	10520	12100	7780	11350	7340	(25.8)
-1.5 m (-4.9 ft)	kg	*9280	*9280	*10280	7090	7540	4730			5660	3640	7.34
	lb	*20460	*20460	*22660	15630	16620	10430			12480	8020	(24.1)
-3.0 m (-9.8 ft)	kg	*12580	*12580	*9230	7190	*6790	4810			*6060	4400	6.44
	lb	*27730	*27730	*20350	15850	*14970	10600			*13360	9700	(21.1)
-4.5 m (-14.8 ft)	kg			*6610	*6610							
	lb			*14570	*14570							

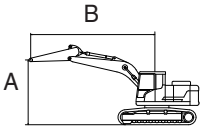
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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A L	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5700	3500	3800	600	-	-	-	-	-

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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)		Capacity		Reach
														m (ft)
7.5 m (24.6 ft)	kg											*3630	*3630	6.89
	lb											*8000	*8000	(22.6)
6.0 m (19.7 ft)	kg									*4310	3890	*3420	*3420	7.92
	lb									*9500	8580	*7540	*7540	(26.0)
4.5 m (14.8 ft)	kg							*4750	*4750	*4490	3820	*3390	3050	8.56
	lb							*10470	*10470	*9900	8420	*7470	6720	(28.1)
3.0 m (9.8 ft)	kg			*10630	*10630	*6990	*6990	*5590	5190	*4900	3690	*3480	2800	8.90
	lb			*23440	*23440	*15410	*15410	*12320	11440	*10800	8140	*7670	6170	(29.2)
1.5 m (4.9 ft)	kg					*8770	7410	*6490	4900	*5370	3550	*3710	2700	8.98
	lb					*19330	16340	*14310	10800	*11840	7830	*8180	5950	(29.5)
0.0 m (0.0 ft)	kg			*6220	*6220	*9930	7020	*7190	4680	5390	3430	*4100	2730	8.80
	lb			*13710	*13710	*21890	15480	*15850	10320	11880	7560	*9040	6020	(28.9)
-1.5 m (-4.9 ft)	kg	*5440	*5440	*9210	*9210	*10290	6870	7370	4570	5320	3360	4580	2920	8.35
	lb	*11990	*11990	*20300	*20300	*22690	15150	16250	10080	11730	7410	10100	6440	(27.4)
-3.0 m (-9.8 ft)	kg	*9050	*9050	*13720	13390	*9900	6880	*7310	4560	5350	3390	5280	3350	7.57
	lb	*19950	*19950	*30250	29520	*21830	15170	*16120	10050	11790	7470	11640	7390	(24.8)
-4.5 m (-14.8 ft)	kg			*12180	*12180	*8570	7040	*6170	4680			*5640	4360	6.34
	lb			*26850	*26850	*18890	15520	*13600	10320			*12430	9610	(20.8)

Note 1. Lifting capacity are based on ISO 10567.

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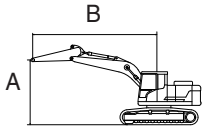
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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A L	2-PIECE BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5874	2900	3800	600	-	-	-	-	-

· : 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
9.0 m (29.5 ft)	kg			*5930	*5930					*5050	*5050	4.83
	lb			*13070	*13070					*11130	*11130	(15.8)
7.5 m (24.6 ft)	kg			*6170	*6170	*5700	5580			*4190	*4190	6.58
	lb			*13600	*13600	*12570	12300			*9240	*9240	(21.6)
6.0 m (19.7 ft)	kg			*6180	*6180	*5930	5550	*4600	3780	*3860	3630	7.65
	lb			*13620	*13620	*13070	12240	*10140	8330	*8510	8000	(25.1)
4.5 m (14.8 ft)	kg	*10240	*10240	*8250	*8250	*6360	5330	*5020	3720	*3760	3110	8.31
	lb	*22580	*22580	*18190	*18190	*14020	11750	*11070	8200	*8290	6860	(27.3)
3.0 m (9.8 ft)	kg			*9440	7670	*7080	5030	*5280	3590	*3810	2840	8.66
	lb			*20810	16910	*15610	11090	*11640	7910	*8400	6260	(28.4)
1.5 m (4.9 ft)	kg			*10140	7080	*7420	4740	5470	3450	*3990	2740	8.74
	lb			*22350	15610	*16360	10450	12060	7610	*8800	6040	(28.7)
0.0 m (0.0 ft)	kg			*9870	6780	*7340	4550	5360	3350	*4350	2790	8.56
	lb			*21760	14950	*16180	10030	11820	7390	*9590	6150	(28.1)
-1.5 m (-4.9 ft)	kg	*7840	*7840	*8760	6730	*6700	4470	*5000	3320	*4190	3020	8.09
	lb	*17280	*17280	*19310	14840	*14770	9850	*11020	7320	*9240	6660	(26.5)
-3.0 m (-9.8 ft)	kg			*6820	*6820	*5260	4530			*3520	*3520	7.29
	lb			*15040	*15040	*11600	9990			*7760	*7760	(23.9)

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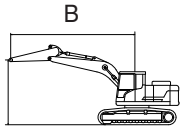
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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A L	LONG REACH	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		8500	6200	5300	800	-	-	-	-	-

· : 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)		10.5 m (34.4 ft)		12.0 m (39.4 ft)		13.5 m (44.3 ft)		Capacity		Reach
																						m (ft)
12.0m	kg																			*770	*770	9.80
39.4ft	lb																			*1700	*1700	(32.1)
10.5m	kg													*1250	*1250					*690	*690	11.17
34.4ft	lb													*2760	*2760					*1520	*1520	(36.7)
9.0m	kg													*1730	*1730	*870	*870			*640	*640	12.21
29.5ft	lb													*3810	*3810	*1920	*1920			*1410	*1410	(40.1)
7.5m	kg													*2020	*2020	*1470	*1470			*620	*620	12.99
24.6ft	lb													*4450	*4450	*3240	*3240			*1370	*1370	(42.6)
6.0m	kg													*2170	*2170	*1850	*1850	*690	*690	*610	*610	13.55
19.7ft	lb													*4780	*4780	*4080	*4080	*1520	*1520	*1340	*1340	(44.5)
4.5m	kg											*2530	*2530	*2350	*2350	*2170	2100	*1150	*1150	*620	*620	13.94
14.8ft	lb											*5580	*5580	*5180	*5180	*4780	4630	*2540	*2540	*1370	*1370	(45.7)
3.0m	kg					*5420	*5420	*4030	*4030	*3300	*3300	*2850	*2850	*2560	2530	*2360	2010	*1440	*1440	*640	*640	14.15
9.8ft	lb					*11950	*11950	*8880	*8880	*7280	*7280	*6280	*6280	*5640	5580	*5200	4430	*3170	*3170	*1410	*1410	(46.4)
1.5m	kg					*6960	*6960	*4870	*4870	*3810	*3810	*3180	3030	*2780	2390	*2510	1910	*1600	1540	*680	*680	14.20
4.9ft	lb					*15340	*15340	*10740	*10740	*8400	*8400	*7010	6680	*6130	5270	*5530	4210	*3530	3400	*1500	*1500	(46.6)
0.0m	kg			*2220	*2220	*5360	*5360	*5550	4900	*4260	3650	*3490	2830	*2990	2260	*2650	1830	*1610	1490	*740	*740	14.08
0.0ft	lb			*4890	*4890	*11820	*11820	*12240	10800	*9390	8050	*7690	6240	*6590	4980	*5840	4030	*3550	3280	*1630	*1630	(46.2)
-1.5m	kg	*2100	*2100	*2900	*2900	*5130	*5130	*6000	4600	*4600	3430	*3740	2680	*3170	2150	*2760	1760	*1360	*1360	*810	*810	13.81
-4.9ft	lb	*4630	*4630	*6390	*6390	*11310	*11310	*13230	10140	*10140	7560	*8250	5910	*6990	4740	*6080	3880	*3000	*3000	*1790	*1790	(45.3)
-3.0m	kg	*2950	*2950	*3740	*3740	*5680	*5680	*6220	4450	*4810	3300	*3900	2580	*3280	2080	*2830	1710			*920	*920	13.35
-9.8ft	lb	*6500	*6500	*8250	*8250	*12520	*12520	*13710	9810	*10600	7280	*8600	5690	*7230	4590	*6240	3770			*2030	*2030	(43.8)
-4.5m	kg	*3820	*3820	*4700	*4700	*6630	*6630	*6230	4410	*4860	3240	*3950	2530	*3310	2050	*2670	1700			*1090	*1090	12.71
-14.8ft	lb	*8420	*8420	*10360	*10360	*14620	*14620	*13730	9720	*10710	7140	*8710	5580	*7300	4520	*5890	3750			*2400	*2400	(41.7)
-6.0m	kg	*4770	*4770	*5800	*5800	*7930	6810	*6020	4450	*4750	3250	*3870	2540	*3200	2060					*1340	*1340	11.84
-19.7ft	lb	*10520	*10520	*12790	*12790	*17480	15010	*13270	9810	*10470	7170	*8530	5600	*7050	4540					*2950	*2950	(38.8)
-7.5m	kg	*5810	*5810	*7100	*7100	*7280	7010	*5570	4560	*4430	3330	*3580	2610	*2390	2150					*1780	*1780	10.68
-24.6ft	lb	*12810	*12810	*15650	*15650	*16050	15450	*12280	10050	*9770	7340	*7890	5750	*5270	4740					*3920	*3920	(35.0)
-9.0m	kg			*8410	*8410	*6130	*6130	*4760	*4760	*3760	3500	*2880	2770							*2740	2730	9.13
-29.5ft	lb			*18540	*18540	*13510	*13510	*10490	*10490	*8290	7720	*6350	6110							*6040	6020	(30.0)

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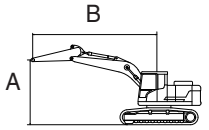
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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A HW	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5700	2000	3800	600	-	-	-	-	-

· : 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 (24.6 ft)	kg									*6050	*6050	5.27
	lb									*13340	*13340	(17.3)
6.0 m (19.7 ft)	kg			*6280	*6280	*5790	5760			*5800	5030	6.52
	lb			*13850	*13850	*12760	12700			*12790	11090	(21.4)
4.5 m (14.8 ft)	kg			*7590	*7590	*6210	5610			*5780	4220	7.25
	lb			*16730	*16730	*13690	12370			*12740	9300	(23.8)
3.0 m (9.8 ft)	kg					*6920	5400	*5900	3930	*5870	3850	7.61
	lb					*15260	11900	*13010	8660	*12940	8490	(25.0)
1.5 m (4.9 ft)	kg					*7550	5220	5940	3860	5760	3750	7.66
	lb					*16640	11510	13100	8510	12700	8270	(25.1)
0.0 m (0.0 ft)	kg			*10580	7620	*7800	5120			6010	3890	7.41
	lb			*23320	16800	*17200	11290			13250	8580	(24.3)
-1.5 m (-4.9 ft)	kg			*10010	7650	*7500	5120			*6340	4360	6.81
	lb			*22070	16870	*16530	11290			*13980	9610	(22.4)
-3.0 m (-9.8 ft)	kg	*11230	*11230	*8540	7810					*6330	5540	5.78
	lb	*24760	*24760	*18830	17220					*13960	12210	(18.9)

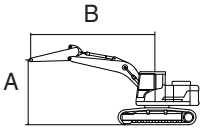
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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A HW	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5700	2400	3800	600	-	-	-	-	-

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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 (24.6 ft)	kg									*5540	*5540	5.82
	lb									*12210	*12210	(19.1)
6.0 m (19.7 ft)	kg					*5370	*5370			*5380	4550	6.97
	lb					*11840	*11840			*11860	10030	(22.9)
4.5 m (14.8 ft)	kg			*7040	*7040	*5860	5640	*5390	4010	*5320	3880	7.65
	lb			*15520	*15520	*12920	12430	*11880	8840	*11730	8550	(25.1)
3.0 m (9.8 ft)	kg			*8790	8130	*6630	5410	*5650	3920	5450	3560	8.00
	lb			*19380	17920	*14620	11930	*12460	8640	12020	7850	(26.2)
1.5 m (4.9 ft)	kg			*10120	7720	*7330	5200	5910	3830	5340	3470	8.05
	lb			*22310	17020	*16160	11460	13030	8440	11770	7650	(26.4)
0.0 m (0.0 ft)	kg			*10540	7560	*7710	5070	5850	3770	5540	3580	7.80
	lb			*23240	16670	*17000	11180	12900	8310	12210	7890	(25.6)
-1.5 m (-4.9 ft)	kg	*10260	*10260	*10190	7560	*7580	5050			*5980	3960	7.25
	lb	*22620	*22620	*22470	16670	*16710	11130			*13180	8730	(23.8)
-3.0 m (-9.8 ft)	kg	*12250	*12250	*9010	7680	*6560	5150			*6060	4870	6.28
	lb	*27010	*27010	*19860	16930	*14460	11350			*13360	10740	(20.6)

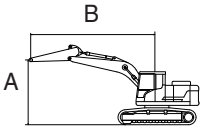
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited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

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A HW	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5700	2900	3800	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)		Capacity		Reach
														m (ft)
7.5 m (24.6 ft)	kg							*4850	*4850			*4270	*4270	6.40
	lb							*10690	*10690			*9410	*9410	(21.0)
6.0 m (19.7 ft)	kg							*4870	*4870			*4010	*4010	7.45
	lb							*10740	*10740			*8840	*8840	(24.4)
4.5 m (14.8 ft)	kg					*6340	*6340	*5420	*5420	*5000	4030	*3970	3560	8.09
	lb					*13980	*13980	*11950	*11950	*11020	8880	*8750	7850	(26.6)
3.0 m (9.8 ft)	kg					*8120	*8120	*6240	5430	*5350	3920	*4090	3290	8.42
	lb					*17900	*17900	*13760	11970	*11790	8640	*9020	7250	(27.6)
1.5 m (4.9 ft)	kg					*9660	7760	*7040	5200	*5750	3800	*4370	3200	8.47
	lb					*21300	17110	*15520	11460	*12680	8380	*9630	7050	(27.8)
0.0 m (0.0 ft)	kg			*5470	*5470	*10390	7520	*7550	5040	5800	3720	*4890	3280	8.24
	lb			*12060	*12060	*22910	16580	*16640	11110	12790	8200	*10780	7230	(27.0)
-1.5 m (-4.9 ft)	kg	*6250	*6250	*10100	*10100	*10320	7460	*7620	4980	5780	3700	5570	3580	7.71
	lb	*13780	*13780	*22270	*22270	*22750	16450	*16800	10980	12740	8160	12280	7890	(25.3)
-3.0 m (-9.8 ft)	kg			*13330	*13330	*9470	7540	*7000	5030			*5830	4270	6.81
	lb			*29390	*29390	*20880	16620	*15430	11090			*12850	9410	(22.4)
-4.5 m (-14.8 ft)	kg			*10170	*10170	*7310	*7310					*5780	*5780	5.36
	lb			*22420	*22420	*16120	*16120					*12740	*12740	(17.6)

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).

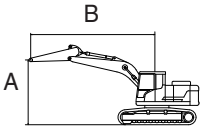
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⚠ Failure to comply to the rated load can cause serious injury, death, or property damage. Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX220A HW	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		5700	3500	3800	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)		Capacity		Reach
														m (ft)
7.5 m (24.6 ft)	kg											*3590	*3590	7.05
	lb											*7910	*7910	(23.1)
6.0 m (19.7 ft)	kg							*4260	*4260	*4310	4130	*3410	*3410	8.02
	lb							*9390	*9390	*9500	9110	*7520	*7520	(26.3)
4.5 m (14.8 ft)	kg							*4850	*4850	*4530	4050	*3400	3210	8.62
	lb							*10690	*10690	*9990	8930	*7500	7080	(28.3)
3.0 m (9.8 ft)	kg					*7240	*7240	*5710	5460	*4960	3910	*3510	2970	8.93
	lb					*15960	*15960	*12590	12040	*10930	8620	*7740	6550	(29.3)
1.5 m (4.9 ft)	kg					*8970	7800	*6600	5180	*5430	3770	*3750	2890	8.97
	lb					*19780	17200	*14550	11420	*11970	8310	*8270	6370	(29.4)
0.0 m (0.0 ft)	kg			*6530	*6530	*10020	7450	*7260	4980	5740	3650	*4170	2950	8.76
	lb			*14400	*14400	*22090	16420	*16010	10980	12650	8050	*9190	6500	(28.7)
-1.5 m (-4.9 ft)	kg	*5900	*5900	*9710	*9710	*10280	7320	*7520	4870	5680	3600	*4910	3170	8.26
	lb	*13010	*13010	*21410	*21410	*22660	16140	*16580	10740	12520	7940	*10820	6990	(27.1)
-3.0 m (-9.8 ft)	kg	*9580	*9580	*14270	*14270	*9790	7350	*7230	4880			*5470	3680	7.43
	lb	*21120	*21120	*31460	*31460	*21580	16200	*15940	10760			*12060	8110	(24.4)
-4.5 m (-14.8 ft)	kg			*11750	*11750	*8290	7530	*5870	5030			*5650	4900	6.13
	lb			*25900	*25900	*18280	16600	*12940	11090			*12460	10800	(20.1)

Note 1. Lifting capacity are based on ISO 10567.
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3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
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6. BUCKET SELECTION GUIDE

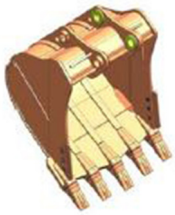
1) 3800 KG COUNTERWEIGHT



General bucket



Heavy duty
(without side cutter)



Rock heavy duty

Type	Capacity		Width		Weight	Tooth	MONO				2-PIECE	
							Recommendation					
	SAE Heaped	CECE heaped	Without side cutter	With side cutter			5.70 m (18' 8") Boom				5.87 m (19' 3") Boom	
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	mm (in)	kg (lb)	EA	2.0 m (6' 7") Arm	2.4 m (7' 10") Arm	2.9 m (9' 6") Arm	3.5 m (11' 6") Arm	2.4 m (7' 10") Arm	2.9 m (9' 6") Arm
General bucket	0.81 (1.06)	0.72 (0.94)	975 (38.4")	1125 (44.3")	700 (1540)	5	●	●	●	●	●	●
	0.92 (1.20)	0.81 (1.06)	1085 (42.7")	1230 (48.4")	750 (1650)	5	●	●	●	●	●	●
	1.05 (1.37)	0.96 (1.26)	1220 (48.0")	1370 (53.9")	790 (1740)	5	●	●	◐	◐	◐	◐
	1.17 (1.53)	1.00 (1.31)	1340 (52.8")	1490 (58.7")	850 (1870)	6	●	◐	◐	■	◐	■
	1.28 (1.67)	1.11 (1.45)	1455 (57.3")	1605 (63.2")	885 (1950)	6	◐	◐	■	X	■	▲
Heavy duty	0.92 (1.20)	0.83 (1.09)	1050 (41.3")	1095 (43.1")	865 (1910)	5	●	●	●	◐	●	◐
	1.08 (1.41)	0.97 (1.27)	1200 (47.2")	1245 (49.0")	935 (2060)	5	●	●	◐	■	◐	■
Rock heavy duty	0.91 (1.19)	0.83 (1.09)	1050 (41.3")	1095 (43.1")	1050 (2310)	4	●	●	●	X	●	◐
	1.23 (1.61)	1.11 (1.45)	1350 (53.1")	1395 (54.9")	1240 (2730)	5	◐	■	■	X	■	▲
	0.87 (1.14)	0.76 (0.99)	1130 (44.5")	1145 (45.1")	935 (2060)	5	●	●	●	X	●	●
	1.20 (1.57)	1.05 (1.37)	1445 (56.9")	1455 (57.3")	1115 (2460)	5	◐	◐	■	X	■	▲

● 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

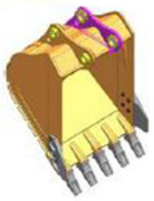
■ Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less

▲ Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3) or less

X Not recommended

※ 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) LONG REACH, 5300 KG COUNTERWEIGHT



Long reach

Type	Capacity		Width		Weight	Tooth	Long reach
							Recommendation
	SAE Heaped	CECE heaped	Without side cutter	With side cutter			8.50 m (27' 11") Boom
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	mm (in)	kg (lb)	EA	6.2 m (20' 4") Arm
LR	0.51 (0.67)	0.45 (0.59)	865 (34.1")	995 (39.2")	395 (870)	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

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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)
HX220A L	Operating weight	kg	(lb)	22280	49120	22760	50180	23040	50790	23320	51410	23040	50790
	Ground pressure	kgf/cm²	(psi)	0.48	6.76	0.42	5.92	0.37	5.25	0.33	4.72	0.42	5.99
	Overall width	mm	(ft-in)	2990	9'10"	3090	10'2"	3190	10'6"	3290	10'10"	3090	10'2"
	Link quantity	EA		49		49		49		49		49	
HX220A LR	Operating weight	kg	(lb)	-	-	-	-	25460	56130	-	-	-	-
	Ground pressure	kgf/cm²	(psi)	-	-	-	-	0.41	5.8	-	-	-	-
	Overall width	mm	(ft-in)	-	-	-	-	3190	10'6"	-	-	-	-
	Link quantity	EA		-		-		49		-		-	
HX220A HW	Operating weight	kg	(lb)	23650	52140	24120	53180	24400	53790	24690	54430	24410	53810
	Ground pressure	kgf/cm²	(psi)	0.5	7.18	0.44	6.28	0.39	5.55	0.35	5	0.45	6.35
	Overall width	mm	(ft-in)	3395	11'2"	3495	11'6"	3595	11'10"	3695	12'2"	3495	11'6"
	Link quantity	EA		49		49		49		49		49	

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
700 mm double grouser	Option	B
800 mm triple grouser	Option	C
800 mm triple grouser (long reach)	Standard	C
900 mm triple 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	CUMMINS / B6.7
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	107 × 124 mm (4.21" × 4.88")
Displacement	6.7 ℓ (408 cu in)
Compression ratio	17.3 : 1
Gross power	173 Hp (129 kW) at 2200 rpm
Net power	170 Hp (127 kW) at 2200 rpm
Max. power	195 Hp (145 kW) at 2000 rpm
Peak Torque	881 N · m (650 lb · ft) at 1,300 rpm
Engine oil quantity	23.1 ℓ (6.1 U.S. gal)
Wet weight or Dry weight	583 kg (1,285 lb)
Starter motor	24 V-4.8 kW
Alternator	24 V-95 A

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 130 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2 × 221 ℓ /min (58.4 U.S. gpm / 48.6 U.K. gpm)
Rated speed	1700 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	10 cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	17 ℓ/min (4.5 U.S. gpm/3.7 U.K. gpm)

4) MAIN CONTROL VALVE

Item		Specification
Type		9 spools two-block
Operating method		Hydraulic pilot system
Main relief valve pressure		350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)] *1 350 kgf/cm^2 (4980 psi) [Not applied power boost]
Port relief valve pressure	Boom	400 kgf/cm^2 (5690 psi)
	Arm	400 kgf/cm^2 (5690 psi), *1 300 kgf/cm^2 (4270 psi)
	Bucket	400 kgf/cm^2 (5690 psi), *1 280 kgf/cm^2 (3980 psi)

[ ] : Power boost *1 : Long reach only

5) SWING MOTOR

Item	Specification
Type	Axial piston motor
Capacity	142.8 cc/rev
Relief pressure	290 kgf/cm^2 (4125 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	1183 kgf · m (8560 lbf · ft) over
Brake release pressure	20.9 kgf/cm^2 (297 psi) over
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification	
	HX220A L/LR	HX220A HW
Type	Variable displacement axial piston motor	
Capacity	171.2/108.5 cc/rev	182.4/105.4 cc/rev
Relief pressure	350 kgf/cm^2 (4980 psi)	
Braking system	Automatic, spring applied hydraulic released	
Braking torque	3028 kgf · m (21900 lbf · ft)	3180 kgf · m (23000 lbf · ft)
Brake release pressure	13.5 kgf/cm^2 (192 psi)	14.2 kgf/cm^2 (202 psi)
Reduction gear type	2-stage planetary	

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Stroke	Ø120 × 1290 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Stroke	Ø140 × 1443 mm
	Cushion	Extend and retract
Adjust cylinder (2-piece boom)	Bore dia × Stroke	Ø150 × 1300 mm
	Cushion	N/A
Arm cylinder (2-piece boom)	Bore dia × Stroke	Ø140 × 1450 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Stroke	Ø120 × 1060 mm
	Cushion	Extend only
Bucket cylinder (Long reach)	Bore dia × Stroke	Ø95 × 900 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	23.1 (6.1)	★SAE 0W-40 SAE 5W-40 SAE 15W-40
DEF/ AdBlue® tank	Mixture of urea and deionized water	48 (12.6)	ISO 22241, High-purity urea + deionized water (32.5:67.5)
Swing drive	Gear oil	6.2 (1.6)	★SAE 75W-90
Final drive		4.5×2 (1.2×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank 160 (42.3) System 275 (72.6)	★ISO VG 15 ISO VG 32 ISO VG 46, HBHO VG 46★3 ISO VG 68
Fuel tank	Diesel fuel★1	400 (106)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★2	40 (10.6)	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
DEF : Diesel Exhaust Fluid, DEF compatible with AdBlue®

★ : Cold region (Russia, CIS, Mongolia)
★1 : Ultra low sulfur diesel
- sulfur content ≤ 15 ppm
★2 : Soft water
City water or distilled water
★3 : HD Hyundai Construction Equipment Bio Hydraulic Oil

※ 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.

※ Do not use any engine oil other than that specified above, as it may clog the diesel particulate filter(DPF).

※ 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

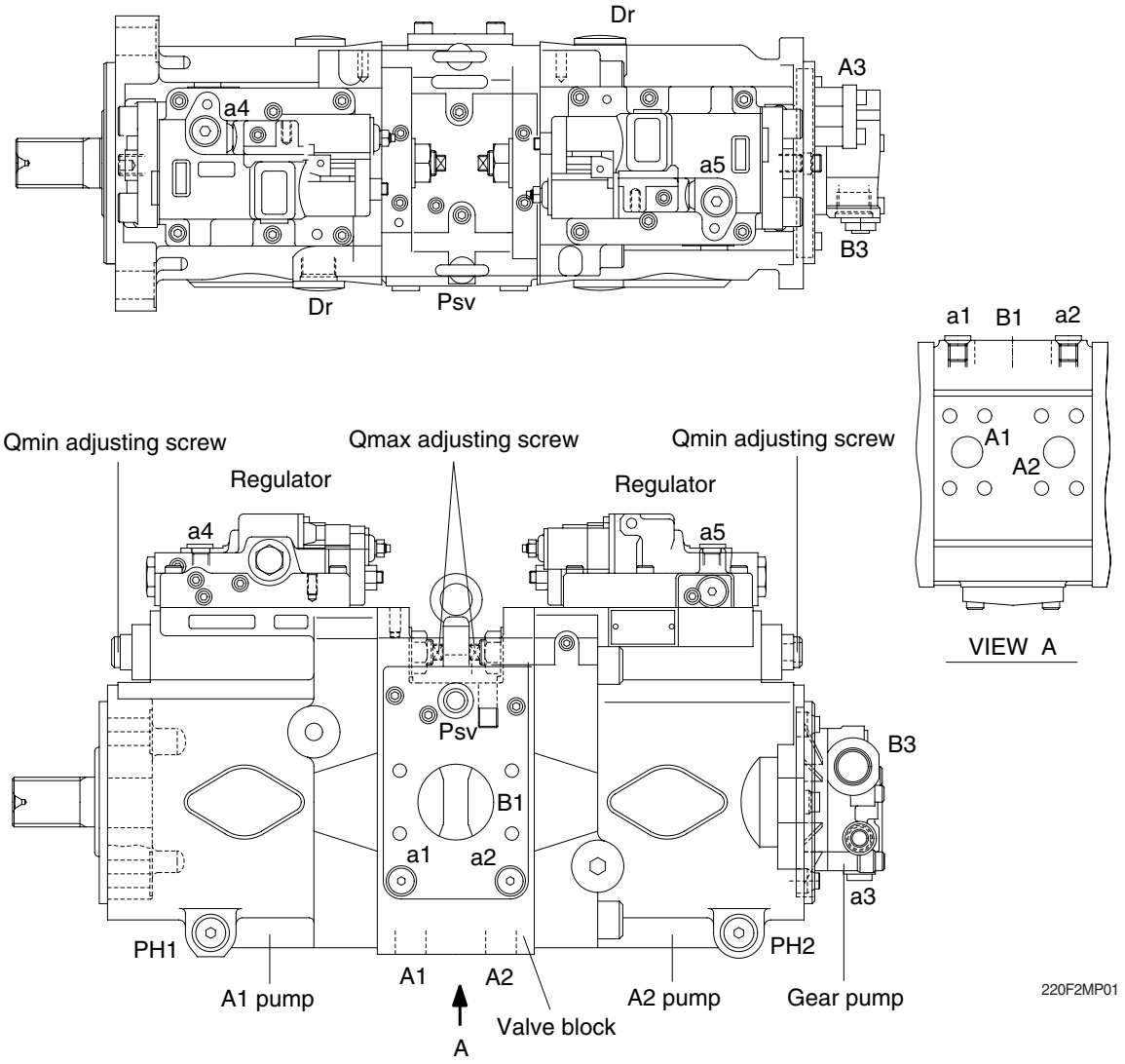
Group 1 Pump Device 2-1
Group 2 Main Control Valve 2-15
Group 3 Swing Device 2-49
Group 4 Travel Device 2-60
Group 5 RCV Lever 2-74
Group 6 RCV Pedal 2-81

GROUP 1 PUMP DEVICE

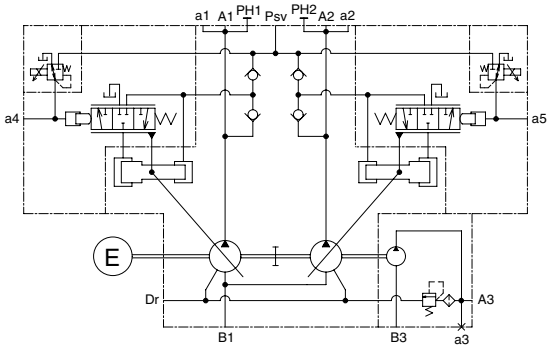
1. STRUCTURE

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

· WITHOUT PTO TYPE



220F2MP01

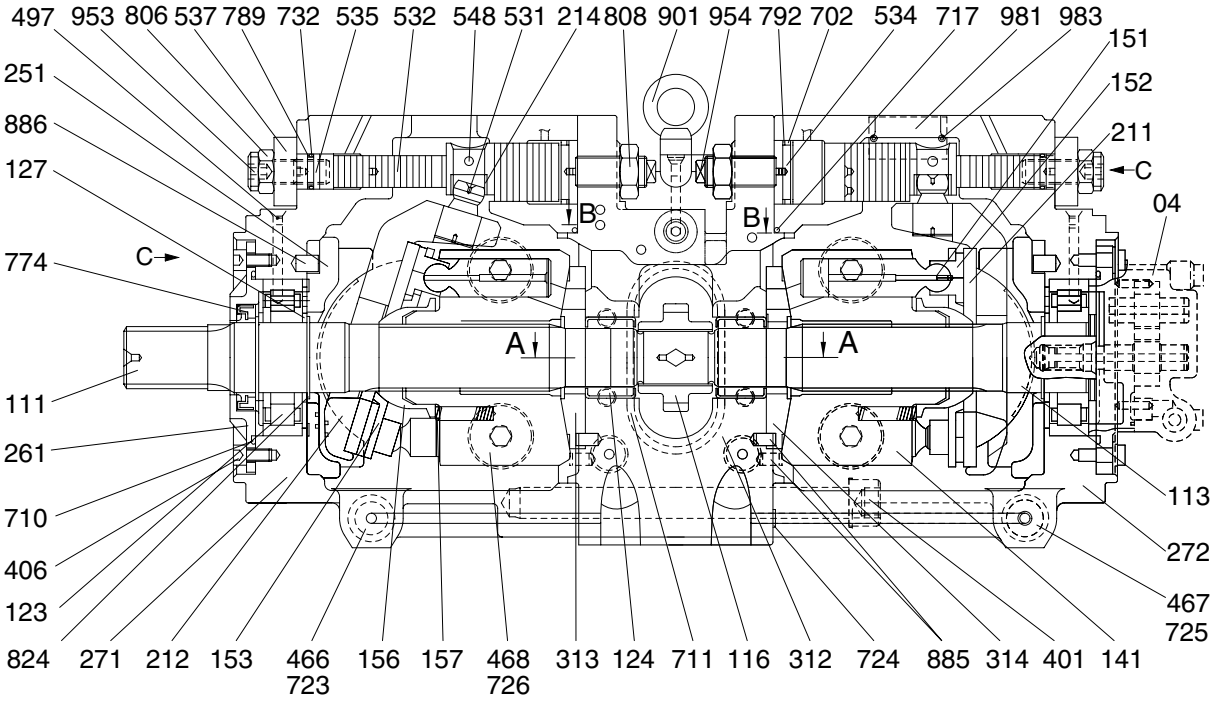


220S2MP02

Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	PF 3/4 - 20
Psv	Servo assist port	PF 3/8 - 17
PH1,2	Pressure sensor port	PF 3/8-17
a1,2	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4-14
a4,5	Gauge port	PF 1/4 - 15
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

1) MAIN PUMP (1/2)

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

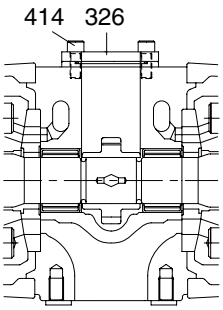


※ Section A-A, B-B, view C : see next page.

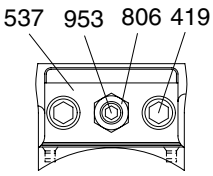
220F2MP05

04	Gear pump	272	Pump casing (R)	711	O-ring
111	Drive shaft (F)	312	Valve block B	717	O-ring
113	Drive shaft (R)	313	Valve plate (R)	723	O-ring
116	1st gear	314	Valve plate (L)	724	Square ring
123	Roller bearing	401	Hexagon socket bolt	725	O-ring
124	Needle bearing	406	Hexagon socket bolt	726	O-ring
127	Bearing spacer	466	Plug	732	O-ring
141	Cylinder block	467	Plug	774	Oil seal
151	Piston	468	Plug	789	Back up ring
152	Shoe	497	Plug	792	Back up ring
153	Set plate	531	Tilting pin	806	Hexagon head nut
156	Spherical bushing	532	Servo piston	808	Hexagon head nut
157	Cylinder spring	534	Stopper (L)	824	Snap ring
211	Shoe plate	535	Stopper (S)	885	Pin
212	Swash plate	537	Servo cover	886	Pin
214	Tilting bushing	548	Feedback pin	901	Eye bolt
251	Support	702	O-ring	953	Set screw
261	Seal cover (F)	710	O-ring	954	Set screw
271	Pump casing (F)				

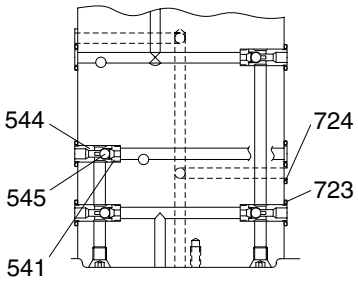
MAIN PUMP (2/2)



SECTION A-A



VIEW C

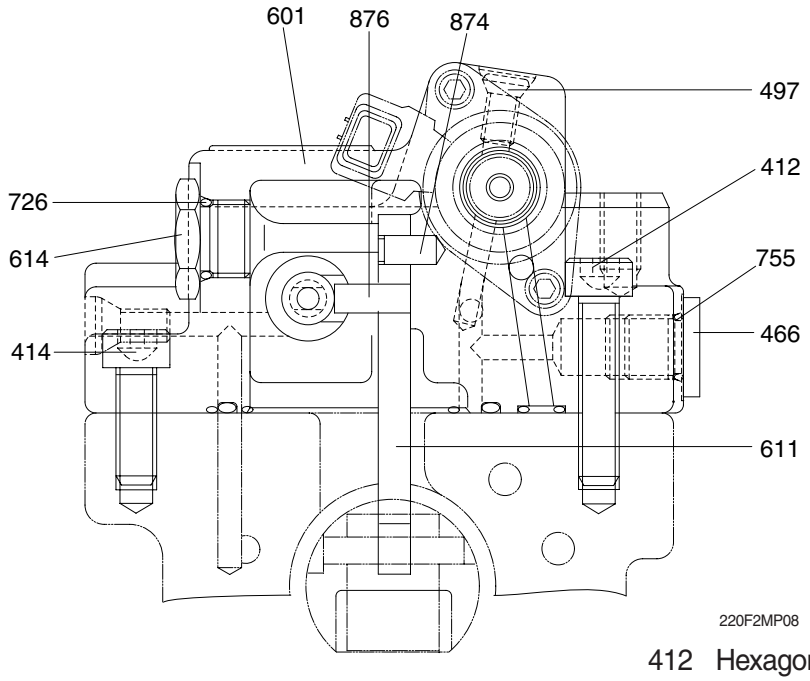


SECTION B-B

220F2MP06

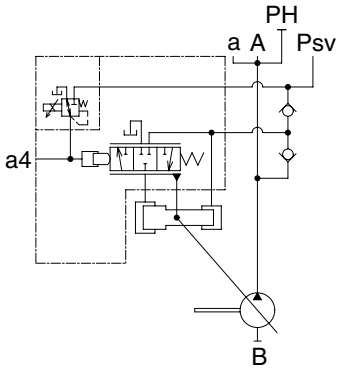
326	Cover	541	Seat	724	Square ring
414	Hexagon socket bolt	544	Stopper 1	806	Hexagon head nut
419	Hexagon socket bolt	545	Steel ball	953	Set screw
537	Servo cover	723	O-ring		

2) REGULATOR (1/2)



220F2MP08

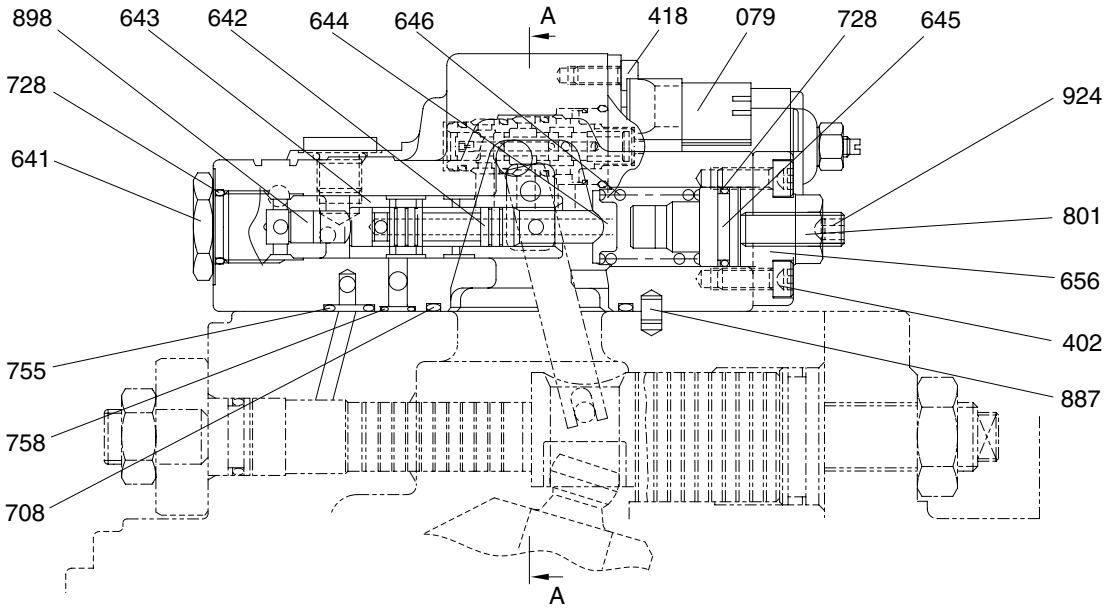
SECTION A-A



412 Hexagon socket screw
414 Hexagon socket screw
466 Plug
497 Plug
601 Casing
611 Feed back lever
614 Adjust plug
726 O-ring
755 O-ring
874 Pivot pin
876 Pin

Port	Port name	Port size
A	Delivery port	SAE 6000 psi 1"
B	Suction port	SAE 2500 psi 2 1/2"
Psv	Servo assist port	PF 3/8-17
a, a4	Gauge port	PF 1/4-15
PH	Pressure sensor port	PF 3/8-17

REGULATOR (2/2)

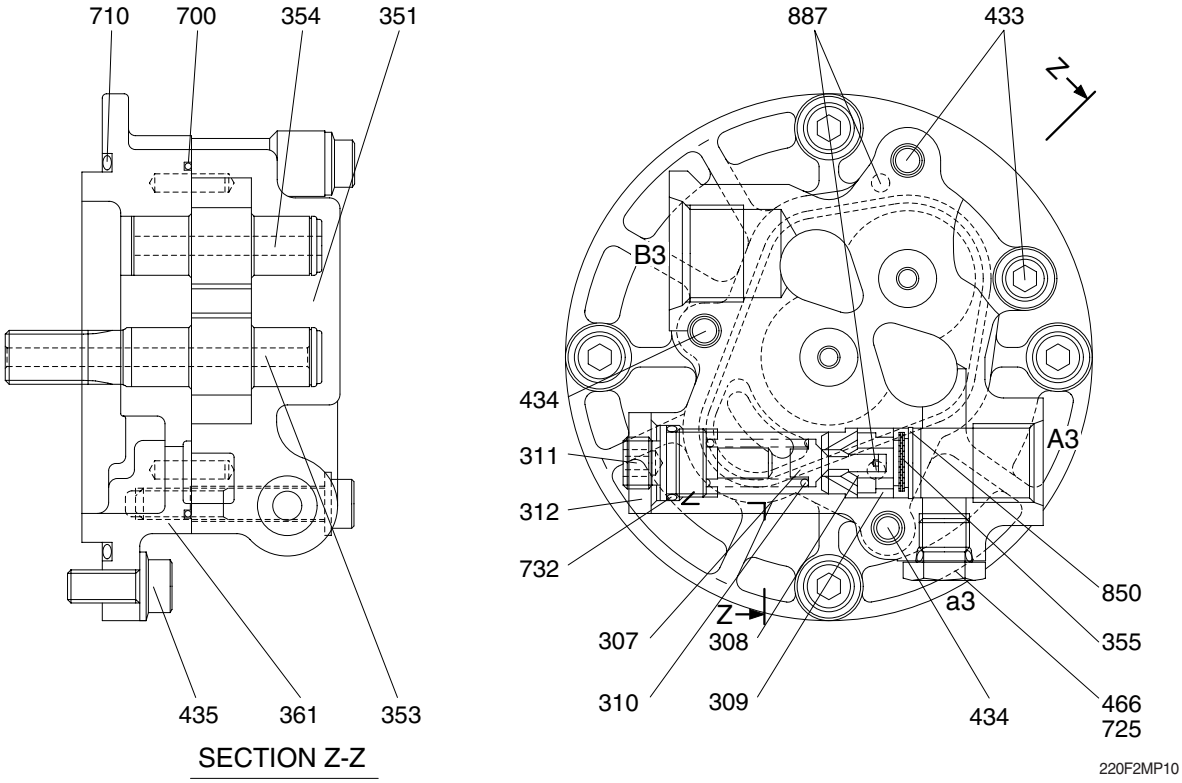


SECTION A-A

220F2MP09

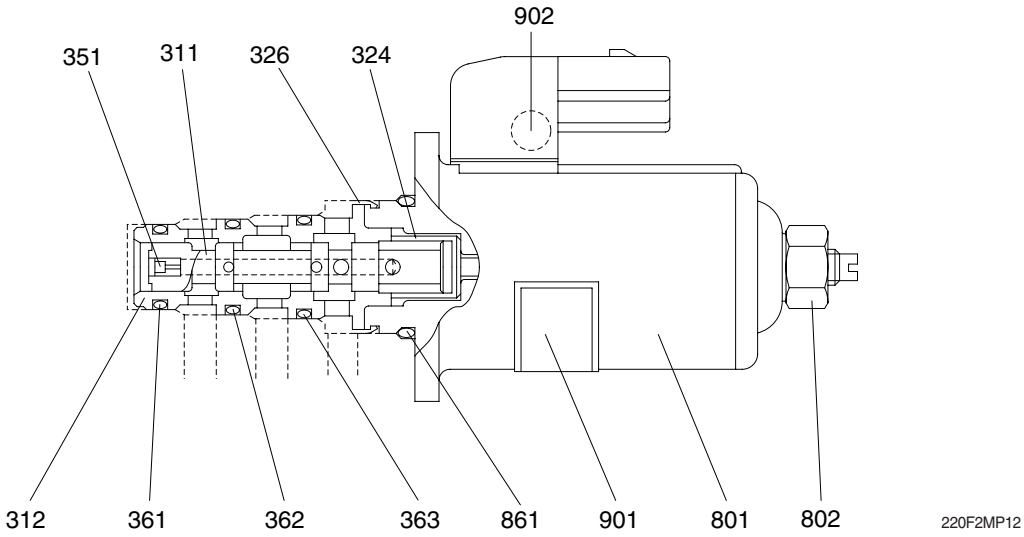
402	Hexagon socket screw	645	Adjust stem (Q)	758	Square ring
418	Hexagon socket screw	646	Pilot spring	801	Nut
641	Pilot plug	656	Cover	887	Pin
642	Pilot spool	708	O-ring	898	Piston piston
432	Pilot sleeve	728	O-ring	924	Set screw
644	Spring seat (Q)	755	O-ring		

3) 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	Adjusting screw	433	Flange socket	732	O-ring
312	Lock nut	434	Flange socket	850	Snap ring
351	Gear case	435	Flange socket	887	Pin

4) PROPORTIONAL REDUCING VALVE ASSY



311	Spool	361	O-ring	802	Seal nut
312	Sleeve	362	O-ring	861	O-ring
324	Spring	363	O-ring	901	Name plate
326	Retaining ring	801	Solenoid	902	Function name plate
351	Orifice				

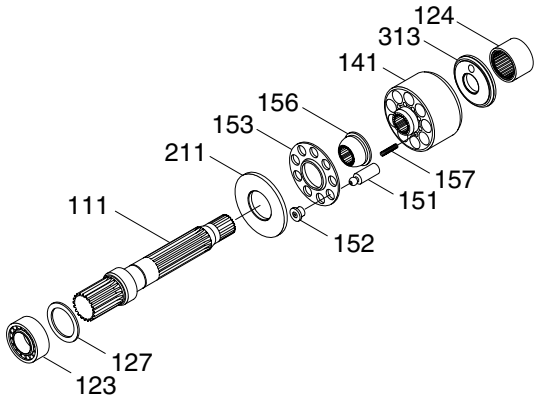
2. MAIN PUMP

The pumps may be 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 flow: and the valve block group that changes over oil suction and discharge: and the PTO group to attach an auxiliary gear pump.

1) ROTARY GROUP

The rotary group consists of drive shaft (F) (111), bearing spacers (127), cylinder block (141), piston shoes (151,152), set plates (153), spherical bushings (156) and cylinder springs (157). The drive shaft is supported by bearings (123,124) at its both ends.

The shoe is caulked to the piston to form a spherical joint for lessening thrust force generated by load pressure and has grooves to slide on the shoe plate (211) smoothly and hydraulically balanced. The piston-shoe sub group is pushed onto the shoe plate by the cylinder springs through the set plate and spherical bushing for enabling smooth sliding on the shoe plate. Similarly, the cylinder block is pushed onto the valve plate (313, 314) by the cylinder springs.



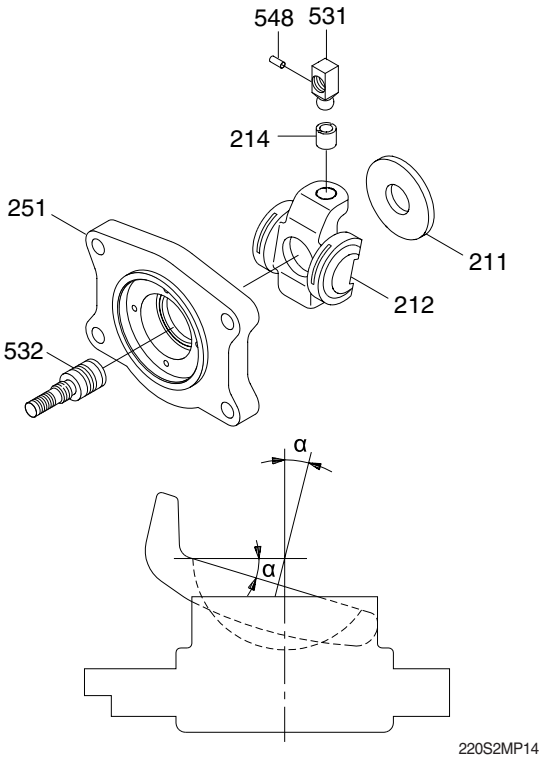
220S2MP13

2) SWASH PLATE GROUP

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

The swash plate is supported by the swash plate support at the cylindrical portion formed on the opposite side of the shoe sliding face.

When the servo piston is moved to the left or right by introducing the hydraulic force controlled by the regulator into the hydraulic chamber provided on both ends of the servo piston, the swash plate slides over the swash plate support through the spherical portion of the tilting pin and can vary the tilting angle (α).



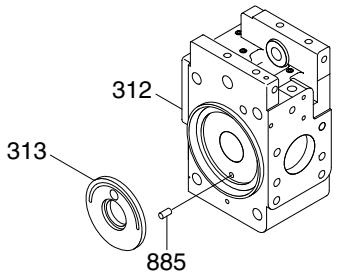
220S2MP14

3) VALVE BLOCK GROUP

The valve block group consists of the valve block (312), valve plate (313, 314) and valve plate pin (885).

The valve plate having two arc ports is attached to the valve block and feeds and collects oil to and from the cylinder block.

The oil exchanged by the valve plate is connected to an external piping through the valve block.



220S2MP15

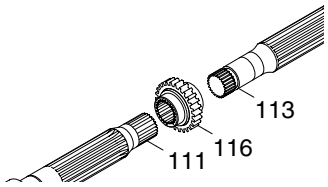
4) PTO GROUP

The PTO group is composed of the 1st gear (116), 2nd gear (111) and 3rd gear (113).

The 2nd gear (111) and 3rd gear (113) are supported by the bearings, respectively and attached to the valve block.

Now, suppose the drive shaft is rotated by the motor or engine, the cylinder block is also rotated through the spline conection. If the swash plate is tilted, the pistons arranged inside the cylinder reciprocate relatively to the cylinder, rotating with the cylinder block. Accordingly, if a piston is focused on, its motion is separating from the valve plate (oil suction process) for 180 degrees, and approaching the valve plate (oil delivery process) for the remaining 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.

In the meantime, the rotation of the drive shaft is picked up by the 1st gear (116), transmitted to the 3rd gear (113) through the 2nd gear (111), and drives the auxiliary pump connected to the 3rd gear (113).



220F2MP11

3. REGULATOR

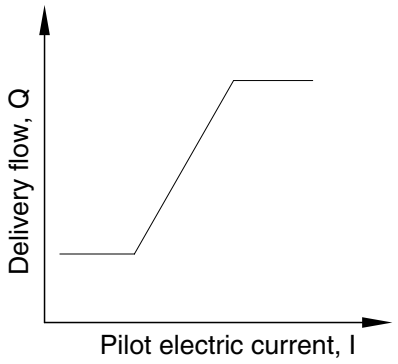
1) OUTLINE

The regulator for the K7V series axial piston pump has various models to satisfy various kinds of specifications required.

Electric flow control

By changing the pilot electric current I for proportional reducing valve, the pump tilting angle (delivery flow) is controlled arbitrarily, as shown in the figure.

This regulator has the positive flow control in which the delivery flow Q increases as the pilot electric current I increases. With this commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.

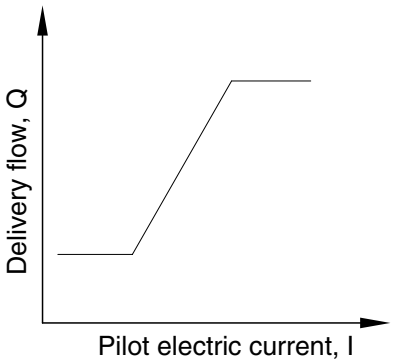


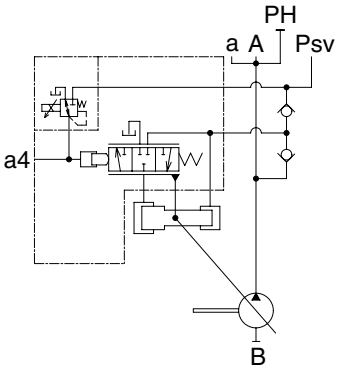
220F2MP16

2) FUNTION

(1) Flow control

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





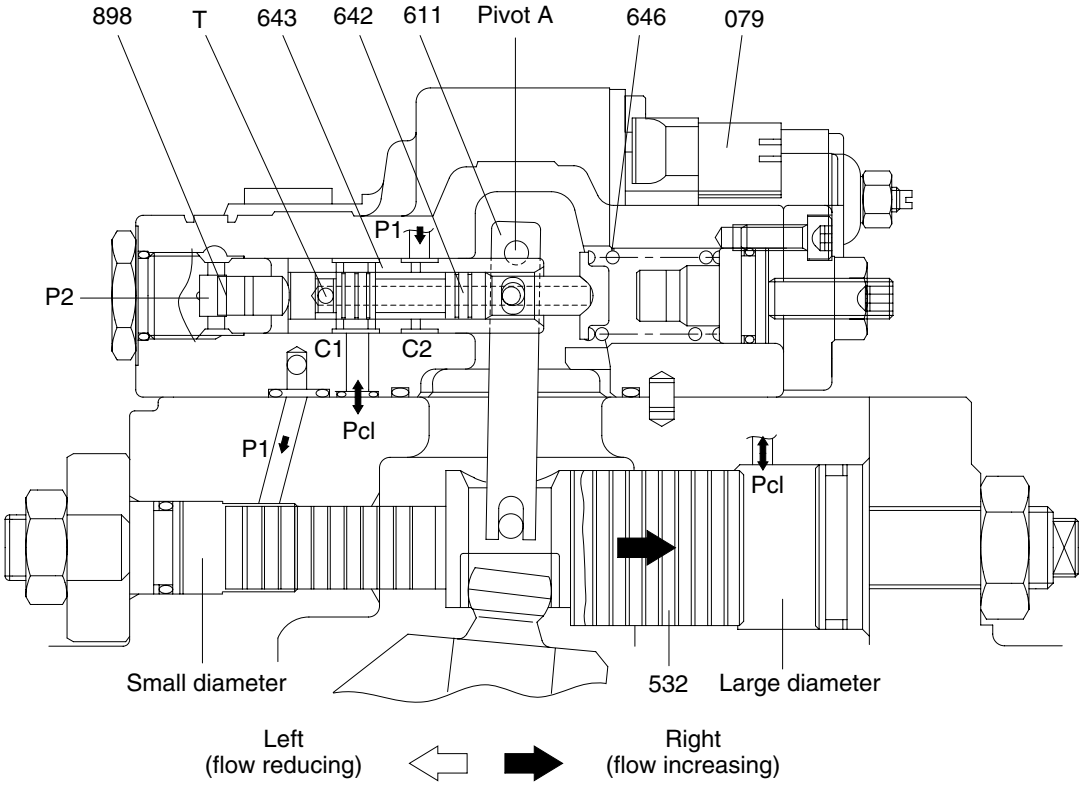
220F2MP17

① Flow increasing funtion

As the pilot electric current I increases, the secondary pressure of the proportional reducing valve (079) increases too. Then the pilot spool (642) through the pilot piston (898) moves to the right to position where the force of the pilot spring (646) balances with the hydraulic force.

The movement of the pilot spool (642) causes the port C1 connects to the tank port (T). This deprives the pressure of the large-diameter section of the servo piston (531) and moves the servo piston (532) to the right by the discharge pressure Pd1 in the small-diameter section, resulting in the flow rate increase.

The feedback lever (611) links both the servo piston (532) and the pilot sleeve (643). When the servo piston (532) moves, the feedback lever (611) rotates around the pivot A, and the pilot sleeve (643) moves to the left. This causes the opening between the pilot sleeve (643) and the pilot spool (642) to close slowly, and the servo piston (532) comes to being stop completely when the port C1 closes completely.



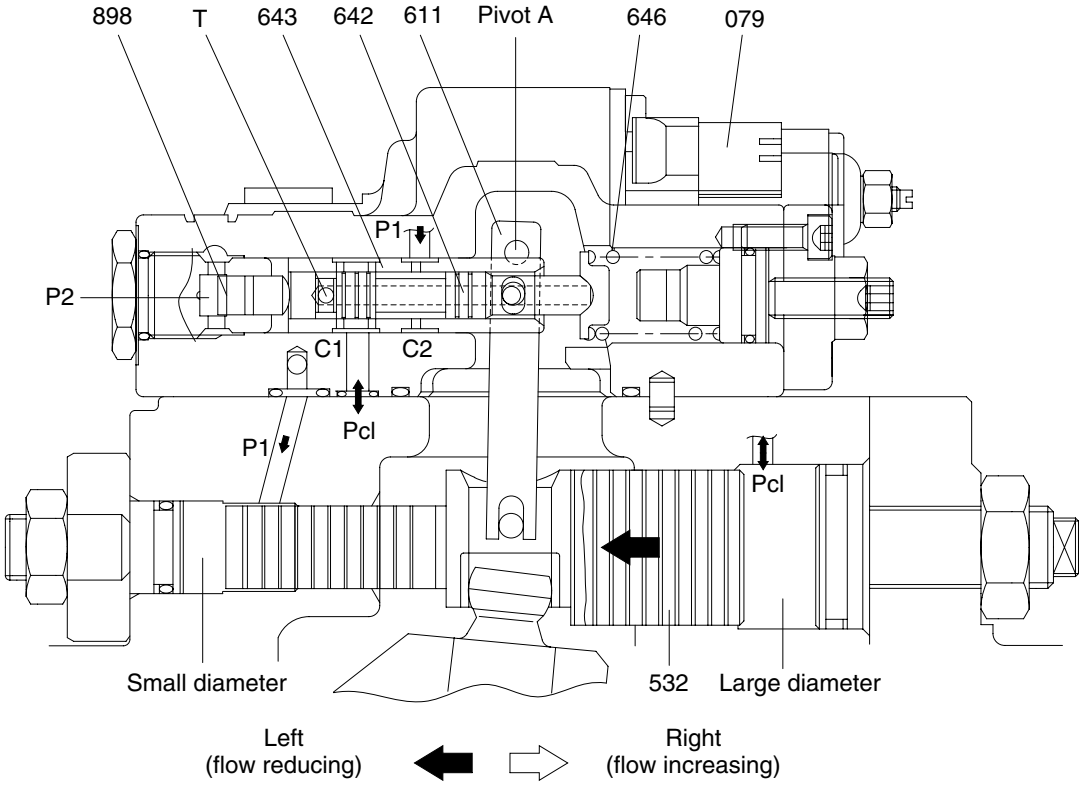
220F2MP25

② **Flow reducing function**

As the pilot electric current I decreases, the secondary pressure of the proportional reducing valve (079) decreases too, the pilot spool (642) moves to the left by action of the pilot spring (646).

The movement of the pilot spool (642) causes the delivery pressure Pd1 to connects to the port C2 through the pilot spool (642) and to be admitted to the large-diameter section of the servo piston (532). Although the delivery pressure Pd1 is constantly admitted to the small-diameter section of servo piston (532), the servo piston (532) moves to the left because of its difference of the area between large and small-diameter section. As a result, the tilting angle is decreased.

As the servo piston (532) moves, the feedback lever (611) rotates around the pivot A, and the pilot sleeve (643) moves to the right till the opening between the pilot spool (642) and pilot sleeve (643) being closed.



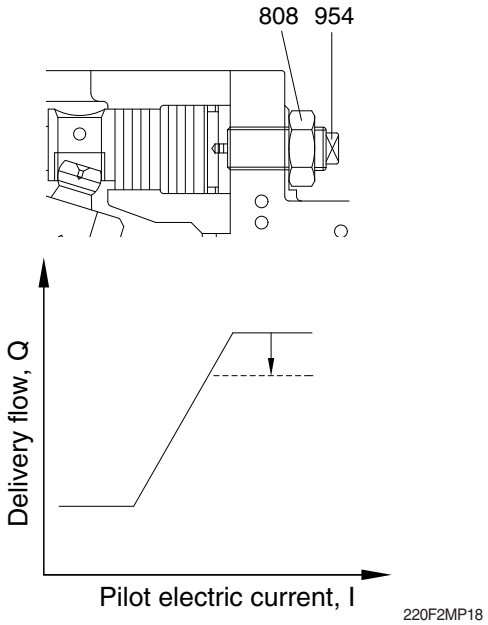
4. ADJUSTMENT OF MAXIMUM AND MINIMUM FLOWS

The maximum flow and minimum flow can be adjusted with the adjusting screws (954, 953) of the pump. The flow control characteristics can be adjusted with the hexagon socket head cap (924). The horsepower control characteristics can be adjusted with the adjusting screw (C. 628) and adjusting stem (C, 627) of the regulator. The maximum flow and minimum flow can be adjusted with the adjusting screws of the pump.

1) ADJUSTMENT OF MAXIMUM FLOW (MAIN PUMP SIDE)

Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head screw (954). Only the maxinum flow is adjusted without changing other control characteristics.

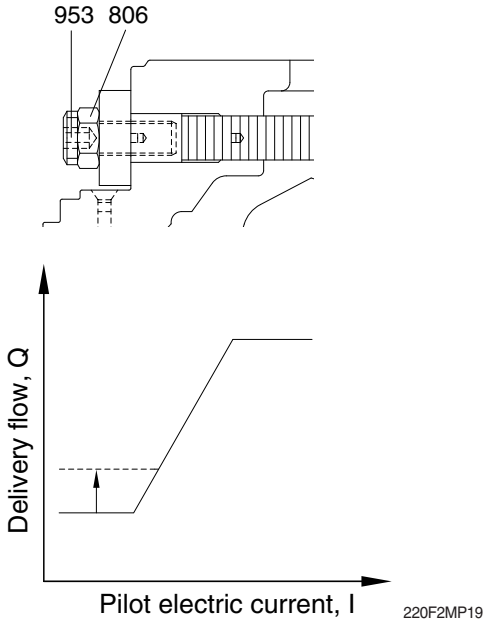
Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min -1)	(Turn)	(ℓ /min)
1700	+1/4	-4.7



2) ADJUSTMENT OF MINIMUM FLOW (MAIN PUMP SIDE)

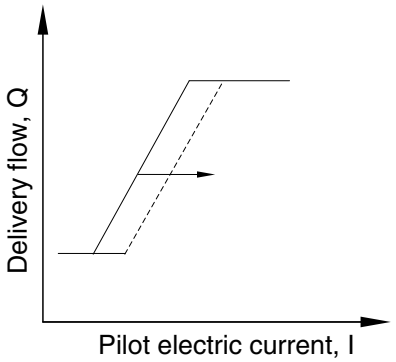
Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagon socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed. However, remember that, if tightened too much, the required horsepower at the maximum delivery pressure (or during relieving) may increase.

Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min -1)	(Turn)	(ℓ /min)
1700	+1/4	+3.3



3) ADJUSTMENT OF LOW CONTROL CHARACHERISTIC.

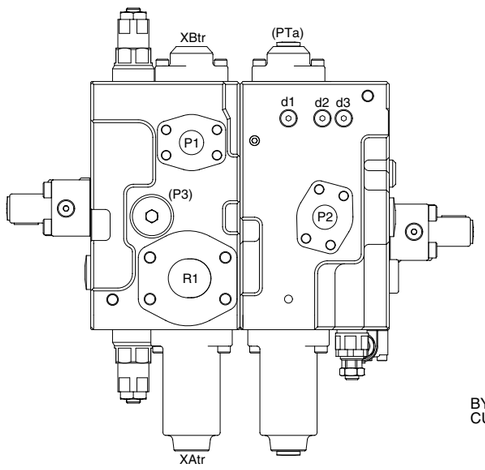
The flow control characteristic can be adjusted with the adjusting screw. Adjust it loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924). Tightening the screw shifts control chart to the right as shown in the figure.

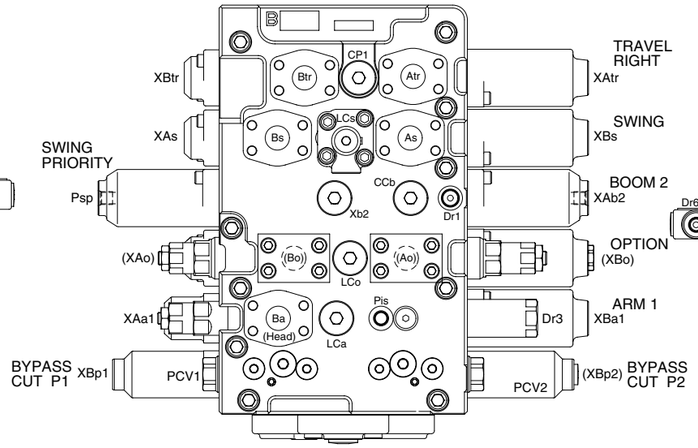


220AL2MP20

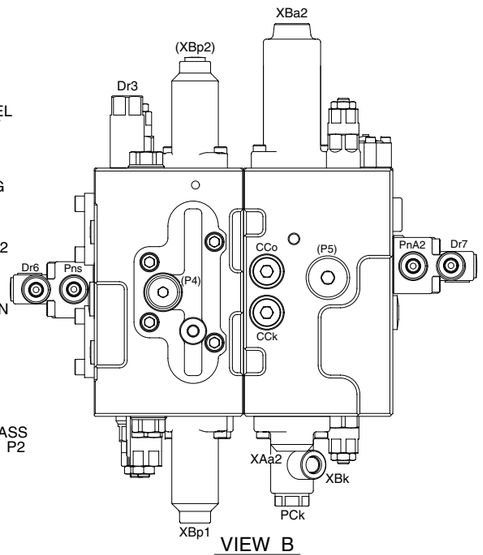
Speed	Flow control characteristics adjustment		
	Tightening amount of adjusting screw (953)	Current change in flow control initiation	Flow change amount
(min $^{-1}$)	(Turn)	(mA)	(ℓ /min)
1700	+1/4	+26.8	-16.9

1. STRUCTURE

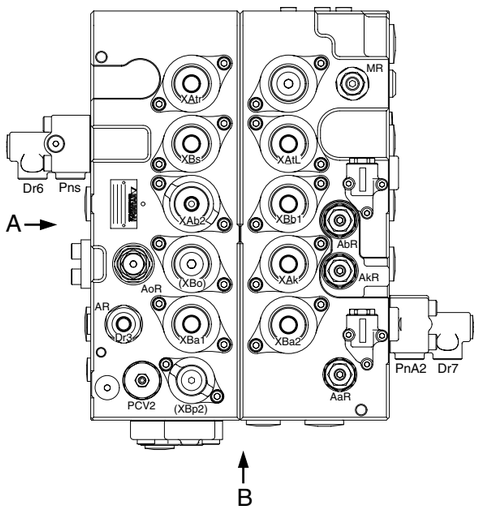


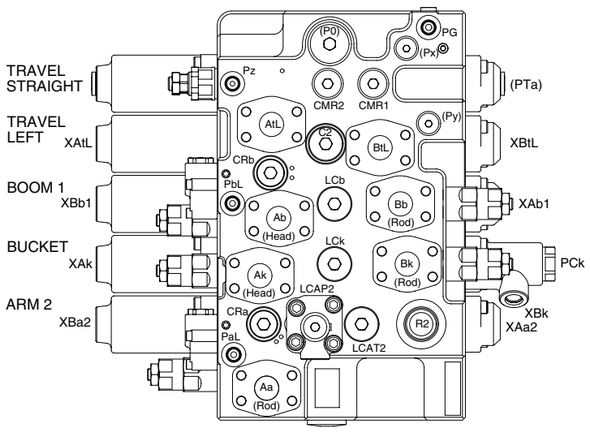


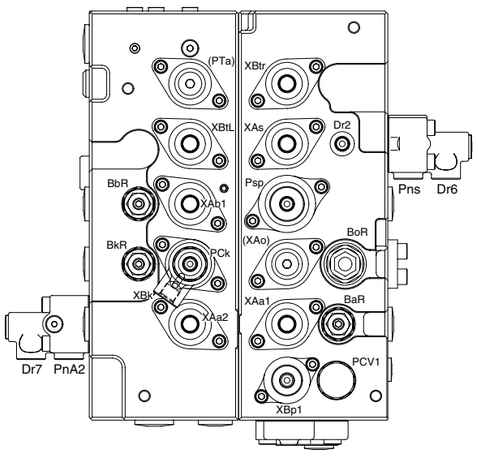
VIEW A



VIEW B



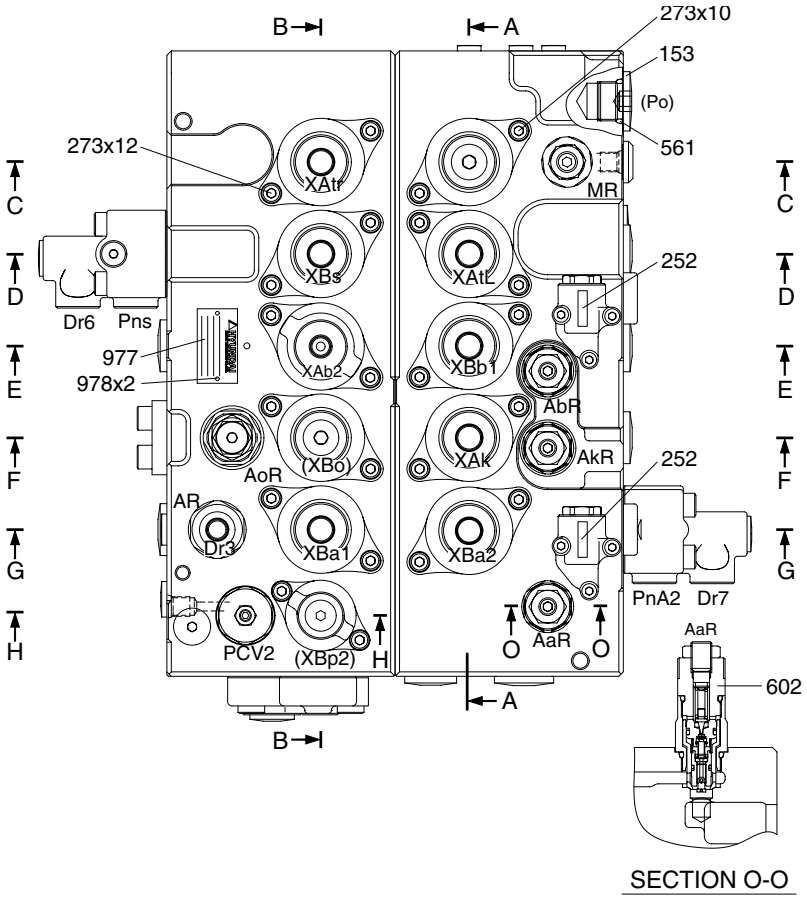




220A2MC01

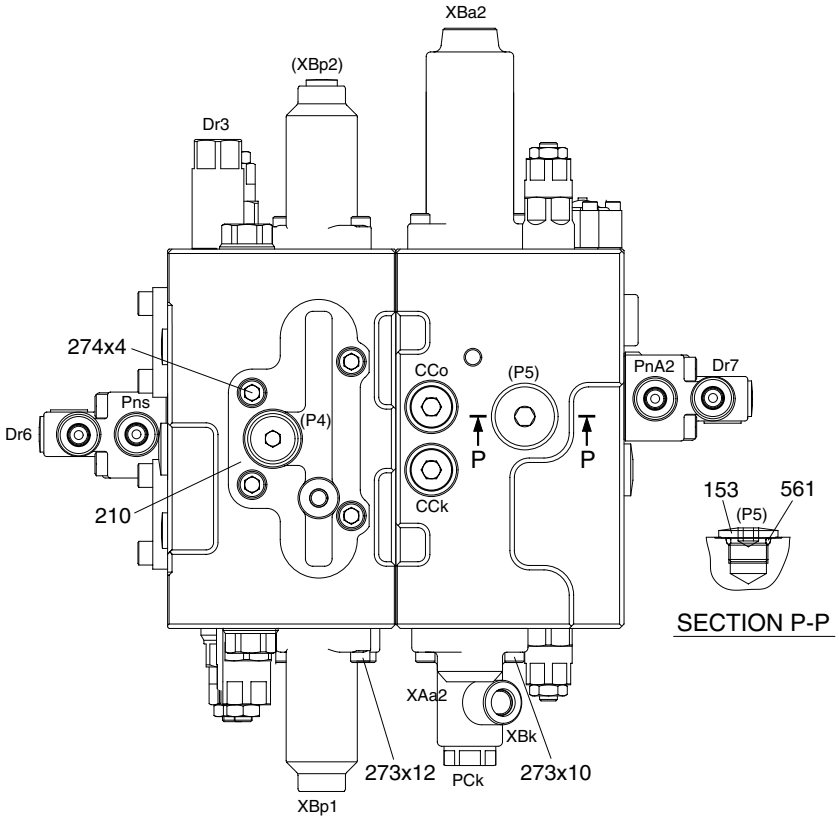
Mark	Port name	Port size	Tightening torque
R2	Make up port for swing	PF 1	20~25kgf · m (115~180lbf · ft)
XAtr XBtr (XAo) (XBo) XAk XBk XAb1 XBb1 XAa2 XBa2 XAtL XBtL XAs XBs XAa1 XBa1 Dr1 (PTa)	Travel right (reverse) pilot port Travel right (forward) pilot port Optional pilot port Optional pilot port Bucket in pilot port Bucket out pilot port Boom up pilot port Boom down pilot port Arm out confluence pilot port Arm in confluence pilot port Travel left (reverse) pilot port Travel left (forward) pilot port Swing left pilot port Swing right pilot port Arm out pilot port Arm in pilot port Drain port Travel straight pilot port	PF 3/8	7~8kgf · m (50.6~57.8lbf · ft)
(Px) (Py) Pz PG Dr2 Dr3 Dr6 Dr7 Pns PaL PbL XAb2 Psp XBp1 (XBp2) PCk Pis PnA2	Pressure port for attachment Pressure port for travel Main relief pilot pressure port Pilot pressure port Drain port Drain port Drain port Drain port Swing logic valve pilot port Lock valve pilot port (arm rod side) Lock valve pilot port (boom head side) Boom up confluence pilot port Swing priority pilot port Bypass cut spool pilot port (P1 side) Bypass cut spool pilot port (P2 side) Bucket in stroke limiter pilot port Arm regeneration cut pilot port Arm2 logic valve pilot port	PF 1/4	3.5~3.9kgf · m (25.3~28.2lbf · ft)
Atr Btr (Ao) (Bo) Ak Bk Ab Bb AtL BtL As Bs Aa Ba P1 P2	Travel motor right side (reverse) port Travel motor right side (forward) port Optional port Optional port Bucket cylinder head side port Bucket cylinder rod side port Boom cylinder head side port Boom cylinder rod side port Travel motor left side (reverse) port Travel motor left side (forward) port Swing motor left port Swing motor right port Arm cylinder rod side port Arm cylinder head side port Pump port (P1 side) Pump port (P2 side)	M10	5~6.6kgf · m (36.1~47.7lbf · ft)
R1	Return port	M12	8.5~11.2kgf · m (61.5~81.1lbf · ft)

1) RELIEF VALVE SIDE VIEW



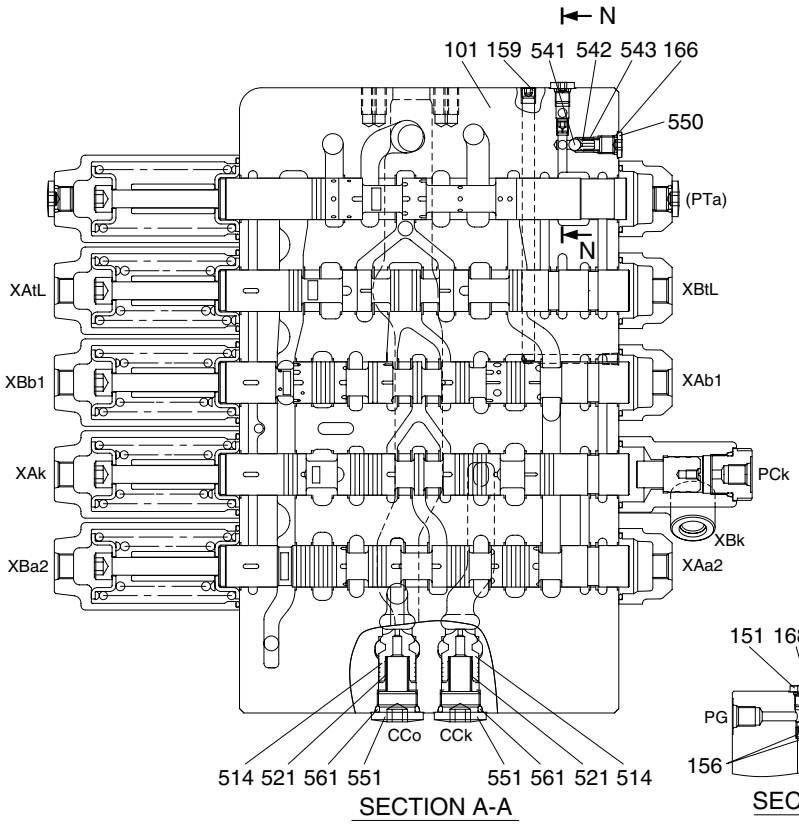
153 Plug
252 Lock valve selector sub assy
273 Socket screw
561 O-ring
602 Port relief valve assy
977 Name plate
978 Pin

2) TANK PORT SIDE BOTTOM VIEW



153 Plug
210 Plate
273 Socket screw
274 Socket screw
561 O-ring

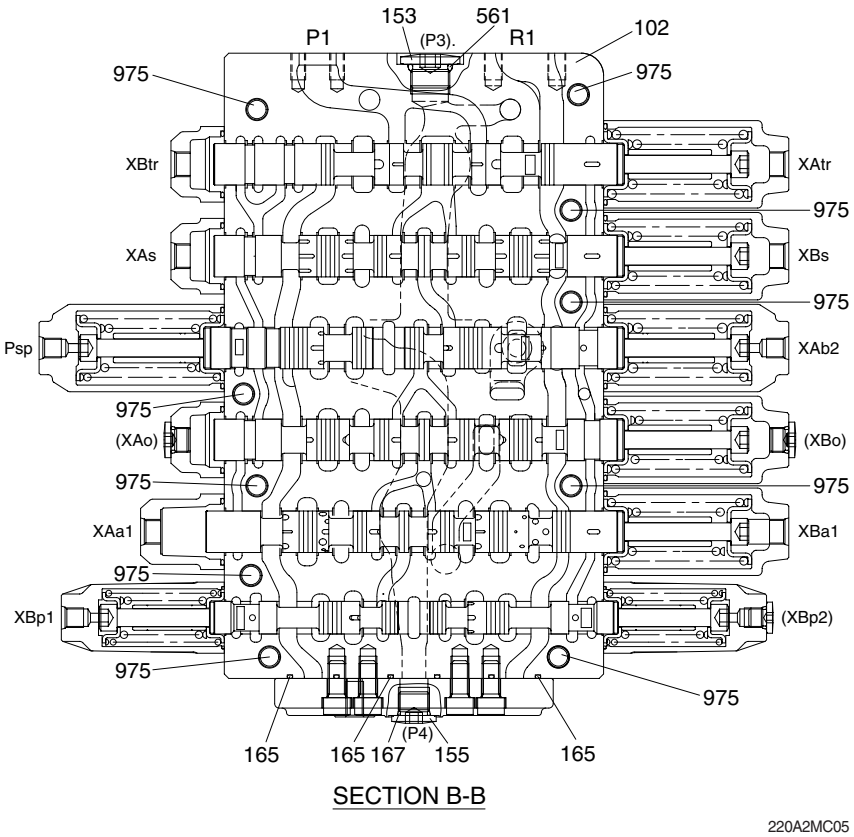
3) CASING A SPOOL SECTION



101 Casing A
151 Plug
156 Plug
159 Plug
166 O-ring
168 O-ring
514 Poppet
521 Spring
541 Steel ball
542 Spring seat
543 Spring
550 Plug
551 Plug
561 O-ring

220A2MC04

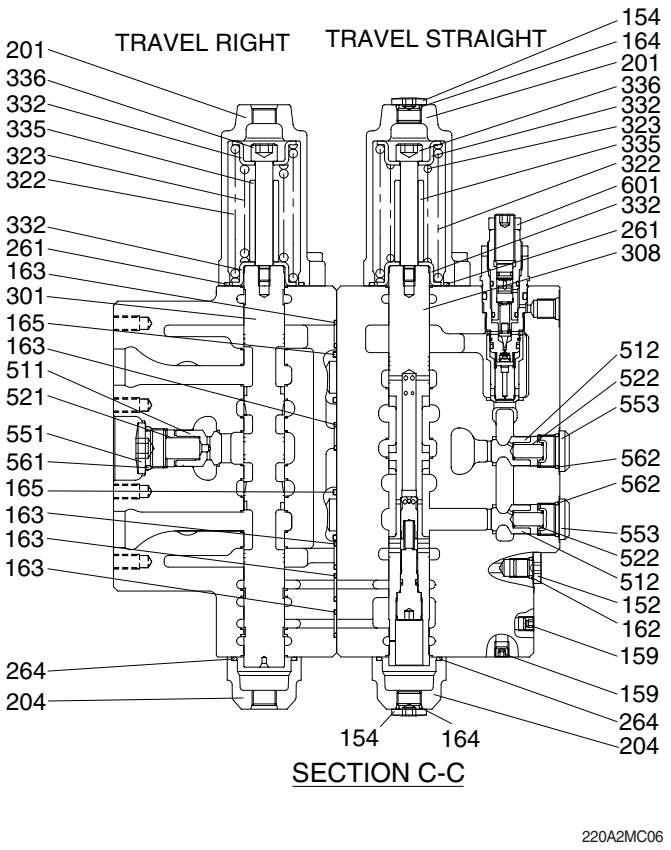
4) CASING B SPOOL SECTION



102 Casing B
153 Plug
155 Plug
165 O-ring
167 O-ring
561 O-ring
975 Socket screw

220A2MC05

5) TRAVEL RIGHT AND TRAVEL STRAIGHT SECTION

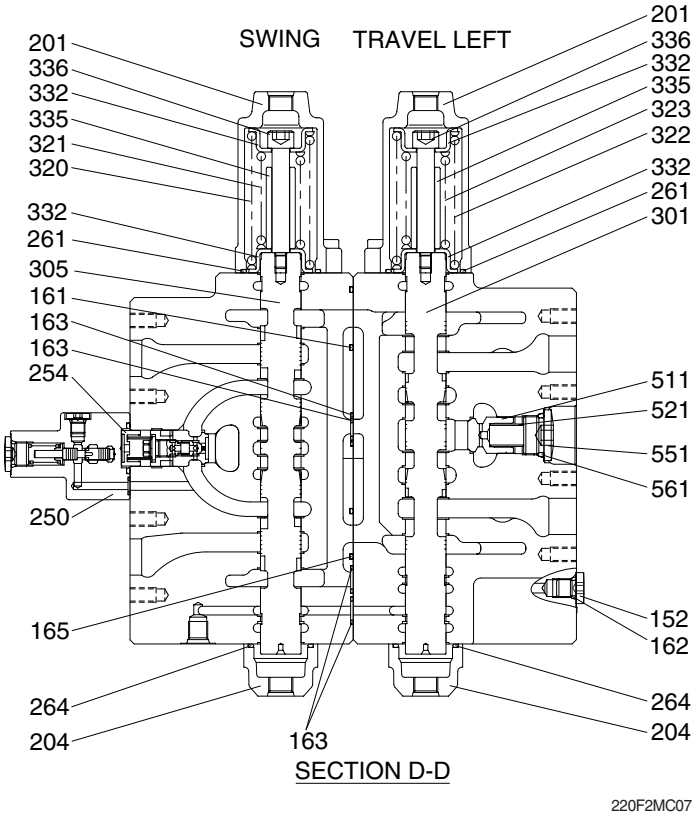


SECTION C-C

220A2MC06

152 Plug
154 Plug
155 Plug
159 Plug
162 O-ring
163 O-ring
164 O-ring
165 O-ring
201 Spring cover
204 Spool cover
261 O-ring
264 Square ring
301 Travel spool
308 Straight travel spool sub assy
322 Spring
323 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
511 Poppet
512 Poppet
521 Spring
522 Spring
551 Plug
553 Plug
561 O-ring
562 O-ring
601 Main relief valve assy

6) SWING AND TRAVEL LEFT SECTION

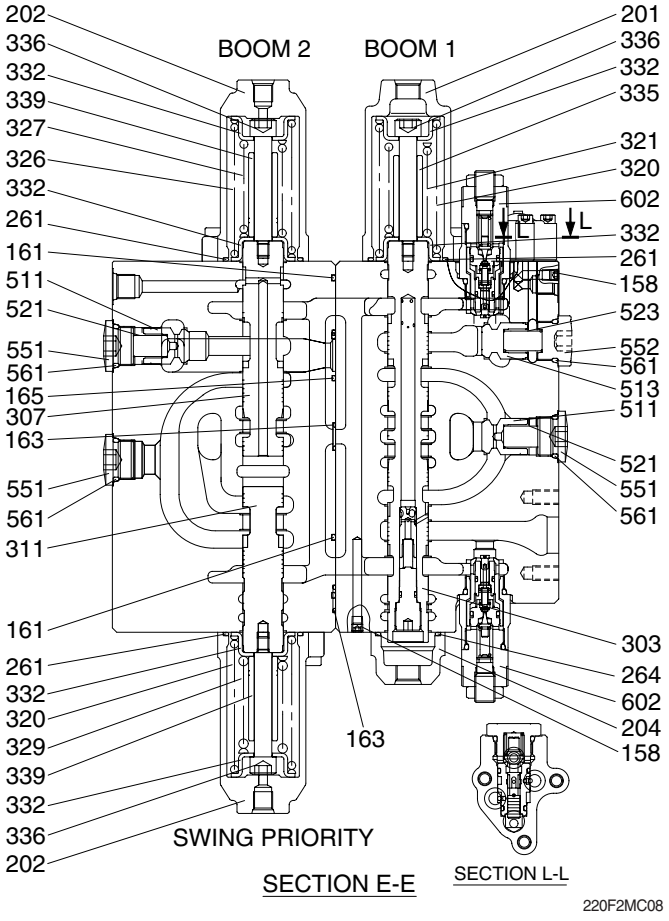


SECTION D-D

220F2MC07

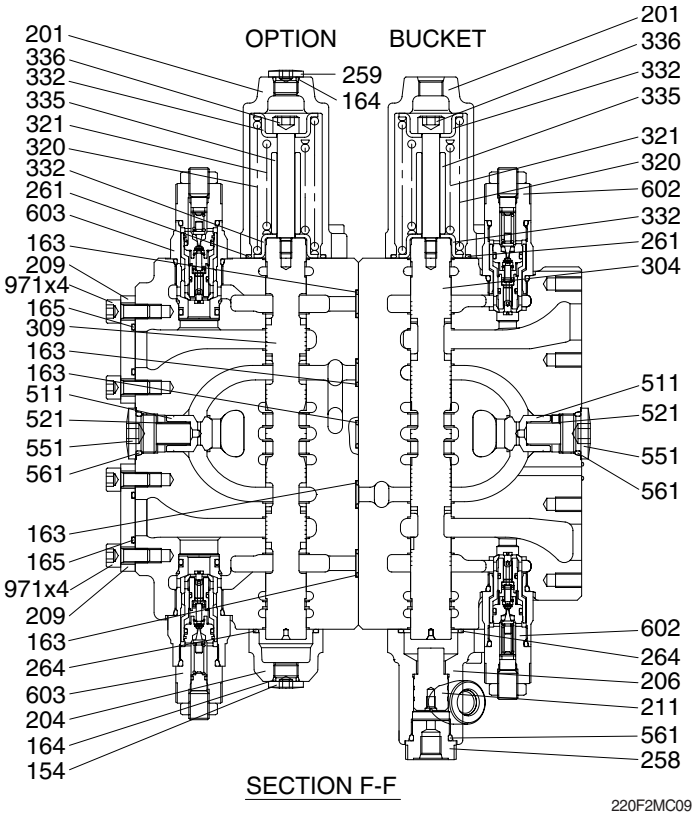
152 Plug
161 O-ring
162 O-ring
163 O-ring
165 O-ring
201 Spring cover
204 Spool cover
250 Logic control valve assy
251 Logic control valve assy
254 Swing Logic poppet assy
261 O-ring
264 Square ring
301 Travel spool
305 Swing spool
320 Spring
321 Spring
322 Spring
323 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
511 Poppet
521 Spring
551 Plug
561 O-ring

7) BOOM 1 AND 2 SECTION



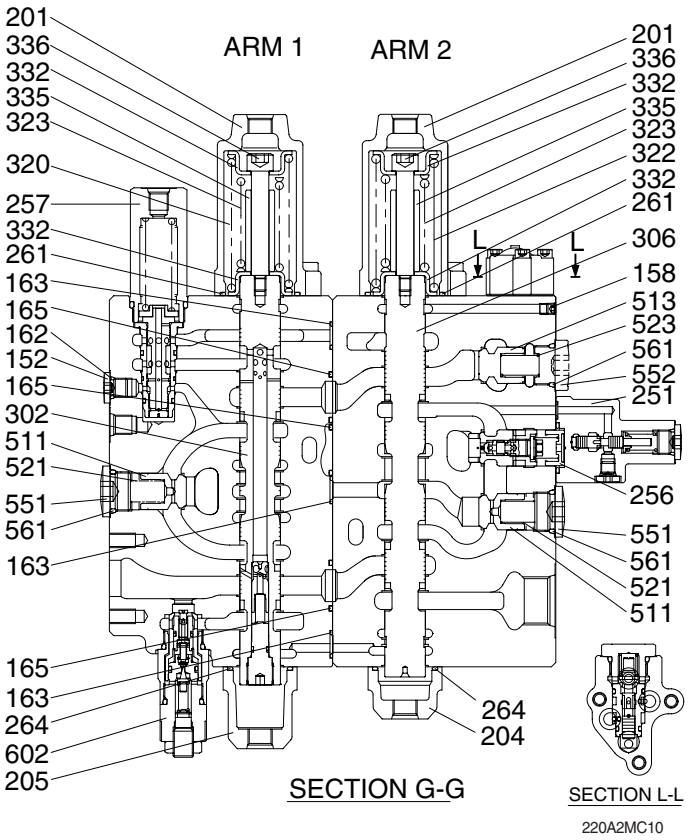
158 Plug
161 O-ring
163 O-ring
165 O-ring
201 Spring cover
202 Spring cover
204 Spool cover
261 O-ring
264 Square ring
303 Boom 1 spool sub assy
307 Boom 2 spool
311 Swing priority spool
320 Spring
321 Spring
326 Spring
327 Spring
329 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
339 Stopper
511 Poppet
513 Poppet
521 Spring
523 Spring
551 Plug
552 Plug
561 O-ring
602 Port relief valve assy

8) BUCKET AND OPTION SECTION



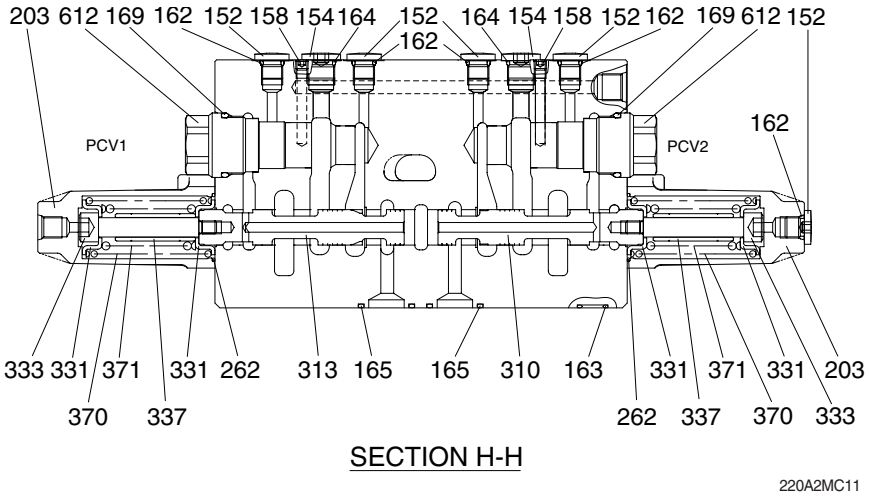
154 Plug
162 O-ring
163 O-ring
164 O-ring
165 O-ring
201 Spring cover
204 Spool cover
205 Spool cover
206 Spool cover
209 Flange
211 Piston
258 Plug
259 Plug
261 O-ring
264 Square ring
304 Bucket spool
309 Option spool
320 Spring
321 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
511 Poppet
521 Spring
551 Plug
561 O-ring
602 Port relief valve assy
603 Port relief valve assy
971 Socket screw

9) ARM 1 AND 2 SECTION



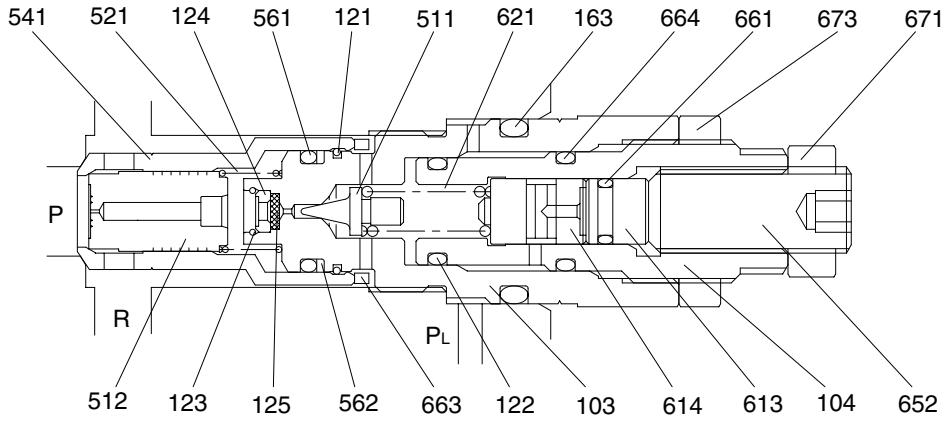
152 Plug
158 Plug
162 O-ring
163 O-ring
165 O-ring
201 Spring cover
204 Spool cover
205 Spool cover
251 Logic control valve assy
256 Arm 2 Logic poppet assy
257 Arm regeneration cut sub assy
261 O-ring
264 Square ring
302 Arm 1 spool sub assy
306 Arm 2 spool
320 Spring
322 Spring
323 Spring
332 Spring seat
335 Stopper
336 Spacer bolt
511 Poppet
513 Poppet
521 Spring
523 Spring
551 Plug
552 Plug
561 O-ring
602 Port relief valve assy

10) BYPASS CUT SECTION



152 Plug
154 Plug
158 Plug
162 O-ring
163 O-ring
164 O-ring
165 O-ring
169 O-ring
203 Spring cover
262 O-ring
310 Bypass cut spool
313 Bypass cut spool
331 Spring seat
333 Spring seat
337 Stopper
370 Spring
371 Spring
612 Plug

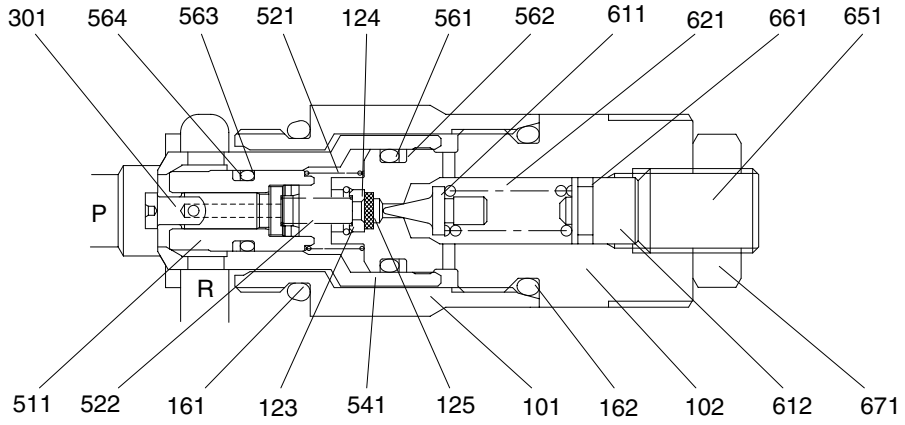
11) MAIN RELIEF VALVE (601)



220F2MC70

103	Plug	512	Plunger	621	Spring
104	Adjust plug	521	Spring	652	Adjust screw
121	C-ring	541	Seat	661	O-ring
122	Spacer	561	O-ring	663	O-ring
123	C-ring	562	Back-up ring	664	O-ring
124	Filler stopper	611	Poppet	671	Lock nut
125	Filler	613	Stopper	673	Lock nut
163	O-ring	614	Piston		

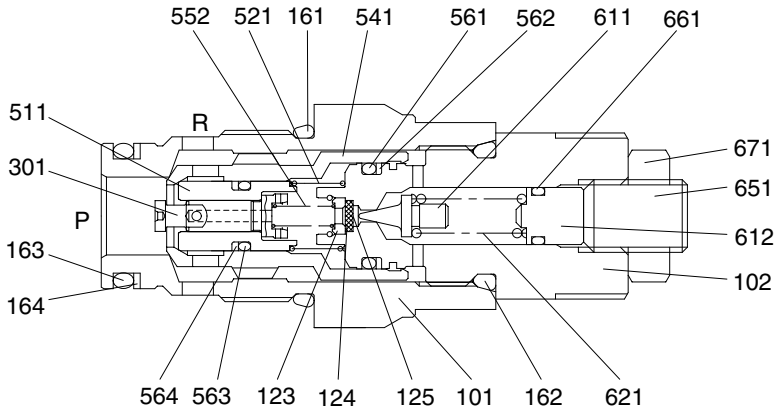
12) PORT RELIEF VALVE (602)



220F2MC71

101	Body	511	Plunger	564	Back-up ring
102	Plug	521	Spring	611	Poppet
161	O-ring	522	Spring	612	Spring seat
162	O-ring	541	Seat	621	Spring
123	O-ring	561	O-ring	651	Adjust screw
124	Filler stopper	562	Back-up ring	661	O-ring
125	Filler	563	O-ring	671	Lock nut

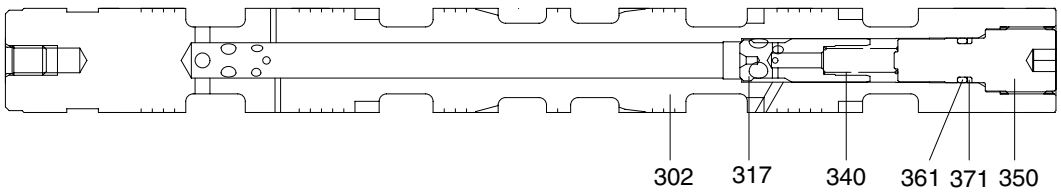
13) PORT RELIEF VALVE (603)



220F2MC72

101	Body	301	Piston	564	Back-up ring
102	Plug	511	Plunger	611	Poppet
123	C-ring	521	Spring	612	Spring seat
124	Filler stopper	522	Spring	621	Spring
125	Filler	541	Seat	651	Adjust screw
161	O-ring	561	O-ring	661	O-ring
162	O-ring	562	Back-up ring	671	Lock nut
163	O-ring	563	O-ring		

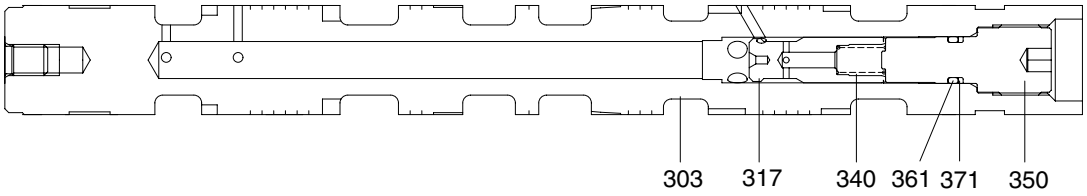
14) ARM 1 SPOOL ASSY (302)



220F2MC73

302	Spool	340	Spring	361	O-ring
317	Plunger	350	Plug	371	Back-up ring

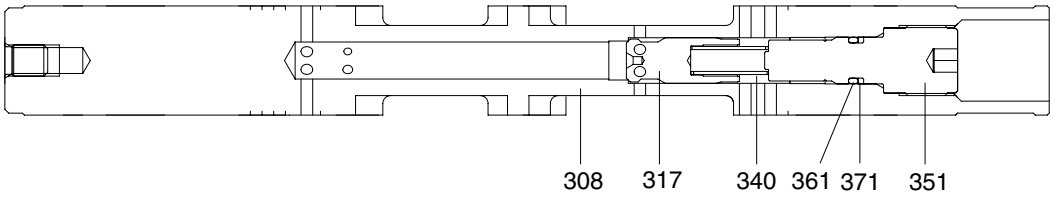
15) BOOM 1 SPOOL ASSY (303)



220F2MC74

303	Spool	340	Spring	361	O-ring
317	Plunger	350	Plug	371	Back-up ring

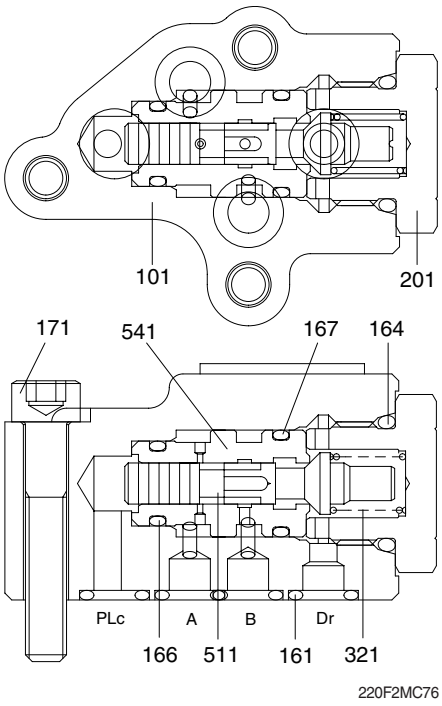
16) TRAVEL STRAIGHT SPOOL (308)



220F2MC75

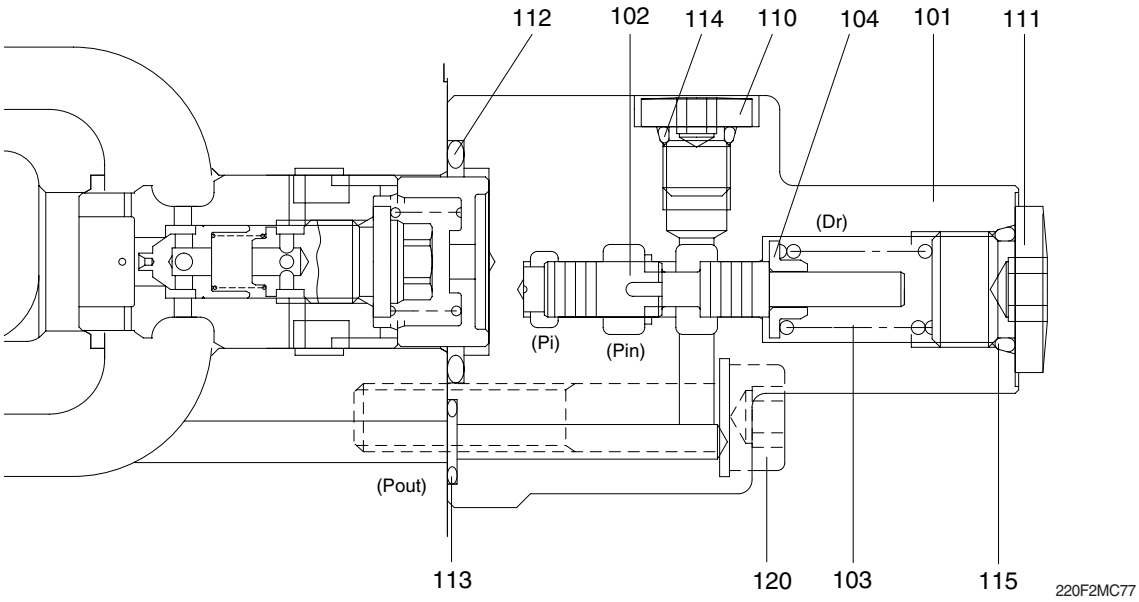
308	Spool	340	Spring	361	O-ring
317	Plunger	351	Plug	371	Back-up ring

17) LOCK VALVE SELECTOR (252)



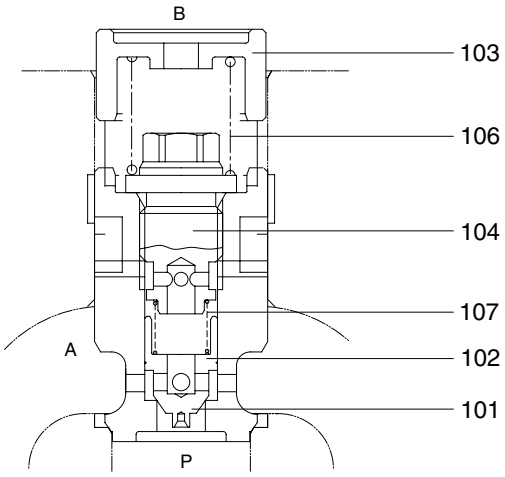
101 Casing
161 O-ring
164 O-ring
166 O-ring
167 O-ring
171 Hex socket head cap screw
201 Plug
321 Spring
511 Spool
541 Sleeve

18) LOGIC CONTROL VALVE ASSY (250, 251)



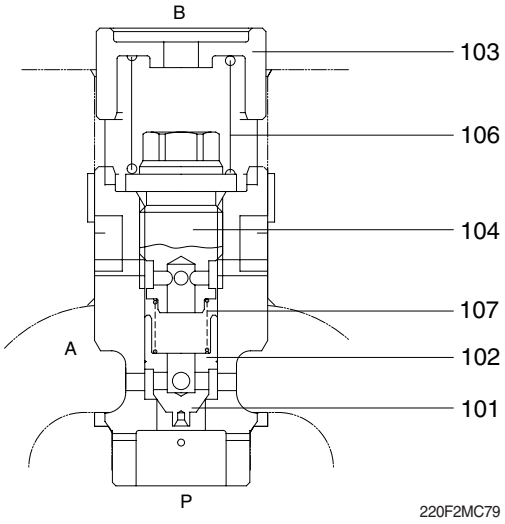
101 Casing
102 Spool
103 Spring
104 Spring seat
110 Plug
111 Plug
112 O-ring
113 O-ring
114 O-ring
115 O-ring
120 Hex socket head cap screw

19) SWING LOGIC POPPET ASSY (254)



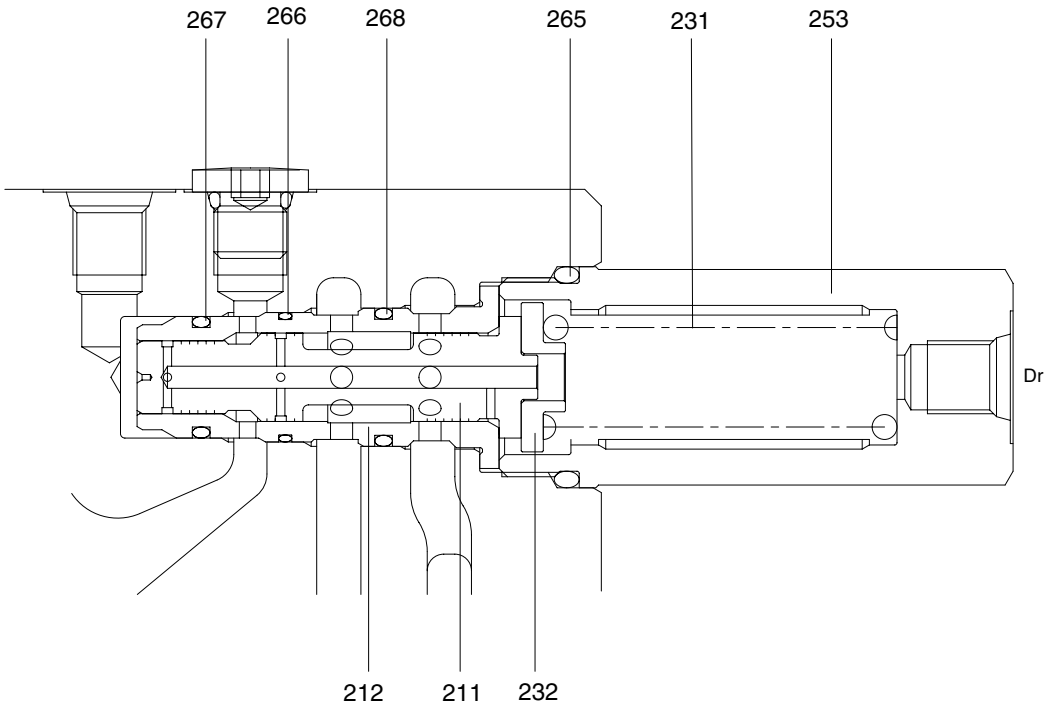
101 Logic poppet
102 Poppet
103 Spring seat
104 Plug
106 Spring
107 Spring

20) ARM 2 LOGIC POPPET ASSY (256)



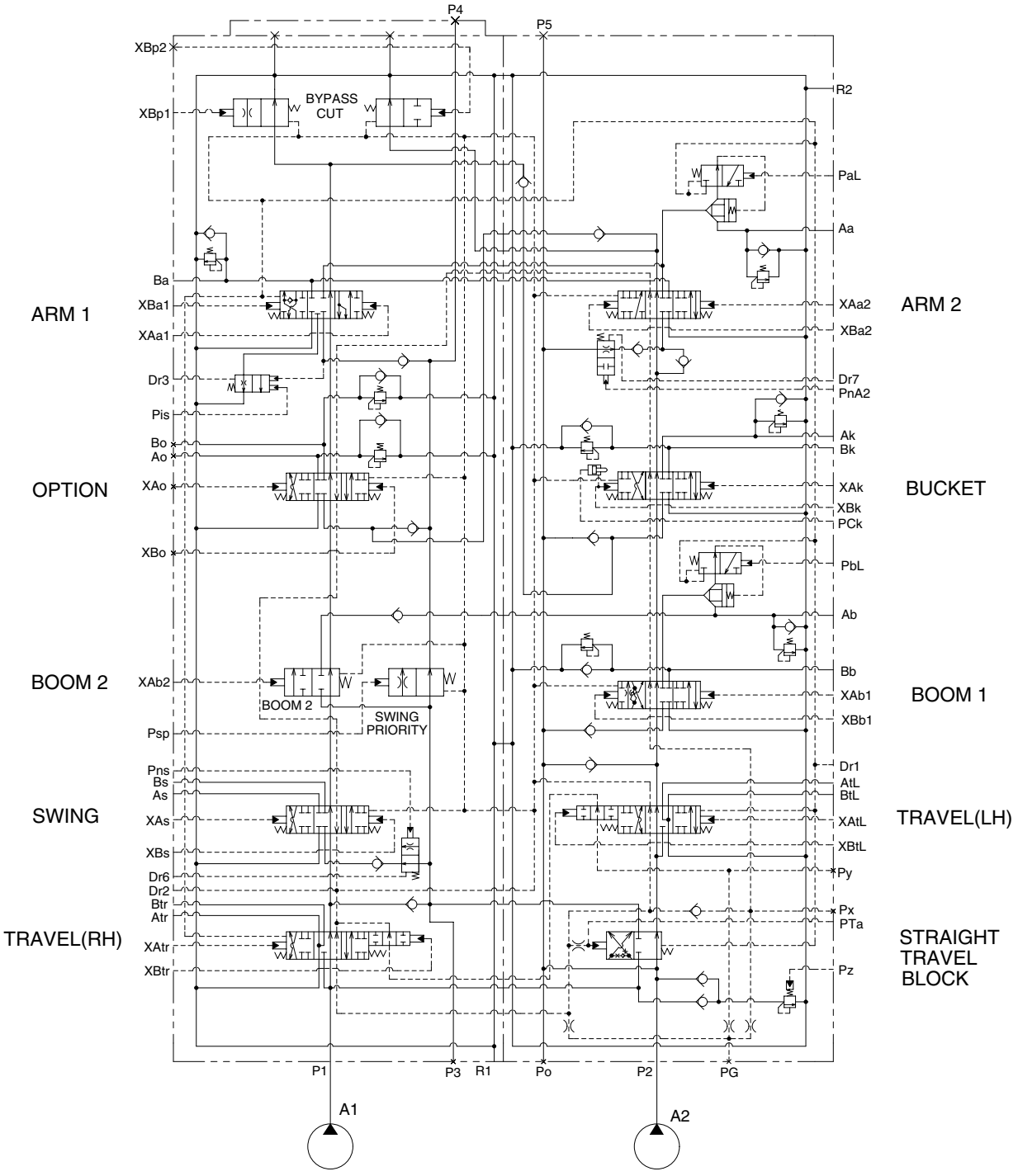
101 Logic poppet
102 Poppet
103 Spring seat
104 Plug
106 Spring
107 Spring

21) ARM REGENERATION CUT SUB ASSY (257)



211	Spool	232	Spring seat	266	O-ring
212	Sleeve	253	Plug	267	O-ring
231	Spring	265	O-ring	268	O-ring

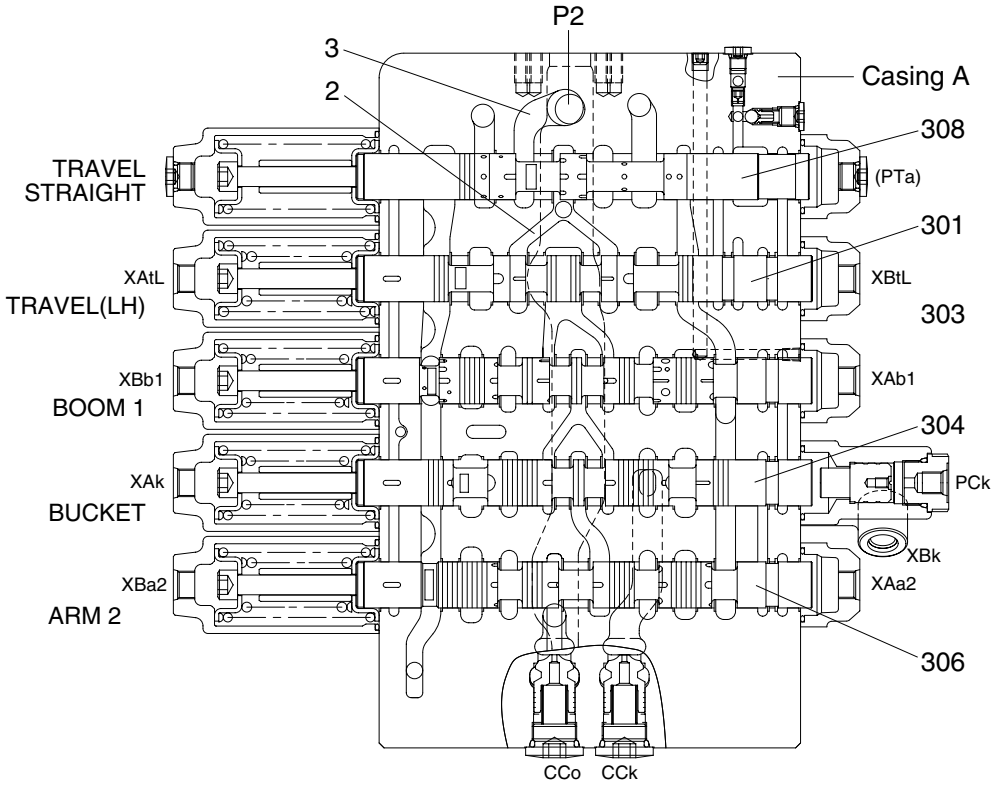
2. HYDRAULIC CIRCUIT



220A2MC12

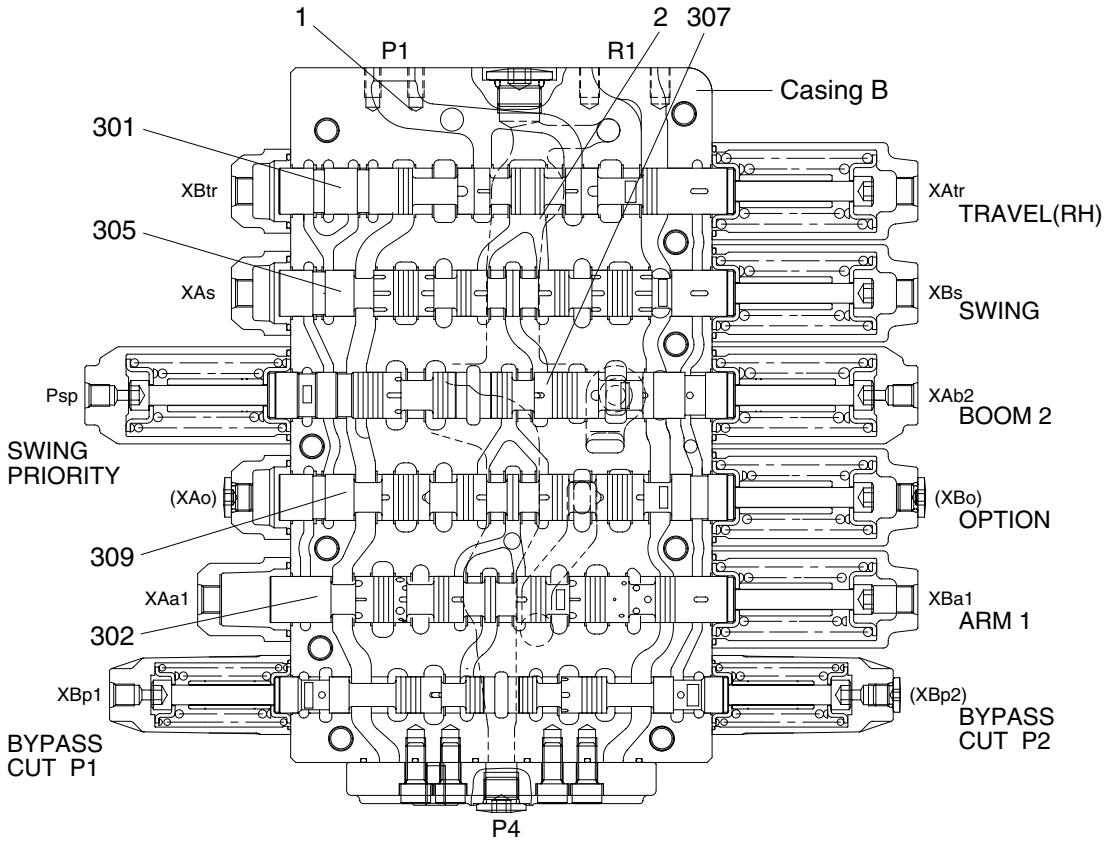
3. FUNCTION

1) CONTROL IN NEUTRAL POSITION



SPOOL SECTION (P2)

220F2MC15



SPOOL SECTION (P1)

220F2MC16

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 right (301), swing (305), boom confluence (boom 2; 307), option (309) and arm 1 (302), and returns to the hydraulic oil tank through the tank port (R1).

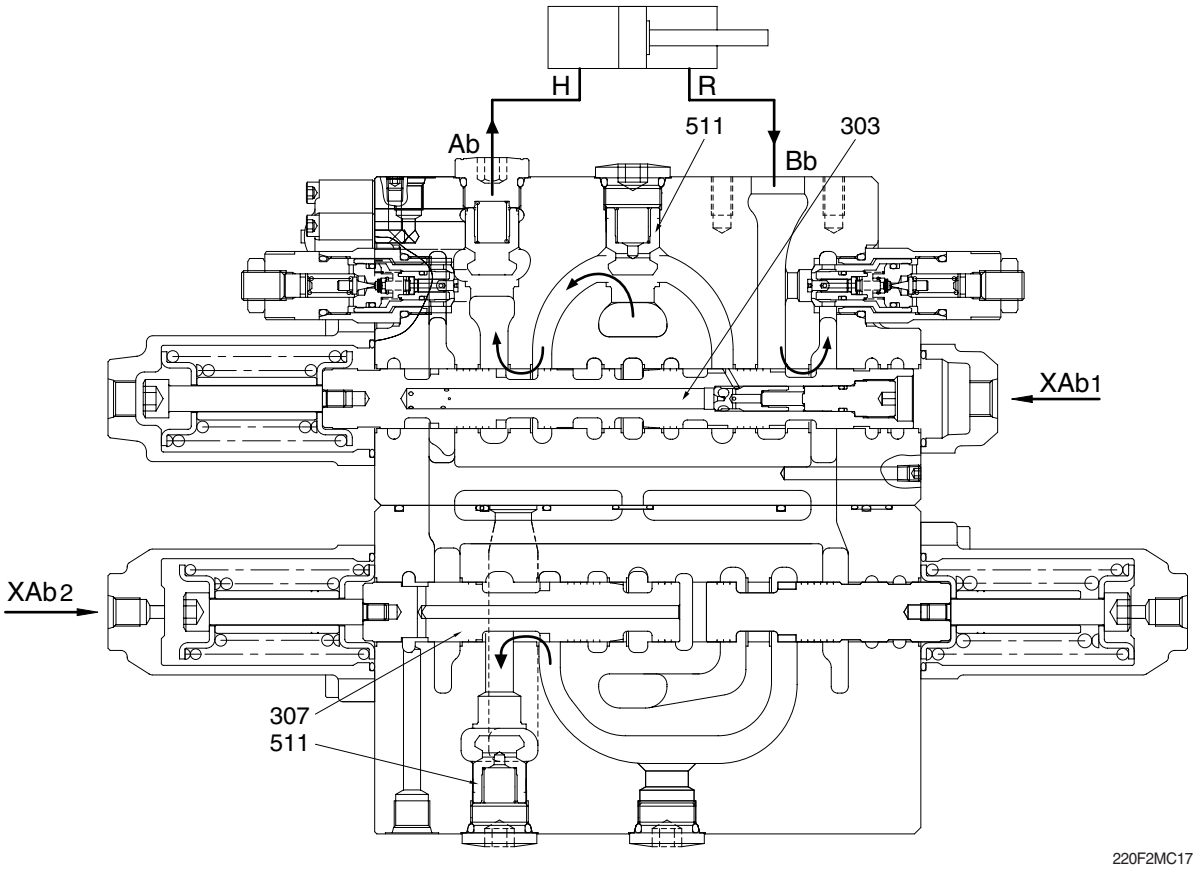
The oil discharged from the hydraulic pump (A2) passes through Port P2, the main path (3), the bypass circuit (2) passing the spools for travel left (301), boom 1 (303), bucket (304) and arm 2 (306), and returns to the hydraulic oil tank through the tank port (R1).

RCV secondary pressure in neutral position of spool is led to electrically controlled regulator and controls the pump discharge flow rate to its minimum value.

2) EACH SPOOL OPERATION

(1) Boom operation

① Boom up operation



Pilot circuit

Since the boom 1 spool (303) transfers and shuts off the side-bypass path, the pressure at Port XAb1, XAb2 increases.

Main circuit

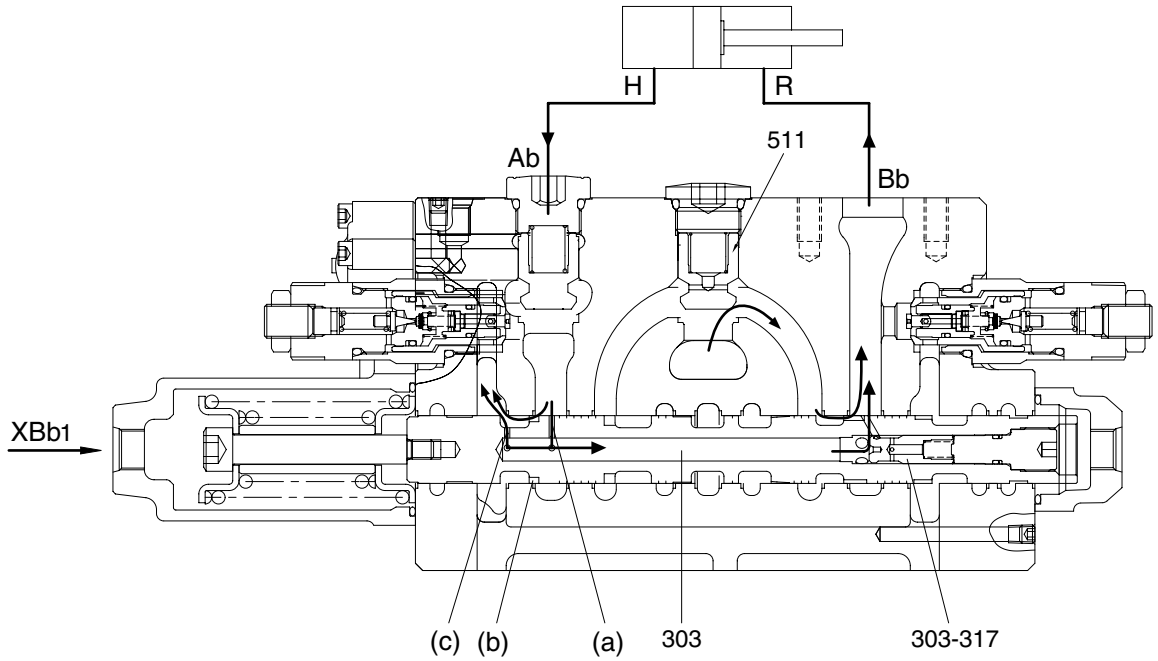
During the boom up operation, the pilot pressure enters through Port XAb1 and moves the boom 1 spool (303) in the left direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows to the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of 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 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 right direction. Though the pressurized oil enters into Port P1, the bypass circuit (2) is shut off due to transfer of the boom 2 spool (307). Therefore, the hydraulic oil flows in the parallel circuit and flows through the U-shaped path to the boom 2 spool (307). Then, the hydraulic oil passes through the periphery of the boom 2 spool (307), pushes open the check valve (511), joins into Port Ab in the inside path, and is supplied to the boom cylinder head side. (Boom confluent flow)

On the other hand, the return oil from the boom cylinder rod side (R) enters through Port Bb and returns to the hydraulic oil tank through the tank port (R1).

② Boom down operation



220F2MC52

Pilot circuit

Since the boom 1 spool (303) transfers and shuts off the side-bypass path, the pressure at Port XBb1 increases.Then, the pressure enters also through Port PbL and the release signal is sent to the lock valve (252).

Main circuit

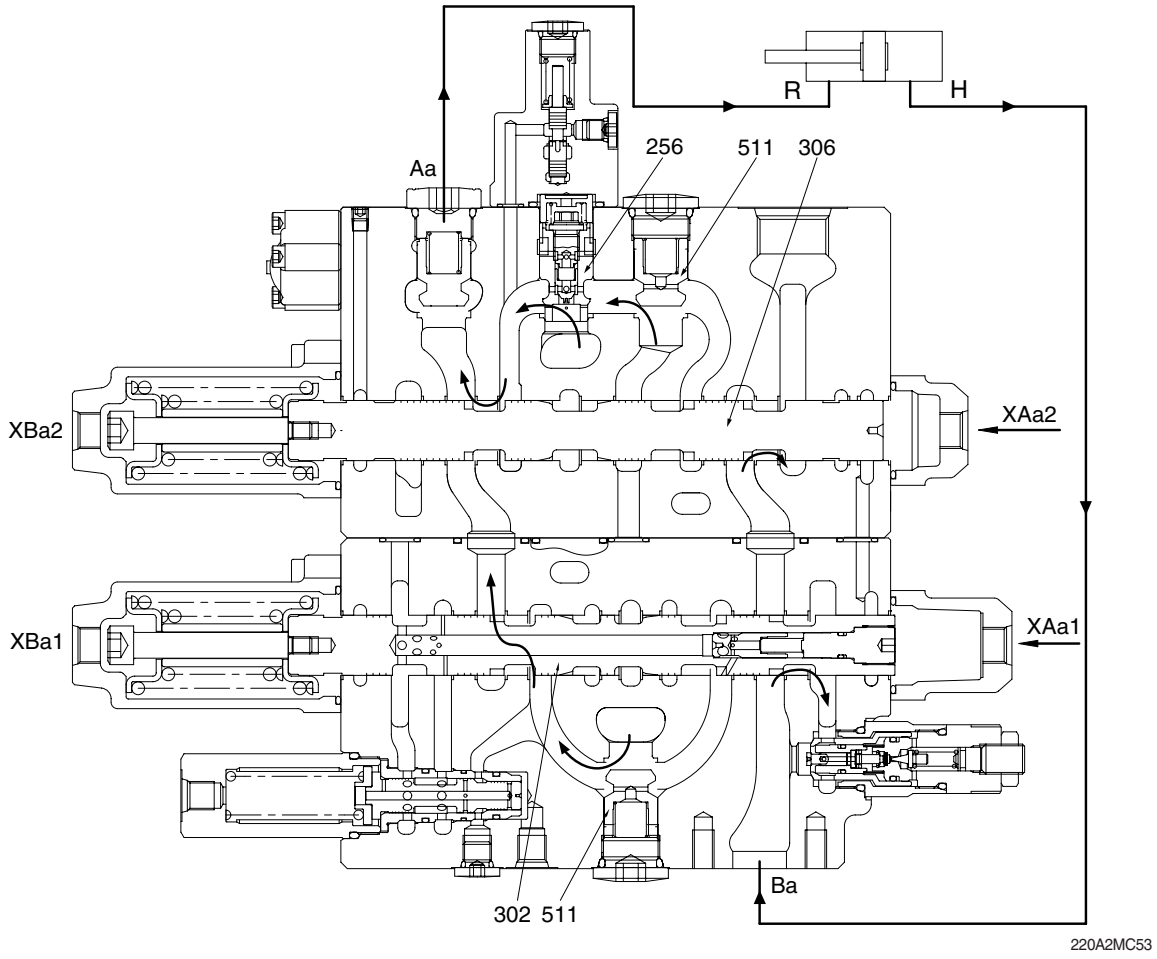
During the boom down operation, the pilot pressure enters through Port XBb1 and transfers the boom 1 spool (303) in the right direction.The pressurized oil entering through Port P2 passes through the main path (3) and flows to the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer 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 to the holes (a) and the notches (b) 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, flows around the outside of the spool.Then, it is supplied again to the boom cylinder rod side as hydraulic oil to lower the boom. (Boom regeneration)
Besides, a part of the return oil from the boom cylinder flows from the hole (c) into the tank.

(2) Arm operation

① Arm out operation



Pilot circuit

Since the arm 2 spool (306) transfers and shuts off the side-bypass path, the pressure at Port XAa1, XAa2 increases.

Main circuit

During the arm out operation, the pilot pressure enters through Ports XAa1 and XAa2.When the pressure enters through Port XAa1 and XAa2, the spools transfer in the left direction.The hydraulic 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 arm 1 spool (302).

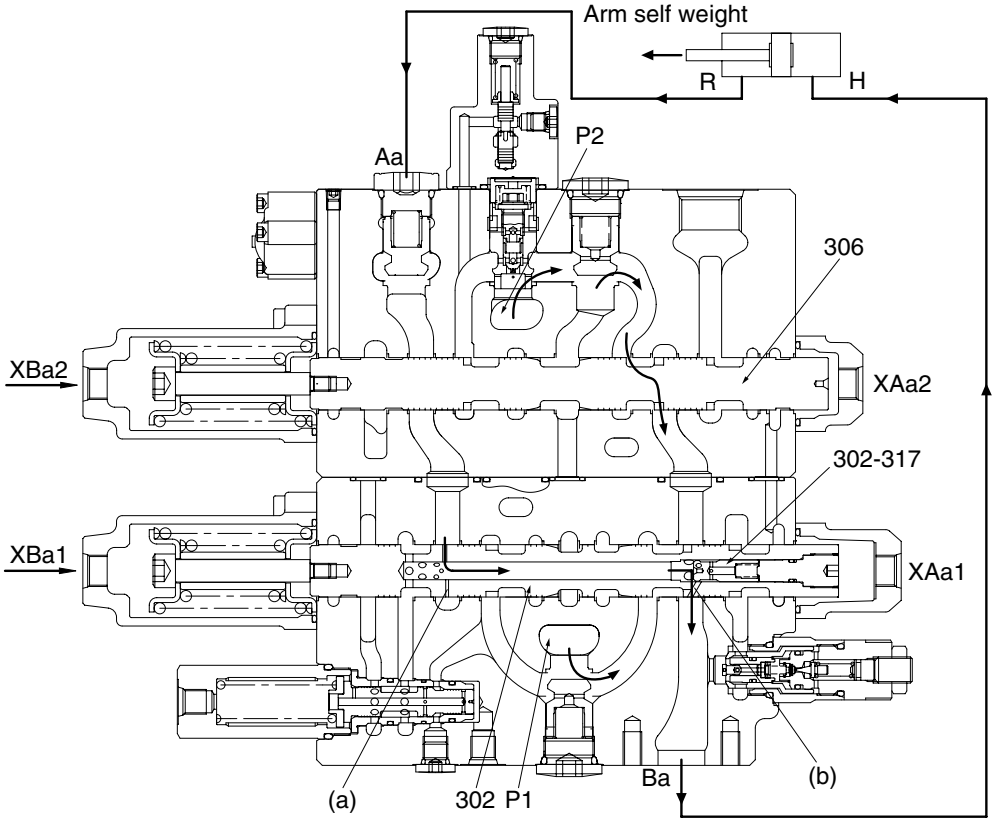
Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 1 spool (302).Then, it flows around the periphery of the arm 1 spool (302) and the arm 2 spool (306) to Port Aa, and is supplied to the arm cylinder rod side (R).

On the other hand, the hydraulic oil entering through Port P2 passes in the main path (3), 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 logic poppet (256) and the hydraulic oil from the bypass circuit (2) 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 the arm 2 spool (306) in the inside path and joins into Port Aa.

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

② Arm in operation

· During light load only



Pilot circuit

Since the arm 2 spool (306) transfers and shuts off the side-bypass path, the pressure at Port XBa1, XBa2 increases. Then, the pressure enters also through Port PaL and the release signal is sent to the lock valve (252).

Main circuit

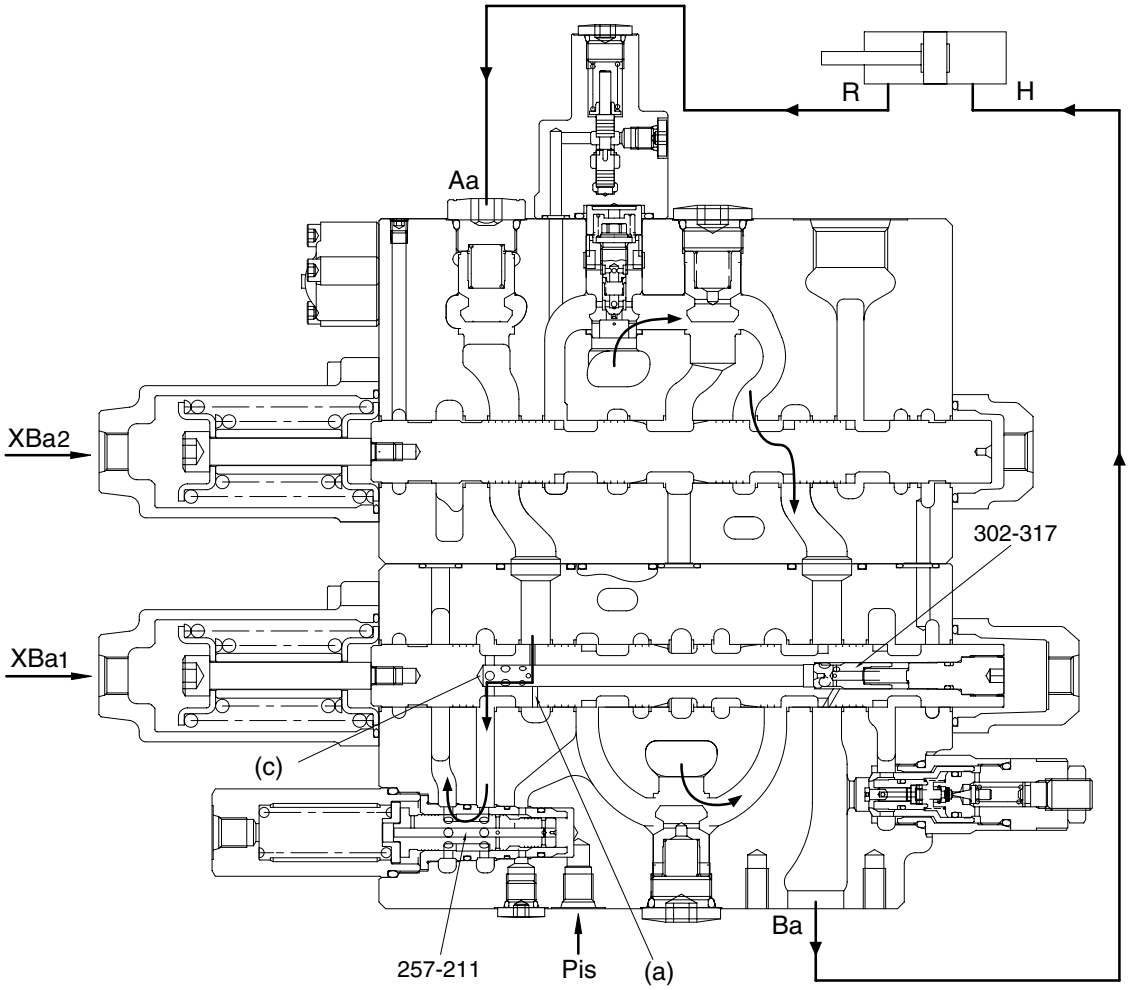
During the arm in operation, the pilot pressure enters through Ports XBa1 and XBa2. When the pressure enters through Port XBa1 and Port XBa2, the spools transfer in the right direction. The hydraulic oil entering through Port P1 passes through the main path (1) and flows to the bypass circuit (2), but the bypass circuit is shut off due to transfer of the arm 1 spool (302).Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) 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 Ba, and is supplied to the arm cylinder head side (H).

On the other hand, the hydraulic oil entering through Port P2 passes in the main path (3), 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 logic poppet (256) and the hydraulic oil from the bypass circuit (2) 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 the arm 2 spool (306) and the arm 1 spool (302) in the inside path and joins into Port Ba.

Besides, 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 periphery hole (a) of the arm 1 spool (302).During a light load only, it pushes open the check valve (302-317) and joins into Port Ba from the spool hole (b).The rest of oil returns to the hydraulic oil tank through the tank port (R1).This is called the arm regeneration function.

· The pressure in the arm cylinder head side (H) increases

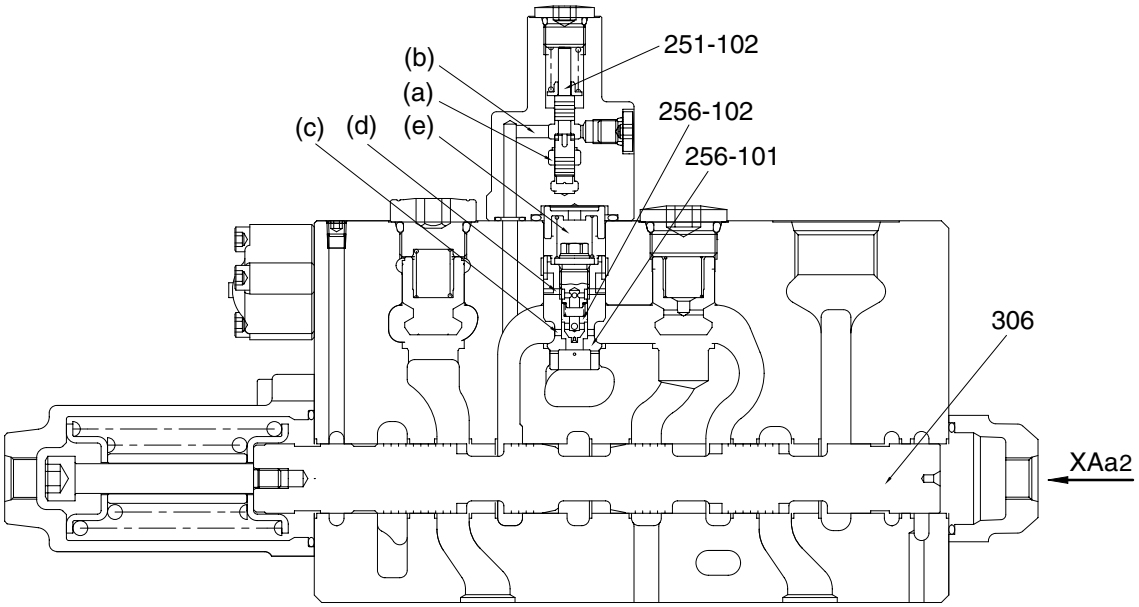


220A2MC55

When the pressure in the arm cylinder head side (H) and the U-shaped path increases, the arm regeneration cut spool (257-211) is transferred in the left direction, 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) to the hydraulic oil tank.

When the Pilot Port Pis of the arm regeneration cut spool (257-211) is pressurized, a part of the return oil from the arm cylinder rod side flows to the arm regeneration cut valve (257) and returns through the tank port (R1) to the hydraulic oil tank. (Variable arm regeneration)

③ Arm 2 logic control valve operation



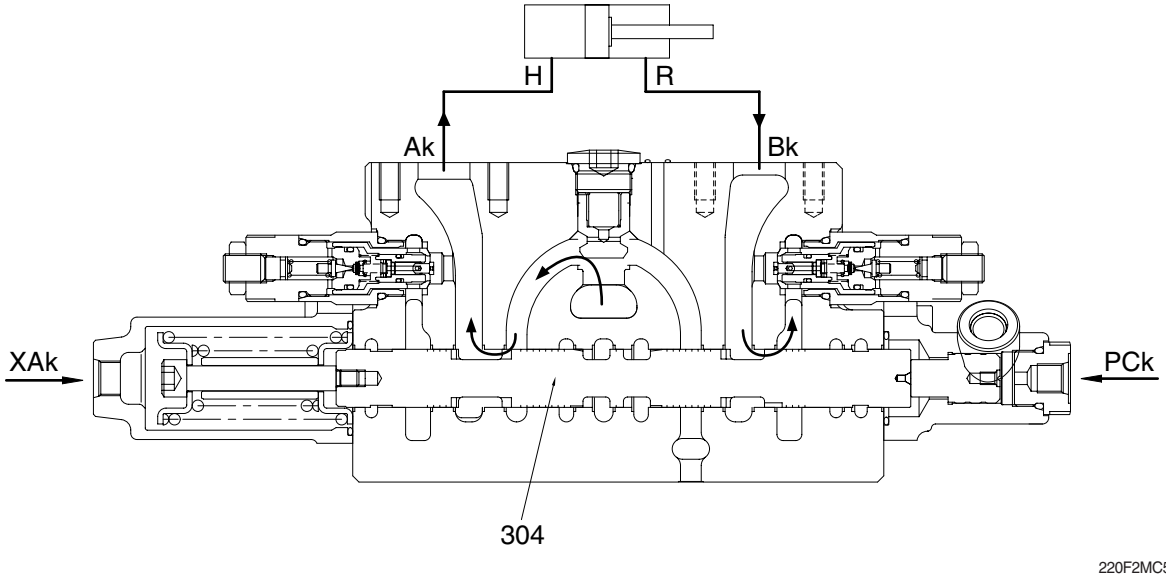
220A2MC116

During both the arm in operation and the boom up operation, the pilot pressure enters through Ports XBa1, XBa2, XAb1, XAb2, PaL and electrically controlled pilot pressure enters to PnA2. The pressure PnA2 transfers the spool (251-102) in the arm 2 logic control valve to the top direction, and the path from (a) to (b) is closed. Hereby, the pressurized oil pushes open the poppet (256-102), passes in the path (c) and (d), enters into the chamber (e), and the poppet (256-101) is pushed to the casing seat. Therefore, the most of pressurized oil entering through Port P2 flows to the boom 1 spool (303) than the arm 2 spool (306) to make the boom hoisting operation most preferential.

On the other hand, in the independent arm in operation, the pilot pressure does not enter through Ports PnA2, and the path from (a) to (b) is not closed, and the hydraulic oil of the chamber (e) flows to the path (a) and (b). The pressurized oil entering through Port P2 pushes open the poppet (256-101) and flows to the arm 2 spool (306).

(3) Bucket operation

① Bucket in operation



Pilot circuit

Since the bucket spool (304) transfers and shuts off the side-bypass path, the pressure at Port XAk increases. Then, the pressure enters also through Port XBp1.

Main circuit

During the bucket in operation, the pilot pressure enters through Port XAk and transfers the bucket spool (304) in the right direction.The pressurized oil entering through Port P2 passes through the main path (3) and flows through the bypass circuit (2), but the bypass circuit (2) 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 spool to Port Ak 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 Bk, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port (R1).

During both the boom up operation and bucket in operation, the pilot pressure enters through Port PCk and the bucket spool transfers in the half stroke not full stroke. Therefore, the most of pressurized oil entering through Port P2 flows to the boom 1 spool (303) than the bucket spool (304) to make the boom up operation most preferential.

② Bucket out operation

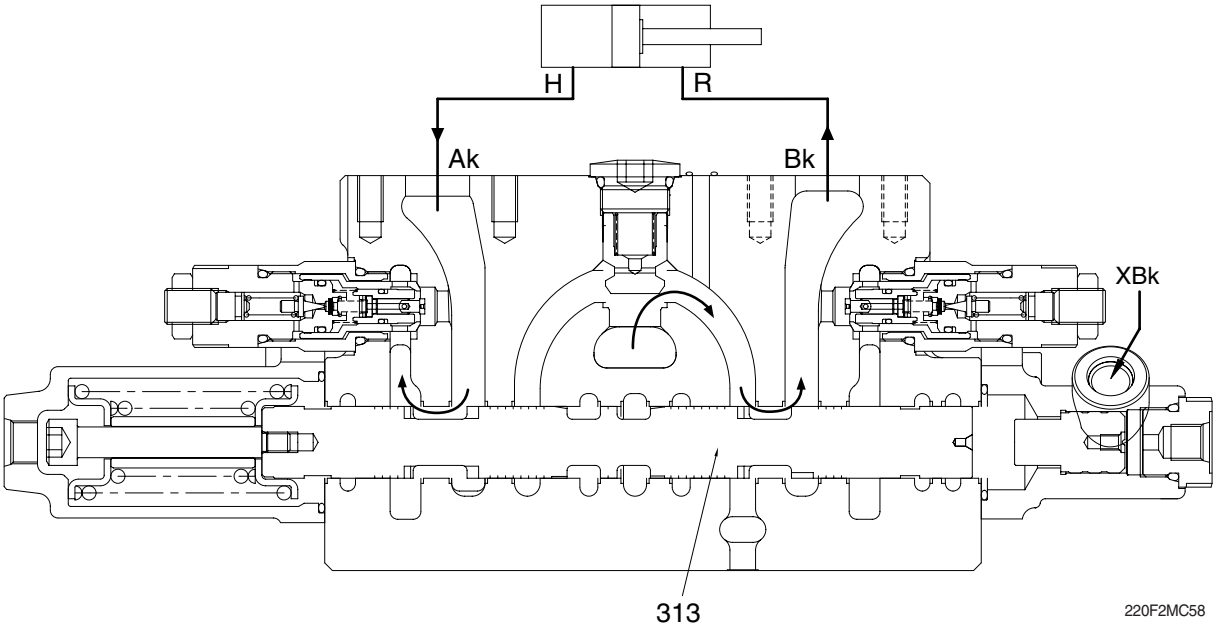
Pilot circuit

Since the bucket spool (304) transfers and shuts off the side-bypass path, the pressure at Port XBk increases. Then, the pressure enters also through Port XBp1.

Main circuit

During the bucket out operation, the pilot pressure enters through Port XBk and transfers the bucket spool (304) in the left direction.The pressurized oil entering through Port P2 passes through the main path (3) and flows through the bypass circuit (2), but the bypass circuit (2) 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 spool to Port Bk and is supplied to the bucket cylinder rod side (R).

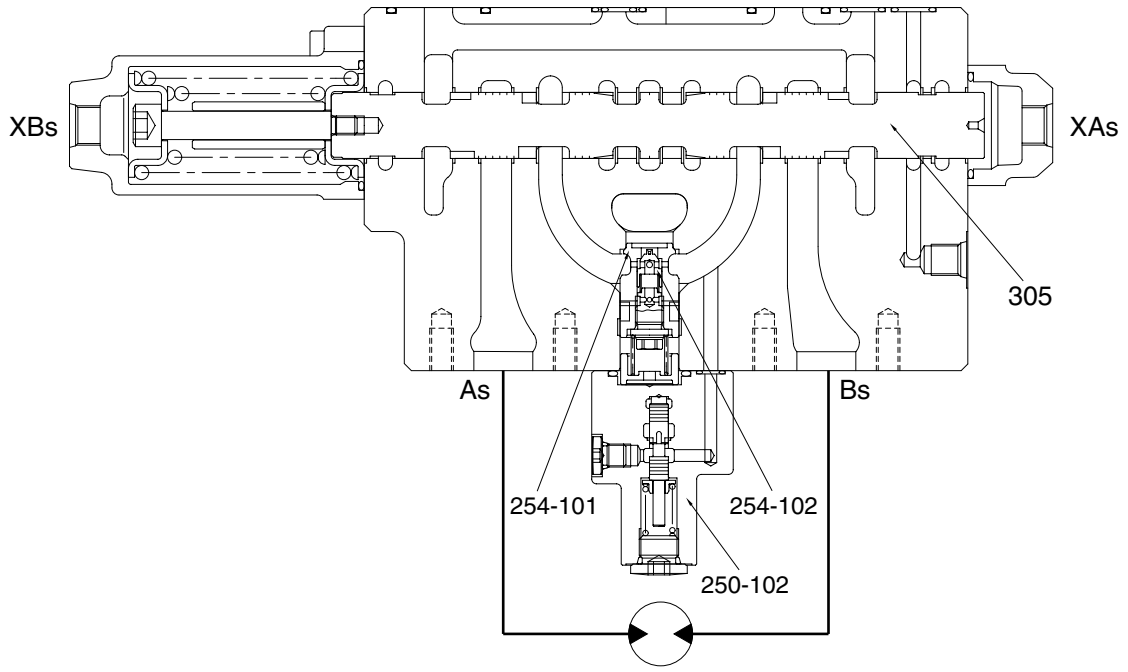
On the other hand, the return oil from the bucket cylinder head side (H) enters through Port Ak, passes around the periphery of the spool, and returns to the hydraulic oil tank through the tank port (R1).



③ Bucket in/out confluence

During the bucket in/out operation, the pilot pressure enters also through Port XBp1 and transfers the bypass-cut spool (313). 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 (313). Therefore, the pressurized oil pushes open the check valve CCk (514), and flows through inside path and the U-shaped path to the bucket spool (304).

(4) Swing operation



① Swing operation

Pilot circuit

Since the swing spool (305) transfers and shuts off the side-bypass path, the pressure at Port XAs (or Xbs) increases.

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 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 swing spool (305). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), 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.

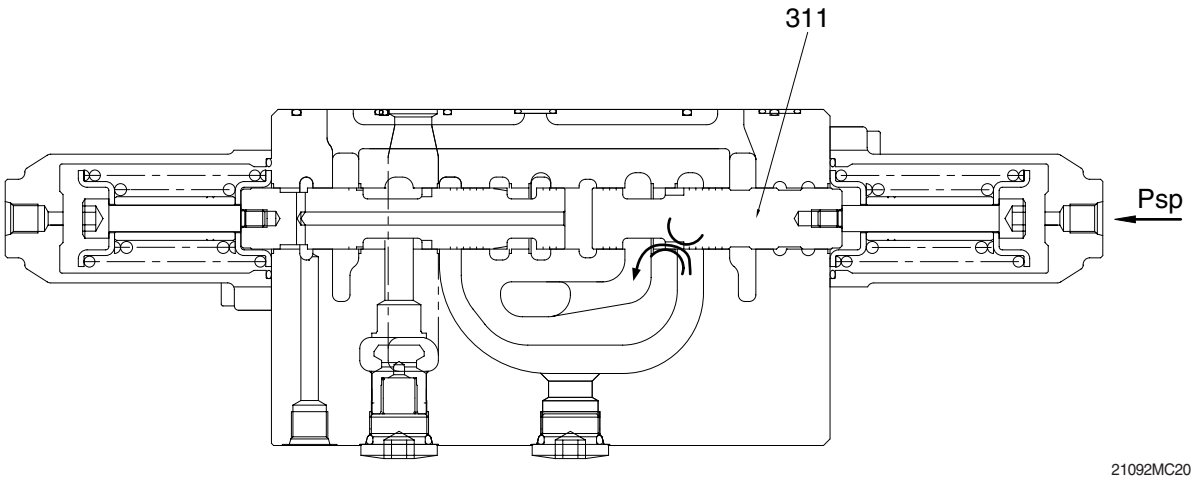
On the other hand, the return oil from the swing motor enters Port Bs (or As) and returns to the hydraulic oil tank through the tank port (R1).

② Swing logic control valve operation

During both the swing operation and the boom up operation, the pilot pressure enters through Ports XBs (or XAs), XAb1, XAb2 and electrically controlled pilot pressure enters to PnA2. The pressure Pns transfers the spool (250-102) in swing logic control valve. Hereby, the pressurized oil pushes open the poppet (254-102), and the poppet (254-101) is pushed to the casing seat. Therefore, the most of pressurized oil entering through Port P1 flows to the boom 2 spool (307) than the swing spool (305) to make the boom up operation most preferential.

On the other hand, in the independent swing operation, the pilot pressure does not enter through Ports Pns. The pressurized oil entering through Port P1 pushes open the poppet (254-101) and flows to the swing spool (305).

③ Swing operation preference function



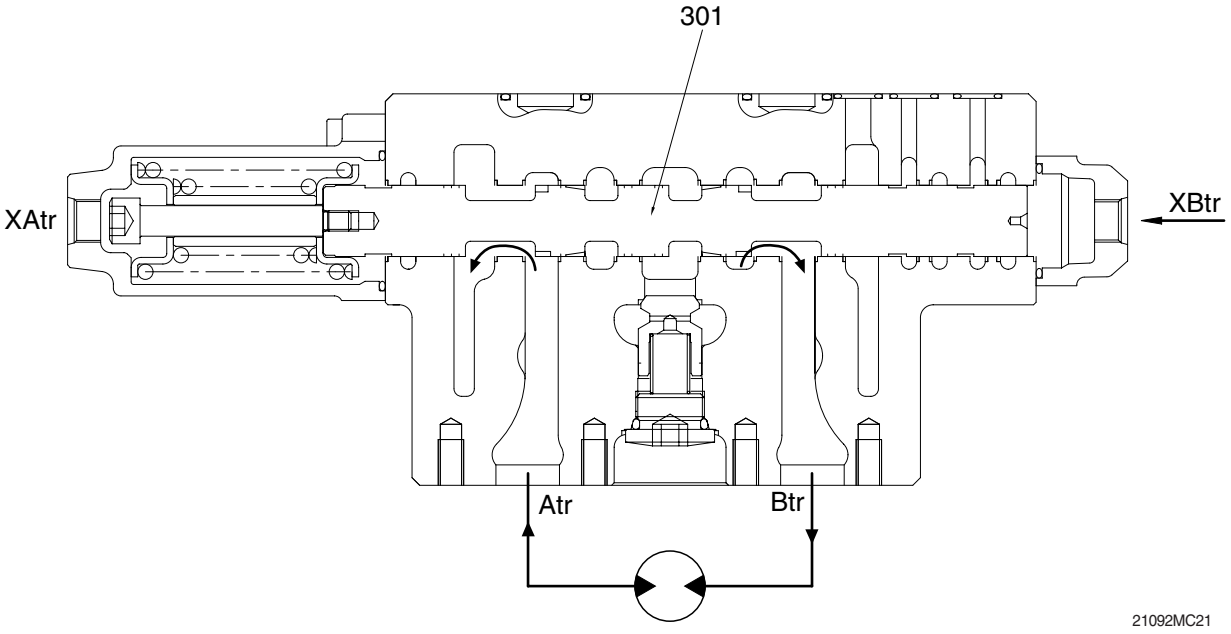
Pilot circuit

The pilot pressure enters through Port Psp to transfer the swing priority spool (311).

Main circuit

Due to transfer of the swing priority spool (311), the open area of the swing priority spool decreases, and the most of the pressurized oil entering through Port P1 flows to the swing side to make the swing operation most preferential.

(5) Travel operation



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 XBtr (or XAtr) increases.

Main circuit

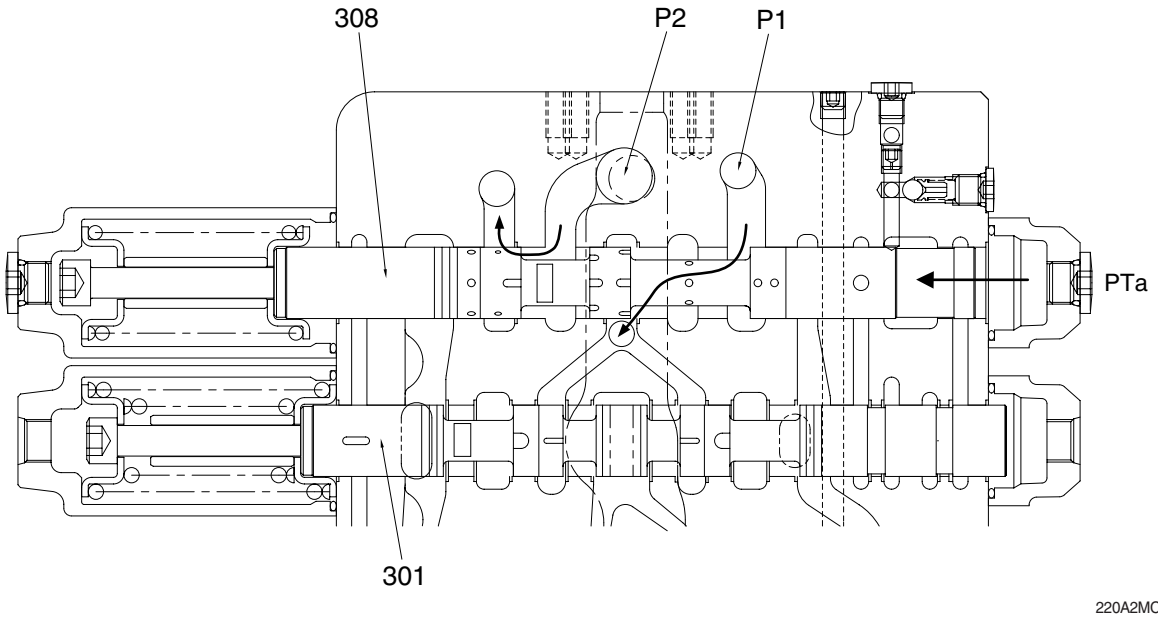
When Pilot Port XBtr of the travel right spool (301) is pressurized, the bypass circuit (2) in the arm 1 side is shut off and the working fluid discharged from the hydraulic pump (A1) through Port Btr and flows to the travel right motor.

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 the working fluid discharged from the hydraulic pump (A2), similarly to that from the hydraulic pump (A1), through Port BtL and flows to the travel left motor.

On the other hand, the return oil from the right and left travel motor passes flows from Port Atr (AtL) to the travel right (left) spools (301) and returns to the hydraulic oil tank through the tank port (R1). In the case of the opposite operation (when the pilot pressure is applied to Ports XAtr and XAtL of the control valve), the operation is similar.

(6) Travel straight operation

Simultaneous operating of both travel spools (301) and other spool.
The following the case that both travel spools (301) and swing spool (305) are changed over.
(When the pilot Ports XAtL, XAtr and XAs are pressurized.)



Pilot circuit

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

Main circuit

After changeover of the travel straight spool (308), the port P1 and both travel spools (301) are connected preferentially and the port P2 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 P1 passes through mainly ports AtL and Atr, and flows to both travel motors separately.

On the other hand, the pressurized oil entering through Port P2 flows to Port As and is supplied to the swing motor.
When the pressure of Port P1 is lower than the pressure of Port P2, the part of oil entering through Port P2 flows into Port P1 side. Therefore, it prevents the travel velocity from slowing rapidly.

3) FUNCTION OF LOCK VALVE

The lock valve (252) is fitted between the arm cylinder rod side (R) and the arm 2 spool (306). It decreases the leakage by the pressure of the cylinder.

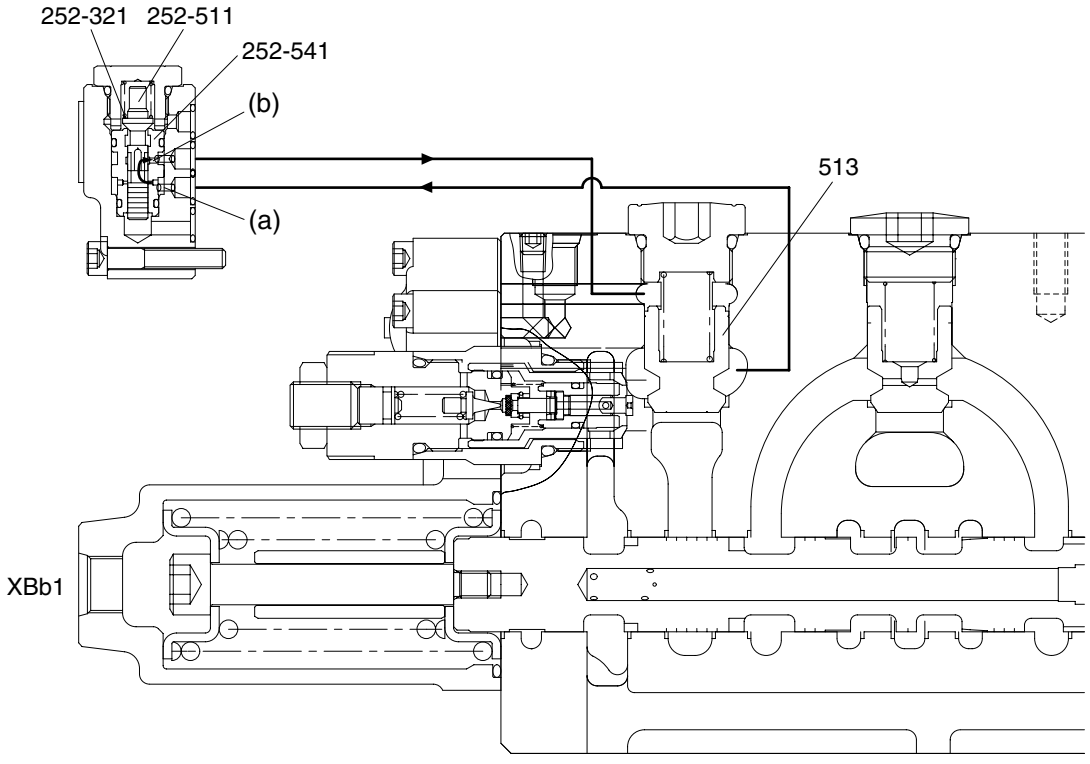
Another lock valve (252) is similarly fitted between the boom cylinder head side (H) and the boom 1 spool (303). It decreases the leakage by the pressure of the cylinder.

(1) Neutral positions of spools

The following is the case of the boom 1 spool (303).(The case of the arm 2 spool (306) is in the same way.)

During the boom 1 spool (303) is in the neutral position, the lock valve (252) is kept in the position shown in figure.The spool (252-511) in the lock valve is pushed to the seat of the sleeve (252-541) by the force of the spring (252-321).

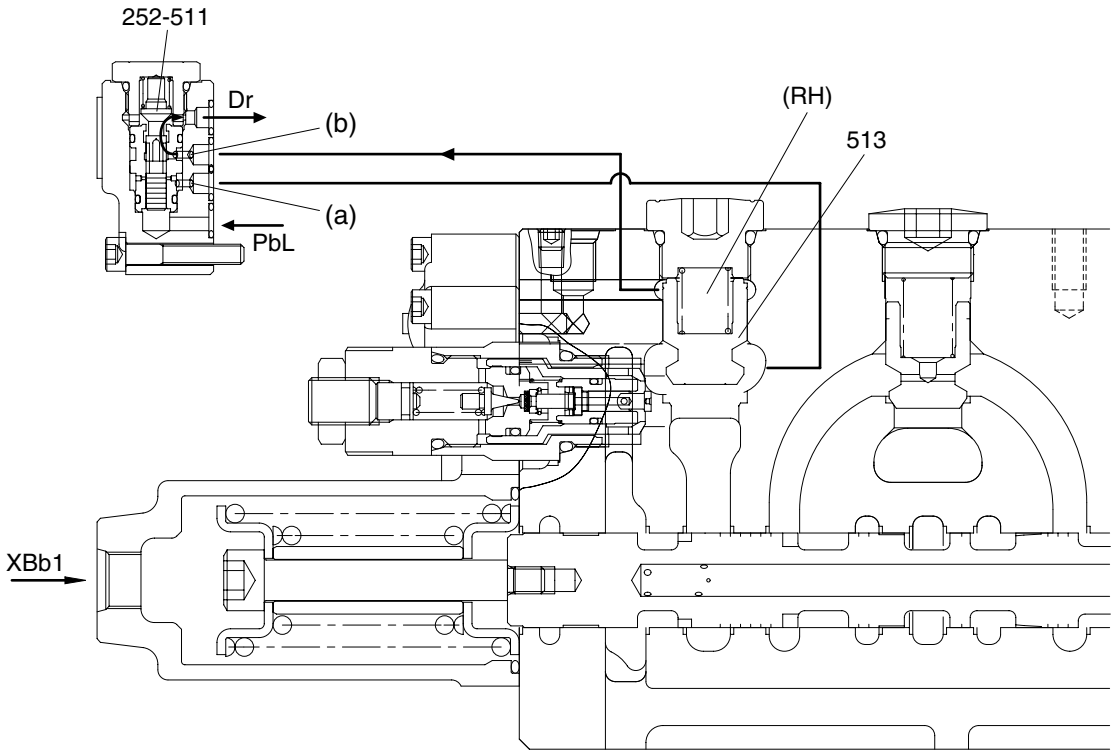
In this position, the pressurized oil from the boom cylinder head side (H) enters through the hole (a), the periphery of the spool (252-511) in the lock valve and the hole (b), and it pushes the poppet (513) to the casing seat, and the leakage is decreased.



220A2MC135

(2) Boom down operation

During the boom down operation, the pilot pressure enters through Port PbL and XBb1. The pilot pressure transfers the spool (252-511) in the lock valve assy in the top direction. By the transfer of the spool (252-511), firstly the hole (a) is blocked and the flow of oil from the boom cylinder head side (H) to the spring chamber (RH) stops. Secondly, the oil in the spring chamber (RH) enters through the 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.



220A2MC136

(3) Boom up operation

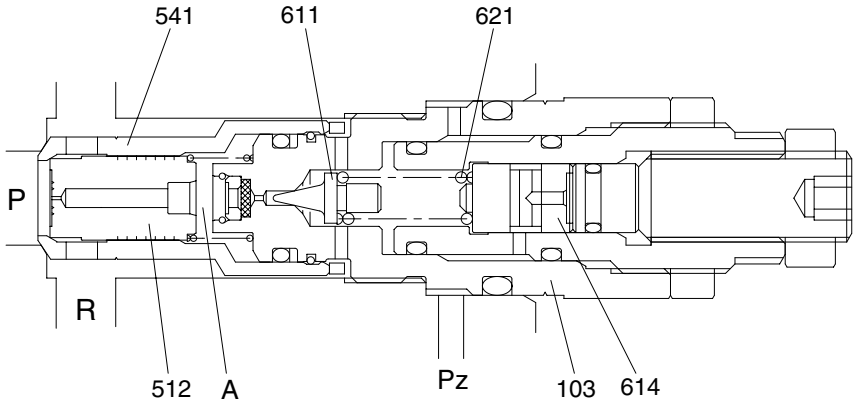
During the boom up operation, the pilot pressure enters through Port XAb1. The oil flowing from the boom 1 spool pushes open the poppet (513) and flows to Port Ab.

4) CIRCUIT PRESSURE PROTECTION

The control valve has two kinds of relief valve to limit the pressure in a circuit.

(1) Main relief valve

The main relief valve is fitted in the P2 housing and functions as follows.



21092MC25

① The hydraulic oil is filled up in the inside space chamber (A) from the path (P) through a hole of the seat (541) and a restriction of the plunger (512), and seats the plunger (512) against the seat (541) securely.

② When the pressure in the path (P) becomes equal to the set load of the spring (621), the poppet (611) opens to make the hydraulic oil flow through a hole of the plug (103), around the poppet (611) and the hydraulic oil flow into the low pressure path (R).

③ Opening of the poppet (611) causes the pressure in the chamber (A) to fall and the plunger (512) to open. As the result the pressurized oil in the path (P) runs into the low pressure path (R) directly.

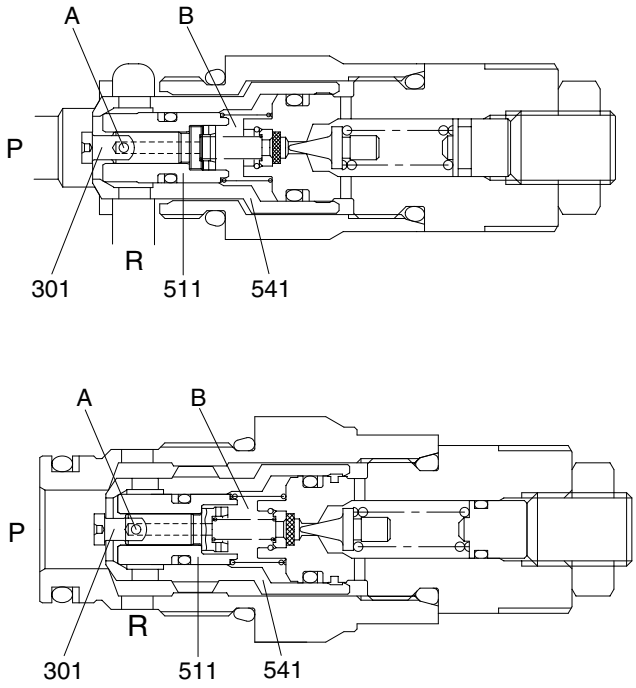
④ When the pressurized oil over 30 kgf/cm^2 enters through the port Pz, it pushes the piston (614), changes the relief set pressure of the spring (621) to the high pressure.

(2) Port relief valve

The port relief valve is fitted between the cylinder port and low-pressure path. In addition to the relief valve, it has the function of an anti-cavitation check valve, and functions as follows:

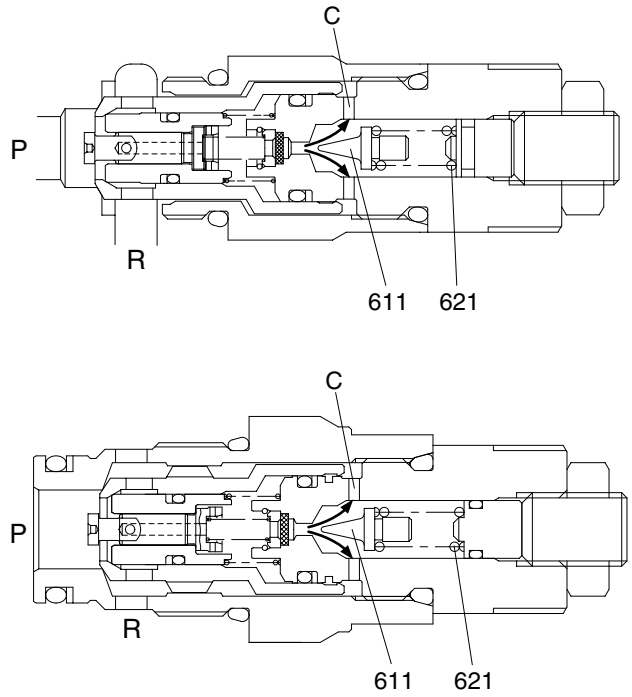
① Function as relief valve

a. The pressurized oil passes through Hole A of the piston (301), fills Chamber B, and seat the plunger (511) against the seat (541) securely.



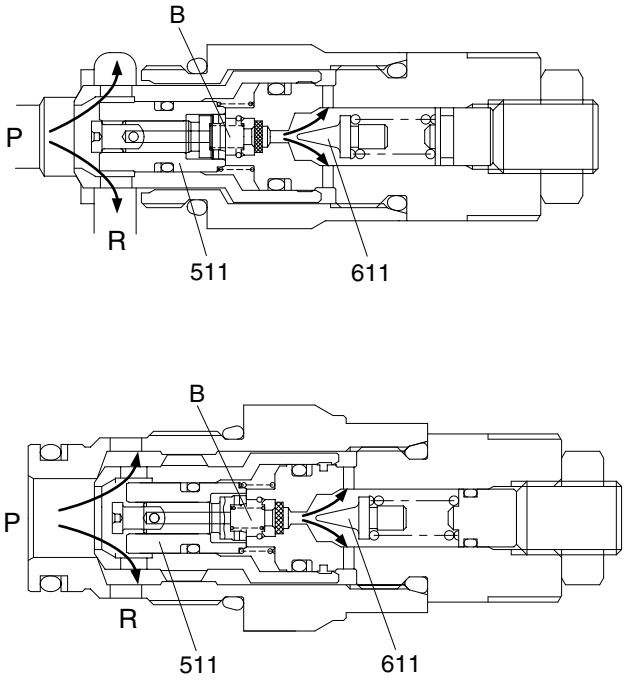
220F2MC66

b. When the pressure in the path (P) exceeds the set pressure of the spring (621 or 622), the pressurized oil pushes open the poppet (611), flows around it, and flows to the low pressure path (R) through hole C.



220F2MC67

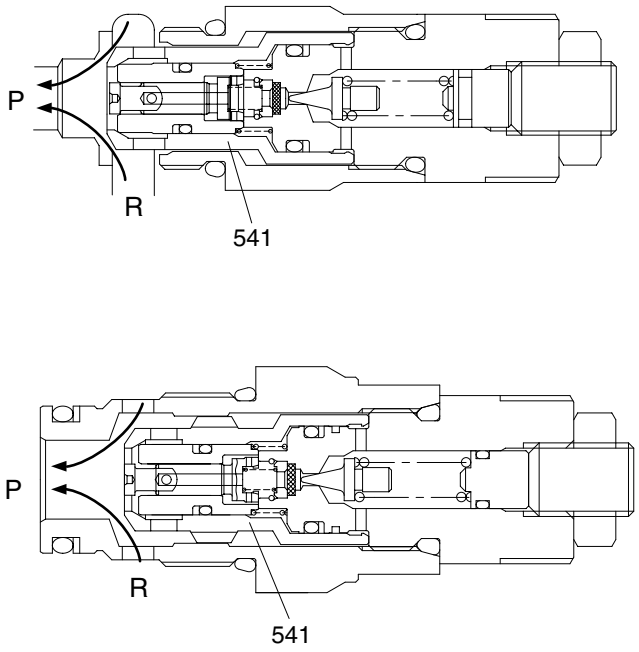
c. Opening of the poppet (611) causes the pressure in Chamber B to fall and the plunger (511) to open.As the result the pressurized oil in the path (P) runs into the low pressure path (R) directly.



220F2MC68

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 the path (R) exceeds it in the path (P), the seat (541) moves in the right direction. Then, sufficient oil passes from the path (R) to the path (P) around the seat (541) and prevents cavitation.



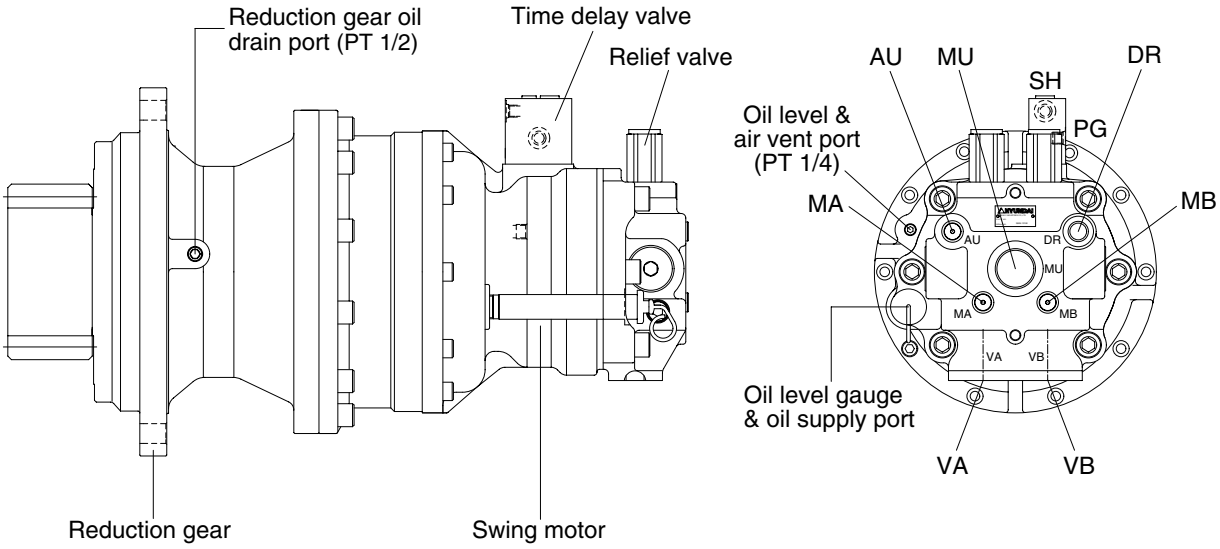
220F2MC69

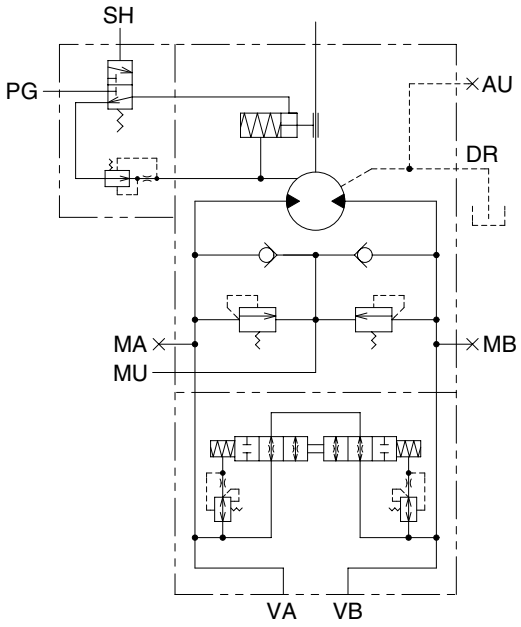
GROUP 3 SWING DEVICE (TYPE 1, 2)

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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



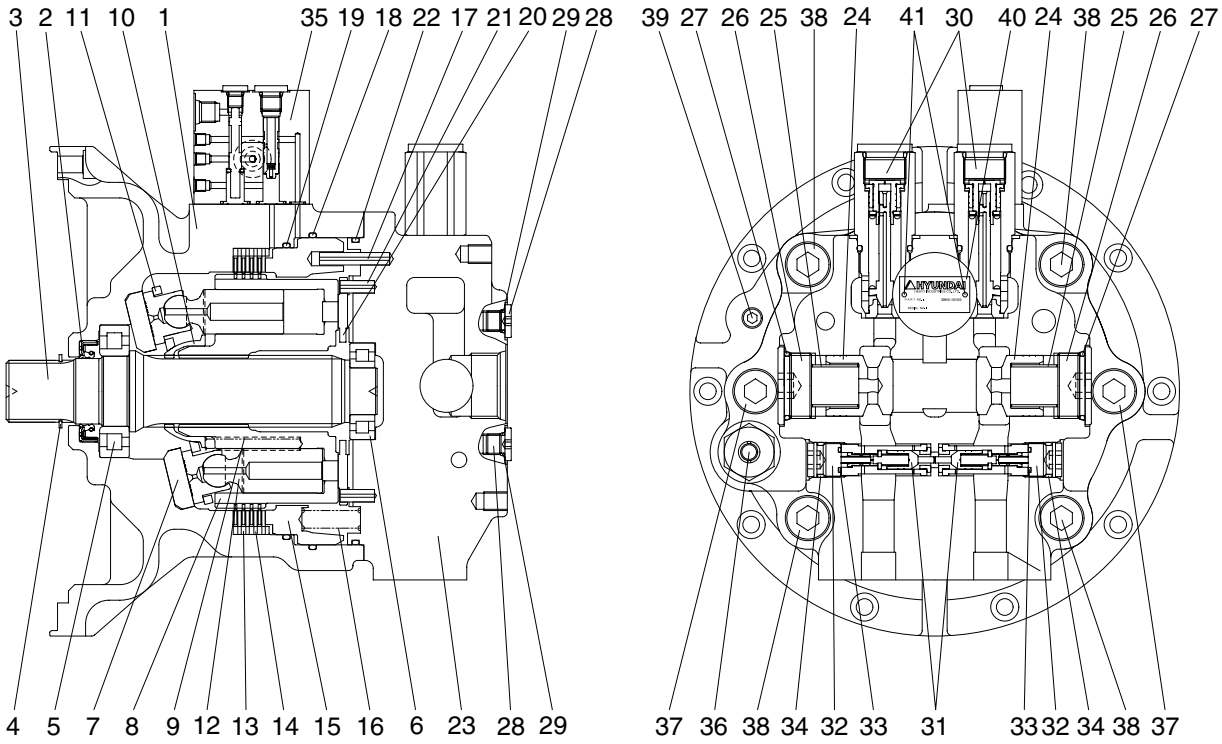


Hydraulic circuit

Port	Port name	Port size
VA	Main port	Ø20
VB	Main port	Ø20
DR	Drain port	PF 1/2
MU	Make up port	PF 1 1/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4
MA, MB	Gauge port	PF 1/4
AU	Air vent port	PF 1/4

220A2SM01

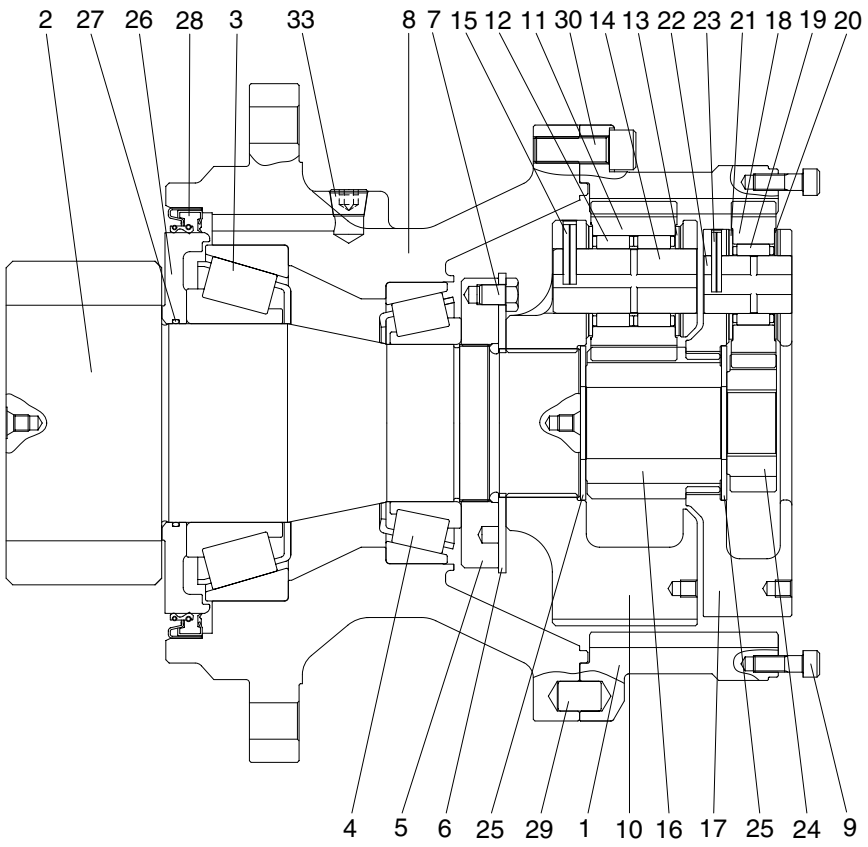
1) SWING MOTOR



220L2SM02

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Brake spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Reactionless valve assy
4	Snap ring	18	O-ring	32	Plug
5	Roller bearing	19	O-ring	33	O-ring
6	Needle bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Time delay valve assy
8	Cylinder block	22	O-ring	36	Level gauge
9	Spring	23	Valve casing	37	Socket bolt
10	Ball guide	24	Check valve	38	Socket bolt
11	Retainer plate	25	Spring	39	Plug
12	Piston assy	26	Plug	40	Name plate
13	Friction plate	27	O-ring	41	Rivet
14	Separate plate	28	Plug		

2) REDUCTION GEAR



220L2SM03

1	Ring gear	11	Planetary gear 2	21	Thrust washer 1
2	Drive shaft	12	Needle bearing 2	22	Carrier pin 1
3	Taper bearing	13	Thrust washer 2	23	Spring pin 1
4	Taper bearing	14	Carrier pin 2	24	Sun gear 1
5	Ring nut	15	Spring pin 2	25	Thrust plate
6	Lock plate	16	Sun gear 2	26	Sleeve
7	Hexagon bolt	17	Carrier 1	27	O-ring
8	Casing	18	Planetary gear 1	29	Parallel pin
9	Socket bolt	19	Needle bearing 1	30	Socket bolt
10	Carrier 2	20	Thrust washer 1	33	Plug

2. PRINCIPLE OF DRIVING

1) GENERATING THE TURNING FORCE

The high hydraulic supplied from a hydraulic pump flows into a cylinder block (8) through valve casing of motor (23), and valve plate (20).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (12).

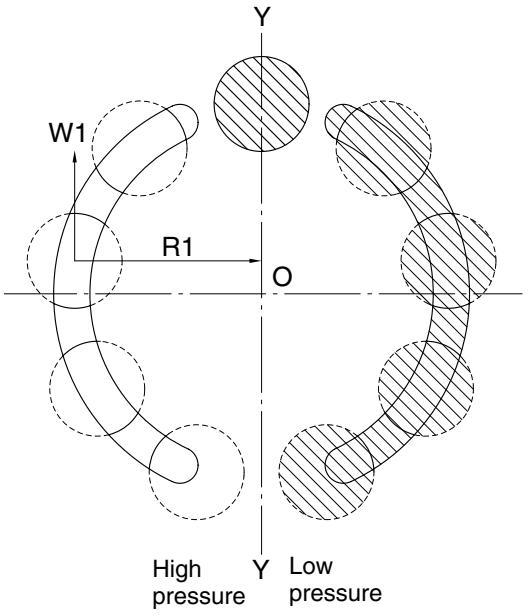
The high hydraulic can generate the force, F1=P×A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

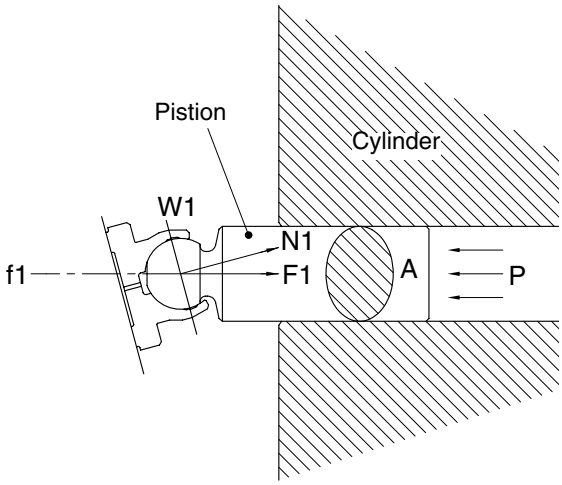
This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α.

W1 generates torque, T=W1×R1, for Y-Y line connected by the upper and lower sides of the piston as following pictures.

The sum of torque (ΣW1×R1), generated from each piston (4~5 pieces) on the side of a high hydraulic, generates the turning force.

This torque transfers the turning force to a cylinder (8) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.





21078TM05

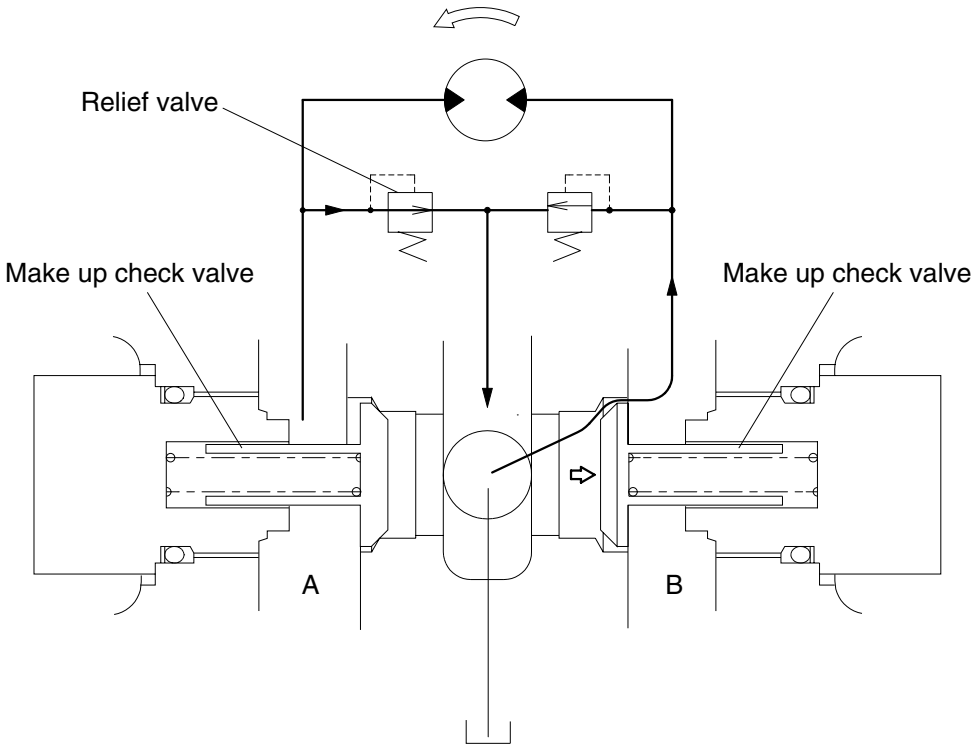
2) MAKE UP VALVE

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.

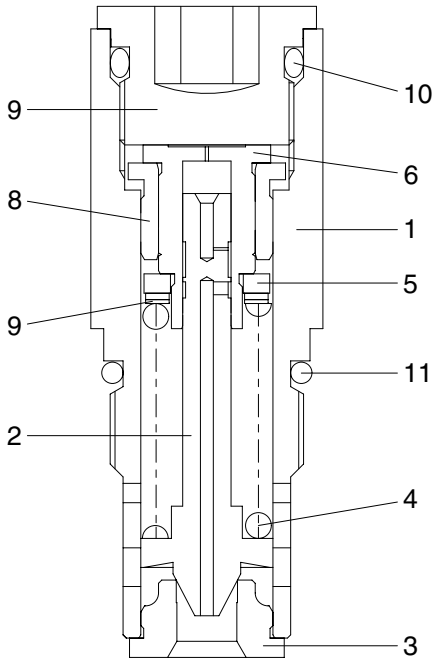
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, the oil in the motor is drain via left relief valve, the drain oil run into motor via right make up valve, which prevent the cavitation of motor.



21092SM04

3) RELIEF VALVE



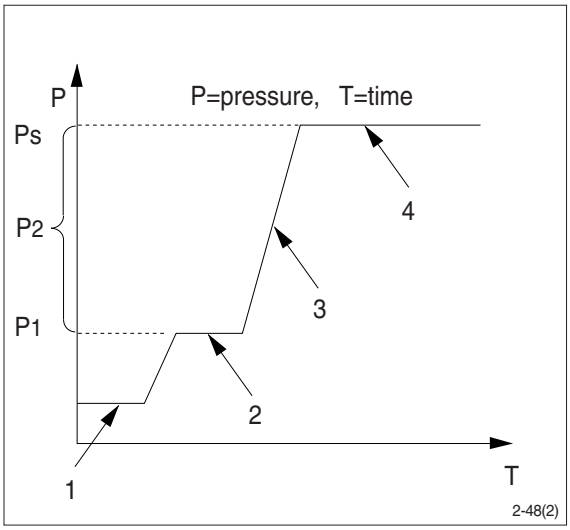
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

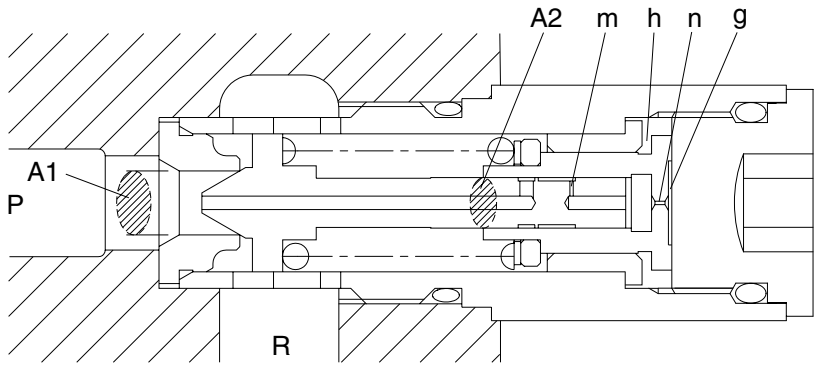
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.



① Ports (P,R) at tank pressure.

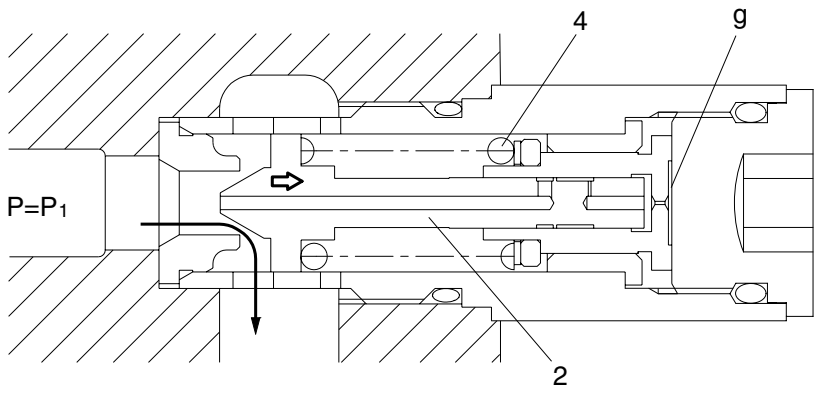


2209A2SM26

② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (4), the plunger (2) moves to the right as shown.

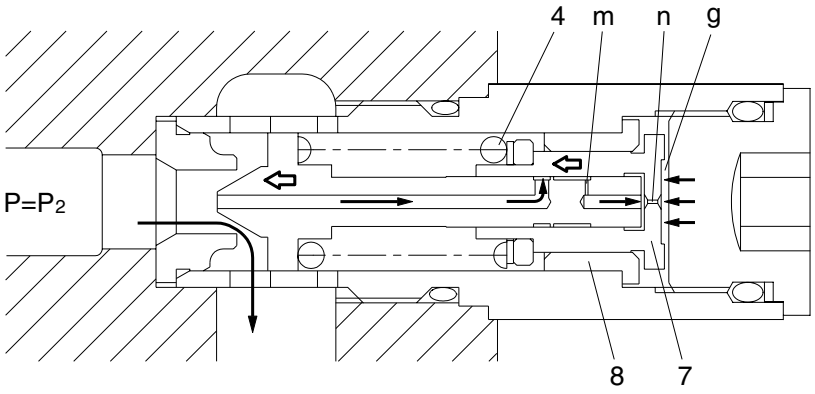
$P_1 \times A_1 = Fsp + Pg \times A_2$

$$P_1 = \frac{Fsp + Pg \times A_2}{A_1}$$



2209A2SM27

③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force (F_{SP}) of spring (4), the piston (7) moves left and stop the piston (7) hits the bottom of bushing (8).

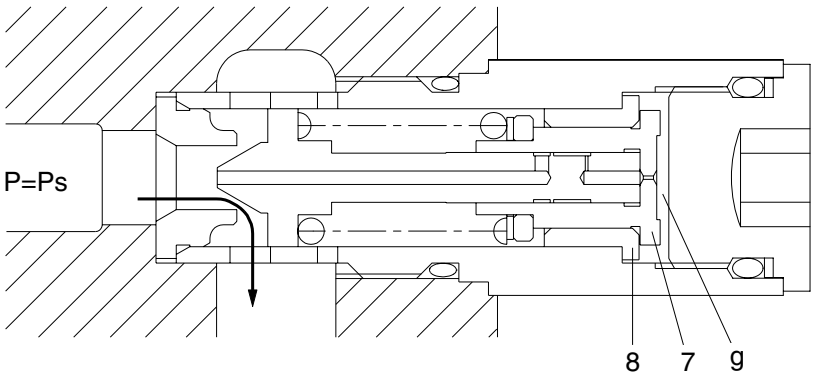


2209A2SM28

④ When piston (7) hits the bottom of bushing (8), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

$Ps \times A_1 = Fsp + Ps \times A_2$

$$Ps = \frac{Fsp}{A_1 - A_2}$$



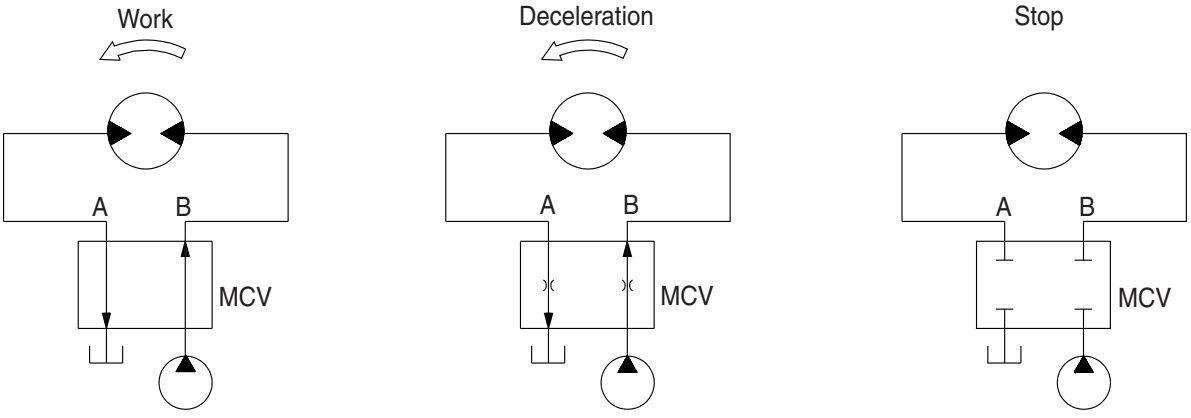
2209A2SM29

4) BRAKE SYSTEM (-#0120)

(1) Control valve swing brake system

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



MCV A, B opened | MCV A, B throttled | MCV A, B closed

2-48(1)

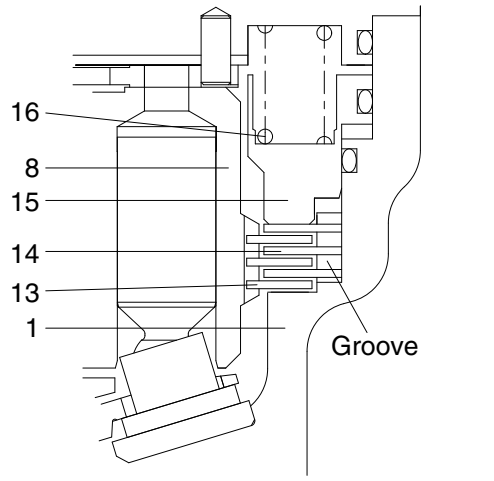
(2) Mechanical swing parking brake system

This is function as a parking brake only when all of the RCV lever (except swing, arm in) are not operated.

① Brake assembly

Circumferential rotation of separate plate (14) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (16) through friction plate (13), separate plate (14) and parking piston (15), friction force occurs there.

Cylinder block (8) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

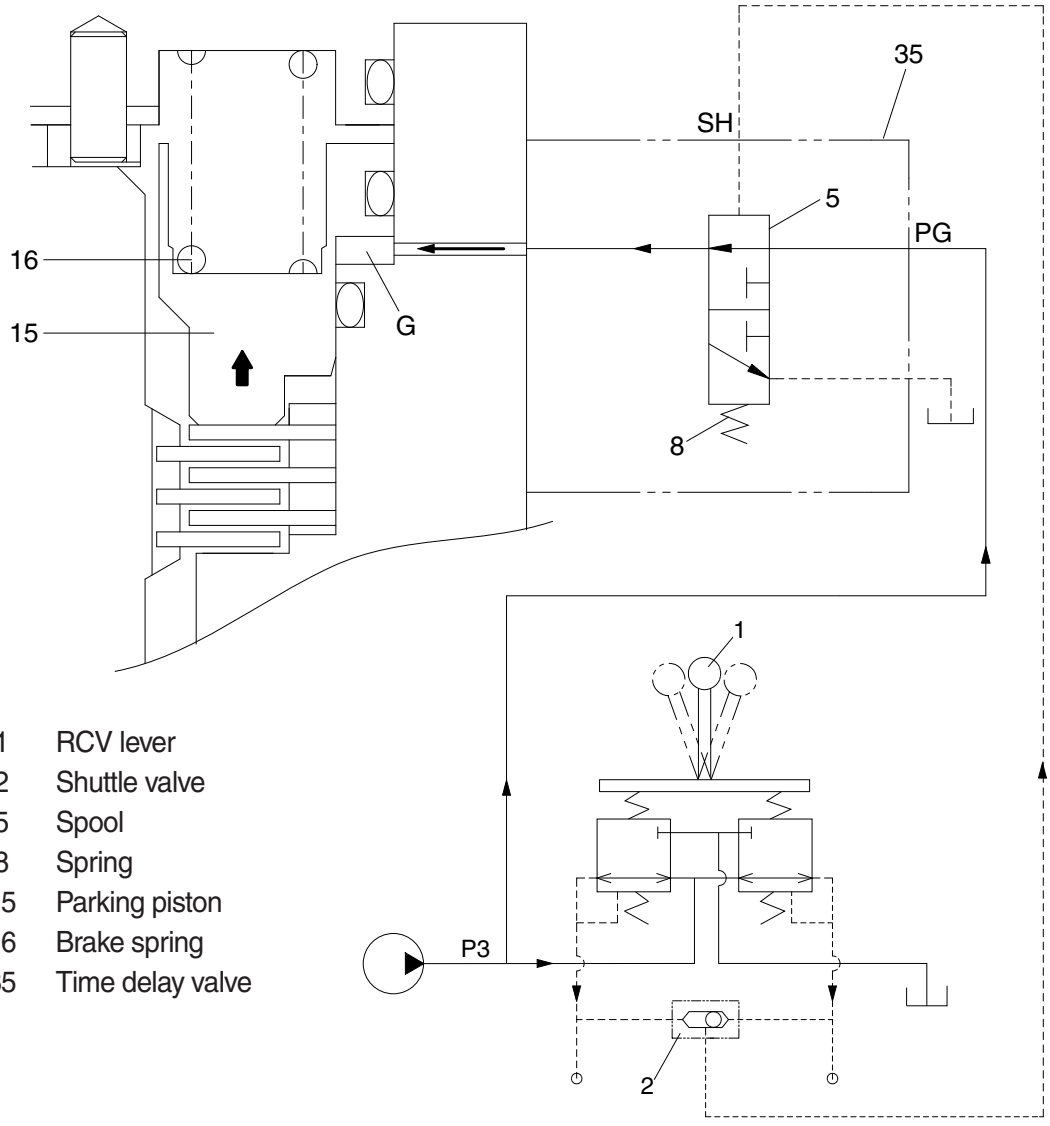


2209A2SM35

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

② Operating principle

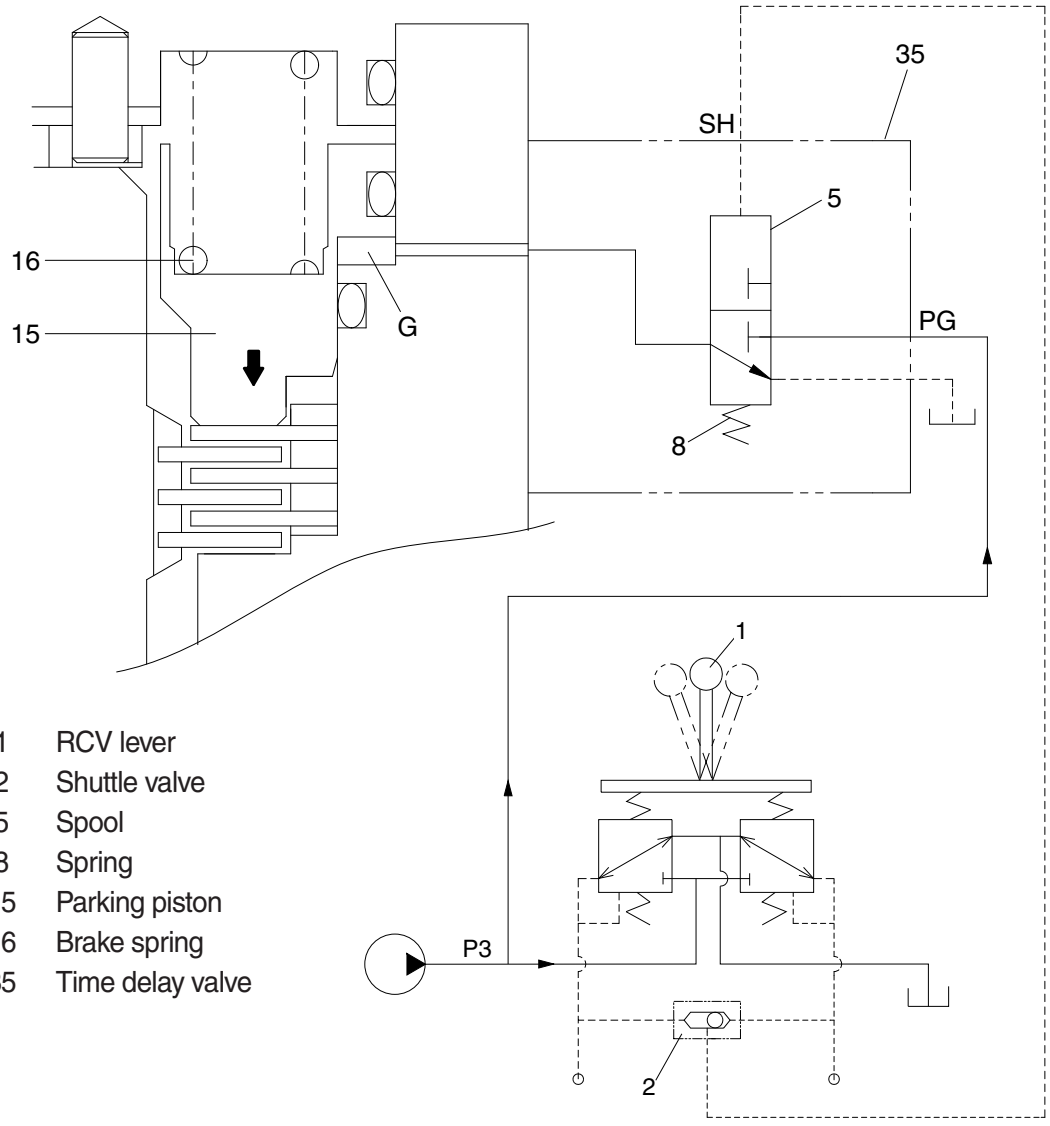
a. When the RCV lever (1) is set to the swing or arm in operating position, the pilot oil go to SH of the time delay valve (35).
This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the parking piston (15) to the upward against the force of the brake spring (16). Thus, it releases the brake force.



1 RCV lever
2 Shuttle valve
5 Spool
8 Spring
15 Parking piston
16 Brake spring
35 Time delay valve

220A2SM04A

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to the top.
Then, the parking piston (15) 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 RCV lever
2 Shuttle valve
5 Spool
8 Spring
15 Parking piston
16 Brake spring
35 Time delay valve

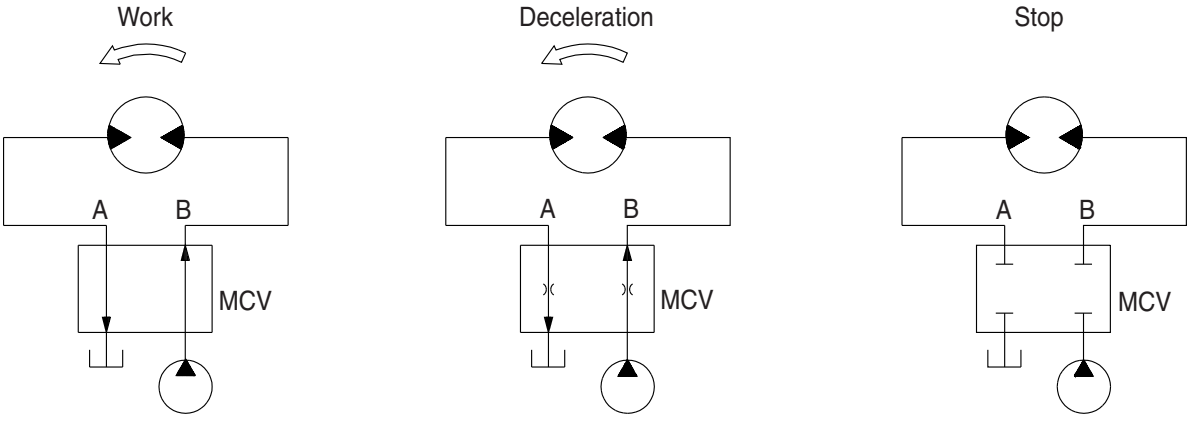
220A2SM05A

4) BRAKE SYSTEM (#0121-)

(1) Control valve swing brake system

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



MCV A, B opened | MCV A, B throttled | MCV A, B closed

2-48(1)

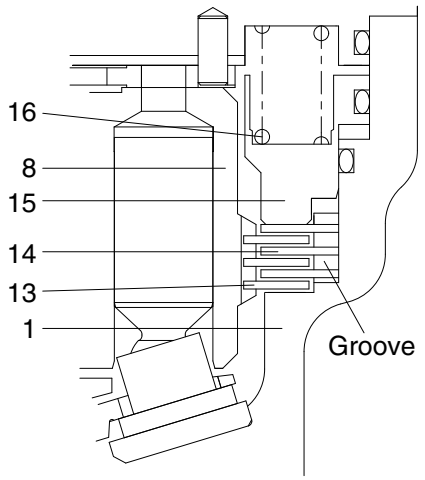
(2) Mechanical swing parking brake system

This is function as a parking brake only when all of the RCV lever (except swing, arm in) are not operated.

① Brake assembly

Circumferential rotation of separate plate (14) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (16) through friction plate (13), separate plate (14) and parking piston (15), friction force occurs there.

Cylinder block (8) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



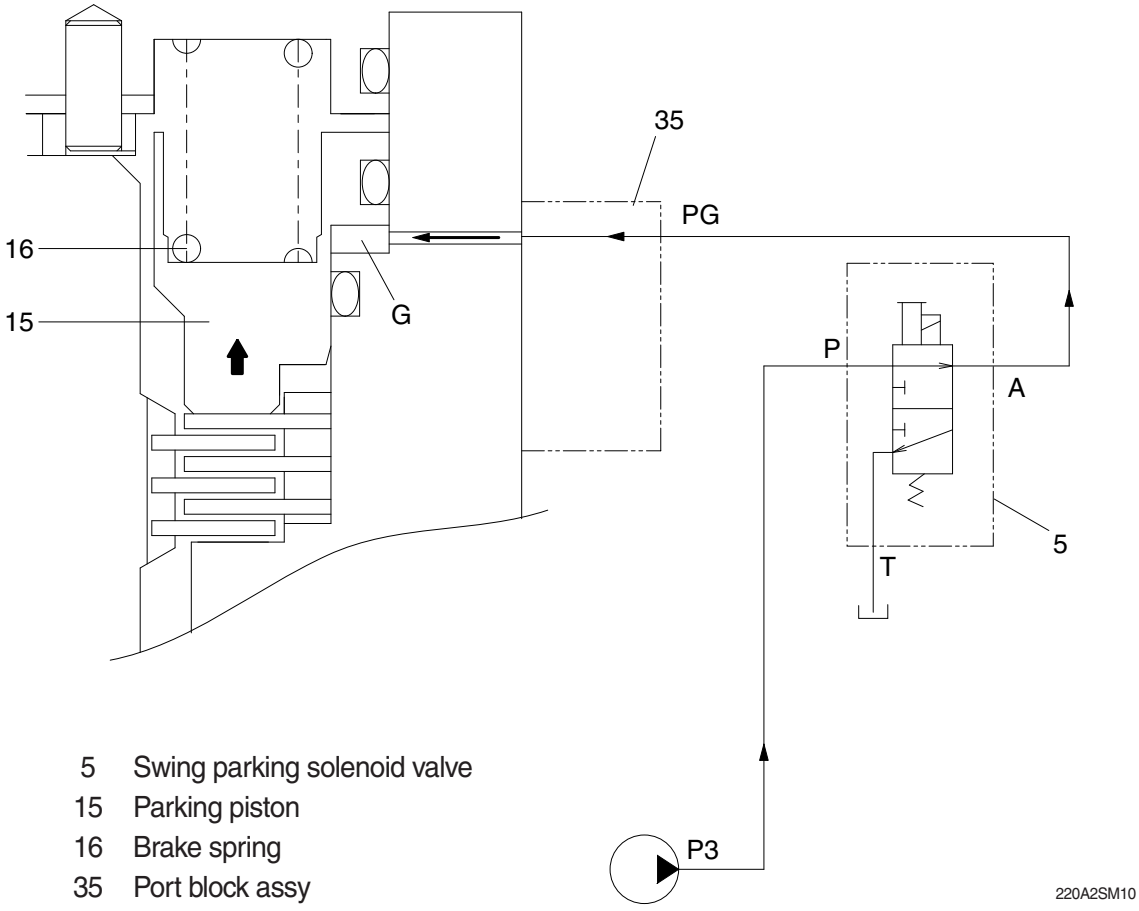
2209A2SM35

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

② Operating principle

a. When any of the swing, arm in, travel and boom up function is operated, the swing parking solenoid valve (5) is shifted to the swing position, so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the parking piston (15) to the upward against the force of the brake spring (16). Thus, it releases the brake force.

b. Stop operation and a few second has been elapsed, the swing parking solenoid valve (5) is shifted to the swing parking position and swing brake works.



5 Swing parking solenoid valve
15 Parking piston
16 Brake spring
35 Port block assy

③ Electric control swing prarking system

a. A safety is ensured by recognizing the swing operation and canceling the swing parking only under specific conditions by releasing parking electronically.

b. After receiving the RCV pressure, the MCU applies the parking release signal.

c. Depending on each RCV operation, there is a time difference between re-entry into swing parking.

Mode	Fine swing switch	RCV operation	Parking delay time
Work mode	ON or OFF (No condition)	Swing	5 sec
		Arm in	1 sec
	ON	Boom up	2 sec
		Travel	3 sec
	OFF	Boom up / Travel	Not applied

④ **Manual override function**

When the swing parking solenoid valve or related electric system is malfunction, the swing parking brake is not released even if the swing lever is operated.

To release the swing parking brake, the manual override function is needed.

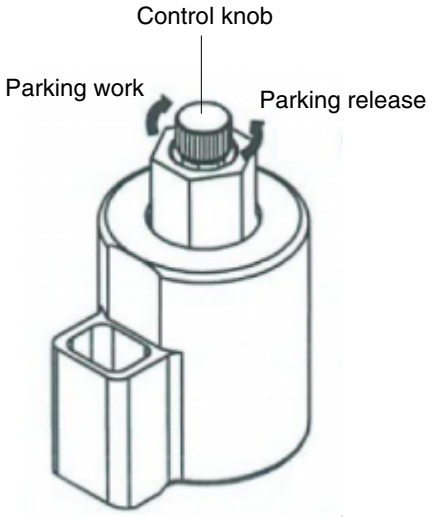
※ **Manual override solenoid valve**

a. Use hand only to turn the control knob (do not use a tool).

b. **Parking brake release**
Turn the control knob to counterclockwise fully (about 2.5 mm)

c. **Parking brake work**
Turn the control knob to clockwise fully.

※ **Be careful not damage the control knob by using a tool or tightening forcibly.**
It can cause malfunction of the solenoid valve.



Swing parking solenoid valve

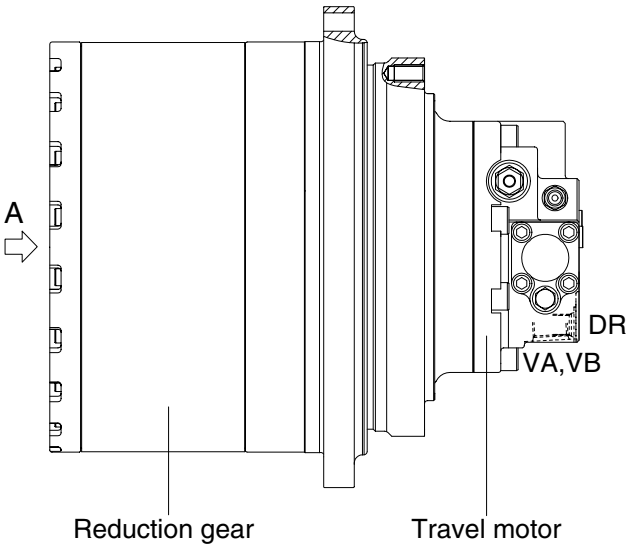
160A2SM11

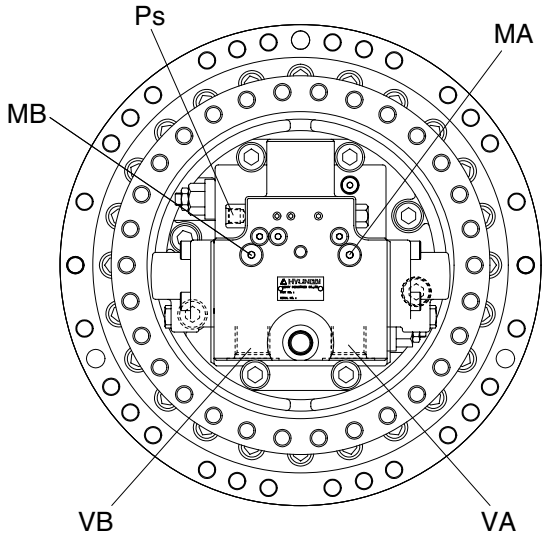
GROUP 4 TRAVEL DEVICE (TYPE 1, 2)

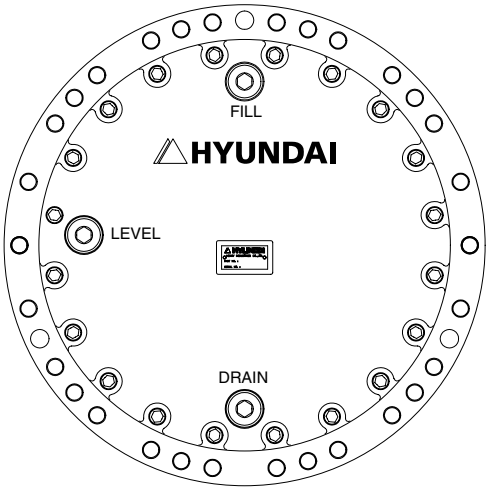
1. CONSTRUCTION

Travel device consists travel motor and gear box.

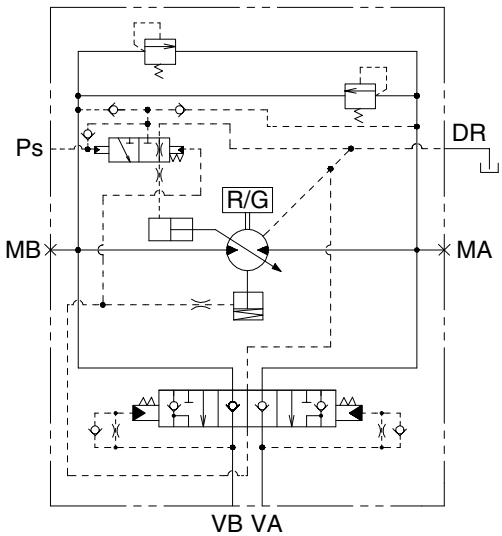
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







VIEW A



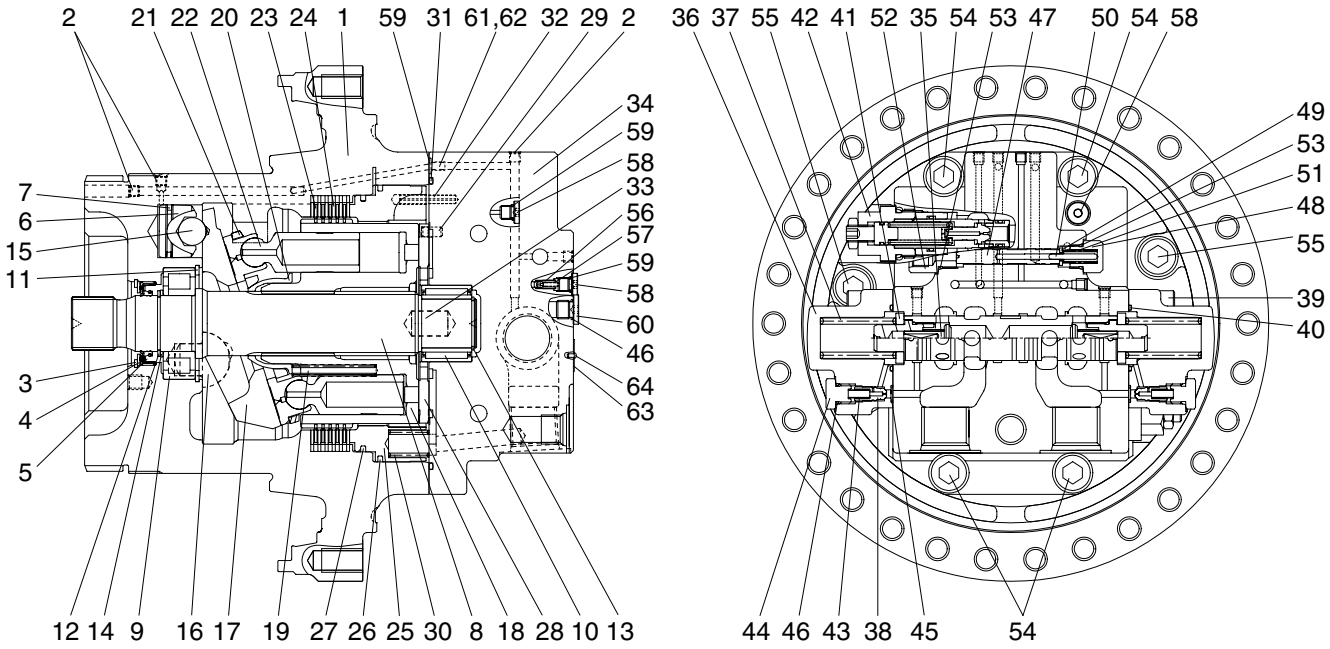
Hydraulic circuit

220L2TM01

Port	Port name	Port size
VA, VB	Valve port	PF 1
Ps	Pilot port	PF 1/4
DR	Drain port	PF 1/2
MA, MB	Gauge port	PF 1/4

2. SPECIFICATION

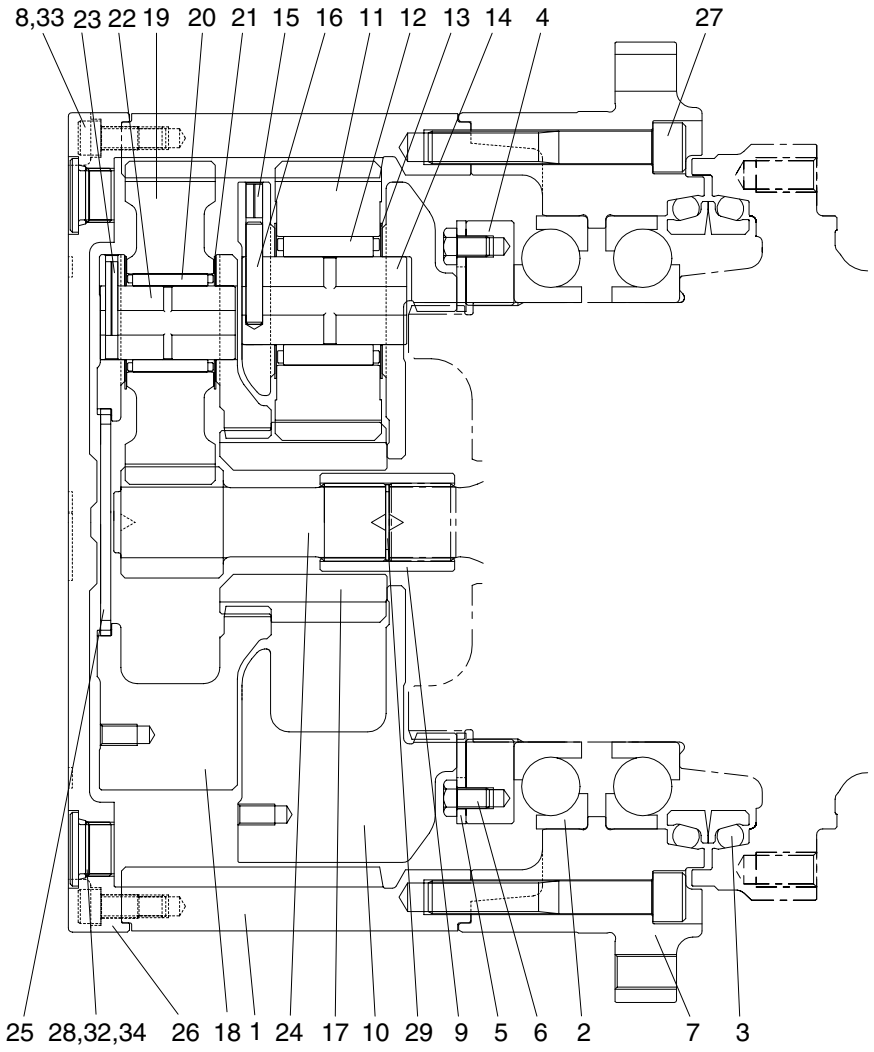
1) TRAVEL MOTOR



220L2TM02

1	Casing	22	Piston assy	44	Plug
2	Plug	23	Friction plate	45	O-ring
3	Oil seal	24	Separated plate	46	O-ring
4	Thrust plate	25	Parking piston	47	Spool
5	Snap ring	26	D-ring	48	Plug
6	Swash piston	27	D-ring	49	Spring seat
7	Piston seal	28	Valve plate	50	Parallel pin
8	Shaft	29	Parallel pin	51	Spring
9	Cylinder roller bearing	30	Brake spring	52	Connector
10	Needle bearing	31	O-ring	53	O-ring
11	Snap ring	32	Spring pin	54	Hexagon socket head bolt
12	Snap ring	33	Parallel pin	55	Hexagon socket head bolt
13	Snap ring (type 1)	34	Rear cover	56	Check valve
13	Retainer C ring (type 2)	35	Main spool assy	57	Spring
14	Thrust plate	36	Spool cover	58	Plug
15	Steel ball	37	Spring	59	O-ring
16	Pivot	38	Restrictor	60	Plug
17	Swash plate	39	Hexagon socket head bolt	61	Restrictor
18	Cylinder block	40	O-ring	62	Restrictor
19	Spring	41	Spring seat	63	Name plate
20	Ball guide	42	Relief valve assy	64	Rivet
21	Retainer plate	43	Spring		

2) TRAVEL REDUCTION GEAR



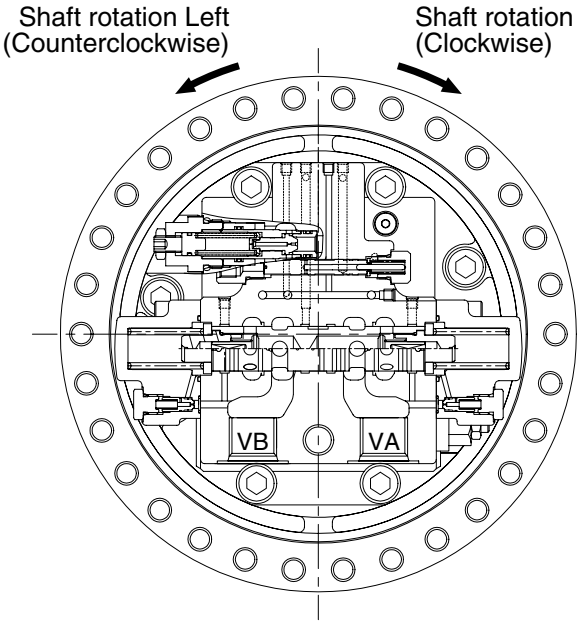
220S2TM22

1	Ring gear	12	Needle bearing 2	24	Sun gear 1
2	Angular bearing (type 1)	13	Thrust washer 2	25	Thrust plate
2	Ball bearing (type 2)	14	Carrier pin 2	26	Cover
3	Floating seal assy	15	Spring pin 2	27	Hexagon socket head bolt
4	Nut ring	16	Solid pin 2	28	Plug
5	Lock plate	17	Sun gear 2	29	Snap ring
6	Hexagon bolt	18	Carrier 1	30	Name plate
7	Housing	19	Planetary gear 1	31	Rivet
8	Hexagon socket head bolt	20	Needle bearing 1	32	O-ring
9	Coupling	21	Thrust washer 1	33	Rubber cap
10	Carrier 2	22	Carrier pin 1	34	Rubber cap
11	Planetary gear 2	23	Spring pin 1		

3. OPERATION

1) MOTOR

High pressure oil delivered form hydraulic pump is led to inlet port that is provided in the brake valve portion and, through the rear cover (34) and valve plate (28), led to cylinder block (18).
The oil flow and direction of shaft rotation are indicated in table.



Inlet port	Outlet port	Direction of shaft rotation (viewing from rear cover)
VB	VA	Right (clockwise)
VA	VB	Left (counterclock wise)

25092TM23

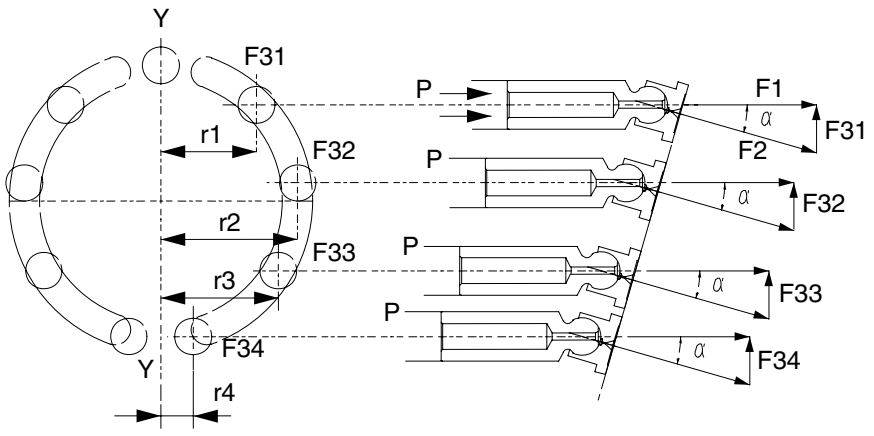
As shown in below figure, high pressure oil is supplied to the pistons which are on one side of the line Y-Y that connects upper and lower dead points and produces force F1.

$F1 = P \times A$ (P : pressure, A : area of piston section)

The swash plate (17) with inclined angle of α divides this force F1 into thrust force F2 and radial force F31-34.
This radial force is applied to axis Y-Y as turning force and generate drive torque of T.

$T = r_1 \cdot F31 + r_2 \cdot F32 + r_3 \cdot F33 + r_4 \cdot F34$

This drive torque is transmitted via cylinder block (18) to driving shaft (8).

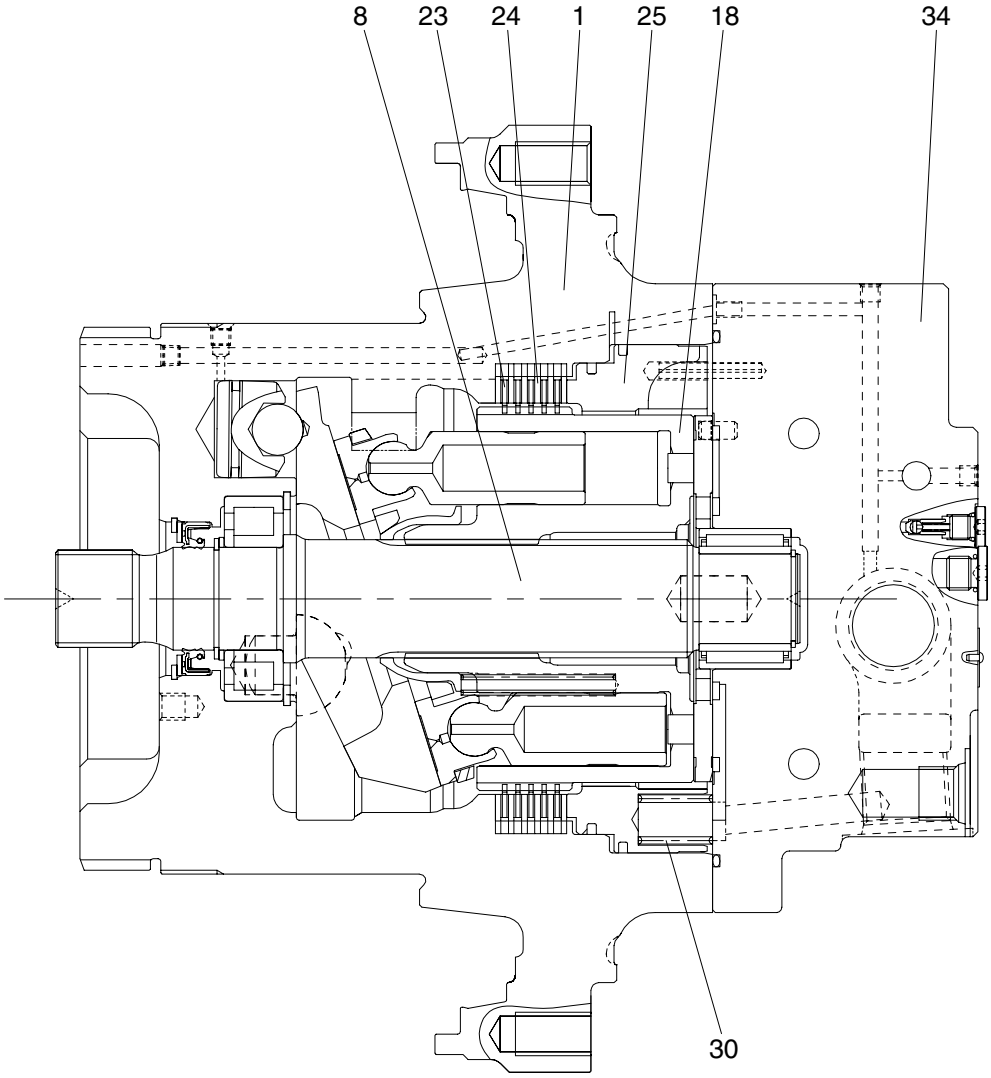


29092TM07

2) PARKING BRAKE

Parking brake is released when high pressure oil selected by the brake valve portion that is connected directly to the rear cover (34), is applied to the parking piston (25).
Otherwise the braking torque is always applied.

This braking torque is generated by the friction between the separated plates (24), inserted into the casing (1), and friction plates (23), coupled to cylinder block (18) by the outer splines.
When no pressure is activated on the parking piston (25), it is pushed by the brake springs (30) and it pushes friction plates (23) and separated plates (24) towards casing (1) and generates the friction force which brakes the rotation of cylinder block (18) and hence the shaft (8).



25092TM24

3) CAPACITY CONTROL MECHANISM

Figure typically shows the capacity control mechanism.

When high speed pilot line is charged with the pressure P_A that overcome the spring (51), the spring (51) is compressed and spool (47) shifts to the right to connect the port P and port C.

Then, the highest pressure is selected by the check valve (56) from inlet and outlet pressure of the motor and high speed pilot line pressure and pushes shifter piston (6). As a result, swash plate (17) turns around the line L which connect the two pivots (16) as shown by dotted lines. The turn stops at the stopper (1-1) of casing and swash plate (17) keeps the position.

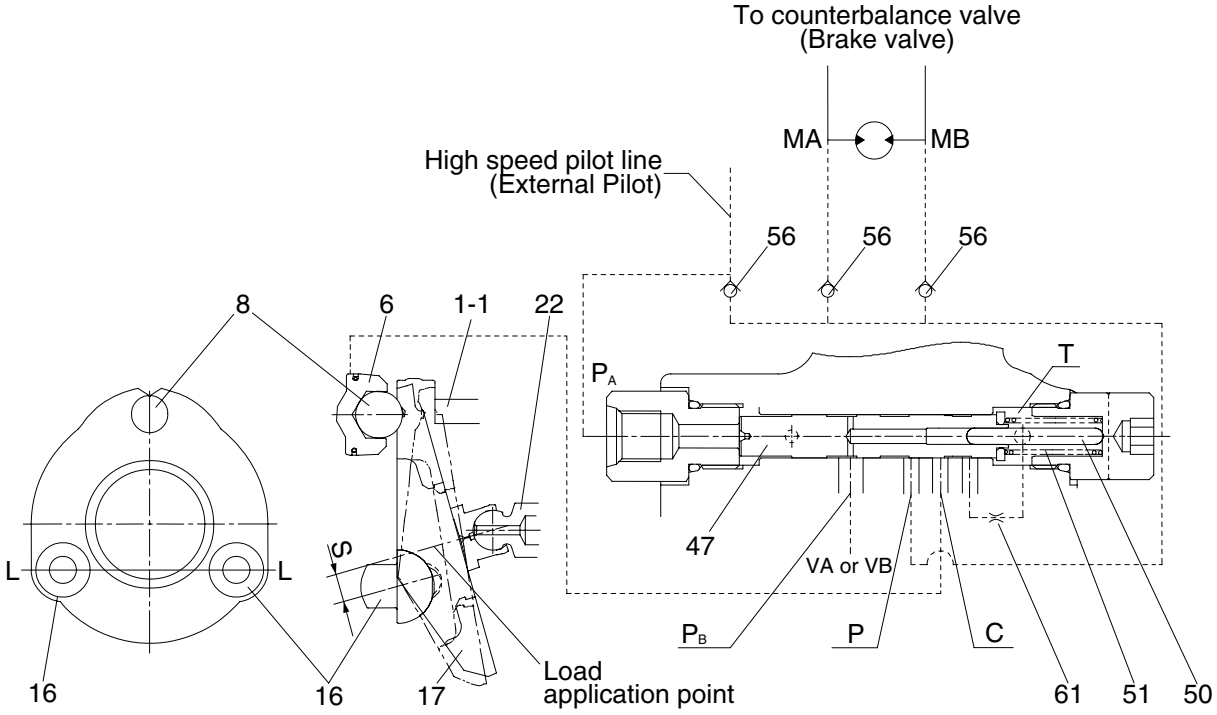
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

When no pressure is in the high speed pilot line P_A, spool (35) is pushed back by the spring (51) and pressure that pressed the shifter piston (6) is released to the hydraulic tank through restrictor (61).

Here, nine pistons are there and they equally spaced on the swash plate (17). The force that summed up those of pistons comes to almost the center of the swash plate (17) as shown. Since the pivots (16) are off-set by S from the center, the rotating force of product S and the force moves swash plate (17) to the former position and the speed returns to low.

When the power demand exceeds the engine power, such as in steep slope climbing or turning at high speed mode, the system step down to the low speed automatically. The mechanism is that: pump pressure is led to the port P_B and this pressure activate on pin (50). When the pressure at P_B exceeds predetermined value, spool (47) returns to the left by the counter-pressure against pin (50) and the pressure on the shifter piston (6) through port C is released to the tank and the motor comes to low speed.

When P_B goes down, the spool (47) moves to the right and the speed become high.

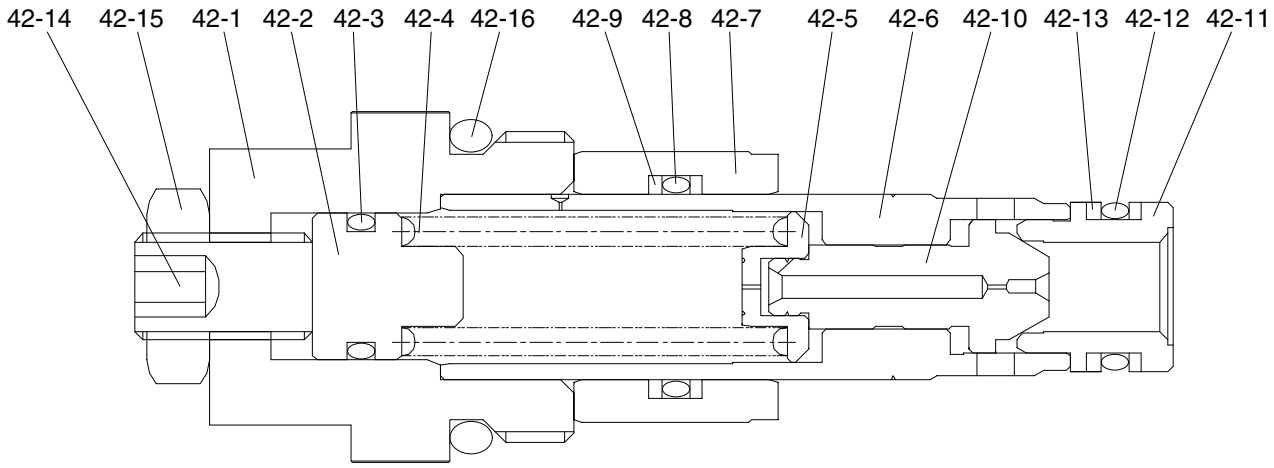


25092TM19

4) OVERLOAD RELIEF VALVE

(1) Structure

This valve is screwed in the motor rear cover (34) and consists of : plug (42-1) that is screwed and fixed in the rear cover (34), poppet (42-10) and supports the poppet seat (42-11), spring (42-4) that is operating relief valve setting pressure and supports the spring seat (42-5), that is inserted in the sleeve (42-6), screw (42-14) that is adjust the spring force, nut (42-15) that fix screw (42-14), piston (42-7) that reduce the shock.



25092TM25

42-1 Plug
42-2 Guide
42-3 O-ring
42-4 Spring
42-5 Spring seat
42-6 Sleeve
42-7 Piston
42-8 O-ring
42-9 Back-up ring
42-10 Poppet
42-11 Poppet seat
42-12 O-ring
42-13 Back-up ring
42-14 Socket screw
42-15 Hexagon nut
42-16 O-ring

(2) Operation

Two pieces of overload valves are located at cross-over position in the counterbalance circuit of brake valve and have the following functions :

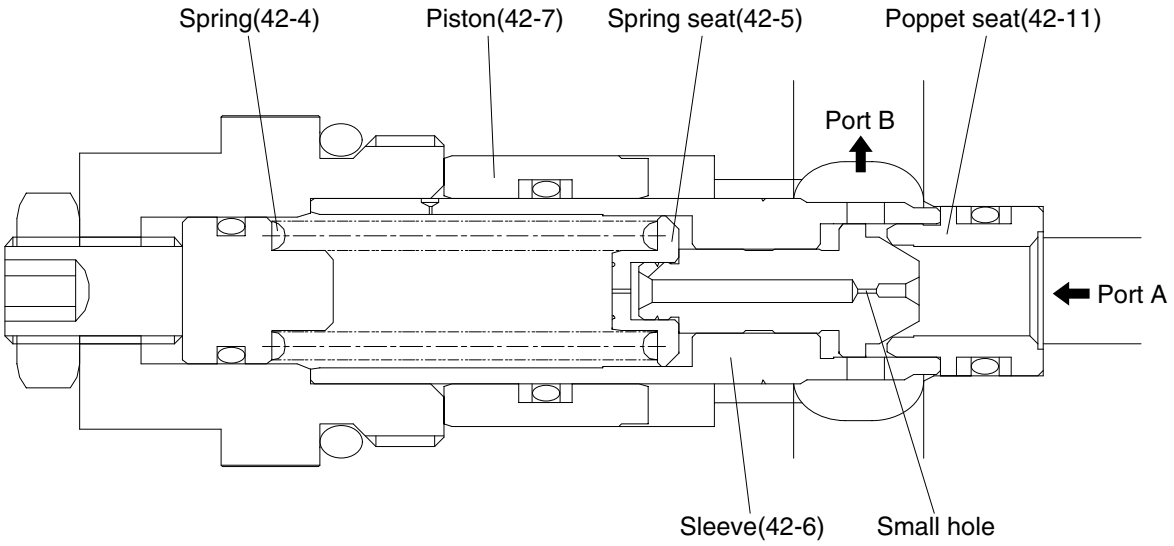
① When hydraulic motor starts, keep the driving pressure below predetermined value and while accelerating, bypasses surplus oil to return line.

② When stopping the motor, keep the brake pressure, that develops on the outlet side of motor, under the predetermined value to stop the inertial force.

③ To accelerate sharply while starting, and to mitigate the braking shock while stopping. For these purposes, the developed pressure is kept comparatively low for a short period, then keep the line pressure as normal value. While the pressure is low, meshing of reduction gears, crawler and sprocket etc. can be smoothly done and the shock are absorbed.

When starting, "A" port pressure of overload valve increases, this pressure is applied to the effective diameter of poppet (42-10) which seats on the poppet seat (42-11) and, at the same time, is delivered, via small hole, to the spring seat (42-5) located inside the sleeve (42-6) and the seat bore pressure increases up to "A" port pressure. The poppet (42-10) opposes to spring (42-4) by the force of the pressure exerted on the area difference between poppet seat's effective diameter and spring seat bore and keep the predetermined pressure.

When hydraulically braking, the piston (42-7) is at the left position by the driving pressure, and when "A" port pressure increases, the pressure is applied also to the piston (42-7) through the small hole in the poppet (42-10) and piston (42-7) moves rightward until it touches the stopper in rear cover. In this while, the poppet (42-10) maintains "A" port pressure at comparatively low against the spring (42-4) force and exhaust oil to "B" port side. After the piston reached to the plug, the valve acts the same as at starting.



25092TM27

5) BRAKE VALVE

(1) Structure

The brake valve portion mainly consists of the following parts:

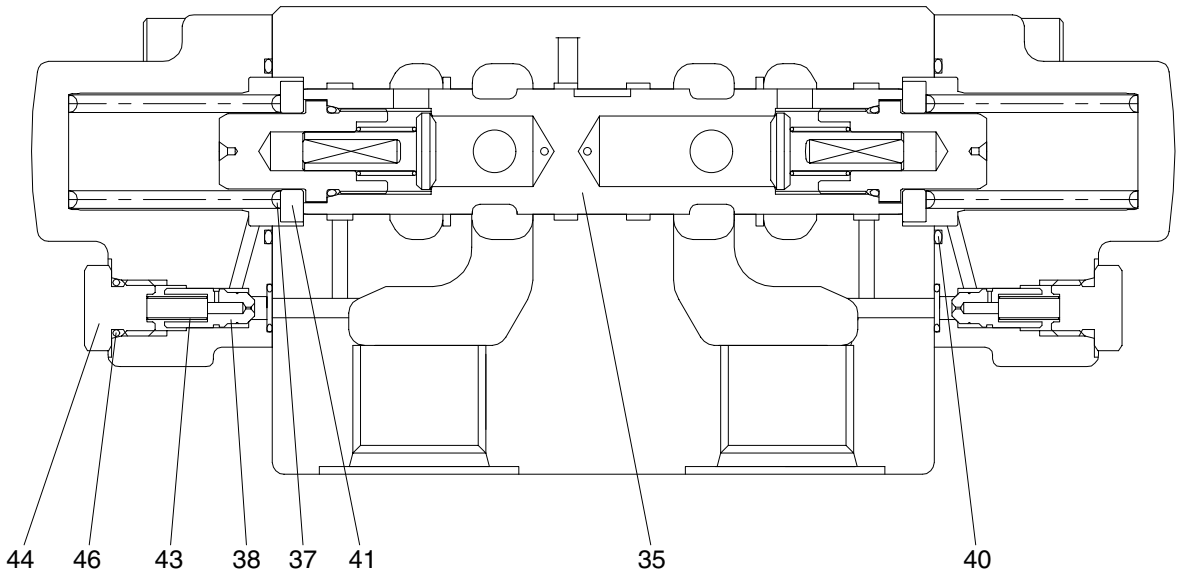
① **Spool**

By shifting the spool (35), the discharged oil from hydraulic motor is automatically shut off or restricted according to the condition and give the effect of holding, accelerating, stopping and counterbalance operations.

(See page 2-74, (2) Operation)

② **Check valve** (built in the spool)

This valve is located in the oil supplying passage to hydraulic motor, and at the same time functions to lock oil displacement. Therefore, this valve serves as not only a suction valve but also a holding valve for hydraulic motor.



25092TM28

35	Main spool	40	O-ring	44	Plug
37	Spring	41	Spring seat	46	O-ring
38	Restrictor	43	Restrictor spring		

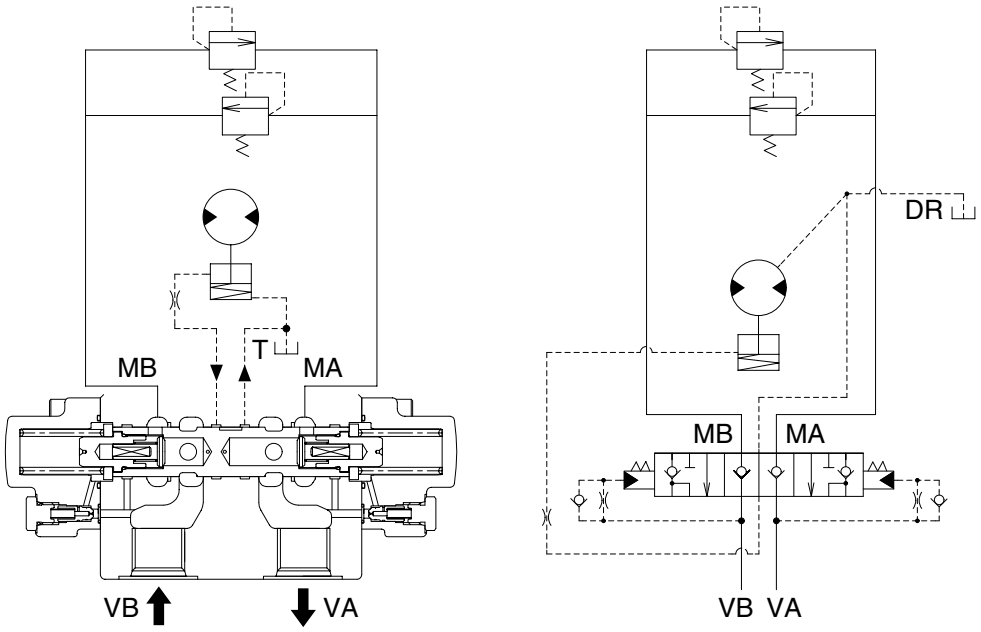
(2) Operation

① Holding operation

When the control valve is at neutral position, VA and VB ports are connected to the tank, and the spring (37) located on both spool ends holds the spool (35) at central position.
Therefore, the passages from VA to MA and VB to MB are closed, which result in closing MA and MB ports connected to hydraulic motor.

Since the passage to parking brake is connected to the tank line, the brake cylinder pressure is equal to the tank pressure and the brake is applied by the springs. Thus, the rotation of the motor is mechanically prevented.
If external torque is exerted on the motor shaft, the motor would not rotate as usual by this negative parking brake.

In case the brake should be released for some reason, pressure is built on MA or MB port. But, due to oil leakage inside hydraulic motor or so, high-pressure oil escapes from the closed circuit and motor rotates a bit. So, the cavitation tends to occur in the lower pressure side of the closed circuit. Then, the check valve, built in the spool (35), operates to avoid the cavitation and opens the passage from VA to MA or from VB to MB. Then the oil equivalent to the leakage is sucked from the tank line to the closed circuit.



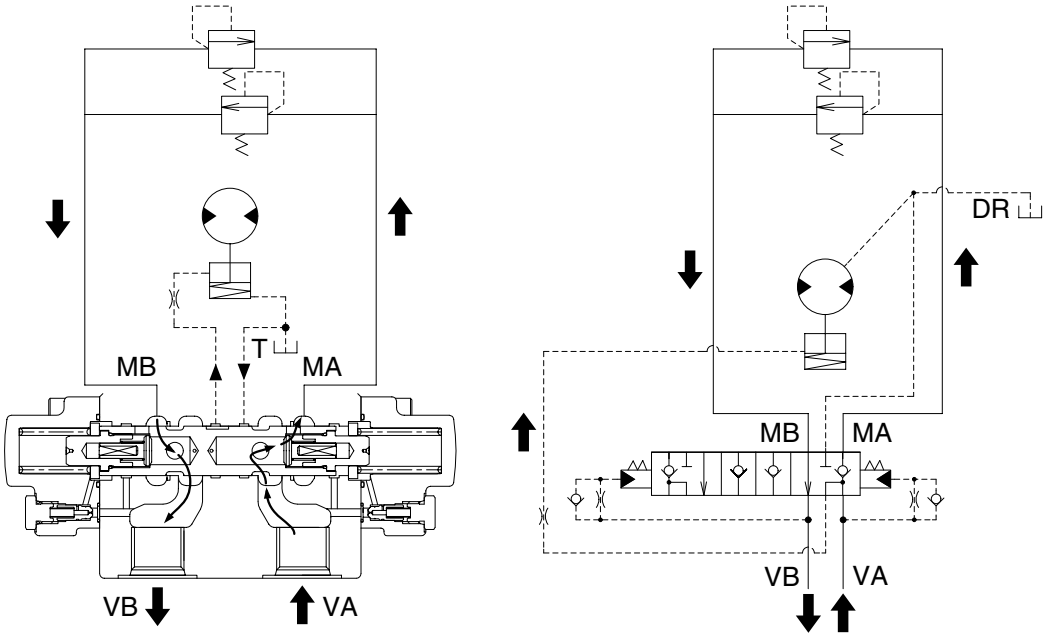
25092TM29

② Accelerating operation

When VA and VB ports are connected respectively to pump and tank by operating the control valve, hydraulic oil from pump is forwarded through VA port to push open the check valve provided inside spool (35), and oil flows to motor via MA port to rotate the motor.

Therefore, the pressure increases and negative brake is released by the pressure supplied from pump. At the same time, the pressure of pilot chamber increases to push and move the spool (35) leftwards, overcoming the spring (37) force. Thus, the return line from MB to VB opens to rotate the motor.

In case inertia load is too big to start rotation, accelerating pressure reaches the set pressure of relief valve and high pressure oil is being relieved while the motor gains the rotational speed.
As the rotational speed goes up, the relieved volume decreases, and finally the motor rotates at a fixed speed.



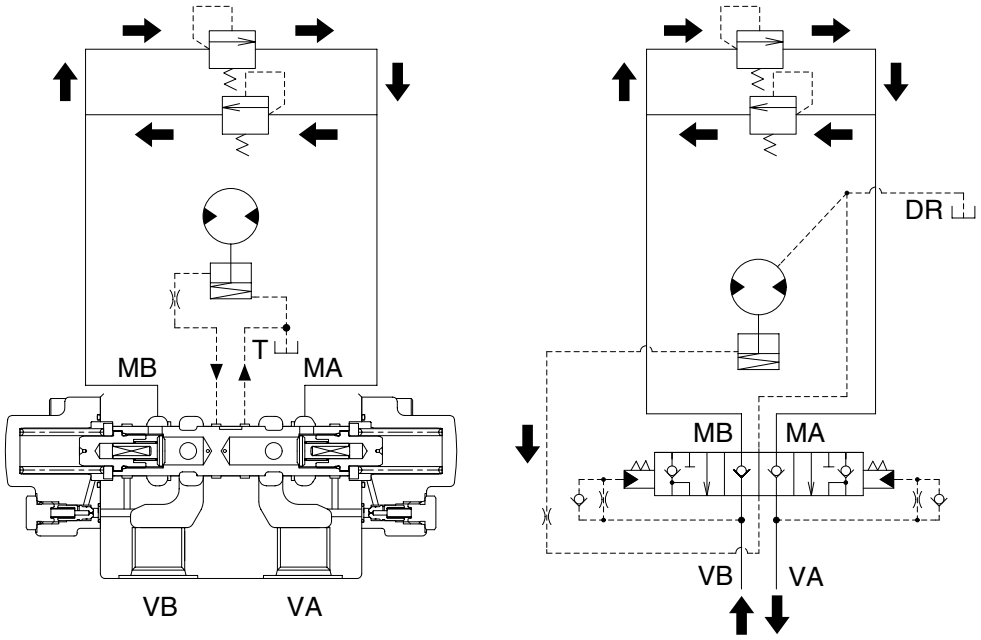
25092TM30

③ Stopping operation

Returning the control valve to neutral position while running the motor, the oil supply is cut off and VA and VB ports are connected to the tank line. Then the pressure of the pilot chamber located on both spool ends become equal, and the spool (35) returns to the neutral position by spring (37) force. Thus, the passage from MA to VA is closed.

Owing to the inertia force of the load, the hydraulic motor tends to continue the rotation. Here, the motor functions as a pump and forwards the oil to MB port but the passage is blocked and MB port pressure increases. Then the relief valve opens to relieve the pressure and rotational speed decelerates and at last the motor stops.

Negative brake release pressure is gradually lowered due to the restrictor and finally the brake works and the motor is mechanically stopped.



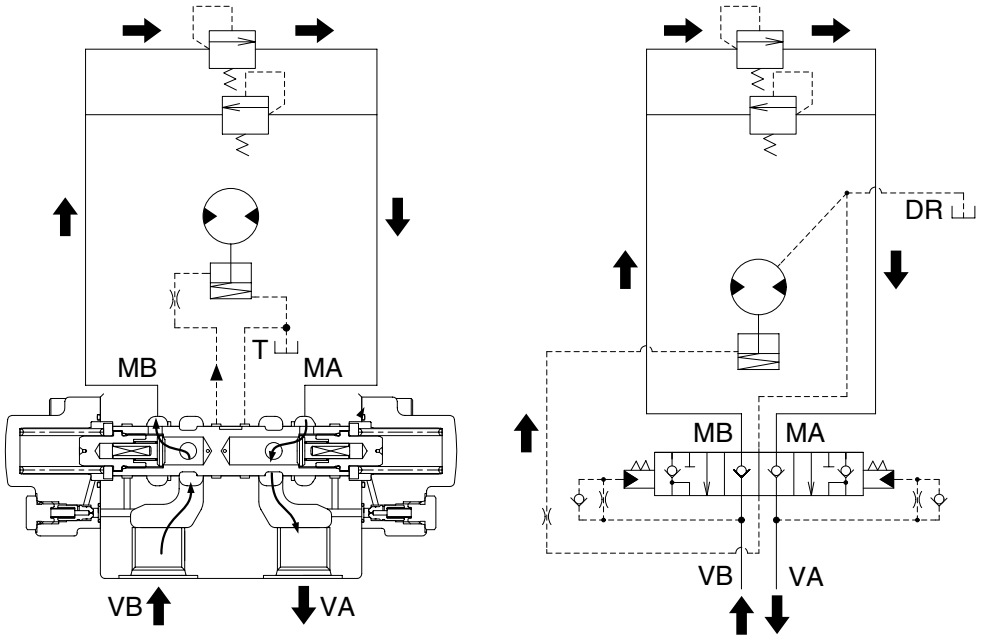
25092TM31

④ Counterbalance operation

Counterbalance operation is required to decelerate slowly the hydraulic motor while absorbing inertia force.

In case the hydraulic oil is gradually decreased from pump to VB port, the drive shaft of hydraulic motor tends to rotate faster than that matched to the volume of oil supply.
Consequently, the pilot chamber pressure on MB to VB side decreases and the spring (37) force moves the spool (35) leftwards towards neutral position.
Therefore, the area of passage from MA to VA becomes smaller and the pressure on MA side rises due to increased resistance in the passage and the motor receives hydraulic braking effect.

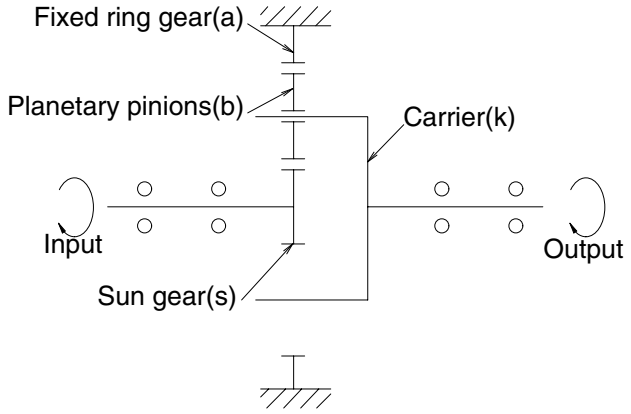
If the motor rotates slower than that matched to the volume of supplied oil, the pilot chamber pressure on VB port increases, and spool (35) moves rightwards to enlarge the area of passage from MA to VA. Therefore the braking effect becomes smaller and the rotational speed of motor is controlled to correspond to the volume of supplied oil.
In order to give stable counterbalance operation, the restrictors (38) are set in the pilot chamber to damp the spool (35) movement.
The parking brake is released during pressure adjusting action of the spool (35).



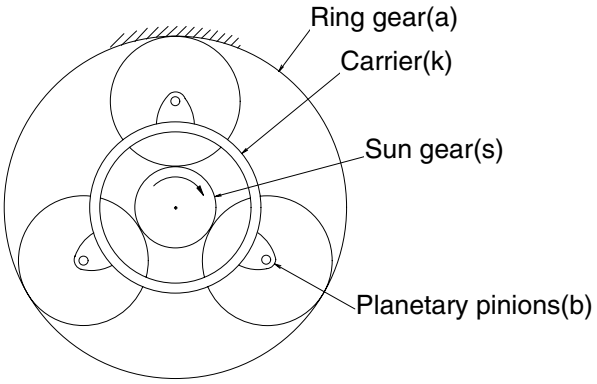
25092TM32

6) REDUCTION GEAR

Reduction unit slows down the rotating speed of motor and converts motor torque to strong rotating force.
This reduction unit utilizes two stages, planetary reduction system.
Planetary reduction system consists of sun gear, planetary gears, (planetary) carriers, and ring gear.
When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gear (s).
This movement is transferred to carrier (k) and deliver the torque.
This mechanism is called planetary gear mechanism.

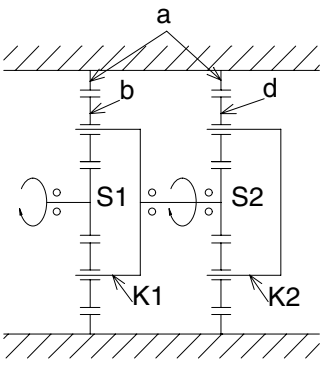


29072TM10



29072TM11

When the sun gear **S1** is driven by input shaft, planetary action occurs among gears **S1**, **a** and **b** and revolution of gear **b** transfers the rotation of carrier **K1** to second sun gear **S2**, and also evokes planetary action between gear **S2, a** and **d**.
This time, because carrier **K2** is fixed to frame, gear **d** drives ring gear **a** and then ring gear **a** rotates to drive sprocket.



29072TM12

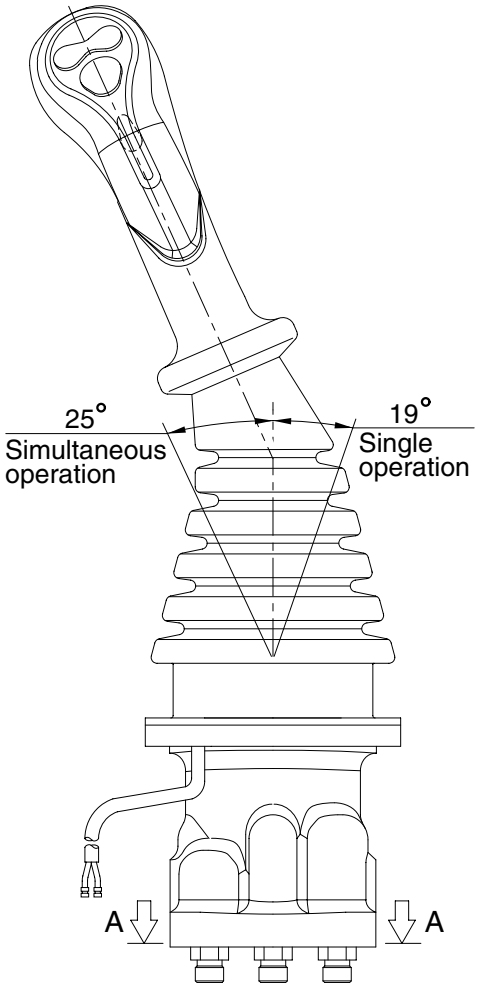
GROUP 5 RCV LEVER

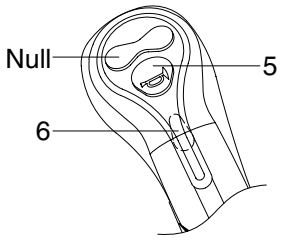
1. STRUCTURE

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.

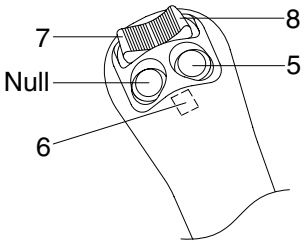
※ Refer to the parts manual for the types of the RCV lever.

1) TYPE M1, M5, M10





TYPE M1, M10

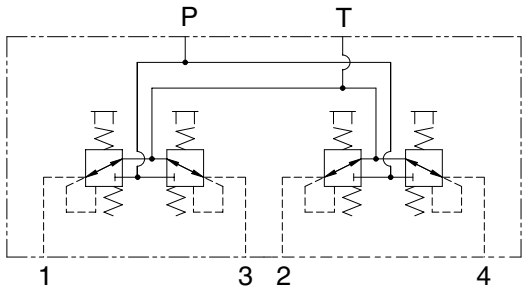


TYPE M5

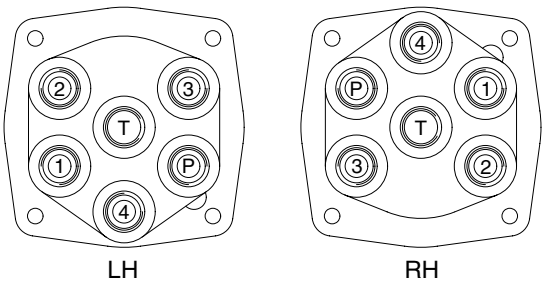
Switches

Type	No.	LH	RH
M1, M10	5	One touch decel	Horn
	6	Power boost	Breaker
M5	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



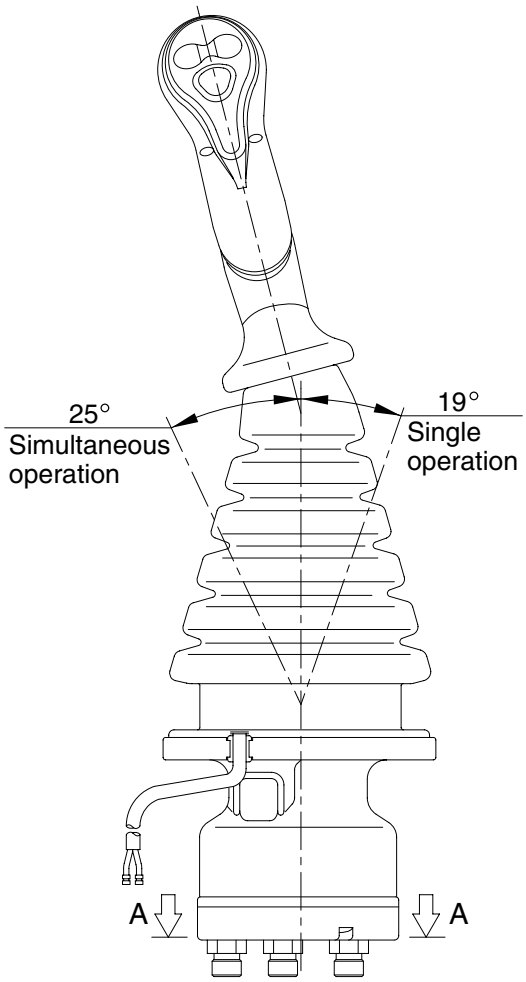
VIEW A-A

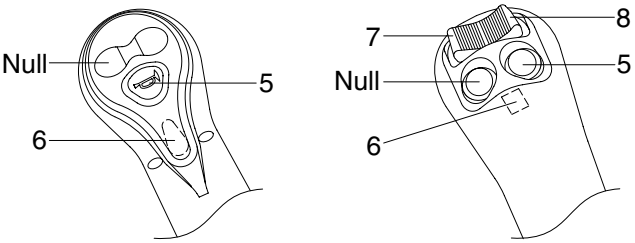
Pilot ports

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	

220F2RL01

2) TYPE M2, M4, M9



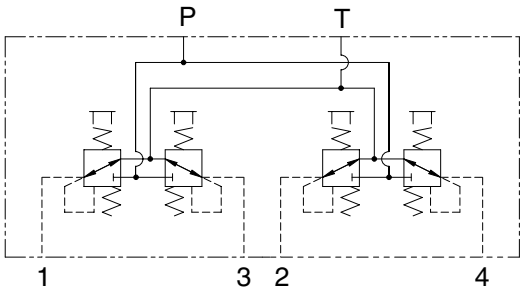


TYPE M2, M9 TYPE M4

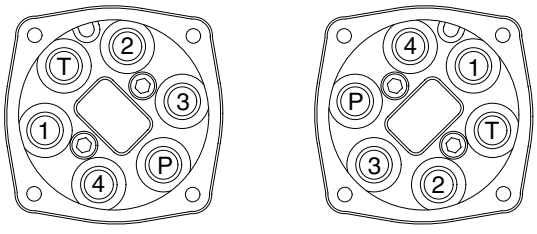
Switches

Type	No.	LH	RH
M2, M9	5	One touch decel	Horn
	6	Power boost	Breaker
M4	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

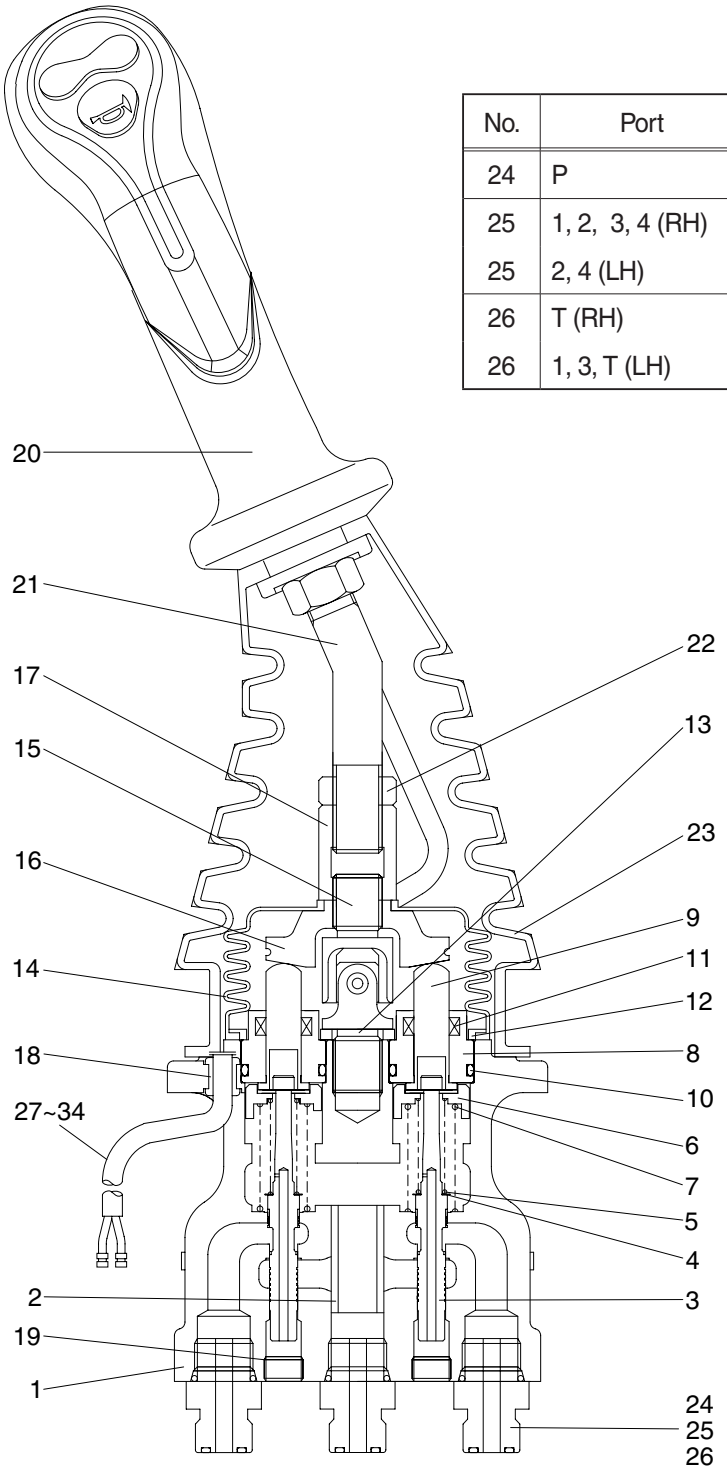
VIEW A-A

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	

220F2RL05

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 Plate
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
29 Connector
30 Connector
31 Small guide
32 Connector
33 Big guide
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.

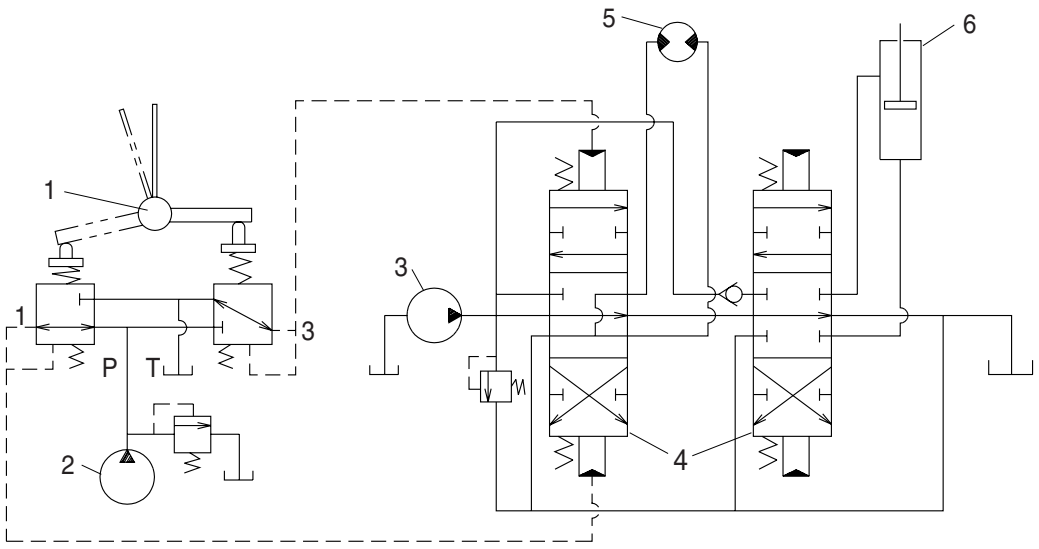
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

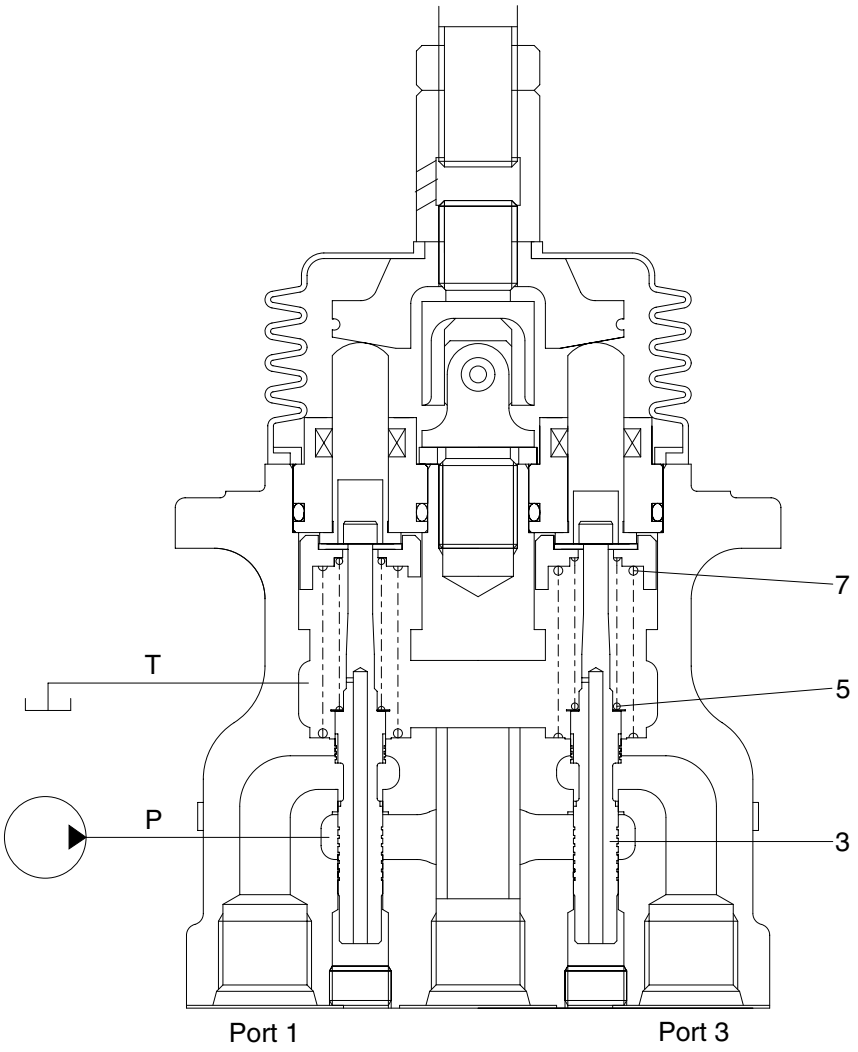
The diagram shown below is the typical application example of the pilot valve.



2-70

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

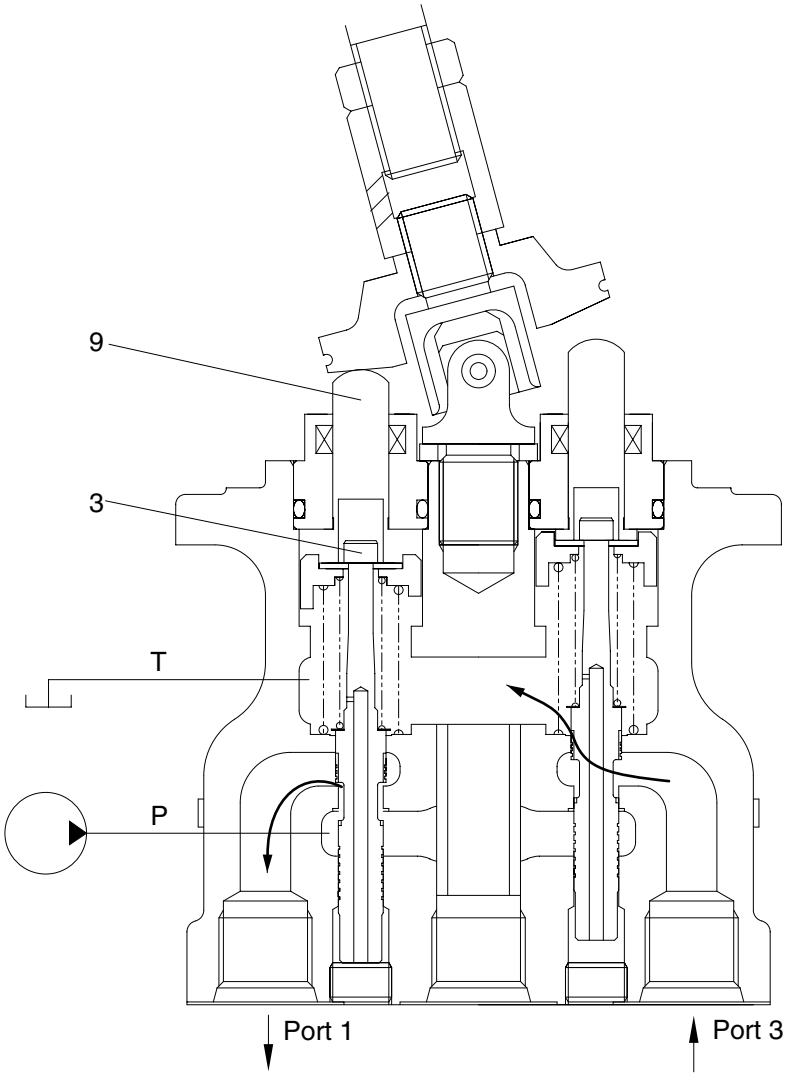
(1) Case where handle is in neutral position



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



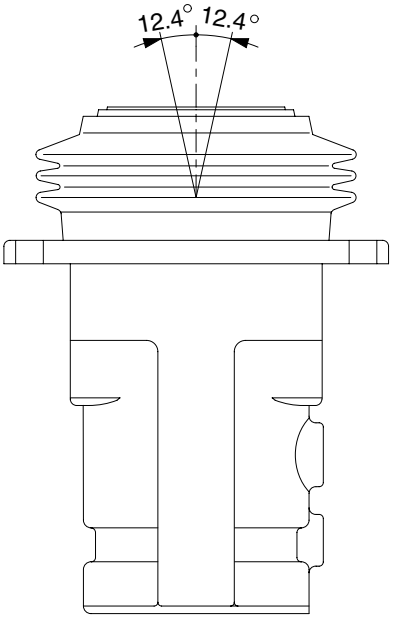
300L2RL04

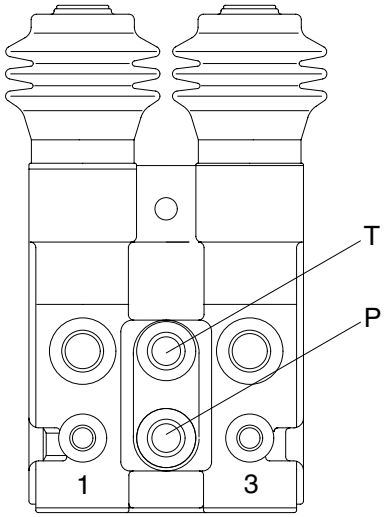
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, 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.

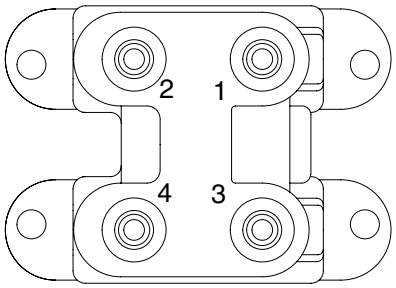
GROUP 6 RCV PEDAL

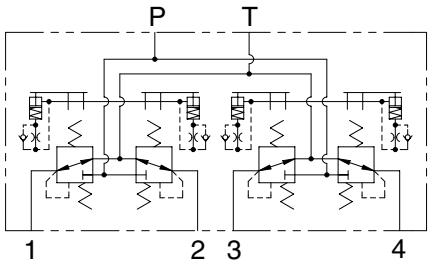
1. STRUCTURE

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)	

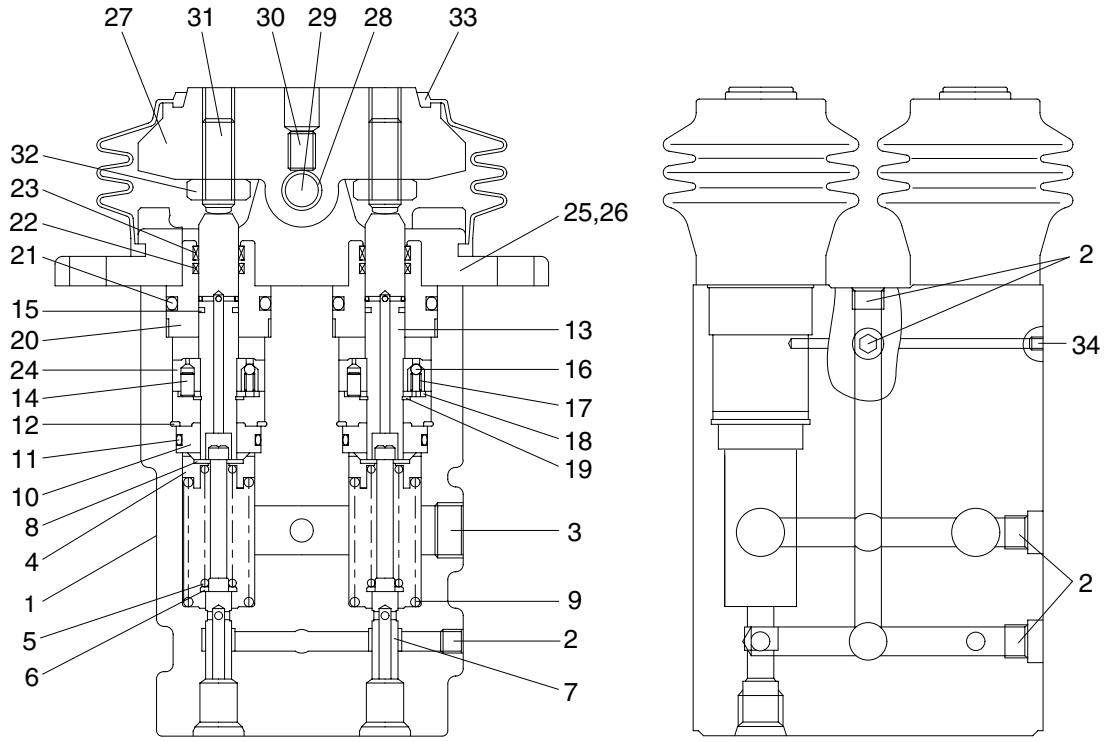
130ZF2RP01

CROSS SECTION

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

The pressure reducing section is composed of the spool (7), spring (5) for setting secondary pressure, return spring (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.



130ZF2RP02

1	Body	13	Push rod	25	Cover
2	Plug	14	Spring pin	26	Wrench 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	19	Snap ring	31	Set screw
8	Stopper	20	Plug	32	Hex nut
9	Spring	21	O-ring	33	Bellows
10	Rod guide	22	Rod seal	34	Expand
11	O-ring	23	Dust seal	35	Name plate
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.

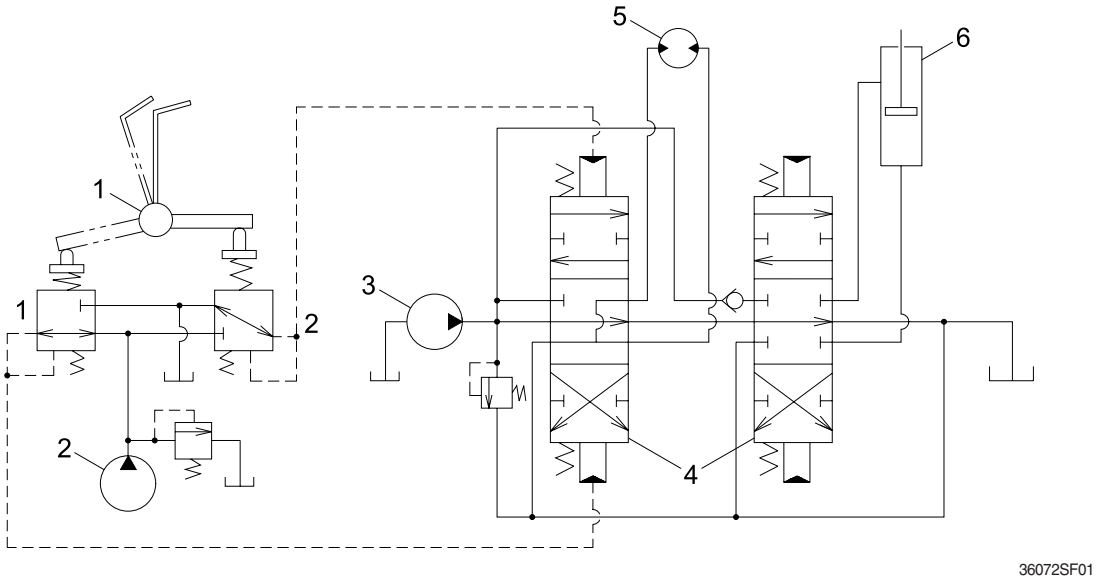
The spring (9) works on the body (1) and spring seat (6) and tries to return the push rod (13) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

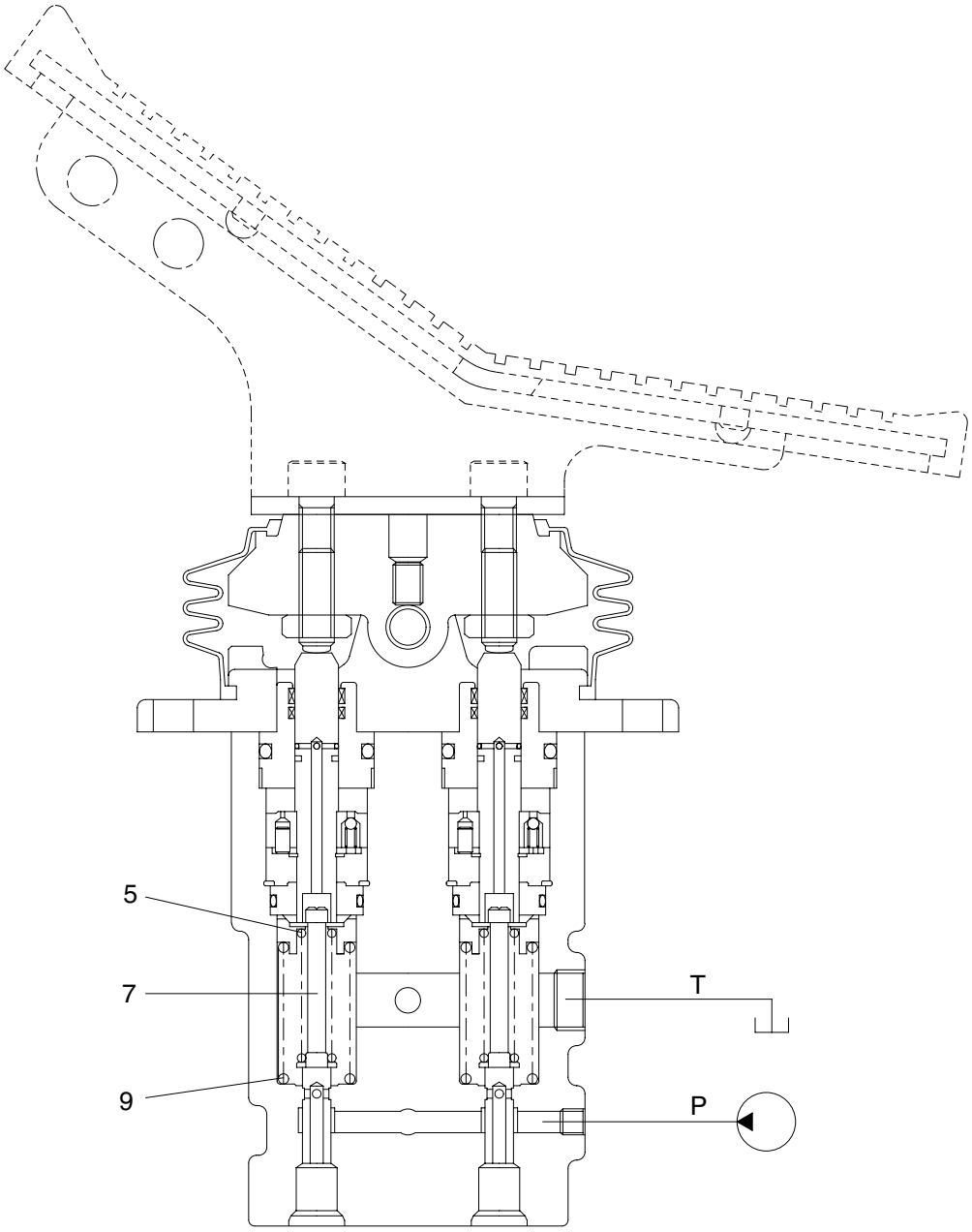
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



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

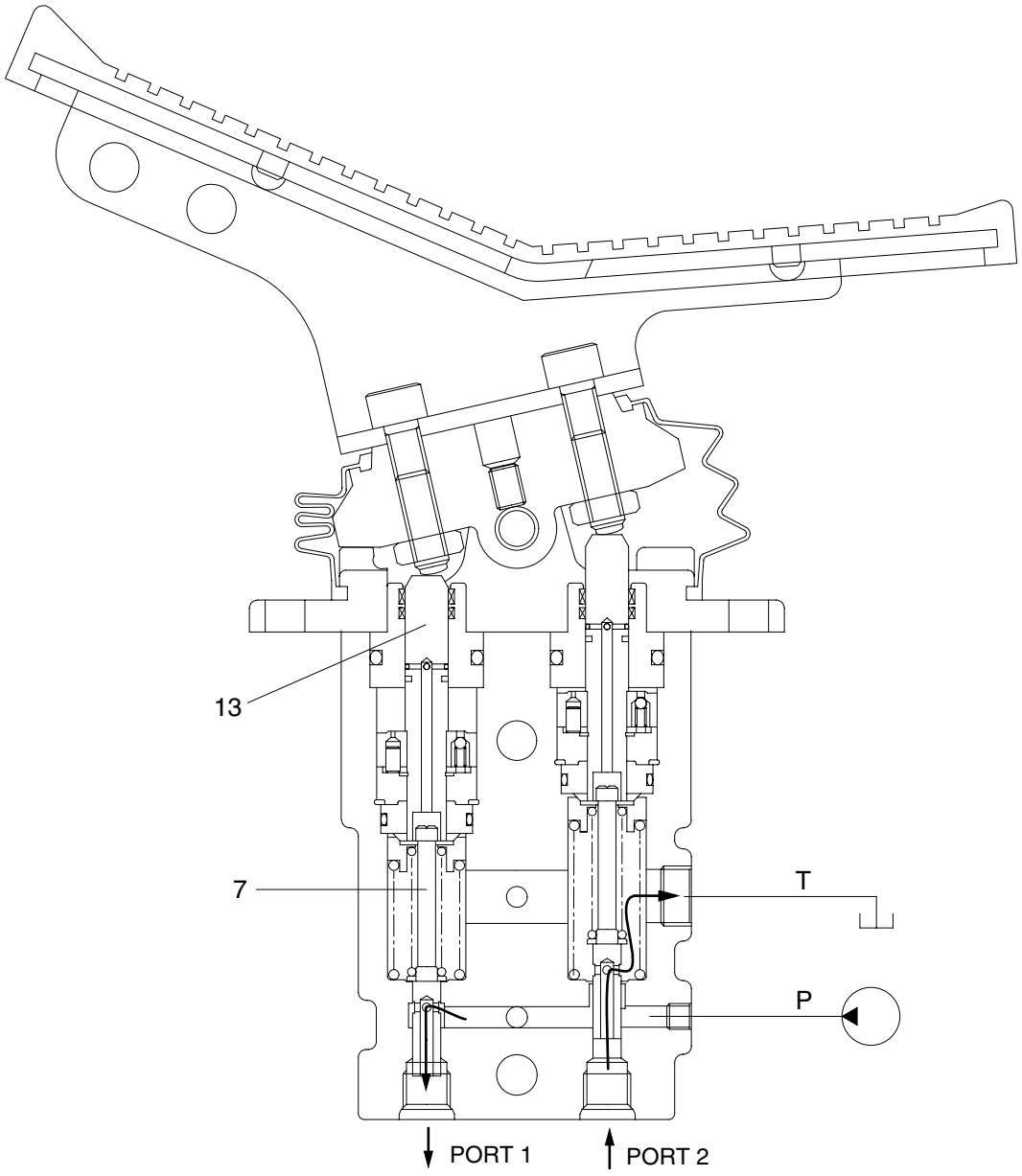
(1) Case where pedal is in neutral position



130ZF2RP03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (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



220F2RP04

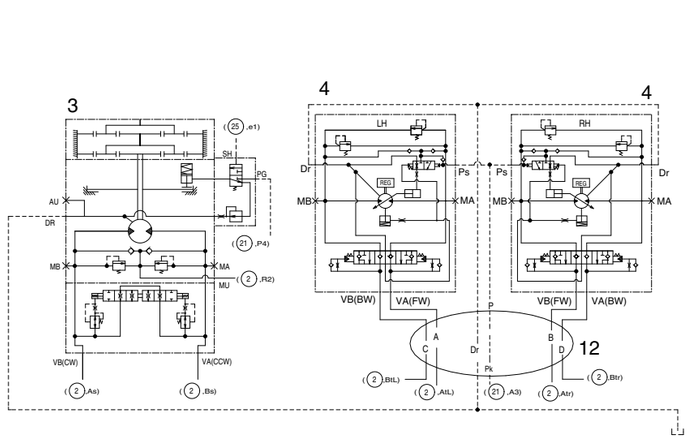
When the push rod (13) is stroked, the spool (7) moves downwards.
Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
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.

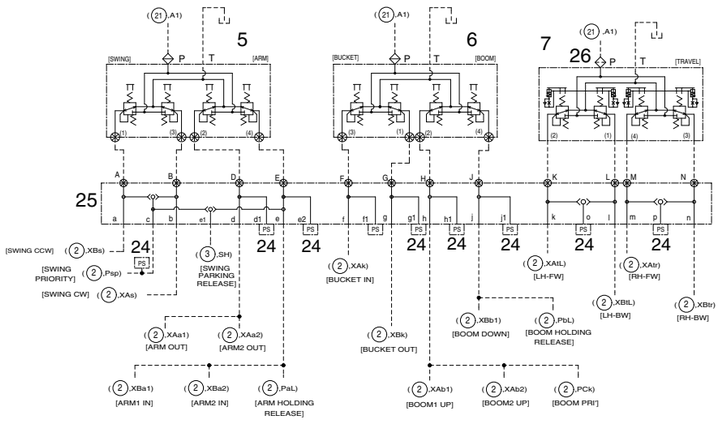
SECTION 3 HYDRAULIC SYSTEM

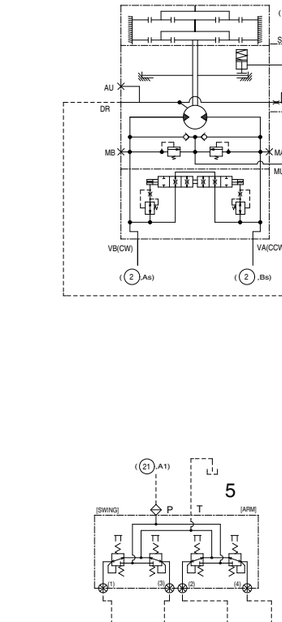
Group 1 Hydraulic Circuit ····· 3-1
Group 2 Main Circuit ····· 3-3
Group 3 Pilot Circuit ····· 3-6
Group 4 Single Operation ····· 3-17
Group 5 Combined Operation ····· 3-27

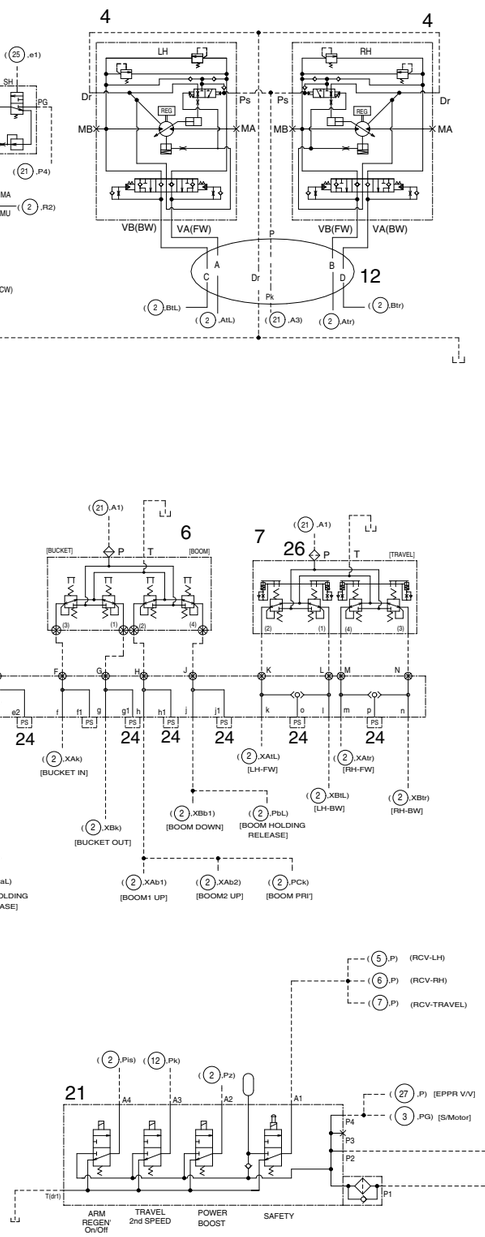
GROUP 1 HYDRAULIC CIRCUIT (MACHINE NO. : -#0697)

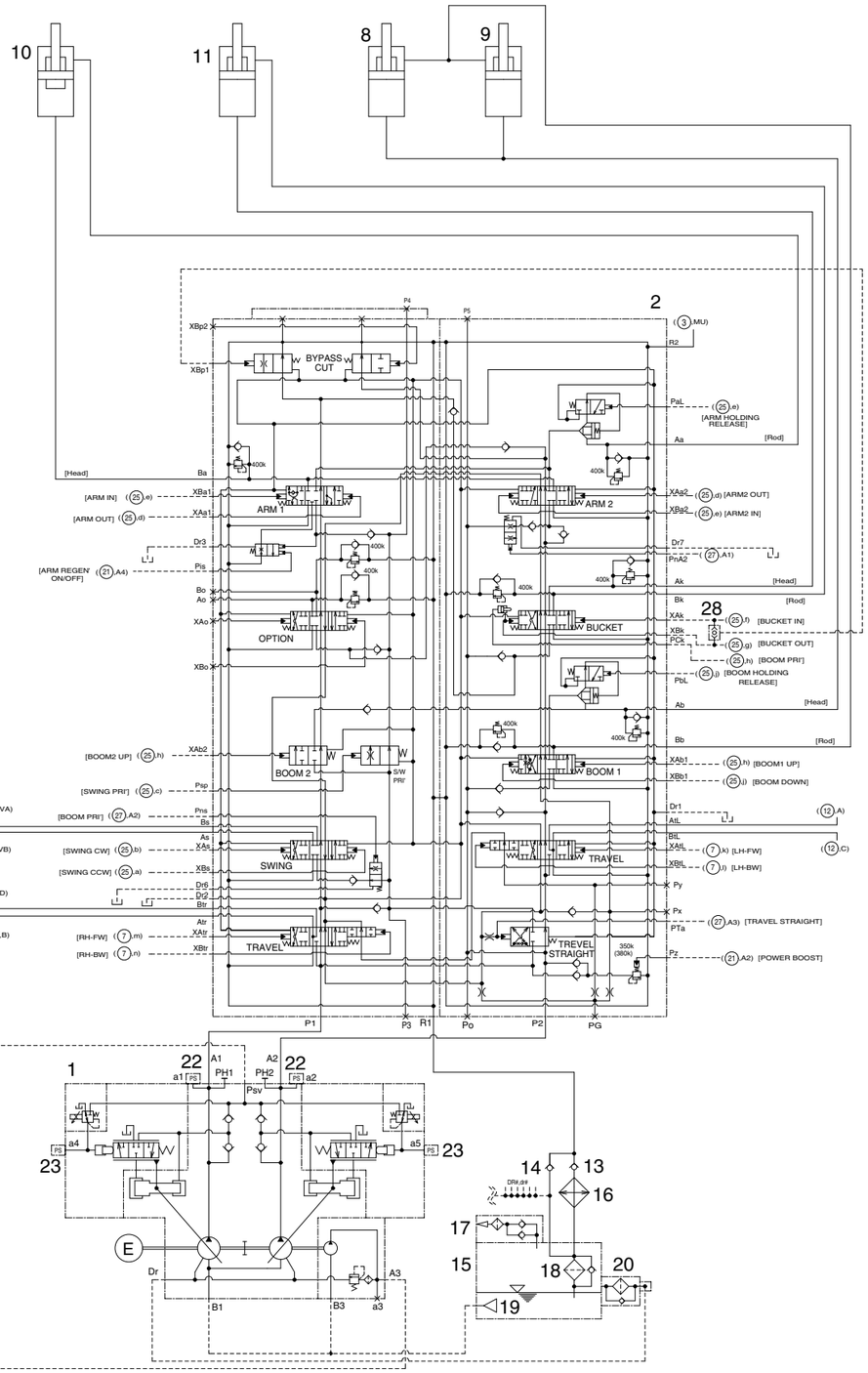
1. HYDRAULIC CIRCUIT (1/2)





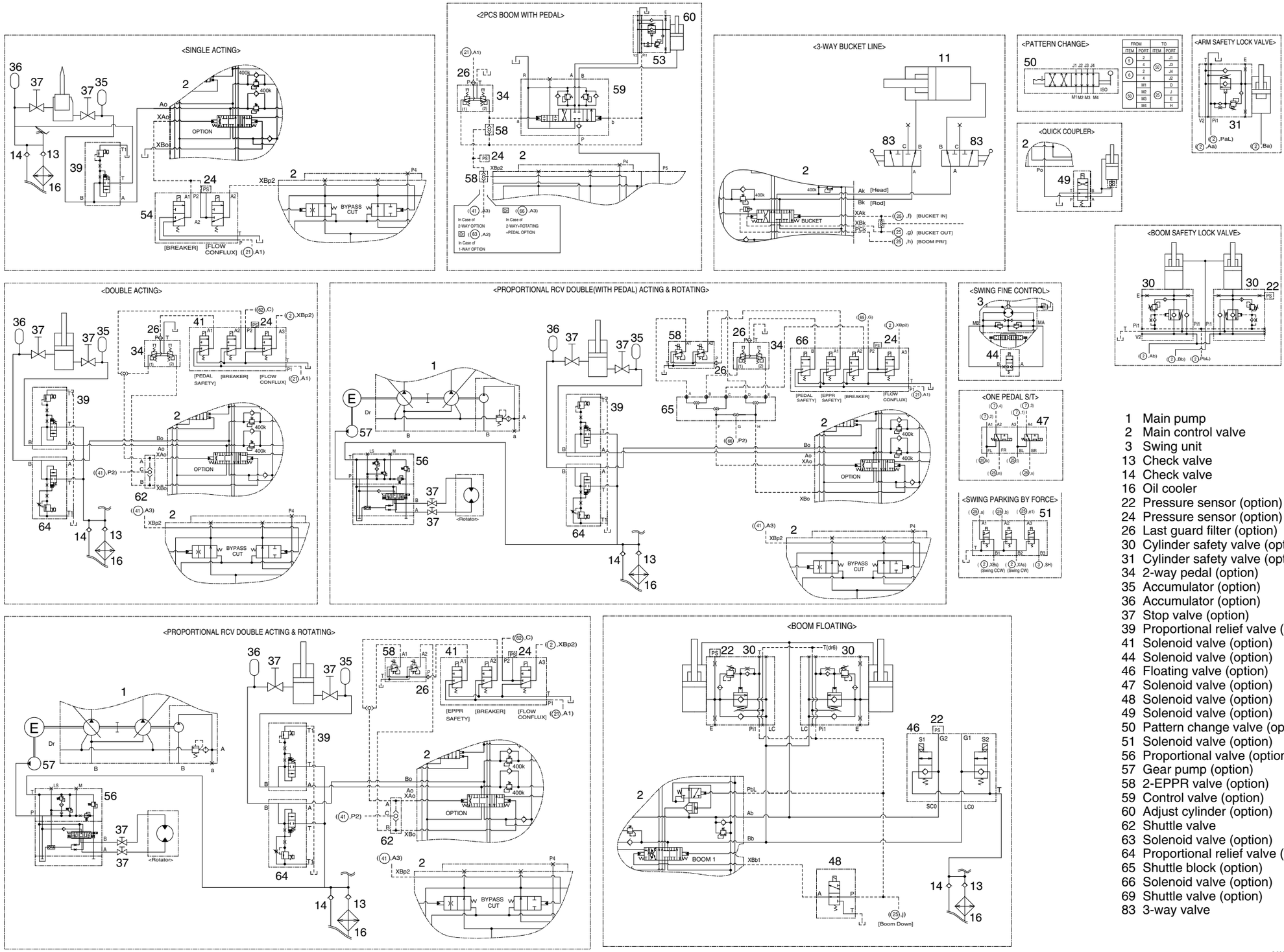






1 Main pump
2 Main control valve
3 Swing unit
4 Travel unit
5 RCV lever (LH)
6 RCV lever (RH)
7 RCV pedal
8 Boom cylinder (LH)
9 Boom cylinder (RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank assy
16 Oil cooler
17 Air breather
18 Return element w/ bypass valve
19 Suction strainer
20 Drain filter
21 4-cartridge valve
22 Pressure sensor
23 Pressure sensor
24 Pressure sensor
25 Shuttle valve
26 Last guard filter
27 2-EPPR valve assy
28 Shuttle tee

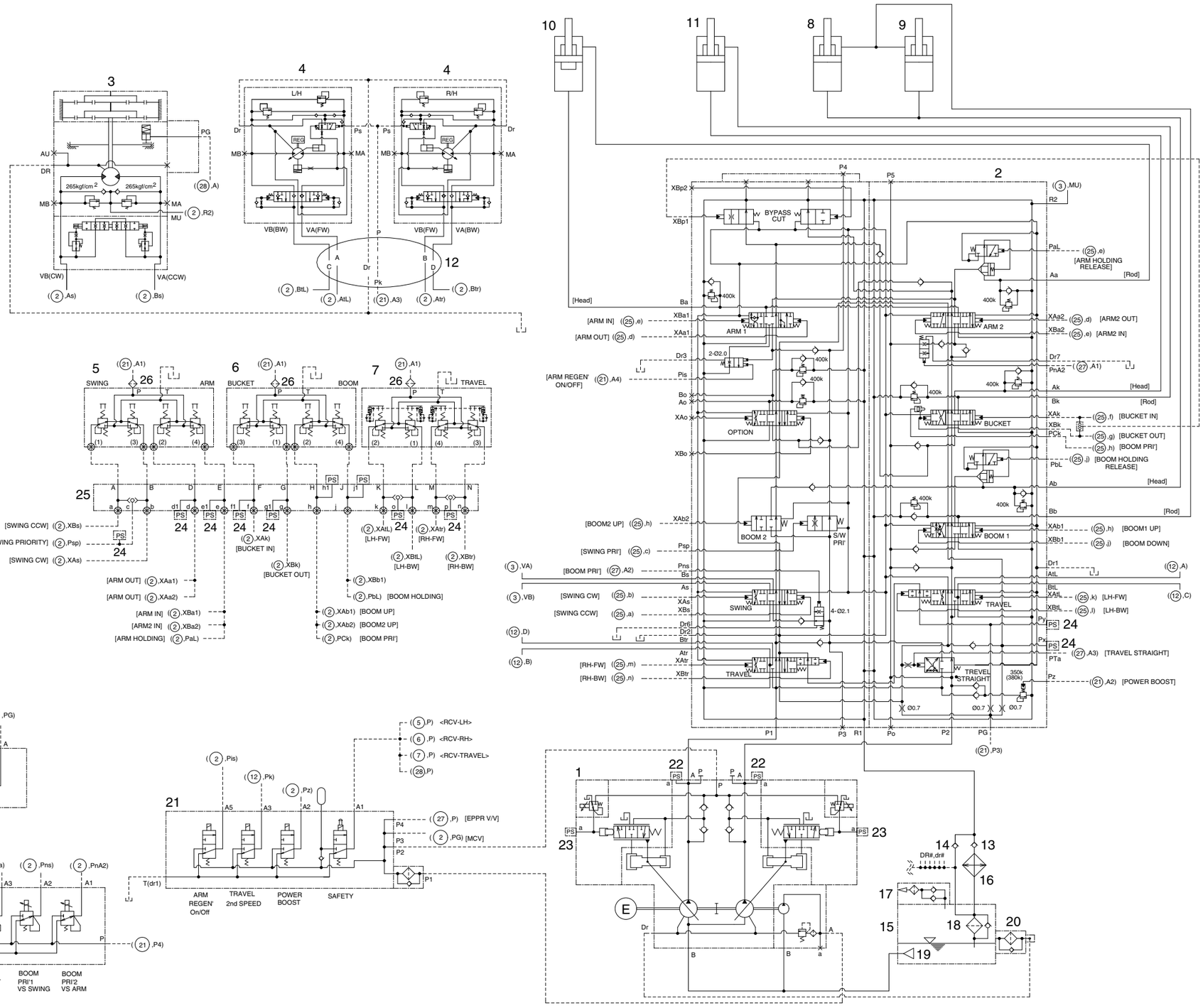
2. HYDRAULIC CIRCUIT (2/2)



1 Main pump
2 Main control valve
3 Swing unit
13 Check valve
14 Check valve
16 Oil cooler
22 Pressure sensor (option)
24 Pressure sensor (option)
26 Last guard filter (option)
30 Cylinder safety valve (option)
31 Cylinder safety valve (option)
34 2-way pedal (option)
35 Accumulator (option)
36 Accumulator (option)
37 Stop valve (option)
39 Proportional relief valve (option)
41 Solenoid valve (option)
44 Solenoid valve (option)
46 Floating valve (option)
47 Solenoid valve (option)
48 Solenoid valve (option)
49 Solenoid valve (option)
50 Pattern change valve (option)
51 Solenoid valve (option)
56 Proportional valve (option)
57 Gear pump (option)
58 2-EPPR valve (option)
59 Control valve (option)
60 Adjust cylinder (option)
62 Shuttle valve
63 Solenoid valve (option)
64 Proportional relief valve (option)
65 Shuttle block (option)
66 Solenoid valve (option)
69 Shuttle valve (option)
83 3-way valve

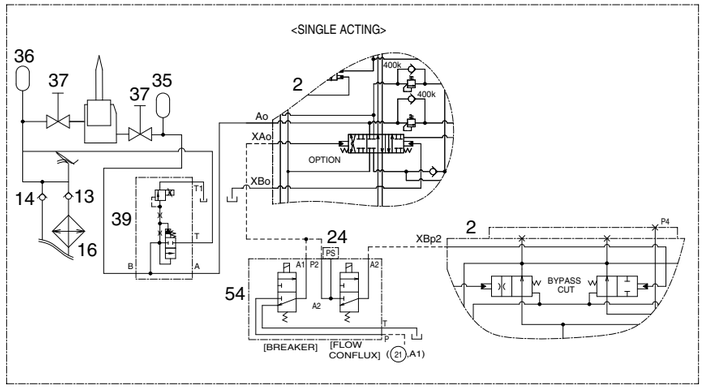
GROUP 1 HYDRAULIC CIRCUIT (MACHINE NO. : #0698-)

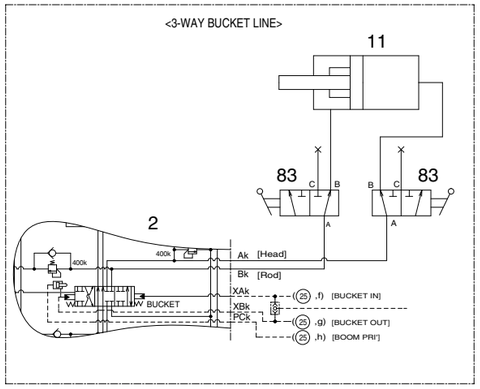
1. HYDRAULIC CIRCUIT (1/3)

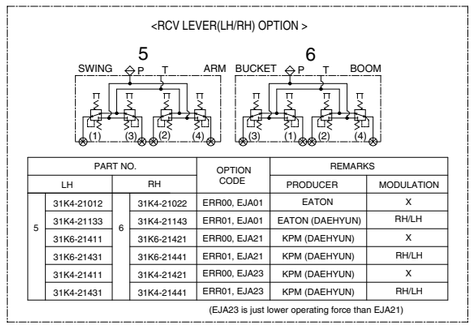


30K6-27100-07 1OF3

2. HYDRAULIC CIRCUIT (2/3)

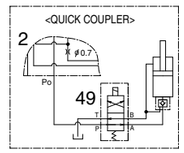


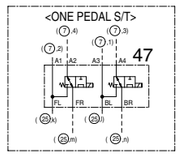


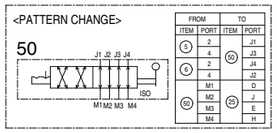


PART NO.				OPTION CODE	REMARKS	
	LH		RH		PRODUCER	MODULATION
5	31K4-21012	6	31K4-21022	ERR00, EJA01	EATON	X
	31K4-21133		31K4-21143	ERR01, EJA01	EATON (DAEHYUN)	RH/LH
	31K6-21411		31K6-21421	ERR00, EJA21	KPM (DAEHYUN)	X
	31K6-21431		31K6-21441	ERR01, EJA21	KPM (DAEHYUN)	RH/LH
	31K4-21411		31K4-21421	ERR00, EJA23	KPM (DAEHYUN)	X
	31K4-21431		31K4-21441	ERR01, EJA23	KPM (DAEHYUN)	RH/LH

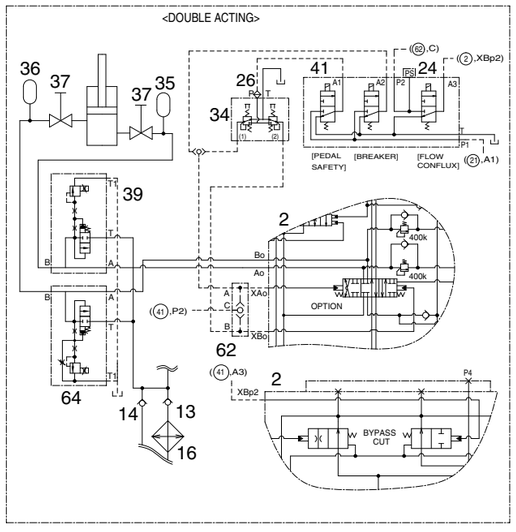
(EJA23 is just lower operating force than EJA21)

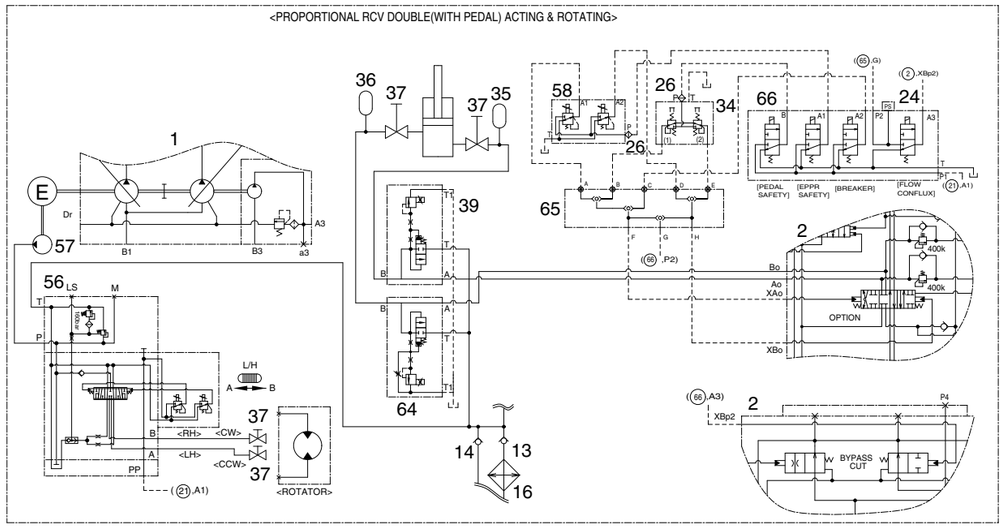


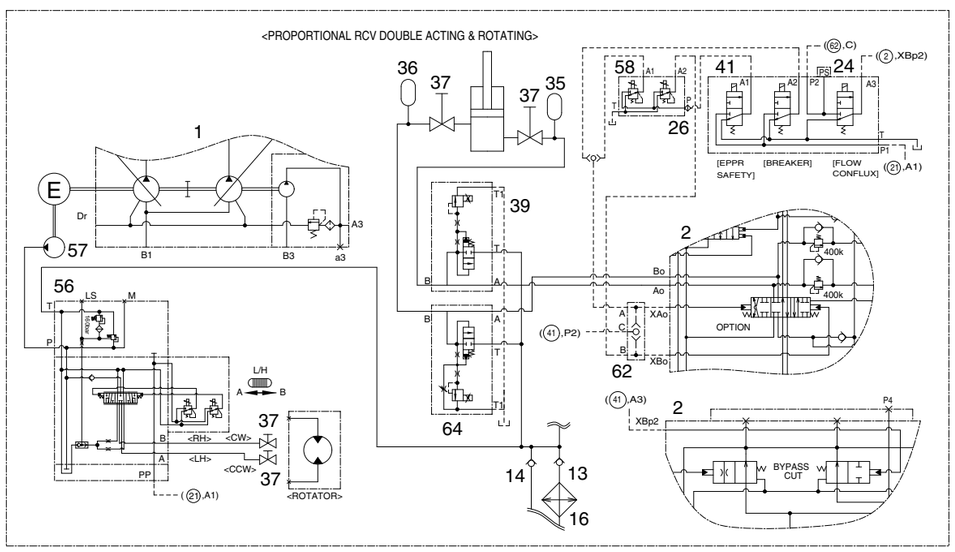


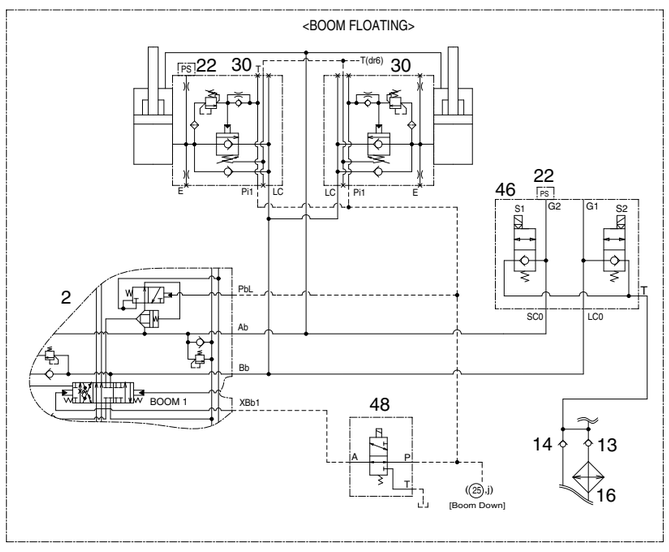


FROM		TO	
ITEM	PORT	ITEM	PORT
5	2	50	J1
	4		J3
6	2		J4
	4		J2
50	M1	25	D
	M2		J
	M3		E
	M4		H



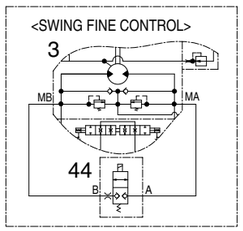


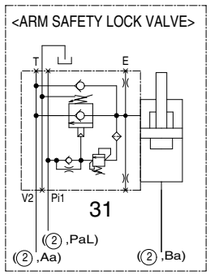


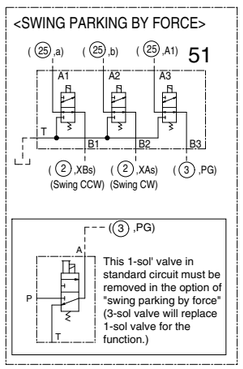


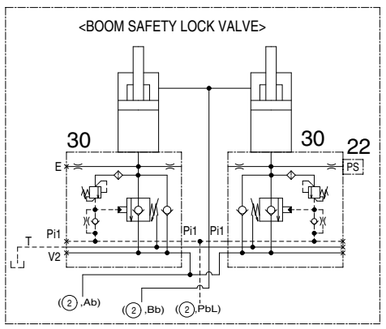
1 Main pump
2 Main control valve
3 Swing unit
13 Check valve
14 Check valve
16 Oil cooler
22 Pressure sensor (option)
24 Pressure sensor (option)
26 Last guard filter (option)
30 Cylinder safety valve (option)
31 Cylinder safety valve (option)
34 2-way pedal (option)
35 Accumulator (option)
36 Accumulator (option)
37 Stop valve (option)
39 Proportional relief valve (option)
41 Solenoid valve (option)
44 Solenoid valve (option)
46 Floating cartridge valve (option)
47 Solenoid valve (option)
48 Solenoid valve (option)
49 Solenoid valve (option)
50 Pattern change valve (option)
56 Proportional valve (option)
57 Gear pump (option)
58 2-EPPR valve (option)
62 Shuttle valve
63 Solenoid valve (option)
64 Proportional relief valve (option)
65 Shuttle block (option)
66 Solenoid valve (option)
83 3-way valve

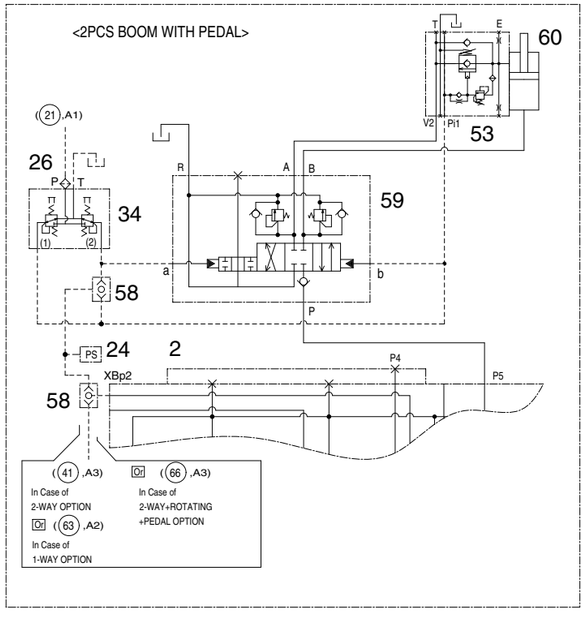
3. HYDRAULIC CIRCUIT (3/3)









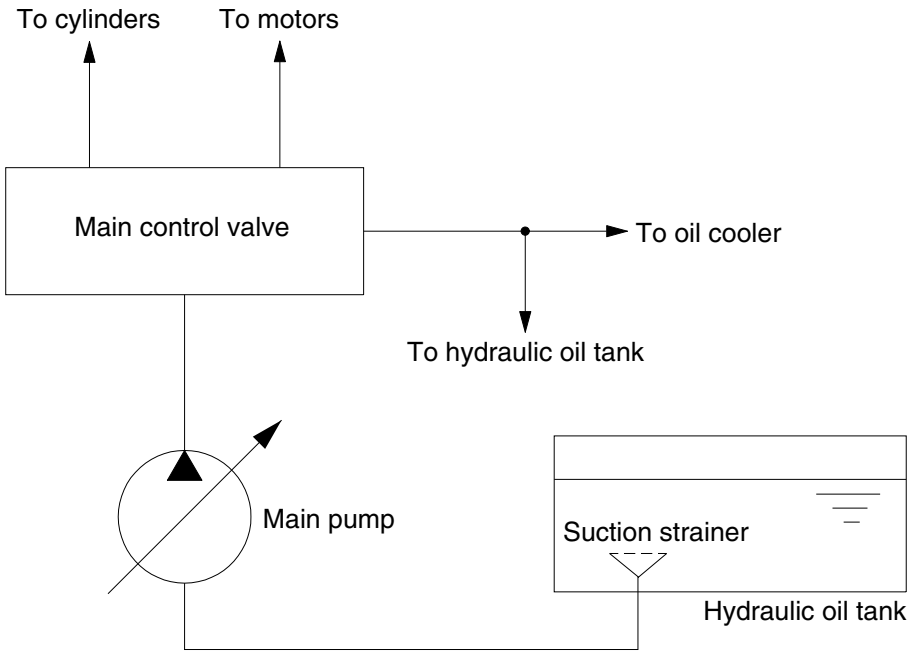


2 Main control valve
3 Swing unit
22 Pressure sensor
24 Pressure sensor
26 Last guard filter
30 Cylinder safety valve (option)
31 Cylinder safety valve (option)
44 Solenoid valve (option)
53 Cylinder safety valve (option)
58 2-EPPR valve (option)
59 Control valve (option)
60 Adjust cylinder (option)
62 Shuttle valve (option)

GROUP 2 MAIN CIRCUIT

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

1. SUCTION AND DELIVERY CIRCUIT

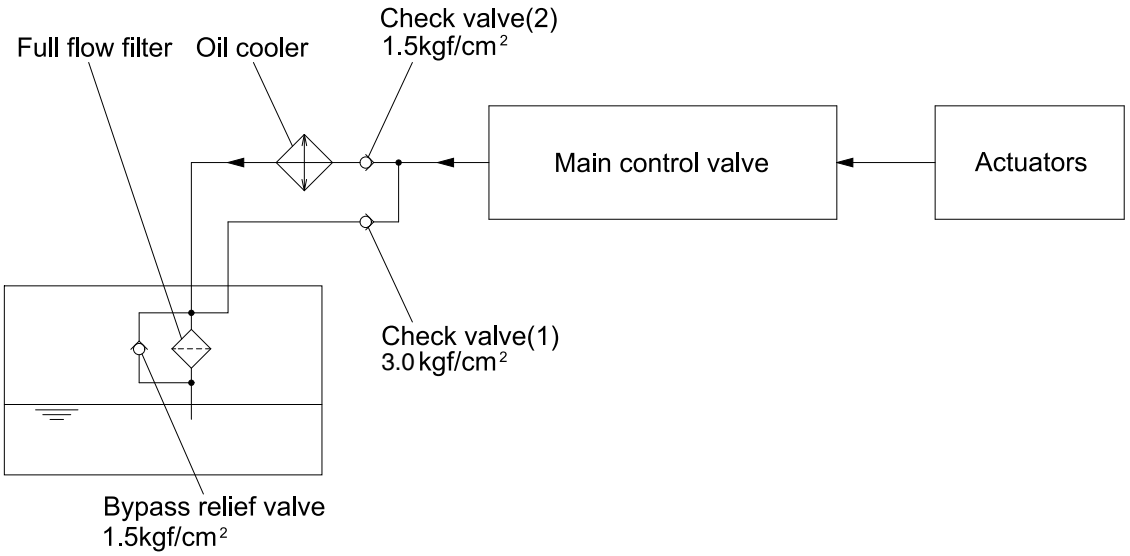


140L3CI01

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 main control valve.
The main control valve controls the hydraulic functions.
The return oil from the actuators flows to the hydraulic tank through the main control valve and the oil cooler.

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

2. RETURN CIRCUIT

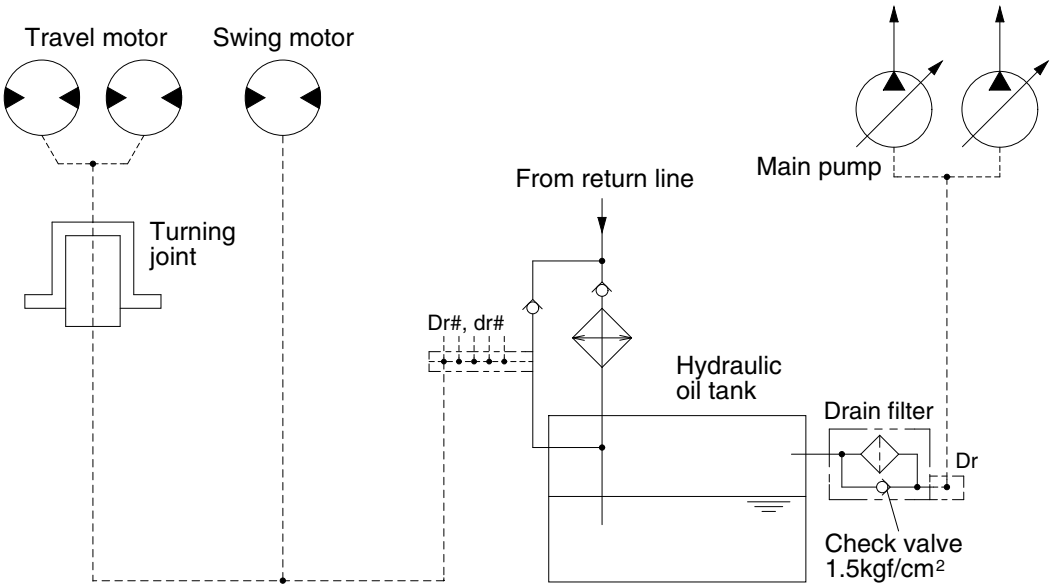


220F3CI01

All oil returned from each actuator returns to the hydraulic tank through the main control valve.
The bypass check valves are provided in the return circuit.
The setting pressure of bypass check valves are 1.5 kgf/cm² (21 psi) and 3.0 kgf/cm² (43 psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.
When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. When the oil pressure exceeds 3.0 kgf/cm² (43 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 returned from right and left side of control valve is combined and filtered by the full-flow filter. A bypass relief valve is provided in the full-flow filter.
When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm² (21 psi) differential pressure.

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

3. DRAIN CIRCUIT



220F3CI02

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 return filter.
When the drain oil pressure exceed 1.5 kgf/cm^2 (21 psi), the oil returns to the hydraulic tank directly.

1) TRAVEL AND SWING MOTOR DRAIN CIRCUIT

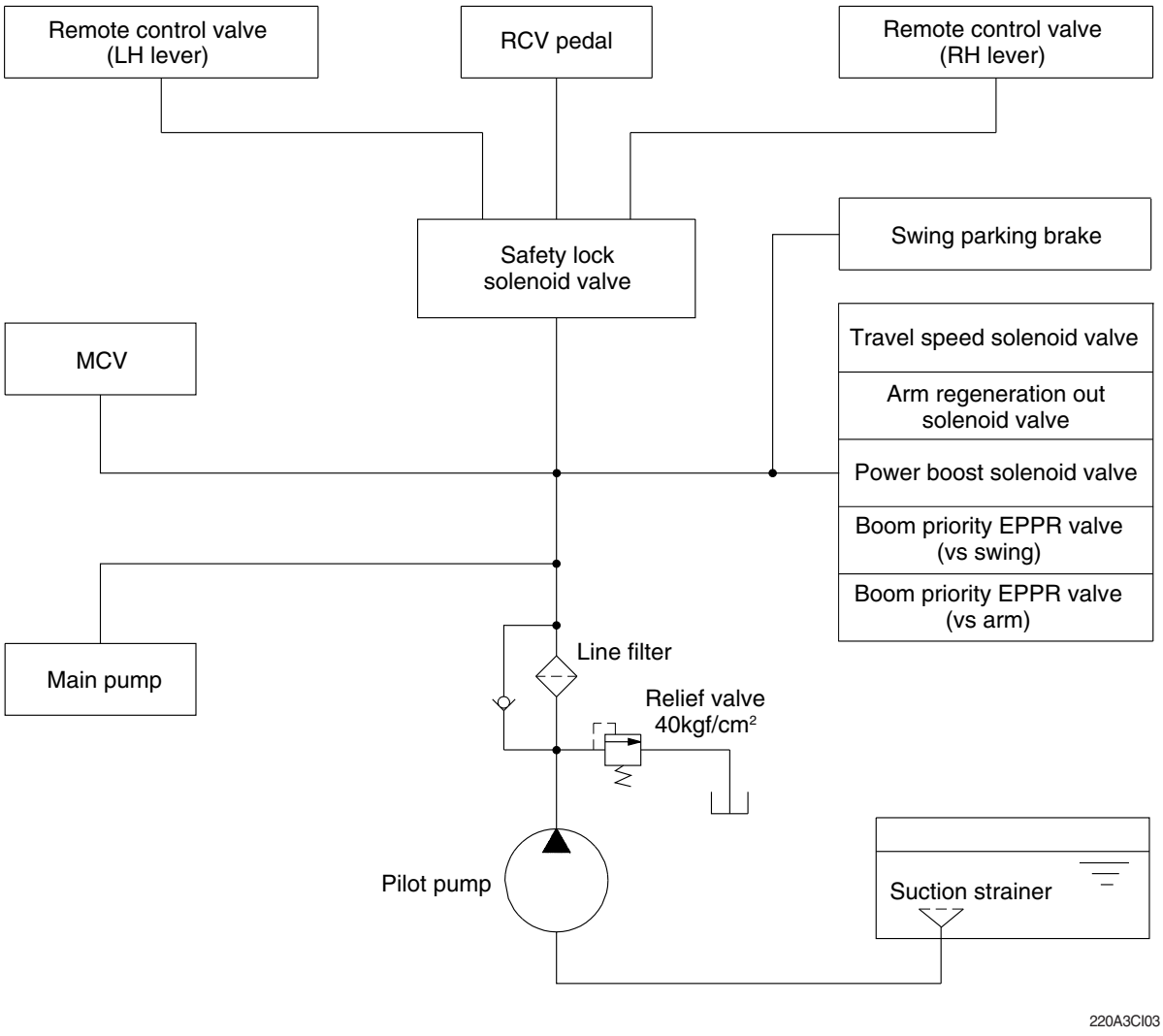
Oil leaked from the right and left travel motors comes out of the drain ports provided in the respective motor casing and join with each other. These oils pass through the turning joint and join with oil leak line of the swing motor and return to the hydraulic tank after being filtered by return filter.

2) MAIN PUMP DRAIN CIRCUIT

Oil leaked from main pump returns 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



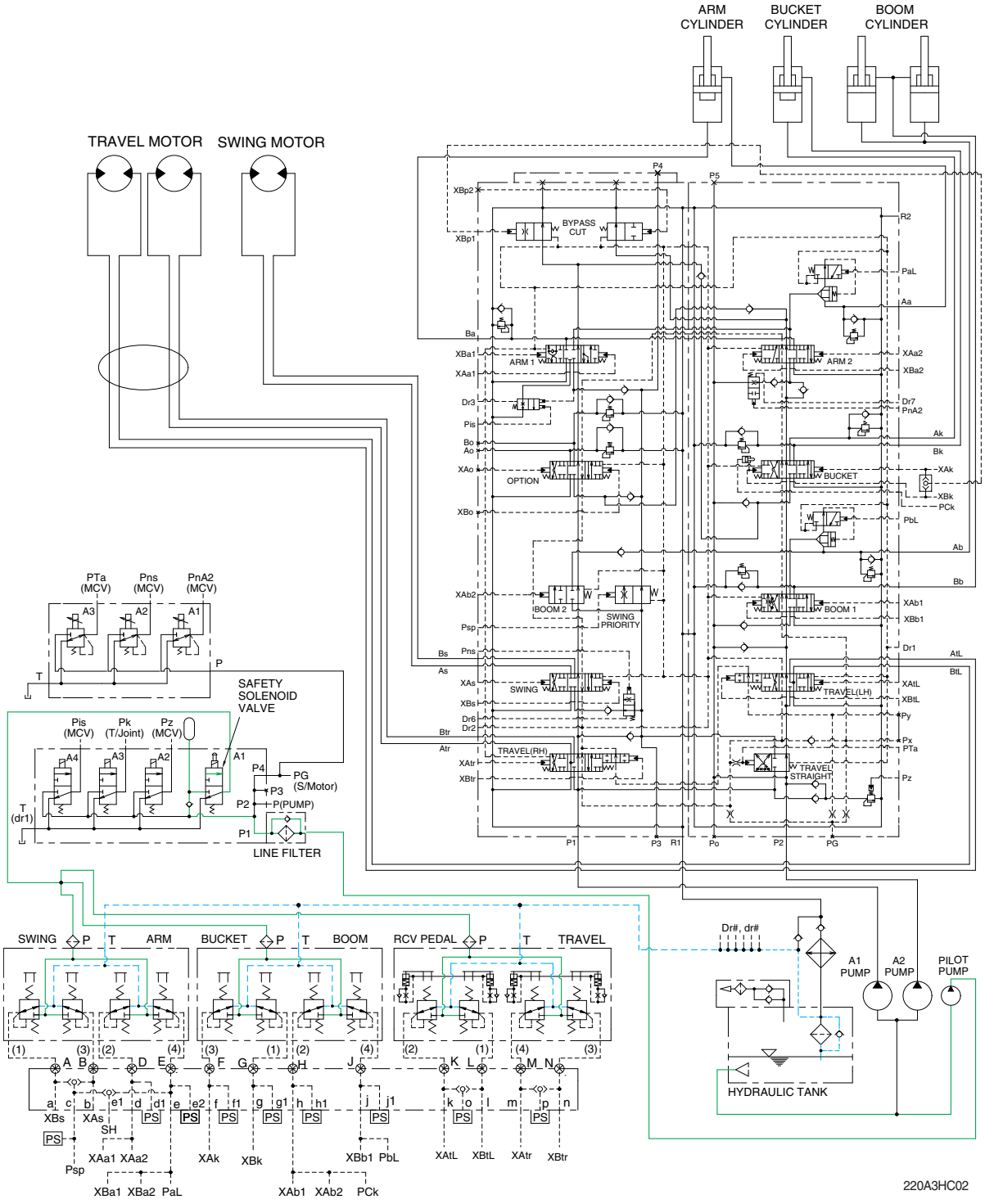
The pilot circuit consists of suction circuit, delivery circuit and return circuit.

The pilot pump is provided with relief valve, receives the oil from the hydraulic tank through the suction filter.

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



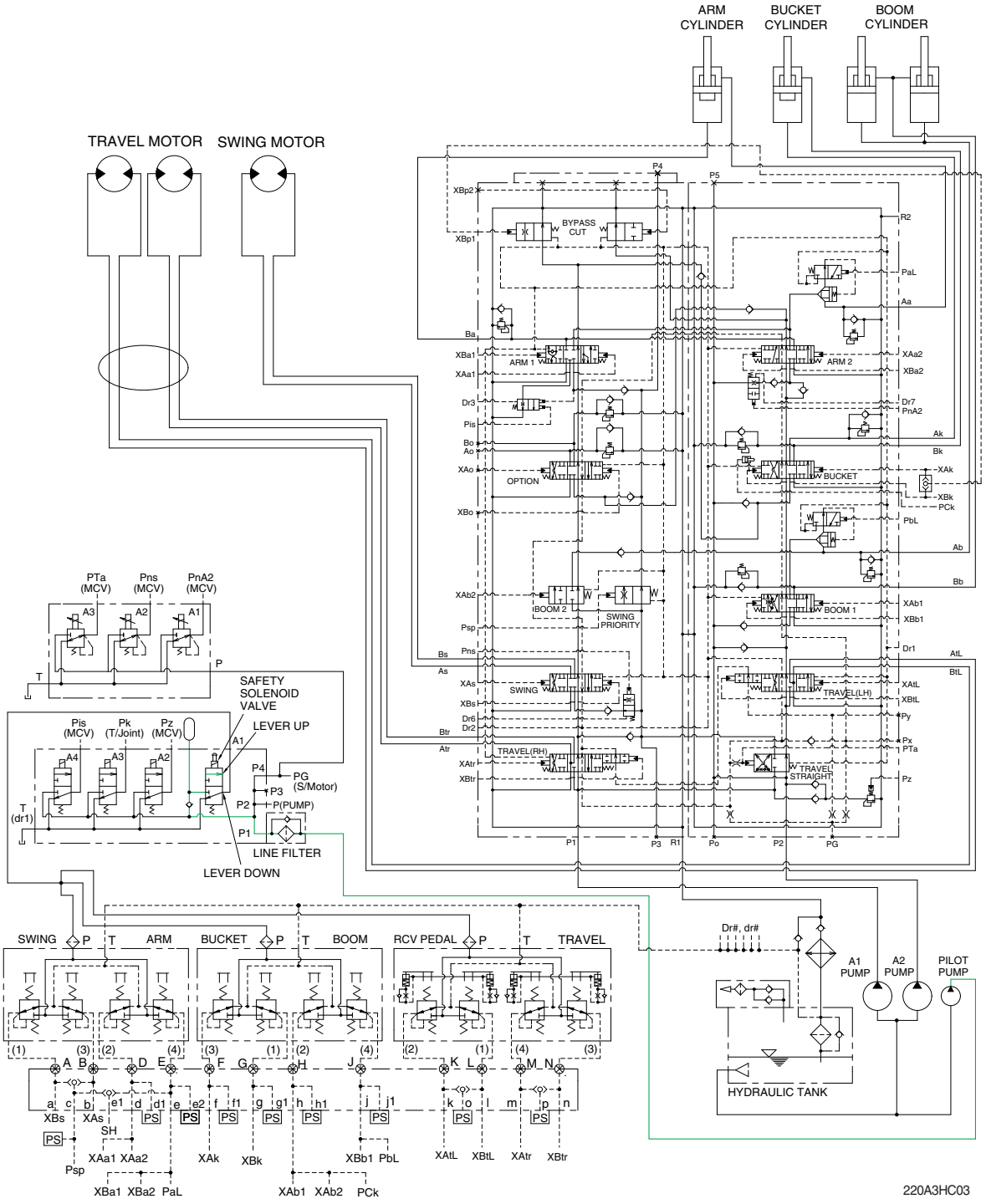
The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

The return oil flow into the hydraulic tank through the cross assy.

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

2. SAFETY VALVE (SAFETY LEVER)

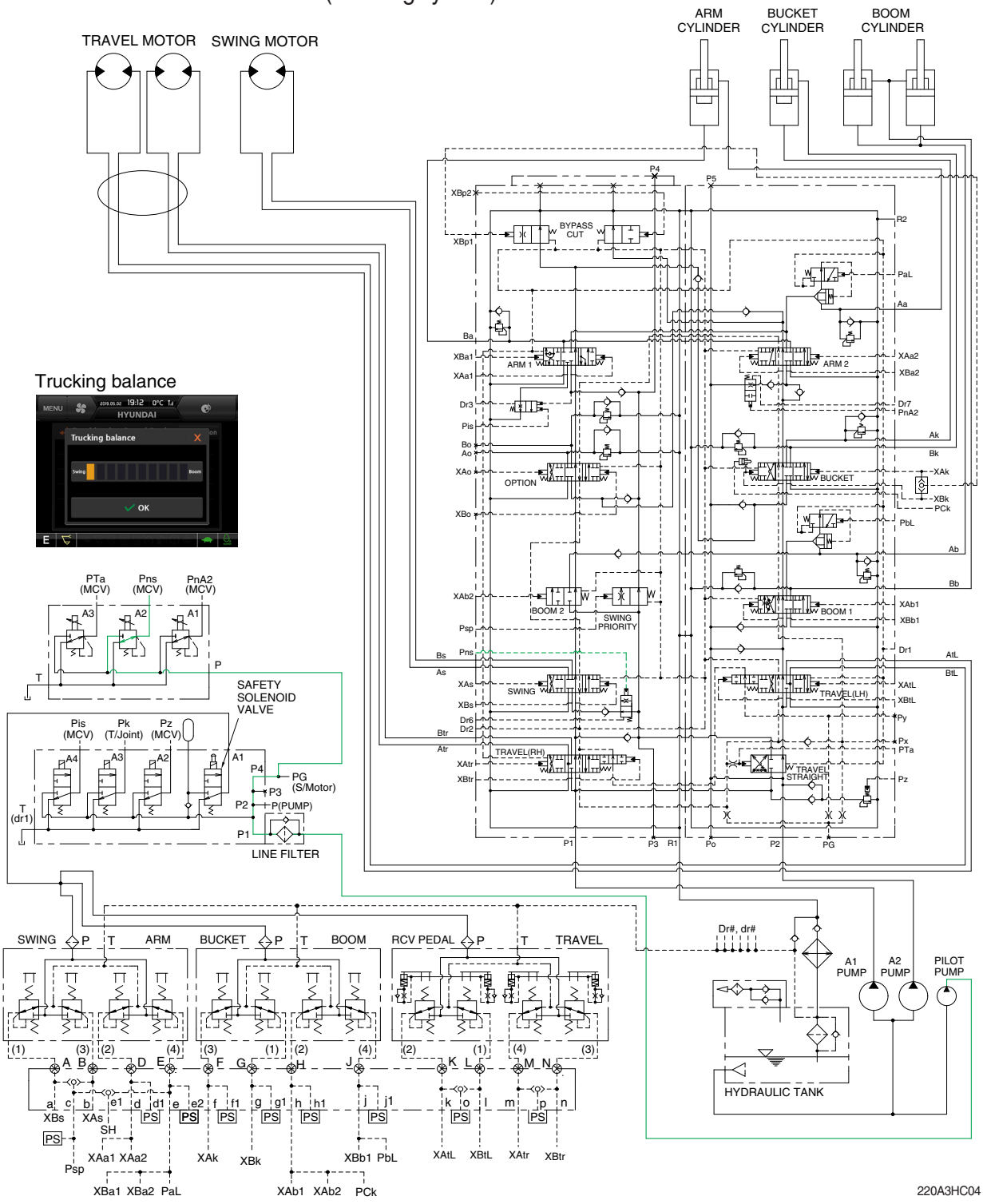


When the lever of the safety solenoid valve is moved upward, oil flows into the remote control valve through solenoid valve and line filter.

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

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

3. BOOM PRIORITY SYSTEM (vs swing system)



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.

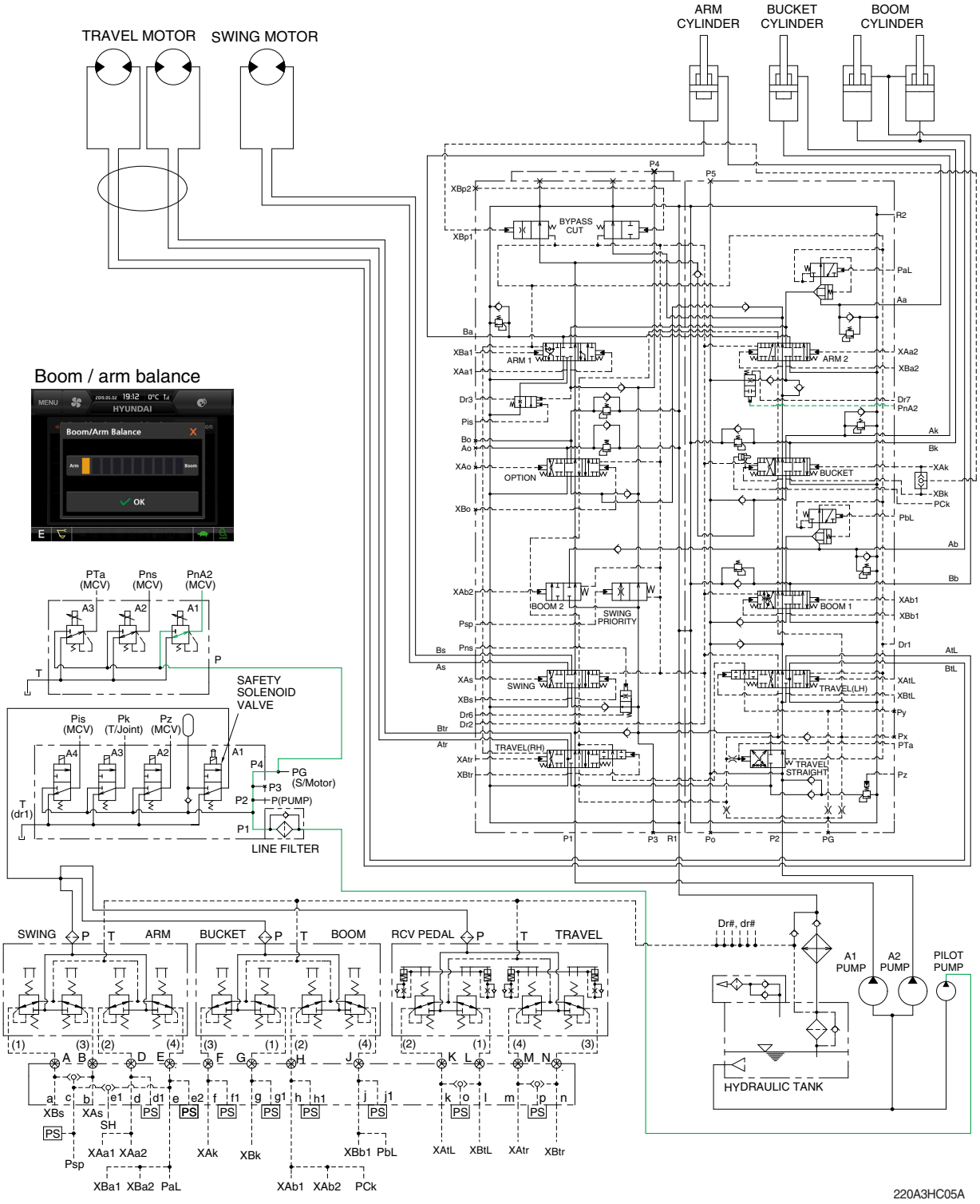
The pilot oil from pilot pump flow into **Pns** port in main control valve through boom priority (vs swing) EPPR valve. **Pns** oil pressure moves swing reducing spool to lower position and oil flow rate to the swing motor decreased.

Then, the boom up speed is increased. This is called the boom priority system (trucking balance).

The trucking balance can be adjusted by the cluster. Refer to page 3-20-1 of the operator's manual.

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

4. BOOM PRIORITY SYSTEM (vs arm system)



When carrying out the combined operation of boom up and arm in, the boom up operating speed is lowered then normal operation.

To increase working efficiency, arm in speed reducing system is used.

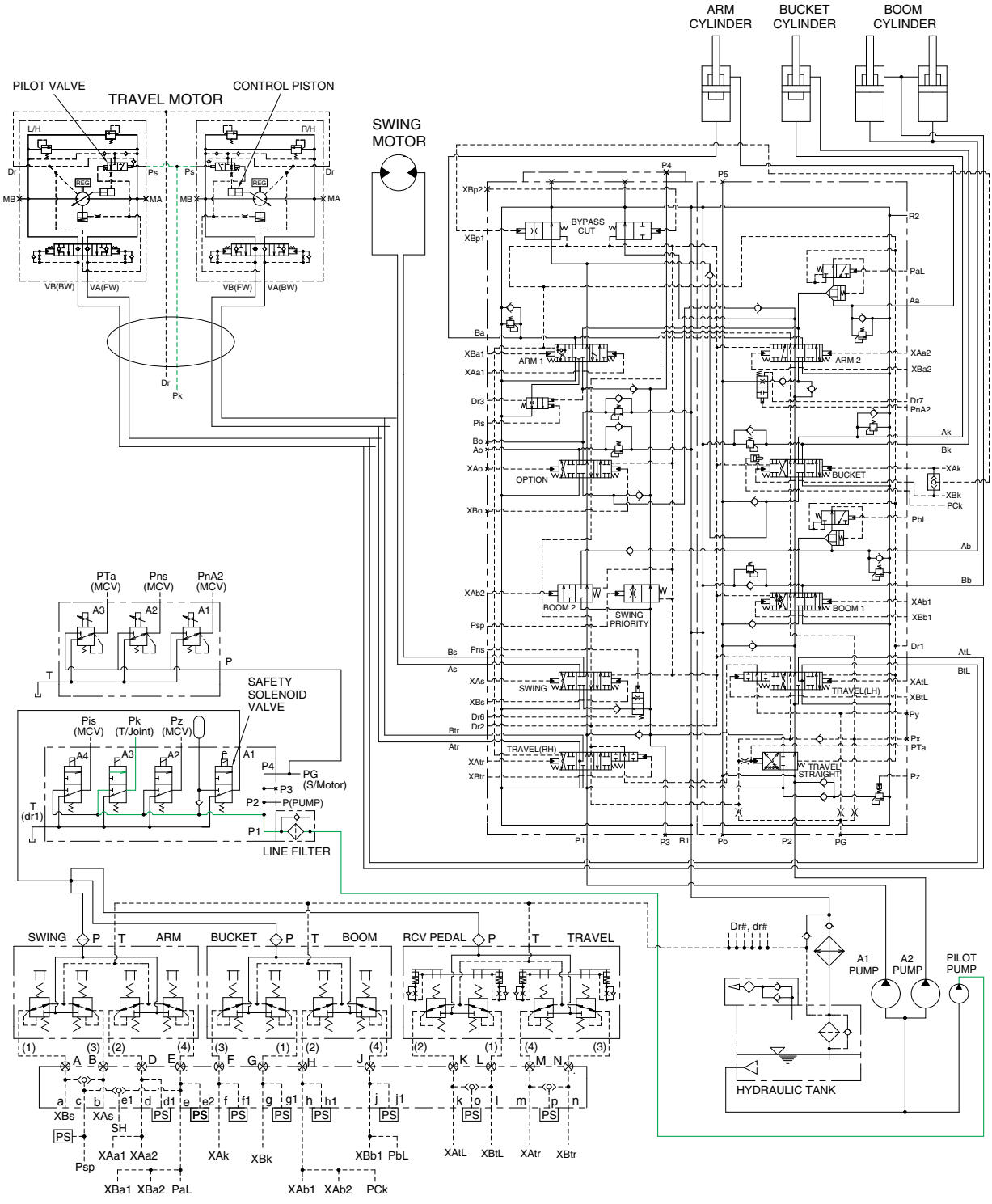
The pilot oil from pilot pump flow into **PnA2** port in main control valve through boom priority (vs arm) EPPR valve. **PnA2** oil pressure moves the arm 2 logic control valve to up position and the oil flow rate to the arm cylinder decreased.

Then, the boom up speed is increased. This is called the boom priority system (boom/arm balance).

The boom/arm balance can be adjusted by the cluster. Refer to page 5-91.

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

5. TRAVEL SPEED CONTROL SYSTEM

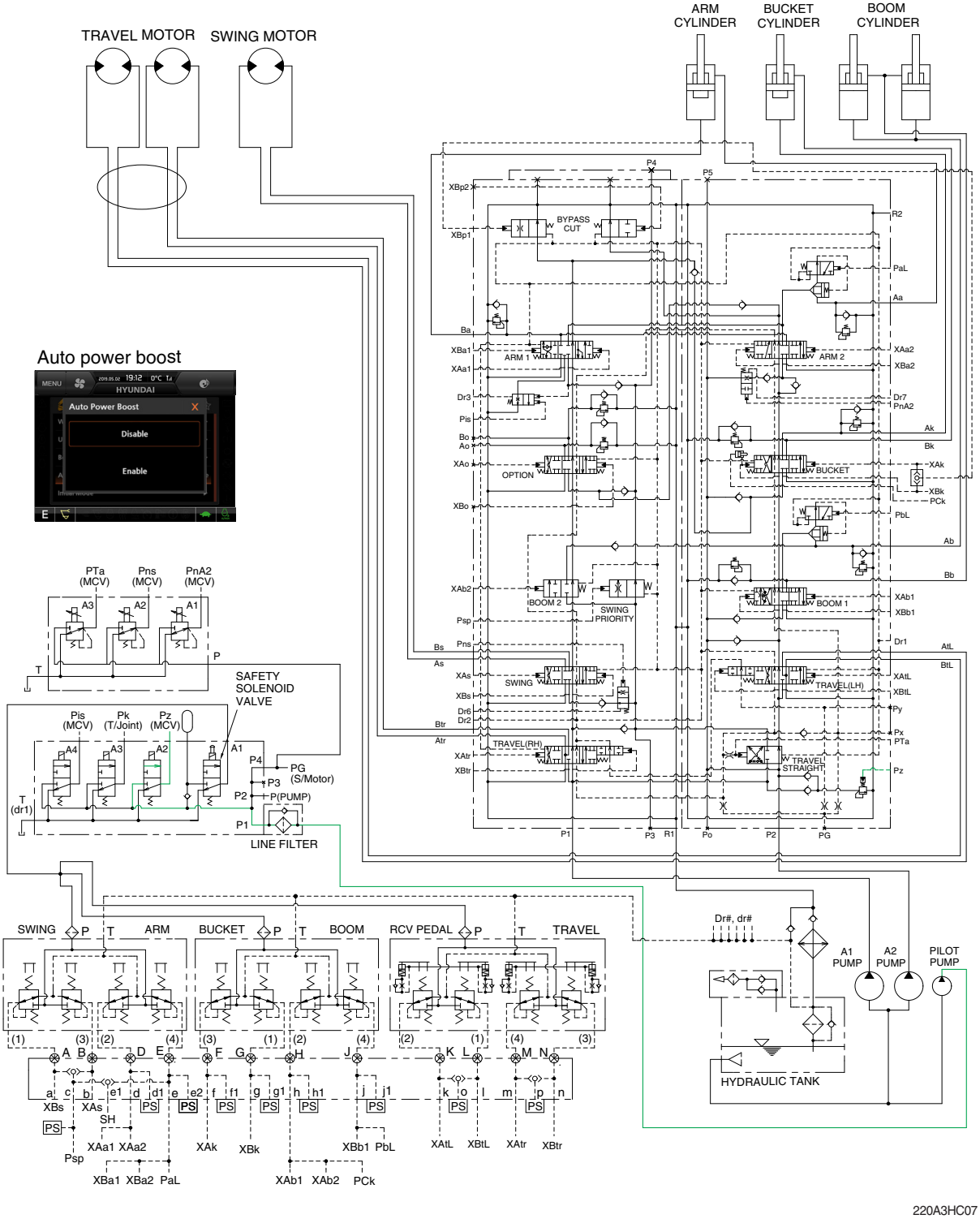


When the travel speed solenoid valve was placed in the Hi position, the pressure oil from pilot pump through line filter flows to port **Ps** of travel speed change over valve, and the control piston are pushed left and right, thus minimizing the displacement.

When the travel speed solenoid valve was placed in the Lo position, the oil of **Ps** 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.

6. MAIN RELIEF PRESSURE CHANGE SYSTEM



220A3HC07

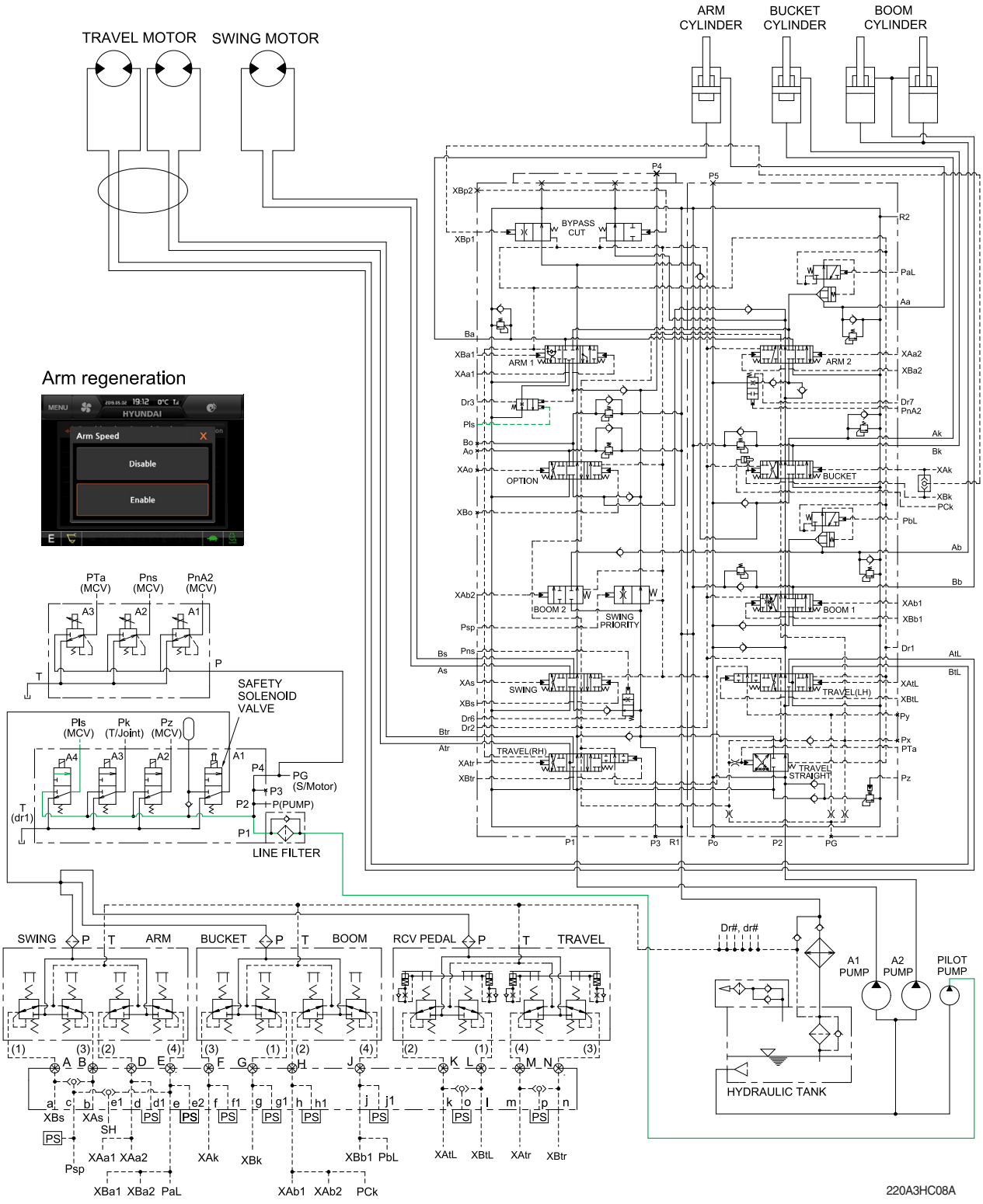
When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into **Pz** port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 350 kgf/cm² (4980 psi) to 380 kgf/cm² (5400 psi) for increasing the digging power.

And even when pressed switch continuously, it is canceled after 8 seconds.

When the auto power boost function is selected to enable on the cluster, the pressure of the main relief pressure is automatically increased to 380 kgf/cm² (5400 psi) as working condition by the MCU. It is operated max 8 seconds.

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

7. ARM REGENERATION CUT SYSTEM



When the arm regeneration is selected to disable on the cluster, the arm regeneration solenoid valve is activated. The pilot oil from pilot pump flow into **Pis** port in main control valve through solenoid valve and the arm regeneration spool is shifted to left.

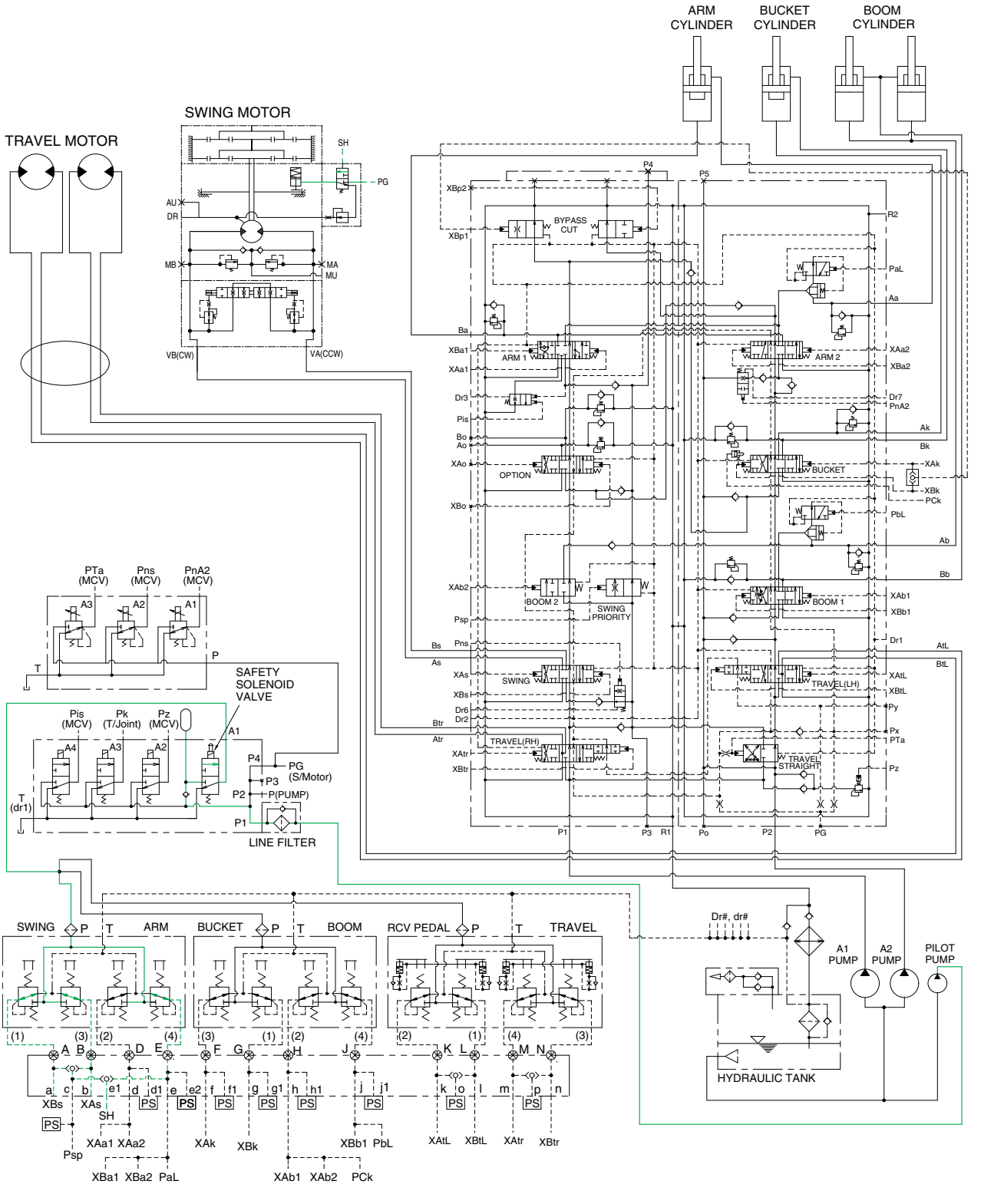
Then, the oil from arm regeneration passage returns to tank and the arm regeneration function is deactivated.

When the arm regeneration is selected to enable on the cluster, the arm regeneration function is activated and arm in operation speed is increased.

Refer to page 2-33 for the arm regeneration function.

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

8. SWING PARKING BRAKE RELEASE



220A3HC09

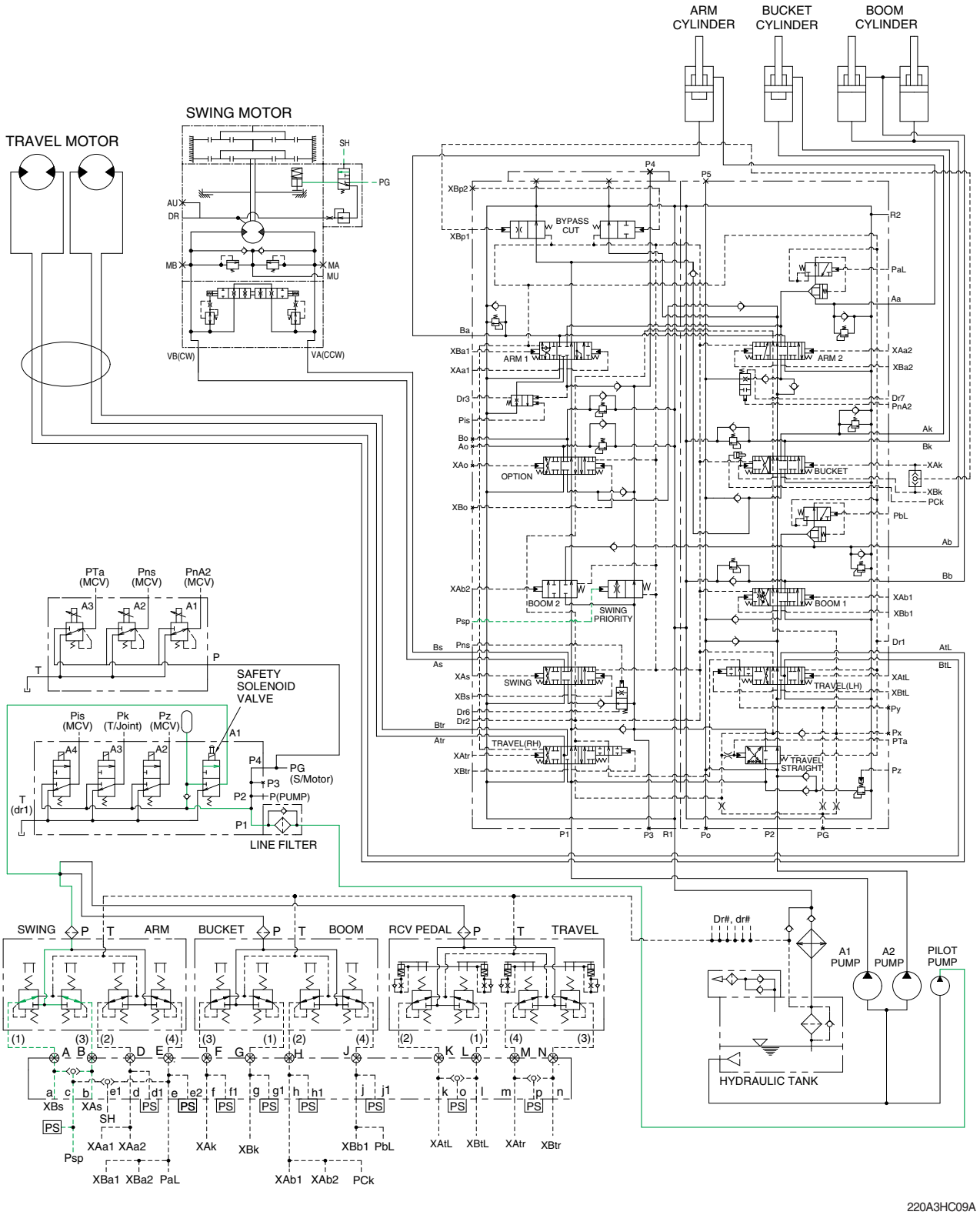
When the swing control lever or arm in lever is tilted, the pilot oil flows into SH port through shuttle valve.

This pressure moves spool of the swing brake valve so, discharged oil from pilot pump 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.

9. SWING PRIORITY SYSTEM



220A3HC09A

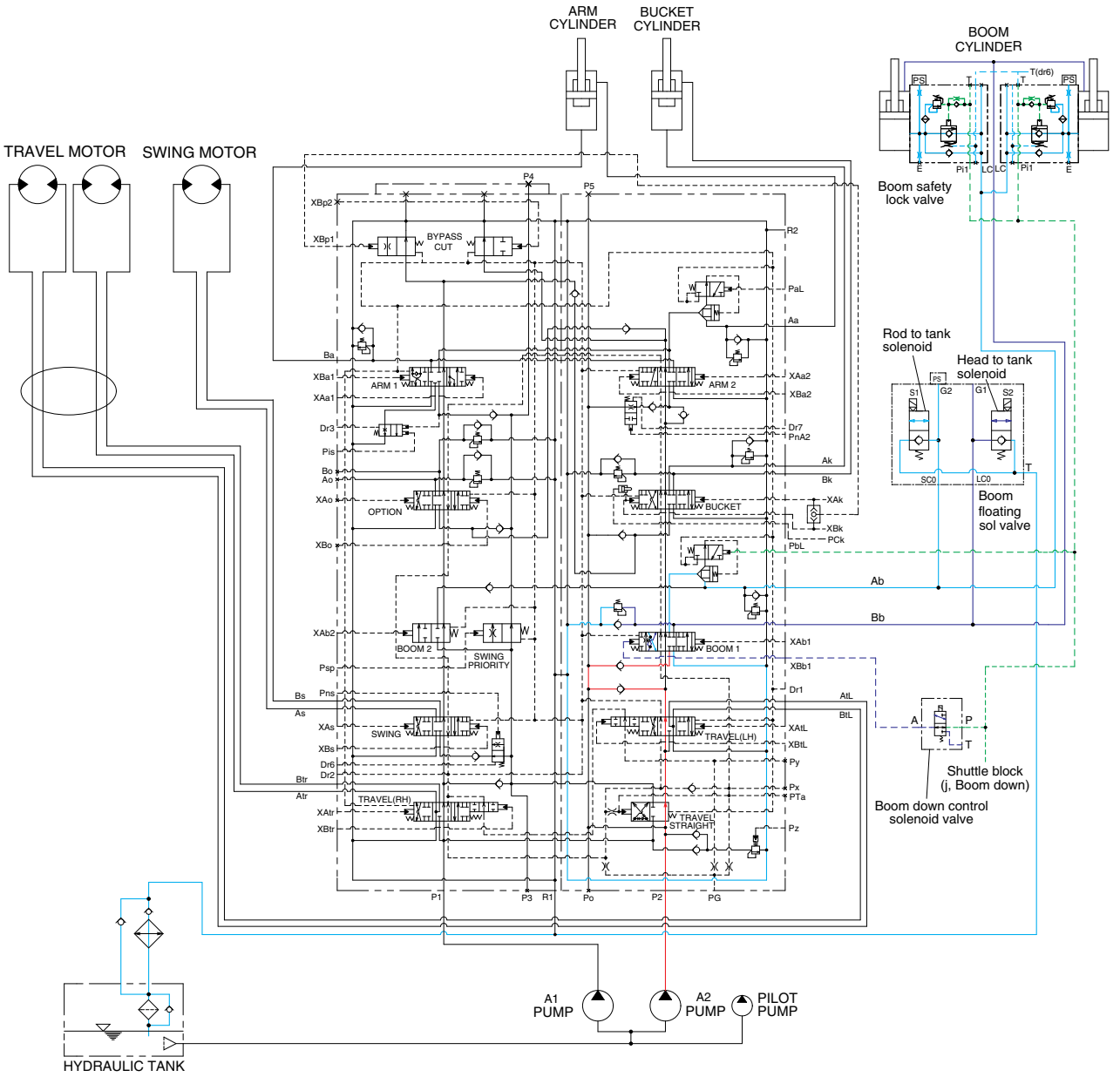
When carrying out the combined operation of swing and arm of the left control valve, the swing speed can be lowered than operating speed of arm.

Psp pressure from the swing shuttle block change the swing priority spool and decreases the oil flow rate to the next section to make the swing operation most preferential.

This is called the swing priority system. For details, refer to page 2-39.

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

10. BOOM FLOATING SYSTEM



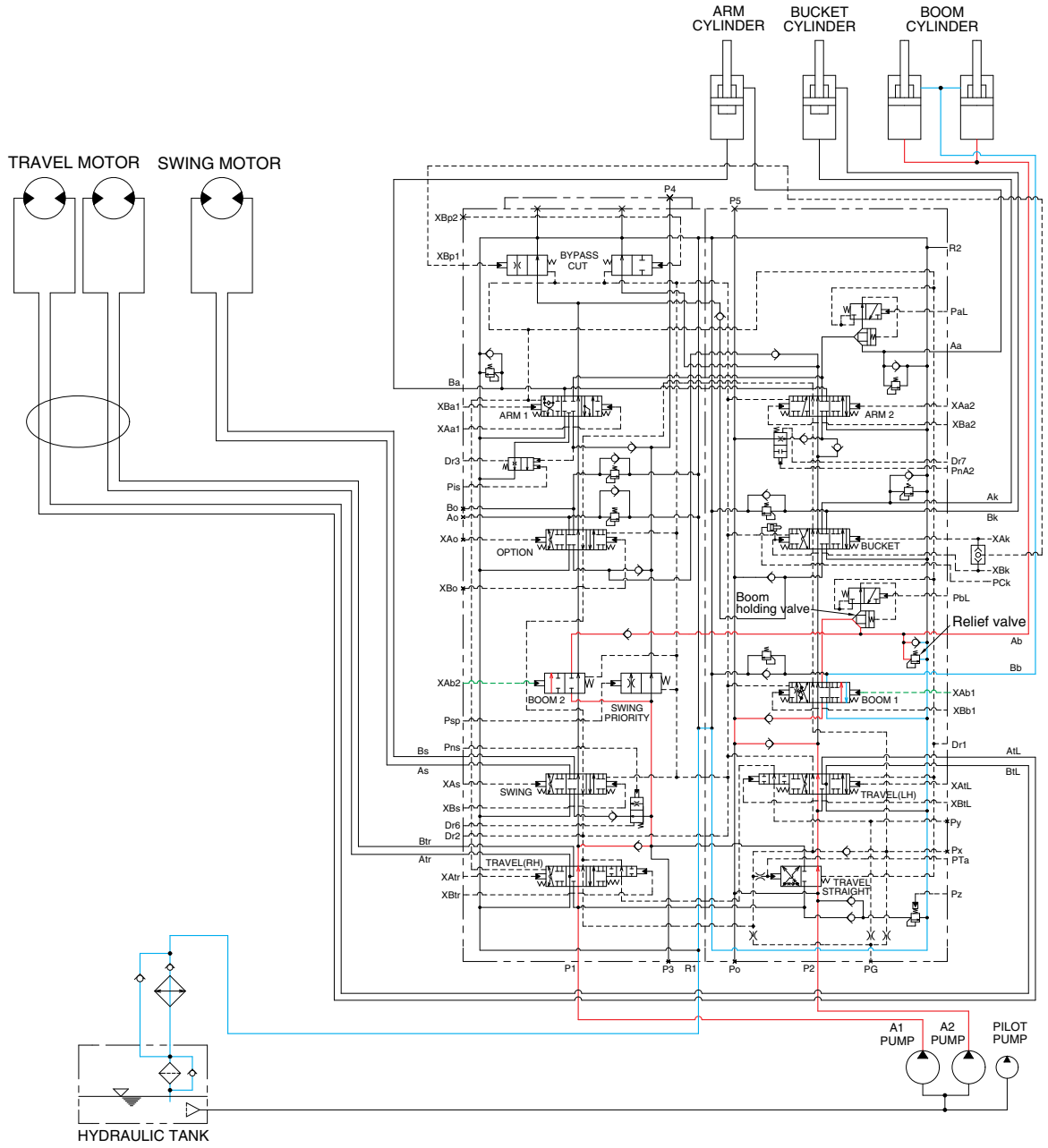
220A3HC30

Smooth and convenient boom movement is accomplished by only arm control lever operation.
The boom floating solenoid values are equipped in the rod and head of boom cylinder that are controlled to act as floating mode.
"Rod to tank solenoid" and "Head to tank solenoid" are active. So the hydraulic oil of rod and head goes to tank, and floating is accomplished. In the mode, boom down cut-off solenoid is active so that boom down pilot pressure is cut.
For more details, refer to page 5-13.

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

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



220A3HC10

When the right 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.

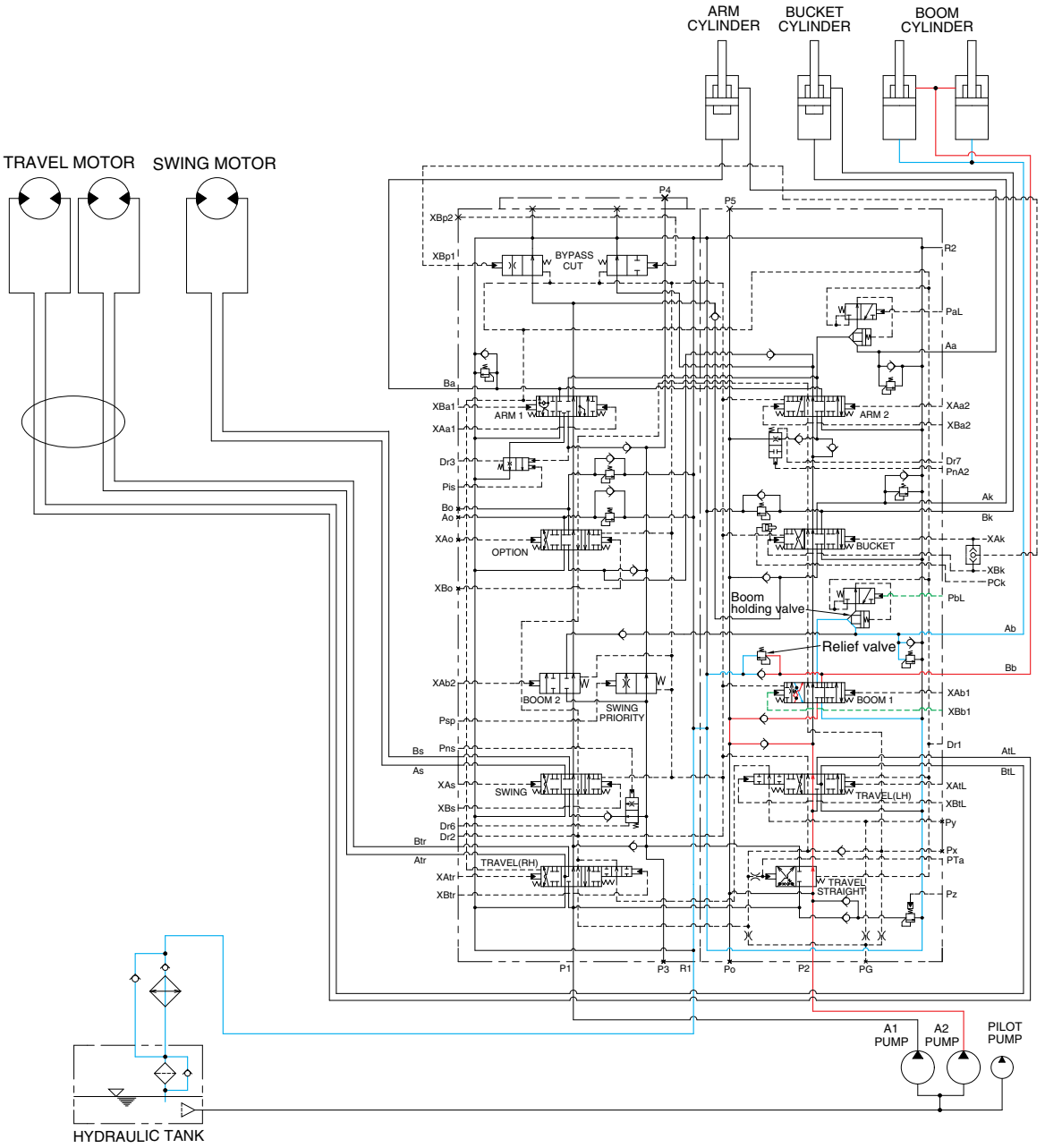
The excessive pressure in the boom cylinder head side is prevented by relief valve.

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

This prevents the hydraulic drift of boom cylinder.

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

2. BOOM DOWN OPERATION



When the right 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) from the remote control valve.

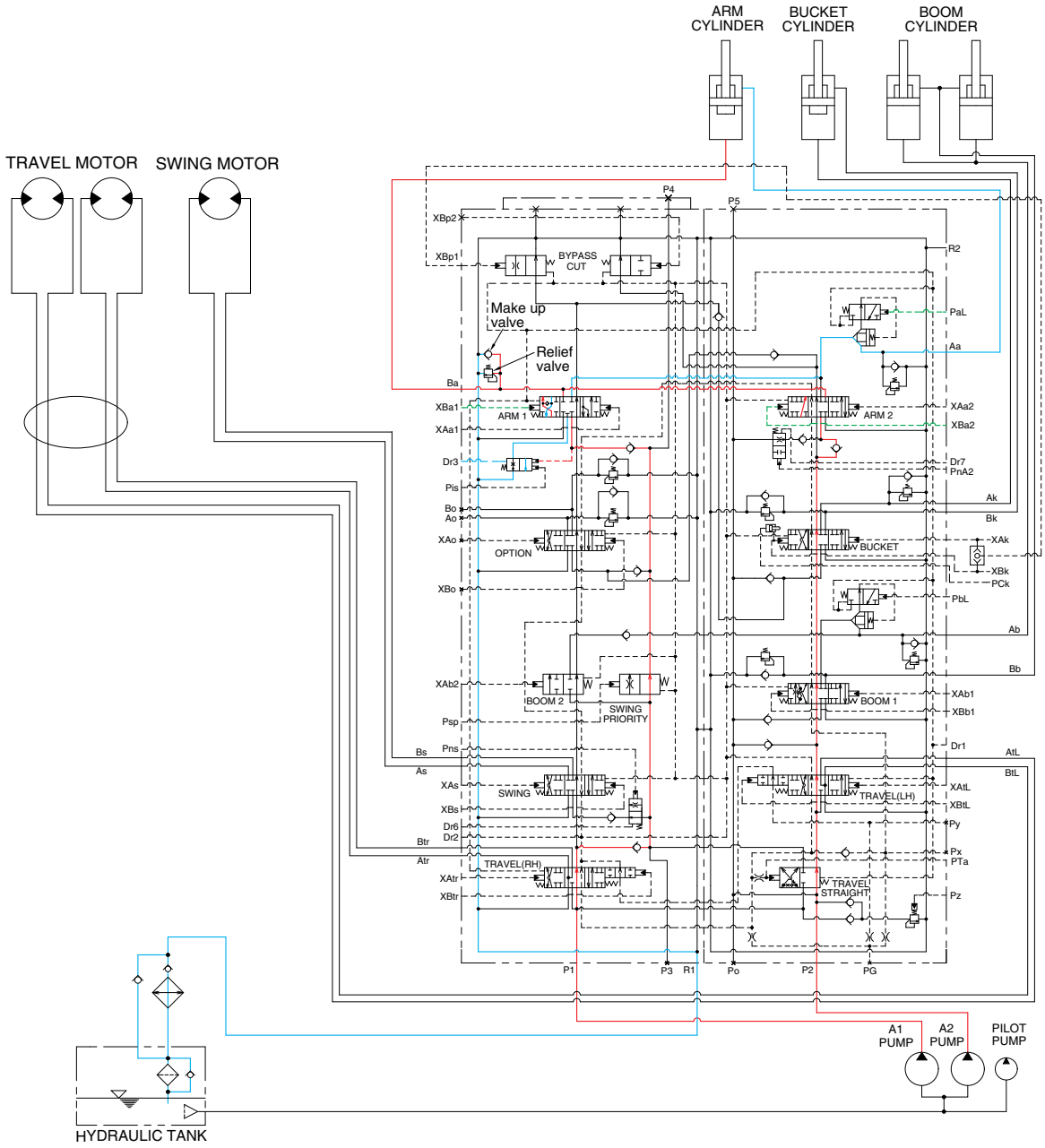
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom spool in the main control valve.

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

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 side is prevented by the relief valve.

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

3. ARM IN OPERATION



220A3HC12

When the left control lever is pulled back, the arm spools in the main control valve are moved to the 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.

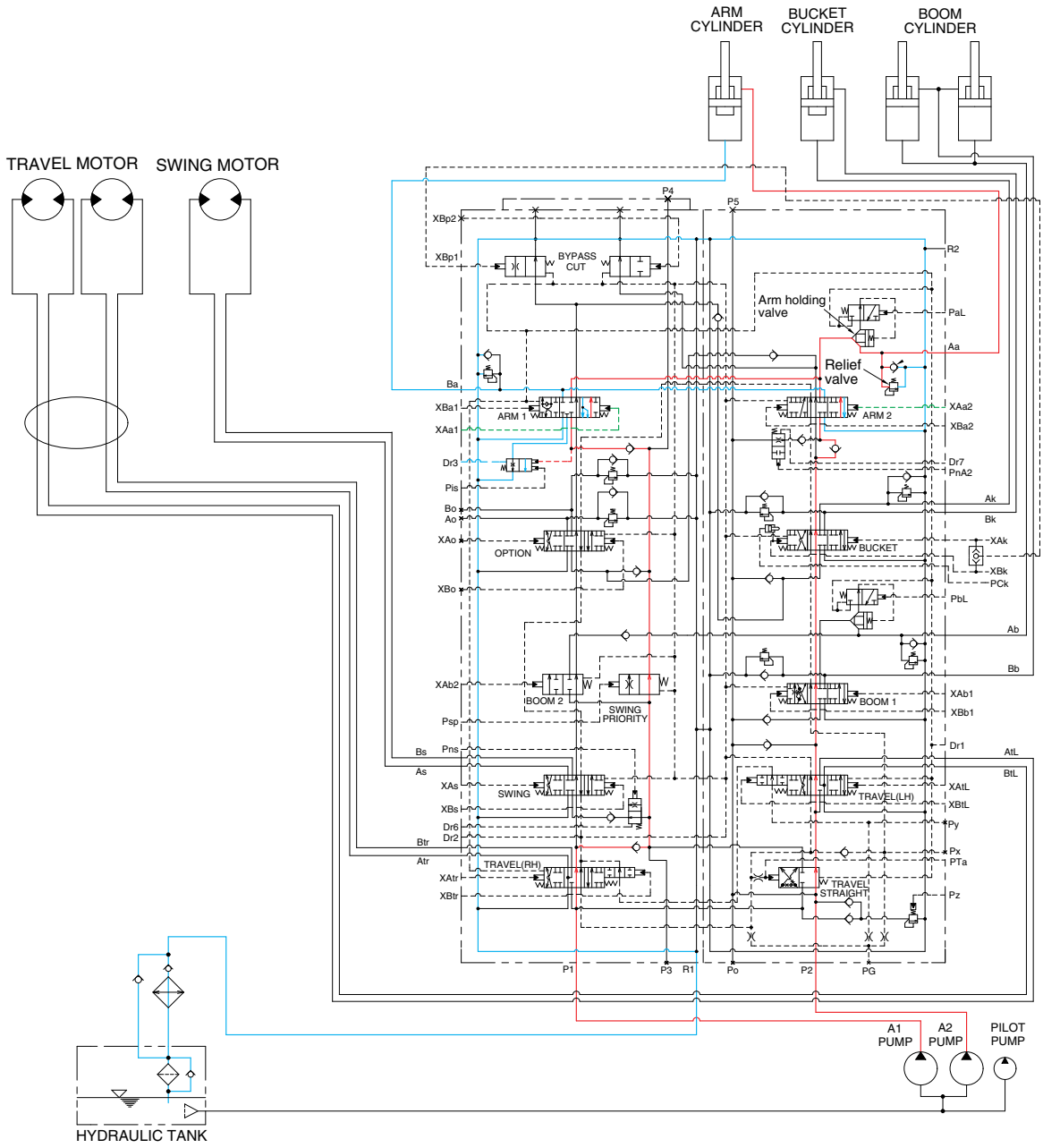
At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 1 spool in the main control valve. When this happens, the arm rolls in.

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



220A3HC13

When the left 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.

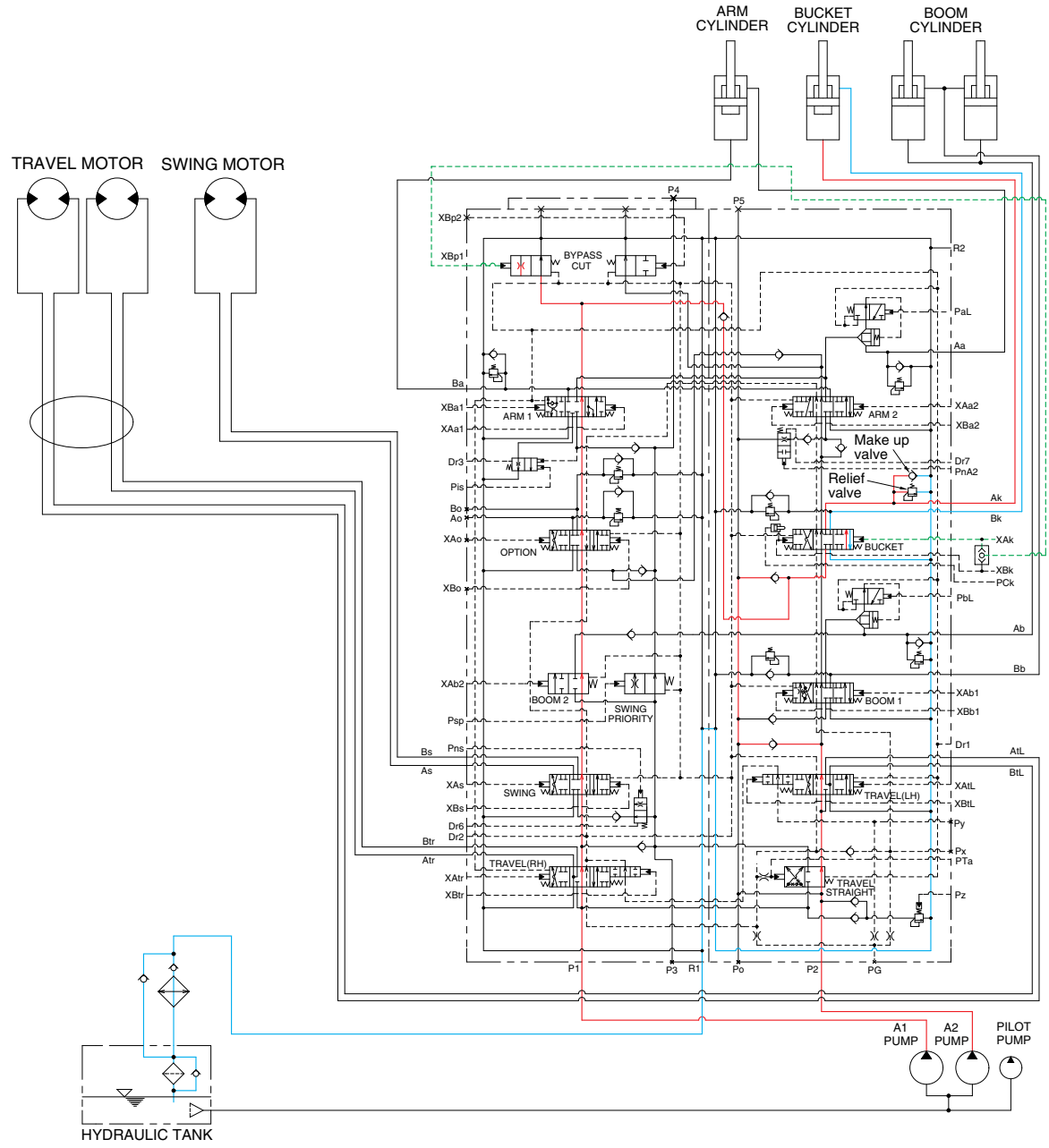
The excessive pressure in the arm cylinder rod side is prevented by relief valve.

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



220A3HC14

When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure (XAk) 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 (XBp1).

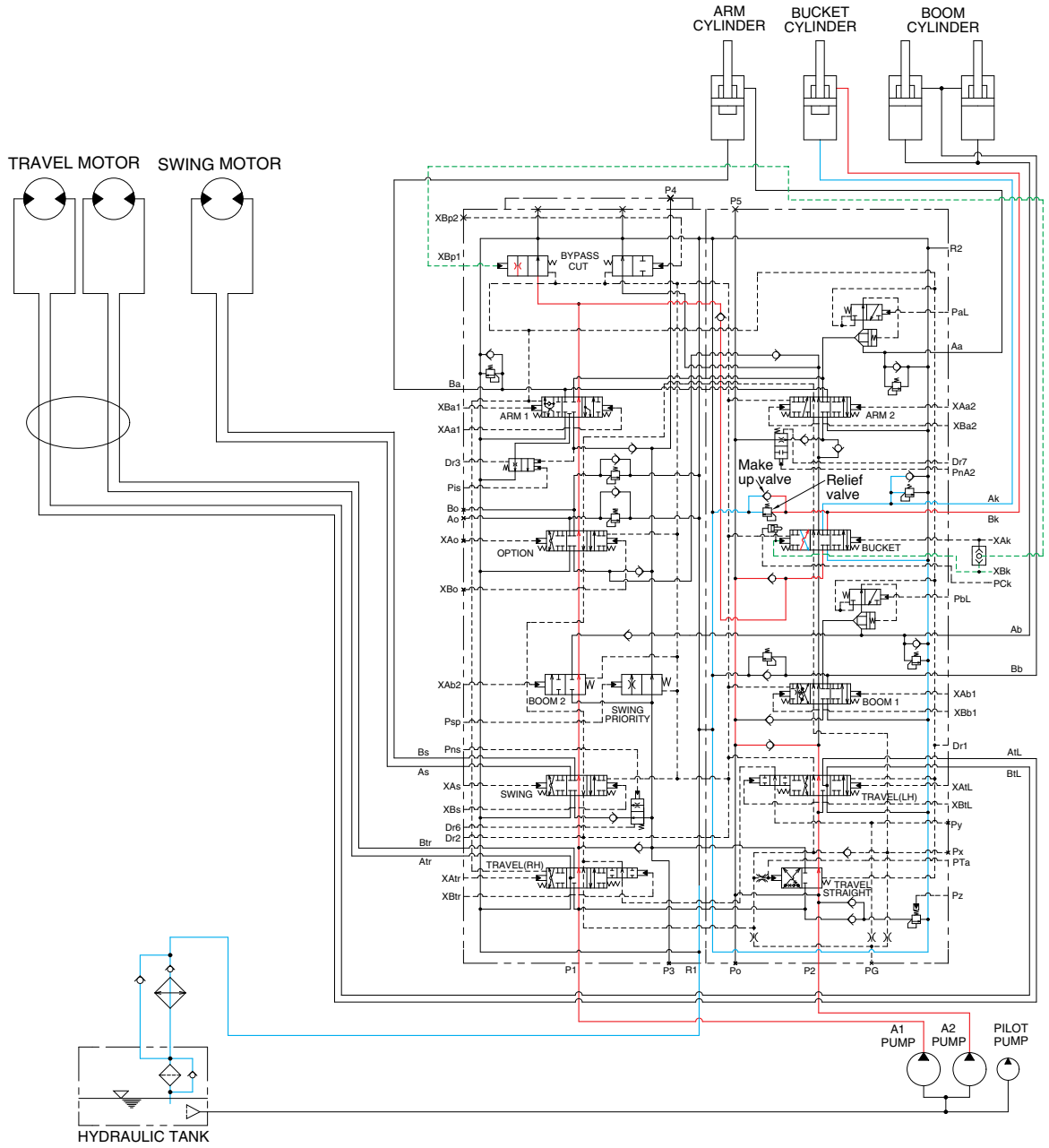
At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls in.

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



220A3HC15

When the right control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure (XBk) 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 (XBp1).

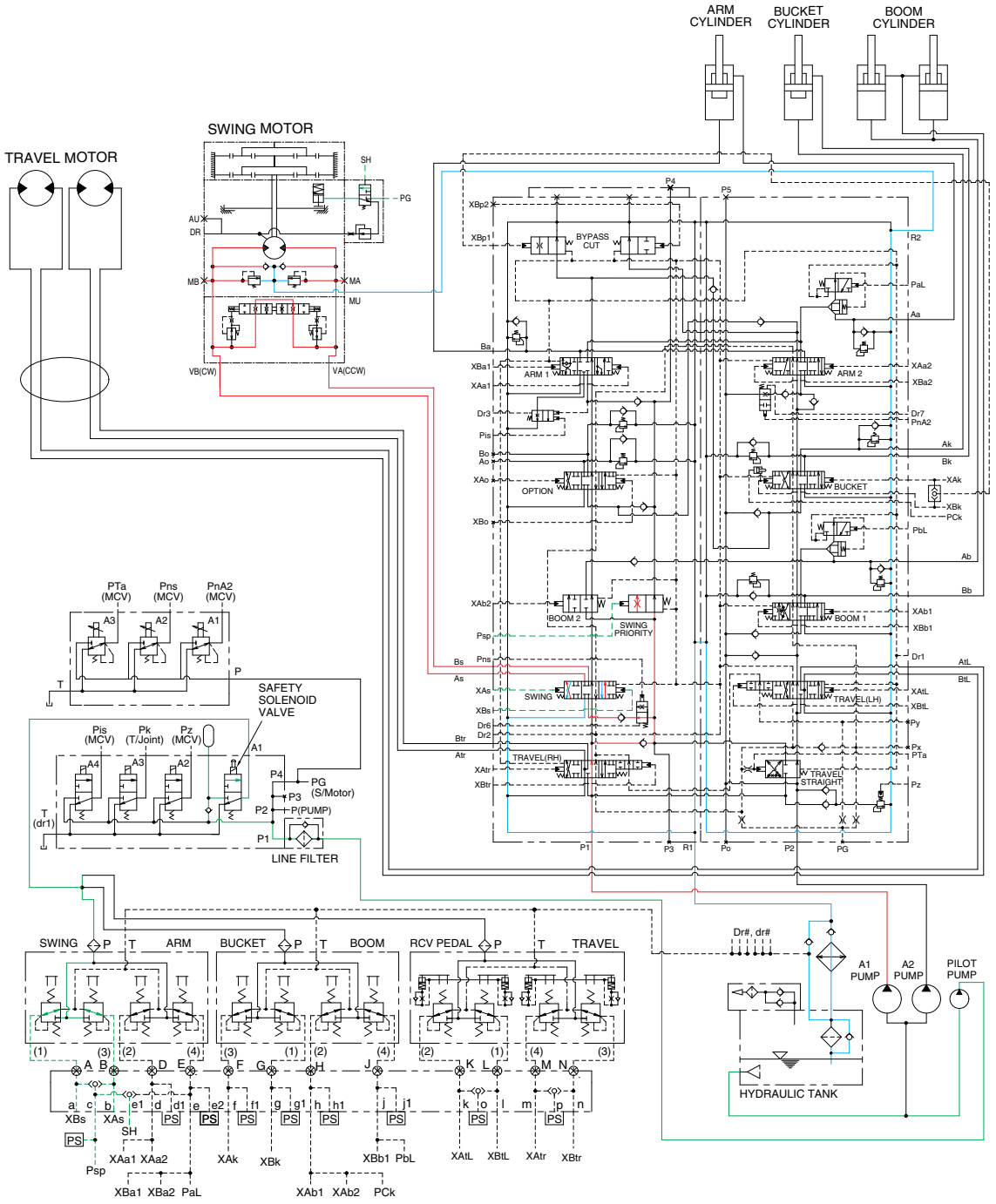
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.

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

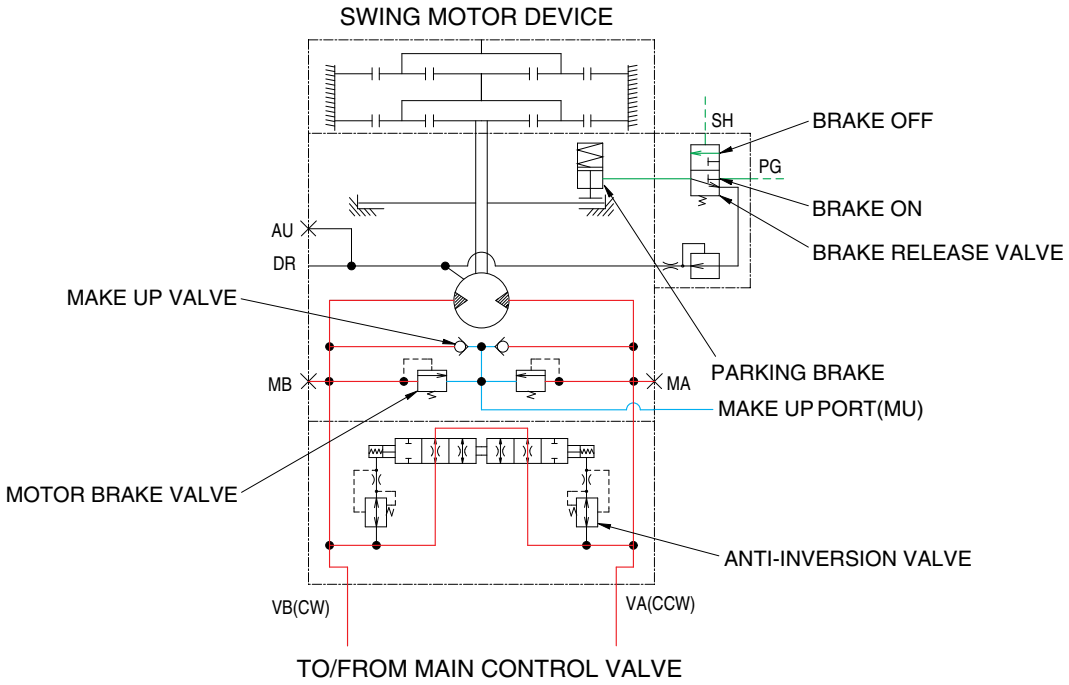


220A3HC16

When the left control lever is pushed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure (XAs or XBs) from the remote control valve.
Also the swing operation preference function is operated by the pilot pressure PCsp (refer to page 2-39).
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.

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

SWING CIRCUIT OPERATION



220F3HC16A

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 to 265 kgf/cm^2 (3770 psi).

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 the swing control lever or arm in control lever is not operated.

PARKING BRAKE "OFF" OPERATION

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

When the the swing control lever or arm in control 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 the swing control lever and arm in control lever placed in the neutral position, the pressure of the pilot oil passage down.

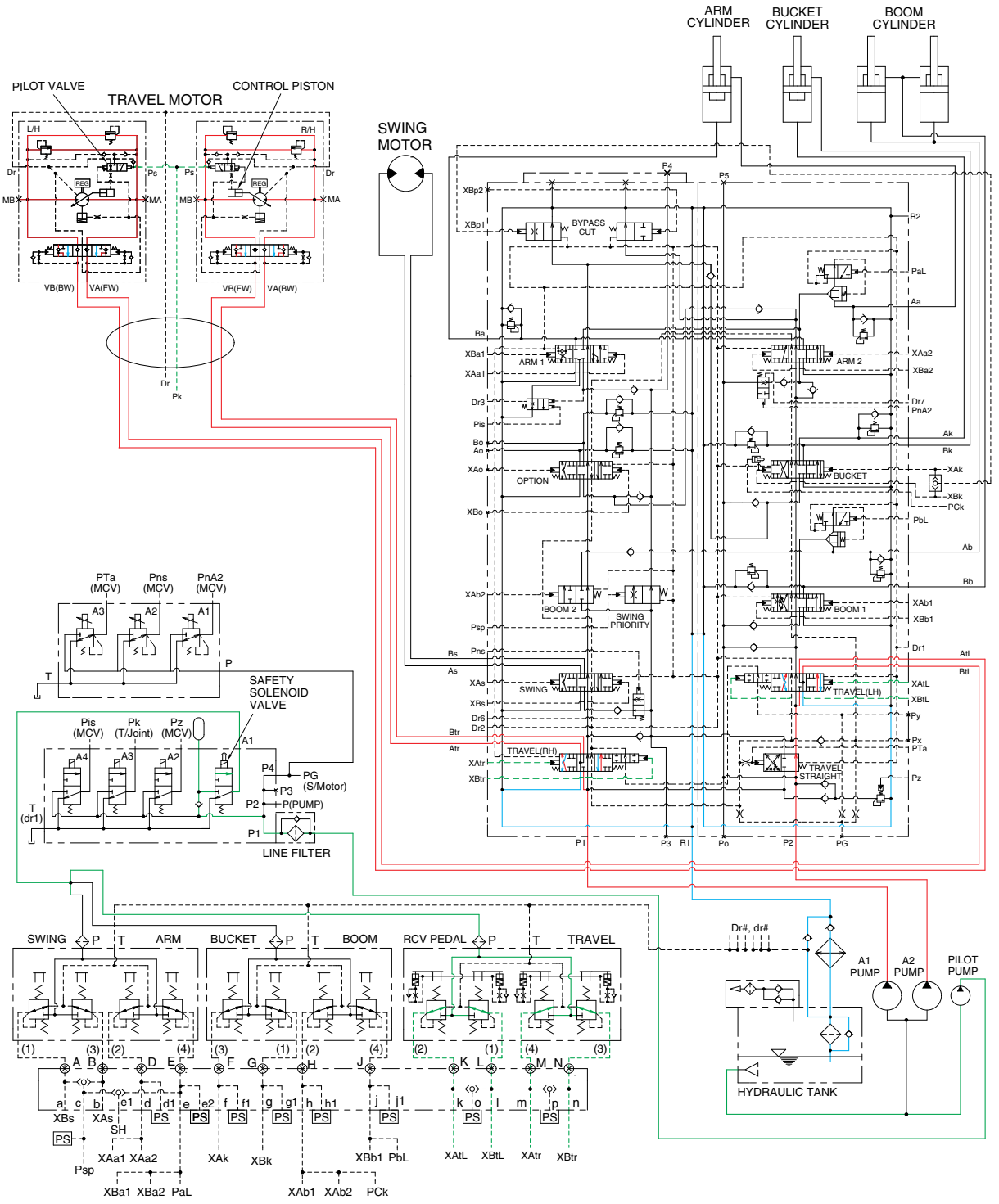
Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the tank. And the brake is set to "ON".

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.

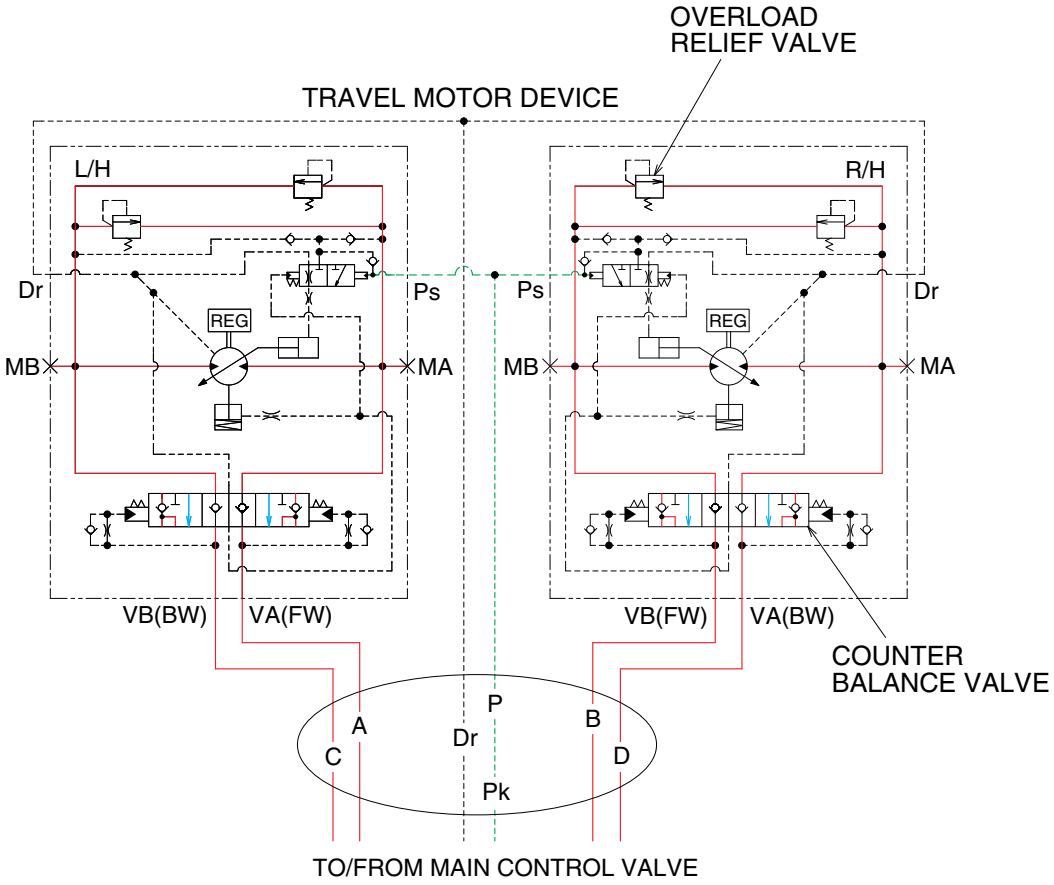
The oil from the each pump flows into the main control valve and then goes to the each travel motor through the turning joint.

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



220F3HC17A

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.

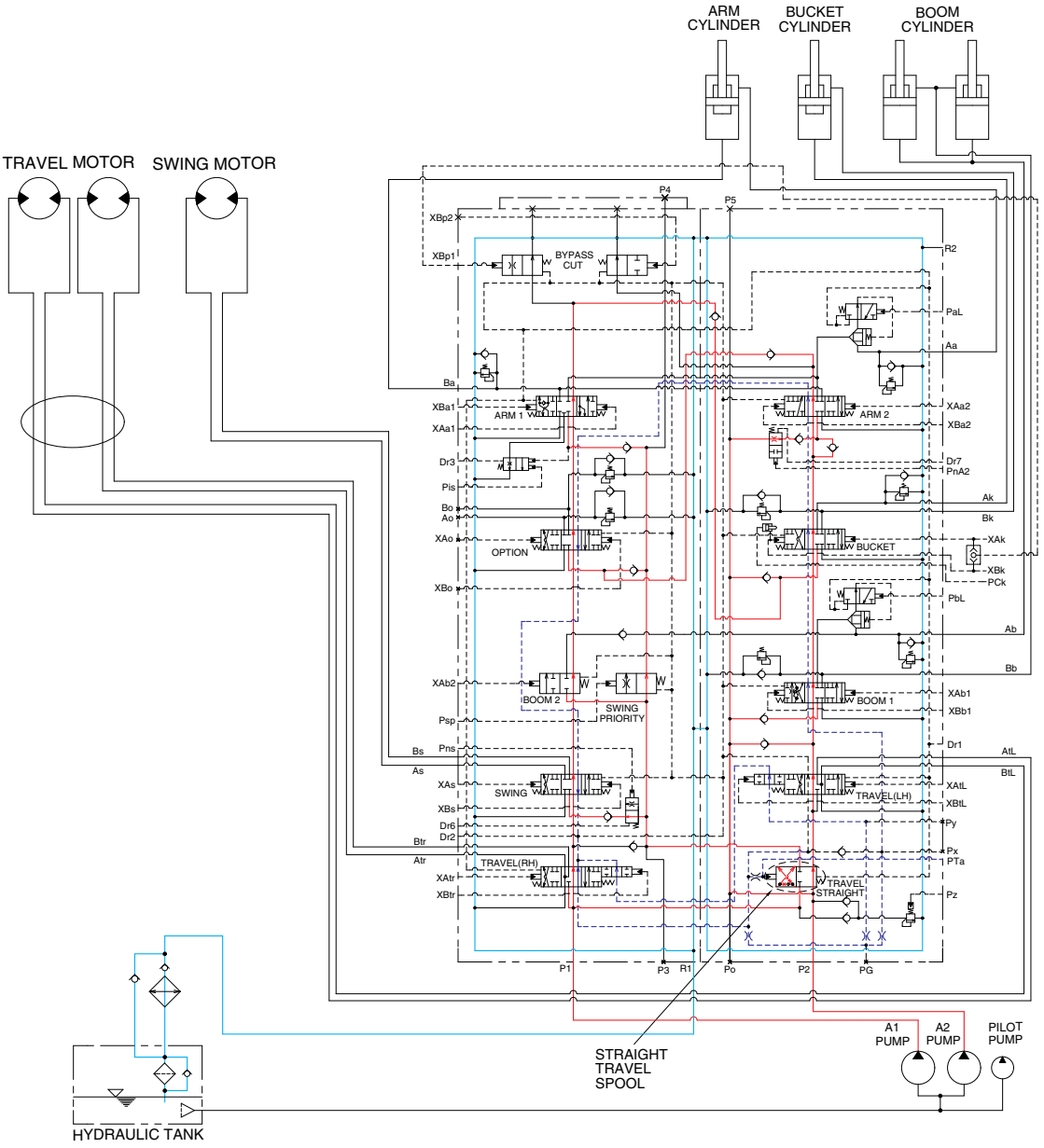
2) OVERLOAD RELIEF VALVE

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.

GROUP 5 COMBINED OPERATION

1. OUTLINE



220A3HC20

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

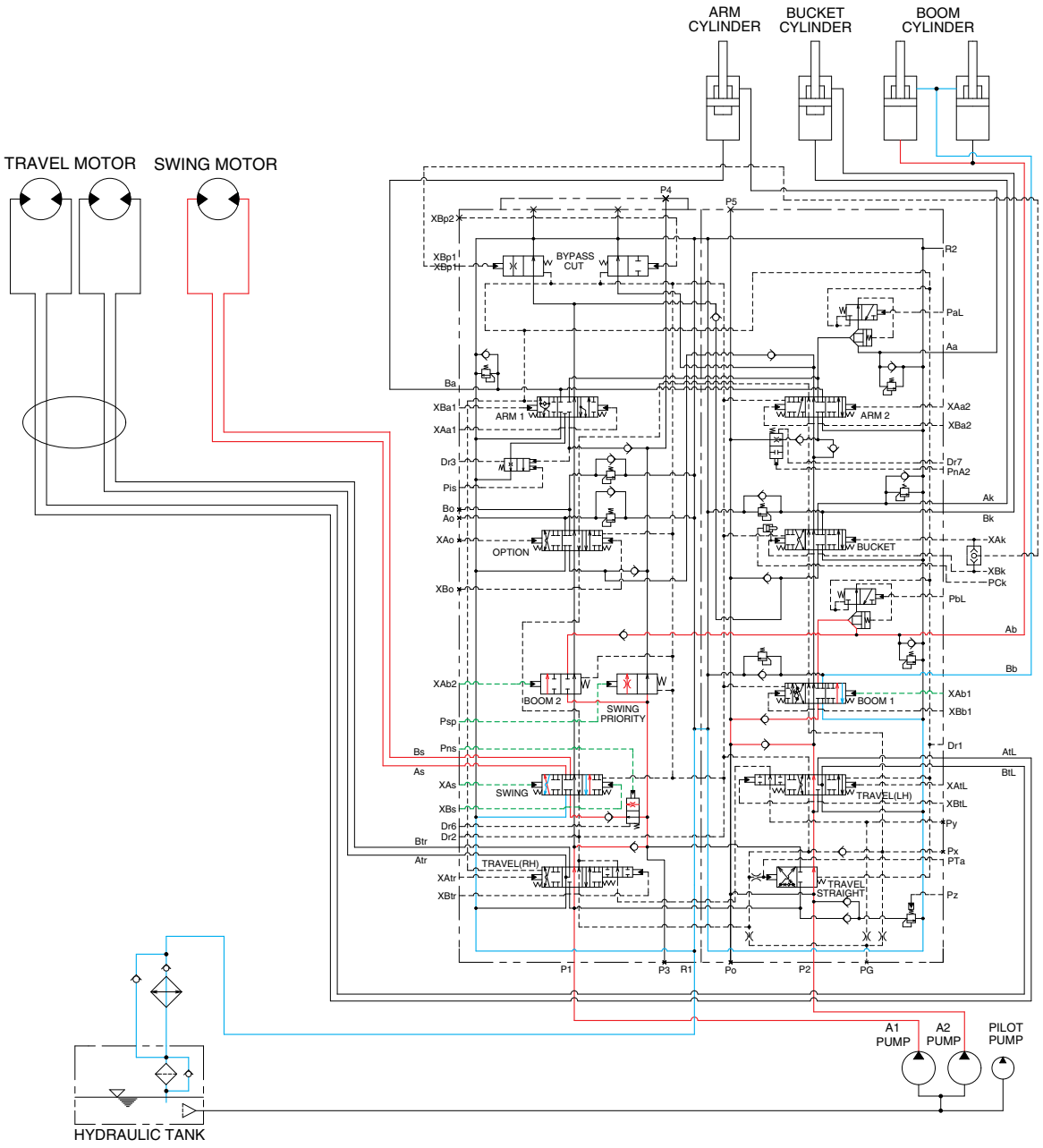
This straight travel spool for straight travel is provided in the main control valve.

If any actuator is operated when traveling, the straight travel spool is pushed to the right by the pilot oil pressure (PTa).

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



220A3HC21

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 (XAb1, XAs, XBs) from the remote control valve.

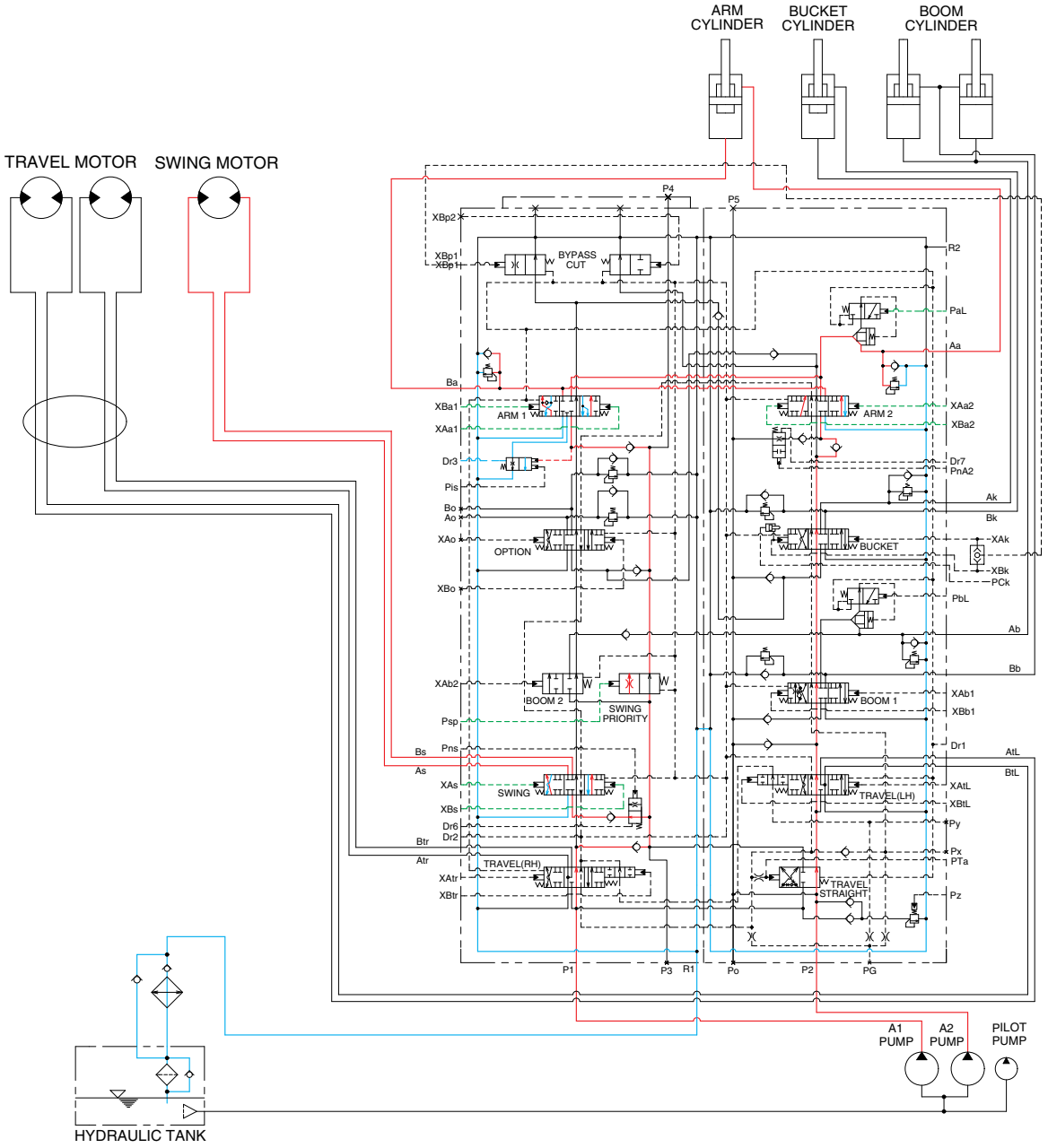
The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

The oil from the A2 pump flows into the boom cylinders through the boom 1 spool in the right control valve. The upper structure swings and the boom is operated.

Refer to page 3-10 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



220A3HC22

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, XBa1, XAa2, XBa2) from the remote control valve.

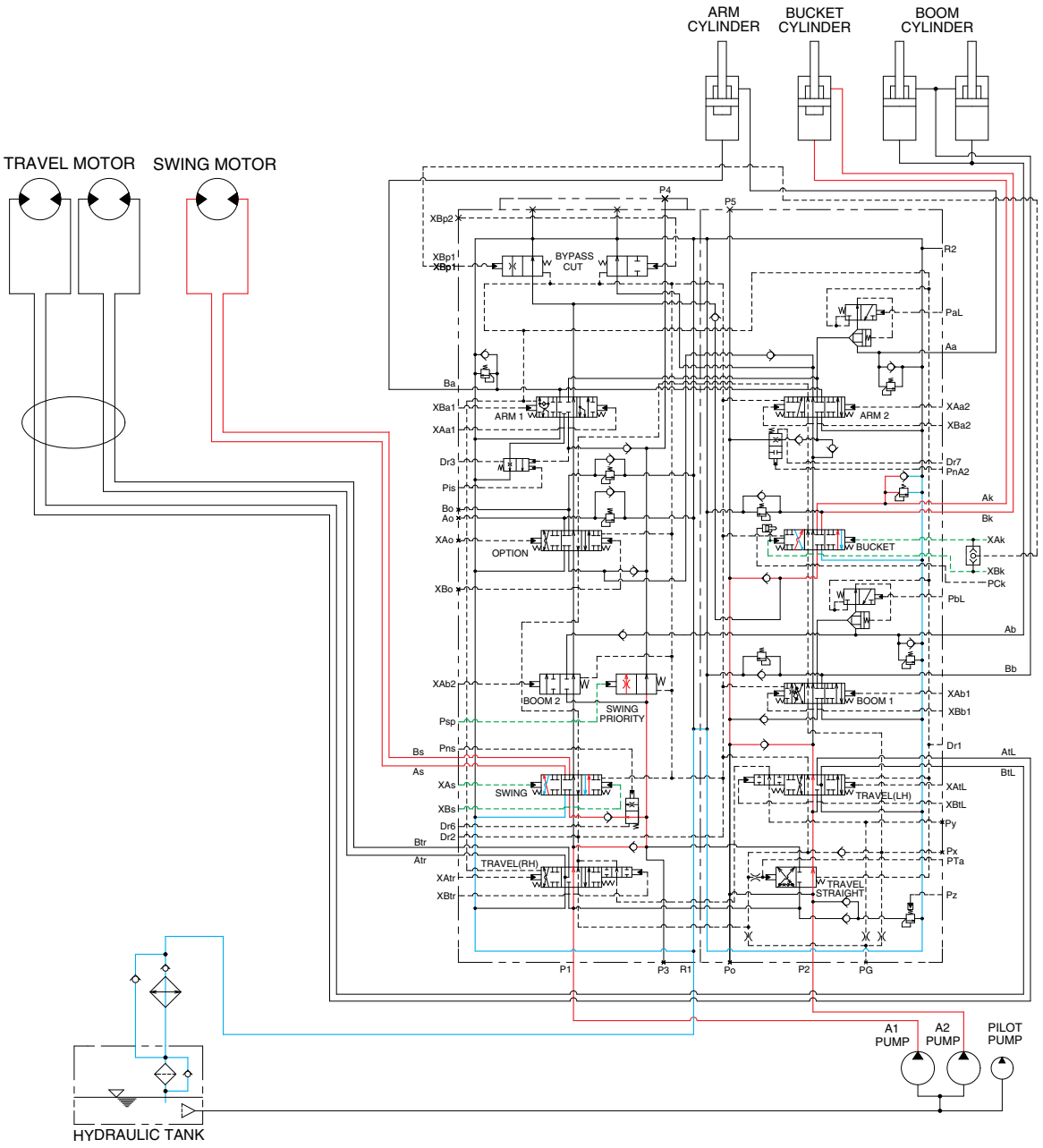
The oil from the A1 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

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

Refer to page 2-39 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



220A3HC23

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, XAk,XBk) from the remote control valve.

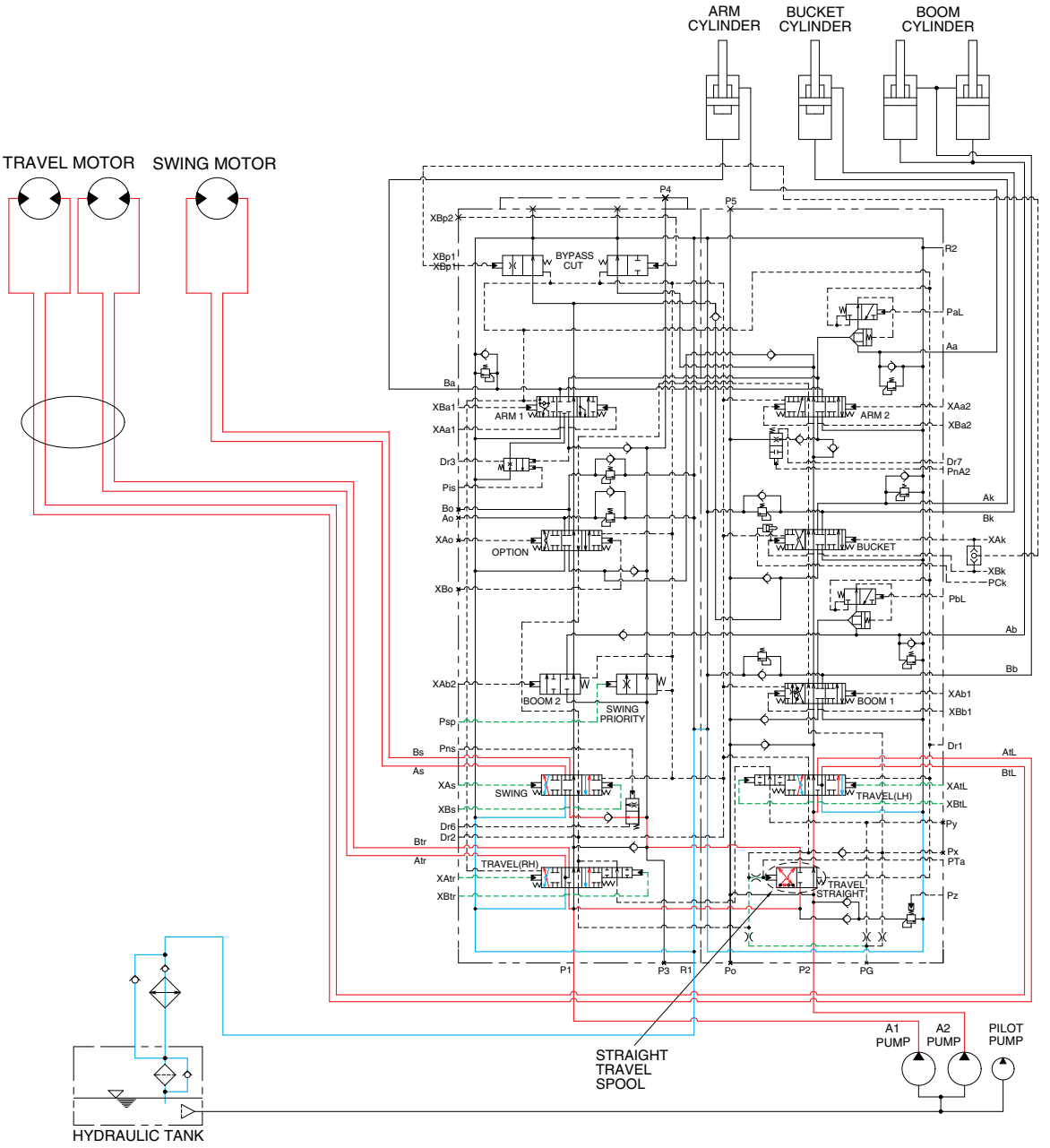
The oil from the A1 pump flows into the swing motor through the swing spool in the left control valve.

The oil from the A2 pump flows into the bucket cylinder through the bucket spool in the right 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



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 (PG) from the pilot pump.

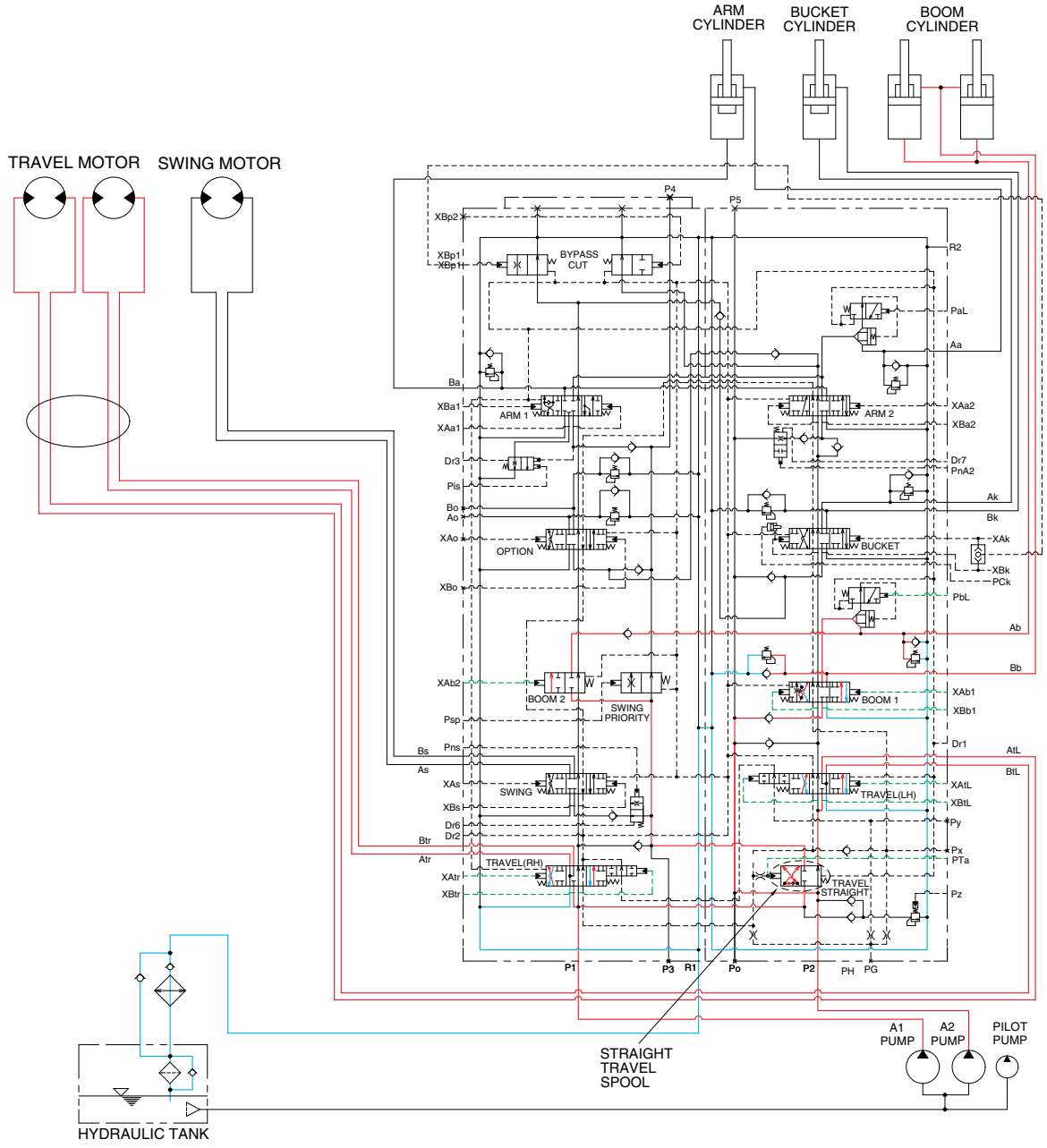
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the swing motor through the swing spool and travel motor through the LH travel spool via the check valve and orifice in the straight travel spool.

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



220A3HC25

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 (XAb1, XBb1, XBb2, XAtr, XBtr, XAtL, XBtL) from the remote control valve and the straight travel spool is pushed to the right by the oil pressure (PG) from pilot pump.

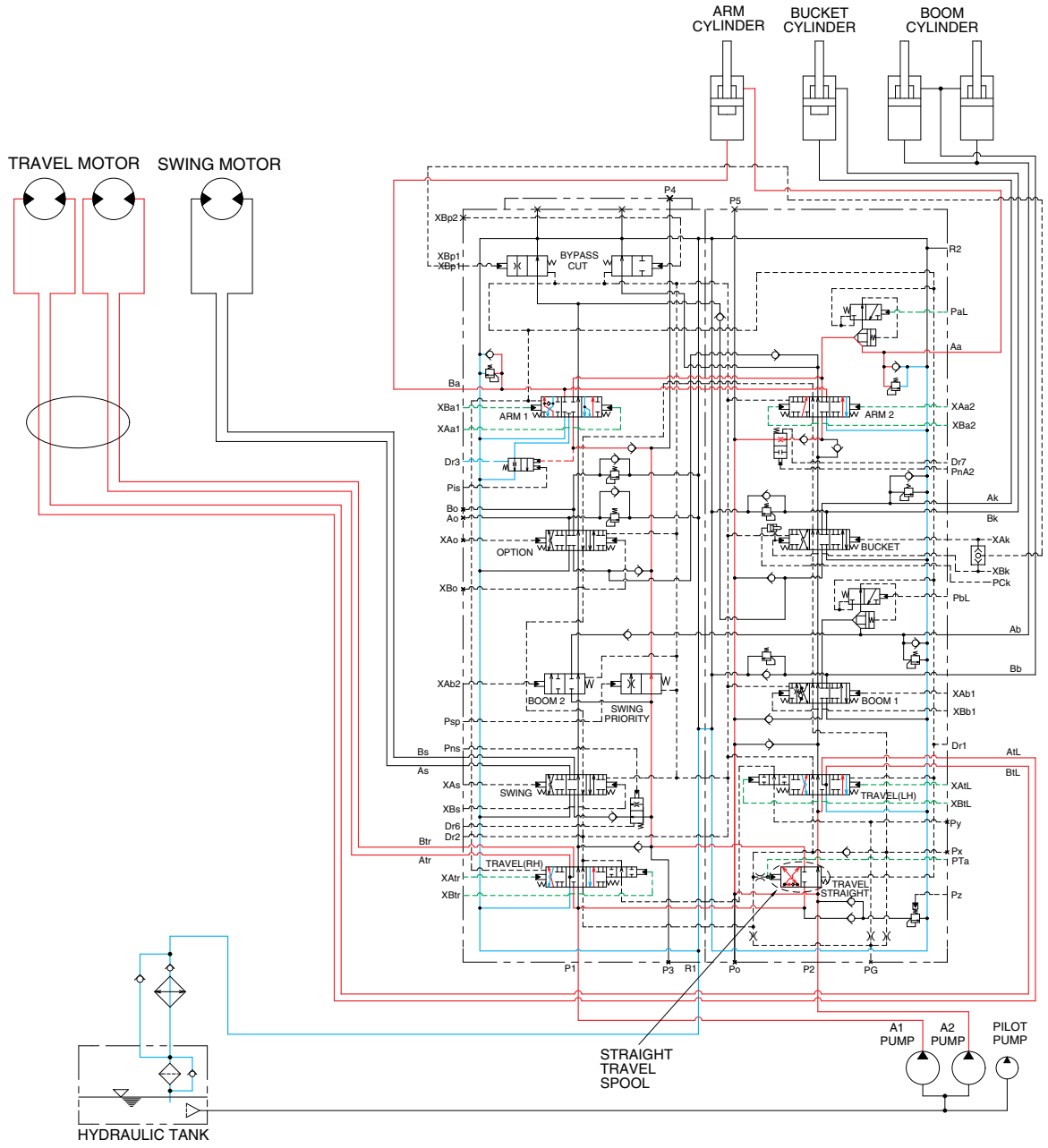
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

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. Also, the oil from the A2 pump flows into the travel motors through the LH travel spool via the check valve and orifice in the straight travel spool.

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



220A3HC26

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 (XAa1, XBa1, XAa2, XBa2, XAtr, XBtr, XAtL, XBtL) from the remote control valve and the straight travel spool is pushed to the right by the oil pressure (PG) from pilot pump.

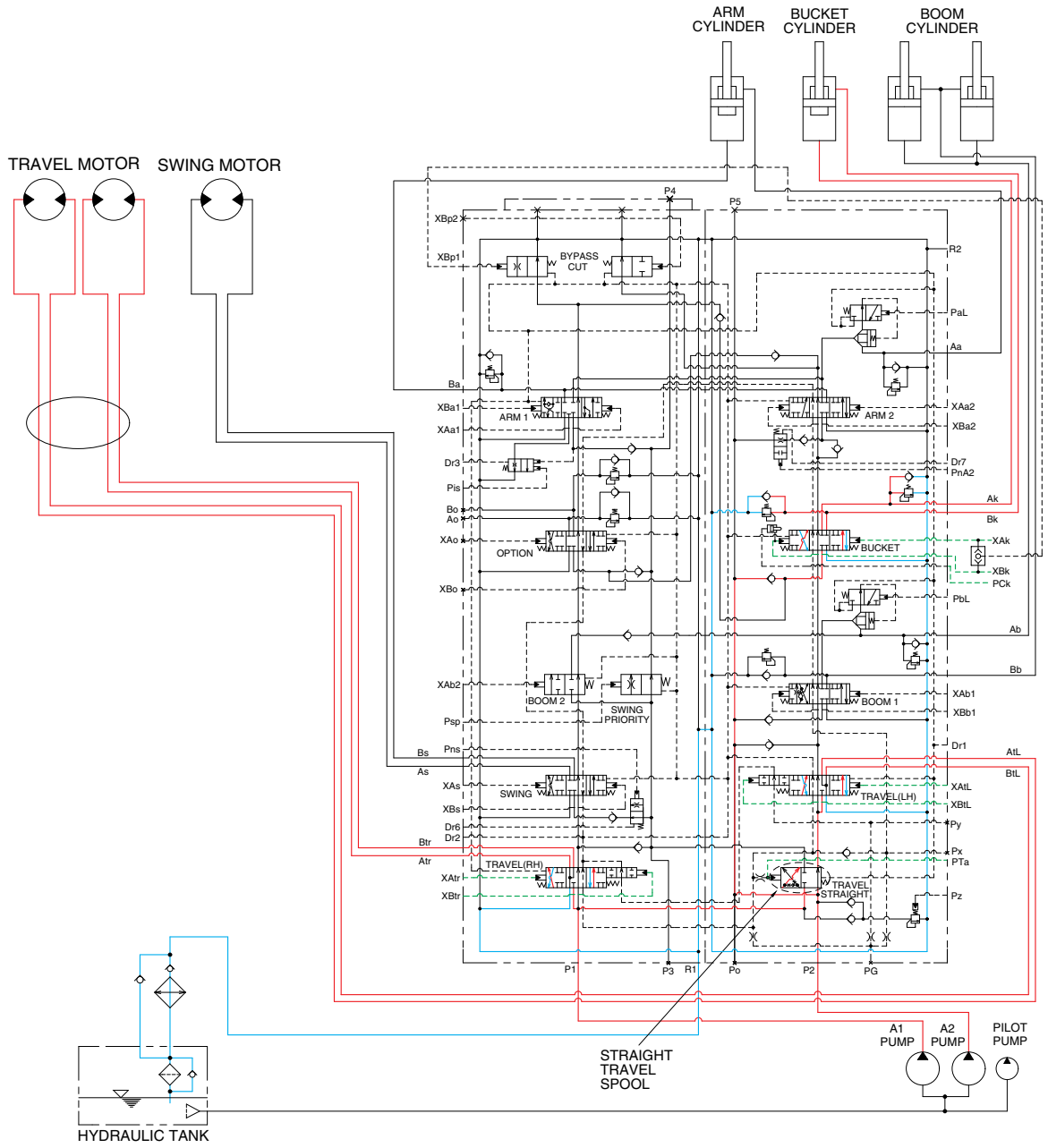
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the arm cylinders through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage. Also, the oil from the rear pump flows into the travel motors through the LH travel spool via the check valve and orifice in the straight travel spool.

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



220A3HC27

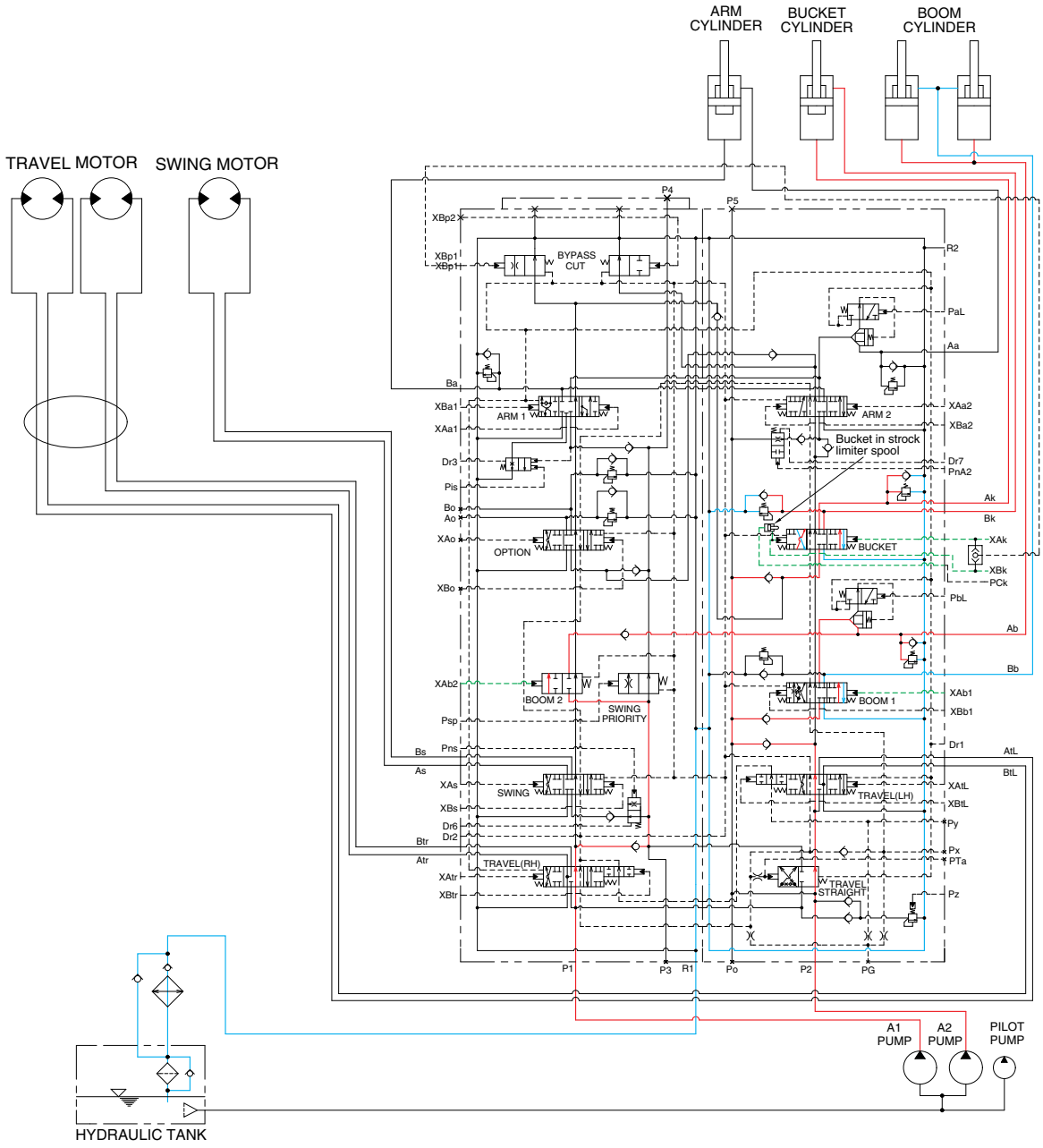
When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure (XAk, XBk, XAtr, XBtr, XAtL, XBtL) from the remote control valve, and the straight travel spool is pushed to the right by the oil pressure (PG) from pilot pump. The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve 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. Also, the oil from the A2 pump flows into the travel motors through the LH travel spool via the check valve and orifice in the straight travel spool.

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



220A3HC28

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 (XAk, XBk, XAb1, XAb2) from the remote control valve. Also, the boom up operation preference function is operated by the pilot pressure PCk (refer to page 2-36).

The oil from the A1 pump flows into the boom cylinders through the boom 2 spool in the left control valve. 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 right control valve.

The boom and bucket are operated.

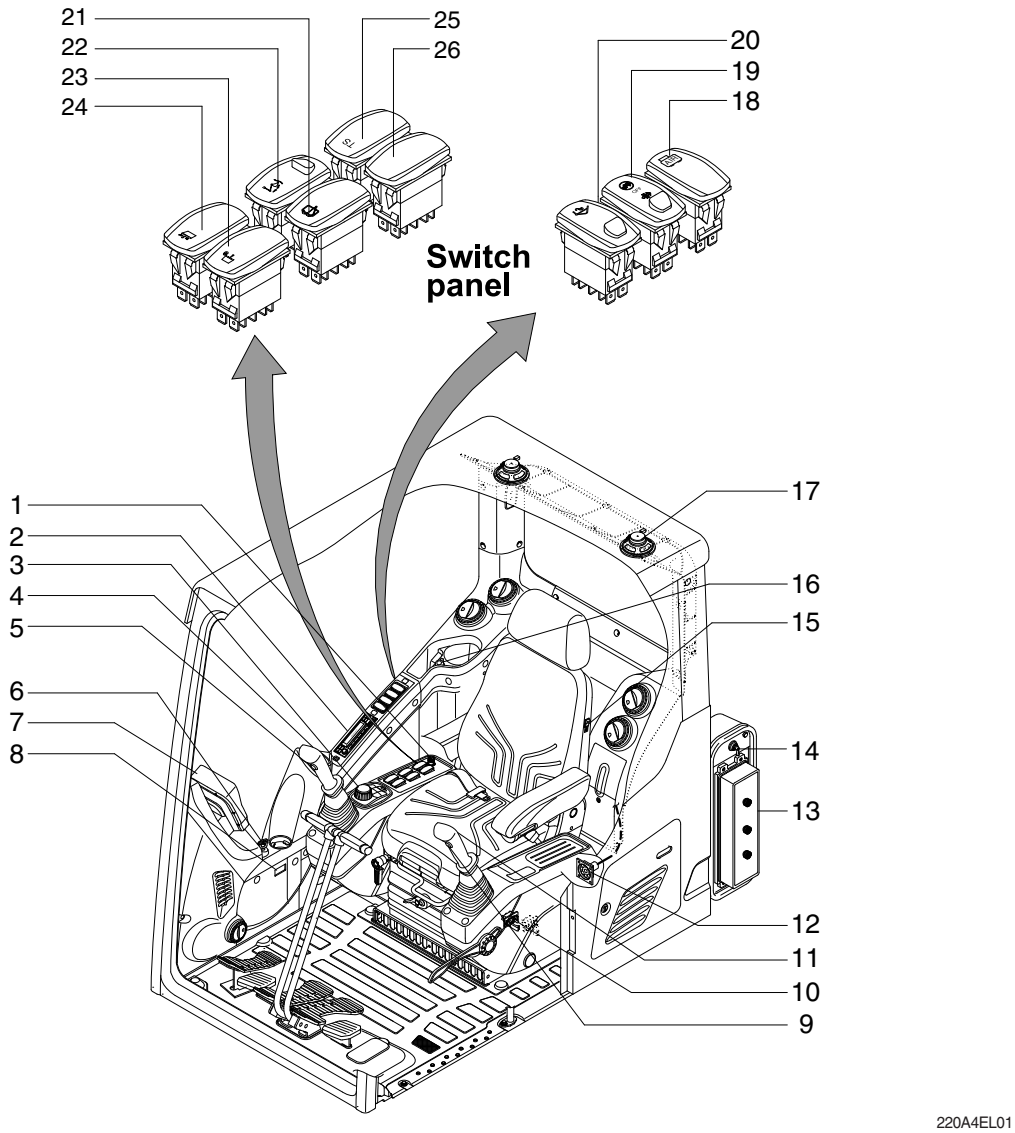
※ The circuit diagram may differ from the equipment, so please check before a repair.

SECTION 4 ELECTRICAL SYSTEM

Group 1 Component Location 4-1
Group 2 Electrical Circuit 4-3
Group 3 Electrical Component Specification 4-23
Group 4 Connectors 4-36

GROUP 1 COMPONENT LOCATION

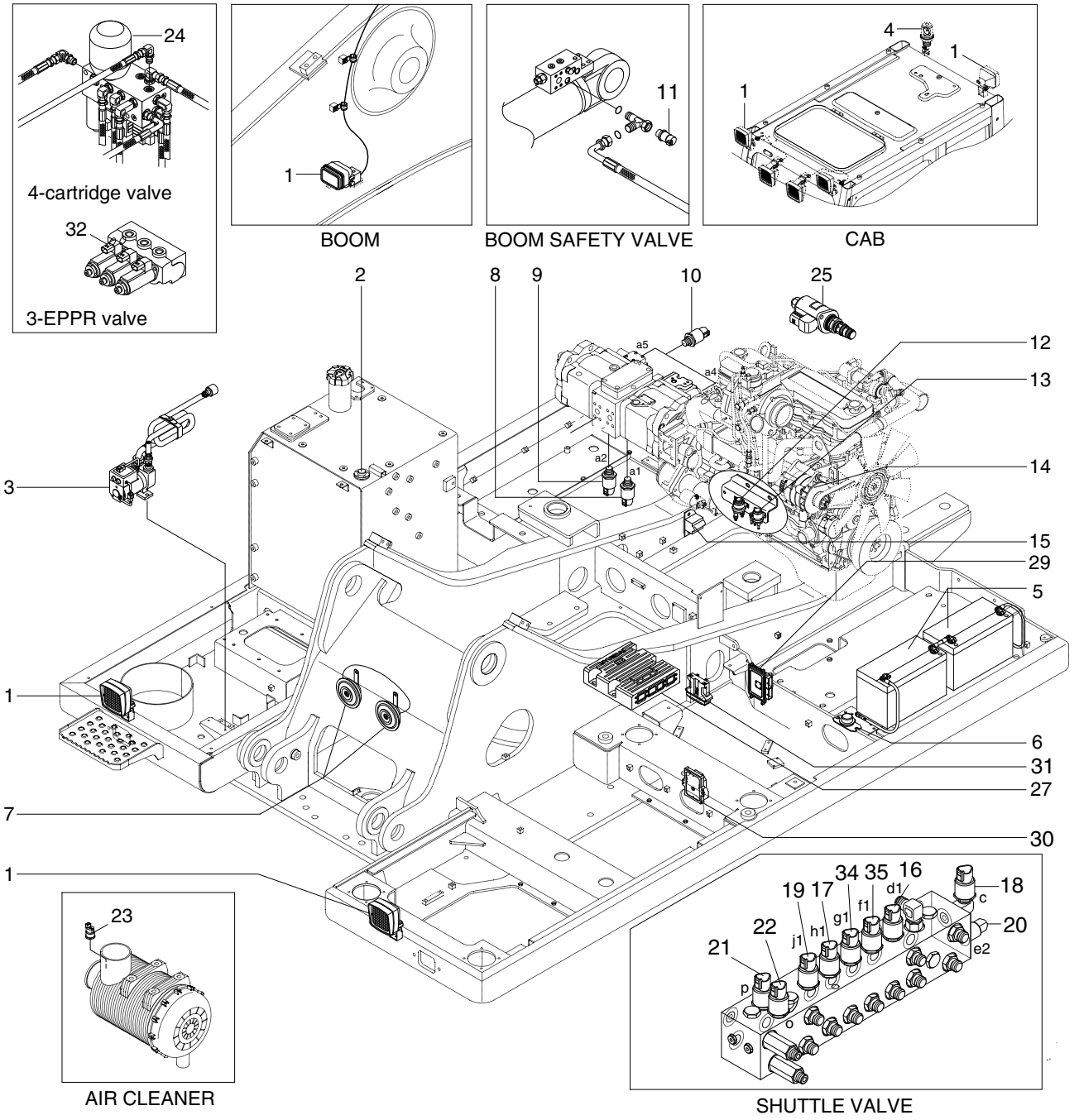
1. LOCATION 1



220A4EL01

1	Cigar lighter	10	Emergency engine stop switch	19	Exhaust system cleaning switch
2	Radio & USB player	11	One touch decel switch	20	Quick coupler switch
3	Jog dial module	12	RS232 & J1939 service socket	21	Lower wiper & washer switch
4	Horn switch	13	Fuse & relay box	22	Boom floating switch
5	Breaker operation switch	14	Master switch	23	Swing lock switch
6	Starting switch	15	Seat heater switch	24	Free/fine swing switch
7	Cluster	16	Power socket	25	Travel straight switch
8	Service meter	17	Speaker	26	Option attach switch
9	Power max switch	18	Air compressor switch		

2. LOCATION 2



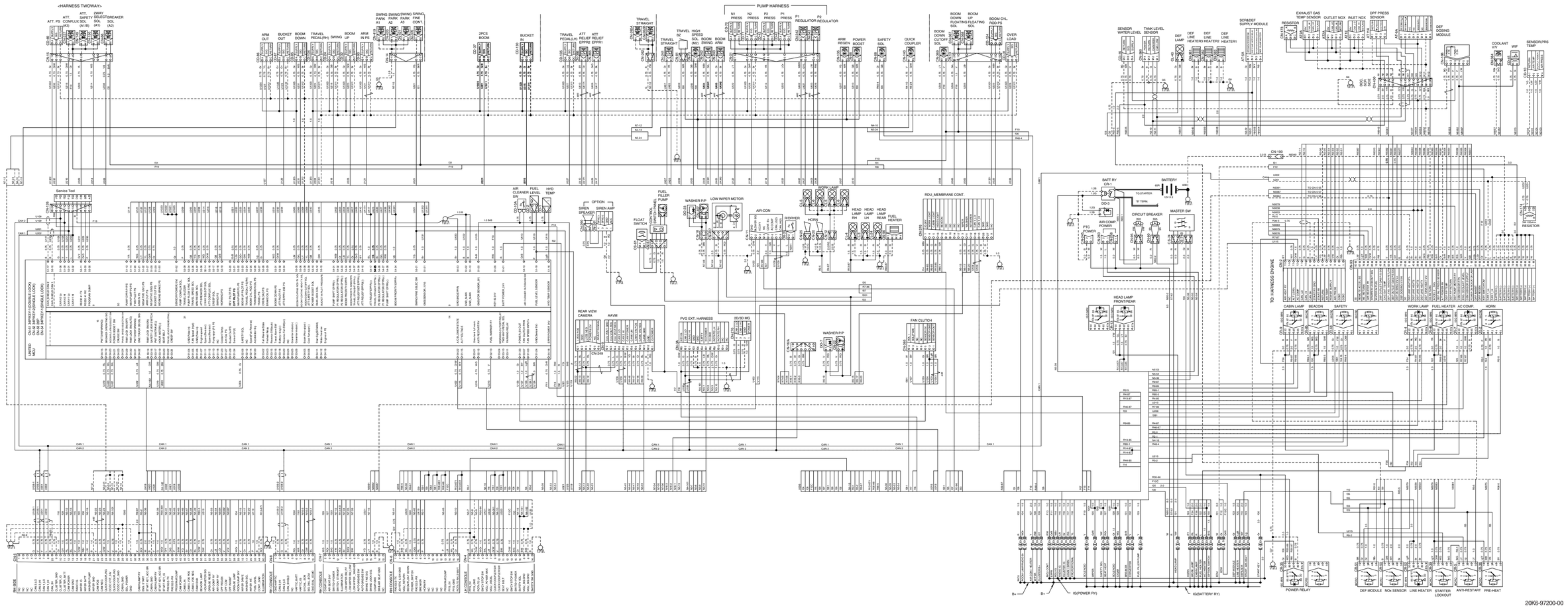
220A4EL02

1	Lamp	12	Start relay	23	Air cleaner sensor (-#00122)
2	Fuel sender	13	Heater relay	24	4-cartridge valve
3	Fuel filler pump	14	Alternator	25	Pump EPPR valve
4	Beacon lamp	15	Travel alarm buzzer	27	United MCU
5	Battery	16	Arm out pressure sensor	29	AAVM controller
6	Battery relay	17	Boom up pressure sensor	30	RDU assy
7	Horn	18	Swing pressure sensor	31	PVG32 controller
8	P1 pressure sensor	19	Boom down pressure sensor	32	3-EPPR valve
9	P2 pressure sensor	20	Arm in pressure sensor	34	Bucket out pressure sensor
10	EPPR pressure sensor	21	RH travel pressure sensor	35	Bucket in pressure sensor
11	Overload pressure sensor	22	LH travel pressure sensor		

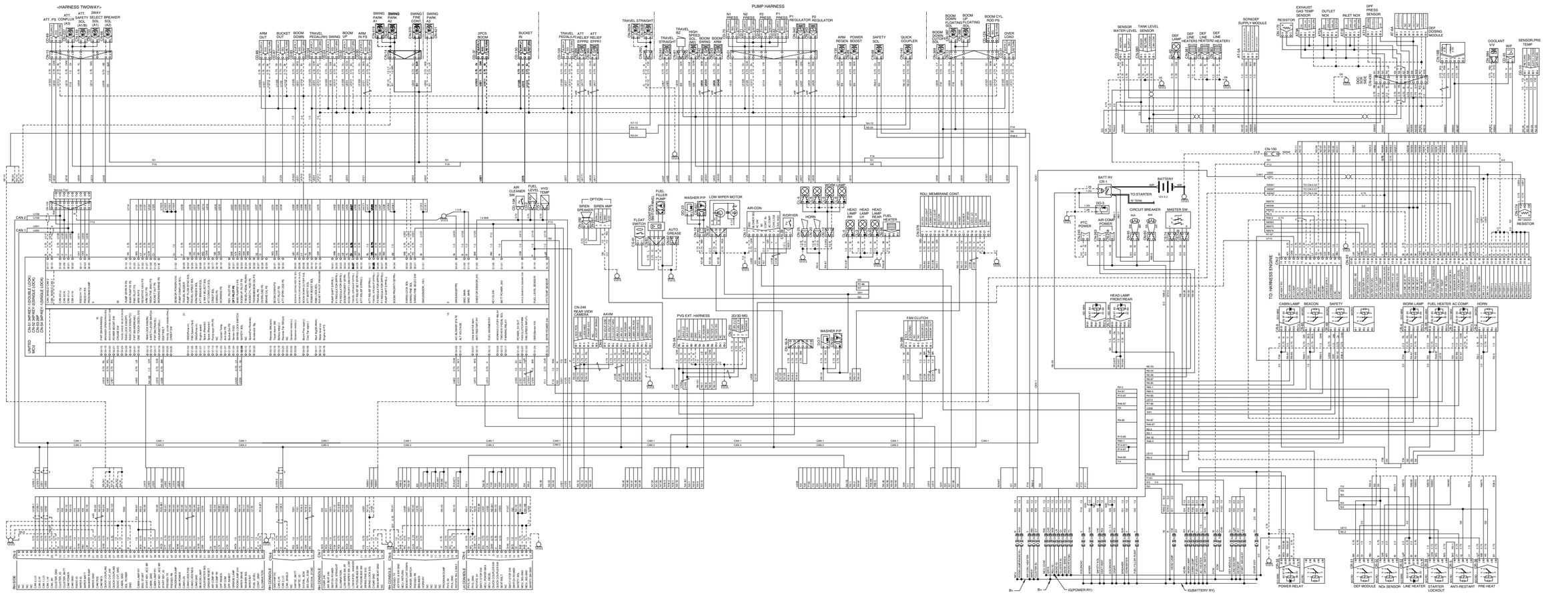
GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/4)

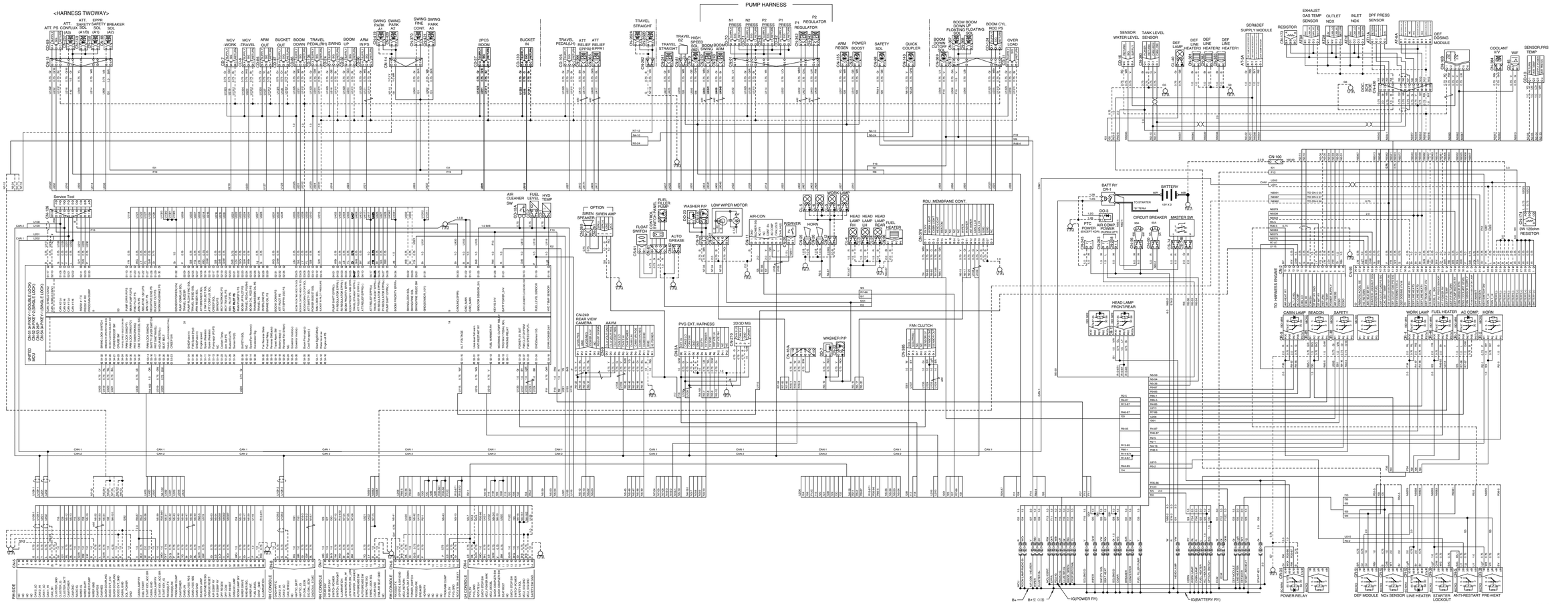
- MACHINE SERIAL NO. : -#00120



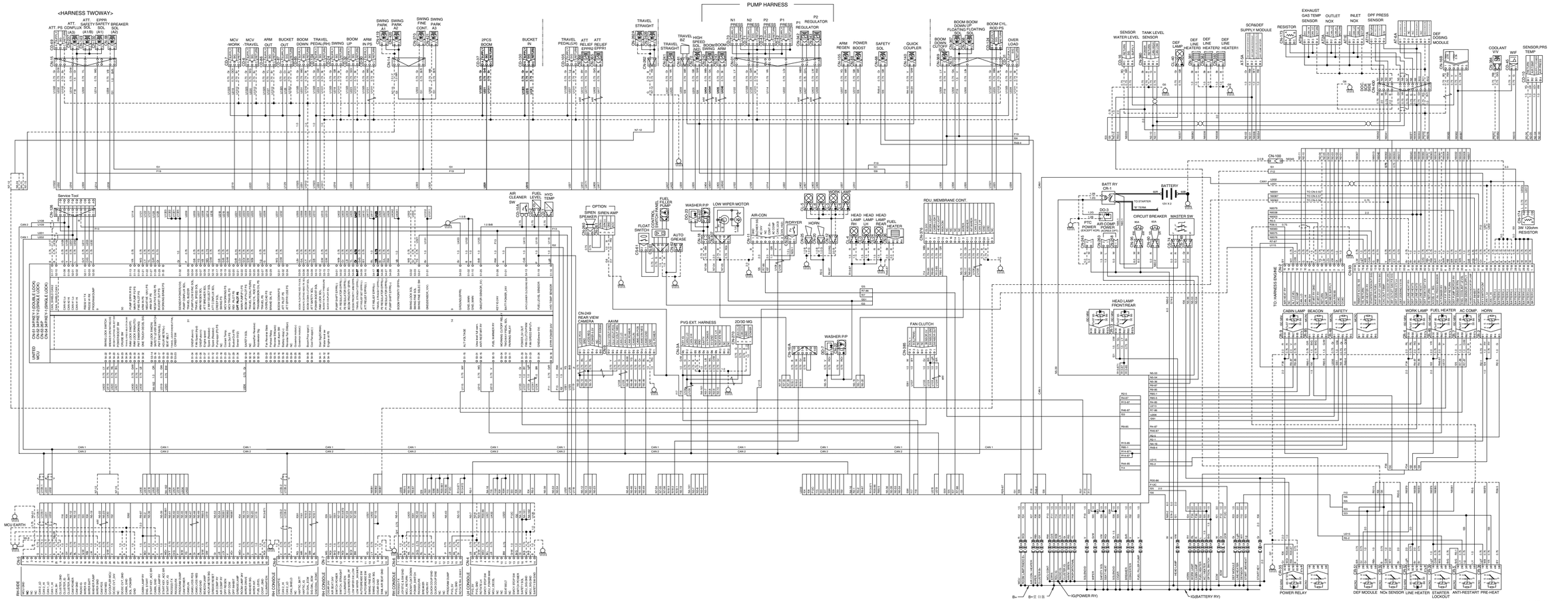
- MACHINE SERIAL NO. : #00121-#00139



- MACHINE SERIAL NO. : #00140-#00605

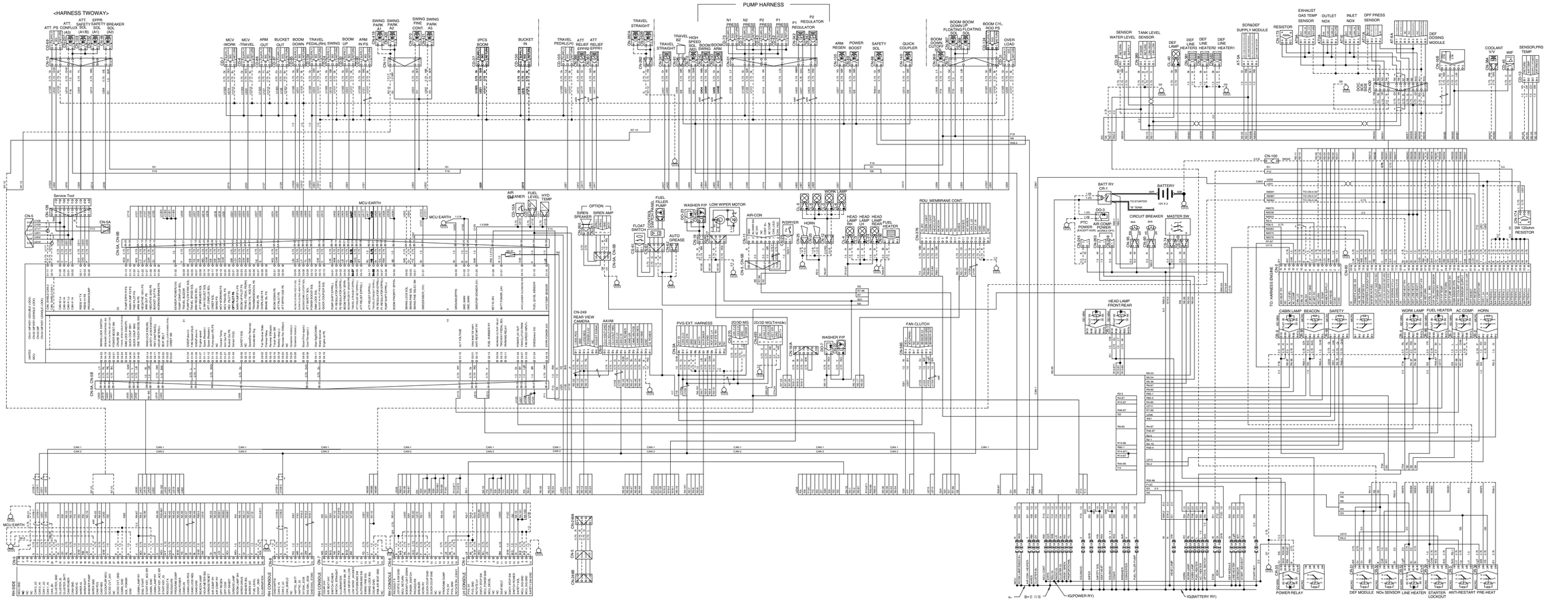


- MACHINE SERIAL NO. : #00606-#1020



20K6-97203-00

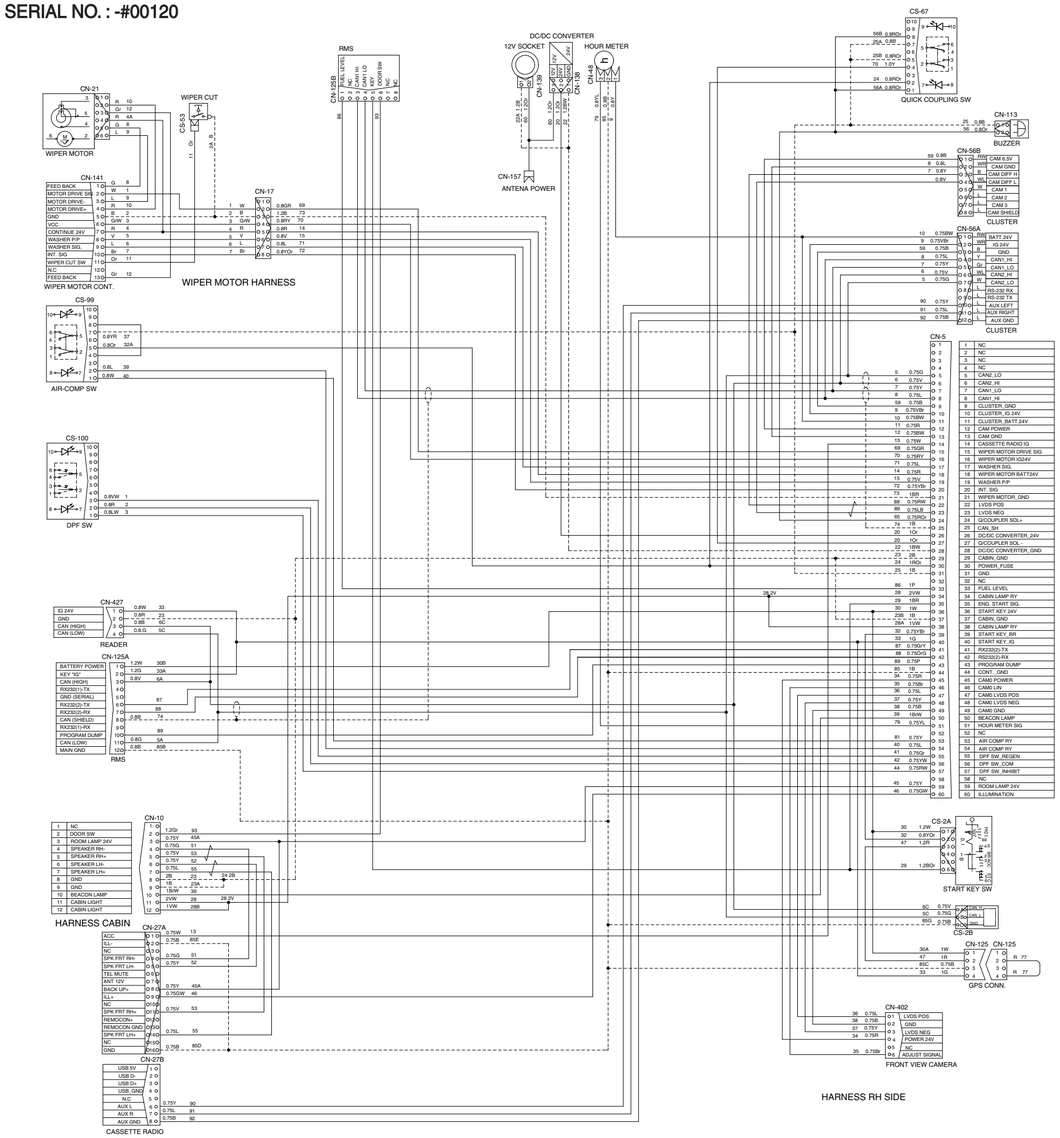
- MACHINE SERIAL NO. : #01021-

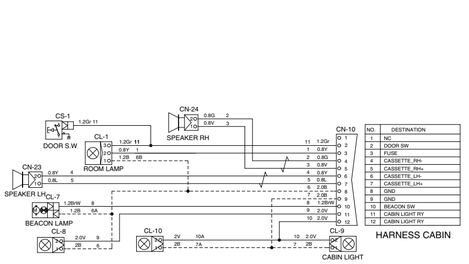


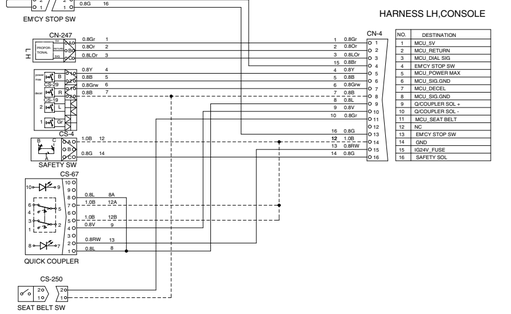
20K6-97205-00

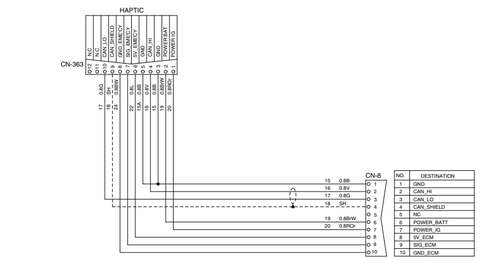
· ELECTRICAL CIRCUIT (2/4)

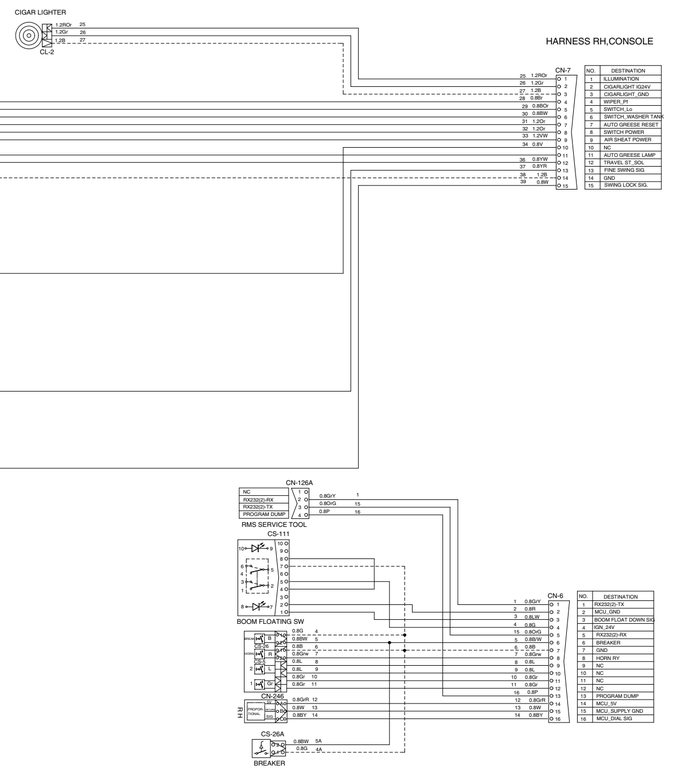
- MACHINE SERIAL NO. : -#00120





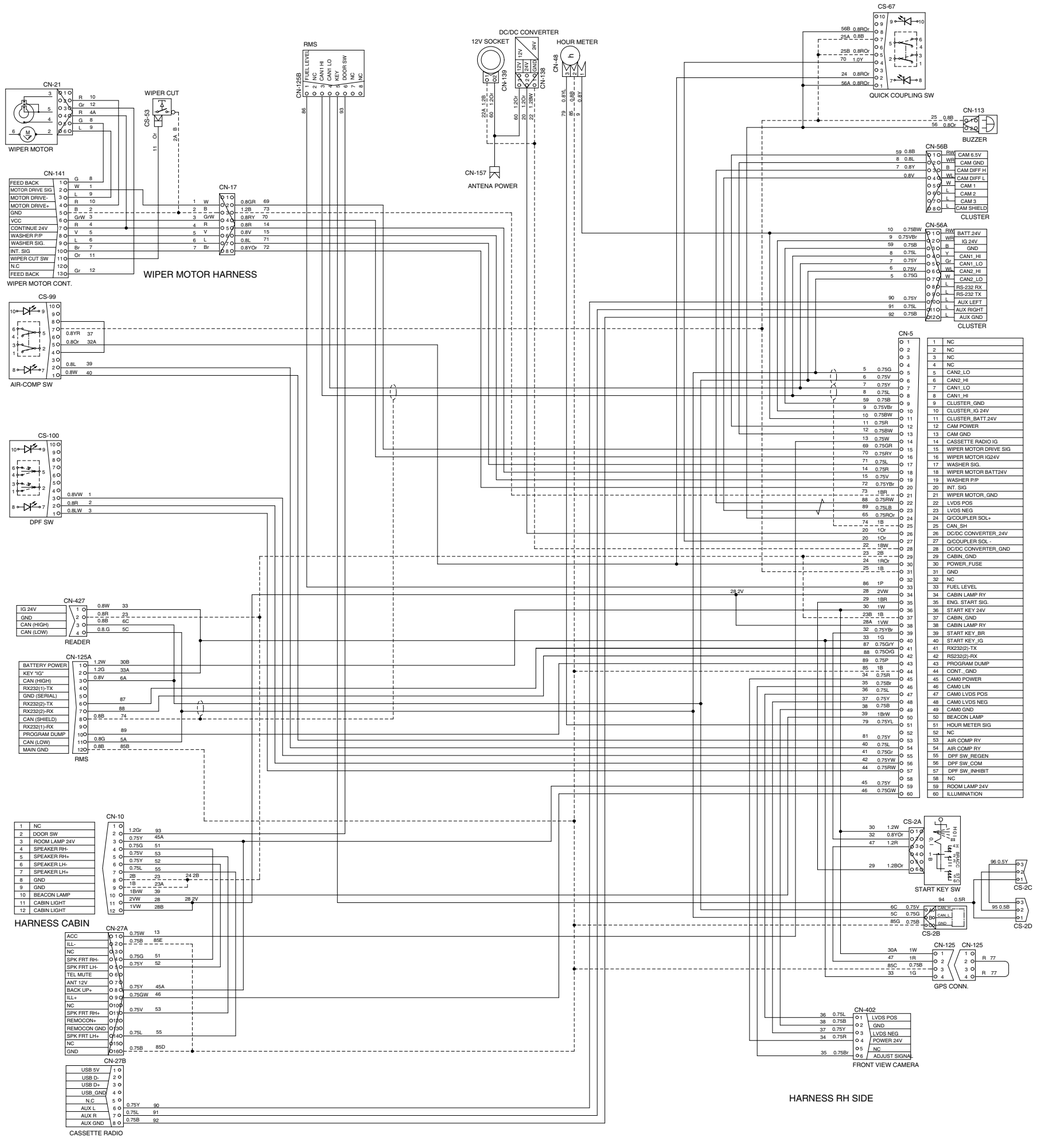


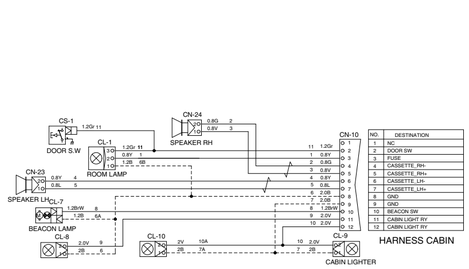


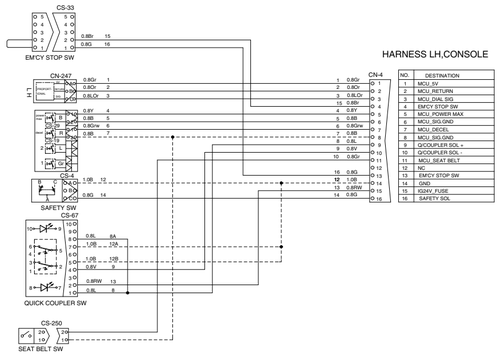


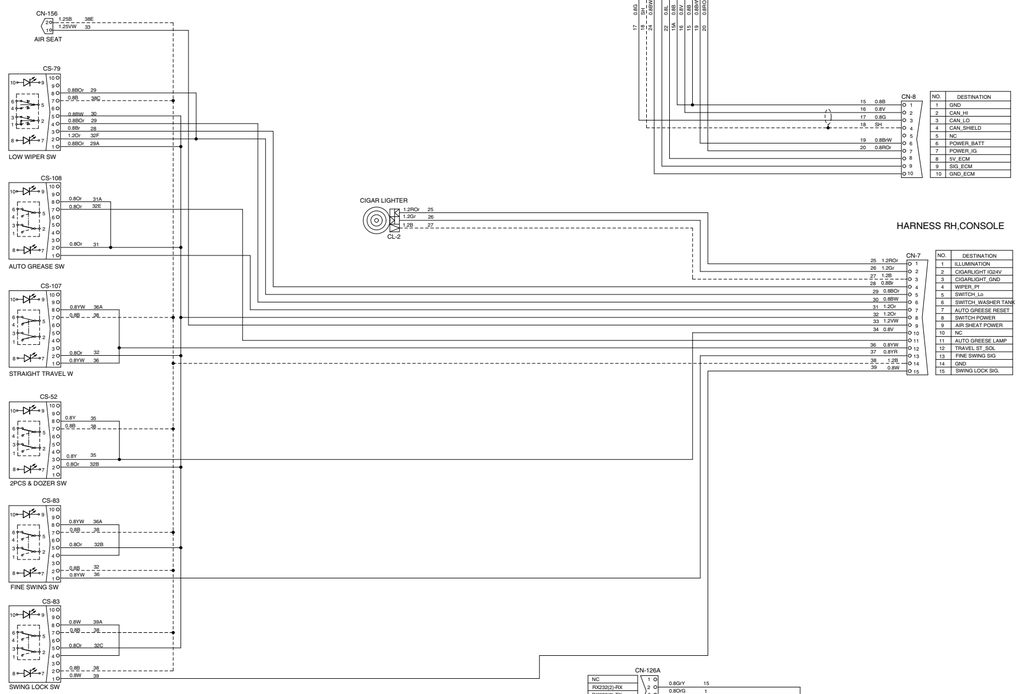
20K8-95100-00

- MACHINE SERIAL NO. : #00121-#00315



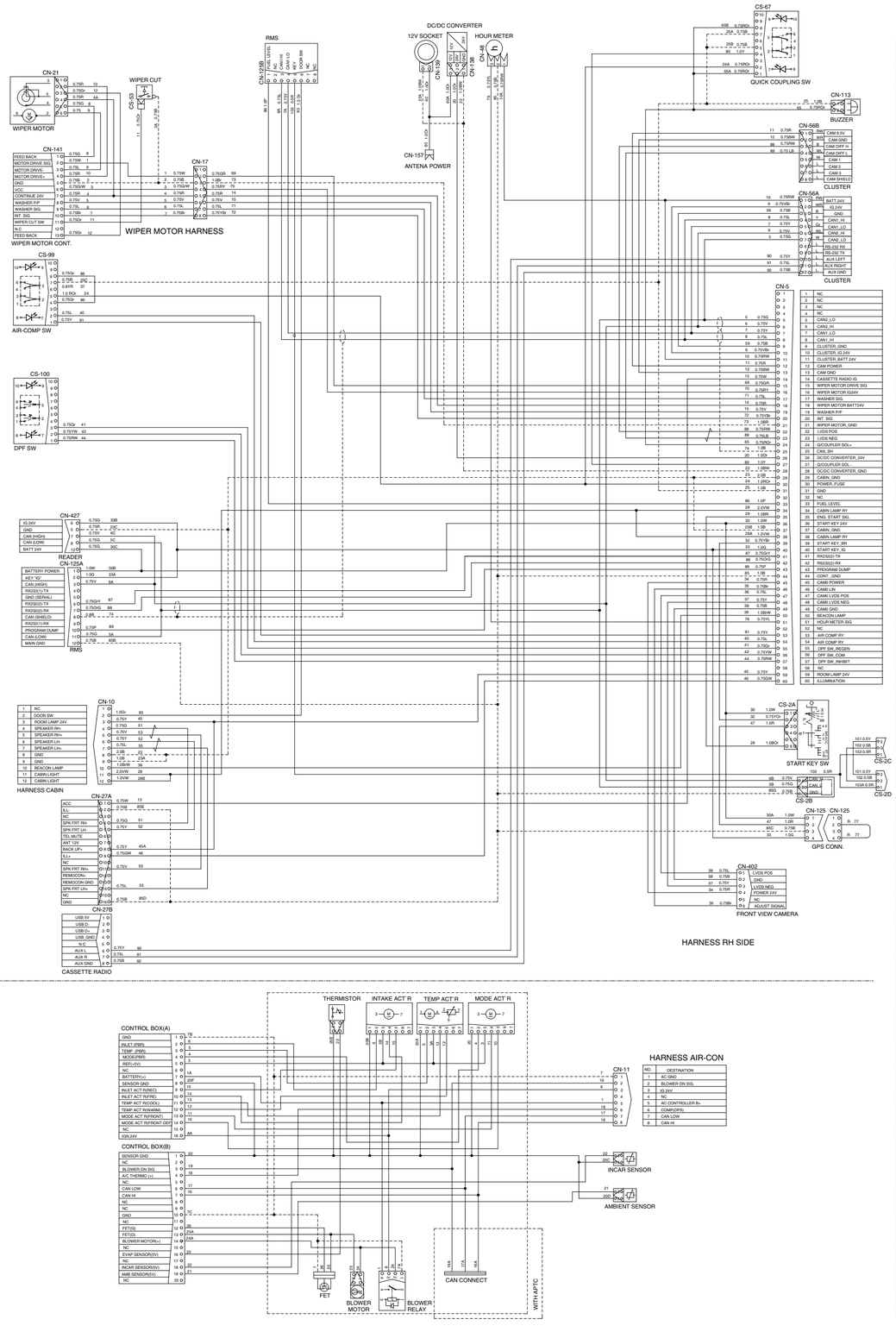






20KB-93100-00

- MACHINE SERIAL NO. : #00316-#00605



NO.	DESTINATION
1	NC
2	NC
3	NC
4	NC
5	CAN2_LO
6	CAN2_HI
7	CAN1_LO
8	CAN1_HI
9	CLUSTER_GND
10	CLUSTER_IG 24V
11	CLUSTER_BATT.24V
12	CAM POWER
13	CAM GND
14	CASSETTE RADIO IG
15	WIPER MOTOR DRIVE SIG
16	WIPER MOTOR IG24V
17	WASHER SIG.
18	WIPER MOTOR BATT24V
19	WASHER P/P
20	INT. SIG.
21	WIPER MOTOR_GND
22	LVDS POS.
23	LVDS NEG.
24	G/COUPLER SOL+
25	CAN_SH
26	DC/DC CONVERTER_24V
27	G/COUPLER SOL-
28	DC/DC CONVERTER_GND
29	CABIN_GND
30	POWER_FUSE
31	GND
32	NC
33	FUEL LEVEL
34	CABIN LAMP RY
35	ENG. START SIG.
36	START KEY 24V
37	CABIN_GND
38	CABIN LAMP RY
39	START KEY_BR
40	START KEY_IG
41	RX(232)-TX
42	RS(232)-RX
43	PROGRAM DUMP
44	CONT._GND
45	CAM0 POWER
46	CAM0 LIN
47	CAM0 LVDS POS
48	CAM0 LVDS NEG
49	CAM0 GND
50	BEACON LAMP
51	HOUR METER SIG.
52	NC
53	AIR COMP RY
54	AIR COMP RY
55	DPF SW_REGEN
56	DPF SW_COM
57	DPF SW_INHIBIT
58	NC
59	ROOM LAMP 24V
60	ILLUMINATION

NO.	DESTINATION
1	NC
2	DOOR SW
3	ROOM LAMP 24V
4	SPEAKER RH+
5	SPEAKER RH-
6	SPEAKER LH+
7	SPEAKER LH-
8	GND
9	GND
10	BEACON LAMP
11	CABIN LIGHT
12	CABIN LIGHT

NO.	DESTINATION
1	CAM M.SV
2	CAM GND
3	CAM DIFF H
4	CAM DIFF L
5	CAM 1
6	CAM 2
7	CAM 3
8	CAM SHIELD

NO.	DESTINATION
1	BATT.24V
2	IG 24V
3	GND
4	CAN1_HI
5	CAN1_LO
6	CAN2_HI
7	CAN2_LO
8	RS-232 RX
9	RS-232 TX
10	AUX LEFT
11	AUX RIGHT
12	AUX GND

NO.	DESTINATION
1	NC
2	NC
3	NC
4	NC
5	CAN2_LO
6	CAN2_HI
7	CAN1_LO
8	CAN1_HI
9	CLUSTER_GND
10	CLUSTER_IG 24V
11	CLUSTER_BATT.24V
12	CAM POWER
13	CAM GND
14	CASSETTE RADIO IG
15	WIPER MOTOR DRIVE SIG
16	WIPER MOTOR IG24V
17	WASHER SIG.
18	WIPER MOTOR BATT24V
19	WASHER P/P
20	INT. SIG.
21	WIPER MOTOR_GND
22	LVDS POS.
23	LVDS NEG.
24	G/COUPLER SOL+
25	CAN_SH
26	DC/DC CONVERTER_24V
27	G/COUPLER SOL-
28	DC/DC CONVERTER_GND
29	CABIN_GND
30	POWER_FUSE
31	GND
32	NC
33	FUEL LEVEL
34	CABIN LAMP RY
35	ENG. START SIG.
36	START KEY 24V
37	CABIN_GND
38	CABIN LAMP RY
39	START KEY_BR
40	START KEY_IG
41	RX(232)-TX
42	RS(232)-RX
43	PROGRAM DUMP
44	CONT._GND
45	CAM0 POWER
46	CAM0 LIN
47	CAM0 LVDS POS
48	CAM0 LVDS NEG
49	CAM0 GND
50	BEACON LAMP
51	HOUR METER SIG.
52	NC
53	AIR COMP RY
54	AIR COMP RY
55	DPF SW_REGEN
56	DPF SW_COM
57	DPF SW_INHIBIT
58	NC
59	ROOM LAMP 24V
60	ILLUMINATION

NO.	DESTINATION
1	NC
2	DOOR SW
3	FUSE
4	CASSETTE_RH+
5	CASSETTE_RH-
6	CASSETTE_LH-
7	CASSETTE_LH+
8	GND
9	GND
10	BEACON SW
11	CABIN LIGHT RY
12	CABIN LIGHT RY

HARNESS CABIN

HARNESS LH,CONSOLE

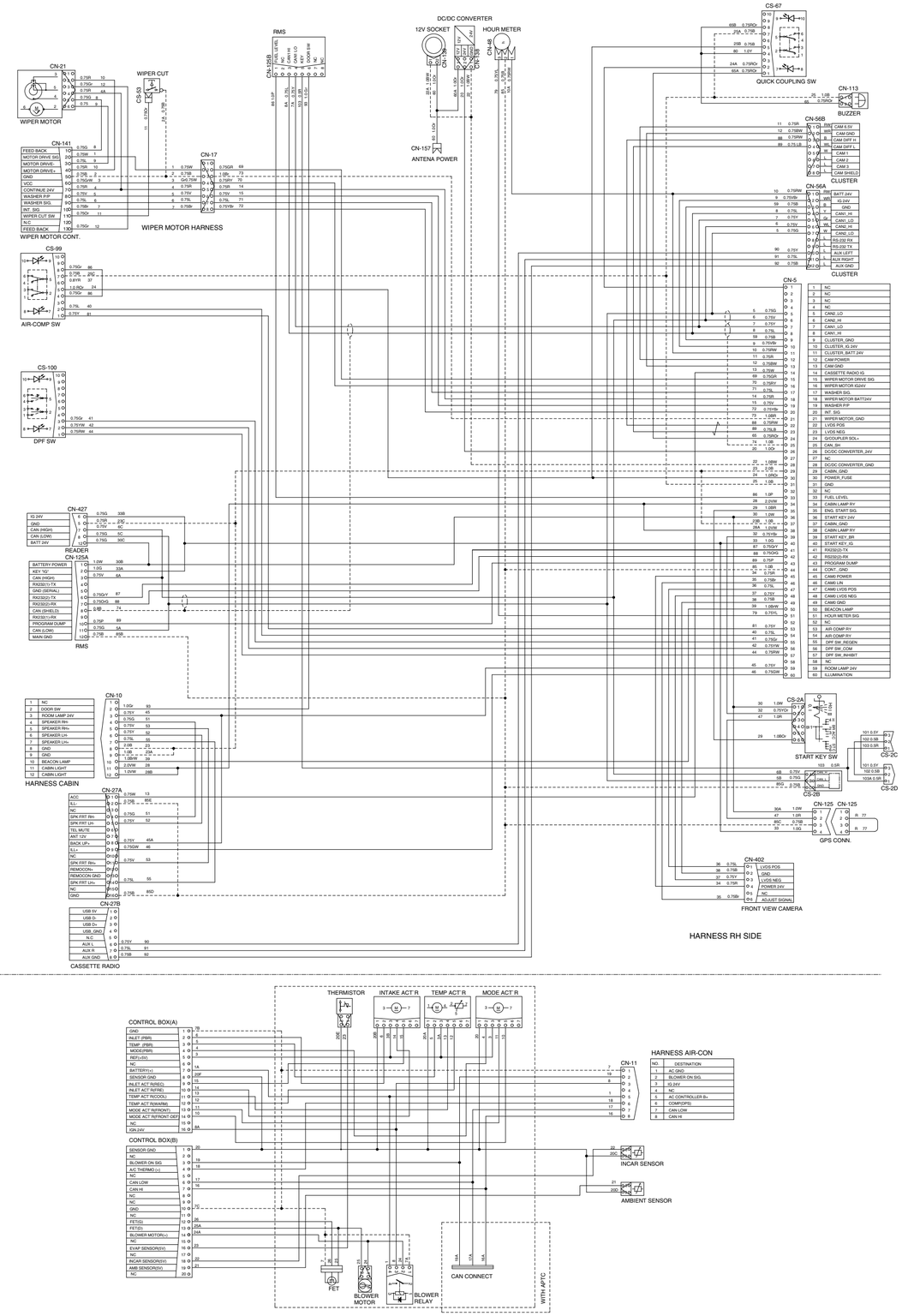
NO.	DESTINATION
1	MCU_5V
2	MCU_RETURN
3	MCU_DIAL SIG
4	EMCY STOP SW
5	MCU_POWER MAX
6	MCU_SIG.GND
7	MCU_DECEL
8	MCU_SIG.GND
9	G/COUPLER SOL+
10	G/COUPLER SOL-
11	MCU_SEAT BELT
12	NC
13	EMCY STOP SW
14	GND
15	IG24V_FUSE
16	SAFETY SOL

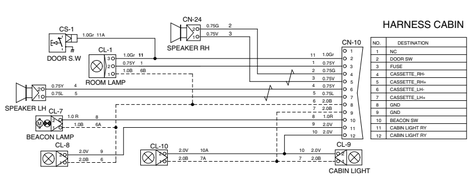
NO.	DESTINATION
1	NC
2	CAN_HI
3	CAN_LO
4	CAN_SHIELD
5	NC
6	POWER_BATT
7	POWER_IG
8	5V_ECM
9	SIG_ECM
10	GND_ECM

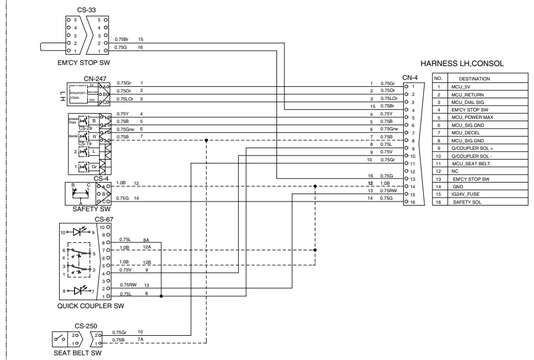
NO.	DESTINATION
1	ILLUMINATION
2	CIGARLIGHT IG24V
3	CIGARLIGHT_GND
4	WIPER_PI
5	SWITCH_1st
6	SWITCH_WASHER TANK
7	AUTO GREESE RESET
8	SWITCH POWER
9	AIR SHEAT POWER
10	NC
11	AUTO GREESE LAMP
12	TRAVEL ST_SOL
13	FINE SWING SIG
14	GND
15	SWING LOCK SIG.

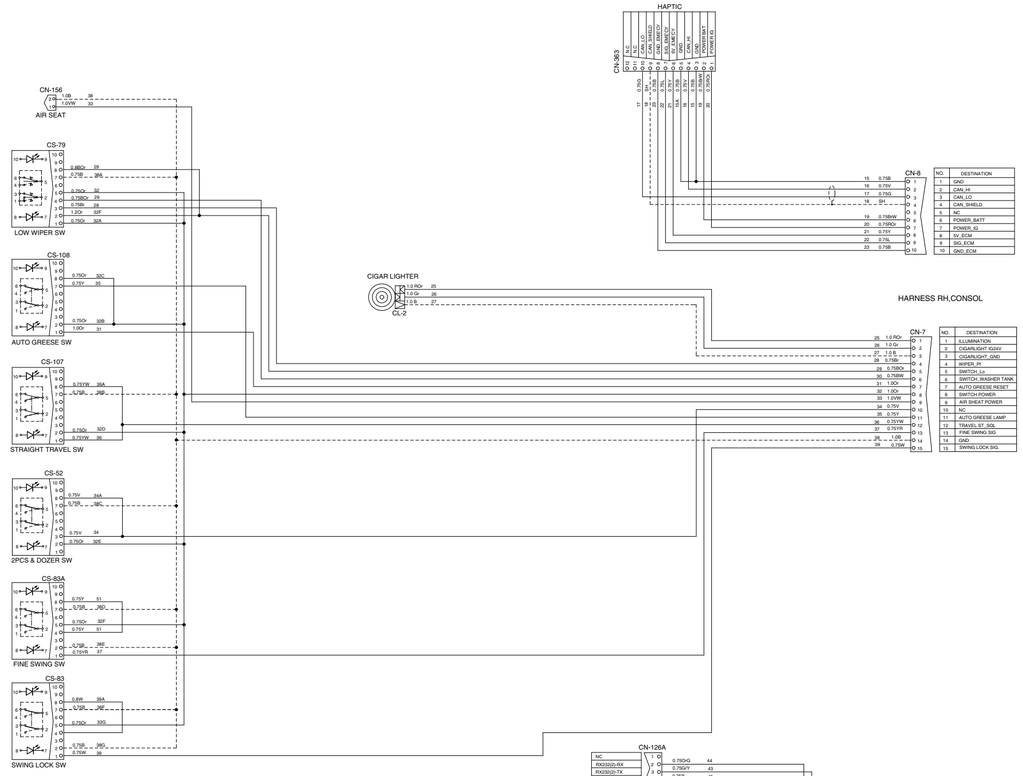
NO.	DESTINATION
1	RX(232)-TX
2	MCU_GND
3	BOOM FLOAT DOWN SIG.
4	IGN_24V
5	RX(232)-RX
6	BREAKER
7	GND
8	HORN RY
9	NC
10	NC
11	NC
12	NC
13	PROGRAM DUMP
14	MCU_5V
15	MCU_SUPPLY GND
16	MCU_DIAL SIG

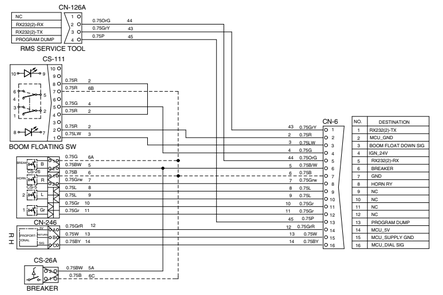
- MACHINE SERIAL NO. : #00606-#01111





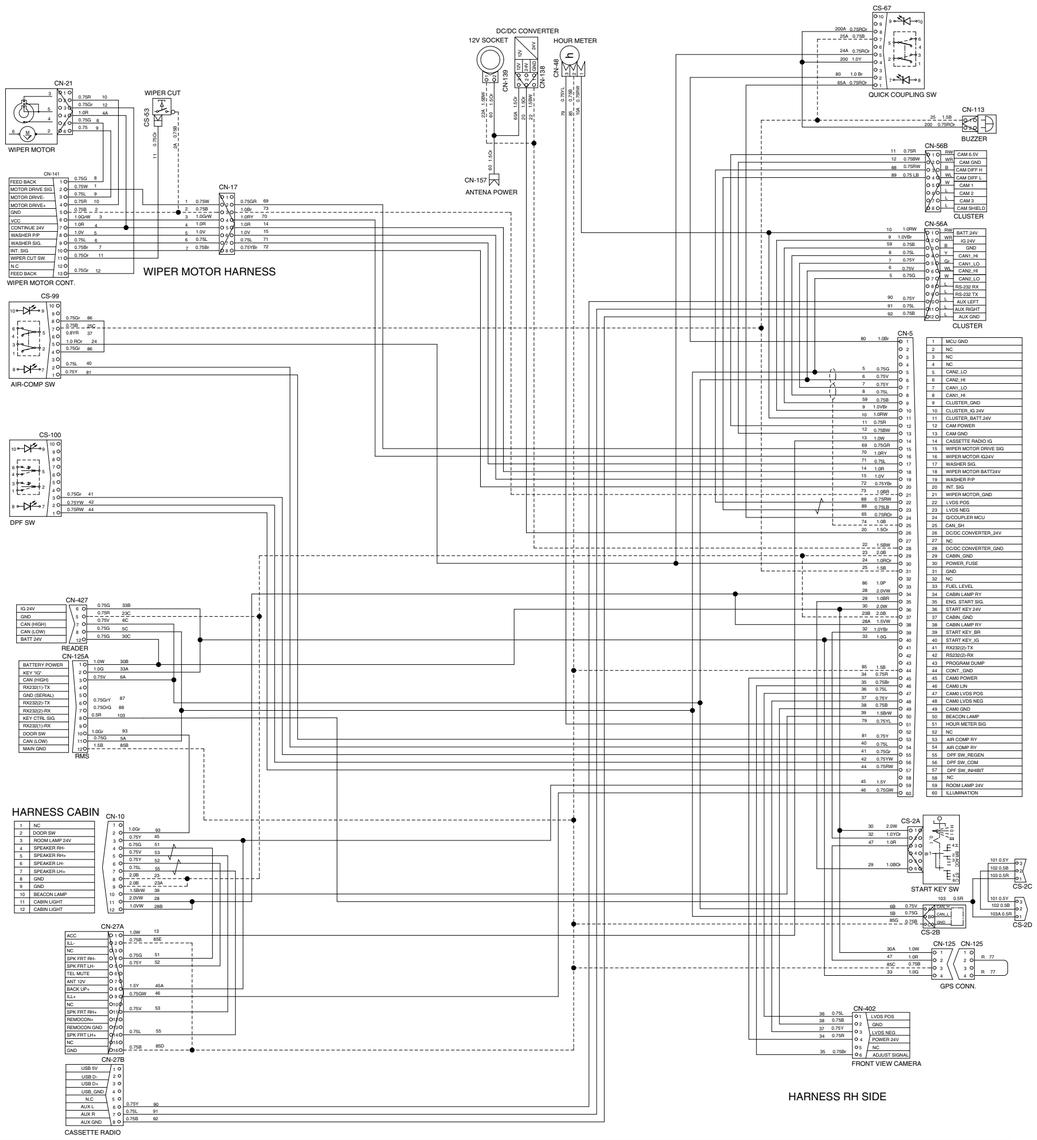


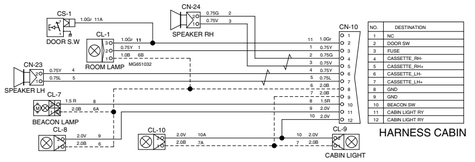


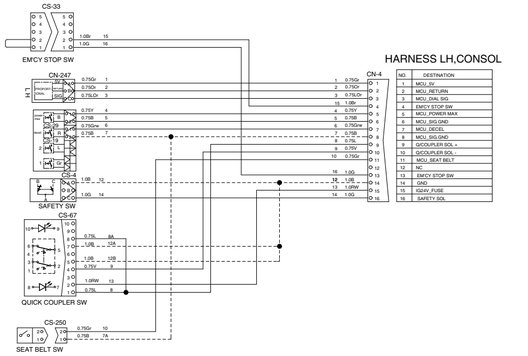


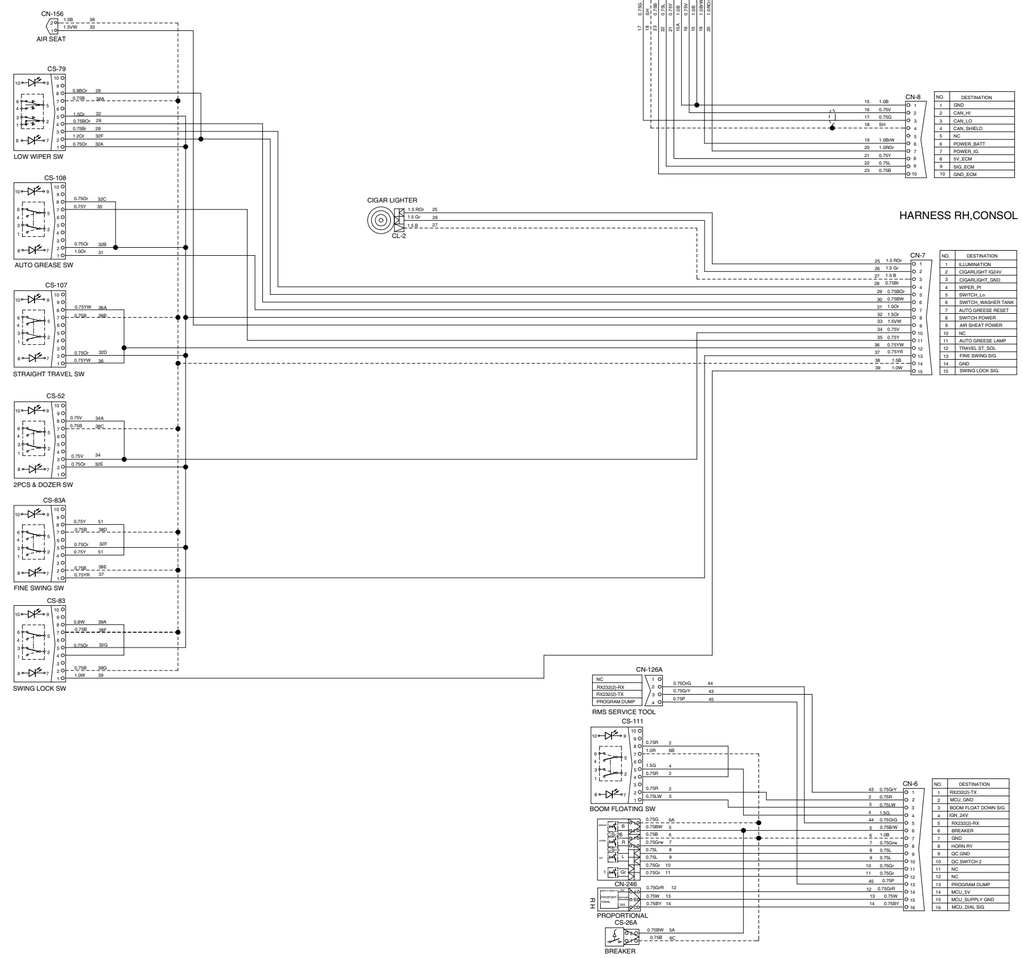
20KB-93103-00

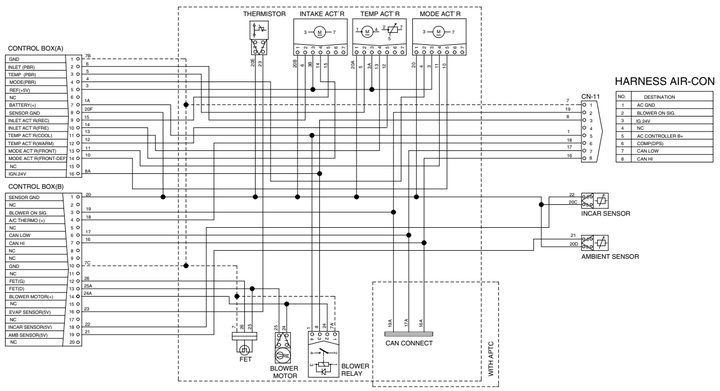
- MACHINE SERIAL NO. : #01112-





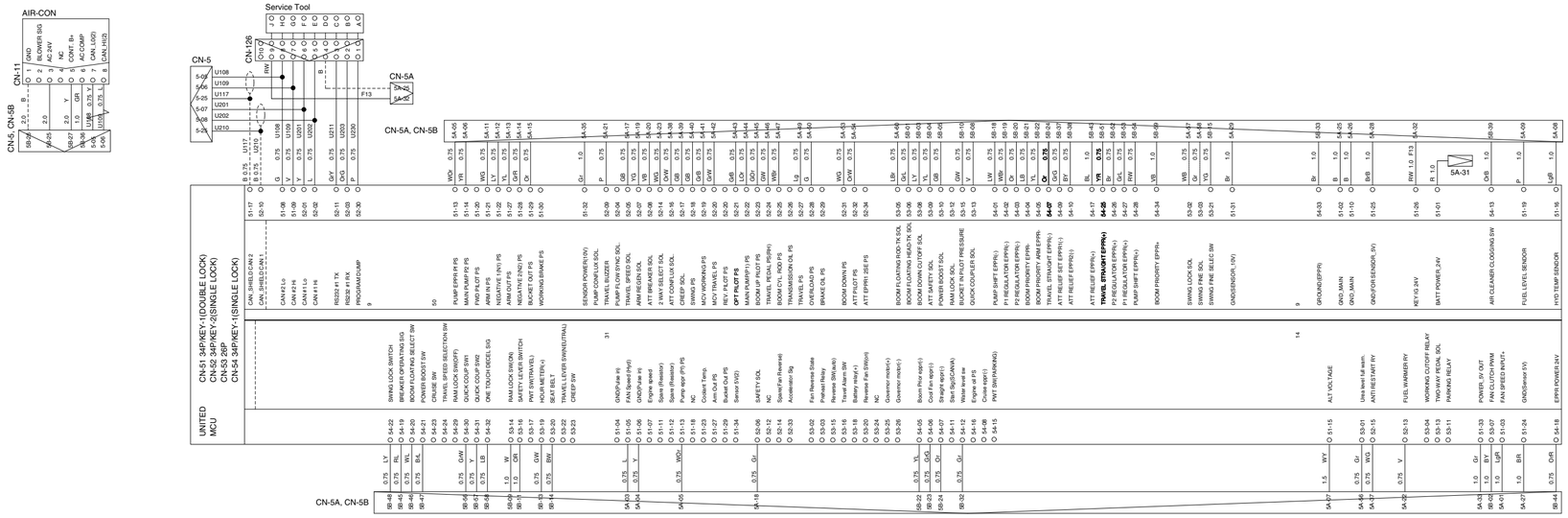






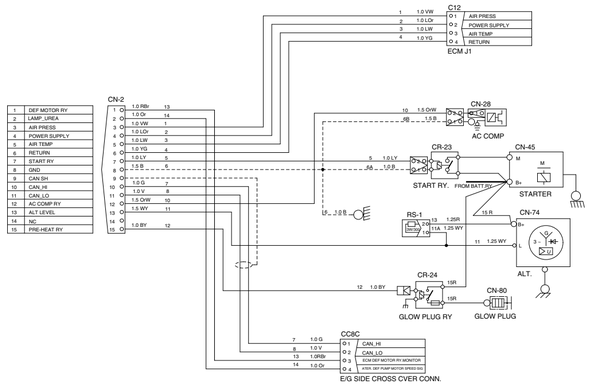
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- MACHINE SERIAL NO. : #01112-

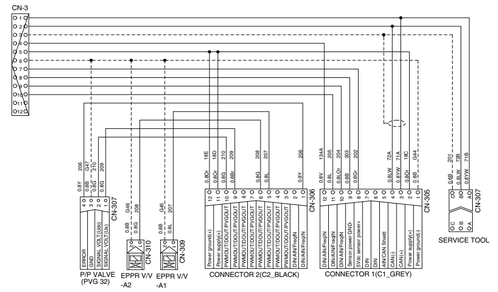


· ELECTRICAL CIRCUIT (3/4)

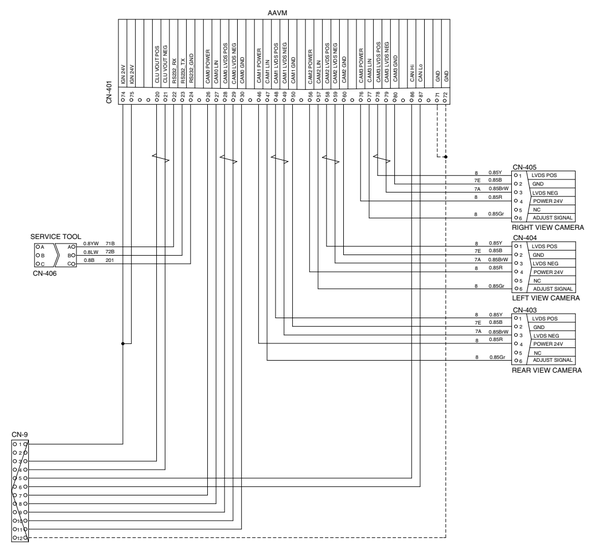
- MACHINE SERIAL NO. : -#00004



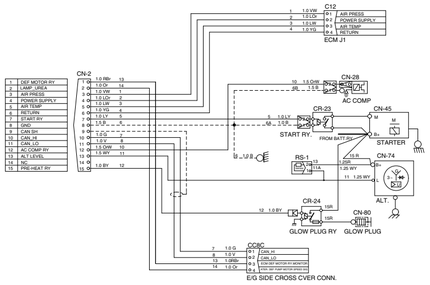
E/G HARNESS



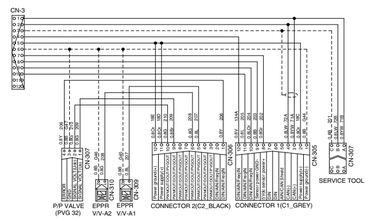
PROPORTIONAL VALVE & LEVER



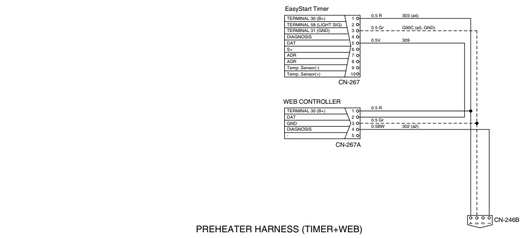
- MACHINE SERIAL NO. : #00005-#00168



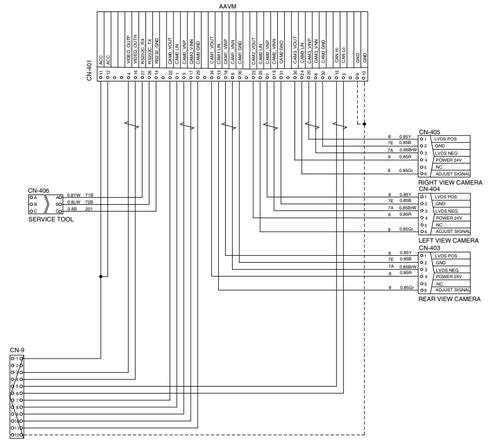
ENGINE HARNESS

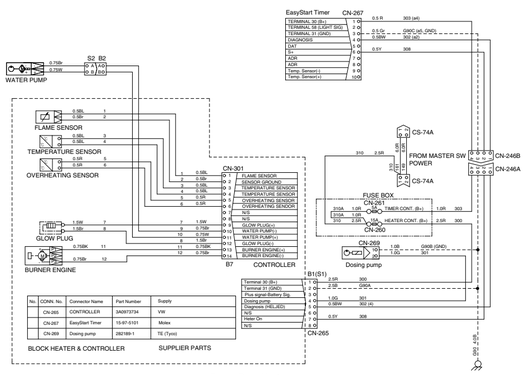


PROPORTIONAL VALVE & LEVER



PREHEATER HARNESS (TIMER+WEB)



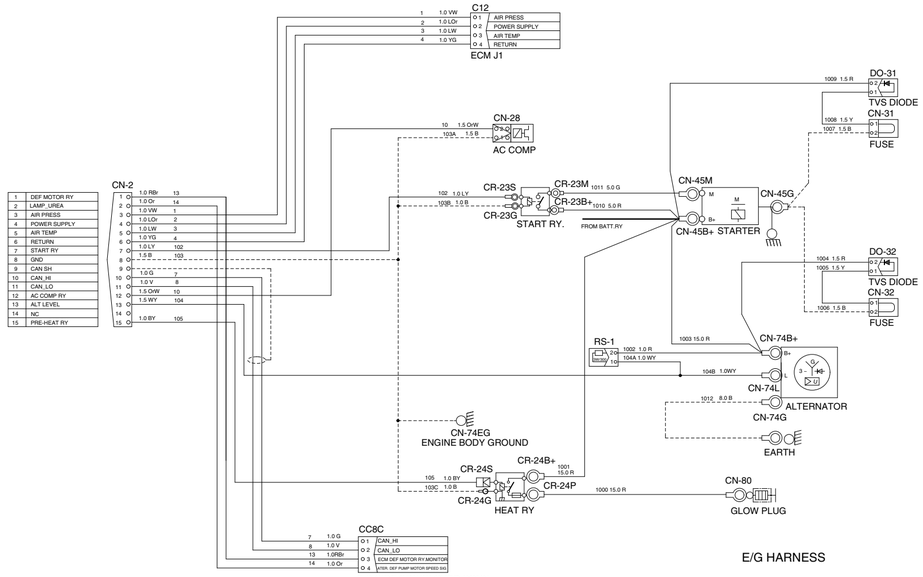


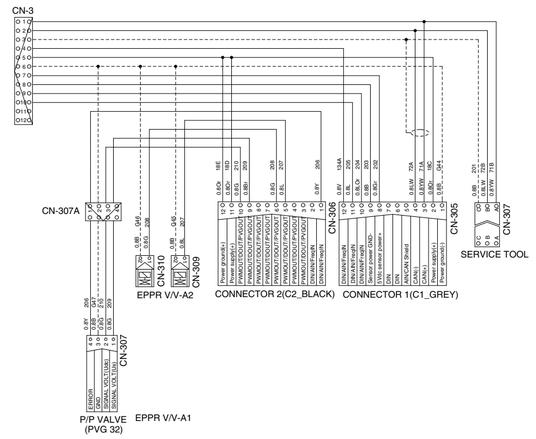
Engine Block Heater

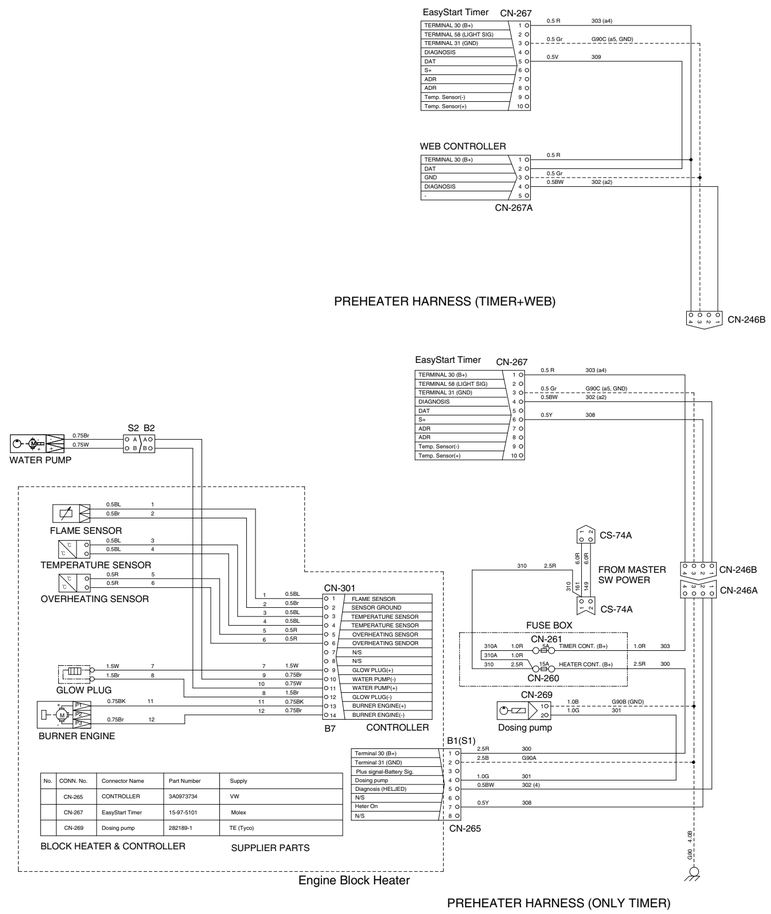
PREHEATER HARNESS (ONLY TIMER)

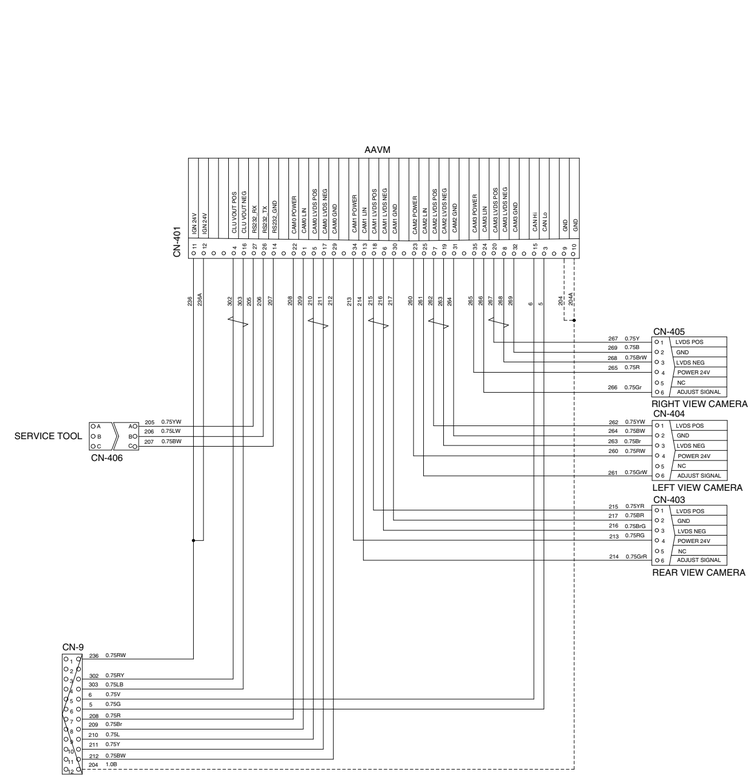
20K8-95301-00

- MACHINE SERIAL NO. : #00169-#00410



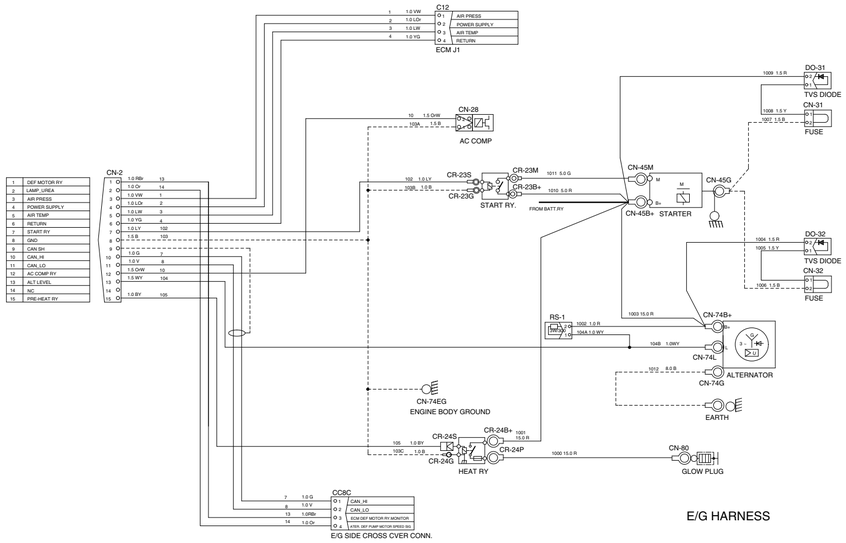




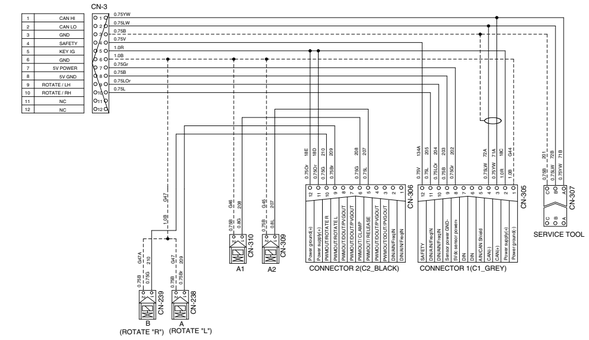


20K8-95302-01

- MACHINE SERIAL NO. : #00411-



E/G HARNESS

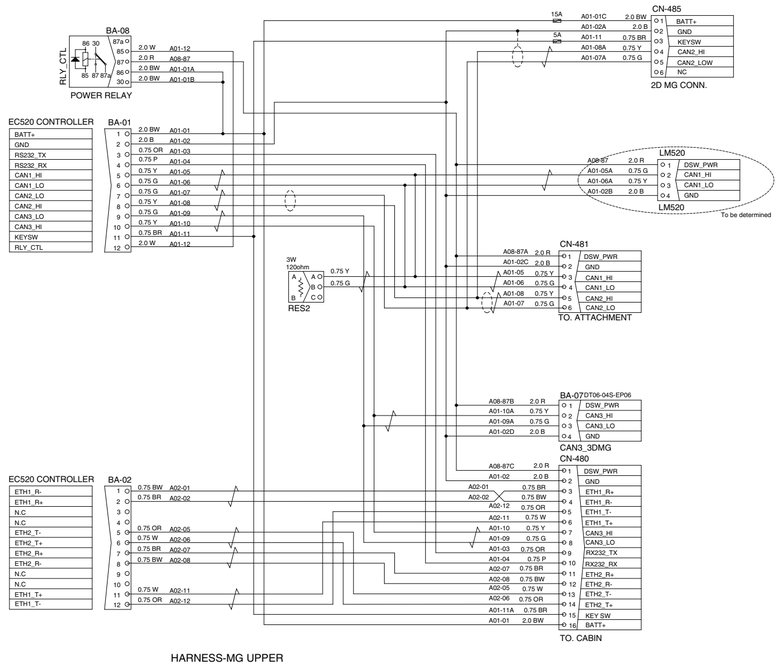


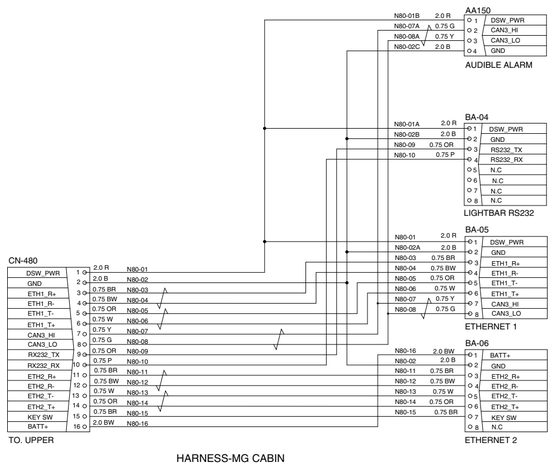
PROPORTIONAL VALVE & LEVER

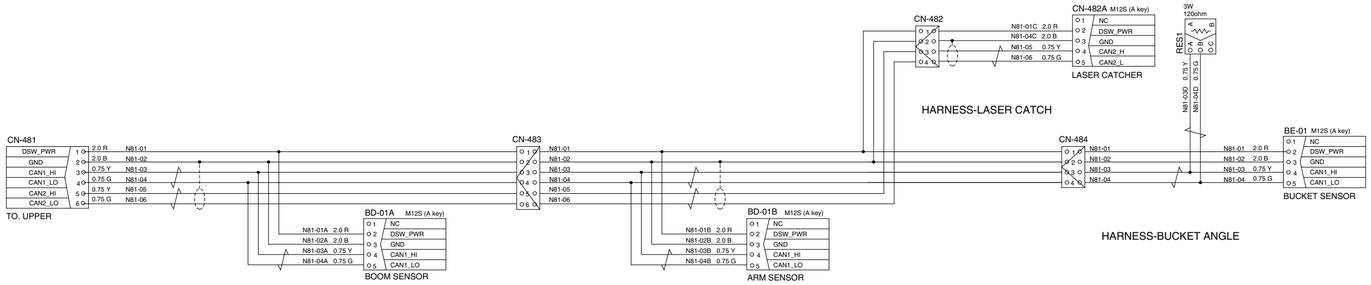
PREHEATER HARNESS (TIMER+WEB)

Engine Block Heater

· ELECTRICAL CIRCUIT (4/4, OPTION : 2D MG)







20K4-94310-00

MEMORANDUM

1. POWER CIRCUIT (MACHINE SERIAL NO. : -#0315)

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-74]

- → Fuse box [No.1] → Engine ECM [CN-93 (1, 25, 26, 27, 28)]
- → Fuse box [No.2] → United MCU [CN-51 (01)]
- → Fuse box [No.3]
  - → DEF module relay [CR-51 (2, 3)]
  - → Urea purging lamp [CL-40 (1)]
- → Fuse box [No.4] → I/conn [CN-5 (59)]
  - → I/conn [CN-10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
    - → I/conn [CN-10 (2)] → RMS [CN-125B (6)]
  - → Radio & USB player [CN-27A (8)]
- → Fuse box [No.5] → Line heater relay [CR-52 (30, 86)]
- → Fuse box [No.6]
  - → Master switch [CS-74B] → I/conn [CN-5 (36)]
    - → Start switch [CS-2A (1)]
    - → RMS [CN-125A (1)]
    - → GPS connection [CN-125 (1)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.7] → I/conn [CN-11 (5)]
  - → AC & Heater controller box A (7)
  - → Blower relay (4)
- → Fuse box [No.8] → I/conn [CN-5 (18)] → I/conn [CN-17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.9]
  - → I/conn [CN-5 (11)]
    - → Cluster [CN-56A (1)]
    - → Hour meter [CN-48 (1)]
  - → I/conn [CN-8 (6)] → Jog dial module [CN-363 (2)]
- → Fuse box [No.10] → NOx sensor relay [CR-50 (3)]
- → Fuse box [No.11] → United MCU [CN-54 (18)]

※ I/conn : Intermediate connector

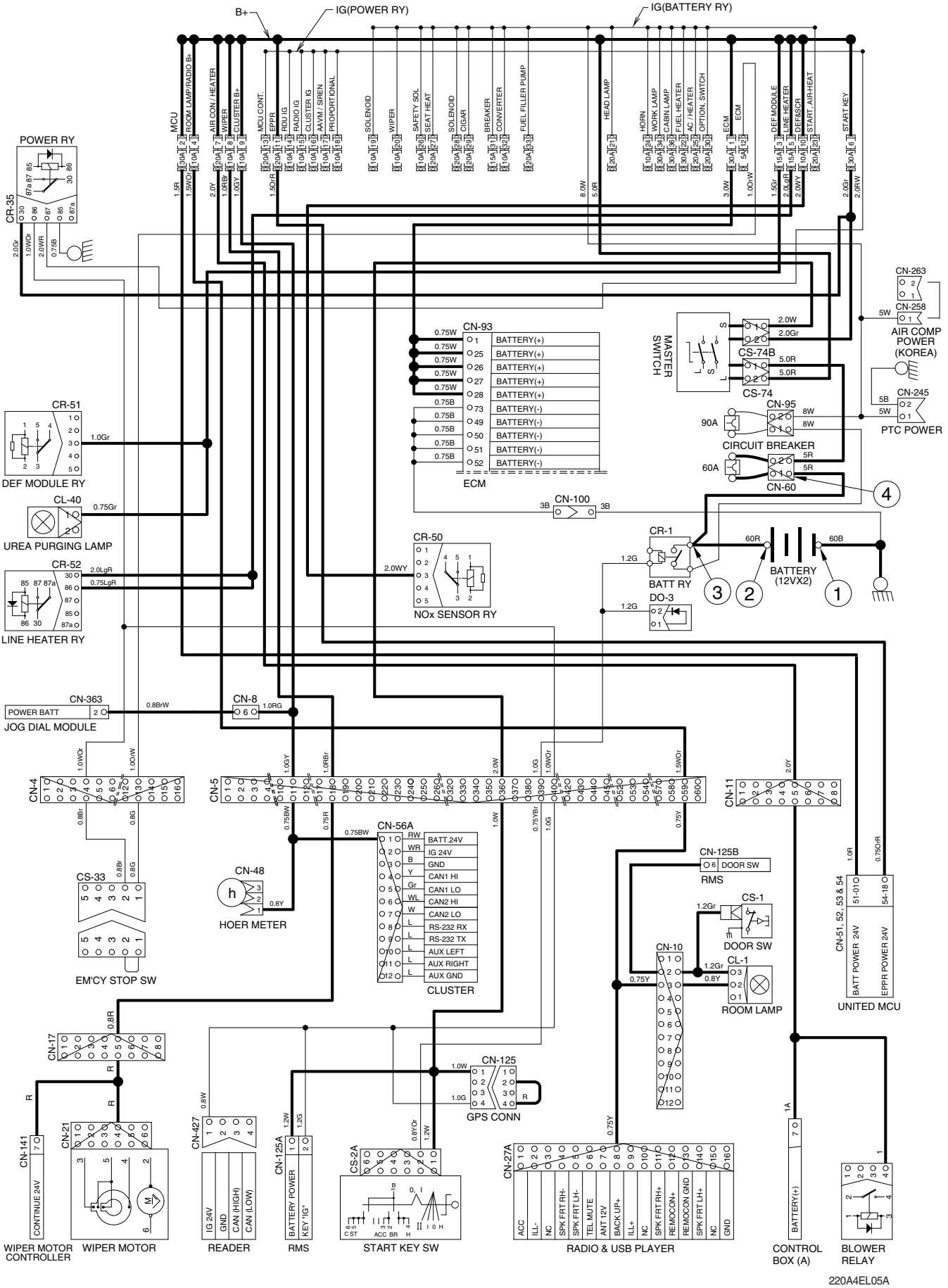
2) CHECK POINT

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 (MACHINE SERIAL NO. : -#0315)



220A4EL05A

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

POWER CIRCUIT (MACHINE SERIAL NO. : #0316-)

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-74]

- → Fuse box [No.1] → Engine ECM [CN-93 (1, 25, 26, 27, 28)]
- → Fuse box [No.2] → United MCU [CN-51 (01)]
- → Fuse box [No.3]
  - → DEF module relay [CR-51 (2, 3)]
  - → Urea purging lamp [CL-40 (1)]
- → Fuse box [No.4] → I/conn [CN-5 (59)]
  - → I/conn [CN-10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
    - → I/conn [CN-10 (2)] → RMS [CN-125B (6)]
  - → Radio & USB player [CN-27A (8)]
- → Fuse box [No.5] → Line heater relay [CR-52 (30, 86)
- → Fuse box [No.6]
  - → Master switch [CS-74B] → I/conn [CN-5 (36)]
    - → Start switch [CS-2A (1)]
    - → RMS [CN-125A (1)]
    - → GPS connection [CN-125 (1)]
    - → Reader [CN-427 (2)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.7] → I/conn [CN-11 (5)]
  - → AC & Heater controller box A (7)
  - → Blower relay (4)
- → Fuse box [No.8] → I/conn [CN-5 (18)] → I/conn [CN-17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.9]
  - → I/conn [CN-5 (11)]
    - → Cluster [CN-56A (1)]
    - → Hour meter [CN-48 (1)]
  - → I/conn [CN-8 (6)] → Jog dial module [CN-363 (2)]
- → Fuse box [No.10] → NOx sensor relay [CR-50 (3)]
- → Fuse box [No.11] → United MCU [CN-54 (18)]

※ I/conn : Intermediate connector

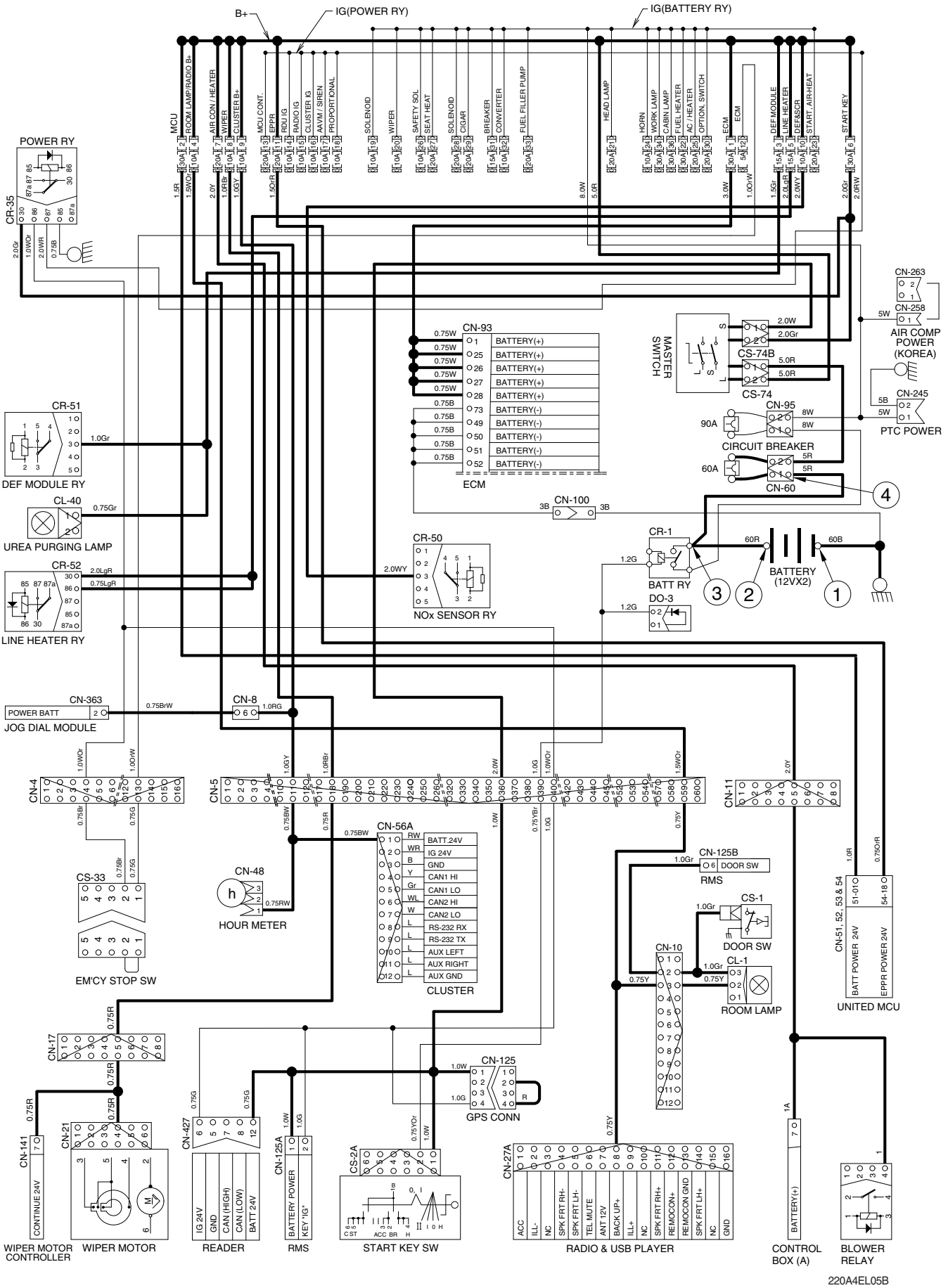
2) CHECK POINT

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 (MACHINE SERIAL NO. : #0316-)



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

2. STARTING CIRCUIT (MACHINE SERIAL NO. : -#0070)

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74]
→ Fuse box [No.6] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]
→ Power relay [CR-35 (30)]

(1) When start key 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 [IG (power)]
→ I/conn [CN-4 (4)]
→ Emergency engine stop sw [CS-33 (2)→(1)] → I/conn [CN-4 (13)]
→ Fuse box [No. 12] → Engine ECM [CN-93 (5)]
→ Reader [CN-427 (1)]
→ RMS [CN-125A (2)]

(2) When start key switch is in START position

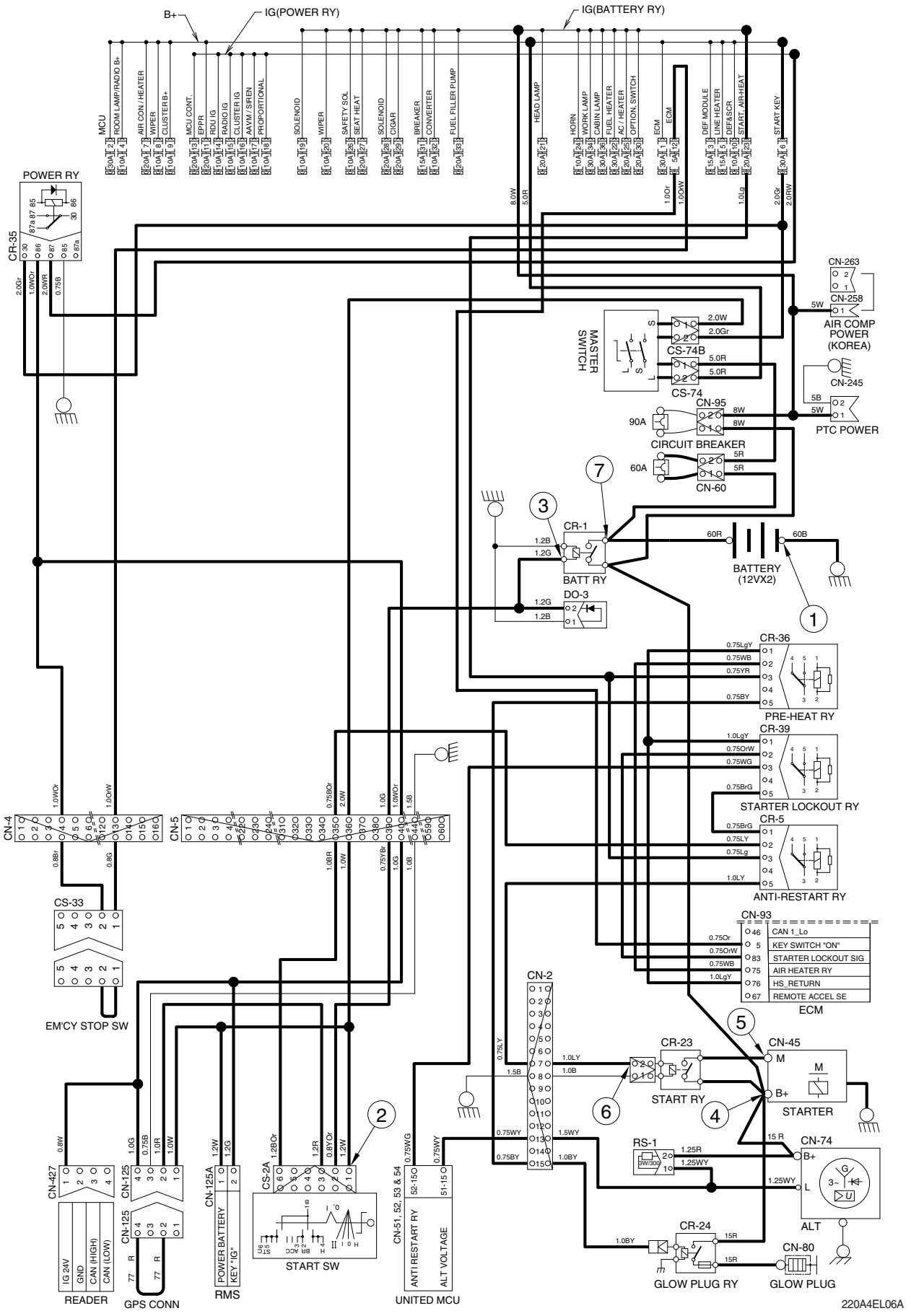
Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (2) → (5)]
→ I/conn [CN-2 (7)] → Start relay [CR-23 (2)] → Starter motor operating

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 (MACHINE SERIAL NO. : -#0070)



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

STARTING CIRCUIT (MACHINE SERIAL NO. : #0071-#0315)

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74]
→ Fuse box [No.6] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]
→ Power relay [CR-35 (30)]

(1) When start key 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 [IG (power)]
  → I/conn [CN-4 (4)]
  → Emergency engine stop sw [CS-33 (2)→(1)] → I/conn [CN-4 (13)]
  → Fuse box [No. 12] → Engine ECM [CN-93 (5)]
- Reader [CN-427 (1)]
- RMS [CN-125A (2)]

(2) When start key switch is in START position

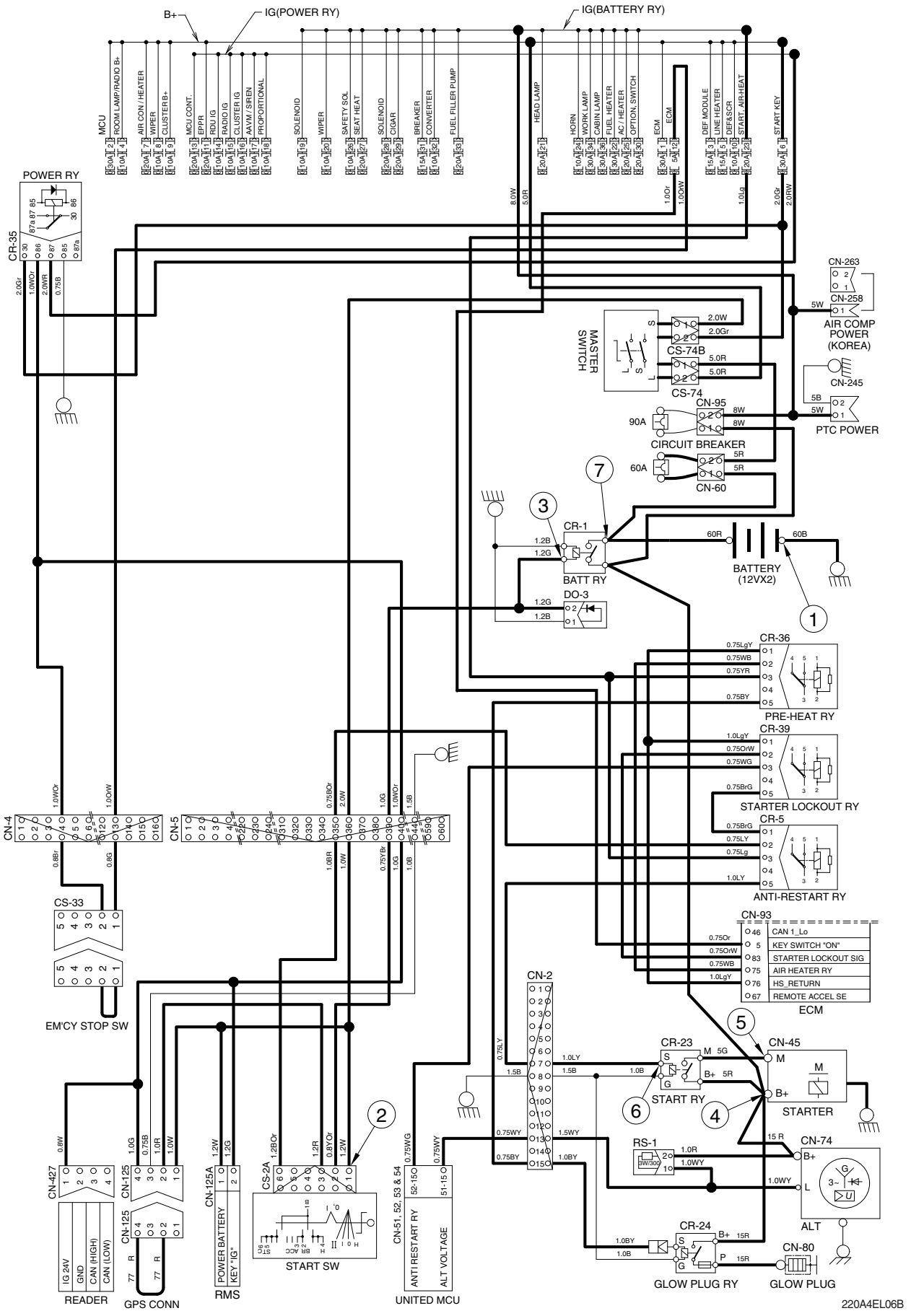
Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (2) → (5)]
→ I/conn [CN-2 (7)] → Start relay [CR-23 (S)] → Starter motor operating

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 (MACHINE SERIAL NO. : #0071-#0315)



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

STARTING CIRCUIT (MACHINE SERIAL NO. : #0316-)

1) OPERATING FLOW

Battery (+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74]
→ Fuse box [No.6] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2A (1)]
→ Power relay [CR-35 (30)]

(1) When start key 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 [IG (power)]
  → I/conn [CN-4 (4)]
  → Emergency engine stop sw [CS-33 (2)→(1)] → I/conn [CN-4 (13)]
  → Fuse box [No. 12] → Engine ECM [CN-93 (5)]
- Reader [CN-427 (6)]
- RMS [CN-125A (2)]

(2) When start key switch is in START position

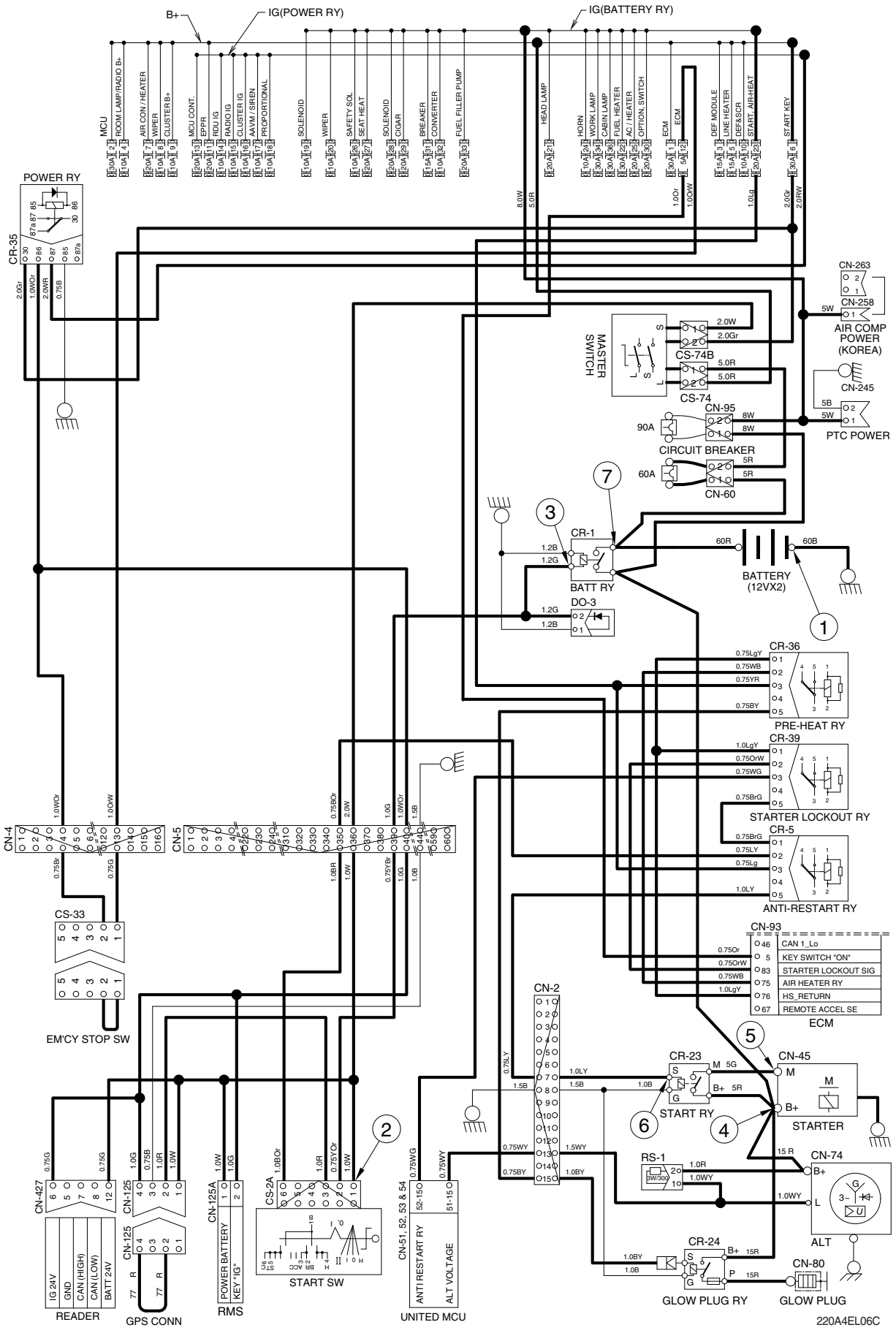
Start switch START [CS-2A (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (2) → (5)]
→ I/conn [CN-2 (7)] → Start relay [CR-23 (S)] → Starter motor operating

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 (MACHINE SERIAL NO. : #0316-)



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

3. CHARGING CIRCUIT (MACHINE SERIAL NO. : -#0070)

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 "L" terminal → I/conn [CN-2 (13)] → United MCU alternator voltage [CN-51 (15)] → Cluster charging warning lamp (Via CAN interface)

(2) Charging flow

Alternator "B^+" terminal → Starter [CN-45 (B^+)] → Battery relay (CR-1)

- → Battery (+) terminal
- → Circuit breaker [CN-60] → Master switch [CS-74] → Fuse box [B^+]
- → Circuit breaker [CN-95] → Fuse box [IG, battery] → Power relay [CR-35 (30→87)]
  - → Fuse box [IG, power]
  - → PTC power [CN-245 (1)]
  - → Air comp power [CN-258 (1)]

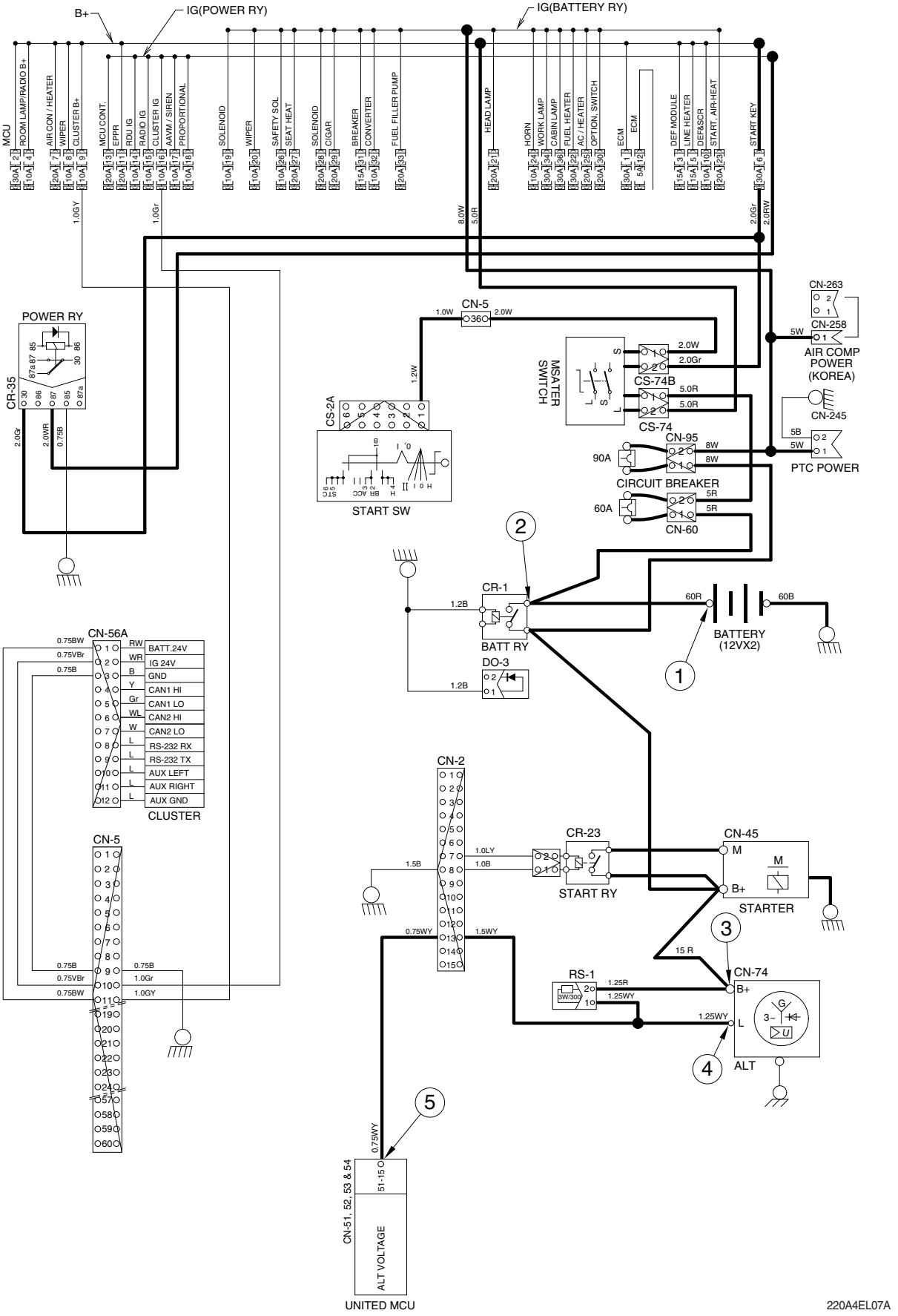
2) CHECK POINT

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

※ GND : Ground

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

CHARGING CIRCUIT (MACHINE SERIAL NO. : #-0070)



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

CHARGING CIRCUIT (MACHINE SERIAL NO. : #0071-)

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 "L" terminal → I/conn [CN-2 (13)] → United MCU alternator voltage [CN-51 (15)] → Cluster charging warning lamp (Via CAN interface)

(2) Charging flow

Alternator "B^+" terminal → Starter [CN-45 (B^+)] → Battery relay (CR-1)

- → Battery (+) terminal
- → Circuit breaker [CN-60] → Master switch [CS-74] → Fuse box [B^+]
- → Circuit breaker [CN-95]
  - → Fuse box [IG, battery] → Power relay [CR-35 (30→87)]
    - → Fuse box [IG, power]
  - → PTC power [CN-245 (1)]
  - → Air comp power [CN-258 (1)]

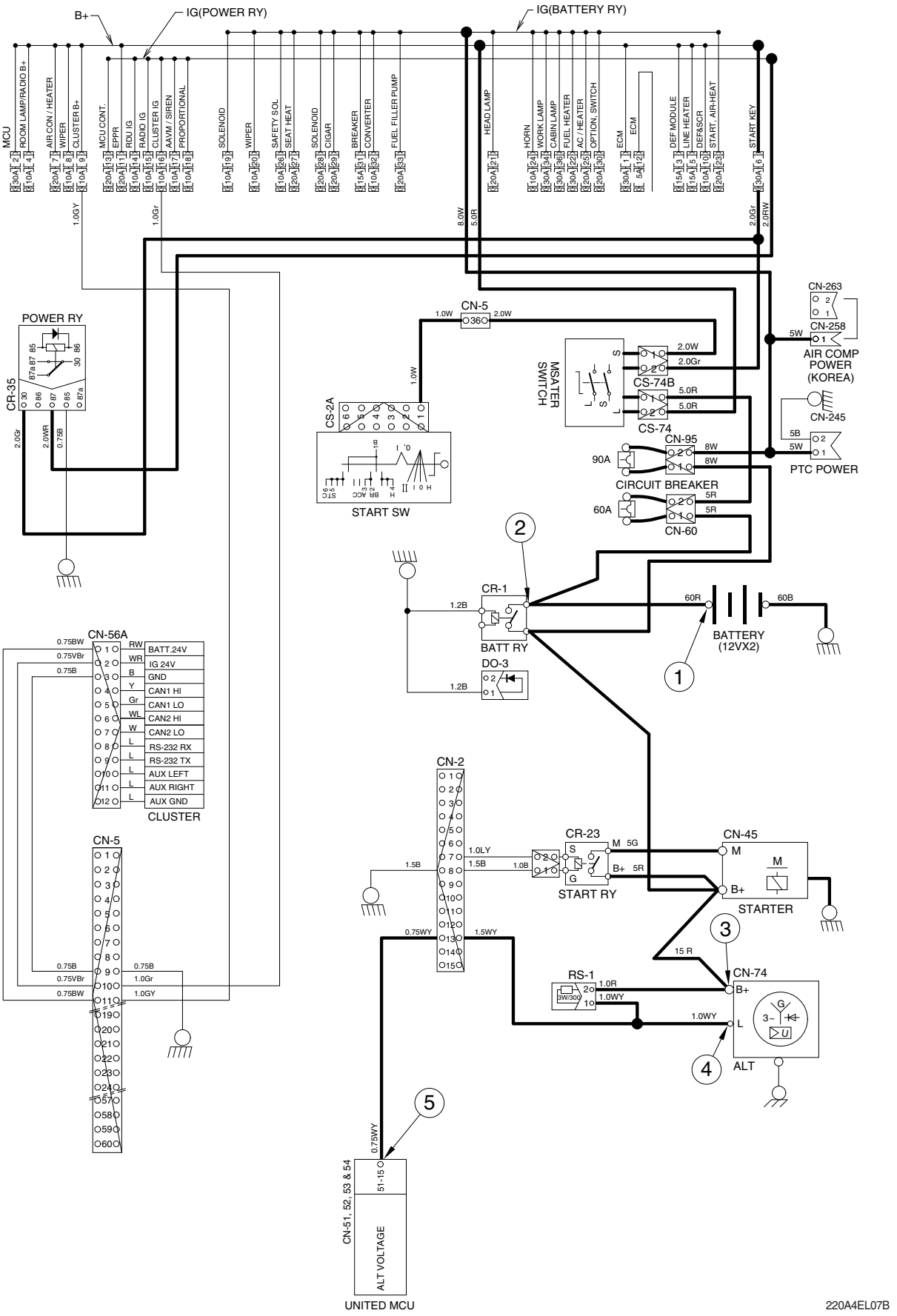
2) CHECK POINT

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

※ GND : Ground

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

CHARGING CIRCUIT (MACHINE SERIAL NO. : #0071-)



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

4. HEAD AND WORK LIGHT CIRCUIT (MACHINE SERIAL NO. : -#0315)

1) OPERATING FLOW

Fuse box (No.21) → Head light relay [CR-13 (30, 86)]
Fuse box (No.34) → Work light relay [CR-4 (30, 86)]
Fuse box (No.14) → RDU 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 (1), CL-4 (1), CL-24 (1)]
→ I/conn [CN-7 (1)] → Cigar lighter [CL-2]
→ I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]

(2) Work light switch ON

Work light switch ON [CN-376 (4)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (1), CL-6 (1)]

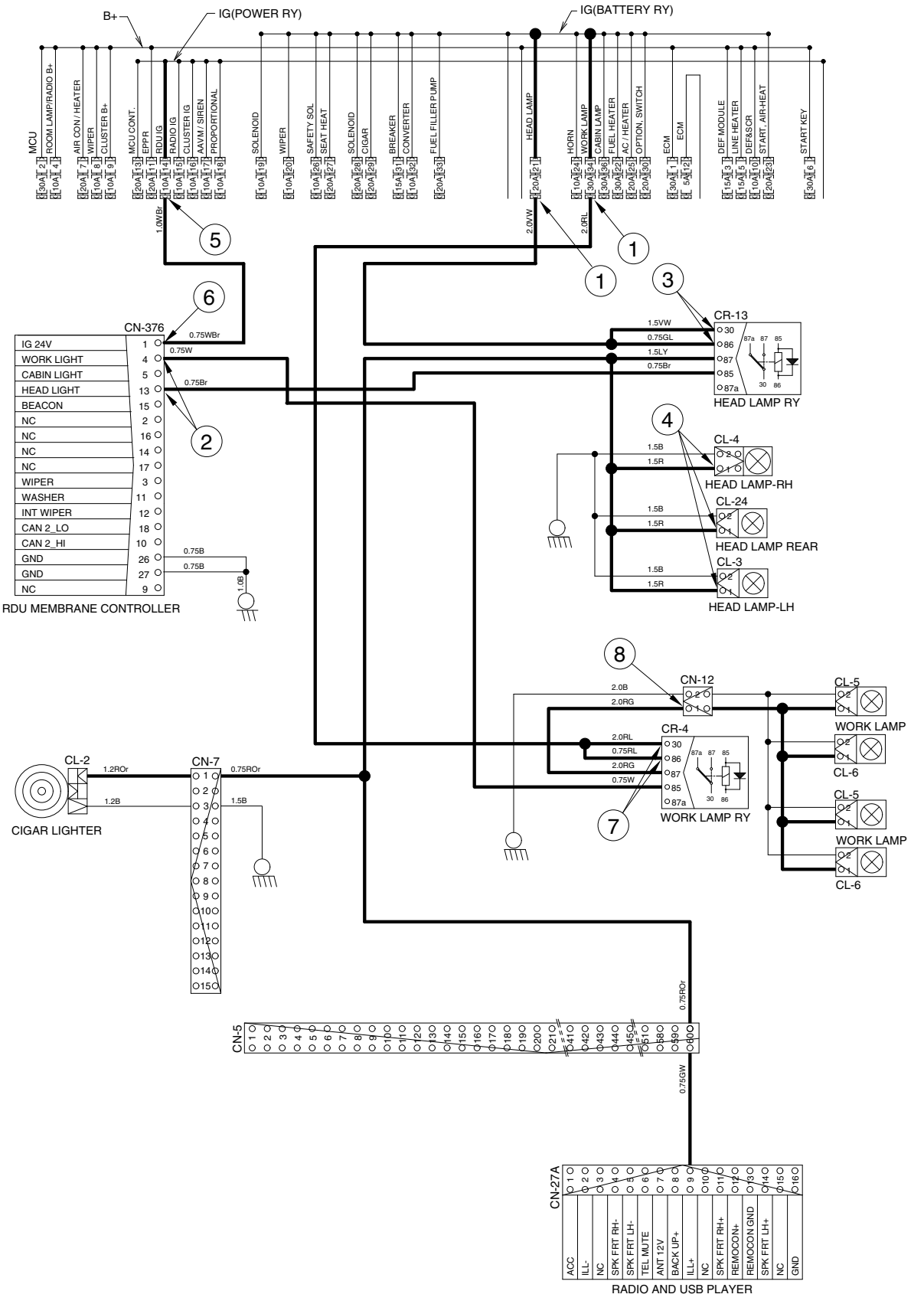
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power output) ③ - GND (head light relay) ④ - GND (head light) ⑤ - GND (fuse box) ⑥ - GND (switch power input) 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 (MACHINE SERIAL NO. : #-0315)



220A4EL08

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

HEAD AND WORK LIGHT CIRCUIT (MACHINE SERIAL NO. : #0316-)

1) OPERATING FLOW

Fuse box (No.21) → Head light relay [CR-13 (30, 86)]
Fuse box (No.34) → Work light relay [CR-4 (30, 86)]
Fuse box (No.14) → RDU 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 (1), CL-4 (1), CL-24 (1)]
→ I/conn [CN-7 (1)] → Cigar lighter [CL-2]
→ I/conn [CN-5 (60)] → Radio & USB player illumination ON [CN-27A (9)]

(2) Work light switch ON

Work light switch ON [CN-376 (4)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (1), CL-6 (1)]

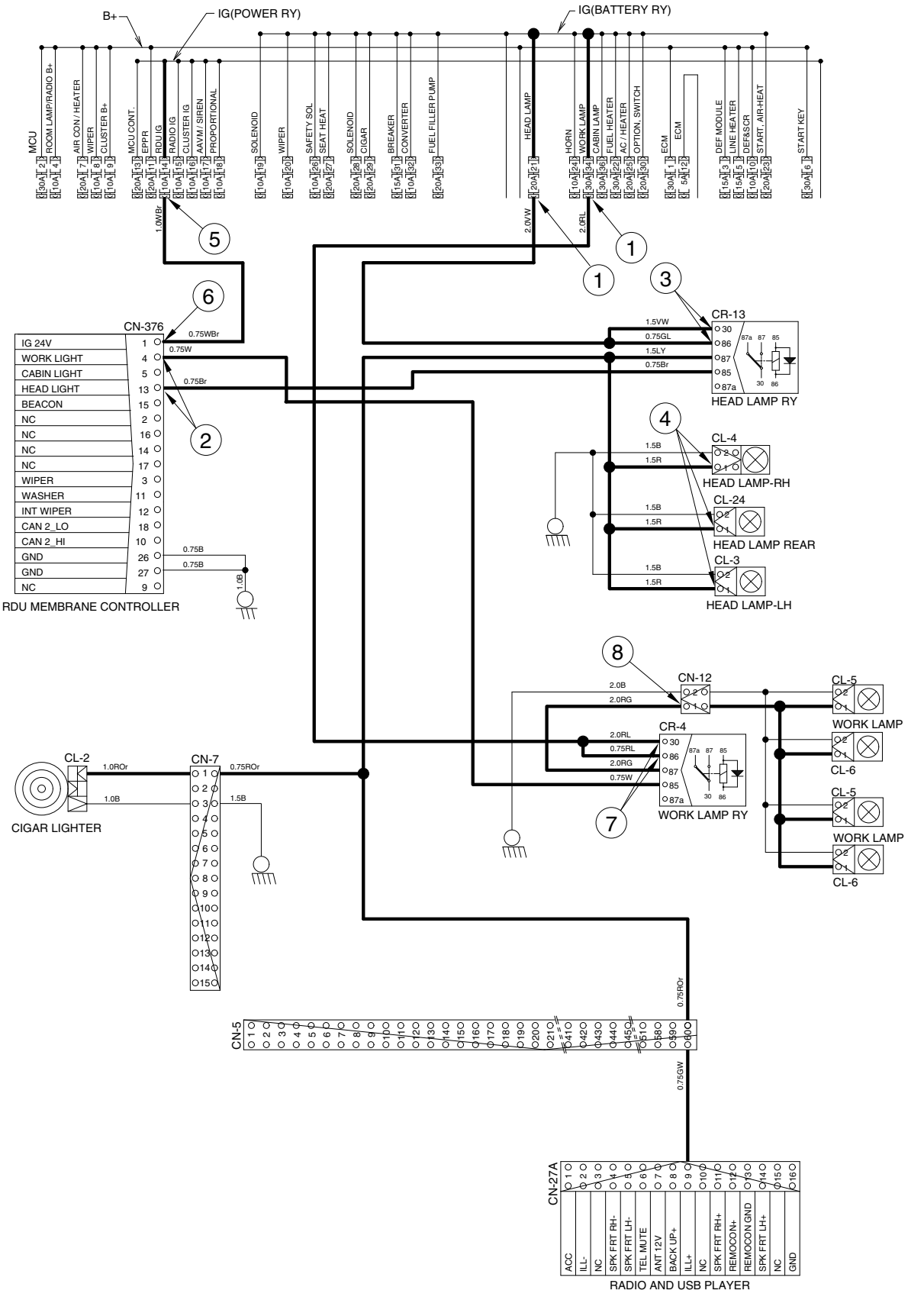
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power output) ③ - GND (head light relay) ④ - GND (head light) ⑤ - GND (fuse box) ⑥ - GND (switch power input) 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 (MACHINE SERIAL NO. : #0316-)



220A4EL08A

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

5. BEACON LAMP AND CAB LIGHT CIRCUIT (MACHINE SERIAL NO. : -#0315)

1) OPERATING FLOW

Fuse box (No.30) → Beacon lamp relay [CR-85 (2, 3)]
Fuse box (No.36) → Cab light relay [CR-9 (30, 86)]
Fuse box (No.14) → RDU 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)]

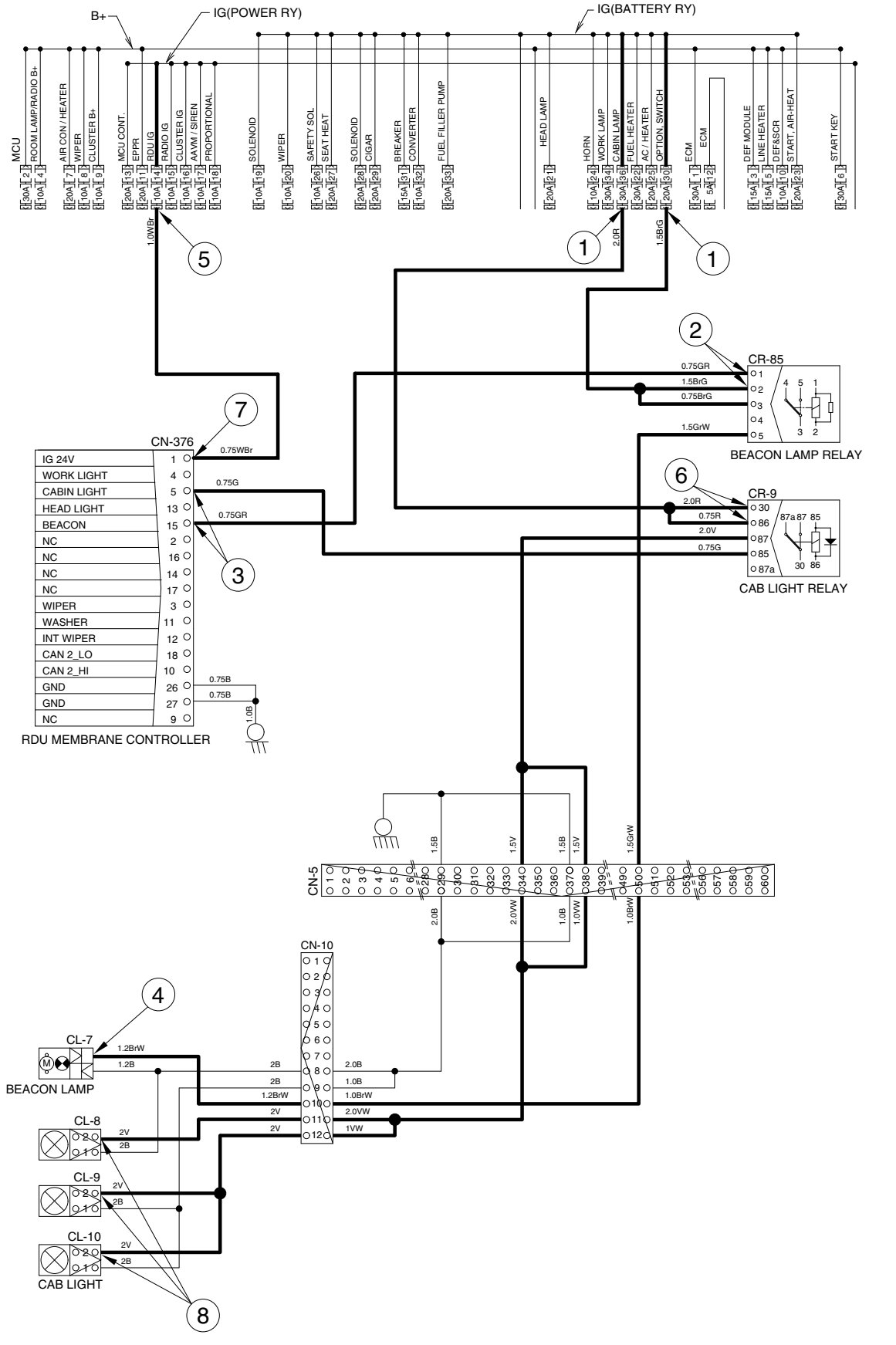
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (beacon lamp relay) ③ - GND (switch power output) ④ - GND (beacon lamp) ⑤ - GND (fuse box) ⑥ - GND (cabin light relay) ⑦ - GND (switch power input) 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 (MACHINE SERIAL NO. : -#0315)



220A4EL09

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

BEACON LAMP AND CAB LIGHT CIRCUIT (MACHINE SERIAL NO. : #0316-)

1) OPERATING FLOW

Fuse box (No.30) → Beacon lamp relay [CR-85 (2, 3)]
Fuse box (No.36) → Cab light relay [CR-9 (30, 86)]
Fuse box (No.14) → RDU 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)]

(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)]

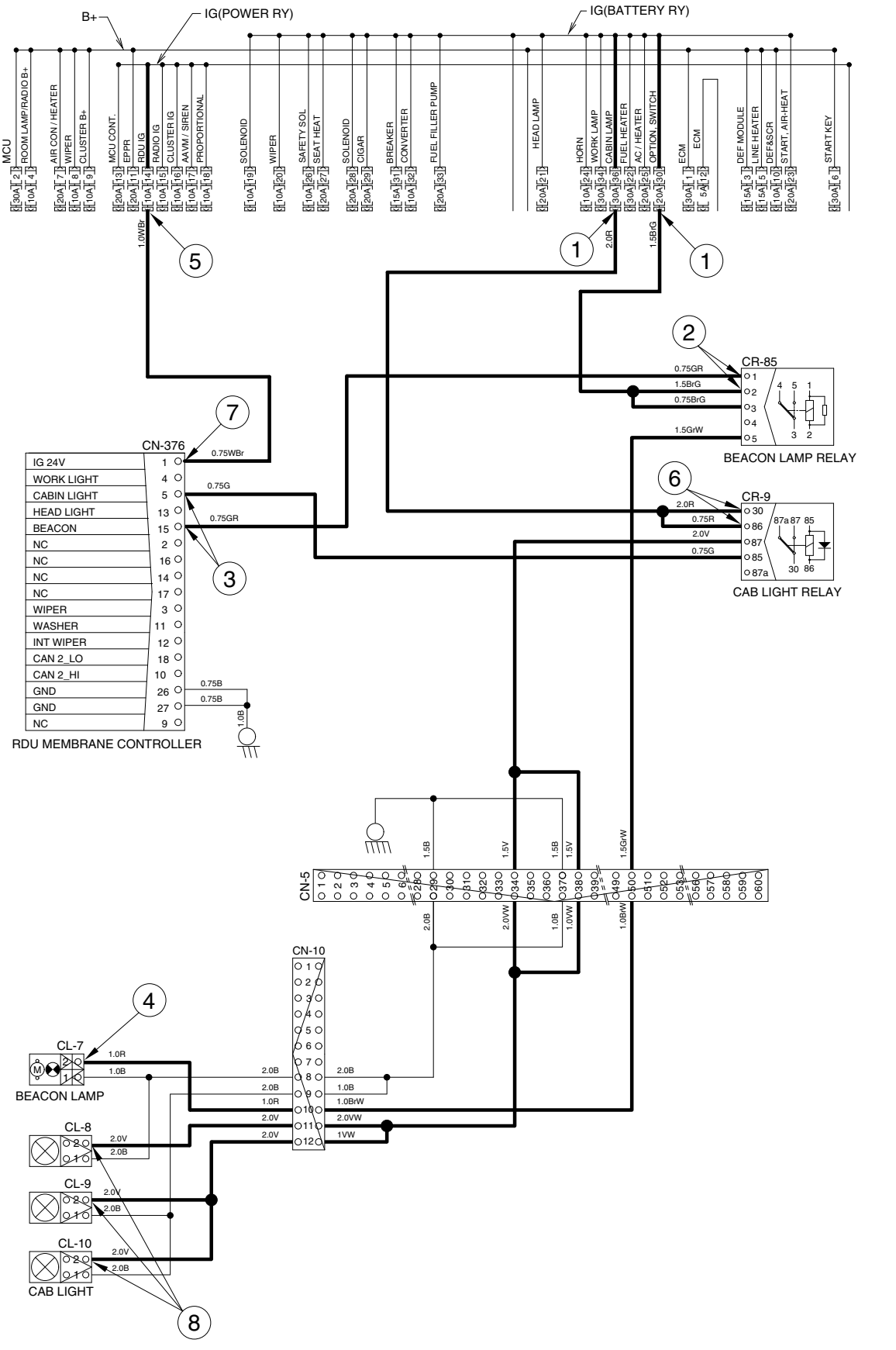
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (beacon lamp relay) ③ - GND (switch power output) ④ - GND (beacon lamp) ⑤ - GND (fuse box) ⑥ - GND (cabin light relay) ⑦ - GND (switch power input) 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 (MACHINE SERIAL NO. : #0316-)



220A4EL09A

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

6. WIPER AND WASHER CIRCUIT (MACHINE SERIAL NO. : -#0315)

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.14) → RDU membrance controller [CN-376 (1)]

Fuse box (No.8) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] → Wiper motor controller [CN-141 (7)]
→ Wiper motor [CN-21 (4)]

Fuse box (No.20) → I/conn [CN-5 (16)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
→ Low wiper motor [CN-407 (3)]
→ Washer 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, 12)] → Wiper motor parking position by wiper motor controller

2) OPERATING FLOW (LOW WIPER)

(1) Key switch ON

Fuse box (No. 30) → I/conn [CN-7 (8)] → Low wiper switch [CS-79 (1, 5)]

(2) Wiper switch ON (1st)

Wiper switch ON [CS-79 (1 → 2)] → I/conn [CN-7 (5)] → Wiper motor [CN-407 (4)] → Wiper operating

(3) Wiper switch ON (2nd)

Wiper switch ON [CS-79 (5 → 4)] → I/conn [CN-7 (6)] → I/conn [CN-18 (2)] → Washer pump [CN-407 (2)]
→ Washer operating →

Wiper switch ON [CS-79 (1 → 2)] → I/conn [CN-7 (5)] → Wiper motor [CN-407 (4)] → Wiper operating

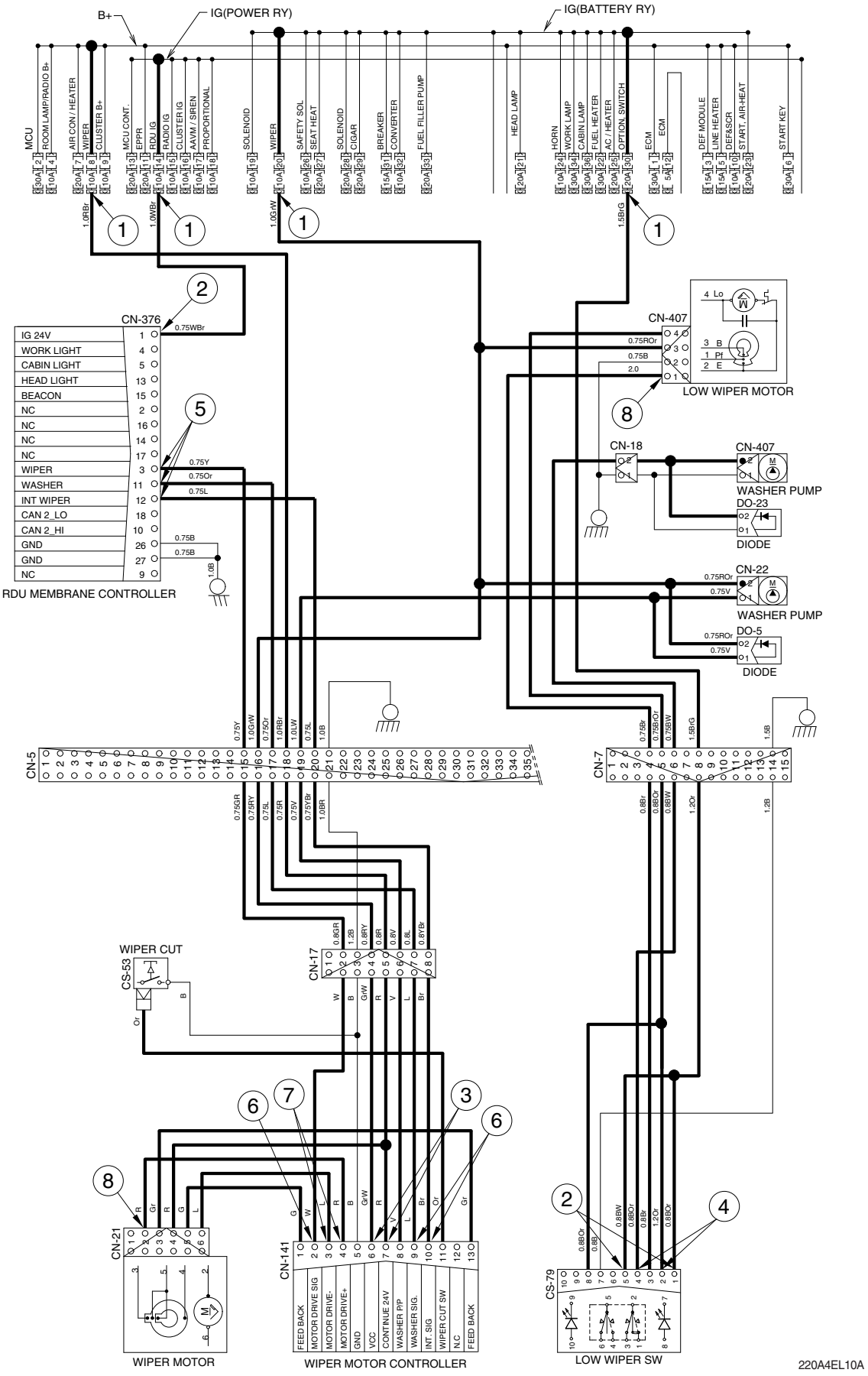
3) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input) ③ - GND (wiper power input) ④ - GND (switch power output)	20~25V
		⑤ - GND (switch power output) ⑥ - GND (wiper power switch input)	0 ~ 5V
		⑦ - GND (wiper power output)	24V
		⑧ - 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 (MACHINE SERIAL NO. : -#0315)



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

6. WIPER AND WASHER CIRCUIT (MACHINE SERIAL NO. : #0316-)

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.14) → RDU membrance controller [CN-376 (1)]

Fuse box (No.8) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] → Wiper motor controller [CN-141 (7)]
→ Wiper motor [CN-21 (4)]

Fuse box (No.20) → I/conn [CN-5 (16)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
→ Low wiper motor [CN-407 (3)]
→ Washer 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, 12)] → Wiper motor parking position by wiper motor controller

2) OPERATING FLOW (LOW WIPER)

(1) Key switch ON

Fuse box (No. 30) → I/conn [CN-7 (8)] → Low wiper switch [CS-79 (1, 5)]

(2) Wiper switch ON (1st)

Wiper switch ON [CS-79 (1 → 2)] → I/conn [CN-7 (5)] → Wiper motor [CN-407 (4)] → Wiper operating

(3) Wiper switch ON (2nd)

Wiper switch ON [CS-79 (5 → 4)] → I/conn [CN-7 (6)] → I/conn [CN-18 (2)] → Washer pump [CN-407 (2)]
→ Washer operating →

Wiper switch ON [CS-79 (1 → 2)] → I/conn [CN-7 (5)] → Wiper motor [CN-407 (4)] → Wiper operating

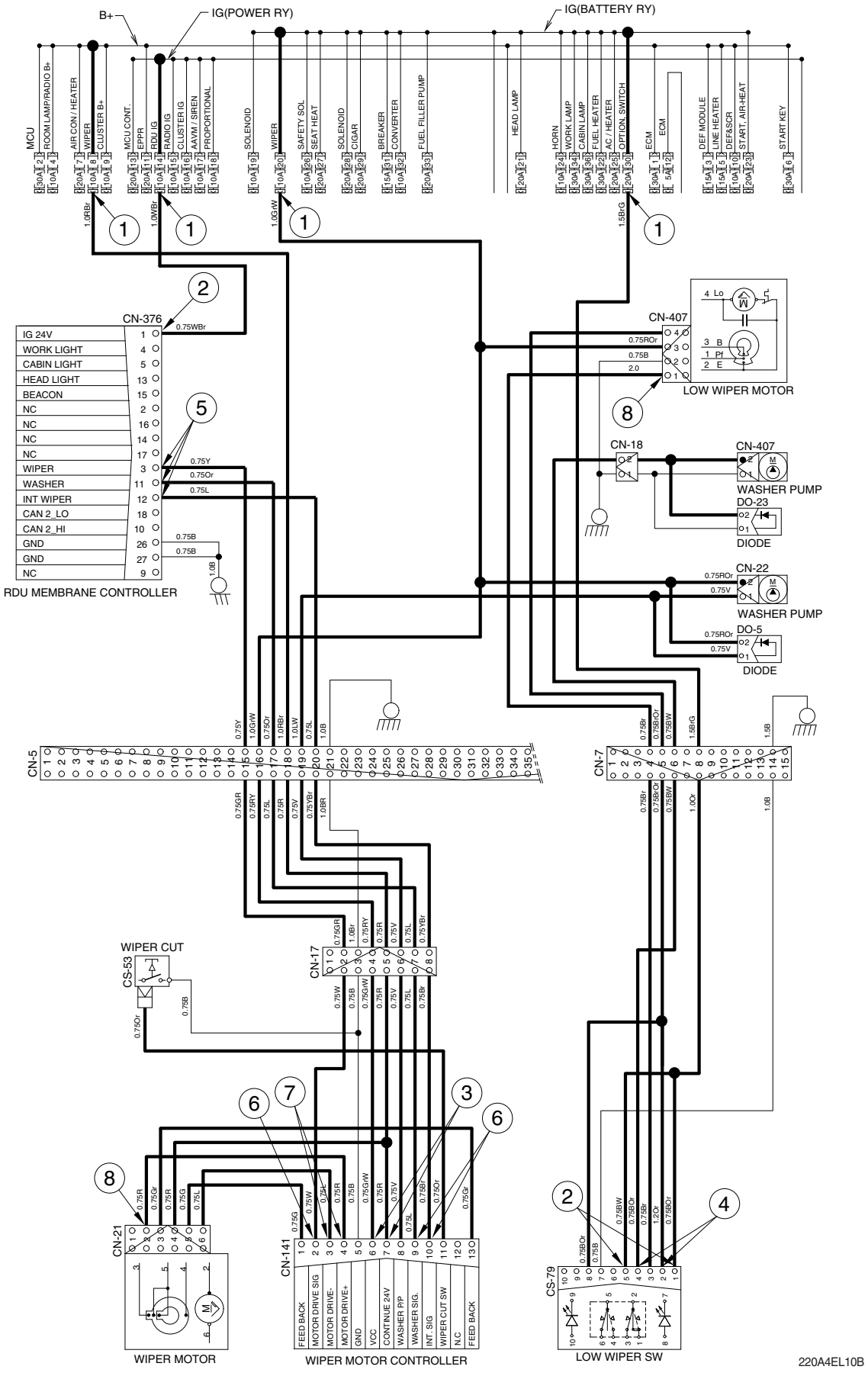
3) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input) ③ - GND (wiper power input) ④ - GND (switch power output)	20~25V
		⑤ - GND (switch power output) ⑥ - GND (wiper power switch input)	0 ~ 5V
		⑦ - GND (wiper power output)	24V
		⑧ - GND (wiper motor)	0 or 24V

※ GND : Ground

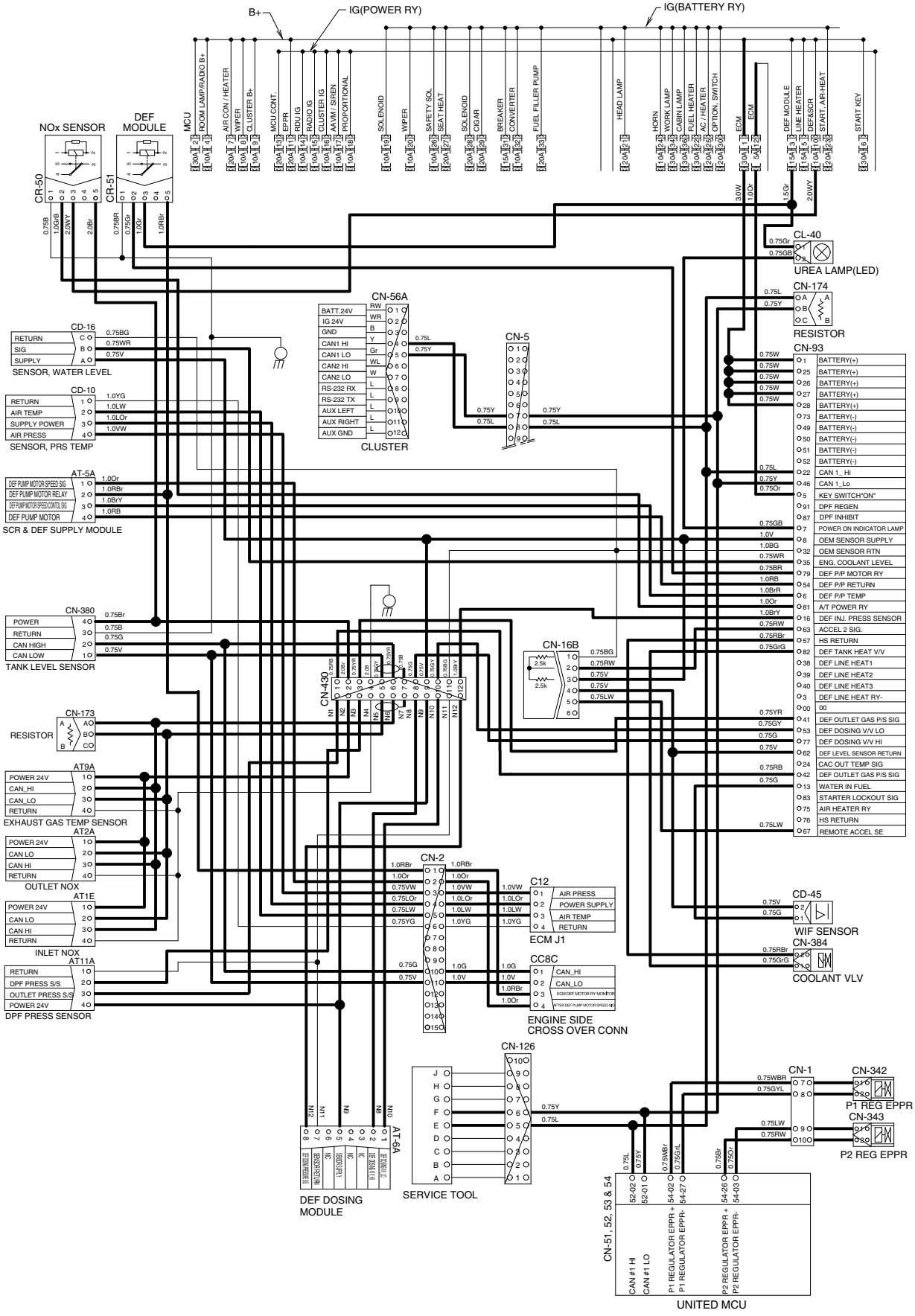
※ The circuit diagram may differ from the equipment, so please check before a repair.

WIPER AND WASHER CIRCUIT (MACHINE SERIAL NO. : #0316-)



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

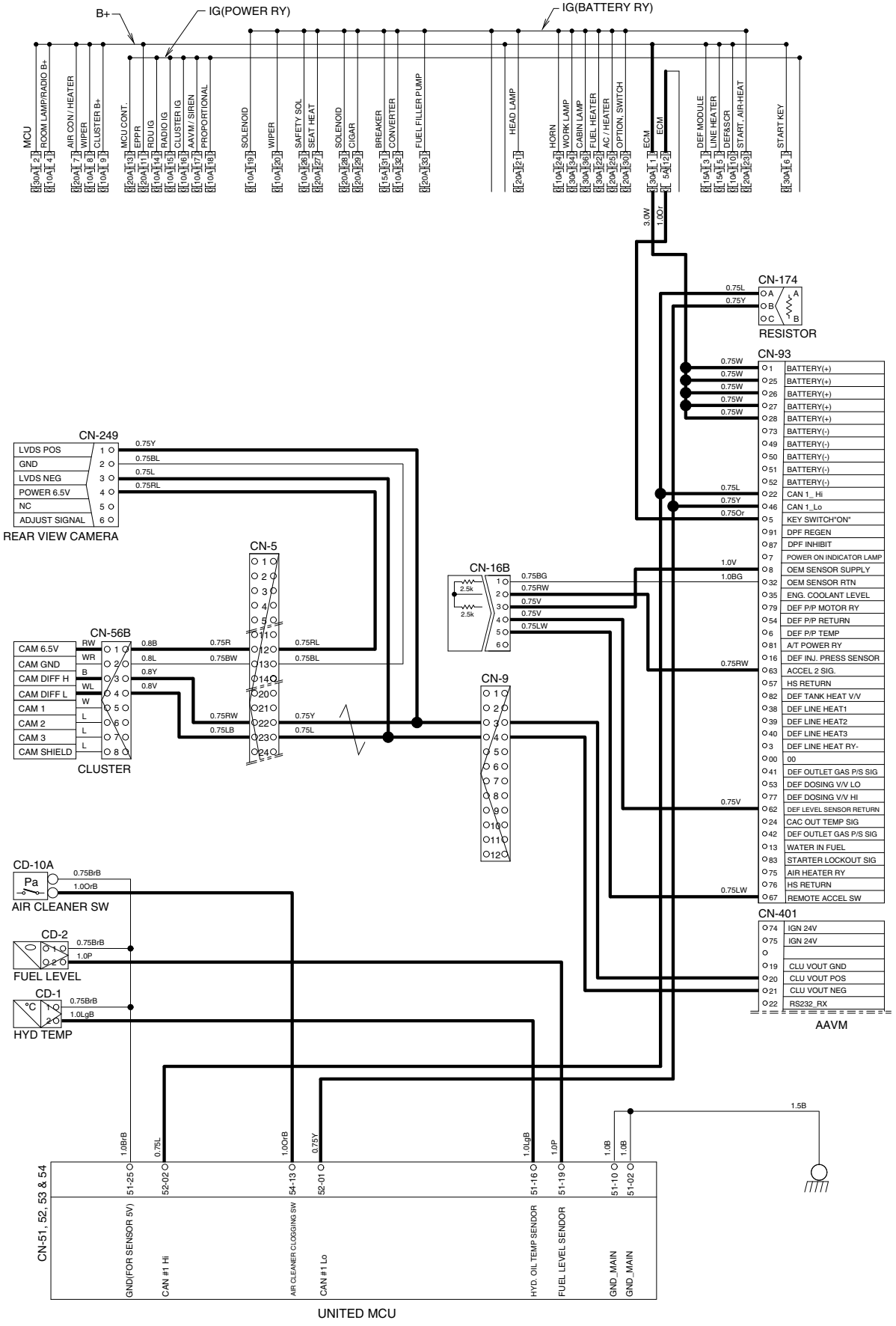
7. CONTROLLER CIRCUIT (MACHINE SERIAL NO. : -#0001)



220A4EL11A

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

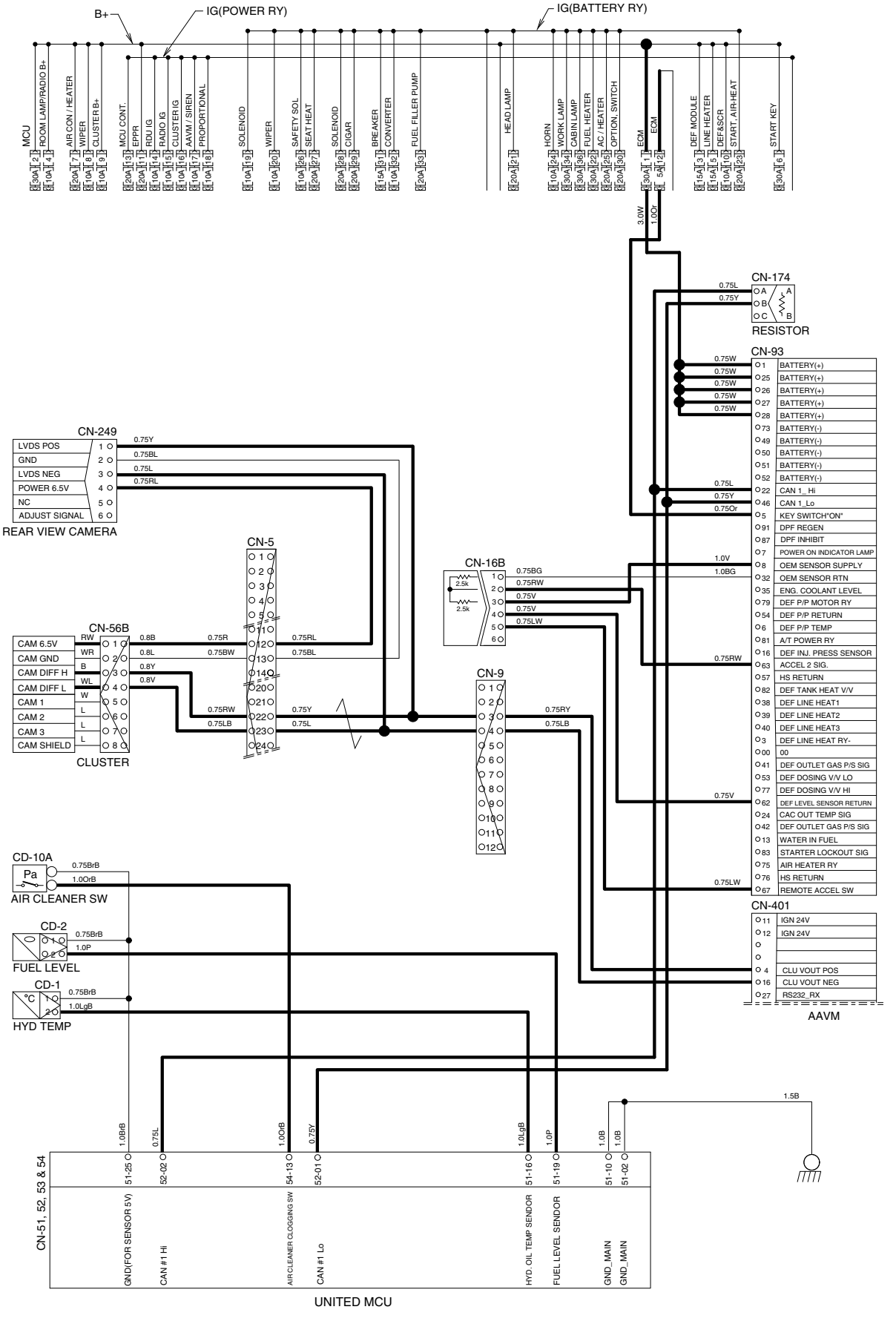
8. MONITORING CIRCUIT (MACHINE SERIAL NO. : -#0070)



220A4EL12

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

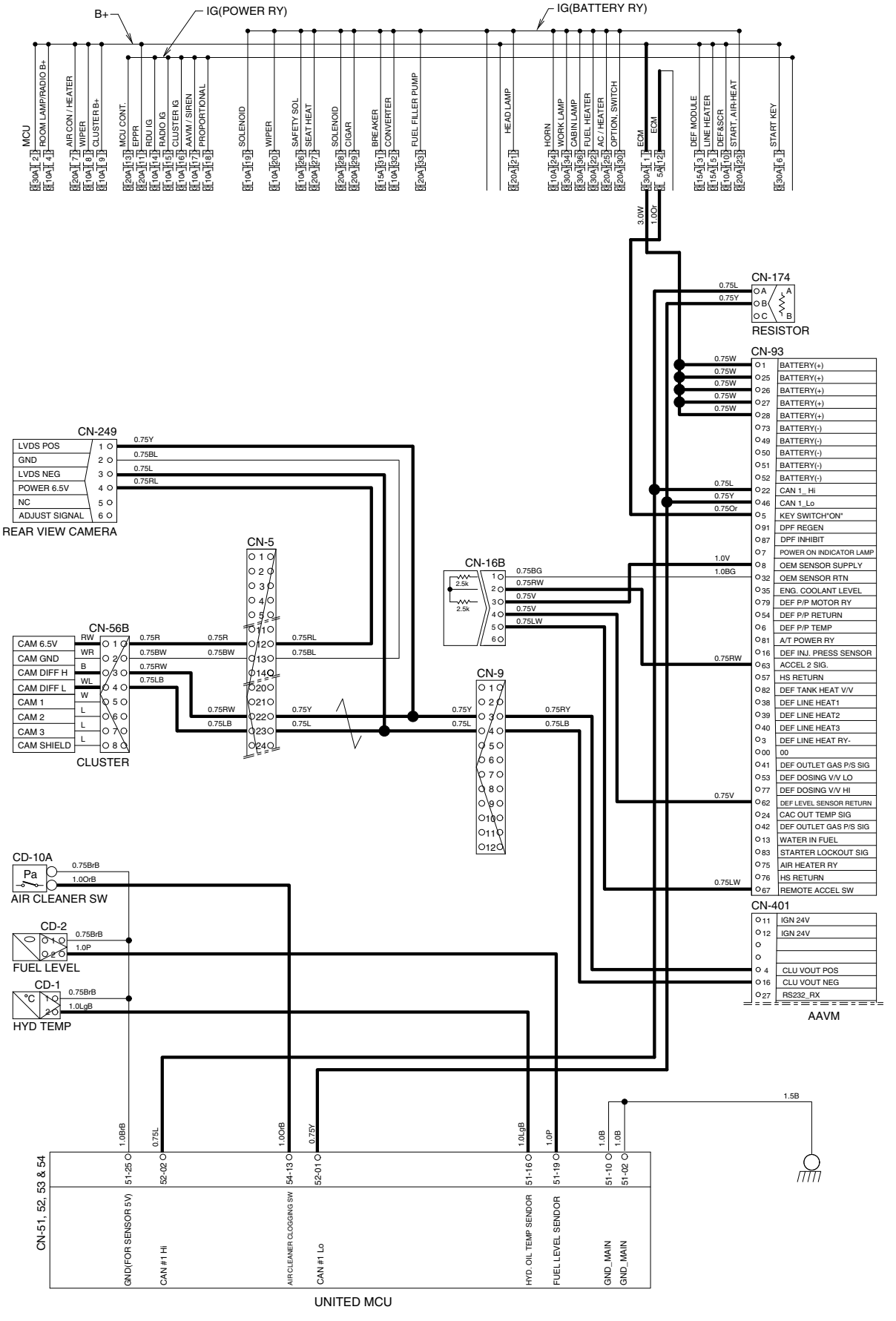
MONITORING CIRCUIT (MACHINE SERIAL NO. : #0071-#0315)



220A4EL12A

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

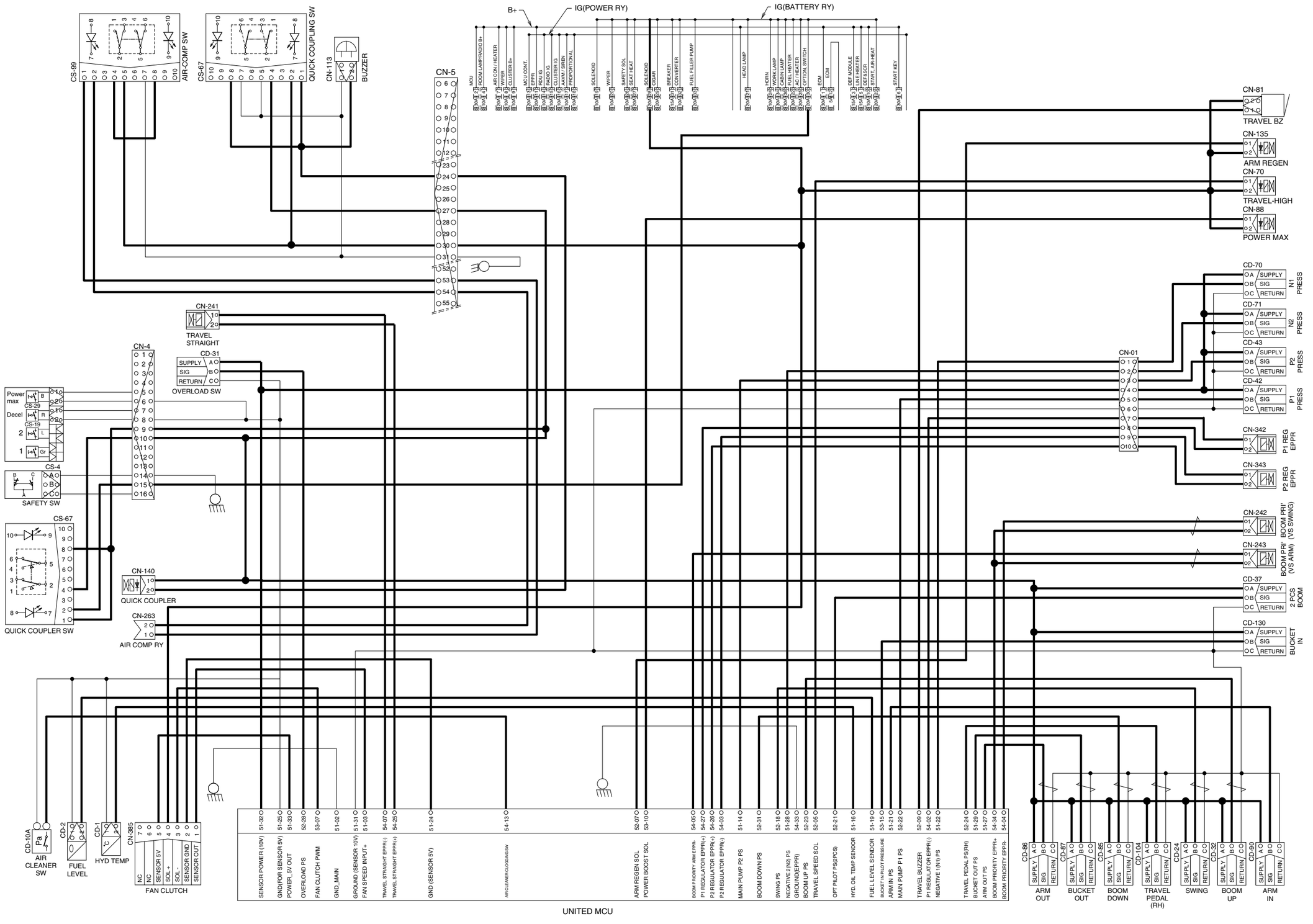
MONITORING CIRCUIT (MACHINE SERIAL NO. : #0316-)



220A4EL12B

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

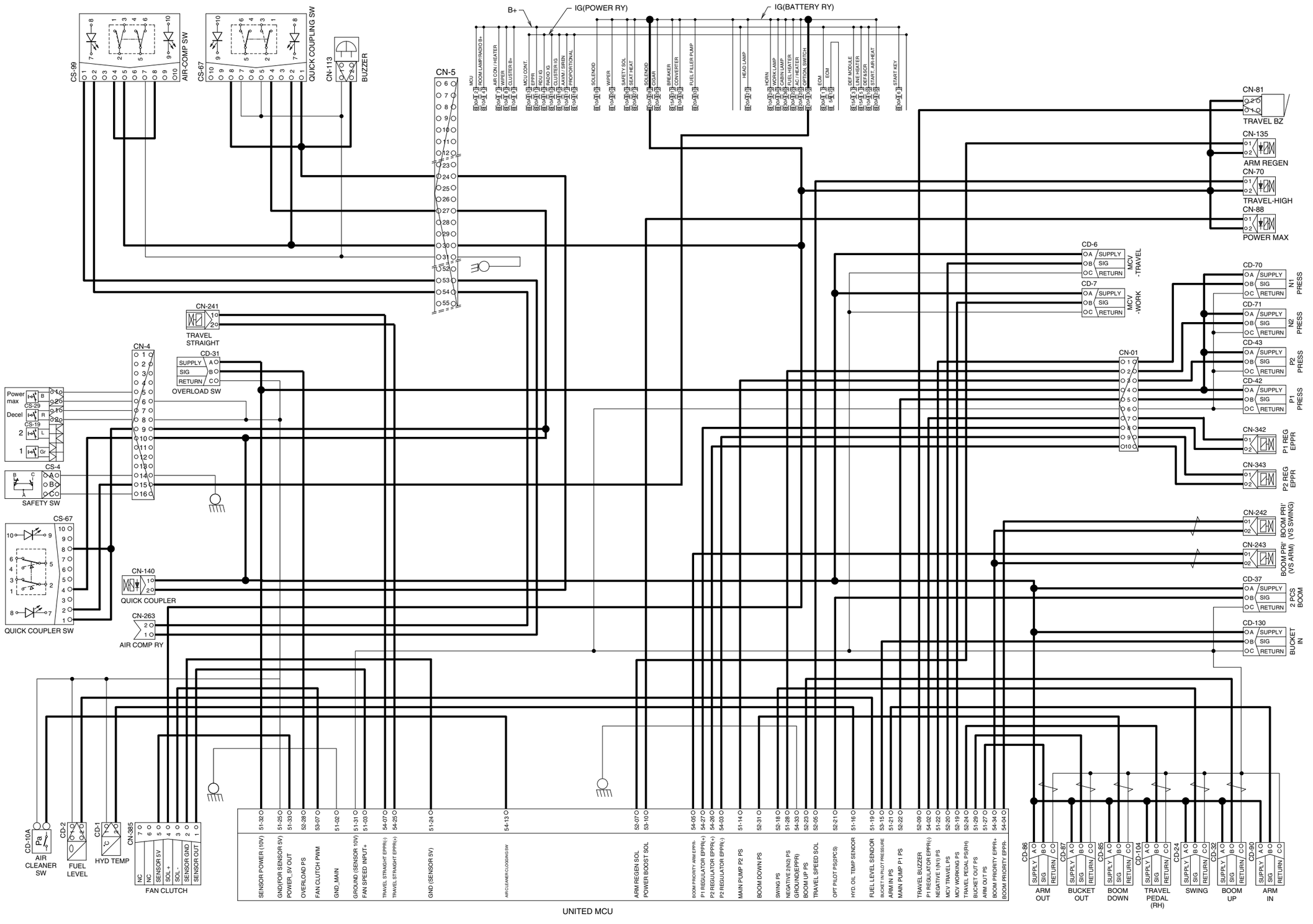
9. ELECTRIC CIRCUIT FOR HYDRAULIC (1/2, MACHINE SERIAL NO. : -#0139)



220A4EL13A

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

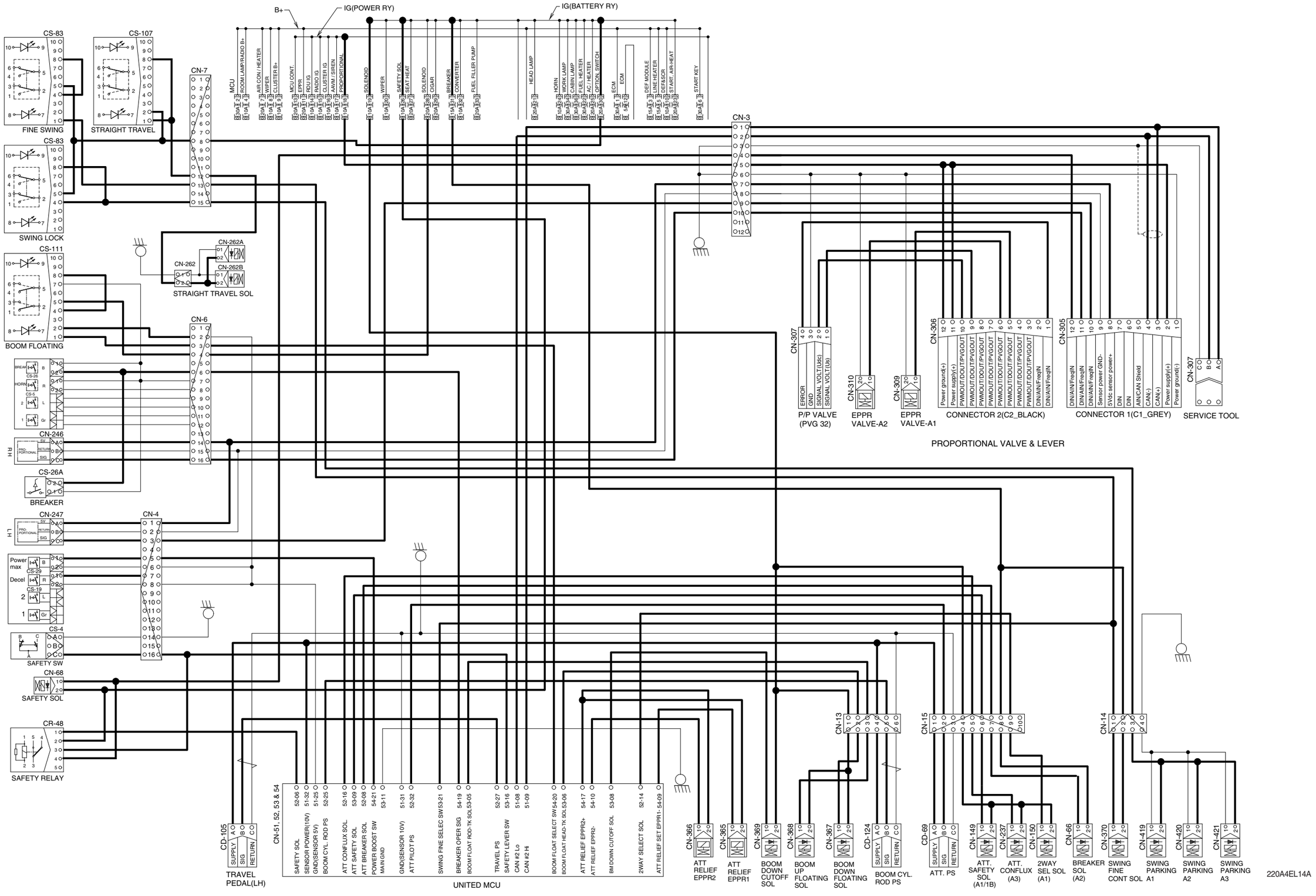
ELECTRIC CIRCUIT FOR HYDRAULIC (1/2, MACHINE SERIAL NO. : #0140-)



220A4EL13B

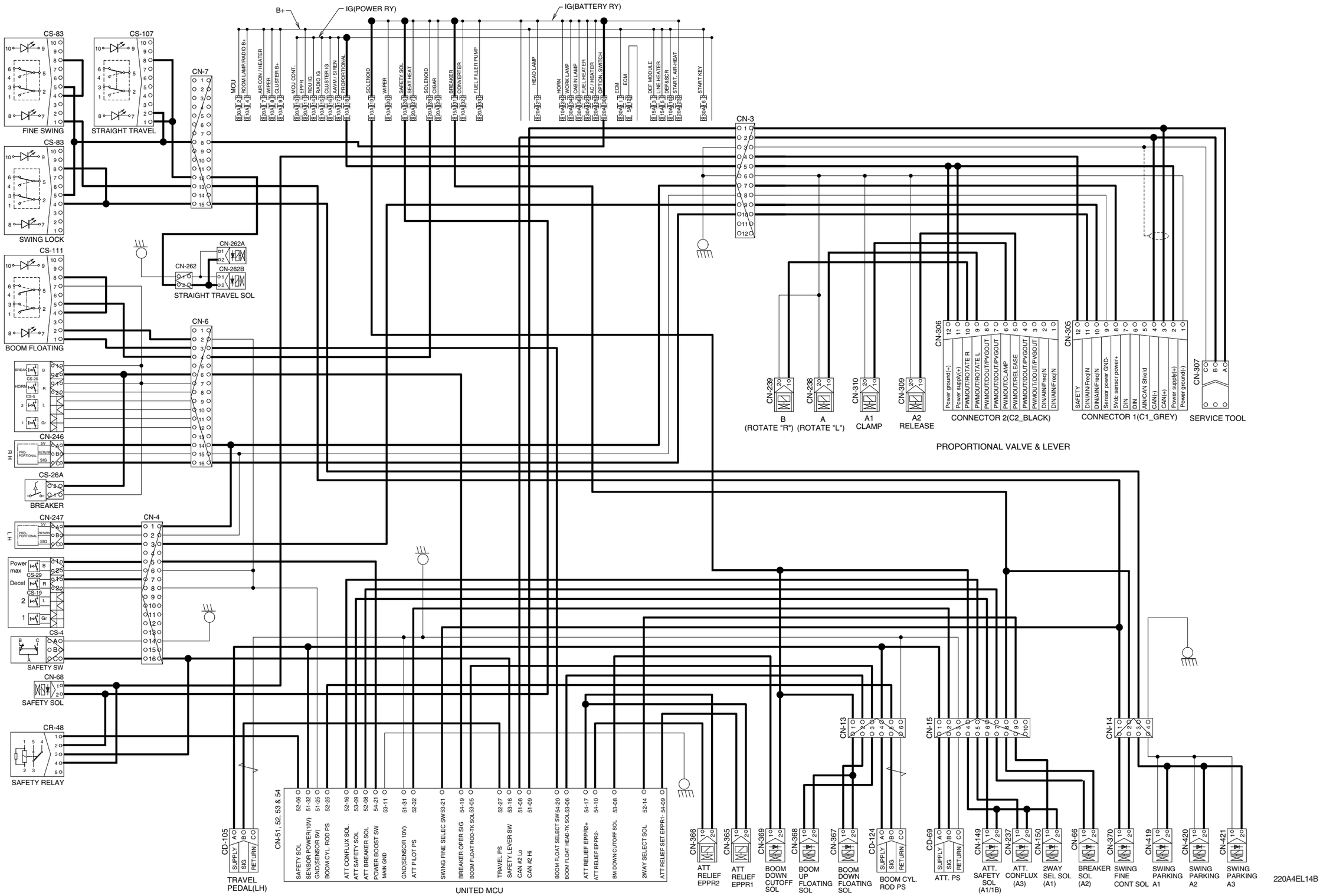
※ The circuit diagram may differ from the equipment, so please check before a repair.

10. ELECTRIC CIRCUIT FOR HYDRAULIC (2/2, MACHINE SERIAL NO. : -#0070)



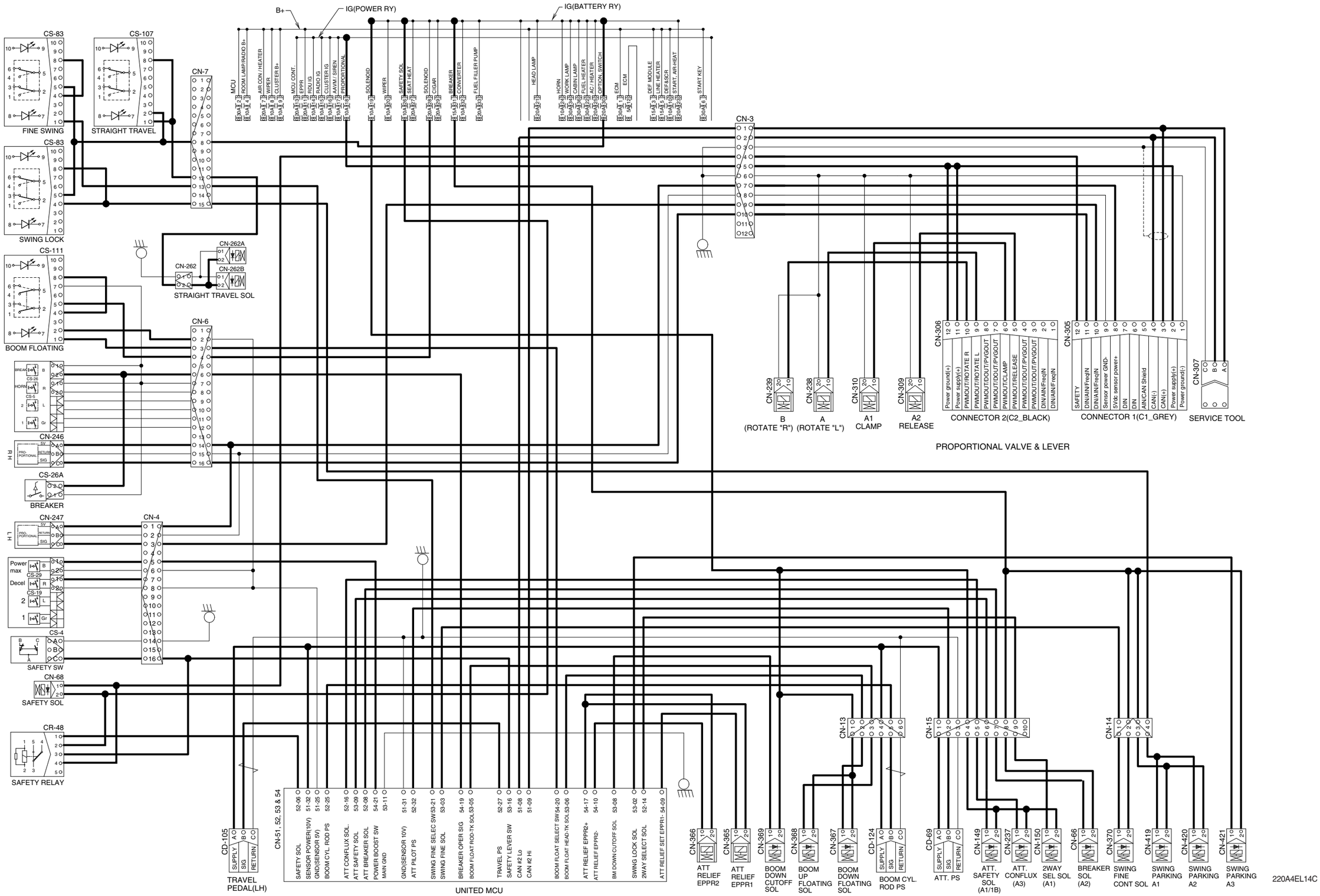
※ The circuit diagram may differ from the equipment, so please check before a repair.

ELECTRIC CIRCUIT FOR HYDRAULIC (2/2, MACHINE SERIAL NO. : #0071-#0139)



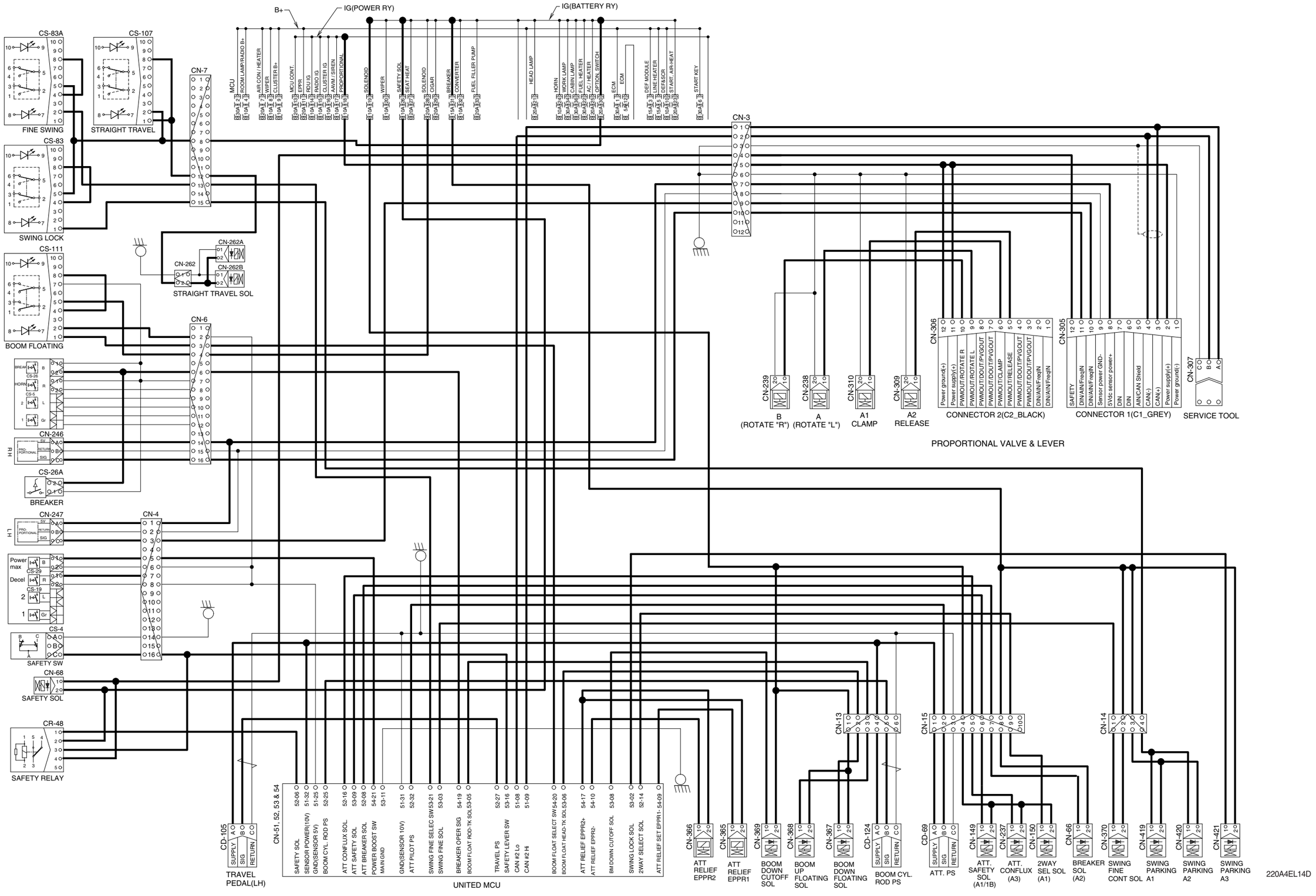
※ The circuit diagram may differ from the equipment, so please check before a repair.

ELECTRIC CIRCUIT FOR HYDRAULIC (2/2, MACHINE SERIAL NO. : #0140-#0315)



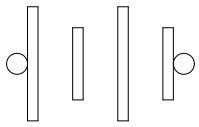
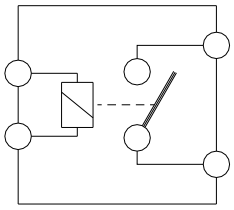
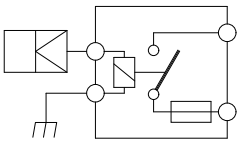
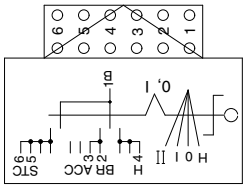
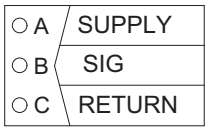
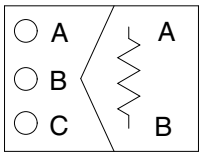
※ The circuit diagram may differ from the equipment, so please check before a repair.

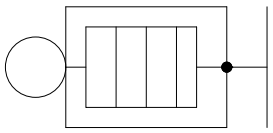
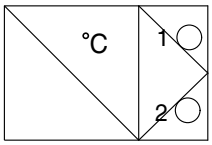
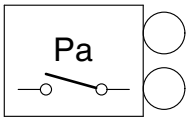
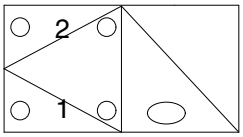
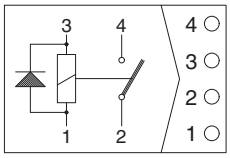
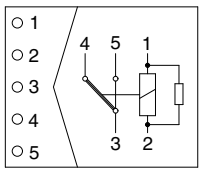
ELECTRIC CIRCUIT FOR HYDRAULIC (2/2, MACHINE SERIAL NO. : #0316-)

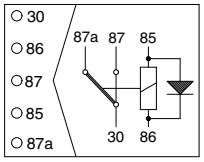
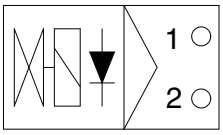
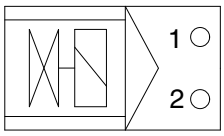
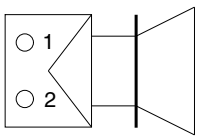
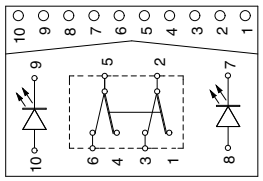
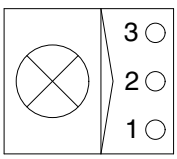


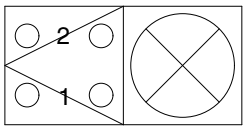
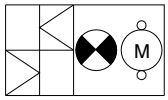
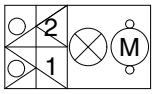
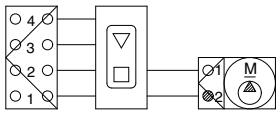
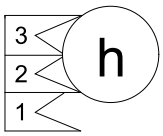
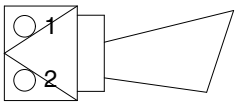
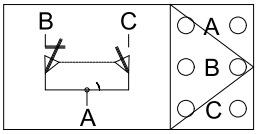
※ The circuit diagram may differ from the equipment, so please check before a repair.

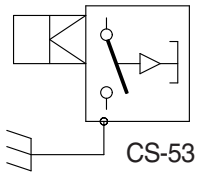
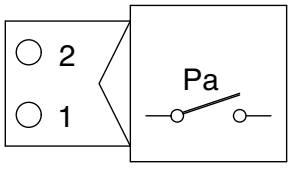
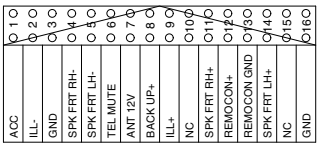
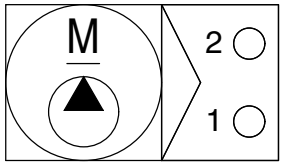
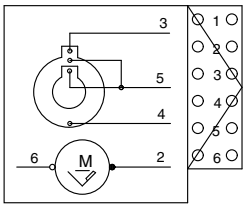
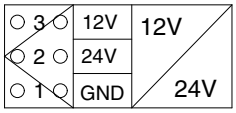
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

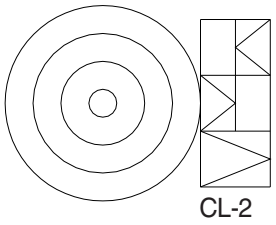
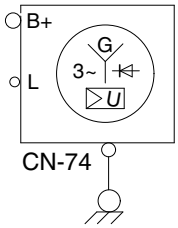
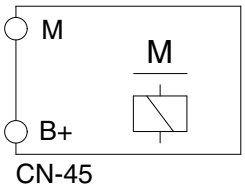
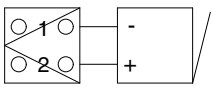
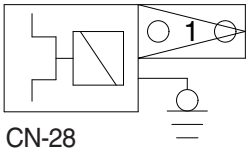
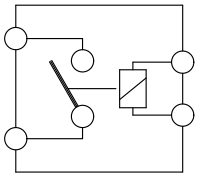
Part name	Symbol	Specifications	Check
Battery		12V × 160Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942Ω (for terminal 1-GND)
Start key	 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-16 CD-24 CD-31 CD-32 CD-37 CD-42 CD-43 CD-69 CD-70 CD-71 CD-85 CD-86 CD-87 CD-90 CD-104 CD-105 CD-124 CD-130	8~30V	※ Check contact Normal : 0.1Ω
Resistor	 CN-173 CN-174	3W	※ Check resistance A-B : 120Ω

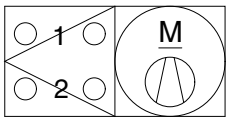
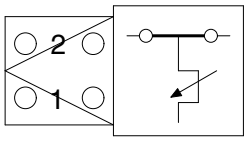
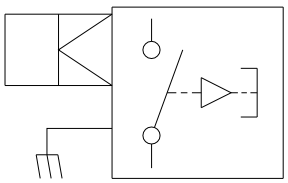
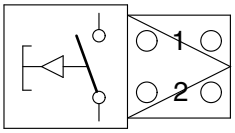
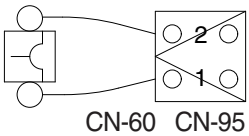
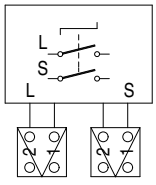
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω
Air cleaner pressure switch (-#00122)	 CD-10A	N.O TYPE	※ Check contact High level : ∞Ω Low level : 0Ω
Fuel level 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-5 CR-36 CR-39 CR-48 CR-50 CR-51 CR-85	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0Ω (for terminal 3-4) ∞Ω (for terminal 3-5)

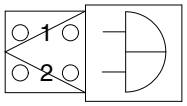
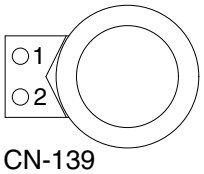
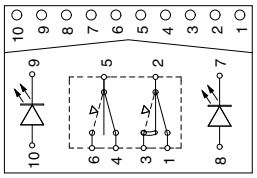
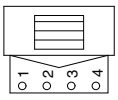
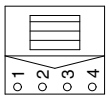
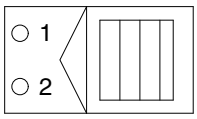
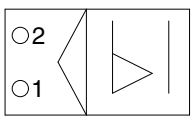
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-7 CR-9 CR-13 CR-35 CR-46 CR-52	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-150 CN-237 CN-262A CN-262B CN-367 CN-368 CN-369 CN-370 CN-419 CN-420 CN-421	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-81 CN-238 (#0070-) CN-239 (#0070-) CN-242 CN-243 CN-309 CN-310 CN-342 CN-343 CN-365 CN-366	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-260 CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-52 CS-67 CS-73 CS-83 CS-83A (#0316-) CS-99 CS-107 CS-108 CS-111	24V 1.5A	※ Check contact Normal ON : 0 Ω (for terminal 2-3, 5-6) ∞ Ω (for terminal 2-1, 5-4) OFF : ∞ Ω (for terminal 2-3, 5-6) 0 Ω (for terminal 2-1, 5-4)
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)

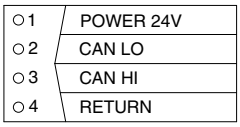
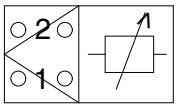
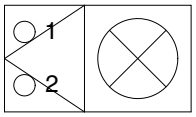
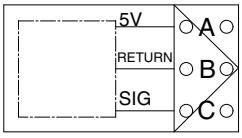
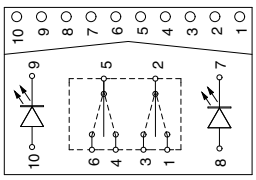
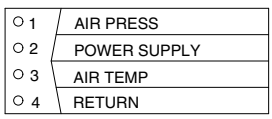
Part name	Symbol	Specifications	Check
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2Ω
Beacon lamp	-#0315  #0316-  CL-7	21V 70W (H1 Type)	※ Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※ Check resistance Normal : 1.0Ω
Hour meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.1 and connect terminal No.2 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)

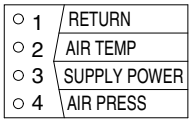
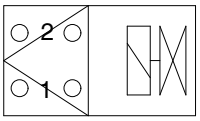
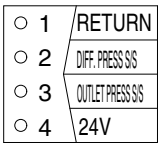
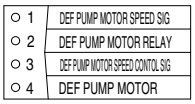
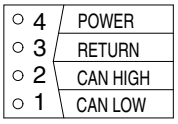
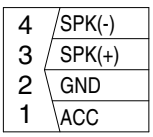
Part name	Symbol	Specifications	Check
Wiper cut switch		24V (N.O TYPE)	※ Check contact Normal : 0Ω(one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : ∞Ω
Radio & USB player	 CN-27A	24V 2A	※ Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22 CN-407	24V 3.8A	※ Check 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)

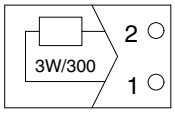
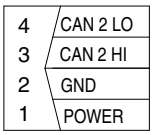
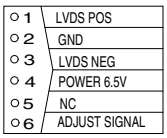
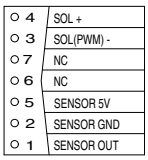
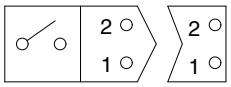
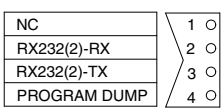
Part name	Symbol	Specifications	Check
Cigar lighter		24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞Ω Operating time : 5~15sec
Alternator		Denso 24V 95A	※ Check contact Normal : 0Ω (for terminal B^+-L) Normal : 24~27.5V
Starter		Denso 24V 4.8kW	※ Check contact Normal : 0.1Ω
Travel alarm		24V 0.5A	※ Check contact Normal : 5.2Ω
Air conditioner compressor		24V 79W	※ Check contact Normal : 13.4Ω
Start relay		24V 300A	※ Check contact Normal : 0.94Ω (for terminal 1-2)

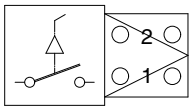
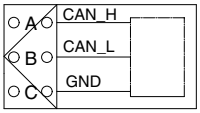
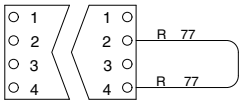
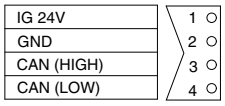
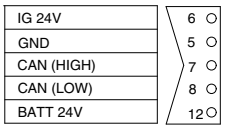
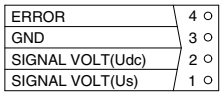
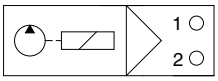
Part name	Symbol	Specifications	Check
Blower motor		24V 9.5A	※ Check resistance Normal : 2.5Ω (for terminal 1-2)
Thermistor (switch)		1˚C OFF 4˚C ON	※ Check resistance Normal : 0Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※ Check resistance Normal : About 5MΩ
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※ Check resistance Normal : ∞Ω
Circuit breaker	 CN-60 CN-95	CN-60 : 60A CN-95 : 90A	※ Check disconnection Normal : 0Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CN-74 CN-74B	6-36V	※ Check disconnection Normal : 0.1Ω

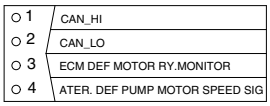
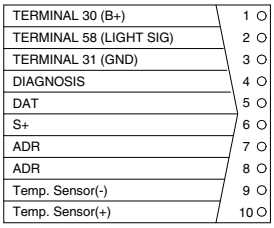
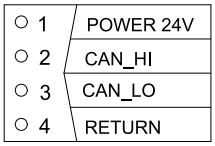
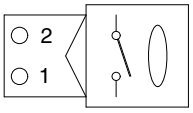
Part name	Symbol	Specifications	Check
Quick coupler buzzer	 CN-113	24V 200mA 107±4dB	-
Socket	 CN-139	12V 10A	-
Switch	 CS-100	24V 8A	※ Check contact Normal ON : 0Ω(for terminal 2-3, 5-6) ∞Ω(for terminal 2-1, 5-4) OFF : ∞Ω(for terminal 2-3, 5-6) 0Ω(for terminal 2-1, 5-4)
Fuel heater	-#0139  #0140-  CN-96	-	-
DEF/AdBlue® line heater	 CN-381 CN-382 CN-383	-	-
WIF sensor	 CD-45	-	-

Part name	Symbol	Specifications	Check
Nox sensor	 AT1E AT2A	-	-
Temperature sensor (A/C)		-	-
DEF/AdBlue® lamp (LED)	 CL-40	-	-
Proportional valve sensor	 CN-246 CN-247	-	-
EPPR valve	 CS-79	24V 8A	※Check contact Normal OFF : ∞Ω (for terminal 1-2, 4-5)
Sensor	 C12	-	-

Part name	Symbol	Specifications	Check
Pressure temp sensor	 CD-10	-	
Coolant valve	 CN-384	-	
DPF pressure sensor	 AT11A	-	
SCR and DEF supply module	 AT-5A	-	
Tank level sensor	 CN-380	-	
Siren AMP	 CN-261	-	

Part name	Symbol	Specifications	Check
Resistor	 RS-1	3W	※ Check resistance Normal : 300Ω
2D/3D MG	 CN-270	-	
Camera (front, rear, side)	 CN-249 CN-402 CN-403 CN-404 CN-405	-	
Fan clutch	 CN-385	-	
Seat belt sw	 CS-250	-	
RMS service tool	 CN-126A	-	

Part name	Symbol	Specifications	Check
Breaker switch	 CS-26A	-	
Start button	 CS-2B	-	
GPS connector	 CN-125	-	
Reader	-#0315  #0316-  CN-427	-	
Proportional valve	-#0070  CN-307	-	
Dosing pump	 CN-269	-	

Part name	Symbol	Specifications	Check
Engine side cross over connector	 CC8C	-	
Easystart timer	 CN-267	-	
Exhaust gas temp sensor	 AT9A	-	
Float switch	 CS-61	-	

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	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	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Frame harness-Side harness RH)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-6	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-7	AMP	15	I/conn (Console harness RH-Frame harness)	368301-1	2-85262-1
CN-8	AMP	10	I/conn (Console harness RH-Frame harness)	S816-010002	174655-2
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-E004
CN-13	AMP	6	I/conn (Frame harness-Boom floating harness)	174262-2	174264-2
CN-14	AMP	4	I/conn (Frame harness-S/f & parking harness)	174257-2	174259-2
CN-15	AMP	10	I/conn (Frame harness-2-way harness)	174655-2	174657-2
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	AMP	8	I/conn (Side harness RH-Wiper harness)	S816-008002	S816-108002
CN-18	AMP	2	Washer tank 2	174352-2	174354-2
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	DEUTSCH	2	Horn	DT06-2S-EP06	-
CN-27A	KUM	16	Radio & USB player	PK145-16017	-
CN-27B	AMP	8	Radio & USB player	-	174984-2
CN-28	KUM	1	Aircon compressor	MG610320	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-108000	-
CN-48	KET	1	Hour meter	2-520193-2	-
CN-51	TE	34	United MCU	2-1473285-3	-
CN-52	TE	34	United MCU	4-1437290-1	-
CN-53	TE	26	United MCU	1473416-1	-
CN-54	TE	34	United MCU	4-1437290-0	-
CN-56A	AMP	12	Cluster	-	174663-2
CN-56B	AMP	8	Cluster	-	174984-2
CN-60	YAZAKI	2	Circuit breaker	-	7222-4220-30

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-61	DEUTSCH	4	Fuel filler pump	DT06-4S-EP06	DT04-4P-E005
CN-62	DEUTSCH	2	Auto grease	DT06-2S-EP06	DT04-2P-E005
CN-66	DEUTSCH	2	Breaker (A2)	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid (A1)	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid (A3)	DT06-2S-EP06	-
CN-74	RING-TERM	1	Alternator "B+" terminal	S820-108000	-
CN-74	RING-TERM	1	Alternator "L" terminal	S820-105000	-
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 (A2)	DT06-2S-EP06	-
CN-93	DELPHI	-	ECM	13964577	-
CN-95	YAZAKI	2	Circuit breaker	-	7222-4220-30
CN-96	AMP	4	I/conn (Frame harness - Fuel warmer harness)	-	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 ground	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-125B	DEUTSCH	8	RMS	DT06-8S	DT04-8P
CN-126	TE/AMP	10	Service tool	1473416-1	S816-110002
CN-135	DEUTSCH	2	Arm regeneration solenoid (A5)	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 coupler solenoid	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	-
CN-147	DELPHI	2	Fuel heater	15300027	-
CN-149	DEUTSCH	2	Attachment safety (A1)	DT06-2S-EP06	-
CN-150	DEUTSCH	2	Pedal safety (B1)	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat	DT06-2S	DT04-2P
CN-157	AMP	1	Antena power	S822-014002	-
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-174	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-237	DEUTSCH	2	Attachment conflux (A3)	DT06-2S-EP06	-
CN-241	DEUTSCH	2	Travel straight solenoid (A3)	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Boom swing solenoid (A2)	DT06-2S-EP06	-
CN-243	DEUTSCH	2	Boom arm solenoid (A1)	DT06-2S-EP06	-
CN-245	FCI	4	PTC power	180900-0	-
CN-246	DEUTSCH	3	Proportional valve-RH	DT06-3S	DT04-3P

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-246A	DEUTSCH	4	Preheater harness	DT06-4S-EP06	-
CN-246B	DEUTSCH	4	Preheater harness	-	DT04-4P-EP06
CN-247	DEUTSCH	3	Proportional valve-LH	DT06-3S	DT04-3P
CN-249	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P-E005
CN-258	KET	1	Air compressor power	MG640944-5	MG650943-5
CN-259	AMP	6	Camera	S816-006002	S816-106002
CN-260	-	3/2	Siren speaker	21K4-40890	21K4-40880
CN-261	MTA	4	Siren AMP	MG610047	MG620046
CN-262	DEUTSCH	2	I/conn (Frame harness - S/travel harness)	DT06-2S-EP06	DT04-2P-E005
CN-262A	DEUTSCH	2	Straight travel solenoid 1	DT06-2S-EP06	-
CN-262B	DEUTSCH	2	Straight travel solenoid 2	DT06-2S-EP06	-
CN-263	DEUTSCH	2	Air compressor relay	DT06-2S-EP06	DT04-2P-E005
CN-265	VW	8	Controller	3A0973734	-
CN-267	MOLEX	10	Preheater timer	15-97-5101	-
CN-269	TE	2	Dosing pump	282189-1	-
CN-270	DEUTSCH	4	2D/3D MG	DT06-4S-EP06	DT04-4P-E005
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	DT06-3P-E005
CN-308	AMP	4	Proportional-PVG32	2-967059-1	-
CN-309	DEUTSCH	2	Proportional-EPPR valve-A1	DT06-2S-EP06	-
CN-310	DEUTSCH	2	Proportional-EPPR valve-A2	DT06-2S-EP06	-
CN-342	AMP	2	P1 pump regulator solenoid	S816-002002	-
CN-343	AMP	2	P2 pump regulator solenoid	S816-002002	-
CN-363	AMP	12	Jog dial module	174045-2	-
CN-365	DEUTSCH	2	Attach EPPR valve-LH	DT06-2S-EP06	DT04-2P-E005
CN-366	DEUTSCH	2	Attach EPPR valve-RH	DT06-2S-EP06	DT04-2P-E005
CN-367	AMP	2	Boom down floating solenoid	85202-1	DT04-2P-E005
CN-368	DEUTSCH	2	Boom up floating solenoid	DT06-2S-EP06	DT04-2P-E005
CN-369	DEUTSCH	2	Boom down cut off solenoid	DT06-2S-EP06	DT04-2P-E005
CN-370	DEUTSCH	2	Swing fine control solenoid	DT06-2S-EP06	DT04-2P-E005
CN-376	TYCO	23	Membrane controller	7706087-2	-
CN-381	DEUTSCH	2	DEF line heater 3	DT06-2S-EP06	-
CN-382	DEUTSCH	2	DEF line heater 2	DT06-2S-EP06	-
CN-383	DEUTSCH	2	DEF line heater 1	DT06-2S-EP06	-
CN-384	TE	2	Coolant valve solenoid	1-967325-3	-
CN-385	-	7	Fan clutch	965570	-
CN-399	DEUTSCH	4	DEF tank level sensor	DT06-4S-EP06	-
CN-401	FCI	90	AAVM controller	-	-

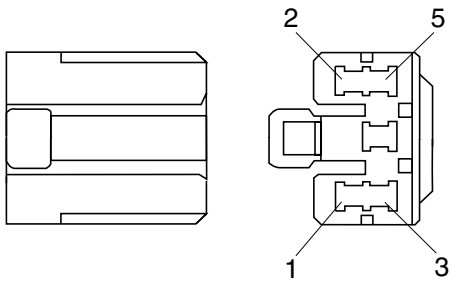
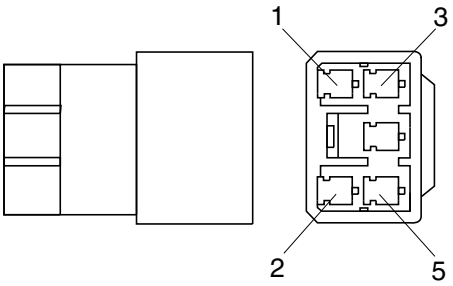
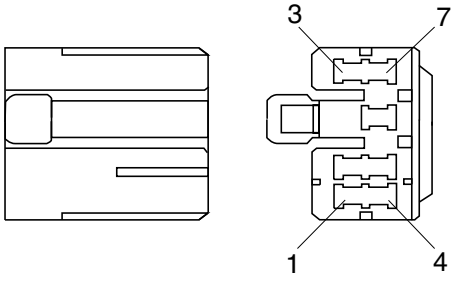
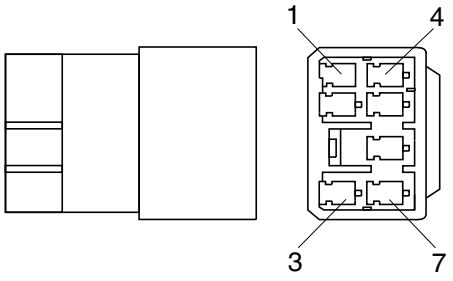
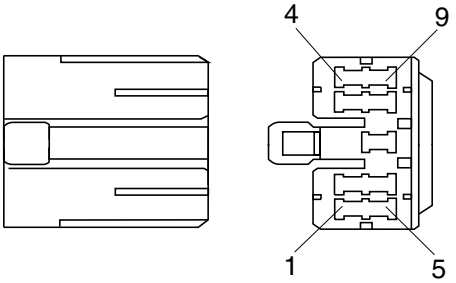
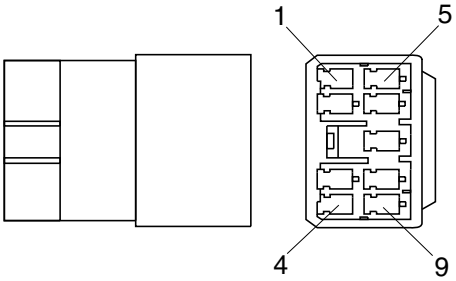
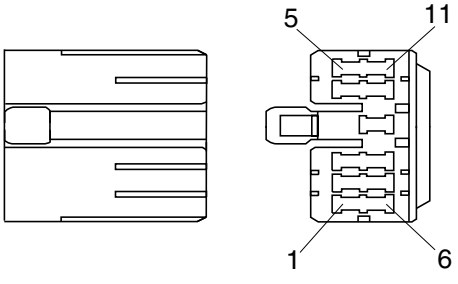
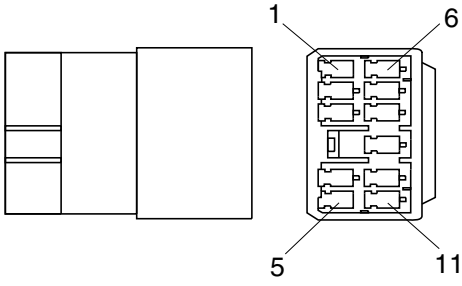
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-402	DEUTSCH	6	Front view camera	DT06-6S-P021	DT04-6P-P021
CN-403	DEUTSCH	6	Rear view camera	DT06-6S-EP06	DT04-6P-EP14
CN-404	DEUTSCH	6	LH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-405	DEUTSCH	6	RH view camera	DT06-6S-EP06	DT04-6P-EP14
CN-406	DEUTSCH	3	Service tool	DT06-3S-EP05	DT04-3P-E005
CN-407	DEUTSCH	4	Low wiper motor	DT06-4S-EP06	DT04-4P-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
		12		5557-12R	5559-12P
CN-429	-	1	CAC out temp sensor	S822-11400	-
CN-430	AMP/Econoseal J	12	I/conn (Frame harness - DEF harness)	174661	S816-112002
AT-1E	TYCO	4	DOC NOx sensor (inlet)	2-1418390-1	-
AT-2A	TYCO	4	SCR NOx sensor (outlet)	1-1418390-1	-
AT-5A	TYCO	4	SCR supply module	2-418390-1	-
AT-6A	TYCO	8	DEF dosing module	1-1418479-1	-
AT-9A	TYCO	4	SCR temperature sensor	4-1418390-1	-
AT-11A	FRAMATOME	4	DEF pressure sensor	54200410	-
C12	FCI	4	Air cleaner	-	54200419
CC8C	DEUTSCH	4	Cross over connector - Engine side	DT06-4S-EP06	-
· 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	S814-002001	S814-102001
CR-24	RING TERM	1	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-39	-	5	Starter lock out relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-48	-	5	Satety ralay	-	-
CR-50	-	5	NOx sensor relay	-	-
CR-51	-	5	DEF module relay	-	-
CR-52	-	5	Line heater relay	-	-

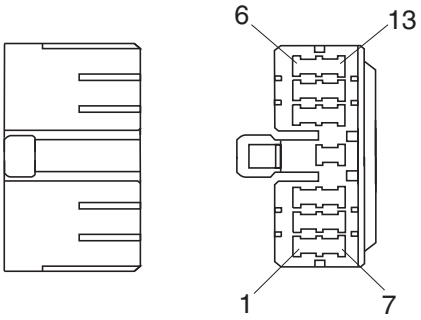
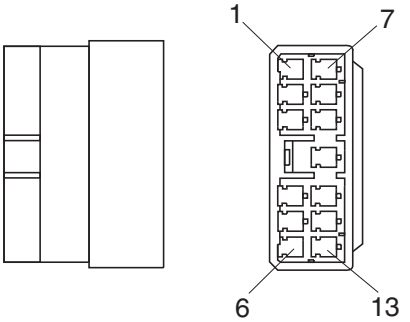
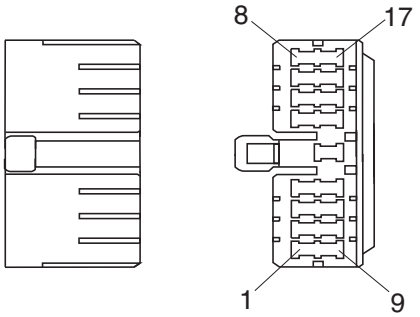
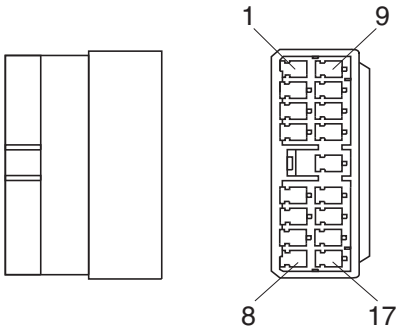
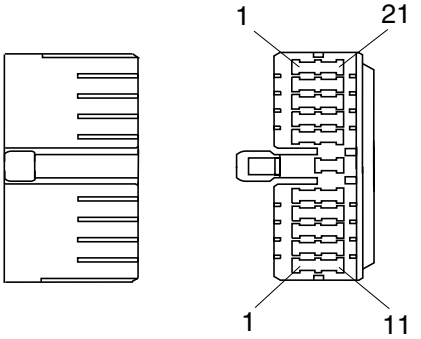
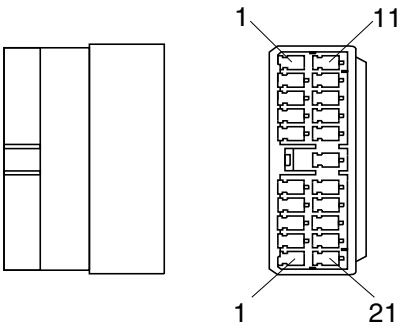
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-85	-	5	Beacon lamp relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2A	WP	6	Start switch	S814-006100	-
CS-2B	DEUTSCH	3	Start button	DT06-3S-EP06	DT04-3P-E005
CS-4	DEUTSCH	3	Safety switch	DT06-3S	-
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	5	Emergency engine stop switch	S816-005002	S816-105002
CS-52	CARLING	10	Adjust & dozer switch	VC2-01	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-61	AMP	2	Floating switch	174352-2	174354-2
CS-67	CARLING	10	Quick coupler switch	VC2-01	-
CS-73	CARLING	10	Swing lock switch	VC2-01	-
CS-73A	CARLING	10	Fine swing switch	VC2-01	-
CS-74	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-74A	KET	2	Power connector	MG610558	MG610557
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-79	CARLING	10	Lower wiper switch	VC2-01	-
CS-83	CARLING	10	Spare switch	VC2-01	-
CS-99	CARLING	10	Air compressor switch	VC2-01	-
CS-100	CARLING	10	Exhaust system cleaning switch	VC2-01	-
CS-107	CARLING	10	Travel straight switch	VC2-01	-
CS-108	CARLING	10	Auto grease switch	VC2-01	-
CS-111	CARLING	10	Boom floating switch	VC2-01	-
CS-250	DEUTSCH	2	Seat switch	DT06-2S	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar lighter	S822-014002	S822-114002
CL-2	AMP	1	Cigar lighter	S810-001202	-
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	DT04-2P
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
CL-24	DEUTSCH	2	Head lamp	DT06-2S-EP06	DT04-2P-E005
CL-40	DEUTSCH	2	DEF/AdBlue® purging lamp	DT06-2S-EP06	DT04-2P
· 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 pilot pressure sw (Py)	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Travel pilot pressure sw (Px)	DT06-3S-EP06	-
CD-10	SUMITOMO	4	Air cleaner switch	6908-0144	-
CD-10A	AMP	2	Air cleaner switch (-#00122)	85202-1	-
CD-16	AMP	3	Water level sensor	1211 0293	-
CD-24	DEUTSCH	3	Swing pilot pressure sw	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload pressure sensor	DT06-3S-EP06	DT04-3P-E005
CD-32	DEUTSCH	3	Boom up pilot pressure sw	DT06-3S-EP06	-
CD-37	DEUTSCH	3	2 pcs boom perssure switch	DT06-3S-EP06	DT04-3P-E005
CD-42	DEUTSCH	3	P1 pump delivery pressure sw	DT06-3S-EP06	-
CD-43	DEUTSCH	3	P2 pump delivery pressure sw	DT06-3S-EP06	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-EP06	-
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 pilot pressure sw	DT06-3S-EP06	-
CD-86	DEUTSCH	3	Arm out pilot pressure sw	DT06-3S-EP06	-
CD-87	DEUTSCH	3	Bucket out pilot pressure sw	DT06-3S-EP06	-
CD-90	DEUTSCH	3	Arm in pilot pressure sw	DT06-3S-EP06	-
CD-104	DEUTSCH	3	RH travel pilot pressure sw	DT06-3S-EP06	-
CD-105	DEUTSCH	3	LH travel pilot pressure sw	DT06-3S-EP06	-
CD-124	DEUTSCH	3	Boom cylinder rod pressure snensor	DT06-3S-EP06	-
CD-130	DEUTSCH	3	Bucket in pilot pressure sw	DT06-3S-EP06	-

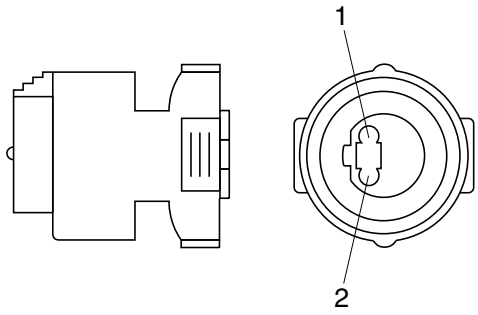
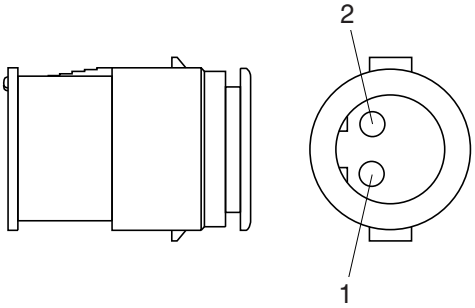
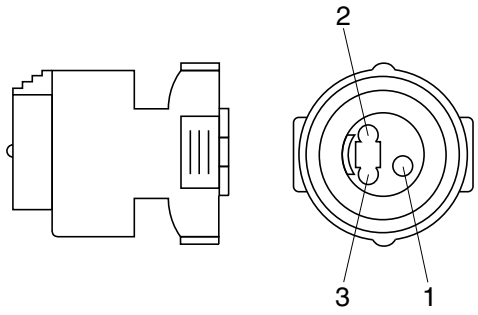
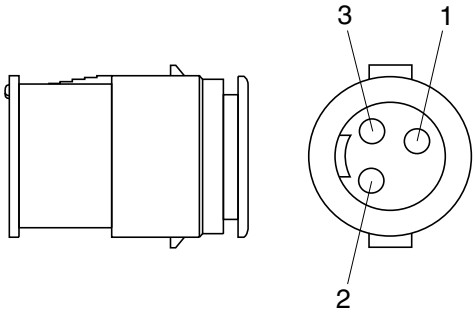
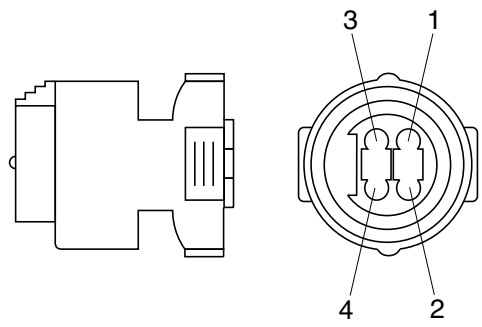
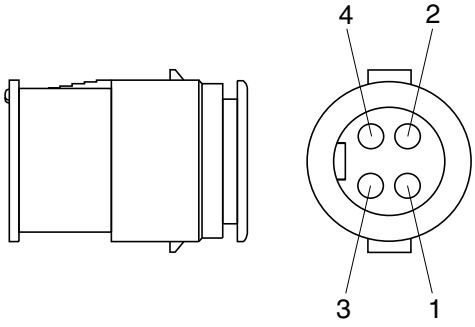
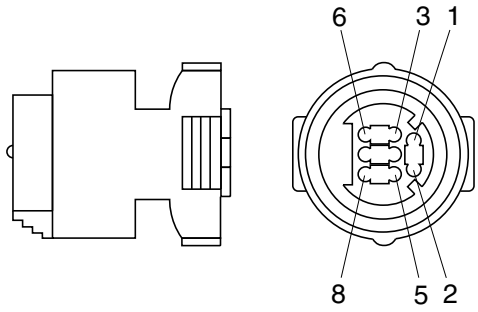
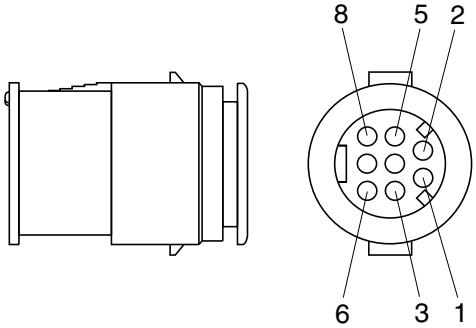
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

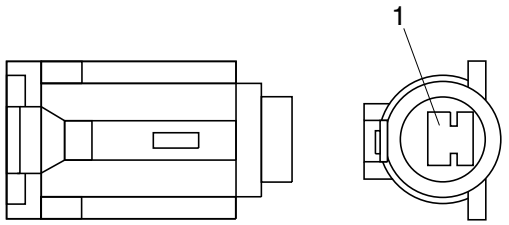
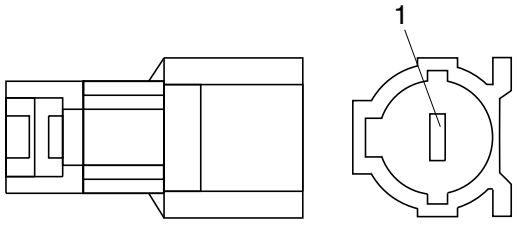
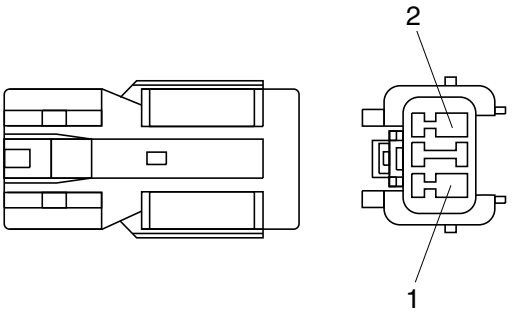
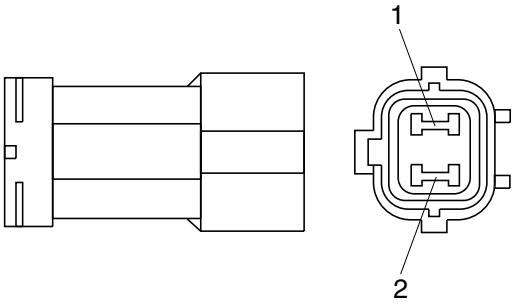
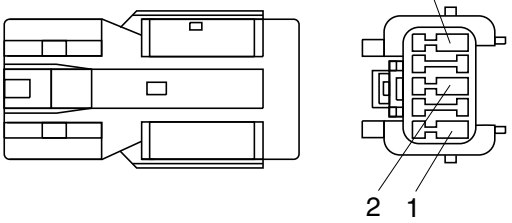
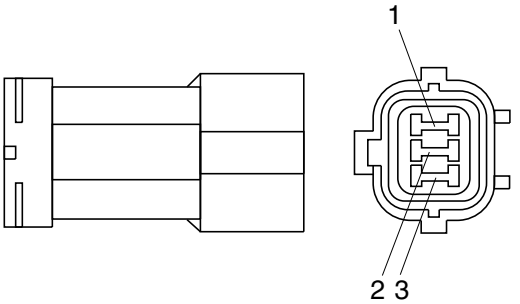
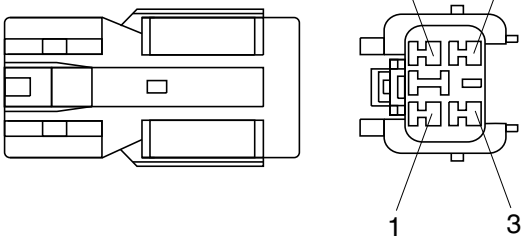
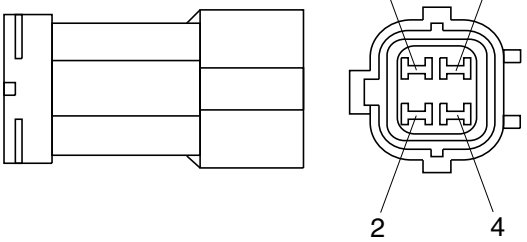
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

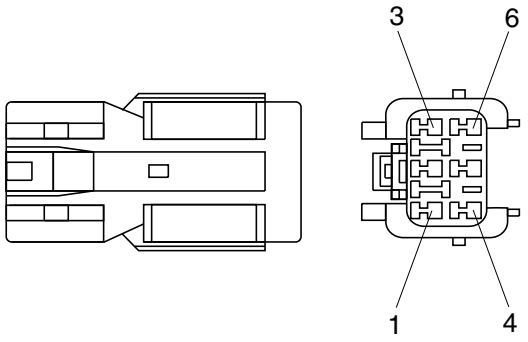
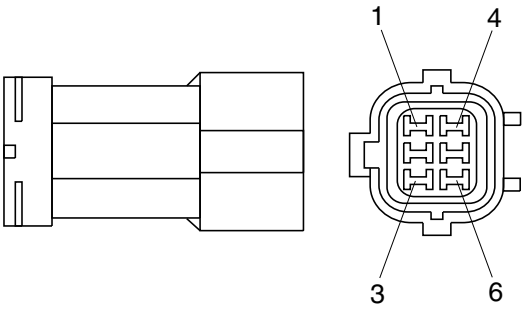
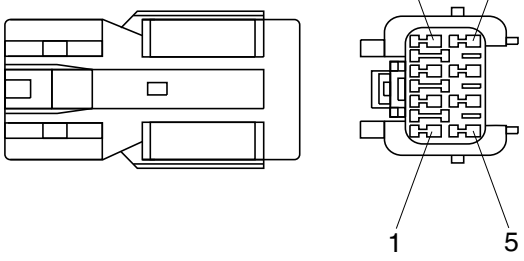
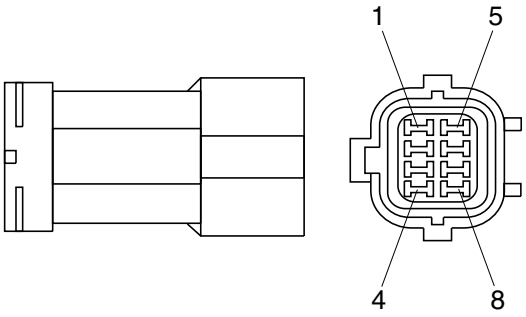
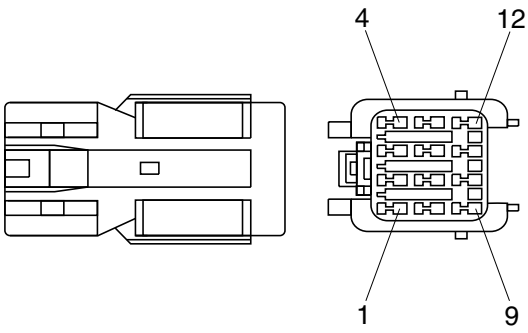
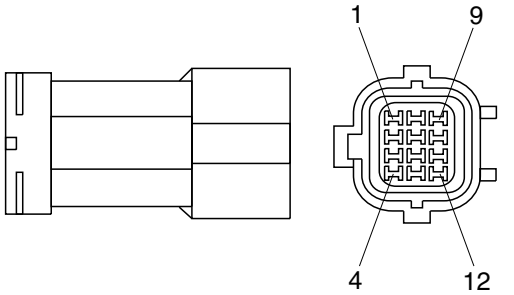
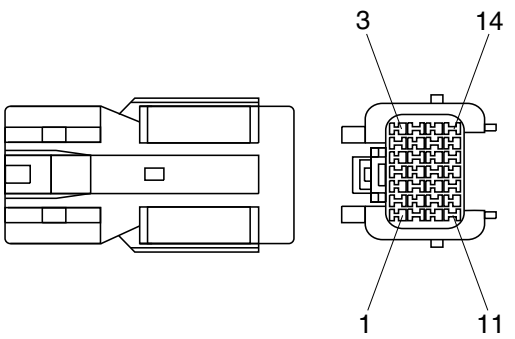
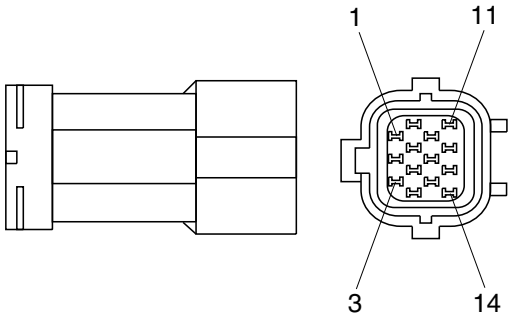
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

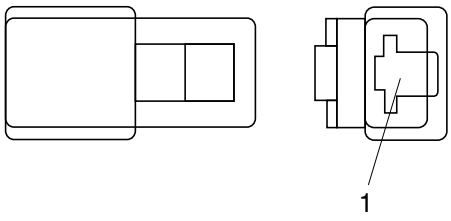
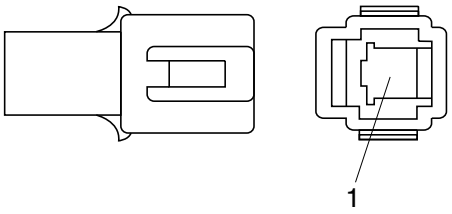
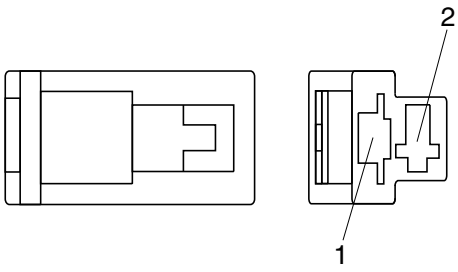
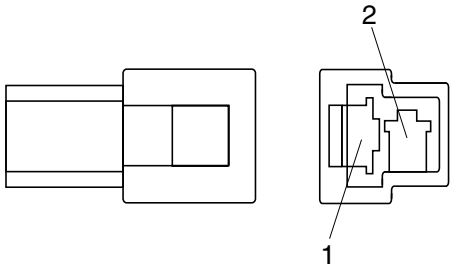
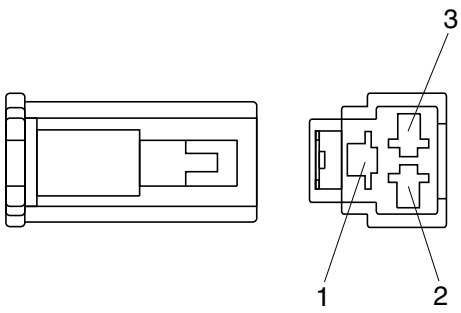
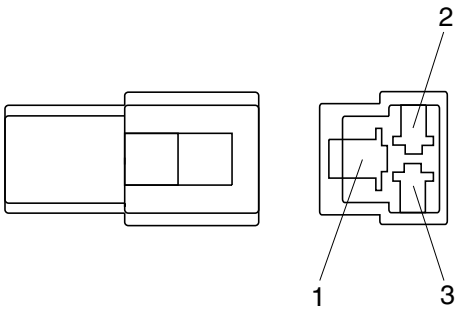
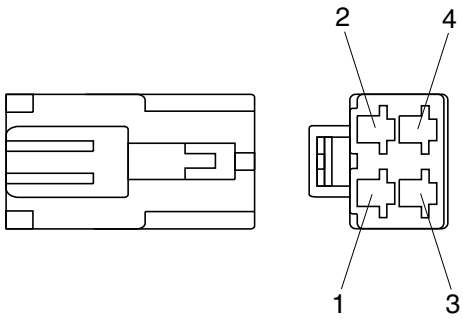
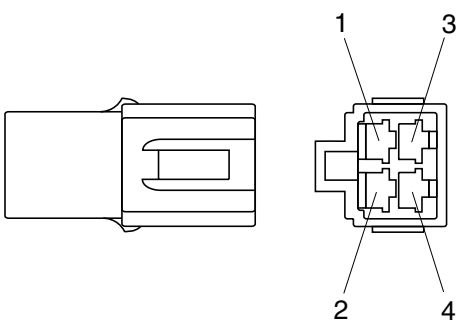
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

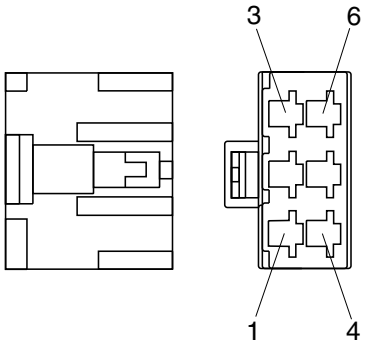
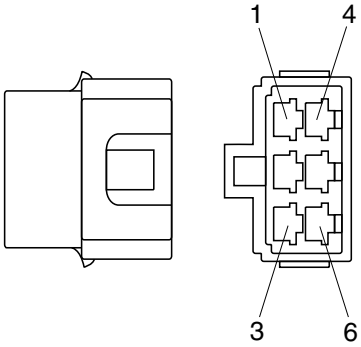
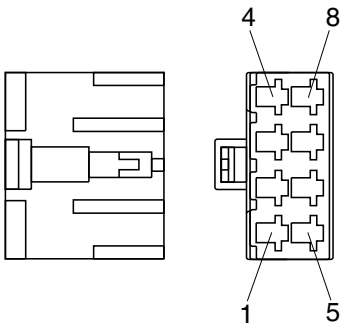
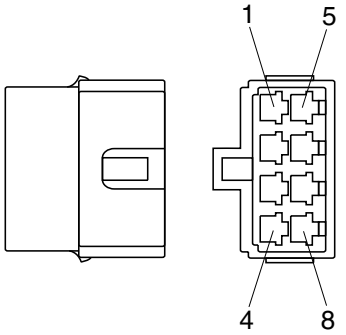
3) SWP TYPE CONNECTOR

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

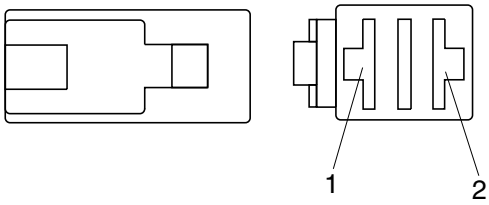
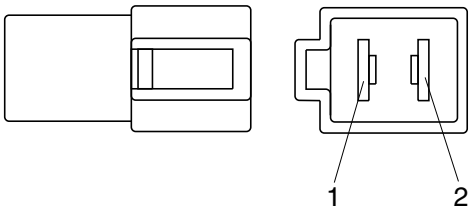
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

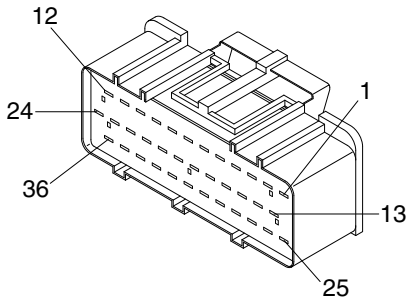
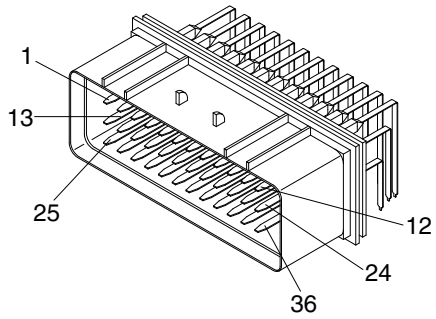
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

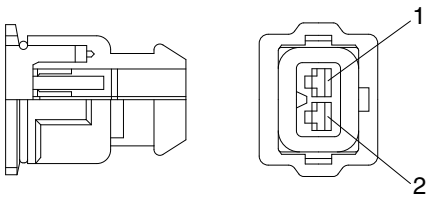
5) 375 FASTEN TYPE CONNECTOR

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

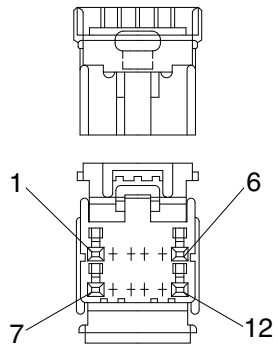
6) AMP ECONOSEAL CONNECTOR

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

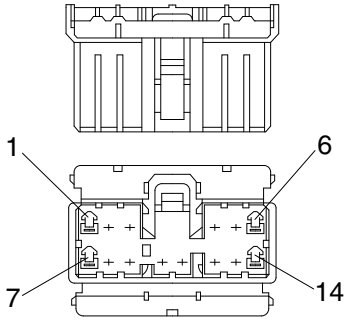
7) AMP TIMER CONNECTOR

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

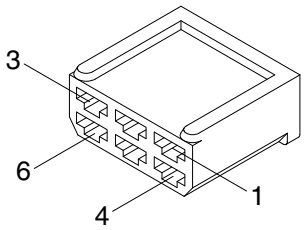
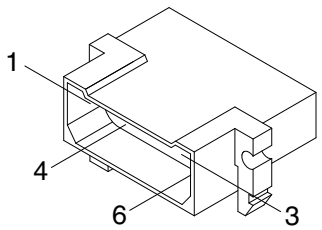
8) AMP 040 MULTILOCK CONNECTOR

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

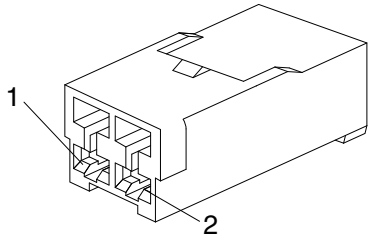
9) AMP 070 MULTILOCK CONNECTOR

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

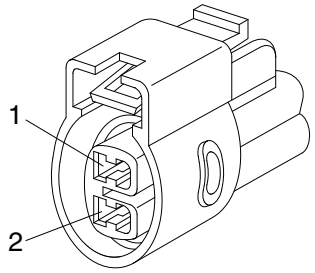
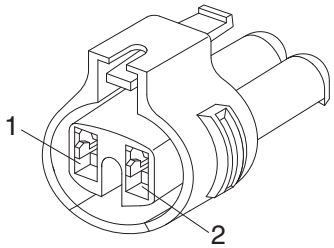
10) AMP FASTIN - FASTON CONNECTOR

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

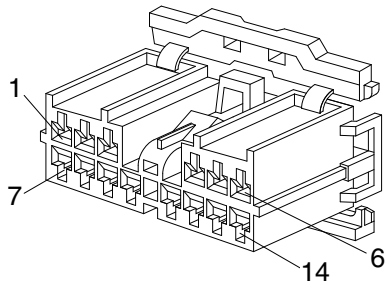
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

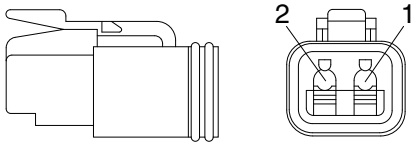
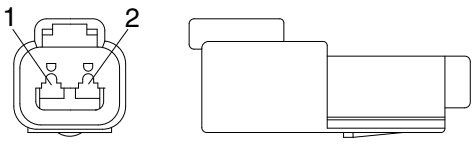
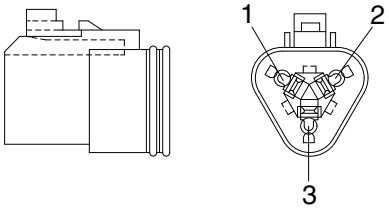
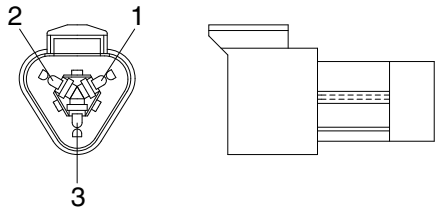
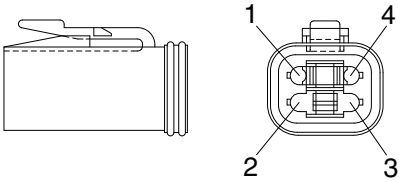
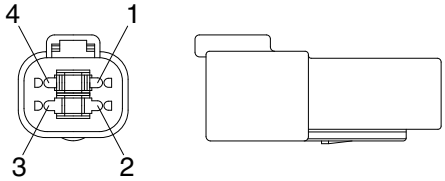
14) DEUTSCH DT CONNECTORS

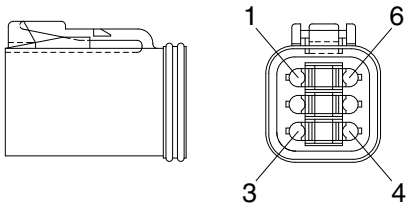
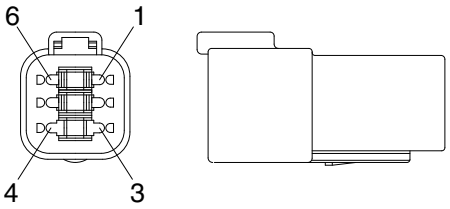
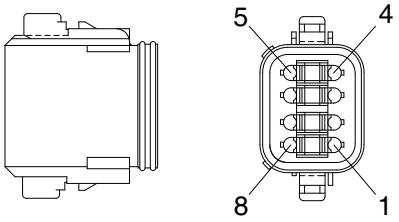
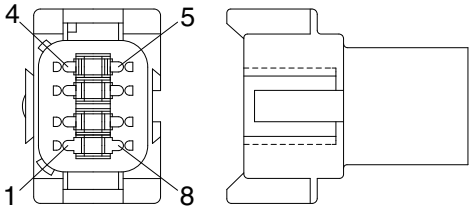
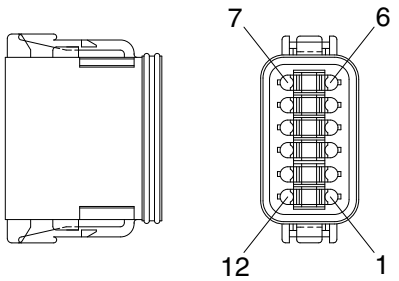
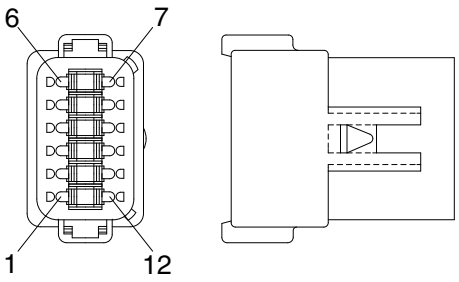
DT 06 - 3S - ★★★★

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

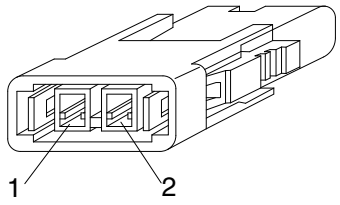
※ Modification

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

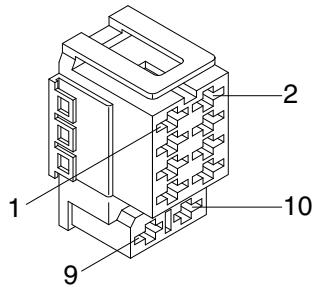
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

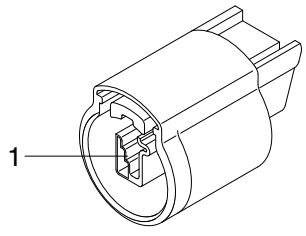
15) MOLEX 2CKTS CONNECTOR

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

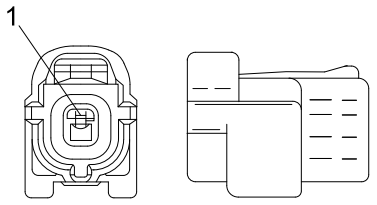
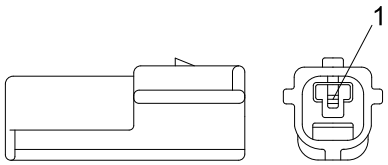
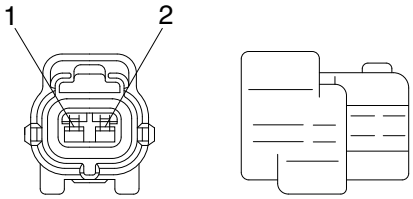
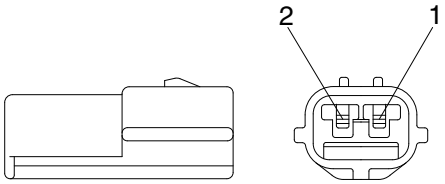
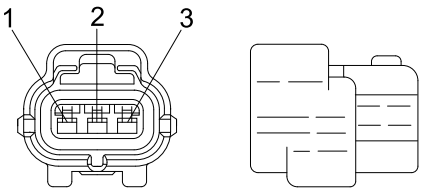
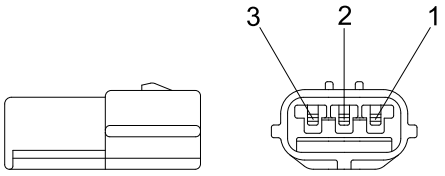
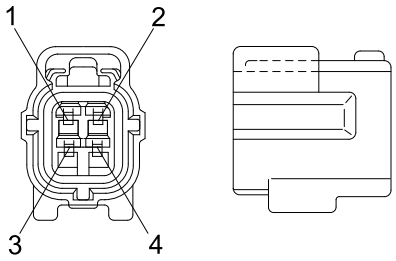
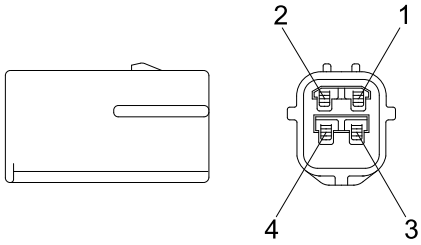
16) ITT SWF CONNECTOR

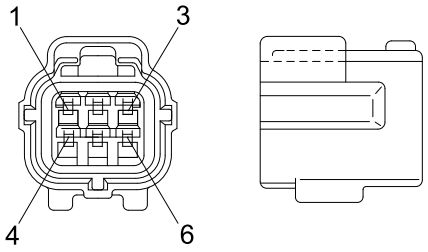
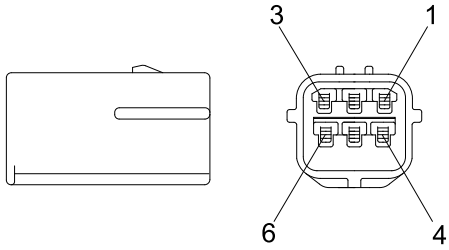
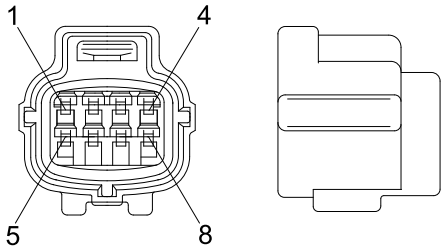
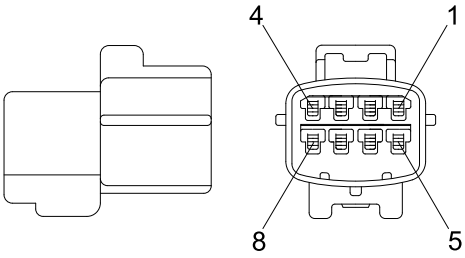
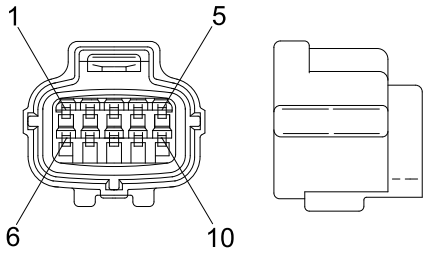
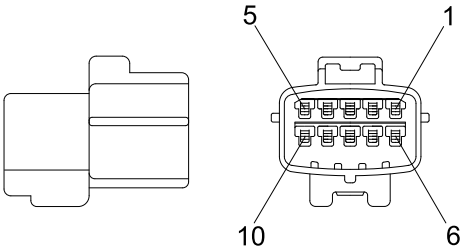
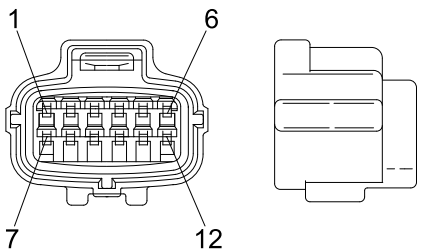
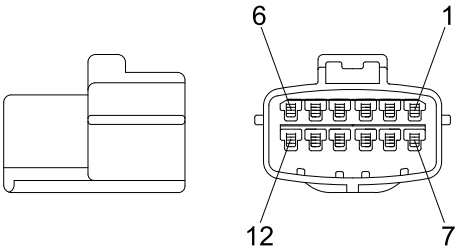
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

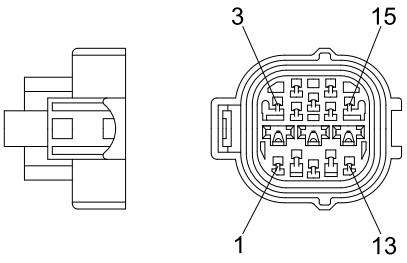
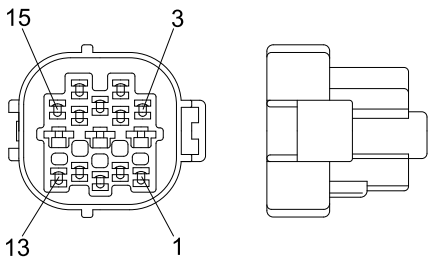
17) MWP NMWP CONNECTOR

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

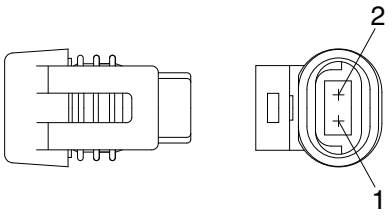
18) ECONOSEAL J TYPE CONNECTORS

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

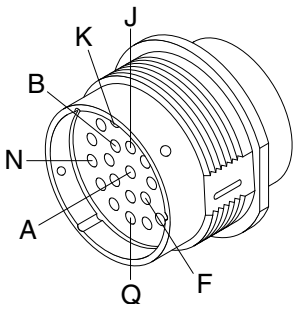
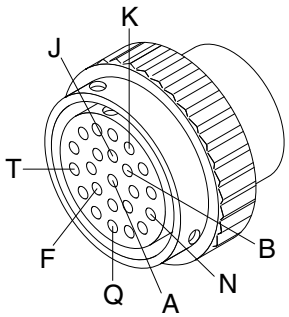
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

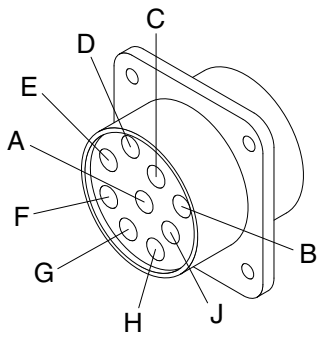
19) METRI-PACK TYPE CONNECTOR

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

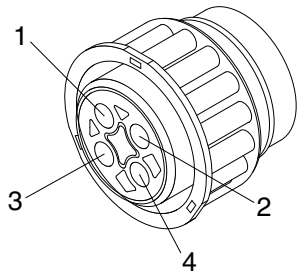
20) DEUTSCH HD30 CONNECTOR

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

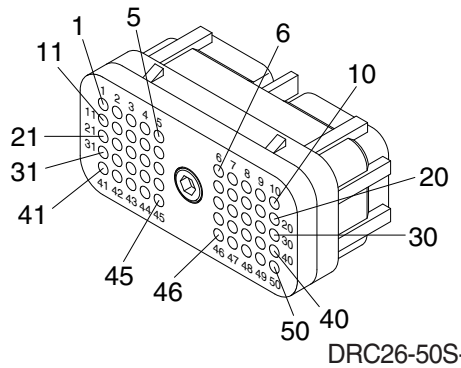
21) DEUTSCH SERVICE TOOL CONNECTOR

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

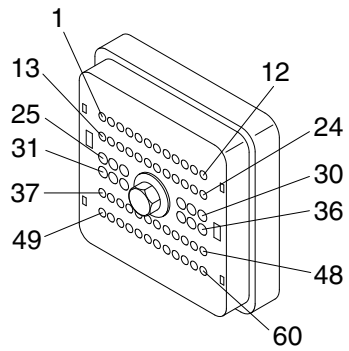
22) AMP FUEL WARMER CONNECTOR

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

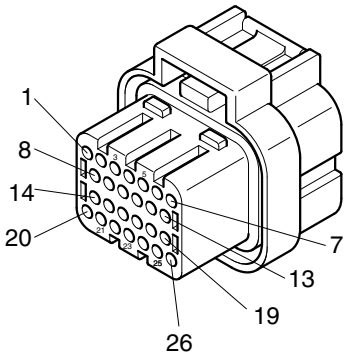
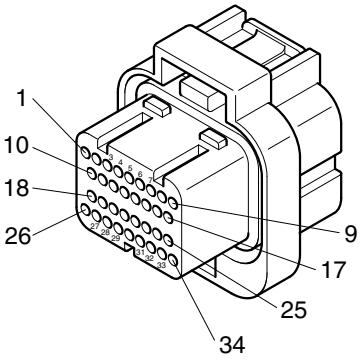
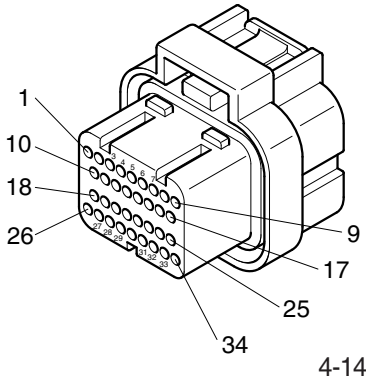
23) DEUTSCH ENGINE ECM CONNECTOR

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

24) DEUTSCH INTERMEDIATE CONNECTOR

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

25) TE MCU CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
26	 1473416-1	
34	 2-1437285-3 4-1437290-0	
34	 4-1437290-1	

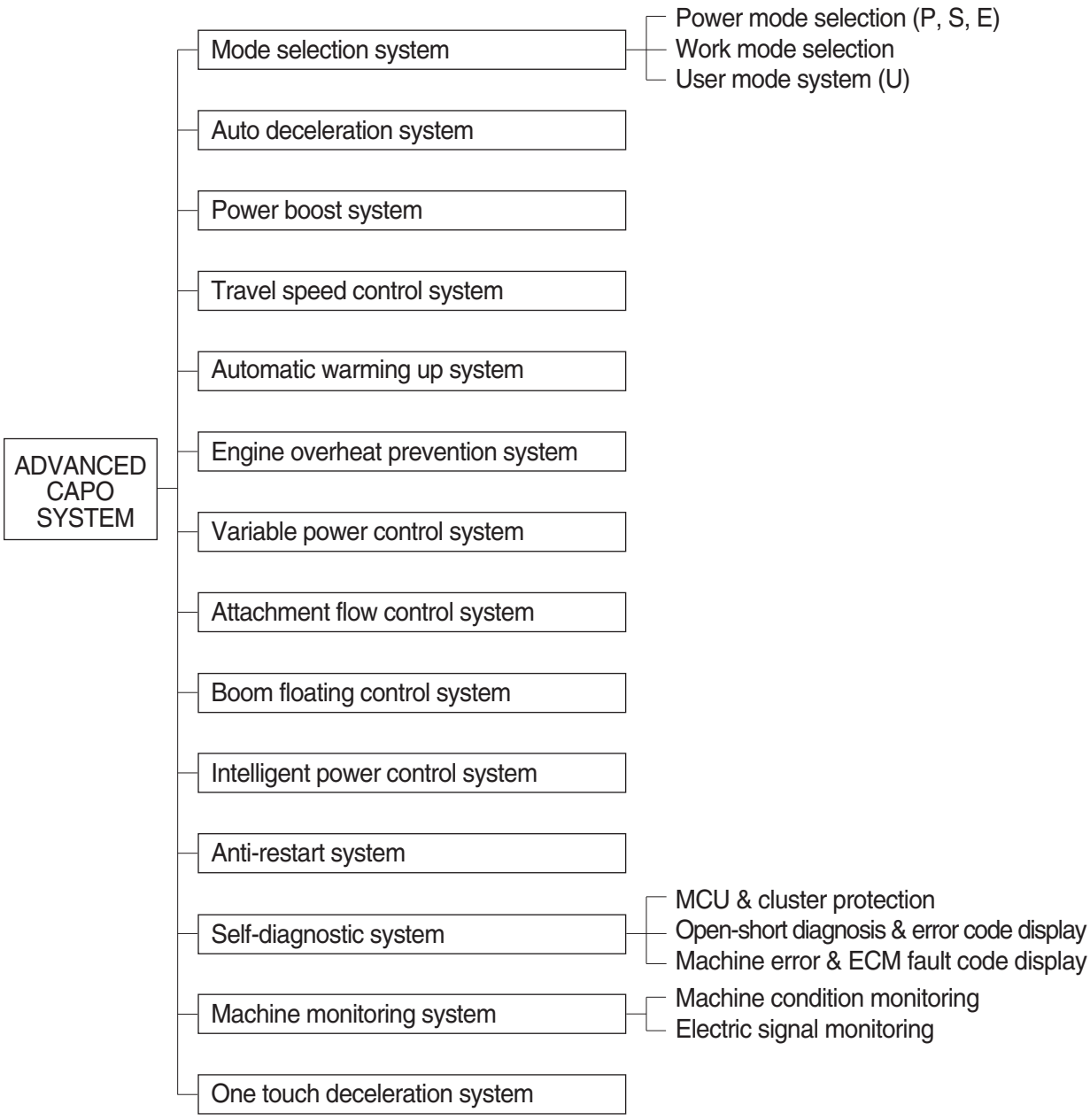
SECTION 5 MECHATRONICS SYSTEM

Group 1 Outline 5-1
Group 2 Mode Selection System 5-3
Group 3 Automatic Deceleration System 5-6
Group 4 Power Boost System 5-7
Group 5 Travel Speed Control System 5-8
Group 6 Automatic Warming Up System 5-9
Group 7 Engine Overheat Prevention System 5-10
Group 8 Variable Power Control System 5-11
Group 9 Attachment Flow Control System 5-12
Group 10 Boom Floating Control System 5-13
Group 11 Intelligent Power Control System 5-14
Group 12 Anti-Restart System 5-16
Group 13 Self-Diagnostic System 5-17
Group 14 Engine Control System 5-63
Group 15 EPPR Valve 5-64
Group 16 Monitoring System 5-69
Group 17 Fuel Warmer System 5-110
Group 18 1 or 2-Way Optional Piping Pressure Removal System 5-111
Group 19 2DMG+ System 5-112

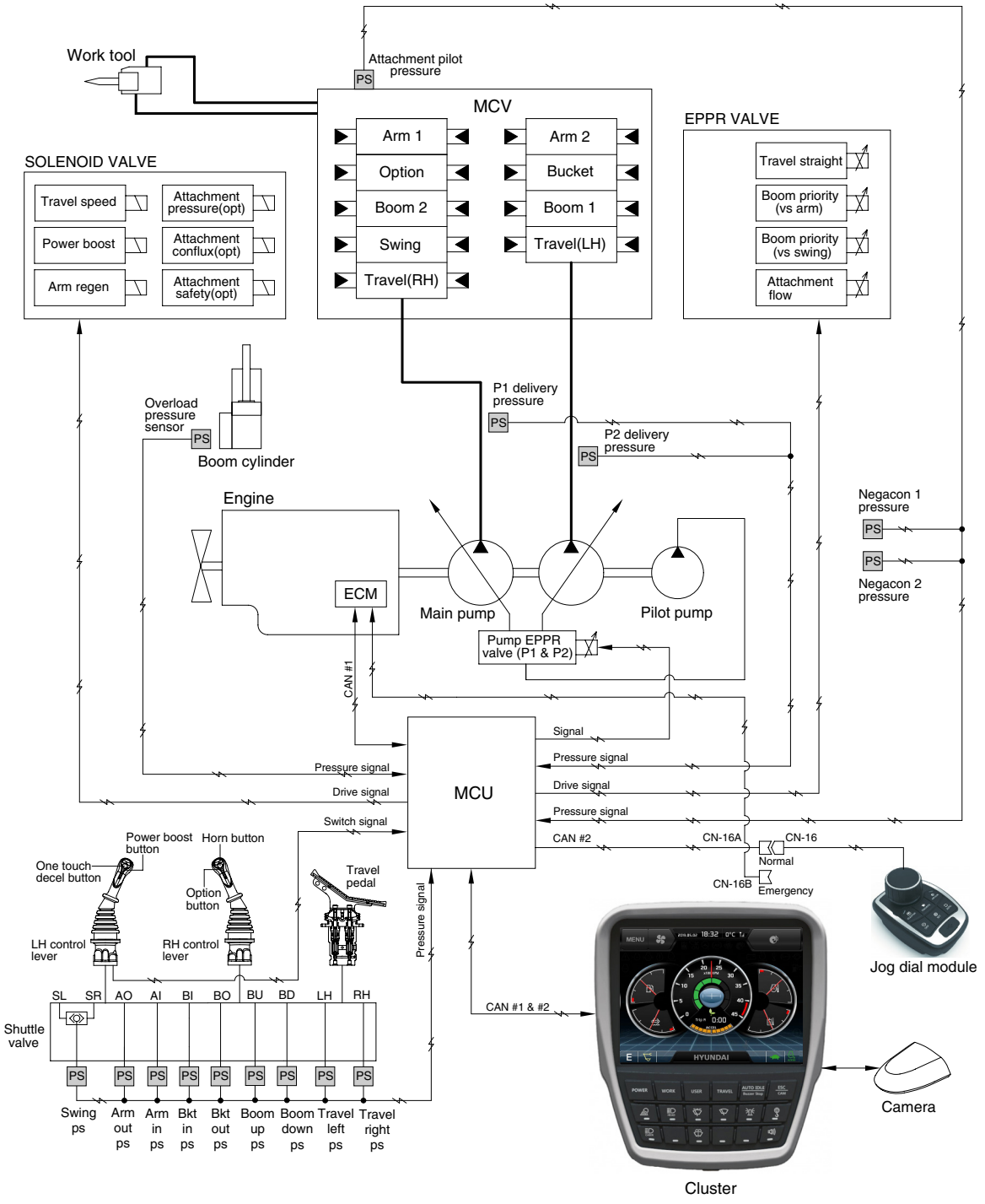
SECTION 5 MECHATRONICS SYSTEM

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.



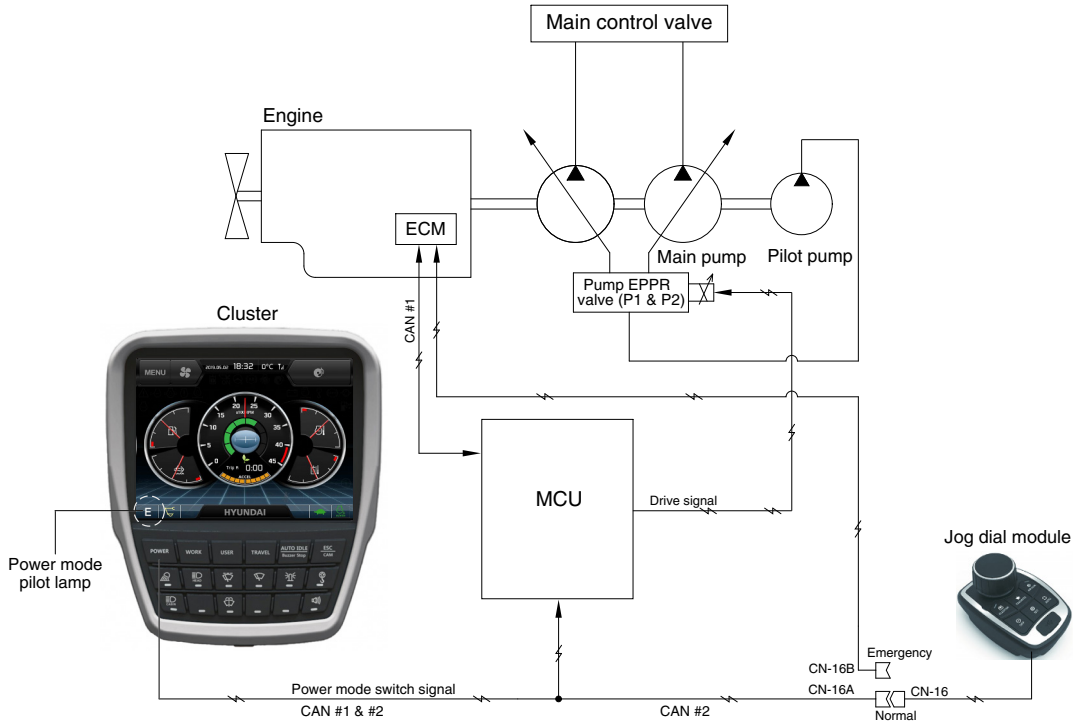
SYSTEM DIAGRAM



220A5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



220A5MS02

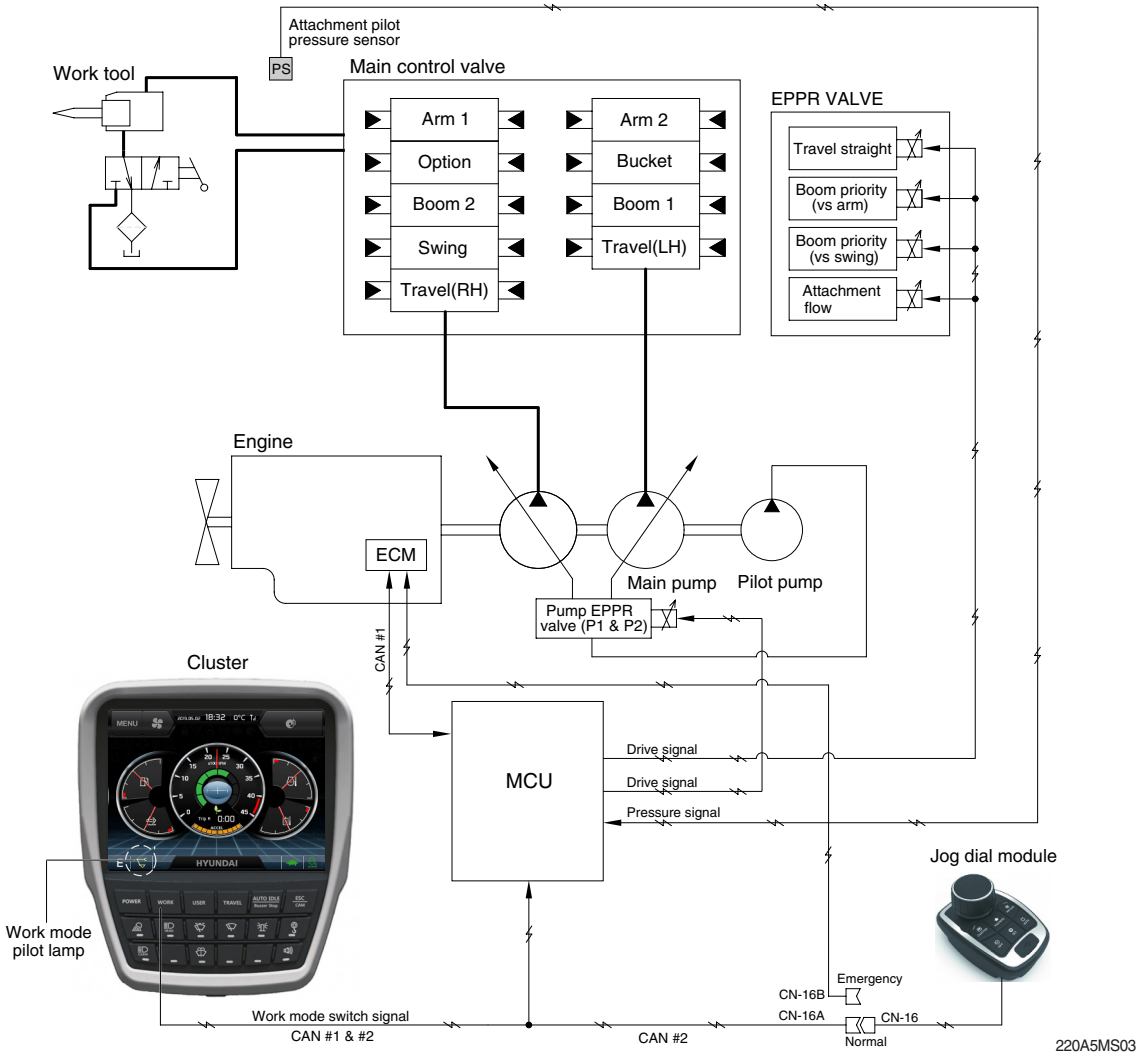
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

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			
		Standard		Option	
		Unload	Load	Unload	Load
P	Heavy duty power	1700±50	1700±50	1700±50	1700±50
S	Standard power	1600±50	1600±50	1700±50	1700±50
E	Economy operation	1600±50	1600±50	1700±50	1700±50
AUTO DECEL	Engine deceleration	1000±100	-	1000±100	-
One touch decel	Engine quick deceleration	850±100	-	850±100	-
KEY START	Key switch start position	850±100	-	850±100	-

2. WORK MODE SELECTION SYSTEM

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



1) GENERAL WORK MODE (bucket)

This mode is used to general digging work.

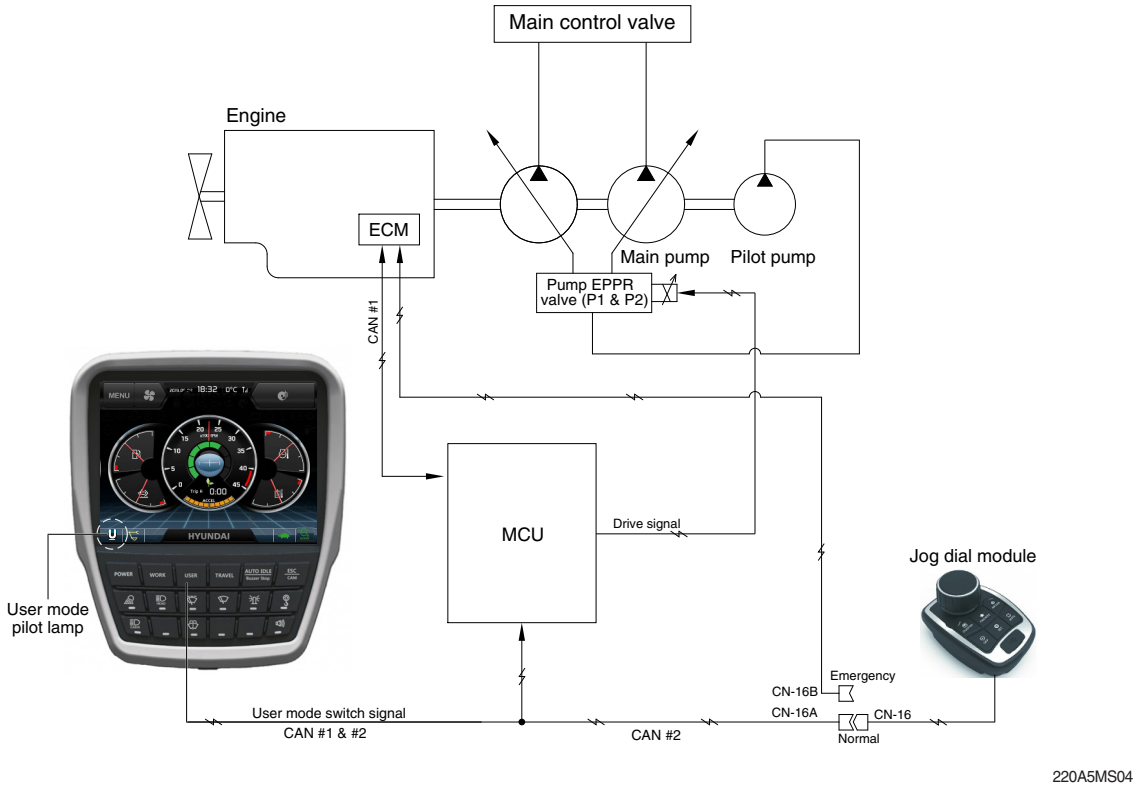
2) ATT WORK MODE (breaker, crusher)

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



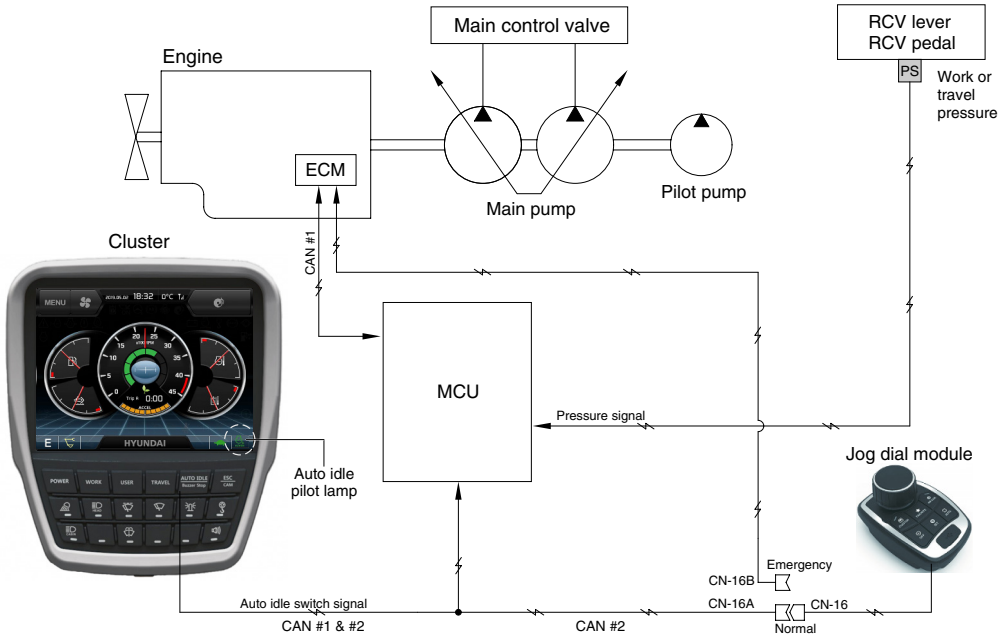
1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift
1	1300	750	10%
2	1400	800	20%
3	1500	850	30%
4	1600	900	40%
5	1700	950	50%
6	1800	1000 (auto decel)	60%
7	1850	1050	70%
8	1900	1100	80%
9	1950	1150	85%
10	2000	1200	90%

※ Refer to page 5-90.

GROUP 3 AUTOMATIC DECELERATION SYSTEM

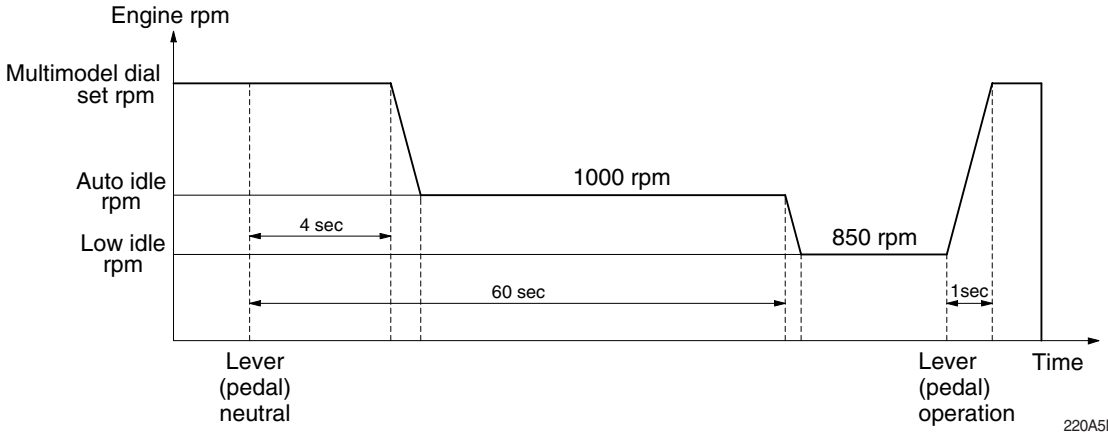


220A5MS05

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 sends throttle command to ECM to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 850 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.



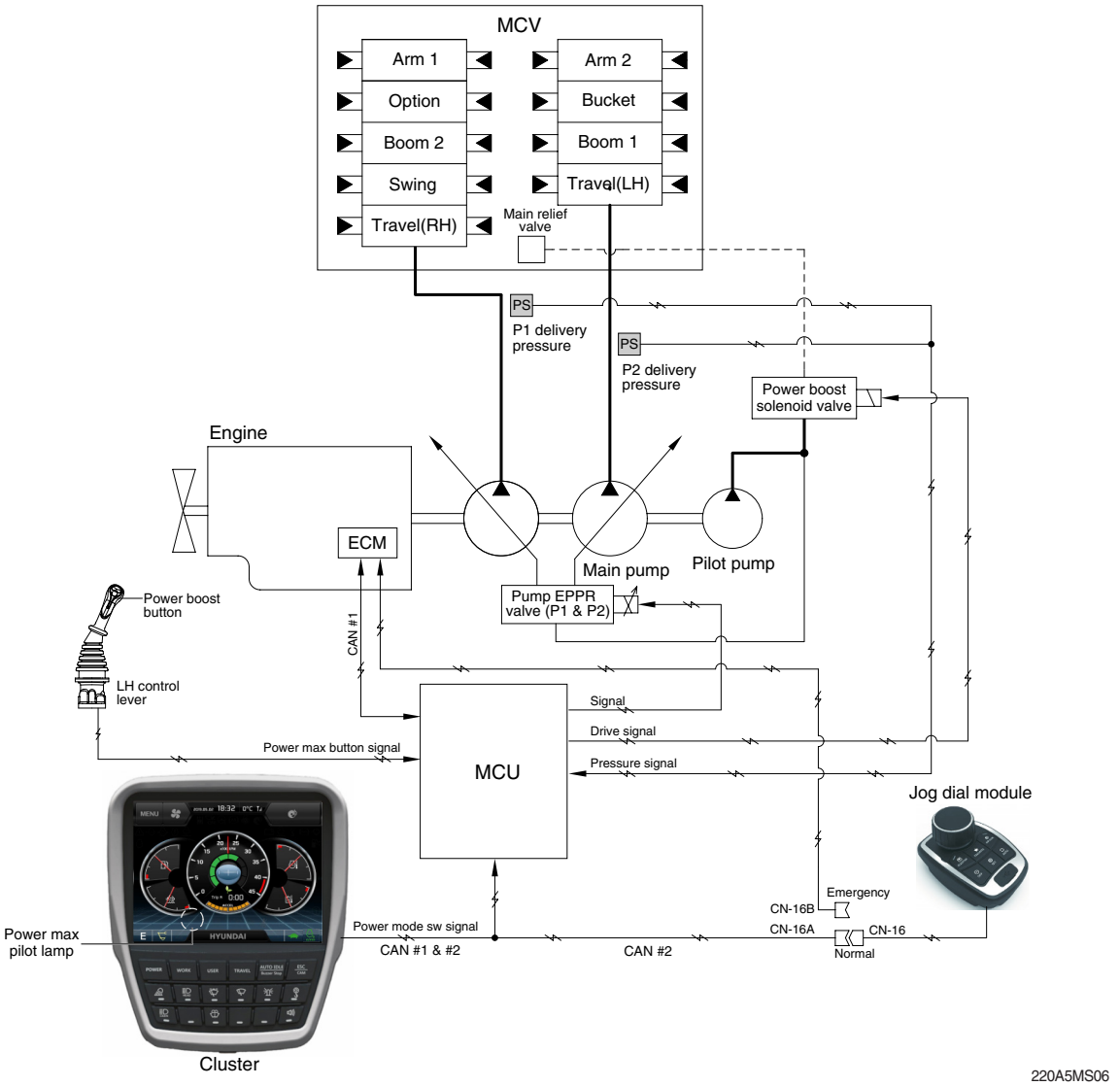
220A5MS105

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



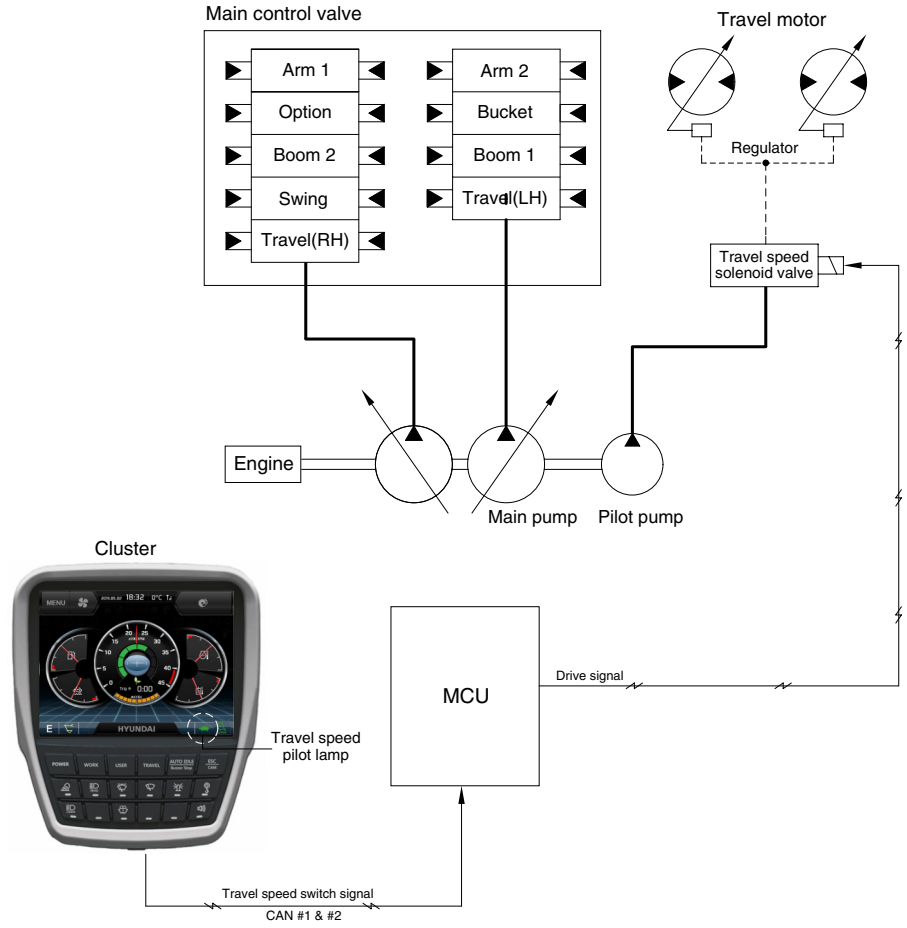
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

· 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



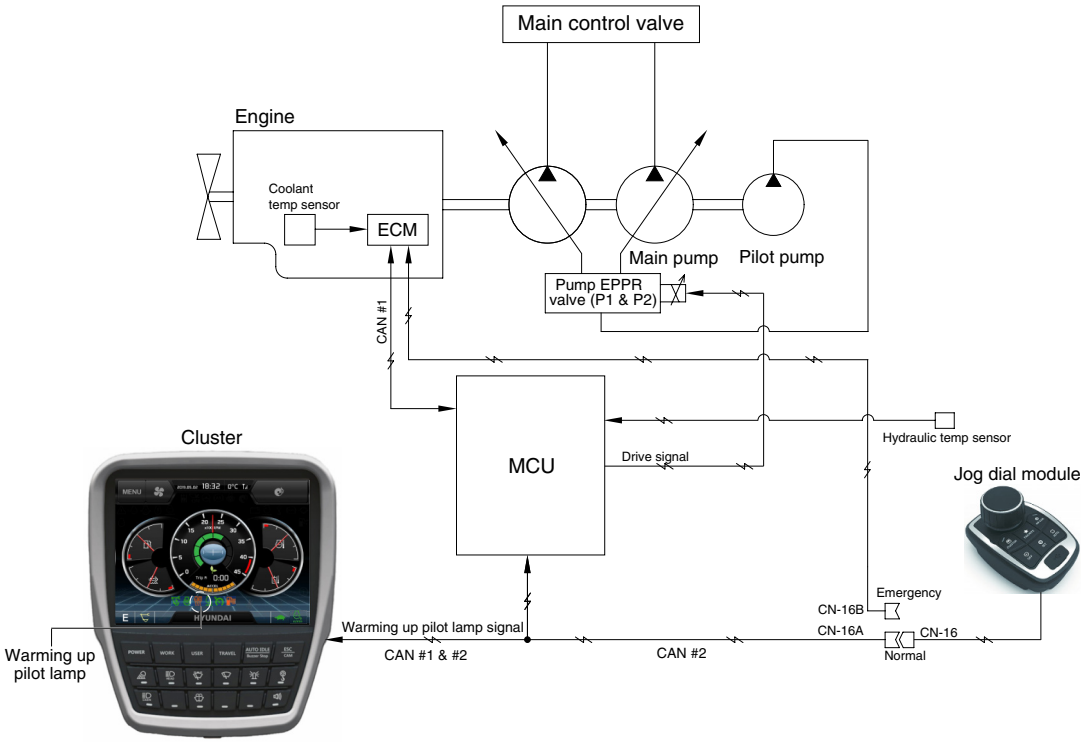
220A5MS07

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

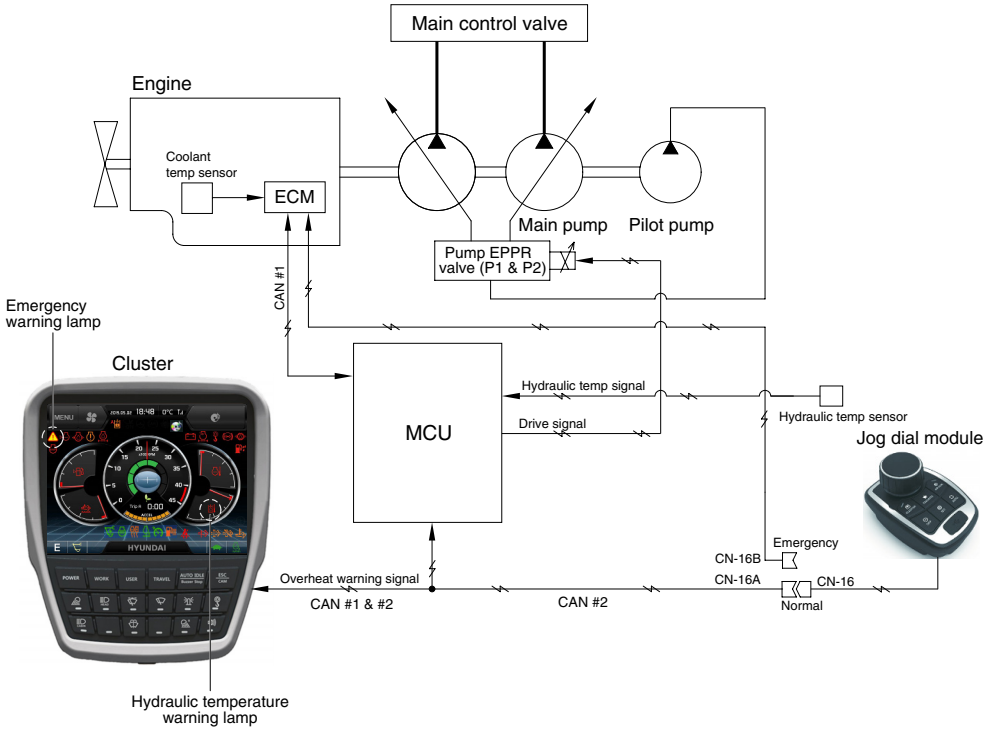


1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1000 rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.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

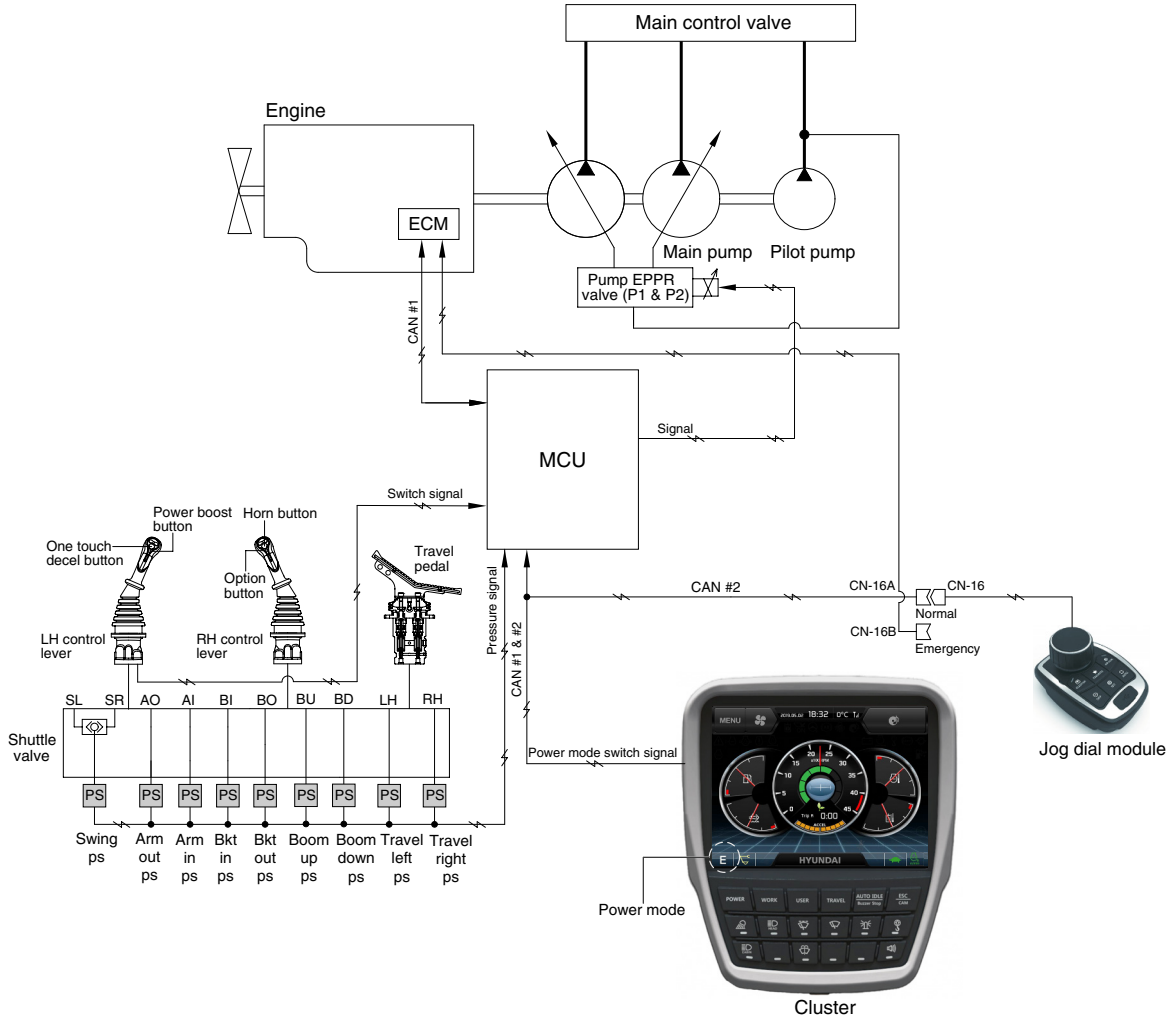


1. If the engine coolant temperature is overheated over 103˚C or the hydraulic oil temperature is overheated over 100˚C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant temperature : Above 103˚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 100˚C - Hydraulic oil temperature : Less than 95˚C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant temperature : Above 107˚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 103˚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



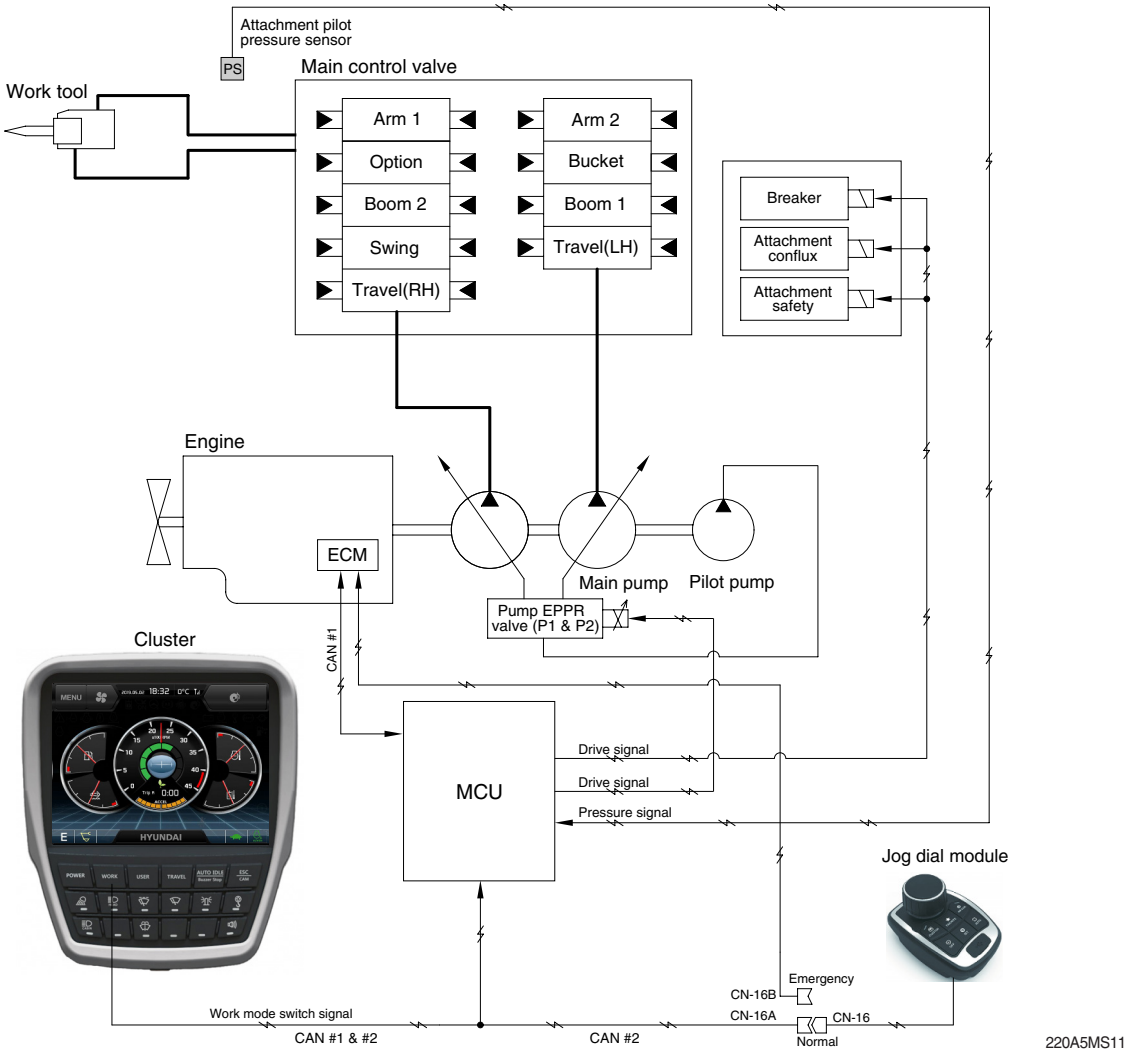
220A5MS10

· 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



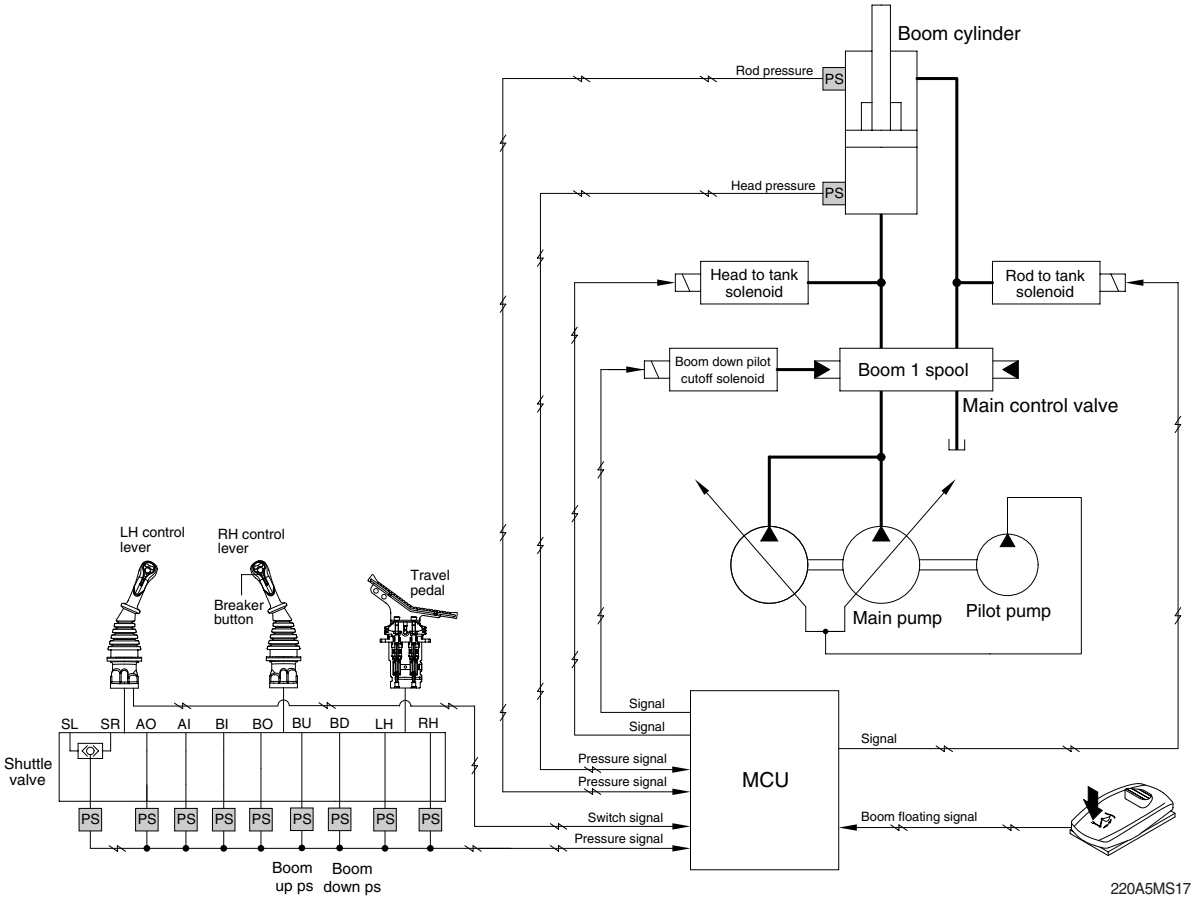
· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool	
	Breaker	Crusher
Flow level	100 ~ 180 lpm	100 ~ 440 lpm
Attach safety solenoid	-	ON
Attach conflux solenoid	ON/OFF	ON/OFF
Breaker solenoid★	ON	-

※ Refer to the page 5-90 for the attachment kinds and max flow.

★ When breaker operating button is pushed.

GROUP 10 BOOM FLOATING CONTROL SYSTEM



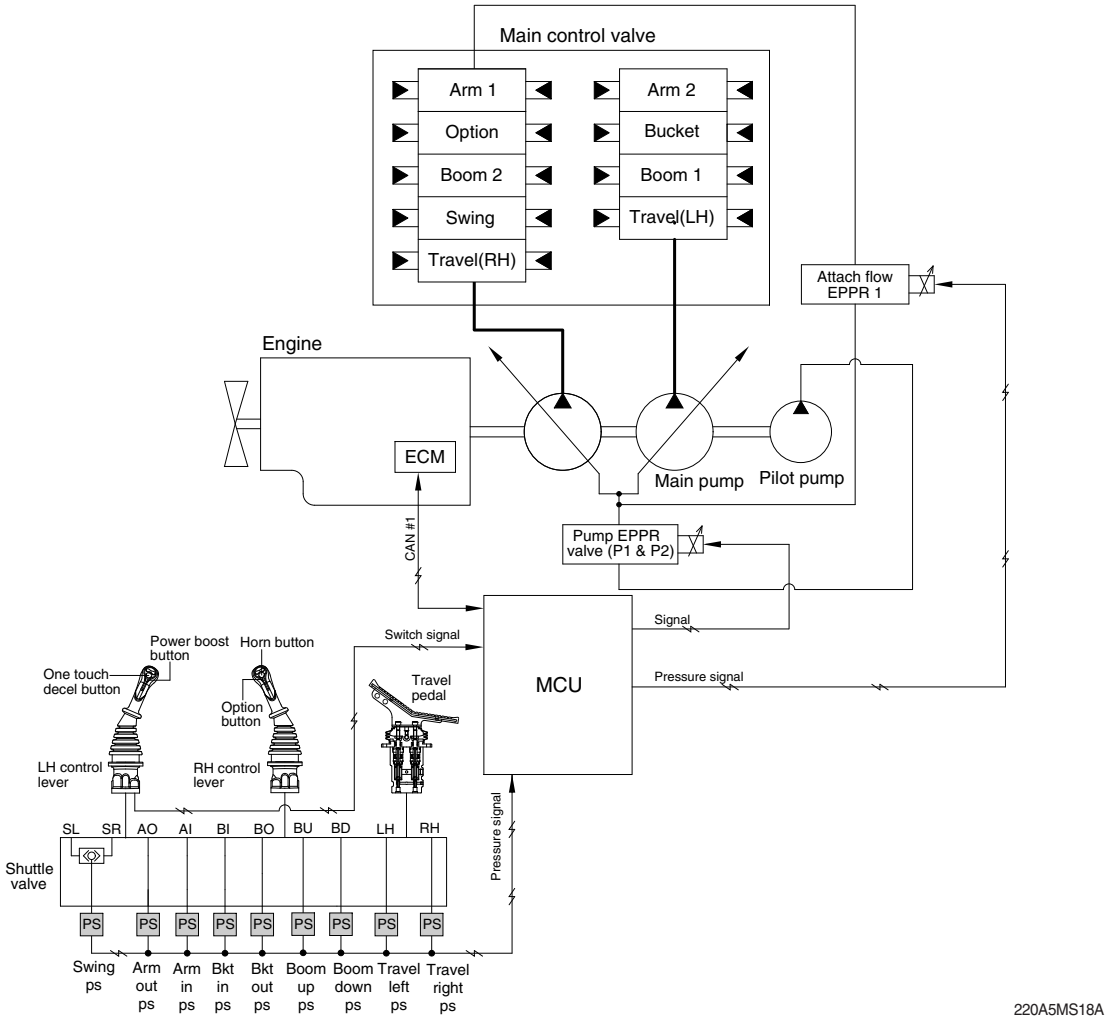
· Boom floating automatically controls boom cylinder along the ground by operating arm cylinder only.

Description		Condition	Function
Work mode★1	Floating mode		
General mode	Boom up floating★2	Floating mode sw : ON	Rod to tank solenoid : ON Head to tank solenoid : OFF Boom down cutoff solenoid : OFF
	Boom up/down floating★2	Floating mode sw : ON Breaker button : Pressed Boom down pilot pressure > 25 bar Boom up pilot pressure < 5 bar	Rod to tank solenoid : ON Head to tank solenoid : ON Boom down cutoff solenoid : ON
Breaker mode	Boom down floating	Floating mode sw : ON Breaker button : Pressed Boom down pilot pressure > 25 bar Boom up pilot pressure < 5 bar	Rod to tank solenoid : OFF Head to tank solenoid : ON Boom down cutoff solenoid : ON
Temporarily canceled		During operation of boom floating Boost sw : Pressed	Rod to tank solenoid : OFF Head to tank solenoid : OFF Boom down cutoff solenoid : OFF

★1 Boom floating is not activated when work mode is crusher mode.

★2 These functions are activated just in case the excavator is not in jack up status.

GROUP 11 INTELLIGENT POWER CONTROL SYSTEM



1. When the requirement of pump flow rate is low, IPC mode controls pump flow rate to improve fuel efficiency. The function works only in Balance or Efficiency mode.

Condition	Function
Arm in with boom up	Limitation of pump flow rate : Activated
Boom down with other actuator	
None of upper condition	Limitation of pump flow rate : Canceled

1) ARM IN WITH BOOM UP

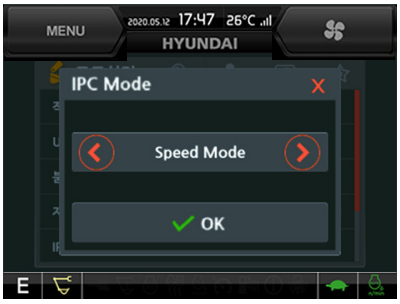
A fuel efficiency is improved by maximizing arm regeneration by reducing pump flow rate during boom up and arm in combination operation.

2) BOOM DOWN WITH OTHER ACTUATOR

The flow for boom-down is replaced with regeneration-flow as much as possible, and fuel consumption is reduced by reducing the flow rate of the pump.

2. IPC MODE SELECTION

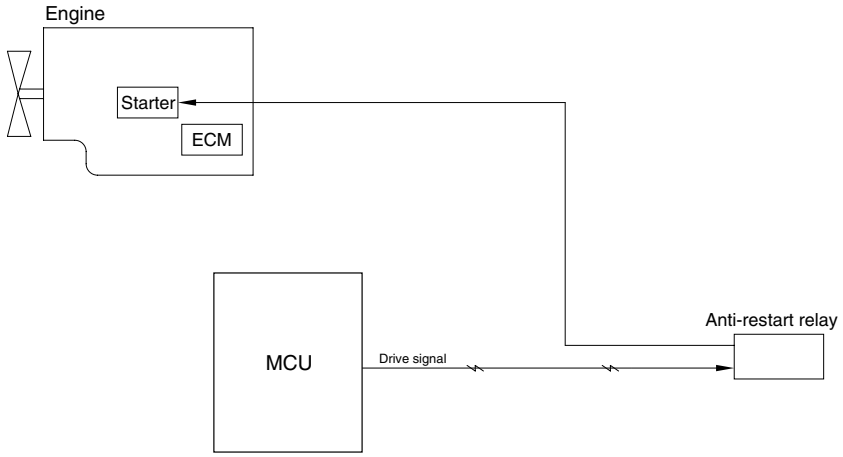
The levels of flow rate limit depends on at IPC mode.



300A3CD52A

IPC mode	Description
Balance mode	Fuel eifficiency ON, limit level 1
Efficiency mode	Fuel eifficiency ON, limit level 2
Speed mode	Fuel eifficiency OFF

GROUP 12 ANTI-RESTART SYSTEM



220A5MS12

1. ANTI-RESTART FUNCTION

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

GROUP 13 SELF-DIAGNOSTIC SYSTEM

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

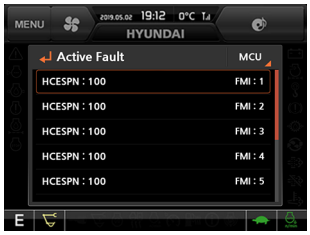
1) Active fault



300A3CD65



300A3CD66



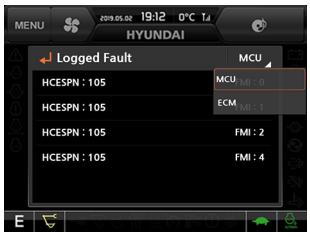
300A3CD67

· The active faults of the MCU, engine ECM or air conditioner can be checked by this menu.

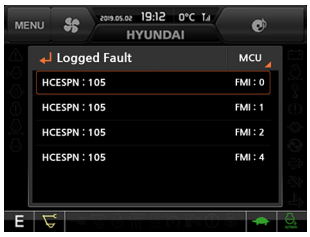
2) Logged fault



300A3CD68



300A3CD69



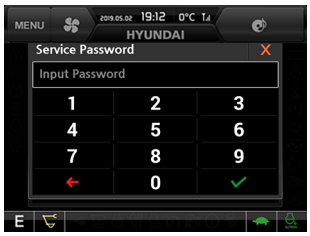
300A3CD70

· The logged faults of the MCU, engine ECM or air conditioner can be checked by this menu.

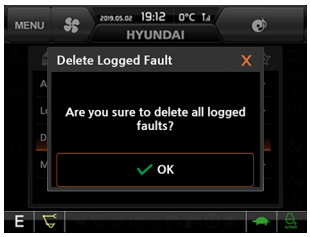
3) Delete logged fault



300A3CD71



300A3CD72



300A3CD73

· The logged faults of the MCU, engine ECM or air conditioner 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-51 (#16) Checking Open/Short 2. CD-1 (#1) - CN-51 (#25) Checking Open/Short				
105 (HX220A L : #0140- HX220A NL : #0036-)	0	10 seconds continuous, Working Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Working Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Working Pilot 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 (#19) Checking Open/Short 2. CD-7 (#A) – CN-51 (#32) Checking Open/Short 3. CD-7 (#C) – CN-51 (#31) Checking Open/Short				
108 (HX220A L : #0140- HX220A NL : #0036-)	0	10 seconds continuous, Travel Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V ≤ Travel Pilot 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 (#27) Checking Open/Short 2. CD-6 (#A) – CN-51 (#32) Checking Open/Short 3. CD-6 (#C) – CN-51 (#31) 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
120	0	10 seconds continuous, P1 pump delivery pressure sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V ≤ P1 pump delivery pressure sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, P1 pump delivery pressure sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – P1 pump delivery Press. display failure 2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure (Checking list) 1. CD-42 (#B) – CN-52 (#22) Checking Open/Short 2. CD-42 (#A) – CN-51 (#32) Checking Open/Short 3. CD-42 (#C) – CN-51 (#31) Checking Open/Short				
121	0	10 seconds continuous, P2 pump delivery pressure sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ P2 pump delivery pressure sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, P2 pump delivery pressure sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – P2 pump delivery Press. display failure 2. Control Function – Automatic voltage increase operation failure, Overload at compensation control failure (Checking list) 1. CD-43 (#B) – CN-51 (#14) Checking Open/Short 2. CD-43 (#A) – CN-51 (#32) Checking Open/Short 3. CD-43 (#C) – CN-51 (#31) Checking Open/Short				
122	1	(when you had conditions mounting pressure sensor) 10 seconds continuous, 0.3V ≤ Overload Press. Sensor Measurement Voltage < 0.8V	●		
	4	(when you had conditions mounting pressure sensor) 10 seconds continuous, Overload Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Overload Press. display failure 2. Control Function – Overload warning alarm failure (Checking list) 1. CD-31 (#B) – CN-52 (#28) Checking Open/Short 2. CD-31 (#A) – CN-51 (#32) Checking Open/Short 3. CD-31 (#C) – CN-51 (#31) 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
	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	●		
123	(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 (#22) Checking Open/Short 2. CD-70 (#A) – CN-51 (#32) Checking Open/Short 3. CD-70 (#C) – CN-51 (#31) Checking Open/Short				
	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	●		
124	(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 (#28) Checking Open/Short 2. CD-71 (#A) – CN-51 (#32) Checking Open/Short 3. CD-71 (#C) – CN-51 (#31) Checking Open/Short				
	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	●		
127	(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 (#23) Checking Open/Short 2. CD-32 (#A) – CN-51 (#32) Checking Open/Short 3. CD-32 (#C) – CN-5 1(#31) 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 (#31) Checking Open/Short 2. CD-85 (#A) – CN-51 (#32) Checking Open/Short 3. CD-85 (#C) – CN-51 (#31) 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 (#21) Checking Open/Short 2. CD-90 (#A) – CN-51 (#32) Checking Open/Short 3. CD-90 (#C) – CN-51 (#31) Checking Open/Short				
133	0	10 seconds continuous, Arm Out Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Arm Out Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Arm Out Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Arm In/Out & Bucket In Pilot Press. display failure 2. Control Function – Engine variable horse power control operation failure (Checking list) 1. CD-86 (#B) – CN-51 (#27) Checking Open/Short 2. CD-86 (#A) – CN-51 (#32) Checking Open/Short 3. CD-86 (#C) – CN-51 (#31) 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
135	0	10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	10 seconds continuous, 0.3V≤ Swing Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	10 seconds continuous, Swing Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(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 (#18) Checking Open/Short 2. CD-24 (#A) – CN-51 (#32) Checking Open/Short 3. CD-24 (#C) – CN-51 (#31) Checking Open/Short				
138	0	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage > 5.2V	●		
	1	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, 0.3V≤ Attachment Pilot Press. Sensor Measurement Voltage < 0.8V	●		
	4	Monitor – Select Attachment(breaker / crusher) 10 seconds continuous, Attachment Pilot Press. Sensor Measurement Voltage < 0.3V	●		
	(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 (#32) Checking Open/Short 2. CD-69 (#A) – CN-51 (#32) Checking Open/Short 3. CD-69 (#C) – CN-51 (#31) Checking Open/Short				
139 (N.A)	1	10 seconds continuous, 0.3V≤ Option Pilot Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Option Pilot Press. Sensor Measurement Voltage < 0.3V			●
	(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				

※ 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
140	5	(Detection) (When Pump regulator EPPR Current is more than 10 mA) 10 seconds continuous, Pump regulator EPPR drive current < 0 mA (Cancellation) (When Pump regulator EPPR Current is more than 10 mA) 3 seconds continuous, Pump regulator EPPR drive current ≥10 mA	●		
	6	(Detection) 10 seconds continuous, Pump regulator EPPR drive current > 1.0A (Cancellation) 3 seconds continuous, Pump regulator EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Pump horse power setting specification difference (Fuel efficiency/speed specification failure) (Checking list) 1. CN-342 (#1)-CN-54 (#02) or CN-343 (#1)-CN-54 (#03) Checking Open/Short 2. CN-342 (#2)-CN-54 (#27) or CN-343 (#2)-CN-54 (#26) Checking Open/Short				
141	5	(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	●		
	6	(Detection) 10 seconds continuous, Boom Priority EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Boom Priority EPPR drive current ≤ 1.0 A	●		
	(Results / Symptoms) 1. Control Function – Boom first control operation failure (Checking list) 1. CN-242 (#1)-CN-54 (#04) or CN-243 (#1)-CN-54 (#05) Checking Open/Short 2. CN-242 (#2)-CN-54 (#34) or CN-243 (#2)-CN-54 (#34) 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
143 (N.A)	5	(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			●
	6	(Detection) 10 seconds continuous, Travel EPPR drive current > 1.0 A (Cancellation) 3 seconds continuous, Travel EPPR drive current ≤ 1.0 A			●
	(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				
145	5	(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	●		
	6	(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	●		
	(Results / Symptoms) 1. Control Function – Remote fan control operation failure (Checking list) 1. CN-385 (#3) – CN-51 (#07) Checking Open/Short 2. CN-385 (#1) – CN-51 (#03) 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
164 (N.A)	4	(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			●
	6	(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			●
	(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				
166	4	(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	●		
	6	(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	●		
	(Results / Symptoms) 1. Control Function – Voltage increase operation failure (Checking list) 1. CN-88 (#1) – CN-53 (#10) Checking Open/Short 2. CN-88 (#2) – Fuse box (#28) 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
167	4	(Detection) (When Travel High Speed Solenoid is Off) 10 seconds continuous, Travel High Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel High Speed Solenoid is Off) 3 seconds continuous, Travel High Speed Solenoid drive unit Measurement Voltage > 3.0V		●	
		(When Parking mode is not) (Detection) (When Travel High Speed Solenoid is Off) 10 seconds continuous, Travel High Speed Solenoid drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Travel High Speed Solenoid is Off) 3 seconds continuous, Travel High Speed Solenoid drive unit Measurement Voltage > 3.0V			●
	6	(Detection) (When Travel High Speed Solenoid is On) 10 seconds continuous, Travel High Speed Solenoid drive current > 4.5 A (Cancellation) (When Travel High Speed Solenoid is On) 3 seconds continuous, Travel High 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 (#05) Checking Open/Short 2. CN-70 (#2) – Fuse box (#28) 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
169	4	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	●		
	6	(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	●		
	(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 (#16) Checking Open/Short 2. CN-237 (#2) – Fuse box (#19) Checking Open/Short				
170	4	(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	●		
	6	(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	●		
	(Results / symptoms) 1. Control Function – Arm regeneration operation failure (Checking list) 1. CN-135 (#1) – CN-52 (#07) Checking Open/Short 2. CN-135 (#2) – Fuse box (#28) 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
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-53 (#09) Checking Open/Short 2. CN-149 (#2) – Fuse box (#19) 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-52 (#08) Checking Open/Short 2. CN-66 (#2) – Fuse box (#31) 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 (N.A)	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 Pump P1 regulator EPPR current is equal or more than 300 mA) 10 seconds continuous, Pump P1 regulator EPPR drive current < 100 mA (Cancellation) (When Pump P1 regulator EPPR current is equal or more than 300 mA) 3 seconds continuous, Pump P1 regulator 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-342 (#2) – CN-54 (#27) Checking Open/Short 2. CN-342 (#1) – CN-54 (#02) 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 Pump P2 regulator EPPR current is equal or more than 300 mA) 10 seconds continuous, Pump P2 regulator EPPR drive current < 100 mA (Cancellation) (When Pump P2 regulator EPPR current is equal or more than 300 mA) 3 seconds continuous, Pump P2 regulator 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-343 (#2) – CN-54 (#26) Checking Open/Short 2. CN-343 (#1) – CN-54 (#03) Checking Open/Short				
196 (N.A)	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 (N.A)	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-51 (#13) Checking Open/Short 2. CD-44 (#A) – CN-51 (#32) Checking Open/Short 3. CD-44 (#C) – CN-51 (#31) 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	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-52 (#25) Checking Open/Short 2. CD-124 (#A) – CN-51 (#32) Checking Open/Short 3. CD-124 (#C) – CN-51 (#31) Checking Open/Short				
218	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 (#05) Checking Open/Short 2. CN-368 (#2) – Fuse box (#19) 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	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 (#08) Checking Open/Short 2. CN-369 (#2) – Fuse box (#19) Checking Open/Short				
221	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-54 (#17) Checking Open/Short 2. CN-365 (#1) – CN-54 (#09) 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
222	5	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	●		
	6	(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	●		
	(Results / Symptoms) 1. Control Function – Option attachment flow control – P2 relief pressure setting failure (Checking list) 1. CN-366 (#2) – CN-54 (#17) Checking Open/Short 2. CN-366 (#1) – CN-54 (#10) Checking Open/Short				
301	3	10 seconds continuous, Fuel Level Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Fuel Level Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Fuel remaining display failure (Checking list) 1. CD-2 (#2) – CN-51 (#19) Checking Open/Short 2. CD-2 (#1) – CN-51 (#25) Checking Open/Short				
325	4	(Model Parameter) mounting Fuel Warmer Relay (Detection) (When Fuel Warmer Relay is Off) 10 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage ≤ 3.0V (Cancellation) (When Fuel Warmer Relay is Off) 3 seconds continuous, Fuel Warmer Relay drive unit Measurement Voltage > 3.0V	●		
	6	(Detection) (When Fuel Warmer Relay is On) 10 seconds continuous, Fuel Warmer Relay drive current > 4.5 A (Cancellation) (When Fuel Warmer Relay is On) 3 seconds continuous, Fuel Warmer Relay drive current ≤ 4.5 A	●		
	(Results / Symptoms) 1. Control Function – Fuel warmer operation failure (Checking list) 1. CR-46 (#85) – CN-52 (#13) Checking Open/Short 2. CR-46 (#86) – Fuse box (#22) 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
501 (N.A)	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-52 (#26) Checking Open/Short 2. CD-5 (#A) – CN-51 (#32) Checking Open/Short 3. CD-5 (#C) – CN-51 (#31) Checking Open/Short				
503 (N.A)	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-52 (#29) Checking Open/Short 2. CD-3 (#A) – CN-51 (#32) Checking Open/Short 3. CD-3 (#C) – CN-51 (#31) Checking Open/Short				
505 (N.A)	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-51 (#30) Checking Open/Short 2. CD-38 (#A) – CN-51 (#32) Checking Open/Short 3. CD-38 (#C) – CN-51 (#31) 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 (N.A)	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-53 (#11) Checking Open/Short 2. CR-66 (#2) – Fuse box (#30) Checking Open/Short				
517 (N.A)	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-53 (#04) 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

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	W
525 (N.A)	4	(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			●
	6	(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			●
	(Results / Symptoms) 1. Control Function – Ram lock control operation failure (Checking list) 1. CN-69 (#1) – CN-53 (#12) Checking Open/Short 2. CN-69 (#2) – Fuse box (#33) Checking Open/Short				
527 (N.A)	4	(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			●
	6	(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			●
	(Results / Symptoms) 1. Control Function – Creep mode operation failure (Checking list) 1. CN-206 (#1) – CN-52 (#17) Checking Open/Short 2. CN-206 (#2) – Fuse box (#30) 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
530 (N.A)	0	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage > 5.2V			●
	1	10 seconds continuous, 0.3V≤ Travel Forward Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Forward Press. Sensor Measurement Voltage < 0.3V			●
	(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-51 (#20) Checking Open/Short 2. CD-73 (#A) – CN-51 (#32) Checking Open/Short 3. CD-73 (#C) – CN-51 (#31) Checking Open/Short				
531 (N.A)	1	10 seconds continuous, 0.3V≤ Travel Reverse Press. Sensor Measurement Voltage < 0.8V			●
	4	10 seconds continuous, Travel Reverse Press. Sensor Measurement Voltage < 0.3V			●
	(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-51 (#20) Checking Open/Short 2. CD-74 (#A) – CN-51 (#32) Checking Open/Short 3. CD-74 (#C) – CN-51 (#31) Checking Open/Short				
705	0	10 seconds continuous, Battery input Voltage > 35V	●		
	1	10 seconds continuous, Battery input Voltage < 18V	●		
	(Results / Symptoms) 1. Control Function – Startup impossibility (Checking list) 1. CS-74 (#1) – CN-51 (#01) Checking Open/Short				
707	1	(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)	●		
	(Results / Symptoms) 1. Control Function – Battery charging circuit failure (Checking list) 1. CS-74 (#1) – CN-51 (#26) 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
714 (N.A)	3	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage > 5.2V	●		
	4	(Model Parameter) Mounting Acc. Dial 10 seconds continuous, Acc. Dial Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Acc. Dial Voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-7 (#15) – CN-52 (#33) Checking Open/Short				
722	4	(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	●		
	6	(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	●		
	(Results / Symptoms) 1. Control Function – Driving alarm operation failure (Checking list) 1. CN-81 (#1) – CN-52 (#09) Checking Open/Short 2. CN-81 (#2) – Fuse box (#28) Checking Open/Short				
831	2	(When mounting the A/C Controller) 60 seconds continuous, A/C Controller Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – A/C Controller operation failure (Checking list) 1. CN-11 (#8) – CN-51 (#09) Checking Open/Short 2. CN-11 (#7) – CN-51 (#08) Checking Open/Short				
840	2	60 seconds continuous, Cluster Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Cluster operation failure (Checking list) 1. CN-56A (#5) – CN-52 (#01) Checking Open/Short 2. CN-56A (#4) – CN-52 (#02) 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
841	2	10 seconds continuous, ECM Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – ECM operation failure (Checking list) 1. CN-93 (#22) – CN-52 (#02) Checking Open/Short 2. CN-93 (#46) – CN-52 (#01) Checking Open/Short				
848	2	(When mounting the Jog Dial Module) 60 seconds continuous, Jog Dial Module Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Jog Dial Module operation failure (Checking list) 1. CN-363 (#4) – CN-51 (#09) Checking Open/Short 2. CN-363 (#10) – CN-51 (#08) 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 (#09) Checking Open/Short 2. CN-125A (#11) – CN-51 (#08) Checking Open/Short				
866	2	(When mounting the AAVM) 60 seconds continuous, AAVM communication Data Error	●		
	(Results / Symptoms) 1. Control Function – AAVM operation failure (Checking list) 1. CN-9 (#5) – CN-51 (#09) Checking Open/Short 2. CN-9 (#6) – CN-51 (#08) Checking Open/Short				
867	2	60 seconds continuous, RDU communication Data Error	●		
	(Results / Symptoms) 1. Control Function – RDU operation failure (Checking list) 1. CN-376 (#10) – CN-51 (#09) Checking Open/Short 2. CN-376 (#18) – CN-51 (#08) 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
868	2	60 seconds continuous, Switch Controller communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Switch Controller operation failure (Checking list) 1. CN-56A (#7) – CN-51 (#08) Checking Open/Short 2. CN-56A (#6) – CN-51 (#09) Checking Open/Short				
869	2	(When mounting the BKCU) 60 seconds continuous, BKCU communication Data Error	●		
	(Results / Symptoms) 1. Control Function – BKCU operation failure (Checking list) 1. CS-2B (#A) – CN-51 (#09) Checking Open/Short 2. CS-2B (#B) – CN-51 (#08) Checking Open/Short				

※ 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	Engine control module critical internal failure	Bad intelligent device or component
122 102 3	Intake manifold 1 pressure sensor circuit	Voltage above normal, or shorted to high source
123 102 4	Intake manifold 1 pressure sensor circuit	Voltage below normal, or shorted to low source
133 974 3	Remote accelerator pedal or lever position sensor 1 circuit	Voltage above normal, or shorted to high source
134 974 4	Remote accelerator pedal or lever position sensor 1 circuit	Voltage below normal, or shorted to low source
135 100 3	Engine oil rifle pressure 1 sensor circuit	Voltage above normal, or shorted to high source
141 100 4	Engine oil rifle pressure 1 sensor circuit	Voltage below normal, or shorted to low source
143 100 18	Engine oil rifle pressure	Data valid but below normal operating range - moderately severe level
144 110 3	Engine coolant temperature 1 sensor circuit	Voltage above normal, or shorted to high source
145 110 4	Engine coolant temperature 1 sensor circuit	Voltage below normal, or shorted to low source
146 110 16	Engine coolant temperature	Data valid but above normal operating range - moderately severe level
147 91 1	Accelerator pedal or lever position 1 sensor circuit frequency	Data valid but below normal operating range
148 91 0	Accelerator pedal or lever position sensor 1	Data valid but above normal operational range - most severe level
151 110 0	Engine coolant temperature	Data valid but above normal operational range - most severe level
153 105 3	Intake manifold 1 temperature sensor circuit	Voltage above normal, or shorted to high source
154 105 4	Intake manifold 1 temperature 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
187 3510 4	Sensor supply 2 circuit	Voltage below normal, or shorted to low source
197 111 18	Coolant level	Data valid but below normal operating range - moderately severe level
227 3510 3	Sensor supply 2 circuit	Voltage above normal, or shorted to high source
234 190 0	Engine crankshaft speed/position	Data valid but above normal operational range - most severe level
235 111 1	Coolant level	Data valid but below normal operational range - most severe level
237 644 2	External speed command input (Multiple unit synchronization)	Data erratic, intermittent or incorrect
238 3511 4	Sensor supply 3 circuit	Voltage below normal, or shorted to low source
239 3511 3	Sensor supply 3 circuit	Voltage above normal, or shorted to high source
241 84 2	Wheel-based vehicle speed	Data erratic, intermittent or incorrect
242 84 10	Wheel-based vehicle speed sensor circuit tampering has been detected	Abnormal rate of change
271 1347 4	Engine fuel pump pressurizing assembly 1 circuit	Voltage below normal, or shorted to low source
272 1347 3	Engine fuel pump pressurizing assembly 1 circuit	Voltage above normal, or shorted to high source
285 639 9	SAE J1939 multiplexing pgn timeout error	Abnormal update rate
286 639 13	SAE J1939 multiplexing configuration error	Out of calibration
288 974 19	SAE J1939 multiplexing remote accelerator pedal or lever position sensor system	Received network data in error
293 441 3	Auxiliary temperature sensor input 1 circuit	Voltage above normal, or shorted to high source

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
294 441 4	Auxiliary temperature sensor input 1 circuit	Voltage below normal, or shorted to low source
297 1388 3	Auxiliary pressure sensor input 2 circuit	Voltage above normal, or shorted to high source
298 1388 4	Auxiliary pressure sensor input 2 circuit	Voltage below normal, or shorted to low source
322 651 5	Injector solenoid driver cylinder 1 circuit	Current below normal or open circuit
323 655 5	Injector solenoid driver cylinder 5 circuit	Current below normal or open circuit
324 653 5	Injector solenoid driver cylinder 3 circuit	Current below normal or open circuit
325 656 5	Injector solenoid driver cylinder 6 circuit	Current below normal or open circuit
331 652 5	Injector solenoid driver cylinder 2 circuit	Current below normal or open circuit
332 654 5	Injector solenoid driver cylinder 4 circuit	Current below normal or open circuit
334 110 2	Engine coolant temperature	Data erratic, intermittent or incorrect
343 629 12	Engine control module warning internal hardware failure	Bad intelligent device or component
349 191 16	Transmission output shaft speed	Data valid but above normal operating range - moderately severe level
351 3597 12	Injector power supply	Bad intelligent device or component
352 3509 4	Sensor supply 1 circuit	Voltage below normal, or shorted to low source
386 3509 3	Sensor supply 1 circuit	Voltage above normal, or shorted to high source
415 100 1	Engine oil rifle pressure	Data valid but below normal operational range - most severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
418 97 15	Water in fuel indicator	Data valid but above normal operating range - least severe level
428 97 3	Water in fuel indicator sensor circuit	Voltage above normal, or shorted to high source
429 97 4	Water in fuel indicator sensor circuit	Voltage below normal, or shorted to low source
431 558 2	Accelerator pedal or lever idle validation switch	Data erratic, intermittent or incorrect
432 558 13	Accelerator pedal or lever idle validation switch circuit	Out of calibration
435 100 2	Engine oil rifle pressure	Data erratic, intermittent or incorrect
451 157 3	Injector metering rail 1 pressure sensor circuit	Voltage above normal, or shorted to high source
452 157 4	Injector metering rail 1 pressure sensor circuit	Voltage below normal, or shorted to low source
483 1349 3	Injector metering rail 2 pressure sensor circuit	Voltage above normal, or shorted to high source
484 1349 4	Injector metering rail 2 pressure sensor circuit	Voltage below normal, or shorted to low source
488 105 16	Intake manifold 1 temperature	Data valid but above normal operating range - moderately severe level
489 191 18	Transmission output shaft speed	Data valid but below normal operating range - moderately severe level
497 1377 2	Multiple unit synchronization switch	Data erratic, intermittent or incorrect
515 3514 3	Sensor supply 6 circuit	Voltage above normal, or shorted to high source
516 3514 4	Sensor supply 6 circuit	Voltage below normal, or shorted to low source
527 702 3	Auxiliary input/output 2 circuit	Voltage above normal, or shorted to high source

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
529 703 3	Auxiliary input/output 3 circuit	Voltage above normal, or shorted to high source
553 157 16	Injector metering rail 1 pressure	Data valid but above normal operating range - moderately severe level
555 101 16	Crankcase pressure	Data valid but above normal operating range - moderately severe level
556 101 0	Crankcase pressure	Data valid but above normal operational range - most severe level
559 157 18	Injector metering rail 1 pressure	Data valid but below normal operating range - moderately severe level
584 677 3	Starter relay driver circuit	Voltage above normal, or shorted to high source
585 677 4	Starter relay driver circuit	Voltage below normal, or shorted to low source
595 103 16	Turbocharger 1 speed	Data valid but above normal operating range - moderately severe level
599 640 14	Auxiliary commanded dual output shutdown	Special instructions
611 1383 31	Engine shut down hot	Condition exists
649 1378 31	Engine oil change interval	Condition exists
687 103 18	Turbocharger 1 speed	Data valid but below normal operating range - moderately severe level
689 190 2	Engine crankshaft speed/position	Data erratic, intermittent or incorrect
691 1172 3	Turbocharger 1 compressor intake temperature circuit	Voltage above normal, or shorted to high source
692 1172 4	Turbocharger 1 compressor intake temperature circuit	Voltage below normal, or shorted to low source
693 1172 7	Turbocharger 1 compressor intake temperature	Data erratic, intermittent or incorrect

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
731 723 7	Engine speed / position camshaft and crankshaft misalignment	Mechanical system not responding or out of adjustment
741 1176 3	Turbocharger 1 compressor intake pressure circuit	Voltage above normal, or shorted to high source
742 1176 4	Turbocharger 1 compressor intake pressure circuit	Voltage below normal, or shorted to low source
743 1176 2	Turbocharger 1 compressor intake pressure	Data erratic, intermittent or incorrect
769 597 3	Brake switch circuit	Voltage above normal, or shorted to high source
771 597 4	Brake switch circuit	Voltage below normal, or shorted to low source
778 723 2	Engine camshaft speed / position sensor	Data erratic, intermittent or incorrect
1117 3597 2	Power supply lost with ignition on	Data erratic, intermittent or incorrect
1239 2623 3	Accelerator pedal or lever position sensor 2 circuit	Voltage above normal, or shorted to high source
1241 2623 4	Accelerator pedal or lever position sensor 2 circuit	Voltage below normal, or shorted to low source
1242 91 2	Accelerator pedal or lever position sensor 1	Data erratic, intermittent or incorrect
1358 91 3	Accelerator pedal or lever position sensor 1 circuit	Voltage above normal, or shorted to high source
1359 91 4	Accelerator pedal or lever position sensor 1 circuit	Voltage below normal, or shorted to low source
1515 91 19	SAE J1939 multiplexed accelerator pedal or lever sensor system	Received network data in error
1539 1387 3	Auxiliary pressure sensor input 1 circuit	Voltage above normal, or shorted to high source
1621 1387 4	Auxiliary pressure sensor input 1 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
1668 1761 4	Aftertreatment 1 diesel exhaust fluid tank level sensor circuit	Voltage below normal, or shorted to low source
1669 1761 3	Aftertreatment 1 diesel exhaust fluid tank level sensor circuit	Voltage above normal, or shorted to high source
1673 1761 1	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operational range -most severe level
1677 3031 4	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Voltage below normal, or shorted to low source
1678 3031 3	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Voltage above normal, or shorted to high source
1679 3031 2	Aftertreatment 1 diesel exhaust fluid tank temperature	Data erratic, intermittent or incorrect
1682 3362 31	Aftertreatment 1 diesel exhaust fluid dosing unit input lines	Condition exists
1685 3364 4	Aftertreatment diesel exhaust fluid quality sensor circuit	Voltage below normal, or shorted to low source
1686 3364 3	Aftertreatment diesel exhaust fluid quality sensor circuit	Voltage above normal, or shorted to high source
1695 3513 3	Sensor supply 5	Voltage above normal, or shorted to high source
1696 3513 4	Sensor supply 5	Voltage below normal, or shorted to low source
1713 3363 16	Aftertreatment 1 diesel exhaust fluid tank heater	Data valid but above normal operating range - moderately severe level
1714 3364 13	Aftertreatment diesel exhaust fluid quality	Out of calibration
1715 3364 11	Aftertreatment diesel exhaust fluid quality	Root cause not known
1843 101 3	Crankcase pressure circuit	Voltage above normal, or shorted to high source
1844 101 4	Crankcase pressure 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
1852 97 16	Water in fuel indicator	Data valid but above normal operating range - moderately severe level
1879 3251 3	Aftertreatment diesel particulate filter differential pressure sensor circuit	Voltage above normal
1881 3251 4	Aftertreatment diesel particulate filter differential pressure sensor circuit	Voltage below normal
1883 3251 2	Aftertreatment diesel particulate filter differential pressure sensor	Data erratic, intermittent or incorrect
1885 3216 4	Aftertreatment 1 intake NOx sensor circuit	Voltage below normal, or shorted to low source
1887 3226 4	Aftertreatment 1 outlet NOx sensor circuit	Voltage below normal, or shorted to low source
1898 641 13	VGT actuator controller	Out of calibration
1921 3251 16	Aftertreatment diesel particulate filter differential pressure	Data valid but above normal operating range
1922 3251 0	Aftertreatment diesel particulate filter differential pressure	Data valid but above normal operating range
1976 641 15	VGT actuator driver over temperature (calculated)	Data valid but above normal operating range - least severe level
1993 4795 31	Aftertreatment 1 diesel particulate filter missing	Condition exists
2185 3512 3	Sensor supply 4 circuit	Voltage above normal, or shorted to high source
2186 3512 4	Sensor supply 4 circuit	Voltage below normal, or shorted to low source
2198 641 11	VGT actuator driver circuit	Root cause not known
2311 633 31	Electronic fuel injection control valve circuit	Condition exists
2321 190 2	Engine crankshaft speed/position	Data erratic, intermittent or incorrect

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
2322 723 2	Engine camshaft speed / position sensor	Data erratic, intermittent or incorrect
2373 1209 3	Exhaust gas pressure sensor 1 circuit	Voltage above normal, or shorted to high source
2374 1209 4	Exhaust gas pressure sensor 1 circuit	Voltage below normal, or shorted to low source
2387 641 7	VGT actuator driver circuit (motor)	Mechanical system not responding or out of adjustment
2448 111 17	Coolant level	Data valid but below normal operating range - least severe level
2468 190 16	Engine speed	Engine crankshaft speed/position - data valid but above normal operating range - moderately severe level
2554 1209 2	Exhaust gas pressure 1	Data erratic, intermittent or incorrect
2557 697 3	Auxiliary PWM driver 1 circuit	Voltage above normal, or shorted to high source
2558 697 4	AuxiliaryPWM driver 1 circuit	Voltage below normal, or shorted to low source
2571 2630 3	Engine charge air cooler outlet temperature	Voltage above normal, or shorted to high source
2572 2630 4	Engine charge air cooler outlet temperature	Voltage below normal, or shorted to low source
2634 641 12	VGT actuator controller	Bad intelligent device or component
2636 641 9	VGT actuator driver circuit	Abnormal update rate
2638 5298 17	Aftertreatment 1 diesel oxidation catalyst conversion efficiency	Data valid but below normal operating range - moderately severe level
2639 3251 15	Aftertreatment diesel particulate filter differential pressure	Data valid but above normal operating range
2771 3226 9	Aftertreatment 1 outlet NOx sensor	Abnormal update rate

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
2778 3481 16	Aftertreatment fuel rate	Data valid but above normal operating range - moderately severe level
2973 102 2	Intake manifold 1 pressure	Data erratic, intermittent or incorrect
3133 3610 3	Aftertreatment 1 diesel particulate filter outlet pressure sensor circuit	Voltage above normal, or shorted to high source
3134 3610 4	Aftertreatment 1 diesel particulate filter outlet pressure sensor circuit	Voltage below normal, or shorted to low source
3135 3610 2	Aftertreatment 1 diesel particulate filter outlet pressure	Data erratic, intermittent or incorrect
3139 3667 3	Engine air shutoff circuit	Voltage above normal, or shorted to high source
3141 3667 4	Engine air shutoff circuit	Voltage below normal, or shorted to low source
3142 4360 3	Aftertreatment 1 SCR intake temperature sensor circuit	Voltage above normal, or shorted to high source
3144 4360 2	Aftertreatment 1 SCR intake temperature sensor	Data erratic, intermittent or incorrect
3146 4363 3	Aftertreatment 1 SCR outlet temperature sensor circuit	Voltage above normal, or shorted to high source
3147 4363 4	Aftertreatment 1 SCR outlet temperature sensor circuit	Voltage below normal, or shorted to low source
3148 4363 2	Aftertreatment 1 SCR outlet temperature sensor	Data erratic, intermittent or incorrect
3151 4974 31	Aftertreatment 1 SCR catalyst system missing	Condition exists
3165 4363 0	Aftertreatment 1 SCR outlet temperature	Data valid but above normal operational range - most severe
3232 3216 9	Aftertreatment 1 intake NOx sensor	Abnormal update rate
3235 4363 16	Aftertreatment 1 SCR outlet temperature	Data valid but above normal operating range - moderately severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3251 4765 16	Aftertreatment 1 diesel oxidation catalyst intake temperature	Data valid but above normal operating range
3253 3242 16	Aftertreatment 1 diesel particulate filter intake temperature	Data valid but above normal operating range
3255 3246 16	Aftertreatment 1 diesel particulate filter outlet temperature	Data valid but above normal operating range
3311 3242 0	Aftertreatment 1 diesel particulate filter intake temperature	Data valid but above normal operation
3312 3246 0	Aftertreatment 1 diesel particulate filter outlet temperature	Data valid but above normal operation
3313 4765 4	Aftertreatment 1 diesel oxidation catalyst intake temperature sensor circuit	Voltage below normal, or shorted to low source
3314 4765 3	Aftertreatment 1 diesel oxidation catalyst intake temperature sensor circuit	Voltage above normal, or shorted to high source
3315 4765 2	Aftertreatment 1 diesel oxidation catalyst intake temperature	Data erratic, intermittent or incorrect
3316 3242 4	Aftertreatment 1 diesel particulate filter intake temperature sensor circuit	Voltage below normal, or shorted to low source
3317 3242 3	Aftertreatment 1 diesel particulate filter intake temperature sensor circuit	Voltage above normal, or shorted to high source
3318 3242 2	Aftertreatment 1 diesel particulate filter intake temperature	Data erratic, intermittent or incorrect
3319 3246 3	Aftertreatment 1 diesel particulate filter outlet temperature sensor circuit	Voltage above normal, or shorted to high source
3321 3246 4	Aftertreatment 1 diesel particulate filter outlet temperature sensor circuit	Voltage below normal, or shorted to low source
3322 3246 2	Aftertreatment 1 diesel particulate filter outlet temperature	Data erratic, intermittent or incorrect
3326 91 9	SAE J1939 multiplexed accelerator pedal or lever sensor system	Abnormal update rate
3341 107 16	Engine air filter differential pressure - data valid but above normal operating range	Moderately severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3375 5397 31	Aftertreatment diesel particulate filter regeneration too frequent	Condition exists
3376 5319 31	Aftertreatment diesel particulate filter incomplete regeneration	Condition exists
3419 5125 3	Sensor supply 7 circuit	Voltage above normal, or shorted to high source
3421 5125 4	Sensor supply 7 circuit	Voltage below normal, or shorted to low source
3497 1761 17	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operating range - least severe level
3498 1761 18	Aftertreatment 1 diesel exhaust fluid tank level	Data valid but below normal operating range - moderately severe level
3527 558 19	Accelerator pedal or lever idle validation switch	Received network data in error
3528 558 9	Accelerator pedal or lever idle validation switch	Abnormal update rate
3542 51 2	Engine intake throttle actuator position sensor	Data erratic, intermittent, or incorrect
3545 3226 31	Aftertreatment 1 outlet NOx sensor	Abnormal rate of change
3547 4096 31	Aftertreatment diesel exhaust fluid tank empty	Condition exists
3558 3361 3	Aftertreatment 1 diesel exhaust fluid dosing unit	Voltage above normal, or shorted to high source
3559 3361 4	Aftertreatment 1 diesel exhaust fluid dosing unit	Voltage below normal, or shorted to low source
3565 5394 3	Aftertreatment 1 diesel exhaust fluid dosing valve 1 circuit	Voltage above normal or shorted to high source
3567 5394 5	Aftertreatment diesel exhaust fluid dosing valve	Current below normal or open circuit
3568 5394 7	Aftertreatment diesel exhaust fluid dosing valve	Mechanical system not responding or out of adjustment

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3571 4334 3	Aftertreatment 1 diesel exhaust fluid pressure sensor	Voltage above normal, or shorted to high source
3572 4334 4	Aftertreatment 1 diesel exhaust fluid pressure sensor	Voltage below normal, or shorted to low source
3574 4334 18	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data valid but below normal operating range
3575 4334 16	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data valid but above normal operating range
3583 5031 10	Aftertreatment 1 outlet nox sensor heater	Abnormal rate of change
3596 4334 2	Aftertreatment 1 diesel exhaust fluid pressure sensor	Data erratic, intermittent or incorrect
3641 748 9	Transmission output retarder	Abnormal update rate
3649 5024 10	Aftertreatment 1 intake NOx sensor heater	Abnormal rate of change
3681 3228 2	Aftertreatment 1 outlet NOx sensor power supply	Data erratic, intermittent or incorrect
3682 3218 2	Aftertreatment 1 intake NOx sensor power supply	Data erratic, intermittent or incorrect
3697 630 12	Engine control module calibration memory	Bad intelligent device or component
3712 5246 0	Aftertreatment SCR operator inducement	Data valid but above normal operational range - most severe level
3714 1569 31	Engine protection torque derate	Condition exists
3725 3216 10	Aftertreatment 1 intake NOx sensor	Abnormal rate of change
3727 5571 7	High pressure common rail fuel pressure relief valve	Mechanical system not responding or out of adjustment
3737 1675 31	Engine starter mode overcrank protection	Condition exists

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
3741 5571 0	High pressure common rail fuel pressure relief valve	Data valid but above normal operational range
3748 3216 20	Aftertreatment 1 intake NOx sensor	Data not rational - drifted high
3765 442 3	Auxiliary temperature sensor input 2 circuit	Voltage above normal, or shorted to high source
3766 442 4	Auxiliary temperature sensor input 2 circuit	Voltage below normal, or shorted to low source
3838 2978 9	Estimated engine parasitic losses - percent torque	Abnormal update rate
3841 596 2	Cruise control enable switch	Data erratic, intermittent or incorrect
3843 5603 9	Cruise control disable command	Abnormal update rate
3845 5603 31	Cruise control disable command	Condition exists
3866 3364 1	Aftertreatment diesel exhaust fluid quality	Data valid but below normal operational range - most severe level
3868 3364 9	Aftertreatment diesel exhaust fluid quality	Abnormal update rate
3878 3364 2	Aftertreatment diesel exhaust fluid quality	Data erratic, intermittent or incorrect
4151 5742 9	Aftertreatment diesel particulate filter temperature sensor module	Abnormal update rate
4152 5743 9	Aftertreatment selective catalytic reduction temperature sensor module	Abnormal update rate
4158 5742 12	Aftertreatment diesel particulate filter temperature sensor module	Bad intelligent device or component
4159 5743 12	Aftertreatment selective catalytic reduction temperature sensor module	Bad intelligent device or component
4161 5742 3	Aftertreatment diesel particulate filter temperature sensor module	Voltage above normal, or shorted to high source

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
4162 5742 4	Aftertreatment diesel particulate filter temperature sensor module	Voltage below normal, or shorted to low source
4163 5742 16	Aftertreatment diesel particulate filter temperature sensor module	Data valid but above normal operating range
4164 5743 3	Aftertreatment selective catalytic reduction temperature sensor module	Voltage above normal, or shorted to high source
4165 5743 4	Aftertreatment selective catalytic reduction temperature sensor module	Voltage below normal, or shorted to low source
4166 5743 16	Aftertreatment selective catalytic reduction temperature sensor module	Data valid but above normal
4259 5742 11	Aftertreatment diesel particulate filter temperature sensor module	Root cause not known
4261 5743 11	Aftertreatment selective catalytic reduction temperature sensor module	Root cause not known
4262 5571 3	High pressure common rail fuel pressure relief valve	Voltage above normal, or shorted to high source
4263 5571 4	High pressure common rail fuel pressure relief valve	Voltage below normal, or shorted to low source
4265 5571 11	High pressure common rail fuel pressure relief valve	Root cause not known
4277 3364 10	Aftertreatment diesel exhaust fluid quality	Abnormal rate of change
4284 5793 9	Desired engine fueling state	Abnormal update rate
4452 3226 7	Aftertreatment 1 outlet NOx sensor closed loop operation	Condition exists
4484 3667 7	Engine air shutoff	Mechanical system not responding or out of Adjustment
4526 521 2	Brake pedal position	Data erratic, intermittent or incorrect
4572 3031 9	Aftertreatment 1 diesel exhaust fluid tank temperature	Abnormal update rate

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
4584 3936 14	Aftertreatment diesel particulate filter system	Special instructions
4585 4792 14	Aftertreatment 1 SCR catalyst system	Special instructions
4677 1761 9	SAE J1939 multiplexing pgn timeout error	Abnormal update rate
4724 702 5	Auxiliary input/output 2 circuit	Current below normal or open circuit
4725 702 6	Auxiliary input/output 2 circuit	Current above normal or grounded circuit
4731 3031 13	Aftertreatment 1 diesel exhaust fluid tank temperature sensor	Out of calibration
4734 701 14	Auxiliary input/output 1	Special instructions
4737 3031 11	Aftertreatment 1 diesel exhaust fluid tank temperature	Root cause not known
4739 1761 11	Aftertreatment 1 diesel exhaust fluid tank level sensor	Root cause not known
4747 3217 20	Aftertreatment intake oxygen sensor	Data not rational - drifted high
4748 3217 21	Aftertreatment intake oxygen sensor	Data not rational - drifted low
4749 3227 20	Aftertreatment outlet oxygen	Data not rational - drifted high
4751 3227 21	Aftertreatment outlet oxygen	Data not rational - drifted low
4768 3521 11	Aftertreatment 1 diesel exhaust fluid property	Root cause not known
4769 1761 10	Aftertreatment 1 diesel exhaust fluid tank level sensor	Abnormal rate of change
4842 3364 15	Aftertreatment diesel exhaust fluid quality	Data valid but above normal operating range - Least severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
4863 5245 31	Aftertreatment diesel exhaust fluid tank low level indicator	-
4953 3353 3	Alternator 1 status	Voltage above normal, or shorted to high source
4954 3353 4	Alternator 1 status	Voltage below normal, or shorted to low source
4956 6713 13	Variable geometry turbocharger actuator software	Out of calibration
4957 6713 31	Variable geometry turbocharger actuator software	Condition exists
5177 6713 9	VGT actuator driver circuit	Abnormal update rate
5248 1623 13	Tachograph output shaft speed	Out of calibration
5292 520809 31	Excessive time since last engine air shutoff maintenance test	Condition exists
5383 3720 15	Aftertreatment 1 diesel particulate filter ash load percent	Data valid but above normal operating range - least severe level
5576 107 15	Engine air filter differential pressure	Data valid but above normal operating range - least severe level
5632 6918 31	SCR system cleaning inhibited due to inhibit switch	Condition exists
5652 1209 15	Exhaust pressure 1	Data valid but above normal operating range - least severe level
5653 6881 9	SCR operator inducement override switch	Abnormal update rate
5654 6881 13	SCR operator inducement override switch	Out of calibration
5655 4364 31	Aftertreatment 1 scr conversion efficiency	Condition exists
5689 3226 11	Aftertreatment 1 outlet nox sensor	Root cause not known

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
5715 3521 10	Aftertreatment 1 diesel particulate filter differential pressure	Abnormal rate of change
5716 3610 10	Aftertreatment 1 diesel particulate filter outlet pressure	Abnormal rate of change
5864 4375 3	Aftertreatment 1 diesel exhaust fluid pump command circuit	Voltage above normal or shorted to high source
5865 4375 4	Aftertreatment 1 diesel exhaust fluid pump command circuit	Voltage below normal or shorted to low source
5866 520953 3	Aftertreatment diesel exhaust fluid dosing unit relay feedback	Voltage above normal or shorted to high source
5867 520953 4	Aftertreatment diesel exhaust fluid dosing unit relay feedback	Voltage below normal or shorted to low source.
5868 4339 7	Aftertreatment 1 scr feedback control status	Mechanical system not responding or out of adjustment
5879 3464 3	Electronic throttle control actuator driver circuit	Voltage above normal or shorted to high source
5881 3464 4	Electronic throttle control actuator driver circuit	Voltage below normal or shorted to low source
5935 4334 7	Aftertreatment 1 diesel exhaust fluid pressure	Mechanical system not responding or out of adjustment
5936 4334 15	Aftertreatment 1 diesel exhaust fluid pressure	Data valid but above normal operating range - least severe level
5938 3750 14	Aftertreatment 1 diesel particulate filter conditions not met for active regeneration	Special instructions
5939 520968 9	Machine constrained operation	Abnormal update rate. No communication or an Invalid data transfer rate has been detected on the J1939 data link between the ECM and the machine
5941 520968 19	Machine constrained operation	Received network data in error. The received J1939 datalink message was not valid.
6256 168 15	Battery 1 voltage	Data valid but below normal operating range - moderately severe level
6257 168 17	Battery 1 voltage	Data valid but below normal operating range - moderately severe level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
6263 647 3	Fan control circuit	Voltage above normal, or shorted to high source
6264 647 4	Fan control circuit	Voltage below normal, or shorted to low source
6456 5484 3	Engine fan clutch 2 control circuit	Voltage above normal, or shorted to high source
6457 5484 4	Engine fan clutch 2 control circuit	Voltage below normal, or shorted to low source
6467 1639 15	Fan speed	Data valid but above normal operational range - most severe level
6468 1639 17	Fan speed	Data valid but below normal operational range - most severe level
6471 6799 3	Fan blade pitch position sensor circuit	Voltage above normal, or shorted to high source
6472 6799 4	Fan blade pitch position sensor circuit	Voltage below normal, or shorted to low source
6475 3363 7	Aftertreatment 1 diesel exhaust fluid tank heater	Mechanical system not responding or out of adjustment
6476 3363 18	Aftertreatment 1 diesel exhaust fluid tank heater	Data valid but below normal operating range - moderately severe level
6477 5491 3	Aftertreatment diesel exhaust fluid line heater relay	Voltage above normal, or shorted to high source
6478 5491 4	Aftertreatment diesel exhaust fluid line heater relay	Voltage below normal, or shorted to low source
6479 3363 3	Aftertreatment 1 diesel exhaust fluid tank heater	Voltage above normal, or shorted to high source
6481 3363 4	Aftertreatment 1 diesel exhaust fluid tank heater	Voltage below normal, or shorted to low source
6497 51 3	Engine intake throttle actuator position sensor circuit	Voltage above normal, or shorted to high source
6498 51 4	Engine intake throttle actuator position sensor circuit	Voltage above normal, or shorted to low source

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
6499 3597 17	ECU power output supply voltage 1	Data valid but below normal operating range - moderately severe level
6511 6655 3	Maintain ECM power lamp	Voltage above normal, or shorted to high source
6512 6655 4	Maintain ECM power lamp	Voltage below normal, or shorted to low source
6513 5745 17	Aftertreatment 1 diesel exhaust fluid dosing unit heater	Data valid but below normal operating range
6522 111 3	Coolant level sensor 1 circuit	Voltage above normal, or shorted to high source
6523 111 4	Coolant level sensor 1 circuit	Voltage below normal, or shorted to low source
6526 1761 13	Aftertreatment 1 diesel exhaust fluid tank level sensor	Out of calibration
6531 4340 3	Aftertreatment 1 diesel exhaust fluid line heater 1 circuit	Voltage above normal, or shorted to high source
6532 4340 4	Aftertreatment 1 diesel exhaust fluid line heater 1 circuit	Voltage below normal, or shorted to low source
6533 4342 3	Aftertreatment 1 diesel exhaust fluid line heater 2 circuit	Voltage above normal, or shorted to high source
6534 4342 4	Aftertreatment 1 diesel exhaust fluid line heater 2 circuit	Voltage below normal, or shorted to low source
6535 4344 3	Aftertreatment diesel exhaust fluid line heater 3 circuit	Voltage above normal, or shorted to high source
6536 4344 4	Aftertreatment diesel exhaust fluid line heater 3 circuit	Voltage below normal, or shorted to low source
6556 729 3	Engine intake air heater 1 circuit	Voltage above normal, or shorted to high source
6557 729 4	Engine intake air heater 1 circuit	Voltage below normal, or shorted to low source
6563 976 2	Auxiliary intermediate (PTO) speed switch validation	Data erratic, intermittent or incorrect

※ Some fault codes are not applied to this machine.

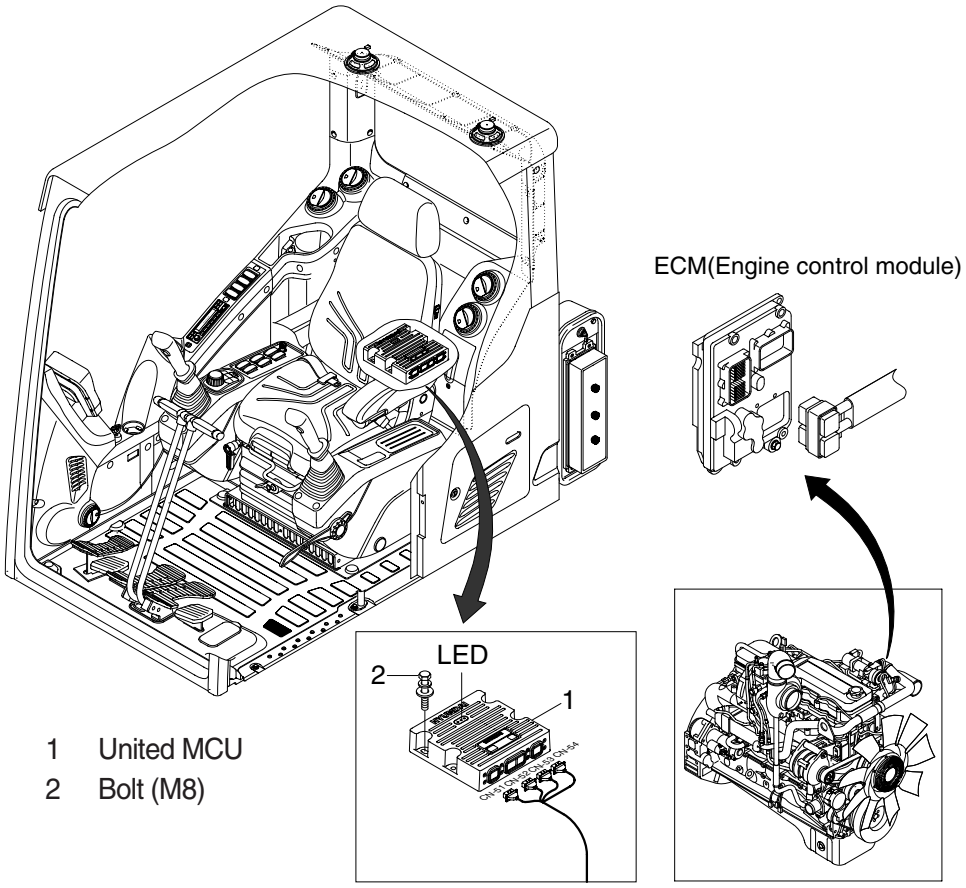
Fault code J1939 SPN J1939 FMI	Item	Description
6568 3695 2	Aftertreatment regeneration inhibit switch	Data erratic, intermittent or incorrect
6583 441 14	Auxiliary temperature sensor input 1	Special instructions
6584 1388 14	Auxiliary pressure sensor input 2	Special instructions
6595 190 11	Engine speed	Root cause not known
6596 3713 31	Diesel particulate filter active regeneration inhibited due to system timeout	Condition exists
6599 521002 31	Engine cranks slowly	Condition exists
6611 6385 3	Engine starter motor relay control circuit	Voltage above normal or shorted to high source
6612 6385 4	Engine starter motor relay control circuit	Voltage below normal or shorted to low source
6613 5842 14	SCR monitoring system malfunction	Special instructions
6618 70 2	Parking brake switch	Data erratic, intermittent, or incorrect
6619 3515 10	Aftertreatment 1 diesel exhaust fluid temperature 2	Abnormal rate of change
6726 4796 31	Aftertreatment 1 diesel oxidation catalyst missing	Condition exists
6752 3364 18	Aftertreatment diesel exhaust fluid quality	Data valid but below normal operating range - moderately severe level
6771 521032 14	Aftertreatment system assembly	Special instructions
6938 5793 9	Desired engine fueling state	Abnormal update rate
6939 7745 9	Engine start request	Abnormal update rate

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Item	Description
7133 7745 13	Engine start request	Out of calibration
7134 7746 13	Engine start consent	Out of calibration
7135 103 15	Engine turbocharger speed	Data valid but above normal operating range - least severe level
7745 1569 14	Engine protection torque derate	Special instructions
7393 7745 9	Engine start request	Abnormal update rate
7453 3242 15	Aftertreatment 1 diesel particulate filter intake temperature	Data valid but above normal operating range - least severe level
7454 3246 15	Aftertreatment 1 diesel particulate filter outlet temperature	Data valid but above normal operating range - least severe level

※ Some fault codes are not applied to this machine.

1. UNITED MCU AND ENGINE ECM



1 United MCU
2 Bolt (M8)

220A5MS13

2. UNITED MCU ASSEMBLY

1) To match the pump absorption torque with the engine torque, united 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 united MCU display as below.

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

G : green, R : red, Y : yellow

GROUP 15 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.

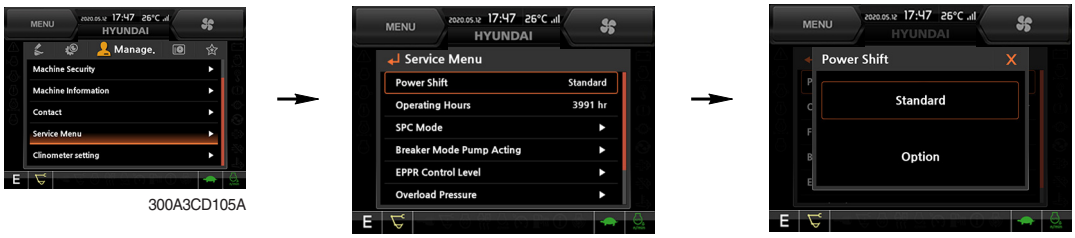
(2) Spool valve

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.

2) HOW TO SWITCH THE POWER SHIFT (STANDARD ↔ OPTION) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the power shift (standard ↔ option).

- Management
  · Service menu



300A3CD105A

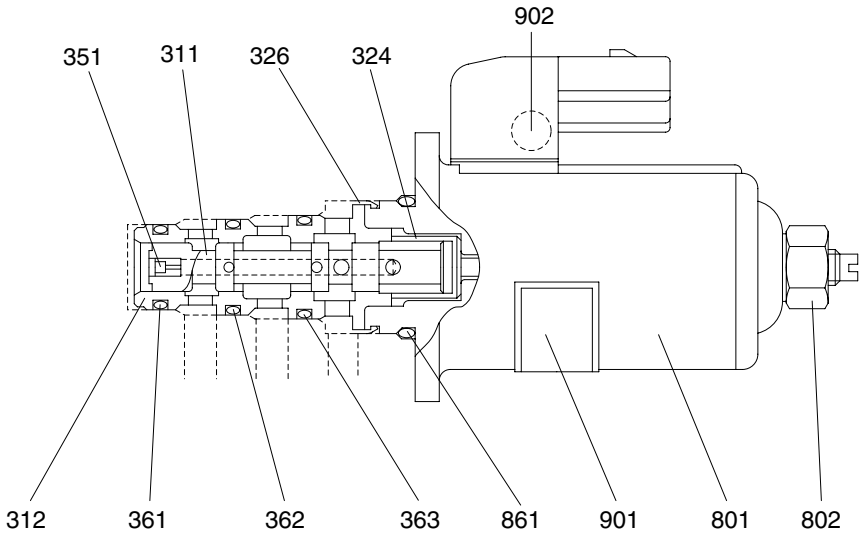
Enter the password 300A3CD106A

300A3CD107A

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

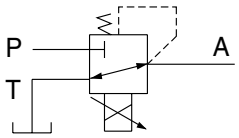
3) OPERATING PRINCIPLE (P1 and P2 pump EPPR valve)

(1) Structure



220F2MP12

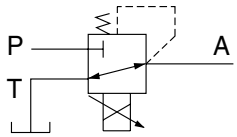
311 Spool
312 Sleeve
324 Spring
326 Retaining ring
351 Orifice
361 O-ring
362 O-ring
363 O-ring
801 Solenoid
801 Seal nut
861 O-ring
901 Name plate
902 Function name plate

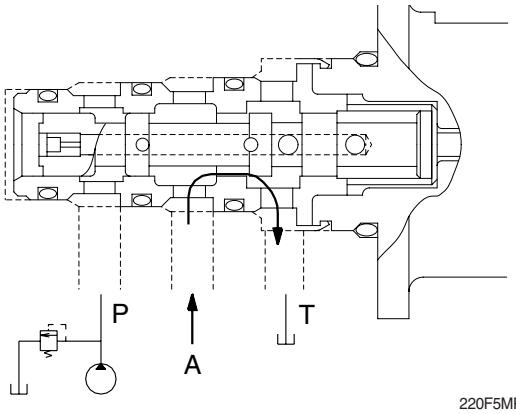


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

Pressure line is blocked and A oil returns to tank.

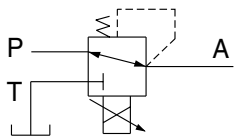


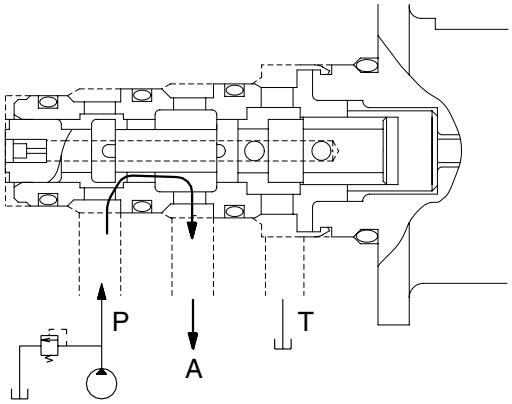


220F5MP13

(3) Operating

Secondary pressure enters into A.





220F5MP14

4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-342 (or 343) from EPPR valve.

② Insert the adapter to CN-342 (or 343) and install multimeter as figure.

③ Start engine.

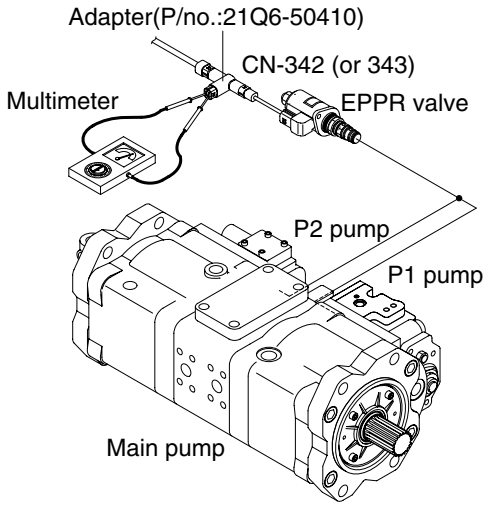
④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal 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



CN-342 for P1 pump
CN-343 for P2 pump

220A5MS21

(2) Check pressure at EPPR valve

① Remove plug and connect pressure gauge as figure.
- Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)

② Start engine.

③ Set S-mode and cancel auto decel mode.

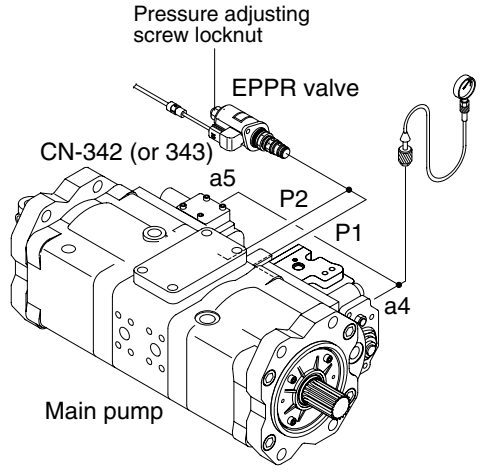
④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1600±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

Spec : 2~25 kgf/cm² (30~350 psi)



a4 for P1 pump
a5 for P2 pump

220A5MS22

2. BOOM PRIORITY EPPR VALVE

1) COMPOSITION

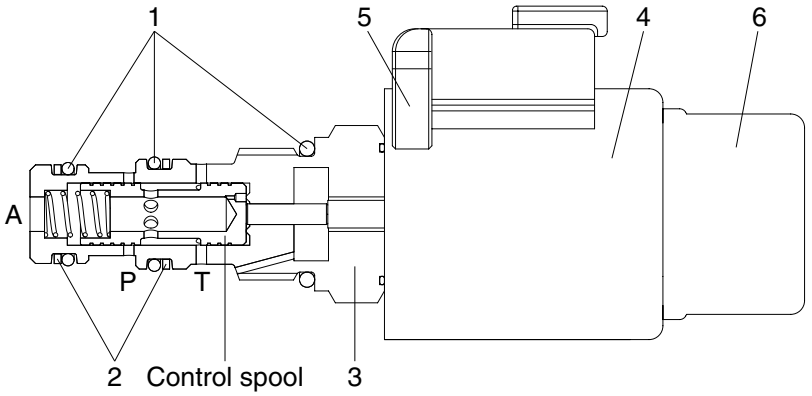
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

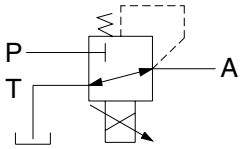
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

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-242 (or 243) from EPPR valve.

② Insert the adapter to CN-242 (or 243) and install multimeter as figure.

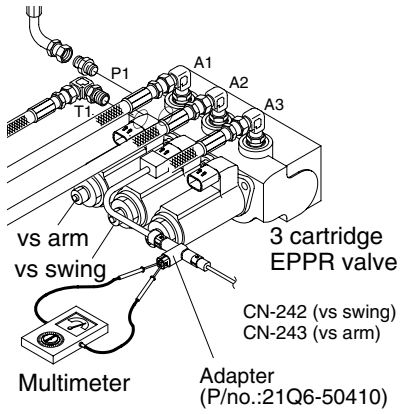
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ If rpm display approx 1600±50 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)



220A5MS15

(2) Check pressure at EPPR valve

① Remove hose from A5 port and connect pressure gauge as figure.
· Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)

② Start engine.

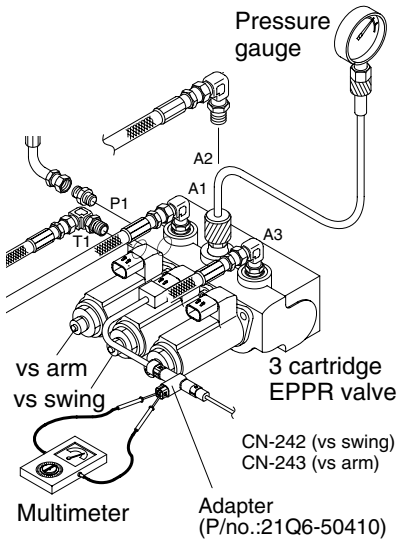
③ Set S-mode and cancel auto decel mode.

④ If rpm display approx 1600±50 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/cm² (170~530 psi)
(combined boom up and swing operation)



220A5MS16

GROUP 16 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



220A5CD20A

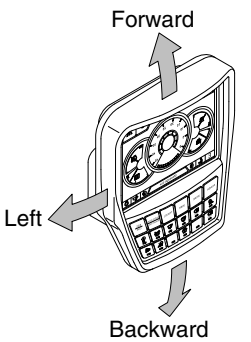
※ **The warning lamp pops up and/or blinks and the buzzer sounds when the machine has a problem.**

The warning lamp blinks until the problem is cleared. Refer to page 5-75 for details.

※ **This cluster is adjustable.**

· Vertical (forward/backward) : each 15°

· Horizontal (left only) : 8°



290F3CD47

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 1100 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

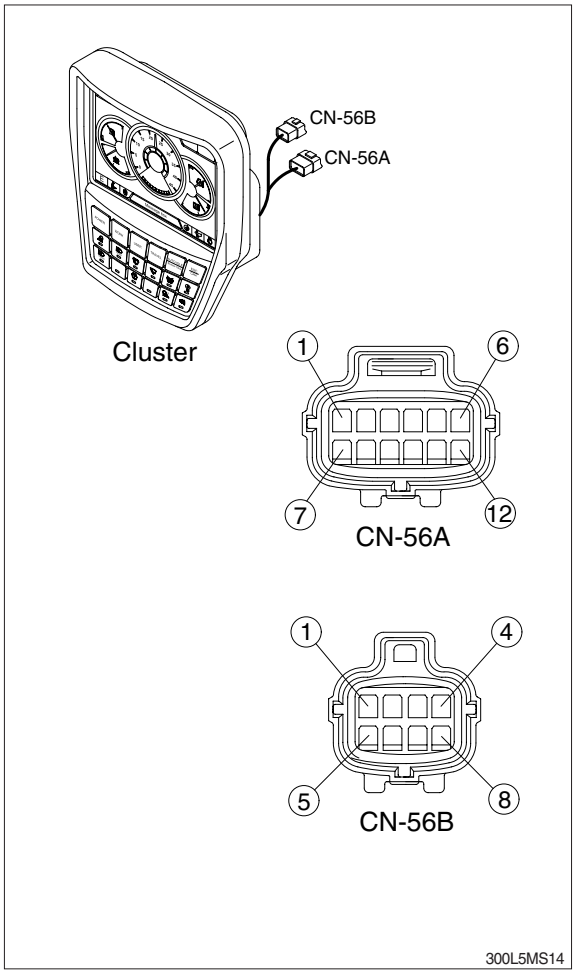
(1) CN-56A

No.	Name	Signal
1	Battery 24V	20~32V
2	Power IG (24V)	20~32V
3	GND	-
4	CAN 1 (H)	0~5V
5	CAN 1 (L)	0~5V
6	CAN 2 (H)	0~5V
7	CAN 2 (L)	20~32V
8	NC	-
9	NC	-
10	Aux left	0~5V
11	Aux right	0~5V
12	Aux GND	-

(2) CN-56B

No.	Name	Signal
1	CAM 6.5V	6.3~6.7V
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	0~5V

NTSC : National Television System Committee



4) GAUGE

(1) Operation screen

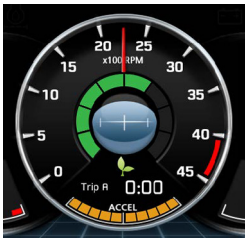
When you first turn starting switch ON, the operation screen will appear.



300A3CD21A

1	RPM / Speed gauge	5	DEF/AdBlue® level gauge
2	Engine coolant temperature gauge	6	Tripmeter display
3	Hydraulic oil temperature gauge	7	Eco guage
4	Fuel level gauge	8	Accel dial gauge

(2) RPM / Speed gauge



300A3CD22

① This displays the engine speed.

(3) Engine coolant temperature gauge



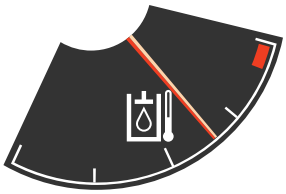
290F3CD53

① This gauge indicates the temperature of coolant.
- White range : 40-107˚C (104-225˚F)
- Red range : Above 107˚C (225˚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



290F3CD54

① This gauge indicates the temperature of hydraulic oil.
- White range : 40-105˚C (104-221˚F)
- Red range : Above 105˚C (221˚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



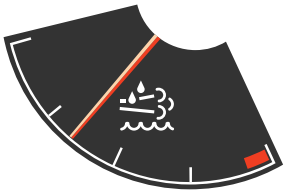
290F3CD55

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) DEF/AdBlue® Level gauge



290F3CD57

① This gauge indicates the amount of liquid in the DEF/AdBlue® tank.

② Fill the DEF/AdBlue® when in the red range, or lamp pops up and the buzzer sounds.

③ Do not overfull DEF/AdBlue®.

※ Refer to page 5-80.

※ 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.

(7) Tripmeter display



290F3CD56

① This displays the engine the tripmeter.

※ Refer to page 5-104 for details.

(8) 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.

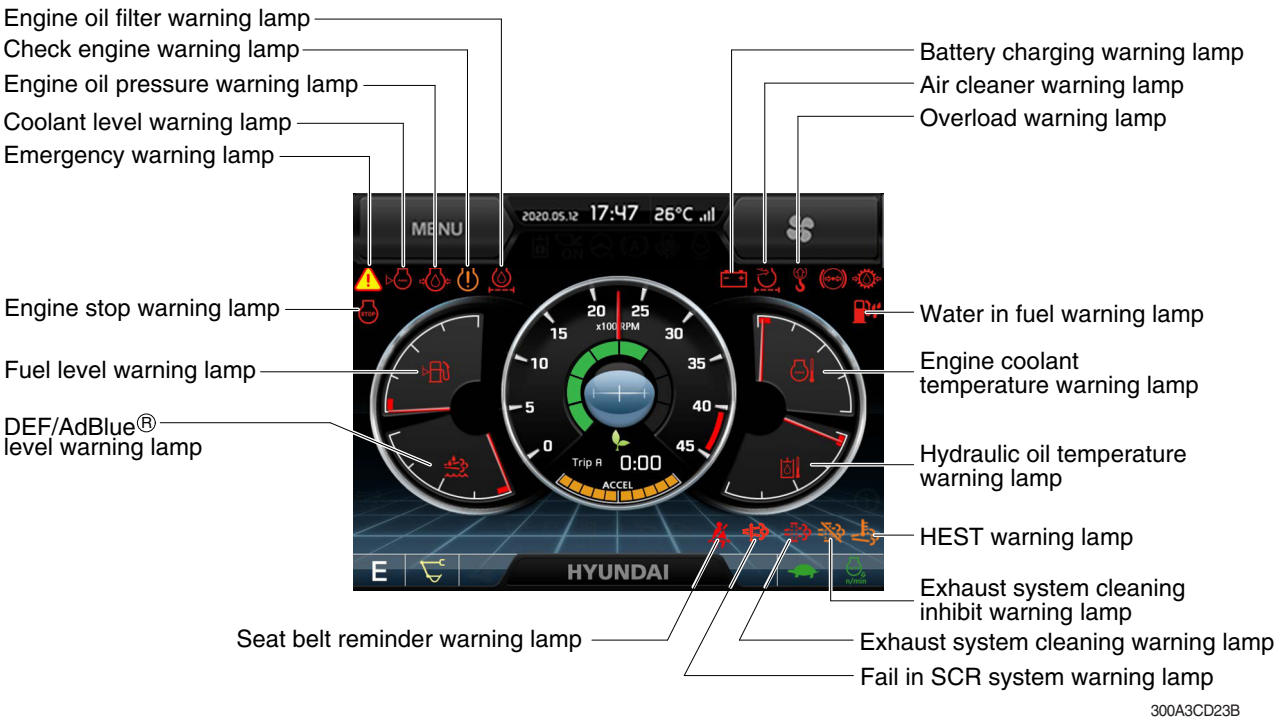
(9) Accel dial gauge



290F3CD59

① This gauge indicates the level of accel dial.

5) WARNING LAMPS

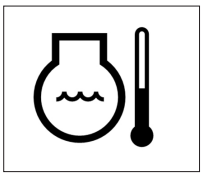


※ Warning lamps and buzzer

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 knob of the jog dial module is pushed - the lamp of the LCD is touched
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position, lights up or blinks and the buzzer stops when; - the buzzer stop switch AUTO IDLE Buzzer Stop is pushed - the knob of the jog dial module is pushed - the lamp of the LCD is touched **※ Refer to page 5-80 for details.**
	Warning lamp pops up on the center of the LCD and the buzzer sounds	· The pop-up warning lamp moves to the original position, lights up and the buzzer stops after 2 seconds elapses.
	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 after 2 seconds elapses.
	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 5-76 for details.**
	Warning lamp lights up and the buzzer sounds	**※ Refer to page 5-80 for details.**

※ Refer to page 5-86 for the buzzer stop switch AUTO IDLE Buzzer Stop and the operator's manual page 3-66 for the jog dial module.

(1) Engine coolant temperature warning lamp



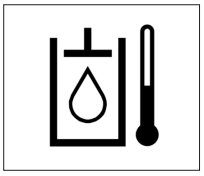
290F3CD61

① Engine coolant temperature warning is indicated in 2 steps.
- 103˚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 AUTO IDLE Buzzer Stop is pushed. The buzzer will stop and , lamps will blink.

③ Check the cooling system when the lamps keep blinking.

(2) Hydraulic oil temperature warning lamp



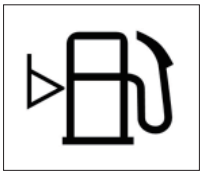
290F3CD62

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 AUTO IDLE Buzzer Stop 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 55 ℓ (14.5 U.S. gal).

② Fill the fuel immediately after the lamp blinks.

(4) Emergency warning lamp



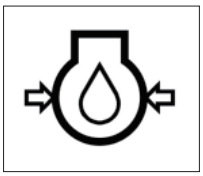
290F3CD64

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 AUTO IDLE Buzzer Stop 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 lights up, shut OFF the engine immediately. Check oil level.

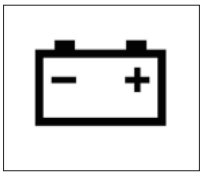
(6) Check engine warning lamp



290F3CD66

① This warning lamp pops up and the buzzer sounds when the communication between MCU and engine ECM is abnormal, or if the cluster received specific fault code from the engine ECM.
② Check the communication line between the two.
If the communication line is OK, then check the fault codes on the cluster.

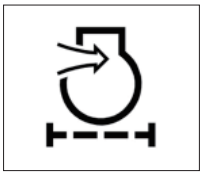
(7) Battery charging warning lamp



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.

(8) 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.

(9) 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.

(10) Engine stop warning lamp



290F3CD252

① This warning lamp pops up and the buzzer sounds after 30 minutes of run time elapses, when the DEF/AdBlue® tank has reached it's minimum level. Stop engine immediately and check actual DEF/AdBlue® level.

② Fill the DEF/AdBlue® immediately.

※ Refer to page 5-80.

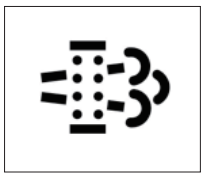
③ This lamp pops up and the buzzer sounds when the maual (stationary) exhuast system cleaning is not performed.

※ Refer to page 5-78.

※ Please contact your HD Hyundai Construction Equipment service center or local dealer.

※ "Engine shutdown" cluster message pops up when the exhaust gas temperature reaches above 800℃.

(11) Exhaust system cleaning warning lamp

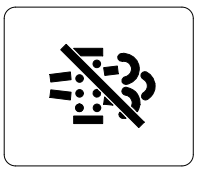


290F3CD70

① This warning lamp lights up or blinks when exhaust system cleaning is needed as seen in the table below.

Warning lamp			Description
Exhaust 	Check engine 	Stop engine 	
Off	Off	Off	· Automatic exhaust system cleaning
Blink	Off	Off	· The status of a manual (stationary) exhaust system cleaning when the exhaust system cleaning switch has been activated. **※ Refer to page 5-79.**
On	On	Off	· The aftertreatment exhaust system needs to be cleaned immediately. · Engine power will be reduced automatically if action is not taken. ※ The exhaust system cleaning can be accomplished by: - Changing to a more challenging duty cycle. - Performing a manual (stationary) exhaust system cleaning.
On	On	On	· These lamps will be ON when a manual (stationary) exhaust system cleaning is not performed. · Stop the engine immediately. · Please contact your HD Hyundai Construction Equipment service center or local dealer.

(12) Exhaust system cleaning inhibit warning lamp

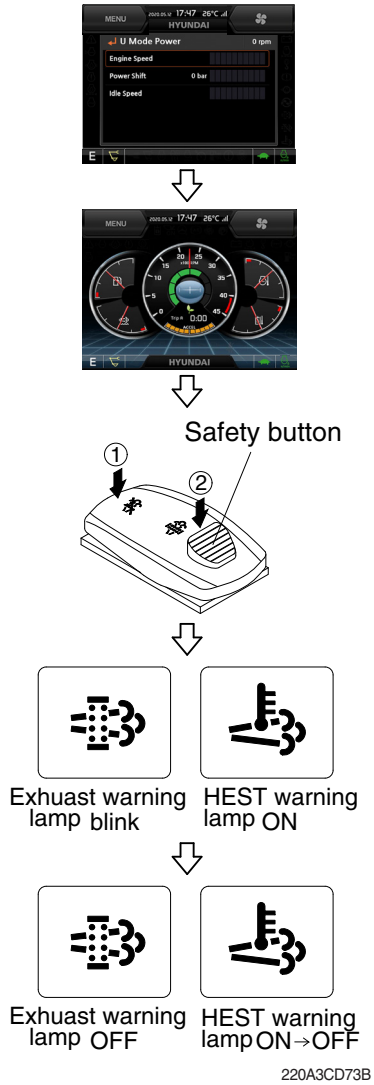


2609A3CD20

① This warning lamp indicates the exhaust system cleaning switch is pushed to the inhibit position, therefore automatic and manual exhaust system cleaning can not occur.

※ Refer to the operator's manaul page 3-42 for the exhaust system cleaning switch.

※ Manual exhaust system cleaning



220A3CD73B

※ Manual exhaust system cleaning must be operated in a fireproof area.

※ To stop a manual exhaust system cleaning before it has completed, set to the exhaust system cleaning switch to the inhibit position or turn OFF the engine.

① Stop and park the machine.

② Pull the safety button and push the switch to position ② to initiate the manual exhaust system cleaning.

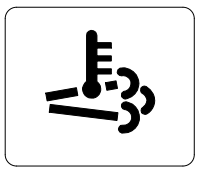
※ Refer to the operator's manual page 3-42 for the exhaust system cleaning switch operation.

※ The engine speed may increase to 950~1050 rpm and exhaust system cleaning begins and it will take approximately 20~30 minutes.

③ The exhaust system cleaning warning lamp will blink and HEST warning lamp will light up during the exhaust system cleaning is operation.

④ The exhaust system cleaning and/or HEST warning lamp light will go off when the exhaust system cleaning is completed.

(13) **HEST** (High exhaust system temperature) **warning lamp**



2609A3CD21

① This warning lamp indicates, when illuminated, that exhaust temperatures are high due to exhaust system cleaning.

② The lamp will also illuminate during a manual exhaust system cleaning.

③ When this lamp is illuminated, be sure the exhaust pipe outlet is not directed at any surface or material that can melt, burn, or explode.

⚠ When this lamp is illuminated, the exhaust gas temperature could reach 800˚C [1500˚F], which is hot enough to ignite or melt common materials, and to burn people.

※ The lamp does not signify the need for any kind of equipment or engine service; It merely alerts the equipment operator to high exhaust temperatures. It is common for the lamp to illuminate on and off during normal equipment operation as the engine completes exhaust system cleaning cycles.

(14) DEF/AdBlue® level warning lamp



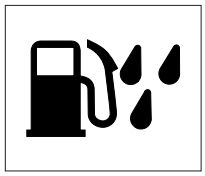
290F3CD257

① This warning lamp when ON or blinking, indicates that the DEF/AdBlue® level is low as per the table below.

※ **It is recommended that the DEF/AdBlue® tank be filled completely full of the DEF/AdBlue® in order to correct any fault conditions.**

Warning lamp				Description
Fail in SCR system	DEF/AdBlue® level	Check engine	Stop engine	
On	On	Off	Off	· The DEF/AdBlue® level has fallen below the initial warning level (10%).
On	On	On	Off	· The DEF/AdBlue® level has fallen below the initial derate level (2.5%). · The engine power will be limited automatically.
On	Blink	On	On	· This happens when 30 minutes has elapsed with empty conditions (0%) of the DEF/AdBlue® tank. · The engine will enter the final derate level which may include low idle lock or engine shutdown with restart limitations. · In order to remove the final derate, the DEF/AdBlue® tank must be filled to above 10% gauge reading.

(15) Water in fuel warning lamp



300A3CD24A

① This warning lamp lights up and the buzzer sounds when the water separator is full of water or malfunctioning.

※ **When this lamp lights up, stop the machine and drain water from the separator.**

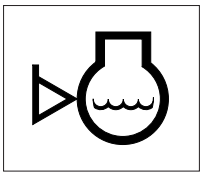
(16) Seat belt reminder warning lamp



300A3CD25

① When operator does not fasten the operator's seat belt, the seat belt reminder warning lamp pops up and the buzzer sounds.
② Fasten the seat belt.

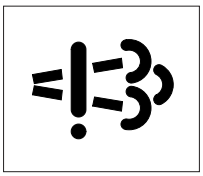
(17) Coolant level warning lamp



760F3CD58

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

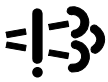
(18) Fail in SCR system warning lamp



300A3CD15

① This warning lamp indicates there are faults related to SCR system.
② The lamp lights up when each of the below warnings is happening.
   a. Low DEF/AdBlue® level
   b. Poor quality of DEF/AdBlue®
   c. Tempering or malfunction in the aftertreatment system
③ Once the lamp lights up, the engine will derate soon.

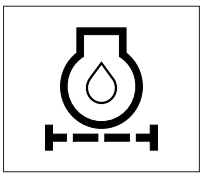
※ Please contact your HD Hyundai Construction Equipment service center or local dealer.

Warning lamp		Torque reduction
	Time	
On	Fault detected	-
On	After 2 h 30 min	· Torque is reduced to 75% of the highest torque.
Blink	After 3 h 45 min	· Torque is reduced to 50% of the highest torque.
Blink rapidly	After 4 hours	· Torque is reduced to 0% (low idling) of the hightest torque within 2~10 min.

※ If a new fault occurs within 40 hours of operation since the first fault, the warning lamp will come ON. After 3 hours of operation, the warning lamp will blink rapidly and torque will be reduced to 0% (low idling) within 2~10 min.

※ Once the fault has been remedied and the engine control unit has received an indication that it is working, torque returns to the normal level.

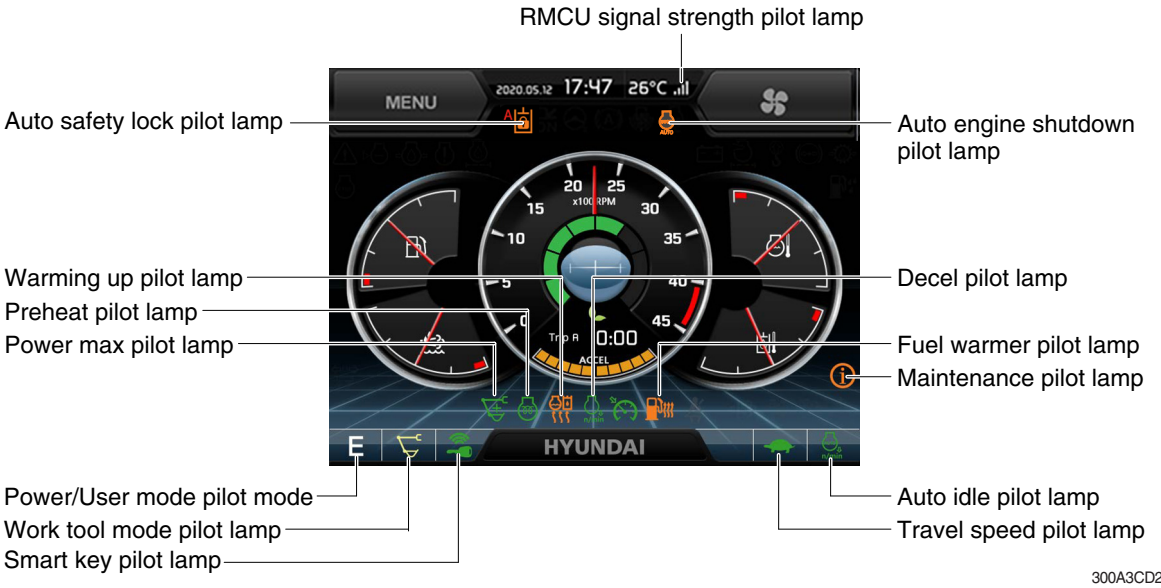
(19) Engine oil filter warning lamp



300A3CD306

① This warning lamp pops up and the buzzer sounds when the engine oil filter is clogged.
② Check the filter and clean or replace it.

6) PILOT LAMPS



300A3CD26A

(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
			Lifting mode
4	Travel mode		Low speed traveling
			High speed traveling
5	Auto idle mode		Auto idle

(2) Power max pilot lamp



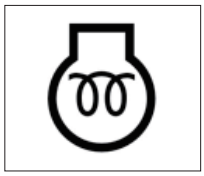
300A3CD32

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 3-45 for power max function.**

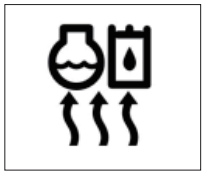
(3) Preheat pilot lamp



290F3CD79

① Turning the start key switch to the ON position starts preheating in cold weather.
② Start the engine after this lamp goes OFF.

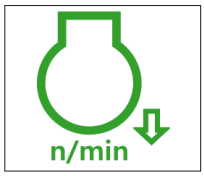
(4) Warming up pilot lamp



290F3CD80

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

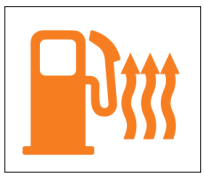
(5) Decel pilot lamp



300A3CD33

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 operator's manual page 3-45.**

(6) Fuel warmer pilot lamp



300A3CD34

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

(7) Maintenance pilot lamp



300A3CD35

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 page 5-97.**

(8) RMCU signal strength pilot lamp (mobile only)

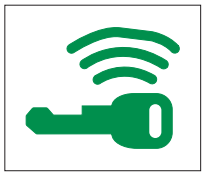


220A3CD200

① This lamp indicates RMCU signal strength as below.

: Searching
: Bad
: Normal
: Good
: Excellent

(9) Smart key pilot lamp (opt)

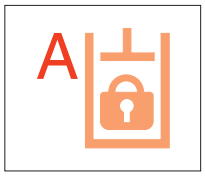


300A3CD36A

① This lamp lights up when the engine is started by the start but-
② ton.
This lamp is red when the a authentication fails, it will be green when it authentication is successful.

※ **Refer to page 5-98.**

(10) Auto safety lock pilot lamp

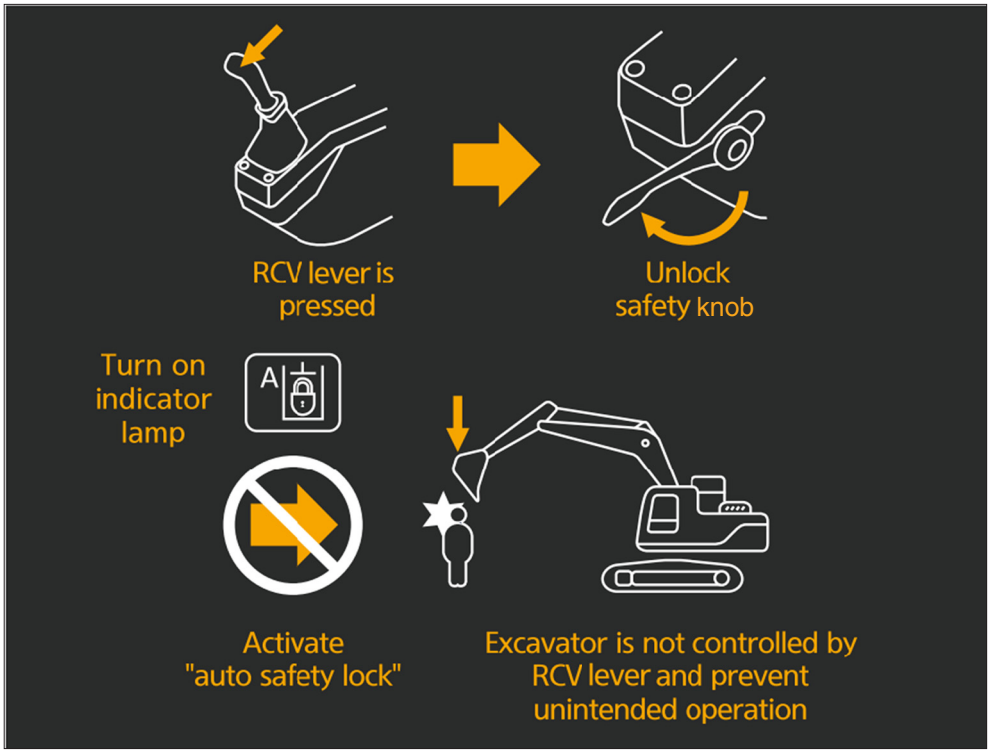


300A3CD37A

① Auto safety lock system prevents unintended operation of the machine in order to improve safety.
② Engine will only start if safety knob is locked.
③ If operator unlocks safety knob when RCV lever is pressed, machine is not controlled by RCV lever.

⚠ **If operator unlocks safety knob while any control/function is being operated, the machine will move violently. This could cause serious injury, death or damage to property.**

④ The function is released only by turning the safety knob to the UNLOCK position and the LOCK position again.



300A3CD38A

(11) Auto engine shutdown pilot lamp



220A3CD202A

① This lamp is turned ON when the auto engine shutdown is activated.

※ **Refer to page 5-93.**

(12) Engine rpm state

Function	Safety Knob	Auto Idle Mode 	One Touch Decel 	RPM State
State 1	Unlock	OFF	OFF	High rpm
State 2	Unlock	OFF	**ON**	Low rpm
State 3	Unlock	**ON**	OFF	Auto Idle rpm
State 4	Lock	**ON**	OFF	Low rpm
State 5	Lock	OFF	**ON**	Low rpm
State 6	Unlock	**ON**	**ON**	Low rpm
State 7	Lock → Unlock	**ON**	**ON**	Low → High → Low rpm (few seconds later)
State 8	Lock	**ON**	OFF	Low rpm
State 9	Lock	**ON**	**ON**	Low rpm

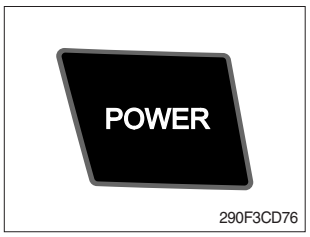
7) SWITCHES



300A3CD39A

※ **When some of the switches are selected, the pilot lamps are displayed on the LCD. Refer to page 5-82 for details.**

(1) Power mode switch

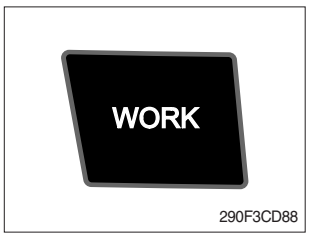


290F3CD76

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.
- E : Economy power work.

② 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)
- : Lifting mode
- Not installed : Breaker or crusher is not installed.

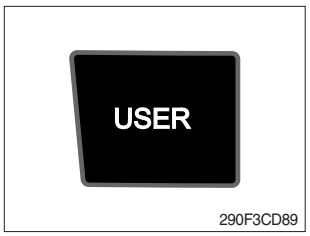
※ **Refer to the operator's manual page 2-7 for details.**



300A3CD168

② If you press this switch for a time (1 second), quick pop-up will appear. When you select an attachment from the popup, the operation mode will immediately switch to selected attachment.

(3) User mode switch



① This switch is used to select the user mode.
② Refer to page 5-90 for another set of the user mode.

(4) Travel speed switch



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



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



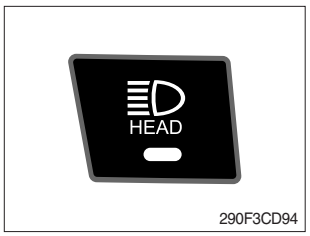
① This switch is used to return to the previous menu or parent menu.
② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-104 for the camera.
③ If the camera is not installed, this switch is used only ESC function.

(7) Work light switch



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



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



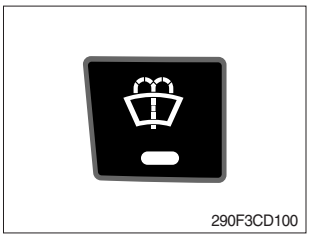
① When this switch is pressed, wipers operate intermittently.
② The pilot lamp lights up when this switch is pressed.

(10) Wiper switch



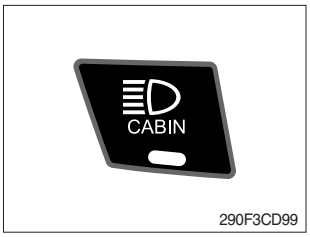
① This switch is used to operate the wiper.
② Note that the wiper will self-park when switched off.
③ The pilot lamp lights up when this switch is pressed.
△ **If the wiper does not operate with the switch in ON position, turn the switch OFF immediately. Check the cause. If the switch remains ON, motor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

(11) Washer switch



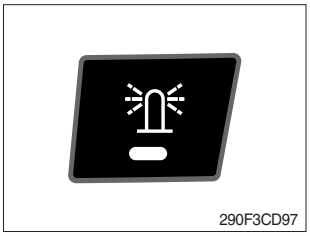
① Washer fluid is sprayed and the wiper is operated only when this switch is pressed.
② The pilot lamp lights up when this switch is pressed.

(12) Cab light switch



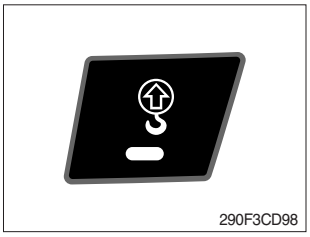
① This switch turns on the cab light.
② The pilot lamp lights up when this switch is pressed.

(13) Beacon switch (opt)



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

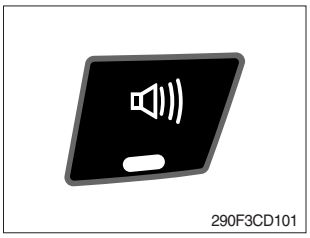
(14) Overload switch (opt)



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.

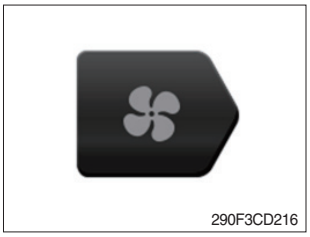
⚠ Overloading the machine could impact the machines stability which could result in tipover hazard. A tipover hazard could result in serious injury or death. Always activate the overload warning device before you handle or lift objects.

(15) Travel alarm switch



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) Air conditioner quick touch switch



① This switch used to select air conditioner control mode.
※ Refer to page 5-106.

(17) Main menu quick touch switch



① This switch is to activate the main menu in the cluster.
※ Refer to page 5-89.

8) MAIN MENU

※ You can select or set the menu by the jog dial module or touch screen.
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.

· Operation screen



300A3CD40A

※ Please refer to the jog dial module, the operator's manual page 3-66 for selection and change of menu and input value.

(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 290F3CD103	Work tool U mode power Combination speed setting Auto power boost IPC mode Auto engine shutdown Initial mode Emergency mode	Breaker, Crusher, Not installed User mode only Load sensitivity, Trucking balance, Boom/Arm balance, Arm speed Enable, Disable Speed mode, Balance mode, Efficiency mode One time, Always, Disable Key on initial mode / initial work mode, Accel initial mode / step Switch function
2	 Monitoring 290F3CD104	Active fault Logged fault Delete logged fault Monitoring	MCU, Engine ECM, FATC, AAVM (option) MCU, Engine ECM, FATC, AAVM (option) All logged fault delete, Initialization canceled Machine information, Switch status, Output status,
3	 Management 290F3CD105	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, jog dial module, switch controller, RMCU, Relay drive unit, FATC, AAVM (option) A/S phone number, A/S phone number change Power shift, Operating hour, Breaker mode pump acting, EPPR current level, Overload pressure, Optional piping pressure removal, Fine swing Clinometer setting Cluster, ETC device
4	 Display 290F3CD106	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, ETC A type, B type
5	 Utilities 290F3CD107	Tripmeter Camera Auto idle time setting	3 kinds (A, B, C) Camera setting, Auto mode (travel) Time setting

(2) Mode setup

① Work tool (Machine Serial No. : -#0974)



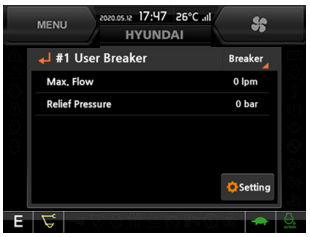
300A3CD41A

A



300A3CD42A

B



300A3CD43A

· 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.
  Relief pressure - Set the relief pressure.

(2) Mode setup

① Work tool (Machine Serial No. : #0975-)



300A3CD41A

A



300A3CD42A

B

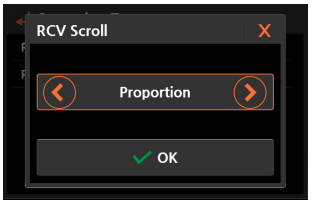


3003CD43B

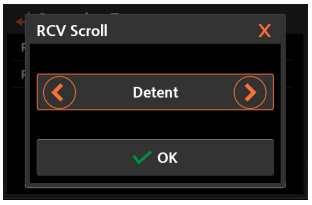
· Select installed optional attachment
- A : It can set the user's attachment.
  It is available in setting #1~#10.
- B : Max flow - Set the maximum flow for the attachment.
  Relief pressure - Set the relief pressure.
  Operation type - Set the operation type for attachment.



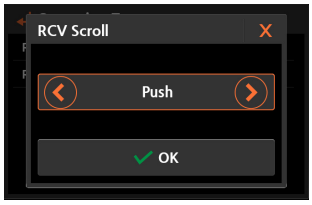
300A3CD651



140WA3CD652A



140WA3CD653A

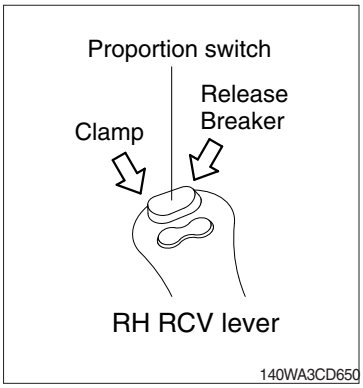


140WA3CD654A

■ Operation type

Operation type is used to set the operation of the proportion switch on the RCV lever if equipped proportional function.

- Push : Switch actuation will be deactivated when the proportion switch is released.
- Detent : Switch actuation will remain even if the proportion switch is released.
  To deactivate, move the switch in the same direction again or to the opposite direction.
- Proportion : Switch actuation is proportional to the movement of the proportion switch.

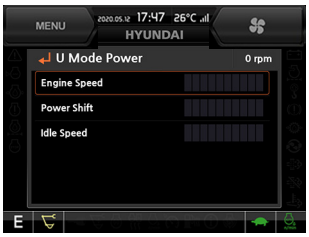


140WA3CD650

② U mode power



300A3CD44A



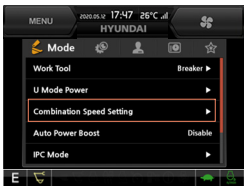
300A3CD45B

· 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.

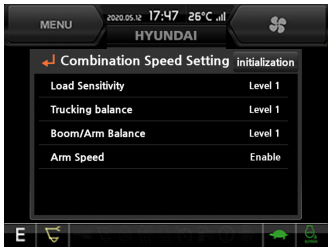
Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift
1	1300	750	10%
2	1400	800	20%
3	1500	850	30%
4	1600	900	40%
5	1700	950	50%
6	1800	1000 (auto decel)	60%
7	1850	1050	70%
8	1900	1100	80%
9	1950	1150	85%
10	2000	1200	90%

※One touch decel & low idle : 850 rpm

③ Combination speed setting



220A3CD300A



220A3CD301A



220A3CD302A

· **Load sensitivity**
- It changes fine control sensitivity. (boom up or arm out operation)
- When the segment is close to high, the fine operation speed is increased. (Load sensitivity is high.)
- It is reccomended to set high segment when lifting heavy duty equipment or load.

⚠ The fine control speed is able to be unexpectedly fast by high setting and load condition. Do use the function through fine control test considering the condition.

· **Trucking balance**

This is control the swing and boom up speed when the combined operation is activated.

- It adjusts the ratio of relative speed in the boom up and swing combination operation.
- The segment is close to swing, the swing speed has a priority.
- The segment of swing is recommended for use in work environments that require high swing speed and acceleration, some slow boom up, and more than 45 degrees.
- The segments are close to boom, the boom up speed has a priority.
- The segment of boom is mainly used in work environments that require high boom up work at a short swing angle of about 45 degrees.

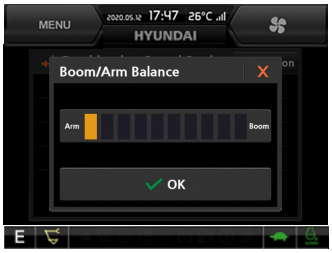


220A3CD303A

· **Boom / Arm balance**

This is control the boom up and arm in speed when the combined operation is activated. It is effective in work place mainly for leveling work.

- When the level is closer to arm, arm in operation speed has more priority than boom up operation.
- When the level is closer to boom, boom up operation speed has more priority than arm in operation.

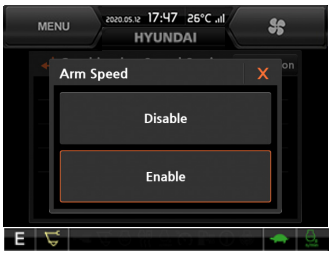


220A3CD304A

· **Arm speed**

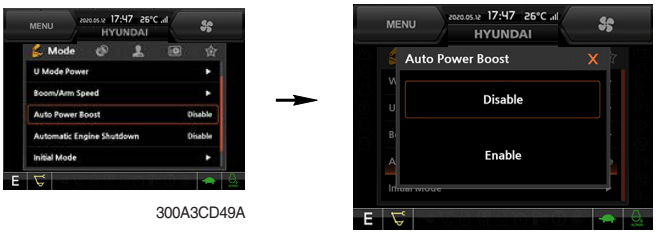
This provides ON and OFF of the regeneration function of the arm in operation.

- Enable means that regeneration is ON, and an energy can be used efficiently through automatic regeneration according to the load.
- Disable means that regeneration is always OFF, and it can be effective for heavy digging work.



220A3CD305A

④ Auto power boost



300A3CD49A

300A3CD50A

· 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
- Disable : Not operated.

※ **The auto power boost function is activated in P mode. It does not work in S mode and E mode.**

⑤ IPC mode



300A3CD51A

300A3CD52A

300A3CD53A

300A3CD54A

300A3CD55A

300A3CD56A

300A3CD57A

· The operator can improve fuel consumption and working speed through IPC mode.
· IPC mode is working by using inertial energy in specific case.
· The IPC mode can be selected by this menu.
- Speed mode / Balance mode / Efficiency mode
· The effect of IPC mode is different at power mode. The fuel efficiency is about 5% in P mode and about 3% in E mode based on Balance mode against Speed mode.
· The manufacturer recommends using the balance mode in IPC mode.

※ **The effect is the result of the standard operation. Depending on the operator's working conditions and machine options, the results could be different.**

※ **Please update the cluster programs if this mode is not displayed in the mode setup menu. Refer to page 5-100.**

⑥ Automatic engine shutdown



300A3CD58A



300A3CD59A



300A3CD60A

· 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



300A3CD61A



300A3CD62B

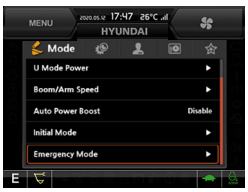
· **Key on initial mode**
  - Selected the power mode is activated when the engine is started.

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

· **Accel initial mode**
  - Last setting value
  - User setting value

· **Accel initial step**
  - 0~9 step

⑧ Emergency mode



300A3CD63A



300A3CD64A

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

(3) Monitoring

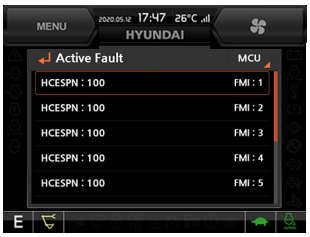
① Active fault



300A3CD65A



300A3CD66A



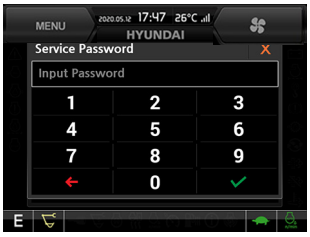
300A3CD67A

· The active faults of the MCU, ECM, FATC, AAVM (option) can be checked by this menu.

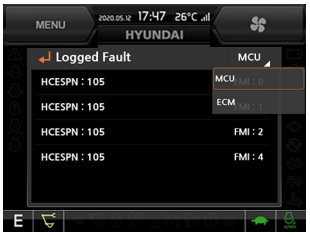
② Logged fault



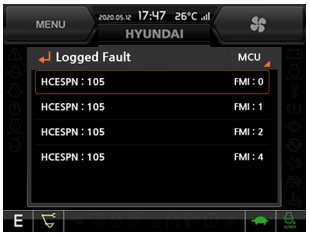
300A3CD68A



300A3CD72A



300A3CD69A



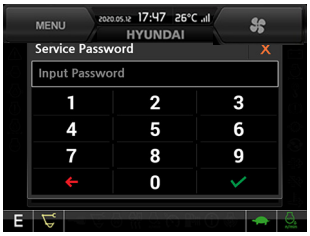
300A3CD70A

· The logged faults of the MCU, ECM, FATC, AAVM (option) can be checked by this menu.

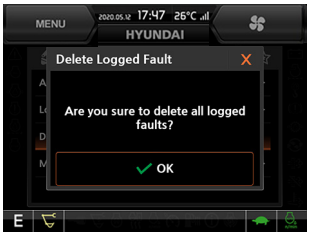
③ Delete logged fault



300A3CD71A



300A3CD72A



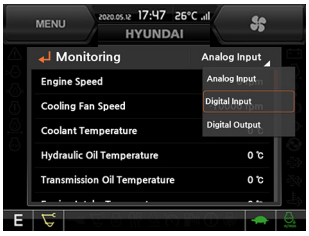
300A3CD73A

· The logged faults of the MCU, ECM, FATC, AAVM (option) can be deleted by this menu.

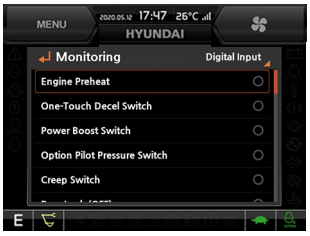
④ Monitoring



300A3CD74A



300A3CD75A



300A3CD76A

- 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 ECO report

This reports the machine's inefficient operation status in order to improve operator's improper working habit.



300A3CD77A

High idle



300A3CD78A

- Shows a breakdown of high idle, idle and relief operation when monitor is on.
- Gives a daily usage breakdown record for a 7 day period and an overall accumulated record from the first operation.

Idle



300A3CD79A

Relief operation



300A3CD80A

② Fuel rate information

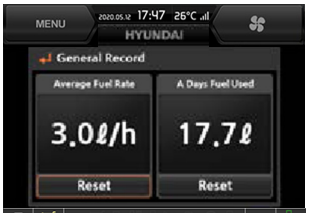


300A3CD81A



300A3CD82A

A



300A3CD83A

B



300A3CD84A

C



300A3CD85A

D



300A3CD86A

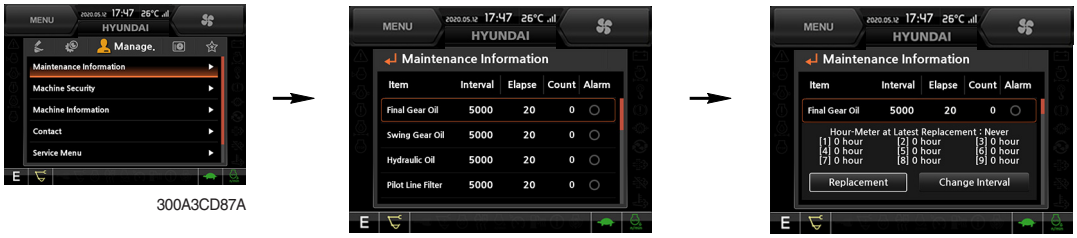
· **General record (A)**
  - Average fuel rate (left) (from "Reset" to now)
    Fuel consumption divided by engine run time (service meter time).
  - A days fuel used (right)
    Fuel consumption from 24:00 (or "Reset" time) to now (MCU real time).

· **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.

· **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".

· **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".

③ Maintenance information



300A3CD87A

300A3CD88A

300A3CD89A

- 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.**

④ Machine security



300A3CD90A



300A3CD91A



300A3CD92A

· **ESL mode setting**

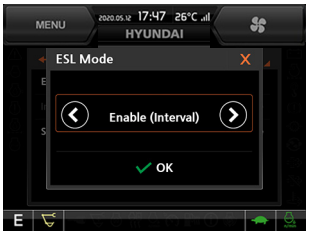
- ESL : Engine Starting Limit
- ESL mode is desingned to be a theft deterrent or will prevent the unauthorized operation of the machine.
- When you Enable the ESL mode, the password will be required when the starting switch is turned to the on position.
- **Machine security**

  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.



300A3CD93A



300A3CD94A

· **Password change**

- The password is 5~10 digits.



300A3CD95A



300A3CD96A



300A3CD91A

Enter the current password



300A3CD99A

Enter the new password



300A3CD98A

Enter the new password again

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

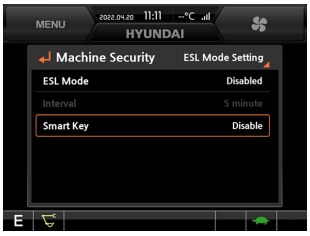
- Smart key



300A3CD90A

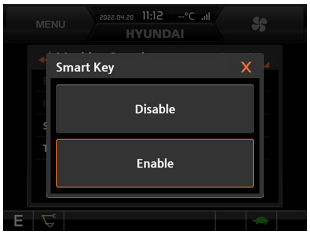


300A3CD91A



300A3CD001

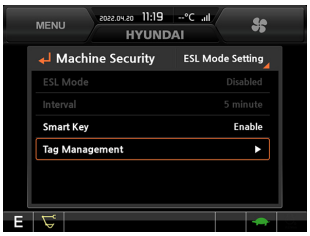
· Smart key is registered when equipped with optional smart key. If smart key is not inside of the cabin, authentication process fails and the password is needed.
· Tag management menu is activated when the Smart key menu is Enabled.
You can register and delete the tags.



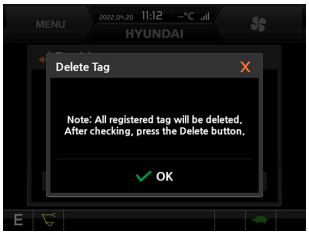
300A3CD002

- 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.

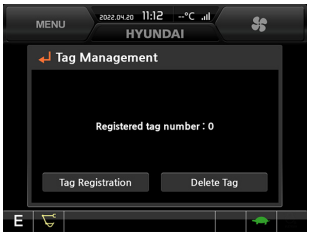


300A3CD003



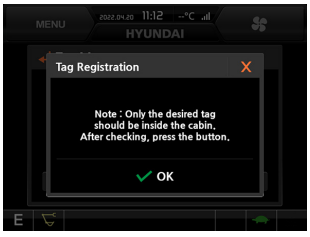
300A3CD006

Deleting



300A3CD004

Registering

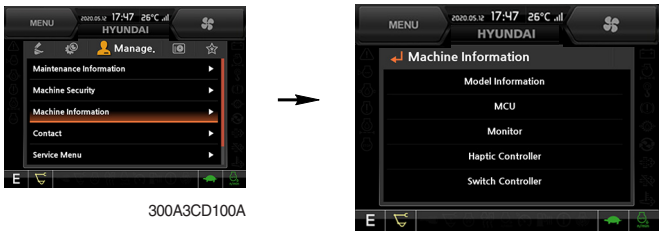


300A3CD005

※ 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.

⑤ Machine Information



300A3CD100A

300A3CD101A

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

⑥ Contact (A/S phone number)



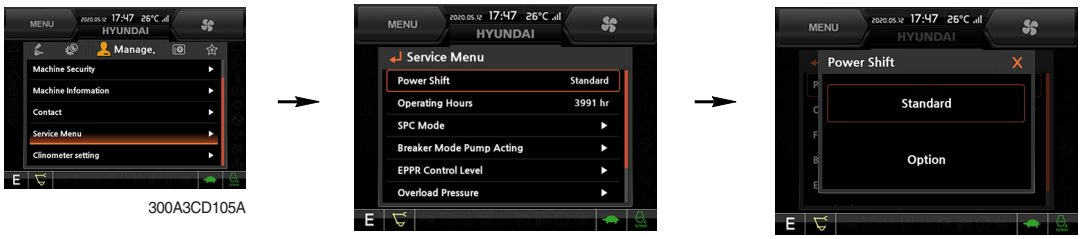
300A3CD102A

300A3CD103A

300A3CD104A

Enter the new A/S phone number

⑦ Service menu



300A3CD105A

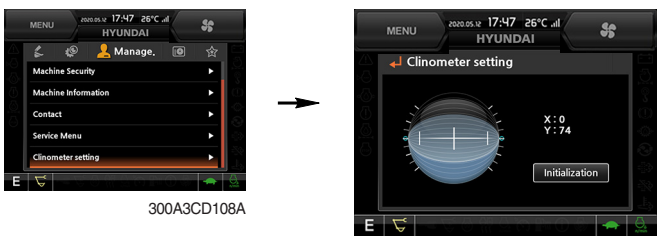
300A3CD106A

300A3CD107A

※ 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 (1 pump / 2 pump)
· EPPR current level (attach flow EPPR 1 & 2, boom priority EPPR, attach relief pressure EPPR 1& 2)
· Overload pressure : 100 ~ 350 bar
· Opitonal piping pressure removal (Disable / Enable)
It is removing the residual pressure remaining in the option line when the quick coupler is operated.
· Fine swing (Disable / Enable)

⑧ Clinometer

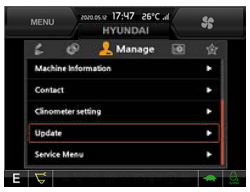


300A3CD108A

300A3CD109A

· 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.

⑨ Update (cluster & ETC devices)



300A3CD110A



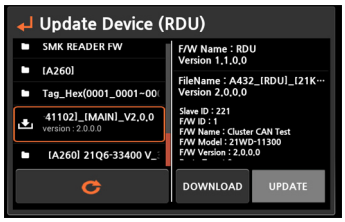
300A3CD111A



300A3CD112A



300A3CD114A



380F3CD06

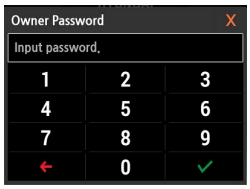
- ETC devices and cluster can be updated through CAN 2 network.
- Insert USB memory stick which includes program files, start download.

⑩ OME (owner menu editing)

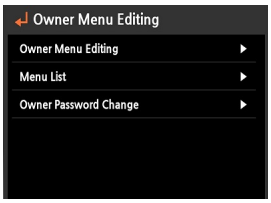
The owner of machine can restrict operator access to set functions.



300A3CD115A



300A3CD115B



300A3CD115C

- **Owner can set the status of the function.**
  - Enable
  - Disable
- **In the menu, owner can set the list of functions in which they would like to lock or leave unlocked.**
- **Owner password (default password : 11111)**
  - Owner can manage and change the password.
  - Necessary to input the password to access function menu.



300A3CD116A



300A3CD117A



300A3CD118A

· **Password change**

- The password is 5~10 digits.



210WF3CD190A



290F3CD140A



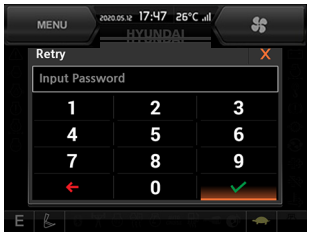
290F3CD135A

Enter the current password



290F3CD142A

Enter the new password



290F3CD143A

Enter the new password again

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

(5) Display

① Display item



300A3CD119A



300A3CD120A



300A3CD121A

· 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



300A3CD122A



300A3CD123A

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

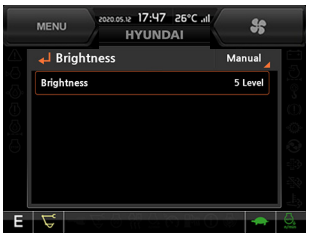
③ Brightness



300A3CD124A



300A3CD125A



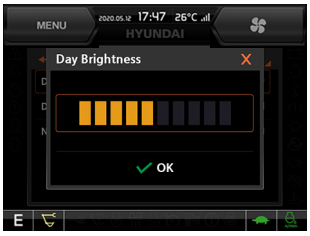
300A3CD126A



300A3CD127A



300A3CD128A



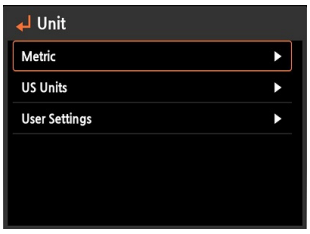
300A3CD129A

· 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



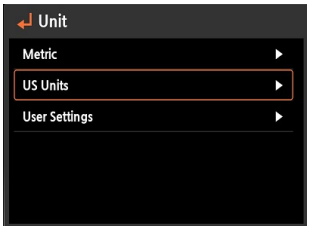
300A3CD130A



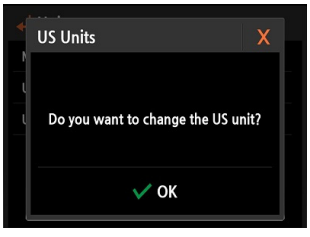
300A3CD130B



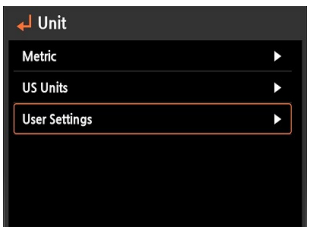
300A3CD130C



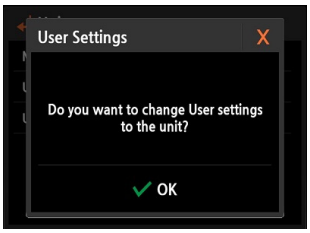
300A3CD130D



300A3CD130E



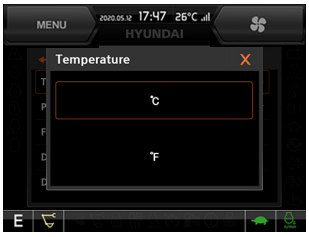
300A3CD130F



300A3CD130G



300A3CD131A



300A3CD132A

· Temperature : ˚C ↔ ˚F
· Pressure : bar ↔ MPa ↔ kgf/cm²
· Volume : ℓ ↔ gal
· Flow : lpm ↔ gpm
· Distance : km ↔ mile
· Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-mm-yy

⑤ Language



300A3CD133A

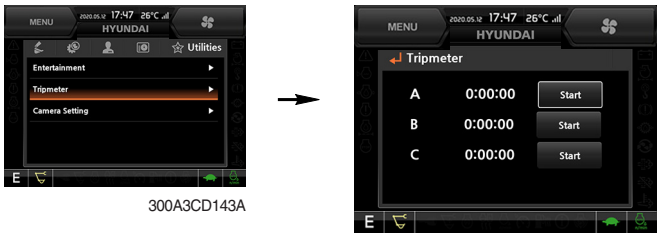


300A3CD134A

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

(6) Utilities

① Tripmeter



300A3CD143A

300A3CD144A

- A maximum of 3 types of tripmeters can be used at the same time.
- Each tripmeter can be turned on by choosing "Start". It can be turned off by choosing "Stop". If the tripmeter icon is activated in the operation screen, it can be controlled directly in this screen.

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.



300A3CD145A

300A3CD146B

300A3CD147A

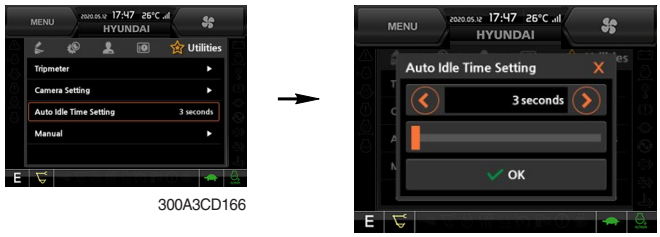
- Auto Mode (Travel) : Enable
  The cluster will automatically shows camera view while machine is traveling.
- In the operation screen, rear camera screen show up when ESC/CAM switch is pushed.



300A3CD97A

290F3CD221

③ Auto idle time setting



300A3CD166

300A3CD167

- The auto idle time is can be set by this menu.
- Time : 3~30 seconds

④ **AAVM** (Advanced Around View Monitoring, option)

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



300A3CD149A

- **Escape switch**

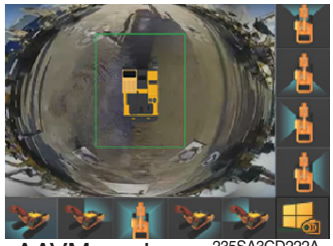
· Activates AAVM mode from the beginning if AAVM is installed.

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



300A3CD97A

Home screen

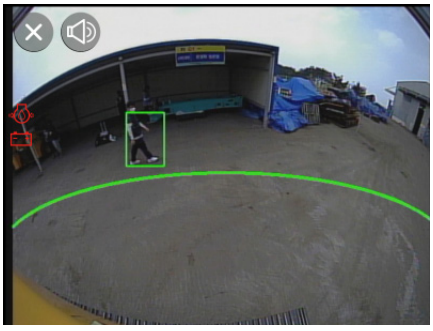


AAVM mode 235SA3CD222A

- **Buzzer stop switch**

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

· User can turn OFF the warning sound by pressing the 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 blue 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.



220A3CD247

· When a worker/pedestrian reaches the red line, which is an internal 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.

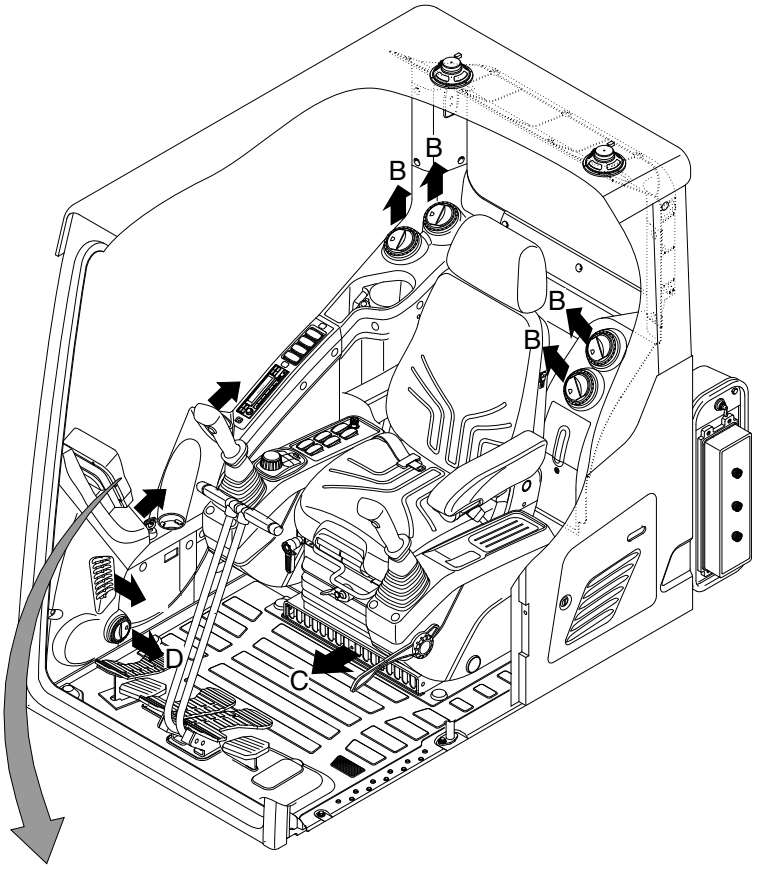
⚠ **Failure to comply may result in serious injury or death.**

※ **In AAVM mode, a touch screen of the LCD is available only. The multimodal dial of the jog dial module is not available.**

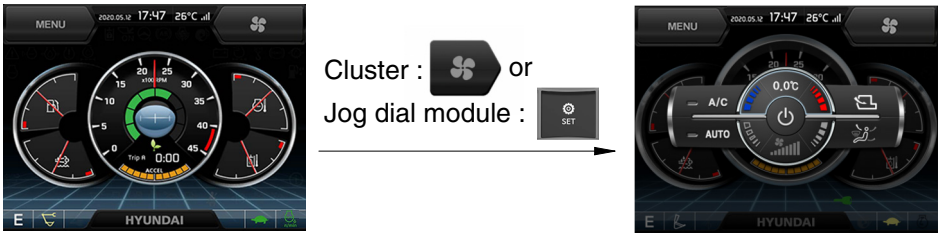
9) AIR CONDITIONER AND HEATER

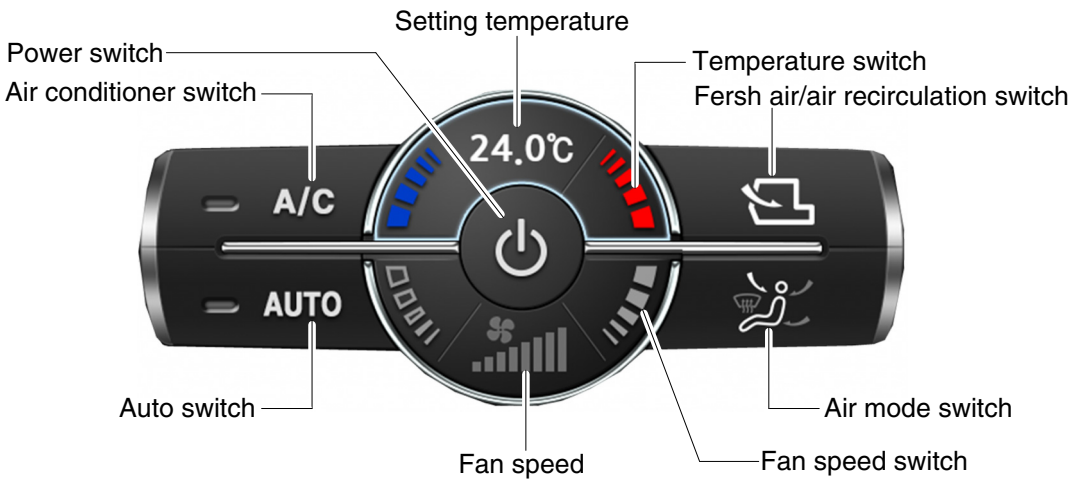
Full auto air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration, sensing ambient and cabin inside temperature.

· **Location of air flow ducts**



Cluster LCD

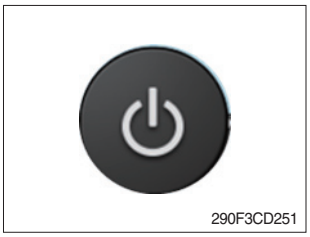




220A3CD21A

※ **Jog dial module : Refer to the operator's manual page 3-66.**

(1) Power switch



① This switch turns the system ON and OFF.
Just before powering OFF, set values are stored.
② Default setting values

Function	Air conditioner	In/outlet	LCD	Temperature	Mode
Value	OFF	Inlet	OFF	Previous sw OFF	Previous sw OFF

(2) Air conditioner switch



① This switch turns the compressor ON/OFF.
※ Air conditioner operates to remove vapor and drains water through a drain hose. Water can be sprayed into the cab in case that the drain cock at the ending point of drain hose has a problem.
In this case, exchange the drain cock.

(3) Auto switch



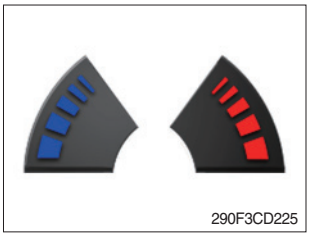
① Auto air conditioner and heater system automatically keeps the optimum condition in accordance with operator's temperature configuration sensing ambient and cabin inside temperature.

(4) Setting temperature



① Displays the temperature setting.

(5) Temperature switch

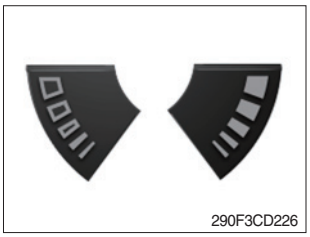


① Setting temperature indication
· Lo (17˚C), 17.5~31.5˚C, Hi (32˚C)
② Max cool and max warm beeps 5 times.
③ The max cool or the max warm position operates per the following table.

Temperature	Compressor	Fan speed	In/outlet	Mode
Max cool	ON	Hi (8 step)	Recirculation	Face
Max warm	OFF	Hi (7 step)	Fresh	Def/Foot

④ Temperature unit can be changed between celsius (˚C) and fahrenheit (˚F)
a. Default status (˚C)
b. The temperature unit can be changed (℃ ↔ ℉) by pressing temperature switchs (Up/Down) simultaneously for more than 5 seconds.

(6) Fan speed switch



① Fan speed is controlled automatically by set temperature.
② This switch controls fan speed manually.
- There are 8 up/down steps to control fan speed.
- The maximum step or the minimum step beeps 5 times.

(7) Fan speed



① Steps 1 through 8 to display the amount of air being circulated.

(8) Fresh air/air recirculation switch



① It is possible to change the air-inlet method.
a. **Fresh air ( )**
Inhaling air from the outside.
b. **Air recirculation ( )**
It recycles the heated or cooled air to increase the energy efficiency.
※ **Change air occasionally when using recirculation for a long periods of time.**
※ **Check condition of an outer filter and an inner filter periodically to maintain good efficiency of the system.**

(9) Air mode switch



① Operating this switch, it beeps and displays symbol of each mode in the following order. (Face → Face/Rear → Face/Rear/Foot → Foot → Def/Foot)

Mode switch		Face	Face/Rear	Face/Rear/Foot	Foot	Def/Foot
Outlet	A	●	●	●		
	B		●	●		
	C			●	●	●
	D					●

② When operating defroster, FRESH AIR/AIR RECIRCULATION switch turns to FRESH AIR mode and air conditioner switch turns ON.

(10) Self diagnosis function

① Diagnostic methods : Diagnostic information window, select

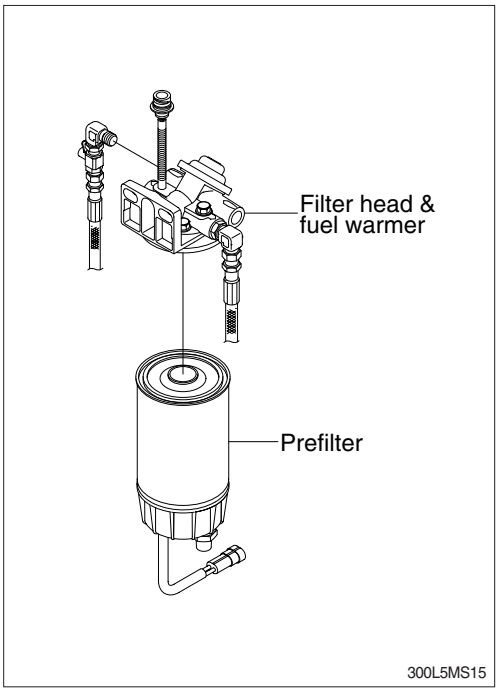
② Diagnostic indication (Displays fault)

Fault code	Description	Fail safe function
F01	Ambient temperature sensor open	20˚C alternate value control
F02	Ambient temperature sensor short	
F03	Cab inside temperature sensor open	25˚C alternate value control
F04	Cab inside temperature sensor short	
F05	Evaporate temperature sensor open	0˚C alternate value control
F06	Evaporate temperature sensor short	
F07	Null	-
F08	Null	-
F09	Mode 1 actuator open/short	The alternate value is face
F10	Mode 1 actuator drive circuit malfunction	If not, the alternate value is Def/Foot
F11	Intake actuator open/short	The alternate value is air recirculation
F12	Intake actuator drive circuit malfunction	The alternate fresh air
F13	Temperature actuator open/short	If opening amount is 0 %, the alternate value is 0 %
F14	Temperature actuator drive circuit malfunction	If not, the alternate value is 100 %
F15	Null	-
F16	Null	-

GROUP 17 FUEL WARMER SYSTEM

1. SPECIFICATION

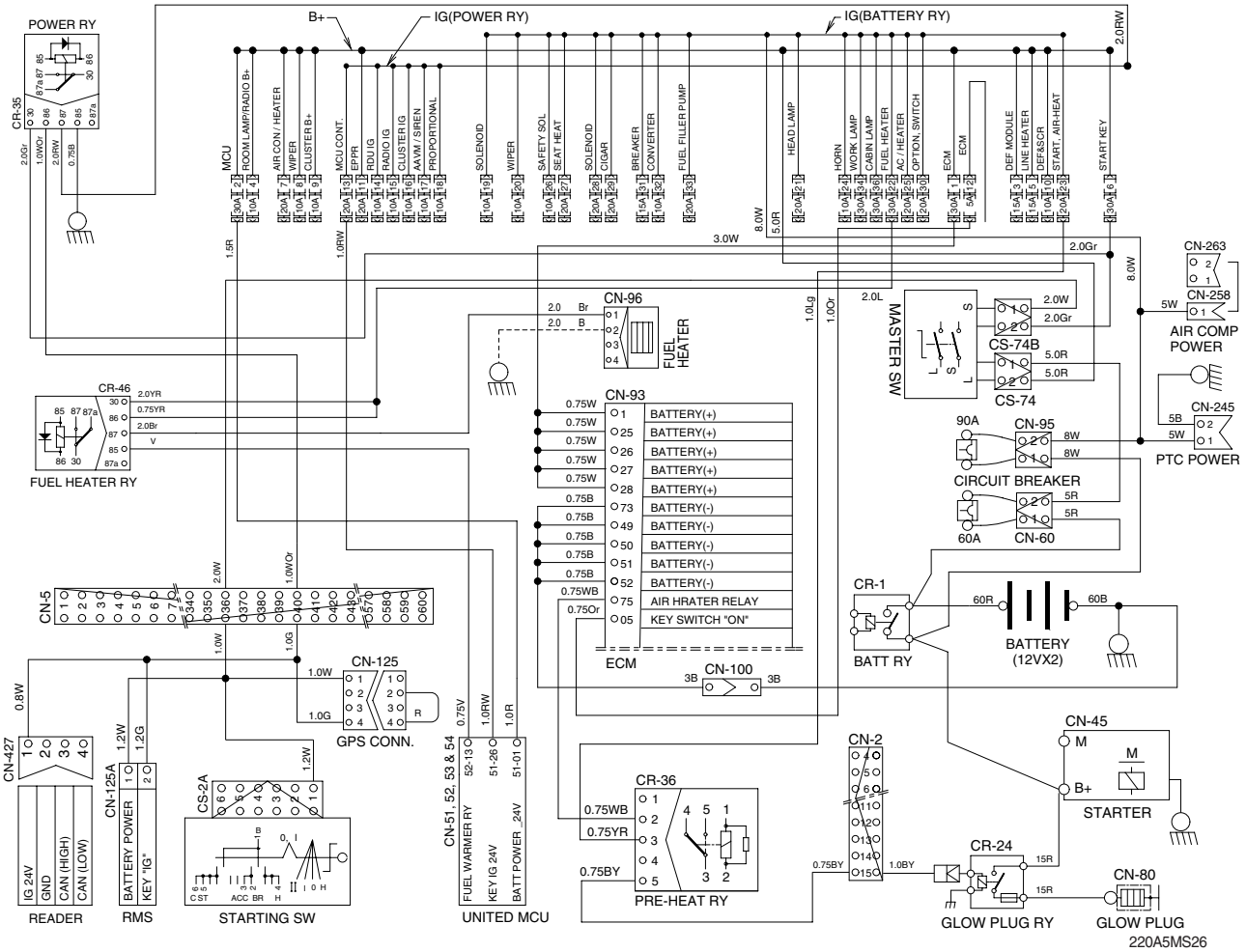
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A



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



GROUP 18 1 or 2-WAY OPTIONAL PIPING PRESSURE REMOVAL SYSTEM

1. OUTLINE

This system can be removed the residual pressure of the optional attachment hydraulic piping when the quick coupler is operated by the switch of the RCV lever and then the oil quick function of the optional attachment is performed.

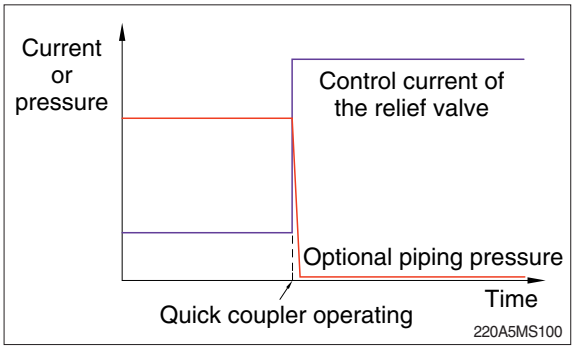
※ Oil quick function

In a convention work, the optional attachments such as breaker or grab are installed on the machine and needed to connect hydraulic piping additionally.

But currently, the hydraulic piping connection is not needed by the work man. The attachment is installed on the machine and the hydraulic pipings are connected by a coupler that is built in the quick coupler automatically and the attachment can be ready to operate immediately. This is called the oil quick function.

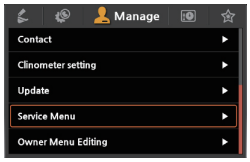
2. OPERATING PRINCIPLE

This is operated by controlling the setting pressure of the electric type relief valve when you operate the quick coupler with the switch of the RCV lever.

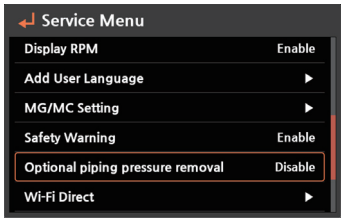


220A5MS100

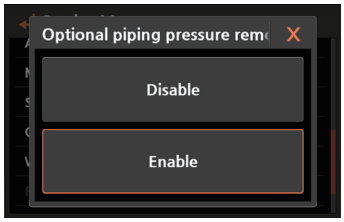
3. SETTING METHOD



220A5MS101



220A5MS102



220A5MS103

1) Optional piping pressure removal is set to Disable in the factory.
2) Optional piping pressure removal is set to Enable then the oil quick function is operated. Also, the caution letter is display on the lower side of the cluster.
3) The setting condition is saved even if shut the engine off.



220A5MS104

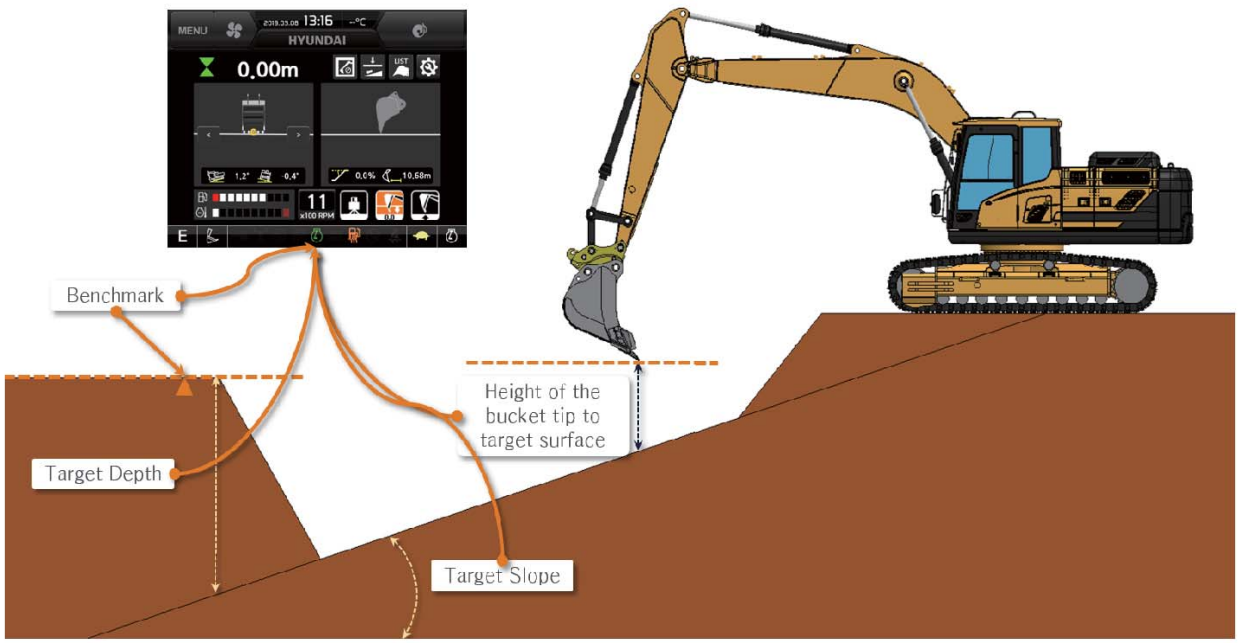
4. CAUTION

1) When the oil quick function is used, the hydraulic drift and etc can be occurred as the modified equipment specification.
2) The status of the cluster must be changed by a manager that is well-acquainted with the function and the operator must be well-informed of the oil quick function and safety work.

GROUP 19 2DMG+ SYSTEM

1. FUNCTION DEFINITION

HD Hyundai Construction Equipment 2DMG+ is a function that calculates the position of the tip of the bucket and transmits distance information to the target surface to the operator in the form of visual indicators and audible alarms through the cluster.



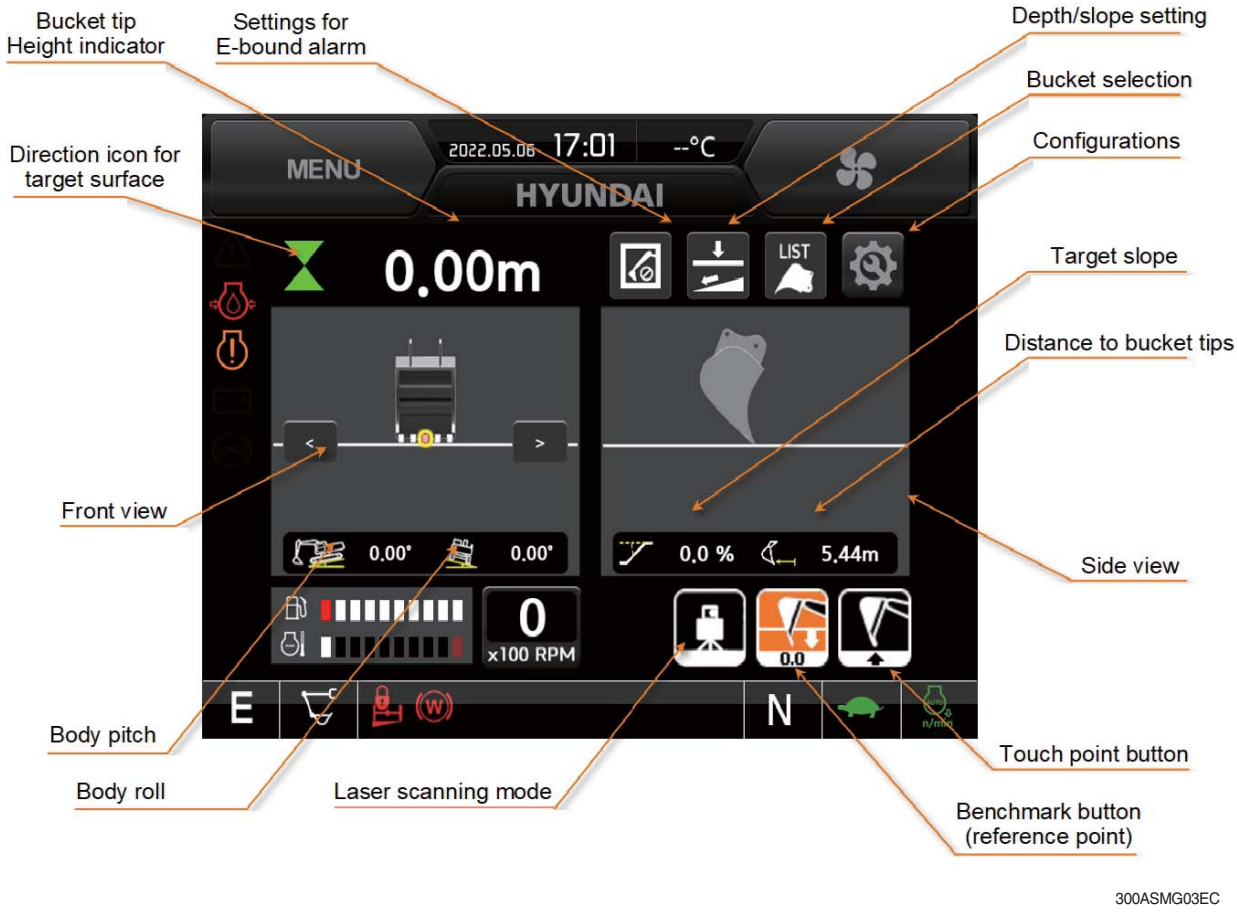
300ASMG01EC

2. SYSTEM LAYOUT



300ASMG02EC

3. 2DMG+ Main Screen



300ASMG03EC

4. 2DMG+ PROBLEM TYPE

No.	Problem	Cause and remedy	Remark
1	Action when the "Sensor failure" message is output	1. Check whether the angle sensor harness is damaged or loosened.	
		2. Check whether the angle sensor function abnormality	
		3. Check whether the CAN gateway function abnormality	
		4. Check whether the CAN termination resistor is damaged	
2	Action when the bucket end height measurement accuracy is abnormal	1. Data error due to internal damage of the angle sensor	
		2. Check current selected bucket	Corresponds to inexperience in user operation
		3. Check compliance with the vertical posture when entering bucket dimensions.	
		4. Check bucket dimensions	
		5. Check design surface (depth/slope) information	
		6. Check compliance with reference point movement procedures	
		7. Enter 2DMG+ setting value after replacing MCU	This needs to be checked in case of MCU or cluster replacement
3	Can not enter MG menu	1. 2DMG+ function not set after cluster replacement	

1) ACTION WHEN THE "SENSOR FAILURE" MESSAGE IS OUTPUT

(1) Check whether the angle sensor harness is damaged or loosened.

① Enter the cluster's 'Current Fault' menu.

a. From the cluster main menu, go through the following path.

b. Monitoring → Active fault

c. If all sensors are defective, refer to ⑤-b Short circuit test (page 5-117) or (3) CAN gateway function error (page 5-119).

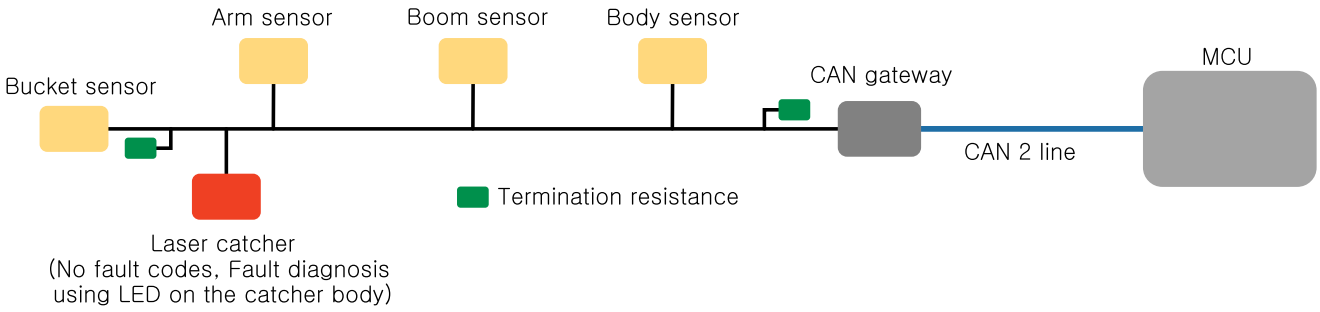


300ASMG10EC

② Check faulty sensors.

No.	Fault code	Fault sensor
1	HCESPN 900	Bucket sensor
2	HCESPN 901	Arm sensor
3	HCESPN 902	Boom sensor
4	HCESPN 903	Body sensor

③ Sensor connection configuration



300ASMG11EC

④ Check the connector of fault sensor is loosened.

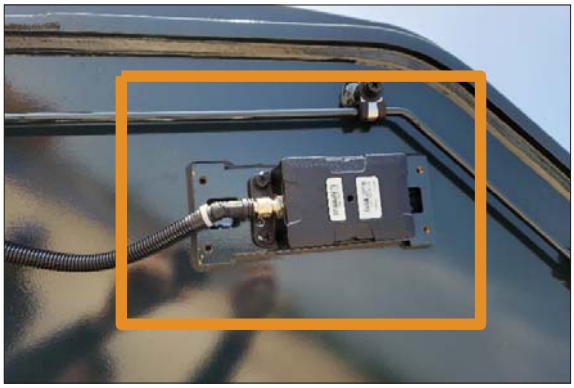
※ When checking the loosened part, re-perform 2DMG+ after tightening

a. Bucket sensor



300ASMG12K

b. Arm sensor



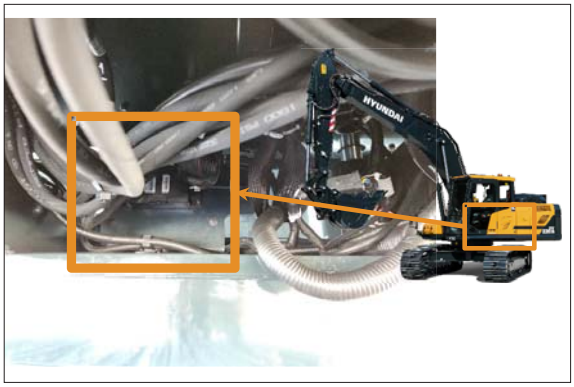
300ASMG13K

c. Boom sensor



300ASMG14K

d. Body sensor

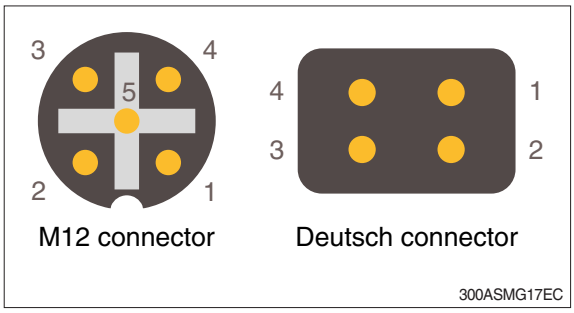


300ASMG15K

⑤ If the connector is not loosened, remove the harness and check for damage.

a. Harness connector pin map (required to check pin number)

Signal	Pin number	
	M12 connector	Deutsch connector
CAN shield	1	-
Vcc : 24V	2	1
GND	3	2
CAN High	4	3
CAN Low	5	4



b. Check for damage using a multimeter.

- Conduct an energization test for each pin between both ends of the harness connector.
- Perform a short circuit test between each pin of the connector.

※ In the case of short circuit, it may occur intermittently due to changes in the posture of the attachment, so short circuit tests are required for various postures.

※ If damage to the harness is confirmed, replace the harness.

(2) Check whether the angle sensor function abnormality.

① Test the operation of the angle sensor.

a. After disconnecting the connector of the laser catcher (other sensors such as boom, arm, bucket, etc. are also possible), install the angle sensor that occurred the fault code instead and check whether the signal is received.

b. If a signal is received, it can be judged to be a problem with the harness connected to the sensor.

c. If the signal is not received, it can be judged as a failure of the sensor itself.

※ After removing the laser catcher cable, perform a mounting test for the sensor that occurred the fault code.



(3) Check whether the can gateway function abnormality.

① Check CAN data of attachment sensor line.

a. Disconnect the Deutsch 4-pin connector near the laser catcher and connect a CAN data collector (PCAN, CANoe, etc.)

b. Check whether the CAN ID data in the table below is being output.

c. If it is output at a period of 20 ms, suspect a malfunction of the CAN gateway itself.



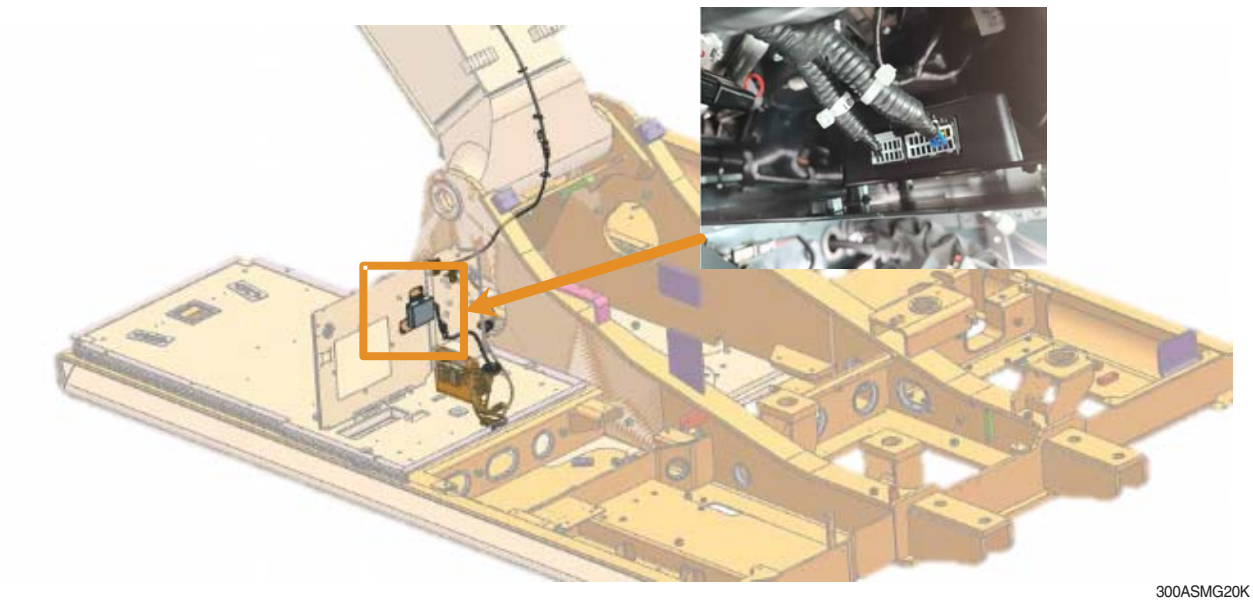
300ASMG19EC

※ CAN ID matching information for each sensor

Sensor	CAN ID
Boom sensor	0x18F029C1
Arm sensor	0x18F029C2
Bucket sensor	0x18F029C3
Body sensor	0x18F029C4

② Mounting location of CAN gateway

It is located near the RMCU at the bottom behind the seat in the cab.



300ASMG20K

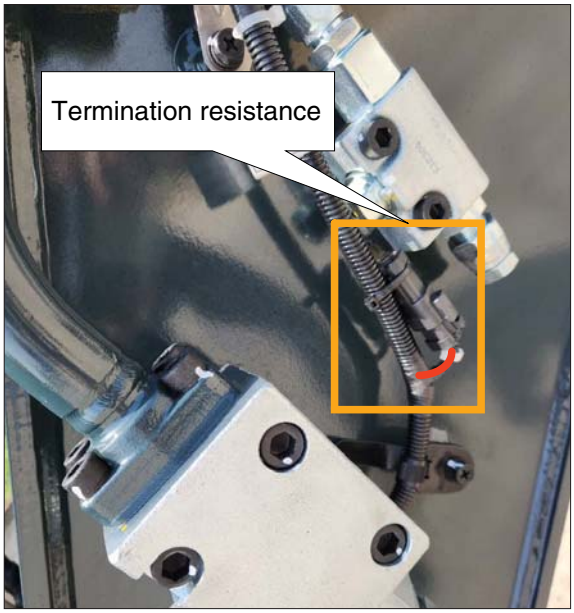
(4) Check whether the can termination resistor is damaged.

① Check whether the termination resistance of the attachment sensor line is normal.

a. If an error occurs in the termination resistance, the CAN line of the attachment will not function properly.

b. After disconnecting the termination resistor, measure the resistance at both ends of the internal pin and check whether a 60 Ω resistance value is output.

c. If the resistance value is normal, check whether the connector branch line indicated in red in the right picture is damaged.



300ASMG21EC

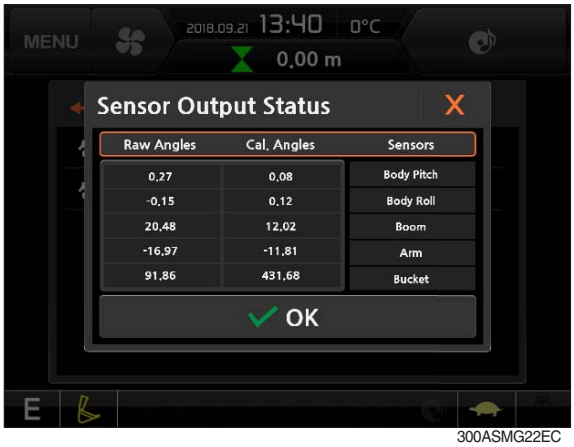
2) ACTION WHEN THE BUCKET END HEIGHT MEASUREMENT ACCURACY IS ABNORMAL

(1) Data error due to internal damage of the angle sensor

① Enter cluster 'Sensor Output Status' menu.

a. From the cluster main menu, go through the following path.

b. Management → Service menu → MG/MC Function set → MG/MC Default set → Monitoring → Sensor Output Status



300ASMG22EC

② Check operation of boom sensor.

a. After adjusting the boom so that the boom 'compensation angle' data is near 0 degrees, check whether the boom remains parallel to the ground as shown in the right picture.

b. Repeat boom up and down operation to check if the 'compensation angle' data of the boom, arm, and bucket changes. (The compensation angle value of the body may change due to vibration, but the change range is less than 1 degree.)



300ASMG23K

※ If abnormal operation is confirmed, replace the boom sensor.

③ Check operation of arm sensor.

a. After adjusting the arm so that the arm 'compensation angle' data is near -90 degrees, check whether the arm's posture remains vertical to the ground as shown in the right picture.

b. Repeat arm in and out operation to check if the 'compensation angle' data of the arm and bucket changes. (The compensation angle value of the body may change due to vibration, but the change range is less than 1 degree.)



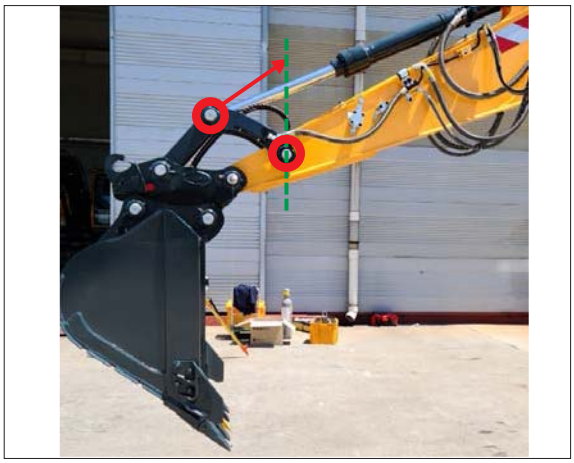
300ASMG24K

※ If abnormal operation is confirmed, replace the arm sensor.

④ Check operation of bucket sensor.

a. After adjusting the bucket so that the bucket 'compensation angle' data is near 90 degrees, check whether the link equipped with the bucket sensor is in a vertical position.

b. Repeat bucket in and out operation to check if the 'compensation angle' data of the bucket changes. (The compensation angle value of the body may change due to vibration, but the change range is less than 1 degree.)



300ASMG25K

※ If abnormal operation is confirmed, replace the bucket sensor.

(2) Check current selected bucket.

① Enter cluster 'Bucket Selection' menu.

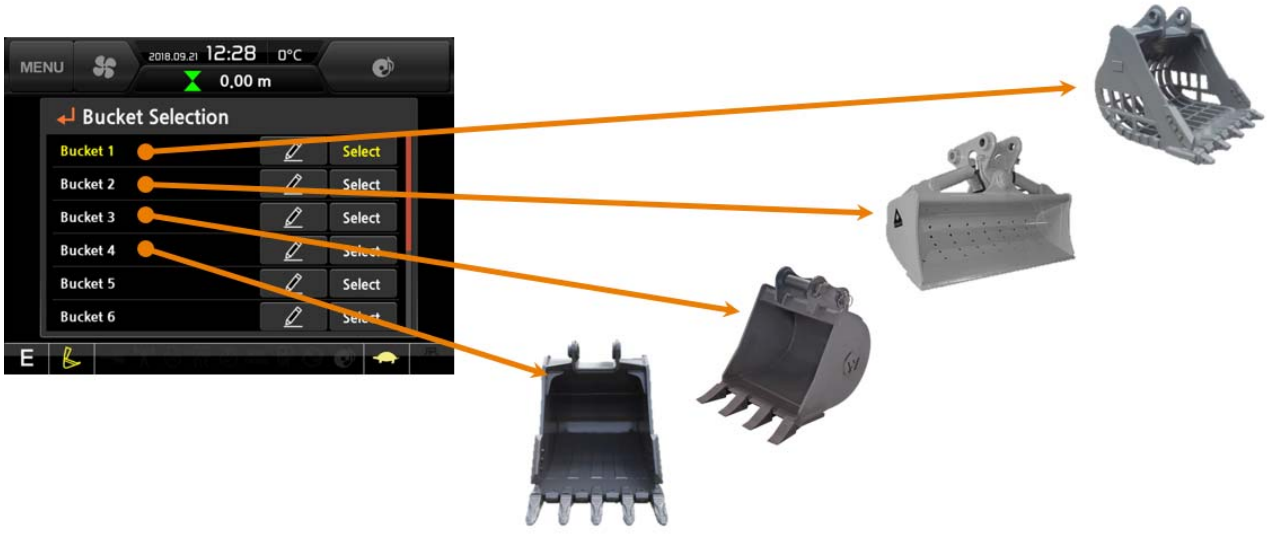
a. From the cluster main menu, go through the following path.

b. MG Main Screen → ⚙ → Bucket selection



300ASMG26EC

② Check that the bucket selected on the menu (highlighted in yellow) matches the currently installed bucket.



300ASMG27EC

※ If a discrepancy is confirmed with the currently installed bucket, change the bucket selection information.

(3) Check compliance with the vertival posture when entering bucket dimensions.

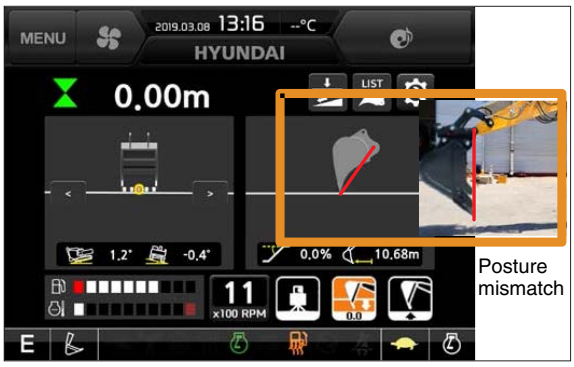
① Adjust the bucket posture to a vertical position using the plumb bob.



300ASMG28K

② Check whether the bucket posture is vertical on the bucket side view screen on the right side of the 2DMG+ main screen.

※ **When a discrepancy in the vertical posture is confirmed, the dimension input procedure is performed again with the bucket in a vertical position.**



300ASMG29EC

(4) Check bucket dimensions.

① Enter cluster 'Bucket Selection' menu.

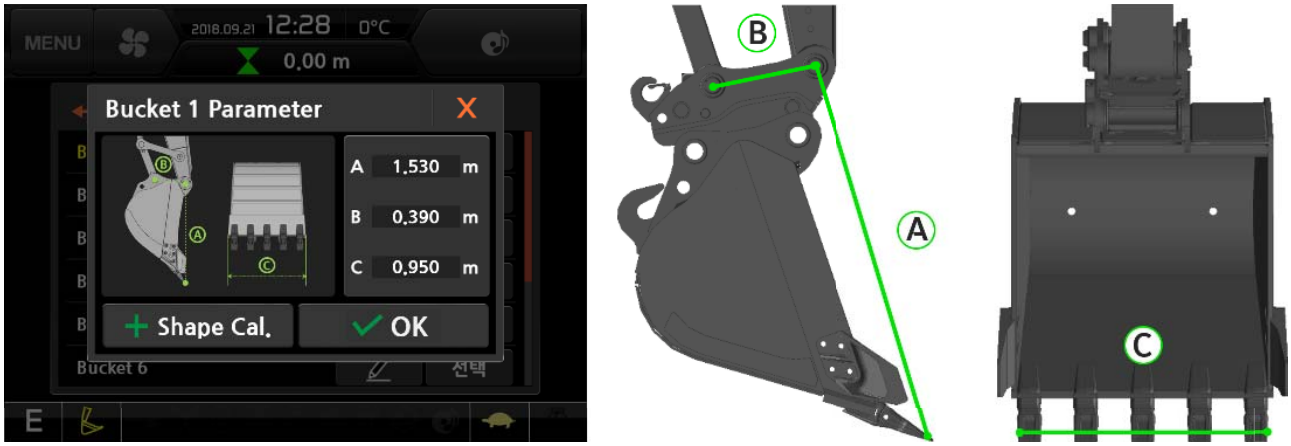
a. From the cluster main menu, go through the following path.

b. MG Main Screen → ⚙ → Bucket selection



300ASMG30EC

② Click on the currently selected bucket to view the dimension information window, then measure and compare the dimensions of the installed bucket.



300ASMG31EC

※ **When discrepancy is confirmed, perform the bucket dimension input procedure.**

※ **If a quick coupler is installed, measure the dimensions based on the bucket rotation center pin at the top of the quick coupler as shown in the picture above.**

(5) Check design surface (depth/slope) information.

① When trenching work is in progress.

a. Enter the depth setting screen and check the set depth.

a) Enter the depth/slope setting screen on the cluster screen

b) MG Main Screen → →



300ASMG32EC

b. After checking the depth settings, check the gradient information on the 2DMG+ main screen.

a) Refer to the right picture and check whether the current slope is set.

b) If a gradient is set, enter the gradient settings screen and initialize the gradient value.
(→ → 초기화 → Confirm button)



300ASMG33EC

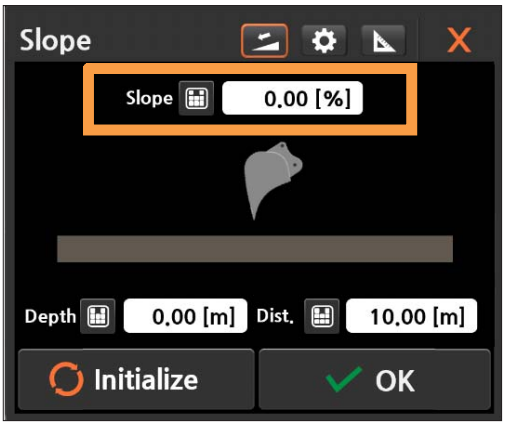
※ **If a slope is set during trenching work, the height measurement error increases as the bucket position moves away from the reference point.**

② When a slope work is in progress.

a. Enter the slope setting screen and check the set slope.

a) Enter the depth/slope setting screen on the cluster screen.

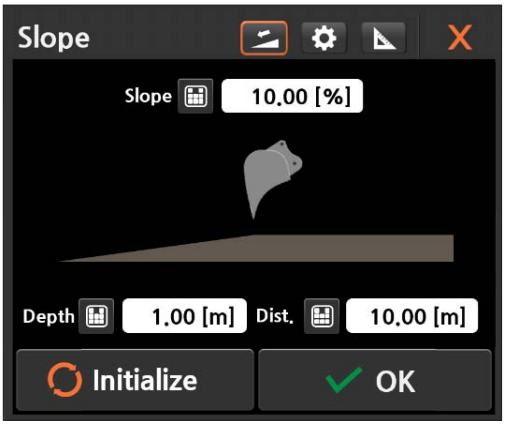
b) MG Main Screen →  → 



300ASMG34EC

b. Check the +/- mark according to the gradient setting value and gradient direction.

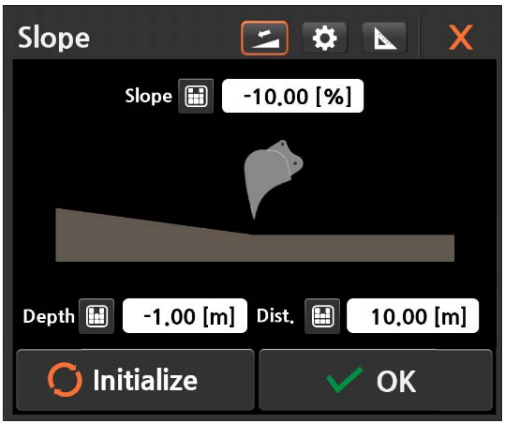
a) In case of (+) slope, slope downward in the direction of the attachment.



300ASMG35EC

b) In case of (-) slope, slope upward in the direction of the attachment.

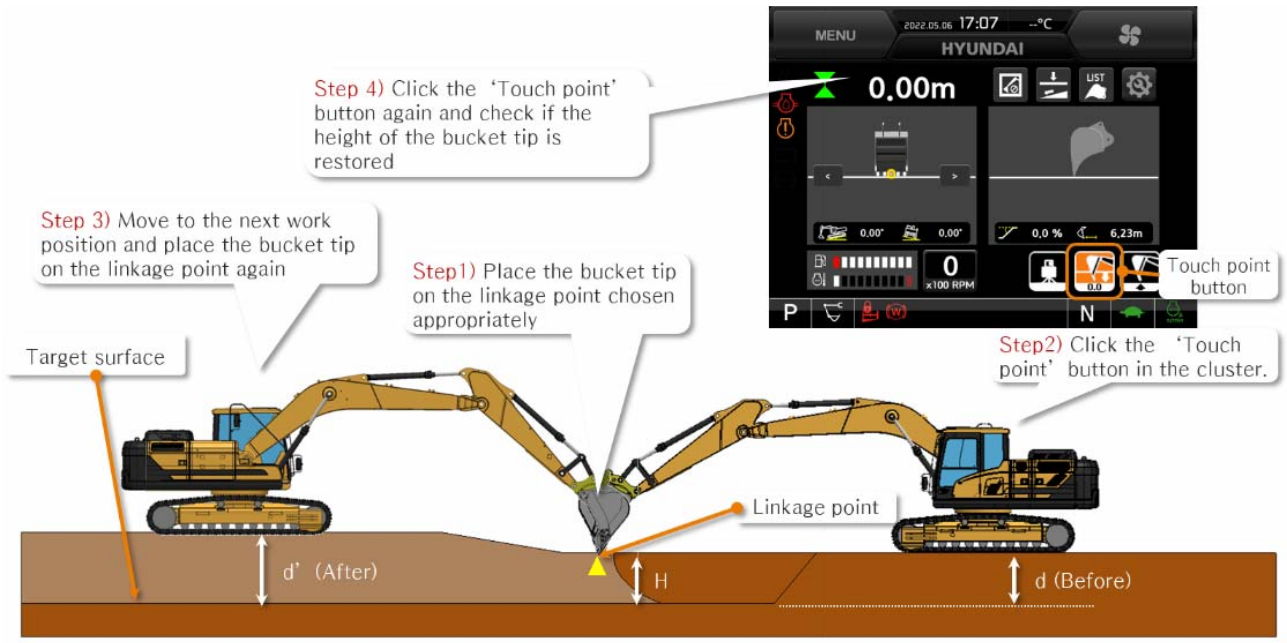
※ **It is necessary to check the value and direction of the currently set gradient by referring to the right picture.**



300ASMG36EC

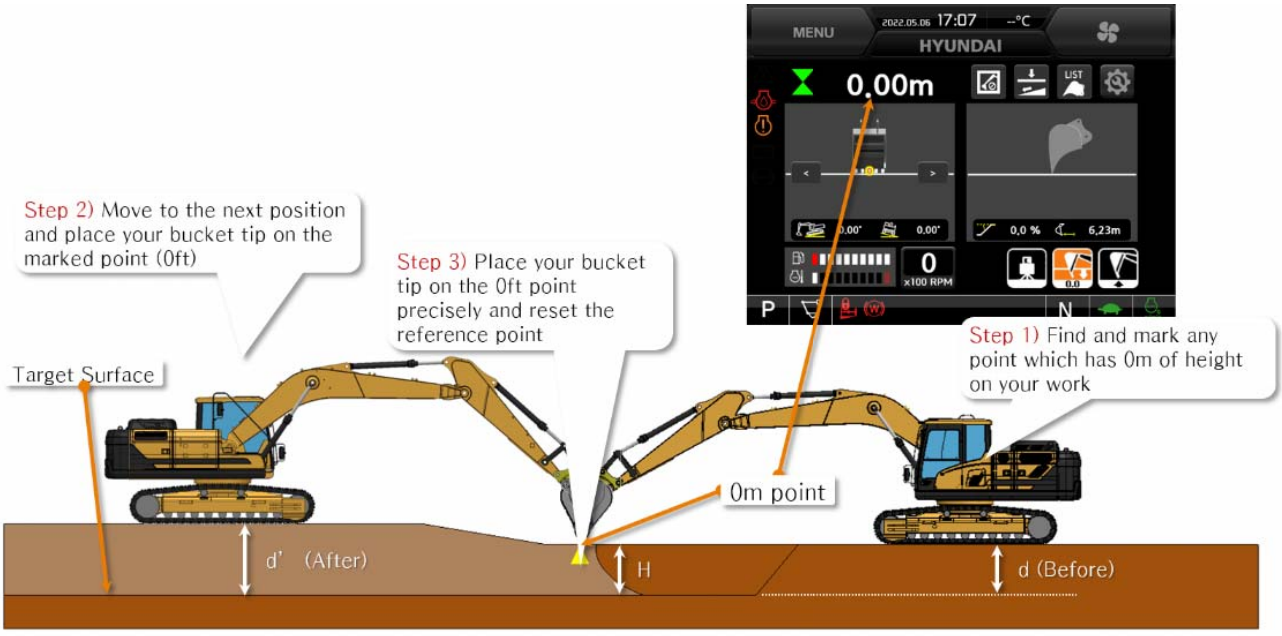
(4) Check compliance with reference point movement procedures.
When moving to a location, check whether the reference point movement function is used according to the procedure. (Refer to operator's manual)

① Touch point utilization



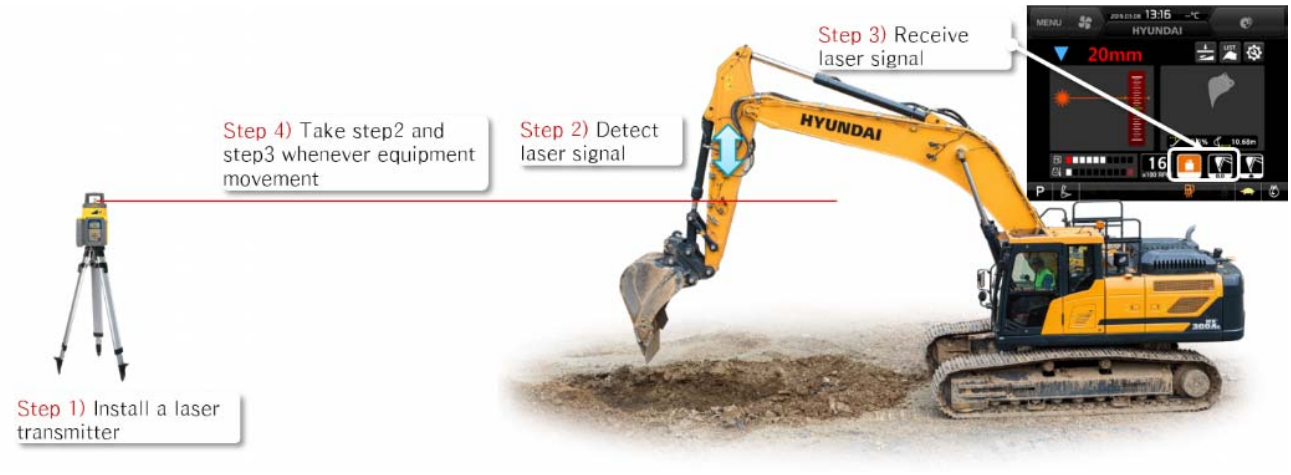
300ASMG38EC

② Reference height utilization



300ASMG39EC

③ Laser catcher utilization



300ASMG40EC

※ If the reference point movement procedures in ①, ②, ③ above are not followed and the work location is moved, measurement errors are likely higher to occur.

(5) Enter 2DMG+ setting value after replacing MCU.

① When replacing MCU, 2DMG+ related information needs to be re-entered.

a. During the 2DMG+ installation process, create a '2DMG+ Option Installation' check sheet that separately organizes 2DMG+ setting data for each machine.

b. After requesting the 2DMG+ person in charge of PS to deliver the check sheet along with the model and serial number, enter the setting information of the check sheet into the cluster.

Check Sheet for 2D MG Option Installation

Date	2020. 9. 18.	Site	■ Ulsan □ Dang-Jin □ etc	Draft	Review	Approval
Model	■ HX145SLCR □ HX260SLA □ HX220SLA □ HX300SLA □ HX235SLCR □ HX330SLA	#	0005			

1. Verification for Installation

① The brackets are properly touched-up after welding	Yes ■	No □
② The bucket-arm connecting harness is not interferred	Yes ■	No □
③ The arm-boom connecting harness is not overstreched	Yes ■	No □
④ The boom-body connecting harness is not overstreched	Yes ■	No □
⑤ The data from each sensor are normal	Yes ■	No □

2. Dimensions

Boom (A-B)	4.603 m	Bucket Pin to Link Pin (C-D)	0.340 m
		Bucket Link (D-E)	0.470 m
Arm (B-C)	2.495 m	Bucket Rod (E-F)	0.415 m

3. Calibration

			Check List		
Offset Angles	Pitch	-0.01			
	Roll	-0.08	① Are the measurement results for each bucket position the same?	Yes ■	No □
	Boom	10.09	② Are the measurement results the same with the real ones?	Yes ■	No □
	Arm	-9.93	③ Are the data for dimensions and calibration angles properly maintained after restarting?	Yes ■	No □
	Bucket	-0.37	④ Are there any problems on the machine?	Yes ■	No □

4. Laser Receiver (Yes □, No ■)

			Check List		
Data	Arm Pin	m			
	Bucket Pin	m	① Is it possible to receive the laser signal?	Yes □	No □
	Arm Width	m	② Is the measurement result using laser singal correct?	Yes □	No □
	Arm Edge	m	③ Is the reference height properly maintained after moving the machine?	Yes □	No □
	Mounting Angle	°	④ Are the data for dimensions and mounting angles properly maintained after restarting?	Yes □	No □

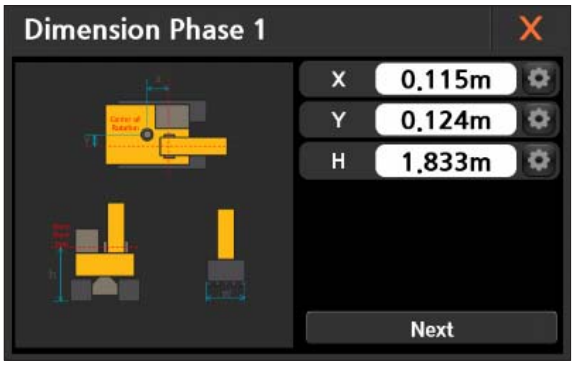
300ASMG41EC

② Input dimensions for 2DMG+ machine.

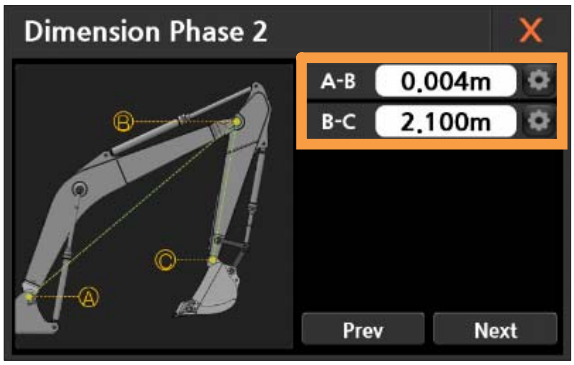
a. Enter the Dimension Phase 1 menu on the cluster menu.

b. Management → Service menu → MG/MC Function set → MG/MC Default set → Dimension set

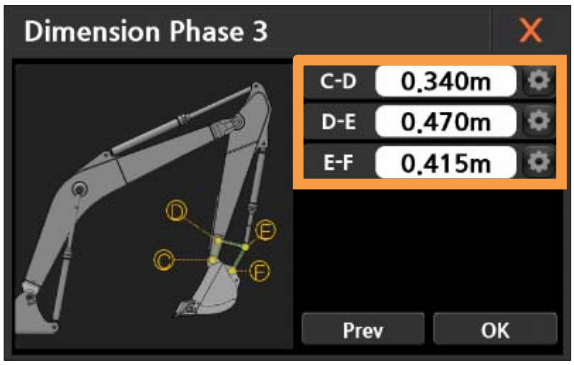
c. In step 1, 'Dimension Phase 1', be careful not to change the default values, and only enter the dimensions of the boom, arm, and bucket link in steps 2 and 3.



300ASMG42EC



300ASMG43EC



300ASMG44EC

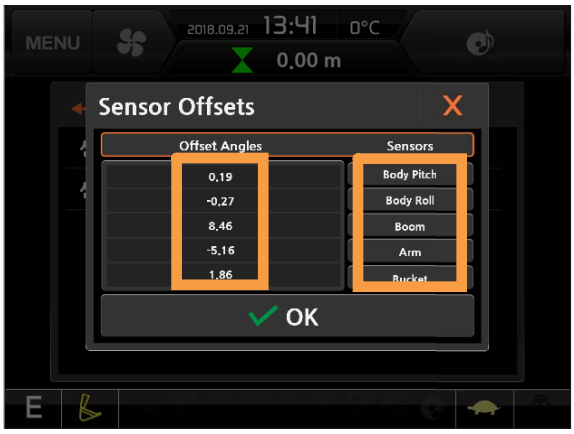
③ Input the angle sensor offset for 2DMG+.

a. Enter the sensor offset menu on the cluster menu.

b. Management → Service menu → MG/MC Function set → MG/MC Default set → Monitoring → Sensor Offsets

c. Refer to the check sheet and enter all offset values for the body roll, body pitch, boom, arm and bucket.

※ If dimension information and sensor offset are not entered after replacing the MCU, the accuracy of 2DMG+ measurement cannot be secured.



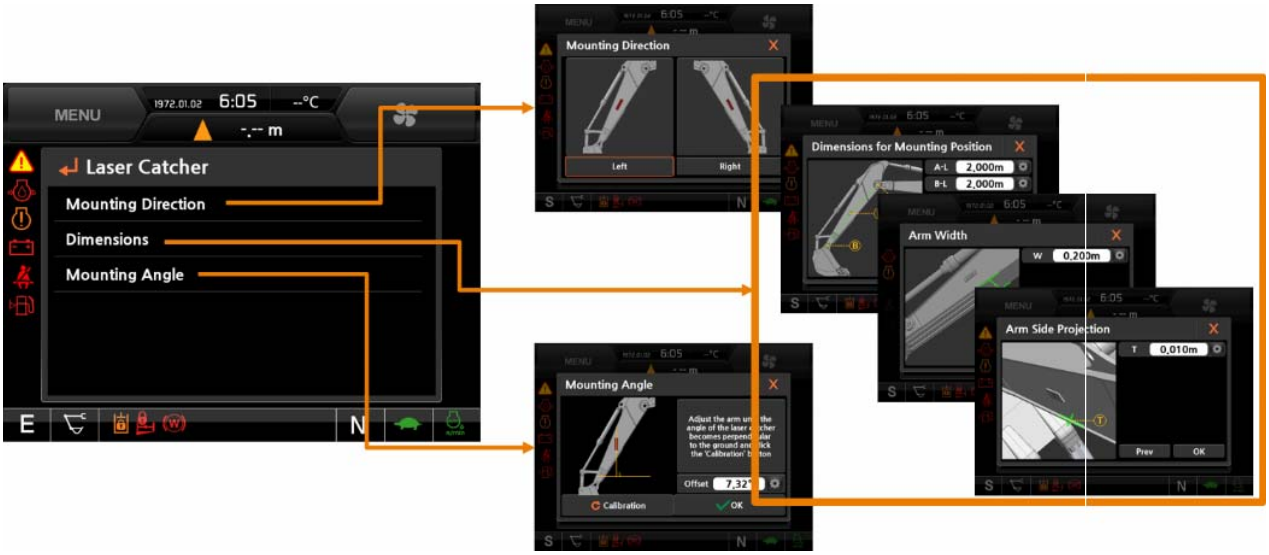
300ASMG45EC

④ Input laser catcher setup information. (If equipped with the laser catcher option.)

a. Enter the laser catcher menu on the cluster menu.

b. Management → Service menu → MG/MC Function set → Laser Catcher

c. Refer to the check sheet and enter the laser mounting location, laser catcher dimensions and laser catcher installation angle.



300ASMG46EC

⑤ Input bucket dimensions.

The bucket dimension input procedure is performed for all buckets owned by the user.



Bucket vertical posture adjustment



Keep vertical posture, input bucket dim (A,B,C)

300ASMG47EC

3) ACTION WHEN YOU CAN NOT ENTER THE CLUSTER'S 2DMG+ MENU

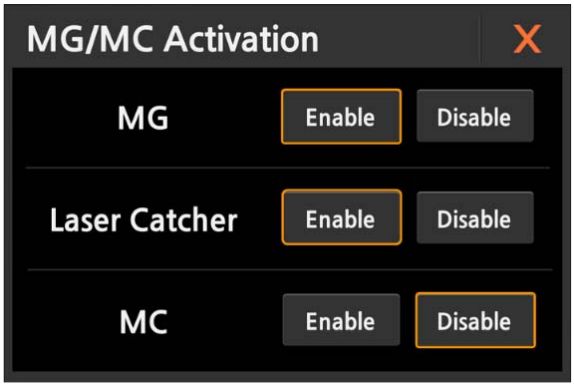
(1) 2DMG+ FUNCTION NOT SET AFTER CLUSTER REPLACEMENT

① Change cluster default settings.

a. From the cluster main menu, enter the function selection menu through the following path.

b. Management → Service menu → MG/MC Function set → MG/MC Activation select

c. Change MG function and laser catcher to "Enable".



300ASMG48EC

SECTION 6 TROUBLESHOOTING

Group 1 Before Troubleshooting ····· 6-1
Group 2 Hydraulic and Mechanical System ····· 6-4
Group 3 Electrical System ····· 6-25
Group 4 Mechatronics System ····· 6-44
Group 5 Air conditioner and Heater System ····· 6-72

SECTION 6 TROUBLESHOOTING

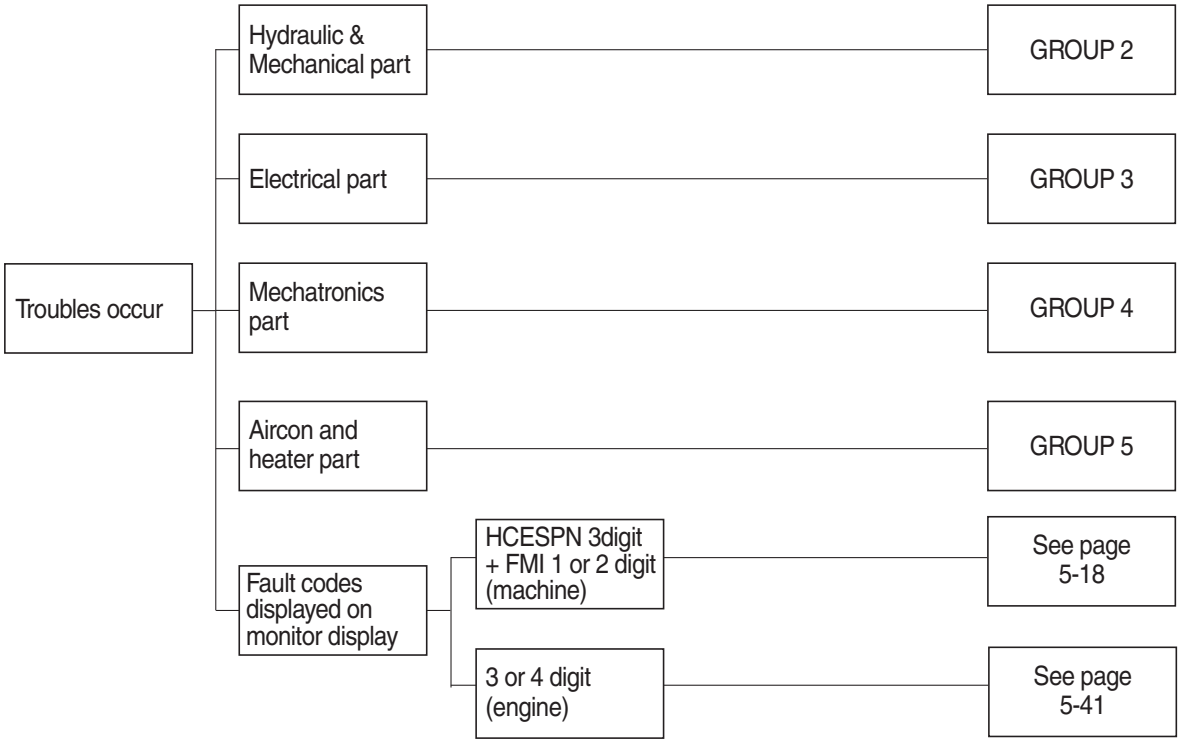
GROUP 1 BEFORE TROUBLESHOOTING

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.**

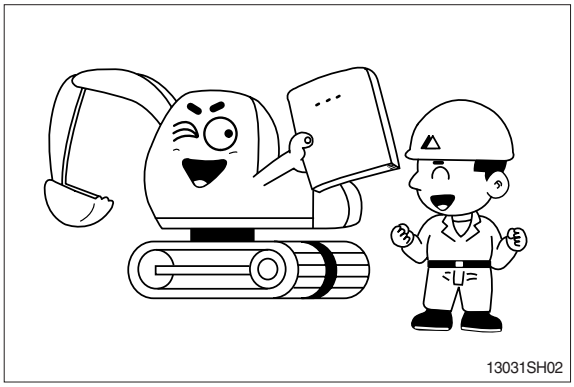


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

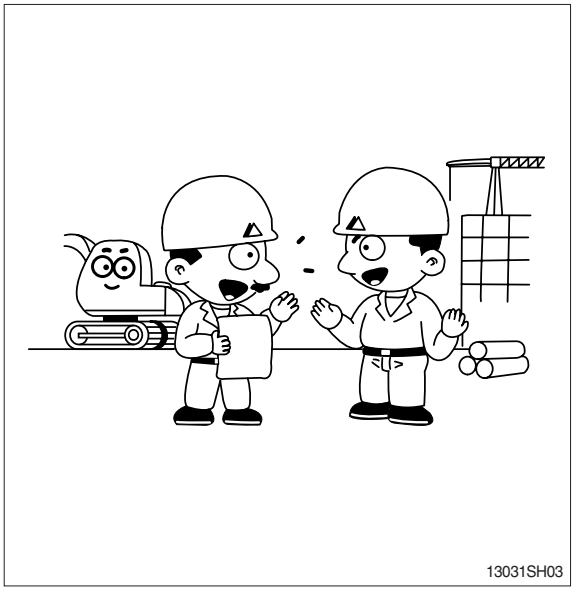
Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.
Especially, deepen the knowledge for the related parts of the trouble.



STEP 2. Ask the operator

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

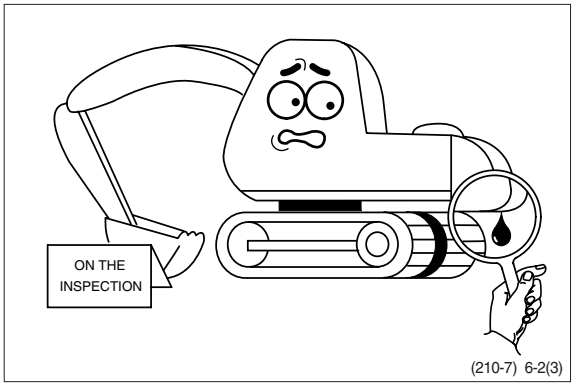
1) How the machine is used and when it is serviced?
2) When the trouble was noticed and what work the machine was doing at that time?
3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
4) Did the machine have any troubles previously?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



STEP 3. Inspect the machine

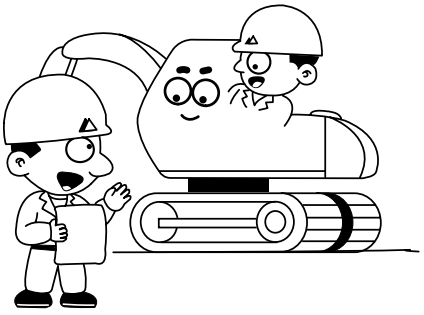
Before starting troubleshooting, check the machine for the daily maintenance points as shown in the operator's manual.

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



STEP 4. Inspect the trouble actually on the machine

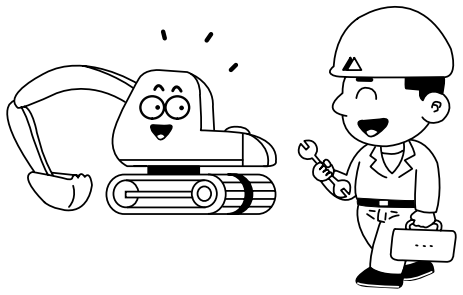
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(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.

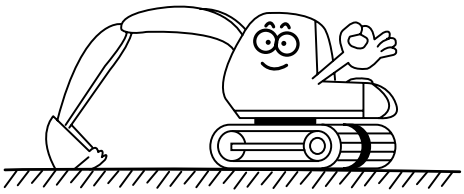


13031SH05

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.

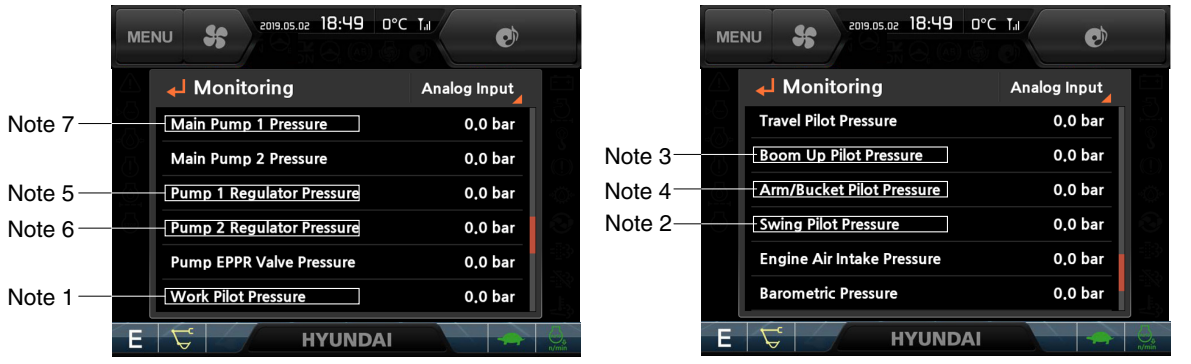
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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

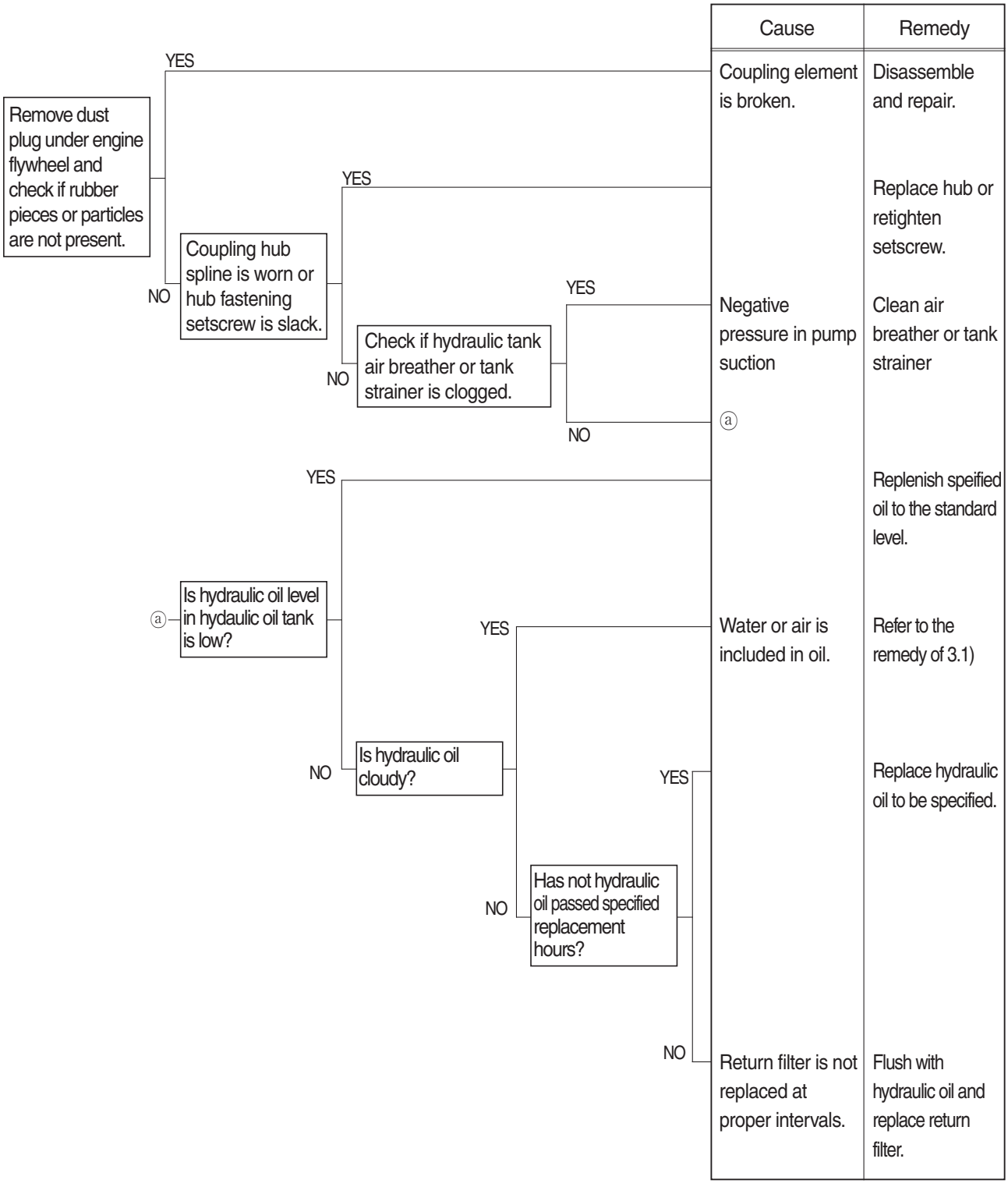
220A6HS01

(2) Specification

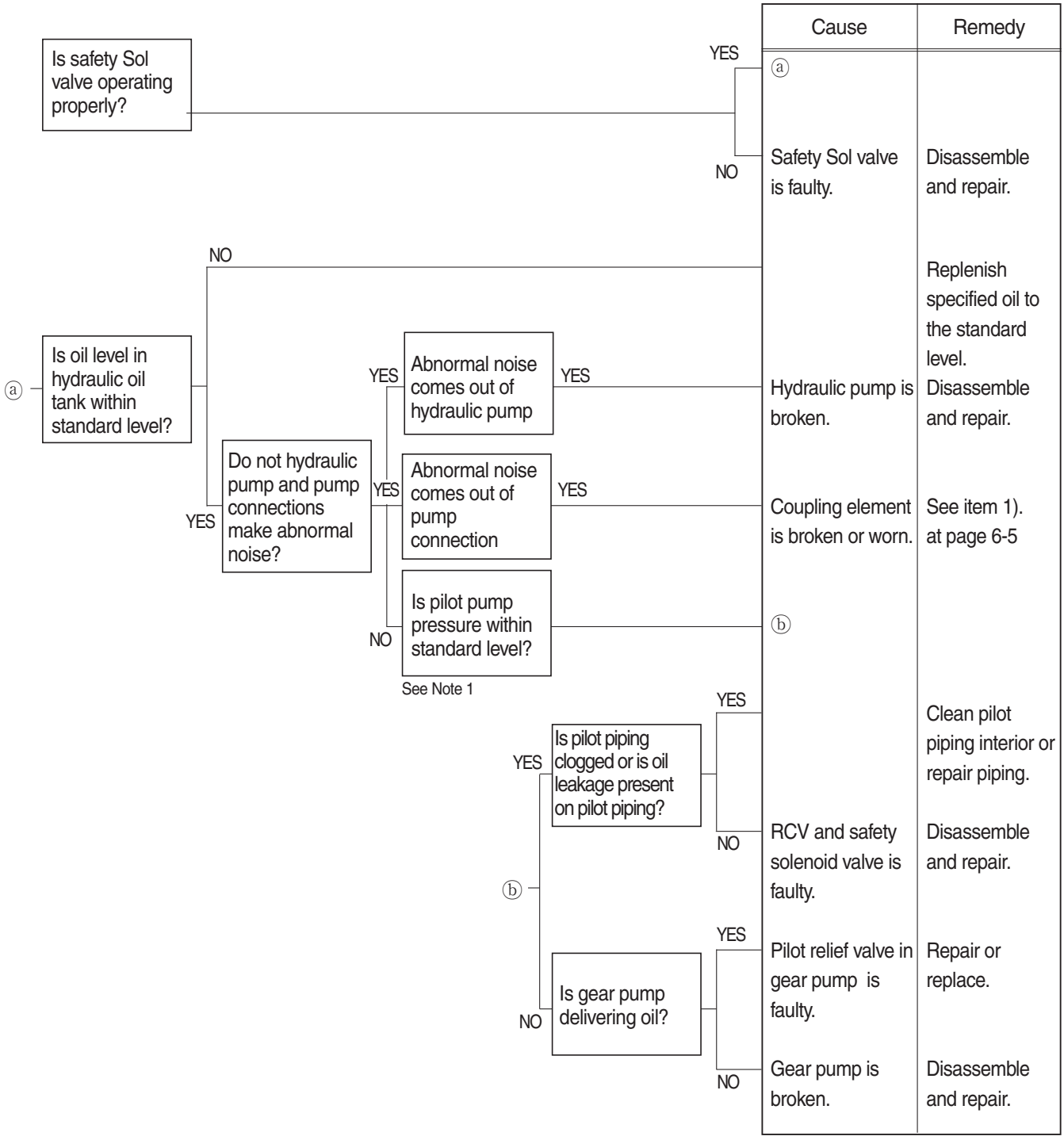
No.	Description	Specification
Note 1	Work pilot pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	Pump 1 regulator pressure	0~50 bar
Note 6	Pump 2 regulator pressure	0~50 bar
Note 7	Pump 1 pressure	350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL



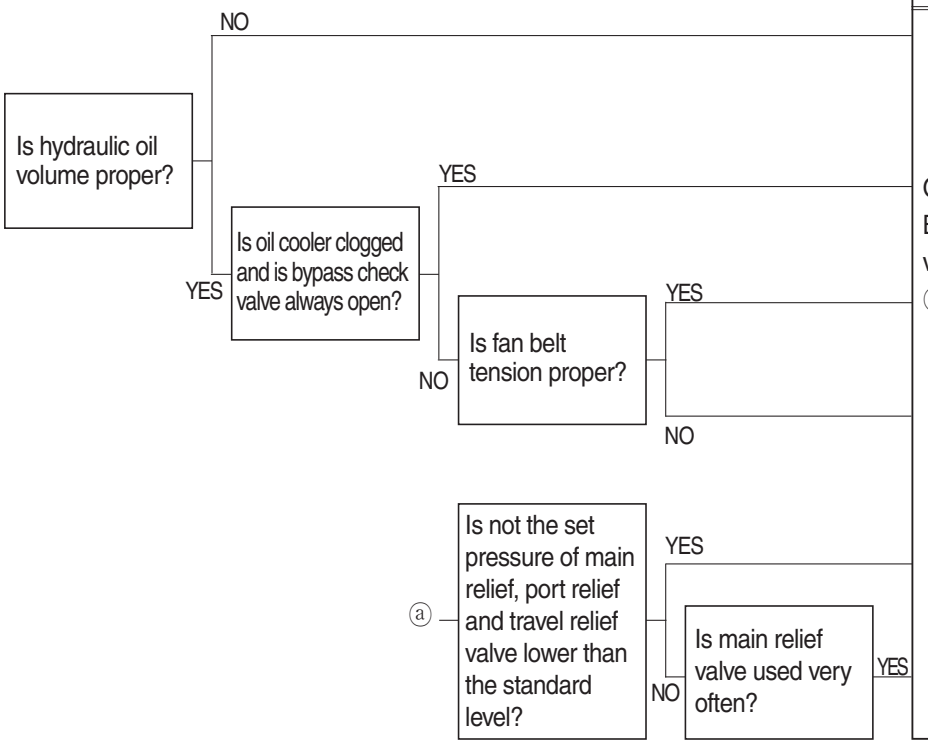
3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY



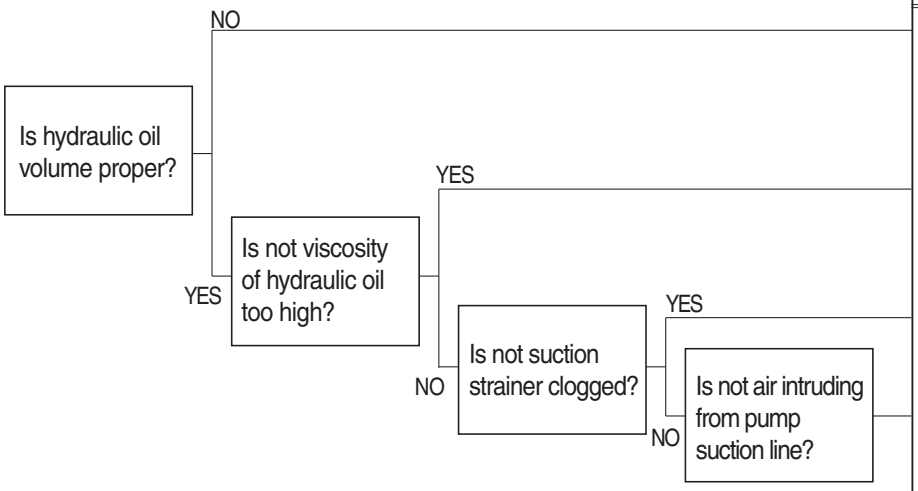
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



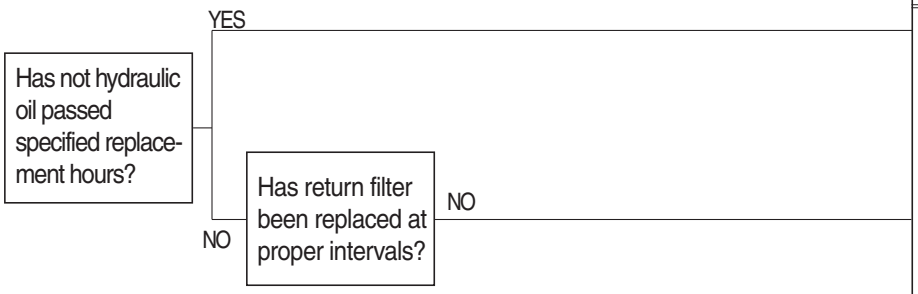
Cause	Remedy
Oil cooler clogged. Bypass check valve is defective. ⓐ	Replenish specified oil to the standard level. Clean oil cooler. Replace
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

3) CAVITATION OCCURS WITH PUMP



Cause	Remedy
	Replenish specified oil to the standard level. Replace oil with one of proper viscosity. Clean suction strainer. Check for air intrusion in suction line and retighten or replace parts.

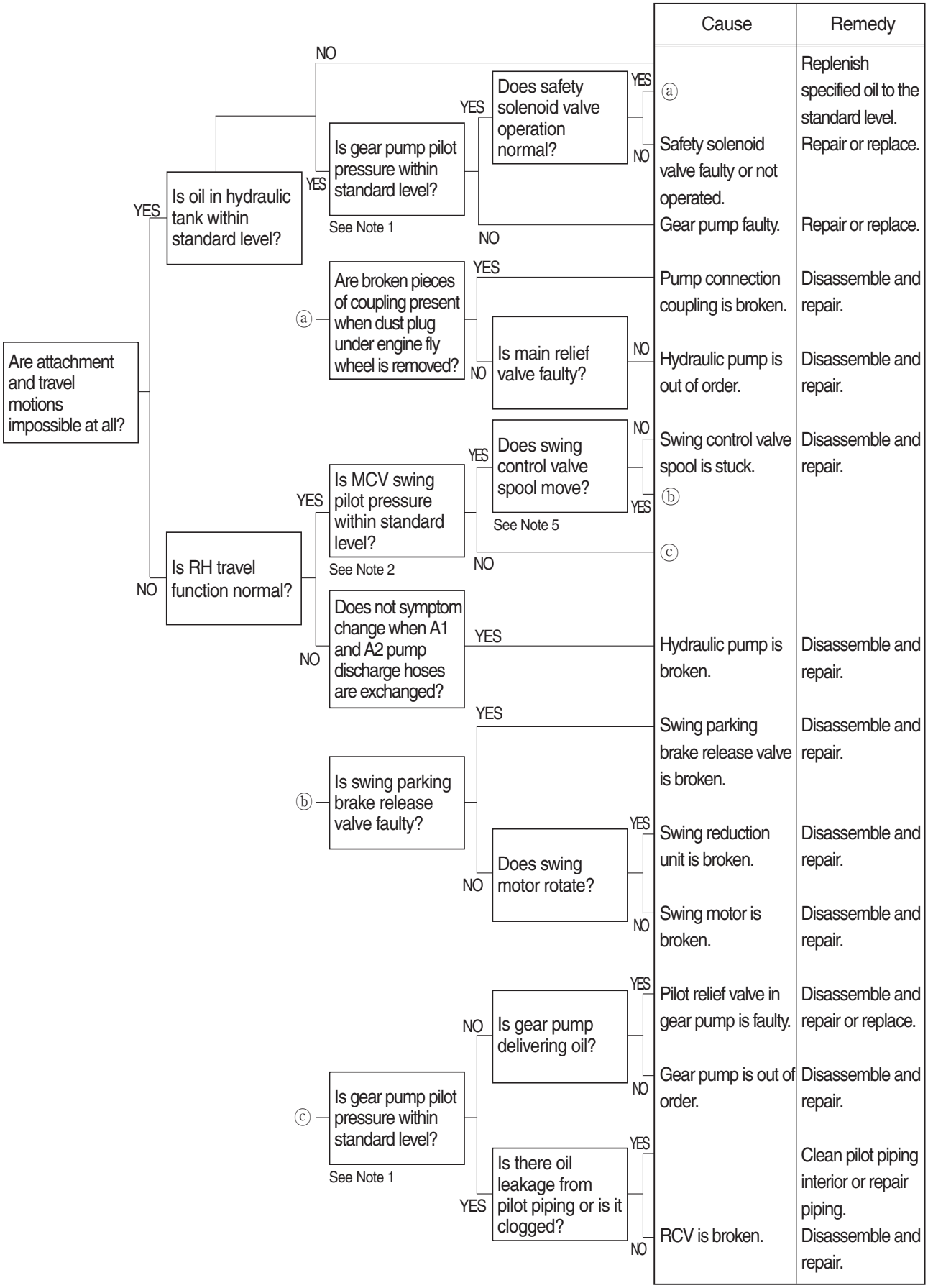
4) HYDRAULIC OIL IS CONTAMINATED



Cause	Remedy
	Replace hydraulic oil to be specified. Flush with hydraulic oil and replace return filter.

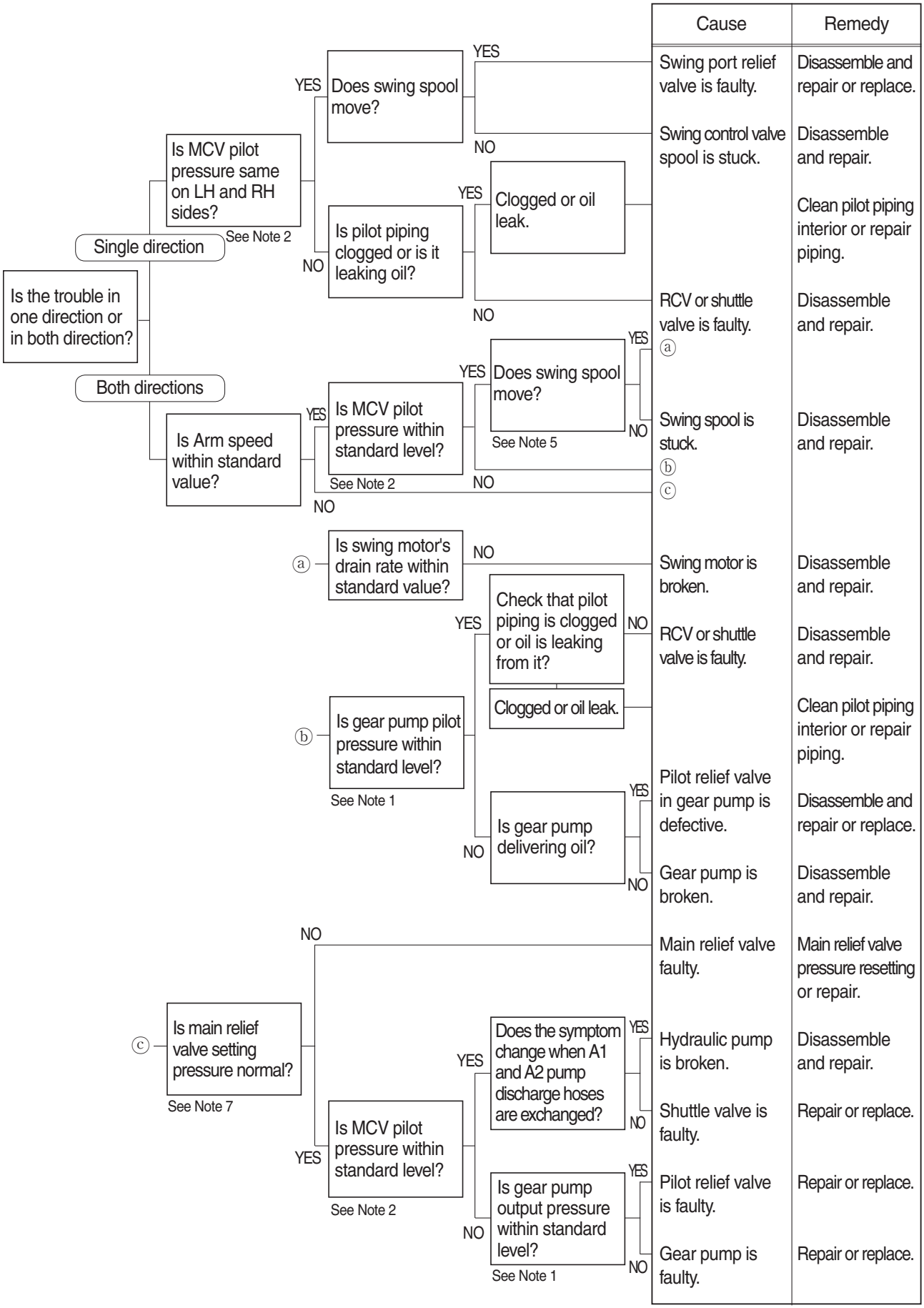
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



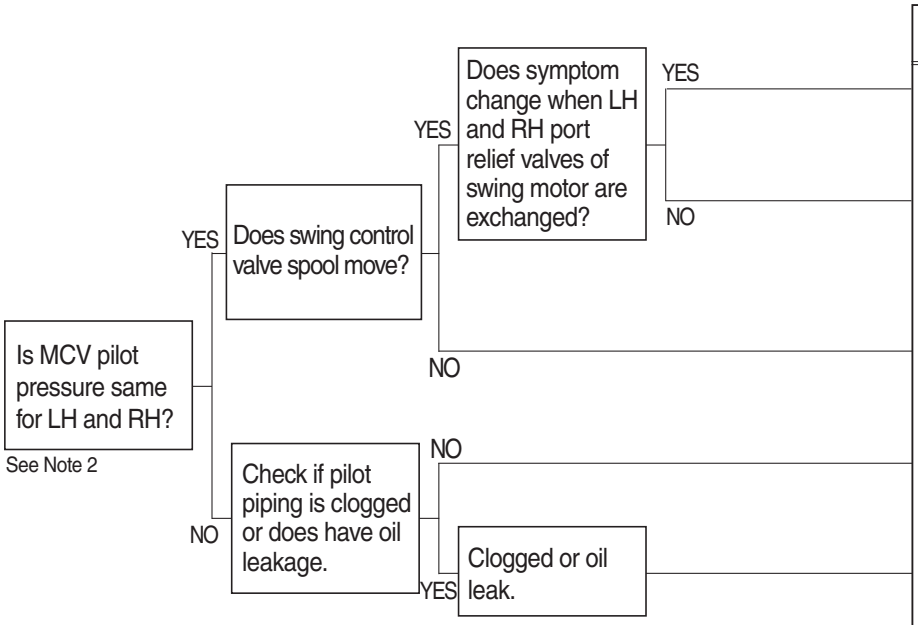
Cause	Remedy
ⓐ Safety solenoid valve faulty or not operated.	Replenish specified oil to the standard level. Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
ⓑ	
ⓒ	
Hydraulic pump is broken.	Disassemble and repair.
Swing parking brake release valve is broken.	Disassemble and repair.
Swing reduction unit is broken.	Disassemble and repair.
Swing motor is broken.	Disassemble and repair.
Pilot relief valve in gear pump is faulty.	Disassemble and repair or replace.
Gear pump is out of order.	Disassemble and repair.
RCV is broken.	Clean pilot piping interior or repair piping. Disassemble and repair.

2) SWING SPEED IS LOW



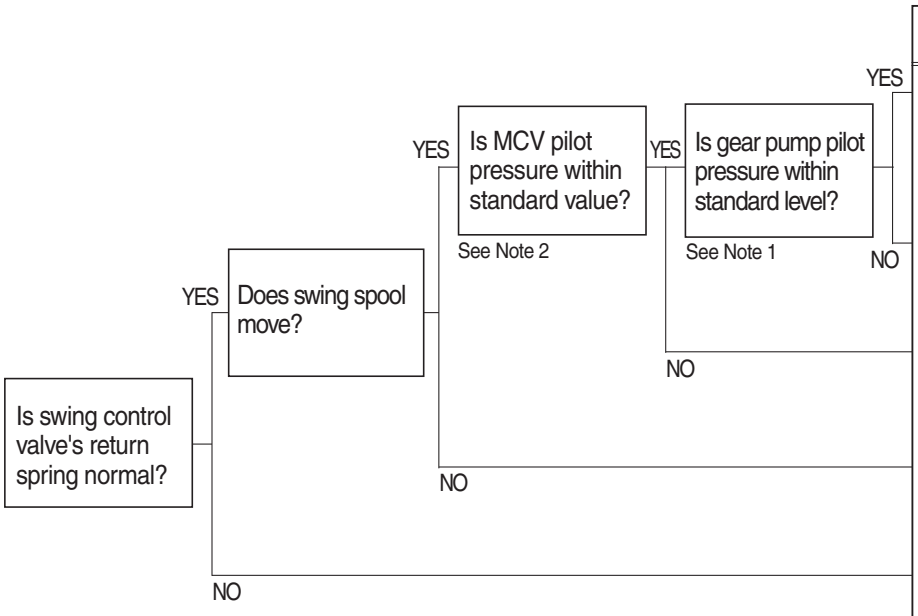
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing control valve spool is stuck.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
RCV or shuttle valve is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Swing motor is broken.	Disassemble and repair.
RCV or shuttle valve is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
Pilot relief valve in gear pump is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
Main relief valve faulty.	Main relief valve pressure resetting or repair.
Hydraulic pump is broken.	Disassemble and repair.
Shuttle valve is faulty.	Repair or replace.
Pilot relief valve is faulty.	Repair or replace.
Gear pump is faulty.	Repair or replace.

3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



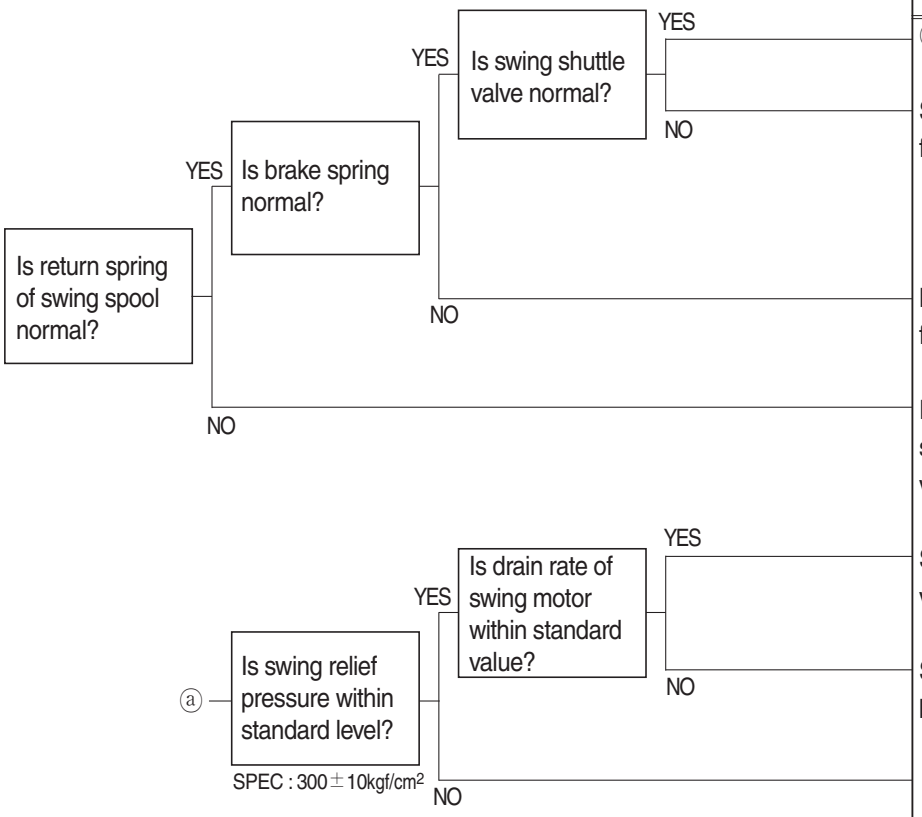
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

4) MACHINE SWINGS BUT DOES NOT STOP



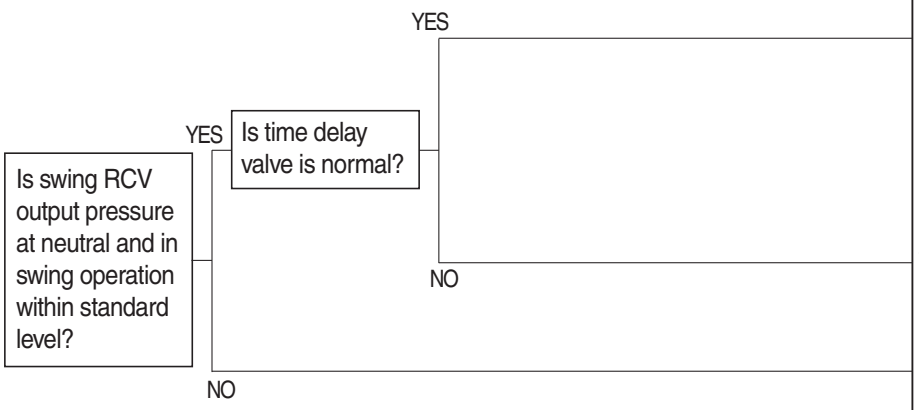
Cause	Remedy
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Return spring is faulty.	Disassemble and replace.

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



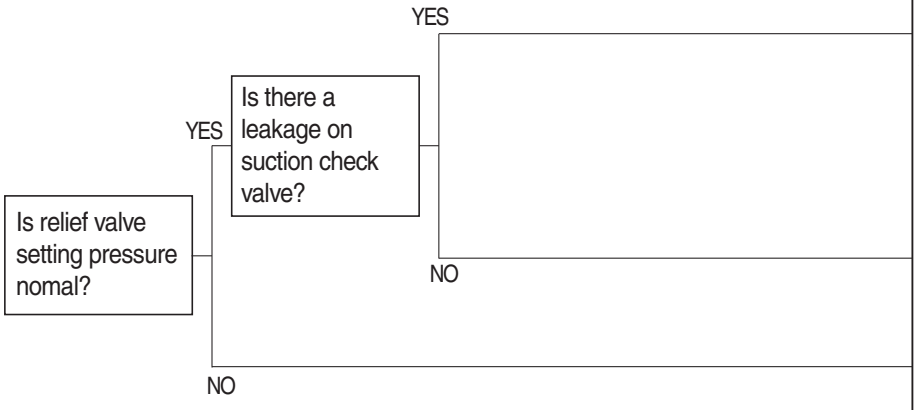
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.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

6) LARGE SHOCK OCCURS WHEN STOP SWINGING



Cause	Remedy
Swing motor is broken.	Disassemble and repair.
Time delay valve is faulty.	Disassemble and repair or replace.
Malfunction of swing RCV	Disassemble and repair.

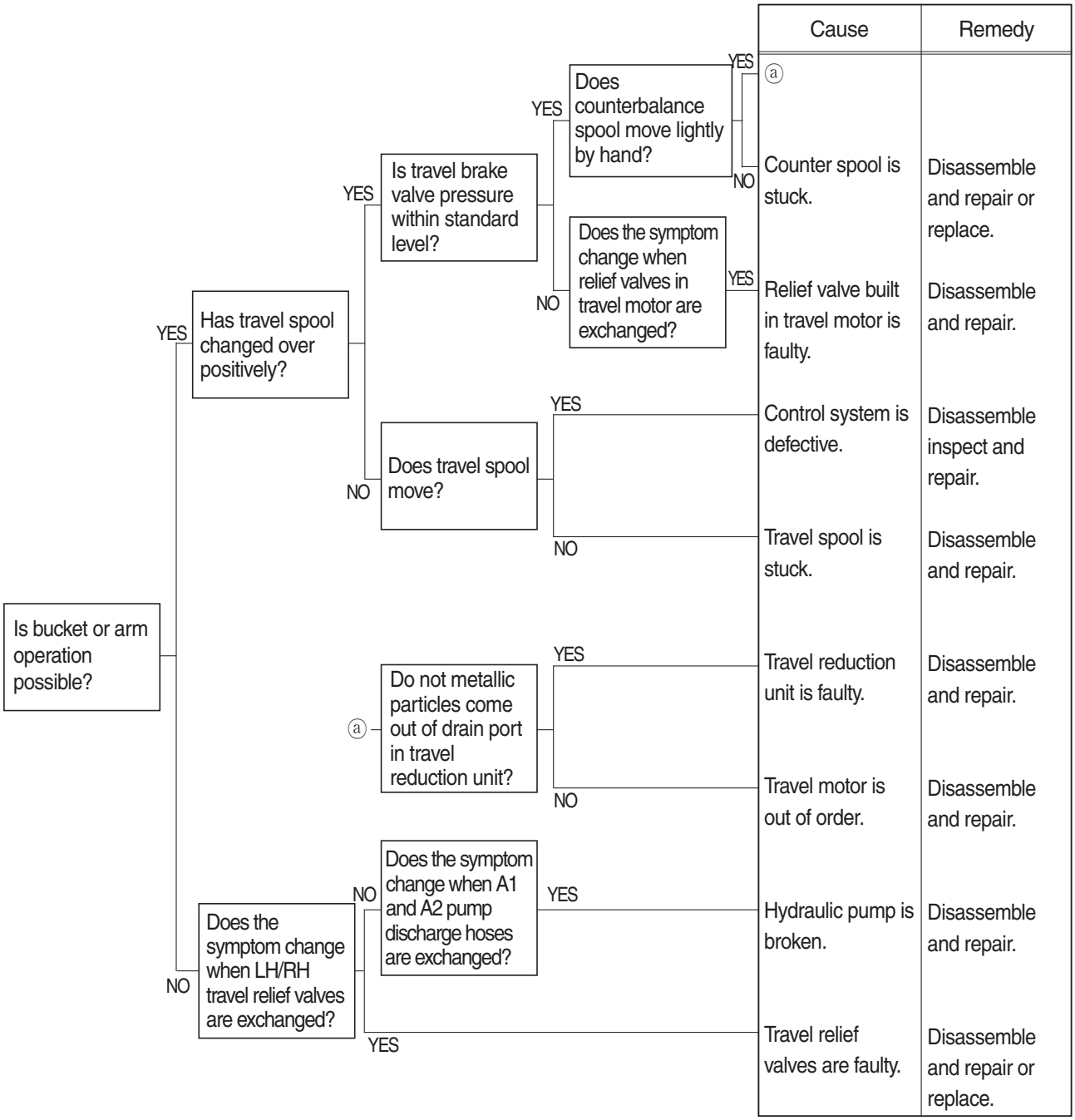
7) LARGE SOUND OCCURS WHEN STOP SWINGING



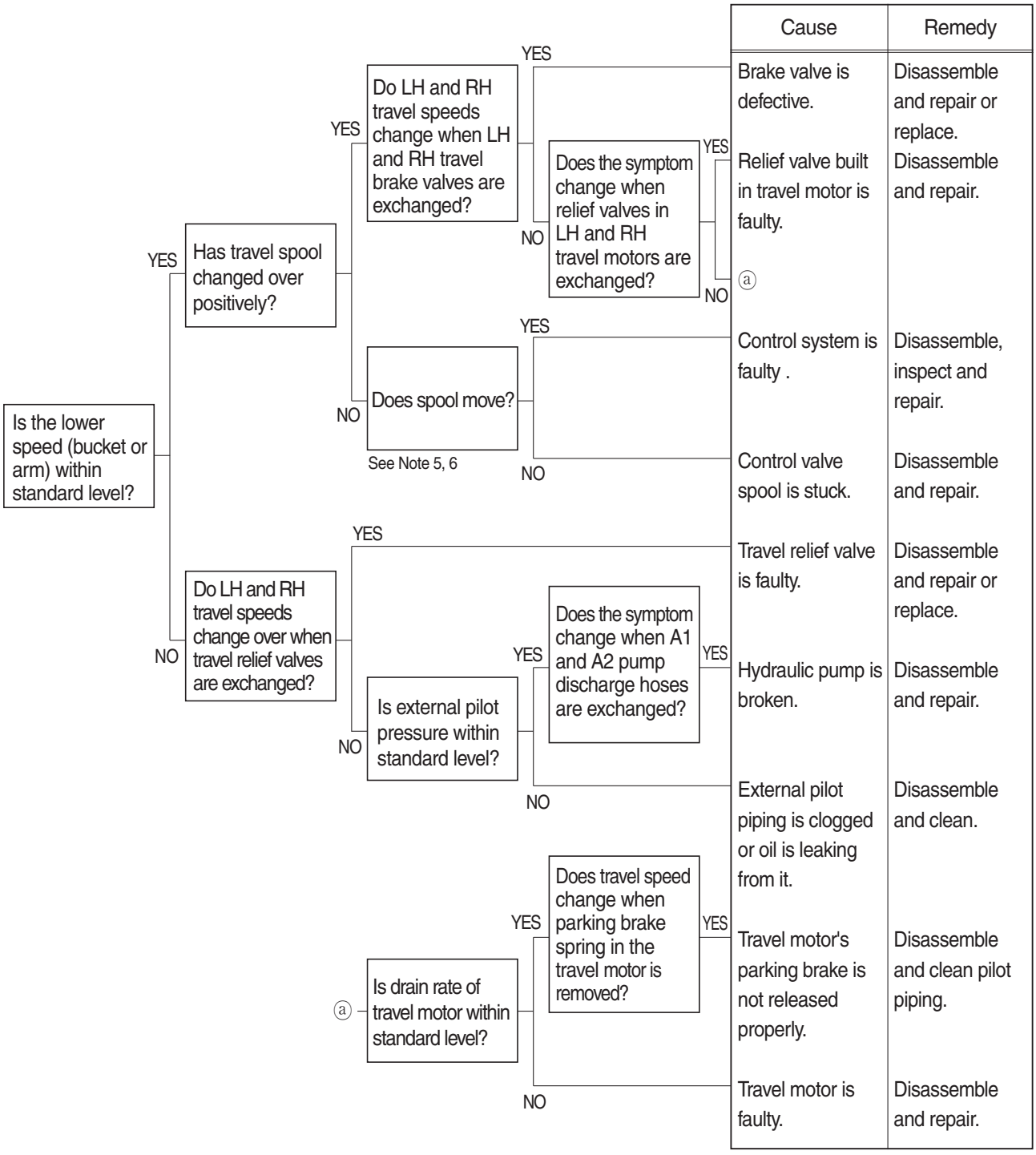
Cause	Remedy
Seal of suction valve is faulty.	Disassemble and repair.
Internal defect of swing motor.	Disassemble and repair.
Malfunction of relief valve.	Adjust swing relief valve pressure or replace swing relief valve.

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

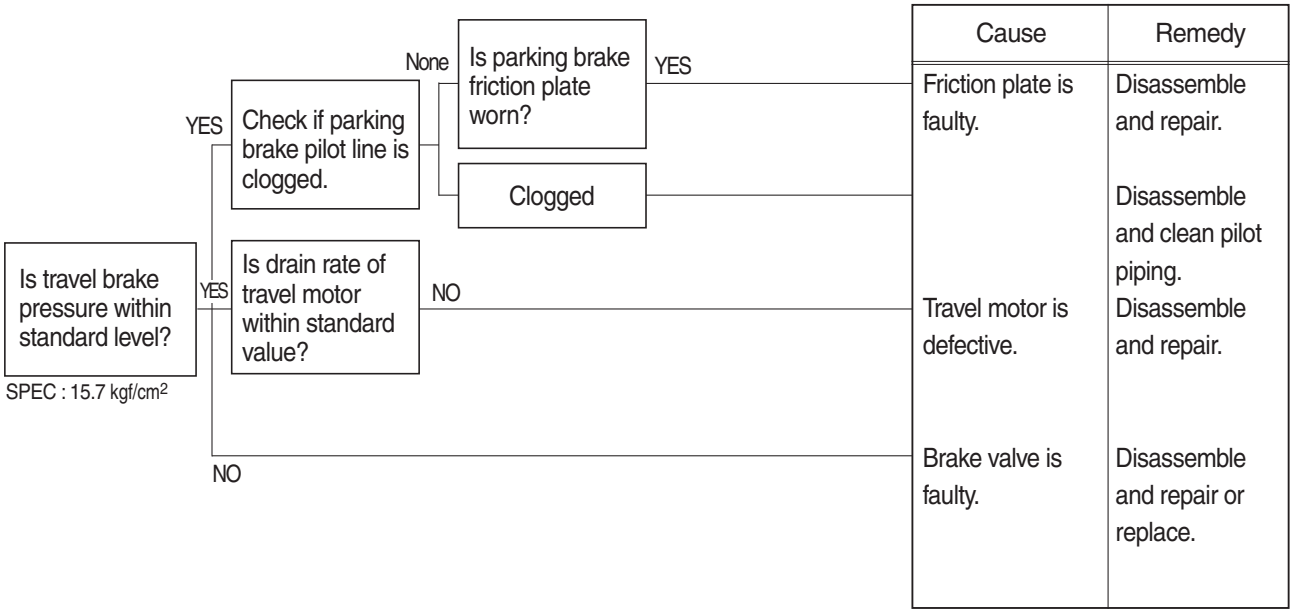


2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES

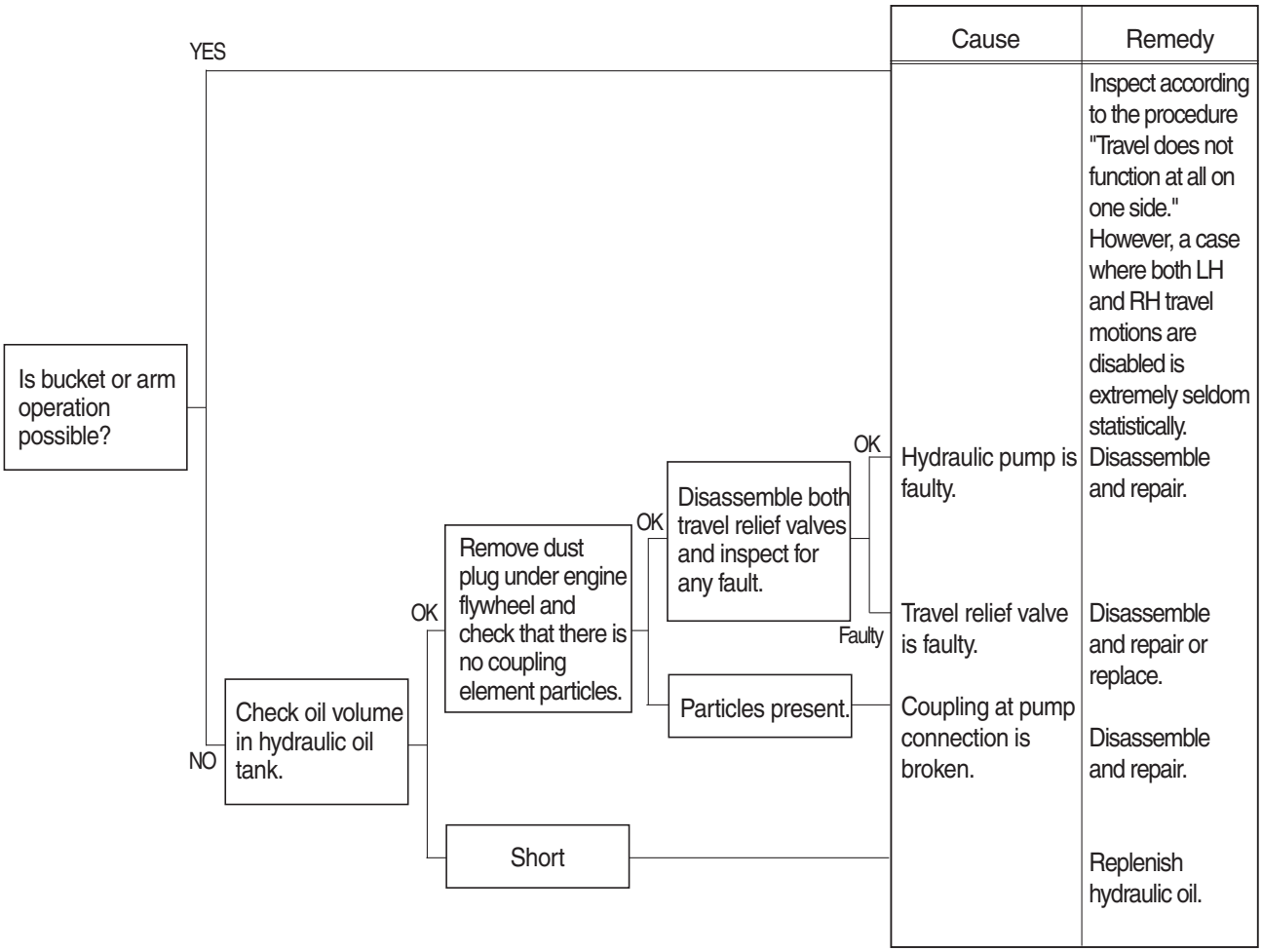


3) MACHINE DOES NOT STOP ON A SLOPE

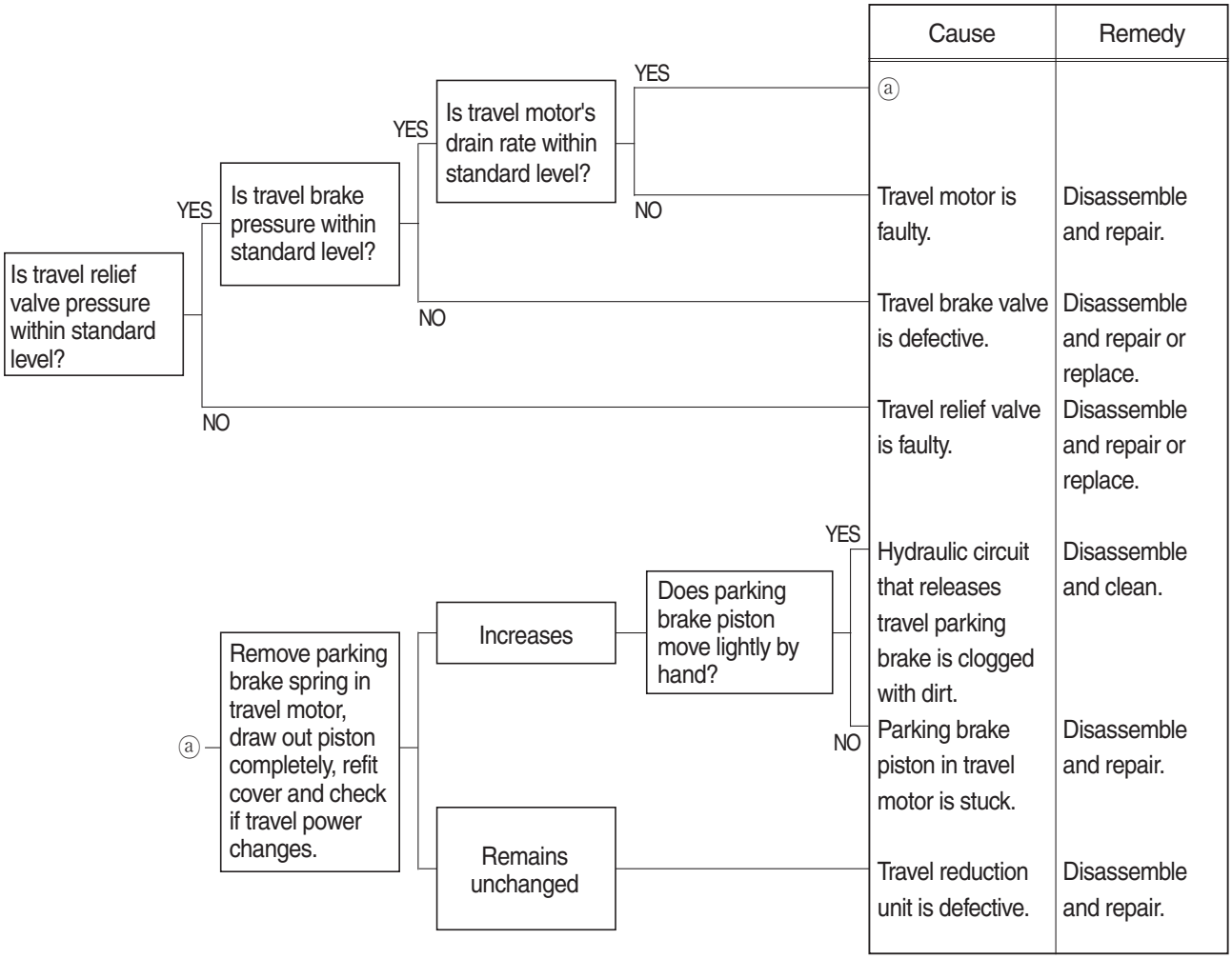
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

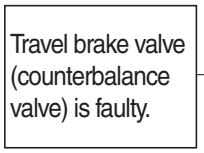


5) TRAVEL ACTION IS POWERLESS (travel only)



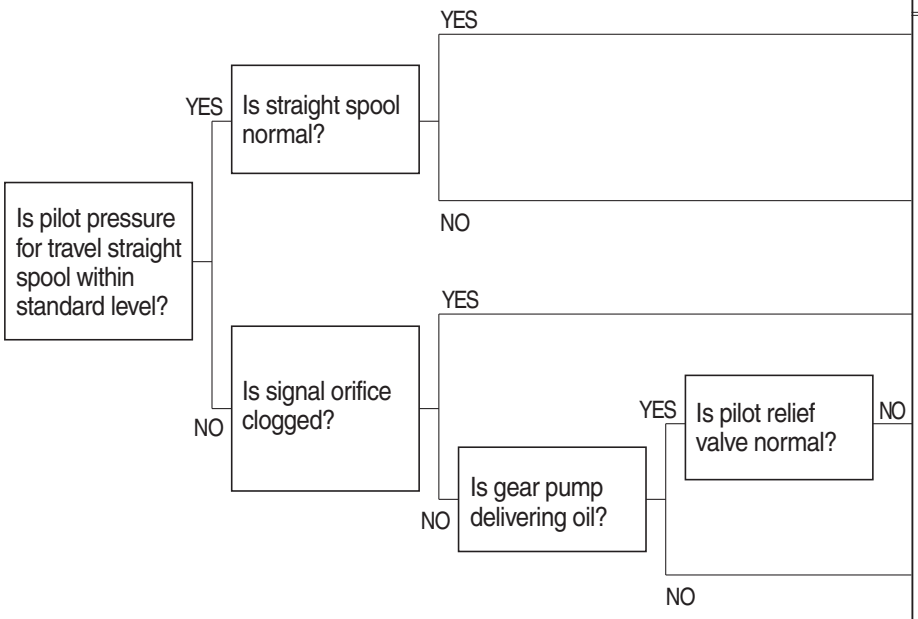
Cause	Remedy
ⓐ	
Travel motor is faulty.	Disassemble and repair.
Travel brake valve is defective.	Disassemble and repair or replace.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic circuit that releases travel parking brake is clogged with dirt.	Disassemble and clean.
Parking brake piston in travel motor is stuck.	Disassemble and repair.
Travel reduction unit is defective.	Disassemble and repair.

6) MACHINE RUNS RECKLESSLY ON A SLOPE



Cause	Remedy
	Disassemble and repair or replace.

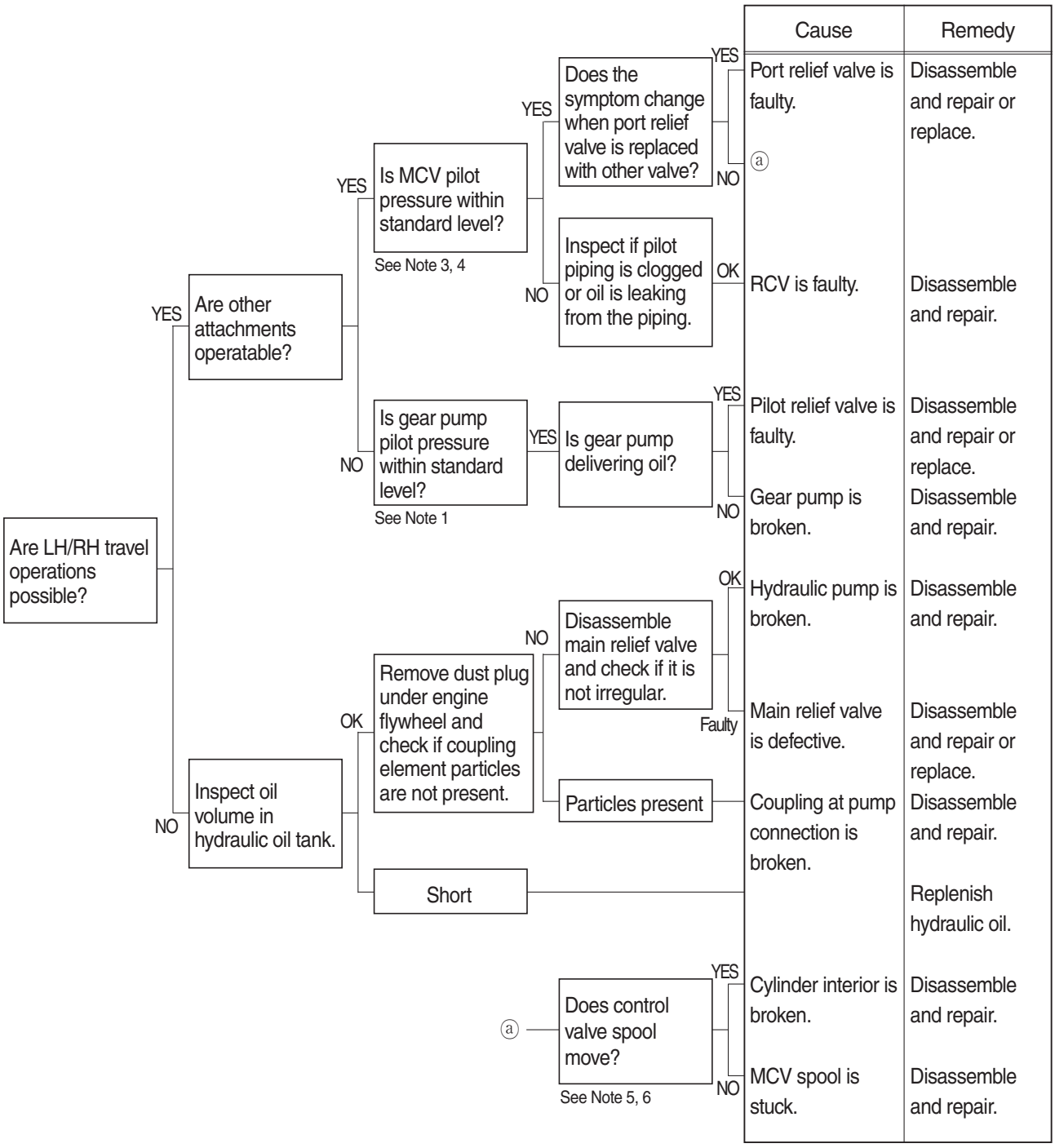
7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME



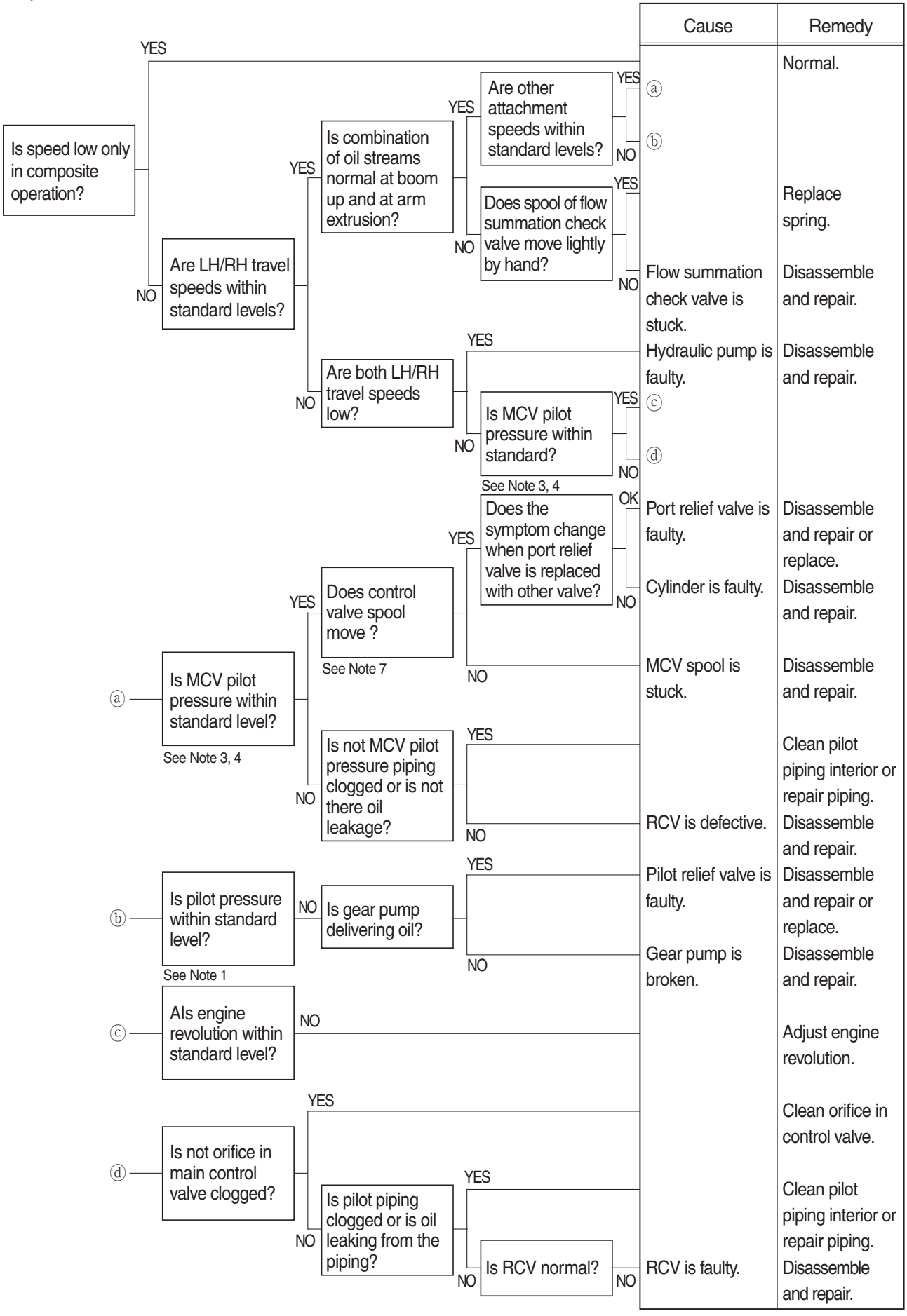
Cause	Remedy
	Normal.
Straight spool is faulty.	Repair or replace.
	Remove dirt on signal orifice.
Pilot relief valve is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.

6. ATTACHMENT SYSTEM

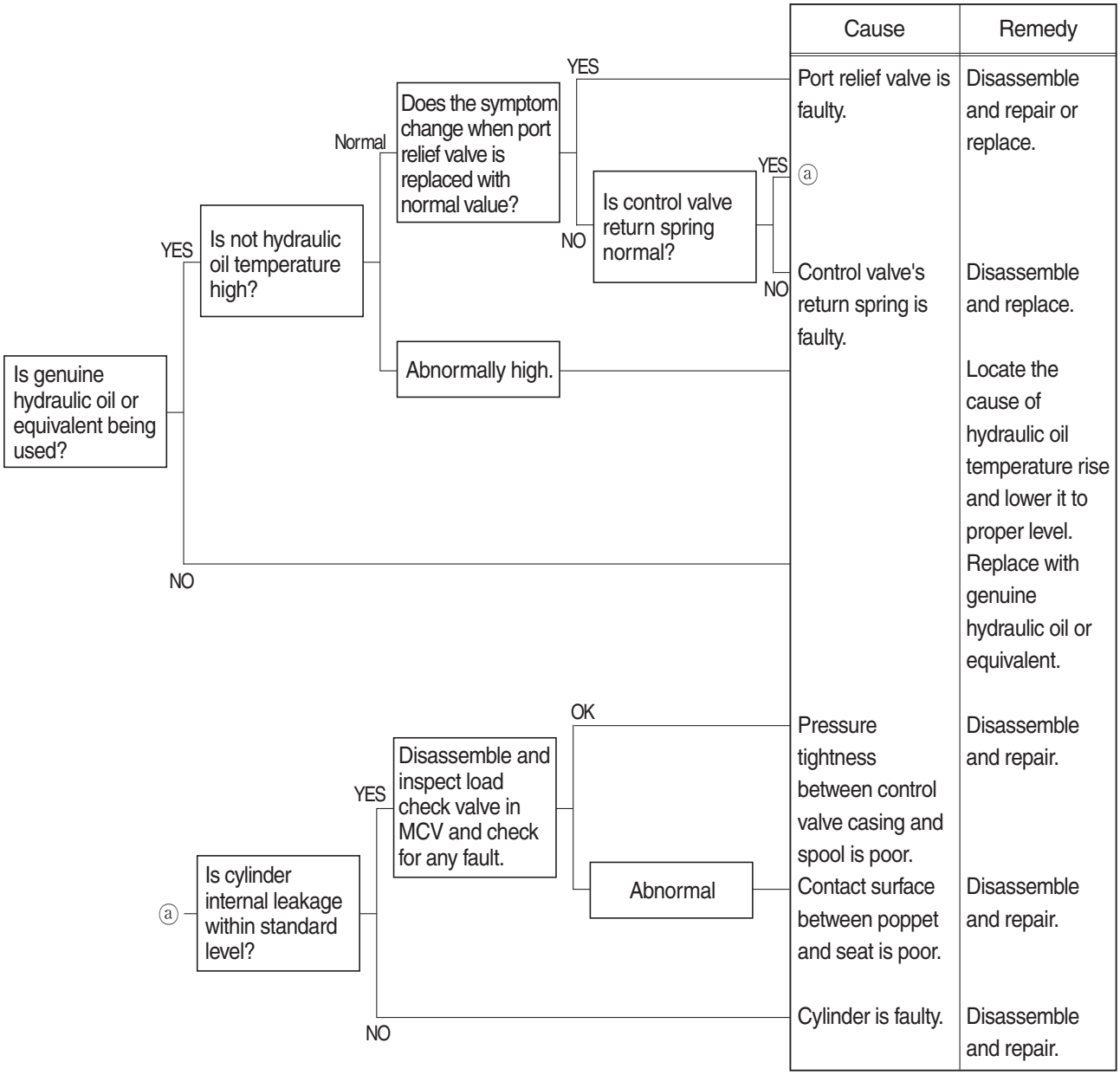
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

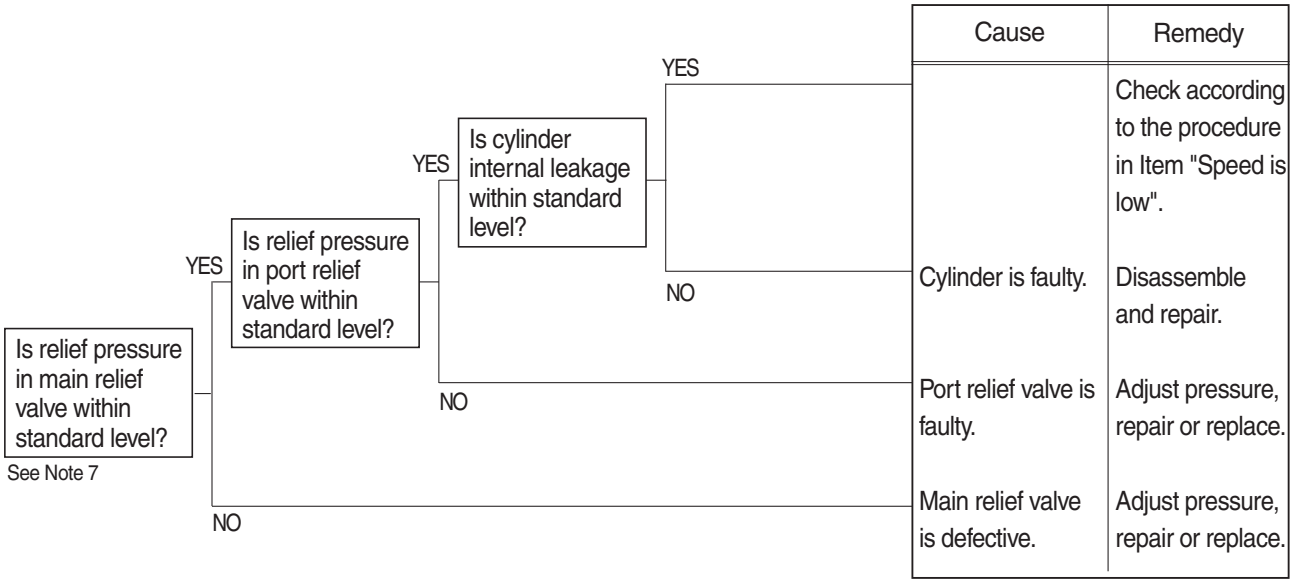


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

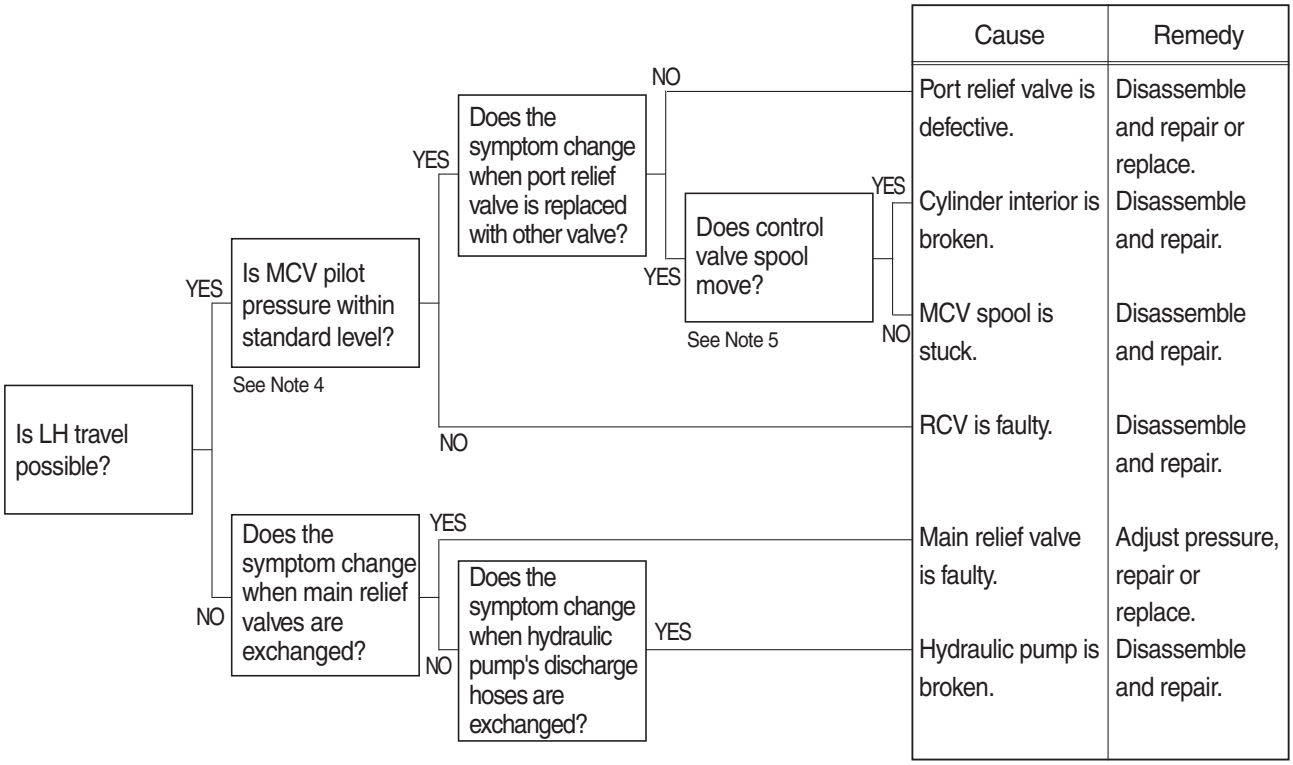


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
ⓐ	
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level. Replace with genuine hydraulic oil or equivalent.
Pressure tightness between 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.

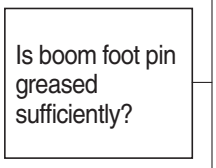
4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

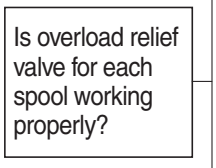


YES

NO

Cause	Remedy
	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.
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.



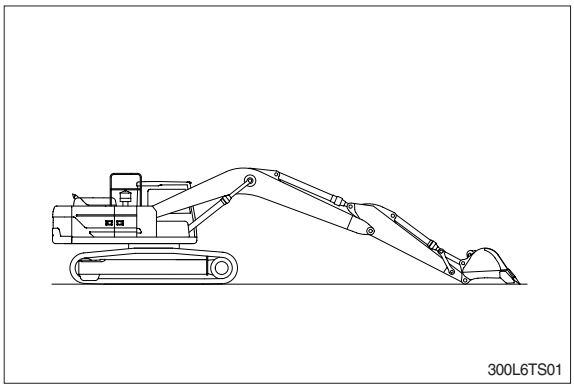
YES

NO

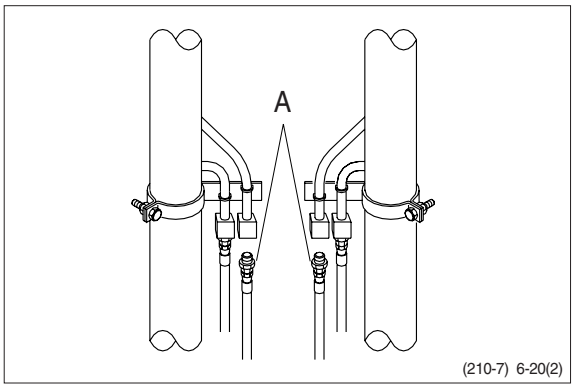
Cause	Remedy
	Refer to 2)
Overload relief valve is faulty.	Disassemble and repair.

※ 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.

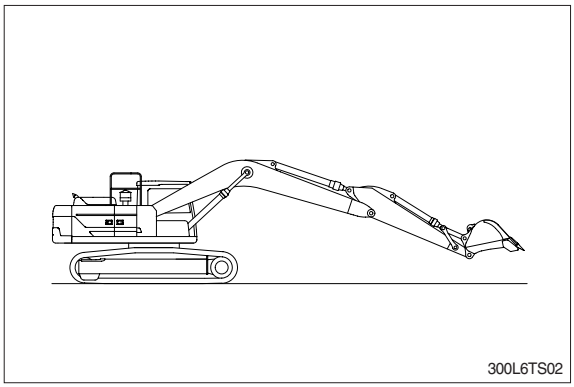


2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



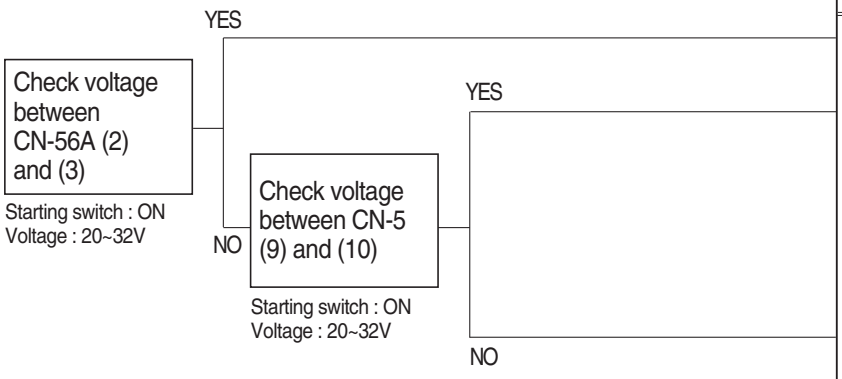
3. Raise bucket OFF the ground by retracting the arm cylinder rod.

   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.



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

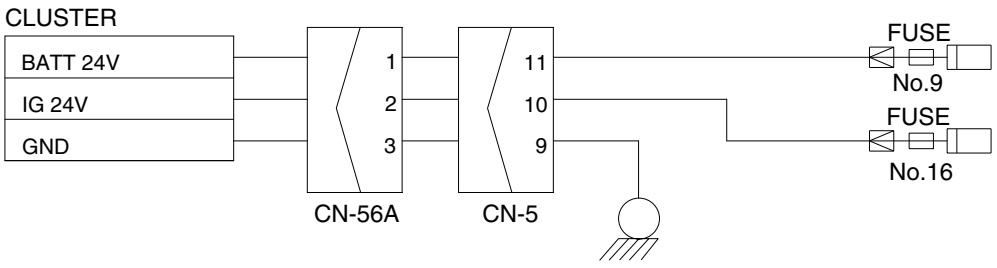
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 9, 16.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5-CN-56A	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (9) -GND or fuse No. 9, 16	Repair or replace (after clean)

Check voltage

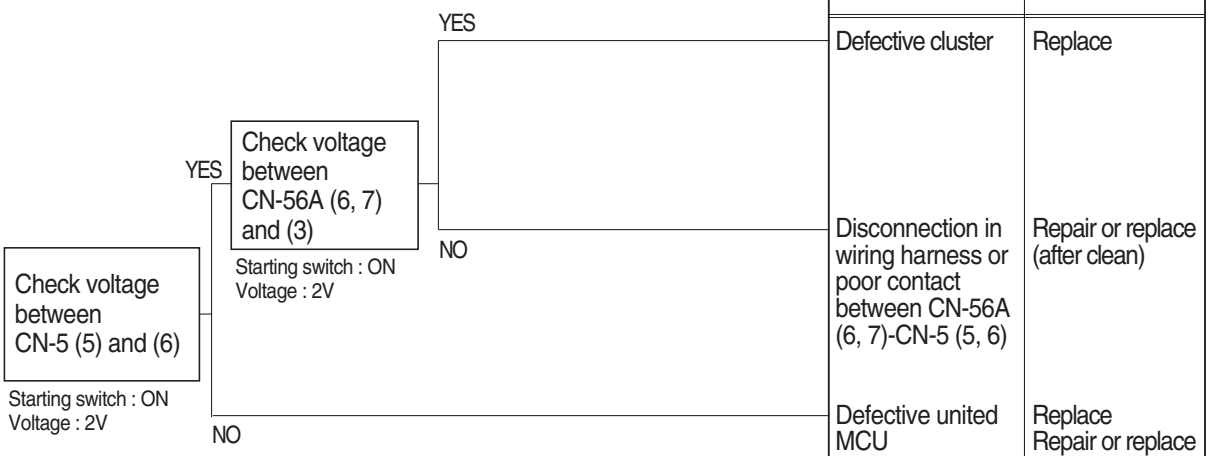
YES	20~32V
NO	0V



300L6ES101

2. ⚠ COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

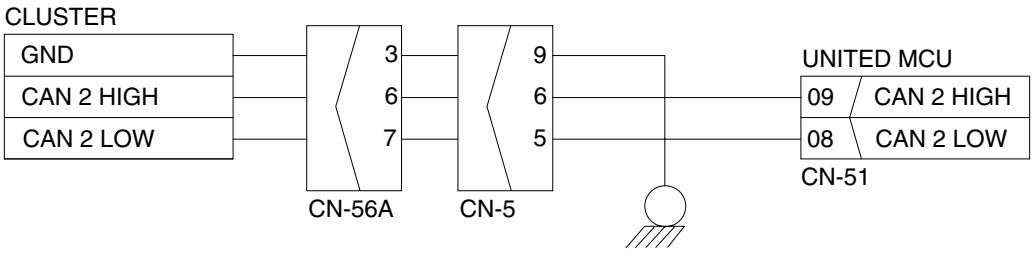
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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 united MCU Disconnection in wiring harness or poor contact between CN-5 (5, 6)- CN-51 (08, 09)	Replace Repair or replace (after clean)

Check voltage

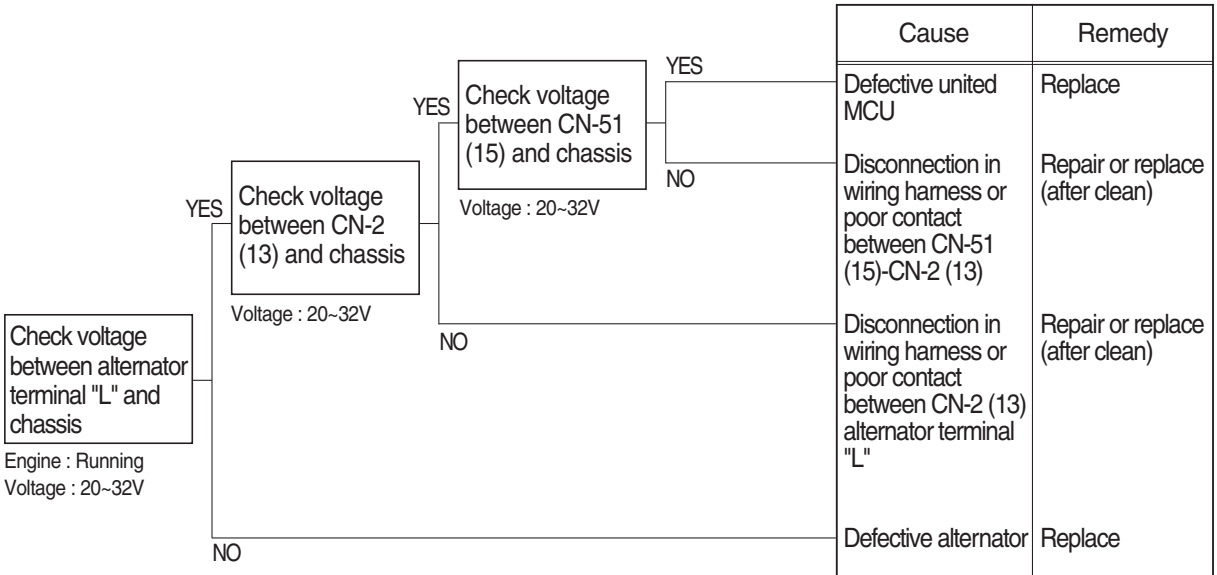
YES	2V
NO	0V



140L6ES102

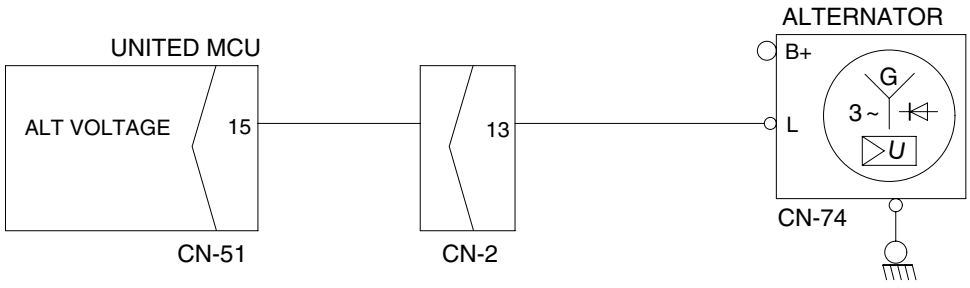
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

· 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

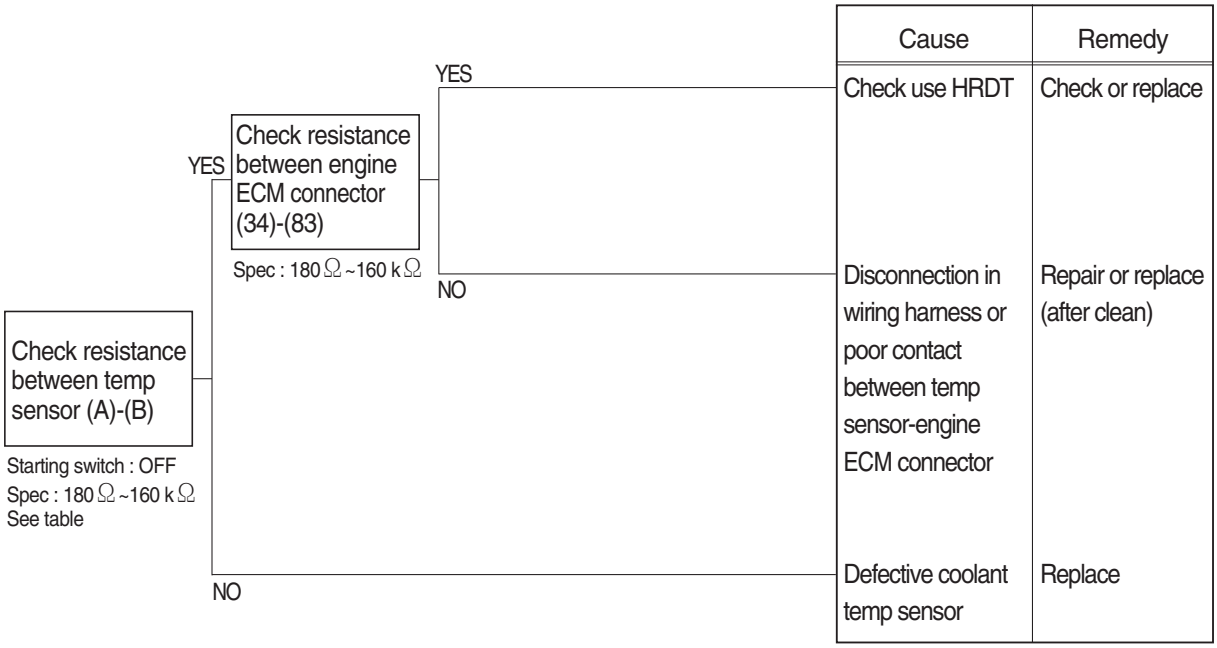
YES	20~32V
NO	0V



220F6ES103

4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

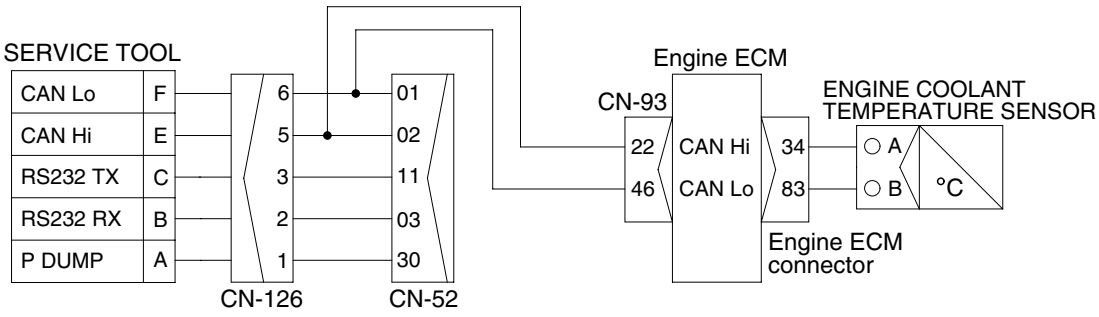
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

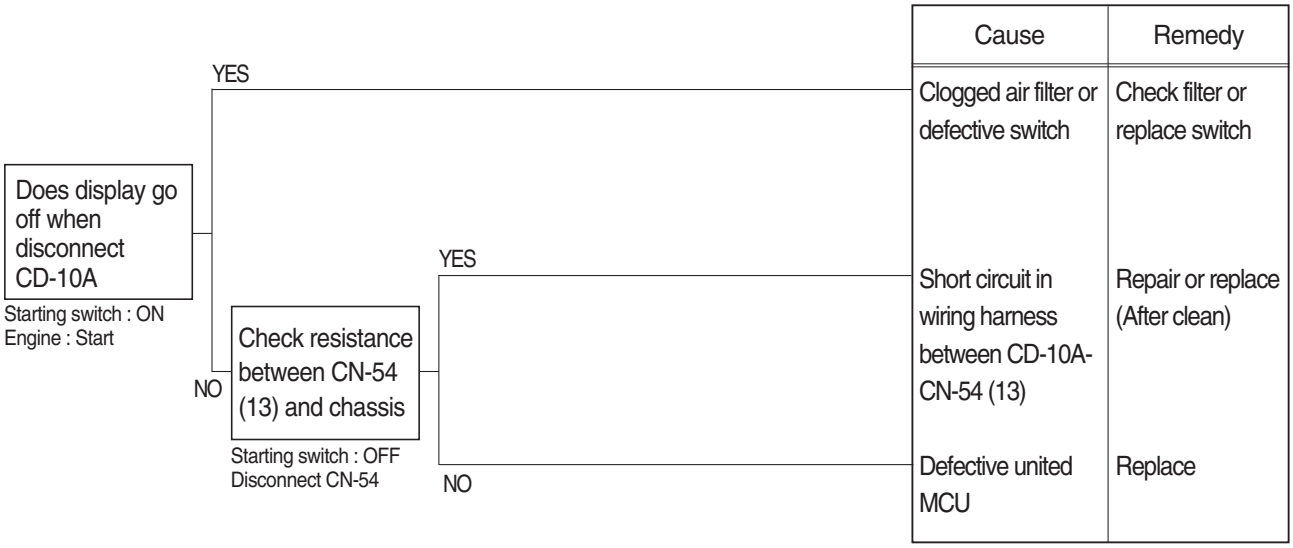
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



300L6ES104

5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

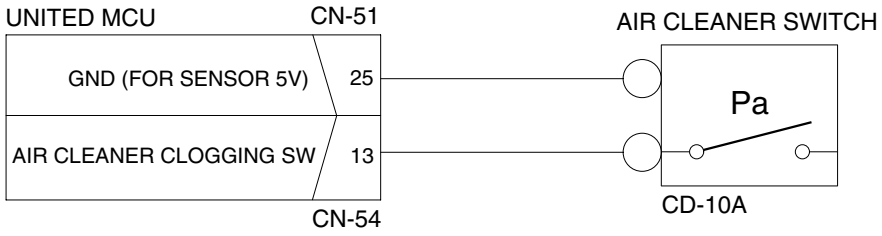
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Clogged air filter or defective switch	Check filter or replace switch
Short circuit in wiring harness between CD-10A-CN-54 (13)	Repair or replace (After clean)
Defective united MCU	Replace

Check resistance

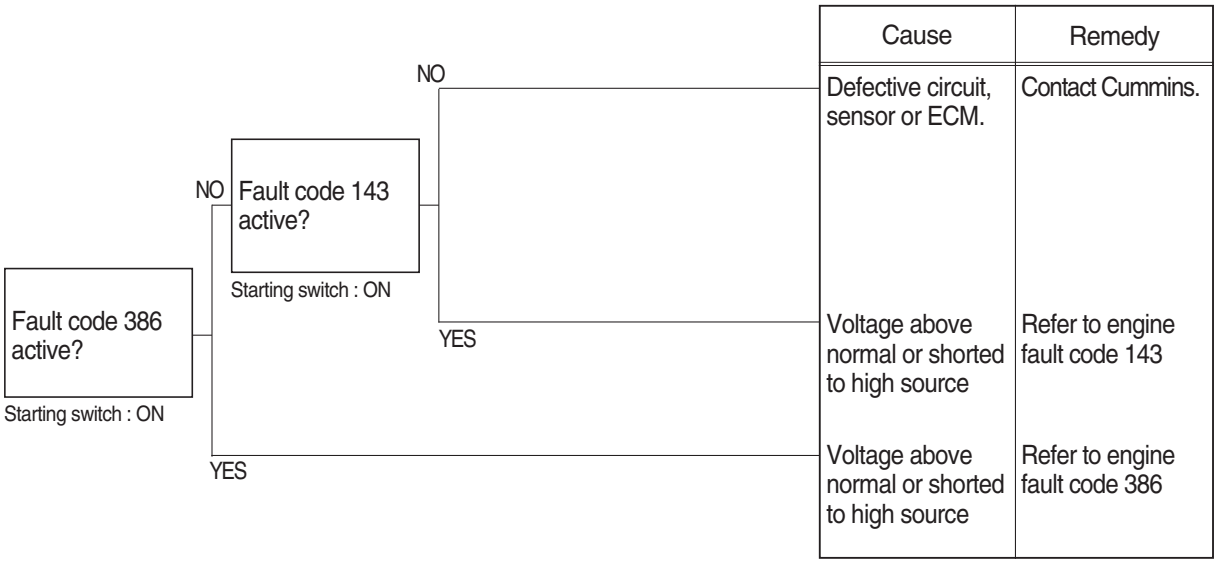
YES	MAX 1Ω
NO	MIN 1MΩ

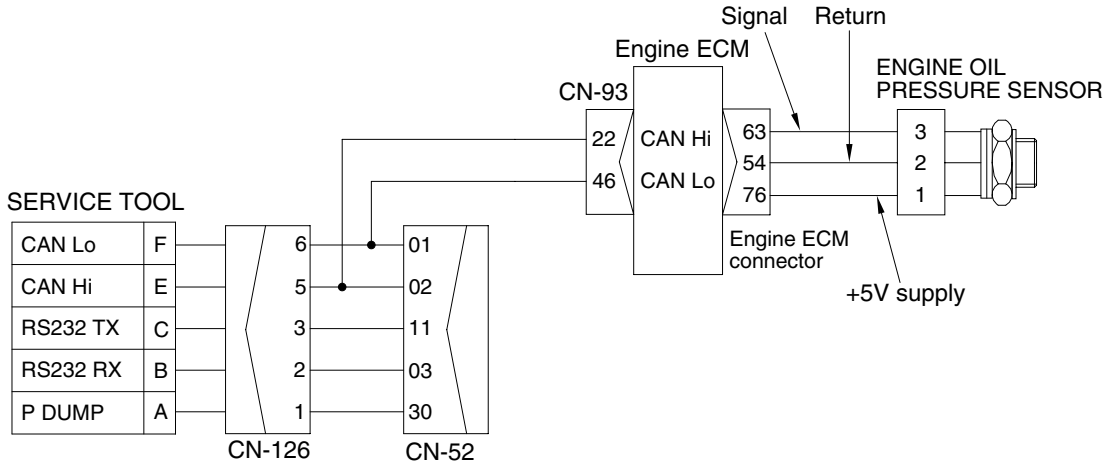


140L6ES106

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.

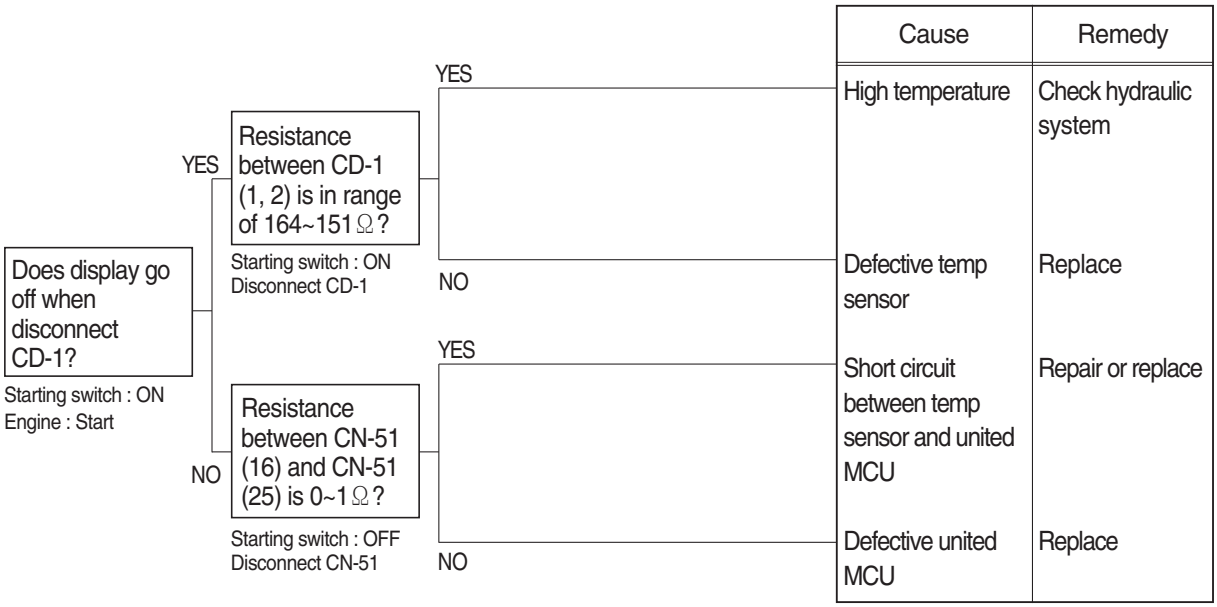


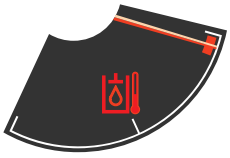


220A6ES107

7. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP (engine is started)

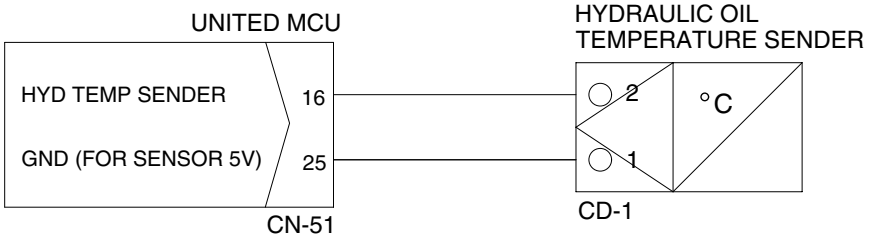
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

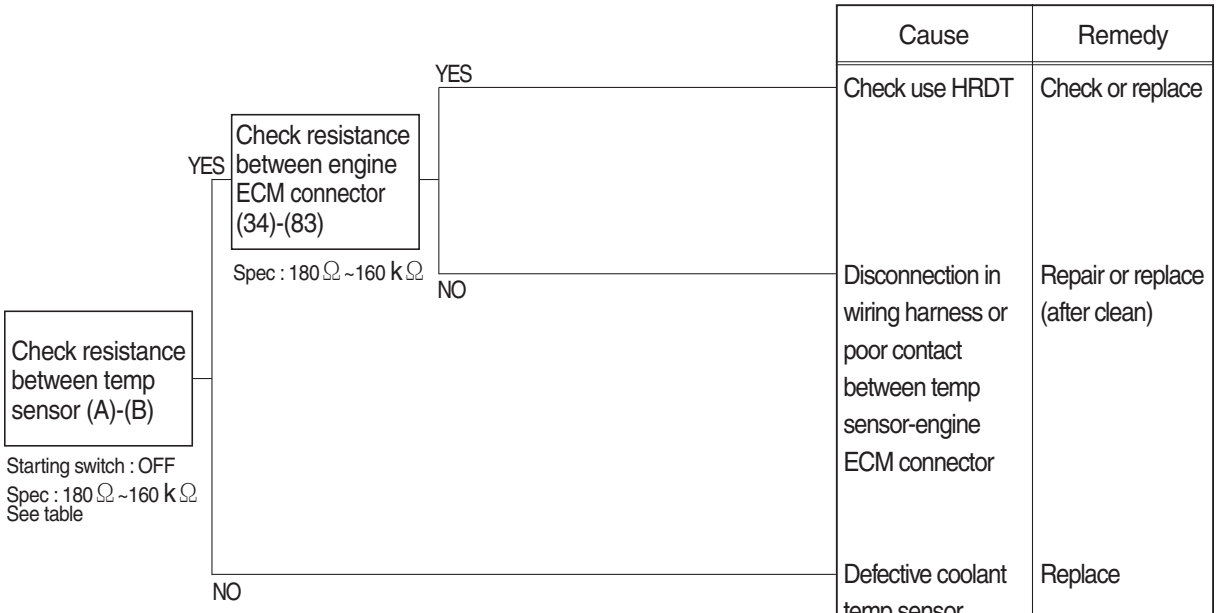
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 ~0.151



140L6ES108

8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

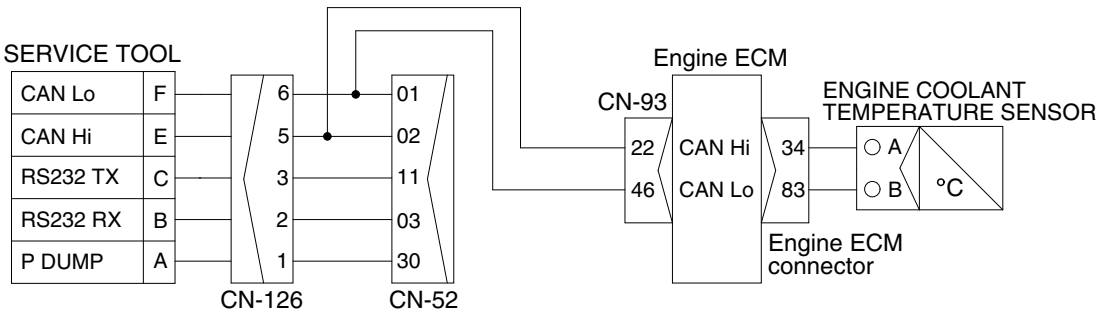
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

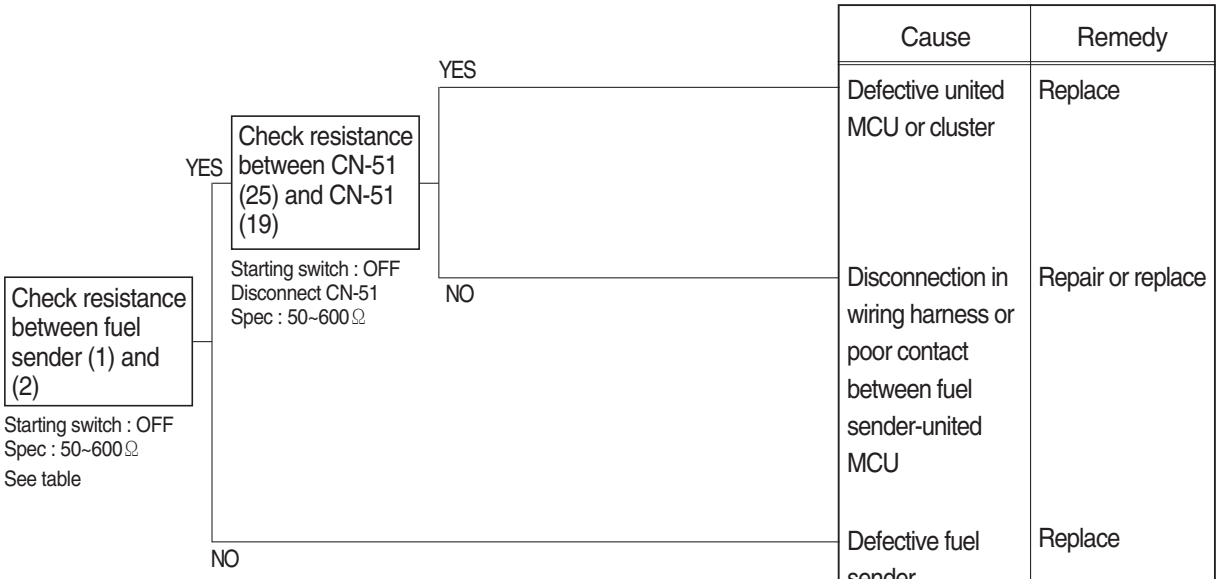
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8

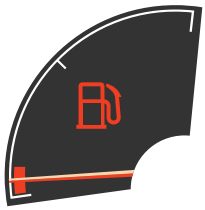


220A6ES104

9. WHEN FUEL GAUGE DOES NOT OPERATE (HCESPN 301, FMI 3 or 4)

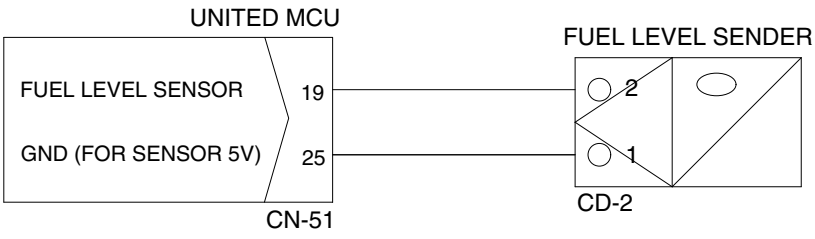
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

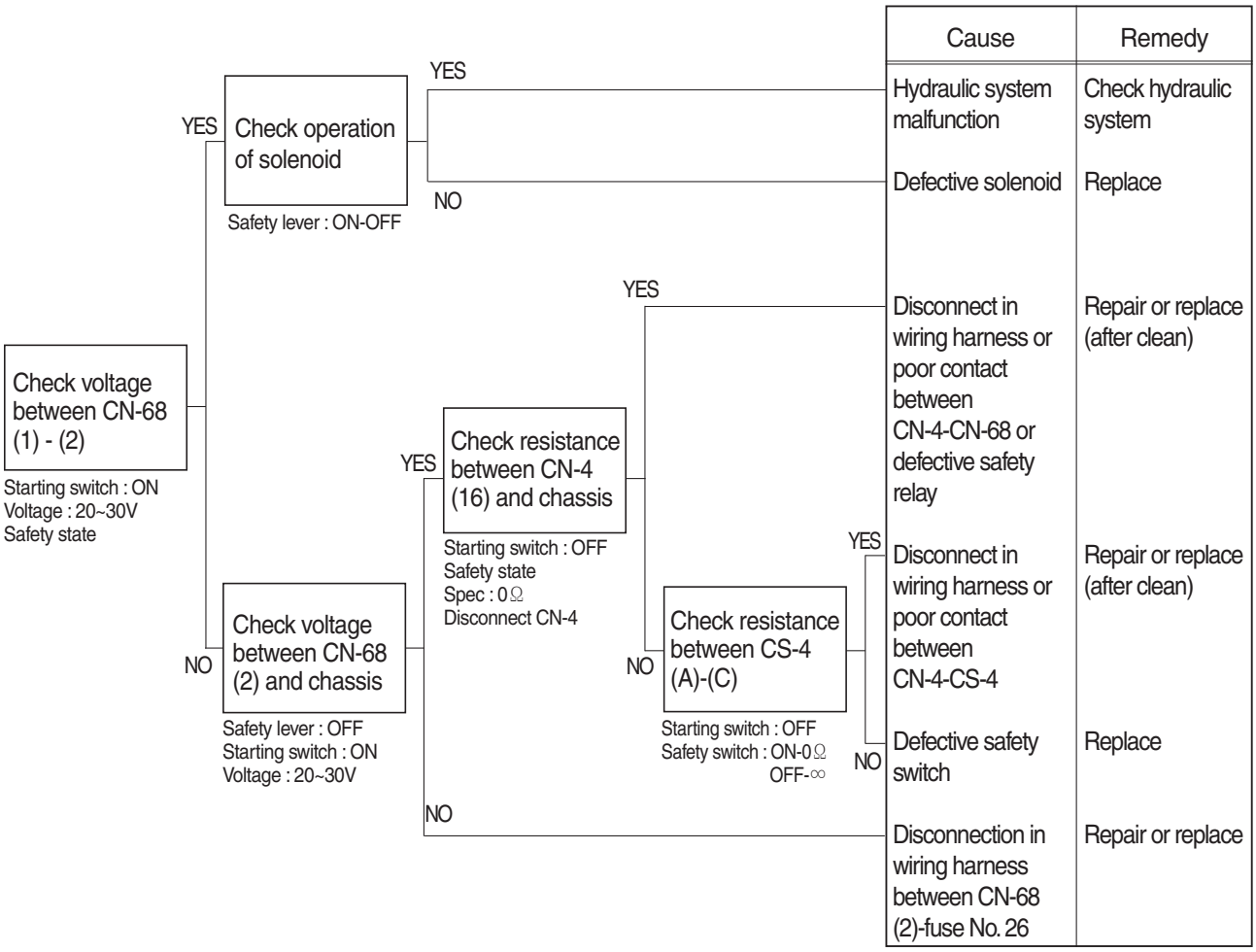
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

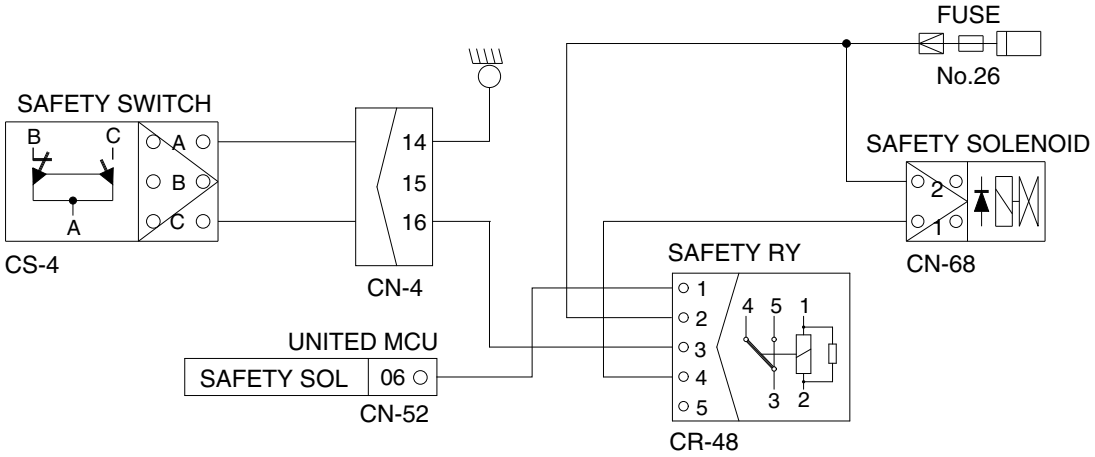


140L6ES110

10. WHEN SAFETY SOLENOID DOES NOT OPERATE (CURRENT VERSION)

· 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. 26.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.
· Auto safety lock function execution condition : When the RCV pilot pressure increases above certain pressure within the standard time after changing the safety knob LOCK → UNLOCK
· Under the above conditions, the electric current is turned off to the safety solenoid, and the function of RCV and pedal is disabled.

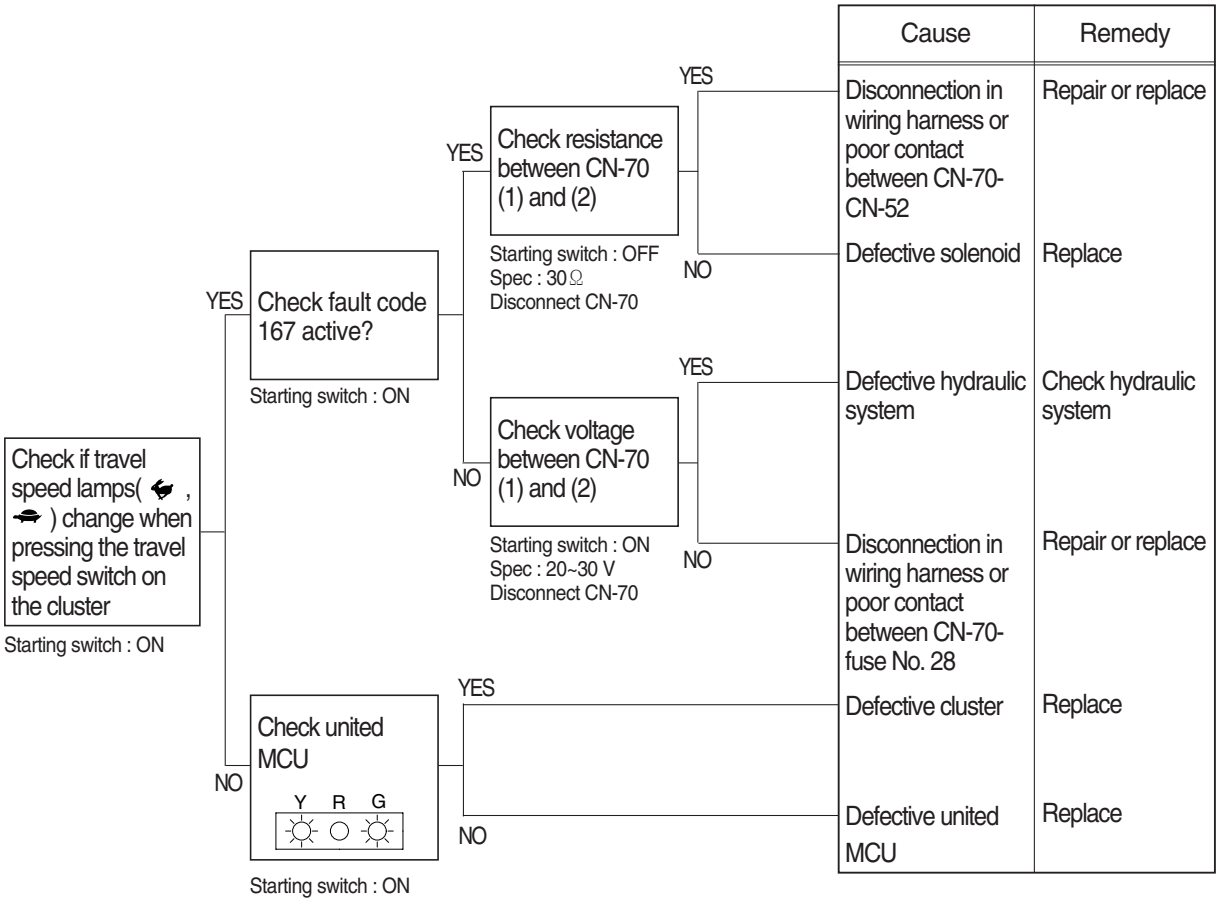


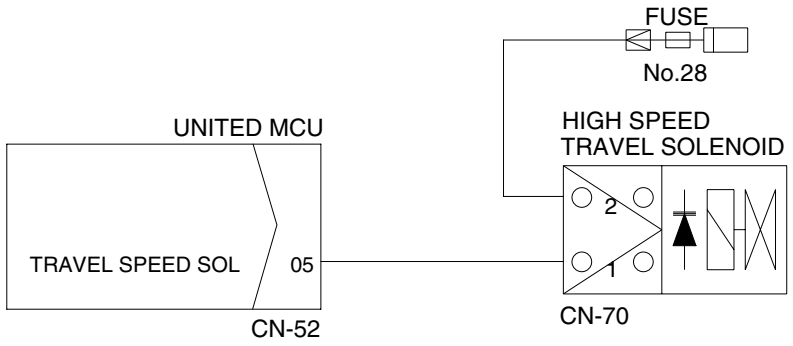


220A6ES109

11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 4 or 6)

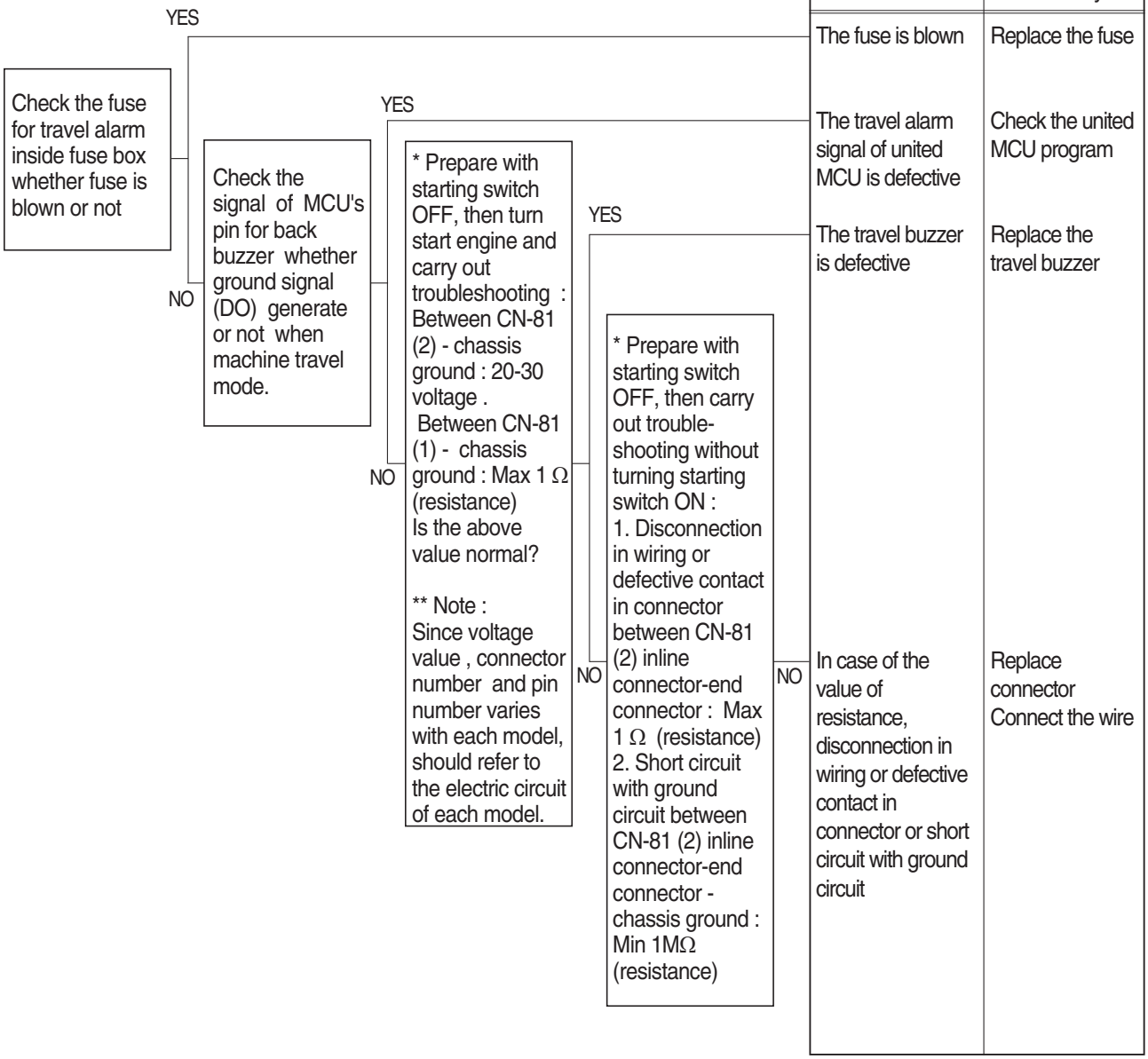
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 28.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



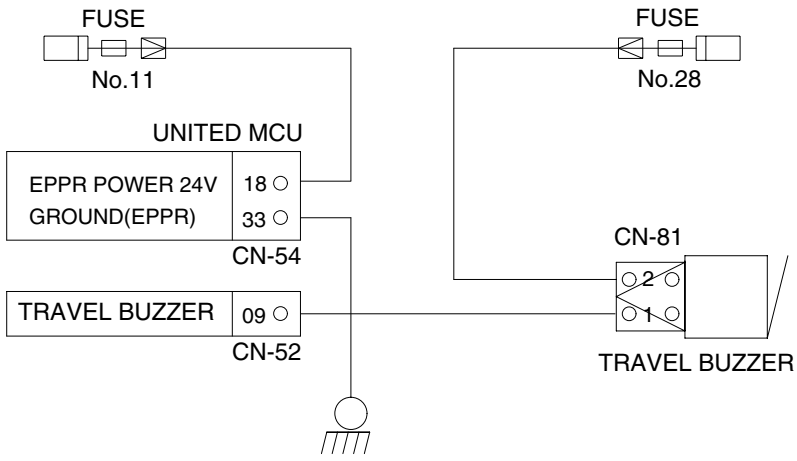


140L6ES107

12. TRAVEL ALARM DOES NOT SOUND OR DOES NOT STOP SOUNDING

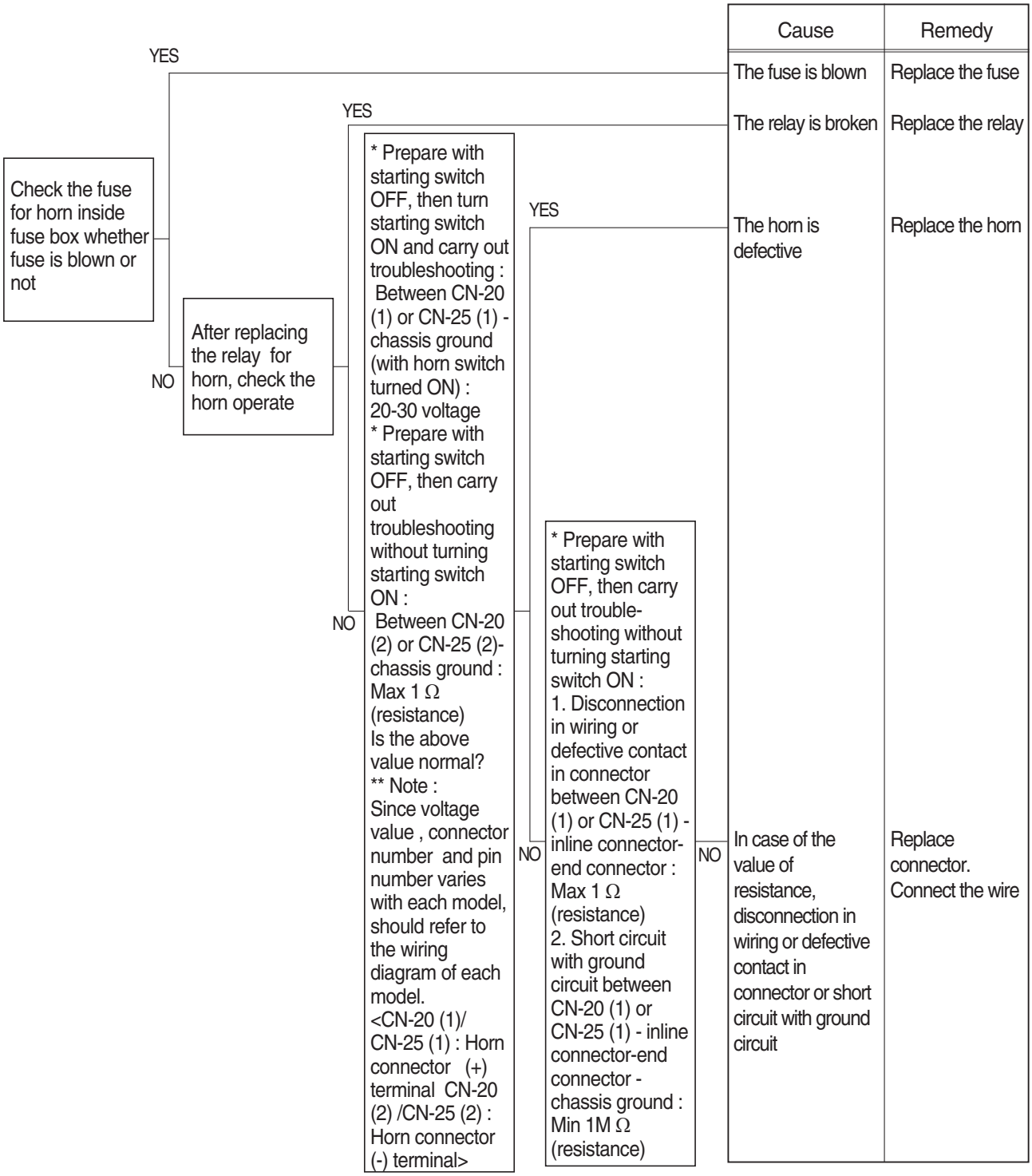


Cause	Remedy
The fuse is blown	Replace the fuse
The travel alarm signal of united MCU is defective	Check the united MCU program
The travel buzzer is defective	Replace the travel buzzer
In case of the value of resistance, disconnection in wiring or defective contact in connector or short circuit with ground circuit	Replace connector Connect the wire



220A6ES150

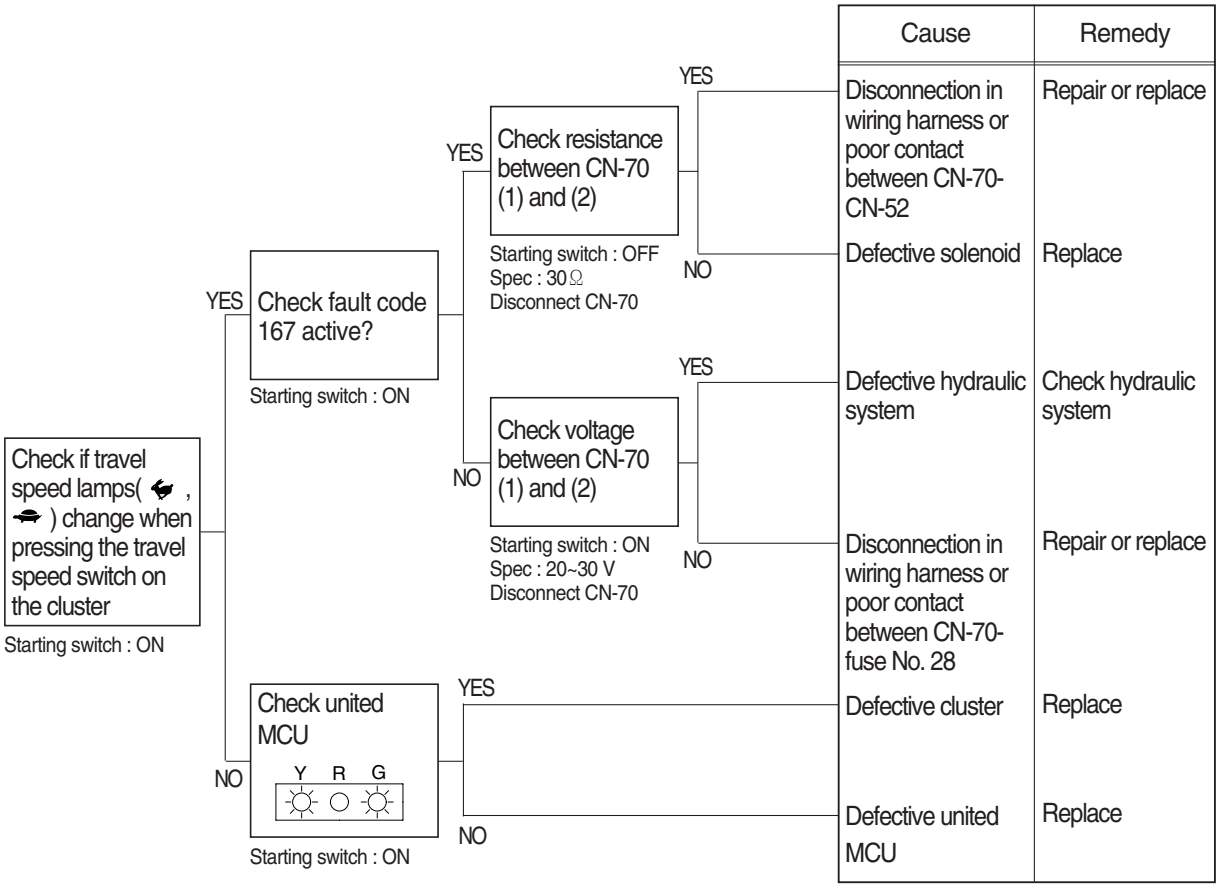
13. HORN DOES NOT SOUND

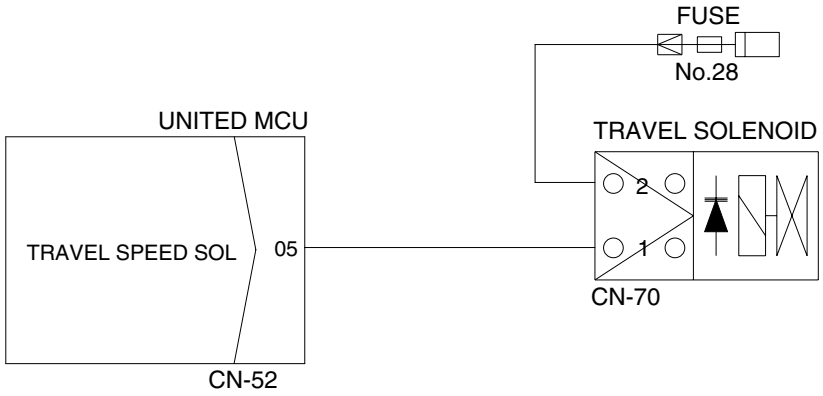


220A6ES151

14. 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. 28.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

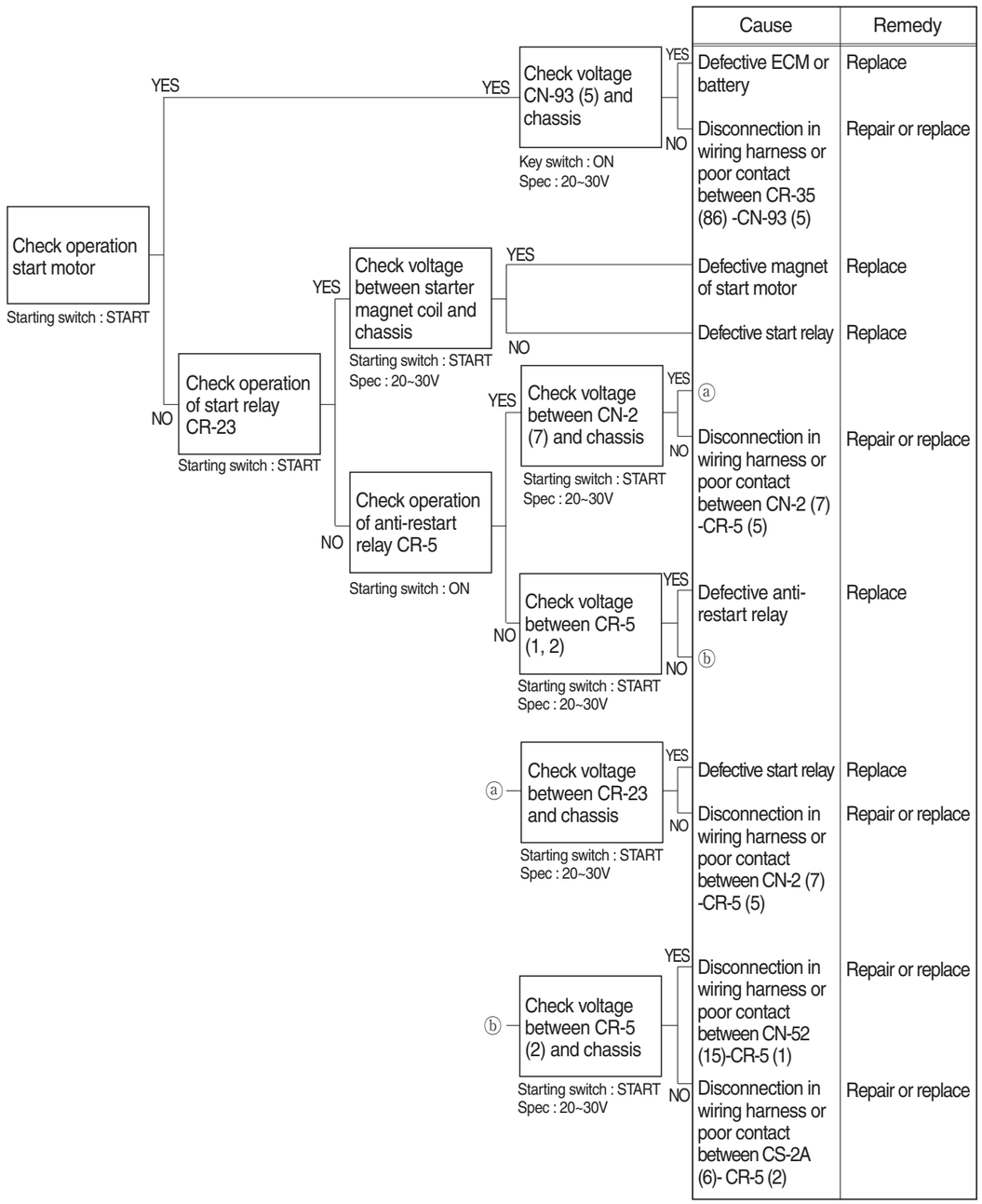




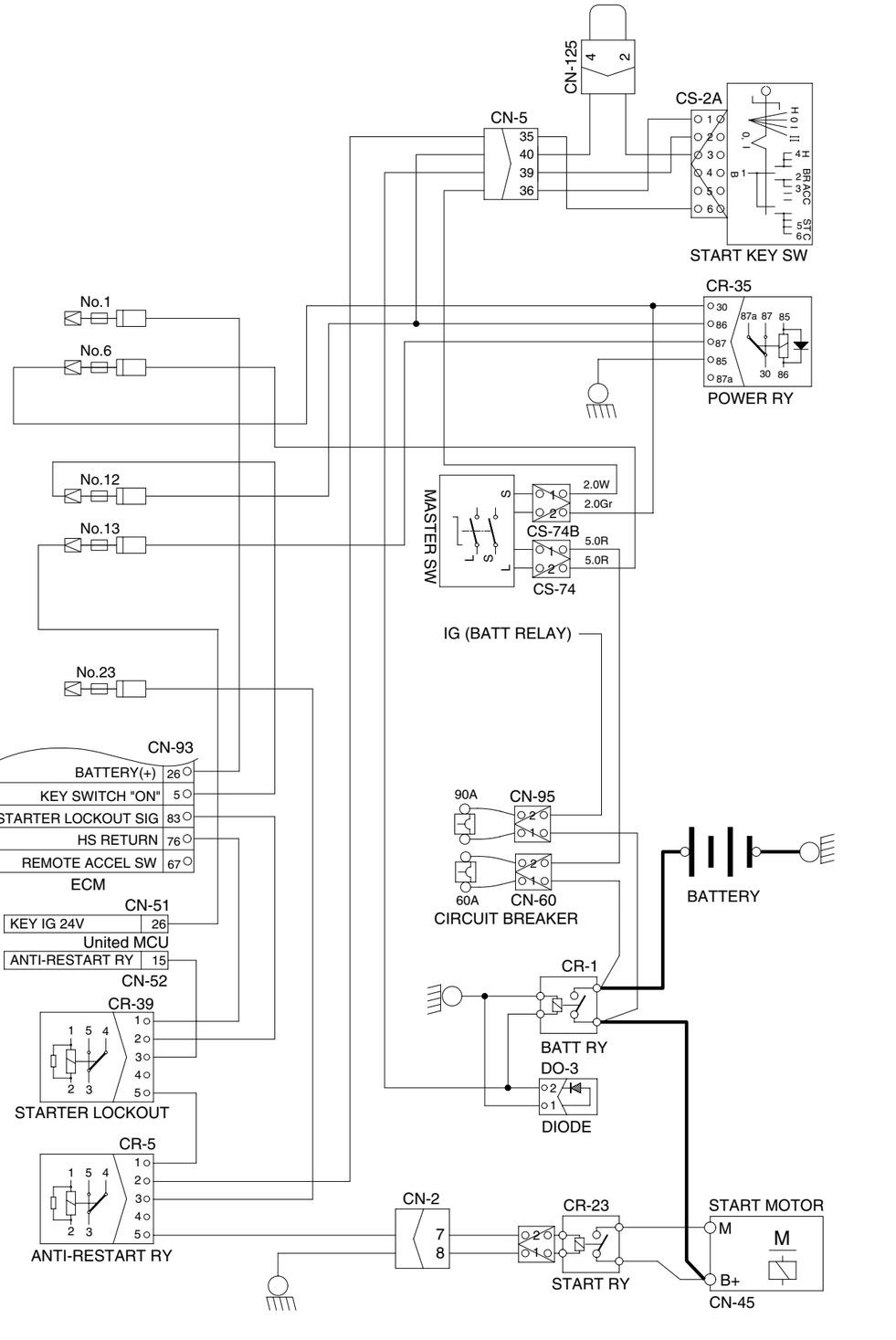
220A6ES03

15. WHEN ENGINE DOES NOT START ([- +] lights up condition)

- 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. 1, 6, 12, 13, 23.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



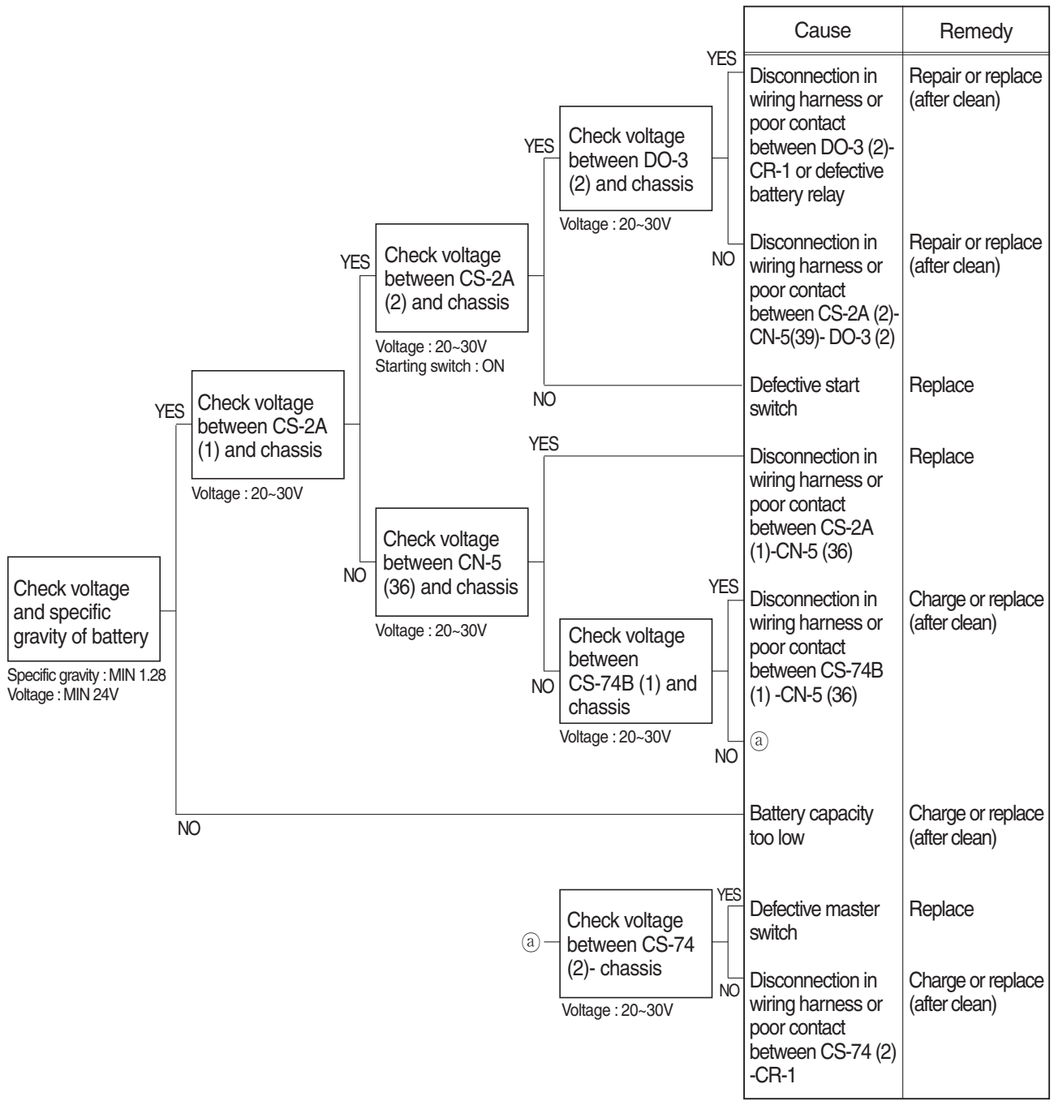
Cause	Remedy
Defective ECM or battery	Replace
Disconnection in wiring harness or poor contact between CR-35 (86) -CN-93 (5)	Repair or replace
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ	
Disconnection in wiring harness or poor contact between CN-2 (7) -CR-5 (5)	Repair or replace
Defective anti-restart relay	Replace
ⓑ	
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CN-2 (7) -CR-5 (5)	Repair or replace
Disconnection in wiring harness or poor contact between CN-52 (15)-CR-5 (1)	Repair or replace
Disconnection in wiring harness or poor contact between CS-2A (6)- CR-5 (2)	Repair or replace



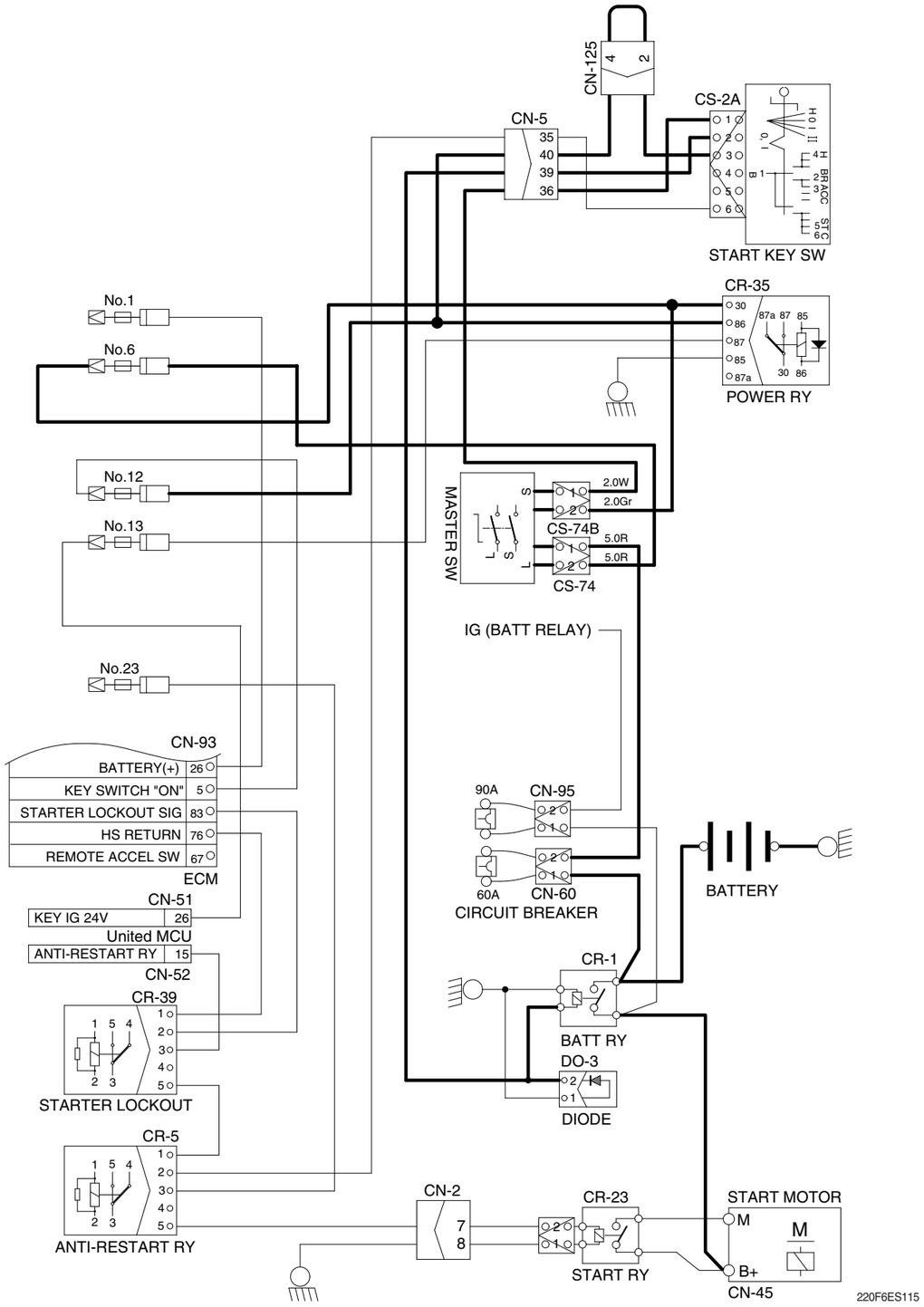
220F6ES114

16. 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 open circuit of circuit breaker (CN-60).
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

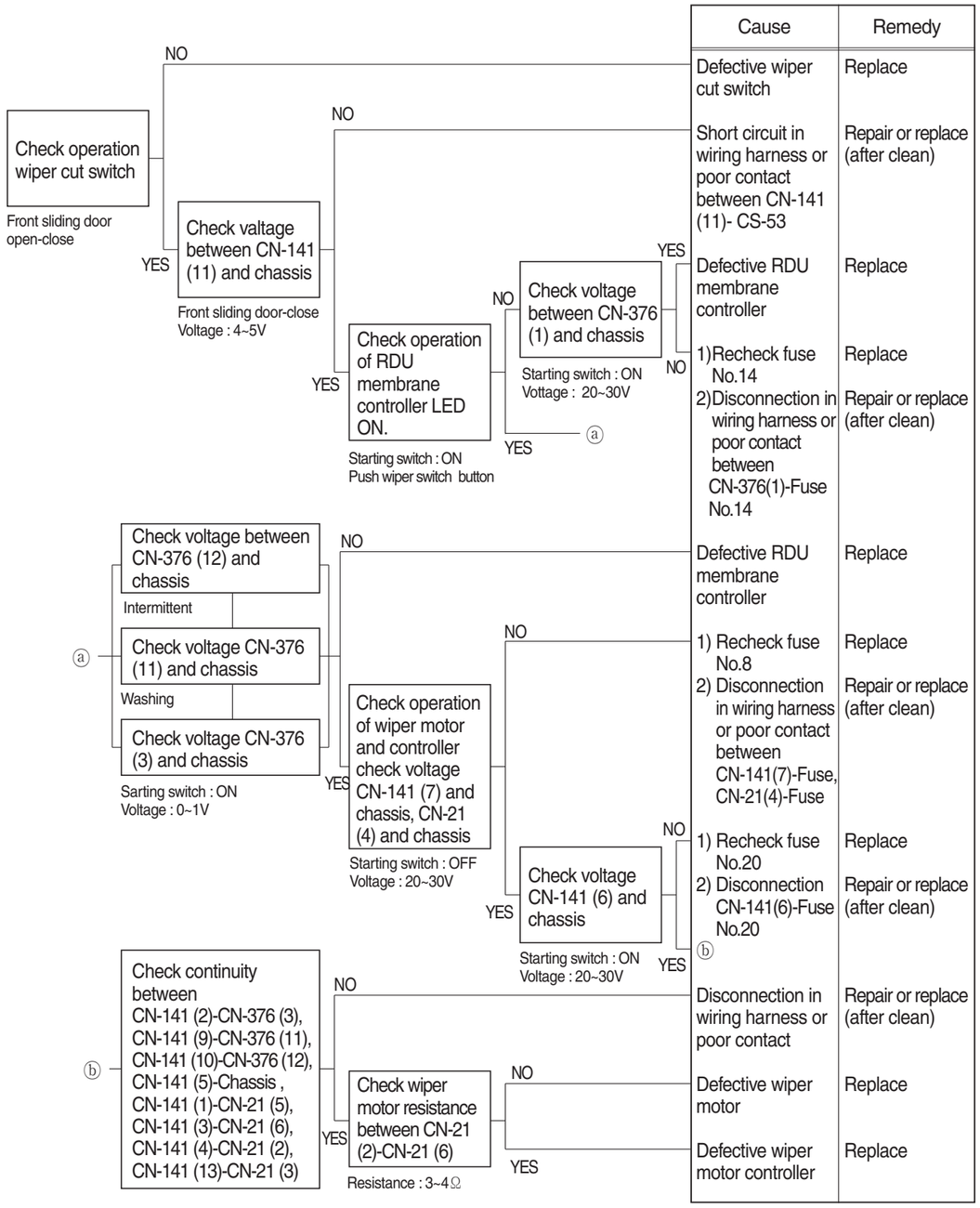


Cause	Remedy
Disconnection in wiring harness or poor contact between DO-3 (2)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2A (2)-CN-5(39)- DO-3 (2)	Repair or replace (after clean)
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2A (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74B (1) -CN-5 (36)	Charge or replace (after clean)
Battery capacity too low	Charge or replace (after clean)
Defective master switch	Replace
Disconnection in wiring harness or poor contact between CS-74 (2) -CR-1	Charge or replace (after clean)

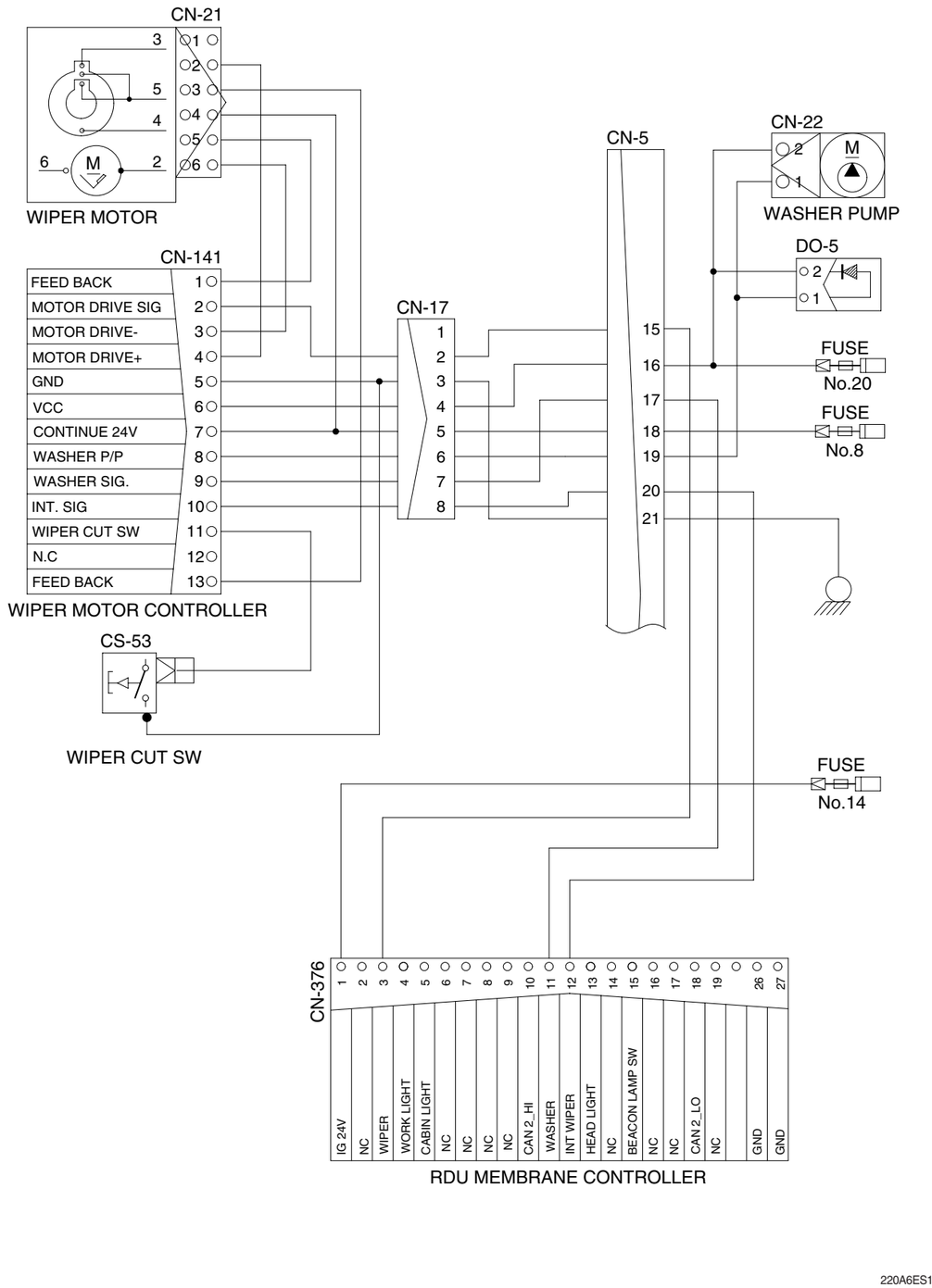


17. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No. 8, 14 and 20 is not blown out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



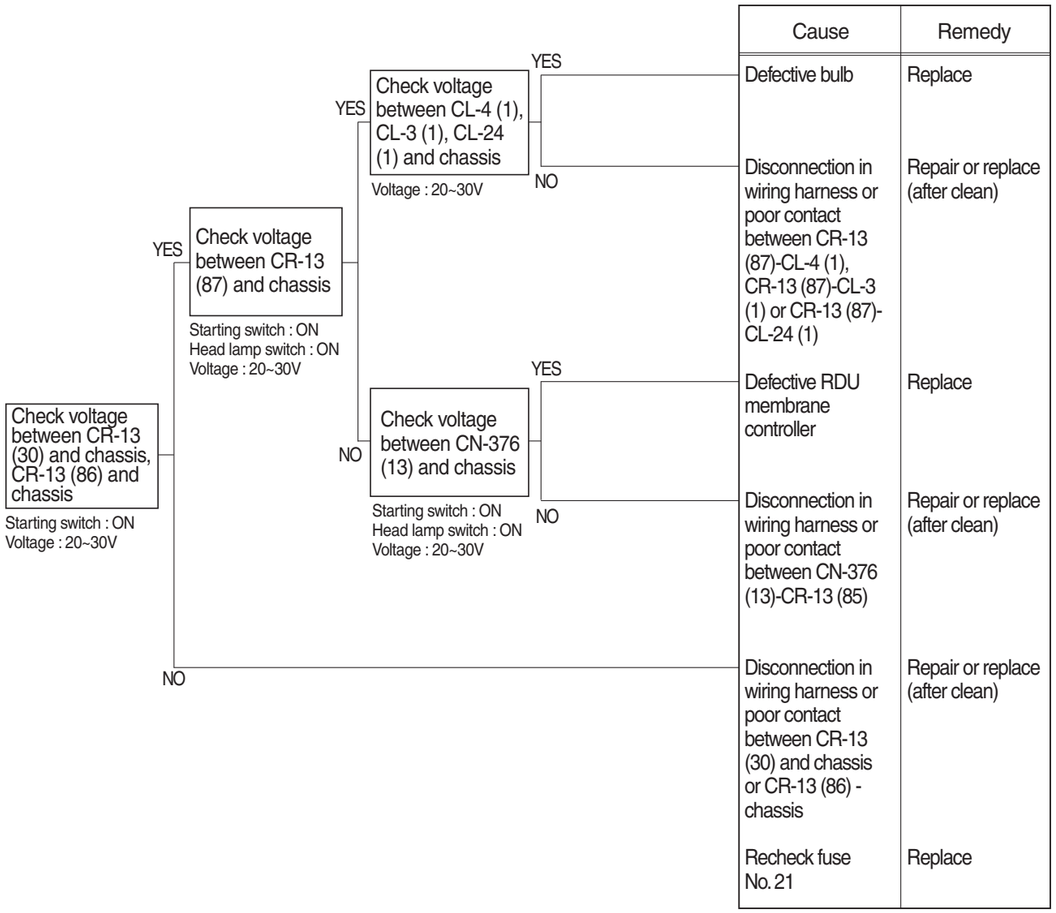
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective RDU membrane controller	Replace
1)Recheck fuse No.14	Replace
2)Disconnection in wiring harness or poor contact between CN-376(1)-Fuse No.14	Repair or replace (after clean)
Defective RDU membrane controller	Replace
1) Recheck fuse No.8	Replace
2) Disconnection in wiring harness or poor contact between CN-141(7)-Fuse, CN-21(4)-Fuse	Repair or replace (after clean)
1) Recheck fuse No.20	Replace
2) Disconnection CN-141(6)-Fuse No.20	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



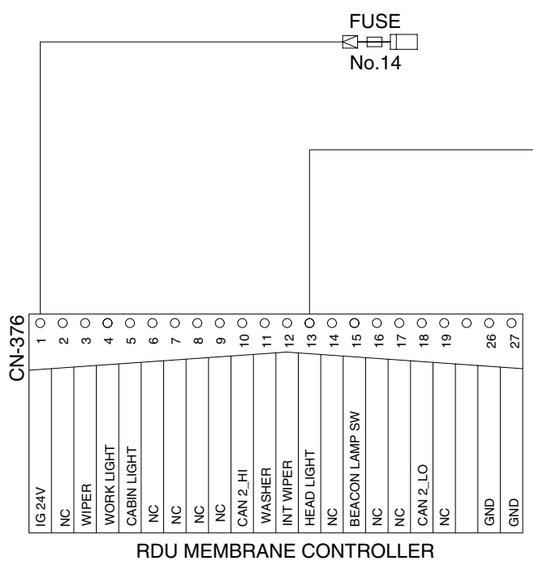
220A6ES116

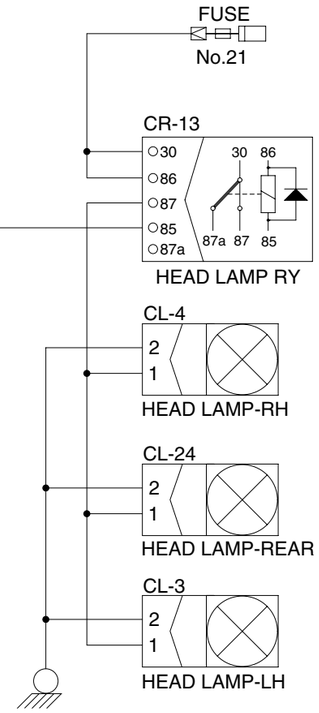
18. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

- 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.14 & 21.
- 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), CR-13 (87)-CL-3 (1) or CR-13 (87)-CL-24 (1)	Repair or replace (after clean)
Defective RDU membrane 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 chassis or CR-13 (86) - chassis	Repair or replace (after clean)
Recheck fuse No. 21	Replace

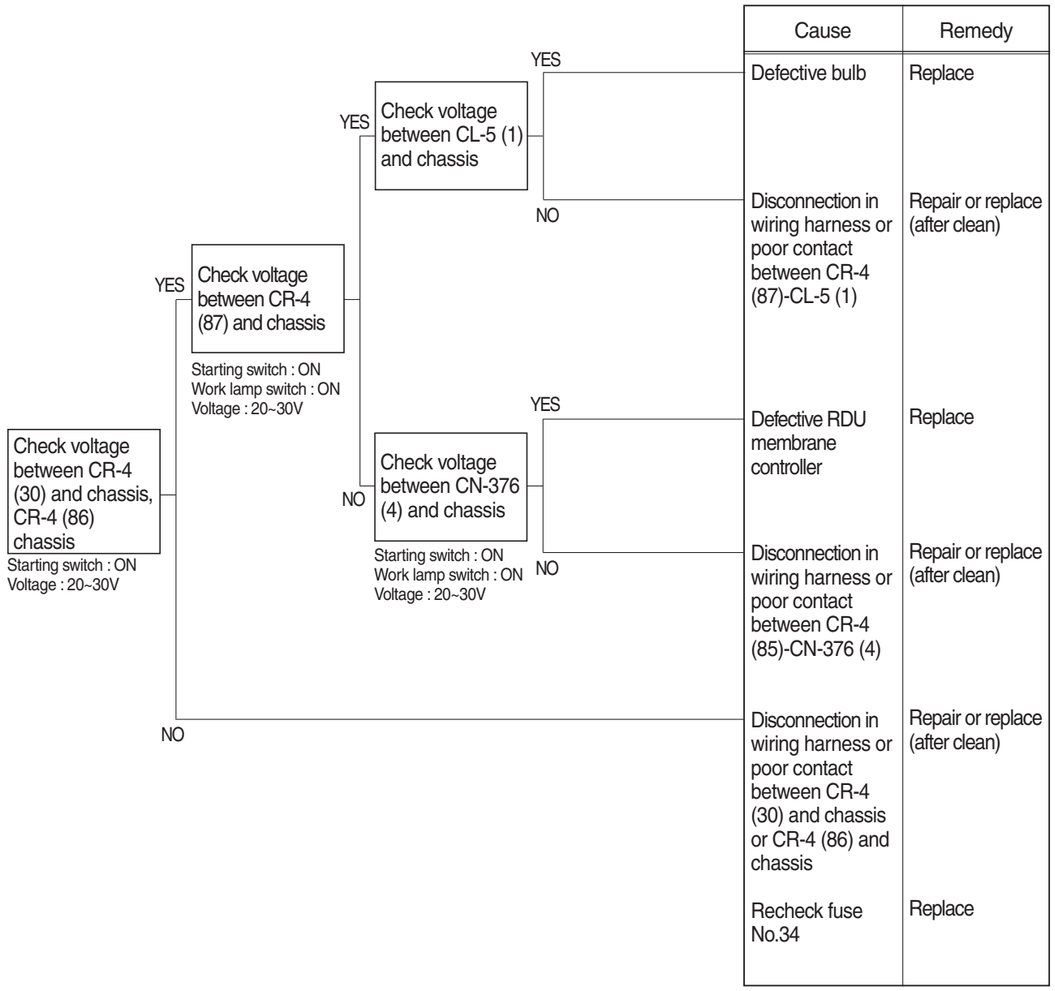




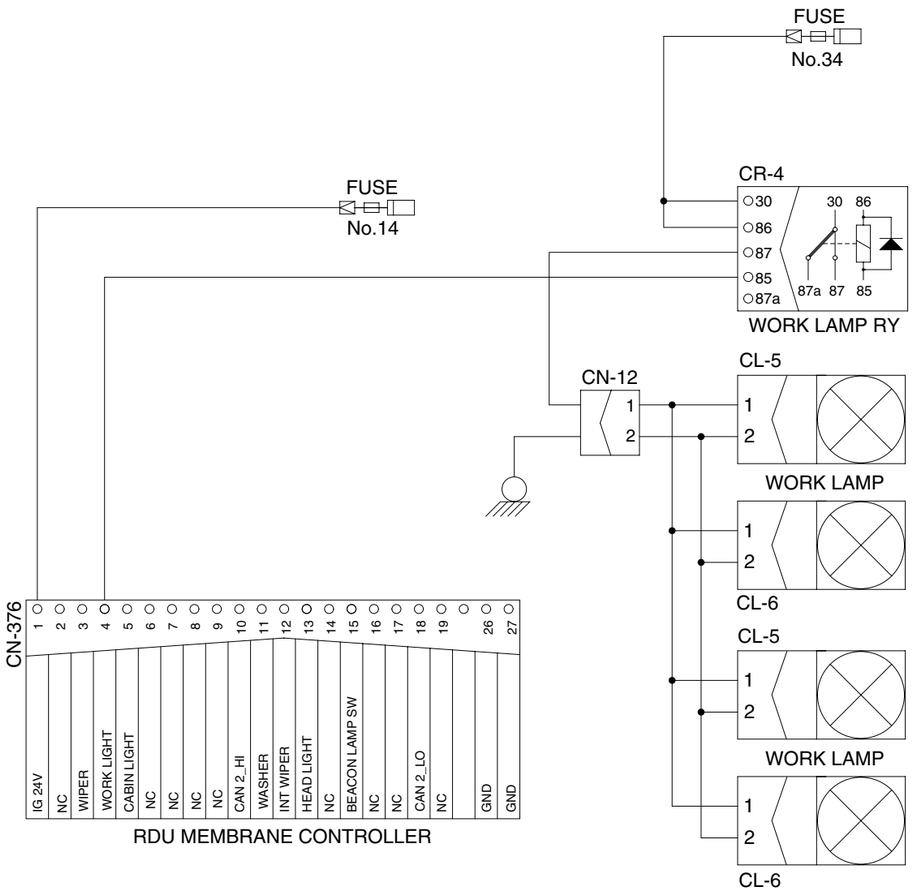
220A6ES117

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

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.14 & 34.
· 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 (1)	Repair or replace (after clean)
Defective RDU membrane 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 chassis or CR-4 (86) and chassis	Repair or replace (after clean)
Recheck fuse No.34	Replace

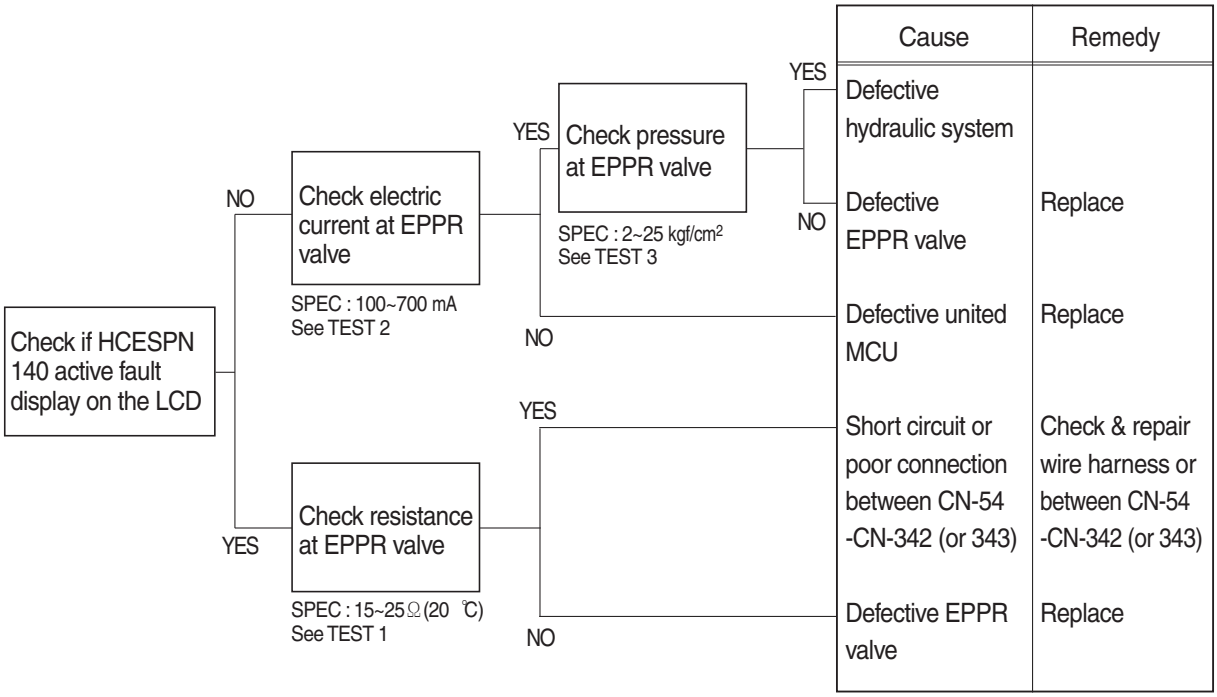


220A6ES118

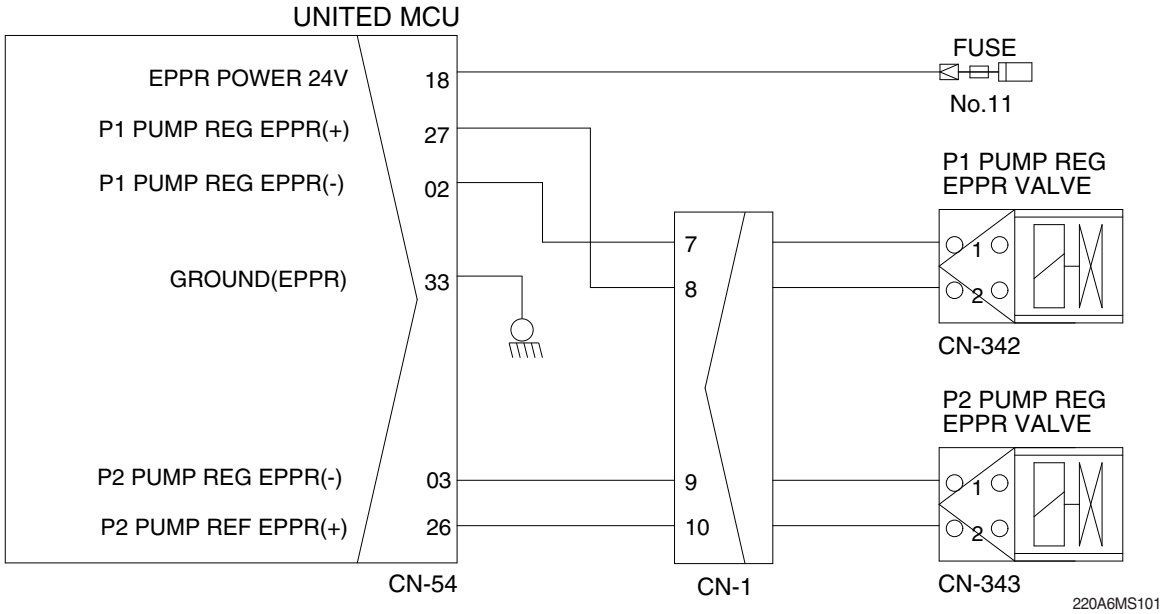
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : P-mode 1700 ± 50 rpm S -mode 1600 ± 50 rpm E-mode 1600 ± 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



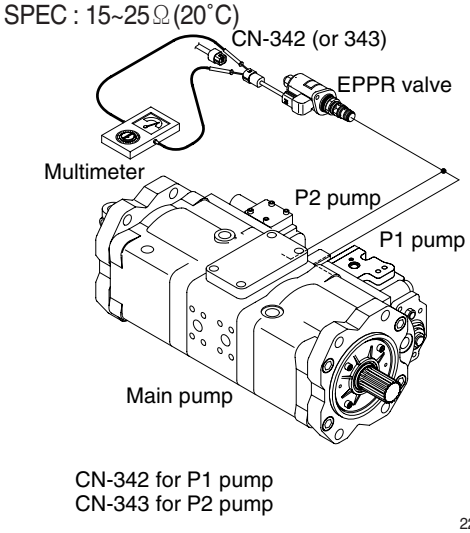
2) TEST PROCEDURE

(1) Test 1 : Check resistance at connector CN-342 (or 343).

① Starting switch OFF.

② Disconnect connector CN-342 (or 343) 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-342 (or 343) from EPPR valve.

② Insert the adapter to CN-342 (or 343) and install multimeter as figure.

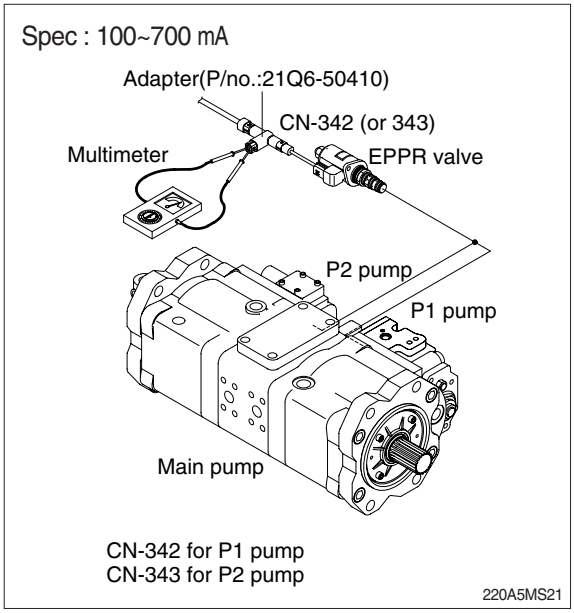
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal 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 Remove plug and connect pressure gauge as figure.

· Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)

② Start engine.

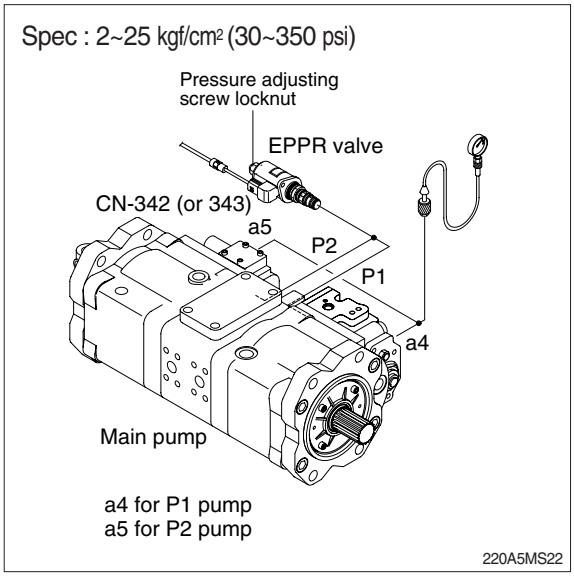
③ Set S-mode and cancel auto decel mode.

④ Position the multimodal dial at 10.

⑤ If tachometer show approx 1600±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

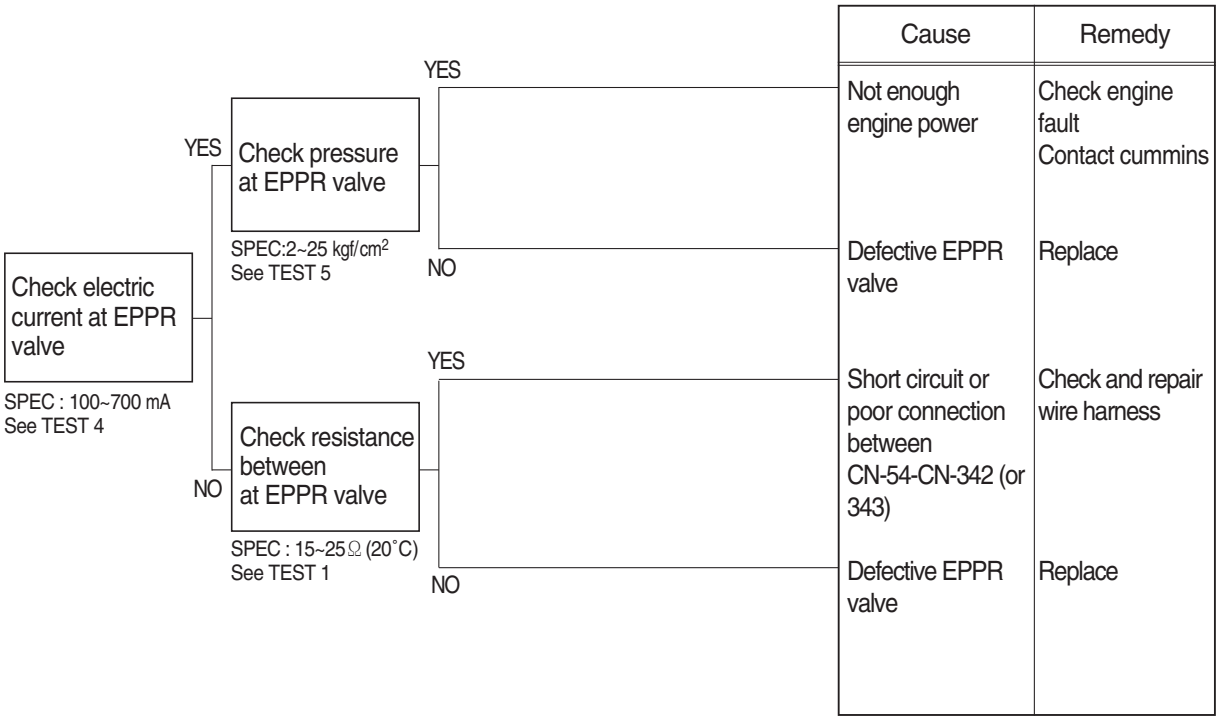
⑦ After adjust, test the machine.



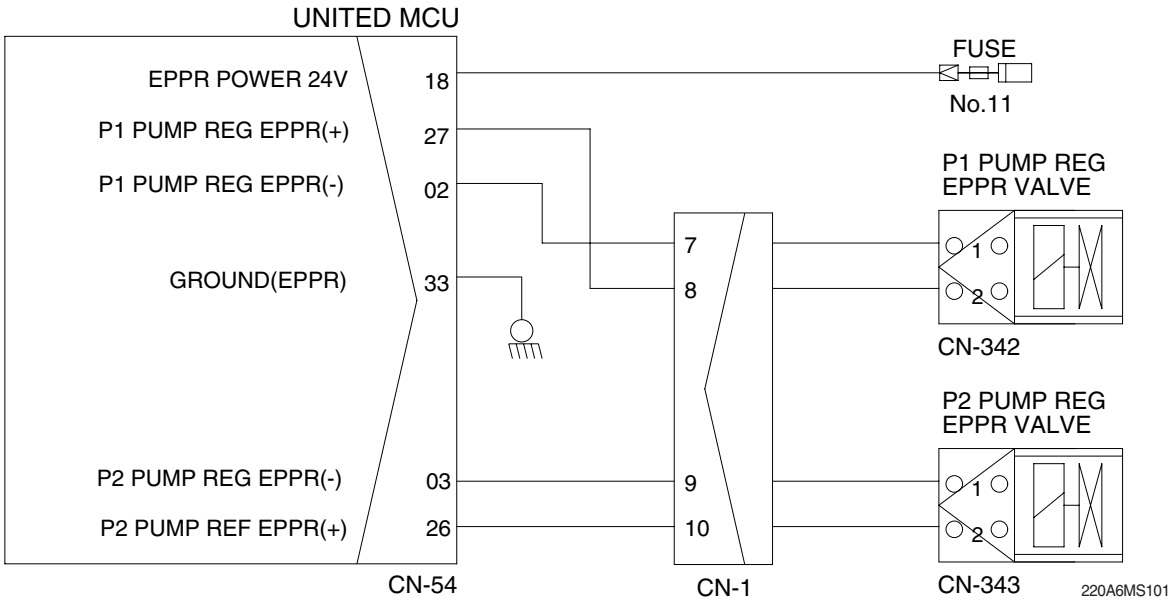
2. ENGINE STALL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



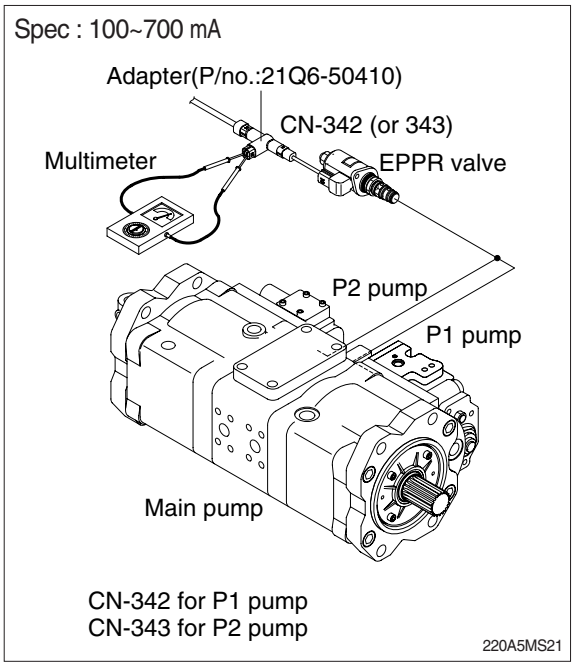
Wiring diagram



2) TEST PROCEDURE

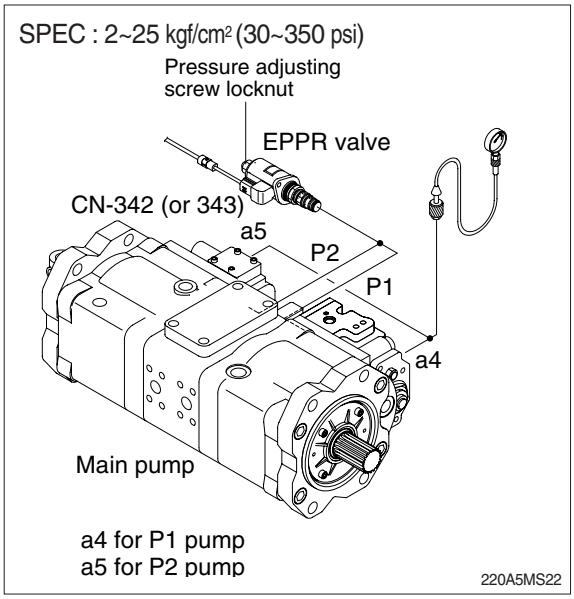
(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-342 (or 343) from EPPR valve.
② Insert the adapter to CN-342 (or 343) and install multimeter as figure.
③ Start engine.
④ Set S-mode and cancel auto decel mode.
⑤ Position the multimodal 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.



(2) Test 5 : Check pressure at EPPR valve.

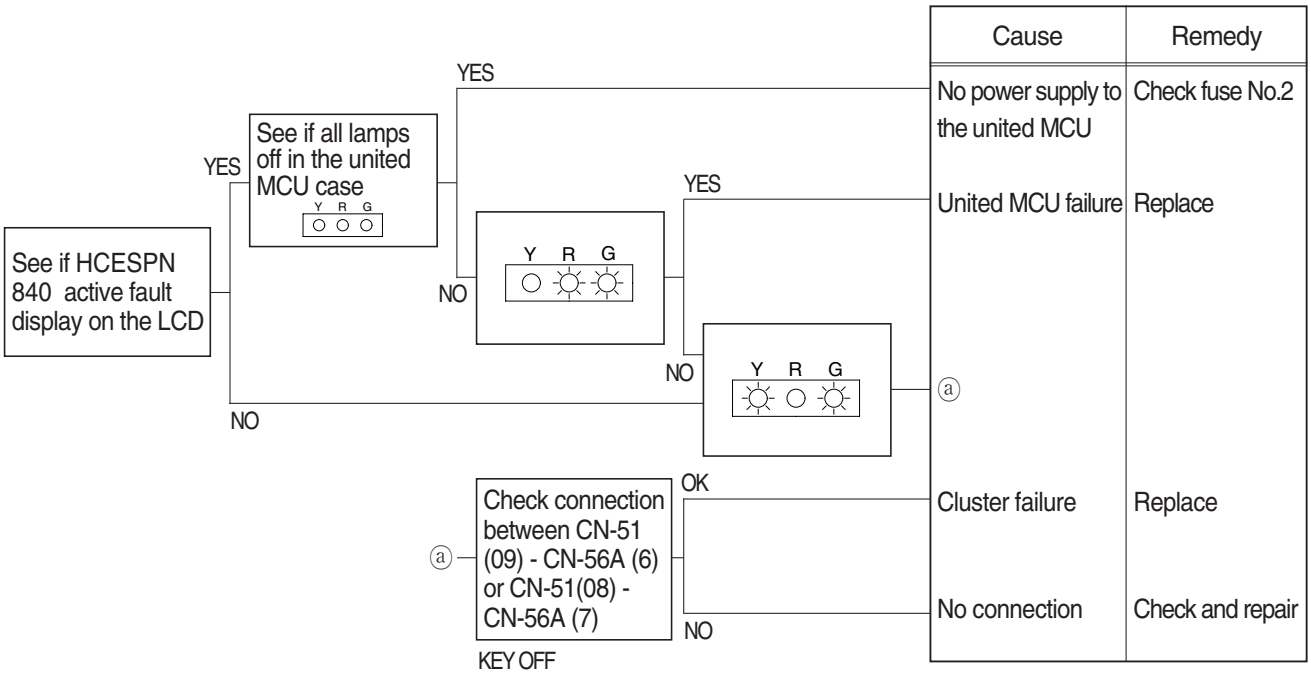
① Remove plug and connect pressure gauge as figure.
· Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the multimodal dial at 10.
⑤ If rpm show approx 1600±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



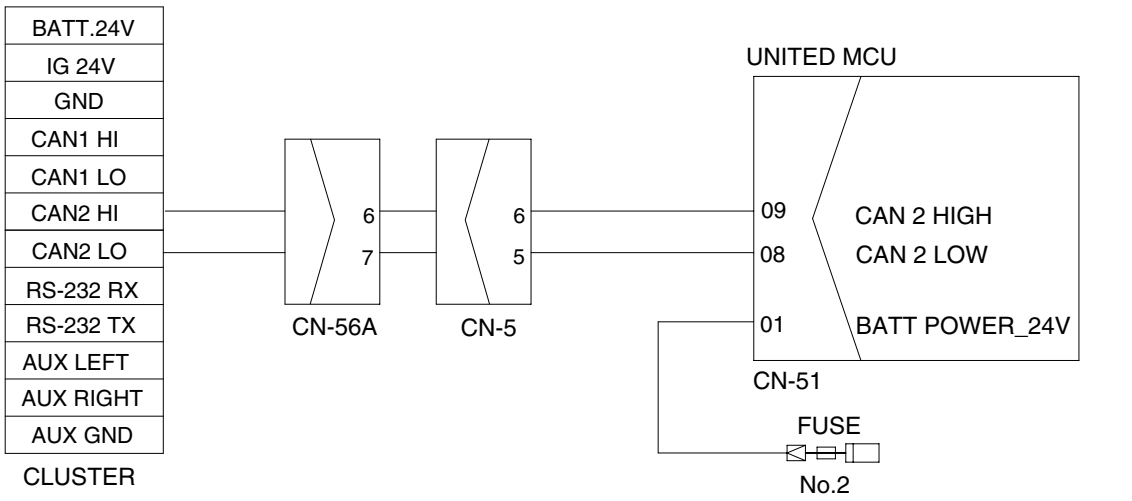
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



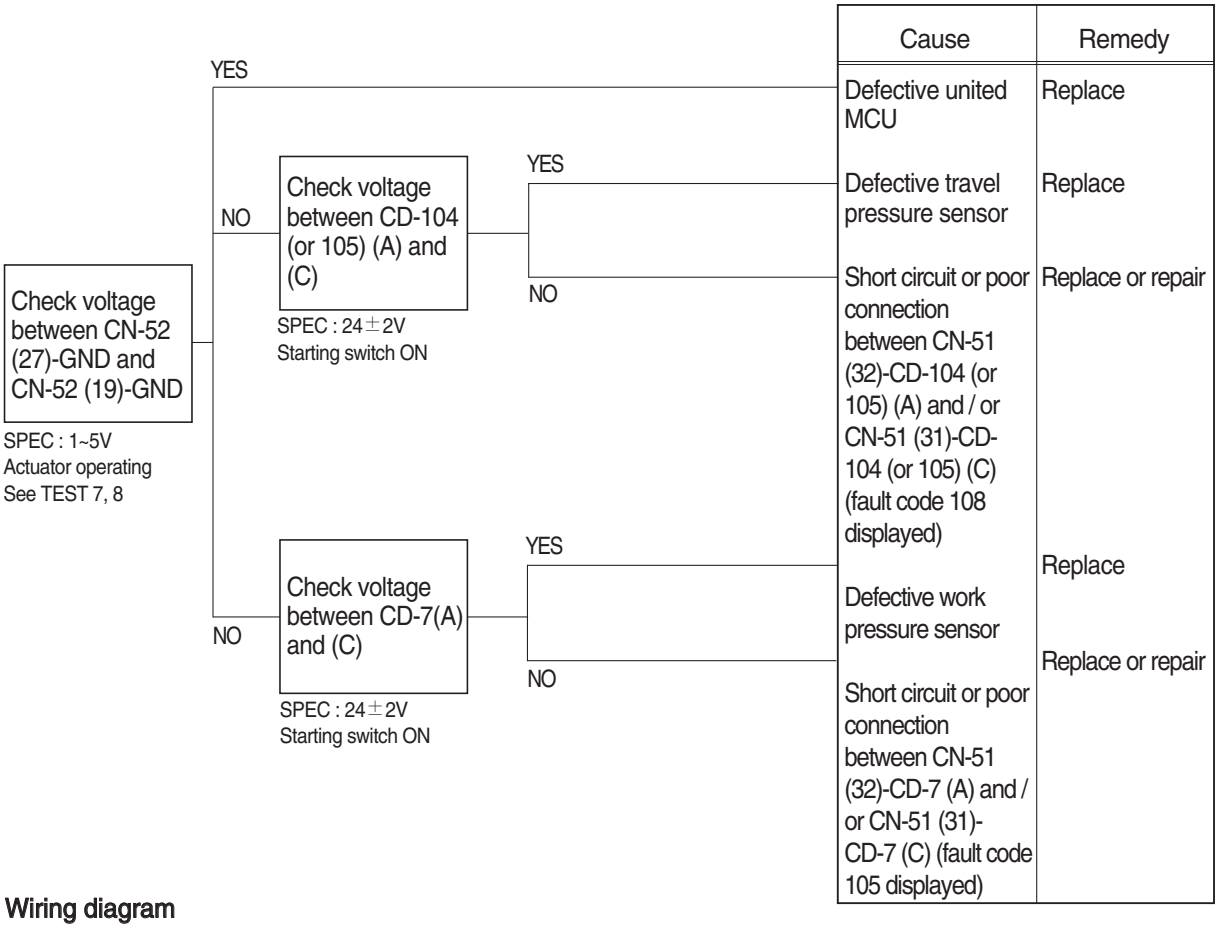
220F6MS102

4. AUTO DECEL SYSTEM DOES NOT WORK (N.A)

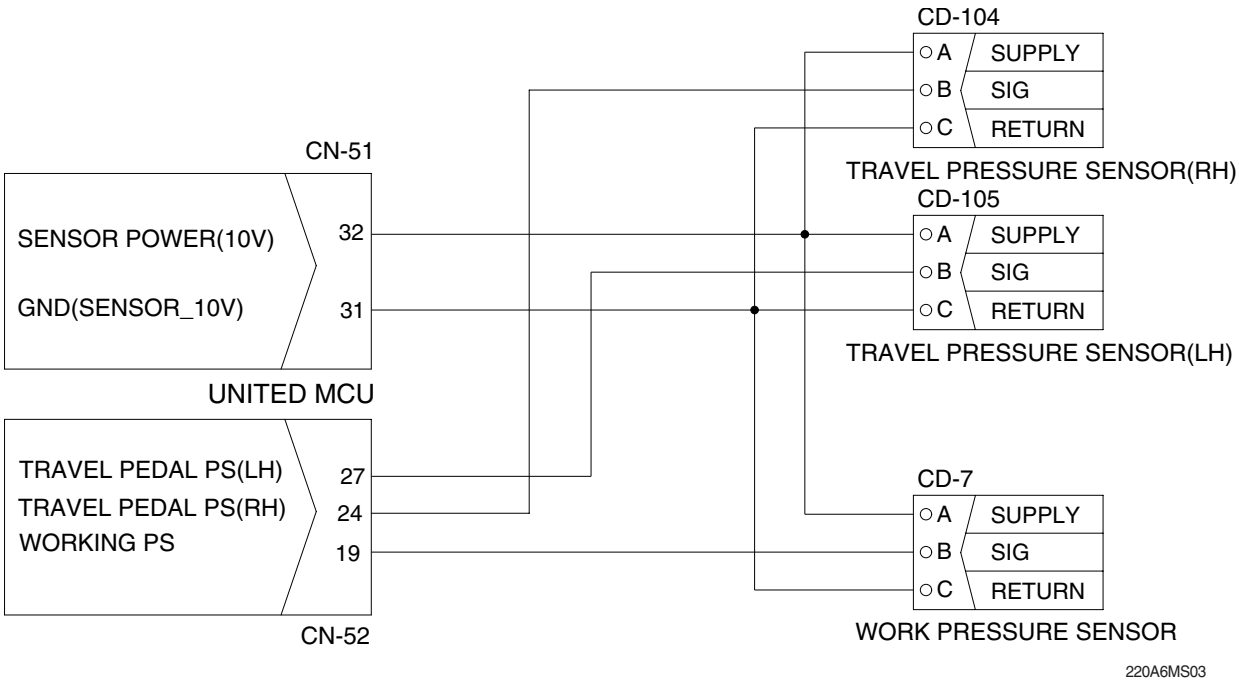
· Fault code : HCESPN 105, FMI 0~4 (work pressure sensor)
HCESPN 108, FMI 0~4 (travel oil pressure sensor)

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS03

2) TEST PROCEDURE (N.A)

(1) Test 7 : Check voltage at CN-52 (24 or 27) 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 (24 or 27) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52 (19) and ground.

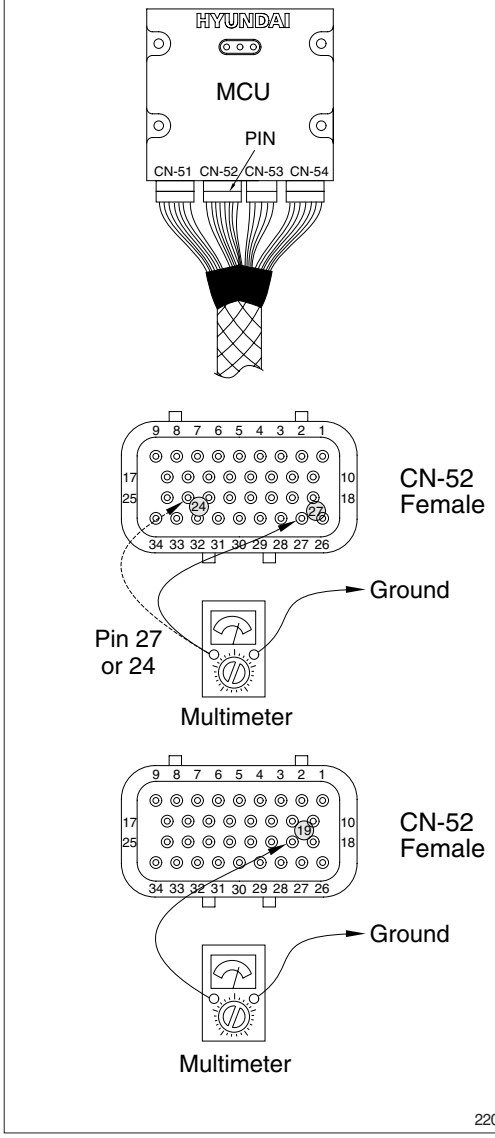
① Prepare 1 piece of thin sharp pin, steel or copper

② Insert prepared pin to rear side of connectors : One pin to (19) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



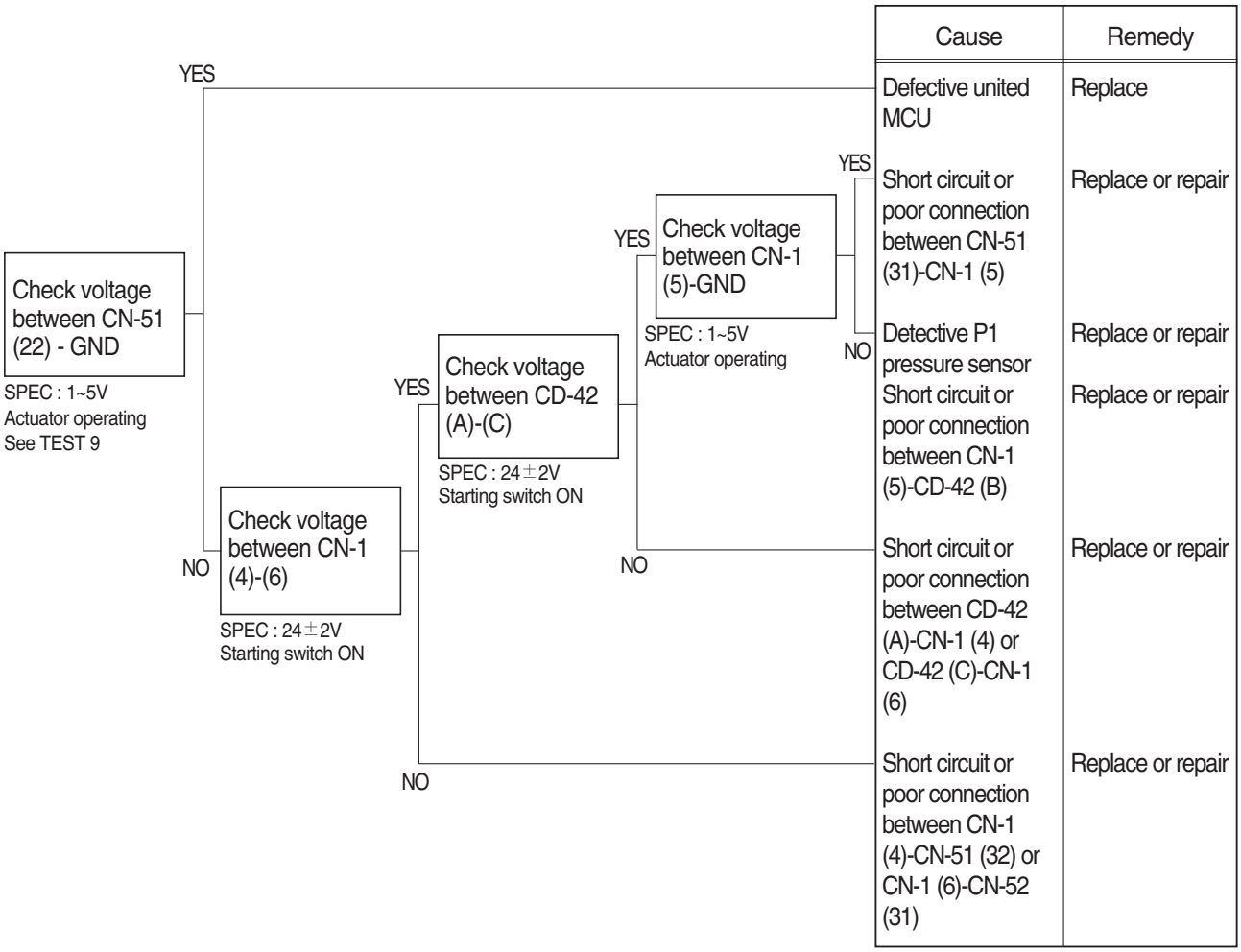
220A6MS104

5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

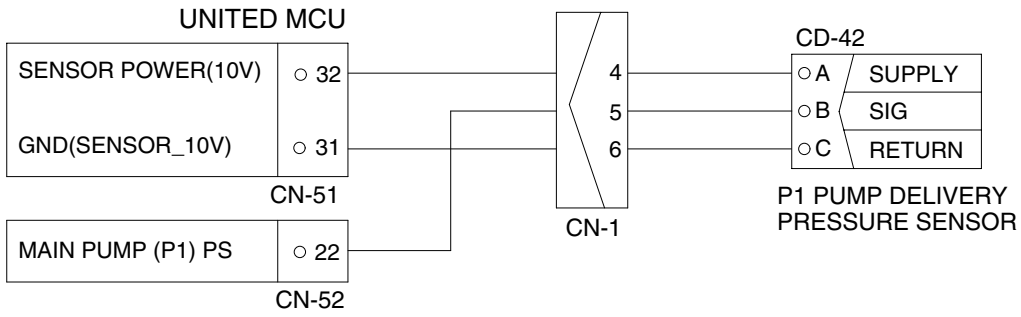
· Fault code : HCESPN 120, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS105

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-52 (22) and ground.

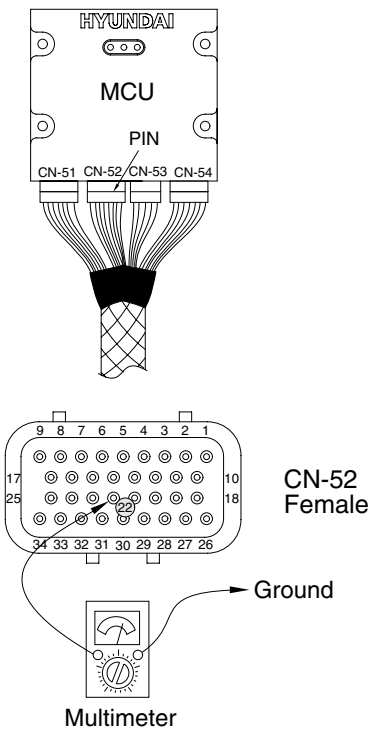
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (22) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



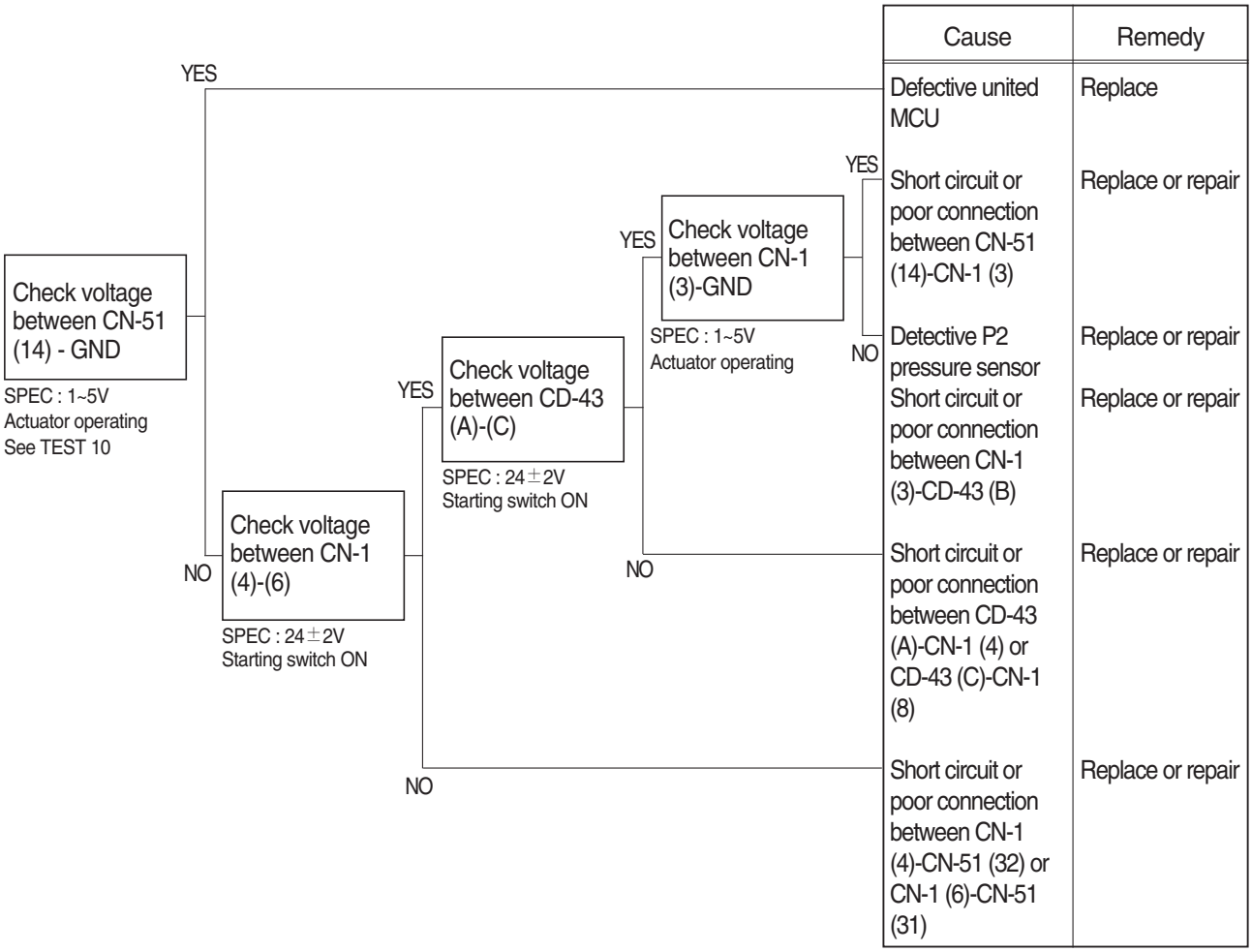
220A6MS106

6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

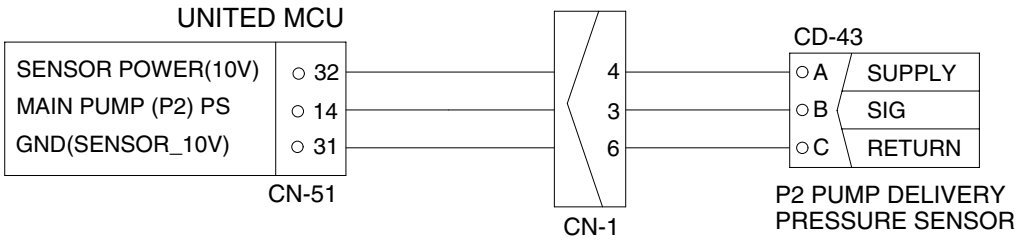
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective united MCU	Replace
Short circuit or poor connection between CN-51 (14)-CN-1 (3)	Replace or repair
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1 (3)-CD-43 (B)	Replace or repair
Short circuit or poor connection between CD-43 (A)-CN-1 (4) or CD-43 (C)-CN-1 (8)	Replace or repair
Short circuit or poor connection between CN-1 (4)-CN-51 (32) or CN-1 (6)-CN-51 (31)	Replace or repair

Wiring diagram



220A6MS107

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-51 (14) and ground.

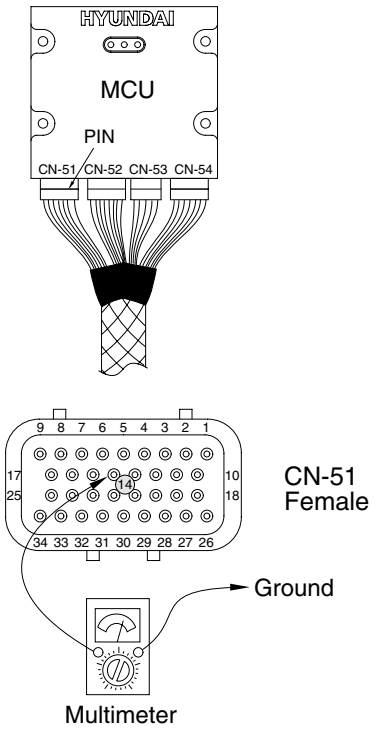
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (14) of CN-51.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



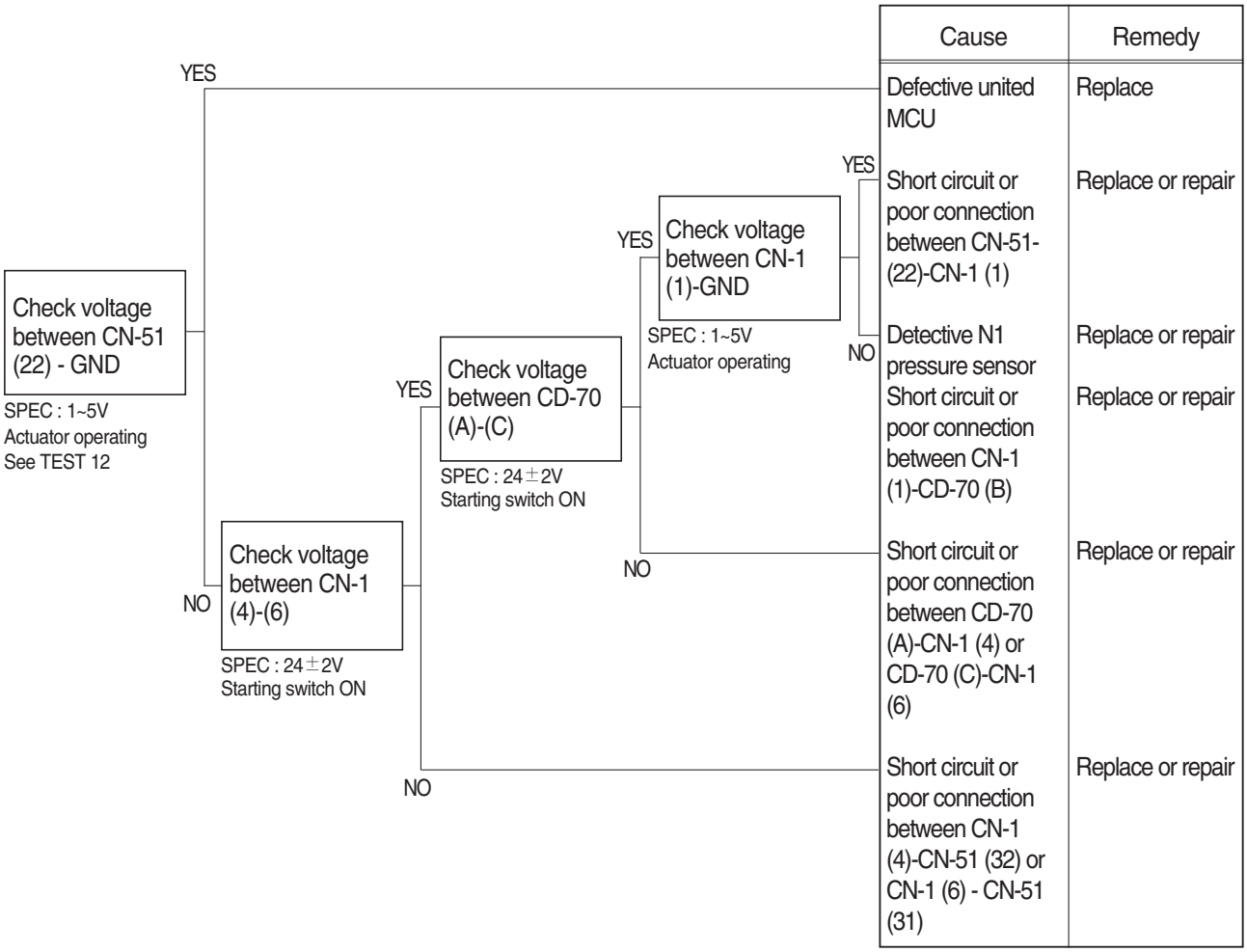
220A6MS108

7. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

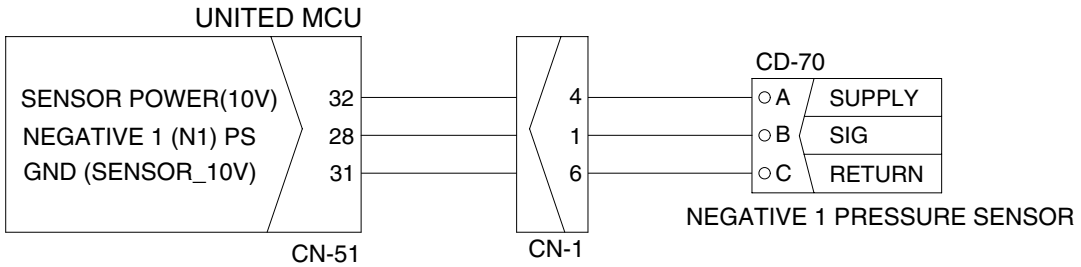
· Fault code : HCESPN 123, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS111

2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-51 (22) and ground.

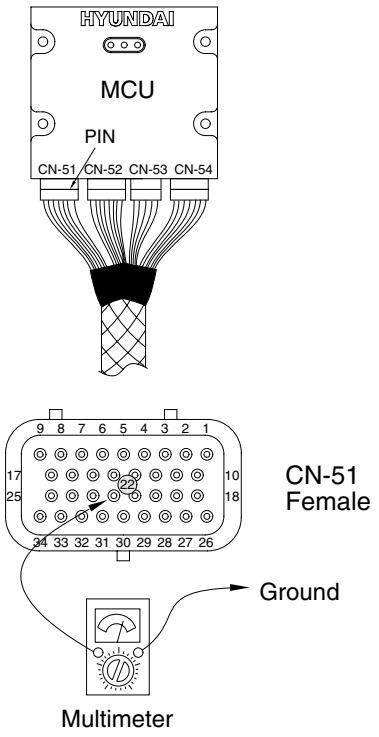
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (22) of CN-51.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



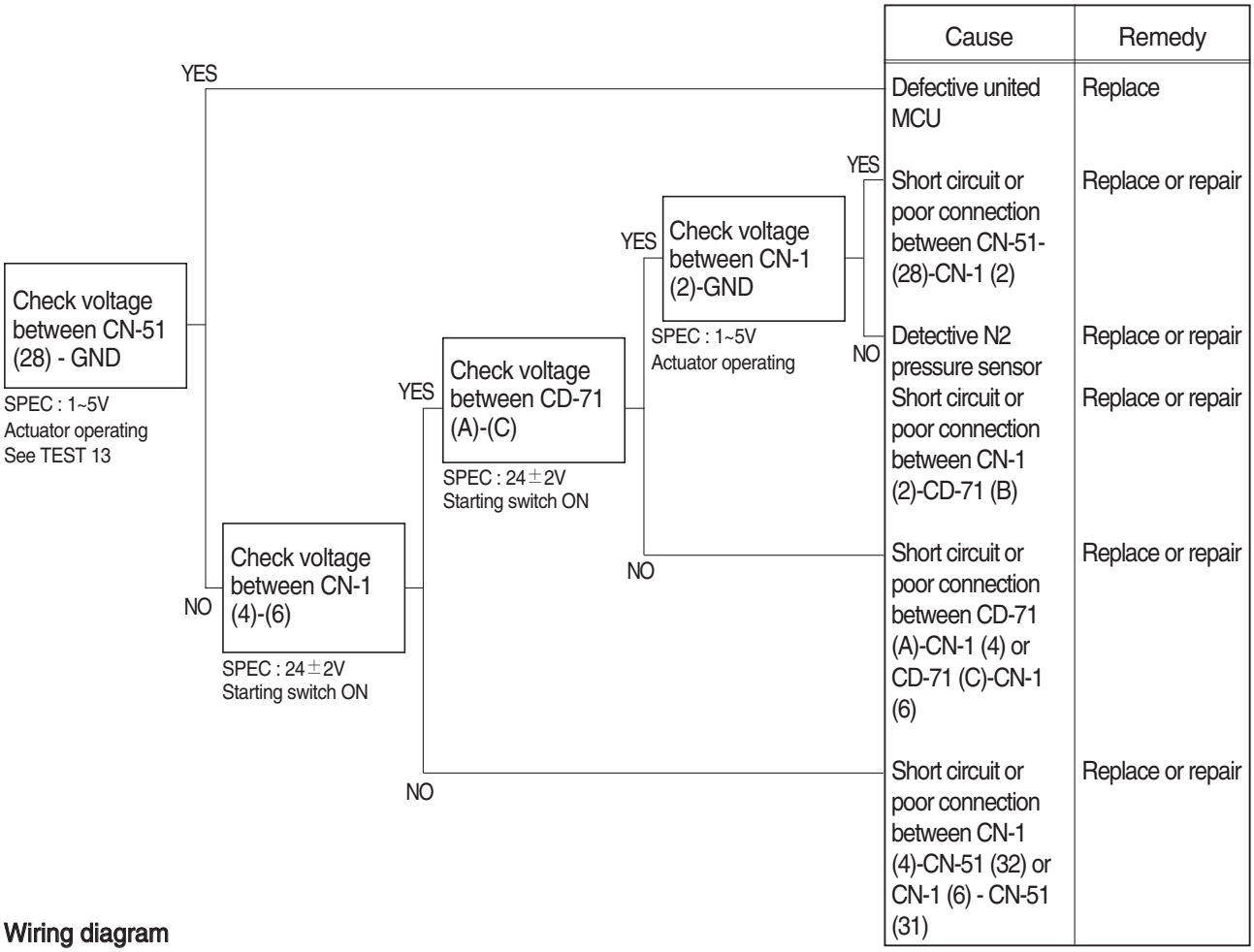
140L6MS112

8. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

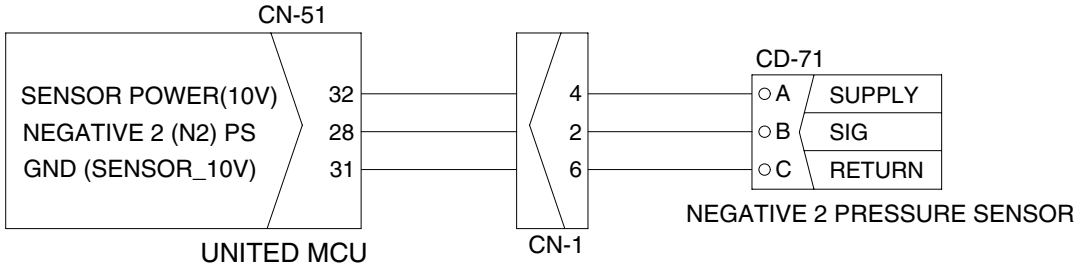
· Fault code : HCESPN 124, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS113

2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-51 (28) and ground.

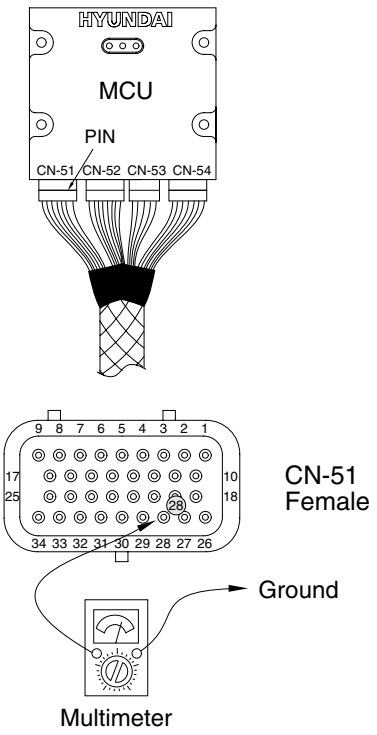
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (28) of CN-51.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



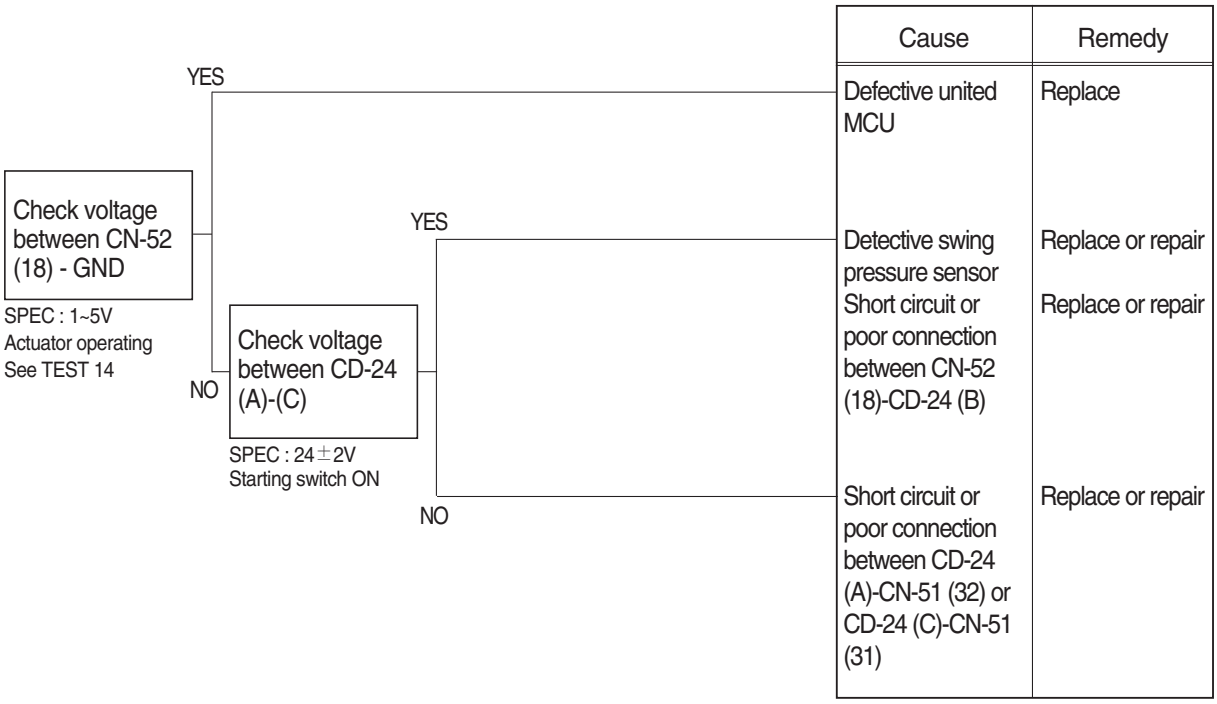
140L6MS114

9. MALFUNCTION OF SWING PRESSURE SENSOR

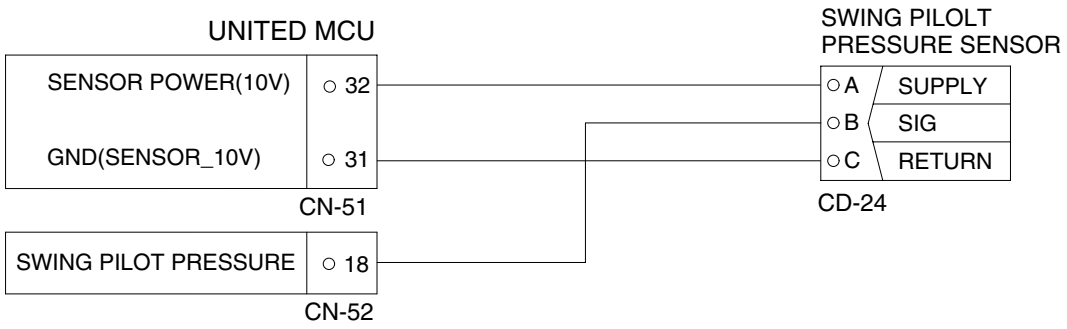
· Fault code : HCESPN 135, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS114

2) TEST PROCEDURE

(1) Test 14 : Check voltage at CN-52 (18) and ground.

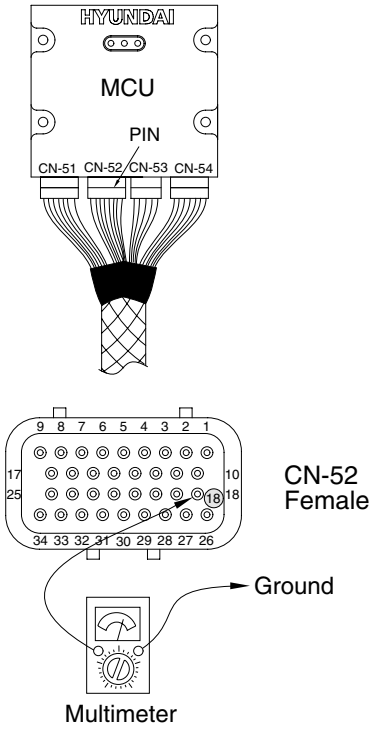
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (18) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



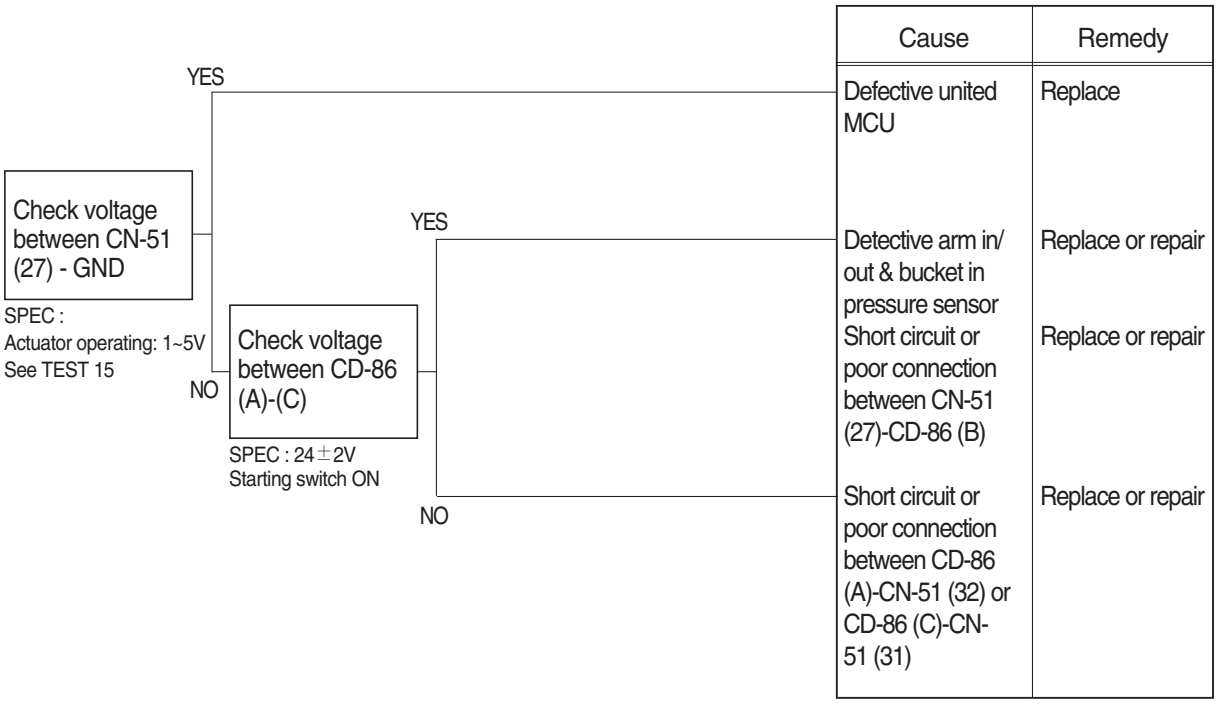
220A6MS116

10. MALFUNCTION OF ARM OUT PRESSURE SENSOR

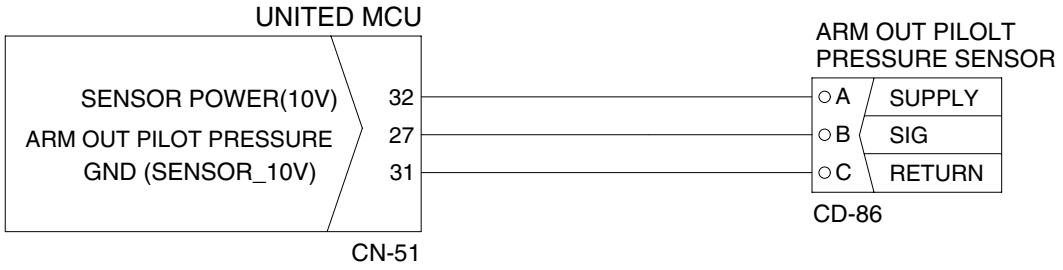
· Fault code : HCESPN 133, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS117

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-51 (27) and ground.

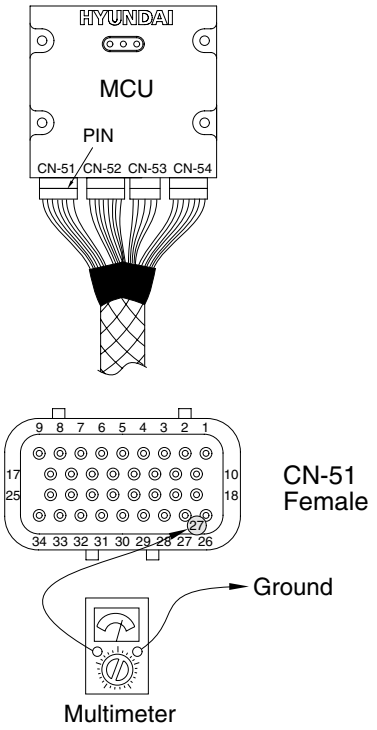
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (27) of CN-51.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



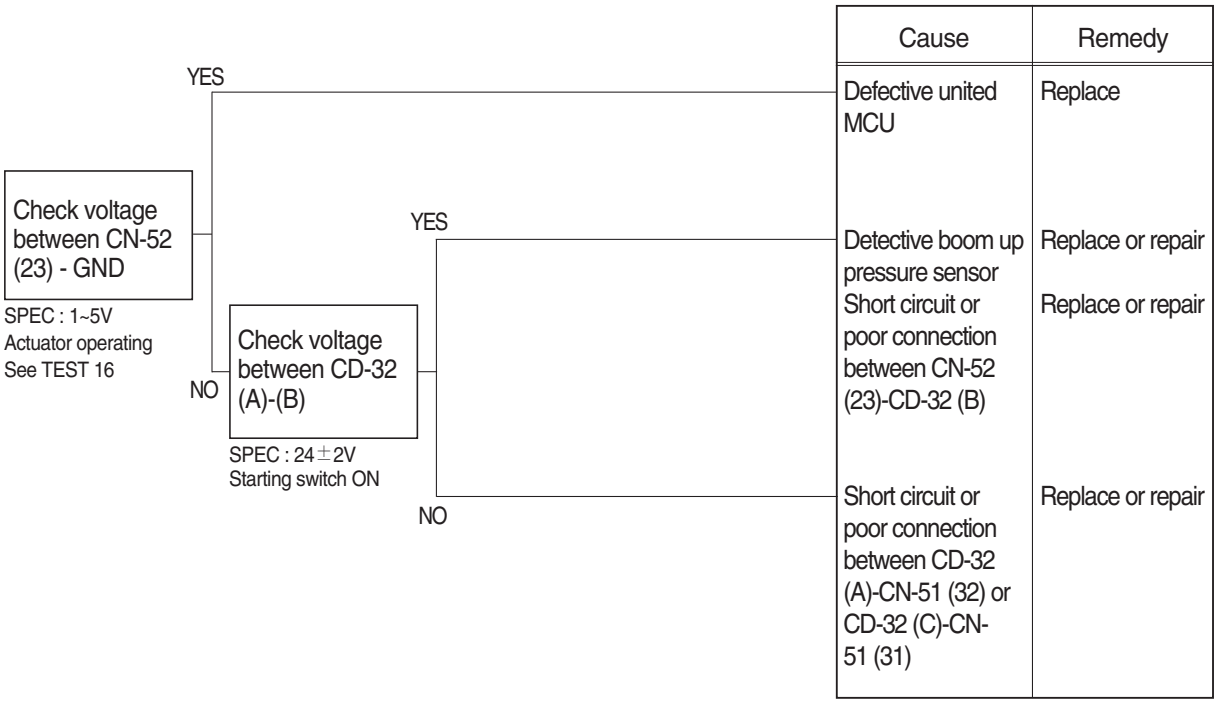
220A6MS118

11. MALFUNCTION OF BOOM UP PRESSURE SENSOR

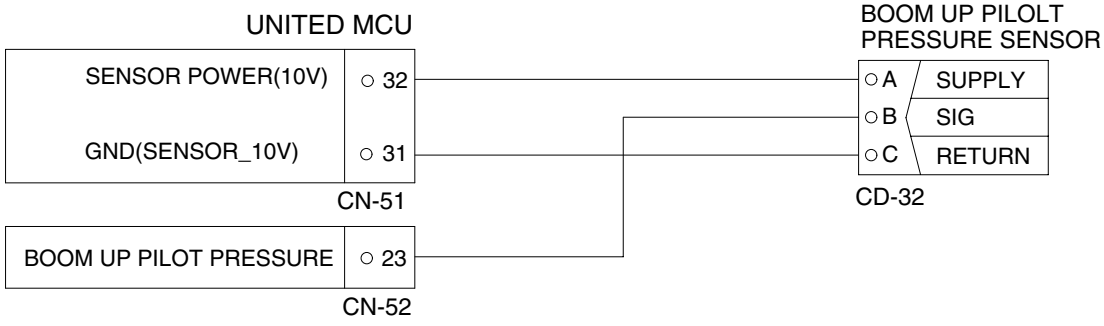
· Fault code : HCESPN 127, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS119

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52 (23) and ground.

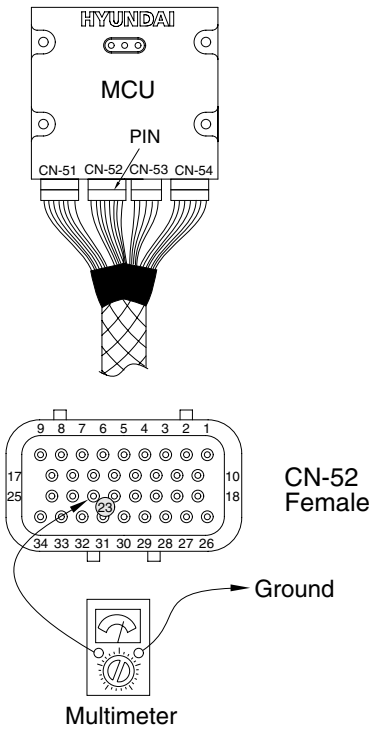
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (23) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



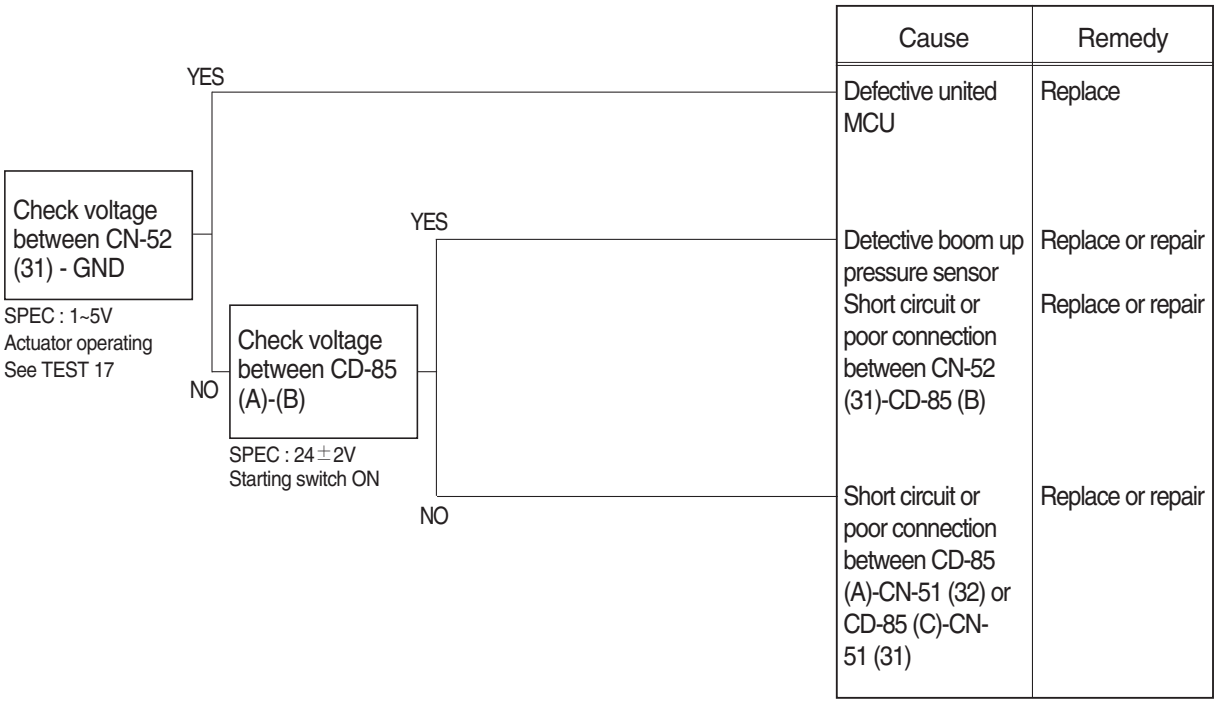
220A6MS120

12. MALFUNCTION OF BOOM DOWN PRESSURE SENSOR

· Fault code : HCESPN 128, FMI 0~4

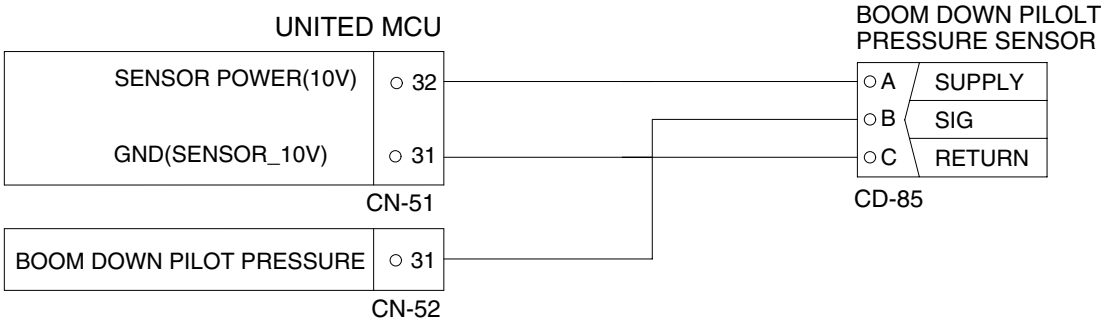
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective united MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (31)-CD-85 (B)	Replace or repair
Short circuit or poor connection between CD-85 (A)-CN-51 (32) or CD-85 (C)-CN-51 (31)	Replace or repair

Wiring diagram



220A6MS121

2) TEST PROCEDURE

(1) Test 17 : Check voltage at CN-52 (31) and ground.

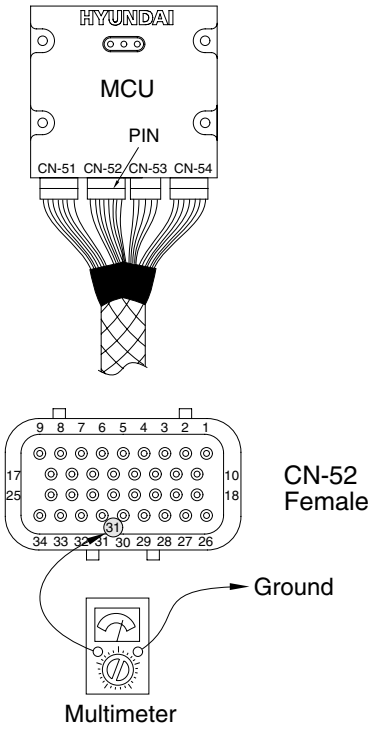
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (31) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



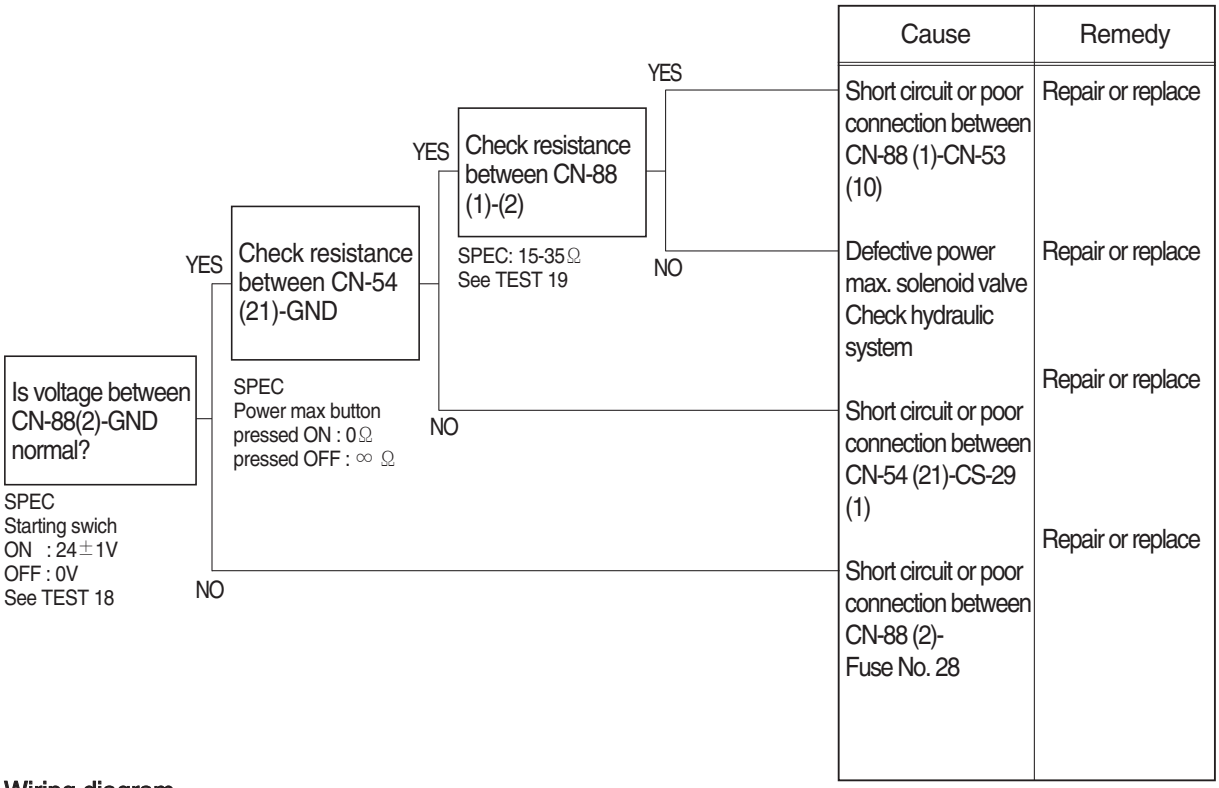
220A6MS122

13. MALFUNCTION OF POWER MAX

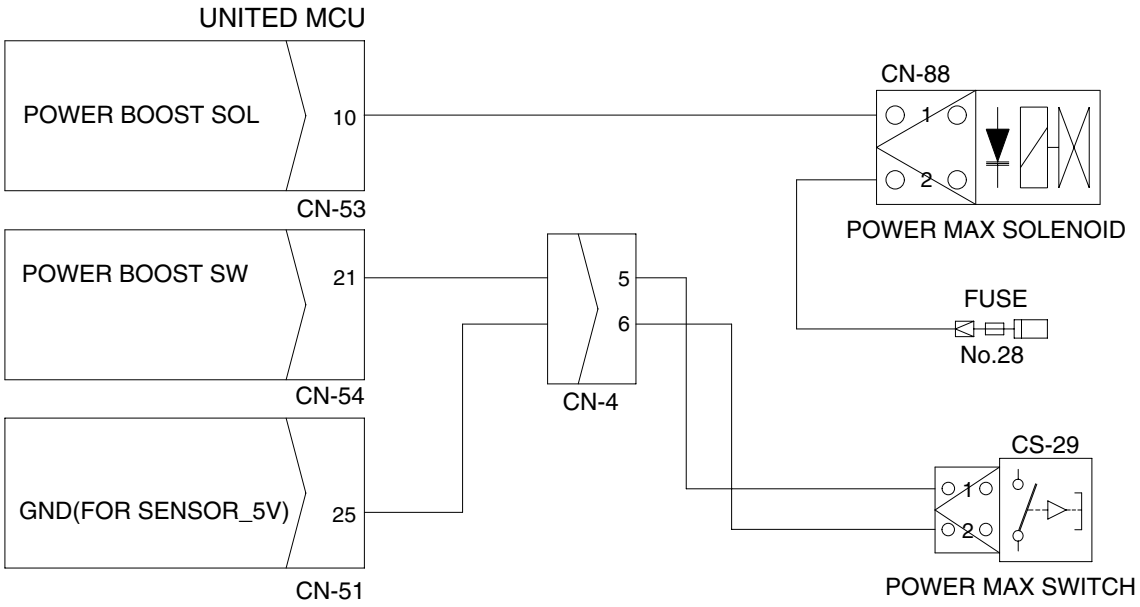
· Fault code : HCESPN 166, FMI 4 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS21

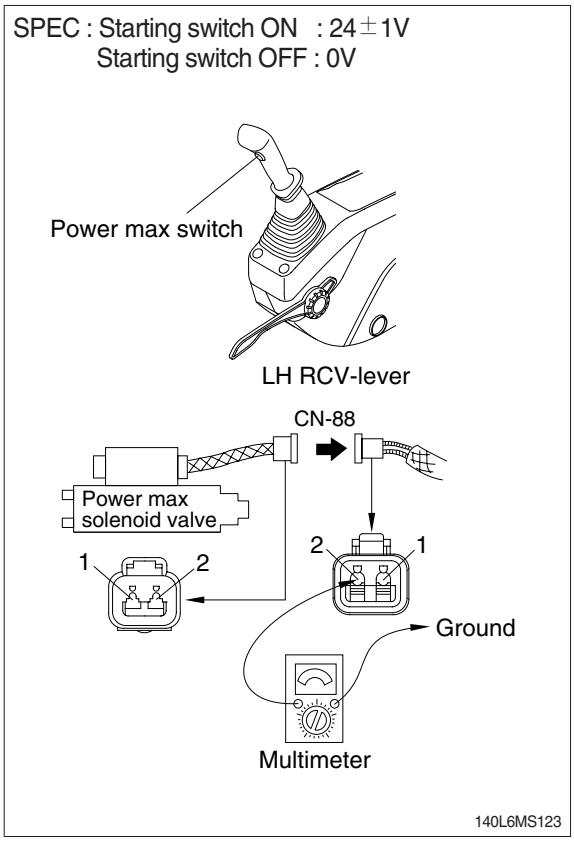
2) TEST PROCEDURE

(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.

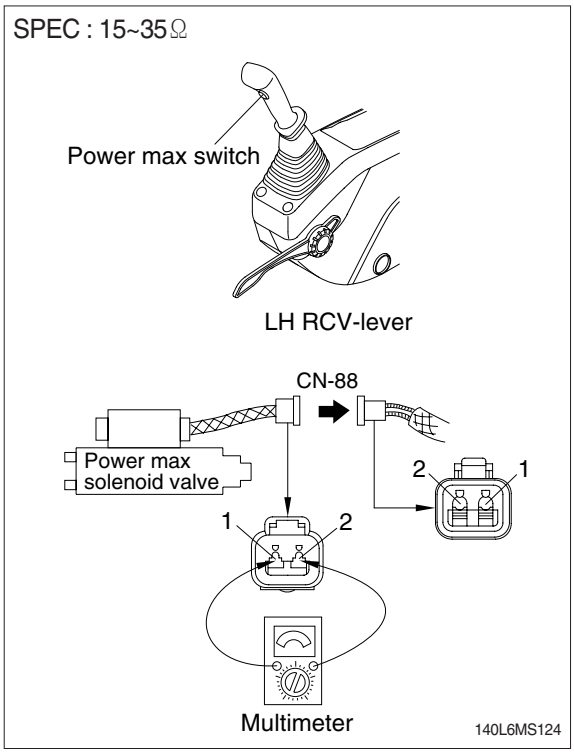


(2) Test 19: Check resistance of the solenoid valve between CN-88 (1)-(2).

① Starting switch OFF.

② Disconnect connector CN-88 from power max solenoid valve.

③ Check resistance as figure.

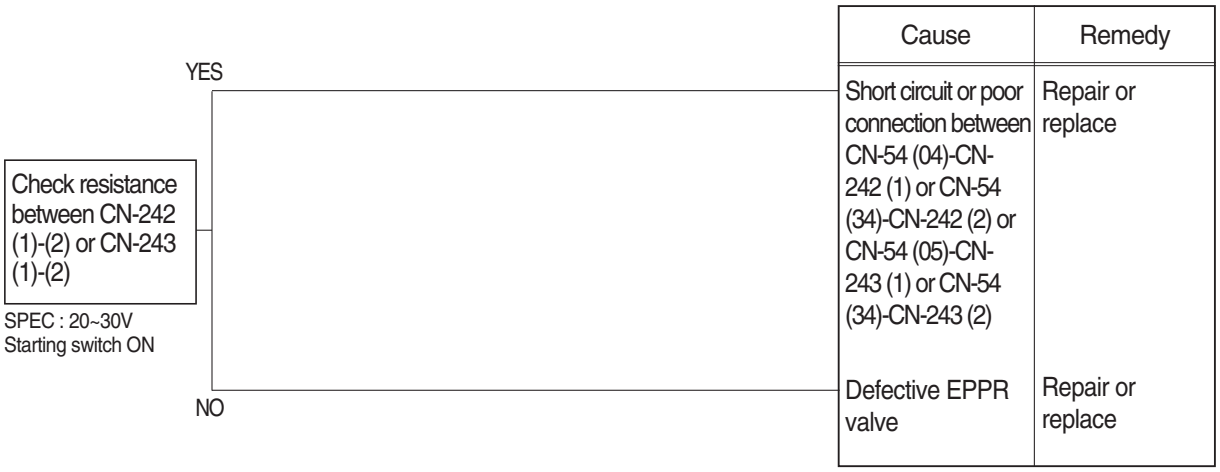


14. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

· Fault code : HCESPN 141, FMI 5 or 6

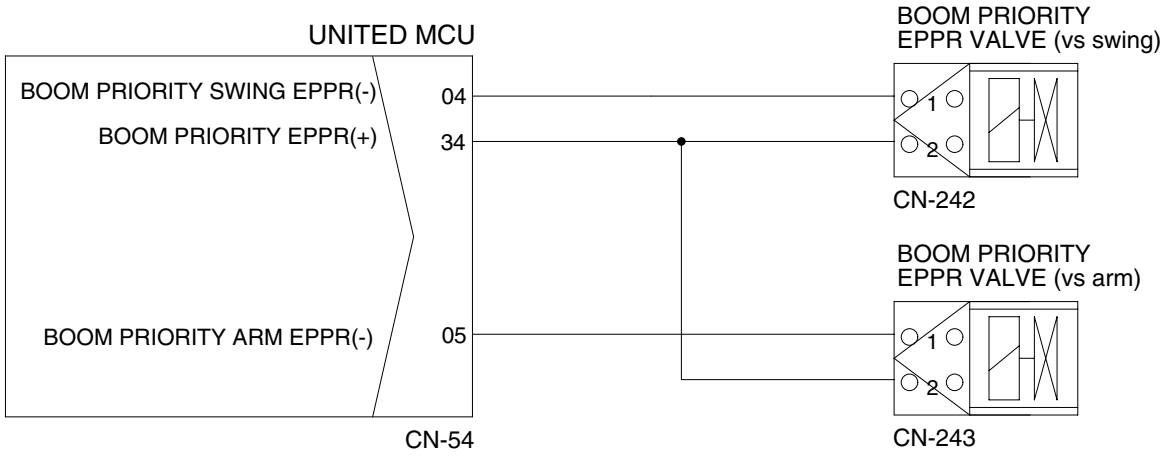
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Short circuit or poor connection between CN-54 (04)-CN-242 (1) or CN-54 (34)-CN-242 (2) or CN-54 (05)-CN-243 (1) or CN-54 (34)-CN-243 (2)	Repair or replace
Defective EPPR valve	Repair or replace

Wiring diagram



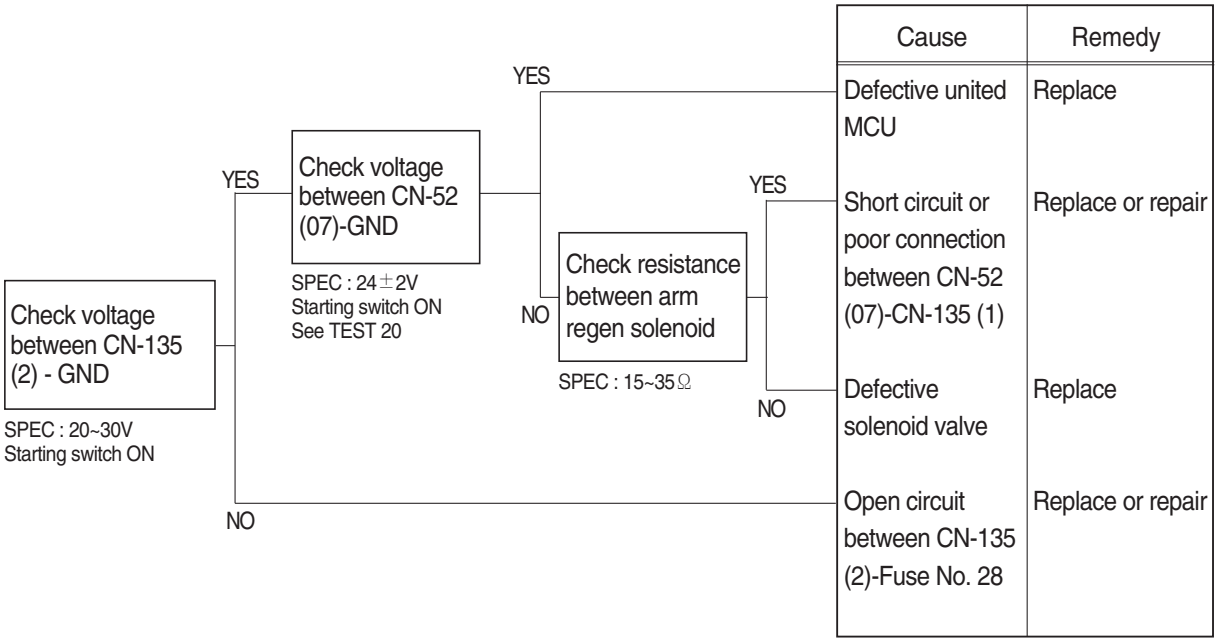
220A6MS123

15. MALFUNCTION OF ARM REGENERATION SOLENOID

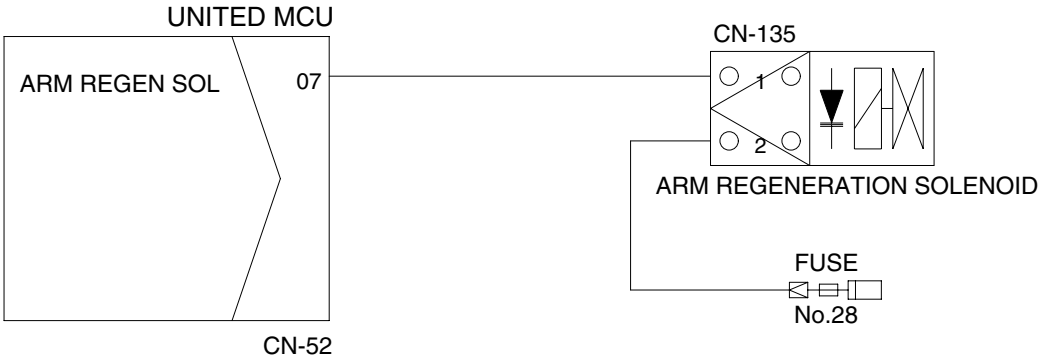
· Fault code : HCESPN 170, FMI 4 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



220A6MS27

2) TEST PROCEDURE

(1) Test 20 : Check voltage at CN-52 (07) and ground.

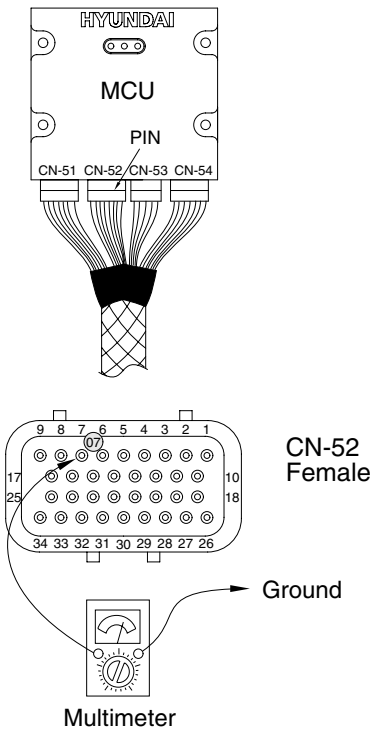
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (07) of CN-52.

③ Starting switch ON.

④ Check voltage as figure.

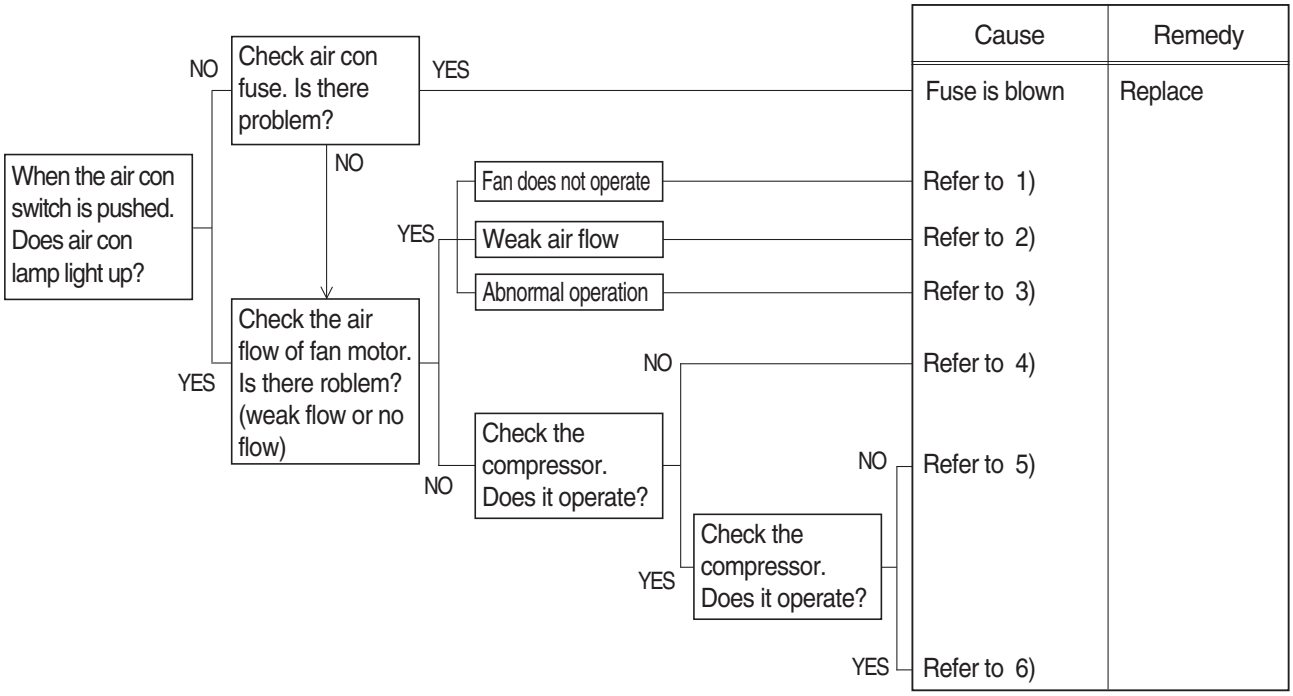
SPEC : Key ON : 24±2 V



140L6MS128

GROUP 5 AIR CONDITIONER & 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 ····· 7-1
Group 2 Major Components ····· 7-21
Group 3 Track and Work Equipment ····· 7-30

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.

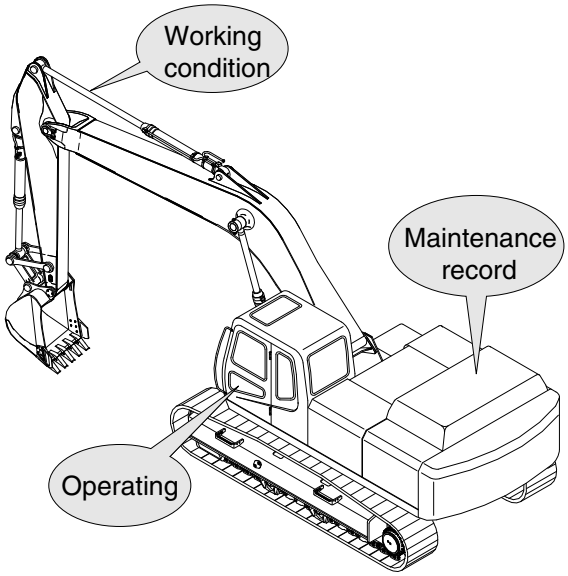
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

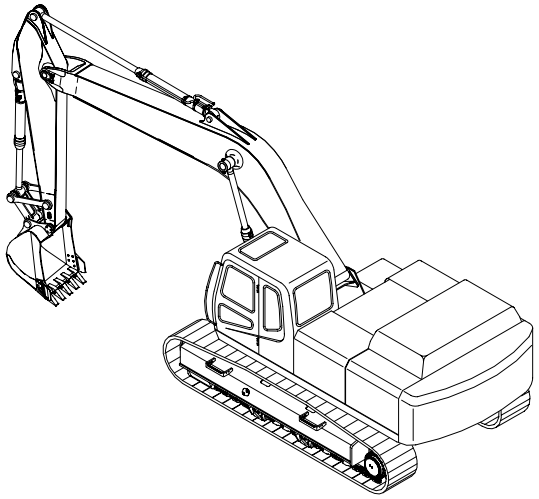


21077MS01

2. TERMINOLOGY

1) STANDARD

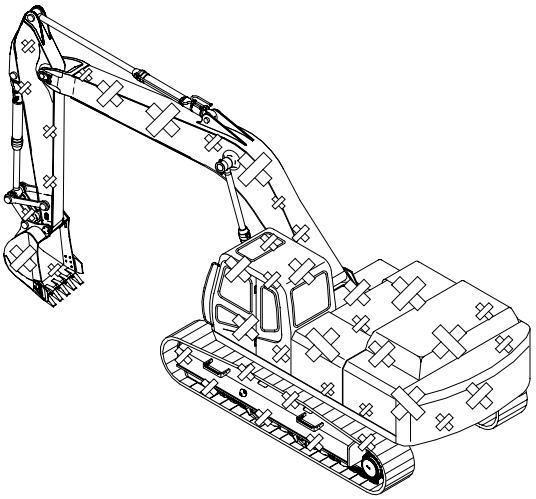
Specifications applied to the brand-new machine, components and parts.



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.

The machine

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

(2) Test area

① Select a hard, flat surface.

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

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

(3) Precautions

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

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

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

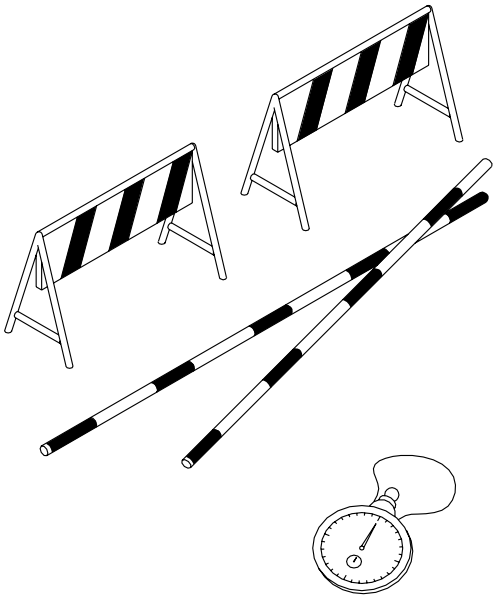
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

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

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

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



(290-7TIER) 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 multimodal 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.

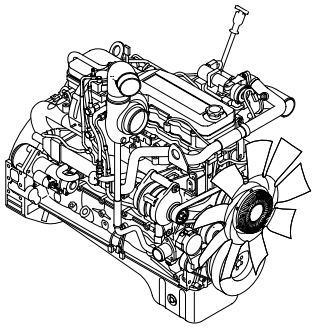
② Measure and record the engine speed at each mode (P, S, E).

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.





300A7MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HX220A L	Start idle	850±100	
	P mode	1700±50	
	S mode	1600±50	
	E mode	1600±50	
	Auto decel	1000±100	
	One touch decel	850±100	

Condition : Set the multimodal dial at 10 (Max) position.

3) TRAVEL SPEED

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

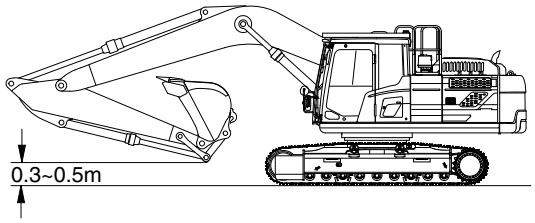
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Prepare a flat and solid test track 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.



260A7MS02

(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.

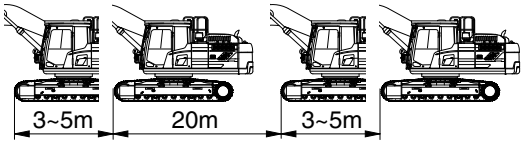
· Power mode switch : P mode

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.



260A7MS03

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX220A L	1 Speed	19.2±2.0	24	
	2 Speed	12.5±1.0	15.7	

4) TRACK REVOLUTION SPEED

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

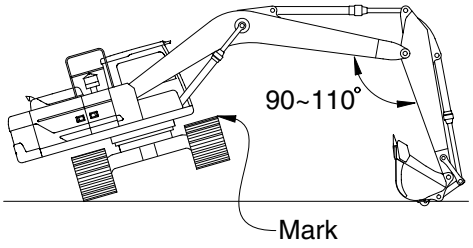
(2) Preparation

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.



300L7MS04

(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
HX220A L	1 Speed	28±2.0	34
	2 Speed	17±2.0	21

5) TRAVEL DEVIATION

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

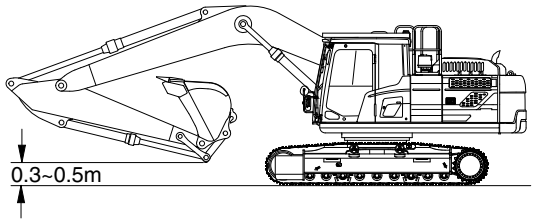
(2) Preparation

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.



260A7MS02

(3) Measurement

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

② Before beginning each test, select the following switch positions.

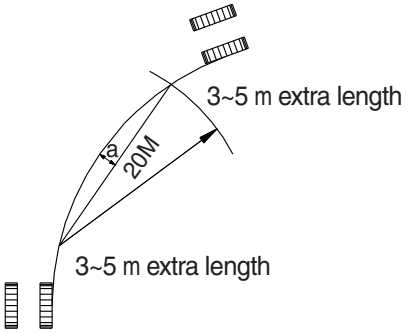
· Power mode switch : P mode

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
HX220A L	200 below	240	-

6) SWING SPEED

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

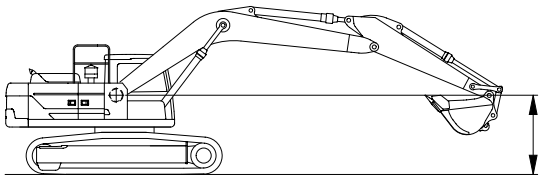
(2) Preparation

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

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

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

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



300L7MS05

(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
HX220A L	P mode	14.4±1.5	18

7) SWING FUNCTION DRIFT CHECK

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

(2) Preparation

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

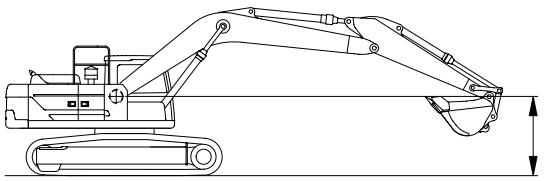
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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

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

⑤ Swing the upperstructure 360˚.

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



300L7MS05

(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

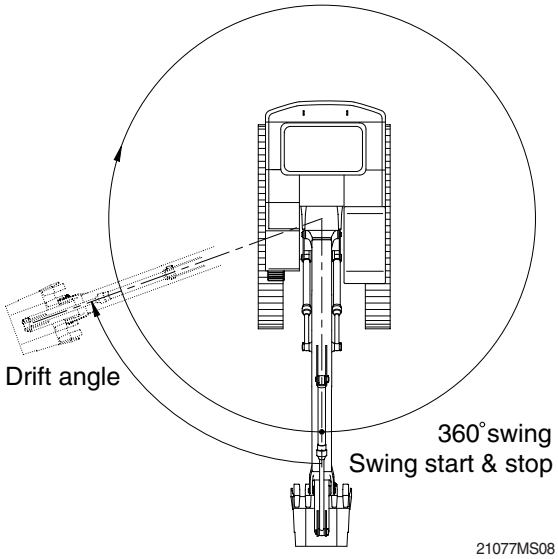
· Power mode switch : P mode

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

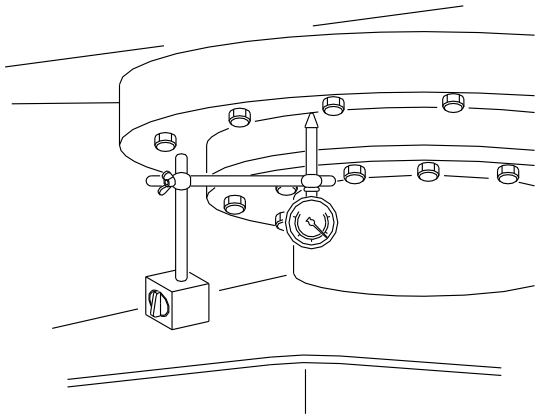
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX220A L	P mode	90 below	157.5	

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)

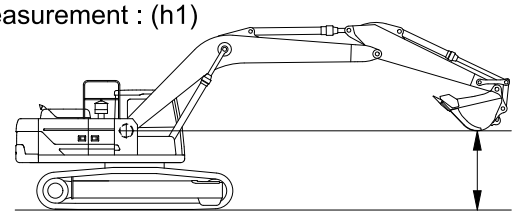
(2) Preparation

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.

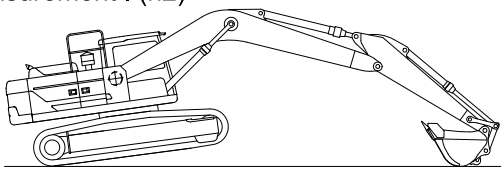
(3) Measurement

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

Measurement : (h1)



Measurement : (h2)



300L7MS06

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX220A L	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.

(3) Measurement

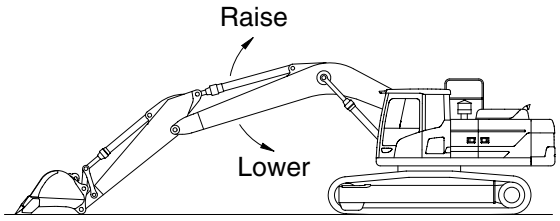
① Select the following switch positions.

· Power mode switch : P mode

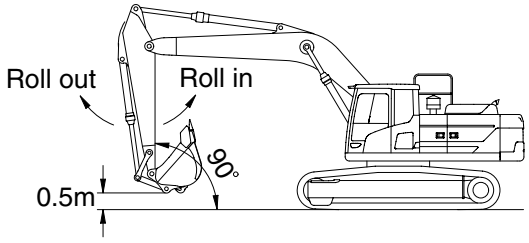
② To measure cylinder cycle times.

- 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.

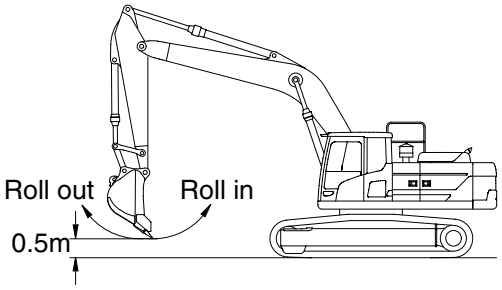
Boom cylinder



Arm cylinder



Bucket cylinder



300L7MS07

- 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
HX220A L	Boom raise		3.5±0.4	4.3	
	Boom lower		2.5±0.4	3.1	
	Arm in	Regen ON	3.0±0.4	3.7	
		Regen OFF	3.3±0.4	4.1	
	Arm out		2.7±0.3	3.4	
	Bucket in		3.0±0.4	3.8	
	Bucket out		2.2±0.3	2.7	

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)

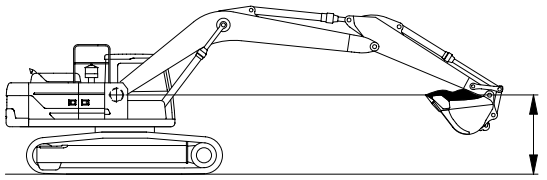
1.5 = Soil specific gravity

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

③ Position the bucket cylinder with the rod 20 to 30 ㎜ 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.



300L7MS08

(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 / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX220A L	Boom cylinder	10 below	20	
	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	60	

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
HX220A L	Boom lever	1.7 or below	2.0	
	Arm lever	1.7 or below	2.0	
	Bucket lever	1.4 or below	2.0	
	Swing lever	1.4 or below	2.0	
	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
HX220A L	Boom lever	90±10	112	
	Arm lever	90±10	112	
	Bucket lever	90±10	112	
	Swing lever	90±10	112	
	Travel lever	139±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

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

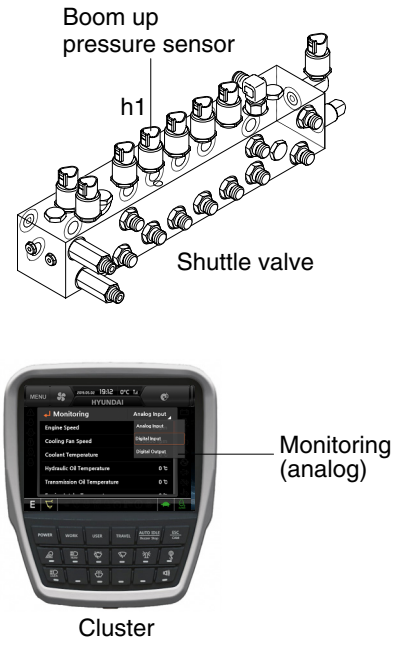
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

② Slowly operate the boom control lever of boom up functions at full stroke over relief and measure the primary pilot pressure by the monitoring menu of the cluster.



220A7MS13

(3) Evaluation

The average measured pressure should meet the following specifications:

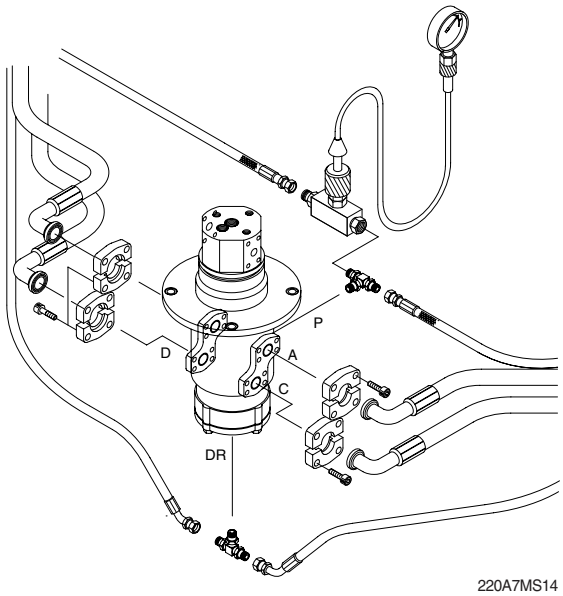
Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
HX220A L	P mode	Over 34	-	

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
④ assembly to turning joint P port as shown. Start the engine and check for on leakage from the adapter.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



220A7MS14

(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
HX220A L	1 Speed	0	-	
	2 Speed	40±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.

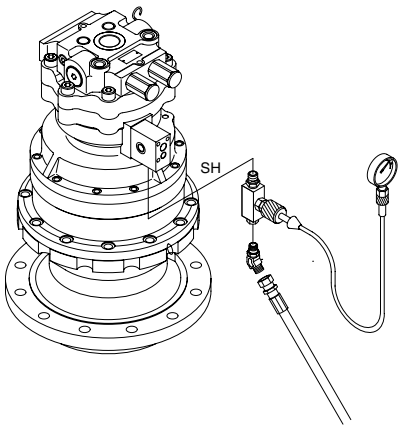
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.

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.



220A7MS15

(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
HX220A L	Brake disengaged	30	Over 4	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

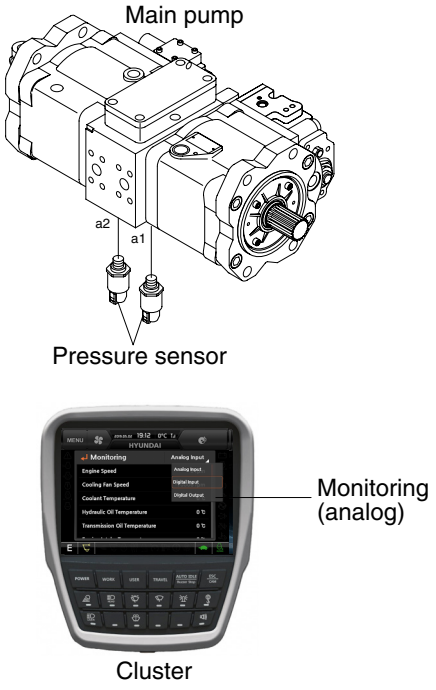
① Keep the hydraulic oil temperature at 50±5˚C.

(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).



220A7MS16

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
HX220A L	High idle	Under 10	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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

(2) Measurement

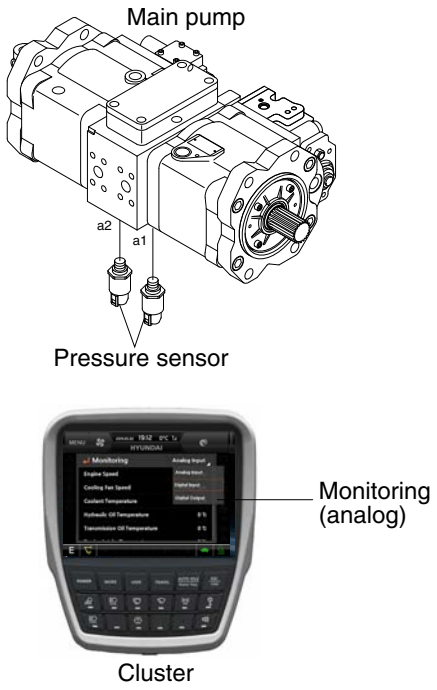
① Select the following switch positions.

· 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.



220A7MS16

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

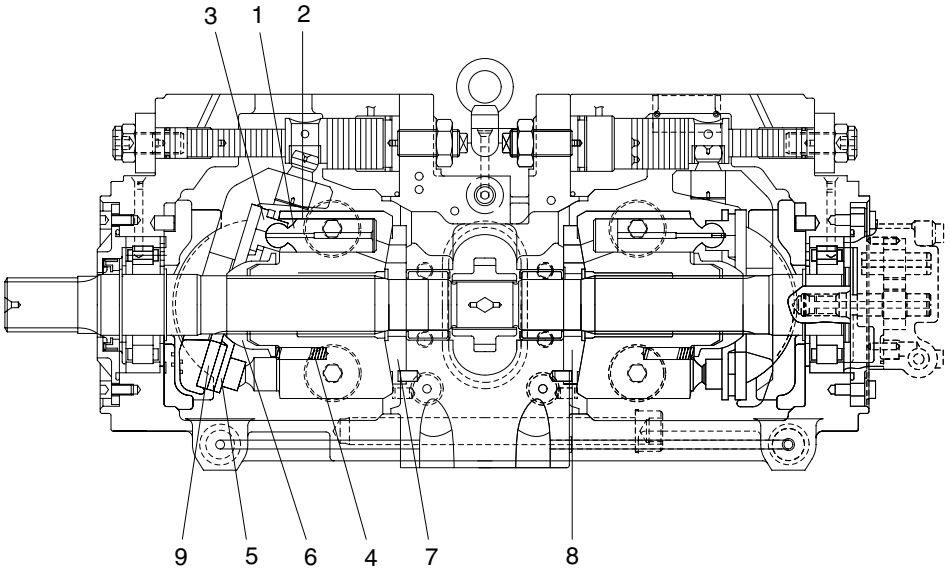
Model	Function to be tested	Standard	Port relief setting
HX220A L	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	350±10	-
	Swing	290±20	-

( ) : Power boost

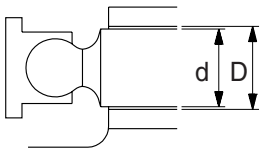
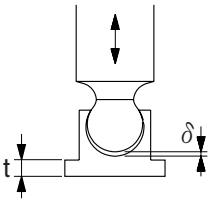
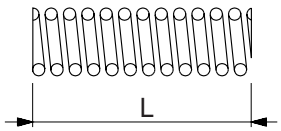
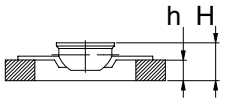
GROUP 2 MAJOR COMPONENT

1. MAIN PUMP

1) WEARING PARTS



220F7MP01

Part name & inspection item		Standard dimension	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.057	Replace piston or cylinder.
Play between piston (1) & shoe caulking section (3) (δ)		0.3	Replace assembly of piston & shoe.
Thickness of shoe (t)		4.8	
Free height of cylinder spring (4) (L)		41.0	Replace cylinder spring.
Combined height of set plate (5) & spherical bushing (6) (H-h)		24.0	Replace set plate or spherical bushing
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	3z	Lapping
	Standard surface roughness (corrected value)	0.4z or lower	

2) TROUBLESHOOTING

(1) Overload of prime mover

Cause	Countermeasure	Caution
The speed or pressure is higher than their specified values.	Set them as specified.	
The torque setting of the regulator is higher than specified value.	Adjust the regulator.	See the pump device of the section 2.
Seizure or damage of a part inside the pump.	Replace the damaged part.	Check the filter and drain oil for abnormal worn metal particles.
Wrong fitting of the regulator piping.	Correct the regulator piping.	

(2) Extreme decrease of pump delivery flow or delivery pressure does not increase.

Cause	Countermeasure	Caution
Failure of the regulator.	Repair the regulator.	See the pump device of the section 2.
Seizure or damage of a part inside the pump.	Replace the damaged parts.	Check the filters and drain oil.
Failure of the attached pump.	Replace the damaged parts.	Remove the attached pump and check the shaft coupling.
Failure of the accessory valve.	Replace the accessory valves. Especially, check the poppets, seats and springs.	See the pump device of the section 2.
Wrong fitting of the regulator piping.	Correct the regulator piping.	

(3) Abnormal noise and abnormal vibrations

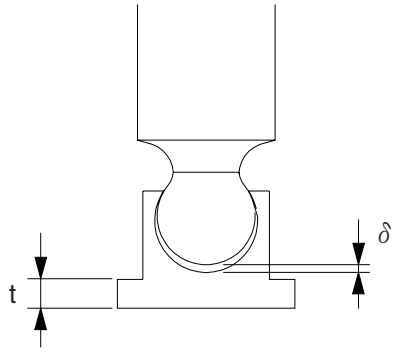
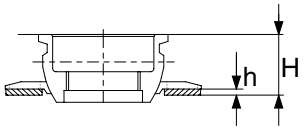
Cause	Countermeasure	Caution
Cavitation	Prevention from cavitation. Check working oil for emulsion.	Low boost press.
Damage in the caulking section of the shoe.	Replace the piston, shoe, shoe plate, etc.	Failure of the attached pump.
Cracking of the cylinder.	Replace the cylinder.	Air leakage at the suction pipe.
Wrong installation of the pump.	Correct installation.	Increased suction resistance.
Hunting of the regulator.	Repair the regulator.	See the pump device of the section 2.
Hunting of the relief valve of the accessory valve.	Repair the accessory valve.	See the pump device of the section 2.
Damage of the gear.	Replace the gear.	

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.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section).
	· O-ring seal sections at both ends.	· Replacement when its sliding section has scratch.
	· Insert spool into casing hole, rotate and reciprocate it.	· Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of spring	· Replacement.
	· Damage of poppet	· Correction or replacement when sealing is incomplete.
	· Insert poppet into casing and function it.	· 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.	· Correction or replacement.
	· Rusting, corrosion or deformation of seal plate.	· Correction or replacement.
Main relief valve, port relief valve & negative control valve	· External rusting or damage.	· Replacement.
	· Contacting face of valve seat.	· Replacement when damaged.
	· Contacting face of poppet.	· Replacement when damaged.
	· Defect of spring.	· Replacement.
	· O-rings and back up rings.	· Replacement in principle.

3. SWING DEVICE (TYPE 1, 2)

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	

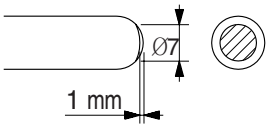
2) SLIDING PARTS

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 (TYPE 1, 2)

Problem		Cause	Remedy
Does not start	Pressure is not developed	· Pump failure · Control valve malfunction	· Check if action other than traveling is available. If faulty, repair. · Check if spool moves correctly. Repair if necessary.
	Pressure in developed	· Brake valve failure -Sleeve stick -Check valve stick · Motor failure -Valve seat seizure · Gear broken and fragment locked · Overloaded	· Replace brake valve · Replace -Check hydraulic oil for contamination · Replace reduction gear · Reduce load
Oil leakage	Leakage from engaging surfaces	· Scratch on engaging surfaces · Loosening by poor bolt tightening	· Correct surfaces by oilstone or sandpaper or replace · Check after retightening
	Leakage from casing	· Plug loosened · Crack formed by stone	· Retighten · Replace reduction gear
	Leakage from floating seal	· Sliding surfaces worn · Creep on O-ring	· Replace reduction gear · Replace floating seal
	Leakage from hydraulic motor	· Bolt loosened · O-ring damaged · Sealing surface scratched	· Tighten properly · Replace O-ring · Correct by oilstone or sandpaper
Coasts on slope excessively		· Poor volumetric efficiency of hydraulic motor · Increase of internal leakage of brake valve · Parking brake not actuated -Spring breakage -Wear of friction plate	· Replace hydraulic motor · Replace brake valve · Replace spring · Replace parking brake
Excessive temperature on reduction gear case		· Pitting on bearing · Lack of gear oil · Hydraulic oil introduced to gear case	· Replace reduction gear · Supply gear oil properly · Check motor and replace oil seal
Meanders	Meanders at low pressure	· Delivery rate is different between right and left · Motor drain rate is different between right and left	· Repair pump · Replace motor
	Meanders at high pressure	· Delivery rate is different between right and left · Motor drain rate is different between right and left	· Repair regulator or pump · Replace motor
	Meanders at high pressure	· Relief pressure dropped at right and left brake valve · Main relief pressure dropped at right or left of control valve	· Replace brake valve · Replace main relief valve
Pump delivery is poor		· Regulator operation poor · External leakage of pump is excessive	· Repair regulator · Repair pump
External leakage of motor is excessive		-	· Replace motor

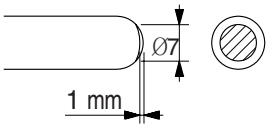
5. RCV LEVER

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.

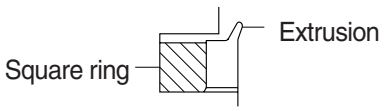
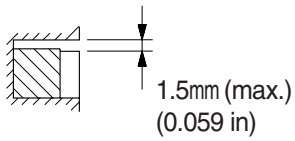
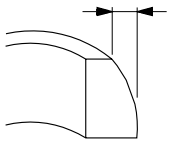
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

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

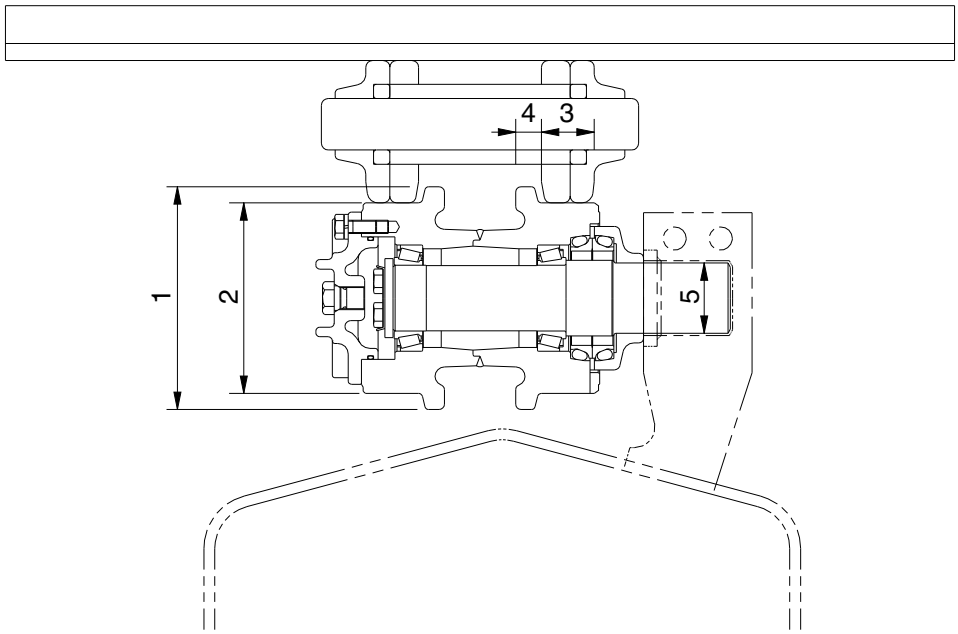
Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure 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

1. TRACK

1) UPPER ROLLER



21037MS02

Unit : mm

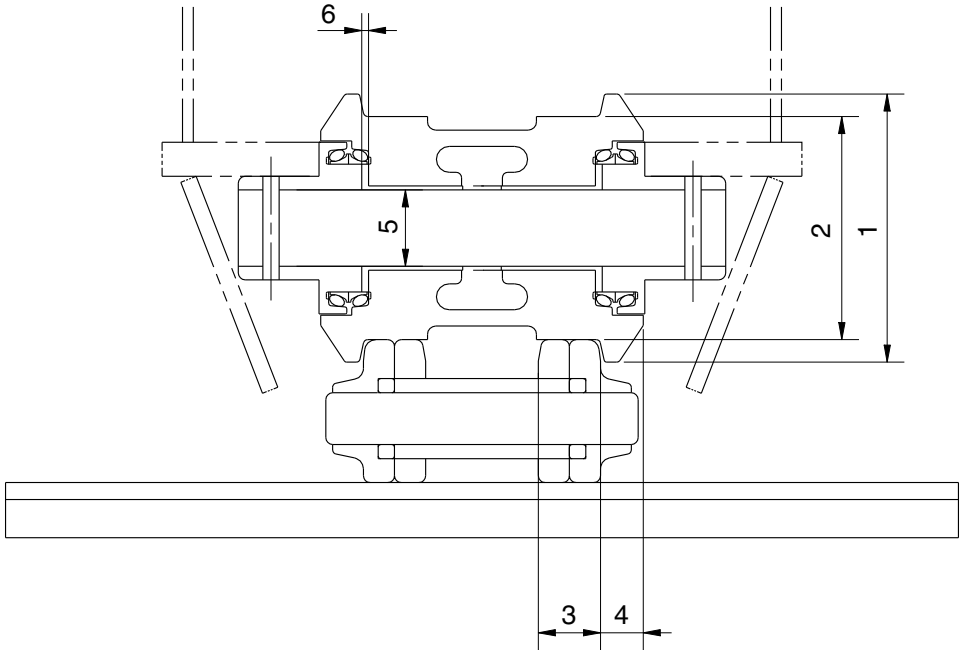
No.	Check item	Criteria						Remedy
1	Outside diameter of flange	Standard size				Repair limit		Rebuild or replace
		Ø169				–		
2	Outside diameter of tread	Ø144				Ø134		
3	Width of tread	44				49		
4	Width of flange	17				–		
5	Clearance between shaft and busing	Standard size & Tolerance				Standard clearance	Clearance limit	Replace bushing
		Shaft		Hole				
		Dimension	Tolerance	Dimension	Tolerance			
		Ø55	-0.05 -0.1	Ø55	0.3 0.1	0.15~0.4	1.2	

(Mahcine Serial No. #1080-)

Unit : mm

No.	Check item	Criteria						Remedy
1	Outside diameter of flange	Standard size				Repair limit		Rebuild or replace
		Ø140				–		
2	Outside diameter of tread	Ø120				Ø110		
3	Width of tread	45				50		
4	Width of flange	18				–		
5	Clearance between shaft and busing	Standard size & Tolerance				Standard clearance	Clearance limit	Replace bushing
		Shaft		Hole				
		Dimension	Tolerance	Dimension	Tolerance			
		Ø45	0 -0.025	Ø45	0.35 0.3	0.3~0.375	1.2	

2) LOWER ROLLER



21037MS01

Unit : mm

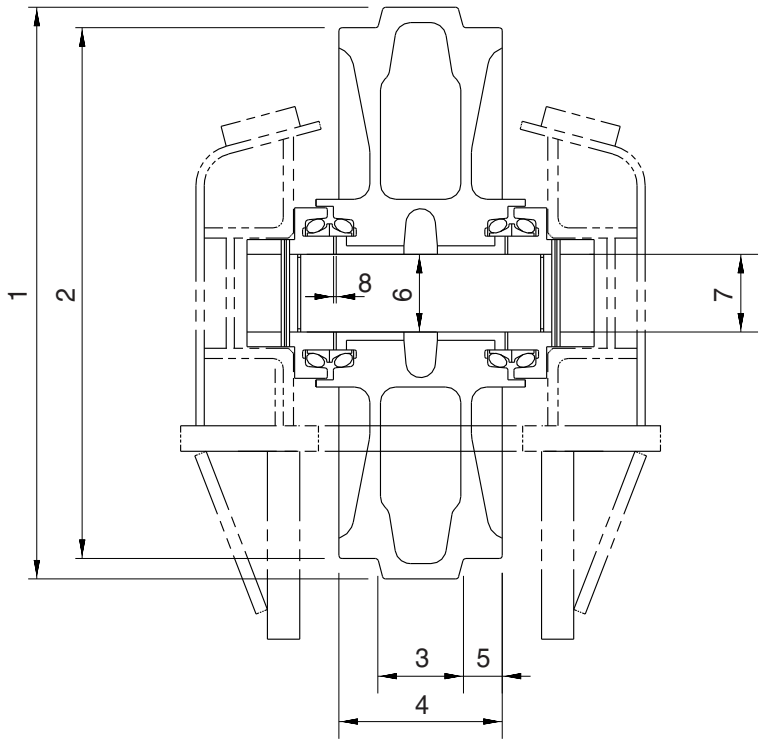
No.	Check item	Criteria						Remedy
1	Outside diameter of flange	Standard size				Repair limit		Rebuild or replace
		Ø200				–		
2	Outside diameter of tread	Ø160				Ø148		
3	Width of tread	48				54		
4	Width of flange	21.5				–		
5	Clearance between shaft and bushing	Standard size and tolerance				Standard clearance	Clearance limit	Replace bushing
		Shaft		Hole				
		Dimension	Tolerance	Dimension	Tolerance			
		Ø70	-0.29 -0.33	Ø70.1	0.46 0	0.39~0.476	2.0	
6	Side clearance of roller (both side)	Standard clearance				Clearance limit		Replace
		0.2~1.2				2.0		

(Mahcine Serial No. #1080-)

Unit : mm

No.	Check item	Criteria						Remedy
1	Outside diameter of flange	Standard size				Repair limit		Rebuild or replace
		Ø185				–		
2	Outside diameter of tread	Ø154				Ø144		
3	Width of tread	49				55		
4	Width of flange	29.5				–		
5	Clearance between shaft and bushing	Standard size and tolerance				Standard clearance	Clearance limit	Replace bushing
		Shaft		Hole				
		Dimension	Tolerance	Dimension	Tolerance			
		Ø65	0 -0.03	Ø65	0.37 0.32	0.32~0.4	2.0	
6	Side clearance of roller (both side)	Standard clearance				Clearance limit		Replace
		0.23~1.44				2.0		

3) IDLER



21037MS03

Unit : mm

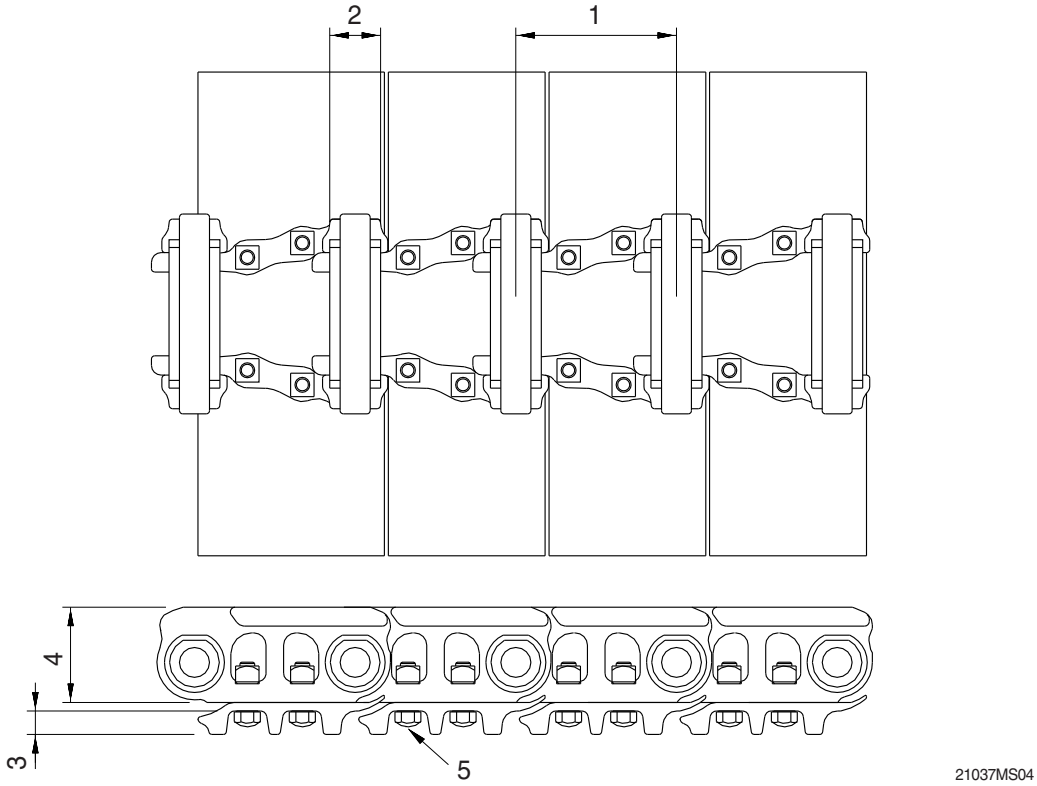
No.	Check item	Criteria						Remedy
1	Outside diameter of flange	Standard size				Repair limit		Rebuild or replace
		Ø560				–		
2	Outside diameter of tread	Ø520				Ø510		
3	Width of protrusion	84				–		
4	Total width	160				–		
5	Width of tread	38				43		
6	Clearance between shaft and bushing	Standard size & Tolerance				Standard clearance	Clearance limit	Replace bushing
		Shaft		Hole				
		Dimension	Tolerance	Dimension	Tolerance			
		Ø75	0 -0.03	Ø75.35	0.05 0	0.35~0.43	2.0	
7	Clearance between shaft and support	Ø75	0 -0.03	Ø75	0.07 0.03	0.03~0.1	1.2	Replace
8	Side clearance of idler (both side)	Standard clearance				Clearance limit		Replace bushing
		0.25~1.2				2.0		

(Mahcine Serial No. #1080-)

Unit : mm

No.	Check item	Criteria						Remedy
1	Outside diameter of flange	Standard size				Repair limit		Rebuild or replace
		Ø541.6				–		
2	Outside diameter of tread	Ø500				Ø490		
3	Width of protrusion	85				–		
4	Total width	160				–		
5	Width of tread	37.5				42.5		
6	Clearance between shaft and bushing	Standard size & Tolerance				Standard clearance	Clearance limit	Replace bushing
		Shaft		Hole				
		Dimension	Tolerance	Dimension	Tolerance			
		Ø75	-0.05 -0.08	Ø75	0.35 0.3	0.35~0.43	2.0	
7	Clearance between shaft and support	Ø75	-0.05 -0.08	Ø75	0.05 0.02	0.07~0.13	1.2	Replace
8	Side clearance of idler (both side)	Standard clearance				Clearance limit		Replace bushing
		0.25~1.2				2.0		

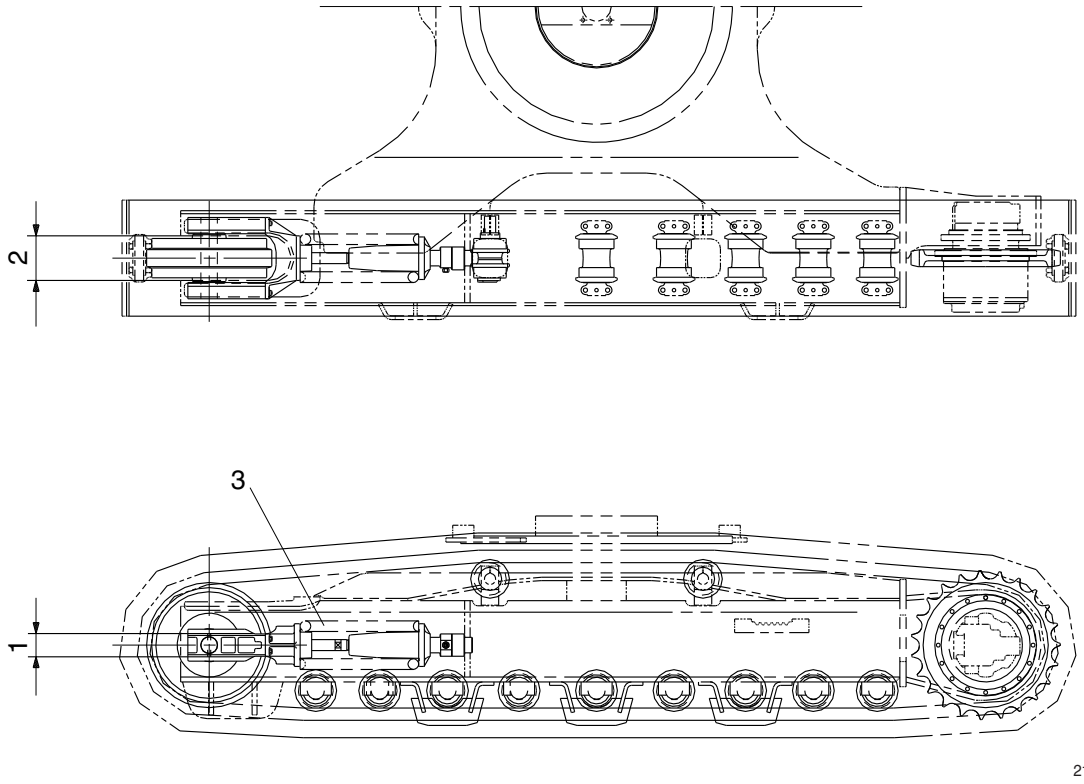
4) TRACK



Unit : mm

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		190	194.4	
2	Outside diameter of bushing	Ø59	Ø51	Rebuild or replace
3	Height of grouser	26	16	
4	Height of link	105	97	
5	Tightening torque	Initial tightening torque : 78 ± 8 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING



21037MS05

Unit : mm

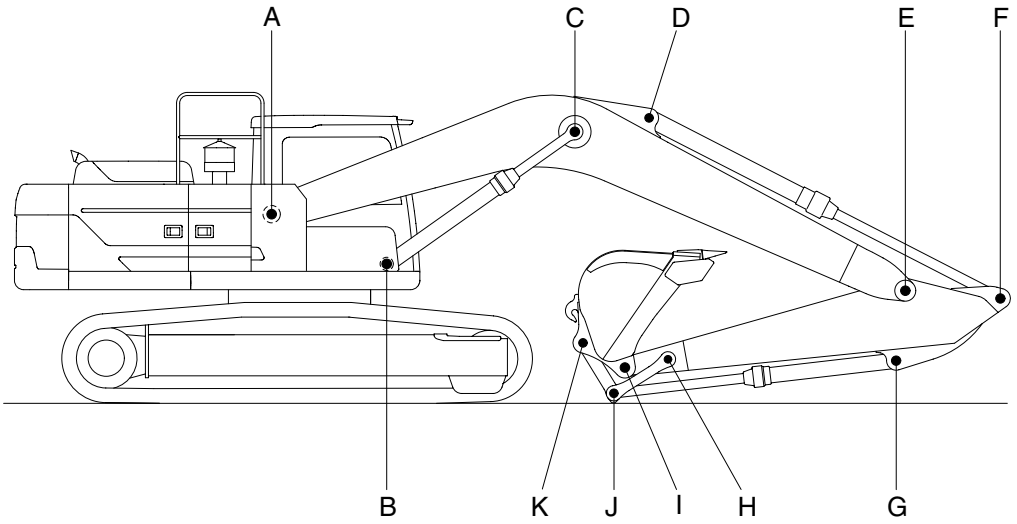
No.	Check item	Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit	Rebuild or replace
		Track frame		113	2.0 0	117	
		Idler support		110	-0.5 -1.0	106	
2	Horizontal width of idler guide	Track frame		272	2.0 0	276	
		Idler support		270	–	267	
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		515	431	13716 kg	–	10973 kg	

(Mahcine Serial No. #1080-)

Unit : mm

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide			Standard size	Tolerance	Repair limit	Rebuild or replace
		Track frame		112	2.0 0	116	
		Idler support		110	0 -0.5	106	
2	Horizontal width of idler guide	Track frame		220	2.0 0	224	
		Idler support		217	0.5 -1.0	214	
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		568	472	13310 kg	–	10648 kg	

2. WORK EQUIPMENT



260L7MS20

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	90	89	88.5	90.5	91	Replace
B	Boom Cylinder Head	80	79	78.5	80.5	81	〃
C	Boom Cylinder Rod	80	79	78.5	80.5	81	〃
D	Arm Cylinder Head	80	79	78.5	80.5	81	〃
E	Boom Front	90	89	88.5	90.5	91	〃
F	Arm Cylinder Rod	80	79	78.5	80.5	81	〃
G	Bucket Cylinder Head	80	79	78.5	80.5	81	〃
H	Arm Link	70	69	68.5	70.5	71	〃
I	Bucket and Arm Link	80	79	78.5	80.5	81	〃
J	Bucket Cylinder Rod	80	79	78.5	80.5	81	〃
K	Bucket Link	80	79	78.5	80.5	81	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

Group 1 Precaution 8-1
Group 2 Tightening Torque 8-4
Group 3 Pump Device 8-7
Group 4 Main Control Valve 8-33
Group 5 Swing Device 8-57
Group 6 Travel Device 8-87
Group 7 RCV Lever 8-119
Group 8 Turning Joint 8-133
Group 9 Boom, Arm and Bucket Cylinder 8-138
Group 10 Undercarriage 8-163
Group 11 Work Equipment 8-176

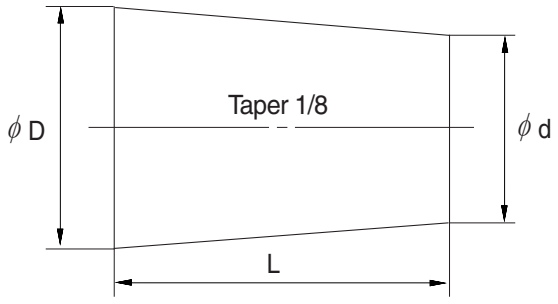
SECTION 8 DISASSEMBLY AND ASSEMBLY

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 100㎜ 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, FR)	M20×2.5	52.1±5.0	377±36.2
3		Engine mounting bolt (bracket-frame, RR)	M24×3.0	90±9.0	651±65.1
4		Radiator mounting bolt	M16×2.0	29.7±4.5	215±32.5
5		Coupling mounting socket bolt	M18×2.5	32±1.0	231±7.2
6		Fuel tank mounting bolt	M20×2.5	46±5.1	333±36.9
7	Hydraulic system	Main pump housing mounting bolt	M10×1.5	6.5±0.7	47±5.1
8		Main pump mounting socket bolt	M20×2.5	42±4.5	304±32.5
9		Main control valve mounting nut	M12×1.75	12.3±1.3	89.0±9.4
10		Hydraulic oil tank mounting bolt	M20×2.5	46±5.1	333±36.9
11		Turning joint mounting bolt, nut	M12×1.75	12.3±1.3	89.0±9.4
12	Power train system	Swing motor mounting bolt	M20×2.5	57.9±5.8	419±42
13		Swing bearing upper part mounting bolt	M20×2.5	57.9±6.0	419±43.4
14		Swing bearing upper part mounting bolt (HW)	M24×3.0	100±15	723±109
15		Swing bearing lower part mounting bolt	M20×2.5	57.9±6.0	419±43.4
16		Swing bearing lower part mounting bolt (HW)	M24×3.0	100±15	723±109
17		Travel motor mounting bolt	M16×2.0	23±2.5	166±18.1
18		Sprocket mounting bolt	M16×2.0	29.7±3.0	215±21.7
19	Under carriage	Carrier roller mounting bolt, nut	M16×2.0 M20×2.5★	29.7±3.0 57.9±6.0★	215±21.7 419±43.4★
20		Track roller mounting bolt	M20×2.5 M16×2.0★	57.9±6.0 29.7±3.0★	419±43.4 215±21.7★
21		Track tension cylinder mounting bolt	M16×2.0	29.7±3.0	215±21.7
22		Track shoe mounting bolt, nut	M20×1.5	78±8.0	564±57.9
23		Track guard mounting bolt (goneral)	M20×2.5	57.9±8.7	419±62.9
24		Track guard mounting bolt (full track)	M24×3.0	100±15	723±109
25	Others	Counterweight mounting bolt	M36×3.0	337±33	2440±239
26		Cab mounting bolt	M12×1.75	12.8±3.0	92.6±21.7
27		Operator's seat mounting bolt	M8×1.25	4.05±0.8	29.3±5.8
28		Under cover mounting bolt	M12×1.75	12.8±3.0	92.6±21.7

★ : Mahcine Serial No. #1080-

※ 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

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) Remove the wirings for the pressure sensors and so on.

(5) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 160 ℓ
(42.3 U.S. gal)

(6) Remove socket bolts (24) and disconnect pipe (10, 11).

(7) Disconnect pilot line hoses (2, 3, 4, 5).

(8) Remove socket bolts (23) and disconnect pump suction tube (1).

※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

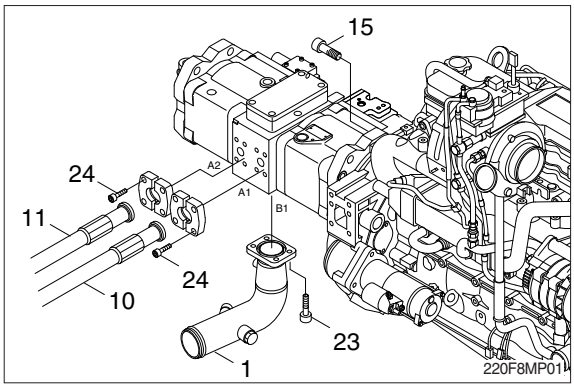
(9) Sling the pump assembly and remove the pump mounting bolts (15).

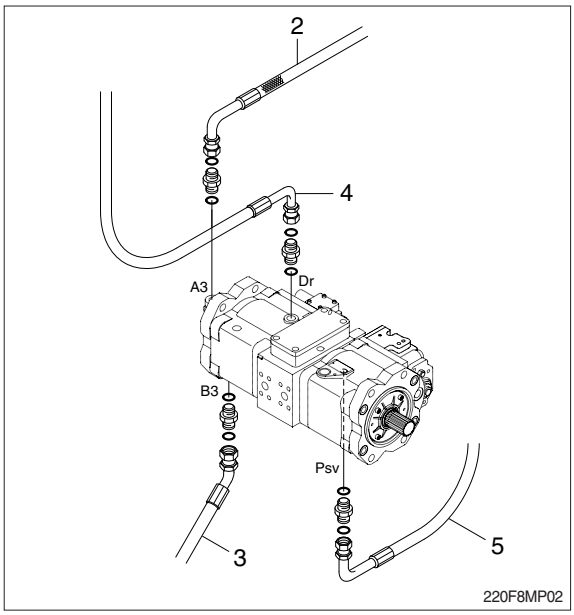
· Weight : 140 kg (310 lb)

· Tightening torque : 42 ± 4.5 kgf·m
(304 ± 32.5 lbf·ft)

※ Pull out the pump assembly from housing. When removing the pump assembly, check that all the hoses have been disconnected.







2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

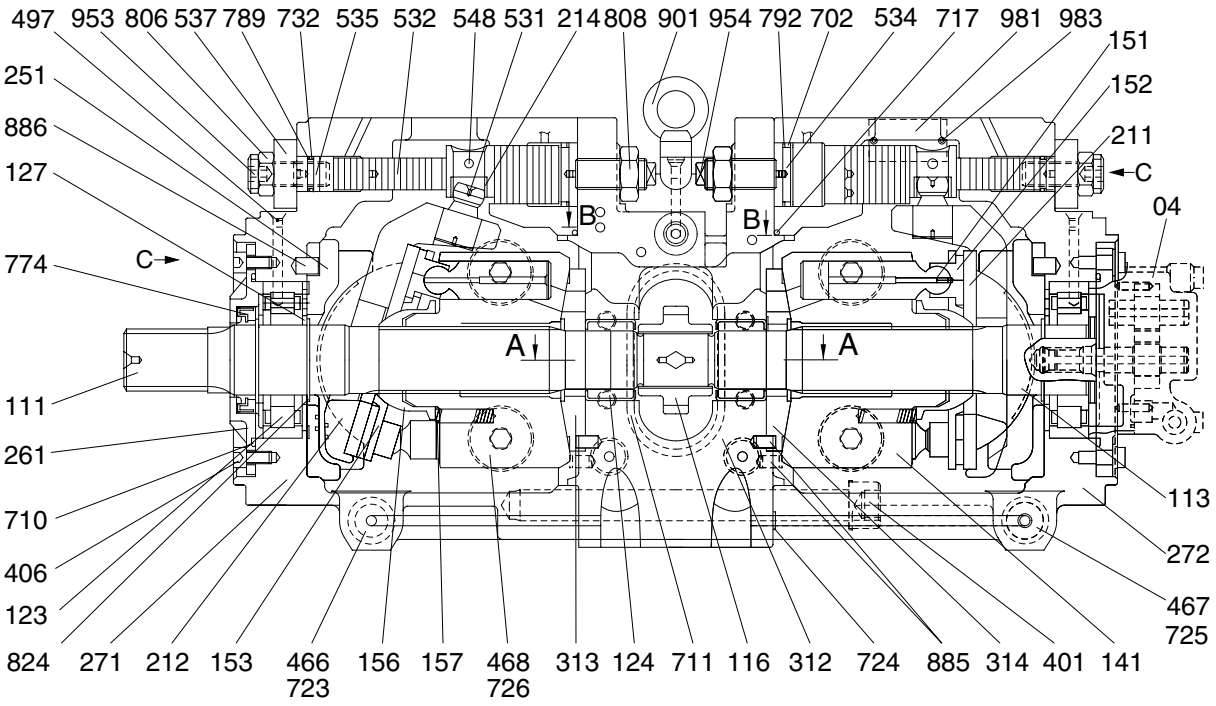
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(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 (1/2)

1) STRUCTURE

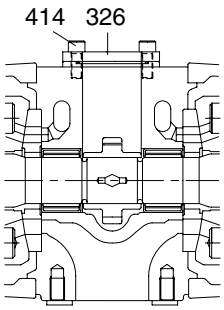


※ Section A-A, B-B, view C : see next page.

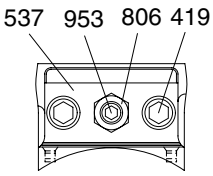
220F2MP05

04	Gear pump	272	Pump casing (R)	711	O-ring
111	Drive shaft (F)	312	Valve block B	717	O-ring
113	Drive shaft (R)	313	Valve plate (R)	723	O-ring
116	1st gear	314	Valve plate (L)	724	Square ring
123	Roller bearing	401	Hexagon socket bolt	725	O-ring
124	Needle bearing	406	Hexagon socket bolt	726	O-ring
127	Bearing spacer	466	Plug	732	O-ring
141	Cylinder block	467	Plug	774	Oil seal
151	Piston	468	Plug	789	Back up ring
152	Shoe	497	Plug	792	Back up ring
153	Set plate	531	Tilting pin	806	Hexagon head nut
156	Spherical bushing	532	Servo piston	808	Hexagon head nut
157	Cylinder spring	534	Stopper (L)	824	Snap ring
211	Shoe plate	535	Stopper (S)	885	Pin
212	Swash plate	537	Servo cover	886	Pin
214	Tilting bushing	548	Feedback pin	901	Eye bolt
251	Support	702	O-ring	953	Set screw
261	Seal cover (F)	710	O-ring	954	Set screw
271	Pump casing (F)				

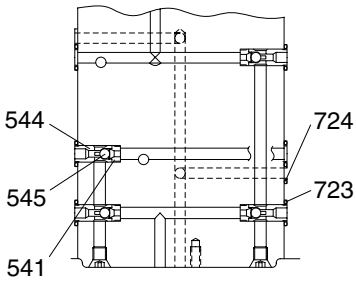
MAIN PUMP (2/2)



SECTION A-A



VIEW C



SECTION B-B

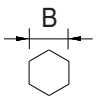
220F2MP06

326	Cover	541	Seat	724	Square ring
414	Hexagon socket bolt	544	Stopper 1	806	Hexagon head nut
419	Hexagon socket bolt	545	Steel ball	953	Set screw
537	Servo cover	723	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the following list.

Tool name & size		Part name		
Name	B	Hexagon socket head bolt	ROH, VP plug (Parallel thread)	Hexagon socket head setscrew
Allen wrench 	6	M 8	PF 1/4	M12, M14
	8	M10	PF 3/8	M16, M18
	10	M12	PF 1/2	M20
	14	M16, M18	PF 3/4	-
	17	M20, M22	PF 1	-
Adjustable angle wrench		Medium size, 1 set		
Screw driver		Minus type screw driver, Medium size, 2 pieces		
Hammer		Plastic hammer, 1 pieces		
Pliers		For snap ring, TSR-160		
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	16.3	118	0.47	12
	M16	23.5	170	0.55	14
	M18	33.7	244	0.55	14
	M20	43.8	317	0.67	17
ROH Plug PF 3/8 or under : S45C PF 1/2 or over : SCM435	PF 1/4	3.0	21.7	0.24	6
	PF 3/8	7.5	54.2	0.31	8
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.3	111	0.47	12

3) DISASSEMBLY

For disassembling the pump, read this section thoughly and then disassemble it in the following sequence. The figures in parentheses after part names show the item in structure drawing.

(1) Select place suitable to disassembling.

※ Select clean place.

※ Spread rubber sheet, cloth or so on overhaul workbench top to prevent parts from being damaged.

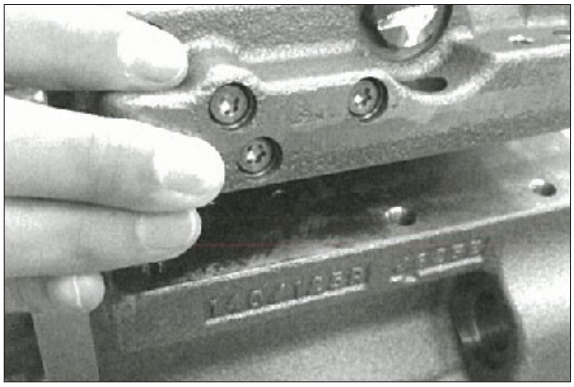
(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let the oil out from pump casing (271, 272).

※ For tandem type pump, remove plugs of both front and rear pumps.

(4) Remove hexagon socket head bolts (412) and remove regulator.

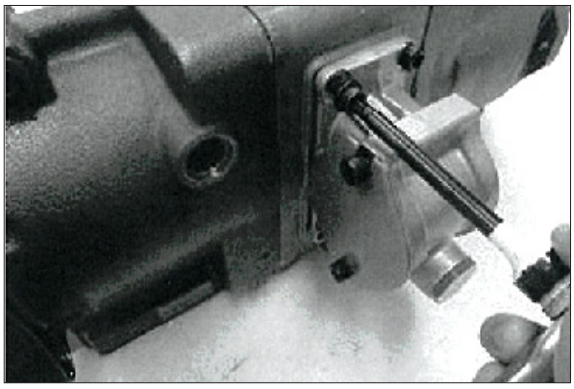
※ Refer to page 8-28 for disassemble regulator.



220F8MP11

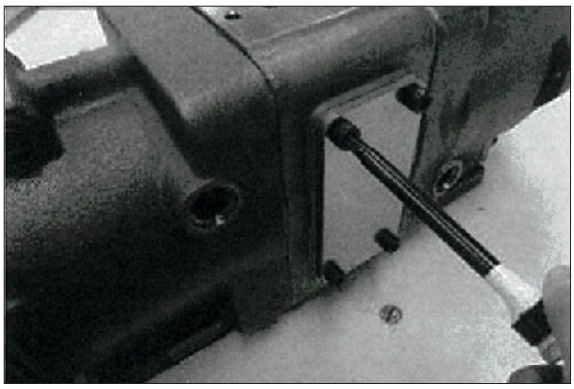
(5) Place the pump horizontally on workbench with its regulator-fitting surface down, and remove PTO unit from valve block (if equipped).

※ Before bringing regulator-fitting surface down, spread rubber sheet on workbench to avoid damaging the surface.



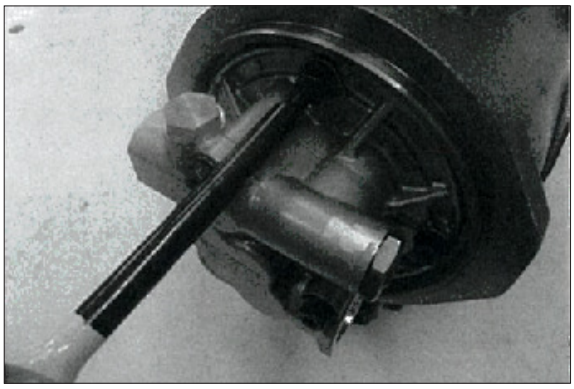
220S8MP13

※ In case the pump is provided without PTO unit, remove the cover (326) with the hexagon socket head cap screws.



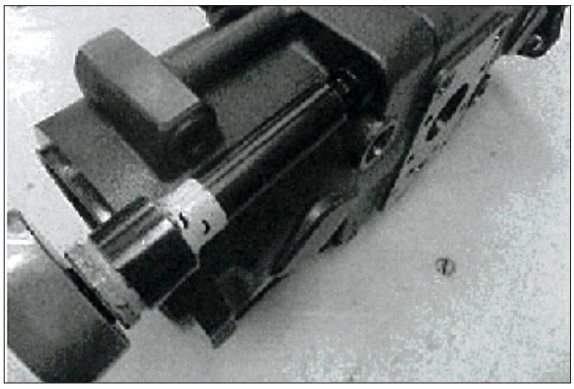
220S8MP14

(6) Remove flange sockets (435) and the gear pump (04).



220S8MP15

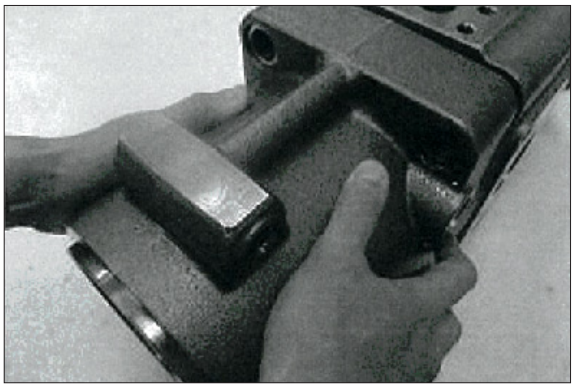
(7) Loosen hexagon socket head bolts (401) which tighten pump casing (F, 271) pump casing (R, 272), and valve block (312).



220S8MP16

(8) Separate pump casing (F, 271), pump casing (272), from valve block (312)

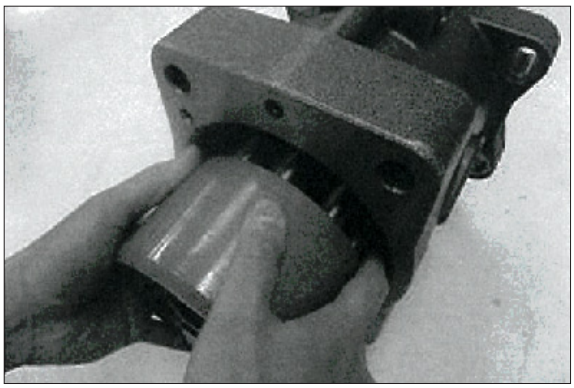
※ Remove the 1st gear (116), when pump casings are separated from valve block.



220S8MP17

(9) Pull out cylinder block (141), piston-shoes (011), set plate (153), spherical bushng (156), and cylinder springs (157) simultaneously from pump casing (F, 271) and (R, 272), straightly over drive shaft (111, 113)

※ Take care not to damage sliding surface of cylinder block (141), spherical bushing (156), piston-shoes (011), swash plate (212), drive shaft (111, 113), etc.

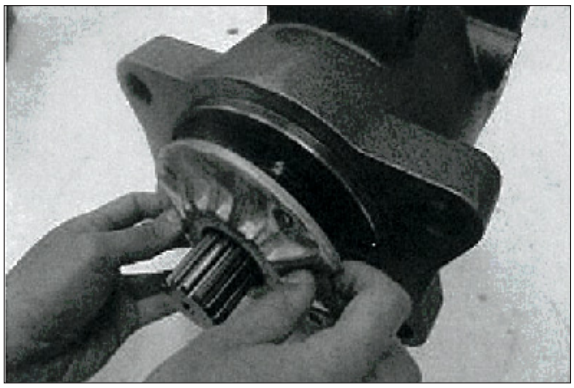


220S8MP18

(10) Remove hexagon socket head bolts (406) and seal cover (F, 261).

※ In the case it is difficult to remove, put flat-blade screwdriver into the notch of seal cover. Then the cover can be removed easily.

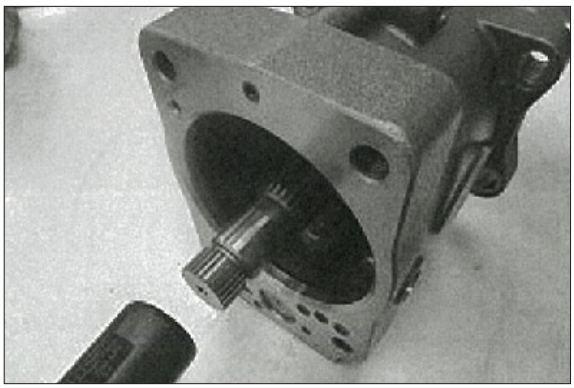
※ Since oil seal is fitted on seal cover (F, 261), take care not to damage it while removing cover.



220S8MP19

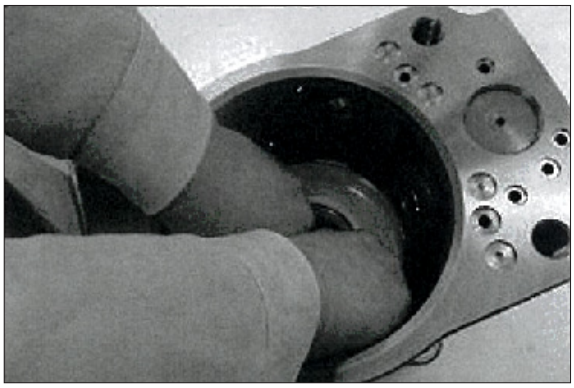
(11) Remove the drive shafts (111, 113) from the pump casing (271, 272), lightly with plastic hammer, remove them from pump casing (271, 272)

※ In the case it is difficult to remove, tap the end of the drive shaft lightly with plastic hammer.

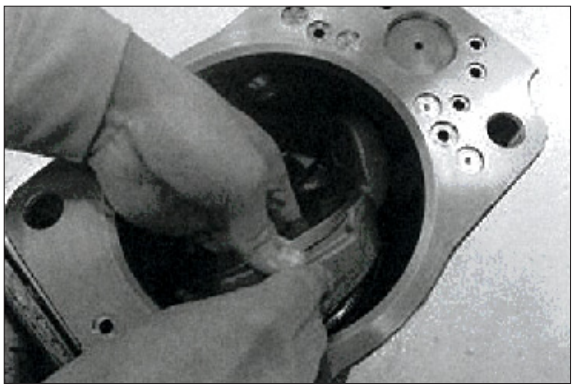


220F8MP20

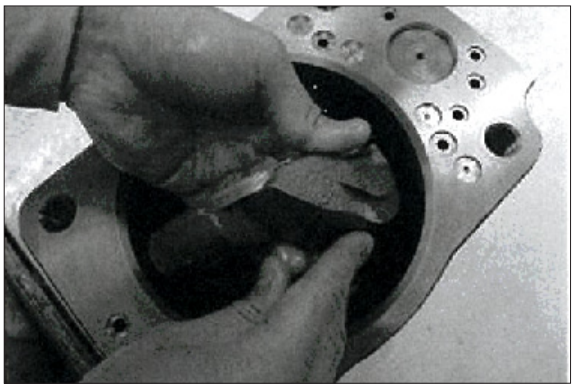
(12) Remove the swash plates (212) and shoe plates (211) from swash plate support (251), and pull out the swash plates with turning shown in this picture from casing.



220S8MP21



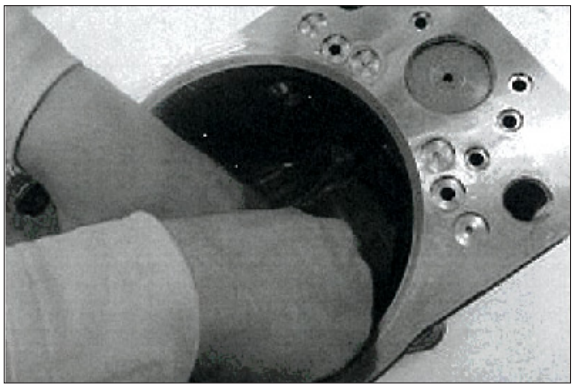
220S8MP22



220S8MP23

(13) Remove swash plate supports (251) from pump casing.

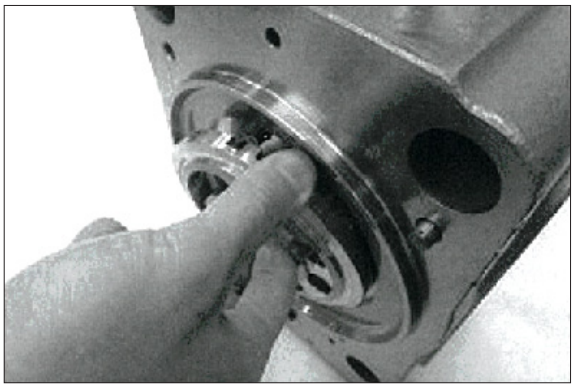
※ In the case it is difficult to remove, tap the opposite side of the swash plate support (251) with plastic hammer to remove it from pump casing easily.



220S8MP24

(14) Remove valve plates (313, 314) from valve block (312)

※ There may be removed in work (7).



220S8MP25

(15) If necessary, remove the servo covers (537), stopper (L, 534), stopper (S, 535), and servo piston sub (530) from pump casing (271, 272).

※ Do not remove needle bearing (124) as far as possible, except the case that the bearing is considered to be out of its life-time.

※ Do not loosen hexagon nuts of valve block (312) and servo cover (537). If loosened, flow setting will be changed.

4) REASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following.

① Do not fail to repair the parts damaged during dissassembling, and repair replacement part in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Apply clean working oil to sliding sections, bearings, etc. before assembling them.

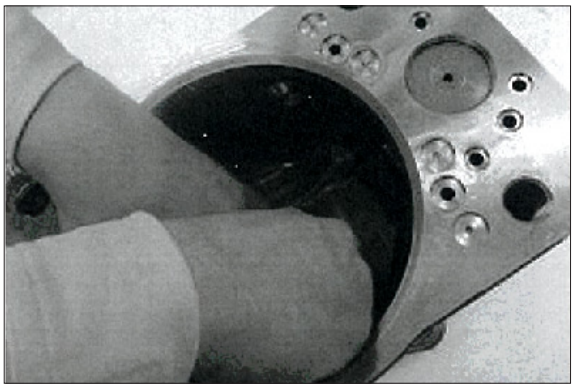
④ In general rule, replace the sealing parts, such as O-ring, oil seal, etc.

⑤ For fitting bolts, plug, etc. prepare a torque wrench or so on, and tighten them with torque shown at page 8-12.

⑥ For the tandem type pump, take care not to mix up parts of the front pump with those of the rear pump

(2) Insert swash plate supports (251) into the casing (F, 271) and (R, 272) with fitting.

※ If the servo piston, stopper (L), stopper (S), and servo cover are removed, fit them to pump casing in advance for reassembling.



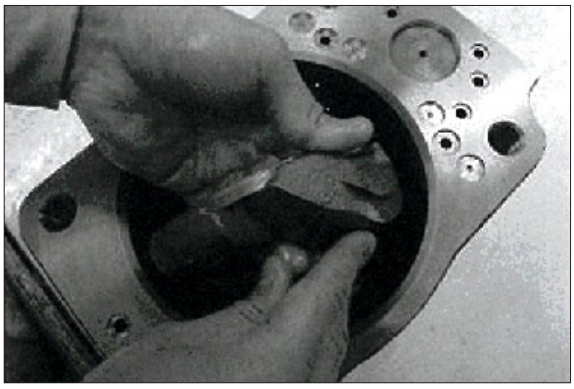
220S8MP24

(3) Attach shoe plate (211) to swash plate (212) and insert tilting pin (531) to tilting bushing (214) of servo piston (532). As shown in the right figure, attach to swash plate support (251) correctly, leaning swash plate and shoe plate.

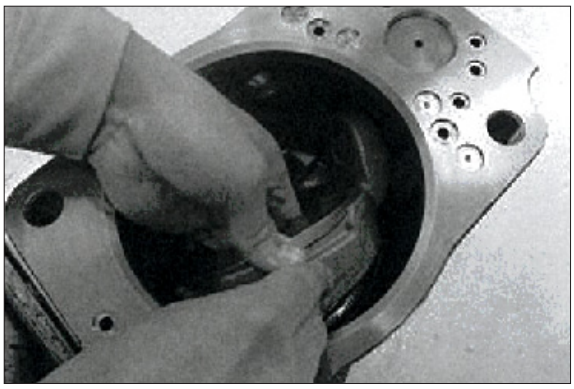
※ Confirm with fingers of both hands that swash plate can moved smoothly.

※ Apply grease to sliding sections of swash plate and swash plate support, to assemble the drive shaft easily.

※ Take care not to damage the sliding surface of the shoe plate.



220S8MP23

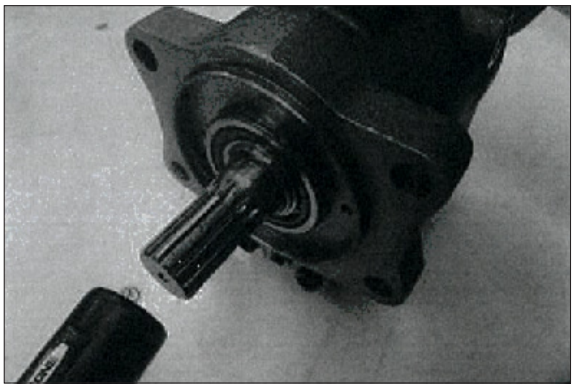


220S8MP22



220S8MP21

(4) Fit drive shaft (111, 113) where bearing (123), bearing spacer (127), snap ring (824) were set to pump casing (271, 272).

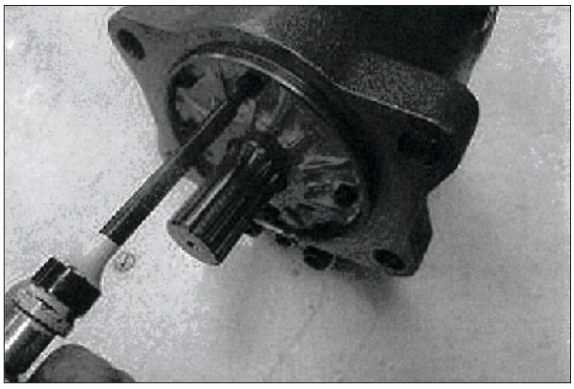


220S8MP20

(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.

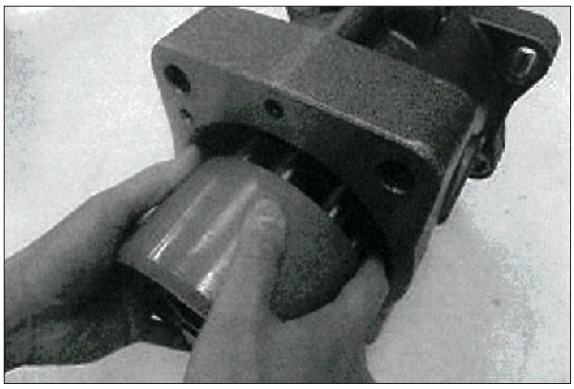


220S8MP26

(6) Assemble piston cylinder sub assembly [cylinder (141), piston sub assembly (151, 152), set plate (153), spherical bushing (156) and cylinder spring (157)].

※ Fit spline phases of spherical bushing and cylinder.

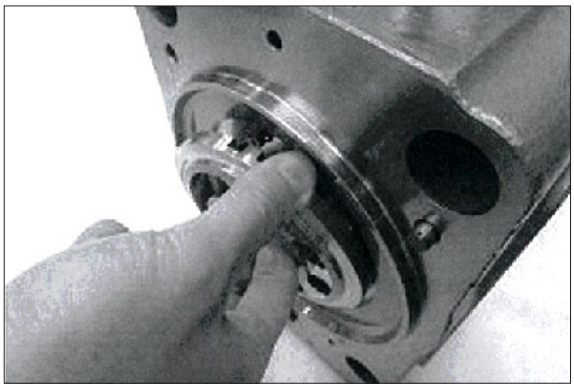
※ Then, insert piston cylinder subassembly into pump casing.



220S8MP18

(7) Fit valve plate (313) to valve block (312) according to pin (885).

※ Take care not to mistake suction/delivery directions of valve plate.



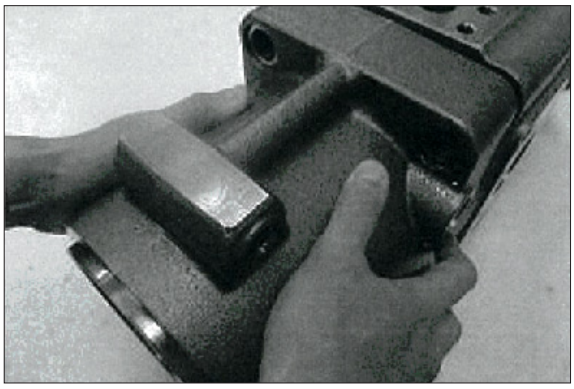
220S8MP27

(8) Place pump horizontally on workbench with its regulator-fitting surface down, and attach pump casing (271) to valve block (312).

※ Before bringing regulator-fitting surface down, spread rubber sheet on workbench and do not damage this surface.

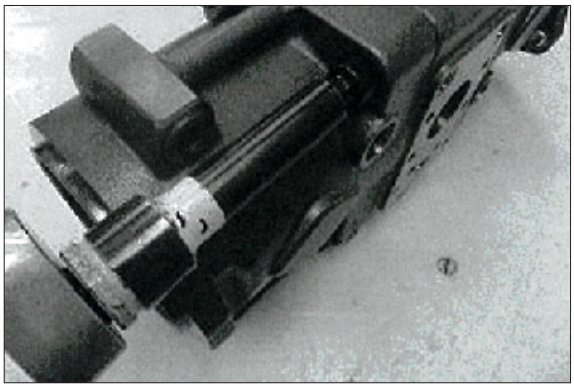
※ Take care not to mistake direction of valve block. [clockwise rotation (viewed from input shaft side)]. Fit the valve block with suction flange left when regulator side below, viewed from front side.

※ Fit 1st gear simultaneously.



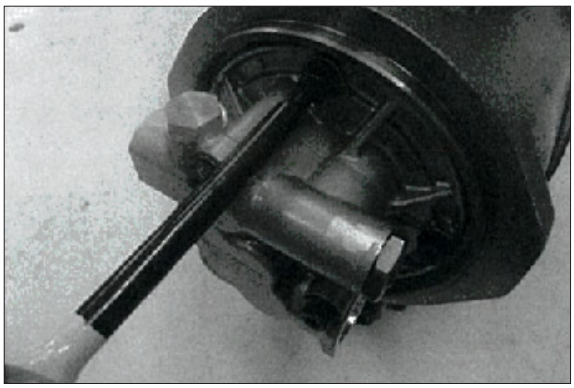
220S8MP17

(9) Fit valve block (312) to pump casing (271, 272) with hexagon socket head bolts (401, 402).



220S8MP16

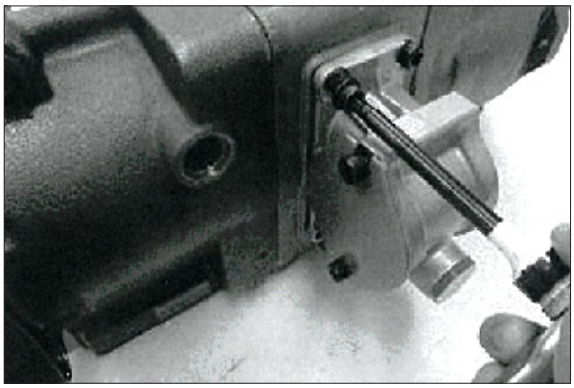
(10) Fit gear pump (04) to pump casing (271) with hexagon socket head bolts.



220S8MP15

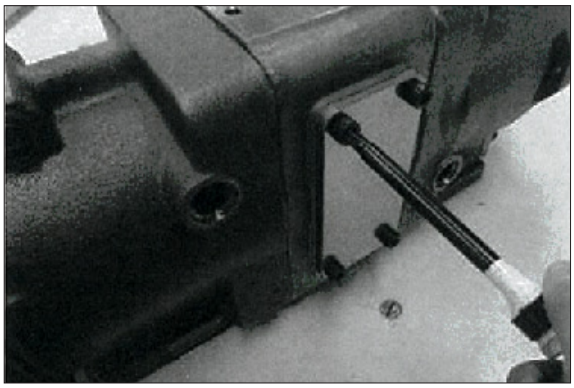
(11) Attach the PTO unit (05) by fastening the flange socket to the valve block (312).

※ Be careful about the attaching direction of the PTO unit.



220S8MP13

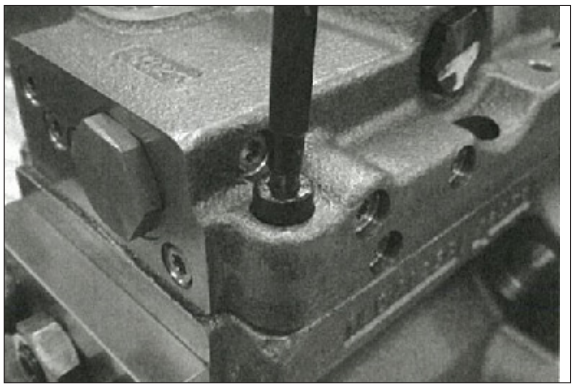
In case the pump is not provided with the PTO unit (05), attach the cover (326) with the hexagon socket head cap screws (414).



220S8MP14

(12) Putting feedback lever of regulator into feedback pin (548) of tilting pin (531), fit regulator with hexagon socket head bolts.

※ Take care not to mix up regulator of front pump with another.



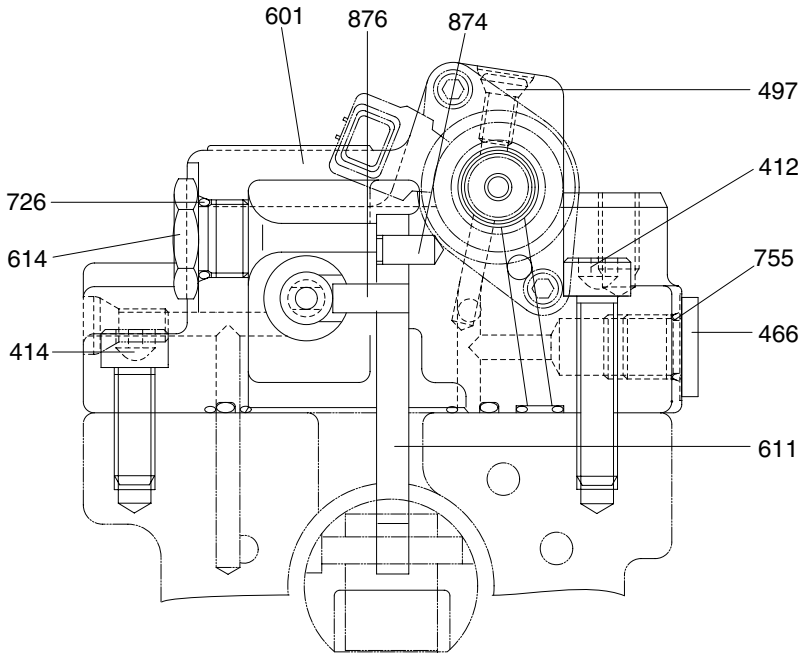
220F8MP28

(13) Fit drain port plug (467).

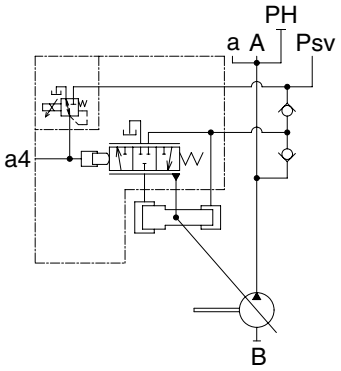
This is the end of reassembling procedure.

3. REGULATOR

1) STRUCTURE (1/2)



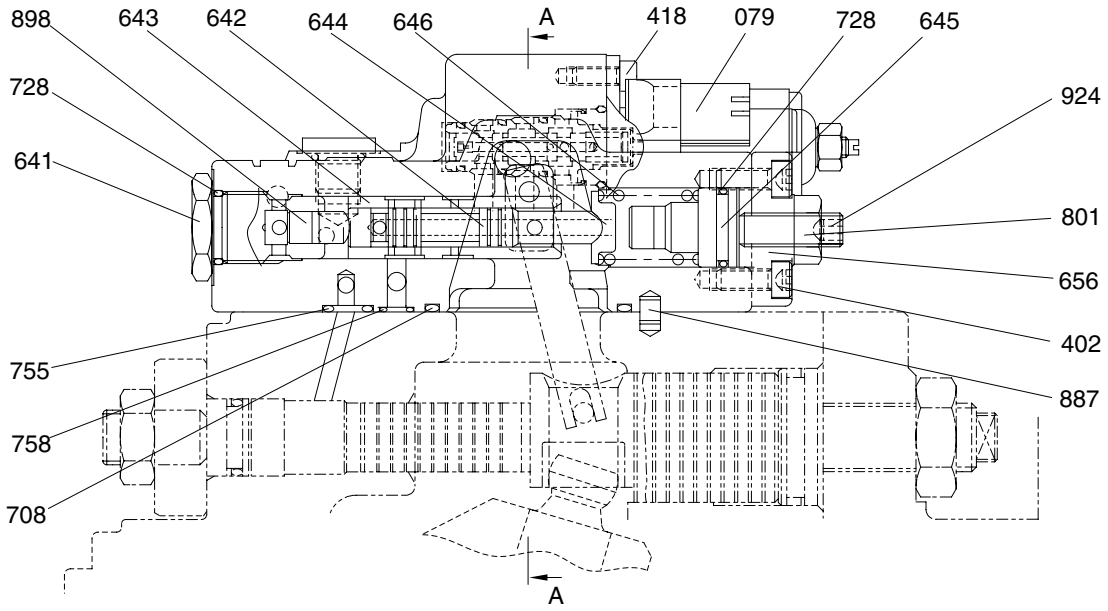
SECTION A-A



220F2MP08

412	Hexagon socket screw	601	Casing	755	O-ring
414	Hexagon socket screw	611	Feedback lever	874	Pivot pin
466	Plug	614	Adjust plug	876	Pin
497	Plug	726	O-ring		

STRUCTURE (2/2)



SECTION A-A

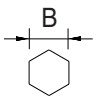
220F2MP09

402	Hexagon socket screw	645	Adjust stem (Q)	758	Square ring
418	Hexagon socket screw	646	Pilot spring	801	Nut
641	Pilot plug	656	Cover	887	Pin
642	Pilot spool	708	O-ring	898	Pilot piston
632	Pilot sleeve	728	O-ring	924	Set serew
644	Spring seat (Q)	755	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the following list.

Tool name & size		Part name		
Name	B	Hexagon socket head cap screw	Pressure plug (taper thread)	Hexagon socket head set screw
Allen wrench Spanner 	4	M 5	-	M8
	5	M 6	-	M10
	6	M 8	ROH 1/4	M12, M14
	22	-	VP 3/8	-
	27	M18	VP 1/2	-
Adjustable angle wrench		Medium size, 1 set		
Torque wrench		Capable of tightening with the specified torques		
Hexagon socket head cap screw		M4, Length : 50 ㎜		

(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 7	3.0	21.7	0.24	6
	M 8	5.8	42	0.31	8
	M 9	10.0	72.3	0.39	10
	M14	16.3	118	0.47	12
	M16	23.5	170	0.55	14
	M18	33.7	244	0.55	14
	M20	43.8	317	0.67	17
	M22	64.2	464	0.67	17
PT Plug (Material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/8	1.2	8.7	0.20	5
	PT 1/4	2.2	15.9	0.24	6
	PT 3/8	4.5	32.5	0.31	8
	PT 1/2	6.6	47.7	0.39	10
ROH Plug PF 3/8 or under : S45C PF 1/2 or over : SCM435	PF 1/4	3.5	25.3	0.24	6
	PF 3/8	7.5	54.2	0.31	8
	PF 1/2	11.2	81.0	0.39	10
	PF 3/4	17.3	125	0.55	14

3) DISASSEMBLY

(1) Preparation for disassembling

① Since the regulator consists of small, precision, and well-finished parts, disassembling and assembling are rather complicated. For this reason, replacement of a regulator assembly is recommended, unless there is a special reason. If in case disassembling is necessary for an unavoidable special reason, read through this manual to the end before starting disassembling.

② Since the regulators on the front pump and the rear pump are set at different pressure and flow values, mark each of them so as not to mix up one of front pump with another.

③ For reason that regulator contain two parts which are tightened with large torque, prepare a vise to hold the regulator stable.

④ The numbers in parentheses after part names represent those in the cross-sectional drawings (on page 8-23, 24)

(2) Select a place for disassembling.

※ Select clean place.

※ Spread rubber sheet or cloth to cover the workbench to prevent parts from being damaged.

(3) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(4) Remove hexagon socket head cap screws (412, 414) and remove regulator from the pump.

※ If the pump is disassembled, check the page 7-21 for this axial piston pump.

※ Take care not to lose O-ring while removing regulator.

(5) Remove hexagon socket head cap screws (418) and remove the proportion reducing valve.

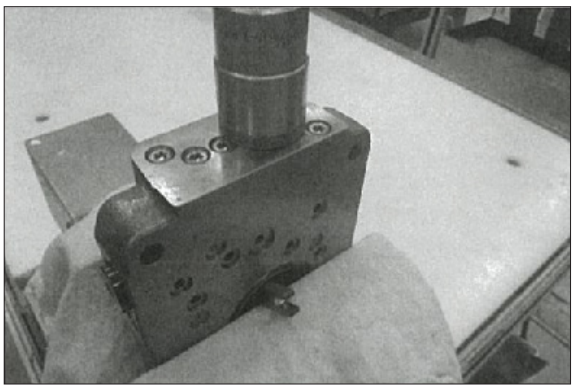
※ Do not damage to the proportional reducing valve's connector.

(6) Loosen the pilot plug (641).

※ Do not remove the pilot plug (641). If it is removed, the pilot spring (646) and the spring stem (Q, 644) will fall from casing.

※ Be careful not to damage regulator casing (601) while loosening the pilot plug (641).

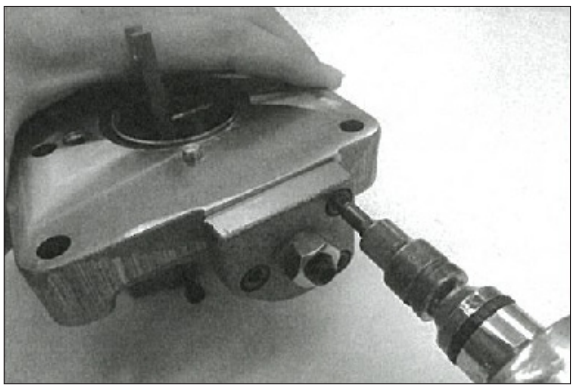
※ Do not damage to the regulator casing while using a vise.



220F8MP30

(7) Remove hexagon socket head cap screws (402) and remove cover (656)

※ Cover (656) is fixed with adjusting screw (924), hexagon nut (801). Do not loosen screw and nut. If they are loosened, adjusted pressure-flow setting will be changed.

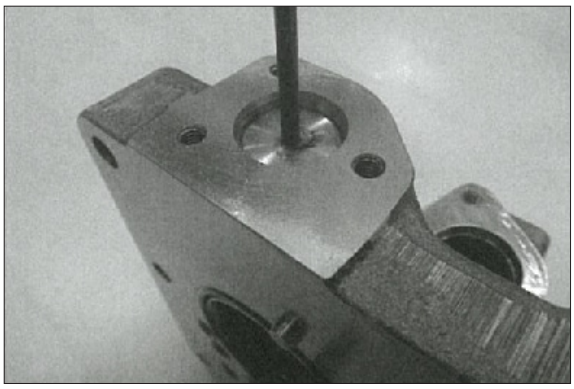


220F8MP31

(8) Remove the adjusting stem (Q, 645), the pilot spring (646), and the spring seat (Q, 644) from regulator.

※ Adjusting stem (Q, 645) can easily be drawn out with M4 screw.

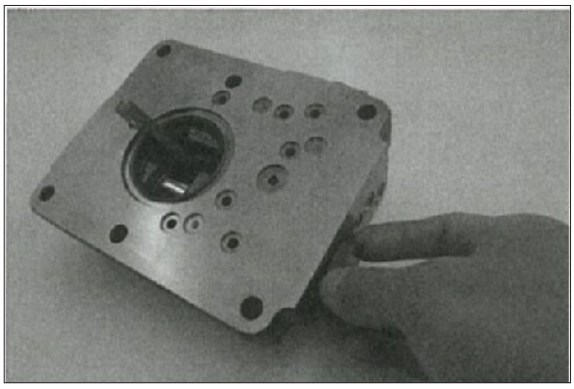
※ Take care not to lose the pilot spring (646) and the spring stem (Q, 644) which they fall from casing when the adjusting stem (Q, 645) is removed.



220F8MP32

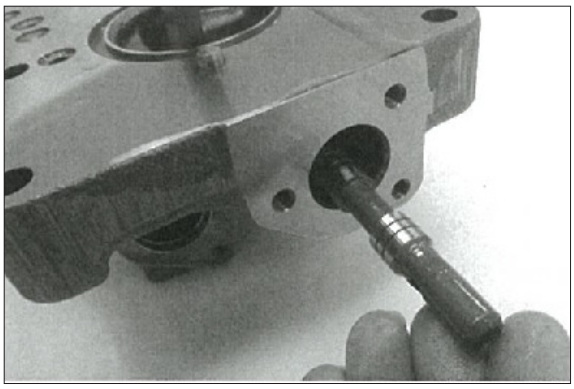
(9) Remove the pilot plug (641) and the pilot piston (898).

※ Take care not to lose the pilot piston (898) because of its smallness.



220F8MP33

(10) Remove the pilot spool (642) from pilot section.

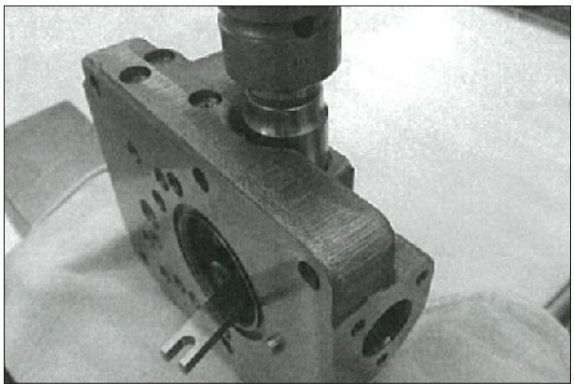


220F8MP34

(11) Remove the adjusting plug (614) and feedback lever (611) from the casing.

※ Be careful not to damage regulator casing (601) while loosening the adjusting plug (614).

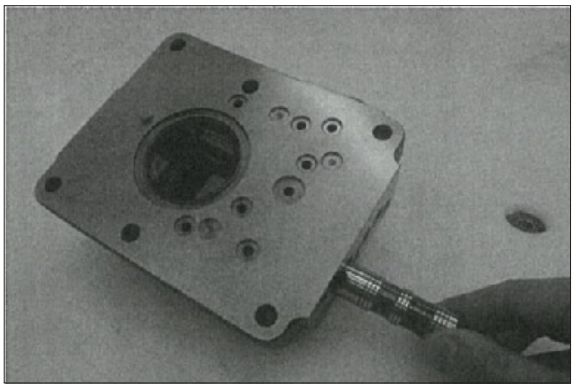
※ Do not remove the pin (876) from the feedback lever (611).



220F8MP35

(12) Remove the pilot sleeve (643).

※ This completes operation.



220F8MP36

※ Since component part are small, take care not to them.

4) REASSEMBLY

(1) For assembling, reverse disassembling procedures. But pay attention to the following.

① Repair parts that were damaged at disassembling.
Prepare replacement parts beforehand.

② Contamination will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Tighten screws, plugs, etc. with their specified torques.

④ Replace seals such as O-ring with new ones as a general rule.

(2) Select a place for assembling.

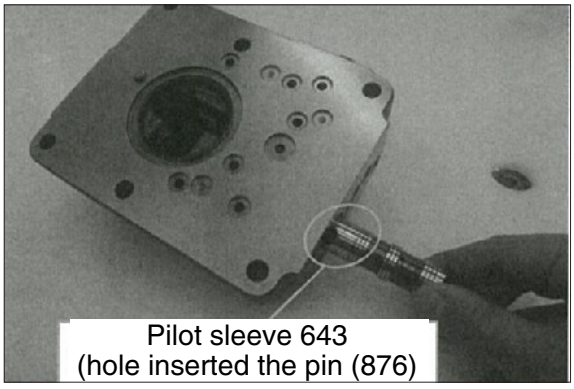
※ Select clean place.

※ Spread rubber sheet or cloth to cover the workbench to prevent parts from being damaged.

(3) Fit the pilot sleeve (643) into pilot section of the casing (601).

※ Be careful not to fit the pilot sleeve (643) with the wrong way.

※ Confirm the the sleeve slides smoothly in casing without sticking.

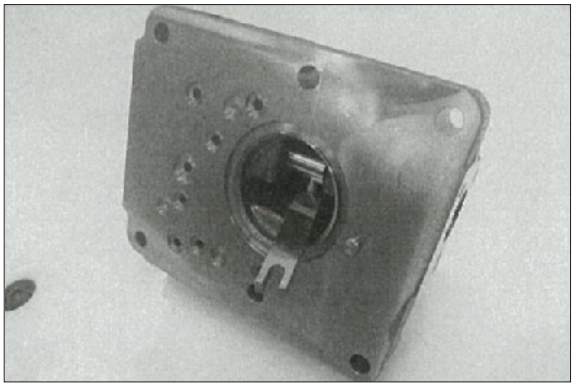


Pilot sleeve 643
(hole inserted the pin (876)

220F8MP37

(4) Insert the pin (876) fixed on feedback lever (611) to the oval shaped hole of the sleeve (643) and fit the hole of the feedback lever to the pin (874) fixed inside the casing (601).

※ If the pilot spool (642) is in the pilot sleeve (643), the pin (876) can not be inserted to the pilot sleeve.

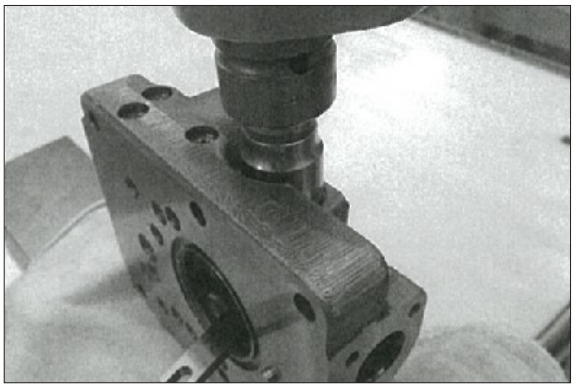


220F8MP38

(5) Tighten the adjusting plug (614) to the casing (601).

※ Be careful not to damage regulator casing (601) while tightening the adjusting plug (614).

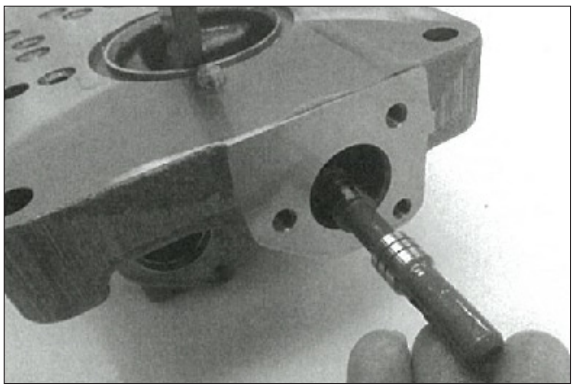
※ Confirm that the sleeve slides smoothly in casing without sticking or excess play among parts.



220F8MP39

(6) Fit the pilot spool (642) into the pilot sleeve (643).

※ Be careful not to fit the pilot spool (642) with the wrong way.

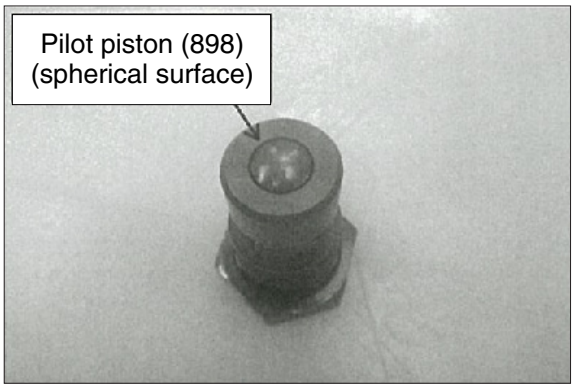


220F8MP40

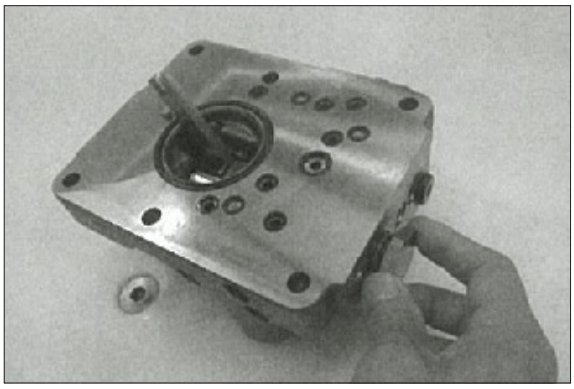
(7) After the pilot piston (898) is fitted into the pilot plug (641), put the plug to the casing (601).

※ Be careful not to fit the pilot piston (898) with the wrong way.

※ At the present stage, it is no need to tighten the pilot plug (641) with recommended torque.



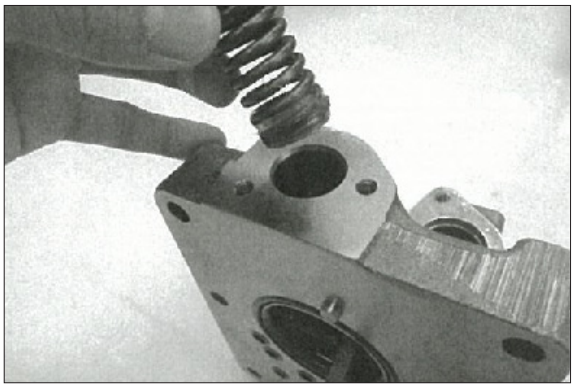
220F8MP41



220F8MP42

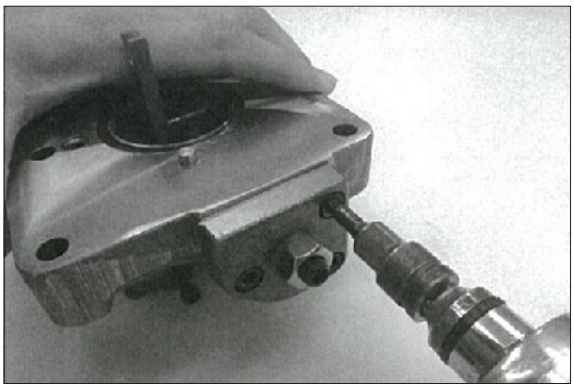
(8) Put the spring seat (Q, 644) and the pilot spring (646) into the pilot section of the casing (601).

※ Be careful not to fall the spring seat (Q). Recommended to apply grease to the spring seat to prevent falling.



220F8MP43

(9) Put the adjusting stem (Q, 645), and tighten the cover (656) with the adjusting screw (924) and the hexagon nut (801) with hexagon socket head cap screws (402).

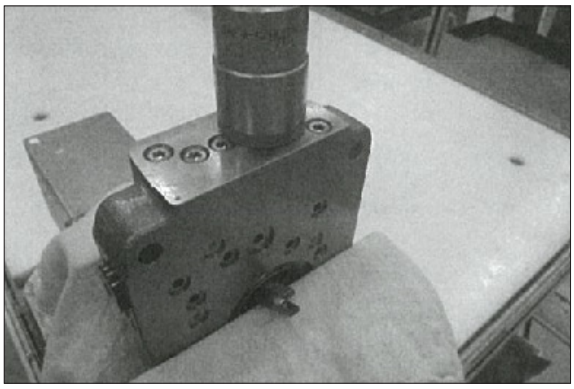


220F8MP44

(10) Tight the pilot plug (641) to the casing (601).

※ Be careful not to damage regulator casing (601) while tightening the pilot plug (641).

※ Do not damage to the regulator casing while using a vise.



220F8MP45

(11) Tighten the proportional reducing valve with hexagon socket head cap screw (418).

※ This completes assembling.

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the wirings for the pressure sensor and so on.

(5) Remove mounting bolts and disconnect pipe.

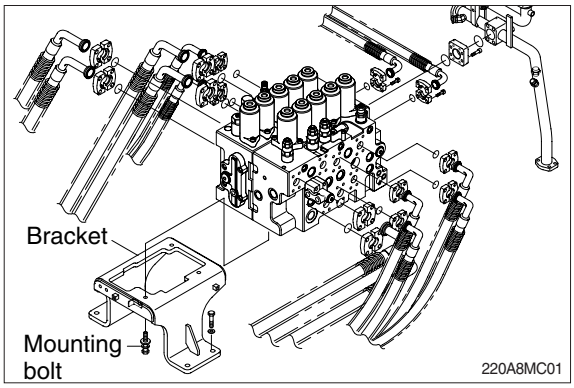
(6) Disconnect pilot line hoses.

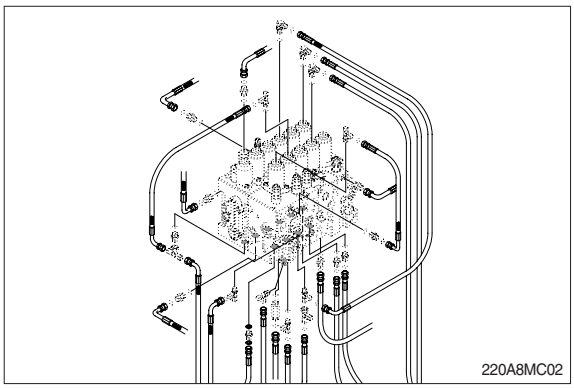
(7) Disconnect pilot piping.

(8) Sling the control valve assembly and remove the control valve mounting bolt and bracket.
- Weight : 220kg(485lb)
- Tightening torque : 12.3 ± 1.3 kgf·m (89.0 ± 9.4 lbf·ft)

(9) Remove the control valve assembly.
When removing the control valve assembly, check that all the piping have been disconnected.





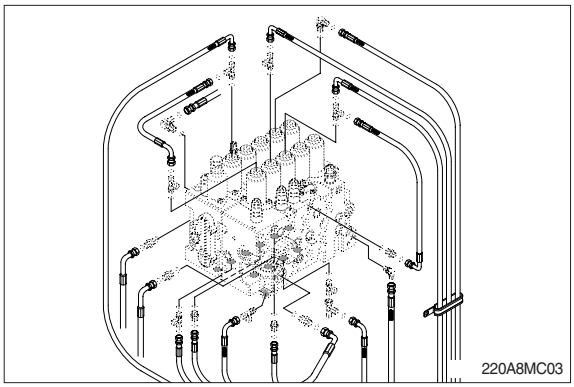


2) INSTALL

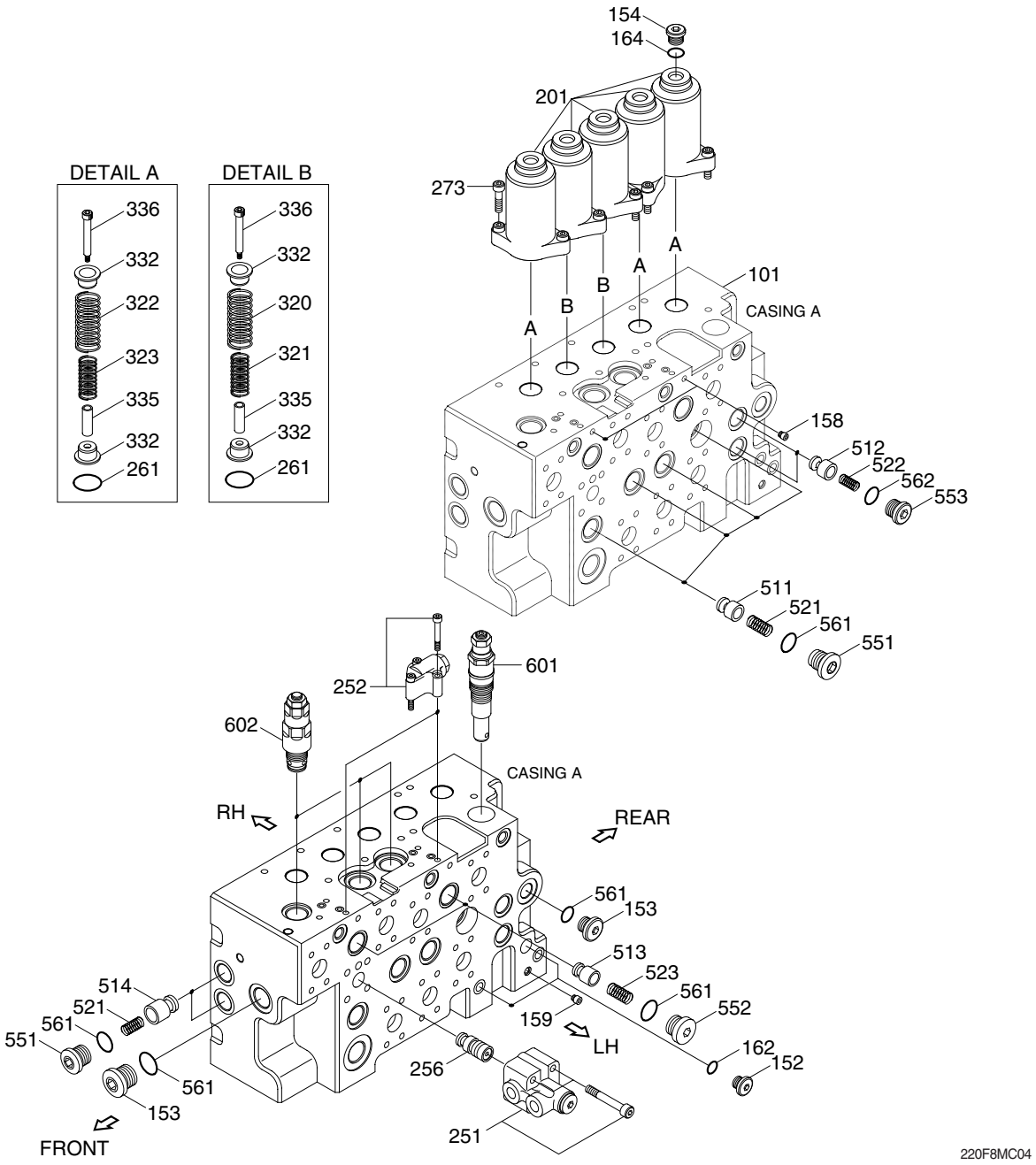
(1) Carry out installation in the reverse order to removal.

(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.



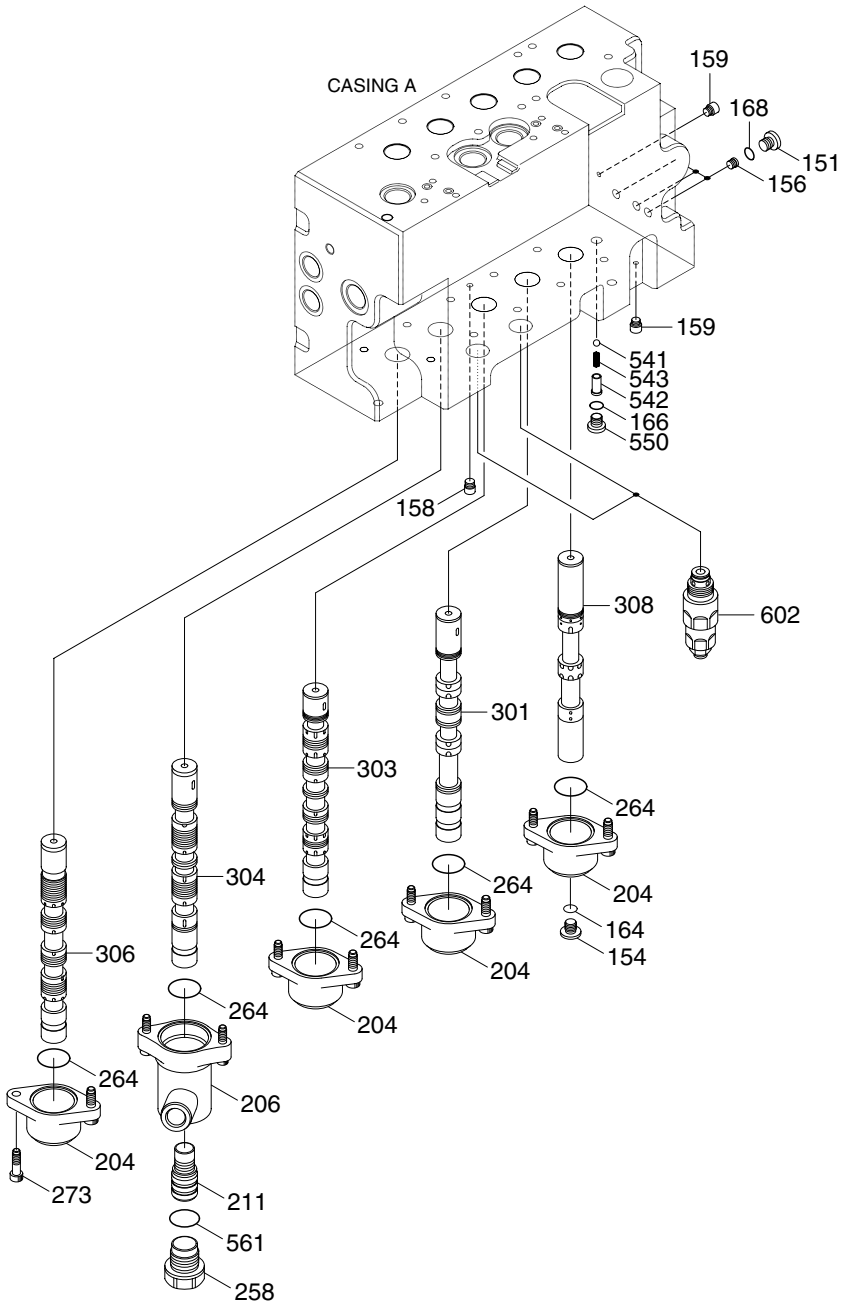
2. STRUCTURE (1/4)



220F8MC04

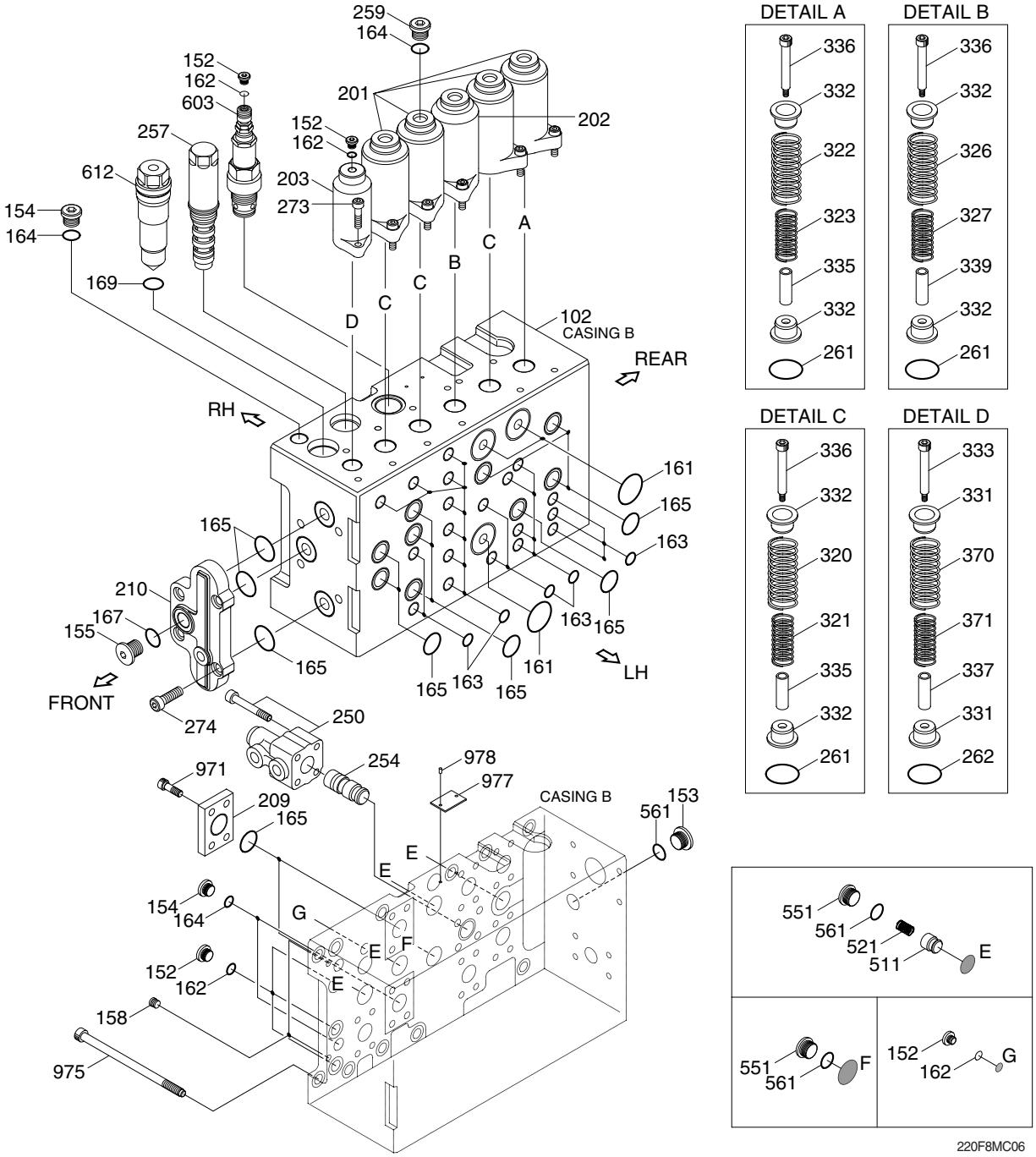
101	Casing A	261	O-ring	514	Poppet
152	Plug	273	Socket screw	521	Spring
153	Plug	320	Spring	522	Spring
154	Plug	321	Spring	523	Spring
158	Plug	322	Spring	551	Plug
159	Plug	323	Spring	552	Plug
162	O-ring	332	Seat	553	Plug
164	O-ring	335	Stopper	561	O-ring
201	Spring cover	336	Bolt	562	O-ring
251	Logic control valve	511	Poppet	601	Main relief valve
252	Selector lock valve	512	Poppet	602	Port relief valve
256	Logic poppet	513	Poppet		

STRUCTURE (2/4)



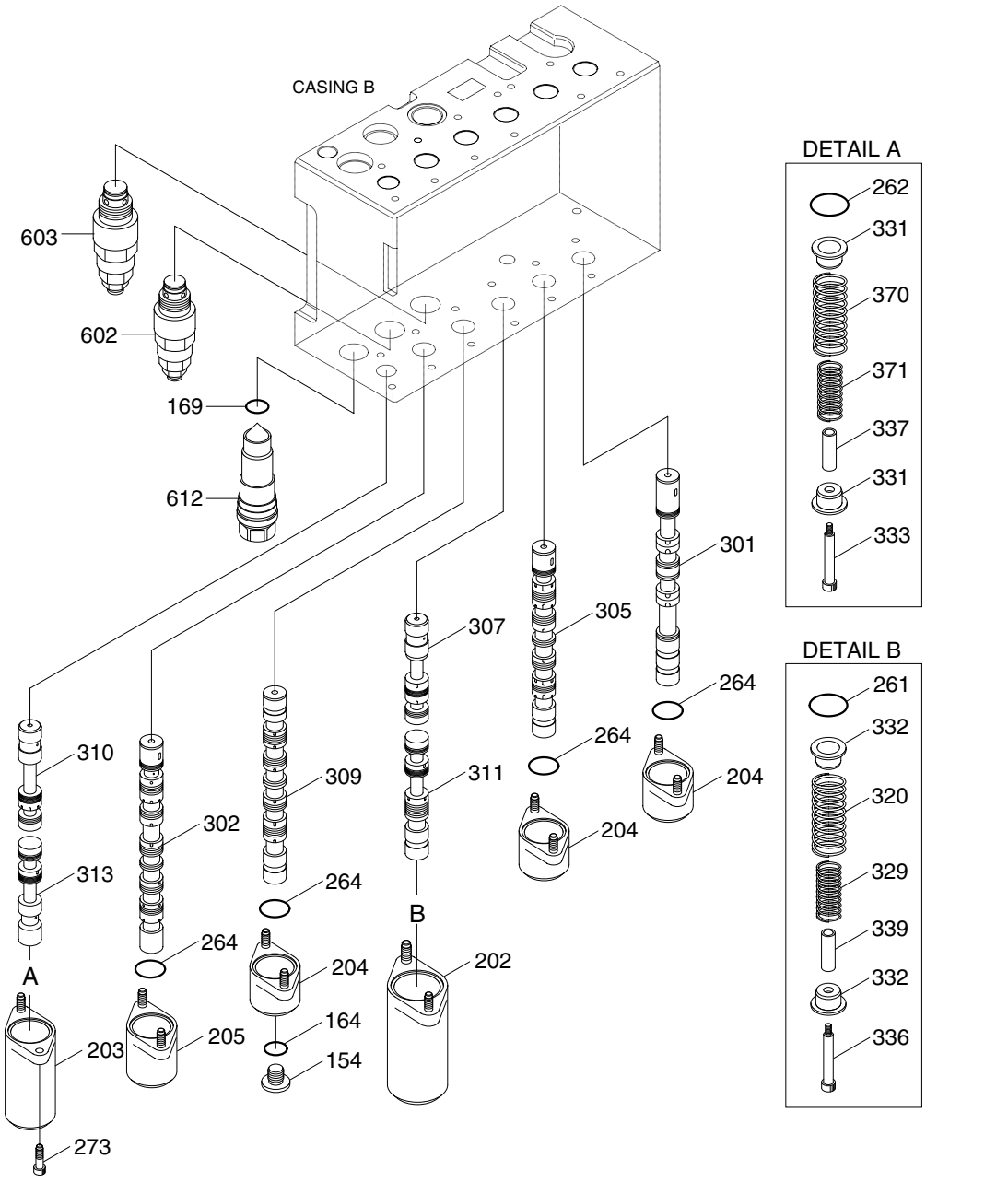
151	Plug	206	Spool cover	308	Straight travel spool
154	Plug	211	Piston	541	Steel ball
156	Orifice	258	Plug	542	Spring seat
158	Plug	264	Square ring	543	Spring
159	Plug	273	Socket screw	550	Plug
164	O-ring	301	Travel, LH spool	561	O-ring
166	O-ring	303	Boom 1 spool	602	Port relief valve
168	O-ring	304	Bucket spool		
204	Spool cover	306	Arm 2 spool		

STRUCTURE (3/4)



102	Casing B	201	Spring cover	274	Socket screw	337	Stopper
152	Plug	202	Spring cover	320	Spring	339	Stopper
153	Plug	203	Spring cover	321	Spring	370	Spring
154	Plug	209	Flange	322	Spring	371	Spring
155	Plug	210	Plate	323	Spring	511	Poppet
158	Plug	250	Logic control valve	326	Spring	521	Spring
161	O-ring	254	Logic poppet	327	Spring	551	Plug
162	O-ring	257	Arm regen cut sub	331	Seat	561	O-ring
163	O-ring	259	Plug	332	Seat	603	Port relief valve
164	O-ring	261	O-ring	333	Spacer bolt	612	Plug
165	O-ring	262	O-ring	335	Stopper	971	Socket screw
167	O-ring	273	Socket screw	336	Bolt	975	Socket screw
169	O-ring						

STRUCTURE (4/4)



154	Plug	301	Travel, RH spool	332	Seat
164	O-ring	302	Arm 1 spool	333	Spacer bolt
169	O-ring	305	Swing spool	336	Spacer bolt
202	Spring cover	307	Boom 2 spool	337	Stopper
203	Spring cover	309	Option spool	339	Stopper
204	Spool cover	310	Bypass cut spool	370	Spring
205	Spool cover	311	Swing priority spool	371	Spring
261	O-ring	313	Bypass cut spool	602	Port relief valve
262	O-ring	320	Spring	603	Port relief valve
264	O-ring	329	Spring	612	Plug
273	Socket screw	331	Seat		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high 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, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working, spread a paper or rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or 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 hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Besides, always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

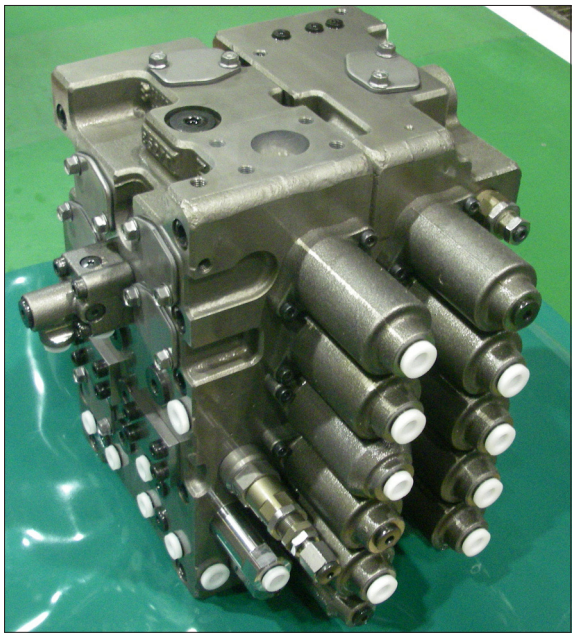
Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Box wrench	Each 1 piece	24, 32, 36
Hexagon key wrench	Each 1 piece	4, 5, 6, 8, 10 and 12
Loctite #262	1 piece	-
Spanner	Each 1 piece	32 (main relief valve, 601) 36 (port relief valve, 603)

3) DISASSEMBLY

The figure in ( ) shown after the part name in the explanation sentence shows its number in the structure figures (8-34~37).

(1) Place control valve on working bench.

※ Disassemble it in clean place and pay attention not to damage flange faces and plate faces.



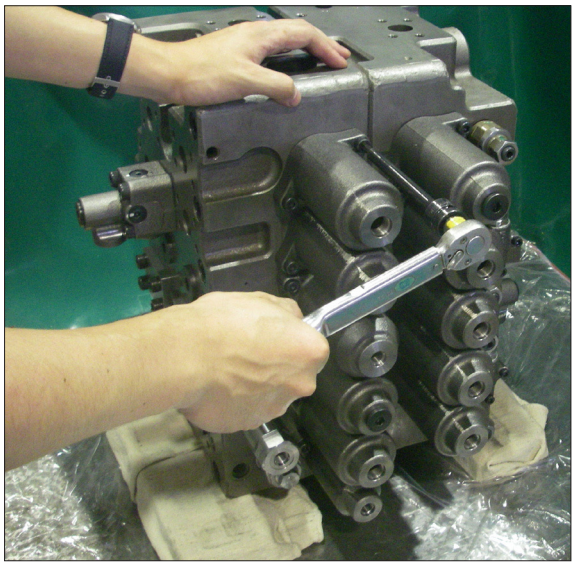
21098MC37

(2) Disassembling of main spools

· Travel (301), bucket (304), swing (305), option (309), arm 2 (306), boom 2 (307), swing priority (311).

① Loosen the hexagon the socket head screw (273) and remove the spring cover (201, 202) and the O-ring (261).

· Hexagon key wrench : 6 ㎜



21098MC38

② Pull out the spool, spring, spring seats (331 or 332), stopper (335 or 339) and spacer bolt (336) in the spool assembly condition from the casing.

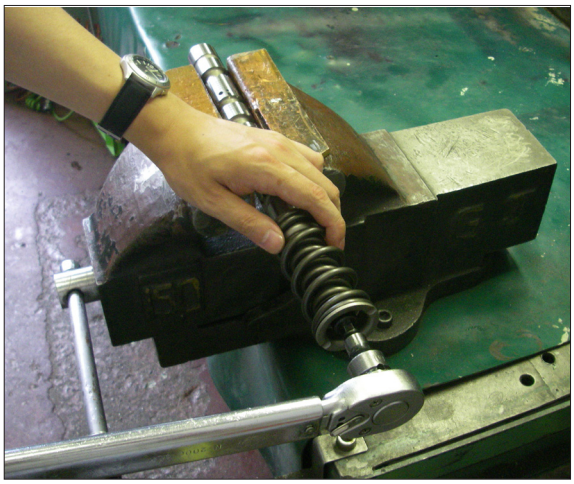
※ When pulling out the spool assembly from casing, pay attention not to damage the casing.



21078MC11

③ Hold the spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336) and disassemble the stopper (335 or 339) and spring seats (332).

· Hexagon key wrench : 10 ㎜



21098MC40

(3) Disassembling of boom 1 spool (303):

① Loosen the hexagon socket head screw (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 ㎜

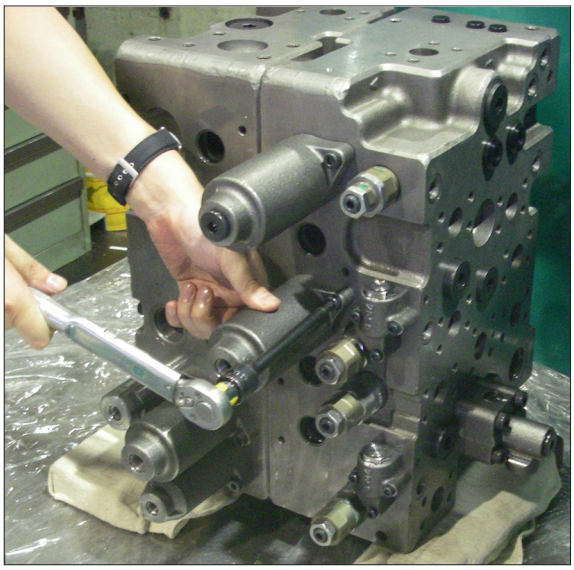
② Pull out the boom 1 spool (303), spring (320, 321), spring seats (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the casing A (101).

※ When pulling out the spool assembly from casing A (101), pay attention not to damage 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 the spring (320, 321), spring seats (332) and stopper (335).

· Hexagon key wrench : 10 ㎜

④ Do not consecutively disassemble the boom1 spool (303) above ③.



21098MC41

(4) Disassembling of arm 1 spool (302):

① Loosen the hexagon socket head screw (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 ㎜

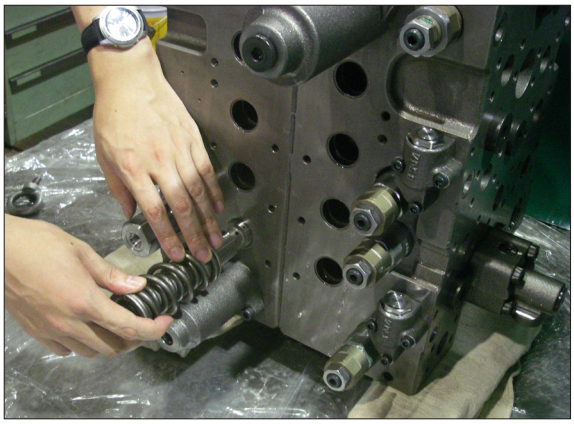
② Pull out the arm 1 spool (302), spring (320, 321), spring seats (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the casing B (102).

※ When pulling out the spool assembly from casing B (102), pay attention not to damage casing.

③ Hold the arm 1 spool (302) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336), and disassemble the spring (320, 321), spring seats (332) and stopper (335).

· Hexagon key wrench : 10 ㎜

④ Do not consecutively disassemble the arm 1 spool (302) above ③.



21098MC42

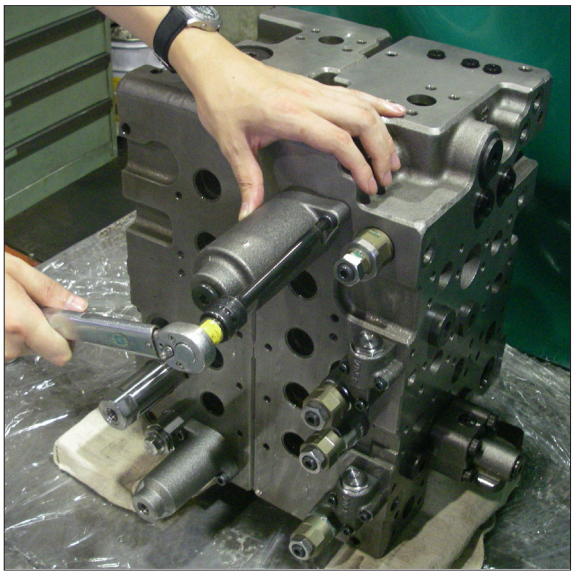
(5) Disassembling of travel straight spool (308):

① Loosen the hexagon socket head screw (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 ㎜

② Pull out the travel straight spool (308), spring (322, 323), spring seat (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the casing A (101).

※ When pulling out the spool assembly from casing A (101), pay attention not to damage casing.



21098MC43

③ Hold the travel straight spool (308) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336) and disassemble the spring (322, 323), spring seats(332) and stopper (335).
· Hexagon key wrench : 10 ㎜

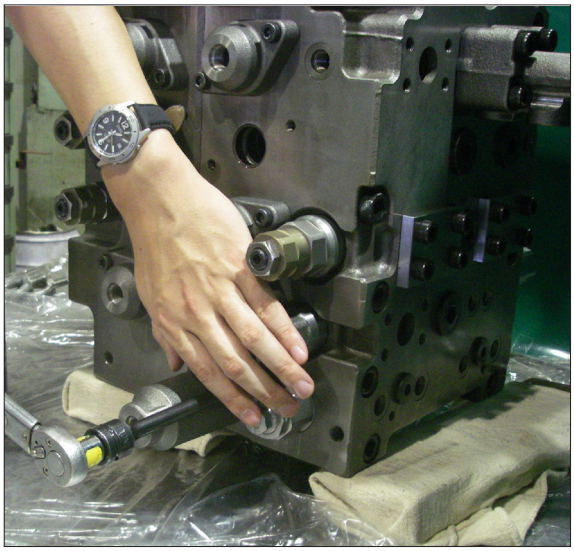
④ Do not consecutively disassemble the travel straight spool (308) above ③.

(6) Disassembling of bypass cut spool (310, 313):

① Loosen the hexagon socket head screw (273), and remove the spring cover (203) and the O-ring (262).
· Hexagon key wrench : 6 ㎜

② Pull out the bypass cut spool (310, 313), spring (370, 371), spring seats (331), stopper (337) and spacer bolt (333) 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 casing.



21098MC44

③ Hold the bypass cut spool (310, 313) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (333) and disassemble the spring (370, 371), spring seats (331) and stopper (337).
· Hexagon key wrench : 10 ㎜

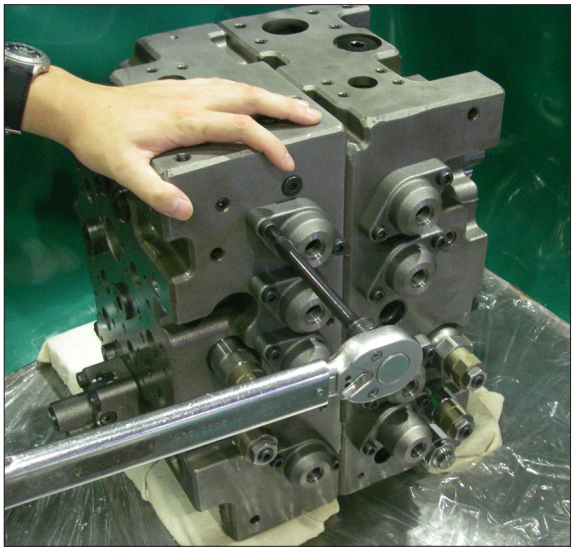


21098MC45

(7) Disassembling of spool covers (204, 205, 206):

① Remove the hexagon socket head screw (273), and remove the spool cover (204, 205, 206) and the O-ring (264).
· Hexagon key wrench : 6 mm

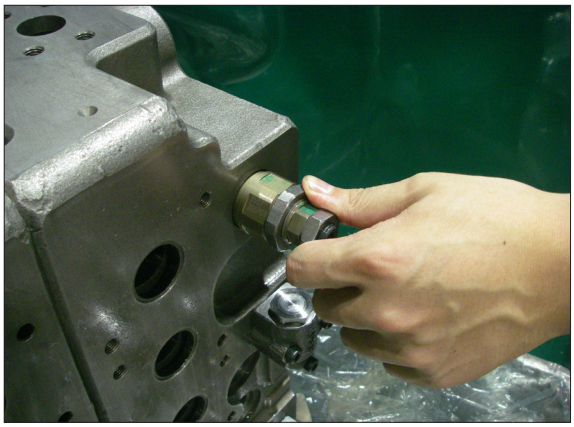
② In removing the bucket spool cover (206), at first loosen the plug (258) before it is removed from the casing B (102). After removing the bucket spring cover (206) remove the plug (551), and take out the piston (211).
· Box wrench : 32 mm



21098MC46

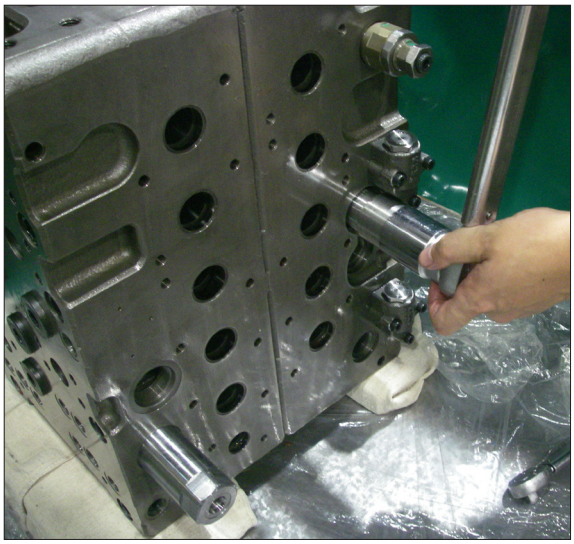
(8) Removal of main relief valve (601) and port relief valves (602, 603) :

① Remove the main relief valve (601) and the port relief valves (602, 603) from the casing.
Main relief valve (601) : spanner 32 mm
Port relief valve (602) : spanner or box wrench 32 mm
Port relief valve (603) : spanner 36 mm

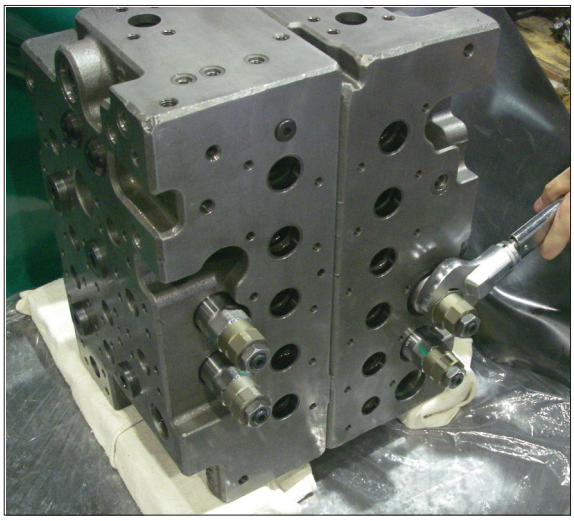


21098MC47

② Do not consecutively disassemble the relief valves after the above ①.



21098MC48



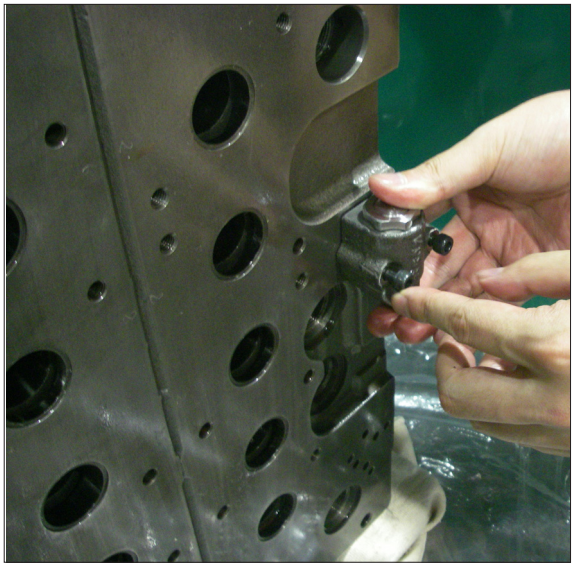
21098MC49

(9) Removal of lock valve selector (252):

① Loosen the hexagon socket head screw (252-171) and remove the lock valve selector (252) and the O-rings (252-161).

· Hexagon key wrench : 5 ㎜

② Do not consecutively disassemble the lock valve selector (252) after the above ①.

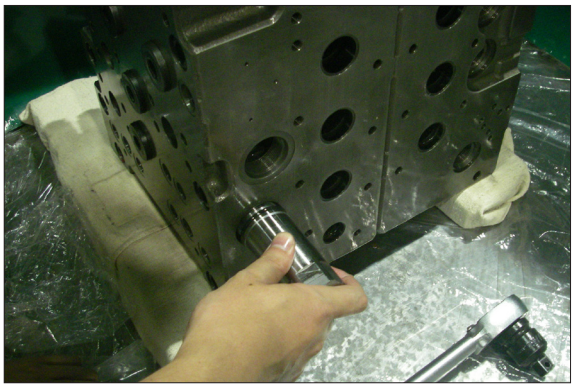


21098MC50

(10) Removal of arm regeneration cut valve (257):

Remove the plug (257-253), spring (257-231), spool (257-211), and sleeve (257-212) from the casing B (102).

· Box wrench : 36 mm



21098MC52

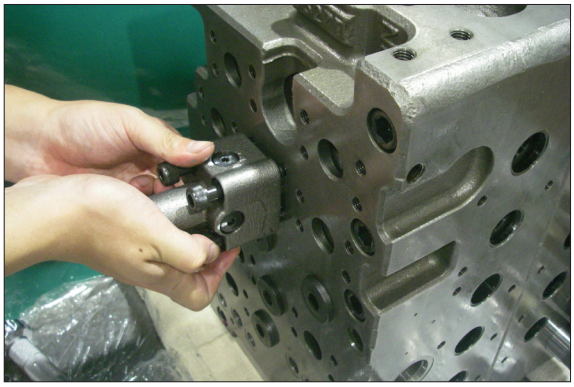
(11) Disassembly of logic control valve (250, 251) and logic poppet (254, 256):

① Loosen the hexagon socket head screw (250-120, 251-120) and remove the logic control valve (250, 251) and the O-rings (250-112 and 113, 251-112 and 113).

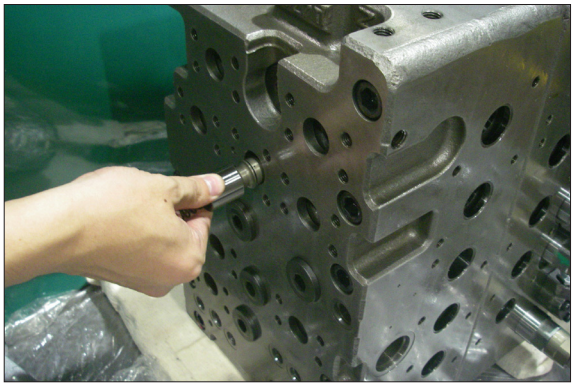
· Hexagon key wrench : 8 mm

② Pull out the logic poppet (254, 256), spring (254-106, 256-106) and spring seat (254-103, 256-103) from the casing.

③ Do not consecutively disassemble the logic control valve and the logic poppet above ②.



21098MC53



21098MC54

(12) Disassembly of check valve :

① CP1, C2, CCb, LCb, LCo, LCk, LCa, LCAT2

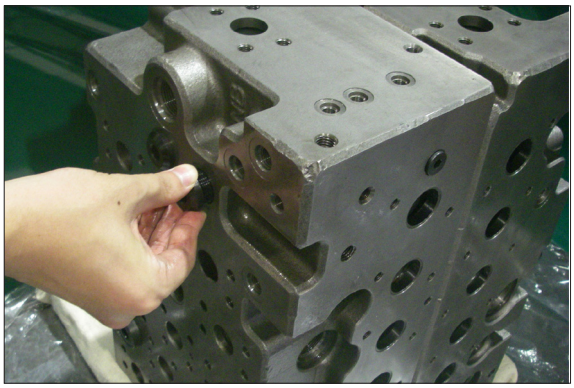
Remove the plug (551) and take out the poppet (511) and the spring (521).

· Hexagon key wrench : 12 mm

② CMR1, CMR2

Remove the plug (553) and take out the poppet (512) and the spring (522).

· Hexagon key wrench : 10 mm

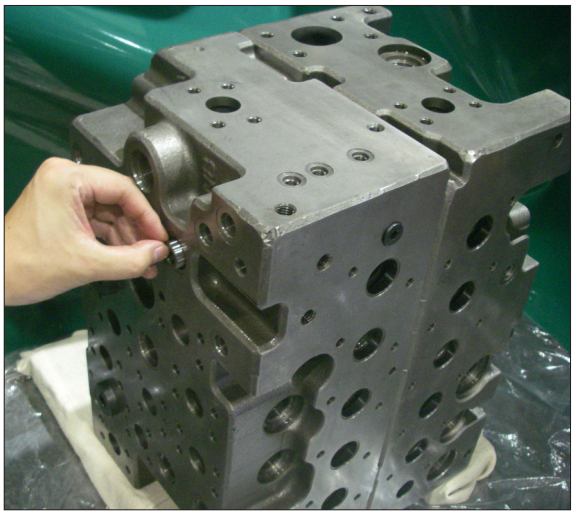


21098MC55

③ CRa, CRb

Remove the plug (552) and take out the poppet (513) and the spring (523).

· Hexagon key wrench : 12 mm



21098MC56

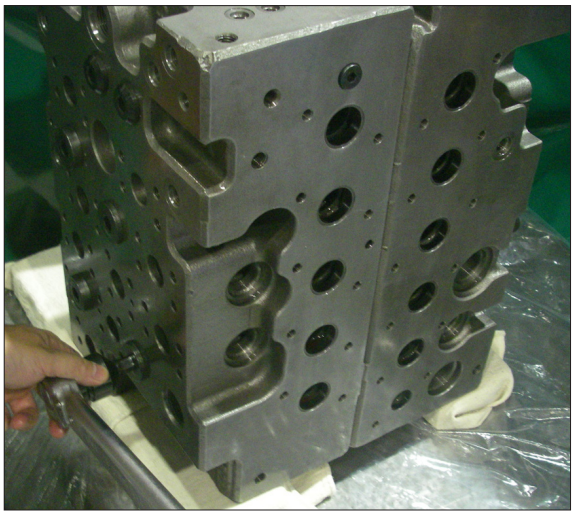
④ CCk, CCo

Remove the plug (551) and take out poppet (514) and the spring (521).

· Hexagon key wrench : 12 mm

⑤ Remove the plug (550) and take out the ball (541), spring (543) and spring seat (542).

· Hexagon key wrench : 6 mm



21098MC57

(13) Disassembly of flanges (209) :

Loosen the hexagon socket head screw (971) and remove the flange (209) and the O-ring (165).

· Hexagon key wrench : 8 mm

(14) Disassembly of plate (210) :

Loosen the hexagon socket head screw (274) and remove the plate (210) and the O-rings (165).

· Hexagon key wrench : 10 mm

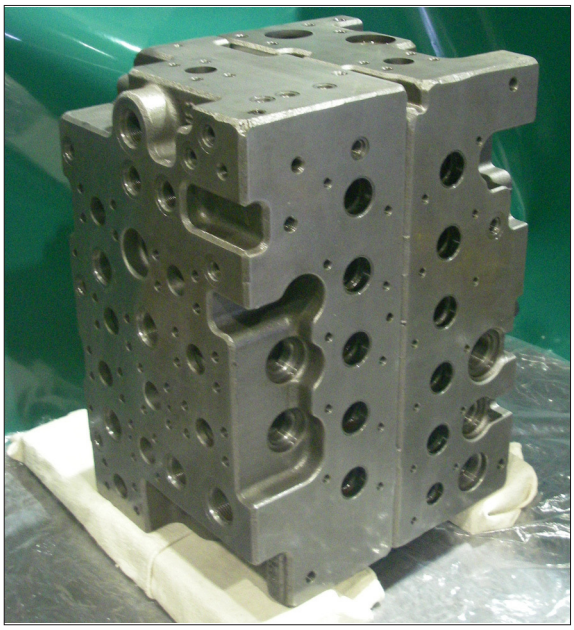
(15) Disassembly of orifices for signal line :

Do not disassemble the plug (151) and orifice (156), except for particular case.

(16) Disassembly of casing :

① Except for particular case, do not disassemble the tie screw of the casing B (102).

② Regarding the plugs not described in above disassembling procedures, the blind plugs for sacrifice holes and for the casing sanitation, do not disassemble them as far as not required specially.



21098MC58

(17) Inspection after disassembling

Clean all the 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 the seal groove faces of the housing and the covers are smooth and free of dust, dent, rust etc.
c. Correct dents and damages on check seat faces of casing, if any, by lapping.
※ Pay attention not to leave lapping agent in the casing.
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 a relief valve does not function properly, repair it, following its inspection procedures.
g. Replace all the 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 orifices of the main poppet and seat section are not clogged with foreign matter.
e. Replace all O-rings with new ones.
f. When any light damage is found in above inspections, correct it by lapping.
g. When any abnormal part is found, replace it with a relief valve assembly.

4) ASSEMBLY

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 structure figure.

③ Cautions in assembling O-rings

a. Pay attention to keep O-rings free from defects in its forming and damages in its handling.

b. Apply grease, hydraulic oil or so on to O-rings and seal-fitting sections for full lubrication.

c. Do not stretch O-rings so much to deform them permanently.

d. 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.

e. Tighten fixing the bolts for all sections with a torque wrench to their respective tightening torque.

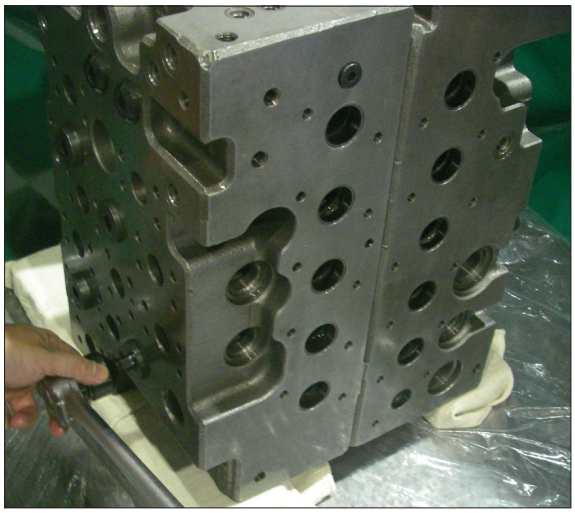
(1) Assembly of check valve :

① Assemble the poppets (511, 512, 513, 514) and the springs (521, 522, 523) : Put the O-rings (561) onto the plugs (551, 552). Put the O-rings (562) onto the plugs (553). Tighten the plugs (551, 552, 553) with their specified torques.

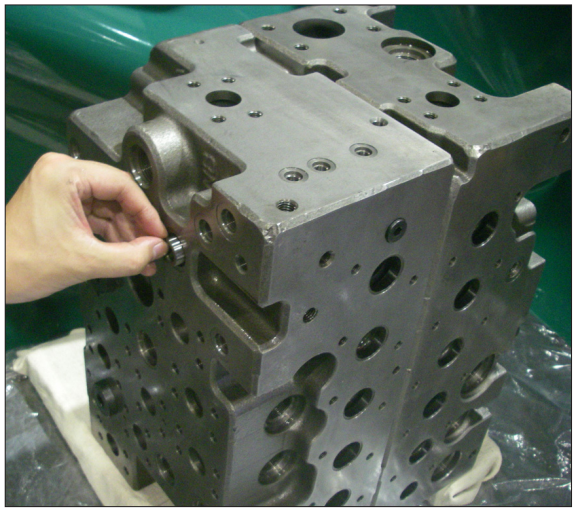
※ Use the poppets, springs and plugs in following groups.

Poppet	Spring	Plug	Remember that
511	521	551	511 in 8 positions
512	522	553	512 in 2 positions
513	523	552	513 in 2 positions
514	521	551	514 in 2 positions

Plug No.	Hexagon key wrench (mm)	Tightening torque (kgf·m)
551	12	23.5 ~ 26.5
552	12	23.5 ~ 26.5
553	10	13.3 ~ 15.3



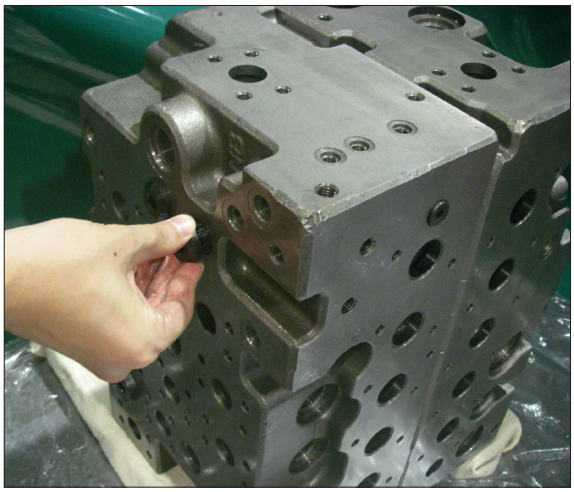
21098MC57



21098MC56

② Assemble of ball (541), spring seat (542) and spring (543) : Put the O-ring (166) onto the plug (550), and tighten the plug (550) with specified torque.

· Hexagon key wrench : 6 mm
· Tightening torque : 2.55 ~ 2.96 kgf·m (18.4~21.4 lbf·ft)



21098MC55

(2) Assembly of plate (210) :

Fit the O-rings (165) to the casing B (102), and tighten the hexagon socket head screw (274) with specified torque.

· Hexagon key wrench : 10 mm
· Tightening torque : 10.0 ~ 12.2 kgf·m (72.3~88.2 lbf·ft)

If this plate face looks downward, turn the control valve.

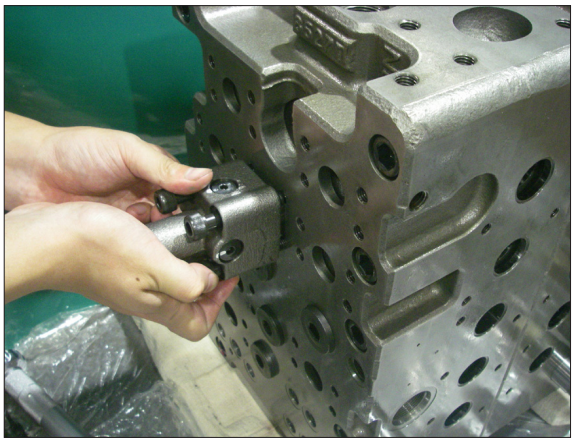
(3) Assembly of flange (209) :

Fit the O-rings (165) to the flange (209), and tighten the hexagon socket head screw (971) with specified torque.

· Hexagon key wrench : 8 mm
· Tightening torque : 5.0 ~ 6.6 kgf·m (36.2~47.7 lbf·ft)

(4) Assemble of logic control valve :

① Put the O-ring (250-115, 251-115) onto the plug (250-111, 251-111).



21098MC53

② Assemble the spool (250-102, 251-102), spring seat (250-104, 251-104) and spring (251-105, 251-105) into the casing (250-101, 251-101) of the logic control valve, and tighten the plug (250-111, 251-111) with specified torque.

· Hexagon key wrench : 8 mm

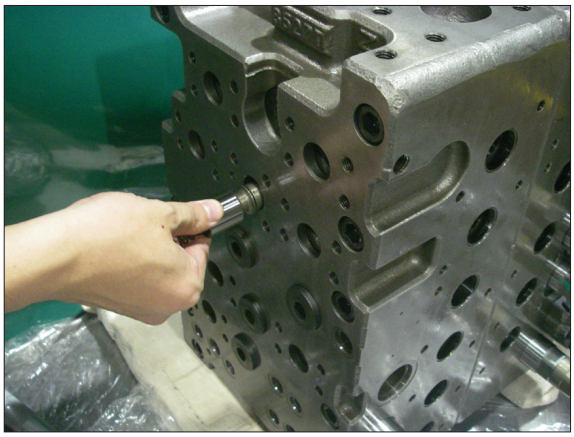
· Tightening torque : 7.0 ~ 8.1 kgf·m
(50.6~58.6 lbf·ft)

③ Assemble the logic poppet (254; poppet, spring, spring seat) into the casing of the control valve.

④ Fit the O-rings (250-112 and 113, 251-112 and 113) to the casing (250-101, 251-101) of the logic control valve, and tighten the hexagon socket head screw (250-120, 251-120) with specified torque.

· Hexagon key wrench : 8 mm

· Tightening torque : 5.0 ~ 6.6 kgf·m
(36.2~47.7 lbf·ft)



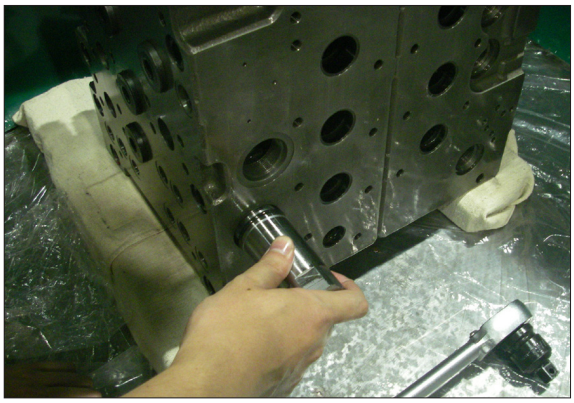
21098MC54

(5) Assembly of arm regeneration cut valve (257) :

Assemble the sleeve (257-212), spool (257-211), and spring (257-231) into the casing B (102). Put the O-ring (265) onto the plug (257-253), and tighten with specified torque.

· Box wrench : 36 mm

· Tightening torque : 7.0 ~ 8.0 kgf·m (50.6~57.9 lbf·ft)



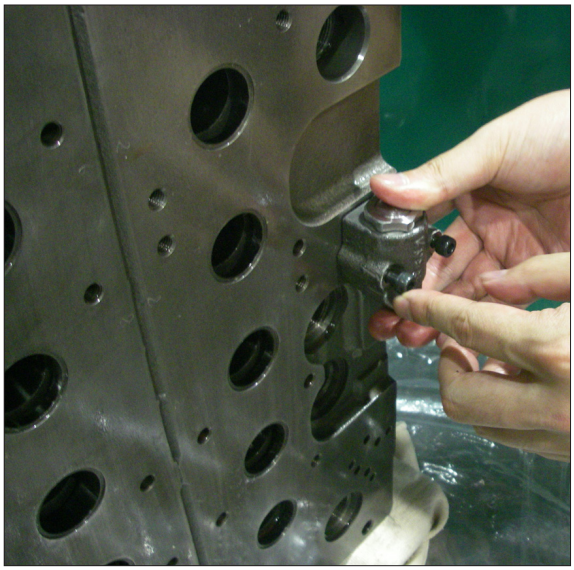
21098MC52

(6) Assembling of lock valve selector (252) :

Fit the O-rings (252-161) to the lock valve selector (252) and tighten the hexagon socket head screw (252-171) with specified torque.

· Hexagon key wrench : 5 mm

· Tightening torque : 1.0 ~ 1.4 kgf·m (7.2~10.1 lbf·ft)

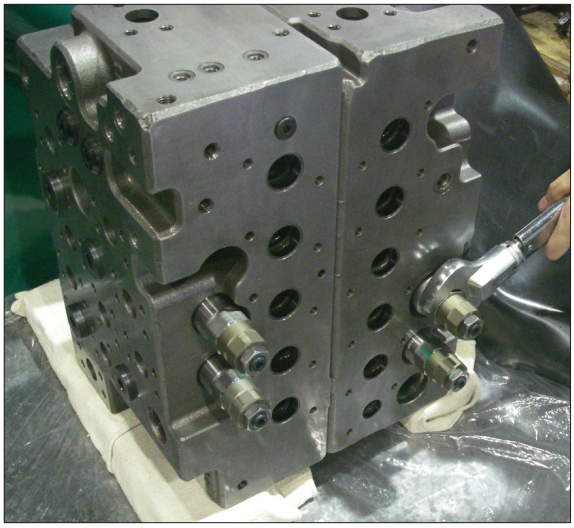


21098MC50

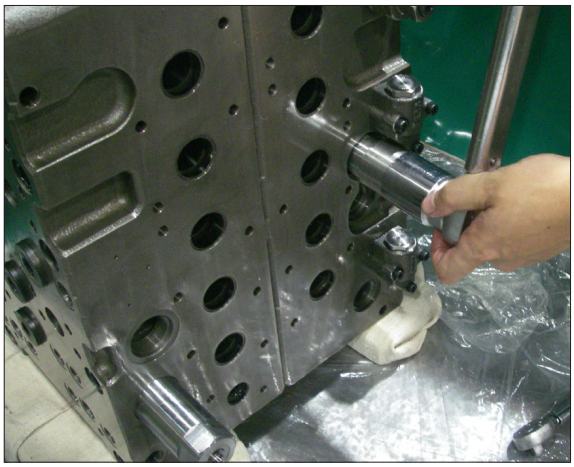
(7) Assembling of main relief valve (601) and port relief valve (602, 603) :

Assemble the main relief valve (601) and the port relief valves (602, 603) to the casing, and tighten them with specified torque.

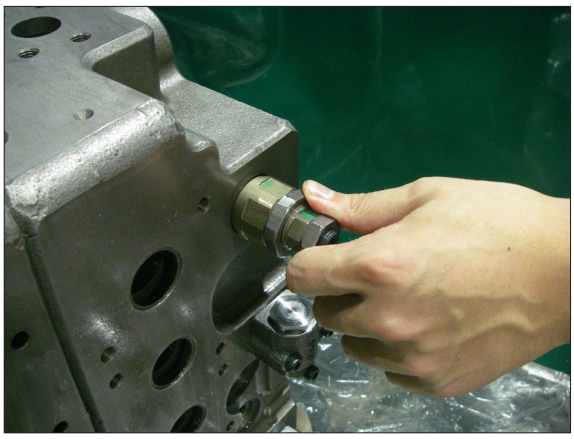
Item	Tool	Tightening torque (kgf·m)
Main relief valve (601)	Spanner 32	7.0 ~ 8.1
Port relief valve (602)	Spanner 32 or box wrench 32	7.0 ~ 8.1
Port relief valve (603)	Spanner 36	12.2 ~14.3



21098MC49



21098MC48



21098MC47

(8) Assemble of 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 so on) in between. Attach the spring seats (332), springs (322, 323) and stopper (335), and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

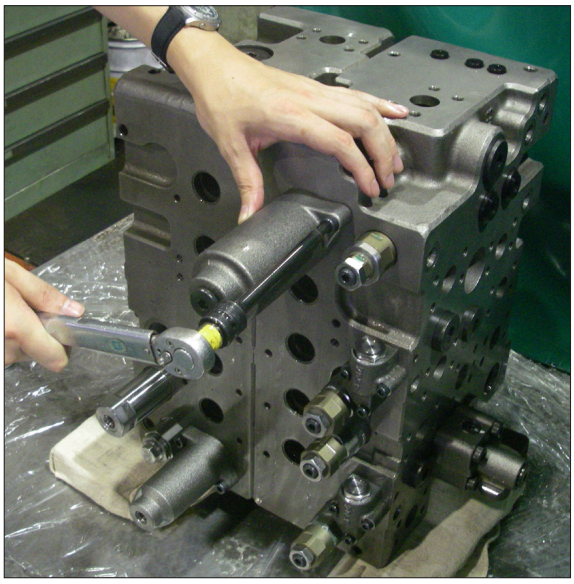
· Tightening torque : 1.6 ~ 1.8 kgf·m
(11.6~13.0 lbf·ft)

※ 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 ① items above into the casing A (101).

※ Fit spool assemblies into casing A (101) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC43

(9) Assembling of boom 1 spool (303) :

① Hold the middle of the boom1 spool (303) in the mouthpiece-attached vise applying a protection plate (aluminum plate and so on) in between. Attach the spring seats (332), springs (320, 321) and stopper (335), and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

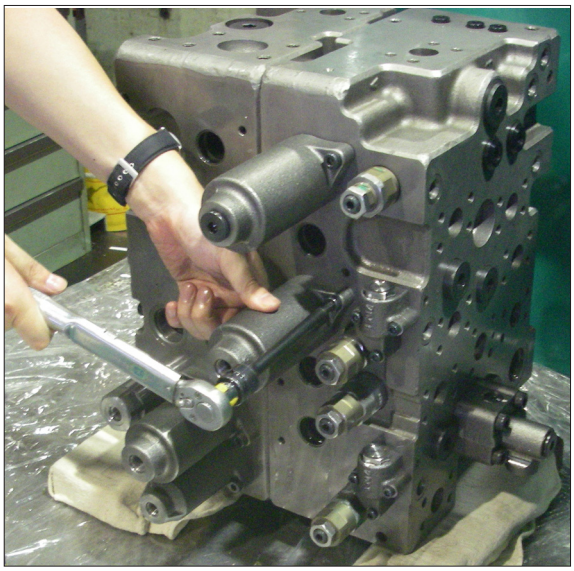
· Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ 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 A (101).

※ Fit spool assemblies into the casing A (101) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC41

(10) Assembling of arm 1 spool (302) :

① Hold the middle of the arm1 spool (302) in the mouthpiece-attached vise applying a protection plate (aluminum plate and so on) in between. Attach the spring seats (332), springs (320, 321) and stopper (335) and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

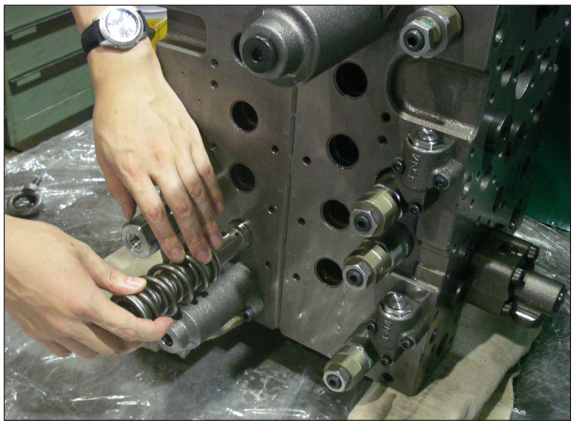
· Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the arm 1 spool (302) is deformed.

② Insert the spool assemblies of items ① above into the casing B (102).

※ Fit spool assemblies into the casing B (102) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC42

(11) **Assembling of main spool (travel (301), bucket (304), swing (305), option (309), arm 2 (306), boom 2 (307), swing priority (311)):**

① Hold the middle of each spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and so on) in between. Attach the spring seats (332), springs and stopper (335 or 339) and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

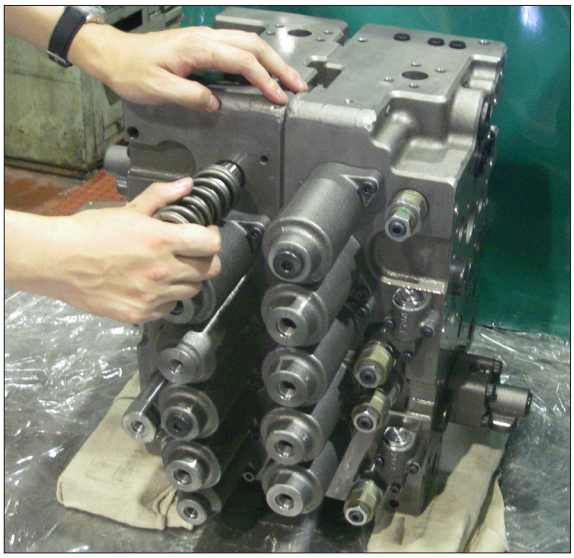
· Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the spool is deformed.

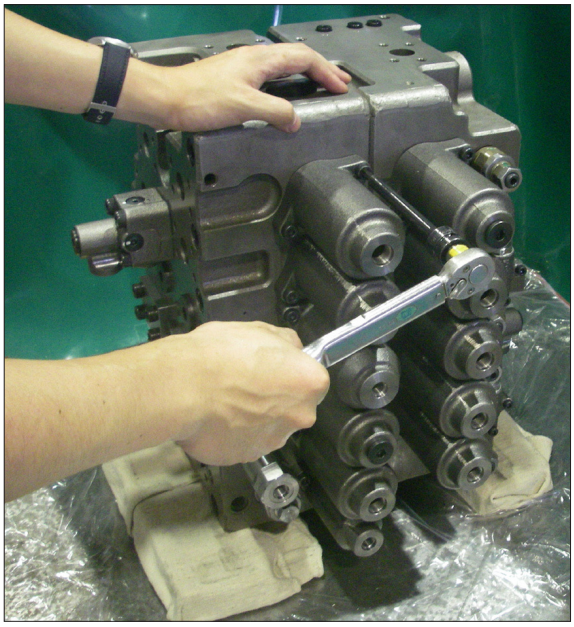
② Insert the spool assemblies of items ① above into the casing A (101) and casing B (102).

※ Fit spool assemblies into casing A (101) and casing B (102) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC39



21098MC38

(12) Assembling of bypass cut spool (310, 313) :

① Hold the middle of each spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and so on) in between. Attach the spring seats (331), springs (370, 371) and stopper (337) and tighten the spacer bolt (333) with specified torque.

※ Before tightening the spacer bolt (333), apply loctite #262 to it.

· Hexagon key wrench : 10 mm

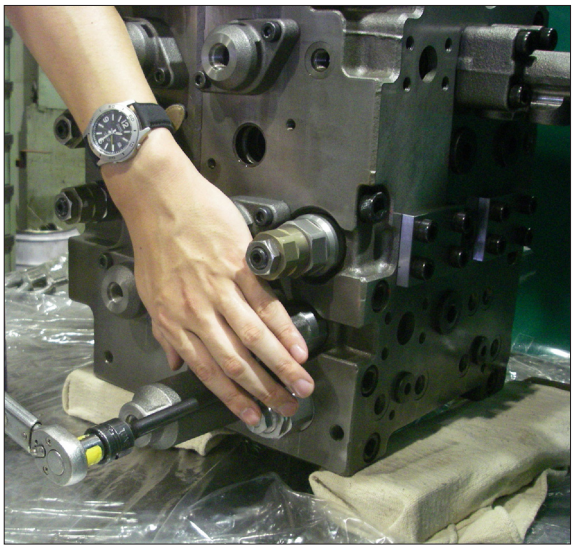
· Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the bypass cut spool (310, 313) is deformed.

② Insert the spool assemblies of Items ① above into the casing B (102).

※ Fit spool assemblies into the casing B (102) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC44

(13) Assembling of covers :

① Fit the O-rings (264) to the spool covers (204, 205, 206) to sides reverse to the spring sides of spools, and tighten the hexagon socket head screw (273) with specified torque.

※ Confirm that O-rings (264) have been fitted to the spool covers (204, 205, 206).

· Hexagon key wrench : 6 mm

· Tightening torque : 2.5 ~ 3.5 kgf·m (18.1~25.3 lbf·ft)

② Bucket spool cover (206) : Assemble piston (355) into bucket spool cover (206). Put O-ring (561) onto plug (258) and tighten it with specified torque.

· Box wrench : 32 mm

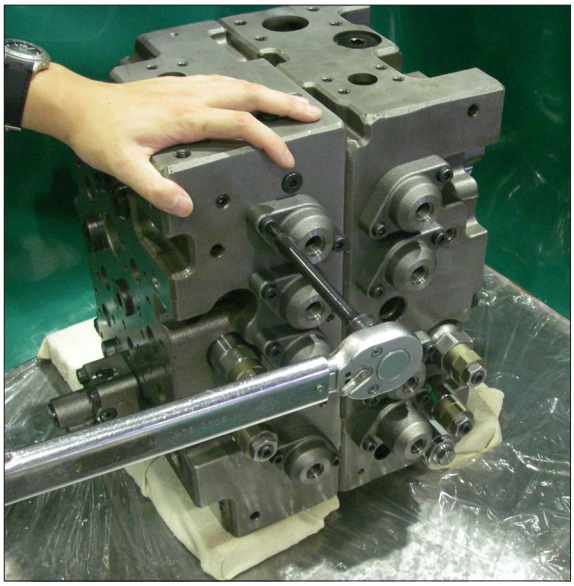
· Tightening torque : 15.3 ~ 18.4 kgf·m (111~133 lbf·ft)

③ Fit the O-rings (261, 262) to spring covers (201, 202, 203) to the spring sides of spools, and tighten the hexagon socket head screw (273) with specified torque.

※ Confirm that O-rings (261,262) have been fitted to spring covers (204, 205, 206).

· Hexagon key wrench : 6 mm

· Tightening torque : 2.5 ~ 3.5 kgf·m (18.1~25.3 lbf·ft)



21098MC46

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 hose assembly (2).

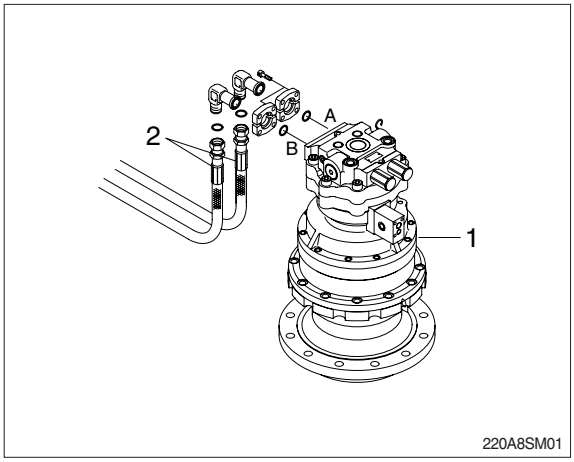
(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 8).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).
- Motor device weight : 61 kg (135 lb)
- Tightening torque : 57.9 ± 5.8 kgf·m (419 ± 42 lbf·ft)

(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



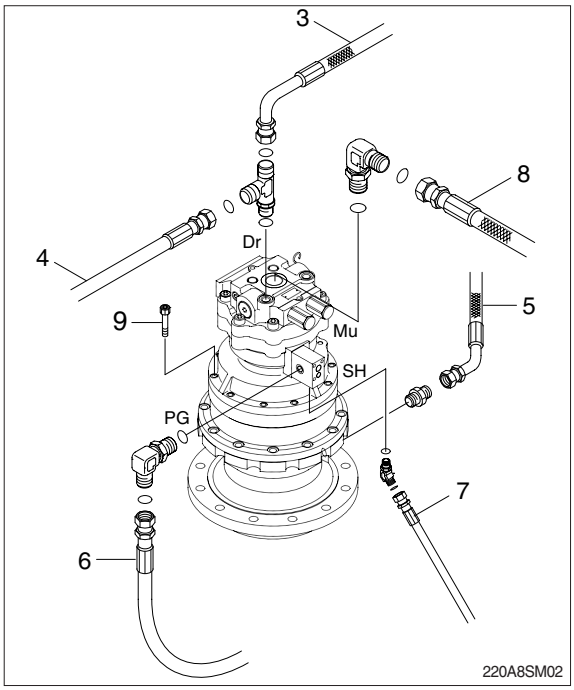


2) INSTALL

(1) Carry out installation in the reverse order to removal.

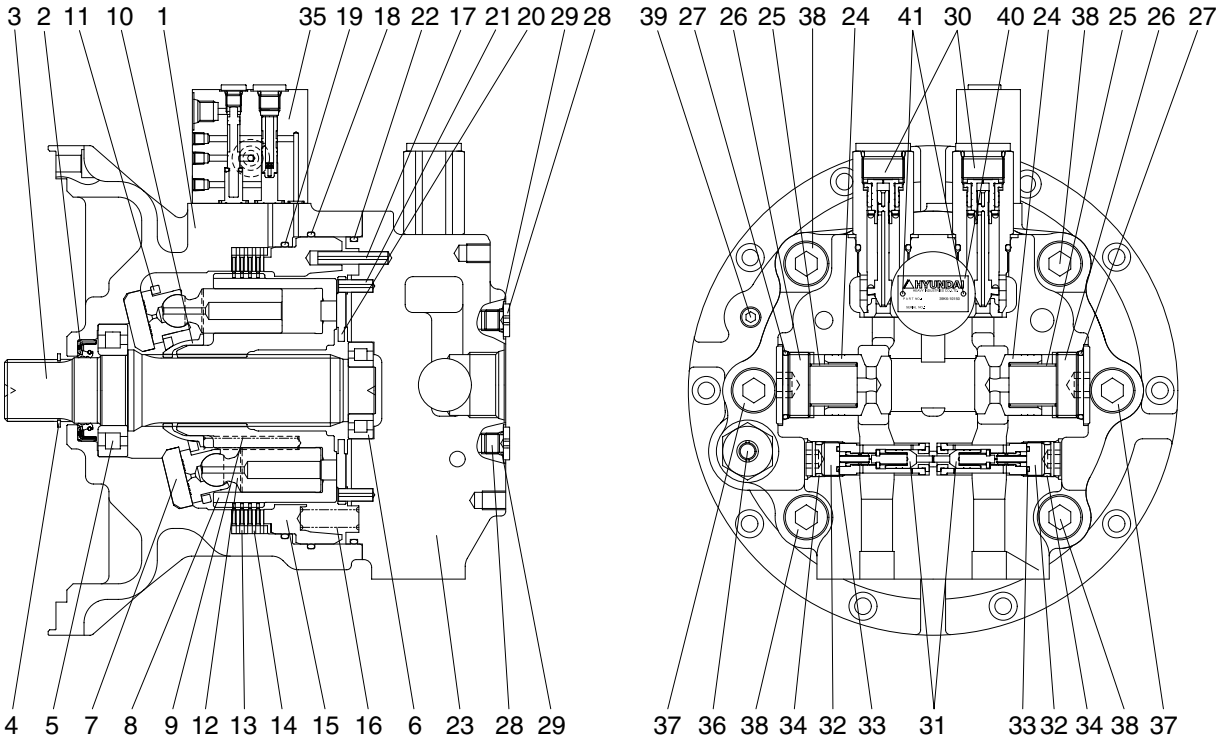
(2) Bleed the air from the swing motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling and check oil come out from plug.
⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.



2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



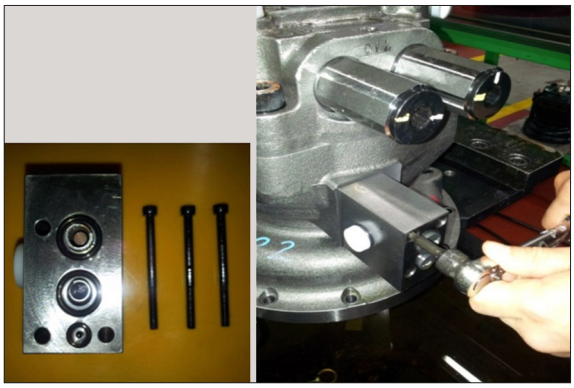
220L2SM02

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Reactionless valve assy
4	Snap ring	18	O-ring	32	Plug
5	Roller bearing	19	O-ring	33	O-ring
6	Needle bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Time delay valve assy
8	Cylinder block	22	O-ring	36	Level gauge
9	Spring	23	Valve casing	37	Socket bolt
10	Ball guide	24	Check valve	38	Socket bolt
11	Retainer plate	25	Spring	39	Plug
12	Piston assy	26	Plug	40	Name plate
13	Friction plate	27	O-ring	41	Rivet
14	Separate plate	28	Plug		

2) DISASSEMBLY

(1) Disassemble drive shaft

① Unloosing socket bolt (time delay valve, 42) and disassemble time delay valve assy (35) from casing (1).



2209A8SM51

② Disassemble level gauge (36) from casing (1).



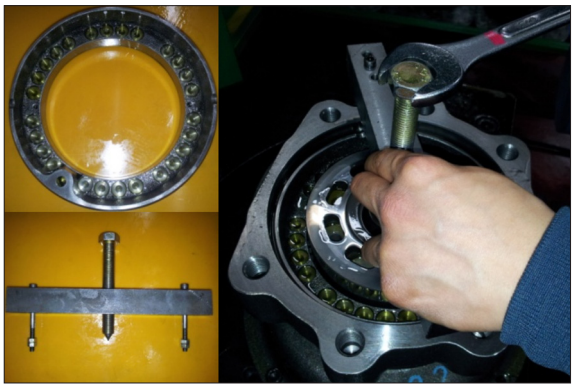
2209A8SM52

③ Hang valve casing (23) on hoist, unloose socket bolt (37, 38) and disassemble from casing (1).



2209A8SM53

④ Disassemble spring (16) and using a jig, disassemble parking piston (15) from casing (1).



2209A8SM54

⑤ Disassemble respectively cylinder block sub (8), friction plate (13), separate plate (14) from casing (1).



2209A8SM55

⑥ Disassemble swash plate (7) from casing (1).



2209A8SM56

⑦ Using a plier jig, disassemble snap ring (4) from casing (1).



2209A8SM57

⑧ Disassemble shaft assy (3), oil seal (2) and O-ring (18, 22) from casing (1).



2209A8SM58

(2) Disassemble cylinder block sub

① Disassemble piston assy (12) from cylinder block (8).



2209A8SM59

② Disassemble ball guide (10) and spring (cylinder block, 9) from cylinder block (8).

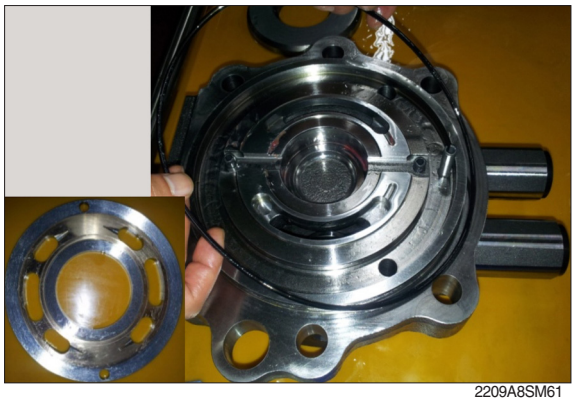
- Ball guide × 1EA
- Spring × 9EA



2209A8SM60

(3) Disassemble valve casing sub

① Disassemble spring pin (17, 21), valve plate (20), O-ring (22) from valve casing (23).



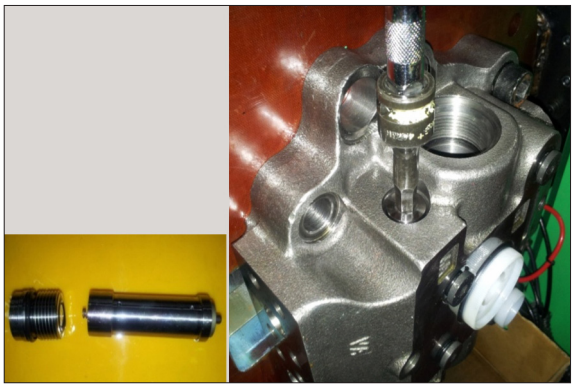
2209A8SM61

② Using a torque wrench, disassemble relief valve (30) from valve casing (23).



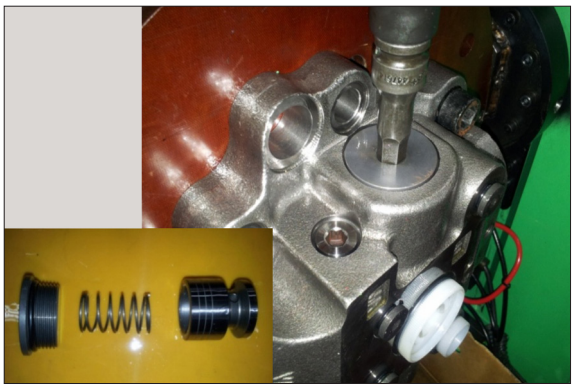
2209A8SM62

③ Using a torque wrench, disassemble plug (32) from valve casing (23) and disassemble O-ring (33, 34) and reactionless valve assy (31).



2209A8SM63

④ Using a torque wrench, disassemble check valve (24) from valve casing (23).



2209A8SM64

⑤ Disassemble plug (28), O-ring (29) from valve casing (23).

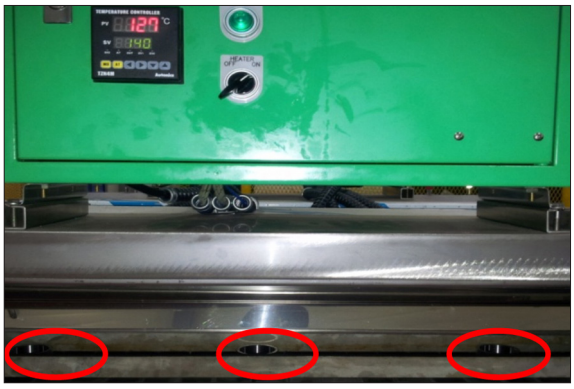


2209A8SM65

3) ASSEMBLING

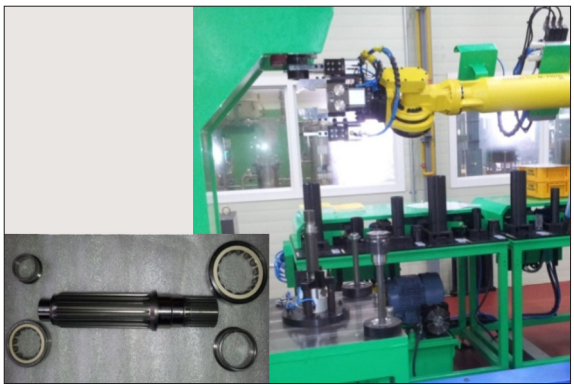
(1) Assemble shaft sub

① Put roller bearing (3) on preheater and provide heat to inner race.
(Temperature in conveyor : 120°C for 3~5 minutes)



2209A8SM66

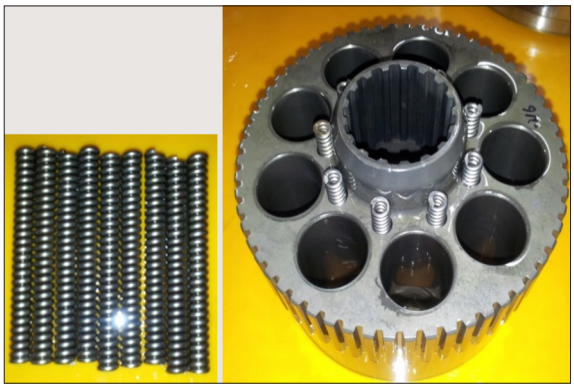
② Using a robot machine, assemble and press preheated roller bearing (3) into shaft (5).



2209A8SM67

(2) Assemble cylinder block sub

① Assemble 9 springs (cylinder block, 9) into cylinder block (8).
- Spring × 9EA



2209A8SM68

② Assemble ball guide (10) into cylinder block (8).
- Ball guide × 1EA



2209A8SM69

③ Assemble 9 piston assy (12) into retainer plate (11).

- Piston assy × 9EA
- Retainer plate × 1EA



2209A8SM70

④ Assemble parts of procedure ② and ③.



2209A8SM71

(3) Assemble valve casing sub

① Assemble make up check valve sub

Assemble check valve (24), O-ring (27), plug (26) in that order and then screw it torque wrench.

- Make up check valve × 2EA
- Spring × 2EA
- Plug × 2EA
- O-ring × 2EA

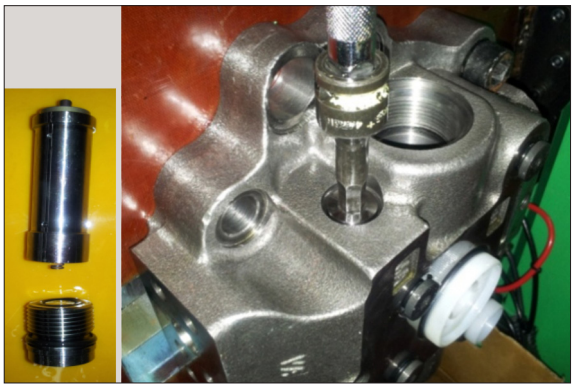


2209A8SM72

② Assemble reactionless valve assy

Assemble reactionless valve assy (31), plug (32), O-ring (33, 34) in that order and then screw it a torque wrench.

- Reactionless valve assy (31) × 2EA
- Plug (32) × 2EA
- O-ring (33, 34) × 2EA



2209A8SM73

③ Using a torque wrench, assemble relief valve (30) 2 sets into valve casing (23).
- Relief valve (30) × 2EA



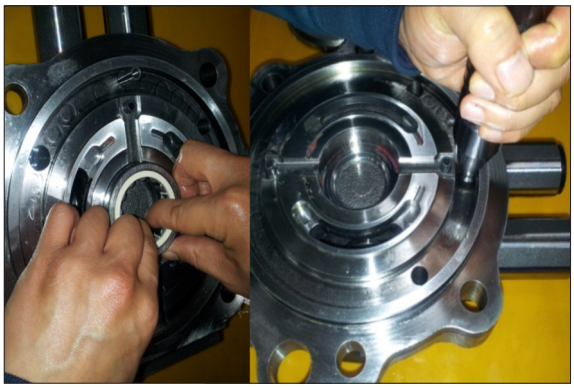
2209A8SM74

④ Assemble plug (28) and O-ring (27) into valve casing (23).
- Plug (28) × 3EA
- O-ring (27) × 3EA



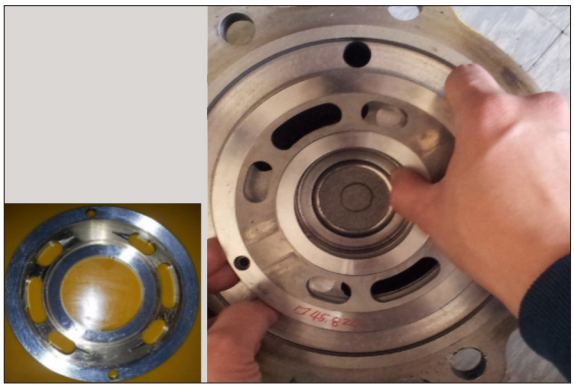
2209A8SM75

⑤ Assemble needle bearing (6) into valve casing (23) and assemble spring pin (17, 21) into valve casing (23).
- Needle bearing (6) × 1EA
- Spring pin (17, 21) × 1EA



2209A8SM76

⑥ Apply some grease valve plate (20) and assemble it into valve casing (23).



2209A8SM77

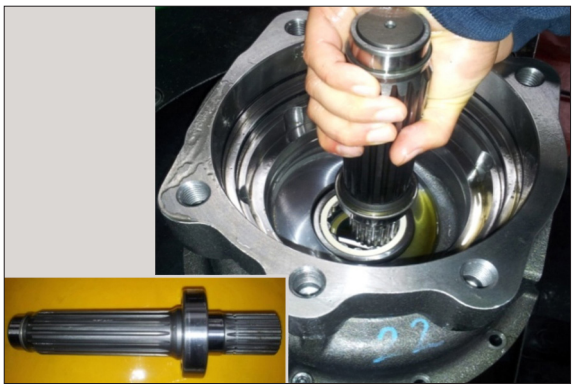
(4) Assemble drive shaft sub

① Using a jig, assemble oil sealing (2) into casing (1).



2209A8SM78

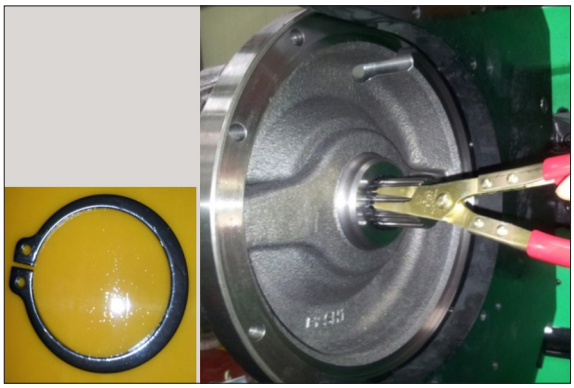
② Fit shaft sub (shaft+roller bearing) into casing (1).



2209A8SM79

③ Using a plier jig, assemble snap ring (4) to shaft (3).

· Snap ring×1EA



2209A8SM80

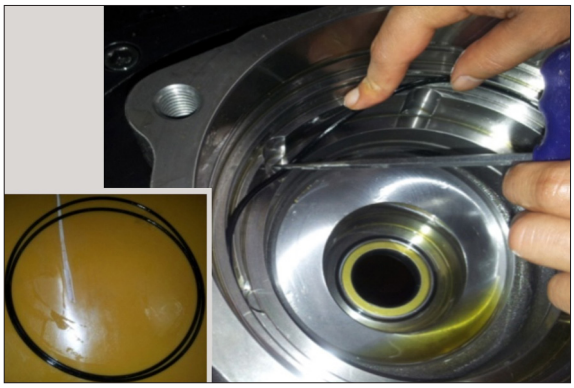
④ Apply some grease swash plate (7) and assemble it into casing (1).

· Swash plate×1EA



2209A8SM81

⑤ Insert O-ring (18, 19) into casing (1).
- O-ring (18) × 1EA
- O-ring (19) × 1EA



2209A8SM82

⑥ Assemble cylinder block (8) into casing (1).



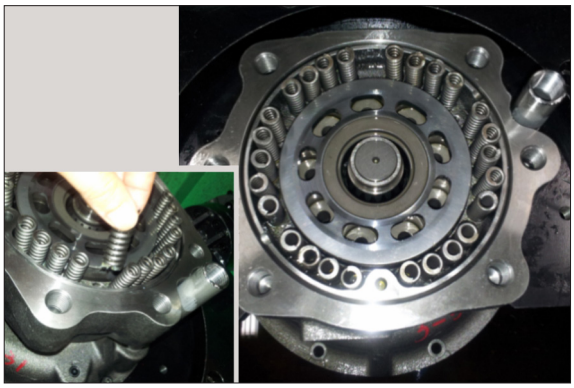
2209A8SM83

⑦ Assemble separate plate (14) and friction plate (13) 4 sets into casing (1) and fit parking piston (15) into casing (1) by a jig or a press.
- Separate plate × 4EA
- Friction plate × 4EA
- Parking piston × 1EA



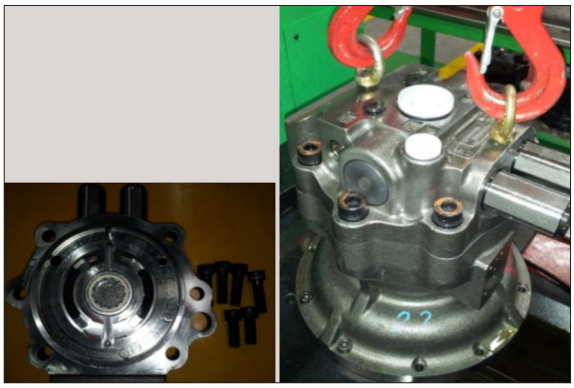
2209A8SM84

⑧ Assemble spring (parking piston, 16) into parking piston (15).
- Spring × 26EA



2209A8SM85

⑨ Lift up valve casing (23) on casing (1) by a crane and assemble it with socket bolts (37, 38).



2209A8SM86

⑩ Assemble level gauge (36) and plug (39) into casing (1).



2209A8SM87

⑪ Assemble time delay valve assy (35) into valve casing (23) with socket bolt (42).

- Time delay valve × 1EA
- Socket bolt × 3EA



2209A8SM88

⑫ **Air pressing test**

Be sure of leakage, after press air into assembled motor and put it in water for 1 minute (pressure : 2 kgf/cm^2).



2209A8SM89

⑬ **Leakage check**

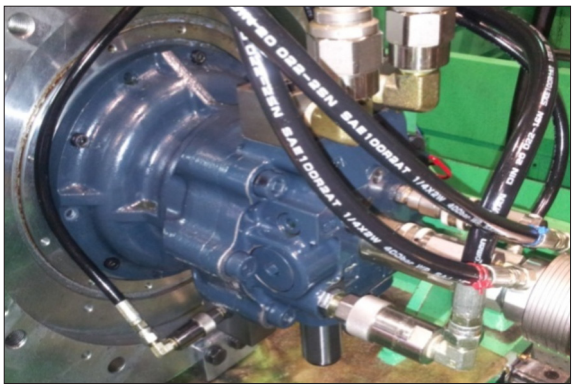
Place motor on a bench tester and after cleaning motor by color check No.1, paint No.3 and be sure of leakage.



2209A8SM90

⑭ **Mount test bench**

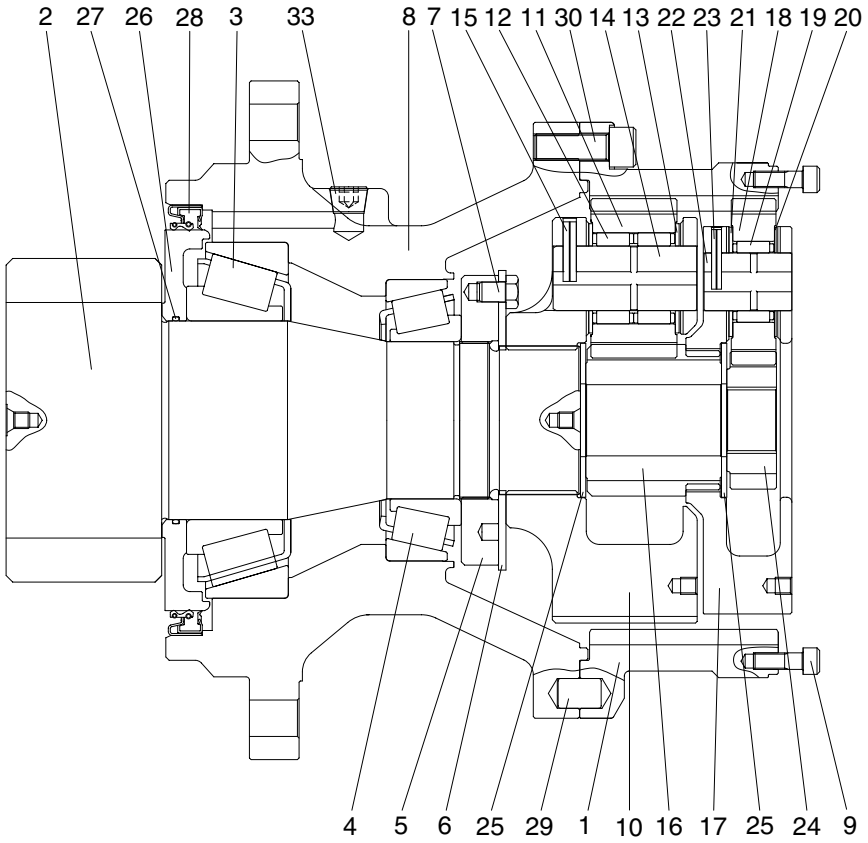
Mounting motor a test bench, test the availability of each part.



2209A8SM91

3. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



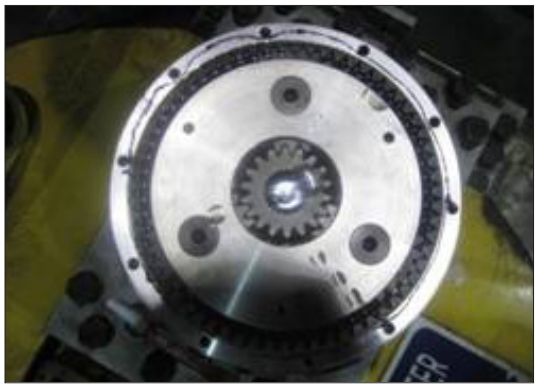
220L2SM03

1	Ring gear	11	Planetary gear 2	21	Thrust washer 1
2	Drive shaft	12	Needle bearing 2	22	Carrier pin 1
3	Taper bearing	13	Thrust washer 2	23	Spring pin 1
4	Taper bearing	14	Carrier pin 2	24	Sun gear 1
5	Ring nut	15	Spring pin 2	25	Thrust plate
6	Lock plate	16	Sun gear 2	26	Sleeve
7	Hexagon bolt	17	Carrier 1	27	O-ring
8	Casing	18	Planetary gear 1	29	Parallel pin
9	Socket bolt	19	Needle bearing 1	30	Socket bolt
10	Carrier 2	20	Thrust washer 1	33	Plug

2) DISASSEMBLY

(1) Preparation

① The reduction gear removed from machine is usually covered with mud.
Wash out side of reduction gear and dry it.
② Setting reduction gear on work stand for disassembling.
③ Mark for mating
Put marks on each mating parts when disassembling so as to reassemble correctly as before.
⚠ Take great care not to pinch your hand between parts while disassembling not let fall parts on your foot while lifting them.



2209A8SM01

(2) Disassembly

① Remove every “Socket bolt (M10)” that secure swing motor and reduction gear.
② Removing carrier sub assy & sun gear
a. Removing No.1 sun gear from No.1 carrier sub assy.
※ Be sure maintaining it vertical with ground when disassembling No.1 sun gear.



2209A8SM02

b. Removing No.1 carrier sub assy screwing I-bolt to tab hole (M10) in No.1 carrier.
Lifting it gradually maintaining it vertical with ground.

※ It’s impossible to disassemble No.1 spring pin. If No.1 spring pin has problem, change whole No.1 carrier sub assy.



2209A8SM03

c. Removing No.2 sun gear from No.2 carrier sub assy.

※ Be sure maintaining it vertical with ground when disassembling No.2 sun gear.



2209A8SM04

d. Removing No.2 carrier sub assy screwing I-bolt to tab hole (M10) in No.2 carrier. Lifting it gradually maintaining it vertical with ground.

※ It's impossible to disassemble No.2 spring pin. If No.2 spring pin has problem, change whole No.2 carrier sub assy.



2209A8SM05

③ Removing ring gear

After unscrewing every socket bolt (M16), remove ring gear from casing.

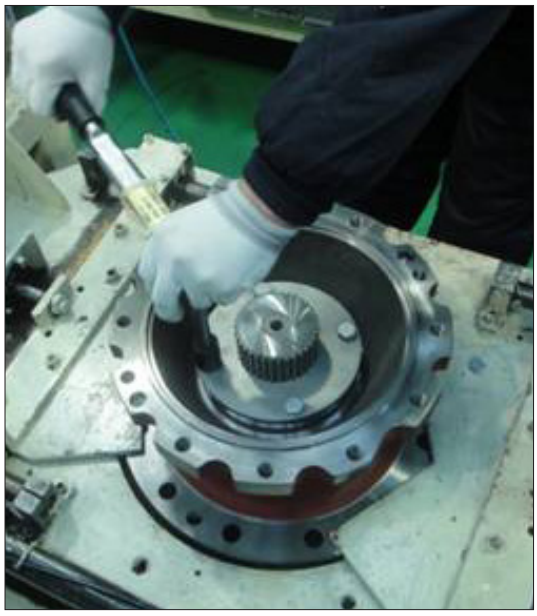
※ Because of liquid gaskets between ring gear and casing, put sharp punch between ring gear and casing and tapping it to remove them.



2209A8SM06

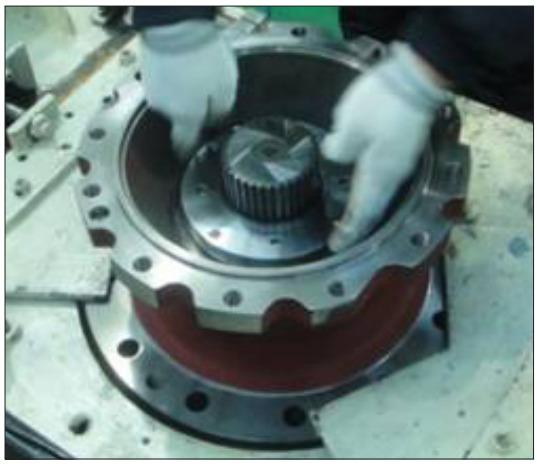
④ Removing drive shaft sub assy

a. Unscrew every hex head bolt (M12) to remove lock plate.



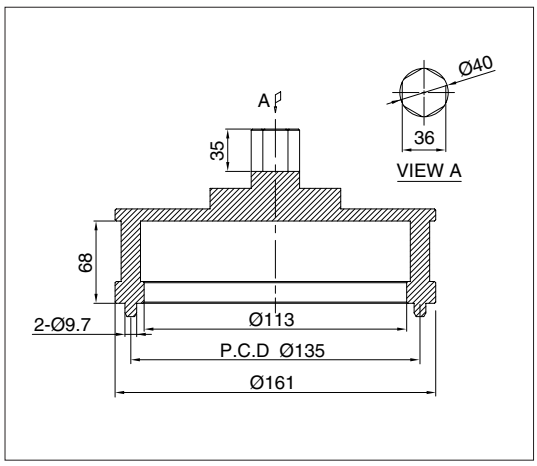
2209A8SM07

b. Rolling ring nut for removing them from drive shaft sub assy.



2209A8SM08

※ Use special tool to roll ring nut to counter clockwise.



220L8SM01

c. Remove drive shaft sub assy from casing.

※ Set a rack for flange of casing, and remove drive shaft sub assy from casing by using press.



2209A8SM09

d. Remove oil seal & taper bearing (small) from casing.

※ Do not re-use oil seal. It is impossible to disassemble drive shaft sub assy.



2209A8SM10



2209A8SM11

4. ASSEMBLY REDUCTION UNIT

1) GENERAL NOTES

(1) Clean every part by kerosene and dry them in a cool and dry place.

(2) Loctite on surface must be removed by solvent.

(3) Check every part for any abnormal.

(4) Each hexagon socket head bolt should be used with loctite #242 applied on its threads.

(5) Apply gear oil slightly on each part before assembling.

⚠ Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.
Inspection before assembling.

Thrust washer

- Check the seizure, abnormal wear or uneven wear.
- Check the unallowable wear.

Gear

- Check the pitting or seizure on tooth surface.
- Check the cracks on the root of tooth.

Bearing

- Rotate it by hands to check such noise or uneven rotation.

2) ASSEMBLING NO.1 CARRIER SUB ASSY

(1) Put thrust plate firmly in No.1 carrier.

(2) After assembling No.1 needle bearing to No.1 planetary gear, put a pair of No.1 thrust washer on both sides of bearing and install them to No.1 carrier.

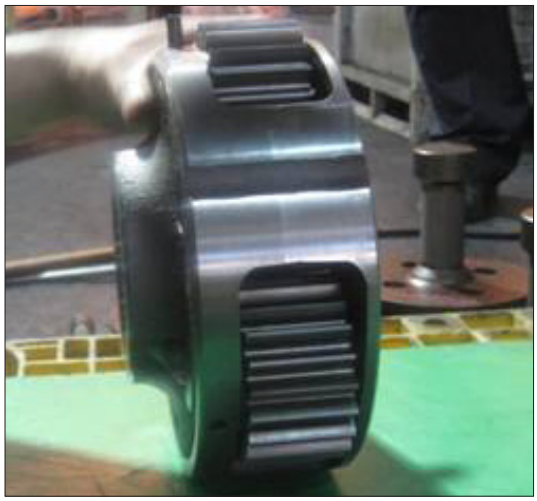


2209A8SM12



2209A8SM13

(3) Make of spring pin hole No.1 pin and No.1 carrier of spring pin hole in line, press No.1 spring pin into the holes.
Make No.1 spring pin hole head for No.1 planetary gear.



2209A8SM14

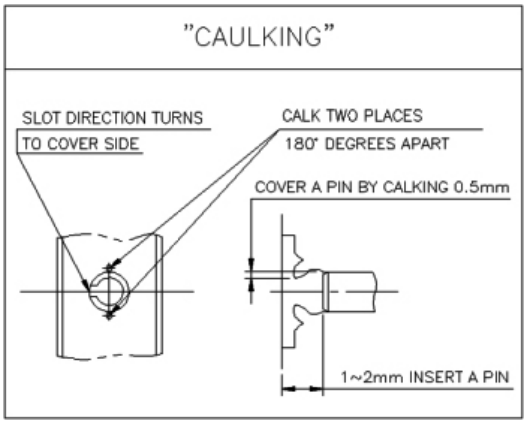
(4) Caulk carrier holes to make No.1 spring pin settle down stably.



2209A8SM15

※ Refer to “Caulking details”

Use paint marker for marking after caulking.



2209A8SM16

2) ASSEMBLING NO.2 CARRIER SUB ASSY

(1) Put thrust plate in firmly No.2 carrier.



2209A8SM17

(2) After assembling No.2 needle bearing to No.2 planetary gear, put 2 pieces of No.2 thrust washer on both sides of bearing and install them to No.2 carrier.



2209A8SM18

(3) Align No.2 spring pin hole and No.2 carrier spring pin hole, put No.2 spring pin into the holes.
Make No.2 spring pin cutting line face to No.2 planetary gear.

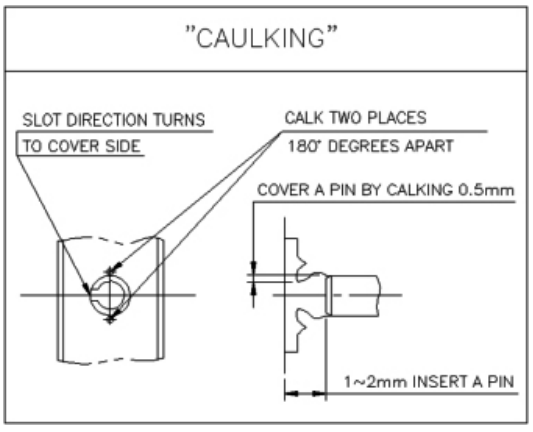


2209A8SM19

(4) Caulk carrier holes to make No.2 spring pin settle down stably.

※ Refer to “Caulking details”

Use paint marker for marking after caulking.



2209A8SM20

3) ASSEMBLING PINION GEAR SUB ASSY

(1) Prepare drive shaft pinion gear vertical with ground.

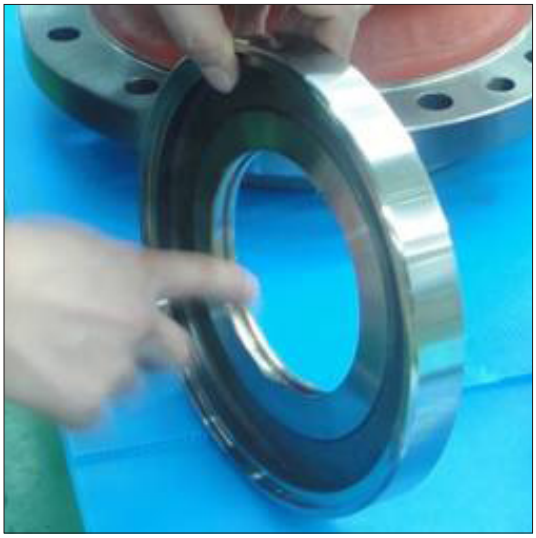


2209A8SM21

(2) Fully apply grease (albania EP02) to O-ring groove of sleeve.

※ Be sure to maintain it vertical with ground when assembling it.

(3) Put O-ring into O-ring groove of sleeve.
Fully apply grease on O-ring.



2209A8SM22

(4) Assemble taper bearing and sleeve into drive shaft using press jig.
Use special jig for pressing. Leave no space between sleeve and taper bearing.



2209A8SM23



2209A8SM24

4) ASSEMBLING BEARING CUP & OIL SEAL (PRESSING)

(1) Put top, bottom bearing cup into casing.
Use special jig for pressing. Pay attention to foreign materials while assembling bearing cup.

※ Flip over casing to assemble oil seal.

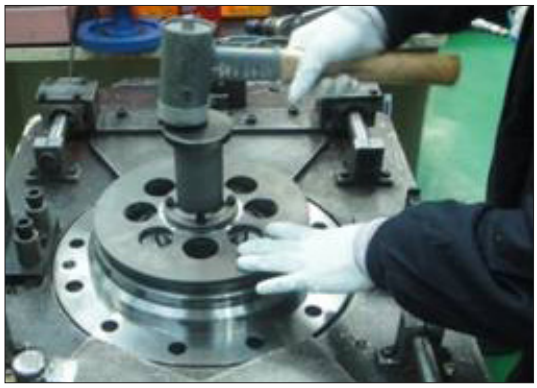


2209A8SM25



2209A8SM26

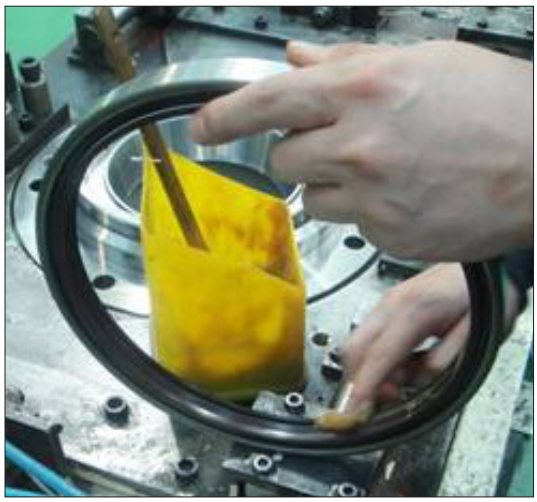
(2) Assemble oil seal to casing.
Use special jig for pressing. Pay attention to direction of dust seal and dent.



2209A8SM27

※WHILE ASSEMBLING OIL SEAL

1. Be sure to set dust seal to gear oil.
2. Before assembling, charge enough grease in oil seal.
3. Before assembling, apply enough grease inside and outside of oil seal.



2209A8SM28

5) ASSEMBLING SHAFT SUB ASSY & RING NUT

(1) After assembling casing & drive shaft sub assy, flip it over.



2209A8SM29

(2) Put drive shaft sub assy into casing.

※ Be sure to maintain it vertical with ground when assembling it.



2209A8SM30

(3) Put taper bearing into it.

Rotate bearing by hands for checking after assembly.



2209A8SM31

(4) Put ring nut into drive shaft sub assy by using special jig.

The tightening torque (M95) = 3.5±0.4 kgf·m
(25.3±2.9 lbf·ft)



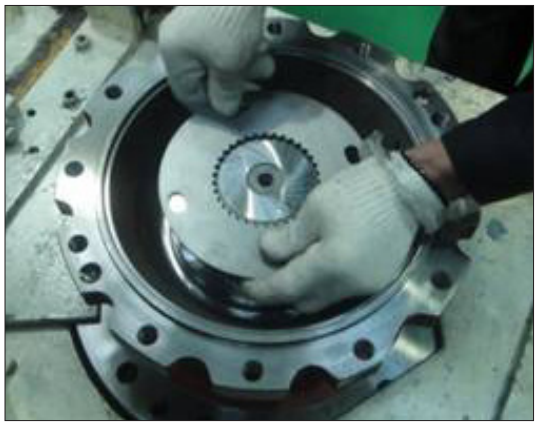
2209A8SM32

※ Apply enough loctite #242 before screwing bolts.



2209A8SM33

(5) Align bolt screw of ring nut with lock plate's hole.
In case of misalign between bolt screw ring nut and lock plate's hole, put lock plate as near as possible to hole of bolt screw of ring nut and make it in line by increasing tightening torque.



2209A8SM34



2209A8SM35

(6) Screw 4 bolts (M12×16) to connect ring nut and lock plate by using torque wrench.
Bolt (M12, 4EA) = 10.9T
The tightening torque = 8.8±0.9 kgf·m
(63.7±6.5 lbf·ft)

※ Apply enough loctite #242 before screwing bolts.



2209A8SM36

(7) Use paint marker for checking surplus parts after assembling.



2209A8SM37

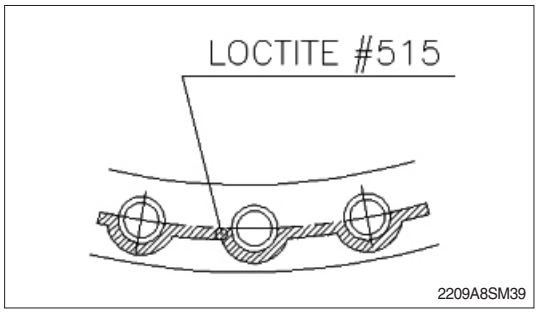
6) ASSEMBLING RING GEAR

(1) Apply loctite #515 bottom of casing sub assy contacting with ring gear without disconnection.



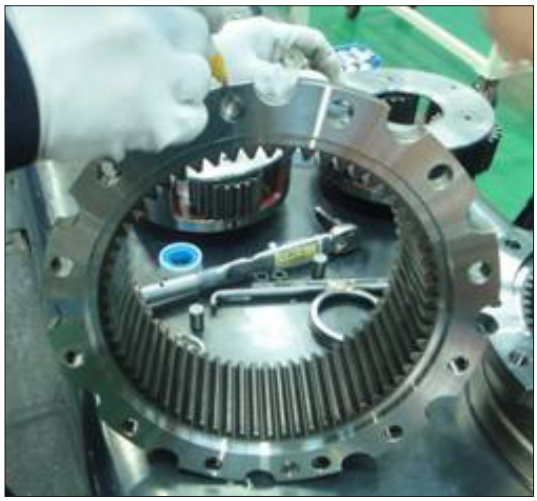
2209A8SM38

Refer to loctite detail.



2209A8SM39

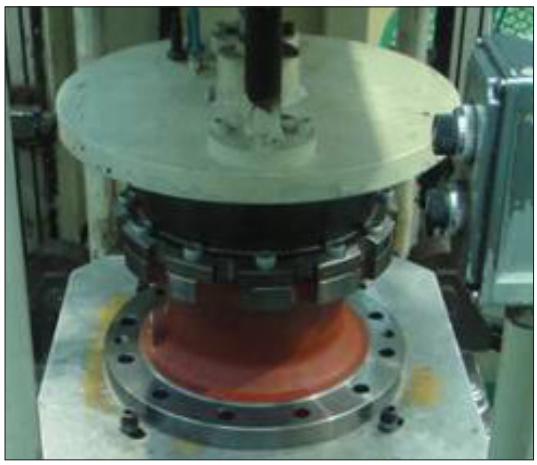
(2) Put parallel pin into hole of casing sub assy. Mark parallel pin position using paint marker.



2209A8SM40

(3) Align ring gear with parallel pin to put them into casing sub assy.

※ Be sure to maintain them vertical with ground while using press.



2209A8SM41

(4) Screw 12 bolts (M16×45) to connect casing sub assy and ring gear (01) by using torque wrench.
Bolt (M16, 12EA) = 12.9T
The tightening torque = 27±2.7 kgf·m
(195±19.5 lbf·ft)

※ Apply enough loctite #242 before screwing bolts.



2209A8SM42

(5) Use paint marker for checking surplus parts after assembling.



2209A8SM43



2209A8SM44

7) ASSEMBLING CARRIER SUB ASSY & SUN GEAR

(1) Put No.2 carrier sub assy along spline of drive shaft spline.

- Screw M10 I-bolt to No.2 carrier sub assy.
- Lifting up No.2 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.2 carrier sub assy by hands to fit No.2 carrier sub assy into drive shaft spline.



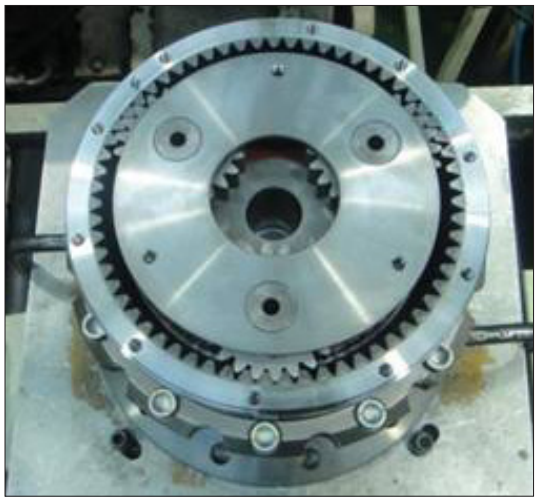
2209A8SM45

(2) Put No.2 sun gear into No.2 carrier sub assy.



2209A8SM46

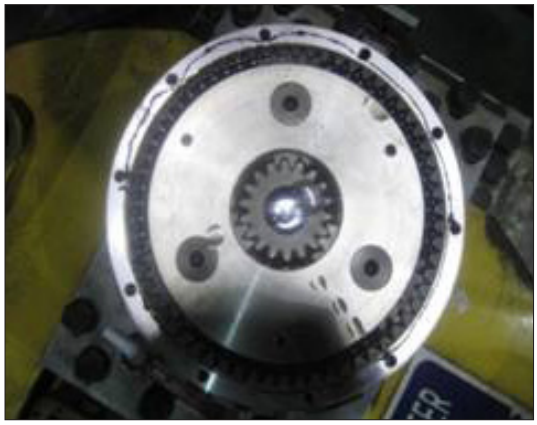
(3) Put No.1 carrier sub assy into No.2 sun gear along spline.
- Screw M10 I-bolt to No.1 carrier sub assy.
- Lifting up No.1 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.1 carrier sub assy by hands to fit No.1 carrier into No.2 sun gear spline.



2209A8SM47

(4) Put No.1 sun gear into No.1 carrier sub assy. Be sure to maintain it vertical with ground. And align with No.1 planetary gear spline.

(5) Rotate No.1 carrier sub assy by hands to check noise.



2209A8SM48

8) MEASURING CLEARANCE & ASSEMBLING NAME PLATE

(1) Check the clearance between ring gear and No.1 sun gear using a tool with dial gauge.

Check the clearance
Dial gauge = -0.3 ~ +2.95



2209A8SM49

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90 °and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**

(5) Remove the cover.

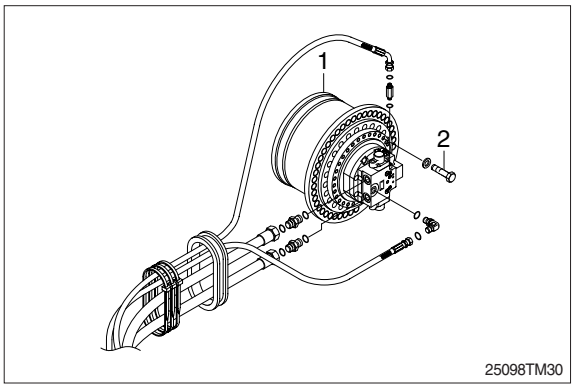
(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(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 : 305 kg (670 lb)
· Tightening torque : 23 ± 2.5 kgf·m
(166 ± 18.1 lbf·ft)


13031GE18



25098TM30

2) INSTALL

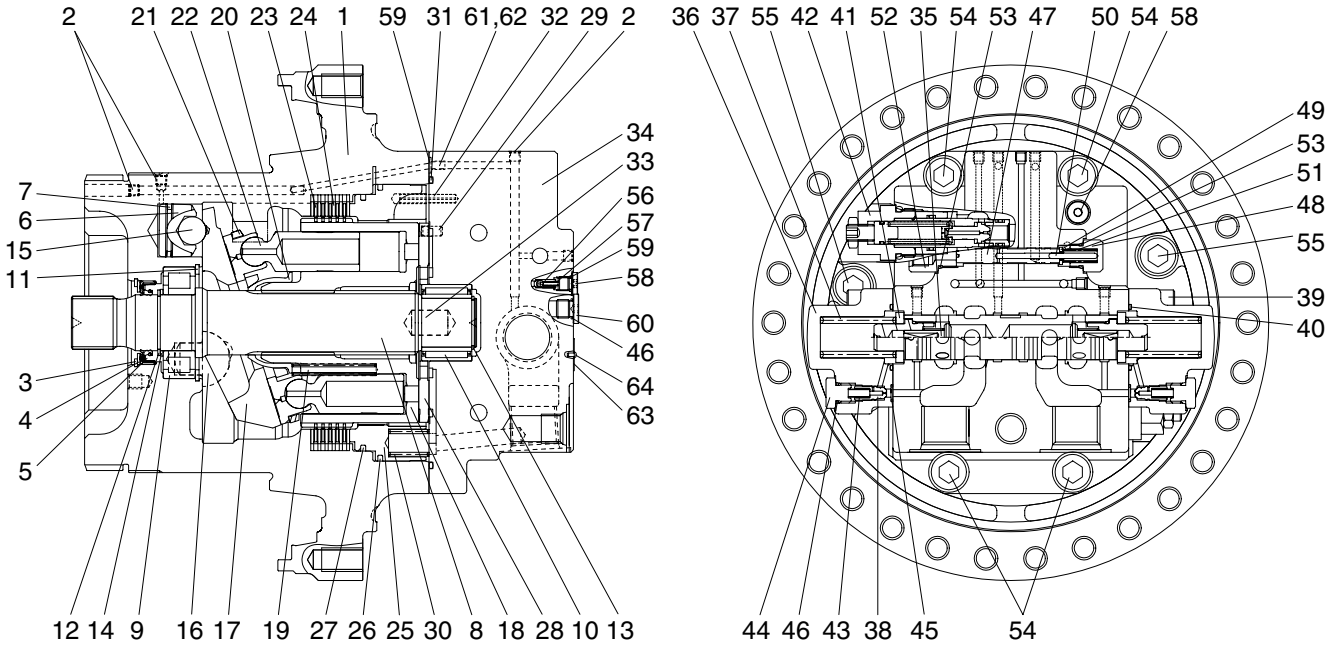
(1) Carry out installation in the reverse order to removal.

(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

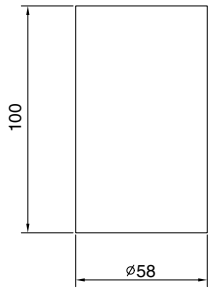
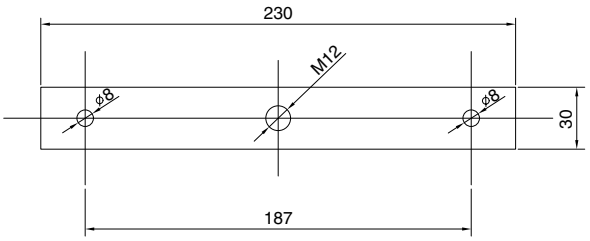
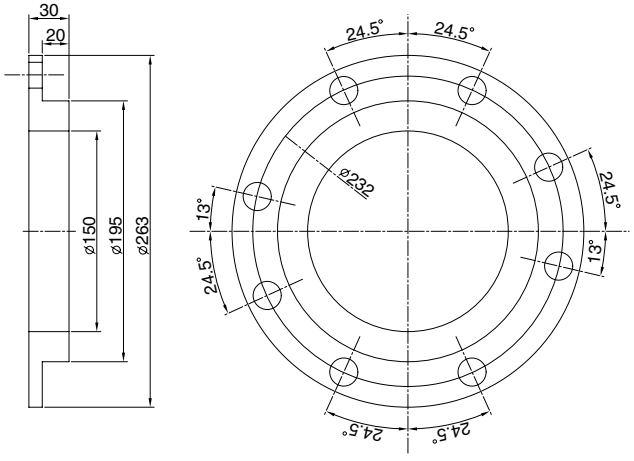


2209A2TM21

1	Casing	22	Piston assy	44	Plug
2	Plug	23	Friction plate	45	O-ring
3	Oil seal	24	Separated plate	46	O-ring
4	Thrust plate	25	Parking piston	47	Spool
5	Snap ring	26	D-ring	48	Plug
6	Piston	27	D-ring	49	Spring seat
7	Piston seal	28	Valve plate	50	Parallel pin
8	Shaft	29	Parallel pin	51	Spring
9	Cylinder roller bearing	30	Spring	52	Connector
10	Needle bearing	31	O-ring	53	O-ring
11	Snap ring	32	Spring pin	54	Hexagon socket head bolt
12	Snap ring	33	Parallel pin	55	Hexagon socket head bolt
13	Snap ring (type 1)	34	Rear cover	56	Check valve
13	Retainer C ring (type 2)	35	Main spool assy	57	Spring
14	Thrust plate	36	Cover	58	Plug
15	Steel ball	37	Spring	59	O-ring
16	Pivot	38	Restrictor	60	Plug
17	Swash plate	39	Hexagon socket head bolt	61	Restrictor
18	Cylinder block	40	O-ring	62	Restrictor
19	Spring	41	Spring seat	63	Name plate
20	Ball guide	42	Relief valve assy	64	Rivet
21	Retainer plate	43	Spring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark
Hexagon wrench	Width across flat 5, 6, 8, 10, 14 mm
Snap ring prier	For shaft Ø60~80 mm
Snap ring prier	For bore Ø32~58 mm
Plastic hammer	1 piece
Screw dirver	Minus (-), medium size, 2 pieces
Torque wrench	10 kgf·m (72.3 lbf·ft), 33 kgf·m (238.6 lbf·ft), 45 kgf·m (325.4 lbf·ft)
Gig for inserting oil seal	 25098TM31
Gig for inserting parking piston (M10×100 bolt 2EA, M12×100 bolt 1EA)	 25098TM32
Gig for pulling out brake piston	 25098TM33

(2) Tightening torque

Item	Name	Size	Torque	
			kgf · m	lbf · ft
2	Plug	NPTF 1/16	1.1±0.1	7.9±0.72
39	Hexagon socket head bolt	M12	1.0±1.0	72.3±7.2
42	Relief valve	1 5/16	34±3.4	246±24.6
44	Plug	PF 1/4	2.8±0.3	20.3±2.17
48	Plug	PF 3/8	5.5±0.5	39.8±3.6
52	Connector	PF 3/8	5.5±0.5	39.8±3.6
54	Hexagon socket head bolt	M18	38±3.8	275±27.5
55	Hexagon socket head bolt	M18	38±3.8	275±27.5
58	Plug	PF 1/8	1.5±0.1	10.8±0.72
60	Plug	PF 1/4	3±0.3	21.7±2.17

3. DISASSEMBLING

1) GENERAL INSTRUCTIONS

⚠ **Combustibles such as white kerosene are used for washing parts.**
These combustibles are easily ignited, and could result in fire or injury.
Be very careful when using.

⚠ **Internal parts are coated with hydraulic fluid during disassembling and are slippery.**
If a part slips out of your hand and fails, it could result in bodily injury or could damage the park.
Be very careful when handling.

(1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.

(2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.

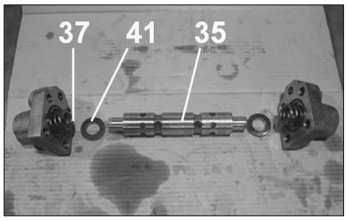
(3) Bofore disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

(4) The piston can be inserted to whichever cylinder block for the initial assembling.
However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.

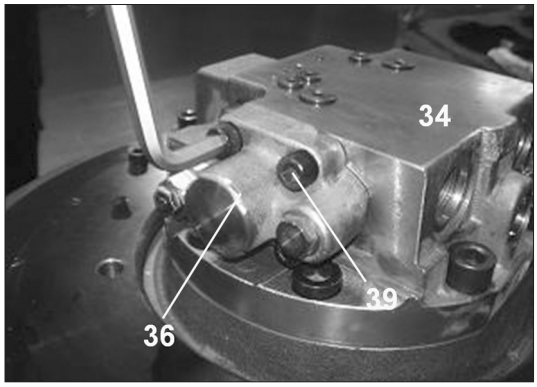
⚠ **Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.**

2) DISASSEMBLING TRAVEL MOTOR

(1) Disassemble the wrench bolt (39) to tighten the spool cover (36) and rear cover (34) by using the L-wrench or impact wrench and then disassemble the spring (37), spring seat (41) and main spool assy (35) in order.

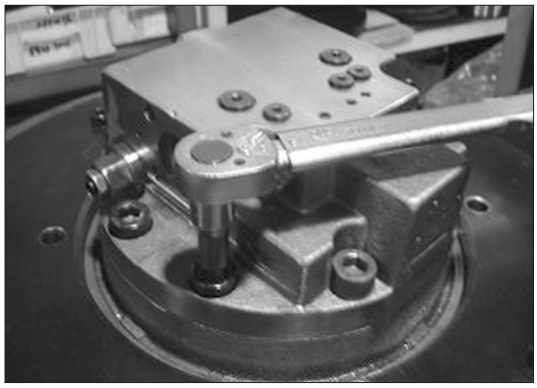


25098TM034



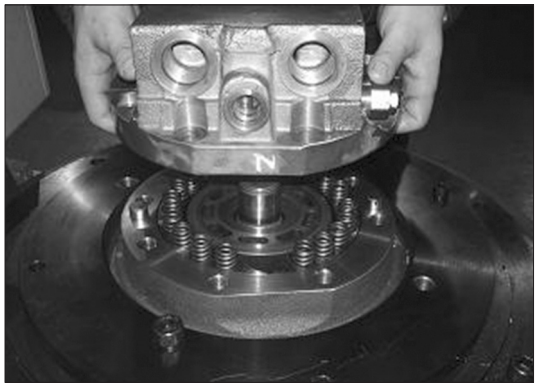
25098TM035

(2) Disassemble the wrench bolt (54, 55) to tighten the casing (1) and rear cover (34) by using the L-wrench or impact wrench.



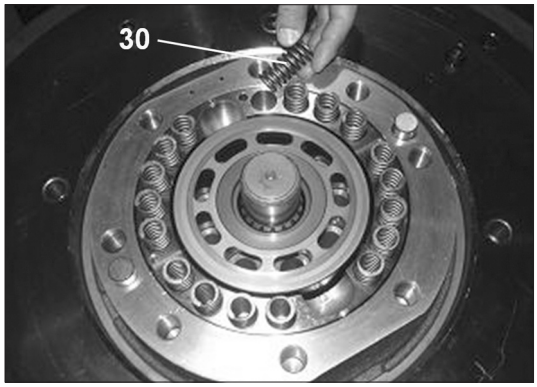
25098TM036

(3) Separate the casing (1) and rear cover (34).



25098TM037

(4) Disassemble the brake spring (30, 18EA) from the piston.

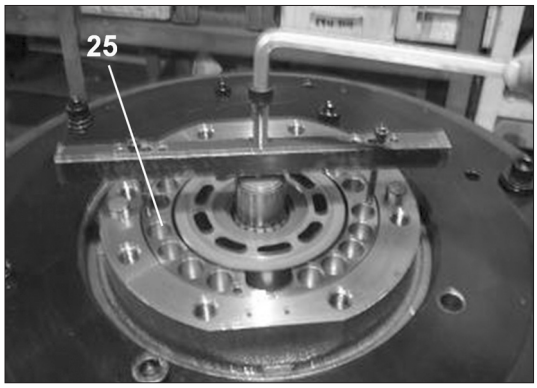


25098TM118

(5) Disassemble the parking piston (25) by using the jig for disassembling parking piston.

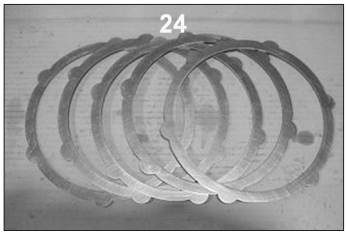


25098TM039

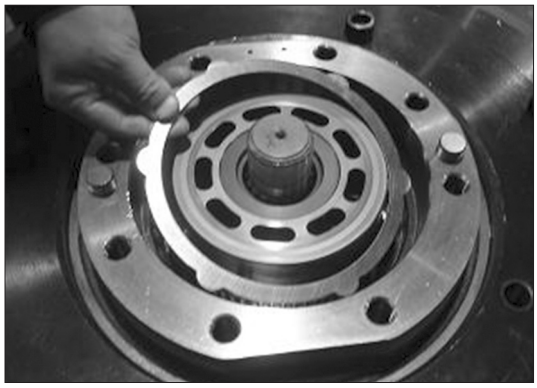


25098TM040

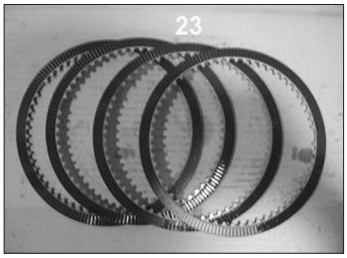
(6) Disassemble the separated plate (24, 5EA) and friction plate (23, 4EA) from the casing.



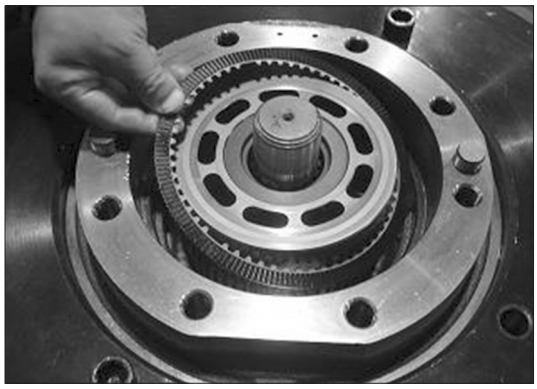
25098TM041



25098TM042

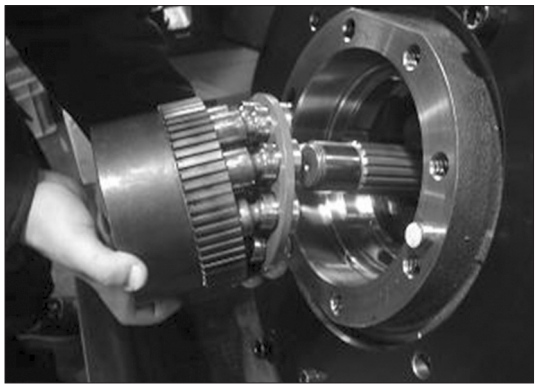


25098TM043



25098TM044

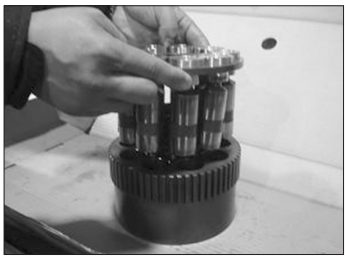
(7) Turn the casing (1) horizontal by using the assemble truck and disassemble the cylinder block kit form the casing (1).

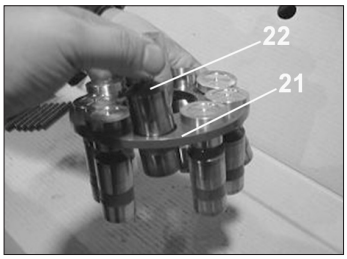


25098TM045

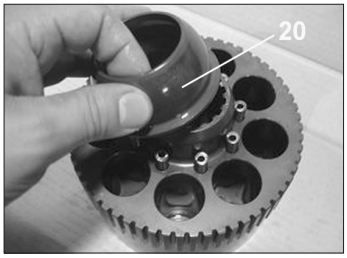
(8) Disassemble the cylinder block (18), retainer plate (21), piston assy (22), ball guide (20) and spring (19) from the cylinder block kit.


25098TM046

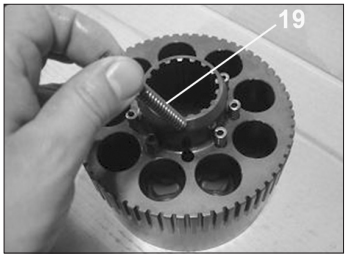

25098TM047



25098TM048



25098TM049

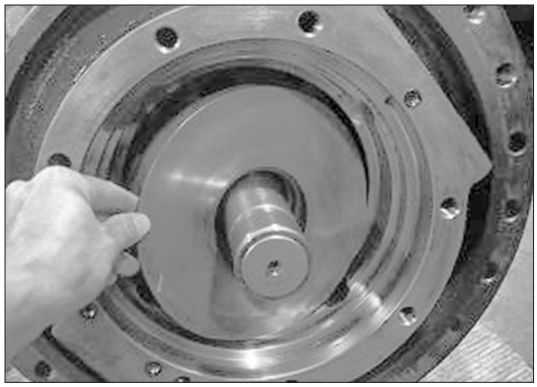


25098TM050

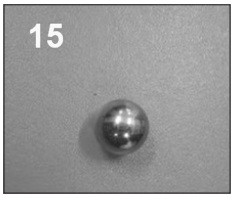
(9) Disassemble the swash plate (17) from the casing.



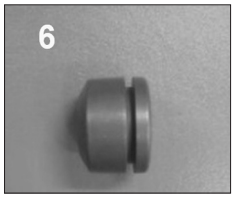
25098TM051


25098TM052

(10) Disassemble the steel ball (15) and swash piston (6) from the casing.



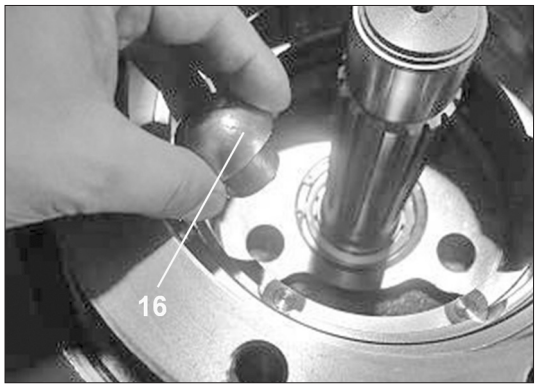
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25098TM054

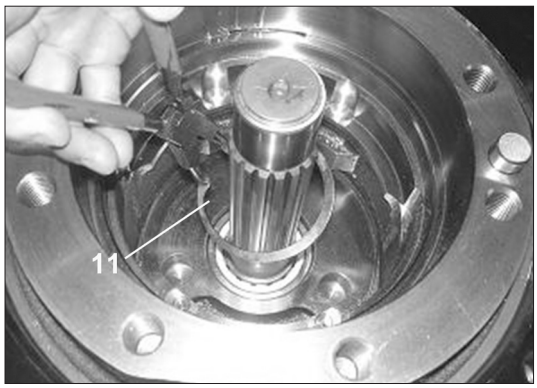

25098TM055

(11) Disassemble the pivot (16, 2EA) from the casing.



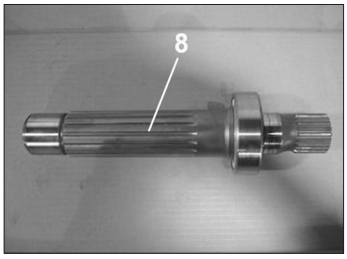
25098TM056

(12) Disassemble the snap ring (11) from the shaft (8) with the pryer for retaining ring.



25098TM057

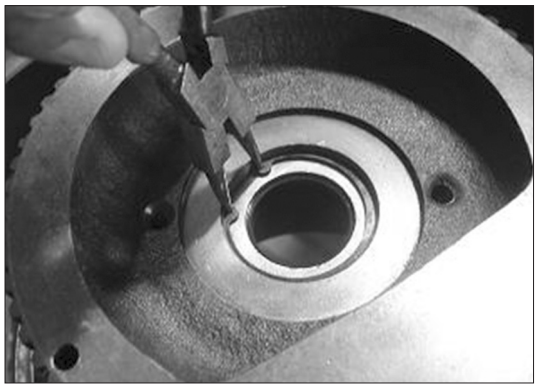
(13) Disassemble the shaft (8) from the casing (1).



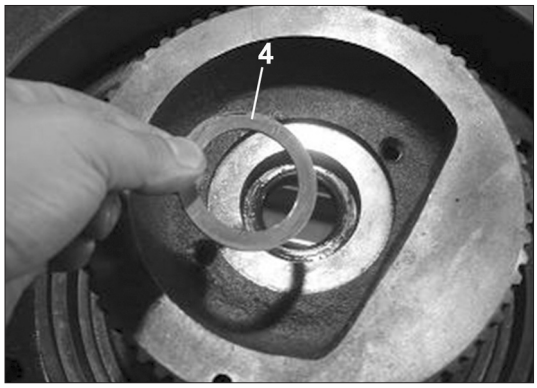
25098TM058


25098TM059

(14) Disassemble the snap ring (5) from the casing (1) with the pryer for retaining ring.


25098TM060

(15) Disassemble the thrust plate (4) from the casing (1).

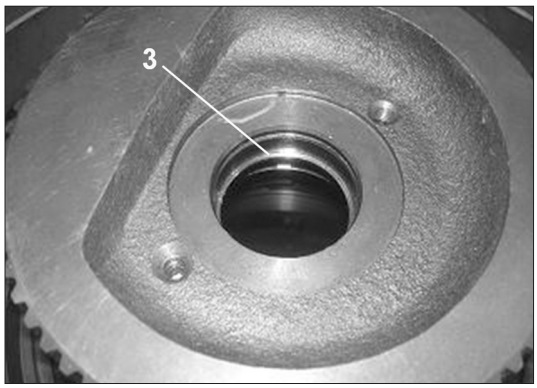


25098TM061

(16) Disassemble the oil seal (3) from the casing (1) with suitable tool.

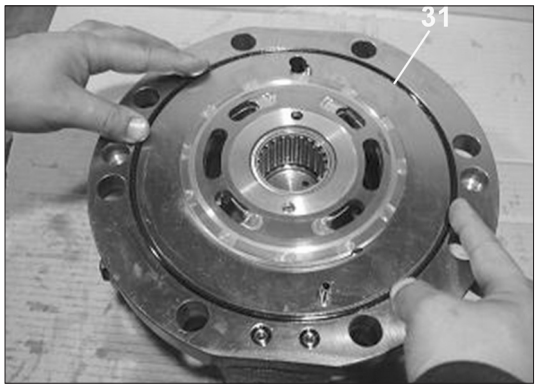


25098TM062



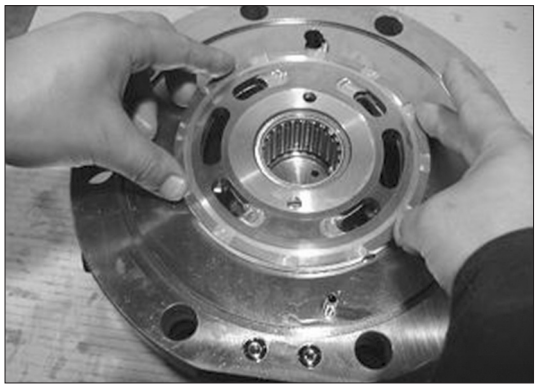
25098TM063

(17) Disassemble the O-ring (31) from the casing (1).

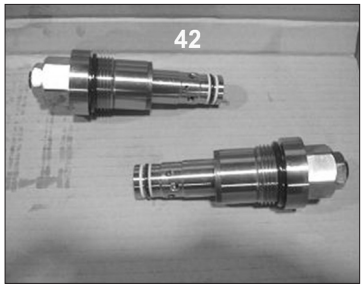


25098TM064

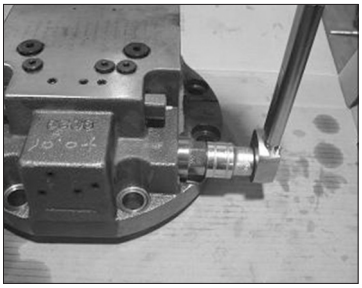
(18) Disassemble the valve plate (28) from the casing (1).

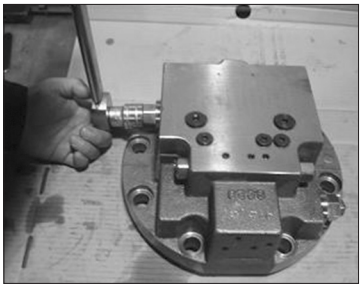

25098TM065

(19) Disassemble the relief valve (42, 2EA) from the rear cover (34) by using the torque wrench.

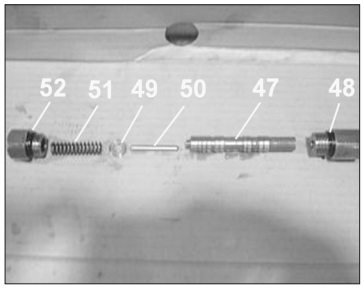


25098TM066

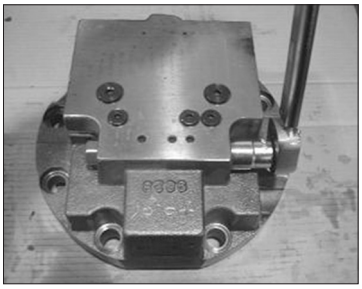

25098TM067

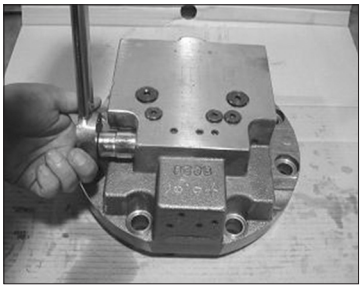

25098TM068

(20) Disassemble both side of the plug (48) and connector (52) from the rear cover (34) by using the torque wrench and then disassemble the spring (51), spring seat (49), parallel pin (50) and spool (47) in order.

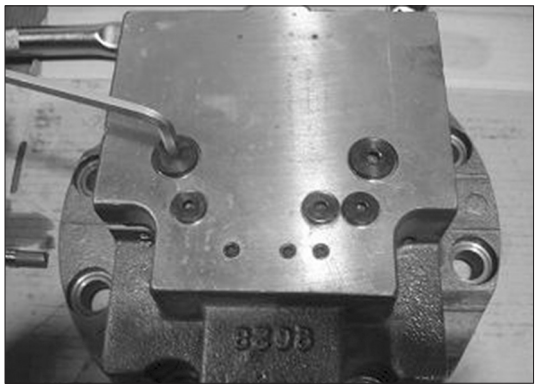


25098TM069

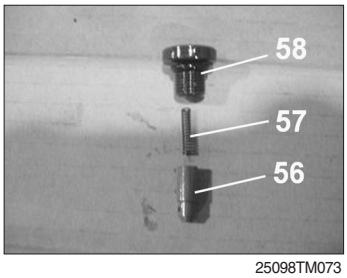

25098TM070


25098TM071

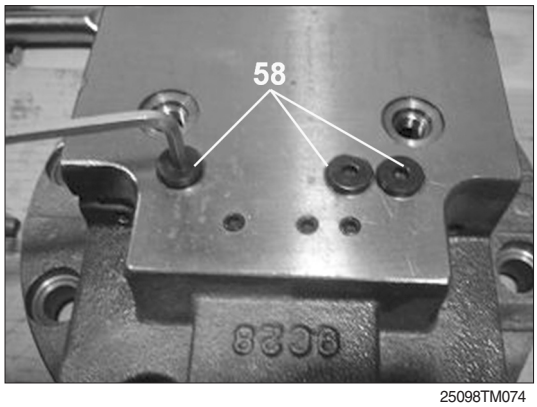
(21) Disassemble the plug (60) from the rear cover.


25098TM072

(22) Disassemble the plug (58) and then disassemble the spring (57) and check valve (56) from the rear cover in order.



25098TM073



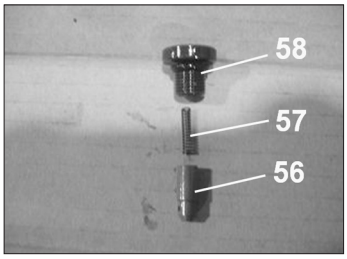
25098TM074

4. REASSEMBLING

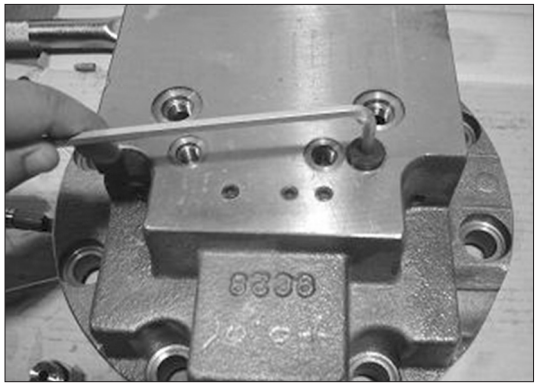
1) ASSEMBLING MOTOR

- REAR COVER ASSY

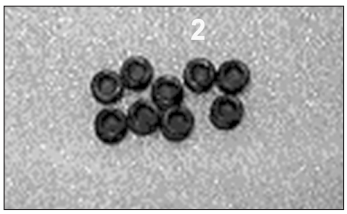
(1) Assemble the check valve (56) and the spring (57) to the rear cover and then tighten the plug (60) by using the L-wrench.



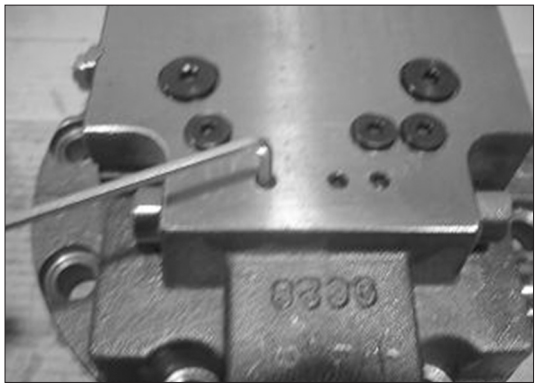
25098TM075


25098TM076

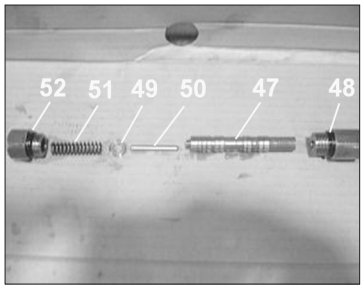
(2) Apply the loctite #242 on the NPTF 1/16 plug (2, 12EA) and tighten it.



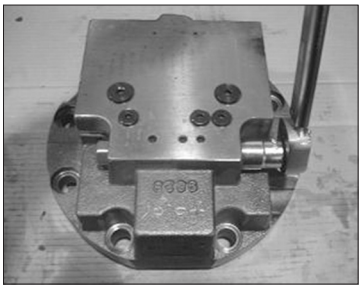
25098TM077

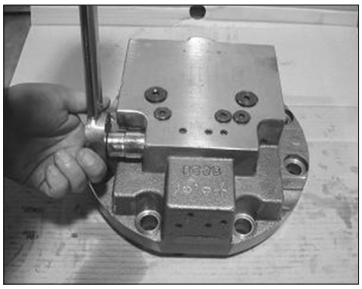

25098TM078

(3) Assemble the spool (47), parallel pin (50), spring seat (49) and spring (51) into the rear cover (34) and tighten both side of the plug (48) and connector (52) into the rear cover (34).

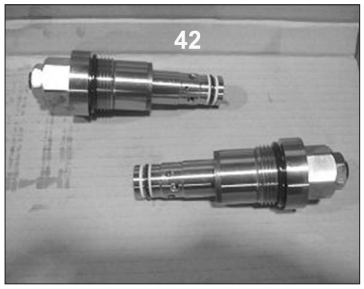


25098TM079

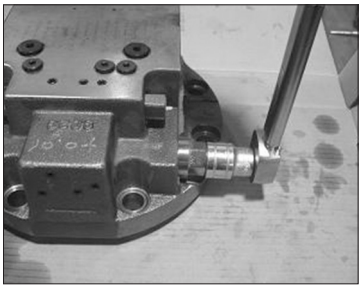

25098TM080

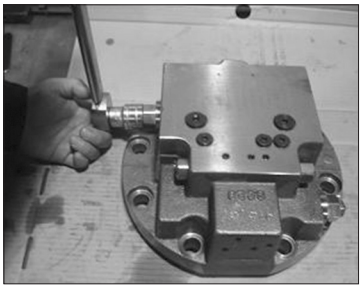

25098TM081

(4) Assemble the relief valve (42, 2EA) into rear cover (34).

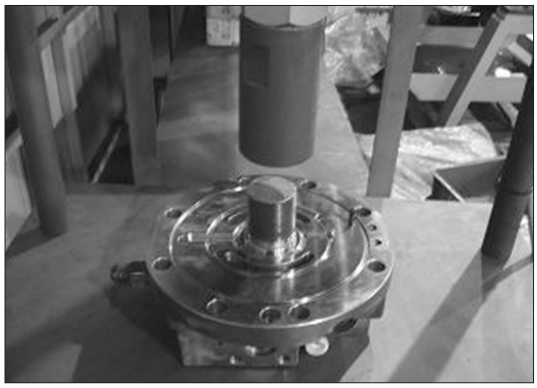


25098TM082


25098TM083


25098TM084

(5) Tight fit the needle bearing (10) into rear cover (34) by using pressing jig.



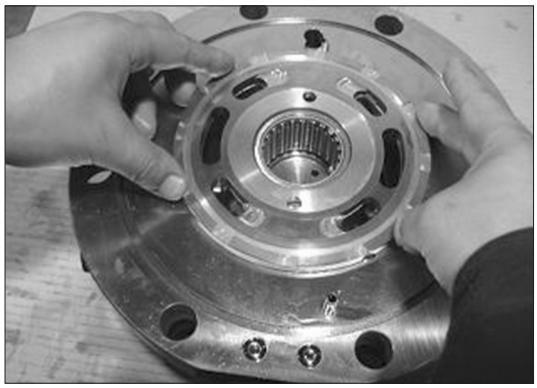
25098TM085

(6) Assemble the spring pin (32) and parallel pin (29) into rear cover (34) by using round bar or small hammer.



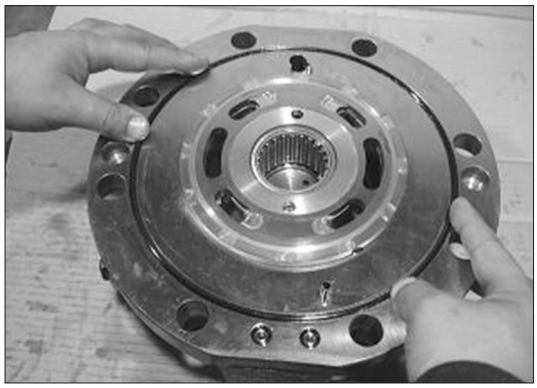
25098TM086

(7) Assemble the valve plate (28) into rear cover (34).
Before assembling, apply some grease on contact surface of the valve plate.



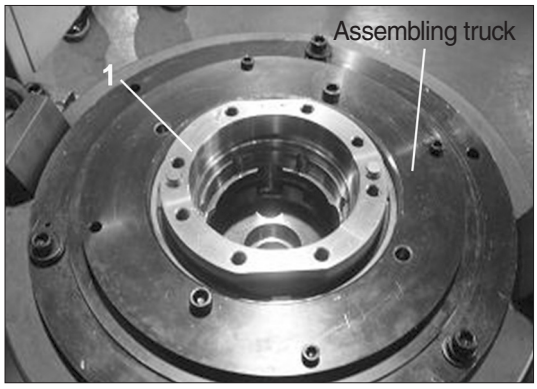
25098TM087

(8) Apply some grease on the O-ring and fit it into groove.



25098TM088

(9) Assemble the casing (1) on the assembling truck.



25098TM089

(10) Tight fit the oil seal (3) into the casing (1) by using jig.

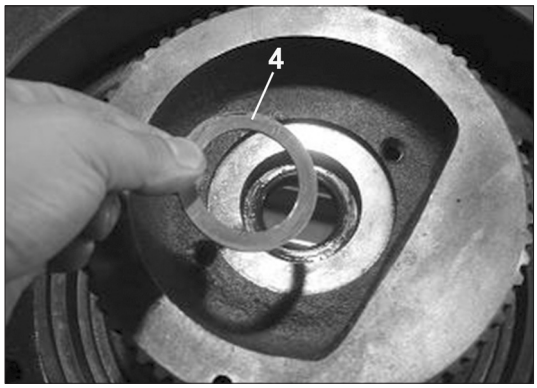
※ Be careful direction of the oil seal.



25098TM090

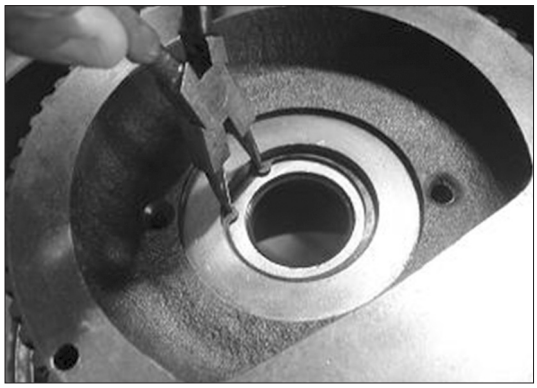

25098TM091

(11) Assemble the thrust plate (4) into the casing (1).



25098TM092

(12) Assemble the snap ring (5) into the casing (1) with the plier for retaining ring.


25098TM093

(13) Heat the roller bearing (9) and fit it into the shaft with shrink fitting.

a. Shrink fitting can be used induction heating system and set the temperature at 100°C.
b. Be careful not to damage the sliding surface of the oil seal of the shaft.


25098TM094

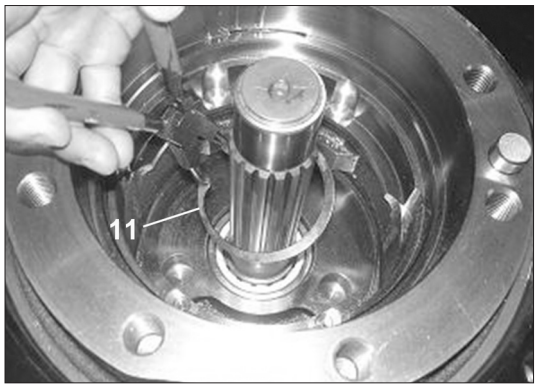

25098TM095


25098TM096

(14) Assemble the heat-fitted shaft (8) into casing (1).

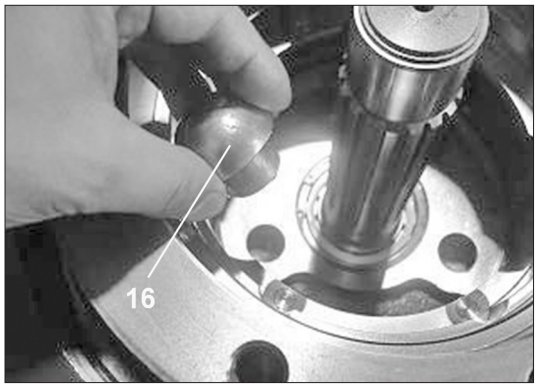

25098TM097

(15) Assemble the snap ring (11) into the casing (1) with the plier for retaining ring.



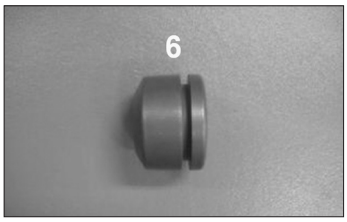
25098TM098

(16) Apply a little grease on the pivot (16, 2EA) and assemble it into the casing (1).



25098TM099

(17) Heat the piston seal (7) and fit it into the swash piston (6) and then tighten it a few minutes by band or tie. Loosen the band or tie and assemble it to the casing (1).

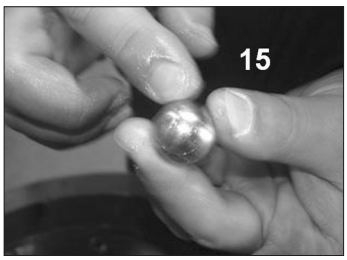


25098TM100

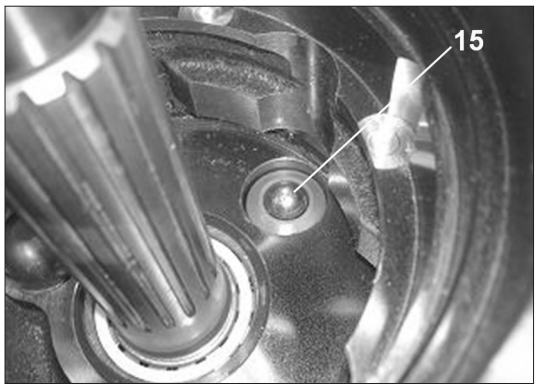


25098TM101

(18) Apply a little grease on the steel ball (15) and assemble it into the swash plate (17).



25098TM102

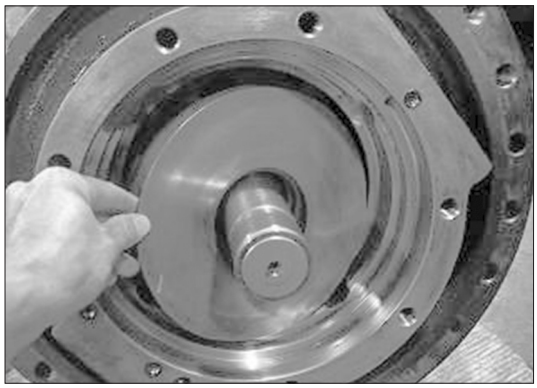


25098TM103

(19) Apply some grease on the steel ball hole of the swash plate (17) and assemble it casing (1).

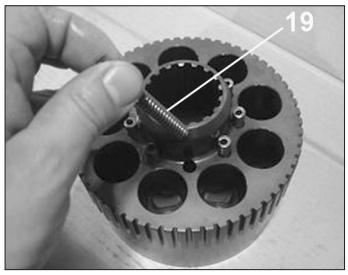


25098TM104

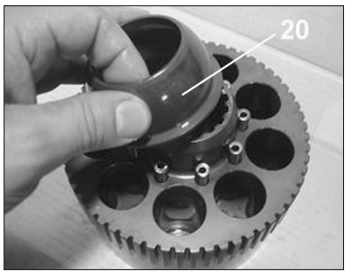


25098TM105

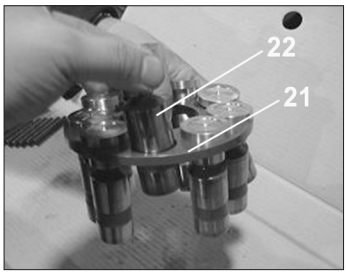
(20) Assemble the spring (19), ball guide (20), retainer plate (21) and piston assy (22) into cylinder block (18) in order.



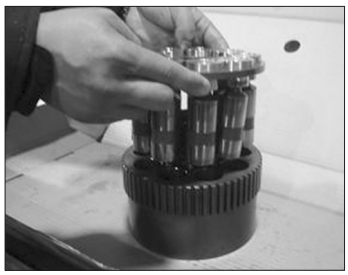
25098TM106



25098TM107

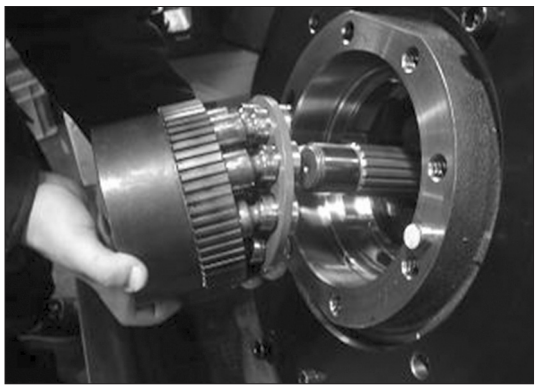


25098TM108


25098TM109


25098TM110

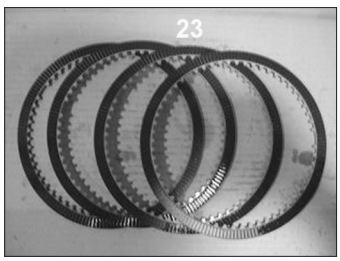
(21) Tilt the casing (1) sideways and assemble the cylinder block kit into the casing (1).


25098TM111

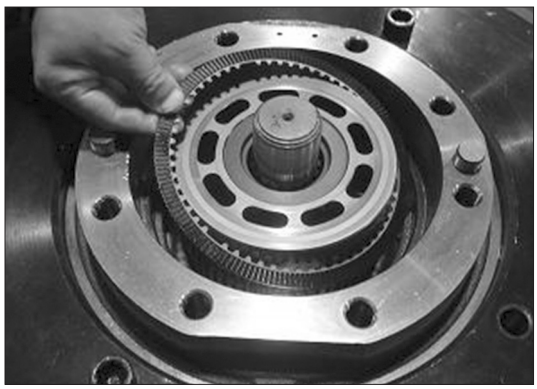
(22) Assemble the separated plate (24) and friction plate (23) into the cylinder block alternately.

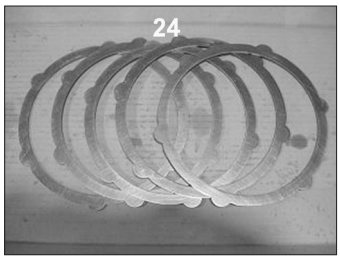
Friction plate : 4EA

Separated plate : 5EA

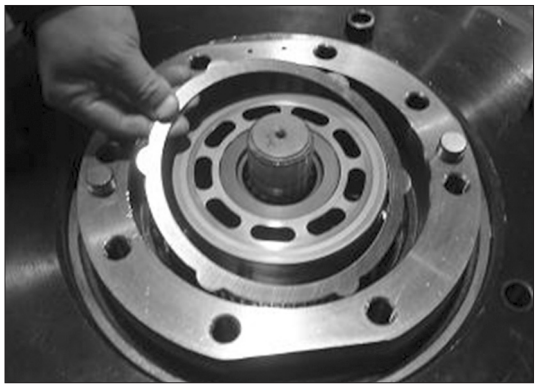


25098TM112


25098TM113

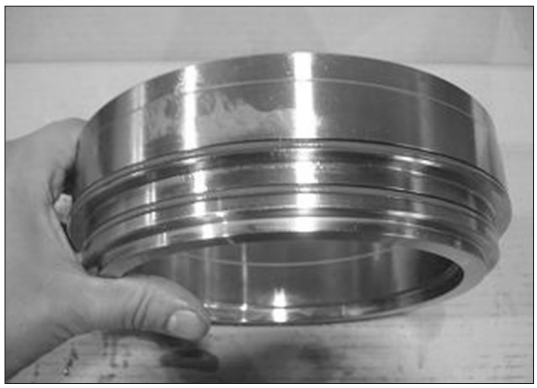


25098TM114



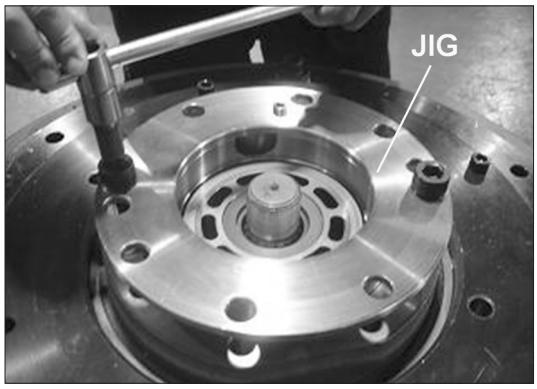
25098TM115

(23) Apply some grease on the D-ring and assemble it parking piston.



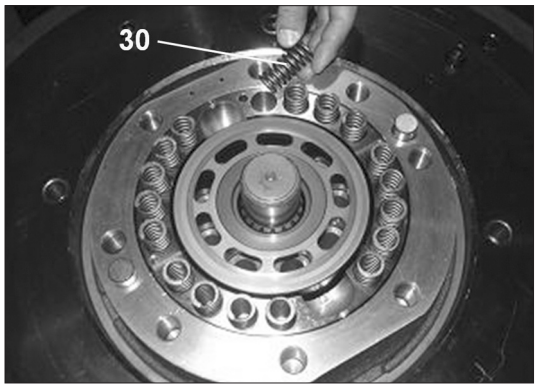
25098TM116

(24) Insert the parking piston into the casing and assemble it by using jig.



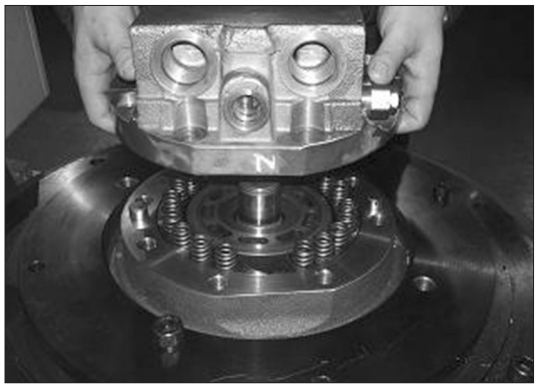
25098TM117

(25) Assemble the brake spring (30, 18EA) into the piston.



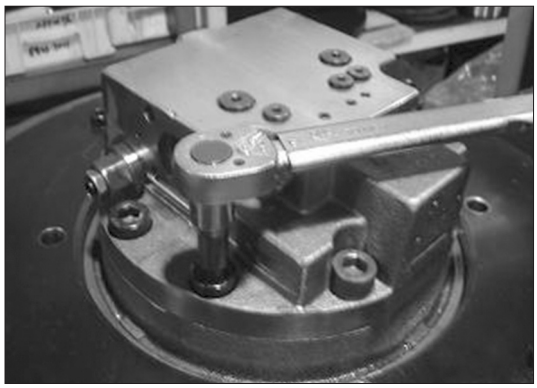
25098TM118

(26) Place the rear cover (34) on the casing (1).



25098TM119

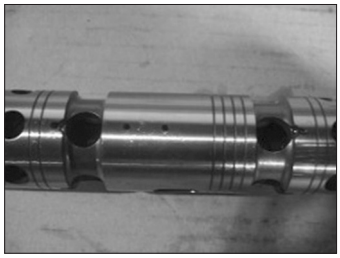
(27) Tighten the casing (1) and rear cover (34) specified torque with wrench bolt (54, 55) by using the impact wrench and torque wrench.



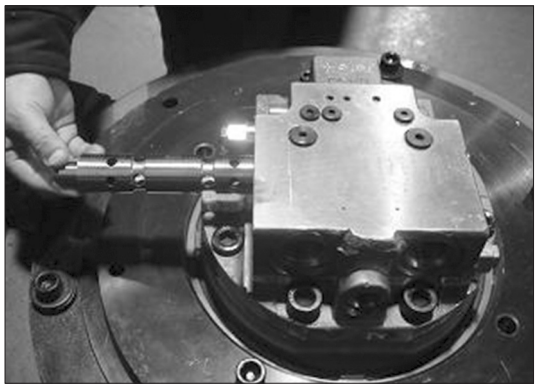
25098TM120

(28) Confirm the insert direction of the main spool assy (35) exactly and assemble it into the rear cover (34).

※ Assure that four balance hole is directed VA port.

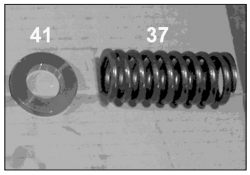


25098TM121

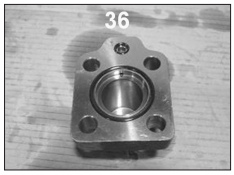


25098TM122

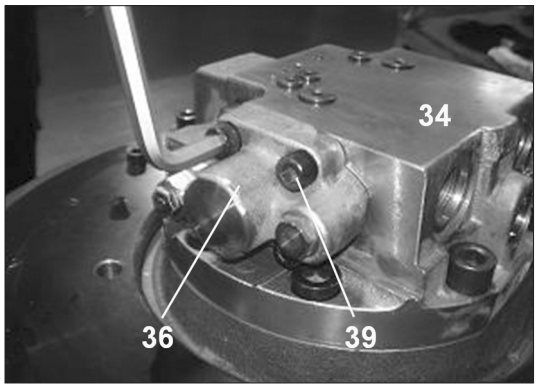
(29) Assemble the spring seat (41), spring (37) and main spool cover (36) into valve plate and tighten the wrench bolt (39, M12x35) by using L-wrench or impact wrench.



25098TM123

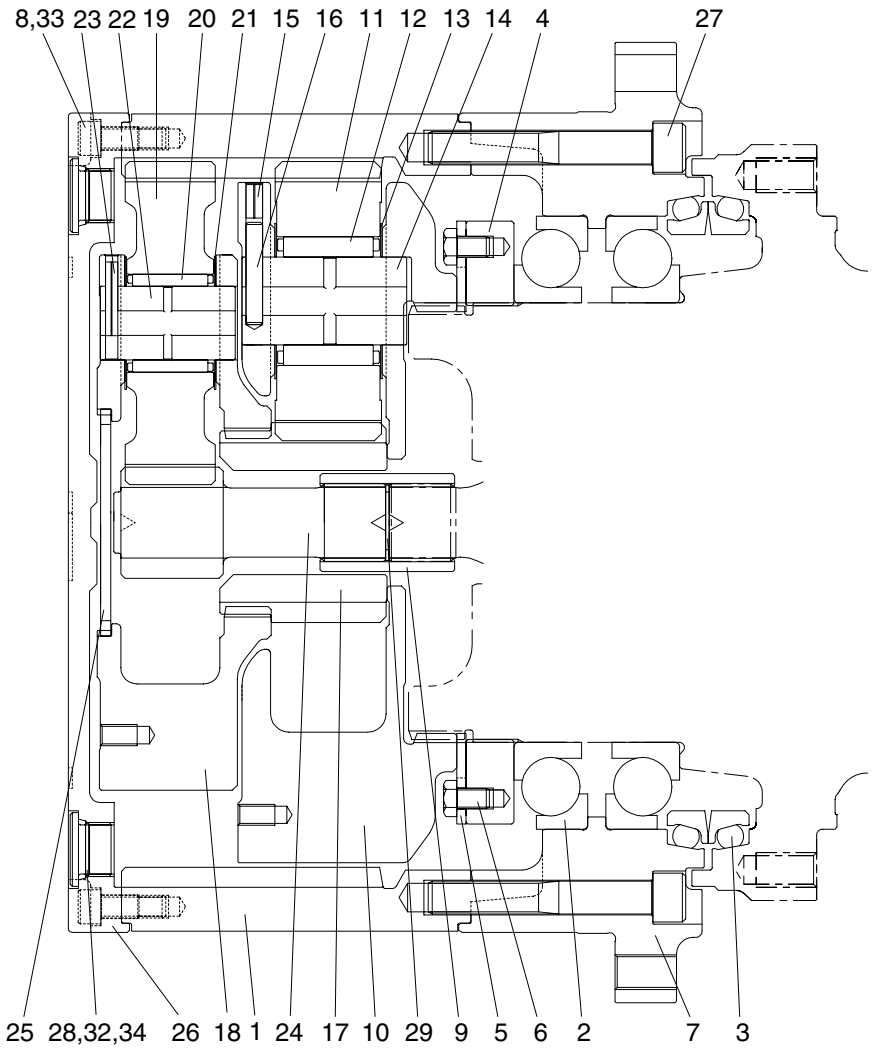


25098TM124



25098TM125

2) TRAVEL REDUCTION GEAR



220S2TM22

1	Ring gear	12	Needle bearing 2	24	Sun gear 1
2	Angular bearing (type 1)	13	Thrust washer 2	25	Thrust plate
2	Ball bearing (type 2)	14	Carrier pin 2	26	Cover
3	Floating seal assy	15	Spring pin 2	27	Hexagon socket head bolt
4	Ring nut	16	Solid pin 2	28	Plug
5	Lock plate	17	Sun gear 2	29	Snap ring
6	Hexagon bolt	18	Carrier 1	30	Name plate
7	Housing	19	Planetary gear 1	31	Rivet
8	Hexagon socket head bolt	20	Needle bearing 1	32	O-ring
9	Coupling	21	Thrust washer 1	33	Rubber cap
10	Carrier 2	22	Carrier pin 1	34	Rubber cap
11	Planetary gear 2	23	Spring pin 1		

6. DISASSEMBLING

1) GENERAL INSTRUCTIONS

⚠ **Combustibles such as white kerosene are used for washing parts.**
These combustibles are easily ignited, and could result in fire or injury.
Be very careful when using.

⚠ **Internal parts are coated with gear oil during disassembling and are slippery.**
If a part slips off from your hand and fails, it could result in bodily injury or could damage the park.
Be very careful when handling.

(1) Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather.
Tools and kerosene to wash parts should also be clean and handled with great care.

(2) Bofore disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

⚠ **Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.**

2) DISASSEMBLING TRAVEL REDUCTION GEAR

(1) Preparation for disassembling

① The reduction units removed from excavator are usually covered with mud. Wash outside of propelling unit and dry it.

② Locate reducer in order for drain port to be at the lowest level, loosen taper screw plug of drain port, and drain oil from reduction gear.

※ While oil is still hot, inside of the unit may be pressurized.

⚠ Take care of the hot oil gushing out of the unit when loosening the plug.

③ Mark for mating

Put marks on each mating parts when disassembling so as to reassemble correctly as before.

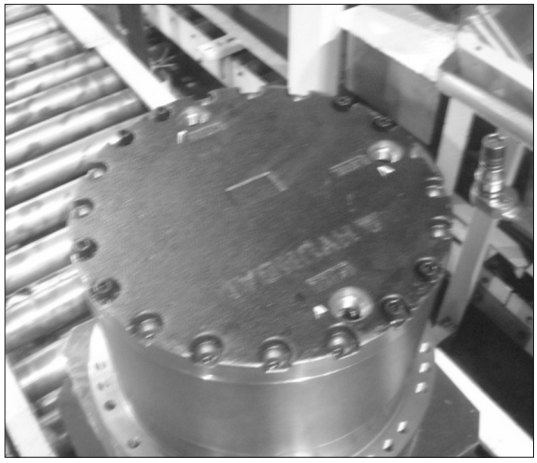


25098TM126

(2) Setting reduction unit (or whole propelling unit) on work stand for disassembling

① Remove 7/16-14UNC hexagon socket head bolts at 3 places from cover almost equally apart each other, and then install 7/16-14UNC eye bolts.

⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

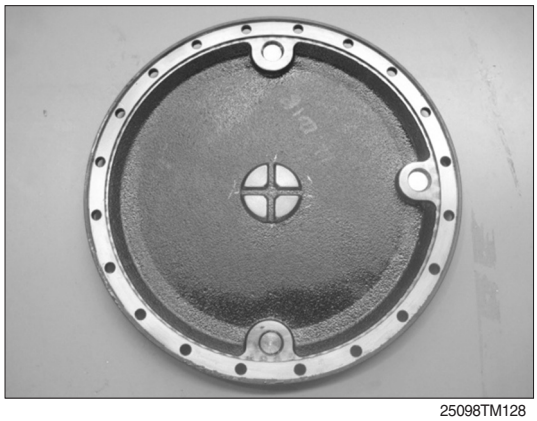


25098TM127

(3) Removing cover

① Remove the rest of 7/16-14UNC hexagon socket head bolts that secure cover and ring gear. Loosen all the socket bolts and then, disassemble cover.

② As the cover is adhered to ring gear, disassemble ring gear and cover by lightly hammering slantwise upward using sharpen punch inserted between the cover and ring gear.



25098TM128

(4) Removing No.1 carrier sub assembly

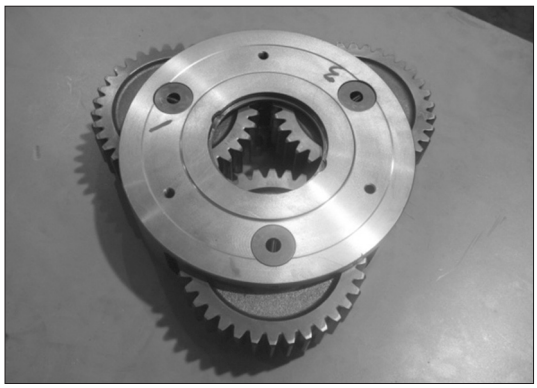
① Screw three M10 eye-bolt in No.1 carrier and lift up and remove No.1 carrier assy.



25098TM129

② Remove No.1 sun gear.

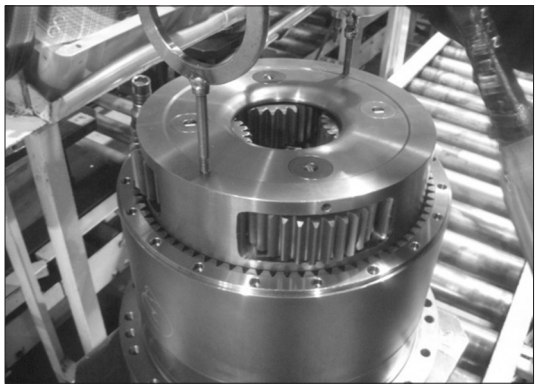
※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.



25098TM130

(5) Removing No.2 carrier sub assembly

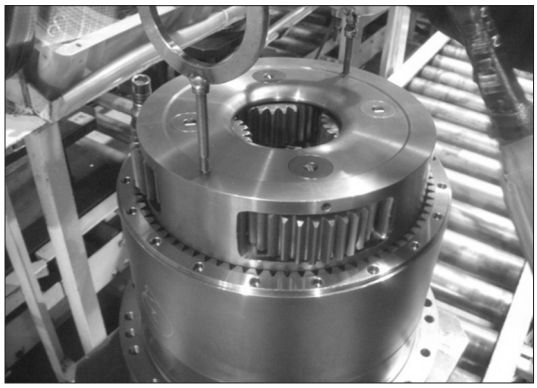
① Screw three M10 eye-bolt in No.2 carrier and lift up and remove No.2 carrier assy.



25098TM131

② Remove No.2 sun gear.

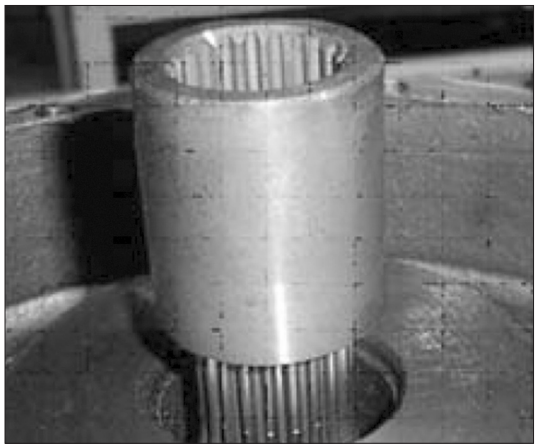
※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.



25098TM132

(6) Removing coupling

① Remove coupling.



25098TM133

(7) Removing ring nut & lock plate

① Remove M12 hexagon head bolts that secure ring nut and lock plate.

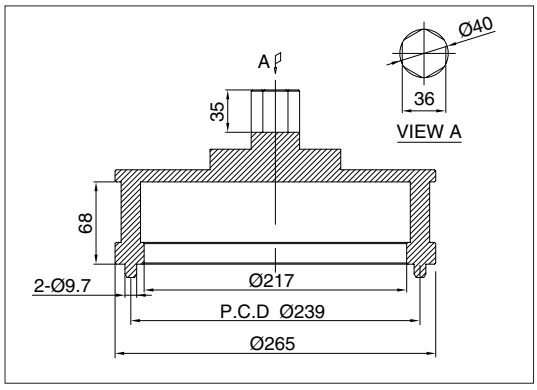
② Remove lock plate.



25098TM134

③ Remove ring nut from motor casing.

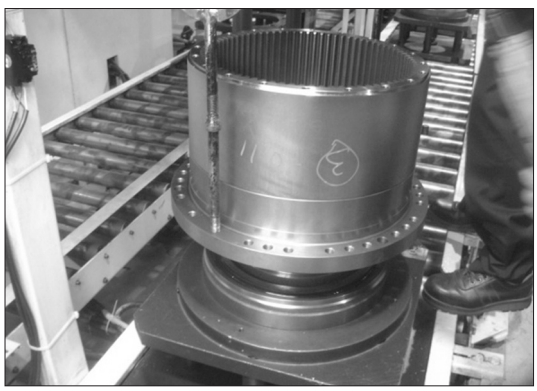
※ Remove the ring nut by using the special tool for removing the ring nut.



220L8TM01

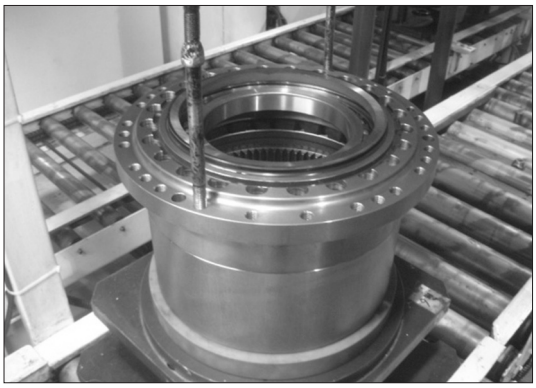
(8) Removing housing sub assembly & ring gear

① Screw 7/16-14UNC eye bolt in housing and lift up ring gear and housing assembly including anguler bearing and floating seal.



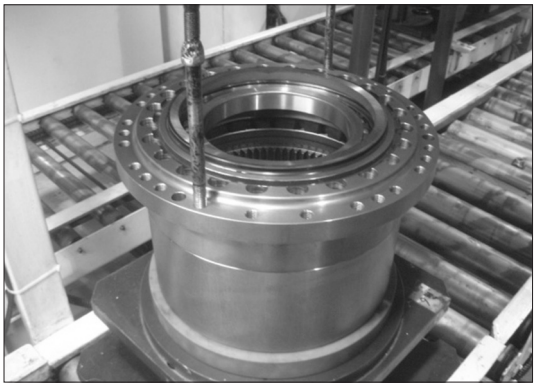
25098TM135

② Setting reduction unit on work stand for disassembling. Remove M16 hexagon socket head bolts that secure ring gear and housing assembly.



25098TM136

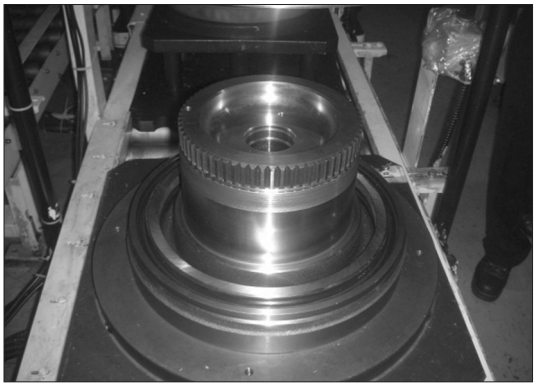
③ As the ring gear is adhered to housing assy, disassemble housing assy and ring gear by lightly hammering slantwise upward using sharpen punch inserted between the housing assy and ring gear.



25098TM137

(9) Removing floating seal

① Lift up a piece of floating seal of motor side.



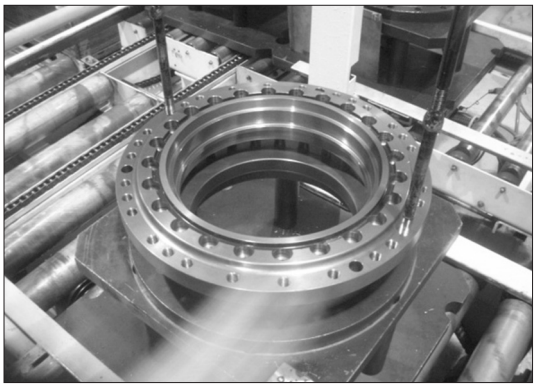
25098TM138

(10) Removing housing sub assembly

① Setting housing assembly on work stand for disassembling.

② After setting housing, lift up a piece of floating seal from housing and then remove it.

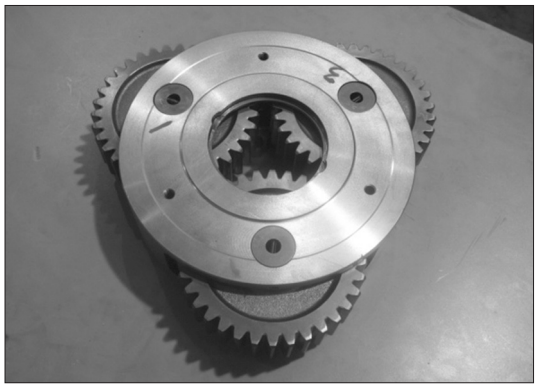
※ Don't disassemble angular bearing.



25098TM139

(11) Disassembling No.1 carrier

① Remove thrust plate.



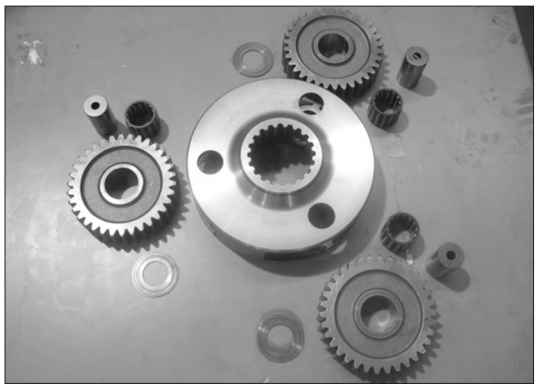
25098TM140

② Knock spring pin fully into No.1 pin.



25098TM141

③ Remove planetary, thrust washer, No.1 pin, bearing from carrier.



25098TM142

(12) Disassembling No.2 carrier

① Knock spring pin fully into No.2 pin.
② Remove No.2 solid pin.
③ Remove planetary, thrust washer, No.2 pin, bearing from carrier.



25098TM143

7. ASSEMBLY REDUTION UNIT

1) GENERAL NOTES

(1) Clean every part by kerosene and dry them by air blow.

(2) Surfaces to be applied by loctite must be decreased by solvent.

(3) Check every part for any abnormal.

(4) Each hexagon socket head bolt should be used with loctite No.242 applied on its threads.

(5) Apply gear oil slightly on each part before assembling.

⚠ Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.
Inspection before reassembling.

Thrust washer

- Check if there are seizure, abnormal wear or uneven wear.
- Check if wear is over the allowable limit.

Gear

- Check if there are pitting or seizure on the tooth surface.
- Check if there are cracks on the root of tooth by die check.

Bearing

- Rotate by hand to see if there are something unusual such as noise or uneven rotation.

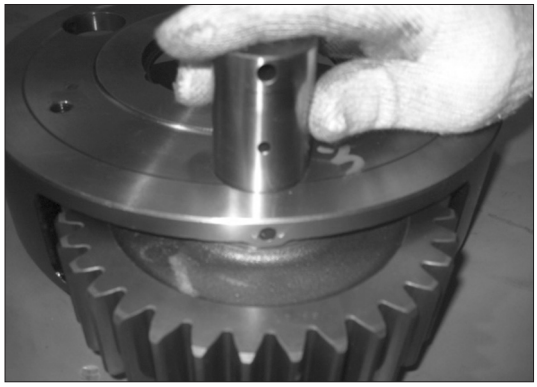
Floating seal

- Check flaw or score on sliding surfaces or O-ring.

2) ASSEMBLING CARRIER 1 ASSY

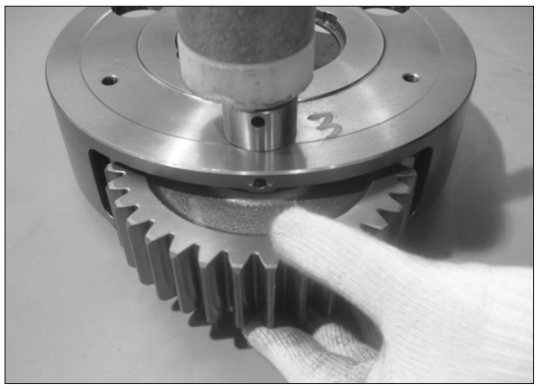
(1) Put No.1 carrier on a flat place.

(2) Install No.1 needle bearing into No.1 planetary gear, put 2EA of No.1 thrust washer on both sides of planetary gear, and then, install it into carrier.



25098TM144

(3) Install No.1 pin into No.1 carrier where the holes for No.1 pin are to be in line with those of No.1 carrier, and then, install spring pins into the holes.



25098TM145

(4) Caulk carrier holes as shown on the picture.

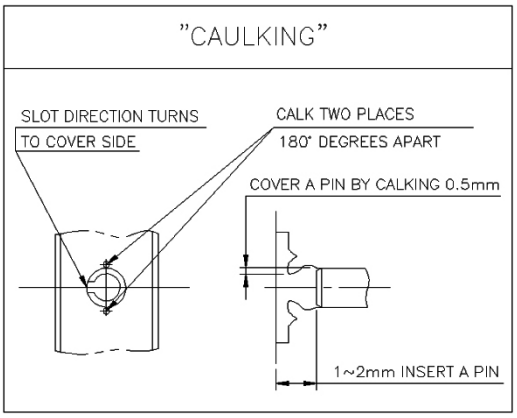


25098TM146

3) ASSEMBLING CARRIER 2 ASSY

(1) Put No.2 carrier on a flat place.

(2) Install No.2 needle bearing into No.2 planetary gear, put 2EA of No.2 thrust washer on both sides of planetary gear, and then, install it into carrier.



25098TM147

(3) After install solid pin into the holes, install No.2 pin into No.1 carrier where the holes for No.1 pin are to be in line with those of No.1 carrier, and then, install spring pins into the holes.

(4) Caulk carrier holes as shown on the picture.

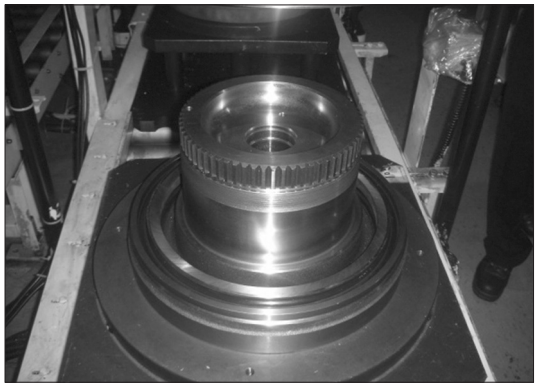


25098TM148

4) ASSEMBLING FLOATING SEAL

(1) Assemble floating seal into motor by use of pressing jig.
Grease the contact parts for floating seal which is assembled into motor.

※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.

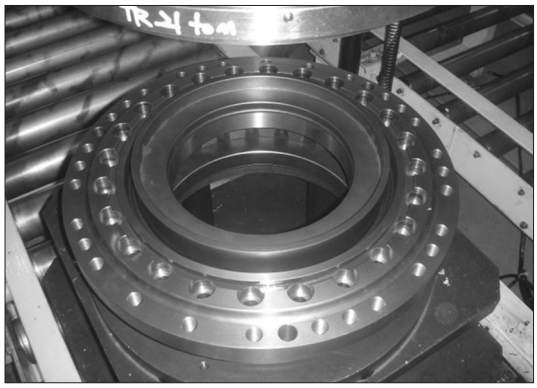


25098TM149

5) ASSEMBLING HOUSING

(1) Heat housing at 60~70˚C while clearing it out and then, assemble floating seal into housing by use of pressing jig.

(2) Setting housing assembly on work stand for assembling.
Assemble angular bearing into housing by use of pressing jig.



25098TM150

(3) Assemble floating seal into housing by use of pressing jig.
Do not reuse the disassembling O-ring.
Grease the contact parts for floating seal which is assembled into housing.

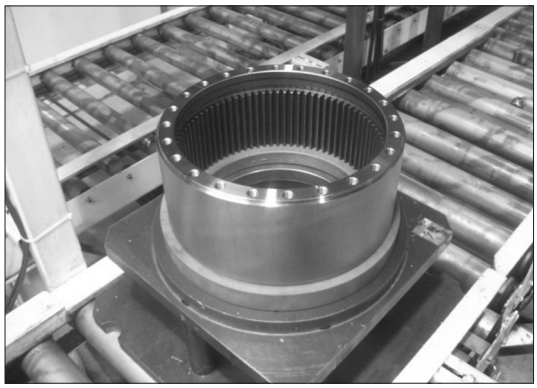
※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.



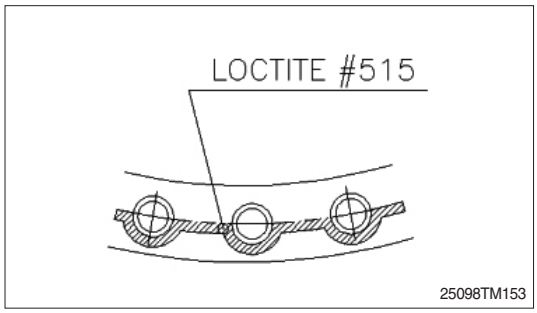
25098TM151

6) ASSEMBLING HOUSING ASSY AND RING GEAR

(1) Setting ring gear on work stand for assembling.
Apply loctite #515 on ring gear for housing without gap.



25098TM152

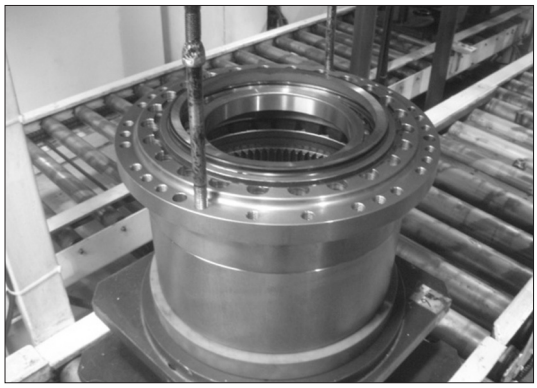


25098TM153

(2) Install M16 eye-bolt on the tap of housing.

(3) Lift housing and then, assemble into housing in order for bolt hole of ring gear and bolt hole of housing to be in line.

(4) Apply loctite #242 on M16 hexagon socket head bolt, and then, bolt.



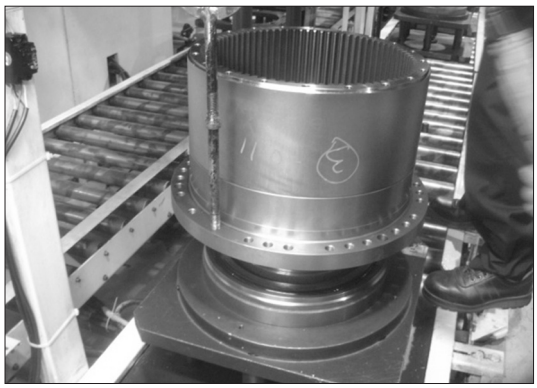
25098TM154

7) ASSEMBLING HOUSING ASSY AND MOTOR

(1) Install 7/16-14UNC eye-bolt on the tap of ring gear.

(2) Assemble housing assembly into motor by use of hoist and eye-bolt.

※ Be sure to tighten eye-bolt deep enough.



25098TM155

8) ASSEMBLING MAIN BEARING

(1) Assemble angular bearing into housing by use of pressing jig.

※ Be sure to maintain it vertical with the ground when assembling bearing.

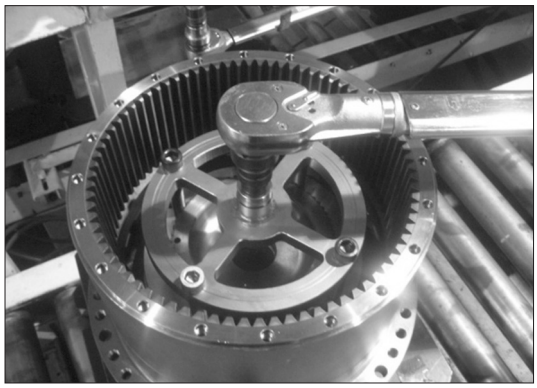


25098TM156

9) ASSEMBLING NUT RING AND LOCK PLATE

(1) Tighten nut ring to specified torque, utilizing special tool.
- Tightening torque : 60.3 kgf·m (436 lbf·ft)

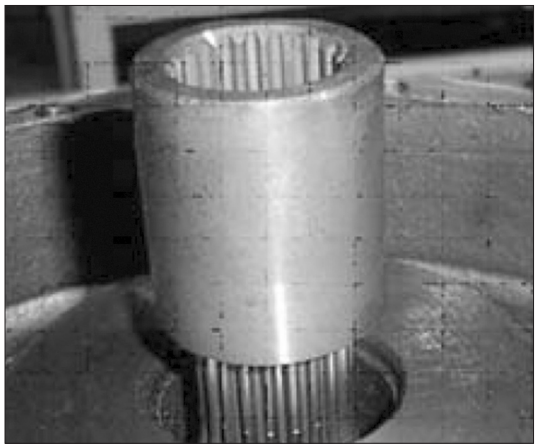
(2) After install lock plate, apply loctite #242 on M12 hexagon head bolt, and then, bolt.
Tighten M12 hexagon head bolt to specified torque, with torque wrench.



25098TM157

10) ASSEMBLING COUPLING

(1) Install coupling on spline of the motor.

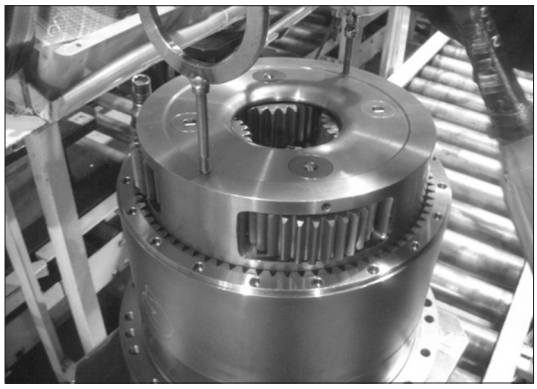


25098TM158

11) ASSEMBLING NO.2 CARRIER SUB ASSEMBLY

(1) Install M10 eye-bolt on No.2 carrier assembly.
(2) Lift No.2 carrier assembly and then, slowly put it down on ring gear.
(3) Rotate planetary gear by hands and install on ring gear.
(4) Rotate No.2 carrier assembly by hands and install on motor.

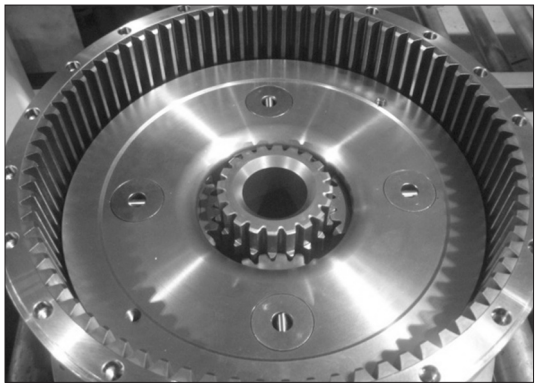
※ Match pin hole of No.2 carrier with main (A, B) port of motor.



25098TM159

12) ASSEMBLING NO.2 SUN GEAR

(1) Install No.2 sun gear on the No.2 planetary gear, matching teeth of them.



25098TM160

13) ASSEMBLING NO.1 CARRIER SUB ASSEMBLY

(1) Install M10 eye-bolt on No.1 carrier assembly.
(2) Lift No.1 carrier assembly and then, slowly put it down on ring gear.
(3) Rotate planetary gear by hands and install on ring gear.
(4) Rotate No.1 carrier assembly by hands and install on No.2 sun gear.



25098TM161

14) ASSEMBLING NO.1 SUN GEAR

(1) Put down No.1 sun gear on No.1 carrier, maintaining it vertical with spline of coupling.

(2) Install No.1 sun gear on No.1 planetary gear, matching their teeth.

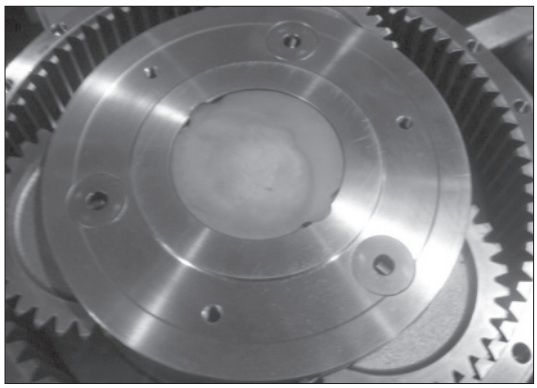


25098TM162

15) ASSEMBLING THRUST PLATE

(1) Assembly thrust plate into No.1 carrier.

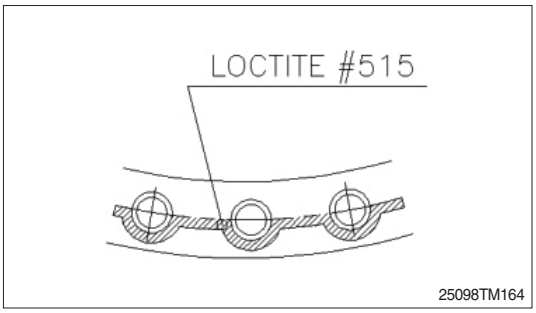
※ Edge of thrust plate direction turns to cover side.



25098TM163

16) ASSEMBLING COVER

(1) Apply loctite #515 on the ring gear for cover without gap.

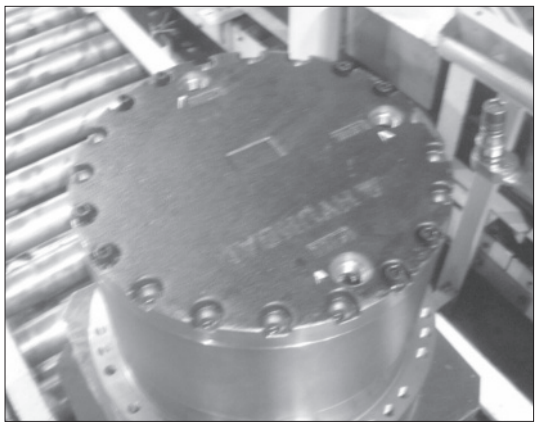


25098TM164

(2) Put cover on ring gear, apply loctite #242 on 7/16-14UNC hexagon socket head bolt, and then, bolt.
Tighten 7/16-14UNC hexagon socket head bolt to specified torque, with torque wrench.

(3) Fill gear oil (4.5 ℓ / 1.2 U.S. gal) into drain port.

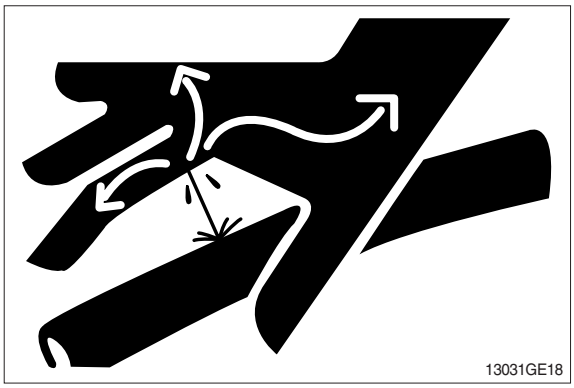
(4) Apply gear oil on PF3/4 hydraulic plug and then, bolt.



25098TM165

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.**

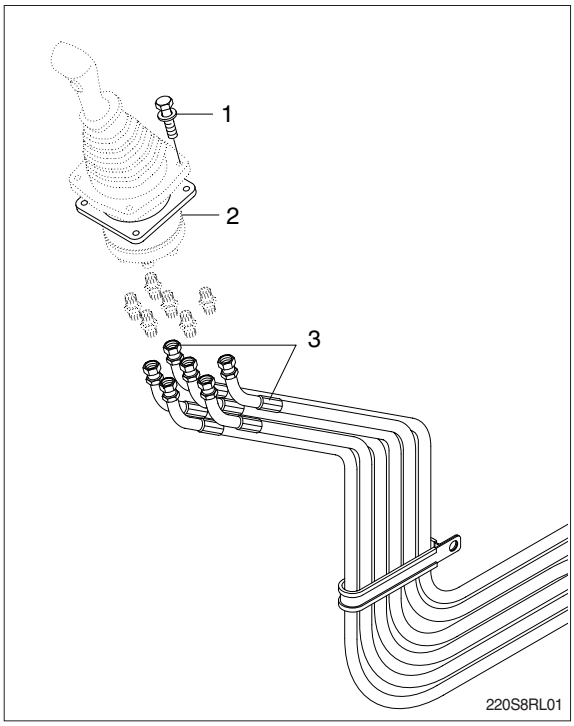
(4) Loosen the socket bolt (1).
Tightening torque : 1.05 ± 0.2 kgf · m
(7.6 ± 1.45 lbf · ft)

(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.



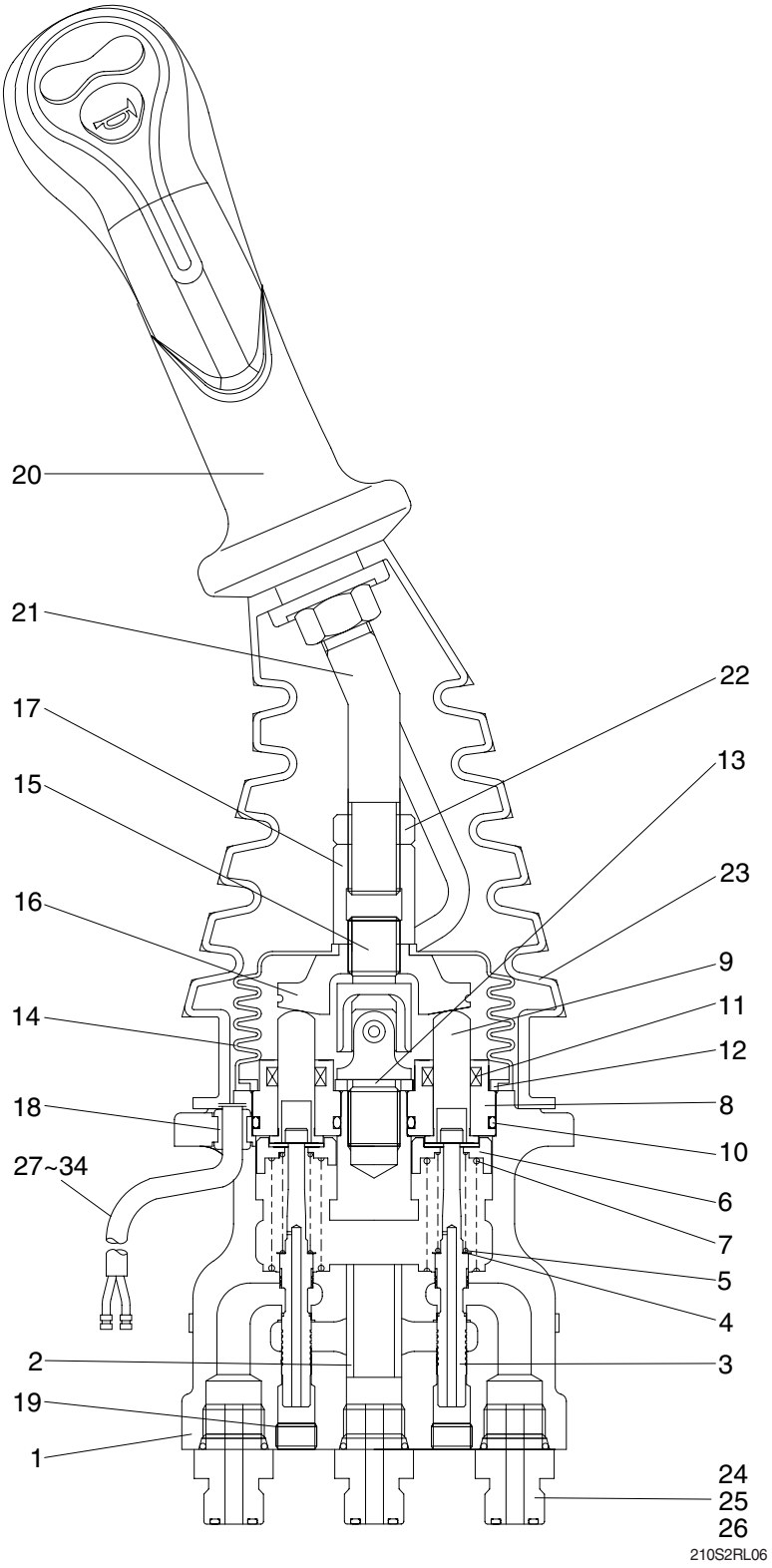
2) INSTALL

(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

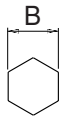
1) STRUCTURE



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 Plate
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
27 Connector
29 Connector
30 Connector
31 Small guide
32 Connector
33 Big guide
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

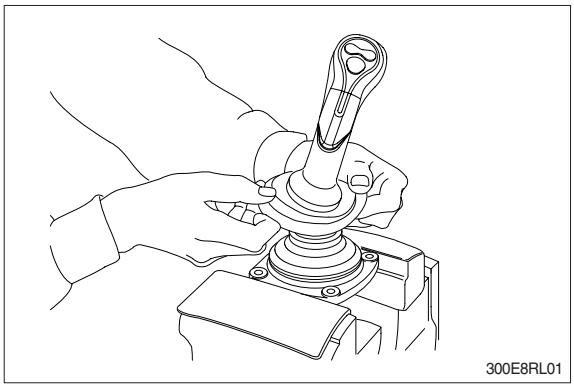
※ Procedures are based on the type M1.

(1) Clean pilot valve with kerosene.

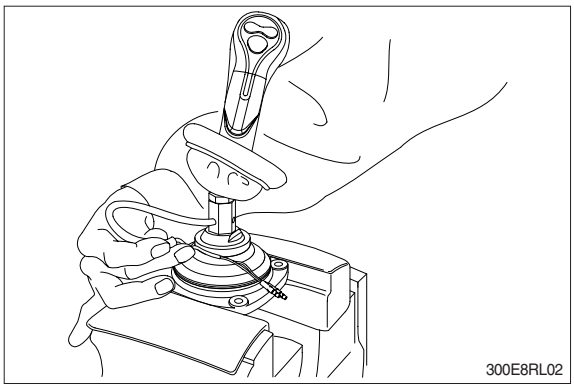
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper (or lead) sheets.

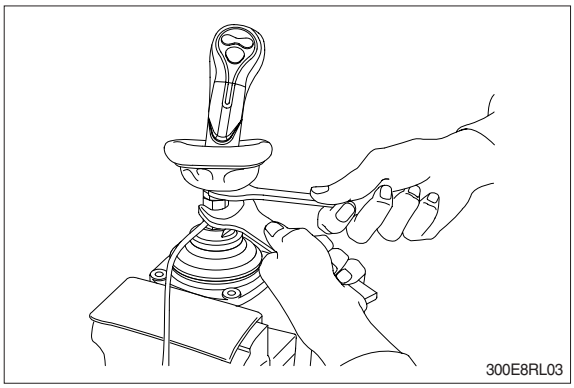
(3) Remove end of boot (23) from case (1) and take it out upwards.



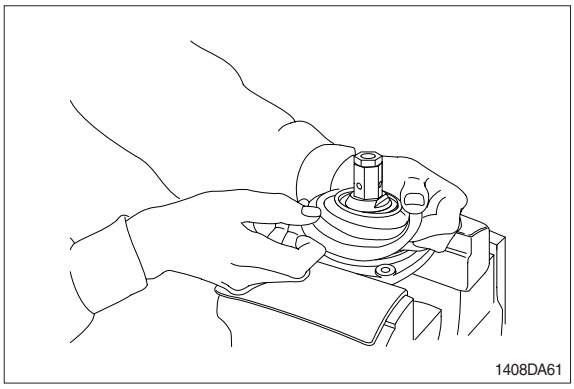
※ For valve with switch, remove cord also through hole of casing.



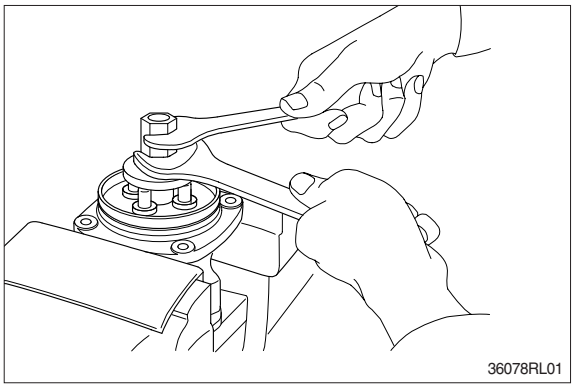
(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.

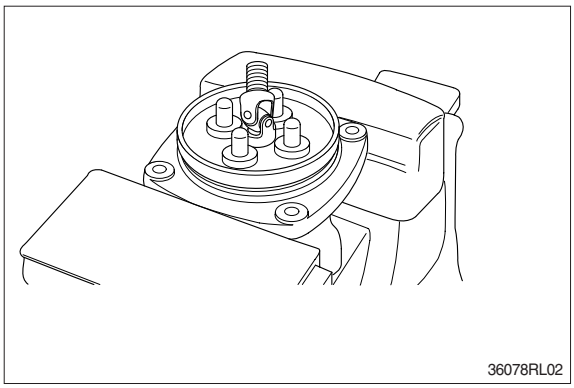


(5) Remove the boot (14).



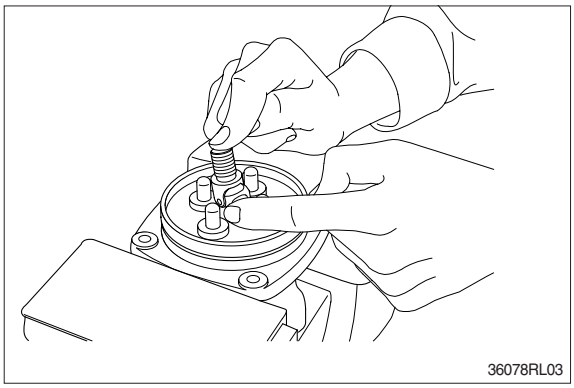
(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.

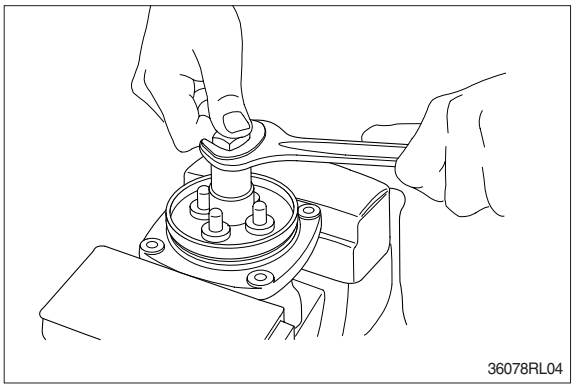




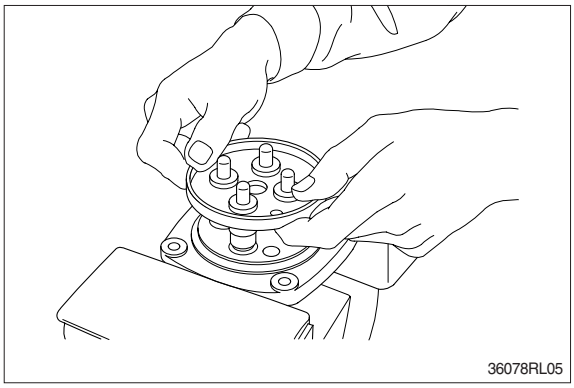
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ 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.





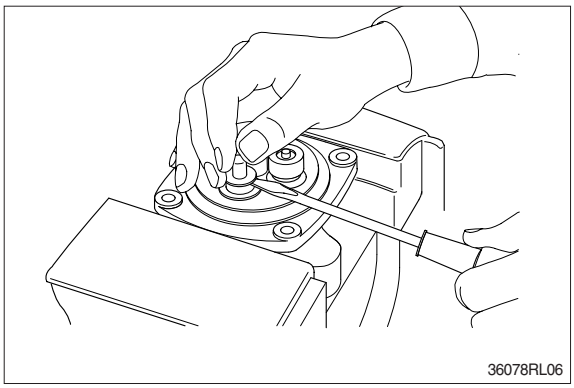
(8) Remove plate (12).



(9) When return spring (7) is weak in force, plug (8) stays in casing because of sliding resistance of O-ring.

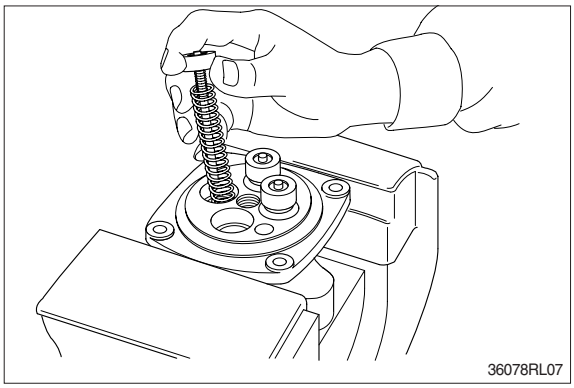
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (7) force.
Pay attention to this.



(10) Remove reducing valve subassembly and return spring (7) out of casing.

※ Record relative position of reducing valve subassembly and return springs.

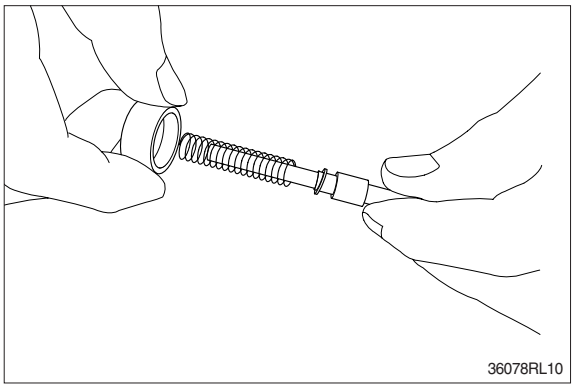


(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.

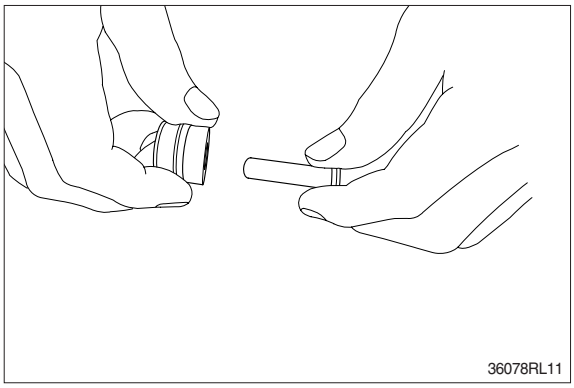
※ Pay attention not to damage spool surface.

※ Record original position of spring seat (6).

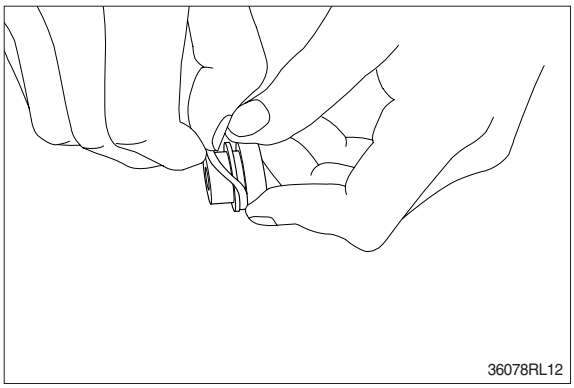
※ Until being assembled, they should be handled as one subassembly group.

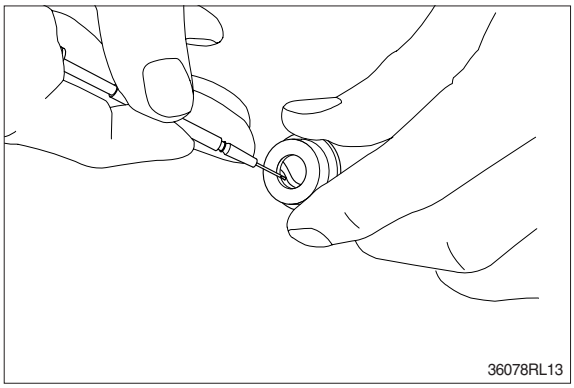


(12) Take push rod (9) out of plug (8).

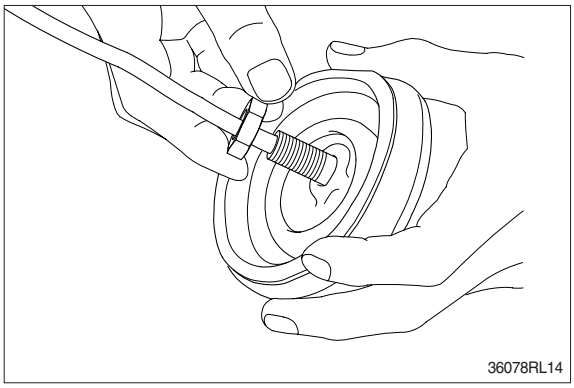


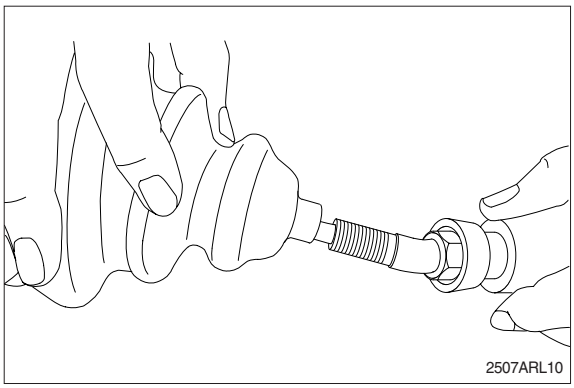
(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.





(14) Remove lock nut (22) and then boot (23).





(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.

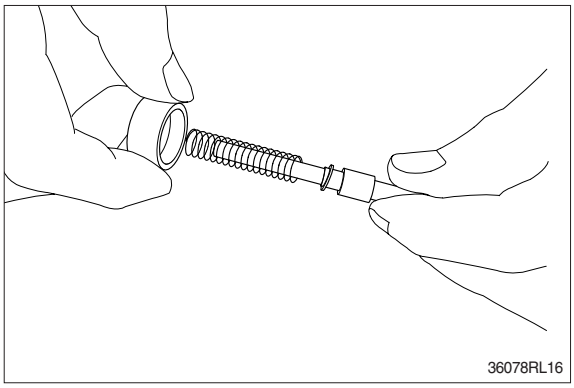
(16) Rust prevention of parts

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.

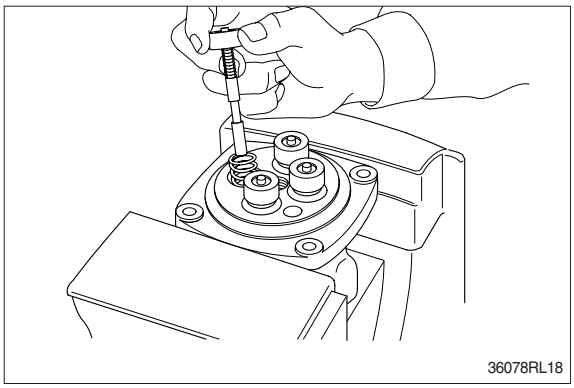
4) ASSEMBLY

(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.

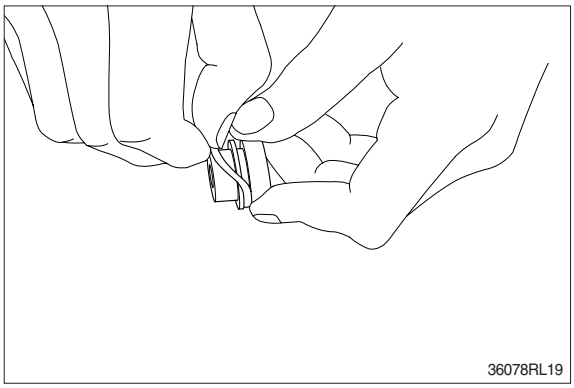


(2) Assemble spring (7) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

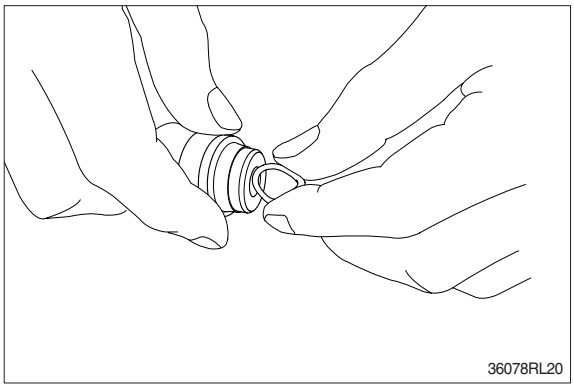


(3) Assemble O-ring (10) onto plug (8).



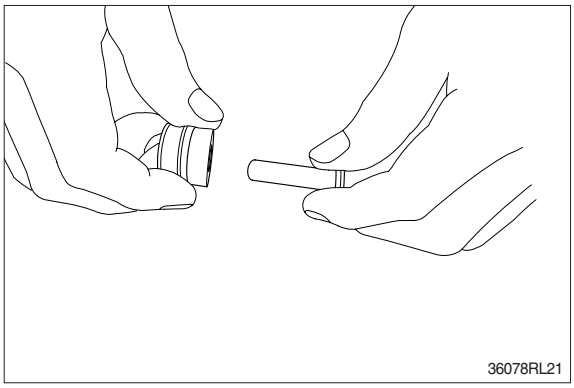
(4) Assemble seal (11) to plug (8).

※ Assemble seal in such lip direction as shown below.



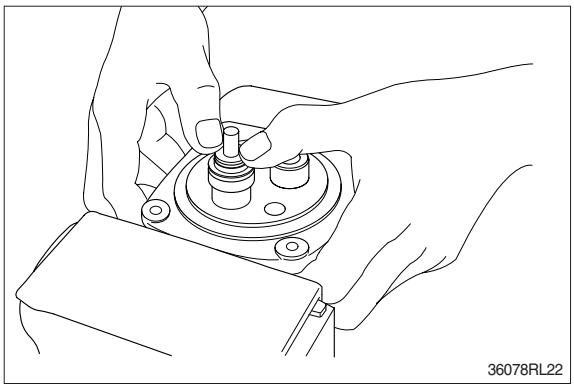
(5) Assemble push rod (9) to plug (8).

※ Apply working oil on push-rod surface.

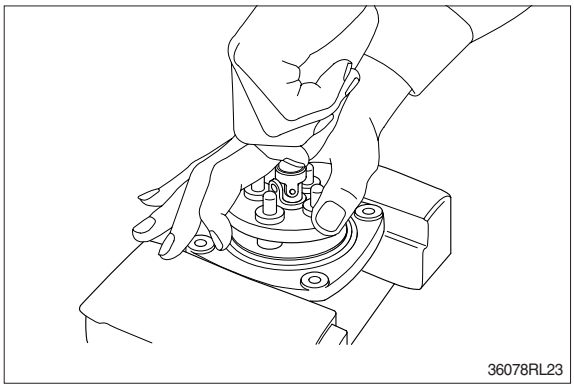


(6) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

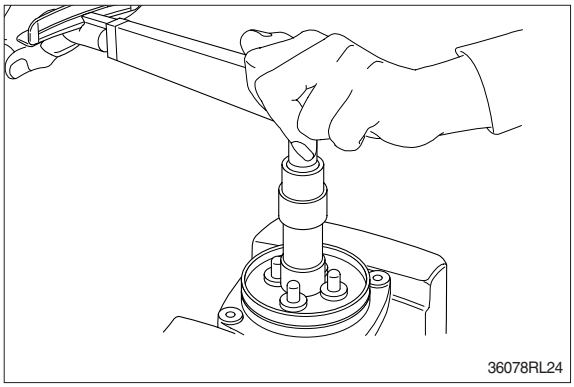


(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.



(8) Fit plate (12).

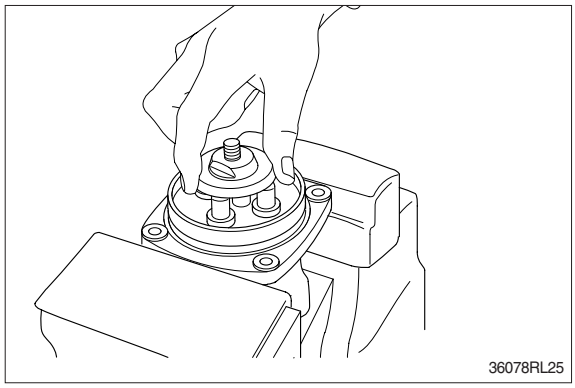
(9) Tighten joint (15) with the specified torque to casing, utilizing jig.



(10) Assemble swash plate (16) to joint (15).

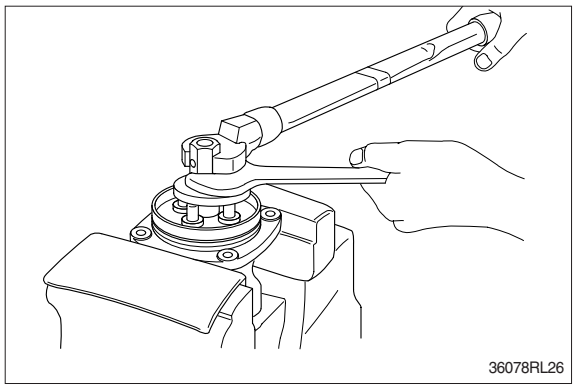
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

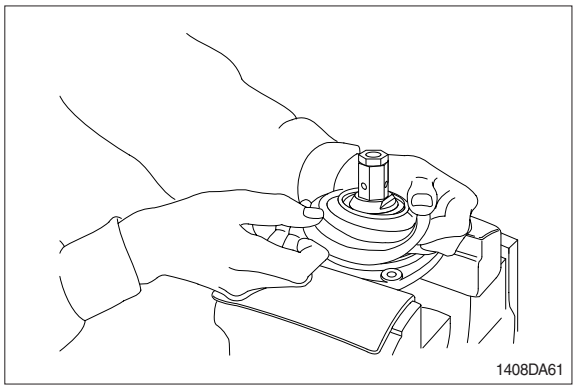


(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.

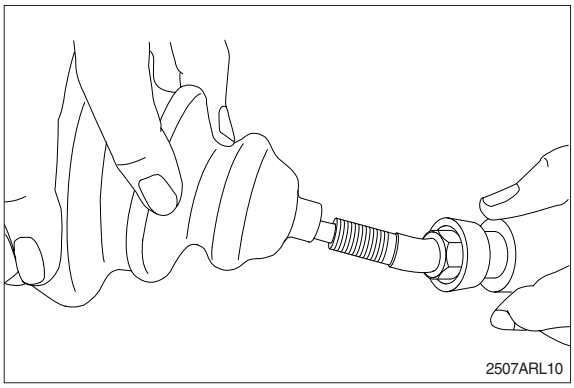
※ During tightening, do not change position of disk.

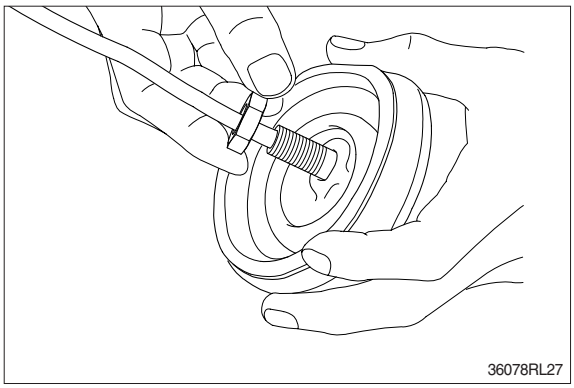


(12) Fit boot (14) to plate.

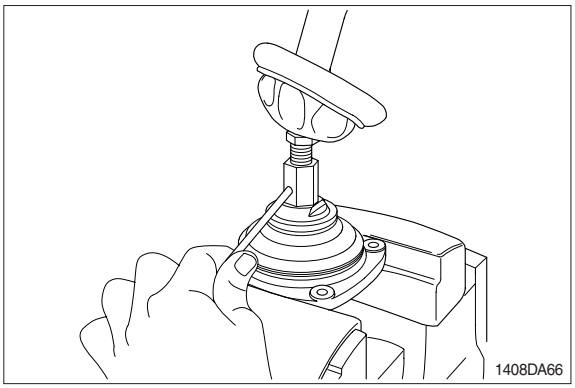


(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.



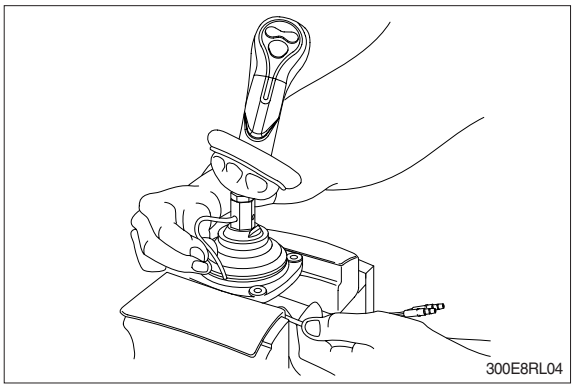


(14) Pull out cord and tube through adjusting nut hole provided in direction 60 ° to 120 ° from casing hole.

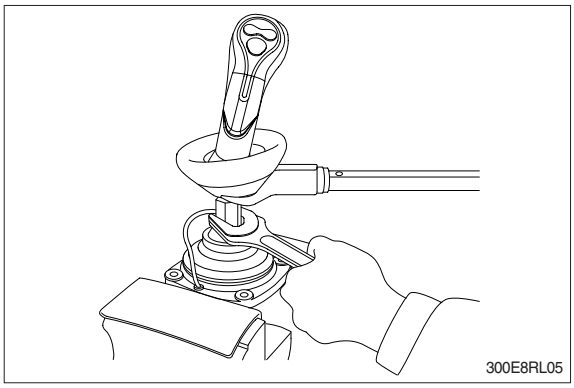


(15) Assemble bushing (18) to plate and pass cord and tube through it.

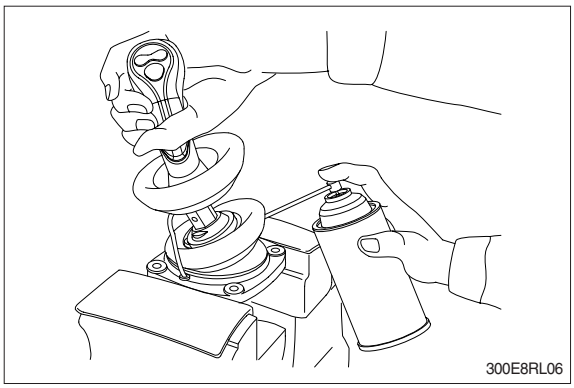
※ Provide margin necessary to operation.



(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

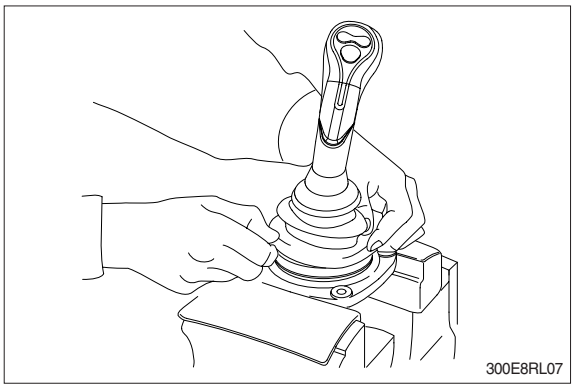


(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(18) Assemble lower end of bellows to casing.

(19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



1. REMOVAL AND INSTALL

1) REMOVAL



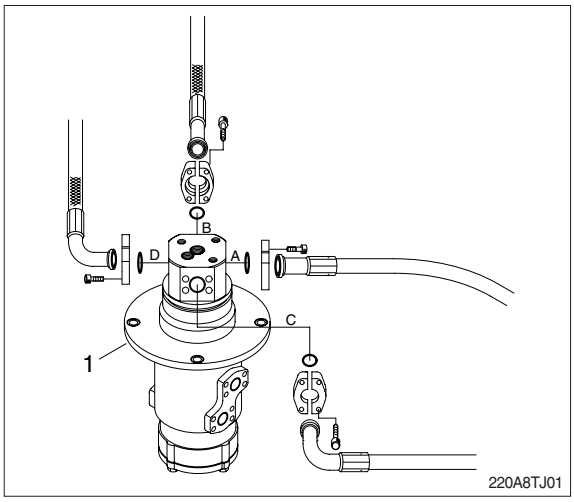
(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



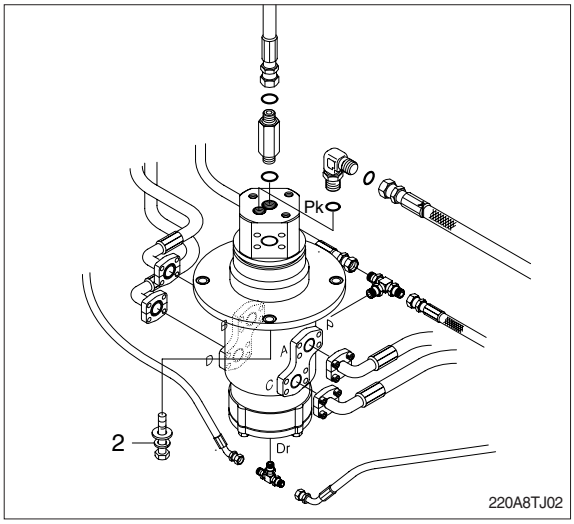
(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).
- Weight : 57 kg (125 lb)
- Tightening torque : 12.3± 1.3 kgf · m (90.0± 9.4 lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

2) INSTALL



(1) Carry out installation in the reverse order to removal.

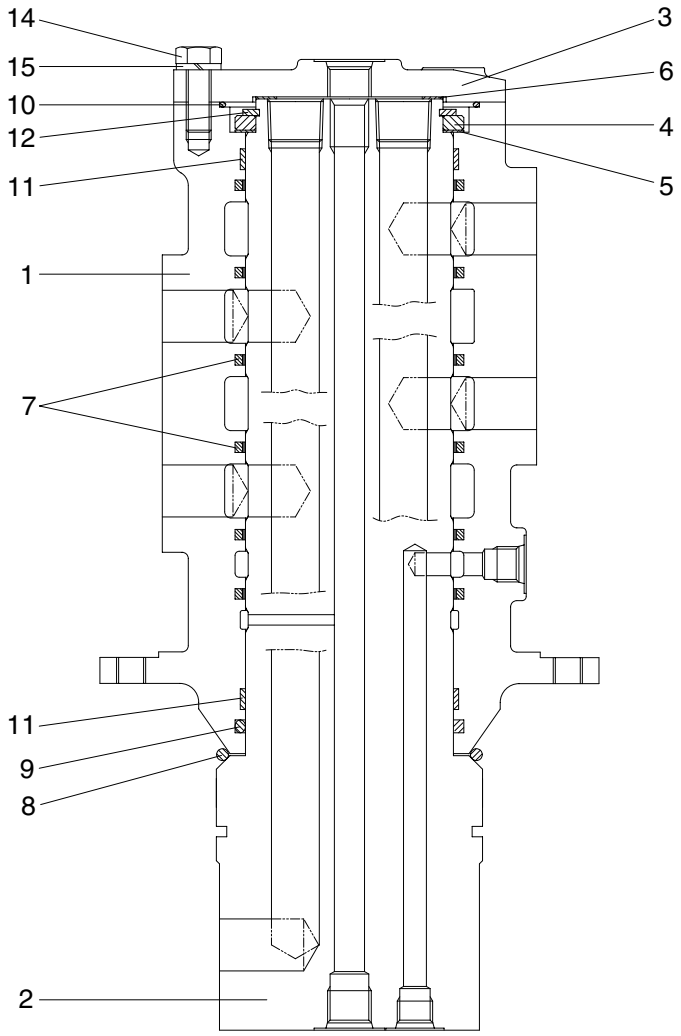
※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



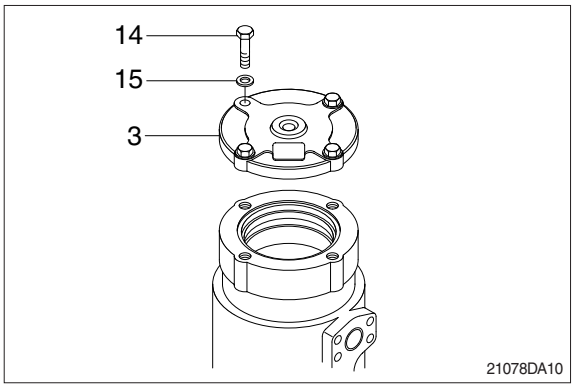
21098TJ01

1	Hub	6	Shim	11	Wear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

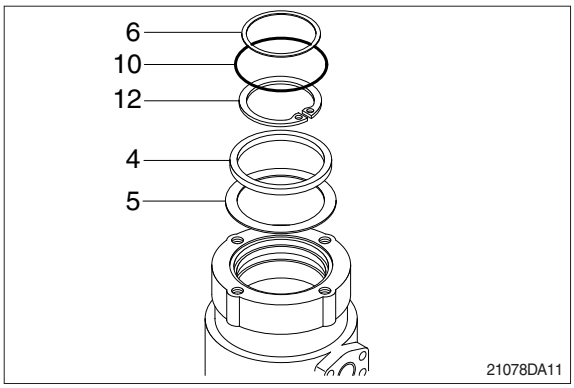
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

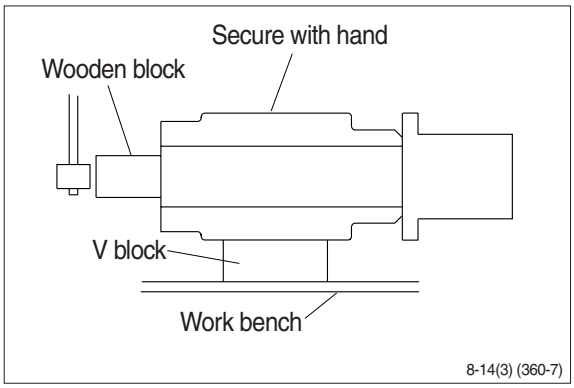
(3) Remove retainer ring (12), spacer (4) and shim (5).



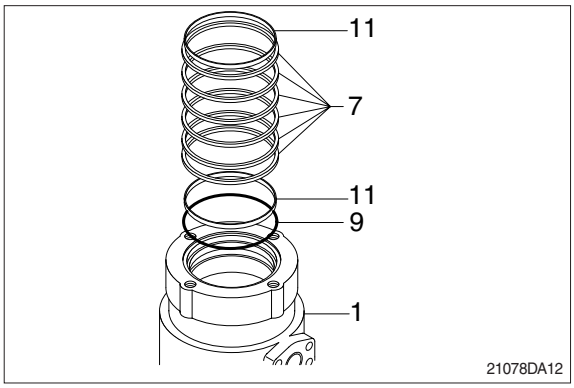
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ 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 (7) and O-ring (9), two wear ring (11) from hub (1).

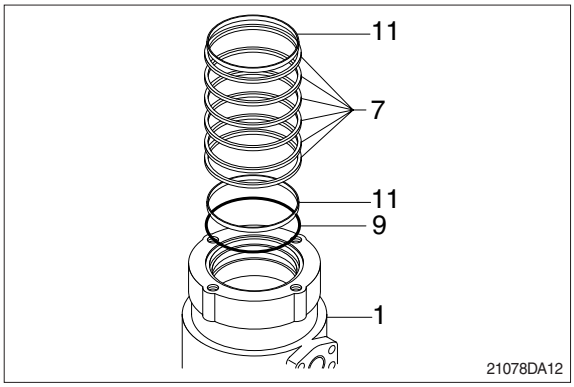


3) ASSEMBLY

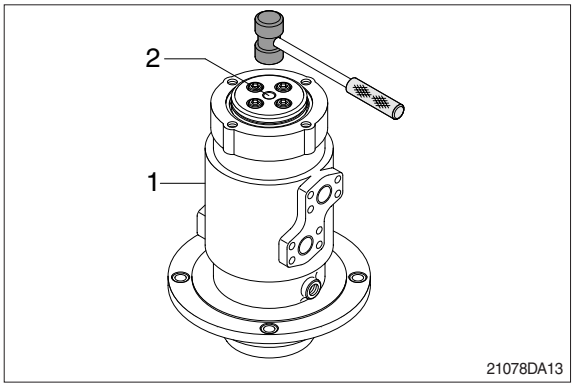
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).

(2) Fit O-ring (8) to shaft (2).



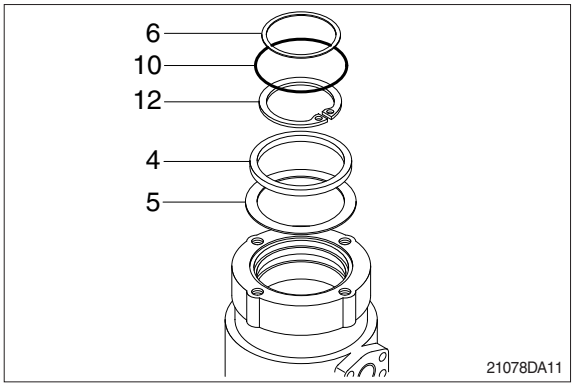
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



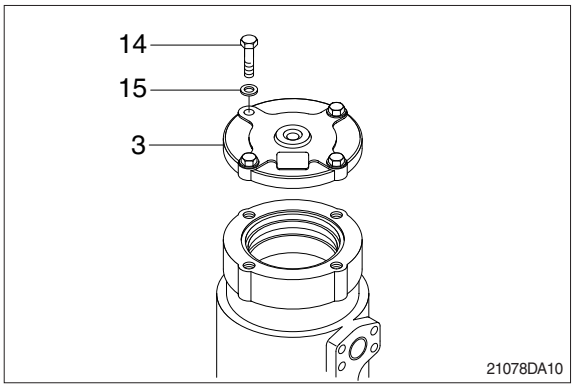
(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(5) Fit O-ring (10) to hub (1).

(6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).
· Torque : 10~12.5 kgf · m
(72.3~90.4 lbf · ft)



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.

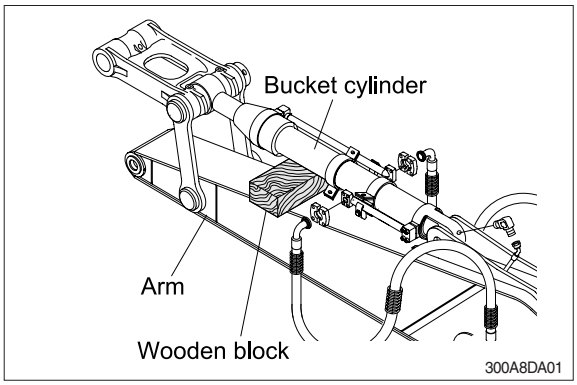
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **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.

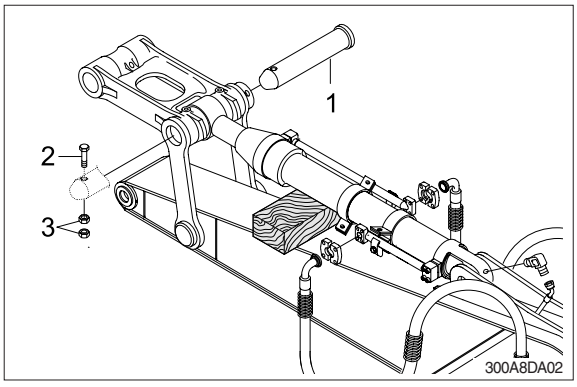


① Set block between bucket cylinder and arm.

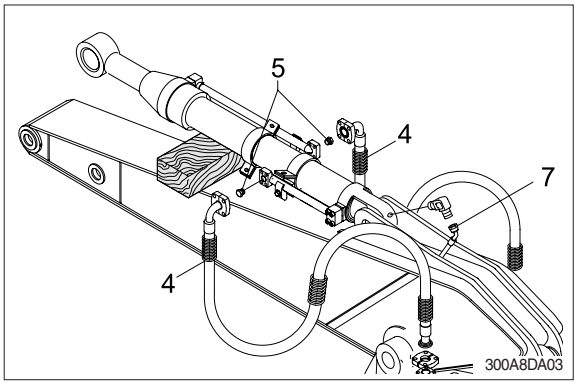


② Remove bolt (2), nut (3) and pull out pin (1).

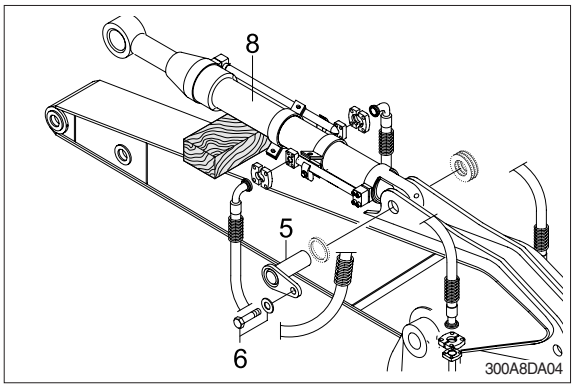
※ Tie the rod with wire to prevent it from coming out.



③ Disconnect bucket cylinder hoses (4), grease line hose (7) and put plugs (5) on cylinder pipe.



④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).
⑤ Remove bucket cylinder assembly (8).
· Weight : 175 kg (390 lb)



(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.

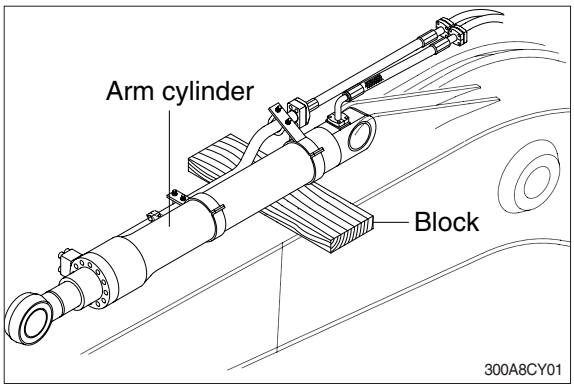
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.



⚠ 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.

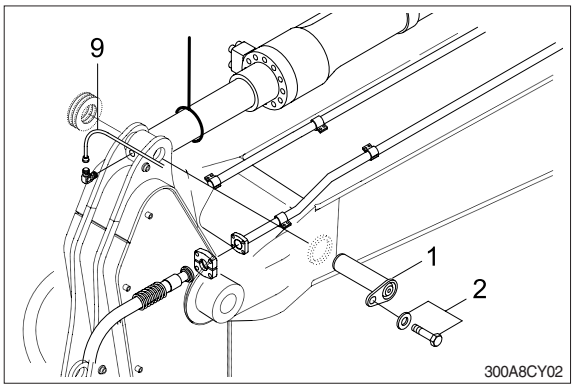
① Set block between arm cylinder and boom.



② Disconnect grease line hose (9).

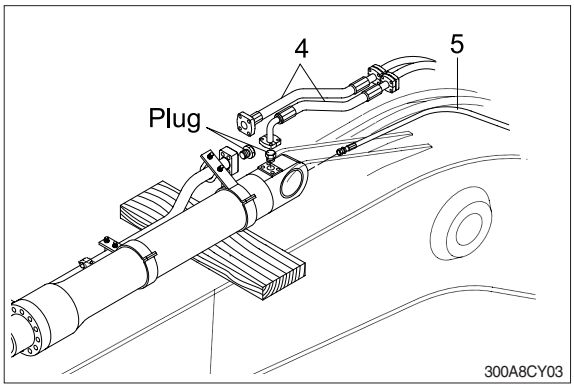
③ Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



④ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

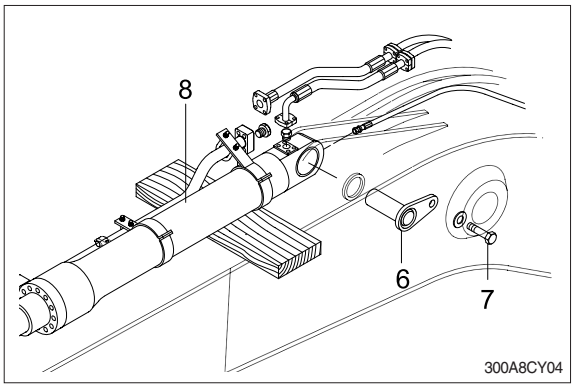
⑤ Disconnect greasing pipings (5).



⑥ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).

⑦ Remove arm cylinder assembly (8).

· Weight : 290 kg (640 lb)



(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.

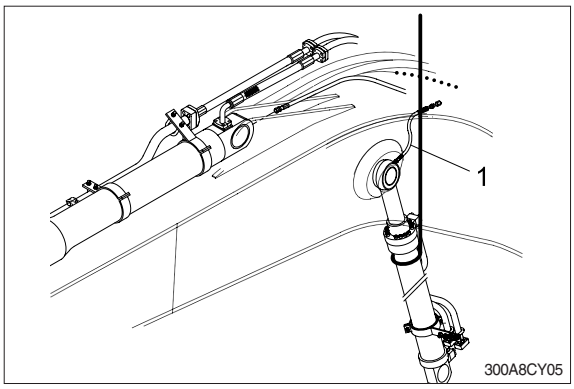


⚠ Escaping fluid under pressure can penetrate the skin causing serious injury.

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

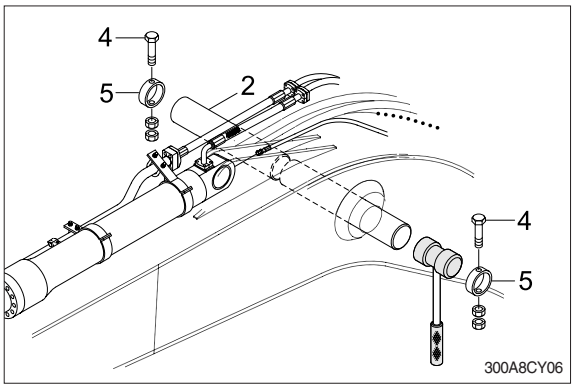
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

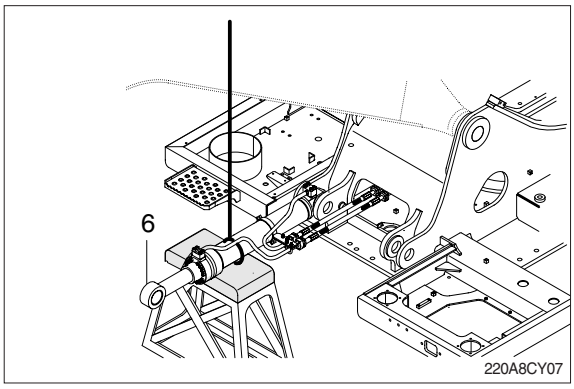


③ Remove bolt (4), stopper (5) and pull out pin (2).

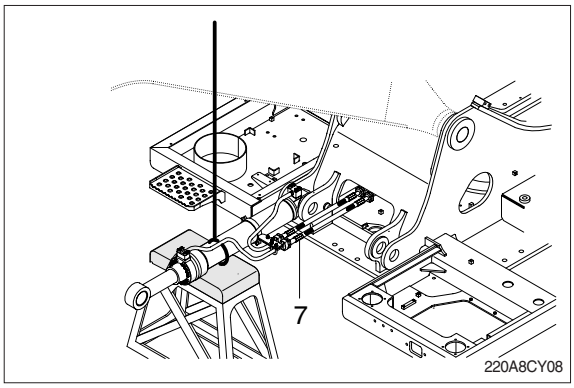
※ Tie the rod with wire to prevent it from coming out.



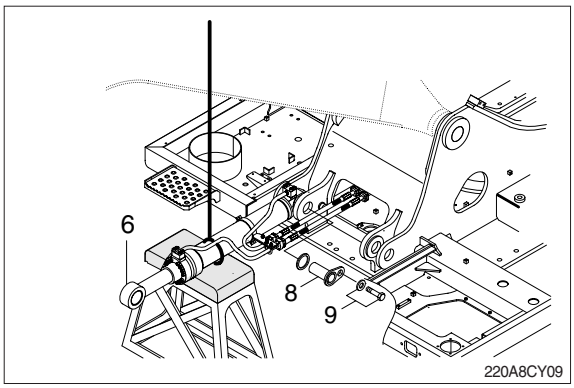
④ Lower the boom cylinder assembly (6) on a stand.



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 : 198 kg (436 lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the boom cylinder.

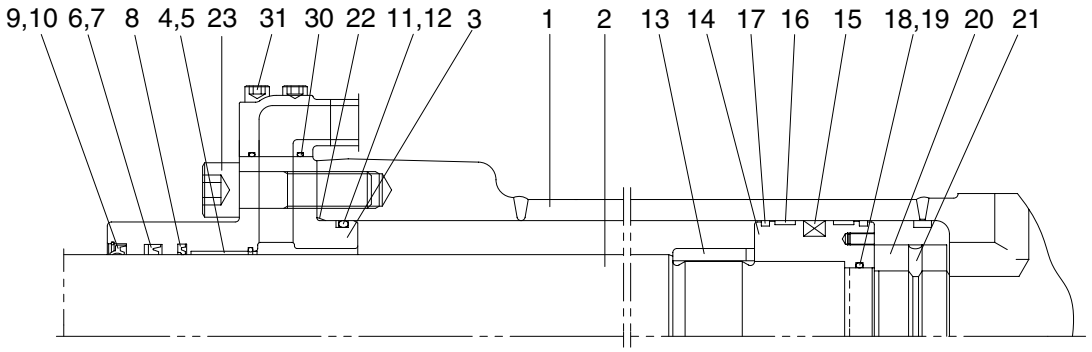
※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

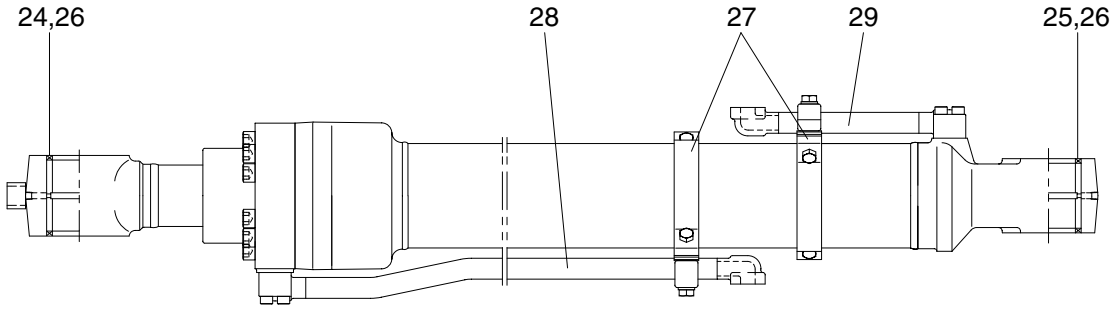
1) STRUCTURE

(1) Bucket cylinder

① Standard (CHANGZHOU)



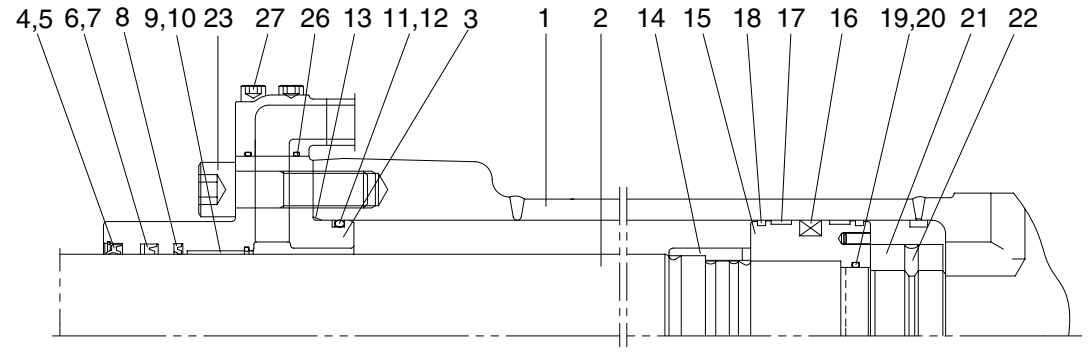
Internal detail



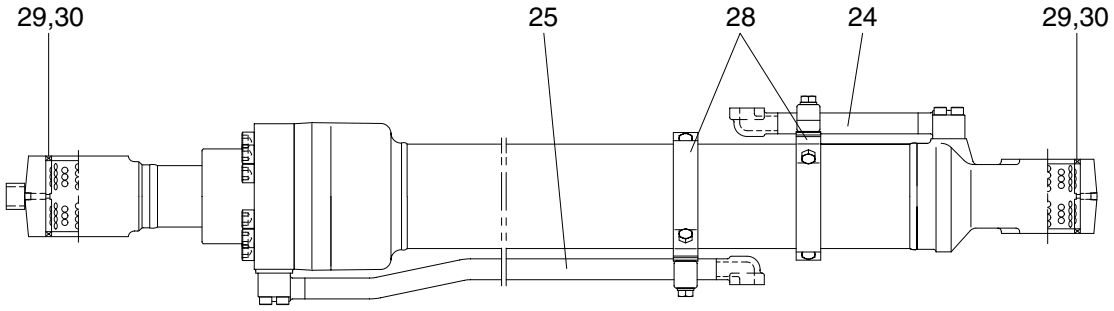
31Q6-60111CGG

1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Dimple bushing
3	Gland	14	Piston	25	Dimple bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

Standard (SHPAC)



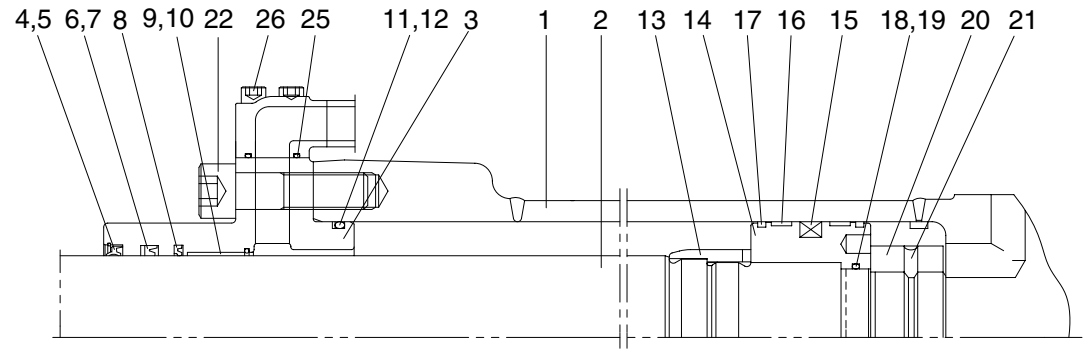
Internal detail



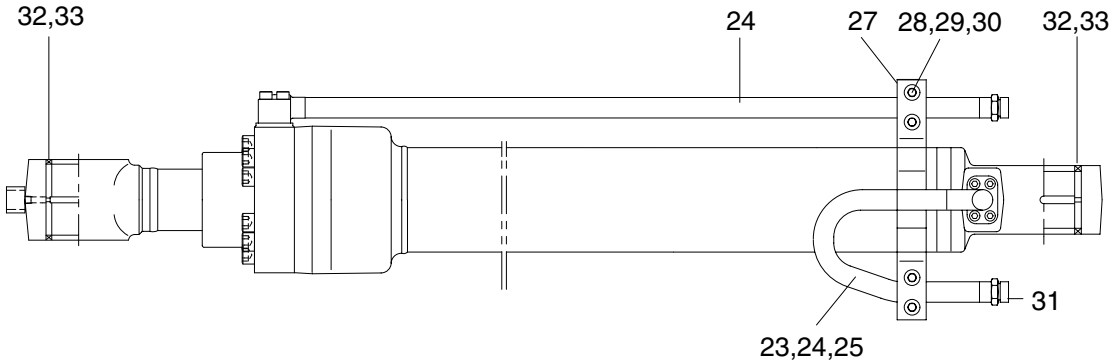
31Q6-60111EGG

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 Long reach (SHPAC)



Internal detail

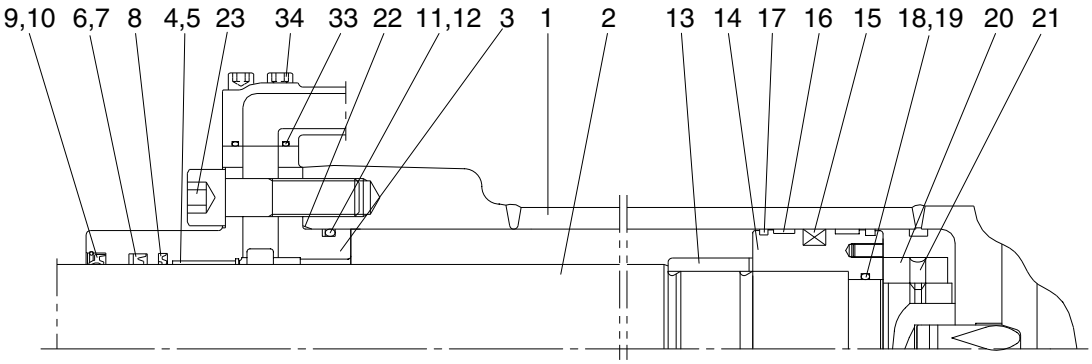


31Q6-66102EGG

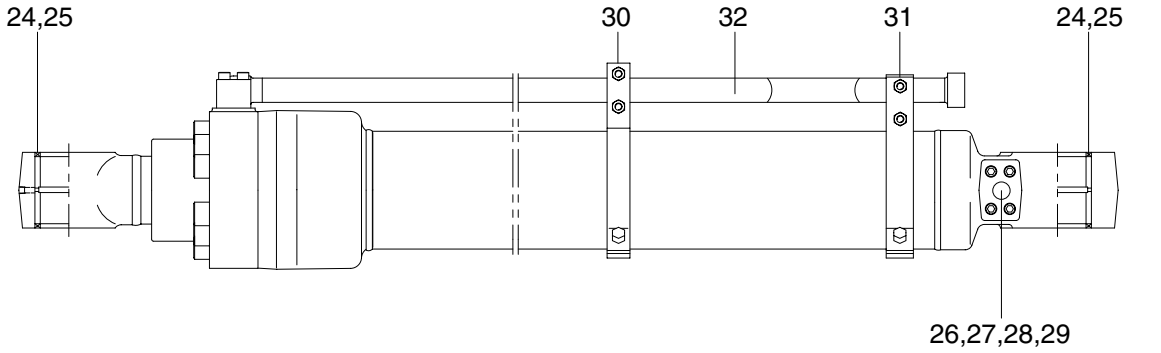
1	Tube assembly	12	Back up ring	23	Pipe assembly-BS
2	Rod assembly	13	Cushion ring	24	Pipe assembly-RD
3	Gland	14	Piston	25	O-ring
4	Dust wiper	15	Piston seal	26	Hexagon socket head bolt
5	Retaining ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	U-bolt
7	Back up ring	18	O-ring	29	Hexagon socket nut
8	Buffer ring	19	Back up ring	30	Spring washer
9	Pin bushing	20	Lock nut	31	O-ring
10	Retaining ring	21	Hexagon socket set screw	32	Pin bushing
11	O-ring	22	Hexagon socket head bolt	33	Dust seal

(2) Arm cylinder

① Standard (CHANGZHOU)



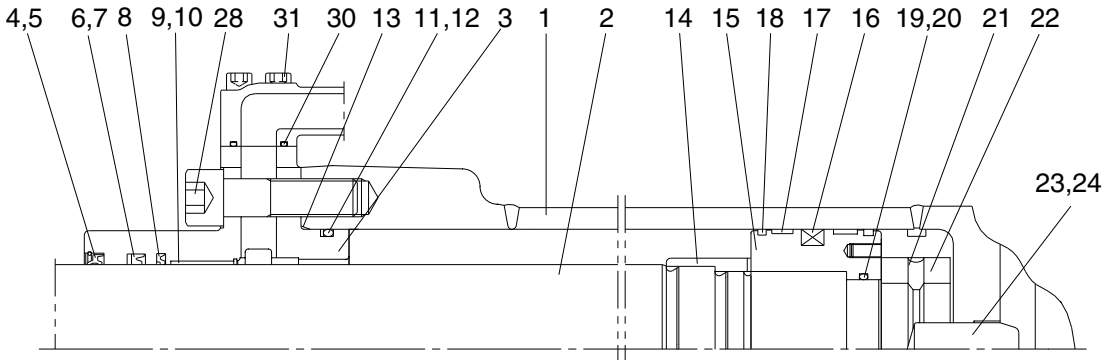
Internal detail



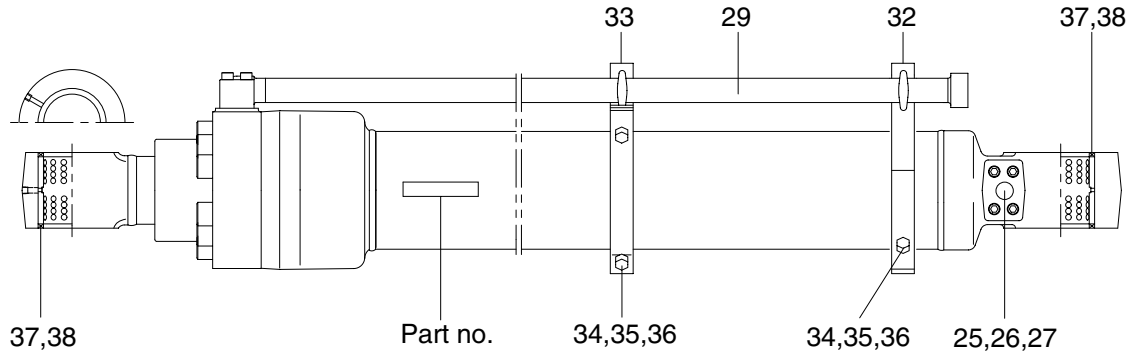
31Q6-50132CGG

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	DD2 bushing	16	Wear ring	28	O-ring
5	Snap ring	17	Dust ring	29	Plug
6	Rod seal	18	O-ring	30	Band assembly-R
7	Back up ring	19	Back up ring	31	Band assembly-B
8	Buffer ring	20	Lock nut	32	Pipe assembly-R
9	Dust wiper	21	Hexagon socket set screw	33	O-ring
10	Snap ring	22	O-ring	34	Hexagon socket head bolt
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Dimple bushing		

Standard (SHPAC)



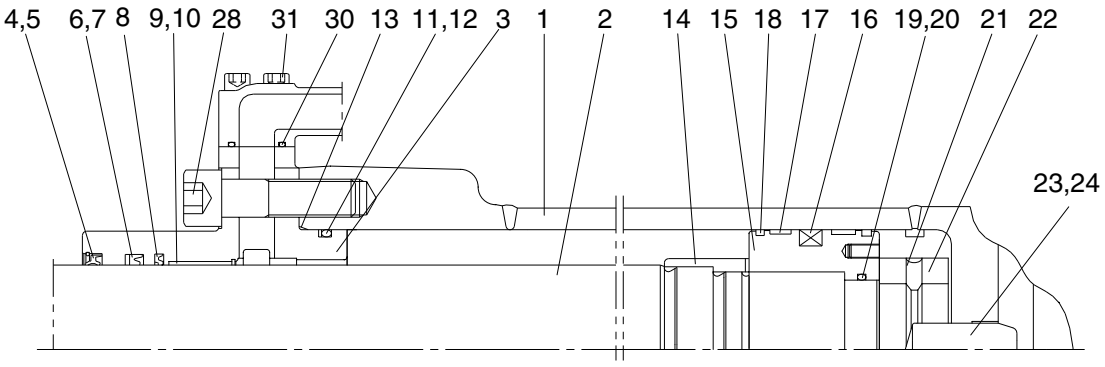
Internal detail



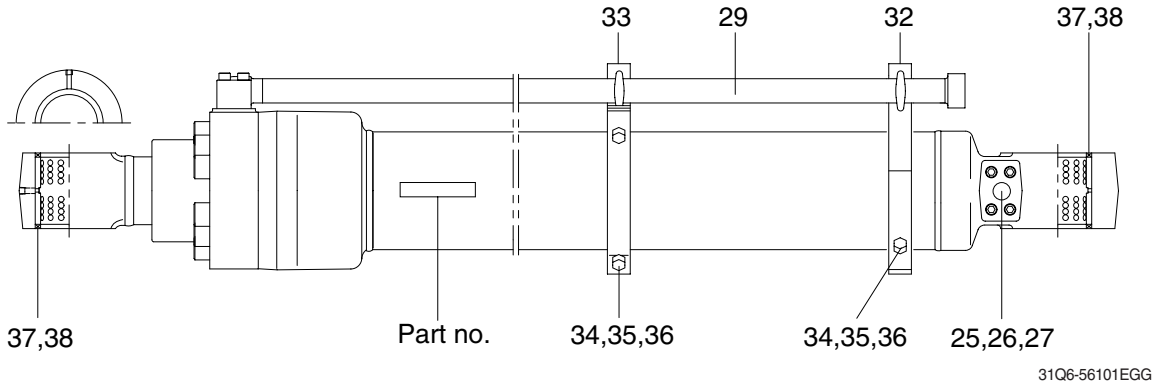
31Q6-50132EGG

1	Tube assembly	14	Cushion ring	27	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	Pin bushing
12	Back up ring	25	Check valve	38	Dust seal
13	O-ring	26	Coil spring		

② Long reach (SHPAC)

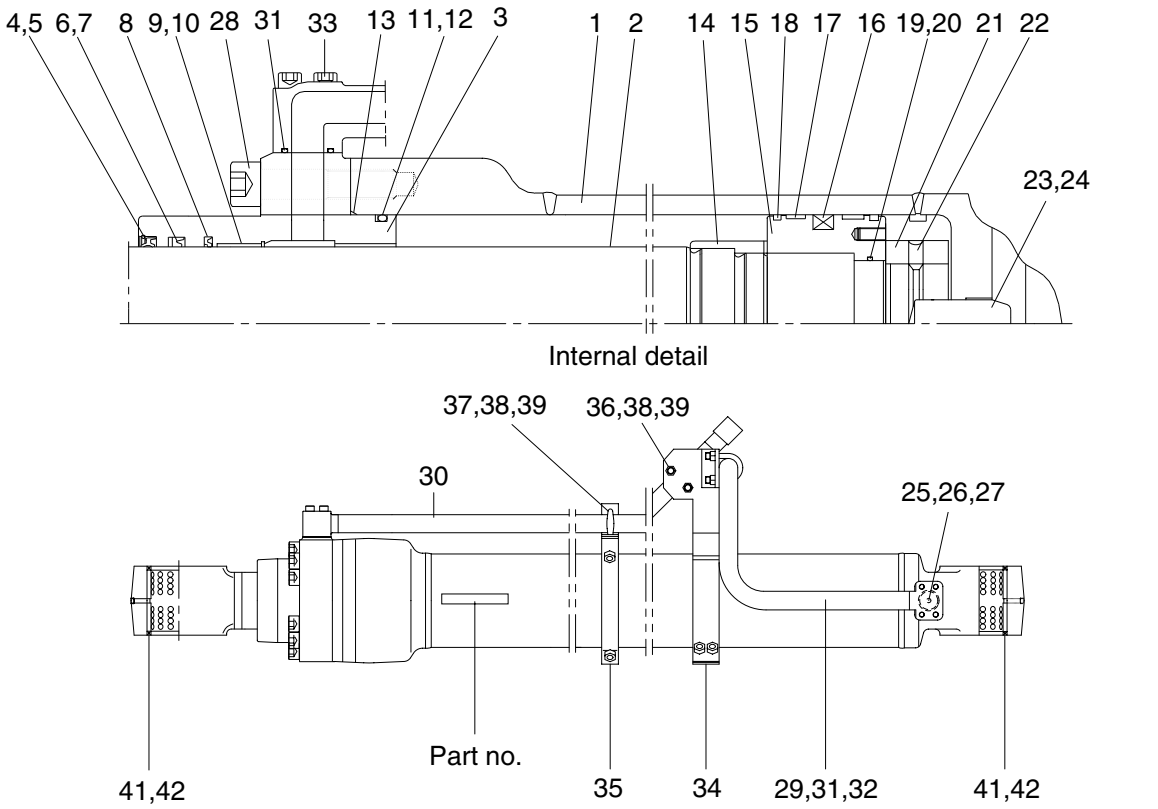


Internal detail



1	Tube assembly	14	Cushion ring	27	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	Pin bushing
12	Back up ring	25	Check valve	38	Dust seal
13	O-ring	26	Coil spring		

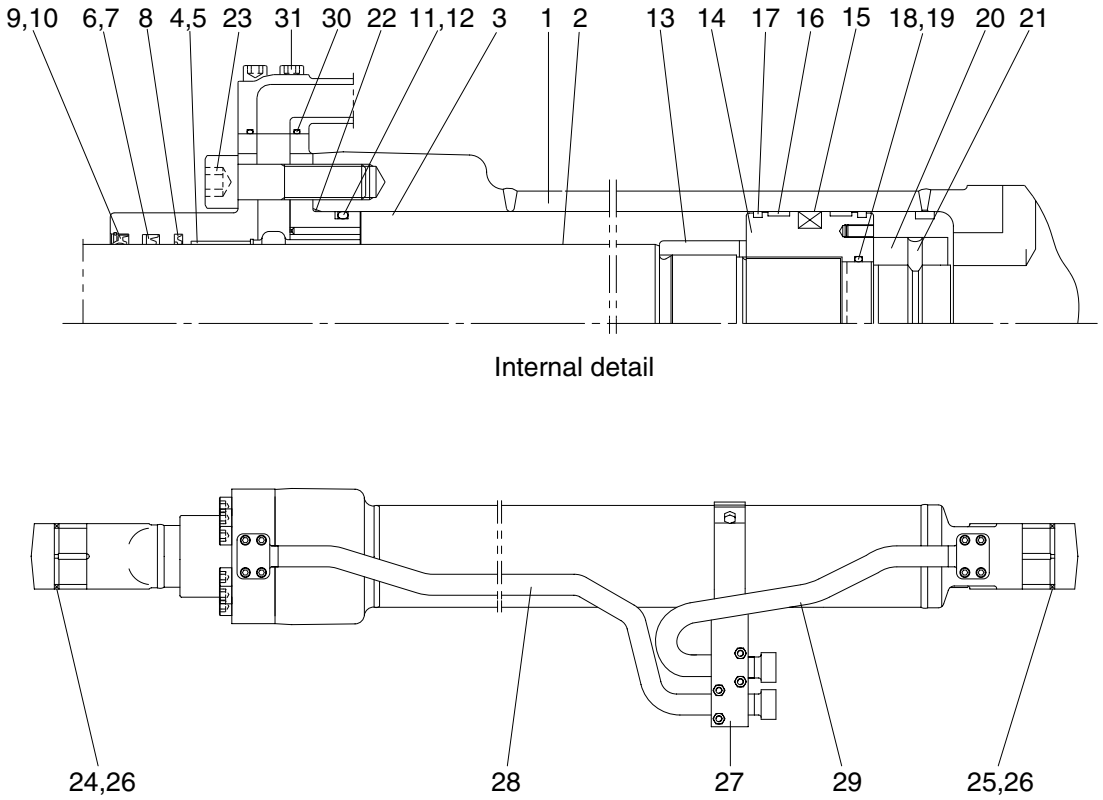
③ 2-piece boom (SHPAC)



31K6-53211E

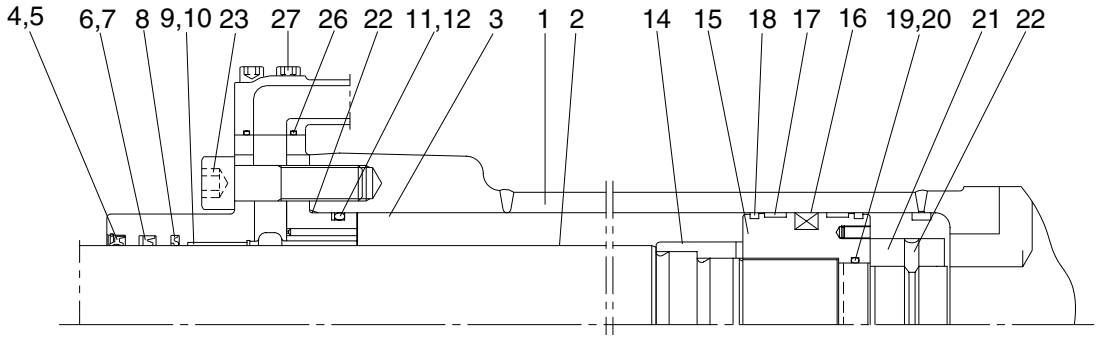
1	Tube assembly	15	Piston	39	Pipe assembly-B
2	Rod assembly	16	Piston seal	30	Pipe assembly-R
3	Gland	17	Wear ring	31	O-ring
4	Dust wiper	18	Dust ring	32	Hexagon socket head bolt
5	Retaining ring	19	O-ring	33	Hexagon socket head bolt
6	Rod seal	20	Back up ring	34	Band assembly-B
7	Back up ring	21	Lock nut	35	Band assembly-R
8	Buffer ring	22	Hexagon socket set screw	36	U-bolt
9	Dry bearing	23	Cushion plunger	38	Hexagon nut
10	Retaining ring	24	Stop ring	39	Spring washer
11	O-ring	25	Check valve	40	O-ring
12	Back up ring	26	Coil spring	41	Dimple bushing
13	O-ring	27	Plug	42	Dust seal
14	Cushion ring	28	Hexagon socket head bolt		

(3) Boom cylinder (CHANGZHOU)

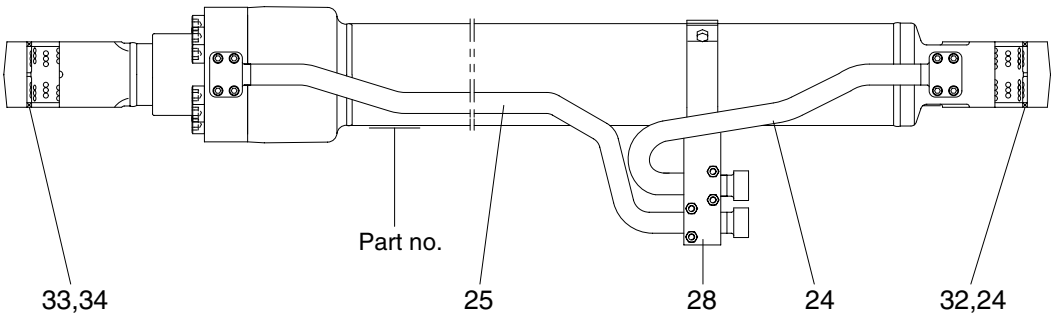


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Dimple bushing
3	Gland	14	Piston	25	Dimple bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

Boom cylinder (SHPAC)



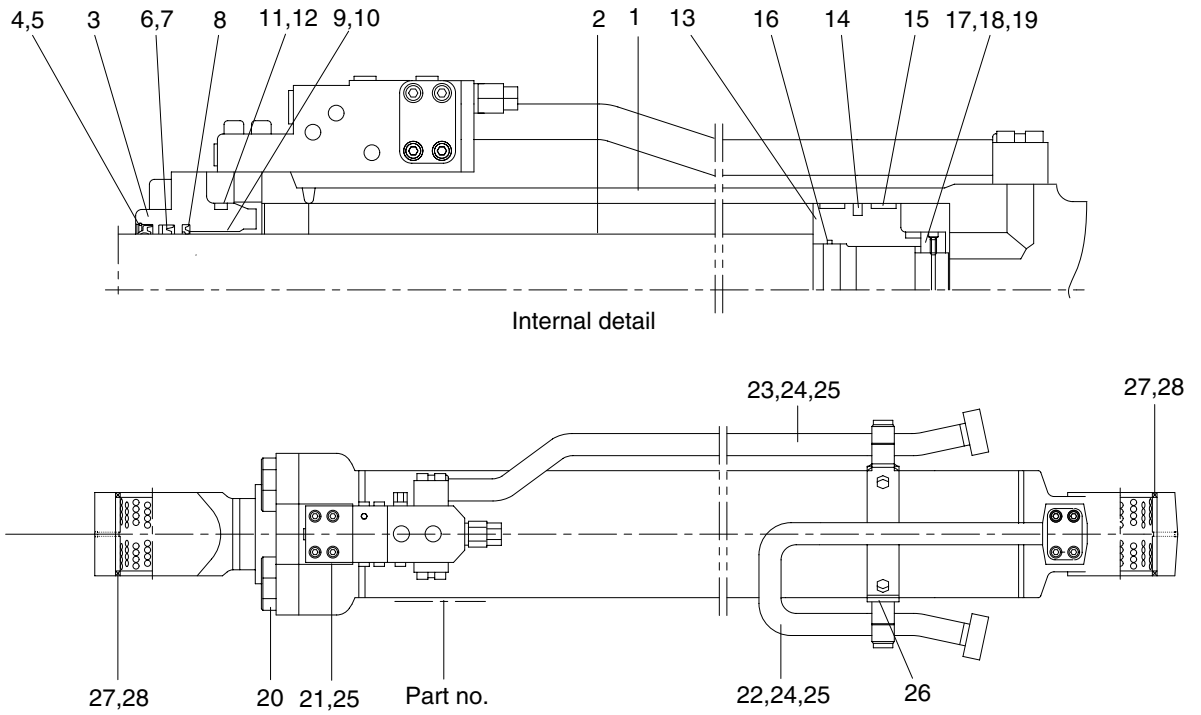
Internal detail



31Q6-50110EGG

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	21	Lock nut	33	Dimple bushing
10	Retaining ring	22	Hexagon socket set screw	34	Dust seal
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Pipe assembly-B		

(4) Adjustment cylinder (SHPAC)

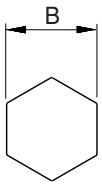


31K6-54151E

1	Tube assembly	11	O-ring	21	Safety valve
2	Rod assembly	12	Back up ring	22	Pipe assembly-B
3	Gland	13	Piston	23	Pipe assembly-R
4	Dust wiper	14	Piston seal	24	O-ring
5	Retaining ring	15	Wear ring	25	Hexagon socket head bolt
6	Rod seal	16	O-ring	26	Band assembly
7	Back up ring	17	Lock nut	27	Pin bushing
8	Buffer ring	18	Lock washer	28	Dust seal
9	Dry bearing	19	Hexagon socket set screw		
10	Retaining ring	20	Hexagon socket head bolt		

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 (standard)	23★1★3	M16	23.0±2.0	166±14.5
		23★1★4	M16	26.7±2.7	193±19.5
		31★3	M10	5.4±0.5	39.1±3.6
		27★4	M10	6.5±0.7	47.0±5.1
	Bucket cylinder (long reach)	22★1★4	M14	17.9±1.8	130±13.0
		26★1★4	M8	3.3±0.3	23.9±2.2
	Boom cylinder	23★1★3	M16	23.0±2.0	166±14.5
		23★1★4	M16	26.7±2.7	193±27.5
		31★3	M10	5.4±0.5	39.1±3.6
		27★4	M10	6.5±0.7	47.0±5.1
	Arm cylinder	23★1★3	M18	32.0±3.0	232±21.7
		28★1★4	M18	38.0±3.8	275±27.5
		28★1★5	M18	38.0±3.8	275±27.5
		34★3	M12	9.4±1.0	68.0±7.2
		31★4	M12	11.3±1.1	81.7±8.0
		33★5	M12	11.3±1.1	81.7±8.0
	Arm cylinder (long reach)	28★1★4	M18	38.0±3.8	275±27.5
		31★4	M12	11.3±1.1	81.7±8.0
	Adjustment cylinder	20★1★4	M20	52.2±5.2	378±37.6
		25★4	M10	6.5±0.7	47.0±5.1

★1 : Apply loctite #243 on the thread of bolt.
★3 : CHANGZHOU
★4 : SHPAC
★5 : 2-piece boom

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Lock nut	Bucket cylinder (standard)	20★3 21★4	- M62	100±10.0 100±10.0	723±72.3 723±72.3
	Bucket cylinder (long reach)	20★4	M48	100±10.0	723±72.3
	Boom cylinder	20★3 21★4	- M56	100±10.0 100±10.0	723±72.3 723±72.3
	Arm cylinder	20★3 21★4 21★5	- M70 M70	150±15.0 150±15.0 150±15.0	1085±108 1085±108 1085±108
	Arm cylinder (long reach)	21★4	M70	150±15.0	1085±108
	Adjustment cylinder	17★4	M65	62±6.0	448±43.4
Piston	Bucket cylinder (standard)	14★3 15★4	- M75	150±15.0 150±15.0	1085±108 1085±108
	Bucket cylinder (long reach)	14★4	M60	150±15.0	1085±108
	Boom cylinder	14★3 15★4	- M75	150±15.0 150±15.0	1085±108 1085±108
	Arm cylinder	14★3 15★4 15★5	- M90 M90	200±20.0 200±20.0 200±20.0	1447±145 1447±145 1447±145
	Arm cylinder (long reach)	15★4	M90	200±20.0	1447±145
	Adjustment cylinder	13★4	M75	97±10	702±72.3
Set screw	Bucket cylinder (standard)	21★3 22★4	M8 M8	2.7±0.3 1.7±0.2	19.5±2.2 12.3±1.4
	Bucket cylinder (long reach)	21★4	M8	1.7±0.2	12.3±1.4
	Boom cylinder	21★3 22★4	M8 M8	2.7±0.3 2.0±0.2	19.5±2.2 14.5±1.4
	Arm cylinder	21★3 22★4 22★5	M10 M10 M10	5.4±0.5 2.5±0.3 2.5±0.3	39.1±3.6 18.1±2.2 18.1±2.2
	Arm cylinder (long reach)	22★4	M10	2.5±0.3	18.1±2.2
	Adjustment cylinder	19★4	M8	1.7±0.2	12.3±1.4

★1 : Apply loctite #243 on the thread of bolt.
★3 : CHANGZHOU
★4 : SHPAC
★5 : 2-piece boom

3) DISASSEMBLY

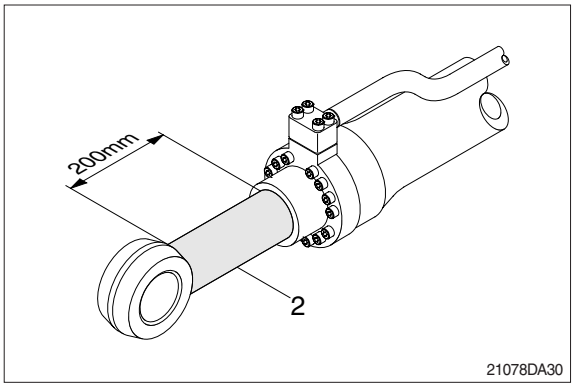
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder. (CHANGZHOU type)

① Hold the clevis section of the tube in a vise.

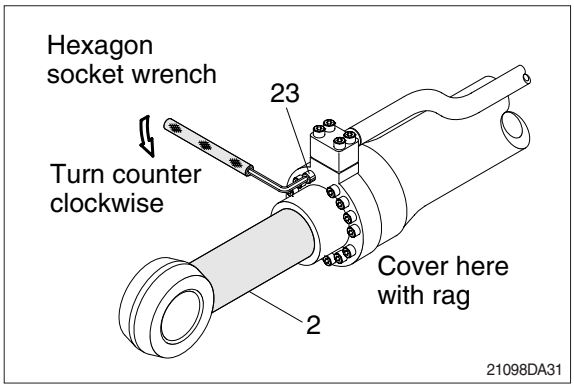
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 ㎜ (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



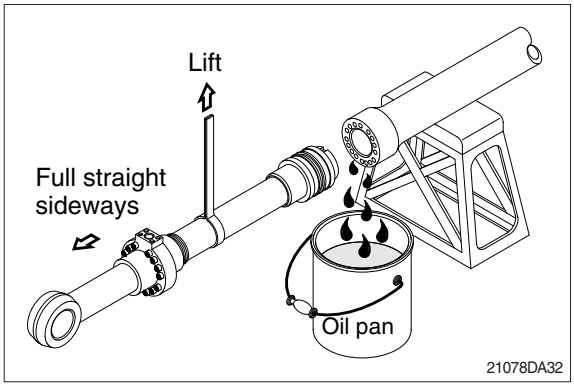
③ Loosen and remove socket bolts (23) of the gland in sequence.

※ 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).

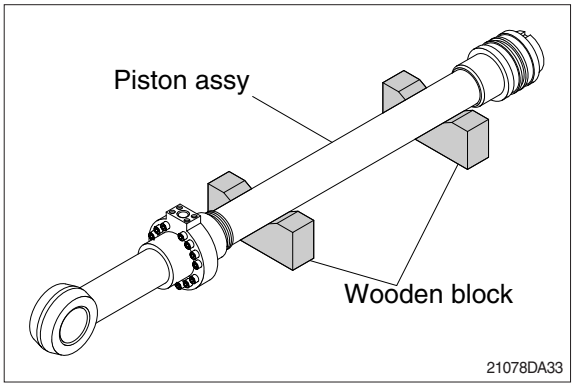
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



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

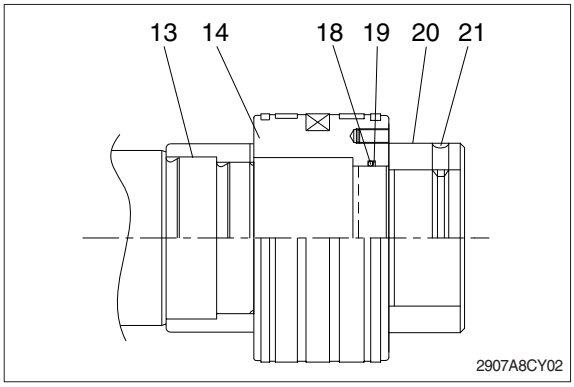
① Remove set screw (21).

② Remove lock nut (20).

※ Since piston (14) and lock nut (20) are tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the piston (14) and lock nut (20).

③ Remove piston assembly (14), back up ring (19), and O-ring (18).

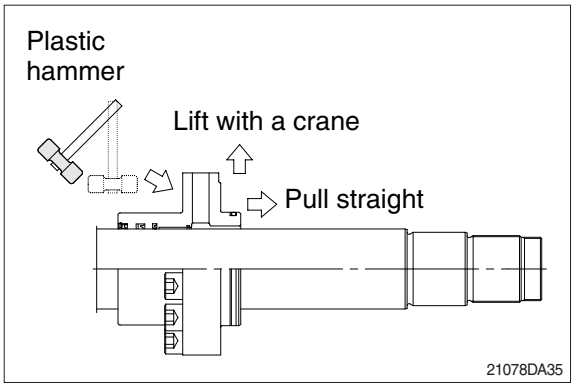
④ Remove cushion ring (13).



⑤ 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).

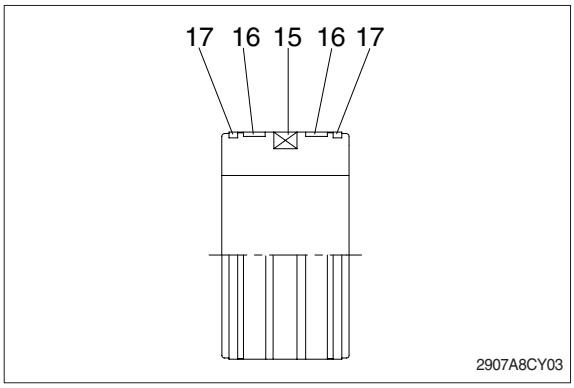


(3) Disassemble the piston assembly

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), O-ring (11) and O-ring (22).

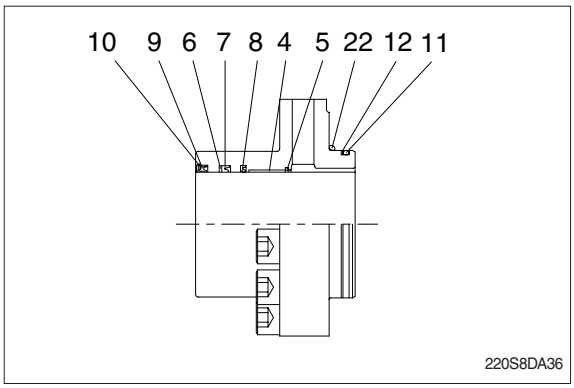
② Remove snap ring (10), dust wiper (9).

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.

※ Do not remove bushing (4).

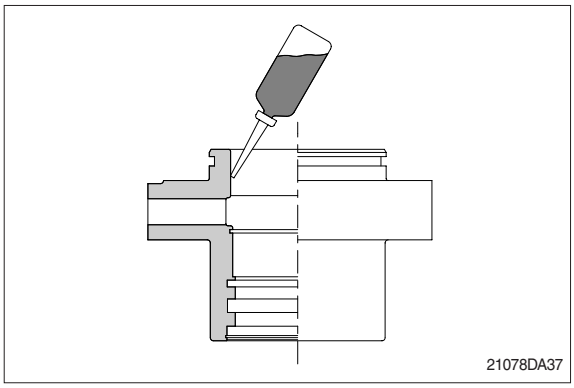


3) ASSEMBLY

(1) Assemble cylinder head assembly

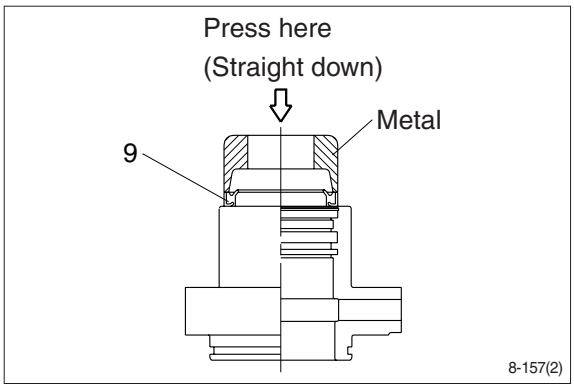
※ Check for scratches or rough surfaces if found smooth with an oil stone.

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.

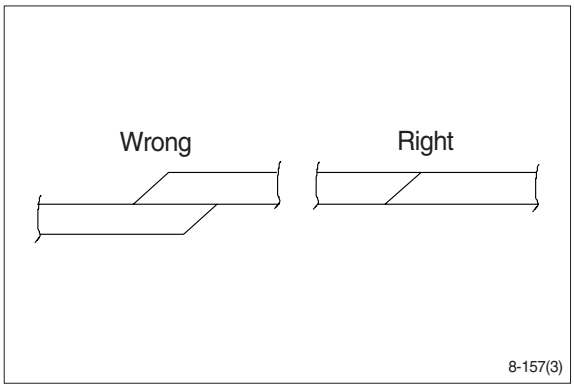
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

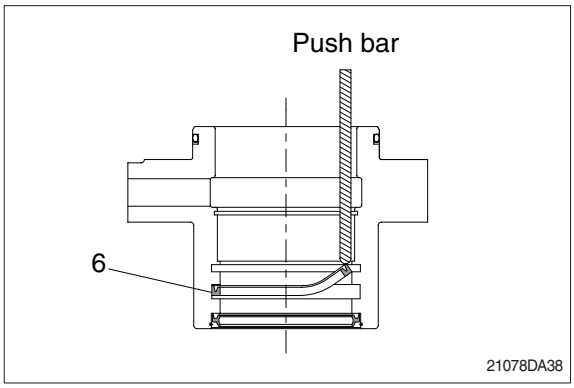
※ Coat each packing with hydraulic oil before fitting it.

※ 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.

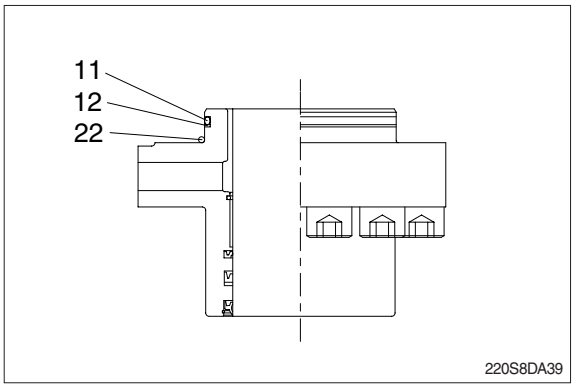
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

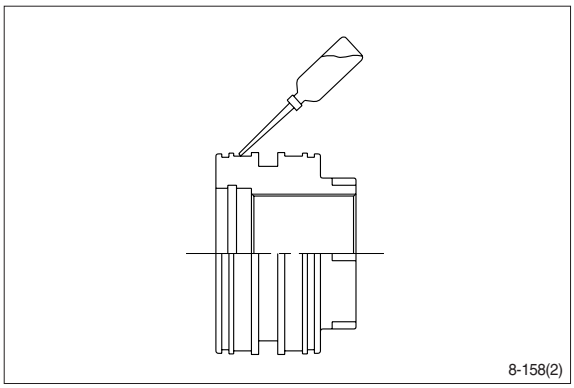
⑥ Fit O-ring (11) and O-ring (22) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

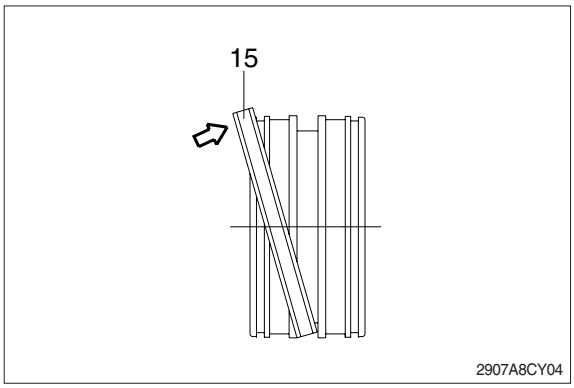
① Coat the outer face of piston (14) with hydraulic oil.



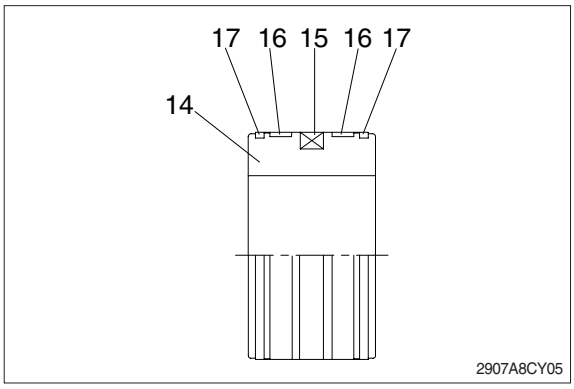
② Fit piston seal (15) to piston.

※ 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).

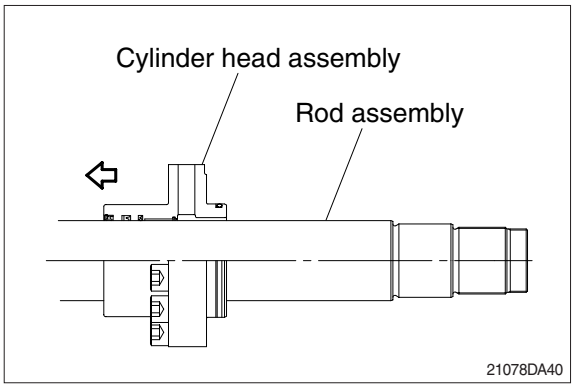


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

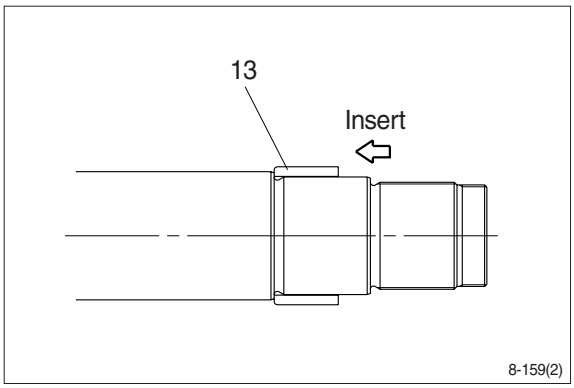
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring (13) to rod assembly.

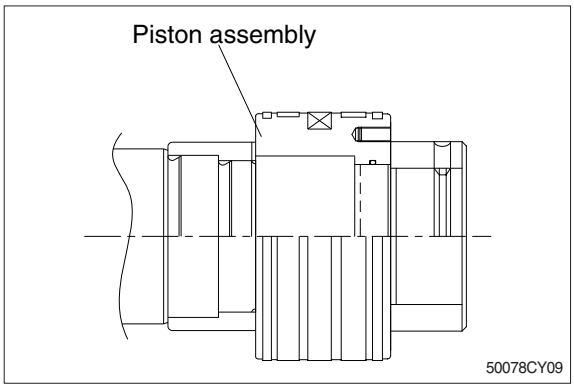
※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

· Tightening torque : 150±15.0 kgf · m (1085±108 lbf · ft)

※ Refer to page 8-154.



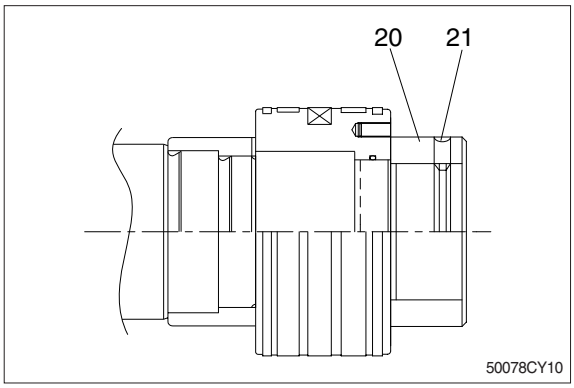
⑥ Fit lock nut (20) and tighten the screw (21).

· Tightening torque :

Item 20 : 100±10.0 kgf·m (723±72.3 lbf·ft)

Item 21 : 2.7±0.3 kgf·m (19.5±2.2 lbf·ft)

※ Refer to page 8-154.



(3) Overall assemble

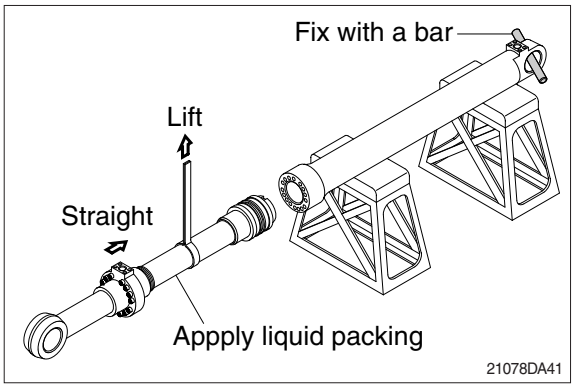
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

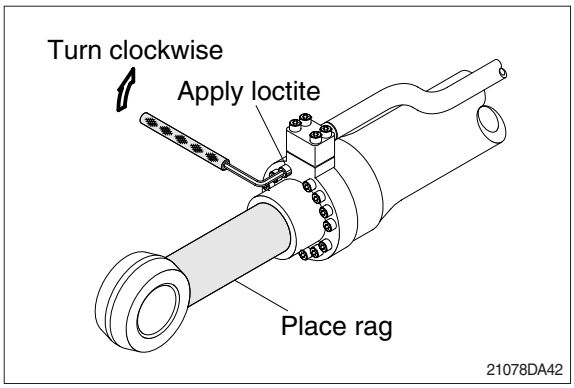
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ 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.





1. TRACK LINK

1) REMOVAL

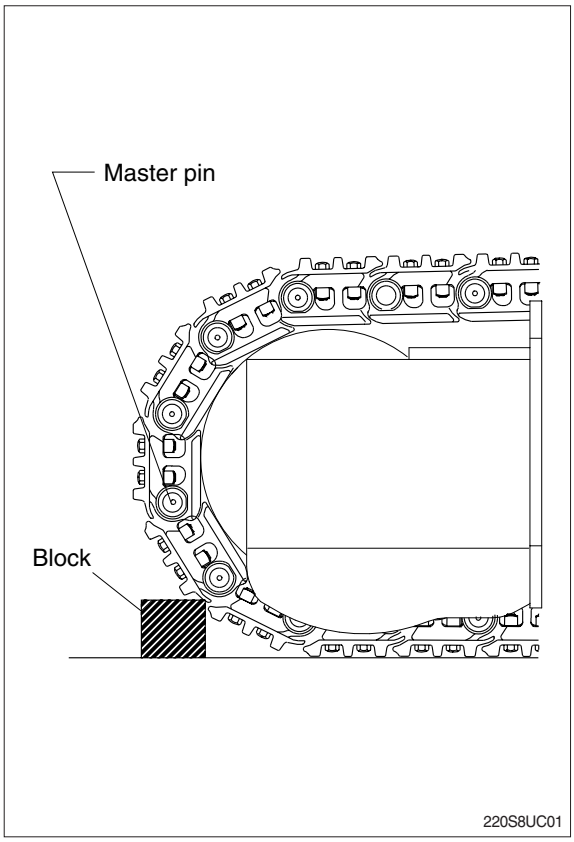
(1) Move track link until master pin is over front idler in the position put wooden block as shown.

(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.

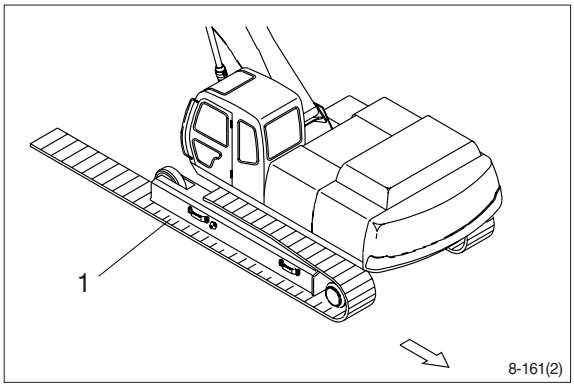
(3) Push out master pin by using a suitable tool.



(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.

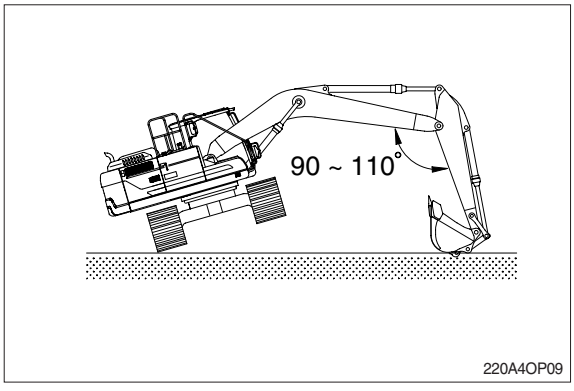
※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.



2) INSTALL

(1) Carry out installation in the reverse order to removal.

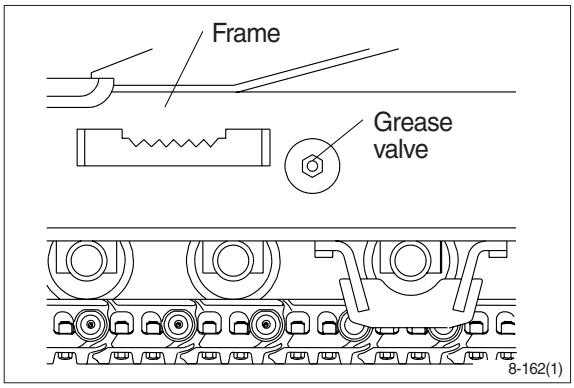
※ Adjust the tension of the track link.



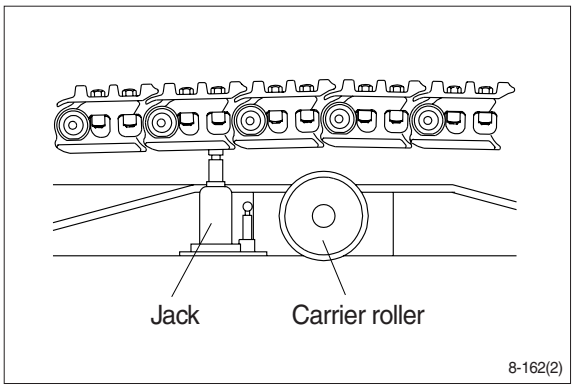
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.

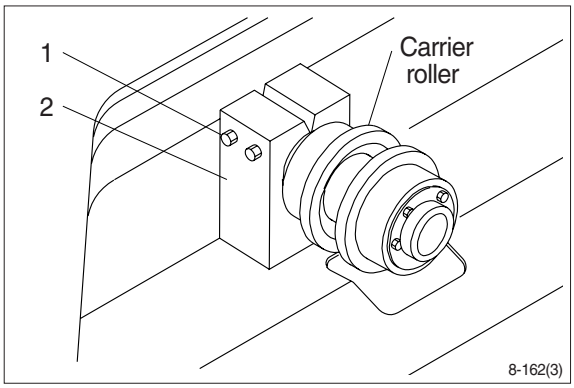


(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.
- Weight : 21 kg (46 lb)
- Tightening torque : 29.7±4.5 kgf·m (215±32.5 lbf · ft)



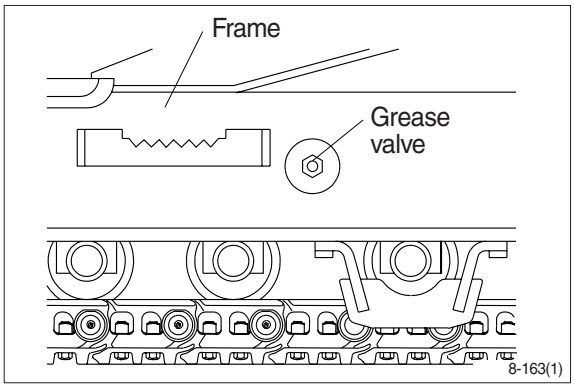
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

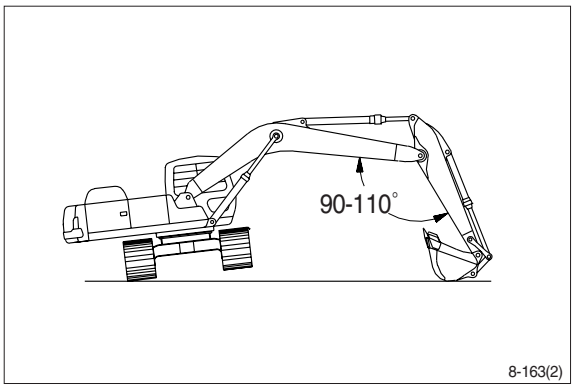
1) REMOVAL

(1) Loosen tension of the track link.



(2) Using the work equipment, push up track frame on side which is to be removed.

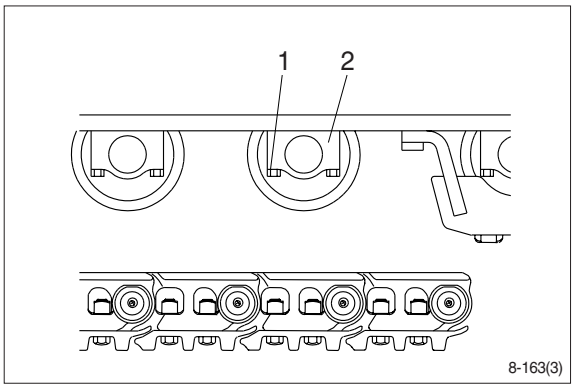
※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 46 kg (106 lb)

· Tightening torque : 57.9±8.7 kgf·m
(419±62.9 lbf · ft)



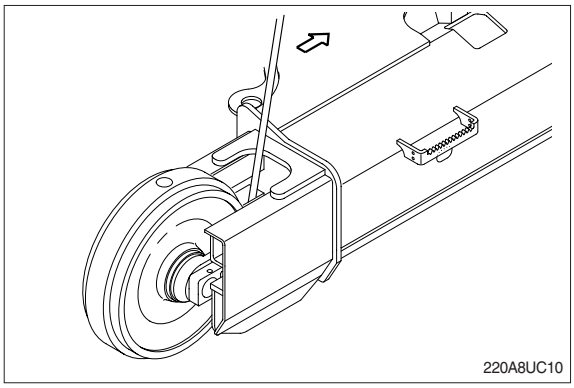
2) INSTALL

(1) Carry out installation in the reverse order to removal.

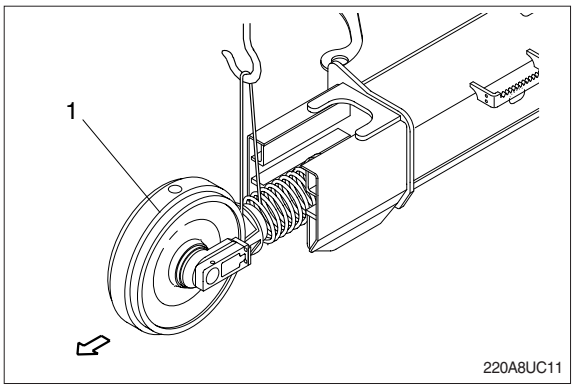
4. IDLER AND RECOIL SPRING

1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.

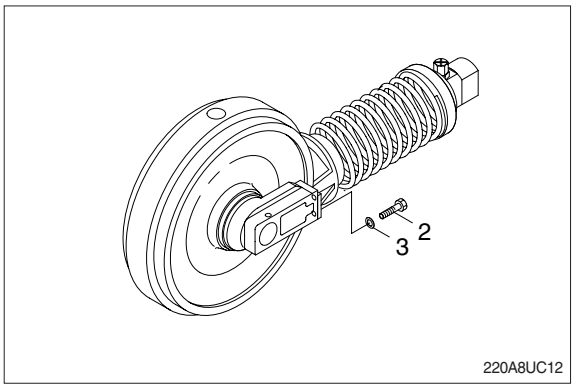

220A8UC10

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 310 kg (680 lb)



220A8UC11

(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.
· Tightening torque : 29.7±4.5 kgf·m
(215±32.5 lbf · ft)

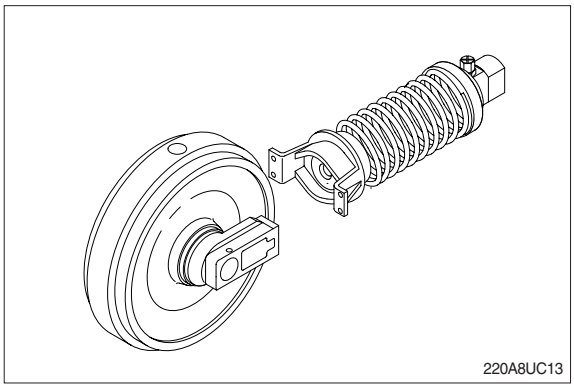


220A8UC12

2) INSTALL

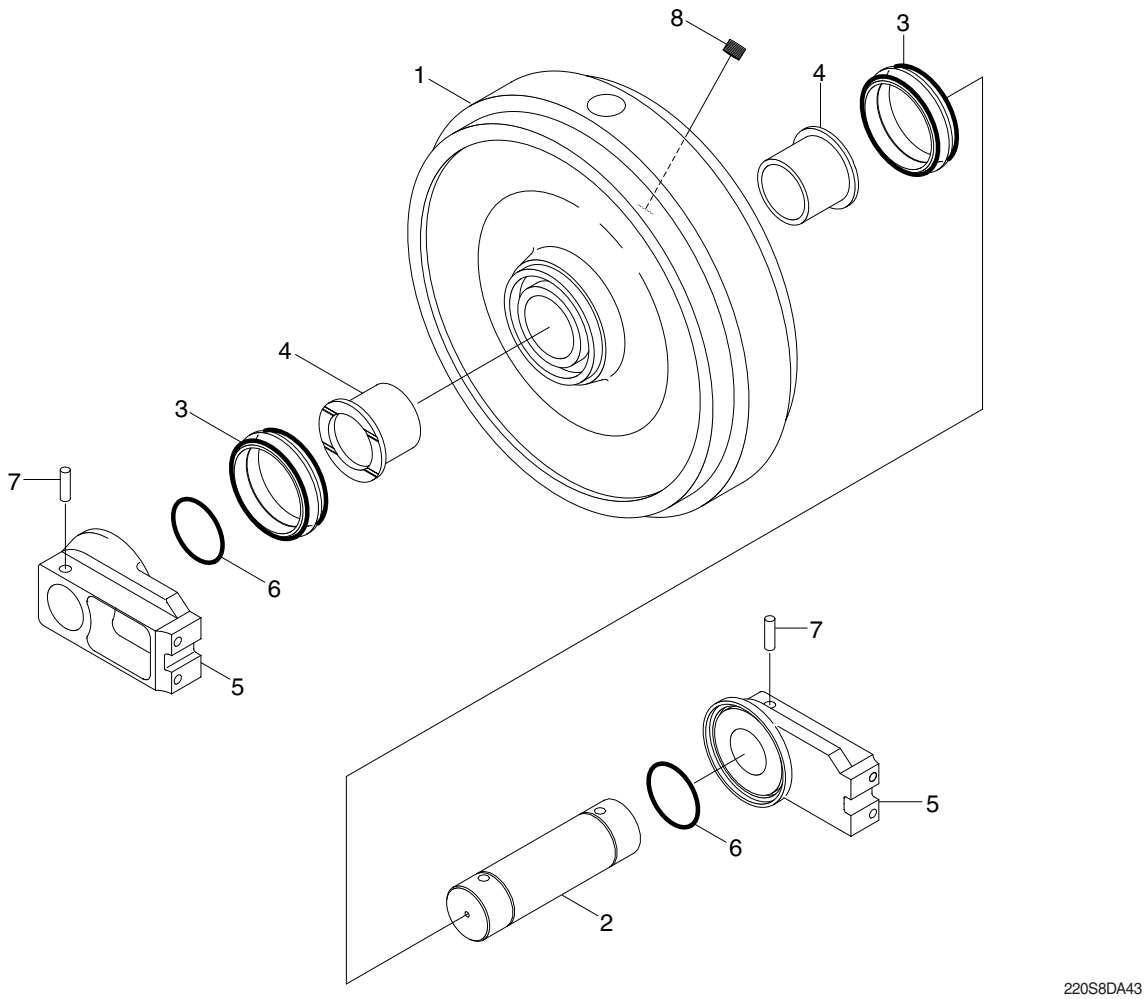
(1) Carry out installation in the reverse order to removal.

※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.


220A8UC13

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



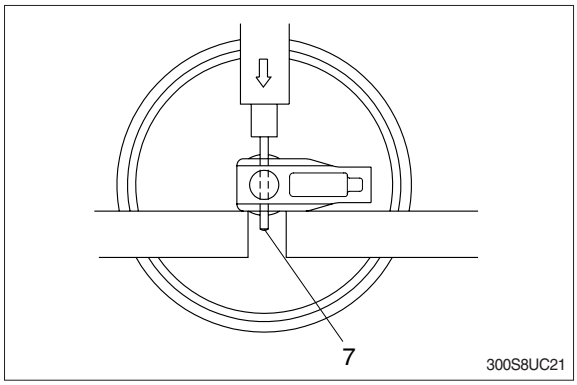
220S8DA43

1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug and drain oil.

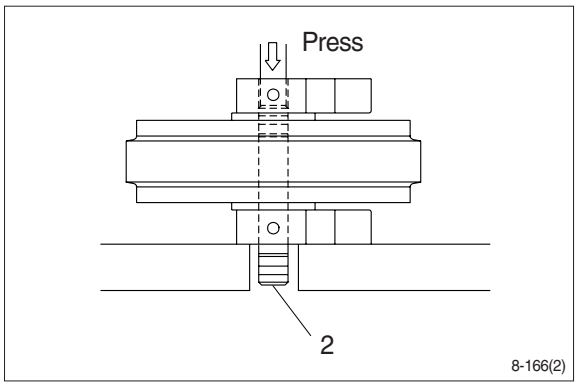
② Draw out the spring pin (7), using a press.



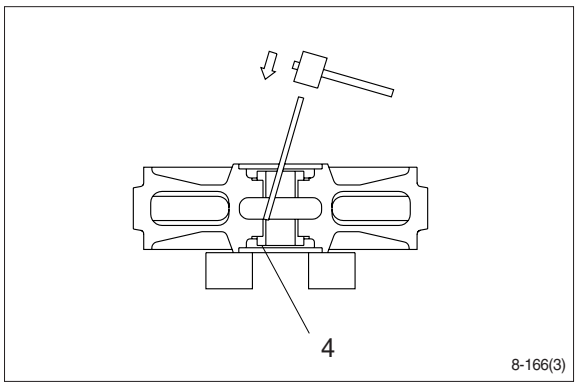
③ Pull out the shaft (2) with a press.

④ Remove seal (3) from idler (1) and bracket (5).

⑤ Remove O-ring (6) from shaft.



⑥ Remove the bushing (4) from idler, using a special tool.
Only remove bushing if replacement is necessity.

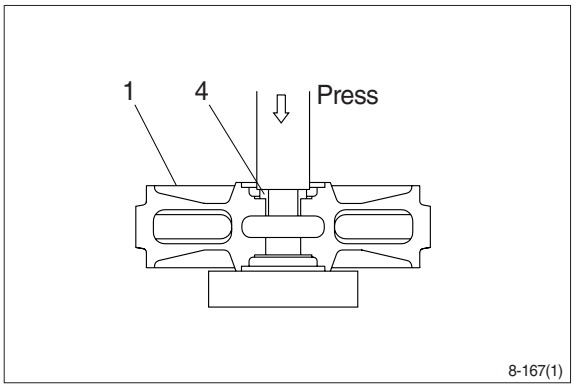


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

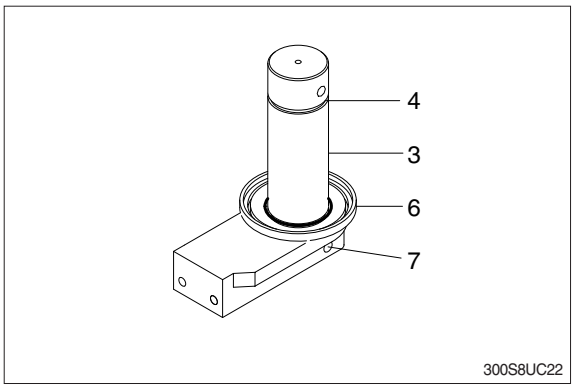
① Cool up bushing (4) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1)

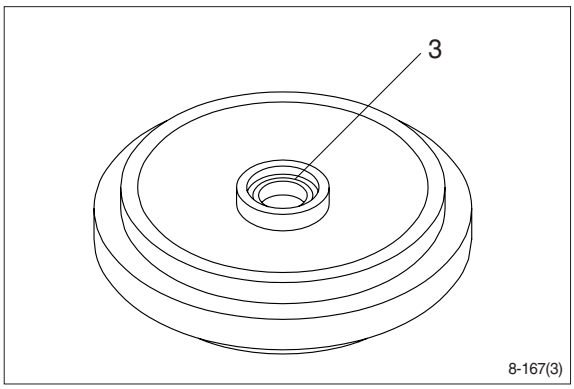
② Coat O-ring (6) with grease thinly, and install it to shaft (2).

③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



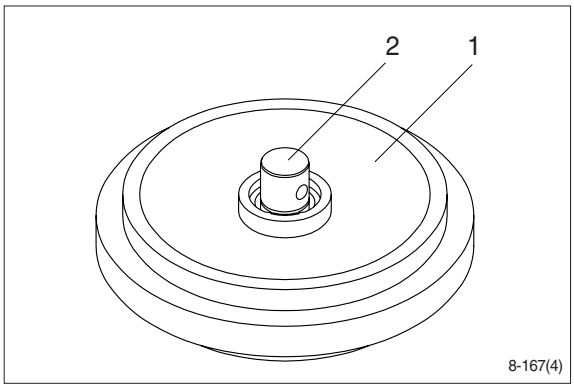
300S8UC22

④ Install seal (3) to shell (1) and bracket (5).



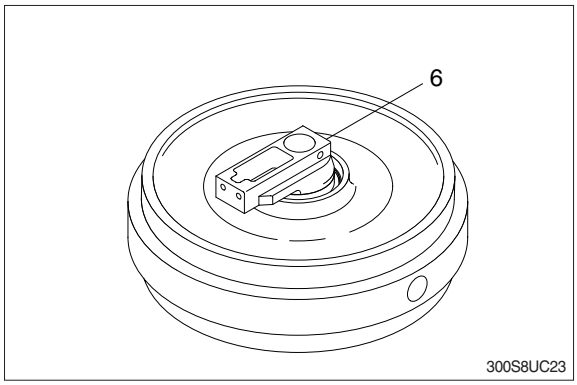
8-167(3)

⑤ Install shaft (2) to shell (1).

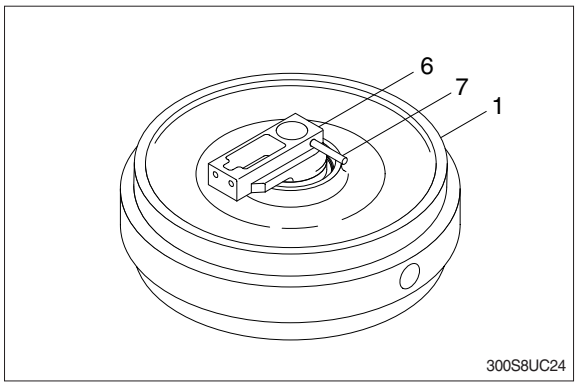


8-167(4)

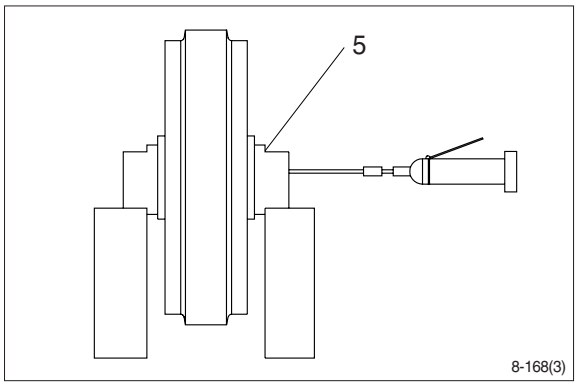
⑥ Install bracket (5) attached with seal (3).



⑦ Knock in the spring pin (7) with a hammer.

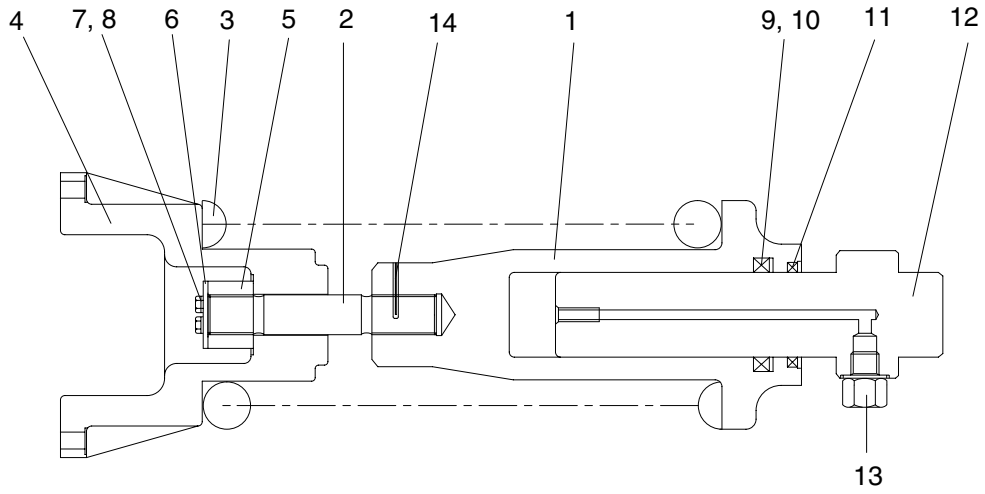


⑧ Lay bracket (5) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

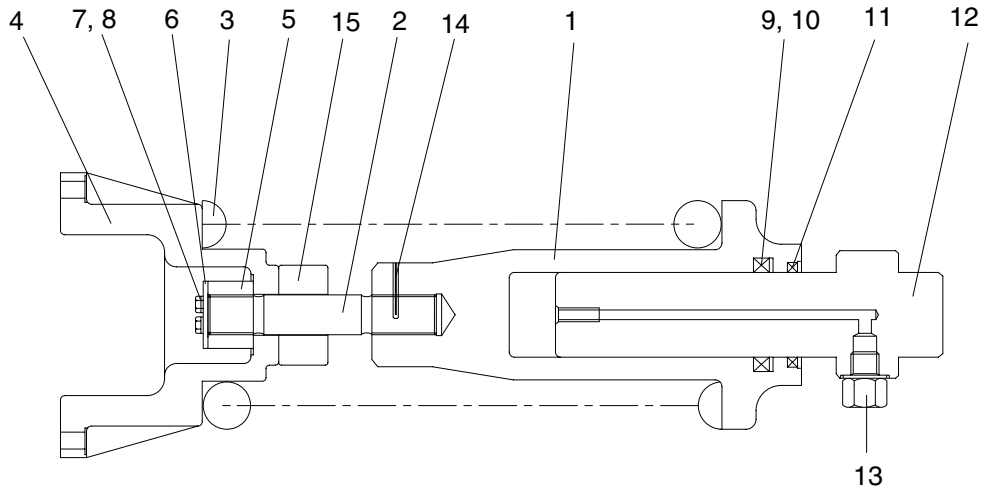
(1) Structure (standard)



220L8UC100

1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal	14	Spring pin
5	Lock nut	10	Back up ring		

Structure (high walker)



220L8UC101

1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal	14	Spring pin
5	Lock nut	10	Back up ring	15	Stopper

(2) Disassembly

※ The illustrations are base on the standard.

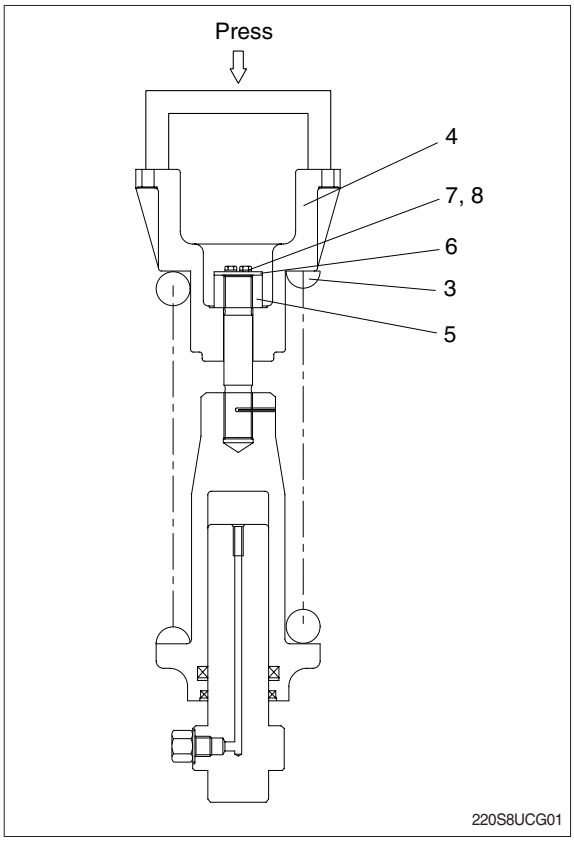
① Apply pressure on spring (3) with a press.

※ 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).

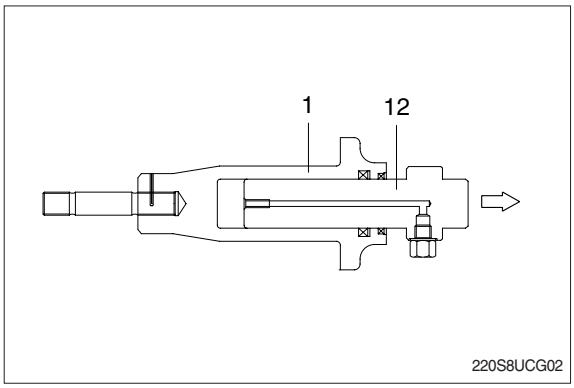
③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket (4) and spring (3).

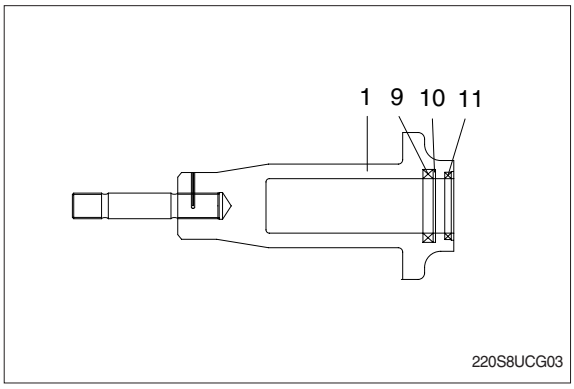


⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



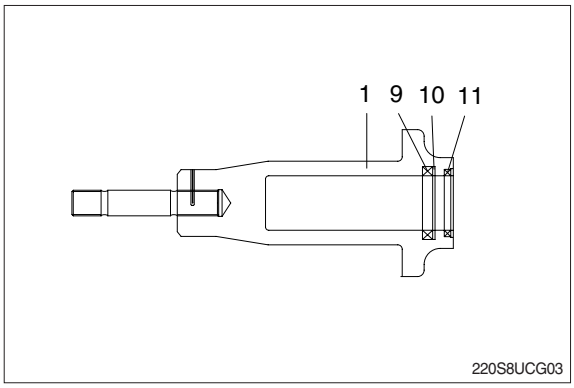
⑦ Remove rod seal (9), back up ring (10) and dust seal (11).



(3) Assembly

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.

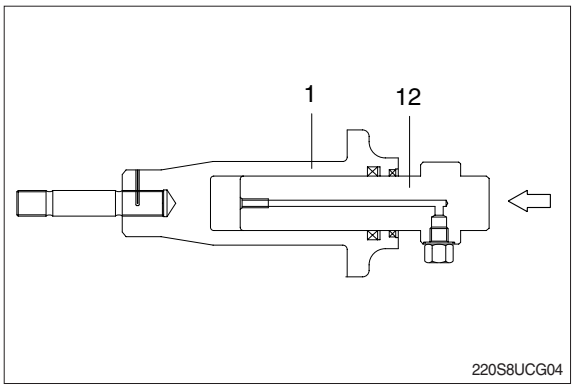


② Pour grease into body (1), then push in rod (12) by hand.
After take grease out of grease valve mounting hole, let air out.

※ 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
Standard : 13±1.0 kgf·m (94±7.2 lbf·ft)
High walker : 13±0.5 kgf·m (94±3.6 lbf·ft)



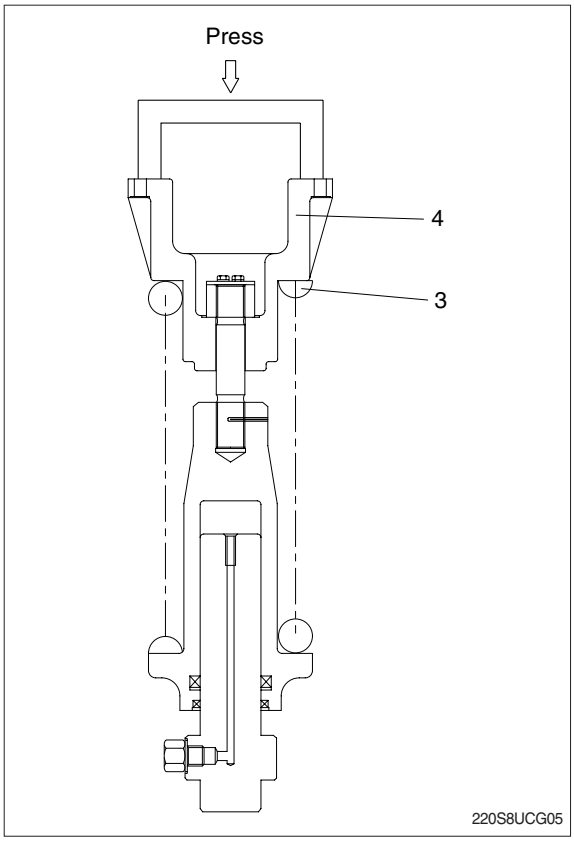
④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

· Spring set load
- Standard : 13716 kg (30239 lb)
- High walker : 16315 kg (35968 lb)

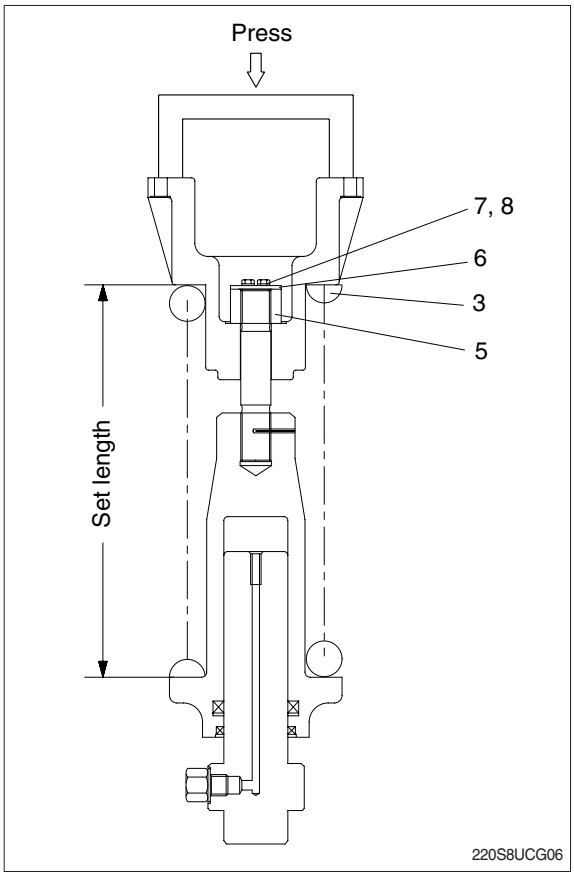
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.

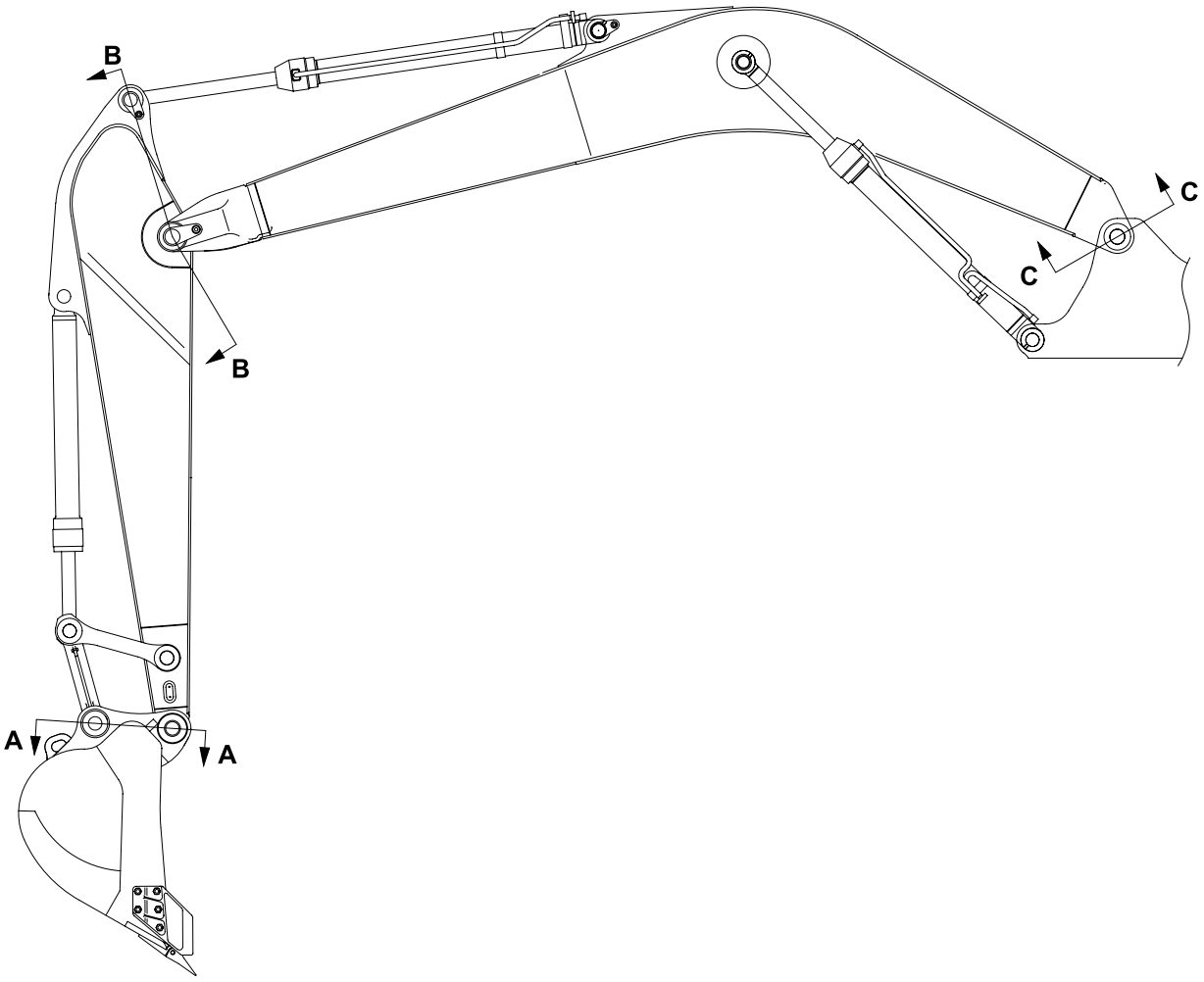


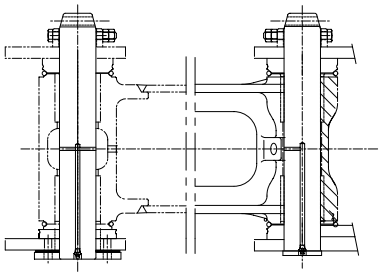
⑥ Lighten the press load and confirm the set length of spring (3).
- Standard : 431 ± 1.5 mm
- High walker : 508 ± 1.5 mm

⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).
· Tightening torque : 15±0.5 kgf·m
(108±3.6 lbf·ft)

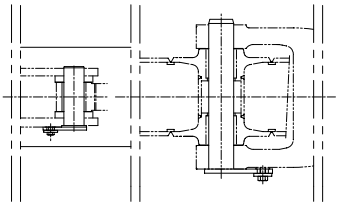


1. STRUCTURE

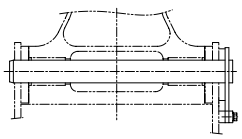




SECTION A



SECTION B



SECTION C

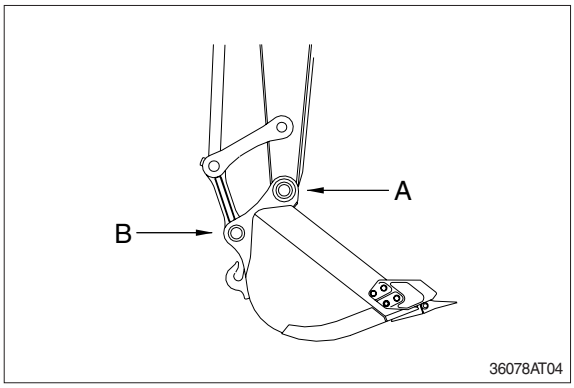
220A8WE10

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

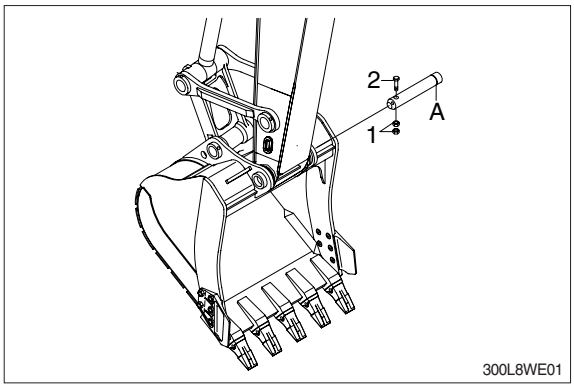
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



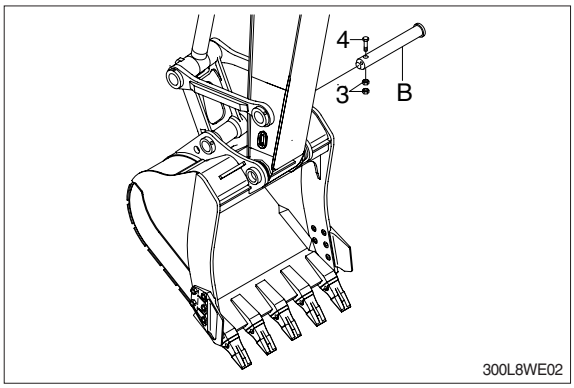
② Remove nut (1), bolt (2) and draw out the pin (A).

· Tightening torque (1) : 29.7±45 kgf·m
(215± 32.5 lbf·ft)



③ Remove nut (3), bolt (4) and draw out the pin (B).

· Tightening torque (3) : 29.7±45 kgf·m
(215± 32.5 lbf·ft)

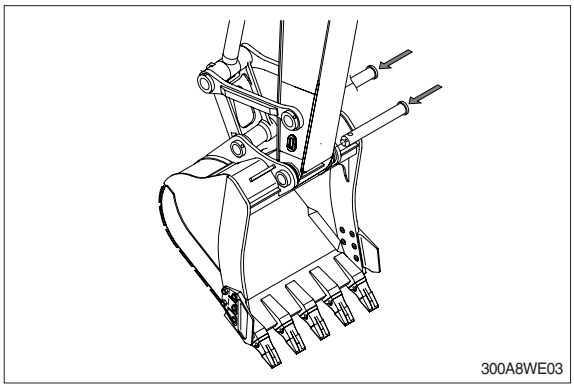


(2) Install

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.**

※ Adjust the bucket clearance.
For detail, see operation manual.



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 (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.

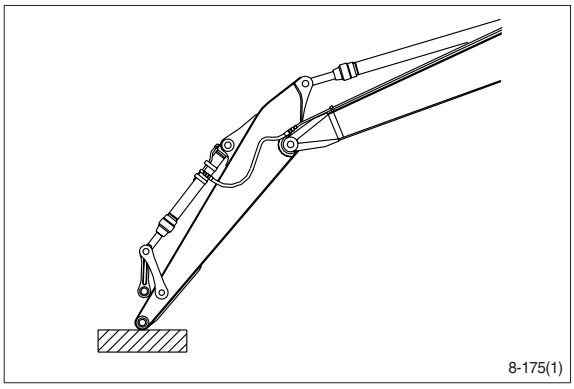
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

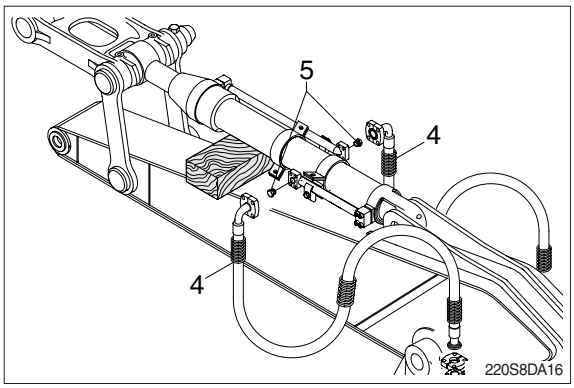
※ Tie the rod with wire to prevent it from coming out.

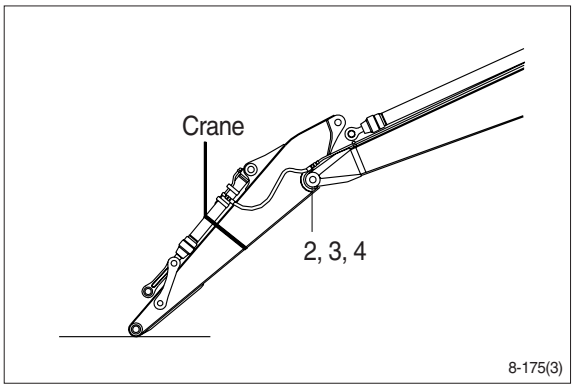
④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.
- Weight : 1095 kg (2410 lb)
- Tightening torque (2) : 29.7±45 kgf·m (215± 32.5 lbf·ft)

※ When lifting the arm assembly, always lift the center of gravity.







(2) Install

① Carry out installation in the reverse order to removal.

⚠ When lifting the arm assembly, always lift the center of gravity.

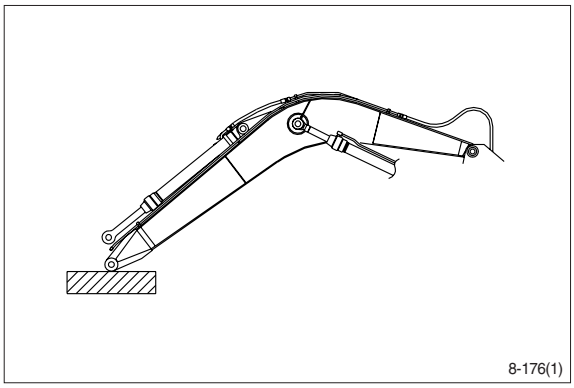
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(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 boom cylinder assembly.

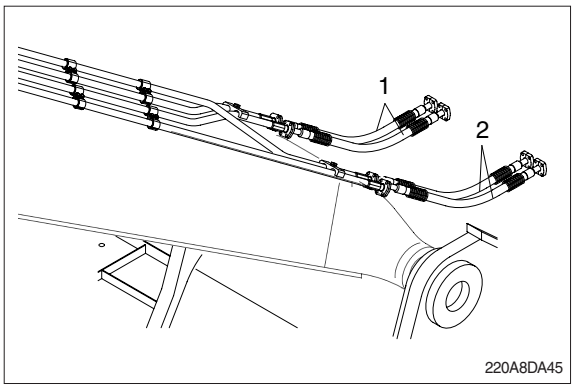


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

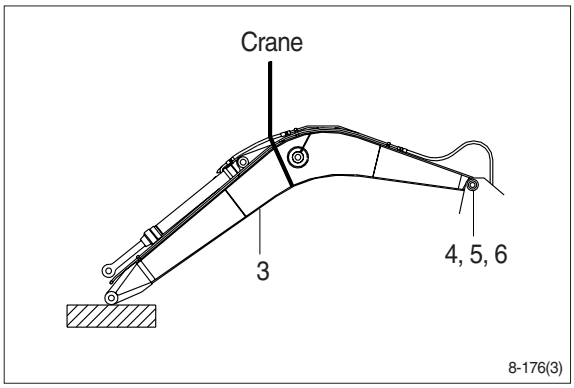
※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).



⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
- Weight :1950 kg (4300 lb)
- Tightening torque (4) : 29.7±45 kgf·m (215± 32.5 lbf·ft)

※ When lifting the boom assembly always lift the center of gravity.



(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.

