SERVICE MANUAL

HYUNDAI

HYUNDAI
HEAVY INDUSTRIES CO.,LTD.

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1. STRUCTURE

This service manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.
This service manual mainly contains the necessary technical information for operations performed in a service workshop.
For ease of understanding, the manual is divided into the following sections.

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

SECTION 2 STRUCTURE AND FUNCTION
This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

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

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

SECTION 5 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.

SECTION 9 COMPONENT MOUNTING TORQUE
This section shows bolt specifications and standard torque values needed when mounting components to the machine.

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

2. HOW TO READ THE SERVICE MANUAL

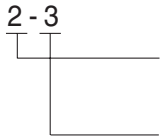
Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI 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



Item number(2. Structure and Function)

Consecutive page number for each item.

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

10 - 4
10 - 4 - 1
10 - 4 - 2] Added pages
10 - 5

Revised edition mark(①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

Convert 55mm into inches.

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

(2) Locate the number 5in 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, 55mm = 2.165 inches.

2. Convert 550mm into inches.

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

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

(3) The original value(550mm) 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 550mm = 21.65 inches.

Millimeters to inches

1mm = 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
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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

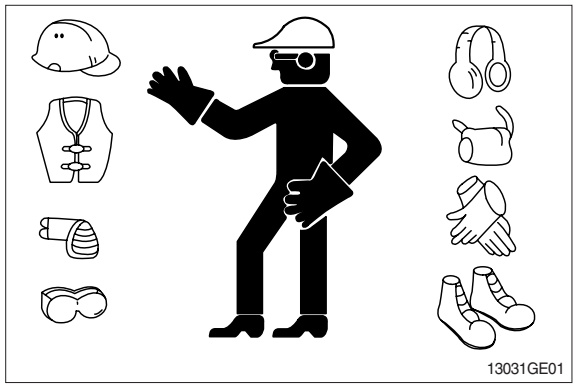
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

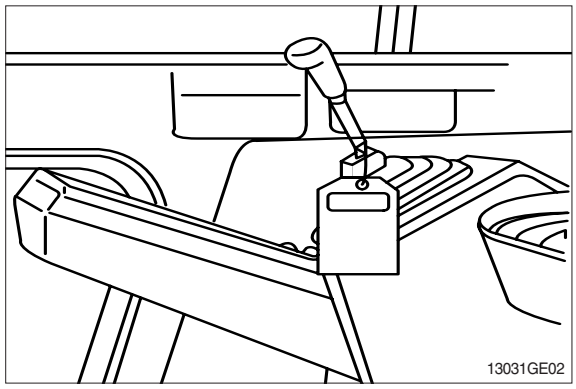
WEAR PROTECTIVE CLOTHING

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



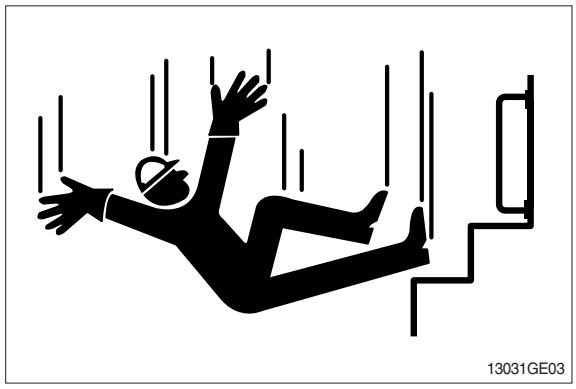
WARN OTHERS OF SERVICE WORK

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.

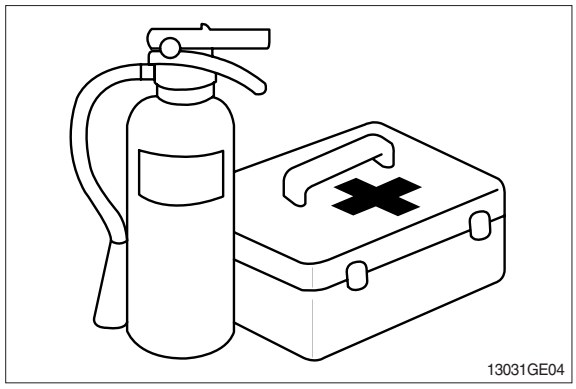


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

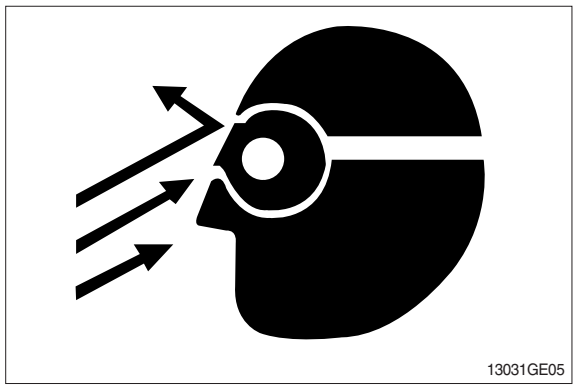
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

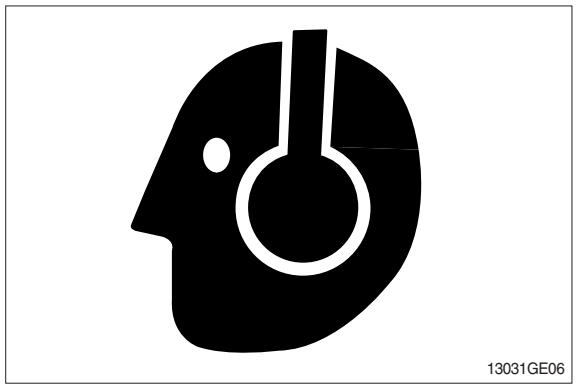
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

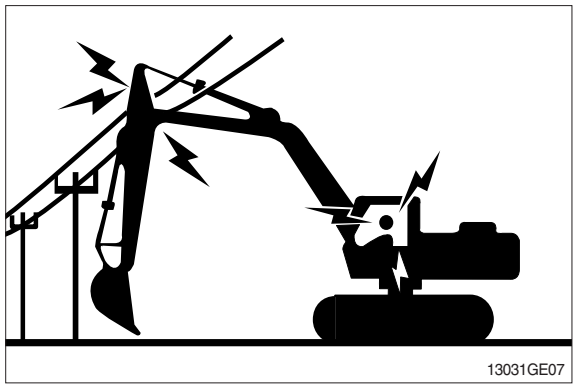
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

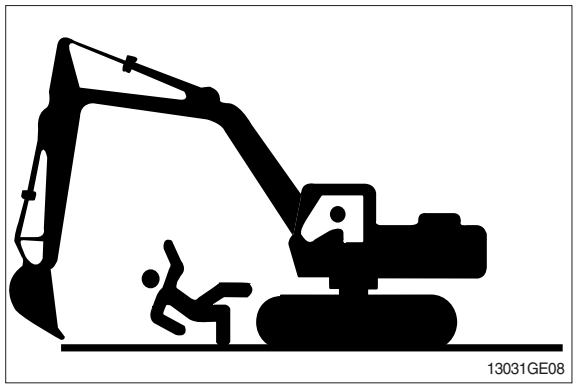
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



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.

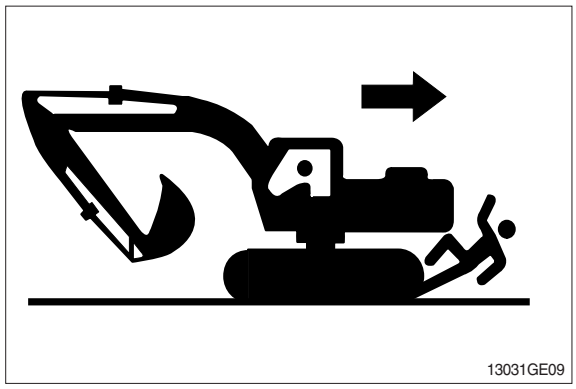

13031GE08

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.

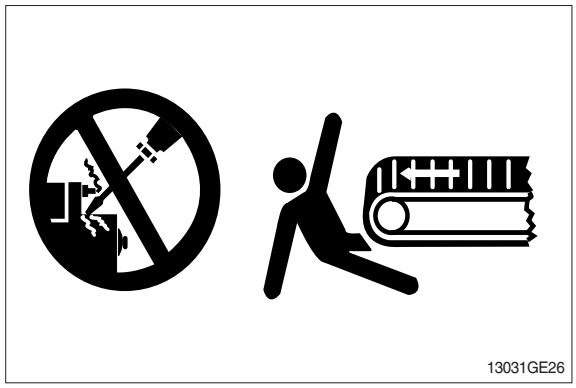
Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.


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

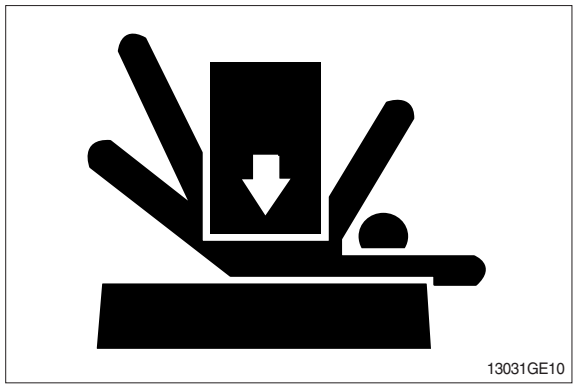
Before working on the machine:

- 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.

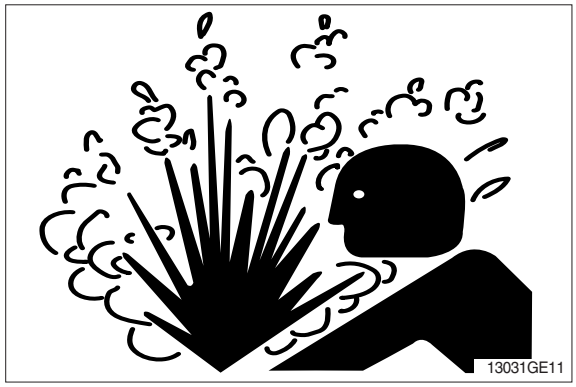
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



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.



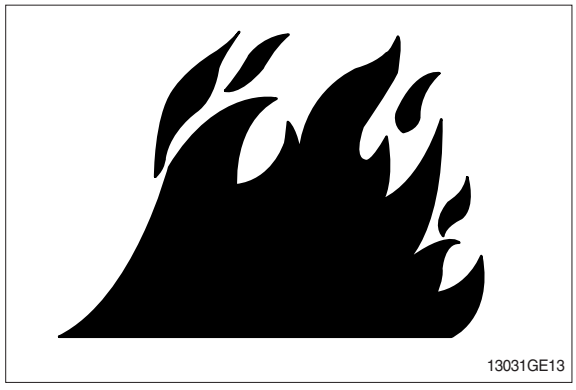
HANDLE FLUIDS SAFELY-AVOID FIRES

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.

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

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

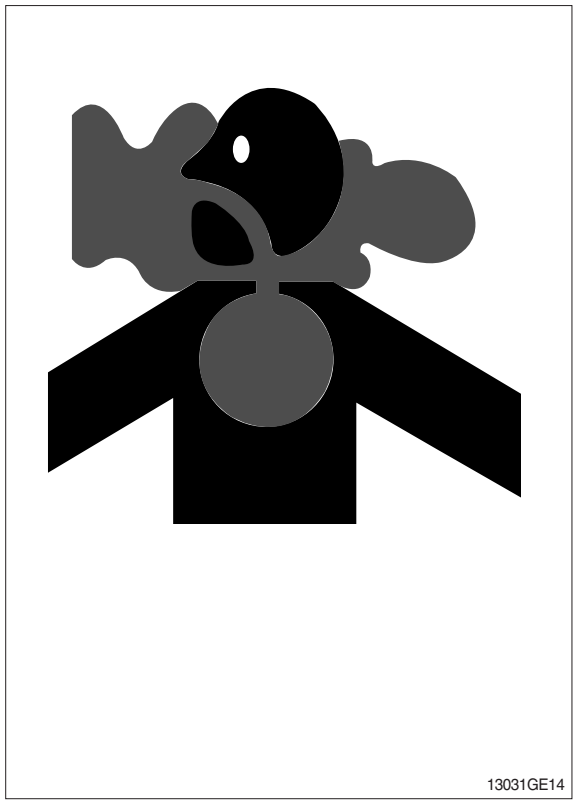
Do not store oily rags; They can ignite and burn spontaneously.



BEWARE OF EXHAUST FUMES

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

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


13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

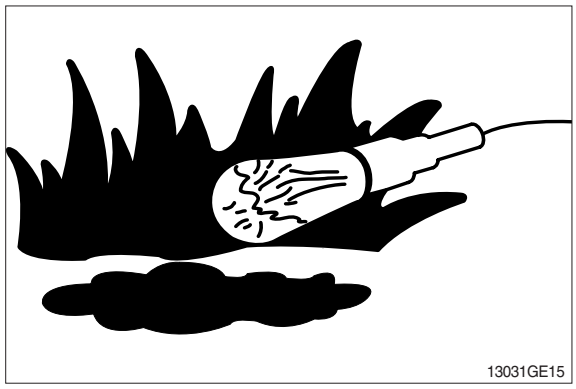
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust.
  Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

ILLUMINATE WORK AREA SAFELY

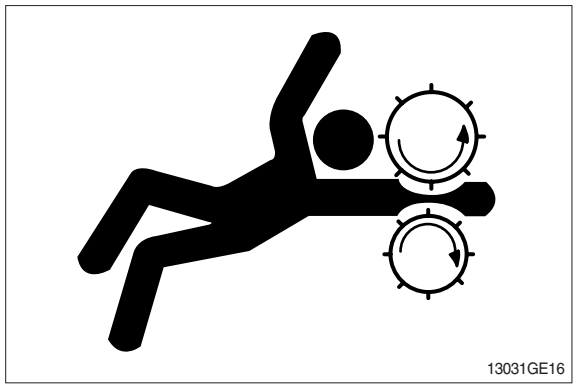
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.


13031GE15

SERVICE MACHINE SAFELY

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

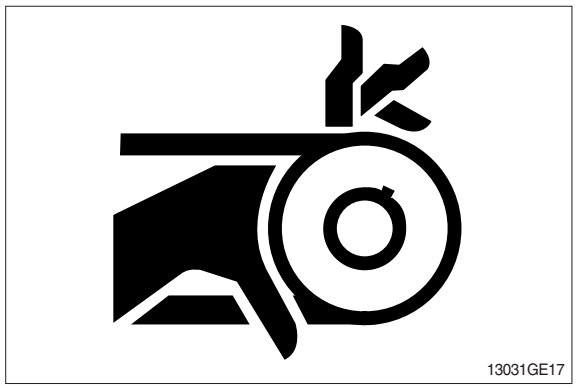
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



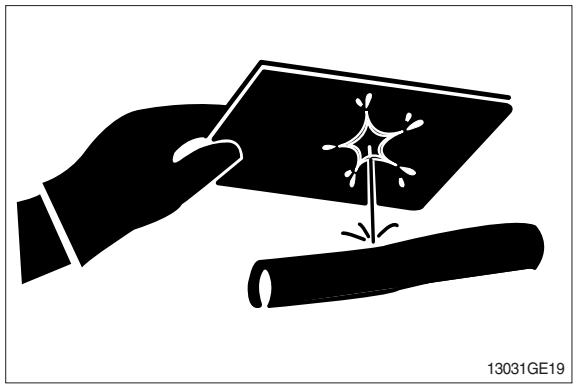
AVOID HIGH PRESSURE FLUIDS

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.

PREVENT BATTERY EXPLOSIONS

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

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

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

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:

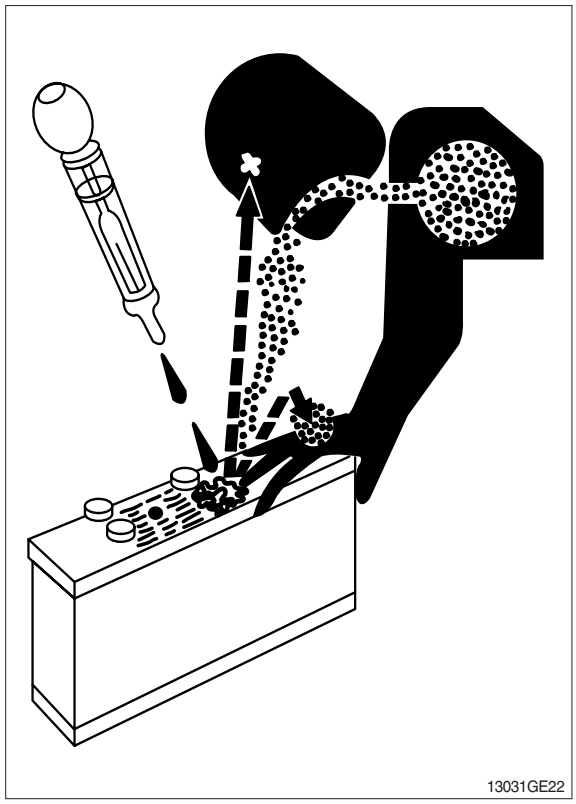
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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.



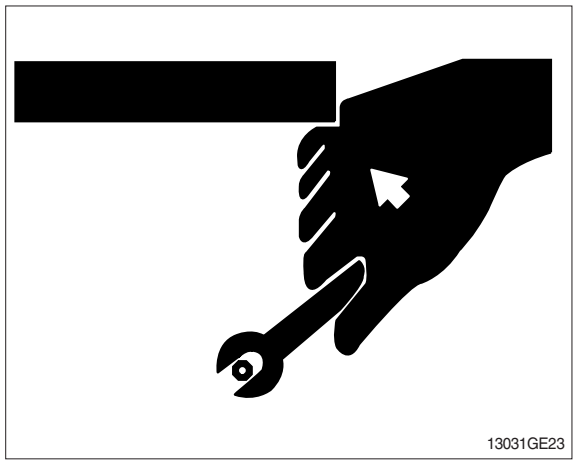
USE TOOLS PROPERLY

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 catalogue.)

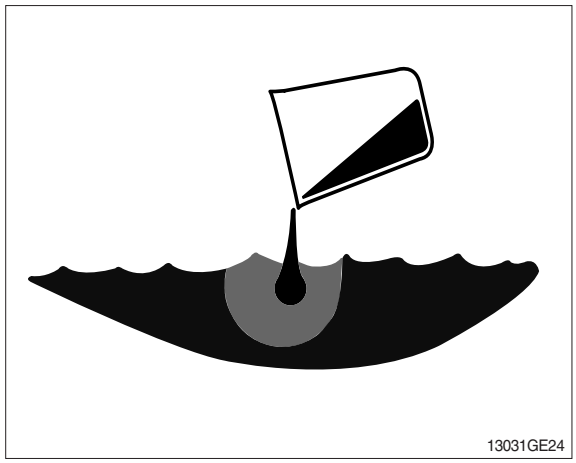


DISPOSE OF FLUIDS PROPERLY

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.

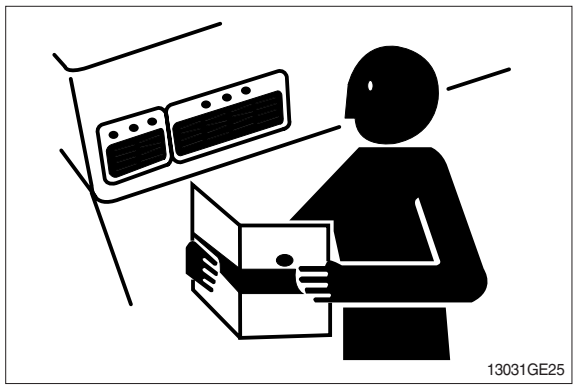
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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.



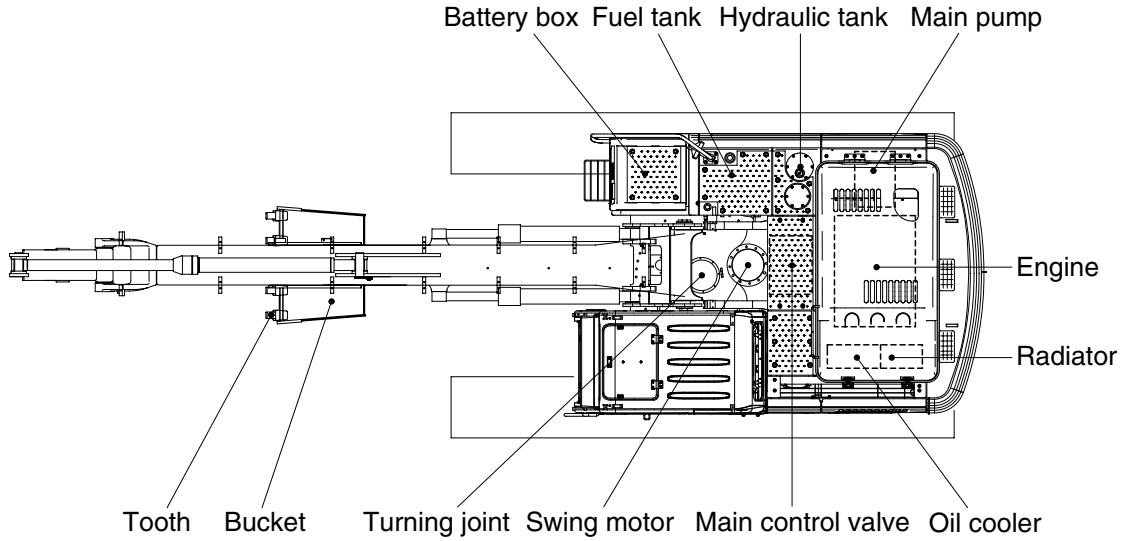
REPLACE SAFETY SIGNS

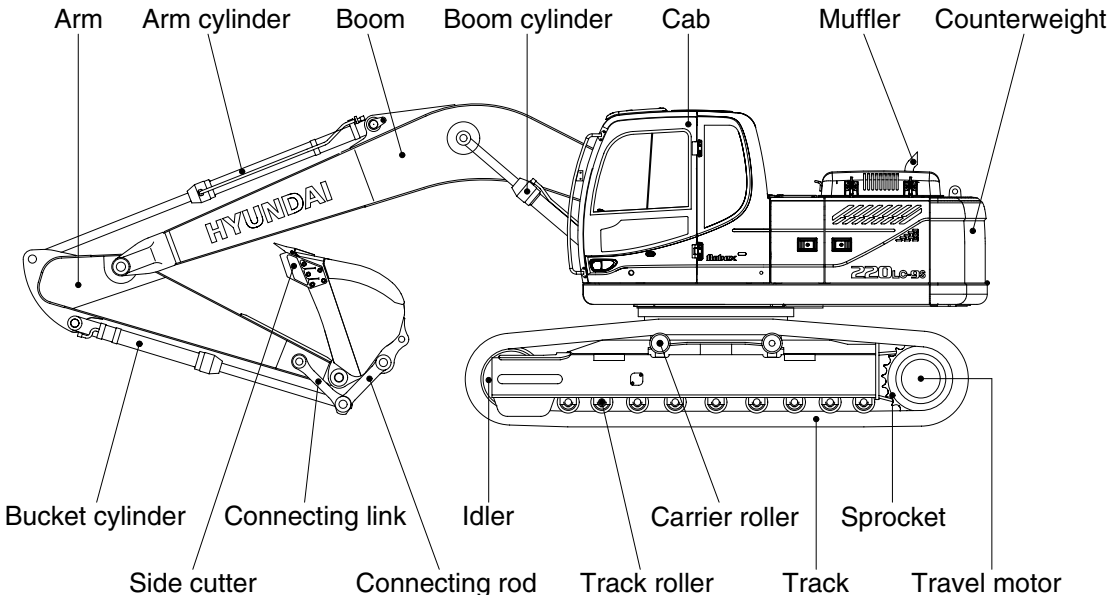
Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



LIVE WITH SAFETY

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


Battery box
Fuel tank
Hydraulic tank
Main pump
Engine
Radiator
Tooth
Bucket
Turning joint
Swing motor
Main control valve
Oil cooler

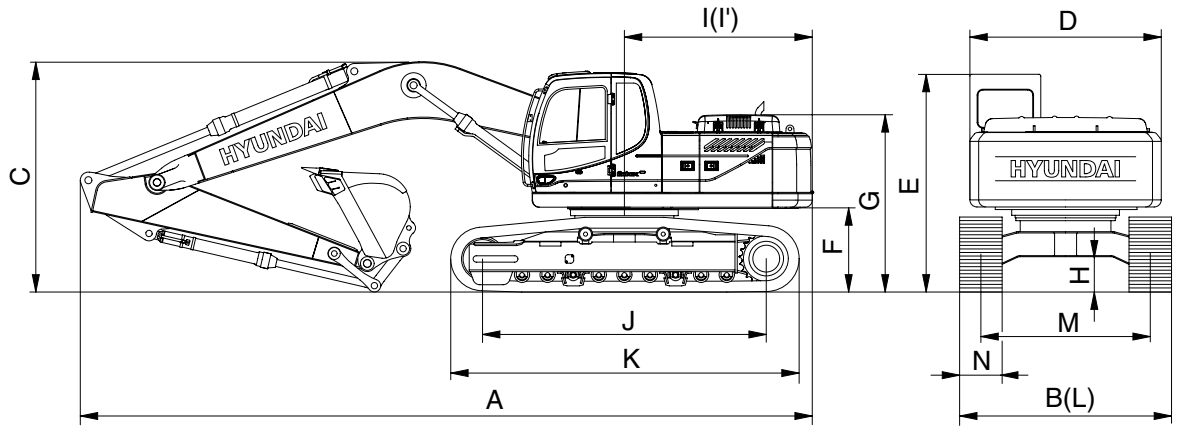

Arm
Arm cylinder
Boom
Boom cylinder
Cab
Muffler
Counterweight
HYUNDAI
Bucket cylinder
Connecting link
Idler
Carrier roller
Sprocket
Side cutter
Connecting rod
Track roller
Track
Travel motor

2209S2SP01

2. SPECIFICATIONS

1) R220LC-9S

· 5.68 m (18' 8") BOOM and 2.92 m (9' 7") ARM

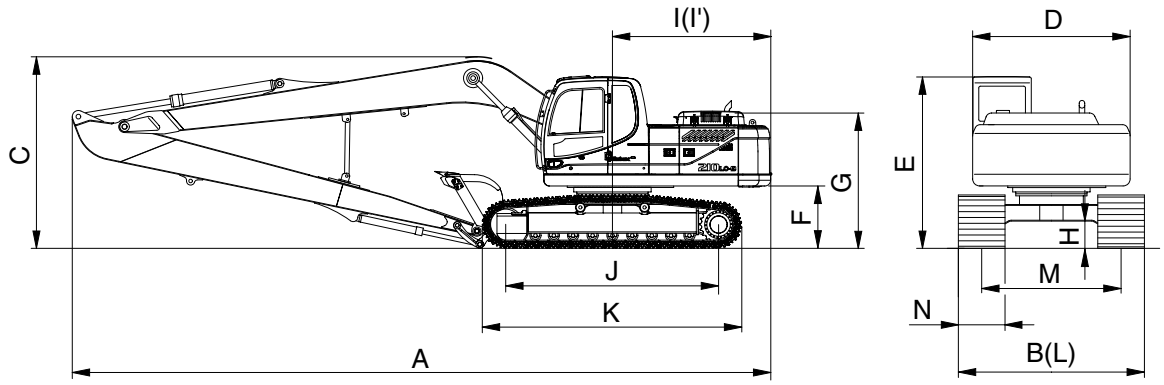


21092SP02

Description		Unit	Specification
Operating weight		kg (lb)	21900 (48280)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.92 (1.20)
Overall length	A	mm (ft-in)	9530 (31' 3")
Overall width, with 600mm shoe	B		2990 (9' 10")
Overall height	C		3030 (9' 11")
Superstructure width	D		2740 (9' 0")
Overall height of cab	E		2920 (9' 7")
Ground clearance of counterweight	F		1060 (3' 6")
Engine cover height	G		2320 (7' 7")
Minimum ground clearance	H		480 (1' 7")
Rear-end distance	I		2770 (9' 1")
Rear-end swing radius	I'		2830 (9' 3")
Distance between tumblers	J		3650 (12' 0")
Undercarriage length	K		4440 (14' 7")
Undercarriage width	L		2990 (9' 10")
Track gauge	M		2390 (7' 10")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.4/5.3 (2.1/3.3)
Swing speed		rpm	11.5
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.46 (6.54)
Max traction force		kg (lb)	21100 (46500)

2) R220LC-9S LONG REACH

· 8.2 m (26' 11") BOOM and 6.3 m (20' 8") ARM

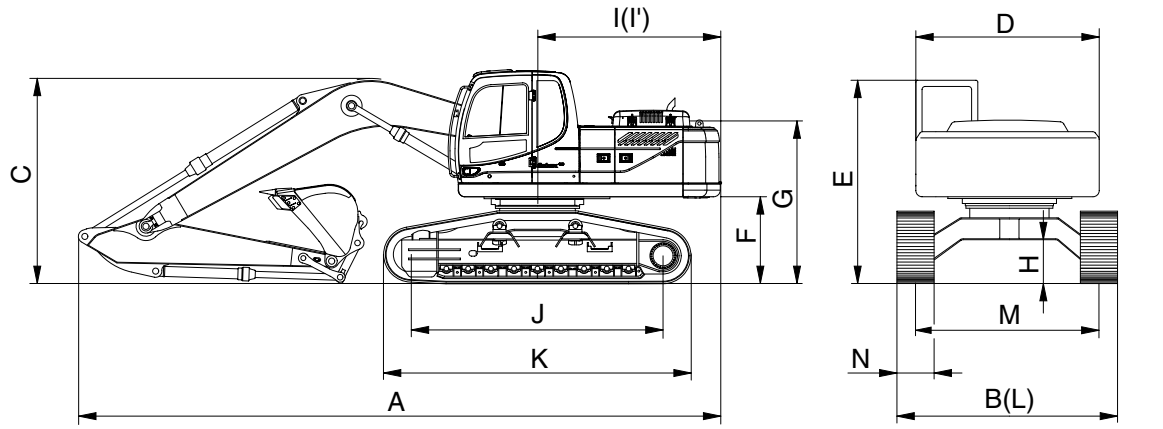


21092SP06

Description		Unit	Specification
Operating weight		kg (lb)	24360 (53700)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.51 (0.67)
Overall length	A	mm (ft-in)	12030 (39' 6")
Overall width, with 800 mm shoe	B		3190 (10' 6")
Overall height	C		3280 (10' 9")
Superstructure width	D		2740 (9' 0")
Overall height of cab	E		2920 (9' 7")
Ground clearance of counterweight	F		1060 (3' 6")
Engine cover height	G		2320 (7' 7")
Minimum ground clearance	H		480 (1' 7")
Rear-end distance	I		2770 (9' 1")
Rear-end swing radius	I'		2830 (9' 3")
Distance between tumblers	J		3650 (12' 0")
Undercarriage length	K		4440 (14' 7")
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)	3.4/5.3 (2.1/3.3)
Swing speed		rpm	11.5
Gradeability		Degree (%)	35 (70)
Ground pressure (800 mm shoe)		kgf/cm^2 (psi)	0.42 (5.97)
Max traction force		kg (lb)	21100 (46500)

3) R220LC-9S HIGH WALKER

· 5.68 m (18' 8") BOOM and 2.92 m (9' 7") ARM



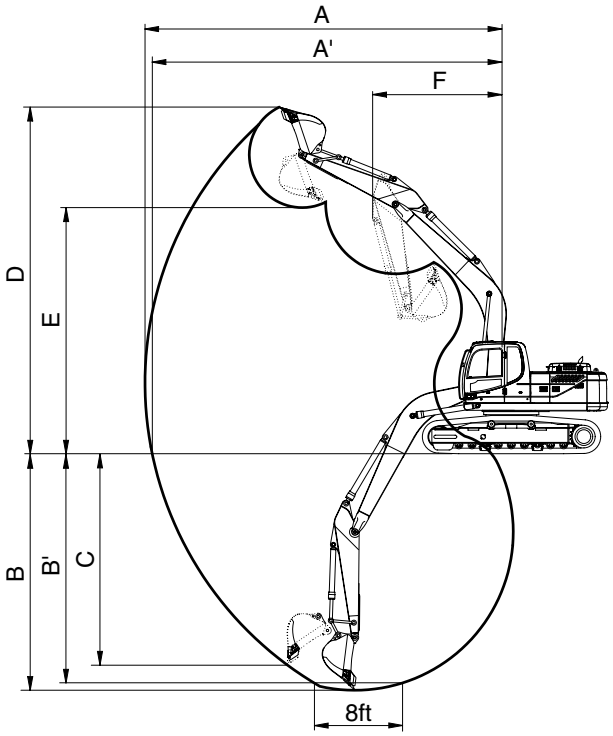
21092SP07

Description		Unit	Specification
Operating weight		kg (lb)	23160 (51060)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.92 (1.20)
Overall length	A	mm (ft-in)	9470 (31' 1")
Overall width, with 600 mm shoe	B		3395 (11' 2")
Overall height	C		3060 (10' 0")
Superstructure width	D		2740 (9' 0")
Overall height of cab	E		3100 (10' 2")
Ground clearance of counterweight	F		1240 (4' 1")
Engine cover height	G		2500 (8' 2")
Minimum ground clearance	H		660 (2' 2")
Rear-end distance	I		2770 (9' 1")
Rear-end swing radius	I'		2830 (9' 3")
Distance between tumblers	J		3650 (12' 0")
Undercarriage length	K		4440 (14' 7")
Undercarriage width	L		3395 (11' 2")
Track gauge	M		2795 (9' 2")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.4/5.3 (2.1/3.3)
Swing speed		rpm	11.5
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.49 (6.97)
Max traction force		kg (lb)	21100 (46500)

3. WORKING RANGE

1) R220LC-9S

· 5.68 m (18' 8") BOOM



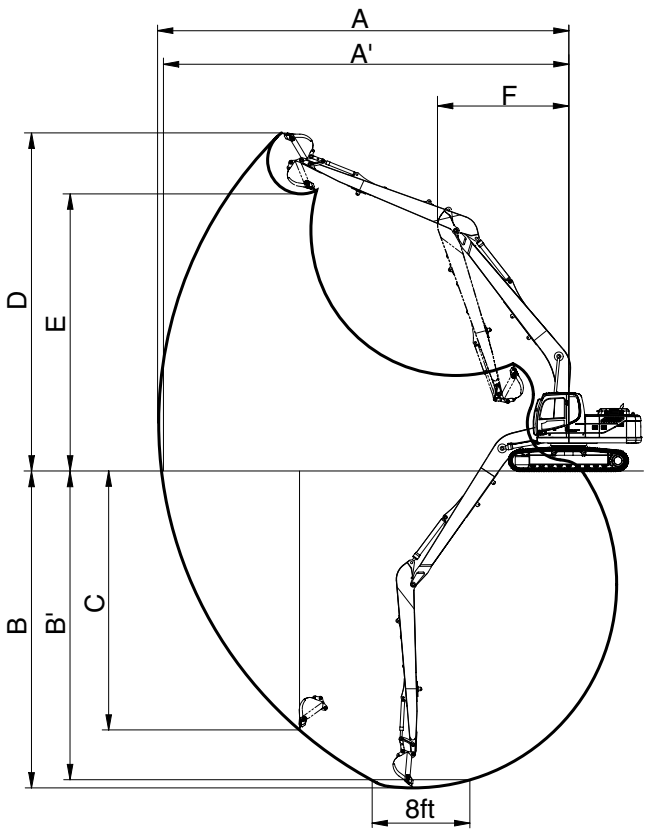
21092SP03

Description		2.0 m (6' 7") Arm	2.40 m (7' 10") Arm	2.92 m (9' 7") Arm	3.90 m (12' 10") Arm
Max digging reach	A	9140 mm (30' 0")	9500 mm (31' 2")	9980 mm (32' 9")	10910 mm (35' 10")
Max digging reach on ground	A'	8960 mm (29' 5")	9330 mm (30' 7")	9820 mm (32' 3")	10770 mm (35' 4")
Max digging depth	B	5820 mm (19' 1")	6220 mm (20' 5")	6730 mm (22' 1")	7720 mm (25' 4")
Max digging depth (8 ft level)	B'	5580 mm (18' 4")	6010 mm (19' 9")	6560 mm (21' 6")	7580 mm (24' 10")
Max vertical wall digging depth	C	5280 mm (17' 4")	5720 mm (18' 9")	6280 mm (20' 7")	7240 mm (23' 9")
Max digging height	D	9140 mm (30' 0")	9340 mm (30' 8")	9600 mm (31' 6")	10110 mm (33' 2")
Max dumping height	E	6330 mm (20' 9")	6520 mm (21' 5")	6780 mm (22' 3")	7290 mm (23' 11")
Min swing radius	F	3750 mm (12' 4")	3740 mm (12' 3")	3740 mm (12' 3")	3650 mm (12' 0")
Bucket digging force	SAE	130.4 [141.6] kN	130.4 [141.6] kN	130.4 [141.6] kN	130.4 [141.6] kN
		13300 [14440] kgf	13300 [14440] kgf	13300 [14440] kgf	13300 [14440] kgf
		29320 [31830] lbf	29320 [31830] lbf	29320 [31830] lbf	29320 [31830] lbf
	ISO	149.1 [161.8] kN	149.1 [161.8] kN	149.1 [161.8] kN	149.1 [161.8] kN
		15200 [16500] kgf	15200 [16500] kgf	15200 [16500] kgf	15200 [16500] kgf
		33510 [36380] lbf	33510 [36380] lbf	33510 [36380] lbf	33510 [36380] lbf
Arm digging force	SAE	144.2 [156.5] kN	119.6 [129.9] kN	102.0 [110.7] kN	84.3 [91.6] kN
		14700 [15960] kgf	12200 [13250] kgf	10400 [11290] kgf	8600 [9340] kgf
		32410 [35190] lbf	26900 [29210] lbf	22930 [24900] lbf	18960 [20590] lbf
	ISO	151.0 [164.0] kN	125.5 [136.3] kN	106.9 [116.1] kN	87.3 [94.8] kN
		15400 [16720] kgf	12800 [13900] kgf	10900 [11830] kgf	8900 [9660] kgf
		33950 [36860] lbf	28220 [30640] lbf	24030 [26090] lbf	19620 [21300] lbf

[ ] : Power boost

2) R220LC-9S LONG REACH

· 8.2 m (26' 11") BOOM

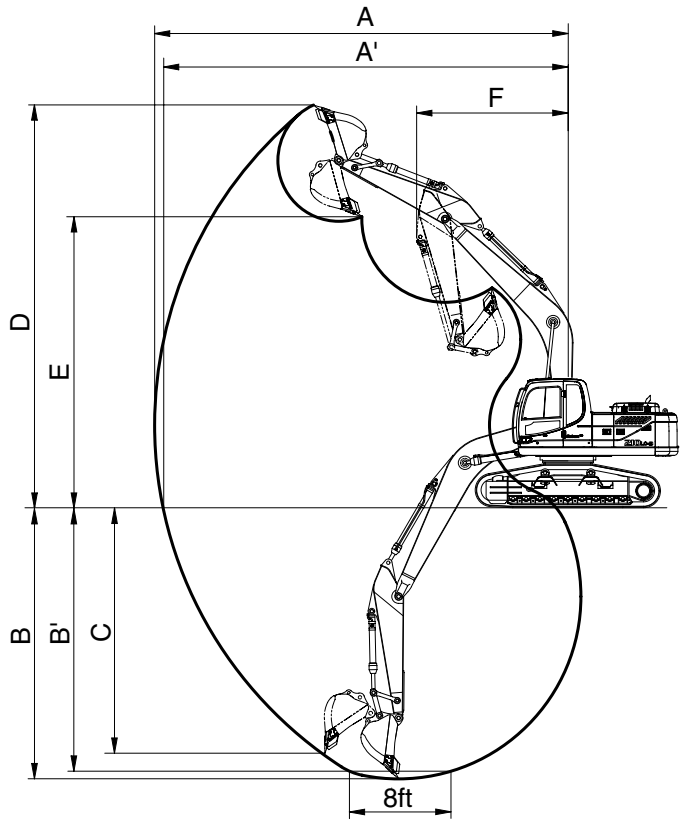


21092SP08

Description		6.3 m (20' 8") Arm
Max digging reach	A	15220 (50' 0")
Max digging reach on ground	A'	15120 (49' 7")
Max digging depth	B	11760 (38' 7")
Max digging depth (8 ft level)	B'	11650 (38' 3")
Max vertical wall digging depth	C	9610 (31' 6")
Max digging height	D	12550 (41' 2")
Max dumping height	E	10280 (33' 8")
Min swing radius	F	4870 (16' 0")
Bucket digging force	SAE	72.6 kN
		7400 kgf
		16310 lbf
	ISO	83.4 kN
		8500 kgf
		18740 lbf
Arm crowd force	SAE	49.0 kN
		5000 kgf
		11020 lbf
	ISO	50.0 kN
		5100 kgf
		11240 lbf

3) R220LC-9S HIGH WALKER

· 5.68 m (18' 8") BOOM



21092SP09

Description		2.0 m (6' 7") Arm	2.40 m (7' 10") Arm	2.92 m (9' 7") Arm	3.90 m (12'10") Arm
Max digging reach	A	9140 mm (30' 0")	9500 mm (31' 2")	9980 mm (32' 9")	10910 mm (35'10")
Max digging reach on ground	A'	8920 mm (29' 3")	9290 mm (30' 6")	9820 mm (32' 3")	10730 mm (35' 2")
Max digging depth	B	5630 mm (18' 6")	6010 mm (19' 9")	6550 mm (21' 6")	7530 mm (24' 8")
Max digging depth (8 ft level)	B'	5390 mm (17' 8")	5820 mm (19' 1")	6380 mm (20'11")	7390 mm (24' 3")
Max vertical wall digging depth	C	5090 mm (16' 8")	5630 mm (18' 6")	6100 mm (20' 0")	7050 mm (23' 1")
Max digging height	D	9330 mm (30' 7")	9530 mm (31' 3")	9780 mm (32' 1")	10300 mm (33' 9")
Max dumping height	E	6520 mm (21' 5")	6710 mm (22' 0")	6960 mm (22'10")	7480 mm (24' 6")
Min swing radius	F	3750 mm (12' 4")	3740 mm (12' 3")	3740 mm (12' 3")	3650 mm (12' 0")
Bucket digging force	SAE	130.4 [141.6] kN	130.4 [141.6] kN	130.4 [141.6] kN	130.4 [141.6] kN
		13300 [14440] kgf	13300 [14440] kgf	13300 [14440] kgf	13300 [14440] kgf
		29320 [31830] lbf	29320 [31830] lbf	29320 [31830] lbf	29320 [31830] lbf
	ISO	149.1 [161.8] kN	149.1 [161.8] kN	149.1 [161.8] kN	149.1 [161.8] kN
		15200 [16500] kgf	15200 [16500] kgf	15200 [16500] kgf	15200 [16500] kgf
		33510 [36380] lbf	33510 [36380] lbf	33510 [36380] lbf	33510 [36380] lbf
Arm crowd force	SAE	144.2 [156.5] kN	119.6 [129.9] kN	102.0 [110.7] kN	84.3 [91.6] kN
		14700 [15960] kgf	12200 [13250] kgf	10400 [11290] kgf	8600 [9340] kgf
		32410 [35190] lbf	26900 [29210] lbf	22930 [24900] lbf	18960 [20590] lbf
	ISO	151.0 [164.0] kN	125.5 [136.3] kN	106.9 [116.1] kN	87.3 [94.8] kN
		15400 [16720] kgf	12800 [13900] kgf	10900 [11830] kgf	8900 [9660] kgf
		33950 [36860] lbf	28220 [30640] lbf	24030 [26090] lbf	19620 [21300] lbf

[ ] : Power boost

4. WEIGHT

1) R220LC-9S

Item	R220LC-9S	
	kg	lb
Upperstructure assembly	9400	20720
Main frame weld assembly	1920	4230
Engine assembly	530	1170
Main pump assembly	140	310
Main control valve assembly	220	485
Swing motor assembly	240	530
Hydraulic oil tank assembly	240	530
Fuel tank assembly	195	430
Counterweight	3800	8380
Cab assembly	440	970
Lower chassis assembly	8700	19180
Track frame weld assembly	2720	6000
Swing bearing	290	640
Travel motor assembly	300	660
Turning joint	55	120
Track recoil spring	140	310
Idler	170	370
Carrier roller	20	45
Track roller	40	90
Track-chain assembly (600 mm standard triple grouser shoe)	1350	2980
Front attachment assembly (5.68 m boom, 2.92 m arm, 0.92 m^3 SAE heaped bucket)	4030	8880
5.68 m boom assembly	1520	3350
2.92 m arm assembly	750	1650
0.92 m^3 SAE heaped bucket	765	1690
Boom cylinder assembly	180	400
Arm cylinder assembly	290	640
Bucket cylinder assembly	175	390
Bucket control link assembly	170	370

2) R220LC-9S LONG REACH

Item	R220LC-9S LONG REACH	
	kg	lb
Upperstructure assembly	9400	20720
Main frame weld assembly	1920	4230
Engine assembly	530	1170
Main pump assembly	140	310
Main control valve assembly	220	485
Swing motor assembly	240	530
Hydraulic oil tank assembly	240	530
Fuel tank assembly	195	430
Counterweight	5300	11680
Cab assembly	440	970
Lower chassis assembly	8700	19180
Track frame weld assembly	2720	6000
Swing bearing	290	640
Travel motor assembly	300	660
Turning joint	55	120
Track recoil spring	140	310
Idler	170	370
Carrier roller	20	45
Track roller	40	90
Track-chain assembly (800 mm standard triple grouser shoe)	1660	3660
Front attachment assembly (8.2 m boom, 6.3 m arm, 0.52 m^3 SAE heaped bucket)	4600	10140
8.2 m boom assembly	2105	4640
6.3 m arm assembly	1100	2430
0.52 m^3 SAE heaped bucket	465	1030
Boom cylinder assembly	180	400
Arm cylinder assembly	270	600
Bucket cylinder assembly	130	290
Bucket control rod assembly	170	370

3) R220LC-9S HIGH WALKER

Item	R220LC-9S HIGH WALKER	
	kg	lb
Upperstructure assembly	9430	20790
Main frame weld assembly	1950	4300
Engine assembly	530	1170
Main pump assembly	140	310
Main control valve assembly	220	485
Swing motor assembly	240	530
Hydraulic oil tank assembly	240	530
Fuel tank assembly	195	430
Counterweight	3800	8380
Cab assembly	440	970
Lower chassis assembly	9015	19870
Track frame weld assembly	3730	8220
Swing bearing	290	640
Travel motor assembly	300	660
Turning joint	55	120
Track recoil spring	140	310
Idler	170	370
Carrier roller	20	45
Track roller	40	90
Track-chain assembly (600 mm standard triple grouser shoe)	1350	2980
Front attachment assembly (5.68 m boom, 2.92 m arm, 0.92 m^3 SAE heaped bucket)	4030	8880
5.68 m boom assembly	1520	3350
2.92 m arm assembly	750	1650
0.92 m^3 SAE heaped bucket	765	1690
Boom cylinder assembly	180	400
Arm cylinder assembly	290	640
Bucket cylinder assembly	175	390
Bucket control rod assembly	170	370

5. LIFTING CAPACITIES

1) ROBEX 220LC-9S

(1) 5.68 m (18' 8") boom, 2.92 m (9' 7") arm equipped with 0.92 m³ (SAE heaped) bucket, 600 mm (24") triple grouser shoe and 3800 kg counterweight.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
7.5 m (25 ft)	kg											*3360	3150	7.78
	lb											*7410	6940	(25.5)
6.0 m (20 ft)	kg									*2340	*2340	*3450	2460	8.74
	lb									*5160	*5160	*7610	5420	(28.7)
4.5 m (15 ft)	kg							*4010	*4010	*3830	3180	*3580	2100	9.32
	lb							*8840	*8840	*8440	7010	*7890	4630	(30.6)
3.0 m (10 ft)	kg			*9780	*9780	*6150	*6150	*4840	4460	*4230	3040	3440	1930	9.59
	lb			*21560	*21560	*13560	*13560	*10670	9830	*9330	6700	7580	4250	(31.5)
1.5 m (5 ft)	kg			*8810	*8810	*7960	6490	*5750	4160	*4710	2880	3390	1880	9.59
	lb			*19420	*19420	*17550	14310	*12680	9170	*10380	6350	7470	4140	(31.5)
Ground Line	kg			*9550	*9550	*9160	6090	*6490	3920	4930	2750	3520	1950	9.31
	lb			*21050	*21050	*20190	13430	*14310	8640	10870	6060	7760	4300	(30.5)
-1.5 m (-5 ft)	kg	*8810	*8810	*12610	11870	*9600	5940	*6870	3800	4860	2690	3920	2190	8.72
	lb	*19420	*19420	*27800	26170	*21160	13100	*15150	8380	10710	5930	8640	4830	(28.6)
-3.0 m (-10 ft)	kg	*12190	*12190	*13980	12040	*9320	5960	*6740	3800			*4460	2710	7.75
	lb	*26870	*26870	*30820	26540	*20550	13140	*14860	8380			*9830	5970	(25.4)
-4.5 m (-15 ft)	kg			*11860	*11860	*8120	6140					*4330	4080	6.16
	lb			*26150	*26150	*17900	13540					*9550	8990	(20.2)

Note 1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The load point is a hook located on the back of the bucket.
4. *indicates load limited by hydraulic capacity.

(2) 5.68 m (18' 8") boom, 2.40 m (7' 10") arm equipped with 0.92 m³ (SAE heaped) bucket, 600 mm (24") triple grouser shoe and 3800 kg counterweight.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20ft)		7.5 m (25ft)		Capacity		Reach
														m (ft)
7.5 m (25 ft)	kg											*3700	3640	7.15
	lb											*8160	8020	(23.5)
6.0 m (20 ft)	kg							*4010	*4010			*3780	2760	8.20
	lb							*8840	*8840			*8330	6080	(26.9)
4.5 m (15 ft)	kg							*4490	*4490	*4230	3130	*3900	2340	8.82
	lb							*9900	*9900	*9330	6900	*8600	5160	(28.9)
3.0 m (10 ft)	kg					*6900	*6900	*5280	4400	*4560	3010	3760	2130	9.11
	lb					*15210	*15210	*11640	9700	*10050	6640	8290	4700	(29.9)
1.5 m (5 ft)	kg					*8560	6380	*6120	4130	*4970	2880	3710	2080	9.10
	lb					*18870	14070	*13490	9110	*10960	6350	8180	4590	(29.9)
Ground Line	kg			*8790	*8790	*9490	6080	*6740	3930	4950	2780	3890	2180	8.81
	lb			*19380	*19380	*20920	13400	*14860	8660	10910	6130	8580	4810	(28.9)
-1.5 m (-5 ft)	kg	*9760	*9760	*13510	12060	*9650	6000	*6960	3850			4390	2480	8.18
	lb	*21520	*21520	*29780	26590	*21270	13230	*15340	8490			9680	5470	(26.8)
-3.0 m (-10 ft)	kg	*14150	*14150	*13240	12280	*9090	6080	*6590	3900			*4700	3190	7.12
	lb	*31200	*31200	*29190	27070	*20040	13400	*14530	8600			*10360	7030	(23.4)
-4.5 m (-15 ft)	kg			*10630	*10630	*7400	6330							
	lb			*23440	*23440	*16310	13960							

2) R220LC-9S LONG REACH

(1) 8.2 m (26' 11") boom, 6.3 m (20' 8") arm equipped with 0.52 m³ (0.68yd³)(SAE heaped) bucket, 800 mm (32") triple grouser shoe and 5300 kg counterweight.

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

Load point height		Load radius														At max. reach		
		4.5 m (15.0 ft)		6.0 m (20.0ft)		7.5 m (25.0 ft)		9.0 m (30.0 ft)		10.5 m (35.0 ft)		12.0 m (40.0 ft)		13.5 m (45.0 ft)		Capacity		Reach
																		m (ft)
10.5 m 35.0 ft	kg lb															*1480 *3260	*1480 *3260	12.11 (39.7)
9.0 m 30.0 ft	kg lb											*930 *2050	*930 *2050			*1510 *3330	*1510 *3330	13.11 (43.0)
7.5 m 25.0 ft	kg lb											*1550 *3420	*1550 *3420			*1550 *3420	1320 2910	13.84 (45.4)
6.0 m 20.0 ft	kg lb									*1600 *3530	*1600 *3530	*1610 *3550	*1610 *3550			*1600 *3530	1160 2560	14.37 (47.1)
4.5 m 15.0 ft	kg lb									*1790 *3950	*1790 *3950	*1730 *3810	1720 3790	*1260 *2780	*1260 *2780	*1660 *3660	1050 2310	14.72 (48.3)
3.0 m 10.0 ft	kg lb					*2520 *5560	*2520 *5560	*2220 *4890	*2220 *4890	*2020 *4450	*2020 *4450	*1880 *4140	1630 3590	*1590 *3510	1220 2690	*1720 *3790	980 2160	14.89 (48.9)
1.5 m 5.0 ft	kg lb	*5620 *12390	*5620 *12390	*3940 *8690	*3940 *8690	*3090 *6810	*3090 *6810	*2590 *5710	*2590 *5710	*2270 *5000	2000 4410	*2050 *4520	1530 3370	*1790 *3950	1170 2580	*1800 *3970	940 2070	14.90 (48.9)
Ground /line	kg lb	*6990 *15410	6720 14820	*4770 *10520	4490 9900	*3620 *7980	3240 7140	*2950 *6500	2430 5360	*2510 *5530	1860 4100	*2220 *4890	1440 3170	*1820 *4010	1110 2450	1880 4140	930 2050	14.75 (48.4)
-1.5 m -5.0 ft	kg lb	*7830 *17260	6210 13690	*5390 *11880	4120 9080	*4060 *8950	2990 6590	*3260 *7190	2260 4980	*2740 *6040	1740 3840	*2380 *5250	1360 3000	*1570 *3460	1070 2360	1930 4250	960 2120	14.42 (47.3)
-3.0 m -10.0 ft	kg lb	*8230 *18140	5990 13210	*5780 *12740	3920 8640	*4370 *9630	2830 6240	*3490 *7690	2140 4720	*2900 *6390	1660 3660	*2490 *5490	1310 2890			2030 4480	1020 2250	13.92 (45.7)
-4.5 m -15.0 ft	kg lb	*8310 *18320	5940 13100	*5950 *13120	3830 8440	*4540 *10010	2740 6040	*3630 *8000	2070 4560	*3000 *6610	1620 3570	2510 5530	1290 2840			*2210 *4870	1140 2510	13.20 (43.3)
-6.0 m -20.0 ft	kg lb	*8100 *17860	6010 13250	*5900 *13010	3840 8470	*4550 *10030	2730 6020	*3640 *8020	2060 4540	*2970 *6550	1620 3570					*2340 *5160	1330 2930	12.25 (40.2)
-7.5 m -25.0 ft	kg lb	*7580 *16710	6180 13620	*5610 *12370	3930 8660	*4350 *9590	2790 6150	*3460 *7630	2120 4670	*2740 *6040	1690 3730					*2460 *5420	1670 3680	10.97 (36.0)
-9.0 m -30.0 ft	kg lb	*6650 *14660	6460 14240	*4980 *10980	4110 9060	*3840 *8470	2940 6480	*2930 *6460	2260 4980									
-10.5 m -35.0 ft	kg lb	*5040 *11110	*5040 *11110	*3730 *8220	*3730 *8220													

Note 1. Lifting capacity are based on SAE J1097 and ISO 10567.

2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.

3. The load point is a hook located on the back of the bucket.

4. *indicates load limited by hydraulic capacity.

3) R220LC-9S HIGH WALKER

(1) 5.68 m (18' 8") boom, 2.92 m (9' 7") arm equipped with 0.92 m³ (SAE heaped) bucket, 600 mm (24") triple grouser shoe and 3800 kg counterweight.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
7.5 m (25 ft)	kg											*3370	*3370	7.93
	lb											*7430	*7430	(26.0)
6.0 m (20 ft)	kg									*2700	*2700	*3460	3130	8.83
	lb									*5950	*5950	*7630	6900	(29.0)
4.5 m (15 ft)	kg							*4110	*4110	*3870	*3870	*3600	2740	9.37
	lb							*9060	*9060	*8530	*8530	*7940	6040	(30.7)
3.0 m (10 ft)	kg			*10440	*10440	*6400	*6400	*4960	*4960	*4290	3930	3680	2560	9.60
	lb			*23020	*23020	*14110	*14110	*10930	*10930	*9460	8660	8110	5640	(31.5)
1.5 m (5 ft)	kg			*8610	*8610	*8150	*8150	*5860	5380	*4760	3770	3650	2530	9.57
	lb			*18980	*18980	*17970	*17970	*12920	11860	*10490	8310	8050	5580	(31.4)
Ground Line	kg			*9870	*9870	*9260	8080	*6560	5150	*5150	3640	3820	2650	9.25
	lb			*21760	*21760	*20410	17810	*14460	11350	*11350	8020	8420	5840	(30.3)
-1.5 m (-5 ft)	kg	*9210	*9210	*13090	*13090	*9600	7940	*6880	5040	5200	3590	4280	2980	8.62
	lb	*20300	*20300	*28860	*28860	*21160	17500	*15170	11110	11460	7910	9440	6570	(28.3)
-3.0 m (-10 ft)	kg	*12660	*12660	*13780	*13780	*9230	7990	*6670	5060			*4470	3710	7.59
	lb	*27910	*27910	*30380	*30380	*20350	17610	*14700	11160			*9850	8180	(24.9)
-4.5 m (-15 ft)	kg			*11470	*11470	*7860	*7860					*4250	*4250	5.89
	lb			*25290	*25290	*17330	*17330					*9370	*9370	(19.3)

Note 1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The load point is a hook located on the back of the bucket.
4. *indicates load limited by hydraulic capacity.

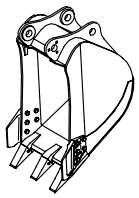
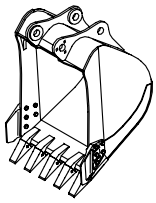
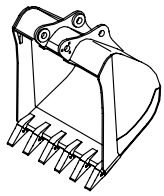
(2) 5.68 m (18' 8") boom, 2.4 m (7' 10") arm equipped with 0.92 m³ (SAE heaped) bucket, 600 mm (24") triple grouser shoe and 3800 kg counterweight.

Load point height		Load radius										At max. reach		
		1.5 m (5 ft)		3.0 m (10 ft)		4.5 m (15 ft)		6.0 m (20 ft)		7.5 m (25 ft)		Capacity		Reach
														m (ft)
7.5 m (25 ft)	kg											*3700	*3700	7.31
	lb											*8160	*8160	(24.0)
6.0 m (20 ft)	kg							*4050	*4050			*3790	3480	8.30
	lb							*8930	*8930			*8360	7670	(27.2)
4.5 m (15 ft)	kg					*5360	*5360	*4580	*4580	*4260	4030	*3920	3020	8.87
	lb					*11820	*11820	*10100	*10100	*9390	8880	*8640	6660	(29.1)
3.0 m (10 ft)	kg					*7130	*7130	*5390	*5390	*4610	3900	4010	2810	9.12
	lb					*15720	*15720	*11880	*11880	*10160	8600	8840	6190	(29.9)
1.5 m (5 ft)	kg					*8720	8370	*6220	5360	*5020	3770	3990	2780	9.08
	lb					*19220	18450	*13710	11820	*11070	8310	8800	6130	(29.8)
Ground Line	kg			*9350	*9350	*9550	8080	*6790	5170	5290	3670	4210	2940	8.75
	lb			*20610	*20610	*21050	17810	*14970	11400	11660	8090	9280	6480	(28.7)
-1.5 m (-5 ft)	kg	*10290	*10290	*14180	*14180	*9620	8020	*6950	5100			*4650	3360	8.07
	lb	*22690	*22690	*31260	*31260	*21210	17680	*15320	11240			*10250	7410	(26.5)
-3.0 m (-10 ft)	kg	*14760	*14760	*12990	*12990	*8950	8120	*6470	5170			*4690	4350	6.94
	lb	*32540	*32540	*28640	*28640	*19730	17900	*14260	11400			*10340	9590	(22.8)
-4.5 m (-15 ft)	kg			*10150	*10150	*7020	*7020							
	lb			*22380	*22380	*15480	*15480							

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

1) GENERAL BUCKET

		
0.51 m³ SAE heaped bucket	※0.92, 0.80, 0.87, 1.10, 1.20 m³ SAE heaped bucket	1.34 m³ SAE heaped bucket

Capacity		Width		Weight	Recommendation			
					5.68 m (18' 8") boom			
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.0 m arm (6' 7")	2.4 m arm (7' 10")	2.92 m arm (9' 7")	3.90 m arm (12' 10")
0.51 m³ (0.67 yd³)	0.45 m³ (0.59 yd³)	700 mm (27.6")	820 mm (32.3")	570 kg (1260 lb)				
0.80 m³ (1.05 yd³)	0.70 m³ (0.92 yd³)	1000 mm (39.4")	1120 mm (44.1")	770 kg (1700 lb)				
0.87 m³ (1.14 yd³)	0.75 m³ (0.98 yd³)	1090 mm (42.9")	1210 mm (47.6")	740 kg (1630 lb)				
※0.92 m³ (1.20 yd³)	0.80 m³ (1.05 yd³)	1150 mm (45.3")	1270 mm (50.0")	770 kg (1700 lb)				
1.10 m³ (1.44 yd³)	0.96 m³ (1.26 yd³)	1320 mm (52.0")	1440 mm (56.7")	830 kg (1830 lb)				
1.20 m³ (1.57 yd³)	1.00 m³ (1.31 yd³)	1400 mm (55.1")	1520 mm (59.8")	850 kg (1870 lb)				
1.34 m³ (1.75 yd³)	1.15 m³ (1.50 yd³)	1550 mm (61.0")	1670 mm (65.7")	920 kg (2030 lb)				

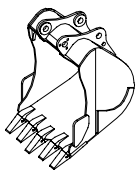
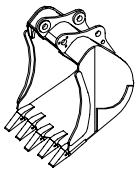
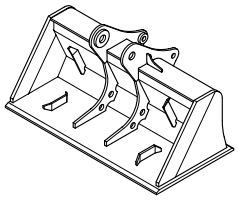
※ : Standard bucket

Applicable for materials with density of 2000 kgf/m³ (3370 lbf/yd³) or less

Applicable for materials with density of 1600 kgf/m³ (2700 lbf/yd³) or less

Applicable for materials with density of 1100 kgf/m³ (1850 lbf/yd³) or less

2) HEAVY DUTY, ROCK-HEAVY DUTY AND SLOPE FINISHING BUCKET

Heavy duty bucket	Rock-heavy duty bucket	Slope finishing bucket
		
◈ 0.74, 0.90, 1.05 m³ SAE heaped bucket	⊙ 0.87, 1.20 m³ SAE heaped bucket	▣ 0.75 m³ SAE heaped bucket

Capacity		Width		Weight	Recommendation			
					5.68 m (18' 8") boom			
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.0 m arm (6' 7")	2.4 m arm (7' 10")	2.92 m arm (9' 7")	3.90 m arm (12' 10")
◈0.74 m³ (0.97 yd³)	0.65 m³ (0.85 yd³)	985 mm (38.8")	-	770 kg (1700 lb)				
◈0.90 m³ (1.18 yd³)	0.80 m³ (1.05 yd³)	1070 mm (42.0")	-	810 kg (1790 lb)				
◈1.05 m³ (1.37 yd³)	0.92 m³ (1.20 yd³)	1290 mm (50.8")	-	890 kg (1960 lb)				
⊙0.87 m³ (1.14 yd³)	0.75 m³ (0.98 yd³)	1140 mm (44.9")	-	900 kg (1980 lb)				
⊙1.20 m³ (1.57 yd³)	1.00 m³ (1.31 yd³)	1410 mm (55.5")	-	1030 kg (2270 lb)				
▣0.75 m³ (0.98 yd³)	0.65 m³ (0.85 yd³)	1790 mm (70.5")	-	880 kg (1940 lb)				

◈ : Heavy duty bucket ⊙: Rock-heavy duty bucket ▣ : Slope finishing bucket

Applicable for materials with density of 2000 kgf/m³ (3370 lbf/yd³) or less

Applicable for materials with density of 1600 kgf/m³ (2700 lbf/yd³) or less

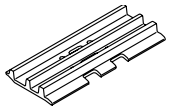
Applicable for materials with density of 1100 kgf/m³ (1850 lbf/yd³) or less

7. UNDERCARRIAGE

1) TRACKS

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

2) TYPES OF SHOES

Model	Shapes		Triple grouser 			
R220LC-9S	Shoe width	mm (in)	600 (24)	700 (28)	800 (32)	900 (36)
	Operating weight	kg (lb)	21900 (48280)	22250 (49050)	22515 (49640)	22780 (50220)
	Ground pressure	kgf/cm^2 (psi)	0.46 (6.54)	0.40 (5.69)	0.36 (5.12)	0.32 (4.55)
	Overall width	mm (ft-in)	2990 (9' 10")	3090 (10' 2")	3190 (10' 6")	3290 (10' 10")
R220LC-9S LONG REACH	Shoe width	mm (in)	-	-	800 (32)	-
	Operating weight	kg (lb)	-	-	24360 (53700)	-
	Ground pressure	kgf/cm^2 (psi)	-	-	0.42 (5.97)	-
	Overall width	mm (ft-in)	-	-	3190 (10' 6")	-
R220LC-9S HIGH WALKER	Shoe width	mm (in)	600 (24)	700 (28)	800 (32)	710 (28)*
	Operating weight	kg (lb)	23160 (51060)	23710 (52270)	23975 (52860)	24135 (53210)
	Ground pressure	kgf/cm^2 (psi)	0.49 (6.97)	0.43 (6.12)	0.38 (5.40)	0.43 (6.12)
	Overall width	mm (ft-in)	3395 (11' 2")	3495 (11' 6")	3595 (11' 10")	3505 (11' 6")

* : Double grouser

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2 EA
Track rollers	9 EA
Track shoes	49 EA

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

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

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

※ **Table 1**

Track shoe	Specification	Category
600 mm triple grouser	Standard	A
700 mm triple grouser	Option	B
800 mm triple grouser	Option	C
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
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles
C	Extremely soft ground (swampy ground)	· Use the shoes only in the conditions that the machine sinks and it is impossible to use the shoes of category A or B · These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins 6BTAA
Type	4-cycle turbocharged diesel engine, low emission
Cooling method	Water cooling
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	102× 120 mm (4.02" × 4.72")
Piston displacement	5880 cc (359 cu in)
Compression ratio	17.3 : 1
Rated gross horse power (SAE J1995)	150 Hp at 1950 rpm (112 kW at 1950 rpm)
Maximum torque at 1500 rpm	62.6 kgf · m (453 lbf · ft)
Engine oil quantity	24 ℓ (6.3 U.S. gal)
Dry weight	496 kg (1094 lb)
High idling speed	2150± 50 rpm
Low idling speed	1050± 100 rpm
Rated fuel consumption	164.8 g/Hp · hr at 1950 rpm
Starting motor	Nippon denso (24 V-4.5 kW)
Alternator	Delco Remy (24 V-50 A)
Battery	2 × 12 V × 100 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 117cc/rev
Maximum pressure	350kgf/cm^2 (4980psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2 × 222 ℓ /min (58.6U.S. gpm/ 48.8U.K. gpm)
Rated speed	1900 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm^2 (570 psi)
Rated oil flow	28.5 ℓ /min (7.5 U.S. gpm/6.3 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)]
Port relief valve pressure	Boom	400 kgf/cm^2 (5690 psi)
	Arm	400 kgf/cm^2 (5690 psi)
	Bucket	400 kgf/cm^2 (5690 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Two fixed displacement axial piston motor
Capacity	151 cc/rev
Relief pressure	265 kgf/cm^2 (3770 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	59 kgf · m (427 lbf · ft)
Brake release pressure	33~50 kgf/cm^2 (470~711 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	350 kgf/cm^2 (4980 psi)
Reduction gear type	2-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	11 kgf/cm^2 (156 psi)
Braking torque	49.3 kgf · m (357 lbf · ft)

7) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5 kgf/cm^2 (92 psi)
	Maximum	25 kgf/cm^2 (356 psi)
Single operation stroke	Lever	61 mm (2.4 in)
	Pedal	123 mm (4.84 in)

8) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 120 × ø 85 × 1290 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 140 × ø 100 × 1510 mm # ø 140 × ø 95 × 1460 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 120 × ø 85 × 1055 mm # ø 100 × ø 70 × 870 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.

: LONG REACH

9) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
R220LC-9S	Standard	600 mm (24")	0.46 kgf/cm^2 (6.54 psi)	49	2990 mm (9' 10")
	Option	700 mm (28")	0.40 kgf/cm^2 (5.69 psi)	49	3090 mm (10' 2")
		800 mm (32")	0.36 kgf/cm^2 (5.12 psi)	49	3190 mm (10' 6")
		900 mm (36")	0.32 kgf/cm^2 (4.55 psi)	49	3290 mm (10' 10")
R220LC-9S LONG REACH	Standard	800 mm (32")	0.39 kgf/cm^2 (5.55 psi)	49	3190 mm (10' 6")
R220LC-9S HIGH WALKER	Standard	600 mm (24")	0.50 kgf/cm^2 (7.11 psi)	49	3395 mm (11' 2")
	Option	700 mm (28")	0.43 kgf/cm^2 (6.12 psi)	49	3495 mm (11' 6")
		800 mm (32")	0.38 kgf/cm^2 (5.40 psi)	49	3595 mm (11' 10")
		※ 710 mm (28")	0.43 kgf/cm^2 (6.12 psi)	49	3505 mm (11' 6")

※ : Double grouser

10) BUCKET

Item	Capacity		Tooth quantity	Width	
	SAE heaped	CECE heaped		Without side cutter	With side cutter
R220LC-9S	0.51 m³ (0.67 yd³)	0.45 m³ (0.59 yd³)	3	700 mm (27.6")	820 mm (32.3")
	0.80 m³ (1.05 yd³)	0.70 m³ (0.92 yd³)	5	1000 mm (39.4")	1120 mm (44.1")
	0.87 m³ (1.14 yd³)	0.75 m³ (0.98 yd³)	5	1090 mm (42.9")	1210 mm (47.6")
	0.92 m³ (1.20 yd³)	0.80 m³ (1.05 yd³)	5	1150 mm (45.3")	1270 mm (50.0")
	1.10 m³ (1.44 yd³)	0.96 m³ (1.26 yd³)	5	1320 mm (52.0")	1440 mm (56.7")
	1.20 m³ (1.57 yd³)	1.00 m³ (1.31 yd³)	5	1400 mm (55.1")	1520 mm (59.8")
	1.34 m³ (1.75 yd³)	1.15 m³ (1.50 yd³)	6	1550 mm (61.0")	1670 mm (65.7")
	◈0.74 m³ (0.97 yd³)	0.65 m³ (0.85 yd³)	5	985 mm (38.8")	-
	◈0.90 m³ (1.18 yd³)	0.80 m³ (1.05 yd³)	5	1070 mm (42.0")	-
	◈1.05 m³ (1.37 yd³)	0.92 m³ (1.20 yd³)	5	1290 mm (50.8")	-
	⊙0.87 m³ (1.14 yd³)	0.75 m³ (0.98 yd³)	5	1140 mm (44.9")	-
	⊙1.20 m³ (1.57 yd³)	1.00 m³ (1.31 yd³)	5	1410 mm (55.5")	-
	▣0.75 m³ (0.98 yd³)	0.65 m³ (0.85 yd³)	-	1790 mm (70.5")	-

◈ : Heavy duty bucket
⊙ : Rock-heavy duty bucket
▣ : Slope finishing bucket

9. RECOMMENDED OILS

Use only oils listed below or equivalent.
Do not mix different brand oil.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C (°F) -20 (-4) / -10 (14) / 0 (32) / 10 (50) / 20 (68) / 30 (86) / 40 (104)
Engine oil pan	Engine oil	24 (6.3)	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	5.0 (1.3)	SAE 85W-140
Final drive		5.8×2 (1.5×2)	
Hydraulic tank	Hydraulic oil	Tank; 160 (42) System; 275 (73)	ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	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 water 50 : 50	35 (9.2)	Ethylene glycol base permanent type

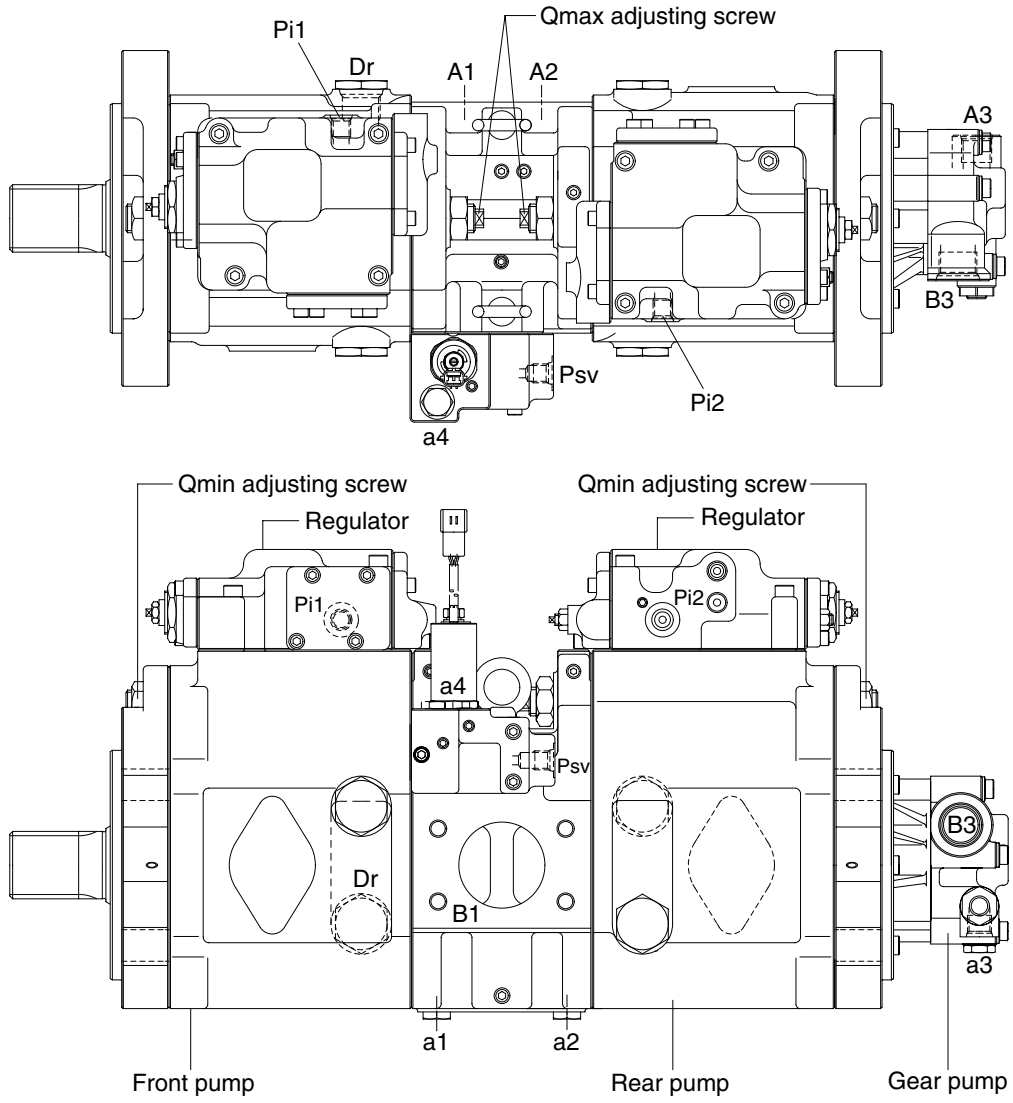
SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Material

SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

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



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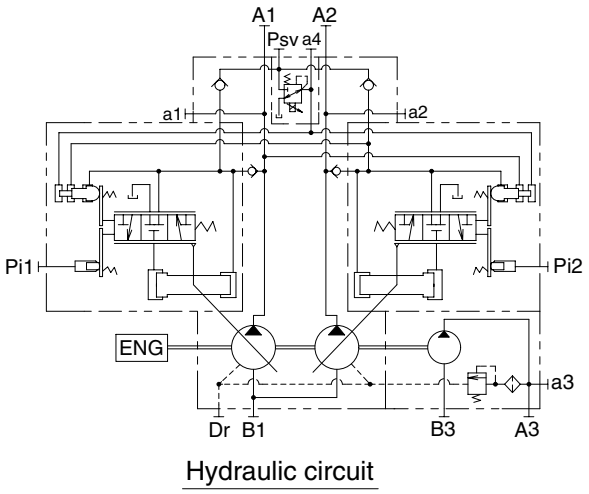
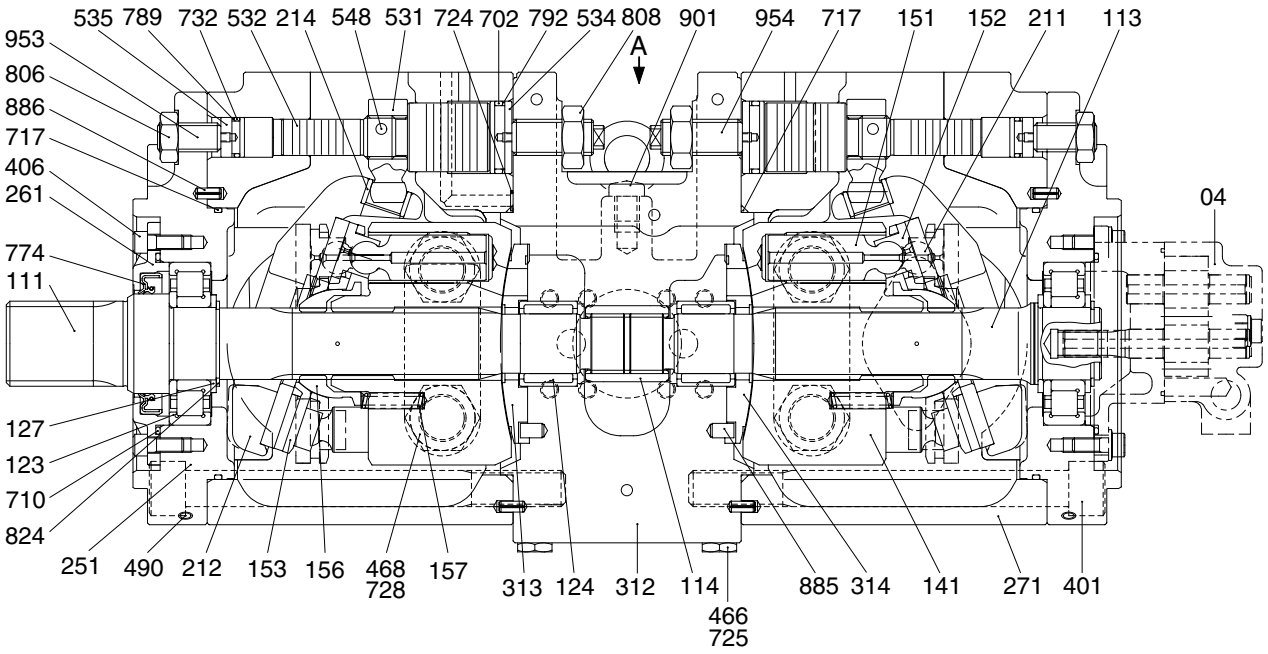


Hydraulic circuit

Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 3/4"
B1	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	PF 3/4 - 20
Pi1,i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1,2,4	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4-14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

1) MAIN PUMP (1/2)

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



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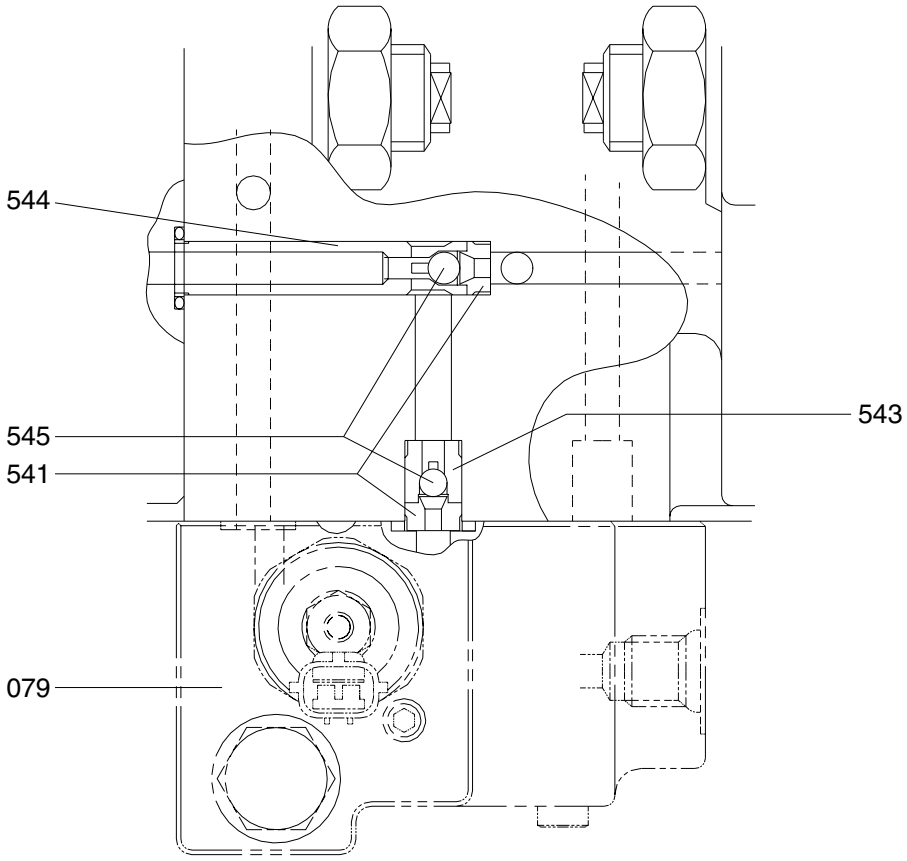
04	Gear pump	261	Seal cover (F)	717	O-ring
111	Drive shaft (F)	271	Pump casing	724	O-ring
113	Drive shaft (R)	312	Valve block	725	O-ring
114	Spline coupling	313	Valve plate (R)	728	O-ring
123	Roller bearing	314	Valve plate (L)	732	O-ring
124	Needle bearing	401	Hexagon socket bolt	774	Oil seal
127	Bearing spacer	406	Hexagon socket bolt	789	Back up ring
141	Cylinder block	466	VP Plug	792	Back up ring
151	Piston	468	VP Plug	806	Hexagon head nut
152	Shoe	490	Plug	808	Hexagon head nut
153	Set plate	531	Tilting pin	824	Snap ring
156	Bushing	532	Servo piston	885	Pin
157	Cylinder spring	534	Stopper (L)	886	Spring pin
211	Shoe plate	535	Stopper (S)	901	Eye bolt
212	Swash plate	548	Pin	953	Set screw
214	Bushing	702	O-ring	954	Set screw
251	Support	710	O-ring		

MAIN PUMP (2/2)

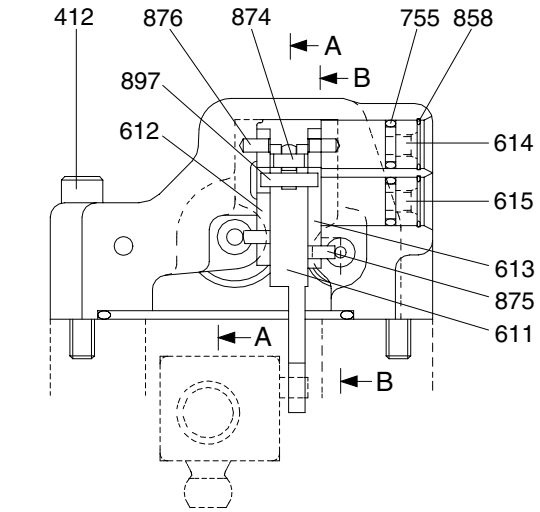


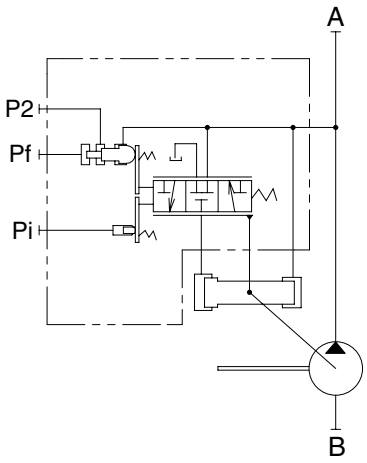
VIEW A

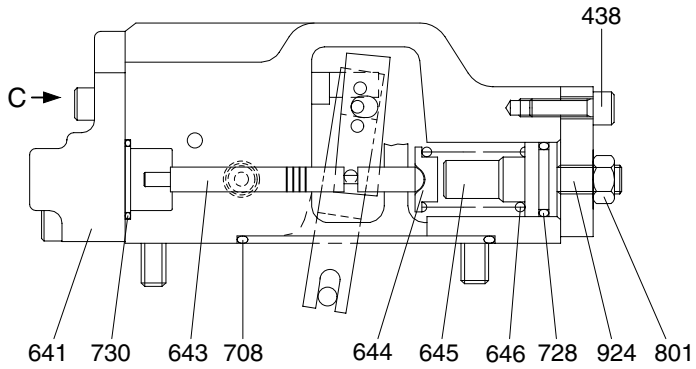
21092MP08

079	Proportional reducing valve	543	Stopper 1	545	Steel ball
541	Seat	544	Stopper 2		

2) REGULATOR (1/2)







SECTION B-B

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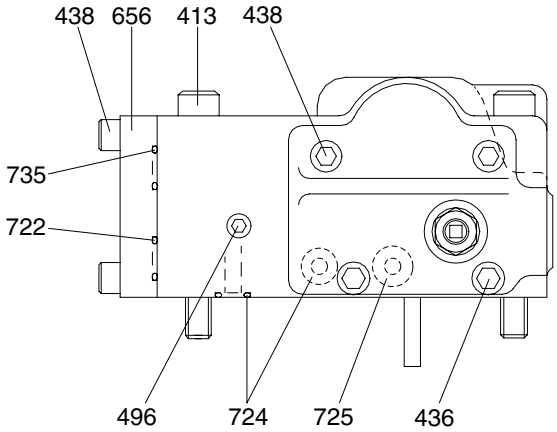
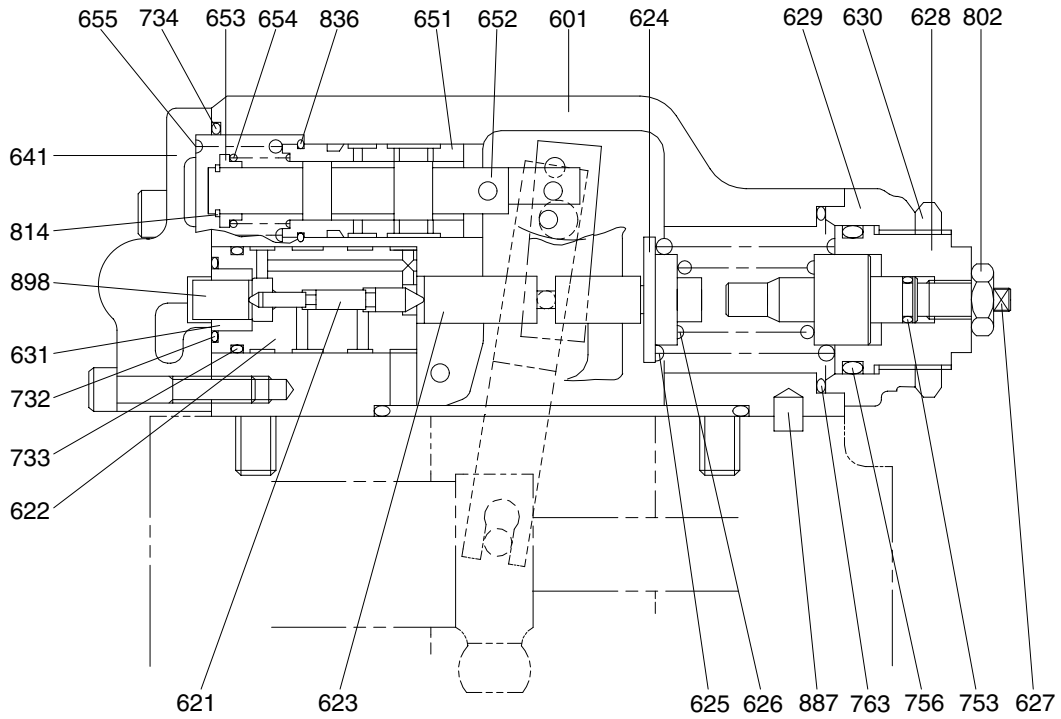


VIEW C

Port	Port name	Port size
A	Delivery port	3/4"
B	Suction port	2 1/2"
Pi	Pilot port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

REGULATOR (2/2)

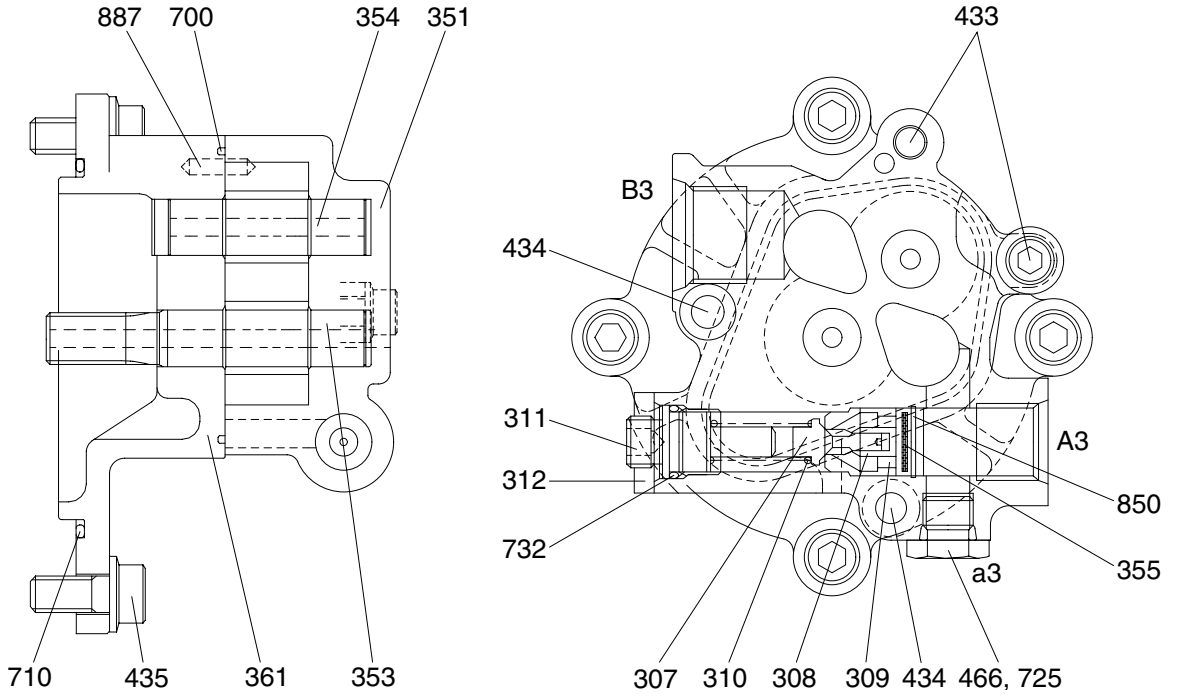


SECTION A-A

21092MP04

412 Hexagon socket screw
413 Hexagon socket screw
436 Hexagon socket screw
438 Hexagon socket screw
496 Plug
601 Casing
611 Feed back lever
612 Lever (1)
613 Lever (2)
614 Fulcrum plug
615 Adjust plug
621 Compensator piston
622 Piston case
623 Compensator rod
624 Spring seat (C)
625 Outer spring
626 Inner spring
627 Adjust stem (C)
628 Adjust screw (C)
629 Cover (C)
630 Lock nut
631 Sleeve, pf
641 Pilot cover
643 Pilot piston
644 Spring seat (Q)
645 Adjust stem (Q)
646 Pilot spring
651 Sleeve
652 Spool
653 Spring seat
654 Return spring
655 Set spring
656 Block cover
708 O-ring
722 O-ring
724 O-ring
725 O-ring
728 O-ring
730 O-ring
732 O-ring
733 O-ring
734 O-ring
735 O-ring
753 O-ring
755 O-ring
756 O-ring
763 O-ring
801 Nut
802 Nut
814 Snap ring
836 Snap ring
858 Snap ring
874 Pin
875 Pin
876 Pin
887 Pin
897 Pin
898 Pin
924 Set screw

3) GEAR PUMP



21092MP05

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

2. FUNCTION

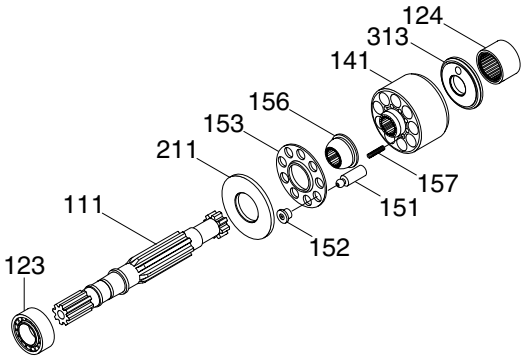
1) MAIN PUMP

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

(1) Rotary group

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

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



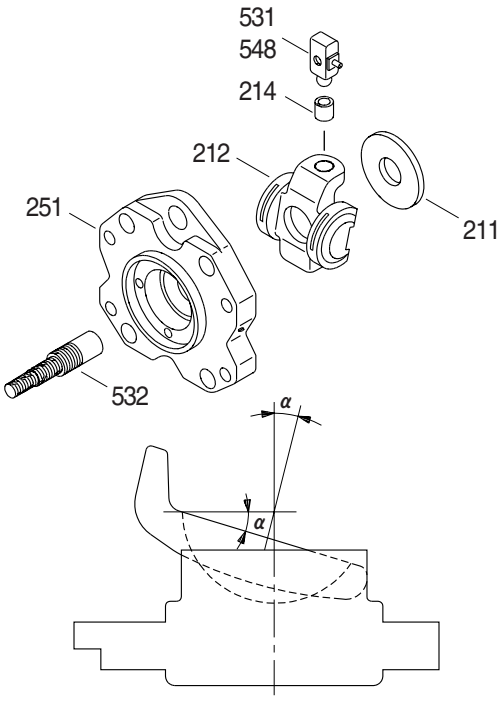
2209S2MP06

(2) Swash plate group

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

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

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



2-7

(3) Valve block group

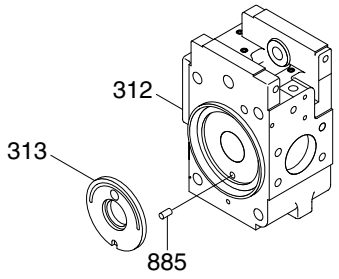
The valve block group consists of valve block (312), valve plate (313) and valve plate pin(885).

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

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

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

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



21092MP07

2) REGULATOR

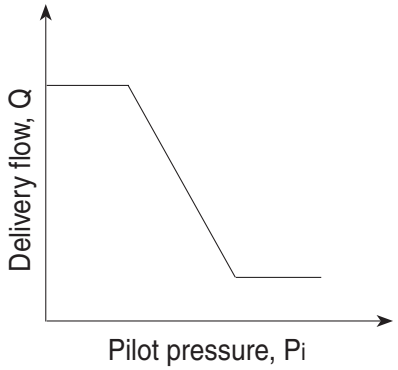
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

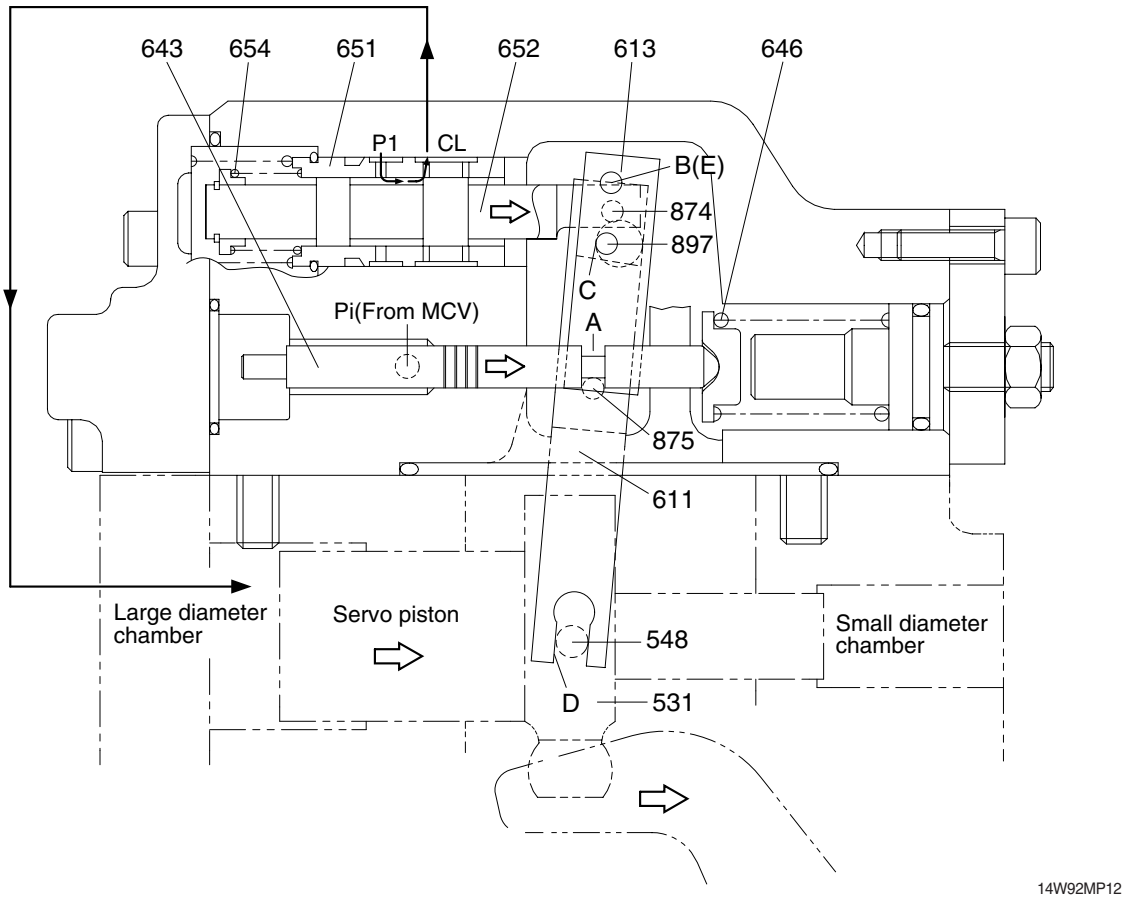
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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

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



① Flow reducing function



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

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

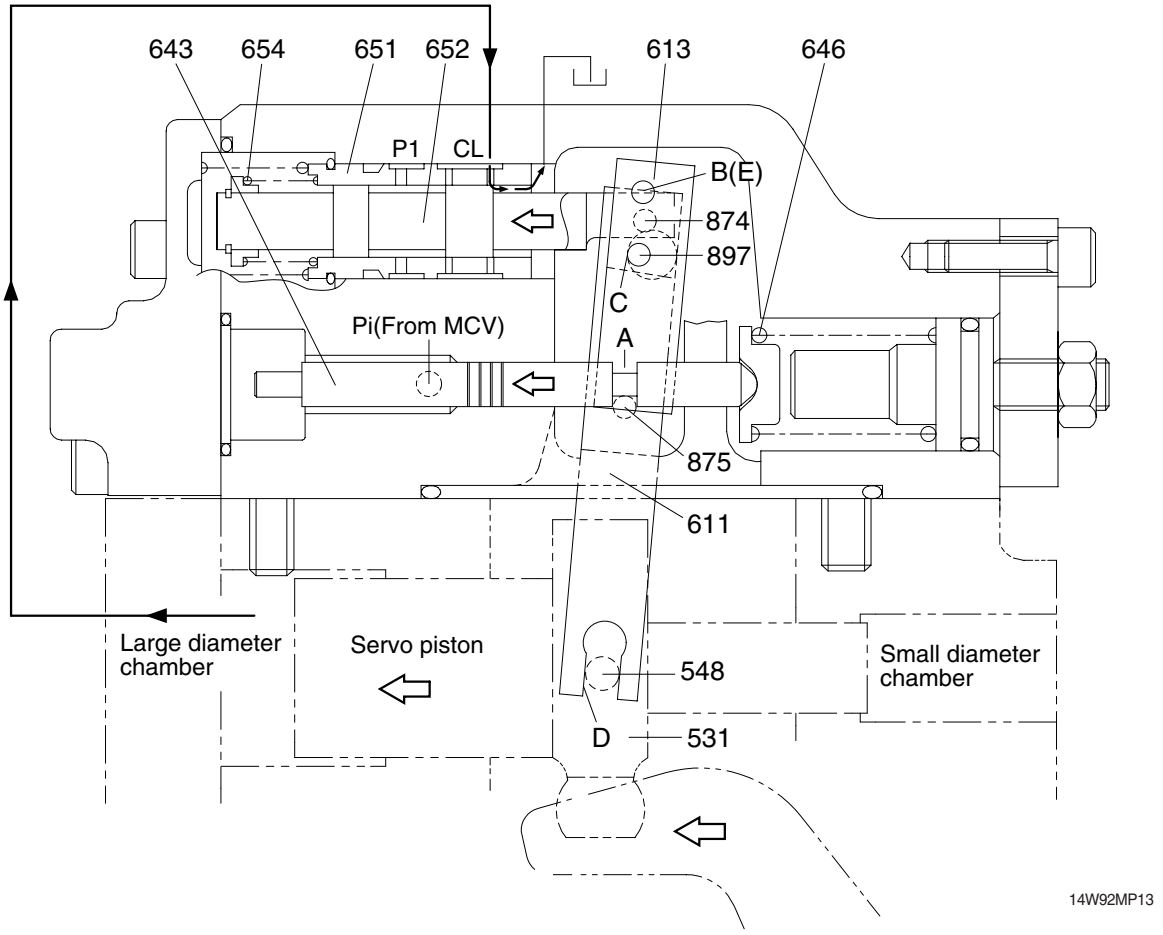
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

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

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

② Flow increasing function

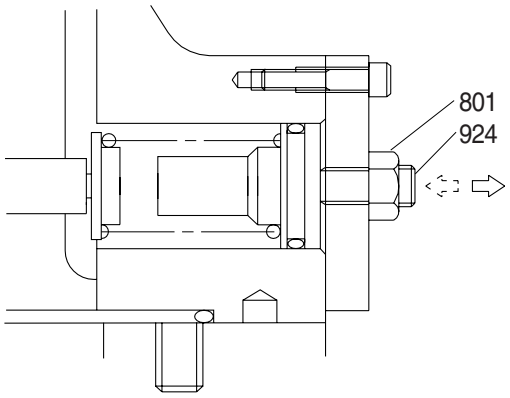


As the pilot pressure Pi decreases, the pilot piston (643) moves to the left by the action of the pilot spring (646) and causes lever 2 (613) to rotate around the fulcrum of point B. Since the pin (897) is pressed against the large hole section (C) of lever 2 by the action of the return spring (654)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

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

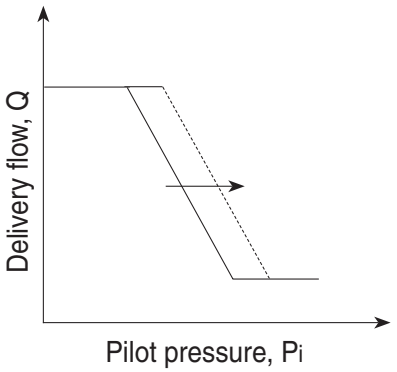
③ Adjustment of flow control characteristic

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



※ **Adjusting value**

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw(924)	Flow control starting pressure change amount	Flow change amount
(min $^{-1}$)	(Turn)	(kgf/cm^2)	(ℓ /min)
1900	+1/4	+1.5	+14.8

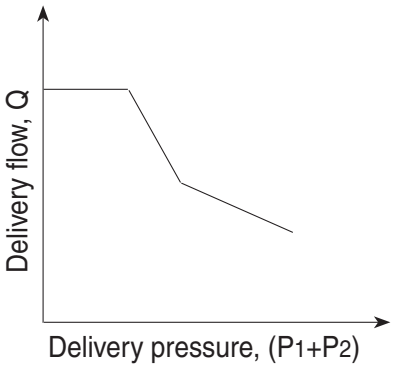


(2) Total horsepower control

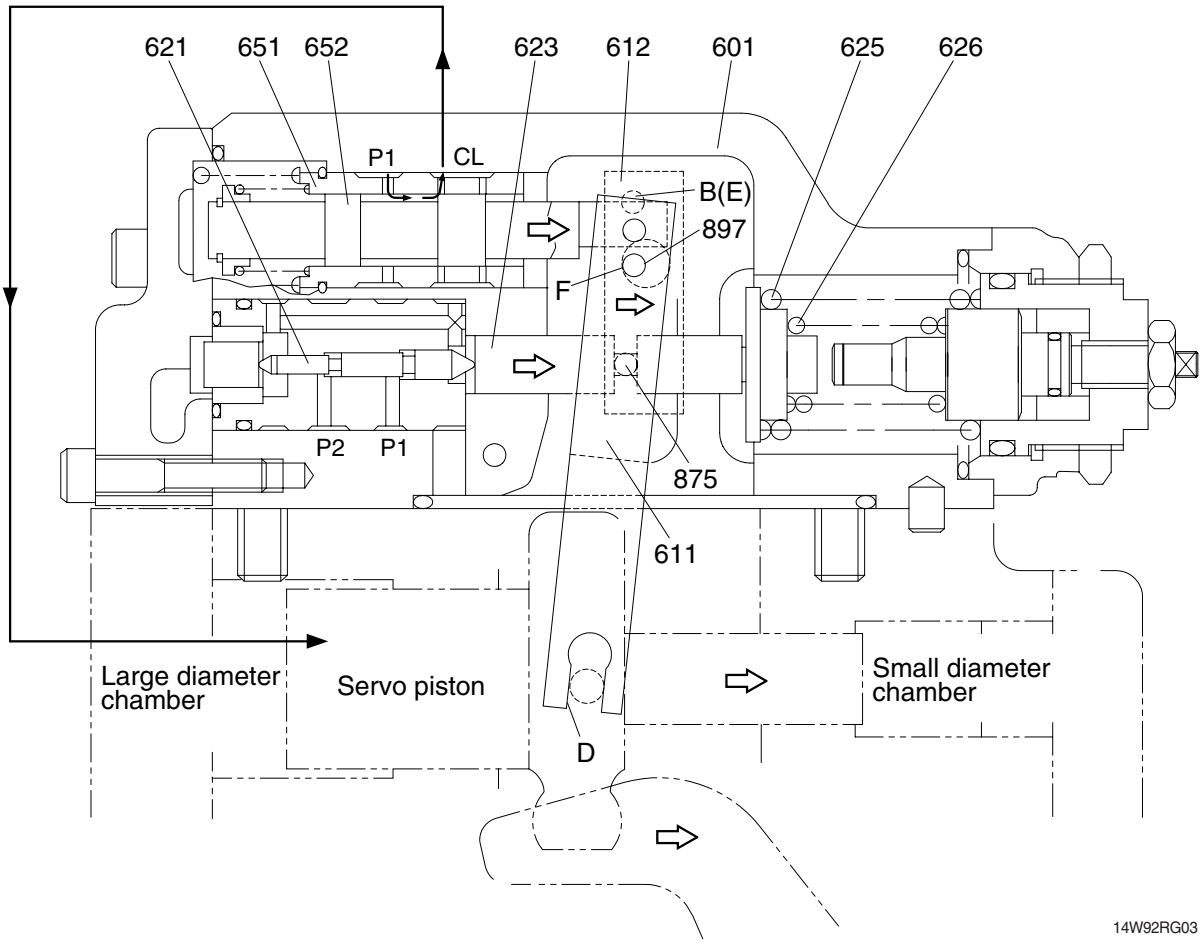
The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.
(The input horsepower is constant when the speed is constant.)
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation :

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

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



① Overload preventive function



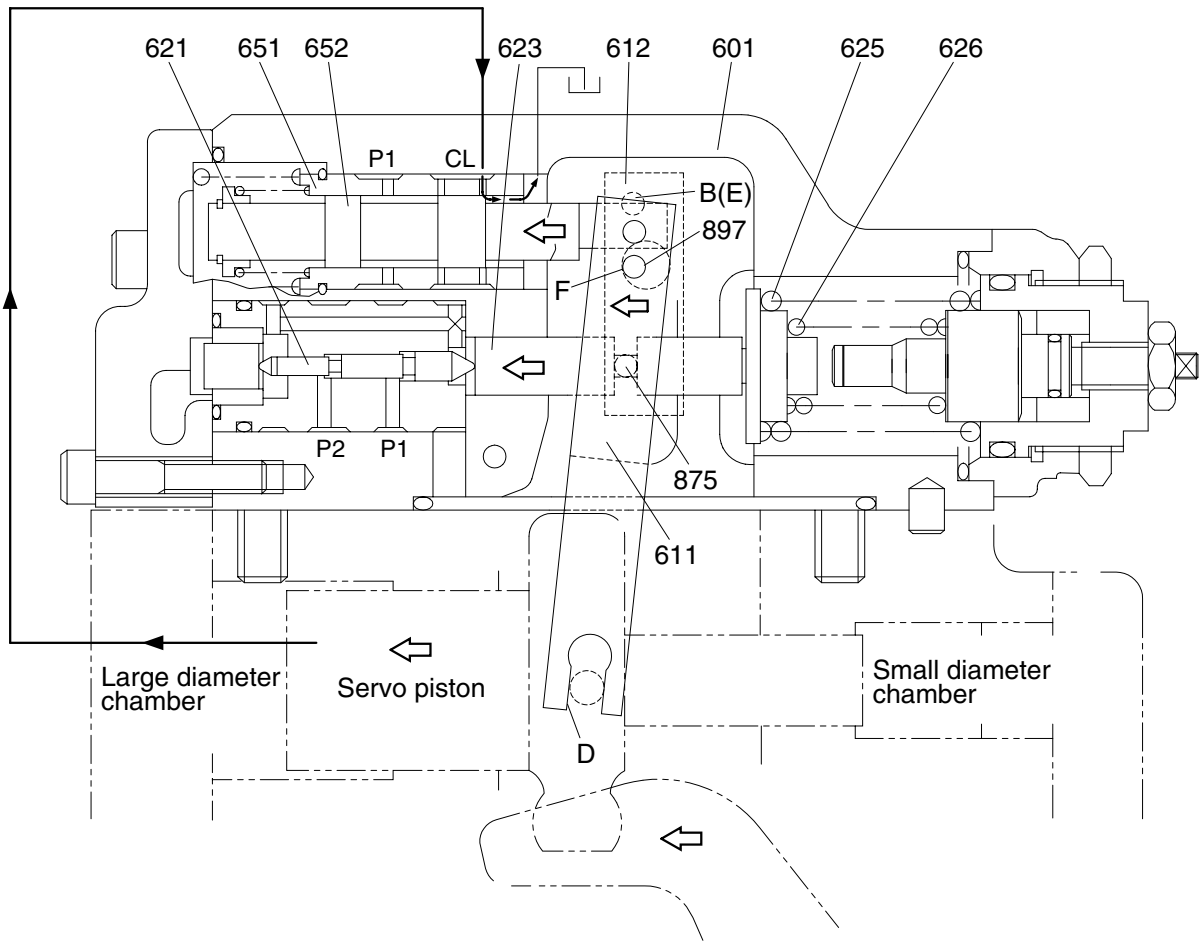
When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force. The movement of the compensating rod is transmitted to lever 1 (612) via pin (875).

Lever 1 rotates around the pin (875) (E) fixed to the casing (601).

Since the large hole section (F) of lever 1 contains a protruding pin (897) fixed to the feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 1 rotates, and then the spool (652) is shifted to the right. As the spool moves, the delivery pressure P1 is admitted to the large diameter section of the servo piston via port CL, causes the servo piston move to the right, reduces the pump delivery, flow rate, and prevents the prime mover from being overloaded.

The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool (652) and sleeve (651) is closed.

② Flow reset function



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

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

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

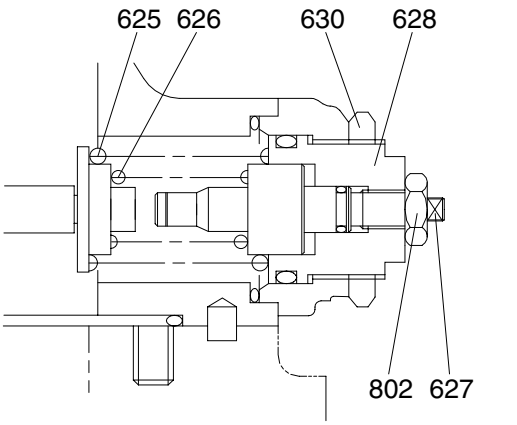
③ **Low tilting angle** (low flow) **command preferential function**

As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (ø 4) protruding from the large hole (ø 8), only the lever lessening the tilting angle contacts the pin (897) ; the hole (ø 8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

④ **Adjustment of input horsepower**

a. **Adjustment of outer spring**

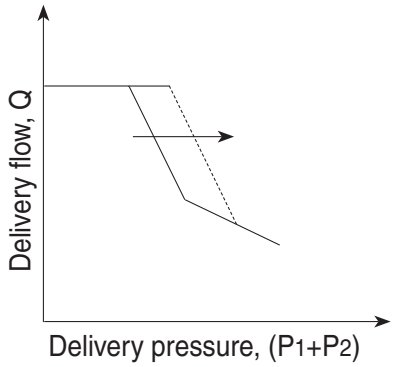
Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by N × A turns at first.(A=1.78)



2107A2MP07

※ **Adjusting value**

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting screw(628)	Compensating control starting pressure change amount	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
1900	+1/4	+16.5	+4.0



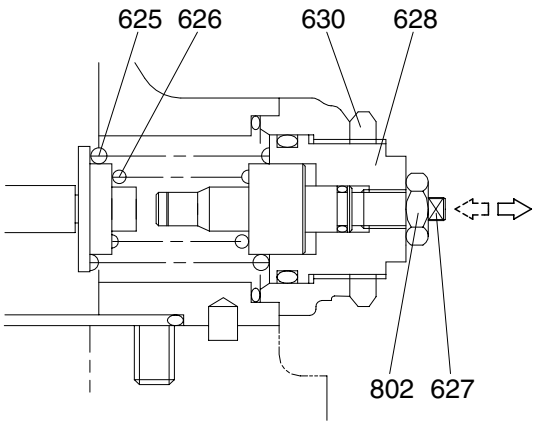
b. Adjustment of inner spring

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

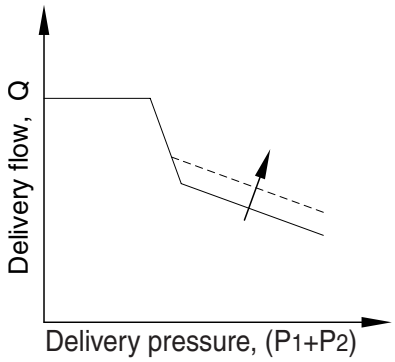
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valve

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount
(min $^{-1}$)	(Turn)	(ℓ /min)	(kgf·m)
1900	+1/4	+11.3	+4.7



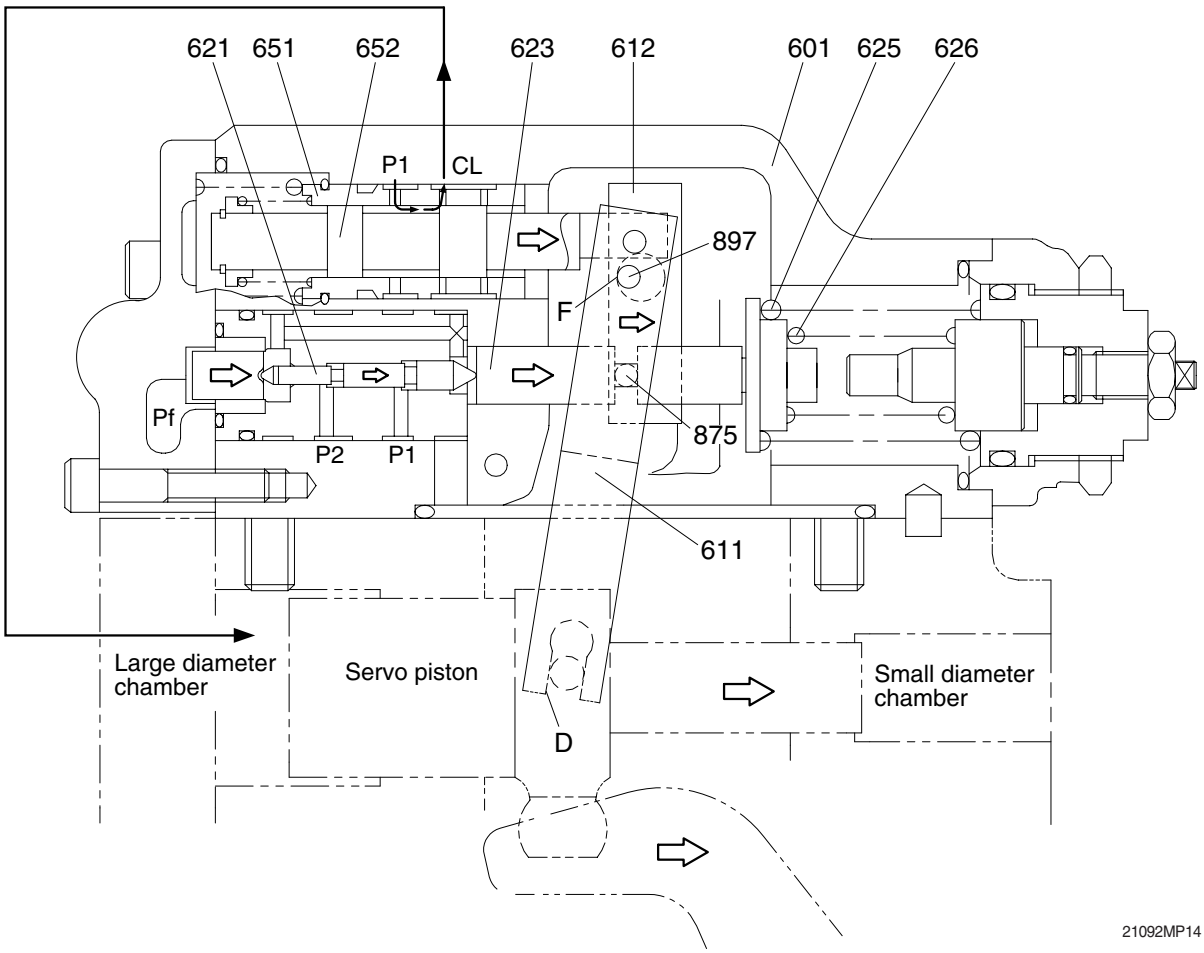
2107A2MP08



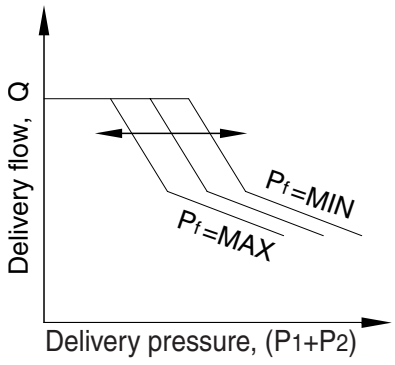
21092MP18

(3) Variable horsepower control

Variable horsepower control can be obtained by supplying pilot pressure.



The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.
Only one proportional pressure reducing valve is provided.
However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level.



This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.
The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.
As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

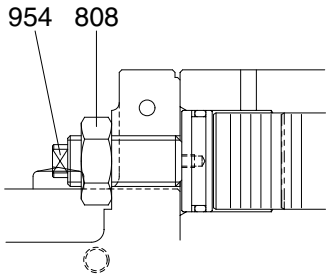
The regulator can adjust the maximum and minimum flows with the adjusting screws.

① Adjustment of maximum flow

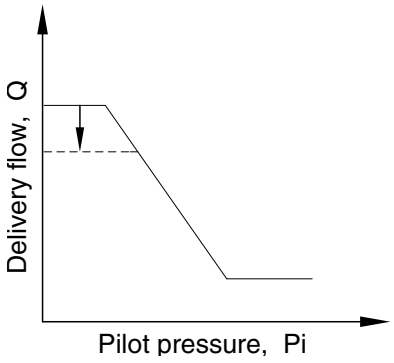
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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

Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min $^{-1}$)	(Turn)	(ℓ /min)
1900	+1/4	-5.5



21092MP23



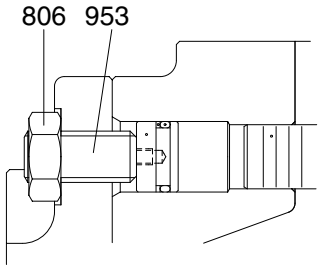
21092MP21

② Adjustment of minimum flow

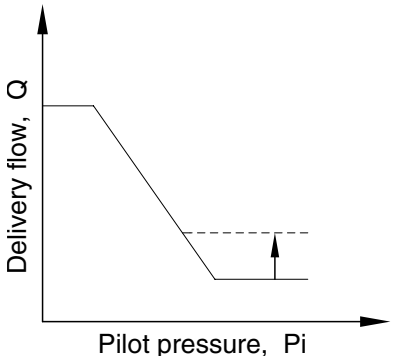
Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min $^{-1}$)	(Turn)	(ℓ /min)
1900	+1/4	+4.4

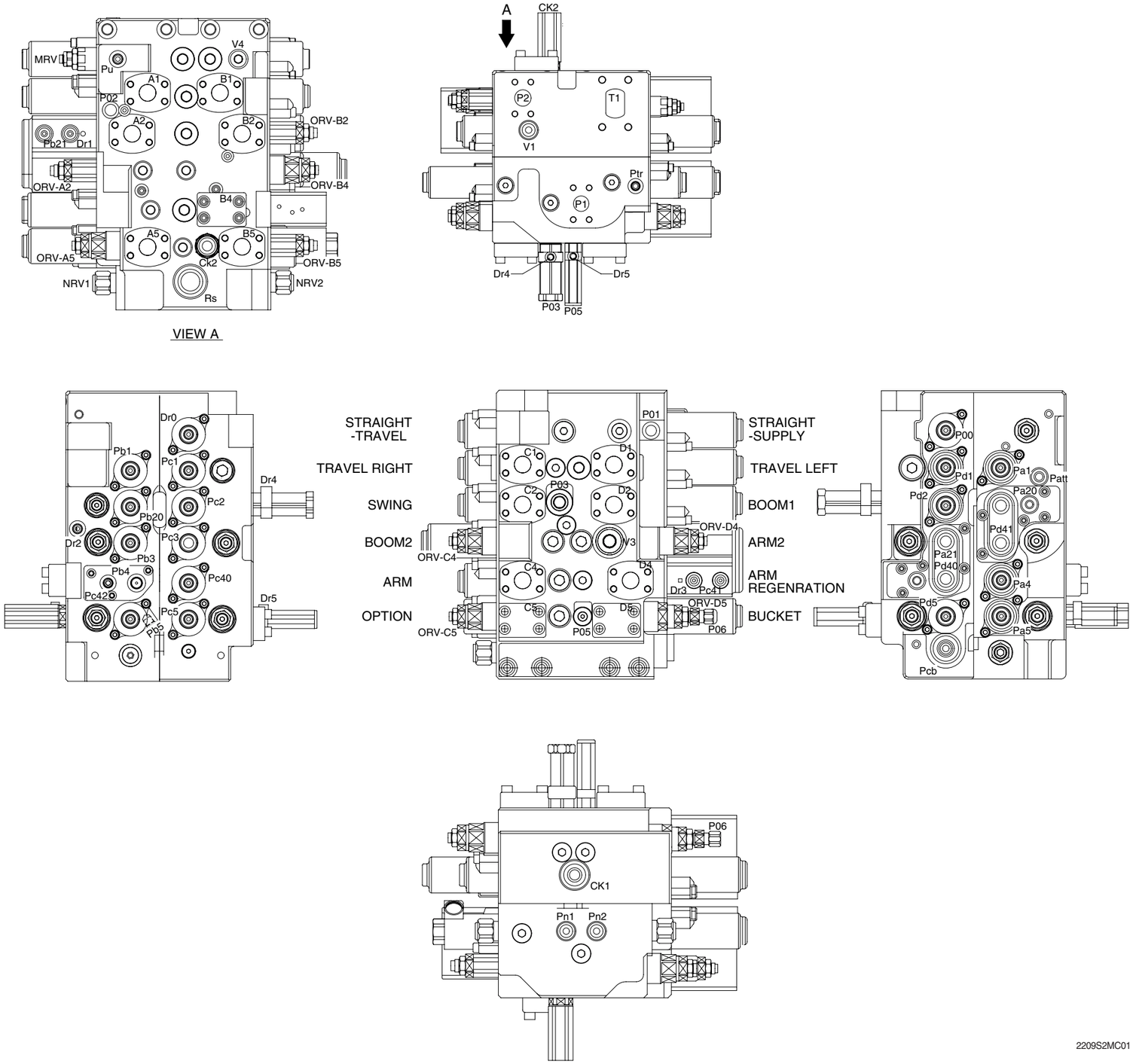


21092MP24



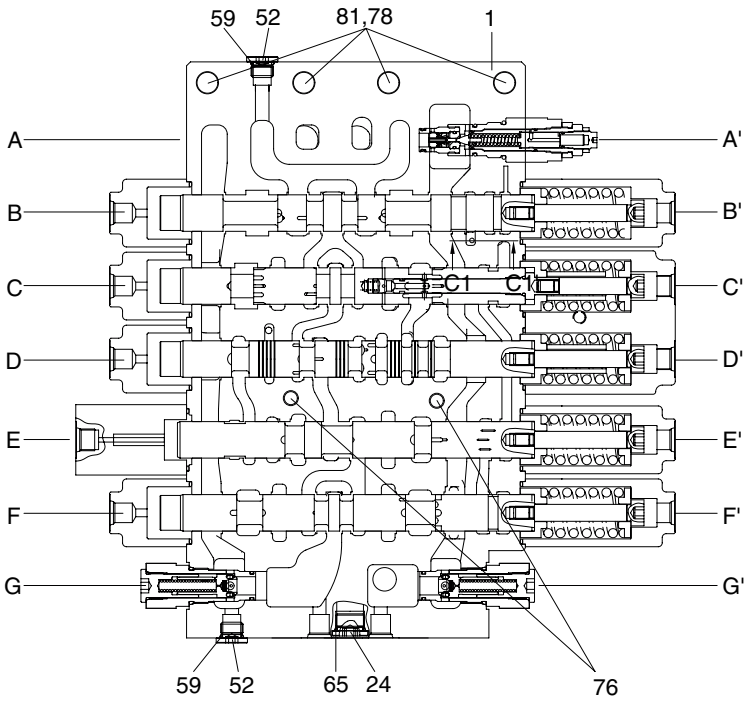
21092MP22

1. STRUCTURE

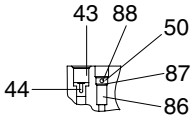


2209S2MC01

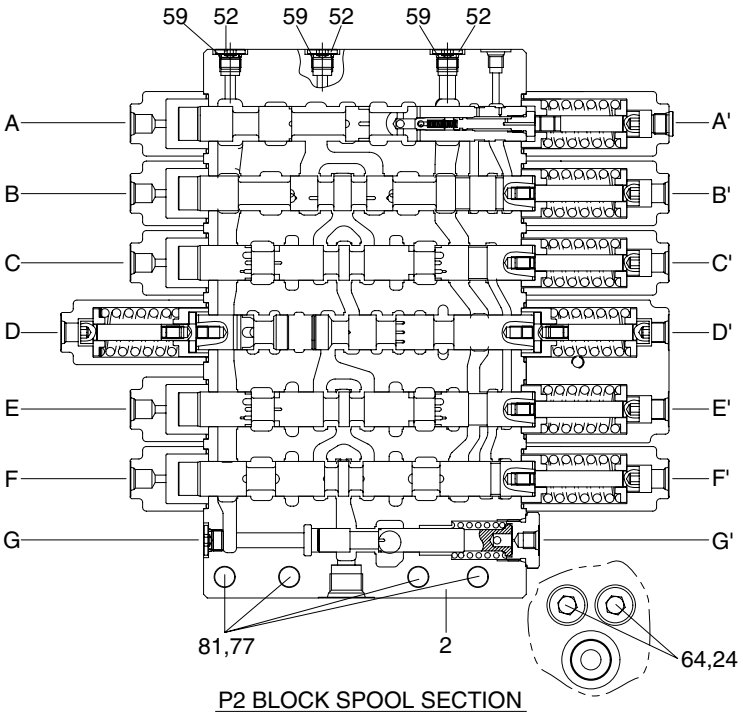
Mark	Port name	Port size	Tightening torque
Rs V3	Make up for swing motor Carry-over P port	PF1	20~25 kgf · m (145~180 lbf · ft)
Patt Pb21 Pcb P01 P02 P03 P04 P05 P06 Pc41 Pc42 Ptr Pu Dr1 Dr2 Dr3	Auto idle signal-attachment Lock valve pilot port (boom) Bucket in confluence pilot port Pilot signal port Pilot signal port Swing logic pilot port Bucket parallel orifice pilot port Option B confluence pilot port Option B 2 stage relief valve pilot port Lock valve pilot port (arm) Arm in regen-cut signal selector port Auto idle signal-travel Power boost Drain port Drain port Drain port	PF1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Ck1 Ck2	Bucket confluence Bucket confluence	PF3/4	17~19 kgf · m (123~137.4 lbf · ft)
Pa1 Pb1 Pc1 Pd1 Pa20 Pa21 Pb20 Pc2 Pd2 Pb3 Pc3 Pa4 Pb4 Pc40 Pd40 Pd41 Pa5 Pb5 Pc5 Pd5 Dr0 Pn1 Pn2 V1 V4	Travel pilot port-LH (FW) Travel pilot port-LH (BW) Travel pilot port-RH (BW) Travel pilot port-RH (FW) Boom up pilot port Boom up confluence pilot port Boom down pilot port Swing pilot port (LH) Swing pilot port (RH) Arm in confluence pilot port Swing priority pilot port Option A pilot port (breaker) Arm in regeneration cut port Arm in pilot port Arm out pilot port Arm out confluence pilot port Bucket in pilot port Bucket out pilot port Option B pilot port Option B pilot port Drain port Negative control signal port (A2 port side) Negative control signal port (A1 port side) Carry-over port Carry-over port	PF3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
A1 B1 C1 D1 A2 B2 C2 D2 B4 C4 D4 A5 B5 C5 D5 P1 P2	Travel motor port-LH (FW) Travel motor port-LH (BW) Travel motor port-RH (BW) Travel motor port-RH (FW) Boom up port Boom down port Swing motor port (LH) Swing motor port (RH) Option A port (breaker) Arm in port Arm out port Bucket in port Bucket out port Option B port Option B port Pump port (A2 side) Pump port (A1 side)	SAE 5000 psi 1"	7.5~9.2 kgf · m (54.2~66.5 lbf · ft)
Dr4 Dr5	Drain port Drain port	PF1/8	1.5~1.9 kgf · m (10.8~13.7 lbf · ft)
T1	Return port	SAE 3000 psi 2" (M12)	6.4~8.6 kgf · m (46.2~62.2 lbf · ft)



P1 BLOCK SPOOL SECTION



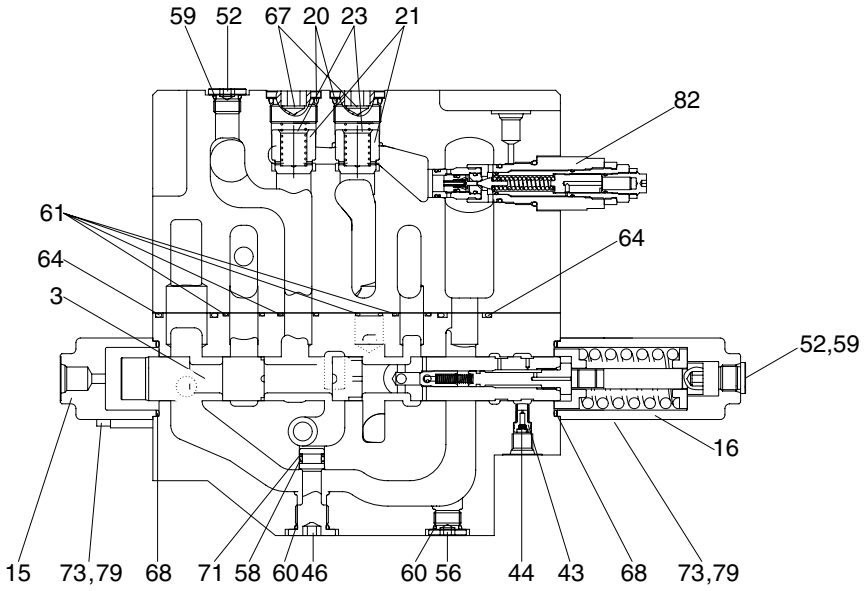
SECTION C1-C1'



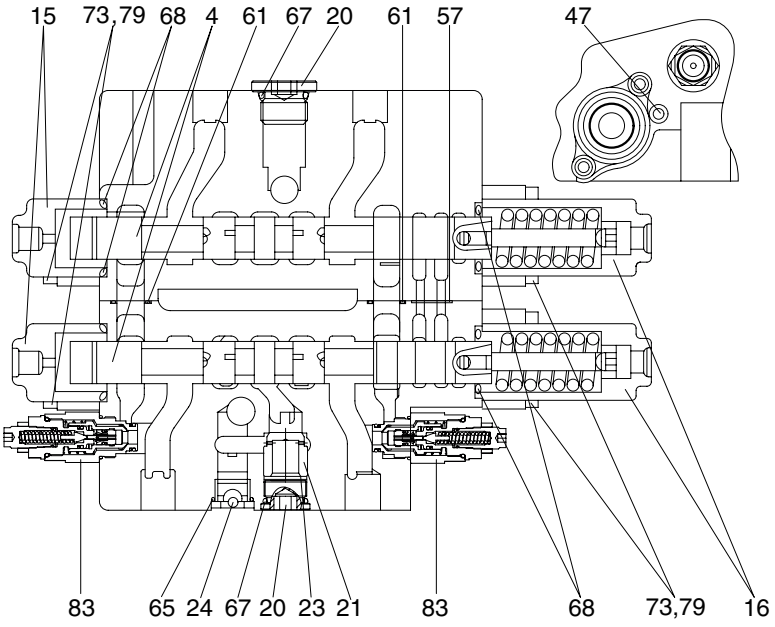
P2 BLOCK SPOOL SECTION

1	Housing (P1)
2	Housing (P2)
24	Plug
43	Orifice-signal
44	Coin type filter
50	O-ring
52	Plug
59	O-ring
64	O-ring
65	O-ring
76	Socket bolt
77	Hex socket head bolt
78	Hex socket head bolt
81	Spring washer
86	Poppet
87	Spring check
88	Plug

300H2MC10



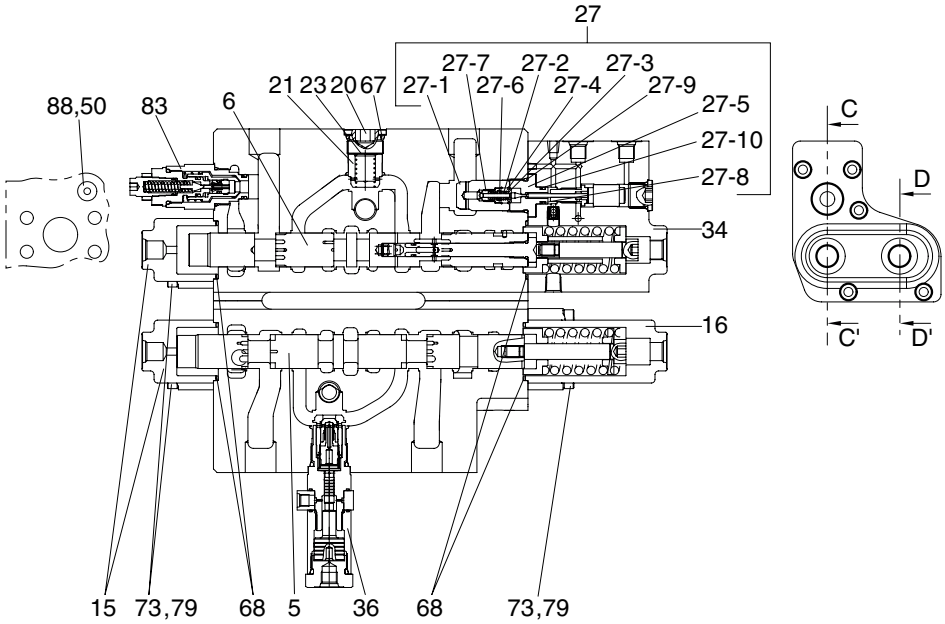
A-A' (STRAIGHT-TRAVEL & SUPPLY)



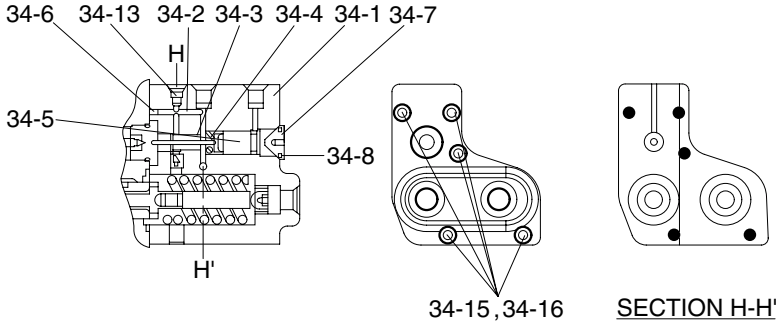
2209S2MC11

B-B' (TRAVEL RIGHT & LEFT)

3	Spool-straight
4	Spool-travel
15	Cover-pilot A
16	Cover-pilot B1
20	Plug
21	Poppet 1-check valve
23	Spring 1-check valve
24	Plug
43	Orifice-signal
44	Coin type filter
46	Plug
47	Plug
52	Plug
56	Plug
57	O-ring
58	O-ring
59	O-ring
60	O-ring
61	O-ring
64	O-ring
65	O-ring
67	O-ring
68	O-ring
71	Back-up ring
73	Hex socket head bolt
79	Washer
82	Main relief valve
83	Main relief valve



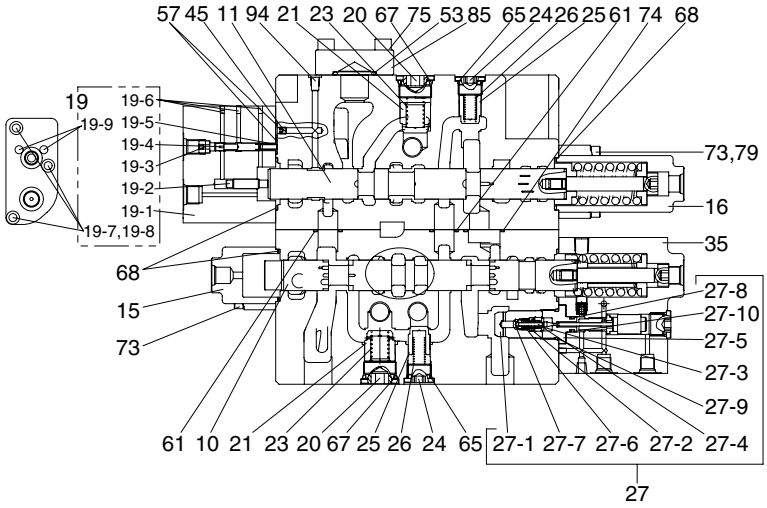
C-C' (SWING & BOOM1)



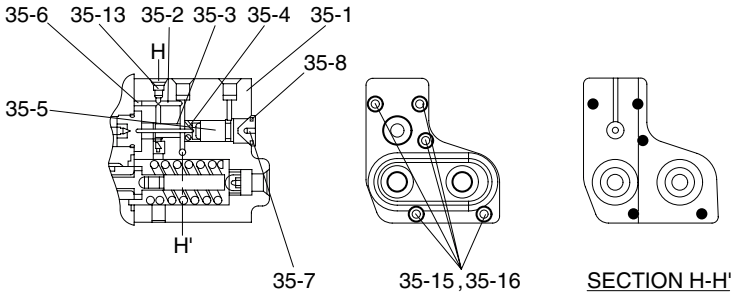
34 DETAIL (HOLDING ASSY)

300H2MC12

5	Spool-swing	27-7	Restrictor-lock valve	34-14	Plug
6	Spool-boom	27-8	O-ring	34-15	Socket bolt
15	Cover-pilot A	27-9	O-ring	34-16	Spring washer
16	Cover-pilot B1	27-10	Back up ring	36	Logic valve
20	Plug	34	Holding kit-A1	50	O-ring
21	Poppet 1-check valve	34-1	Block-H/D P1	56	O-ring
23	Spring 1-check valve	34-2	Piston 1-holding	66	O-ring
27	Holding kit-B	34-3	Guide piston-holding	67	O-ring
27-1	Poppet	34-4	Spring 1-lock valve	68	O-ring
27-2	Spring	34-5	Piston 2-holding	70	Back-up ring
27-3	Poppet guide	34-6	Plug	73	Hex socket head bolt
27-4	Pilot poppet	34-7	Plug	79	Washer
27-5	Poppet seat	34-8	Plug	83	Overload relief valve
27-6	C-ring	34-13	Plug	88	Plug



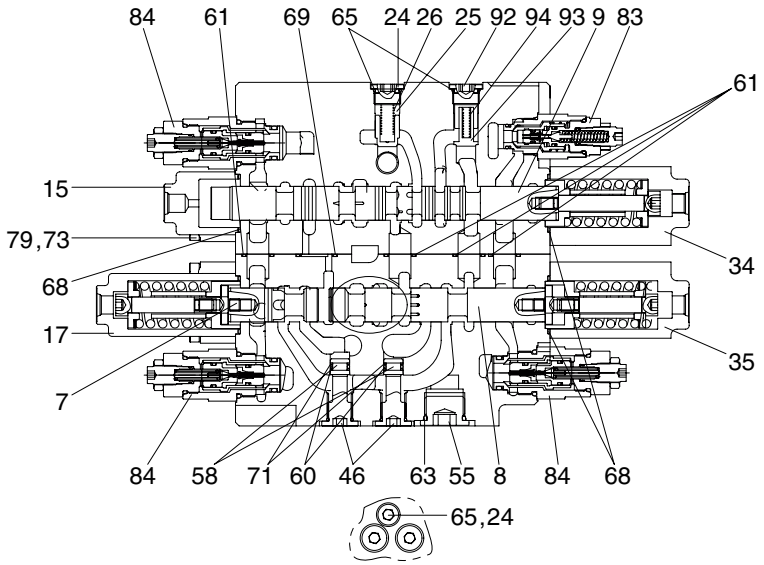
E-E' (ARM & ARM REGENRATION)



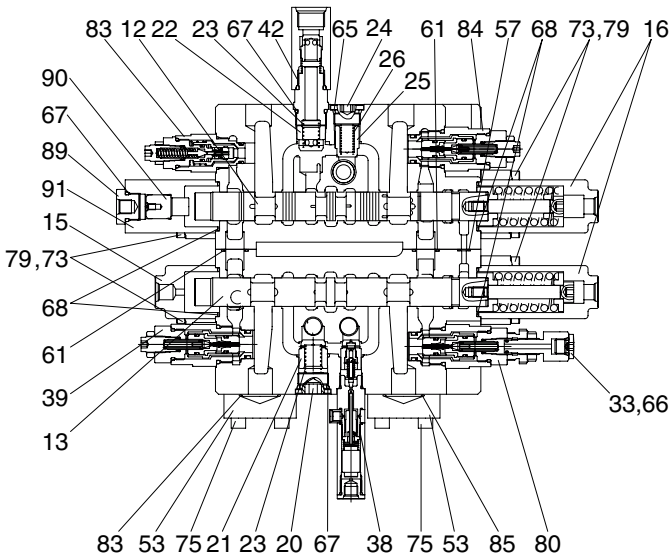
35 DETAIL (HOLDING ASSY)

300H2MC13

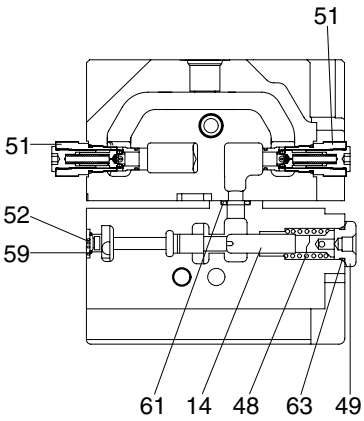
10	Spool-arm	27	Poppet-lock valve	35-13	Plug
11	Spool-arm regeneration	27-1	Poppet	35-15	Socket bolt
15	Cover-pilot A	27-2	Spring	35-16	Spring washer
16	Cover-pilot B1	27-3	Poppet guide	45	Orifice-plug
19	Arm-regeneration	27-4	Pilot poppet	53	Flange
19-1	Block-regeneration	27-5	Poppet seat	56	O-ring
19-2	Piston-cut off	27-6	C-ring	57	O-ring
19-3	Stopper-regeneration	27-7	Restrictor-lock valve	61	O-ring
19-4	Spool-regeneration	27-8	O-ring	65	O-ring
19-5	Spring-regeneration	27-9	O-ring	66	O-ring
19-6	Plug	27-10	Back up ring	67	O-ring
19-7	Socket bolt	35	Holding kit-A2	68	O-ring
19-8	Spring wahser	35-1	Block-H/D P2	70	Back-up ring
19-9	Pin-regeneration	35-2	Piston 1-holding	73	Hex socket head bolt
20	Plug	35-3	Guide piston-holding	74	O-ring
21	Poppet 1-check valve	35-4	Spring 1-lock valve	75	Socket bolt
23	Spring 1-check valve	35-5	Piston 2-holding	79	Washer
24	Plug	35-6	Plug	85	O-ring
25	Poppet 2-check valve	35-7	Plug		
26	Spring 2-check valve	35-8	Plug		



D-D' (SWING PRIORITY-BOOM2 & ARM2)



F-F' (OPTION & BUCKET)

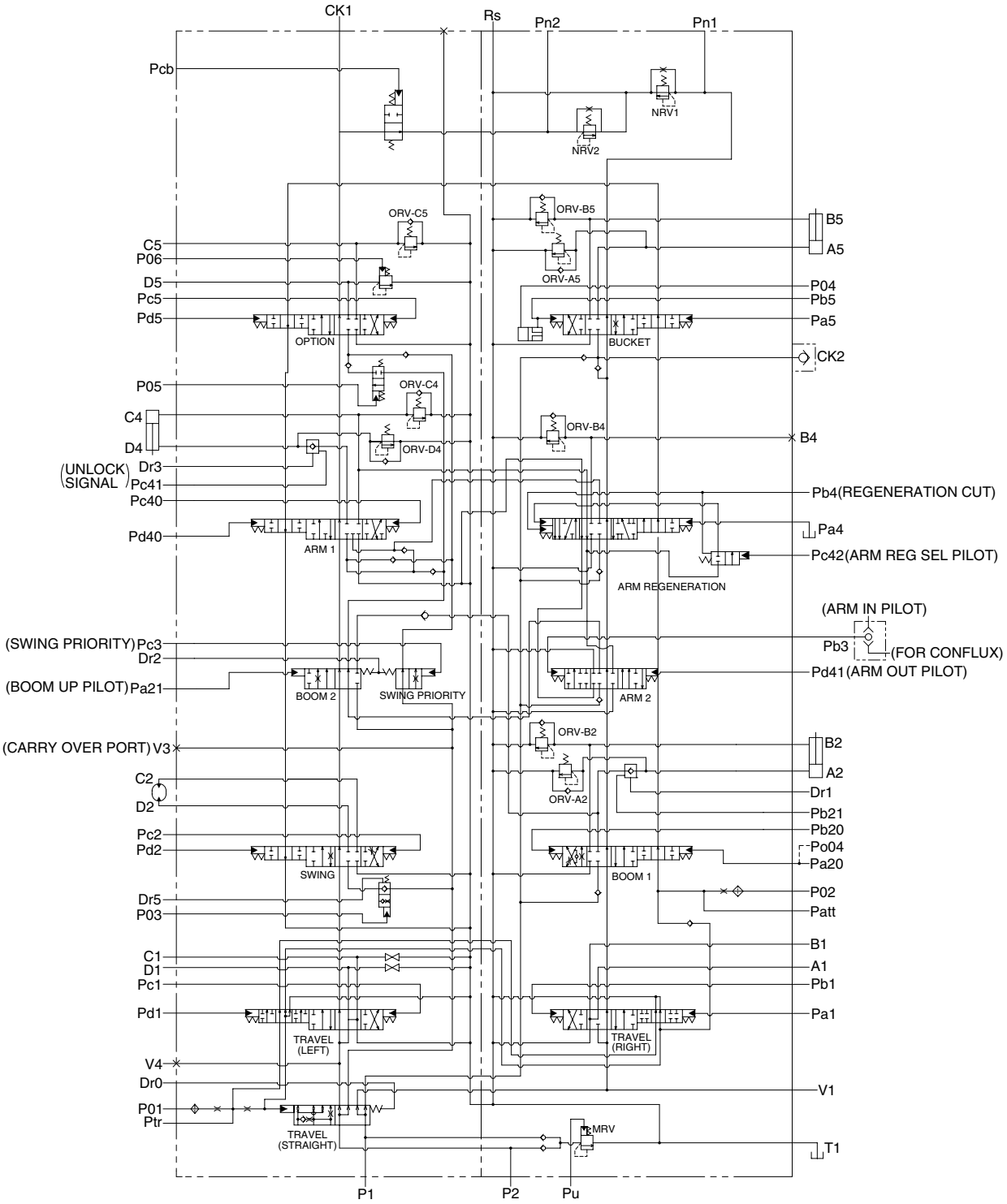


G-G' (CENTER BYPASS CUT-OFF & NEGATIVE CONTROL)

2209S2MC14

7 Spool-swing priority
8 Spool-boom 2
9 Spool-arm 2
12 Spool-bucket
13 Spool-option
14 BC spool
15 Cover-pilot A
16 Cover-pilot B1
17 Cover-pilot B2
20 Plug
21 Poppet 1-check valve
22 Poppet L/C-bucket
23 Spring 1-check valve
24 Plug
25 Poppet 2-check valve
26 Spring 2-check valve
34 Holding kit
35 Holding kit
38 Load check valve assy
39 Overload relief valve
42 Check valve
46 Plug
48 Spring-BC spool
49 Plug-BC spool
51 Negative control valve
52 Plug
53 Flange
55 Plug
57 O-ring
58 O-ring
59 O-ring
60 O-ring
61 O-ring
63 O-ring
65 O-ring
67 O-ring
68 O-ring
69 O-ring
71 Back-up ring
73 Hex socket head bolt
75 Socket bolt
79 Washer
80 Overload relief valve
83 Overload relief valve
84 Overload relief valve
85 O-ring
89 Plug
90 Piston
91 Pilot cover C1
92 Plug
93 Poppet
94 Spring

2. HYDRAULIC CIRCUIT



300H2MC02

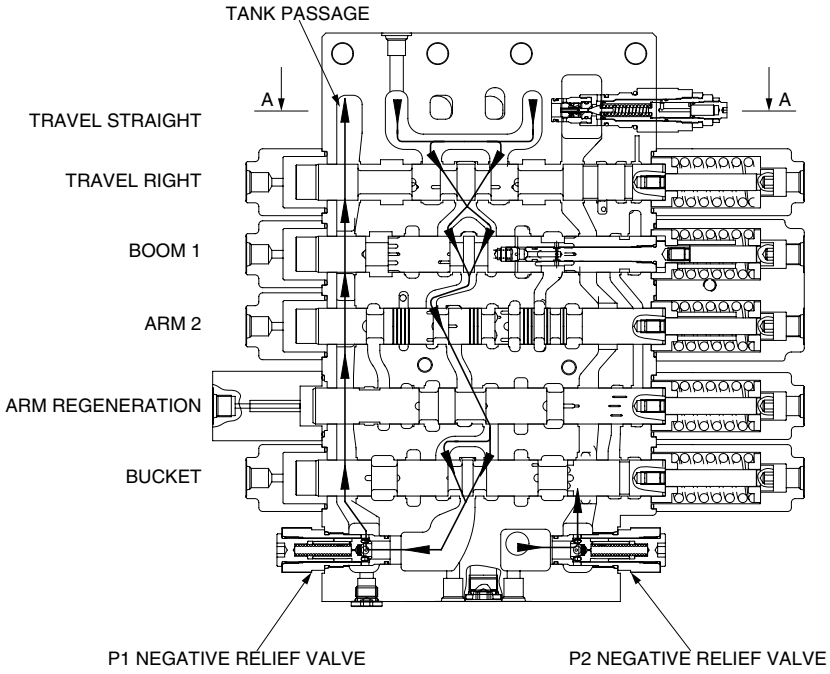
3. FUNCTION

1) CONTROL IN NEUTRAL

(1) P1 SIDE

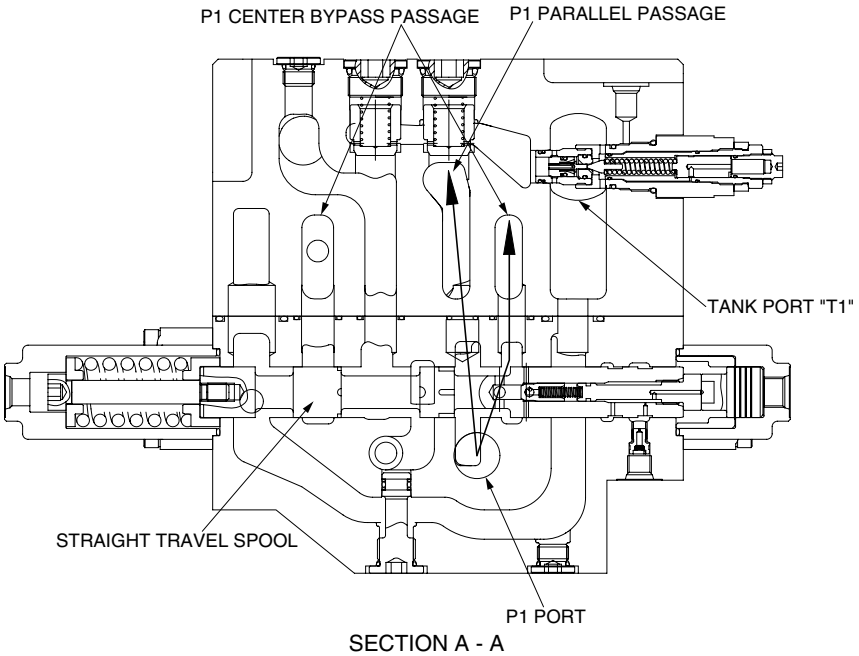
The hydraulic fluid from pump flows into the main control valve through the inlet port "P1", pass the land of the travel straight spool, into the P1 bypass passage and P1parallel passage.

When the straight travel spool is in neutral position, the bypass passage is not shut off. Then the hydraulic fluid from the pump P1 is directed to the tank through the bypass passage of spools : travel right, boom 1, arm 2, arm regeneration & option A and bucket, the negative relief valve of P1, tank passage, and the tank port "T1"



P1 SPOOL SECTION

29092MC03B



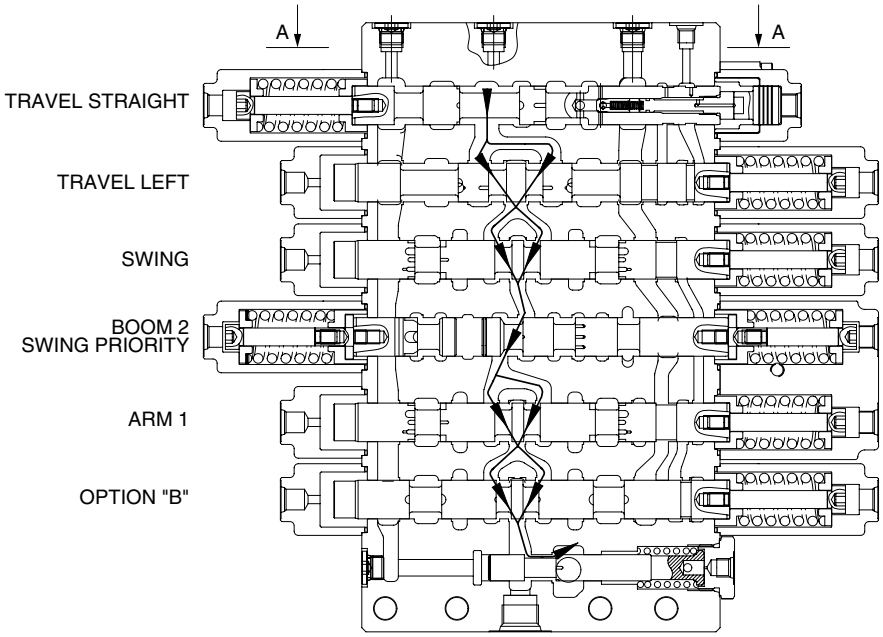
SECTION A - A

29092MC04

(2) P2 SIDE

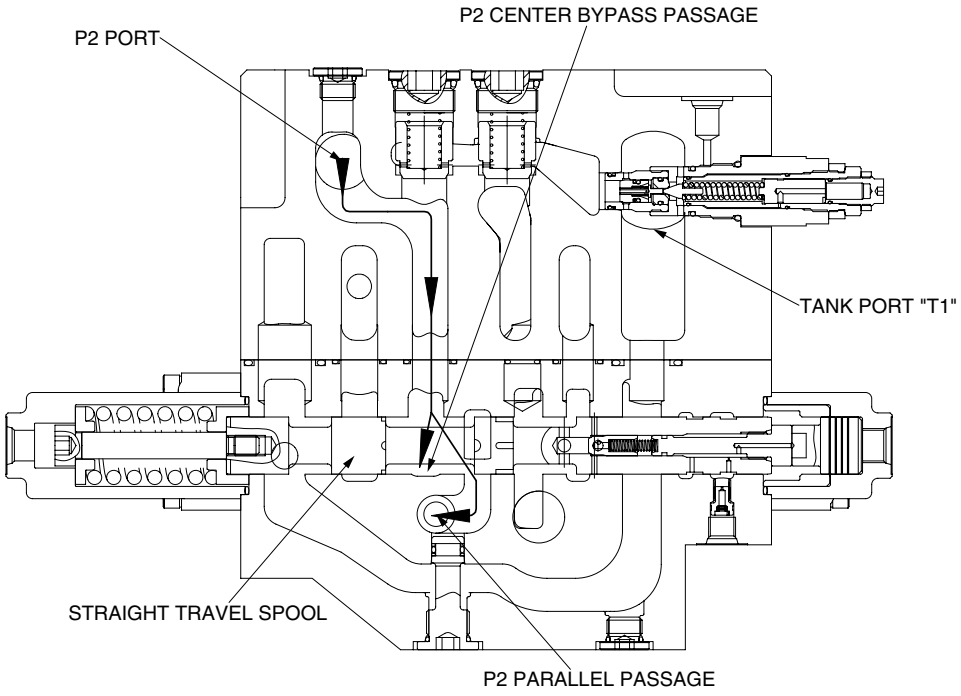
The hydraulic fluid from pump flows into the main control valve through the inlet port "P2", pass the land of the straight travel spool, into the P2 bypass passage and P2 parallel passage.

When the straight travel spool is in neutral position, the bypass passage is not shut off. Then the hydraulic fluid from the pump P2 is directed to the tank through the bypass passage of spools : travel left, swing, boom 2 & swing priority, arm 1, option "B" and option "C" of bypass passage summation, and the negative relief valve of P2, the tank passage and the tank port "T1".



P2 spool section

29092MC06



SECTION A - A

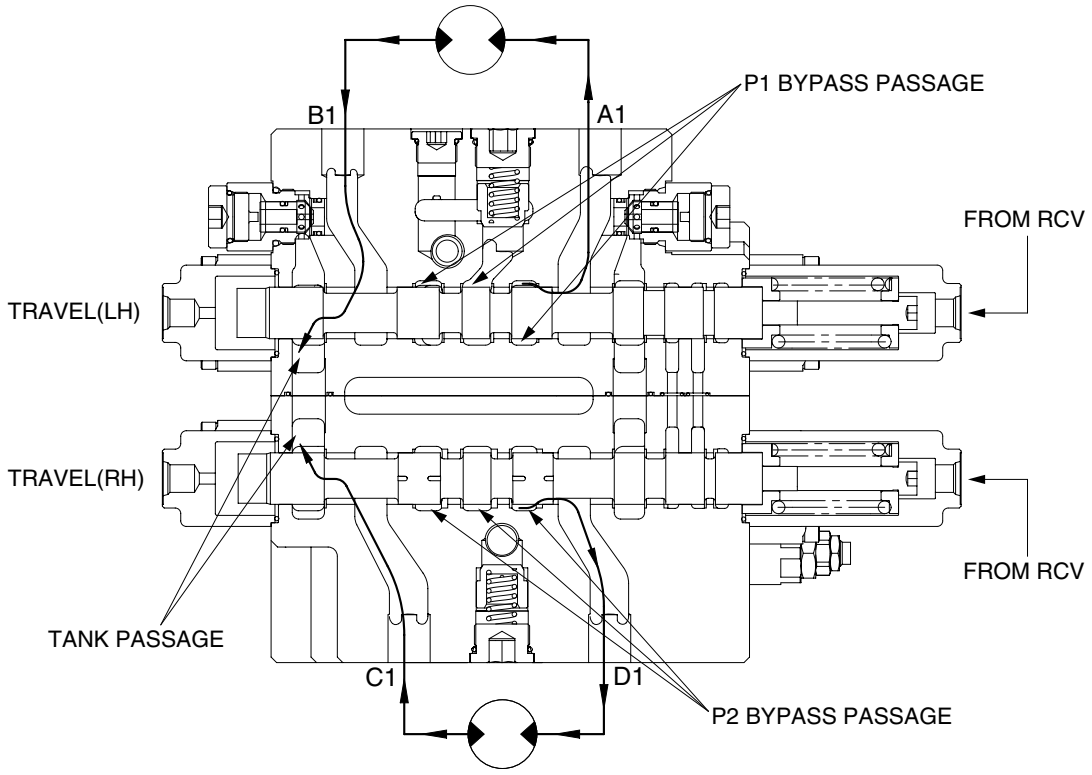
29092MC05A

2) TRAVEL OPERATION

(1) TRAVEL FORWARD OPERATION

During the travel forward operation, the pilot pressure of RCV is supplied to the port of the spring side, and it shifts travel right and left spools in the left direction against springs. Hydraulic fluid from the pump flows into the bypass passage of travel spool through the land of the straight travel spool.

Then the bypass passage is shut off by the movement of the spool, they are directed to the each travel motor through port B1 and D1. At the same time, the hydraulic fluid from the each travel motor through port A1 and C1 returns to the tank passage through the travel spools.

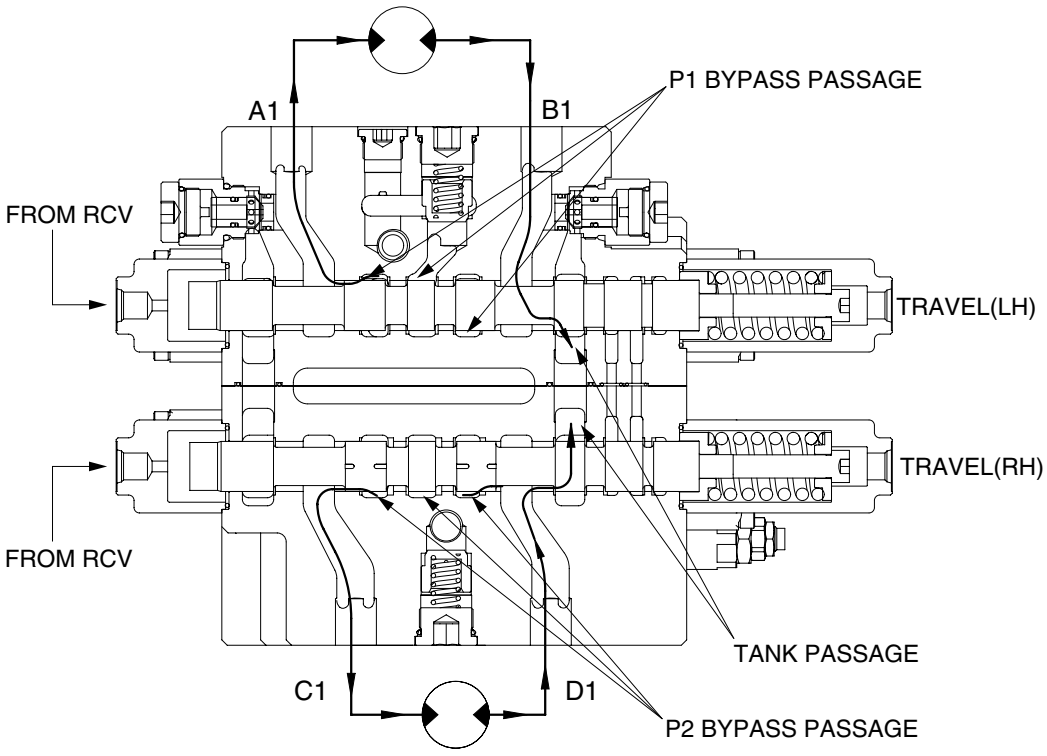


29092MC07

(2) TRAVEL REVERSE OPERATION

During the travel reverse operation, the pilot pressure of RCV is supplied to the port of the spring opposite side, and it shifts travel right and left spools in the right direction against springs. Hydraulic fluid from the pump flows into the bypass passage of travel spool through the land of the straight travel spool.

Then the bypass passage is shut off by the movement of the spool, they are directed to the each travel motor through port A1 and C1. At the same time, the hydraulic fluid from the each travel motor through port B1 and D1 returns to the tank passage through the travel spools.



2209SH2MC08

(3) TRAVEL STRAIGHT FUNCTION

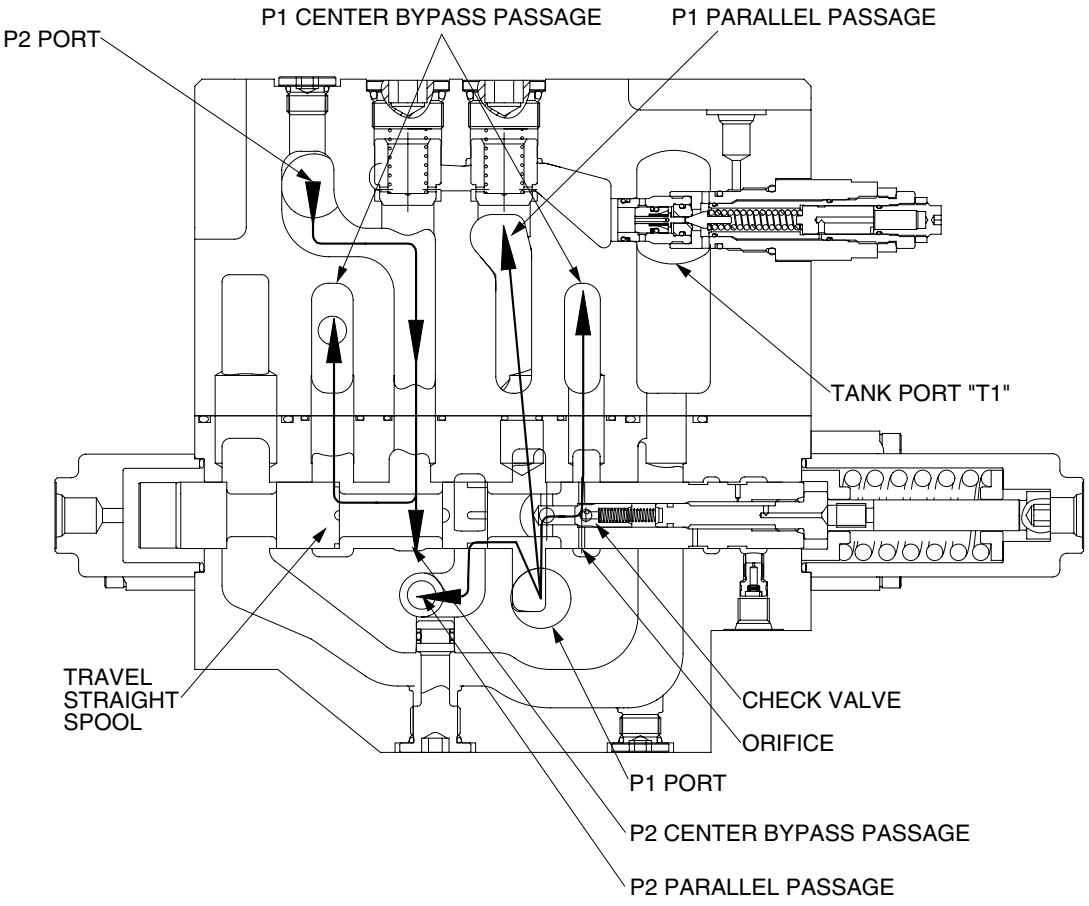
Straight travel valve is the valve for keeping traveling straight when boom, arm, bucket or swing is operated at the time of traveling. Therefore the oil from the P1 and P2 pump flows into the control valve through the each passage in neutral condition.

When the both travels and any of attachment is switched, the pilot pressure is applied the port of spring chamber and the travel straight spool is shifted.

When the straight travel spool is switched, the oil pressure from P1 is led to the each attachment switching section through the P1 and P2 parallel passage. Also some of oil id combined with bypass of P1 side by opening of check valve of spool inside through the orifice of the straight travel spool.

On the other hand, the oil from P2 is supplied to the both travel section through P1 and P2 bypass passage.

Therefore, when attachment is switched at the time of both travels, since the oil of P2 mainly flows to both travels, and the oil of P1 mainly flows to attachments, it can keep traveling straight.



29092MC09

3) BOOM OPERATION

(1) BOOM UP OPERATION

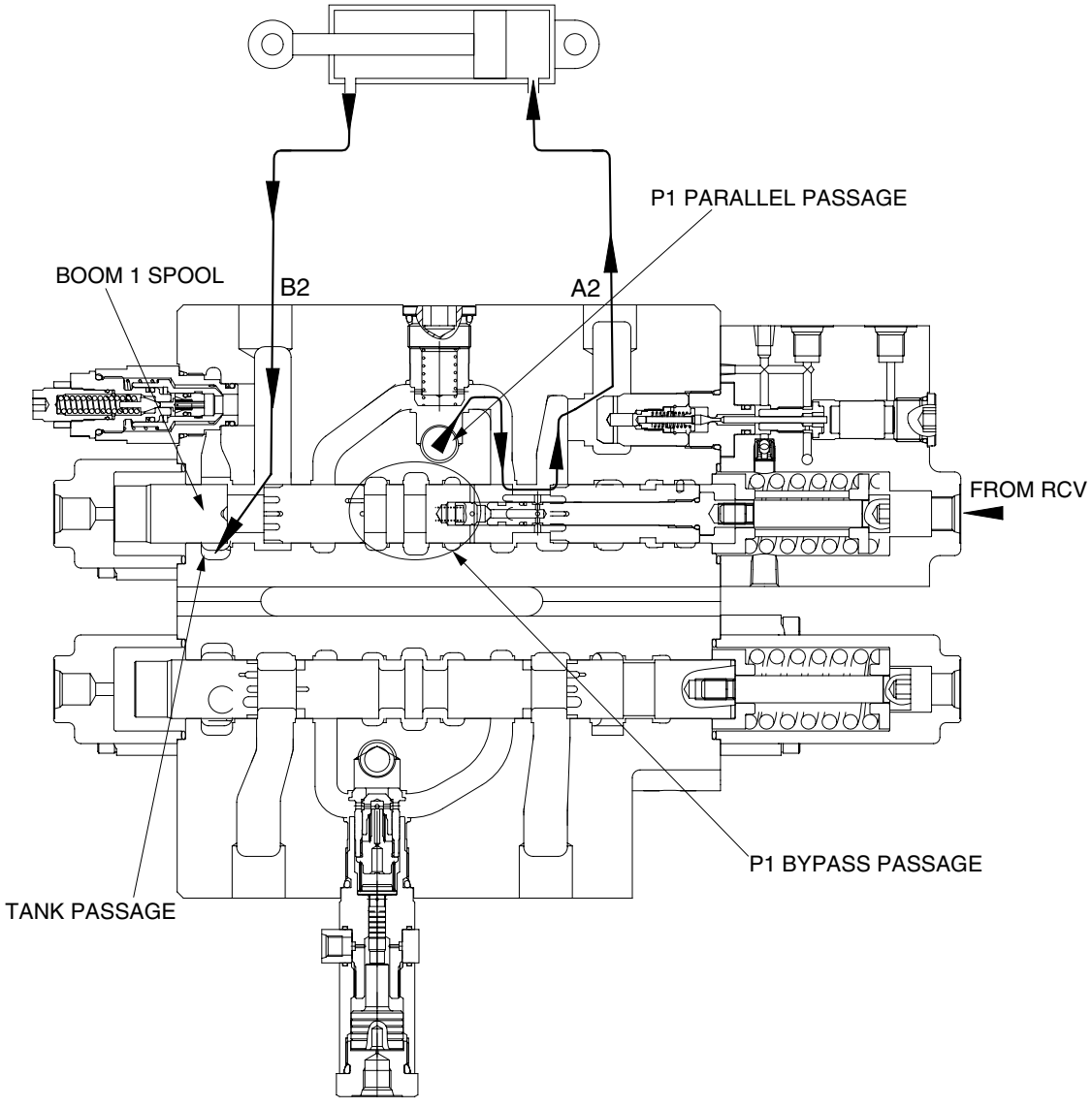
During boom up operation, the pilot secondary pressure from RCV is supplied to the port of the spring side and shifts the boom 1 spool in the left direction. The bypass passage is shut off by the movement of the spool and the hydraulic oil fluid from pump P1 is entered P1 parallel passage and then passes through the load check valve, bridge passage and boom holding valve then flows into the port A2.

Following this it flows into the head side of the boom cylinder.

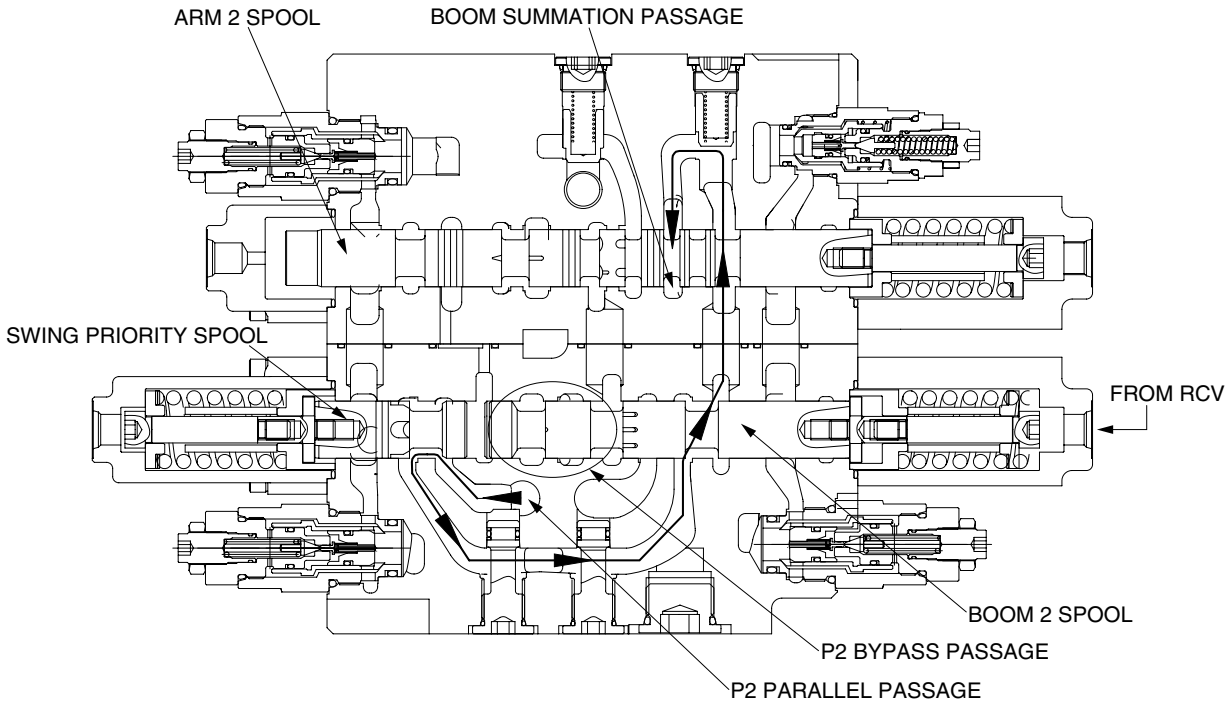
(In this case, the boom holding valve is free flow condition)

At the same time, the pilot pressure from RCV is supplied to the port of the spring side of boom 2 and shifts the boom 2 spool. The bypass passage is shut off by the movement of the spool and the hydraulic oil fluid from pump P2 entered boom summation passage via the P2 parallel passage, the land of the swing priority spool, notch of the boom 2 spool, arm 2 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder.

At the same time, the flow from rod side of the boom cylinder return to the boom 1 spool through the port B2. There after it is directed to the hydraulic oil tank through the tank passage.



29092MC10A


ARM 2 SPOOL
BOOM SUMMATION PASSAGE
SWING PRIORITY SPOOL
FROM RCV
BOOM 2 SPOOL
P2 BYPASS PASSAGE
P2 PARALLEL PASSAGE

29092MC11

(2) BOOM DOWN OPERATION

During the boom lowing operation, the pilot pressure from RCV is supplied to the port of the spring opposite side and shifts the boom 1 spool in the right direction.

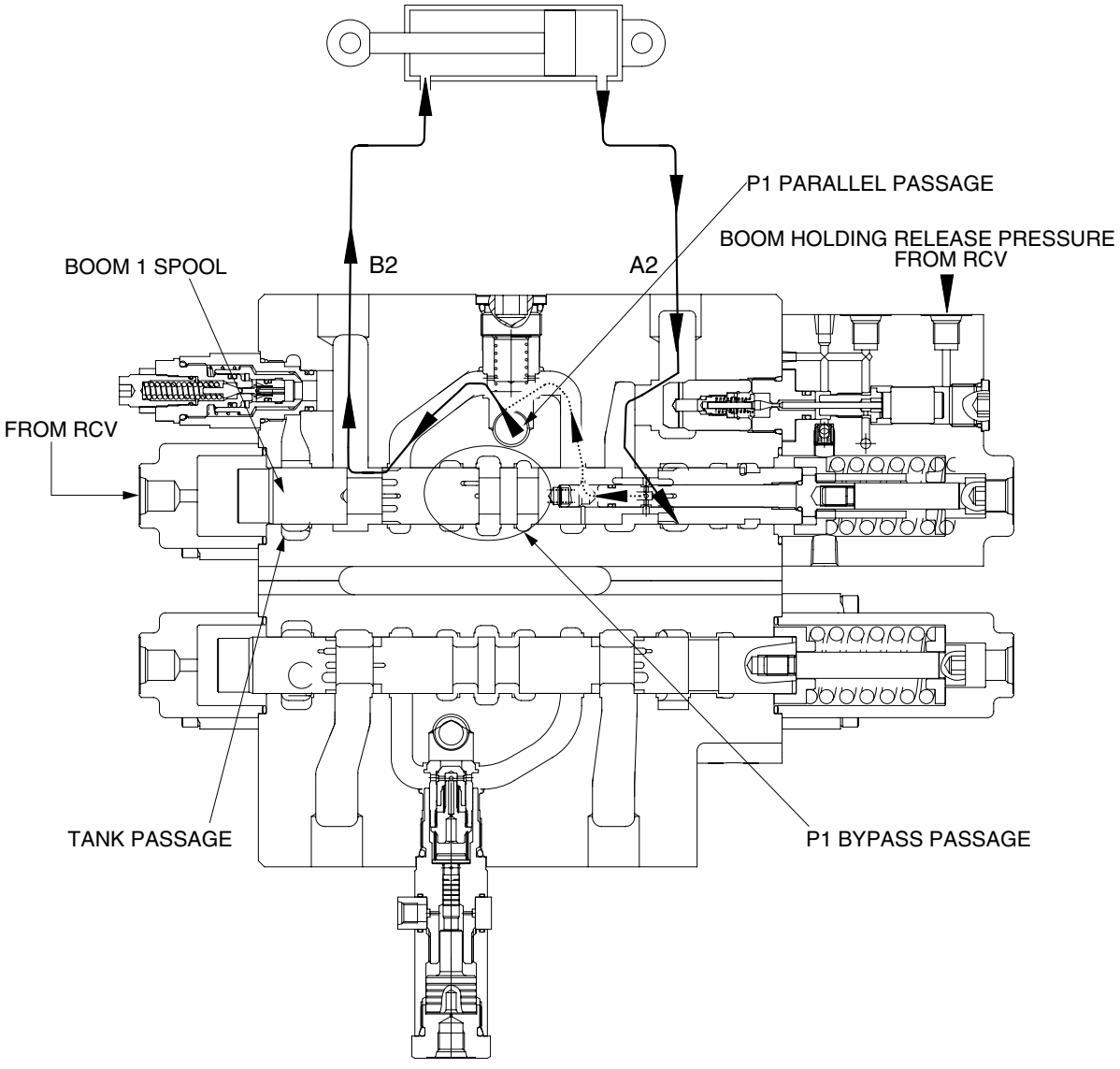
The bypass passage is shut off by the movement of the spool and the hydraulic fluid from the pump P1 enters the parallel passage and is directed to the port B2 through the load check valve. Following this, it flows into the rod side of the boom cylinder.

At the same time, the return flow from the head side of the boom cylinder returns to the port A2 and boom holding valve. And it is directed to the hydraulic oil tank through opened tank passage by movement of the boom 1 spool.

Meanwhile some of return flow is directed to P1 parallel passage through the internal passage of the boom 1 spool. (boom regeneration)

In this case, the holding valve is open condition, for details of the boom holding valve, see page following page.

During the boom lowering operation, the fluid from P2 pump is not summation.

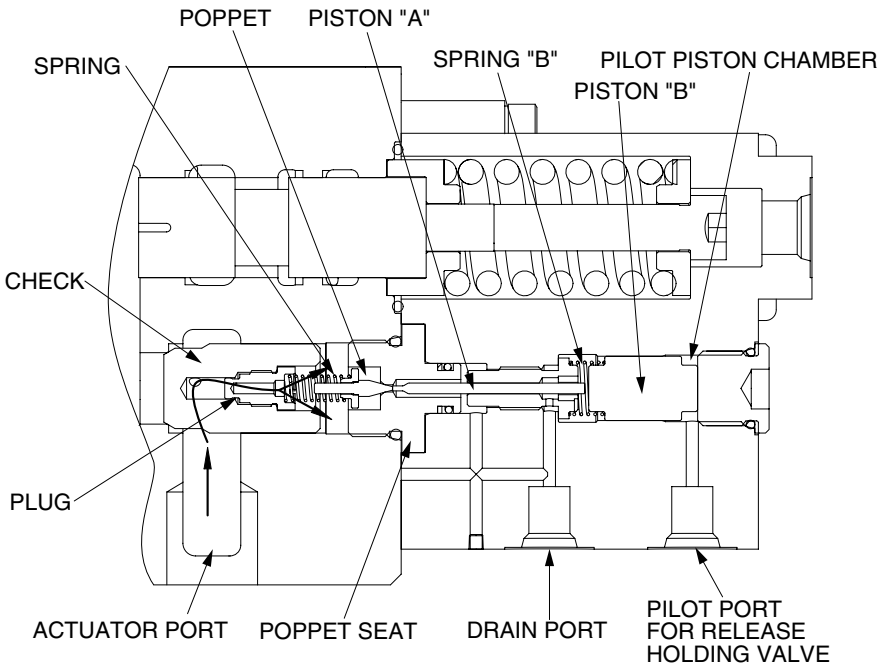


29092MC12

4) HOLDING VALVE OPERATION

(1) HOLDING OPERATION

At neutral condition, the pilot piston chamber is connected to drain port through the pilot port.
And the piston "B" is supported with spring "B".
Also, the pressured fluid from actuator entered to inside of the holding valve through the periphery hole of check, crevice of the check and the plug and the periphery hole of plug.
Then, this pressured oil pushed the poppet to the poppet seat and the check to the seat of body.
So the hydraulic fluid from actuator is not escaped and the actuator is not moved.



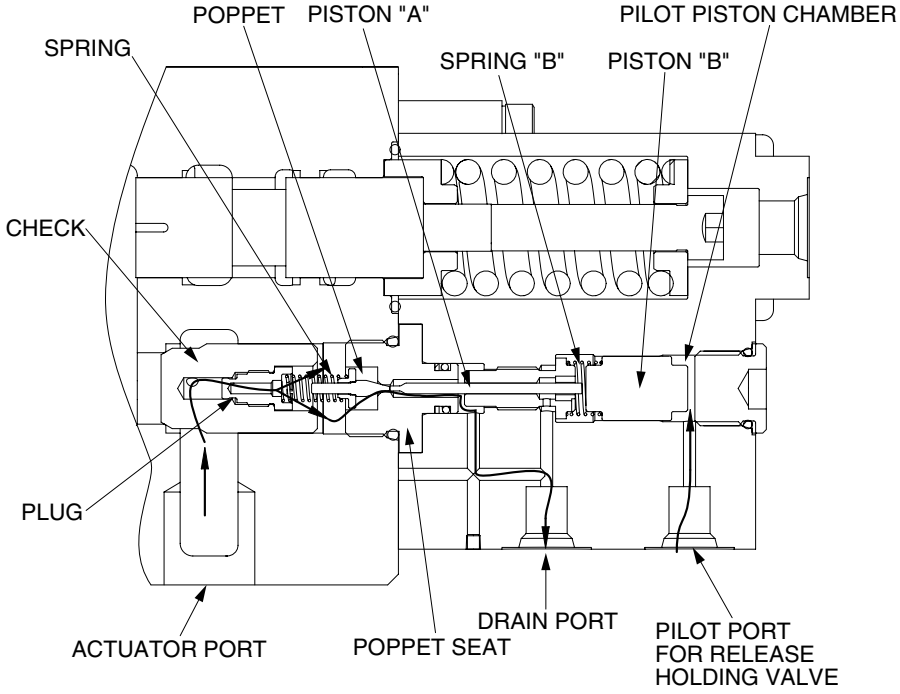
29092MC13

(2) RELEASE HOLDING OPERATION

The pilot pressure is supplied to the pilot port for release holding valve and shifts the piston "B" in the left direction against the spring "B", and shifts the poppet in the left direction through piston "B" and piston "A" against spring "B" and shifts the spool in the left side.

At same time, the return fluid from actuator returns to the drain port through the periphery hole of check, crevice of the check and the plug, the periphery hole of the plug, in side of holding valve, crevice of the poppet and the poppet seat, the periphery hole of the poppet seat, crevice of socket and spool and internal passage of spool.

When the poppet is opened, pressure of inside of holding valve is decreased and the return fluid from actuator returns to the tank passage through the notch of spool.



29092MC14

5) BUCKET OPERATION

(1) BUCKET IN OPERATION

① Bucket operation only

During the bucket in operation, the pilot secondary pressure from RCV is supplied to port of the spring side and shifts the bucket spool in the left direction.

The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P1 entered P1 parallel passage and is directed to the port A5 through the check2.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port A5 through the check1.

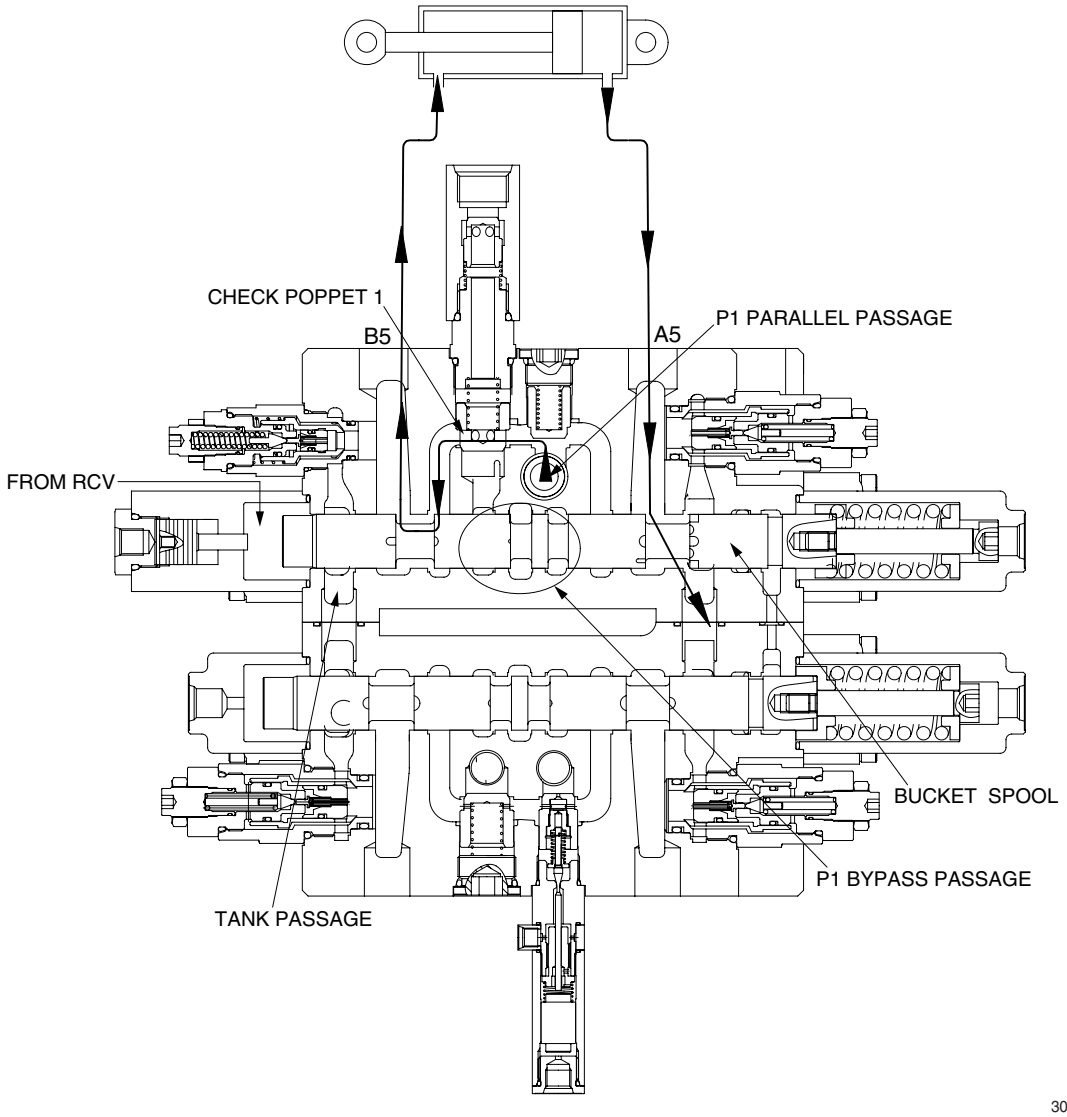
Following this it flows into the head side of the bucket cylinder.

The return flow from the rod side of the bucket cylinder returns to the bucket spool through the port B5. Thereafter it is directed to the hydraulic oil tank through the tank passage.

② Bucket operation with arm or boom operation

When combined operation, mostly same as above but the fluid from bypass passage is empty.

So only the fluid from parallel passage is supplied to the bucket cylinder. Also, parallel passage is installed the orifice for supplying the fluid from pump to the boom or the arm operation prior to the bucket operation.



300H2MC16

(2) BUCKET OUT OPERATION

① Bucket operation only

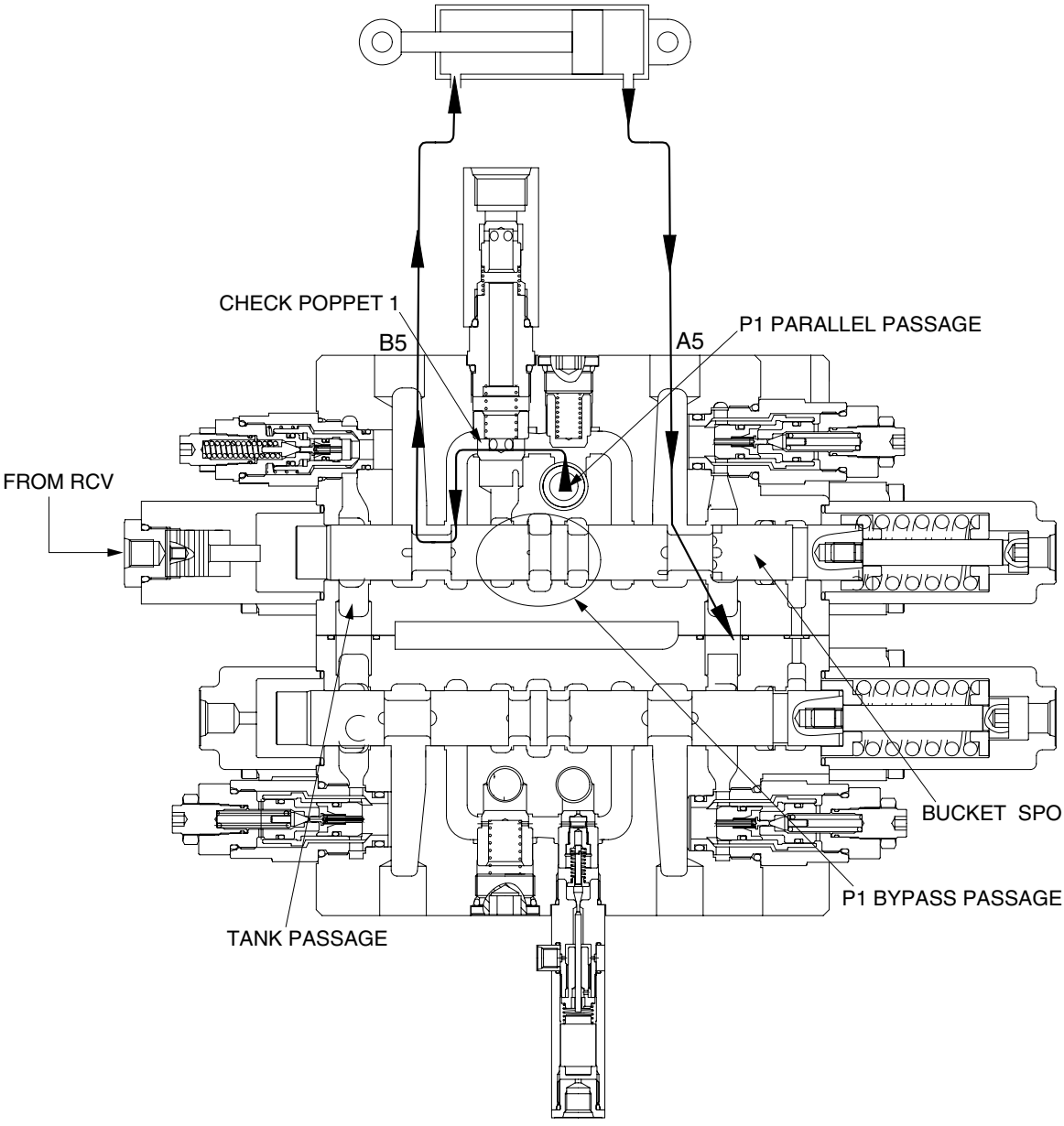
During the bucket out operation, the pilot secondary pressure from RCV is supplied to port of the spring opposite side and shifts the bucket spool in the left direction.

The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P1 entered P1 parallel passage and is directed to the port B5 through the check1.

The return flow from the rod side of the bucket cylinder returns to the hydraulic oil tank through the tank passage and the port A5.

② Bucket operation with arm or boom operation

When combined operation, the same as above.



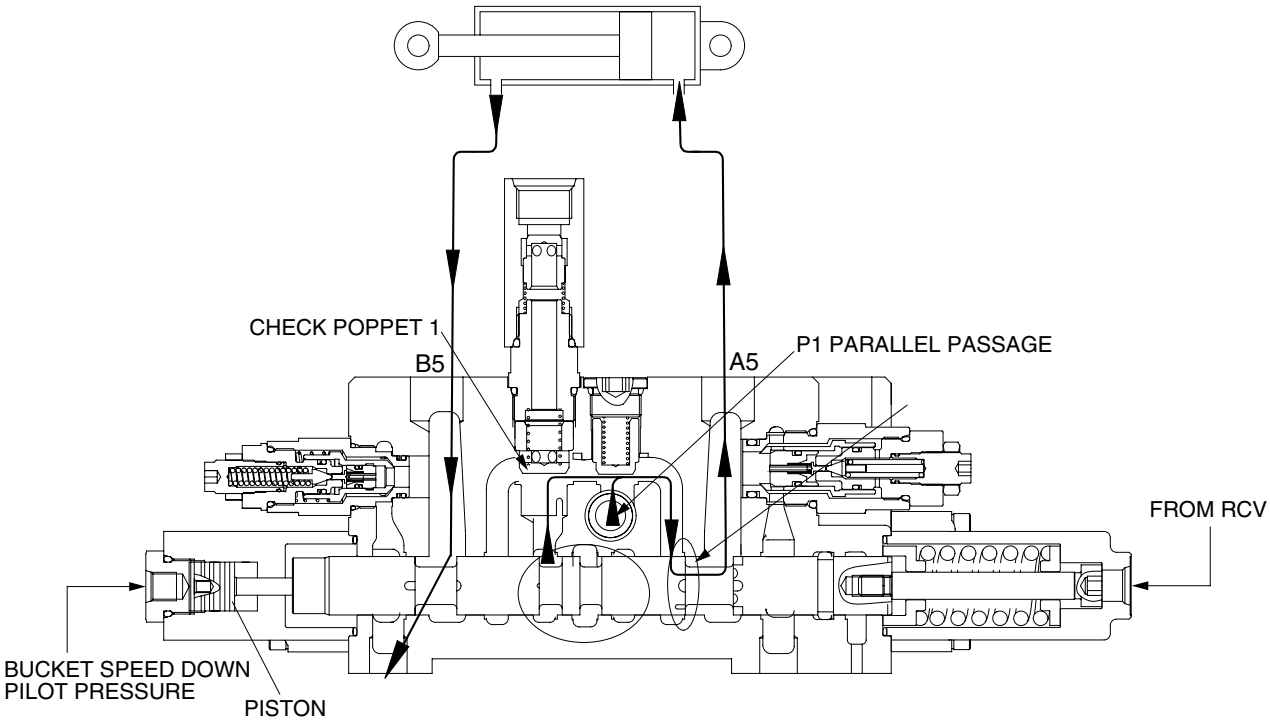
29092MC16

(3) BUCKET SLOW OPERATION

This function is used to speed up of the boom by reducing the bucket speed when bucket operation with boom operation simultaneously.

When the boom up operation, the boom up pilot pressure is supplied the pilot port of bucket spool stroke limit and the piston is shifted to the right and then the bucket spool stroke is limited and the open of the bucket spool is reduced.

Accordingly, the oil of the bucket spool is reduced and the boom speed up.



300H2MC17

6) SWING OPERATION

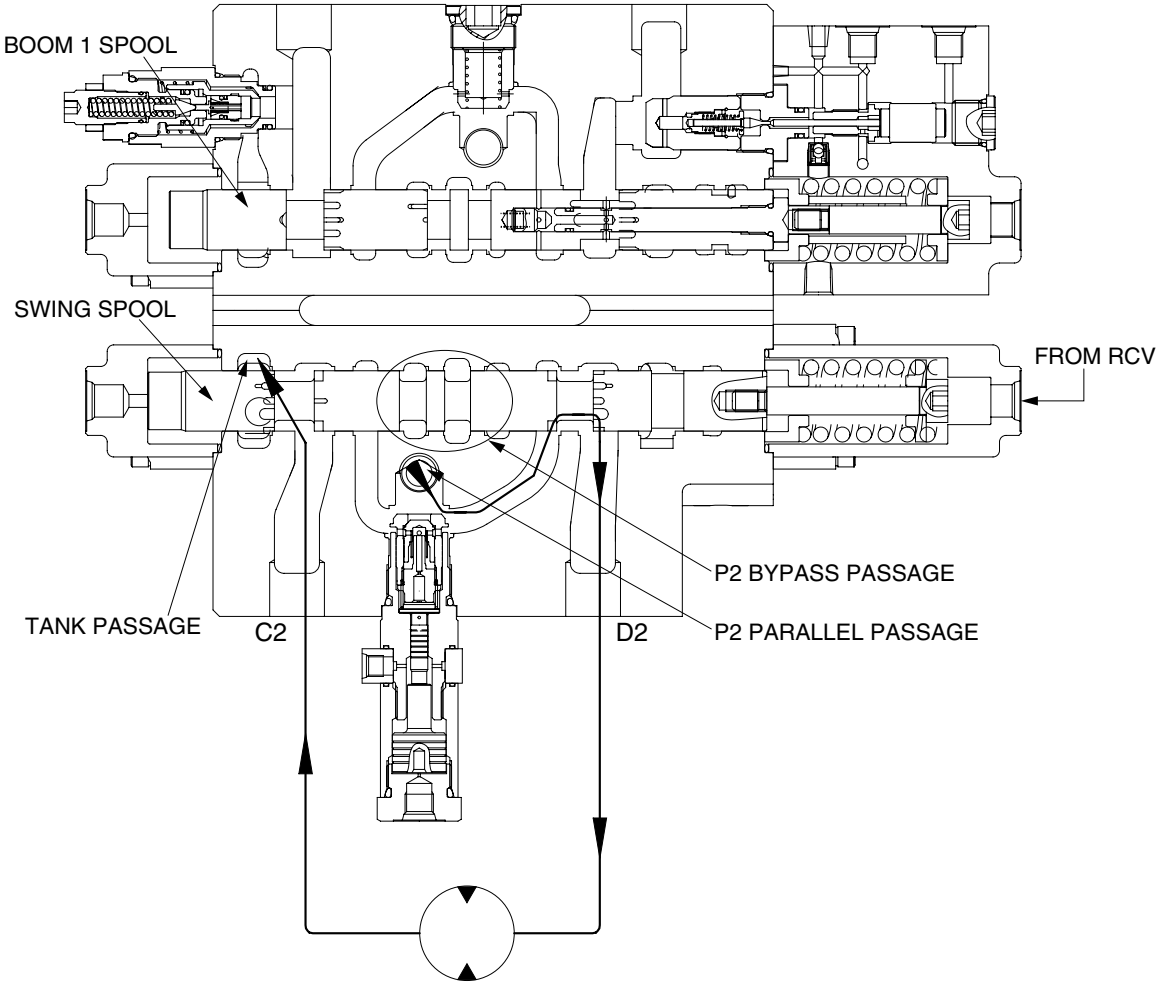
(1) SWING LEFT & RIGHT OPERATION

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shift the swing spool in left direction. The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P2 flows into swing spool through the parallel passage. Then it is directed to swing motor through the port D2.

As the result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port C2, swing spool and the tank passage.

In case of swing right operation, the operation is similar to swing left operation but the pilot secondary pressure from the RCV is supplied to the port of the spring opposite side.

Accordingly, the hydraulic fluid from pump P2 flows into swing motor through the port C2 and returns to the hydraulic oil tank through the port D2 and the tank passage.

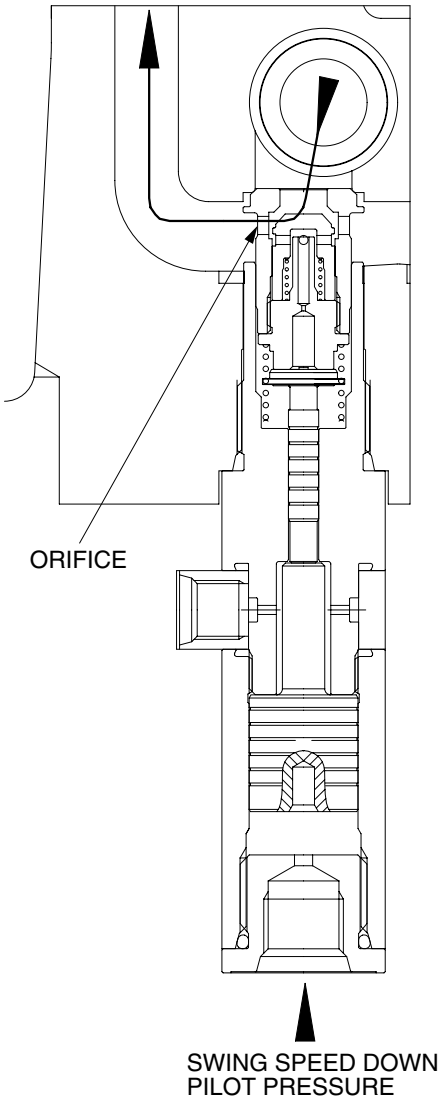


29092MC18

(2) SWING SLOW DOWN OPERATION

This operation is used to speed up the boom or arm by reducing the swing speed when swing operation with boom or arm operation.

The poppet of swing logic valve is closed by the pilot pressure of swing speed down is supplied to the port, the fluid from the port P2 is drained through orifice. Accordingly, the fluid from the port P2 is reduced and swing speed is slow down.



29092MC19

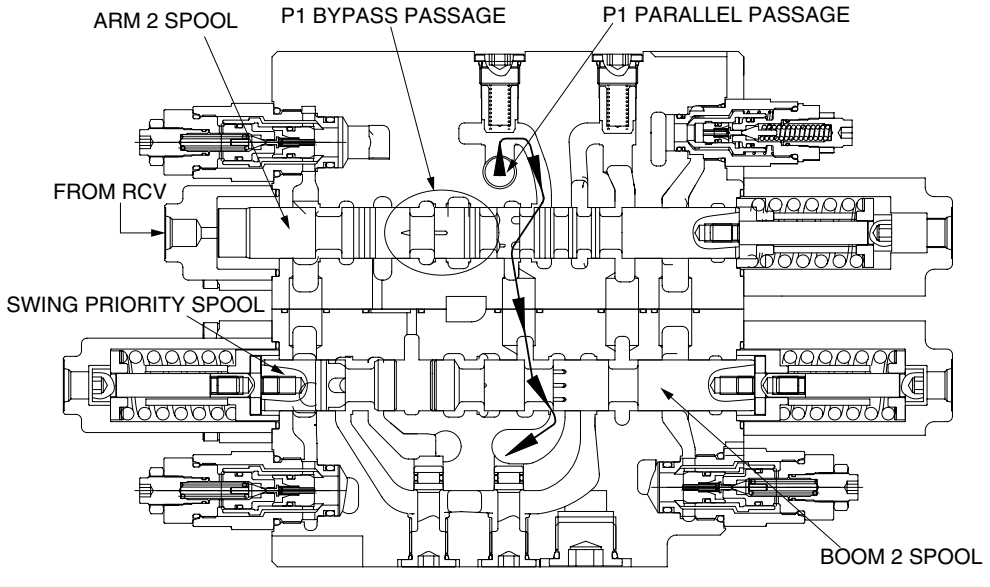
7) ARM OPERATION

(1) ARM IN OPERATION

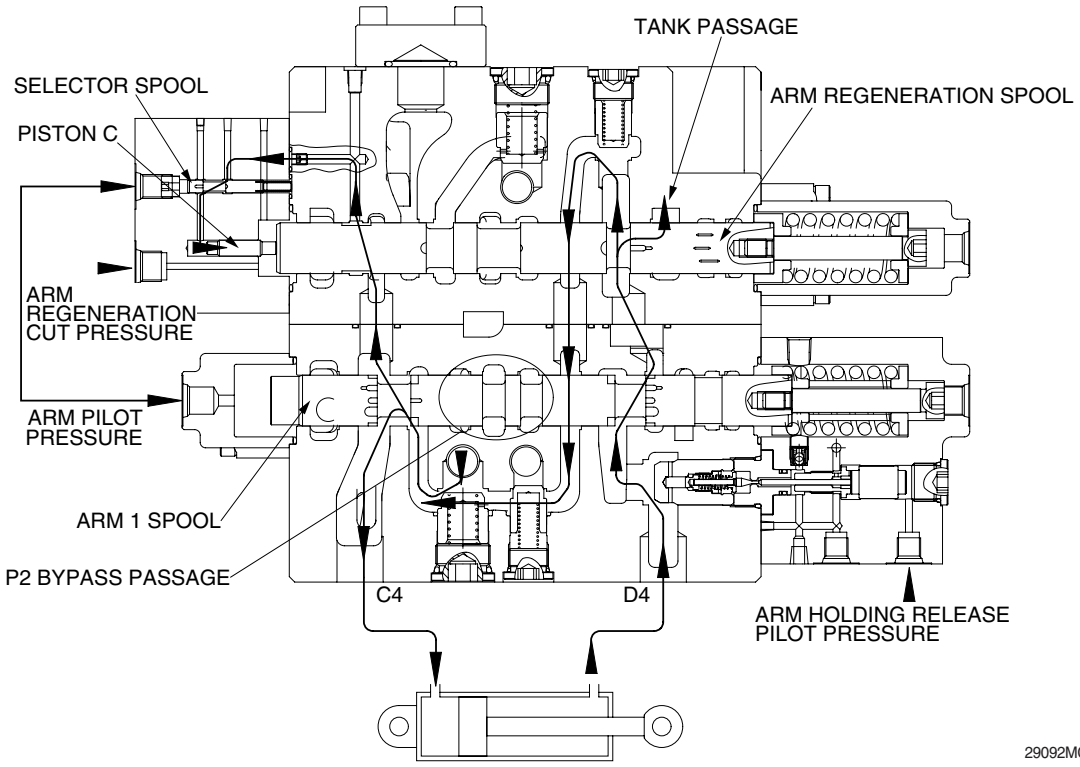
During arm in operation, the pilot secondary pressure from the RCV is supplied to the port of spring opposite side and shifts arm 1 spool in the right direction.

The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic oil from the pump P2 flows into the arm cylinder head side through P2 parallel passage, the load check valve, bridge passage and the port C4.

At same time, the pilot secondary pressure from the RCV is supplied to the port of spring opposite side and shifts arm 2 spool in the right direction. The bypass passage is shut off by the movement of the spool and the hydraulic fluid from the pump P1 flows into the arm summation passage through parallel passage, the check valve, the arm 2 spool and the boom 2 spool. Then it entered the arm cylinder head side with hydraulic fluid from arm 1 spool.



29092MC20



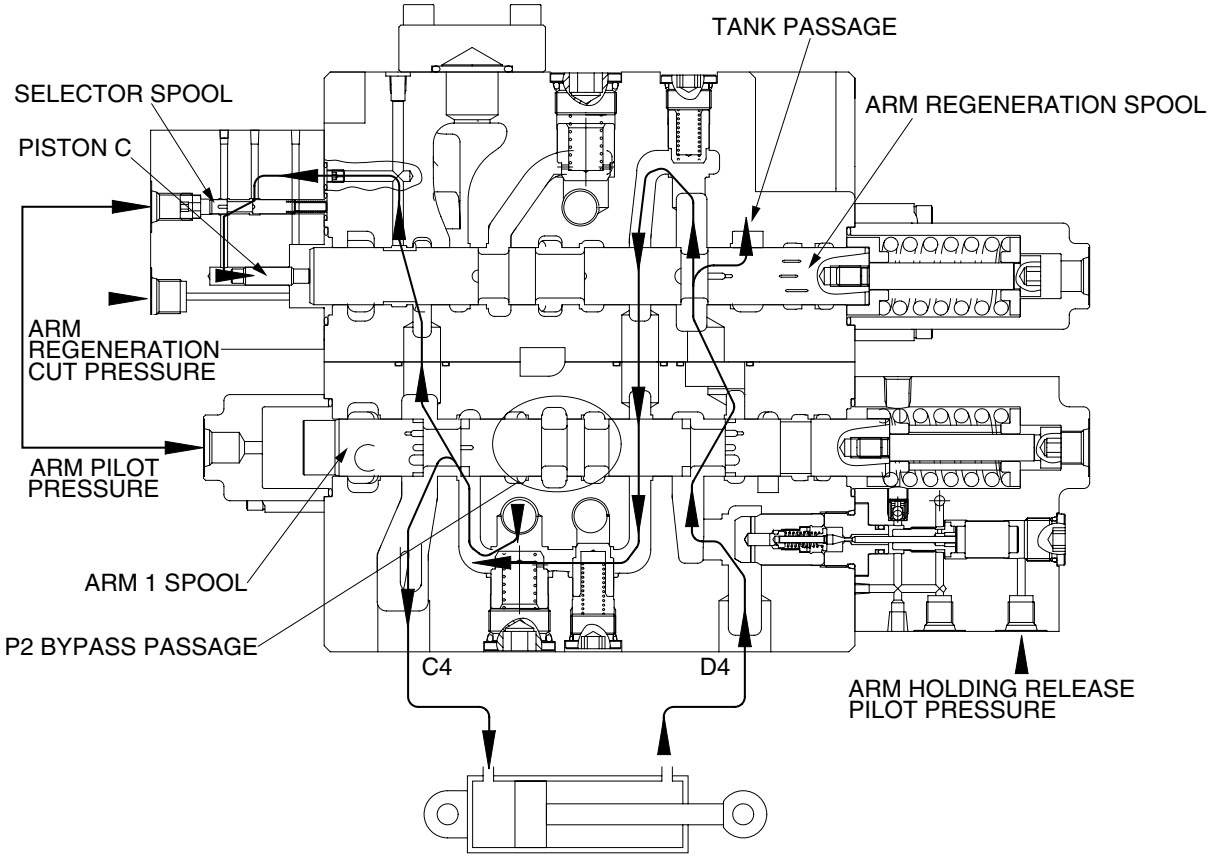
29092MC21

ARM REGENERATION

The return flow from the arm cylinder rod side is pressurized by self weight of arm and so, returns to port D4. The pressurized oil returning to port D4 enters the arm regeneration spool through the arm holding valve and the arm 1 spool. It is supplied the arm cylinder head through internal passage. This is called the arm regeneration function.

The amount of regeneration fluid is changed by movement of the arm regeneration spool. A few fluids after P2 parallel passage is push piston "C" through the notch of arm regeneration spool and selector spool. At this time, the selector spool is opened by pilot pressure from RCV.
Then, the arm regeneration spool shifts to right side and flow to tank pass increases and regeneration flow decreases. Therefore, pressure of arm cylinder head increases, then, arm regeneration flow decreases.

Furthermore, the arm regeneration cut pressure is supplied to the port of spring opposite side and arm regeneration spool is move into the right direction fully. The flow from the arm cylinder rod is returned to the hydraulic oil tank and regeneration function is not activated. (The return fluid is maximum condition)



29092MC21

(2) ARM OUT OPERATION

During arm out operation, the pilot secondary pressure from RCV is supplied to the port of spring side and shifts arm 1 spool in the left direction.

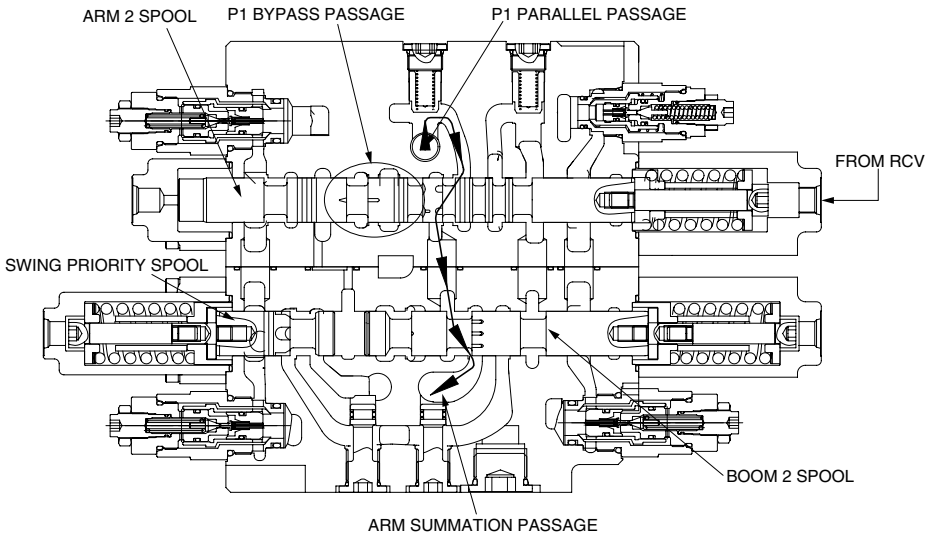
The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P2 flows into arm 1 spool through the parallel passage. Then it enters into the arm cylinder rod side through the load check valve, bridge passage, arm holding valve and the port D4.

Also, the pilot secondary pressure from RCV is supplied to the port of spring side and shifts arm 2 spool in the left direction.

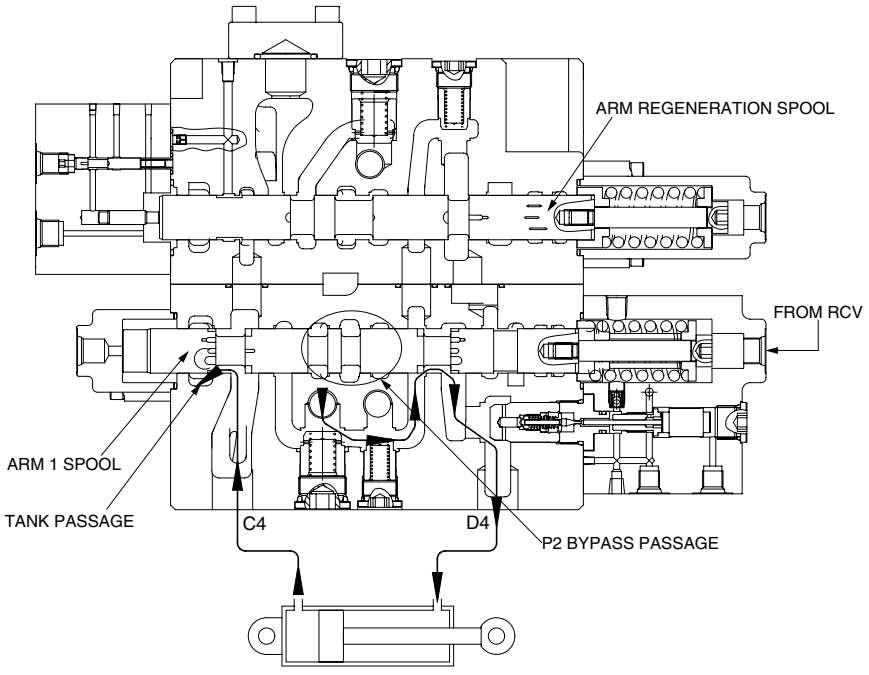
The bypass passage is shut off by the movement of the spool and some of the hydraulic fluid from pump P2 bypassed through bypass notch. The rest of hydraulic fluid from pump P2 flows into the arm summation passage through P1 parallel passage the check valve arm 2 spool and boom 2 spool.

Then it enters into the arm cylinder rod side with the fluid from the arm 1 spool.

The return flow from the arm cylinder head side returns to the hydraulic tank through the port C4 the arm 1 spool and tank passage.



29092MC22



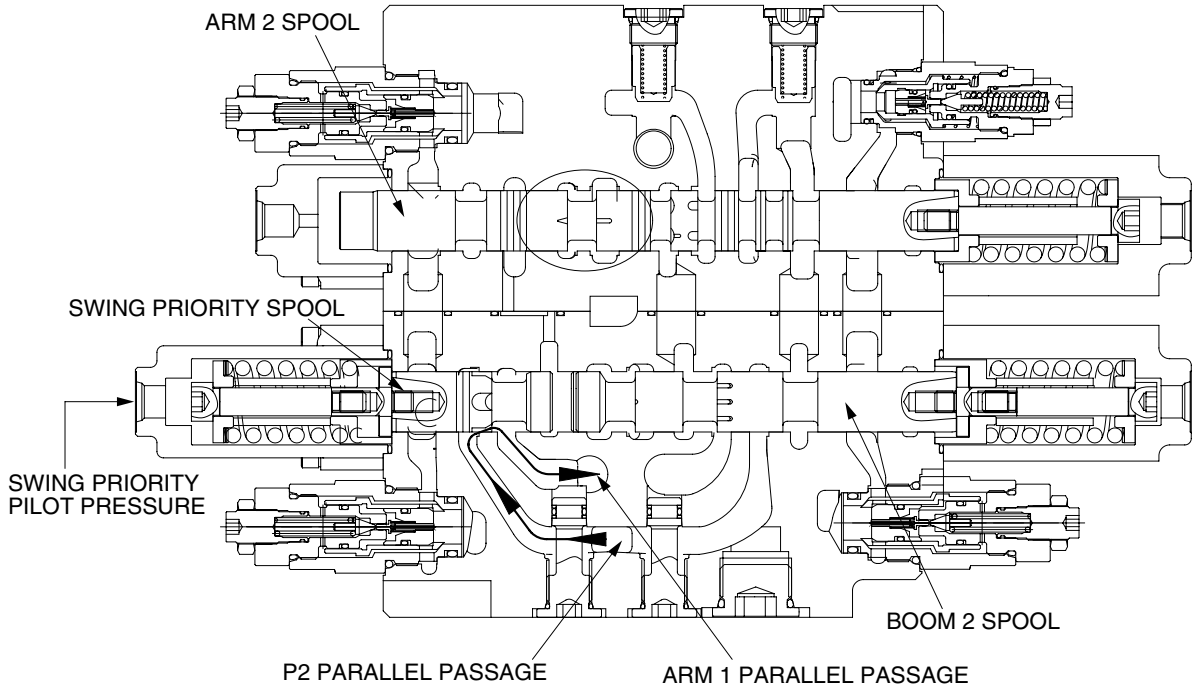
29092MC23

8) SWING PRIORITY FUNCTION

During swing priority operation, the pilot secondary pressure is supplied to the port of the spring side of the swing priority spool and shift swing priority spool in the right direction.

The hydraulic fluid from P2 parallel passage flows into the parallel passage of arm 1 side through swing priority spool and the passage "A" and also flows into the boom 2 spool.

When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the fluid from pump P2 flows to swing side more then the boom 2, arm 1, option B and bucket summation spools to make the swing operation most preferential.



29092MC24

9) OPERATION OF OPTION

(1) OPERATION BY PUMP P2

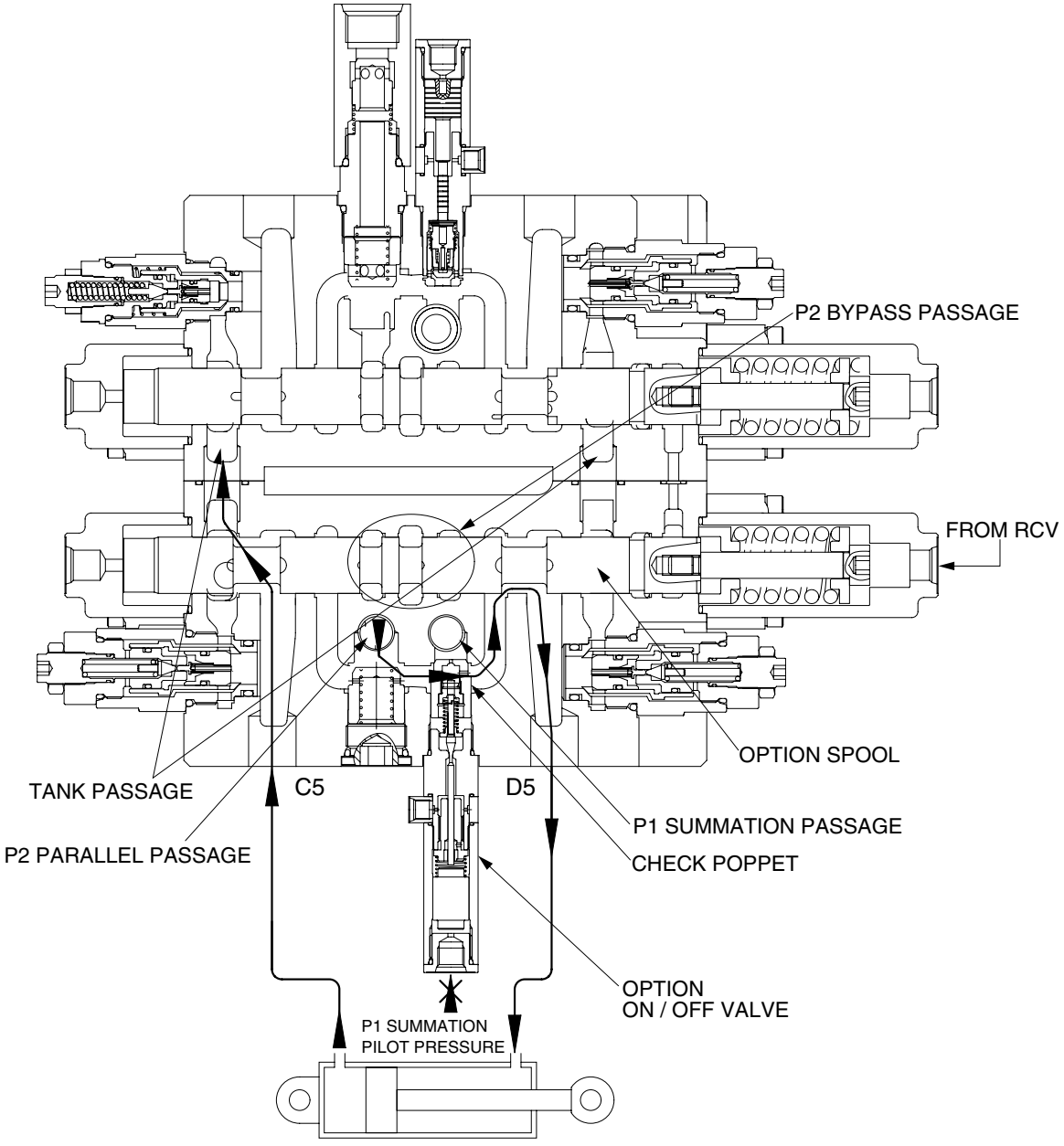
The pilot secondary pressure from RCV is supplied to the port of spring side and shifts option spool as the figure.

The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P2 flows into actuator through the load check valve, bridge passage and port D5.

If the pilot pressure is not supplied to P1 summation pilot port and is not shifts arm 2 spool. Accordingly, the pump P1 fluid connected the parallel passage is not flowing the check poppet of option ON/OFF valve and the fluid from pump is not joined the fluid from P2.

At the same time, the fluid from actuator returns to the tank passage through port C5 and notch of the option spool.

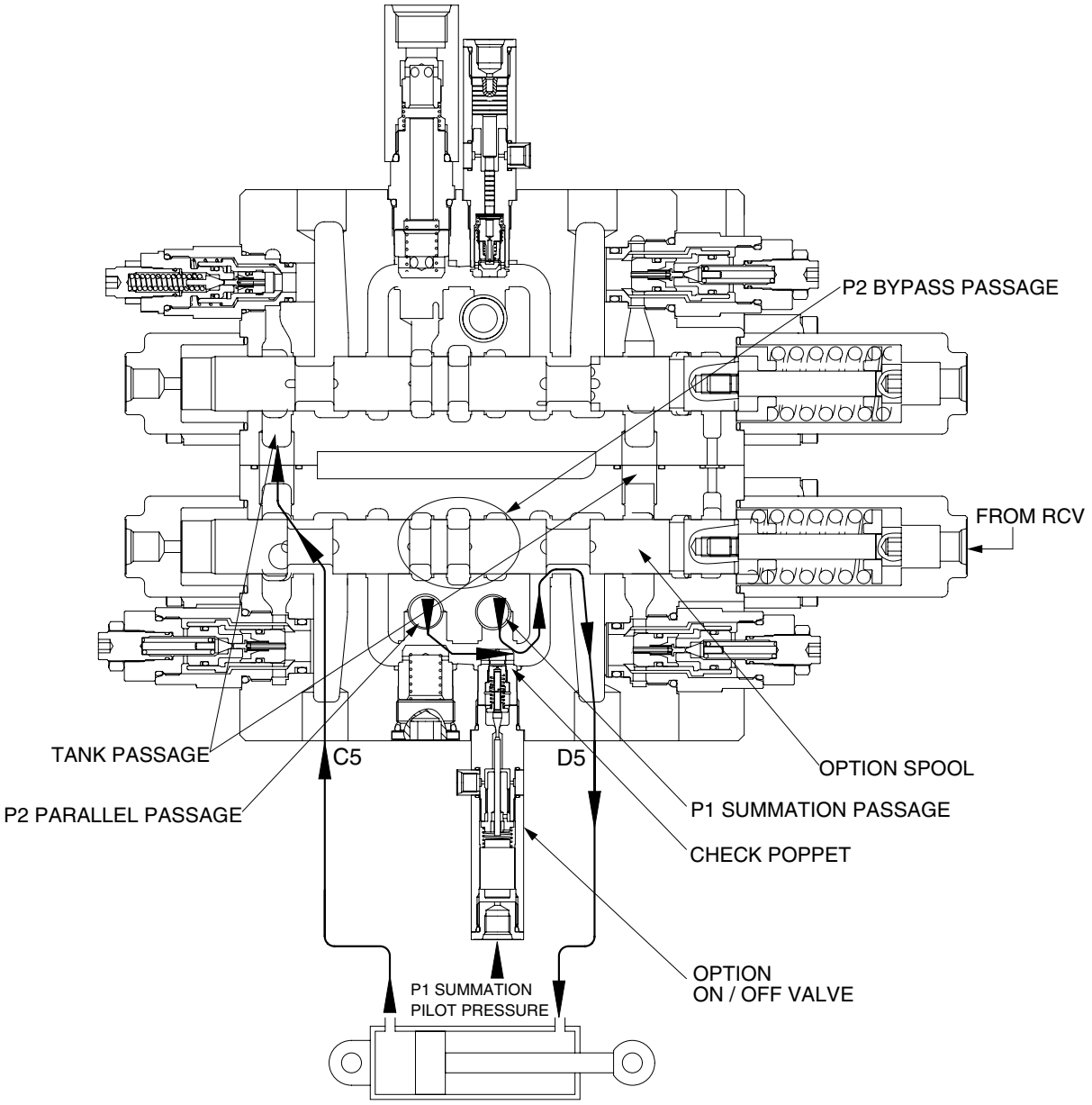
In case of reverse operation, the operating principle is same as above.



29092MC26

(2) SUMMATION OPERATION WITH PUMP P1

The pilot pressure from RCV is supplied to option pilot port and one of arm 2 pilot port at the same time, the fluid for the arm summation is build up. This fluid flows into the arm 1 spool priority but the arm is not operated, the fluid flows into P1 summation passage. Now the pilot pressure of RCV is supplied to the P1 summation pilot port of option ON/OFF valve, the fluid from pump P1 opens the load check valve and flows into port D5 with the fluid of pump P2.



29092MC27

11) NEGATIVE RELIEF VALVE OPERATION

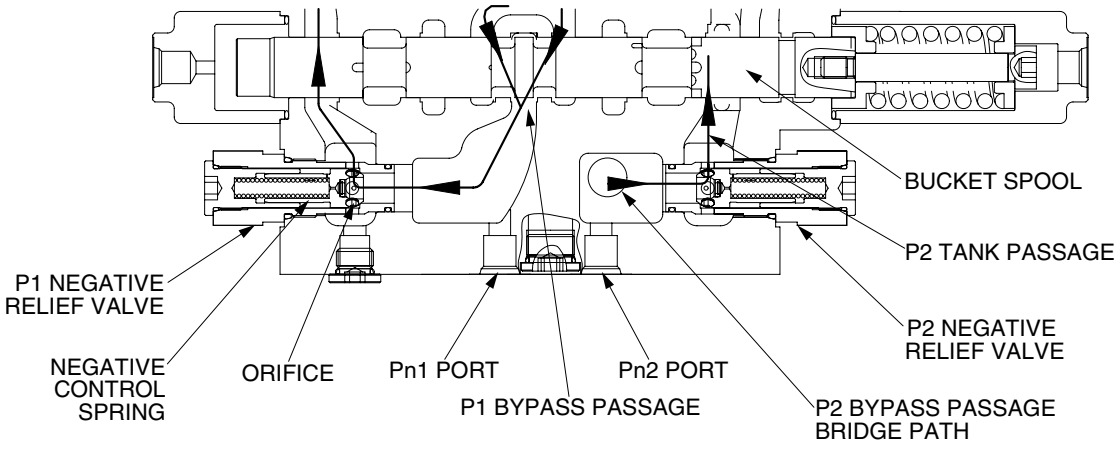
When no function is being actuated on P1 side, the hydraulic fluid from the pump P1, flows into the tank passage through the bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump P1 regulator.

It controls the pump regulator so as to minimize the discharge of the pump P1.

The bypass passage is shut off when the shifting of one or more spools and the flow through bypass passage became zero. The pressure of negative control signal becomes zero and the discharge of the pump P1 becomes maximum.

The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

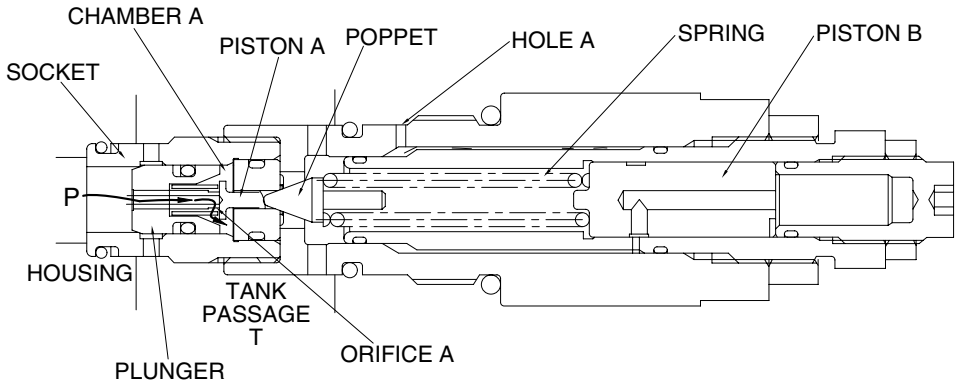
For the pump P2 the same negative control principle.



29092MC28

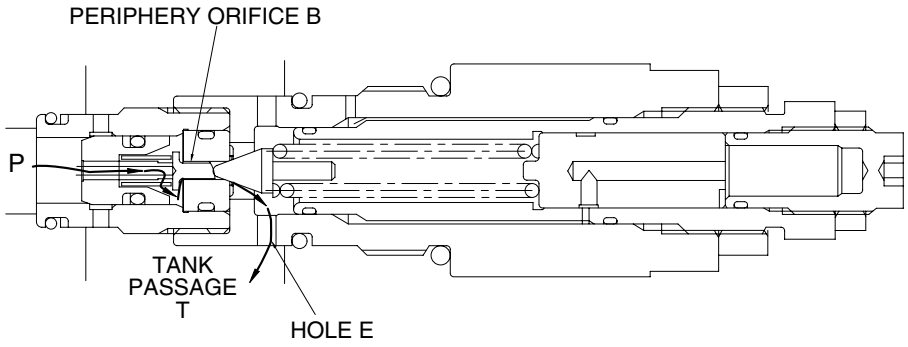
12) OPERATION OF MAIN RELIEF VALVE

(1) The pressurized oil passes through the orifice (A) of the plunger is filled up in chamber A of the inside space, and seats the plunger against the housing securely.



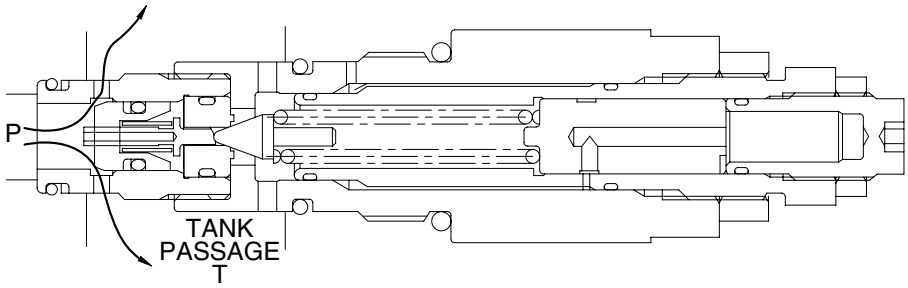
29092MC29

(2) When the pressure at (P) becomes equal to the set pressure of the spring the hydraulic oil passes through the piston (A) pushes open the poppet and flows to tank passage (T) through the plunger internal passage, periphery orifice A, chamber A, periphery orifice B and the hole (E).



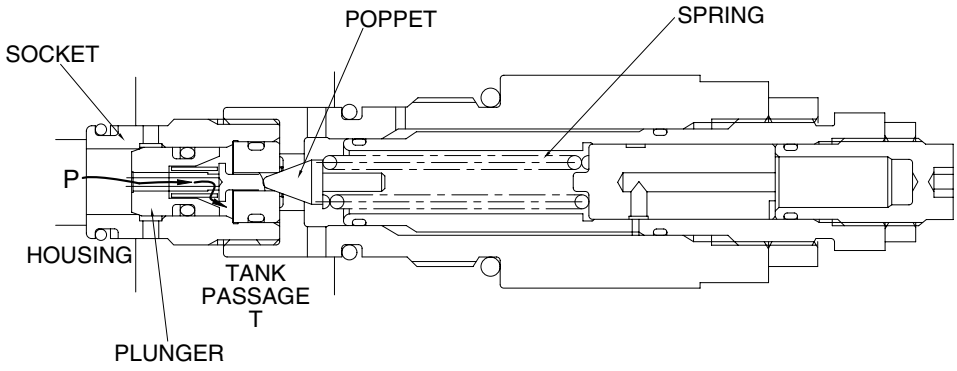
29092MC30

(3) Opening the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



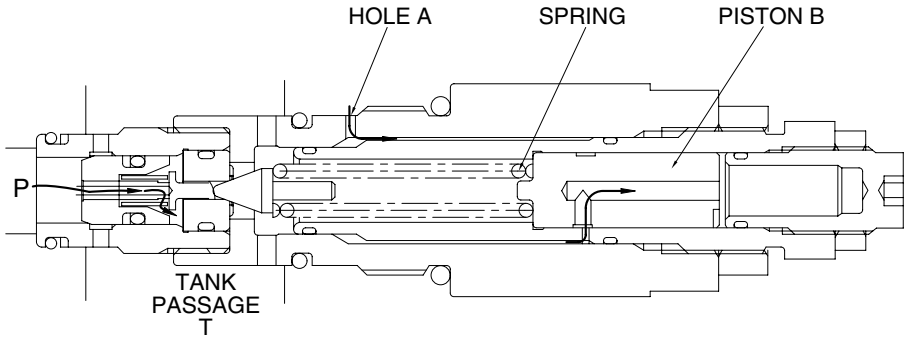
29092MC31

(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



29092MC29-2

(5) When the power boost switch is ON, the pilot pressure enters through hole A.
It pushes the piston (B) in the left direction to increase the force of the spring and change the relief set pressure to the high pressure.

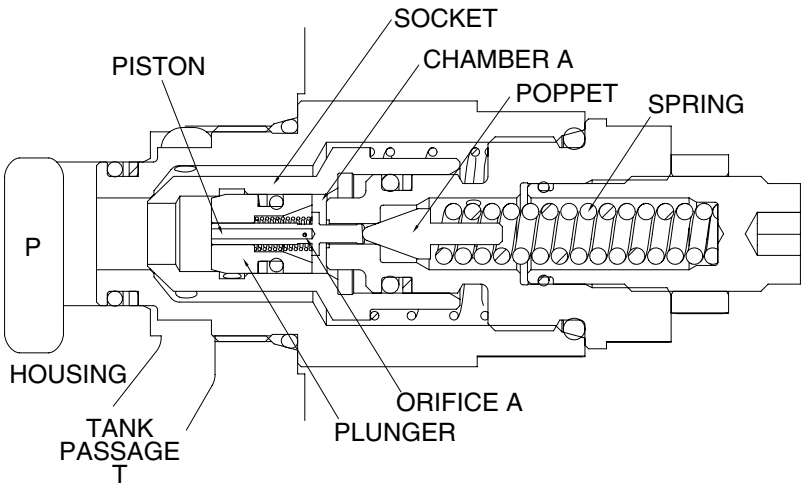


29092MC29-1

13) OPERATION OF OVERLOAD RELIEF VALVE

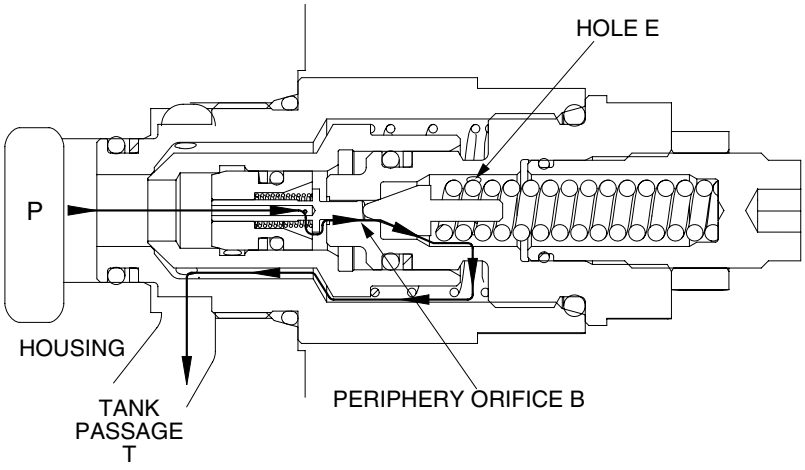
FUNCTION AS RELIEF VALVE

(1) The pressurized oil passes through the piston and orifice A is filled up in chamber A of the inside space and seat the plunger against the socket and the socket against the housing securely.



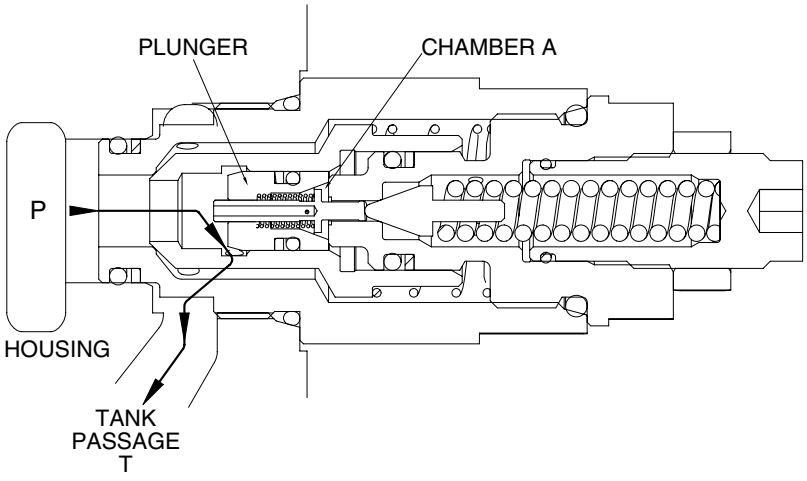
29092MC32

(2) When the pressure at port P becomes equal to the set pressure of the spring, the pressurized oil pushes open the poppet and flows to tank passage (T) through the plunger internal passage, orifice A, chamber A, periphery orifice B and hole E.



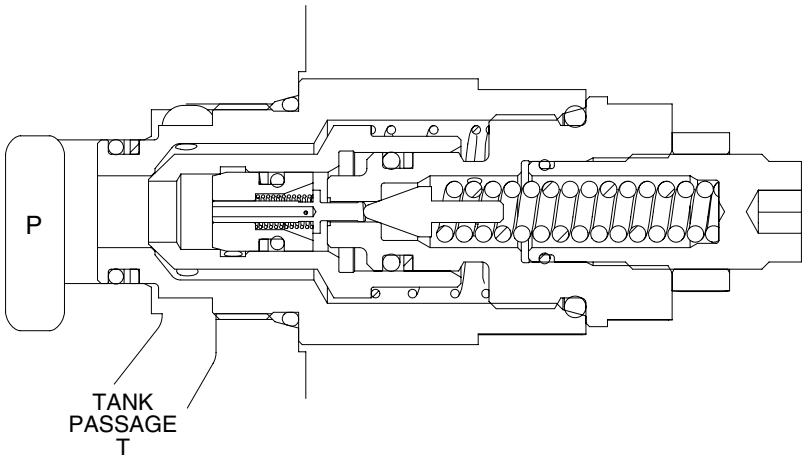
29092MC33

(3) Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



29092MC34A

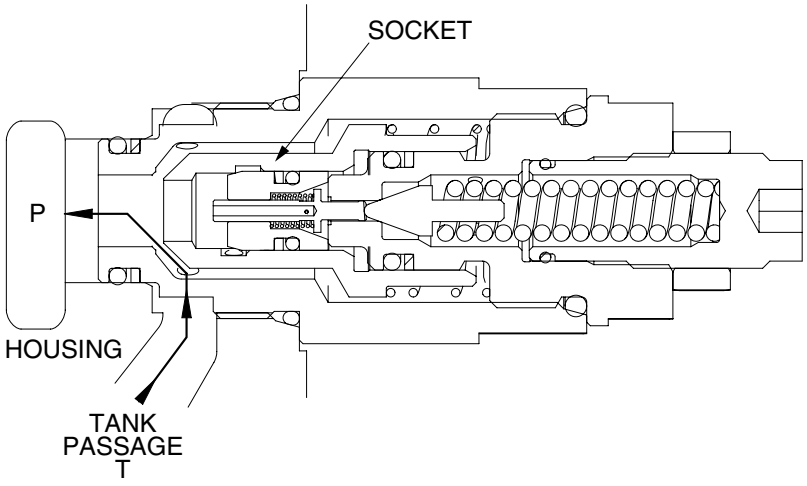
(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



29092MC32-1

MAKE-UP FUNCTION

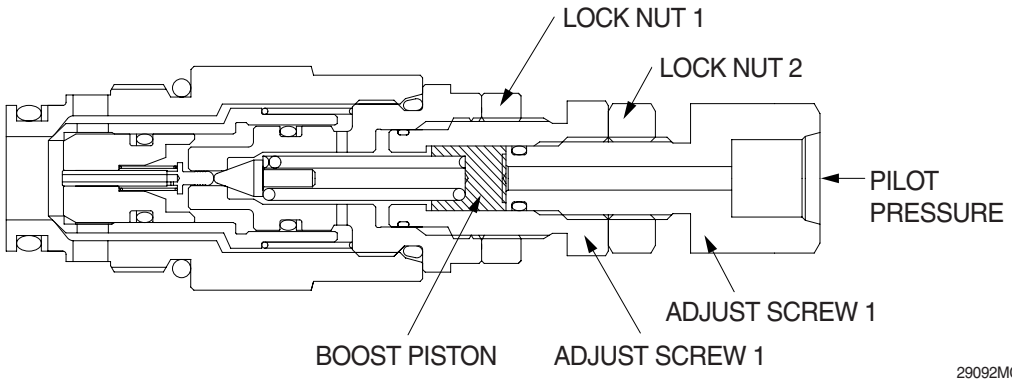
(5) When negative pressure exists at port P, the oil is supplied through tank passage (T). When the pressure at tank passage (T) becomes higher than that of at port P, the socket moves in the right direction. Then, sufficient oil passes around the socket from tank passage (T) to port P and fills up the space.



29092MC35

14) BREAKER OVERLOAD RELIEF VALVE FUNCTION

(1) The structure and function of 2 stage relief valve is similar with the overload relief but it can set the higher pressure by pilot pressure.



29092MC46

Boost function

(1) When the pilot pressure is supplied, the spring is a little compressure by moving of the boost piston and the set pressure is higher as length of spring compressed.

Pressure set method

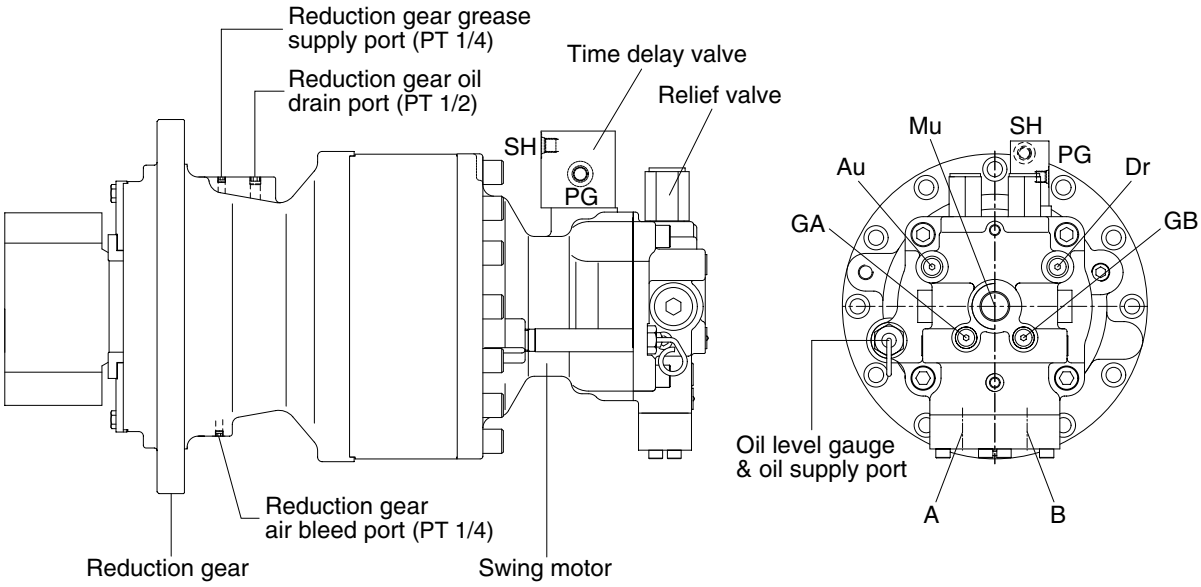
(2) Loosen lock nut 1 and 2 and then full tighten adjust screw 2.
(3) Set the high pressure by adjusting the adjust screw 1 and 2 and then fix it by the lock nut 1.
Keep the adjust screw 1 do not move when fixing the lock nut 1.
(4) Set the low pressure by adjusting the adjust screw 2 and then fix it by the lock nut 2.
Keep the adjust screw 2 do not move when fixing the lock nut 2.

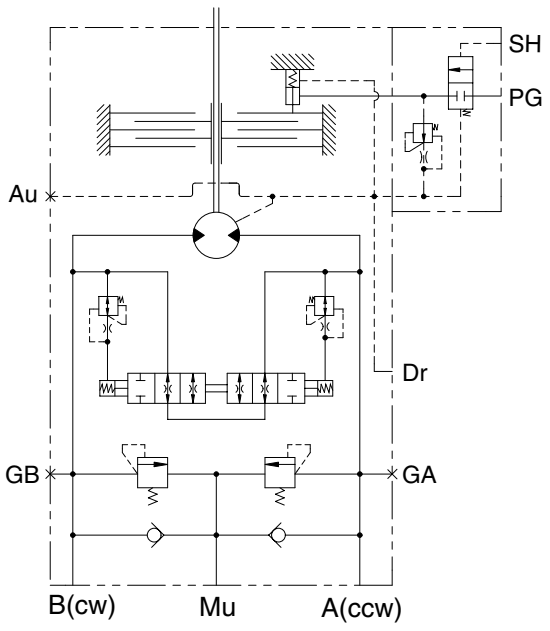
GROUP 3 SWING DEVICE

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.



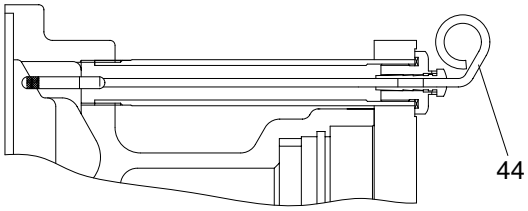


Hydraulic circuit

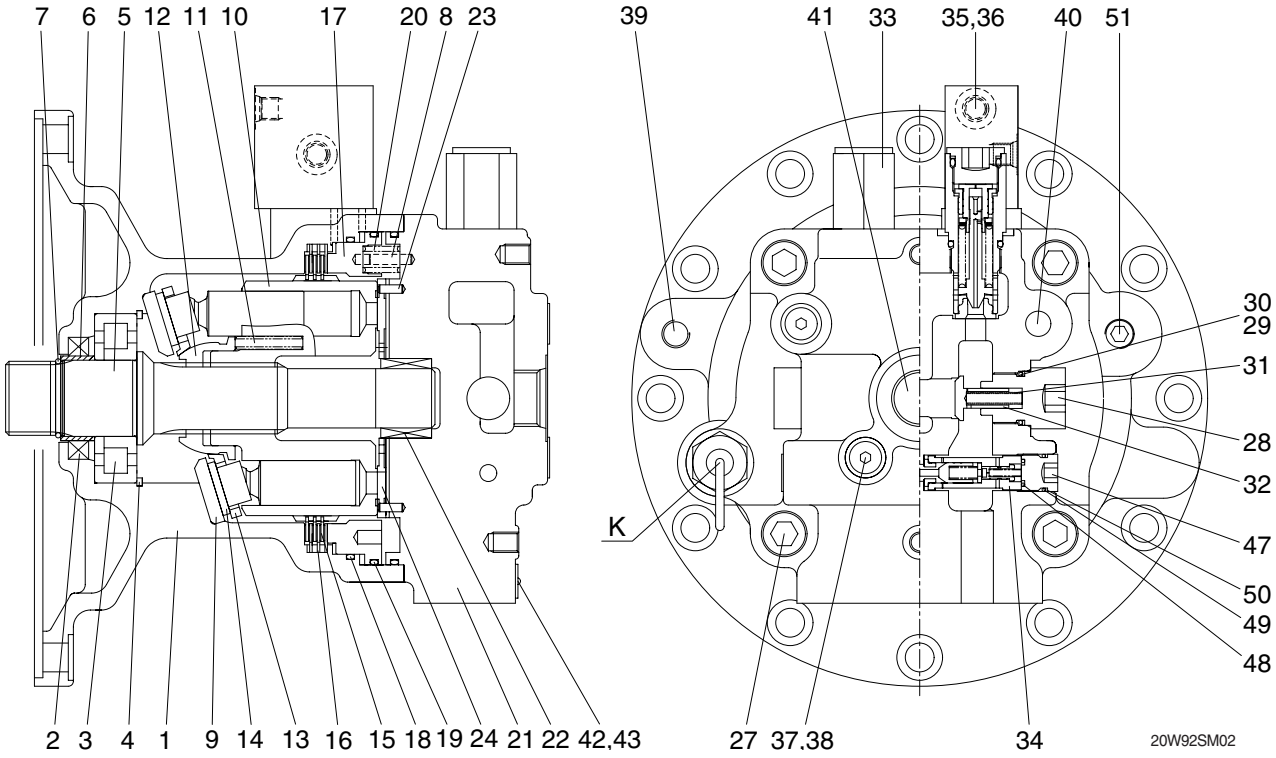
Port	Port name	Port size
A	Main port	ø 20
B	Main port	ø 20
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1
PG	Brake release port	PF 1/4
SH	Stand by port	PF 1/4
GA, GB	Gauge port	PF 1/4
Au	Air vent port	PF 1/4

21092SM01

1) SWING MOTOR

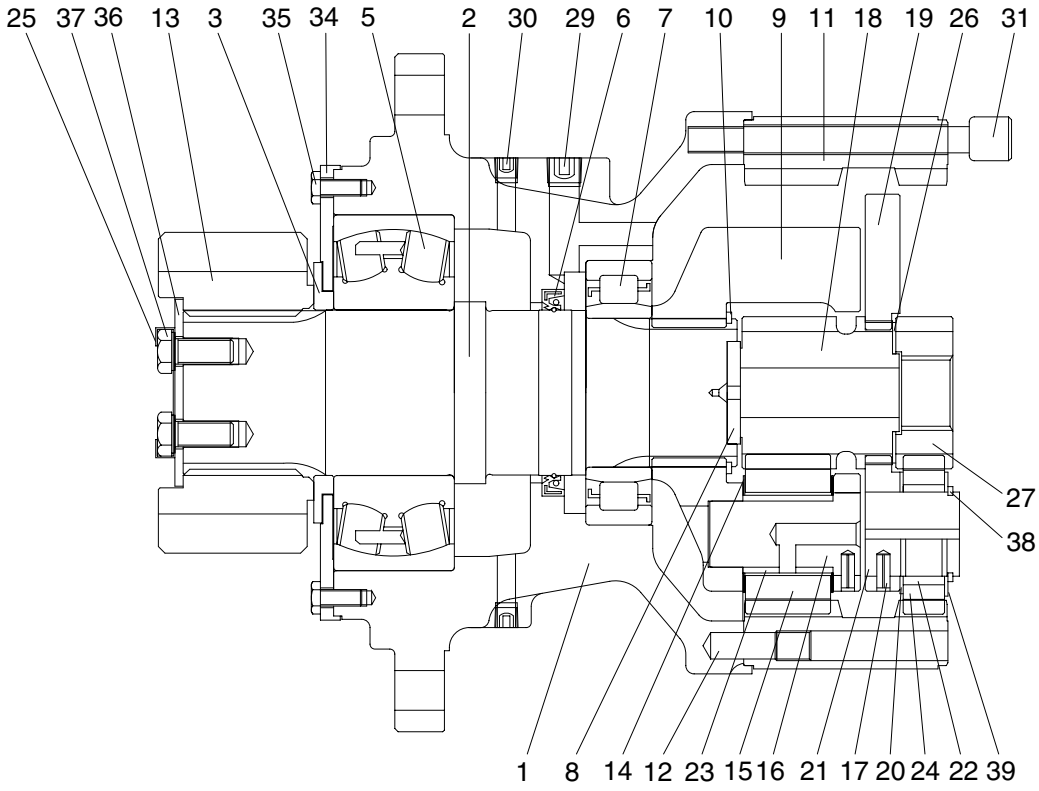


DETAIL K



1	Body	18	O-ring	37	Plug
2	Oil seal	19	O-ring	38	O-ring
3	Roller bearing	20	Brake spring	39	Plug
4	Snap ring	21	Rear cover	40	Plug
5	Shaft	22	Needle bearing	41	Plug
6	Bushing	23	Pin	42	Name plate
7	Stop ring	24	Valve plate	43	Rivet
8	Pin	27	Wrench bolt	44	Level gauge
9	Shoe plate	28	Plug	45	Flange
10	Cylinder block	29	Back up ring	46	O-ring
11	Spring	30	O-ring	47	Plug
12	Ball guide	31	Spring	48	O-ring
13	Set plate	32	Check	49	O-ring
14	Piston assy	33	Relief valve	50	Back up ring
15	Friction plate	34	Anti-inversion valve	51	Plug
16	Separate plate	35	Time delay valve		
17	Brake piston	36	Wrench bolt		

2) REDUCTION GEAR



21092SM03

1	Casing	14	Thrust washer	26	Side plate 3
2	Drive shaft	15	Planet gear 2	27	Sun gear 1
3	Spacer	16	Pin & bushing	29	Plug
5	Roller bearing	17	Spring pin	30	Plug
6	Oil seal	18	Sun gear 2	31	Socket bolt
7	Roller bearing	19	Carrier 1	34	Cover plate
8	Thrust plate	20	Side plate 1	35	Hexagon bolt
9	Carrier 2	21	Pin 1	36	Lock plate
10	Stop ring	22	Needle cage	37	Hexagon bolt
11	Ring gear	23	Bushing 2	38	Stop ring
12	Knock pin	24	Planet gear 1	39	Side plate 2
13	Pinion gear	25	Lock washer		

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder (10) through valve casing of motor (21), and valve plate (24).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (14).

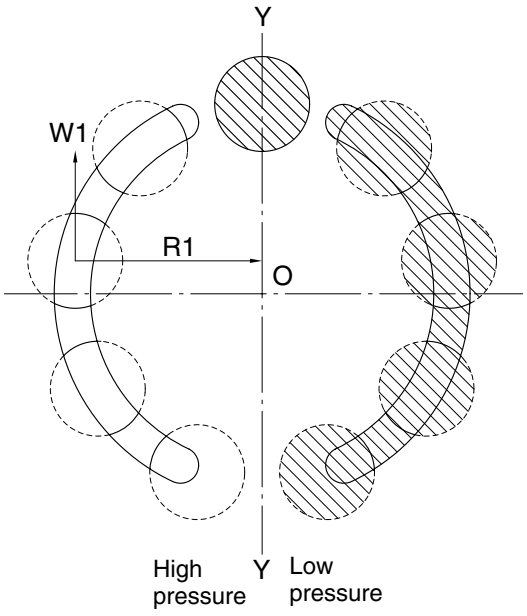
The high hydraulic can generate the force, F1=P × A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

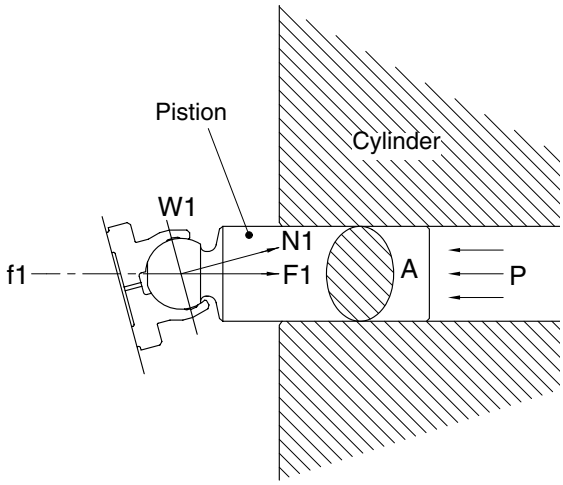
This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α .

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 (10) 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

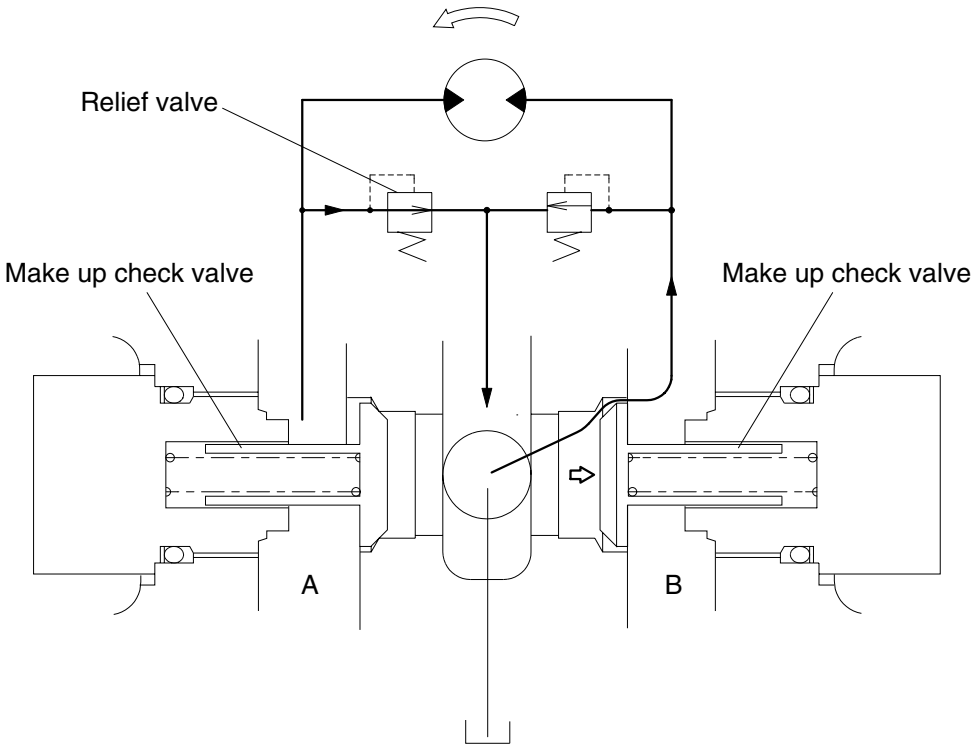
2) MAKE UP VALVE

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.

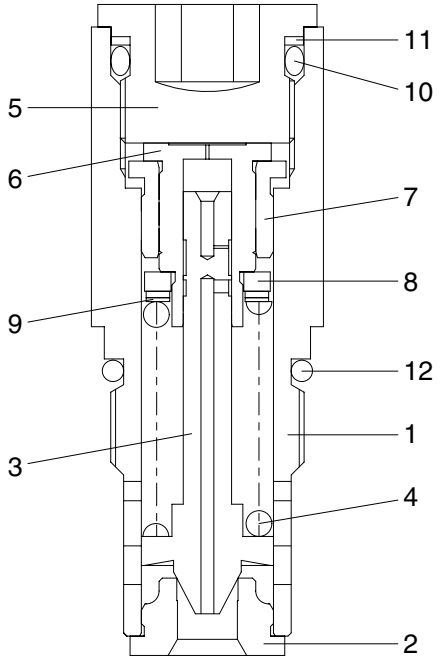
Pressurized oil into the port B, the motor rotate counterclockwise.

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



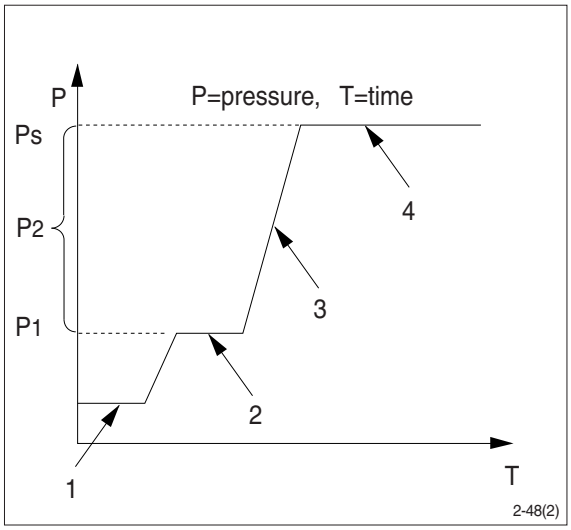
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

(1) Construction of relief valve

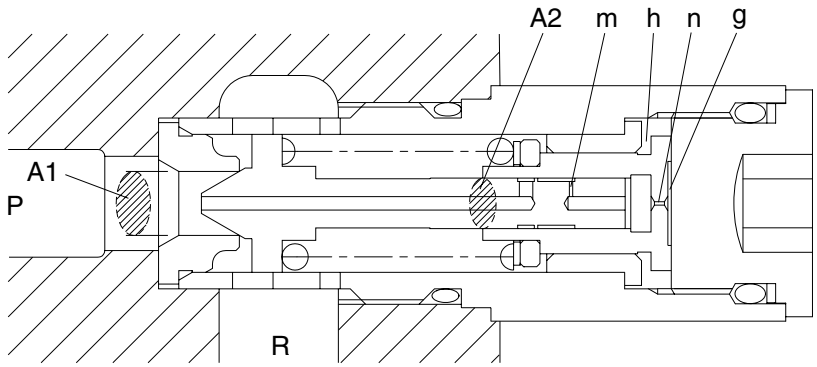
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.

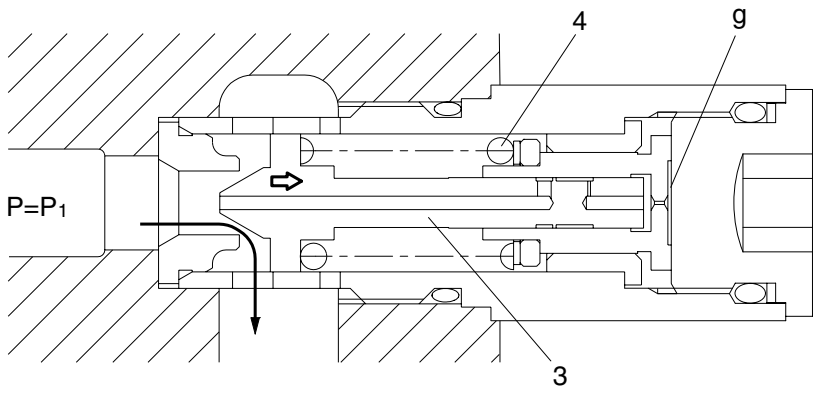


14007A2SM06

② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (4), the plunger (3) moves to the right as shown.

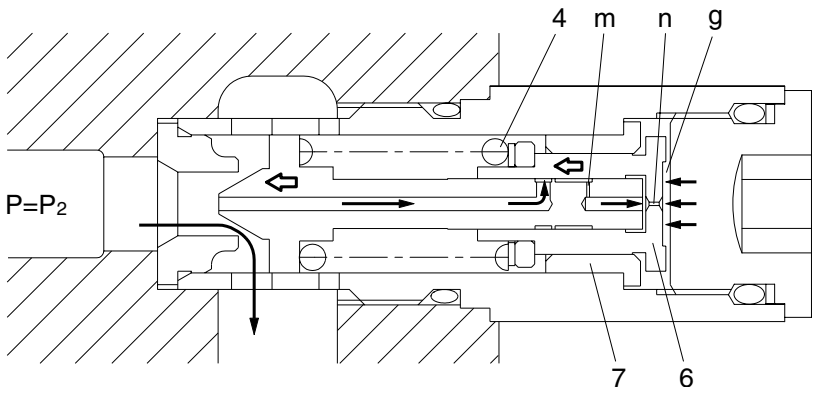
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



14007A2SM07

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 (6) moves left and stop the piston (6) hits the bottom of bushing (7).

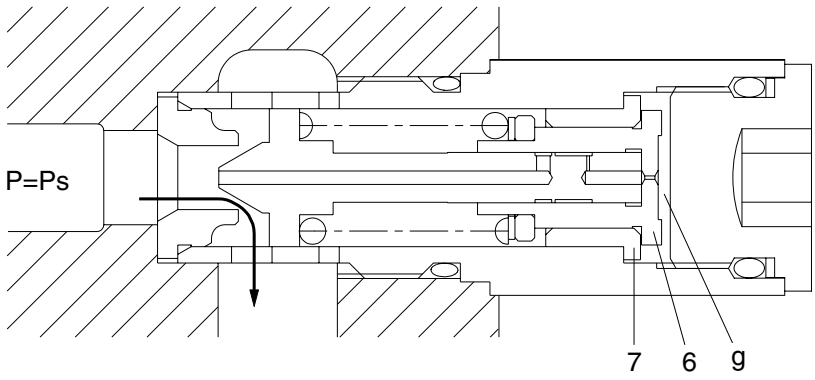


14007A2SM08

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

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

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



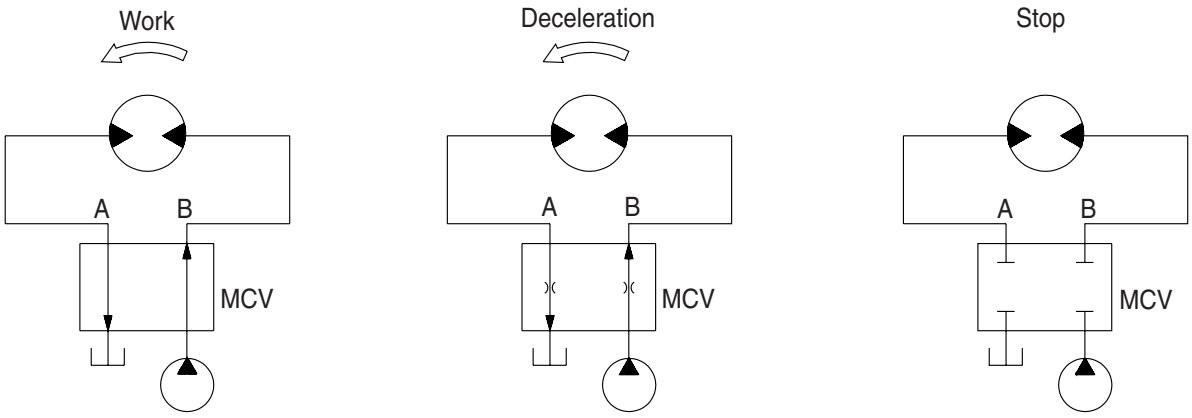
14007A2SM09

4) BRAKE SYSTEM

(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)

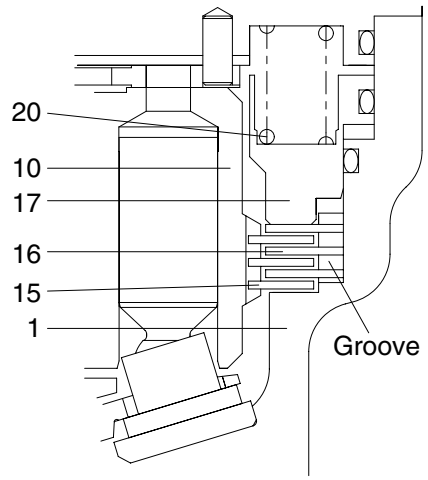
(2) Mechanical swing parking brake system

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

① **Brake assembly**

Circumferential rotation of separate plate (16) is constrained by the groove located at housing (1). When housing is pressed down by brake spring (20) through friction plate (15), separate plate (16) and brake piston (17), friction force occurs there.

Cylinder block (10) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

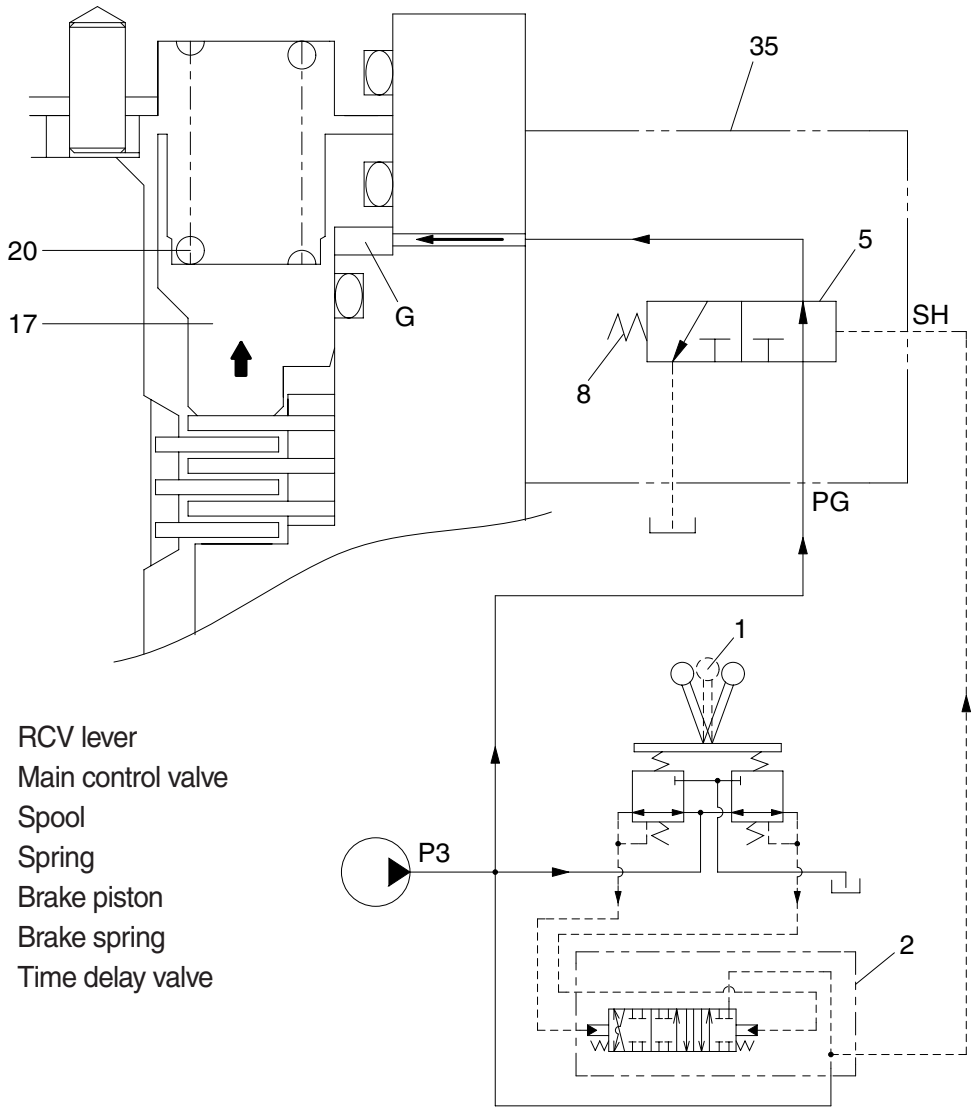


21092SM15

1	Housing	16	Separate plate
10	Cylinder block	17	Brake piston
15	Friction plate	20	Spring

② **Operating principle**

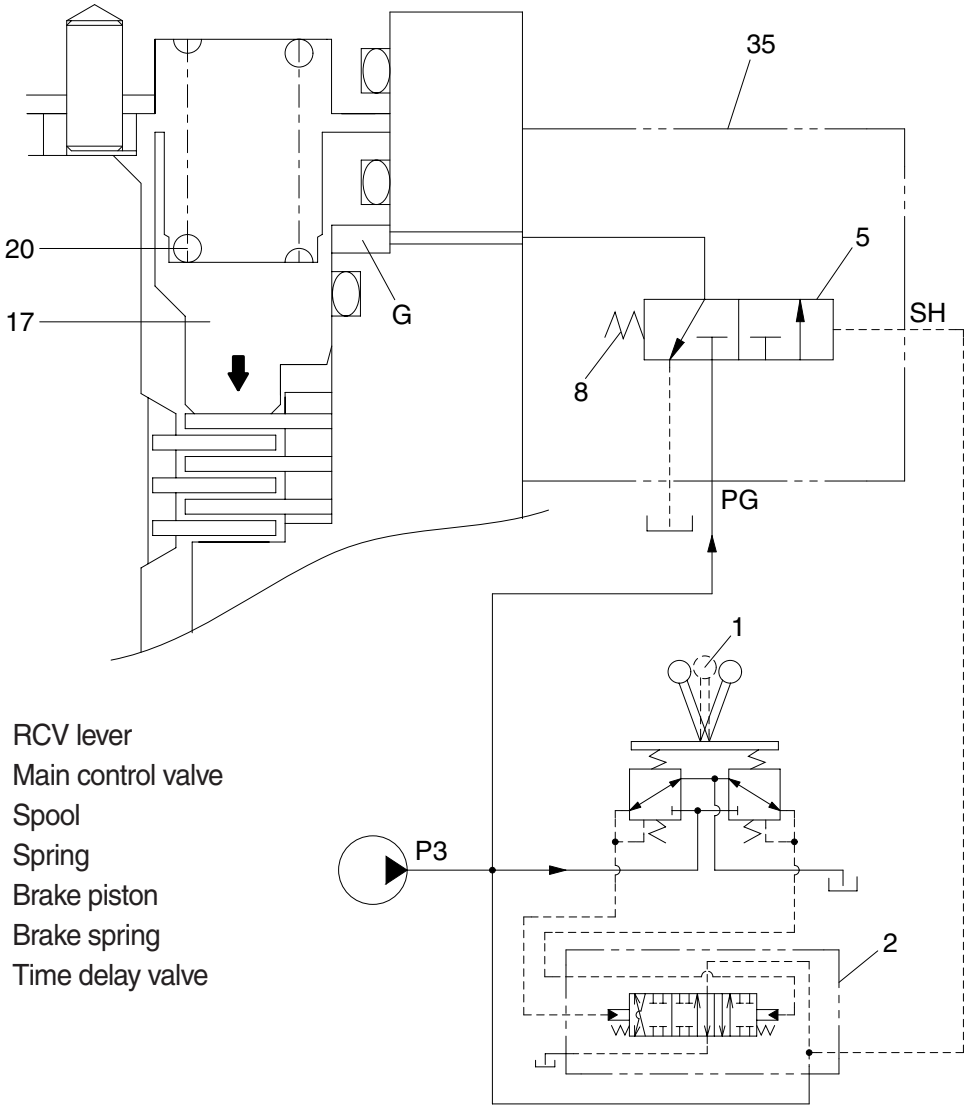
a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (35). This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the piston (17) to the upward against the force of the spring (20). Thus, it releases the brake force.



1 RCV lever
2 Main control valve
5 Spool
8 Spring
17 Brake piston
20 Brake spring
35 Time delay valve

21092SM16

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the brake piston (17) 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 Main control valve
5 Spool
8 Spring
17 Brake piston
20 Brake spring
35 Time delay valve

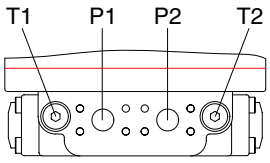
21092SM17

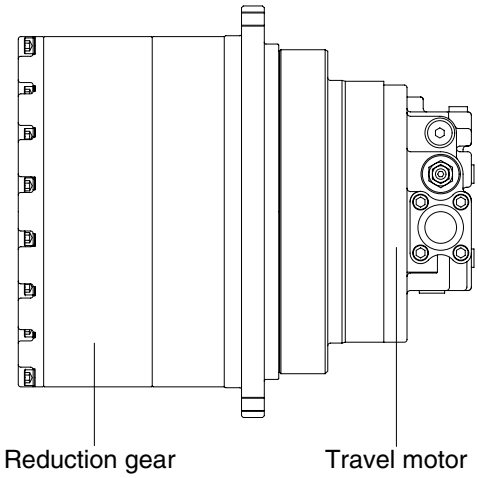
GROUP 4 TRAVEL DEVICE

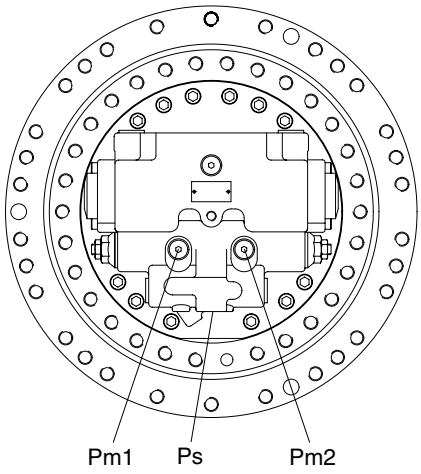
1. STRUCTURE

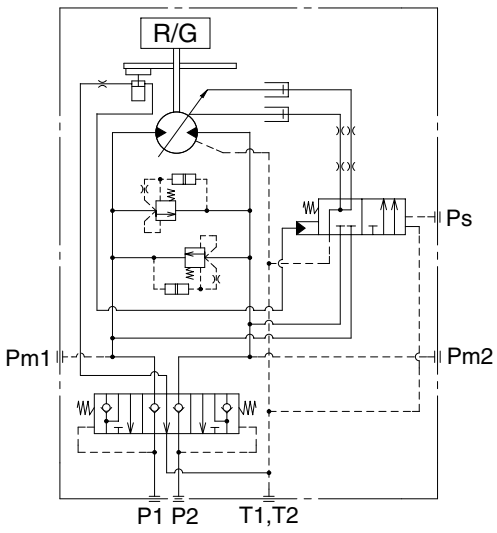
A Hydraulic motor includes followings.

- Part of rotary generating turning force
- Part of a valve of relief
- Part of Brake
- Part of a valve of counterbalance
- Part of flowing changeover
- Part of auto changeover







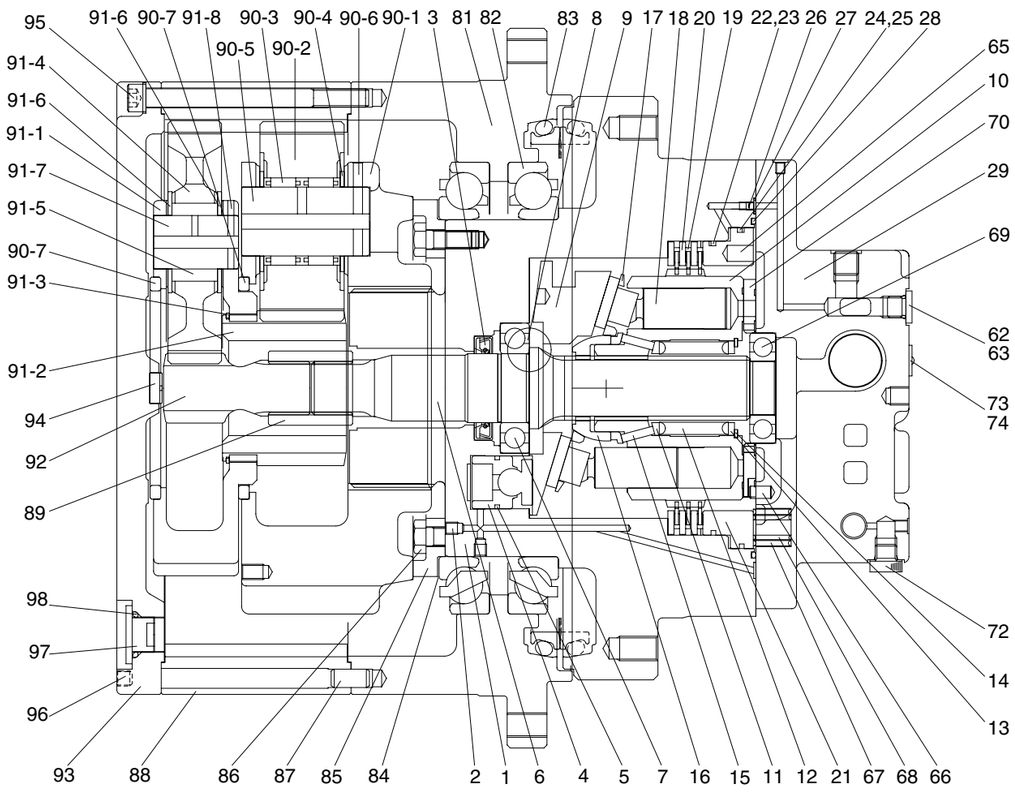


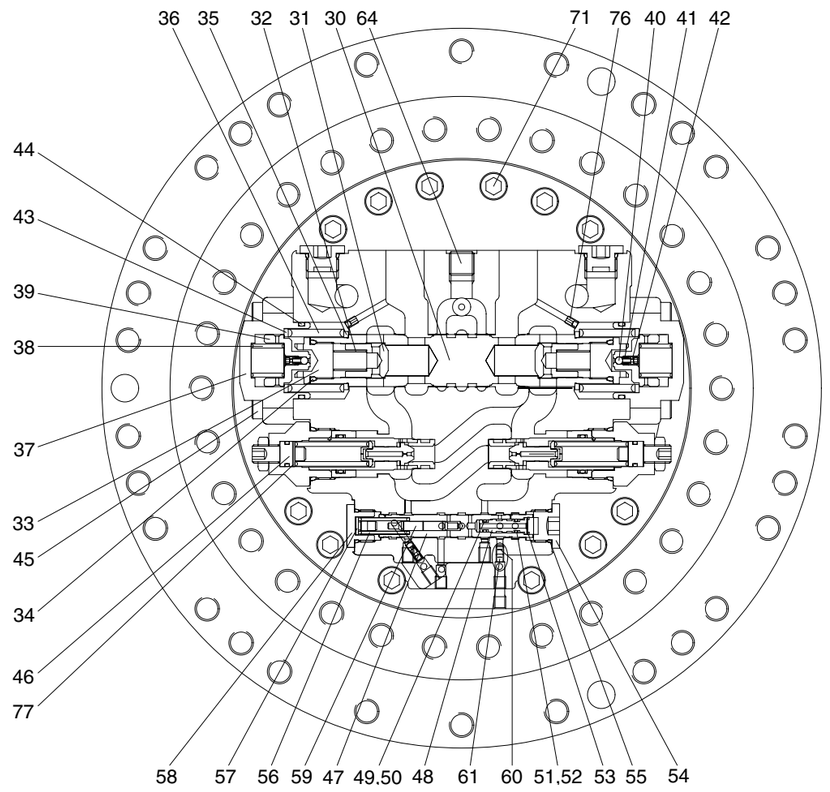
Hydraulic circuit

21092TM01

Port	Port name	Port size
P_1, P_2	Main port	SAE 4694psi 1"
Pm_1, Pm_2	Gauge port	PF 1/4
T_1, T_2	Drain port	PF 1/2
Ps	2 speed control port	PF 1/4

1) STRUCTURE





21092TM02

1	Shaft casing	20	Plate	39	Spool	58	Plug	77	Shim	91-1	Carrier No.1
2	Plug	21	Parking piston	40	Steel ball	59	Spool	81	Housing	91-2	Sun-gear No.2
3	Oil seal	22	O-ring	41	Spring	60	Orifice	82	Main bearing	91-3	Retaining ring
4	Swash piston	23	Back up ring	42	Plug	61	Orifice	83	Floating seal	91-4	Planetary gear No.1
5	Piston ring	24	O-ring	43	Spring seat	62	Plug	84	Shim	91-5	Needle bearing No.1
6	Shaft	25	Back up ring	44	O-ring	63	O-ring	85	Retainer	91-6	Thrust washer
7	Bearing	26	Orifice	45	Wrench bolt	64	Plug	86	Hex head bolt	91-7	Pin No.1
8	Steel ball	27	O-ring	46	Relief valve assy	65	Pin	87	Parallel pin	91-8	Spring pin
9	Swash plate	28	O-ring	47	Spool	66	Pin	88	Ring gear	92	Sun gear No.1
10	Cylinder block	29	Rear cover	48	Guide	67	Spring	89	Coupling	93	Cover
11	Spring seat	30	Spool	49	O-ring	68	Spring	90	Carrier assy No.2	94	Pad
12	Spring	31	Check	50	Back up ring	69	Bearing	90-1	Carrier No.2	95	Hex socket head bolt
13	End plate	32	Spring	51	O-ring	70	Valve plate	90-2	Planetary gear No.2	96	Hex socket Screw
14	Snap ring	33	Plug	52	Back up ring	71	Wrench bolt	90-3	Needle bearing No.2	97	Hydraulic plug
15	Pin	34	O-ring	53	Snap ring	72	Plug	90-4	Thrust washer	98	O-ring
16	Ball guide	35	Spring seat	54	plug	73	Name plate	90-5	Pin No.2	99	Name plate
17	Set plate	36	Spring	55	O-ring	74	Rivet	90-6	Spring pin		
18	Piston assy	37	Cover	56	Spring	75	Seal kit	90-7	Thrust ring		
19	Friction plate	38	Spring	57	Spring seat	76	Orifice	91	Carrier assy No.1		

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder (10) through valve casing of motor (29), and valve plate (77).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston(18).

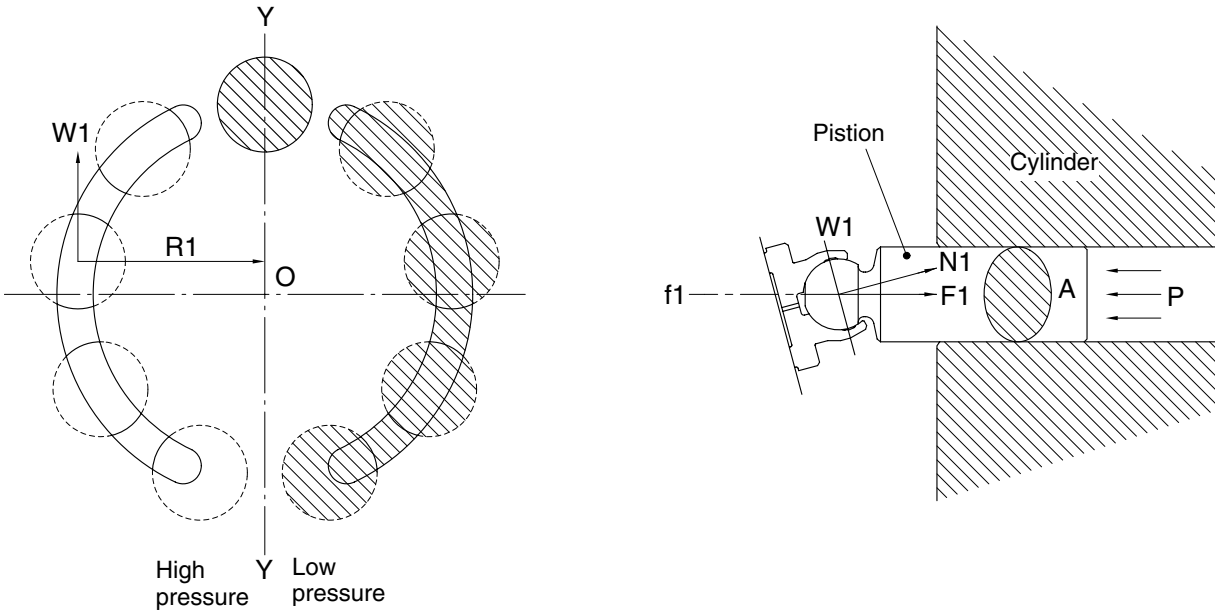
The high hydraulic can generate the force, F1 = P × A (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate (09) of a tilt angle, α .

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

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

This torque transfers the turning force to a cylinder (10) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.



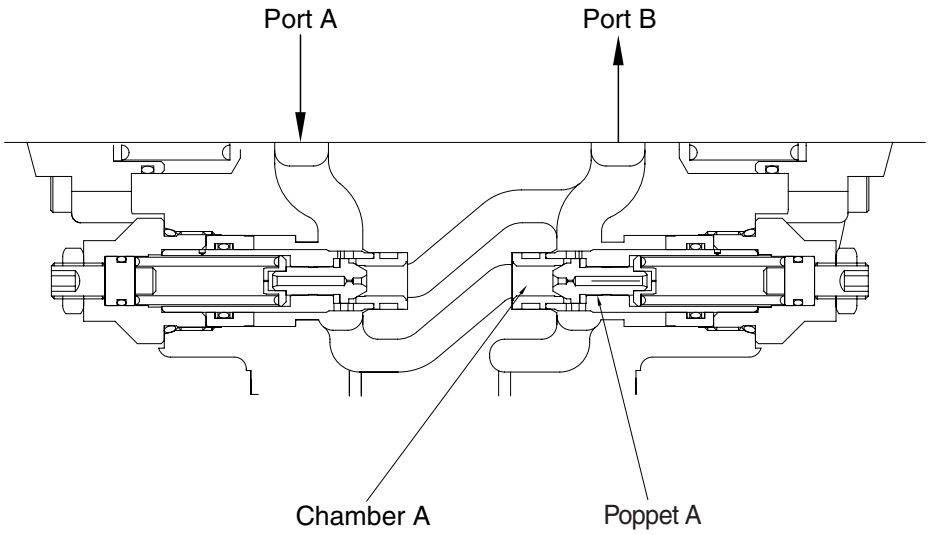
21078TM05

2.2 Working of relief valve

Relief valve carries on two functions of followings.

1) It standardizes a pressure in case of driving a hydraulic motor ; bypasses and extra oil in a motor inlet related to acceleration of an inertia to an outlet.

2) In case of an inertia stopped, it forces an equipment stopped, according to generating the pressure of a brake on the projected side.
Room A is always connected with port A of a motor. If the pressure of port is increased, press poppet A. And if it is higher than the setting pressure of a spring, the oil of an hydraulic flows from room A to port B, because poppet A is detached from the contact surface of seat A.



21078TM06A

2.3 Working of negative brake

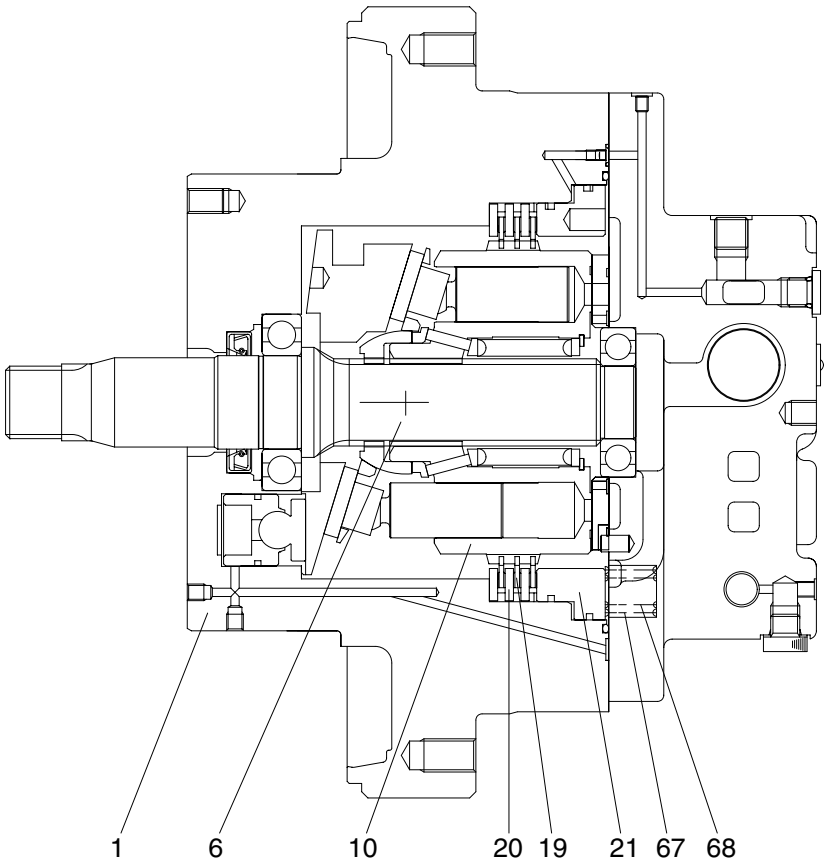
When the operating pressure is supplied to the brake piston (21) through the spool (simultaneous peripheral operation online) built in the shaft casing (1), the negative brake is released.

When the pressure does not work, the brake always runs.

The force of a brake is generated by the frictional force among a separate plate (20) fixed by shaft casing, parking piston (21) and a frictional plate (19) connected through spline outside a cylinder block (10).

When a pressure does not work on the part of piston, brake spring presses brake piston; oil in a brake room flows into the drain of a motor through an orifice; in that time, brake piston compresses a frictional plate and a detached plate in the middle of shaft casing (1) and brake piston (21) according to the force that presses 10 pieces of brake springs (67, 68); finally, it makes a frictional force.

This frictional force helps the brake fixing a turning shaft (6) connected by a cylinder and spline operated.

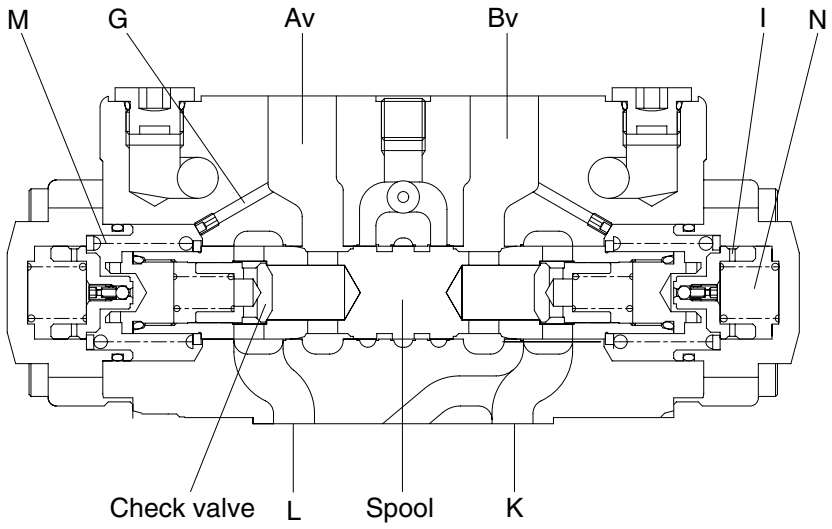


21092TM07

2.4 Counterbalance valve

Av port is connected to a hydraulic pump; Bv port is connected to a tank.

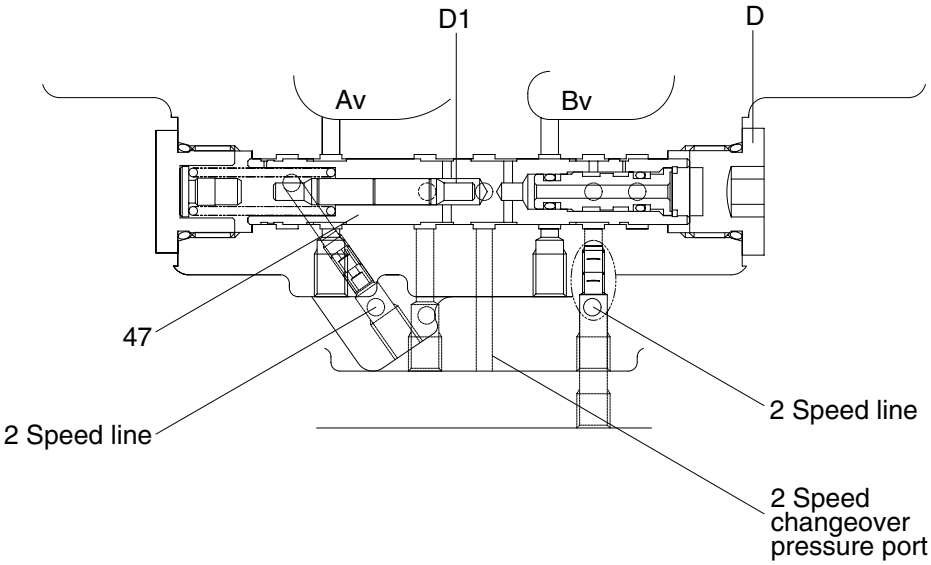
An oil supplied from a hydraulic pump presses check valve and flows into L port. It makes a hydraulic motor circulated. The oil pressure out of a pump is increased and transferred to spring room M through the path G because negative brake is working on. When the pressure of room M exceeds the force of spring that keeps spool at its neutral position, the spool begins to move the right side.
An oil in room N is sent to room M by orifice I and discharged from G line to a tank.
Then the spool moves to the right and the oil flows from K to Bv.



21078TM08

2.5 Working description of automatic switch (at normal speed)

Due to no pressure on pilot now, spool (47) is not working.



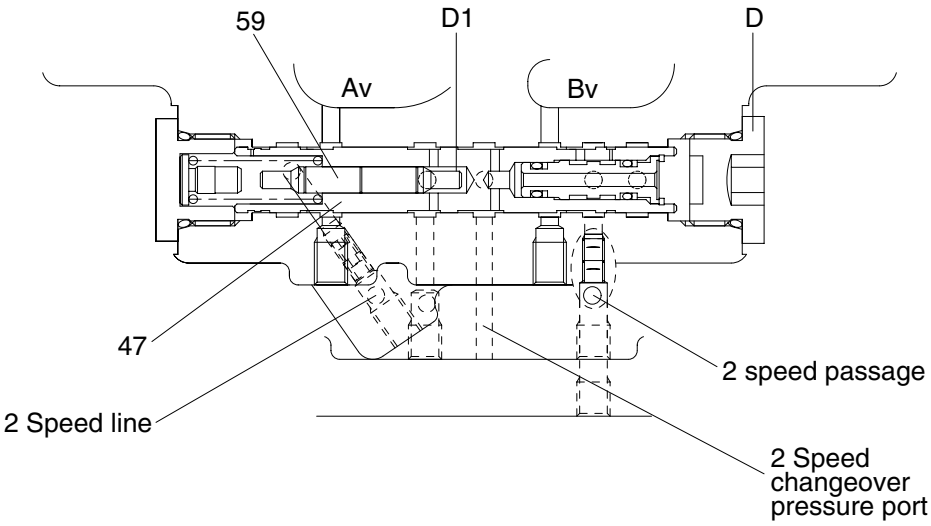
(Normal speed)

21078TM09

2.6 Working description of automatic switch (at high speed)

At normal speed, once the hydraulic oil which is through the inner path of spool (47) flows into high speed switching pressure port (the pressure of external pilot : Pi = 35 kgf/cm^2) spool(47) moves from right to left.

At high speed, turning pressure of motor (D1) is over 250 kgf/cm^2, when the power forcing to spool (59) (Pressure, P1) is stronger than spool (47) and spool (59) is pushed out, after then spool (47) moves from left to right. So it is switched.



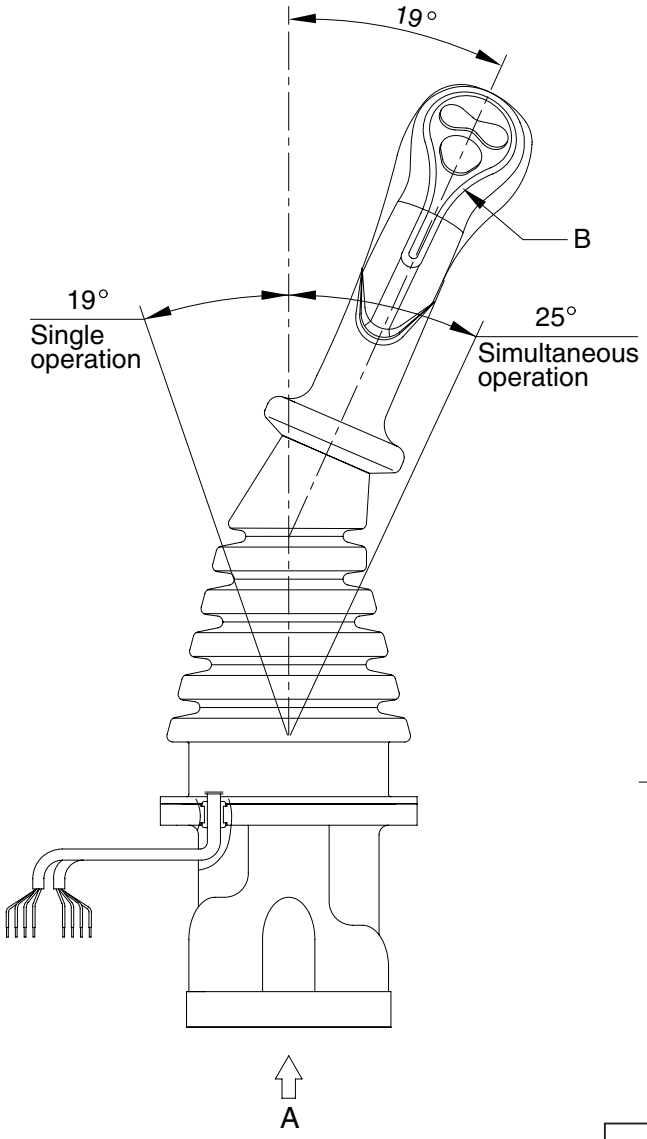
(High speed)

21078TM10

GROUP 5 RCV LEVER

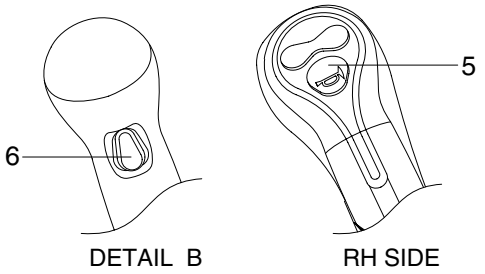
1. STRUCTURE

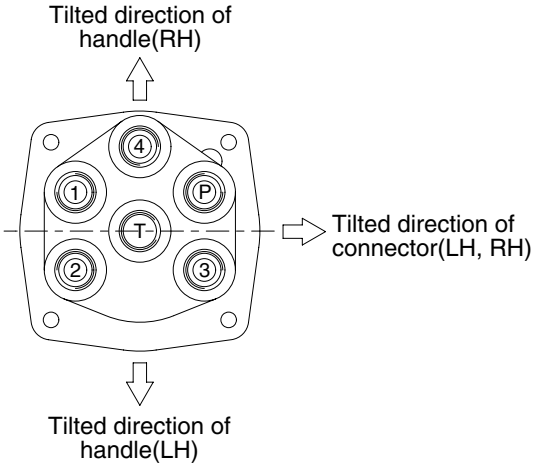
The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.



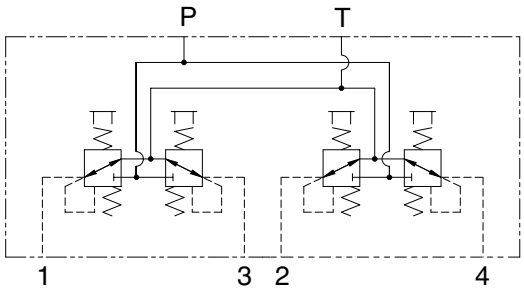
Switches

No.	LH	RH
5	One touch decel	Horn
6	Power boost	Breaker





VIEW A



Hydraulic circuit

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 in port	Boom down port	
3	Right swing port	Bucket in port	
4	Arm out port	Boom up port	

1409S2RL01

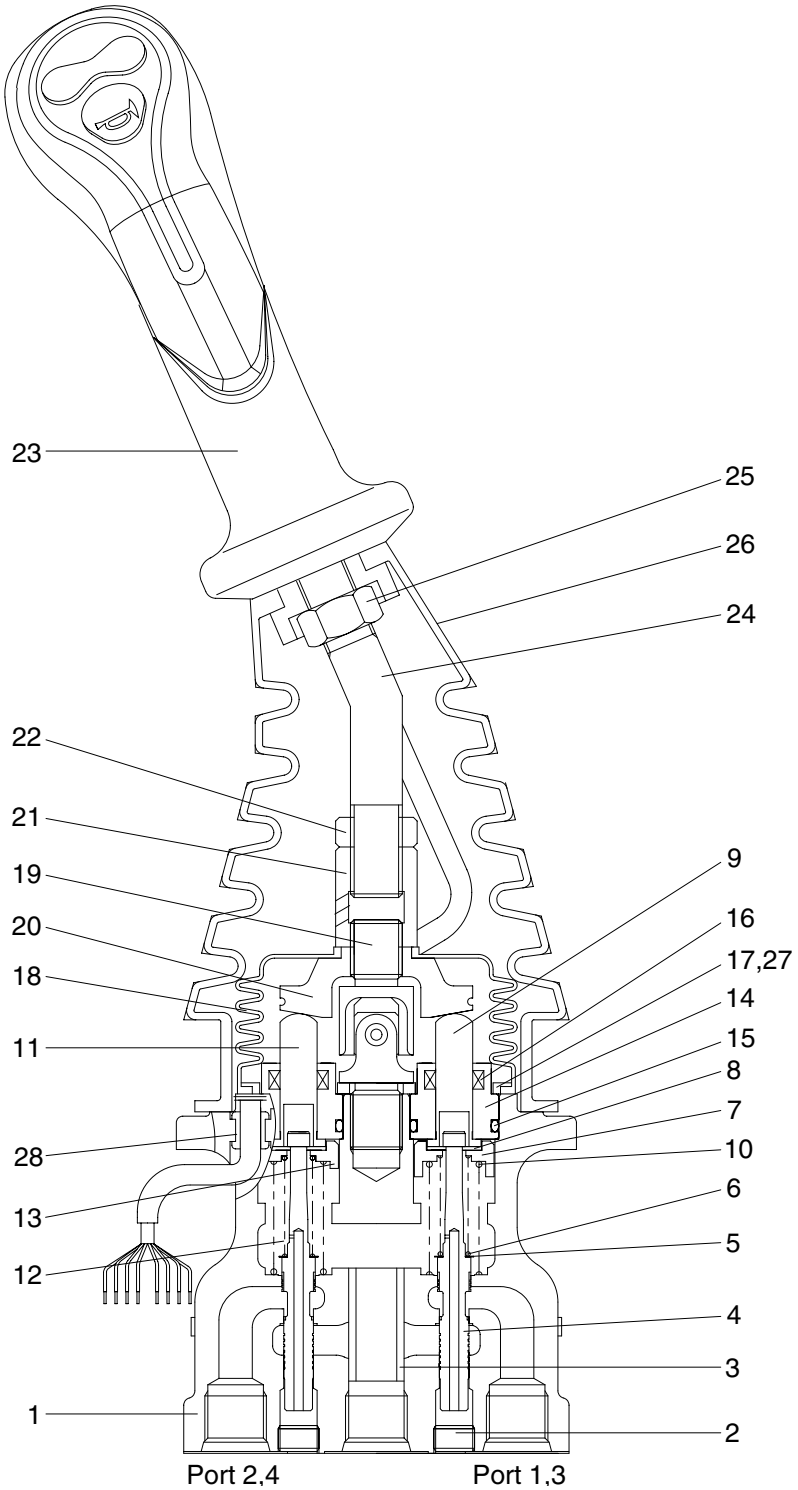
CROSS SECTION

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

The pressure reducing section is composed of the spool (4), spring (6) for setting secondary pressure, return spring (10), stopper (8), spring seat (7, 13) and shim (5). 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, 11) by the return spring.

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

CROSS SECTION



1409S2RL02

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

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

The functions of the spool (4) 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 (6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (9,11) is inserted and can slide in the plug (14).

For the purpose of changing the displacement of the push rod through the swash plate (20) and adjusting nut (21) are provided the handle (23) that can be tilted in any direction around the fulcrum of the universal joint (19) center.

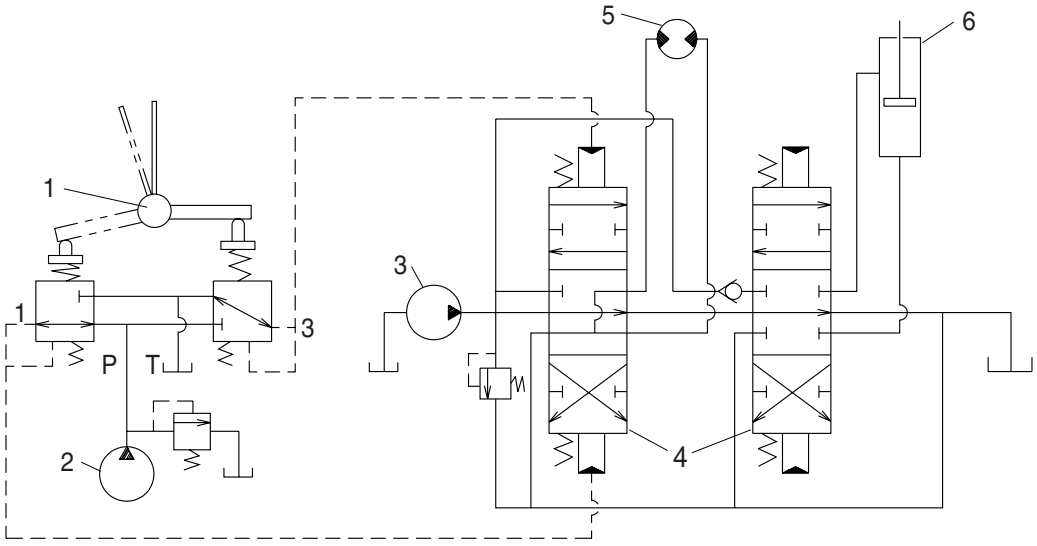
The spring (10) works on the case (1) and spring seat (7, 13) and tries to return the push rod (9,11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

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

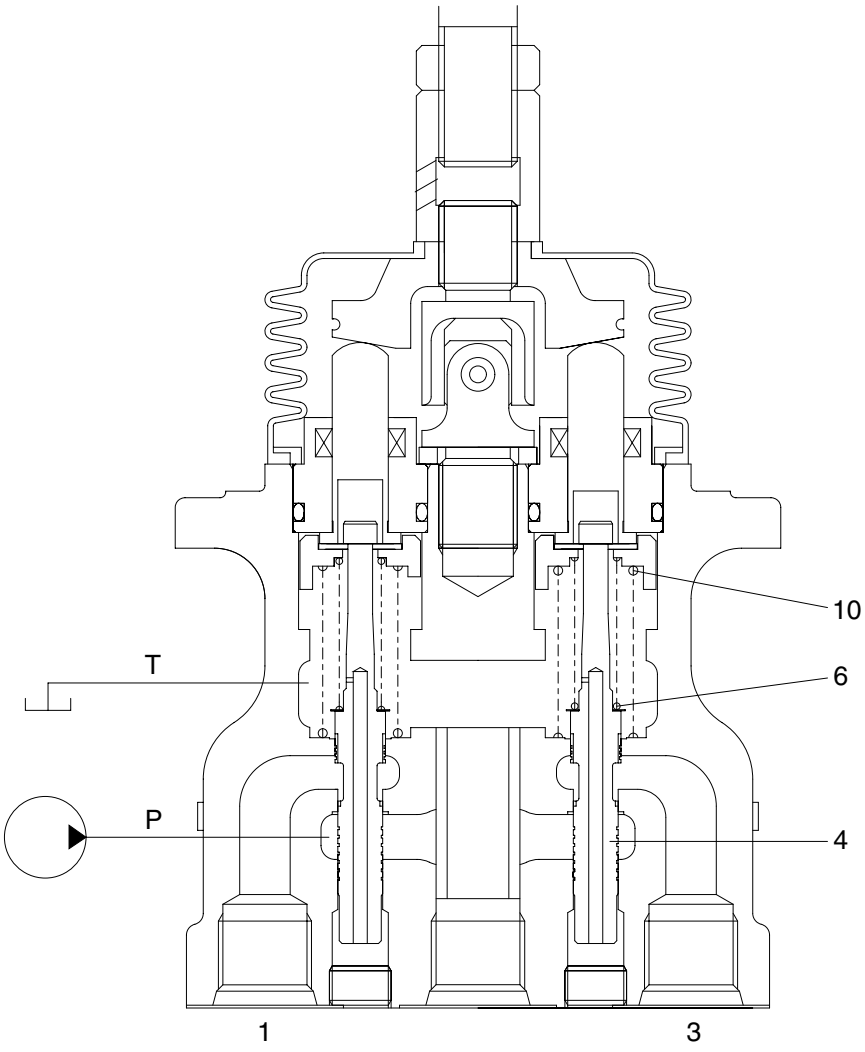
The diagram shown below is the typical application example of the pilot valve.



2-70

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

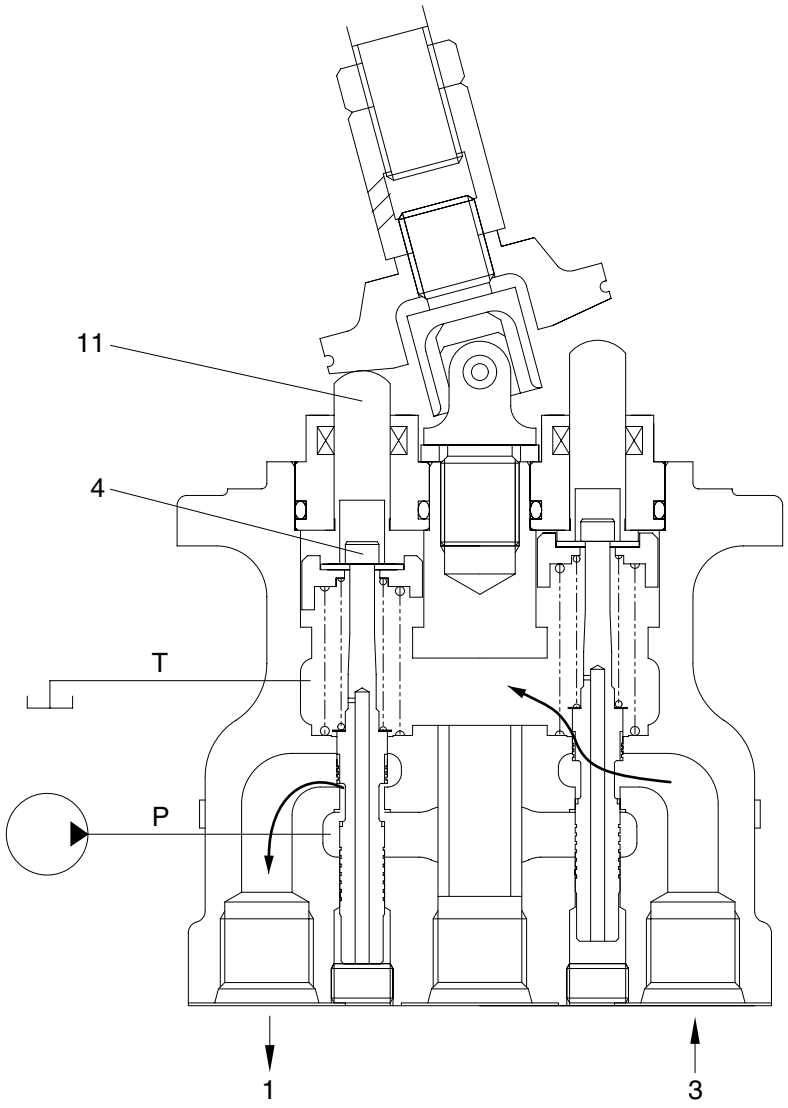
(1) Case where handle is in neutral position



21092RL03

The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (4). Therefore, the spool is pushed up by the spring (10) 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



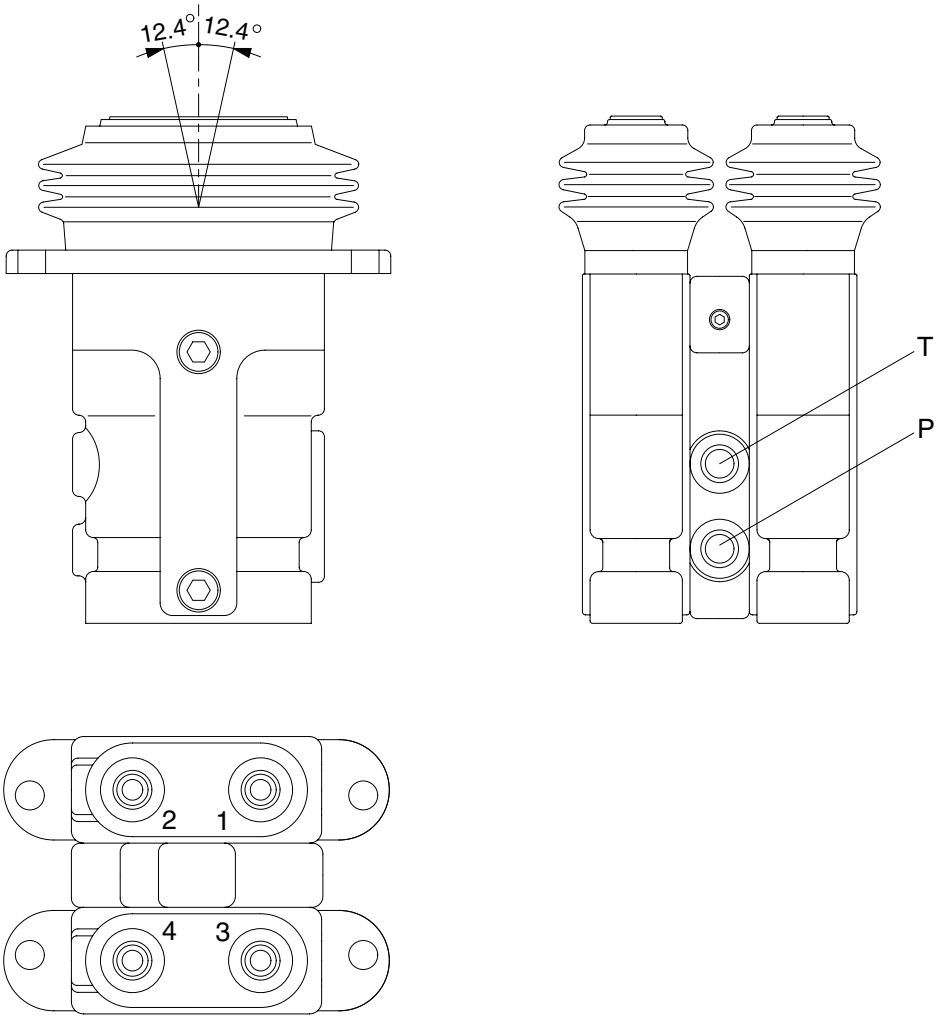
21092RL04

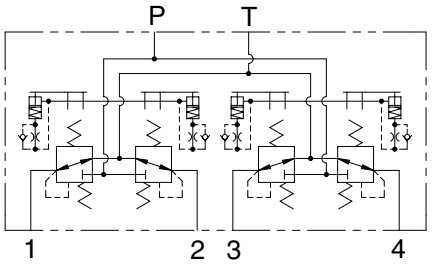
When the push rod (11) is stroked, the spool (4) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the 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)	

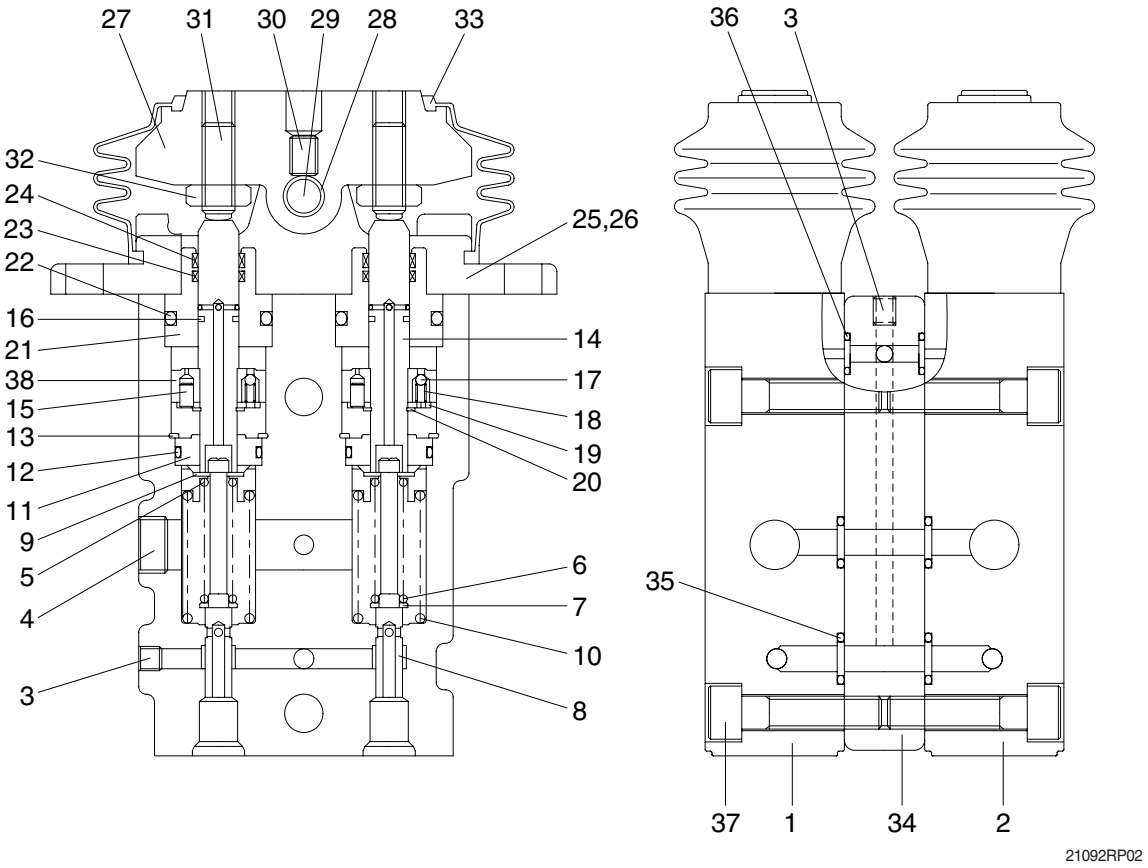
21092RP01

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 (8), spring (6) for setting secondary pressure, return spring (10), stopper (9), and spring seat (7). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 19 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (14) 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.



1	Body(1)	14	Push rod	27	Cam
2	Body(2)	15	Spring pin	28	Bushing
3	Plug	16	Seal	29	Cam shaft
4	Plug	17	Steel ball	30	Set screw
5	Spring seat	18	Spring	31	Set screw
6	Spring	19	Plate	32	Nut
7	Spring seat	20	Snap ring	33	Bellows
8	Spool	21	Plug	34	Space
9	Stopper	22	O-ring	35	O-ring
10	Spring	23	Rod seal	36	O-ring
11	Rod guide	24	Dust seal	37	Socket bolt
12	O-ring	25	Cover	38	Piston
13	Snap ring	26	Socket bolt		

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 (8) 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 (6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (14) is inserted and can slide in the plug (21).

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.

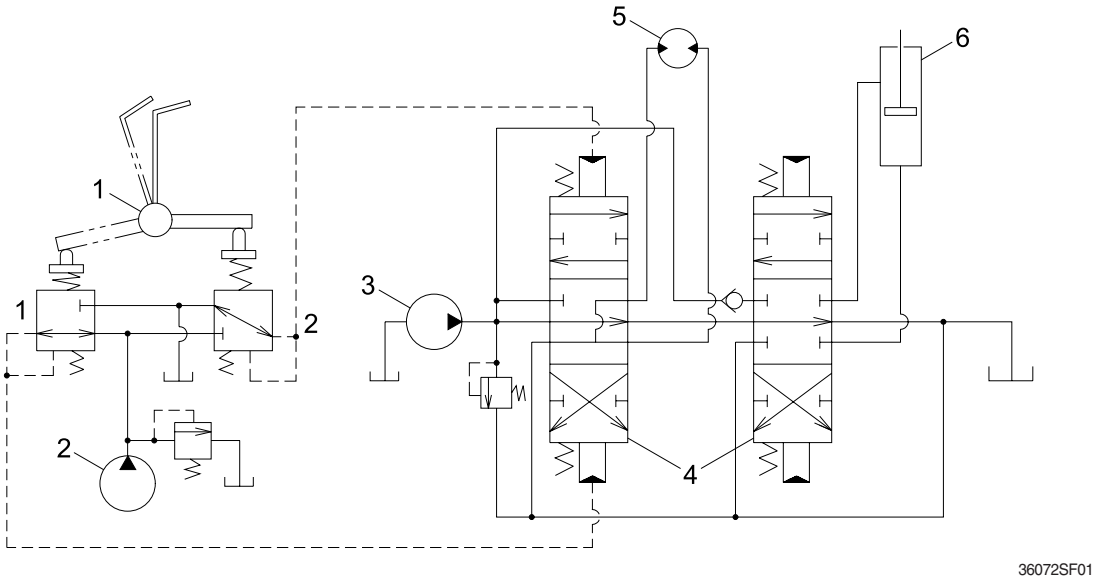
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

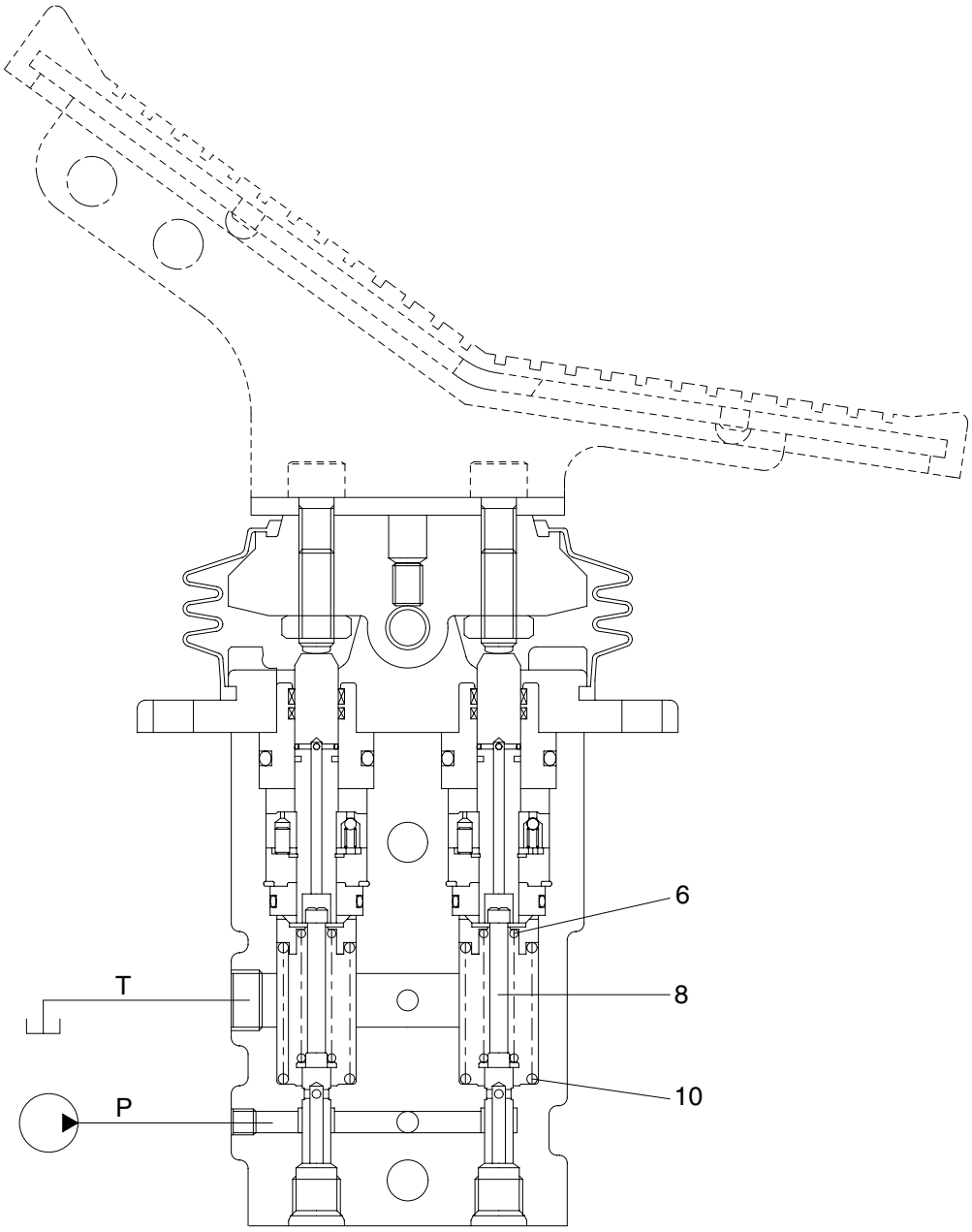
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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



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

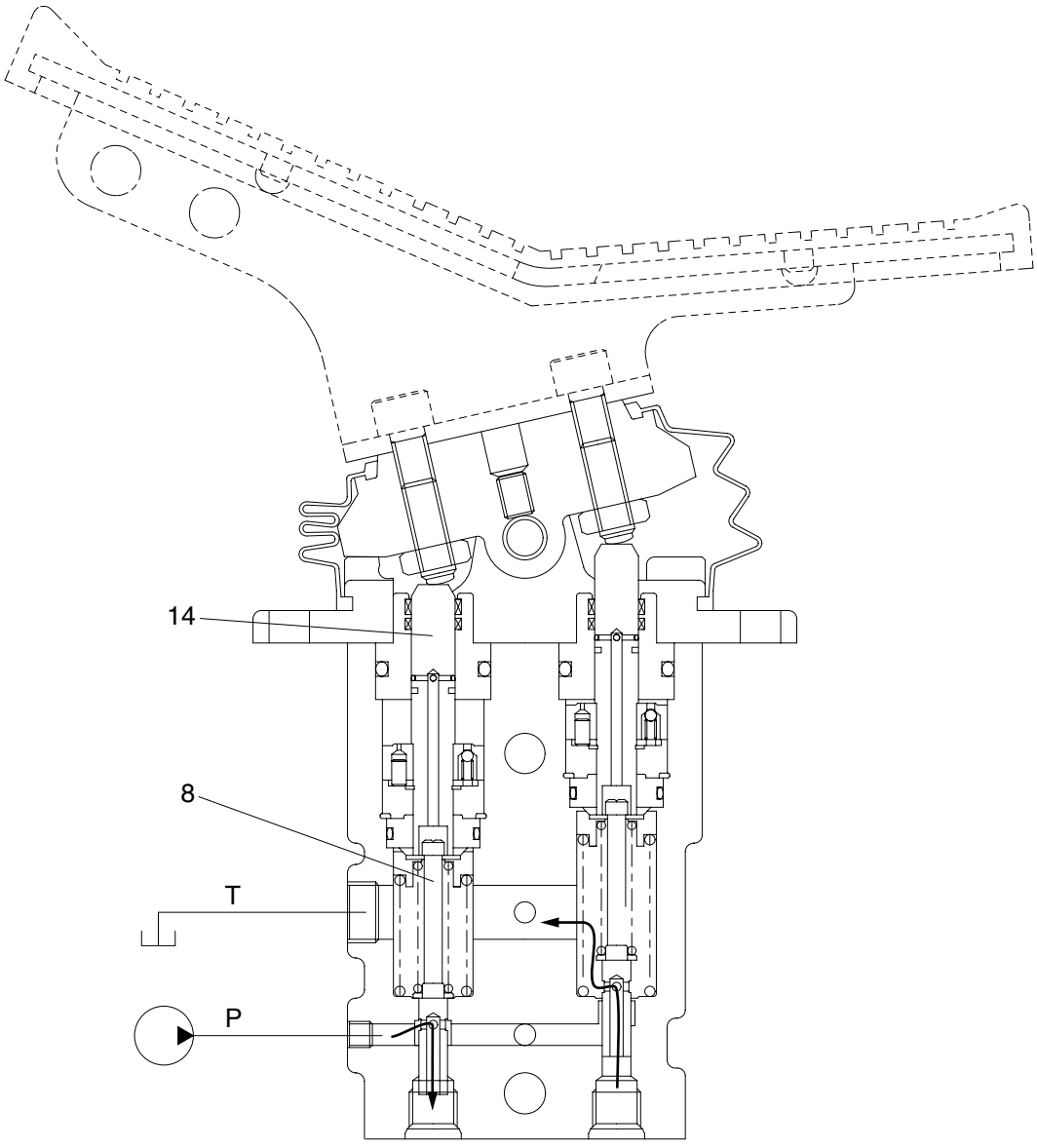
(1) Case where pedal is in neutral position



21092RP03

The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (8). Therefore, the spool is pushed up by the spring (10) to the position of port 2 in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where pedal is tilted

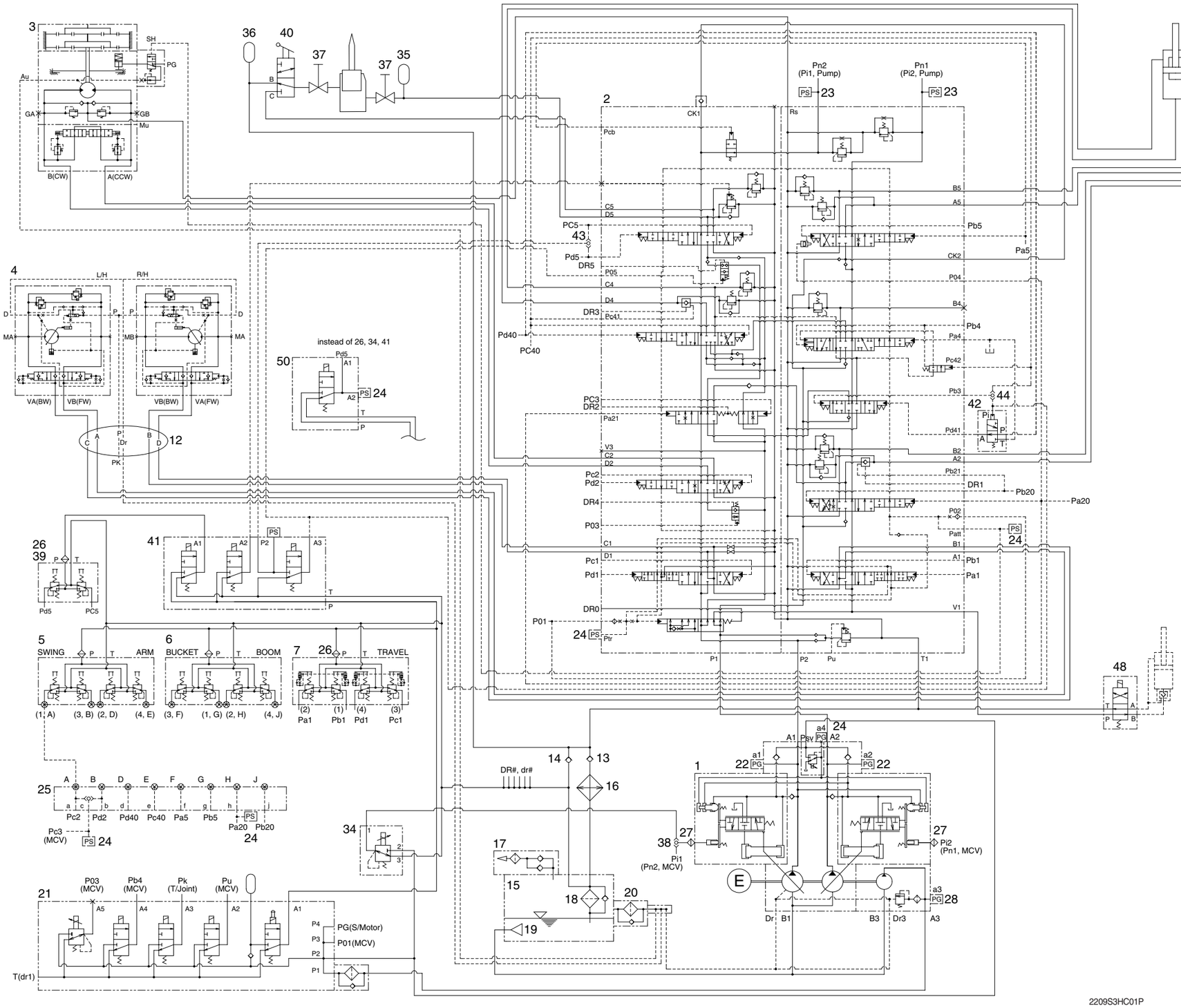


21092RP04

When the push rod (14) is stroked, the spool (8) 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

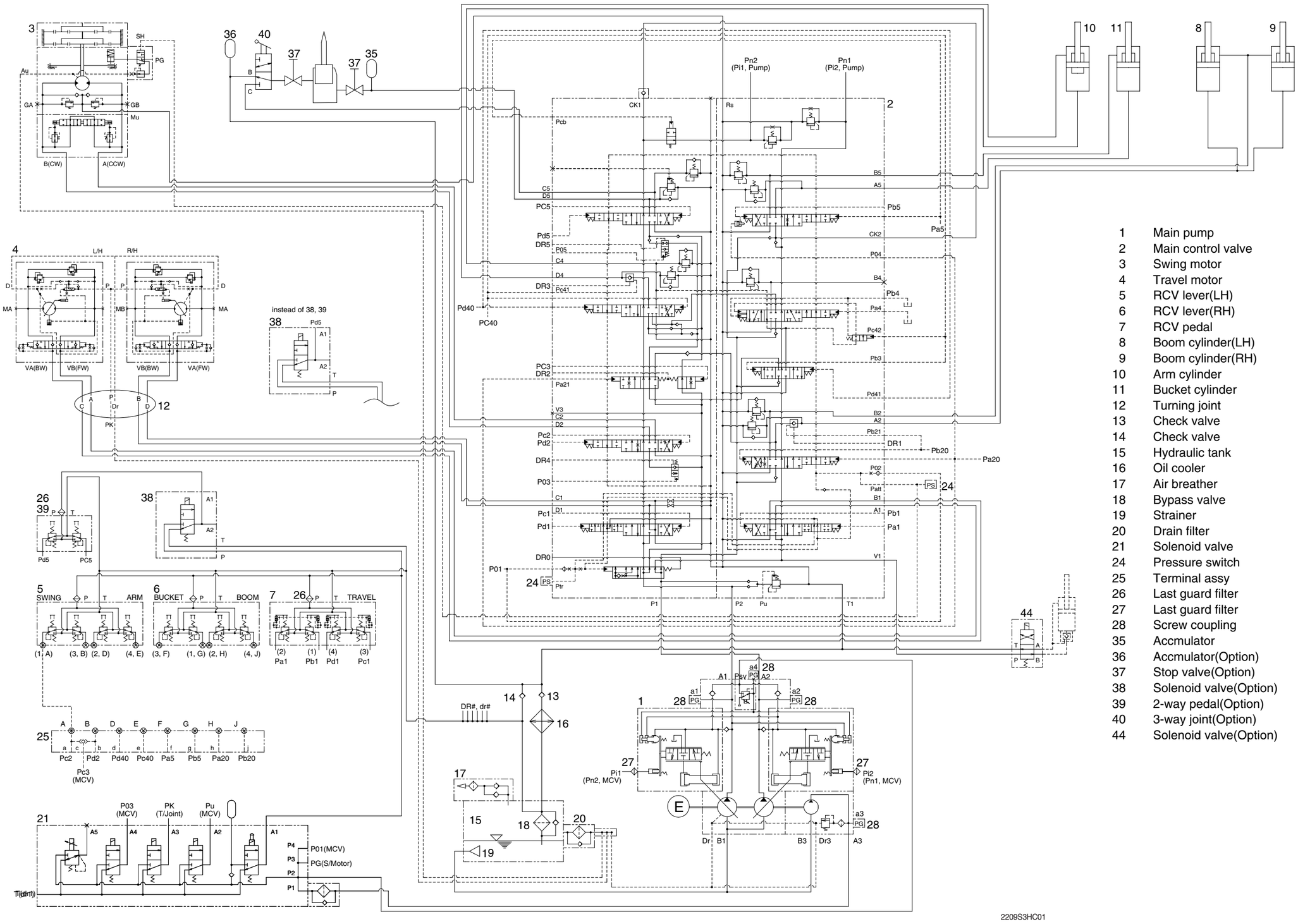
GROUP 1 HYDRAULIC CIRCUIT (CLUSTER TYPE 1)



2209S3HC01P

1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Bypass valve
19 Strainer
20 Drain filter
21 Solenoid valve
22 Pressure sensor
23 Pressure sensor
24 Pressure sensor
25 Terminal
26 Last guard filter
27 Last guard filter
28 Screw coupling
34 1 EPPR valve
35 Accmulator
36 Accmulator(option)
37 Stop valve(option)
38 Shuttle valve
39 2-way Pedal (option)
40 3-way joint(option)
41 Solenoid valve(option)
42 Pilot Selector valve(option)
43 Shuttle valve
44 Shuttle valve
48 Solenoid valve(option)
50 Solenoid valve(option)

■ HYDRAULIC CIRCUIT (CLUSTER TYPE 2)

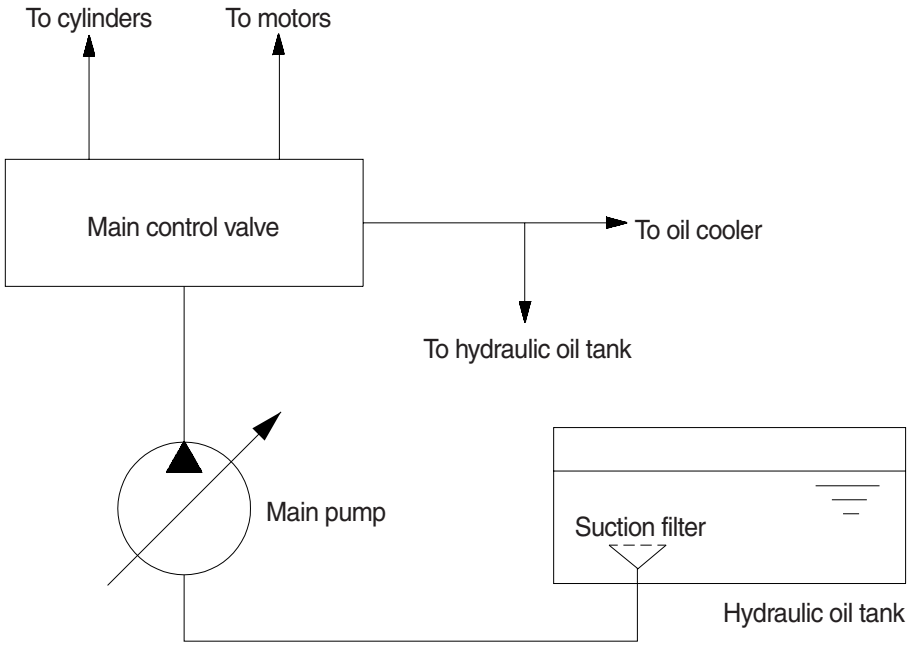


1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Bypass valve
19 Strainer
20 Drain filter
21 Solenoid valve
24 Pressure switch
25 Terminal assy
26 Last guard filter
27 Last guard filter
28 Screw coupling
35 Accmulator
36 Accmulator(Option)
37 Stop valve(Option)
38 Solenoid valve(Option)
39 2-way pedal(Option)
40 3-way joint(Option)
44 Solenoid 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 tandem axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

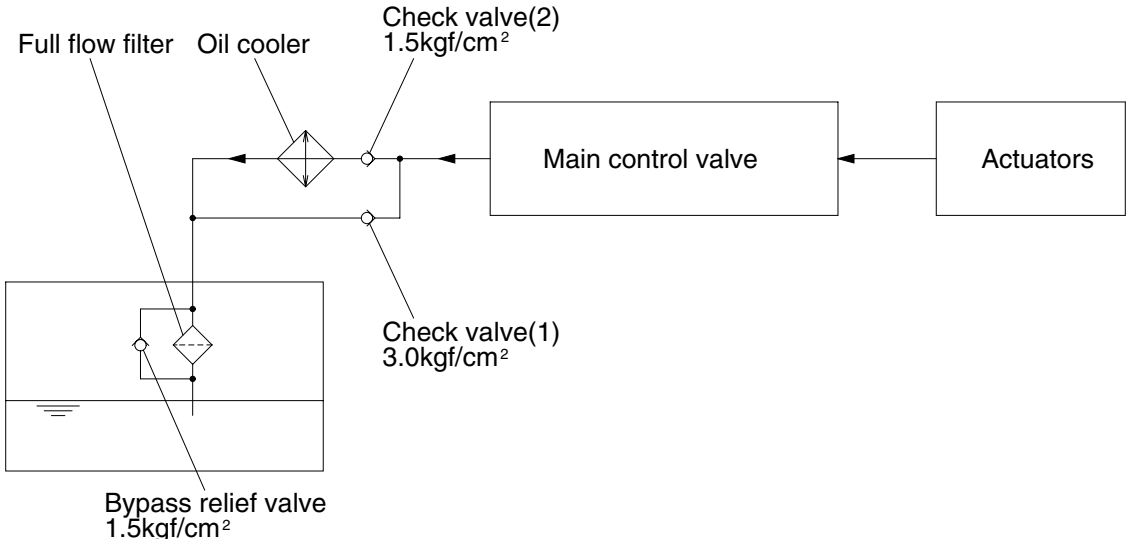
1. SUCTION AND DELIVERY CIRCUIT



3-02

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

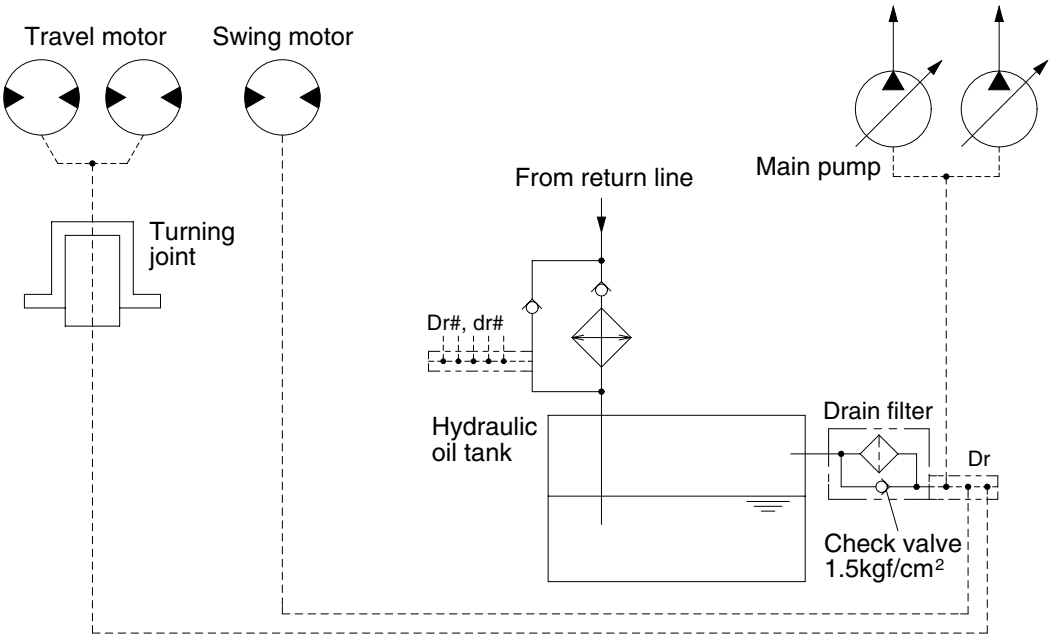
2. RETURN CIRCUIT



21073CI01

All oil from each actuator returns to the hydraulic tank through the control valve.
The bypass check valves are provided in the return circuit.
The setting pressure of bypass check valves are 1.5 kgf/cm² (21psi) and 3.0 kgf/cm² (43psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.
When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. The oil pressure exceeds 3.0 kgf/cm² (43psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).
The full-flow filter and bypass relief valve are provided in the hydraulic tank.
The oil from right and left side of control valve is combined and filtered by the return filter. A bypass relief valve is provided in the full-flow filter.
When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm² (21psi) differential pressure.

3. DRAIN CIRCUIT



21093CI02

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.
When the drain oil pressure exceed 1.5 kgf/cm2 (21psi), the oil returns to the hydraulic tank directly.

1) TRAVEL MOTOR DRAIN CIRCUIT

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

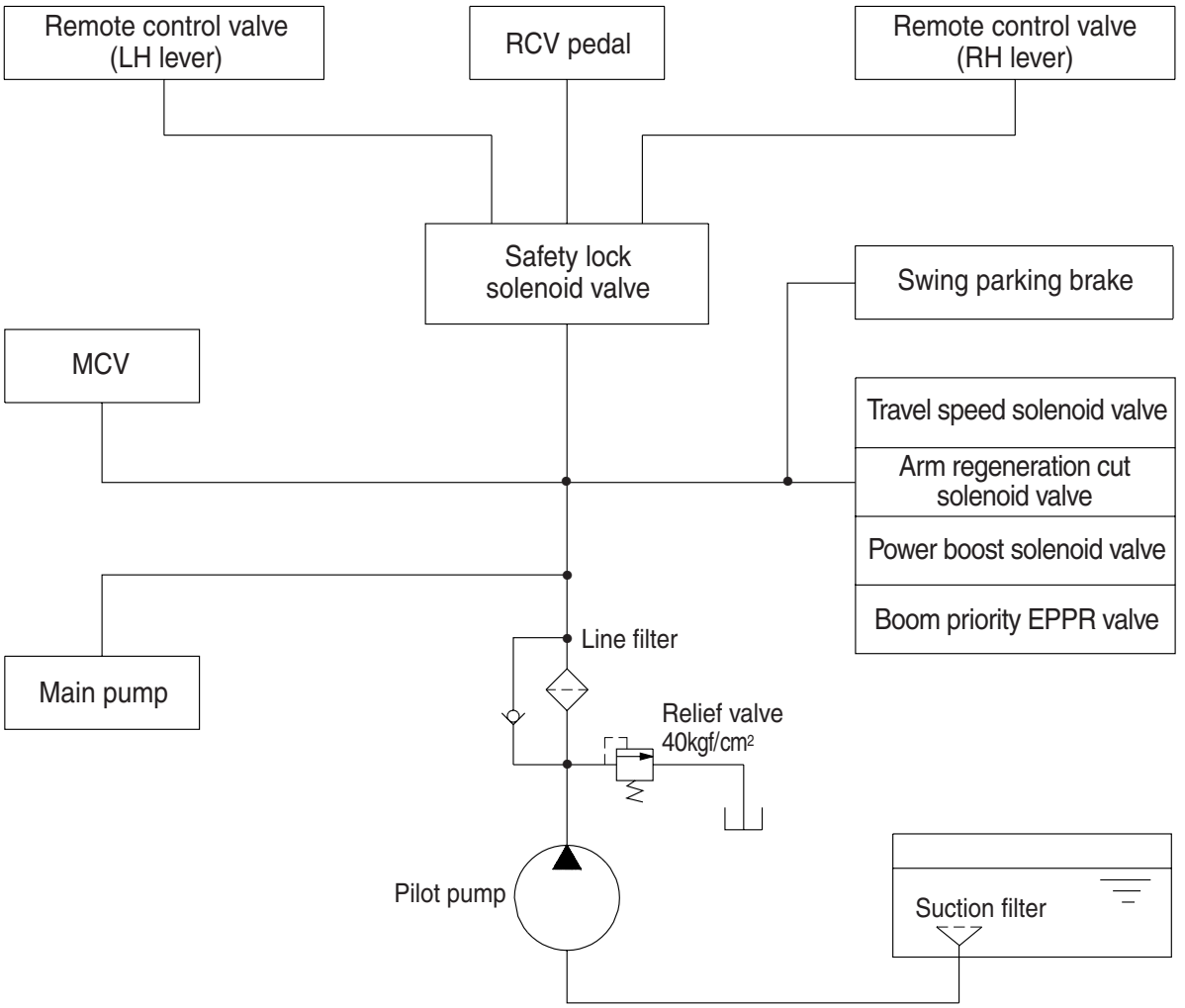
2) SWING MOTOR DRAIN CIRCUIT

Oil leaking from the swing motor come out and return to the hydraulic tank passing through a drain filter.

3) MAIN PUMP DRAIN CIRCUIT

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

GROUP 3 PILOT CIRCUIT



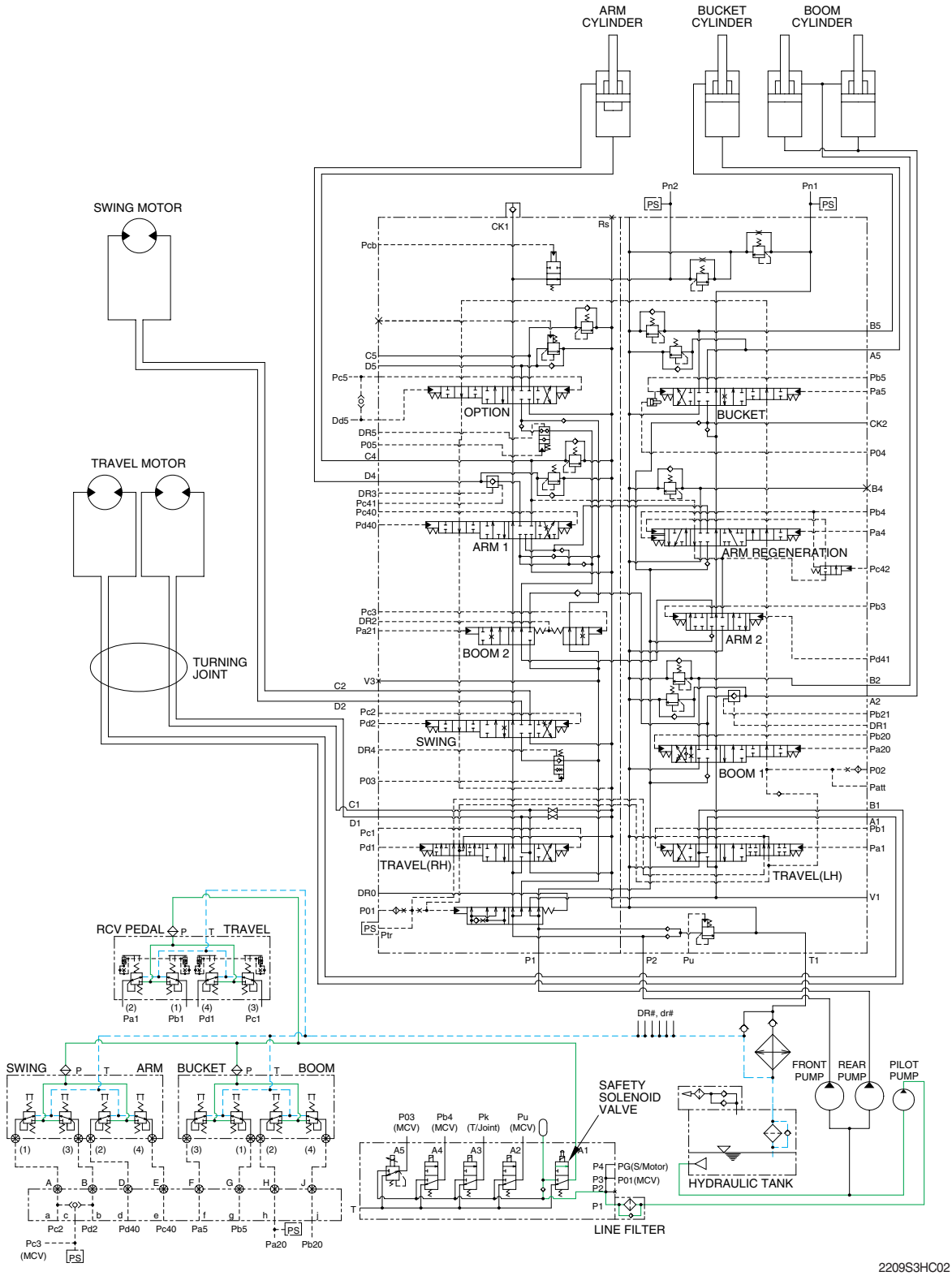
(210-7) 3-05

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.

1. SUCTION, DELIVERY AND RETURN CIRCUIT

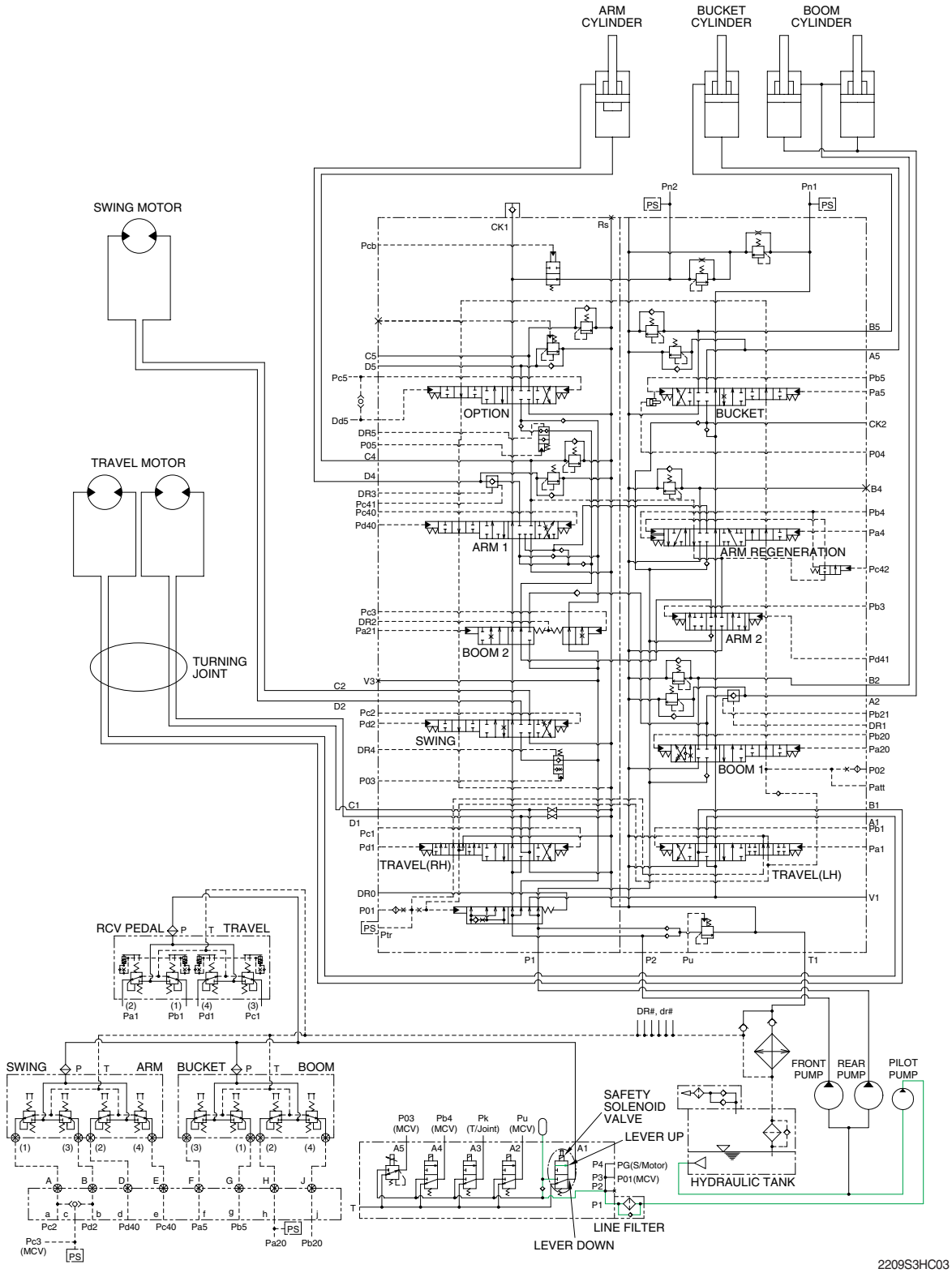


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

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

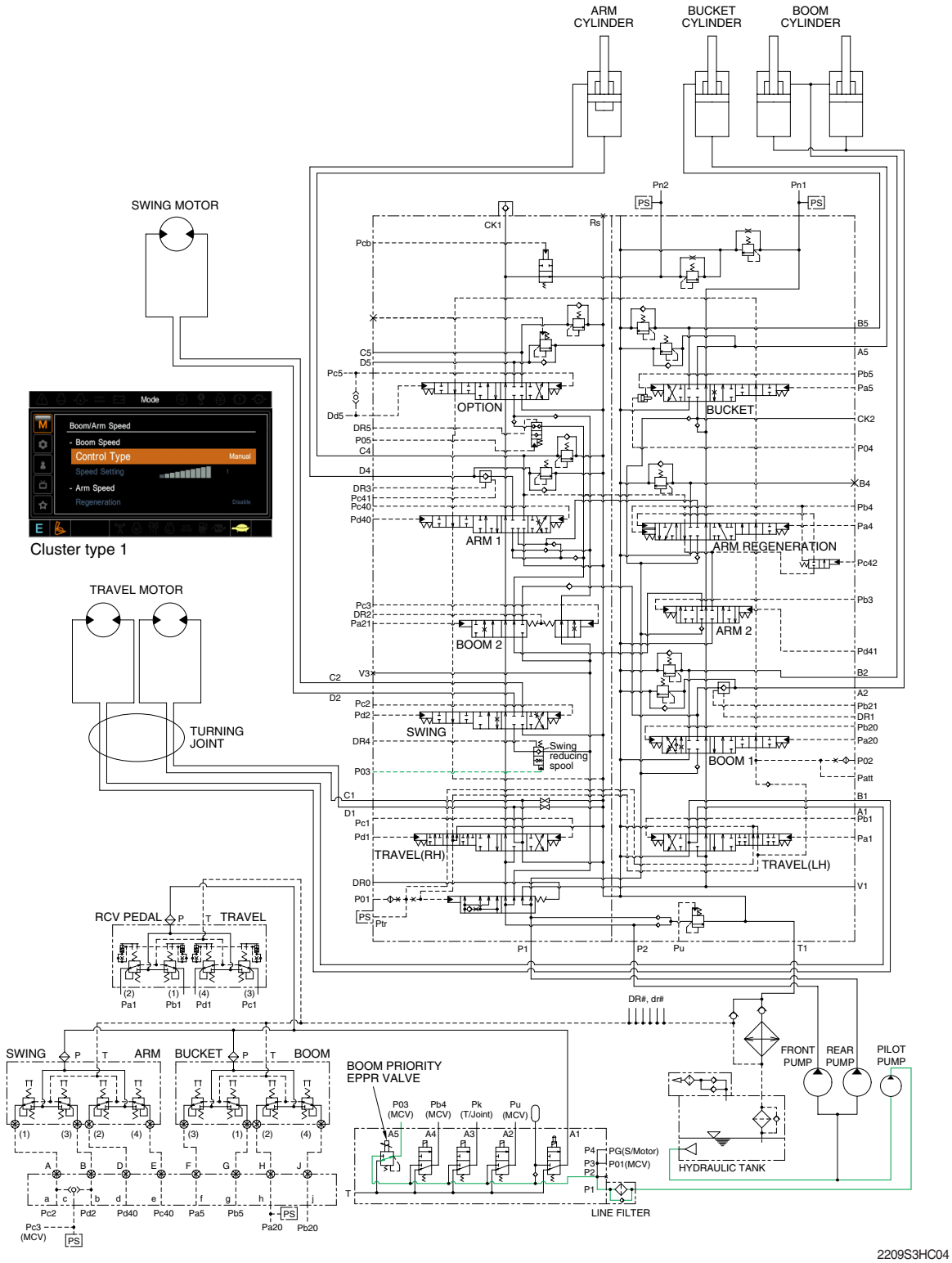
2. SAFETY SOLENOID VALVE (SAFETY LEVER)



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

When the lever of the safety solenoid valve moved upward, oil does not flows into the remote control valve, because of blocked by the spool.

3. BOOM PRIORITY SYSTEM



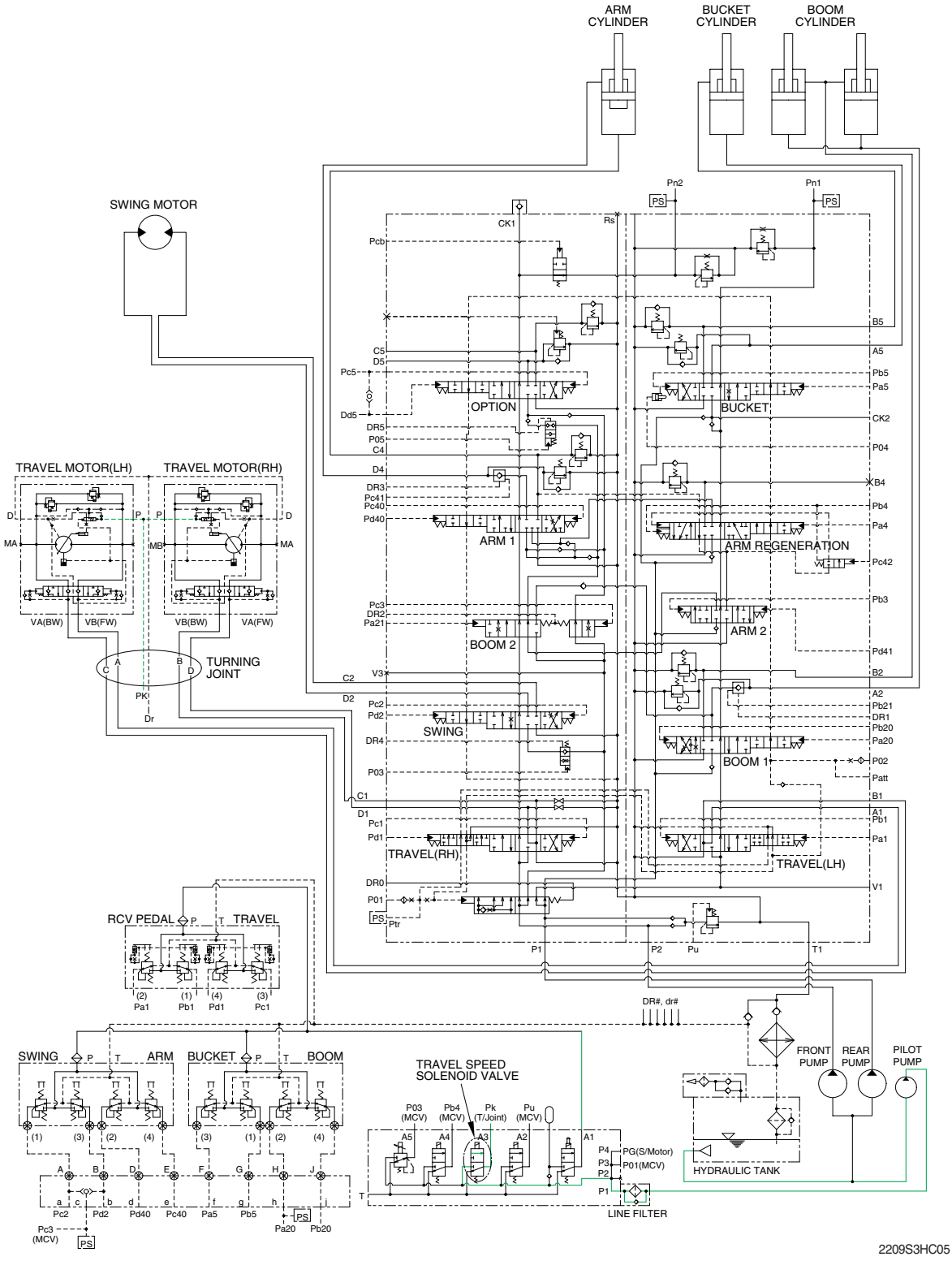
When carrying out the combined operation of swing and boom up, the boom up operating speed is lowered then normal operation.

To increase working efficiency, swing speed reducing system is used.

The pilot oil from pilot pump flow into **P03** port in main control valve through boom EPPR valve. **P03** oil pressure moves swing reducing spool to upper position and oil flow rate to the swing motor decreased.

Then, the boom up speed is increased. This is called the boom priority system.

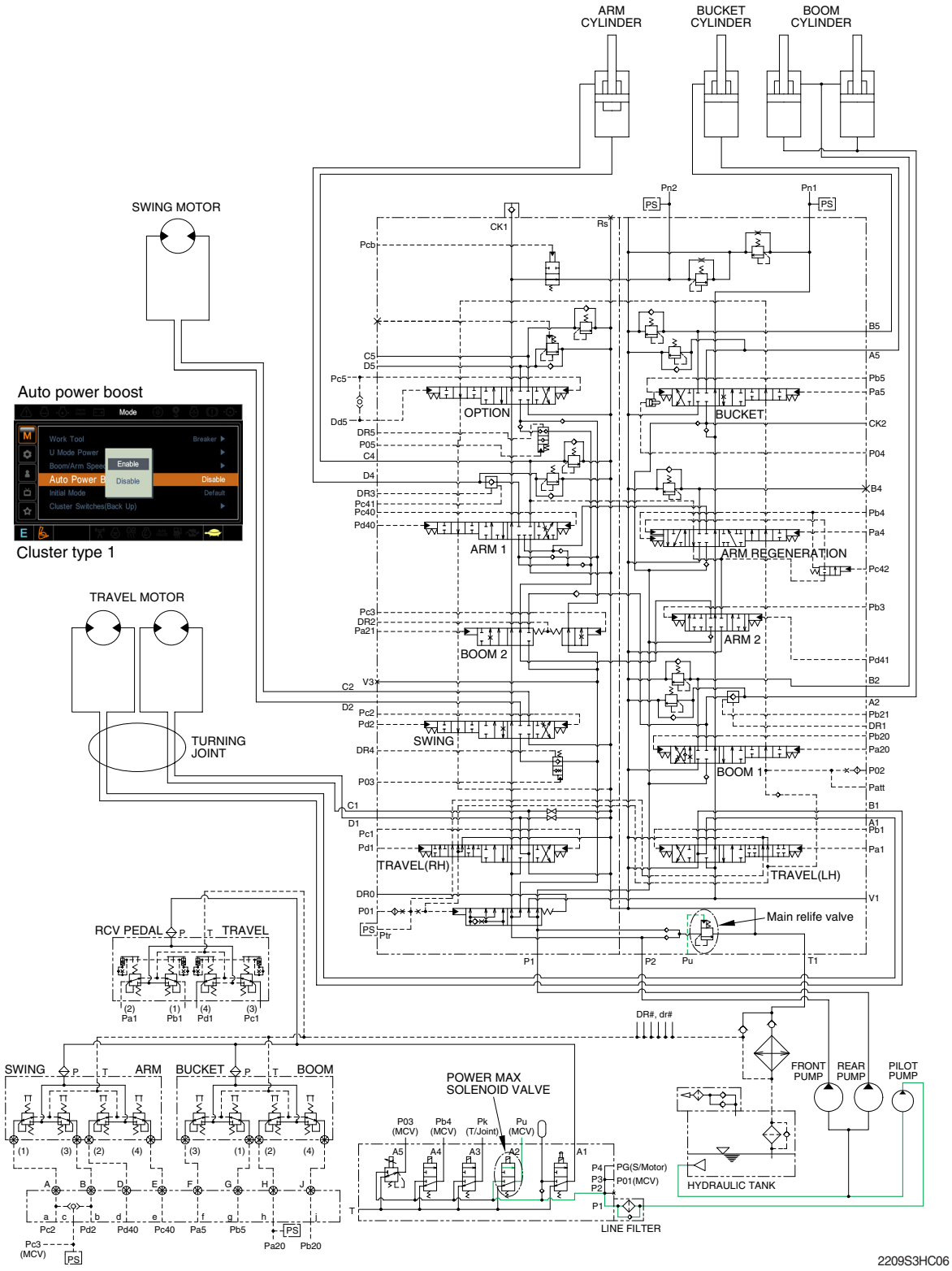
4. TRAVEL SPEED CONTROL SYSTEM



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

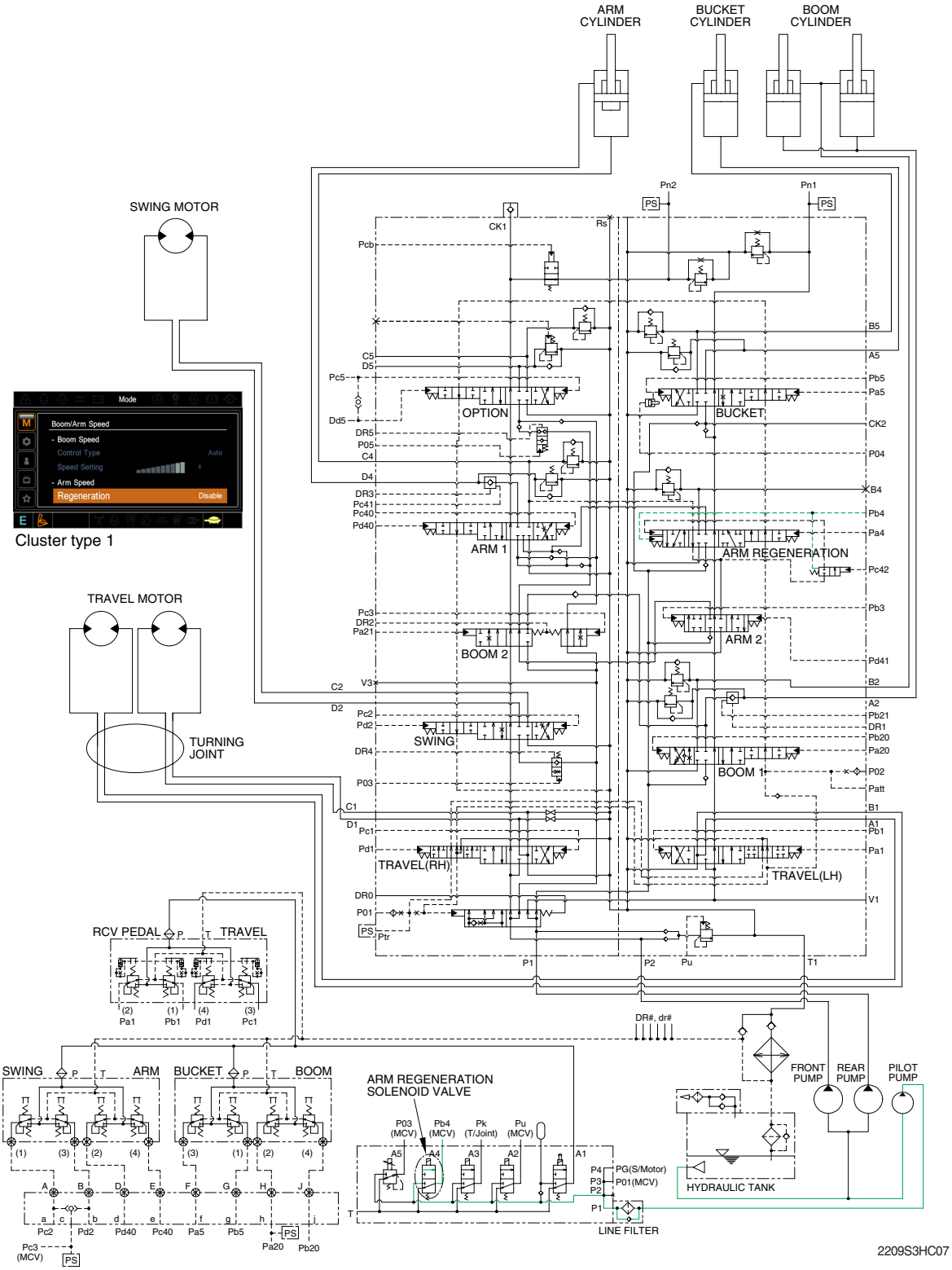
When the travel speed solenoid valve was placed in the Lo position, the oil of **P** port return to the tank and the control piston is returned, thus maximizing the displacement.

5. MAIN RELIEF PRESSURE CHANGE CIRCUIT



When the power max switch on the left control lever is pushed ON, the power max solenoid valve is actuated, the discharged oil from the pilot pump into Pu port of the main relief valve of main control valve ; Then the setting pressure of the main control valve is raises from 350 kgf/cm^2 to 380 kgf/cm^2 for increasing the digging power. And even when press continuously, it is canceled after 8 seconds.

6. ARM REGENERATION CUT SYSTEM (CLUSTER TYPE 1)



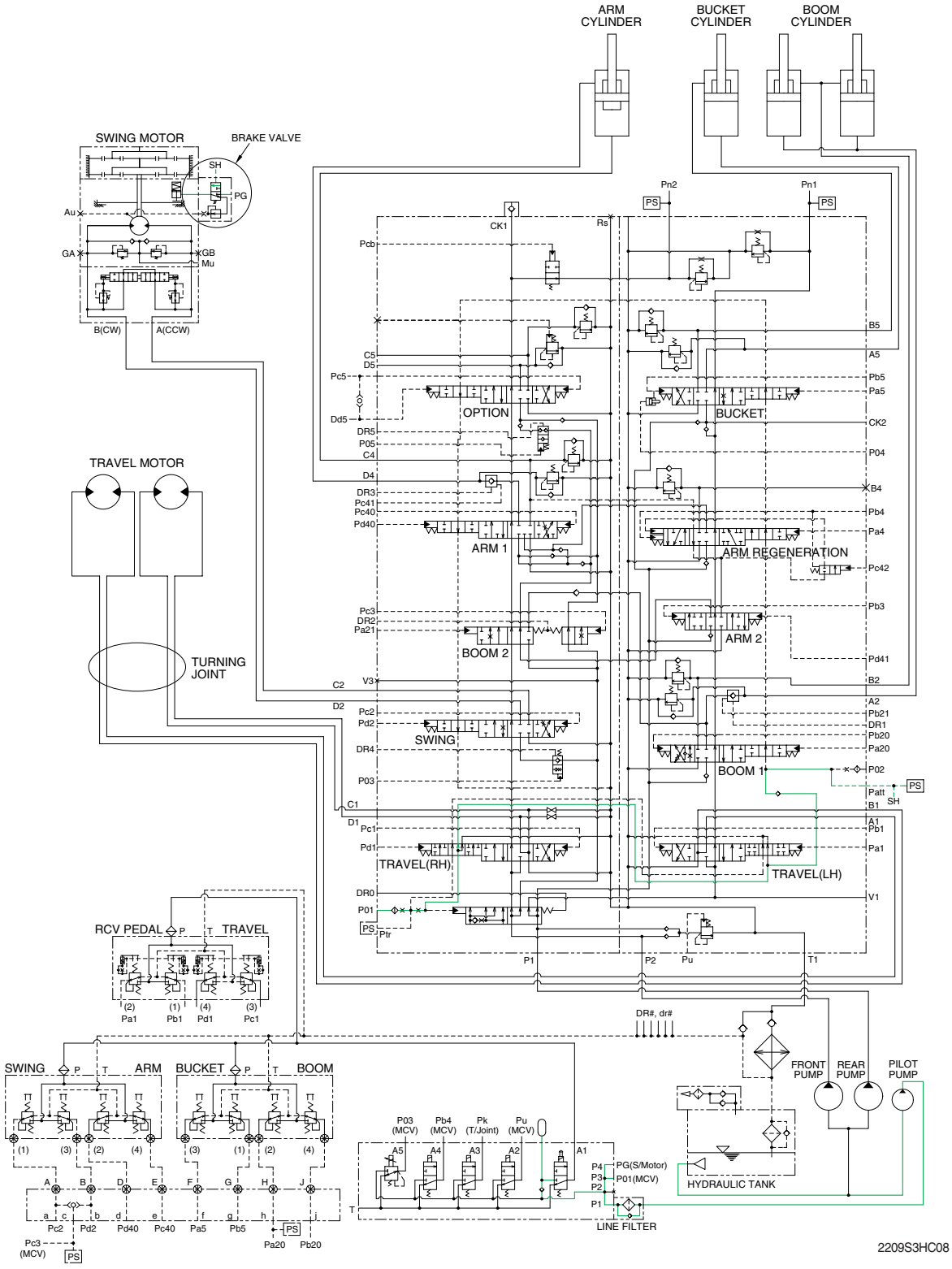
When the arm regeneration is selected to disable on the cluster, the arm regeneration solenoid valve is activated. The pilot oil from pilot pump flow into **Pb4** port in main control valve through solenoid valve and the arm regeneration spool is shifted to right.

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 2-43 for the arm regeneration function.

7. SWING PARKING BRAKE RELEASE



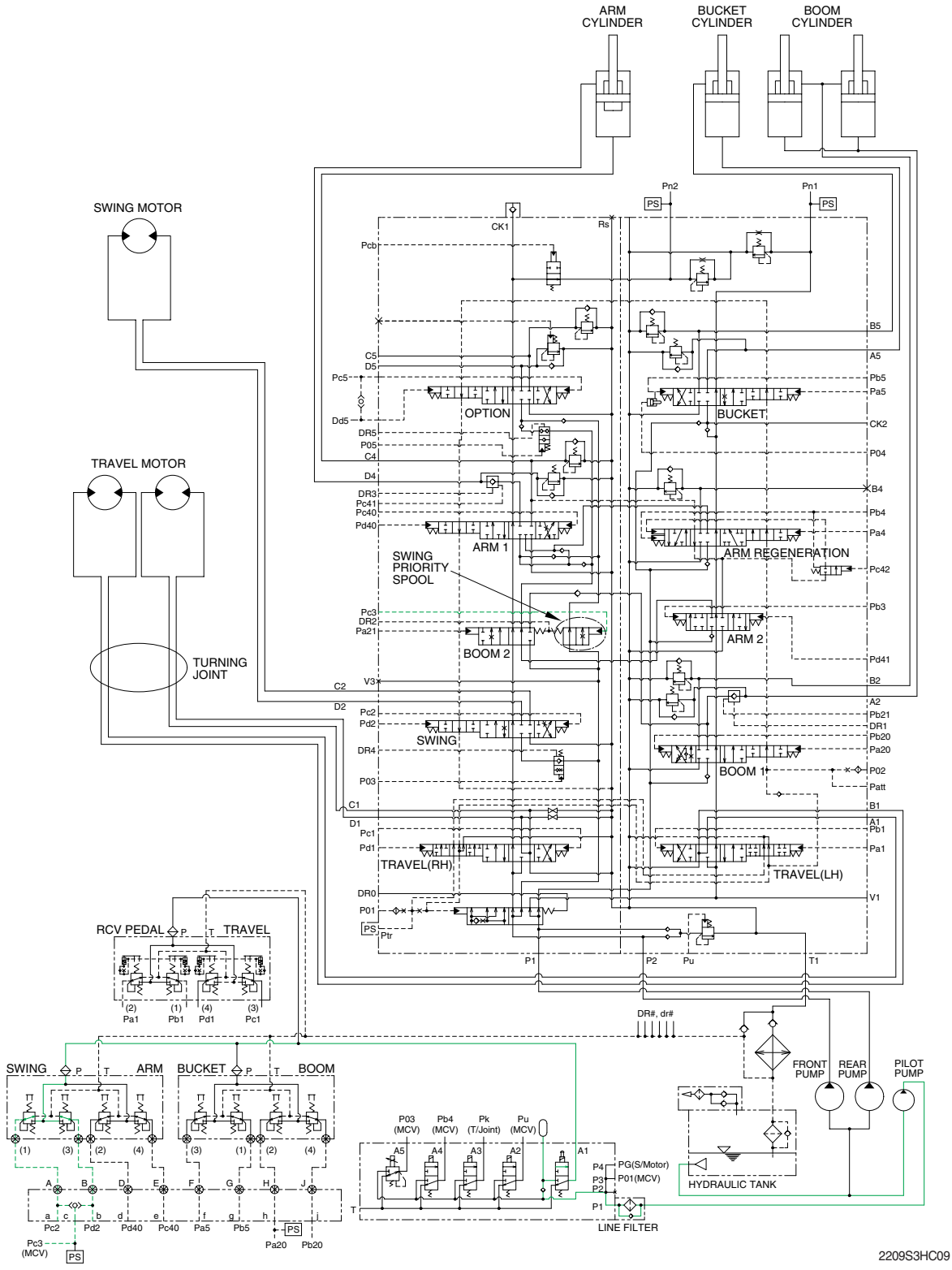
When one of the RCV lever (except travel lever) is tilted, the pilot oil flows into SH port through main control valve.

This pressure moves spool so, discharged oil from pilot valve flows to swing motor PG port.

This pressure is applied to swing motor disc, thus the brake is released.

When all of the RCV lever are set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

8. SWING PRIORITY SYSTEM



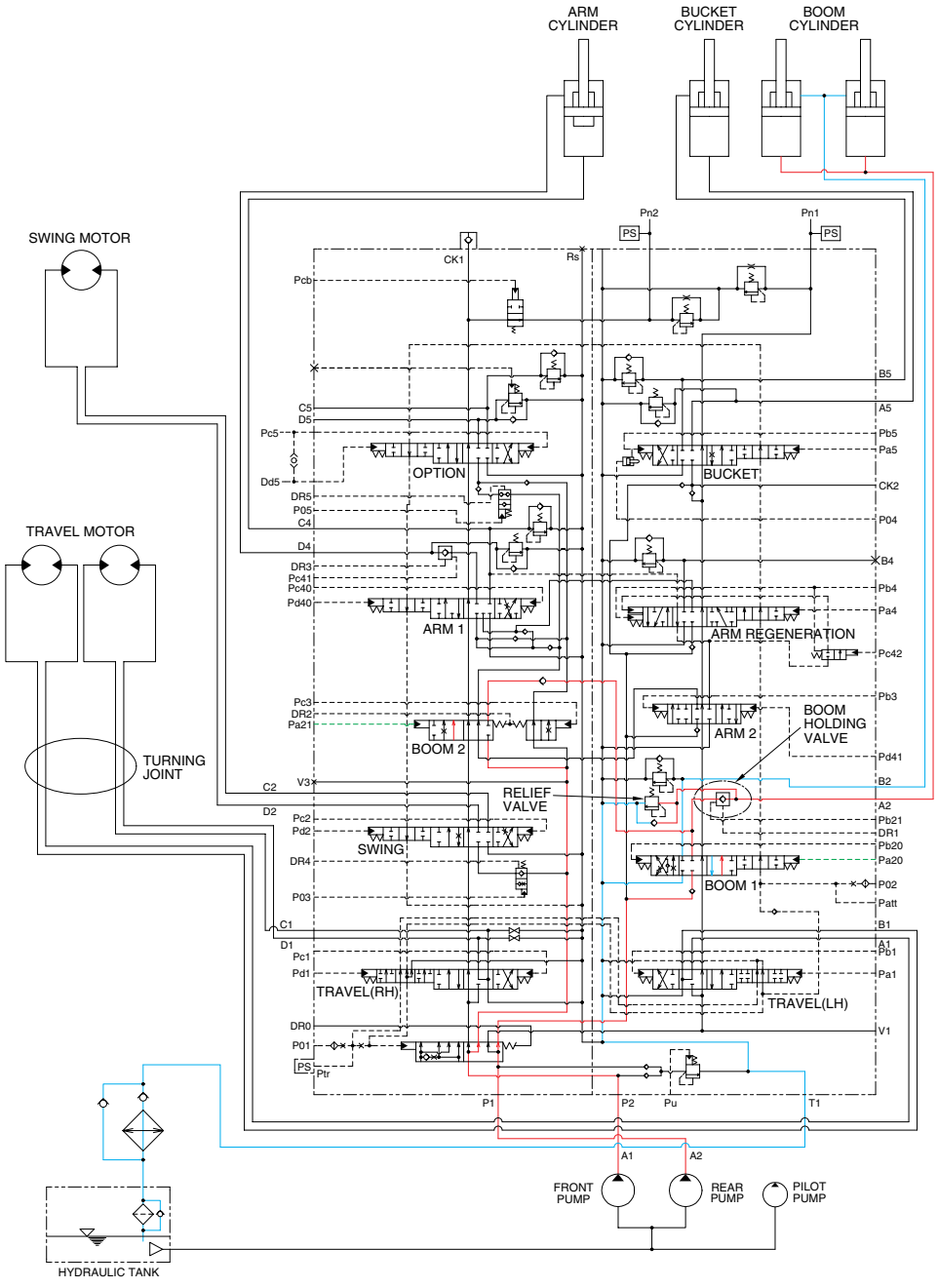
When carrying out the combined operation of swing and arm of the left control valve, the swing speed can be lowered than operating speed of arm.

Pc3 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 2-45.

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



2209S3HC10

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

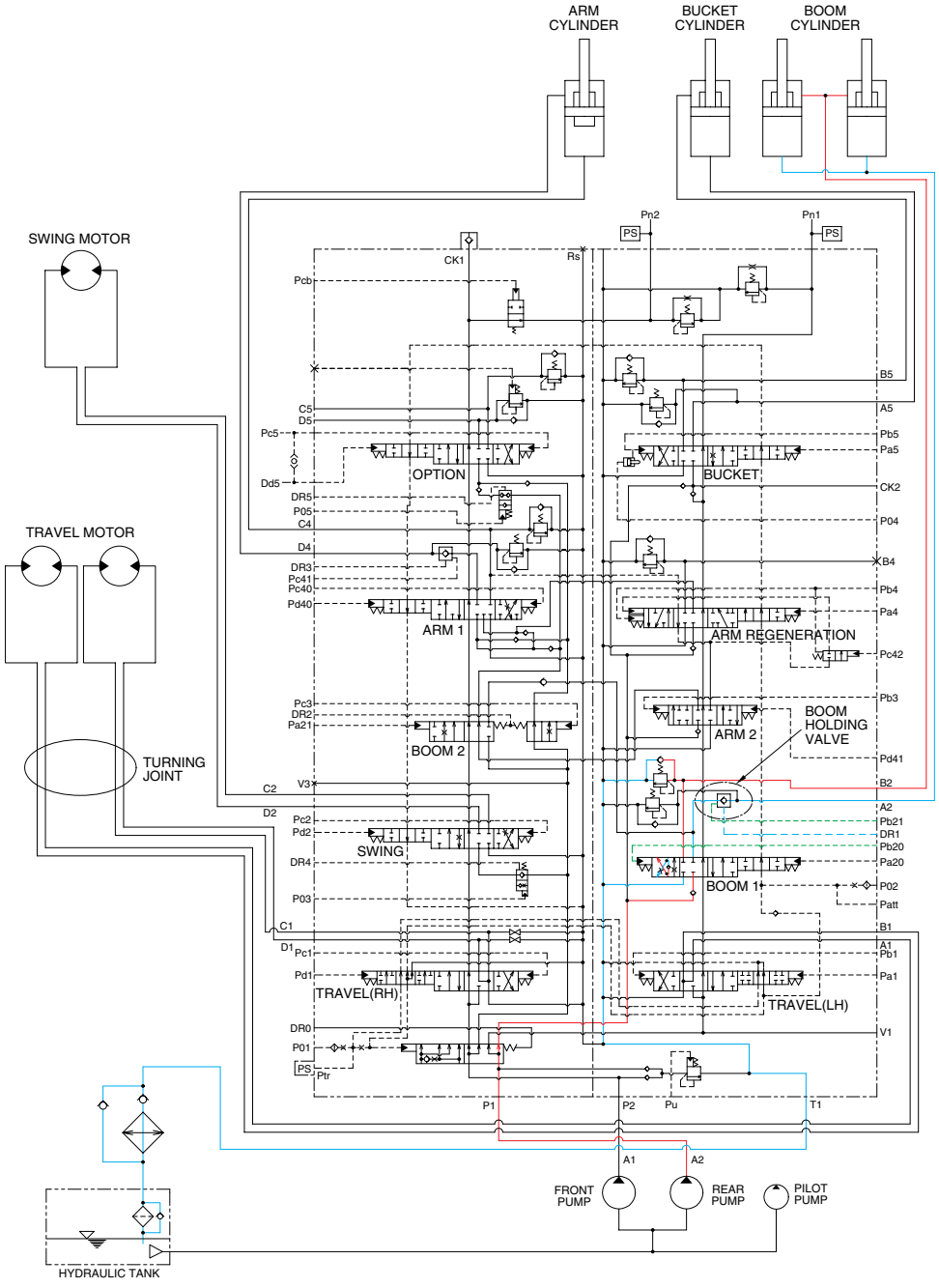
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up.

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

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

This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



2209S3HC11

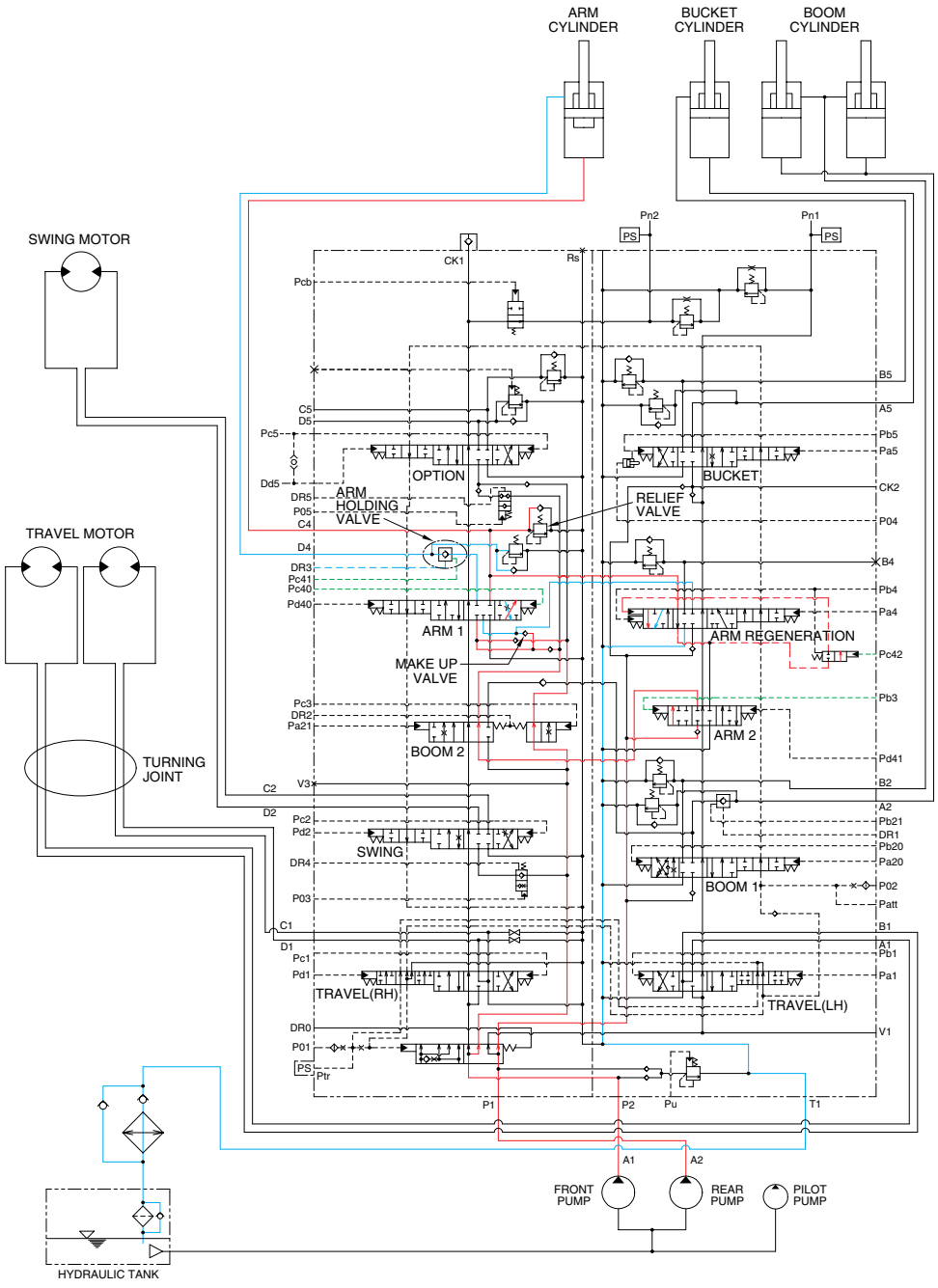
When the RH control lever is pushed forward, the boom spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.

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 rear pump, and flows into the small chamber of the boom cylinder.

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

3. ARM IN OPERATION



When the LH 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 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.

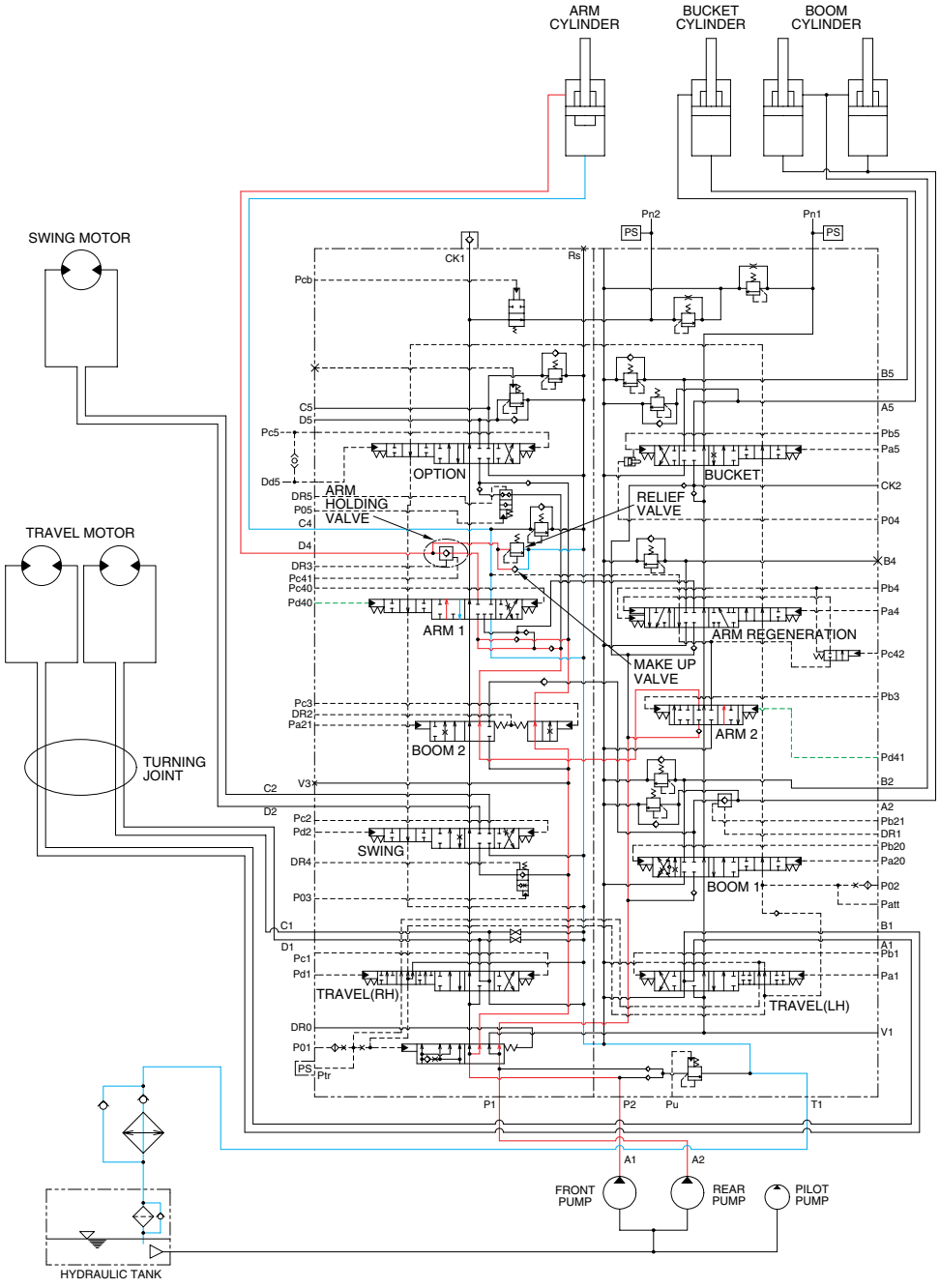
At the same time, the oil from the small chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm roll in.

When the roll in speed of arm is faster, the oil returned from the small chamber of arm cylinder combines with the oil from both pump, and flows into the large chamber of the arm cylinder by a make up valve.

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

Refer to page 3-12 for the arm regeneration.

4. ARM OUT OPERATION



When the LH control lever is pushed forward, the arm spools in the main control valve are moved to the roll out position by the pilot oil pressure 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 spool in the main control valve.

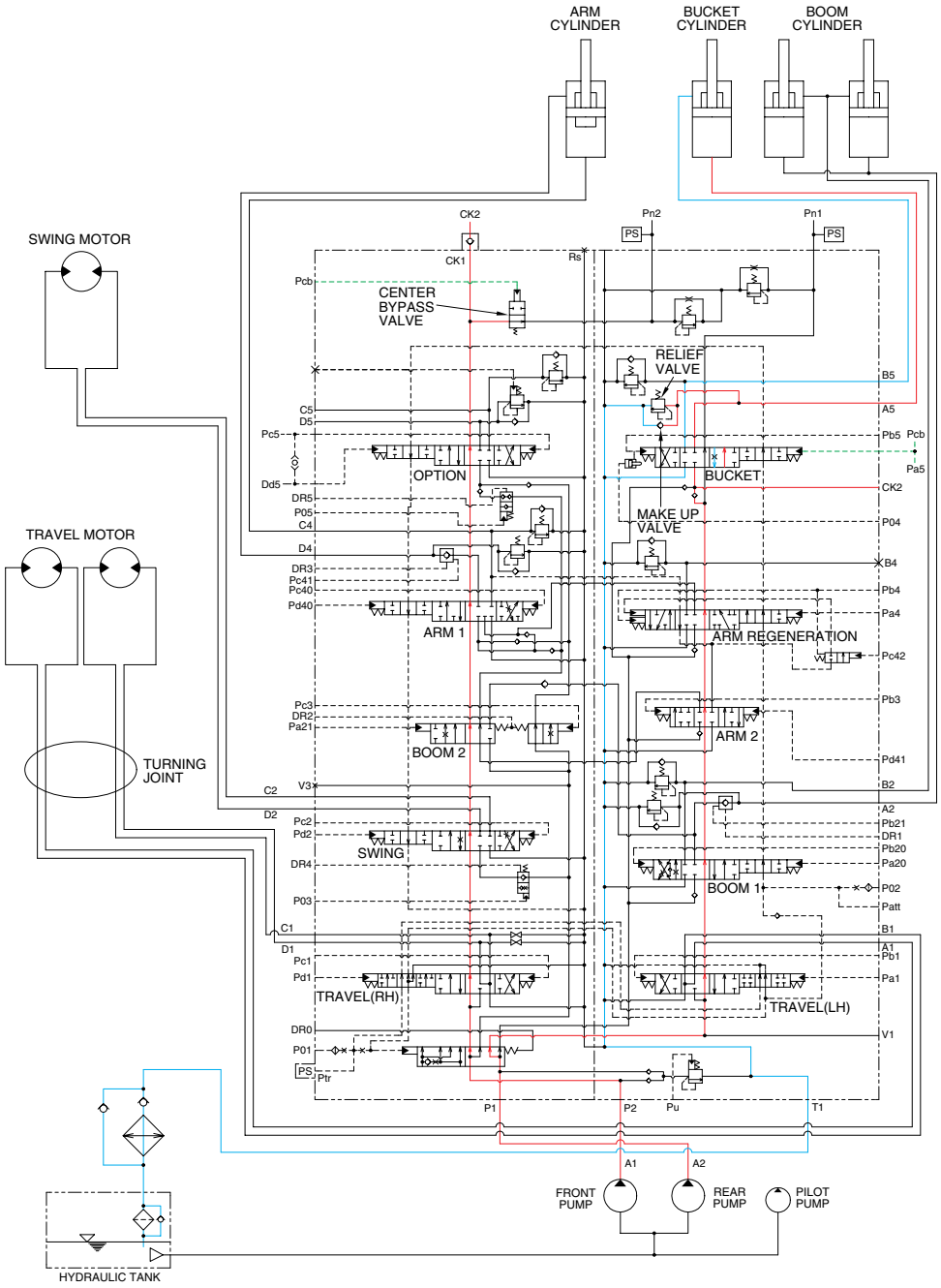
When this happens, the arm roll out. When the roll out speed of arm is faster, the oil returned from the large chamber of arm cylinder combines with the oil from both pump, and flows into the small chamber of the arm cylinder by a make up valve.

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

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

This prevents the hydraulic drift of arm cylinder.

5. BUCKET IN OPERATION



2209S3HC14

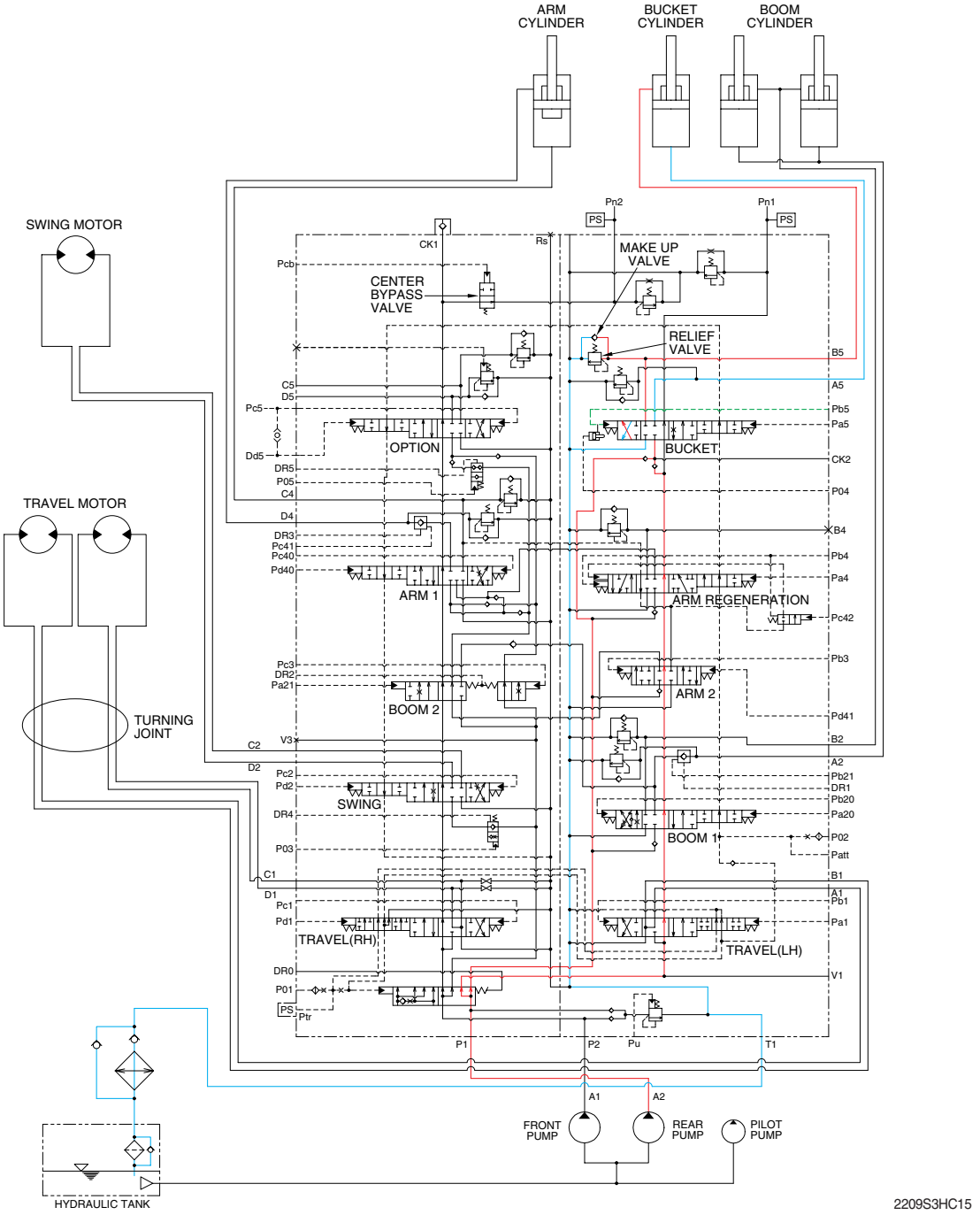
When the RH control lever is manually placed in the bucket roll in position. Then the oil flows from pilot pump through the pilot valve to bucket section of the main control valve. Here the spool position is moved to bucket roll in position.

The center bypass valve is change over by the pilot pressure (Pcb) and then the oil from A2 pump is joint to the flow of A1 pump via check 1 and external piping.

The oil flows from both pump through rod end of the cylinder through the bucket section returned to the hydraulic tank.

The cavitation which will happen to the bottom of the bucket cylinder is prevented by a make up valve, on other hand. The excessive pressure is also prevented by an overload relief valve in the main control valve.

6. BUCKET OUT OPERATION



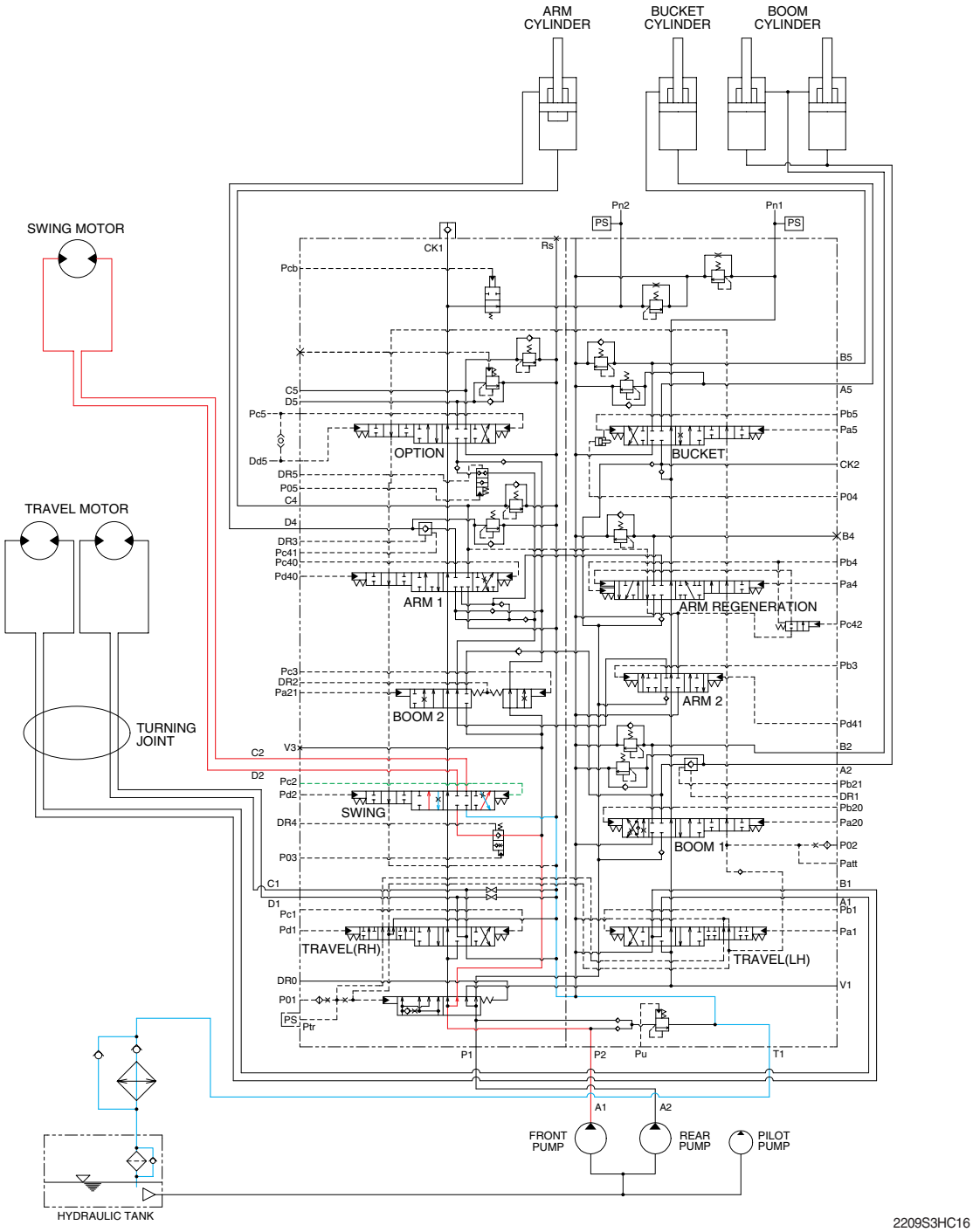
When the RH control lever is manually placed in the bucket roll out position. Then the oil flows from pilot pump through the pilot valve to bucket section of the main control valve. Here the spool position is moved to bucket roll out position.

The oil flows from A2 pump through bucket section of main control valve to the rod end of the bucket cylinder, and to roll out bucket.

The return oil flows from the bottom end of the cylinder through the bucket section returned to the hydraulic tank.

The cavitation which will happen to the rod of the bucket cylinder is prevented by a make up valve, on other hand. The excessive pressure is also prevented by an overload relief valve in the main control valve.

7. SWING OPERATION



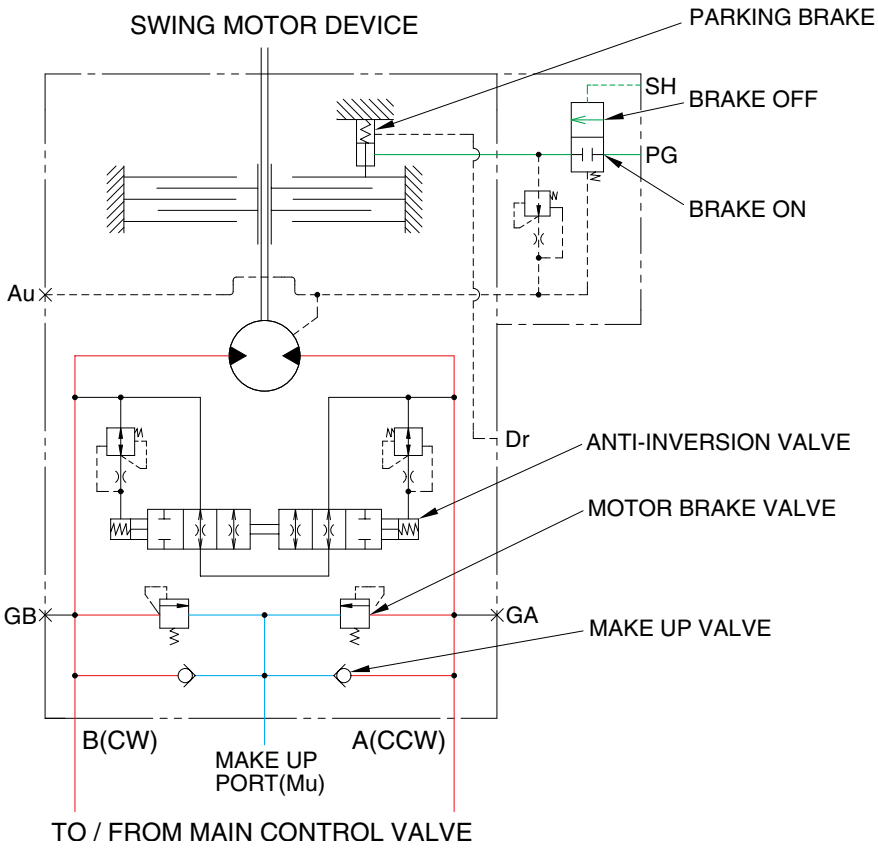
2209S3HC16

When the LH control lever is manually placed in the left (right) swing position. Then the oil flows from A1 pump through the swing section of the main control valve to swing motor to left (right) swing the superstructure. The return oil flows from swing motor through the swing section of the main control valve returned to the tank.

When the 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". The swing parking brake, make up valve and the overload relief valve are provide in the swing motors. The cavitation which will happen to the swing motor is prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

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

PARKING BRAKE "OFF" OPERATION

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

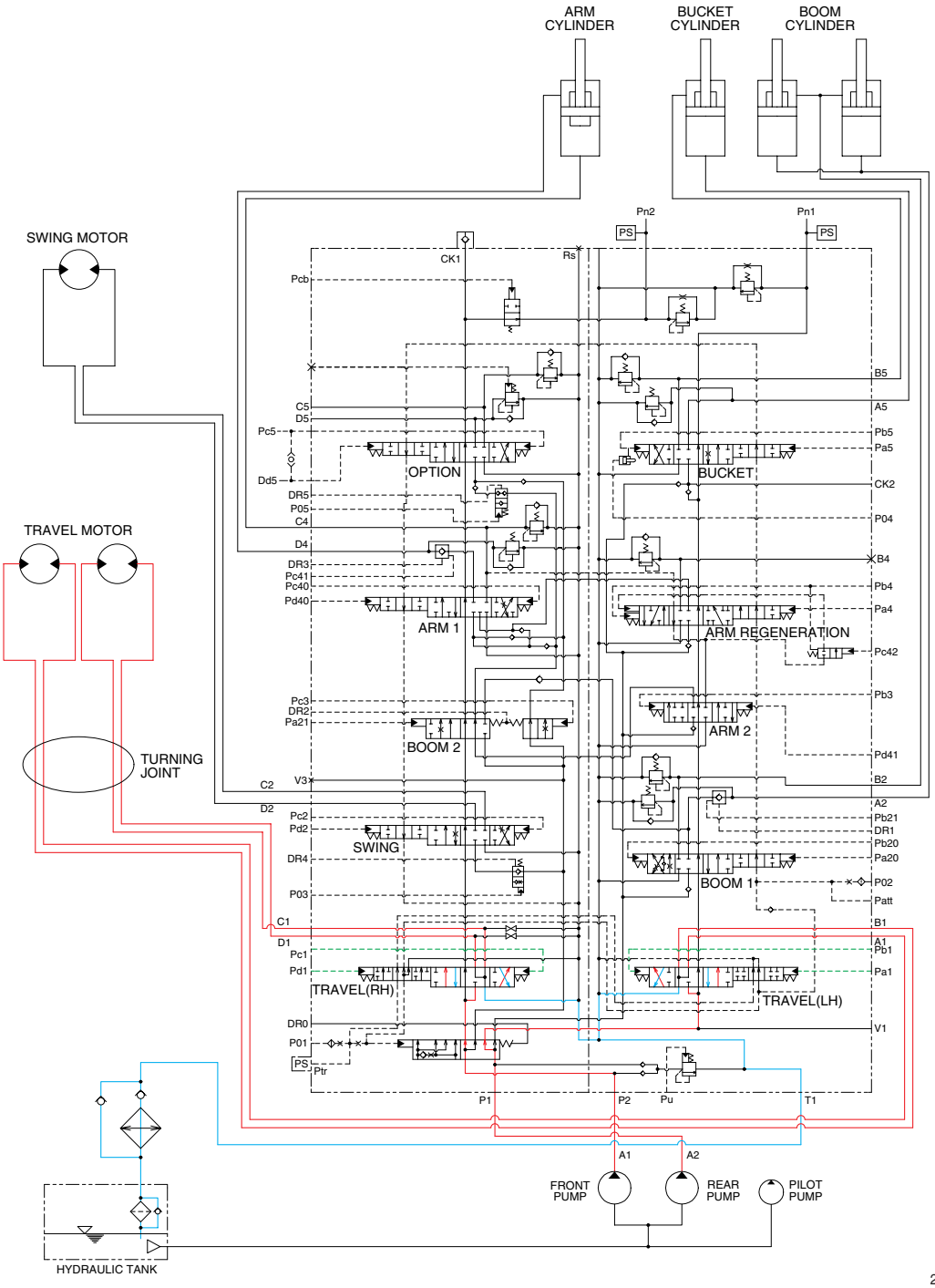
PARKING BRAKE "ON" OPERATION

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

4) ANTI-INVERSION VALVE

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

8. TRAVEL FORWARD AND REVERSE OPERATION



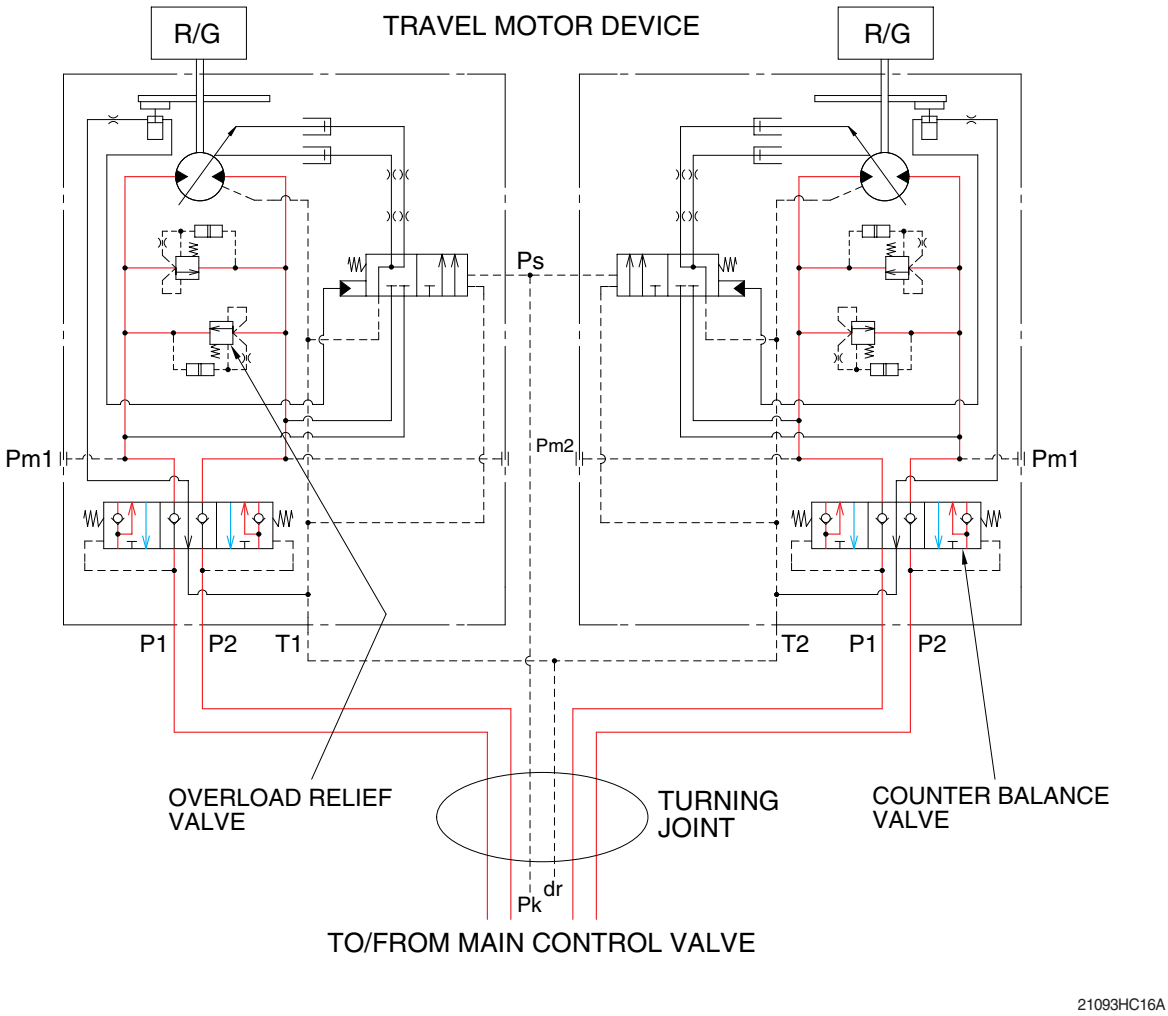
2209S3HC18

When the right and left travel levers are manually placed to the forward or reverse position, the oil flows from pilot pump through the pilot valve to travel sections of the main control valve.

Here, spool position is moved to forward and reverse position. The oil flows from A2 pump through the travel (RH) section of the main control valve and turning joint to the right travel motor and oil flows from A1 pump through the travel (LH) section of the main control valve and turning joint to the left travel motor and move the machine forward or reverse.

The return oil flows from both travel motor through the turning joint and travel (RH, LH) sections returned to the tank.

TRAVEL CIRCUIT OPERATION



21093HC16A

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

1) COUNTER BALANCE VALVE

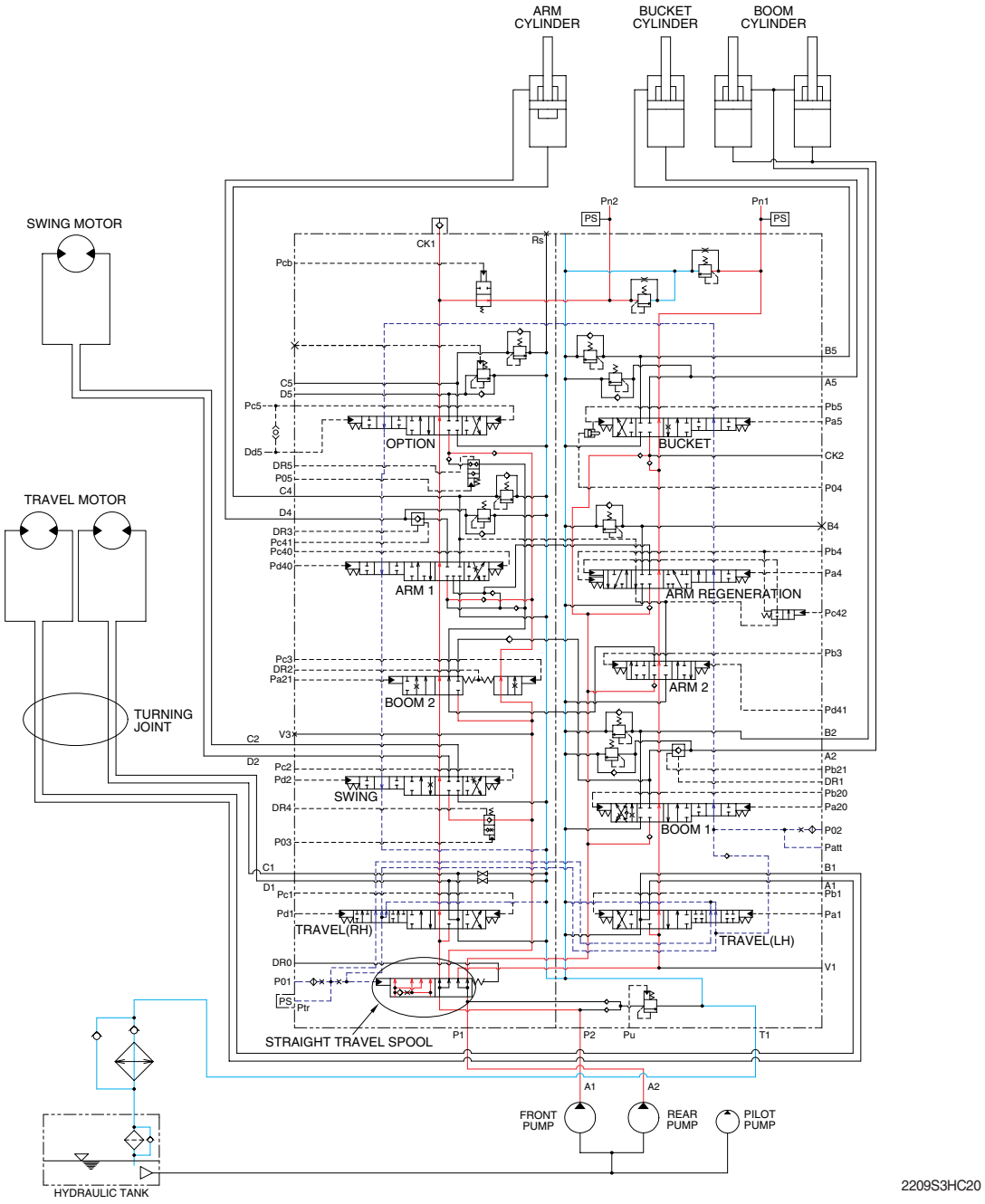
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 350 kgf/cm^2 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.

GROUP 5 COMBINED OPERATION

1. OUTLINE



2209S3HC20

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

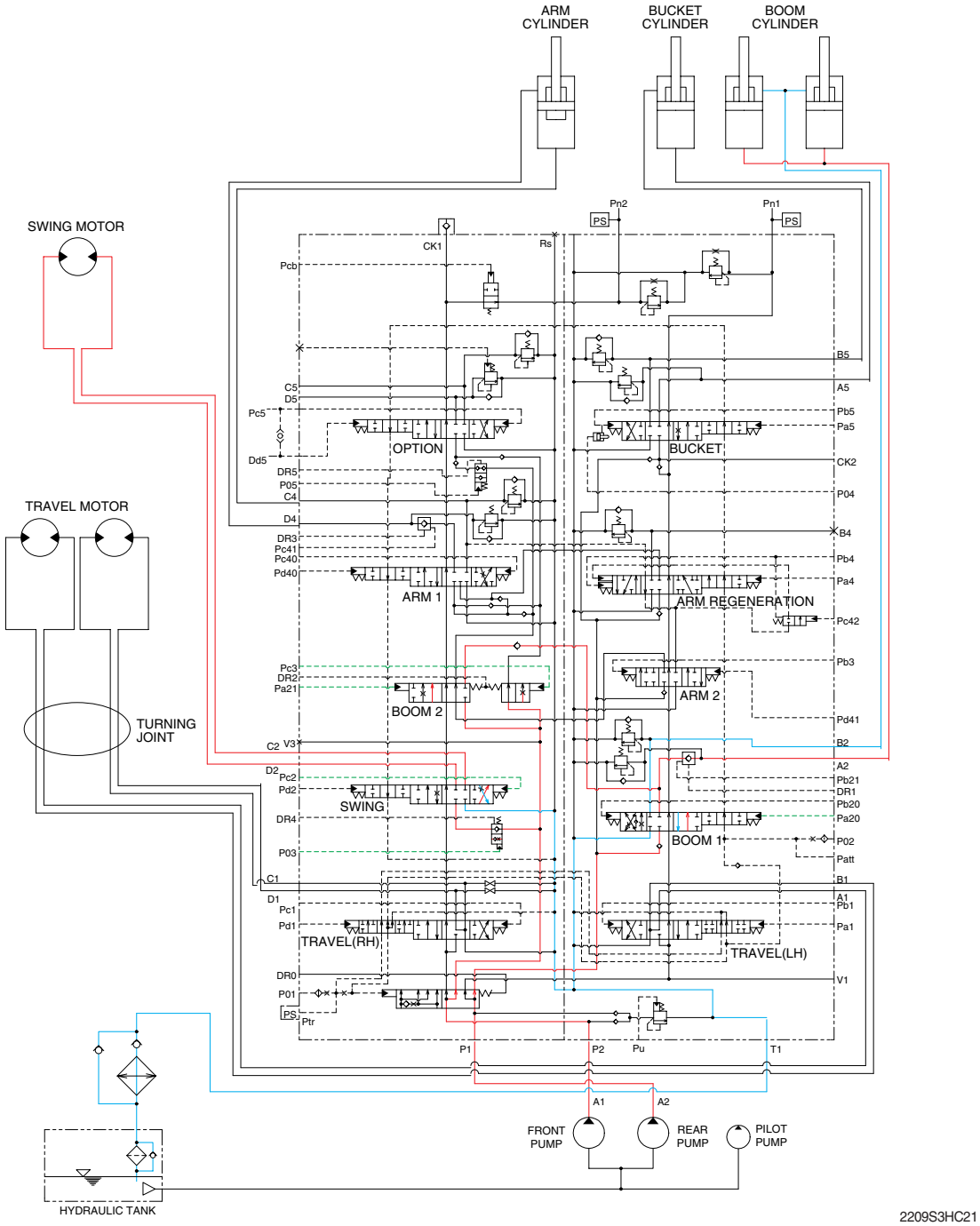
STRAIGHT TRAVEL SPOOL

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

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

Consequently, the left and right travel oil supply passage are connected, and equivalent amount of oil flows into the left and right travel motors. This keeps the straight travel.

2. COMBINED SWING AND BOOM UP OPERATION



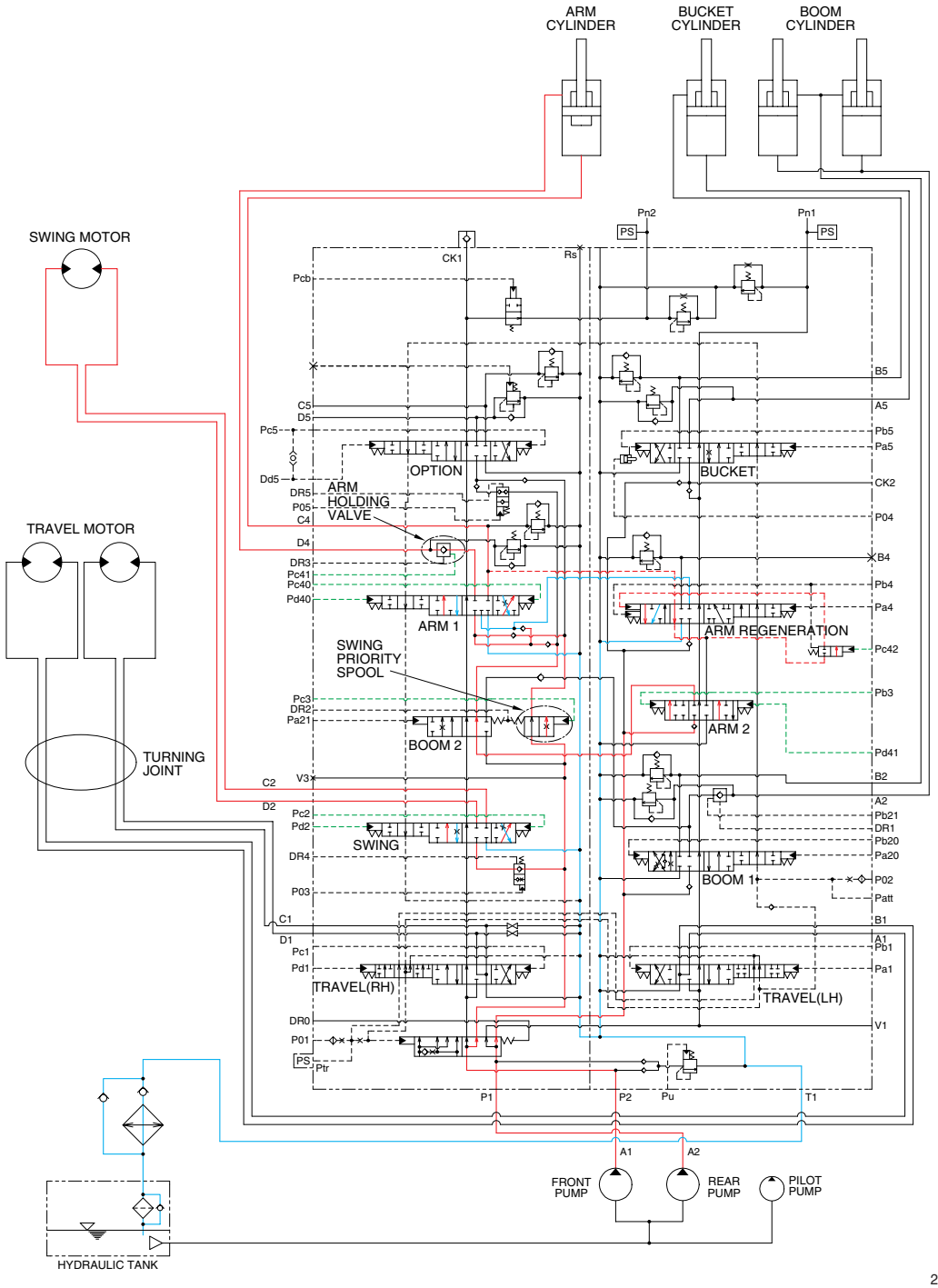
When the swing and boom up functions are operated, simultaneously the swing spool and boom spools changed. The oil flows from the A2 pump through boom1 section of the main control valve to boom cylinders and the boom functions.

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

The upper structure swing and the boom is up.

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

3. COMBINED SWING AND ARM OPERATION



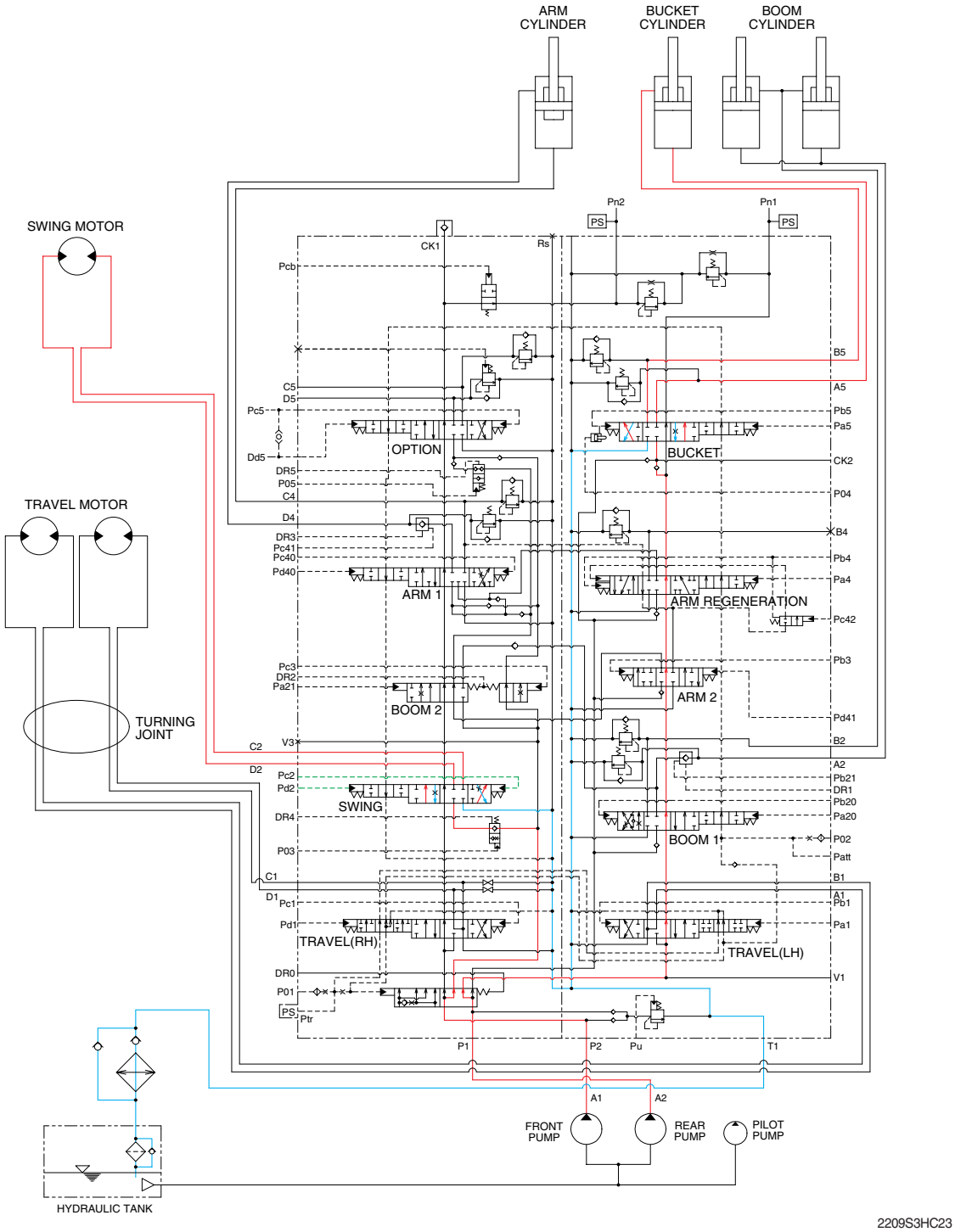
2209S3HC22

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 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.

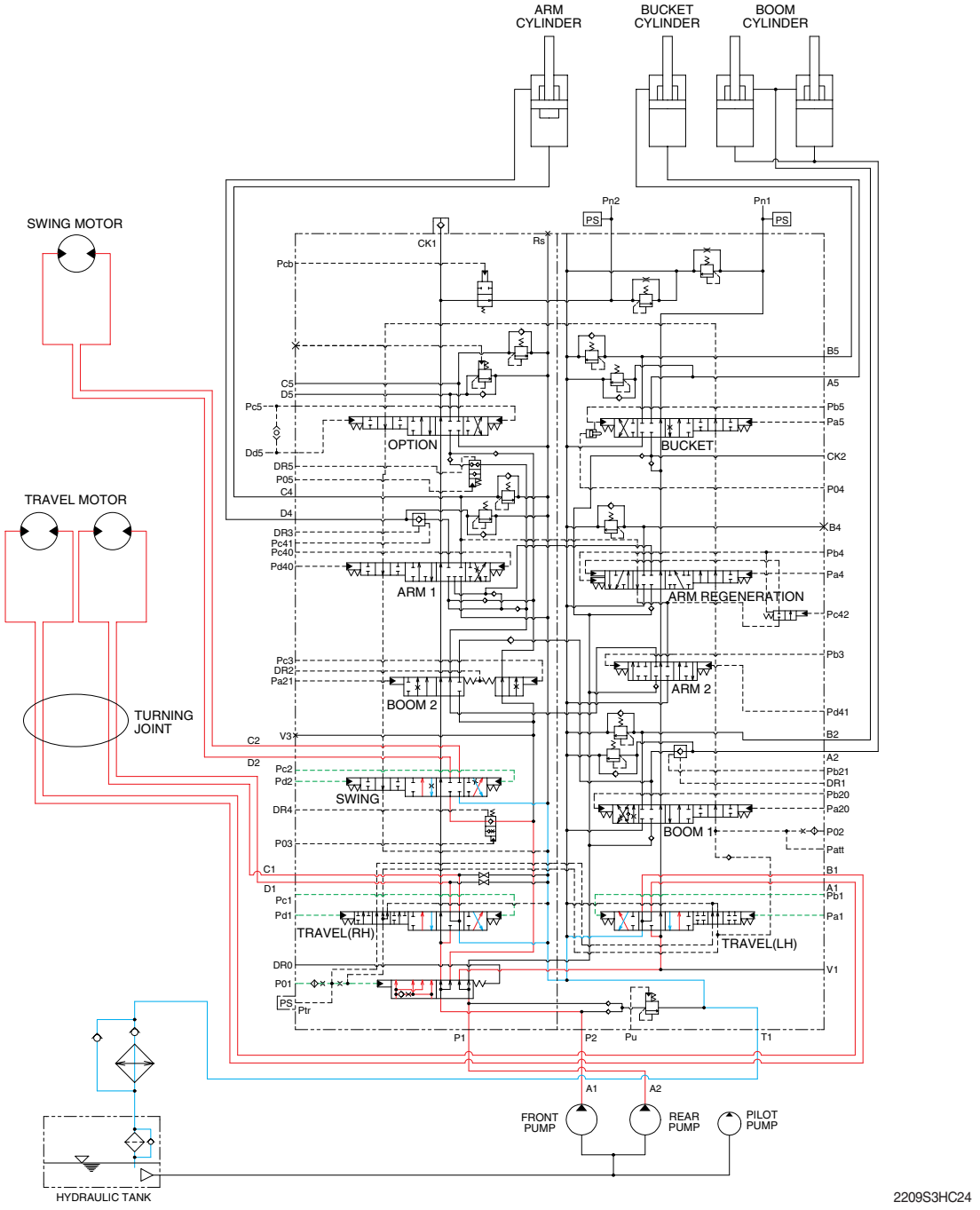
The oil from the A2 pump flows into the arm cylinder through the arm 2 spool of the right control valve. The upper structure swings and the arm is operated.

4. COMBINED SWING AND BUCKET OPERATION



When the swing and bucket functions are operated, the swing and bucket spools changed. The oil flows from the A2 pump through the bucket section of the main control valve to the bucket cylinder and the bucket functions. The oil flows from A1 pump through swing section of the main control valve to the swing motor and swing the superstructure.

5. COMBINED SWING AND TRAVEL OPERATION

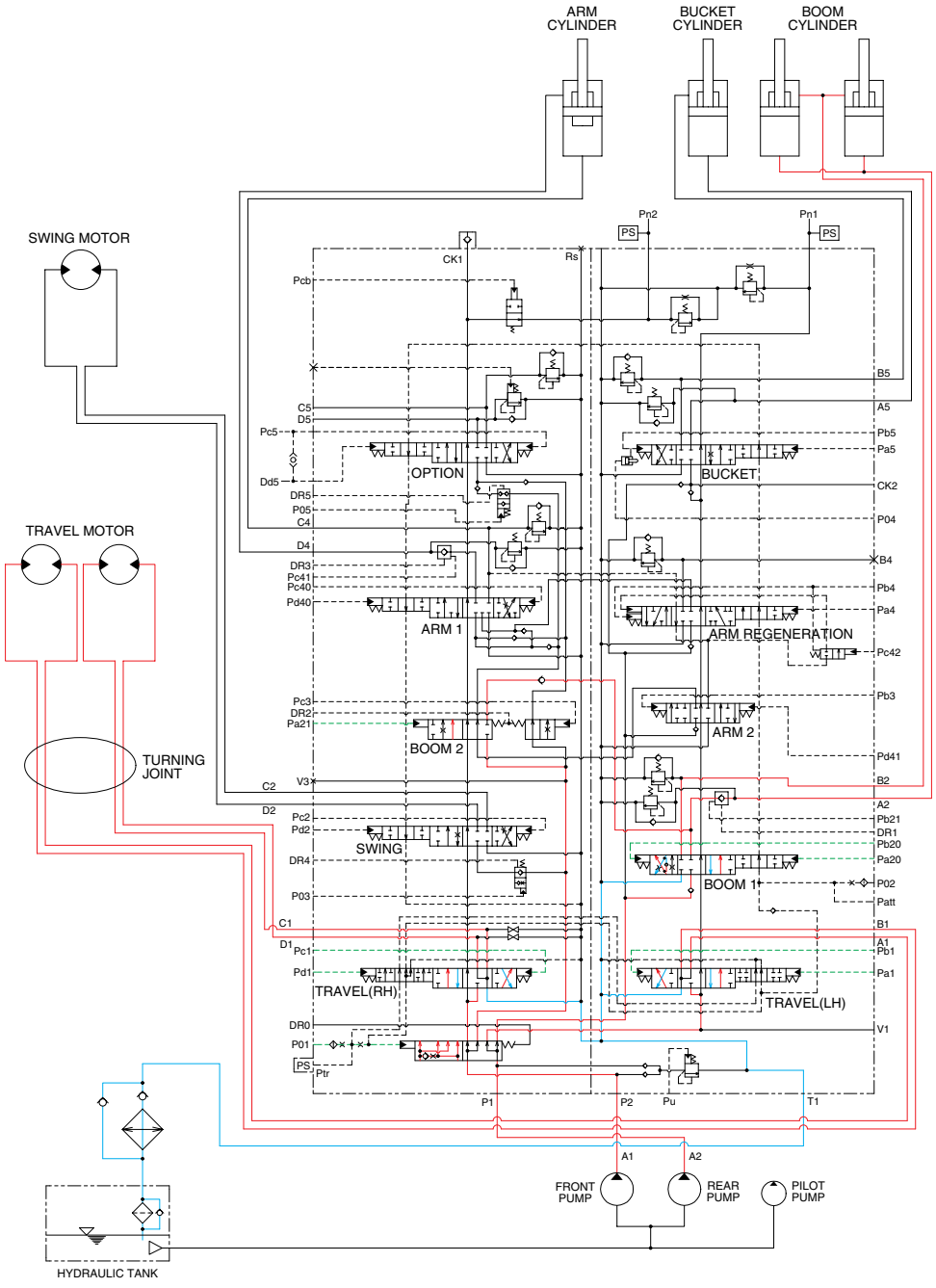


When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve. At the same time, the straight travel spool is pushed to the right by the pilot oil pressure from the pilot pump.

The oil from the A2 pump flows into the swing motor through the swing spool. The oil from the A1 pump flows into the travel motor through the RH travel spool of the right control valve and the LH travel spool of the left control valve via the straight travel spool.

The superstructure swings and the machine travels straight.

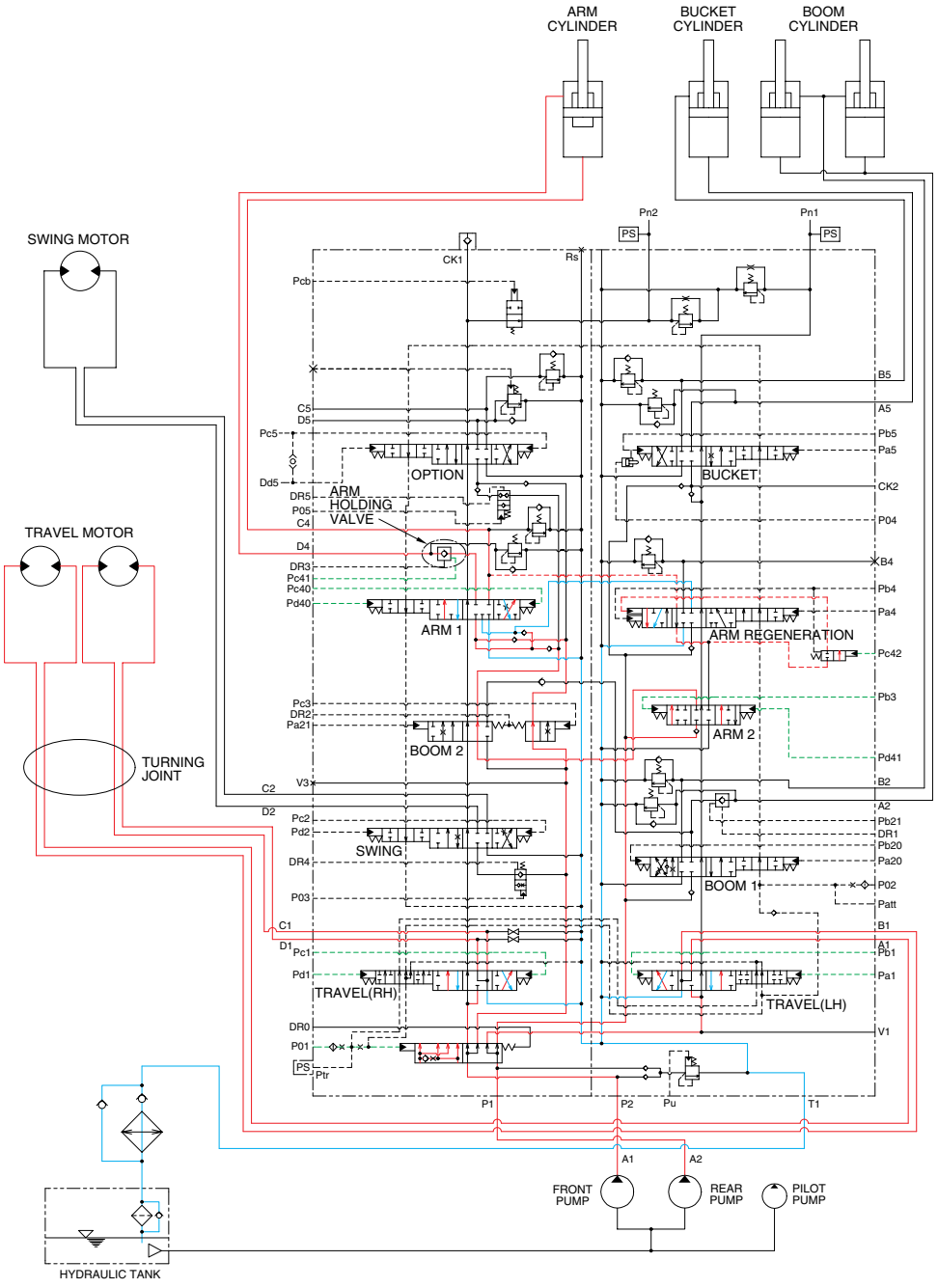
6. COMBINED BOOM AND TRAVEL OPERATION



2209S3HC25

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 from the remote control valve. At the same time, the straight travel spool is pushed to the right by the pilot oil pressure from the pilot pump. 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 passage in case boom up operation. The oil from the A1 pump flows into the travel motors through the RH travel spool of the right control valve and the LH travel spool of the left control valve via the straight travel spool.

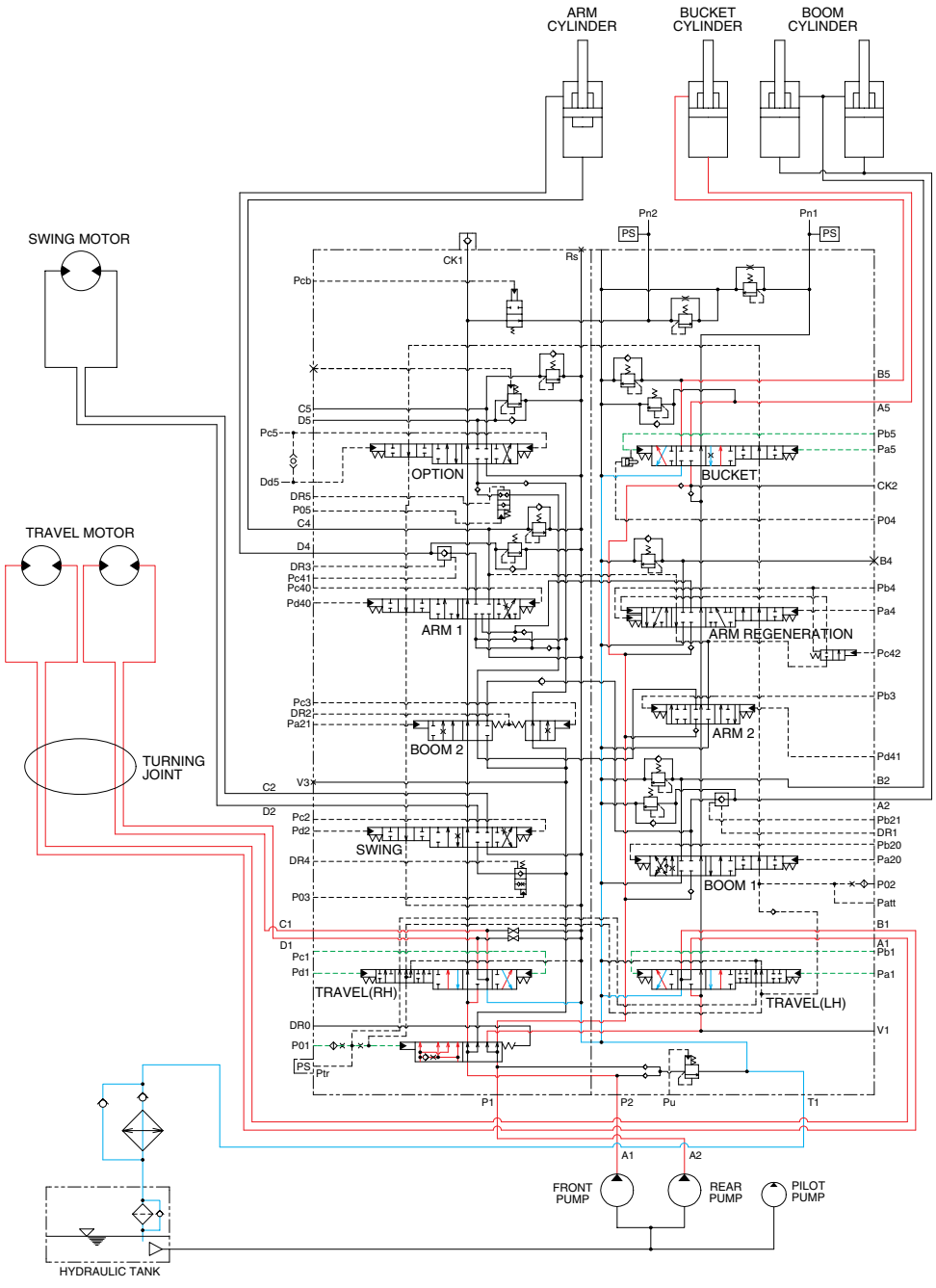
7. COMBINED ARM AND TRAVEL OPERATION



2209S3HC26

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 from the remote control valve. At the same time, the straight travel spool is pushed to the right by the pilot oil pressure from the pilot pump. 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. The oil from the A1 pump flows into the travel motors through the RH travel spool of the right control valve and the LH travel spool of the left control valve via the straight travel spool.

8. COMBINED BUCKET AND TRAVEL OPERATION

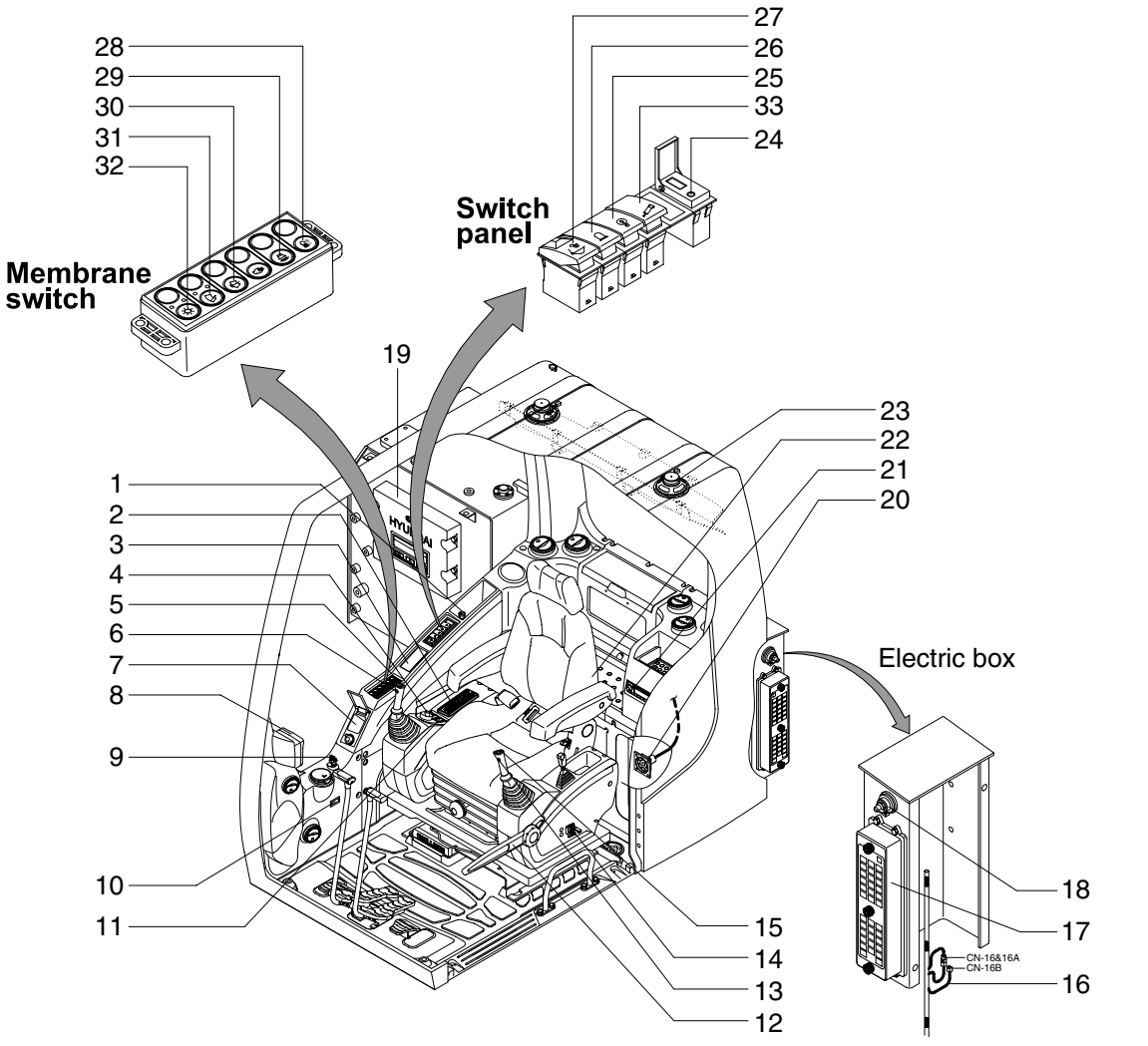


When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve. At the same time, the straight travel spool is pushed to the right by the pilot oil pressure from the pilot pump. The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage. The oil from the A1 pump flows into the travel motors through the RH travel spool of the right control valve and the LH travel spool of the left control valve via the straight travel spool of the control valve.

SECTION 4 ELECTRICAL SYSTEM

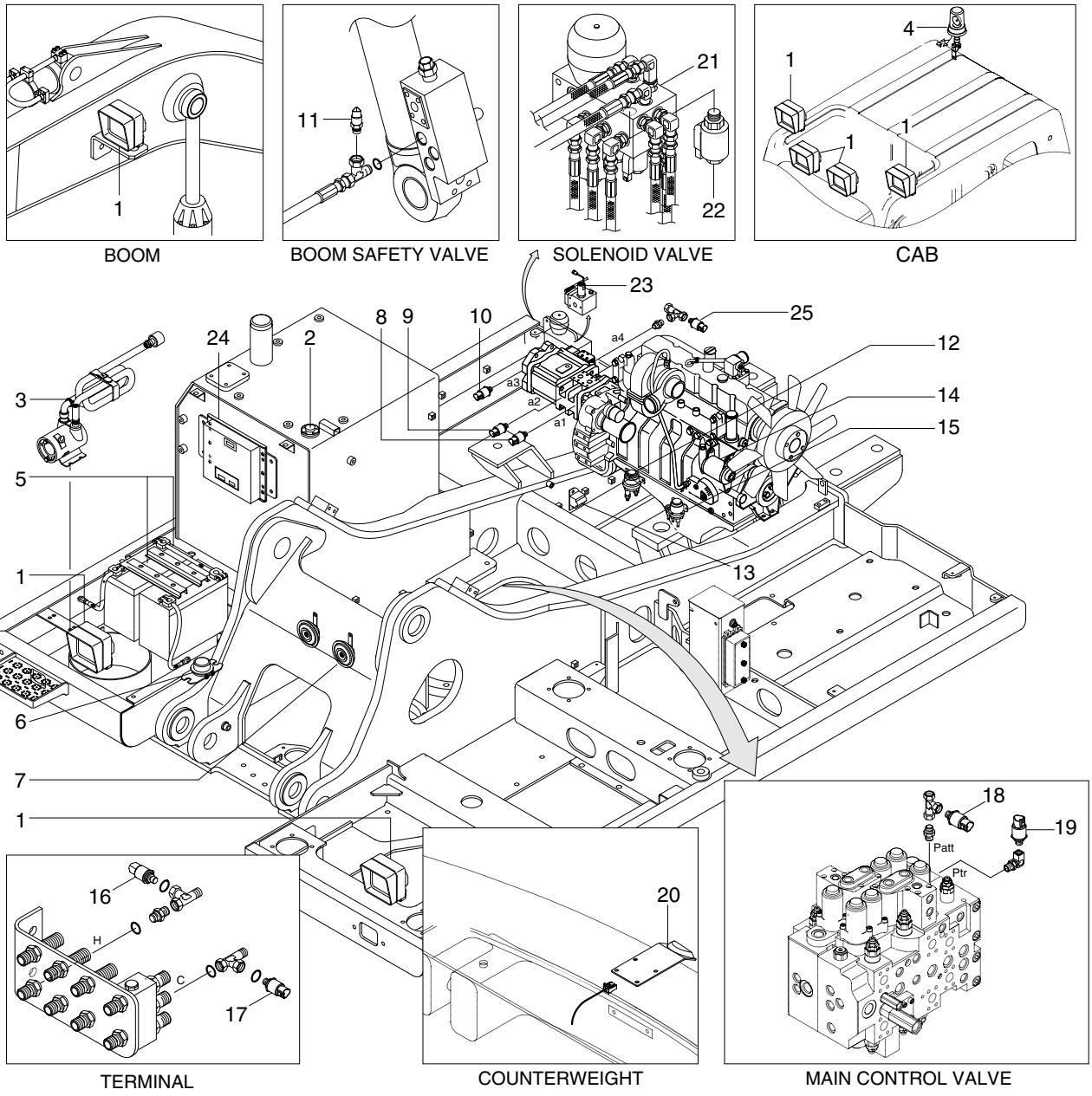
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



1	Cigar lighter	12	Safety lever	23	Speaker
2	Air conditioner & heater switch	13	Power max switch	24	USB socket
3	Remote controller	14	Emergency engine stop switch	25	Overload switch
4	Accel dial switch	15	One touch decel switch	26	Beacon switch
5	Horn switch	16	Emergency engine connector	27	Quick clamp switch
6	Breaker operation switch	17	Fuse & relay box	28	Cab light switch
7	Handsfree	18	Master switch	29	Travel alarm switch
8	Cluster	19	Machine control unit	30	Washer switch
9	Start switch	20	RS232 service socket	31	Wiper switch
10	Hour meter	21	Radio & USB player	32	Main light switch
11	Air compressor switch	22	Heated seat switch	33	Breaker switch

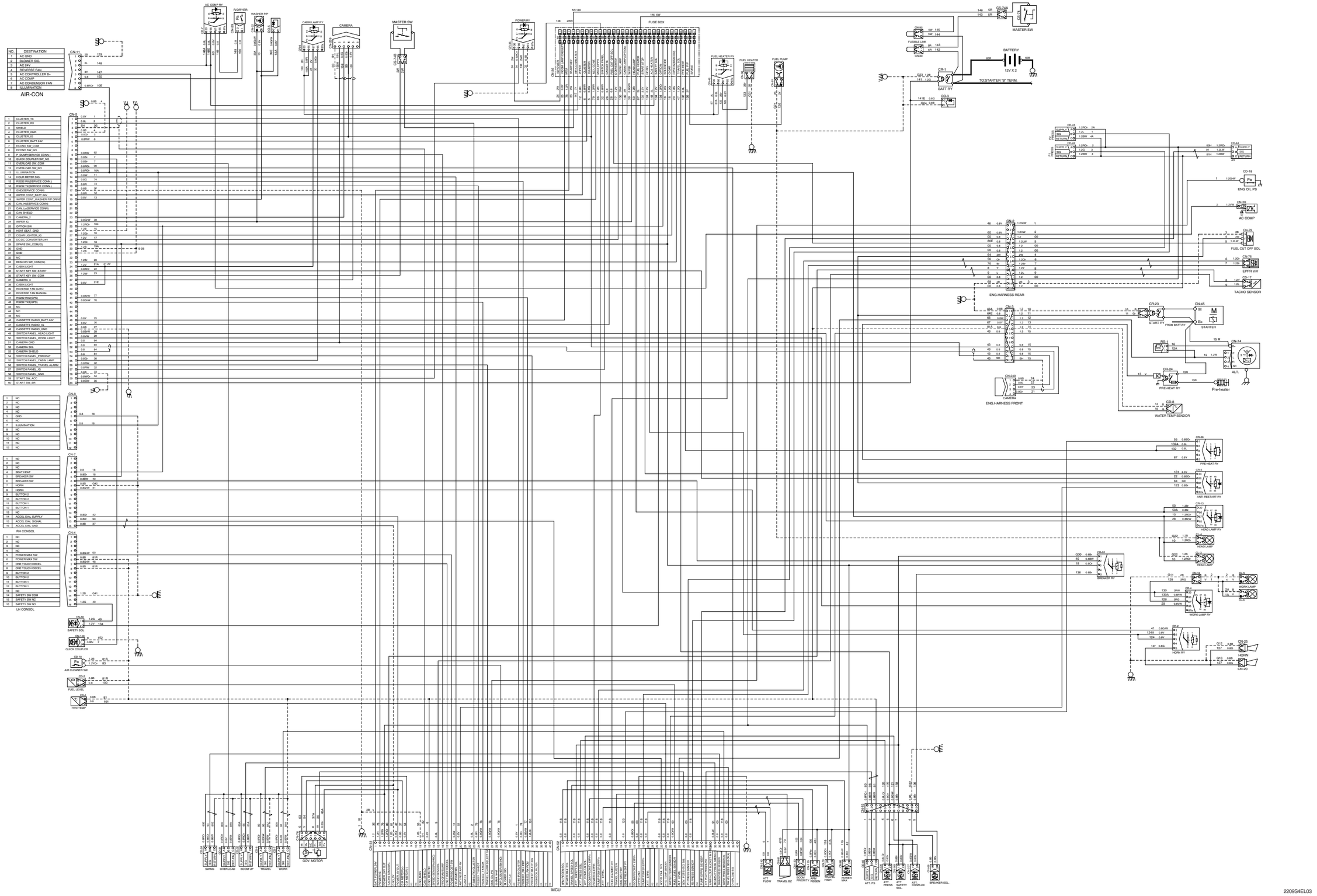
2. LOCATION 2



1	Lamp	10	P3 pressure sensor	19	Travel pressure sensor
2	Fuel sender	11	Overload pressure sensor	20	Rear view camera
3	Fuel filler pump	12	Start relay	21	Solenoid valve
4	Beacon lamp	13	Back buzzer	22	Boom priority EPPR valve
5	Battery	14	Alternator	23	Pump EPPR valve
6	Battery relay	15	Heater relay	24	Machine control unit (MCU)
7	Horn	16	Boom up pressure sensor	25	Attachment flow EPPR vlv
8	P1 pressure sensor	17	Swing pressure sensor		
9	P2 pressure sensor	18	Attach pressure sensor		

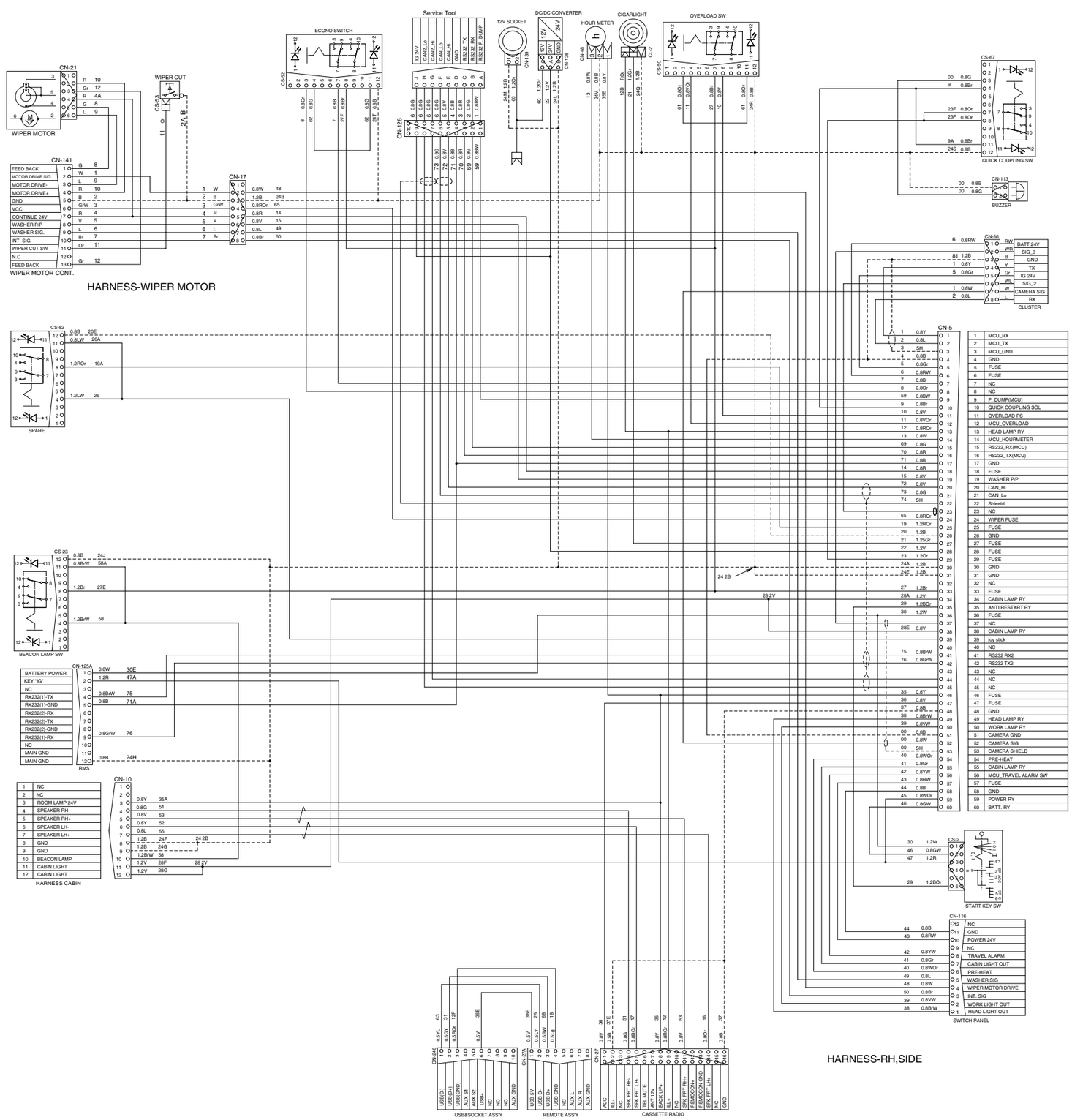
※ Cluster type 1 only : 10, 16, 17, 25

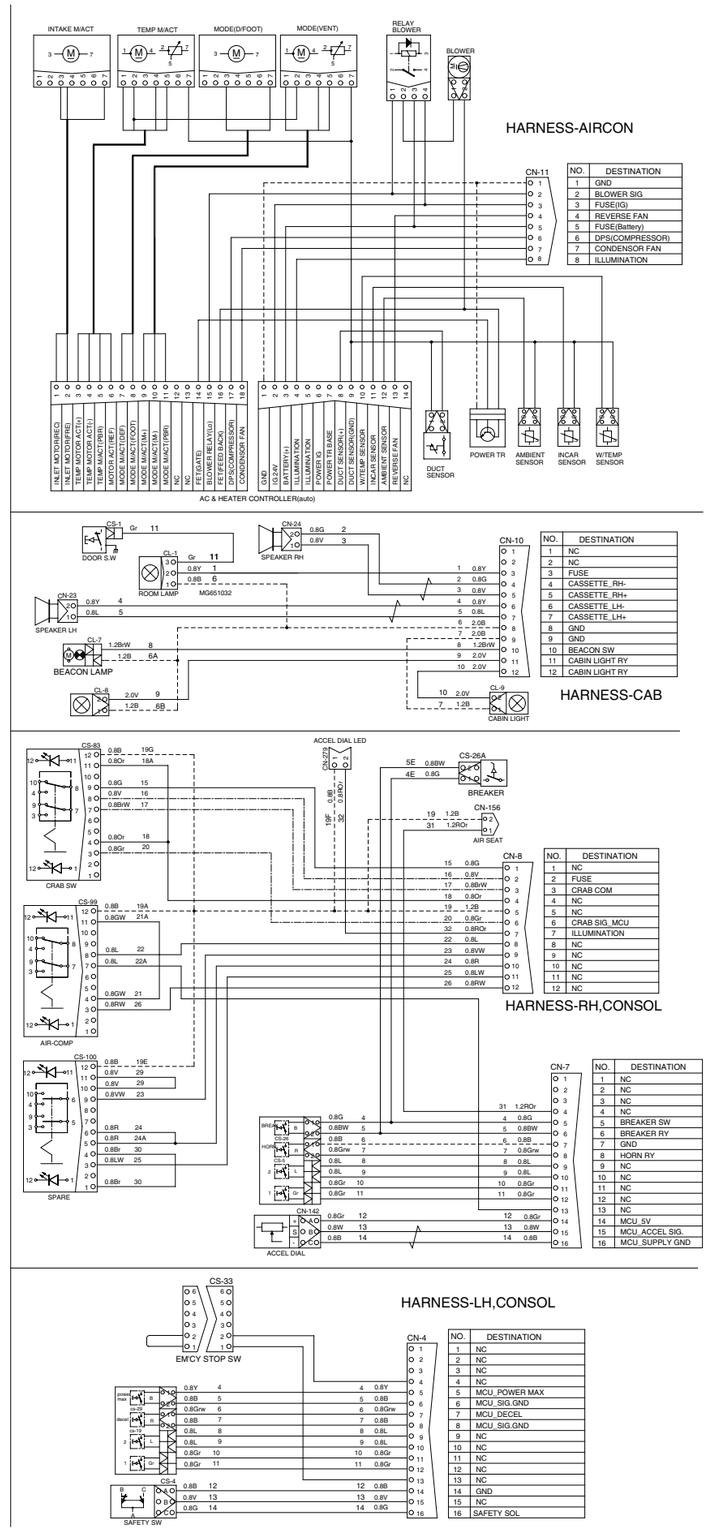
GROUP 2 ELECTRICAL CIRCUIT (1/2, CLUSTER TYPE 1)



2209S4EL03

· **ELECTRICAL CIRCUIT** (2/2, CLUSTER TYPE 1)





NO.	DESTINATION
1	GND
2	BLOWER SIG
3	FUSE(IG)
4	REVERSE FAN
5	FUSE(Battery)
6	DPS(COMPRESSOR)
7	CONDENSOR FAN
8	ILLUMINATION

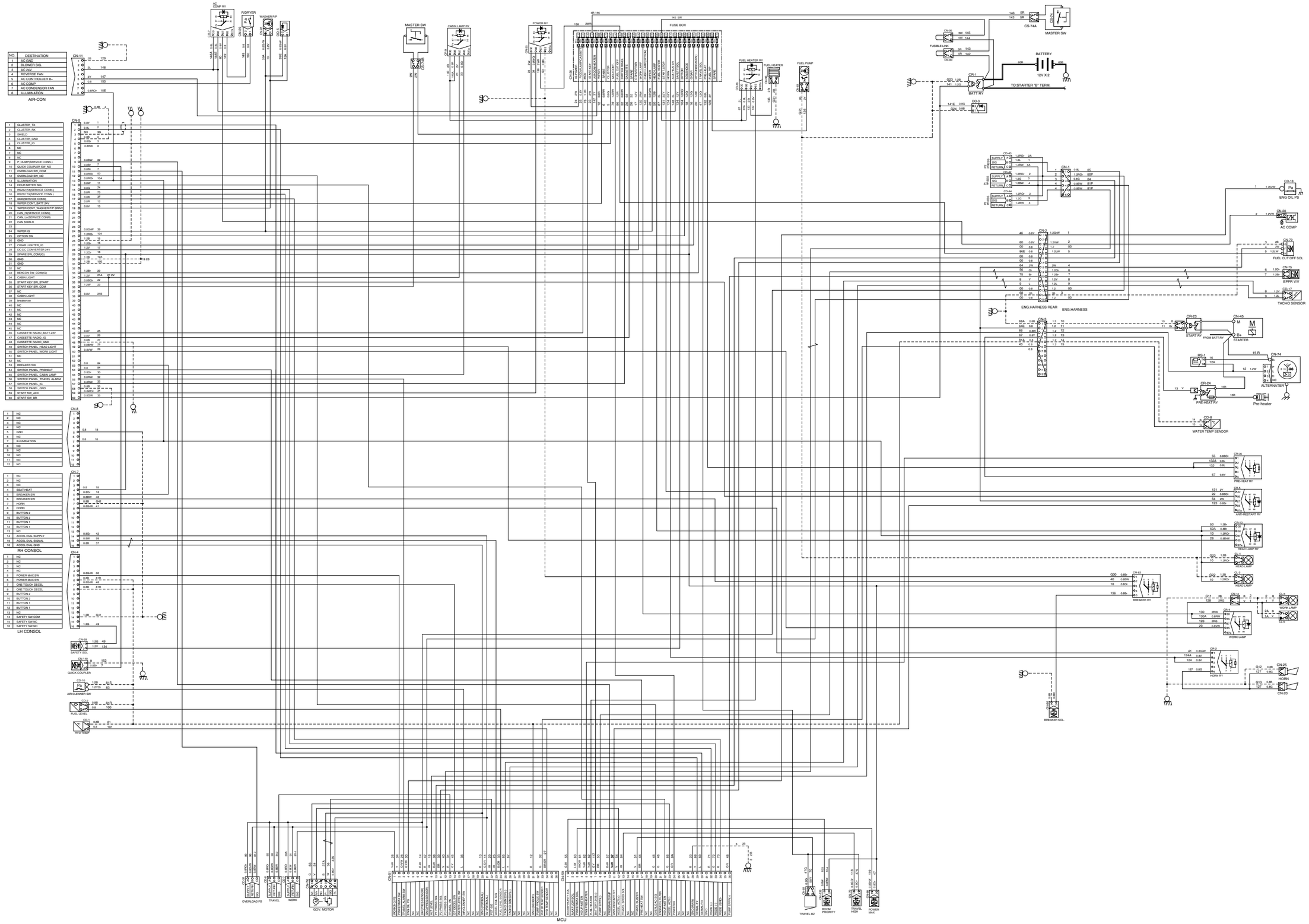
NO.	DESTINATION
1	NC
2	NC
3	FUSE
4	CASSETTE_RH-
5	CASSETTE_RH+
6	CASSETTE_LH-
7	CASSETTE_LH+
8	GND
9	GND
10	BEACON SW
11	CABIN LIGHT RY
12	CABIN LIGHT RY

NO.	DESTINATION
1	NC
2	FUSE
3	CRAB COM
4	NC
5	NC
6	CRAB SIG, MCU
7	ILLUMINATION
8	NC
9	NC
10	NC
11	NC
12	NC

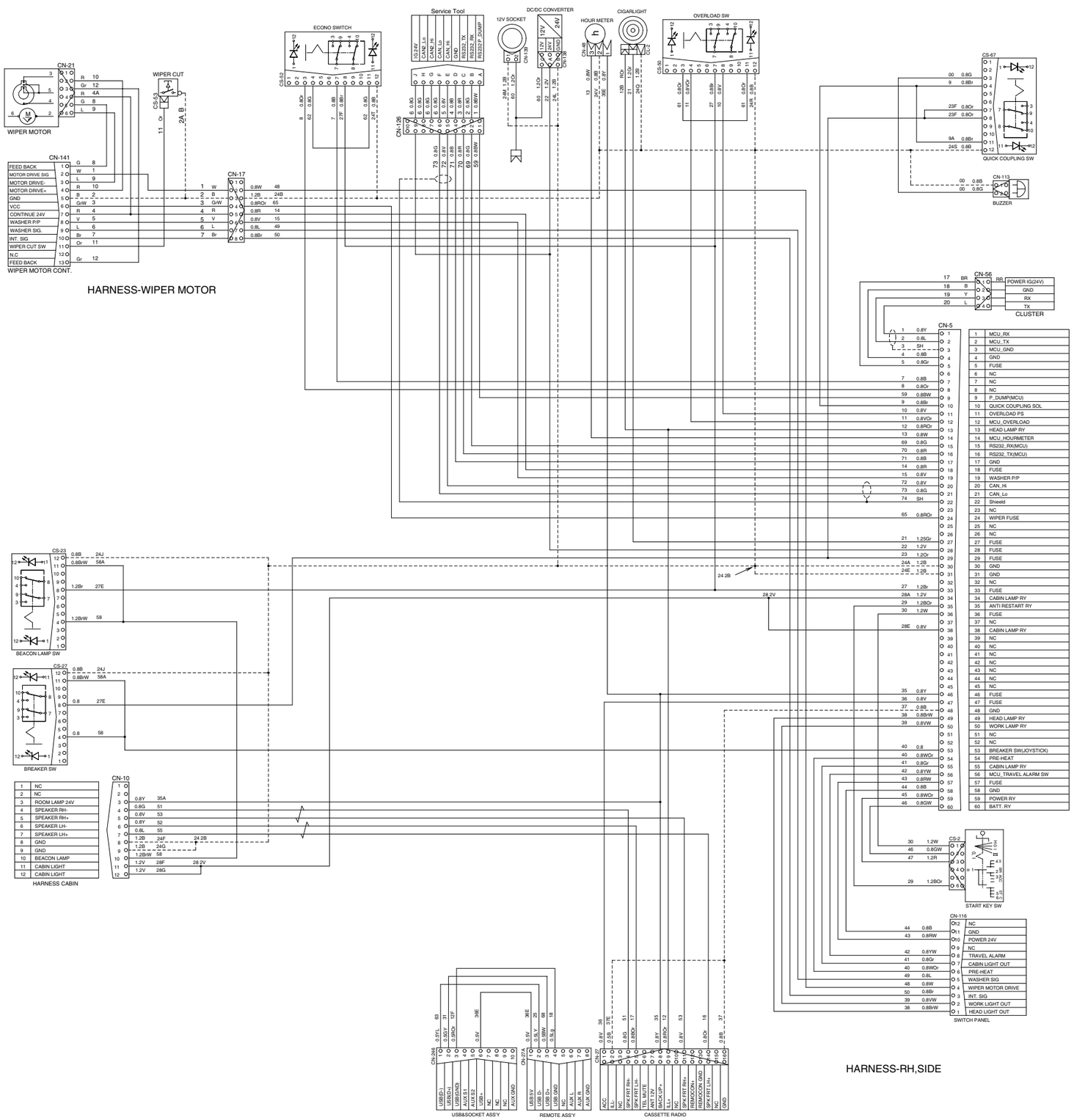
NO.	DESTINATION
1	NC
2	NC
3	NC
4	NC
5	BREAKER SW
6	BREAKER RY
7	GND
8	HORN RY
9	NC
10	NC
11	NC
12	NC
13	NC
14	MCU_5V
15	MCU_ACCEL SIG.
16	MCU_SUPPLY GND

NO.	DESTINATION
1	NC
2	NC
3	NC
4	NC
5	MCU_POWER MAX
6	MCU_SIG.GND
7	MCU_DECEL
8	MCU_SIG.GND
9	NC
10	NC
11	NC
12	NC
13	NC
14	GND
15	NC
16	SAFETY SOL

· **ELECTRICAL CIRCUIT** (1/2, CLUSTER TYPE 2)



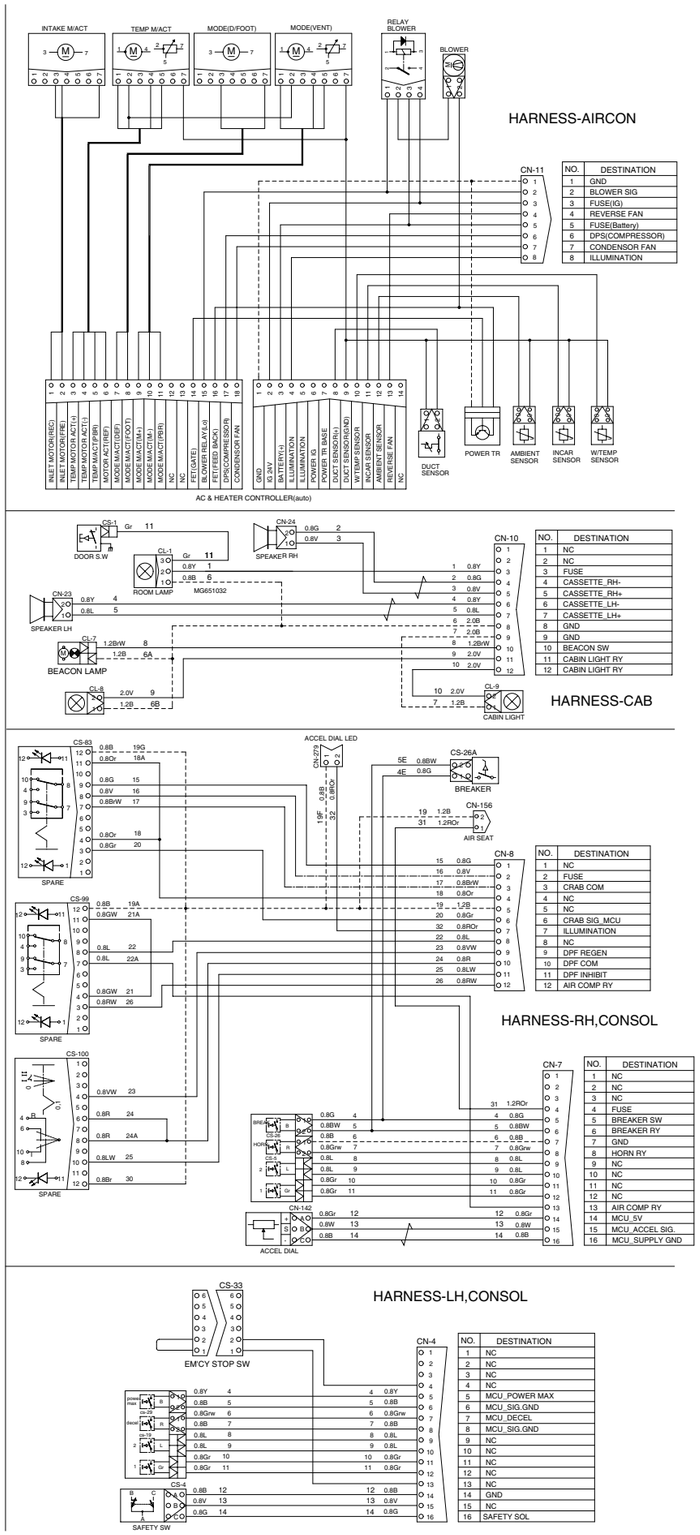
· **ELECTRICAL CIRCUIT** (2/2, CLUSTER TYPE 2)



1	MCU_RX
2	MCU_TX
3	MCU_GND
4	GND
5	FUSE
6	NC
7	NC
8	NC
9	P_DUMP(MCU)
10	QUICK COUPLING SOL
11	OVERLOAD PS
12	MCU_OVERLOAD
13	HEAD LAMP RY
14	MCU_HOURMETER
15	RS232_RX(MCU)
16	RS232_TX(MCU)
17	GND
18	FUSE
19	WASHER P/P
20	CAN_HI
21	CAN_Lo
22	Shield
23	NC
24	WIPER FUSE
25	NC
26	NC
27	FUSE
28	FUSE
29	FUSE
30	GND
31	GND
32	NC
33	FUSE
34	CABIN LAMP RY
35	ANTI RESTART RY
36	FUSE
37	NC
38	CABIN LAMP RY
39	NC
40	NC
41	NC
42	NC
43	NC
44	NC
45	NC
46	FUSE
47	FUSE
48	GND
49	HEAD LAMP RY
50	WORK LAMP RY
51	NC
52	NC
53	BREAKER SW(JOYSTICK)
54	PRE-HEAT
55	CABIN LAMP RY
56	MCU_TRAVEL ALARM SW
57	FUSE
58	GND
59	POWER RY
60	BATT. RY

1	NC
2	NC
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

1	NC
2	NC
3	CAN_Lo
4	CAN_HI
5	NC
6	NC
7	NC
8	NC
9	NC
10	NC
11	NC
12	NC
13	NC
14	NC
15	NC
16	NC
17	NC
18	NC
19	NC
20	NC



NO.	DESTINATION
1	GND
2	BLOWER SIG
3	FUSE(IG)
4	REVERSE FAN
5	FUSE(Battery)
6	DPS(COMPRESSOR)
7	CONDENSOR FAN
8	ILLUMINATION

NO.	DESTINATION
1	NC
2	NC
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

NO.	DESTINATION
1	NC
2	FUSE
3	CRAB COM
4	NC
5	NC
6	CRAB SIG_MCU
7	ILLUMINATION
8	NC
9	DPF REGEN
10	DPF COM
11	DPF INHIBIT
12	AIR COMP RY

NO.	DESTINATION
1	NC
2	NC
3	NC
4	FUSE
5	BREAKER SW
6	BREAKER RY
7	GND
8	HORN RY
9	NC
10	NC
11	NC
12	NC
13	AIR COMP RY
14	MCU_5V
15	MCU_ACCEL SIG.
16	MCU_SUPPLY GND

NO.	DESTINATION
1	NC
2	NC
3	NC
4	NC
5	MCU_POWER MAX
6	MCU_SIG.GND
7	MCU_DECEL
8	MCU_SIG.GND
9	NC
10	NC
11	NC
12	NC
13	NC
14	GND
15	NC
16	SAFETY SOL

MEMORANDUM

1. POWER CIRCUIT (CLUSTER TYPE 1)

The negative terminal of battery is grounded to the machine chassis through master switch.
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 → Fusible link [CN-60] → Master switch [CS-74]

- → Fuse box [No.1] → Power relay [CR-35 (30)]
- → Fuse box [No.2] → I/conn [CN-5 (46)]
  - → I/conn [CN -10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & USB player [CN-27 (8)]
- → Fuse box [No.3] → MCU [CN-51 (1)]
- → Fuse box [No.4] → Master switch [CS-74B] → I/conn [CN-5 (36)]
  - → Start switch [CS-2 (1)]
  - → RMS [CN-125A (1)]
- → Fuse box [No.5] → I/conn [CN-11 (5)]
  - → AC & Heater controller (3)
  - → Blower relay (3)
- → Fuse box [No.6] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.7] → I/conn [CN - 5 (6)] → Cluster [CN -56 (1)]

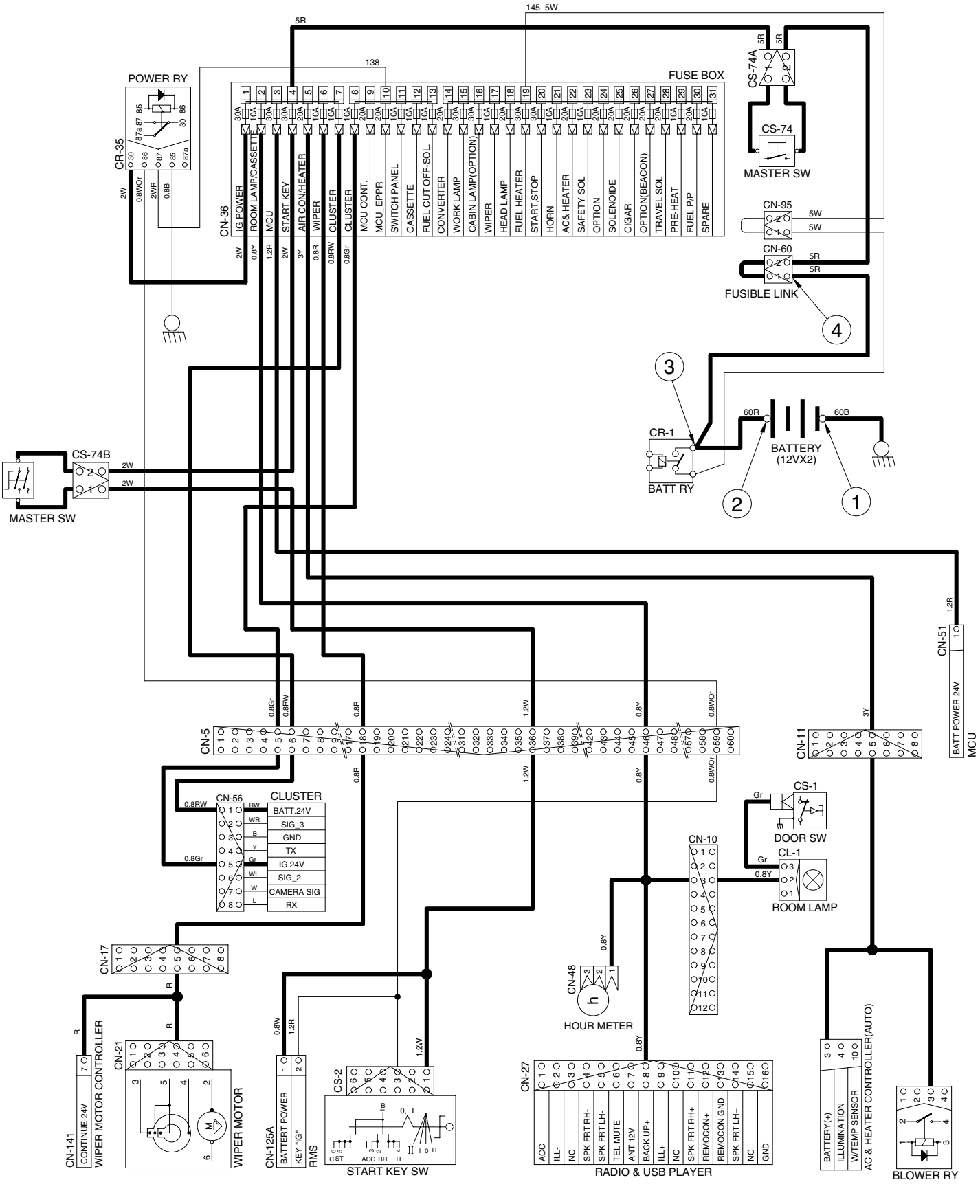
※ I/conn : Intermediate connector

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	OFF	① - GND (battery 1EA)	10~12.5V
		② - GND (battery 2EA)	20~25V
		③ - GND (battery 2EA)	20~25V
		④ - GND (fusible link)	20~25V

※ GND : Ground

POWER CIRCUIT (CLUSTER TYPE 1)



2. POWER CIRCUIT (CLUSTER TYPE 2)

The negative terminal of battery is grounded to the machine chassis through master switch.
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 → Fusible link [CN-60] → Master switch [CS-74A]

- → Fuse box [No.1] → Power relay [CR-35 (30)]
- → Fuse box [No.2] → I/conn [CN-5 (46)]
  - → I/conn [CN -10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & USB player [CN-27 (8)]
- → Fuse box [No.3] → MCU [CN-50 (7)]
- → Fuse box [No.4] → Master switch [CS-74B] → I/conn [CN-5 (36)] → Start switch [CS-2 (1)]
- → Fuse box [No.5] → I/conn [CN-11 (5)]
  - → AC & Heater controller (3)
  - → Blower relay (3)
- → Fuse box [No.6] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.8] → I/conn [CN - 5 (5)] → Cluster [CN -56 (1)]

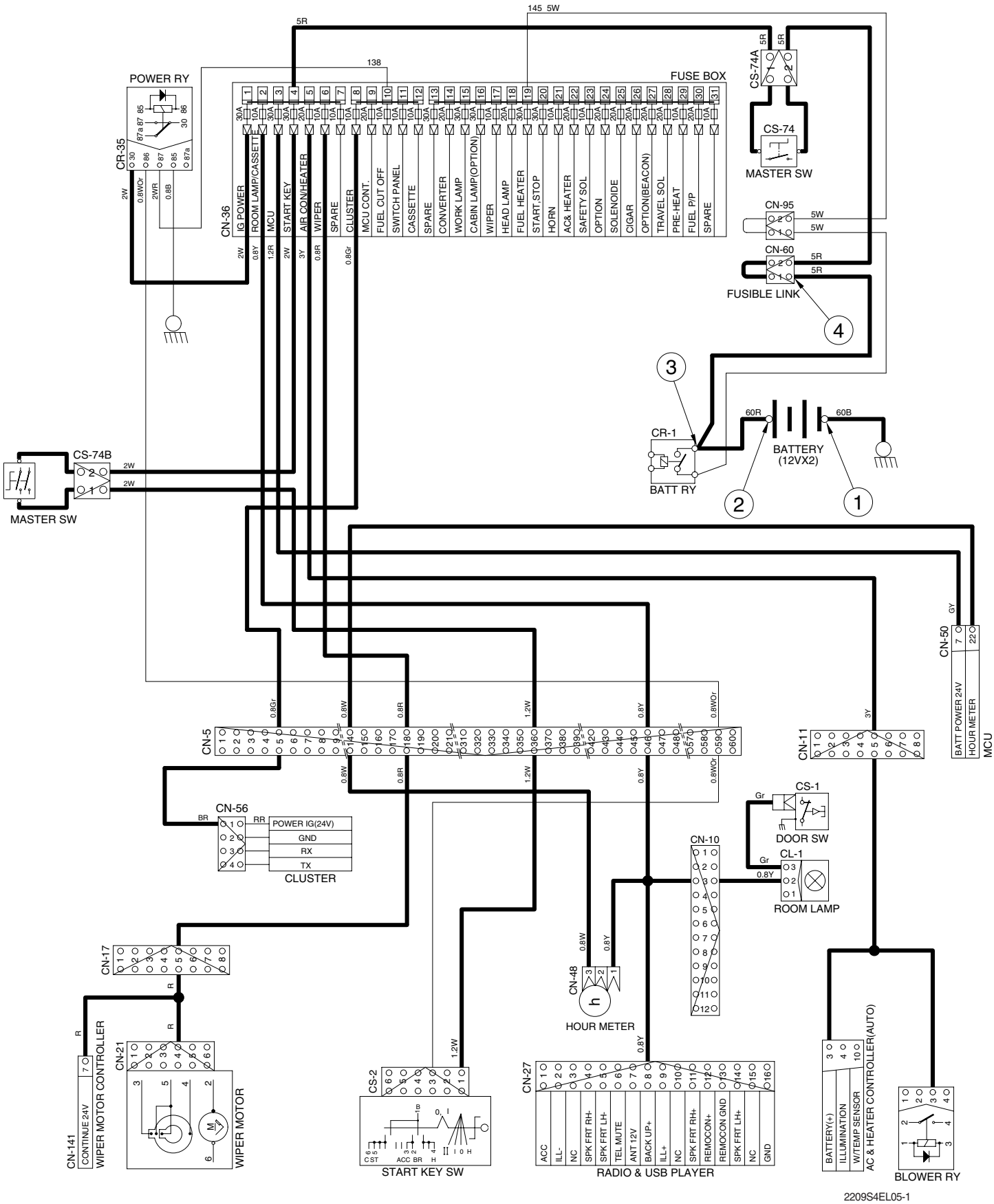
※ I/conn : Intermediate connector

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	OFF	① - GND (battery 1EA)	10~12.5V
		② - GND (battery 2EA)	20~25V
		③ - GND (battery 2EA)	20~25V
		④ - GND (fusible link)	20~25V

※ GND : Ground

POWER CIRCUIT (CLUSTER TYPE 2)



3. STARTING CIRCUIT (CLUSTER TYPE 1)

1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Fusible link [CN-60] → Master switch [CS-74]
→ Fuse box [No.4] → Master switch [CS-74B] → I/conn [CN-5(36)] → Start switch [CS-2(1)]

(1) When start key switch is in ON position

- Start switch ON [CS-2 (2)] → I/conn [CN-5 (60)] → Battery relay [CR-1]
  → Battery relay operating (all power is supplied with the electric component)
- Start switch ON [CS-2 (3)] → I/conn [CN-5 (59)] → Power relay [CR-35 (86) → (87)]
  → Fuse box [No.13] → I/conn [CN-2 (5)] → Fuel cut off solenoid [CN-79 (H)]

(2) When start key switch is in START position

Start switch START [CS-2 (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (86) → (87)]

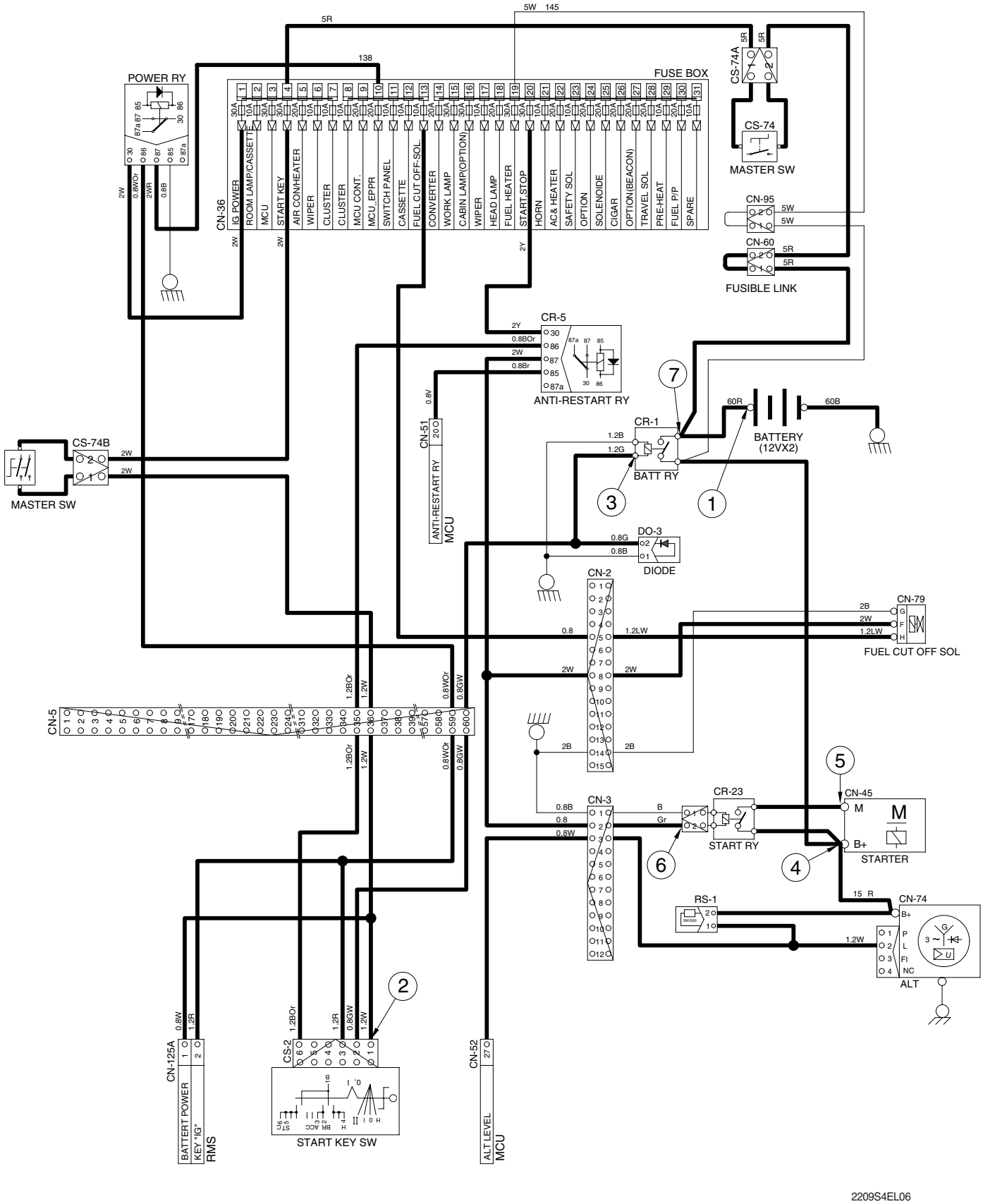
- I/conn [CN-3 (2)] → Start relay [CR-23]
- I/conn [CN-2 (8)] → Fuel cut off solenoid [CN-79 (F)]

2) CHECK POINT

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

※ GND : Ground

STARTING CIRCUIT (CLUSTER TYPE 1)



4. STARTING CIRCUIT (CLUSTER TYPE 2)

1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Fusible link [CN-60] → Master switch [CS-74] → Fuse box [No.4] → Master switch [CS-74B] → I/conn [CN-5(36)] → Start switch [CS-2(1)]

(1) When start key switch is in ON position

- Start switch ON [CS-2 (2)] → I/conn [CN-5 (60)] → Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)
- Start switch ON [CS-2 (3)] → I/conn [CN-5 (59)] → Power relay [CR-35 (86) → (87)] → Fuse box [No.10] → I/conn [CN-2 (5)] → Fuel cut off solenoid [CN-79 (H)]

(2) When start key switch is in START position

Start switch START [CS-2 (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (86) → (87)]

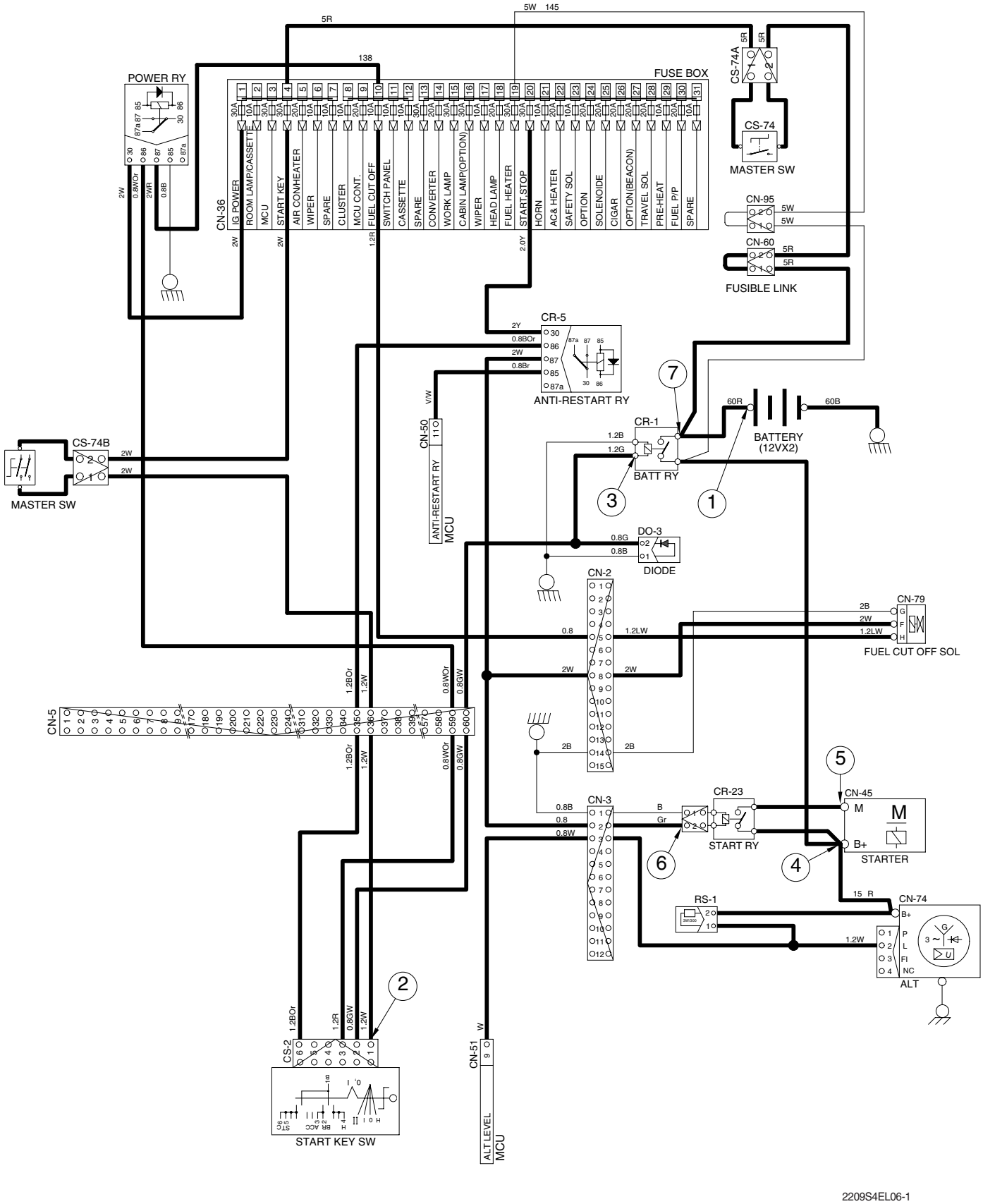
- I/conn [CN-3 (2)] → Start relay [CR-23]
- I/conn [CN-2 (8)] → Fuel cut off solenoid [CN-79 (F)]

2) CHECK POINT

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

※ GND : Ground

STARTING CIRCUIT (CLUSTER TYPE 2)



5. CHARGING CIRCUIT (CLUSTER TYPE 1)

When the starter is activated and the engine is started, the operator releases the key 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-3 (3)] → MCU alternator level [CN-52 (27)]
→ Cluster charging warning lamp(Via serial interface)

(2) Charging flow

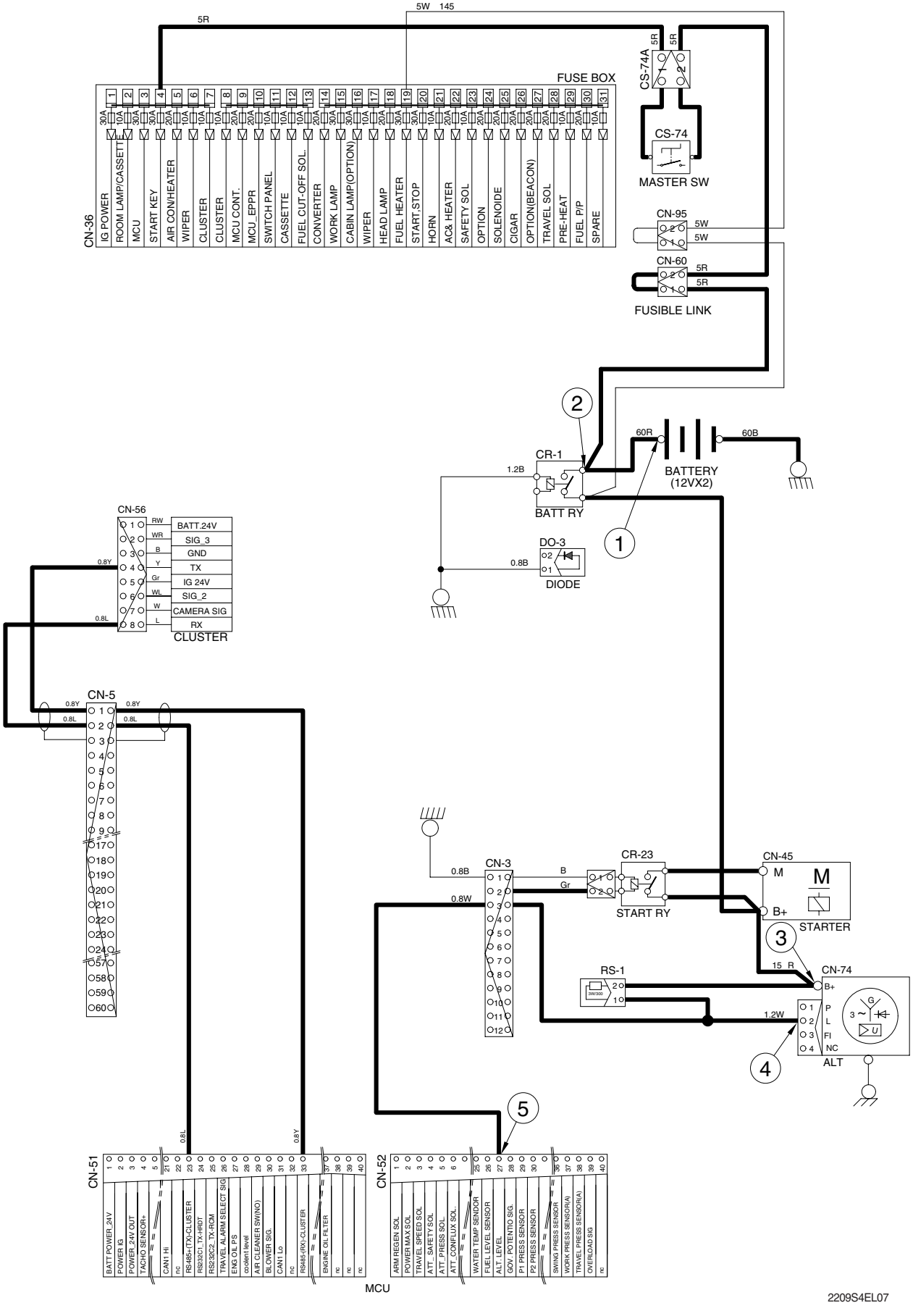
Alternator "B^+" terminal → Battery relay(M8) → Battery(+) terminal
→ Fusible link [CN-60] → Master switch [CS-74]
→ Fuse box

2) CHECK POINT

Engine	Start switch	Check point	Voltage
Run	ON	① - GND (battery voltage) ② - GND (battery relay) ③ - GND (alternator B^+ terminal) ④ - GND (alternator L terminal) ⑤ - GND (MCU)	20~30V

※ GND : Ground

CHARGING CIRCUIT (CLUSTER TYPE 1)



6. CHARGING CIRCUIT (CLUSTER TYPE 2)

When the starter is activated and the engine is started, the operator releases the key 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-3 (3)] → MCU alternator level [CN-51 (9)]
→ Cluster charging warning lamp(Via serial interface)

(2) Charging flow

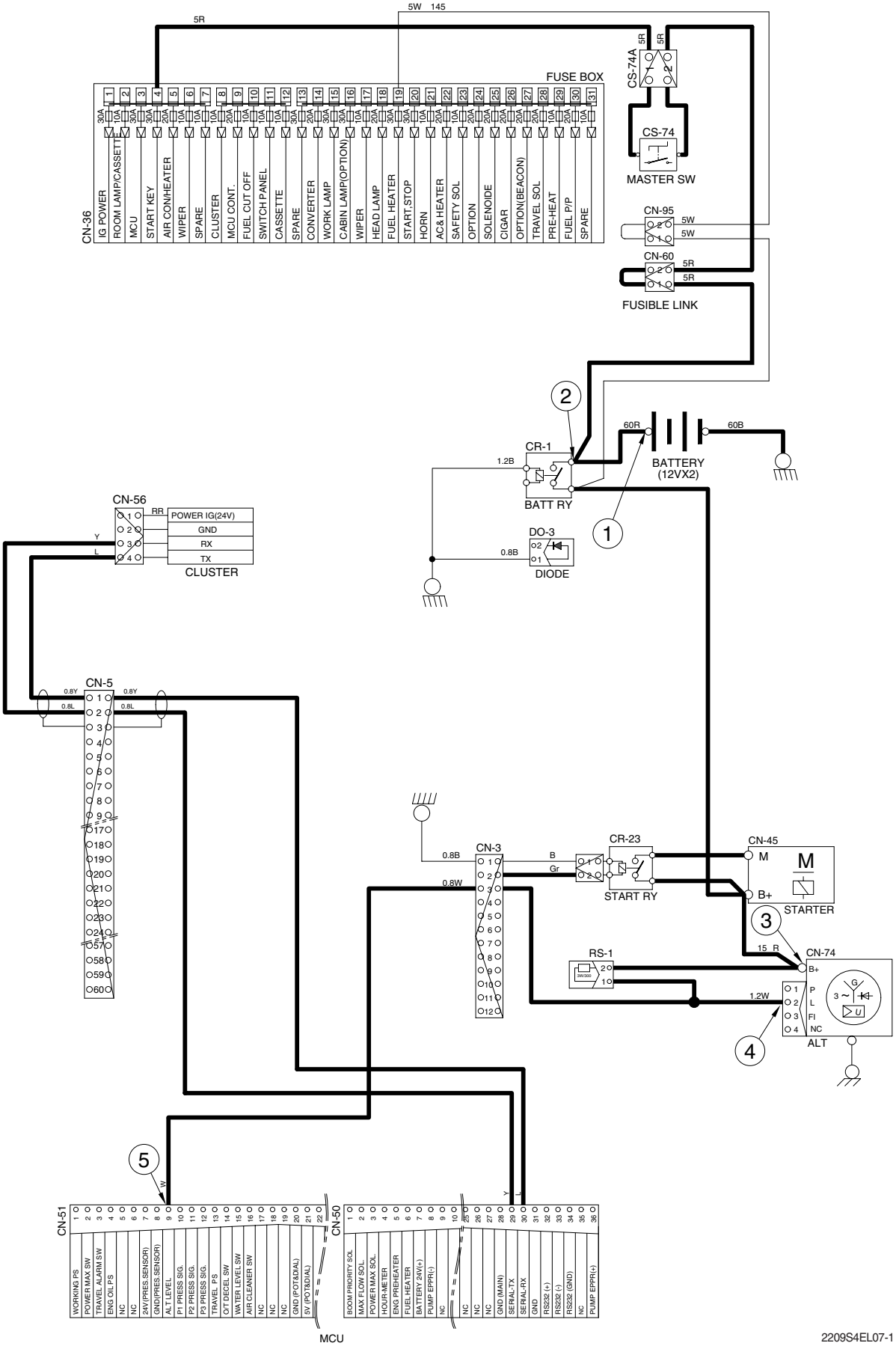
Alternator "B^+" terminal → Battery relay(M8) → Battery(+) terminal
→ Fusible link [CN-60] → Master switch [CS-74] → Fuse box

2) CHECK POINT

Engine	Start switch	Check point	Voltage
Run	ON	① - GND (battery voltage) ② - GND (battery relay) ③ - GND (alternator B^+ terminal) ④ - GND (alternator L terminal) ⑤ - GND (MCU)	20~30V

※ GND : Ground

CHARGING CIRCUIT (CLUSTER TYPE 2)



7. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.18) → Head light relay [CR-13 (30, 86)]
Fuse box (No.15) → Work light relay [CR-4 (30, 86)]

(1) Head light switch ON

Head light switch ON [CN-116 (1)] → I/conn [CN-5 (49)] → Head light relay [CR-13 (85) → (87)]
- → Head light ON [CL-3 (1)] , [CL-4 (1)]
- → I/conn [CN-11 (8)] → AC & Heater controller illumination ON [4]
- → I/conn [CN-5 (13)]
  - → Cigar light [CL-2]
  - → Radio & USB player illumination ON [CN-27 (9)]

(2) Work light switch ON

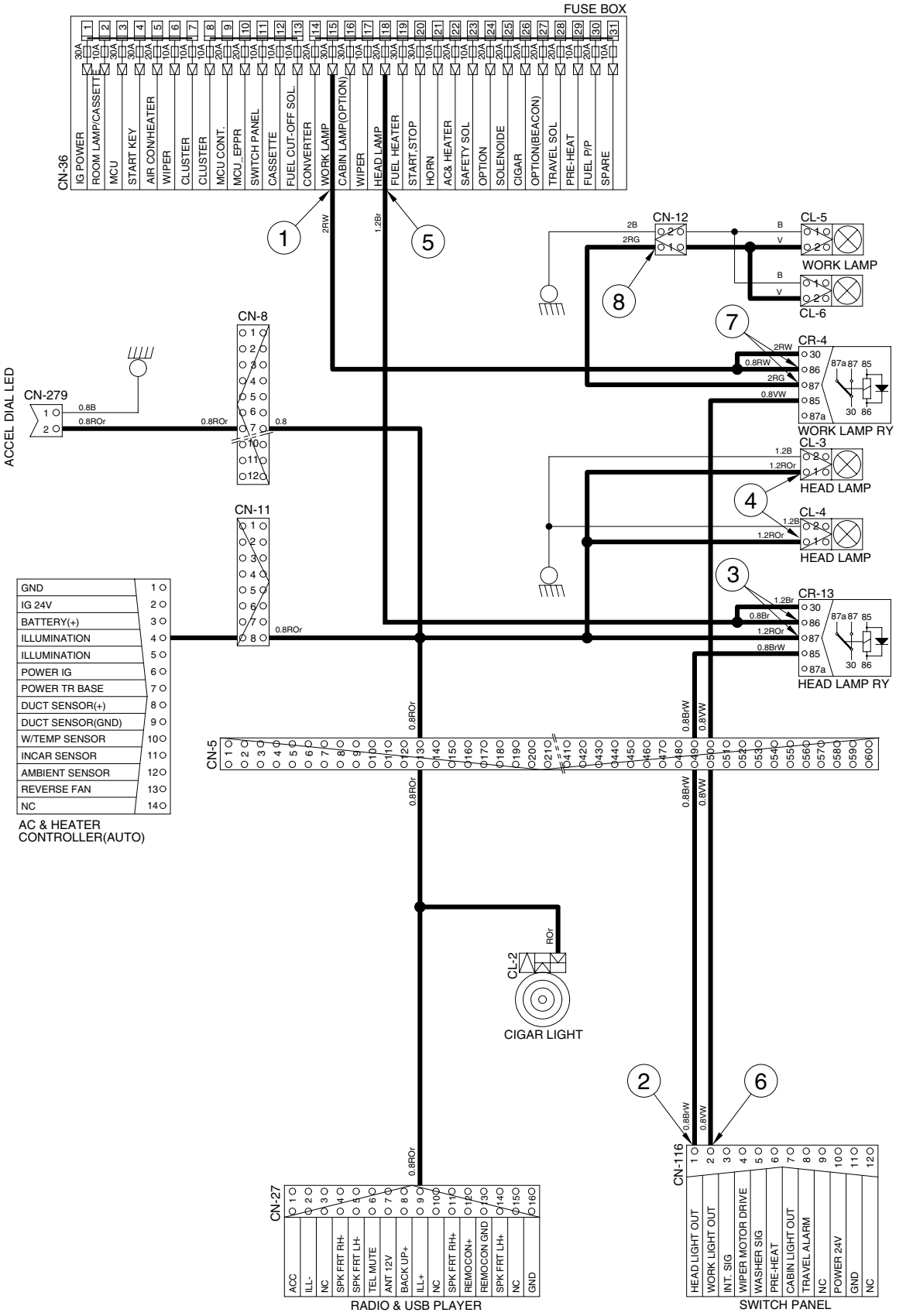
Work light switch ON [CN-116 (2)] → I/conn [CN-5 (50)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

2) CHECK POINT

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

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



2209S4EL08

8. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.27) → I/conn [CN-5 (33)] → Beacon lamp switch [CN-23 (8)]
Fuse box (No.16) → Cab light relay [CR-9 (30, 86)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CS-23 (4)] → Switch indicator lamp ON [CS-23 (11)]
→ I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]

(2) Cab light switch ON

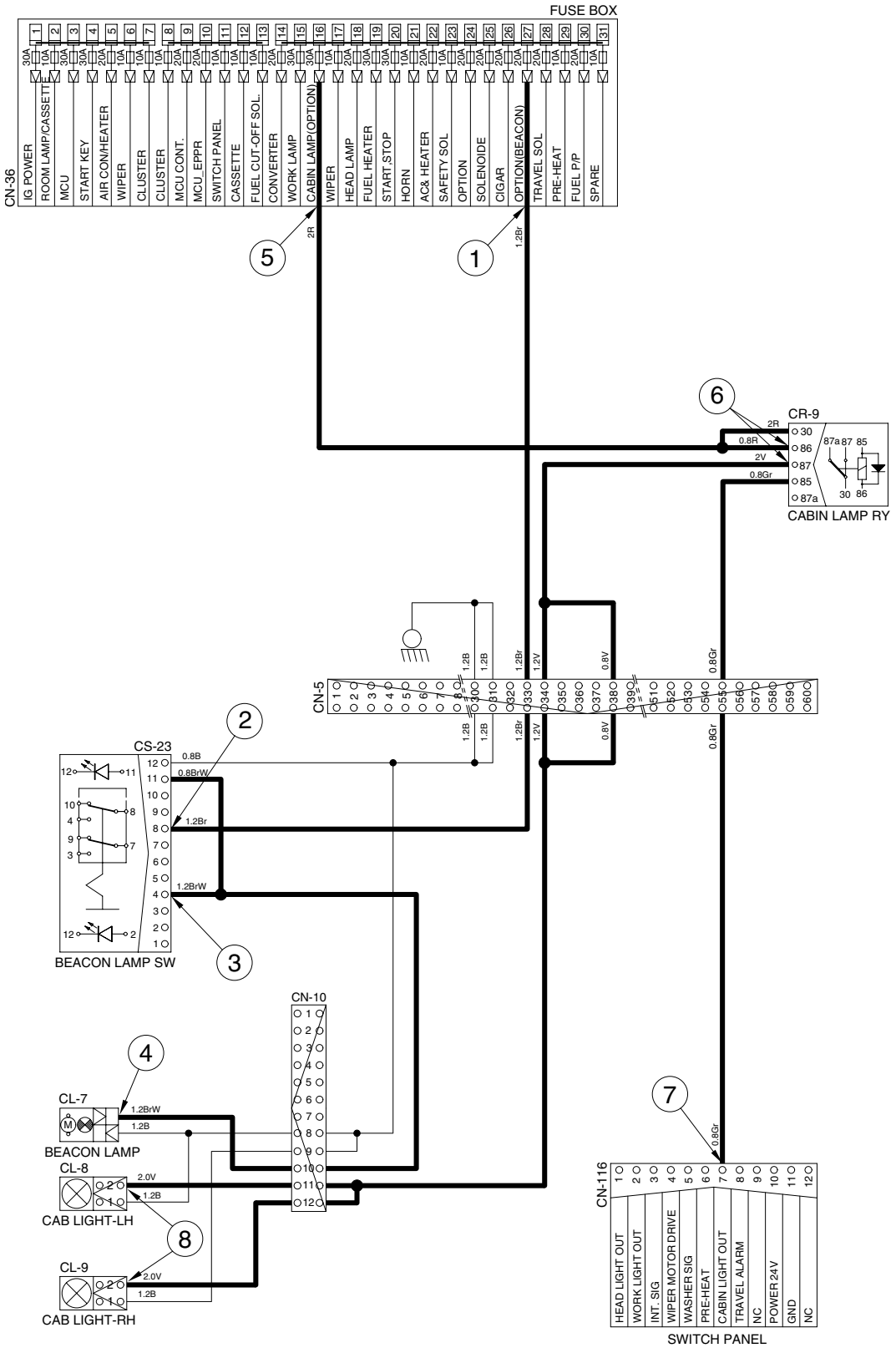
Cab light switch ON [CN-116 (7)] → I/conn [CN-5 (55)] → Cabin lamp relay [CR-9 (85) → (87)]
→ I/conn [CN-5 (34, 38)] → I/conn [CN-10 (11)] → Cab light ON [CL-8 (2)]
→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2)]

2) CHECK POINT

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

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



2209S4EL09

9. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.11) → I/conn [CN-5 (57)] → Switch panel [CN-116 (10)]

Fuse box (No.6) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] → Wiper motor controller [CN-141(7)]
→ Wiper motor [CN-21(4)]

Fuse box (No.17) → I/conn [CN-5 (24)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
→ Washer pump [CN-22 (2)]

(2) Wiper switch ON : 1st step (Intermittent)

Wiper switch ON [CN-116 (3)] → I/conn [CN-17 (8)] → Wiper motor controller [CN-141 (10) → (3)]
→ Wiper motor intermittently operating [CN-21 (6)]

(3) Wiper switch ON : 2nd step (continual)

Wiper switch ON [CN-116(4)] → I/conn[CN-17(2)] → Wiper motor controller [CN-141(2) → (4)]
→ Wiper motor operating [CN-21(2)]

(4) Washer switch ON

Washer switch ON [CN-116 (5)] → 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-116 (4)] → I/conn[CN-17 (2)] → Wiper motor controller [CN-141 (2) → (4)]
→ Wiper motor operating [CN-21 (2)]

(5) Auto parking(when switch OFF)

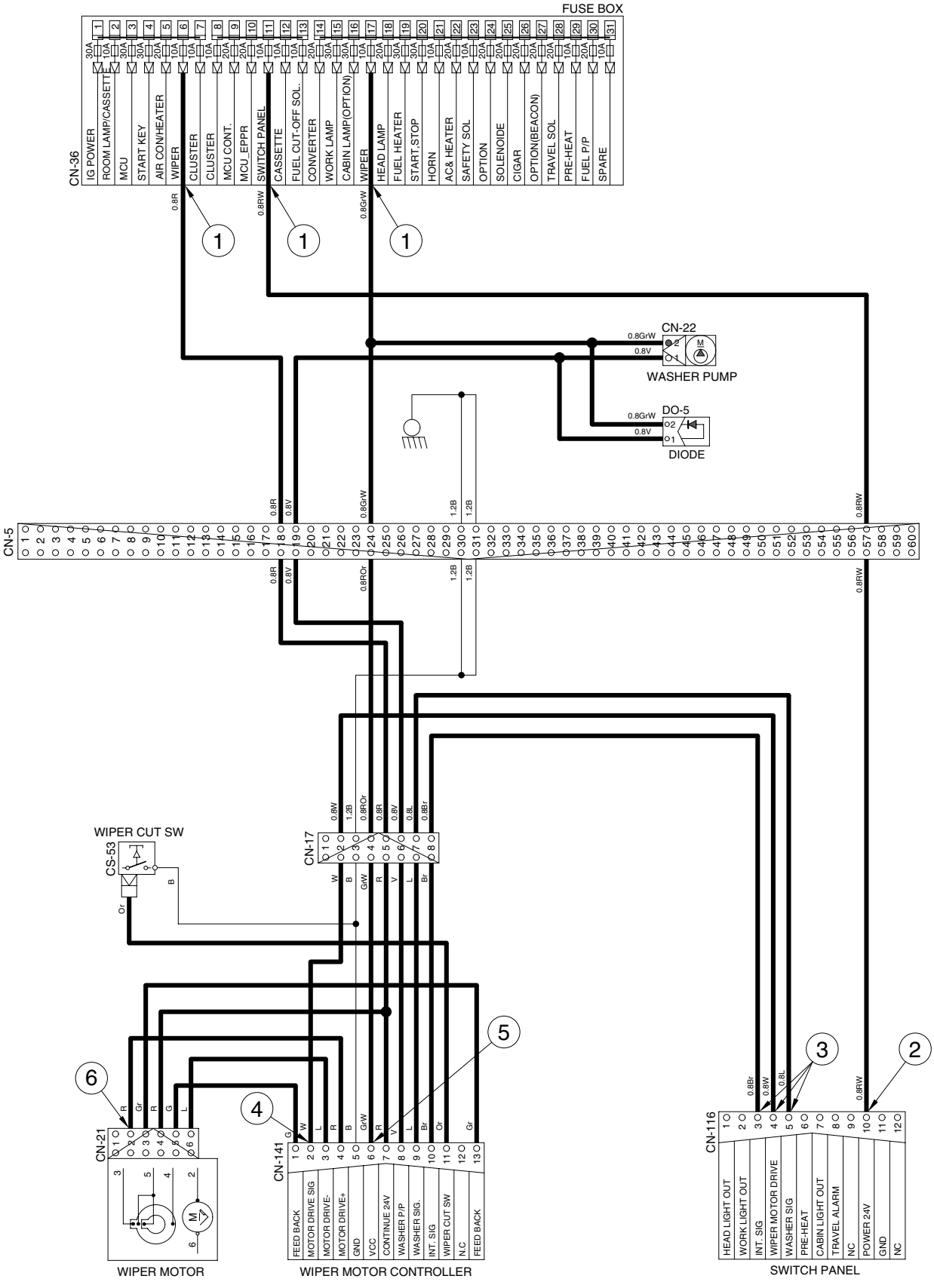
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

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

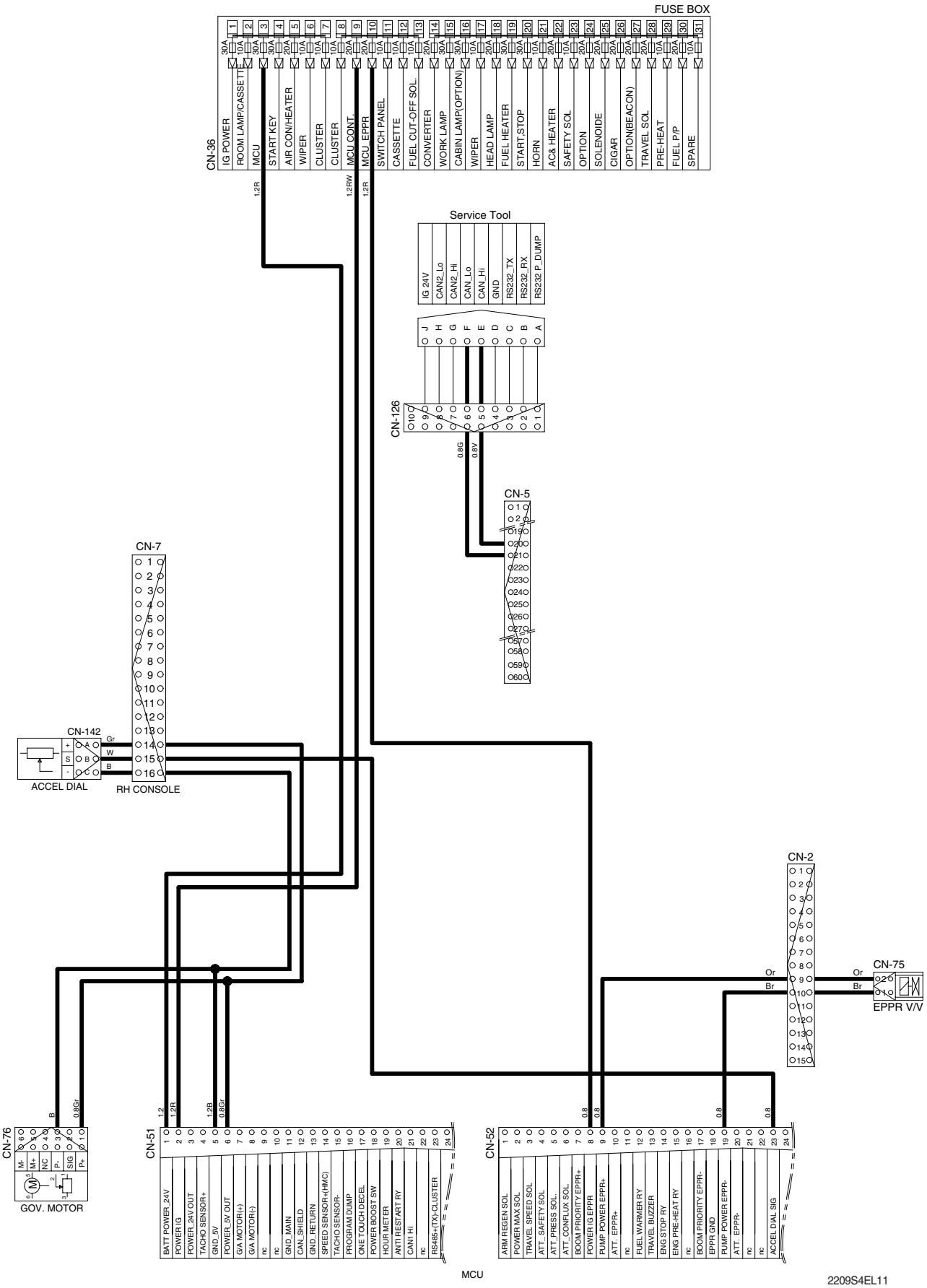
※ GND : Ground

WIPER AND WASHER CIRCUIT

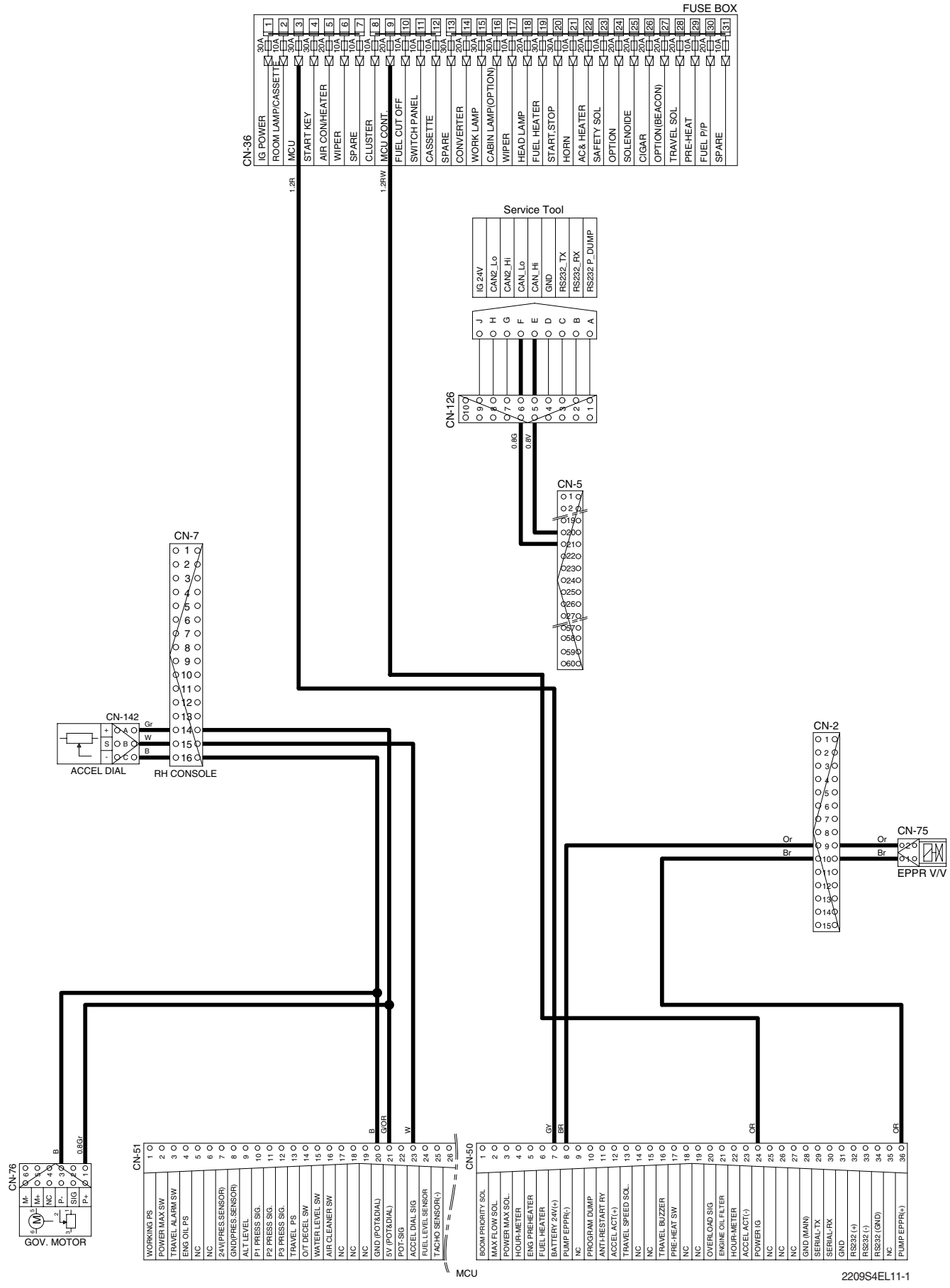


2209S4EL10

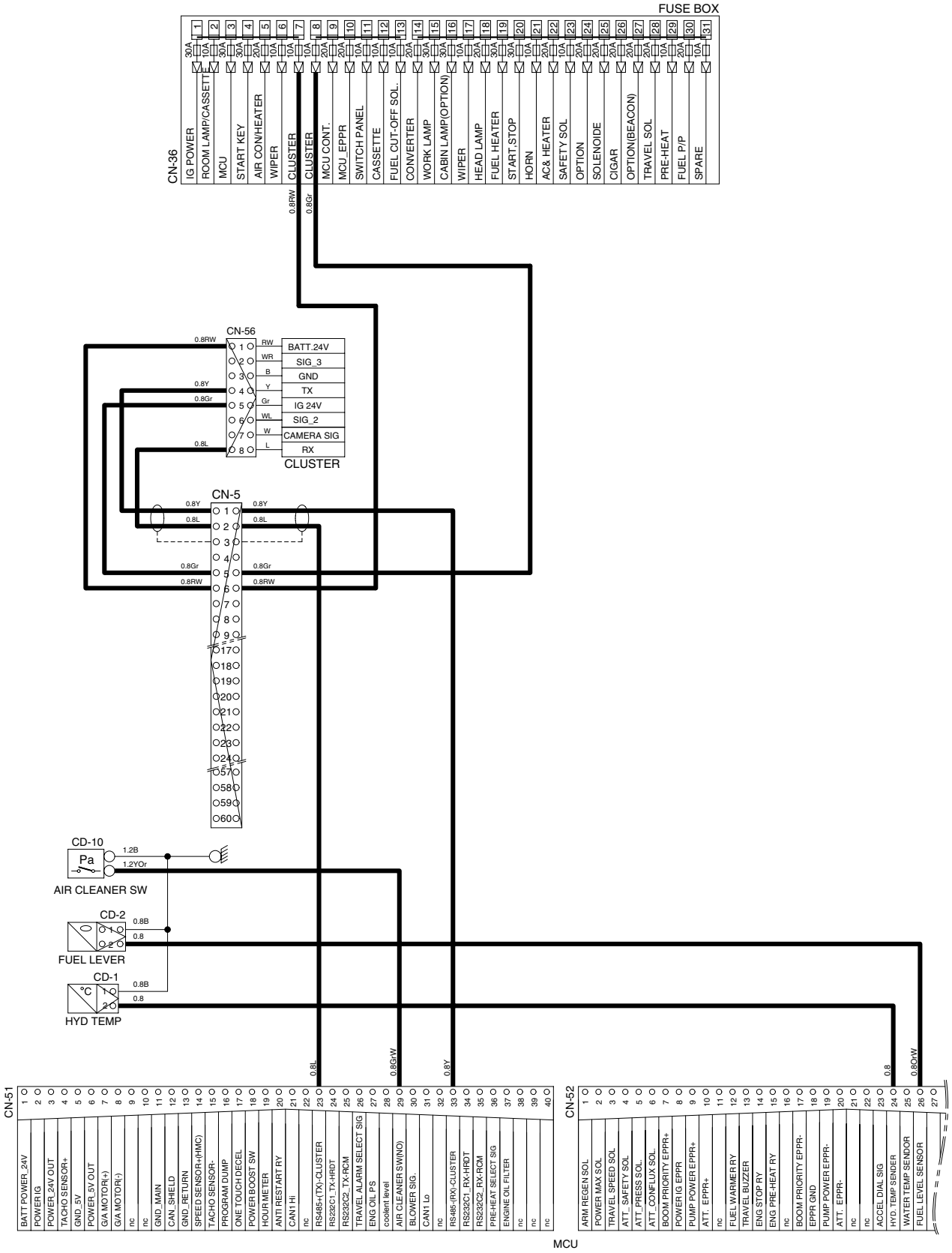
CONTROLLER CIRCUIT (CLUSTER TYPE 1)



CONTROLLER CIRCUIT (CLUSTER TYPE 2)

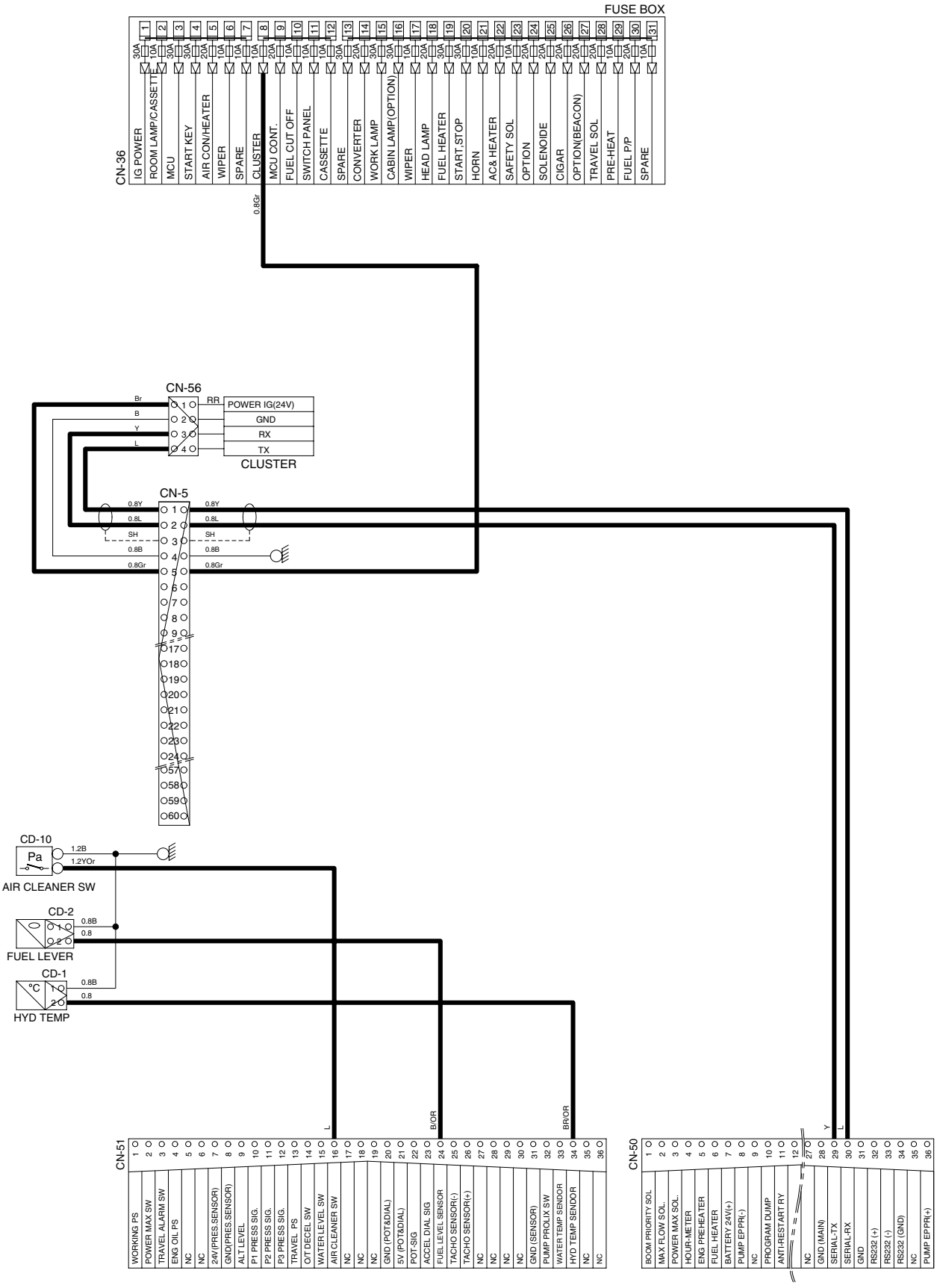


MONITORING CIRCUIT (CLUSTER TYPE 1)



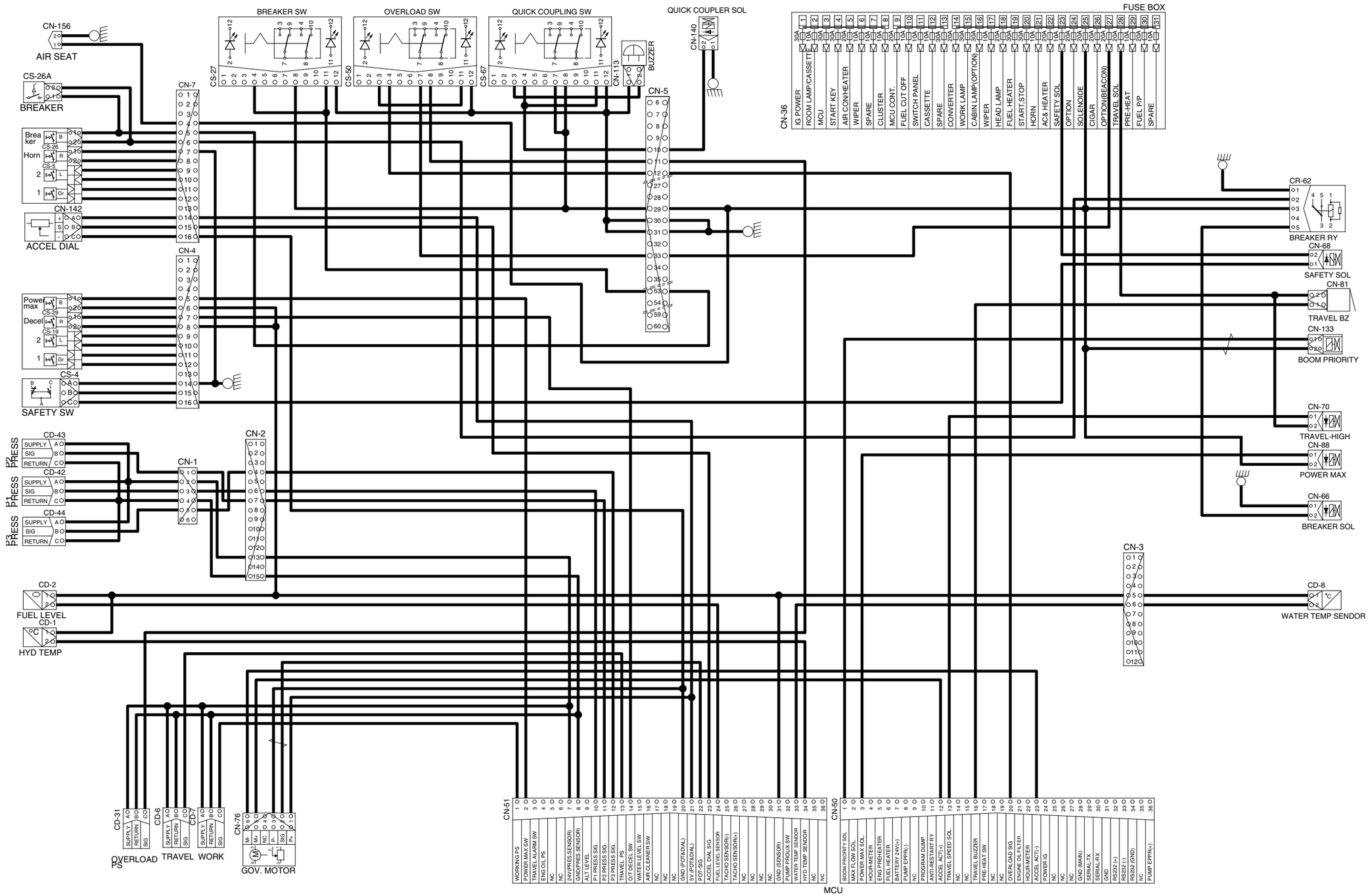
2209S4EL12

MONITORING CIRCUIT (CLUSTER TYPE 2)



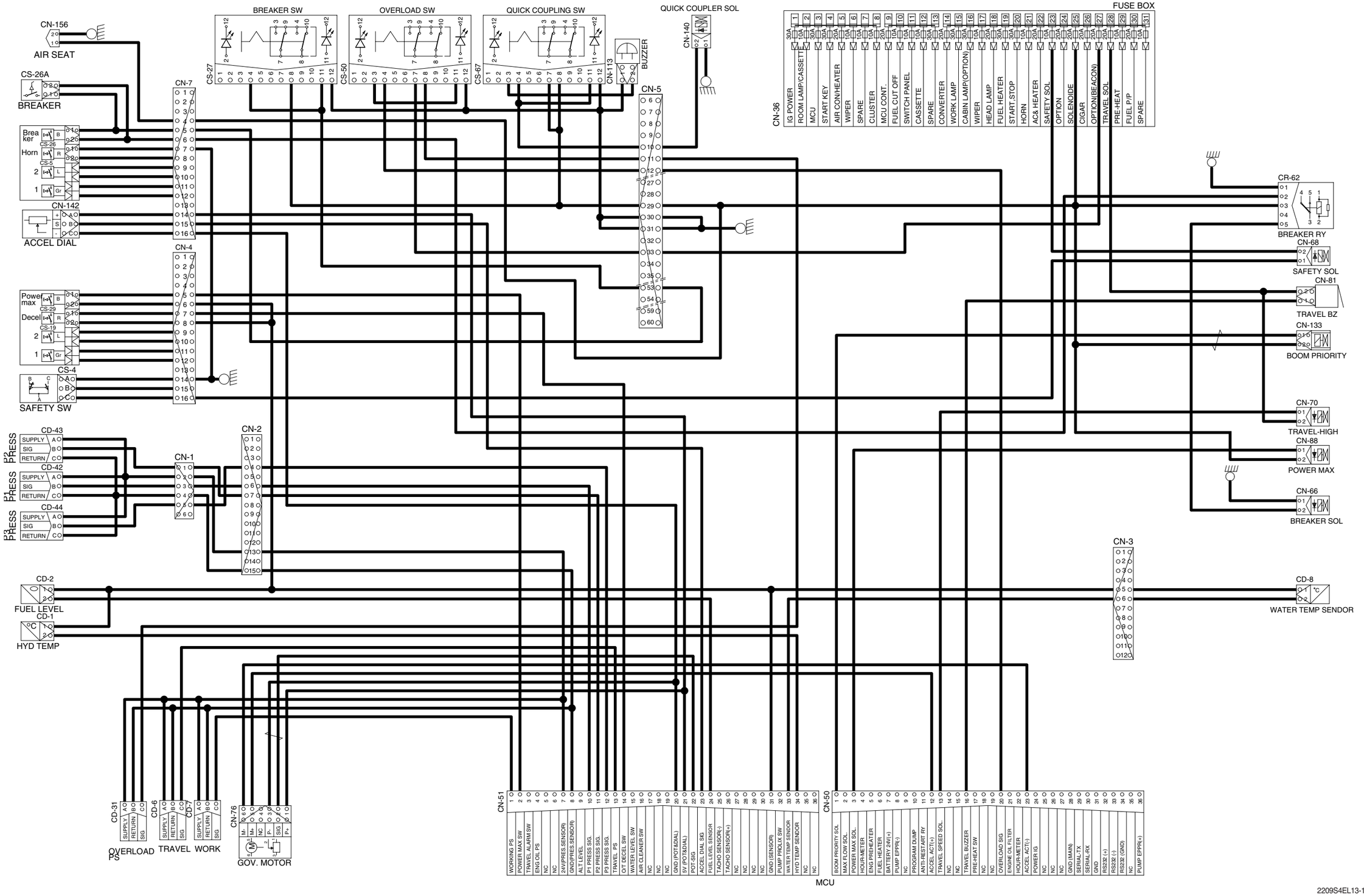
2209S4EL12-1

ELECTRIC CIRCUIT FOR HYDRAULIC (CLUSTER TYPE 1)

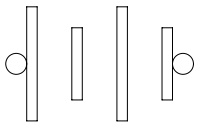
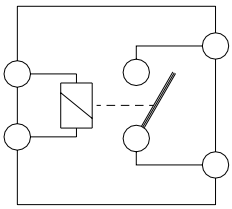
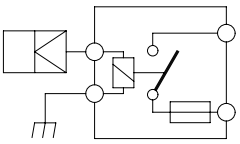
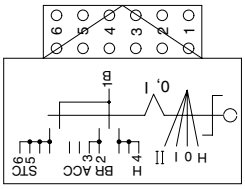
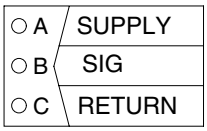
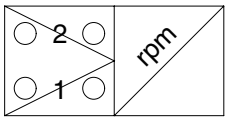


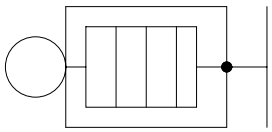
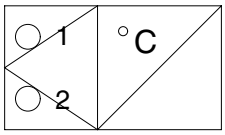
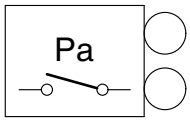
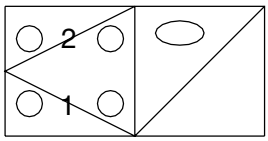
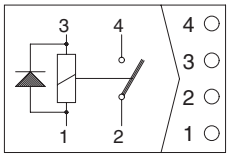
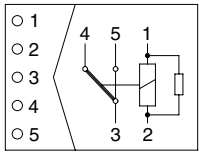
2209S4EL13

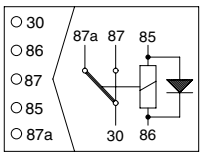
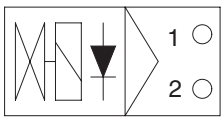
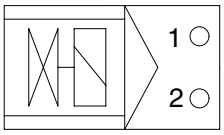
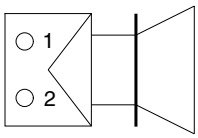
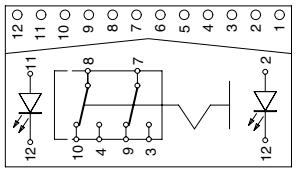
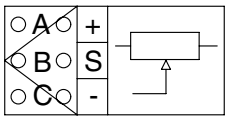
ELECTRIC CIRCUIT FOR HYDRAULIC (CLUSTER TYPE 2)

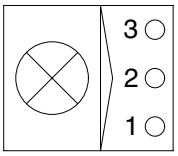
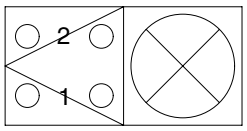
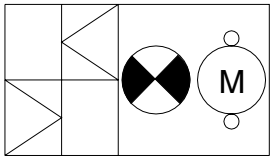
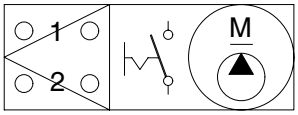
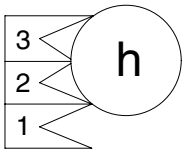
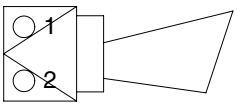


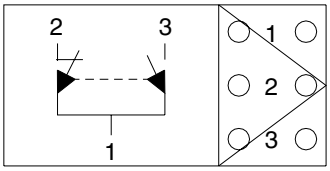
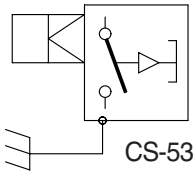
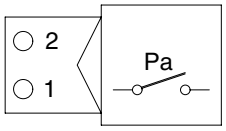
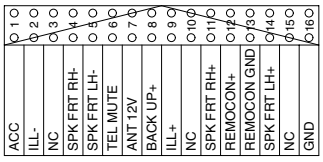
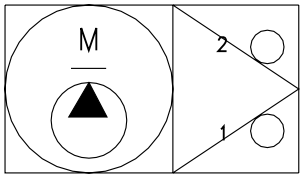
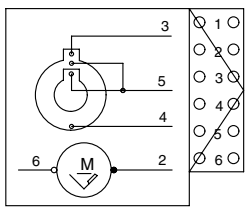
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

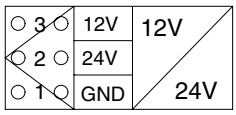
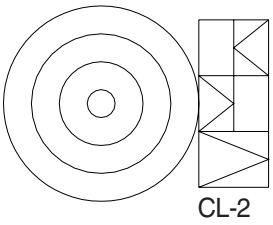
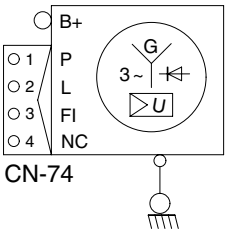
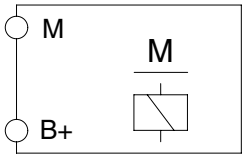
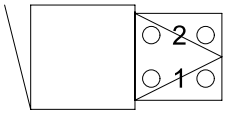
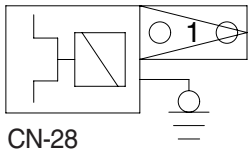
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start key	 CS-2	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞ Ω (for each terminal) ON : 0 Ω (for terminal 1-3 and 1-2) START : 0 Ω (for terminal 1-5)
Pressure sensor	 CD-6 CD-7 CD-31 CD-42 CD-43 CD-44 * CLUSTER TYPE1 (CD-24, CD-32, CD-69)	8~30V	※ Check contact Normal : 0.1 Ω
Speed sensor	 CD-17	-	※ Check resistance Normal : 300 Ω (For terminal 1, 2)

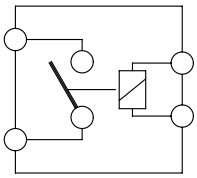
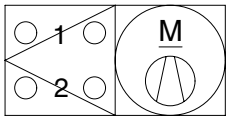
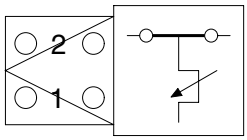
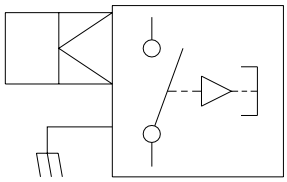
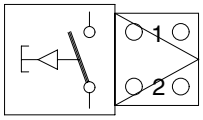
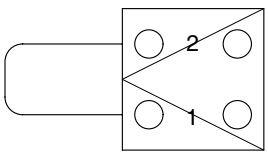
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12 Ω
Temperature sensor (hydraulic, water)	 CD-1 CD-8	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air cleaner pressure switch	 CD-10	(N.O TYPE)	※ Check contact High level : ∞ Ω Low level : 0 Ω
Fuel sender	 CD-2	-	※ Check resistance Full : 50 Ω 6/12 : 350 Ω 11/12 : 100 Ω 5/12 : 400 Ω 10/12 : 150 Ω 4/12 : 450 Ω 9/12 : 200 Ω 3/12 : 500 Ω 8/12 : 250 Ω 2/12 : 550 Ω 7/12 : 300 Ω 1/12 : 600 Ω Empty warning : 700 Ω
Relay (air con blower)		24V 20A	※ Check resistance Normal : About 200 Ω (for terminal 1-3) 0 Ω (for terminal 2-4)
Relay	 CR-2 CR-36 CR-62 • CLUSTER TYPE 1 (CR-51)	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)

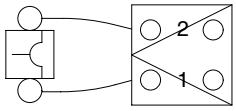
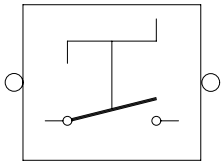
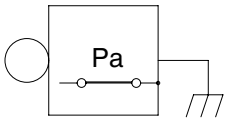
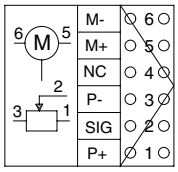
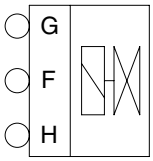
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-68 CN-70 CN-88 CN-140 • CLUSTER TYPE 1 (CN-66, CN-135, CN-149, CN-236, CN-237)	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-75 CN-133 CN-242	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-23 CS-50 CS-52 CS-67 CS-82 CS-83 CS-99 CS-100	24V 8A	※ Check contact Normal ON : 0 Ω (for terminal 3-7, 4-8) ∞ Ω (for terminal 7-9, 8-10) OFF : ∞ Ω (for terminal 3-7, 4-8) 0 Ω (for terminal 7-9, 8-10)
Accel dial	 CN-142	-	※ Check resist Normal : About 5k Ω (for terminal A-C) ※ Check voltage Normal : About 5V (for terminal A-C) : 2~4.5V (for terminal C-B)

Part name	Symbol	Specifications	Check
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)
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2 Ω
Beacon lamp	 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 : 1.0 Ω
Service meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※ Check operation Supply power(24V) to each terminal and connect ground.

Part name	Symbol	Specifications	Check
Safety switch	 CS-4	24V 15A (N.C TYPE)	※Check contact Normal : 0 Ω (for terminal 1-2) ∞ Ω (for terminal 1-3) Operating : ∞ Ω (for terminal 1-2) 0 Ω (for terminal 1-3)
Wiper cut switch	 CS-53	24V (N.O TYPE)	※Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※Check contact Normal : ∞ Ω
Radio & USB plalyer	 CN-27	24V 2A	※Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※Check disconnection Normal : 7 Ω (for terminal 2-6)

Part name	Symbol	Specifications	Check
DC/DC Converter	 CN-138	12V 3A	24V (1-2) 12V (1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※ Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	 CN-74	24V 50A	※ Check contact Normal : 0Ω (for terminal B+-I) Normal : 24~27.5V
Starter	 CN-45	Denso 24V 4.5kW	※ Check contact Normal : 0.1Ω
Travel alarm	 CN-81	24V 0.5A	※ Check contact Normal : 5.2Ω
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4Ω

Part name	Symbol	Specifications	Check
Start relay	 CR-23	24V 300A	※Check contact Normal : 0.94 Ω (for terminal 1-2)
Blower motor		24V 9.5A	※Check resistance Normal : 2.5 Ω (for terminal 1-2)
Duct sensor (switch)		1˚C OFF 4˚C ON	※Check resistance Normal : 0 Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※Check resistance Normal : About 5M Ω
Switch (power max, one touch decal, horn, breaker)	 CS-5 CS-19 CS-26 CS-26A CS-29	24V 6A	※Check resistance Normal : ∞ Ω
Fusible link (cluster type 2)	 CN-60 CN-95	60A	※Check disconnection normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)

Part name	Symbol	Specifications	Check
Fusible link (cluster type 1)	 CN-60 CN-95	60A	※ Check disconnection Normal : 0.1 Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74A CS-74B	6-36V	※ Check disconnection Normal : 0.1 Ω
Pressure switch (for engine oil)	 CD-18	0.5kgf/cm² (N.C TYPE)	※ Check resistance Normal : 0 Ω (CLOSE)
Accel actuator	 CN-76	-	※ Check resistance Normal : 1-2 Ω (for terminal 5-6) 0.8-1.2k Ω (for terminal 1-3)
Fuel cut-off	 CN-79	24V	※ Check resistance Normal : 15-25 Ω

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	6	I/conn (Frame harness-Pump PS harness)	S816-006002	S816-106002
CN-2	AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-3	AMP	12	I/conn (Frame harness-Engine harness)	S816-012002	S816-112002
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-8	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12P-BE02
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-15	AMP	12	I/conn (Frame harness)	S816-012002	S816-112002
CN-17	AMP	8	I/conn (Wiper harness)	S816-008002	S816-108002
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-22	KET	2	Washer pump	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27	KUM	16	Radio and USB player	PK145-16017	-
CN-27A	AMP	8	USB Player	S816-008002	S816-108002
CN-28	KUM	1	Aircon compressor	MWP-01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-308000	DT04-4P-E005
CN-48	KET	1	Service meter	2-520193-2	-
CN-50	AMP	36	MCU (cluster type 2)	344111-1	-
CN-51	DEUTSCH	40	MCU (cluster type 1)	DRC26-40SA	-
CN-51	AMP	36	MCU (cluster type 2)	344111-1	-
CN-52	DEUTSCH	40	MCU (cluster type 1)	DRC26-40SB	-
CN-56	AMP	8	Cluster (type 1)	-	S816-108002
CN-56A	DEUTSCH	4	Cluster (type 2)	-	DT04-4P-E004
CN-60	AMP	2	Fusible link	21N4-01320	S813-130201
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	DT04-2P-EP005
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S	-

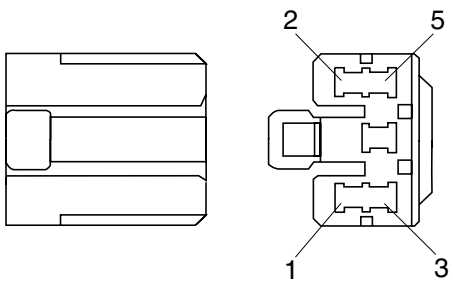
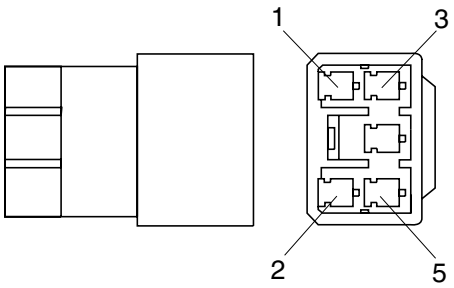
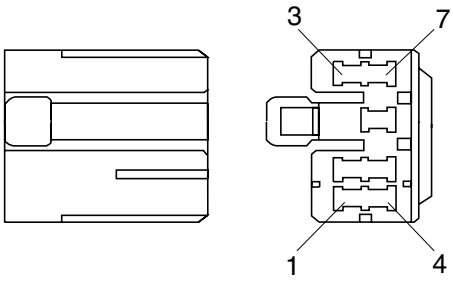
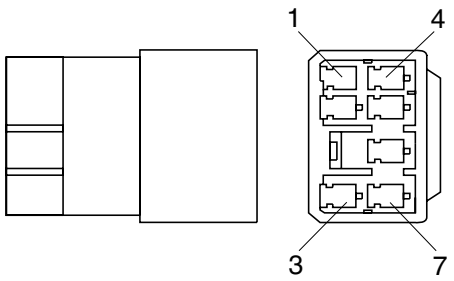
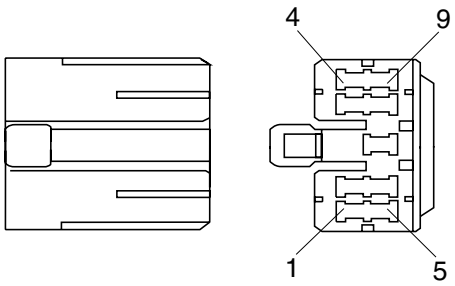
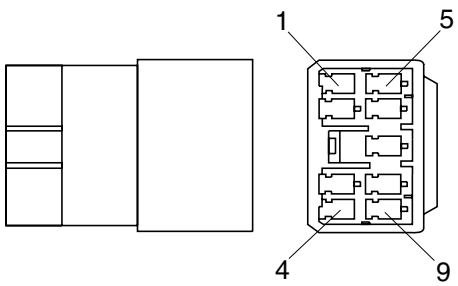
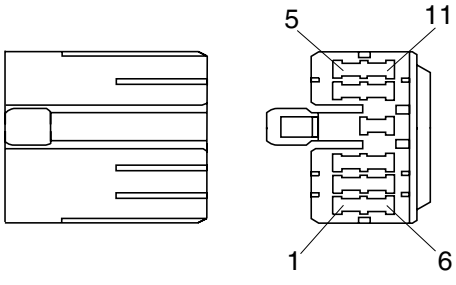
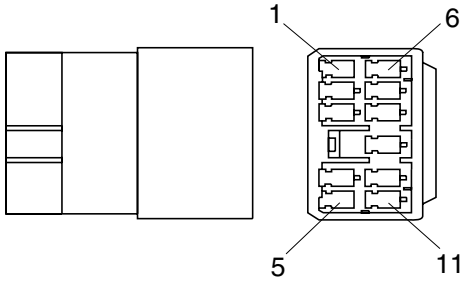
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-74	AMP	4	Alternator "L" terminal	12186568	-
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-76	DEUTSCH	6	Accel actuator	DT06-6S-EP06	-
CN-79	RING-TERM	3	Fuel cut off solenoid (cluster type 1)	ST710289-2	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-95	YAZAKI	2	Fusible link	21N4-01311	7122-4125-50
CN-96	AMP	4	Fuel warmer	2-967325-3	-
CN-113	KET	2	Travel buzzer	MG651205-5	-
CN-116	AMP	12	Switch panel	176116	-
CN-126	AMP	10	Service tool	S816-010002	S816-110002
CN-133	DEUTSCH	2	Boom priority solenoid	DT06-2S-EP06	-
CN-135	DEUTSCH	2	Arm regeneration solenoid	DT06-2S-EP06	-
CN-138	DEUTSCH	3	DC/DC Converter	DT06-3S	-
CN-139	AMP	2	12V socket	172434-2	-
CN-140	DEUTSCH	2	Quick clamp solenoid	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	DT04-3P-EP10
CN-142	DEUTSCH	3	Accel dial	DT06-3S-EP06	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat	-	DT04-2P-E005
CN-170	AMP	2	Heated seat	12052641	-
CN-236	DEUTSCH	2	Attach pressure solenoid	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach flow solenoid	DT06-2S-EP06	DT04-2P-E005
CN-246	AMP	10	USB & Socket assy	316988-6	-
CN-247	DEUTSCH	8	PWM convert	DT06-08SA-EP06	DT04-8P
CN-249	AMP	4	Rear view camera	S816-004002	S816-104002
CN-279	AMP	2	Accel dial LED	S816-002002	-
· Relay					
CR-1	RING-TERM	-	Battery relay	ST730135-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Work 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	AMP	2	Start relay	-	S814-102001

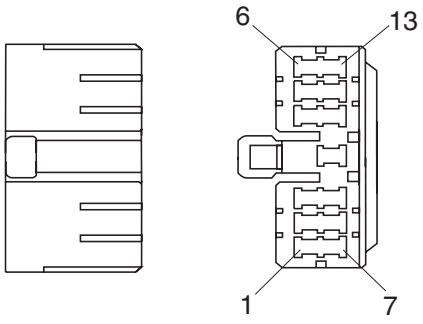
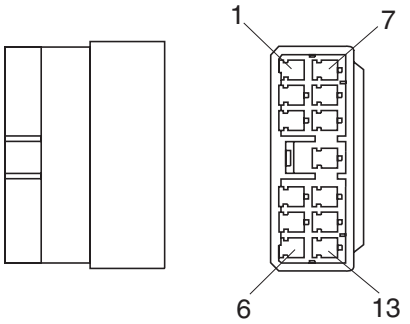
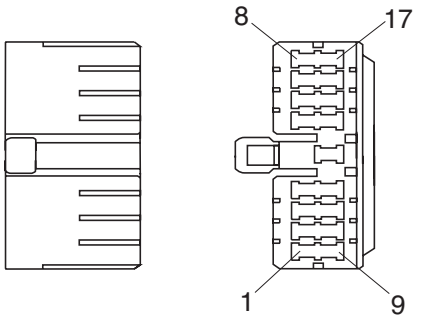
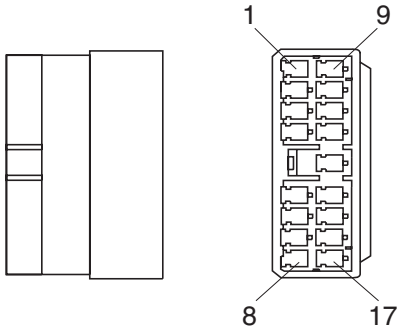
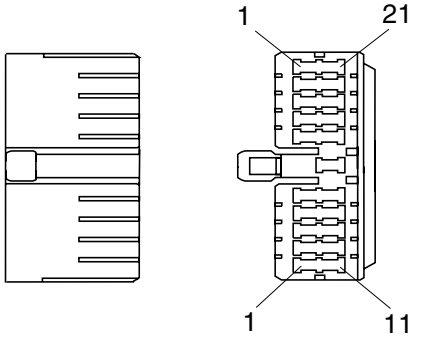
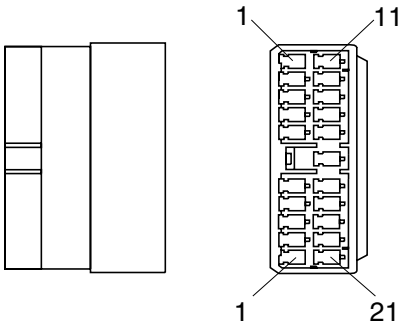
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-24	AMP	1	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	WP	6	Start key switch	S814-006100	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E005
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P-E005
CS-20	AMP	1	Safety switch	S822-014002	-
CS-23	SWF	12	Beacon lamp switch	SWF589790	-
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-EP06	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-27	SWF	12	Breaker switch	SWF 589790	-
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
CS-33	AMP	6	Emergency engine stop switch	S816-006002	S816-106002
CS-50	SWF	12	Overload switch	SWF589790	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	SWF	12	Quick clamp switch	SWF 589790	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-82	SWF	12	Heated seat switch	SWF 589790	-
CS-83	SWF	12	Spare switch	SWF589790	-
CS-99	SWF	12	Spare switch	SWF 589790	-
CS-100	SWF	12	Spare switch	SWF 589790	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar light	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	DT04-2P-E005
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-5	AMP	2	Work lamp-LH	180923-0	-
CL-6	AMP	2	Work lamp-RH	180923-0	-
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT-2P
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Sensor, sender					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel level sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure sensor	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure sensor	DT06-3S-EP06	-
CD-8	AMP	2	Water temperature sender	85202-1	-
CD-10	RING TERM	-	Air cleaner switch	ST730135-2	-
CD-17	-	2	Speed sensor	-	S818-120221
CD-18	RING TERM	1	Engine oil pressure switch	S820-104000	-
CD-24	DEUTSCH	3	Swing sensor (cluster type 1)	DT06-3S-EP06	-
CD-31	AMP	3	Overload sensor (cluster type 1)	S816-003002	S816-103002
CD-32	DEUTSCH	3	Boom up sensor (cluster type 1)	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-69	DEUTSCH	3	Attach pressure sensor (cluster type 1)	DT06-3S-EP06	-

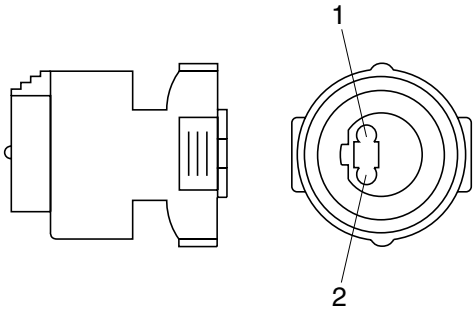
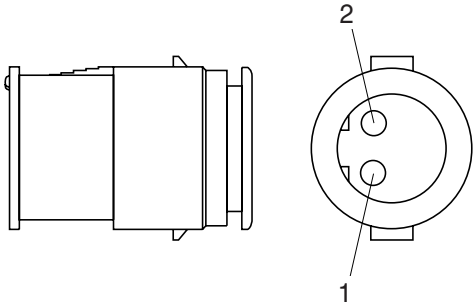
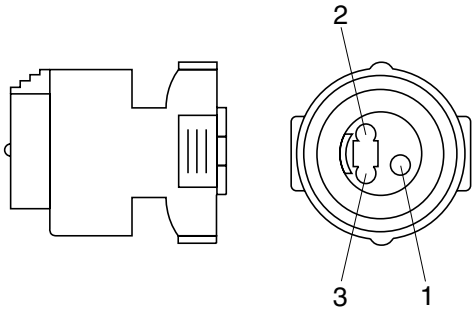
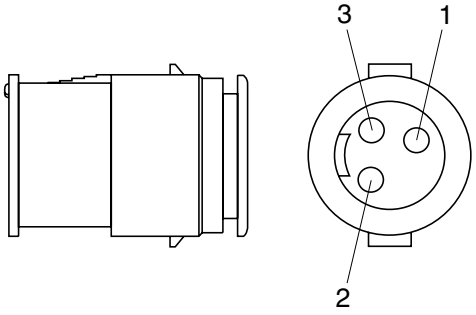
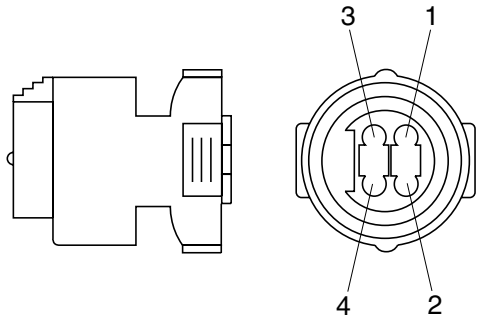
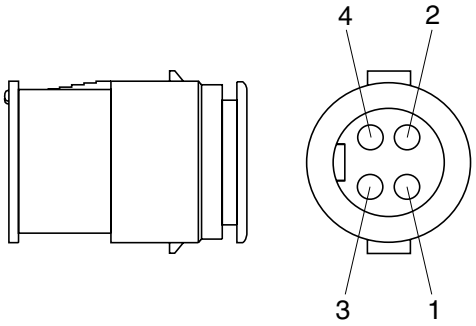
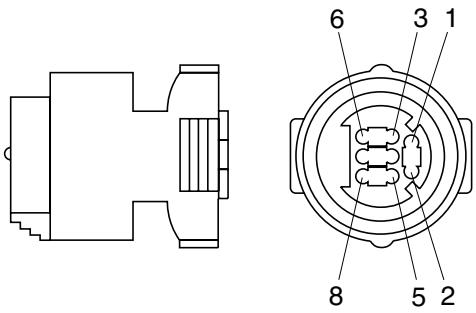
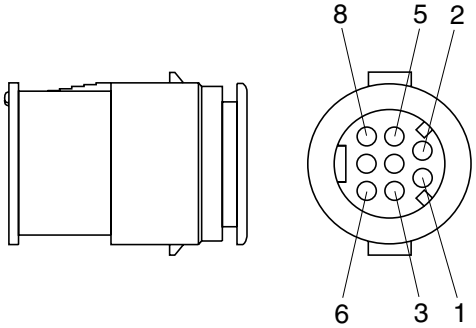
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

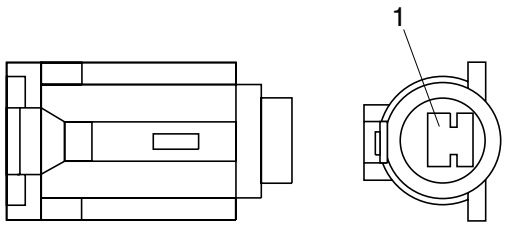
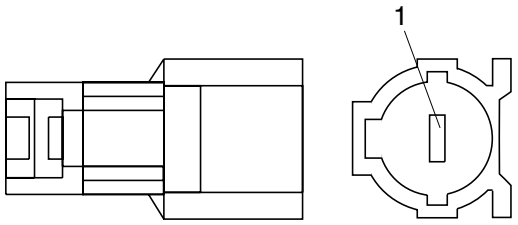
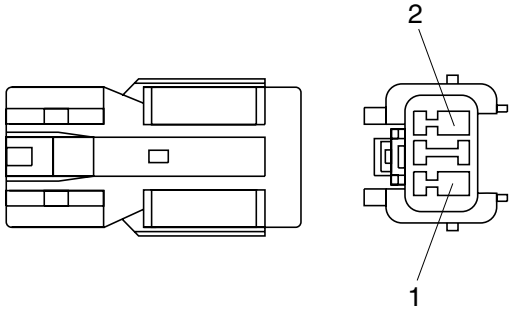
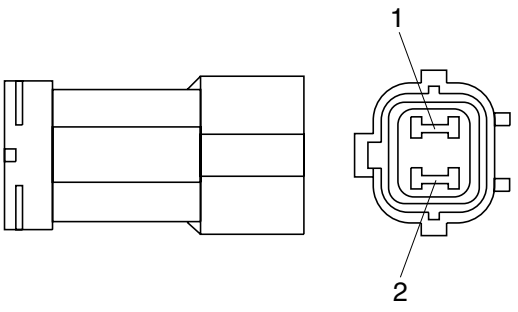
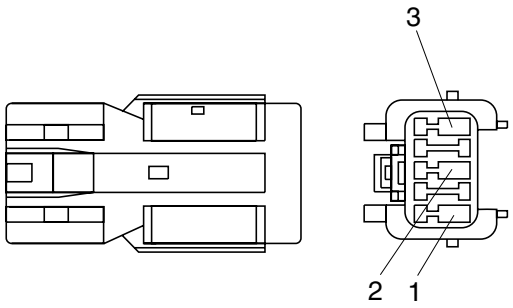
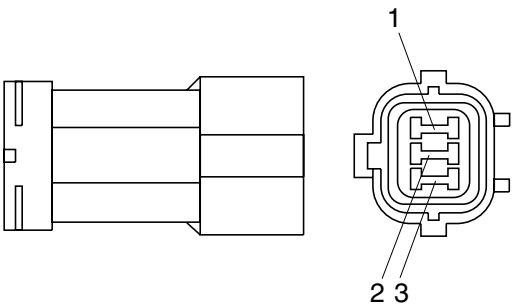
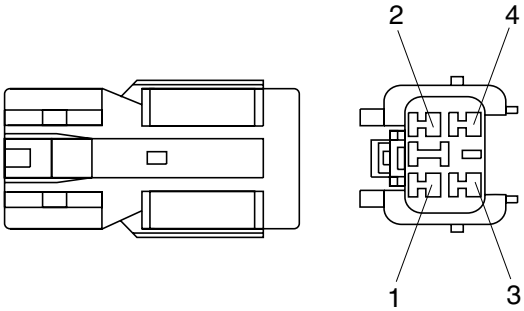
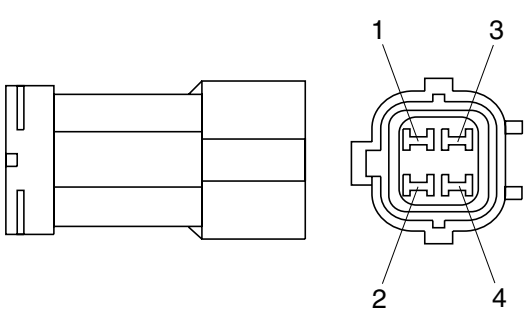
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

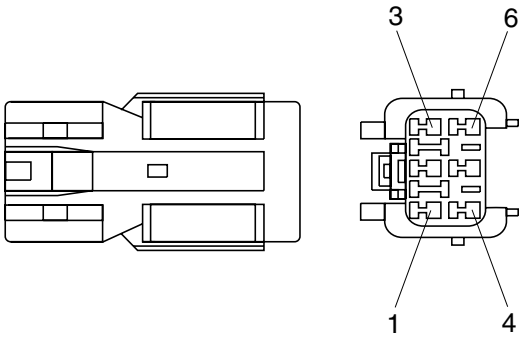
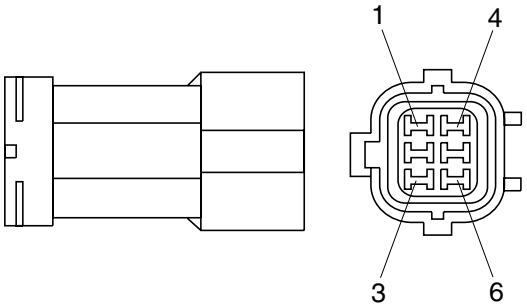
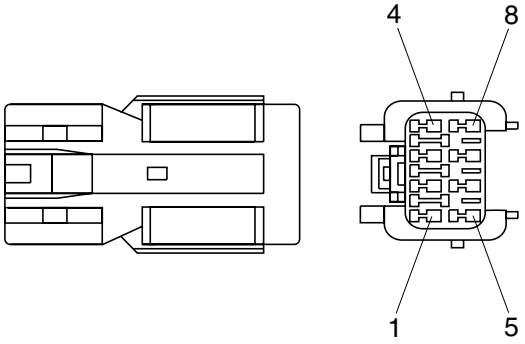
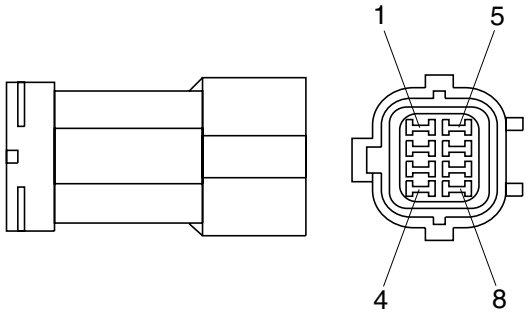
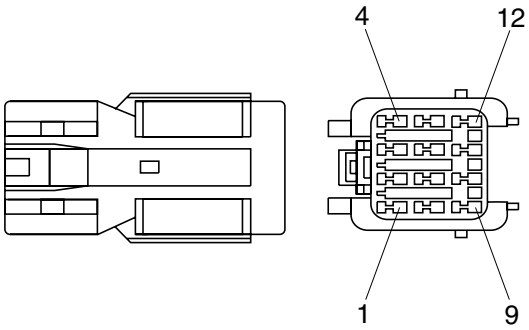
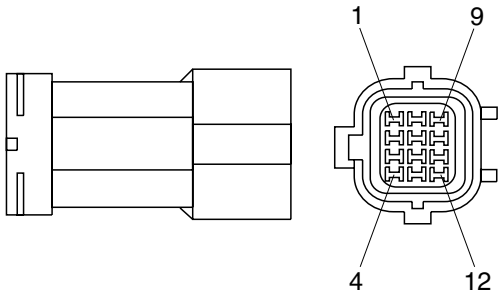
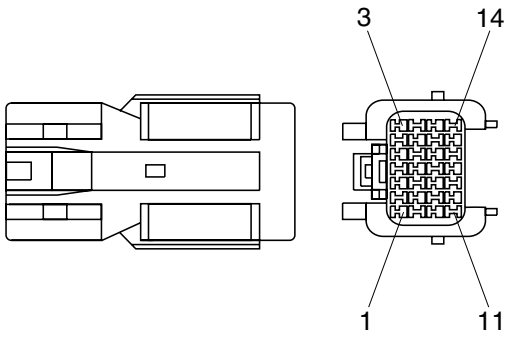
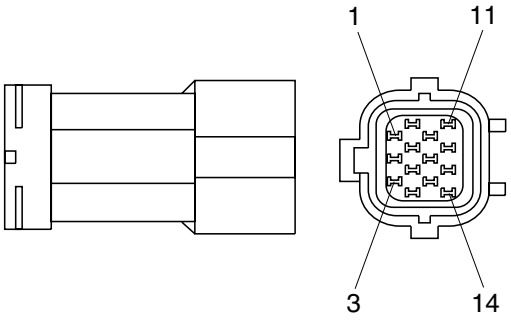
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

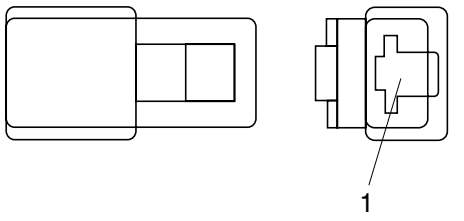
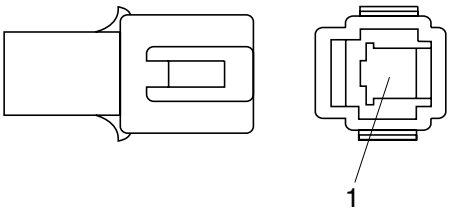
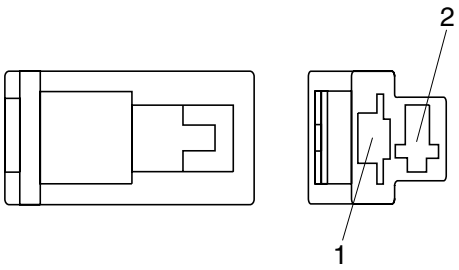
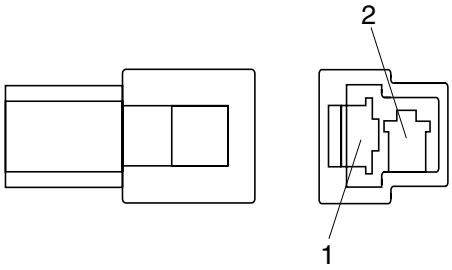
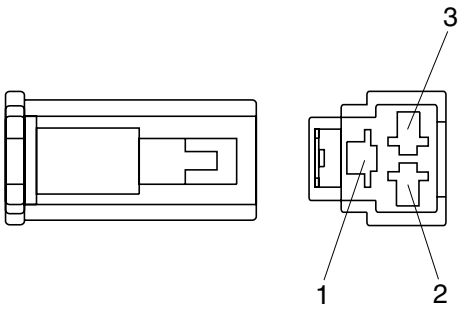
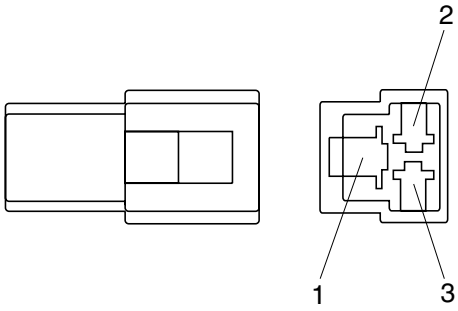
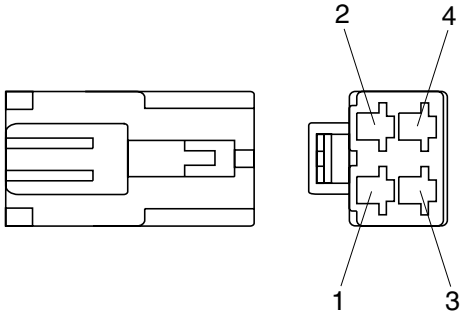
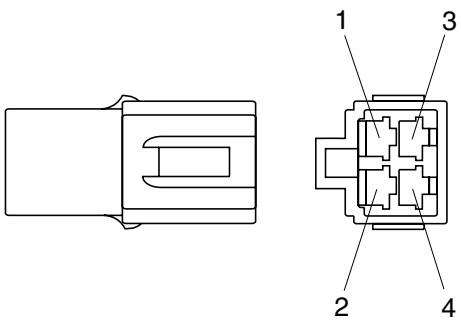
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

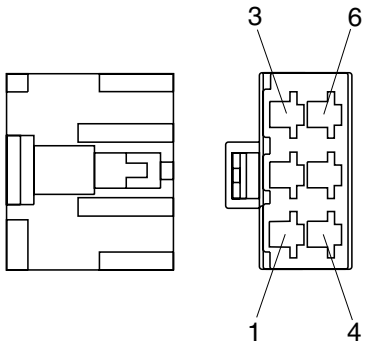
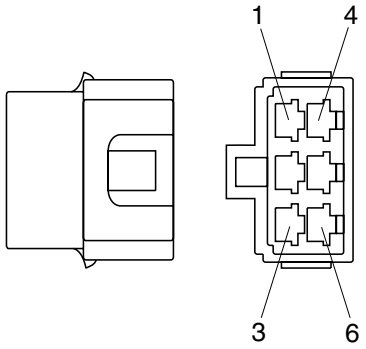
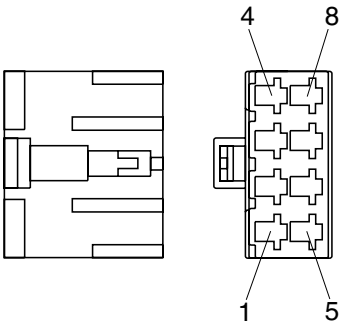
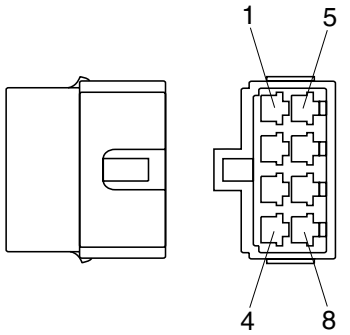
3) SWP TYPE CONNECTOR

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

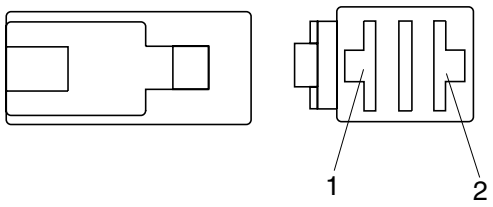
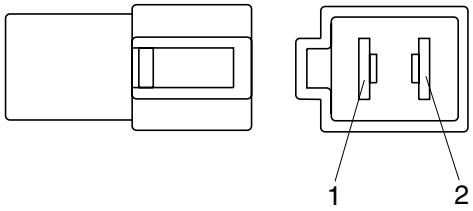
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

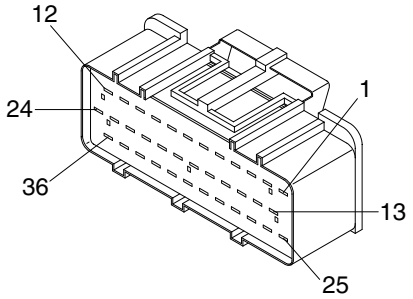
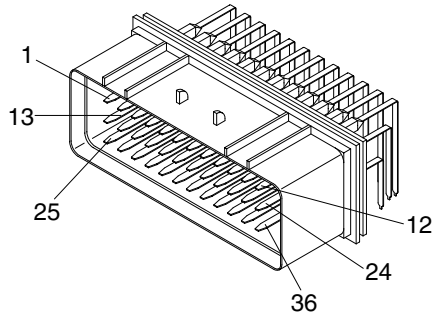
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

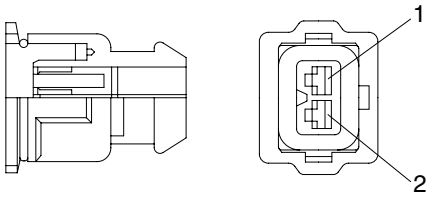
5) 375 FASTEN TYPE CONNECTOR

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

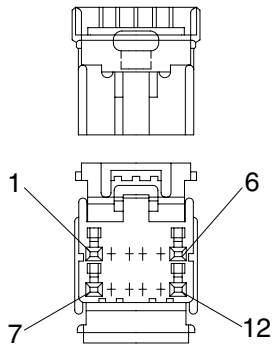
6) AMP ECONOSEAL CONNECTOR

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

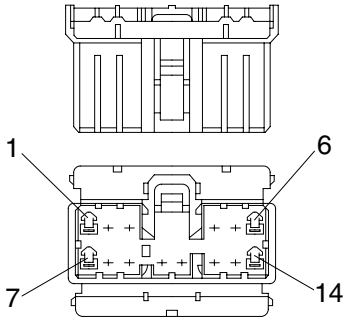
7) AMP TIMER CONNECTOR

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

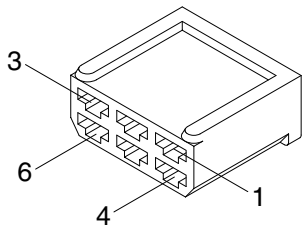
8) AMP 040 MULTILOCK CONNECTOR

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

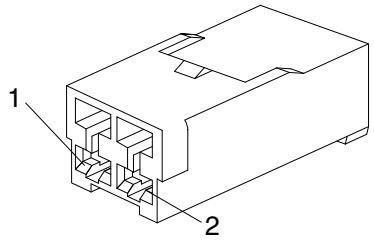
9) AMP 070 MULTILOCK CONNECTOR

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

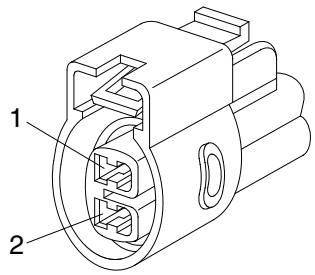
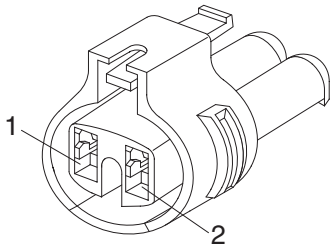
10) AMP FASTIN - FASTON CONNECTOR

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

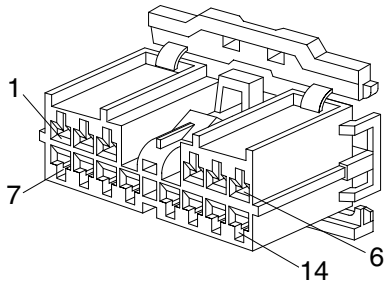
11) KET 090 CONNECTOR

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	

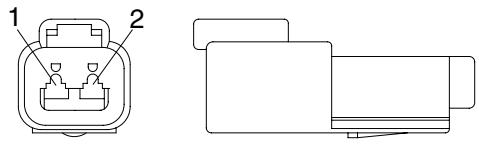
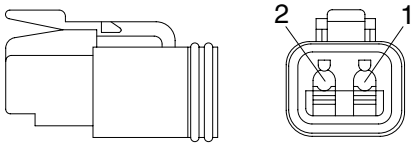
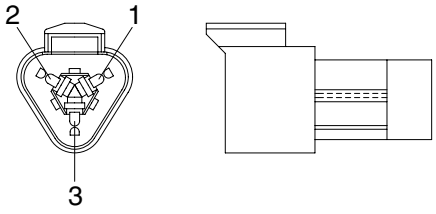
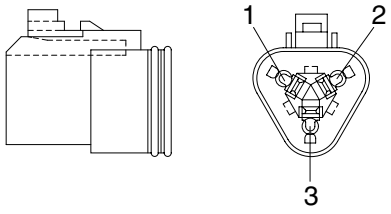
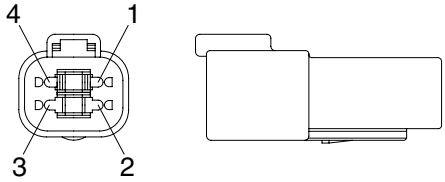
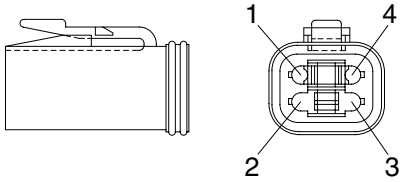
14) DEUTSCH DT CONNECTORS

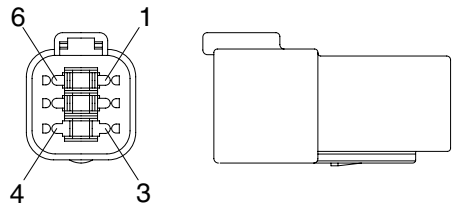
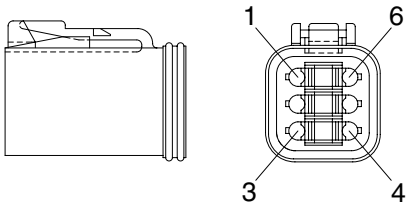
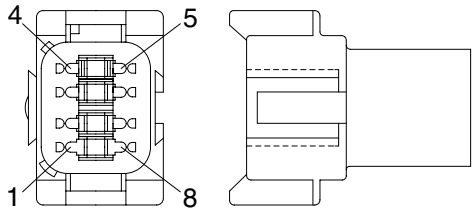
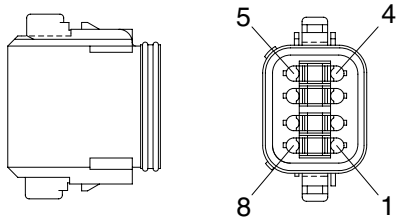
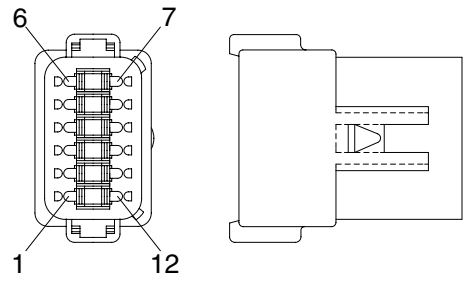
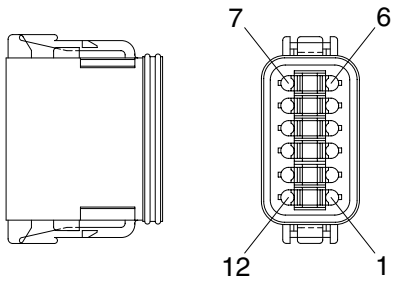
DT 06 - 3S - ★★★★

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

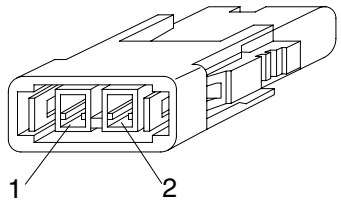
※ Modification

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

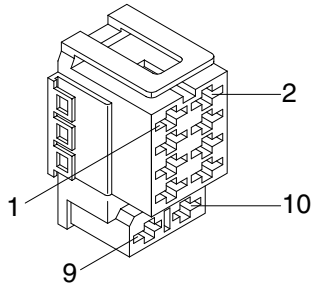
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

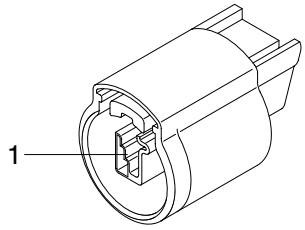
15) MOLEX 2CKTS CONNECTOR

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

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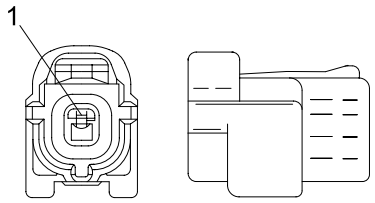
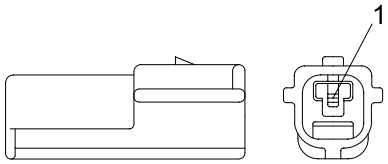
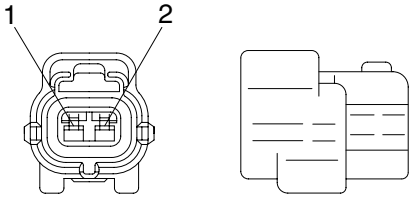
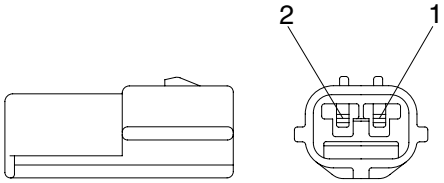
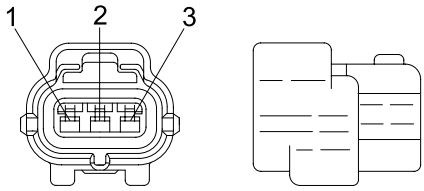
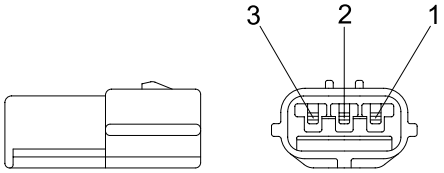
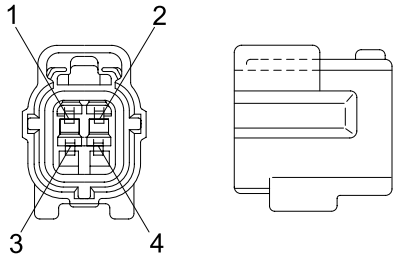
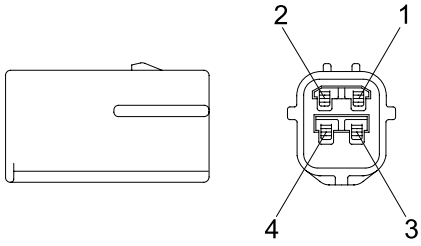
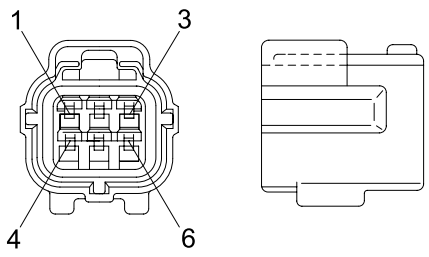
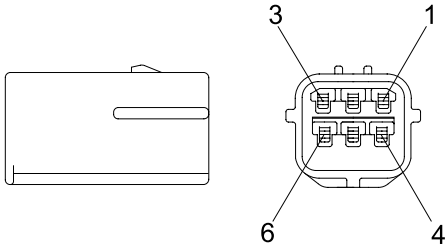
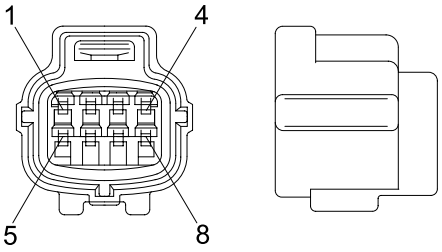
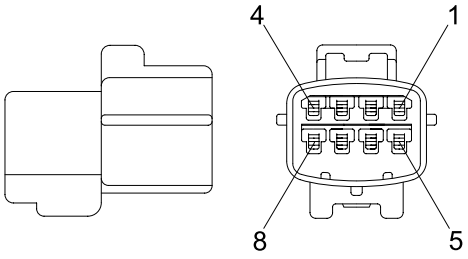
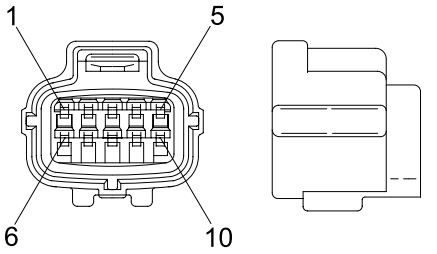
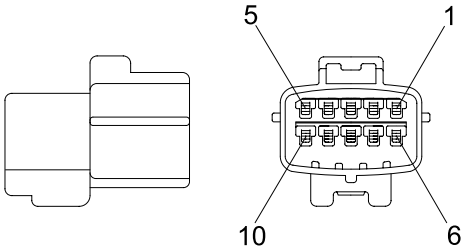
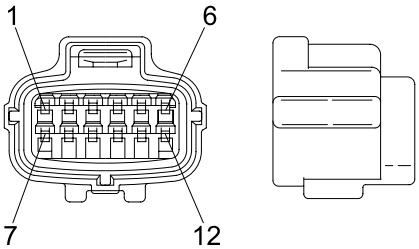
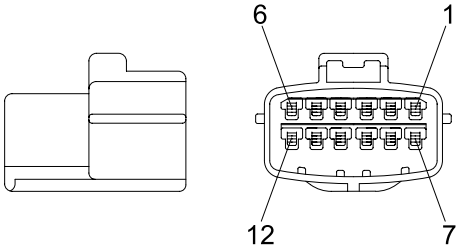
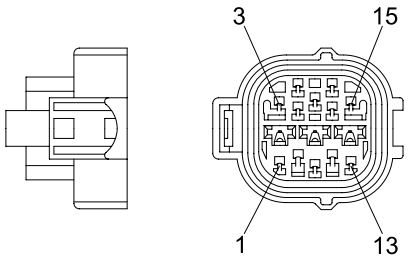
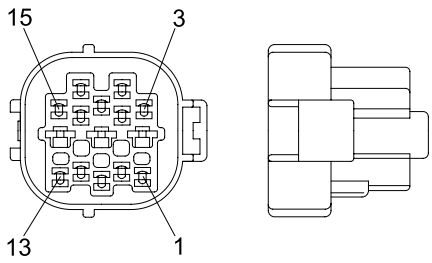
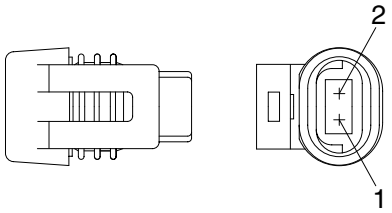
1	 S816-001002	 S816-101002
2	 S816-002002	 S816-102002
3	 S816-003002	 S816-103002
4	 S816-004002	 S816-104002

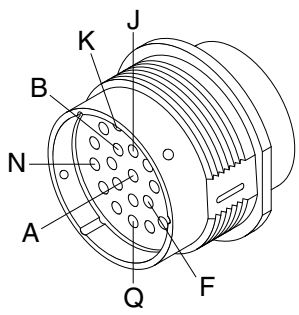
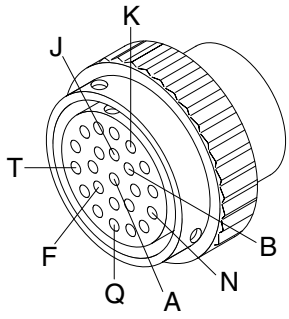
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

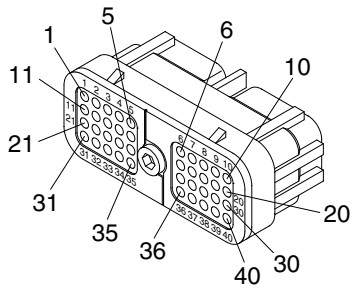
19) METRI-PACK TYPE CONNECTOR

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

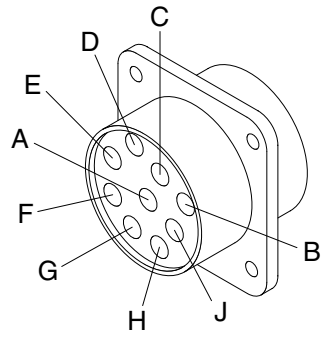
20) DEUTSCH HD30 CONNECTOR

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

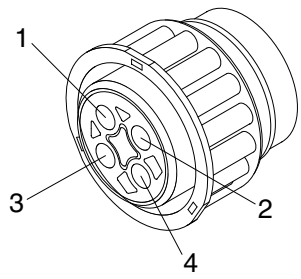
21) DEUTSCH MCU CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
40	 DRC26-40SA/B	

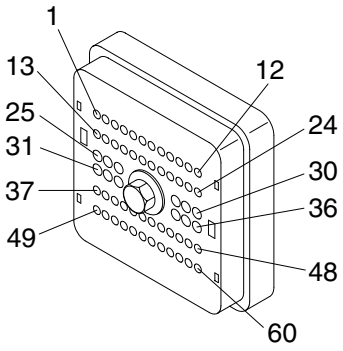
22) DEUTSCH SERVICE TOOL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
9	 HD10-9-96P	

23) AMP FUEL WARMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
4	 2-967325-3	

24) DEUTSCH INTERMEDIATE CONNECTOR

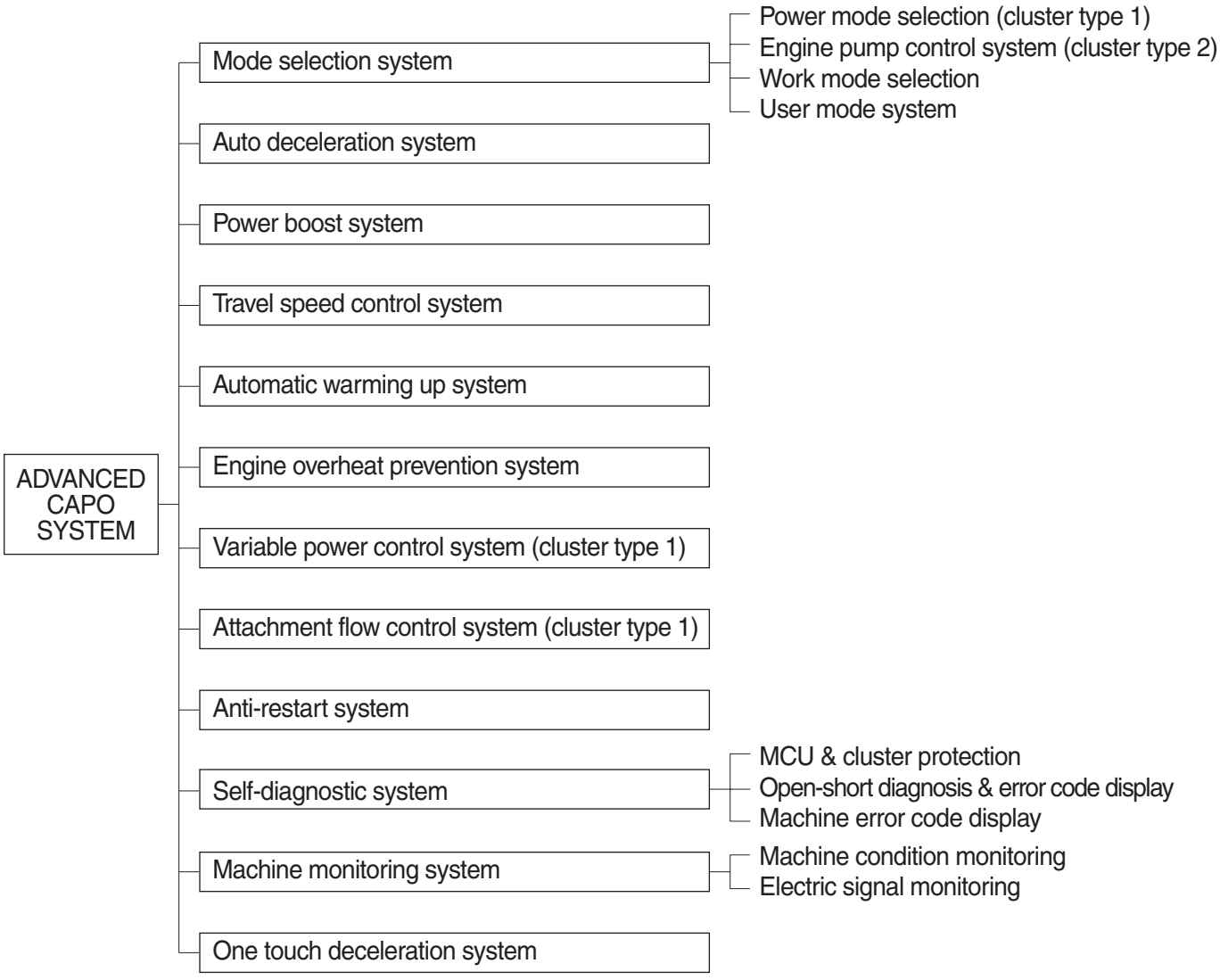
No. of pin	Receptacle connector (female)	Plug connector (male)
60	 DRB16-60SAE-L018	

SECTION 5 MECHATRONICS SYSTEM

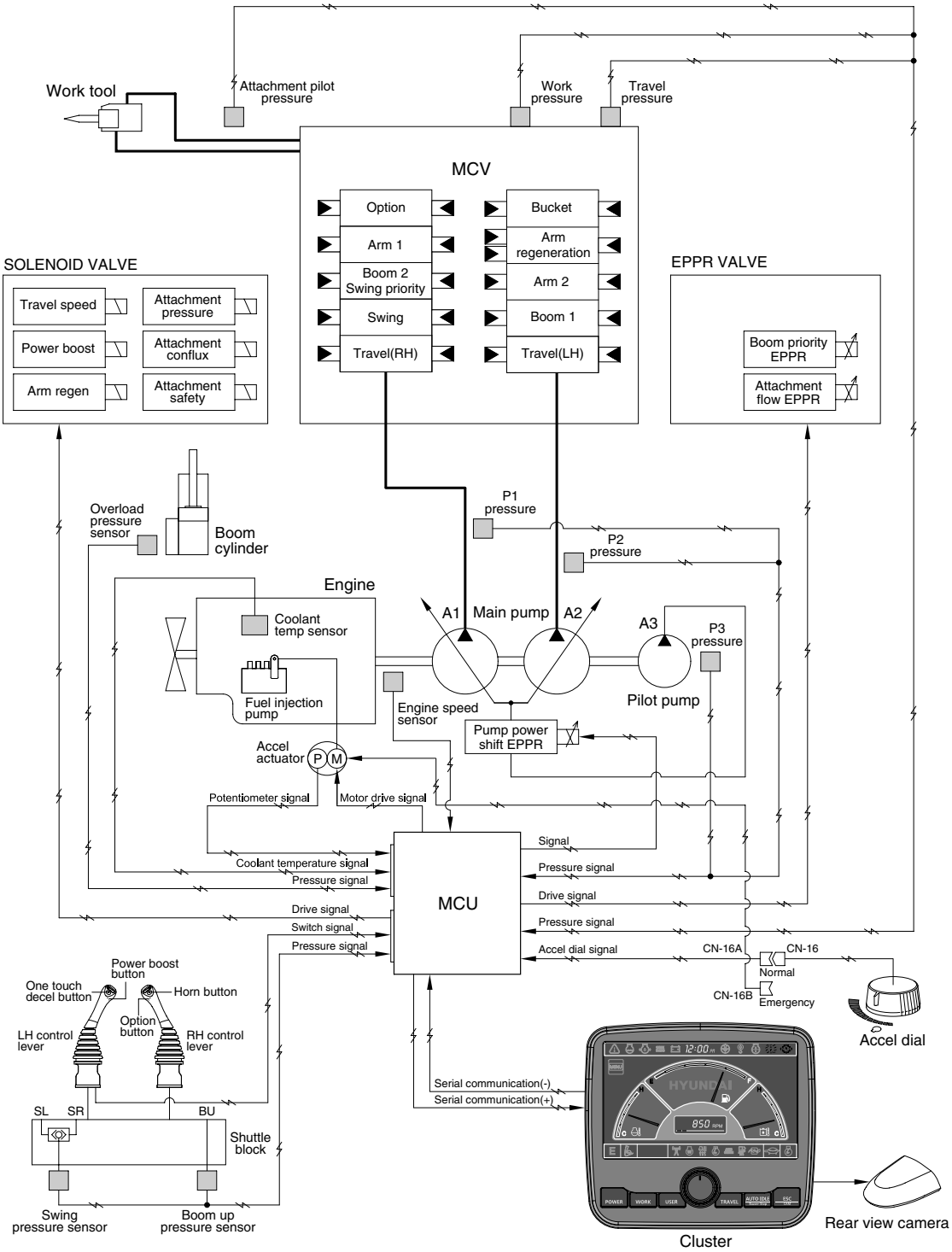
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

■ Cluster type 1 - ADVANCED CAPO (Computer Aided Power Optimization) system
■ Cluster type 2 - NEW CAPO (Computer Aided Power Optimization) system
The 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 accel actuator, 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.

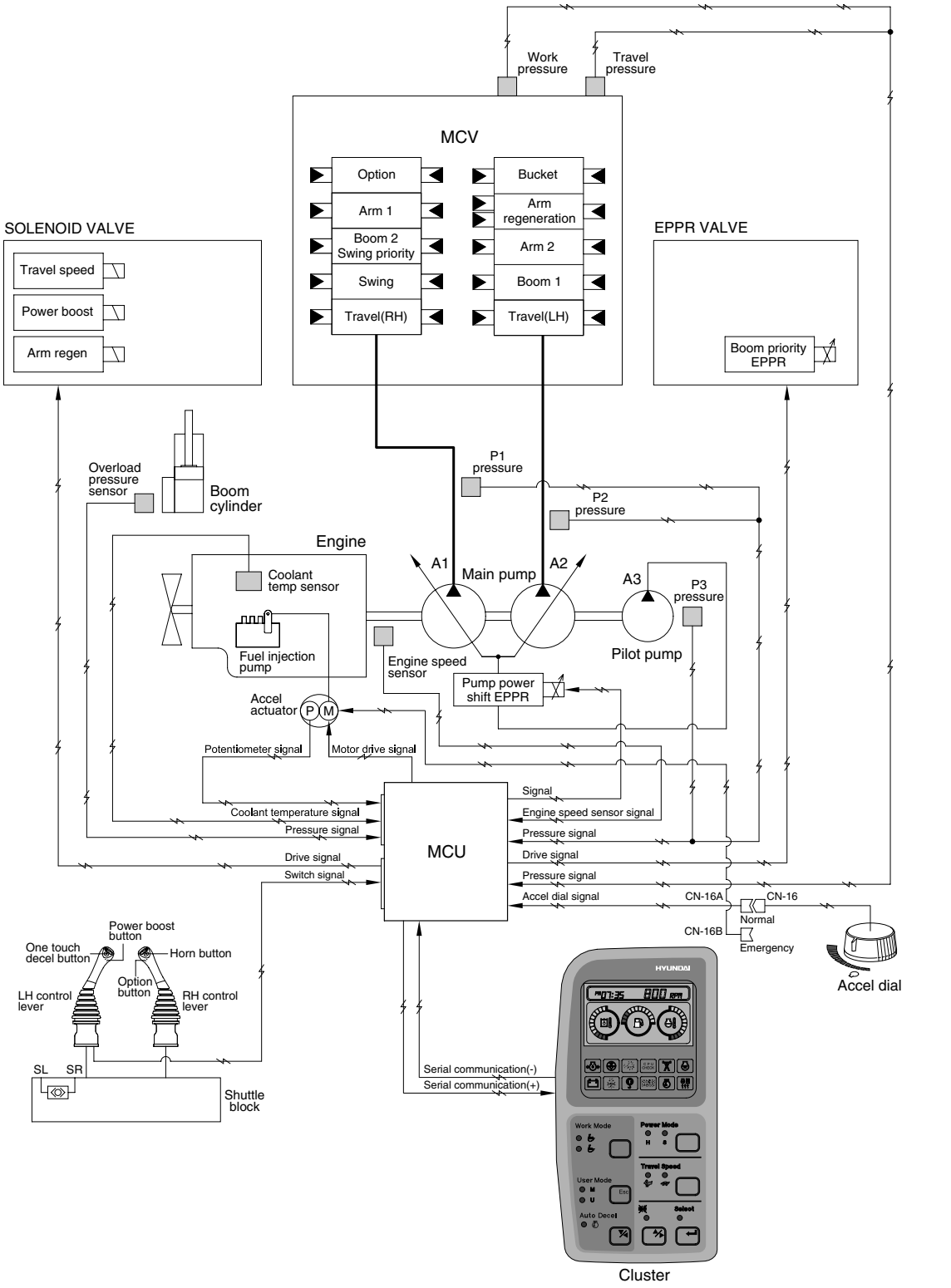


SYSTEM DIAGRAM (CLUSTER TYPE 1)



2209S5MS01

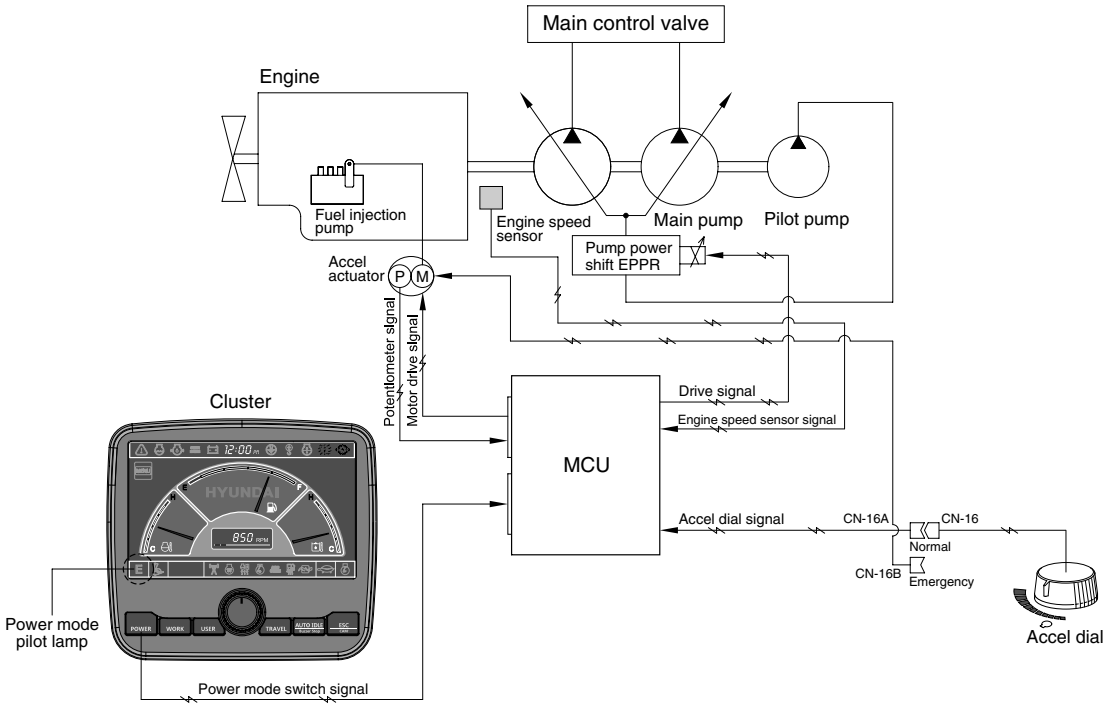
SYSTEM DIAGRAM (CLUSTER TYPE 2)



2209S5MS51

GROUP 2 MODE SELECTION SYSTEM (CLUSTER TYPE 1)

1. POWER MODE SELECTION SYSTEM



1409S5MS02

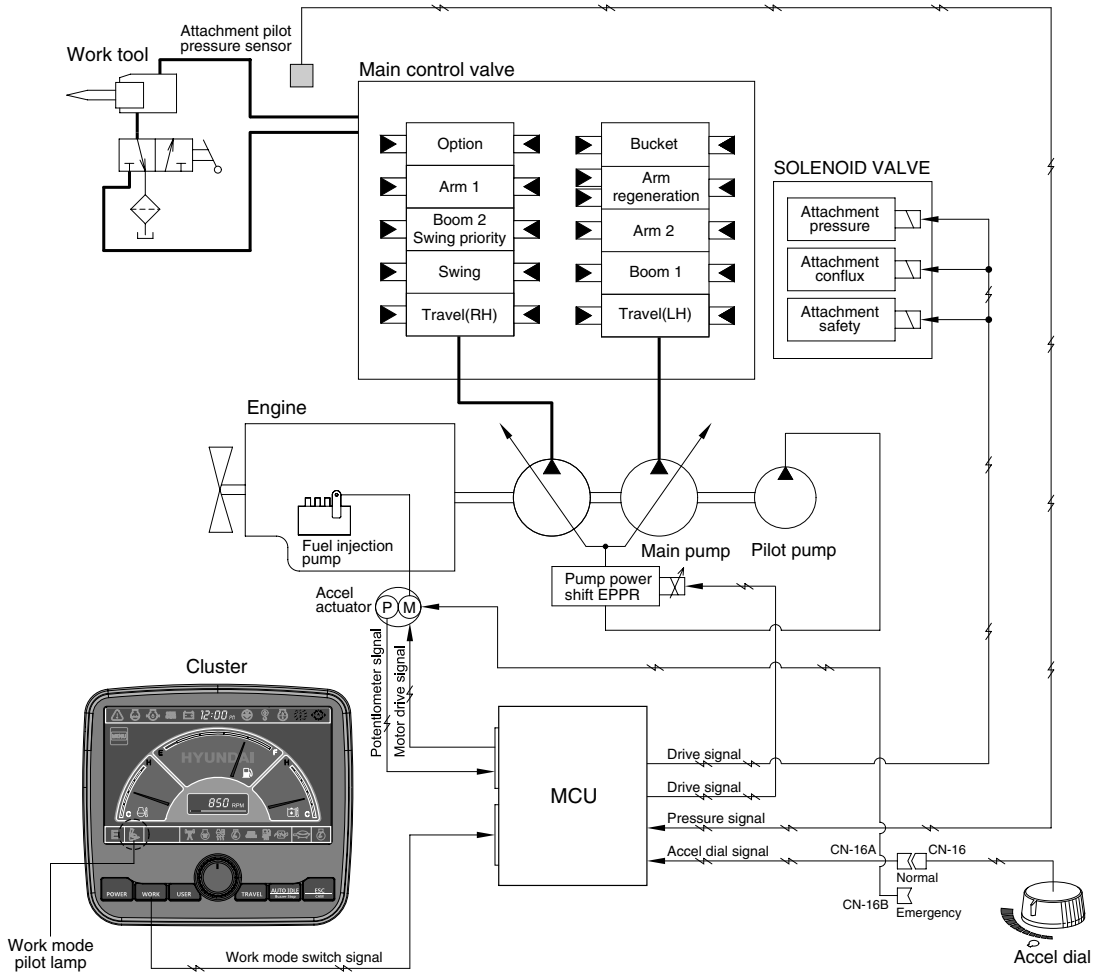
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	2100±50	1900±50	2200±50	2000±50	330±30	10	280±30	7
S	Standard power	2000±50	1800±50	2050±50	1850±50	360±30	12±3	290±30	8±3
E	Economy operation	1900±50	1700±50	1950±50	1750±50	360±30	12±3	290±30	8±3
AUTO DECEL	Engine deceleration	1150±100	-	1150±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3

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

2. WORK MODE SELECTION SYSTEM

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



2209S5MS03

1) GENERAL WORK MODE (bucket)

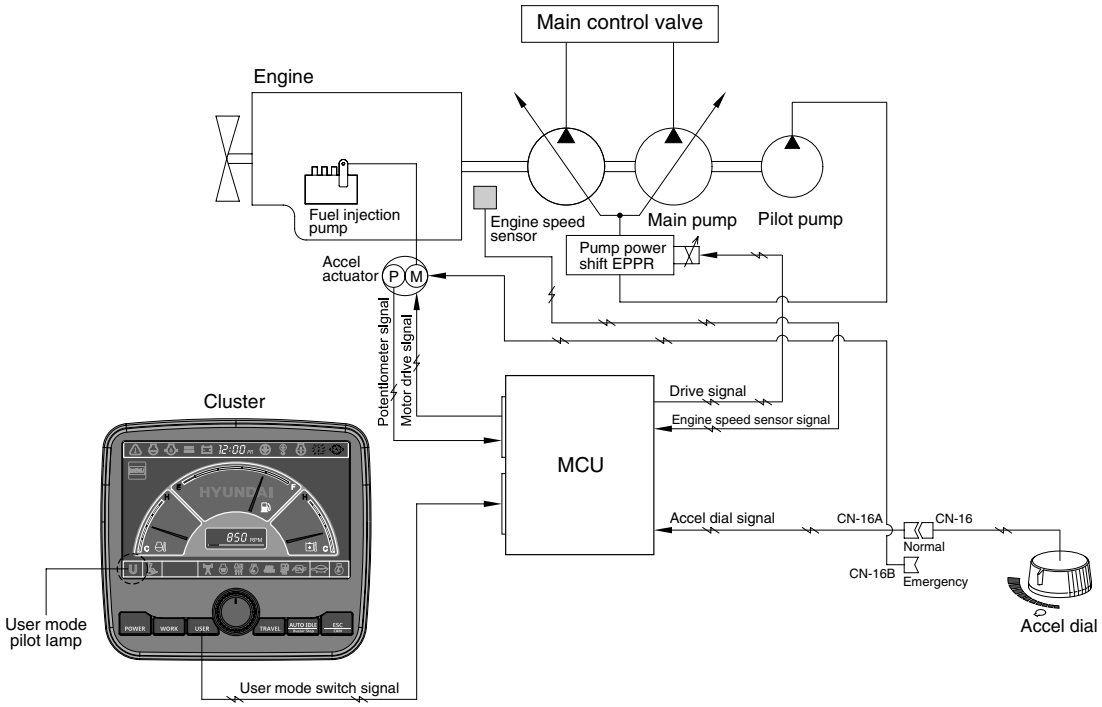
This mode is used to general digging work.

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	ON
Attachment pressure solenoid	OFF	OFF	ON
Attachment conflux solenoid	OFF	OFF	ON/OFF
Attachment flow EPPR current	100 mA	100~700 mA	100~700 mA

3. USER MODE SELECTION SYSTEM



1409S5MS04

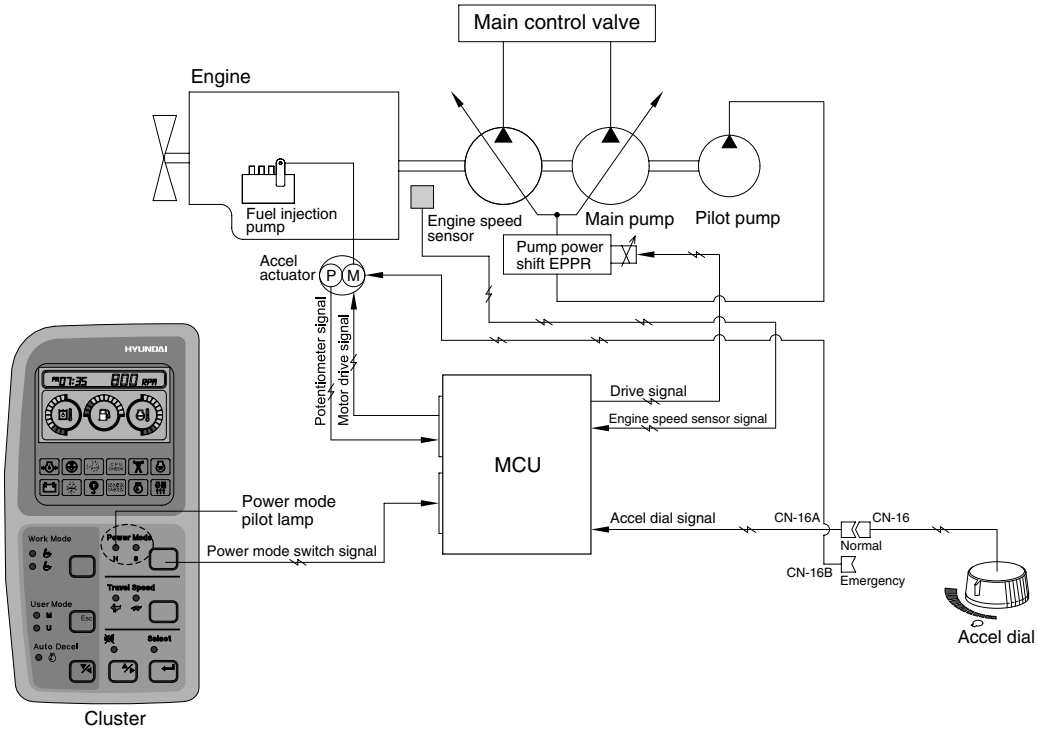
1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1500	1000 (low idle)	0
2	1600	1050	3
3	1700	1100	6
4	1800	1150 (decel rpm)	9
5	1900	1200	12
6	2000	1250	16
7	2050	1300	20
8	2100	1350	26
9	2150	1400	32
10	2200	1450	38

■ MODE SELECTION SYSTEM (CLUSTER TYPE 2)

1. POWER MODE SELECTION SYSTEM



1409S5MS52

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

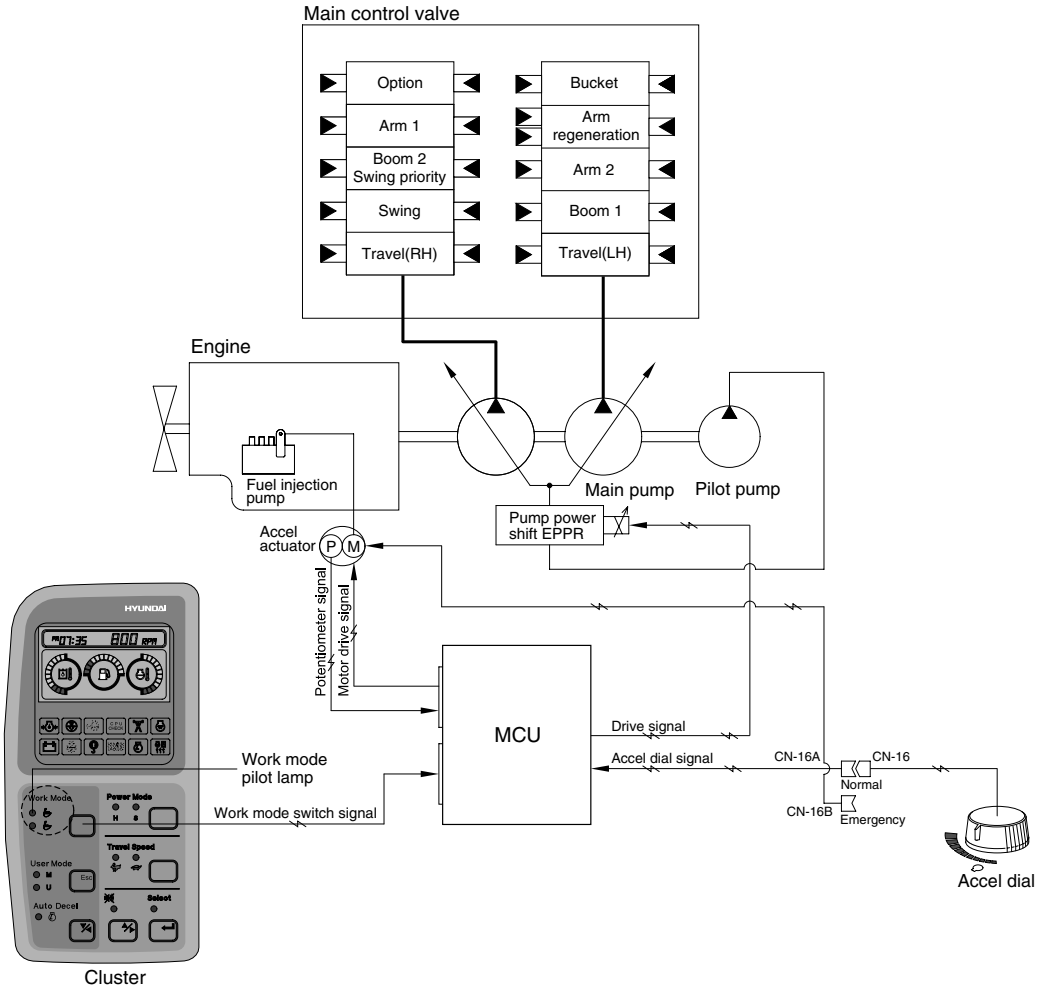
The combination of 3 power modes (M, H, S) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm²)	Current (mA)	Pressure (kgf/cm²)
M	Maximum power	2100±50	1900±50	2200±50	2000±50	330±30	10	280±30	7
H	High power	2000±50	1800±50	2050±50	1850±50	360±30	12±3	290±30	8±3
S	Standard power	1900±50	1700±50	1950±50	1750±50	360±30	12±3	290±30	8±3
AUTO DECEL	Engine deceleration	1150±100	-	1150±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	1000±100	-	1000±100	-	700±30	38±3	700±30	38±3

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

2. WORK MODE SELECTION SYSTEM

2 Work mode can be selected for the optional work speed of the machine operation.



2209S5MS53

1) HEAVY DUTY WORK MODE

Boom and arm operation speed faster than general work mode.

2) GENERAL WORK MODE

When key switch is turned ON, this mode is selected and swing operation speed is faster than heavy duty work mode.

Work mode	Swing priority solenoid	Max flow cut-off solenoid
Heavy duty	OFF	OFF
General	ON	OFF

3. USER MODE SELECTION SYSTEM

An operator can change the engine and pump and memorize it for his preference.

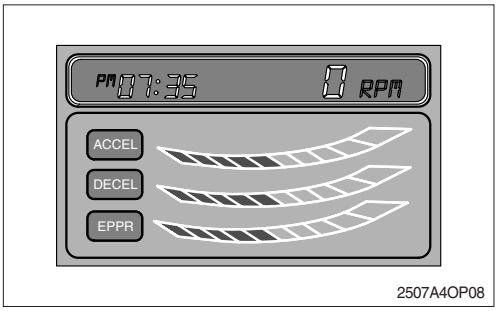
Mode	Operation
U	High idle rpm, auto decel rpm EPPR pressure can be modulated and memorized separately

HOW TO MODULATE THE MEMORY SET

1) Each memory mode has a initial set which are mid-range of max engine speed, auto decel rpm, and EPPR valve input current.

2) High idle rpm, auto decel rpm, EPPR pressure can be modulated and memorized separately in the U-mode.

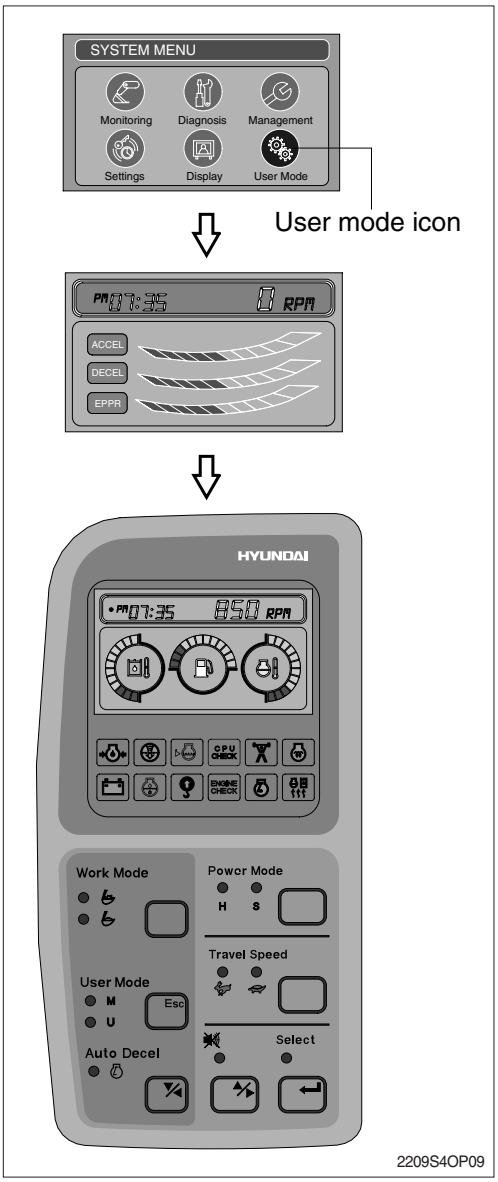
※ Refer to the page 5-72 for set of user mode.



2507A4OP08

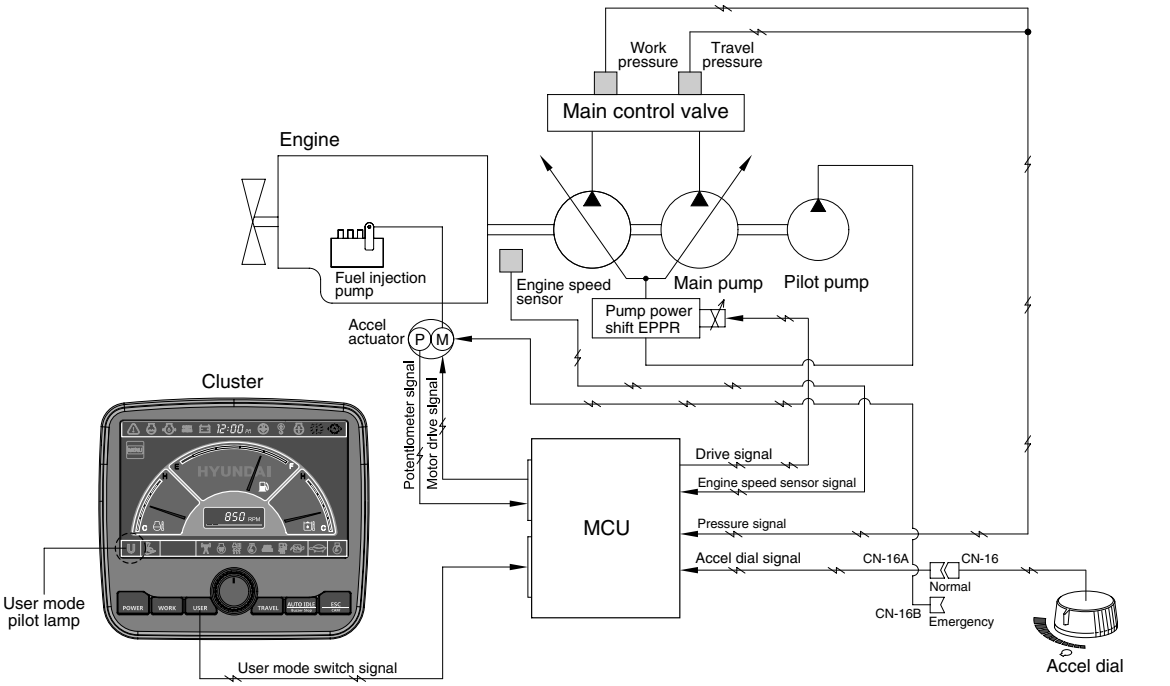
· LCD segment vs parameter setting

Segment (▮)	ACCEL (rpm)	DECEL (rpm)	EPPR (mA)
1	1500	1000 (low idle)	150
2	1600	1050	200
3	1700	1100	250
4	1800	1150 (decel rpm)	300
5	1900	1200	350
6	2000	1250	400
7	2050	1300	450
8	2100	1350	500
9	2150	1400	550
10	2200	1450	600



2209S4OP09

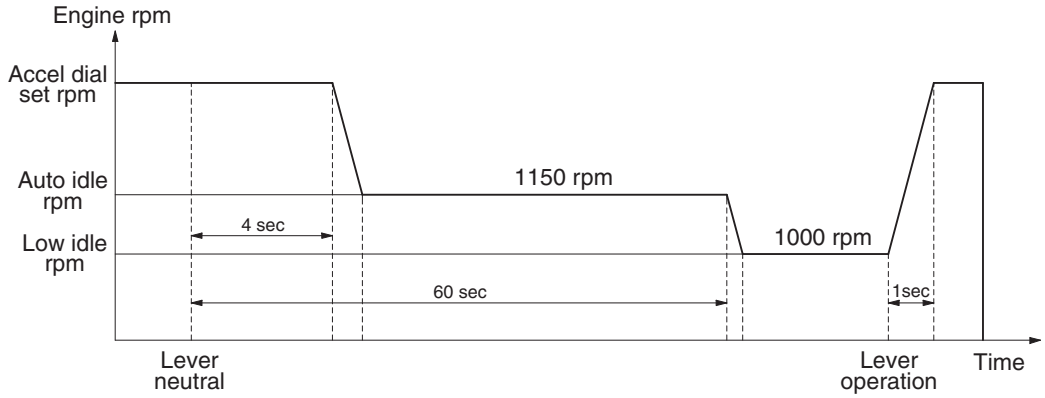
GROUP 3 AUTOMATIC DECELERATION SYSTEM (CLUSTER TYPE 1)



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 drives the accel actuator to reduce the engine speed to 1150 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 1000 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.

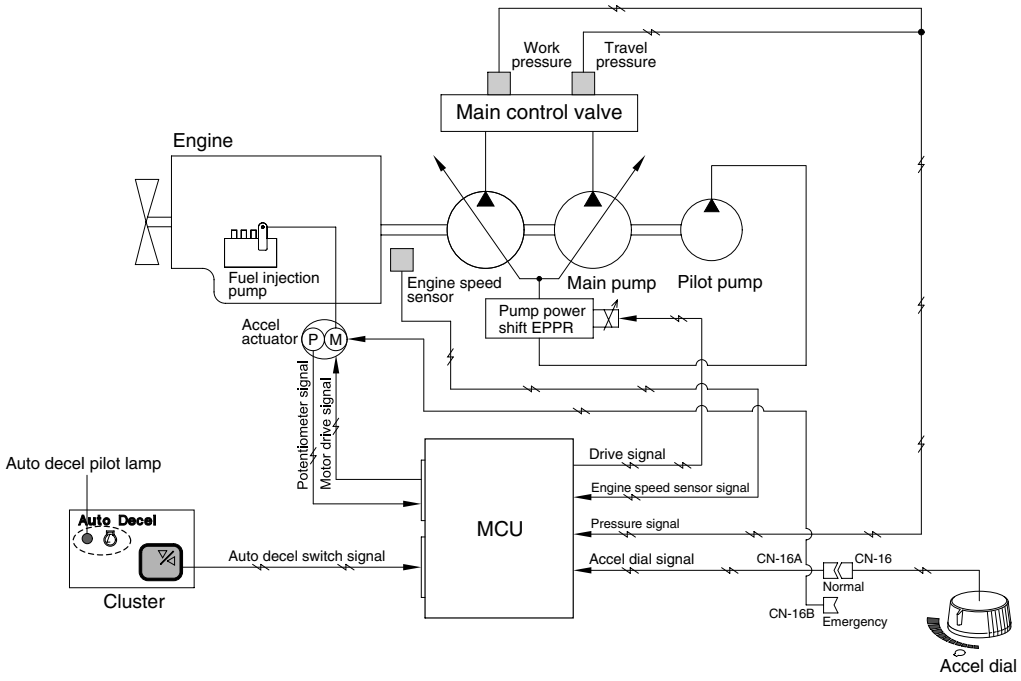


2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

■ AUTOMATIC DECELERATION SYSTEM (CLUSTER TYPE 2)

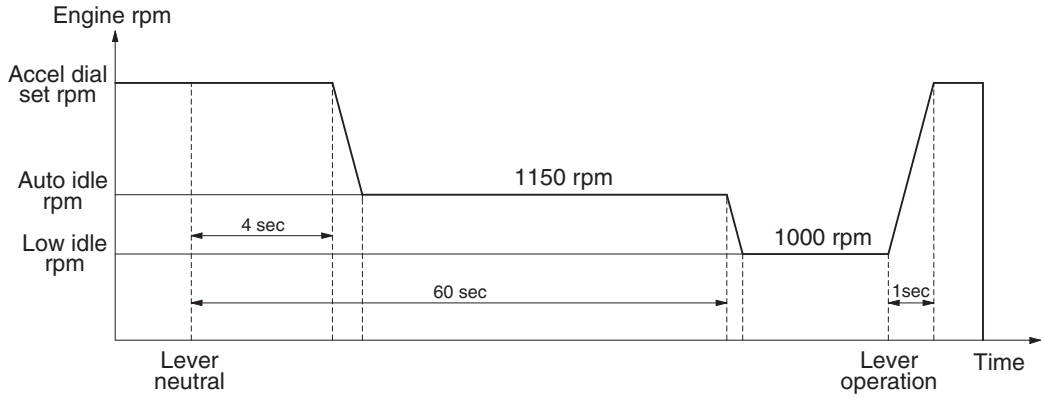


1409S5MS55

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 drives the accel actuator to reduce the engine speed to 1150 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 1000 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 decel 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.



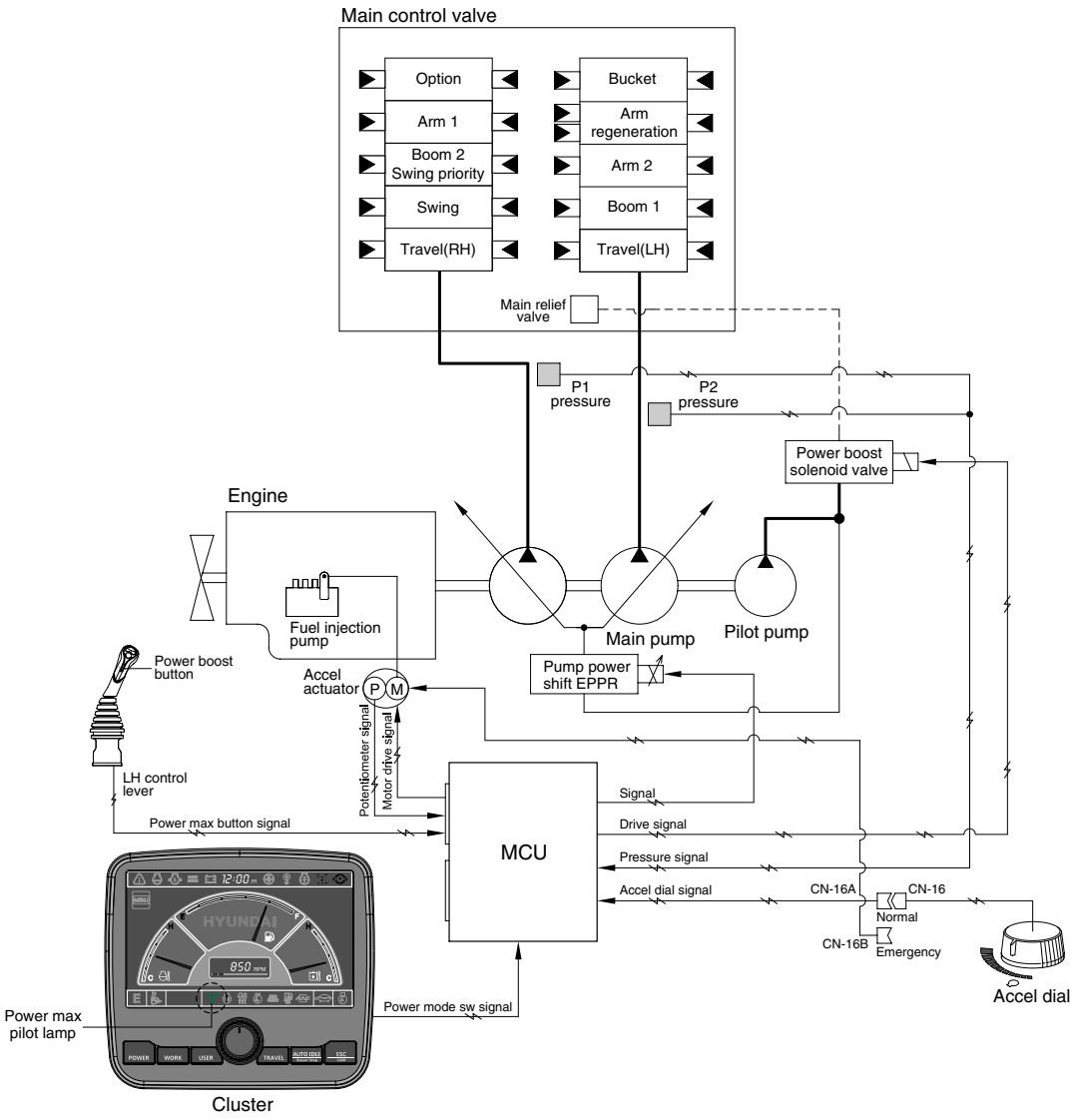
2209S5MS06

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM (CLUSTER TYPE 1)



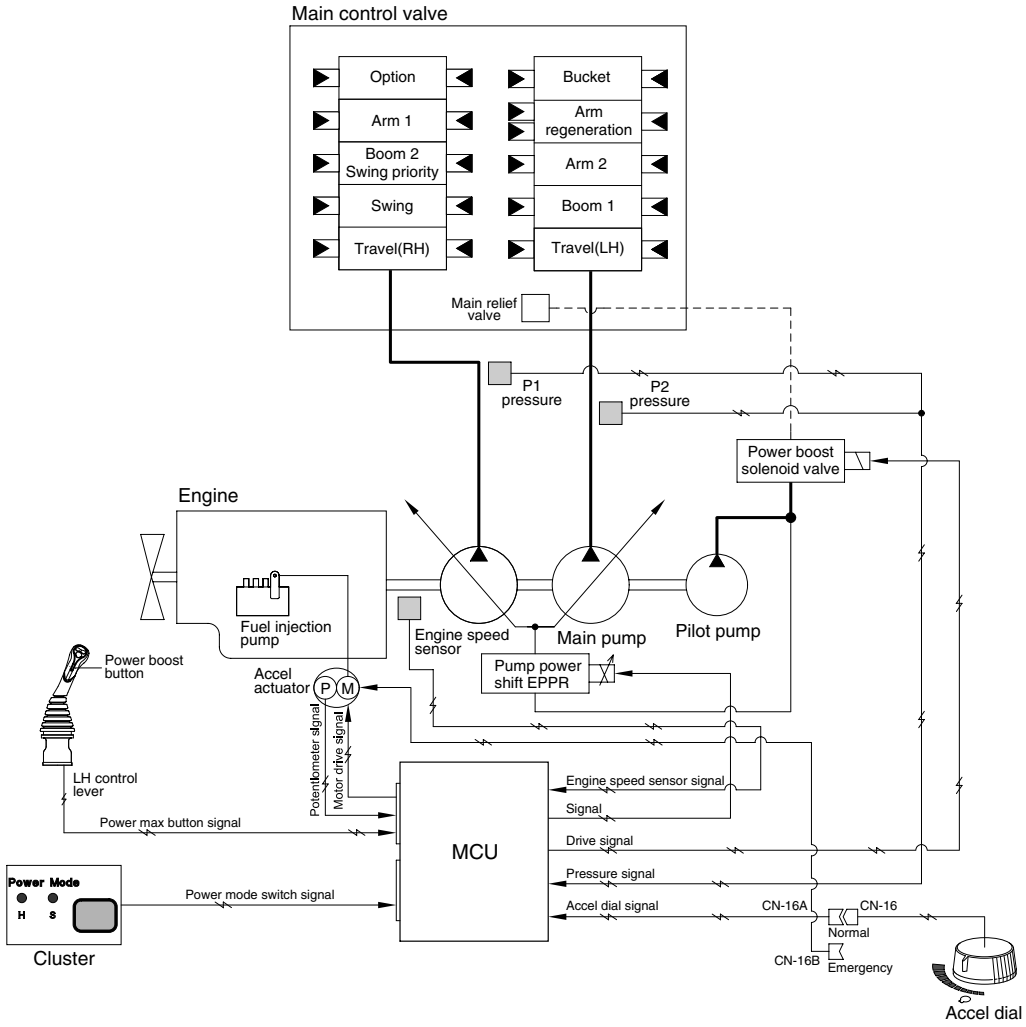
2209S5MS07

- 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 Accel dial : over 8	- Power mode : P - Accel 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.

■ POWER BOOST SYSTEM (CLUSTER TYPE 2)



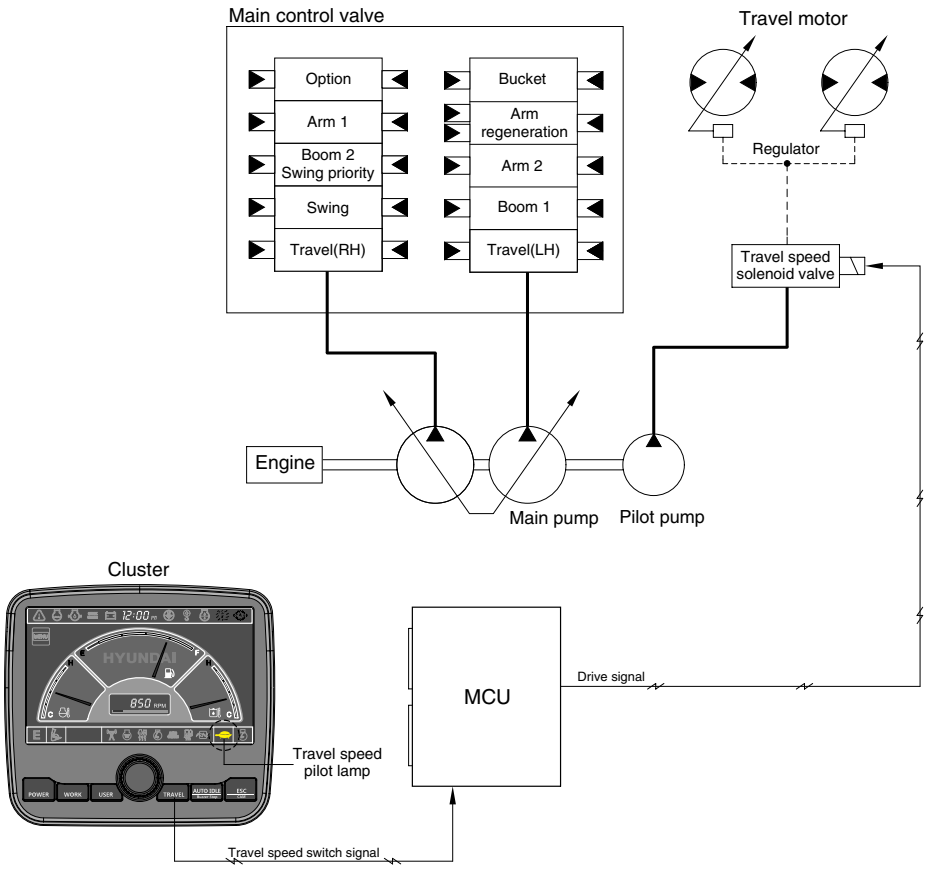
2209S5MS57

- When the power boost switch on the left control lever knob is pushed ON, the maximum digging power is increased by 10 %.
- When the power set is at M, H or S and 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	Power boost switch	
	OFF	ON
Power set	H or S	H
	M	M
Main relief valve set pressure	350 kgf/cm^2	380 kgf/cm^2
Time of operation	-	Even when pressed continuously, it is canceled after 8 sec.

※ Default - Power boost solenoid valve : OFF

GROUP 5 TRAVEL SPEED CONTROL SYSTEM (CLUSTER TYPE 1)



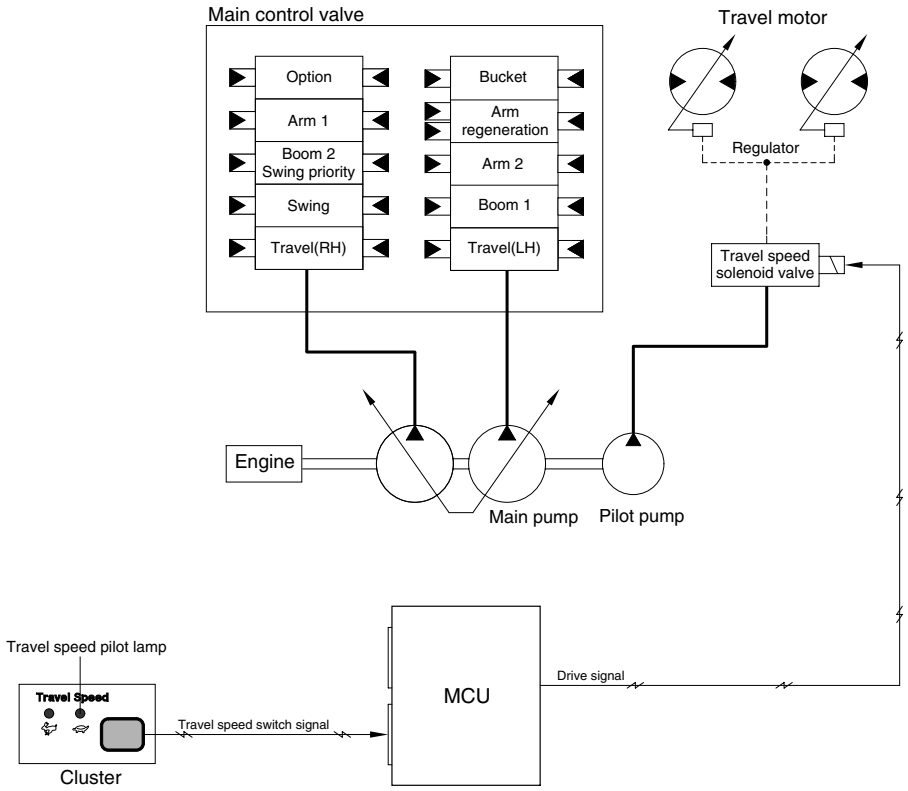
2209S5MS08

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)

■ TRAVEL SPEED CONTROL SYSTEM (CLUSTER TYPE 2)



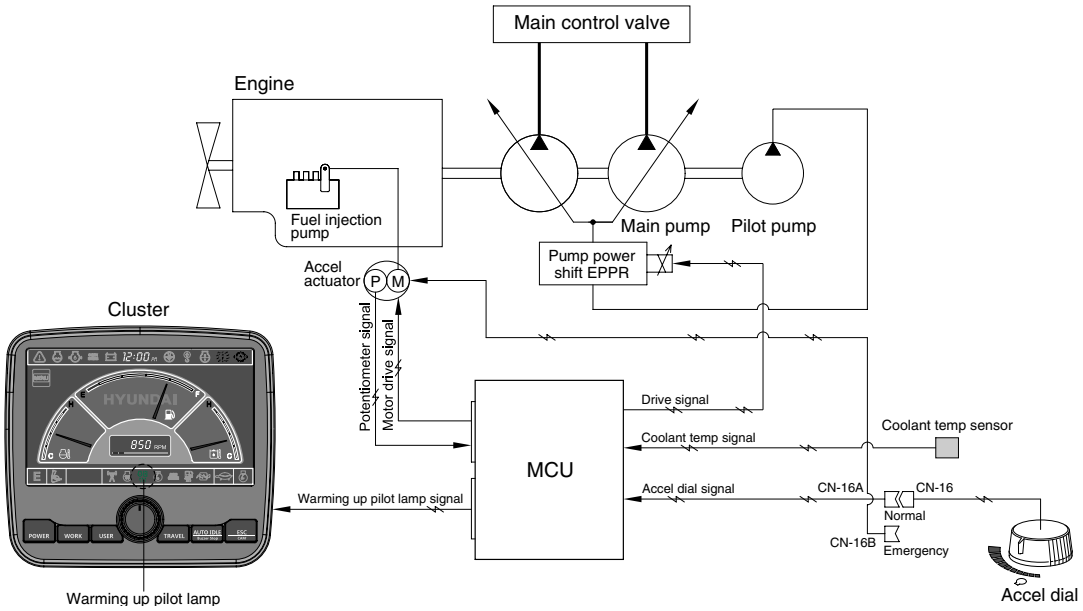
2209S5MS58

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 (CLUSTER TYPE 1)



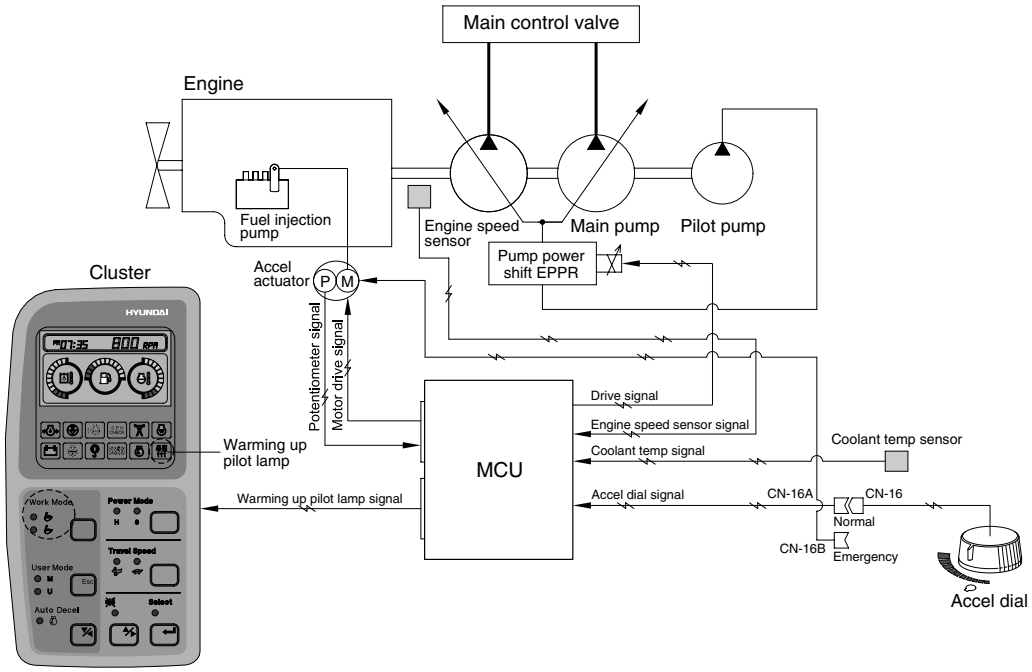
1409S5MS09

1. The MCU reads engine coolant temperature through the temperature sensor and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1150 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

■ AUTOMATIC WARMING UP SYSTEM (CLUSTER TYPE 2)



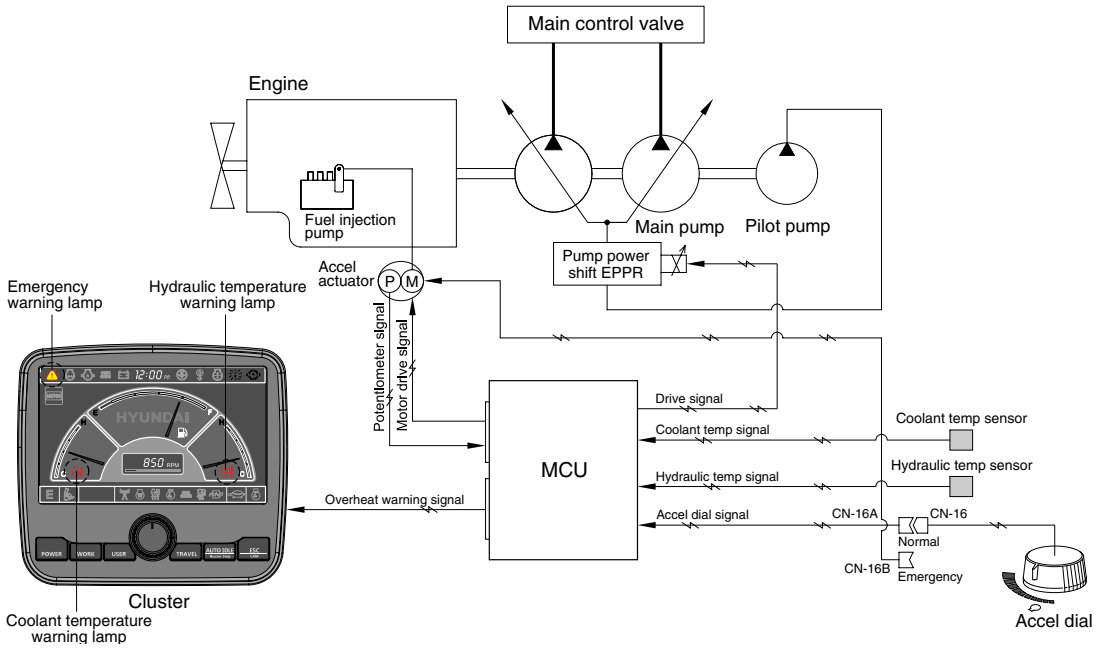
1409S5MS59

1. The MCU reads engine coolant temperature through the temperature sensor and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1150rpm. 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 (S 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 (CLUSTER TYPE 1)



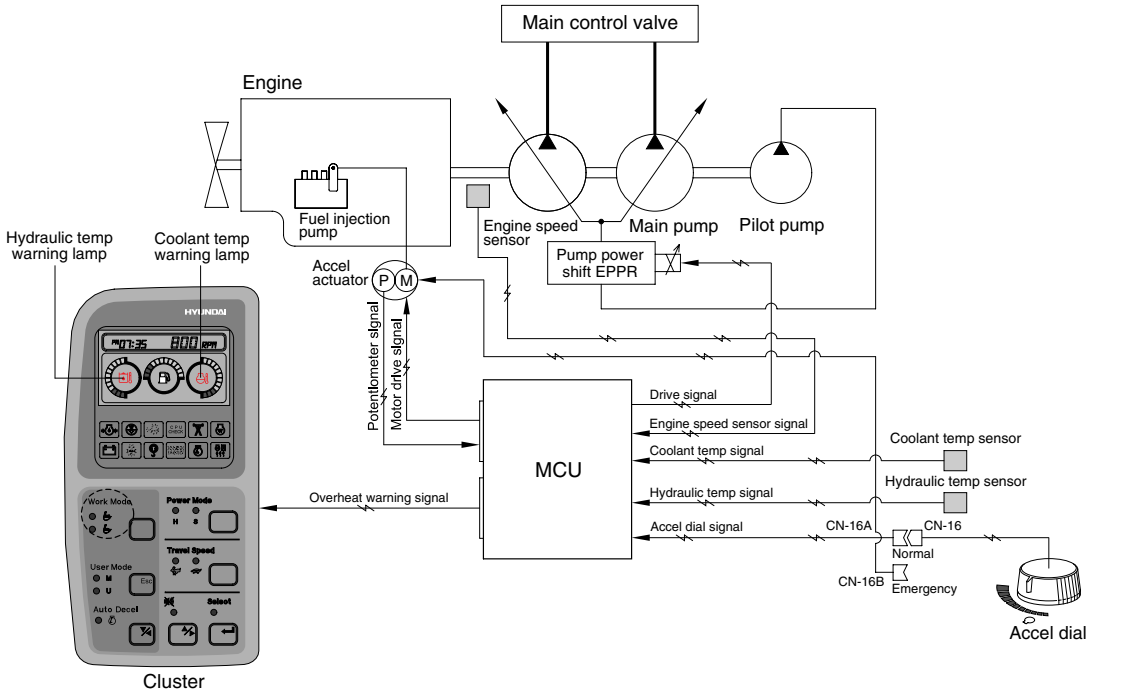
1409S5MS10

1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 103˚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 or hydraulic oil temperature : Above 100˚C	- Warning lamp buzzer : ON - Pump absorption torque is reduced.
	Canceled	- Coolant or hydraulic oil temperature : Less than 95˚C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant or 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 or hydraulic oil temperature : Less than 101˚C	- Return to pre-set the engine speed. - Hold pump absorption torque on the first step warning.

■ ENGINE OVERHEAT PREVENTION SYSTEM (CLUSTER TYPE 2)

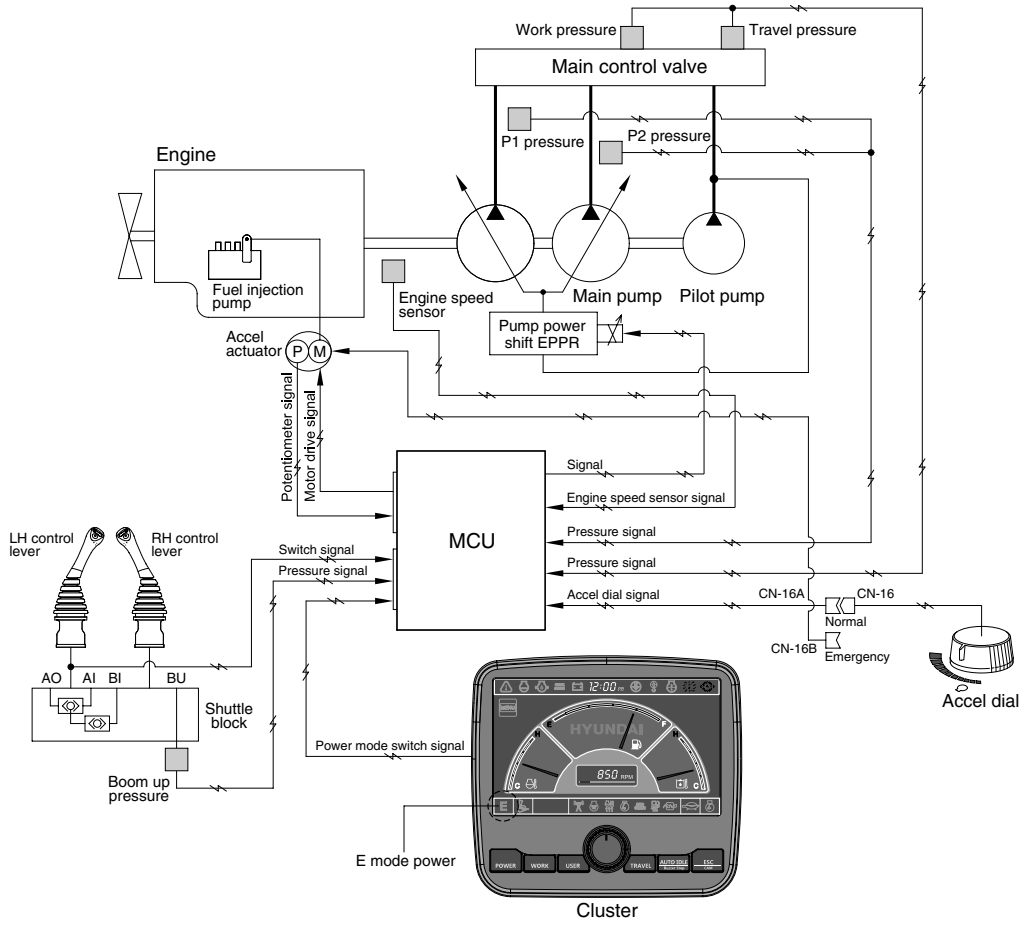


1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 100˚C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant or hydraulic oil temperature : Above 100˚C	- Warning lamp : ON - Pump absorption torque is reduced.
	Canceled	- Coolant or hydraulic oil temperature : Less than 95˚C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant or 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 or 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 (CLUSTER TYPE 1)



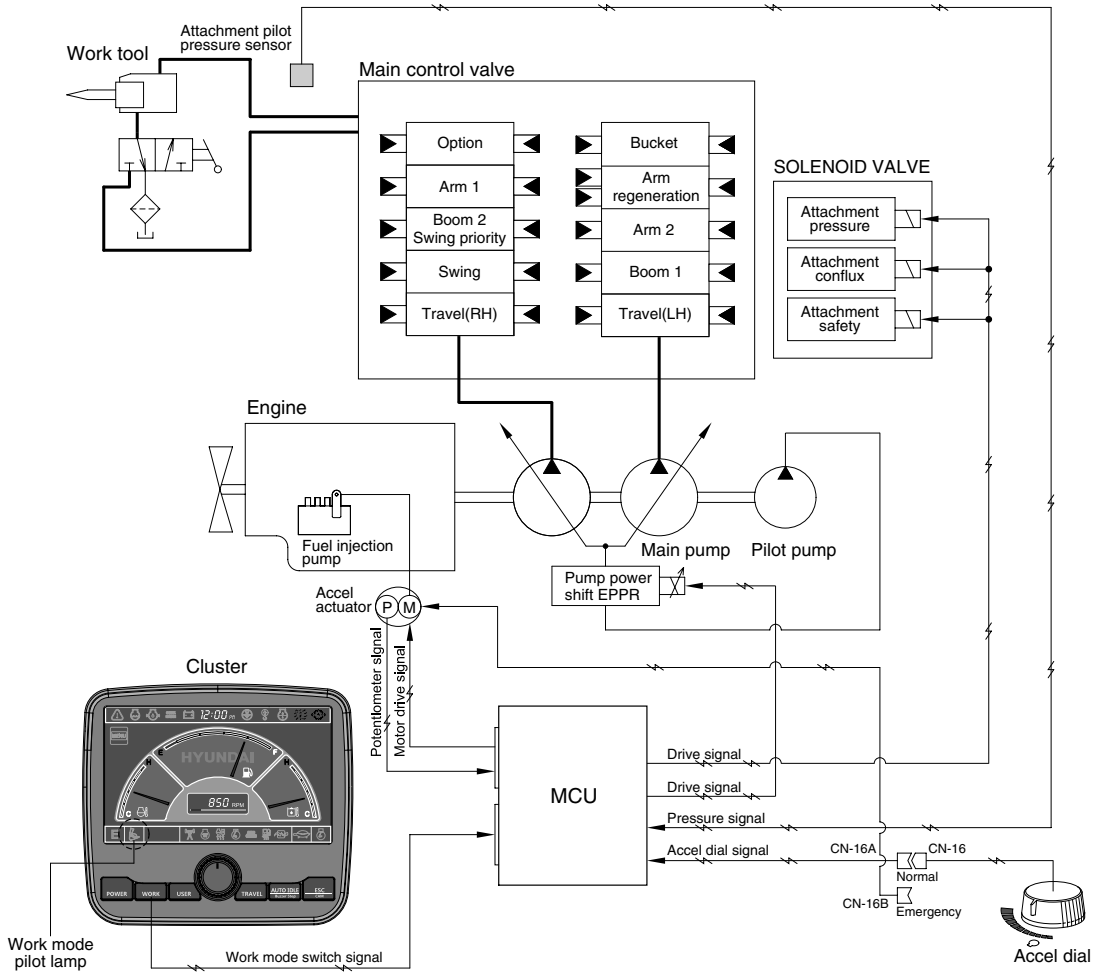
1409S5MS11

· 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	E
Work mode	General (bucket)
Pressure sensor	Normal

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

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM (CLUSTER TYPE 1)



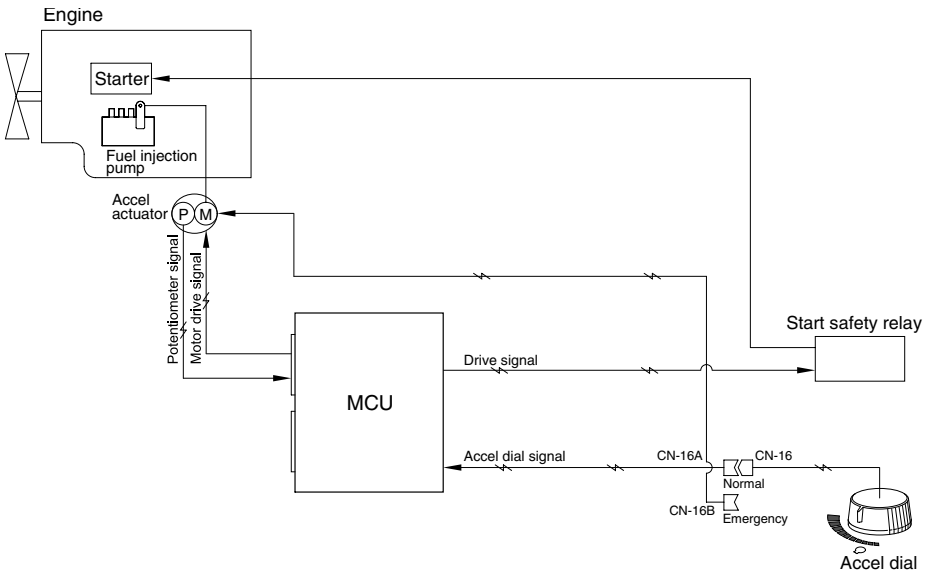
2209S5MS03

· 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	Max 7 step, reduced 10 lpm each step	Max 4 step, reduced 20 lpm each step
Attach safety solenoid	ON	ON
Attach pressure solenoid	OFF	ON
Attach conflux solenoid	OFF	ON / OFF

※ Refer to the page 5-50 for the attachment kinds and max flow.

GROUP 10 ANTI-RESTART SYSTEM



1409S5MS12

1. ANTI-RESTART FUNCTION

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

2. When a replacement or taking-off of the MCU is needed, connect CN-16 and CN-16B to ensure the engine start without the MCU.

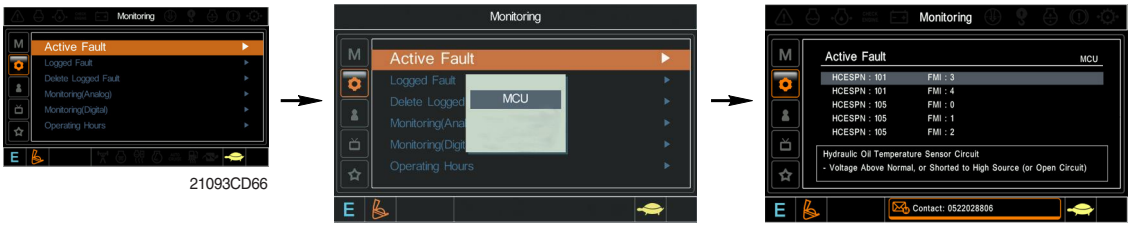
GROUP 11 SELF-DIAGNOSTIC SYSTEM (CLUSTER TYPE 1)

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

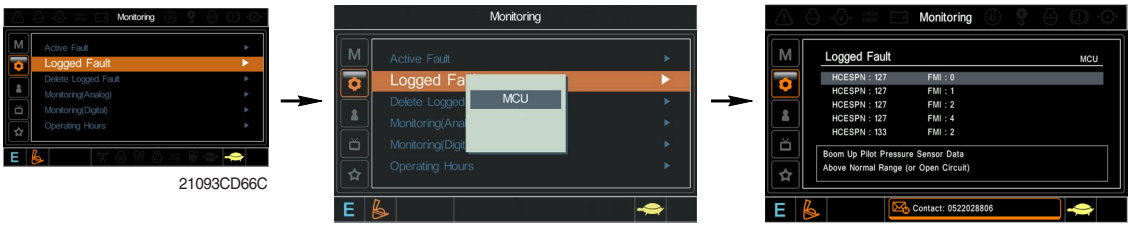
1) Active fault



21093CD66 21093CD66A-1 21093CD66B

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

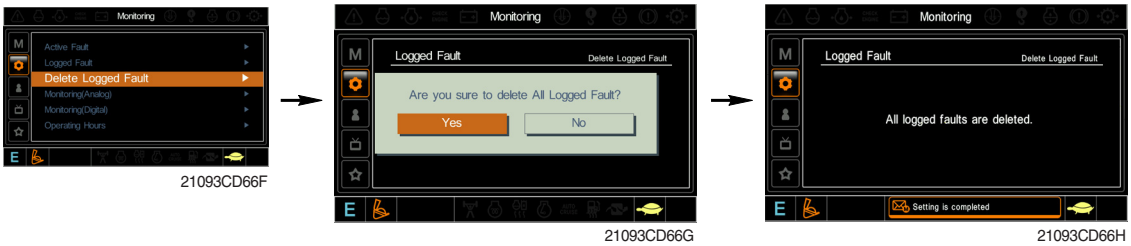
2) Logged fault



21093CD66C 21093CD66D-1 21093CD66E

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

3) Delete fault



21093CD66F 21093CD66G 21093CD66H

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

3. MACHINE ERROR CODES TABLE

Error code		Description
HCESPN	FMI	
101	3	Hydraulic oil temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Hydraulic oil temperature circuit - Voltage below normal, or shorted to low source.
105	0	Working pressure sensor data above normal range.
	1	Working pressure sensor data below normal range.
	2	Working pressure sensor data error.
	4	Working pressure sensor circuit - Voltage below normal, or shorted to Low source.
108	0	Travel oil pressure sensor data above normal range.
	1	Travel oil pressure sensor data below normal range.
	2	Travel oil pressure sensor data error.
	4	Travel oil pressure sensor circuit - Voltage below normal, or shorted to low source.
120	0	Main pump 1 (P1) pressure sensor data above normal range.
	1	Main pump 1 (P1) pressure sensor data below normal range.
	2	Main pump 1 (P1) pressure sensor data error.
	4	Main pump 1 (P1) pressure sensor circuit - Voltage below normal, or shorted to low source.
121	0	Main pump 2 (P2) pressure sensor data above normal range.
	1	Main pump 2 (P2) pressure sensor data below normal range.
	2	Main pump 2 (P2) pressure sensor data error.
	4	Main pump 2 (P2) pressure sensor circuit - Voltage below normal, or shorted to low source.
122	0	Overload pressure sensor data above normal range.
	1	Overload pressure sensor data below normal range.
	2	Overload pressure sensor data error.
	4	Overload pressure sensor circuit - Voltage below normal, or shorted to low source.
123	0	Negative 1 pressure sensor data above normal range.
	1	Negative 1 pressure sensor data below normal range.
	2	Negative 1 pressure sensor data error.
	4	Negative 1 pressure sensor circuit - Voltage below normal, or shorted to low source.
124	0	Negative 2 Pressure sensor data above normal range.
	1	Negative 2 Pressure sensor data below normal range.
	2	Negative 2 Pressure sensor data error.
	4	Negative 2 Pressure sensor circuit - Voltage below normal, or shorted to low source.
125	0	Pilot pump (P3) pressure sensor data above normal range.
	1	Pilot pump (P3) pressure sensor data below normal range.
	2	Pilot pump (P3) pressure sensor data error.
	4	Pilot pump (P3) pressure sensor circuit - Voltage below normal, or shorted to low source.
127	0	Boom up pilot pressure sensor data above normal range.
	1	Boom up pilot pressure sensor data below normal range.
	2	Boom up pilot pressure sensor data error.
	4	Boom up pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
135	0	Swing pilot pressure sensor data above normal range.
	1	Swing pilot pressure sensor data below normal range.
	2	Swing pilot pressure sensor data error.
	4	Swing pilot pressure sensor circuit - Voltage below normal, or shorted to low source.

※ Some error codes are not applied to this machine.

Error code		Description
HCESPN	FMI	
138	0	Attachment pilot pressure sensor data above normal range.
	1	Attachment pilot pressure sensor data below normal range.
	2	Attachment pilot pressure sensor data error.
	4	Attachment pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
140	5	Pump EPPR valve circuit - Current below normal, or open circuit.
	6	Pump EPPR valve circuit - Current above normal.
141	5	Boom priority EPPR valve circuit - Current below normal, or open circuit.
	6	Boom priority EPPR valve circuit - Current above normal.
143	5	Travel EPPR valve circuit - Current below normal, or open circuit.
	6	Travel EPPR valve circuit - Current above normal.
144	5	Attachment flow EPPR valve circuit - Current below normal, or open circuit.
	6	Attachment flow EPPR valve circuit - Current above normal.
145	5	Remote cooling fan EPPR valve circuit - Current below normal, or open circuit.
	6	Remote cooling fan EPPR valve circuit - Current above normal.
150	5	Left rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Left rotate EPPR valve circuit - Current above normal.
151	5	Right rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Right rotate EPPR valve circuit - Current above normal.
152	5	Left tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Left tilt EPPR valve circuit - Current above normal.
153	5	Right tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Right tilt EPPR valve circuit - Current above normal.
166	5	Power max solenoid circuit - Current below normal, or open circuit.
	6	Power max solenoid circuit - Current above normal.
167	5	Travel speed solenoid circuit - Current below normal, or open circuit.
	6	Travel speed solenoid circuit - Current above normal.
168	5	Attachment pressure solenoid circuit - Current below normal, or open circuit.
	6	Attachment pressure solenoid circuit - Current above normal.
169	5	Attachment conflux solenoid circuit - Current below normal, or open circuit.
	6	Attachment conflux solenoid circuit - Current above normal.
170	5	Arm regeneration solenoid circuit - Current below normal, or open circuit.
	6	Arm regeneration solenoid circuit - Current above normal.
171	5	Attachment safety solenoid circuit - Current below normal, or open circuit.
	6	Attachment safety solenoid circuit - Current above normal.
181	5	Remote cooling fan reverse solenoid circuit - Current below normal, or open circuit.
	6	Remote cooling fan reverse solenoid circuit - Current above normal.
301	5	Fuel level sensor circuit - Voltage above normal, or shorted to high source.
	6	Fuel level sensor circuit - Voltage below normal, or shorted to low source.
304	3	Engine coolant temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Engine coolant temperature sensor circuit - Voltage below normal, or shorted to low source.
310	8	Engine speed signal error - Abnormal frequency or pulse width.
322	3	Engine preheat relay circuit - Voltage above normal, or shorted to high source.
	4	Engine preheat relay circuit - Voltage below normal, or shorted to low source.
325	3	Fuel warmer relay circuit - Voltage above normal, or shorted to high source.
	4	Fuel warmer relay circuit - Voltage below normal, or shorted to low source.

※Some error codes are not applied to this machine.

Error code		Description
HCESPN	FMI	
340	3	Potentiometer (G/A) circuit - Voltage above normal, or shorted to high source.
	4	Potentiometer (G/A) circuit - Voltage below normal, or shorted to low source.
341	5	Governor actuator circuit - Current below normal, or open circuit.
	6	Governor actuator circuit - Current above normal.
501	0	Transmission oil pressure sensor data above normal range.
	1	Transmission oil pressure sensor data below normal range.
	2	Transmission oil pressure sensor data error.
	4	Transmission oil pressure sensor circuit - Voltage below normal, or shorted to low source.
503	0	Brake pressure sensor data above normal range.
	1	Brake pressure sensor data below normal range.
	2	Brake pressure sensor data error.
	4	Brake pressure sensor circuit - Voltage below normal, or shorted to low source.
505	0	Working brake pressure sensor data above normal range.
	1	Working brake pressure sensor data below normal range.
	2	Working brake pressure sensor data error.
	4	Working brake pressure sensor circuit - Voltage below normal, or shorted to low source.
506	3	Working brake lamp circuit - Voltage above normal, or shorted to high source.
	4	Working brake lamp circuit - Voltage below normal, or shorted to low source.
520	3	Ram lock lamp circuit - Voltage above normal, or shorted to high source.
	4	Ram lock lamp circuit - Voltage below normal, or shorted to low source.
525	5	Ram lock solenoid circuit - Current below normal, or open circuit.
	6	Ram lock solenoid circuit - Current above normal.
530	0	Travel F pilot pressure sensor data above normal range.
	1	Travel F pilot pressure sensor data below normal range.
	2	Travel F pilot pressure sensor data error.
	4	Travel F pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
531	0	Travel R pilot pressure sensor data above normal range.
	1	Travel R pilot pressure sensor data below normal range.
	2	Travel R pilot pressure sensor data error.
	4	Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
701	3	Hourmeter circuit - Voltage above normal, or shorted to high source.
	4	Hourmeter circuit - Voltage below normal, or shorted to low source.
705	0	MCU input voltage high.
	1	MCU input voltage low.
707	1	Alternator node I voltage low.
714	3	Acc. dial circuit - Voltage above normal, or shorted to high source.
	4	Acc. dial circuit - Voltage below normal, or shorted to low source.
715	3	Rotate signal input circuit - Voltage above normal, or shorted to high source.
	4	Rotate signal input circuit - Voltage below normal, or shorted to low source.
716	3	Tilt signal input circuit - Voltage above normal, or shorted to high source.
	4	Tilt signal input circuit - Voltage below normal, or shorted to low source.
722	3	Travel alarm (buzzer) circuit - Voltage above normal, or shorted to high source.
	4	Travel alarm (buzzer) circuit - Voltage below normal, or shorted to low source.
830	12	MCU internal memory error.
840	2	Cluster communication data error.
843	2	Option #1 (CAN 2) communication data error.
850	2	RMCU communication data error.

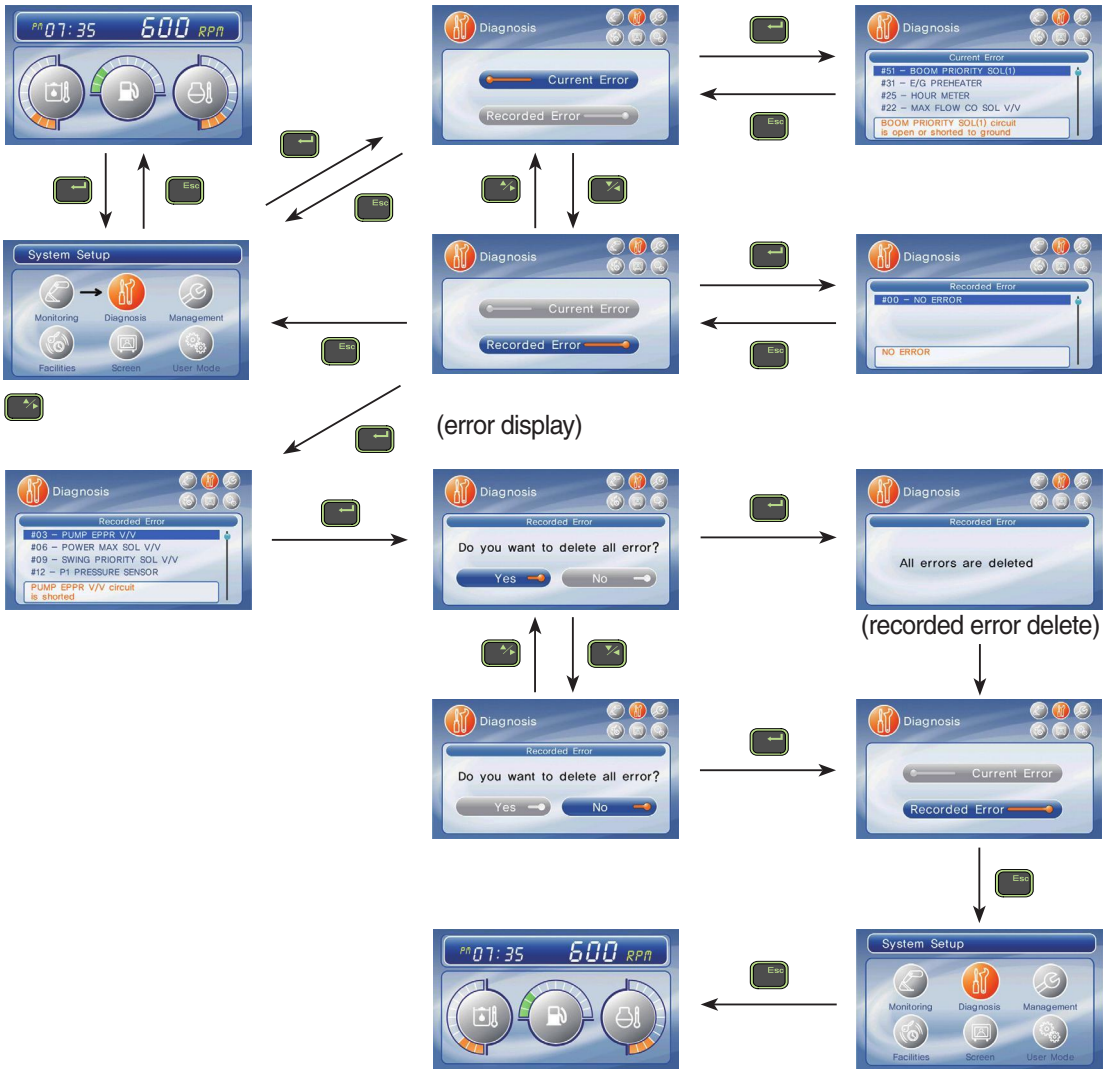
※ Some error codes are not applied to this machine.

■ SELF-DIAGNOSTIC SYSTEM (CLUSTER TYPE 2)

1. OUTLINE

When any abnormality occurs in the NEW 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. CURRENT ERROR DISPLAY

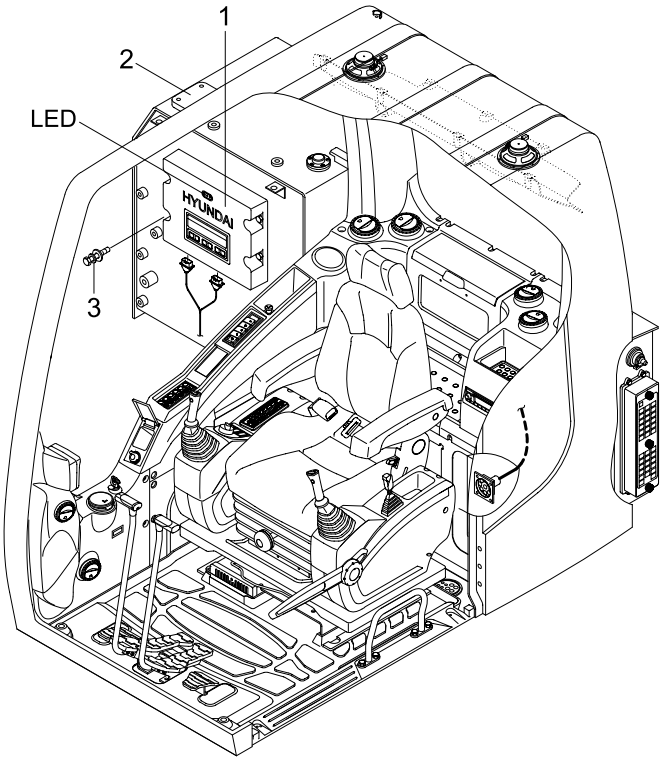


3. MACHINE ERROR CODES TABLE (CLUSTER TYPE 2)

Error code No.	Description
1	Short circuit in accel actuator system
2	Potentiometer circuit is shorted to Vcc (5V) or battery +
3	Short circuit in pump EPPR valve system
4	Short circuit in boom down EPPR valve system
5	Short circuit in travel speed solenoid system
6	Short circuit in power boost solenoid system
7	Short circuit in max flow solenoid system
10	Short circuit in hour-meter system
11	Accel dial circuit is shorted to Vcc(5V) or battery +
12	P1 pressure sensor circuit is shorted to power supply (24V) line
13	P2 pressure sensor circuit is shorted to power supply (24V) line
14	P3 pressure sensor circuit is shorted to power supply (24) line
15	Boom down pressure circuit is shorted to power supply (24V) line
16	Accel actuator circuit is open or shorted to ground
17	Potentiometer circuit is open or shorted to ground
18	Pump EPPR valve circuit is open or shorted to ground
19	Boom down EPPR valve circuit is open or shorted to ground
20	Travel speed solenoid circuit is open or shorted to ground
21	Power boost solenoid circuit is open or shorted to ground
22	Max flow solenoid circuit is open or shorted to ground
25	Hour-meter circuit is open or shorted to ground
26	Accel dial circuit is open or shorted to ground
27	P1 pressure sensor circuit is open or shorted to ground
28	P2 pressure sensor circuit is open or shorted to ground
29	P3 pressure sensor circuit is open or shorted to ground
30	Boom down pressure sensor circuit is open or shorted to ground
31	Engine preheater circuit is open or shorted to ground
32	Travel alarm buzzer circuit is open or shorted to ground
33	Alternator circuit is open or shorted to ground
34	Controller input voltage is below 18V
35	Controller input voltage is over 38V
36	Communication error with cluster
37	Engine speed sensor circuit is open or shorted to ground
38	Anti-restart relay circuit is open or shorted to ground
39	Accel actuator does not stop at a target position
40	There is more than 500rpm difference between target speed and actual speed

Error code No.	Description
41	Hydraulic oil temperature sensor circuit is shorted to ground
42	Fuel level sensor circuit is shorted to ground
43	Coolant temperature sensor circuit is shorted to ground
44	Boom up pressure sensor circuit is shorted to power supply (24V) line
45	Hydraulic oil temperature sensor circuit is open or shorted to battery +
46	Fuel level sensor circuit is open or shorted to battery +
47	Coolant temperature sensor circuit is open or shorted to battery +
48	Boom up pressure sensor circuit is open or shorted to ground
49	Engine preheater circuit is shorted to battery +
51	Boom priority solenoid circuit is open or shorted to ground
56	Travel alarm buzzer circuit is shorted to battery +
58	Boom priority solenoid circuit is shorted to battery +

1. MCU (Machine Control Unit)



1 MCU
2 Fuel tank
3 Bolt (M8)

1409S5MS13

2. MCU ASSEMBLY

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

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

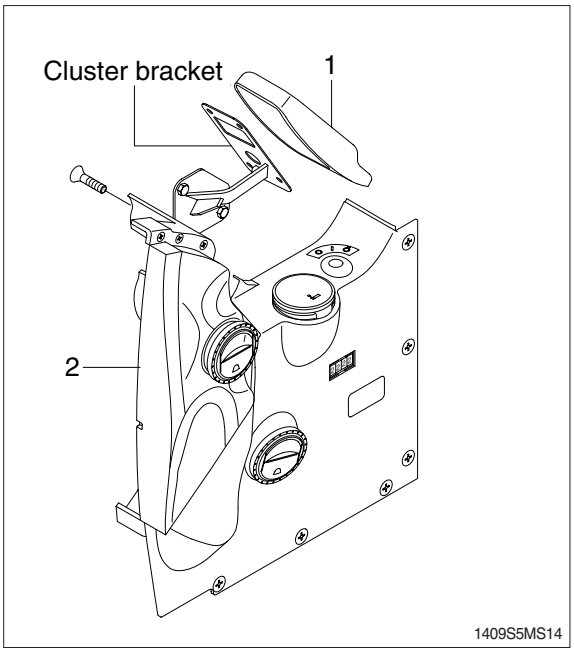
LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on MCU	· Change the MCU
G and Y are turned ON	Trouble on serial communication line	· Check if serial communication lines between controller and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	· Check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

G : green, R : red, Y : yellow

3. EXCHANGE METHOD OF THE ROM IN THE CLUSTER (TYPE 2)

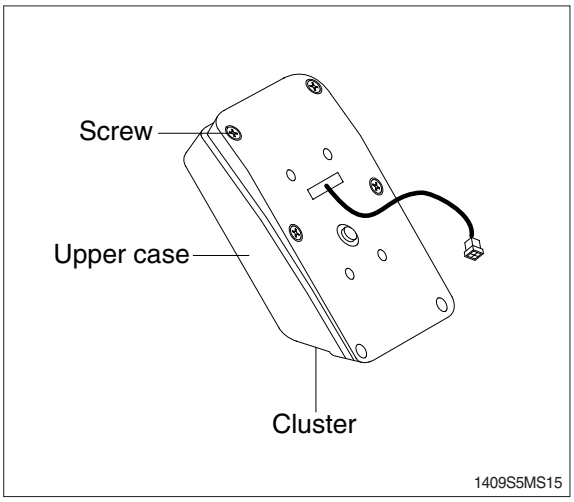
1) Disassemble the wiper motor cover (2).

2) Disassemble the cluster (1).

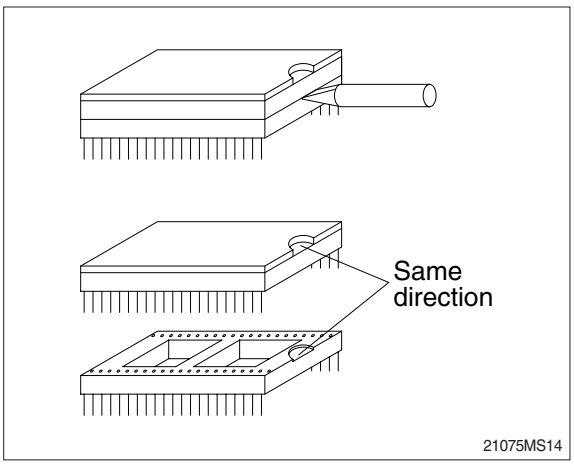


3) Loosen the screws (6 ea) located back of the cluster.

4) Then you can open the upper case of the cluster easily.



6) Install the new ROM.(be careful of direction and assemble the cluster in the reverse order to removal).



GROUP 13 EPPR VALVE (CLUSTER TYPE 1)

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

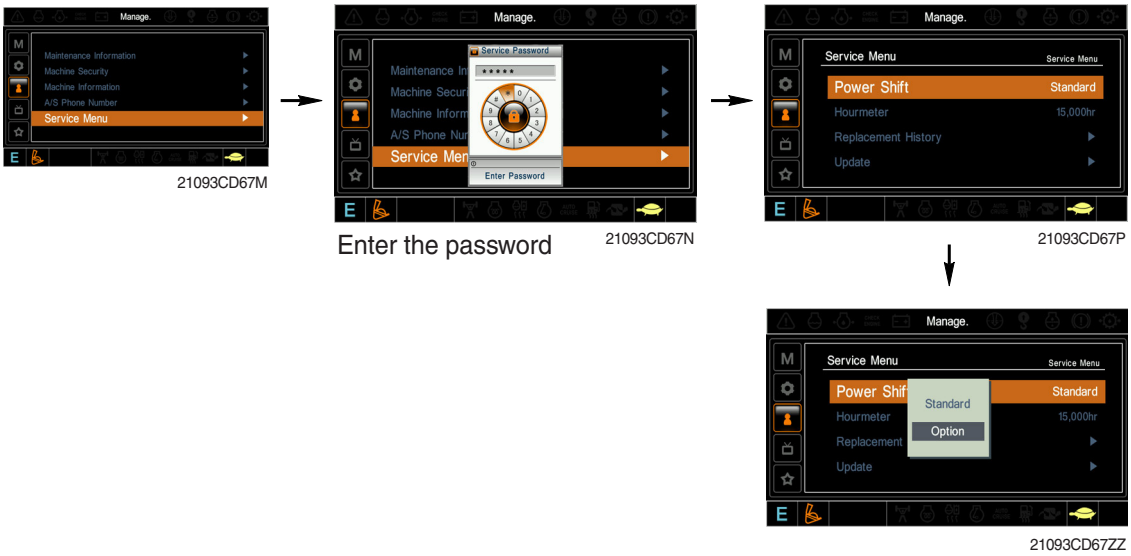
(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm²	psi		
Standard (Stage : 1.0)	P	10	142	330 ± 30	2100 ± 50
	S	12 ± 3	171 ± 40	360 ± 30	2000 ± 50
	E	12 ± 3	171 ± 40	360 ± 30	1900 ± 50
Option (Stage : 2.0)	P	7	100	280 ± 30	2200 ± 50
	S	8 ± 3	114 ± 40	290 ± 30	2050 ± 50
	E	8 ± 3	114 ± 40	290 ± 30	1950 ± 50

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

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

- Management
  · Service menu



21093CD67M

Enter the password 21093CD67N

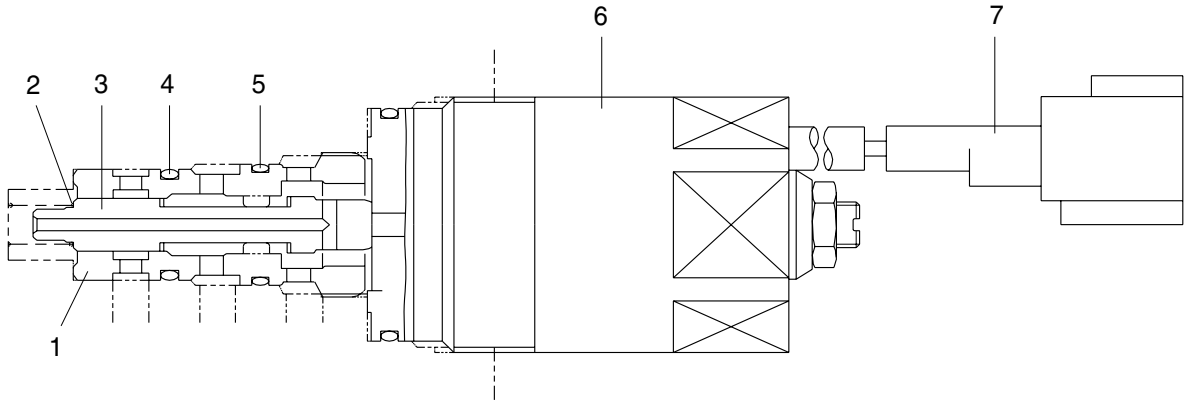
21093CD67P

21093CD67ZZ

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

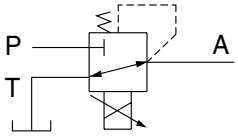
3) OPERATING PRINCIPLE (CLUSTER TYPE 1, 2)

(1) Structure (pump EPPR valve)



5-22(1)

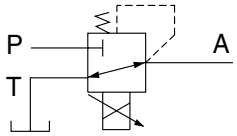
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

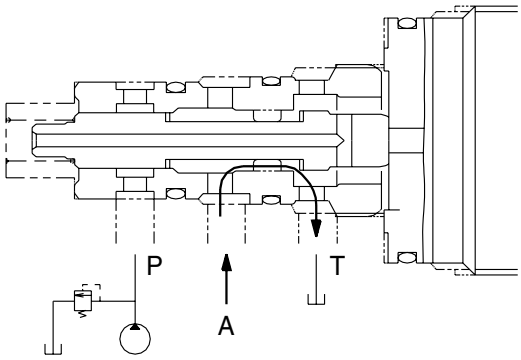


P	Pilot oil supply line (pilot pressure)
T	Return to tank
A	Secondary pressure to flow regulator at main pump

(2) Neutral

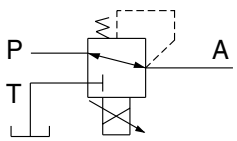
Pressure line is blocked and A oil returns to tank.

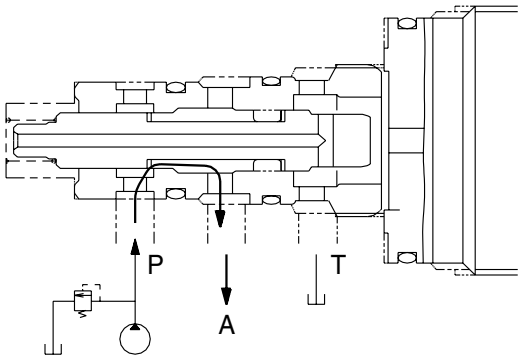




(3) Operating

Secondary pressure enters into A.





5-22(2)

4) EPPR VALVE CHECK PROCEDURE
(CLUSTER TYPE 1, 2)

(1) Check electric current value at EPPR valve

① Disconnect connector CN-75 from EPPR valve.

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

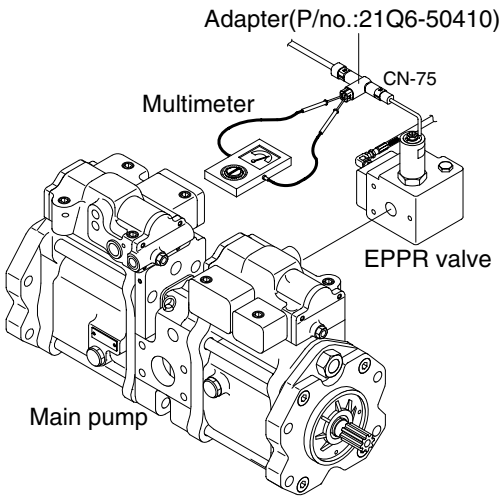
③ Start engine.

④ Set power mode and cancel auto decel mode.
- Cluster type 1 : S-mode
- Cluster type 2 : H-mode

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 2000±50 rpm check electric current at bucket circuit relief position.

Spec : 100~700 mA



21095MS21

(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 power mode and cancel auto decel mode.
- Cluster type 1 : S-mode
- Cluster type 2 : H-mode

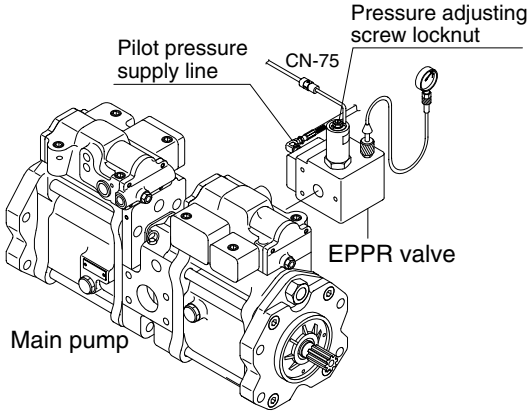
④ Position the accel dial at 10.

⑤ If rpm display approx 2000±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)



2107A5MS13

2. BOOM PRIORITY EPPR VALVE (CLUSTER TYPE 1, 2)

1) COMPOSITION

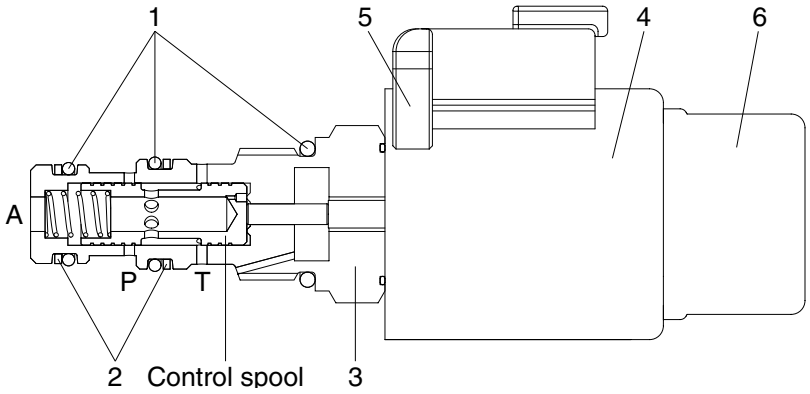
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

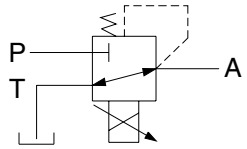
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30 Ω and 24 V.

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.

4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

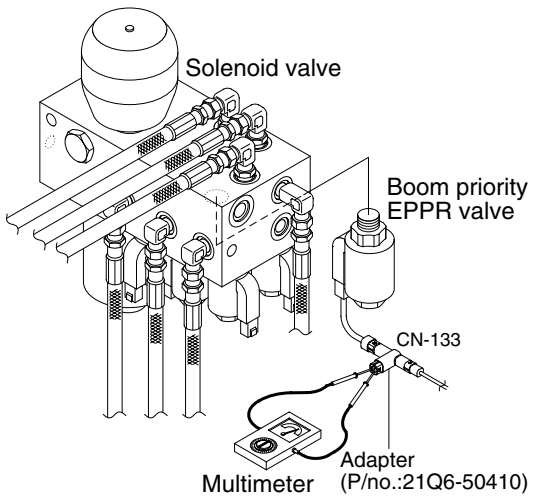
① Disconnect connector CN-133 from EPPR valve.

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

③ Start engine.

④ If rpm display approx 2000±50 rpm check electric current in case of combined boom up and swing operation.

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



21095MS15

(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)

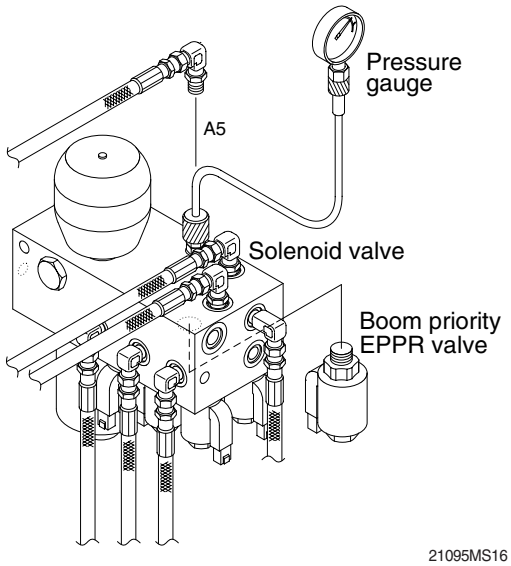
② Start engine.

③ If rpm display approx 2000±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

④ If pressure is not correct, adjust it.

⑤ After adjust, test the machine.

Spec : 12~37 kgf/cm² (170~530 psi)
(bucket relief operation)



21095MS16

■ EPPR VALVE (CLUSTER TYPE 2)

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm²	psi		
Standard (ver : 3.1)	M	10	142	330 ± 30	2100 ± 50
	H	12 ± 3	171 ± 40	360 ± 30	2000 ± 50
	S	12 ± 3	171 ± 40	360 ± 30	1900 ± 50
Option (ver : 4.1)	M	7	100	280 ± 30	2200 ± 50
	H	8 ± 3	114 ± 40	290 ± 30	2050 ± 50
	S	8 ± 3	114 ± 40	290 ± 30	1950 ± 50

2) HOW TO SWITCH THE VERSION (3.1 ↔ 4.1) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the version(3.1 ↔ 4.1).

- Dual mode
  · Changing the MCU mode

GROUP 14 MONITORING SYSTEM (CLUSTER TYPE 1)

1. OUTLINE

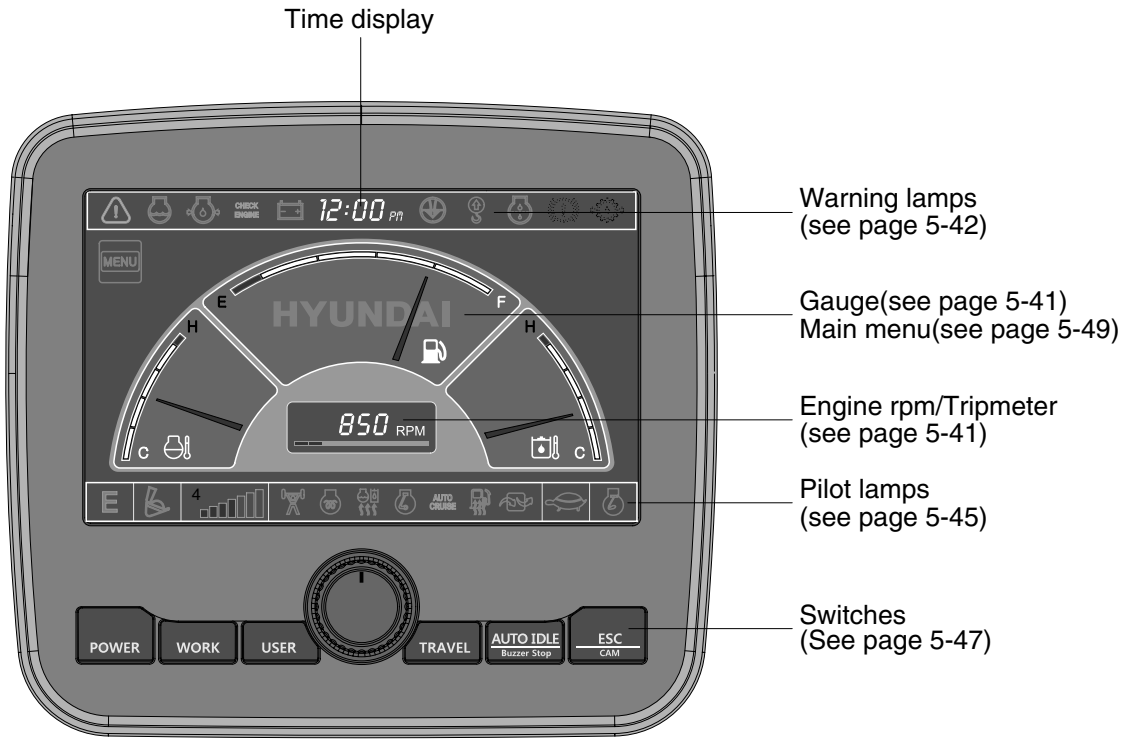
Monitoring system consists of the monitor part and switch part.

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



1409S5MS30

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

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

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

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

a. Engine rpm display : 0 rpm
b. Engine coolant temperature gauge : White range
c. Hydraulic oil temperature gauge : White range
d. Fuel level gauge : White range

③ Indicating lamp state

a. Power mode pilot lamp : E mode or U mode
b. Work mode pilot lamp : General operation mode (bucket)
c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display indicates at present rpm
b. Gauge and warning lamp : Indicate at present condition.

※ When normal condition : All warning lamp OFF

c. Work mode selection : General work
d. Power mode selection : E mode or U mode
e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON
b. After engine started, engine speed increases to 1150 rpm.

※ Others same as above.

③ When abnormal condition

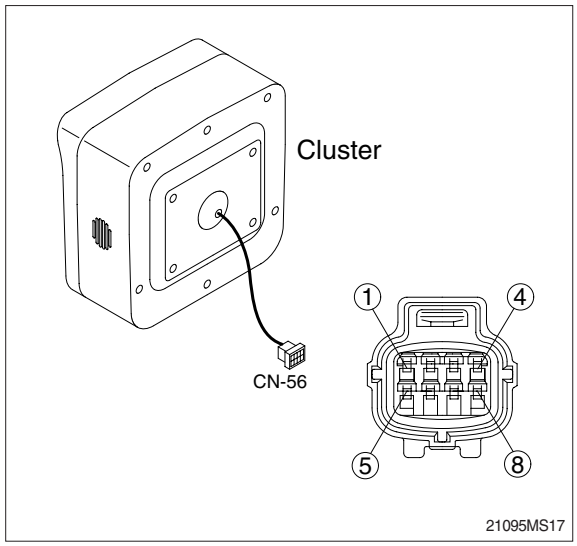
a. The warning lamp lights up and the buzzer sounds.
b. If BUZZER STOP switch is pressed, buzzer sound is canceled but the lamp warning lights up until normal condition.

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

3. CLUSTER CONNECTOR

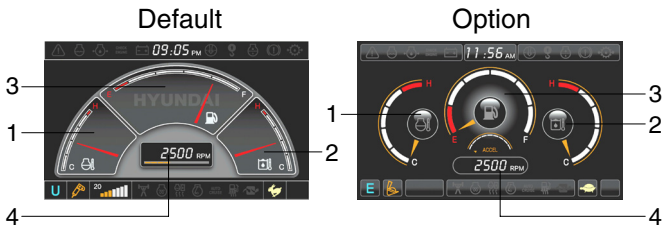
No.	Name	Signal
1	Battery 24V	20~32V
2	Signal 3	NTSC
3	GND	-
4	Serial + (TX)	0~5V
5	Power IG (24V)	20~32V
6	Signal 2	NTSC
7	Camera signal	NTSC
8	Serial - (RX)	0~5V

※ NTSC : the united states National Television Systems Committee



2) GAUGE

(1) Operation screen

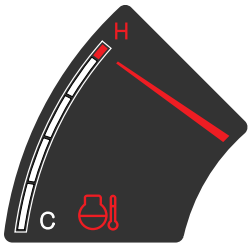


21093CD07A

1 Engine coolant temperature gauge
2 Hydraulic oil temperature gauge
3 Fuel level gauge
4 RPM / Tripmeter display

※ **Operation screen type can be set by the screen type menu of the display. Refer to page 5-59 for details.**

(2) Engine coolant temperature gauge



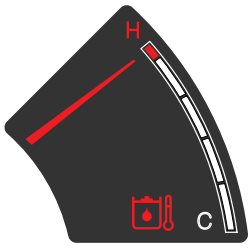
21093CD07G

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 blinks in red, 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 on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

(3) Hydraulic oil temperature gauge



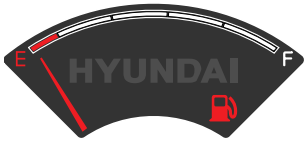
21093CD07E

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 blinks is red, 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 on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

(4) Fuel level gauge



21093CD07F

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

② Fill the fuel when the red range, or lamp blinks in red.

※ **If the gauge indicates the red range or lamp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

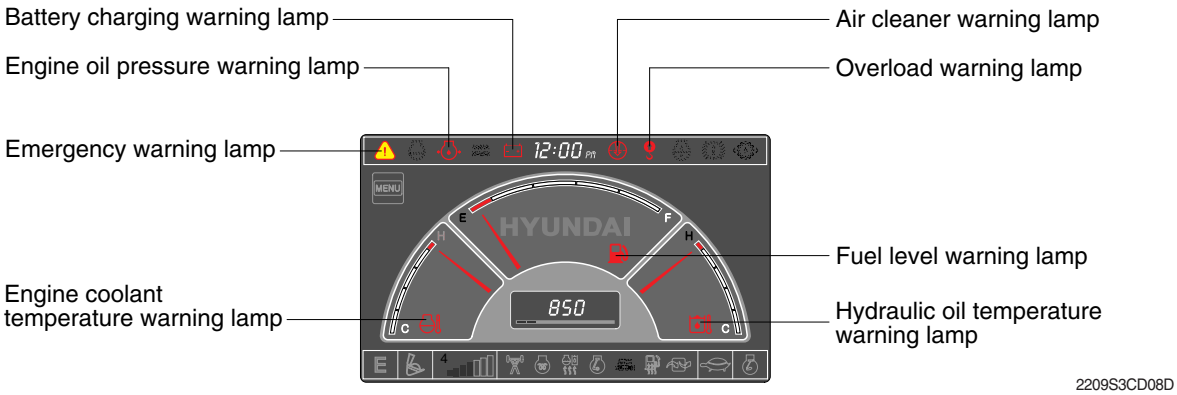
(5) RPM / Tripmeter display

21093CD02D

① This displays the engine speed or the tripmeter.

※ **Refer to page 5-57 for details.**

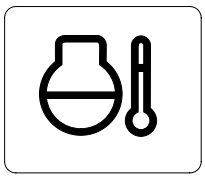
3) WARNING LAMPS



2209S3CD08D

※ **Each warning lamp on the top of the LCD pops up on the center of LCD and the buzzer sounds when the each warning is happened. The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. And the buzzer stops.**
Refer to page 5-48 for the select switch.

(1) Engine coolant temperature



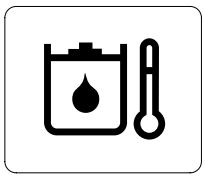
21093CD08A

① Engine coolant temperature warning is indicated two steps.
- 103˚C over : The lamp blinks.
- 107˚C over : The lamp pops up on the center of LCD and the buzzer sounds.

② The pop-up lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.

③ Check the cooling system when the lamp keeps ON.

(2) Hydraulic oil temperature



21093CD08C

① Hydraulic oil temperature warning is indicated two steps.
- 100˚C over : The lamp blinks and the buzzer sounds.
- 105˚C over : The lamp pops up on the center of LCD and the buzzer sounds.

② The pop-up lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.

③ Check the hydraulic oil level and hydraulic oil cooling system.

(3) Fuel level

21093CD08B

① This warning lamp blinks and the buzzer sounds when the level of fuel is below 55 ℓ (14.53 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

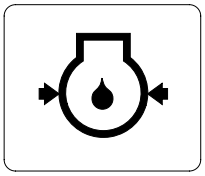
21093CD30

① This lamp pops up and the buzzer sounds when each of the below warnings is happened.
- Engine coolant overheating (over 105˚C)
- Hydraulic oil overheating (over 105˚C)
- Pump EPPR circuit abnormal or open
- Attachment flow EPPR circuit abnormal or open
- MCU input voltage abnormal
- Accel dial circuit abnormal or open
- Cluster communication data error

※ **The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. Also the buzzer stops. This is same as following warning lamps.**

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

(5) Engine oil pressure warning lamp

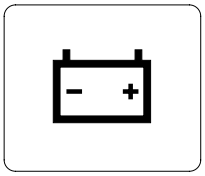


21093CD32

① This lamp blinks when the engine oil pressure is low.

② If the lamp blinks, shut OFF the engine immediately. Check oil level.

(6) Battery charging warning lamp

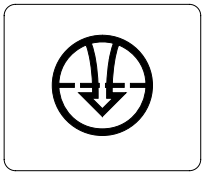


21093CD34

① This lamp blinks when the battery charging voltage is low.

② Check the battery charging circuit when this lamp blinks.

(7) Air cleaner warning lamp

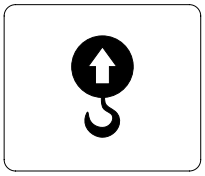


21093CD35

① This lamp blinks when the filter of air cleaner is clogged.

② Check the filter and clean or replace it.

(8) Overload warning lamp (opt)

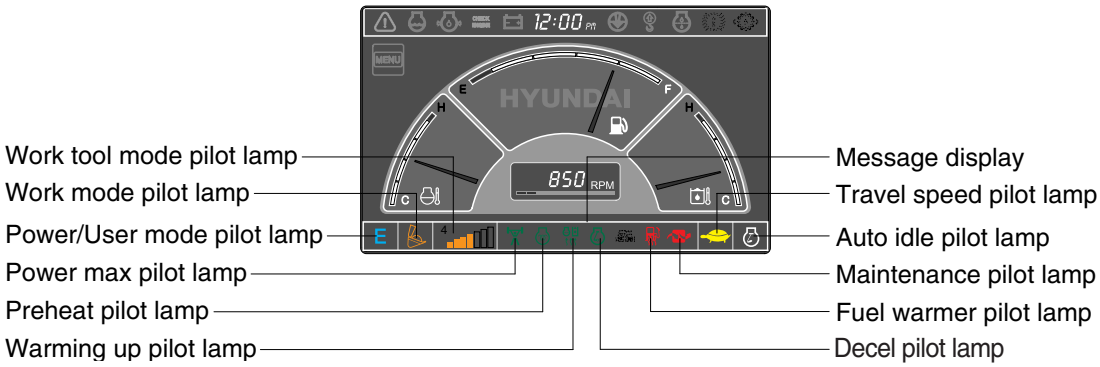


21093CD36

① When the machine is overload, the overload warning lamp blinks during the overload switch is ON. (if equipped)

② Reduce the machine load.

4) PILOT LAMPS



21093CD09

(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 mode		General operation mode
			Breaker operation mode
			Crusher operation mode
4	Travel mode		Low speed traveling
			High speed traveling
5	Auto idle mode		Auto idle
6	Work tool mode	4	Oil flow level of breaker or crusher mode
7	Message display	M	"Setting is completed" display after selection

(2) Power max pilot lamp

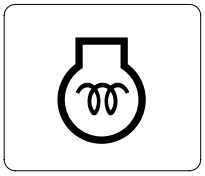
21093CD38

① The lamp will be ON when pushing power max switch on the LH RCV lever.

② The power max function is operated maximum 8 seconds.

※ **Refer to the operator's manual page 3-37 for power max function.**

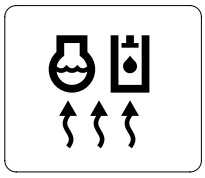
(3) Preheat pilot lamp



21093CD39

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

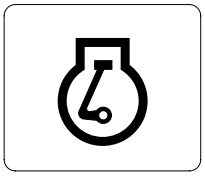
(4) Warming up pilot lamp



21093CD40

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

(5) Decel pilot lamp



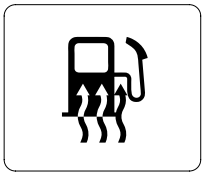
21093CD41

① Operating one touch decel switch on the RCV lever makes the lamp ON.
② Also, the lamp will be ON and engine speed will be lowered automatically to save fuel consumption when all levers and pedals are at 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 3-37.

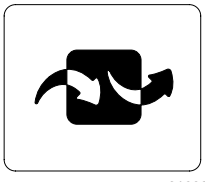
(6) Fuel warmer pilot lamp



21093CD43

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

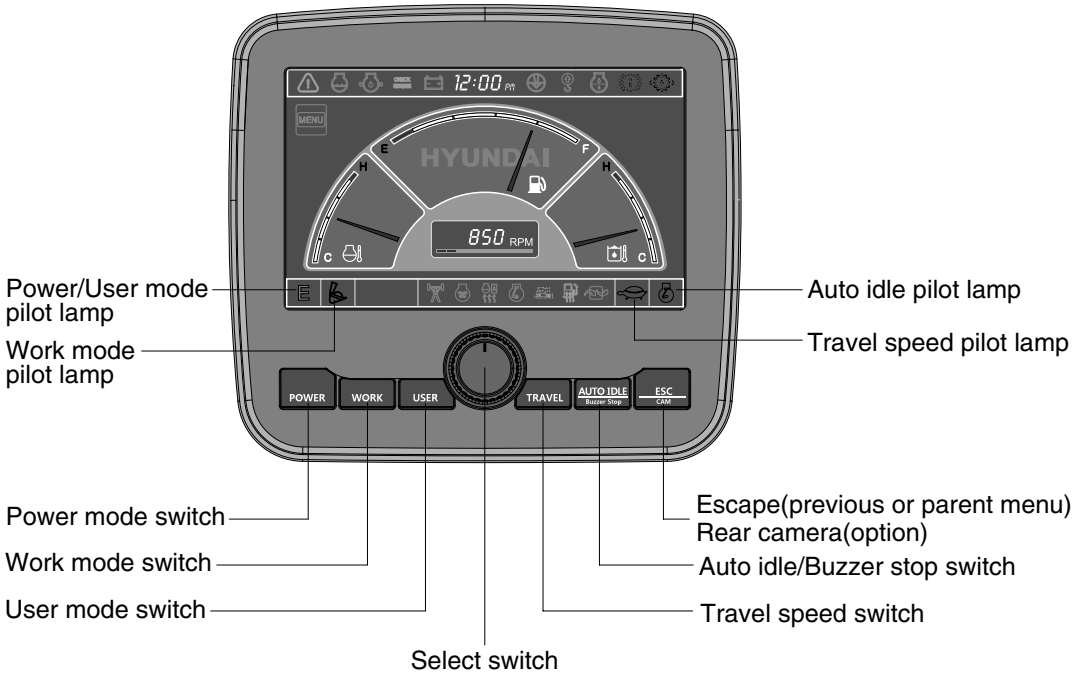
(7) Maintenance pilot lamp



21093CD44

① This lamp will be ON when the consuming parts are needed to change or replace. It means that the change or replacement interval of the consuming parts remains below 30 hours.
② Check the message in maintenance information of main menu. Also, this lamp lights ON for 3 minutes when the start switch is ON position.

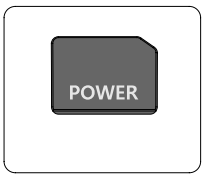
5) SWITCHES



21093CD45

※ **When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 3-7 for details.**

(1) Power mode switch

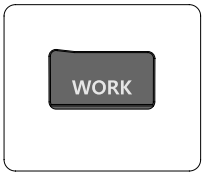


21093CD45A

① This switch is to select the machine power mode and selected power mode pilot lamp is displayed on the pilot lamp position.
- P : Heavy duty power work.
- S : Standard power work.
- E : Economy power work.

② The pilot lamp changes E → S → P → E in order.

(2) Work mode switch

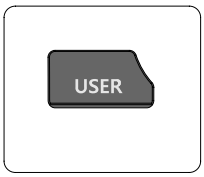


21093CD45C

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

※ **Refer to the operator's manual page 4-10 for details.**

(3) User mode switch

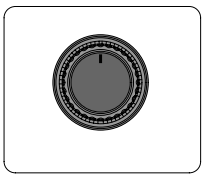


21093CD45D

① This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.
- Memory : Push more than 2 seconds.
- Action : Push within 2 seconds.
- Cancel : Push this switch once more within 2 seconds.

② Refer to the page 5-50 for another set of user mode.

(4) Select switch



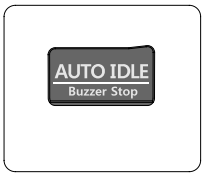
21093CD45E

① This switch is used to select or change the menu and input value.

② Knob push
- Long (over 2 sec) : Return to the operation screen
- Medium (0.5~2 sec) : Return to the previous screen
- Short (below 0.5 sec) : Select menu

③ Knob rotation
This knob changes menu and input value.
- Right turning : Down direction / Increase input value
- Left turning : Up direction / Decreased input value

(5) Auto idle/ buzzer stop switch

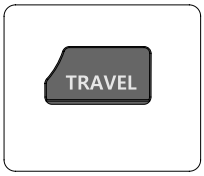


21093CD45F

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.

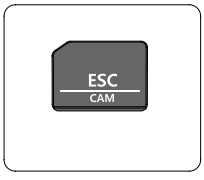
(6) Travel speed control switch



21093CD45G

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

(7) Escape/Camera switch



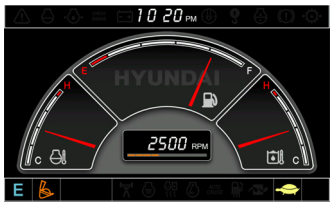
21093CD45H

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 5-60 for the camera.

③ If the camera is not installed, this switch is used only ESC function.

6) MAIN MENU



21093CD64

21093CD64A

Press

21093CD64B

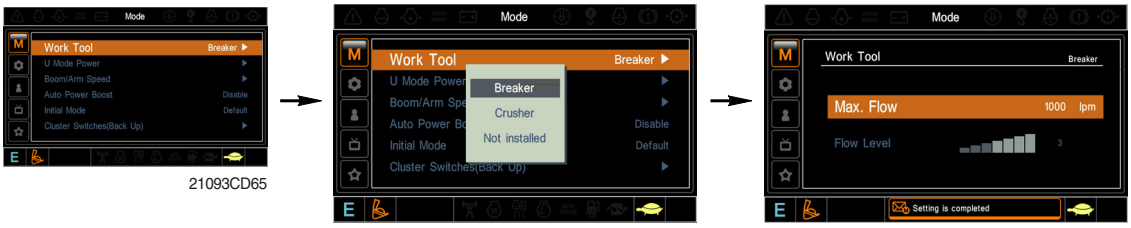
※ **Please refer to select switch, page 5-48 for selection and change of menu and input value.**

(1) Structure

No	Main menu	Sub menu	Description
1	M Mode 21093CD64D	Work tool U mode power Boom/Arm speed Auto power boost Initial mode Cluster switch (back up)	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable Default, U mode Switch function
2	Monitoring 21093CD64E	Active fault Logged fault Delete logged fault Monitoring (analog) Monitoring (digital) Operating hours	MCU MCU All logged fault delete, Initialization canceled Machine information Switch status, Output status Operating hours for each mode
3	Management 21093CD64F	Maintenance information Machine security Machine Information A/S phone number Service menu	Replacement, Change interval oils and filters ESL mode setting, Password change Cluster, MCU, Engine, Machine A/S phone number, A/S phone number change Power shift, Hourmeter, Replacement history, Update
4	Display 21093CD64G	Display item Clock Brightness Unit Language Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Date format Korean, English, Chinese A type, B type
5	Utilities 21093CD64H	Tripmeter DMB Entertainment Camera setting Message box	3 kinds (A, B, C) DMB select, DAB select, Channel scan, Exit Play MP4, codec. Basic direction, Display switching, Full screen Record for fault, attachment etc.

(2) Mode setup

① Work tool



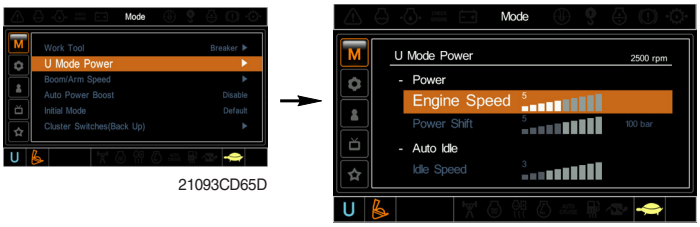
21093CD65 21093CD65A 21093CD65B

A B

- A : Select one installed optional attachment.
- B : Max flow - Set the maximum flow for the attachment.
  Flow level - Reduce the operating flow from maximum flow.
  Breaker - Max 7 steps, Reduced 10 lpm each step.
  Crusher - Max 4 steps, Reduced 20 lpm each step.

※ **The flow level is displayed with the work mode pilot lamp.**

② U mode power

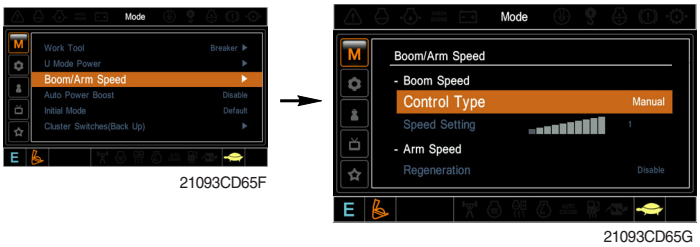


21093CD65D 21093CD65E

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

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1500	1000 (low idle)	0
2	1600	1050	3
3	1700	1100	6
4	1800	1150 (decel rpm)	9
5	1900	1200	12
6	2000	1250	16
7	2050	1300	20
8	2100	1350	26
9	2150	1400	32
10	2200	1450	38

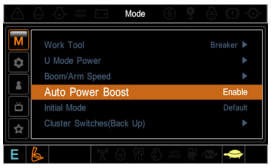
③ Boom/Arm speed



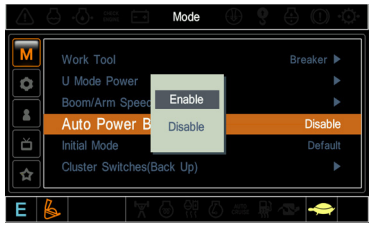
21093CD65F 21093CD65G

- **Boom speed**
  - Control type
    Manual - Boom up speed is fixed as set steps.
    Auto - Boom up speed is automatically adjusted as working conditions by the MCU.
  - Speed setting - Boom up speed is increased as much as activated steps.
- **Arm speed**
  - Regeneration - Arm regeneration function can be activated or cancelled.
    Enable - Arm in speed is up.
    Disable - Fine operation.

④ Auto power boost



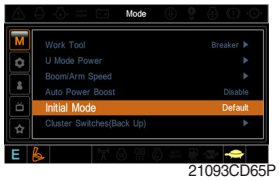
21093CD65L



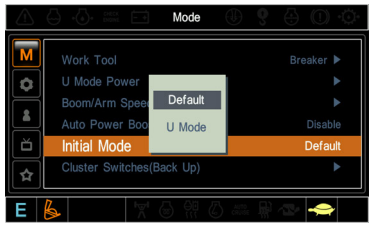
21093CD65M

- 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.

⑤ Initial mode



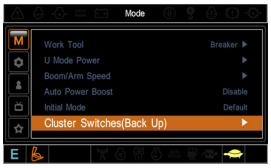
21093CD65P



21093CD65Q

- Default - The initial power mode is set E mode when the engine is started.
- U mode - The initial power mode is set U mode when the engine is started.

⑥ Cluster switch (back up)



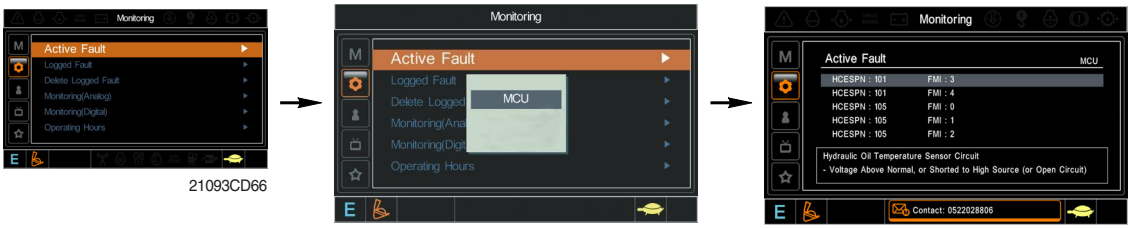
21093CD65S

21093CD65T

- The cluster switch can be selected and changed by this menu when the switches are abnormal on the cluster.
- In order to exit "Cluster switch" mode, please put the cursor on the ESC/CAM switch by turning the select switch and push the select switch.
- In "Cluster switch", other switches except "Select switch" do not work.

(3) Monitoring

① Active fault



21093CD66 21093CD66A-1 21093CD66B

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

② Logged fault

21093CD66C 21093CD66D-1 21093CD66E

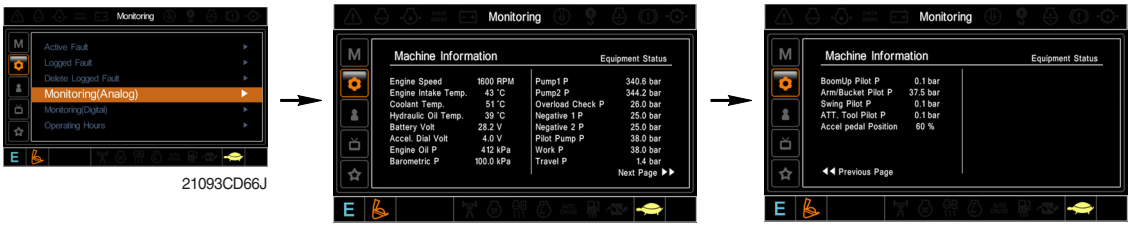
- The logged faults of the MCU can be checked by this menu.

③ Delete logged fault

21093CD66F 21093CD66G 21093CD66H

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

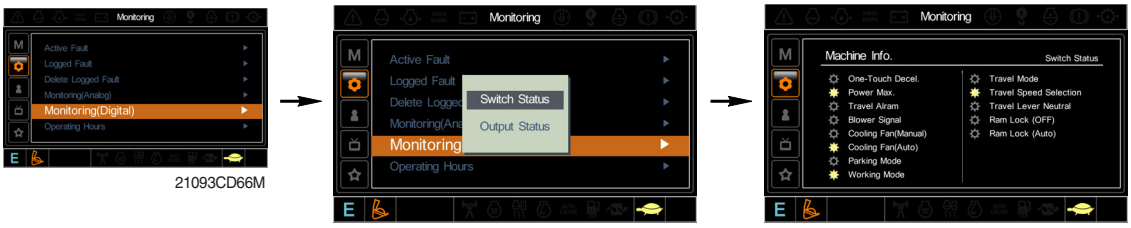
④ Monitoring(Analog)



21093CD66J 21093CD66K 21093CD66L

- The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu.

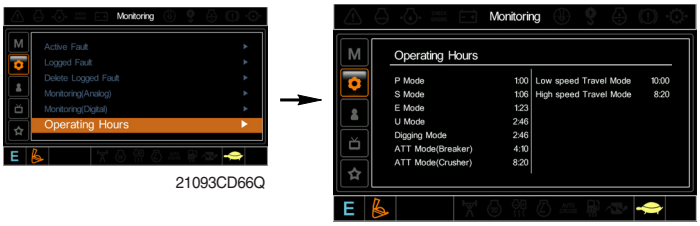
⑤ Monitoring (digital)



21093CD66M 21093CD66N 21093CD66P

- The switch status or output status can be confirmed by this menu.
- The activated switch or output pilot lamps ☼ are light ON.

⑥ Operating hours



21093CD66Q 21093CD66R

- The operating hour of each mode can be confirmed by this menu.

(4) Management

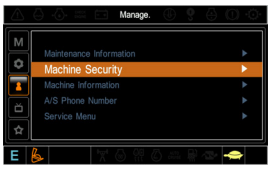
① Maintenance information

21093CD67 21093CD67A 21093CD67Q 21093CD67R 21093CD67S 21093CD67T

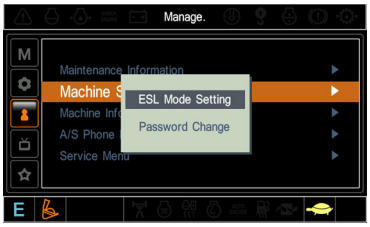
- Alarm(☼ ✹ ✹) : Gray ☼ - Normal
  Yellow ✹ - First warning
  Red ✹ - Second warning
- Replacement : The elapsed time will be reset to zero (0).
- Change interval : The change or replace interval can be changed in the unit of 50 hours.
- OK : Return to the item list screen.
- **Change or replace interval**

No	Item	Interval
1	Engine oil	500
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	5000
5	Pilot line filter	1000
6	Drain filter	1000
7	Hydraulic oil return filter	1000
8	Engine oil filter	500
9	Fuel filter	500
10	Pre-filter	500
11	Hydraulic tank breather	250
12	Air cleaner (inner)	500
13	Radiator coolant	2000
14	Swing gear pinion grease	1000

② Machine security



21093CD67C



21093CD67D

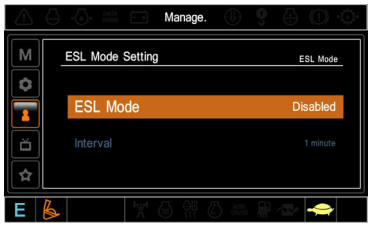
21093CD67E

- **ESL mode**
  - ESL : Engine Starting Limit
  - ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
  - If the ESL mode was selected Enable, the password will be required when the start switch is turned ON.
  - Disable : Not used ESL function

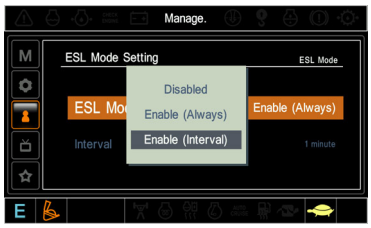
    Enable (always) : The password is required whenever the operator start engine.

    Enable (interval) : The password is required when the operator start engine first. But the operator can restart the engine within the interval time without inputting the password.

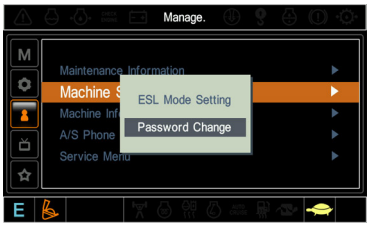
    The interval time can be set maximum 4 hours.



21093CD67EE



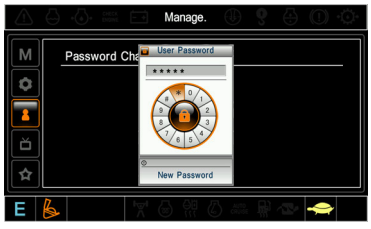
21093CD67H



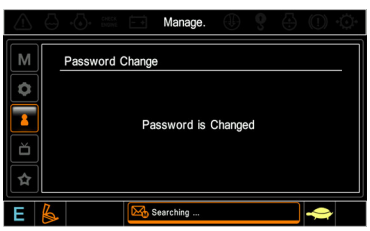
21093CD67U

Enter the current password 21093CD67V

- **Password change**
  - The password is 5~10 digits.



Enter the new password 21093CD67VV



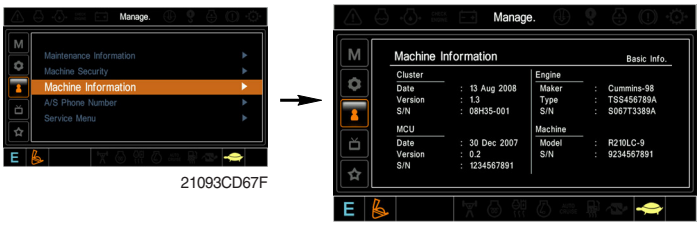
21093CD67X

The new password is stored in the MCU.

21093CD67XX

Enter the new password again

③ Machine Information



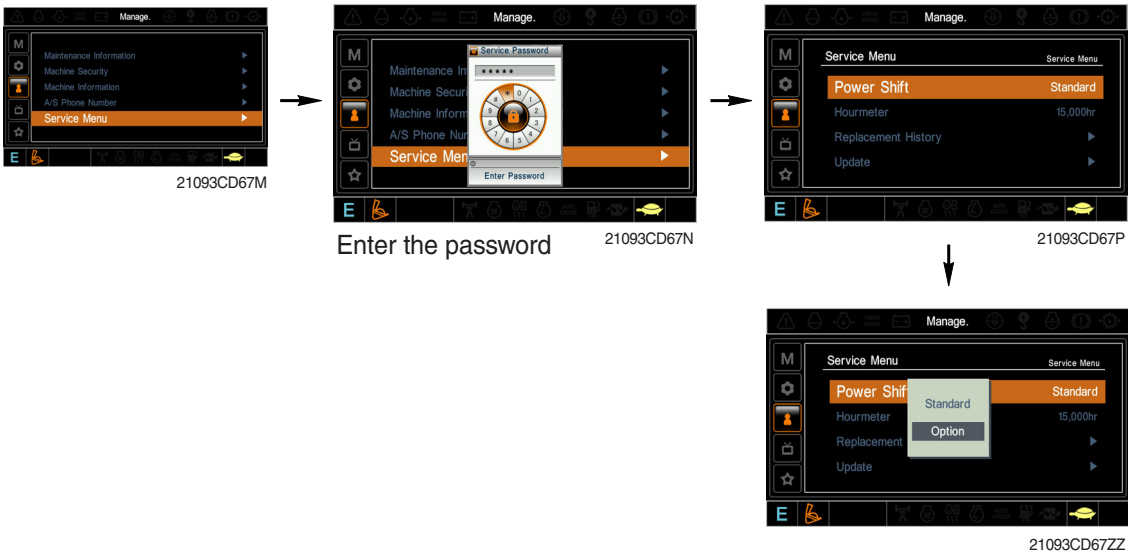
21093CD67F 21093CD67G

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

④ A/S phone number

21093CD67J 21093CD67K 21093CD67L 21093CD67Z 21093CD67Y

⑤ Service menu

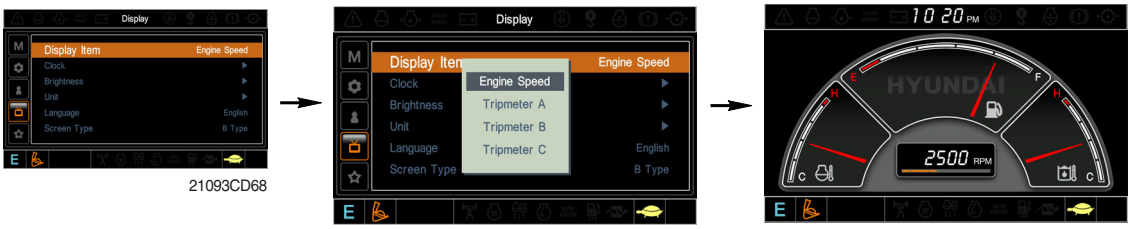


21093CD67M Enter the password 21093CD67N 21093CD67P 21093CD67ZZ

· Power shift (standard/option) : Power shift pressure can be set by option menu.
· Hourmeter : Operating hours since the machine line out can be checked by this menu.
· Replacement history : Replacement history of the MCU and cluster can be checked by this menu.
· Update : Firm ware can be upgraded by this menu. (the USB port is located under the cluster)

(5) Display

① Display item



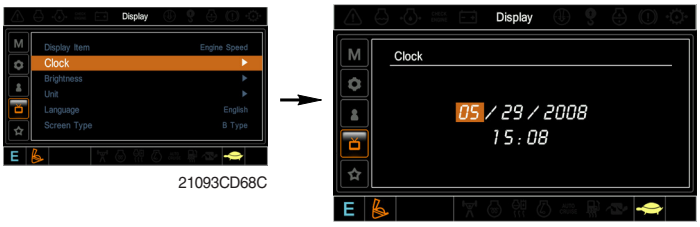
21093CD68 21093CD68A 21093CD68W

21093CD68B 21093CD68E

Center display

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

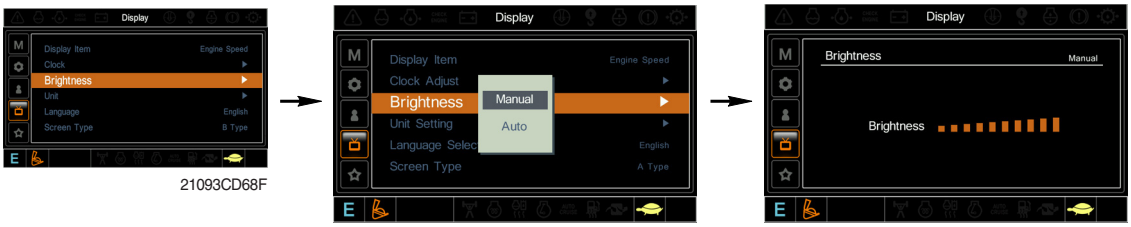
② Clock



21093CD68C 21093CD68D

- The first line's three spots "**/**/****" represent Month/Day/Year each.
- The second line shows the current time. (0:00~23:59)

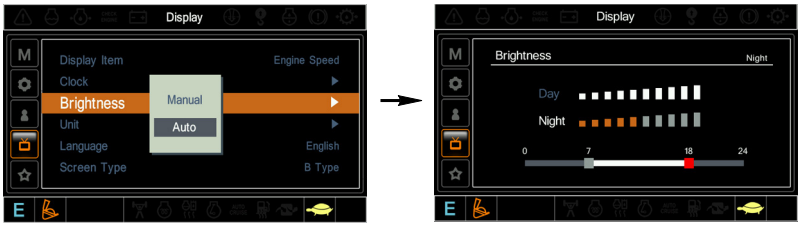
③ Brightness



21093CD68F

Manual (1st~10th step) 21093CD68G

21093CD68H



Auto (day/night) 21093CD68J

21093CD68K

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

④ Unit

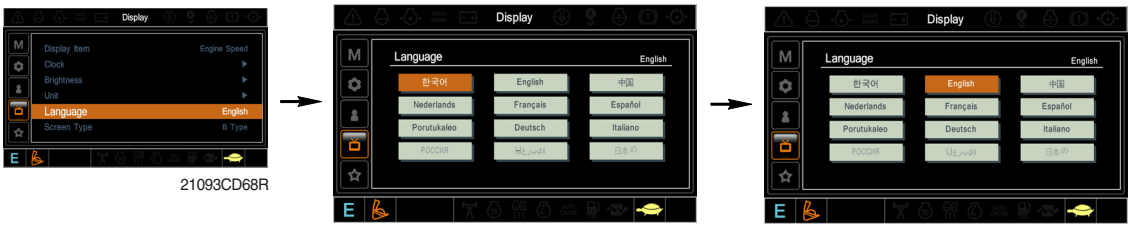
21093CD68L

21093CD68M

21093CD68N

- Temperature : ˚C ↔˚F
- Pressure : bar ↔ MPa ↔ kgf/cm²
- Flow : lpm ↔ gpm
- Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-Mar-yy

⑤ Language



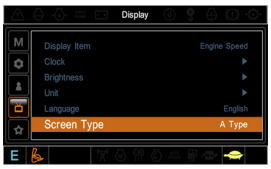
21093CD68R

21093CD68S

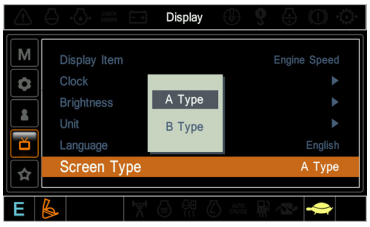
21093CD68T

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

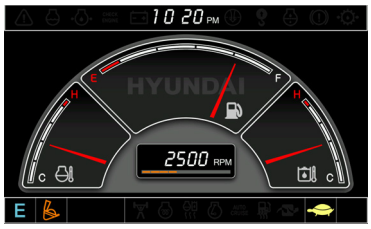
⑥ Screen type



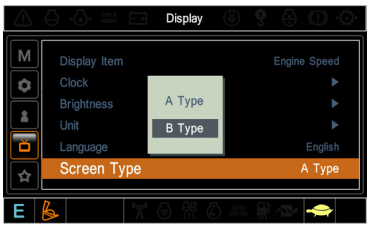
21093CD68U



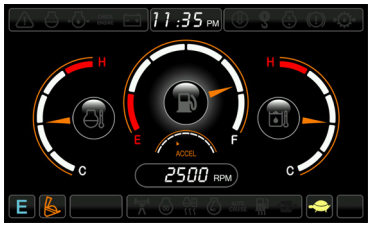
A Type 21093CD68V



Standard 21093CD68W



B Type 21093CD68X

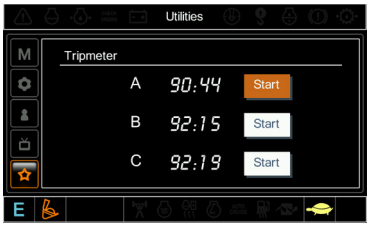


Option 21093CD68Y

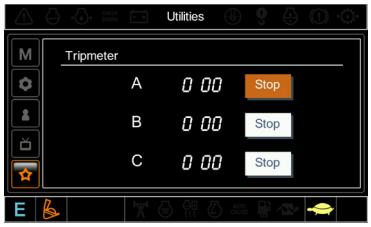
(6) Utilities

① Tripmeter

21093CD69



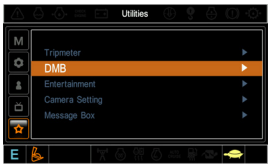
21093CD69A



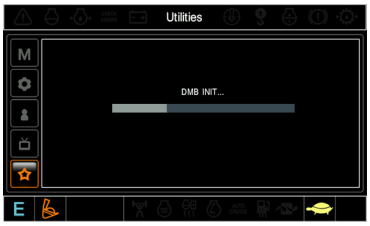
21093CD69B

- Maximum 3 kinds of tripmeters can be used at the same time.
- Each tripmeter can be turned on by choosing "Start" while it also can be turned off by choosing "Stop".
- If the tripmeter icon is activated in the operation screen, it can be controlled directly there.

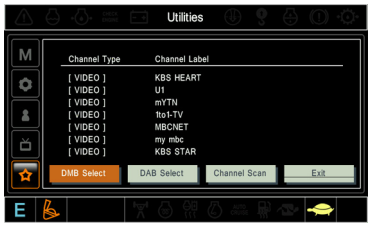
② DMB



21093CD69C



21093CD69D

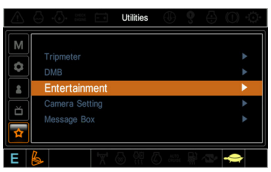


21093CD69E

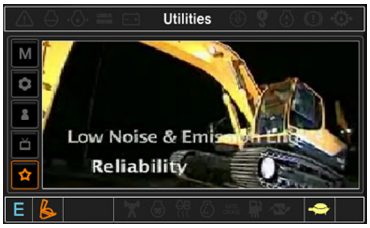
- DMB select : TV channel can be selected by this menu.
- DAB select : Audio channel can be selected by this menu.
- Channel scan : This menu can be used other region for TV/Audio.
- Exit : Exit DMB menu

③ Entertainment

- Play MP4 or codec file of external hard disk through USB port.
- The USB port is located under the cluster.

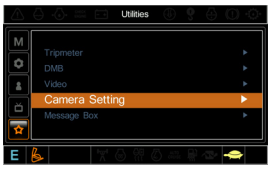


21093CD69F

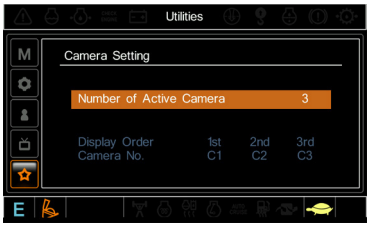


21093CD69G

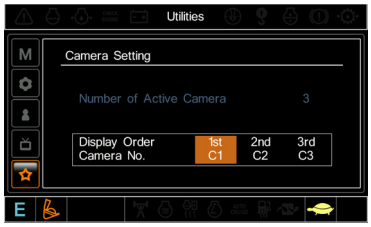
④ Camera setting



21093CD69J



21093CD69K



21093CD69L

- Three cameras can be installed on the machine.
- The display order can be set by this menu.

21093CD69M

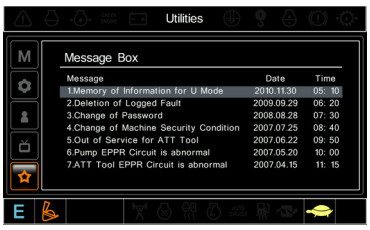
21093CD69N

- If the camera was not equipped, this menu is not useful.
- In the operation screen, if the ESC/CAM switch is pushed, the first ordered display camera will be viewed.
- Turnning the select switch in clockwise direction, the next ordered will be shown and in counter-clockwise direction, the previously ordered will be shown.
- Push the select switch, the displayed screen will be enlargement.

⑤ Message box

- **The history of the machine operating status can be checked by this menu.**

21093CD69Q



21093CD69R

■ MONITORING SYSTEM (CLUSTER TYPE 2)

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

1409S5MS80

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor initial 5 seconds

a. All lamps light up.
b. Buzzer sound.

② Check monitor after 5 seconds : Indicate cluster version and machine condition

a. Cluster program version :「1.00」←Indicates program version「1.00」for 5 seconds.
b. Tachometer : 0rpm
c. Fuel gauge : All light up below appropriate level
d. Hydraulic temperature : All light up below appropriate level
e. Engine coolant temperature gauge : All light up below appropriate level
f. Warning lamp

※ During start key ON the engine oil pressure lamp and battery charging lamp go on, but it is not abnormal.
※ When engine coolant temperature below 30°C , the warming up lamp lights up.

③ Indicating lamp state

a. Work mode selection : General work
b. Power mode selection : S mode
c. User mode selection : No LED ON
d. Auto decel LED : ON
e. Travel speed pilot lamp : Low (turttle)

(2) Start of engine

① Check machine condition

a. Tachometer 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 : S mode
e. User mode selection : No LED ON
f. Auto decel LED : ON
g. Travel speed pilot lamp : Low (turttle)

② When warming up operation

a. Warming up lamp : ON
b. 10 seconds after engine started, engine speed increases to 1150 rpm (auto decel LED : ON)

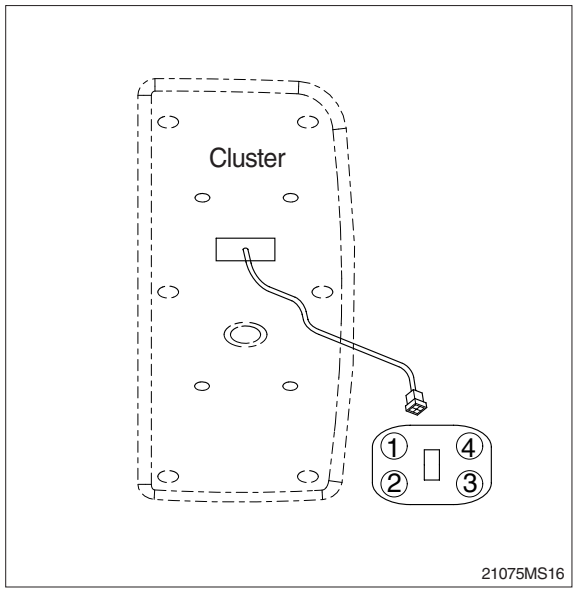
※ Others same as above ①.

③ When abnormal condition

a. The lamp lights up and the buzzer sounds.
b. If **BUZZER STOP** switch is pressed, buzzer sound is canceled but the lamp light up until normal condition.

3. CLUSTER CONNECTOR

No.	Signal	Input / Output
1	Power IG(24V)	Input(20~32V)
2	GND	Input(0V)
3	Serial-(RX)	Input(Vpp=12V)
4	Serial+(TX)	Output(Vpp=4V)



2) LCD MAIN OPERATION DISPLAY

Default screen

1607A3CD02A

Option screen

1607A3CD02B

1 Time display
2 RPM display
3 Hydraulic oil temperature gauge
4 Fuel level gauge
5 Engine coolant temperature gauge

(1) Time display

1607A3CD02C

① This displays the current time.

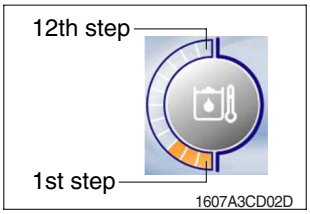
※ **Refer to the page 5-68 to set time for details.**

(2) RPM display

1607A3CD02C

① This displays the engine rpm.

(3) Hydraulic oil temperature gauge



1607A3CD02D

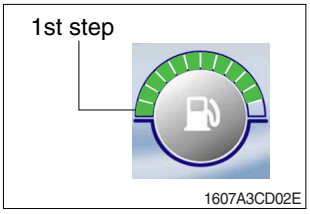
① This gauge indicates the temperature of hydraulic oil in 12 step gauge.
- ·1st step : Below 30˚C (86˚F)
- ·2nd~10th step : 30-105˚C (86-221˚F)
- ·11th~12th step : Above 105˚C (221˚F)

② The gauge between 2nd and 10th steps illuminates when operating.

③ Keep idling engine at low speed until the gauge between 2nd and 10th steps illuminates, before operation of machine.

④ When the gauge of 11th and 12th steps illuminates, reduce the load on the system. If the gauge stays in the 11th~12th steps, stop the machine and check the cause of the problem.

(4) Fuel level gauge



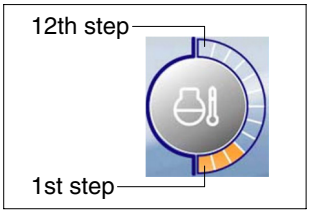
1607A3CD02E

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

② Fill the fuel when the 1st step or fuel icon blinks in red.

※ **If the gauge illuminates the 1st step or fuel icon blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

(5) Engine coolant temperature gauge



1607A3CD02F

① This gauge indicates the temperature of coolant in 12 step gauge.
- · 1st step : Below 30˚C (86˚F)
- · 2nd~10th step : 30-105˚C (86-221˚F)
- · 11th~12th step : Above 105˚C (221˚F)

② The gauge between 2nd and 10th steps illuminates when operating.

③ Keep idling engine at low speed until the gauge between 2nd and 10th steps illuminates, before operation of machine.

④ When the gauge of 11th and 12th steps illuminates, turn OFF the engine, check the radiator and engine.

3) WARNING OF MAIN OPERATION SCREEN

(1) Warning display

① Engine coolant temperature


- This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 105˚C (221˚F).
- Check the cooling system when the lamp blinks.

② Fuel level


- This lamp blinks and the buzzer sounds when the level of fuel is below 31 ℓ (8.2 U.S. gal).
- Fill the fuel immediately when the lamp blinks.

③ Hydraulic oil temperature


- This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 105˚C (221˚F).
- Check the hydraulic oil level when the lamp blinks.
- Check for debris between oil cooler and radiator.

④ All gauge


- This lamp blinks and the buzzer sounds when the all gauge is abnormal.
- Check the each system when the lamp blinks.

⑤ Communication error

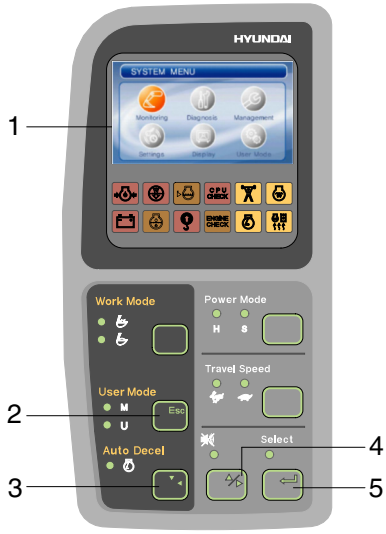
- Communication problem between MCU and cluster makes the lamp blinks and the buzzer sounds.
- Check if any fuse for MCU burnt off.
  If not check the communication line between them.

(2) Pop-up icon display

No	Switch	Selected mode	Interval
1	Work mode switch	General work mode	
		Heavy duty work mode	
2	Power mode switch	High power work mode	
		Standard power work mode	

No	Switch	Selected mode	Interval
3	Auto deceleration switch	Light ON	
		Light OFF	
4	Travel speed control switch	Low speed	
		High speed	

4) LCD



2209S3CD05

1 : LCD

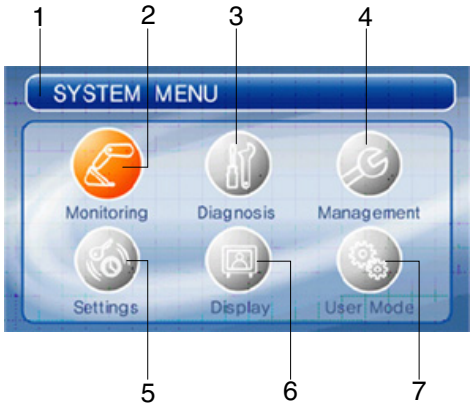
2 : Escape,
Return to the previous menu

3 : Down / Left Direction

4 : Up/Right Direction

5 : Select (enter)
Activate the currently chosen item

(1) Main menu



2507A4OP94

1 SYSTEM MENU : Menu information

2 : Monitoring
- Equipment, Switch, Output

3 : Diagnosis
- Current error, Recorded error

4 : Maintenance

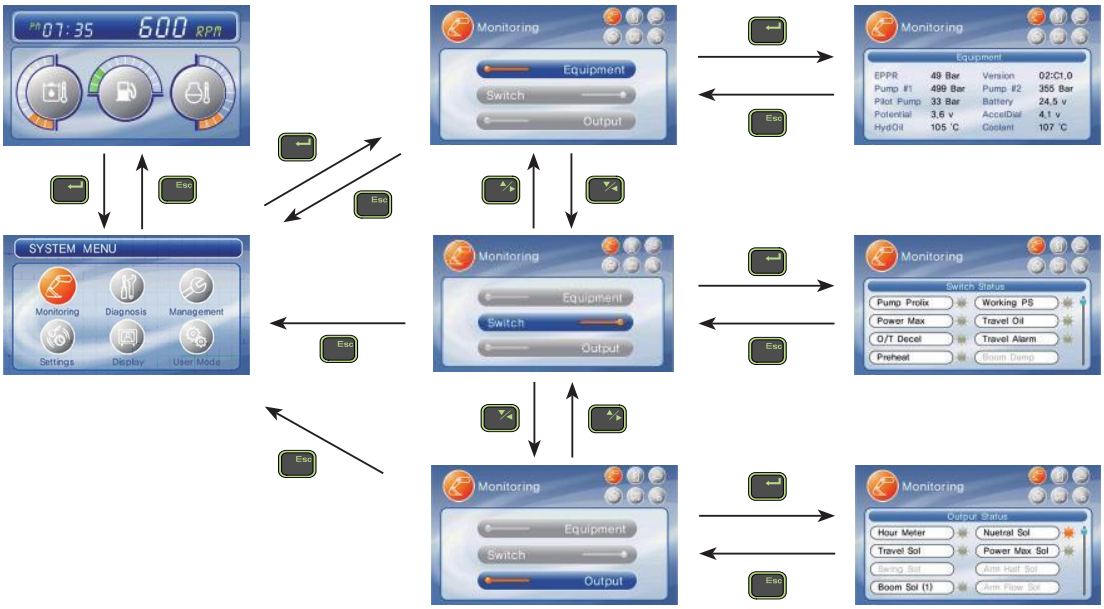
5 : Settings
- Time set, Dual mode
- System lock (reserved)

6 : Display
- Operation skin, Brightness, Language

7 : User mode

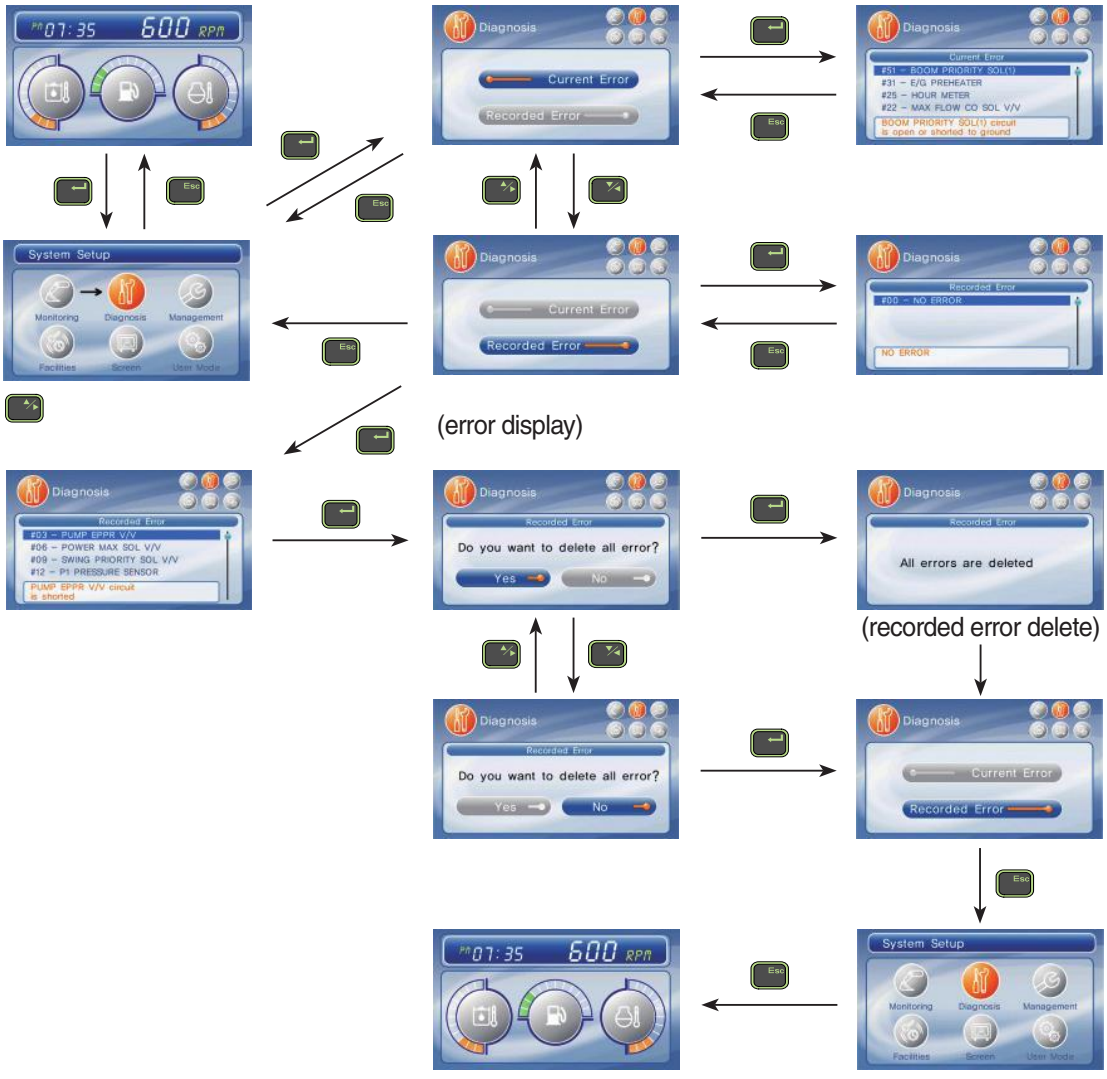
(2) Display map

① Monitoring



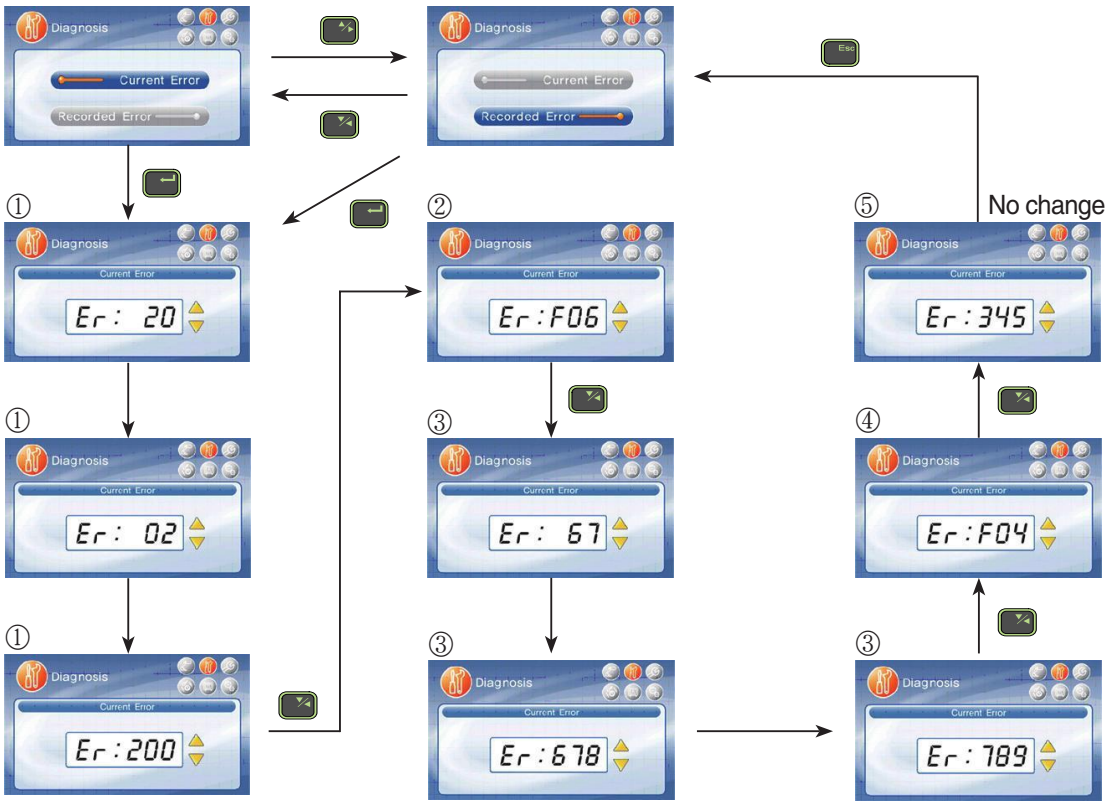
② Diagnosis

a. Protocol type 1

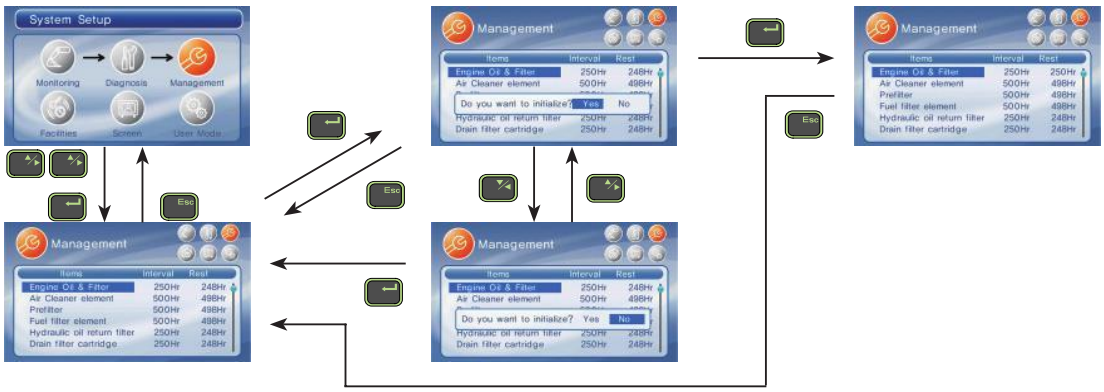


b. Protocol type 2

- If there are more than 2 error codes, each one can be displayed by pressing or switch respectively.
- 3 error codes (①SPN200200, ②FMI06, ③SPN6789, ④FMI04, ⑤345) display.



③ Maintenance



④ Setting

a. Time set

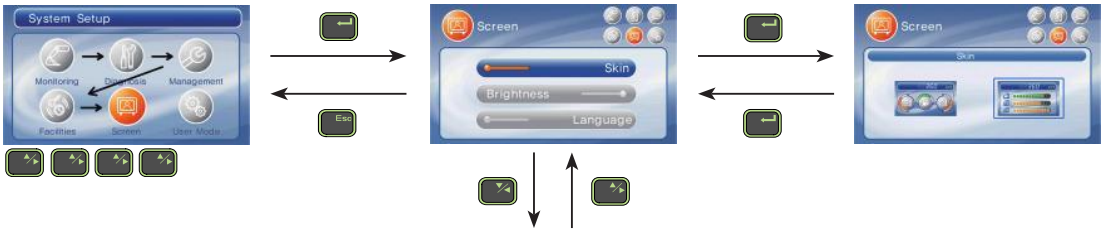
b. System lock - Reserved

c. Dual mode

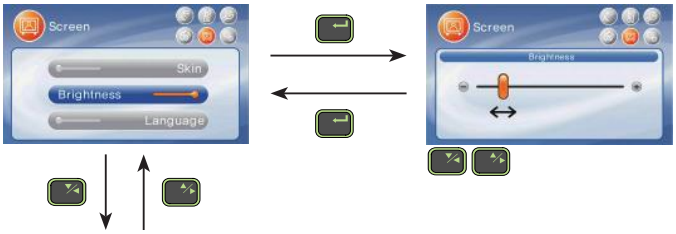
- Changing the MCU mode

⑤ Display

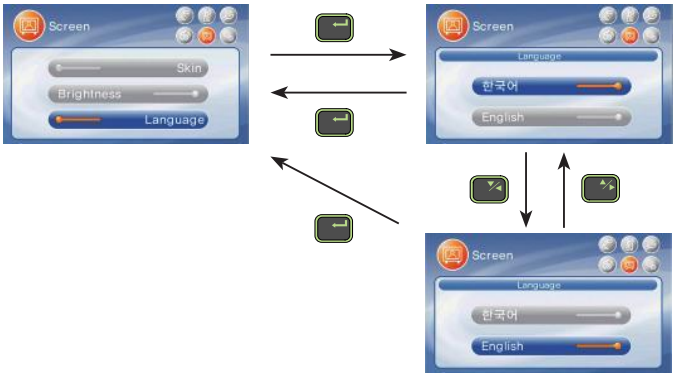
a. Operation skin



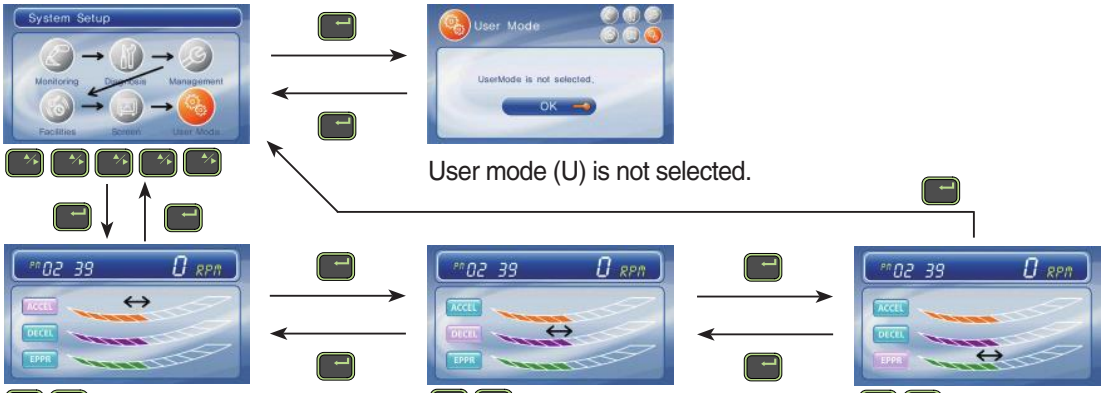
b. Brightness



c. Language



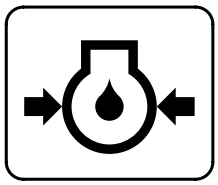
⑥ User mode



User mode (U) is not selected.

5) WARNING AND PILOT LAMP

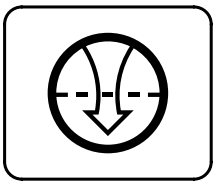
(1) Engine oil pressure warning lamp



21073CD07

① This lamp blinks and the buzzer sounds after starting the engine because of the low oil pressure.
② If the lamp blinks during engine operation, shut OFF engine immediately. Check oil level.

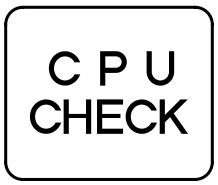
(2) Air cleaner warning lamp



21073CD08

① This lamp blinks and the buzzer sounds when the filter of air cleaner is clogged.
② Check the filter and clean or replace it.

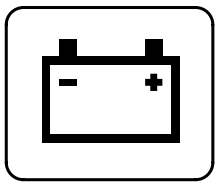
(3) MCU check warning lamp



21073CD10

① If any fault code is received from MCU, this lamp blinks and the buzzer sounds.
② Check the communication line between MCU and cluster.

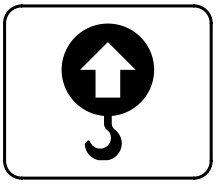
(4) Battery charging warning lamp



21073CD13

① This lamp blinks and the buzzer sounds when the starting switch is ON, it is turned OFF after starting the engine.
② Check the battery charging circuit when this lamp blinks during engine operation.

(5) Overload warning lamp



21073CD15

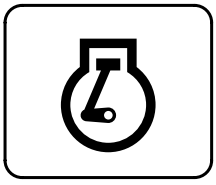
① When the machine is overload, the overload warning lamp blinks during the overload switch is ON.

(6) Power max pilot lamp

21073CD11

① The lamp will be ON when pushing power max switch on the LH RCV lever.

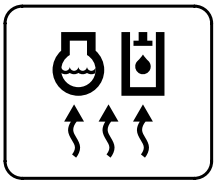
(7) Decel pilot lamp



21073CD17

① Operating auto decel or one touch decel makes the lamp ON.
② The lamp will be ON when pushing one touch decel switch on the LH RCV lever.

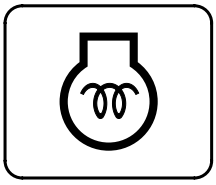
(8) Warming up pilot lamp



21073CD18

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

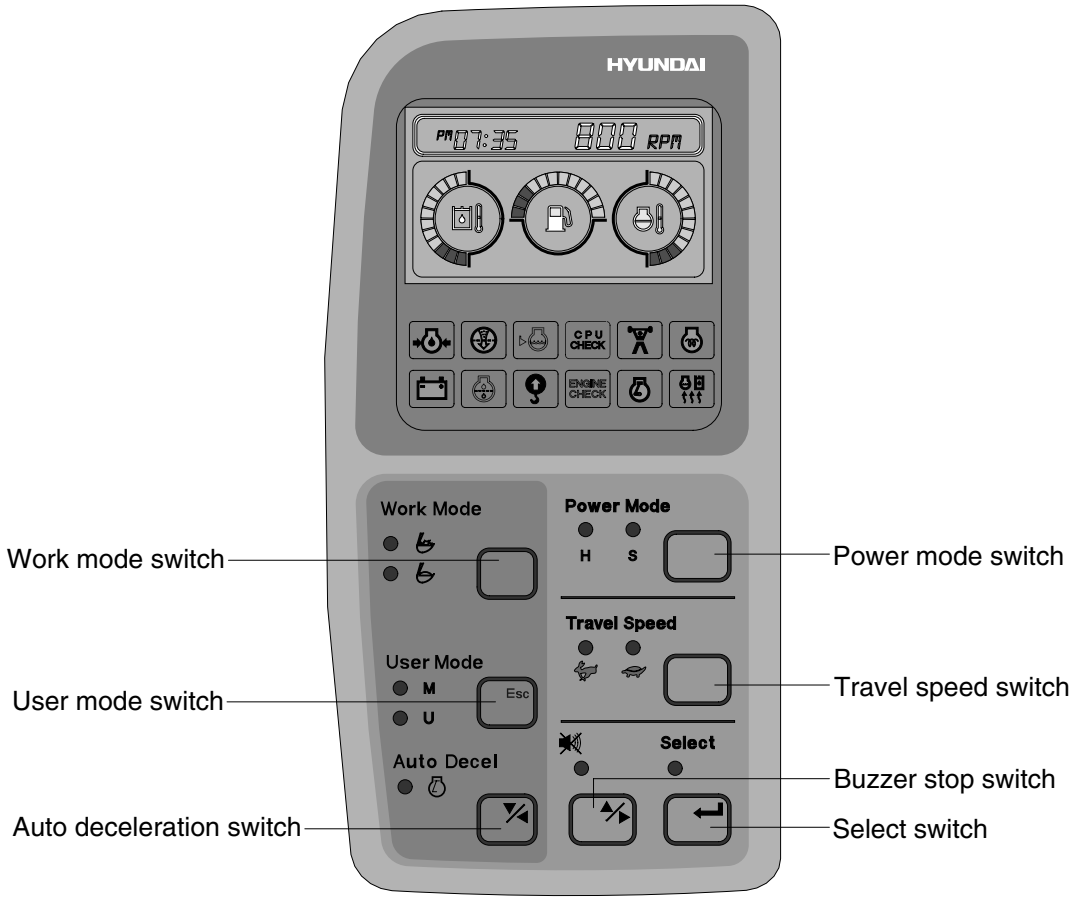
(9) Preheat pilot lamp



21073CD12

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

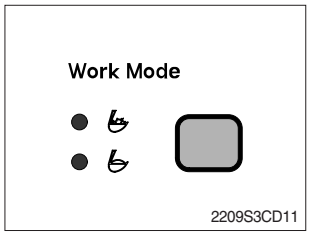
6) SWITCH PANEL



2209S3CD10

※ **When the switches (Work mode, Power mode, Auto decel, Travel speed control) are selected, the pop-up icon is displayed on the LCD.**
Refer to the page 3-25 for details.

(1) Work mode switch

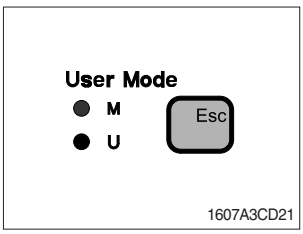


2209S3CD11

① This switch is to select the machine operation mode, which shifts from general operation mode to heavy duty operation mode by pressing the switch.
- : Heavy duty work mode
- : General work mode

※ **Refer to the operator's manual page 4-15 for details.**

(2) User mode switch

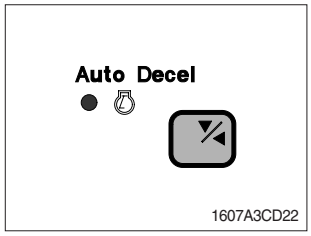


1607A3CD21

① This switch is to select the maximum power or user mode.
- M : Maximum power
- U : Memorizing operators preferable power setting.

※ **Refer to the operator's manual page 4-15 for details.**

(3) Auto deceleration switch

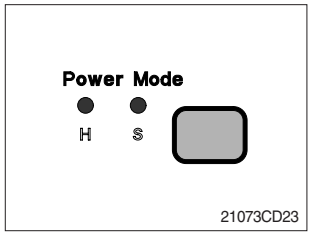


① This switch is used to actuate or cancel the auto deceleration function.

② When the switch actuated and all control levers and pedals are at neutral position, engine speed will be lowered automatically to save fuel consumption.

- Light ON : Auto deceleration function is selected.
- Light OFF : a. Auto deceleration function is cancelled so that the engine speed increased to previous setting value.
  b. One touch decel function is available.

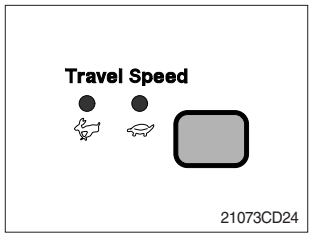
(4) Power mode switch



① The lamp of selected mode is turned ON by pressing the switch ( ).

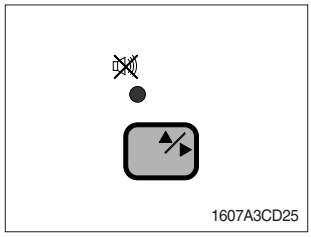
- H : High power work.
- S : Standard power work.

(5) Travel speed control switch



① This switch is to control the travel speed which is changed to high speed (rabbit mark) by pressing the switch and low speed (turtle mark) by pressing it again.

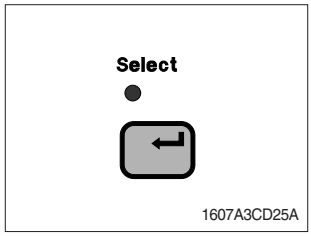
(6) Buzzer stop switch



① When the starting switch is turned ON first, normally the alarm buzzer sounds for 2 seconds during lamp check operation.

② The red lamp lights ON and the buzzer sounds when the machine has a problem.
In this case, press this switch and buzzer stops, but the red lamp lights until the problem is cleared.

(7) Select switch



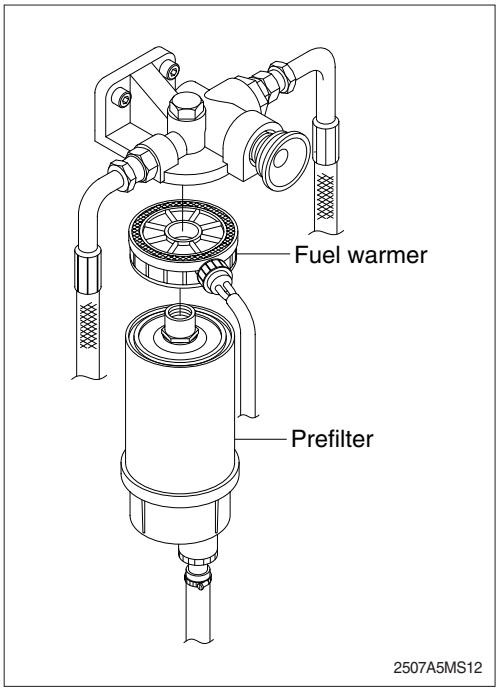
① This switch is used to enter main menu and sub menu of LCD.

※ **Refer to the page 5-66 for details.**

GROUP 15 FUEL WARMER SYSTEM

1. SPECIFICATION

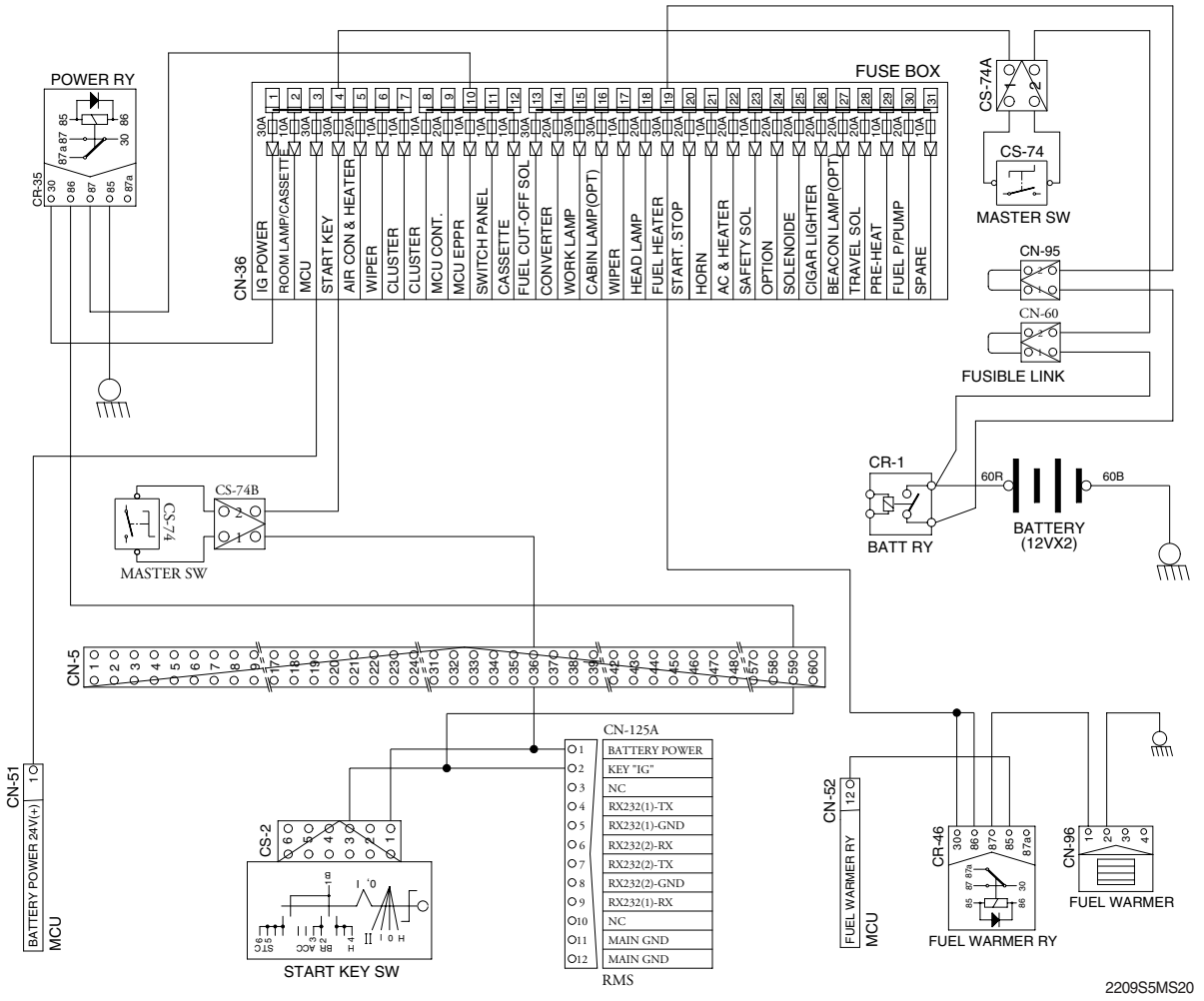
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A



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



SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

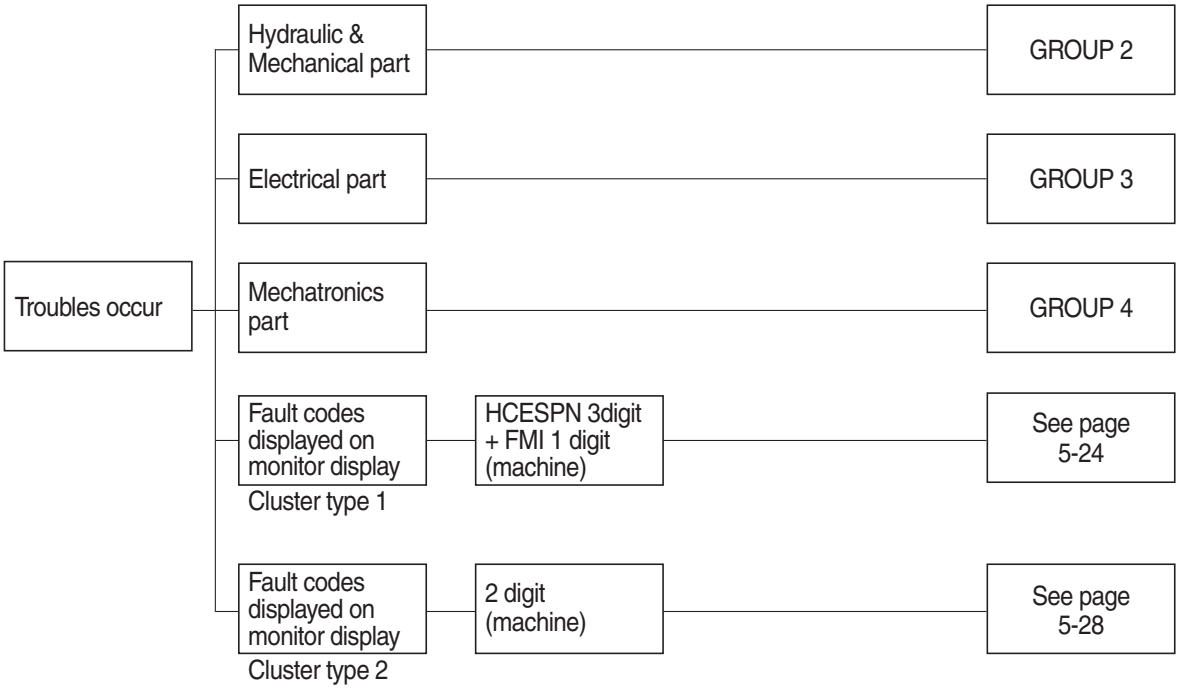
GROUP 1 BEFORE TROUBLESHOOTING

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 and Mechatronics system. At each system part, an operator can check the machine according to the troubleshooting process diagram.

※ **Before carring out troubleshooting procedure, check monitoring menu in the cluster.**

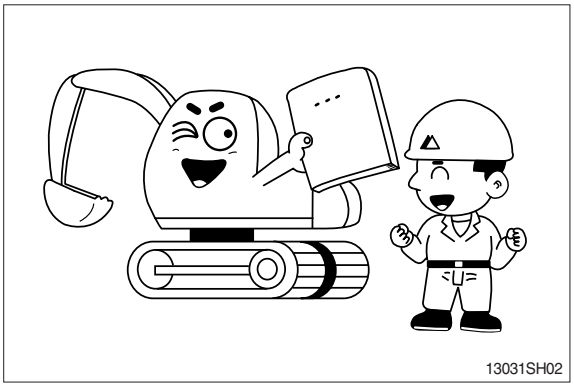


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

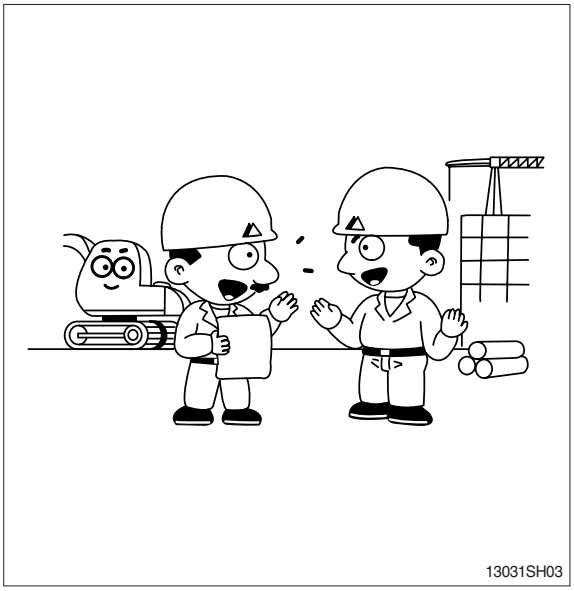
Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.
Especially, deepen the knowledge for the related parts of the trouble.


13031SH02

STEP 2. Ask the operator

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

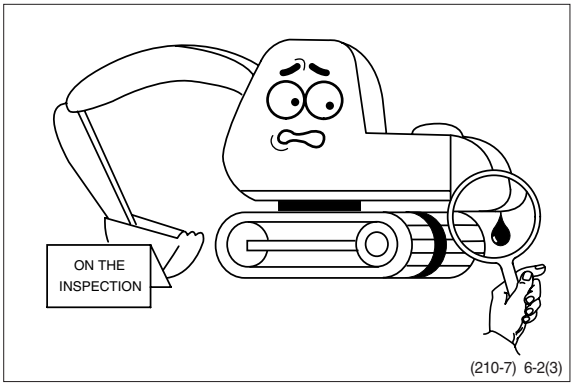
1) How the machine is used and when it is serviced?
2) When the trouble was noticed and what work the machine was doing at that time?
3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
4) Did the machine have any troubles previously?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


13031SH03

STEP 3. Inspect the machine

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

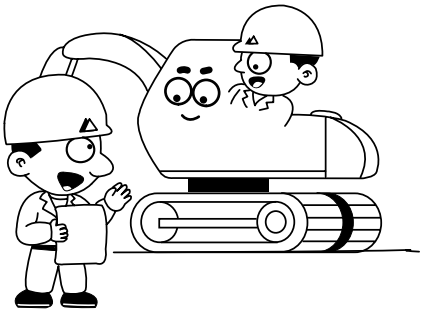
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

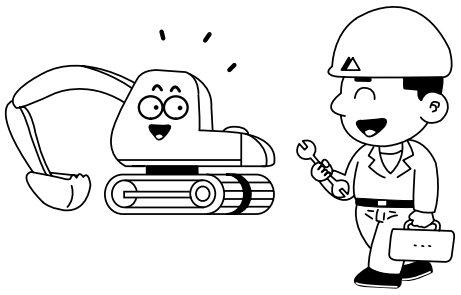
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 6-3(1)

STEP 5. Perform troubleshooting

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

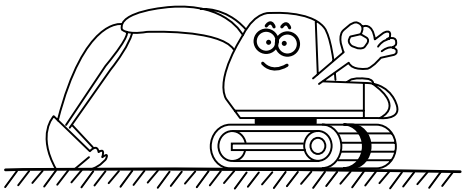


13031SH05

STEP 6. Trace a cause

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

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



(210-7) 6-3(3)

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

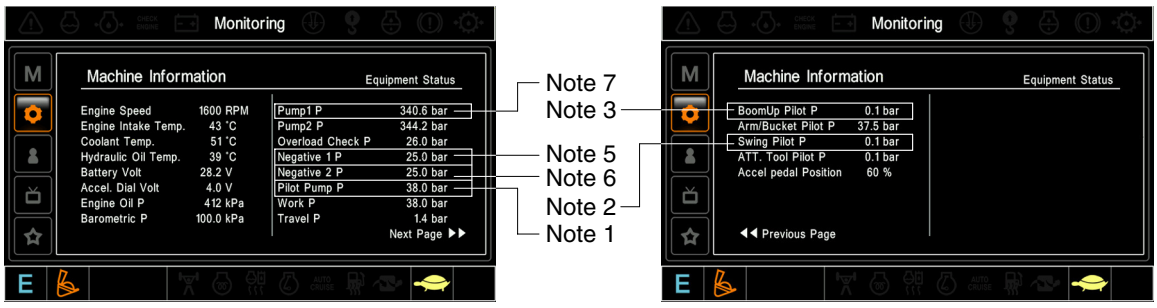
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

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

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

2) MACHINE STATUS MONITORING ON THE CLUSTER (CLUSTER TYPE 1)

(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

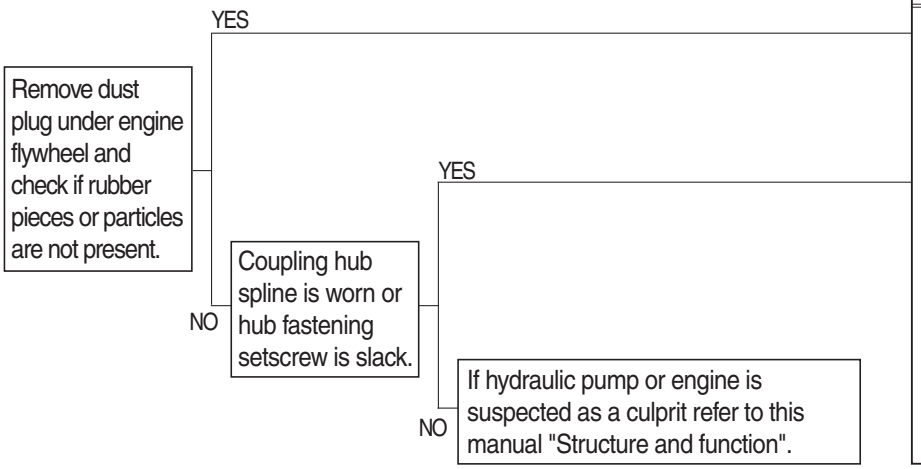
1409S6HS01

(2) Specification

No.	Description	Specification
Note 1	Pilot pump pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 5	P1 pump control pressure	0~25 bar
Note 6	P2 pump control pressure	0~25 bar
Note 7	Pump 1 pressure	350 bar

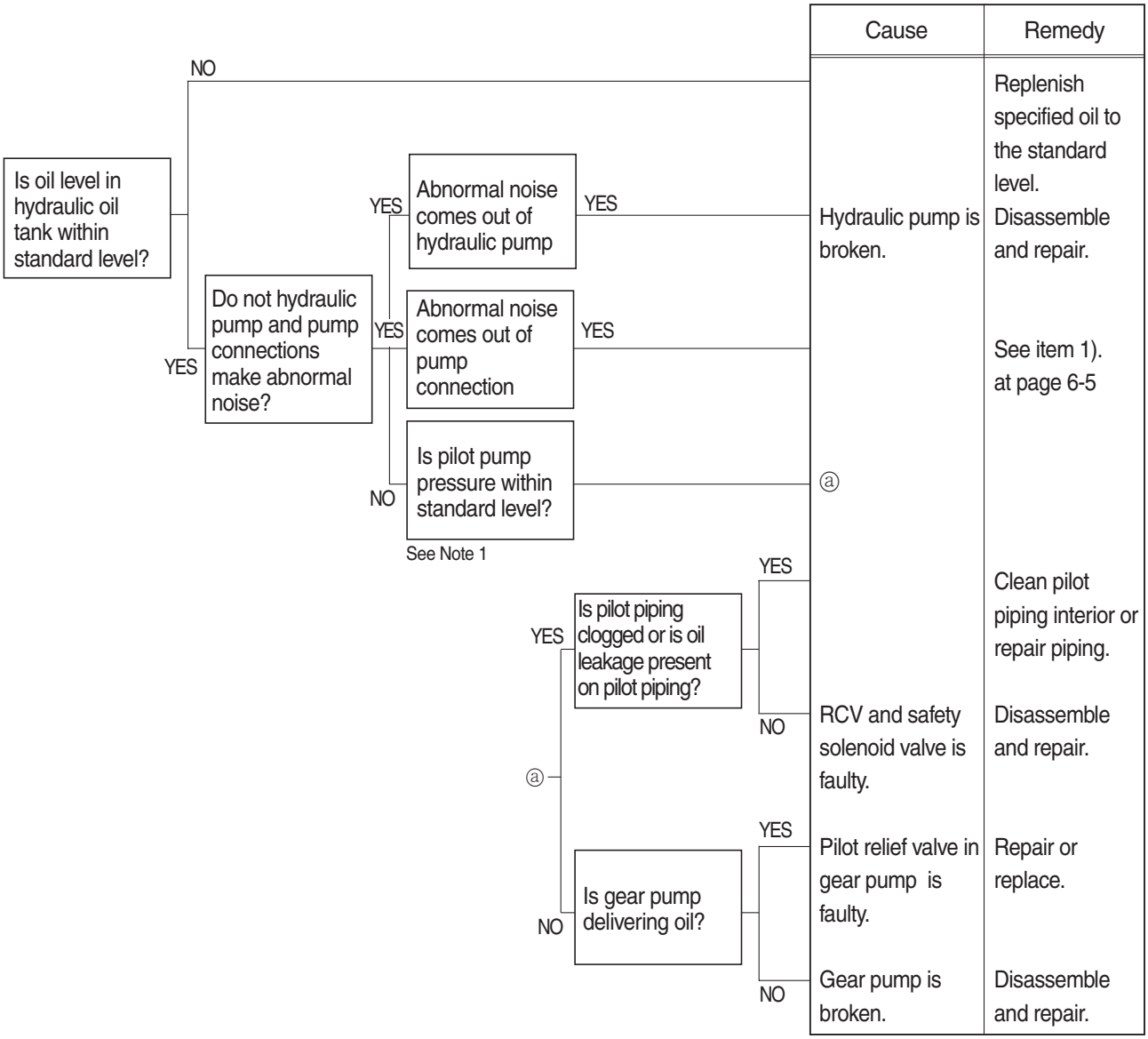
2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



Cause	Remedy
Coupling element is broken.	Disassemble and repair.
	Replace hub or retighten setscrew.

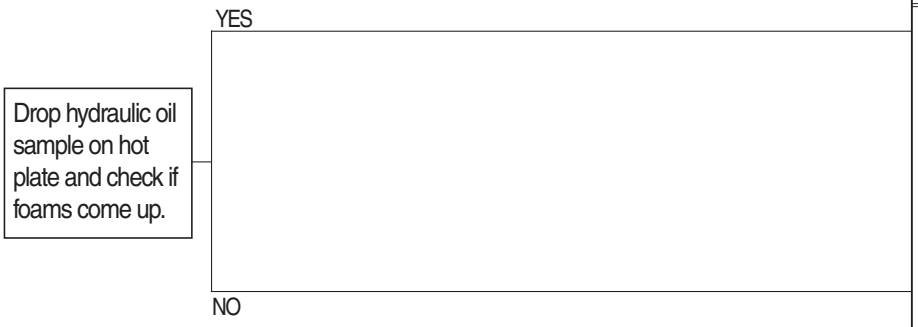
2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL



Cause	Remedy
	Replenish specified oil to the standard level.
Hydraulic pump is broken.	Disassemble and repair.
	See item 1). at page 6-5
ⓐ	
	Clean pilot piping interior or repair piping.
RCV and safety solenoid valve is faulty.	Disassemble and repair.
Pilot relief valve in gear pump is faulty.	Repair or replace.
Gear pump is broken.	Disassemble and repair.

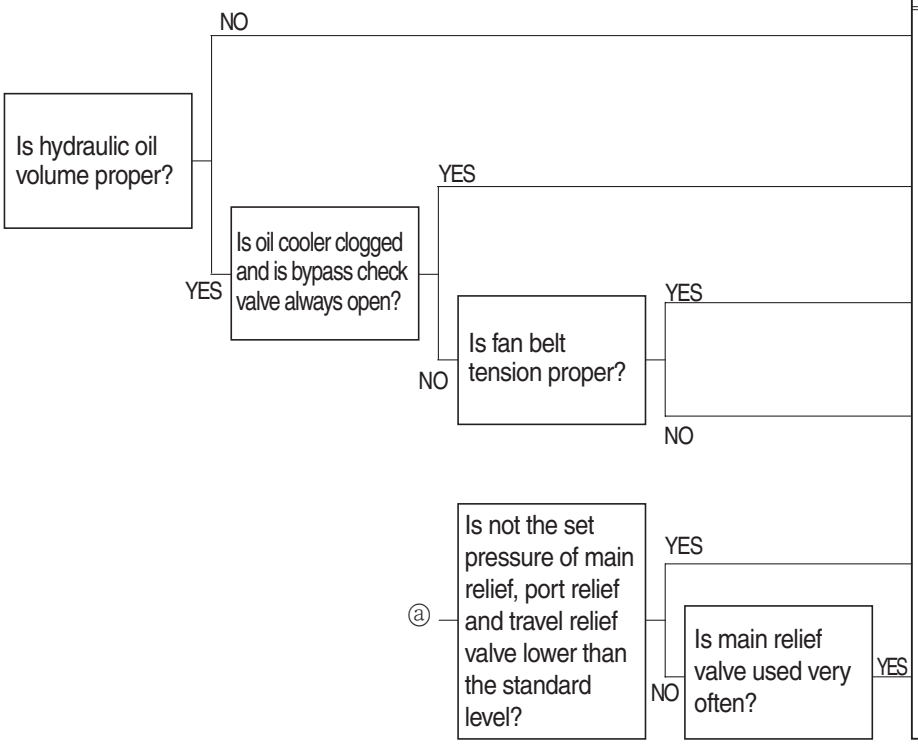
3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY



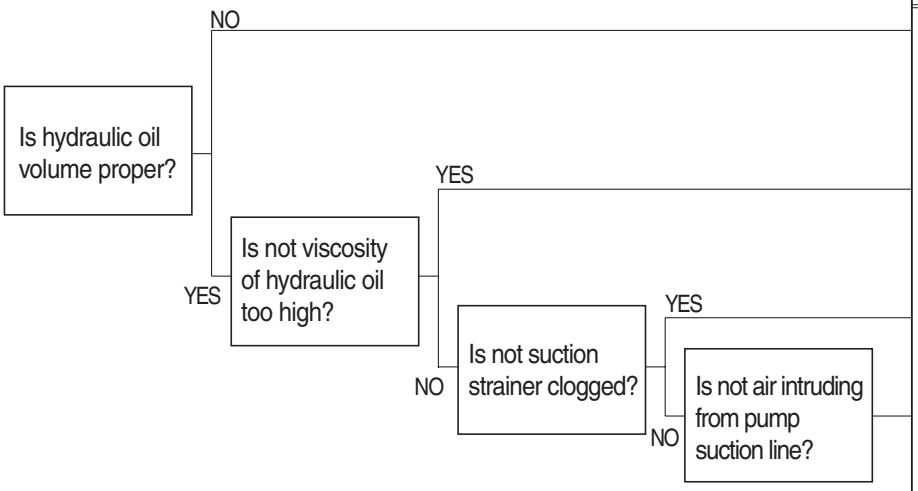
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



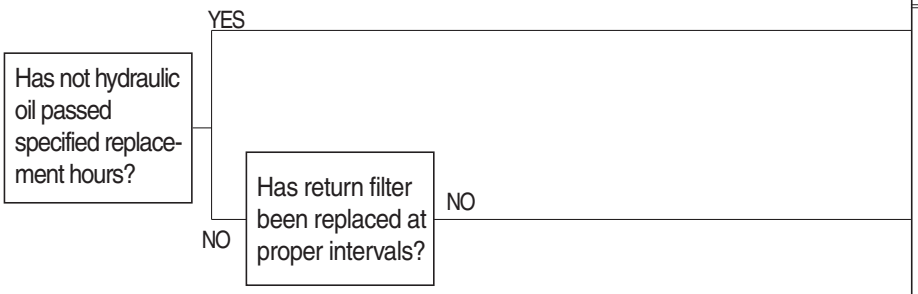
Cause	Remedy
Oil cooler clogged. Bypass check valve is defective. ⓐ	Replenish specified oil to the standard level. Clean oil cooler. Replace
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

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.

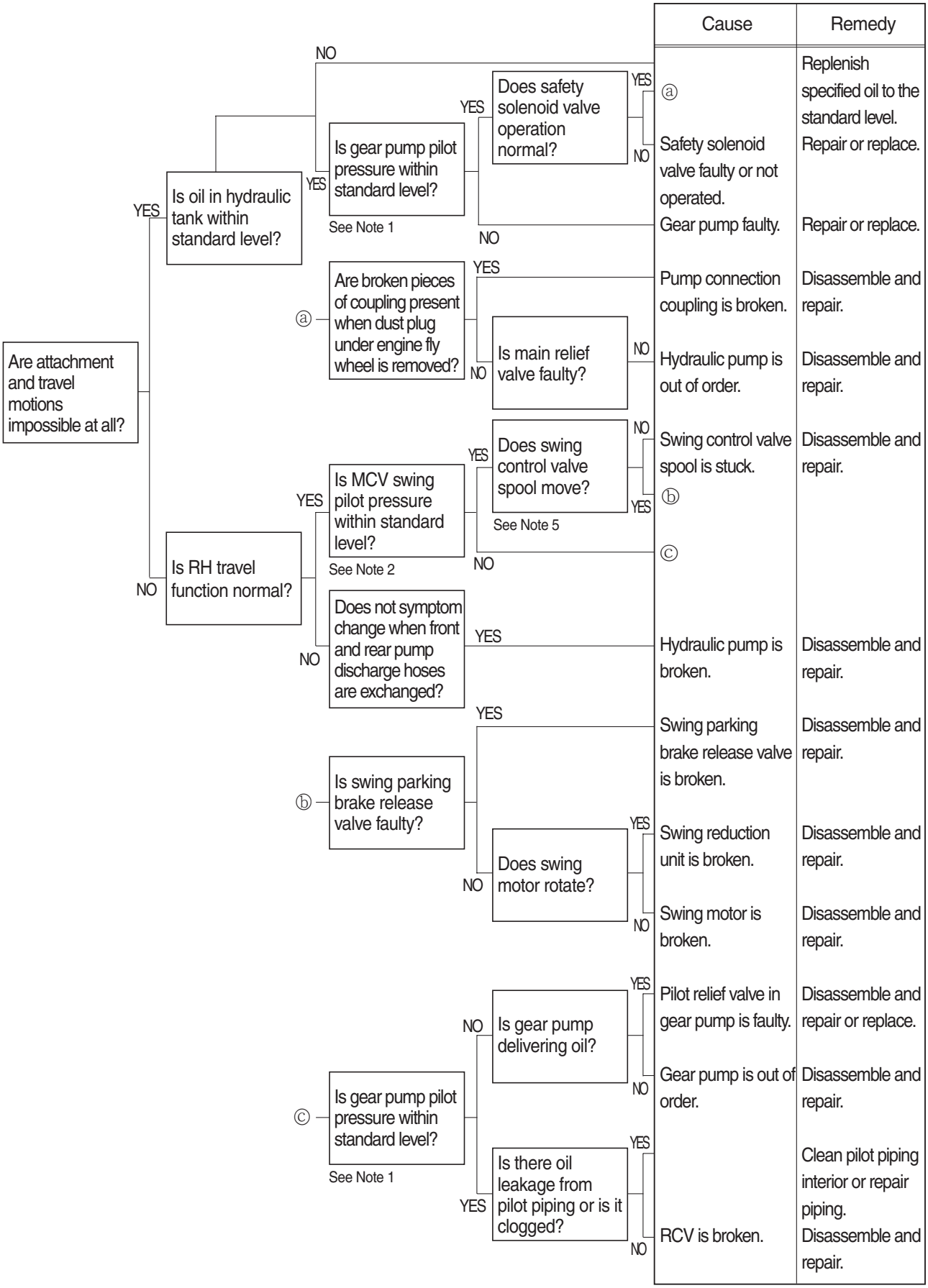
4) HYDRAULIC OIL IS CONTAMINATED



Cause	Remedy
	Replace hydraulic oil to be specified. Flush with hydraulic oil and replace return filter.

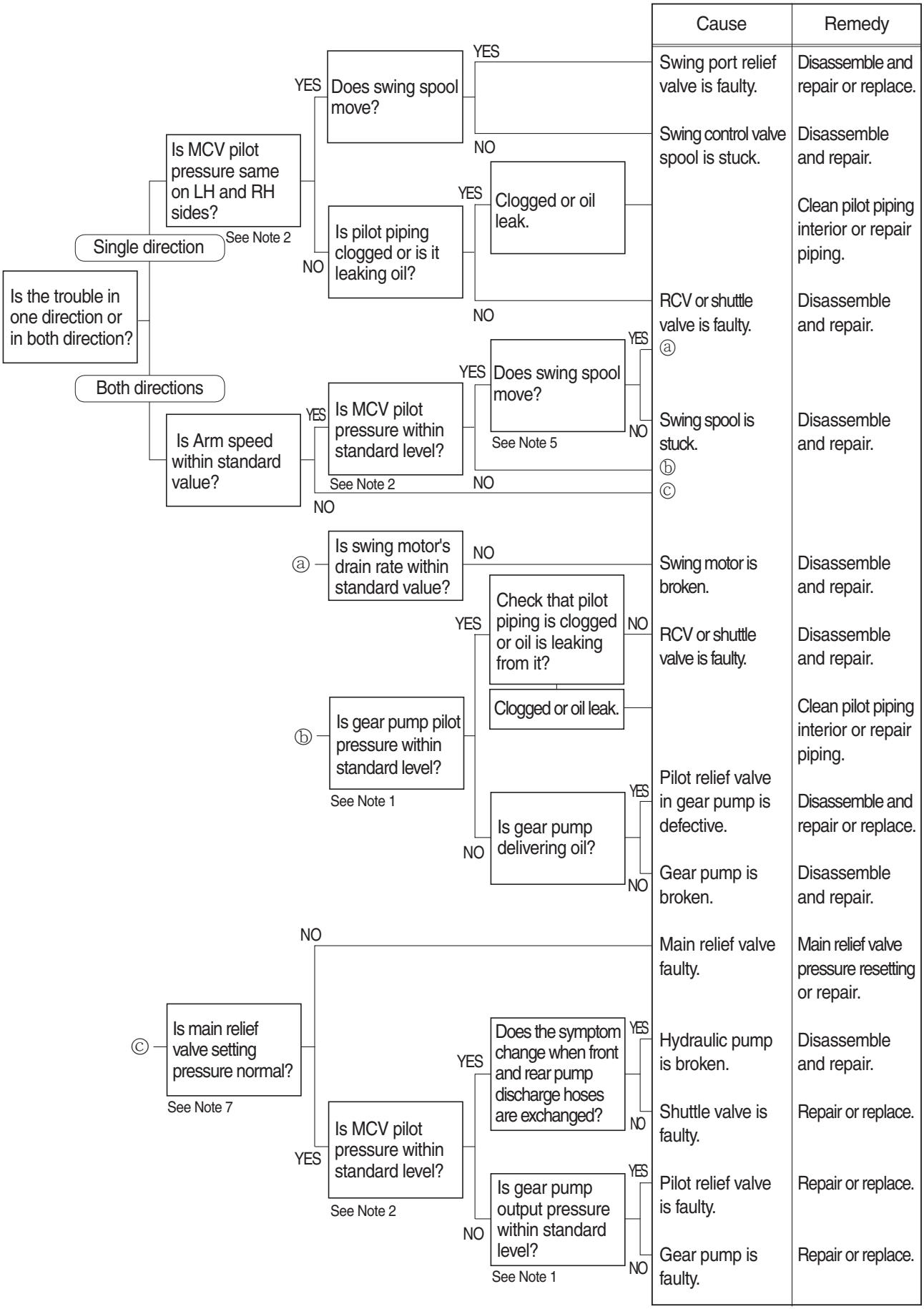
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE

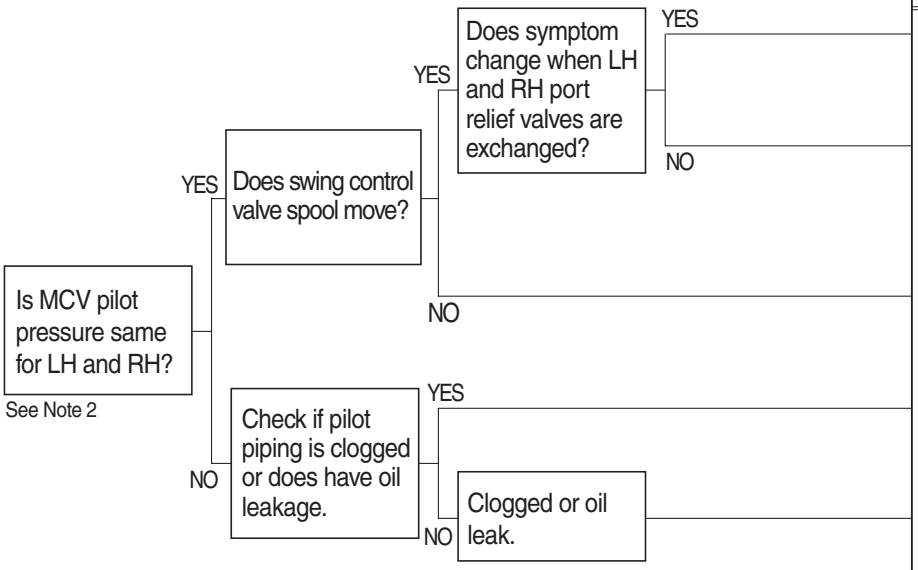


Cause	Remedy
ⓐ	Replenish specified oil to the standard level.
Safety solenoid valve faulty or not operated.	Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool 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

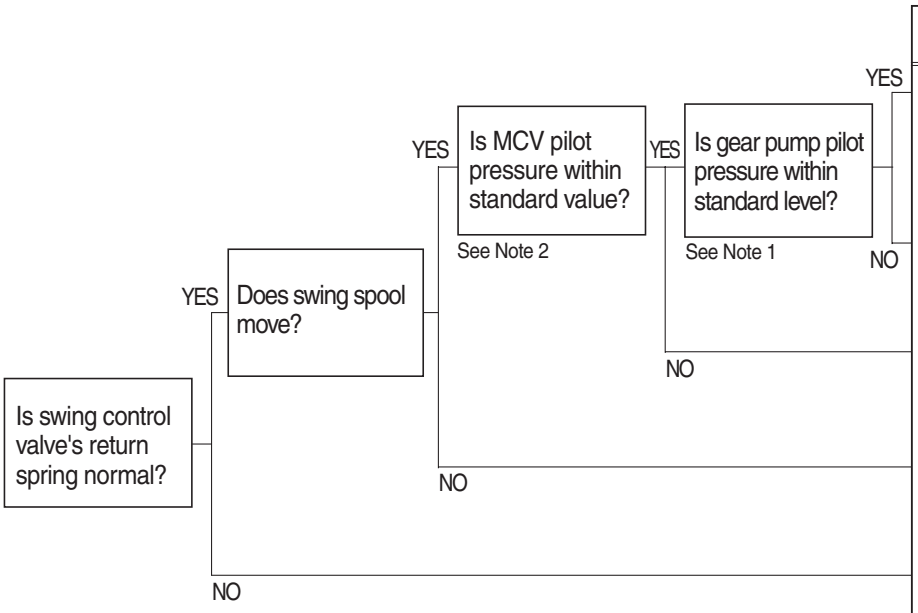


3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



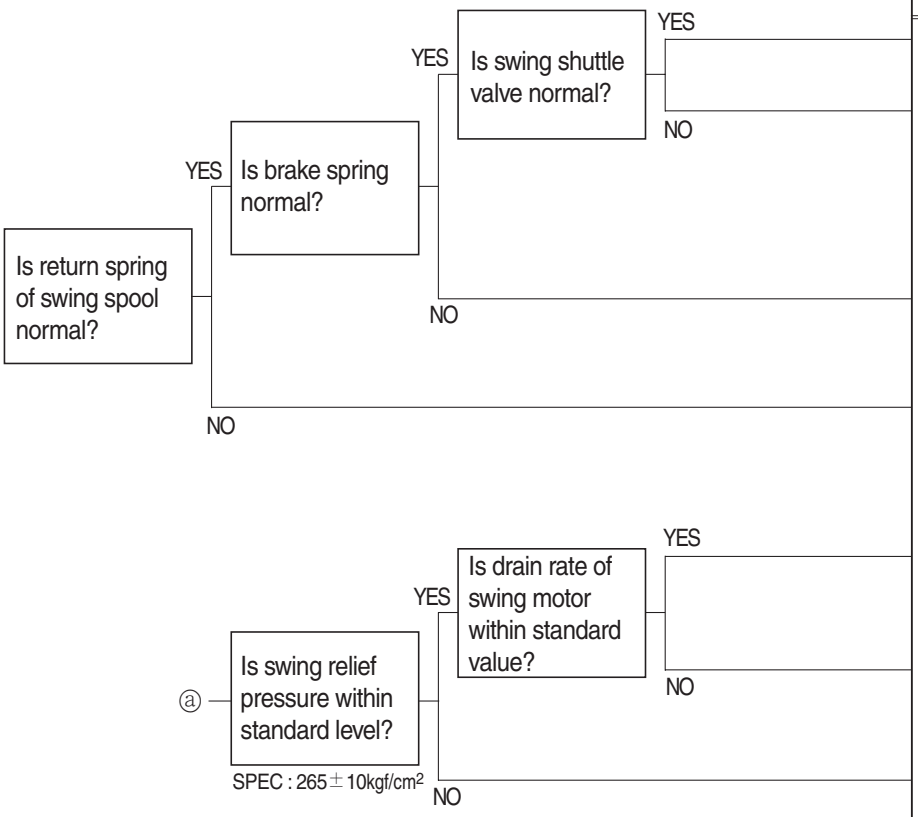
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

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.

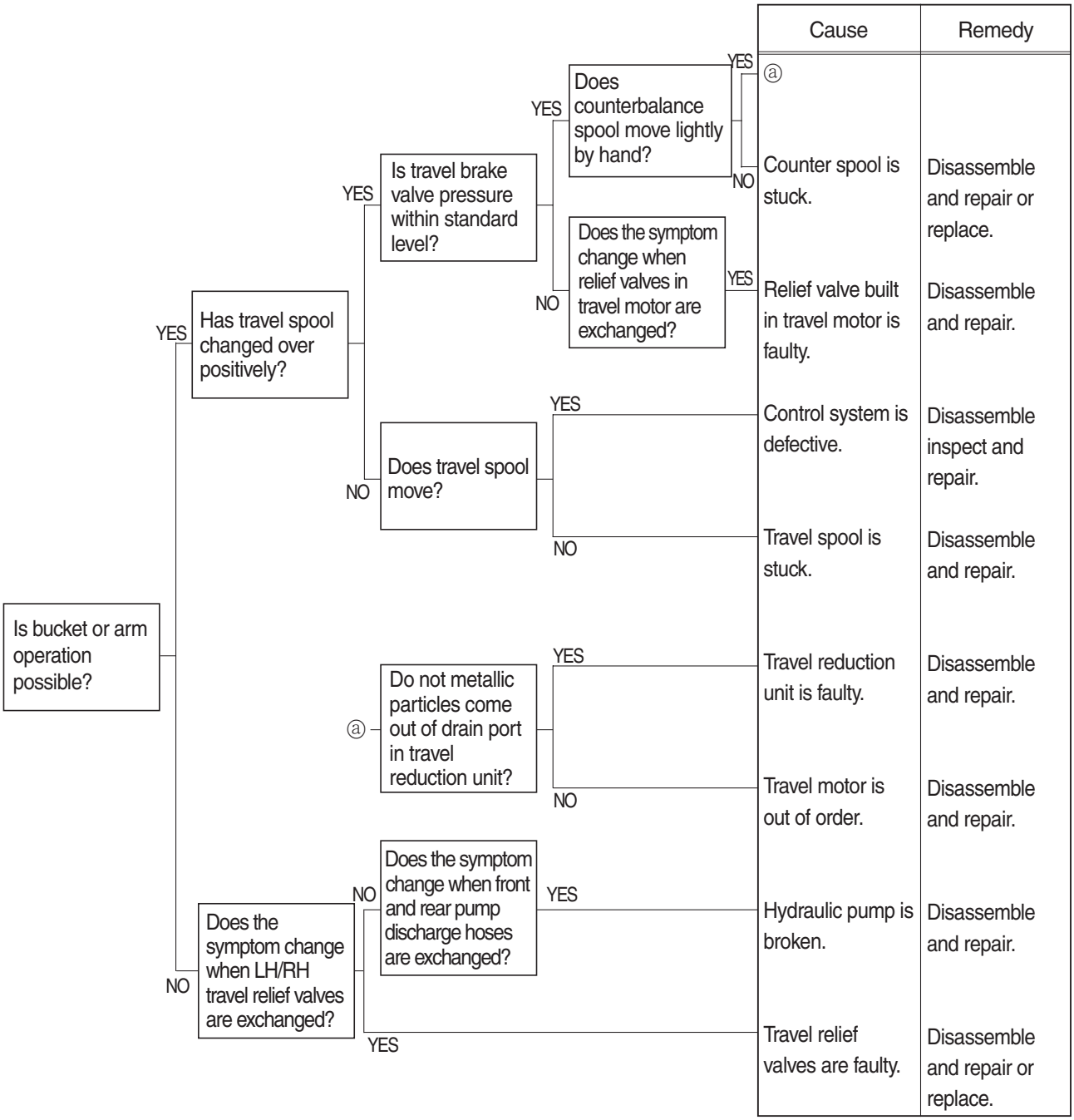
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



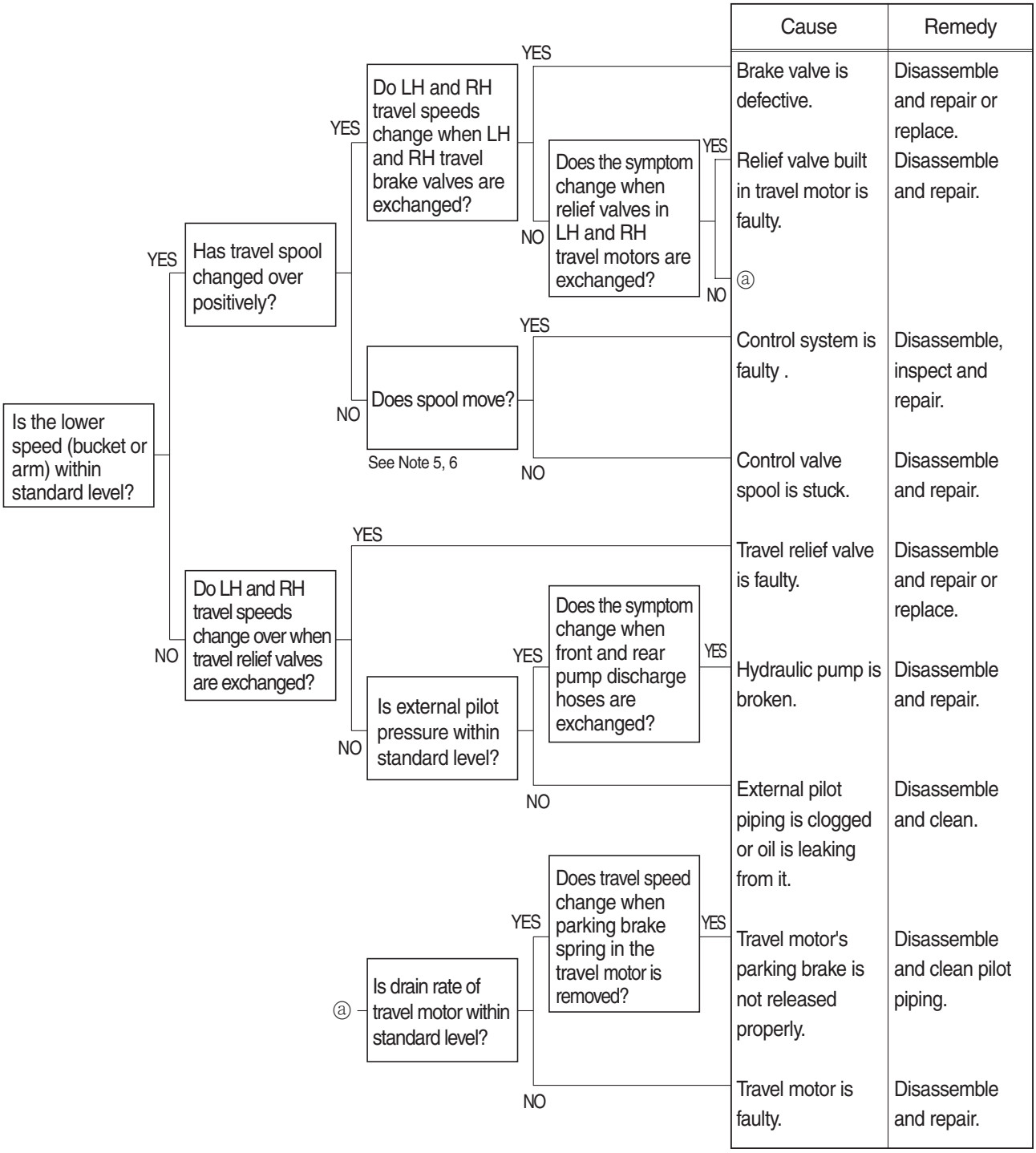
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.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

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



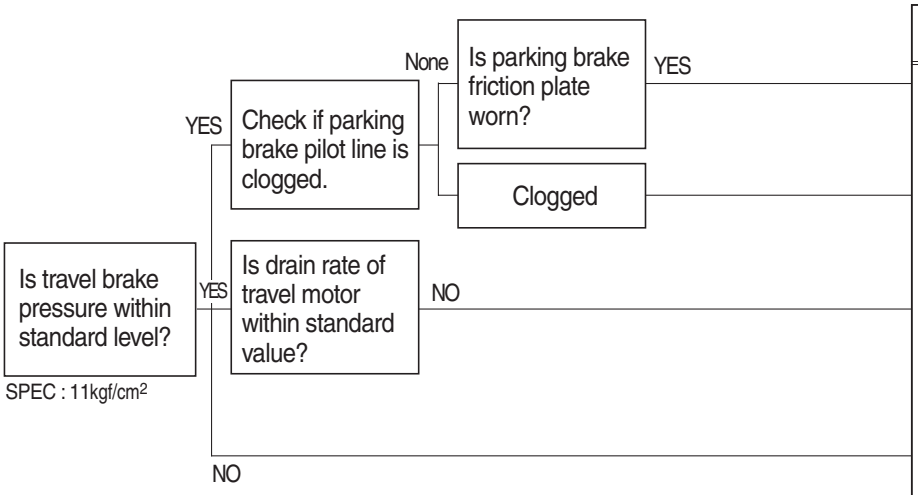
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
ⓐ	
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic pump is broken.	Disassemble and repair.
External pilot piping is clogged or oil is leaking from it.	Disassemble and clean.
Travel motor's parking brake is not released properly.	Disassemble and clean pilot piping.
Travel motor is faulty.	Disassemble and repair.

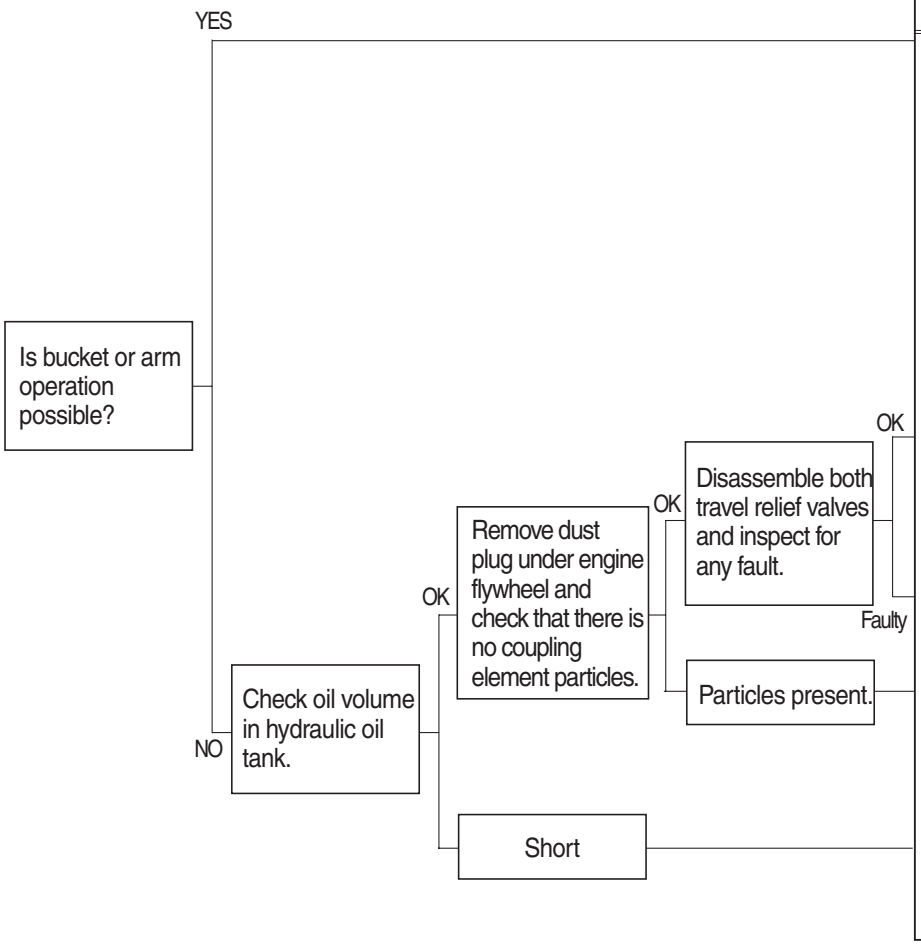
3) MACHINE DOES NOT STOP ON A SLOPE

Machine is pulled forward as sprocket rotates during digging operation.



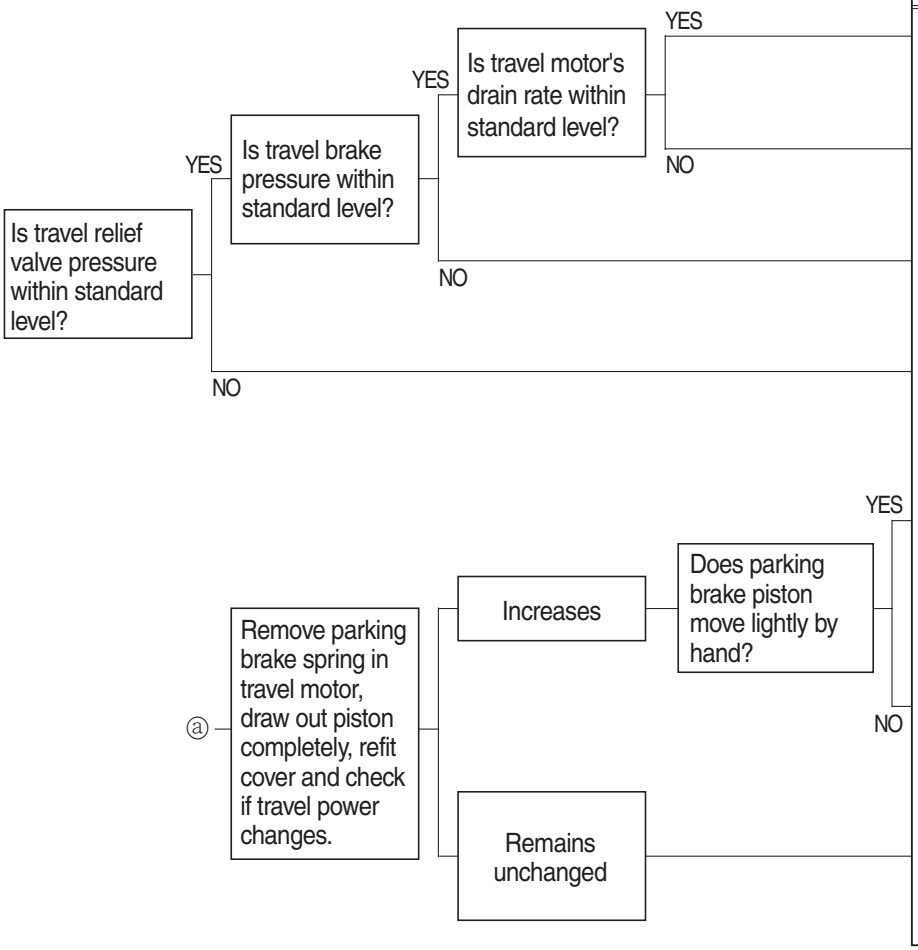
Cause	Remedy
Friction plate is faulty.	Disassemble and repair.
Clogged	Disassemble and clean pilot piping.
Travel motor is defective.	Disassemble and repair.
Brake valve is faulty.	Disassemble and repair or replace.

4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



Cause	Remedy
Hydraulic pump is faulty.	Inspect according to the procedure "Travel does not function at all on one side." However, a case where both LH and RH travel motions are disabled is extremely seldom statistically. Disassemble and repair.
Travel relief valve is faulty.	Disassemble and repair or replace.
Coupling at pump connection is broken.	Disassemble and repair.
	Replenish hydraulic oil.

5) TRAVEL ACTION IS POWERLESS (travel only)

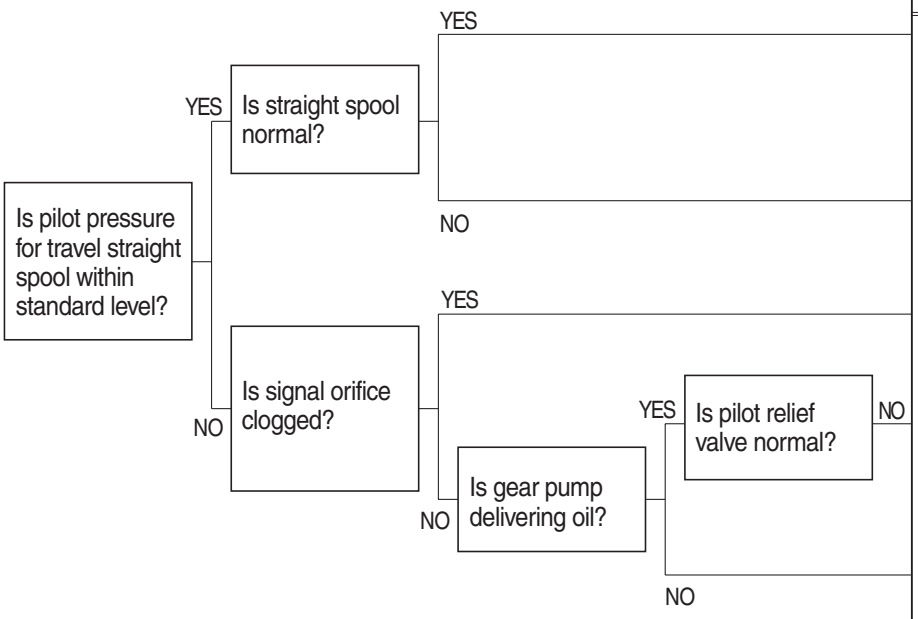


Cause	Remedy
ⓐ	
Travel motor is faulty.	Disassemble and repair.
Travel brake valve is defective.	Disassemble and repair or replace.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic circuit that releases travel parking brake is clogged with dirt.	Disassemble and clean.
Parking 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.

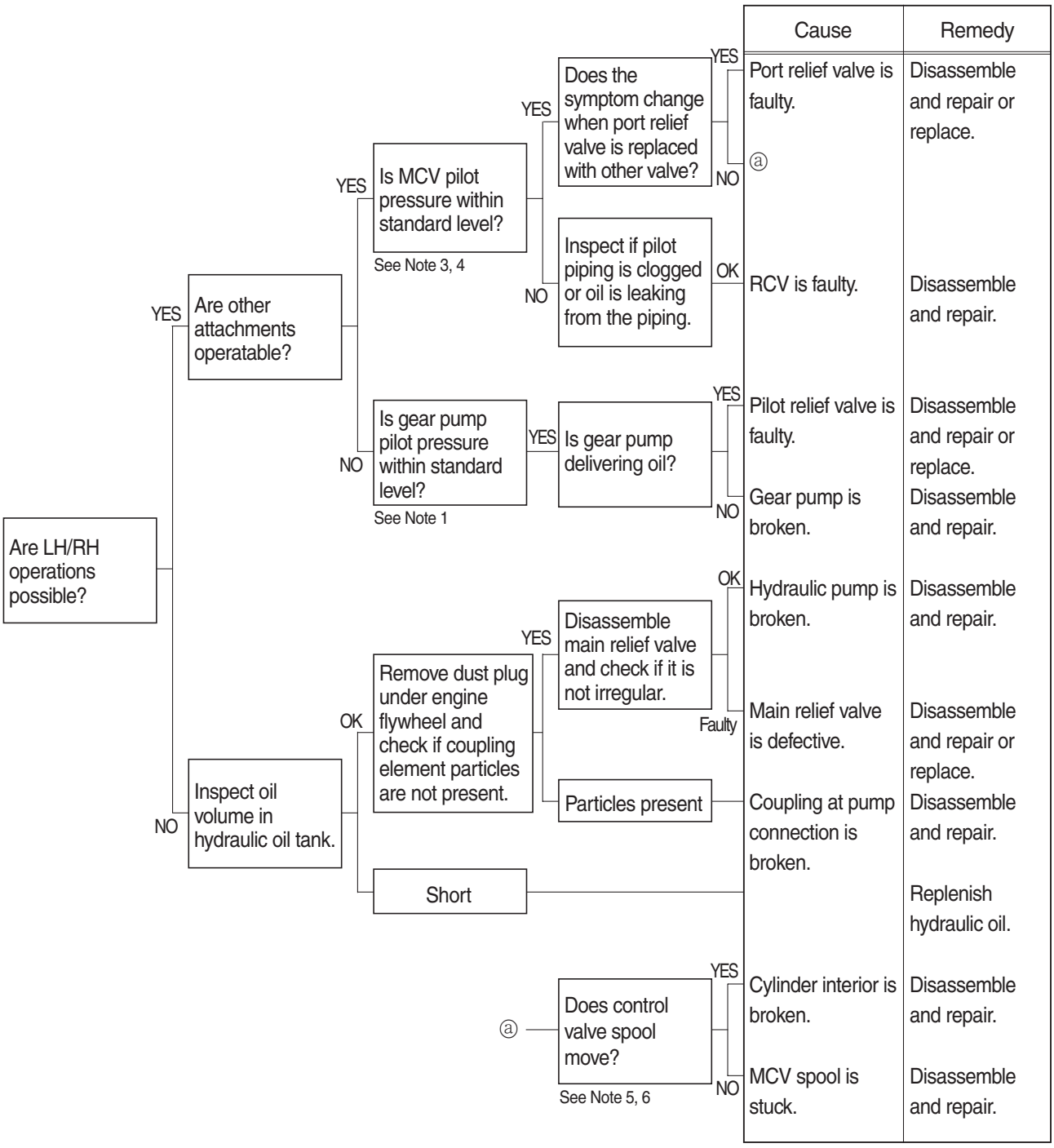
7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME



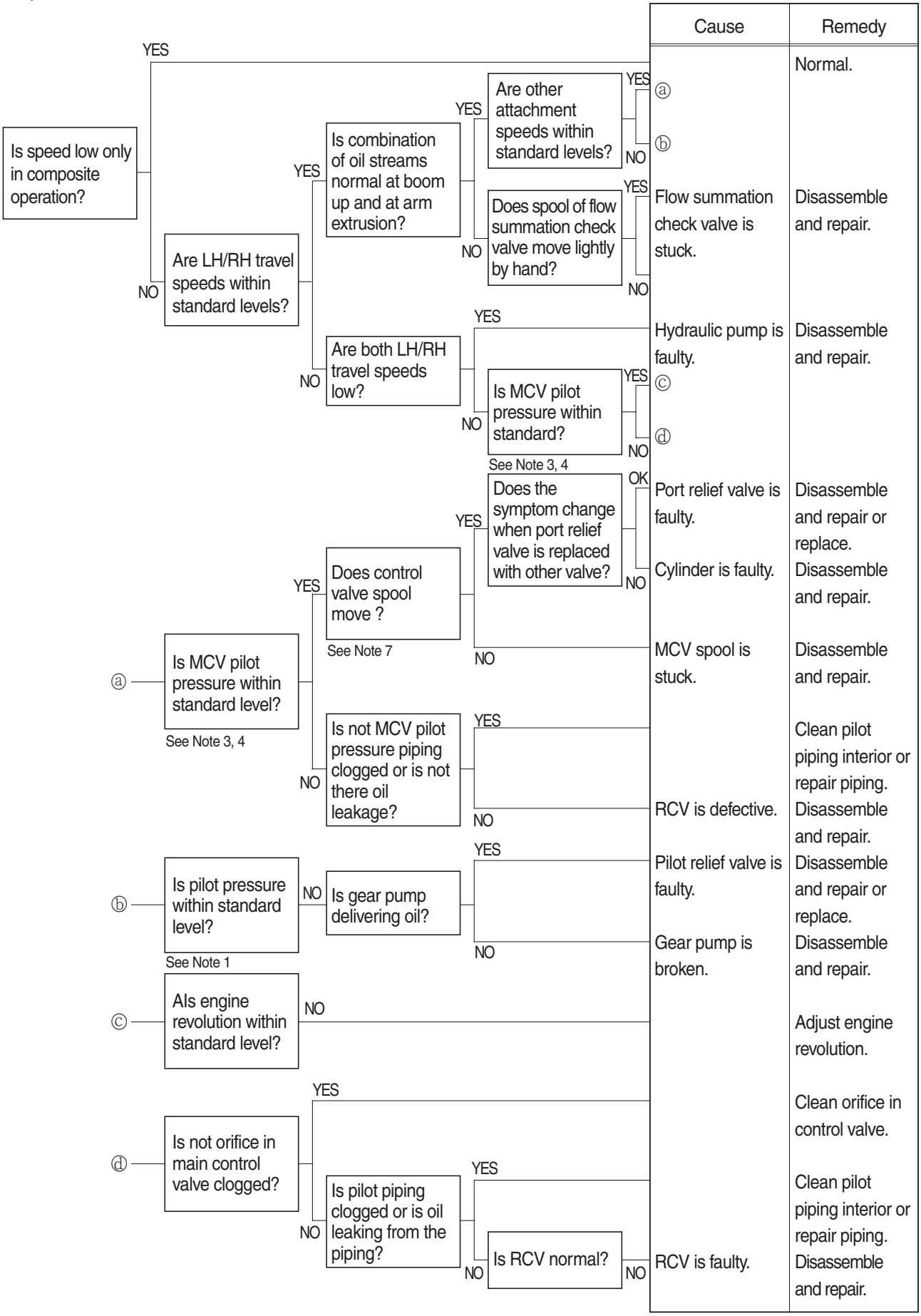
Cause	Remedy
	Normal.
Straight spool is faulty.	Repair or replace.
	Remove dirt on signal orifice.
Pilot relief valve is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.

6. ATTACHMENT SYSTEM

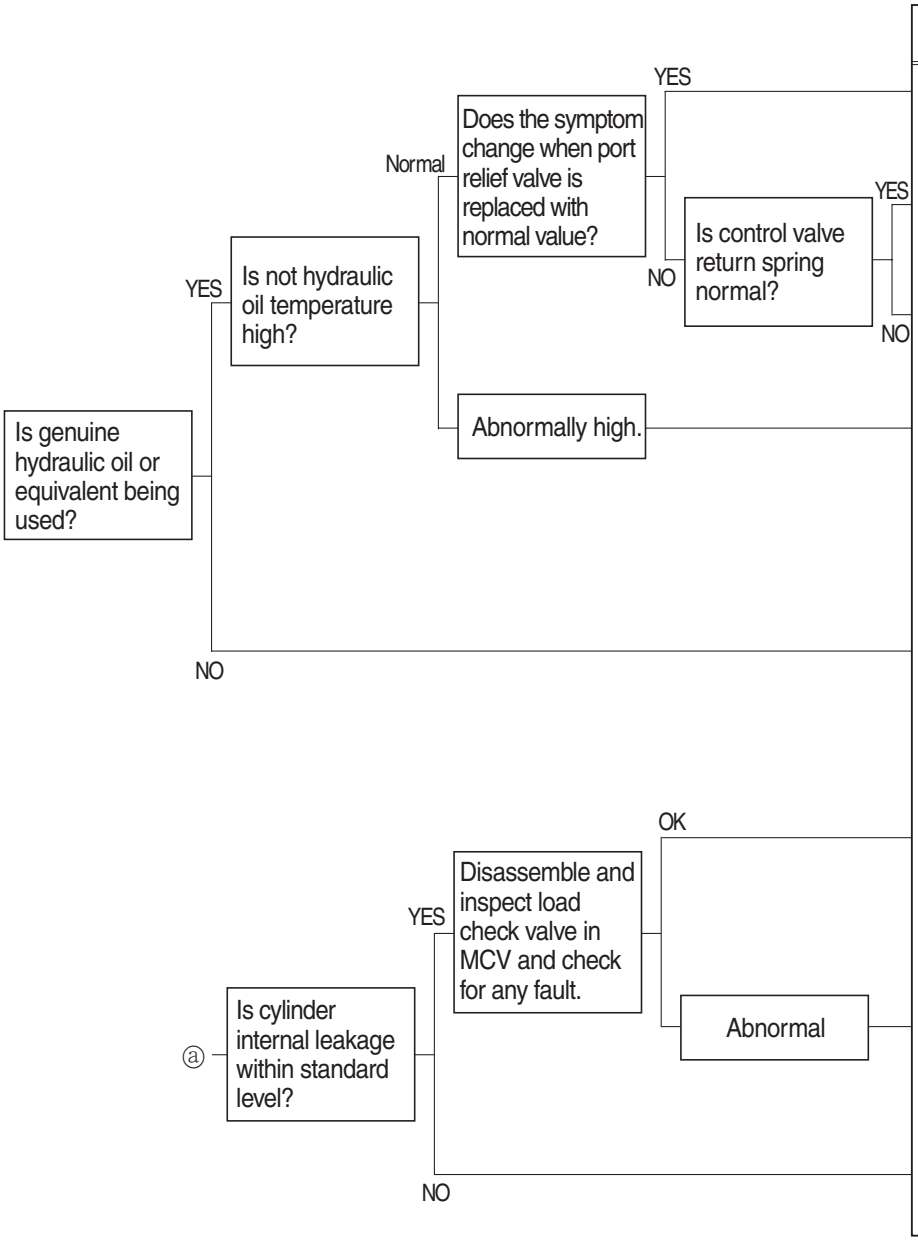
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

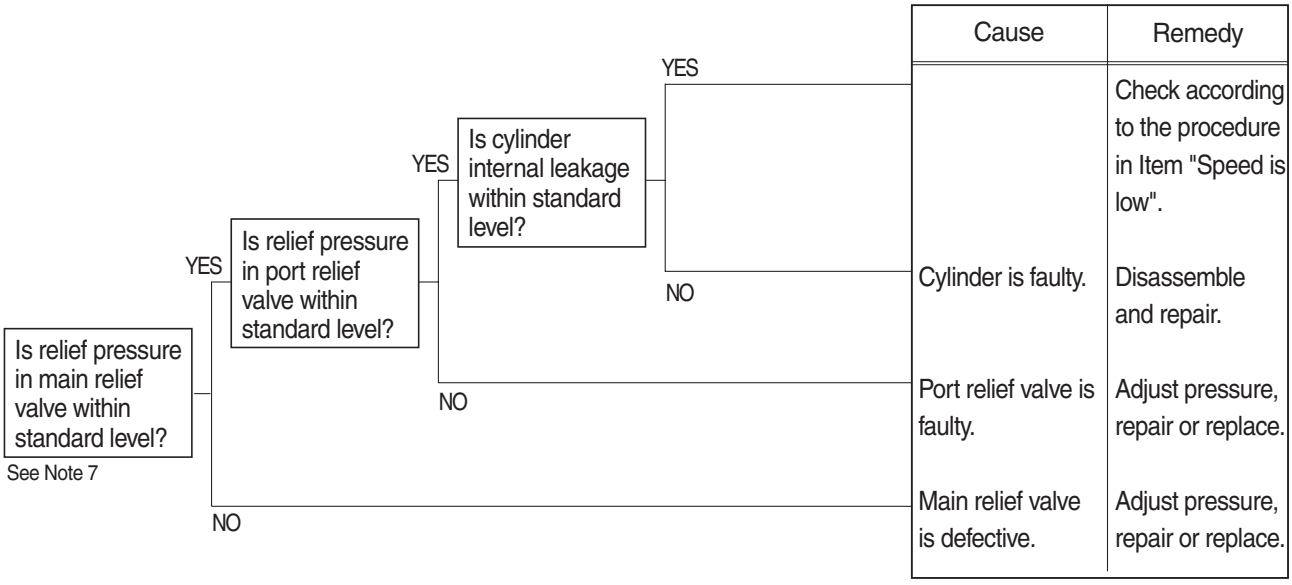


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



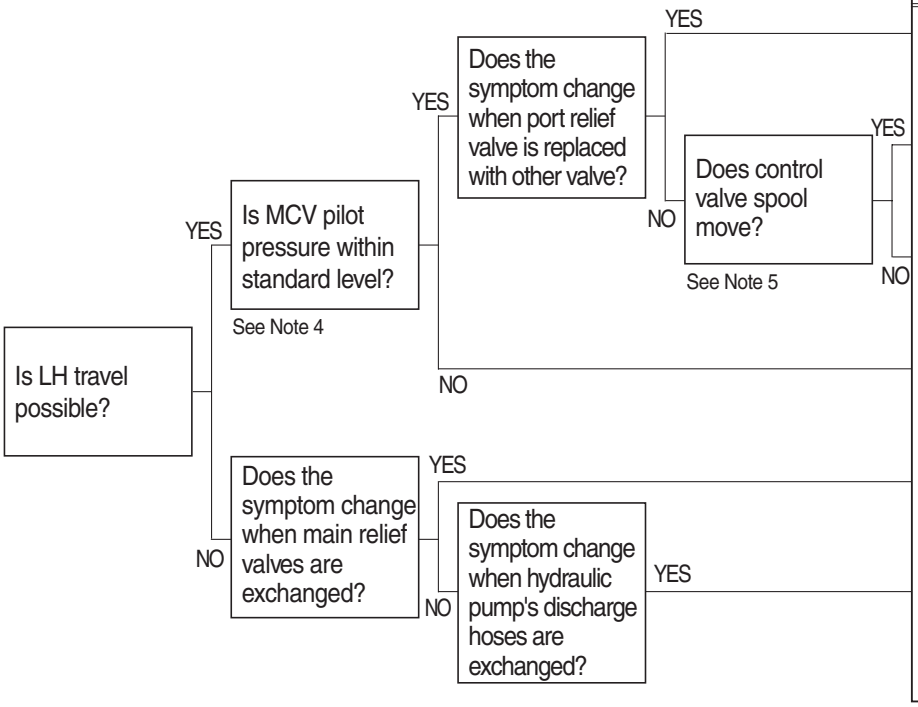
Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level. Replace with genuine hydraulic oil or equivalent.
Pressure tightness between 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



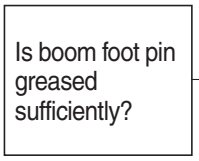
Cause	Remedy
Cylinder is faulty.	Check according to the procedure in Item "Speed is low". Disassemble and repair.
Port relief valve is faulty.	Adjust pressure, repair or replace.
Main relief valve is defective.	Adjust pressure, repair or replace.

5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



Cause	Remedy
Port relief valve is defective.	Disassemble and repair or replace.
Cylinder interior is broken.	Disassemble and repair.
MCV spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
Main relief valve is faulty.	Adjust pressure, repair or replace.
Hydraulic pump is broken.	Disassemble and repair.

6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED



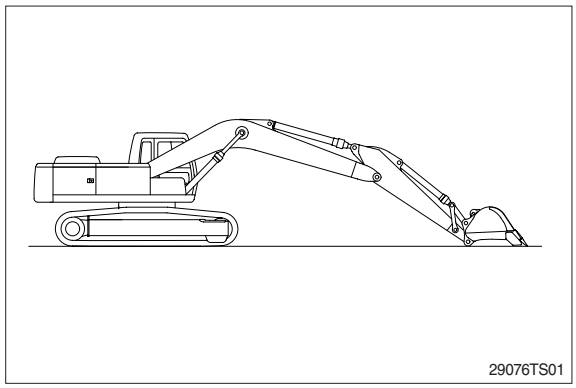
YES

NO

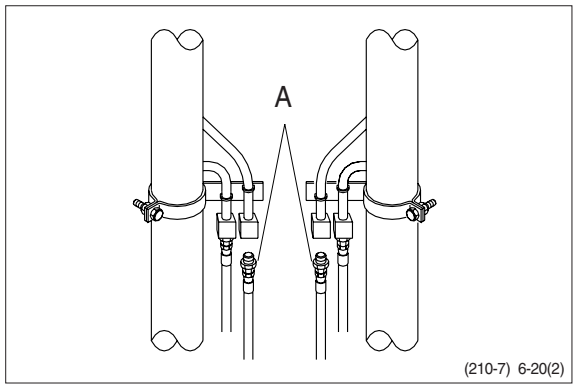
Cause	Remedy
	Frictional noise occurs between the sliding faces of boom cylinder's oil seal and boom proper. ※ Frictional noise will disappear if they are kept used.
Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in an initial stage, supply sufficient grease. If seizure is in a grown state, correct it by paper lapping or with an oil stone.

※ 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.

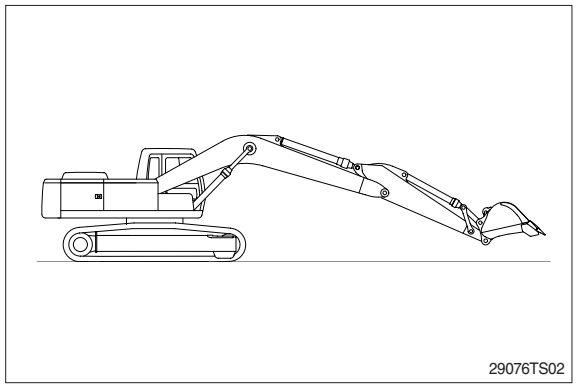


2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



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

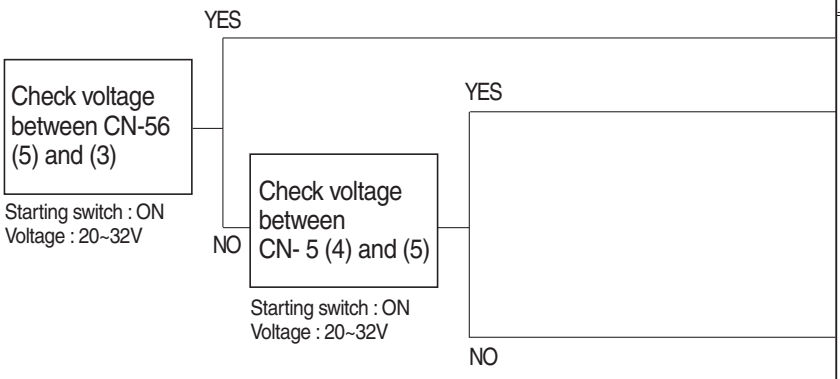
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



GROUP 3 ELECTRICAL SYSTEM (CLUSTER TYPE 1)

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

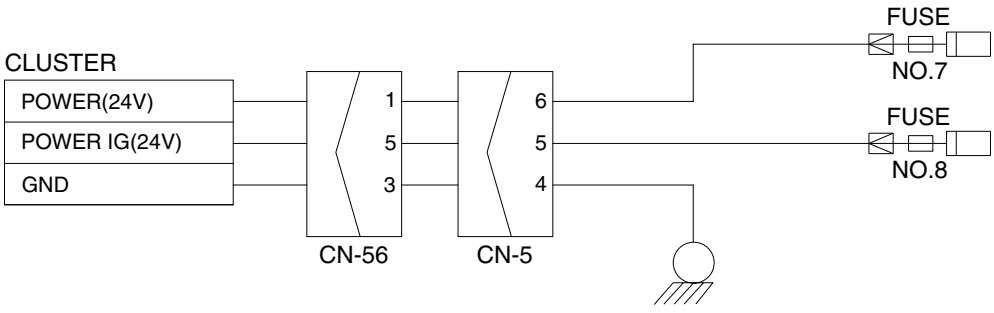
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.7 and 8 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5-CN-56	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (4) -GND or fuse No.7, 8	Repair or replace (after clean)

Check voltage

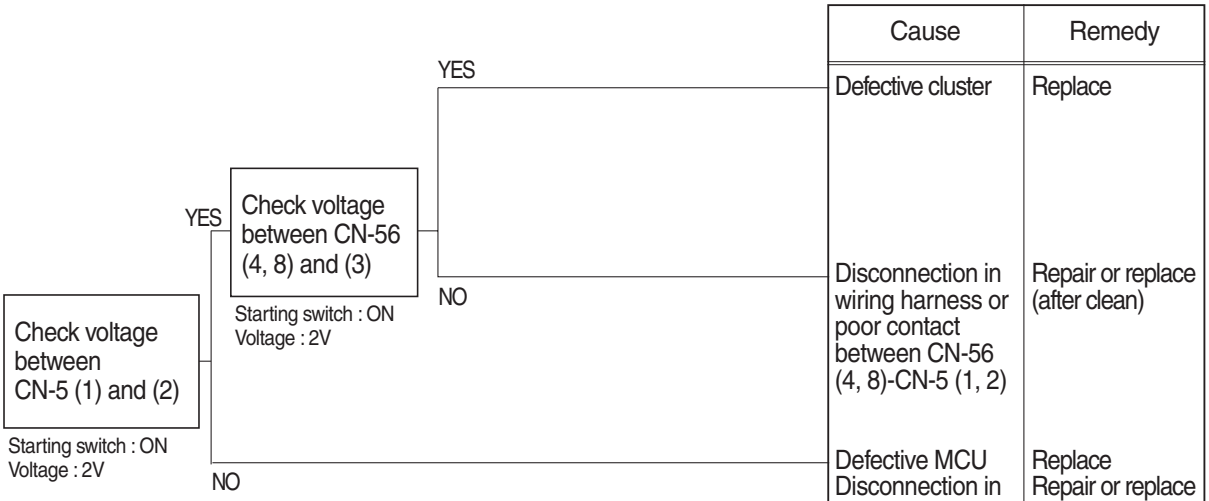
YES	20~32V
NO	0V



1409S6ES01

2. ⚠ COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

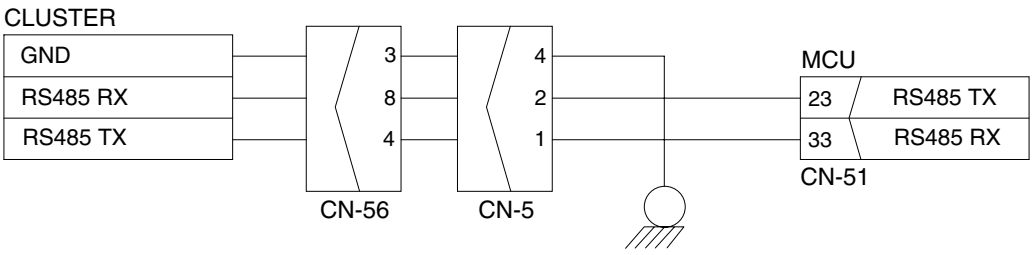
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56 (4, 8)-CN-5 (1, 2)	Repair or replace (after clean)
Defective MCU Disconnection in wiring harness or poor contact between CN-5 (1, 2)- CN-51(23, 33)	Replace Repair or replace (after clean)

Check voltage

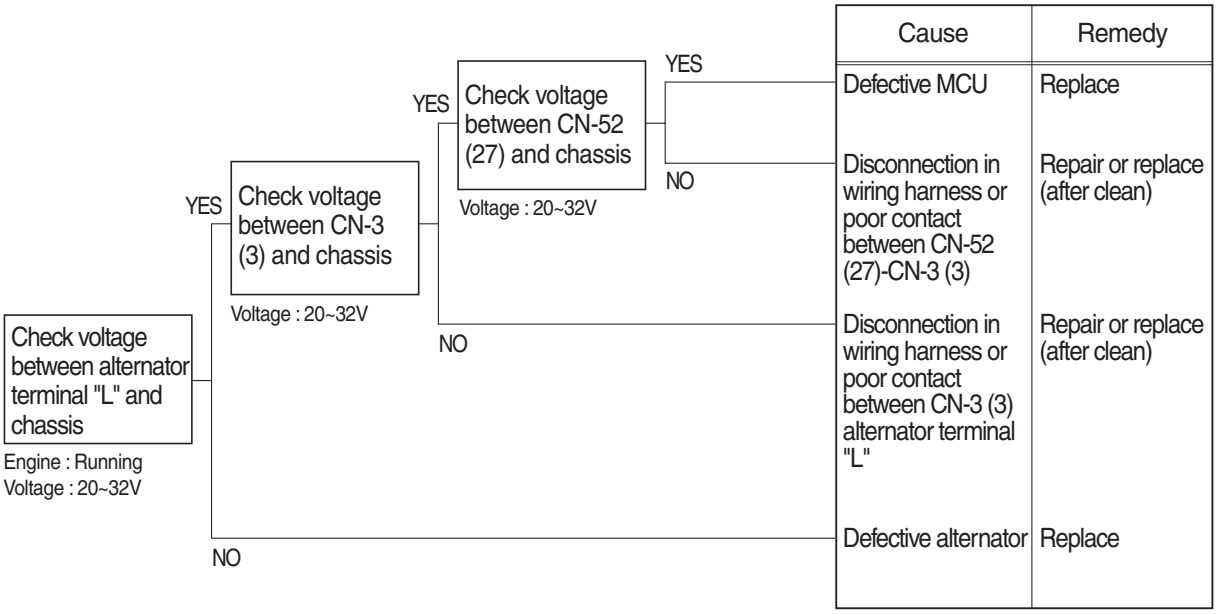
YES	2V
NO	0V



1409S6ES02

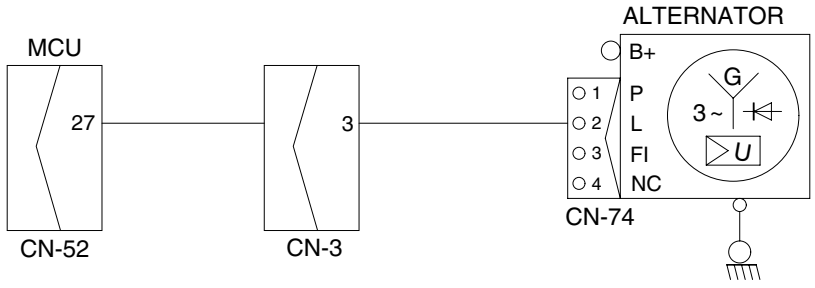
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

- 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

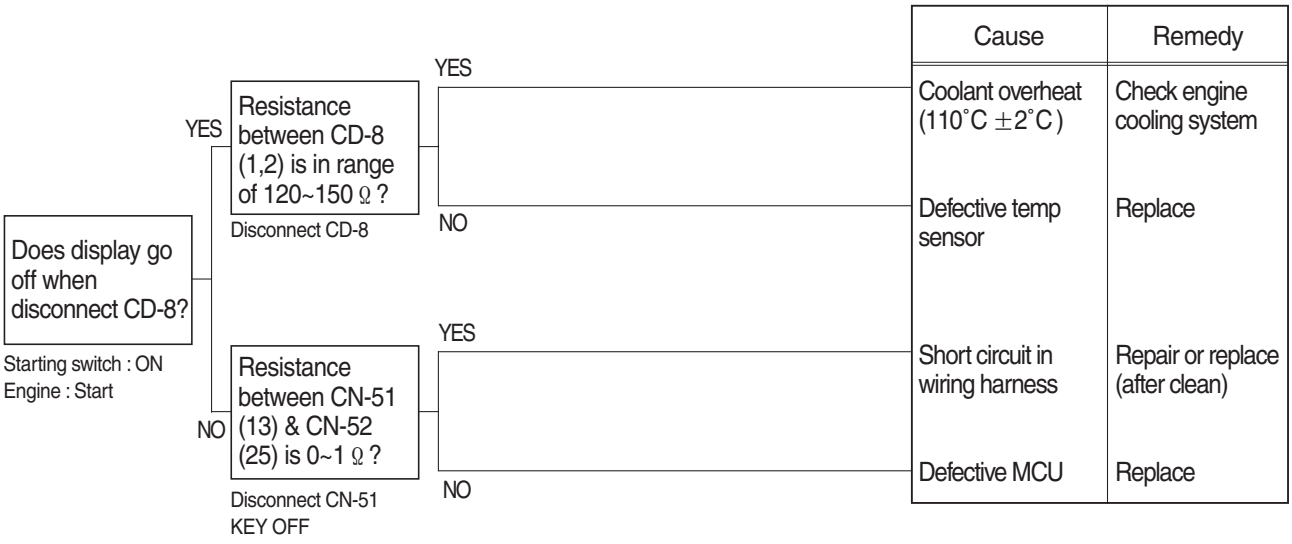
YES	20~32V
NO	0V

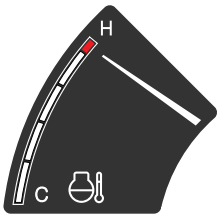


1409S6ES03

4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

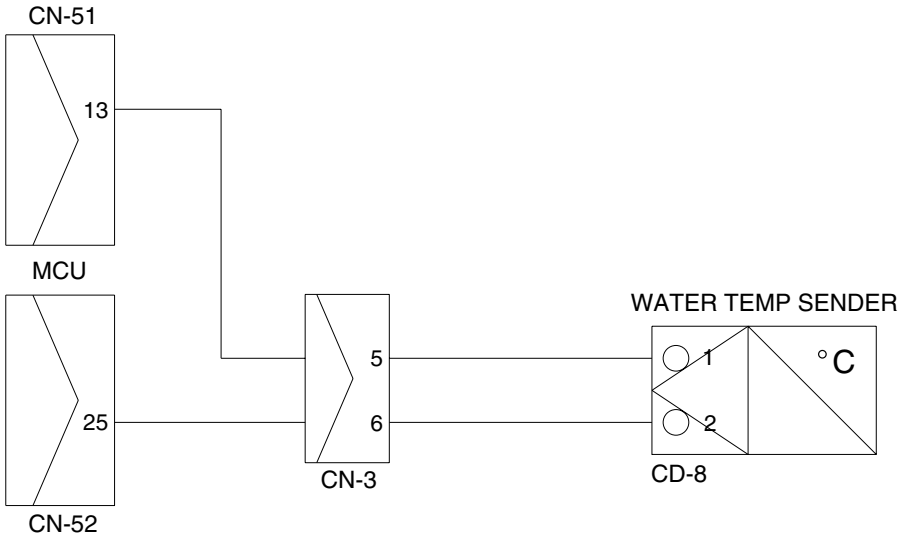
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

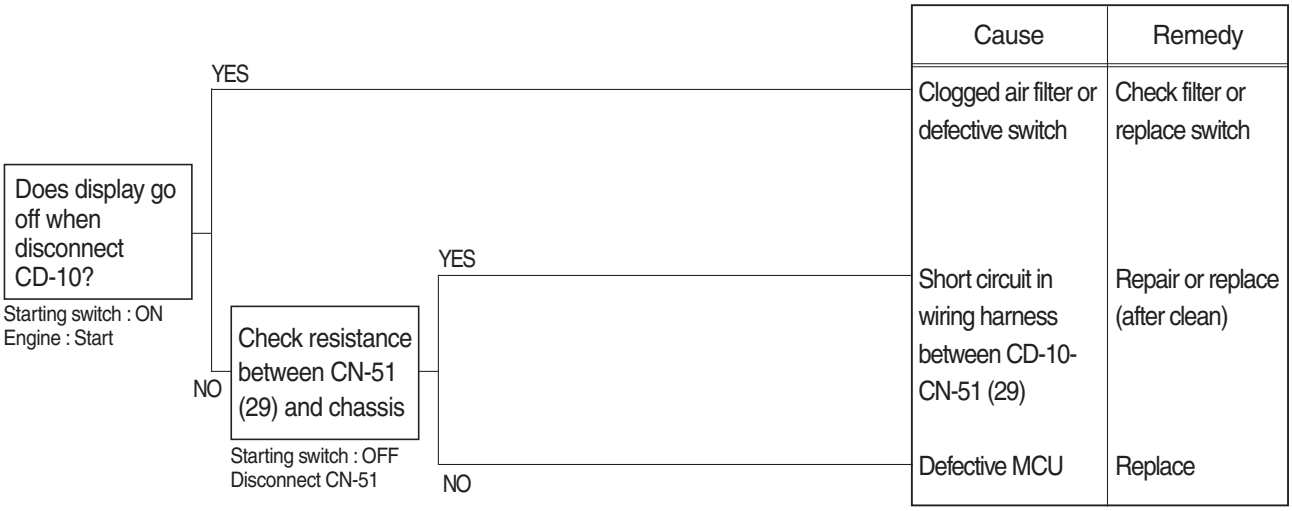
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



1409S6ES04

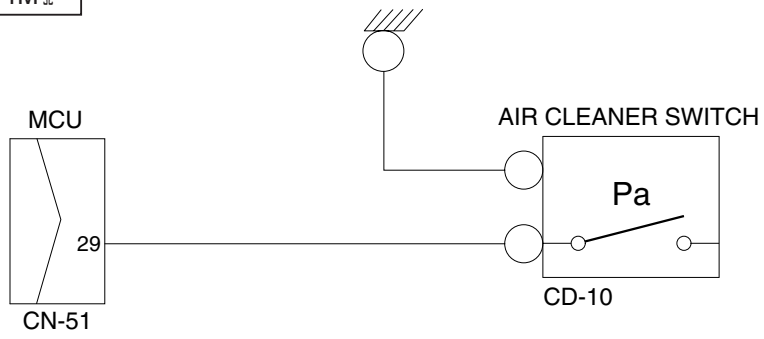
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

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



Check resistance

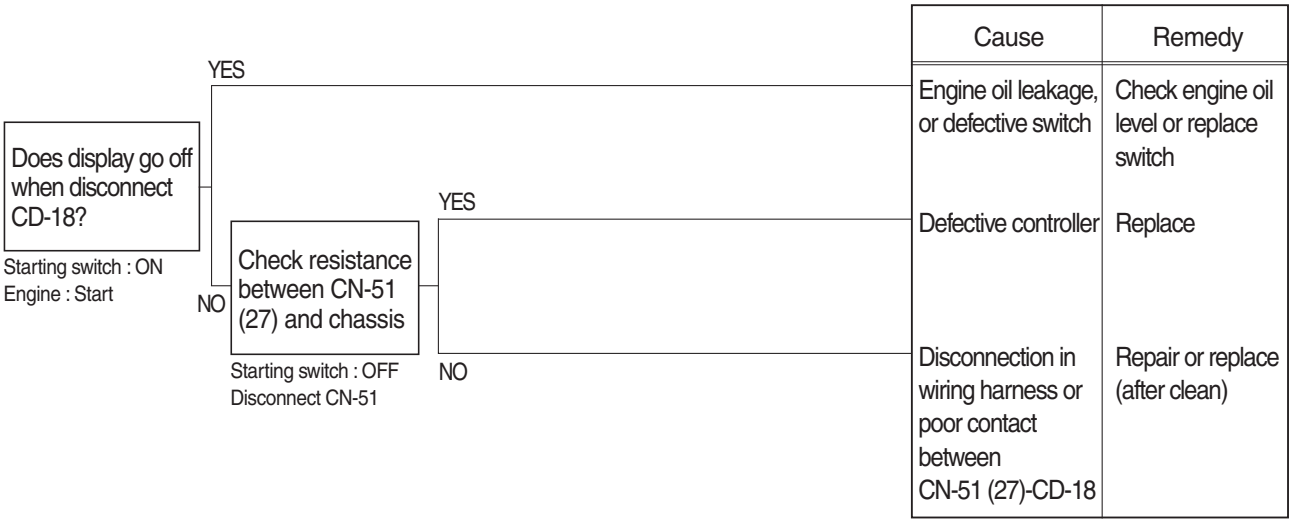
YES	MAX 1Ω
NO	MIN 1MΩ



1409S6ES05

6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

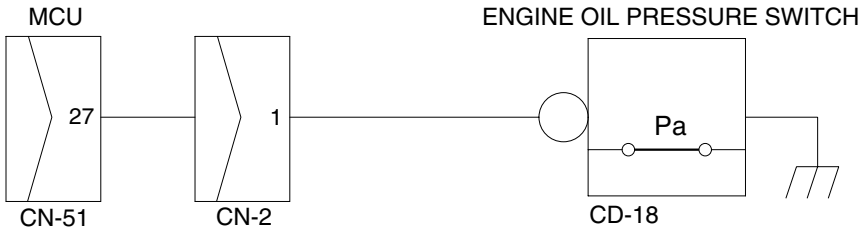
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Engine oil leakage, or defective switch	Check engine oil level or replace switch
Defective controller	Replace
Disconnection in wiring harness or poor contact between CN-51 (27)-CD-18	Repair or replace (after clean)

Check resistance

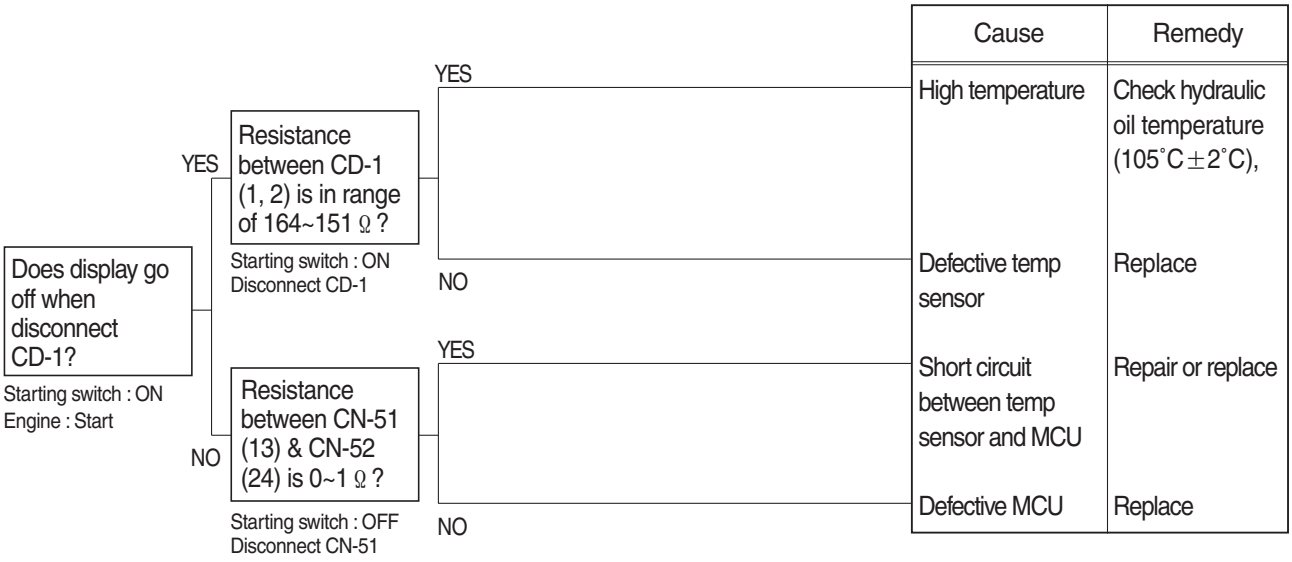
YES	MAX 1Ω
NO	MIN 1MΩ



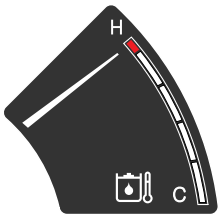
1409S6ES06

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.

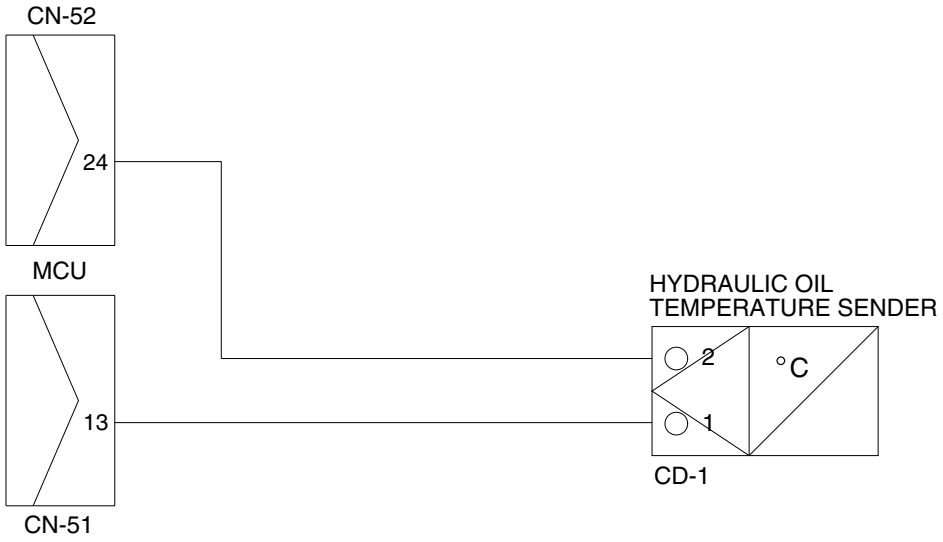


Cause	Remedy
High temperature	Check hydraulic oil temperature (105˚C±2˚C),
Defective temp sensor	Replace
Short circuit between temp sensor and MCU	Repair or replace
Defective MCU	Replace



Check Table

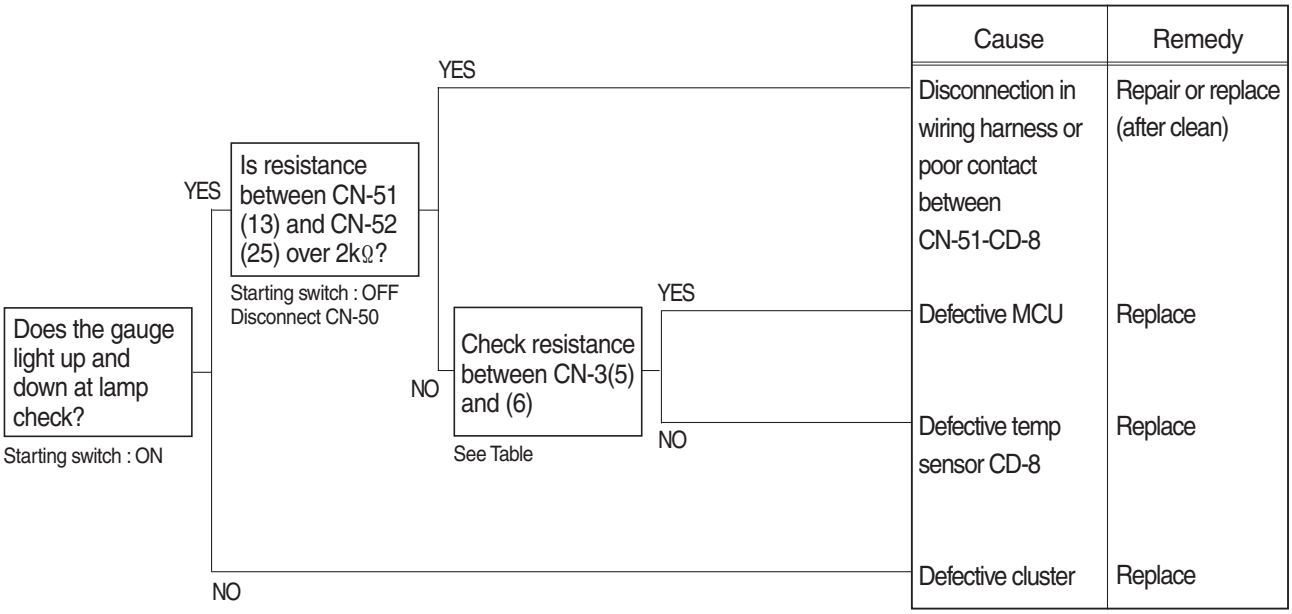
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151

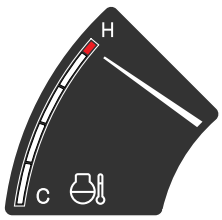


1409S6ES07

8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE (HCESPN 304, FMI 3 or 4)

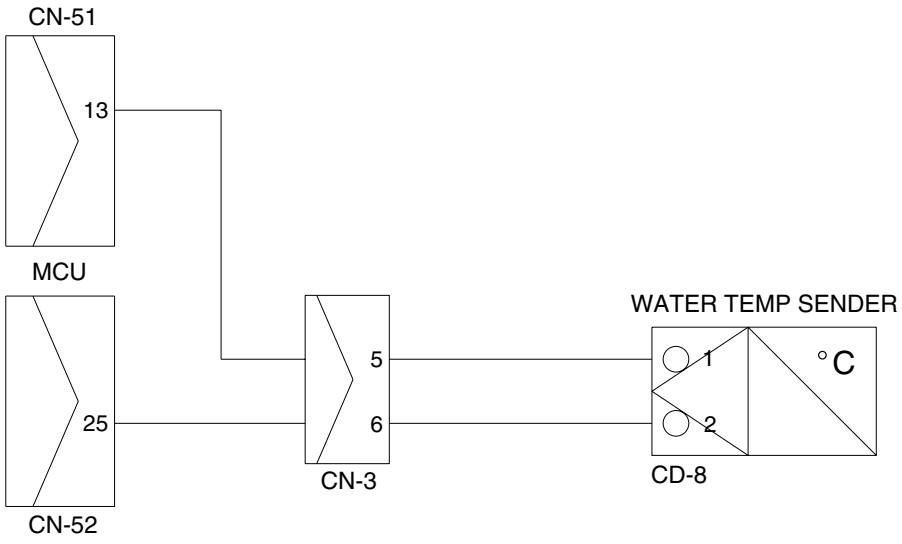
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

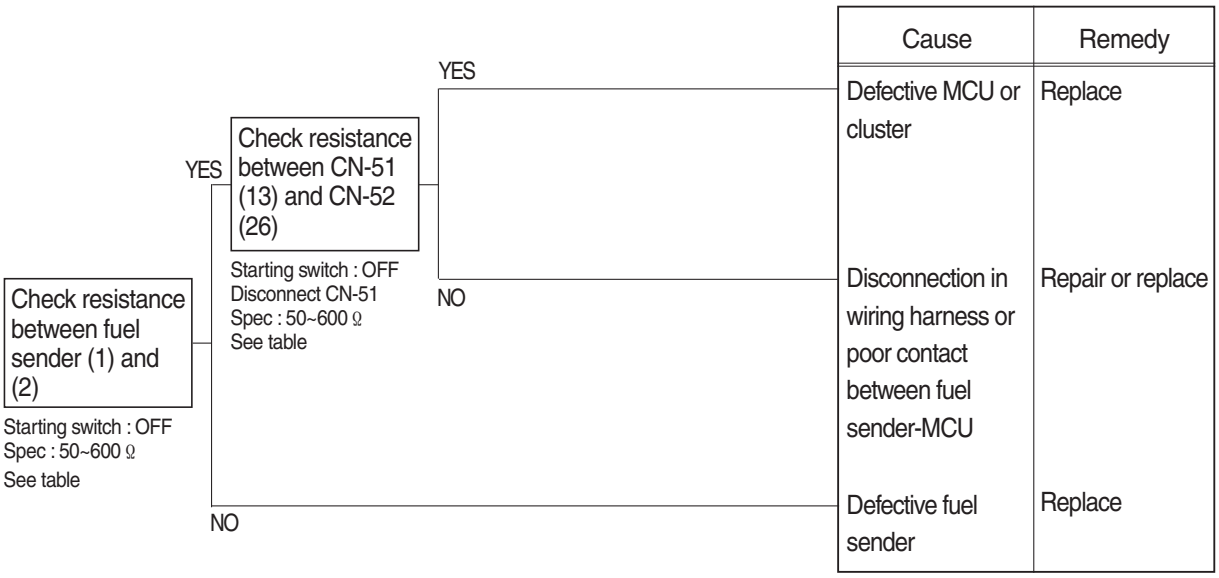
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



1409S6ES04

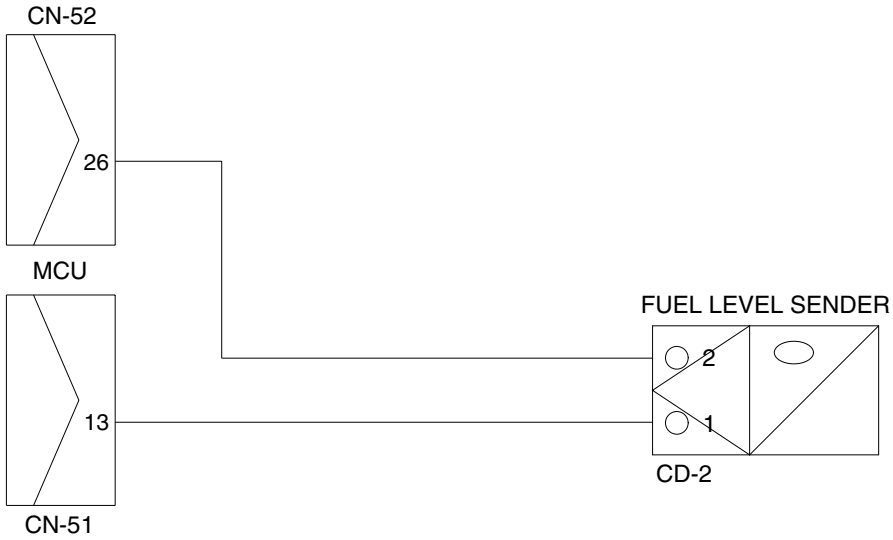
9. WHEN FUEL GAUGE DOES NOT OPERATE (HCESPN 301, FMI 3 or 4)

- 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

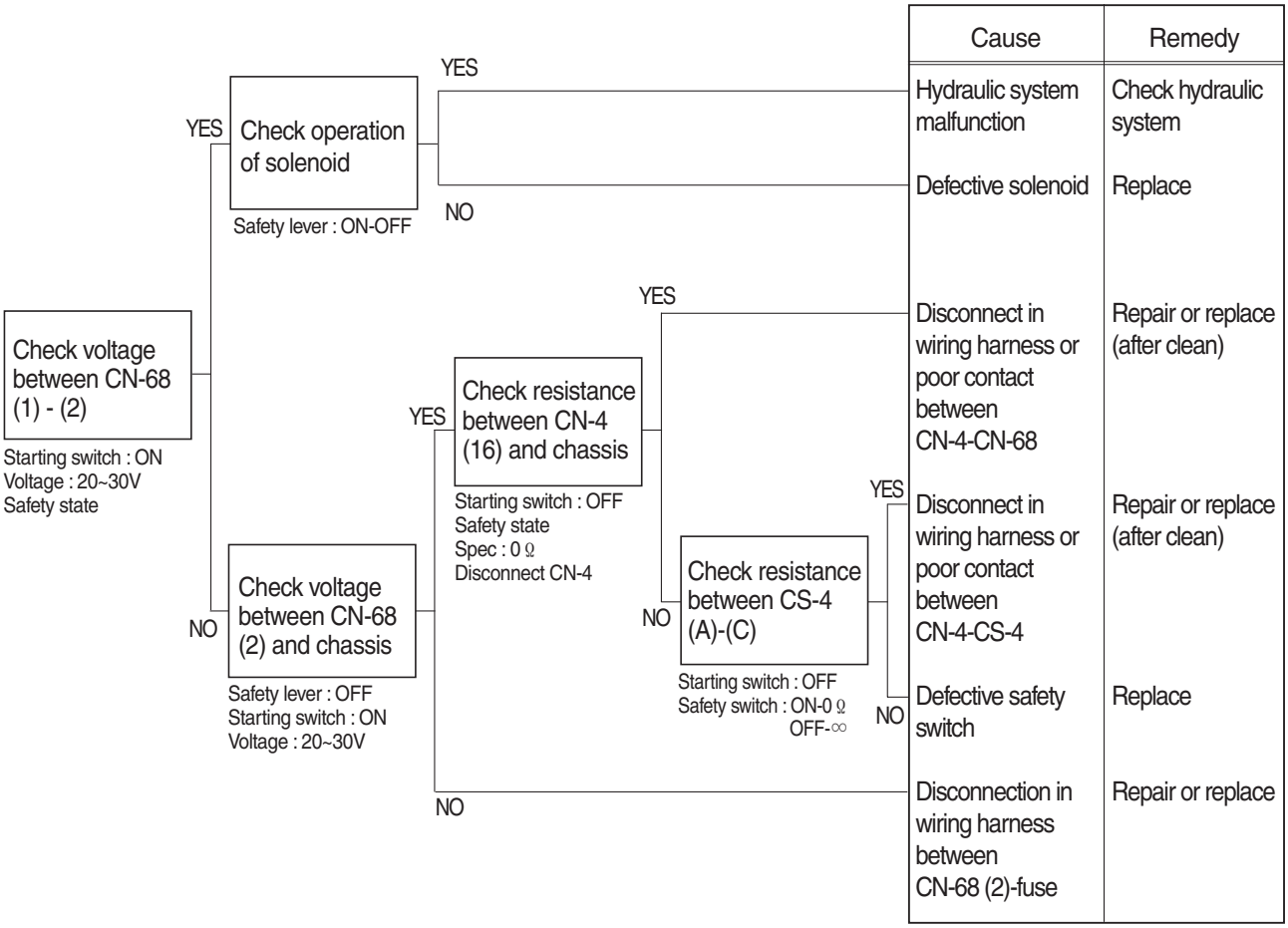
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

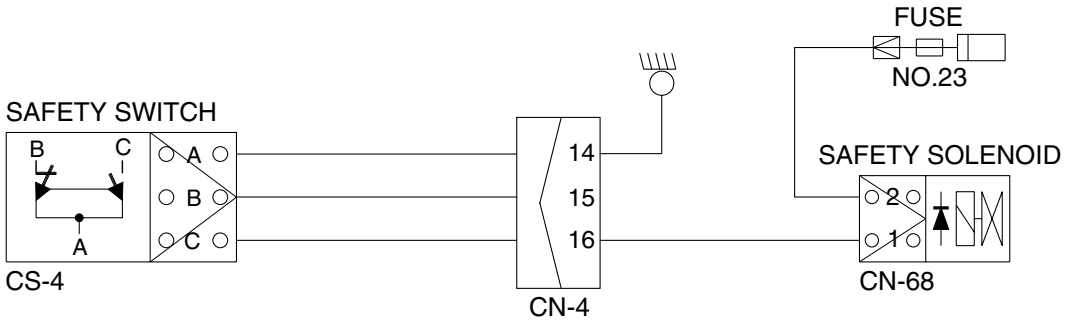


1409S6ES09

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.23 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

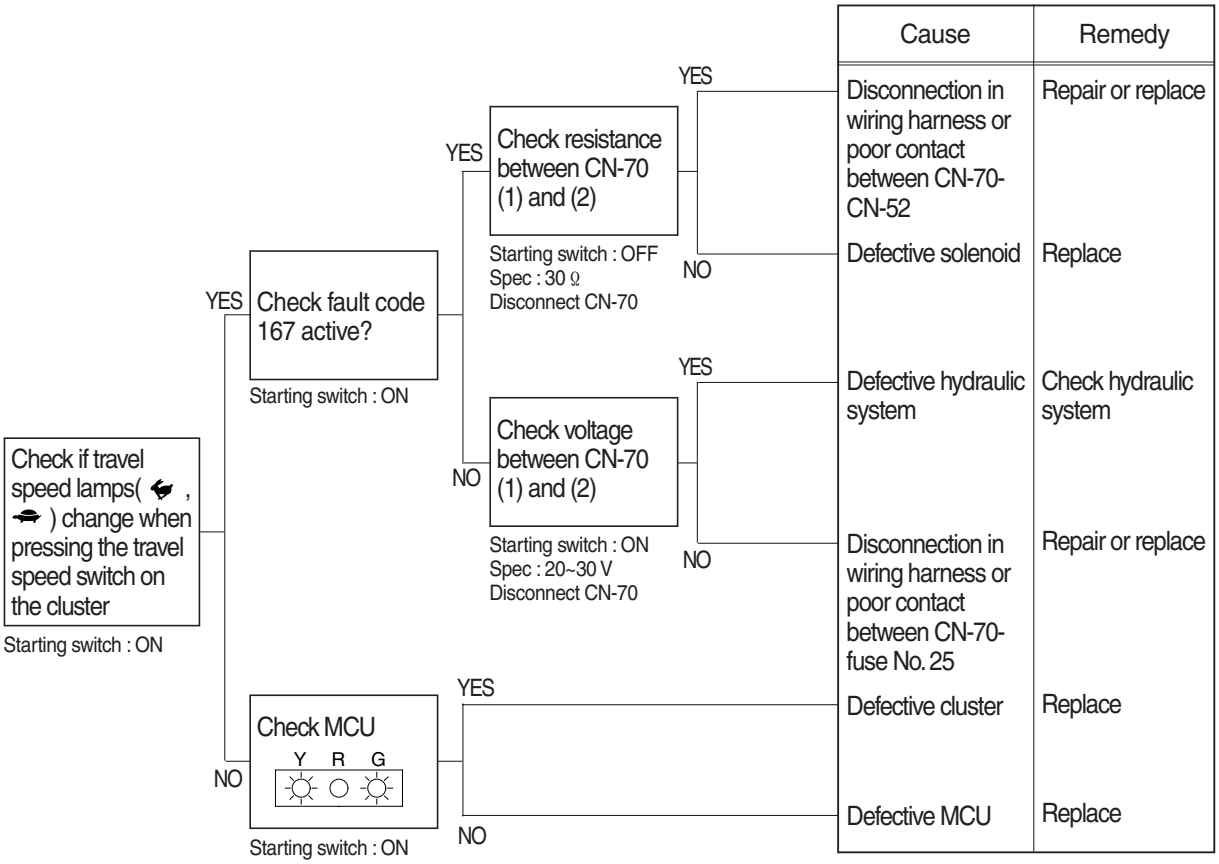


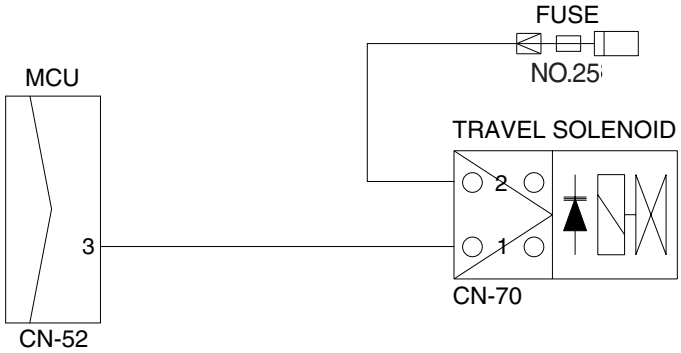


21096ES10

11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 5 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 fuse No. 25 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

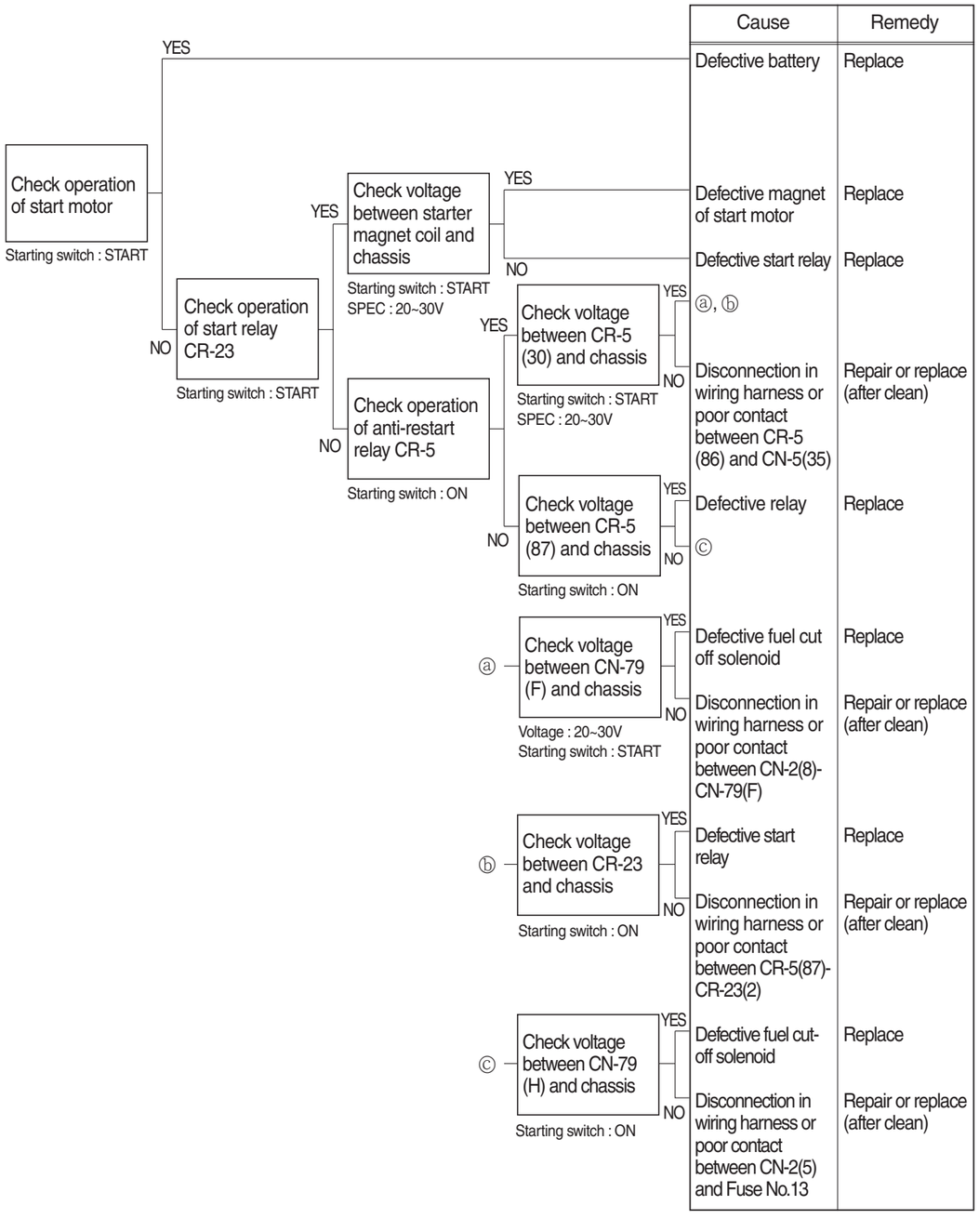


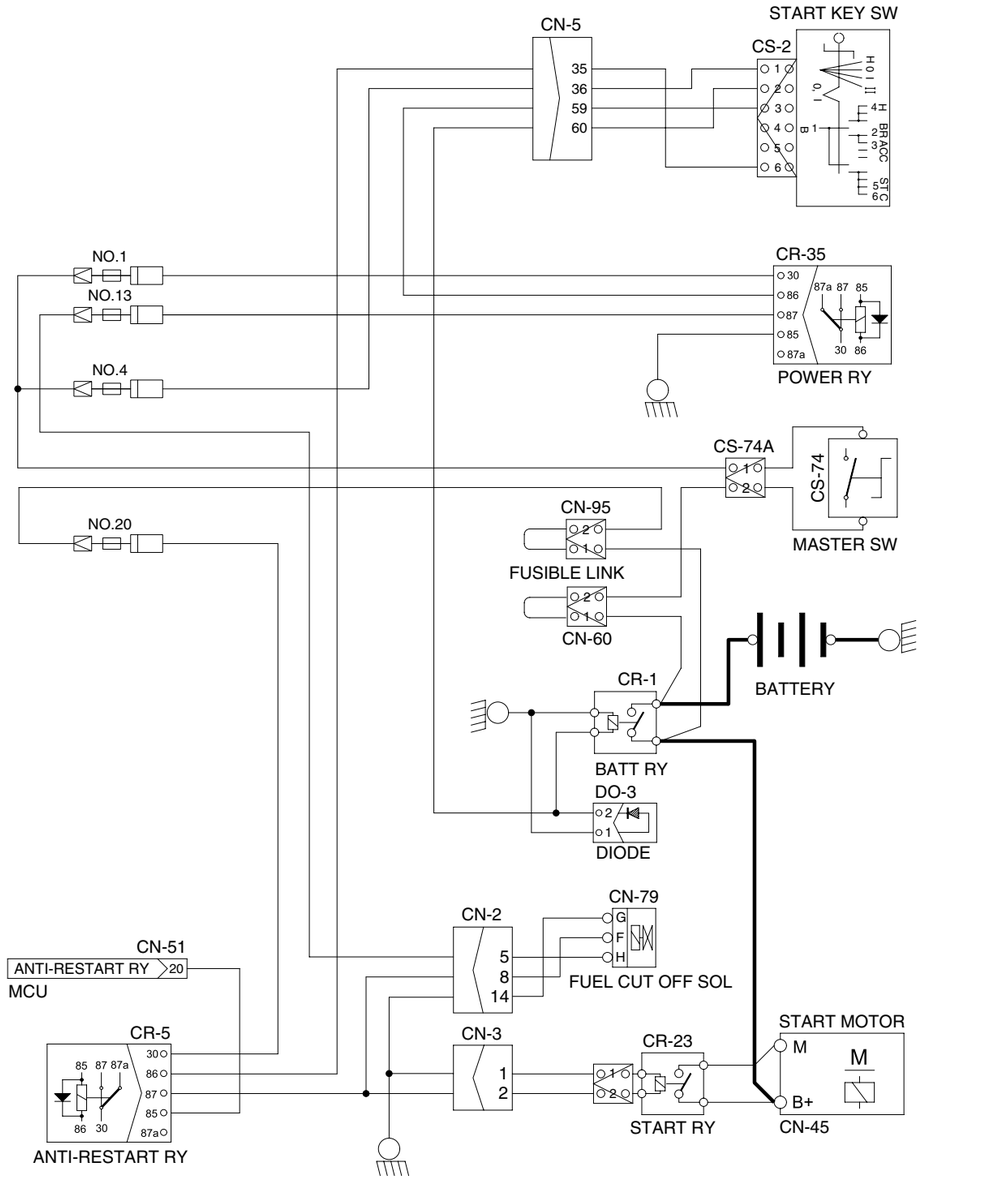


1409S6ES11

12. WHEN ENGINE DOES NOT START (lights up condition)

- Check supply of the power at engine stop solenoid while starting switch is ON.
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 1, 4, 13 and 20 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

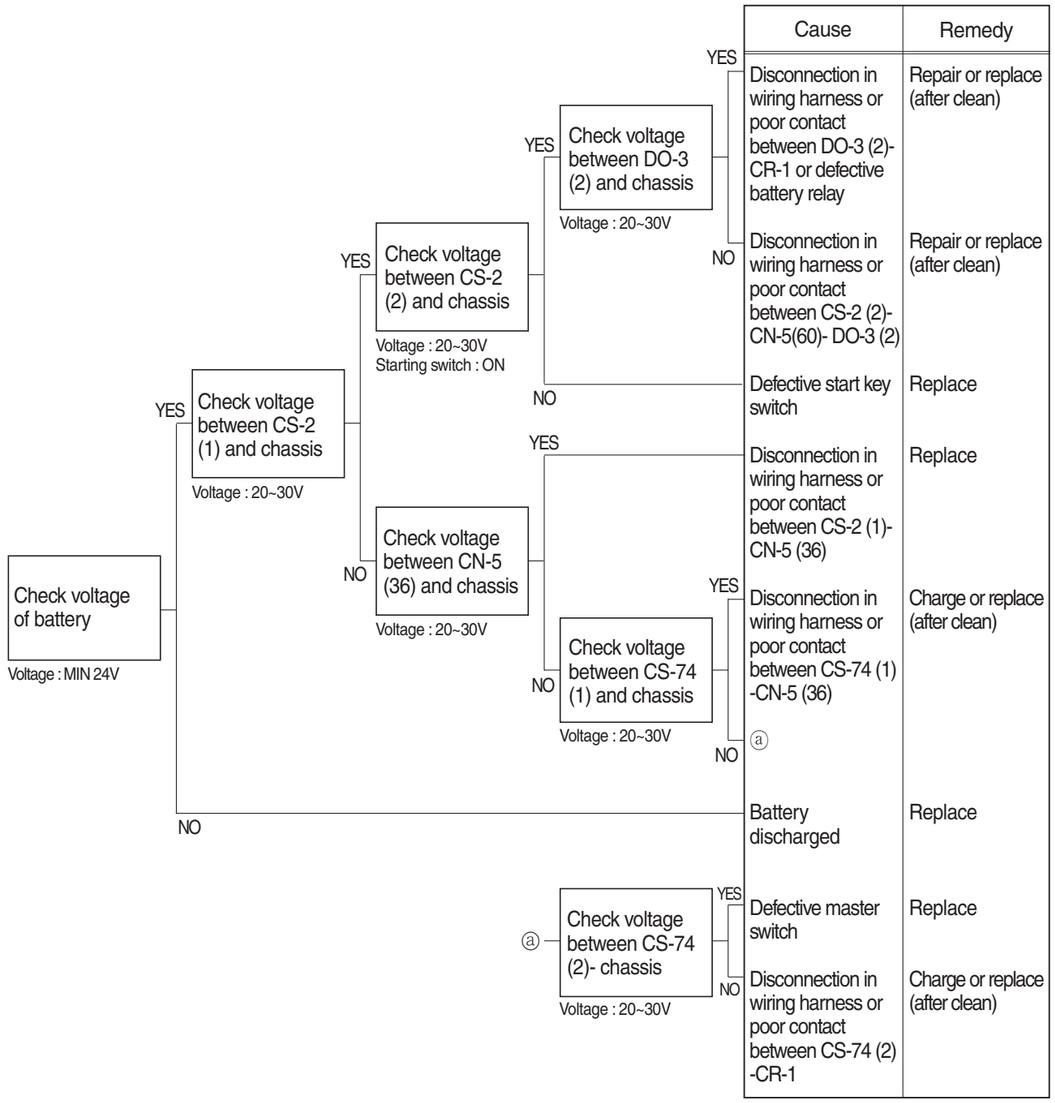




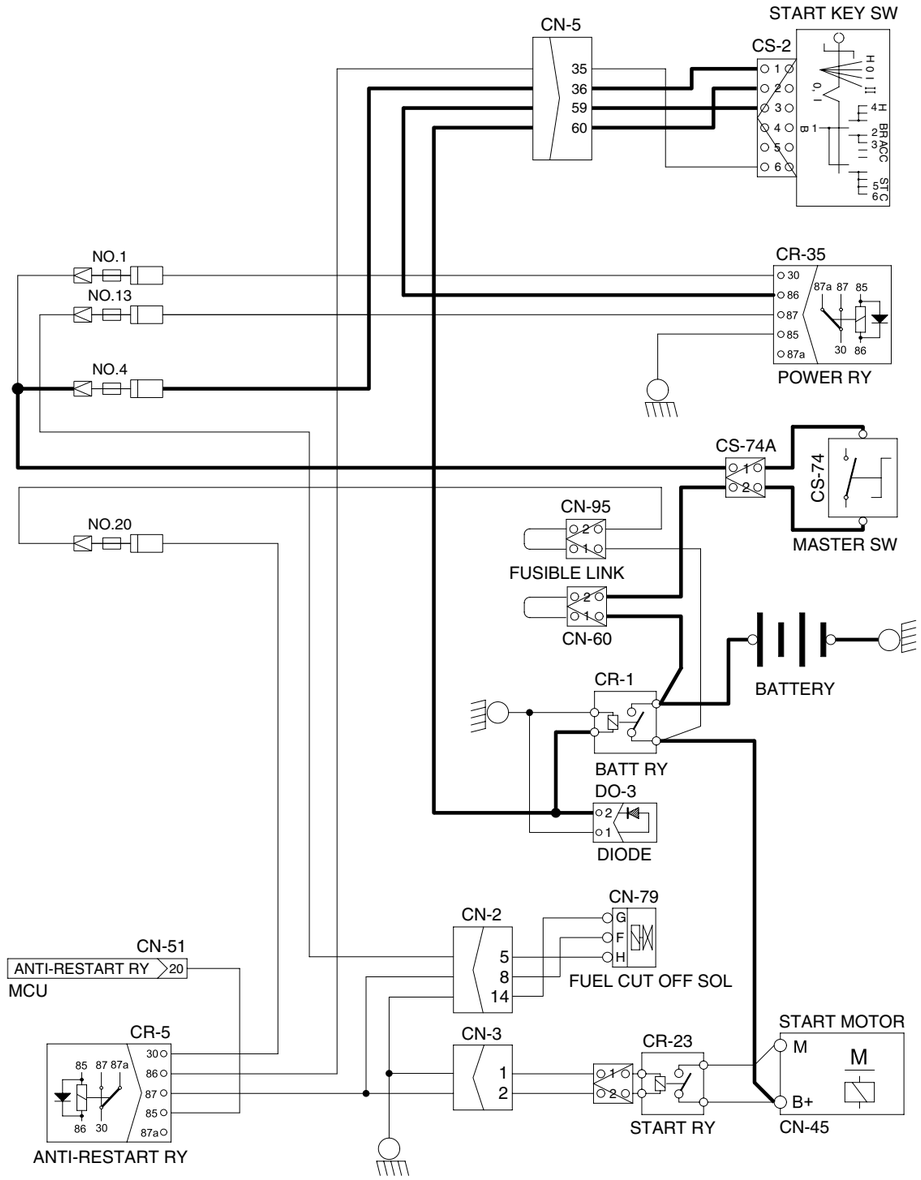
2209S6ES12

13. 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 fusible link (CN-60).
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



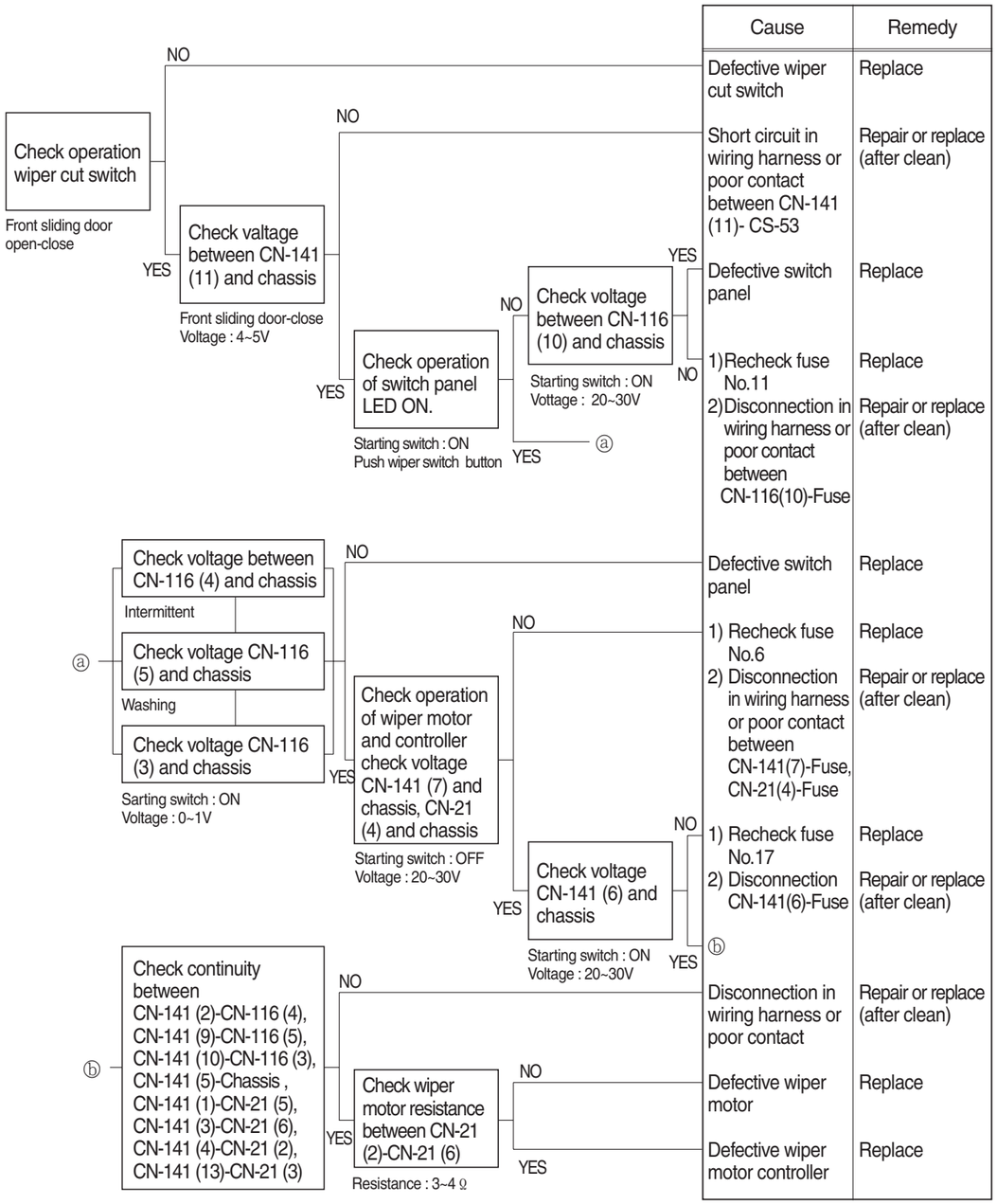
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-3 (2)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2 (2)-CN-5(60)- DO-3 (2)	Repair or replace (after clean)
Defective start key switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74 (1) -CN-5 (36)	Charge or replace (after clean)
Battery discharged	Replace
Defective master switch	Replace
Disconnection in wiring harness or poor contact between CS-74 (2) -CR-1	Charge or replace (after clean)



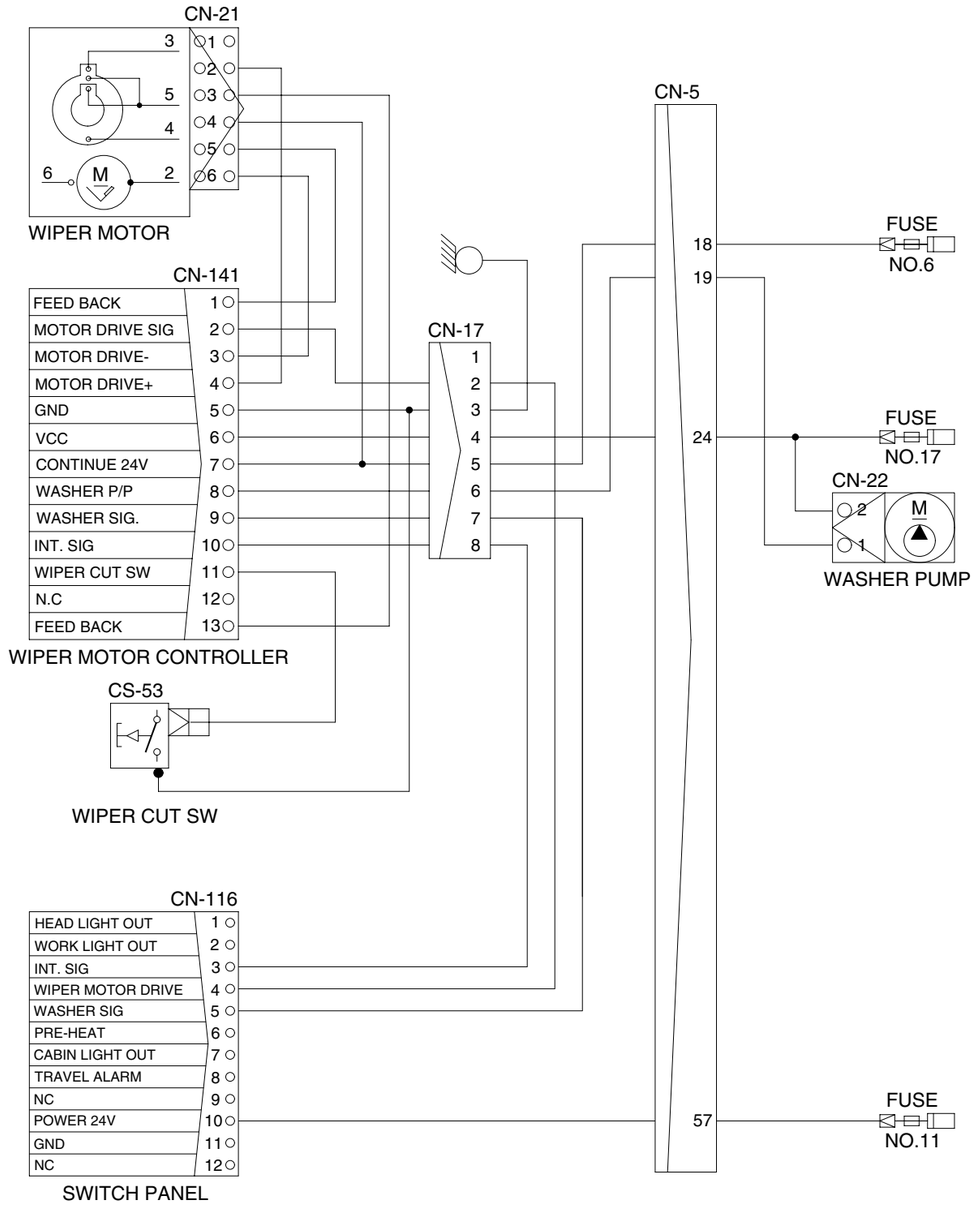
2209S6ES13

14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 6, 11 and 17 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



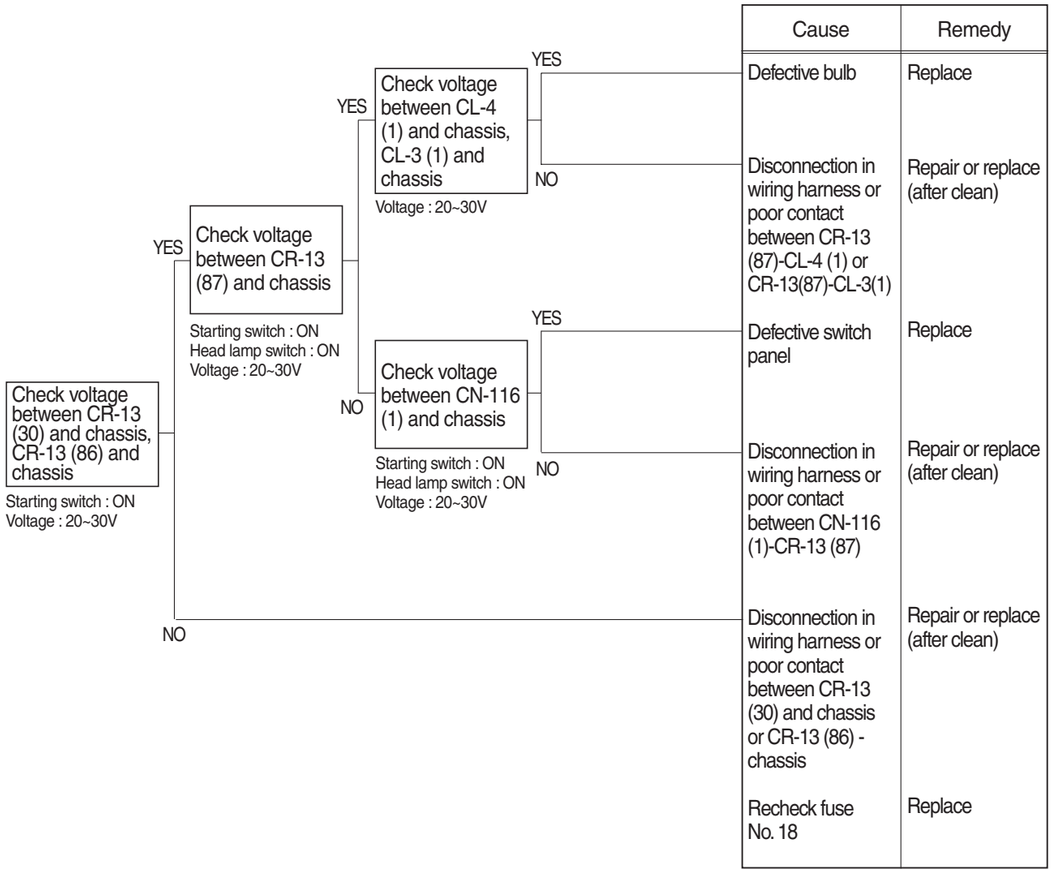
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective switch panel	Replace
1)Recheck fuse No.11	Replace
2)Disconnection in wiring harness or poor contact between CN-116(10)-Fuse	Repair or replace (after clean)
Defective switch panel	Replace
1) Recheck fuse No.6	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.17	Replace
2) Disconnection CN-141(6)-Fuse	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



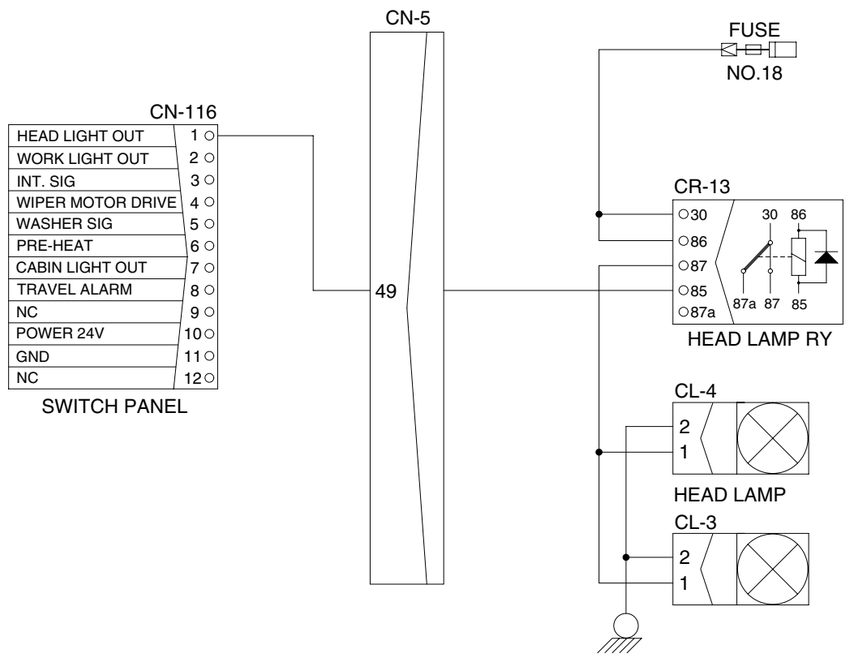
2209S6ES14

15. 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 fuse No.18 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



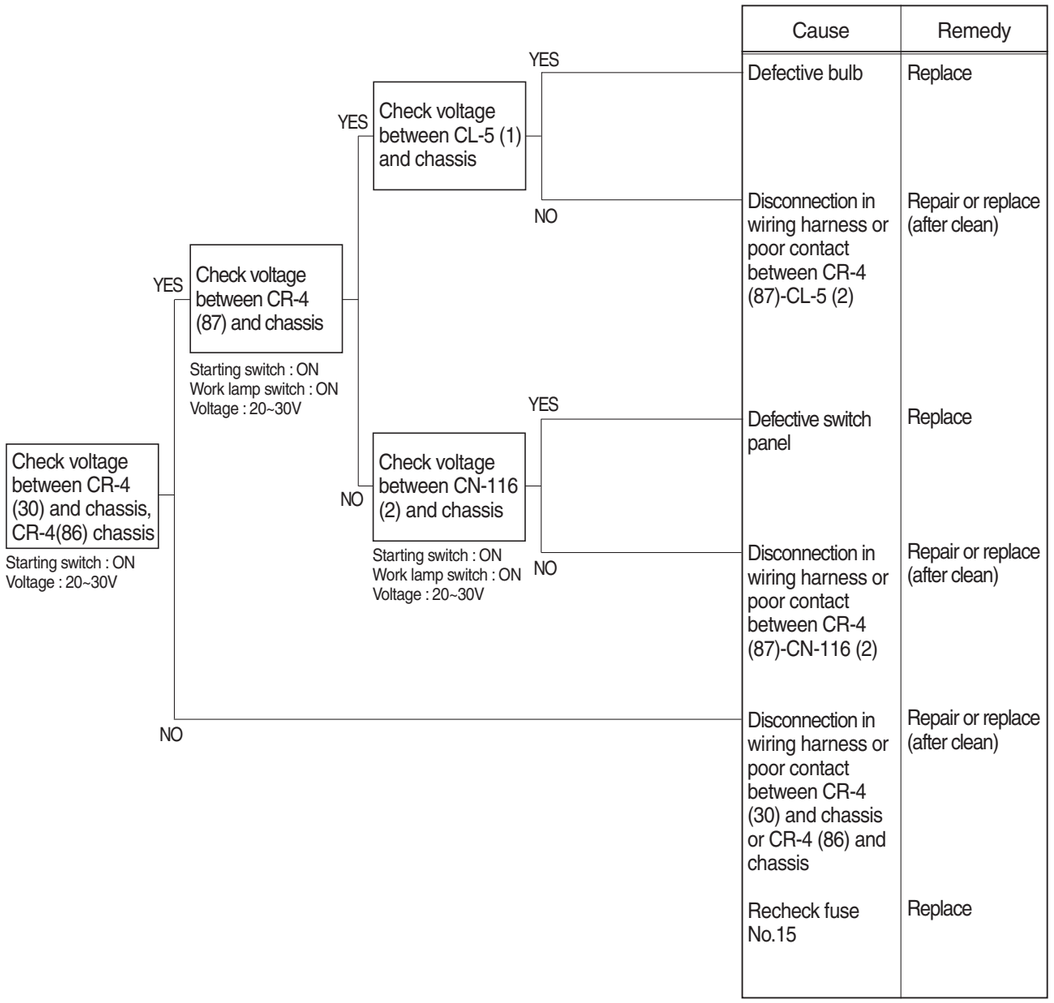
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13(87)-CL-3(1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (87)	Repair or replace (after clean)
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. 18	Replace

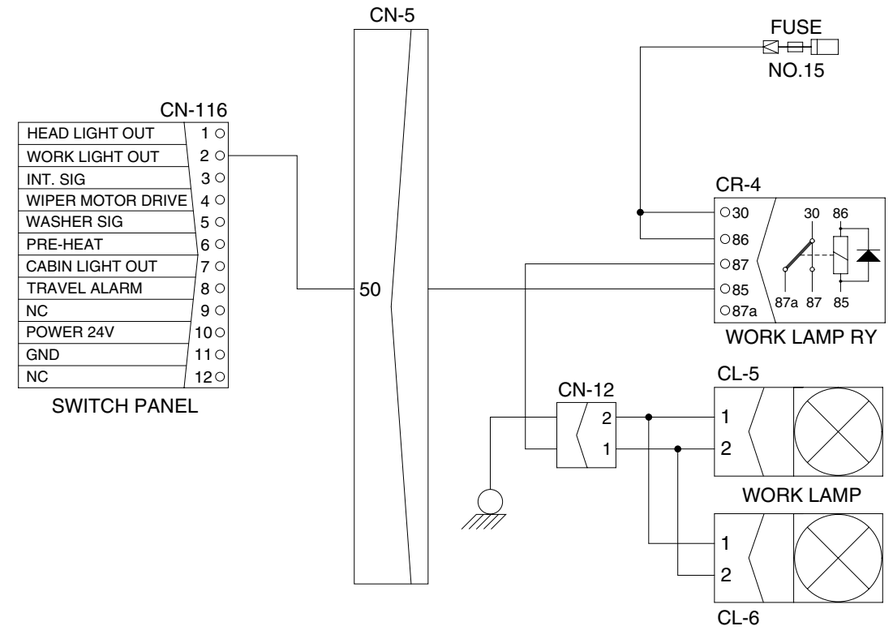


14096ES15

16. 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 fuse No.15 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



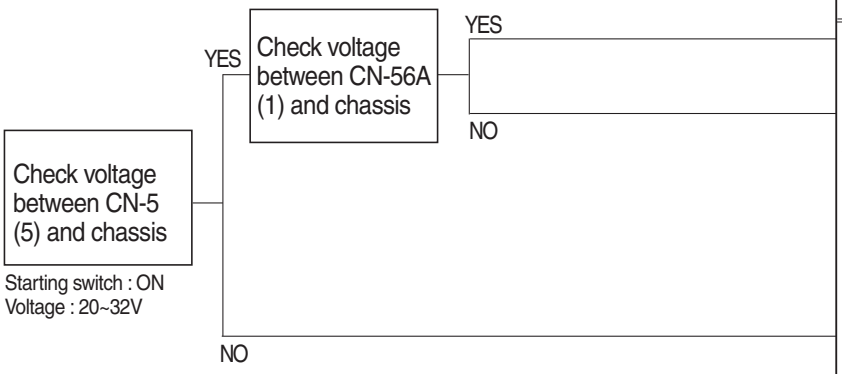


21096ES16

■ ELECTRICAL SYSTEM (CLUSTER TYPE 2)

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

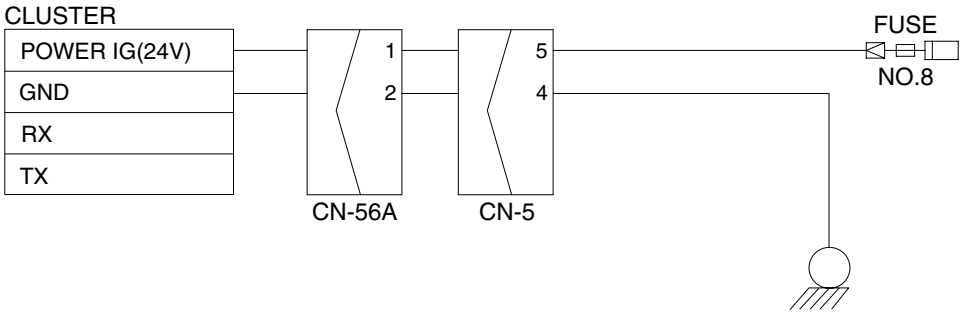
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 8 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-5(5) -CN-56A(1)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5(5) and fuse No.8	Repair or replace (after clean)

Check voltage

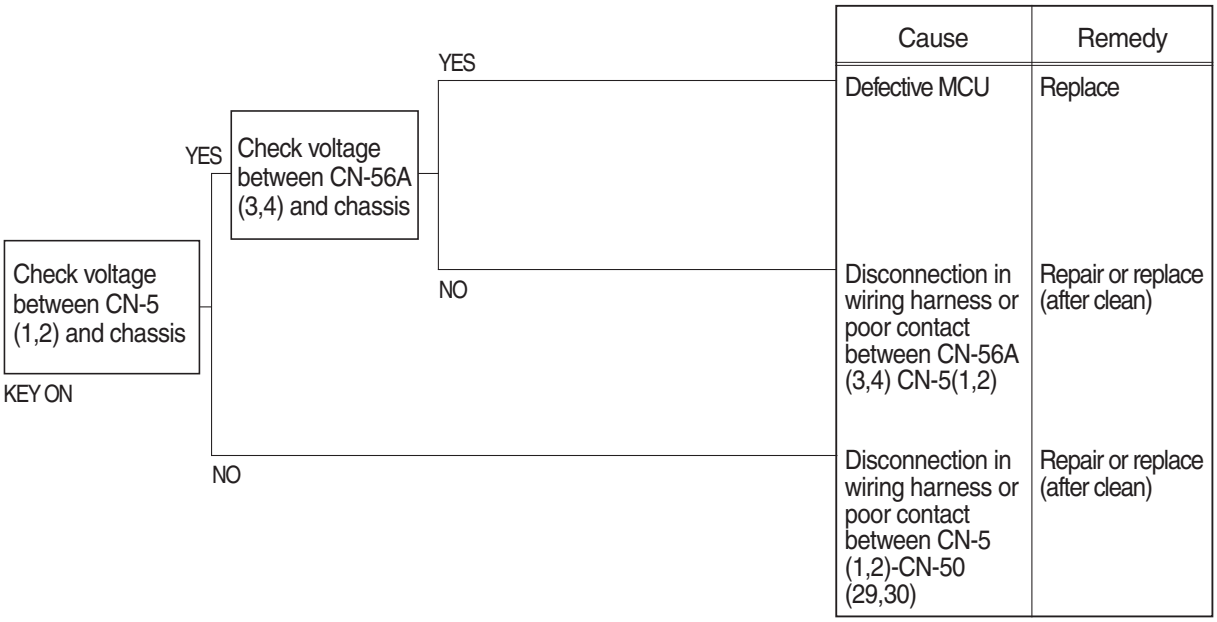
YES	20 ~ 32V
NO	0V



2209S6ES51

2. COMMUNICATION ERROR FLASHES ON THE CLUSTER

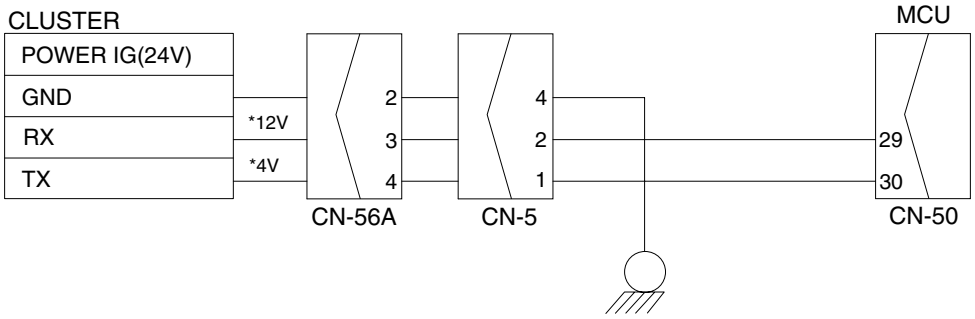
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective MCU	Replace
Disconnection in wiring harness or poor contact between CN-56A (3,4) CN-5(1,2)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-5 (1,2)-CN-50 (29,30)	Repair or replace (after clean)

Check voltage

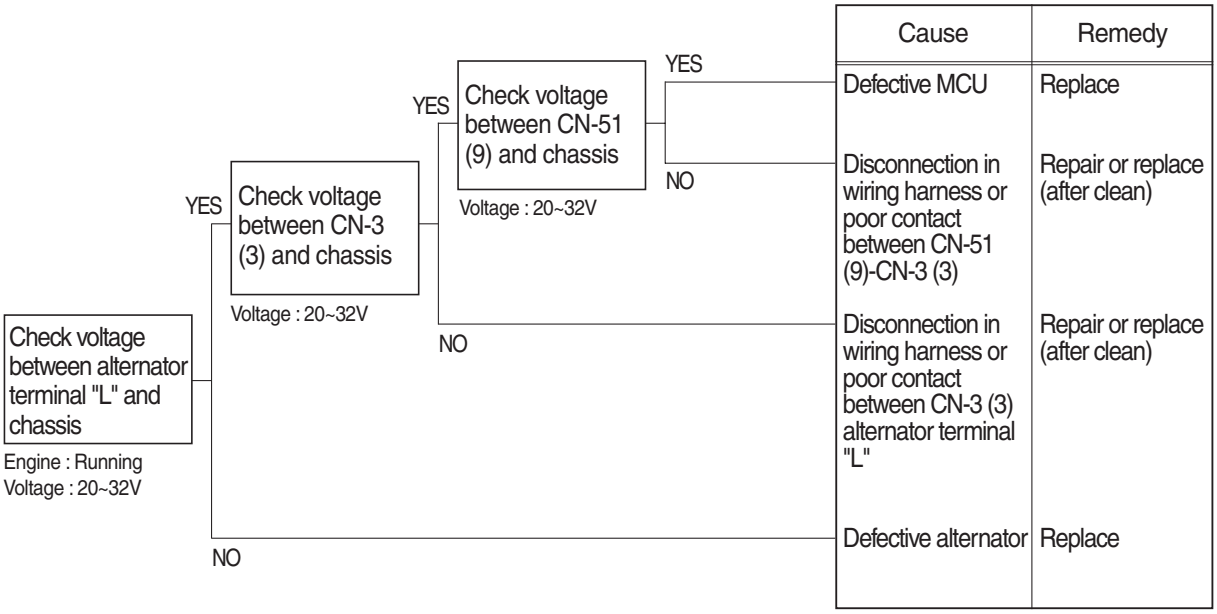
YES	*4V	*12V
NO	0V	0V



1409S6ES52

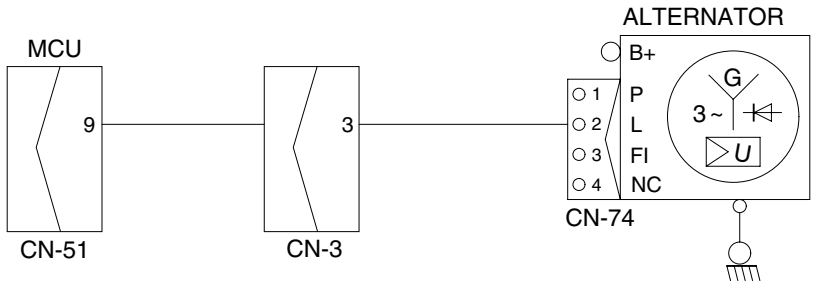
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (starting switch : ON)

- 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

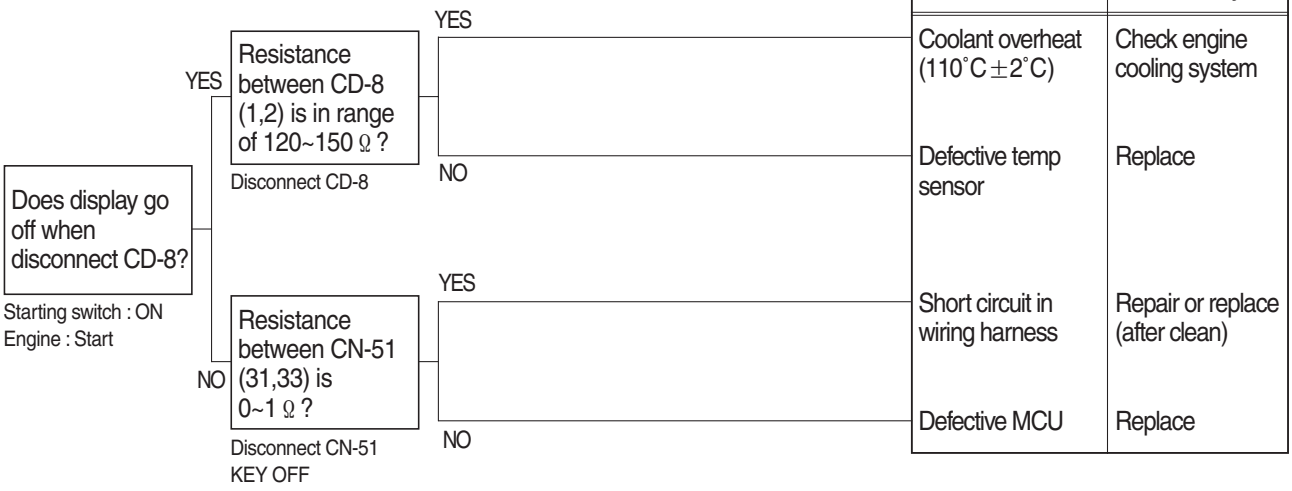
YES	20~32V
NO	0V



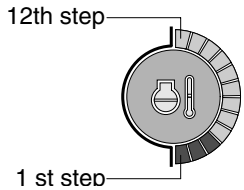
1409S6ES53

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.

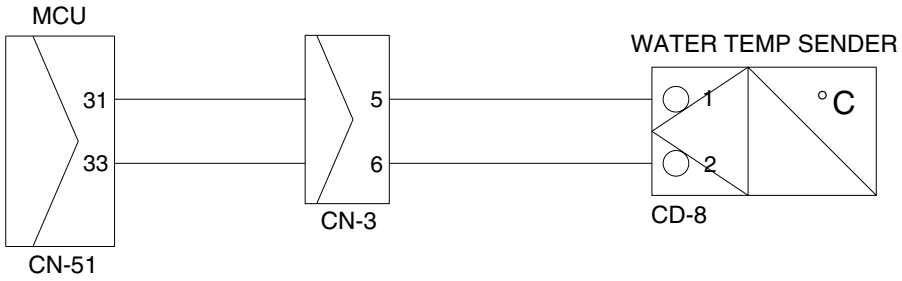


Cause	Remedy
Coolant overheat (110˚C±2˚C)	Check engine cooling system
Defective temp sensor	Replace
Short circuit in wiring harness	Repair or replace (after clean)
Defective MCU	Replace



Check Table

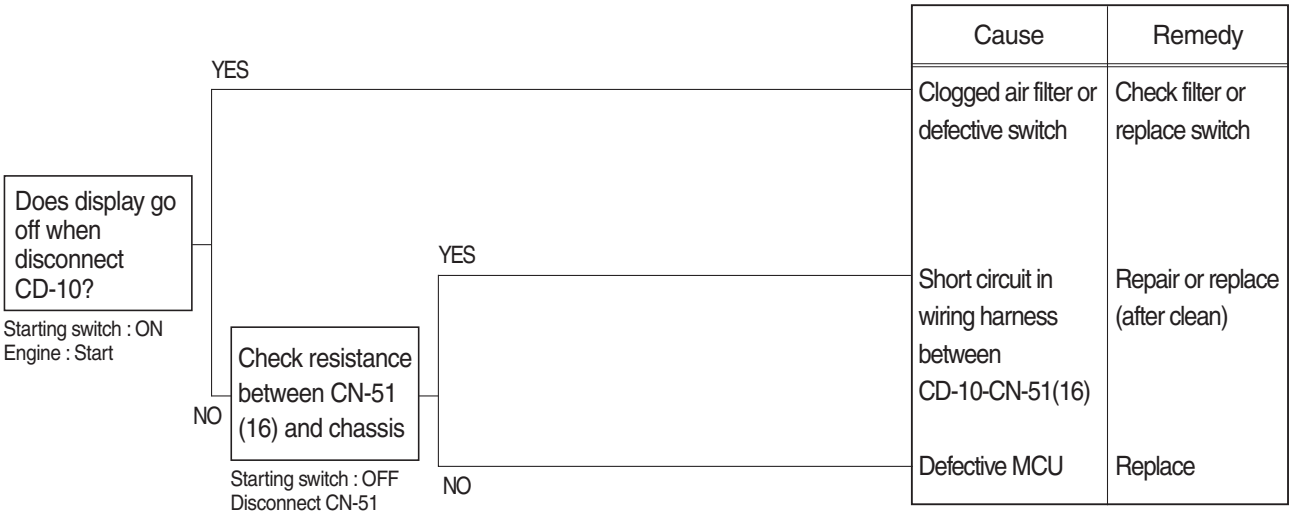
Range	1st step	2nd~10th step	11th~12th step
Temperature	~29˚C	30~105˚C	105˚C ~



1409S6ES54

5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

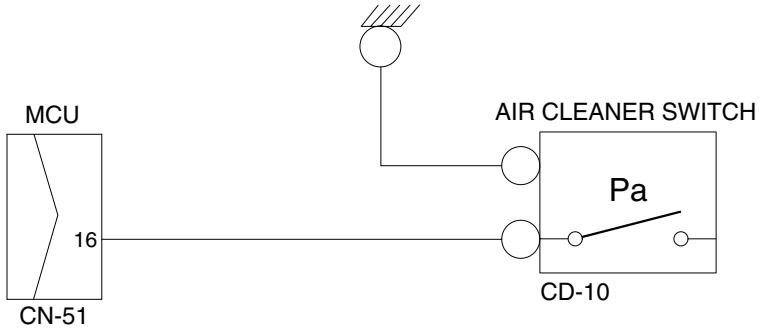
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Clogged air filter or defective switch	Check filter or replace switch
Short circuit in wiring harness between CD-10-CN-51(16)	Repair or replace (after clean)
Defective MCU	Replace

Check resistance

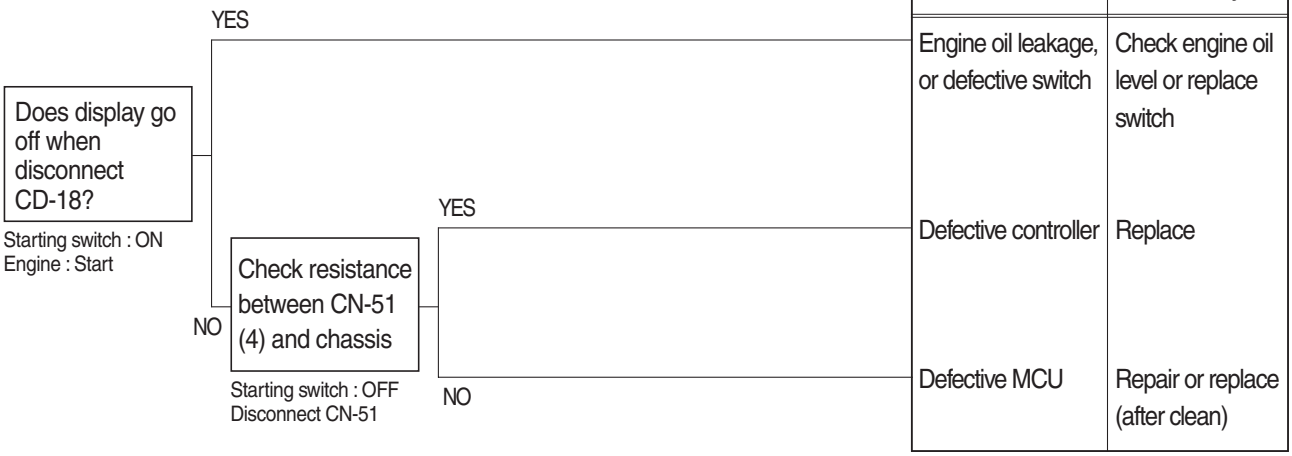
YES	MAX 1Ω
NO	MIN 1M Ω



1409S6ES55

6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

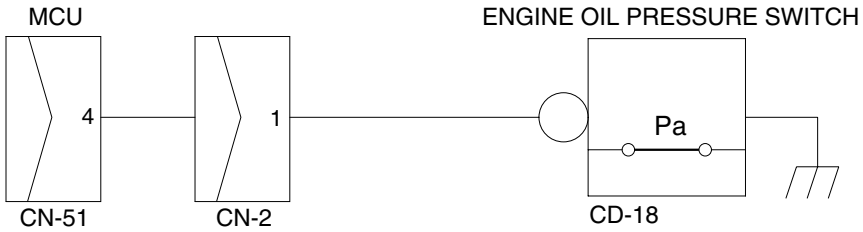
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Engine oil leakage, or defective switch	Check engine oil level or replace switch
Defective controller	Replace
Defective MCU	Repair or replace (after clean)

Check resistance

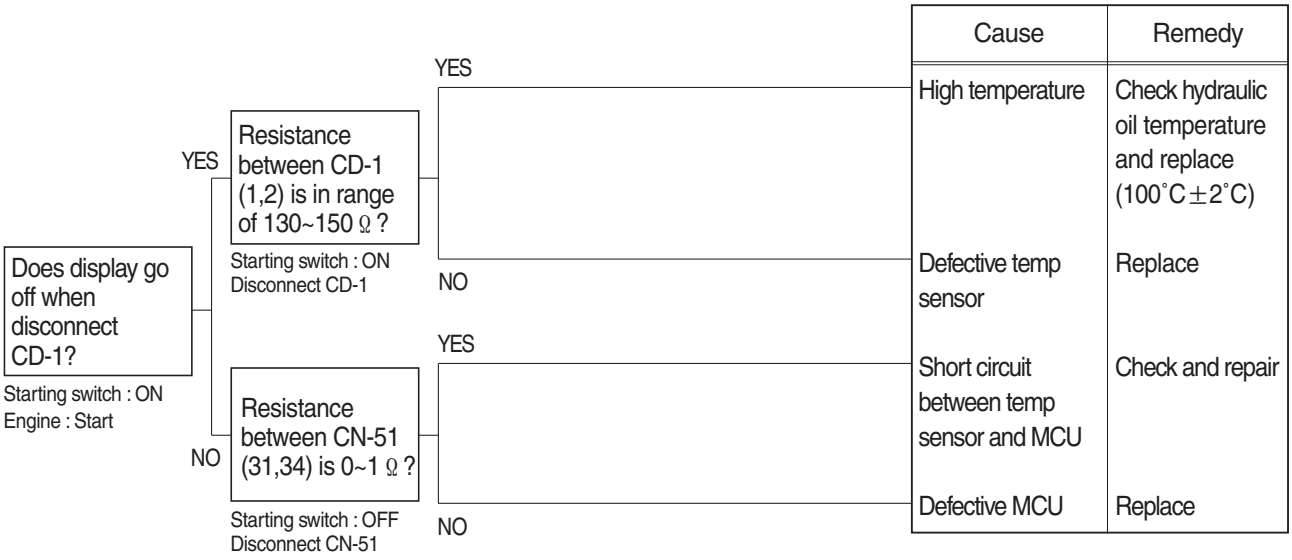
YES	MAX 1Ω
NO	MIN 1M Ω



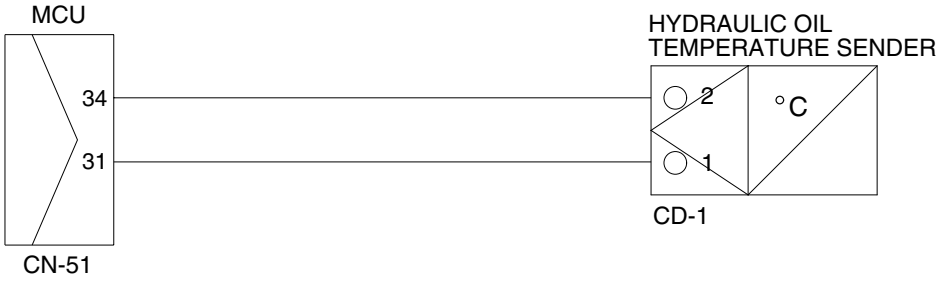
1409S6ES56

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.



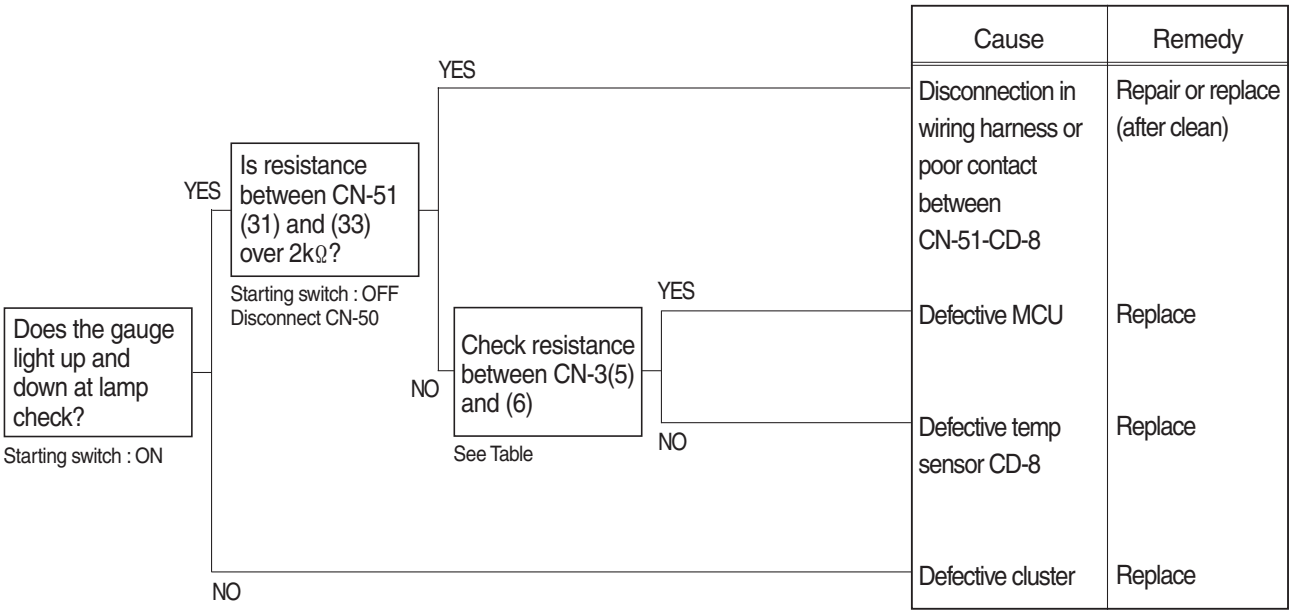
Cause	Remedy
High temperature	Check hydraulic oil temperature and replace (100˚C±2˚C)
Defective temp sensor	Replace
Short circuit between temp sensor and MCU	Check and repair
Defective MCU	Replace



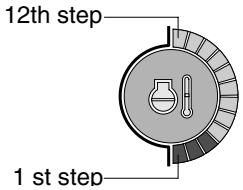
1409S6ES57

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.

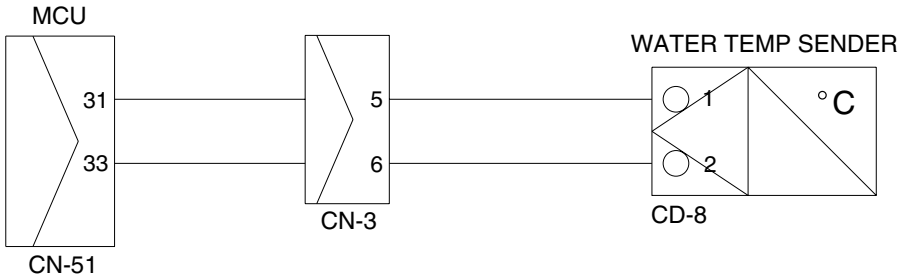


Cause	Remedy
Disconnection in wiring harness or poor contact between CN-51-CD-8	Repair or replace (after clean)
Defective MCU	Replace
Defective temp sensor CD-8	Replace
Defective cluster	Replace



Check Table

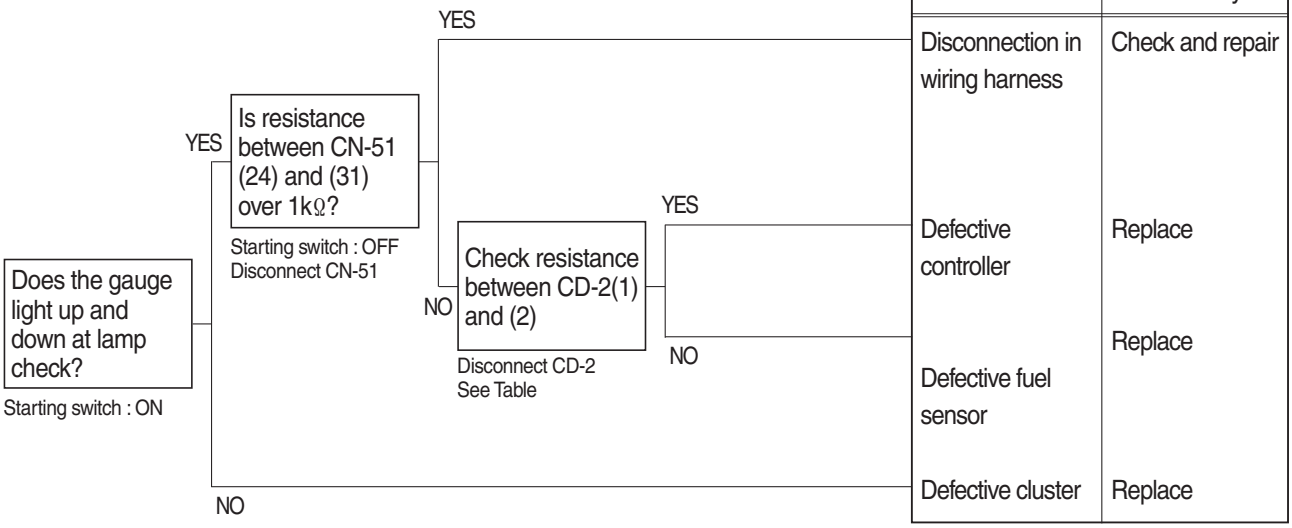
Range	1st step	2nd~10th step	11th~12th step
Temperature	~29° C	30~105° C	105° C ~

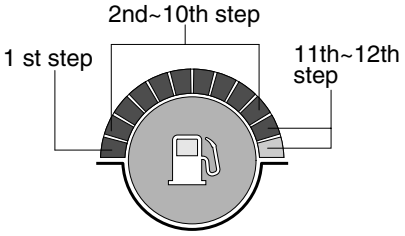


1409S6ES54

9. WHEN FUEL GAUGE DOES NOT OPERATE (check warning lamp ON/OFF)

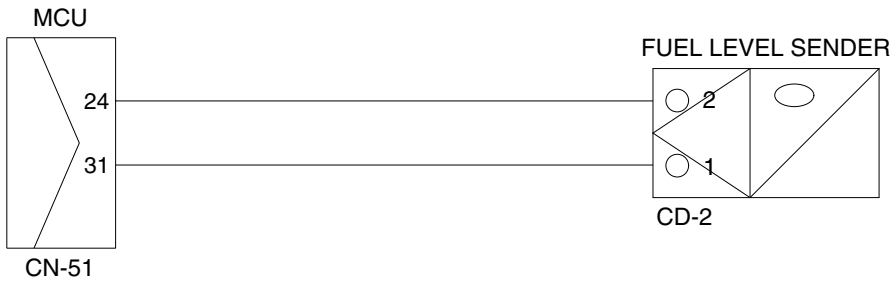
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

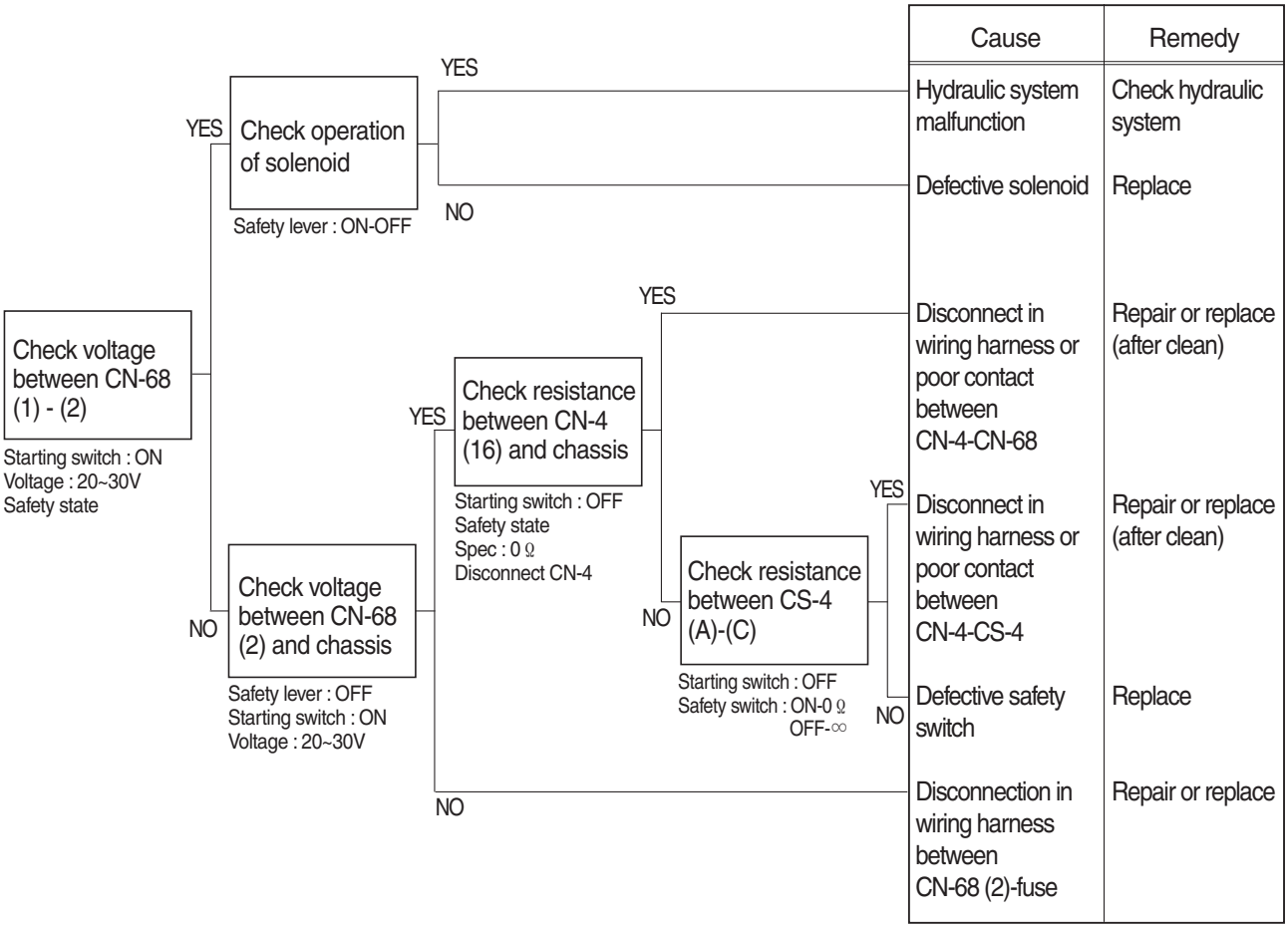
Item \ Range	1st step	2nd~10th step	11th~12th step
Unit Resistance(Ω)	700~601	600~101	~100
Tolerance(%)	±5	±5	±5

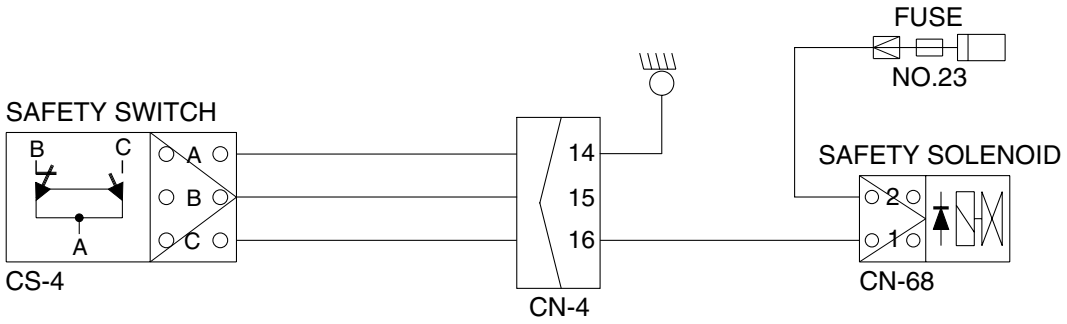


1409S6ES59

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.23 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

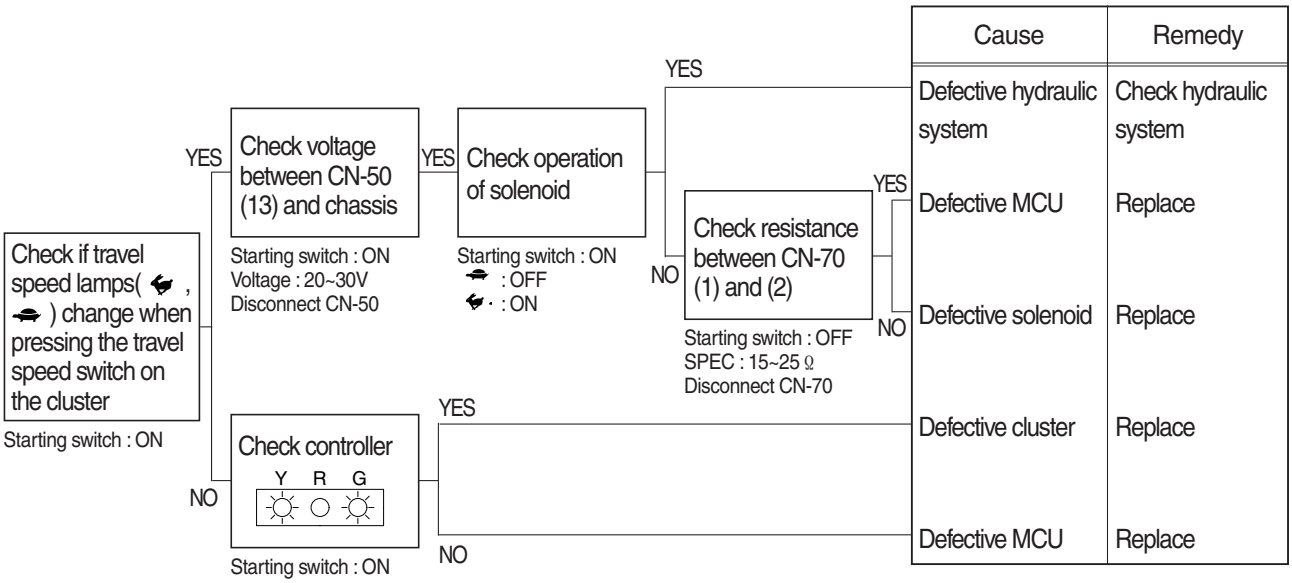


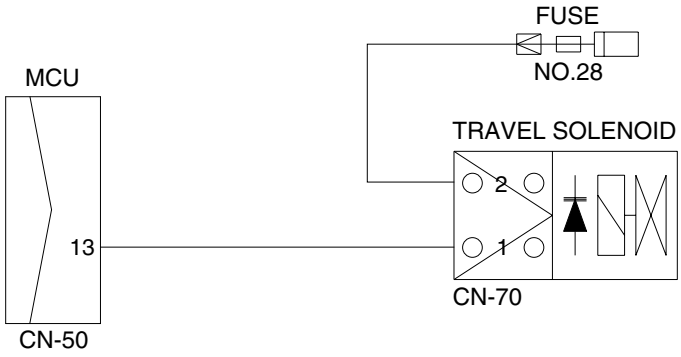


21096ES10

11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 28.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

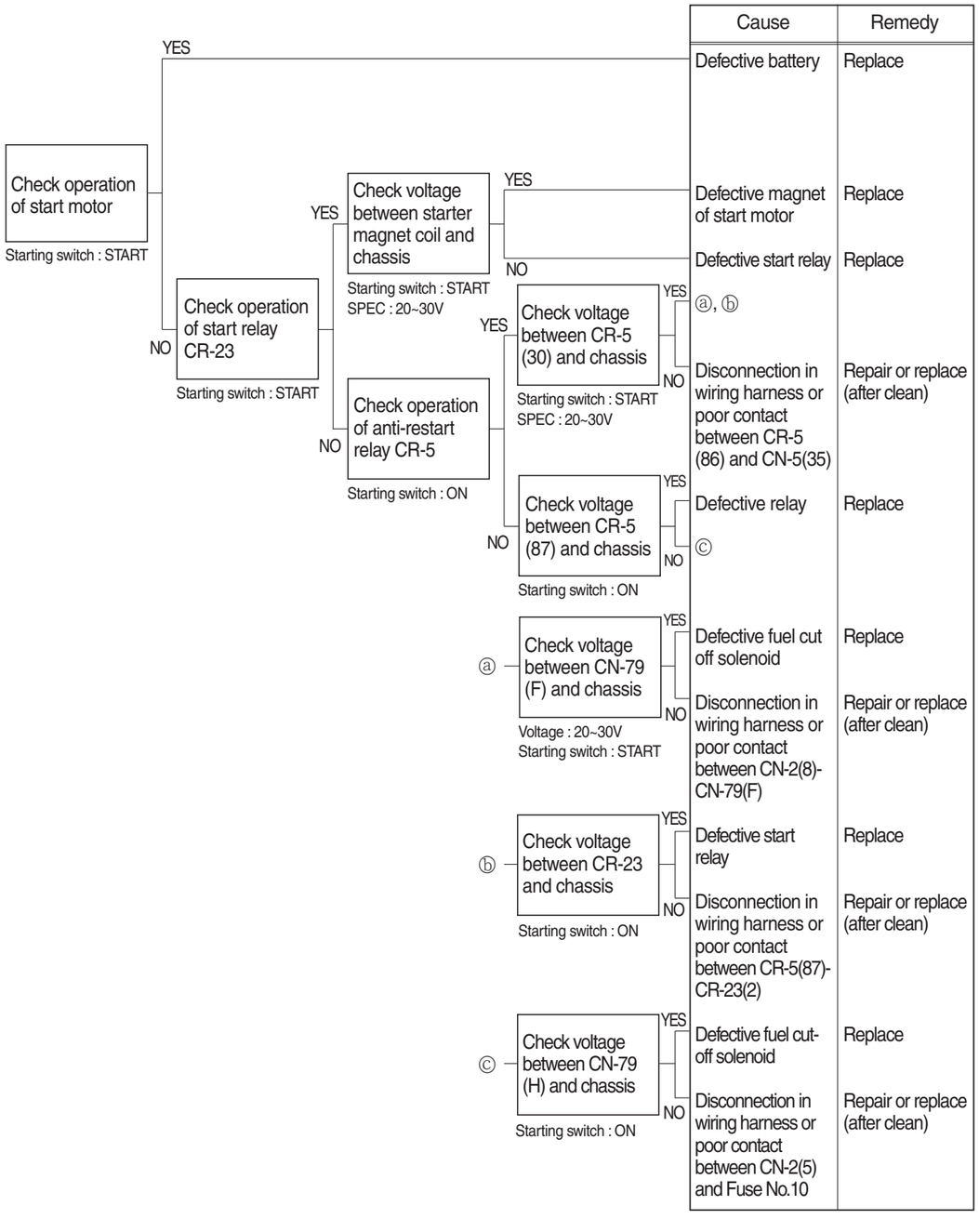


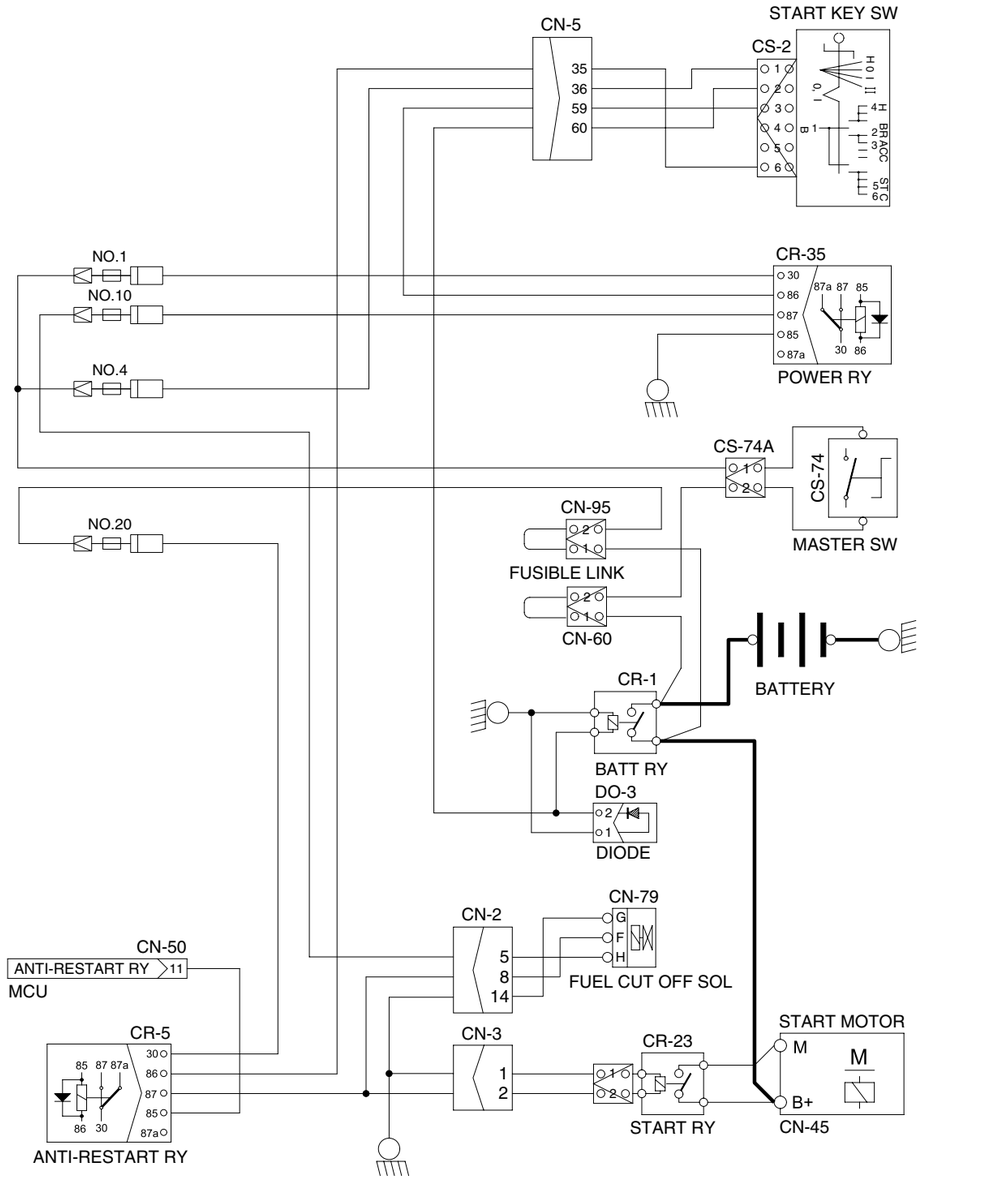


1409S6ES61

12. WHEN ENGINE DOES NOT START ([- +] lights up condition)

- Check supply of the power at engine stop solenoid while starting switch is ON.
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 1, 4, 10 and 20 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

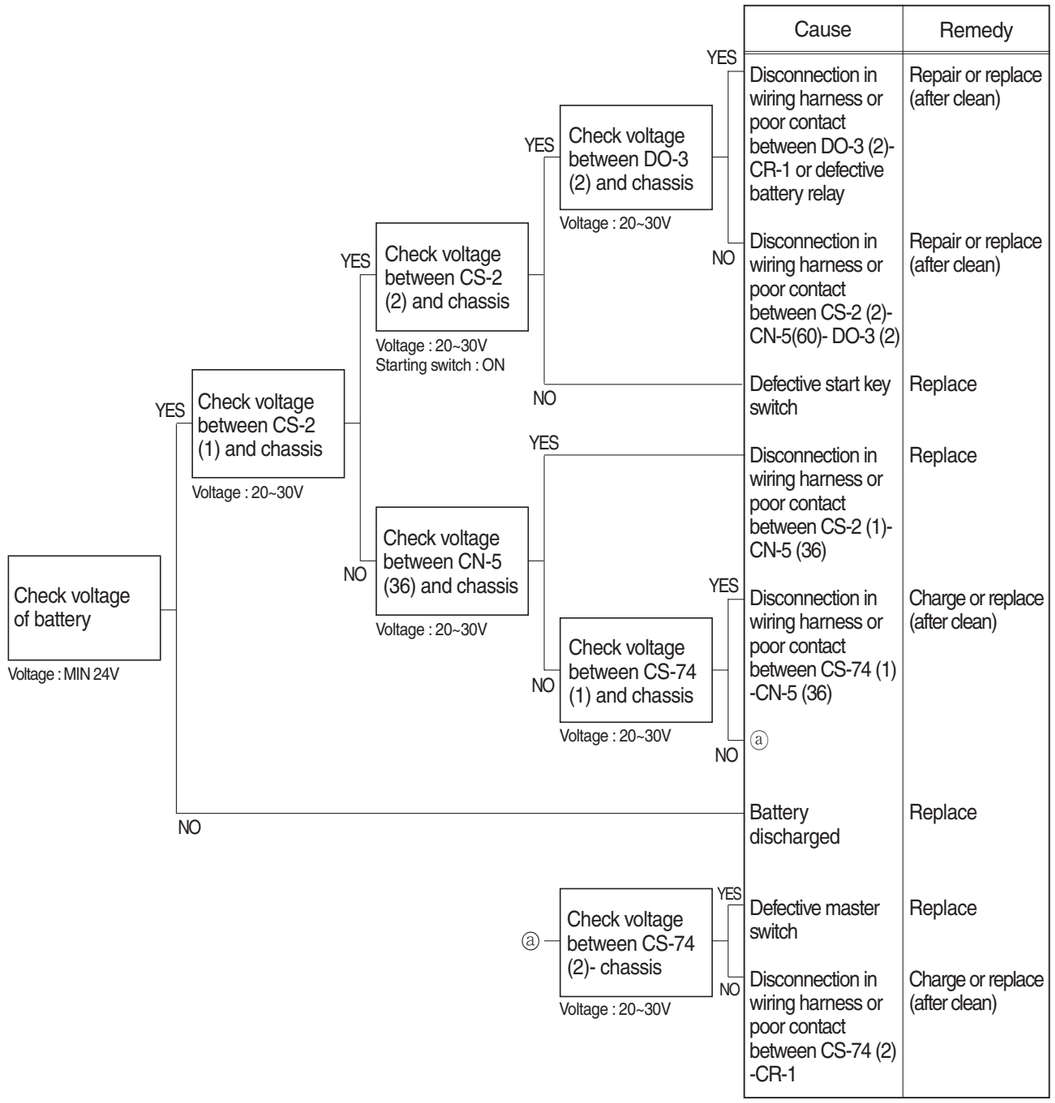




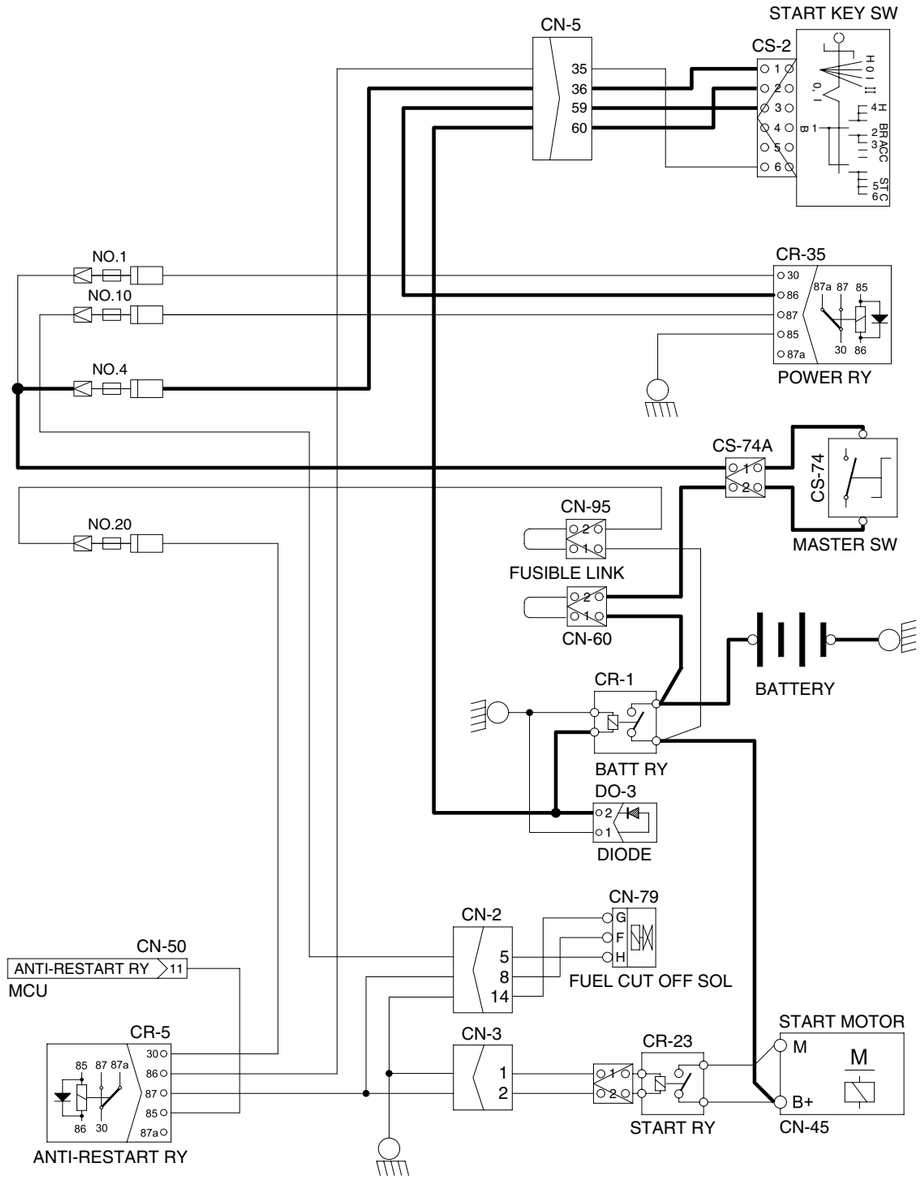
2209S6ES15

13. 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 fusible link (CN-60).
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



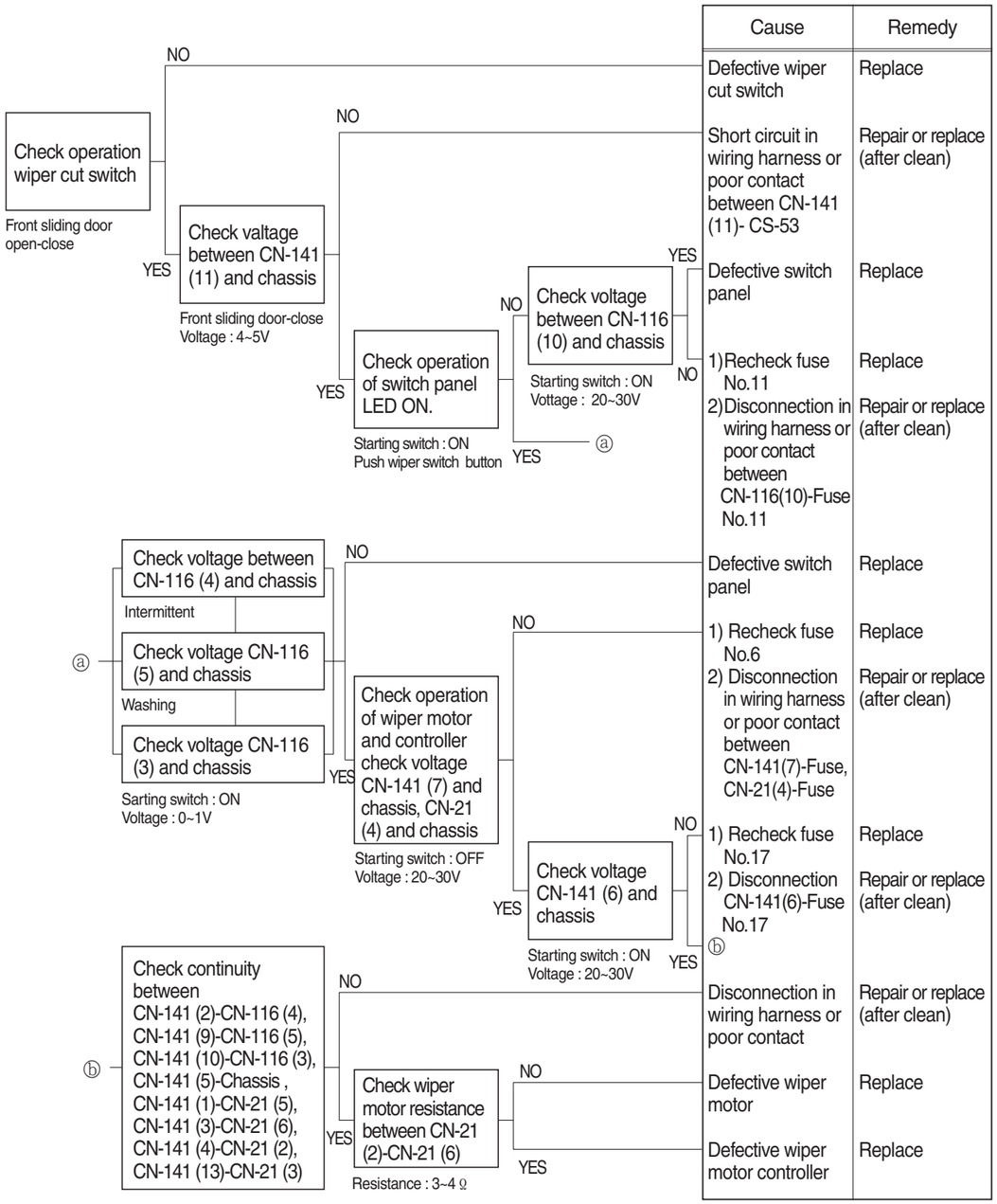
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-3 (2)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2 (2)-CN-5(60)- DO-3 (2)	Repair or replace (after clean)
Defective start key switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74 (1) -CN-5 (36)	Charge or replace (after clean)
Battery discharged	Replace
Defective master switch	Replace
Disconnection in wiring harness or poor contact between CS-74 (2) -CR-1	Charge or replace (after clean)



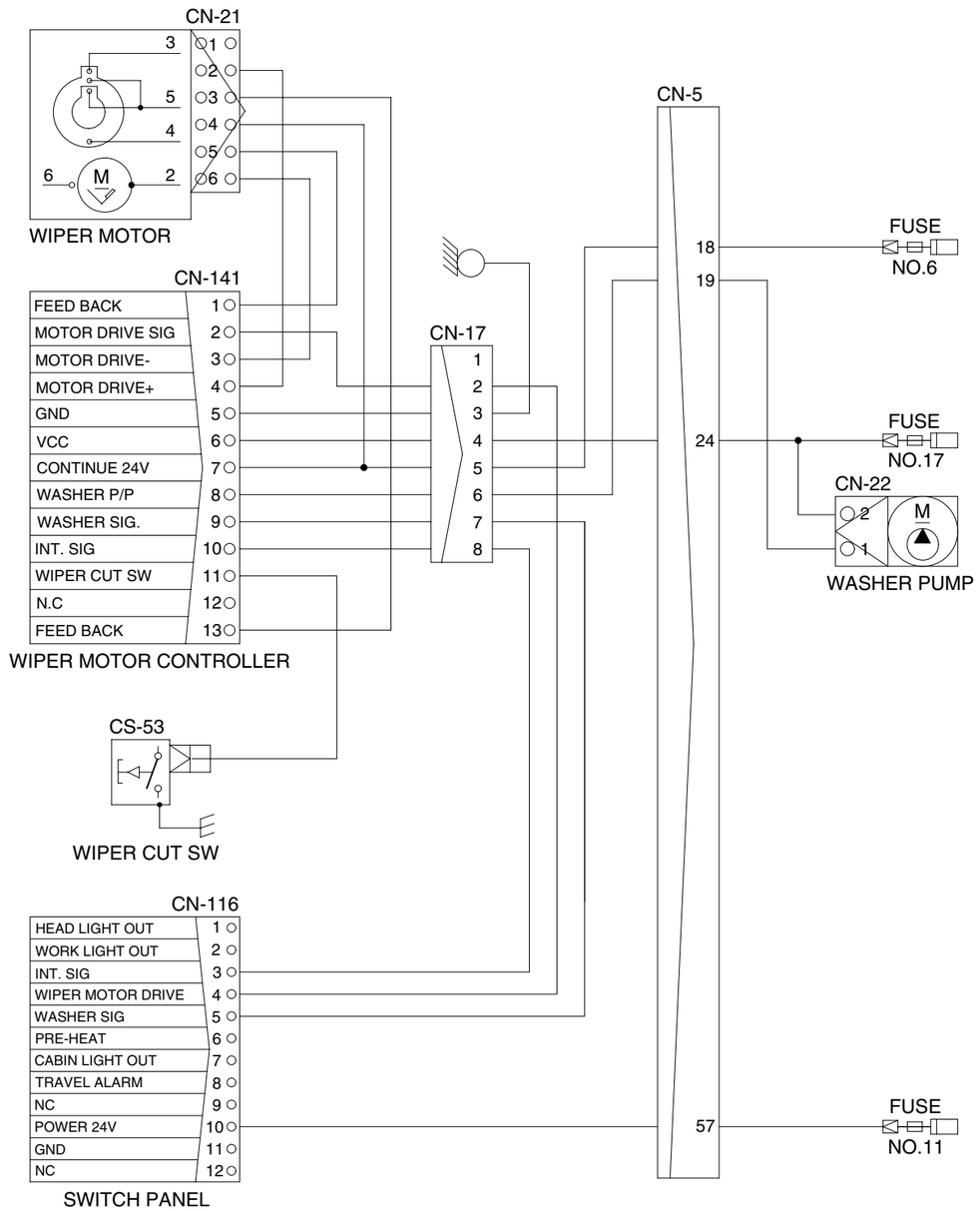
2209S6ES16

14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 6, 11 and 17 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



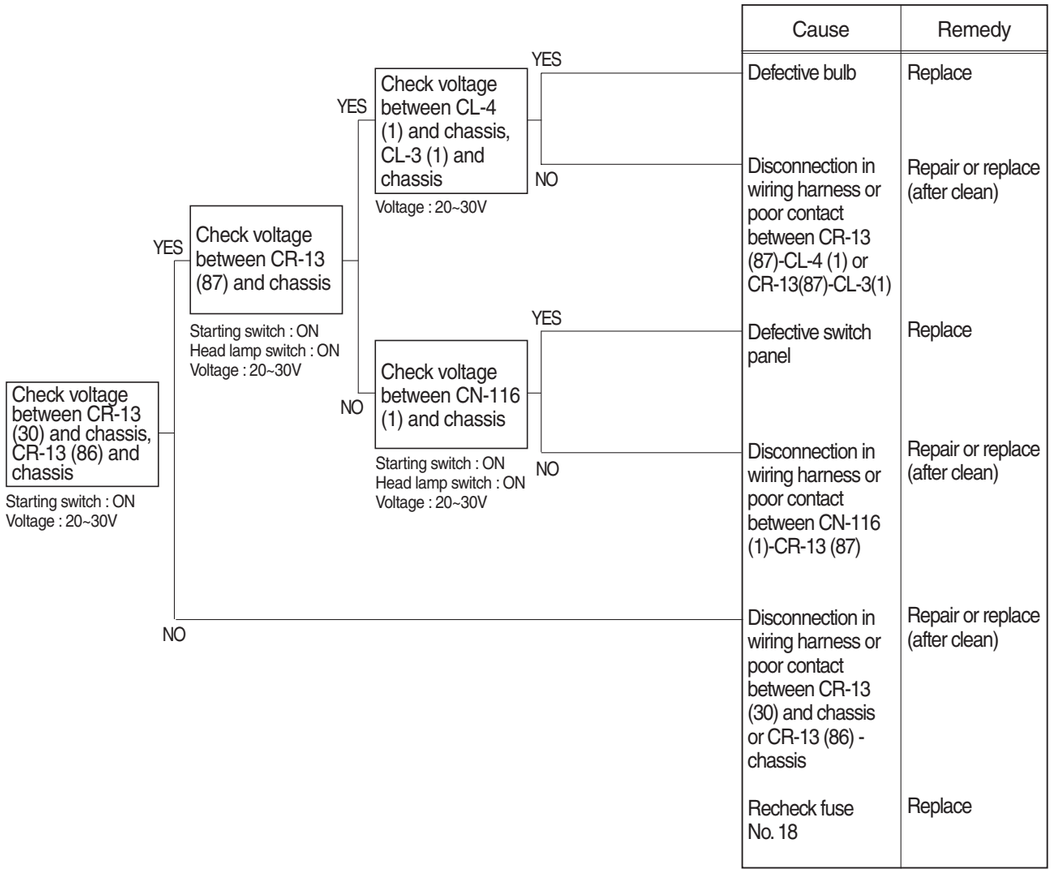
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective switch panel	Replace
1)Recheck fuse No.11	Replace
2)Disconnection in wiring harness or poor contact between CN-116(10)-Fuse No.11	Repair or replace (after clean)
Defective switch panel	Replace
1) Recheck fuse No.6	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.17	Replace
2) Disconnection CN-141(6)-Fuse No.17	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



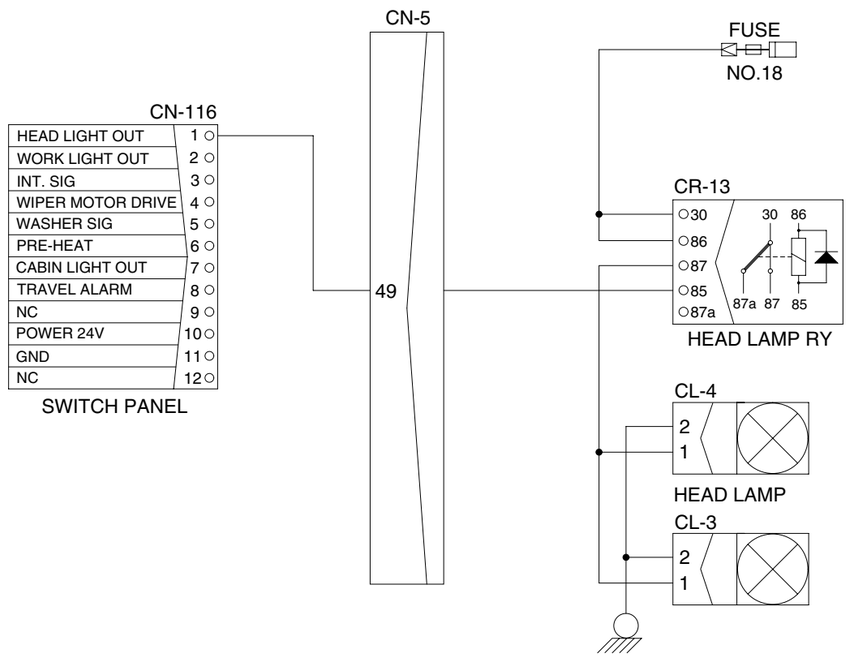
21096ES14

15. 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 fuse No.18 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



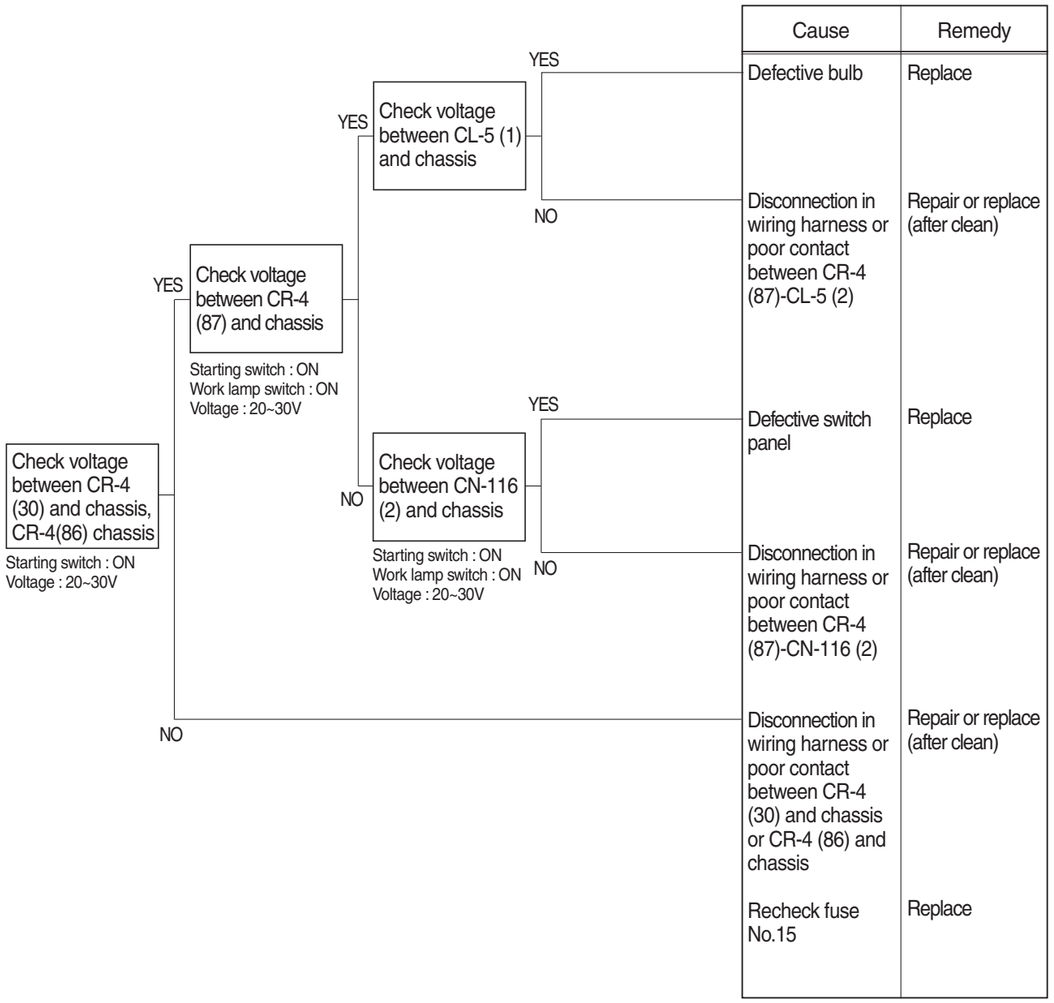
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13(87)-CL-3(1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (87)	Repair or replace (after clean)
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. 18	Replace

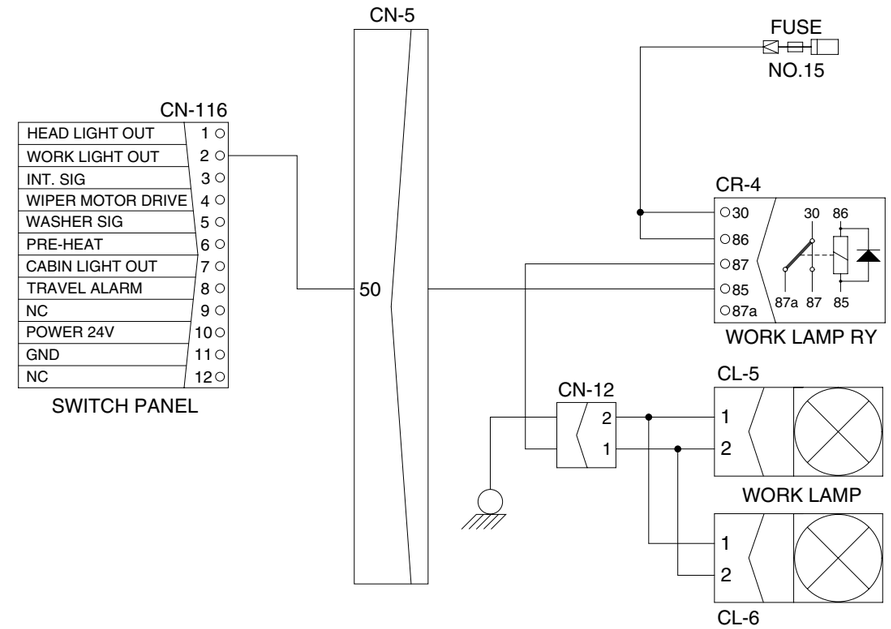


14096ES15

16. 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 fuse No.15 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



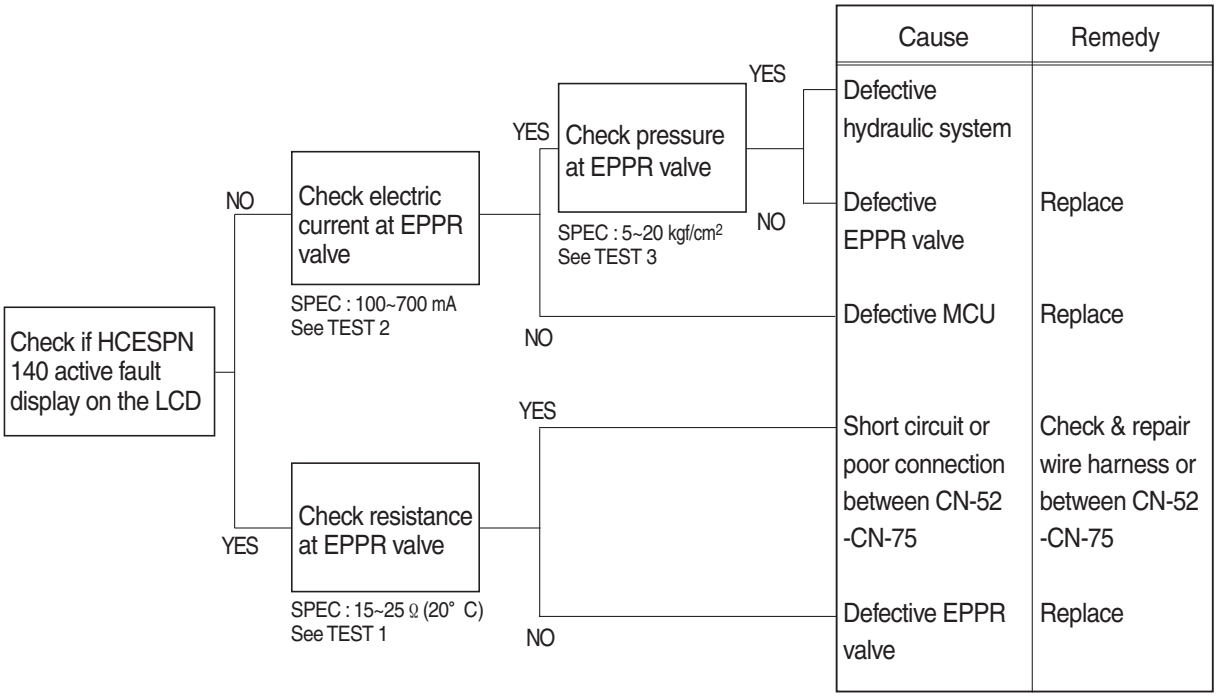


21096ES16

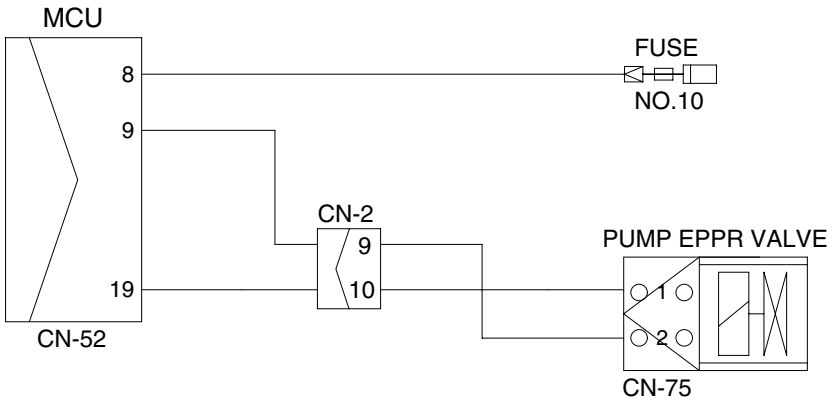
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : P-mode 2100 ± 50 rpm S -mode 2000 ± 50 rpm E-mode 1900 ± 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



2209S6MS01

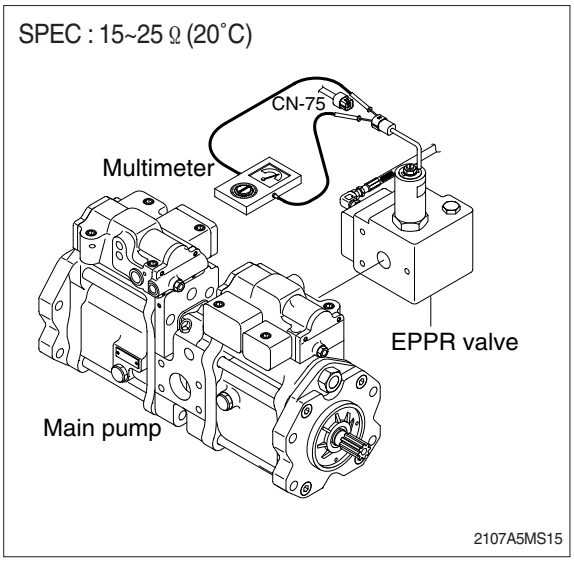
2) TEST PROCEDURE

(1) Test 1 : Check resistance at connector CN-75.

① Starting key OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.



(2) Test 2 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.

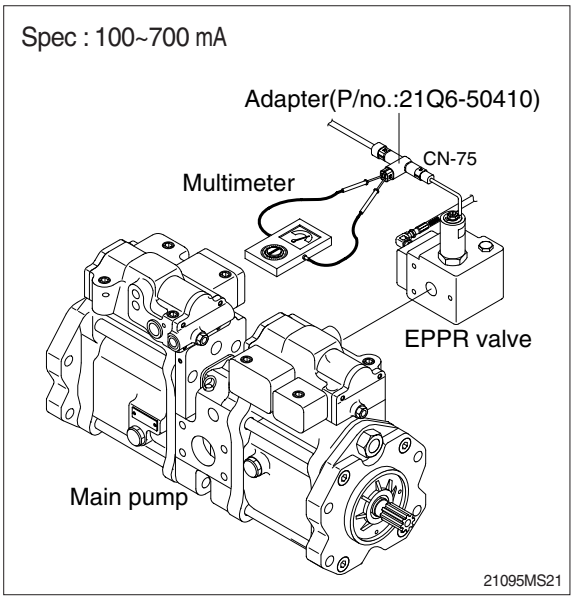
② Insert the adapter to CN-75 and install multimeter as figure.

③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display approx 2000±50 rpm 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 710 psi)

② Start engine.

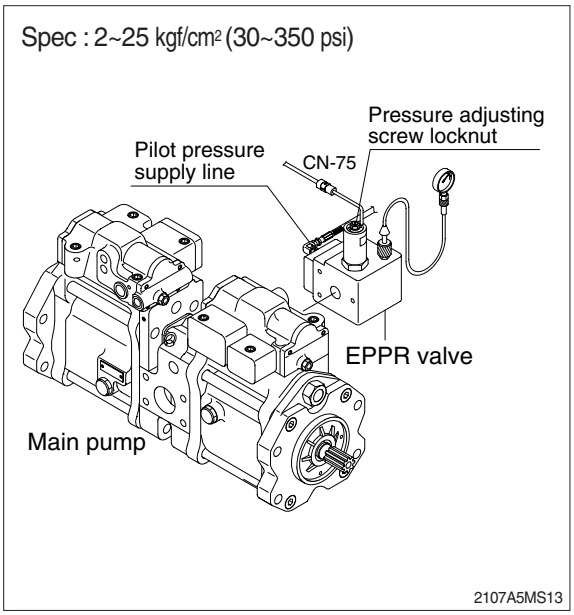
③ Set S-mode and cancel auto decel mode.

④ Position the accel dial at 10.

⑤ If rpm display approx 2000±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

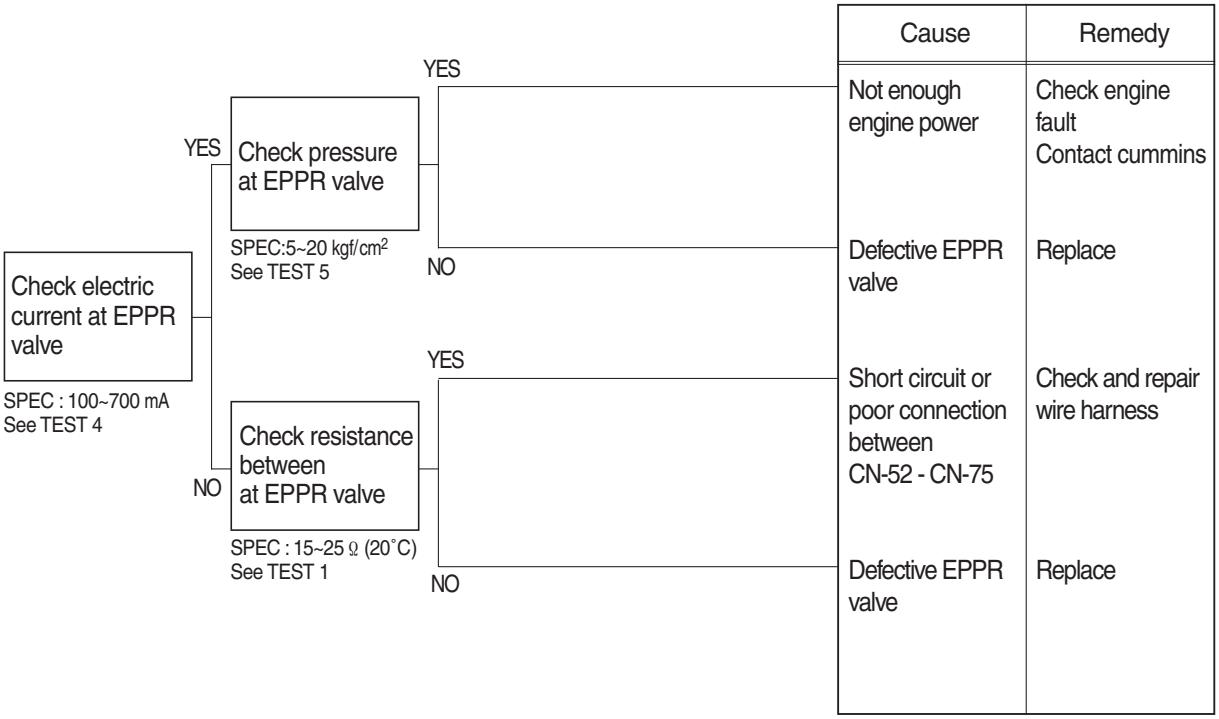
⑦ After adjust, test the machine.



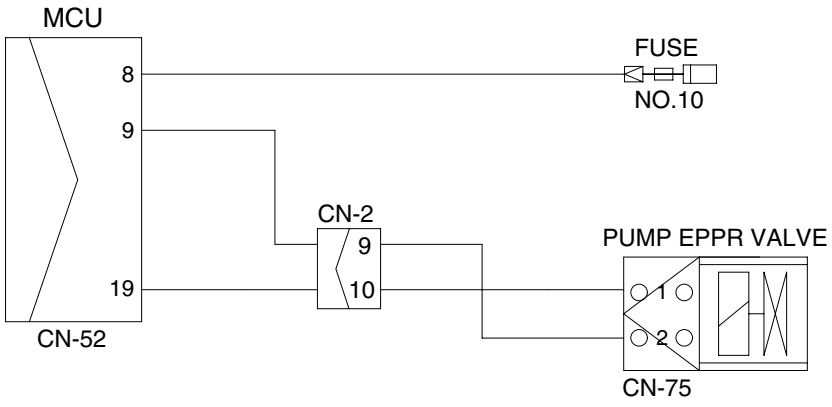
2. ENGINE STALL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

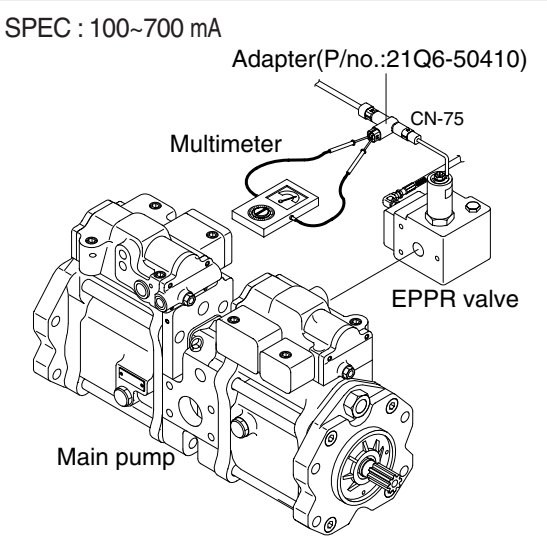


2209S6MS01

2) TEST PROCEDURE

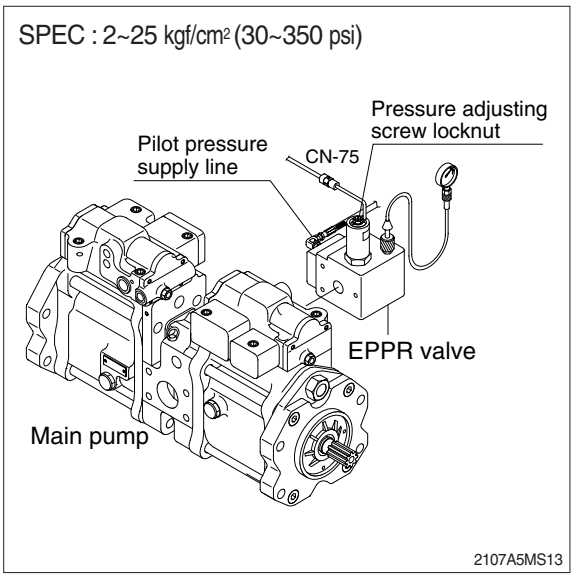
(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set S-mode and cancel auto decel mode.
⑤ Position the accel dial at 10.
⑥ If rpm display approx 2000±50 rpm check electric current at bucket circuit relief position.



(2) Test 5 : Check pressure at EPPR valve.

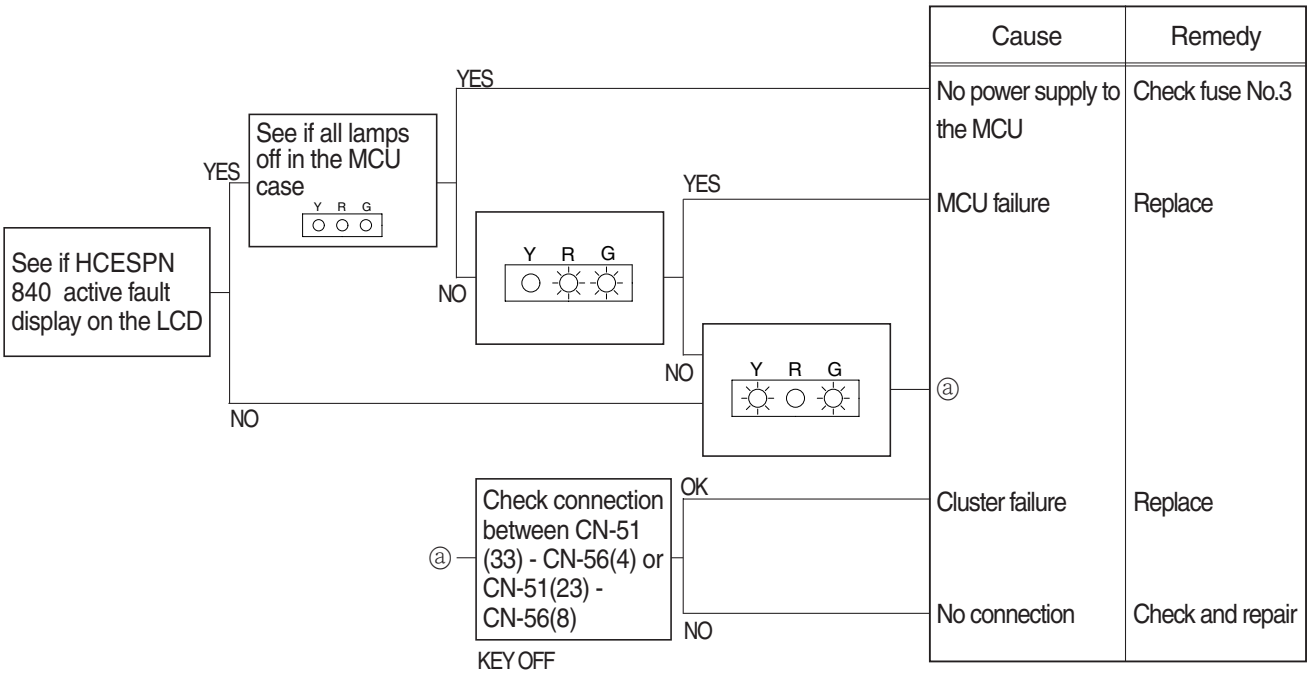
① Remove plug and connect pressure gauge as figure.
 · Gauge capacity : 0 to 50 kgf/cm² (0 to 710 psi)
② Start engine.
③ Set S-mode and cancel auto decel
④ mode.
⑤ Position the accel dial at 10.
 If rpm display approx 2000±50 rpm check pressure at relief position of bucket circuit
⑥ by operating bucket control lever.
⑦ If pressure is not correct, adjust it.
 After adjust, test the machine.



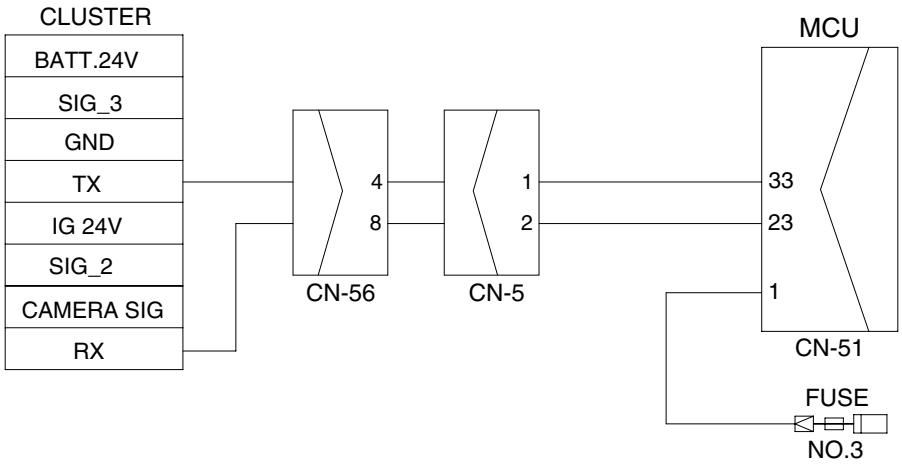
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

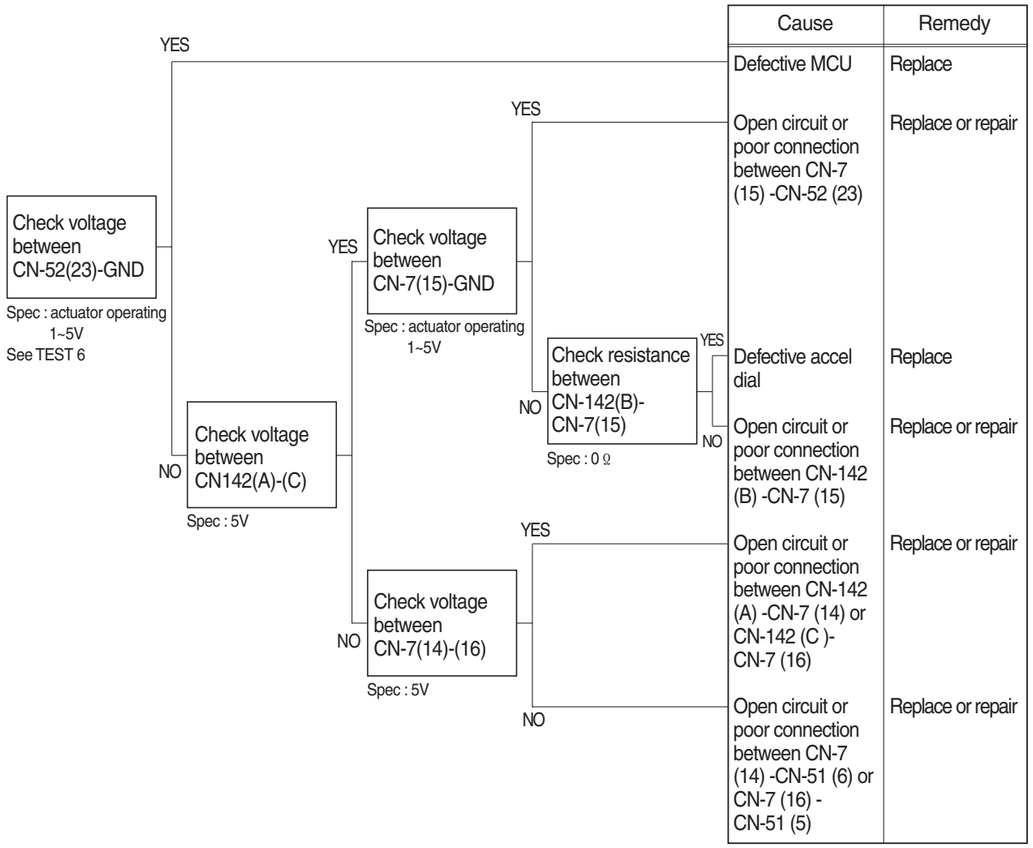


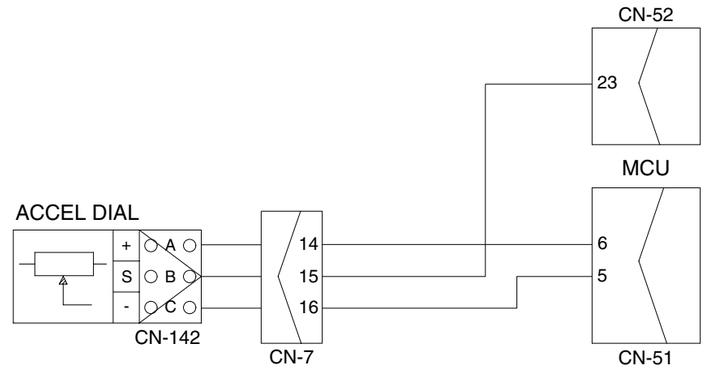
1409S6MS03

4. MALFUNCTION OF ACCEL DIAL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE





1409S6MS04

2) TEST PROCEDURE

(1) Test 6 : Check voltage at CN-52(23) and ground.

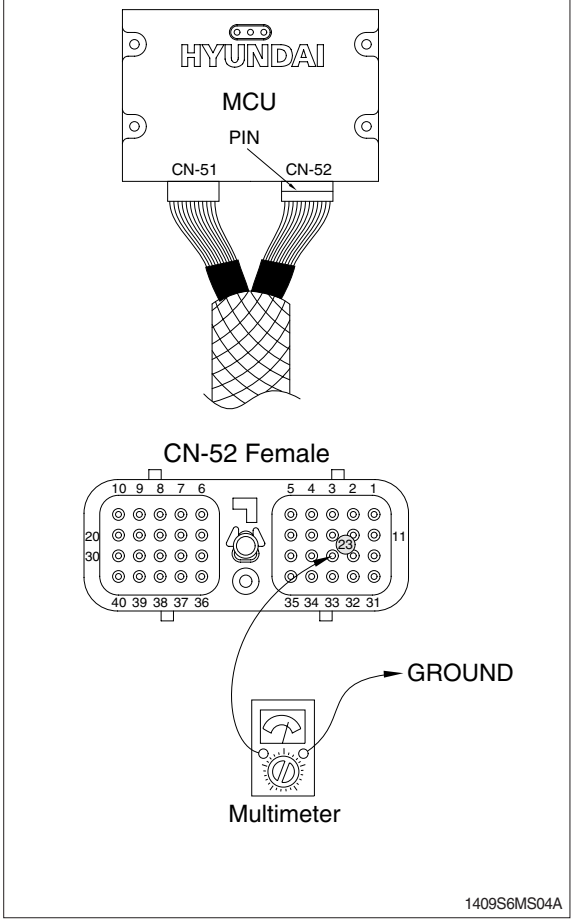
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (23) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



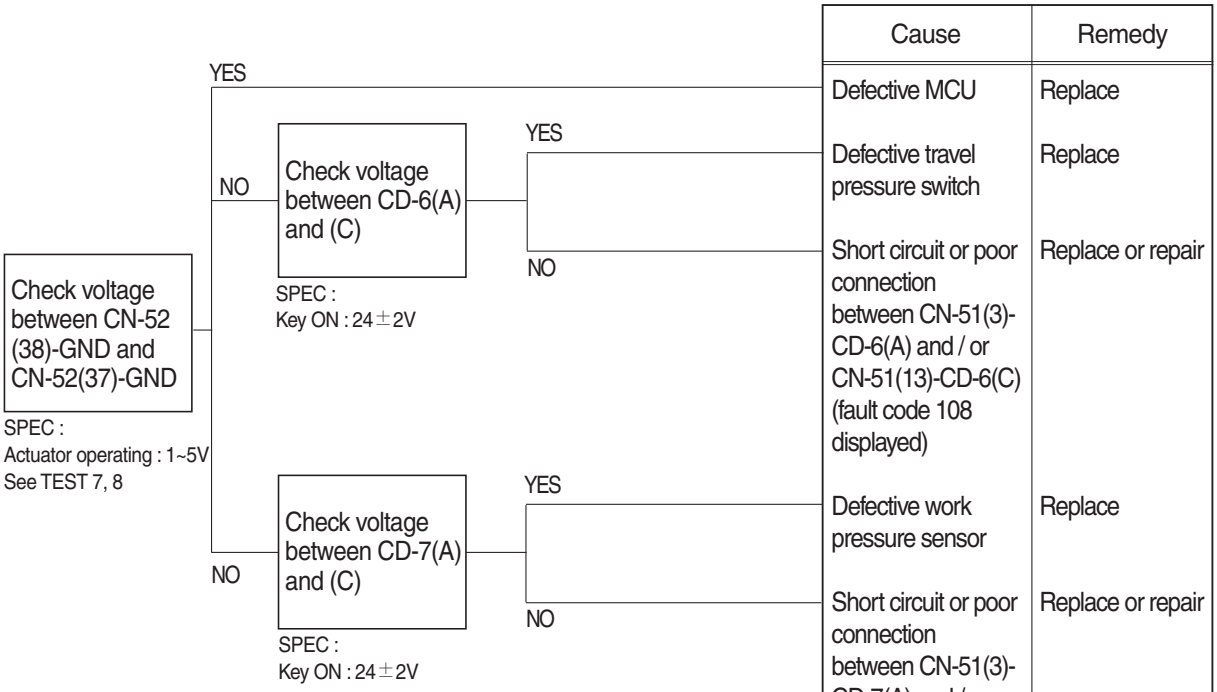
1409S6MS04A

5. AUTO DECEL SYSTEM DOES NOT WORK

· Fault code : HCESPN 105, FMI 0~4 (work pressure sensor)
HCESPN 108, FMI 0~4 (travel oil pressure sensor)

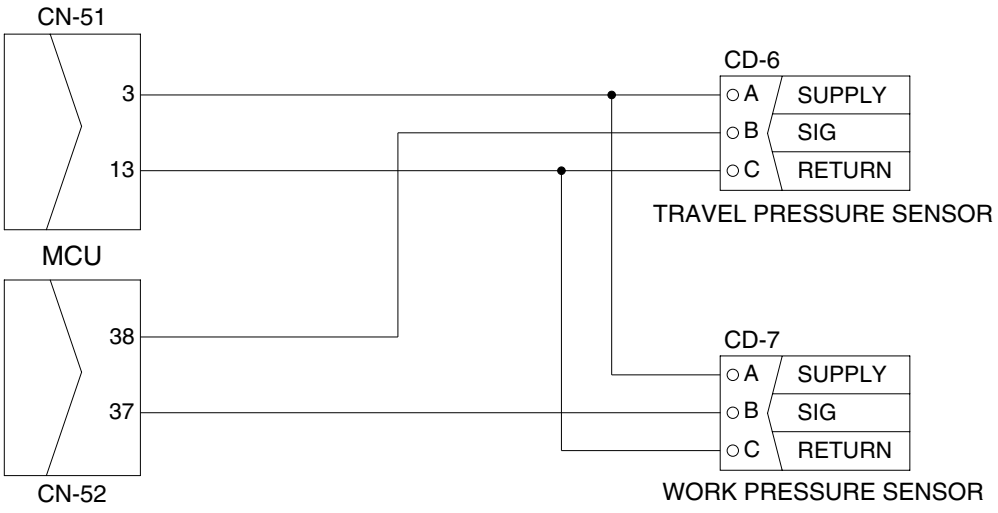
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51(3)-CD-6(A) and / or CN-51(13)-CD-6(C) (fault code 108 displayed)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51(3)-CD-7(A) and / or CN-51(13)-CD-7(C) (fault code 105 displayed)	Replace or repair

Wiring diagram



1409S6MS05

2) TEST PROCEDURE

(1) Test 7 : Check voltage at CN-52(38) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (38) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52(37)and ground.

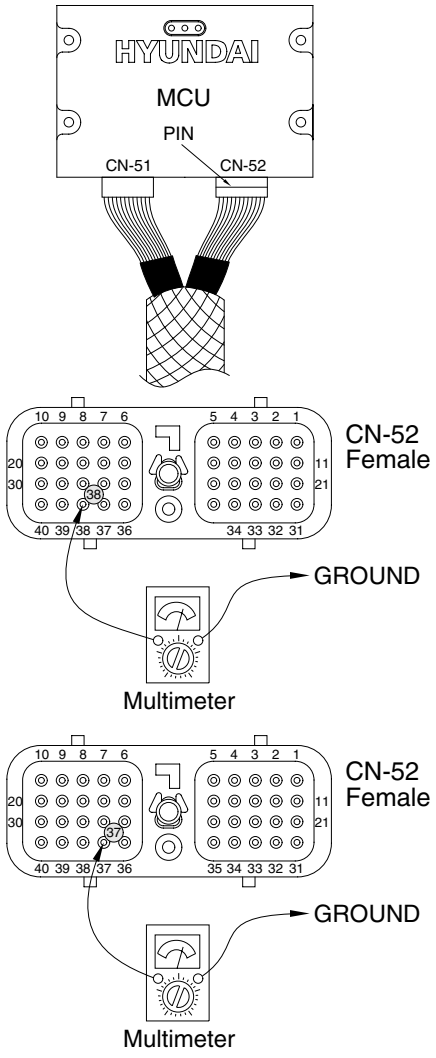
① Prepare 1 piece of thin sharp pin, steel or copper

② Insert prepared pin to rear side of connectors : One pin to (37) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



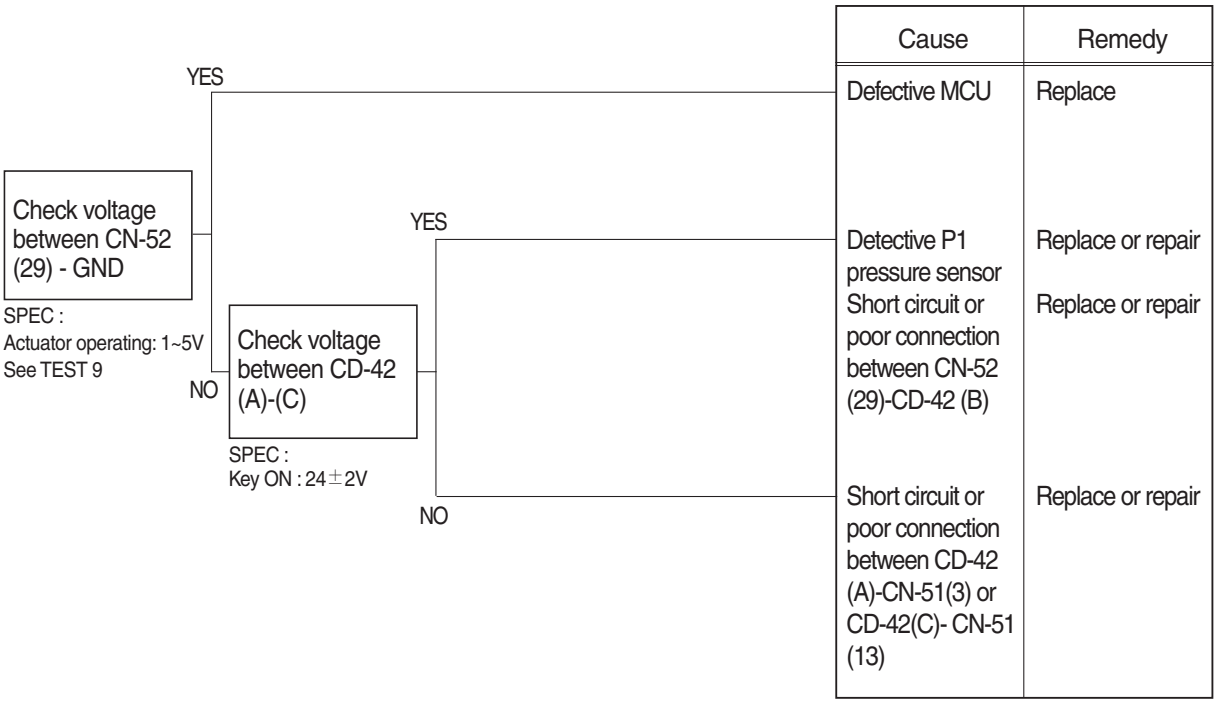
1409S6MS05A

6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

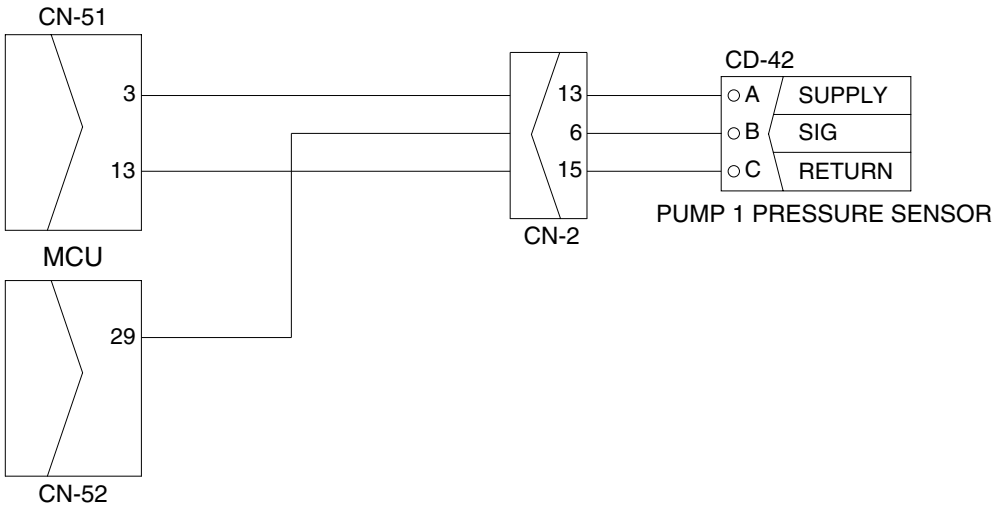
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (29)-CD-42 (B)	Replace or repair
Short circuit or poor connection between CD-42 (A)-CN-51(3) or CD-42(C)- CN-51 (13)	Replace or repair

Wiring diagram



2209S6MS06

2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52(29) and ground.

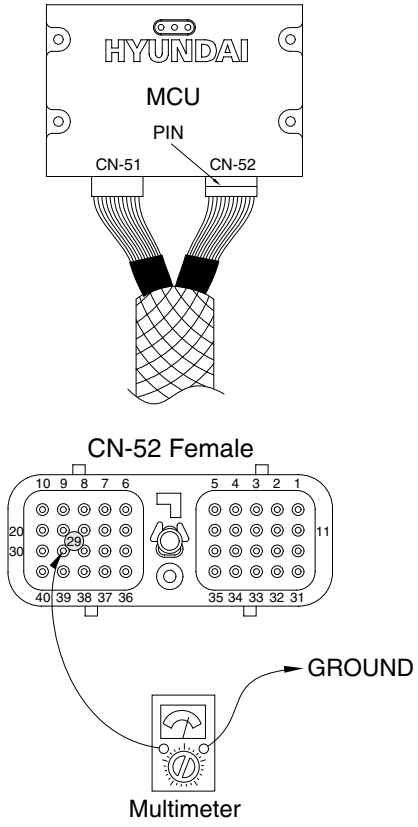
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (29) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



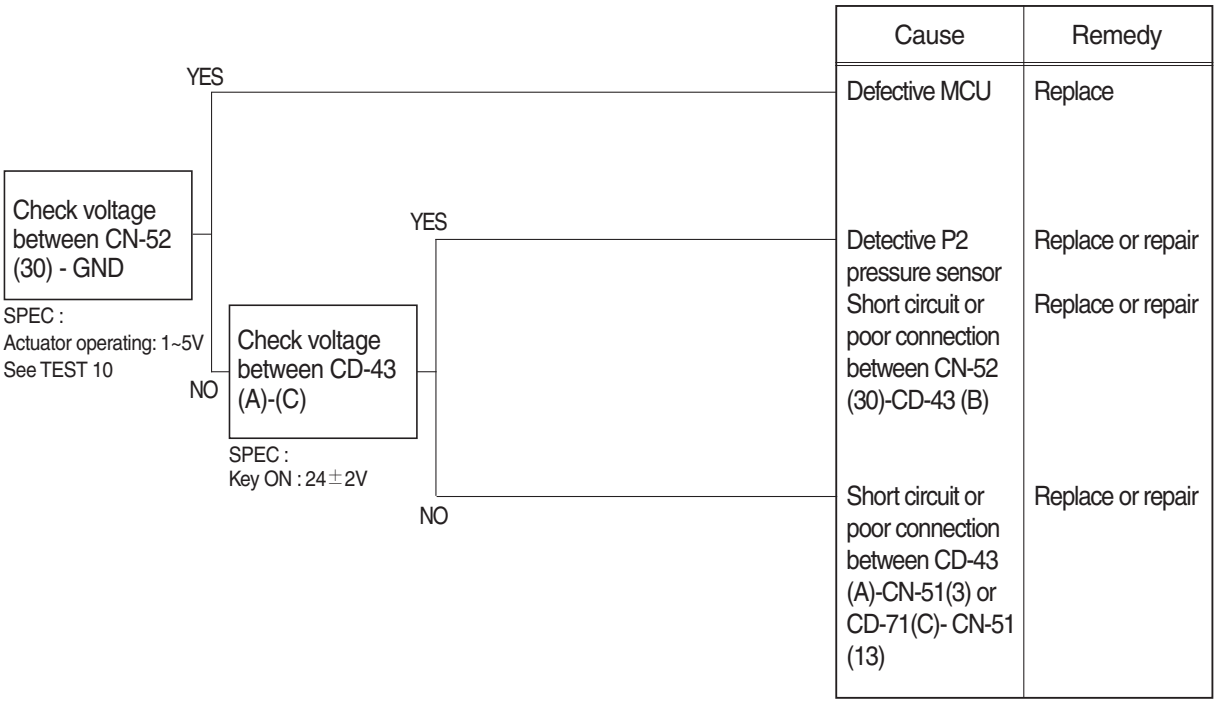
1409S6MS06A

7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

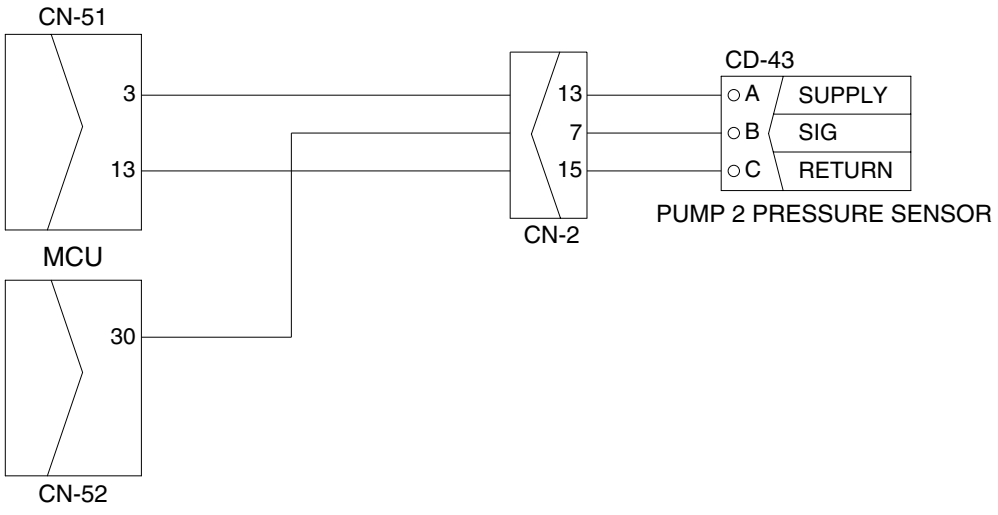
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (30)-CD-43 (B)	Replace or repair
Short circuit or poor connection between CD-43 (A)-CN-51(3) or CD-71(C)- CN-51 (13)	Replace or repair

Wiring diagram



2209S6MS07

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52(30) and ground.

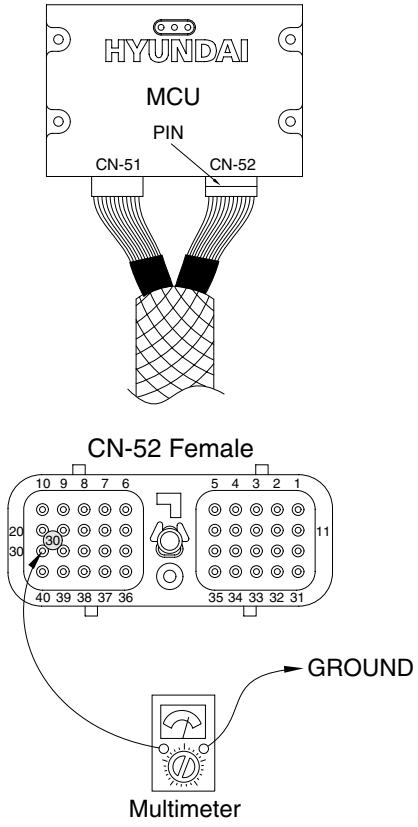
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (30) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



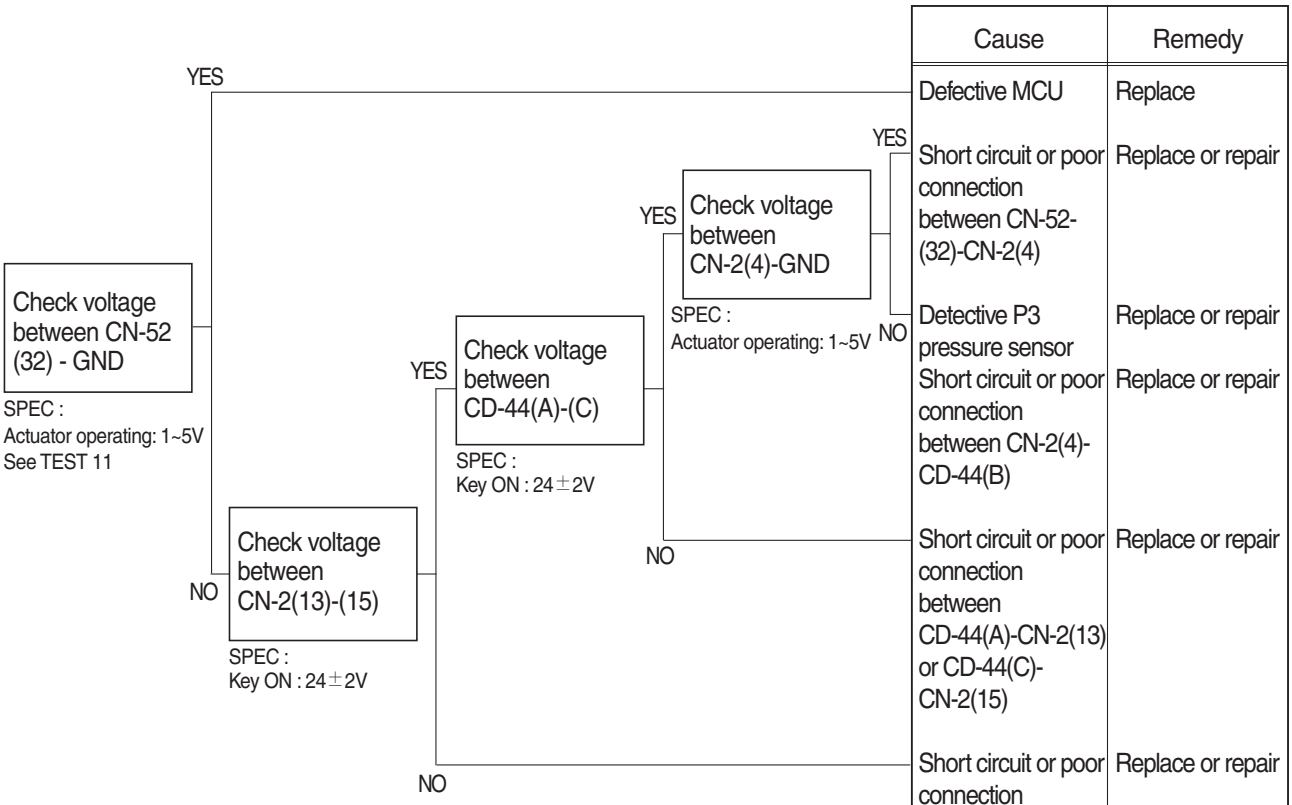
1409S6MS07A

8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

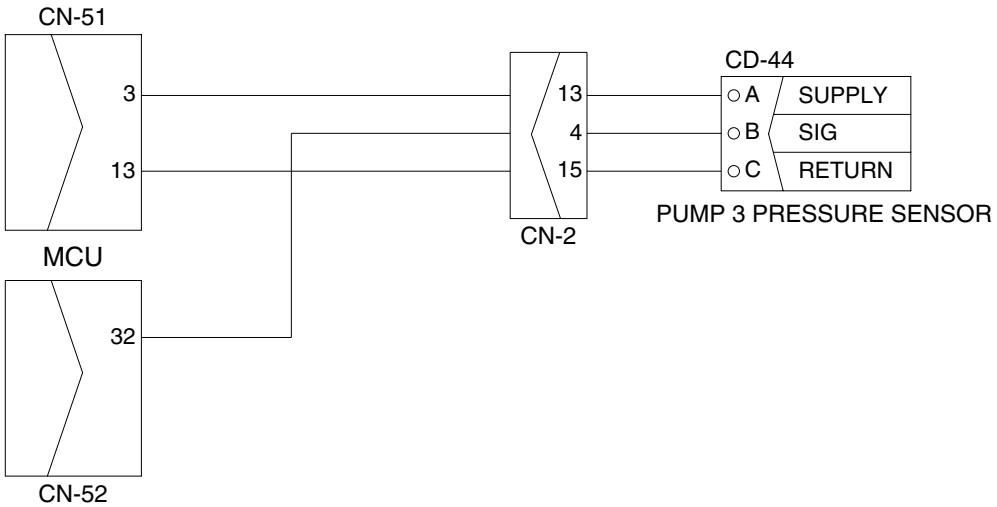
· Fault code : HCESPN 125, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



1409S6MS08

2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-52(32) and ground.

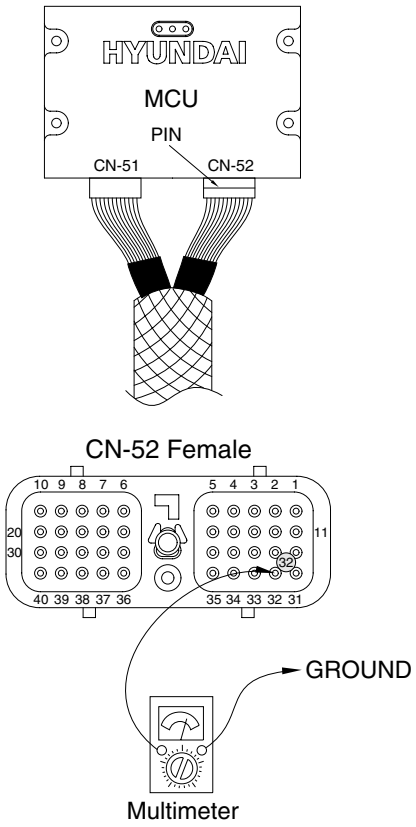
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (32) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



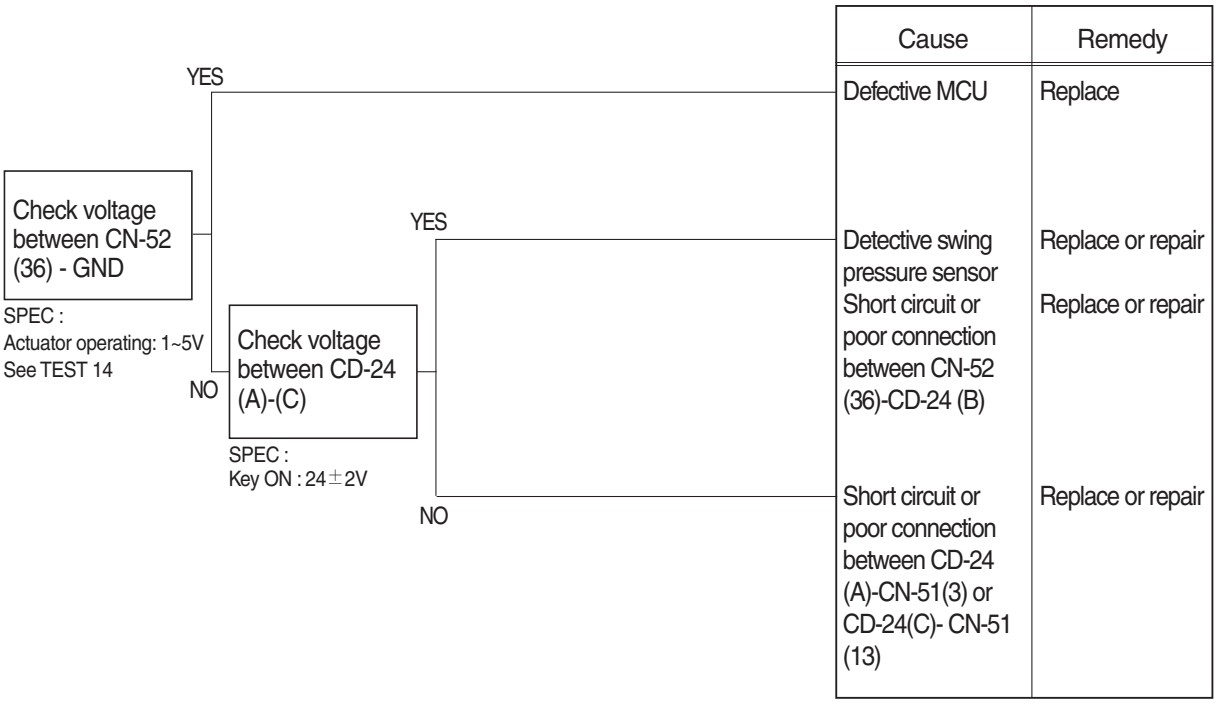
1409S6MS08A

9. MALFUNCTION OF SWING PRESSURE SENSOR

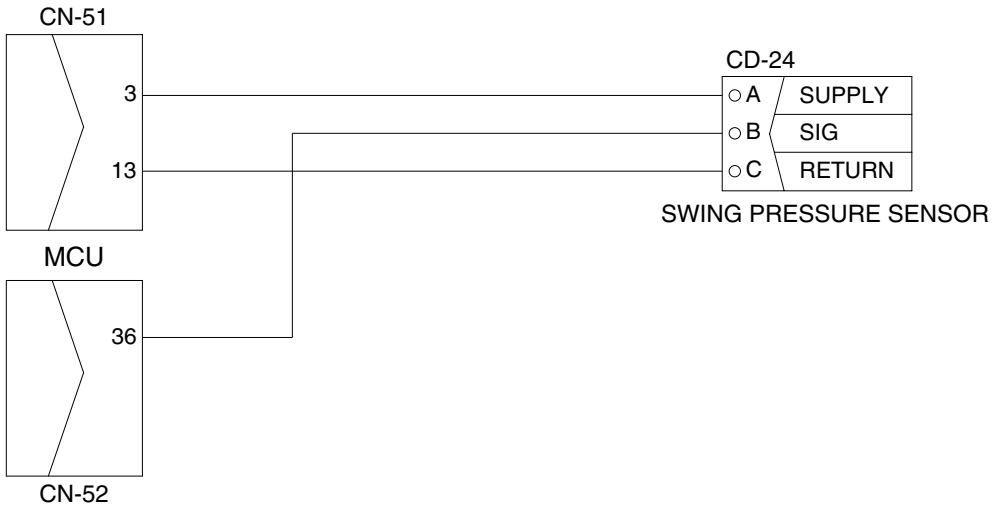
· Fault code : HCESPN 135, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



1409S6MS11

2) TEST PROCEDURE

(1) Test 14 : Check voltage at CN-52(36) and ground.

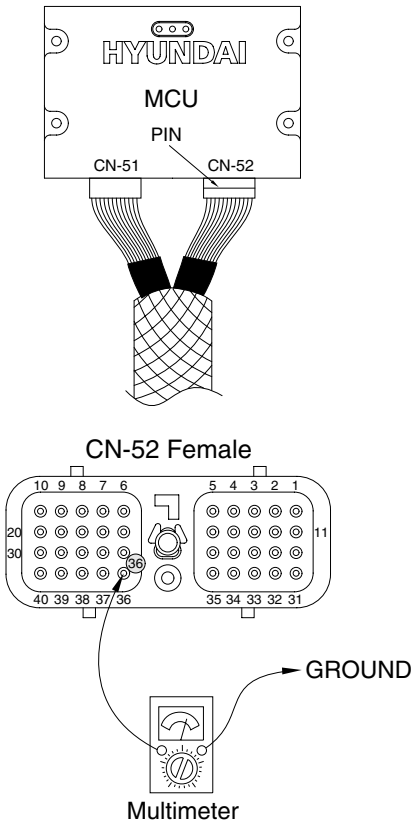
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (36) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



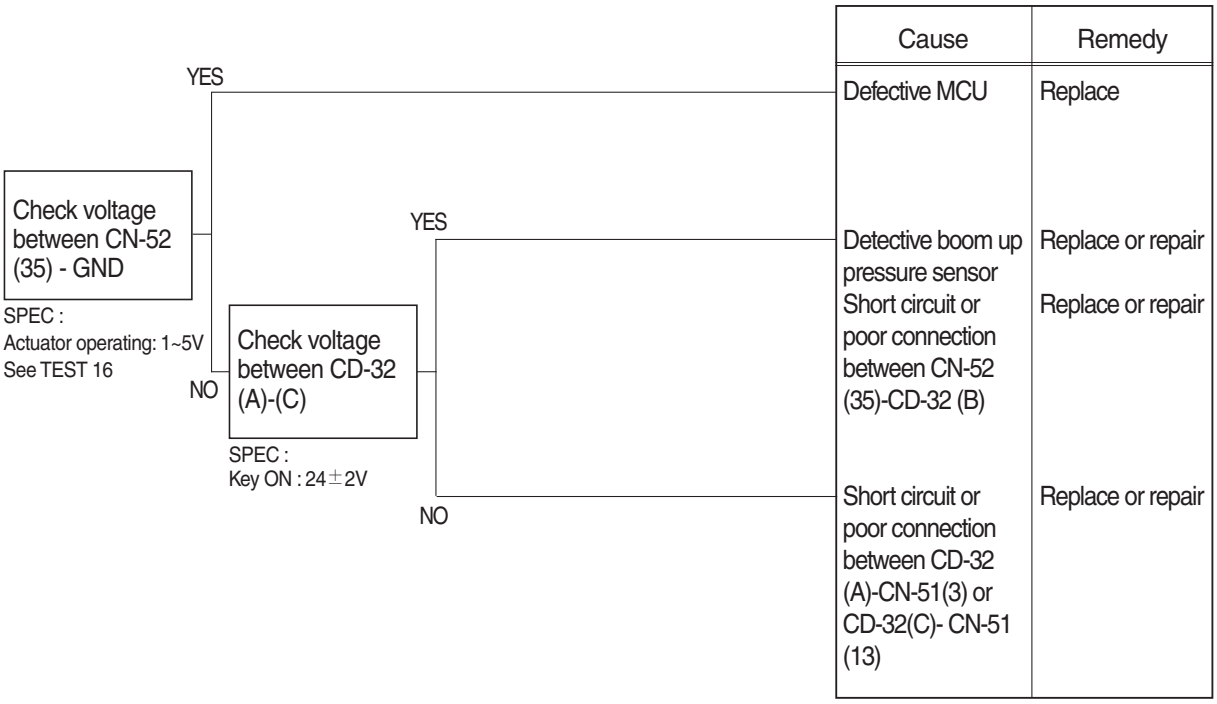
1409S6MS11A

10. MALFUNCTION OF BOOM UP PRESSURE SENSOR

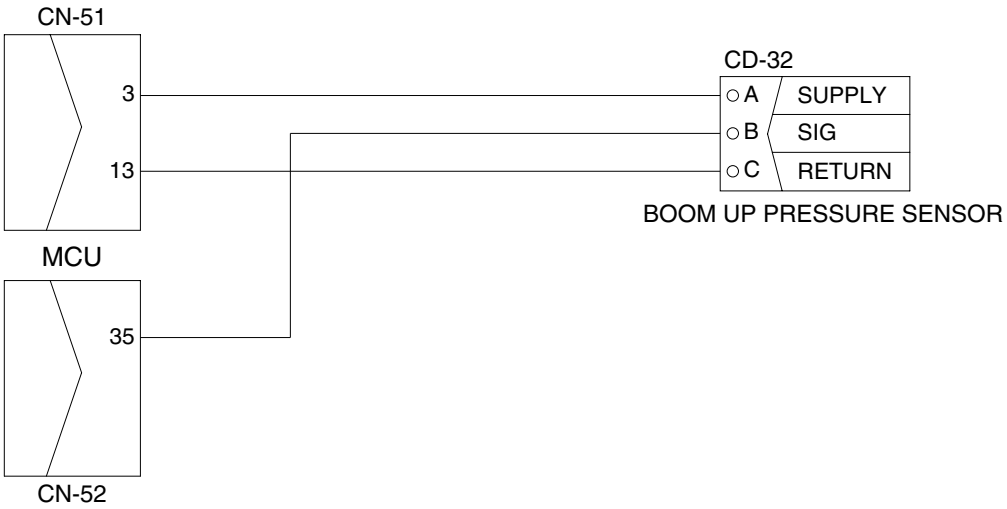
· Fault code : HCESPN 127, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



1409S6MS13

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52(35) and ground.

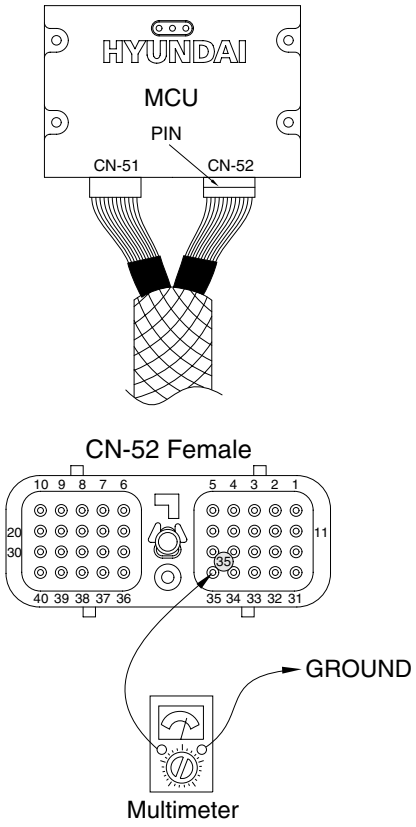
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (35) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



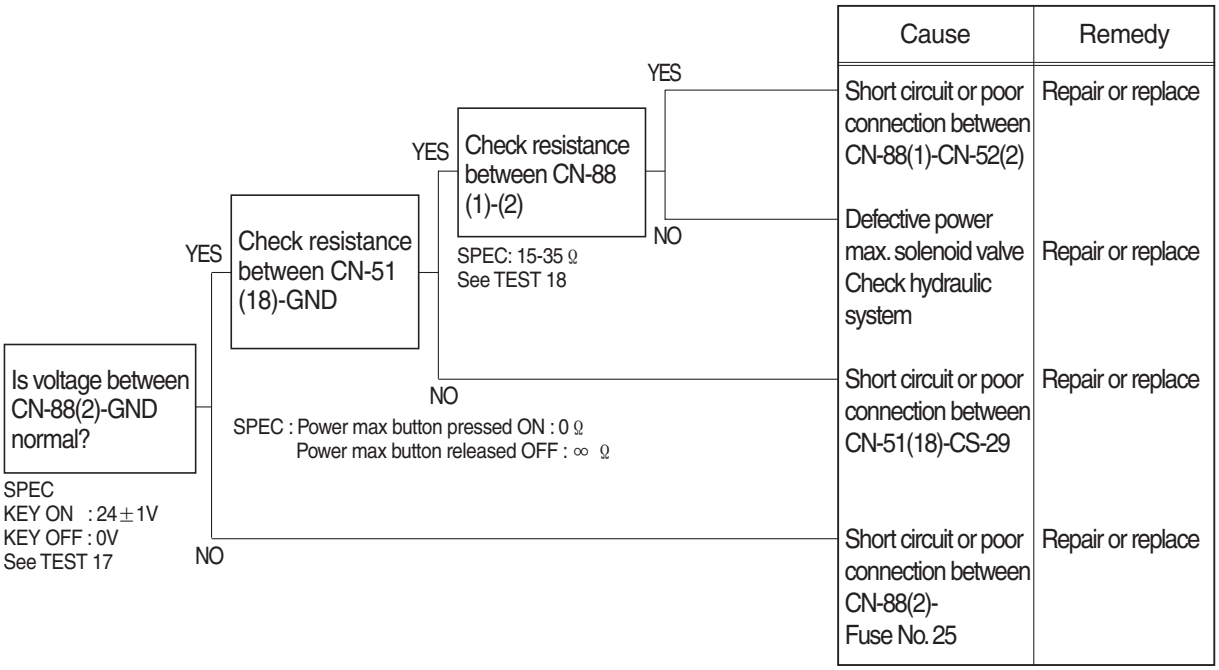
1409S6MS13A

11. MALFUNCTION OF POWER MAX

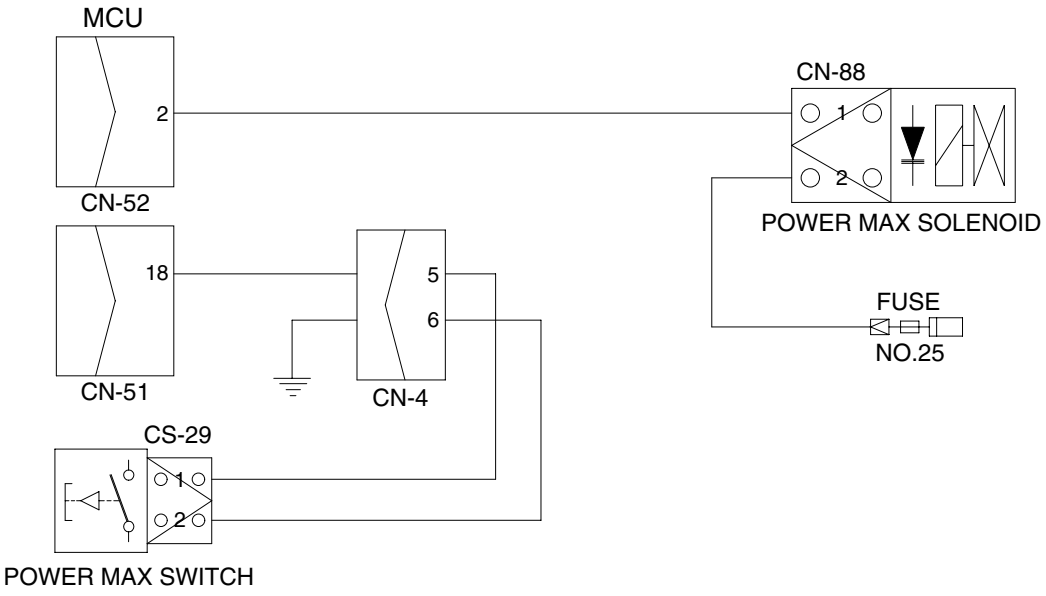
· Fault code : HCESPN 166, FMI 4 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



2209S6MS14

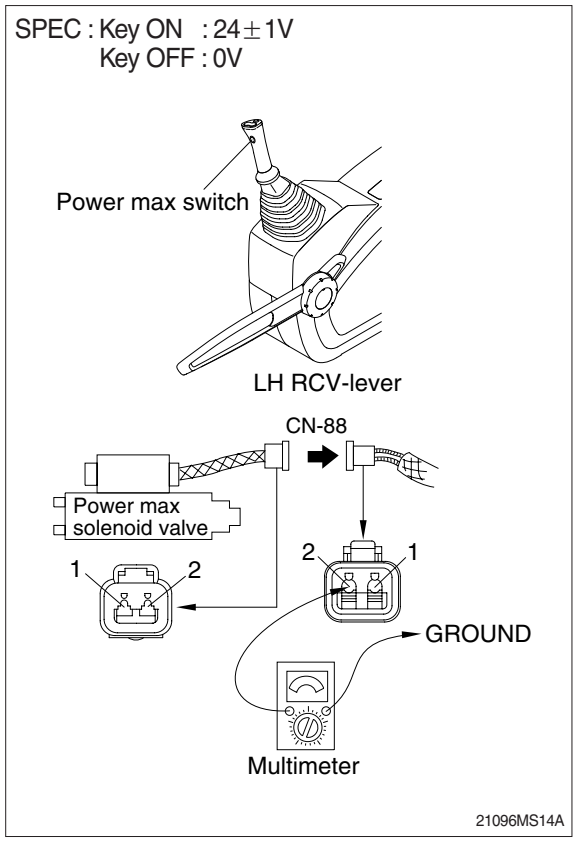
2) TEST PROCEDURE

(1) Test 17: Check voltage between connector CN-88(2) - GND.

① Disconnect connector CN-88 from power max solenoid valve.

② Start key ON.

③ Check voltage as figure.

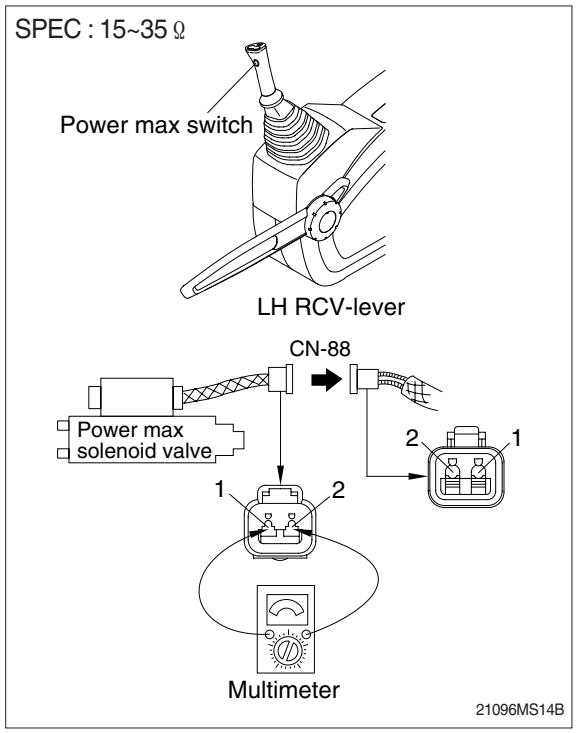


(2) Test 18: Check resistance of the solenoid valve between CN-88(1)-(2).

① Starting key OFF.

② Disconnect connector CN-88 from power max solenoid valve.

③ Check resistance as figure.

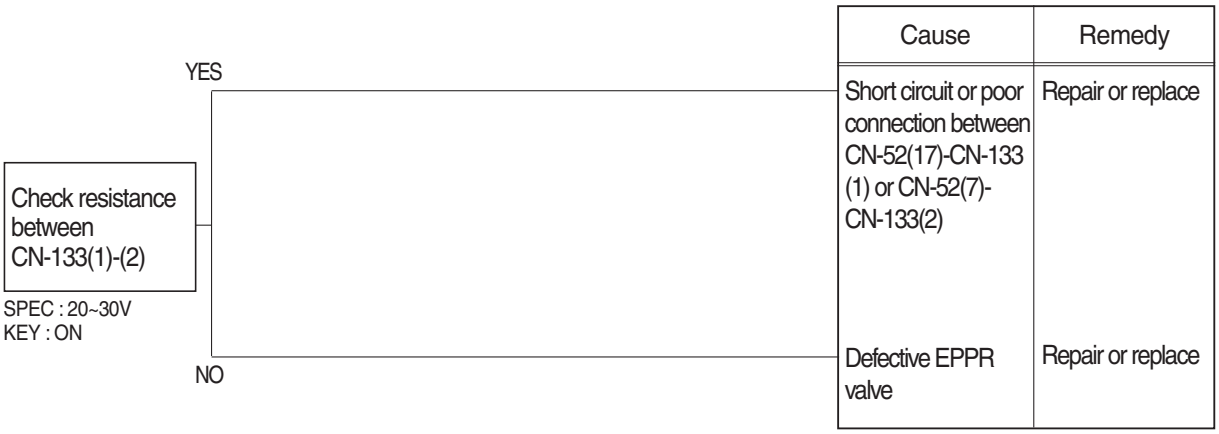


12. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

· Fault code : HCESPN 141, FMI 5 or 6

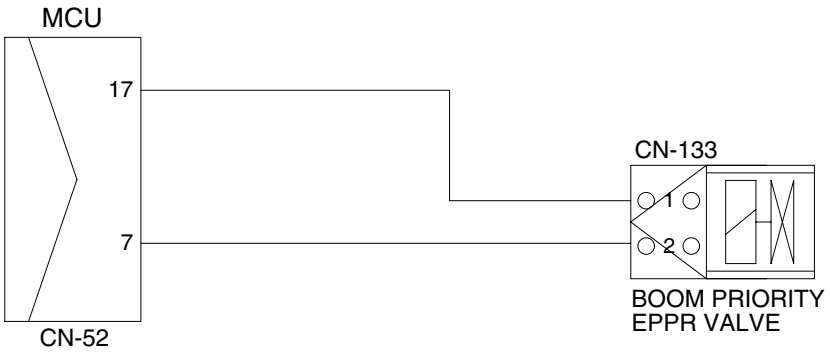
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Short circuit or poor connection between CN-52(17)-CN-133 (1) or CN-52(7)-CN-133(2)	Repair or replace
Defective EPPR valve	Repair or replace

Wiring diagram



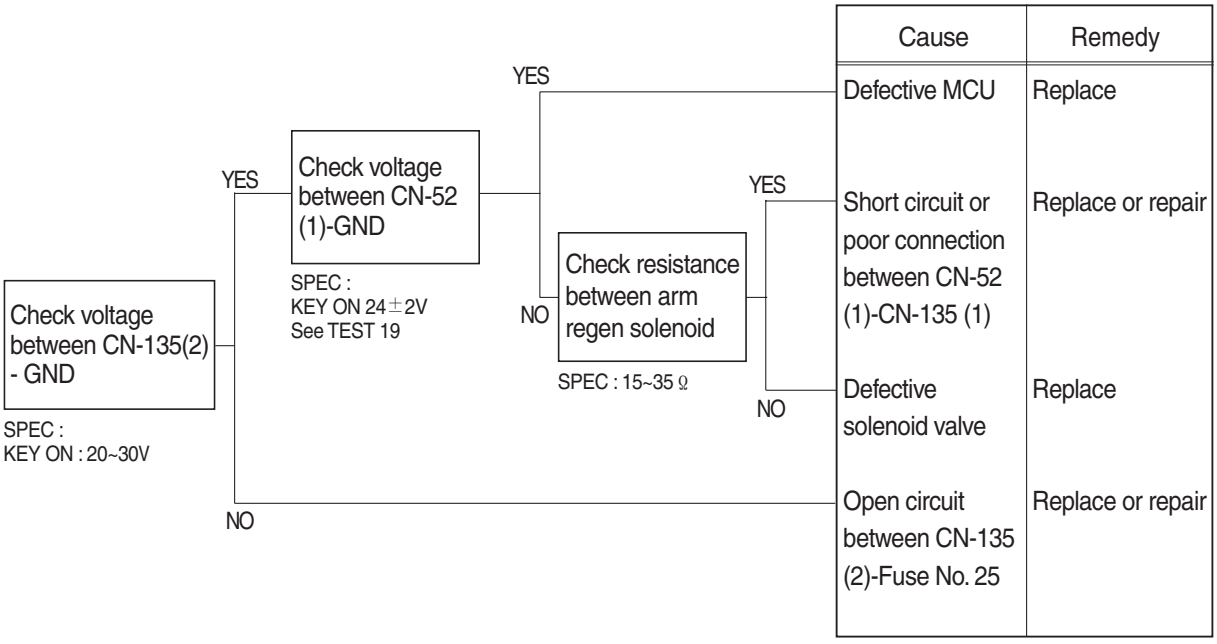
1409S6MS15

13. MALFUNCTION OF ARM REGENERATION SOLENOID

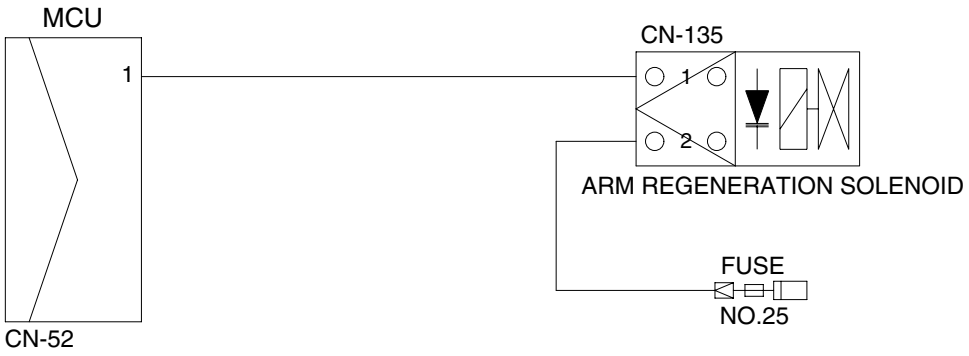
· Fault code : HCESPN 170, FMI 4 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



2209S6MS16

2) TEST PROCEDURE

(1) Test 19 : Check voltage at CN-52(1) and ground.

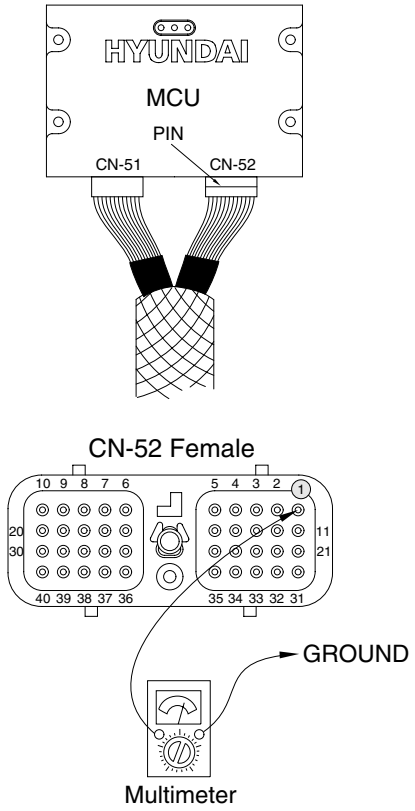
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (1) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Key ON : 24±2 V



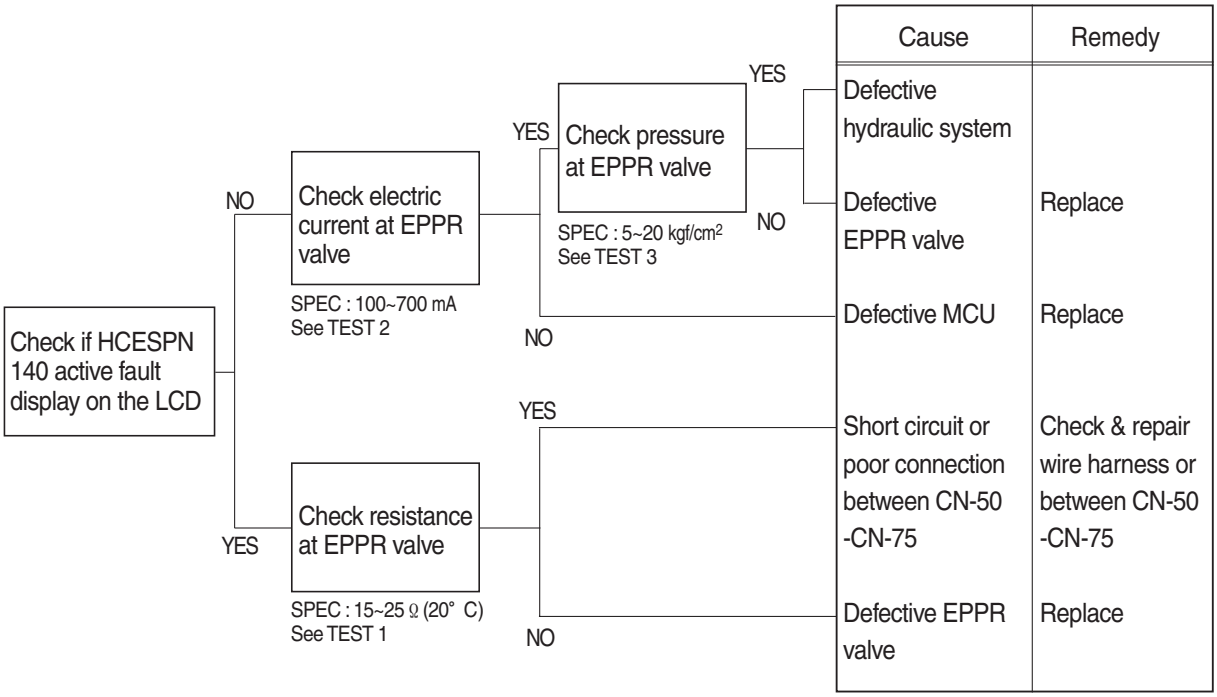
2209SH6MS16A

■ MECHATRONICS SYSTEM (CLUSTER TYPE 2)

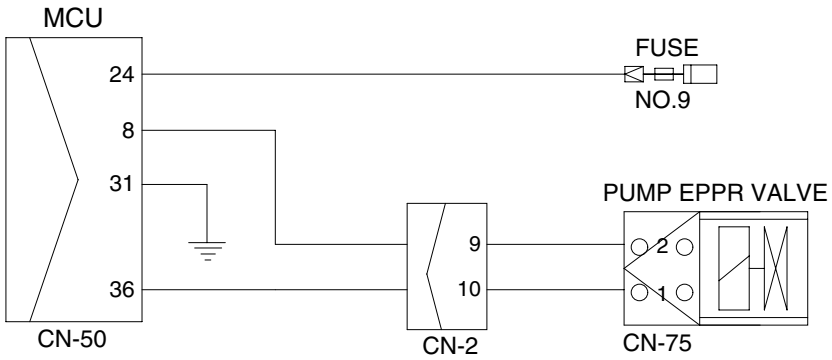
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : M-mode 2100± 50 rpm H -mode 2000 ± 50 rpm S-mode 1900 ± 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



2209S6MS17

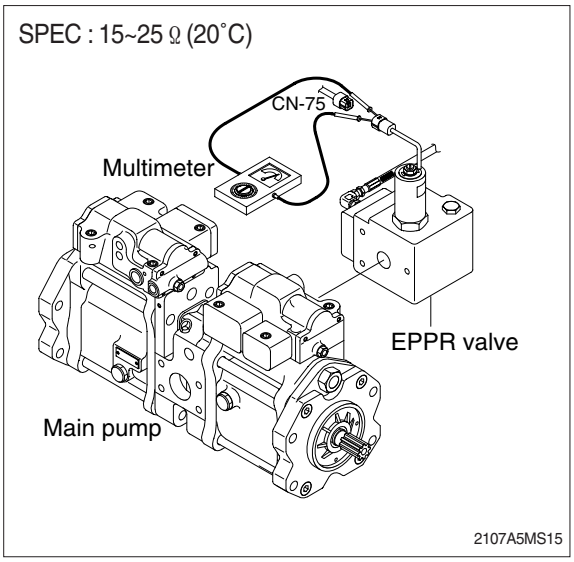
2) TEST PROCEDURE

(1) Test 1 : Check resistance at connector CN-75.

① Starting key OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.



(2) Test 2 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.

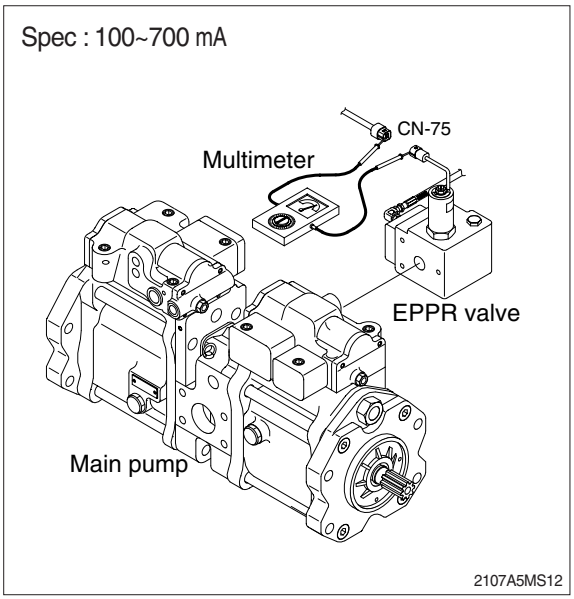
② Insert the adapter to CN-75 and install multimeter as figure.

③ Start engine.

④ Set H-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display approx 2000±50 rpm 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 710 psi)

② Start engine.

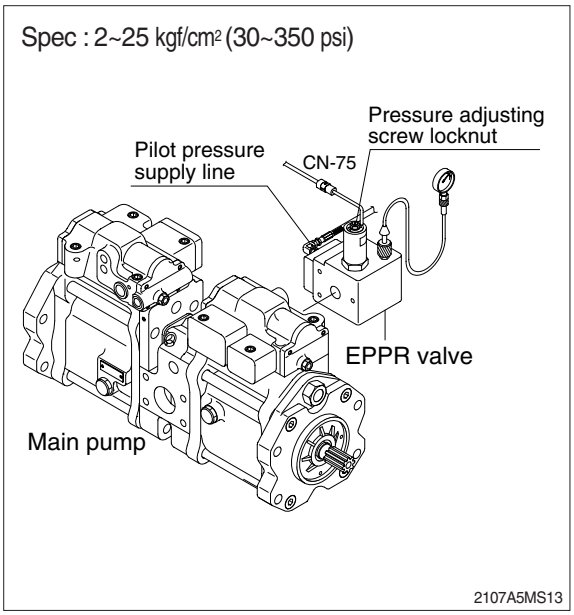
③ Set H-mode and cancel auto decel mode.

④ Position the accel dial at 10.

⑤ If rpm display approx 2000±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

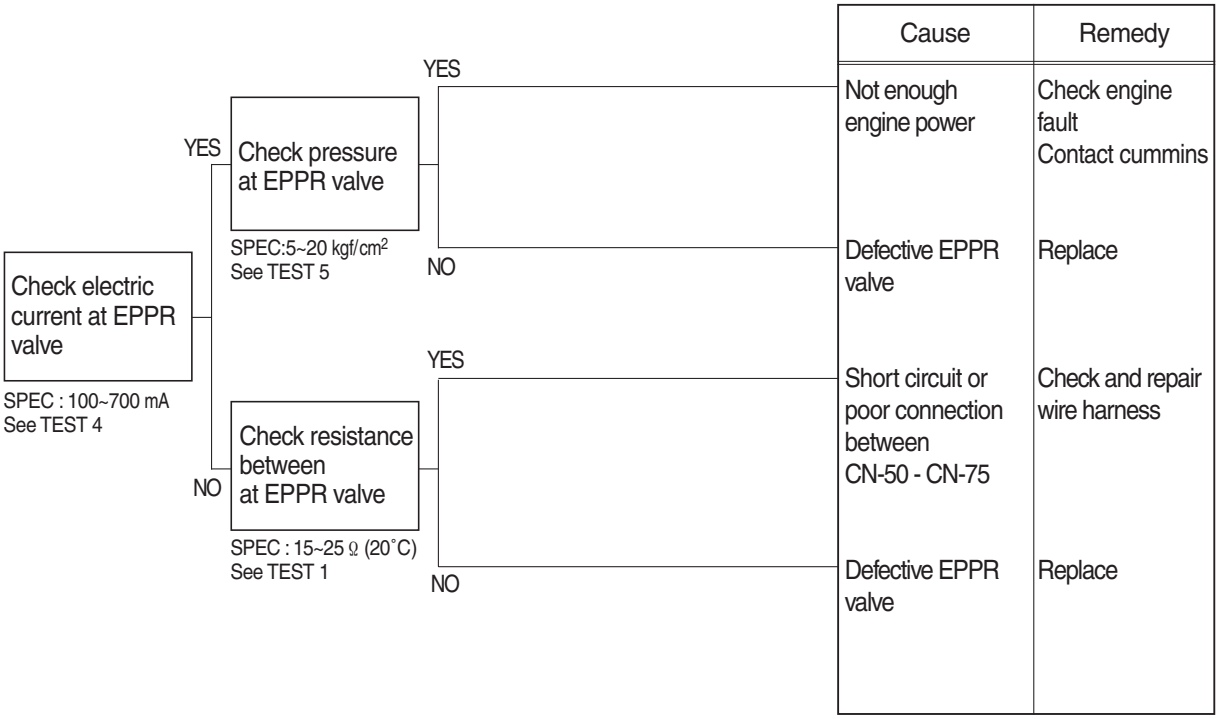
⑦ After adjust, test the machine.



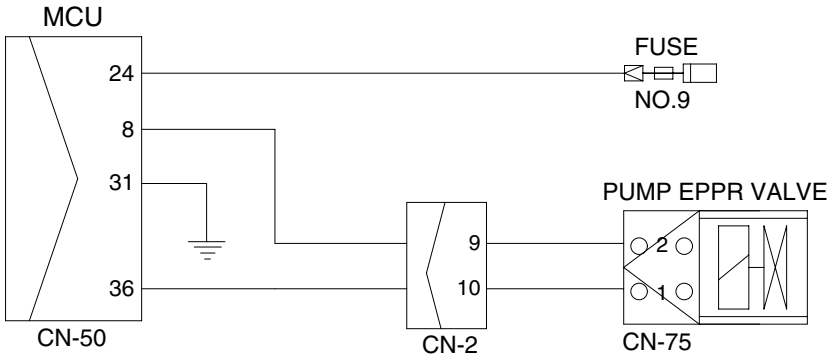
2. ENGINE STALL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



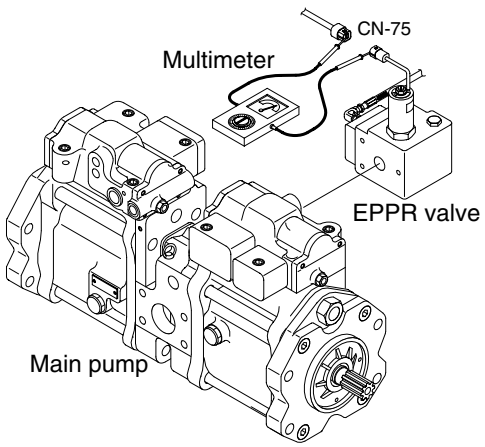
2209S6MS17

2) TEST PROCEDURE

(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set H-mode and cancel auto decel mode.
⑤ Position the accel dial at 10.
⑥ If rpm display approx 2000±50 rpm check electric current at bucket circuit relief position.

SPEC : 100~700 mA

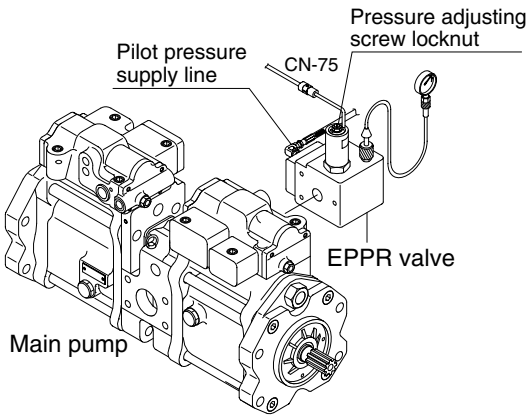


2107A5MS12

(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 710 psi)
② Start engine.
③ Set H-mode and cancel auto decel
④ mode.
⑤ Position the accel dial at 10.
If rpm display approx 2000±50 rpm check pressure at relief position of bucket circuit
⑥ by operating bucket control lever.
⑦ If pressure is not correct, adjust it.
After adjust, test the machine.

SPEC : 2~25 kgf/cm² (30~350 psi)

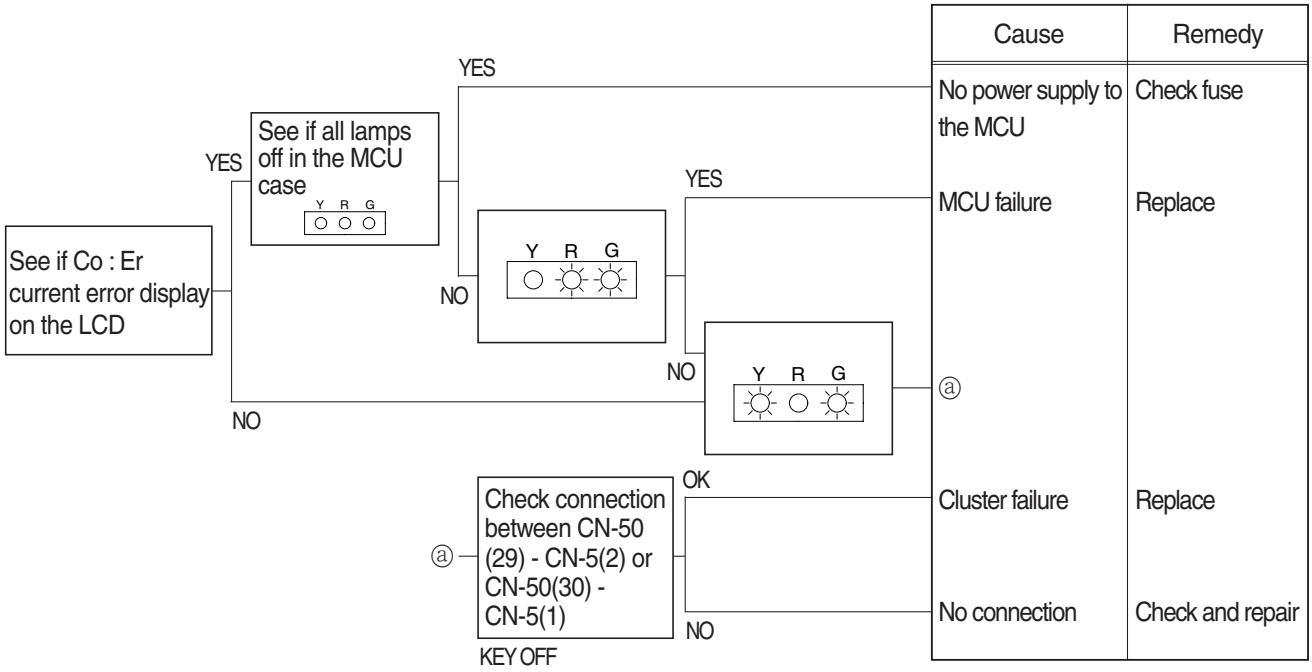


2107A5MS13

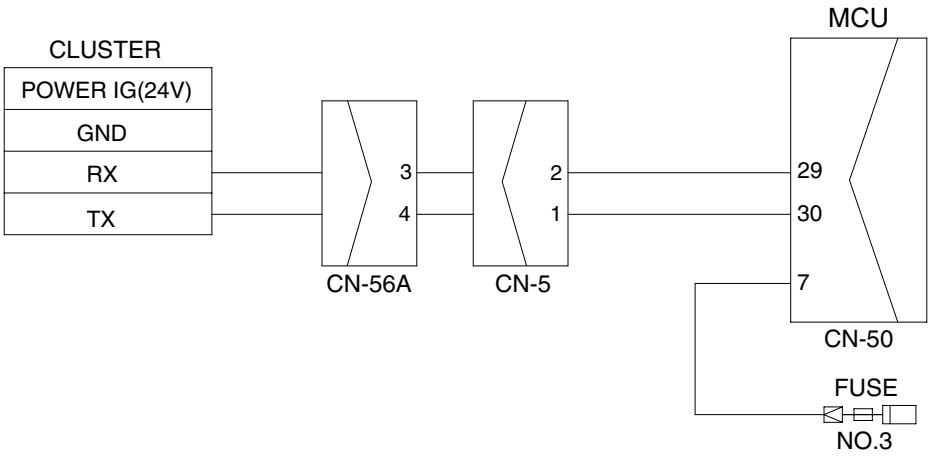
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

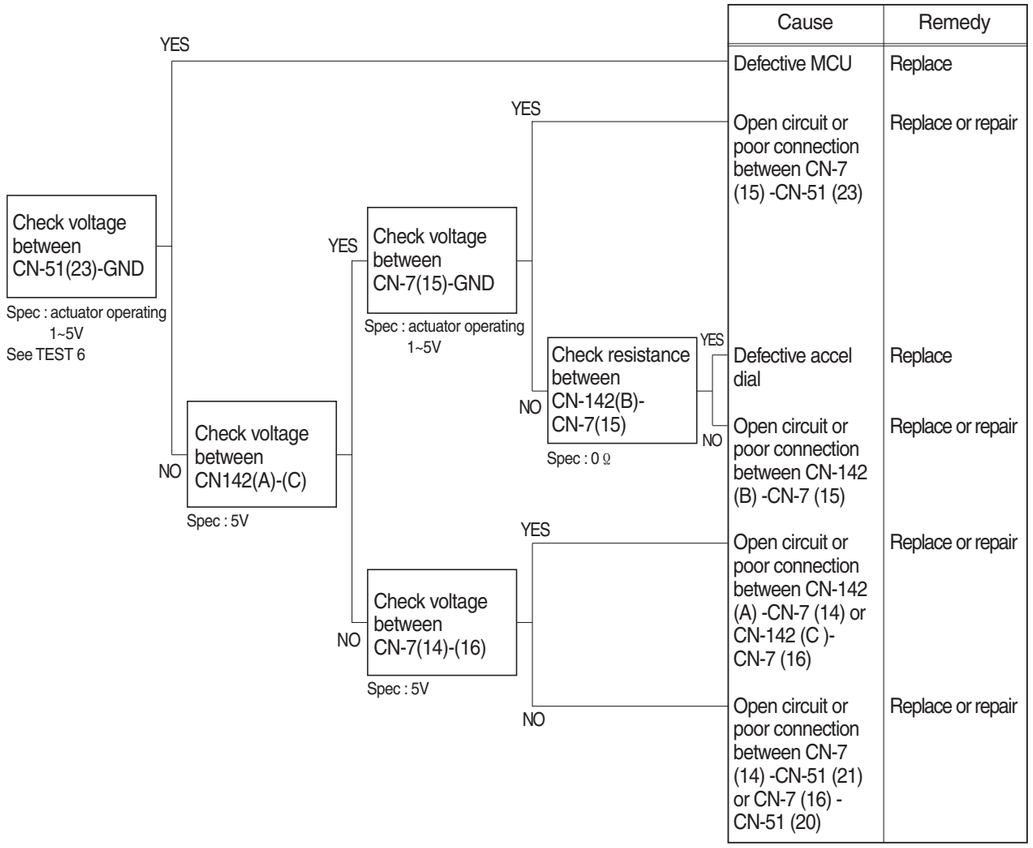


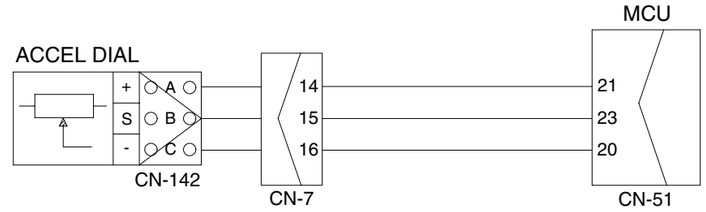
1409S6MS53

4. MALFUNCTION OF ACCEL DIAL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE





1409S6MS54

2) TEST PROCEDURE

(1) Test 6 : Check voltage at CN-51(23) and ground.

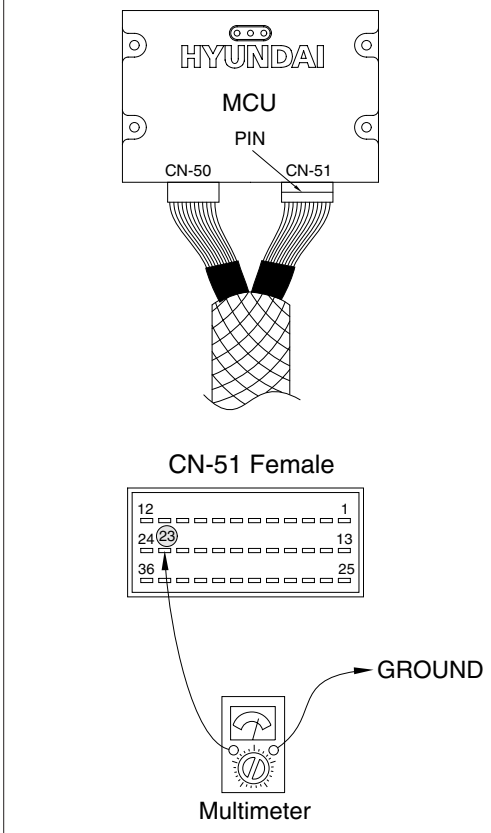
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (23) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

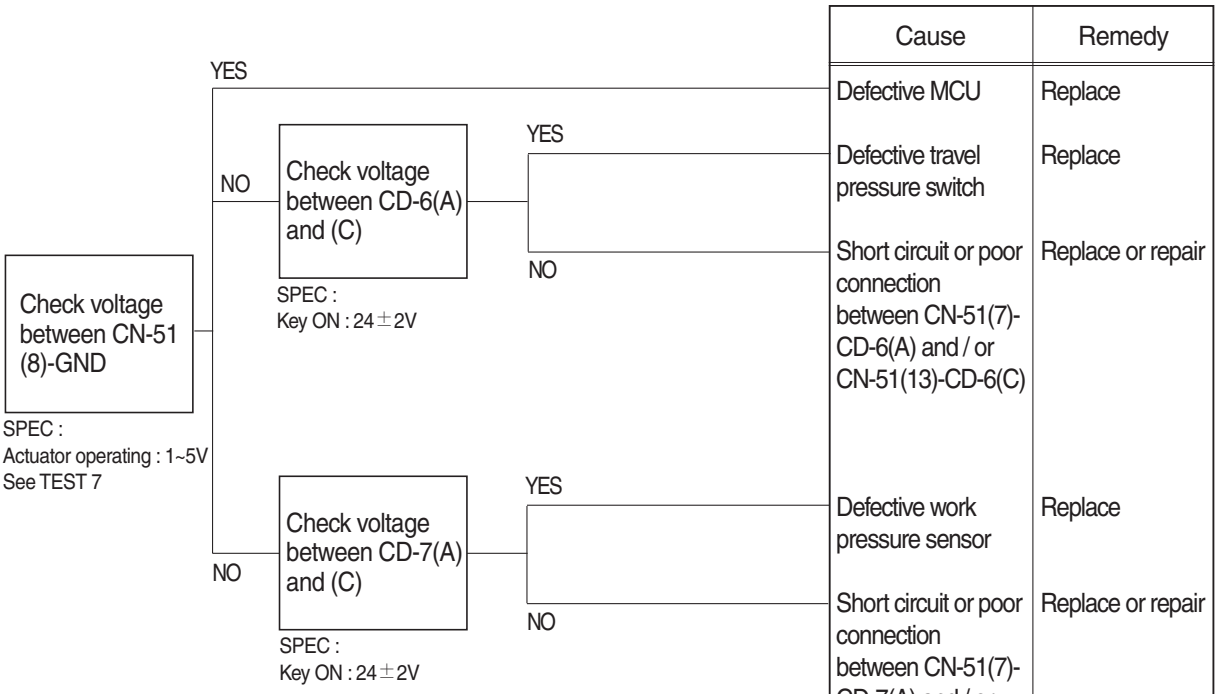


1409S6MS54A

5. AUTO DECEL SYSTEM DOES NOT WORK

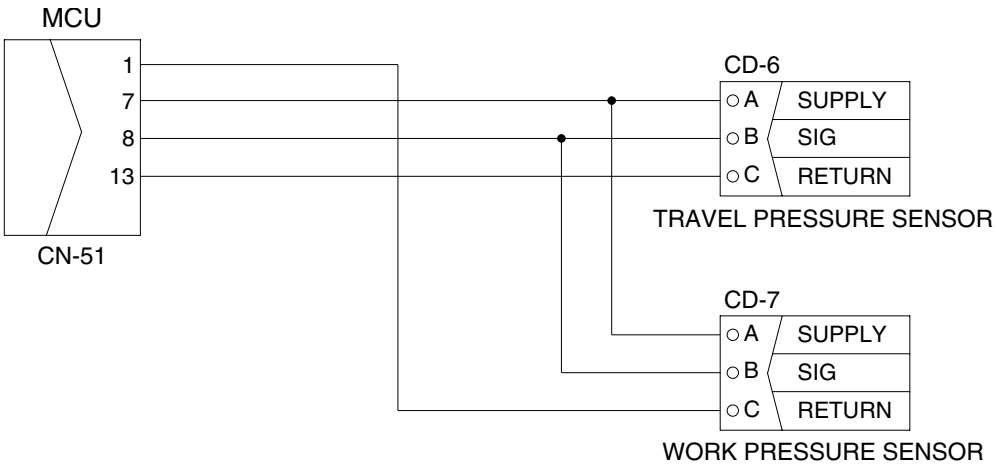
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51(7)-CD-6(A) and / or CN-51(13)-CD-6(C)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51(7)-CD-7(A) and / or CN-51(1)-CD-7(C)	Replace or repair

Wiring diagram



1409S6MS55

2) TEST PROCEDURE

(1) Test 7 : Check voltage at CN-51(8) and ground.

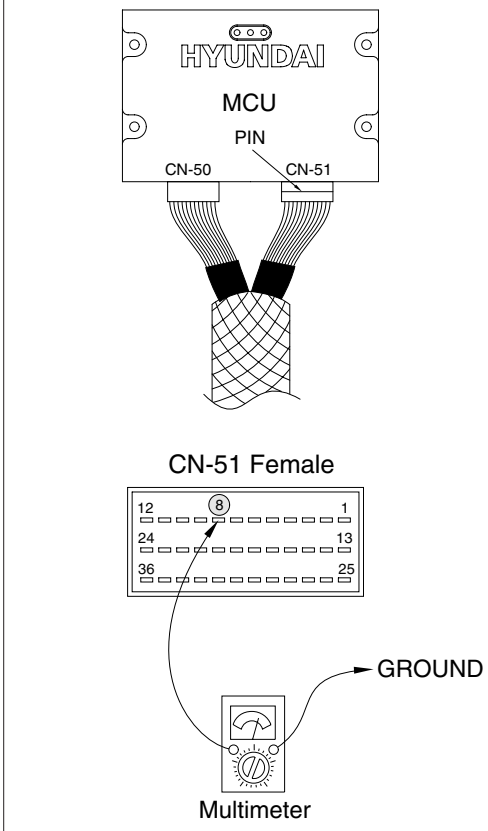
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (8) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

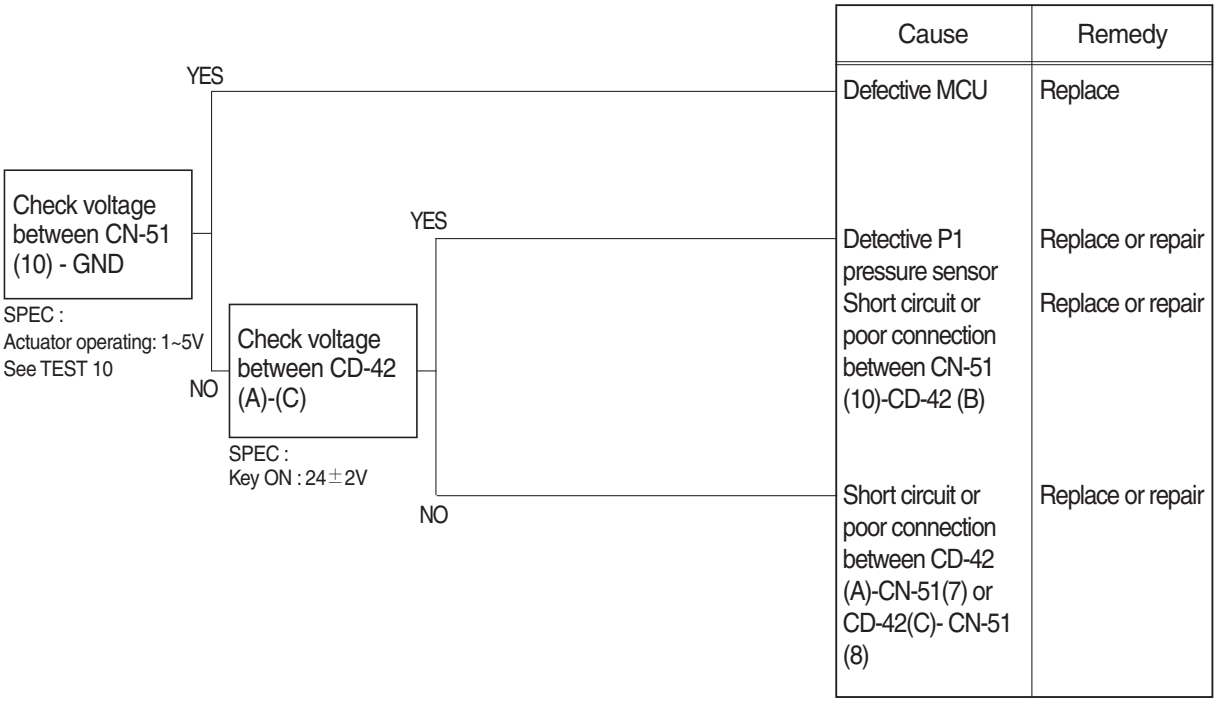
SPEC : Actuator operating : 1~5 V



6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

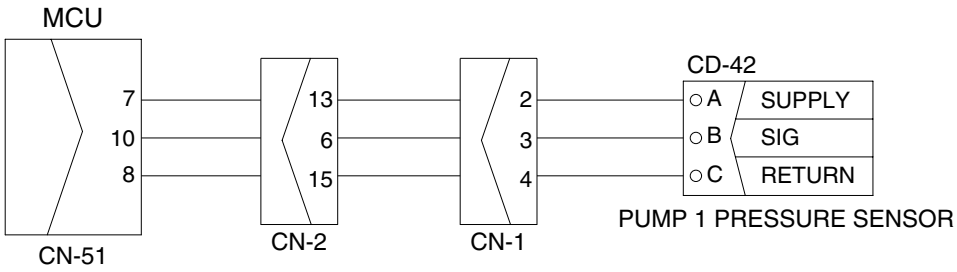
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-51 (10)-CD-42 (B)	Replace or repair
Short circuit or poor connection between CD-42 (A)-CN-51(7) or CD-42(C)- CN-51 (8)	Replace or repair

Wiring diagram



2209S6MS19

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-51(10) and ground.

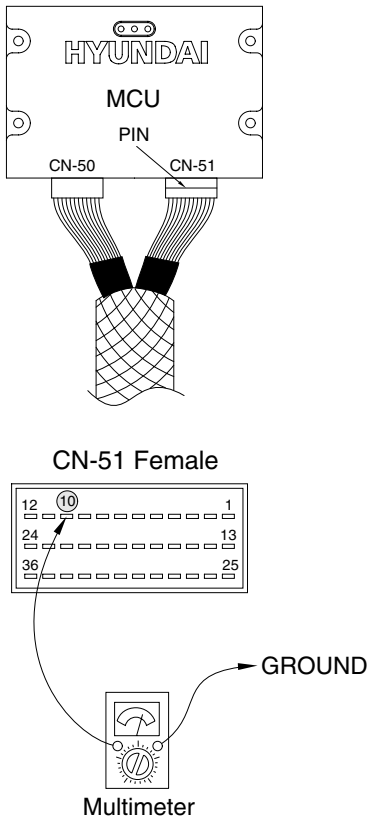
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (10) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

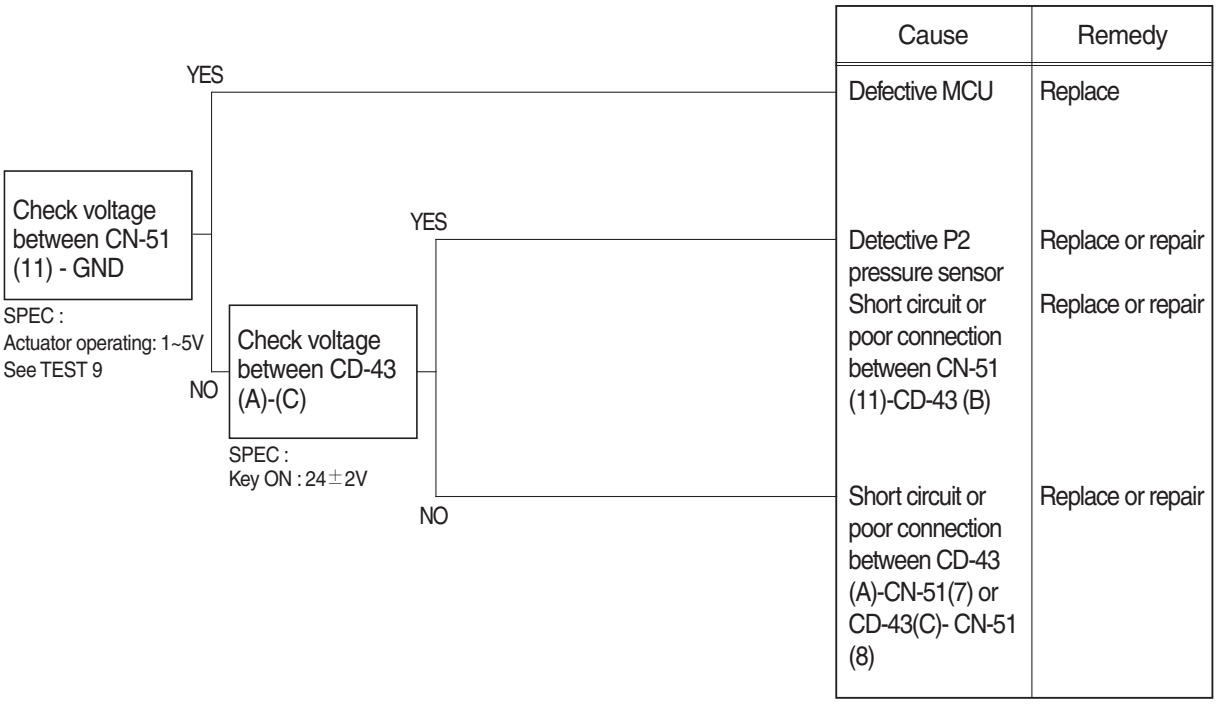


1409S6MS56A

7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

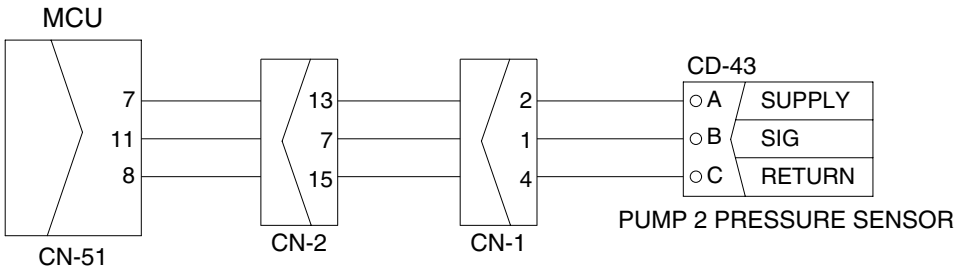
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-51 (11)-CD-43 (B)	Replace or repair
Short circuit or poor connection between CD-43 (A)-CN-51(7) or CD-43(C)- CN-51 (8)	Replace or repair

Wiring diagram



2209S6MS20

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-51(11) and ground.

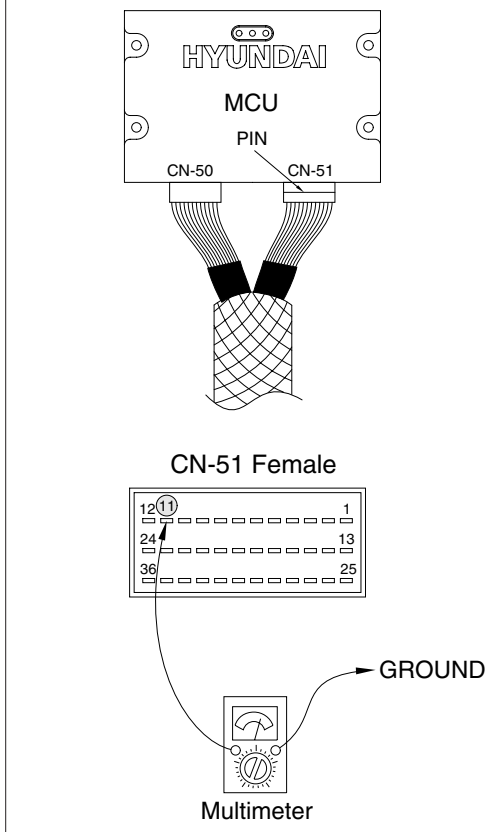
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (11) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

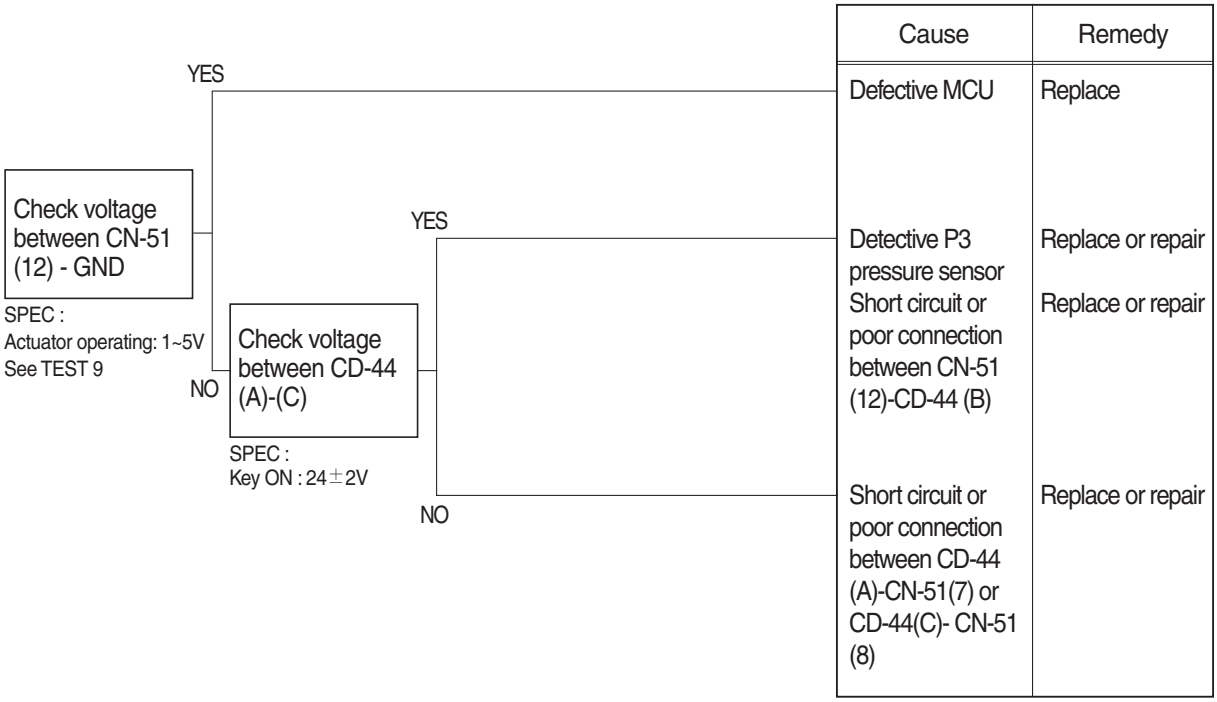


1409S6MS57A

8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

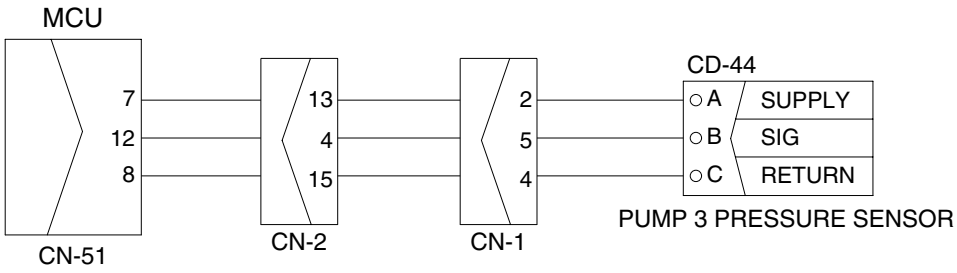
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-51 (12)-CD-44 (B)	Replace or repair
Short circuit or poor connection between CD-44 (A)-CN-51(7) or CD-44(C)- CN-51 (8)	Replace or repair

Wiring diagram



2209S6MS21

2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-51(12) and ground.

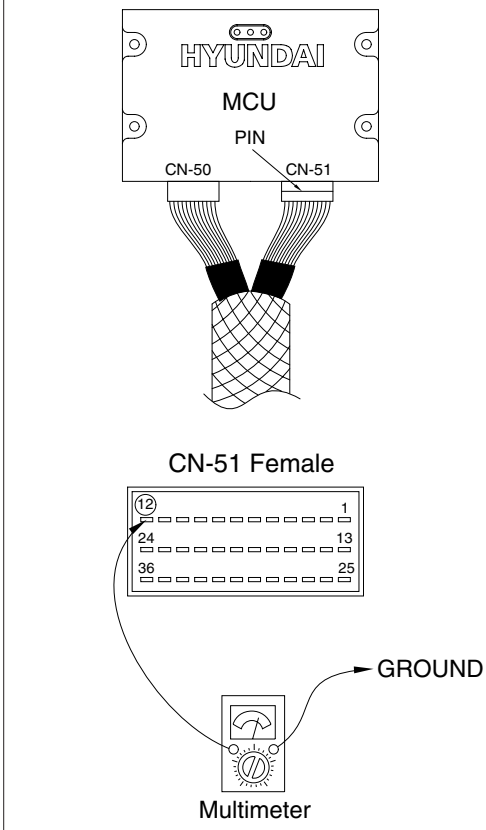
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (12) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

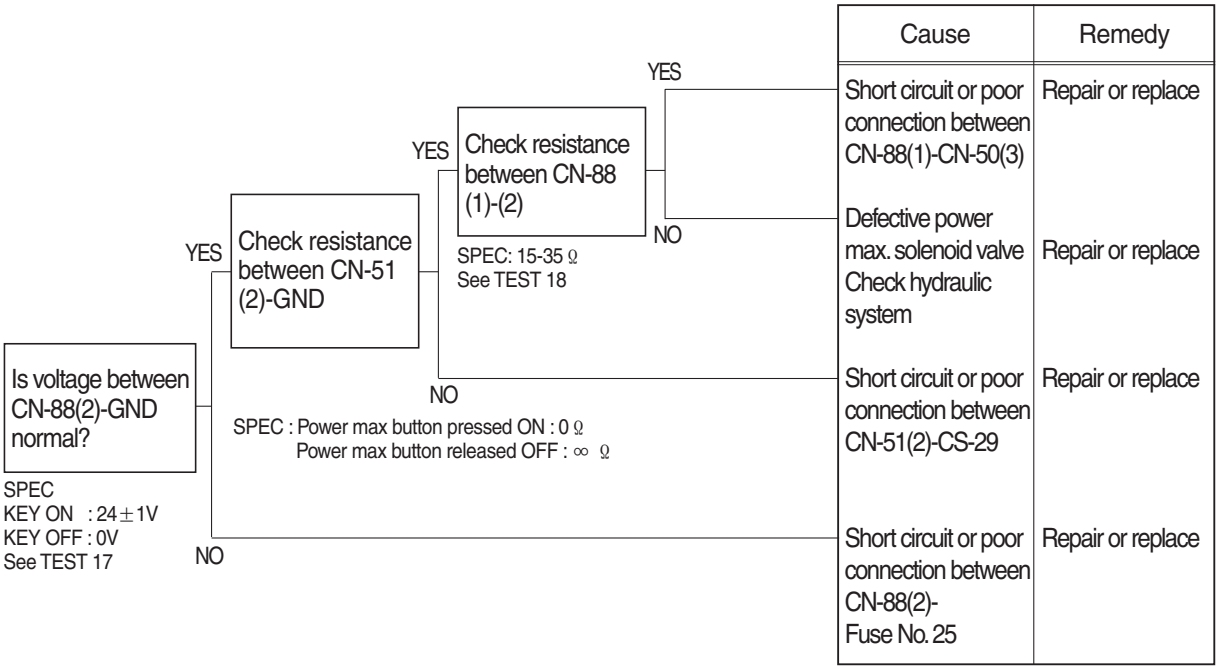


1409S6MS58A

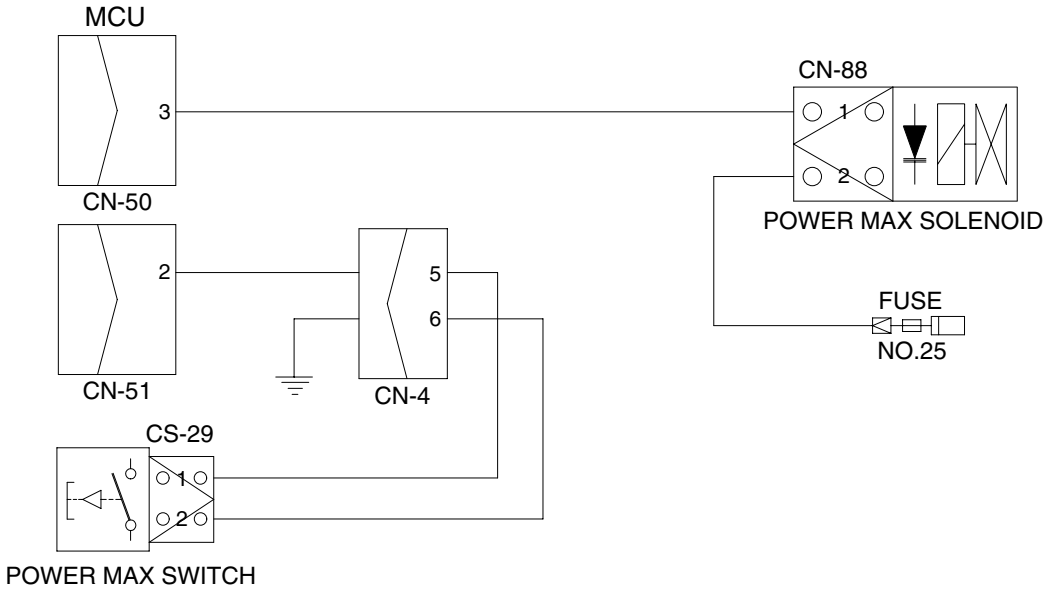
9. MALFUNCTION OF POWER MAX

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



1409S6MS64

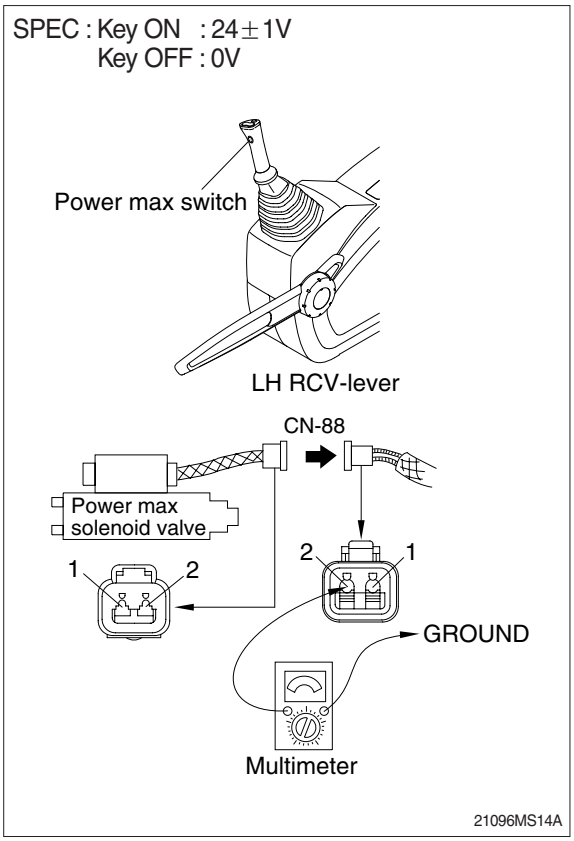
2) TEST PROCEDURE

(1) Test 17: Check voltage between connector CN-88(2) - GND.

① Disconnect connector CN-88 from power max solenoid valve.

② Start key ON.

③ Check voltage as figure.

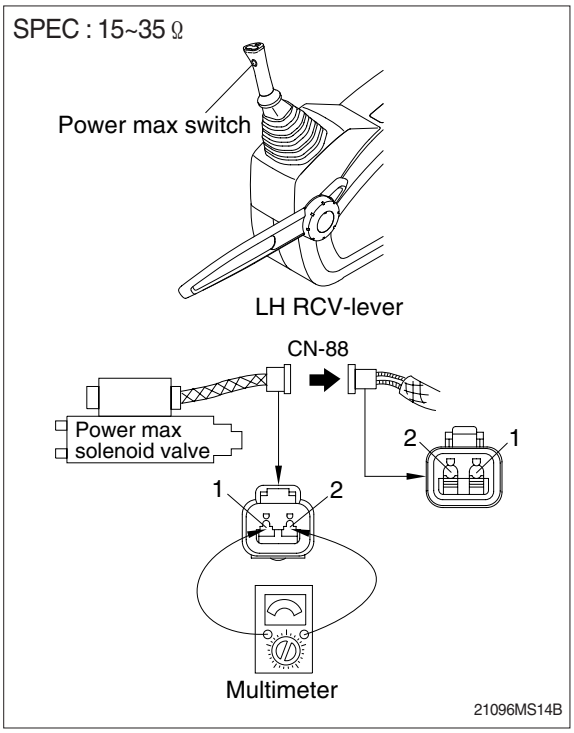


(2) Test 18: Check resistance of the solenoid valve between CN-88(1)-(2).

① Starting key OFF.

② Disconnect connector CN-88 from power max solenoid valve.

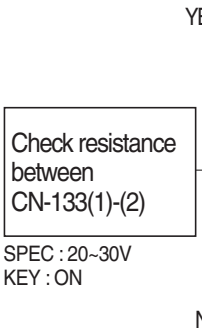
③ Check resistance as figure.



10. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE

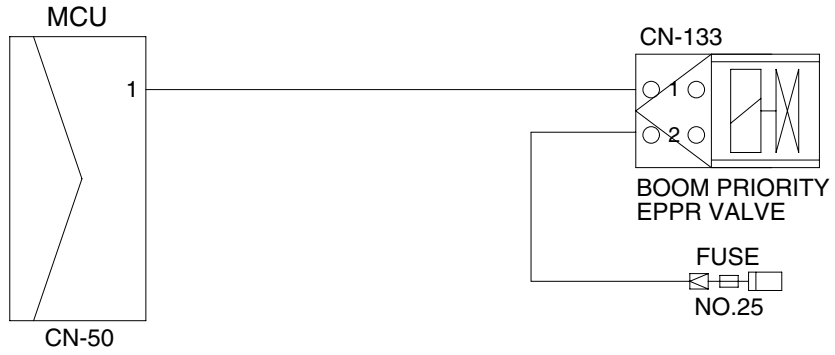


YES

NO

Cause	Remedy
Short circuit or poor connection between CN-50(1)-CN-133 (1) or Fuse No. 25 - CN-133(2)	Repair or replace
Defective EPPR valve	Repair or replace

Wiring diagram



2209S6MS22

SECTION 7 MAINTENANCE STANDARD

SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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

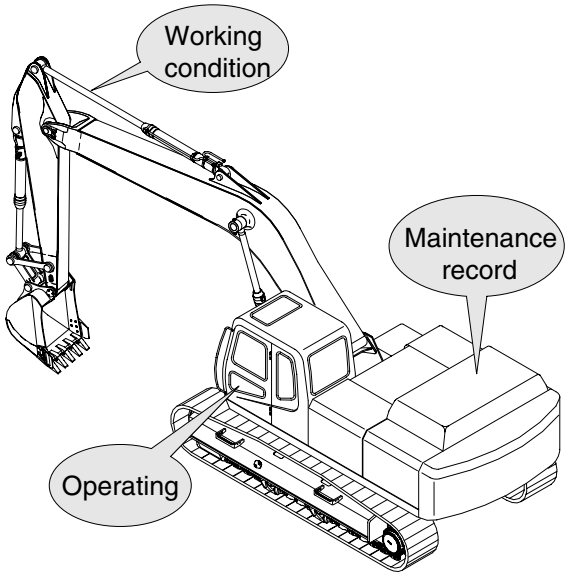
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

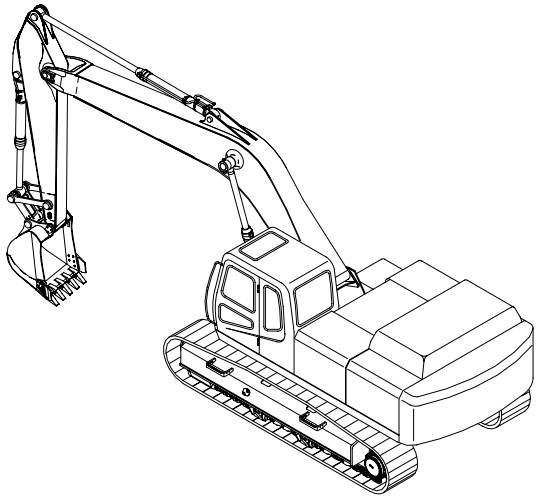


21077MS01

2. TERMINOLOGY

1) STANDARD

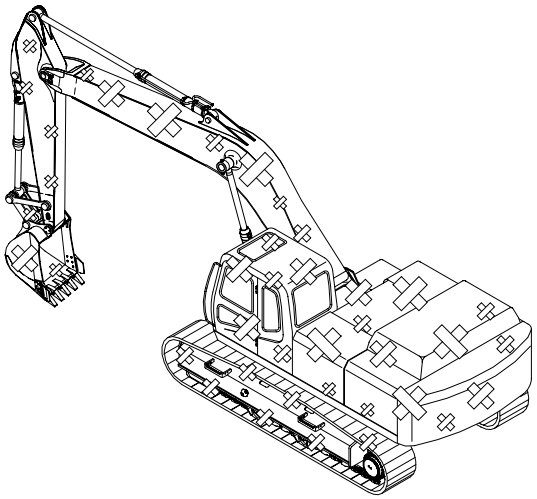
Specifications applied to the brand-new machine, components and parts.



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.

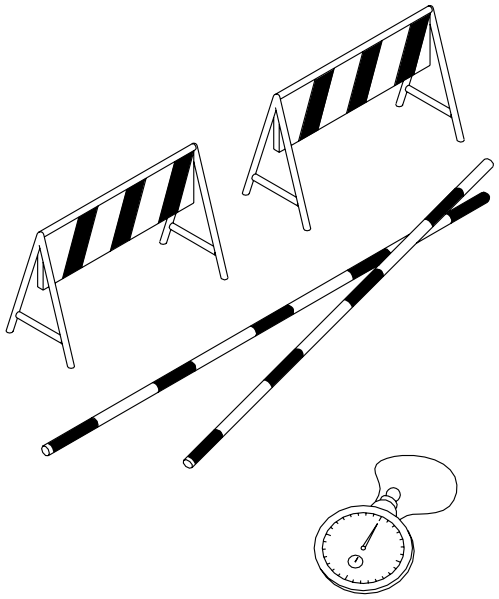
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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 accel dial at 10 (Max) position.

③ Measure the engine RPM.

(3) Measurement

① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

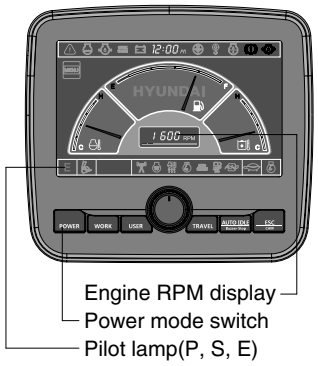
② Measure and record the engine speed at each mode.

③ Select the P-mode (cluster type 1).
Select the M-mode (cluster type 2).

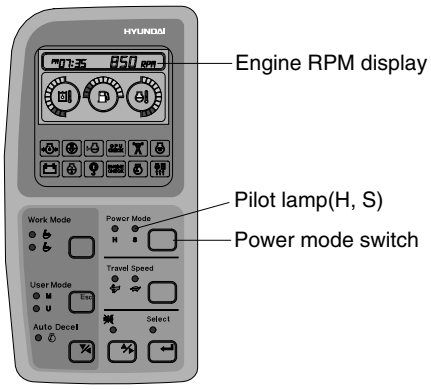
④ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.

⑤ Measure and record the auto deceleration speed.

CLUSTER TYPE 1



CLUSTER TYPE 2



2209S7MS03

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R220LC-9S	Start idle	850±100	
	P (M) mode	2100±50	
	S (H) mode	2000±50	
	E (S) mode	1900±50	
	Auto decel	1150±100	
	One touch decel	1000±100	

Condition : Set the accel dial at 10 (Max) position.

3) TRAVEL SPEED

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

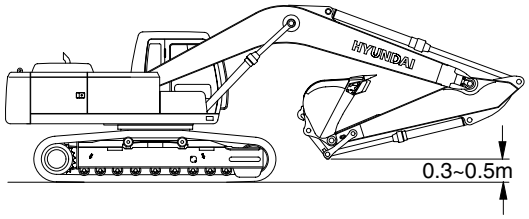
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



21097MS04

(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.

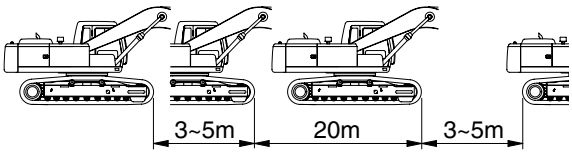
· Power mode switch :
P mode (cluster type 1)
M mode (cluster type 2)

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.



21077MS05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
R220LC-9S	1 Speed	18.9±2.0	23.6	
	2 Speed	13.1±1.0	16.4	

4) TRACK REVOLUTION SPEED

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

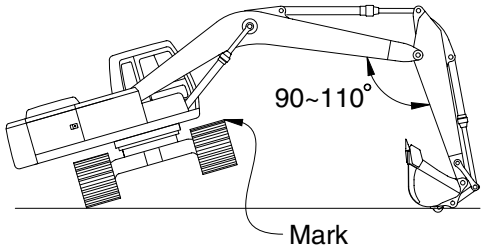
(2) Preparation

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.



21077MS06

(3) Measurement

① Select the following switch positions.

- Travel mode switch : 1 or 2 speed
- Power mode switch :
  P mode (cluster type 1)
  M mode (cluster type 2)
- 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
R220LC-9S	1 Speed	28.8±2.0	35.4
	2 Speed	19.2±2.0	23.4

5) TRAVEL DEVIATION

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

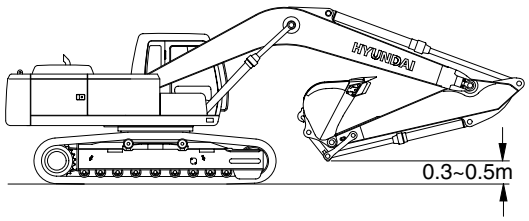
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



21097MS04

(3) Measurement

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

② Before beginning each test, select the following switch positions.

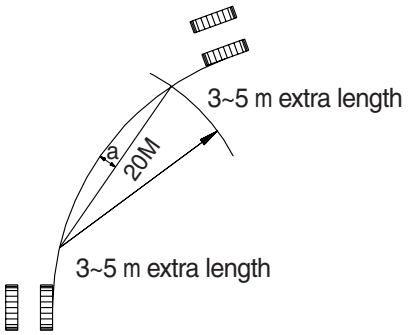
· Power mode switch :
P mode (cluster type 1)
M mode (cluster type 2)

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
R220LC-9S	200 below	240	

6) SWING SPEED

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

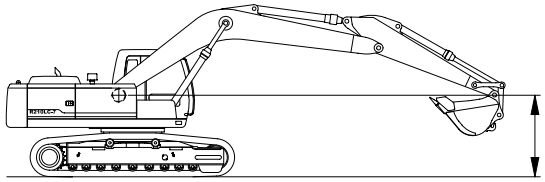
(2) Preparation

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.



21077MS07

(3) Measurement

① Select the following switch positions.

· Power mode switch :
P mode (cluster type 1)
M mode (cluster type 2)

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

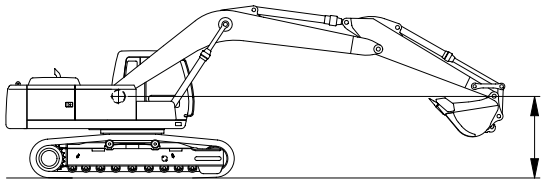
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
R220LC-9S	P mode (cluster type 1)	15.8±1.5	19.0
	M mode (cluster type 2)		

7) SWING FUNCTION DRIFT CHECK

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



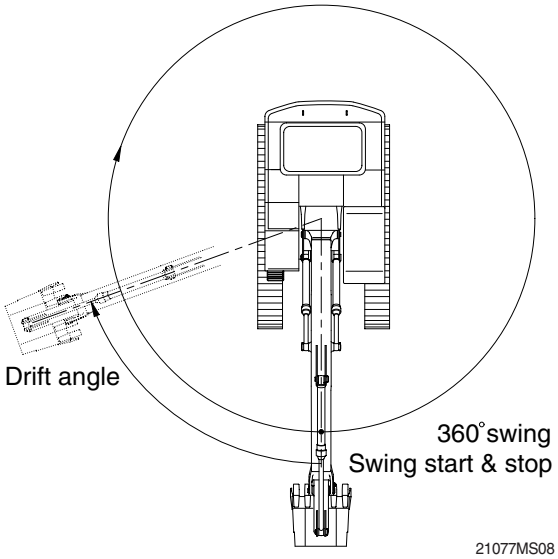
21097MS07

(2) Preparation

① Check the lubrication of the swing gear and swing bearing.
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
④ Make two chalk marks: one on the swing bearing and one directly below it on the track frame.
⑤ Swing the upperstructure 360˚.
⑥ Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① Conduct this test in the M mode.
② Select the following switch positions.
· Power mode switch :
P mode (cluster type 1)
M mode (cluster type 2)
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

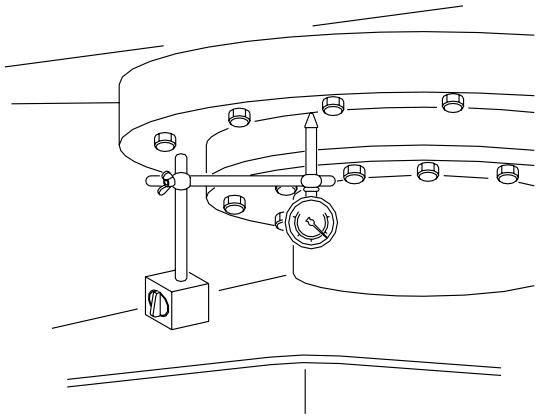
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R220LC-9S	P mode (cluster type 1)	90 below	128.7	
	M mode (cluster type 2)			

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)

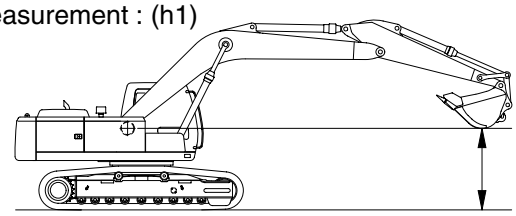
(2) Preparation

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.

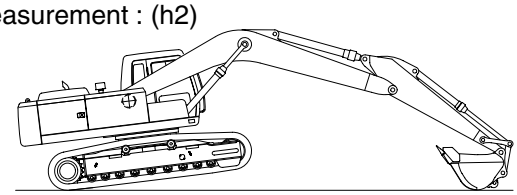
(3) Measurement

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)



21077MS09

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R220LC-9S	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.

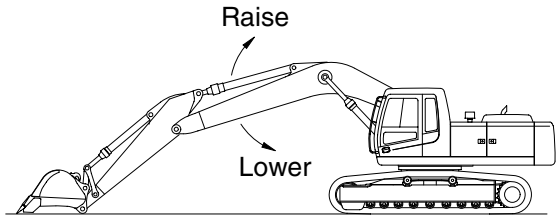
· Power mode switch :
P mode (cluster type 1)
M mode (cluster type 2)

② To measure cylinder cycle times.

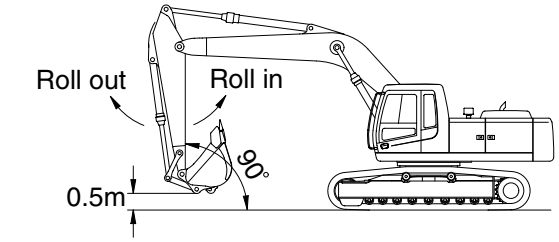
- Boom cylinders.
Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.

- 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.

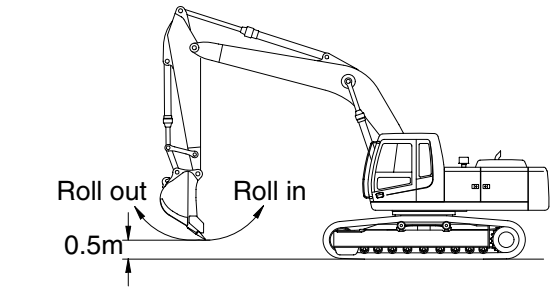
Boom cylinder



Arm cylinder



Bucket cylinder



21077MS10

- 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
R220LC-9S	Boom raise		3.5±0.4	4.1	
	Boom lower		2.5±0.4	3.2	
	Arm in	Regen ON	3.2±0.4	3.8	Cluster type 1
		Regen OFF	3.7±0.4	4.5	
	Arm in		3.7±0.4	4.5	Cluster type 2
	Arm out		3.0±0.3	3.8	
	Bucket in		2.5±0.4	3.3	
	Bucket out		2.3±0.3	2.9	

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

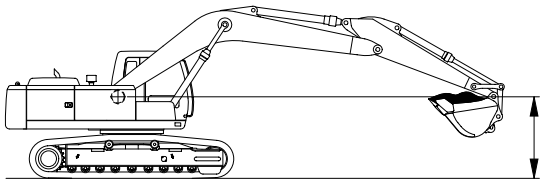
① Load bucket fully. Instead of loading the bucket, weight(W) of the following specification can be used.
- $W=M^3 \times 1.5$
  Where :
  M^3 = Bucket heaped capacity (m^3)
  1.5 = Soil specific gravity

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.



21077MS11

(3) Measurement

① Stop the engine.

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

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

(4) The measured drift should be within the following specifications.

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
R220LC-9S	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 : cluster type 1
M mode : cluster type 2

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
R220LC-9S	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
R220LC-9S	Boom lever	112±10	134	
	Arm lever	112±10	134	
	Bucket lever	90±10	112	
	Swing lever	90±10	112	
	Travel lever	139±10	178	

13) PILOT PRIMARY PRESSURE (CLUSTER TYPE 1)

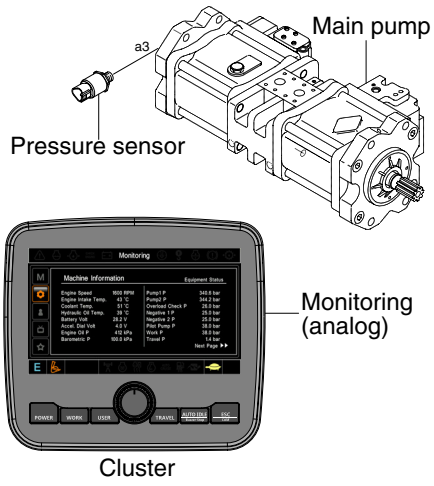
(1) Preparation

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

(2) Measurement

① Select the following switch positions.
- Power mode switch : P mode
- Auto decel switch : OFF

② Measure the primary pilot pressure by the monitoring menu of the cluster.



21097MS12

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R220LC-9S	P mode	40^{+2}_{0}	-	

■ PILOT PRIMARY PRESSURE (CLUSTER TYPE 2)

(1) Preparation

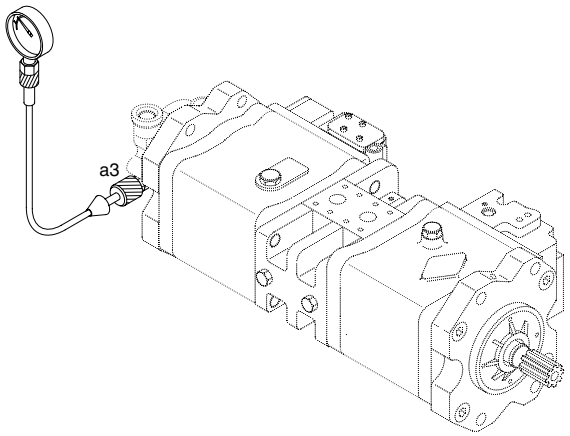
① Stop the engine.

② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.

③ Loosen and remove plug on the pilot pump delivery port and connect pressure gauge.

④ Start the engine and check for oil leakage from the port.

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



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(2) Measurement

① Select the following switch positions.
- Mode selector : M mode
- Auto decel switch : OFF

② Measure the primary pilot pressure in the M mode.

(3) Evaluation

The average measured pressure should be within the following specifications.

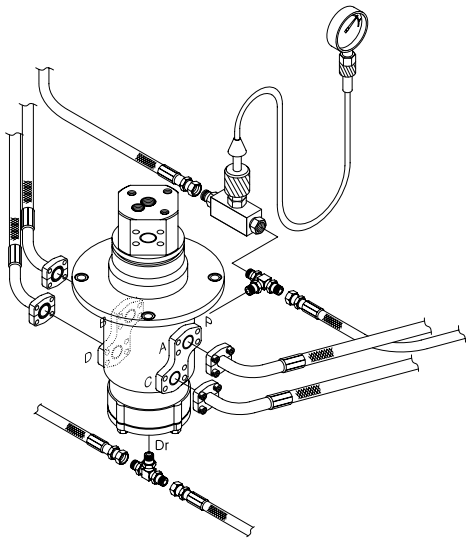
Unit : kgf / cm²

Model	Engine speed	Standard	Alowable limits	Remarks
R220LC-9S	M mode	40^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ To measure the speed selecting pressure: Install a connector and pressure gauge
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.



21077MS13

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed
· Mode selector :
P mode (cluster type 1)
M mode (cluster type 2)
② Measure the travel speed selecting pressure in the Hi or Lo mode.
③ Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the fast speed pressure.
④ Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R220LC-9S	1 Speed	0	-	
	2 Speed	40±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.

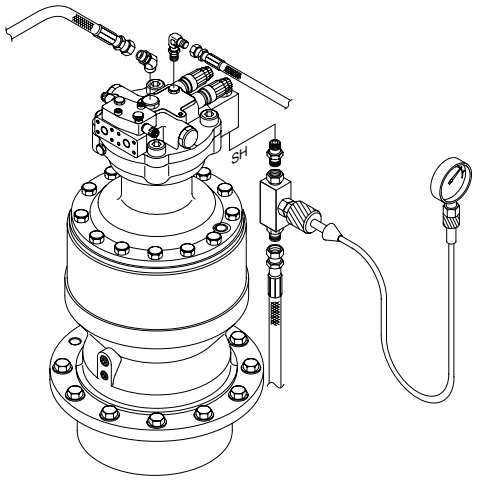
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.

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.



21077MS14

(2) Measurement

① Select the following switch positions.

· Power mode switch :
P mode (cluster type 1)
M mode (cluster type 2)

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
R220LC-9S	Brake disengaged	40	Over 9	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE (CLUSTER TYPE 1)

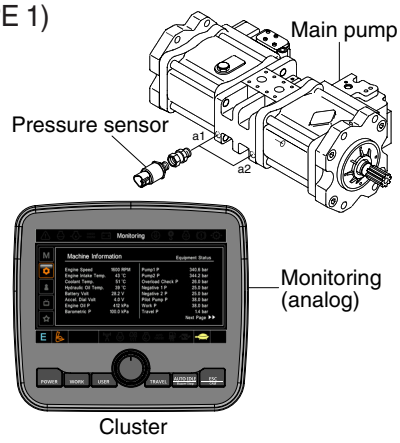
(1) Preparation

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).



21097MS15

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R220LC-9S	High idle	40±5	-	

■ MAIN PUMP DELIVERY PRESSURE (CLUSTER TYPE 2)

(1) Preparation

① Stop the engine.

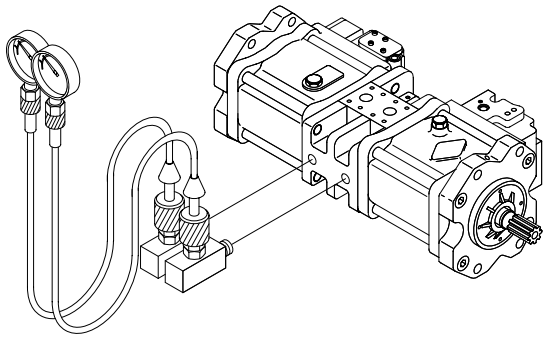
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.

③ Push the pressure release button to bleed air.

④ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port as shown.

⑤ Start the engine and check for oil leakage from the port.

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



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(2) Measurement

① Select the following switch positions.
- Mode selector : M mode
- Auto decel switch : OFF

② Measure the primary pilot pressure in the M mode.

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Engine speed	Standard	Alowable limits	Remarks
R220LC-9S	High idle	40±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING (CLUSTER TYPE 1)

(1) Preparation

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

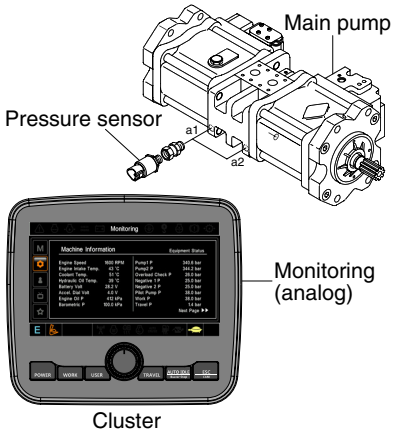
(2) Measurement

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.



21097MS15

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

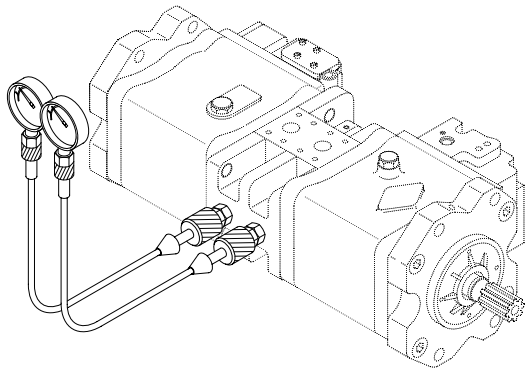
Model	Function to be tested	Standard	Port relief setting at 20 lpm
R220LC-9S	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	350±10	-
	Swing	265±10	-

( ) : Power boost

■ SYSTEM PRESSURE REGULATOR RELIEF SETTING (CLUSTER TYPE 2)

(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 Push the pressure release button to bleed air.
④ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port as shown.
⑤ Start the engine and check for oil leakage from the port.
⑥ Keep the hydraulic oil temperature at 50±5˚C.



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(2) Measurement

① Select the following switch positions.
· Mode selector : M mode
② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.
③ In the swing function, place bucket against an immovable object and measure the relief pressure.
④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.

(3) Evaluation

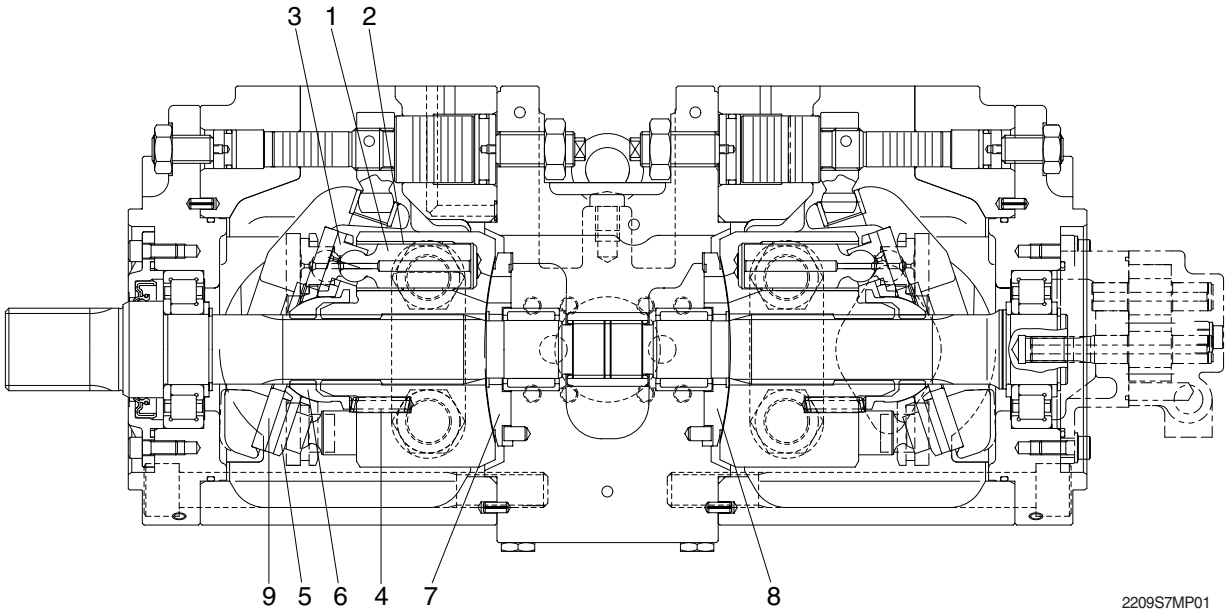
The average measured pressure should be within the following specifications.

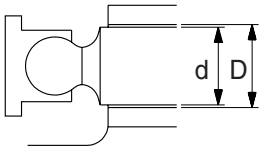
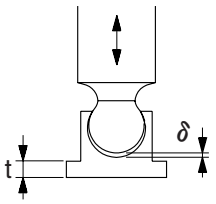
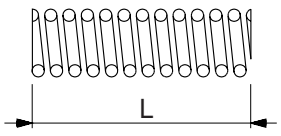
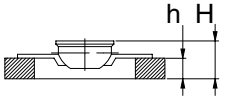
Unit : kgf / cm^2

Model	Function to be tested	Standard	Remarks
R220LC-9S	Boom, Arm, Bucket	350 (380)±10	-
	Travel	350±10	-
	Swing	265±10	-

( ) : Power boost

1. MAIN PUMP



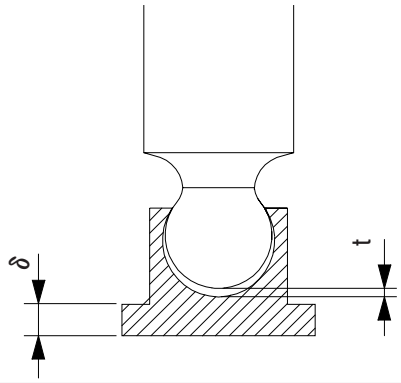
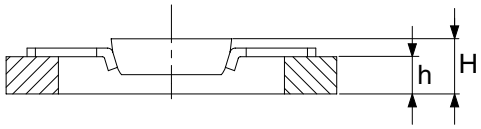
Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.039	0.067	Replace piston or cylinder.
Play between piston (1) & shoe caulking section (3) (δ)		0-0.1	0.3	Replace assembly of piston & shoe.
Thickness of shoe (t)		4.9	4.7	
Free height of cylinder spring (4) (L)		41.1	40.3	Replace cylinder spring.
Combined height of set plate (5) & spherical bushing (6) (H-h)		23.0	22.0	Replace retainer or set plate.
Surface roughness for valve plate (sliding face) (7,8), swash plate (shoe plate area) (9), & cylinder (2) (sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (corrected value)	0.4z or lower		

2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratches, rust or corrosion.	· In case of damage in following section, replace casing. - Sliding sections of casing hole and spool, especially land sections applied with held pressure. - Seal pocket section where spool is inserted. - Sealing section of port where O-ring contacts. - Sealing section of each relief valve for main and port. - Sealing section of plug. - Other damages that may damage normal function.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool into casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of spring · Damage of poppet · Insert poppet into casing and function it.	· Replacement. · Correction or replacement when sealing is incomplete. · Normal when it can function lightly and smoothly without sticking.
Spring and related parts	· Rusting, corrosion, deformation or breakage of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & posi-nega conversion valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · O-rings and back up rings.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement in principle.

3. SWING DEVICE

1) WEARING PARTS

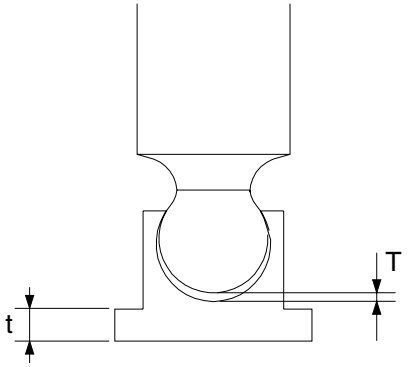
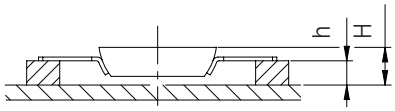
Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section (δ)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	5.5	5.3	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H)	6.5	6.0	Replace set of retainer plate and sperical bushing
Thickness of friction plate (h)	4.0	3.6	Replace
 2507A7MS04		 2507A7MS05	

2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z (Ra=0.2) (LAPPING)	3-Z (Ra=0.8)	
Shoe plate	0.4-Z (Ra=0.1) (LAPPING)	3-Z (Ra=0.8)	
Cylinder	1.6-Z (Ra=0.4) (LAPPING)	12.5-Z (Ra=3.2)	
Valve plate	0.8-Z (Ra=0.2) (LAPPING)	6.3-Z (Ra=1.6)	

4. TRAVEL MOTOR

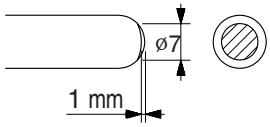
1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.025	0.050	Replace piston or cylinder block
Play between piston and shoe caulking section (T)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	4.5	4.3	Replace assembly of piston and shoe
Combined height of set plate and ball guide (H)	7.3	7.0	Replace set of set plate and ball guide
Thickness of friction plate	3.0	2.6	Replace
			

2) SLIDING PARTS

Part name	Standard roughness	Remark
Shoe	0.8S	-
Shoe plate	0.8S	-
Cylinder	0.8S	-
Valve plate	0.8S	-

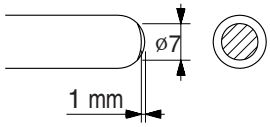
5. RCV LEVER

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 μ m, 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.

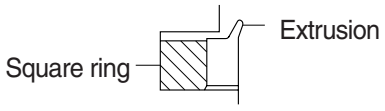
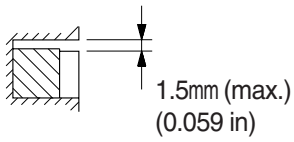
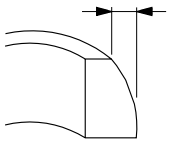
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

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 10μ m, 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

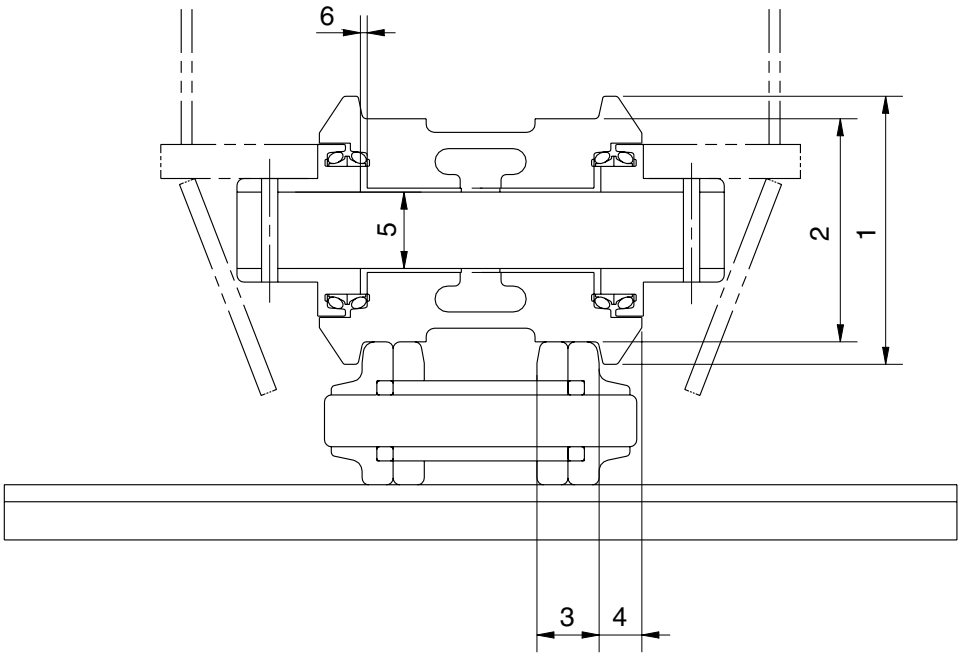
Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure 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) TRACK ROLLER

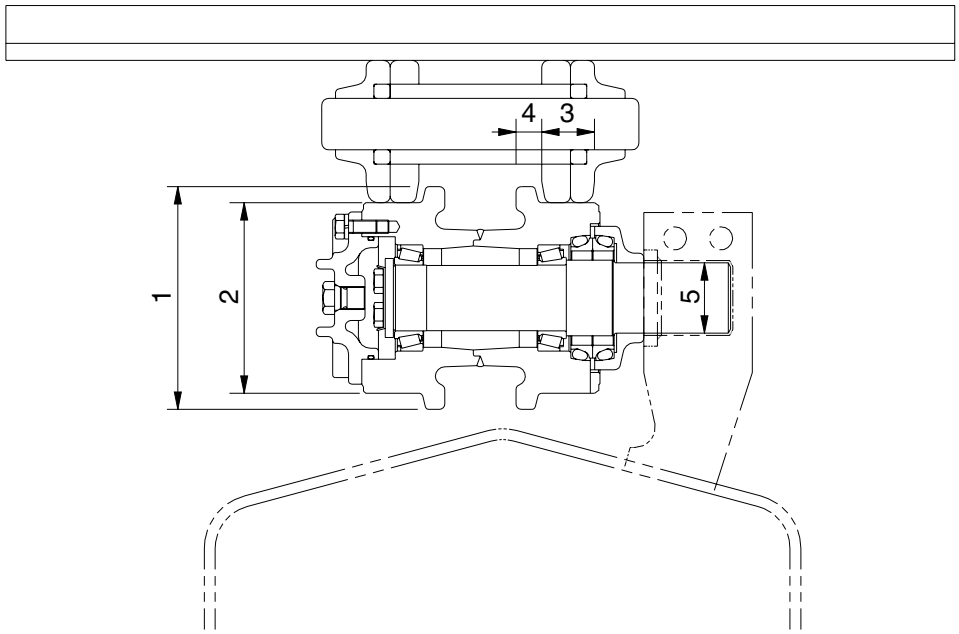


21037MS01

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		ø 195		-		
2	Outside diameter of tread	ø 160		ø 148		
3	Width of tread	43.5		49.5		
4	Width of flange	20.5		-		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		ø 70 -0.29 -0.33	ø 70.1 +0.46 0	0.39 to 0.476	2.0	
6	Side clearance of roller (both side)	Standard clearance		Clearance limit		Replace
		0.26~1.22		2.0		

2) CARRIER ROLLER

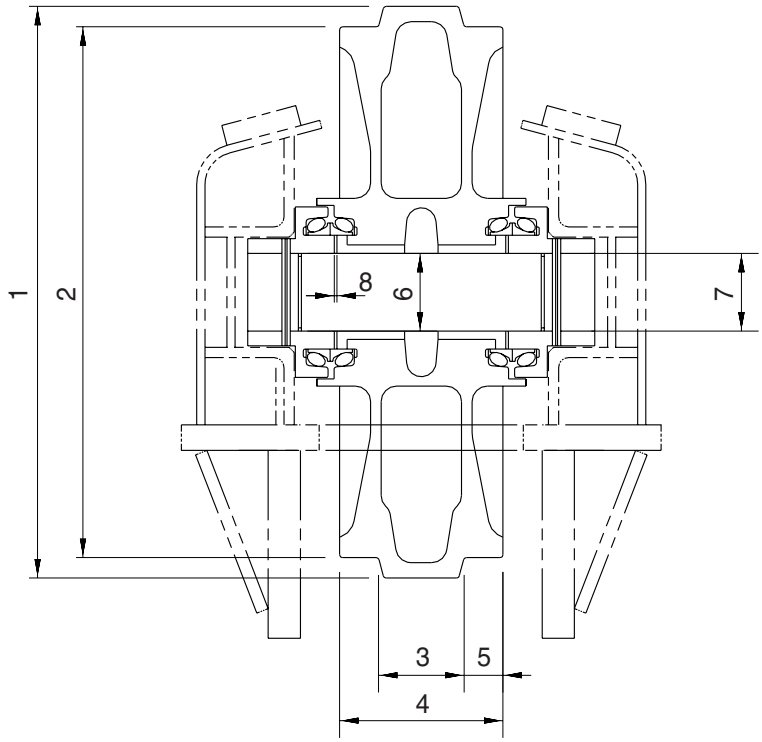


21037MS02

Unit : mm

No.	Check item	Criteria					Remedy
1	Outside diameter of flange	Standard size			Repair limit		Rebuild or replace
		ø 169			-		
2	Outside diameter of tread	ø 144			ø 134		
3	Width of tread	44			49		
4	Width of flange	17			-		
5	Clearance between shaft and support	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		ø 55	-0.05 -0.1	+0.3 +0.1	0.15 to 0.4	1.2	

3) IDLER

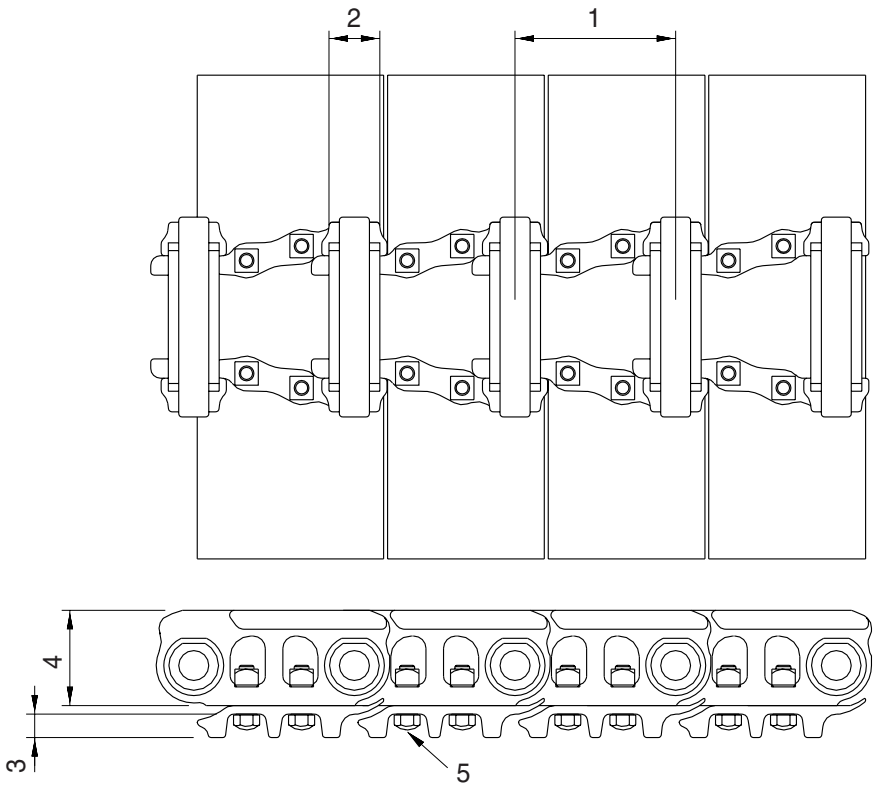


21037MS03

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of protrusion	Standard size		Repair limit		Rebuild or replace
		ø 560		-		
2	Outside diameter of tread	ø 520		ø 510		
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			
		ø 75 $^{0}_{-0.03}$	ø 75.35 $^{+0.05}_{0}$	0.35 to 0.43	2.0	
7	Clearance between shaft and support	ø 75 $^{0}_{-0.03}$	ø 75 $^{+0.07}_{+0.03}$	0.03 to 0.1	1.2	Replace
8	Side clearance of idler (both side)	Standard clearance		Clearance limit		Replace bushing
		0.25 to 1.2		2.0		

4) TRACK

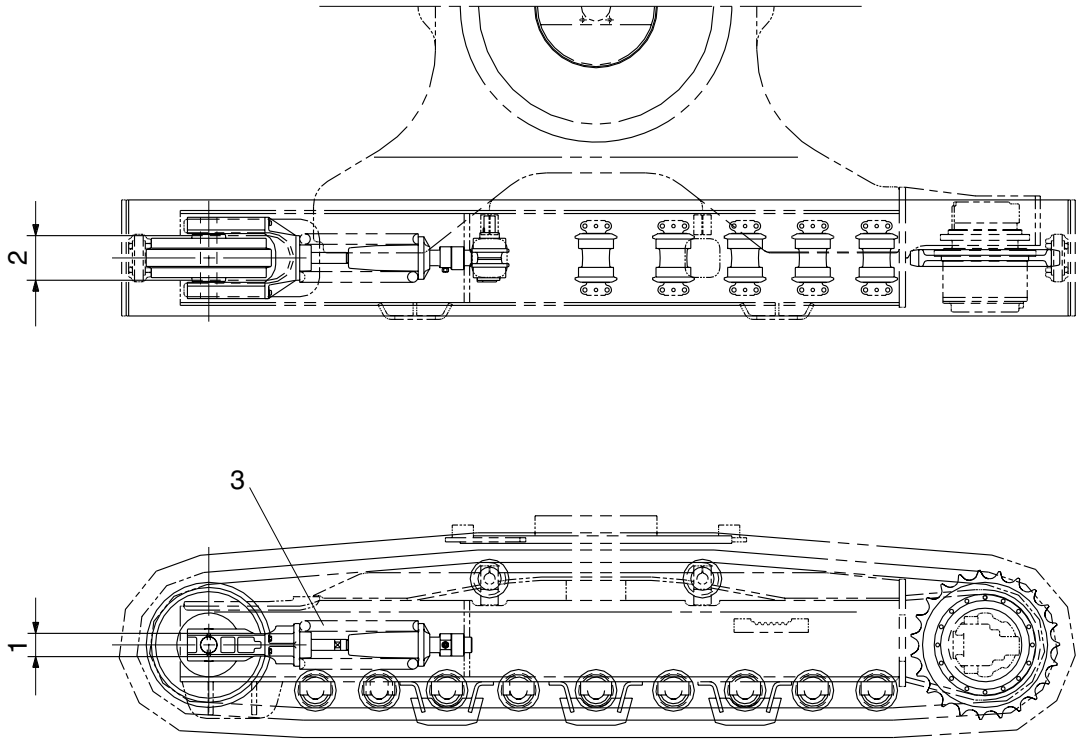


21037MS04

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	ø 59	ø 51	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

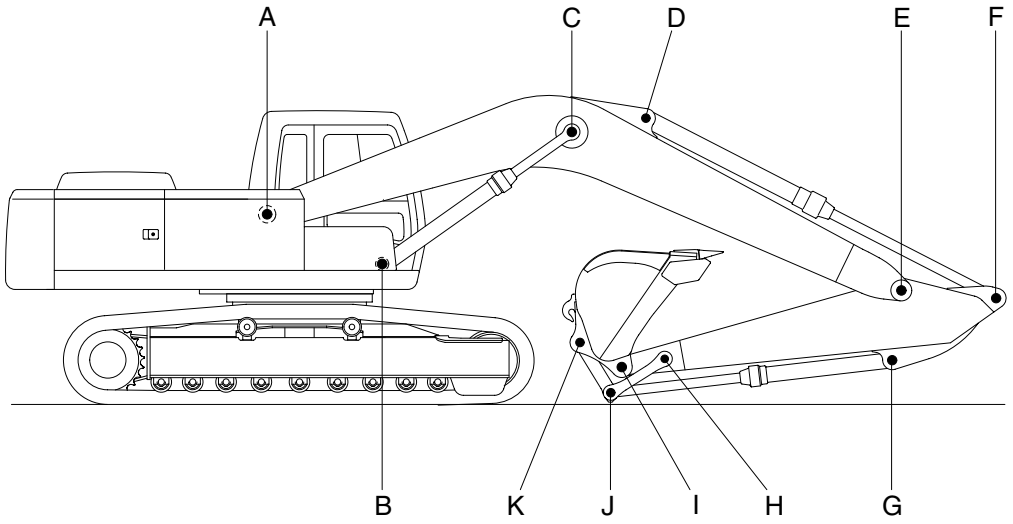


21037MS05

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	117		
		Idler support	110	- 0.5 - 1.0	106		
2	Horizontal width of idler guide	Track frame	272	+2 0	276		
		Idler support	270	-	267		
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		ø235×515	431	13716kg	-	10973kg	

2. WORK EQUIPMENT



21077MS20

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

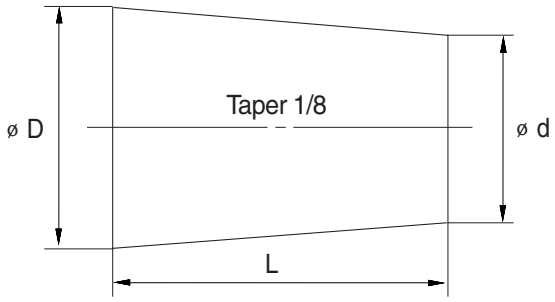
SECTION 8 DISASSEMBLY AND ASSEMBLY

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	12.8 ± 3.0	92.6 ± 21.7
2		Engine mounting bolt (bracket-frame, FR)	M20 × 2.5	55 ± 3.5	398 ± 25
3		Engine mounting bolt (bracket-frame, RR)	M24 × 3.0	97 ± 7.0	702 ± 51
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	57.9 ± 8.7	419 ± 62.9
7	Hydraulic system	Main pump housing mounting bolt	M10 × 1.5	4.8 ± 0.3	34.7 ± 2.2
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	57.9 ± 8.7	419 ± 62.9
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	58.4 ± 5.8	422 ± 42
13		Swing bearing upper part mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
14		Swing bearing lower part mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
15		Travel motor mounting bolt	M16 × 2.0	23 ± 2.5	166 ± 18.1
16		Sprocket mounting bolt	M16 × 2.0	26 ± 3.0	188 ± 21.7
17	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7± 3.0	215 ± 21.7
18		Track roller mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
19		Track tension cylinder mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
20		Track shoe mounting bolt, nut	M20 × 1.5	78 ± 8.0	564 ± 57.9
21		Track guard mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
22	Others	Counterweight mounting bolt	M36 × 3.0	340 ± 10	2460 ± 72.3
23		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
24		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.73 ~ 4.12	19.7 ~ 29.8
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 79.5	9.8 ~ 15.8	71 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 167
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 343
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	350 ~ 457	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.5	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1655
M36 × 4.0	174 ~ 236	1261 ~ 1703	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.17 ~ 3.37	15.7 ~ 24.3	3.04 ~ 4.44	22.0 ~ 32.0
M10 × 1.25	4.46 ~ 6.66	32.3 ~ 48.2	5.93 ~ 8.93	42.9 ~ 64.6
M12 × 1.25	7.78 ~ 11.58	76.3 ~ 83.7	10.6 ~ 16.0	76.6 ~ 115
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 130	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 194	26.6 ~ 36.0	193 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 390	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 515	70.7 ~ 95.7	512 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 664	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1338	182 ~ 248	1314 ~ 1795
M36 × 3.0	192 ~ 260	1389 ~ 1879	262 ~ 354	1893 ~ 2561

2) PIPE AND HOSE (FLARE TYPE)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

3) PIPE AND HOSE (ORFS TYPE)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130
1-7/16-12	41	21	152
1-11/16-12	50	35	253

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

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

(6) Remove socket bolts (23) and disconnect pipe (7, 8).

(7) Disconnect pilot line hoses (2, 3, 4, 5, 6, 7).

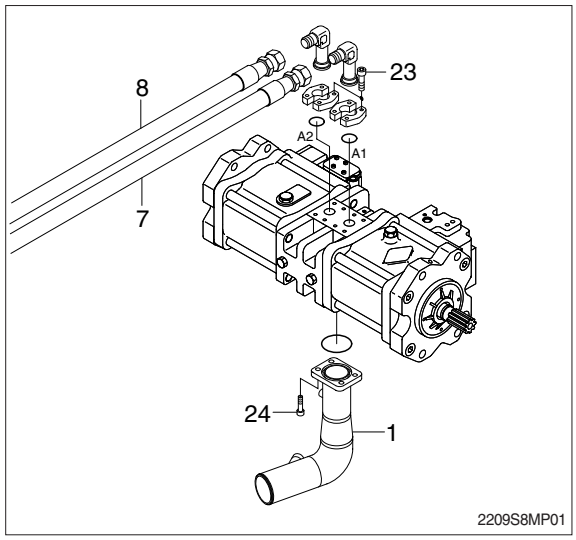
(8) Remove socket bolts(24) and disconnect pump suction tube (1).

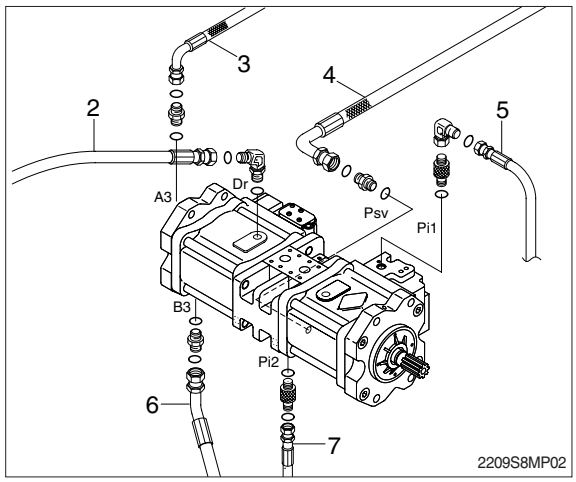
※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(9) Sling the pump assembly and remove the pump mounting bolts.

- Weight : 140 kg (310 lb)

※ 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.

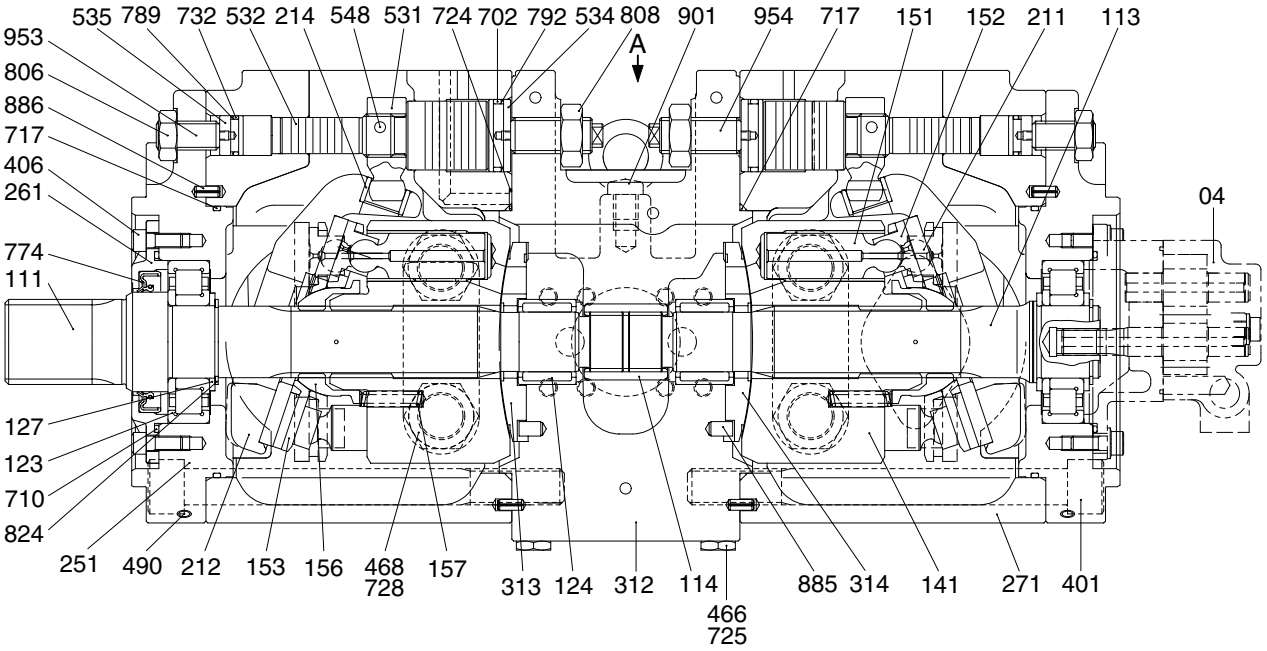
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(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)

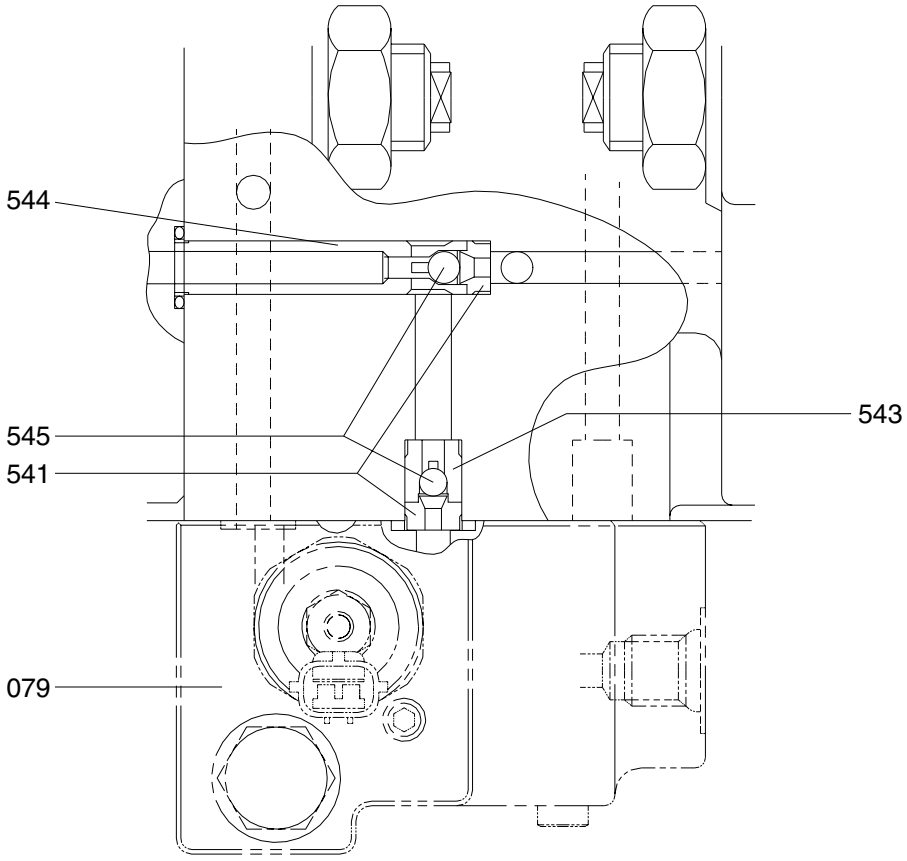
The main pump consists of two piston pumps (front & rear) and valve block.



2209S2MP02

04	Gear pump	261	Seal cover (F)	717	O-ring
111	Drive shaft (F)	271	Pump casing	724	O-ring
113	Drive shaft (R)	312	Valve block	725	O-ring
114	Spline coupling	313	Valve plate (R)	728	O-ring
123	Roller bearing	314	Valve plate (L)	732	O-ring
124	Needle bearing	401	Hexagon socket bolt	774	Oil seal
127	Bearing spacer	406	Hexagon socket bolt	789	Back up ring
141	Cylinder block	466	VP Plug	792	Back up ring
151	Piston	468	VP Plug	806	Hexagon head nut
152	Shoe	490	Plug	808	Hexagon head nut
153	Set plate	531	Tilting pin	824	Snap ring
156	Bushing	532	Servo piston	885	Pin
157	Cylinder spring	534	Stopper (L)	886	Spring pin
211	Shoe plate	535	Stopper (S)	901	Eye bolt
212	Swash plate	548	Pin	953	Set screw
214	Bushing	702	O-ring	954	Set screw
251	Support	710	O-ring		

MAIN PUMP (2/2)



VIEW A

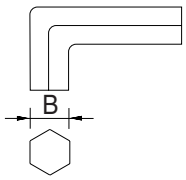
21092MP08

541 Seat
543 Stopper 1
544 Stopper 2
545 Steel ball
079 Proportional reducing valve

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="5">Part name</td></tr>
<tr><td>Name</td><td>B</td><td>Hexagon socket head bolt</td><td>PT plug (PT thread)</td><td>PO plug (PF thread)</td><td colspan="2">Hexagon socket head setscrew</td></tr>
<tr><td rowspan="5">Allen wrench
 
</td><td>4</td><td>M 5</td><td>BP-1/16</td><td>-</td><td colspan="2">M 8</td></tr>
<tr><td>5</td><td>M 6</td><td>BP-1/8</td><td>-</td><td colspan="2">M10</td></tr>
<tr><td>6</td><td>M 8</td><td>BP-1/4</td><td>PO-1/4</td><td colspan="2">M12, M14</td></tr>
<tr><td>8</td><td>M10</td><td>BP-3/8</td><td>PO-3/8</td><td colspan="2">M16, M18</td></tr>
<tr><td>17</td><td>M20, M22</td><td>BP-1</td><td>PO-1, 1 1/4, 1 1/2</td><td colspan="2">-</td></tr>
<tr><td rowspan="6">Double ring spanner, socket wrench, double (single) open end spanner
 
</td><td>-</td><td colspan="2">Hexagon socket head bolt</td><td colspan="2">Hexagon nut</td><td>VP plug (PF thread)</td></tr>
<tr><td>19</td><td colspan="2">M12</td><td colspan="2">M12</td><td>VP-1/4</td></tr>
<tr><td>24</td><td colspan="2">M16</td><td colspan="2">M16</td><td>-</td></tr>
<tr><td>27</td><td colspan="2">M18</td><td colspan="2">M18</td><td>VP-1/2</td></tr>
<tr><td>30</td><td colspan="2">M20</td><td colspan="2">M20</td><td>-</td></tr>
<tr><td>36</td><td colspan="2">-</td><td colspan="2">-</td><td>VP-3/4</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="5">Medium size, 1 set</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="5">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="5">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="5">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="5">Steel bar of key material approx. 10 × 8 × 200</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="5">Capable of tightening with the specified torques</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (Material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (Material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

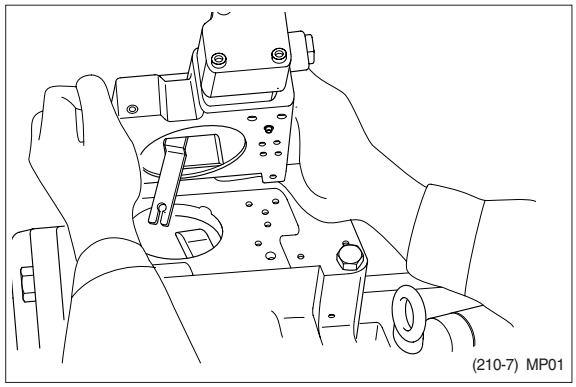
※ Select clean place.

※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing (front and rear pump).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.



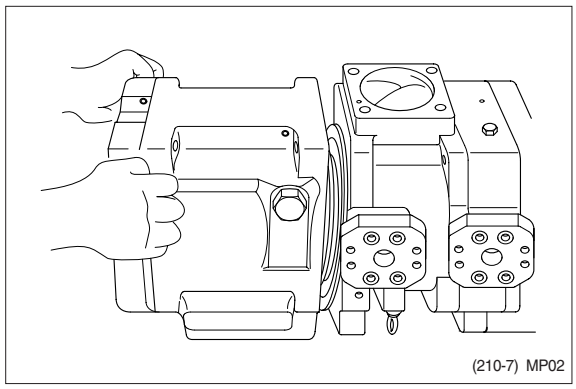
(210-7) MP01

(5) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve block (312).

※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

(6) Place pump horizontally on workbench with its regulator-fitting surface down and separate pump casing (271) from valve block (312).

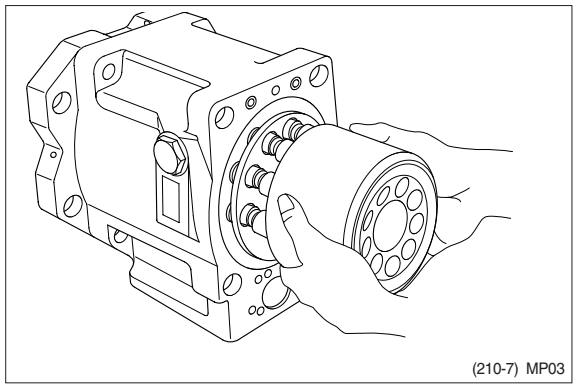
※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.



(210-7) MP02

(7) Pull cylinder block (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.



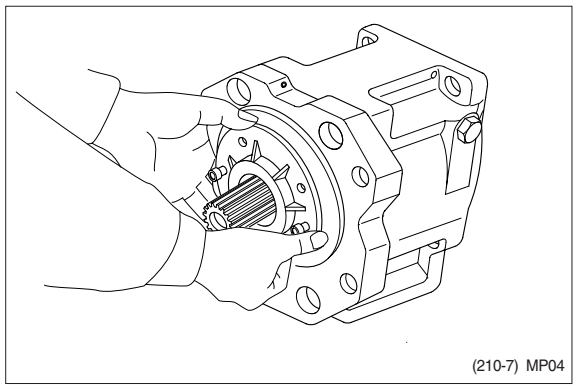
(210-7) MP03

(8) Remove hexagon socket head bolts (406) and then seal cover (F, 261).

※ Fit bolt into pulling out tapped hole of seal cover (F), and cover can be removed easily.

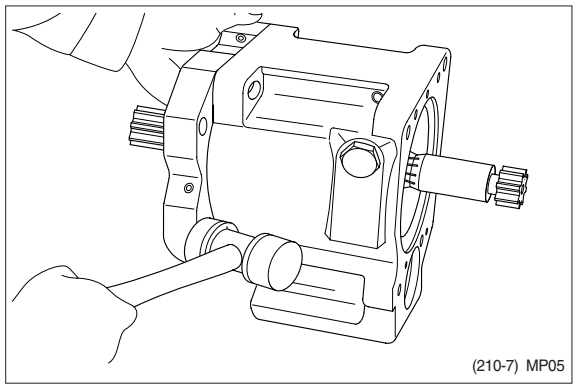
※ Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover.

(9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).
In case fitting a gear pump, first, remove gear pump.



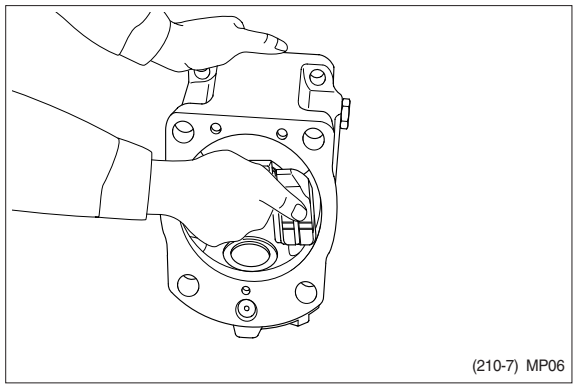
(210-7) MP04

(10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



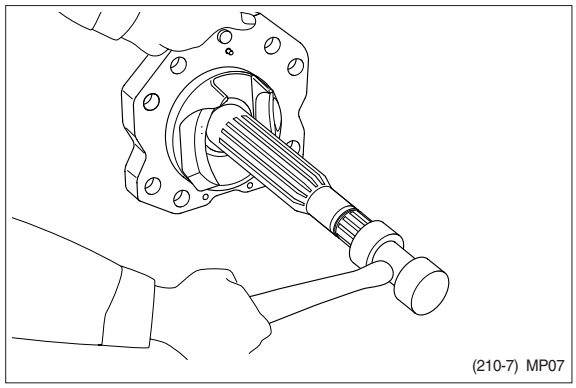
(210-7) MP05

(11) Remove shoe plate (211)and swash plate (212) from pump casing (271).



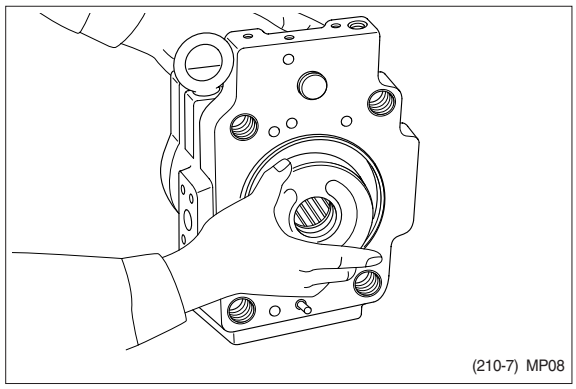
(210-7) MP06

(12) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.


(210-7) MP07

(13) Remove valve plates (313, 314) from valve block (312).

※ These may be removed in work (6).


(210-7) MP08

(14) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) and splined coupling (114) from valve block (312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve block and swash plate support.
If loosened, flow setting will be changed.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

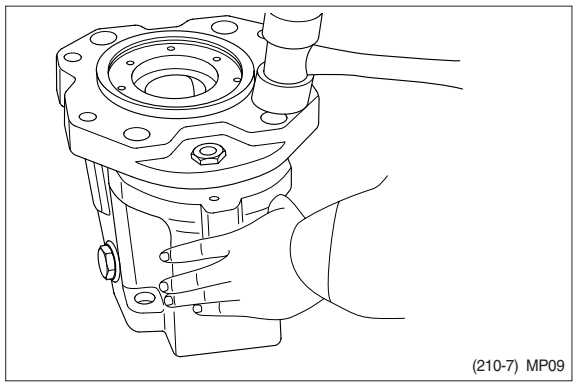
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.

※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (Medium strength) to their threaded sections.

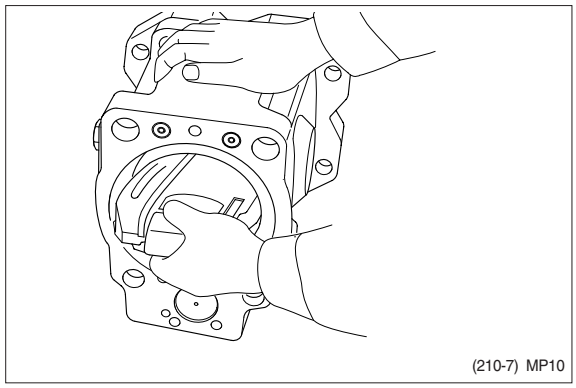


(210-7) MP09

(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.

※ Confirm with fingers of both hands that swash plate can be removed smoothly.

※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.

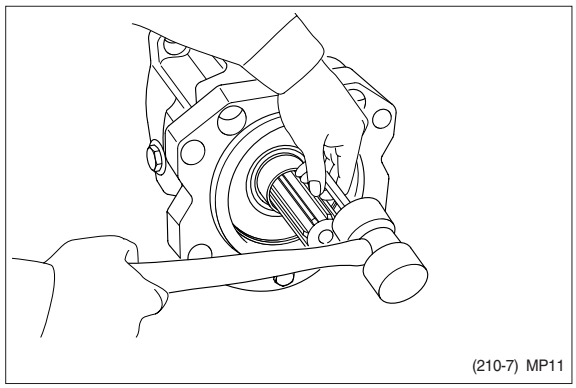


(210-7) MP10

(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).

※ Do not tap drive shaft with hammer or so on.

※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.
Fit them fully, using steel bar or so on.



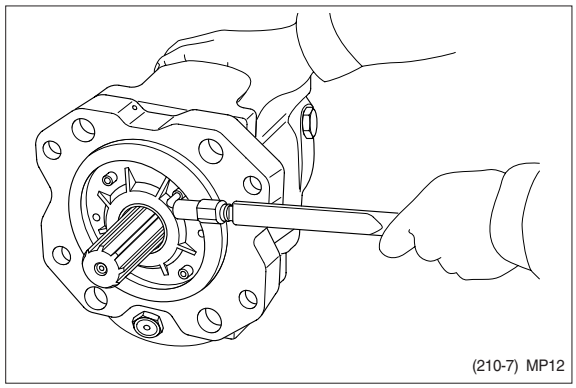
(210-7) MP11

(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).

※ Apply grease lightly to oil seal in seal cover (F).

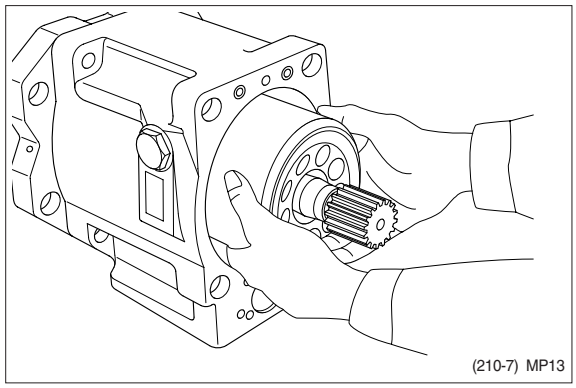
※ Assemble oil seal, taking full care not to damage it.

※ For tandem type pump, fit rear cover (263) and seal cover (262) similarly.



(210-7) MP12

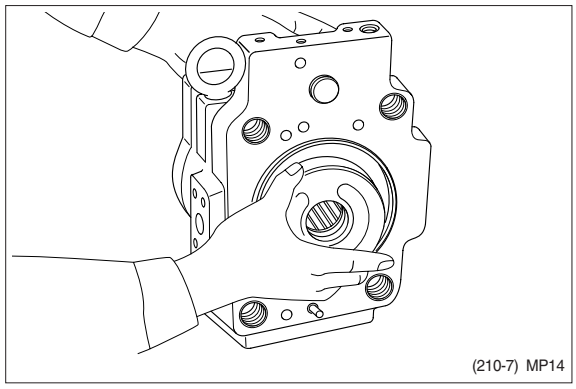
(6) Assemble piston cylinder subassembly 〔cylinder block (141), piston subassembly (151, 152), set plate (153), spherical bush (156), spacer (158) and cylinder spring (157)〕.
Fit spline phases of retainer and cylinder.
Then, insert piston cylinder subassembly into pump casing.



(210-7) MP13

(7) Fit valve plate (313) to valve block (312), entering pin into pin hole.

※ Take care not to mistake suction / delivery directions of valve plate.



(210-7) MP14

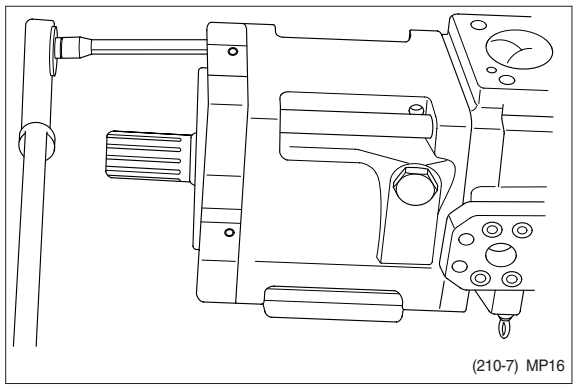
(8) Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).

※ At first assemble this at rear pump side, and this work will be easy.

※ Take care not to mistake direction of valve block.

※ Clockwise rotation (Viewed from input shaft side) - Fit block with regulator up and with delivery flange left, viewed from front side.

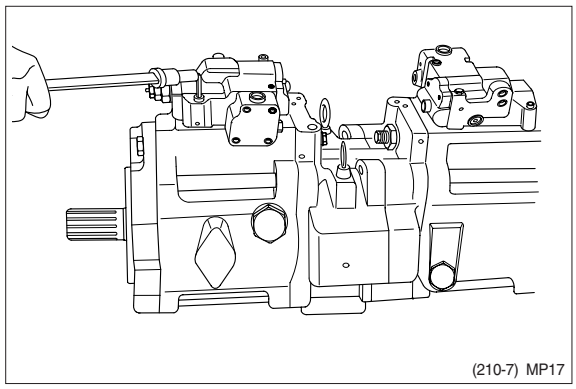
※ Counter clockwise rotation (Viewed from input shaft side) - Fit block with delivery flange right, viewed from front side.



(210-7) MP16

(9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).

※ Take care not to mistake regulator of front pump for that of rear pump.

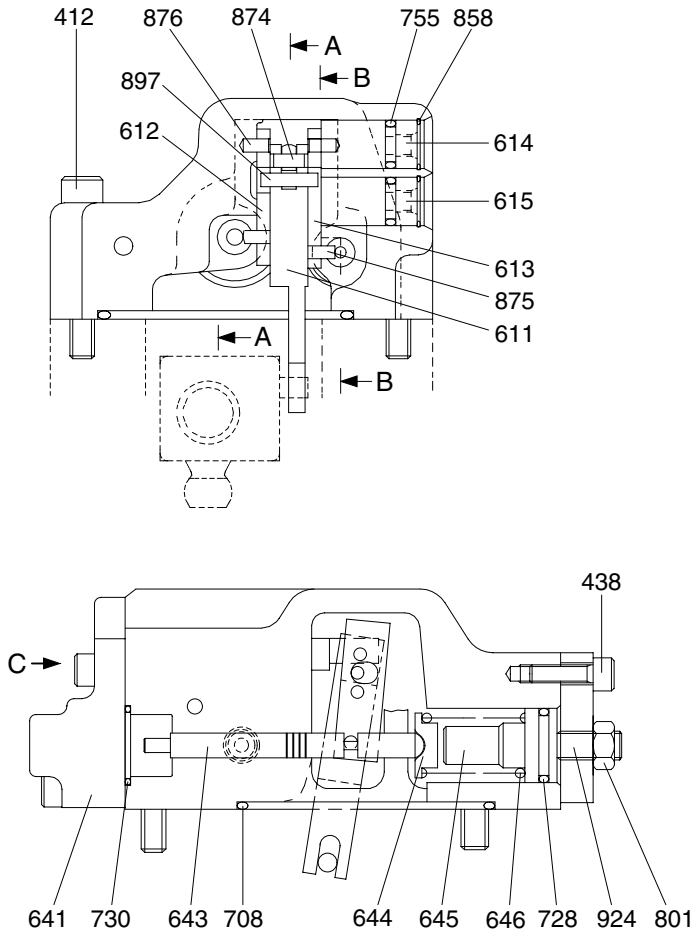


(210-7) MP17

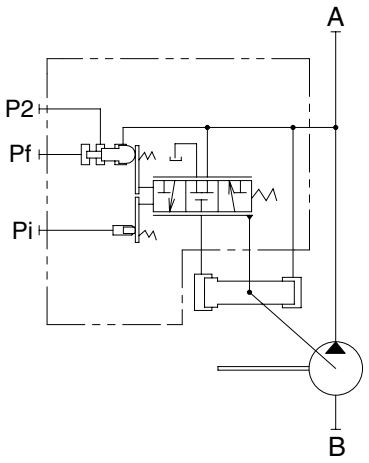
(10) Fit drain port plug (468).

This is the end of reassembling procedures.

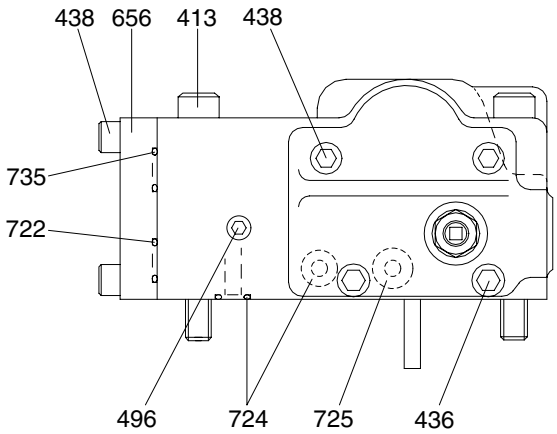
3. REGULATOR (1/2)



SECTION B-B



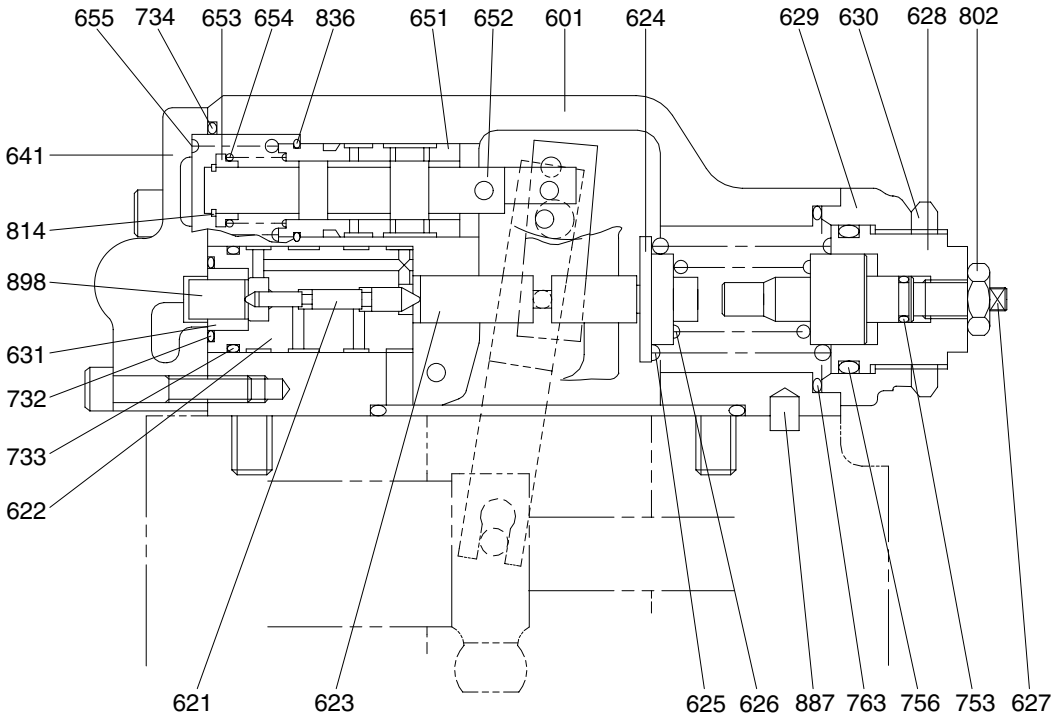
2209S2MP03



VIEW C

Port	Port name	Port size
A	Delivery port	3/4"
B	Suction port	2 1/2"
Pi	Pilot port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

REGULATOR (2/2)



SECTION A-A

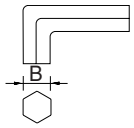
21092MP04

412 Hexagon socket screw
413 Hexagon socket screw
436 Hexagon socket screw
438 Hexagon socket screw
496 Plug
601 Casing
611 Feed back lever
612 Lever (1)
613 Lever (2)
614 Fulcrum plug
615 Adjust plug
621 Compensator piston
622 Piston case
623 Compensator rod
624 Spring seat (C)
625 Outer spring
626 Inner spring
627 Adjust stem (C)
628 Adjust screw (C)
629 Cover (C)
630 Lock nut
631 Sleeve, pf
641 Pilot cover
643 Pilot piston
644 Spring seat (Q)
645 Adjust stem (Q)
646 Pilot spring
651 Sleeve
652 Spool
653 Spring seat
654 Return spring
655 Set spring
656 Block cover
708 O-ring
722 O-ring
724 O-ring
725 O-ring
728 O-ring
730 O-ring
732 O-ring
733 O-ring
734 O-ring
735 O-ring
753 O-ring
755 O-ring
756 O-ring
763 O-ring
801 Nut
802 Nut
814 Snap ring
836 Snap ring
858 Snap ring
874 Pin
875 Pin
876 Pin
887 Pin
897 Pin
898 Pin
924 Set screw

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="5">Part name</td></tr>
<tr><td>Name</td><td>B</td><td>Hexagon socket head bolt</td><td>PT plug (PT thread)</td><td>PO plug (PF thread)</td><td colspan="2">Hexagon socket head setscrew</td></tr>
<tr><td rowspan="3">Allen wrench  </td><td>4</td><td>M 5</td><td>BP-1/16</td><td>-</td><td colspan="2">M 8</td></tr>
<tr><td>5</td><td>M 6</td><td>BP-1/8</td><td>-</td><td colspan="2">M10</td></tr>
<tr><td>6</td><td>M 8</td><td>BP-1/4</td><td>PO-1/4</td><td colspan="2">M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double (single) open end spanner  </td><td>-</td><td colspan="2">Hexagon head bolt</td><td colspan="2">Hexagon nut</td><td>VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="2">M 8</td><td colspan="2">M 8</td><td>-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="5">Small size, Max 36㎜</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="5">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="5">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="5">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="5">4 × 100 ㎜</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="5">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="5">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="5">M4, Length : 50 ㎜</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (Material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (Material : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

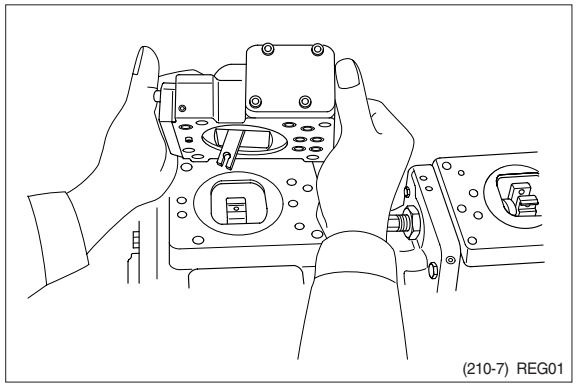
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.

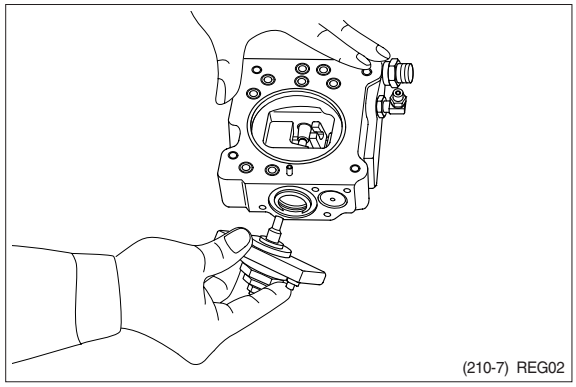


(210-7) REG01

(4) Remove hexagon socket head screw (438) and remove cover (C,629)

※ Cover (C) is fitted with adjusting screw (C, 628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

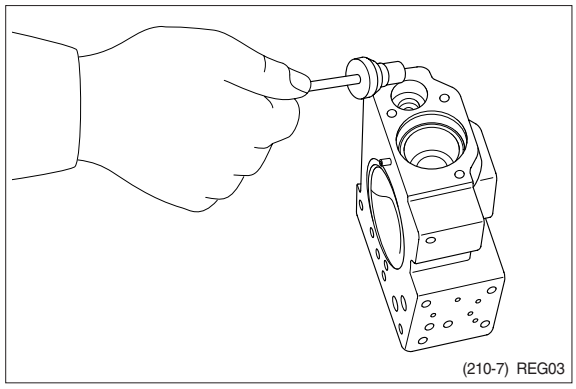
※ Do not loosen these screws and nuts. If they are loosened, adjusted pressure-flow setting will vary.



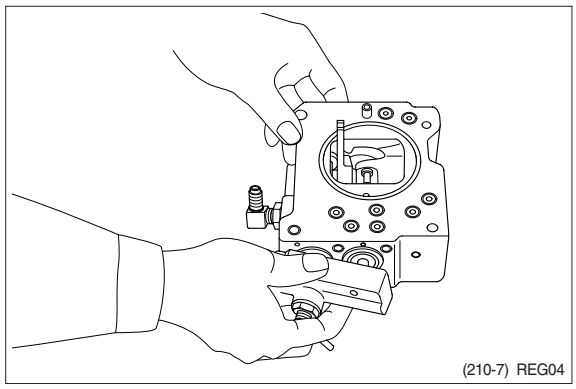
(210-7) REG02

(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.

※ Adjusting ring (Q,645) can easily be drawn out with M4 bolt.


(210-7) REG03

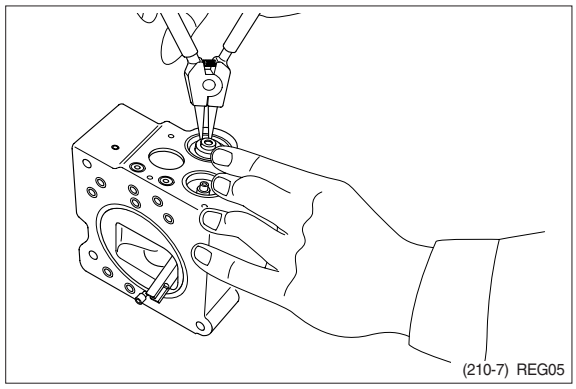
(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.


(210-7) REG04

(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).

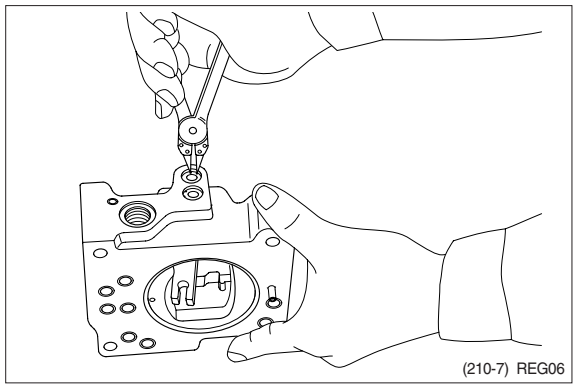
※ Sleeve (651) is fitted with snap ring (836).

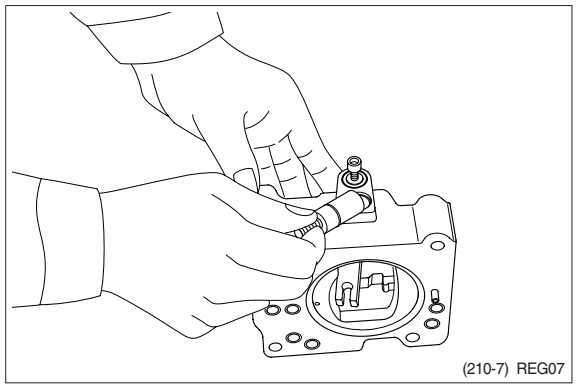
※ When removing snap ring (814), return spring (654) may pop out.
Take care not to lose it.


(210-7) REG05

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).

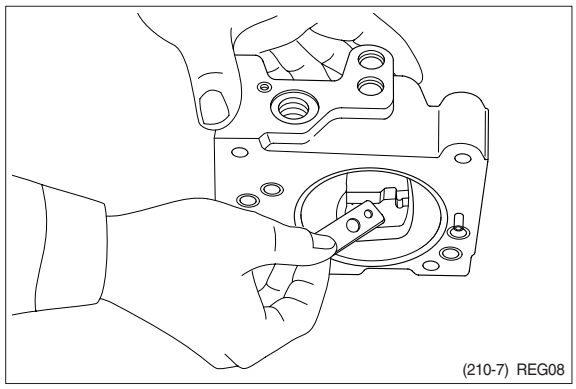
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.


(210-7) REG06


(210-7) REG07

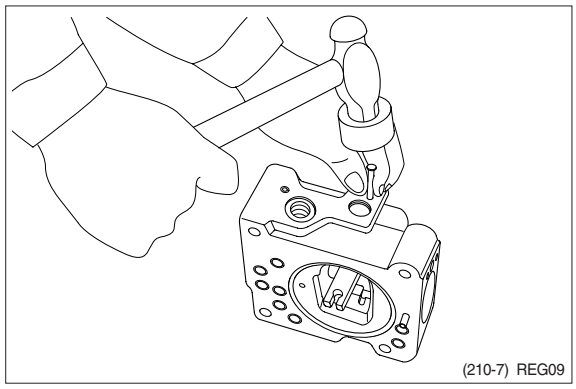
(9) Remove lever (2, 613). Do not draw out pin (875).

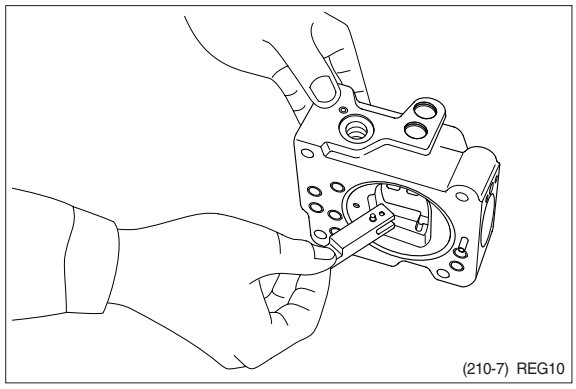
※ Work will be promoted by using pincers or so on.


(210-7) REG08

(10) Draw out pin (874) and remove feedback lever (611).

Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).


(210-7) REG09


(210-7) REG10

(11) Remove lever (1, 612). Do not draw out pin (875).

(12) Draw out pilot piston (643) and spool (652).

(13) Draw out piston case (622), compensating piston (621) and compensating rod (623).

※ Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand. Mixing of foreign matter will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

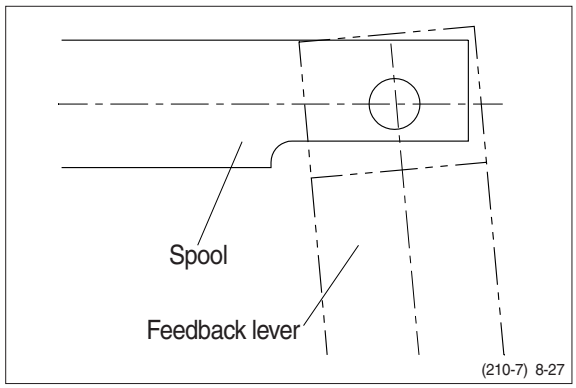
(2) Put compensating rod (623) into compensating hole of casing (601).

(3) Put pin force-fitted in lever (1, 612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.

(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

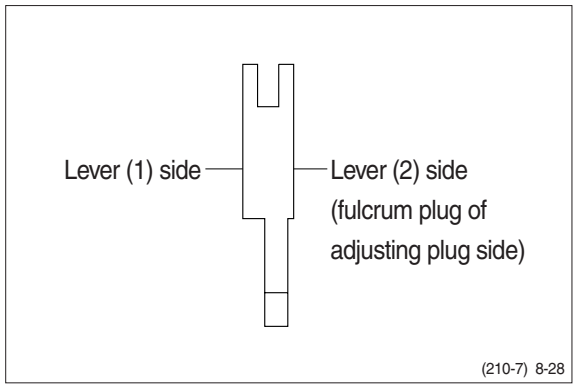
※ Pay attention to orientation of spool.



(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).

※ Insert pin in feedback lever a little to ease operation.

※ Take care not to mistake direction of feedback lever.

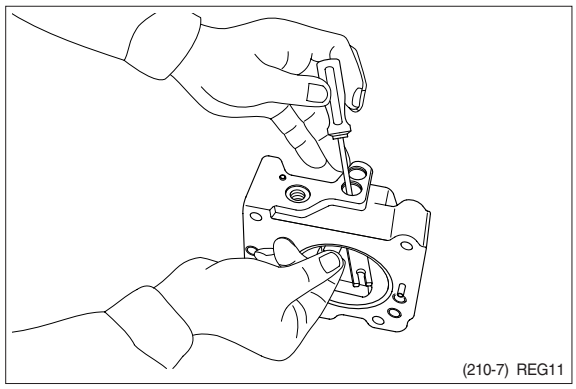


(210-7) 8-28

(6) Put pilot piston (643) into pilot hole of casing.

※ Confirm that pilot piston slides smoothly without binding.

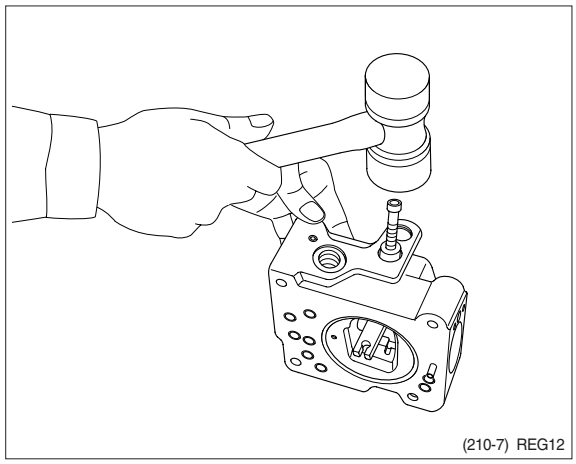
(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).


(210-7) REG11

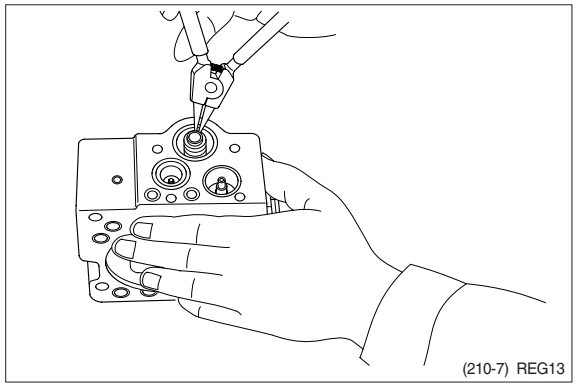
(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever (2).
Then fix locking ring (858).

(9) Insert adjusting plug (615) and fit locking ring.

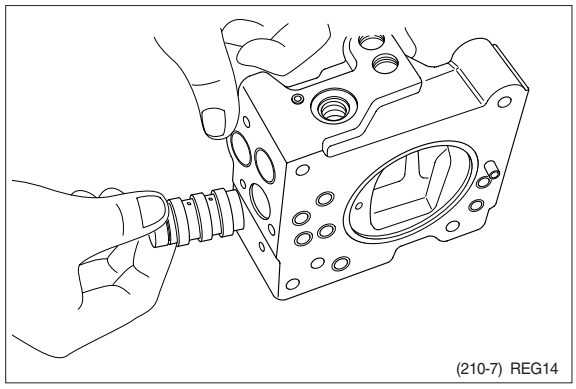
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


(210-7) REG12

(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).

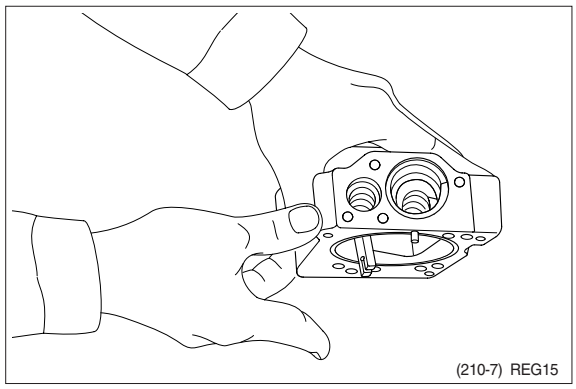

(210-7) REG13

(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).


(210-7) REG14

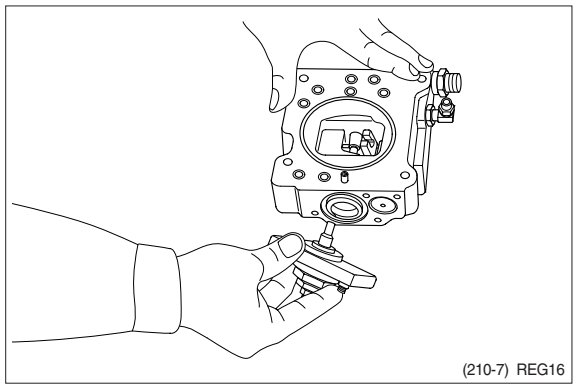
(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

※ When fitting spring seat, take care not to mistake direction of spring seat.


(210-7) REG15

(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.


(210-7) REG16

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 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.
- Weight : 220 kg (485 lb)

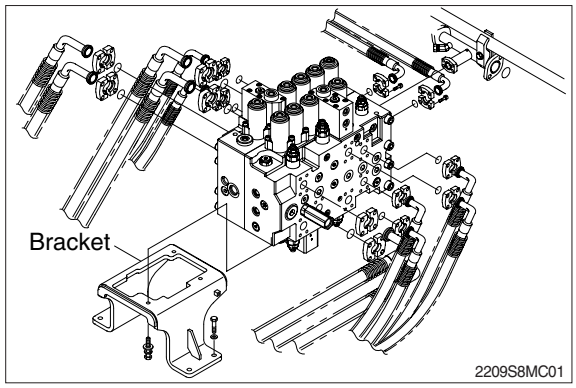
(9) Remove the control valve assembly.
When removing the control valve assembly, check that all the piping have been disconnected.

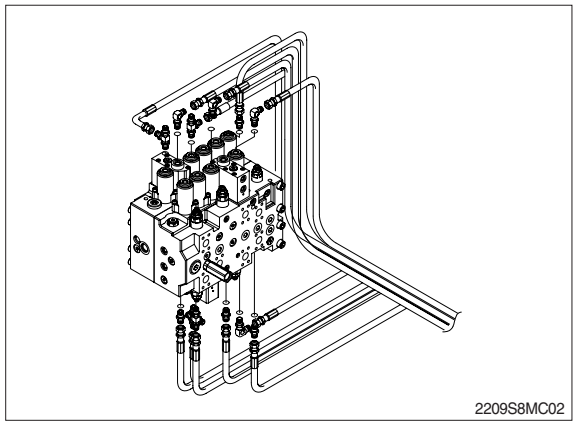
2) INSTALL

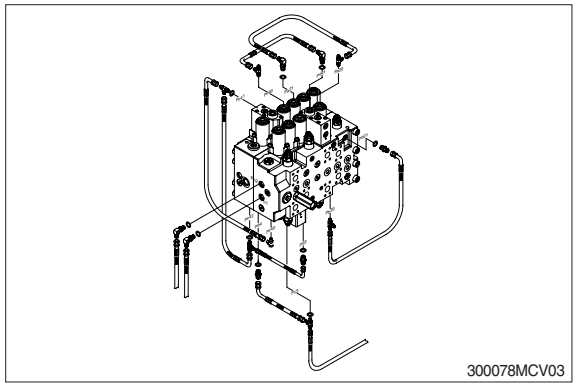
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.
① Cylinder (boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.

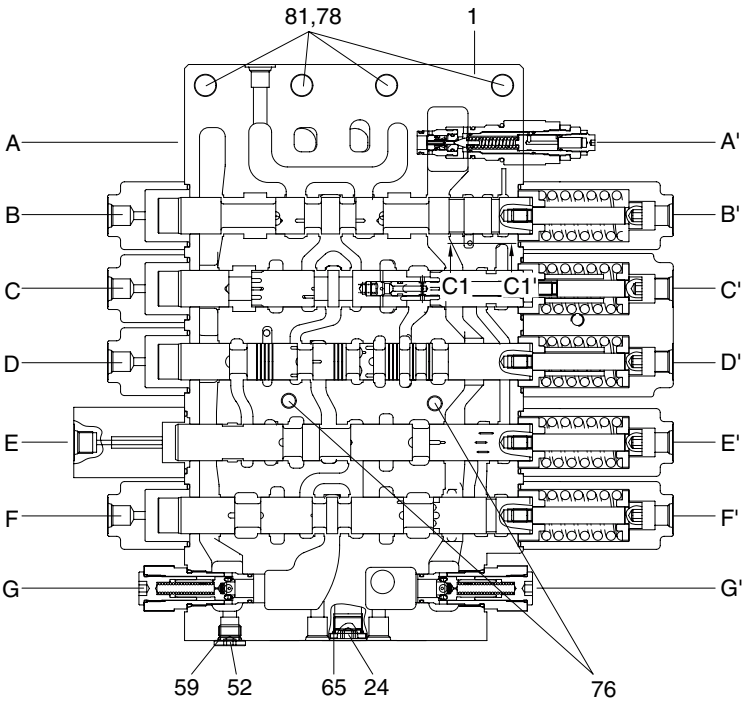
(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.



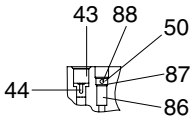




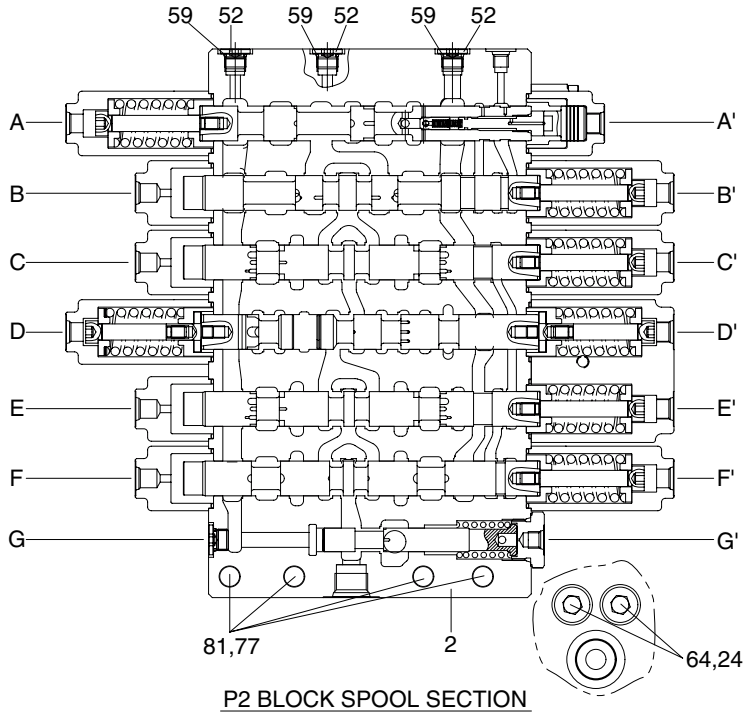
2. STRUCTURE



P1 BLOCK SPOOL SECTION



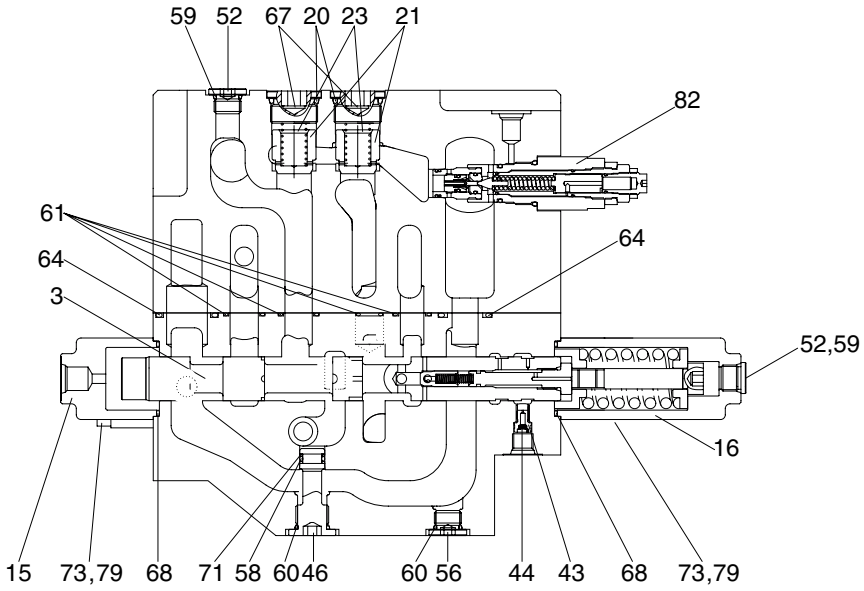
SECTION C1-C1'



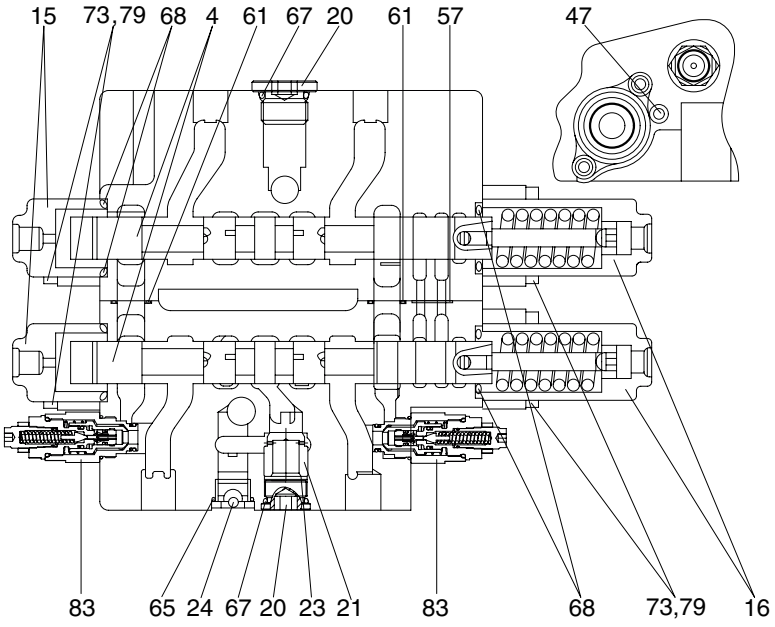
P2 BLOCK SPOOL SECTION

1	Housing (P1)
2	Housing (P2)
24	Plug
43	Orifice-signal
44	Coin type filter
50	O-ring
52	Plug
59	O-ring
64	O-ring
65	O-ring
76	Socket bolt
77	Hex socket head bolt
78	Hex socket head bolt
81	Spring washer
86	Poppet
87	Spring check
88	Plug

29092MC40



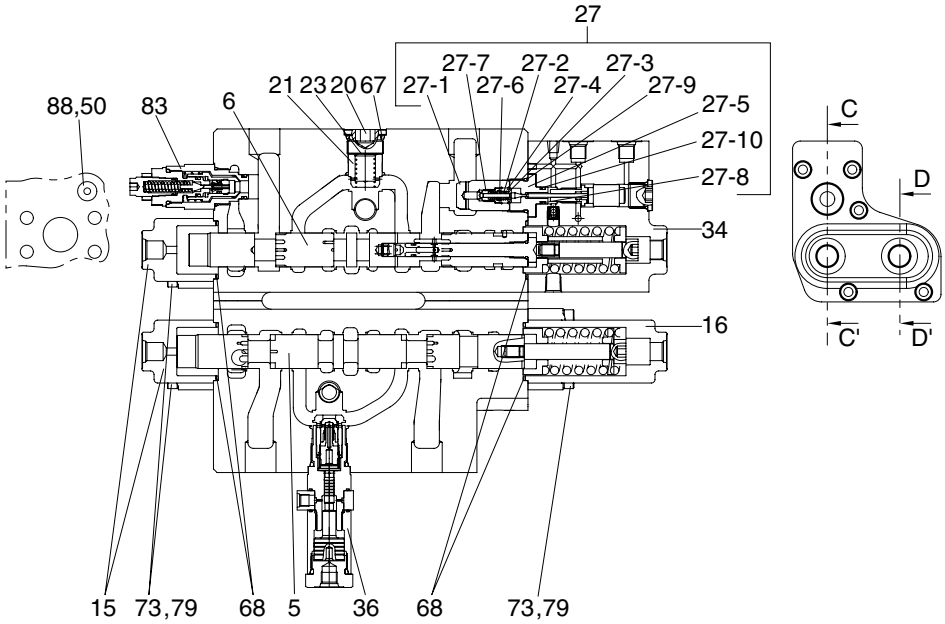
A-A' (STRAIGHT-TRAVEL & SUPPLY)



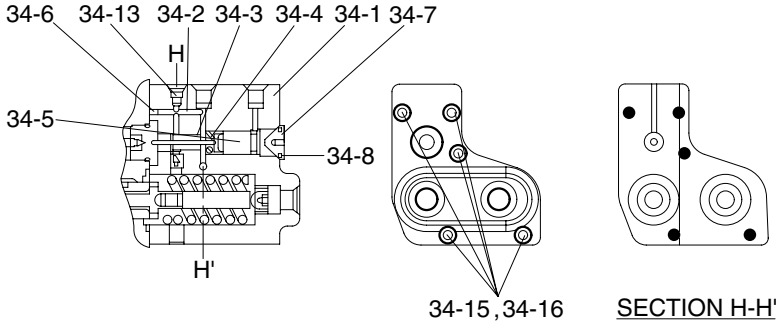
2209S2MC11

B-B' (TRAVEL RIGHT & LEFT)

3	Spool-straight
4	Spool-travel
15	Cover-pilot A
16	Cover-pilot B1
20	Plug
21	Poppet 1-check valve
23	Spring 1-check valve
24	Plug
43	Orifice-signal
44	Coin type filter
46	Plug
47	Plug
52	Plug
56	Plug
57	O-ring
58	O-ring
59	O-ring
60	O-ring
61	O-ring
64	O-ring
65	O-ring
67	O-ring
68	O-ring
71	Back-up ring
73	Hex socket head bolt
79	Washer
82	Main relief valve
83	Main relief valve



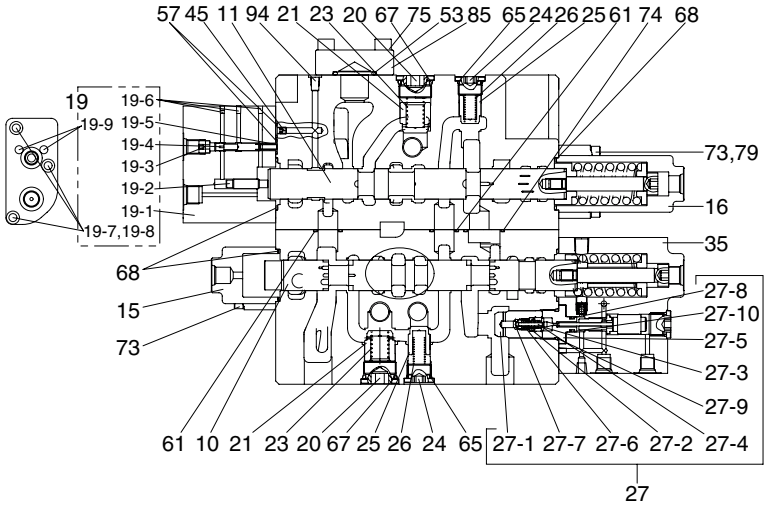
C-C' (SWING & BOOM1)



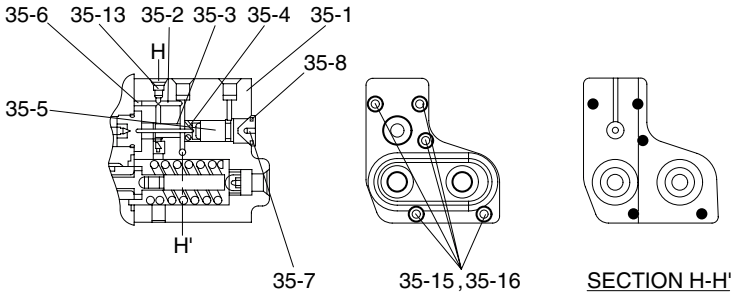
34 DETAIL (HOLDING ASSY)

300H2MC12

5	Spool-swing	27-7	Restrictor-lock valve	34-14	Plug
6	Spool-boom	27-8	O-ring	34-15	Socket bolt
15	Cover-pilot A	27-9	O-ring	34-16	Spring washer
16	Cover-pilot B1	27-10	Back up ring	36	Logic valve
20	Plug	34	Holding kit-A1	50	O-ring
21	Poppet 1-check valve	34-1	Block-H/D P1	56	O-ring
23	Spring 1-check valve	34-2	Piston 1-holding	66	O-ring
27	Holding kit-B	34-3	Guide piston-holding	67	O-ring
27-1	Poppet	34-4	Spring 1-lock valve	68	O-ring
27-2	Spring	34-5	Piston 2-holding	70	Back-up ring
27-3	Poppet guide	34-6	Plug	73	Hex socket head bolt
27-4	Pilot poppet	34-7	Plug	79	Washer
27-5	Poppet seat	34-8	Plug	83	Overload relief valve
27-6	C-ring	34-13	Plug	88	Plug



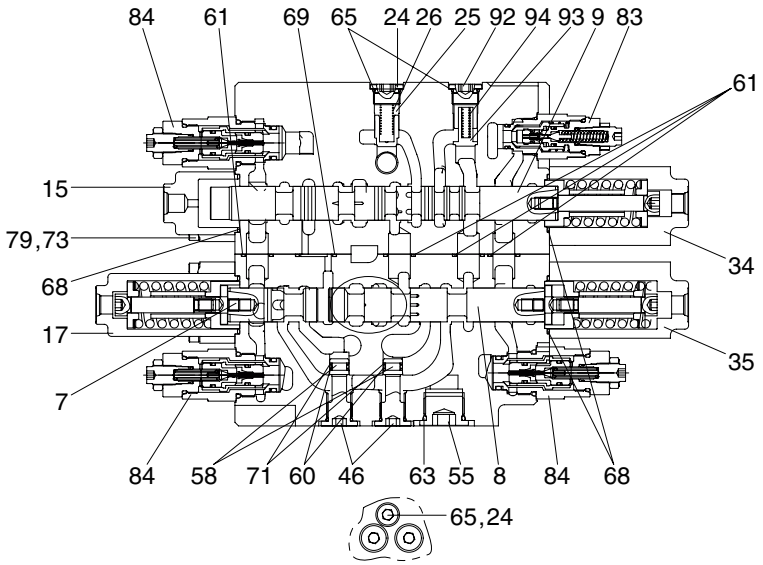
E-E' (ARM & ARM REGENRATION)



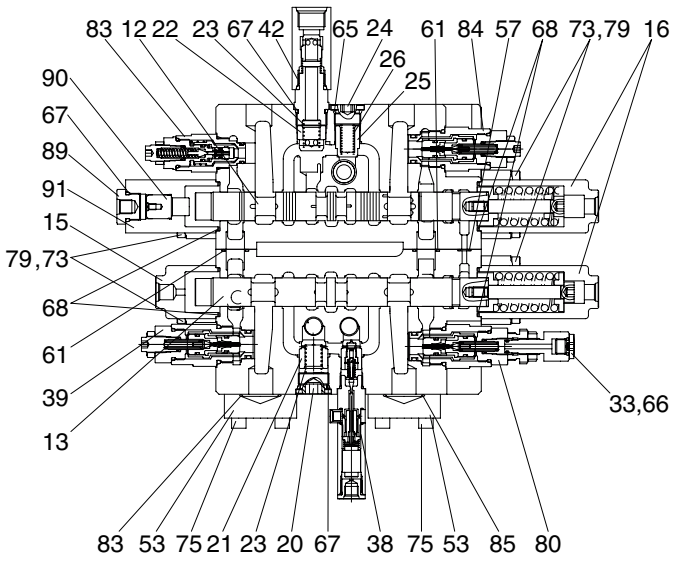
35 DETAIL (HOLDING ASSY)

300H2MC13

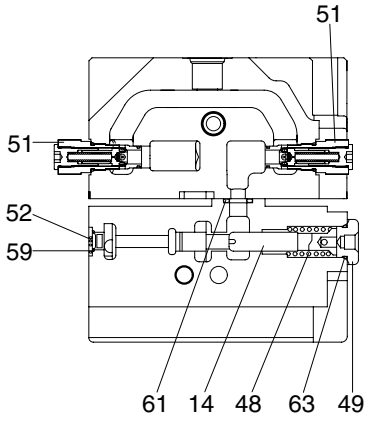
10	Spool-arm	27	Poppet-lock valve	35-13	Plug
11	Spool-arm regeneration	27-1	Poppet	35-15	Socket bolt
15	Cover-pilot A	27-2	Spring	35-16	Spring washer
16	Cover-pilot B1	27-3	Poppet guide	45	Orifice-plug
19	Arm-regeneration	27-4	Pilot poppet	53	Flange
19-1	Block-regeneration	27-5	Poppet seat	56	O-ring
19-2	Piston-cut off	27-6	C-ring	57	O-ring
19-3	Stopper-regeneration	27-7	Restrictor-lock valve	61	O-ring
19-4	Spool-regeneration	27-8	O-ring	65	O-ring
19-5	Spring-regeneration	27-9	O-ring	66	O-ring
19-6	Plug	27-10	Back up ring	67	O-ring
19-7	Socket bolt	35	Holding kit-A2	68	O-ring
19-8	Spring wahser	35-1	Block-H/D P2	70	Back-up ring
19-9	Pin-regeneration	35-2	Piston 1-holding	73	Hex socket head bolt
20	Plug	35-3	Guide piston-holding	74	O-ring
21	Poppet 1-check valve	35-4	Spring 1-lock valve	75	Socket bolt
23	Spring 1-check valve	35-5	Piston 2-holding	79	Washer
24	Plug	35-6	Plug	85	O-ring
25	Poppet 2-check valve	35-7	Plug		
26	Spring 2-check valve	35-8	Plug		



D-D' (SWING PRIORITY-BOOM2 & ARM2)



F-F' (OPTION & BUCKET)



G-G' (CENTER BYPASS CUT-OFF & NEGATIVE CONTROL)

2209S2MC14

7 Spool-swing priority
8 Spool-boom 2
9 Spool-arm 2
12 Spool-bucket
13 Spool-option
14 BC spool
15 Cover-pilot A
16 Cover-pilot B1
17 Cover-pilot B2
20 Plug
21 Poppet 1-check valve
22 Poppet L/C-bucket
23 Spring 1-check valve
24 Plug
25 Poppet 2-check valve
26 Spring 2-check valve
34 Holding kit
35 Holding kit
38 Load check valve assy
39 Overload relief valve
42 Check valve
46 Plug
48 Spring-BC spool
49 Plug-BC spool
51 Negative control valve
52 Plug
53 Flange
55 Plug
57 O-ring
58 O-ring
59 O-ring
60 O-ring
61 O-ring
63 O-ring
65 O-ring
67 O-ring
68 O-ring
69 O-ring
71 Back-up ring
73 Hex socket head bolt
75 Socket bolt
79 Washer
80 Overload relief valve
83 Overload relief valve
84 Overload relief valve
85 O-ring
89 Plug
90 Piston
91 Pilot cover C1
92 Plug
93 Poppet
94 Spring

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) As hydraulic equipments, not only this valve are constructed precisely with very small clearances, disassembling and assembling must be carefully done in a clean place with preventing dusts and contaminants from entering.

(2) Prepare the section drawing and study the structure of MCV and then start disassembly work.

(3) When removing the control valve from the machine, install caps on every ports, and wash the outside of the assembly with confirming the existence of caps before disassembling.
Prepare a suitable table and some clean papers or rubber mat on the table for disassembling.

(4) If the components are left disassembled, they may get rust. Make sure to measure the greasing and sealing.

(5) For carrying the control valve, never hold with pilot cover or relief valve and overload relief valve and carefully treat the valves.

(6) Do not tap the valve even if the spool movement is not smooth.

(7) Several tests for such as relief characteristics, leakage, overload relief valve setting and flow resistance are required after re-assembling, and the hydraulic test equipments for those tests are needed.
Therefore, do not disassemble what cannot perform test adjustment, even if it can disassemble.

※ Be sure to observe the mark (※) description in the disassembly and assembly procedures.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Hexagon wrench	Each 1 piece	5, 6, 10, 12 and 14
Socket wrench	Each 1 piece	27 and 32
Spanner	Each 1 piece	26 and 32 (main relief valve)

3) DISASSEMBLY

(1) Removing spool

① The case of the section without holding valve

Instruction for removing the travel spool (for instance) is follows :

Remove two hex socket bolts by 5 ㎜ allen key wrench, then remove pilot cover.

※ Pay attention not to lose the O-ring under the pilot cover.

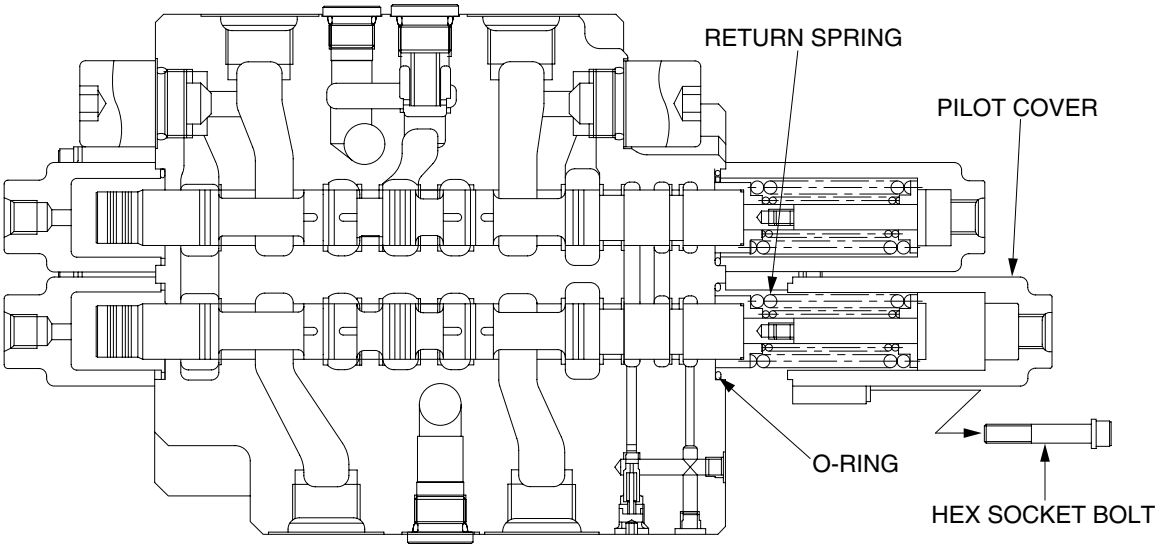
As the return spring portion of travel spool comes out, pull the spring straight slowly, by which spool assembly is removed.

※ The spools have to remove from the spring side.

Other spools (no lock valve type) can be removed in the same manner but the swing priority spool is reversed.

※ When spool replace, do not disassemble of a spool by any cases. Please replace by spool assembly.

※ Please attach using a tag etc. in the case of two or more kinds of spool replace, and understand a position.



29098MC01

② **The case of the section with holding valve**

Instruction for removing the boom spool (for instance) is follows :

Remove five hex socket bolts with washer by 5 ㎜ allen key wrench. Then remove pilot cover with internal parts below figure.

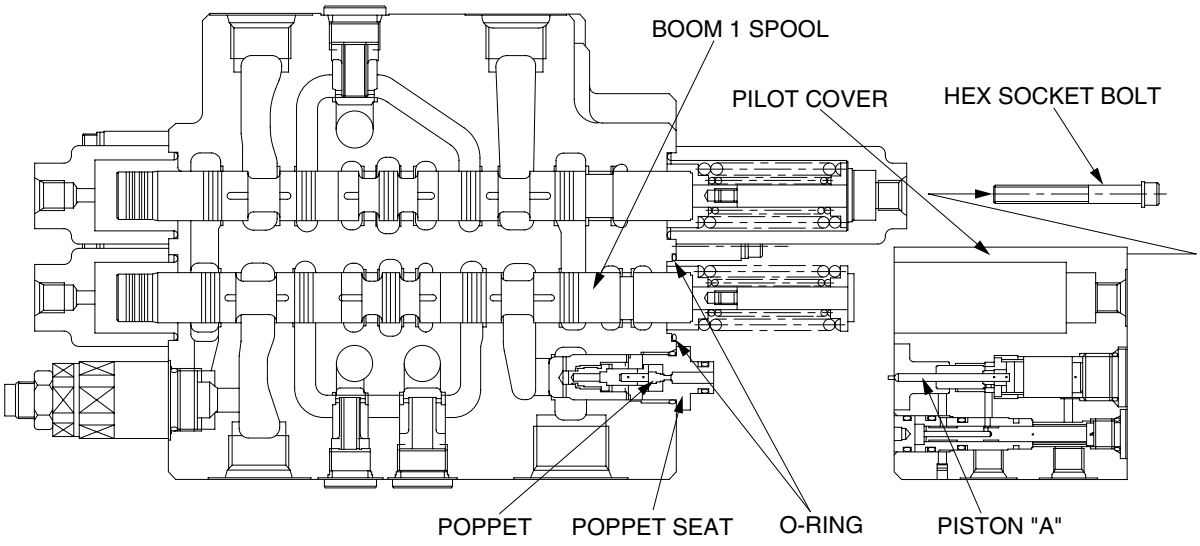
※ Be careful not to separate O-ring and poppet under pilot cover.

※ Pay attention not to damage the exposed piston A under pilot cover.

As the return spring portion of boom 1 spool comes out, pull the spring straight slowly, by which spool assembly is removed.

※ The spools have to remove form the spring side.

※ When spool replace, do not disassemble of a spool by any cases, please replace by spool assembly.



29098MC02

(2) Removing holding valve

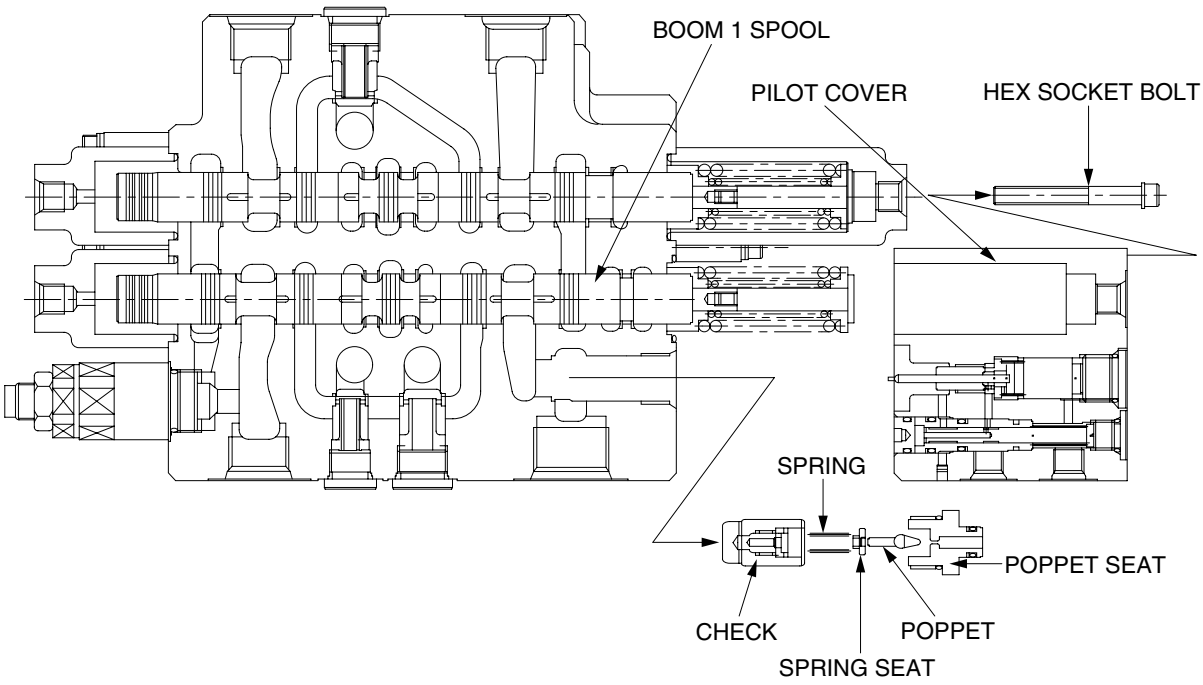
Remove the pilot cover with the holding valve as described on previous page.

※ Do not disassembled internal parts of the pilot cover.

Loosen the poppet seat by 26 ㎜ spanner and remove the poppet, the spring seat, the spring and the check in order.

※ Pay attention not to lose the poppet.

※ Do not disassembled internal parts of the check because the plug, functioning orifice, can damage easily.

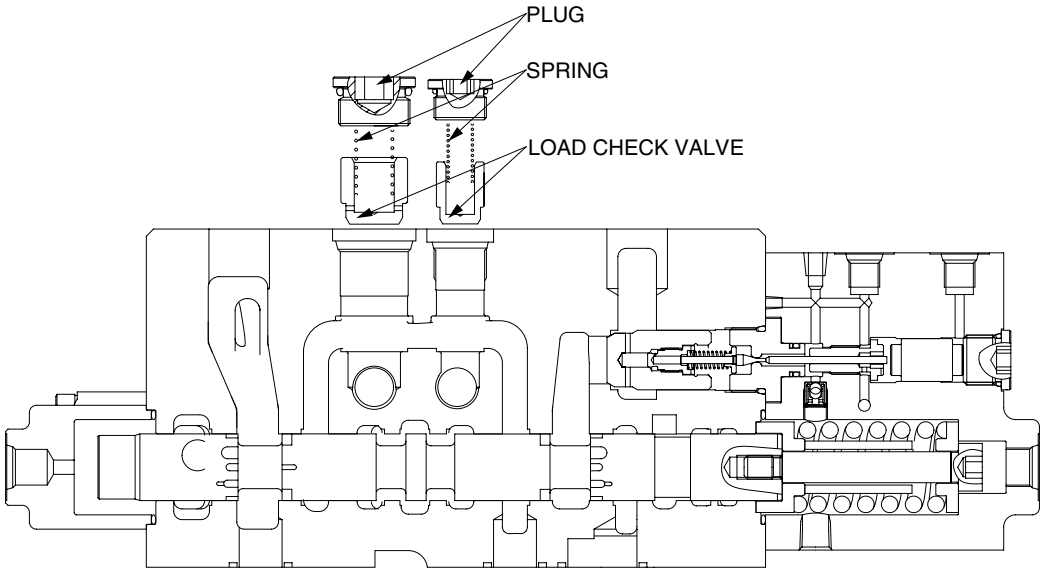


29098MC03

(3) Removing load check valve and negative relief valve

① The load check valve

- Fix the body to suitable work bench. Loosen the plug by 10 ㎜ allen key wrench.
- Remove the spring and the load check valve with pincers or magnet.

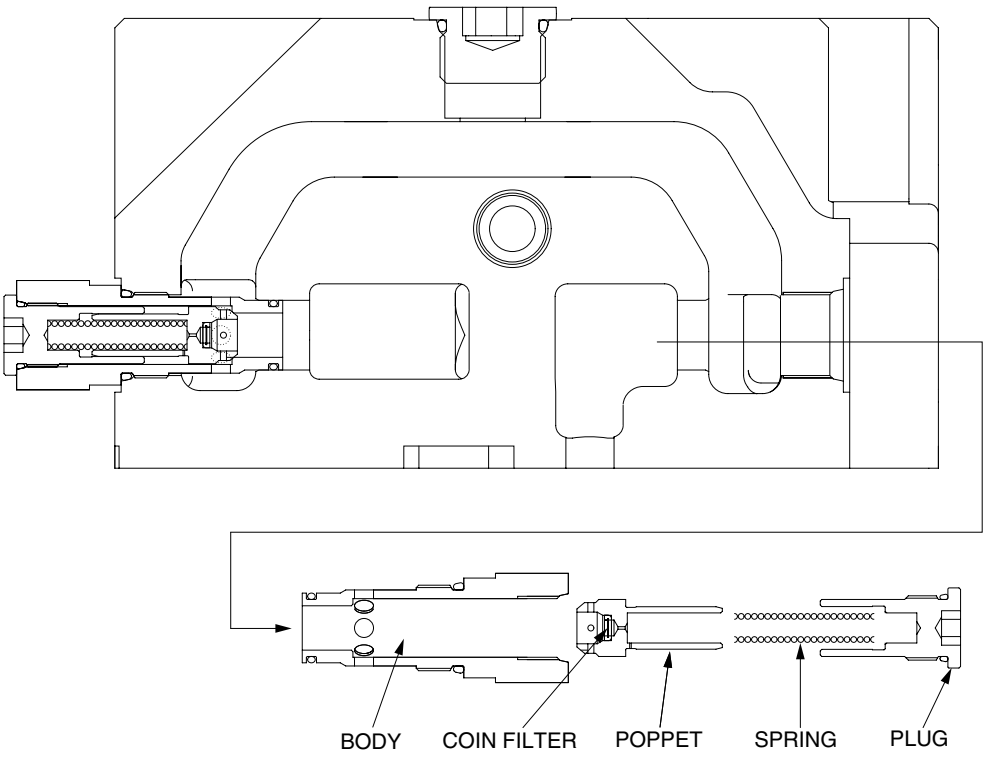


29098MC04

② The negative relief valve

Loosen the socket by 12 ㎜ allen key wrench.

Remove the spring, the spring holder, the piston and the negative control poppet.



29098MC05

※ Do not disassemble the coin filter inside the negative control poppet because of forced fit.

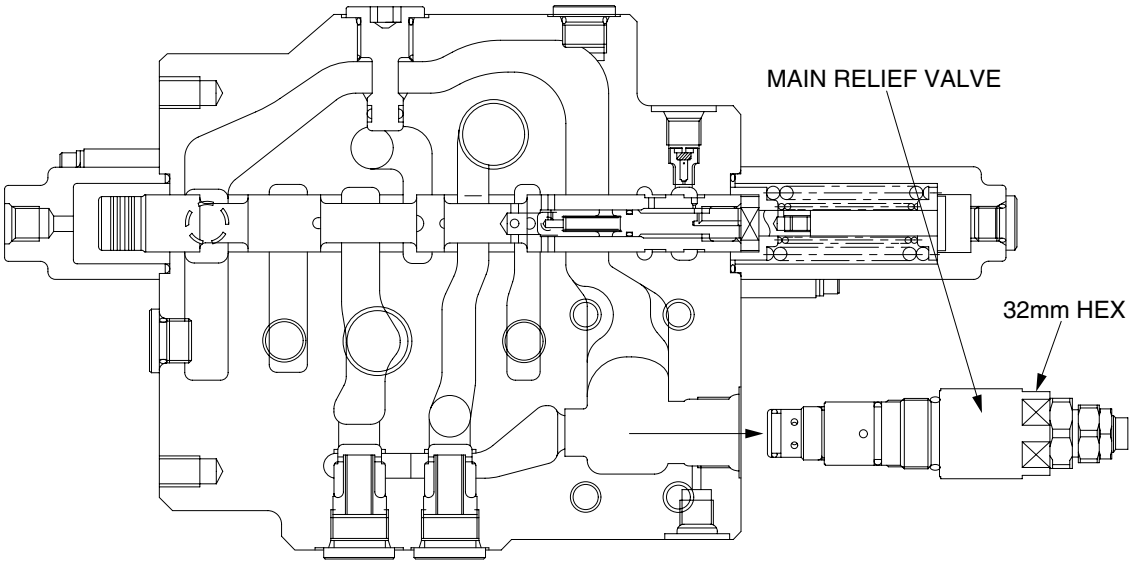
(4) Removing main relief valve and overload relief valve

Fix the valve body to suitable work bench. Remove the main relief valve by 32 mm spanner and remove the overload relief valve 32 mm spanner (standard) or 36 mm spanner (optional).

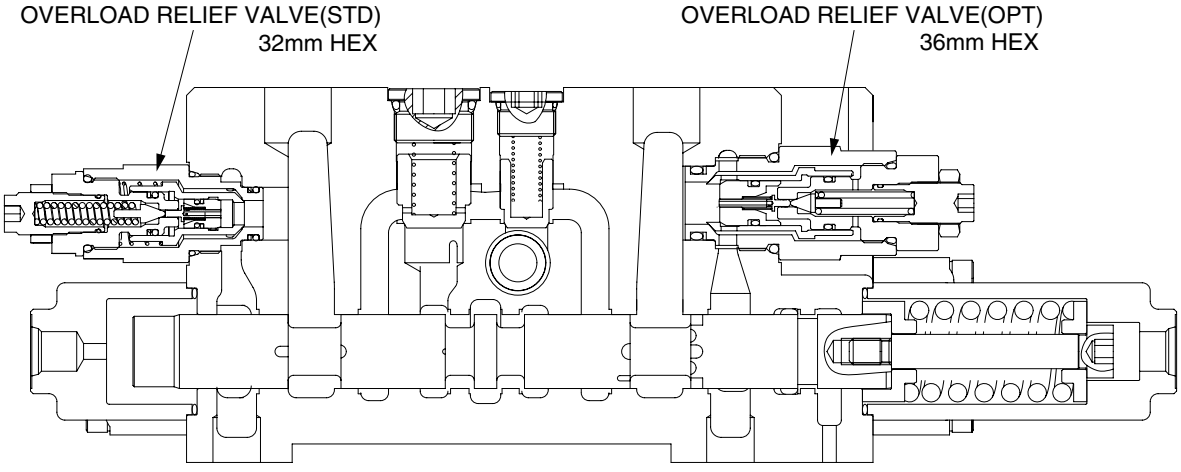
※ When disassembled, tag the relief valve for identification so that they can be reassembled correctly.

※ Pay attention not to damage seat face of disassembled main relief and overload relief valve.

※ Main relief and overload relief valve are very critical parts for performance and safety of the machine. Also, the pressure set is very difficult. Therefore, any abnormal parts are found, replace it with completely new relief valve assembly.



29098MC06



29098MC07

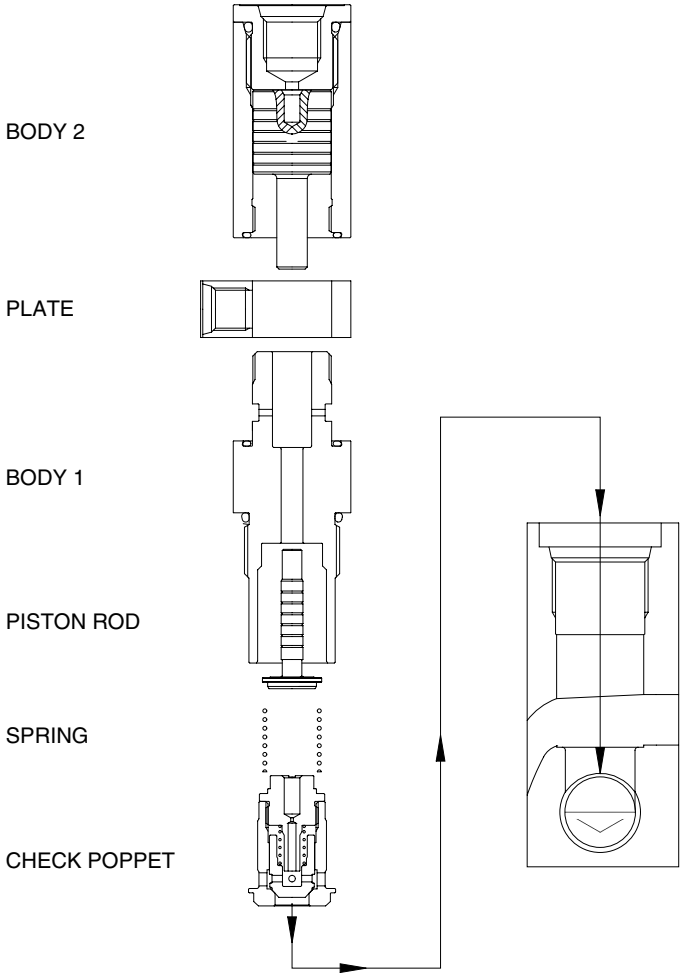
(5) Removing the swing logic valve and bucket logic valve

- Fix the valve body to suitable work bench.
- Loosen the body 2 by 32 mm spanner (swing logic valve) or 24 mm spanner (bucket logic valve) and remove it.
- Remove the banjo plate.
- Loosen the body 1 as the same spanner of body 2 and remove it.
- Remove the check poppet and spring.

※ Pay attention not to damage seat face of removed check poppet.

※ Do not disassemble the check poppet and replace it with a assembly in case any abnormal parts are found.

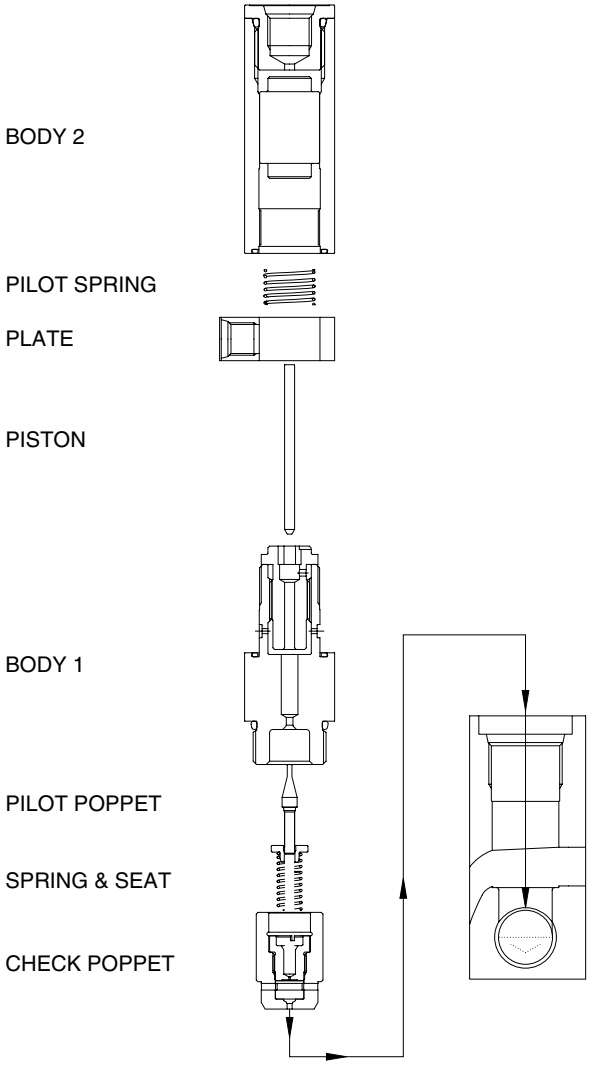
※ Pay attention not to lose and separation while disassembling and assembling.



29098MC08

(6) Removing the option ON/OFF valve

- Fix the valve body to suitable work bench.
- Loosen the body 2 by 24 mm spanner and remove it.
- Remove the banjo plate.
- Loosen the body 1 as the same spanner of body 2 and remove it.
- Remove the pilot poppet, spring and seat.
- Remove the check poppet.



29098MC09

4) ASSEMBLY

(1) Precaution

① When you assemble, please wash all parts by pure cleaning liquid.
② For re-assembling, basically use only bland new seals for all portions.
③ Apply grease or hydraulic oil to the seals and seal fitting section to make the sliding smooth, unless otherwise specified.
④ Pay attention not to roll the O-ring when fitting and it may cause oil leakage.
⑤ Do not tap the valve even if the spool movement is not smooth.
⑥ Prepare the section drawing and study the structure of MCV and then start disassembly work.
⑦ Tighten bolt and parts with thread for all section by torque wrench to the respective tightening torque.

(2) Assembly

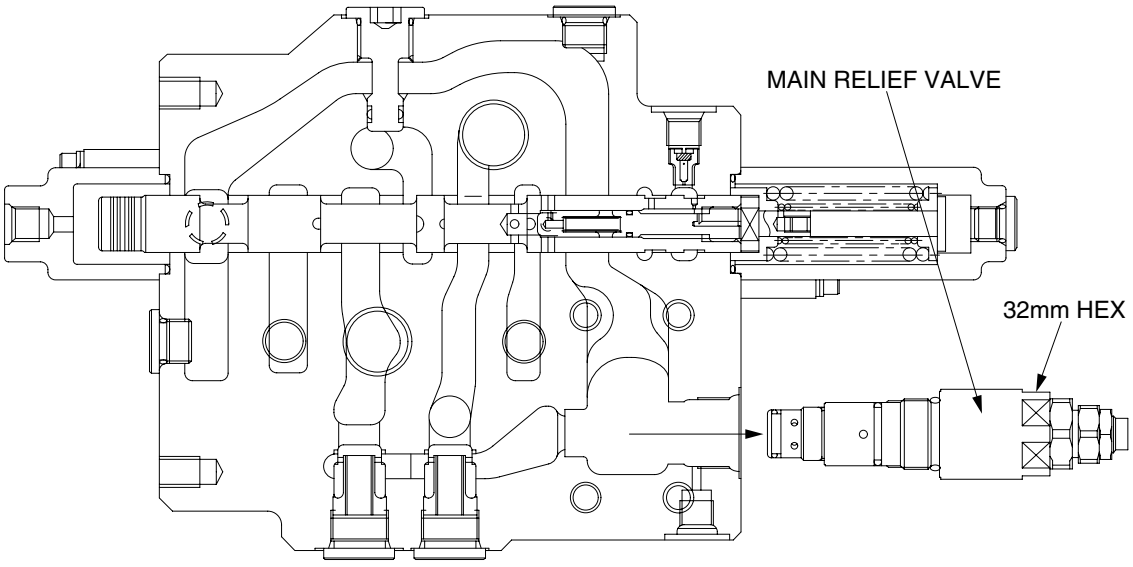
Explanation only is shown for the assembly, refer to the figures shown in the previous disassembly section.

① Main relief and overload relief valve

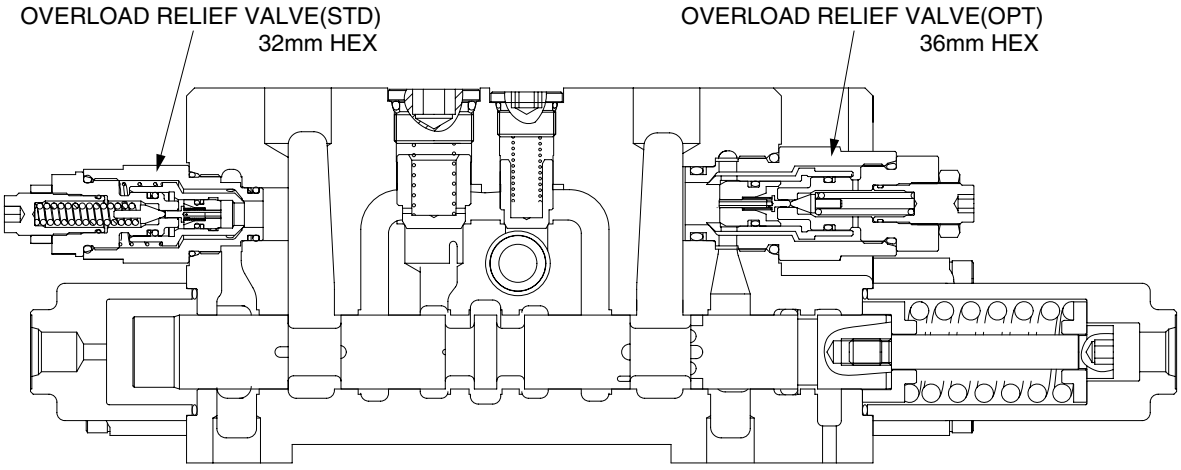
Fix the valve body to suitable work bench.

Install main relief valve and overload relief valve into the body and tighten to the specified torque by 32 mm torque wrench.

· Tightening torque : 8~9 kgf·m (57.8~65.1 lbf·ft)



29098MC06



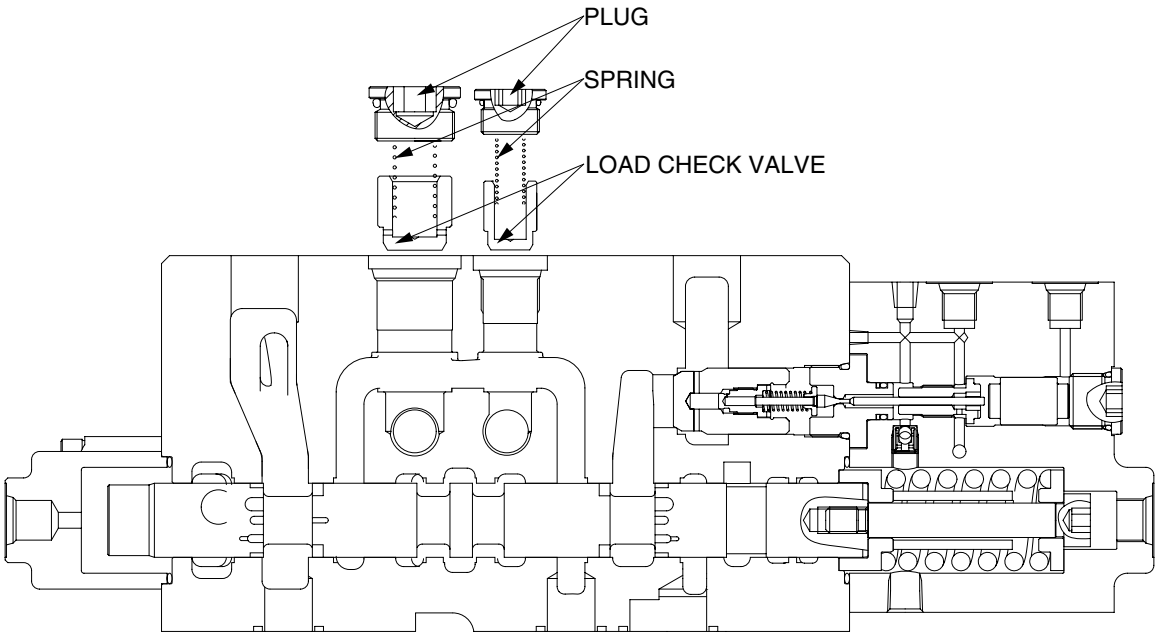
29098MC07

② Load check valve

Assemble the load check valve and spring.

Put O-rings on to plug and tighten plug to the specified torque by 10 mm torque wrench.

· Tightening torque : 6~7 kgf·m (43.4~50.6 lbf·ft)

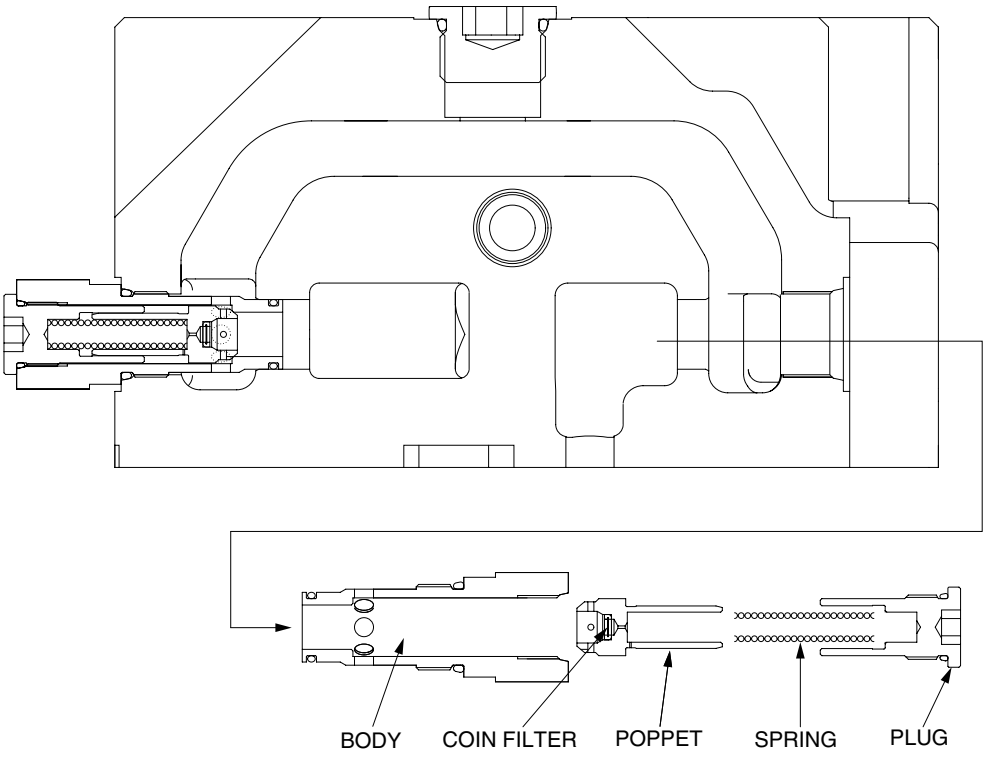


29098MC04

③ Negative control relief valve

Assemble the nega-con poppet, piston, spring holder and spring into body in order and tighten the socket to the specified torque by 12 mm torque wrench.

· Tightening torque : 8~9 kgf·m (57.8~65.1 lbf·ft)



29098MC05

④ **Holding valves**

Assemble the check, spring seat and poppet into the hole of valve body in order.

Tighten the poppet seat to the specified torque by 25 mm torque wrench.

· Tightening torque : 6~7 kgf·m (43.4~50.6 lbf·ft)

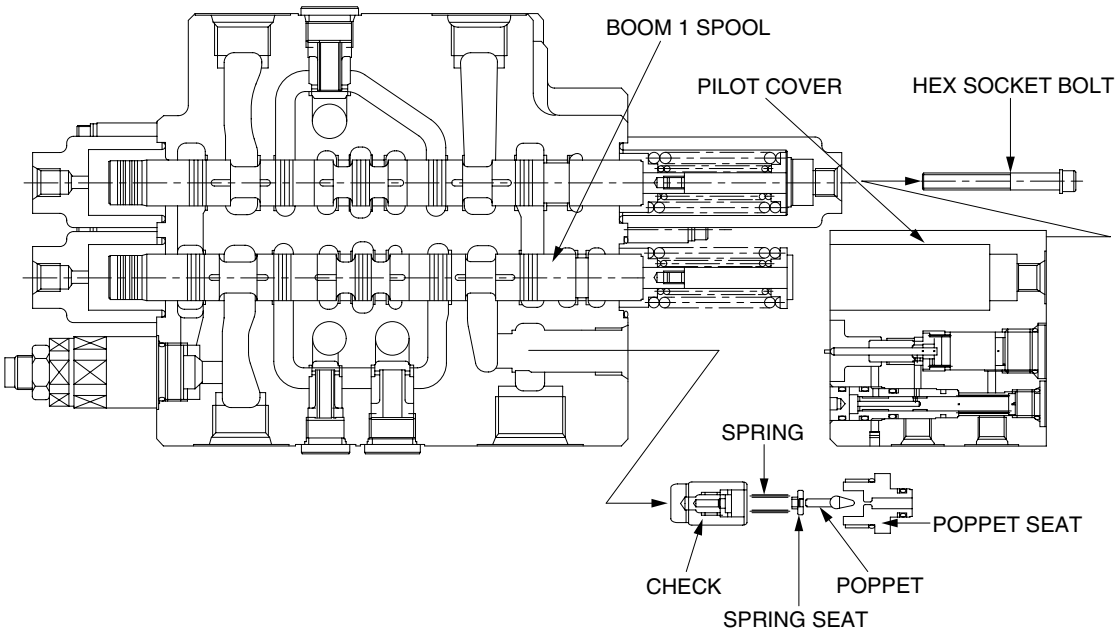
Fit the "piston A" under pilot cover with internal parts into hole on the poppet seat.

Tighten hexagon socket head bolt to specified torque by 5 mm torque wrench.

· Tightening torque : 1~1.1 kgf·m (7.2~7.9 lbf·ft)

※ Pay attention poppet not to separation.

※ Confirm that O-rings have been well fitted on the groove of body. (Apply grease on O-ring)



29098MC03

⑤ Main spool

Put the spool position upward and fix it to the vise. Carefully insert the previously assembled spool assemblies into their respective bores within of body.

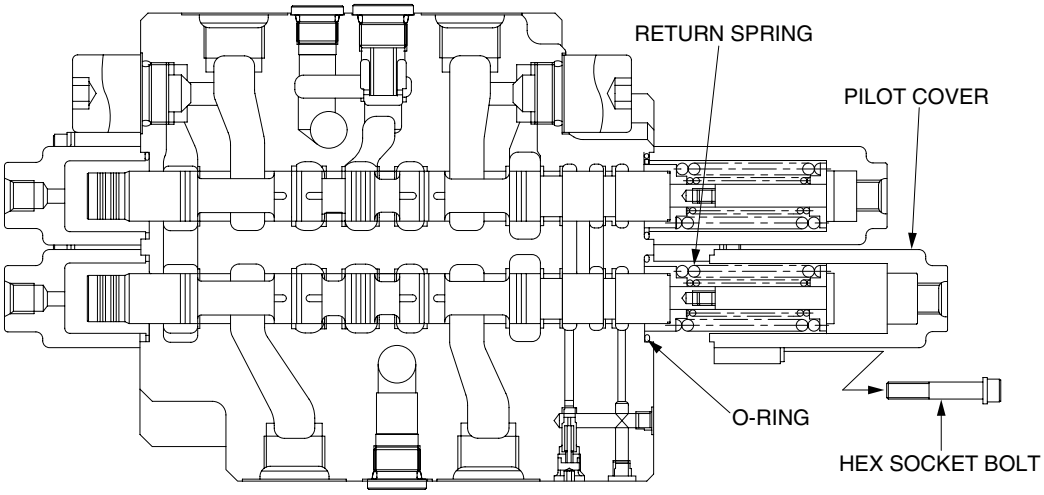
Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.

Fit the pilot cover to the groove of the valve body.

Confirm that O-rings have been fitted on the groove of body. (Apply grease on O-ring)

Tighten the two socket bolt to the specified torque by 5 ㎜ torque wrench.

· Tightening torque : 1~1.1 kgf·m (7.2~7.9 lbf·ft)



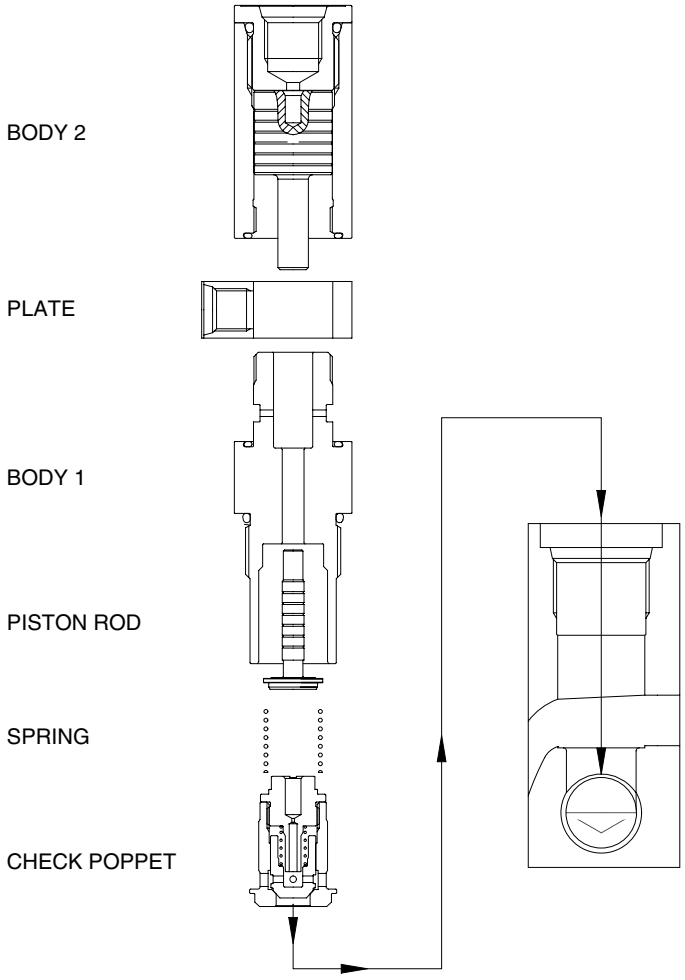
29098MC01

⑥ The swing logic valve and bucket logic valve

- Assemble the piston rod, spring and check poppet into the body 1 in order.
- Install the body 1 assembly into valve body and tighten to the specified torque.
  · Tightening torque : 2.9 kgf·m (21.0 lbf·ft)
- Assemble the banjo plate.

※ Confirm O-ring has been seated on the groove of banjo plate.

- Tighten the body 2 to the specified torque.
  · Tightening torque : 1.5 kgf·m (10.8 lbf·ft)



29098MC08

⑦ Option ON/OFF valve

- Assemble the check poppet into the valve body.

※ Push the check poppet about half of hole.

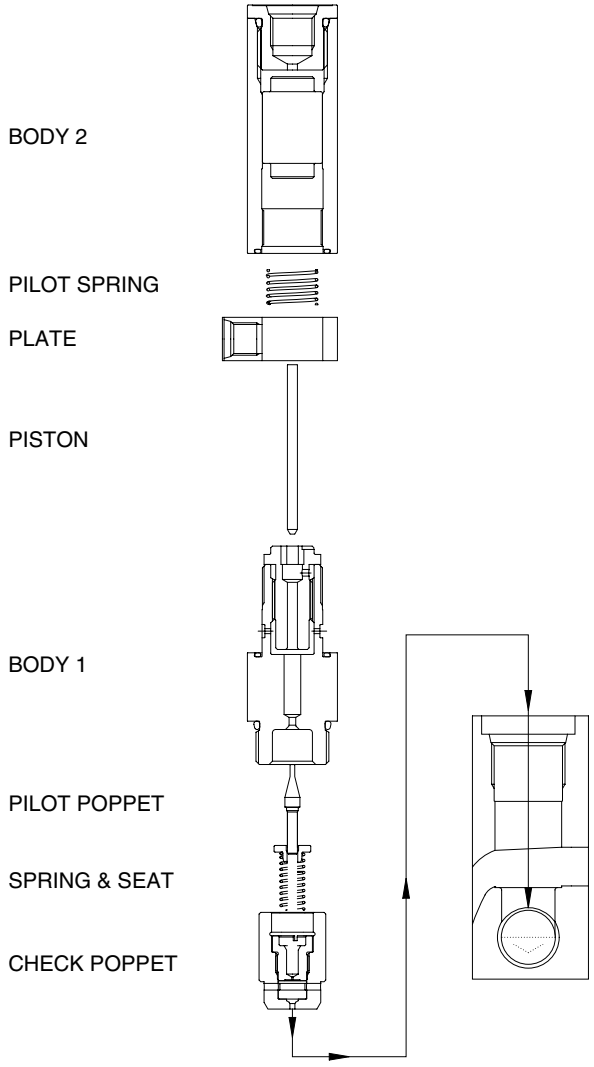
- Assemble the pilot poppet, spring and seat into check poppet.

※ As it can not be fixed, hang it diagonally.

- Insert the end of pilot poppet into the machined center hole of body 1 and push it complete
- slowly. Then tighten to the specified torque.
  · Tightening torque : 2.9 kgf·m (21.0 lbf·ft)

※ Tighten socket piston.

- When push the piston to the end, confirm the repulsive spring force.
- Assemble the banjo plate.
- Put the pilot spring into body 2 and assemble it into body 1 and then tighten to the specified torque.
  · Tightening torque : 1.5 kgf·m (10.8 lbf·ft)



29098MC09

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).

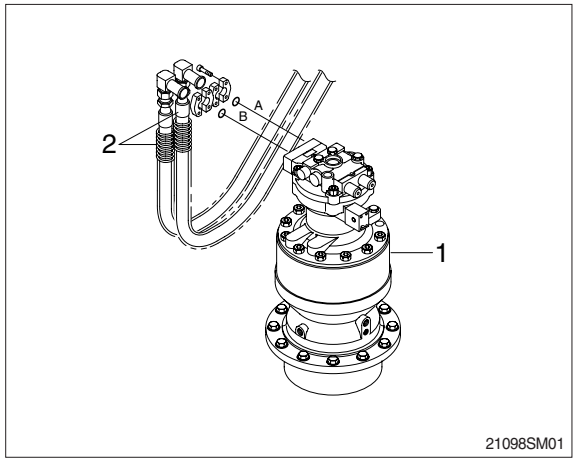
(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 8).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).

· Motor device weight : 61 kg (135 lb)

(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.

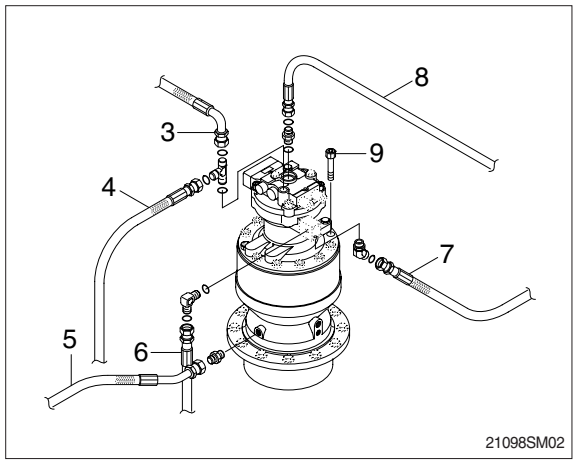
② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

④ Start the engine, run at low idling and check oil come out from plug.

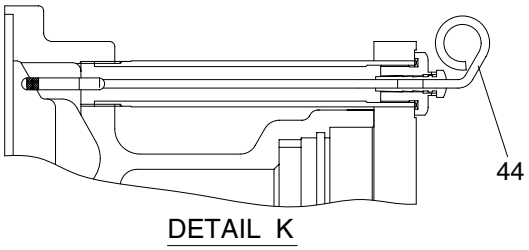
⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

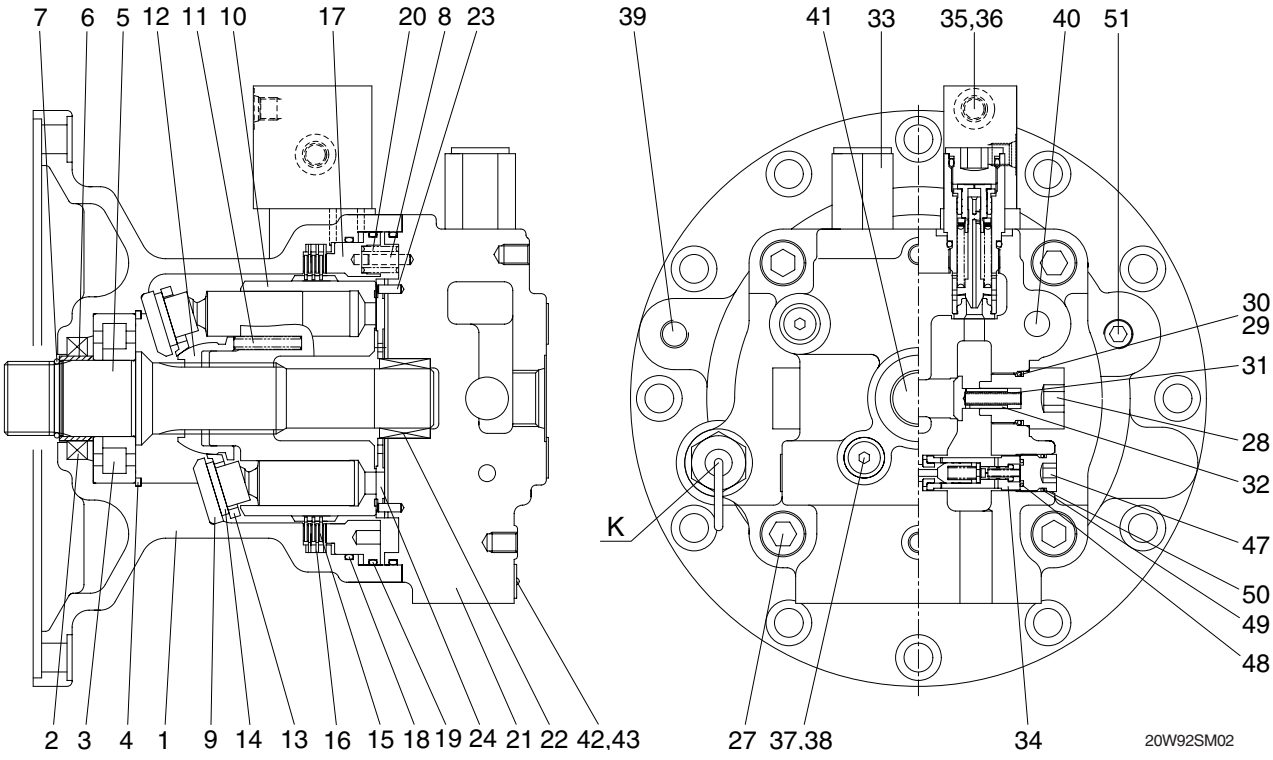


2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



DETAIL K

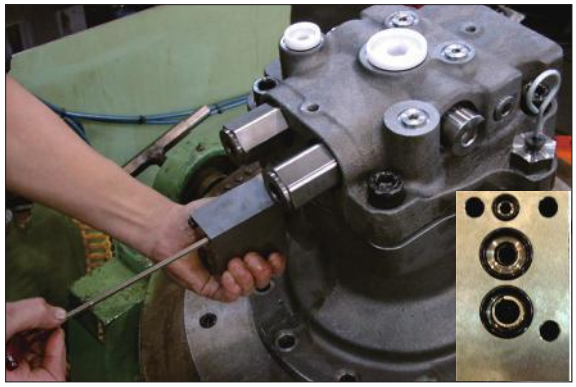


1	Body	18	O-ring	37	Plug
2	Oil seal	19	O-ring	38	O-ring
3	Roller bearing	20	Brake spring	39	Plug
4	Snap ring	21	Rear cover	40	Plug
5	Shaft	22	Needle bearing	41	Plug
6	Bushing	23	Pin	42	Name plate
7	Stop ring	24	Valve plate	43	Rivet
8	Pin	27	Wrench bolt	44	Level gauge
9	Shoe plate	28	Plug	45	Flange
10	Cylinder block	29	Back up ring	46	O-ring
11	Spring	30	O-ring	47	Plug
12	Ball guide	31	Spring	48	O-ring
13	Set plate	32	Check	49	O-ring
14	Piston assy	33	Relief valve	50	Back up ring
15	Friction plate	34	Anti-inversion valve	51	Plug
16	Separate plate	35	Time delay valve		
17	Brake piston	36	Wrench bolt		

2) DISASSEMBLING

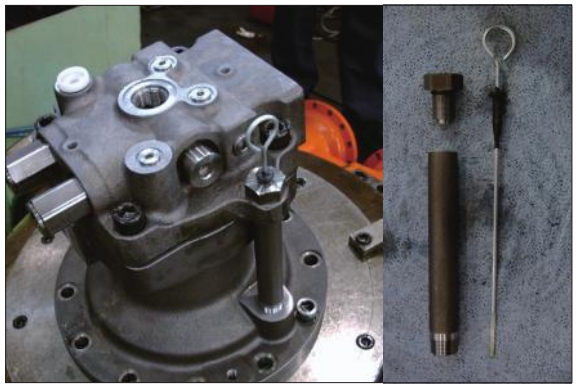
(1) Disassemble the sub of a TURNING AXIS

① Unloosing wrench bolt and disassemble time delay valve assy (35) from rear cover (21)



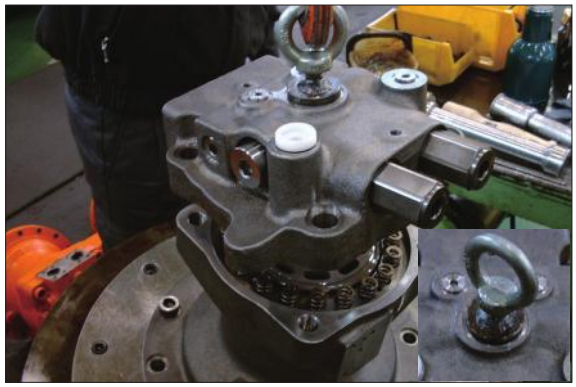
14078SM201/201A

② Disassemble level gauge (44) from body (1).



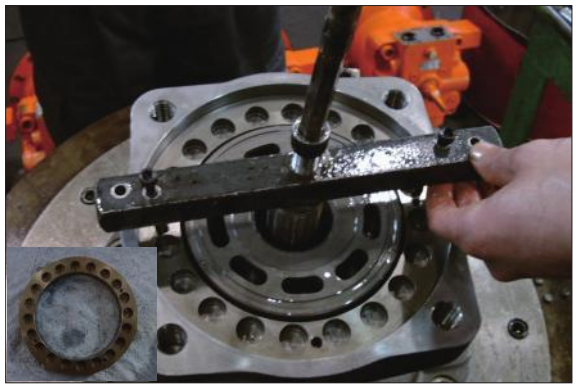
14078SM202/202A

③ Hang rear cover (21) on hoist, unloose wrench bolt (27) and disassemble from body (1).



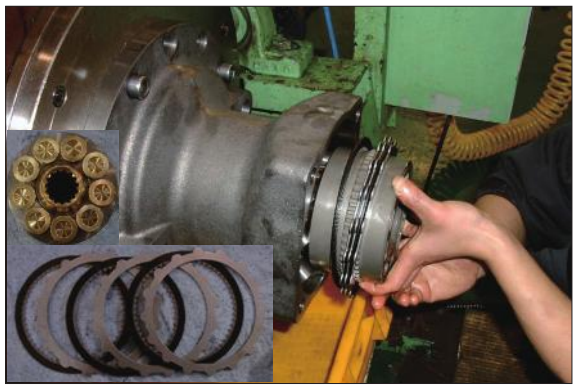
14078SM203/203A

④ Using a jig, disassemble break piston (17) from body (1).



14078SM204/204A

⑤ Disassemble respectively cylinder block assy, friction plate (15), plate (16) from body (1).



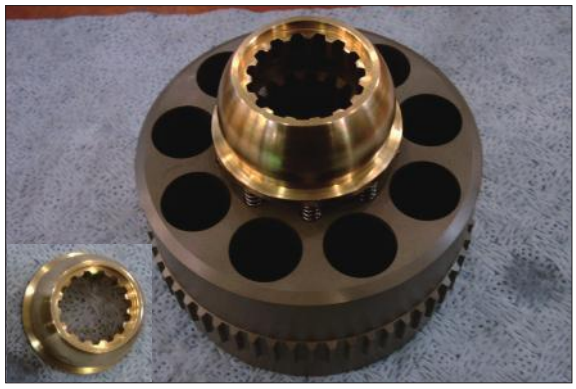
14078SM205/205A/B

(2) Disassemble cylinder block assy sub

① Disassemble piston assy (14), set plate (13) from cylinder block assy.

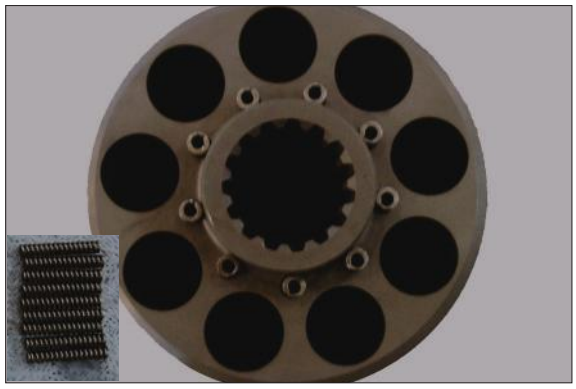
14078SM206/205B

② Disassemble ball guide (12) from cylinder block (10).



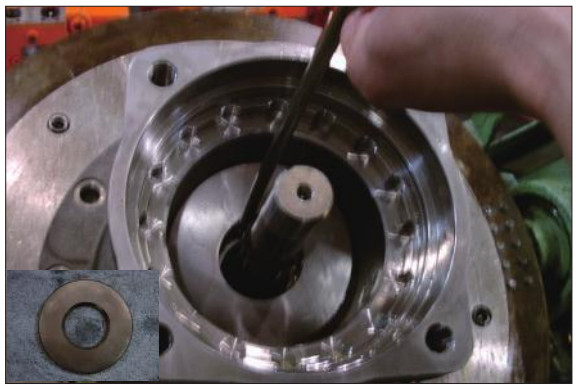
14078SM207/207A

③ Disassemble spring (11) from cylinder block (10).



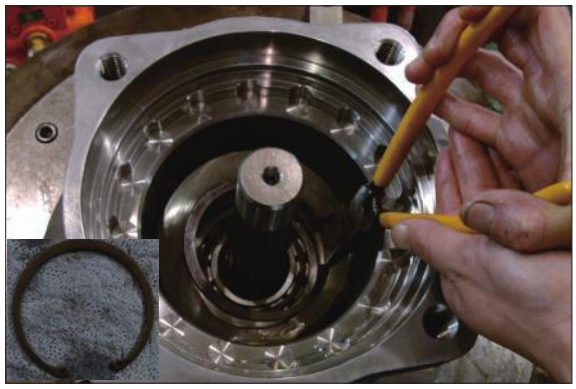
14078SM208/208A

④ Disassemble shoe plate (9) from body (1).



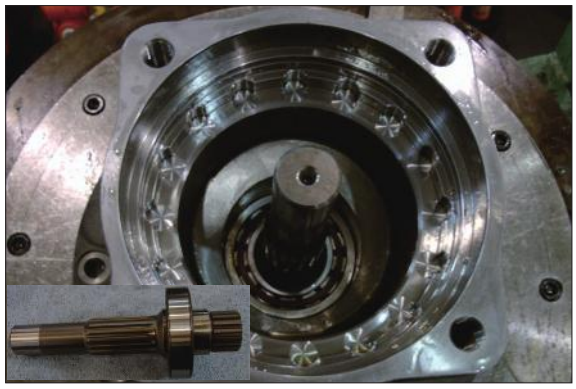
14078SM209/209A

⑤ Using a plier jig, disassemble snap ring (4) from shaft (5).



14078SM210/210A

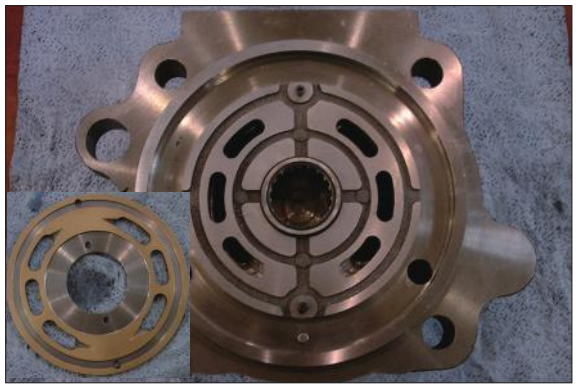
⑥ Disassemble shaft assy from body (1).



14078SM211/211A

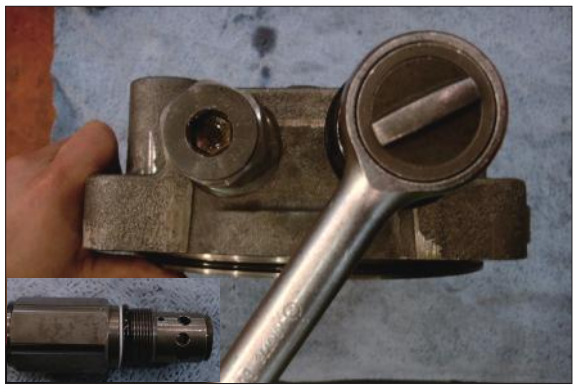
(3) Disassemble rear cover assy sub

① Disassemble pin (8, 23), valve plate (24) from rear cover (21).



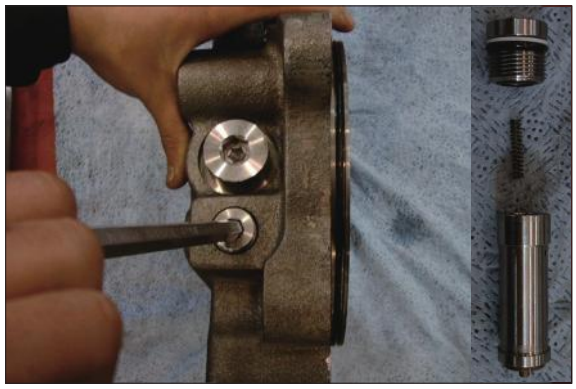
14078SM212/212A

② Using a torque wrench, disassemble relief valve assy (33) 2 set from rear cover (21).



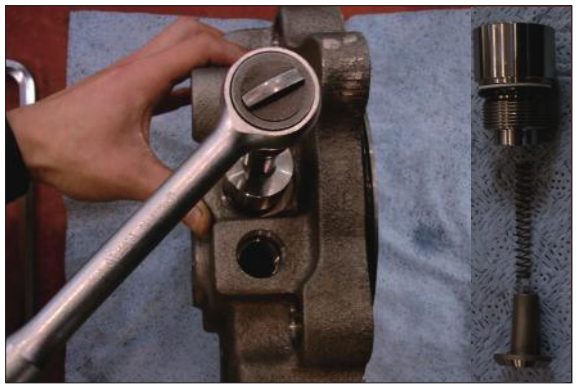
14078SM213/213A

③ After disassembling plug with a L-wrench from rear cover (21), disassemble respectively back up ring, O-ring, O-ring, spring, anti-inversion valve assy (34)



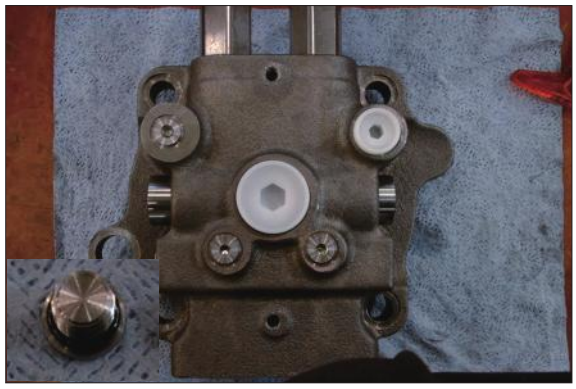
14078SM214/214A

④ Disassemble make up check valve assy with a torque wrench from rear cover (21).



14078SM215/215A

⑤ Disassemble respectively plug (37, 40, 41), with a L-wrench from rear cover (21).

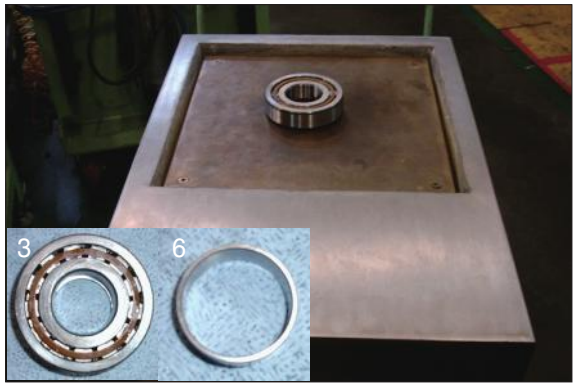


14078SM216/216A

3) ASSEMBLING

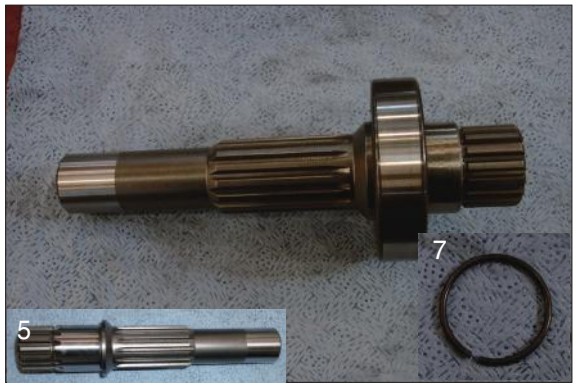
(1) Assemble the sub of a turning axls

① Put roller bearing (3), bushing (6) on pre-heater and provide heat to inner wheel (compressing temp : 290˚C for 2minutes)
- Roller bearing × 1 EA
- Bushing × 1 EA



14078SM217/217A/B

② After assembling and compressing pre-heated roller bearing (3), bushing (6) into shaft (5).
- Stop ring × 1 EA
- Shaft × 1 EA

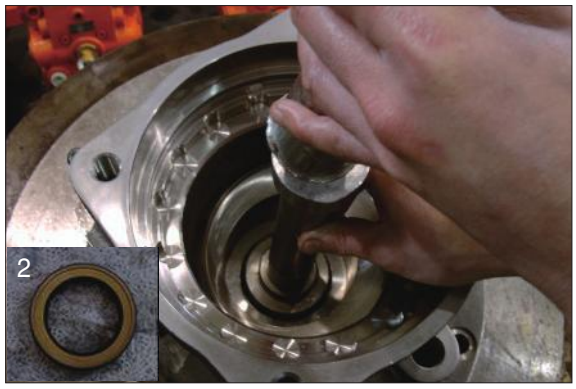


14078SM218/218A/B

③ Put body (1) on a assembling jig, fix it with bolts to prohibit moving.

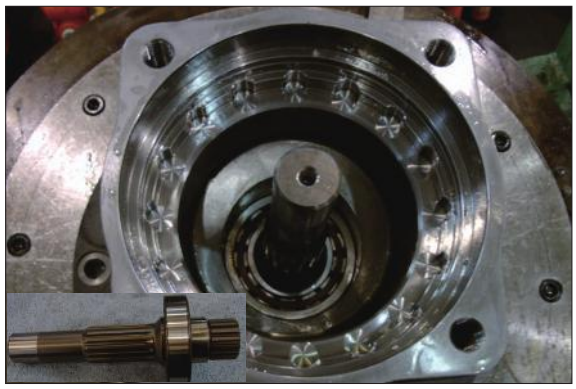

14078SM219

④ Using a compressing tool and steel stick, assemble oil seal (2) into body (1).
· Oil seal × 1 EA



14078SM220/220A

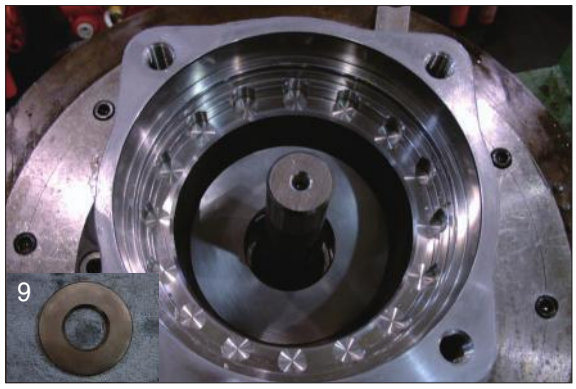
⑤ Insert above shaft sub into body (1) and assemble it with a steel stick.


14078SM211/211A

⑥ Fix snap ring (4) to shaft with a plier jig.
· Snap ring × 1 EA

14078SM210/210A

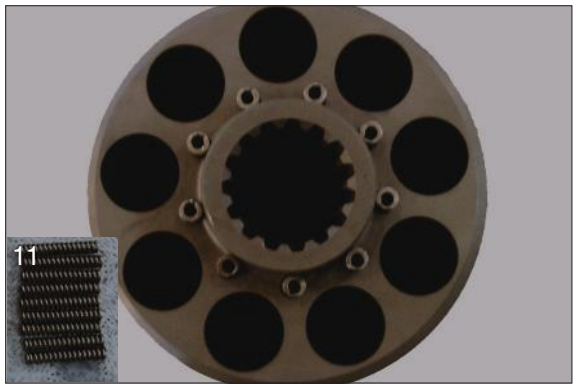
⑦ Spread grease on shoe plate (9) and assemble on the body.
· Shoe plate × 1 EA



14078SM222/209A

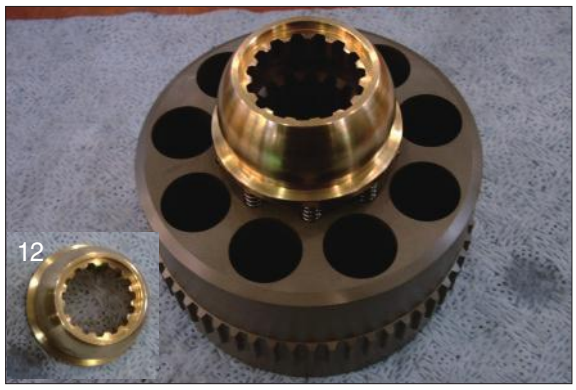
(2) Assemble the sub of cylinder block assy

① Assemble spring (11) 9 set into cylinder block (10).
- Spring × 9 EA



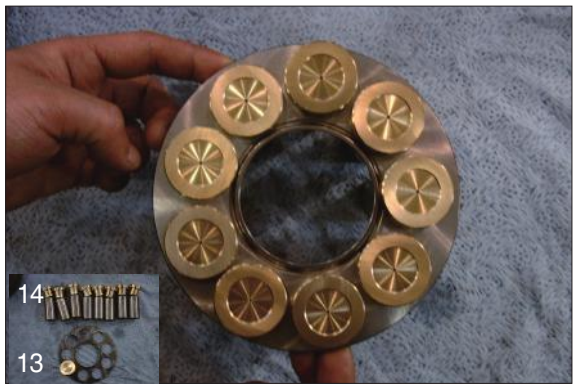
14078SM208/208A

② Assemble ball guide (12) into cylinder.
- Ball guide × 1 EA



14078SM207/207A

③ Assemble piston assy (14) 9 set into set plate (13).
- Piston assy × 9 EA
- Set plate × 1 EA

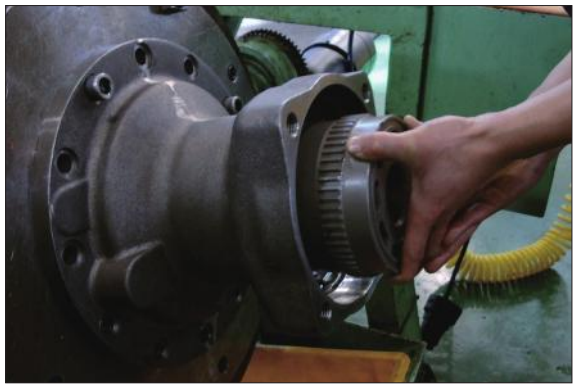


14078SM223/223A

④ Assemble above item ② and ③.

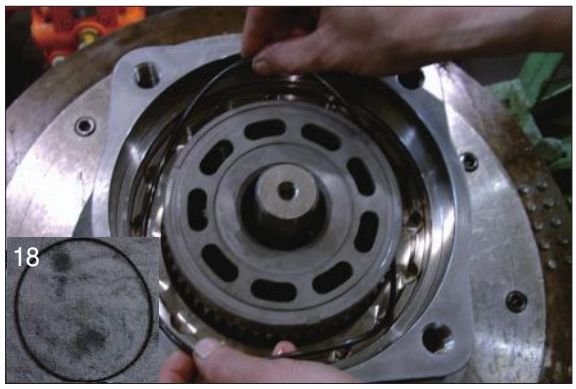

14078SM224

⑤ Assemble cylinder block assy into body (1).



14078SM225

⑥ Assemble O-ring (18) into body (1).
- O-ring × 1 EA

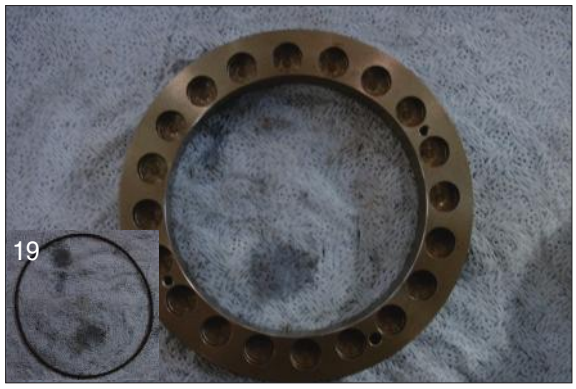


14078SM226/226A

⑦ Assemble 3 set of plate (16), friction plate (15) respectively into body.
- Plate × 3 EA
- Friction plate × 3 EA

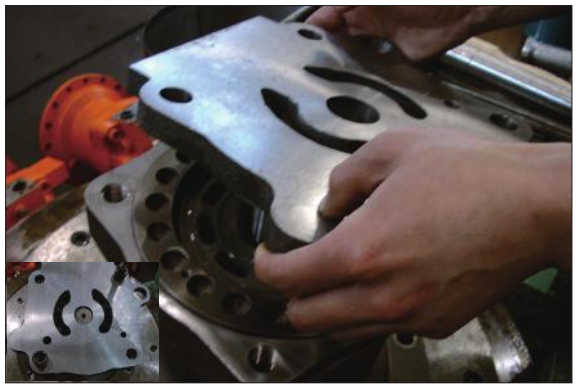
14078SM227/205A

⑧ Assemble O-ring (19) into break piston (17).
- O-ring × 2 EA



14078SM228/226A

⑨ Insert break piston assy into body (1) and compress it with a jig and hammer.



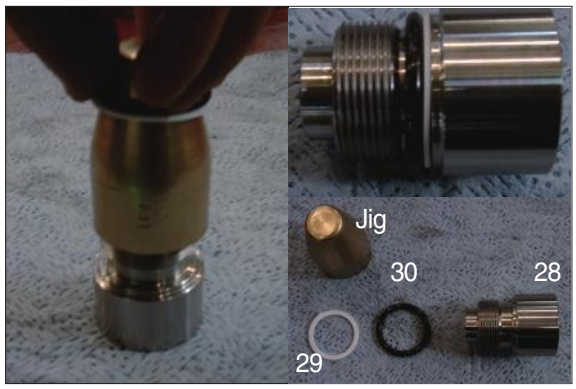
14078SM229/229A

⑩ Assemble spring (20) (20 EA) into break piston (17).
- Spring × 20 EA

14078SM230/230A

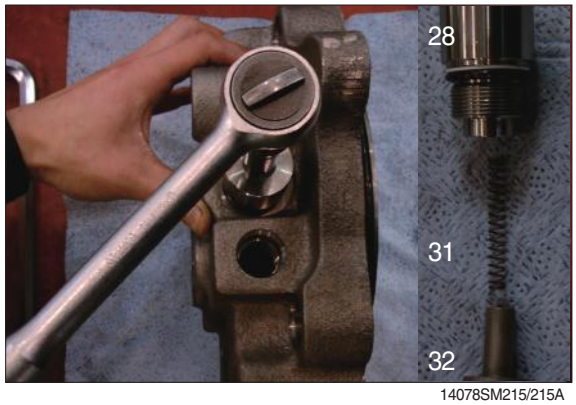
(3) Assemble the sub of rear cover assy sub

① Assemble the sub of make up check valve assy.
Assemble O-ring (30), back up ring (29) into plug (28) with a O-ring assembling jig.
- Plug ×1 EA
- Back up ring ×1 EA
- O-ring ×1 EA



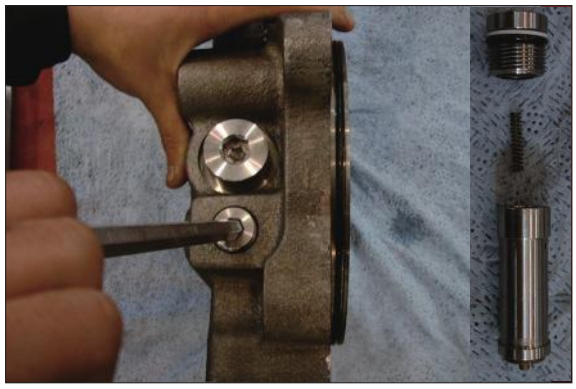
14078SM231/231A/B

② Assemble respectively make up check valve assy spring (31), check (32), plug (28) into rear cover (21) after then screw it torque wrench.
- Make up check sub × 2 set
- Spring × 2 EA
- Check × 3 EA



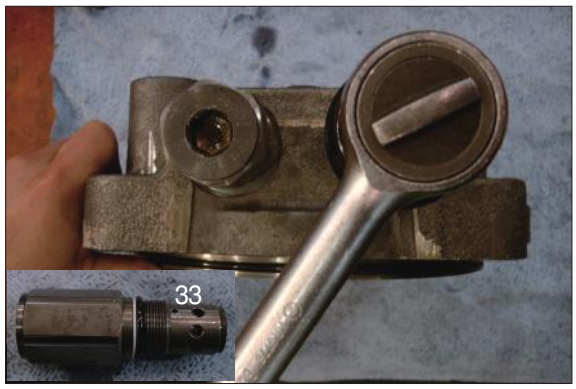
14078SM215/215A

③ Assemble respectively plug (47), back up ring, O-ring, O-ring, spring, anti-rotating valve assy (34) into rear cover (21). (Bilateral symmetry assembling)
- Anti-Inversion v/v assy × 2 set
- O-ring (P12) × 2 EA
- O-ring (P18) × 2 EA
- Back up ring (P18) × 2 EA



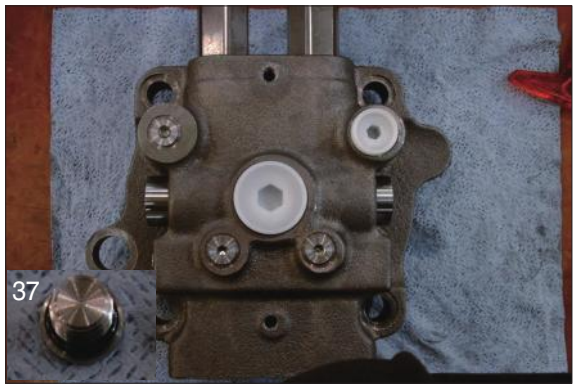
14078SM214/214A

④ Assemble relief valve assy (33) 2set into rear cover (21) with a torque wrench. (Bilateral symmetry assembling)



14078SM213/213A

⑤ Assemble plug (37), plug (40, 41) into rear cover (21) with a L-wrench.
* Plug × 3 EA (PF1/4)

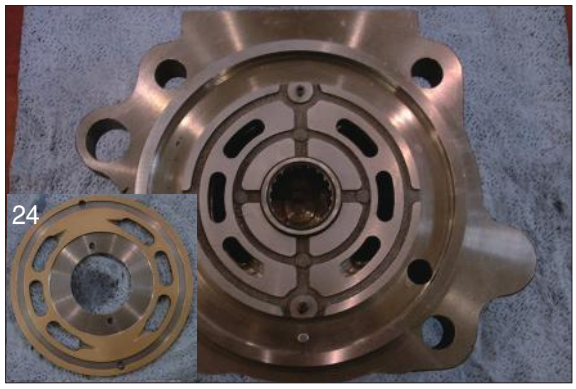


14078SM216/216A

⑥ After assembling needle bearing (22) into rear cover (21), with a hammer assemble pin (8, 23).
* Pin × 1 EA
* Pin × 2 EA

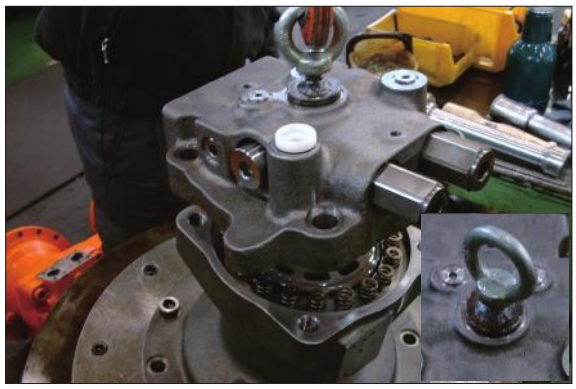
14078SM212

⑦ Spreading grease on valve plate (24), assemble into rear cover (21).
- Valve plate × 1 EA

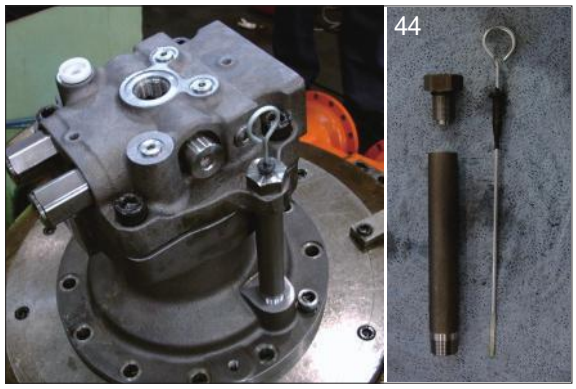


14078SM212/212A

⑧ Lift up rear cover assy on body (1) by a crane and assemble it with a wrench bolt (27).

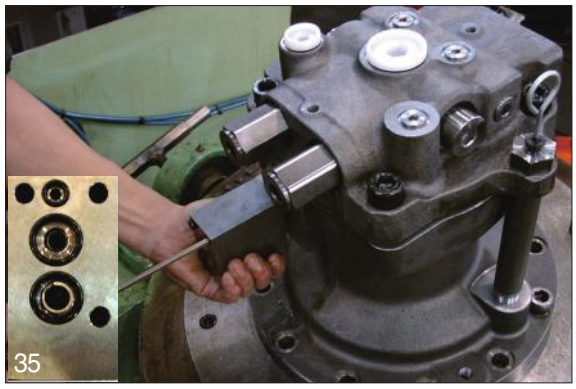

14078SM203/203A

⑨ Assemble level gauge (44) into body (1).



14078SM202/202A

⑩ Assemble time delay valve assy (35) into rear cover (21) with a wrench bolt (36).



14078SM01/201A

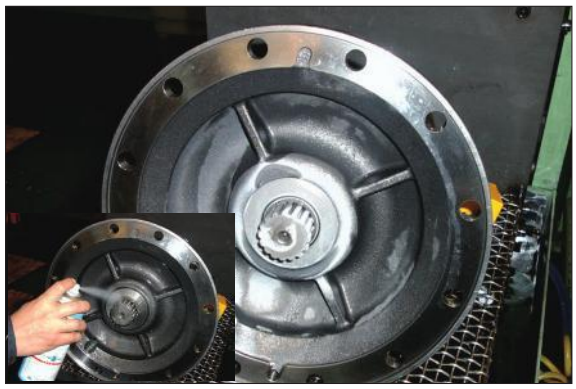
(4) Air pressing test

Be sure of leakage, after press air into assembled motor

14078SM232

(5) Leakage check

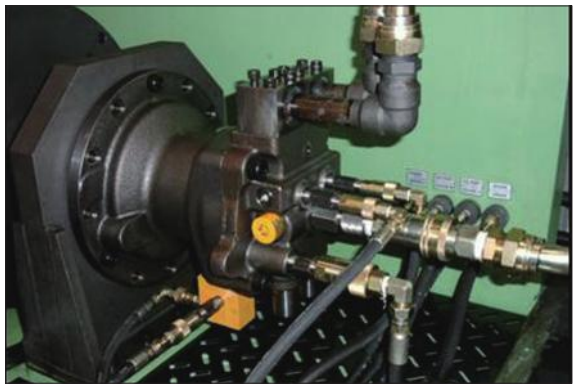
After cleaning motor by color check No.1, paint No.3 and be sure of leakage.



14078SM233/233A

(6) Mount test bench

Mounting motor test bench, test the availability of each part.



220078SM14

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

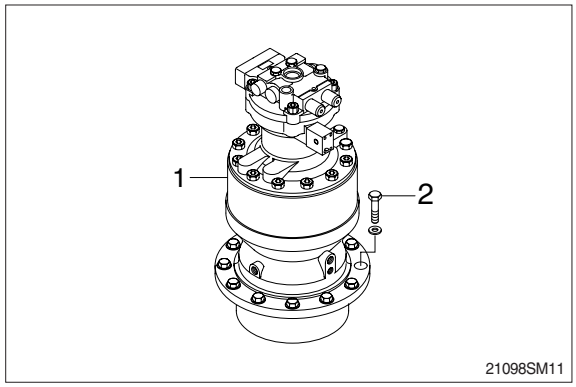
(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 180 kg (396 lb)

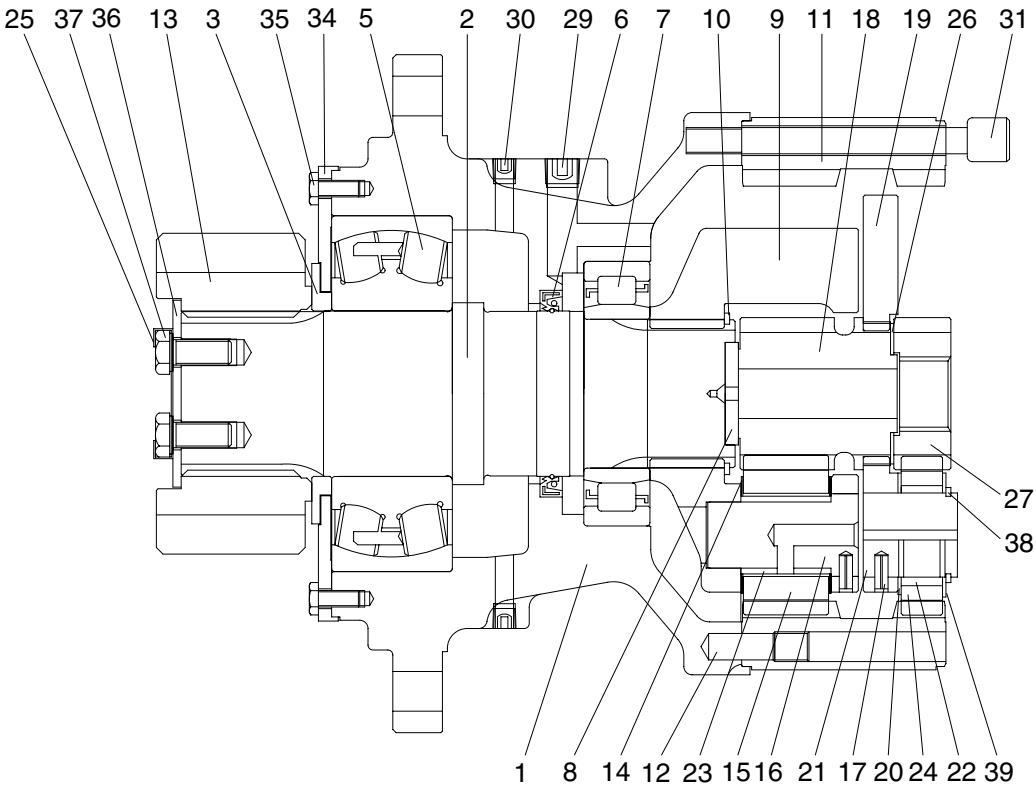
2) INSTALL

(1) Carry out installation in the reverse order to removal.
· Tightening torque : 58.4±6.4 kgf · m (422±46.3 lbf · ft)



4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



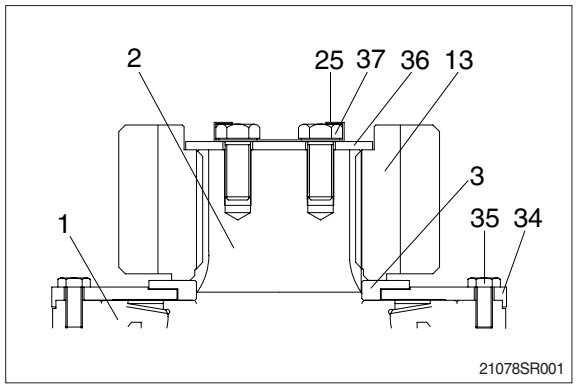
21092SM03

1	Casing	14	Thrust washer	26	Side plate 3
2	Drive shaft	15	Planet gear 2	27	Sun gear 1
3	Spacer	16	Pin & bushing	29	Plug
5	Roller bearing	17	Spring pin	30	Plug
6	Oil seal	18	Sun gear 2	31	Socket bolt
7	Roller bearing	19	Carrier 1	34	Cover plate
8	Thrust plate 3	20	Side plate 1	35	Hexagon bolt
9	Carrier 2	21	Pin 1	36	Lock plate
10	Stop ring	22	Needle cage	37	Hexagon bolt
11	Ring gear	23	Bushing 2	38	Stop ring
12	Knock pin	24	Planet gear 1	39	Side plate 2
13	Pinion gear	25	Lock washer		

2) DISASSEMBLY

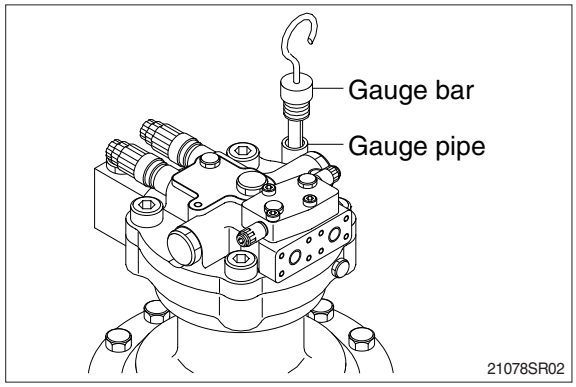
(1) Spread off the 4 corners of lock washer (25) with a tool.

※ Do not reuse lock washer (25).
Loosen the bolts (37) and then remove lock washer (25) and lock plate (36) from the pinion gear (13).
Remove pinion gear (13) and spacer (3) from the drive shaft (2).
Remove cover plate (34) from the casing (1) by loosening the hexagon bolts (35).

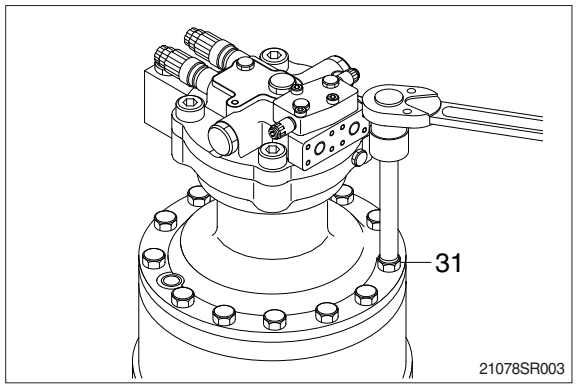


(2) Remove gauge bar and gauge pipe from the swing motor casing.

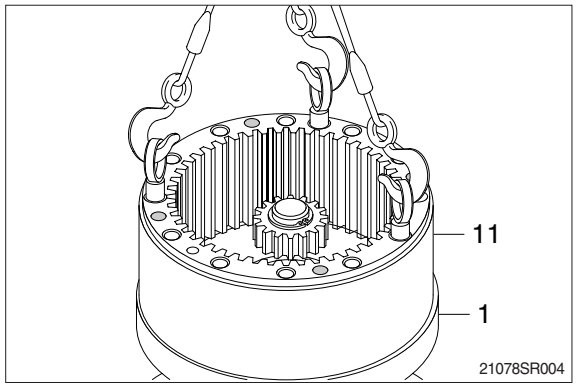
※ Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



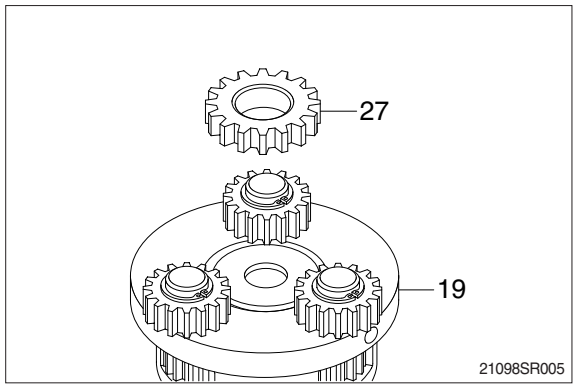
(3) Loosen the socket bolts (31) to separate swing motor from reduction gear.



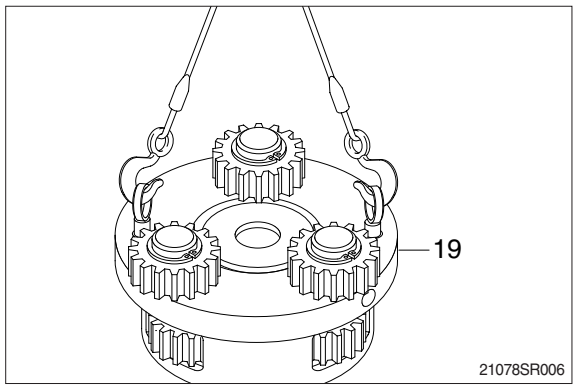
(4) Tighten 3 M16 eye bolts to the ring gear (11) and then lift the ring gear (11) out of the casing (1).



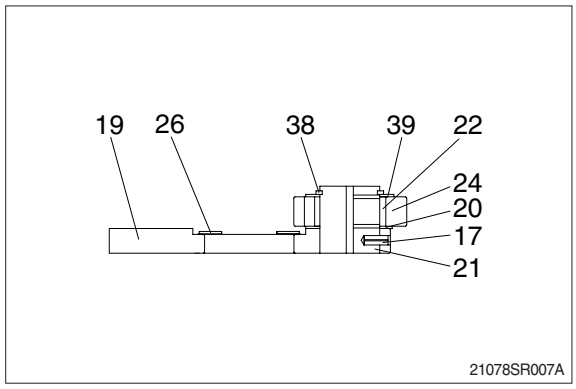
(5) Remove sun gear1 (27).



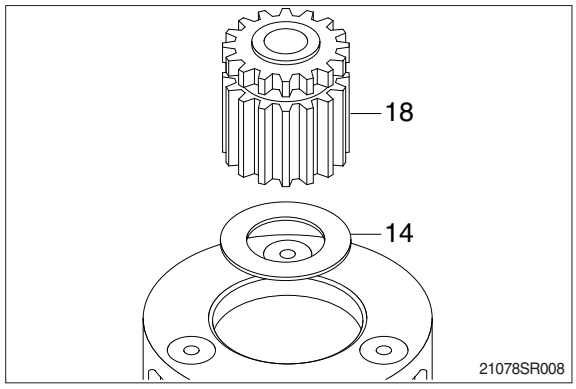
(6) Tighten two M10 eye bolts to carrier1 (19) and lift up and remove carrier1 (19) as subassembly.



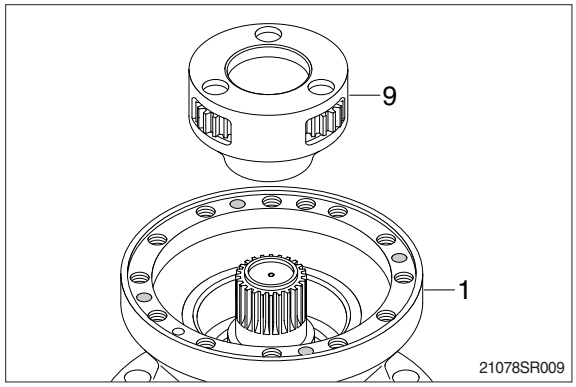
(7) Disassembling carrier1 (19) assembly.
① Remove stop ring (38).
② Remove side plate2 (39), planet gear1 (24), needle cage (22), side plate1 (20) and side plate3 (26) from the carrier.
③ Using M8 solid drill, crush spring pin (17) so that the pin1 (21) can be removed by hammering.
④ Remove side plate3 (26) from carrier1 (19).
※ Do not reuse spring pin (17).
※ Do not remove pin1 (21), carrier1 (19) and spring pin (17) but in case of replacement.
※ Put matching marks on the planet gear1 (24) and the pin1 (21) for easy reassembly.



(8) Remove sun gear2 (18) and thrust washer (14).



(9) Remove carrier2 (9) assembly from casing (1).



(10) Disassembling carrier2 (9) assembly

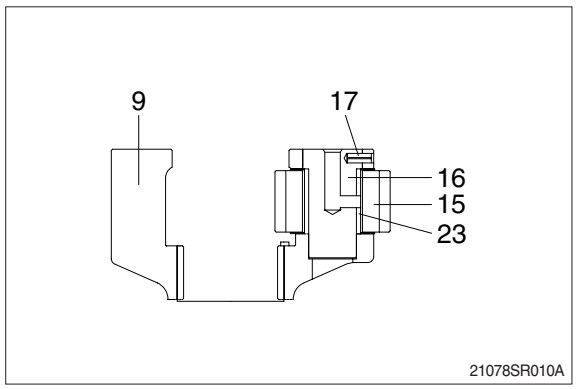
① Using M8 solid drill, crush spring pin (17) so that the pin & bushing (16) can be removed.

※ Do not reuse spring pin (17).

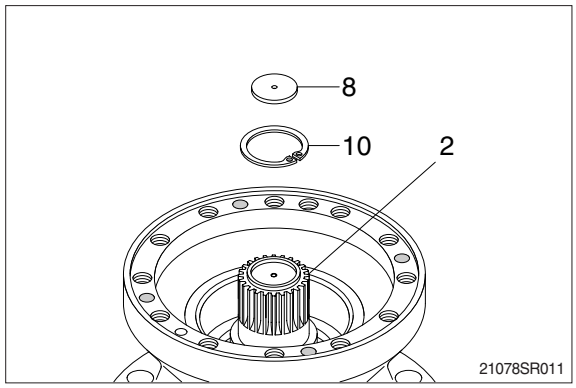
② Remove pin & bushing (16), planet gear2 (15) and bushing2 (23) from the carrier2 (9).

※ Put matching marks on the planet gear2 (15) and the pin & bushing (16) for easy reassembly.

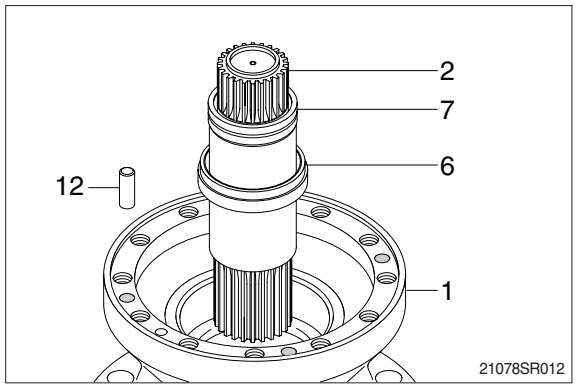
※ Do not disassemble pin & bushing (16), carrier2 (9) and spring pin (17) but in case of replacement.



(11) Remove thrust plate (8) and stop ring (10) from the drive shaft (2).

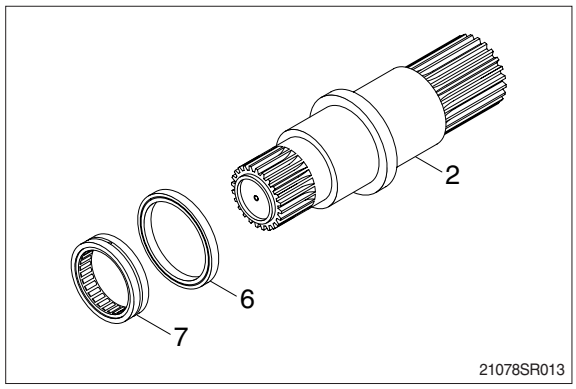


(12) Remove drive shaft (2) with roller bearing (7) and oil seal (6) assembled.
Remove knock pin (12) from the casing (1).

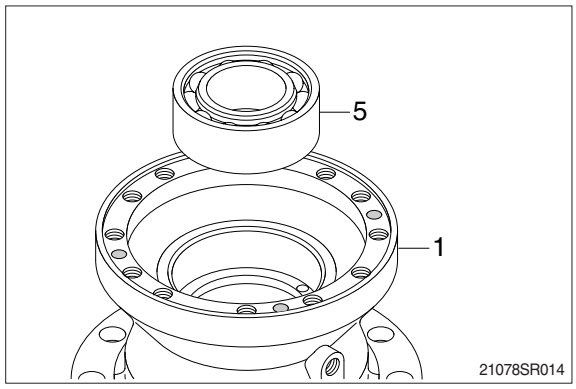


(13) Remove roller bearing (7) and oil seal (6) from the drive shaft (2).

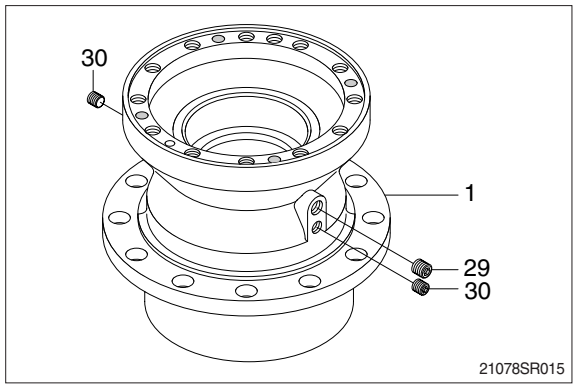
※ Do not reuse oil seal (6) once removed.



(14) Using the bearing disassembly tool, remove roller bearing (5).

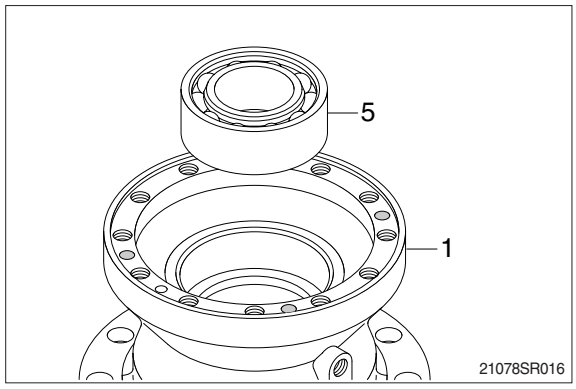


(15) Remove plugs (29, 30) from the casing (1).

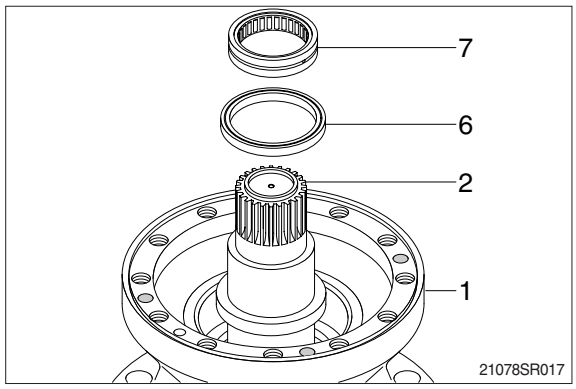


3) ASSEMBLY

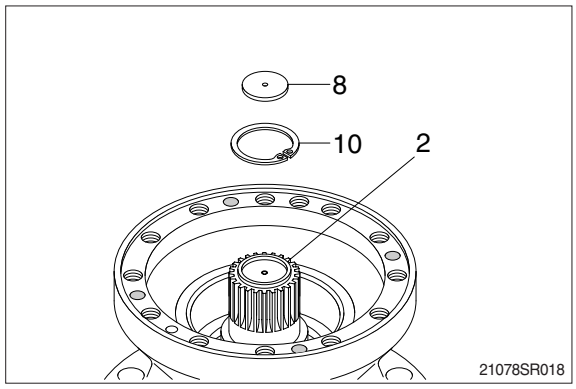
(1) Assemble roller bearing (5) inside the casing (1).



(2) Assemble the drive shaft (2) into the casing (1) and then install oil seal (6) and roller bearing (7).



(3) Install stop ring (10) and thrust plate (8) on top of drive shaft (2).



(4) Assembling carrier2 (9) assembly.

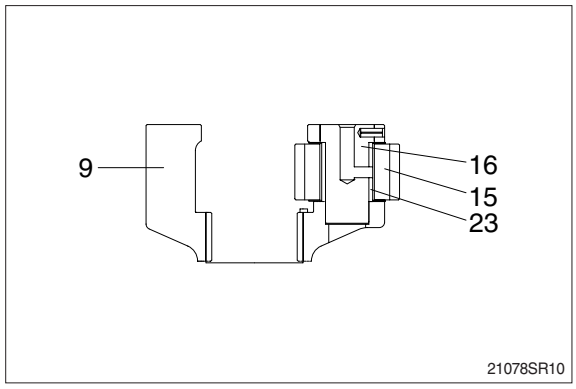
① Install thrust washer (14) inside the carrier2 (9).

② Install bushing2 (23) inside the planet gear2 (15) and then assemble them to the carrier2 (9).

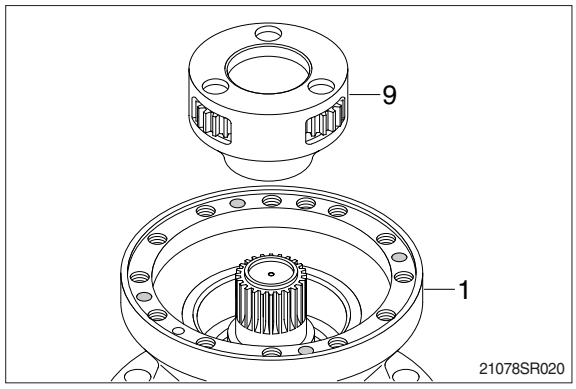
③ Assemble the pin & bushing (16) to the carrier2 (9) and then press the spring pin (17) by hammering.

④ Punch 2 points of the spring pin (17) lip.

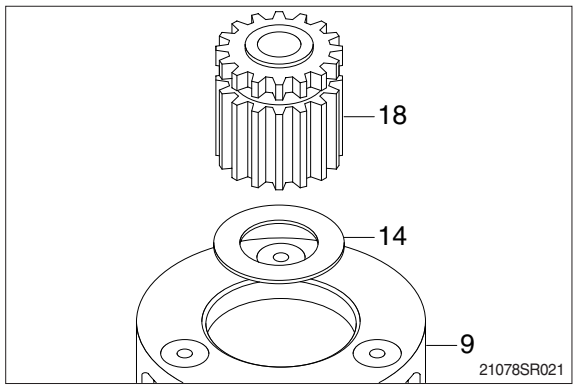
※ Take care not to mistake the matching marks of each part.



(5) Assemble carrier2 (9) assembly correctly to the drive shaft (2).



(6) Assemble sun gear2 (18) and thrust washer (14) to the center of the carrier2 (9) assembly.



(7) Assembling carrier1 (19) assembly.

① Assemble the pin1 (21) to the carrier1 (19) and then press the spring pin (17) by hammering.

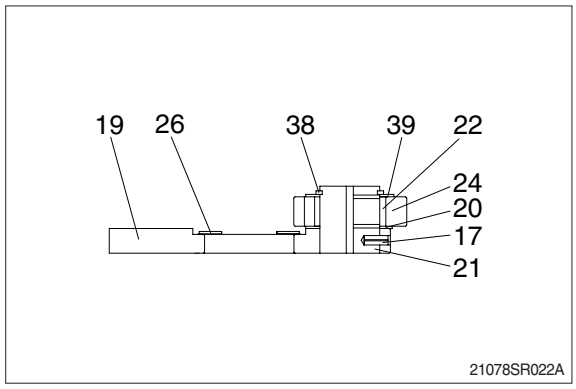
② Punch 2 points of the spring pin's (17) lip.

③ Install side plate3 (26) onto the center of carrier1 (19).

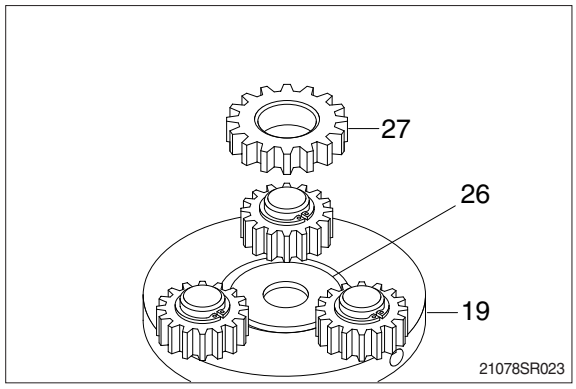
④ Install needle cage (22) into the planet gear1 (24).

⑤ Assemble side plate (20), planet gear1 (24), side plate2 (39) and then stop ring (38) to the pin1 (21).

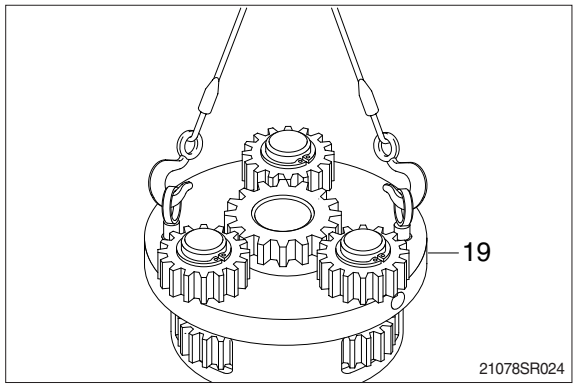
※ Take care not to mistake the matching marks of each part.



(8) Install sun gear1 (27) onto the side plate3 (26).



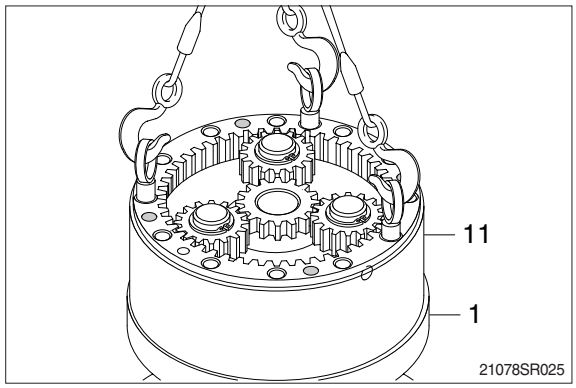
(9) Assemble carrier 1 (19) assembly onto the carrier2 assembly.



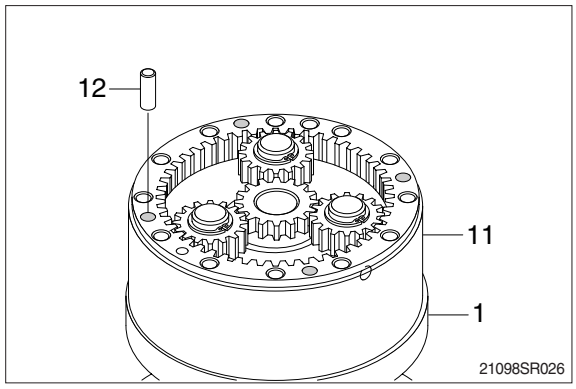
(10) Apply loctite to the tapped holes of casing (1).

(11) Tighten 3 M16 eye bolts to the ring gear (11) and lift up and then assemble it onto the casing (1).

※ Don't fail to coincide the knock pin (12) holes.



(12) Hammer 4 knock pins (12) around the ring gear (11).

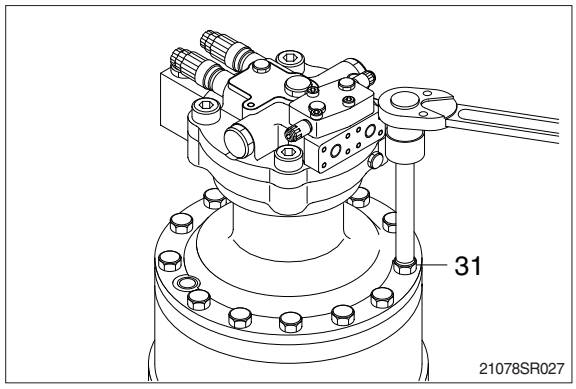


(13) Apply loctite to the tapped holes of the ring gear (11) and then mount swing motor onto the ring gear (11).

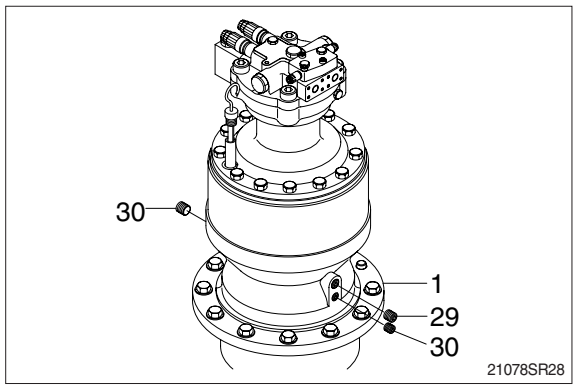
※ Don't fail to coincide the gauge bar (33) hole.

(14) Tighten socket bolts (31) around the swing motor assembly.

· Tightening torque : 24kgf · m (173lbf · ft)



(15) Assemble plugs (29, 30).



(16) Turn the swing motor assembly upside down and assemble cover plate (34) by tightening the hexagon bolts (35).

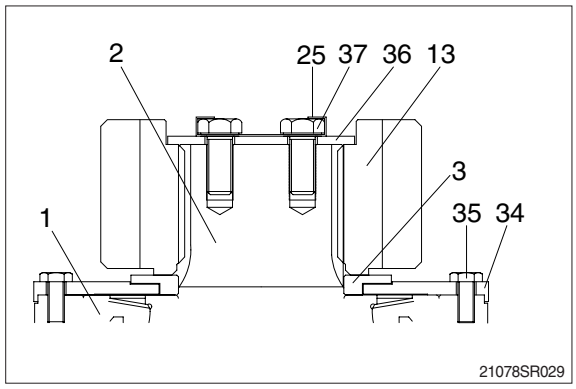
Install spacer (3) and pinion gear (13) to the drive shaft (2).

Assemble lock plate (36) on the pinion gear (13).

Assemble 2 lock washers (25) on the lock plate (36) with their 2 hole coincided individually to the tapped holes of drive shaft (2).

Tighten hexagon bolts (37) to the drive shaft (2) and then fold all the lock washer (25) corners over the hexagon bolts (37).

· Tightening torque : 24kgf · m (173lbf · ft)



(17) Inject oil into the reduction gear.

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.

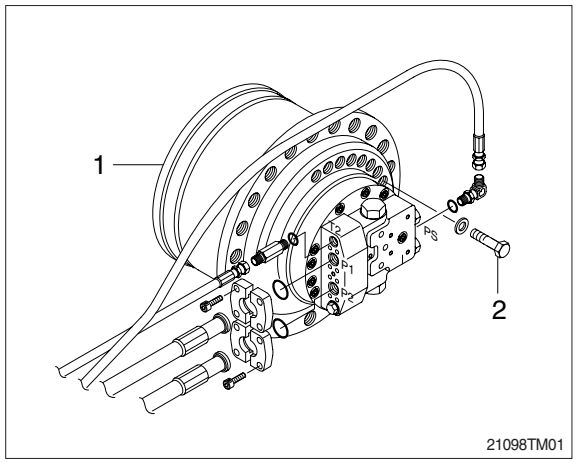
(6) Remove the hose.

※ 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 : 300 kg (660 lb)



2) INSTALL

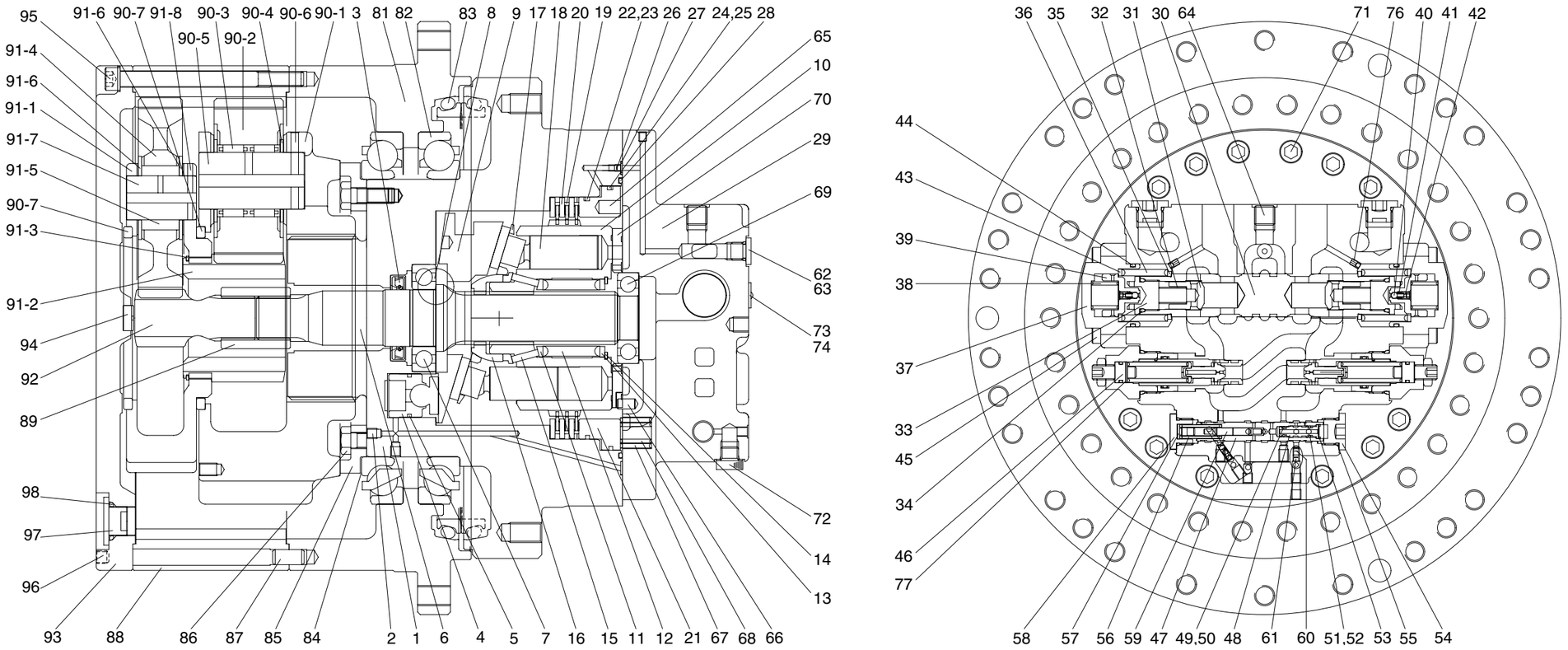
(1) Carry out installation in the reverse order to removal.

(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

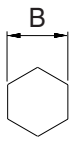


21092TM02

1	Shaft casing	20	Plate	39	Spool	58	Plug	76	Orifice	90-7	Thrust ring
2	Plug	21	Parking piston	40	Steel ball	59	Spool	77	Shim	91	Carrier assy No.1
3	Oil seal	22	O-ring	41	Spring	60	Orifice	81	Housing	91-1	Carrier No.1
4	Swash piston	23	Back up ring	42	Plug	61	Orifice	82	Main bearing	91-2	Sun-gear No.2
5	Piston ring	24	O-ring	43	Spring seat	62	Plug	83	Floating seal	91-3	Retaining ring
6	Shaft	25	Back up ring	44	O-ring	63	O-ring	84	Shim	91-4	Planetary gear No.1
7	Bearing	26	Orifice	45	Wrench bolt	64	Plug	85	Retainer	91-5	Needle bearing No.1
8	Steel ball	27	O-ring	46	Relief valve assy	65	Pin	86	Hex head bolt	91-6	Thrust washer
9	Swash plate	28	O-ring	47	Spool	66	Pin	87	Parallel pin	91-7	Pin No.1
10	Cylinder block	29	Rear cover	48	Guide	67	Spring	88	Ring gear	91-8	Spring pin
11	Spring seat	30	Spool	49	O-ring	68	Spring	89	Coupling	92	Sun gear No.1
12	Spring	31	Check	50	Back up ring	69	Bearing	90	Carrier assy No.2	93	Cover
13	End plate	32	Spring	51	O-ring	70	Valve plate	90-1	Carrier No.2	94	Pad
14	Snap ring	33	Plug	52	Back up ring	71	Wrench bolt	90-2	Planetary gear No.2	95	Hex socket head bolt
15	Pin	34	O-ring	53	Snap ring	72	Plug	90-3	Needle bearing No.2	96	Hex socket Screw
16	Ball guide	35	Spring seat	54	plug	73	Name plate	90-4	Thrust washer	97	Hydraulic plug
17	Set plate	36	Spring	55	O-ring	74	Rivet	90-5	Pin No.2	98	O-ring
18	Piston assy	37	Cover	56	Spring	75	Seal kit	90-6	Spring pin	99	Name plate
19	Friction plate	38	Spring	57	Spring seat						

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name		Remark	
Allen wrench		2.5, 4, 6, 10	
Socket for socket wrench, spanner	Socket	8, 14, 24, 27	
Torque wrench		Capable of tightening with the specified torques	
Pliers		-	
Plastic and iron hammer		Wooden hammer allowed. Normal 1 or so	
Monkey wrench		-	
Oil seal inserting jig		-	
Bearing pliers		-	
Seal tape		-	
Eye bolt		M10, M12, M14	
Press (0.5 ton)		-	
Oil stone		-	
Bearing assembling jig		-	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Plug	2	NPT 1/16	1±0.1	7.2±0.7
Orifice	26	M5	0.7±0.1	5±0.7
Wrench bolt	45	M12×40	10±1.0	72±7.0
Relief valve	46	HEX 27	18±1.0	130±7.0
Plug	54	PF 1/2	8.5±1.0	61±7.0
Plug	58	HEX 24	5±1.0	36±7.0
Plug	62	PF 1/4	5±1.0	36±7.0
Wrench bolt	71	M12×35	10±1.0	72±7.0
Hex head bolt	-	M12×25	11±1.5	79±10
Hex socket head bolt	-	M12×155	11±1.5	79±10
Hex socket head plug	-	PF 3/4	19±1	137±7.0

3. OUTLINE OF DISASSEMBLING

1) GENERAL SUGGESTIONS

(1) Select a clean place for dismantling.
Spread a rubber plate on a working table in order to prohibit the damage of parts.

(2) Clean a deceleration equipment and a motor part, washing out dirt and unnecessary substances.

(3) Without any damage of O-ring, oil seal, the adhered surface of other seals, a gear, a pin, the adhered surface of other bearings, and the surface of moisturized copper, treat each parts.

(4) Numbers written in the parenthesis, ( ), next to the name of a part represent the part numbers of a cross-sectional view annexed with a drawing.

(5) The side of a pipe in a motor can be written as a rear side; the side of out-put as a front side.

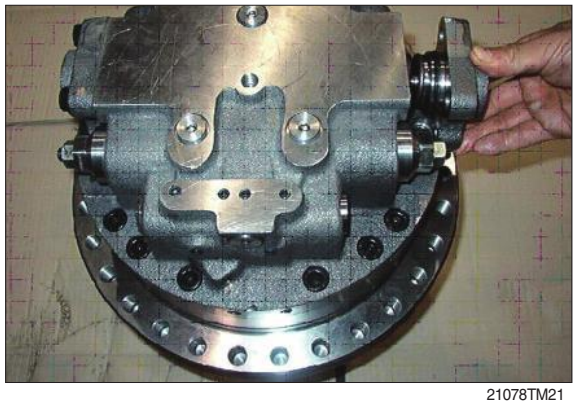
(6) Using and combining a liquid gasket, both sides must be dried completely before spraying a liquid gasket.

(7) In case of bonding bolts, combine a standard torque by torque wrench after spraying loctite 262 on the tab parts. (It can be dealt as assembling NPTF screws and an acceleration equipment.)

3.1 DISASSEMBLING

1) Unloosing wrench bolt and disassemble cover (37).

※ Wrench bolt = M12×40L-8EA
(purchasing goods)

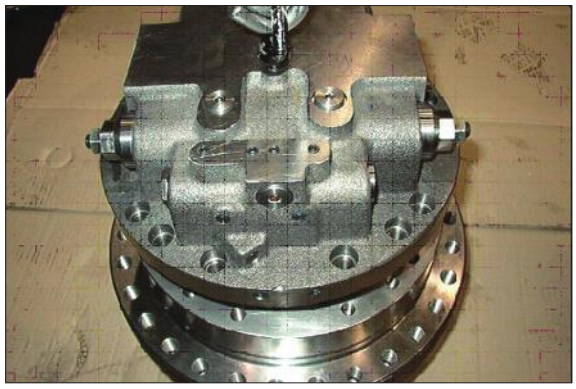


21078TM21

2) Disassemble parts related to C.B.V.

21078TM22

3) Unloosing wrench bolt (M12×35L, 16EA) and disassemble rear cover assembly from motor assembly.



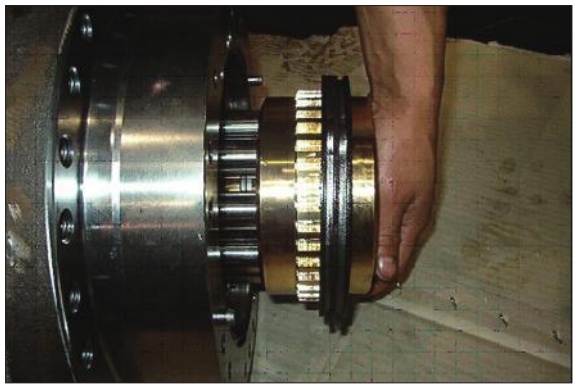
21078TM23

21078TM24

4) Dismantle packing piston (21) using compressed air.

21078TM25

5) Disassembly rotary kit from motor assembly (cylinder block assembly, piston assembly, ball guide, set plate, friction plate, steel plate...)



21078TM26

6) Using a jig, disassemble swash plate (9) from shaft casing.

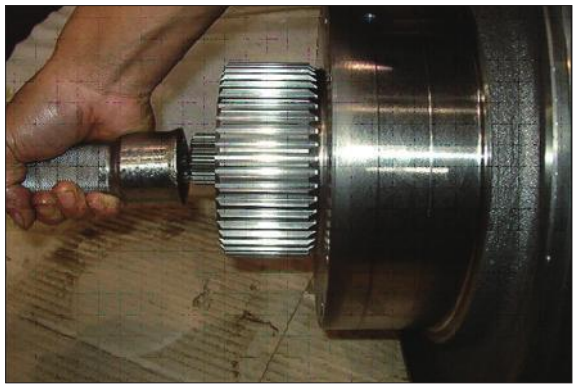
21078TM27

7) Using compressed air, disassemble piston swash (4) piston ring (5), respectively.

21078TM28

21078TM29

8) Using a hammer, disassemble shaft (6) from shaft casing (1).



21078TM30

■ **Disassemble cylinder sub.**

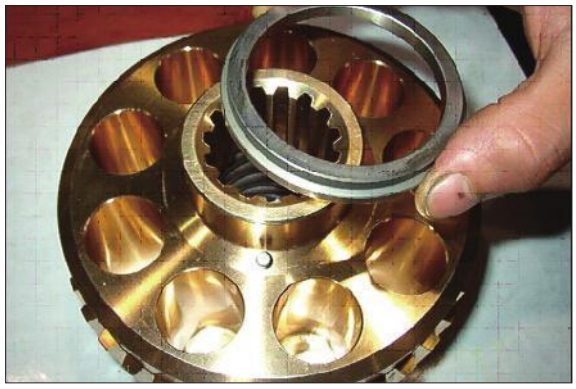
9) Disassemble cylinder block assembly, piston assembly (9) and seat plate (M).

21078TM31

21078TM32

10) Disassemble ball guide (16), ring and pin (15) from cylinder block, respectively.

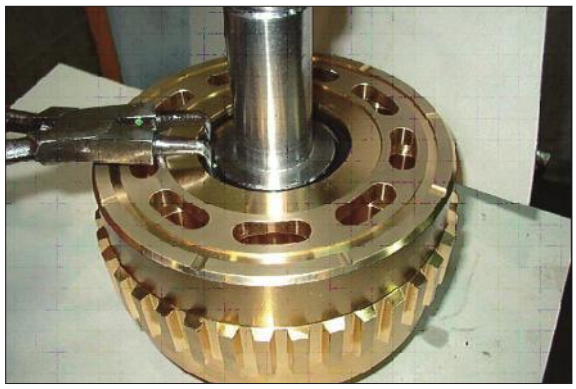
21078TM33



21078TM34

21078TM35

11) Pushing spring (12) by an assembling jig, disassemble snap ring (14), spring seat (13), spring (12) and spring seat (11), respectively.

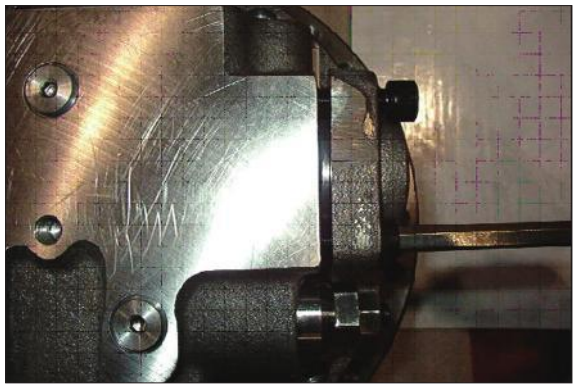


21078TM36

21078TM37

■ **Disassemble valve casing sub.**

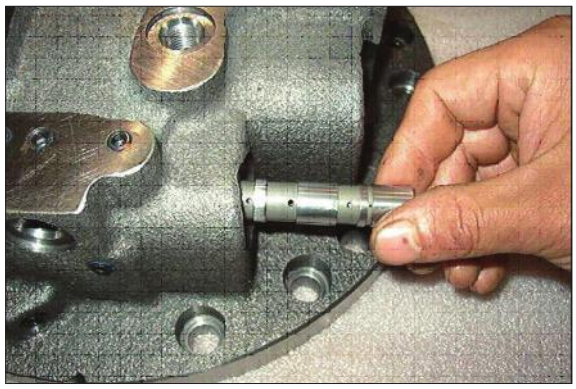
12) Using an hexagon wrench, unloosing wrench bolt (45) and disassemble cover (37), spring (38), spool (39), spring seat (43), spring (36) and spring seat (35), respectively.
(Same balance on both sides)



21078TM38

21078TM39

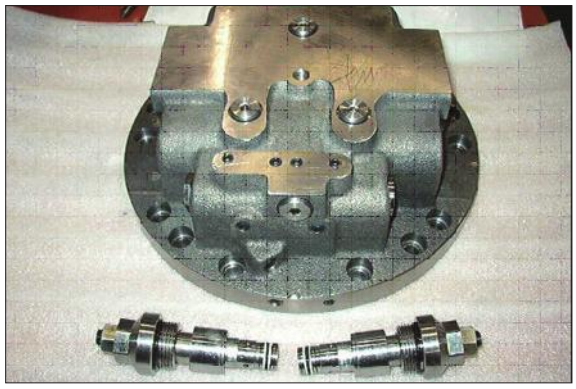
13) Disassemble spool (59), spool (47), O-ring (51), guide (48) and snap ring (53) on rear cover, respectively.



21078TM40

21078TM41

14) Using a torque wrench, disassemble relief assembly (46) on rear cover.



21078TM42

4. OUTLINE FOR ASSEMBLING

1) GENERAL SUGGESTIONS

(1) After washing each parts cleanly, dry it with compressed air.
Provided that you do not wash friction plate with treated oil.

(2) In bonding each part, fasten bond torque.

(3) When using a hammer, do not forget to use a plastic hammer.

4.1 ASSEMBLING

■ **Assemble the sub of turning axis**

1) Using a jig, assemble oil seal (3) into shaft casing (1)

21078TM43

2) Have a bearing (8) thermal reacted into shaft (6).

21078TM44

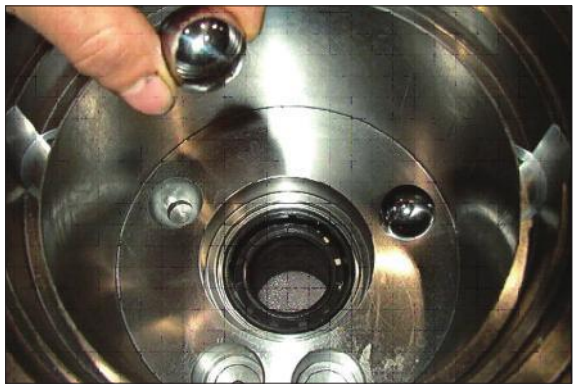
21078TM45

21078TM46

3) Using a jig, assemble shaft assembly into shaft casing (1).

21078TM47

4) After spreading grease on steel ball (8) assemble into shaft casing (1).

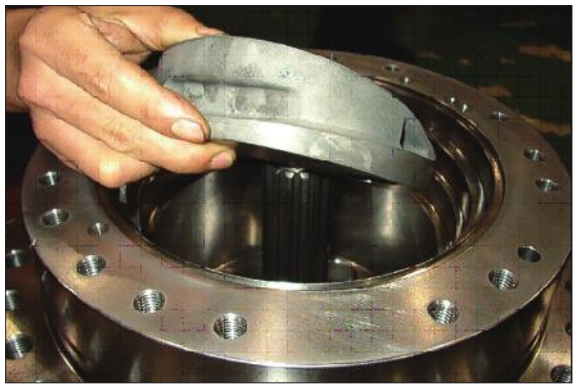


21078TM48

5) Assemble swash piston assembly (4, 5) into shaft casing (1).

21078TM49

6) Assemble swash plate (9) into shaft casing (1).

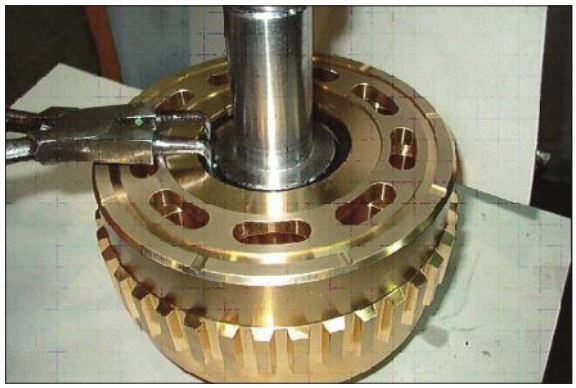


21078TM50

■ **Assemble cylinder block sub.**

7) Assemble spring seat (13), spring (12), spring seat (11) into cylinder block (10) respectively, pushing spring (12) using by a jig, assemble snap ring (14) with a snap ring (14).

21078TM51

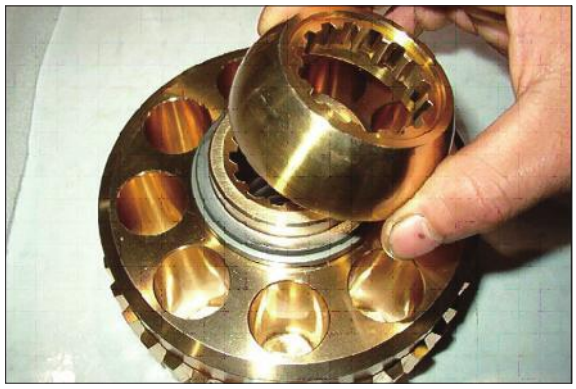


21078TM52

8) Assemble ring, pin (15) on cylinder block (10) ball guide (16) respectively.

21078TM53

21078TM54



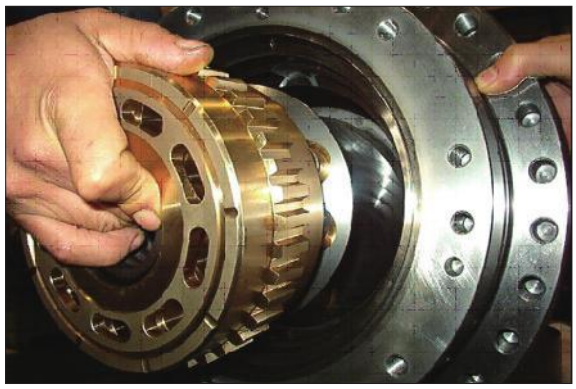
21078TM55

9) Assemble cylinder block assembly, piston assembly (9), seat plate (17).

21078TM56

21078TM57

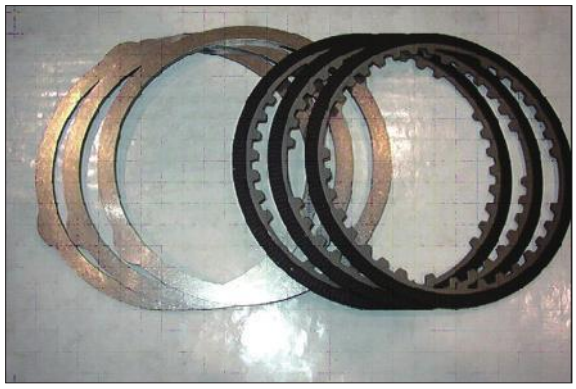
10) Assemble cylinder block assembly (9) into shaft casing (1).



21078TM58

11) Assemble friction plate (19) and plate (20) into shaft casing (1) respectively, prepare 6 set.

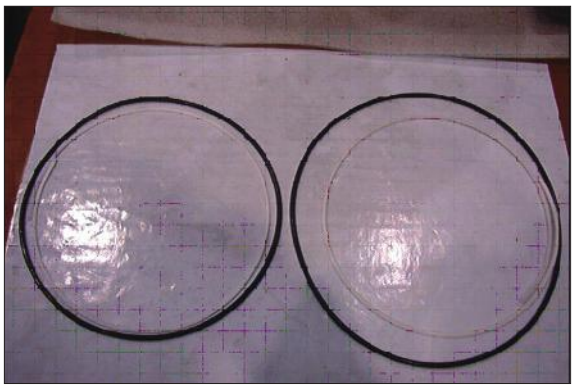
21078TM59



21078TM59-1

12) Assemble O-ring (22, 23) into packing piston (21).

21078TM60



21078TM60-1

13) After spreading grease on packing piston (21) bond wrench bolt and assemble shaft casing (1).

21078TM61

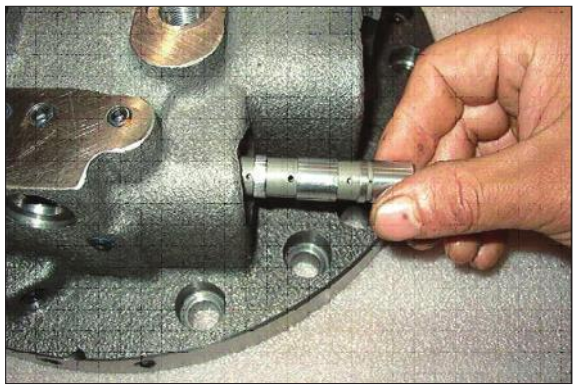
■ **Assemble rear cover sub.**

14) Using a jig, assemble bearing (69) into rear cover (29).

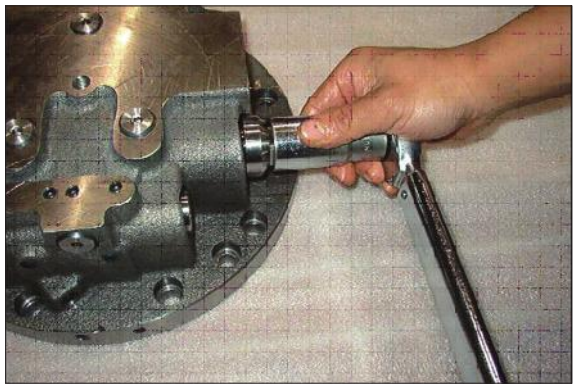
21078TM62

15) After assembling spool (59), spool (47), O-ring (51), guide (48) and snap ring (53) respectively into rear cover (29).
Using torque wrench, assemble it.

21078TM63



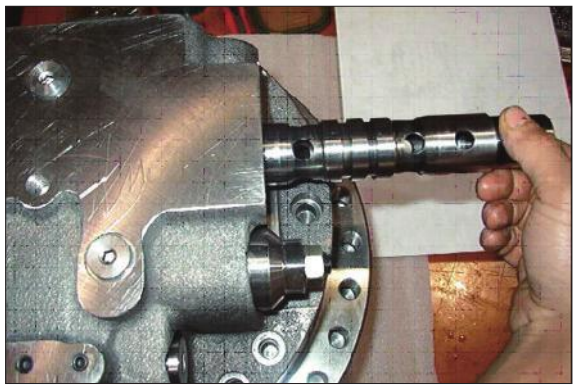
21078TM64



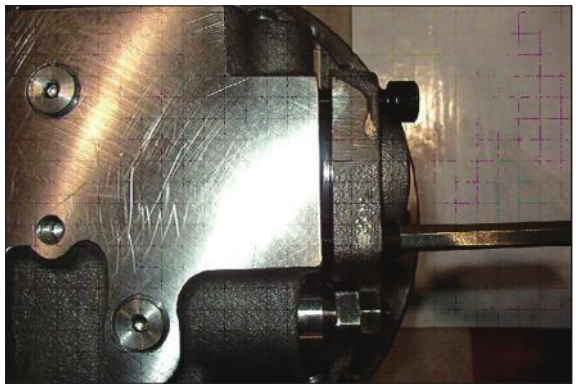
21078TM65

16) Assemble spring seat (35), spring (36), spring seat (43), spool (39), spring (38), cover (37) respectively and assemble wrench bolt (45).
(Same balance on both sides)

21078TM66



21078TM67



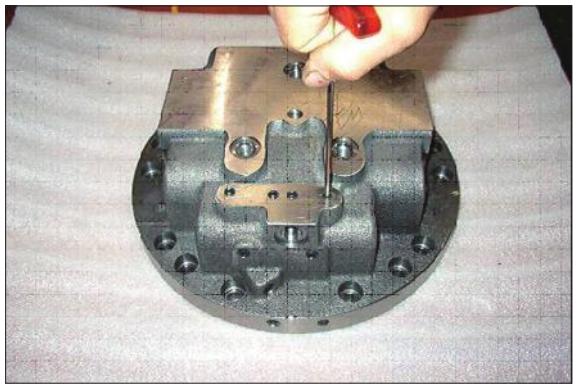
21078TM67-1

17) Assemble plug (2).

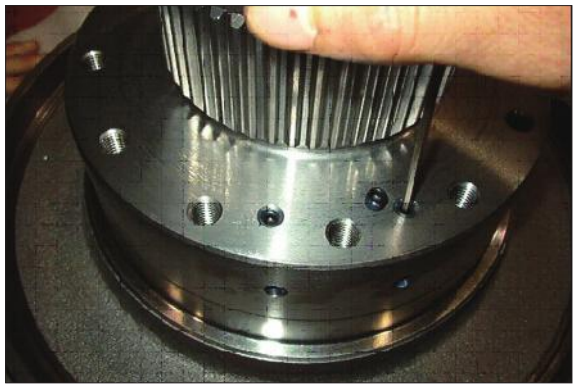
※ Plug (NPT1/16) - 11EA

21078TM68

21078TM69



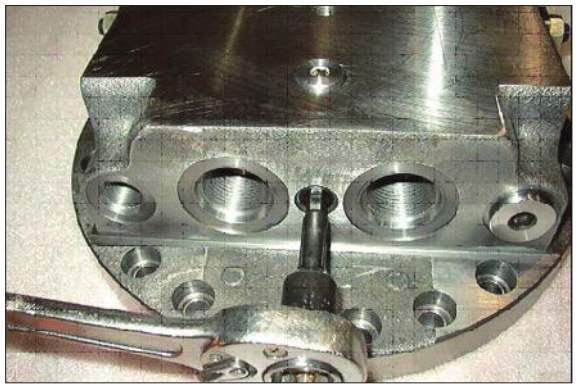
21078TM70



21078TM71

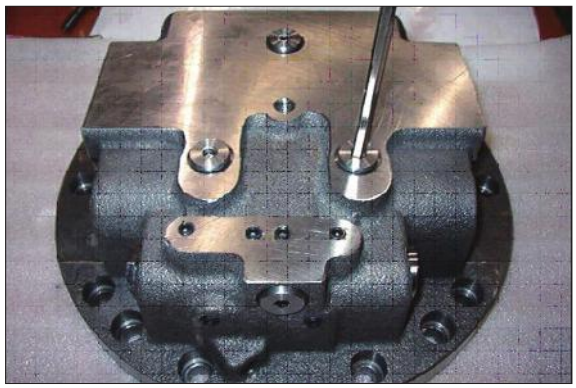
18) Assemble plug (64).

※ Plug (PT3/8) - 11EA

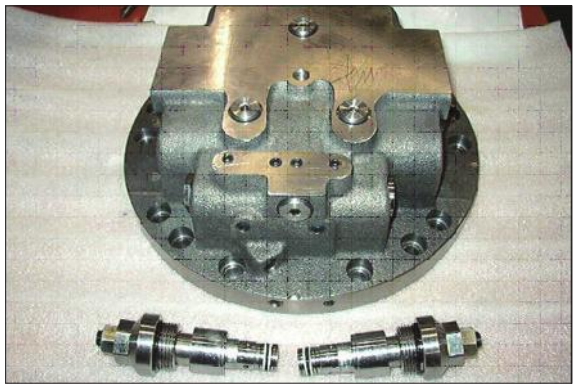


21078TM72

19) Assemble plug (62, 63) into rear cover (29) and assemble relief valve assembly.



21078TM73



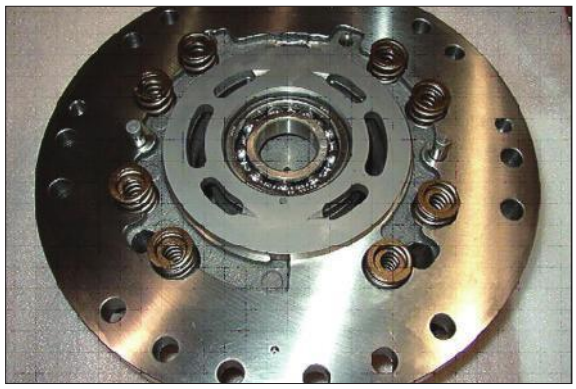
21078TM74

20) Put spring (67, 68) together into rear cover (29), prepare 6 set.

21078TM75

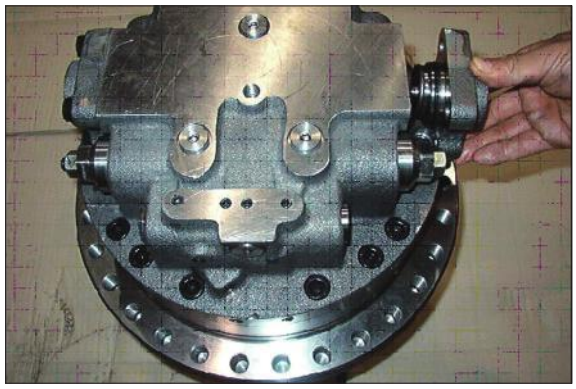
21078TM76

21) Assemble valve plate (70) into rear cover (29).



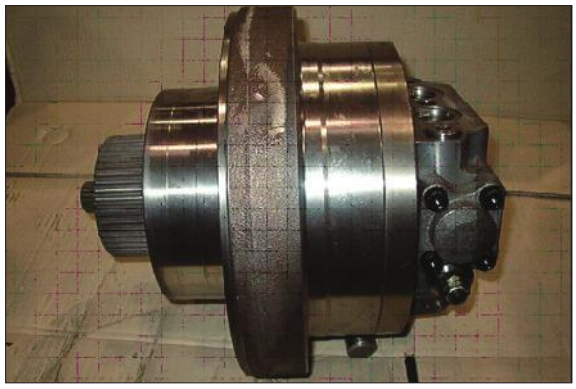
21078TM77

22) After assembling shaft casing (1) and rear cover (29).
Assemble spool assembly (30), spring (38), spool (39), cover (37) after then complete assembly with wrench bolt (45).



21078TM78

23) Finish assembly.



21078TM79

5.1 DISASSEMBLING REDUCTION UNIT

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.

21078TM80

2) Setting reduction unit (or whole propelling unit) on work stand for disassembling

(1) Remove M12 hexagon socket head bolts (95) at 3 places from cover (93) almost equally apart each other, and then install M12×155L eye bolts.
Lift up the unit using them and place it on work stand with cover upward.

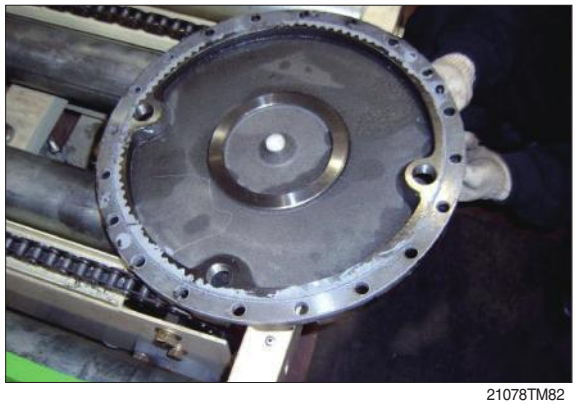
⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

21078TM81

3) Removing cover

(1) Remove the rest of M12 hexagon socket head bolts (95) that securing gear and housing. Loosen all the socket bolts and then, disassemble cover.

(2) As the cover (93) is adhered to ring gear (88), disassemble ring gear (88) and cover (93) vy lightly hammering slantwise upward using sharpen punch inserted between the cover and ring gear.



21078TM82

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.

21078TM83

(2) Remove No.1 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.

21078TM84

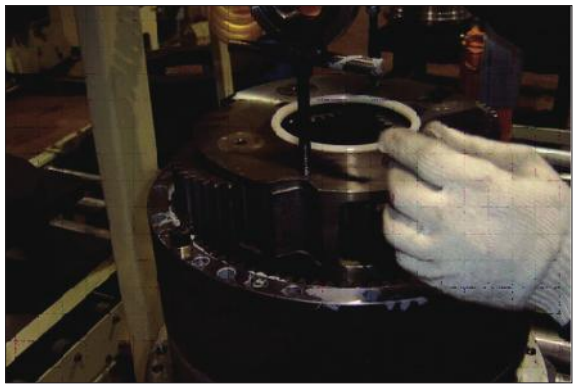
5) Removing No.2 carrier sub assembly

(1) Screw three M10 eye-bolt in No.2 carrier and lift up and remove No.2 carrier assy.

21078TM85

(2) Remove No.2 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.2 sun gear.



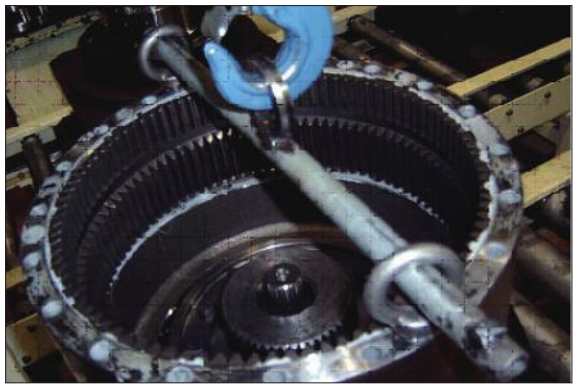
21078TM86

6) Removing ring gear

(1) As the ring gear (88) is adhered to housing (81), disassemble ring gear (88) and housing (81) by lightly hammering slantwise upward using sharpen punch inserted between the ring gear and housing.

※ Carefully disassembling ring gear not to make scratch on it.

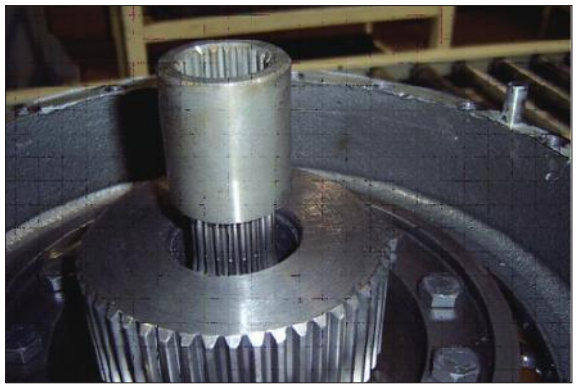
(2) Screw M14 eye-bolt in ring gear and lift up and remove it.



21078TM87

7) Removing coupling

(1) Remove coupling.



21078TM88

8) Removing retainer & shim

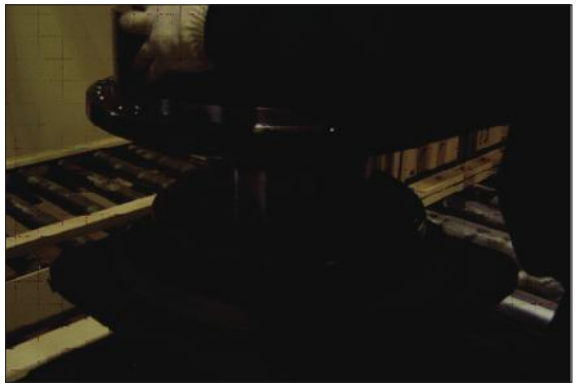
(1) Remove M12 hexagon socket head bolts that secure retainer and motor.

(2) Remove retainer & shim.

21078TM89

9) Removing housing sub assembly

(1) Screw M12 eye bolt in housing and lift up housing assembly including angular bearing and floating seal.



21078TM90

10) Removing floating seal

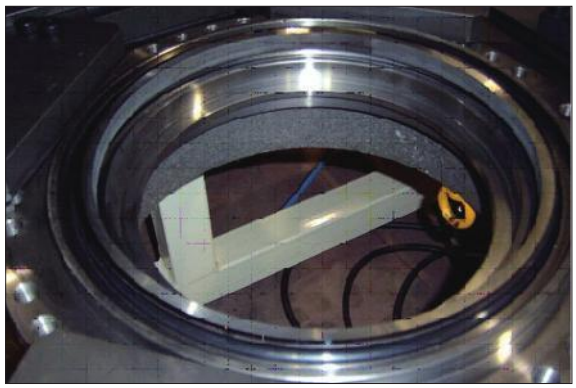
(1) Lift up a piece of floating seal of motor side.

21078TM91

11) Disassembling housing assembly

(1) After turning housing, lift up a piece of floating seal from housing and then remove it.

※ Don't disassemble angular bearing.



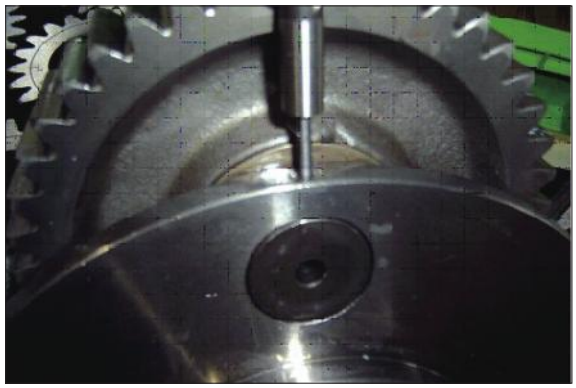
21078TM92

12) Disassembling No.1 carrier

(1) Remove thrust ring (90-7) from carrier.

(2) Knock spring pin (91-8) fully into No.1 pin (91-7).

(3) Remove planetary, thrust washer, No.1 pin, bearing from carrier.



21078TM93

21078TM94

21078TM95

13) Disassembling No.2 carrier

(1) Disassemble No.2 carriers, using the same method for No.1 carrier assembly.

21078TM96

21078TM97

6.1 ASSEMBLY REDUCTION GEAR

■ General notes

Clean every part by kerosene and dry them by air blow.
Surfaces to be applied by locktite must be decreased by solvent.
Check every part for any abnormals.
Each hexagon socket head bolt should be used with locktite No.
262 applied on its threads.
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.

Gears

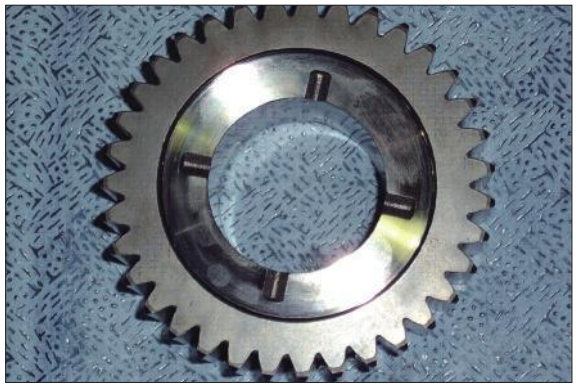
- Check if there are pitting or seizure on the tooth surface.
- Check if there are cracks on the root of tooth by die check.

Bearings

- Rotate by hand to see if there are something unusual such as noise or uneven rotation.

Floating seal

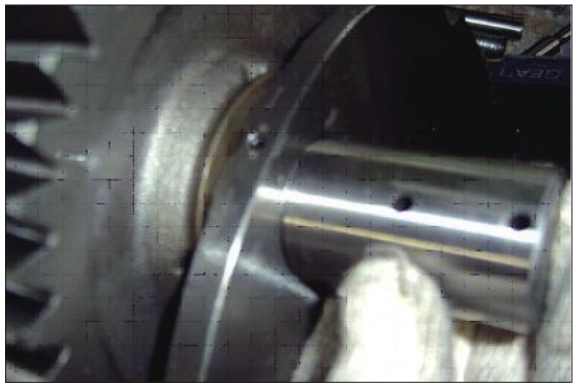
- Check flaw or score on sliding surfaces or O-ring.


21078TM98

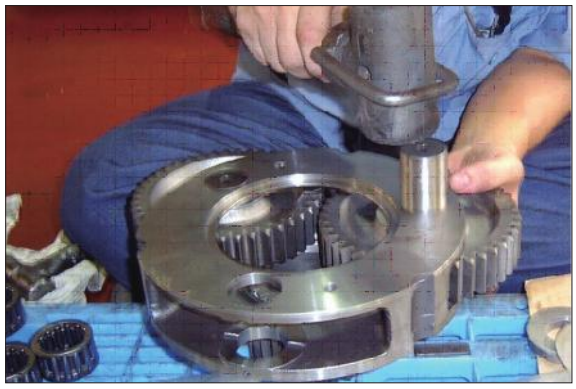
1) Assembling No.1 carrier

(1) Put No.1 carrier (91-1) on a flat place.

(2) Install No.1 needle bearing (91-5) into No.1 planetary gear (91-4), put 2EA of No.1 thrust washer (91-6) on both sides of bearing, and then, install it into carrier.


21078TM99

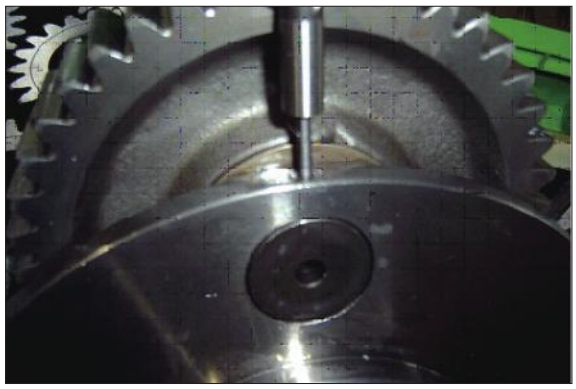
(3) Install No.1 pin (91-5) into No.1 carrier where the holes for No.1 pin (91-5) are to be in line with those of No.1 carrier, and then, install spring pins into the holes.



21078TM100

(4) Caulk carrier holes as shown on the picture.

(5) Assembly thrust ring (90-7) into carrier.

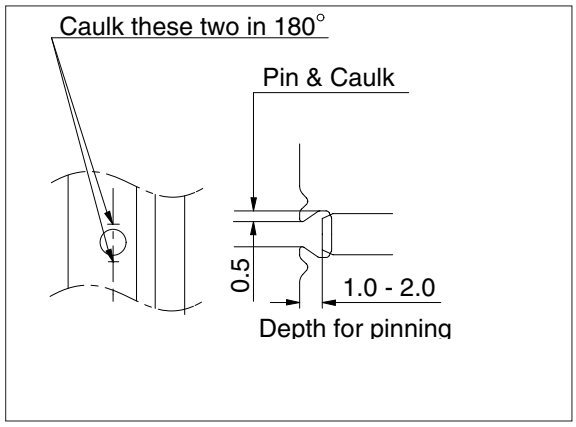


21078TM101

2) Assembling No.2 carrier

(1) Put No.2 carrier (90-1) on a flat place.

(2) Install No.2 needle bearing (90-3) into No.2 planetary gear (90-2), put 2EA of No.2 thrust washer (90-4) on both sides of bearing, and then, install it into carrier.



21078TM102

(3) Install No.2 pin (90-5) into No.2 carrier where the holes for No.2 pin (90-5) are to be in line with those of No.2 carrier, and then, install spring pins into the holes.

21078TM103

(4) Caulk carrier holes as shown on the picture.

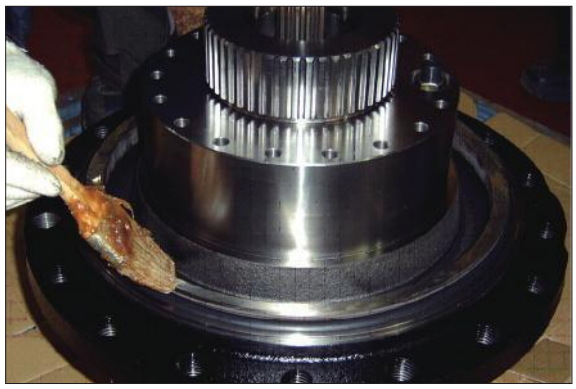
(5) Assembly thrust ring (90-7) into carrier.

21078TM104

3) Assembling floating seal (83) and main bearing (82)

(1) Assemble floating seal into motor by use of pressing jig. Grease the contact parts for floating seal which is assembled into motor.

(2) Heat bearing at 60~70˚C and then, put into the motor side.



21078TM105

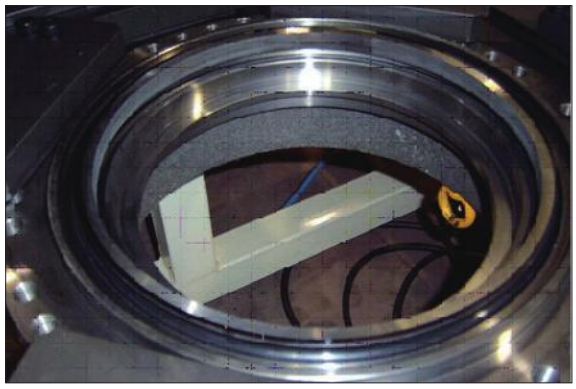
※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.

21078TM106

4) 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.

※ Be sure to maintain it vertical with the ground when assembling floating seal.



21078TM705

5) Installing housing assembly

(1) Install 2EA of M12 eye-bolt into housing assembly.

(2) Assemble housing into motor by use of hoist and eye-bolt.

※ Be sure to tighten eye-bolt deep enough.

21078TM108

6) Installing main bearing (82)

(1) Heat main bearing at 60~70° C and then, install.

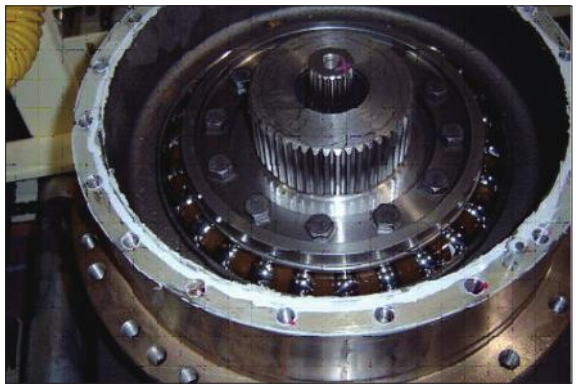
※ Be sure to maintain it vertical with the ground when assembling bearing.

21078TM109

7) Installing retainer (85) and shim (84)

(1) Measure clearance between main bearing and retainer by use of jig to decide the thickness of shim and select an appropriate shim, and then, assemble retainer.

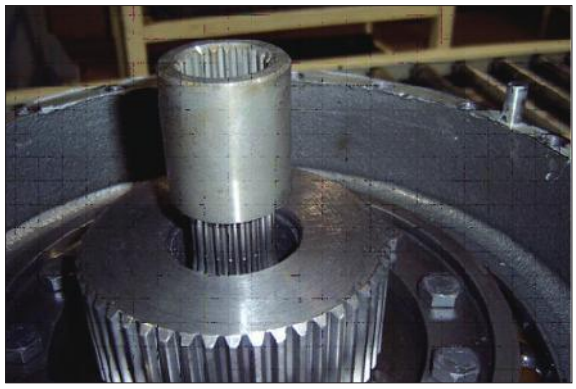
(2) Apply locktite (#262) on M12 hexagon head bolt, and then, bolt.



21078TM110

8) Installing coupling

(1) Install coupling on spline of the motor.



21078TM111

9) Installing ring gear

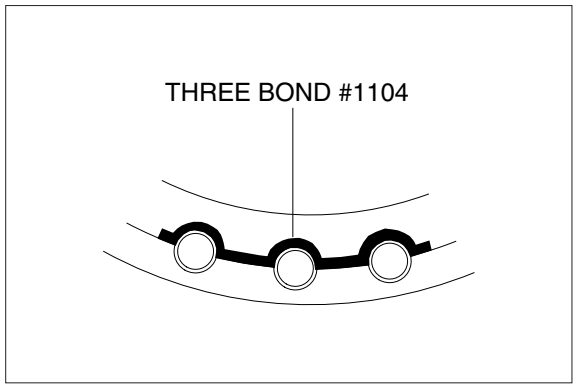
(1) Apply three bone #1104 (loctite #515) on housing for ring gear without gap.

(2) Insert lock pin into housing hole.

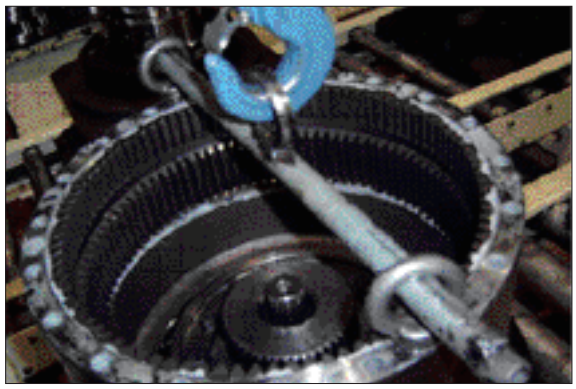
(3) Install M14 eye-bolt on the tap of ring gear.

(4) Lift ring gear and then, assemble into housing in order for hole of ring gear and parallel pin of housing to be in line.

(5) Temporarily secure 4EA of M12 hexagon socket bolt and shim with cover thickness having appropriate torque.



21078TM112A



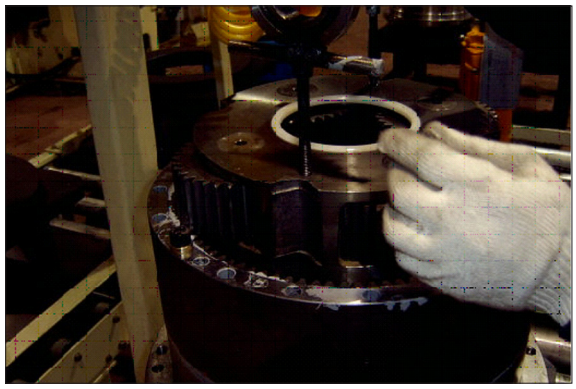
21078TM113

10) Installing 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.



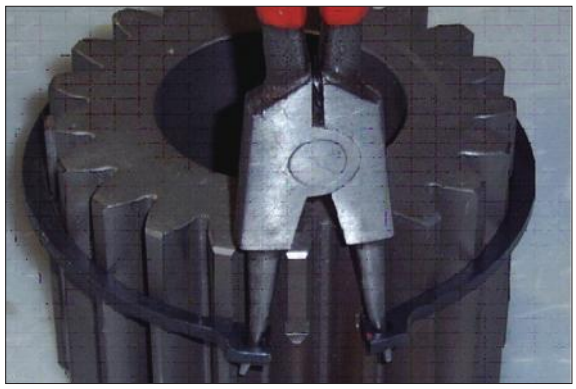
21078TM114

11) Installing No.2 sun gear (91-2)

(1) Install No.2 sun gear on the spline of No.2 carrier and No.2 planetary gear, matching teeth of them.

21078TM115

(2) Install No.2 sun gear on the spline of No.2 carrier and No.2 planetary gear, matching teeth of them.



21078TM116

12) Installing No.1 carrier sub assembly

(1) Install M10 eye-bolt on No.2 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.

21078TM117

13) Installing No.1 sun gear (92)

(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.

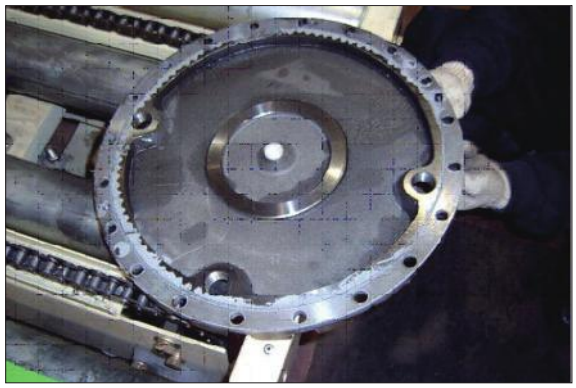
21078TM118

14) Installing cover (93)

(1) Beat pad (94) with plastic hammer, and press it into the center of cover.

(2) Apply three bond #1104 (loctite #515) on the ring gear for cover without gap.

(3) Put cover on ring gear, apply loctite (#262) on M12 hexagon socket head bolt, and then, bolt.



21078TM119

(4) Fill gear oil (5.8liter) into drain port.

(5) Apply gear oil on PF3/4 hydraulic plug (97) and then, bolt.

21078TM120

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.

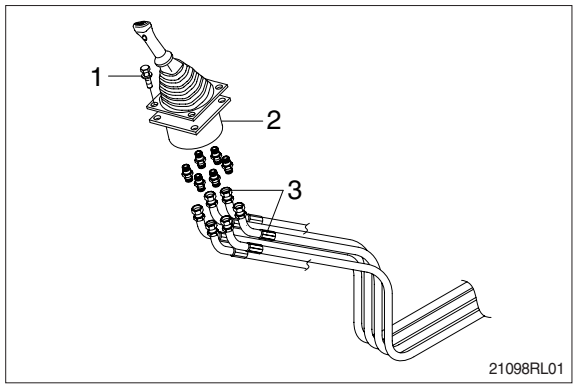
(4) Loosen the socket bolt (1).

(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.



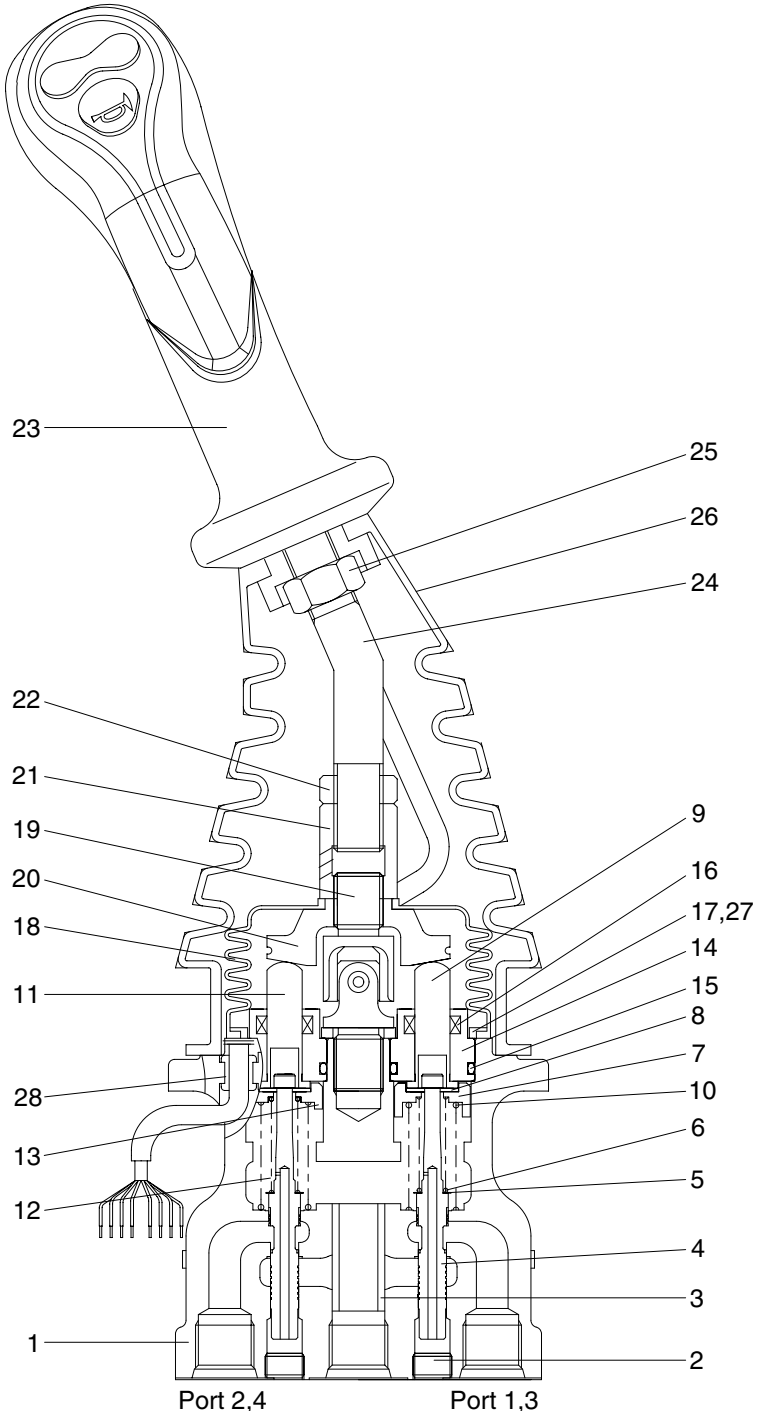
2) INSTALL

(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

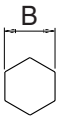


1409S2RL02

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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanner	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
Plug	2	PT 1/8	3.0	21.7
Joint	19	M14	3.5	25.3
Swash plate	20	M14	5.0±0.35	36.2±2.5
Adjusting nut	21	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

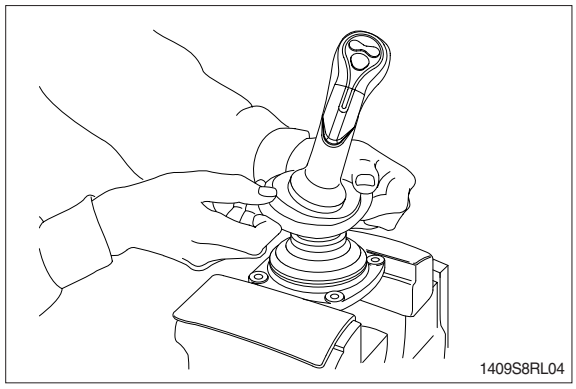
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

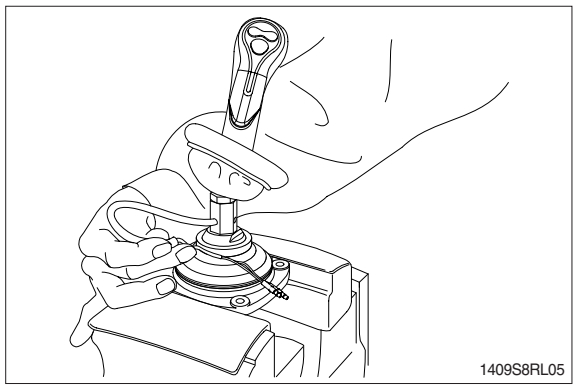
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper (or lead) sheets.

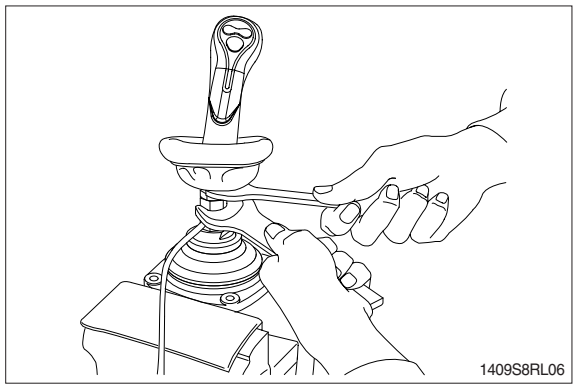
(3) Remove end of boot (26) from case (1) and take it out upwards.



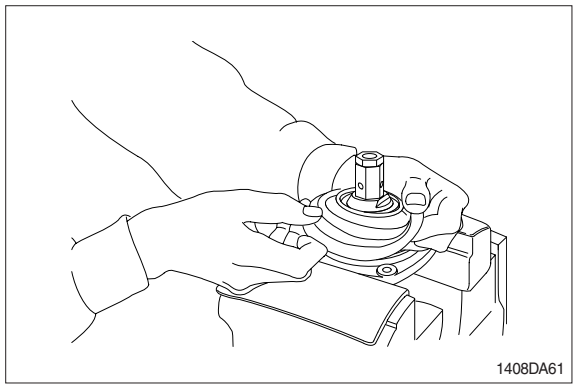
※ For valve with switch, remove cord also through hole of casing.



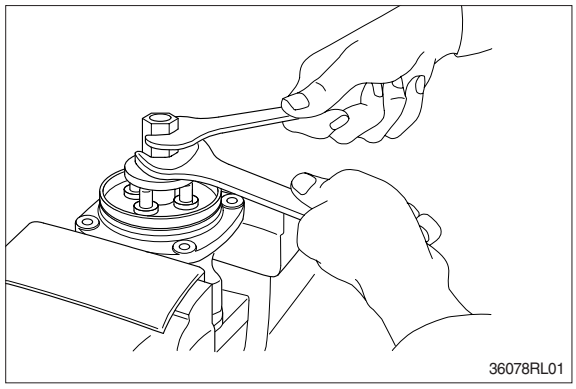
(4) Loosen lock nut (22) and adjusting nut (21) with spanners on them respectively, and take out handle section as one body.

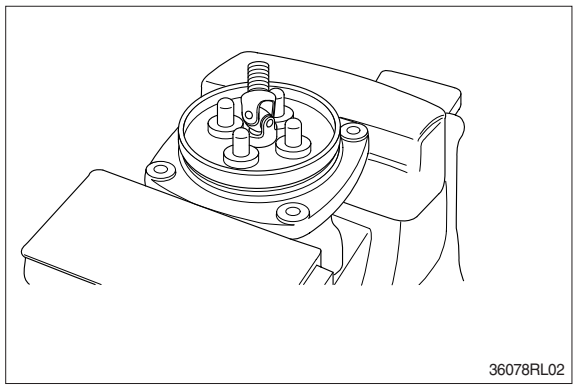


(5) Remove the boot (18).



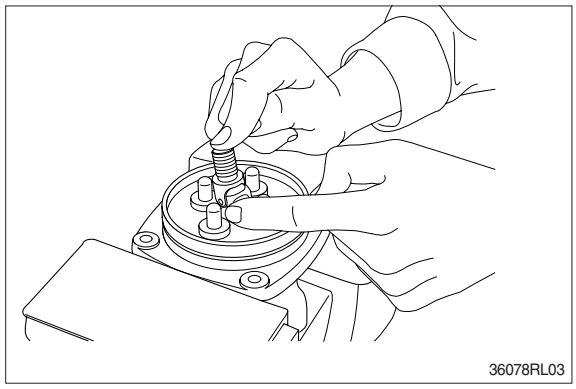
(6) Loosen adjusting nut (21) and swash plate (20) with spanners on them respectively, and remove them.

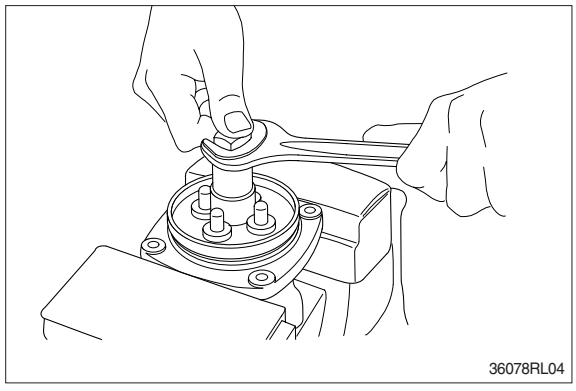




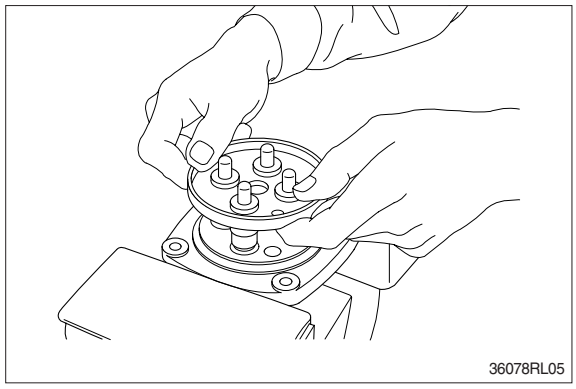
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (10) is strong in force, plate (17), plug (14) and push rod (11) will come up on loosening joint.
Pay attention to this.





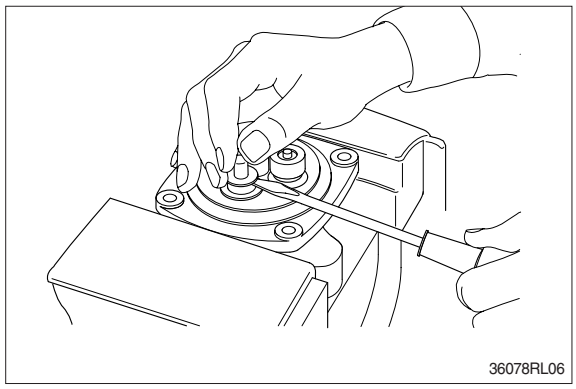
(8) Remove plate (17).



(9) When return spring (10) is weak in force, plug (14) stays in casing because of sliding resistance of O-ring.

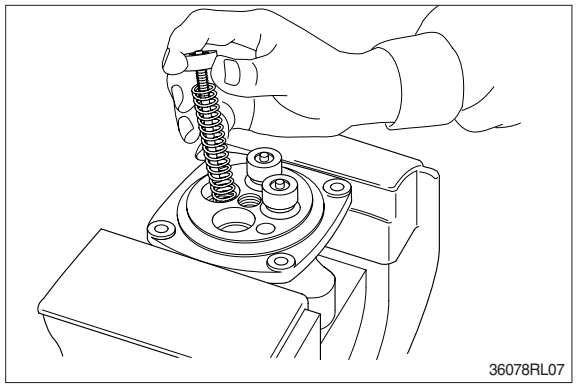
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (10) force.
Pay attention to this.

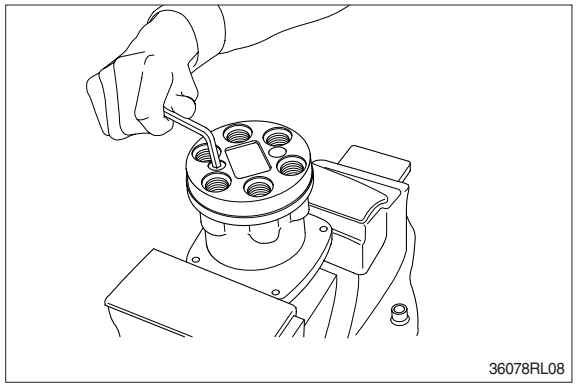


(10) Remove reducing valve subassembly and return spring (10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.

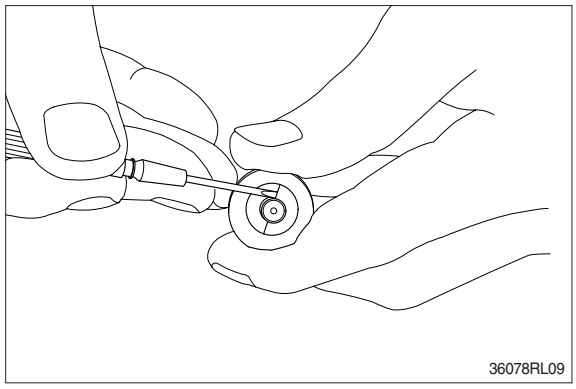


(12) For disassembling reducing valve section, stand it vertically with spool (4) bottom placed on flat workbench. Push down spring seat (7) and remove two pieces of semicircular stopper (8) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

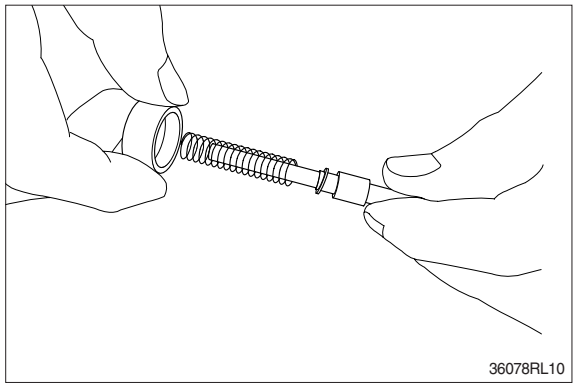
※ Record original position of spring seat (7).

※ Do not push down spring seat more than 6mm.

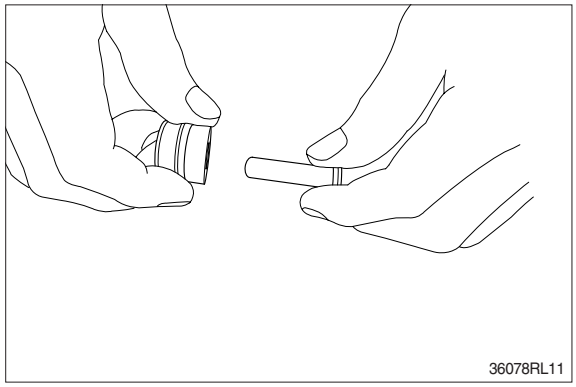


(13) Separate spool (4), spring seat (7), spring (6) and shim (5) individually.

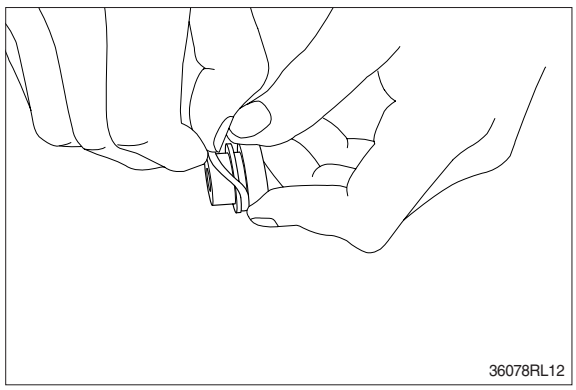
※ Until being assembled, they should be handled as one subassembly group.

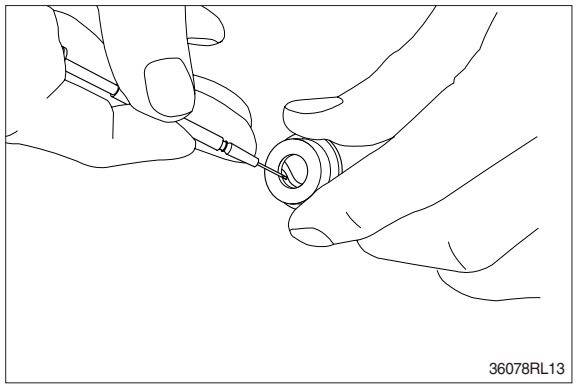


(14) Take push rod (11) out of plug (14).

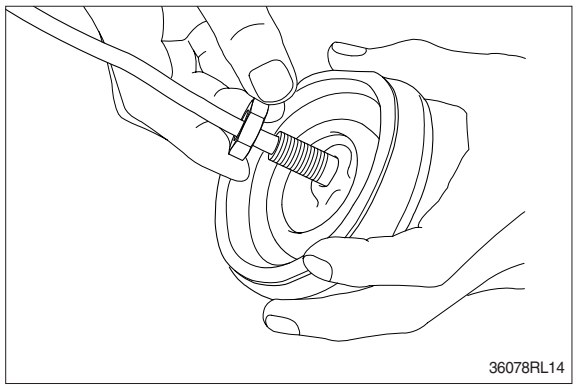


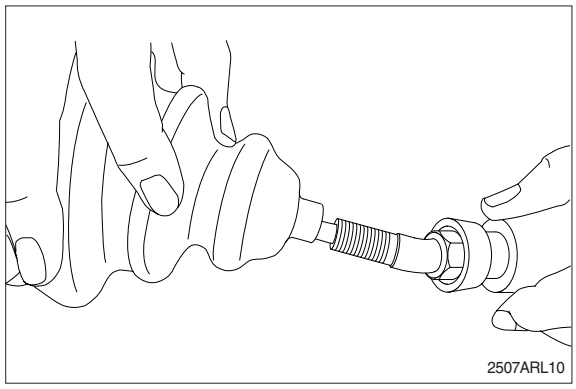
(15) Remove O-ring (15) and seal (16) from plug (14).
Use small minus screwdriver or so on to remove this seal.





(16) Remove lock nut (22) and then boot (26).





(16) 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.

(17) Rust prevention of parts

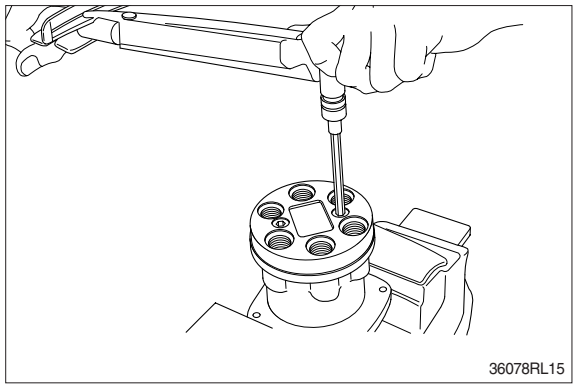
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

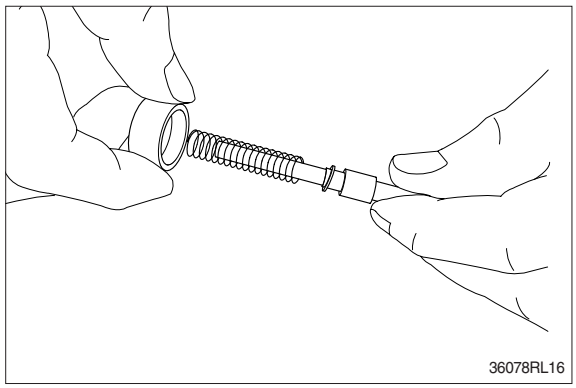
4) ASSEMBLY

(1) Tighten hexagon socket head plug (2) to the specified torque.

※ Tighten two bolts alternately and slowly.

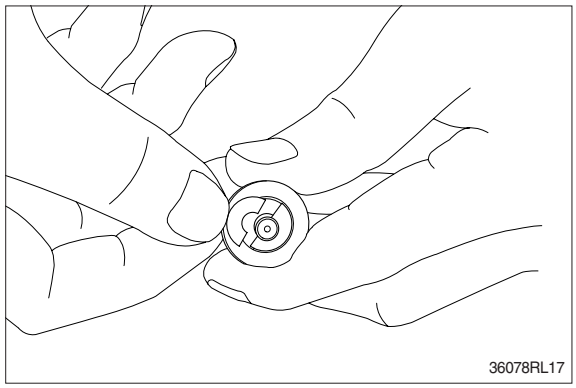


(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



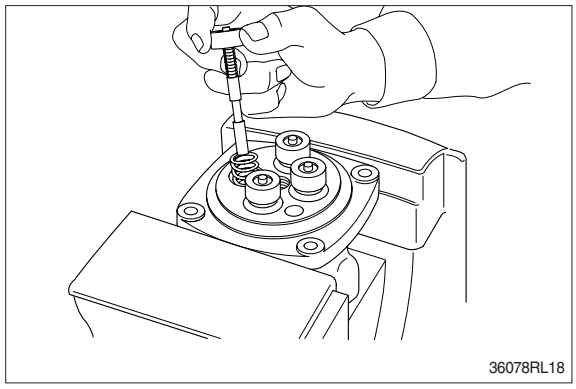
(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (8) on spring seat without piling them on.

※ Assemble stopper (8) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.

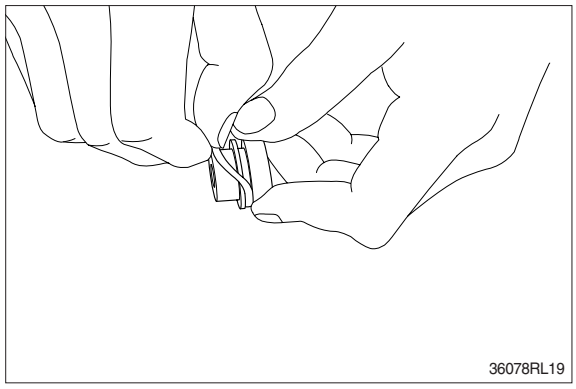


(4) Assemble spring (10) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

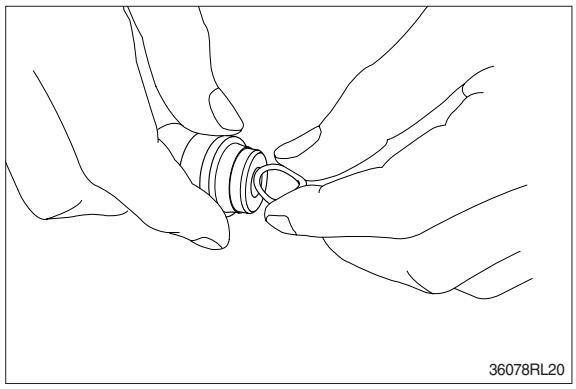


(5) Assemble O-ring (15) onto plug (14).



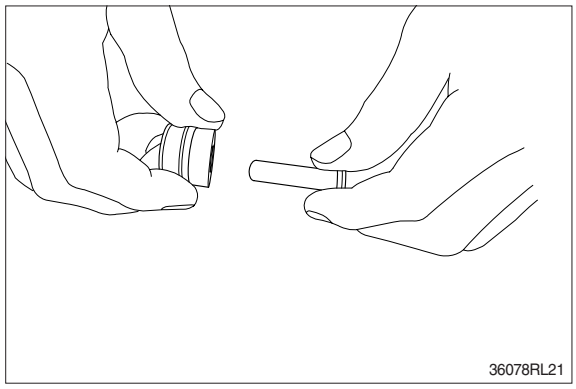
(6) Assemble seal (16) to plug (14).

※ Assemble seal in such lip direction as shown below.



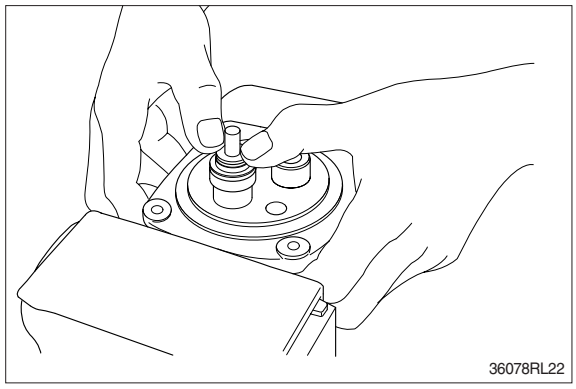
(7) Assemble push rod (11) to plug (14).

※ Apply working oil on push-rod surface.

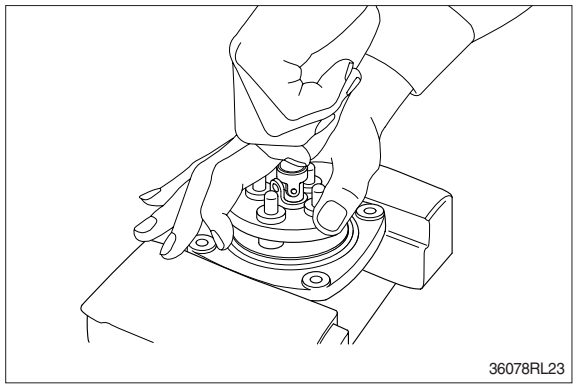


(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

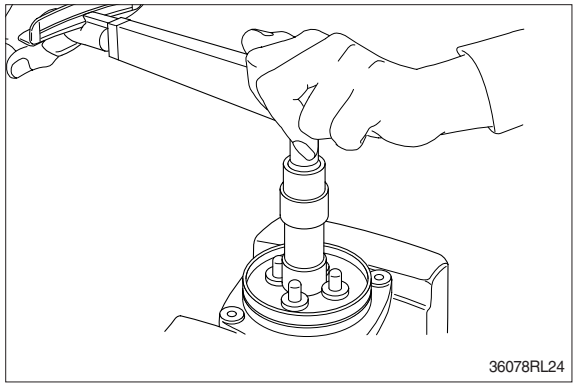


(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (17), and tighten joint (19) temporarily.



(10) Fit plate (17).

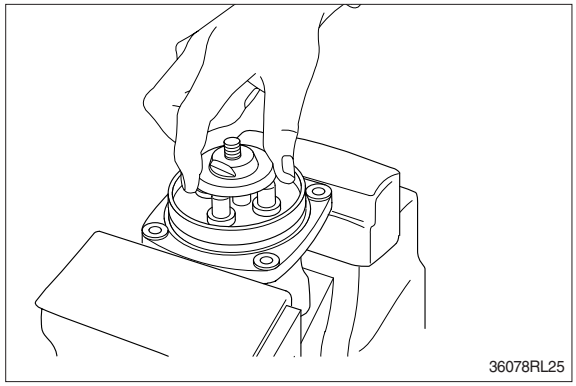
(11) Tighten joint (19) with the specified torque to casing, utilizing jig.



(12) Assemble swash plate (20) to joint (19).

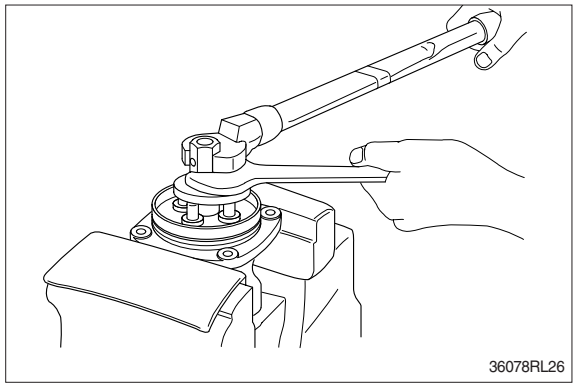
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

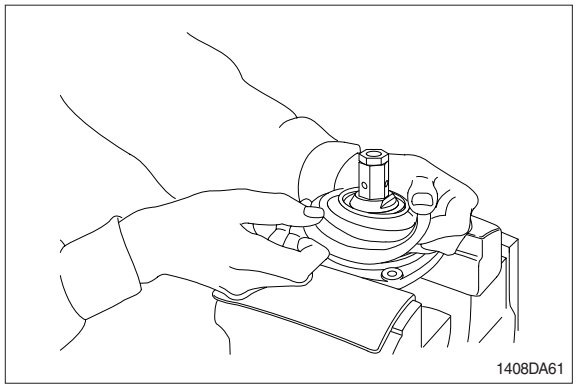


(13) Assemble adjusting nut (21), apply spanner to width across flat of plate (20) to fix it, and tighten adjusting nut to the specified torque.

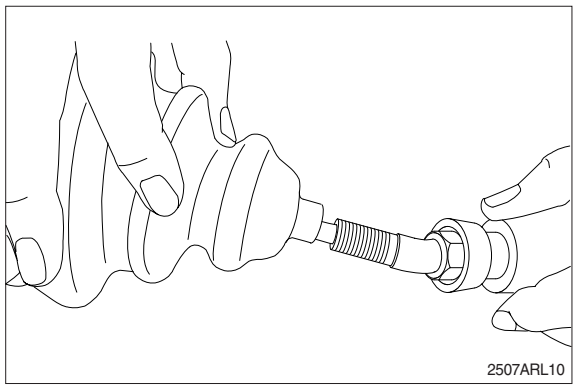
※ During tightening, do not change position of disk.

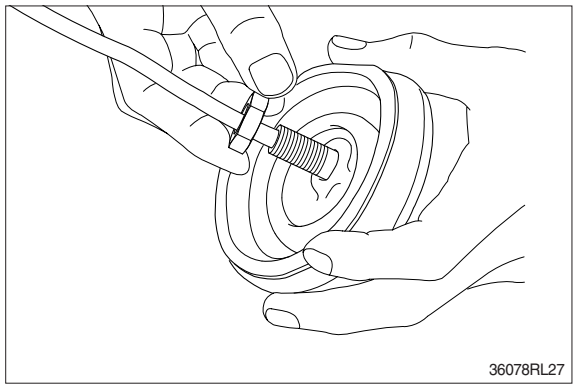


(14) Fit boot (18) to plate.

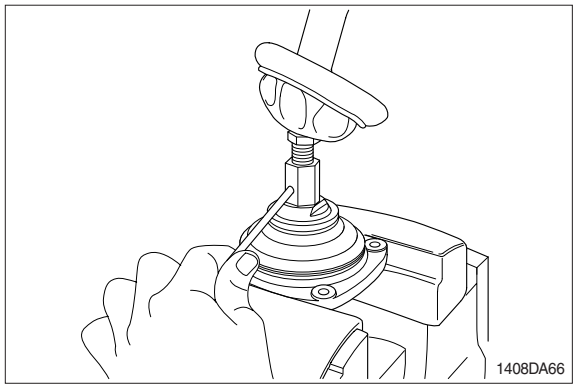


(15) Fit boot (26) and lock nut (22), and handle subassembly is assembled completely.



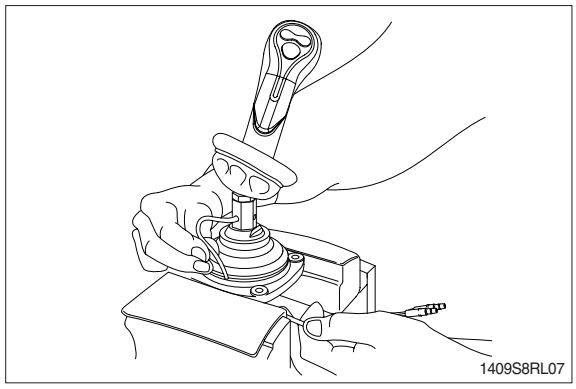


(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.

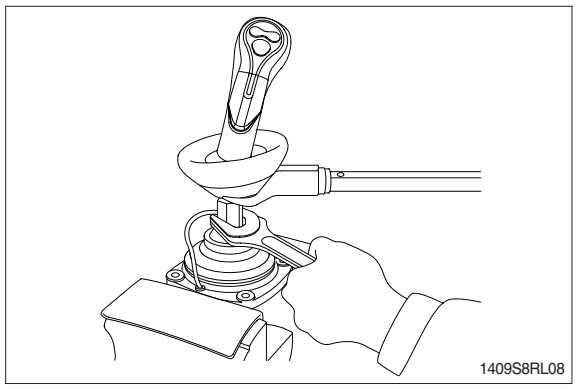


(17) Assemble bushing (28) to plate and pass cord and tube through it.

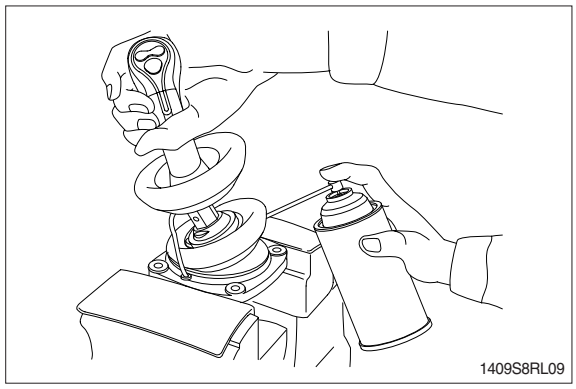
※ Provide margin necessary to operation.



(18) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

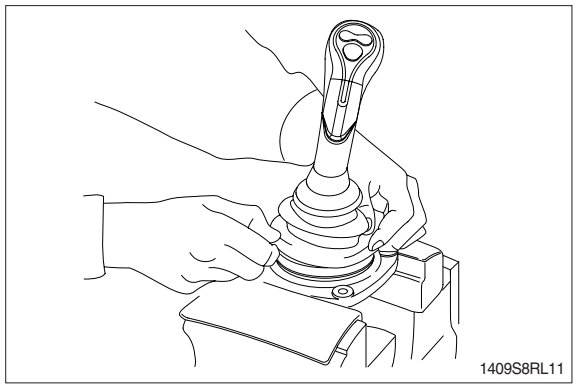


(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



1. REMOVAL AND INSTALL

1) REMOVAL

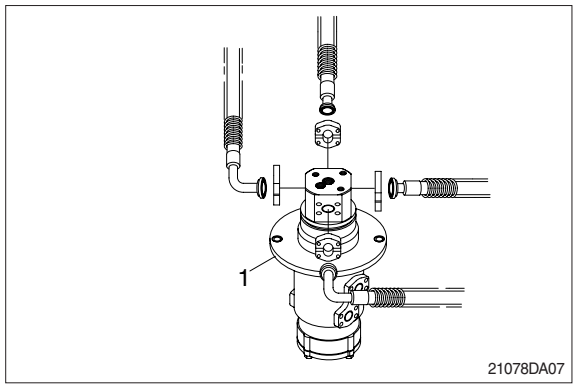
(1) Lower the work equipment to the ground and stop the engine.

(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.



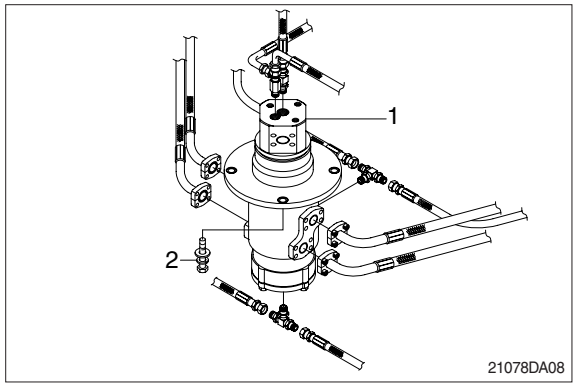
(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).
- Weight : 55 kg (120 lb)
- Tightening torque : 12.3± 1.3 kgf · m (88.9± 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.

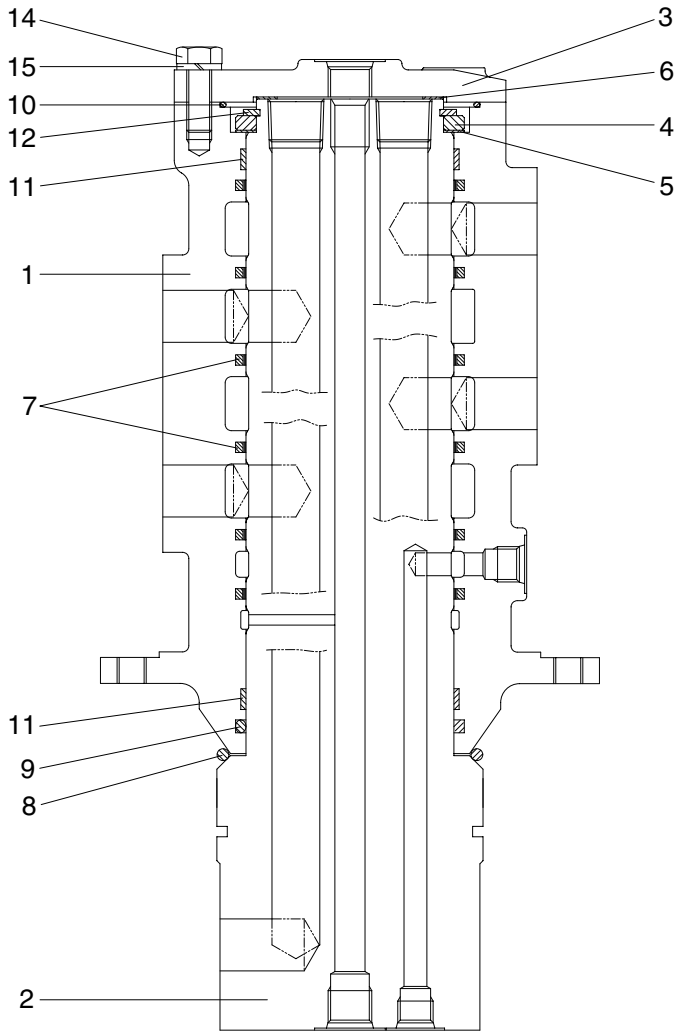
※ Take care of turning joint direction.

※ 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



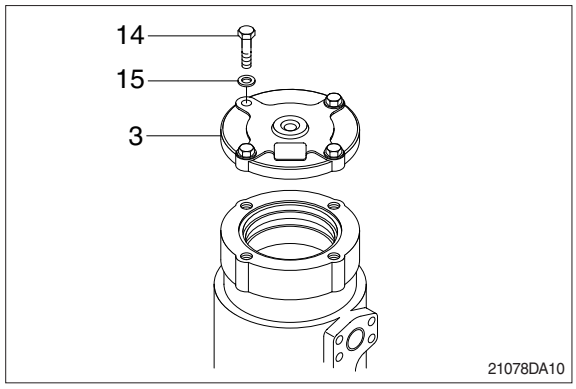
21098TJ01

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

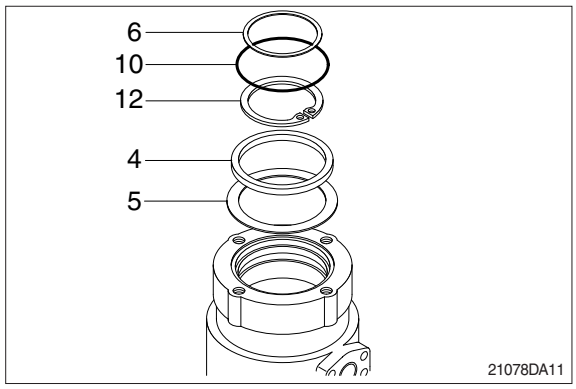
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

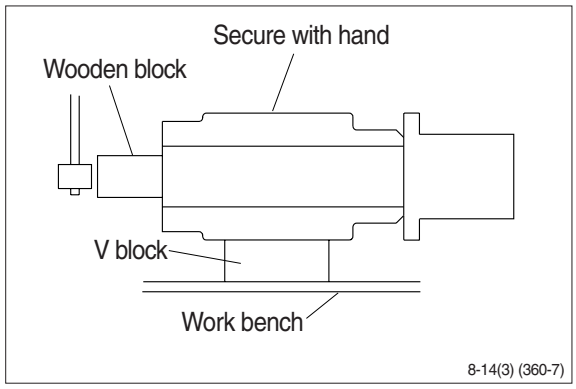
(3) Remove retainer ring (12), spacer (4) and shim (5).



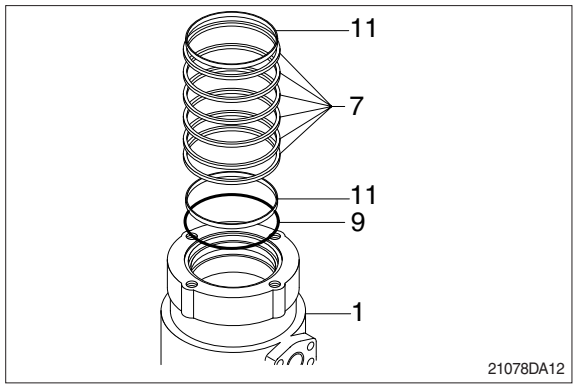
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ 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).

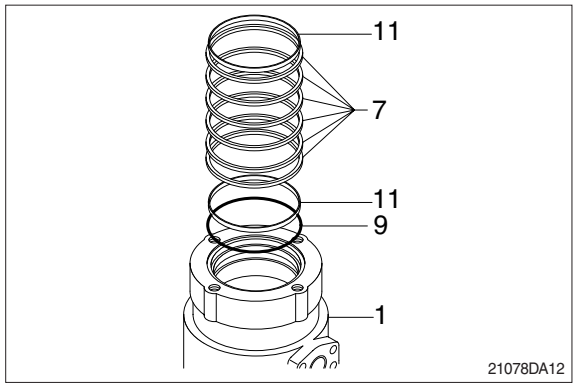


3) ASSEMBLY

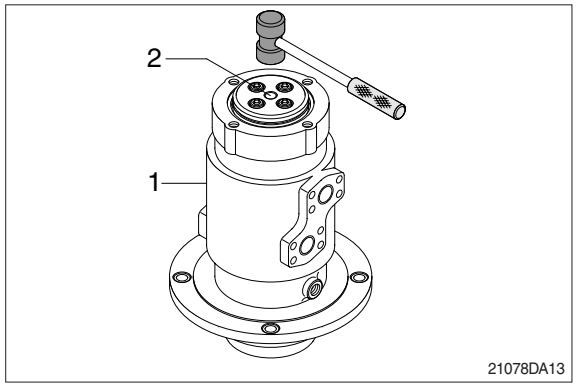
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(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).



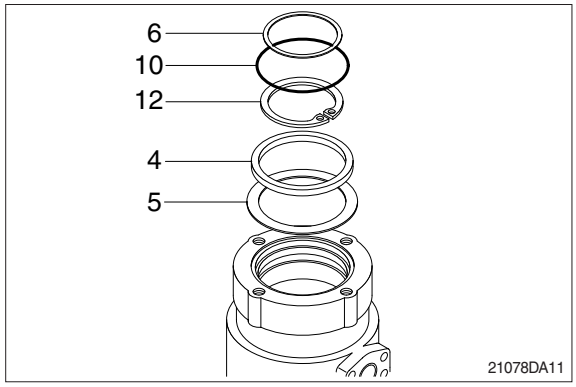
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



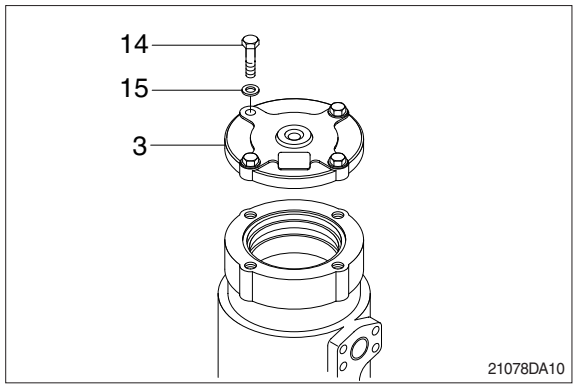
(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(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.

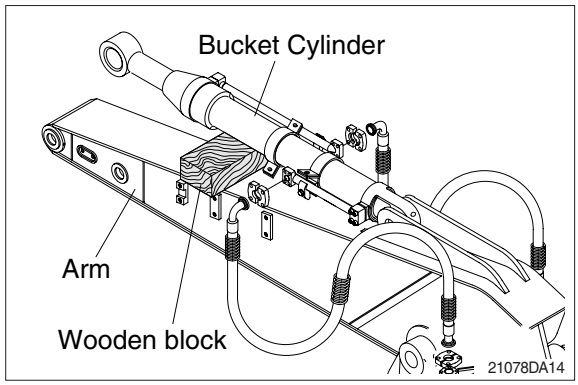
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

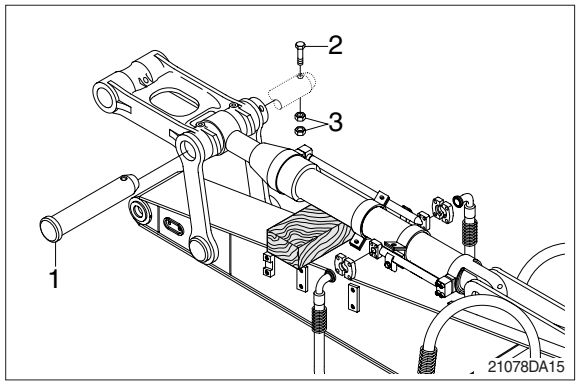
※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between bucket cylinder and arm.

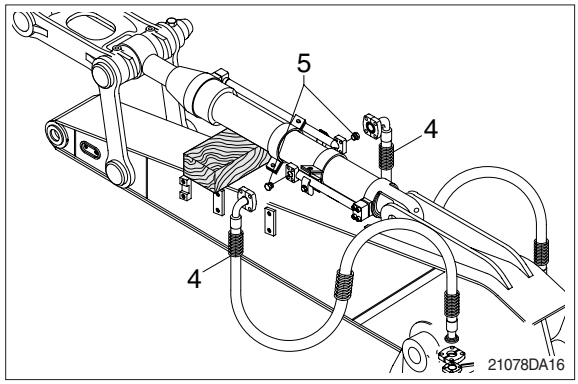


② Remove bolt (2), nut (3) and pull out pin (1).

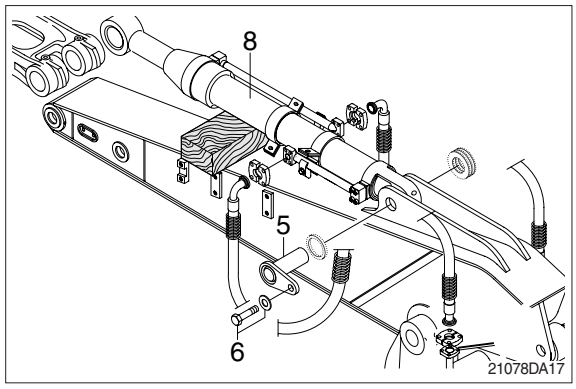
※ Tie the rod with wire to prevent it from coming out.



③ Disconnect bucket cylinder hoses (4) 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.

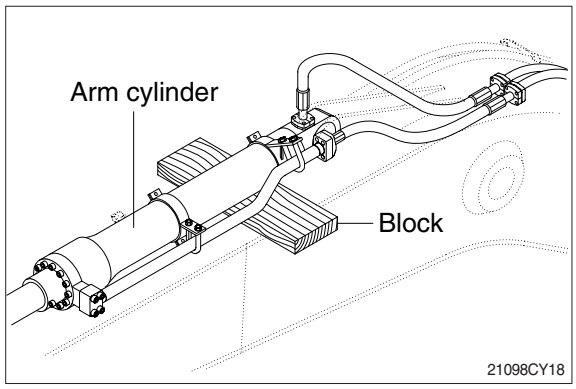
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

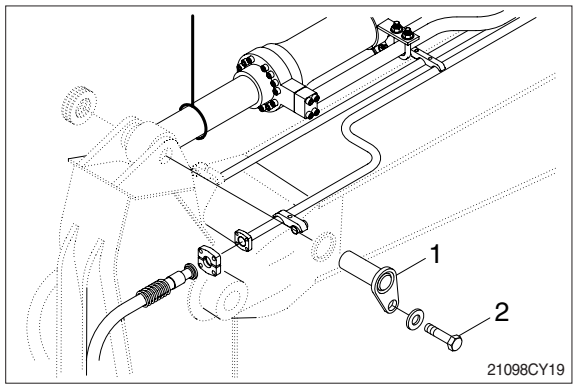
※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.



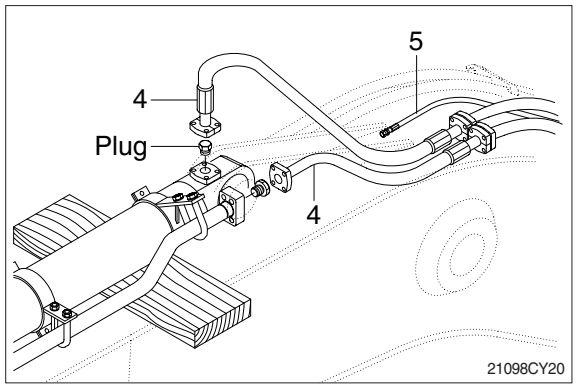
② Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

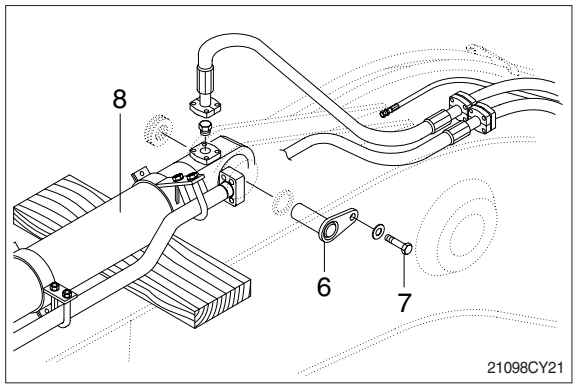
④ Disconnect greasing pipings (5).



⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).

⑥ 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.

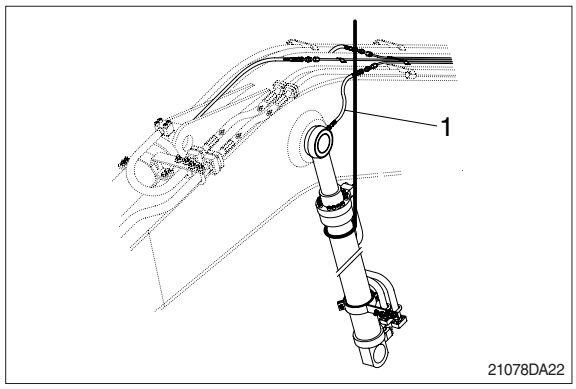
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ 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.

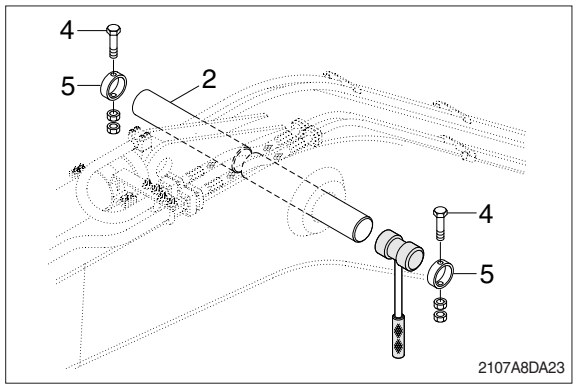
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

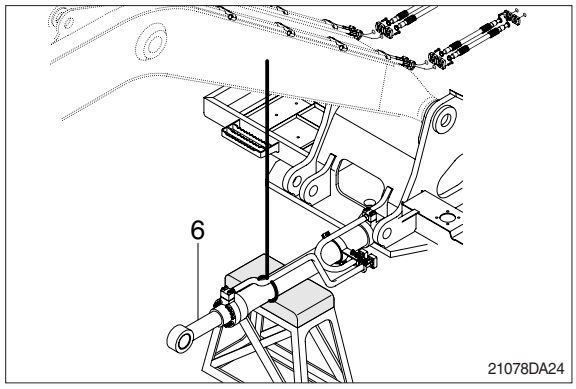


③ Remove bolt (4), stopper (5) and pull out pin (2).

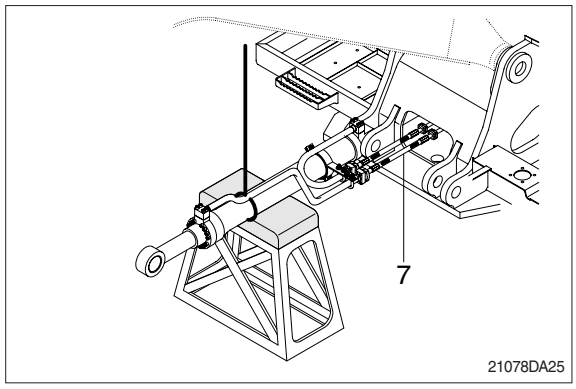
※ Tie the rod with wire to prevent it from coming out.



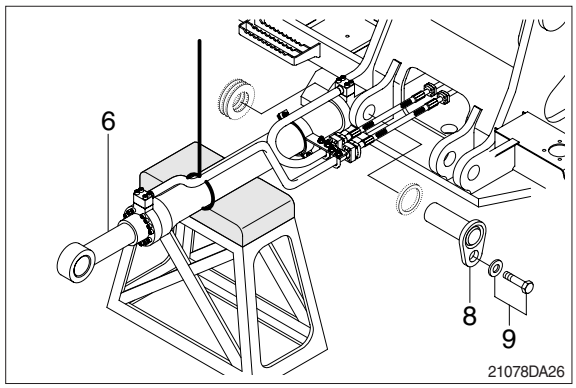
④ Lower the boom cylinder assembly (6) on a stand.



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 : 180 kg (400 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.**

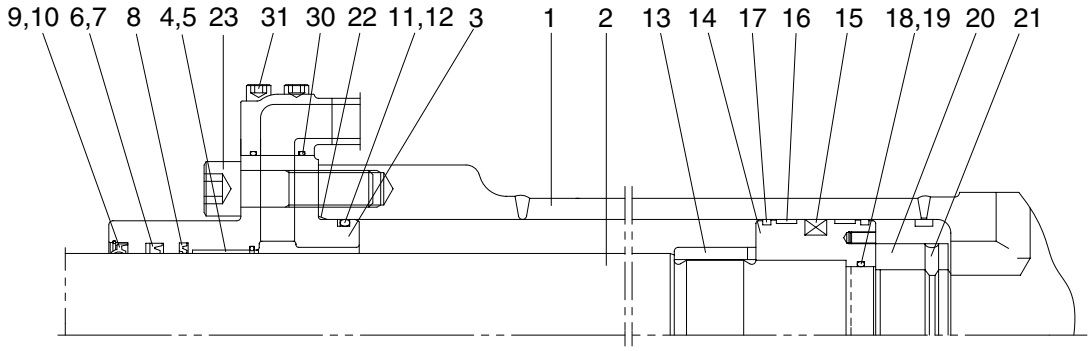
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

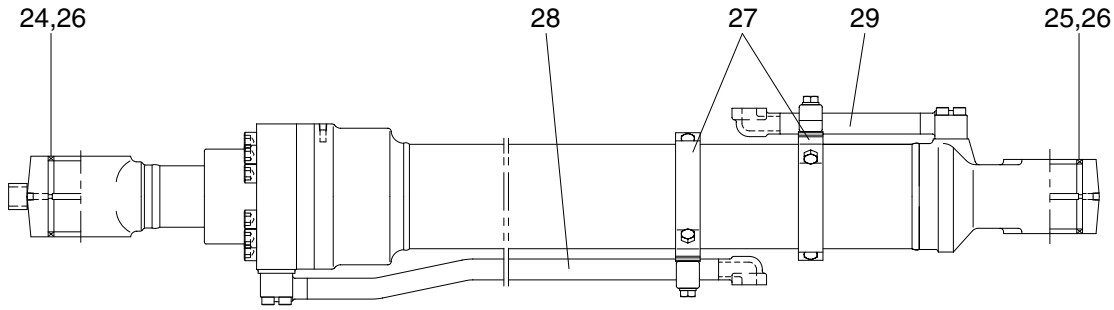
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder



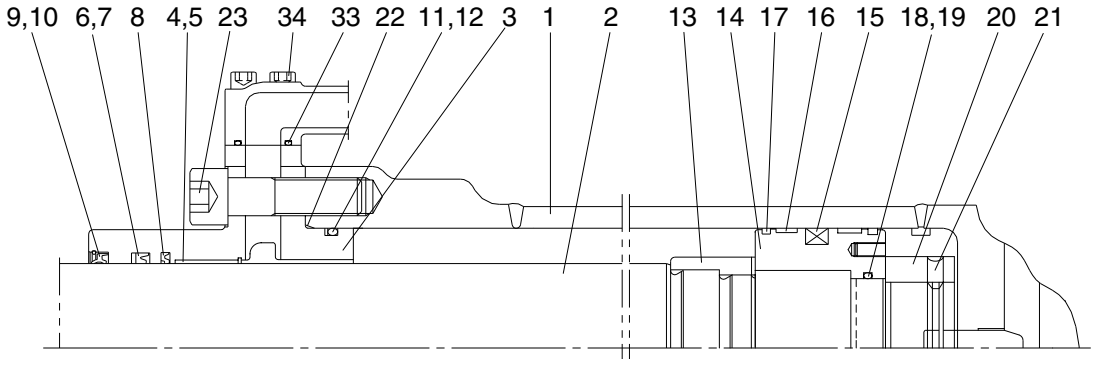
Internal detail



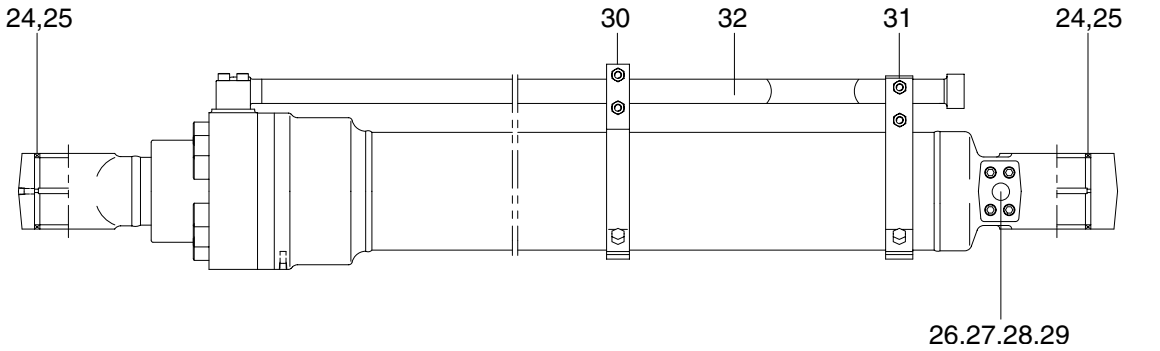
21098CY01

1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	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		

(2) Arm cylinder



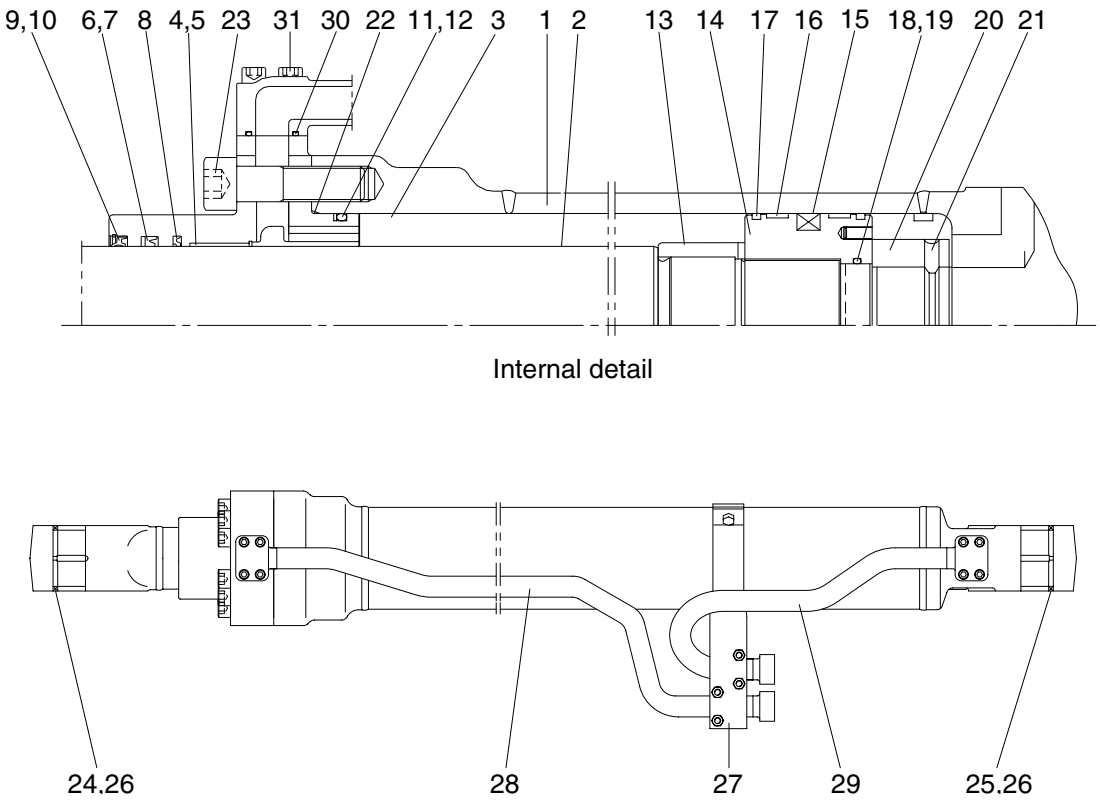
Internal detail



21098CY02

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	Pin bushing		

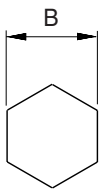
(3) Boom cylinder



1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	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		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tools		Remark
Allen wrench	6	
	8	
	14	
	17	
Spanner	7	
	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Socket head bolt	Bucket cylinder	23	M16	23±2.0	166±14.5
		31	M10	5.4±0.5	39.1±3.6
	Boom cylinder	23	M16	23±2.0	166±14.5
		31	M10	5.4±0.5	39.1±3.6
	Arm cylinder	23	M18	32±3.0	232±21.7
		34	M12	9.4±1.0	68±7.2
Lock nut	Bucket cylinder	20	-	100±10	723±72.3
	Boom cylinder	20	-	100±10	723±72.3
	Arm cylinder	20	-	150±15	1085±108
Piston	Bucket cylinder	14	-	150±15	1085±108
	Boom cylinder	14	-	150±15	1085±108
	Arm cylinder	14	-	200±20	1447±145

3) DISASSEMBLY

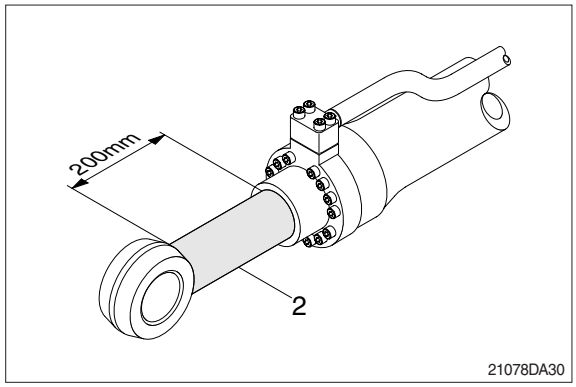
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

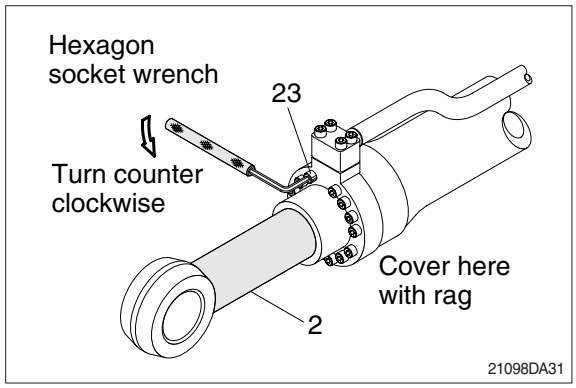
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200mm (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



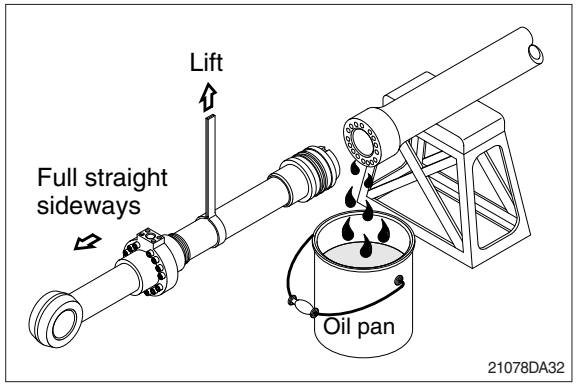
③ Loosen and remove socket bolts (23) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



④ Draw out cylinder head and rod assembly together from tube assembly (1).

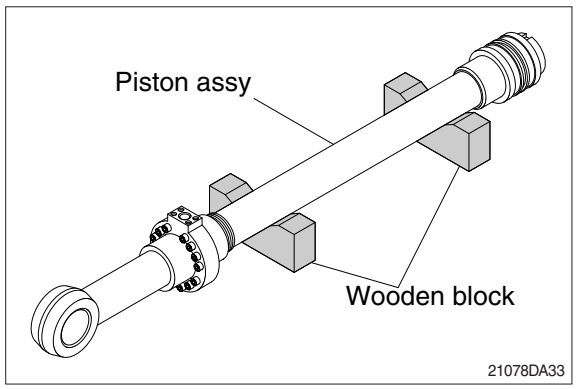
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

※ Cover a V-block with soft rag.

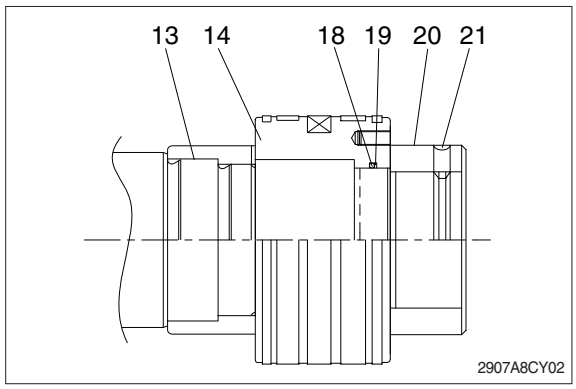


(2) Remove piston and cylinder head

① Remove set screw (21).

※ Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock set screw (21) and lock nut (20).

② Remove piston assembly (14), back up ring (19), and O-ring (18).

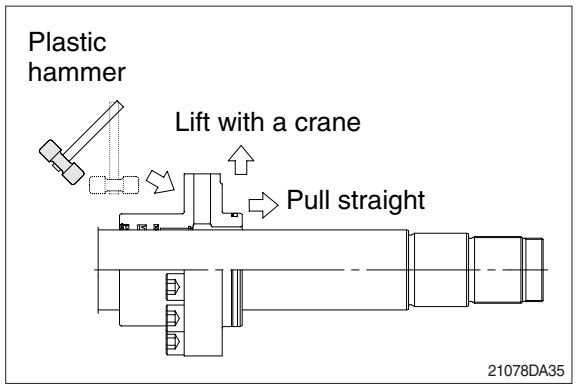


③ Remove the cylinder head assembly from rod assembly (2).

※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.

※ Pull it straight with cylinder head assembly lifted with a crane.

Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

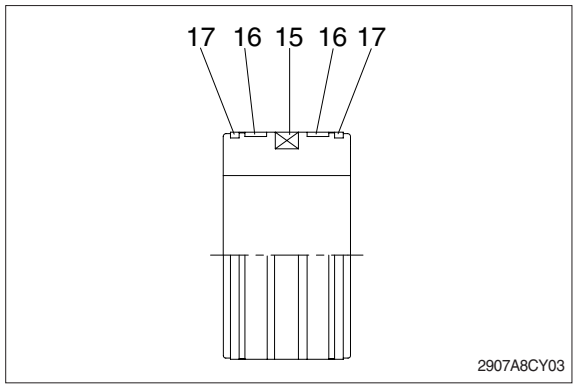


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

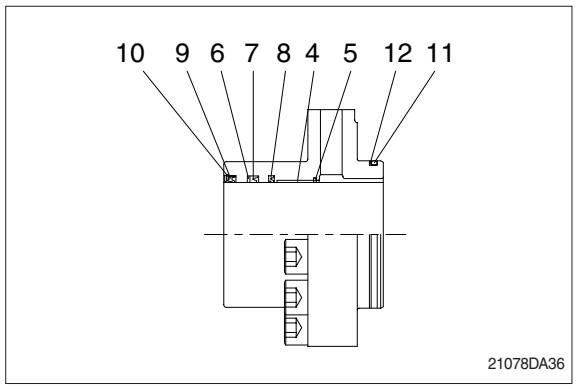
② Remove snap ring (10), dust wiper (9).

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).

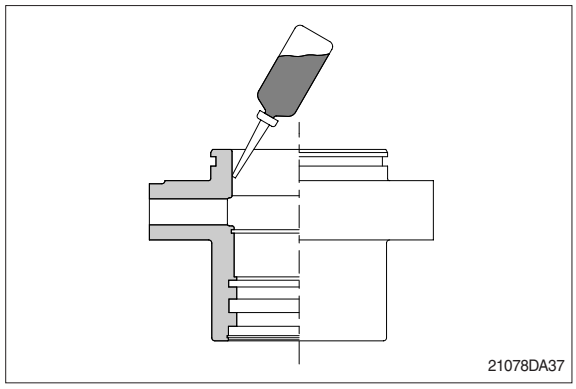


3) ASSEMBLY

(1) Assemble cylinder head assembly

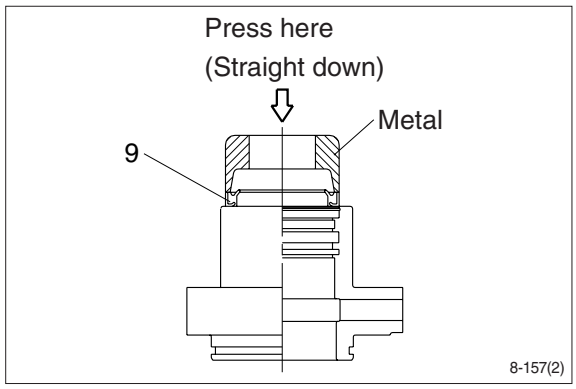
※ Check for scratches or rough surfaces if found smooth with an oil stone.

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.

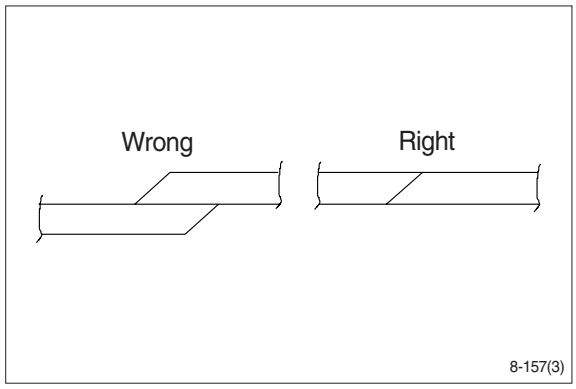
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

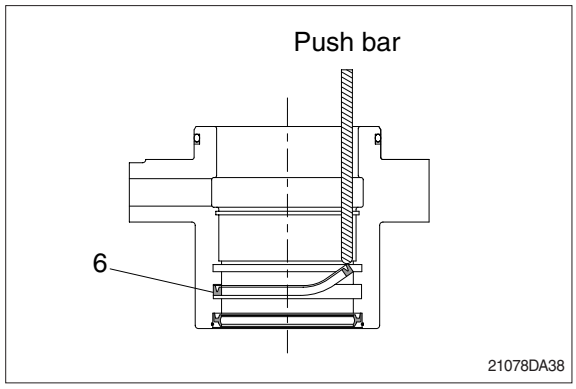
※ Coat each packing with hydraulic oil before fitting it.

※ 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.

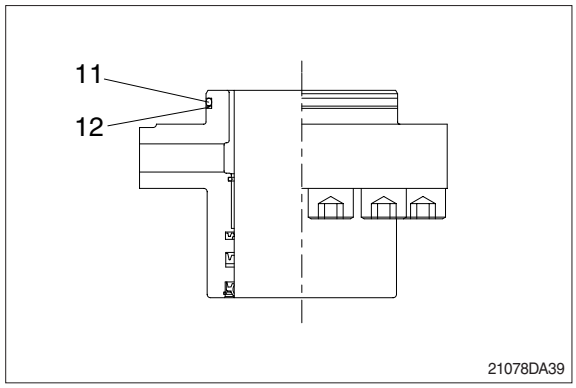
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

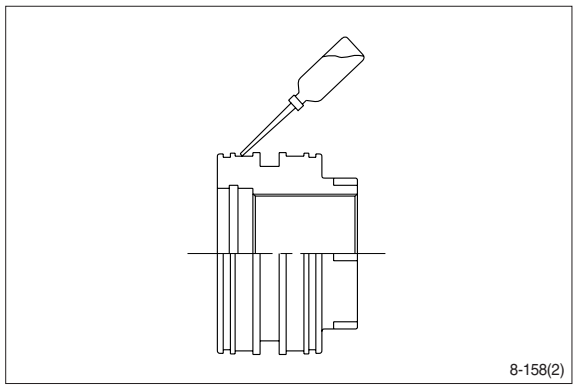
⑥ Fit O-ring (11) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

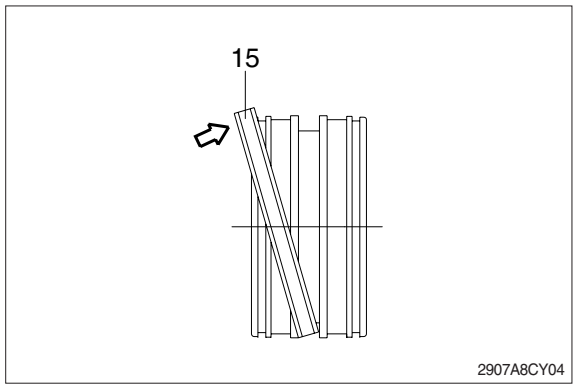
① Coat the outer face of piston (14) with hydraulic oil.



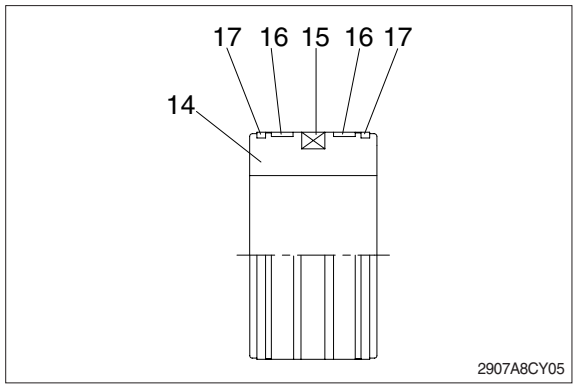
② Fit piston seal (15) to piston.

※ 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).

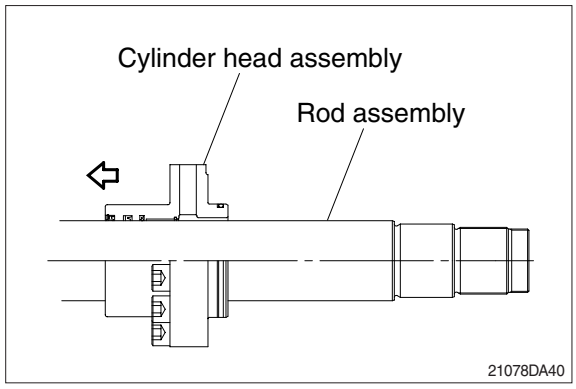


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

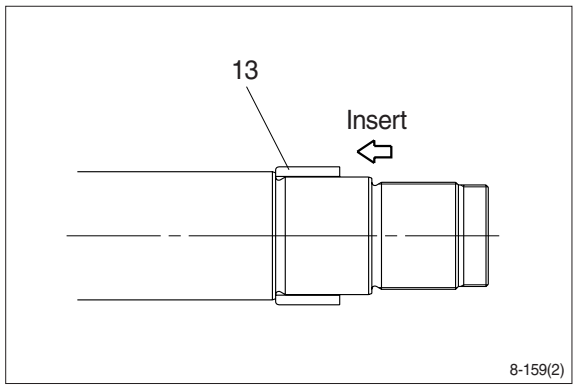
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



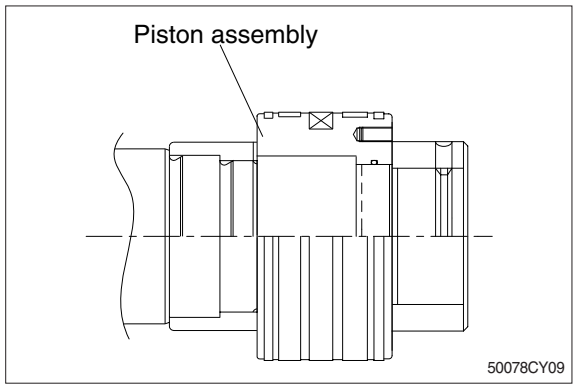
④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

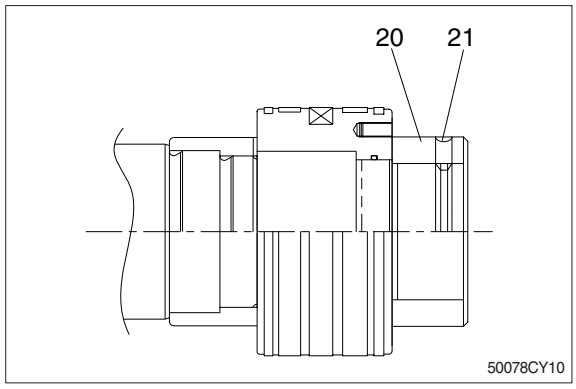
· Tightening torque : 150±15 kgf · m
(1085±108 lbf · ft)



⑥ Fit lock nut (20) and tighten the screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
20	Bucket	100±10	723±72.3
	Boom	100±10	723±72.3
	Arm	150±15	1085±108
21		2.7±0.3	19.6±2.2



(3) Overall assemble

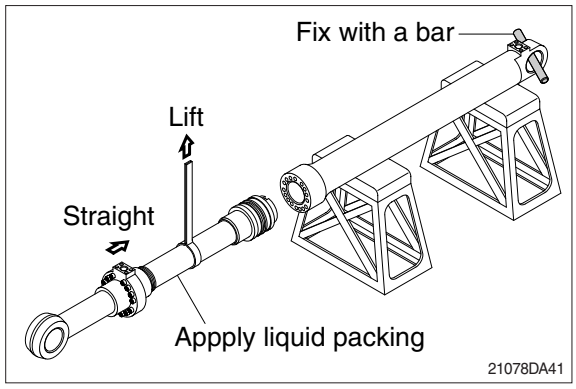
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

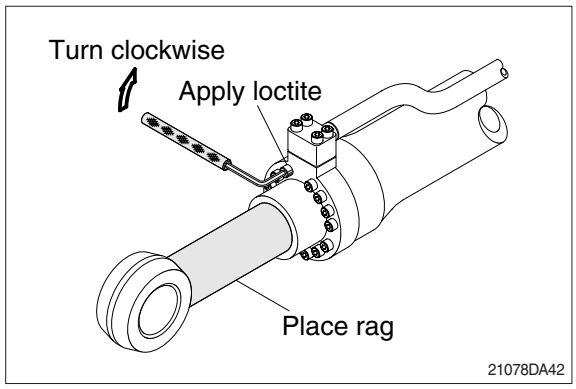
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ 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

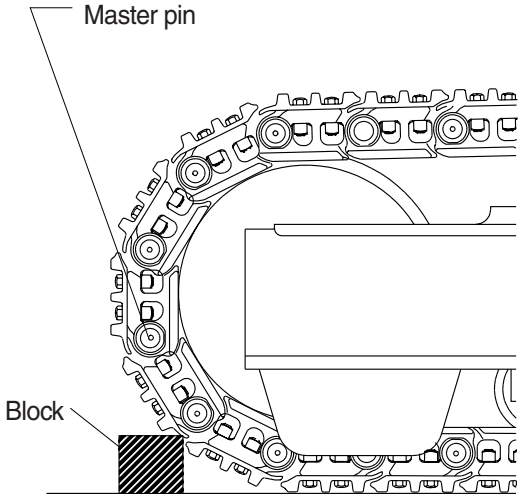
1) REMOVAL

(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.

(3) Push out master pin by using a suitable tool.

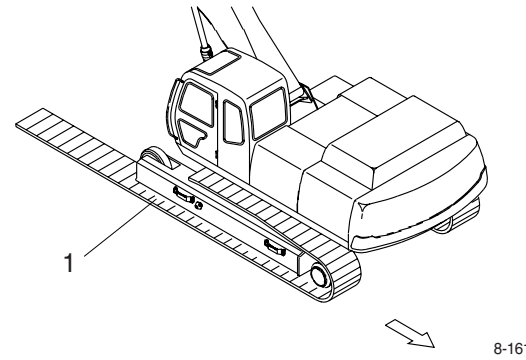


8-161(1)

(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.

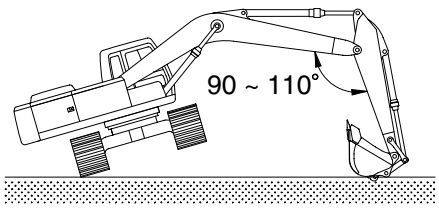


8-161(2)

2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.



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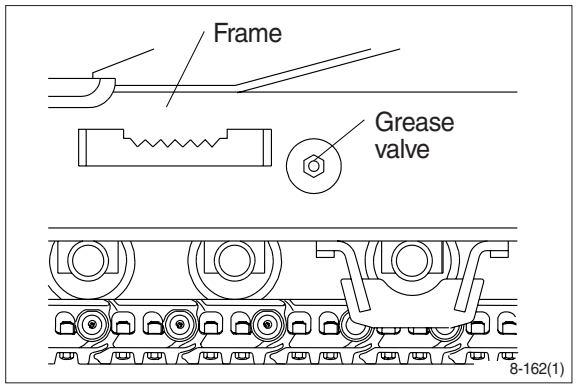
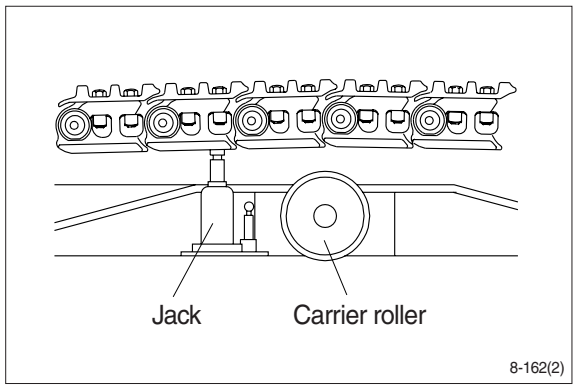
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.

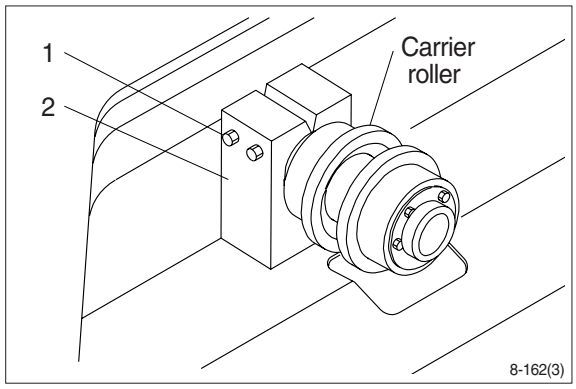


(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.
- Weight : 20 kg (45 lb)



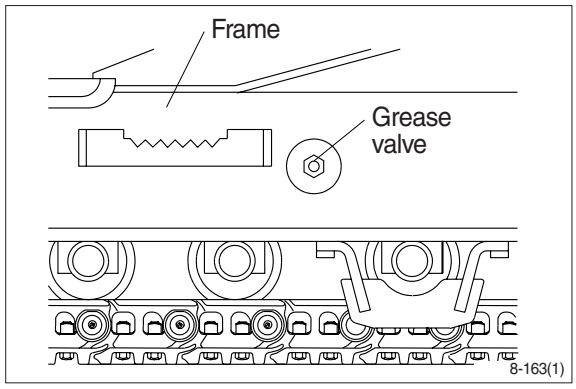
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

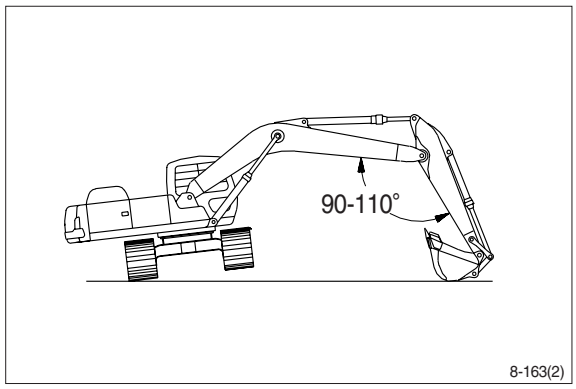
1) REMOVAL

(1) Loosen tension of the track link.



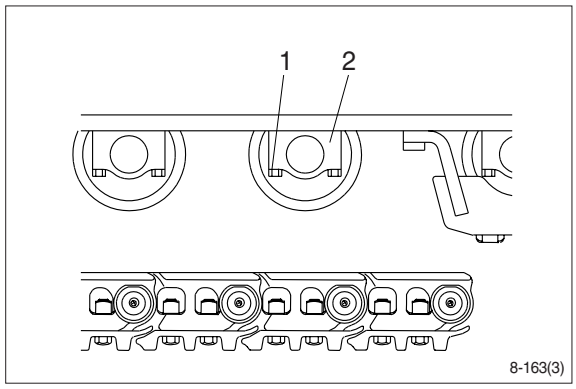
(2) Using the work equipment, push up track frame on side which is to be removed.

※ 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 : 40 ㎏ (90 ㏪)



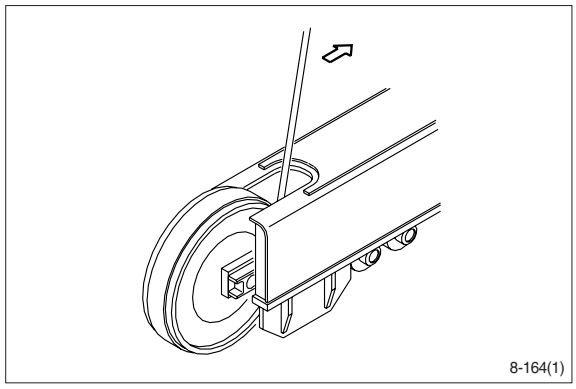
2) INSTALL

(1) Carry out installation in the reverse order to removal.

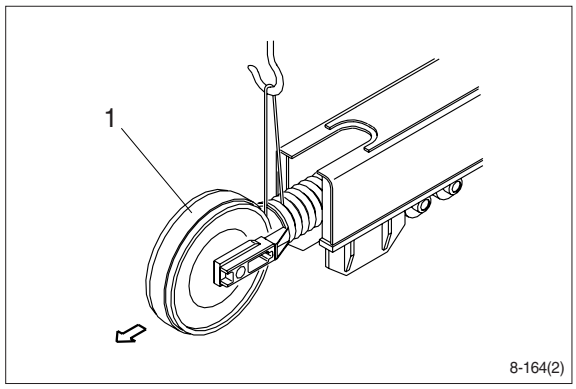
4. IDLER AND RECOIL SPRING

1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.

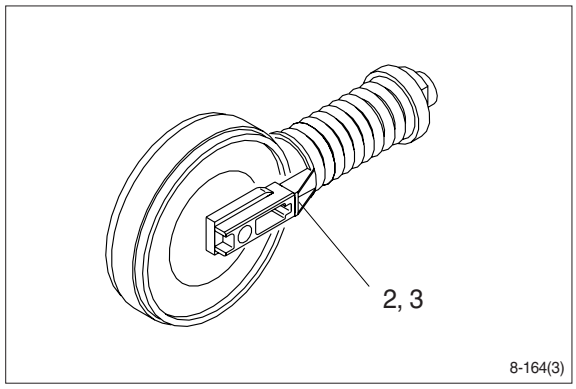

8-164(1)

(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)



8-164(2)

(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.

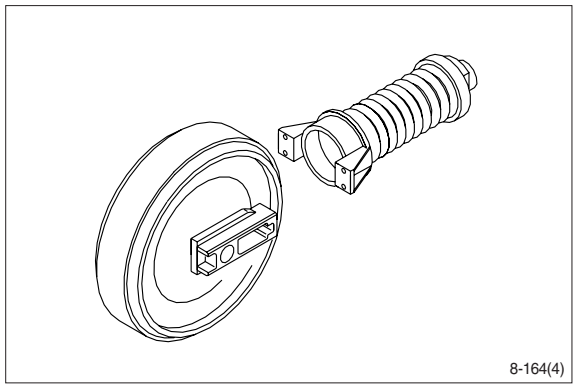


8-164(3)

2) INSTALL

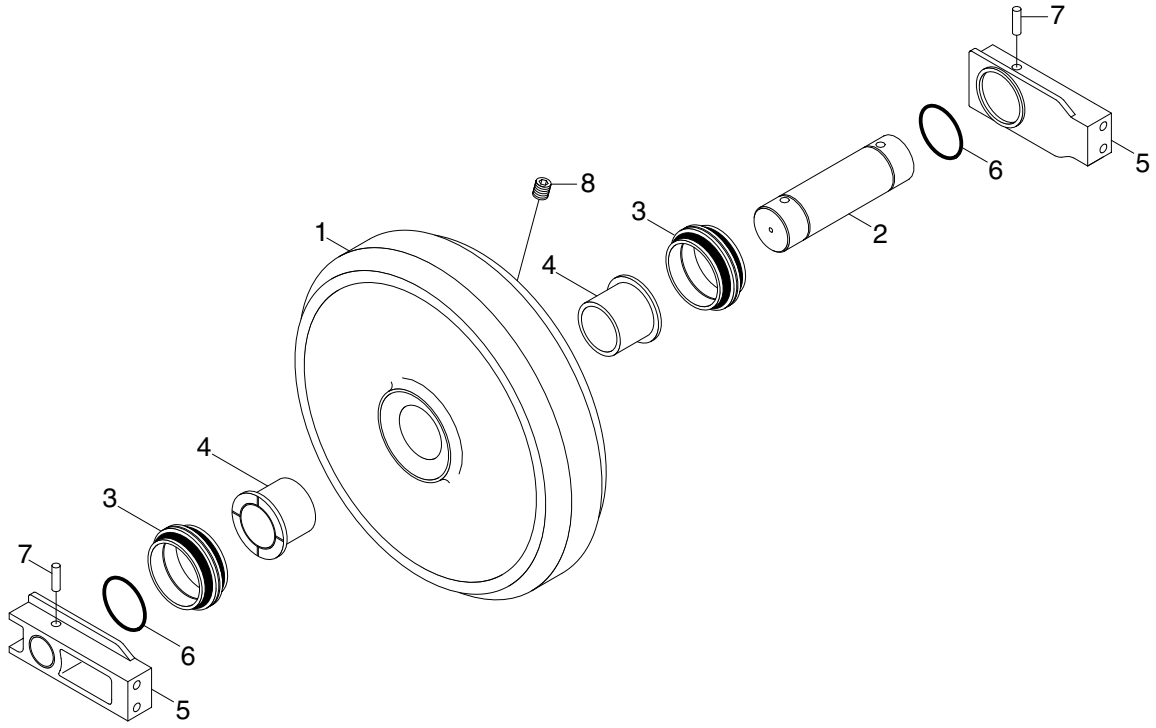
(1) Carry out installation in the reverse order to removal.

※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.


8-164(4)

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



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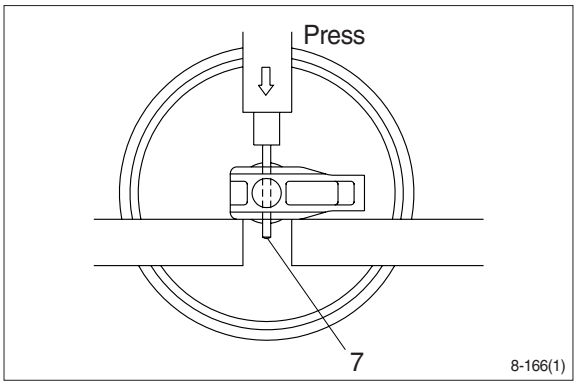
1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug and drain oil.

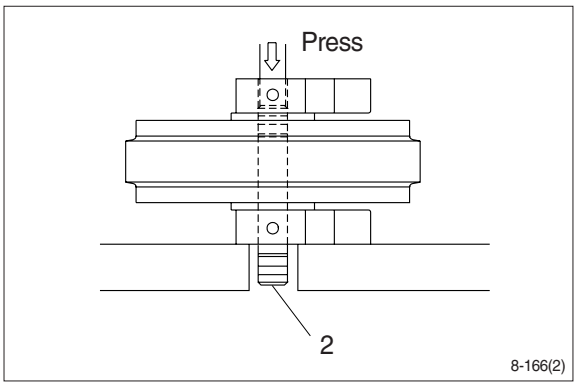
② Draw out the spring pin (7), using a press.



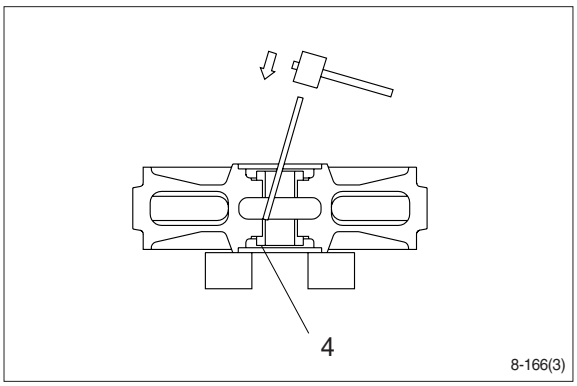
③ Pull out the shaft (2) with a press.

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.

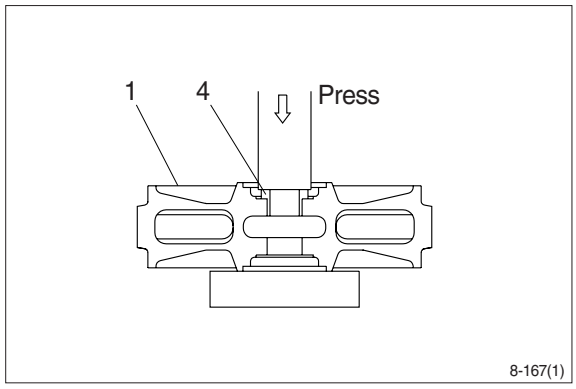


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

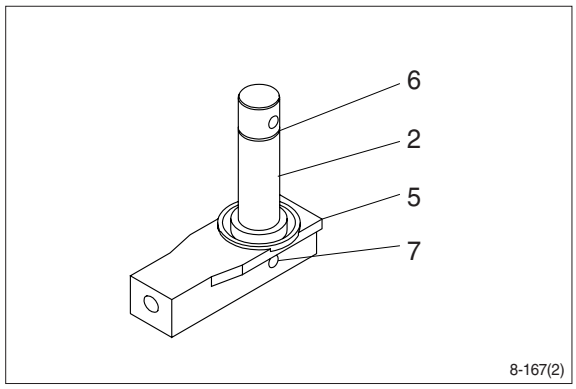
① Cool up bushing (4) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1)

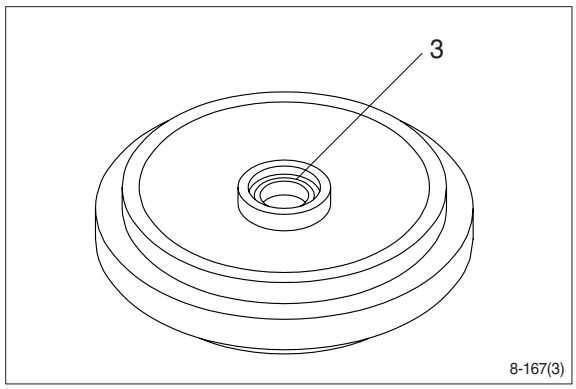
② Coat O-ring (6) with grease thinly, and install it to shaft (2).

③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



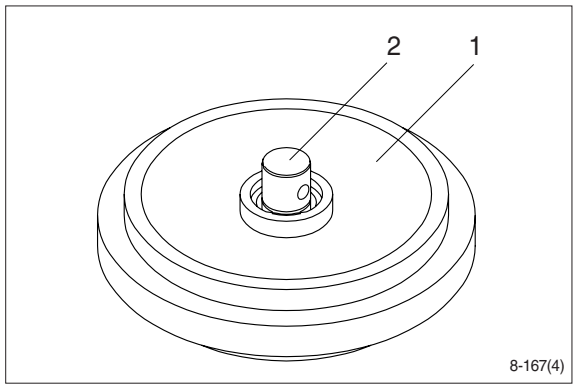
8-167(2)

④ Install seal (3) to shell (1) and bracket (5).



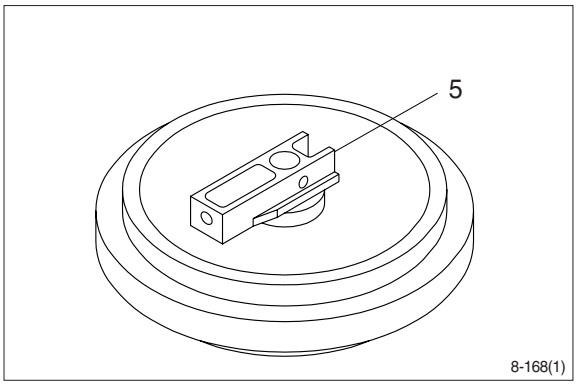
8-167(3)

⑤ Install shaft (2) to shell (1).

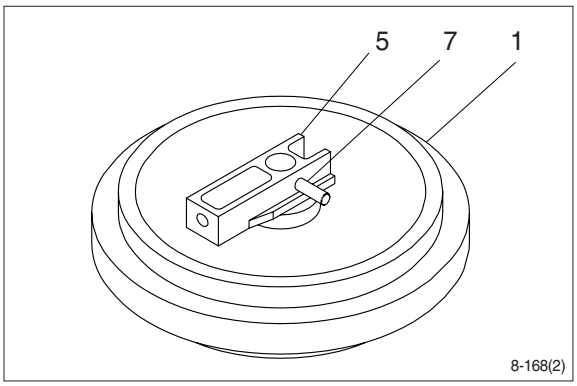


8-167(4)

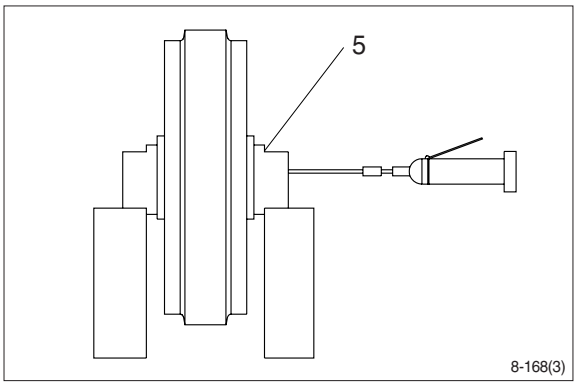
⑥ Install bracket (5) attached with seal (3).



⑦ Knock in the spring pin (7) with a hammer.

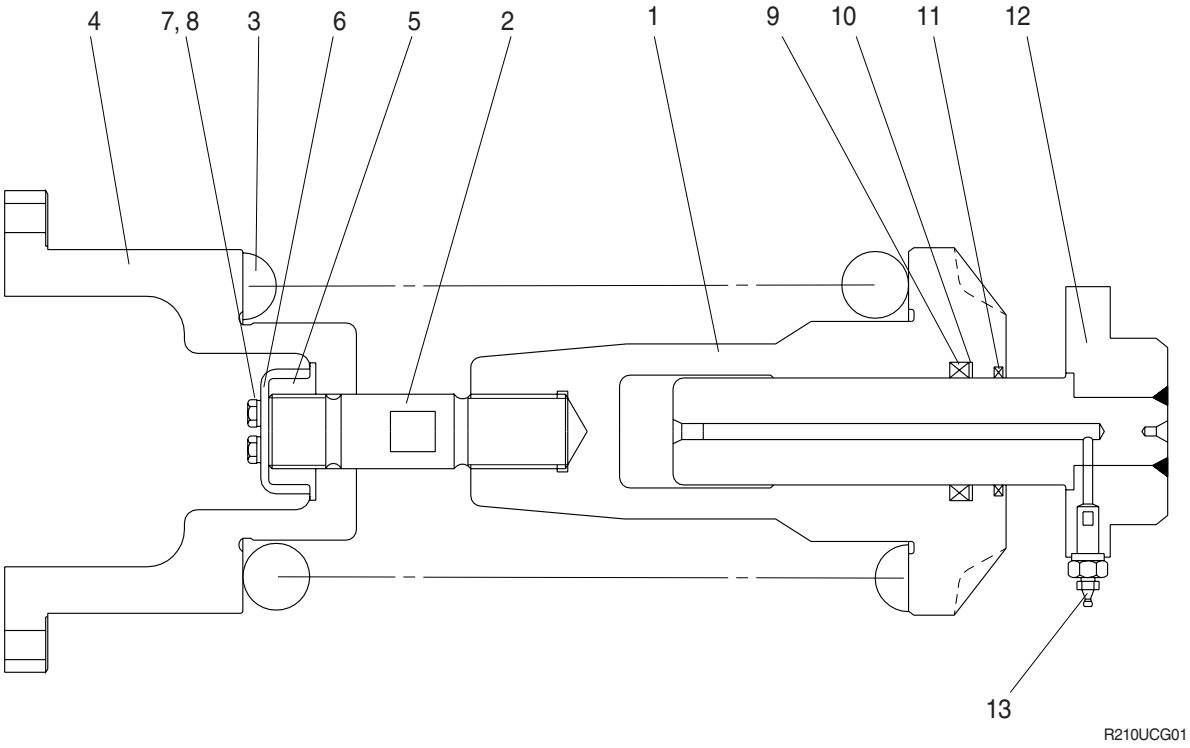


⑧ Lay bracket (5) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod assembly
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal		
5	Lock nut	10	Back up ring		

(2) Disassembly

① Apply pressure on spring (3) with a press.

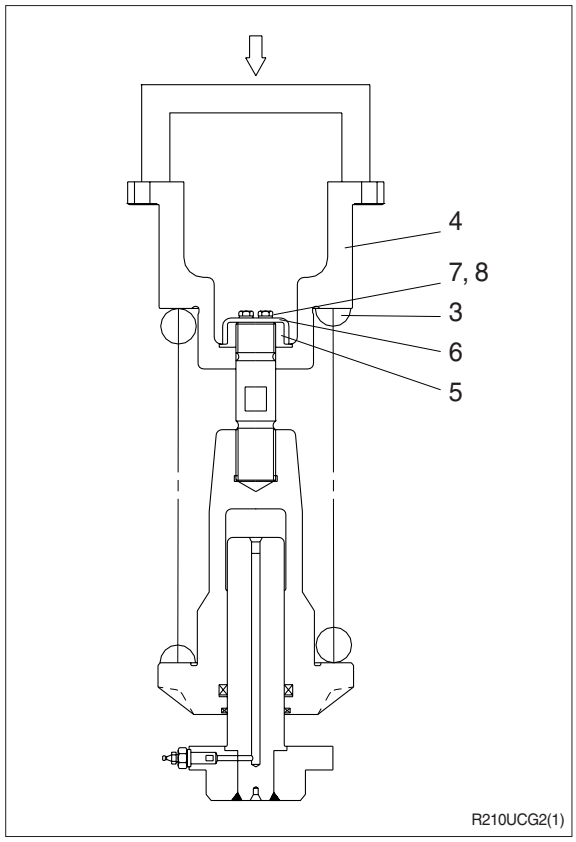
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

・Spring set load : 13716 kg (30238 lb)

② Remove bolt (7), spring washer (8) and lock plate (6).

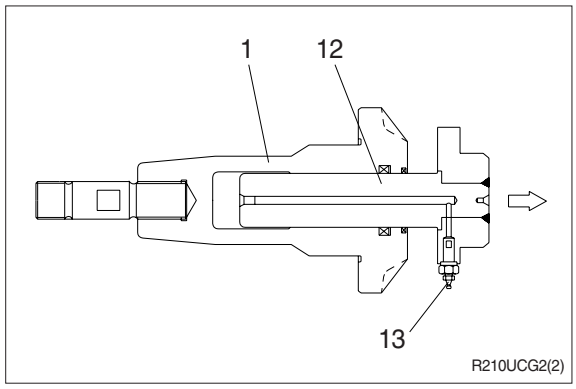
③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket (4) and spring (3).

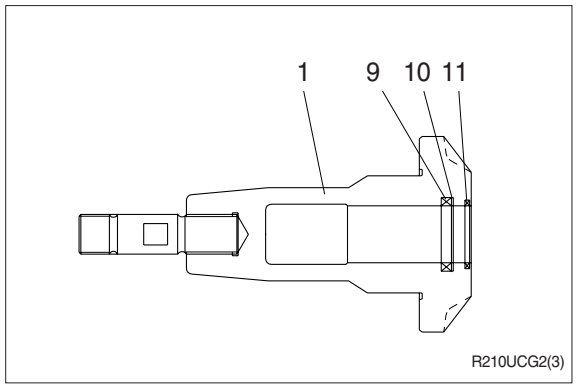


⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



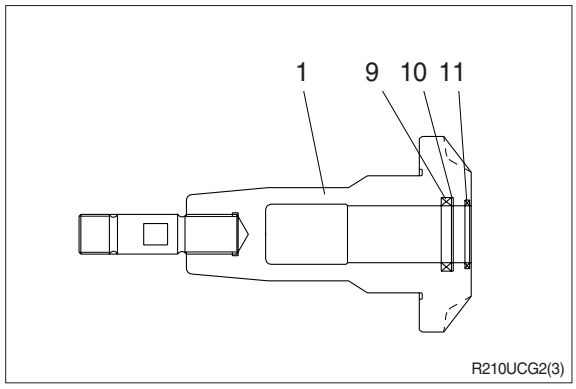
⑦ Remove rod seal (9), back up ring (10) and dust seal (11).



(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.



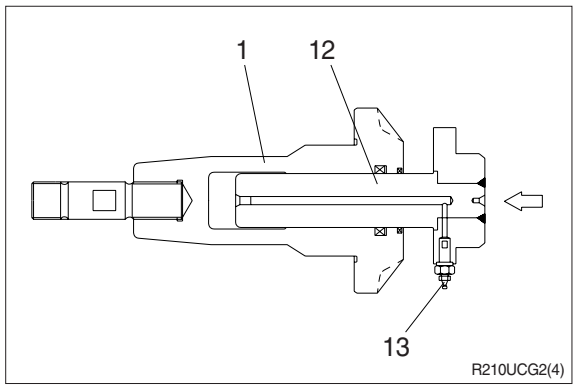
② Pour grease into body (1), then push in rod (12) by hand.

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 : 10±0.5 kgf · m (72.3±3.6 lbf · ft)

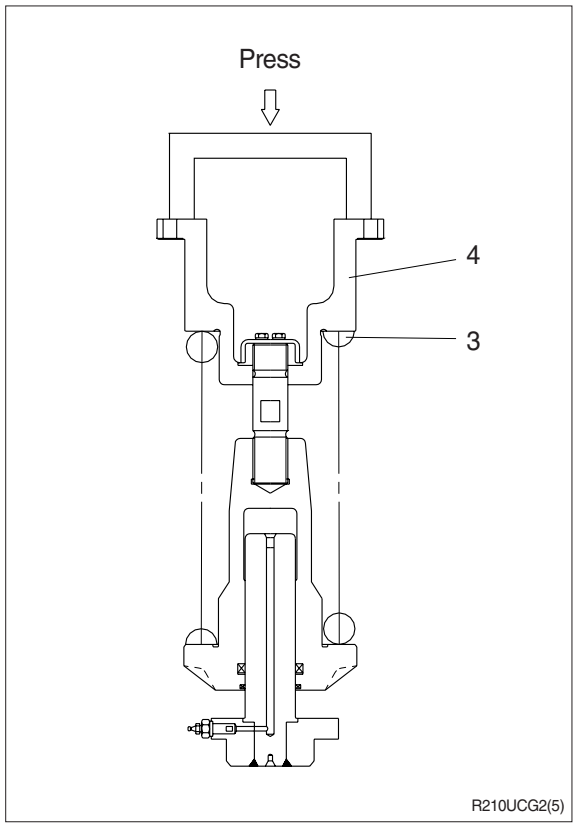


④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

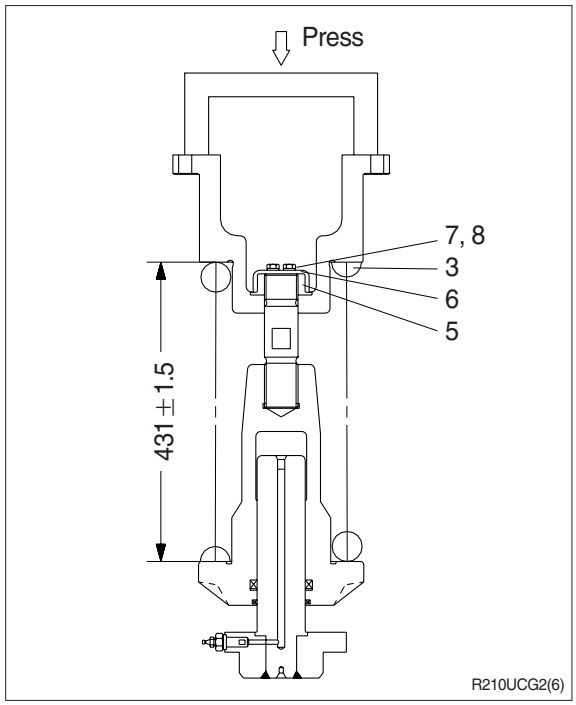
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.

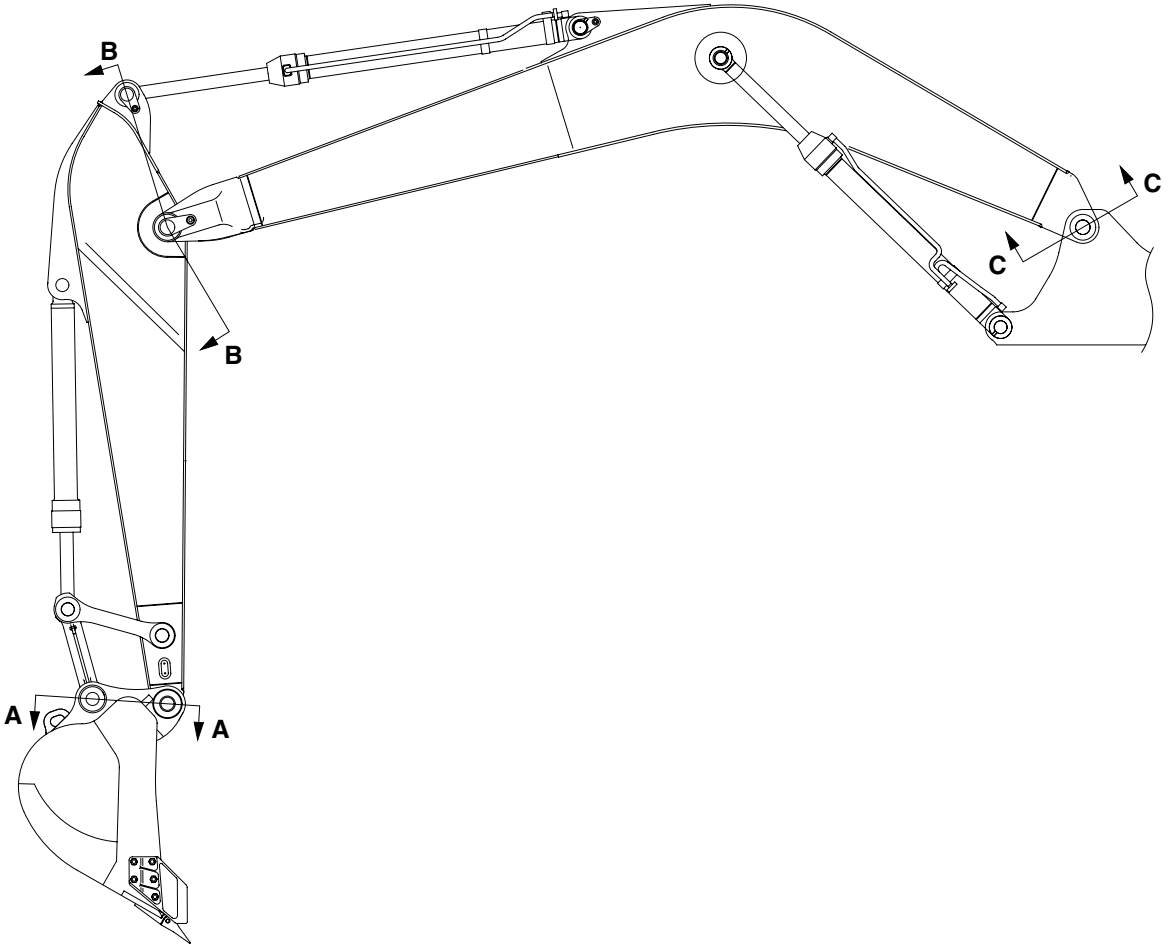


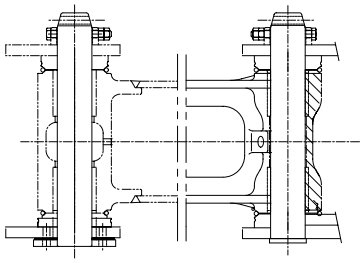
⑥ Lighten the press load and confirm the set length of spring (3).

⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).

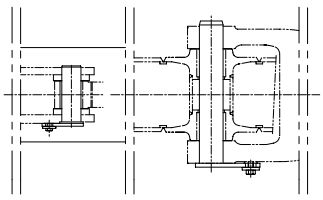


1. STRUCTURE

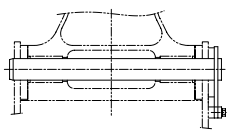




SECTION A



SECTION B



SECTION C

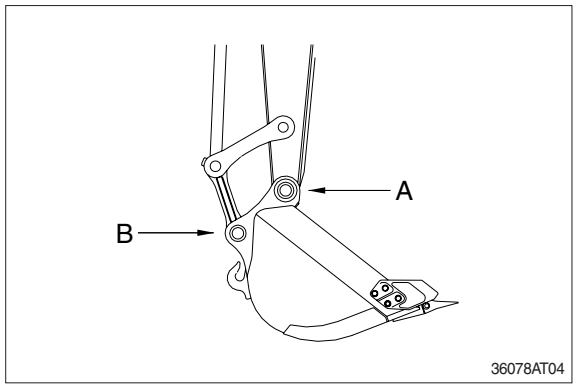
21078DA44

2. REMOVAL AND INSTALL

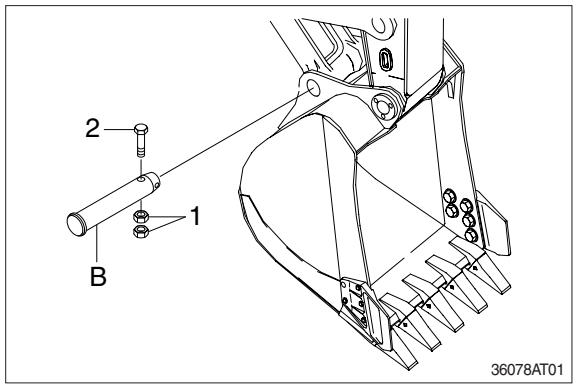
1) BUCKET ASSEMBLY

(1) Removal

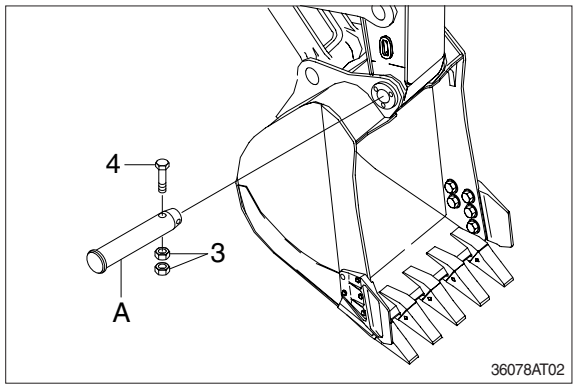
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut (1), bolt (2) and draw out the pin (A).



③ Remove nut (3), bolt (4) and draw out the pin (B).

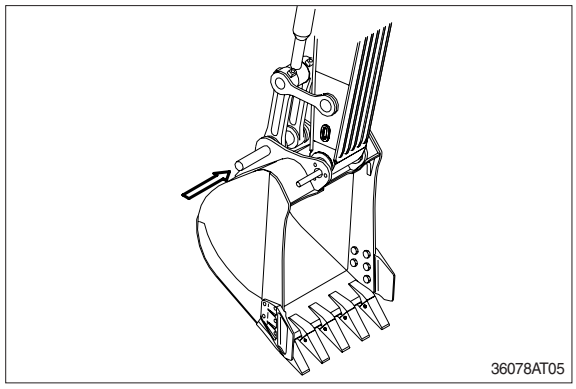


(2) Install

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.**

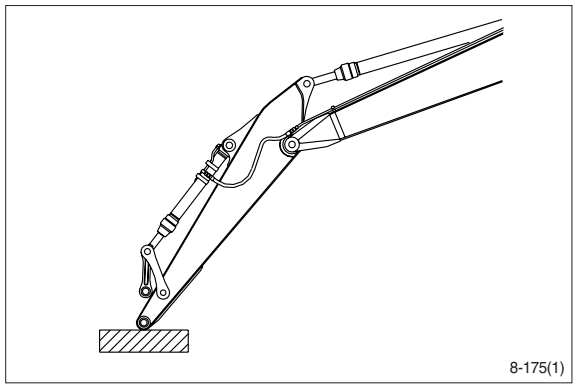
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

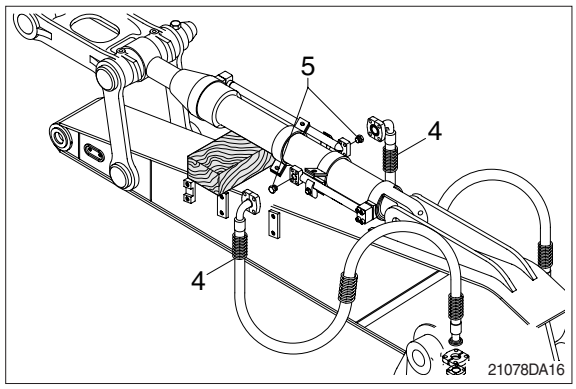
※ Tie the rod with wire to prevent it from coming out.

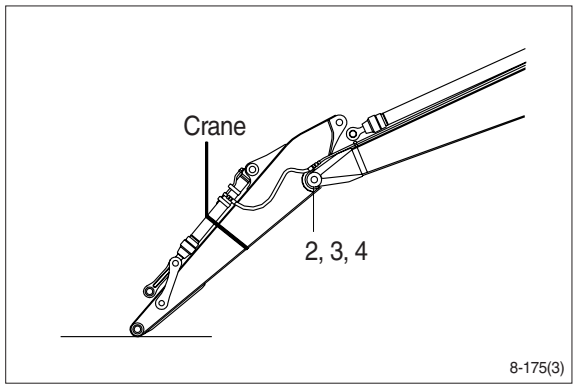
④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

※ · Weight : 1050 kg (2310 lb)
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.**

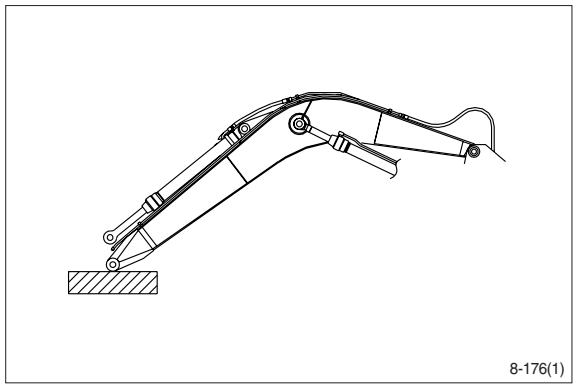
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(1) Removal

① Remove arm and bucket assembly.
For details, see removal of arm and bucket assembly.

② Remove boom cylinder assembly from boom.
For details, see removal of arm cylinder assembly.

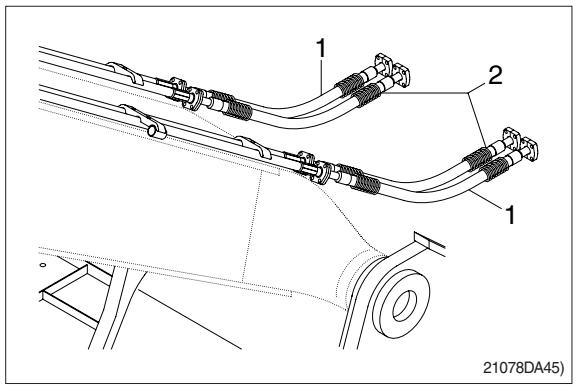


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

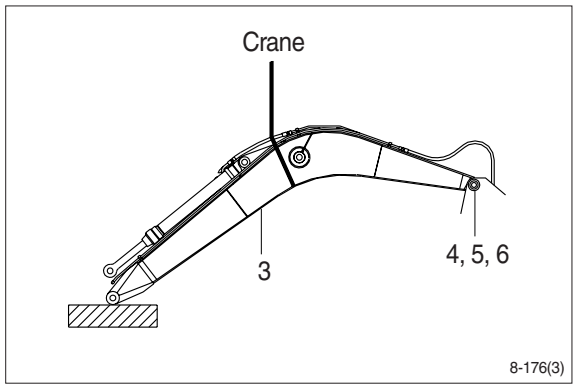
※ When the hose are disconnected, oil may spurt out.

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)

※ When lifting the boom assembly always lift the center of gravity.

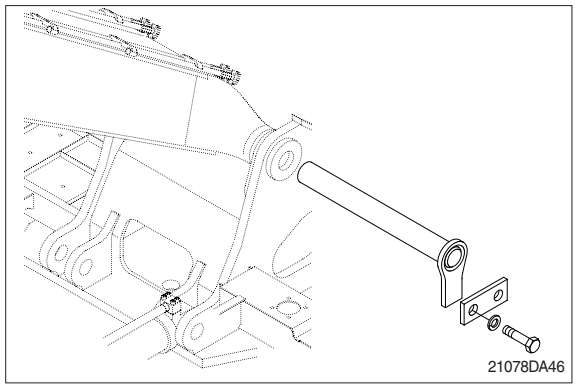


(2) Install

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.



SECTION 9 COMPONENT MOUNTING TORQUE

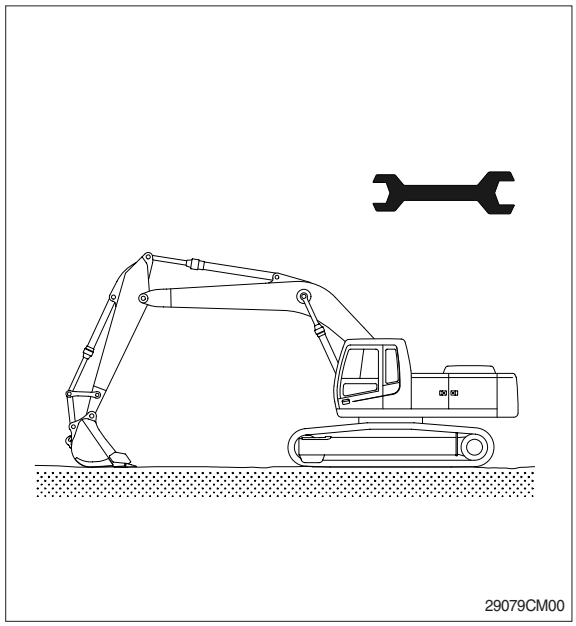
SECTION 9 COMPONENT MOUNTING TORQUE

GROUP 1 INTRODUCTION GUIDE

1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
2. Use genuine Hyundai spare parts.
   We expressly point out that Hyundai will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases Hyundai cannot assume liability for any damage.

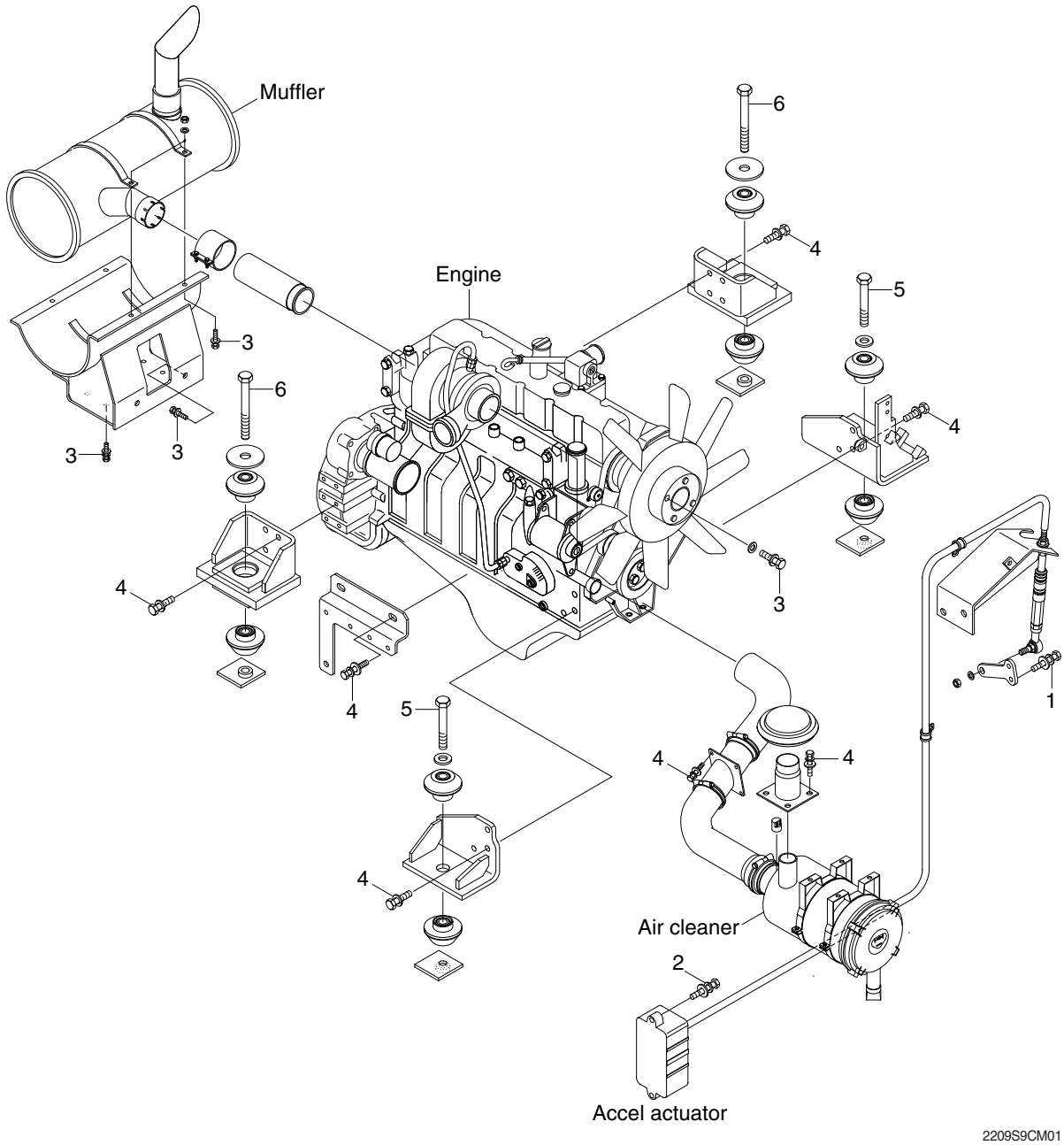
※ Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.

※ Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.



GROUP 2 ENGINE SYSTEM

1. ENGINE AND ACCESSORIES MOUNTING



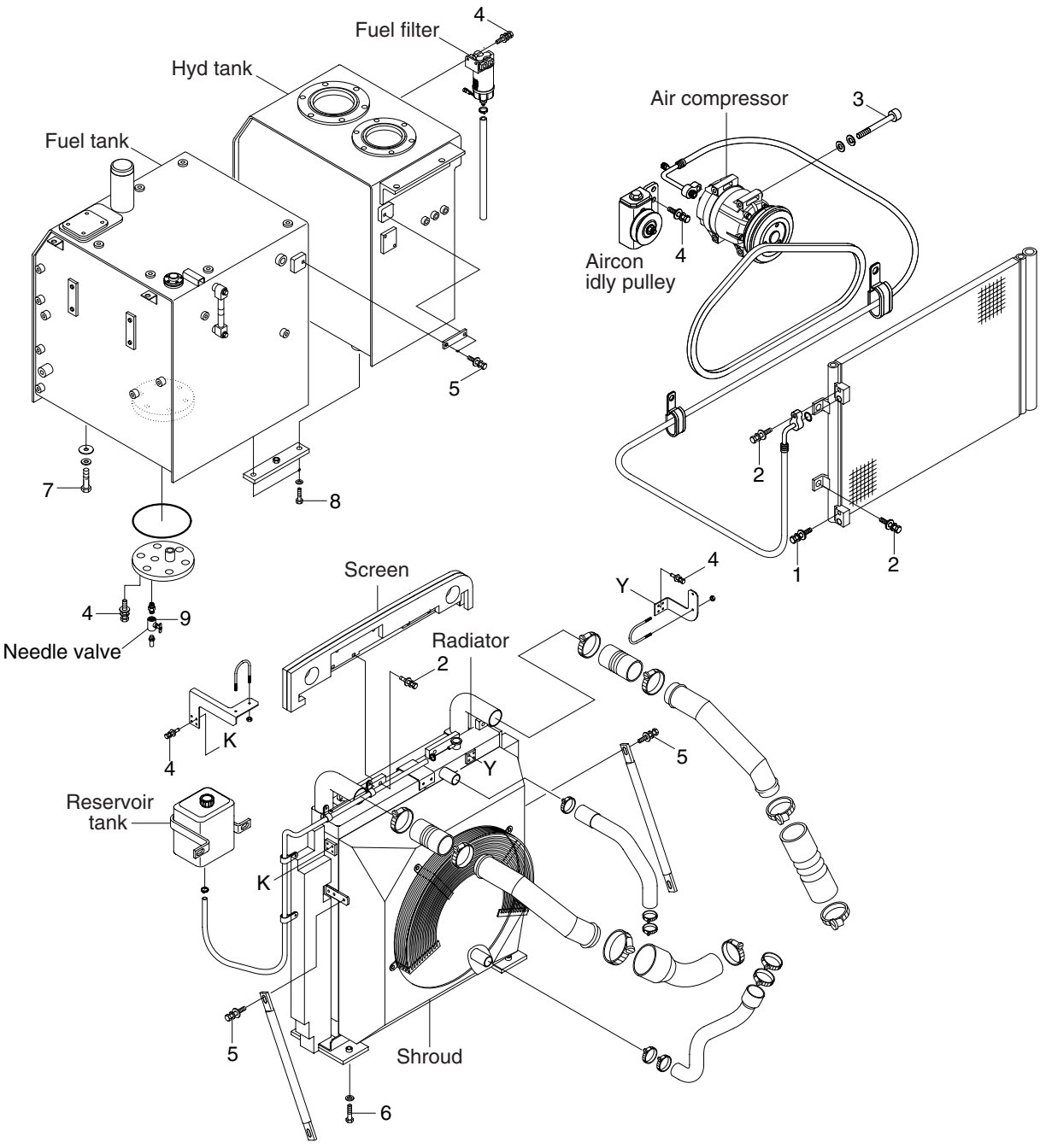
2209S9CM01

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6 × 1.0	1.05 ± 0.2	7.6 ± 1.4
2	M 8 × 1.25	2.5 ± 0.5	18.1 ± 3.6
3	M10 × 1.5	6.9 ± 1.4	49.9 ± 10.1

Item	Size	kgf · m	lbf · ft
4	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
5	M20 × 2.5	55 ± 3.5	398 ± 25.3
6	M24 × 3.0	97 ± 7.0	701 ± 51

2. COOLING SYSTEM AND FUEL TANK MOUNTING



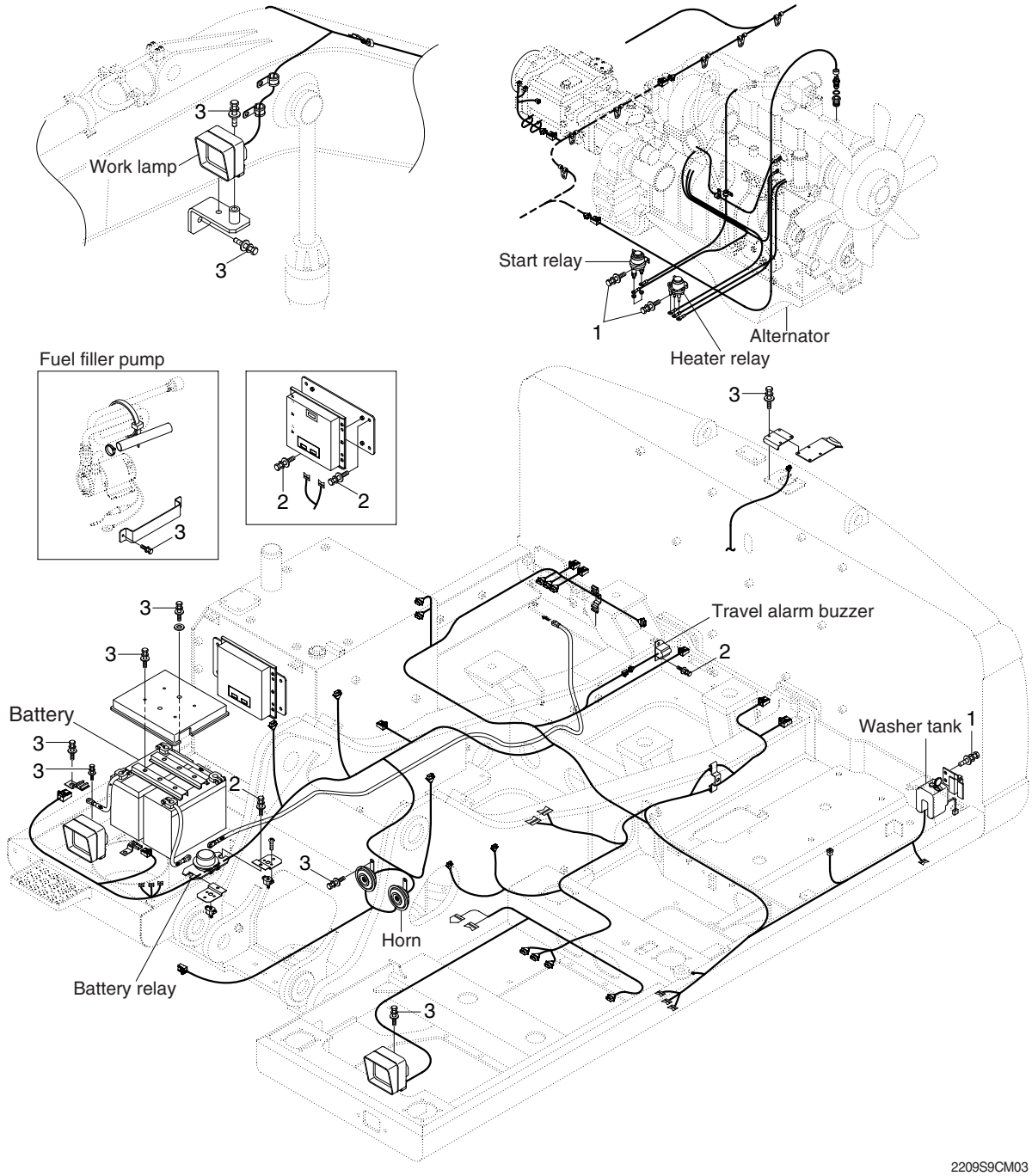
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.0	4.5±0.9	32.5±6.5
4	M10×1.5	6.9±1.4	49.9±10.1
5	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
6	M16×2.0	29.7±4.5	215±32.5
7	M20×2.5	46±5.1	333±36.9
8	M20×2.5	57.9±8.7	419±62.9
9	-	2.3±0.6	16.6±4.3

GROUP 3 ELECTRIC SYSTEM

1. ELECTRIC COMPONENTS MOUNTING 1

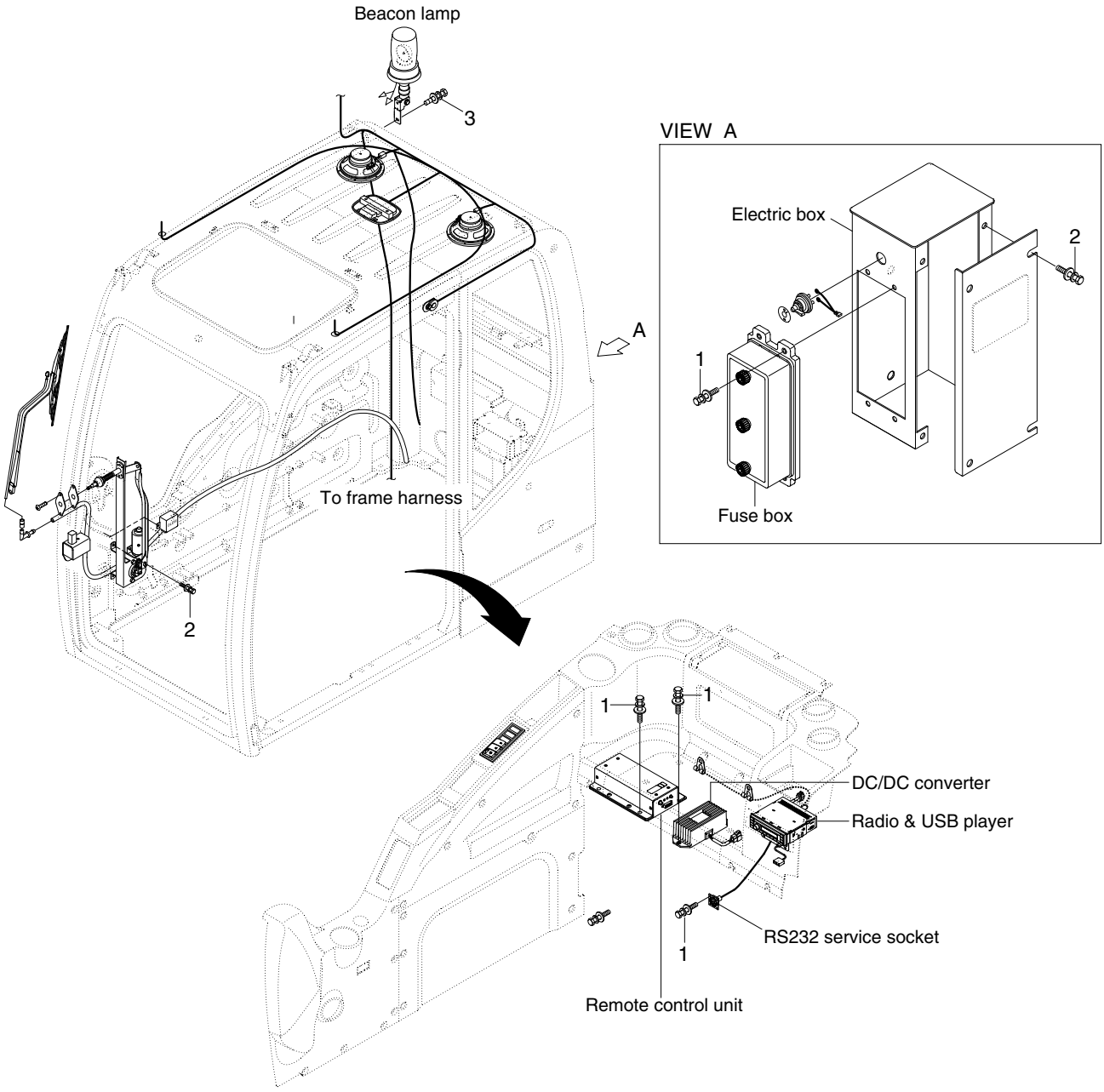


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
3	M10×1.5	6.9±1.4	49.9±10.1

ELECTRIC COMPONENTS MOUNTING 2

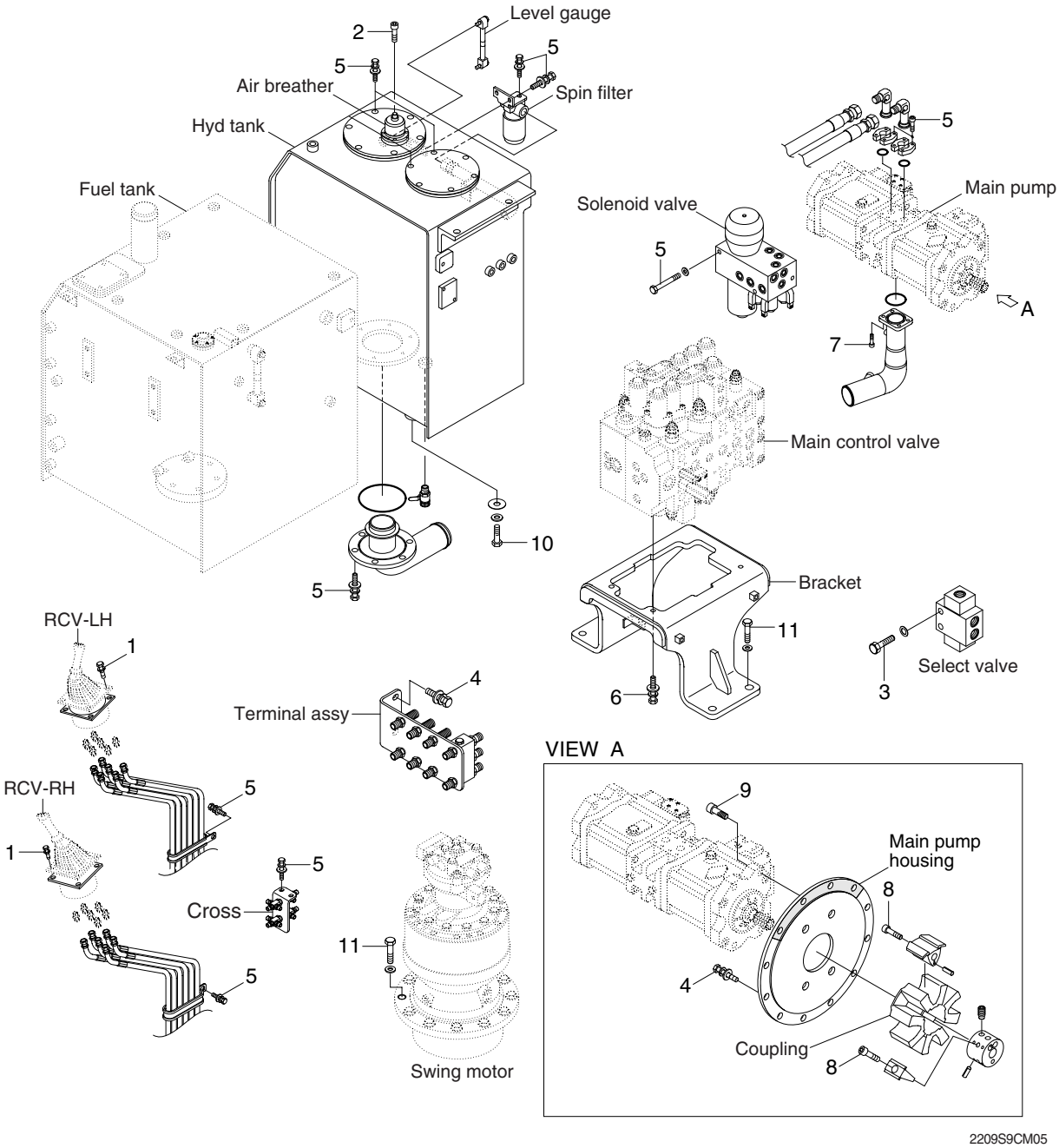


2209S9CM04

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	6.9±1.4	49.9±10.1

1. HYDRAULIC COMPONENTS MOUNTING 1



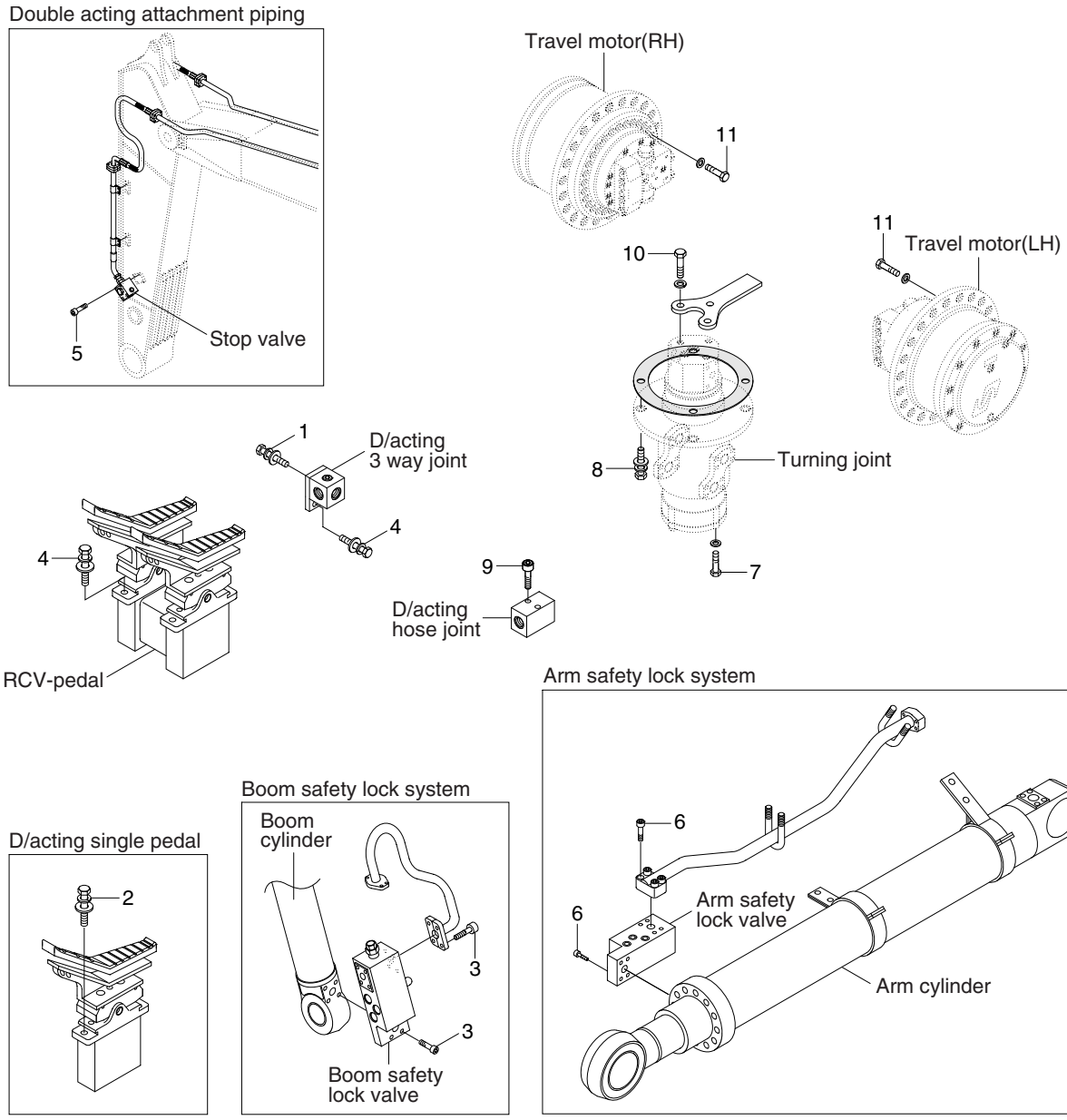
2209S9CM05

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 6×1.0	1.44±0.3	10.4±2.2
3	M 8×1.25	2.5±0.5	18.1±3.6
4	M10×1.5	4.8±0.3	34.7±2.2
5	M10×1.5	6.9±1.4	49.9±10.1
6	M12×1.75	12.3±1.3	89±9.4

Item	Size	kgf · m	lbf · ft
7	M12×1.75	14.7±2.2	106±15.9
8	M18×2.5	32±1.0	231±7.2
9	M20×2.5	42±4.5	304±32.5
10	M20×2.5	46±5.1	333±36.9
11	M20×2.5	58.4±6.4	422±46.3

HYDRAULIC COMPONENTS MOUNTING 2



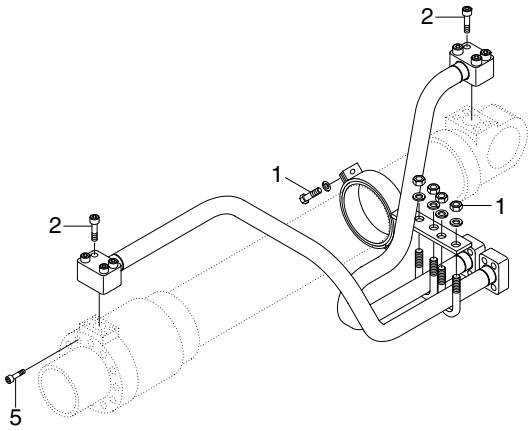
21099CM06

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M10×1.5	5.4±0.5	39±3.6
4	M10×1.5	6.9±1.4	49.9±10.1
5	M10×1.5	8.27±1.7	59.8±12.3
6	M12×1.75	9.4±1.0	68±7.2

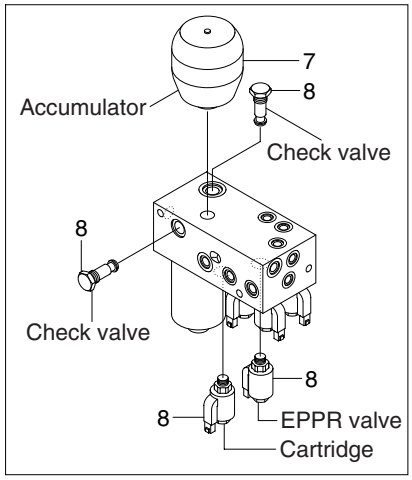
Item	Size	kgf · m	lbf · ft
7	M12×1.75	12.3±1.3	89±9.4
8	M12×1.75	12.8±3.0	92.6±21.7
9	M12×1.75	14.7±2.2	106±15.9
10	M14×2.0	19.6±2.9	142±21.0
11	M16×2.0	23.0±2.5	166±18.1

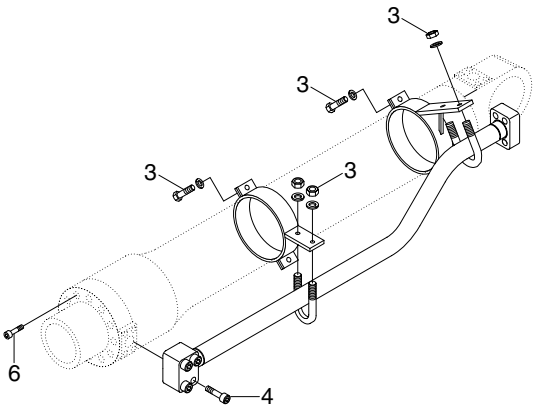
HYDRAULIC COMPONENTS MOUNTING 3



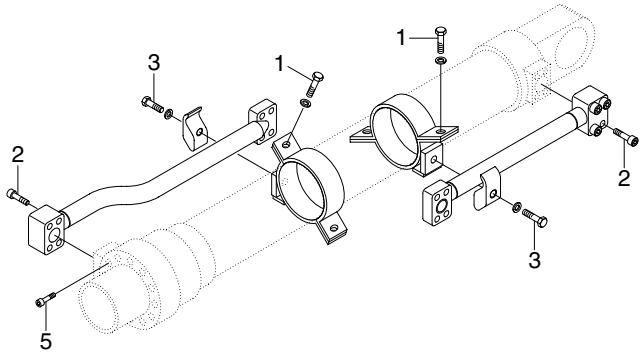
BOOM CYLINDER

Solenoid valve





ARM CYLINDER



BUCKET CYLINDER

21099CM07

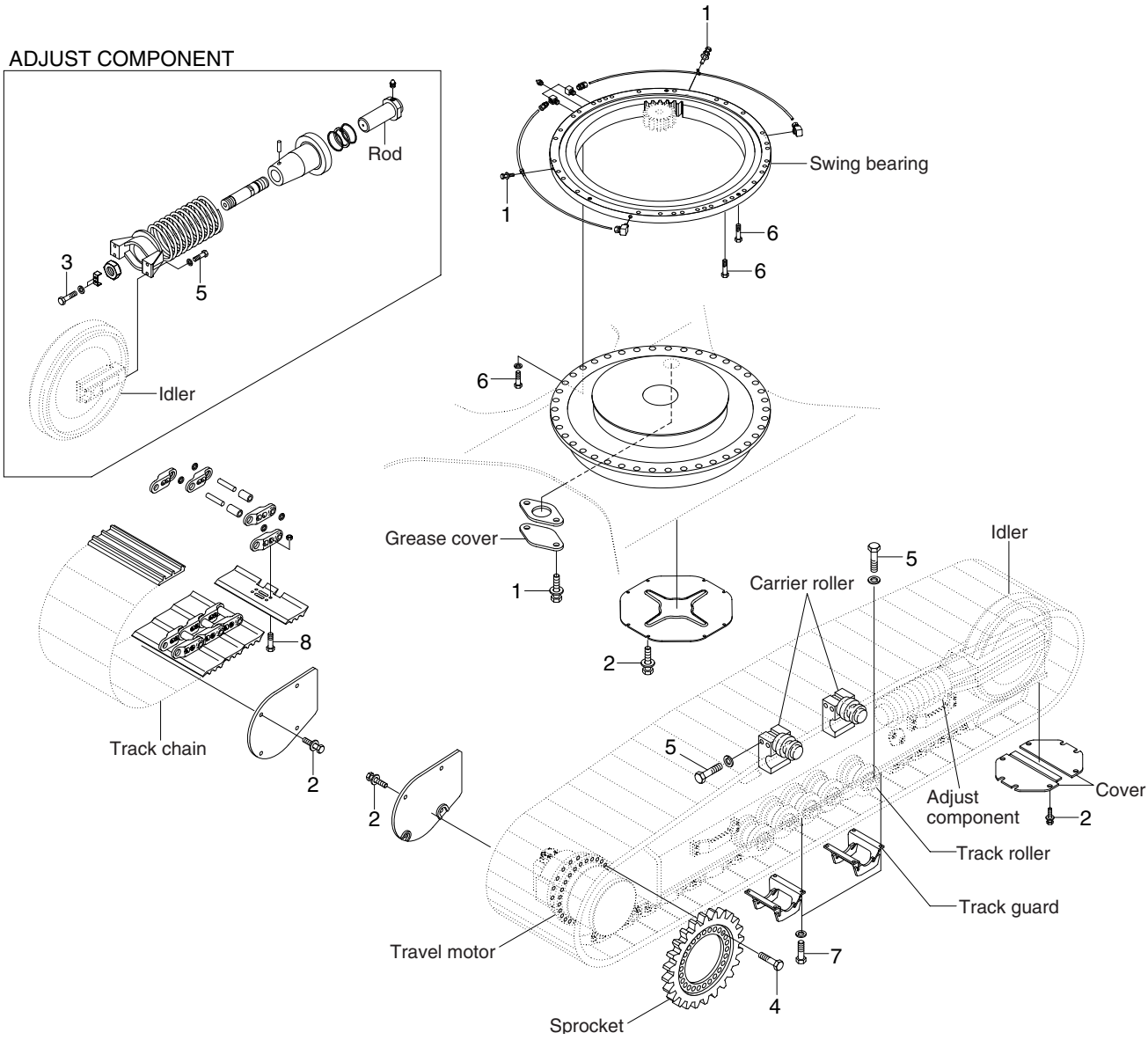
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	3.2±0.3	23.1±2.2
2	M10×1.5	5.4±0.5	39.1±3.6
3	M12×1.75	5.5±0.6	39.8±4.3
4	M12×1.75	9.4±1.0	68.0±7.2

Item	Size	kgf · m	lbf · ft
5	M16×2.0	23±2.0	166±14.5
6	M18×2.5	32±3.0	232±21.7
7	Accumulator	5.6±0.5	40.5±3.6
8	Check valve	2.5±0.5	18±3.6

GROUP 5 UNDERCARRIAGE

1. UNDERCARRIAGE MOUNTING



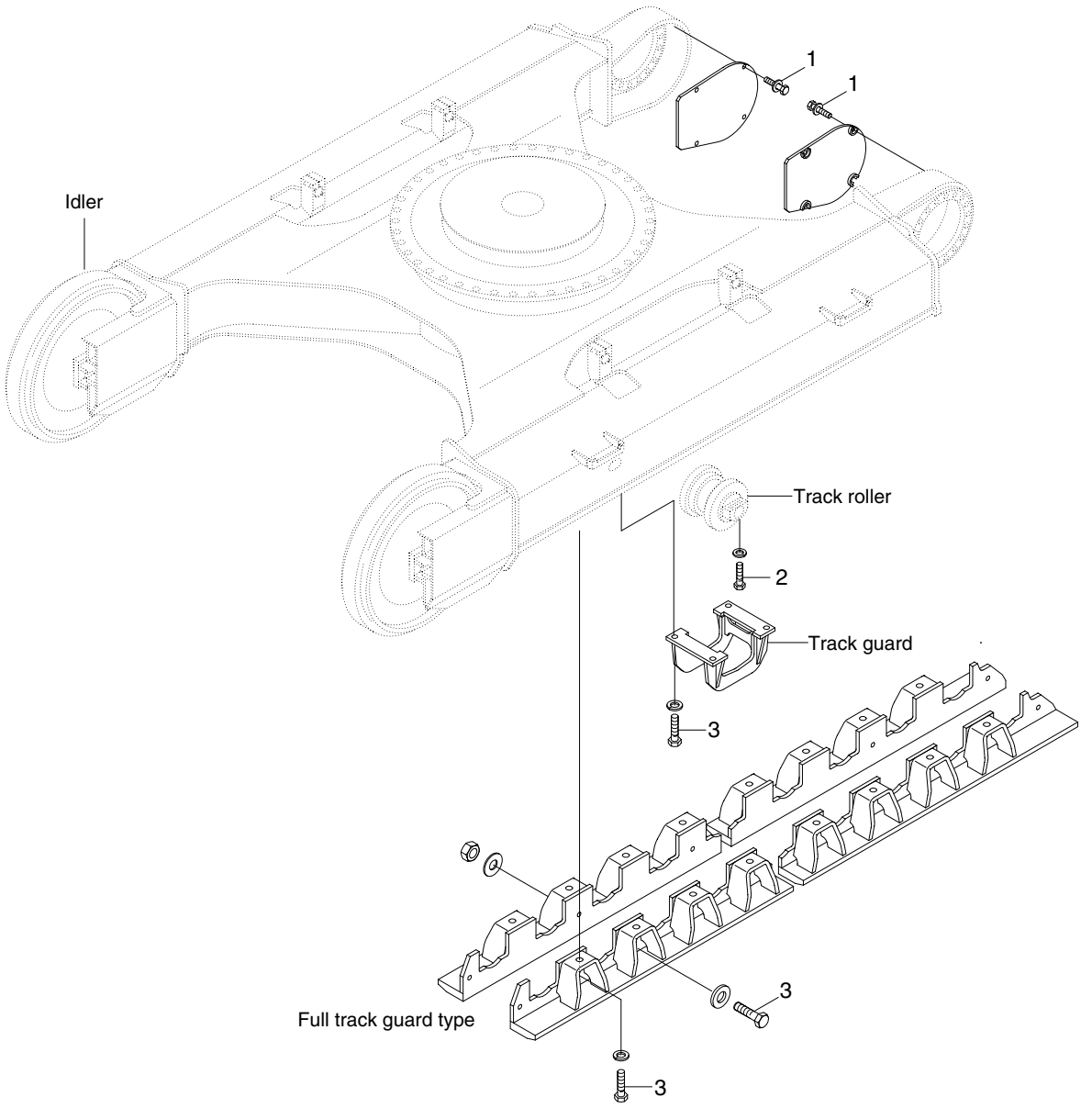
2209S9CM08

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M12×1.25	15±0.5	108±3.6
4	M16×2.0	26±2.5	188±18.1

Item	Size	kgf · m	lbf · ft
5	M16×2.0	29.7±4.5	215±32.5
6	M20×2.5	57.8±6.4	418±46.3
7	M20×2.5	57.9±8.7	419±62.9
8	M20×2.5	78±8.0	564±57.9

2. UNDERCARRIAGE MOUNTING (HIGH WALKER)



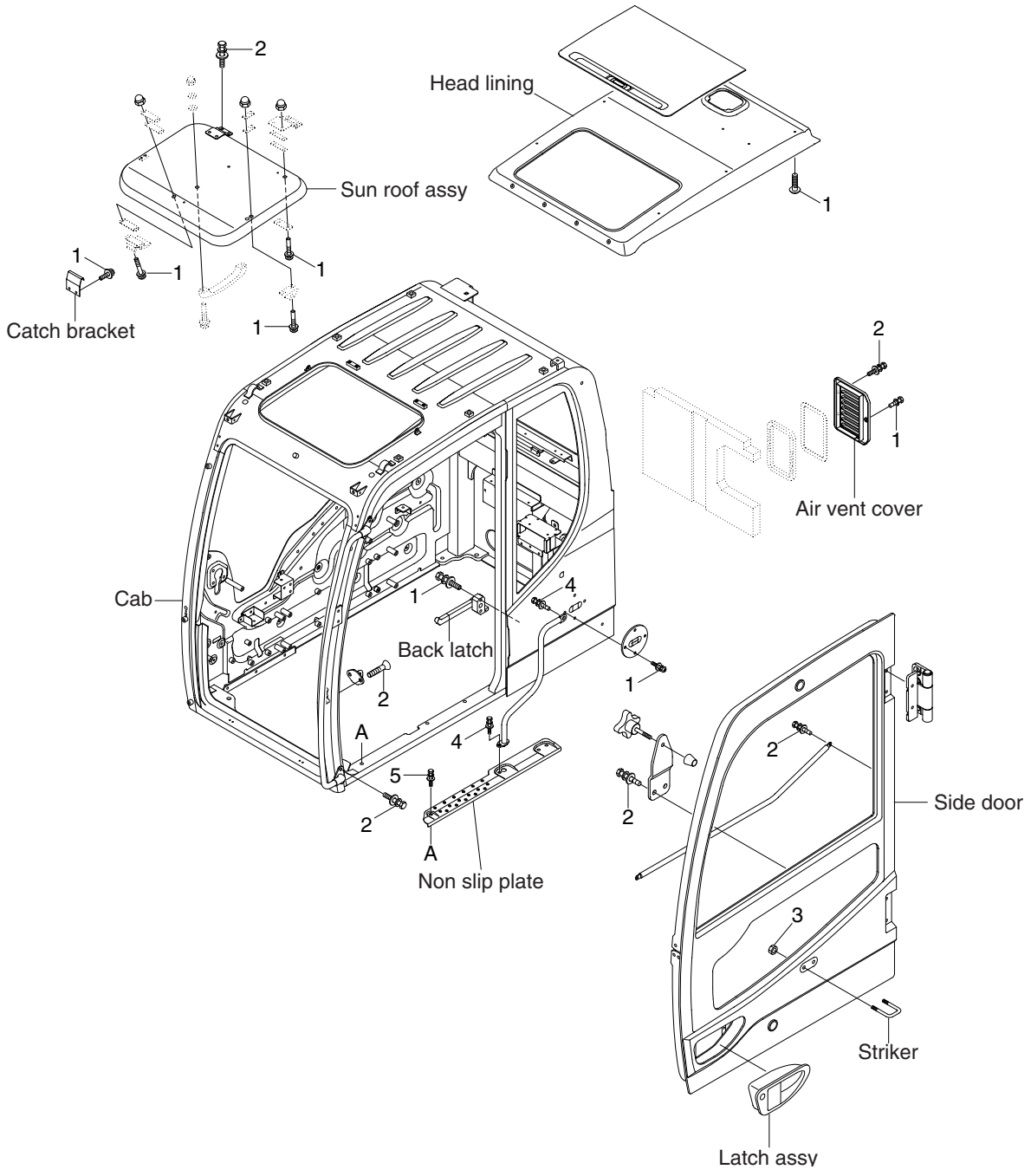
2209S9CM09

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M12×1.75	12.8±3.0	92.6±21.7
2	M20×2.5	29.7±4.5	215±32.5
3	M24×3.0	100±15	723±108

GROUP 6 STRUCTURE

1. CAB AND ACCESSORIES MOUNTING

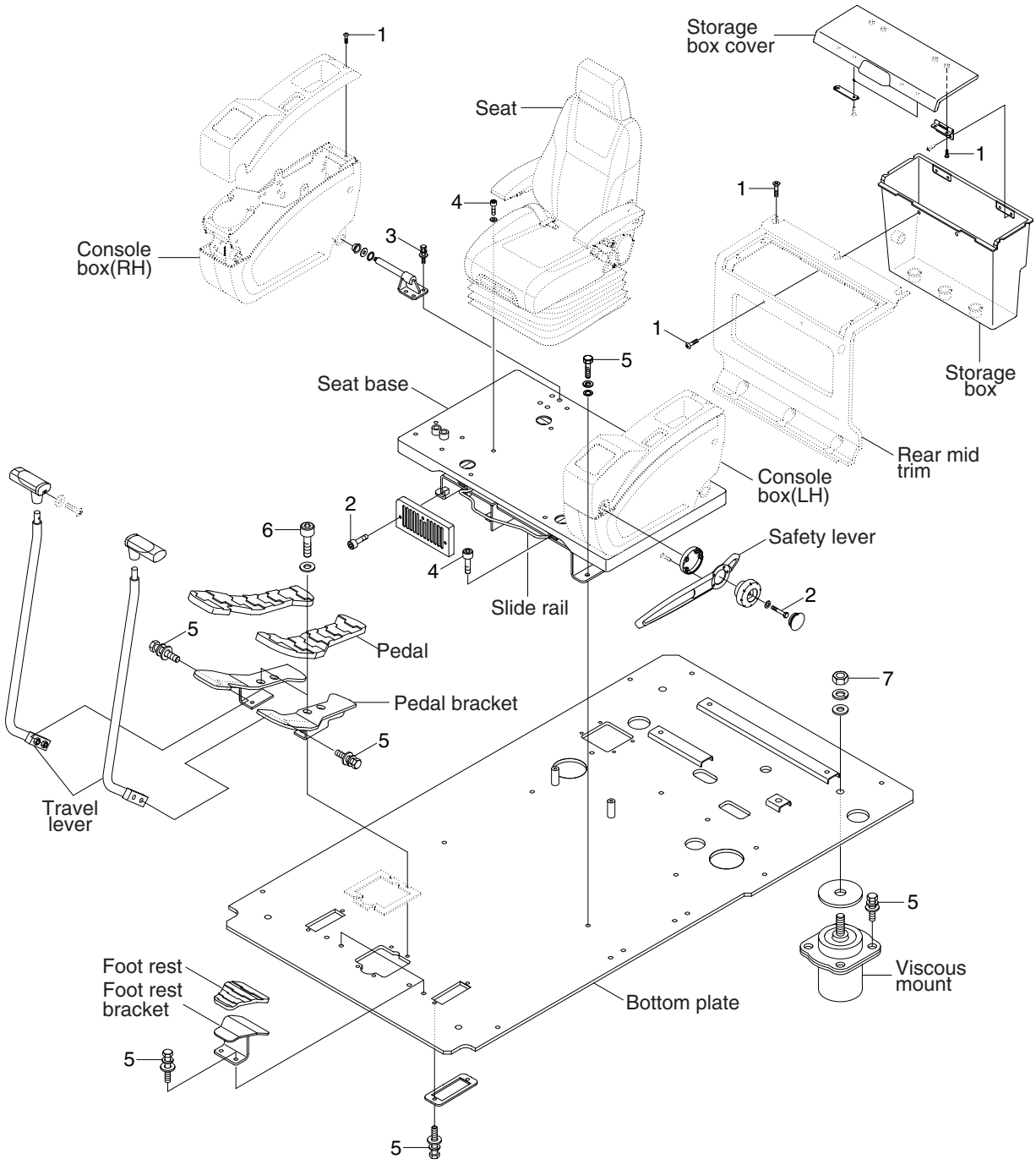


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.44±0.3	10.4±2.2
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	4.7±0.9	34±6.5

Item	Size	kgf · m	lbf · ft
4	M10×1.5	8.27±1.7	59.8±12.3
5	M12×1.75	12.8±3.0	92.6±21.7

2. CAB INTERIOR MOUNTING

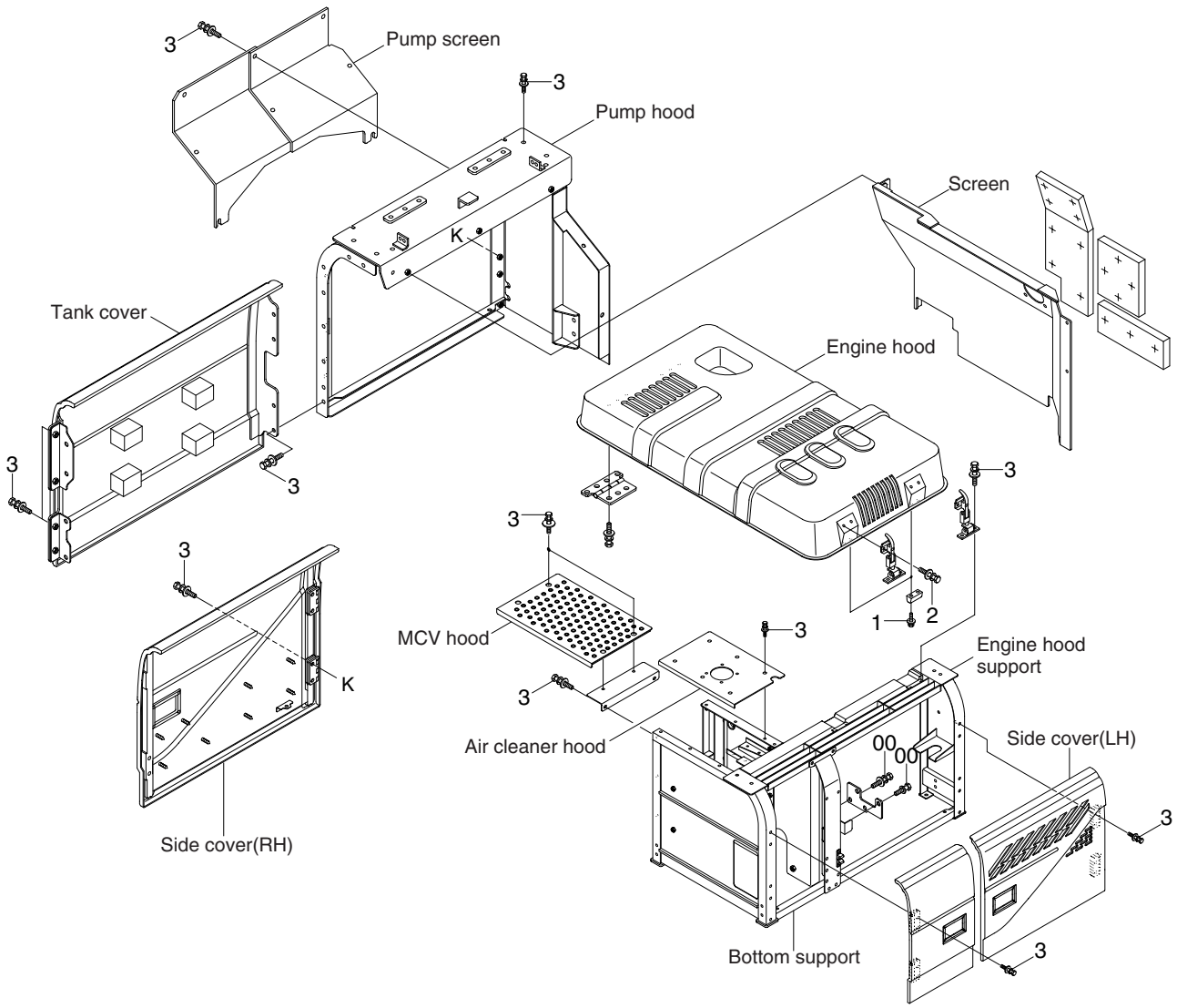


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	0.49±0.1	3.5±0.7
2	M 6×1.0	1.05±0.2	7.6±1.4
3	M 8×1.25	3.43±0.7	24.8±5.1
4	M 8×1.25	4.05±0.8	29.3±5.8

Item	Size	kgf · m	lbf · ft
5	M10×1.5	6.9±1.4	49.9±10.1
6	M10×1.5	8.27±1.7	59.8±12.3
7	M16×2.0	29.7±4.5	215±32.5

3. COWLING MOUNTING

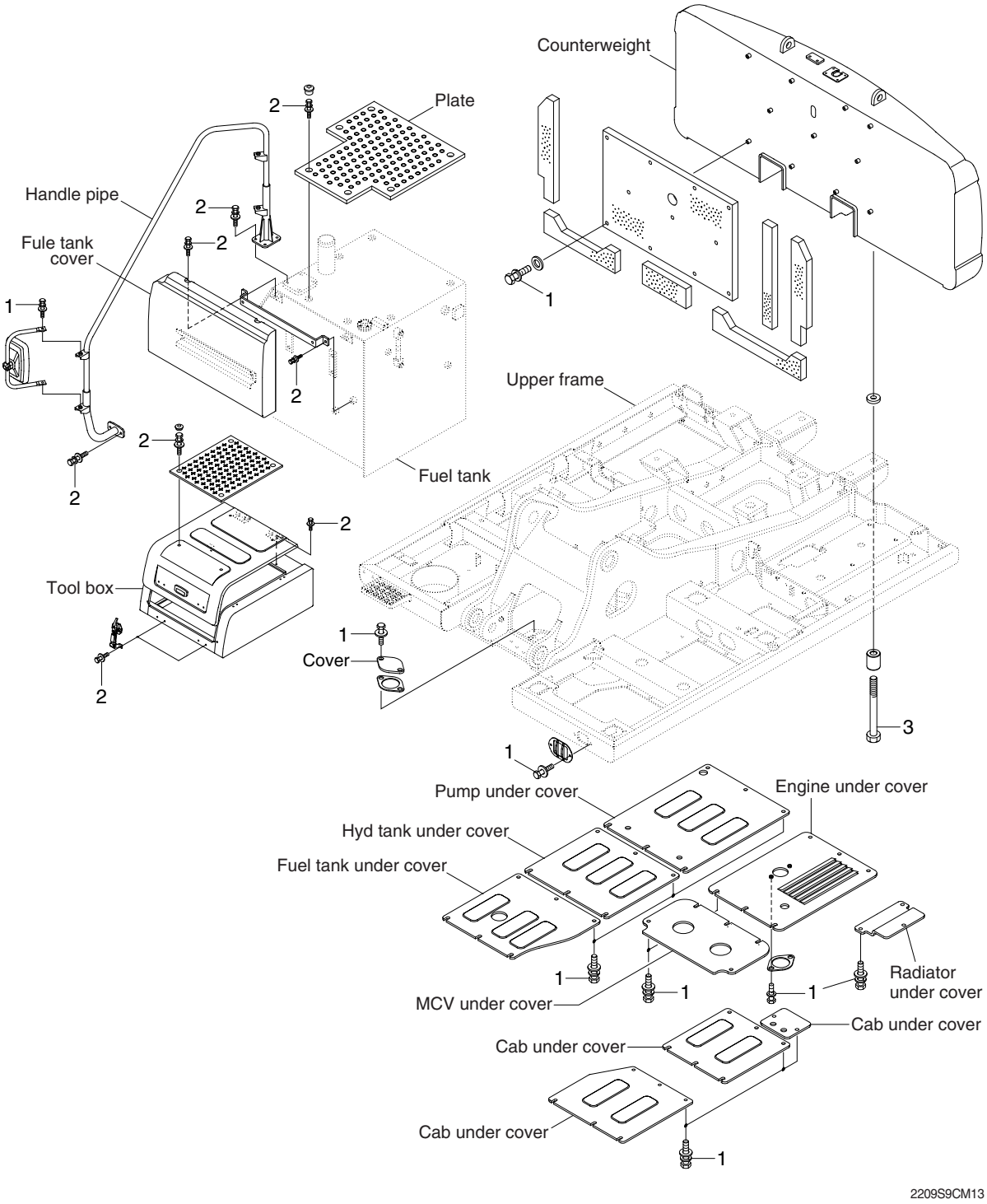


2209S9CM12

· Tightening torque

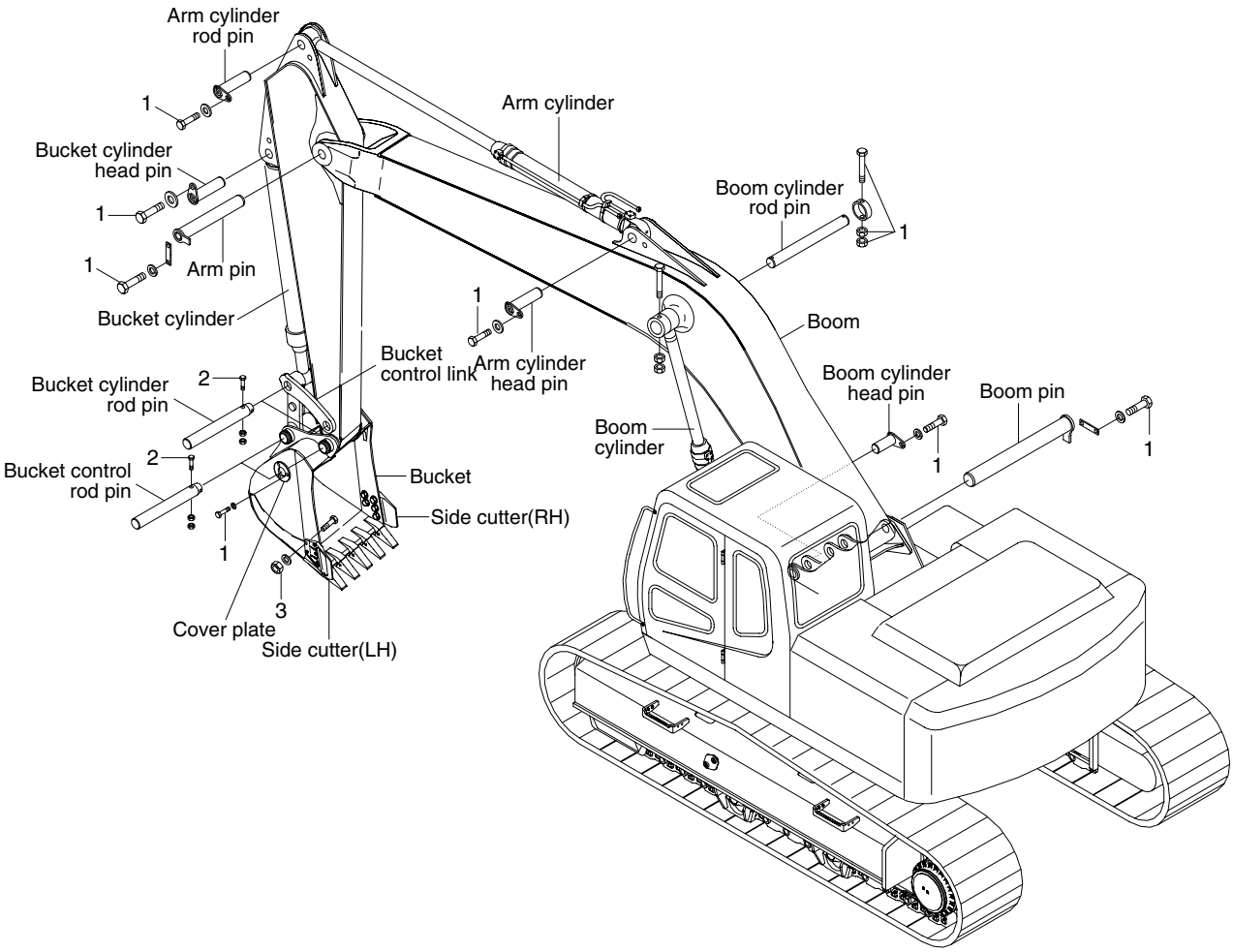
Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.4
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M12×1.75	12.8±3.0	92.6±21.7

4. COUNTERWEIGHT AND COVERS MOUNTING



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M36×3.0	340±10	2460±72.3



21099CM14

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M16×2.0	29.7±4.5	215±32.5
2	M20×2.5	57.9±8.7	419±62.9
3	M22×2.5	81.9±16.1	592±116