HYUNDAI

CONSTRUCTION EQUIPMENT

Service Manual



Hyundai R330LC-9S, R330NLC-9S Crawler Excavator

Service Repair Manual

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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

   2 - 3
   - 2 : Item number(2. Structure and Function)
   - 3 : 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
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

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

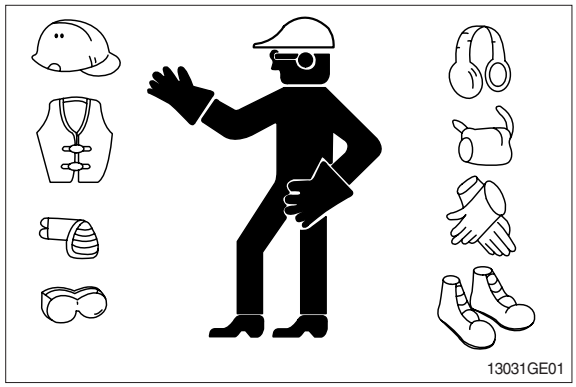
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

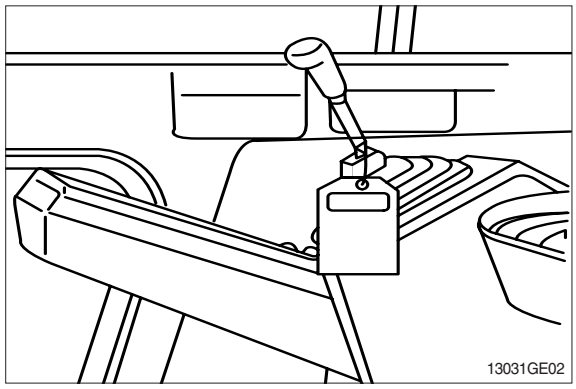
WEAR PROTECTIVE CLOTHING

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



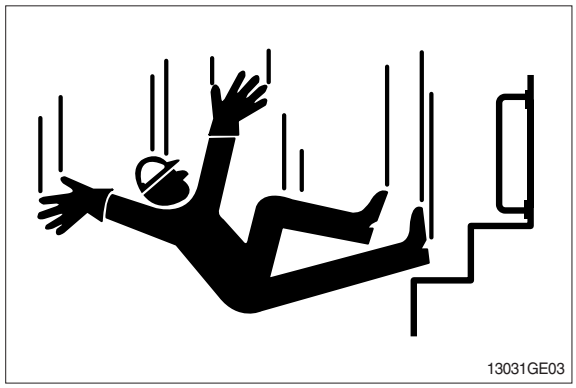
WARN OTHERS OF SERVICE WORK

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



USE HANDHOLDS AND STEPS

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

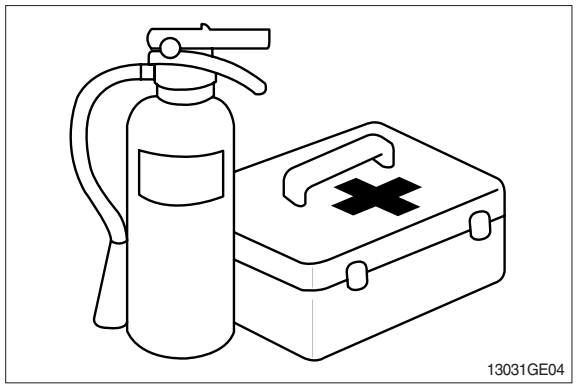


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

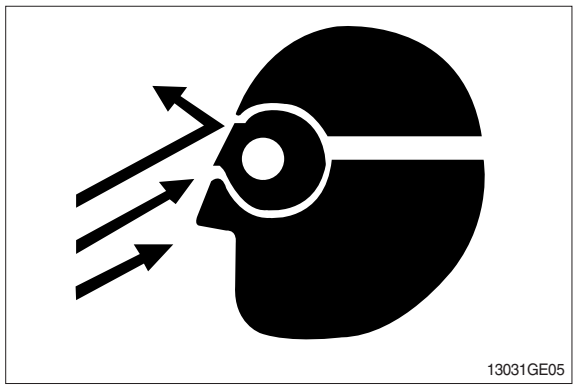
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

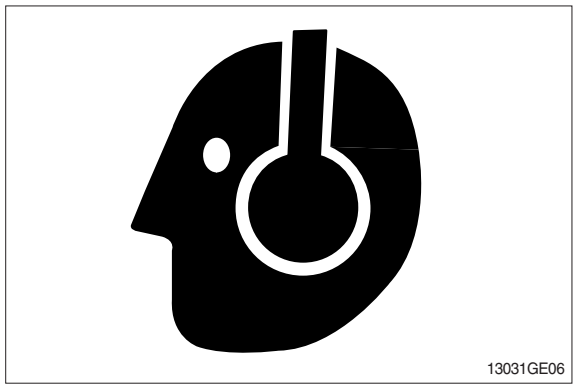
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

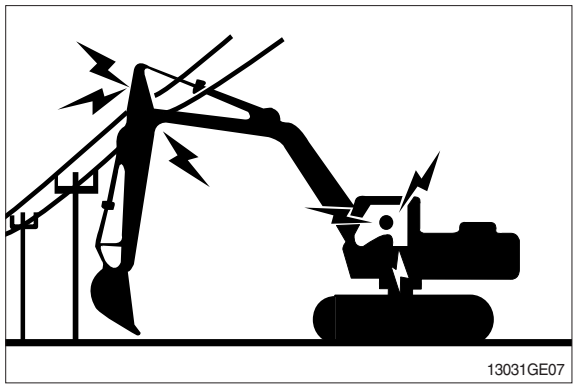
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

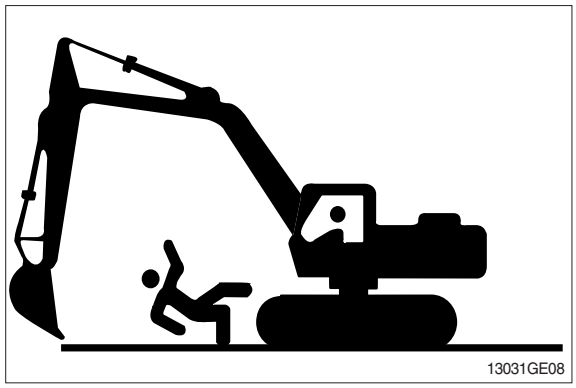
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



KEEP RIDERS OFF EXCAVATOR

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

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

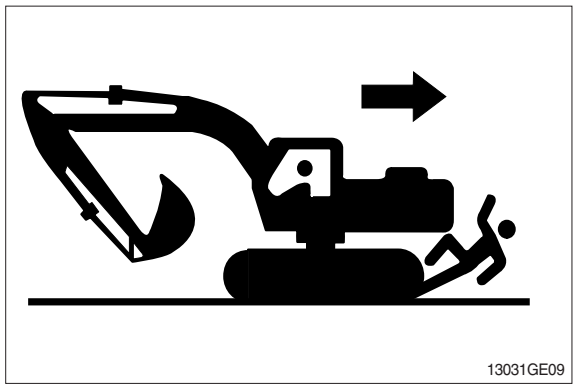

13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

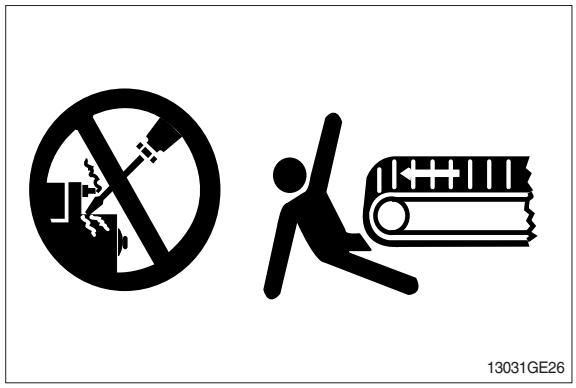
Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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


13031GE26

PARK MACHINE SAFELY

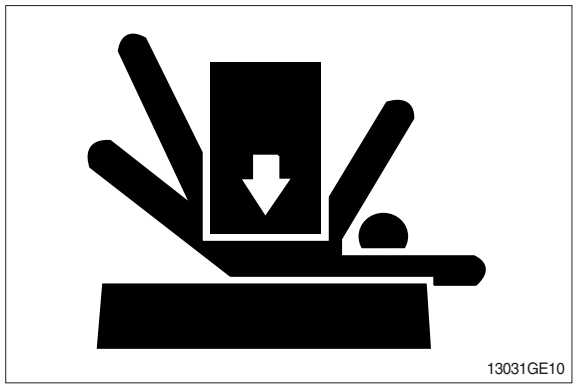
Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

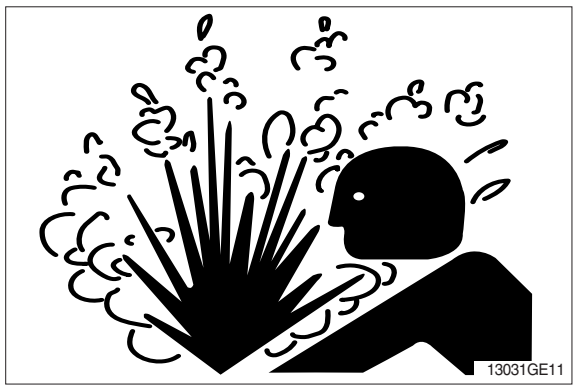
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.



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

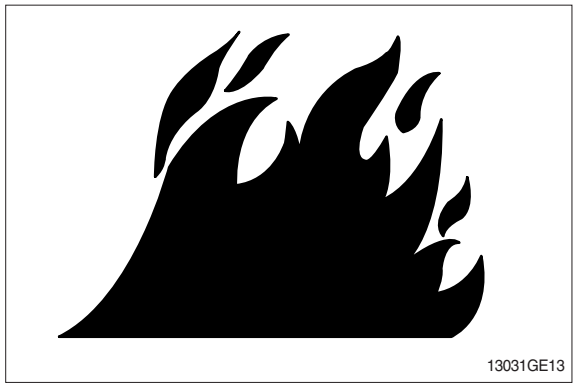
Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.



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

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

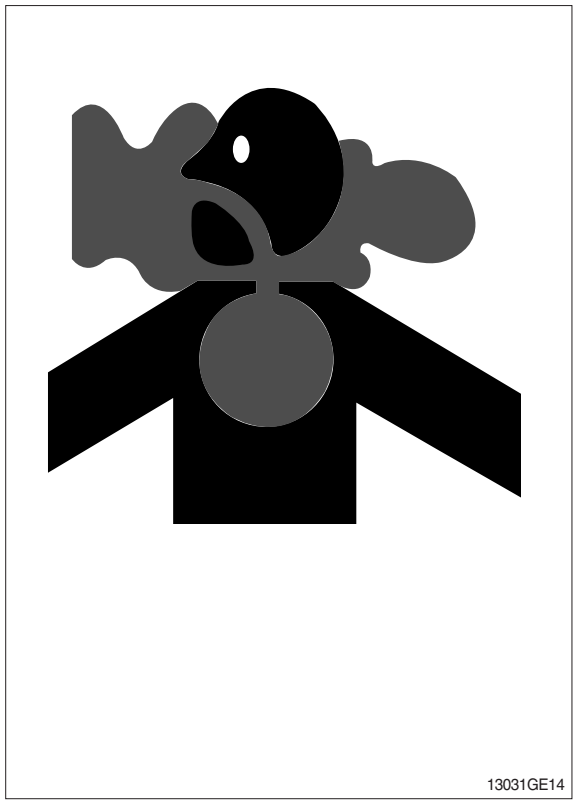
Do not store oily rags; They can ignite and burn spontaneously.



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.



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.

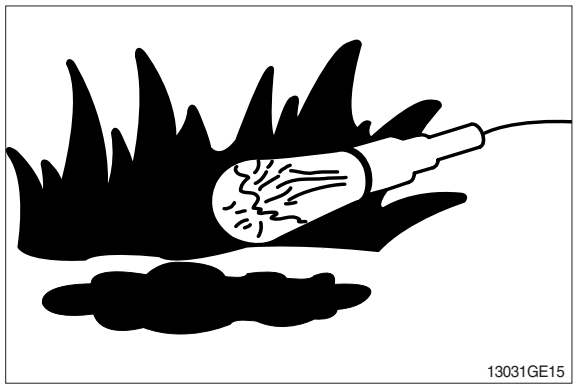
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

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

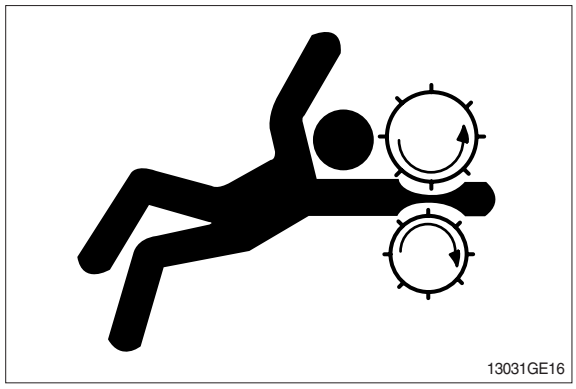
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



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.

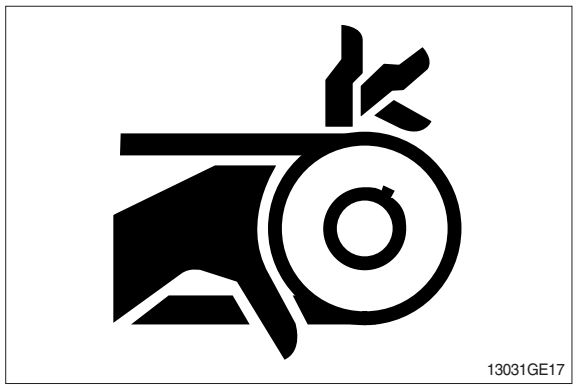
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



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

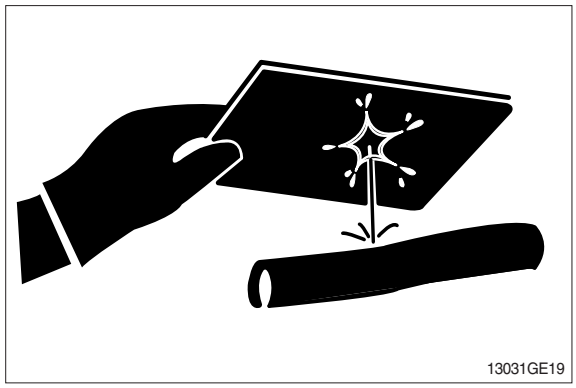
Escaping fluid under pressure can penetrate the skin causing serious injury.

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:

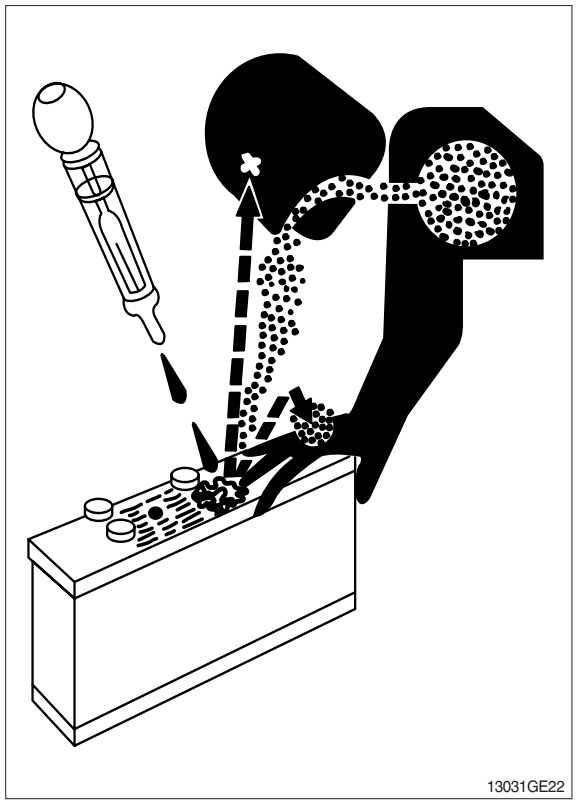
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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.



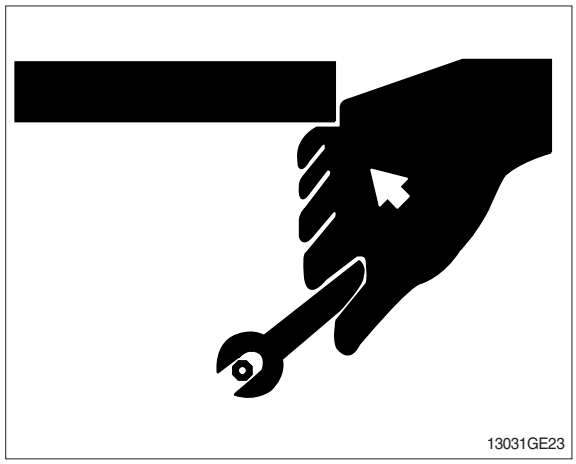
USE TOOLS PROPERLY

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.)

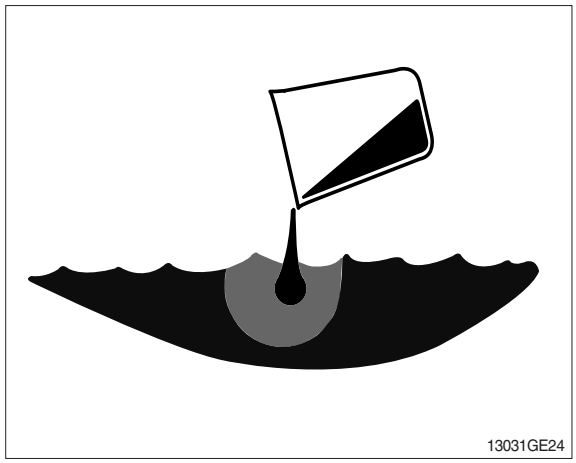


DISPOSE OF FLUIDS PROPERLY

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.

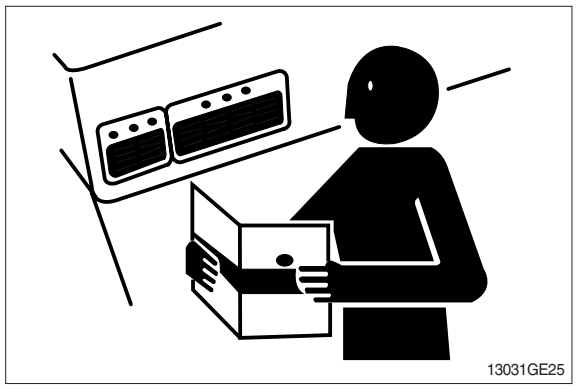
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

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.


13031GE24

REPLACE SAFETY SIGNS

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

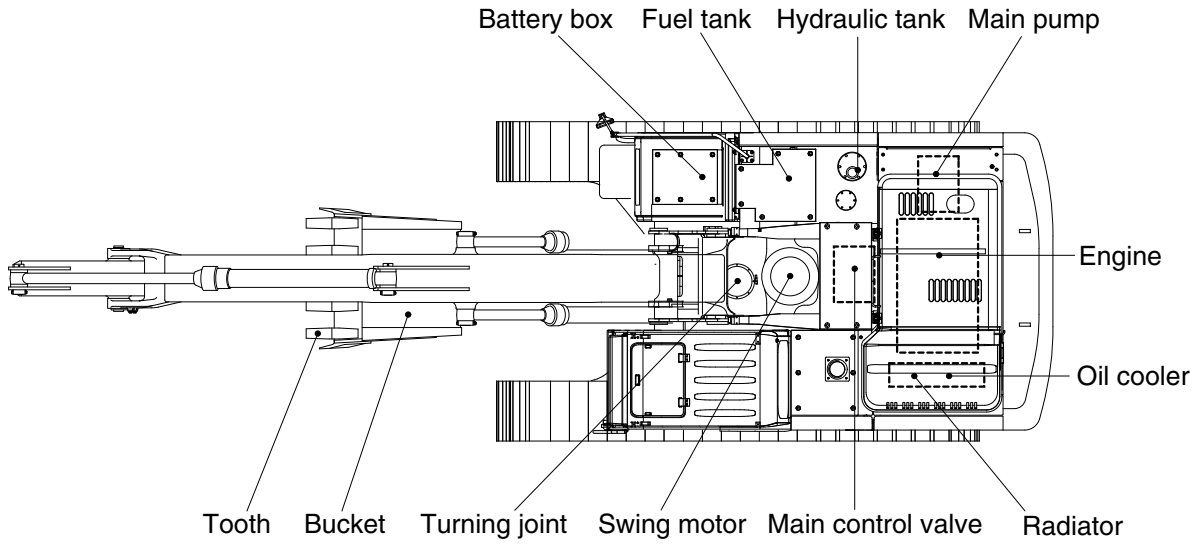

13031GE25

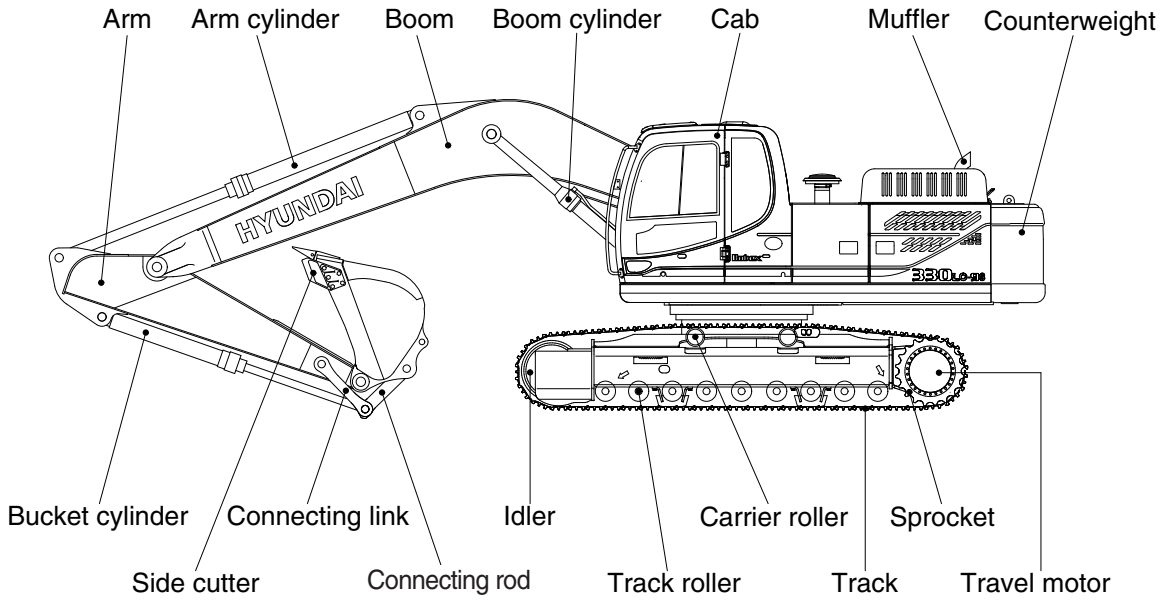
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT



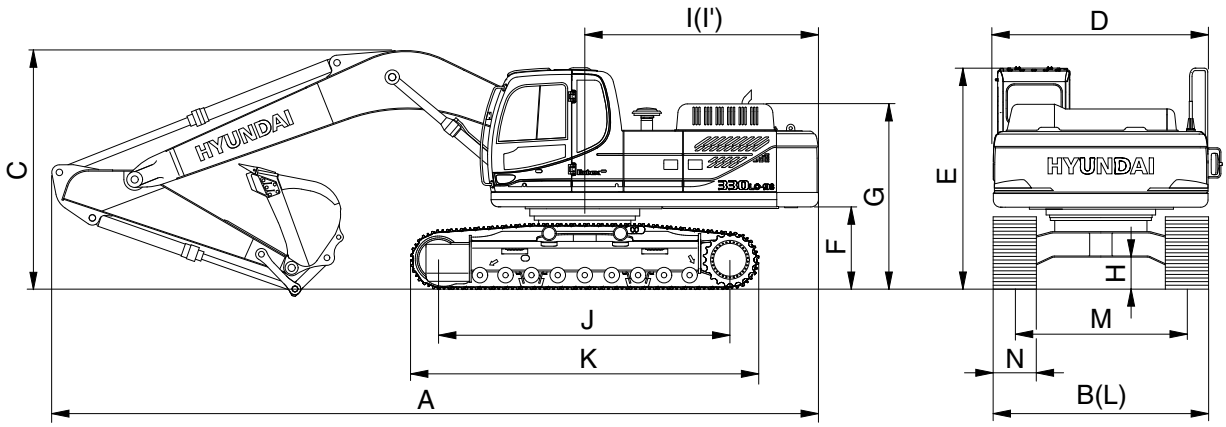


3309S2SP01

2. SPECIFICATIONS

1) R330LC-9S

· 6.45 m (21' 2") BOOM and 3.20 m (10' 6") ARM

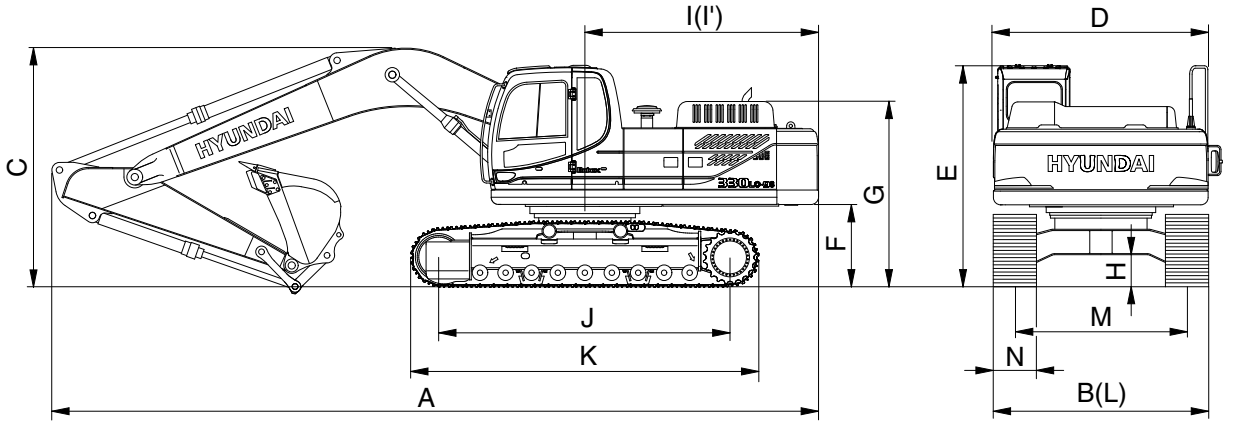


3309S2SP02

Description		Unit	Specification
Operating weight		kg (lb)	32700 (72090)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	1.44 (1.88)
Overall length	A	mm (ft-in)	10980 (36' 0")
Overall width, with 600 mm shoe	B		3280 (10' 9")
Overall height	C		3380 (11' 1")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3140 (10' 4")
Ground clearance of counterweight	F		1200 (3' 11")
Engine cover height	G		2580 (8' 6")
Minimum ground clearance	H		500 (1' 8")
Rear-end distance	I		3315 (10' 11")
Rear-end swing radius	I'		3380 (11' 1")
Distance between tumblers	J		4030 (13' 3")
Undercarriage length	K		4940 (16' 2")
Undercarriage width	L		3280 (10' 9")
Track gauge	M		2680 (8' 10")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.8 (2.1/3.6)
Swing speed		rpm	9.5
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.63 (8.96)
Max traction force		kg (lb)	29500 (65040)

2) R330NLC-9S

· 6.45 m (21' 2") BOOM and 3.20 m (10' 6") ARM

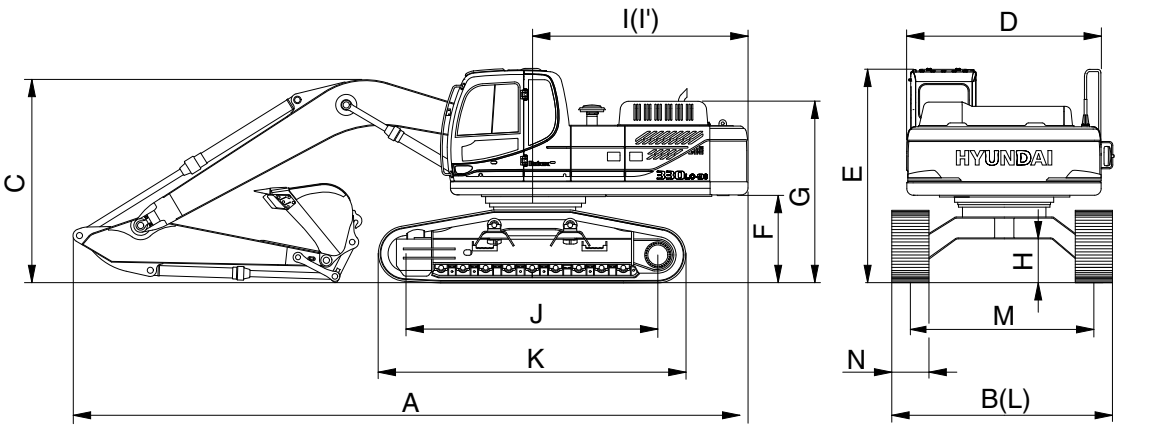


3309S2SP03

Description		Unit	Specification
Operating weight		kg (lb)	32500 (71650)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	1.44 (1.88)
Overall length	A	mm (ft-in)	10980 (36' 0")
Overall width, with 600 mm shoe	B		2990 (9' 10")
Overall height	C		3380 (11' 1")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3140 (10' 4")
Ground clearance of counterweight	F		1200 (3' 11")
Engine cover height	G		2580 (8' 6")
Minimum ground clearance	H		500 (1' 8")
Rear-end distance	I		3315 (10' 11")
Rear-end swing radius	I'		3380 (11' 1")
Distance between tumblers	J		4030 (13' 3")
Undercarriage length	K		4940 (16' 2")
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)	3.3/5.8 (2.1/3.6)
Swing speed		rpm	9.5
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.62 (8.82)
Max traction force		kg (lb)	29500 (65040)

3) R330LC-9S HIGH WALKER

· 6.45 m (21' 2") BOOM and 3.20 m (10' 6") ARM

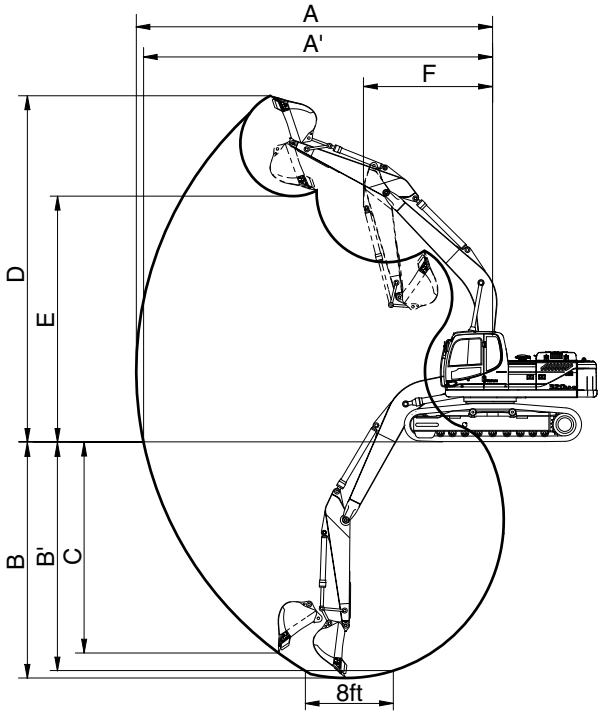


3309S2SP04

Description		Unit	Specification
Operating weight		kg (lb)	35200 (77600)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	1.44 (1.88)
Overall length	A	mm (ft-in)	10910 (35' 10")
Overall width, with 600 mm shoe	B		3470 (11' 5")
Overall height	C		3360 (11' 0")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3390 (11' 1")
Ground clearance of counterweight	F		1500 (4' 11")
Engine cover height	G		2880 (9' 5")
Minimum ground clearance	H		765 (2' 6")
Rear-end distance	I		3315 (10' 11")
Rear-end swing radius	I'		3380 (11' 1")
Distance between tumblers	J		4030 (13' 3")
Undercarriage length	K		4940 (16' 2")
Undercarriage width	L		3470 (11' 5")
Track gauge	M		2870 (9' 5")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.3/5.8 (2.1/3.6)
Swing speed		rpm	9.5
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.68 (9.67)
Max traction force		kg (lb)	29500 (65040)

3. WORKING RANGE

1) R330LC-9S, R330NLC-9S

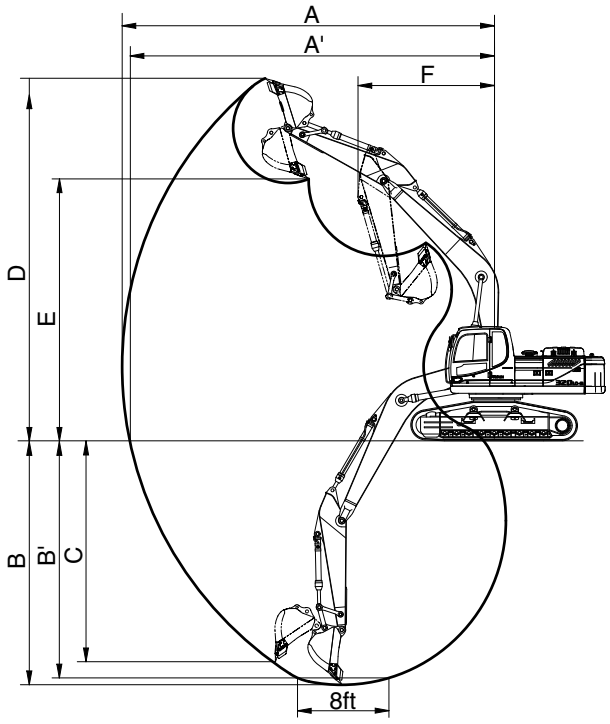


32092SP05

Description		6.45 m (21' 2") Arm				6.15 m (20' 2") Boom
		2.2 m (7' 3") Arm	2.5 m (8' 2") Arm	3.2 m (10' 6") Arm	4.05 m (13' 3") Arm	2.2 m (7' 3") Arm
Max digging reach	A	10330 mm (33'11")	10550 mm (34' 7")	11140 mm (36' 7")	11950 mm (39' 2")	10020 mm (32'10")
Max digging reach on ground	A'	10110 mm (33' 2")	10330 mm (33'11")	10940 mm (35'11")	11760 mm (38' 7")	9800 mm (32' 2")
Max digging depth	B	6370 mm (20'11")	6670 mm (21'11")	7370 mm (24' 2")	8220 mm (27' 0")	6160 mm (20' 3")
Max digging depth (8ft level)	B'	6160 mm (20' 3")	6470 mm (21' 3")	7210 mm (23' 8")	8080 mm (26' 6")	5950 mm (19' 6")
Max vertical wall digging depth	C	5980 mm (19' 7")	5920 mm (19' 5")	6360 mm (20'10")	7260 mm (23'10")	5710 mm (18' 9")
Max digging height	D	10220 mm (33' 6")	10170 mm (33' 4")	10310 mm (33'10")	10710 mm (35' 2")	9940 mm (32' 7")
Max dumping height	E	7050 mm (23' 2")	7050 mm (23' 2")	7240 mm (23' 9")	7630 mm (25' 0")	6780 mm (22' 3")
Min swing radius	F	4700 mm (15' 5")	4500 mm (14' 9")	4470 mm (14' 8")	4470 mm (14' 8")	4520 mm (14'10")
Bucket digging force	SAE	189.3 [205.5] kN	189.3 [205.5] kN	189.3 [205.5] kN	189.3 [205.5] kN	189.3 [205.5] kN
		19300 [20950] kgf	19300 [20950] kgf	19300 [20950] kgf	19300 [20950] kgf	19300 [20950] kgf
		42560 [46200] lbf	42560 [46200] lbf	42560 [46200] lbf	42560 [46200] lbf	42560 [46200] lbf
	ISO	211.8 [230.0] kN	211.8 [230.0] kN	211.8 [230.0] kN	211.8 [230.0] kN	211.8 [230.0] kN
		21600 [23450] kgf	21600 [23450] kgf	21600 [23450] kgf	21600 [23450] kgf	21600 [23450] kgf
		47610 [51700] lbf	47610 [51700] lbf	47610 [51700] lbf	47610 [51700] lbf	47610 [51700] lbf
Arm crowd force	SAE	196.6 [213.4] kN	178.9 [194.2] kN	143.2 [155.5] kN	119.6 [129.9] kN	196.6 [213.4] kN
		20000 [21760] kgf	18200 [19810] kgf	14600 [15860] kgf	12200 [13240] kgf	20000 [21760] kgf
		44190 [47980] lbf	40220 [43670] lbf	32190 [34960] lbf	26890 [29190] lbf	44190 [47980] lbf
	ISO	202.8 [220.2] kN	185.1 [201.0] kN	147.1 [159.7] kN	122.7 [133.3] kN	202.8 [220.2] kN
		20700 [22450] kgf	18900 [20500] kgf	15000 [16280] kgf	12515 [13590] kgf	20700 [22450] kgf
		45600 [49510] lbf	41620 [45190] lbf	33070 [35900] lbf	27590 [29950] lbf	45600 [49510] lbf

[ ] : Power boost

2) R330LC-9S HIGH WALKER



32092SP06

Description		6.45 m (21' 2") Arm				6.15 m (20' 2") Boom
		2.2 m (7' 3") Arm	2.5 m (8' 2") Arm	3.2 m (10' 6") Arm	4.05 m (13' 3") Arm	2.2 m (7' 3") Arm
Max digging reach	A	10330 mm (33'11")	10550 mm (34' 7")	11140 mm (36' 7")	11950 mm (39' 2")	10020 mm (32'10")
Max digging reach on ground	A'	10040 mm (32'11")	10270 mm (33' 8")	10880 mm (35' 8")	11710 mm (38' 5")	9730 mm (31'11")
Max digging depth	B	6100 mm (20' 0")	6400 mm (21' 0")	7100 mm (23' 4")	7950 mm (26' 1")	5880 mm (19' 3")
Max digging depth (8ft level)	B'	5890 mm (19' 4")	6200 mm (20' 4")	6940 mm (22' 9")	7800 mm (25' 7")	5680 mm (18' 8")
Max vertical wall digging depth	C	5700 mm (18' 8")	5650 mm (18' 6")	6080 mm (19'11")	6980 mm (22'11")	5440 mm (17'10")
Max digging height	D	10500 mm (34' 5")	10450 mm (34' 3")	10590 mm (34' 9")	10990 mm (36' 1")	10220 mm (33' 6")
Max dumping height	E	7330 mm (24' 1")	7330 mm (24' 1")	7520 mm (24' 8")	7910 mm (25'11")	7060 mm (23' 2")
Min swing radius	F	4700 mm (15' 5")	4500 mm (14' 9")	4470 mm (14' 8")	4470 mm (14' 8")	4520 mm (14'10")
Bucket digging force	SAE	189.3 [205.5] kN	189.3 [205.5] kN	189.3 [205.5] kN	189.3 [205.5] kN	189.3 [205.5] kN
		19300 [20950] kgf	19300 [20950] kgf	19300 [20950] kgf	19300 [20950] kgf	19300 [20950] kgf
		42550 [46200] lbf	42550 [46200] lbf	42550 [46200] lbf	42550 [46200] lbf	42550 [46200] lbf
	ISO	211.8 [230.0] kN	211.8 [230.0] kN	211.8 [230.0] kN	211.8 [230.0] kN	211.8 [230.0] kN
		21600 [23450] kgf	21600 [23450] kgf	21600 [23450] kgf	21600 [23450] kgf	21600 [23450] kgf
		47620 [51700] lbf	47620 [51700] lbf	47620 [51700] lbf	47620 [51700] lbf	47620 [51700] lbf
Arm crowd force	SAE	196.6 [213.4] kN	178.9 [194.2] kN	143.2 [155.5] kN	119.6 [129.9] kN	196.6 [213.4] kN
		20000 [21760] kgf	18200 [19810] kgf	14600 [15850] kgf	12200 [13240] kgf	20000 [21760] kgf
		44190 [47980] lbf	40220 [43670] lbf	32190 [34950] lbf	26890 [29190] lbf	44190 [47980] lbf
	ISO	202.8 [220.2] kN	185.1 [201.0] kN	147.1 [159.7] kN	122.7 [133.3] kN	202.8 [220.2] kN
		20700 [22450] kgf	18900 [20500] kgf	15000 [16290] kgf	12515 [13590] kgf	20700 [22450] kgf
		45600 [49510] lbf	41620 [45190] lbf	33070 [35900] lbf	27590 [29950] lbf	45600 [49510] lbf

[ ] : Power boost

4. WEIGHT

1) R330LC-9S, R330NLC-9S

Item	R330LC-9S		R330NLC-9S	
	kg	lb	kg	lb
Upperstructure assembly	14390	31720	←	←
Main frame weld assembly	3760	8290	←	←
Engine assembly	620	1370	←	←
Main pump assembly	200	440	←	←
Main control valve assembly	220	490	←	←
Swing motor assembly	370	820	←	←
Hydraulic oil tank assembly	230	490	←	←
Fuel tank assembly	210	450	←	←
Counterweight	6200	13670	←	←
Cab assembly	490	1080	←	←
Radiator total assy	280	620	←	←
Lower chassis assembly	11500	25770	11360	25040
Track frame weld assembly	3970	8750	3835	8450
Swing bearing	410	900	←	←
Travel motor assembly	360	800	←	←
Turning joint	50	110	←	←
Tension cylinder	210	450	←	←
Idler	250	540	←	←
Sprocket	80	170	←	←
Carrier roller	40	80	←	←
Track roller	60	120	←	←
Track-chain assembly (600 mm standard triple grouser shoe)	1860	4100	←	←
Front attachment assembly (6.45 m boom, 3.2 m arm, 1.44 m^3 SAE heaped bucket)	6390	14090	←	←
6.45 m boom assembly	2540	5600	←	←
3.2 m arm assembly	1160	2560	←	←
1.44 m^3 SAE heaped bucket	1120	2470	←	←
Boom cylinder assembly	300	660	←	←
Arm cylinder assembly	380	840	←	←
Bucket cylinder assembly	270	570	←	←
Bucket control linkage assembly	370	820	←	←

2) R330LC-9S HIGH WALKER

Item	kg	lb
Upperstructure assembly	14790	32600
Main frame weld assembly	3760	8290
Engine assembly	620	1370
Main pump assembly	200	440
Main control valve assembly	220	490
Swing motor assembly	370	820
Hydraulic oil tank assembly	230	490
Fuel tank assembly	210	450
Counterweight	6600	14550
Cab assembly	490	1080
Radiator total assy	280	620
Lower chassis assembly	14000	30860
Track frame weld assembly	6180	13620
Swing bearing	410	900
Travel motor assembly	360	800
Turning joint	50	110
Tension cylinder	210	450
Idler	250	540
Sprocket	80	170
Carrier roller	40	80
Track roller	60	120
Track-chain assembly (600 ㎜ standard triple grouser shoe)	1860	4100
Front attachment assembly (6.45 m boom, 3.2 m arm, 1.44 m^3 SAE heaped bucket)	6390	14090
6.45 m boom assembly	2540	5600
3.2 m arm assembly	1160	2560
1.44 m^3 SAE heaped bucket	1120	2470
Boom cylinder assembly	300	660
Arm cylinder assembly	380	840
Bucket cylinder assembly	270	570
Bucket control linkage assembly	370	820

5. LIFTING CAPACITIES

1) R330LC-9S

(1) 6.15 m (20' 2") boom, 2.2 m (7' 3") arm equipped with 1.44 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

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

Load point height		Load radius								At max. reach		
		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0m (20.0 ft)		7.5 m (25.0 ft)		Capacity		Reach
												m (ft)
7.5 m (25.0 ft)	kg									*7480	5800	7.69
	lb									*16490	12790	(25.2)
6.0 m (20.0 ft)	kg					*8380	*8380	*8070	5900	7160	4610	8.61
	lb					*18470	*18470	*17790	13010	15790	10160	(28.2)
4.5 m (15.0 ft)	kg			*12080	*12080	*9630	8430	*8490	5760	6330	4020	9.16
	lb			*26630	*26630	*21230	18580	*18720	12700	13960	8860	(30.1)
3.0 m (10.0 ft)	kg			*15590	12350	*11230	7930	8690	5530	5960	3740	9.39
	lb			*34370	27230	*24760	17480	19160	12190	13140	8250	(30.8)
1.5 m (5.0 ft)	kg			*18040	11560	12140	7500	8450	5310	5930	3710	9.35
	lb			*39770	25490	26760	16530	18630	11710	13070	8180	(30.7)
Ground Line	kg			*18760	11280	11850	7250	8280	5160	6250	3910	9.02
	lb			*41360	24870	26120	15980	18250	11380	13780	8620	(29.6)
-1.5 m (-5.0 ft)	kg	*16910	*16910	*18280	11280	11760	7170	8240	5130	7070	4450	8.37
	lb	*37280	*37280	*40300	24870	25930	15810	18170	11310	15590	9810	(27.5)
-3.0 m (-10 ft)	kg	*22970	*22970	*16680	11470	11870	7270			*8360	5670	7.29
	lb	*50640	*50640	*36770	25290	26170	16030			*18430	12500	(23.9)
-4.5 m (-15.0 ft)	kg	*17920	*17920	*13190	11900							
	lb	*39510	*39510	*29080	26230							

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) 6.45 m (21' 2") boom, 3.2 m (10' 6") arm equipped with 1.44 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

Load point height		Load radius												At max. reach		
		1.5 m (5.0 ft)		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		7.5 m (25.0 ft)		9.0 m (30.0 ft)		Capacity		Reach
																m (ft)
7.5 m (25.0 ft)	kg									*5240	*5240			*5970	4280	9.06
	lb									*11550	*11550			*13160	9440	(29.7)
6.0 m (20.0 ft)	kg									*6500	5990			5630	3540	9.84
	lb									*14330	13210			12410	7800	(32.3)
4.5 m (15.0 ft)	kg							*8090	*8090	*7190	5740	*5440	4060	5070	3130	10.31
	lb							*17840	*17840	*15850	12650	*11990	8950	11180	6900	(33.8)
3.0 m (10.0 ft)	kg					*13400	12410	*9820	7840	*8110	5420	6270	3910	4790	2920	10.52
	lb					*29540	27360	*21650	17280	*17880	11950	13820	8620	10560	6440	(34.5)
1.5 m (5.0 ft)	kg					*16400	11330	*11460	7290	8260	5120	6100	3750	4740	2860	10.48
	lb					*36160	24980	*25260	16070	18210	11290	13450	8270	10450	6310	(34.4)
Ground Line	kg			*10240	*10240	*17910	10800	11500	6920	8000	4890	5960	3620	4920	2970	10.19
	lb			*22580	*22580	*39480	23810	25350	15260	17640	10780	13140	7980	10850	6550	(33.4)
-1.5 m (-5.0 ft)	kg	*11380	*11380	*14470	*14470	*18150	10650	11300	6740	7870	4760			5400	3270	9.63
	lb	*25090	*25090	*31900	*31900	*40010	23480	24910	14860	17350	10490			11900	7210	(31.6)
-3.0 m (-10.0 ft)	kg	*15350	*15350	*19470	*19470	*17370	10730	11300	6740	7880	4770			6380	3920	8.74
	lb	*33840	*33840	*42920	*42920	*38290	23660	24910	14860	17370	10520			14070	8640	(28.7)
-4.5 m (-15.0 ft)	kg			*21820	*21820	*15410	11010	*11230	6920					*7480	5360	7.37
	lb			*48100	*48100	*33970	24270	*25200	15260					*16490	11820	(24.2)
-6.0 m (-20.0 ft)	kg					*11340	*11340									
	lb					*25000	*25000									

2) R330NLC-9S

(1) 6.15 m (20' 2") boom, 2.2 m (7' 3") arm equipped with 1.44 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

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

Load point height		Load radius								At max. reach		
		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0m (20.0 ft)		7.5 m (25.0 ft)		Capacity		Reach
												m (ft)
7.5 m (25.0 ft)	kg									*7480	4910	7.69
	lb									*16490	10820	(25.2)
6.0 m (20.0 ft)	kg					*8380	7500	*8070	4970	7120	3860	8.61
	lb					*18470	16530	*17790	10960	15700	8510	(28.2)
4.5 m (15.0 ft)	kg			*12080	11320	*9630	7110	*8490	4840	6280	3330	9.16
	lb			*26630	24960	*21230	15670	*18720	10670	13850	7340	(30.1)
3.0 m (10.0 ft)	kg			*15590	10200	*11230	6630	8640	4620	5910	3080	9.39
	lb			*34370	22490	*24760	14620	19050	10190	13030	6790	(30.8)
1.5 m (5.0 ft)	kg			*18040	9460	12060	6220	8390	4400	5880	3040	9.35
	lb			*39770	20860	26590	13710	18500	9700	12960	6700	(30.7)
Ground Line	kg			*18760	9200	11770	5980	8230	4260	6200	3210	9.02
	lb			*41360	20280	25950	13180	18140	9390	13670	7080	(29.6)
-1.5 m (-5.0 ft)	kg	*16910	*16910	*18280	9190	11680	5910	8190	4220	7030	3670	8.37
	lb	*37280	*37280	*40300	20260	25750	13030	18060	9300	15500	8090	(27.5)
-3.0 m (-10 ft)	kg	*22970	18930	*16680	9370	11800	6000			*8360	4720	7.29
	lb	*50640	41730	*36770	20660	26010	13230			*18430	10410	(23.9)
-4.5 m (-15.0 ft)	kg	*17920	*17920	*13190	9770							
	lb	*39510	*39510	*29080	21540							

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) 6.45 m (21' 2") boom, 3.2 m (10' 6") arm equipped with 1.44 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

Load point height		Load radius												At max. reach		
		1.5 m (5.0 ft)		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		7.5 m (25.0 ft)		9.0 m (30.0 ft)		Capacity		Reach
																m (ft)
7.5 m (25.0 ft)	kg									*5240	5170			*5970	3580	9.06
	lb									*11550	11400			*13160	7890	(29.7)
6.0 m (20.0 ft)	kg									*6500	5060			5590	2920	9.84
	lb									*14330	11160			12320	6440	(32.3)
4.5 m (15.0 ft)	kg							*8090	7130	*7190	4810	*5440	3360	5030	2540	10.31
	lb							*17840	15720	*15850	10600	*11990	7410	11090	5600	(33.8)
3.0 m (10.0 ft)	kg					*13400	10240	*9820	6540	*8110	4510	6230	3210	4760	2350	10.52
	lb					*29540	22580	*21650	14420	*17880	9940	13730	7080	10490	5180	(34.5)
1.5 m (5.0 ft)	kg					*16400	9230	*11460	6010	8200	4210	6050	3050	4710	2290	10.48
	lb					*36160	20350	*25260	13250	18080	9280	13340	6720	10380	5050	(34.4)
Ground Line	kg			*10240	*10240	*17910	8730	11420	5650	7950	3990	5920	2930	4880	2380	10.19
	lb			*22580	*22580	*39480	19250	25180	12460	17530	8800	13050	6460	10760	5250	(33.4)
-1.5 m (-5.0 ft)	kg	*11380	*11380	*14470	*14470	*18150	8590	11220	5480	7810	3870			5360	2640	9.63
	lb	*25090	*25090	*31900	*31900	*40010	18940	24740	12080	17220	8530			11820	5820	(31.6)
-3.0 m (-10.0 ft)	kg	*15350	*15350	*19470	17640	*17370	8660	11220	5480	7820	3880			6340	3190	8.74
	lb	*33840	*33840	*42920	38890	*38290	19090	24740	12080	17240	8550			13980	7030	(28.7)
-4.5 m (-15.0 ft)	kg			*21820	18170	*15410	8930	*11430	5660					*7480	4430	7.37
	lb			*48100	40060	*33970	19690	*25200	12480					*16490	9770	(24.2)
-6.0 m (-20.0 ft)	kg					*11340	9470									
	lb					*25000	20880									

3) R330LC-9S HIGH WALKER

(1) 6.15 m (20' 2") boom, 2.2 m (7' 3") arm equipped with 1.44 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

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

Load point height		Load radius								At max. reach		
		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0m (20.0 ft)		7.5 m (25.0 ft)		Capacity		Reach
												m (ft)
7.5 m (25.0 ft)	kg									*7480	6400	7.90
	lb									*16490	14110	(25.9)
6.0 m (20.0 ft)	kg					*8560	*8560	*8100	6850	*7570	5250	8.74
	lb					*18870	*18870	*17860	15100	*16690	11570	(28.7)
4.5 m (15.0 ft)	kg			*12730	*12730	*9910	9670	*8620	6680	6870	4670	9.22
	lb			*28060	*28060	*21850	21320	*19000	14730	15150	10300	(30.2)
3.0 m (10.0 ft)	kg			*16170	14300	*11520	9170	*9400	6440	6550	4420	9.40
	lb			*35650	31530	*25400	20220	*20720	14200	14440	9740	(30.8)
1.5 m (5.0 ft)	kg			*18290	13590	*12850	8760	9250	6230	6590	4440	9.31
	lb			*40320	29960	*28330	19310	20390	13730	14530	9790	(30.5)
Ground Line	kg			*18750	13380	12960	8530	9100	6100	7020	4730	8.93
	lb			*41340	29500	28570	18810	20060	13450	15480	10430	(29.3)
-1.5 m (-5.0 ft)	kg	*18620	*18620	*18070	13410	12910	8490	9090	6090	8060	5450	8.21
	lb	*41050	*41050	*39840	29560	28460	18720	20040	13430	17770	12020	(26.9)
-3.0 m (-10 ft)	kg	*22250	*22250	*16210	13640	*12030	8630			*8240	7100	7.03
	lb	*49050	*49050	*35740	30070	*26520	19030			*18170	15650	(23.1)
-4.5 m (-15.0 ft)	kg			*12130	*12130							
	lb			*26740	*26740							

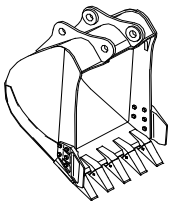
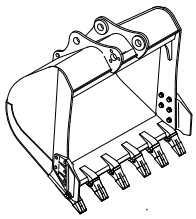
Note 1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The load point is a hook located on the back of the bucket.
4. *indicates load limited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

(2) 6.45 m (21' 2") boom, 3.2 m (10' 6") arm equipped with 1.44 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe.

Load point height		Load radius												At max. reach		
		1.5 m (5.0 ft)		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		7.5 m (25.0 ft)		9.0 m (30.0 ft)		Capacity		Reach
																m (ft)
7.5 m (25.0 ft)	kg									*5730	*5730			*5990	4840	9.24
	lb									*12630	*12630			*13210	10670	(30.3)
6.0 m (20.0 ft)	kg									*6600	*6600			6100	4100	9.95
	lb									*14550	*14550			13450	9040	(32.6)
4.5 m (15.0 ft)	kg							*8400	*8400	*7350	6650	*5820	4790	5570	3700	10.37
	lb							*18520	*18520	*16200	14660	*12830	10560	12280	8160	(34.0)
3.0 m (10.0 ft)	kg					*14050	*14050	*10150	9060	*8290	6320	6920	4620	5330	3500	10.53
	lb					*30970	*30970	*22380	19970	*18280	13930	15260	10190	11750	7720	(34.5)
1.5 m (5.0 ft)	kg					*16800	13300	*11720	8530	9070	6020	6750	4460	5320	3480	10.45
	lb					*37040	29320	*25840	18810	20000	13270	14880	9830	11730	7670	(34.3)
Ground Line	kg			*10990	*10990	*18040	12850	12640	8180	8840	5810	6630	4350	5570	3650	10.11
	lb			*24230	*24230	*39770	28330	27870	18030	19490	12810	14620	9590	12280	8050	(33.2)
-1.5 m (-5.0 ft)	kg	*12090	*12090	*15330	*15330	*18080	12750	12480	8040	8730	5700			6170	4060	9.50
	lb	*26650	*26650	*33800	*33800	*39860	28110	27510	17730	19250	12570			13600	8950	(31.2)
-3.0 m (-10.0 ft)	kg	*16150	*16150	*20540	*20540	*17110	12870	12510	8070	8770	5740			7390	4910	8.53
	lb	*35600	*35600	*45280	*45280	*37720	28370	27580	17790	19330	12650			16290	10820	(28.0)
-4.5 m (-15.0 ft)	kg			*20940	*20940	*14870	13200	*10980	8300					*7390	6870	7.03
	lb			*46160	*46160	*32780	29100	*24210	18300					*16290	15150	(23.1)

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

	
1.44 m³ SAE heaped bucket	1.74 m³ SAE 2.10 m³ SAE heaped bucket

Capacity m³ (yd³)				Width mm (in)				Weight kg (lb)		Tooth EA	Recommendation mm (ft-in)				
											6150 (20' 2") boom				6450 (21' 2") boom
SAE heaped		CECE heaped		Without side cutter		With side cutter					2200 (7' 3") Arm	2200 (7' 3") Arm	2500 (8' 2") Arm	3200 (10' 6") Arm	4050 (13' 3") Arm
1.44	(1.88)	1.25	(1.63)	1380	(54")	1,500	(59")	1150	(2540)	5	●	●	●	◐	■
1.74	(2.28)	1.50	(1.96)	1620	(64")	1,740	(69")	1260	(2780)	6	●	◐	◐	■	▲
2.10	(2.75)	1.80	(2.35)	1910	(75")	2,030	(80")	1650	(3640)	6	■	■	■	▲	

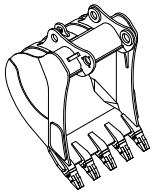
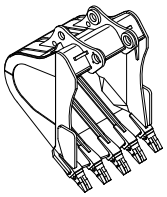
● Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less

◐ Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less

■ Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less

▲ Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less

2) ROCK AND HEAVY DUTY BUCKET

	
◈1.44 m³ SAE heaped bucket	⊙1.44 m³ SAE ⊙1.60 m³ SAE ⊙1.73 m³ SAE ⊙1.83 m³ SAE heaped bucket

Capacity m³ (yd³)				Width mm (in)		Weight kg (lb)		Tooth EA	Recommendation mm (ft-in)				
									6150 (20' 2") boom				6450 (21' 2") boom
SAE heaped		CECE heaped							2200 (7' 3") Arm	2200 (7' 3") Arm	2500 (8' 2") Arm	3200 (10' 6") Arm	4050 (13' 3") Arm
◈1.44	(1.88)	1.25	(1.63)	1470	(58")	1410	(3110)	5	●	●	●	◐	■
⊙1.44	(1.88)	1.25	(1.63)	1470	(58")	1485	(3270)	5	●	●	●	◐	■
⊙1.60	(2.09)	1.39	(1.82)	1585	(62")	1650	(3640)	5	●	◐	◐	■	▲
⊙1.73	(2.26)	1.50	(1.96)	1710	(67")	1675	(3690)	5	◐	◐	◐	■	▲
⊙1.83	(2.39)	1.59	(2.08)	1765	(69")	1850	(4080)	5	◐	■	■	▲	

◈ : Heavy duty bucket

⊙ : Rock-Heavy duty bucket

● Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less

◐ Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less

■ Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less

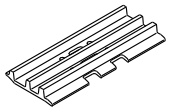
▲ Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less

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			
						
R330LC-9S	Shoe width	mm (in)	600(24)	700(28)	800(32)	900(36)
	Operating weight	kg (lb)	32700(72090)	33280(73410)	33640(74300)	34040(75180)
	Ground pressure	kgf/cm^2 (psi)	0.63(8.96)	0.55(7.82)	0.48(6.83)	0.44(6.26)
	Overall width	mm (ft-in)	3280(10' 9")	3380(11' 1")	3480(11' 5")	3580(11' 9")
R330NLC-9S	Shoe width	mm (in)	600(24)	-	-	-
	Operating weight	kg (lb)	32500(71650)	-	-	-
	Ground pressure	kgf/cm^2 (psi)	0.62(8.82)	-	-	-
	Overall width	mm (ft-in)	2990(9' 10")	-	-	-
R330LC-9S HIGH WALKER	Shoe width	mm (in)	600(24)	700(28)	800(32)	Double Grouser 710(28)
	Operating weight	kg (lb)	35200(77600)	35800(78920)	36200(79810)	36680(80690)
	Ground pressure	kgf/cm^2 (psi)	0.68(9.67)	0.59(8.39)	0.52(7.39)	0.47(6.68)
	Overall width	mm (ft-in)	3470(11' 5")	3570(11' 9")	3670(12' 0")	3580(11' 9")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2EA
Track rollers	9EA
Track shoes	48EA

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
710 mm double grouser	Option	B
800 mm triple grouser	Option	C
900 mm triple grouser	Option	C

※ **Table 2**

Category	Applications	Applications
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 gound (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 C8.3-C / HYUNDAI HM8.3
Type	4-cycle turbocharged charger air cooled diesel engine
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	114 × 135 mm (4.49" × 5.32")
Piston displacement	8300 cc (506 cu in)
Compression ratio	18 : 1
Rated gross horse power (SAE J1995)	263 Hp at 1900 rpm (196 kW at 1900 rpm)
Maximum torque	124.3 kgf · m (899 lbf · ft) at 1300 rpm
Engine oil quantity	25.5 ℓ (6.7 U.S. gal)
Dry weight	620 kg (1367 lb)
High idling speed	1950+50 rpm
Low idling speed	850±50 rpm
Rated fuel consumption	155.5 g/Hp · hr at 1750 rpm
Starting motor	24V-7.2 kW
Alternator	24V-90A
Battery	2 × 12V × 160Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 148.6 cc/rev
Rated oil flow	2 × 282 ℓ /min (74.5 U.S. gpm / 62.0 U.K. gpm)
Rated speed	1900 rpm

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15cc/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
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Overload relief valve pressure	400 kgf/cm^2 (5690 psi)

[ ]: Power boost

5) SWING MOTOR

Item	Specification
Type	Axial piston motor
Capacity	169.4 cc/rev
Relief pressure	300 kgf/cm^2 (4270 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	70 kgf · m (505 lbf · ft)
Brake release pressure	26 kgf/cm^2 (370 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement bent-axis axial piston motor
Relief pressure	350 kgf/cm^2 (4980 psi)
Capacity (max / min)	154.8/88.5 cc/rev
Reduction gear type	3-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	9 kgf/cm^2 (128 psi)
Braking torque	40 kgf · m (290 lbf · ft)

7) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5 kg/cm^2 (92 psi)
	Maximum	26 kg/cm^2 (370 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 150 × ø 105 × 1480 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 160 × ø 110 × 1685 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 140 × ø 100 × 1285 mm
	Cushion	Extend only

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

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

9) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
R330LC-9S	Standard	☆600 mm (24")	0.63 kgf/cm^2 (8.96 psi)	48	3280 mm (10' 9")
	Option	☆700 mm (28")	0.55 kgf/cm^2 (7.82 psi)	48	3380 mm (11' 1")
		☆800 mm (32")	0.48 kgf/cm^2 (6.83 psi)	48	3480 mm (11' 5")
		☆900 mm (36")	0.44 kgf/cm^2 (6.26 psi)	48	3580 mm (11' 9")
R330NLC-9S	Standard	☆600 mm (24")	0.62 kgf/cm^2 (8.82 psi)	48	2990 mm (9' 10")
R330LC-9S H/WALKER	Standard	☆600 mm (24")	0.68 kgf/cm^2 (9.67 psi)	48	3470 mm (11' 5")
	Option	☆700 mm (28")	0.59 kgf/cm^2 (8.39 psi)	48	3570 mm (11' 9")
		☆800 mm (32")	0.52 kgf/cm^2 (7.39 psi)	48	3670 mm (12' 0")
		★710 mm (28")	0.47 kgf/cm^2 (6.68 psi)	48	3580 mm (11' 9")

☆ : Triple grouser

★ : Double grouser

10) BUCKET

Item		Capacity m^3 (yd^3)				Tooth quantity EA	Width mm (in)			
		SAE heaped		CECE heaped			Without side cutter		With side cutter	
R330LC-9S R330NLC-9S H/WALKER	Standard	1.44	(1.88)	1.25	(1.63)	5	1380	(54")	1500	(59")
	Option	1.74	(2.28)	1.50	(1.96)	6	1620	(64")	1740	(69")
		2.10	(2.75)	1.80	(2.35)	6	1910	(75")	2030	(80")
		◈1.44	(1.88)	1.25	(1.63)	5	1470	(58")		
		⊙1.44	(1.88)	1.25	(1.63)	5	1470	(58")		
		⊙1.60	(2.09)	1.39	(1.82)	5	1585	(62")		
		⊙1.73	(2.26)	1.50	(1.96)	5	1710	(67")		
		⊙1.83	(2.39)	1.59	(2.08)	5	1765	(69")		

◈ : Heavy duty bucket
◎ : Rock-Heavy duty bucket

9. RECOMMENDED OILS

Use only oils listed below. Do not mix different brand oil.
Please use HYUNDAI genuine oil and grease.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C(°F) -50 (-58) -30 (-22) -20 (-4) -10 (14) 0 (32) 10 (50) 20 (68) 30 (86) 40 (104)
Engine oil pan	Engine oil	28 (7.4)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	11.0 (2.9)	★SAE 75W-90
Final drive		8.0×2 (2.1×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank: 190 (50) System: 330 (87)	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	500 (132)	★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	40 (10.56)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

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

★ : Cold region
Russia, CIS, Mongolia

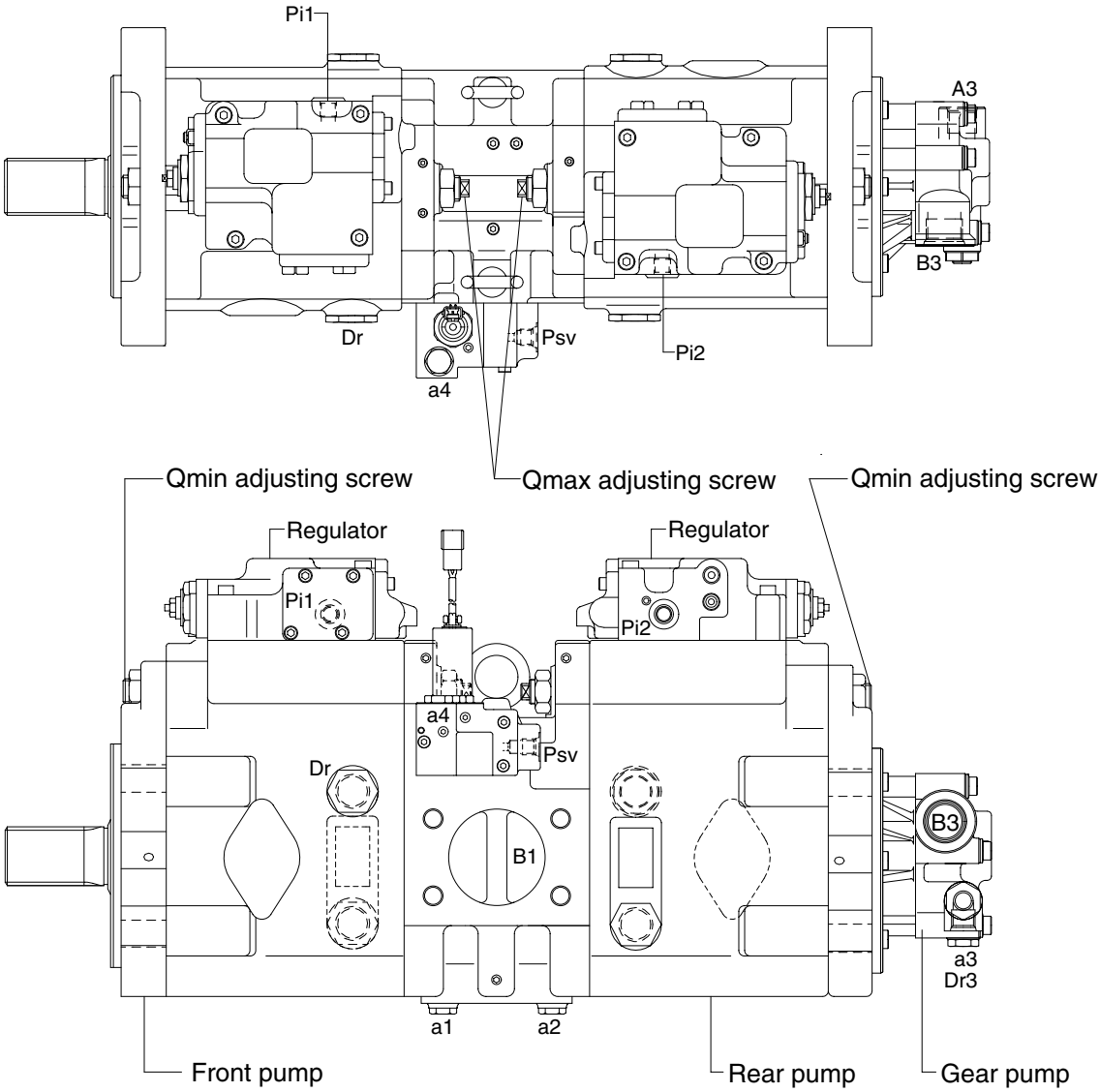
SECTION 2 STRUCTURE AND FUNCTION

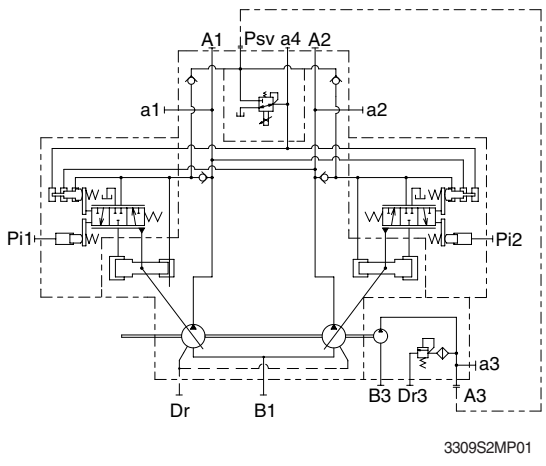
Group 1 Pump Device ····· 2-1
Group 2 Main Control Valve ····· 2-20
Group 3 Swing Device ····· 2-46
Group 4 Travel Device ····· 2-57
Group 5 RCV Lever ····· 2-66
Group 6 RCV Pedal ····· 2-73

GROUP 1 PUMP DEVICE

1. STRUCTURE

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

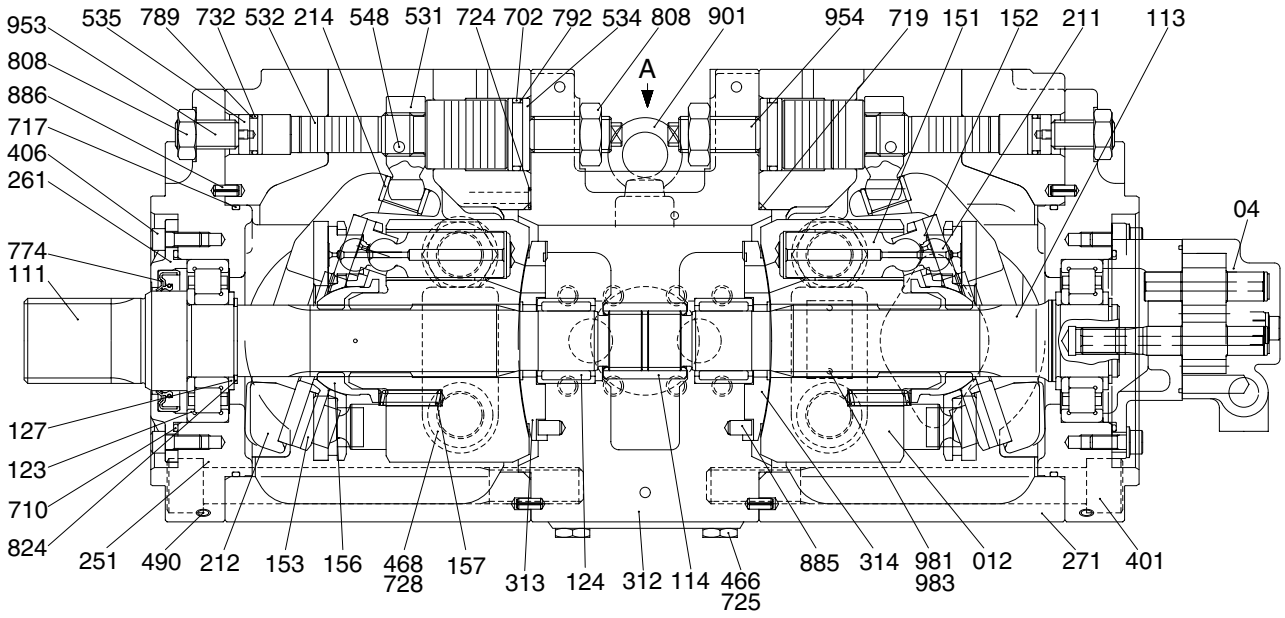




Port	Port name	Port size
A1, 2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2000psi 3"
Dr	Drain port	PF 3/4 - 23
Pi1, i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1, 2, 4	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4 - 14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5
Dr3	Gear pump drain port	PF 3/8 - 15

1) MAIN PUMP(1/2)

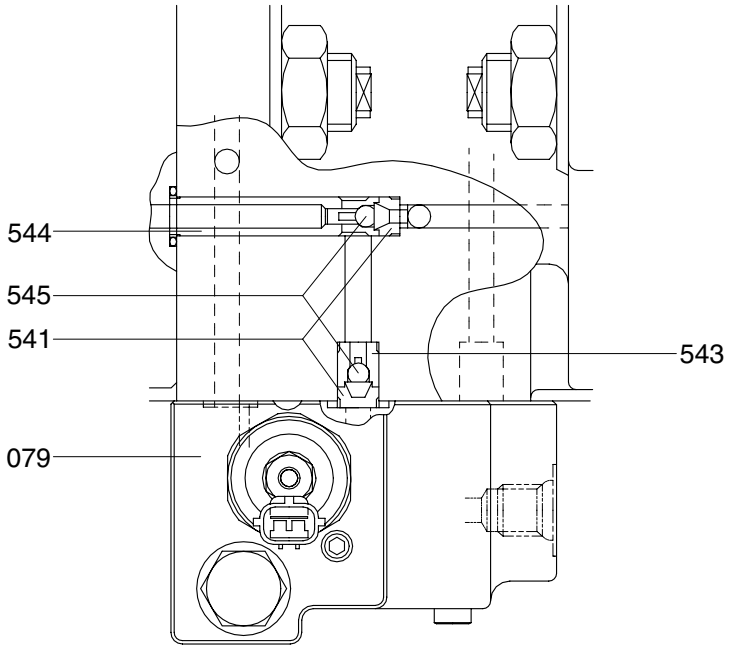
The main pump consists of two piston pumps (front & rear) and valve block.



33092MP02A

04	Gear pump	271	Pump casing	719	O-ring
111	Drive shaft (F)	312	Valve block	724	O-ring
113	Drive shaft (R)	313	Valve plate (R)	725	O-ring
114	Gear	314	Valve plate (L)	728	O-ring
123	Roller bearing	401	Hexagon socket bolt	732	O-ring
124	Needle bearing	406	Hexagon socket bolt	774	Oil seal
127	Bearing spacer	466	VP plug	789	Back up ring
151	Piston	468	VP plug	792	Back up ring
152	Shoe	490	VP 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	Swash plate support	710	O-ring	981	Name plate
261	Seal cover (F)	717	O-ring	983	Pin

MAIN PUMP (2/2)

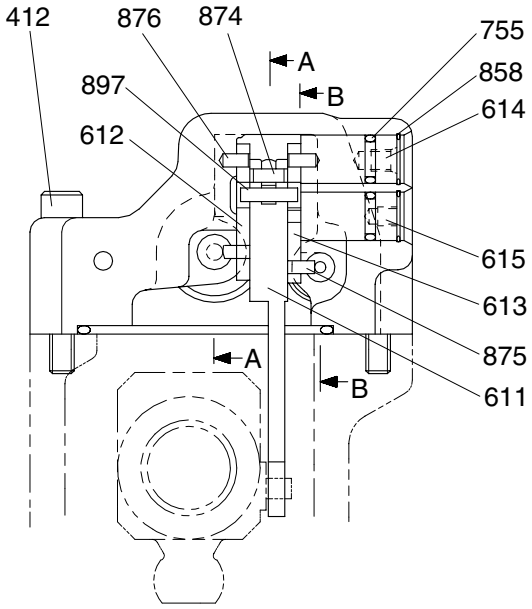


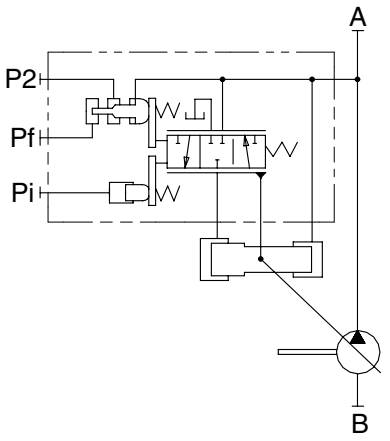
VIEW A

32092MP03

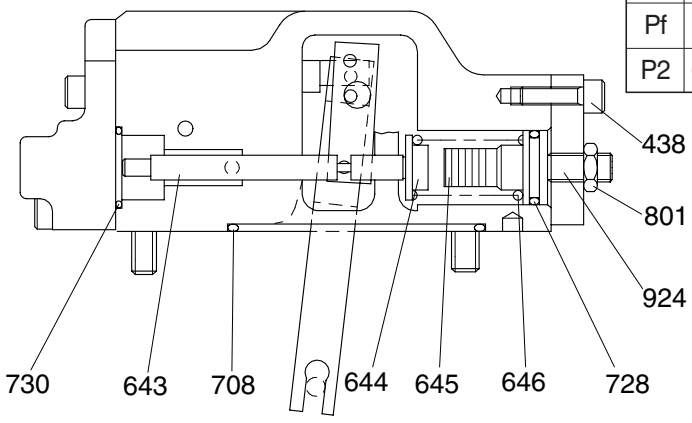
079	Proportional reducing valve	543	Stopper 1	545	Steel ball
541	Seat	544	Stopper 2		

2) REGULATOR (1/2)

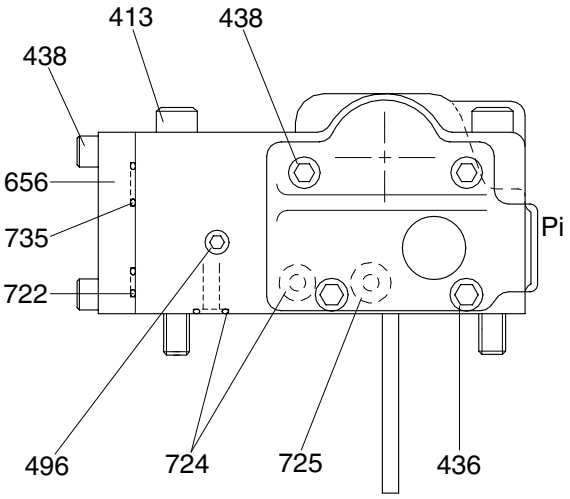




Port	Port name	Port size
A	Delivery port	1"
B	Suction port	3"
Pi	Pilot port	PF 1/4-15
Pf	Power shift pressure	-
P2	Companion delivery pressure	-



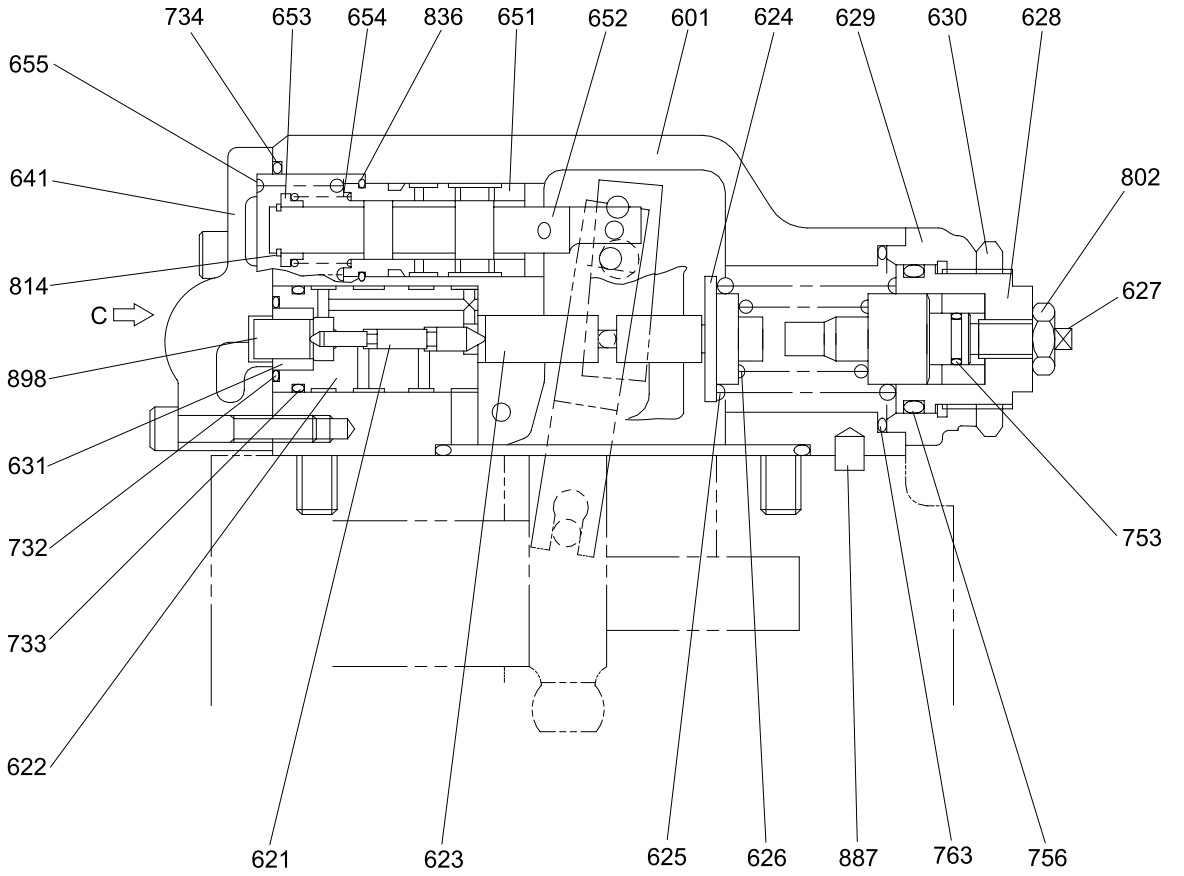
SECTION B-B



VIEW C

32092MP04

REGULATOR (2/2)

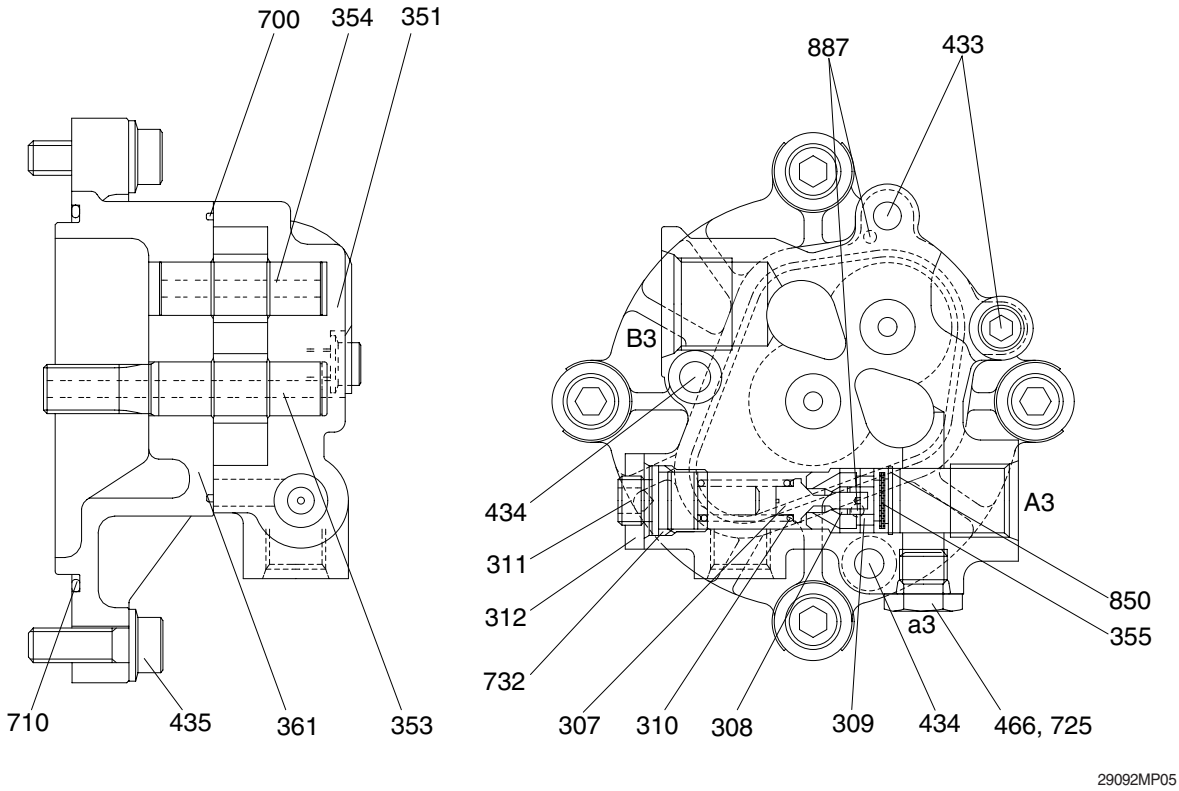


SECTION A-A

29092MP04A

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



29092MP05

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

2. FUNCTION

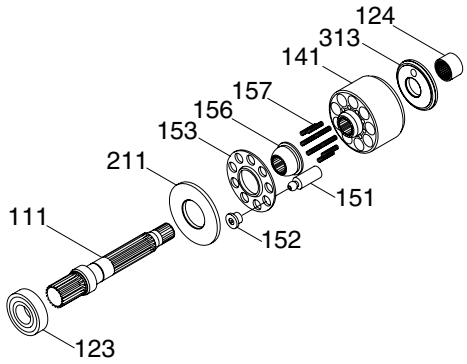
1) MAIN PUMP

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 bush (156), and cylinder spring (157). The drive shaft is supported by bearing (123,124) at its both ends.

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



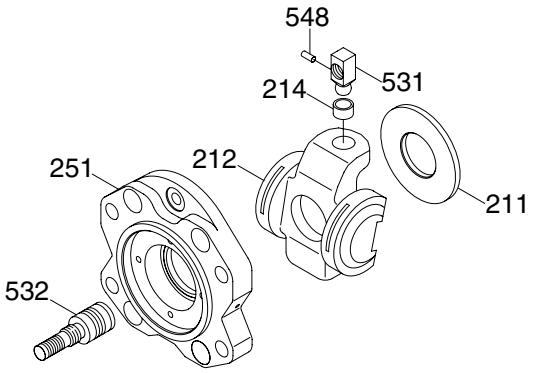
29092MP06

(2) Swash plate group

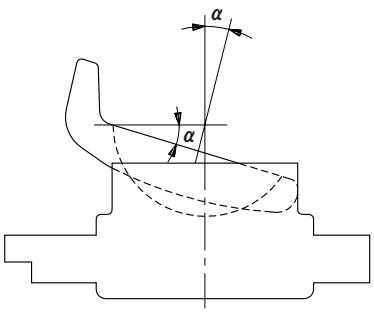
The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

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)



29092MP07



2-7

(3) Valve block group

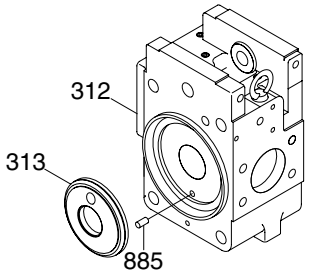
The valve block group consists of valve block (312), valve plate (313) and valve plate pin (885).

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.



29092MP08

2) REGULATOR

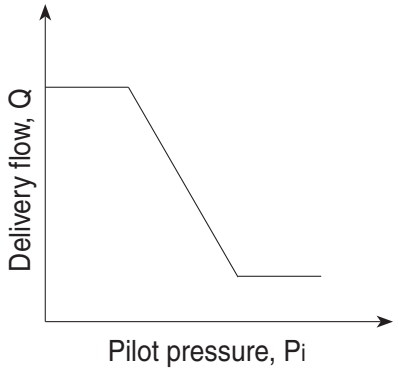
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

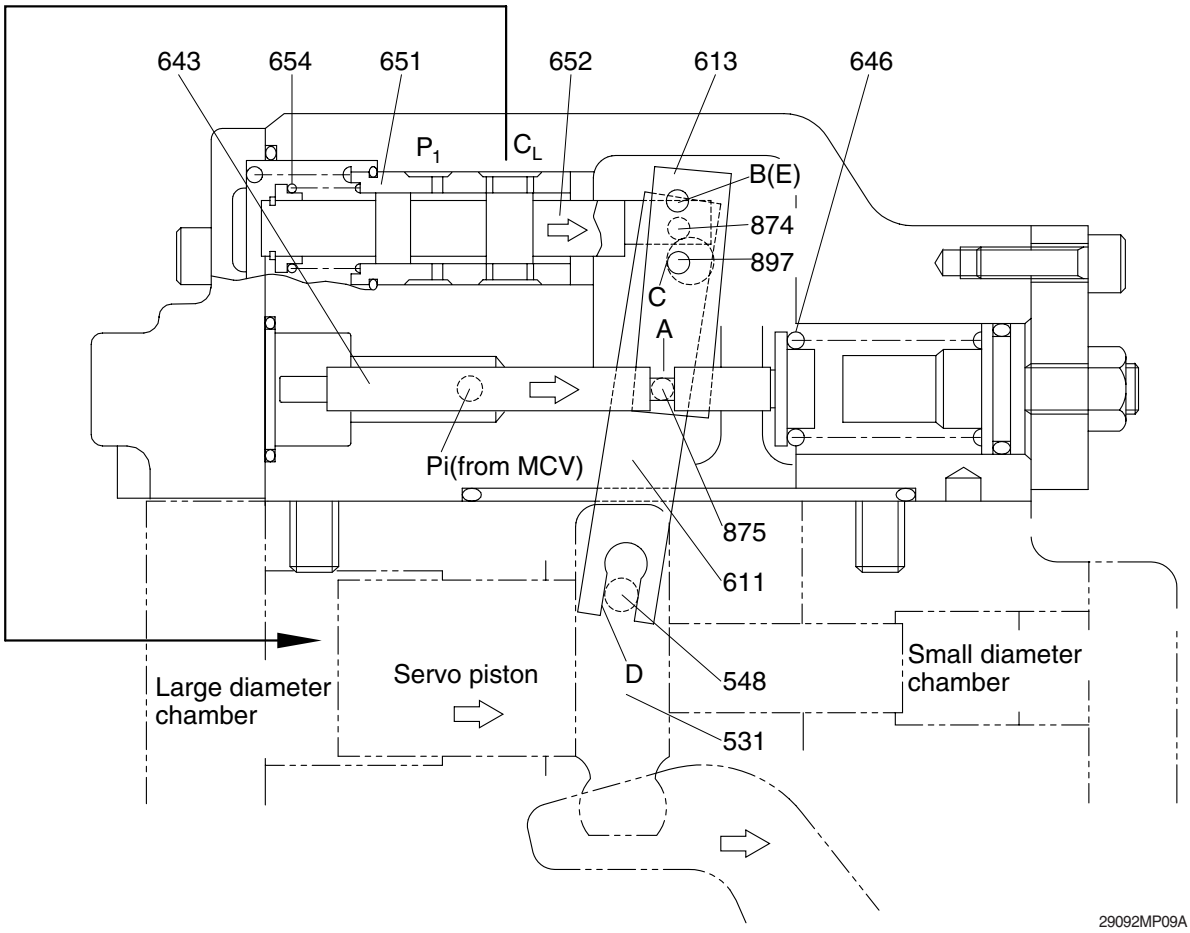
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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.

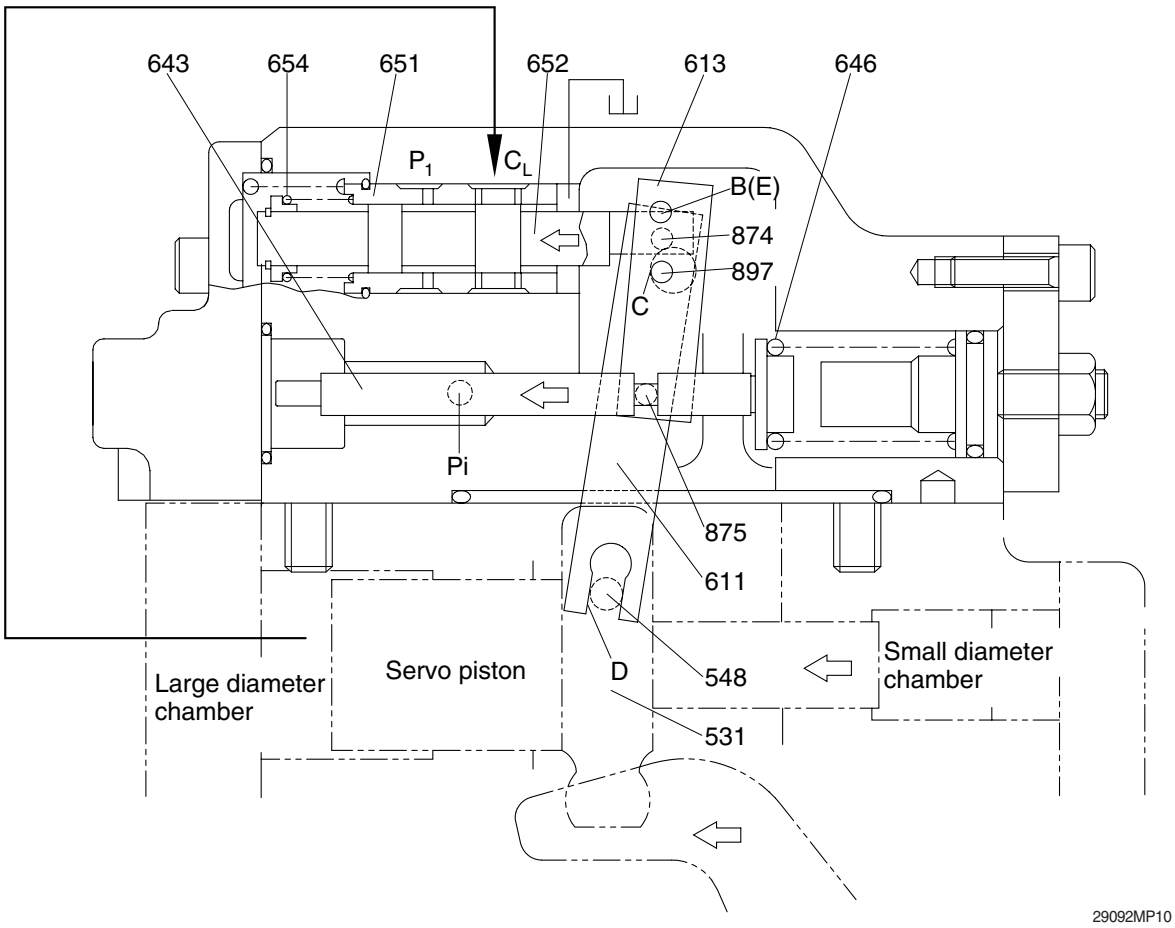
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

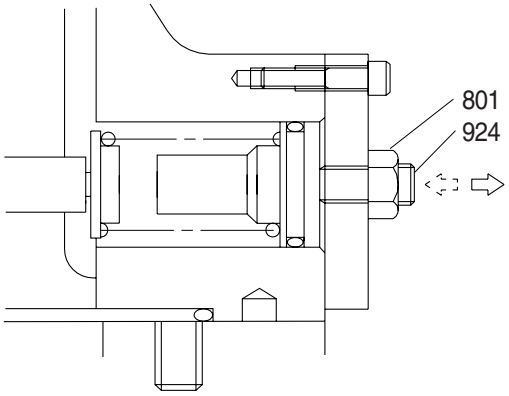


As the pilot pressure Pi decreases, the pilot piston (643) moves to the left by the action of the pilot spring (646) and causes lever 2 (613) to rotate around the fulcrum of point B. Since the pin (897) is pressed against the large hole section (C) of lever 2 by the action of the return spring (654) 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.

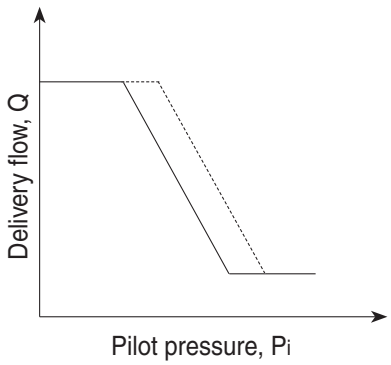
As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

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.



2-12



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

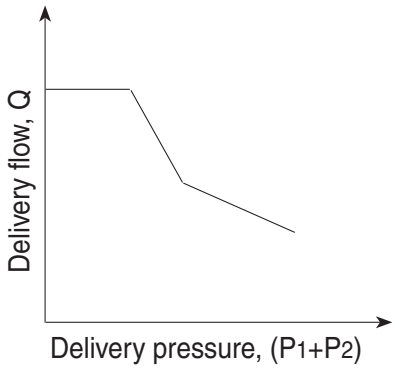
Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount
(min $^{-1}$)	(Turn)	(kgf/cm^2)	(ℓ /min)
1750	+1/4	+1.5	+22.1

(2) Total horsepower control

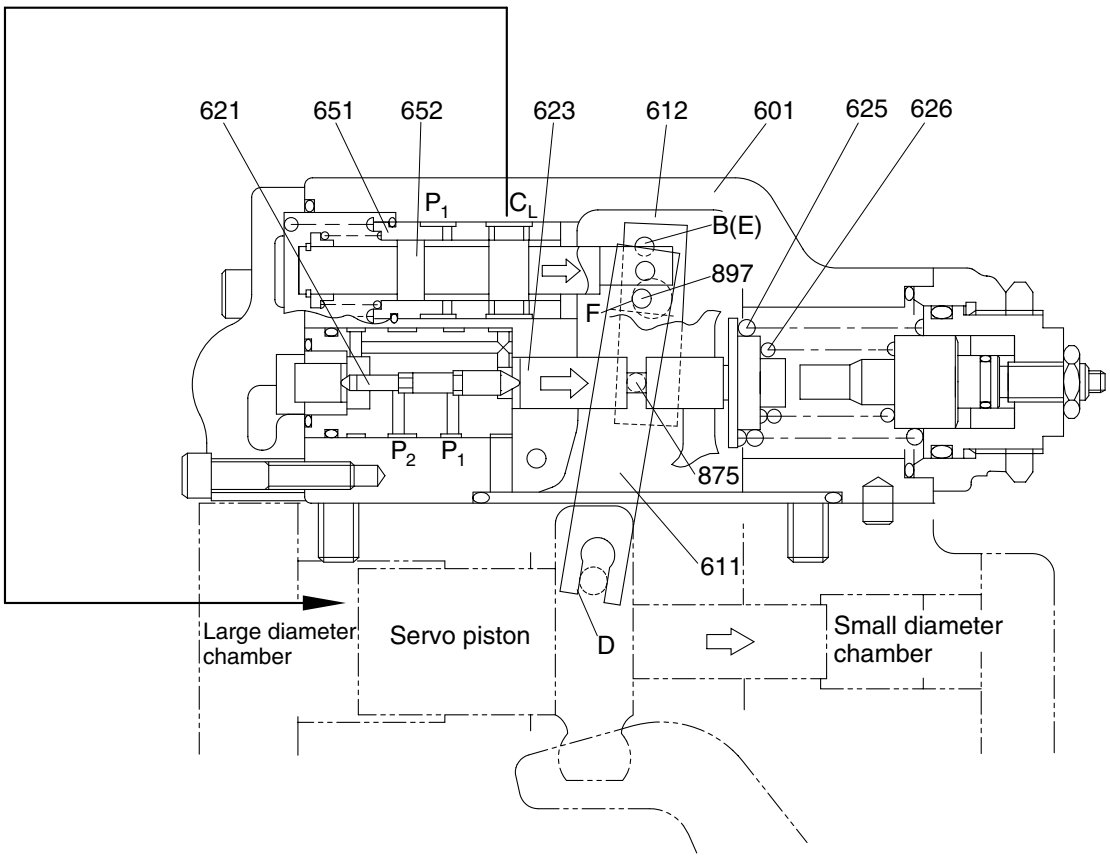
The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.
(The input horsepower is constant when the speed is constant.)
Since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



29092MP11

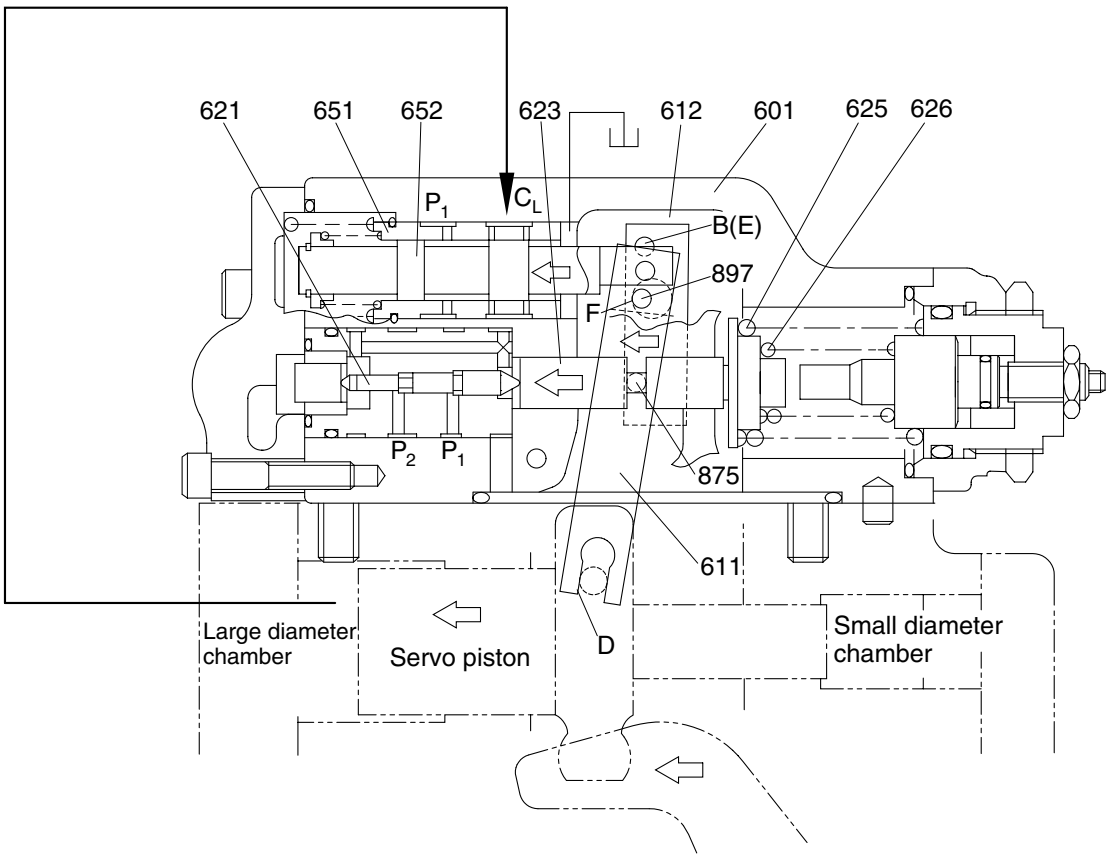
When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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



29092MP12

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

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

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

③ Low tilting angle (low flow) command preferential function

As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (ø4) protruding from the large hole (ø8), only the lever lessening the tilting angle contacts the pin (897) ; the hole (ø8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

④ Adjustment of input horsepower

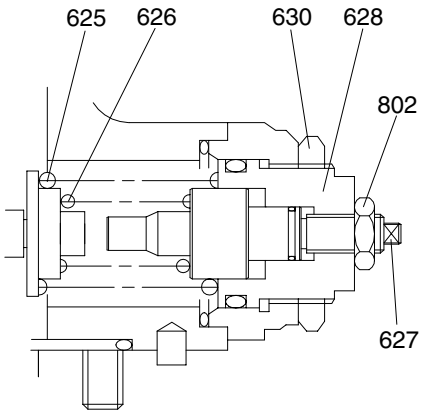
Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one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

a. Adjustment of outer spring

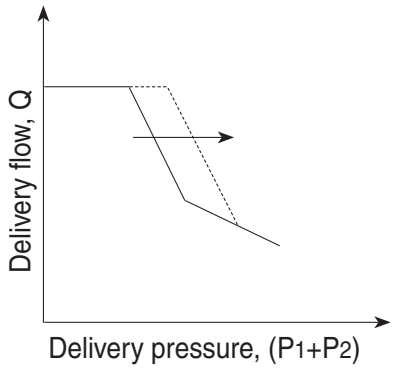
Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting screw QI (627) by N × A turns at first. (A=1.59)

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

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw (C) (628)	Compensating control starting pressure change amount	Input torque change amount
(min $^{-1}$)	(Turn)	(kgf/cm^2)	(kgf · m)
1750	+1/4	+20.0	+8.3



8007A2MP03



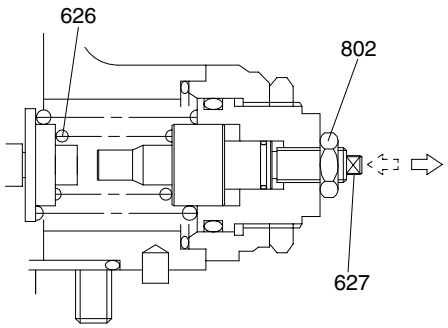
b. Adjustment of inner spring

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

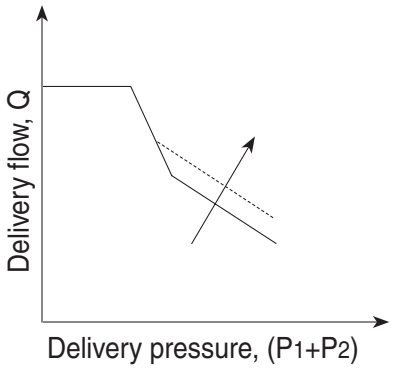
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

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

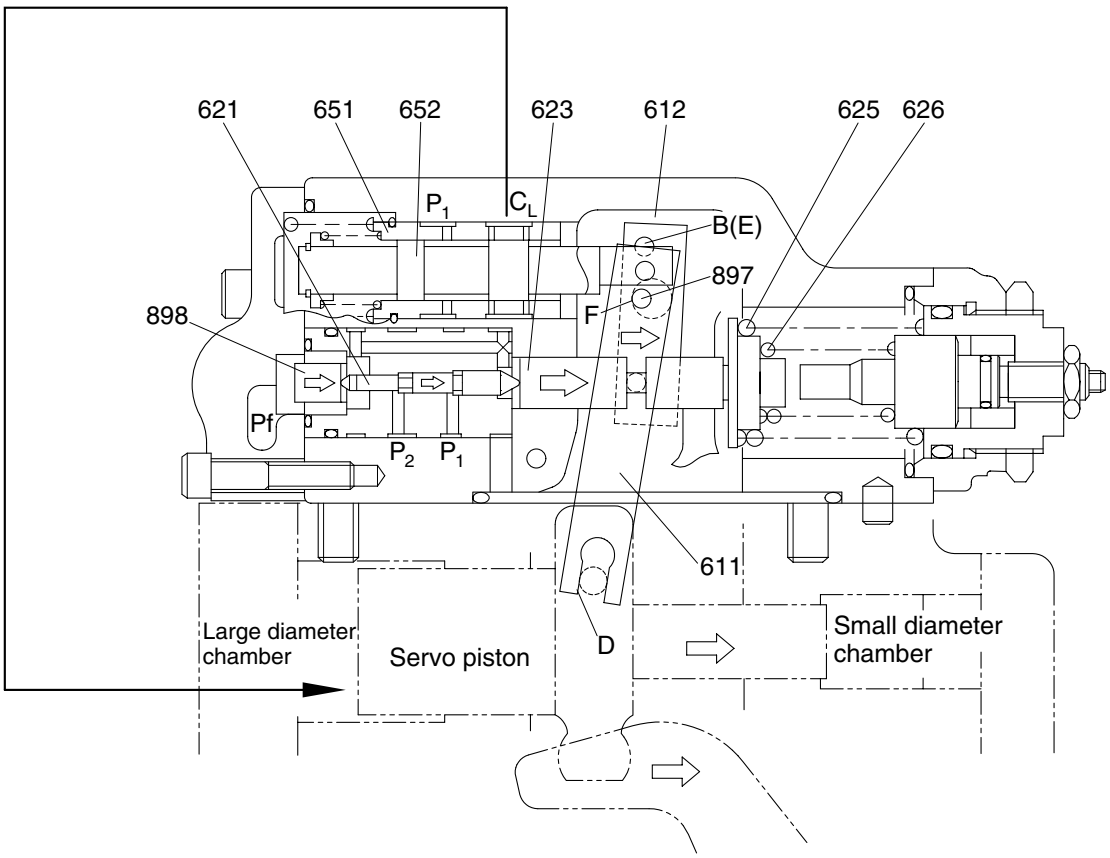
Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw (QI) (627)	Flow change amount (rpm)	Input torque change amount
(min $^{-1}$)	(Turn)	(ℓ /min)	(kgf · m)
1750	+1/4	+15.9	+8.5



8007A2MP04

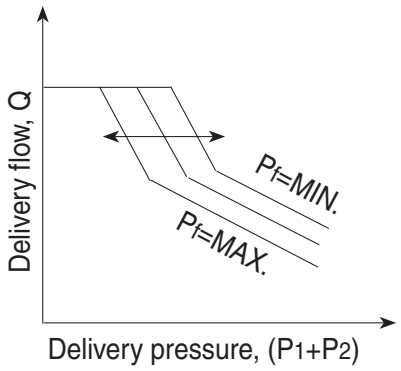


(3) Power shift control



29092MP13

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



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

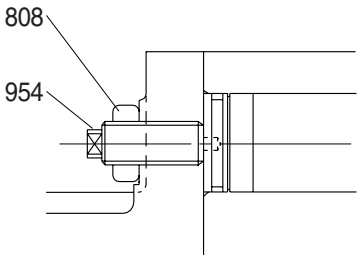
(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

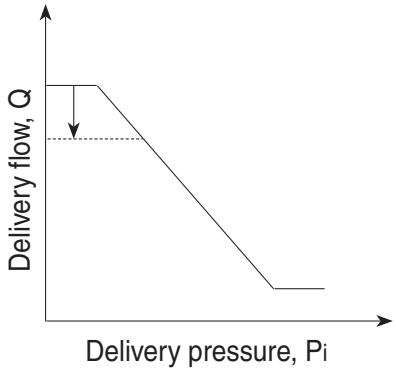
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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

Speed (min -1)	Adjustment of max flow	
	Tightening amount of adjusting screw (954) (Turn)	Flow change amount (ℓ /min)
1750	+1/4	-6.7



2-19(1)

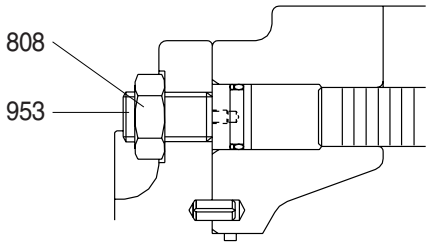


② Adjustment of minimum flow

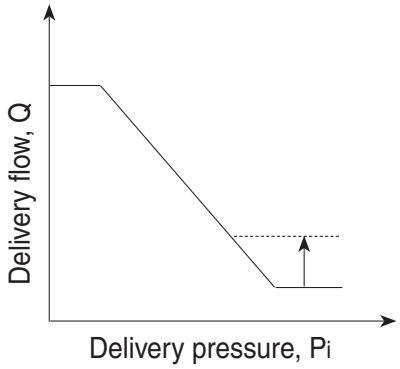
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

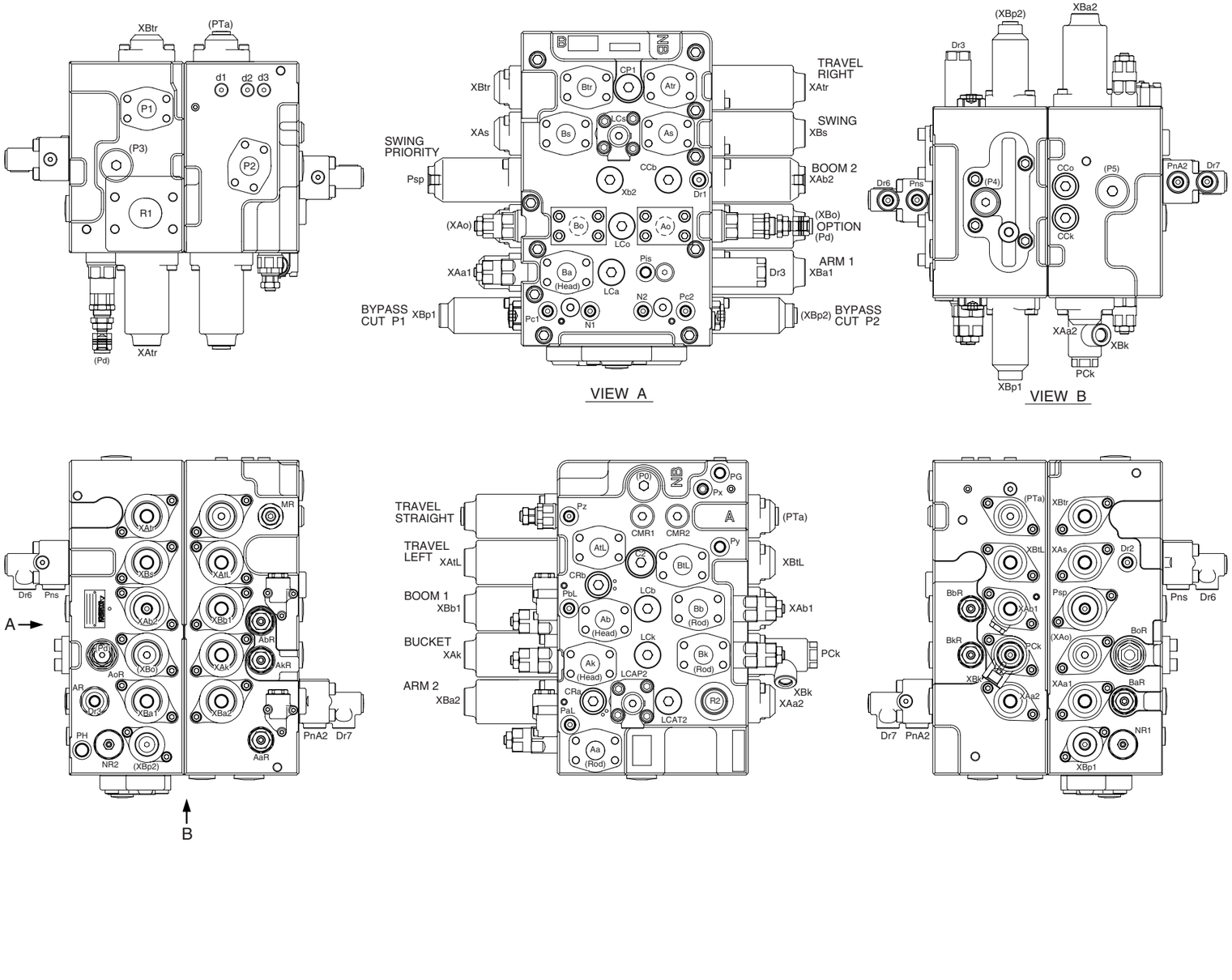
Speed (min -1)	Adjustment of min flow	
	Tightening amount of adjusting screw (953) (Turn)	Flow change amount (ℓ /min)
1750	+1/4	+6.7



2-19(2)

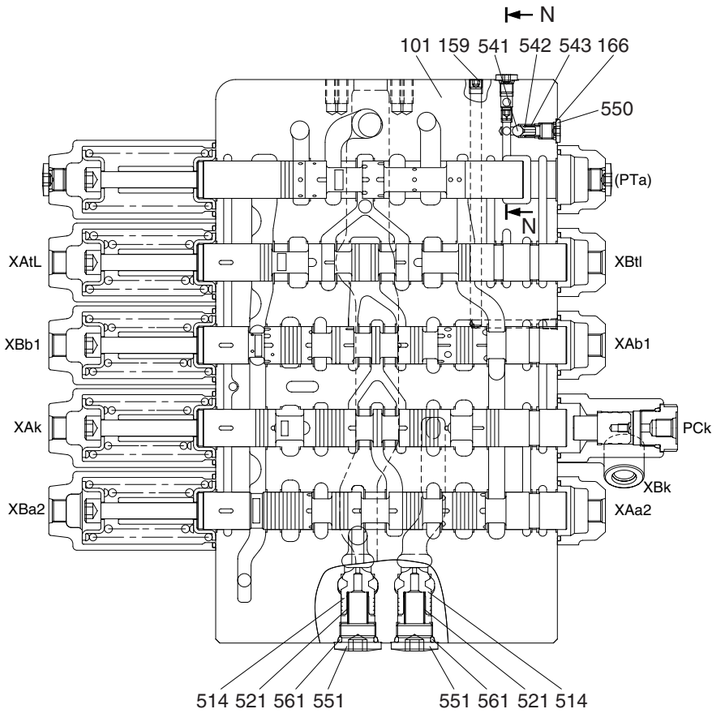


1. STRUCTURE

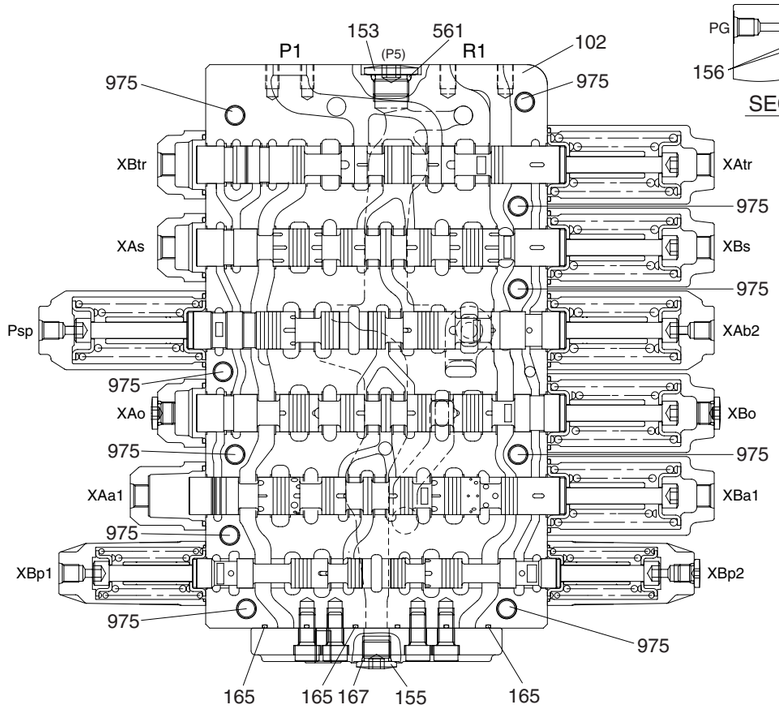


32092MC01

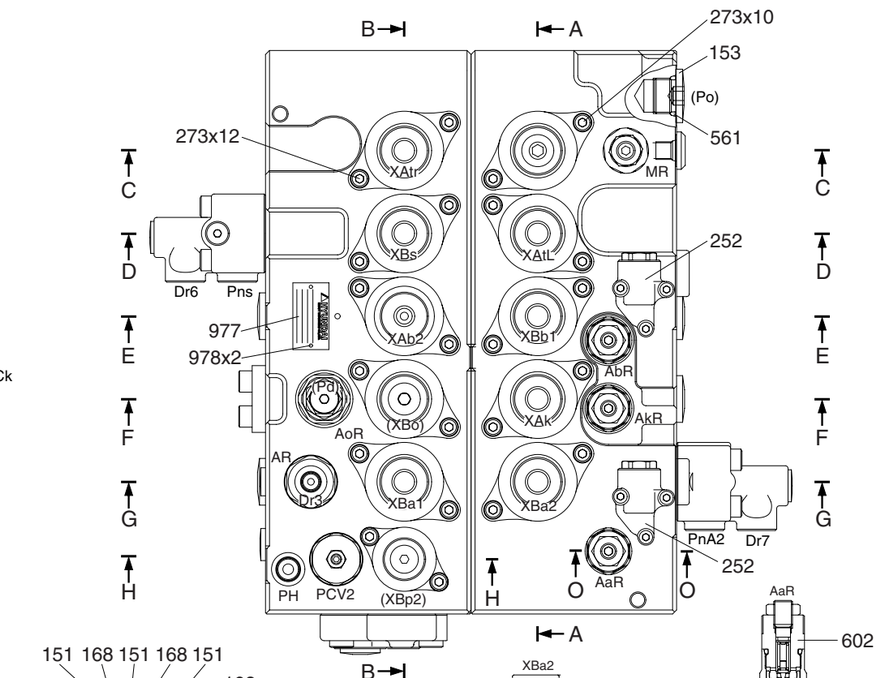
Mark	Port name	Port size	Tightening torque
R2	Make up port for swing	PF 1	20~25 kgf · m (115~180 lbf · ft)
XAtr XBtr (XAo) (XBo) XAk XBk XAb1 XBb1 XAa2 XBa2 XAtL XBtL XAs XBs XAa1 XBa1 (PH) Dr1	Travel right (reverse) pilot port Travel right (forward) pilot port Optional pilot port Optional pilot port Bucket in pilot port Bucket out pilot port Boom up pilot port Boom down pilot port Arm out confluence pilot port Arm in confluence pilot port Travel left (reverse) pilot port Travel left (forward) pilot port Swing left pilot port Swing right pilot port Arm out pilot port Arm in pilot port Pilot pressure port Drain port	PF 3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
Px Py Pz PG Dr2 Dr3 Dr6 Dr7 Pns PaL PbL XAb2 Psp XBp1 (XBp2) (Pd) Pc1 Pc2 PCk Pis N1 N2 PnA2	Pressure port for attachment Pressure port for travel Main relief pilot pressure port Pilot pressure port Drain port Drain port Drain port Drain port Swing logic valve pilot port Lock valve pilot port (arm rod side) Lock valve pilot port (boom head side) Boom up confluence pilot port Swing priority pilot port Bypass cut spool pilot port (P1 side) Bypass cut spool pilot port (P2 side) Breaker high pressure pilot lamp Posi-nega pressure port (P1 side) Posi-nega pressure port (P2 side) Bucket in stroke limiter pilot port Arm regeneration cut pilot port Arm1 Nega-con pressure port Boom1 Nega-con pressure port Arm2 logic valve pilot port	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Atr Btr (Ao) (Bo) Ak Bk Ab Bb AtL BtL As Bs Aa Ba P1 P2	Travel motor right side (reverse) port Travel motor right side (forward) port Optional port Optional port Bucket cylinder head side port Bucket cylinder rod side port Boom cylinder head side port Boom cylinder rod side port Travel motor left side (reverse) port Travel motor left side (forward) port Swing motor left port Swing motor right port Arm cylinder rod side port Arm cylinder head side port Pump port (P1 side) Pump port (P2 side)	M10	5~6.6 kgf · m (36.1~47.7 lbf · ft)
R1	Return port	M12	8.5~11.2 kgf · m (61.5~81.1 lbf · ft)

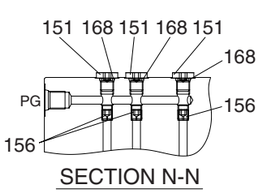


SECTION A-A

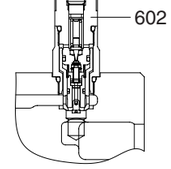


SECTION B-B





SECTION N-N

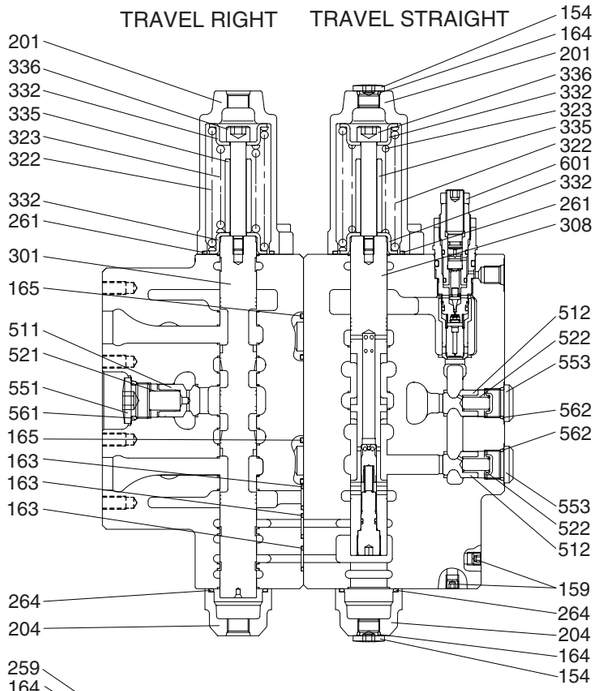


SECTION O-O

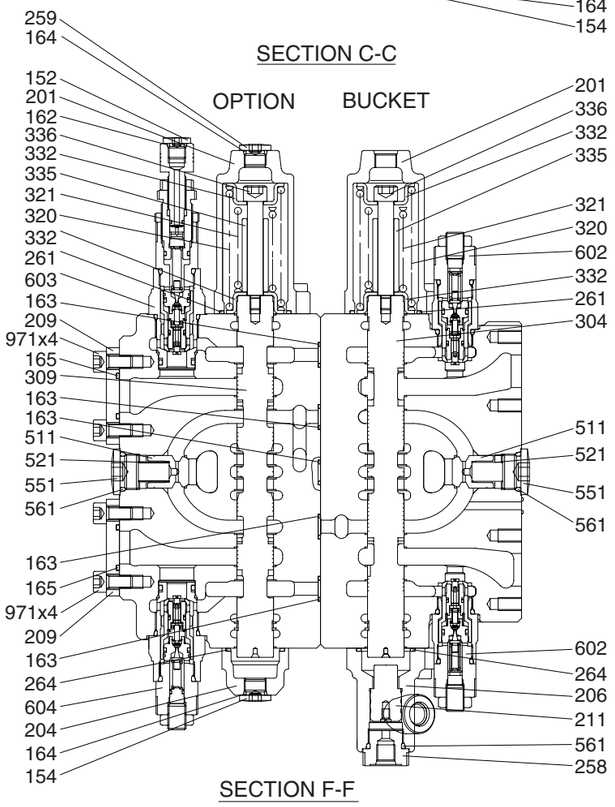
SECTION P-P

32092MC02

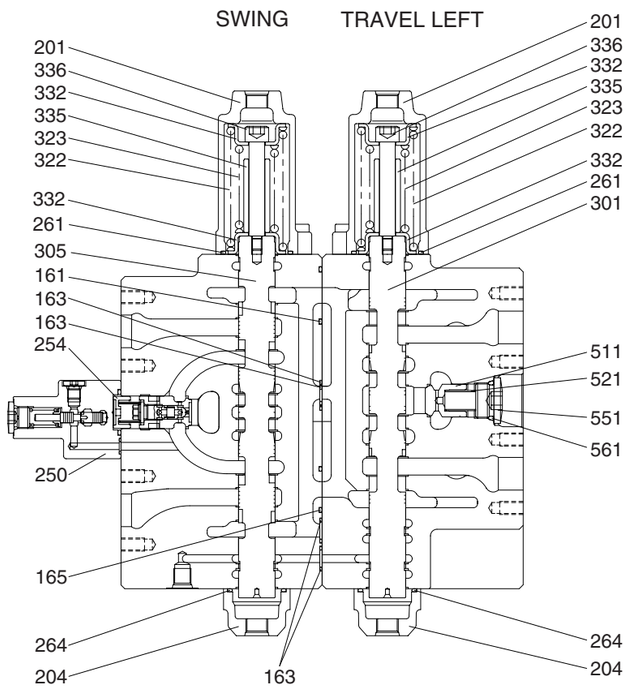
101	Casing A (P2 housing)	308	Straight travel spool sub assy
102	Casing B (P1 housing)	309	Spool (option)
151	Plug	310	Bypass cut spool
152	Plug	311	Swing priority spool
153	Plug	313	Bypass cut spool
154	Plug	320	Spring
155	Plug	321	Spring
156	Orifice	322	Spring
158	Plug	323	Spring
159	Plug	326	Spring
161	O-ring	327	Spring
162	O-ring	329	Spring
163	O-ring	331	Spring seat
164	O-ring	332	Spring seat
165	O-ring	333	Bolt-spacer
166	O-ring	335	Stopper
167	O-ring	336	Bolt-spacer
168	O-ring	337	Stopper
201	Cover	339	Stopper
202	Cover	370	Spring
203	Cover	371	Spring
204	Cover	372	Spring
205	Cover	373	Spring
206	Cover	511	Poppet
208	Cover	512	Poppet
209	Flange	513	Poppet
210	Plate	514	Poppet
211	Piston	521	Spring
250	Logic control valve assy	522	Spring
251	Logic control valve assy	523	Spring
252	Lock valve selector sub assy	541	Steel ball
254	Logic poppet assy	542	Spring seat
256	Logic poppet assy	543	Spring
257	Arm regeneration cut sub assy	550	Plug
258	Plug	551	Plug
259	Plug	552	Plug
260	Plug	553	Plug
261	O-ring	561	O-ring
262	O-ring	562	O-ring
264	O-ring	601	Main relief valve assy
273	Socket bolt	602	Port relief valve assy
274	Socket bolt	603	Port relief valve assy
301	Travel spool	604	Port relief valve assy
302	Arm 1 spool sub assy	610	Nega-con relief valve
303	Boom 1 spool sub assy	971	Bolt
304	Bucket spool	975	Bolt
305	Swing spool	977	Name plate
306	Arm 2 spool	978	Pin
307	Boom 2 spool		



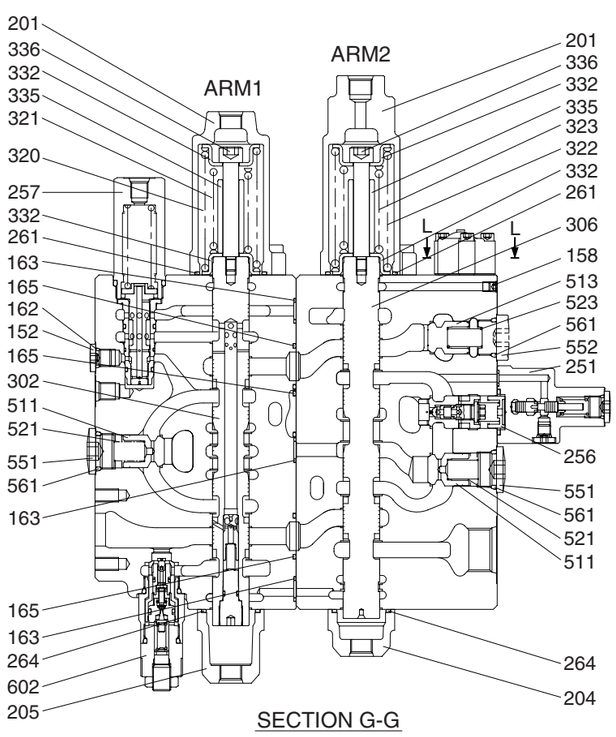
SECTION C-C



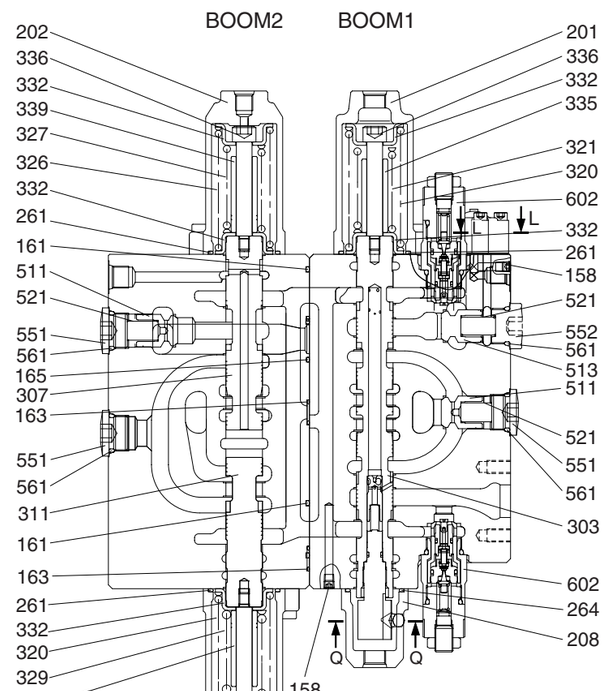
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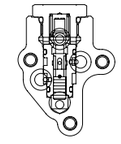
SECTION D-D



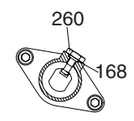
SECTION G-G



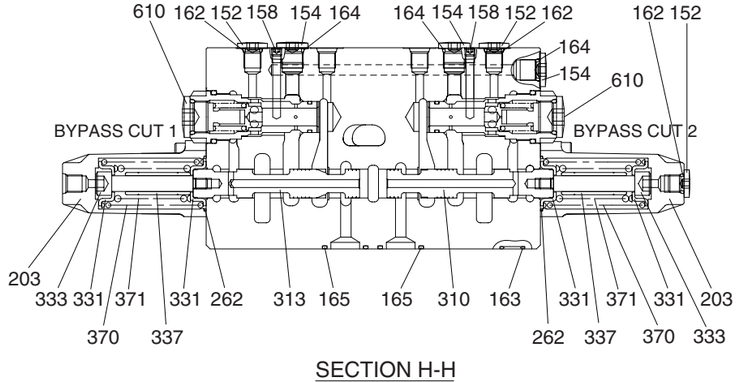
SWING PRIORITY



SECTION E-E



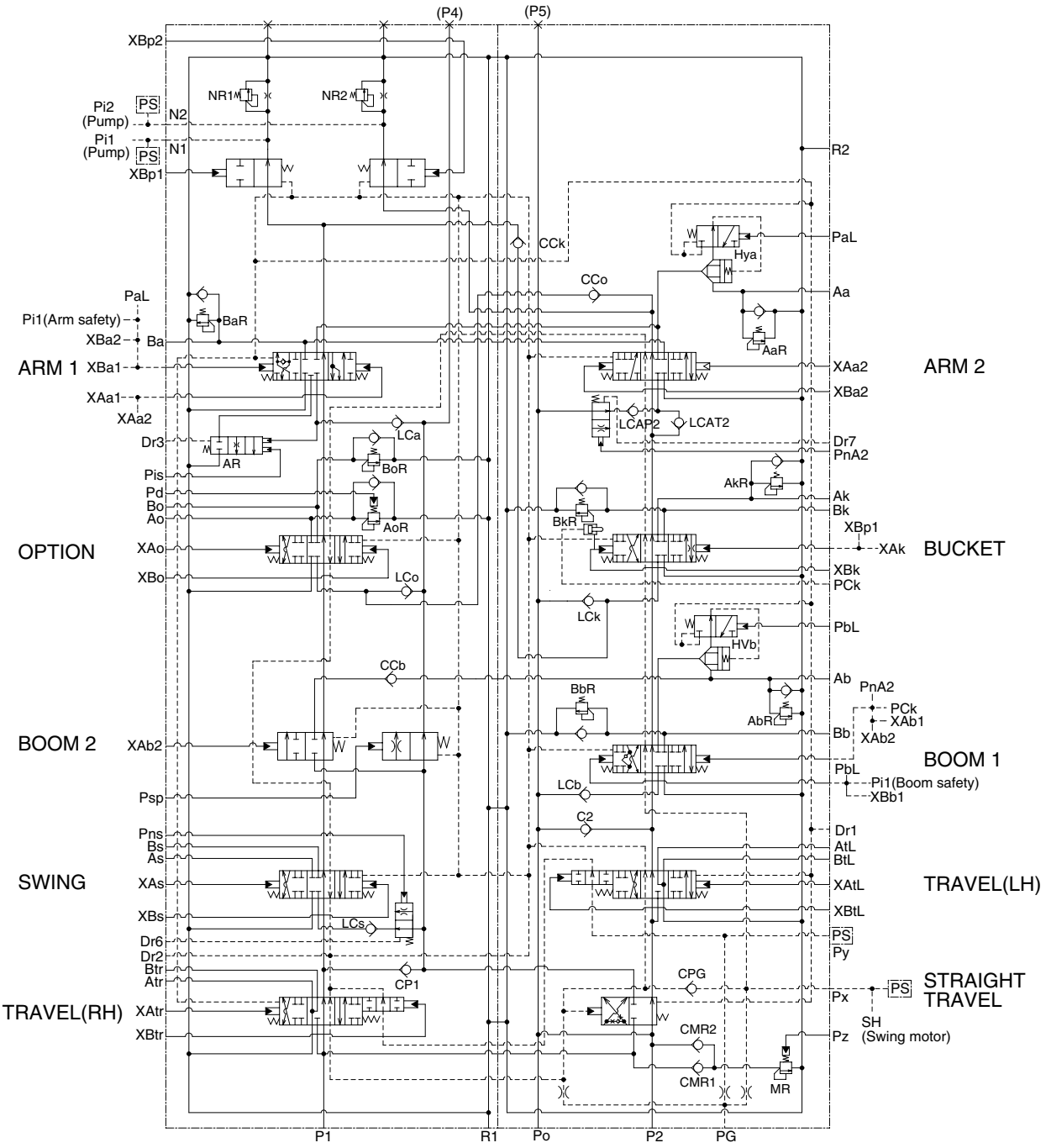
SECTION L-L SECTION Q-Q



SECTION H-H

32092MC03

2. HYDRAULIC CIRCUIT



32092MC04

3. FUNCTION

1) CONTROL IN NEUTRAL POSITION

Main circuit

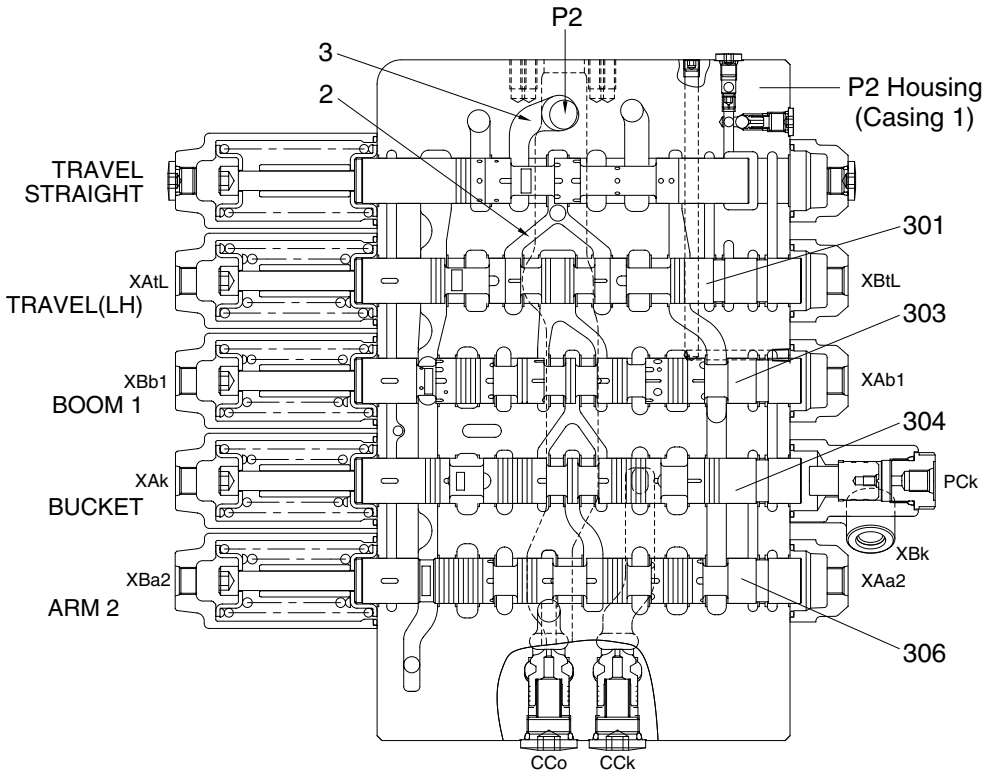
When all spools are in the neutral positions, the pressurized oil discharged from the hydraulic pump (A1) passes through Port P1, the main path (1), the bypass circuit (2) passing the spools for travel right (301), swing (305), boom confluence (boom 2; 307), option (309) and arm 1 (302), and the arm 1 side negative control relief valve (610), and returns to the hydraulic oil tank through the tank port (R1).

The negative control signal pressure of the arm 1 side negative control relief valve (610) is led from Port N1 to the regulator on the hydraulic pump (A1) side, and controls the pump discharge flow rate to its minimum value.

The oil discharged from the hydraulic pump (A2) passes through Port P2, the main path (3), the bypass circuit (2) passing the spools for travel left (301), boom 1 (303), bucket (304) and arm 2 (306), and the boom1 side negative control relief valve (610), and returns to the hydraulic oil tank through the tank port (R1).

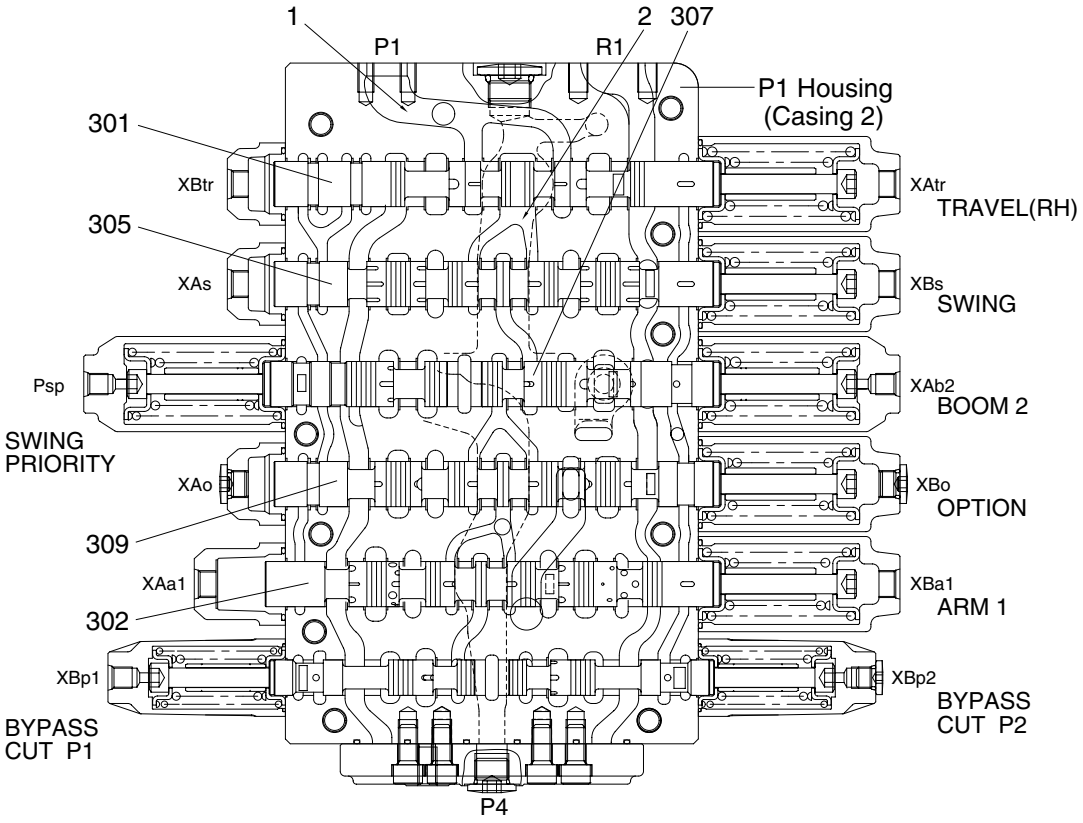
The negative control signal pressure of the boom 1 side negative control relief valve (610) is led from Port N2 to the regulator on the hydraulic pump (A2) side, and controls the pump discharge flow rate to its minimum value.

When any of nine main spools is changed over, the bypass circuit (2) is cut off and the hydraulic oil at Port N1 or N2 in the negative control circuit is shut off.



SPOOL SECTION(P2)

32092MC05

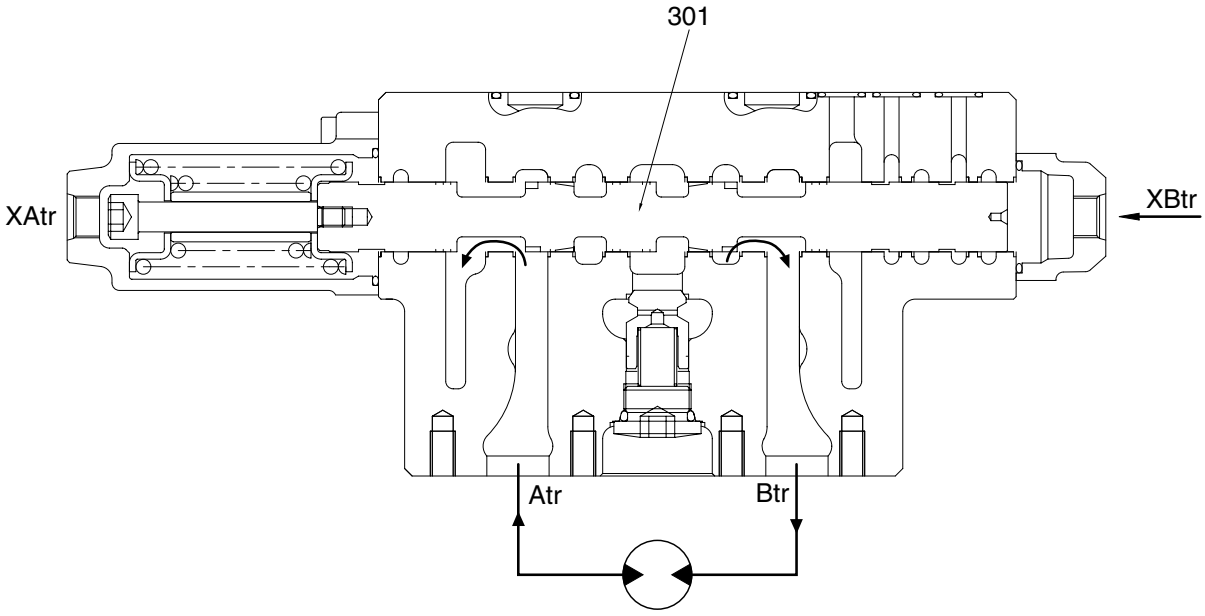


SPOOL SECTION(P1)

32092MC06

2) EACH SPOOL OPERATION

(1) Travel control



21092MC21

Pilot circuit

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

Main circuit

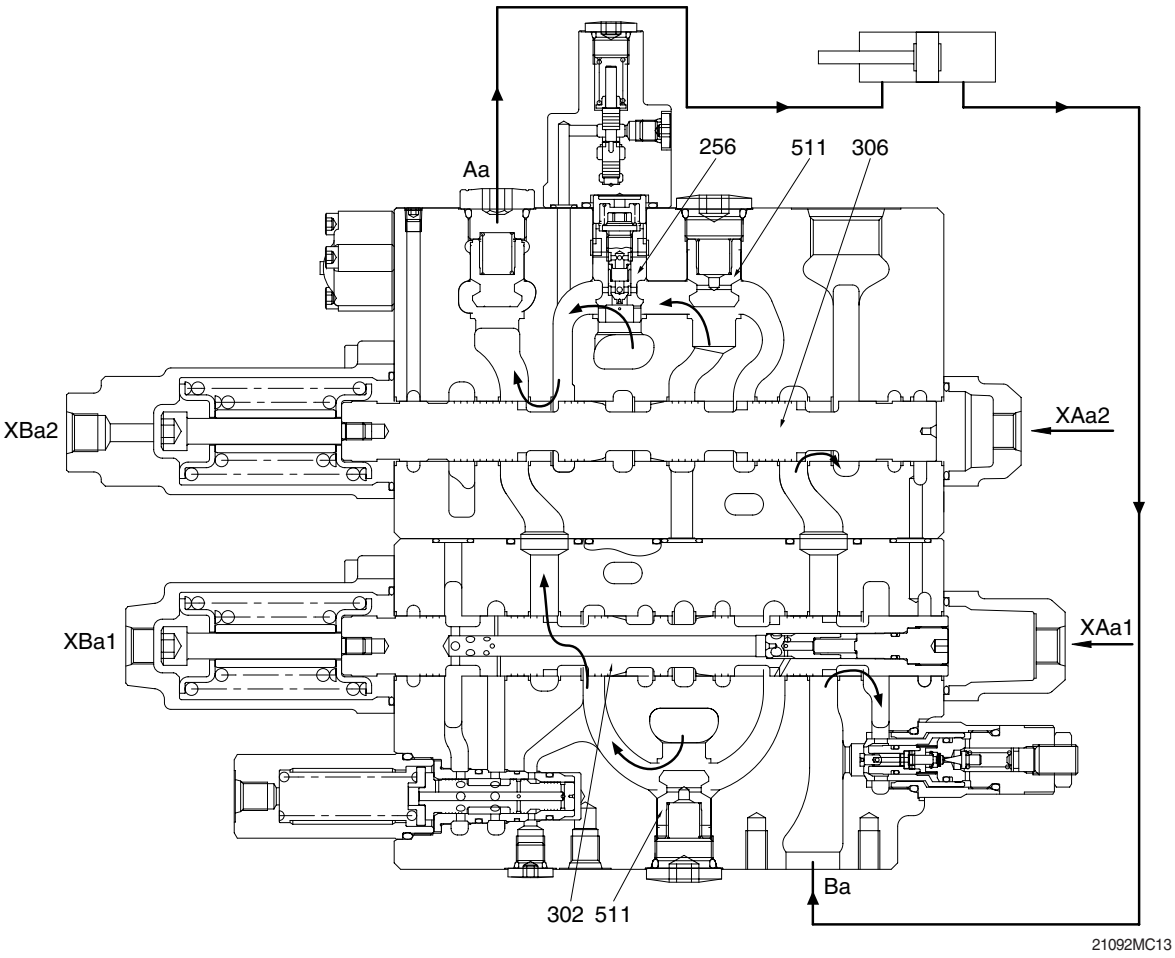
When Pilot Port XBtr of the travel right spool (301) is pressurized, the bypass circuit (2) in the arm 1 side is shut off and the working fluid discharged from the hydraulic pump (A1) through Port Btr and flows to the travel right motor.

When Pilot Port XBtL of the travel left spool (301) is pressurized, the bypass circuit (2) in the boom 1 side is shut off and the working fluid discharged from the hydraulic pump (A2), similarly to that from the hydraulic pump (A1), through Port BtL and flows to the travel left motor.

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

(2) Arm control

① Arm out operation



Pilot circuit

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

Main circuit

During the arm out operation, the pilot pressure enters through Ports XAa1 and XAa2. When the pressure enters through Port XAa1 and XAa2, the spools transfer in the left direction. The hydraulic oil entering through Port P1 passes through the main path (1) and flows to the bypass circuit (2), but the bypass circuit is shut off due to transfer of the arm 1 spool (302).

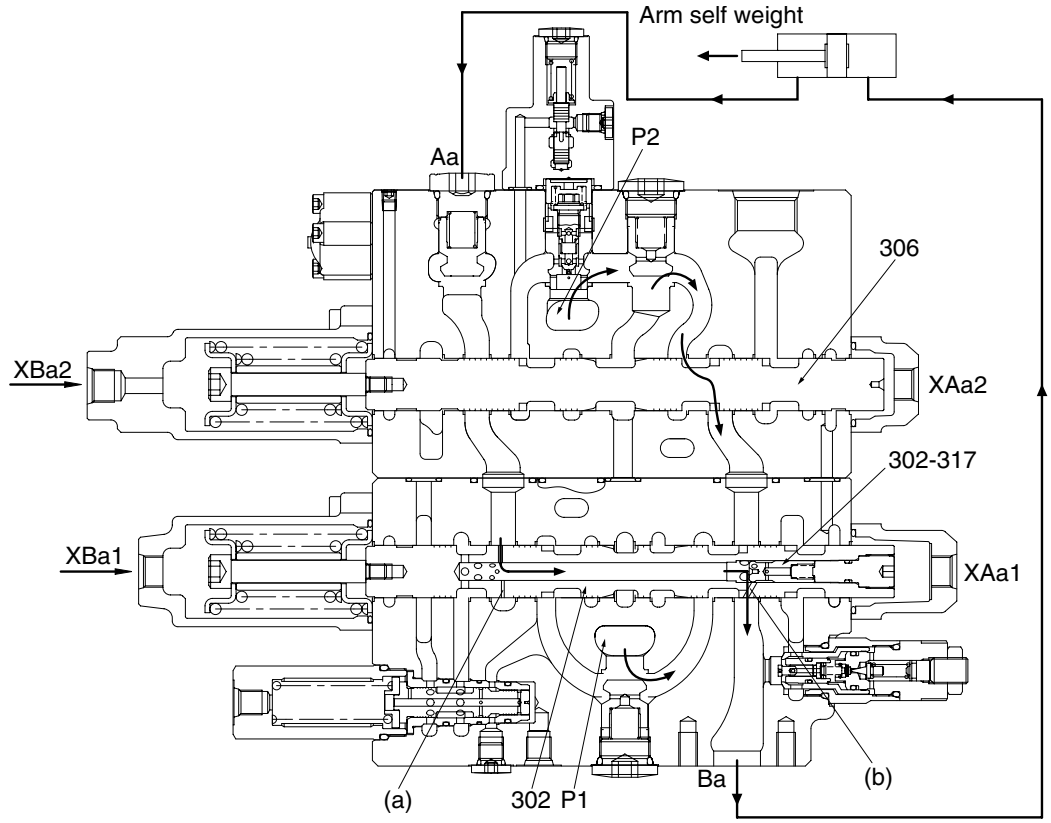
Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 1 spool (302). Then, it flows around the periphery of the arm 1 spool (302) and the arm 2 spool (306) to Port Aa, and is supplied to the arm cylinder rod side.

On the other hand, the hydraulic oil entering through Port P2 passes in the main path (3), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (306). The hydraulic oil from the parallel circuit pushes open the logic poppet (256) and the hydraulic oil from the bypass circuit (2) pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (306). Then, it flows around the periphery of the arm 2 spool (306) in the inside path and joins into Port Aa.

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

② Arm in operation

· During light load only



21092MC14

Pilot circuit

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

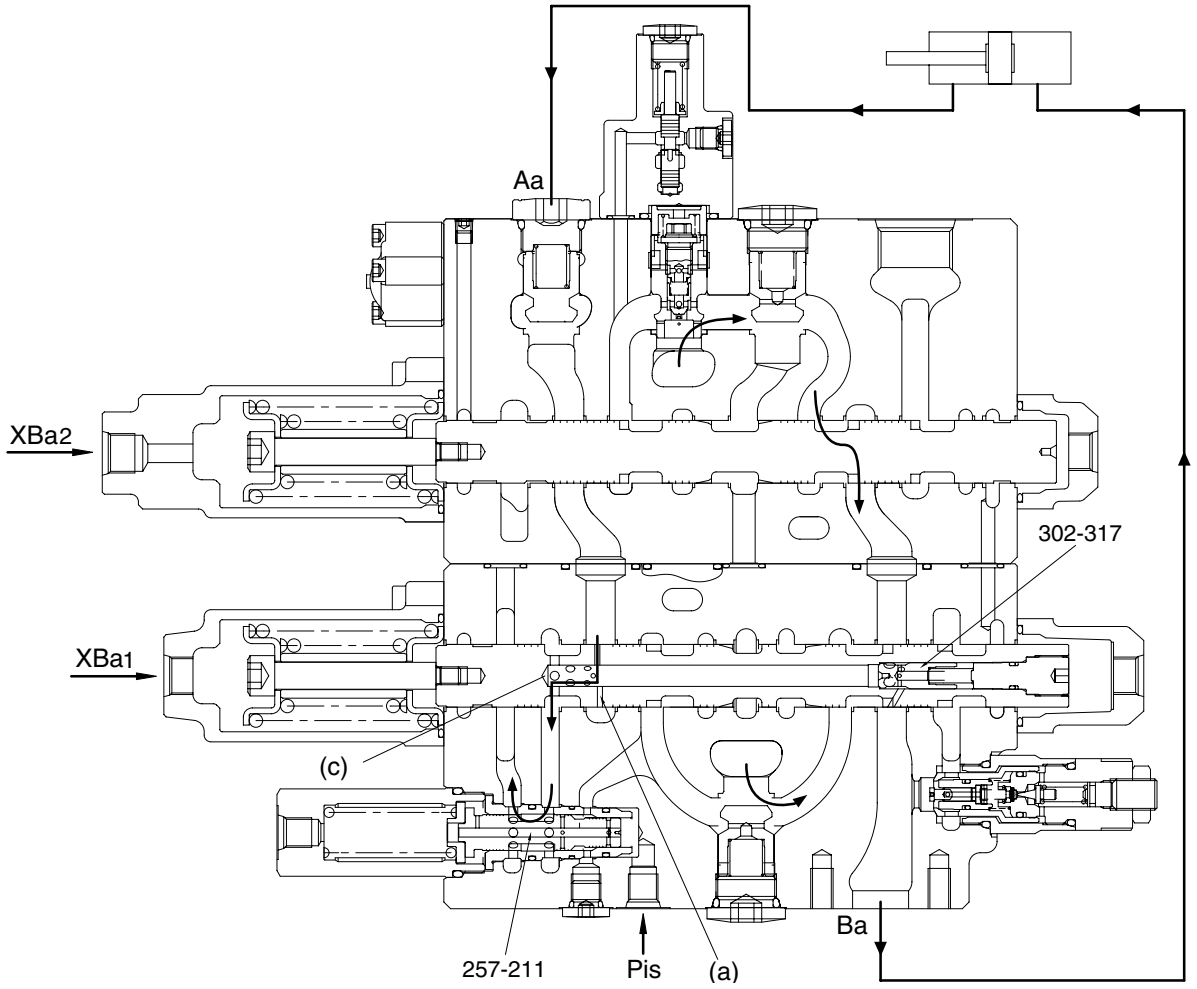
Main circuit

During the arm in operation, the pilot pressure enters through Ports XBa1 and XBa2. When the pressure enters through Port XBa1 and Port XBa2, the spools transfer in the right direction Fig. MC14. The hydraulic oil entering through Port P1 passes through the main path (1) and flows to the bypass circuit (2), but the bypass circuit is shut off due to transfer of the arm 1 spool (302). Therefore, the hydraulic oil from the parallel circuit pushes open the check valve (511) and flows through the U-shaped path to the arm 1 spool (302). Then, it flows around the periphery of the arm 1 spool (302) to Port Ba, and is supplied to the arm cylinder head side.

On the other hand, the hydraulic oil entering through Port P2 passes in the main path (3), and flows into the bypass circuit (2), and the bypass circuit is shut off due to transfer of the arm 2 spool (306). The hydraulic oil from the parallel circuit pushes open the logic poppet (256) and the hydraulic oil from the bypass circuit (2) pushes open the check valve (511) and flows through the U-shaped path to the arm 2 spool (306). Then, it flows around the periphery of the arm 2 spool (306) and the arm 1 spool (302) in the inside path and joins into Port Ba.

Besides, the return oil from the arm cylinder rod side is pressurized by self-weight of the arms and so on, and returns to Port Aa. The pressurized oil returning to Port Aa enters into the spool through the periphery hole (a) of the arm 1 spool (302). During a light load only, it pushes open the check valve (302-317) and joins into Port Ba from the spool hole (b). The rest of oil returns to the hydraulic oil tank through the tank port (R1). This is called the arm regeneration function.

· The pressure in the arm cylinder head side increases

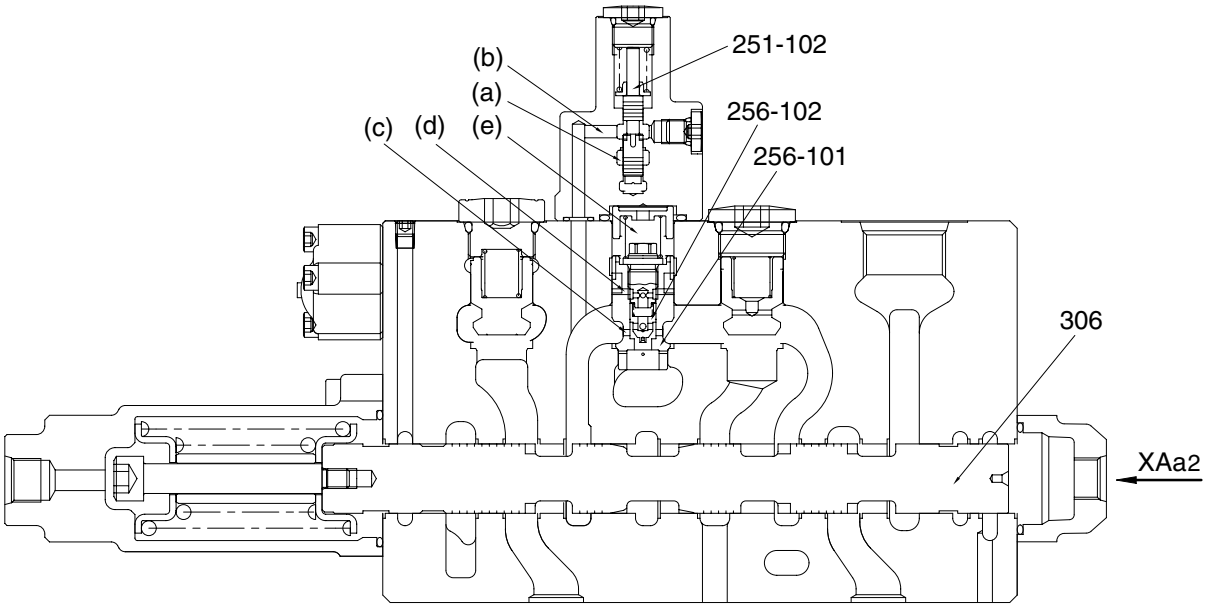


21092MC15

When the pressure in the arm cylinder head side and the U-shaped path increases, the arm regeneration cut spool (257-211) is transferred in the left direction, and at the same time the check valve (302-317) is closed by its backpressure. This shuts off the arm regeneration function, and the return oil from the arm cylinder rod side enters from Port Aa through the periphery hole (a) of the arm 1 spool (302) into the spool, flows to the arm regeneration cut valve (257) through the periphery hole (c) of the arm 1 spool (302), and returns through the tank port (R1) to the hydraulic oil tank.

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

③ Arm 2 logic control valve operation



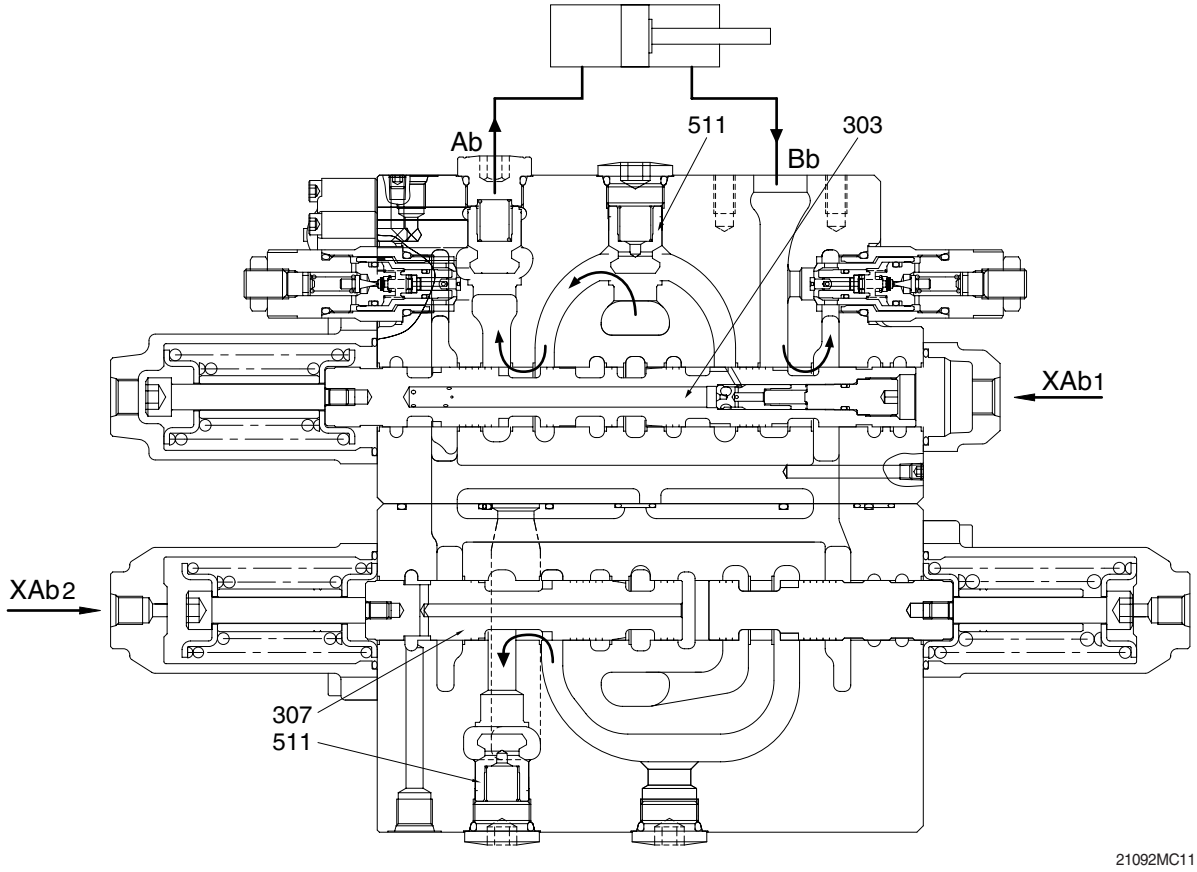
21092MC16

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

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

(3) Boom control

① Boom up operation



Pilot circuit

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

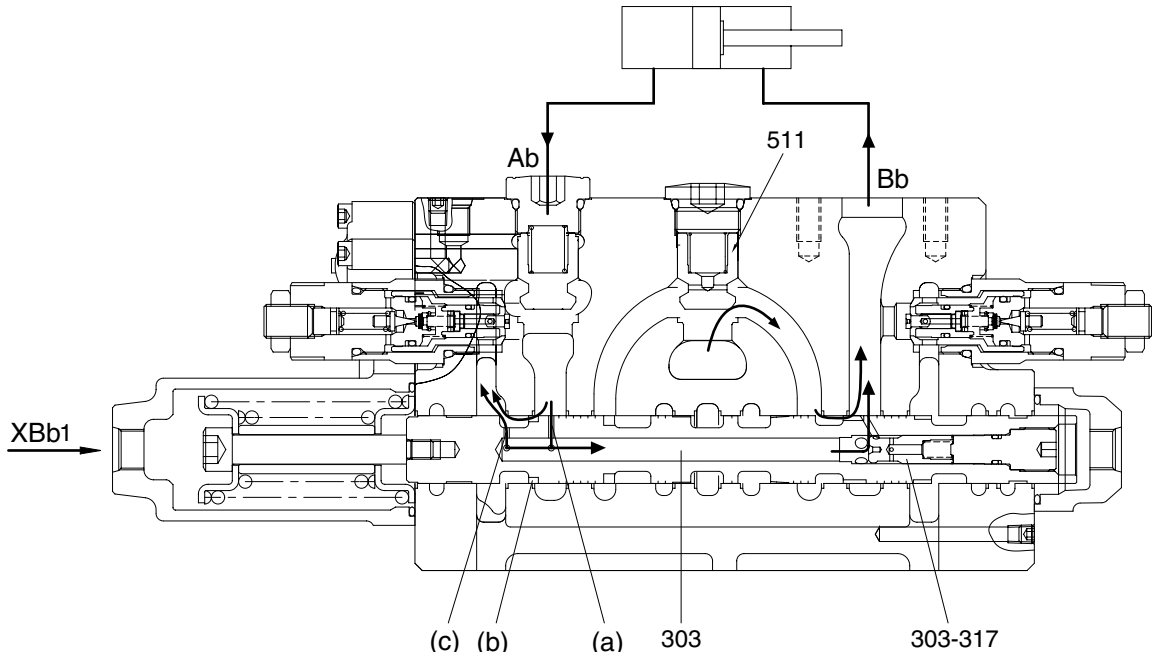
Main circuit

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

At the same time, the pilot pressure enters also through Port XAb2 to transfer the boom 2 spool (307) in the right direction. Though the pressurized oil enters into Port P1, the bypass circuit (2) is shut off due to transfer of the boom 2 spool (307). Therefore, the hydraulic oil flows in the parallel circuit and flows through the U-shaped path to the boom 2 spool (307). Then, the hydraulic oil passes through the periphery of the boom 2 spool (307), pushes open the check valve (511), joins into Port Ab in the inside path, and is supplied to the boom cylinder head side. (Boom confluent flow)

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

② **Boom down operation**



21092MC12

Pilot circuit

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

Main circuit

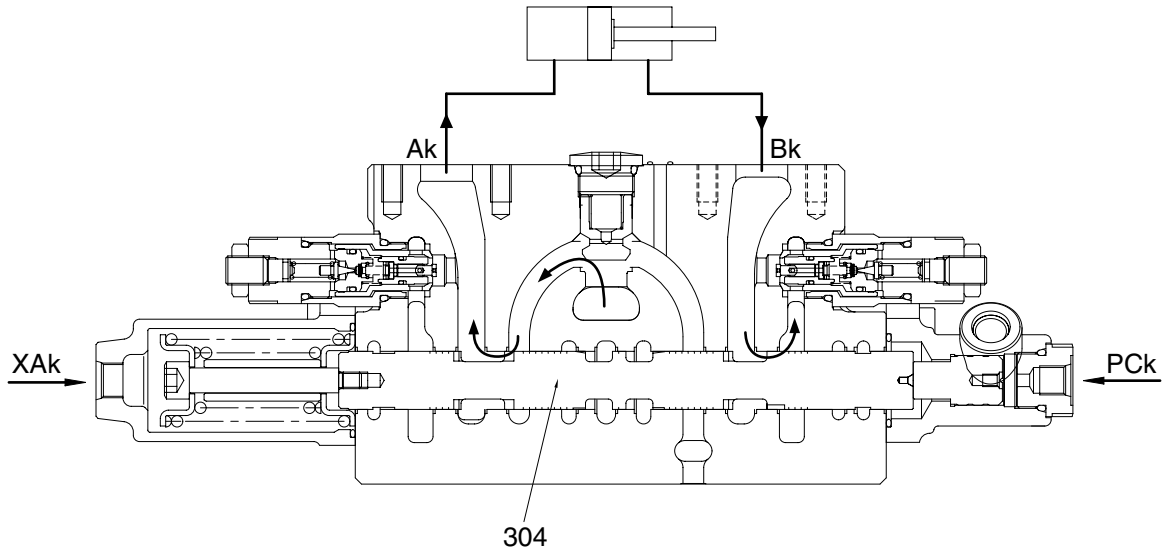
During the boom down operation, the pilot pressure enters through Port XBb1 and transfers the boom 1 spool (303) in the right direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows to the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the boom 1 spool (303). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the boom 1 spool (303). Then, it flows around the periphery of the boom 1 spool (303) to Port Bb and is supplied to the boom cylinder rod side.

On the other hand, the return oil from the boom cylinder head side passes to the holes (a) and the notches (b) of the boom 1 spool (303).

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

(4) Bucket control

① Bucket in operation



Pilot circuit

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

Main circuit

During the bucket in operation, the pilot pressure enters through Port XAk and transfers the bucket spool (304) in the right direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bucket spool (304). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the bucket spool (304). Then, it flows through the periphery of the spool to Port Ak and is supplied to the bucket cylinder head side.

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

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

② **Bucket out operation**

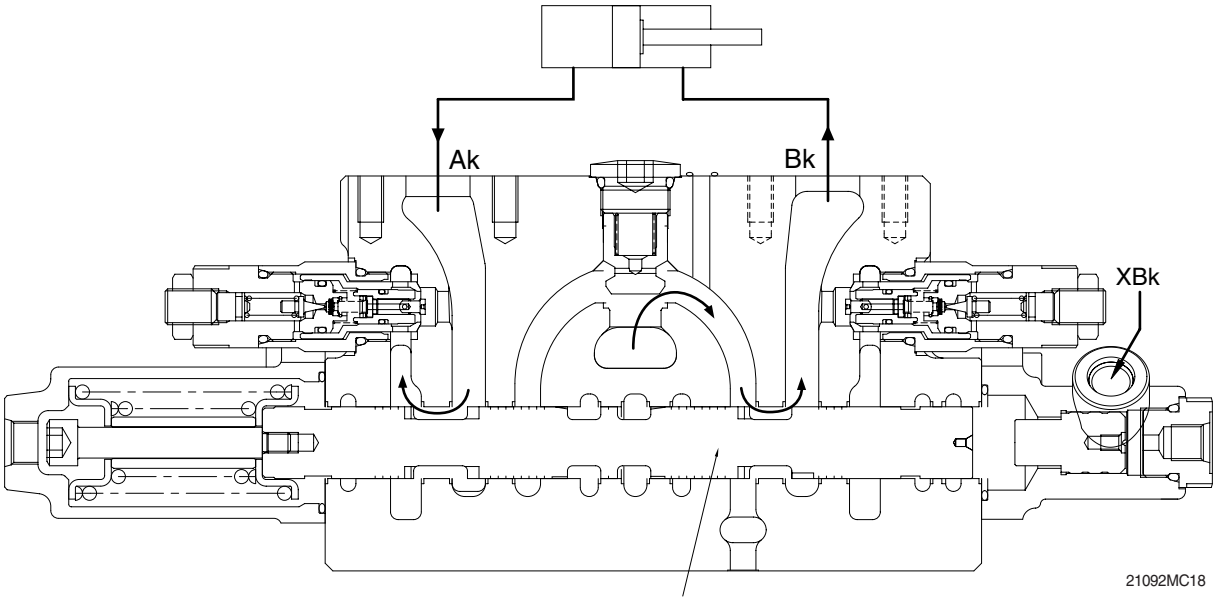
Pilot circuit

Since the bucket spool (304) transfers and shuts off the side-bypass path, the pressure at Port Px increases.

Main circuit

During the bucket out operation, the pilot pressure enters through Port XBk and transfers the bucket spool (304) in the left direction. The pressurized oil entering through Port P2 passes through the main path (3) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bucket spool (304). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the bucket spool (304). Then, it flows through the periphery of the spool to Port Bk and is supplied to the bucket cylinder rod side.

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



③ **Bucket in confluence**

During the bucket in operation, the pilot pressure enters also through Port XBp1 and transfers the bypass-cut spool (313). The pressurized oil entering through Port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the bypass-cut spool (313). Therefore, the pressurized oil pushes open the check valve CCk (514), and flows through inside path and the U-shaped path to the bucket spool (304).

(5) Swing control

① Swing operation

Pilot circuit

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

Main circuit

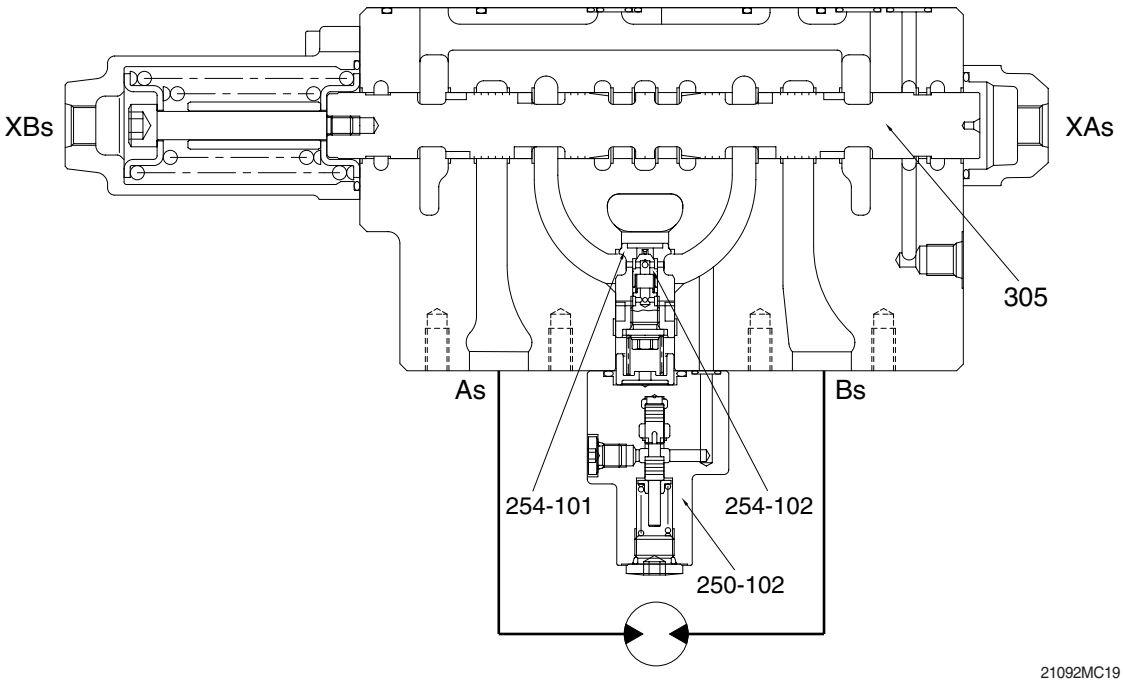
During the swing operation, the pilot pressure enters through Port XAs (or XBs) and transfers the swing spool (305). The pressurized oil entering through Port P1 passes through the main path (1) and flows through the bypass circuit (2), but the bypass circuit (2) is shut off due to transfer of the swing spool (305). Therefore, the pressurized oil flows into the parallel circuit, pushes open the check valve (511), and flows through the U-shaped path to the swing spool (305). Then, it flows through the periphery of the spool to Port As (or Bs) and is supplied to the swing motor.

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

② Swing logic control valve operation

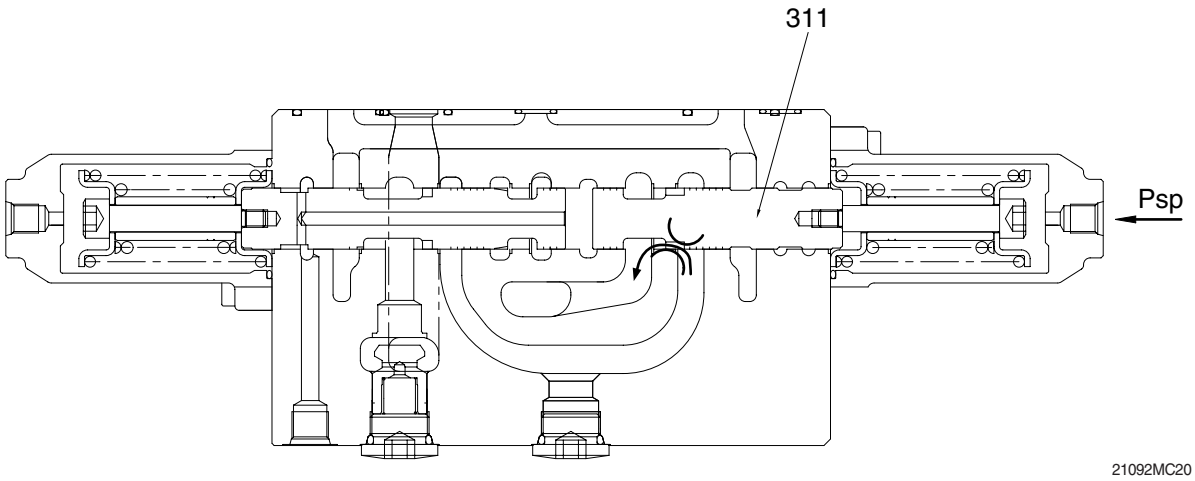
During both the swing operation and the boom up operation, the pilot pressure enters through Ports XBs (or XAs), XAb1, XAb2 and Pns. The pressure Pns transfers the spool (250-102) in swing logic control valve. Hereby, the pressurized oil pushes open the poppet (254-102), and the poppet (254-101) is pushed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

On the other hand, in the independent swing operation, the pilot pressure does not enter through Ports Pns. The pressurized oil entering through Port P1 pushes open the poppet (254-101) and flows to the swing spool (304).



21092MC19

③ Swing operation preference function



Pilot circuit

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

Main circuit

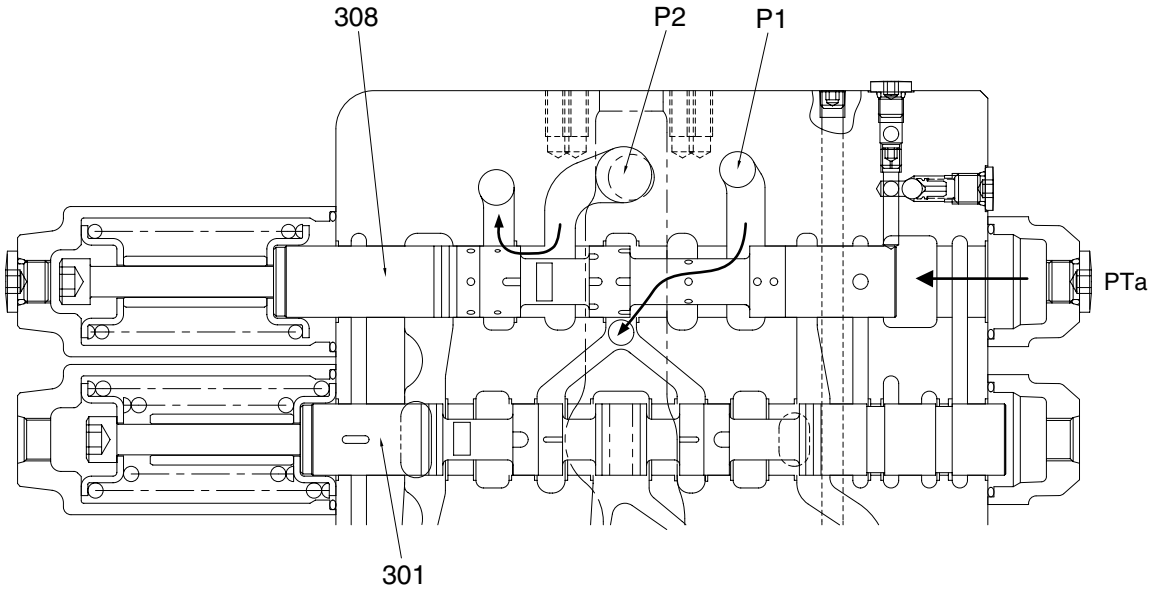
Due to transfer of the swing priority spool (311), the open area of the swing priority spool decreases, and the most of the pressurized oil entering through Port P1 flows to the swing side to make the swing operation most preferential.

(6) **Travel straight operation**

Simultaneous operating of both travel spools (301) and other spool.

A case where both travel spools (301) and swing spool (305) are changed over will be considered.

(The pilot Ports XAtL, XAtr and XAs are pressurized.)



Pilot circuit

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

Main circuit

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

On the other hand, the pressurized oil entering through Port P2 flows to Port As and is supplied to the swing motor.

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

3) FUNCTION OF LOCK VALVE

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

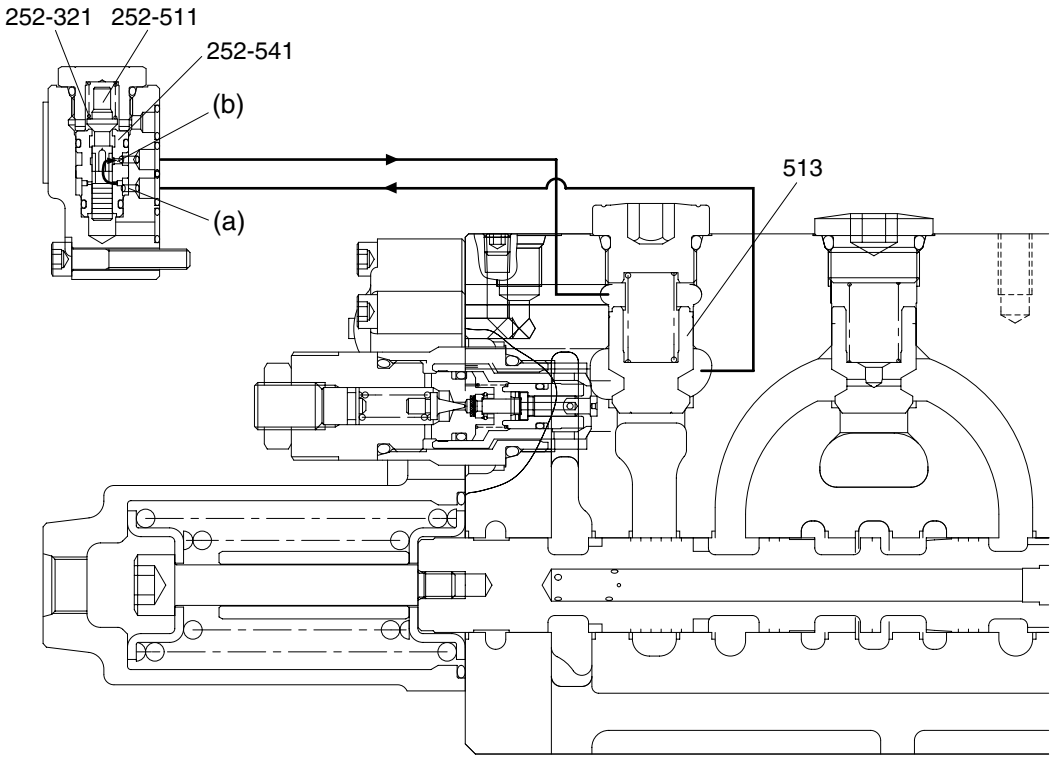
Another lock valve (252) is similarly fitted between the boom cylinder head side and the boom 1 spool (303). It decreases the leakage by the pressure of the cylinder.

(1) Neutral positions of spools

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

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

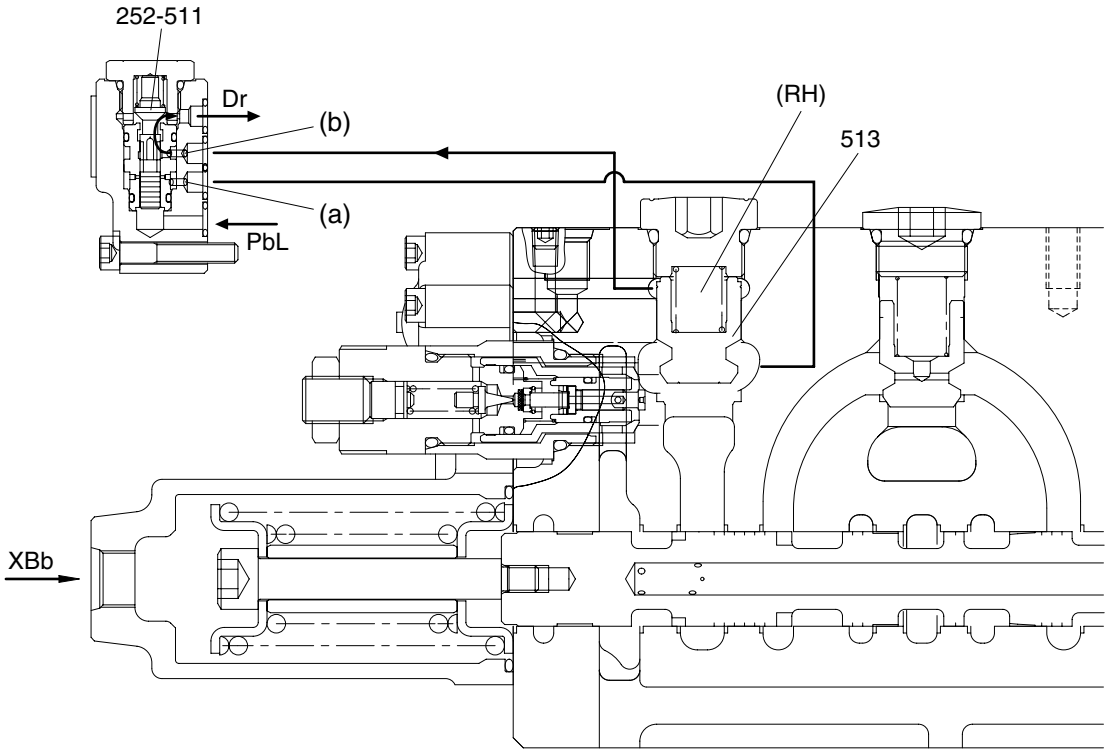
In this position, the pressurized oil from the boom cylinder head side enters through the hole (a), the periphery of the spool (252-511) in the lock valve and the hole (b), and it pushes the poppet (513) to the casing seat, and the leakage is decreased.



21092MC35

(2) Boom down operation

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



21092MC36

(3) Boom up operation

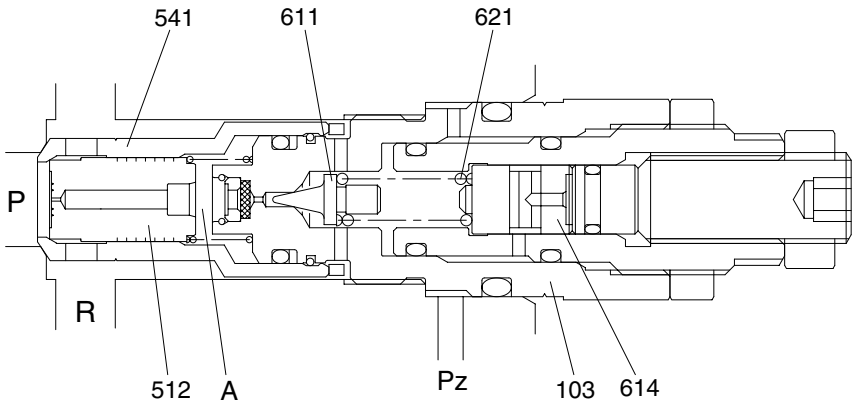
During the boom up operation, the pilot pressure enters through Port XAb1. The oil flowing from the boom 1 spool pushes open the poppet (513) and flows to Port Ab.

5) CIRCUIT PRESSURE PROTECTION

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

(1) Main relief valve

The main relief valve is fitted in the casing A and functions as follows.



21092MC25

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

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

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

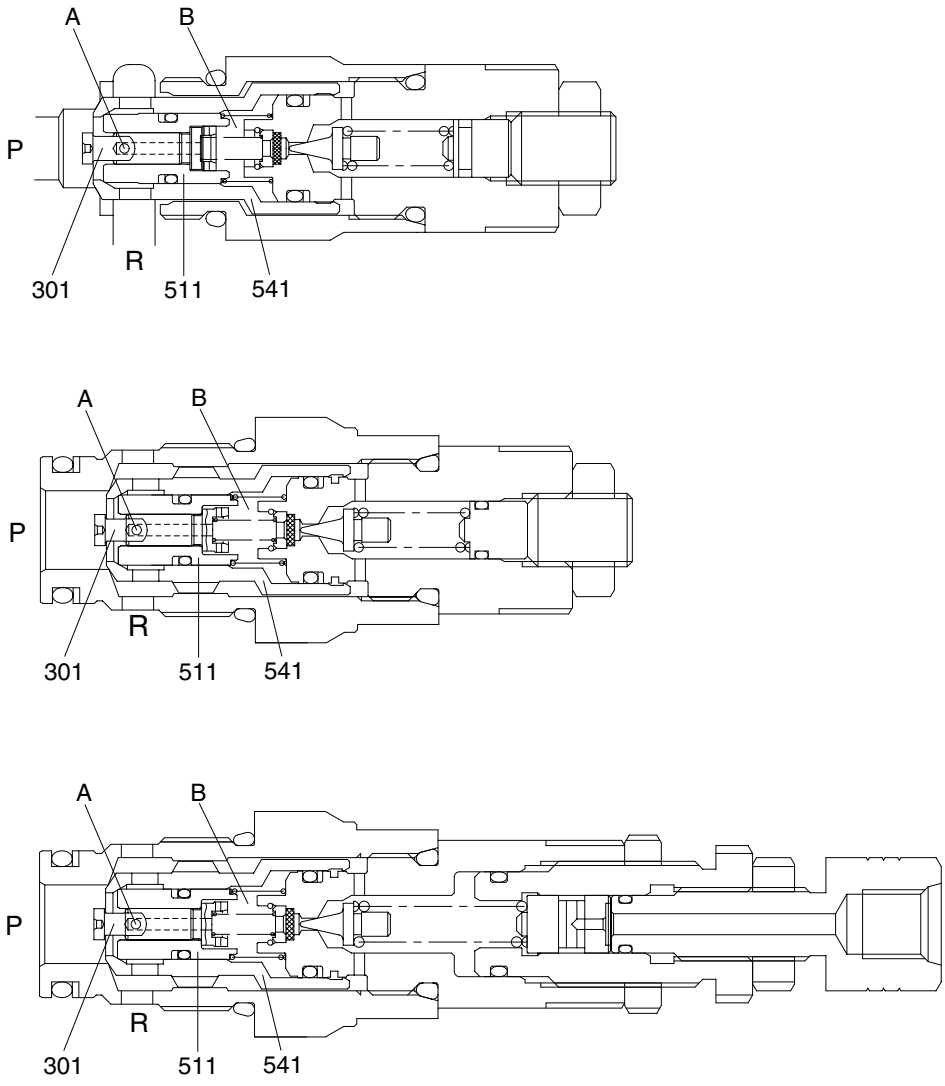
④ When the pressurized oil higher than pressure 30 kgf/cm^2 enters through the port Pz, it pushes the piston (614) to change the relief set pressure of the spring (621) to the high pressure.

(2) Port relief valve

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

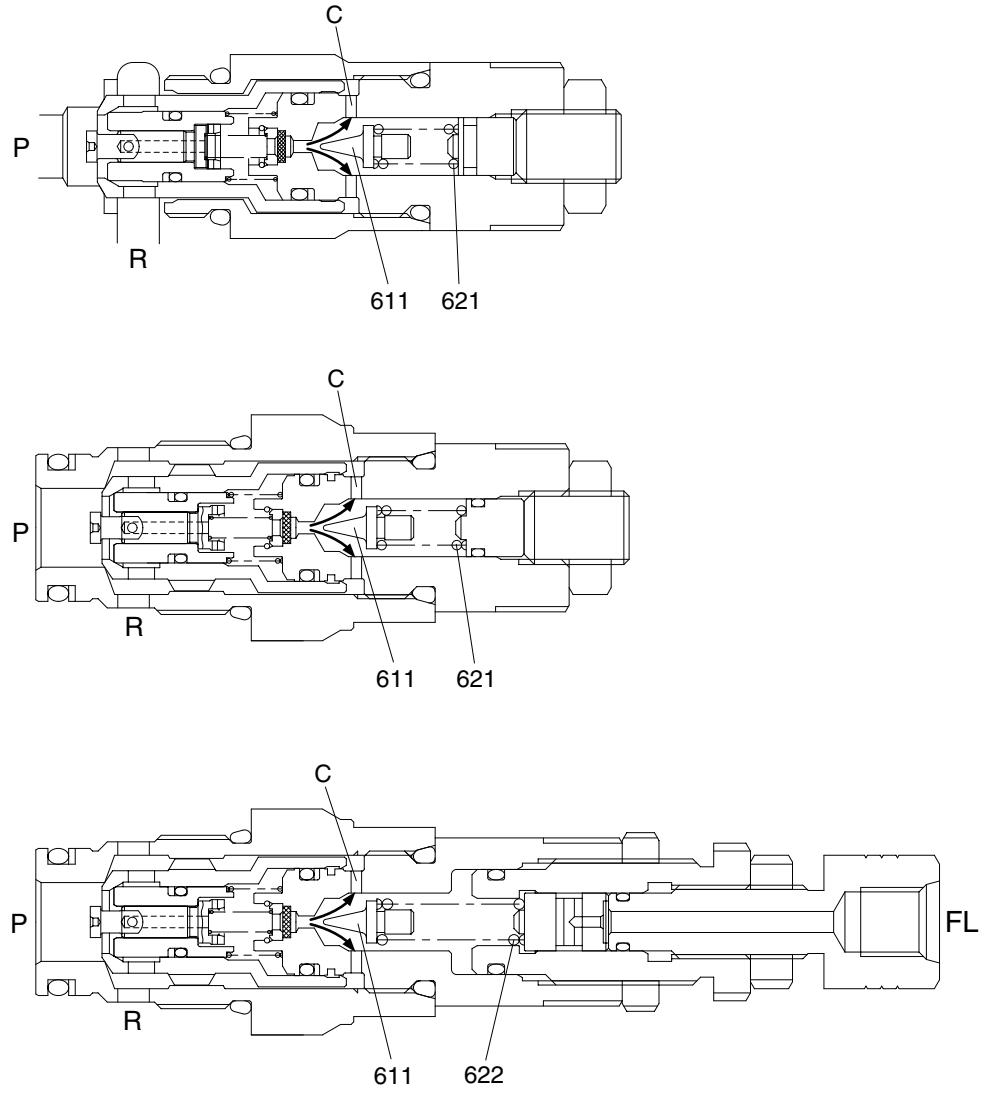
① Function as relief valve

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



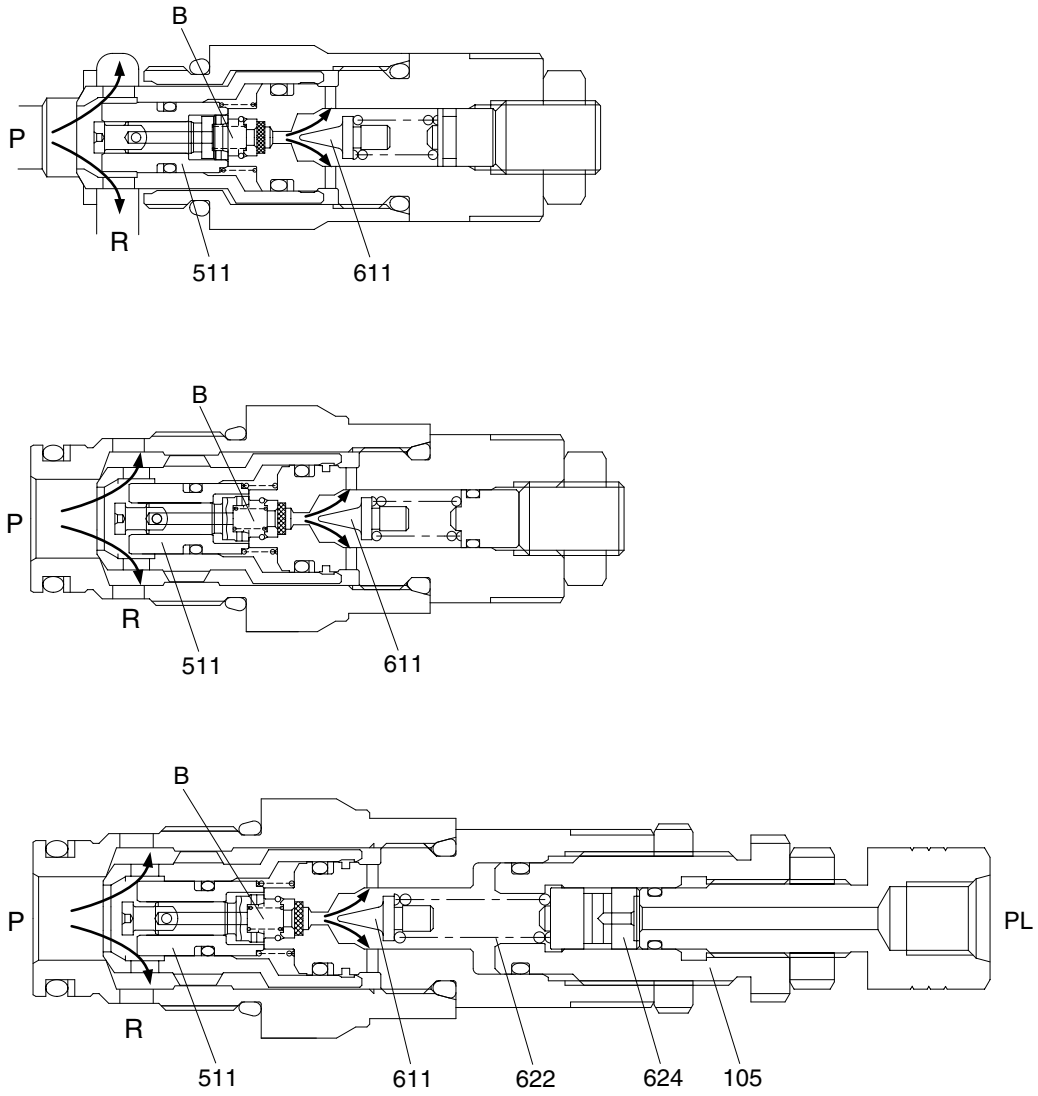
21092MC26

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



21092MC27

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

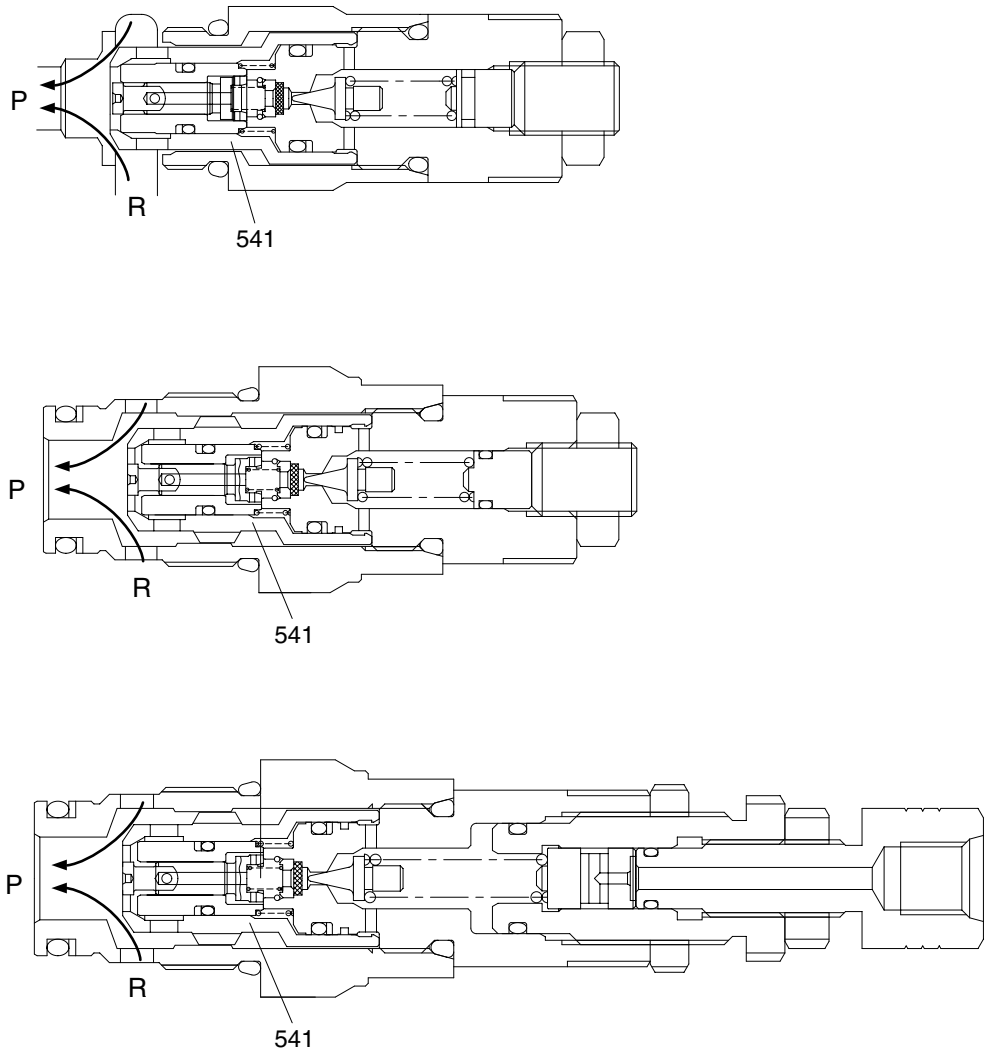


21092MC28

d. When the pressurized oil higher than pressure 25 kgf/cm^2 enters through the port PL, it pushes the piston (624) to change the relief set pressure of the spring (622) to the high pressure.

② **Function as Anti-Cavitation Check Valve**

When any negative pressure exists in the path (P), the oil is supplied through the path (R). When the pressure at (R) becomes higher than that in the path (P), the seat (541) moves in the right direction. Then, sufficient oil passes around the seat (541) from the path (R) to the path (P) and prevents cavitation.

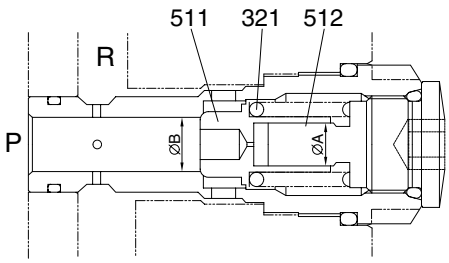


21092MC29

(3) Negative control relief valve

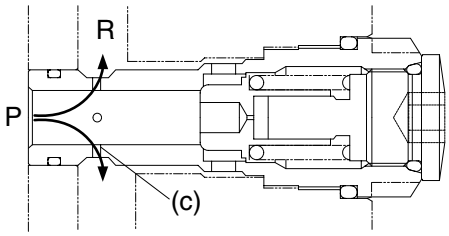
The negative control relief valve is fitted between tne downstream of the center bypass path and low-pressure path, and functions as follows.

① When the pressure in the path (P) falls below the set level of the spring (321), the poppet (511) is in the condition shown in the figure. The pressure acting area of the poppet (511) is reduced to (ϕ B - ϕ A), as the area ϕ B is cancelled by the area ϕ A of the damping rod (512).



32092MC07

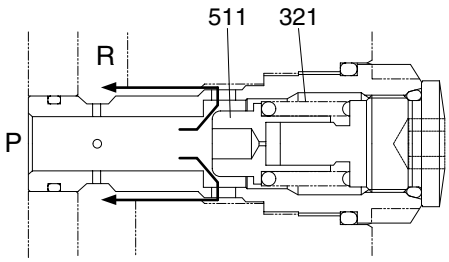
② In this condition, the pressurized oil in the path (P) runs out to the path (R) through the orifice (c).



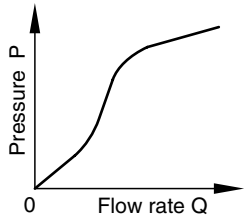
32092MC08A

③ When the pressure in the path (P) goes over the set P pressure of the spring (321), the poppet (511) opens. Then, the pressurized oil in the path (P) passes around the outside of the poppet (511) and flows to the low-pressure path (R).

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



32092MC09A



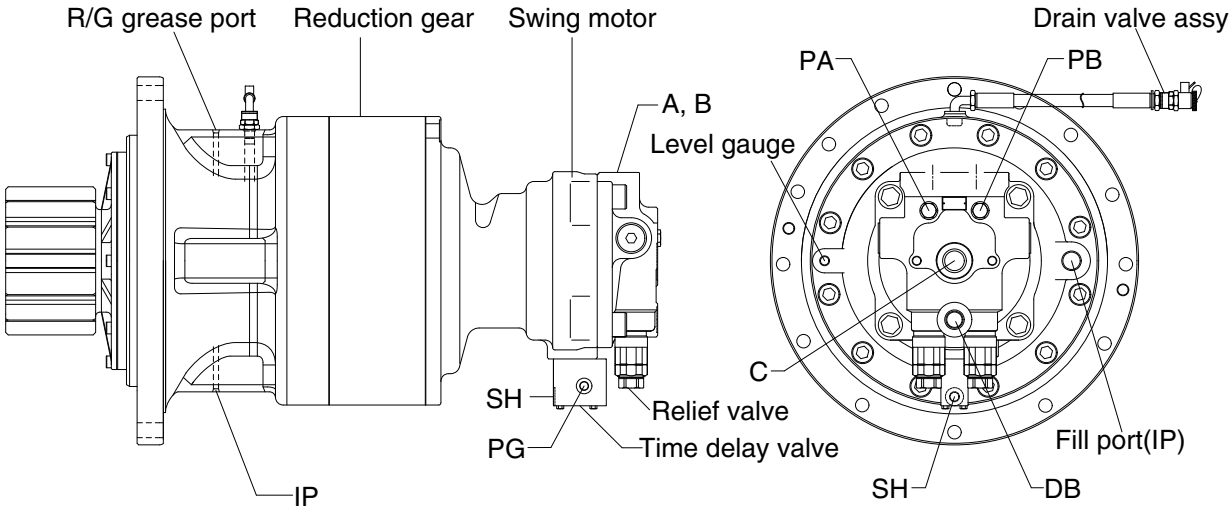
32092MC10

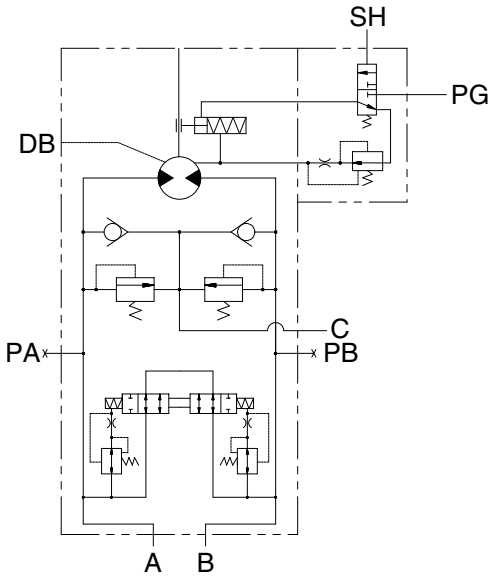
GROUP 3 SWING DEVICE

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.

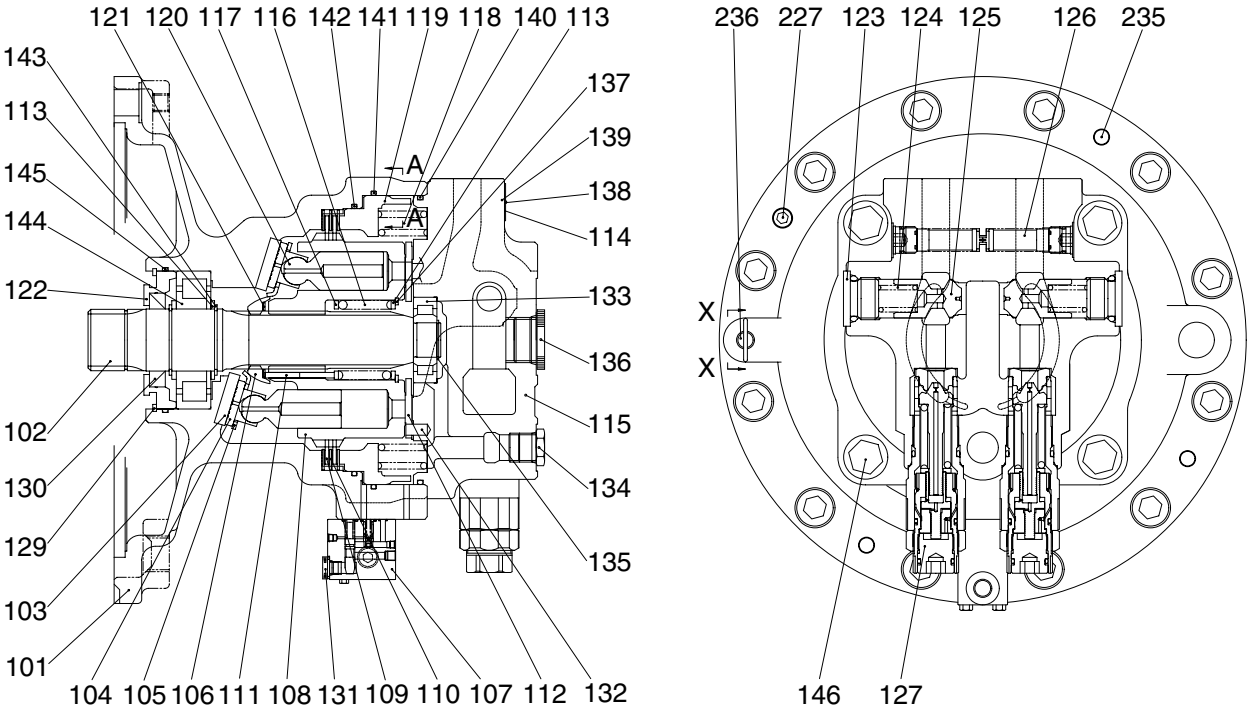




32092SM01

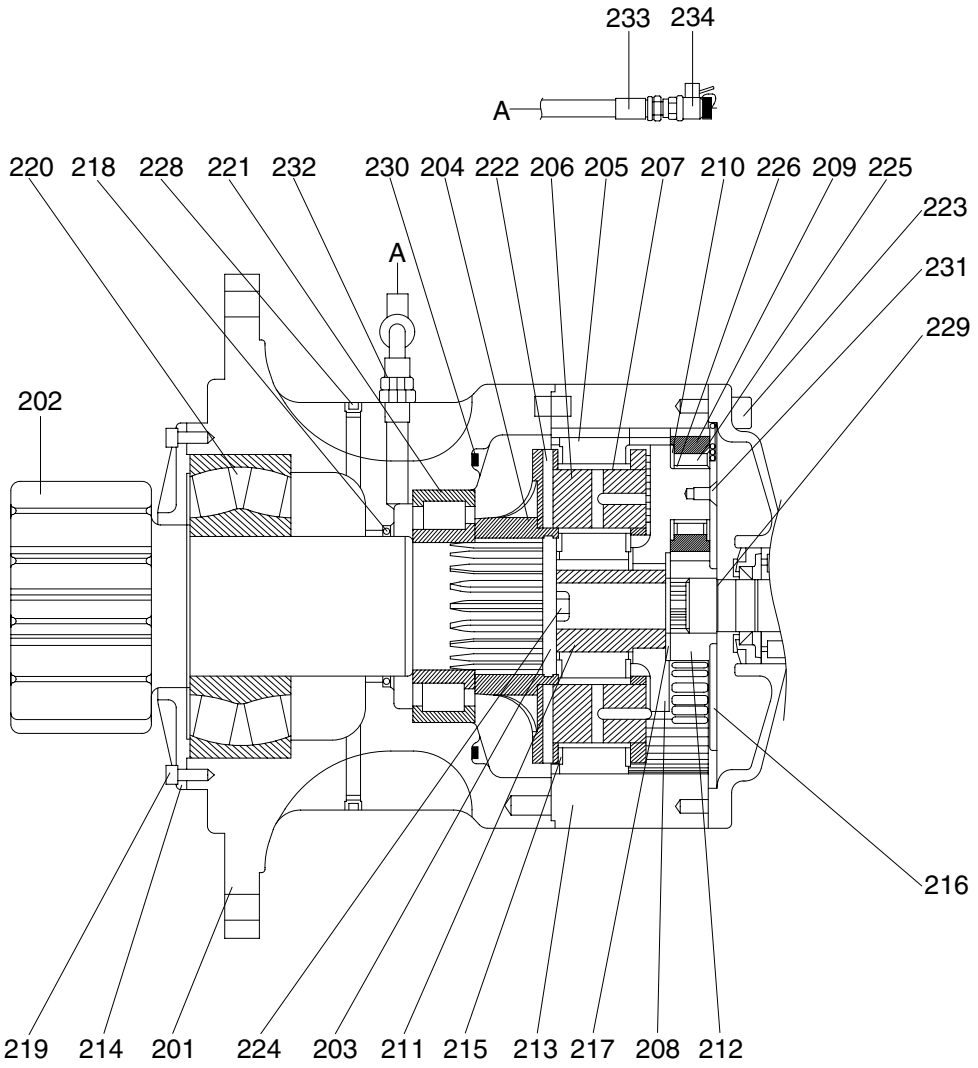
Port	Port name	Port size
A, B	Main port	SAE 5000psi 3/4"
DB	Drain port	PF 1/2-19
C	Make up port	PF 1-24
PA, PB	Gauge port	PF 1/4-12
PG	Brake release stand by port	PF 1/4-12
SH	Brake release pilot port	PF 1/4-12
IP	Grease inlet port	PT 1/4

1) SWING MOTOR



101	Casing A1	118	Brake spring	135	Ring snap
102	Drive shaft	119	Brake piston	136	Dust plug
103	Shoe plate	120	Piston	137	Ring snap
104	Shoe	121	Spacer F	138	Name plate
105	Retainer	122	Front cover	139	Rivet screw
106	Spherical bush	123	RO plug	140	O-ring
107	Brake valve	124	Spring	141	O-ring
108	Cylinder block	125	Plunger K	142	O-ring
109	Friction plate	126	S/reaction less valve	143	Ring snap
110	Separation pate	127	Relief valve	144	Roller bearing
111	Push rod	128	VP plug	145	O-ring
112	Valve plate	129	Ring snap	146	Socket bolt
113	Spacer	130	Oil seal	227	Socket bolt
114	VP plug	131	Dust plug	235	Pin
115	Valve casing	132	Pin spring	236	Level gauge
116	Cylinder spring	133	Roller bearing	237	Air breather assy
117	Spacer R	134	Dust plug		

2) REDUCTION GEAR



32092RG01

201	Casing	212	Sun gear 1	223	Socket bolt
202	Pinion shaft	213	Ring gear	224	Hex bolt
203	Preload plate	214	Cover	225	Needle bearing
204	Carrier 2	215	Thrust washer	226	Inner ring
205	Planet gear 2	216	Thrust plate	228	PT plug
206	Pin	217	Thrust washer	229	Snap ring
207	Bush	218	Oil seal	230	Magnet
208	Carrier 1	219	Socket bolt	231	Flat head screw
209	Planet gear 1	220	Spherical roller bearing	232	Connector
210	Thrust washer	221	Cylindrical roller bearing	233	Hose assembly
211	Sun gear 2	222	Spring pin	234	Drain valve assembly

2. FUNCTION

1) ROTARY PART

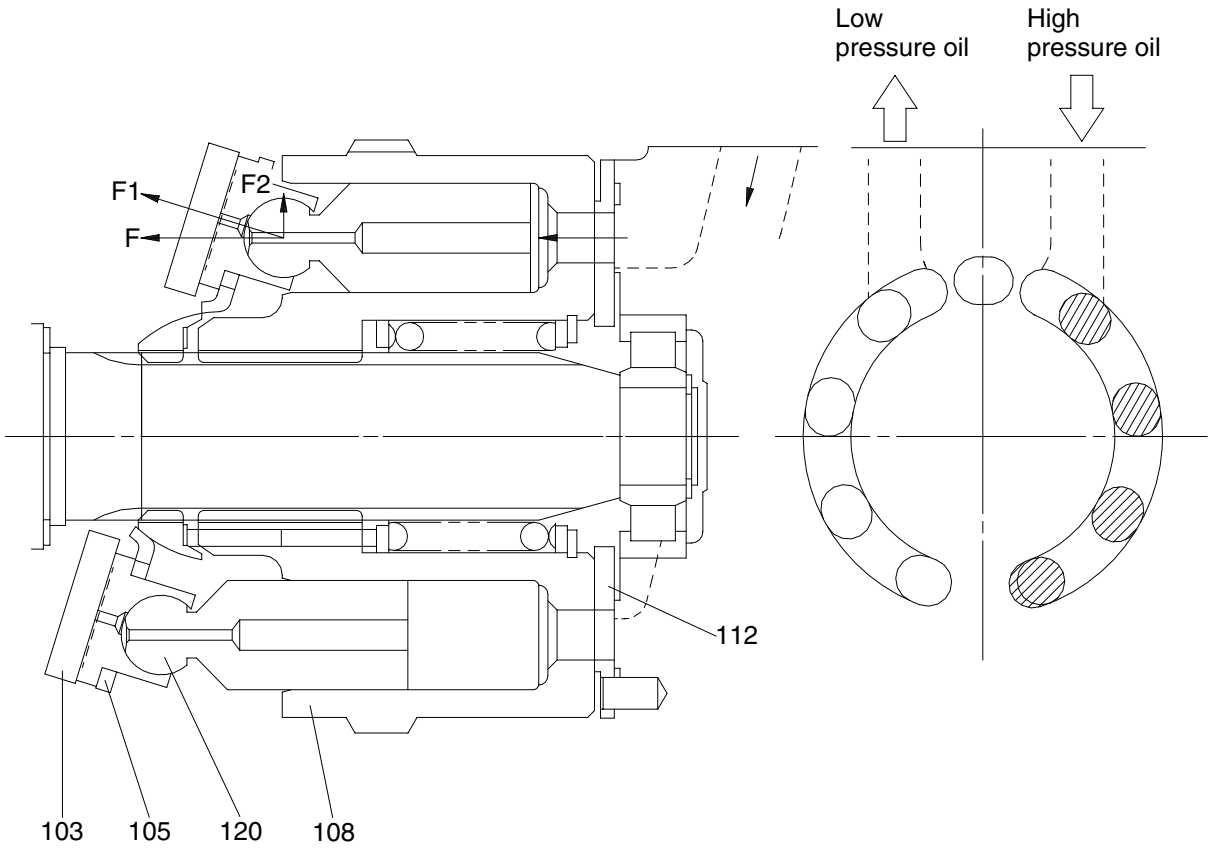
When high pressurized oil enters a cylinder through port (a), which is the inlet of valve plate (112), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston (120) upon the retainer (105) which acts upon the shoe plate (103) via an hydrostatic bearing. Force F1 perpendicular to shoe plate (103) and force F2 perpendicular to cylinder center.

Being transferred to the cylinder block (108) through piston, force F2 causes rotational moment at surroundings of cylinder.

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

$$T = \frac{p \times q}{2\pi},\ q = Z \cdot A \cdot PCD \cdot \tan\theta,\ F1 = \frac{F}{\cos\theta},\ F_2 = F\tan\theta,\ S = PCD \times \tan\theta$$

Where p : Effective difference of pressure (kgf/cm^2)
q : Displacement (cc/rev)
T : Output torque (kgf · cm)
Z : Piston number (9EA)
A : Piston area (cm^2)
θ : Tilting angle of swash plate (degree)
S : Piston stroke (cm)



32092SM03

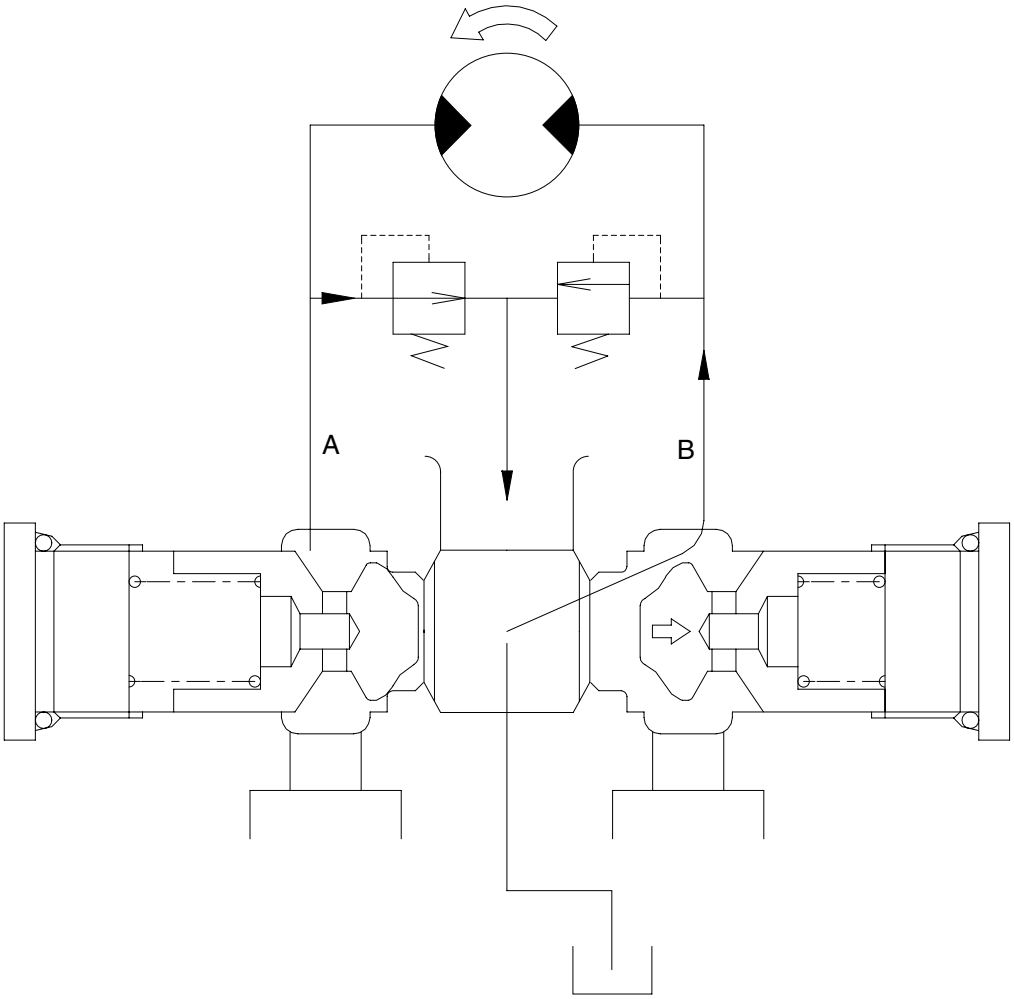
2) MAKE UP VALVE

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.

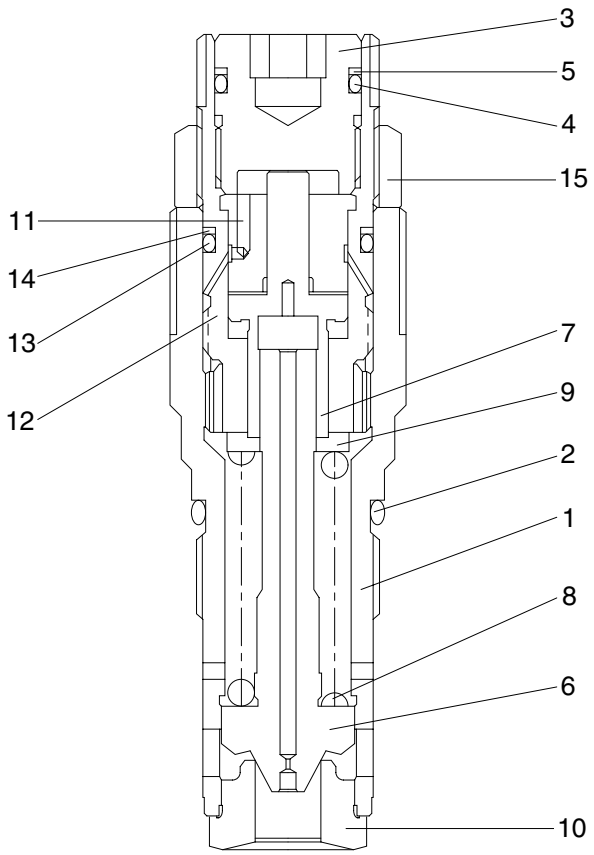
Pressurized oil into the port B, the motor rotate counterclockwise.

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.



29072SM09

3) RELIEF VALVE



29072SM03

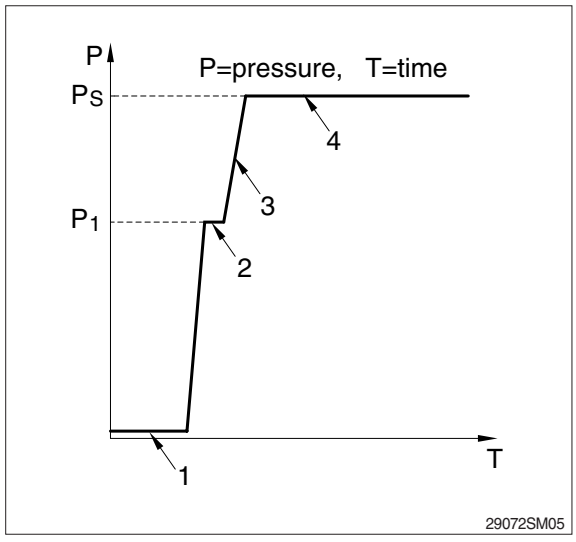
1 Body
2 O-ring
3 Plug
4 O-ring
5 Back up ring
6 Plunger
7 Piston
8 Spring
9 Seat spring
10 Seat
11 Sleeve
12 Adjust plug
13 O-ring
14 Back up ring
15 Nut

(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.

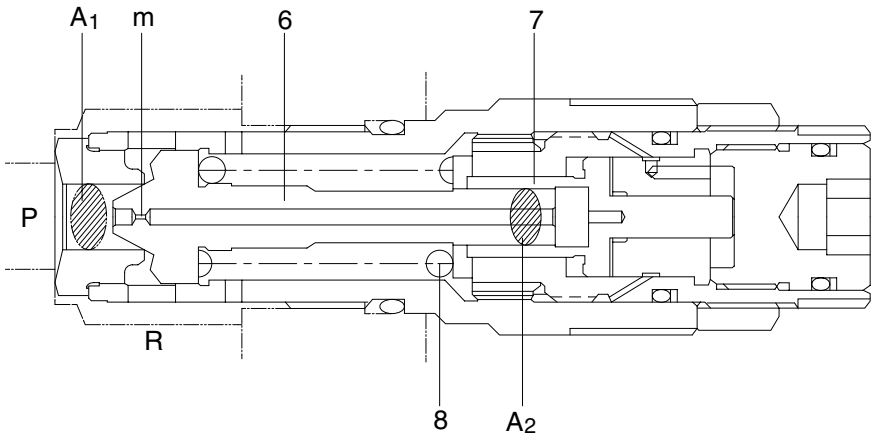
(2) Function of relief valve

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.



29072SM05

① Ports (P, R) at tank pressure.

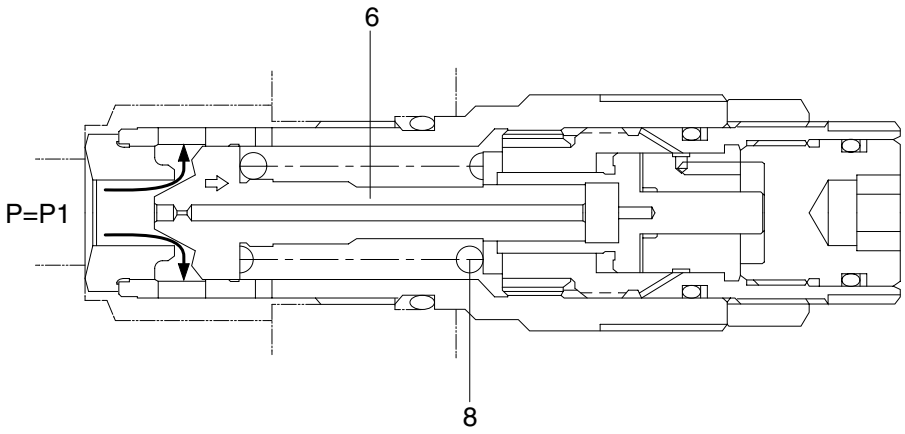


29072SM04

② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (8), the plunger (6) moves to the right as shown.

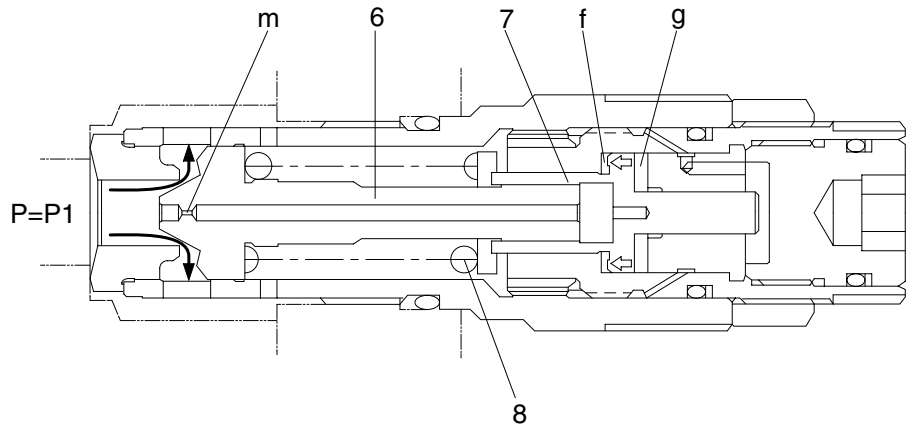
$$P_1 \times A_1 = Fsp + P_1 \times A_2$$

$$P_1 = \frac{Fsp}{A_1 - A_2}$$



29072SM06

③ When the pressure of chamber g reaches the preset force (Fsp) of spring (8), the piston (7) moves right and stop the piston (7) hits the end of body.

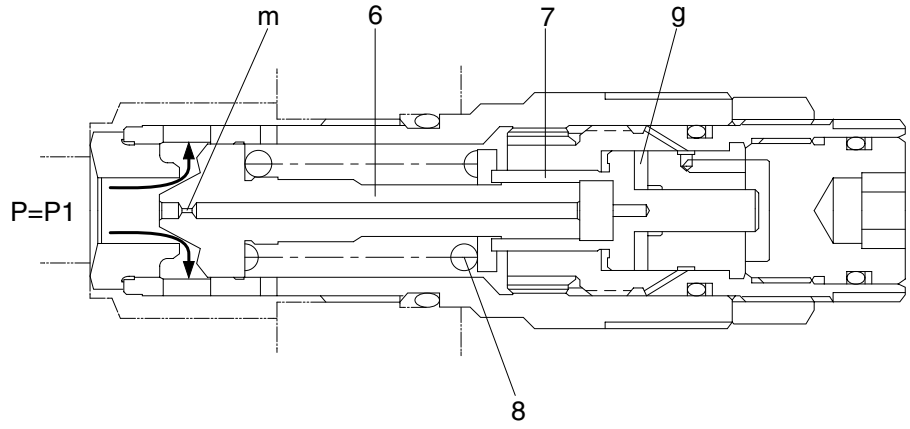


29072SM07

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

$$Ps \times A1 = Fsp + Ps \times A3$$

$$Ps = \frac{Fsp}{A1 - A3}$$



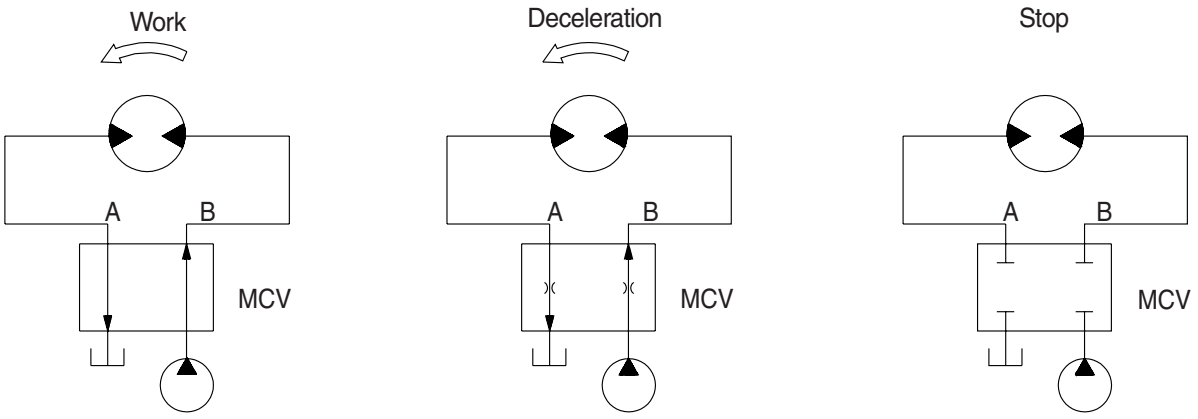
29072SM08

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

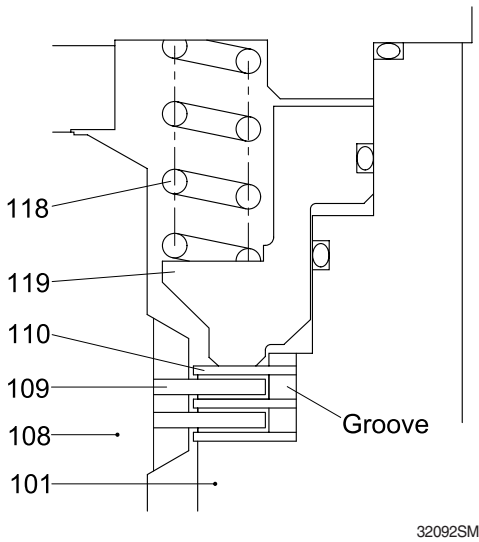
(2) Mechanical swing parking brake system

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

① Brake assembly

Circumferential rotation of separate plate (110) is constrained by the groove located at casing (101). When housing is pressed down by brake spring (118) through friction plate (109), separate plate (110) and brake piston (119), friction force occurs there.

Cylinder block (108) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

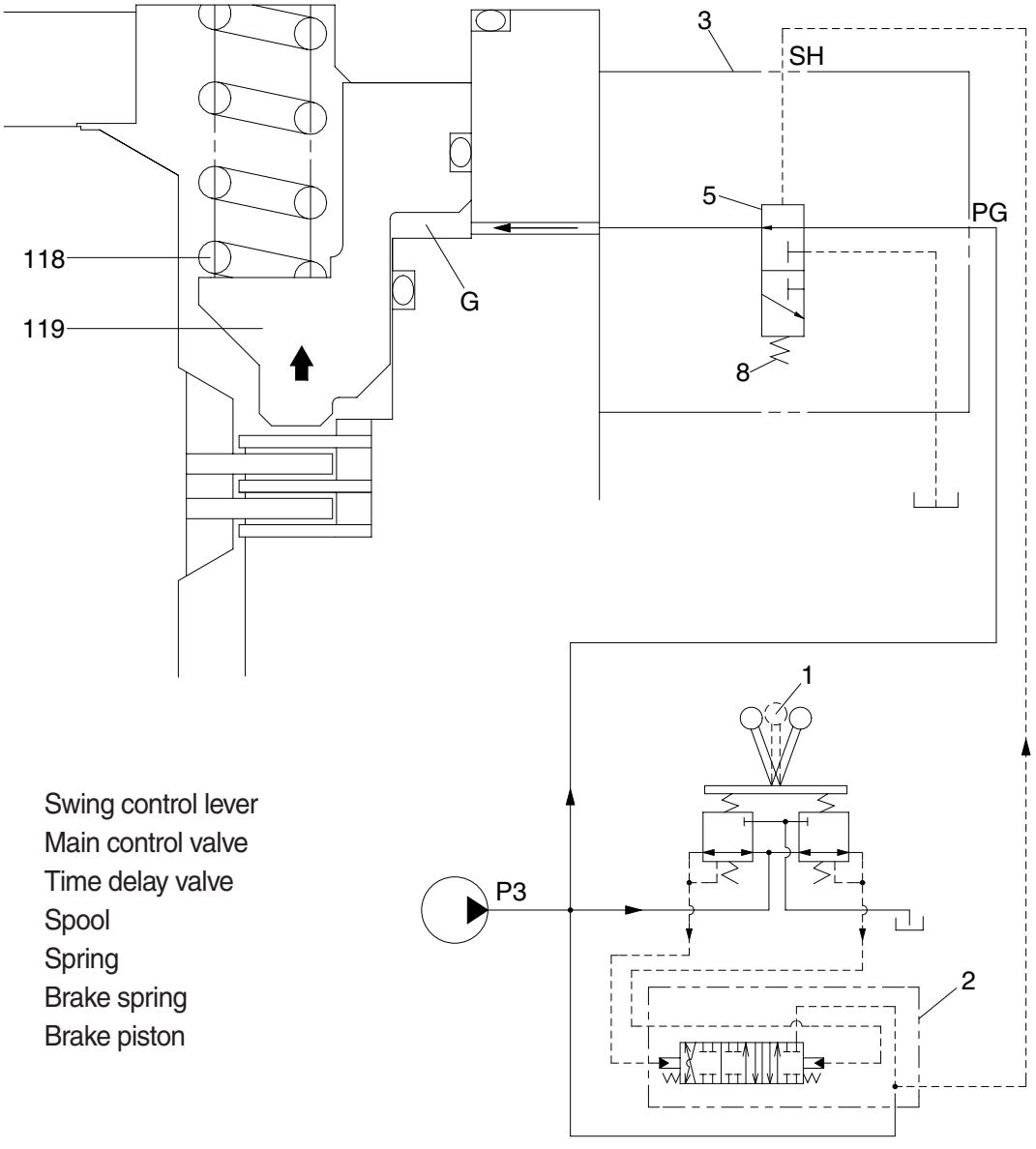


32092SM04

101	Casing	110	Separate plate
108	Cylinder block	118	Brake spring
109	Friction plate	119	Brake piston

② Operating principle

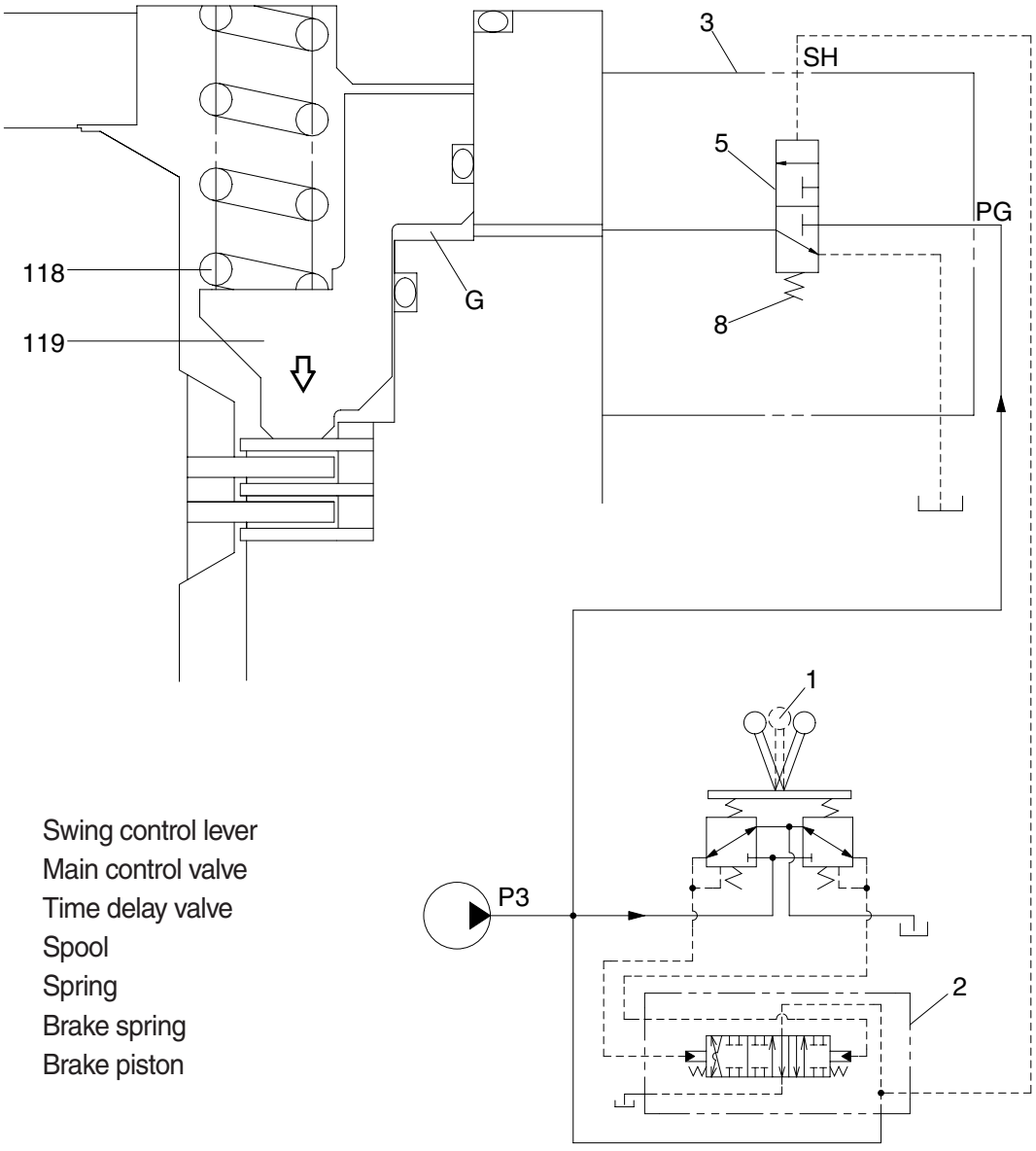
a. When the swing control lever (1) is set to the swing position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (3).
This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the piston (119) to the upward against the force of the spring (118). Thus, it releases the brake force.



1	Swing control lever
2	Main control valve
3	Time delay valve
5	Spool
8	Spring
118	Brake spring
119	Brake piston

32092SM05

b. When the swing control lever (1) is set the neutral position, the spool (5) returns to right.
Then, the piston (119) is moved lower by spring (118) force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



1	Swing control lever
2	Main control valve
3	Time delay valve
5	Spool
8	Spring
118	Brake spring
119	Brake piston

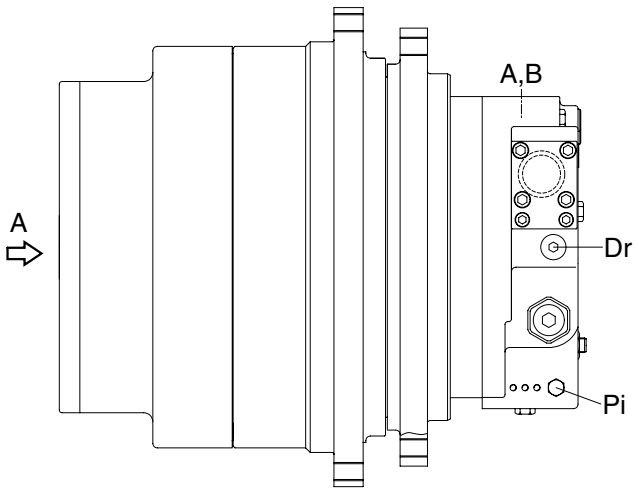
32092SM06

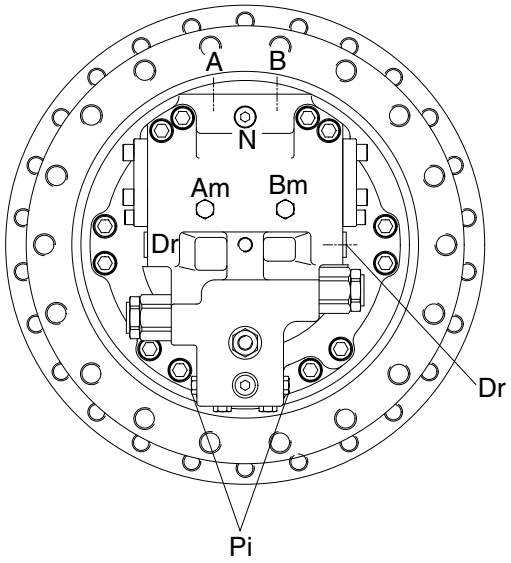
GROUP 4 TRAVEL DEVICE

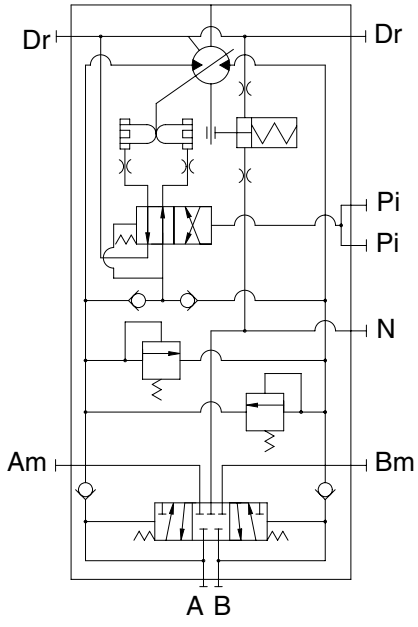
1. CONSTRUCTION

Travel device consists travel motor and gear box.

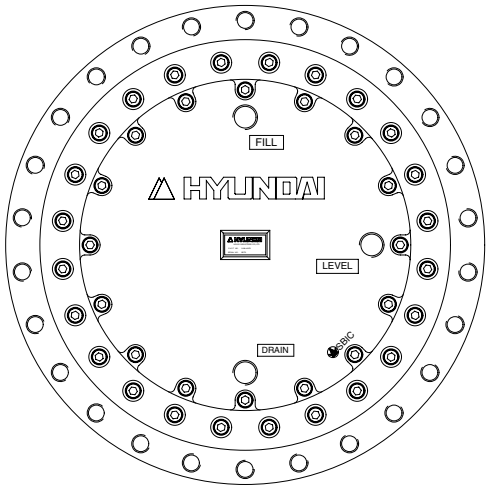
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







CIRCUIT DIAGRAM



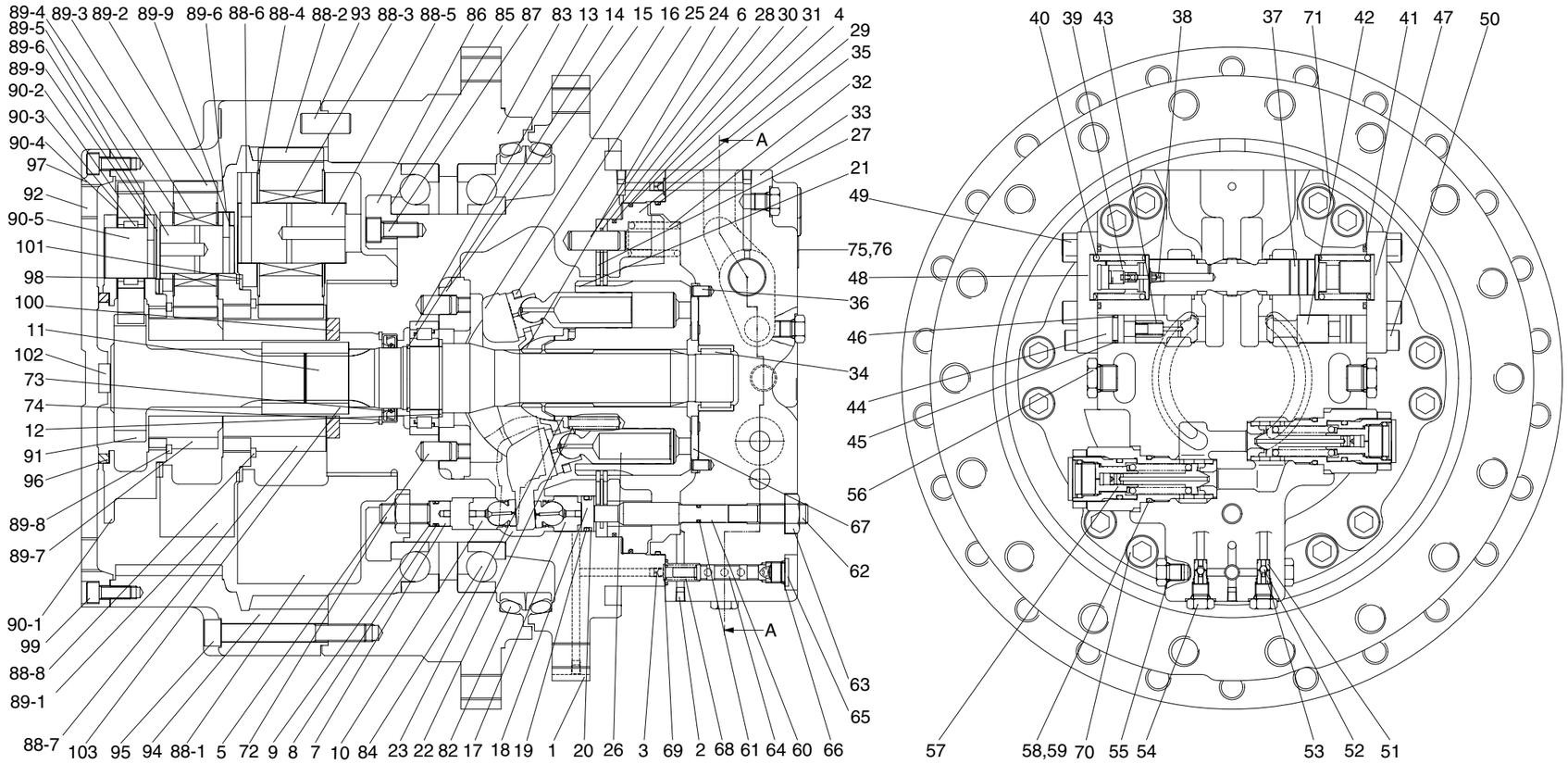
VIEW A

300072TM01A

Port	Port name	Port size
A, B	Valve port	SAE 6000psi 1"
Pi	2 speed control port	PF 1/4
Dr	Drain port	PF 1/2
Am, Bm	Gauge port	PF 1/4
N	Parking release port	PF 1/4

2. SPECIFICATION

1) TRAVEL MOTOR



SECTION A-A

29092TM30

1	Casing	16	Plate	31	Ring	46	Back up ring	61	O-ring	83	Housing	89-1	Carrier No.2	91	Sun gear No.1
2	Plug	17	Piston	32	Spring	47	Cap	62	Lock screw	84	Bearing	89-2	Planetary gear No.2	92	Plug
3	Screw	18	Stopper	33	Valve casing	48	Cap	63	Nut	85	Shim	89-3	Needle No.2	93	Lock pin
4	Screw	19	O-ring	34	Needle bearing	49	Bolt	64	Spool	86	Retainer	89-4	Thrust washer No.2	94	Ring gear
5	Pin	20	Back up ring	35	O-ring	50	Socket bolt	65	Plug	87	Bolt	89-5	Pin No.2	95	Bolt
6	Pin	21	Cylinder block	36	Pin	51	Seat	66	O-ring	88	Carrier No.3	89-6	Spring pin No.2	96	Thrust ring No.1
7	Stopper	22	Cylinder spring	37	Spool	52	Steel ball	67	Valve plate	88-1	Carrier No.3	89-7	Sun gear No.2	97	Cover
8	O-ring	23	Spacer	38	Screw	53	Stopper	68	Spring	88-2	Planetary gear No.3	89-8	Snap ring No.2	98	Thrust ring No.2
9	Back up ring	24	Guide	39	Damping check	54	Plug	69	O-ring	88-3	Needle No.3	89-9	Spring pin No.2	99	Bolt
10	Piston	25	Plate	40	Spring	55	O-ring	70	Socket bolt	88-4	Thrust washer No.3	90	Carrier No.1	100	Motor ring
11	Shaft	26	Piston & Shoe assy	41	O-ring	56	Plug	71	Socket bolt	88-5	Pin No.3	90-1	Carrier No.1	101	Thrust ring No.3
12	Spacer	27	Plate	42	Plunger	57	Relief valve	72	Lock screw	88-6	Spring pin No.3	90-2	Planetary gear No.1	102	Pad
13	Roller bearing	28	Plate	43	Spring	58	O-ring	73	Oil seal	88-7	Sun gear No.3	90-3	Needle bearing No.1	103	Coupling
14	Stop ring	29	Brake	44	Stopper	59	Back up ring	74	Lock ring	88-8	Snap ring No.3	90-4	Thrust washer No.1		
15	Support	30	Ring	45	O-ring	60	Rod	82	Floating Seal	89	Carrier No.2	90-5	Pin No.1		

3. PRINCIPLE OF DRIVING

1) WORKING OF ROTARY GROUP

The high pressurized hydraulic oil which is supplied from a hydraulic pump is flows into a cylinder block (21) through the valve casing (33) of motor, and valve plate (67).

The rotary group has a construction that the above high pressurized hydraulic oil is flow only one side of the line Y-Y which connect the upper and lower dead point of the piston (26).

This high pressurized hydraulic oil works on the piston and generating the force F1, F1 = P * A (P : supplied pressure, A : pressure receving area), like following pictures.

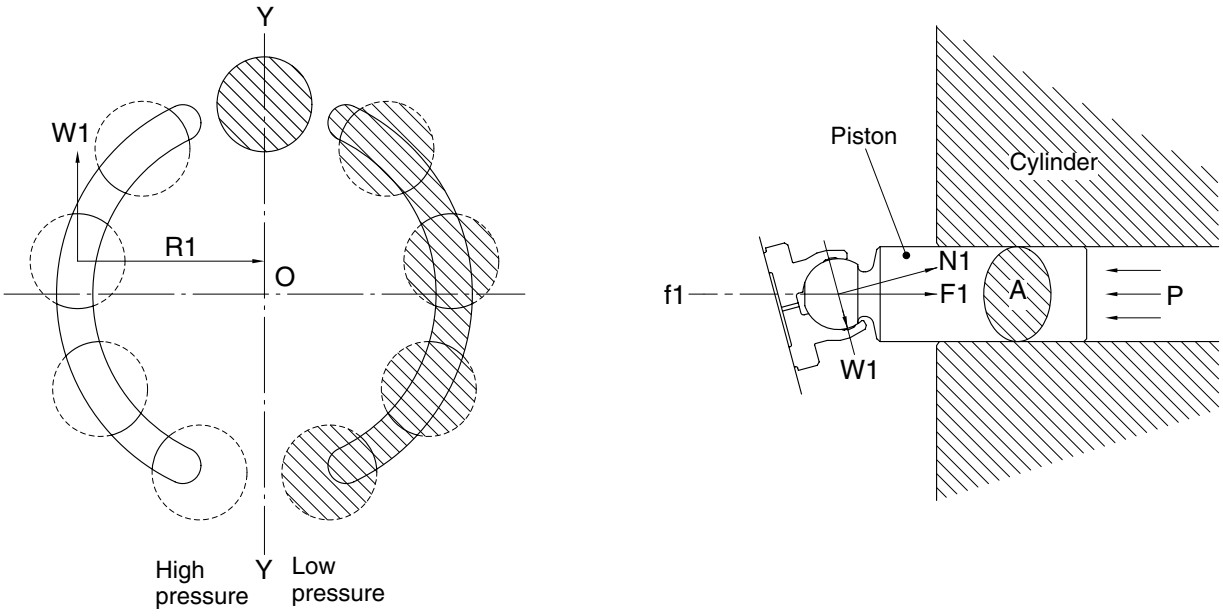
This force, F1, is devided by the swash plate (16) having a tilting angle α into the thrust component N1 and radial component W1.

The W1 generates torque, T = W1 * R1, in respect to the line Y-Y.

This torque generated by each piston on the high pressurized hydraulic oil side is summed up onto a resultant torque $\sum$ (W1 * R1), which prodeces torque for rotation.

This torque transfers the rotation force to the cylinder block (21) through the pistons.

Since the cylinder block is spline-coupled with the shaft, the rotation force is transmitted to the shaft accordingly.



2907A2TM07

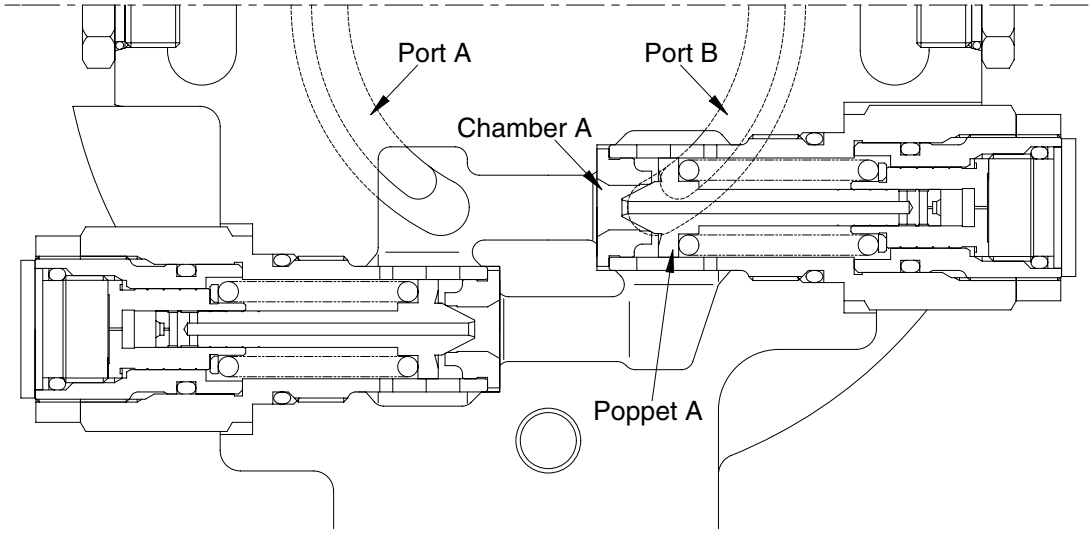
2) WORKING OF RELIEF VALVE

Relief valve carries on two function of following.

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

(2) In case of an inertia object stopped, relief valve is generating a break pressure at the outlet and stop it forcedly.

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



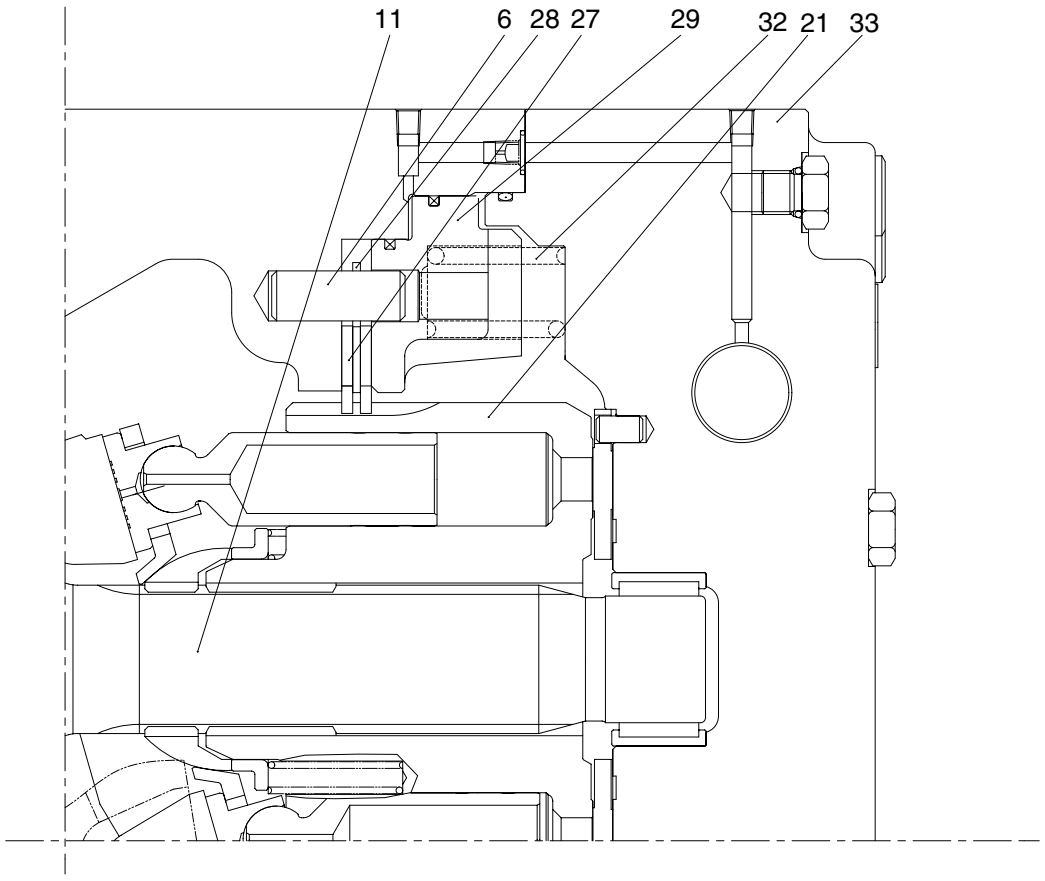
2907A2TM04

1) WORKING OF NEGATIVE BRAKE

The negative brake is released applying to the brake piston (29) the pressure led through built in the valve casing (33) spool. With no pressure working, the brake force is always ensured.

The brake force is generated by the frictional force among a plate (28) fixed by pin (6) and shaft casing, brake piston (29) and a frictional plate (27) connected through spline outside the cylinder block (21).

Without pressure being applied to the brake piston, the brake piston is pushed by ten brake springs (32) and the friction plate and separator plate are held between the brake piston and casing. This friction force restrains the shaft (11) spline-coupled with the cylinder block, and thus functions the brake.



300072TM05

4) COUNTERBALANCE VALVE

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

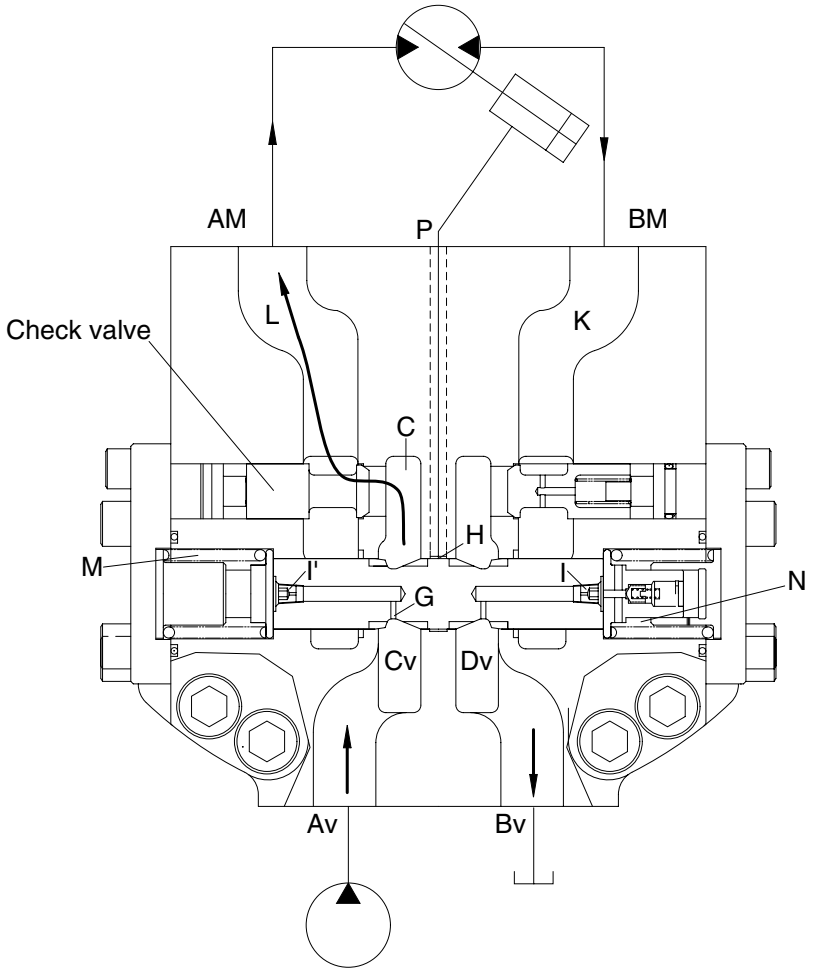
The oil supplied from the hydraulic pump passed through Av → Cv → C sequence, pushed up the poppet of the check valve, passed through L to port AM, and is supplied to the hydraulic motor to turn it. But the brake is operated. Therefore, the pump discharge oil pressure is increases. And the pressure is led via passage G to spring room M. When the pressure in room M exceed the value equivalent to the force of the spring which holds the spool at its neutral position, the spool begins to move right.

The oil in room N is sent to room Dv by orifice I and discharged from Bv port to a tank. So spool moves to the right. The oil flows as the way of K → Dv → Bv sequence. Also according to the oil path as composed way Cv → H → P sequence, the pressure of Av pump is provided to the port P. An working oil in room N is discharged through orifice and a gap. Therefore the switching operation of spool is driving slowly.

When the pump discharge pressure fall, spool moves to the left side by a spring at the side of room N.

Also spool moves to the left, the hydraulic oil in room M is sent to Cv room through orifice I' and discharged to the Av port.

When the pressure at port Av fall down to the tank pressure, the pressure of room M is as the same as that the tank pressure and becomes equal to that in room N, and so the spool returns to its neutral position.



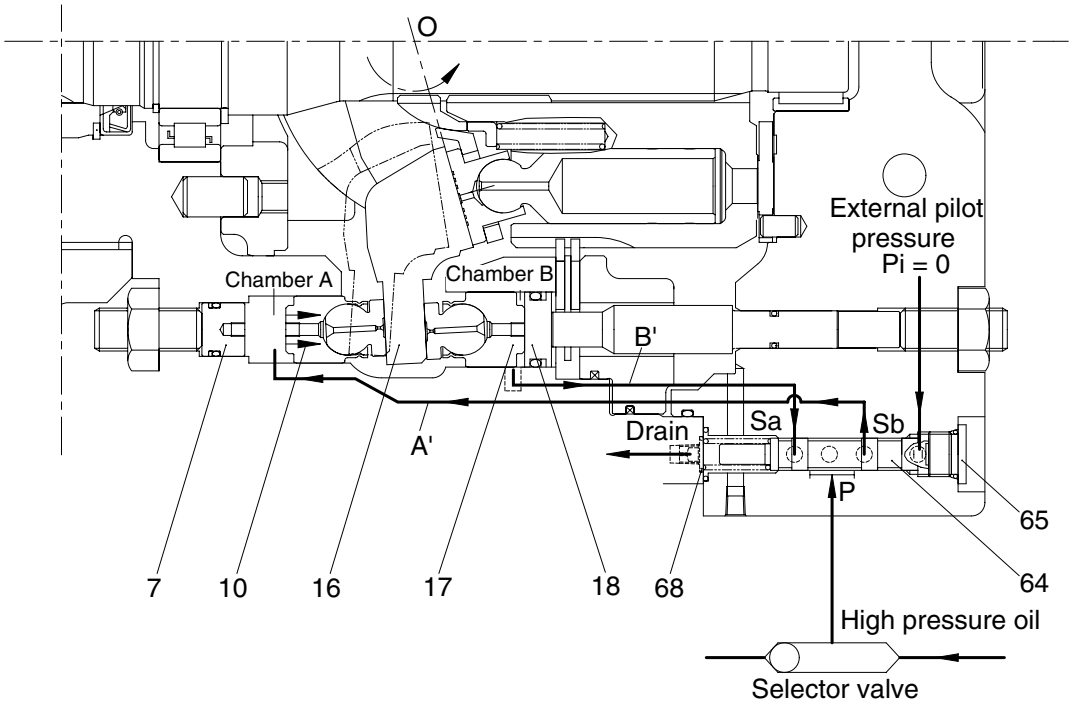
300072TM06

5) WORKING OF DISPLACEMENT CHANGEOVER

The capacity of the travel motor is changed by changing the tilting angle of this swash plate(16). The tilting angle changes by displacement changeover valve.

(1) External pilot pressure : Pi = 0 (large displacement)

By means of the built-in high pressure selector mechanism in the valve casing (33), the high pressure oil working on the motor function to port P of the displacement-changeover valve.
A the spool (64) assembled in the displacement changeover valve is pressed to plug (65) by the spring (68), the high pressure oil at port P flows to port Sb.
This high pressure oil flows through oil passage (passage A') of valve casing (33) and shaft casing works to chamber A.
This oil in chamber B flows through passage B' and port Sa into the drain line. The displacement changeover piston (17) is pushed right and the swash plate (16) moves in the arrowed direction around rotation center 'O'. The swash plate moves until it touched stopper (18), and then is fixed there.



29092TM09

(2) External pilot pressure : Pi ≥ 20 kgf/cm² (small displacement)

If the force operating on spool (64) of the displacement changeover valve is stronger than the spring (68), and the spool moves to the left side.

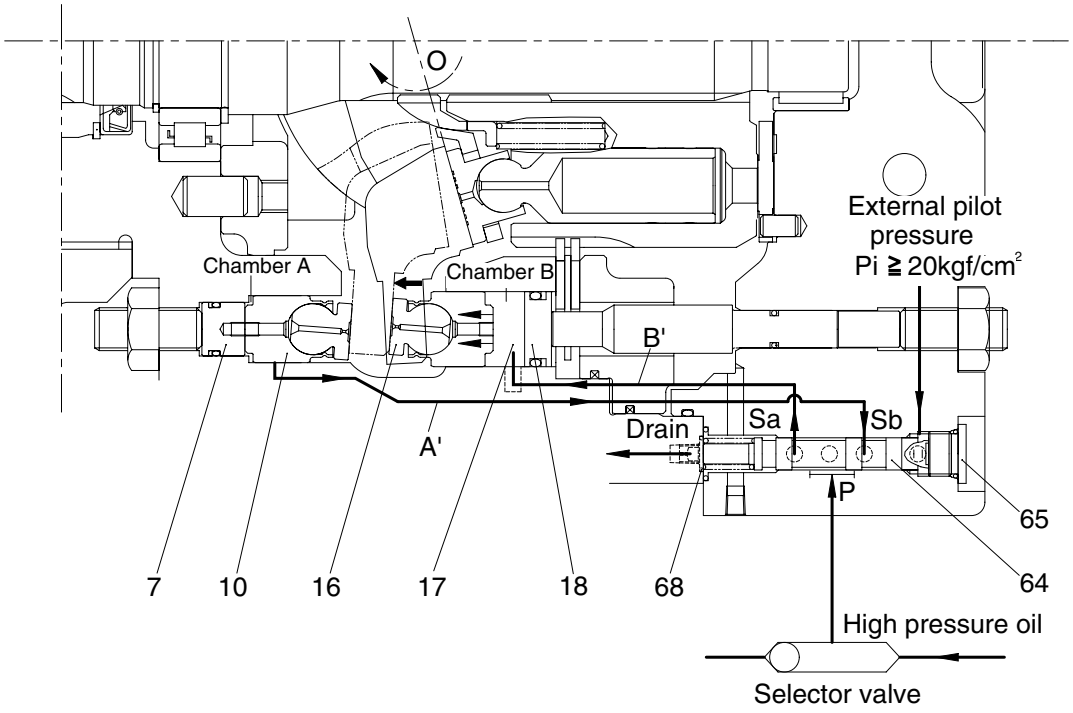
The high pressure oil is works on room B through passage Sa → B' from port P.

The oil in chamber A flows into the drain line through the passage A' → Sb.

The displacement changeover piston (17) is pushed left and the swash plate (16) moves in the arrowed direction around rotation center 'O'. The swash plate moves until it touches stopper (7), and then is fixed there.

If the load increase while the motor is working with its small displacement (Pi ≥ 20kgf/cm², 2nd speed) until the motor inlet port pressure reaches the preset value, the motor increase its displacement in response to the load, while maintaining the pressure at the preset value (automatic 2 -speed function). As motor inlet port pressure reaches the preset value and then spool (64) moves right side, inlet pressure oil flows into chamber A through port Sb and the swash plate moves until it touches stopper (17). If the load further increase until the displacement of the motor reaches the maximum value, the inlet port pressure increase further.

If the load decreases under this condition, the motor continues reducing its displacement in the reverse sequence. As the load and inlet port pressure decreases and reaches the preset value, spool (64) moves left side by the pilot pressure (Pi). Therefore inlet port pressure flow into chamber B through port Sa and the swash plate moves until it touches stopper (10).



2907A2TM06

6) REDUCTION GEAR

(1) Planetary gear mechanism

Reduction unit slows down the rotating speed of motor and converts motor torque to strong rotating force.

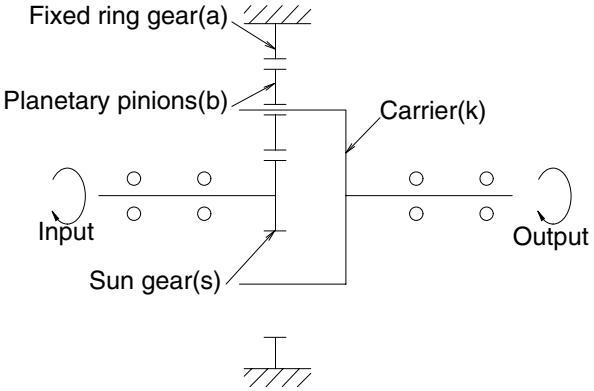
This reduction unit utilizes two stages, planetary reduction system.

Planetary reduction system consists of sun gear, planetary gears, carriers and ring gear.

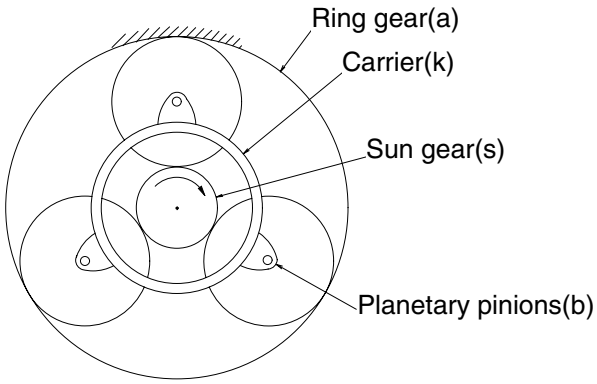
When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gears (s).

This movement is transferred to carrier (k) and deliver the torque.

This mechanism is called planetary gear mechanism.



2907A2TM11

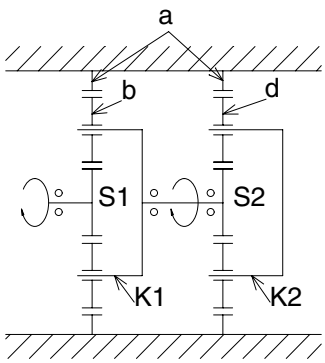


2907A2TM11

(2) Two stages reduction gear

When the sun gear **S1** is driven by input shaft, planetary action occurs among gears **S1**, **a** and **b** and revolution of gear **b** transfers the rotation of carrier **K1** to second sun gear **S2**, and also evokes planetary action between gear **S2**, **a** and **d**.

This time, because carrier **K2** is fixed to frame, gear **d** drives ring gear **a** and then ring gear a rotates to drive sprocket.

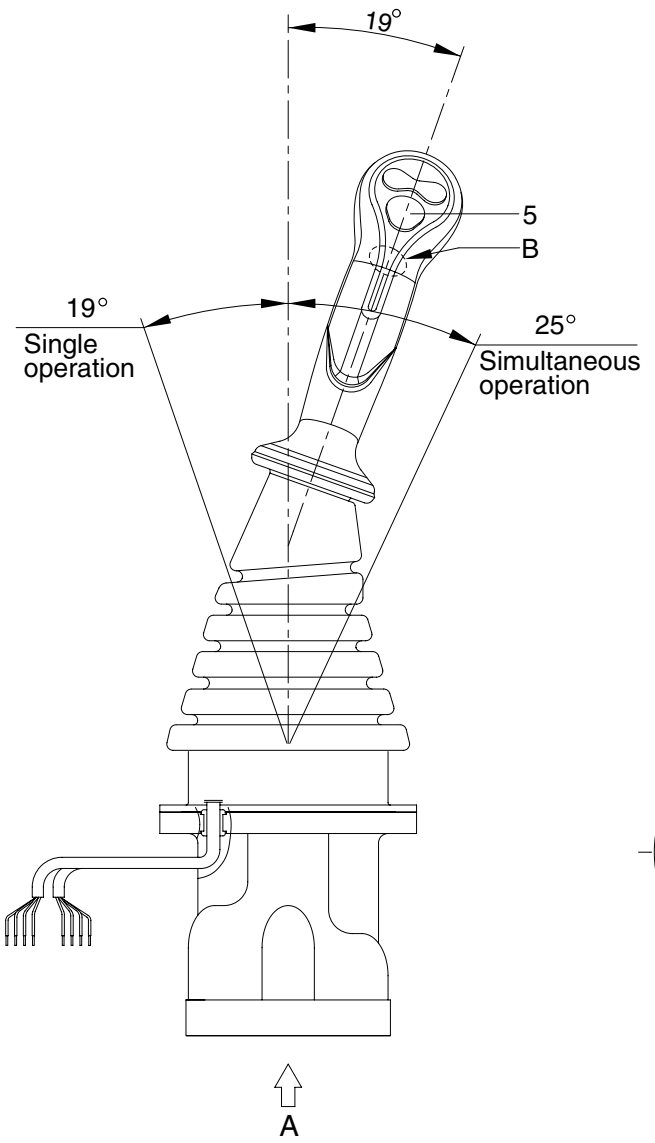


2907A2TM12

GROUP 5 RCV LEVER

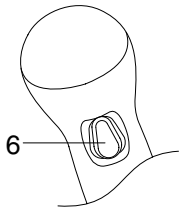
1. STRUCTURE

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.

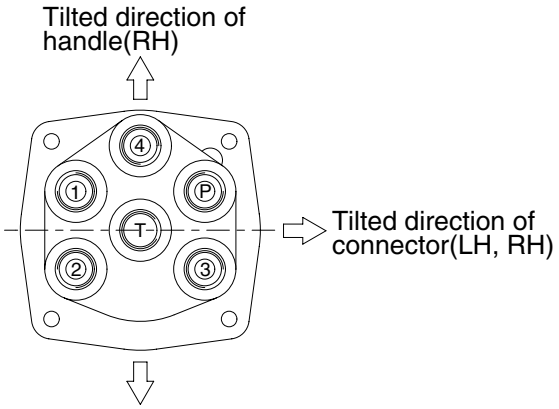


Switches

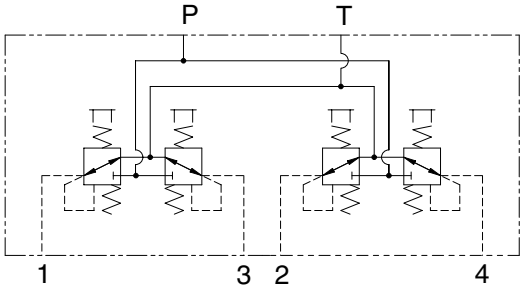
No.	LH	RH
5	One touch decel	Horn
6	Power boost	Breaker



DETAIL B



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	

3009SH2RL01

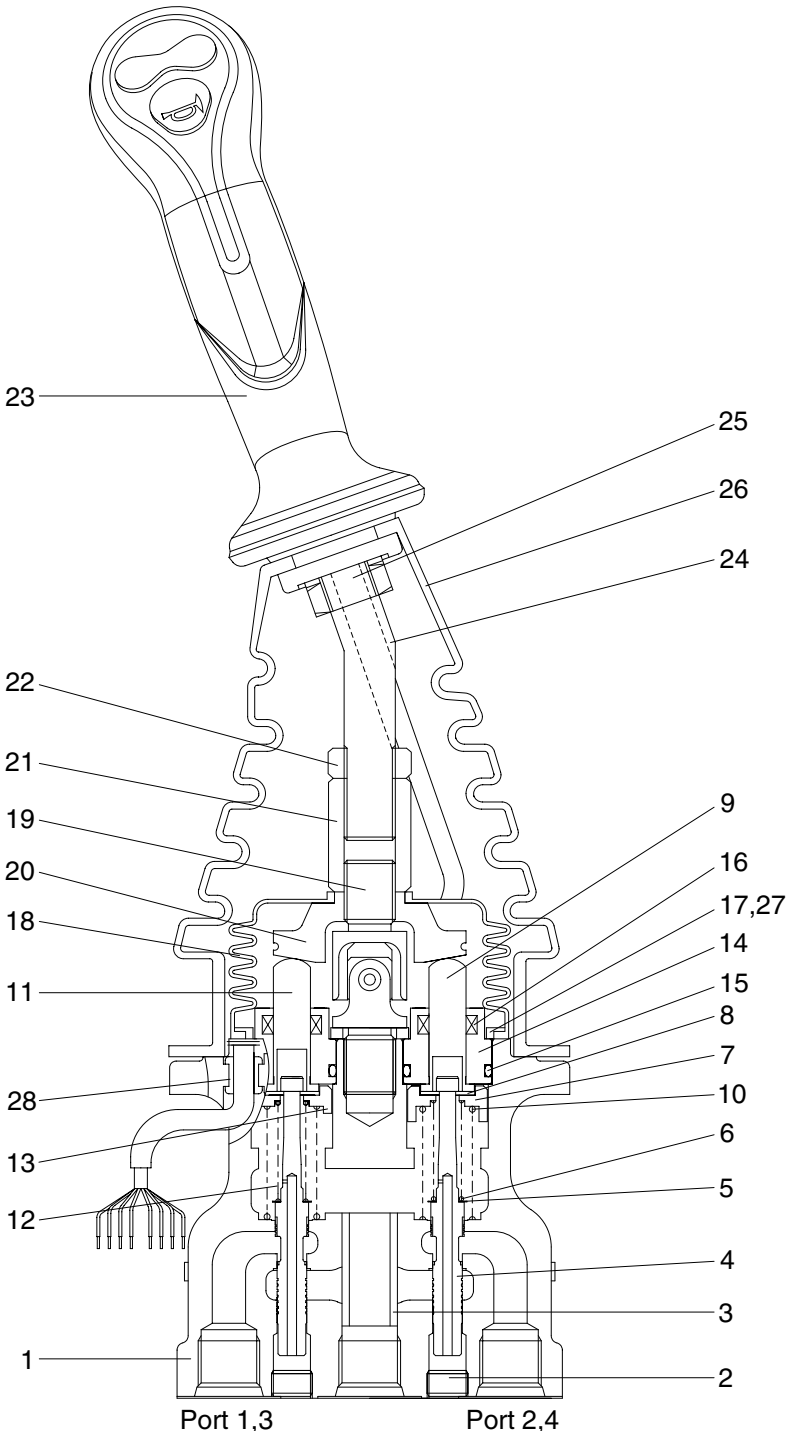
CROSS SECTION

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



300E2RL02

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.

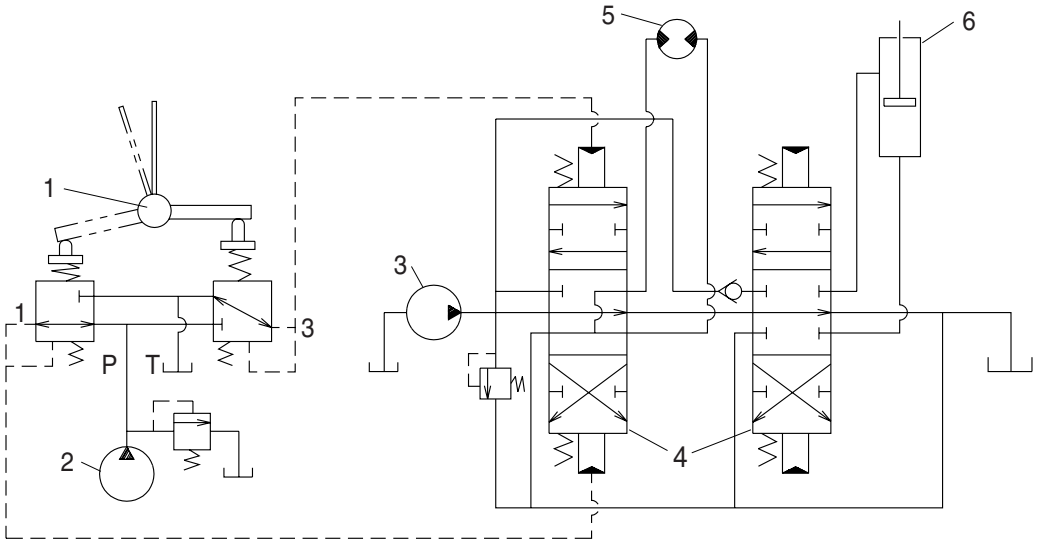
The spring (10) works on the case (1) and spring seat (7, 13) and tries to return the push rod (9,11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

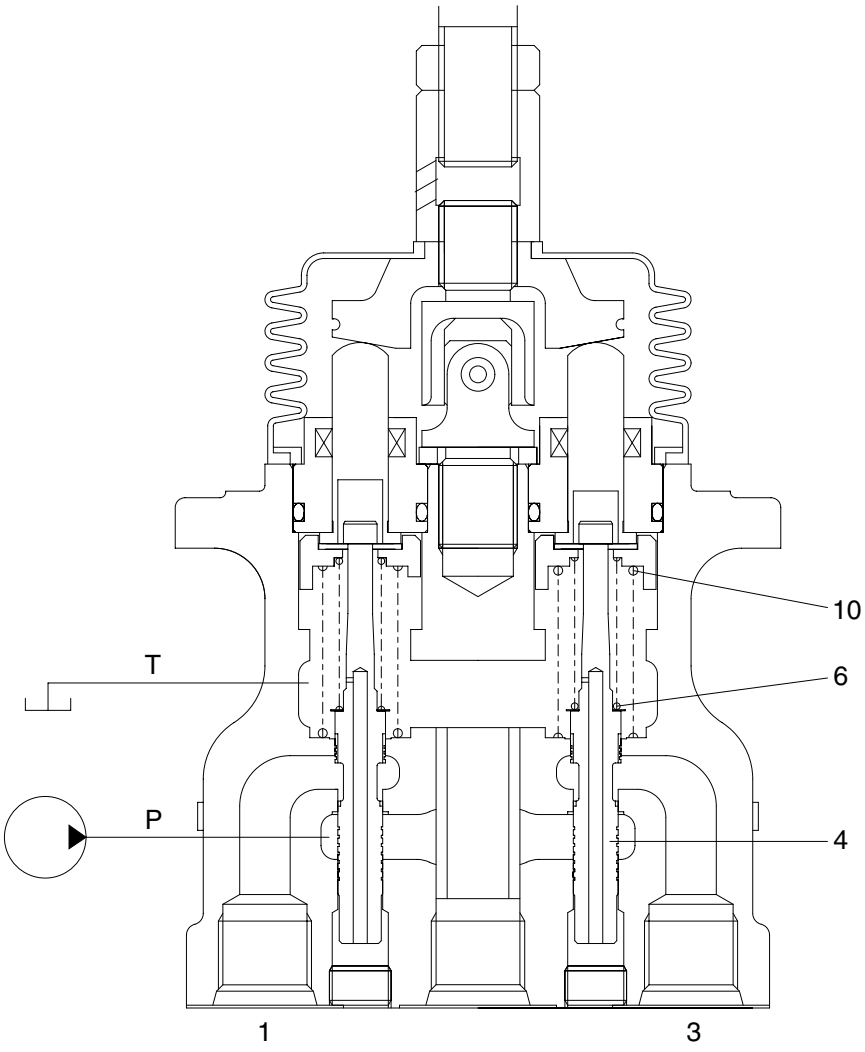
The diagram shown below is the typical application example of the pilot valve.



2-70

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

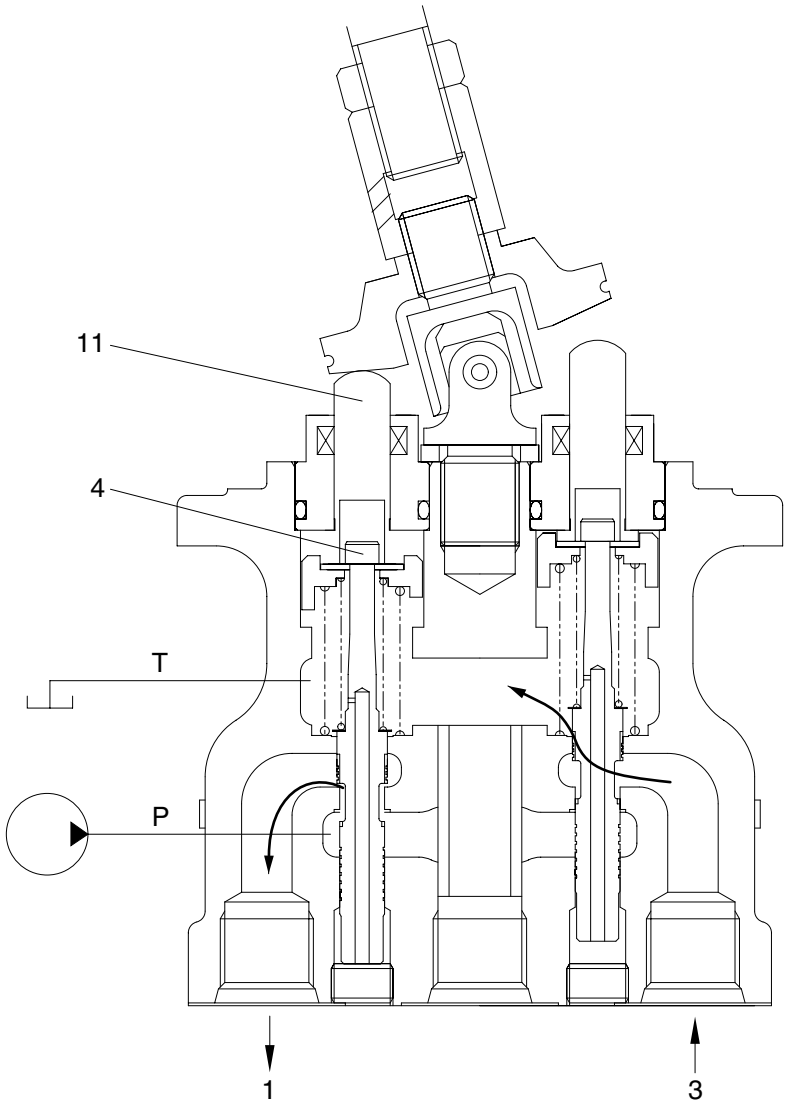
(1) Case where handle is in neutral position



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



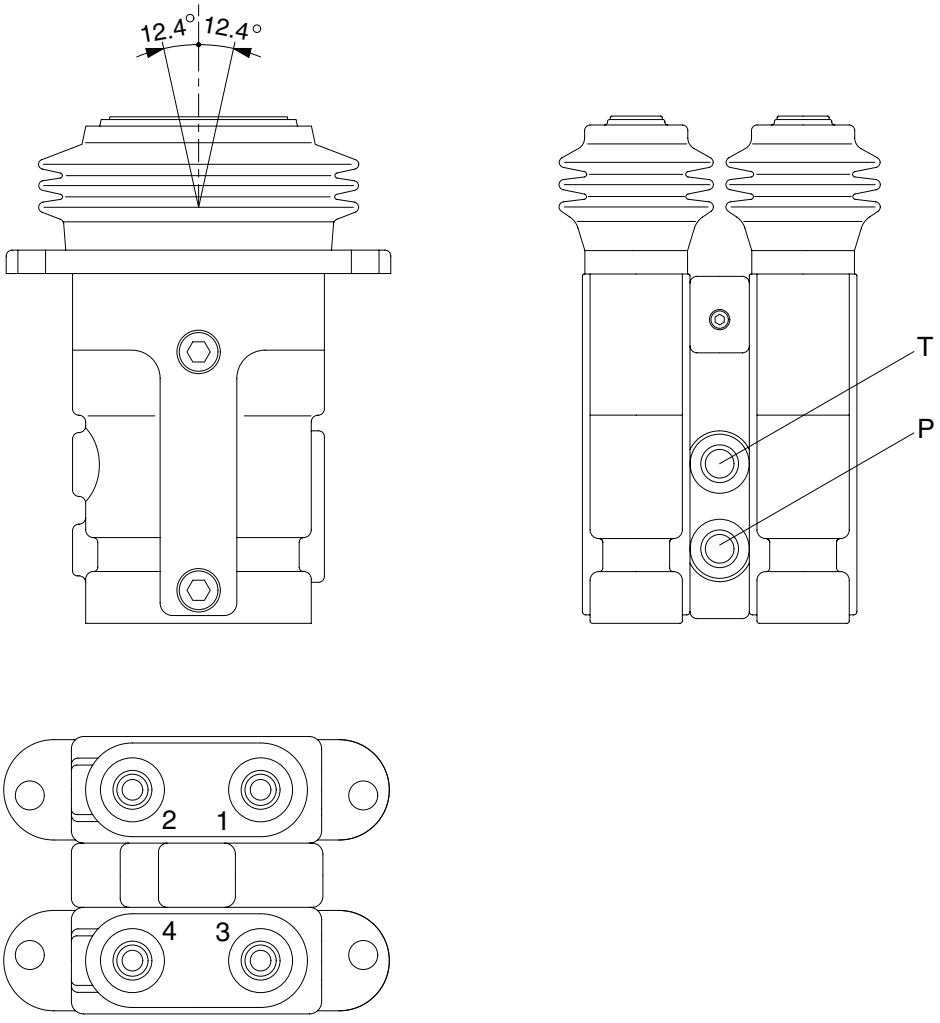
21092RL04

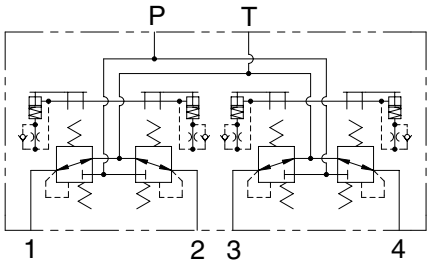
When the push rod (11) is stroked, the spool (4) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the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

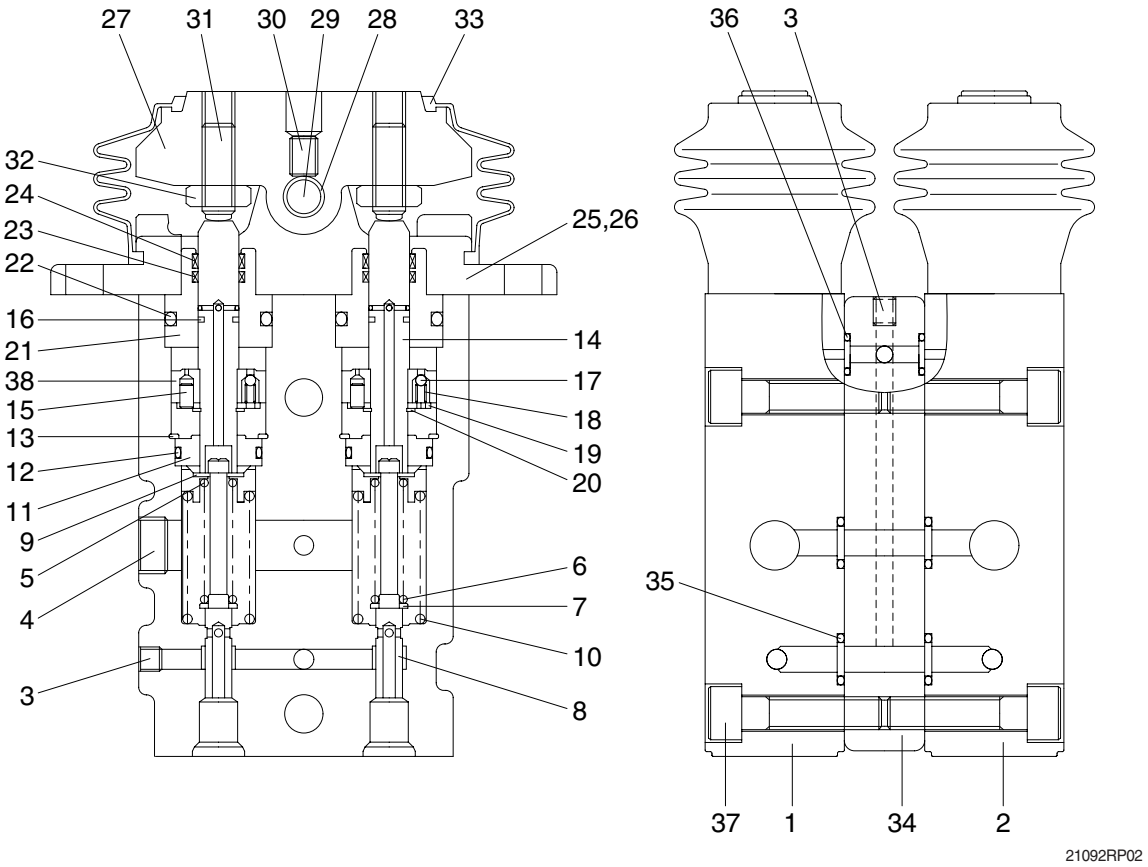
21092RP01

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.

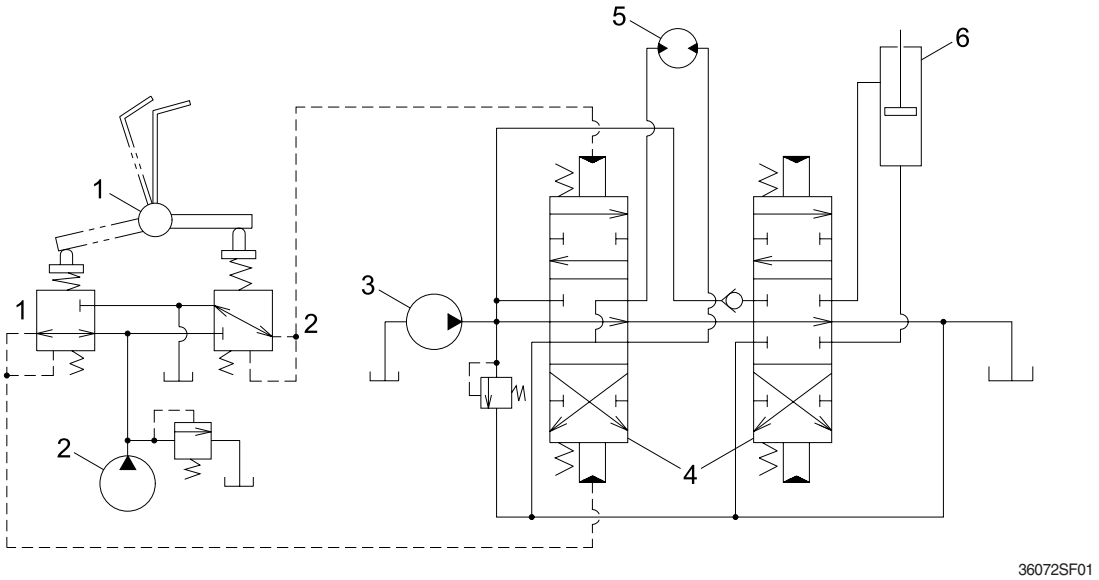
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

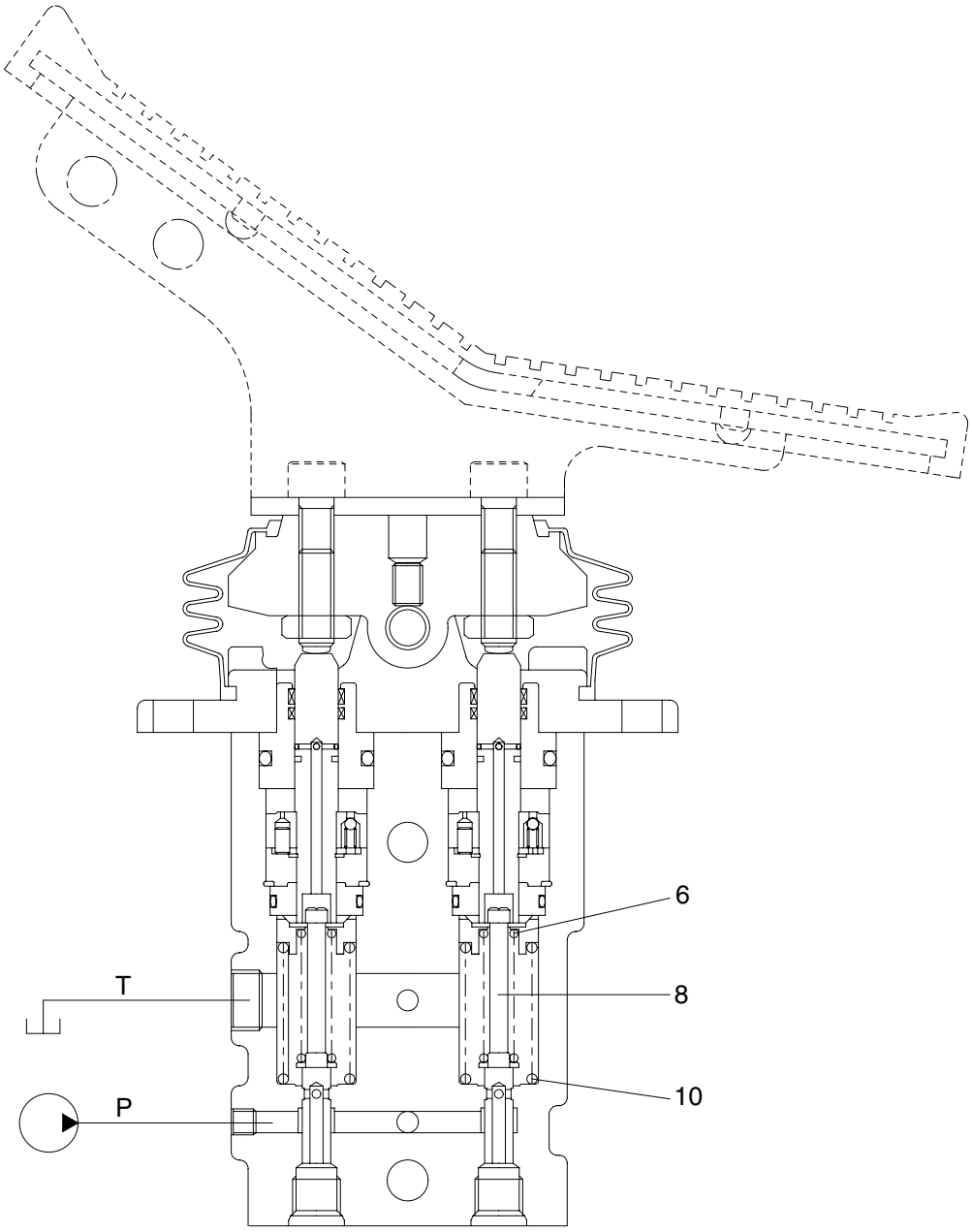
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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

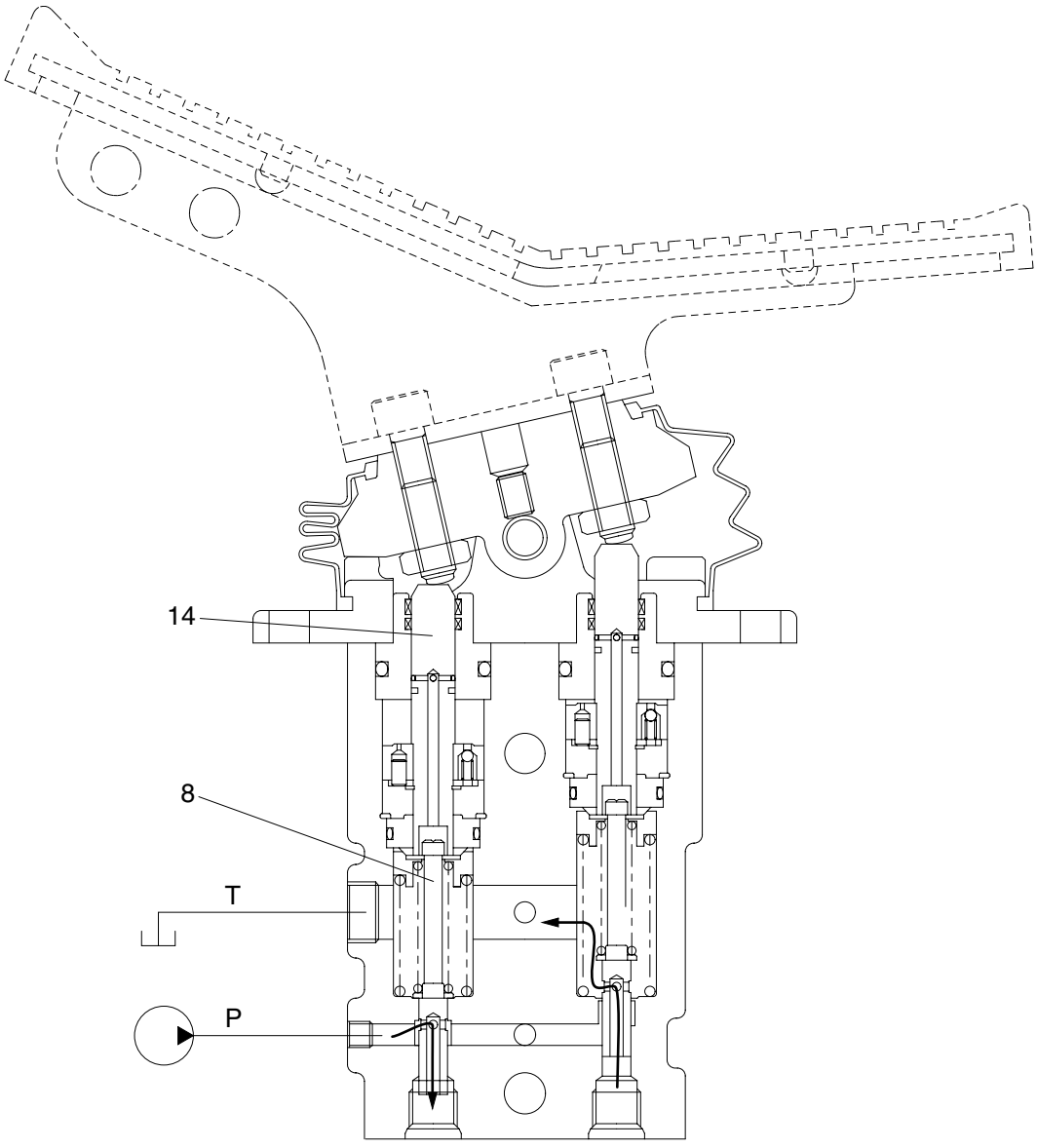
(1) Case where pedal is in neutral position



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



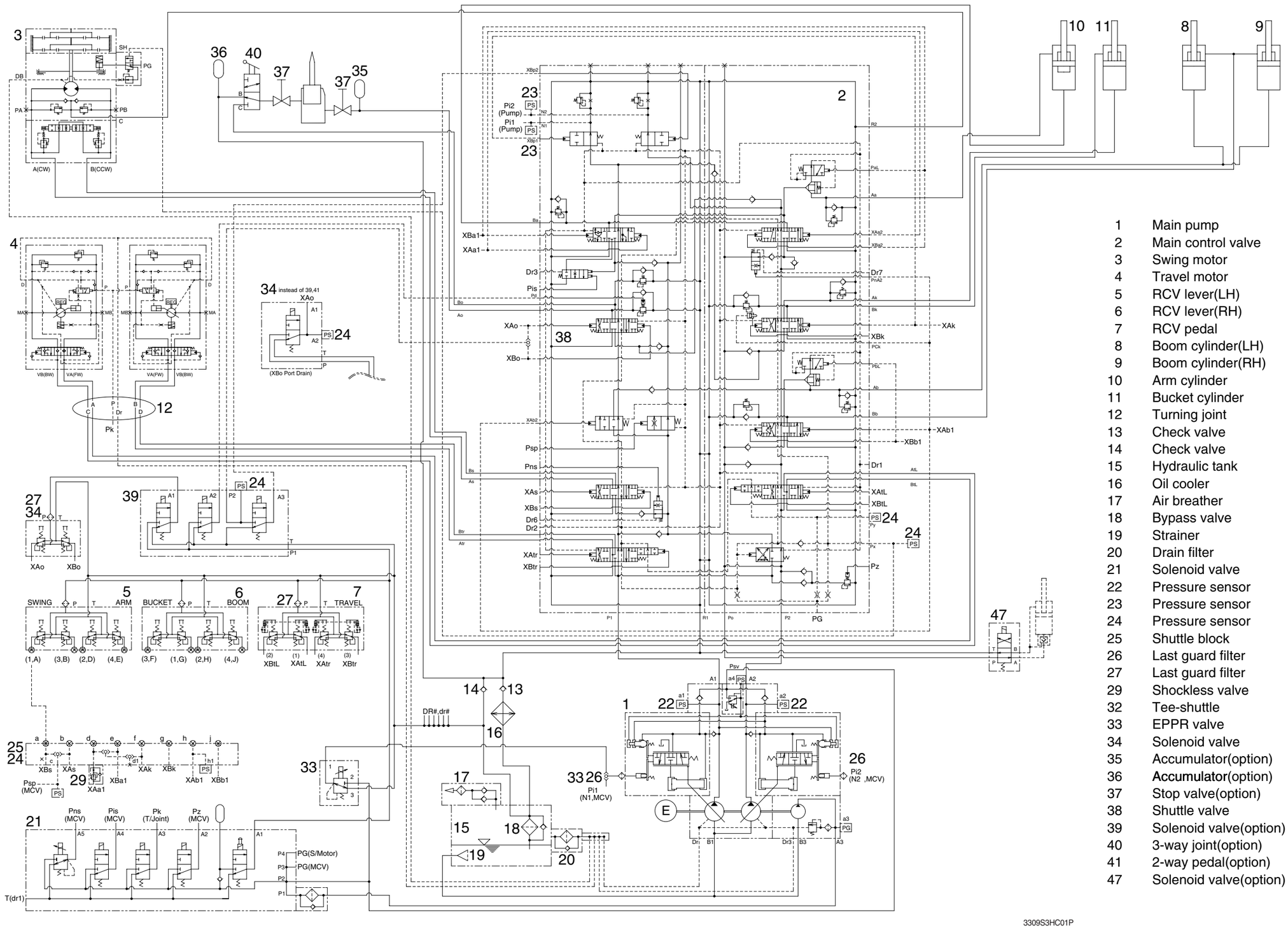
21092RP04

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 ····· 3-1
Group 2 Main Circuit ····· 3-3
Group 3 Pilot Circuit ····· 3-6
Group 4 Single Operation ····· 3-14
Group 5 Combined Operation ····· 3-24

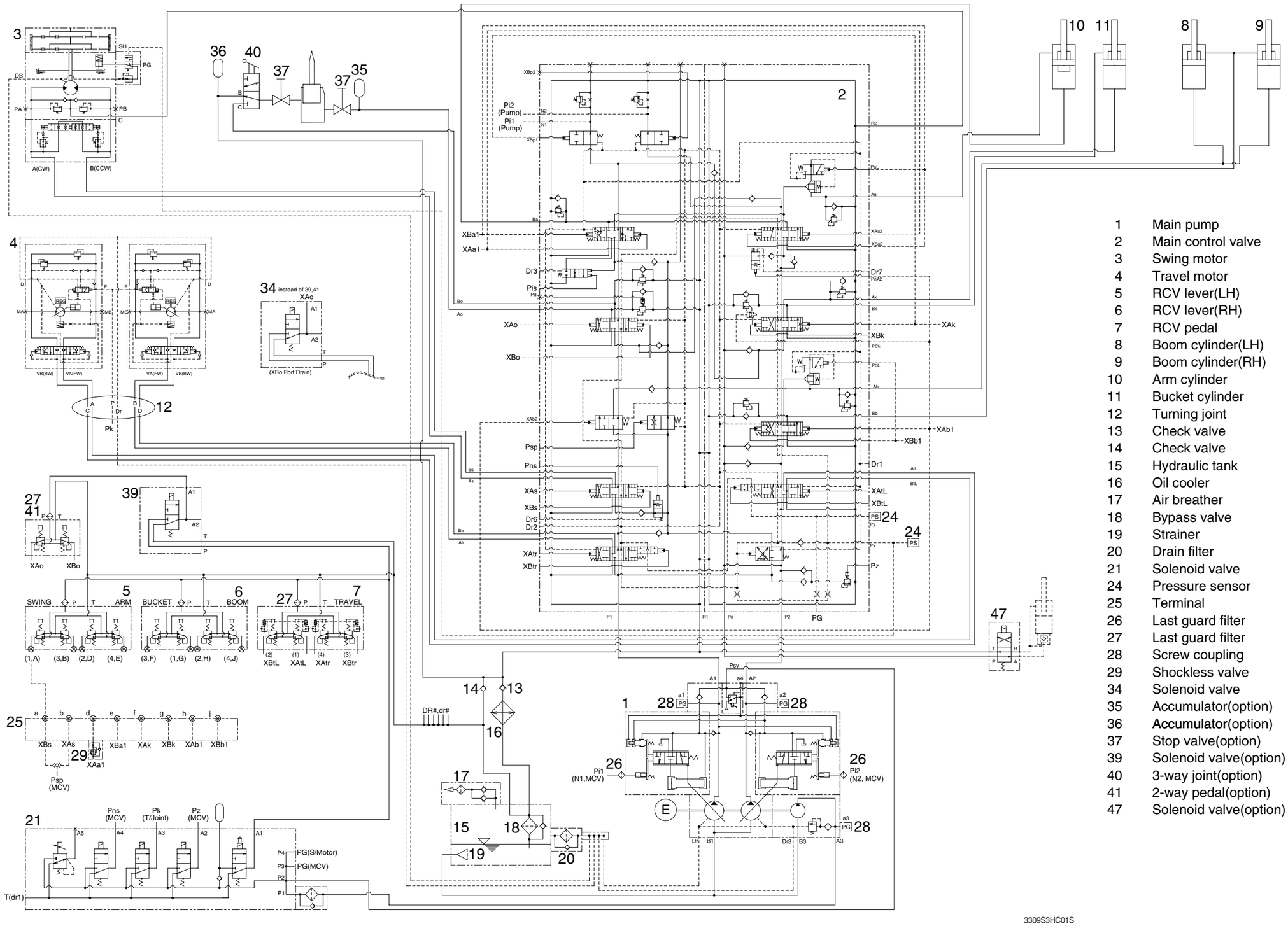
GROUP 1 HYDRAULIC CIRCUIT (CLUSTER TYPE 1)



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	Shuttle block
26	Last guard filter
27	Last guard filter
29	Shockless valve
32	Tee-shuttle
33	EPPR valve
34	Solenoid valve
35	Accumulator(option)
36	Accumulator(option)
37	Stop valve(option)
38	Shuttle valve
39	Solenoid valve(option)
40	3-way joint(option)
41	2-way pedal(option)
47	Solenoid valve(option)

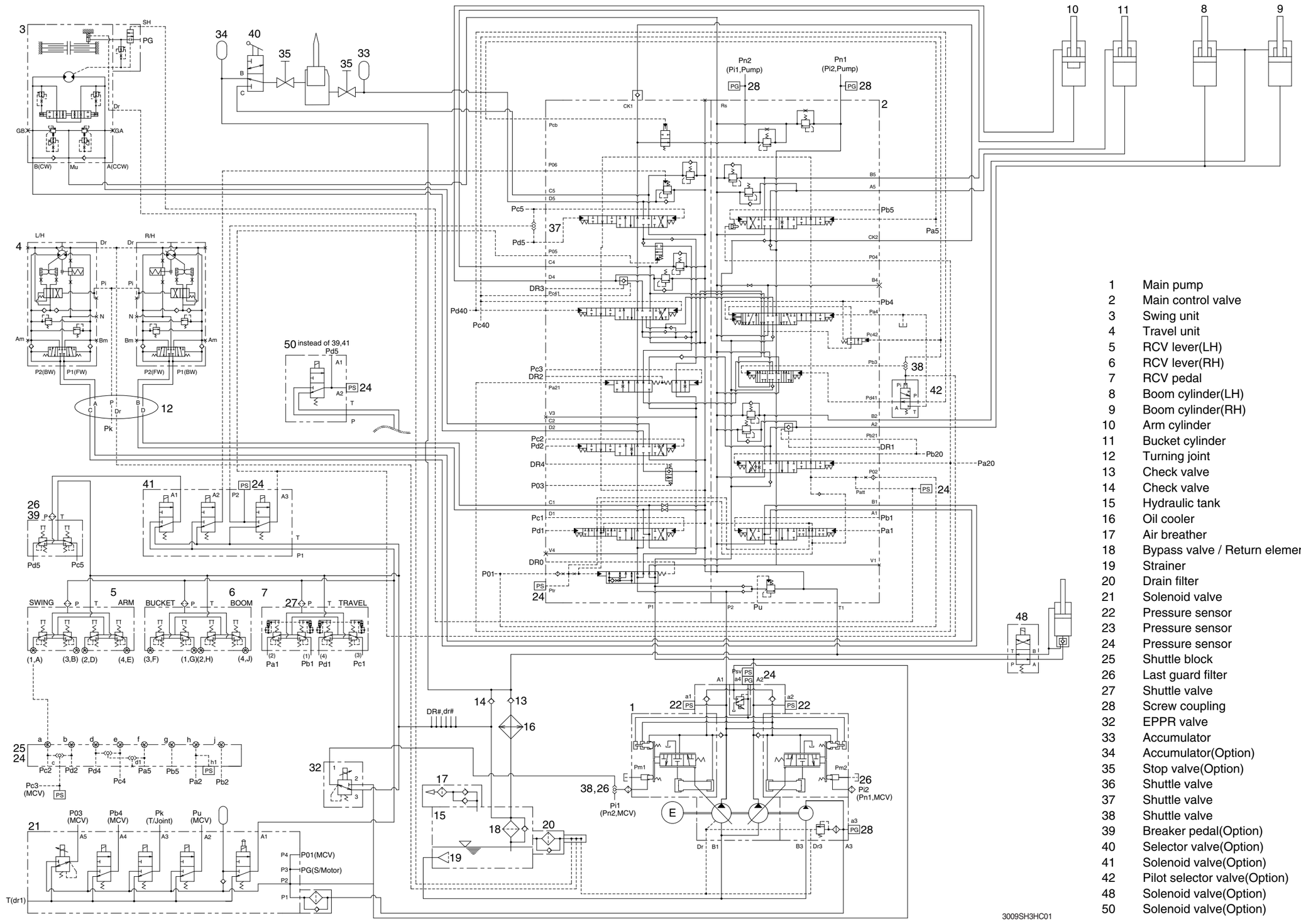
3309S3HC01P

■ HYDRAULIC CIRCUIT (CLUSTER TYPE 2)



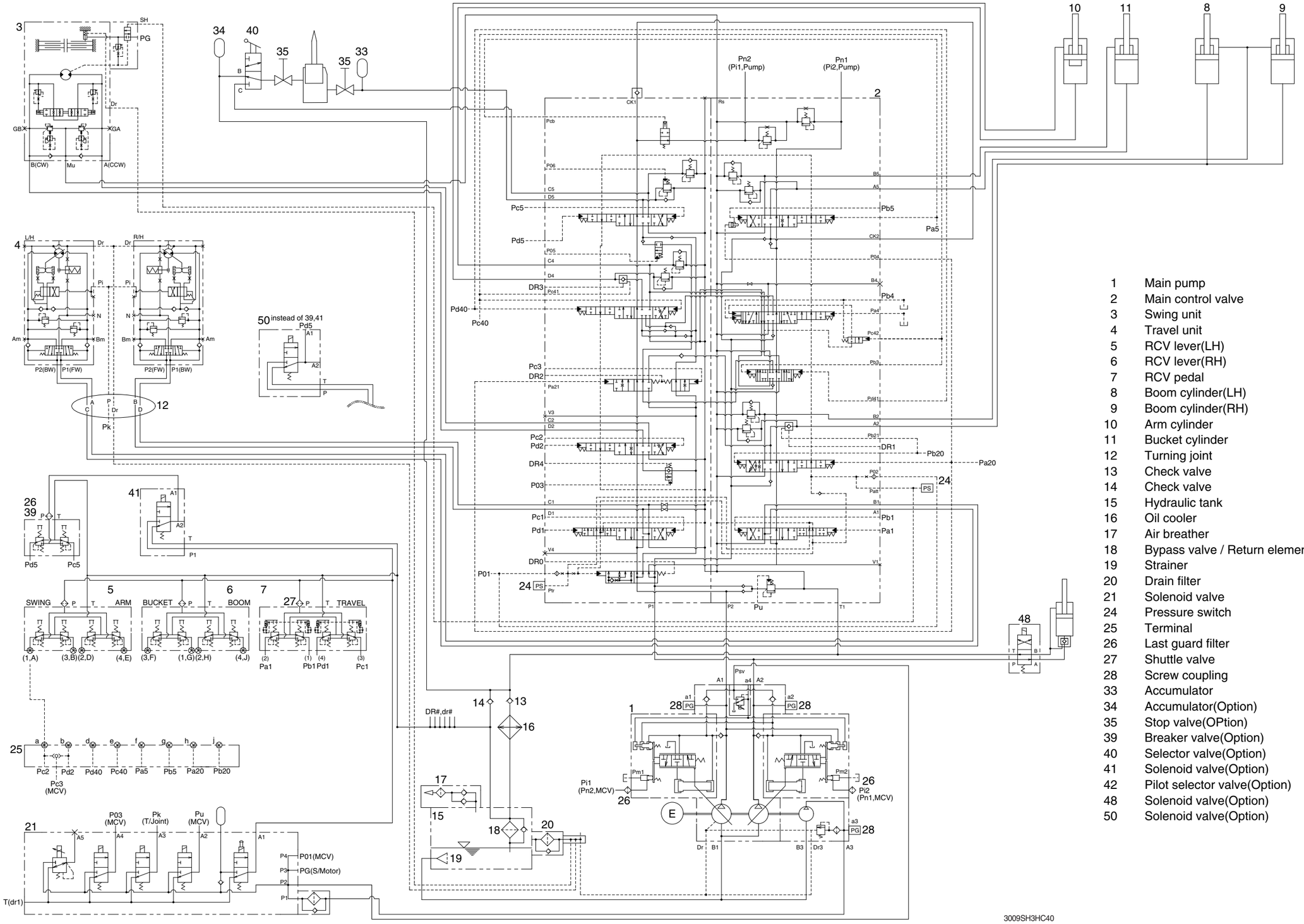
3309S3HC01S

■ HYDRAULIC CIRCUIT (CLUSTER TYPE 1, MCV TYPE 2, 3)



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

■ HYDRAULIC CIRCUIT (CLUSTER TYPE 2, MCV TYPE 2, 3)



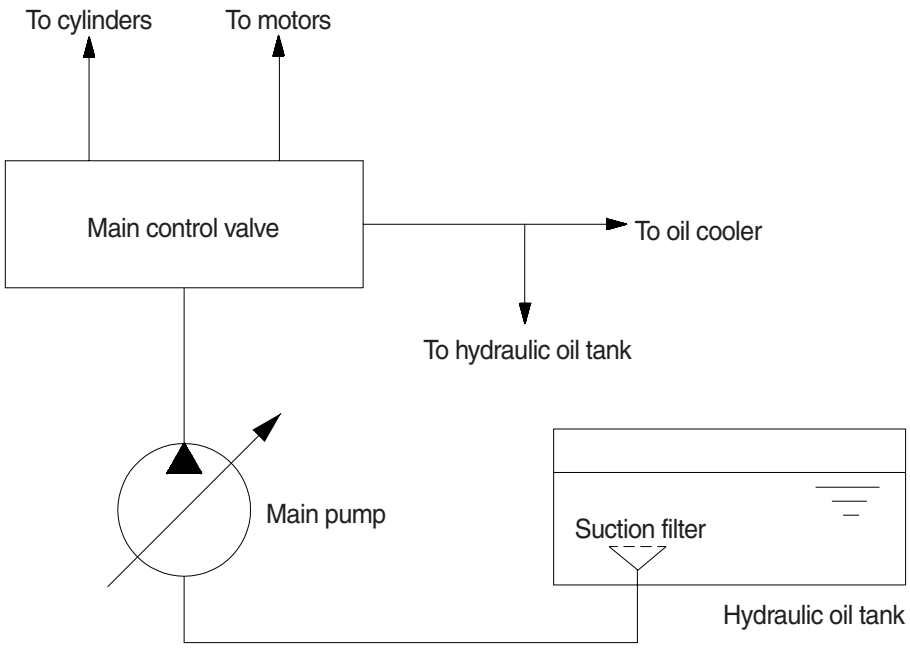
3009SH3HC40

1 Main pump
2 Main control valve
3 Swing unit
4 Travel unit
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Bypass valve / Return element
19 Strainer
20 Drain filter
21 Solenoid valve
24 Pressure switch
25 Terminal
26 Last guard filter
27 Shuttle valve
28 Screw coupling
33 Accumulator
34 Accumulator(Option)
35 Stop valve(OPtion)
39 Breaker valve(Option)
40 Selector valve(Option)
41 Solenoid valve(Option)
42 Pilot selector valve(Option)
48 Solenoid valve(Option)
50 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.

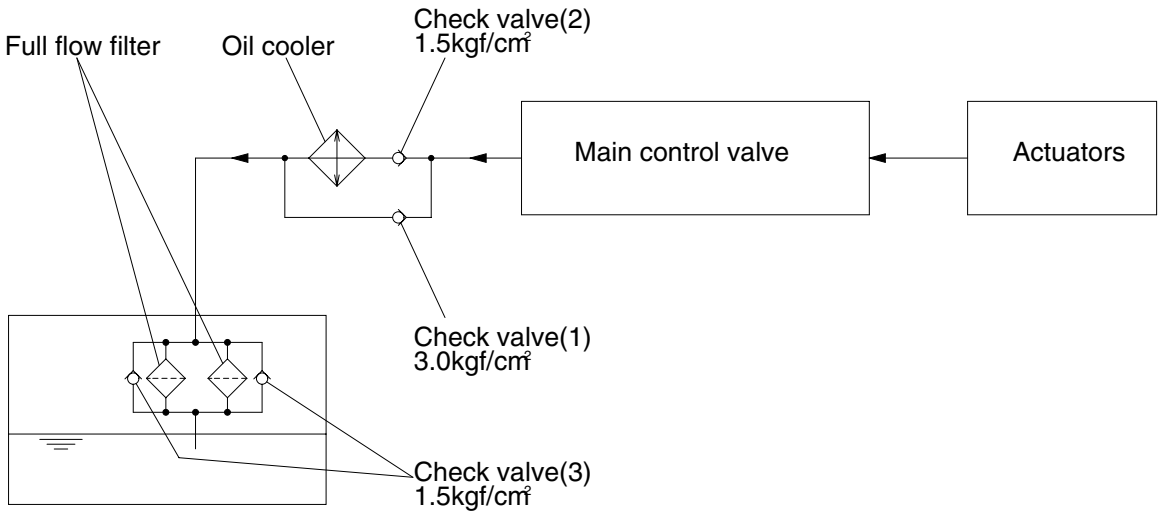
1. SUCTION AND DELIVERY CIRCUIT



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



29073CI01

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.

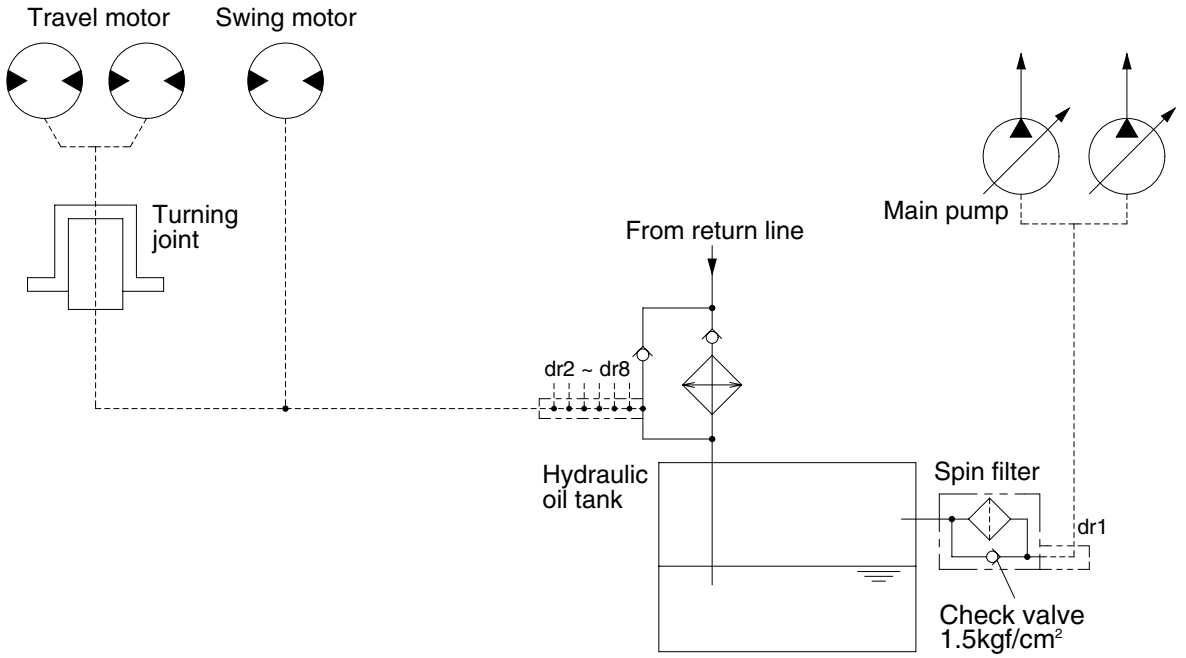
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

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



R29073CL02

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 spin filter and full flow filter in the hydraulic tank. 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 full flow filter in the hydranlic tank.

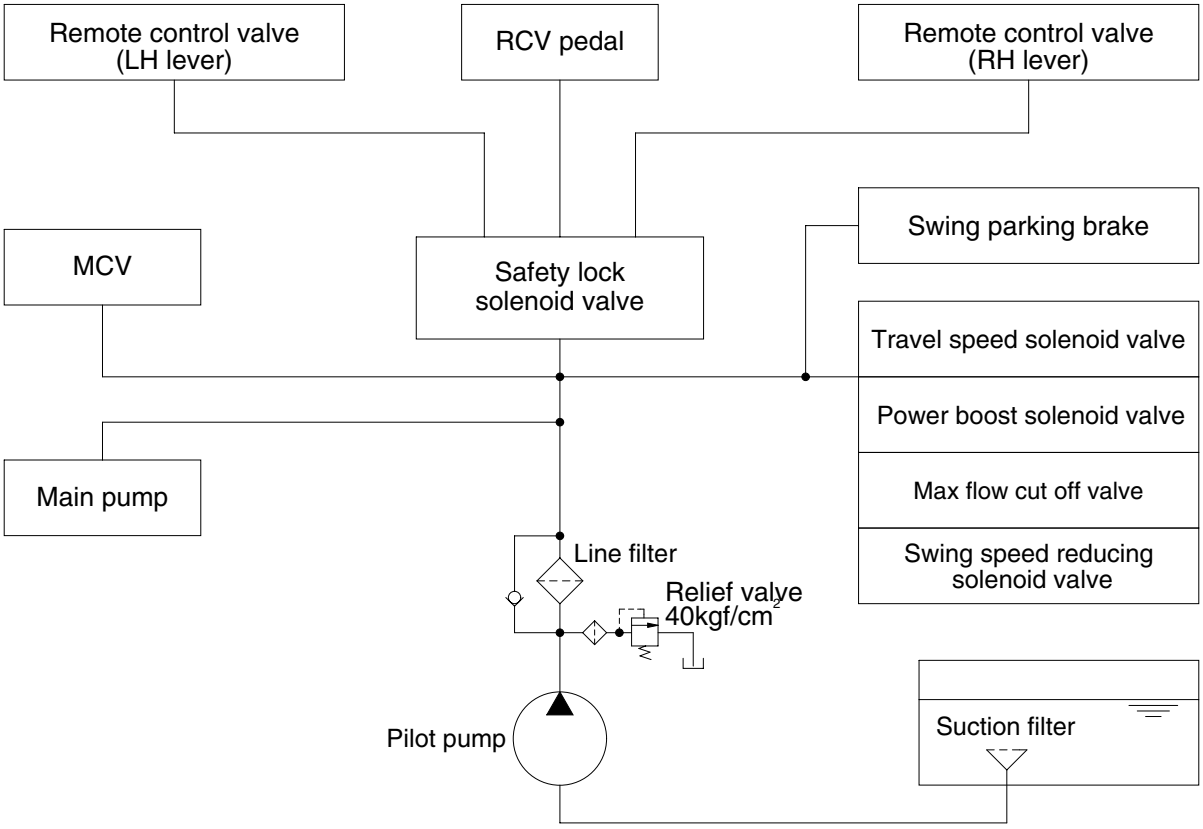
2) SWING MOTOR DRAIN CIRCUIT

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

3) MAIN PUMP DRAIN CIRCUIT

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

GROUP 3 PILOT CIRCUIT



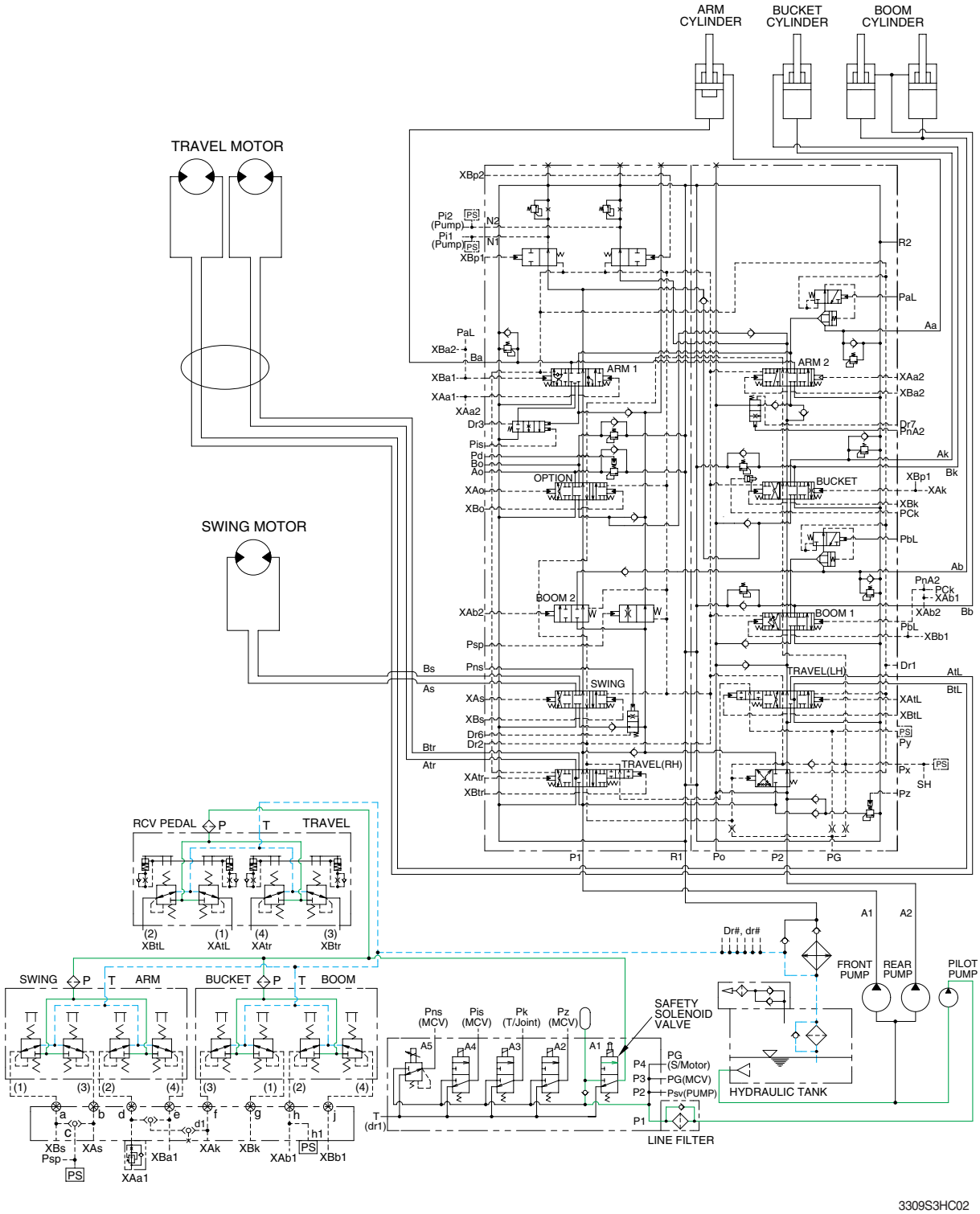
32093CI01

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

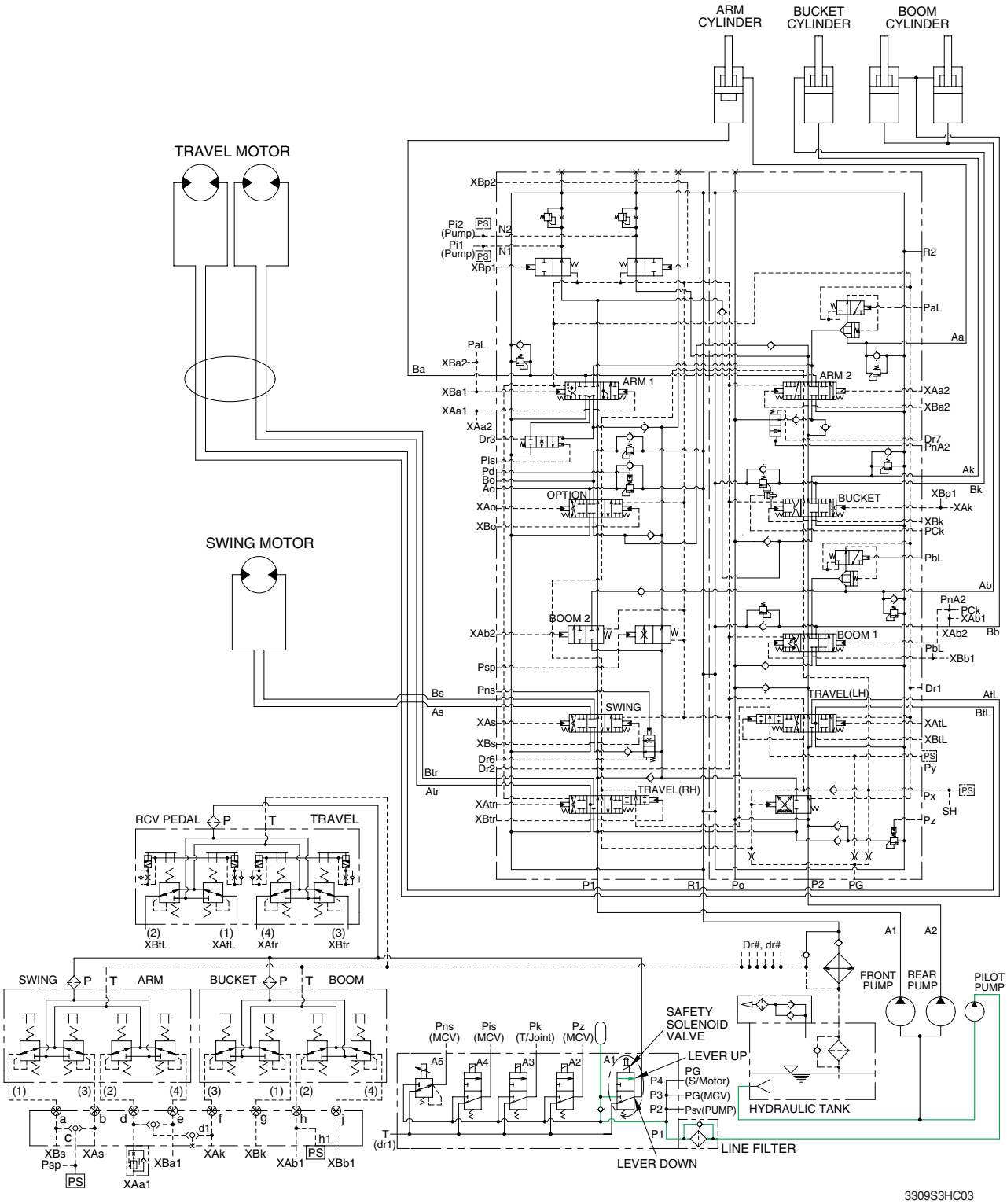


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

The return oil flow into the hydraulic tank.

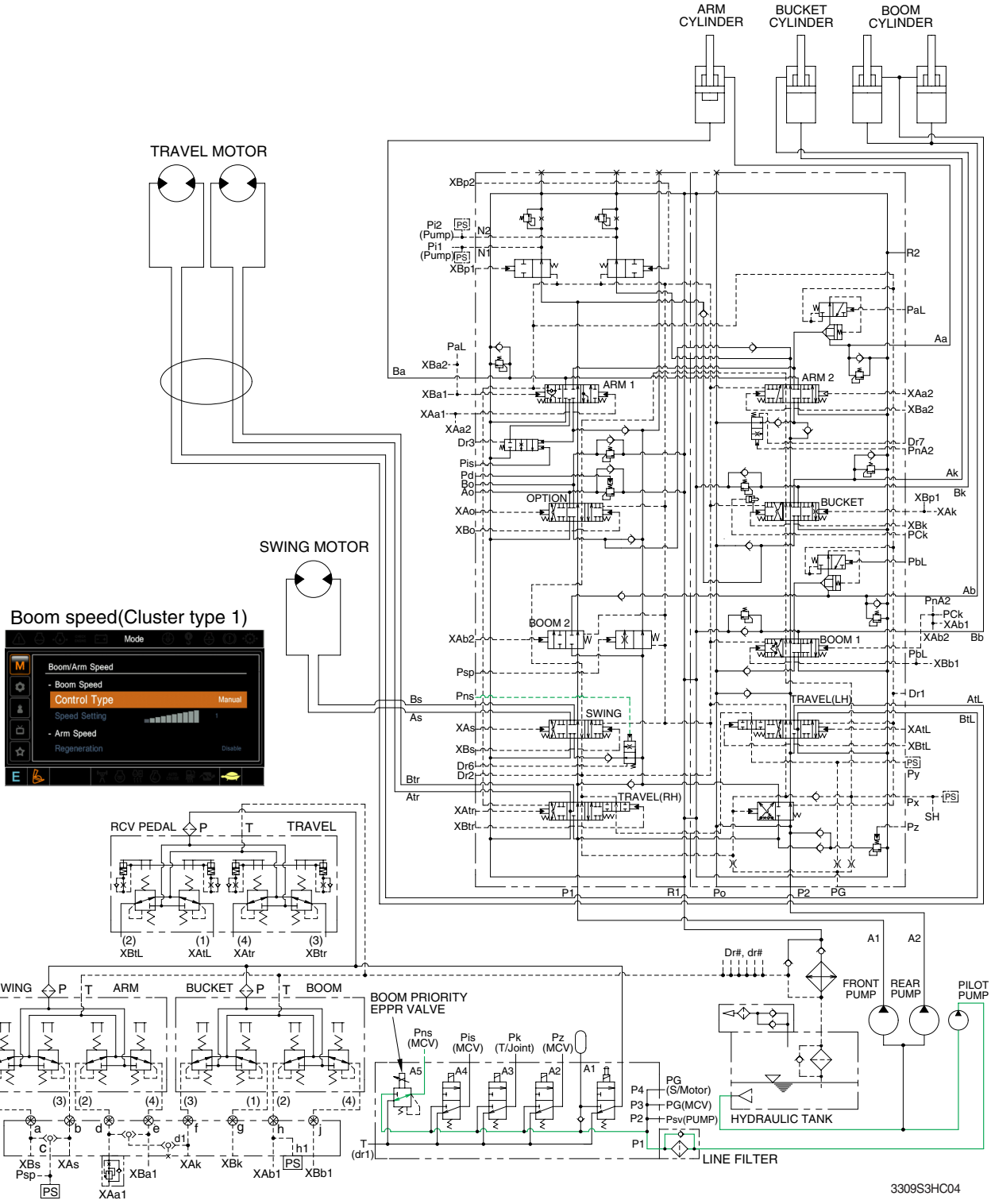
2. SAFETY VALVE (SAFETY LEVER)



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

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

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.

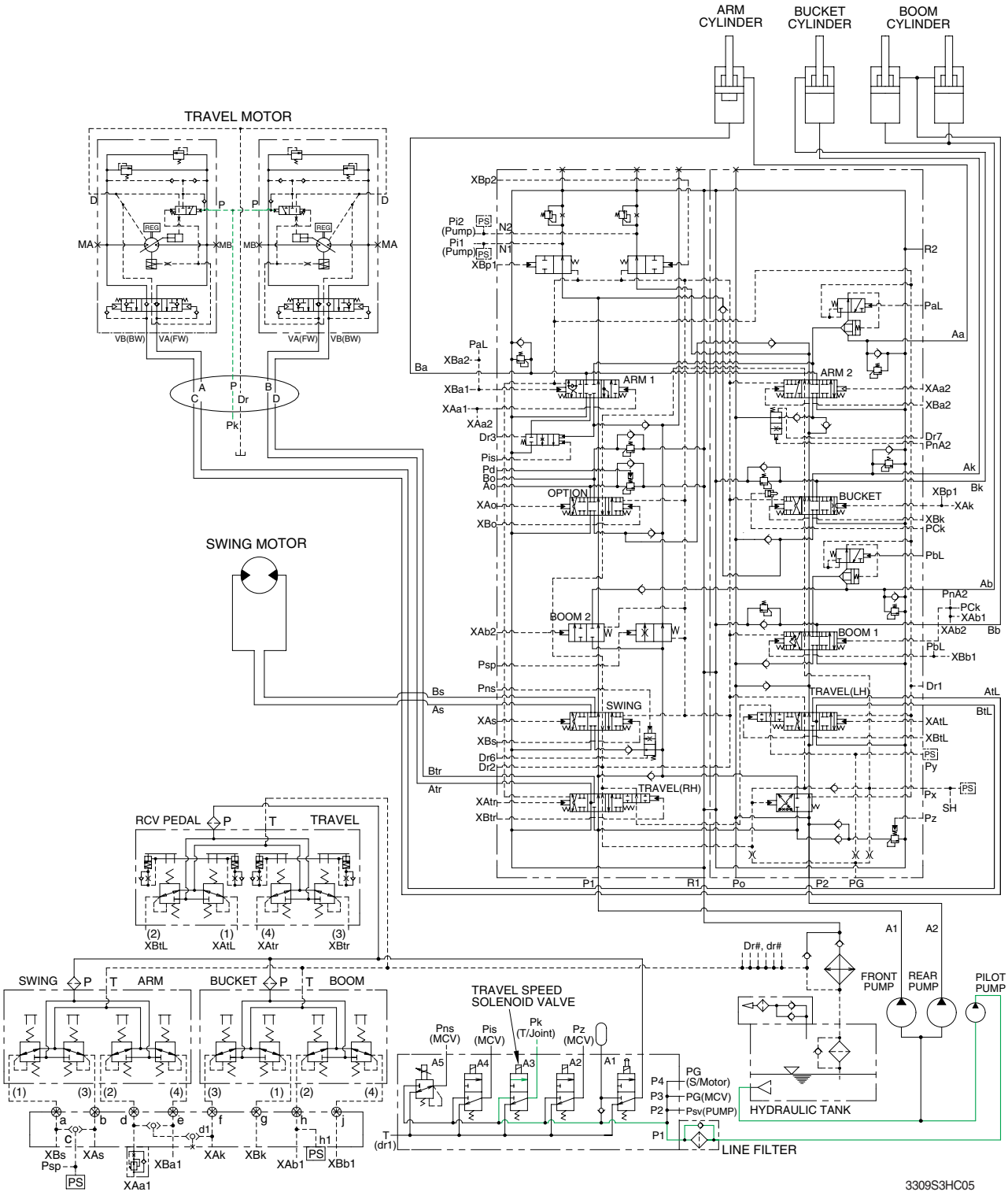
To increase working efficiency, swing speed reducing system is used.

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

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

The boom up speed can be adjusted by the cluster. Refer to page 3-12 of the operator's manual.

4. TRAVEL SPEED CONTROL SYSTEM



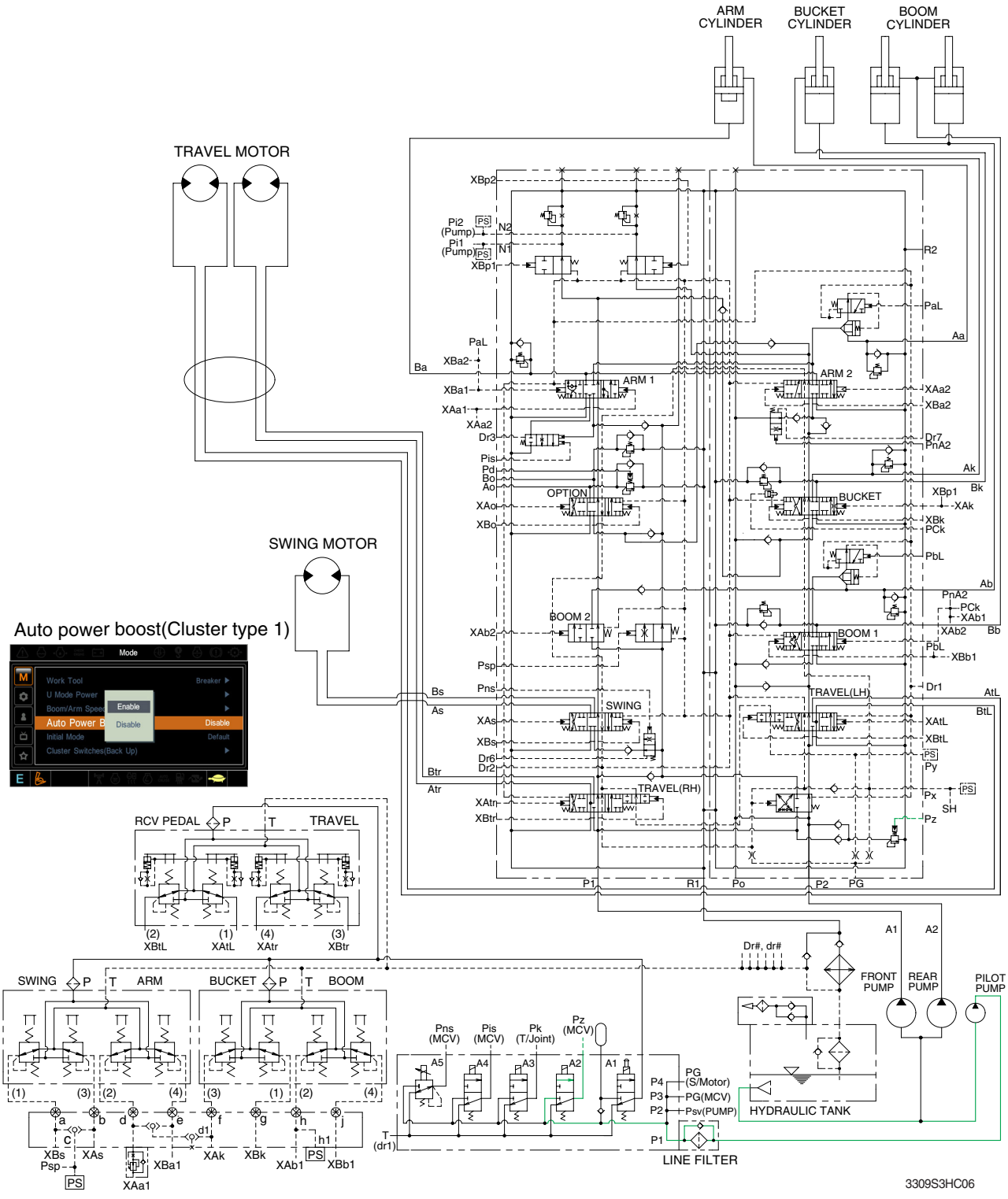
When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the **P** port of pilot valve in the travel motors.

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

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

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

5. MAIN RELIEF PRESSURE CHANGE CIRCUIT

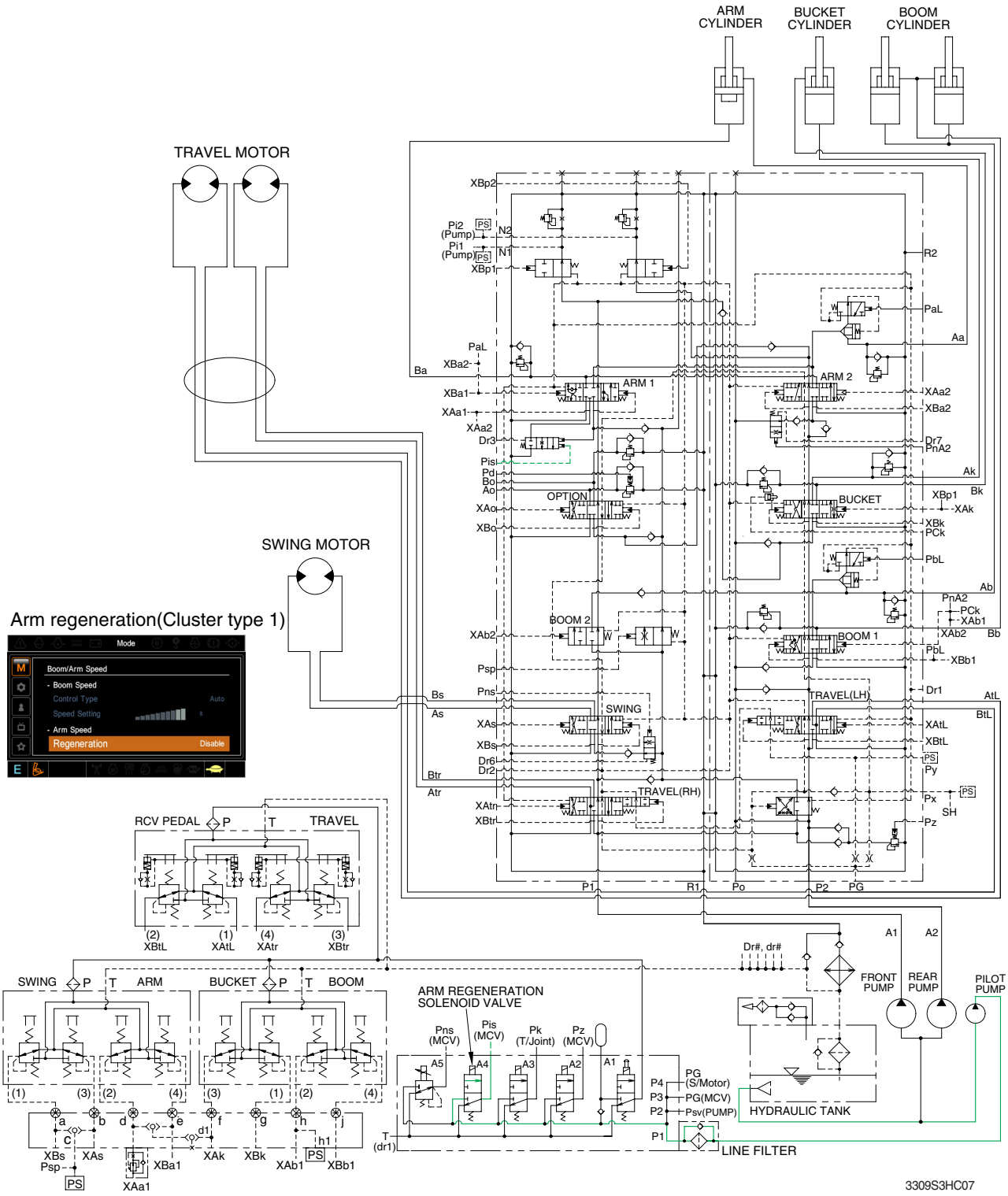


When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into **Pz** port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 350 kgf/cm^2 to 380 kgf/cm^2 for increasing the digging power.

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

When the auto power boost function is selected to enable on the cluster, the pressure of the main relief pressure is automatically increased to 380 kgf/cm^2 as working condition by the MCU. It is operated max 8 seconds.

6. ARM REGENERATION CUT SYSTEM (CLUSTER TYPE 1)



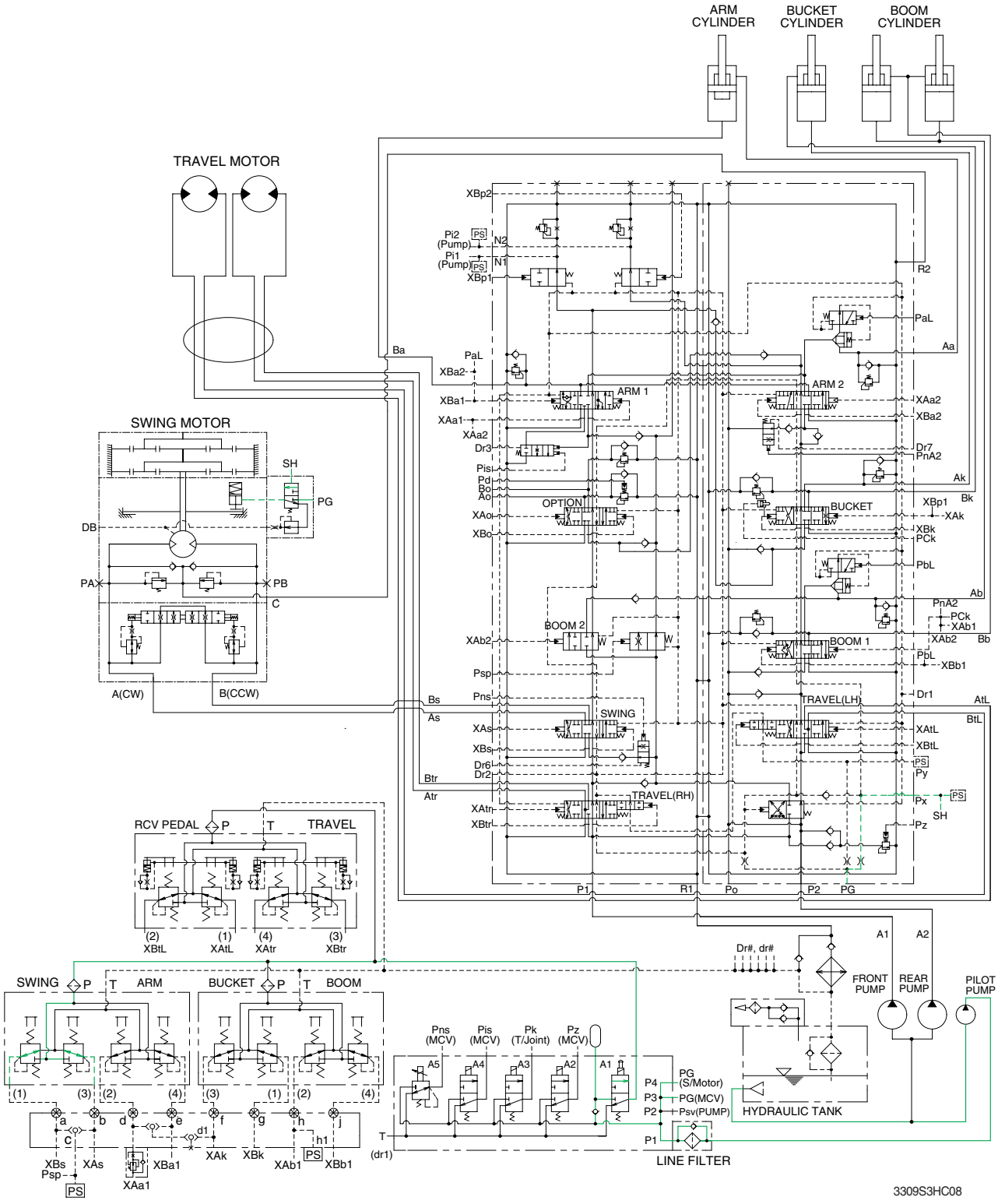
When the arm regeneration is selected to disable on the cluster, the arm regeneration solenoid valve is activated. The pilot oil from pilot pump flow into **Pis** port in main control valve through solenoid valve and the arm regeneration spool is shifted to left.

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

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

Refer to page 2-29 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.

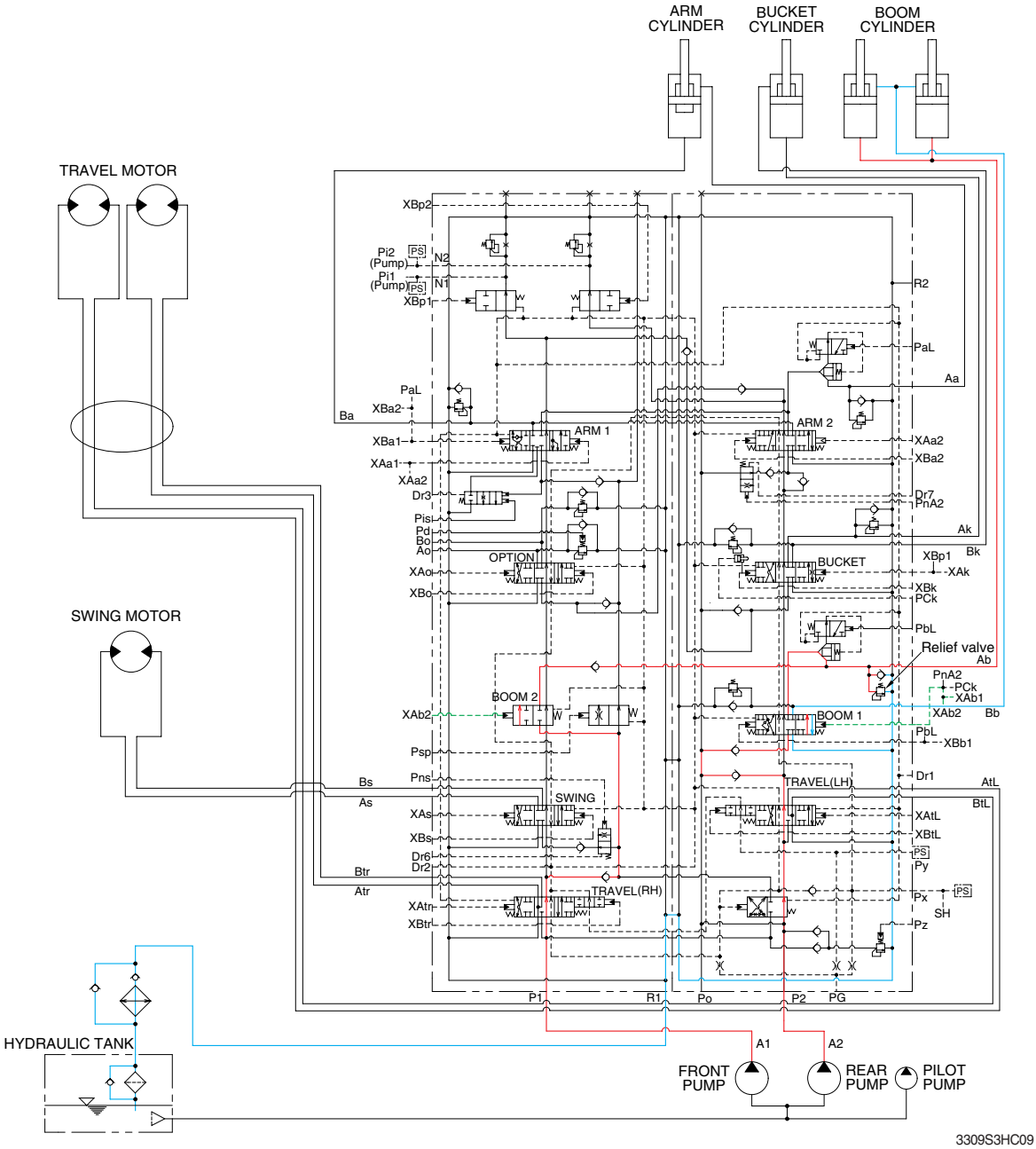
This pressure moves spool so, discharged oil from pilot valve flows to swing motor PG port.

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.

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



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

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

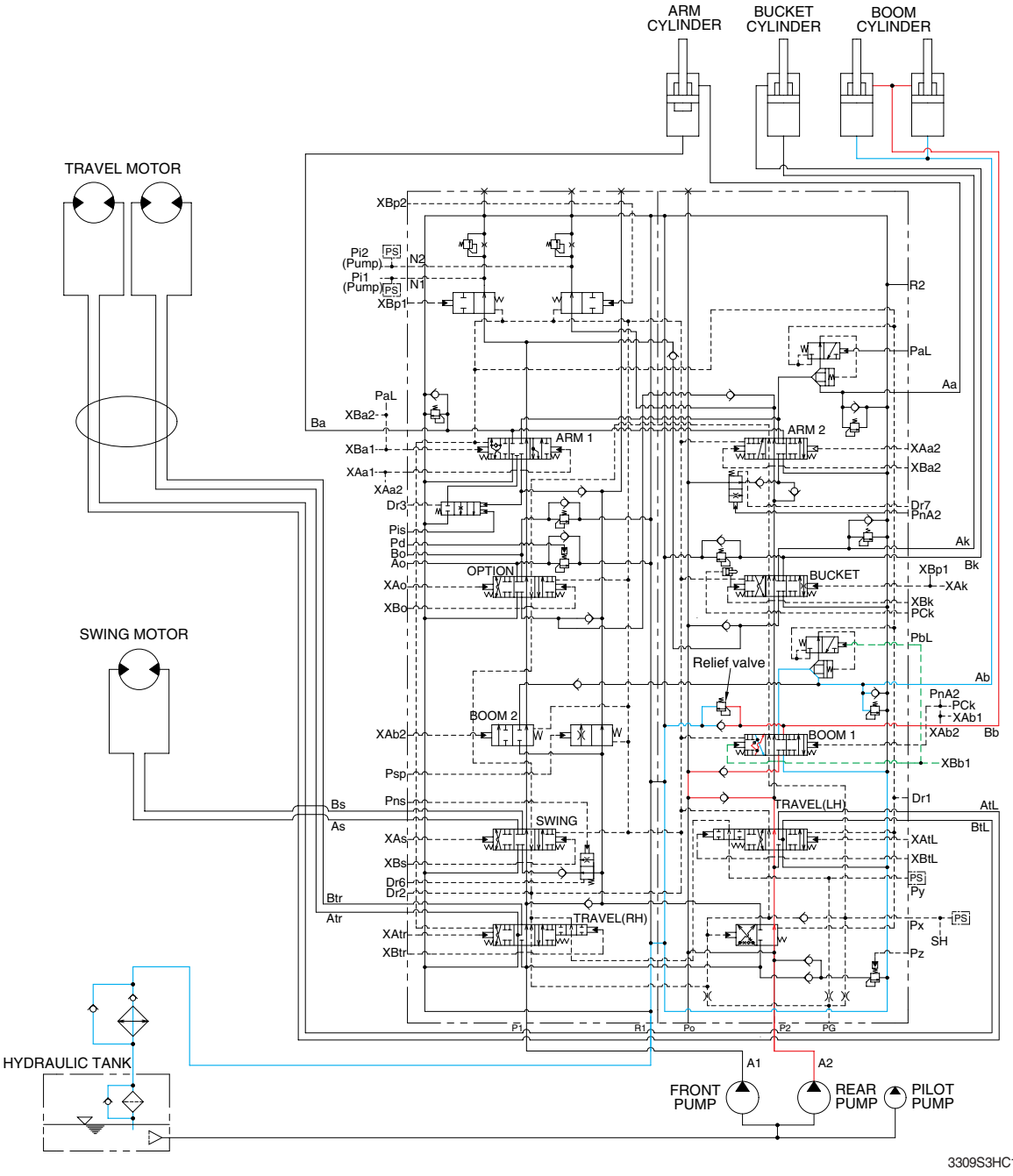
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up.

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

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

This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



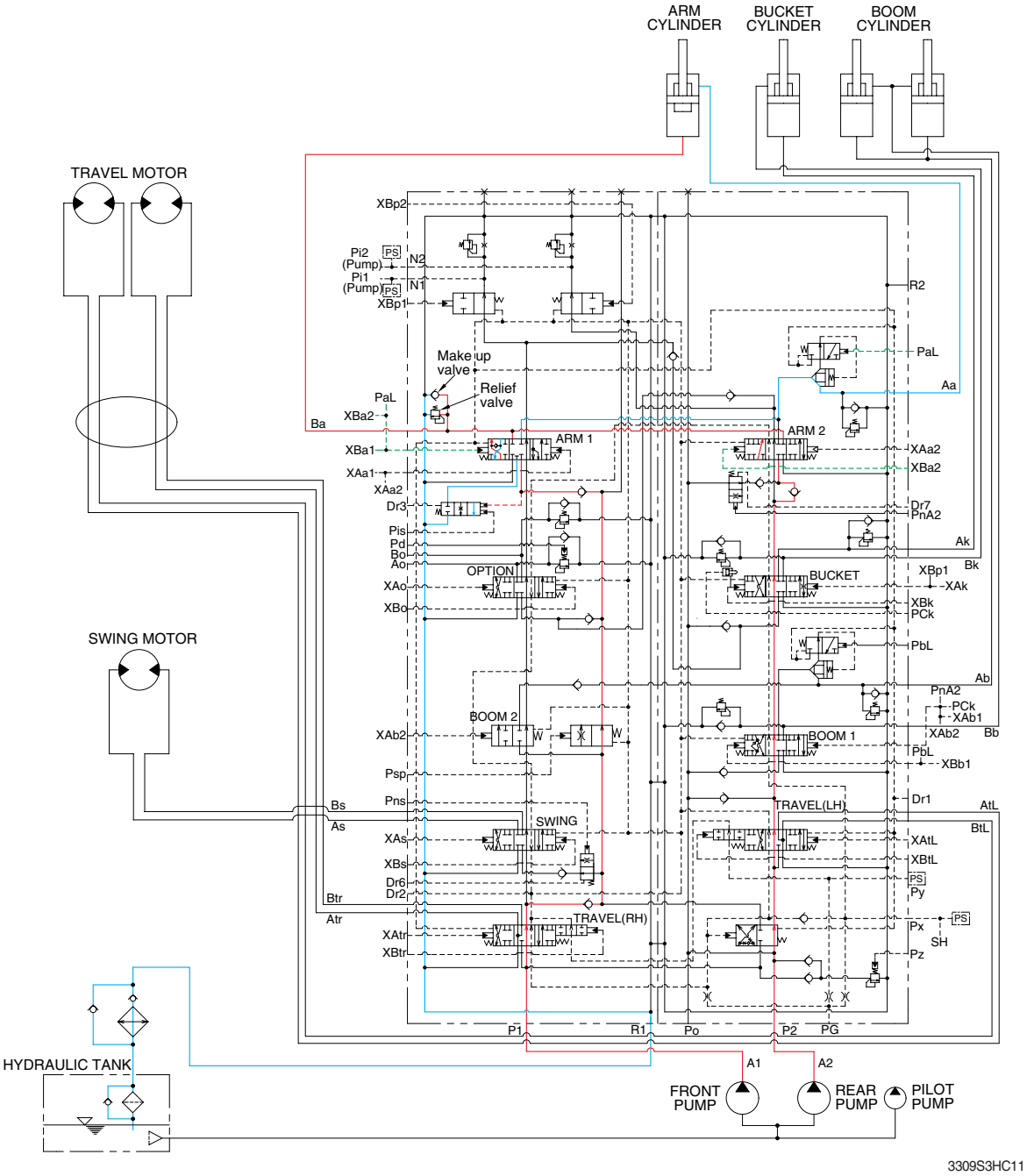
When the right control lever is pushed forward, the boom 1 spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.

The oil from the rear 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 side is prevented by the relief valve.

3. ARM IN OPERATION



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

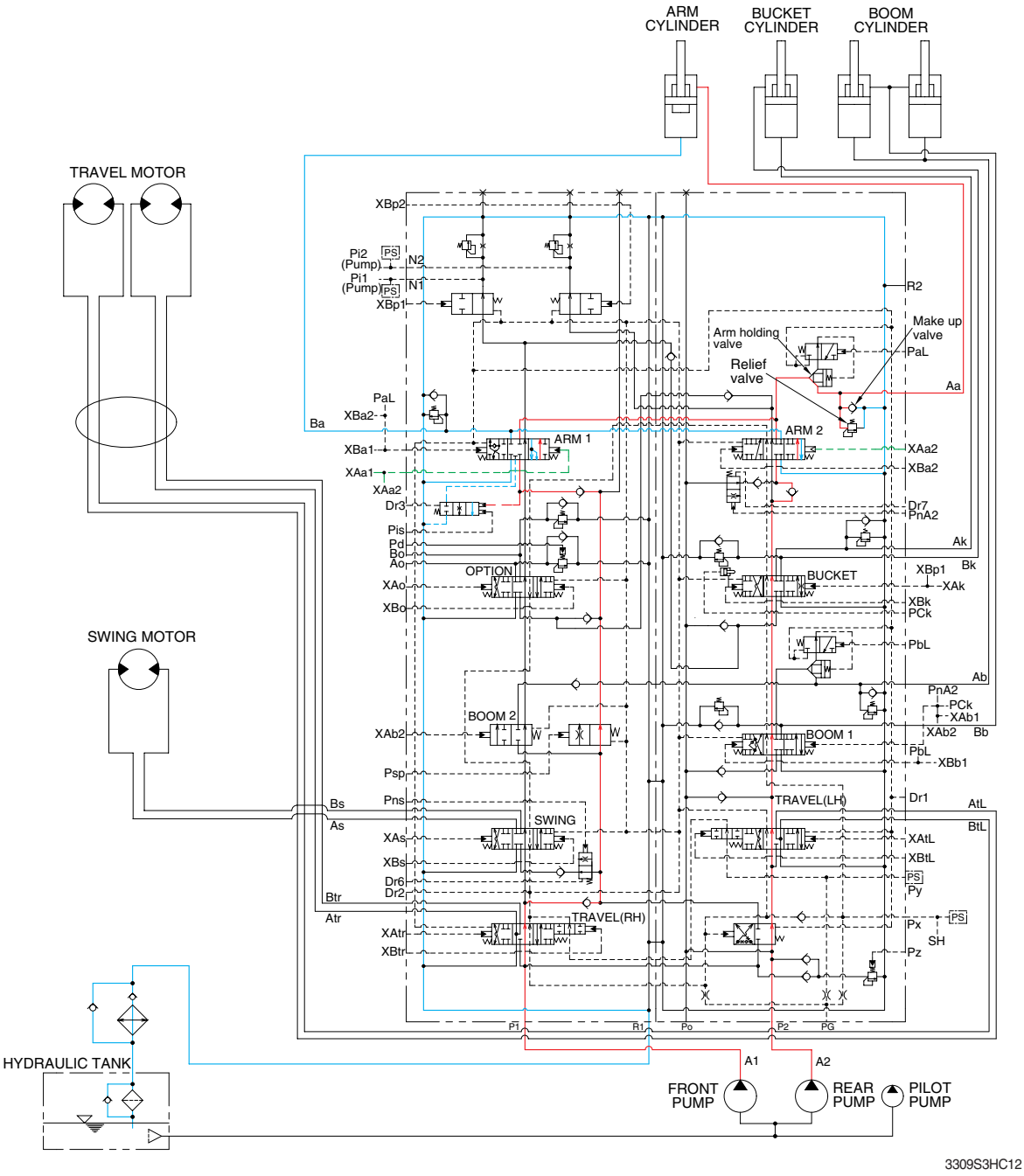
The oil from the front and rear pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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

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

The cavitation which will happen to the head side of the arm cylinder is also prevented by the make-up valve in the main control valve.

4. ARM OUT OPERATION



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

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

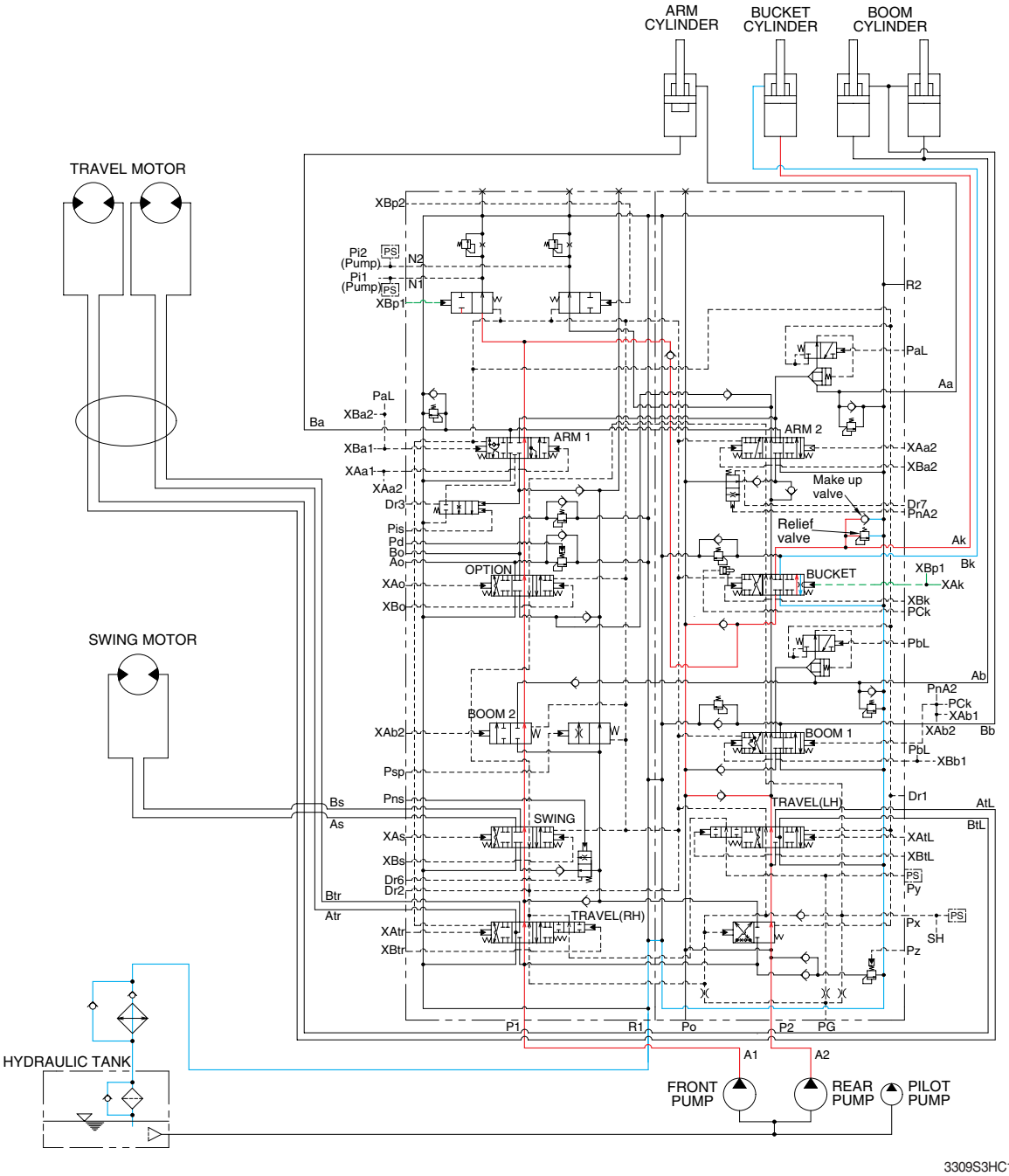
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spools in the main control valve. When this happens, the arm rolls out.

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

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

The cavitation which will happen to the rod side of the arm cylinder is also prevented by the make-up valve in the main control valve.

5. BUCKET IN OPERATION



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

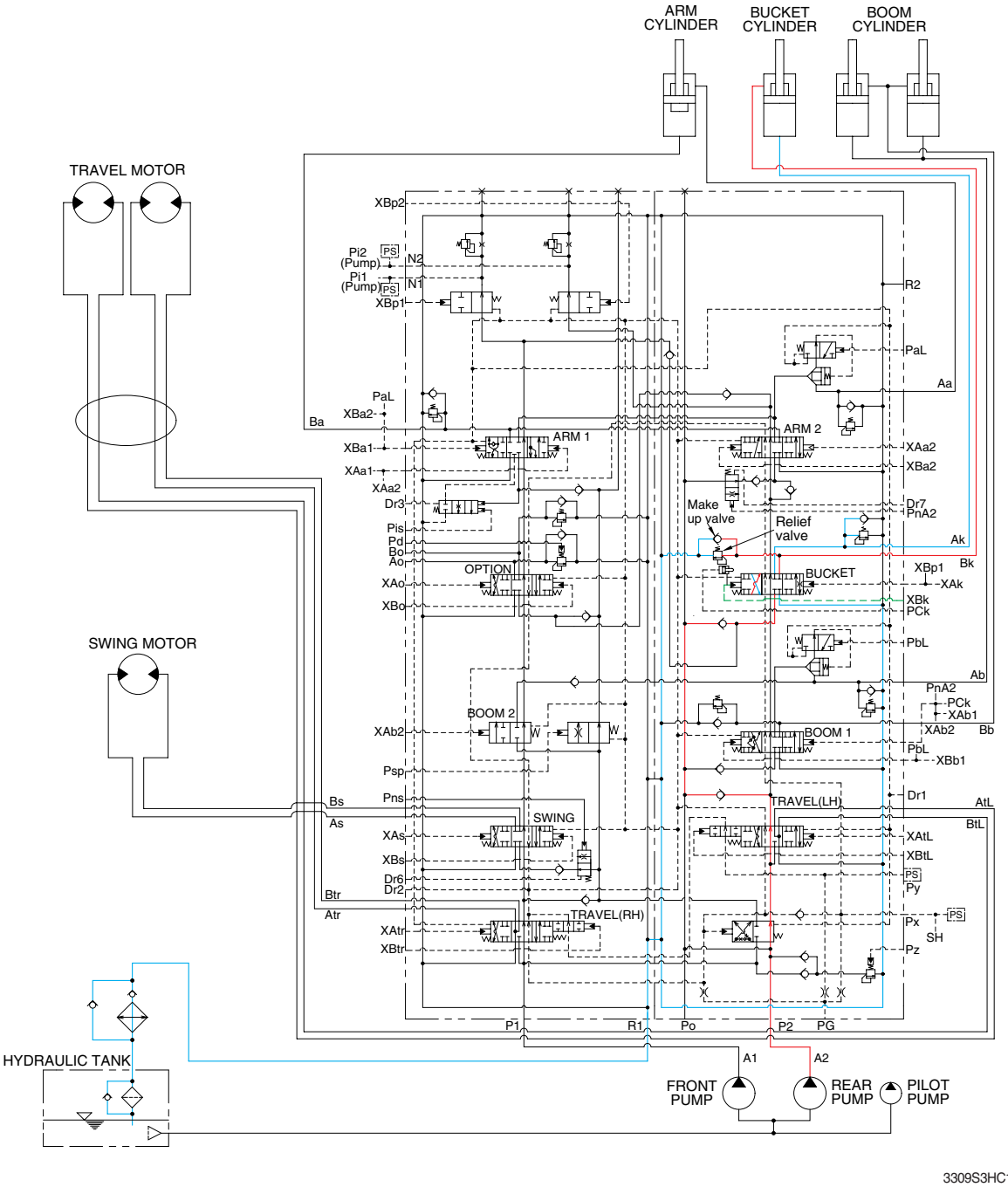
The oil from the rear pump flows into the main control valve and then goes to the large chamber of bucket cylinder. The oil form the front pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (XBp1).

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

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

The cavitation which will happen to the head side of the bucket cylinder is also prevented by the make-up valve in the main control valve.

6. BUCKET OUT OPERATION



3309S3HC14

When the right control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure from the remote control valve.

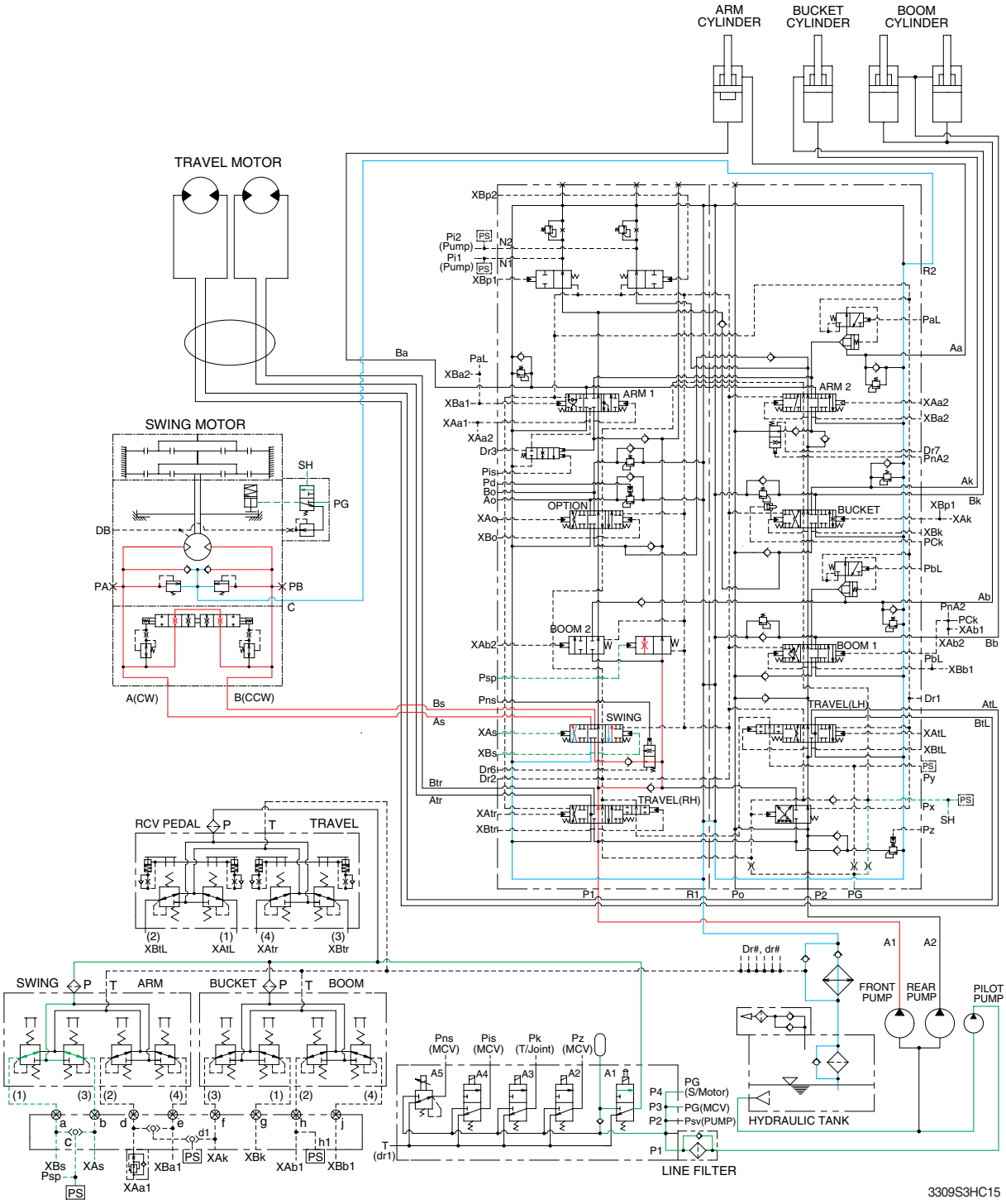
The oil from the rear pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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

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

The cavitation which will happen to the rod side of the bucket cylinder is also prevented by the make-up valve in the main control valve.

7. SWING OPERATION



When the left control lever is pushed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure from the remote control valve.

Also the swing operation preference function is operated by the pilot pressure Psp (refer to page 2-36).

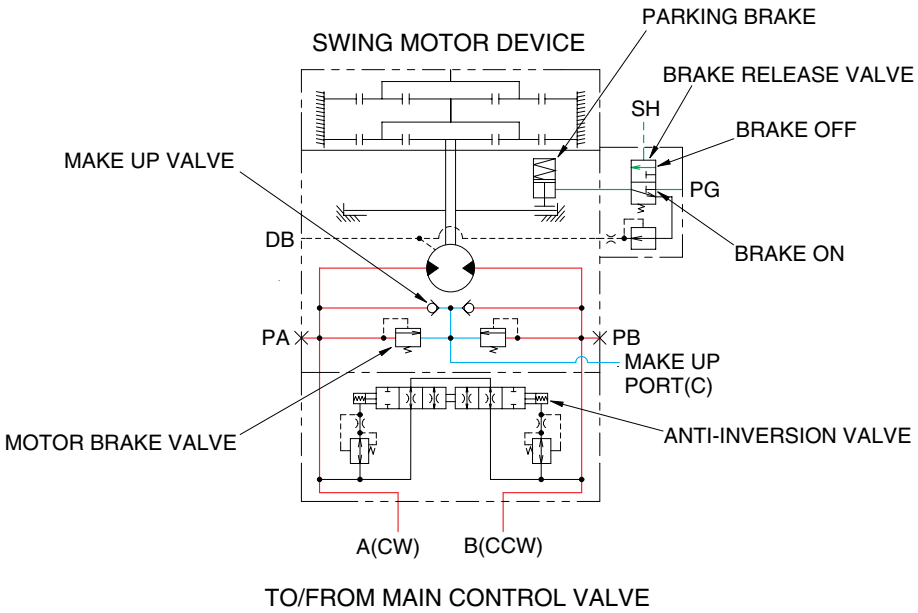
The oil from the front pump flows into the main control valve and then goes to the swing motor.

At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

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

The swing parking brake, make up valve and the motor brake valve are provided in the swing motor. The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



3309S3HC16

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.

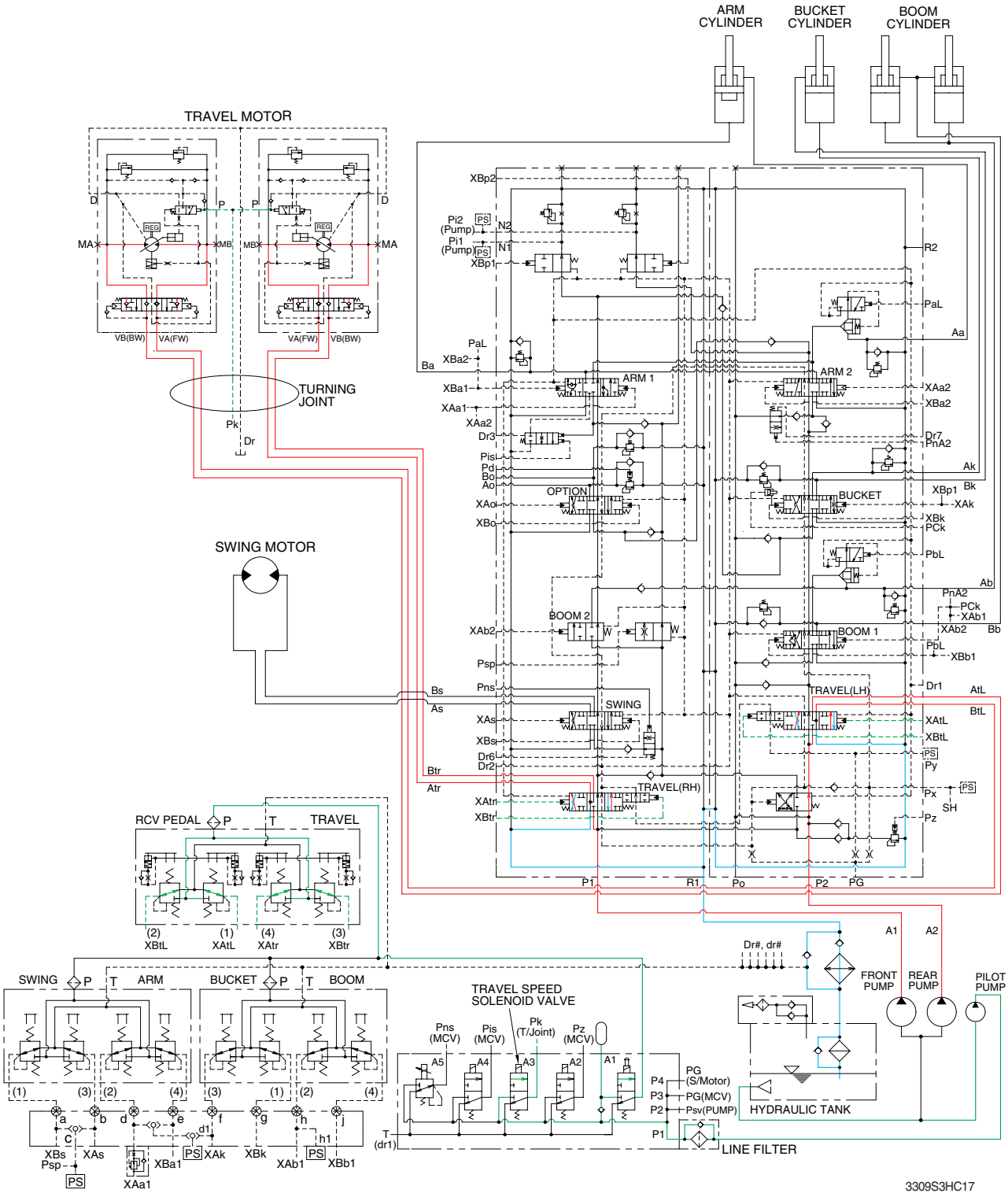
PARKING BRAKE "ON" OPERATION

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



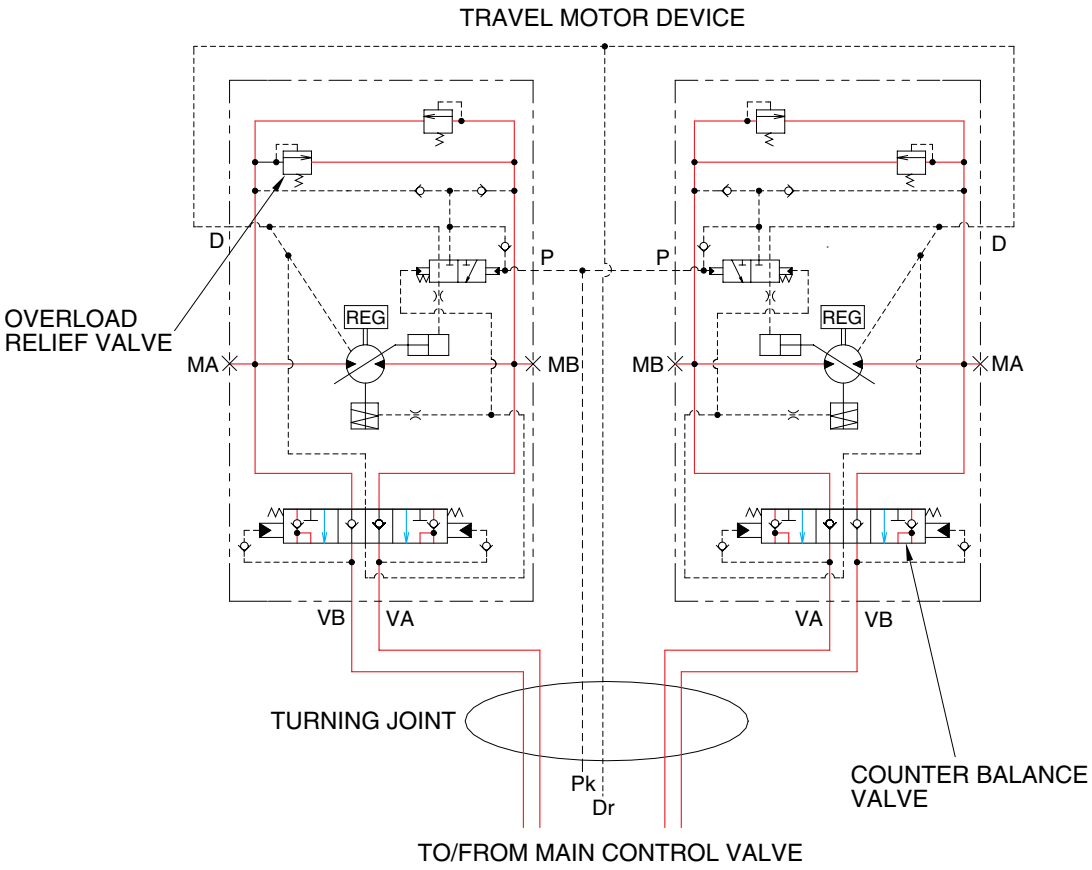
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

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

The return oil from both travel motors returns to the hydraulic oil tank through the turning joint and the travel spools in the main control valve.

When this happens, the machine moves to the forward or reverse.

TRAVEL CIRCUIT OPERATION



3309S3HC18

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

1) COUNTER BALANCE VALVE

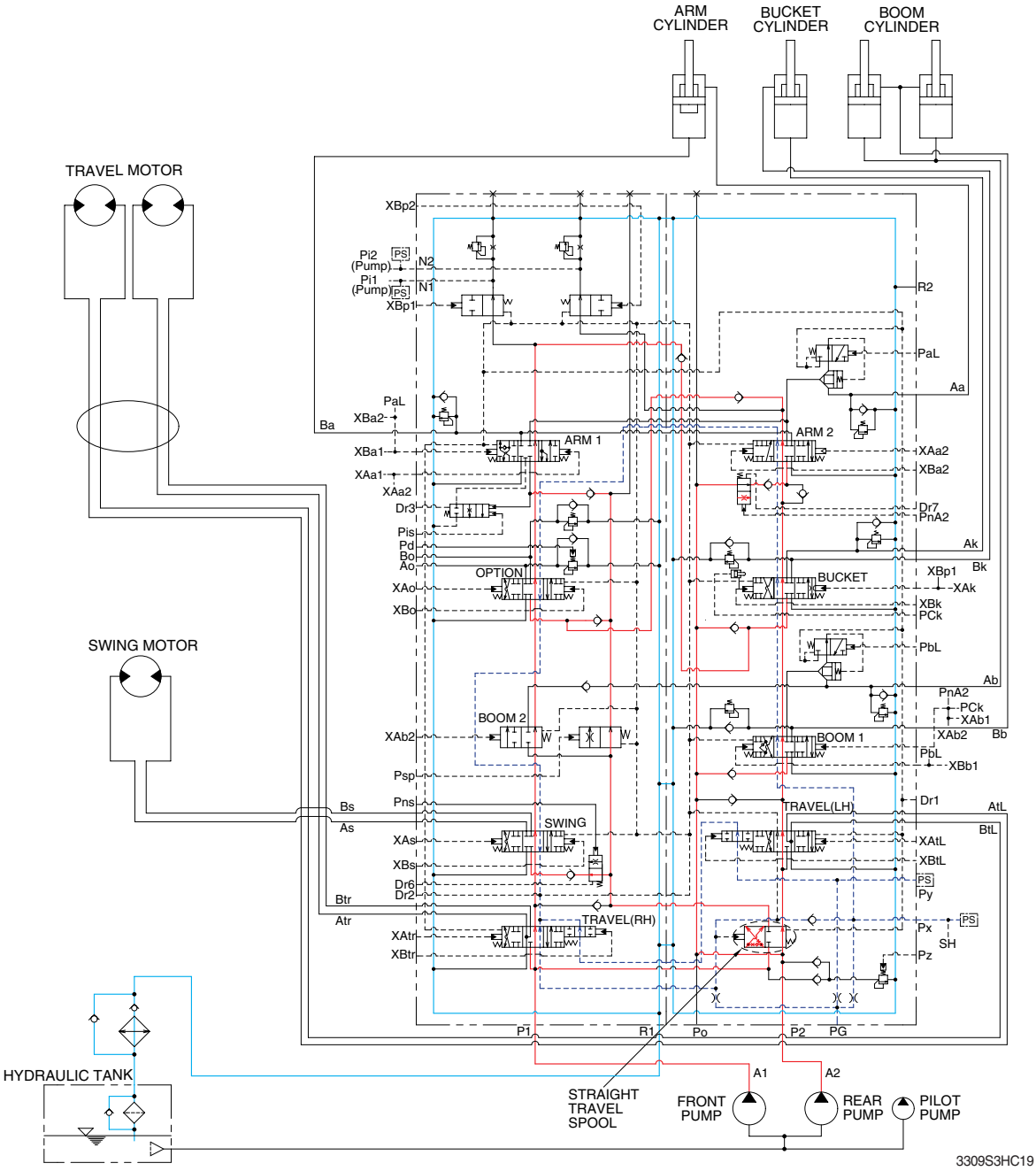
When stopping the motor of slope descending, this valve to prevent the motor over run.

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



The oil from the front and rear 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.

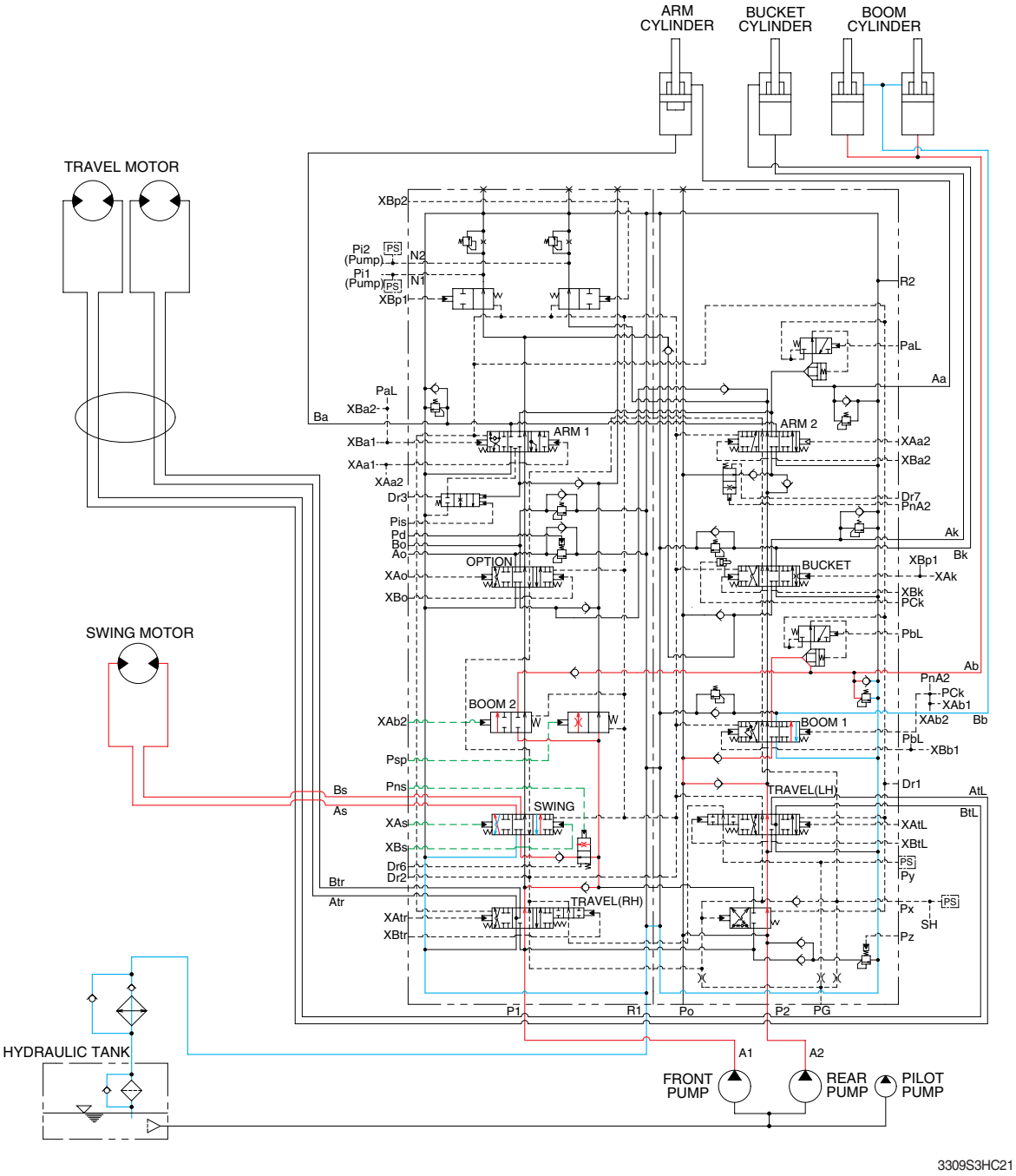
STRAIGHT TRAVEL SPOOL

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.

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



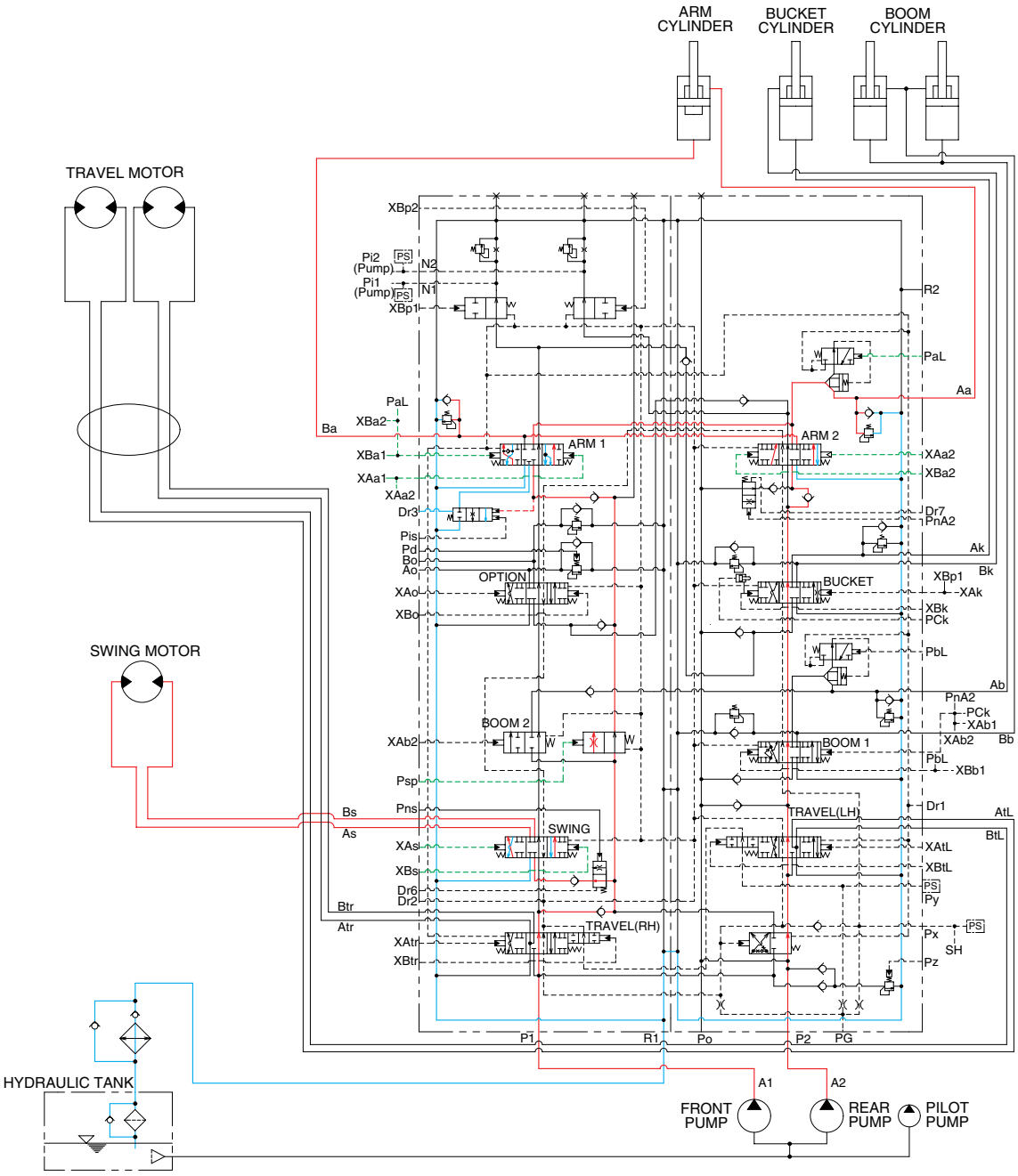
When the swing and boom up functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

Refer to page 3-8 for the boom priority system.

3. COMBINED SWING AND ARM OPERATION



3309S3HC22

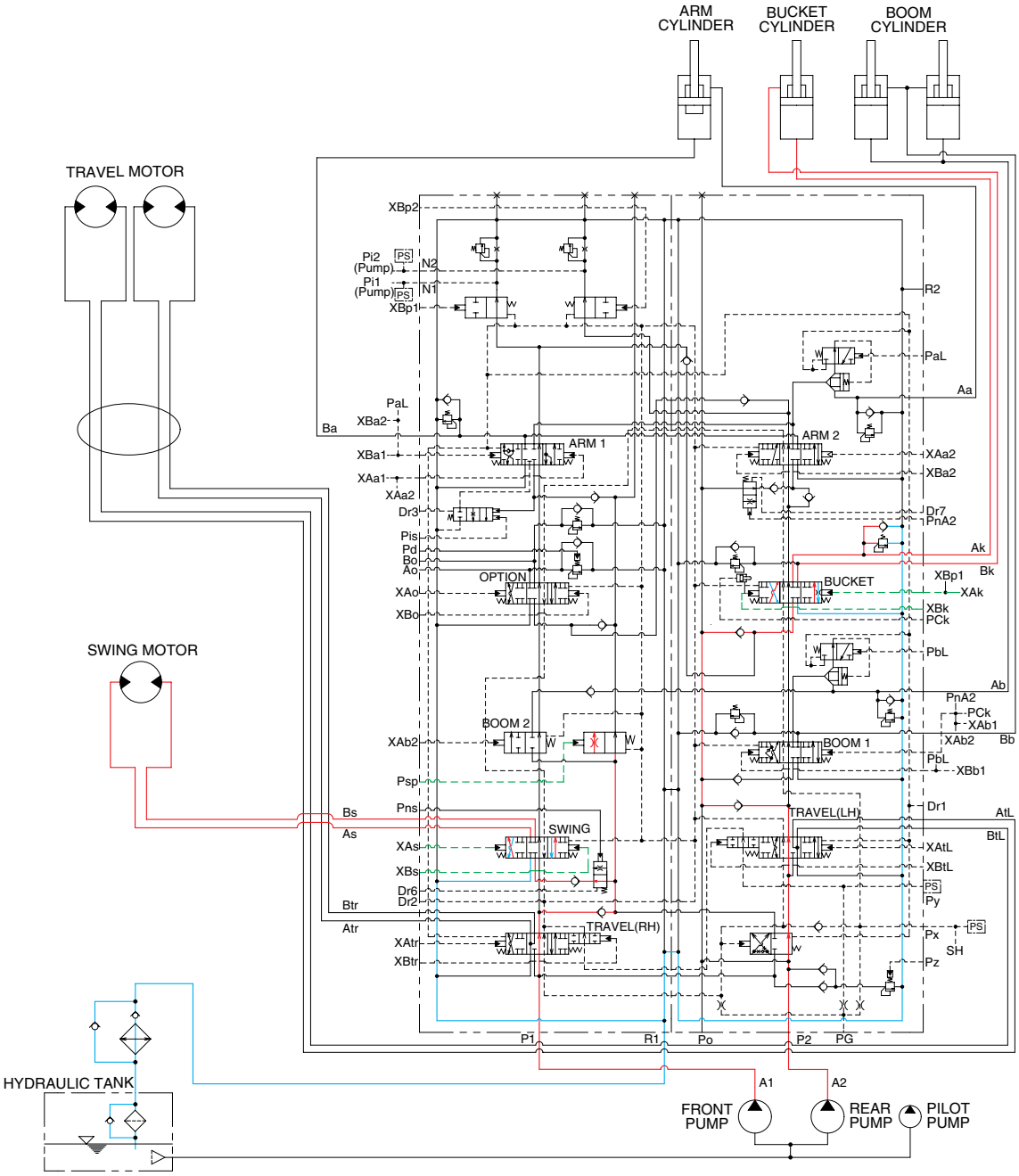
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

Refer to page 2-35 for the swing operation preference function.

4. COMBINED SWING AND BUCKET OPERATION



3309S3HC23

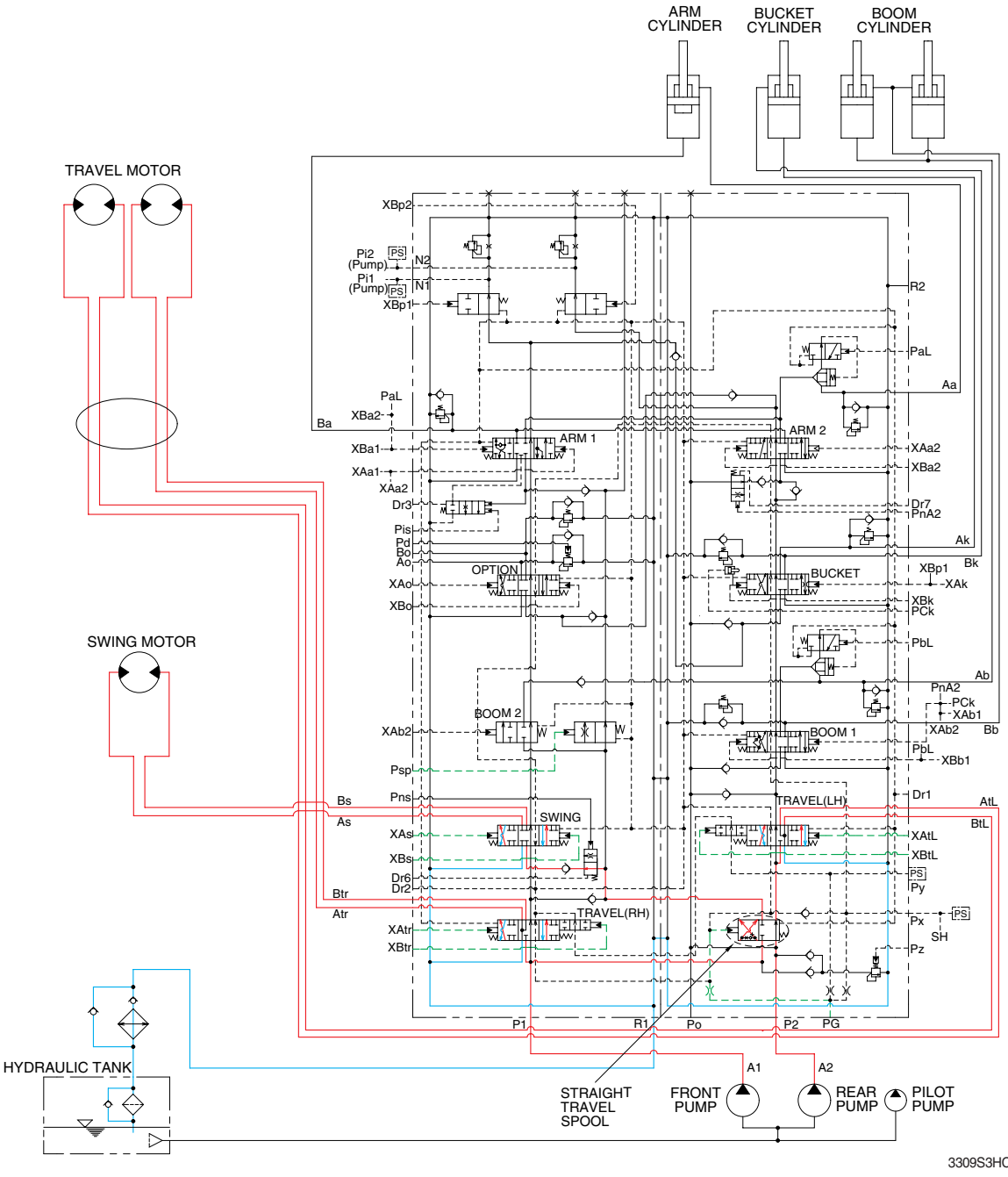
When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

The oil from the rear pump flows into the bucket cylinder through the bucket spool in the right control valve.

The upper structure swings and the bucket is operated.

5. COMBINED SWING AND TRAVEL OPERATION



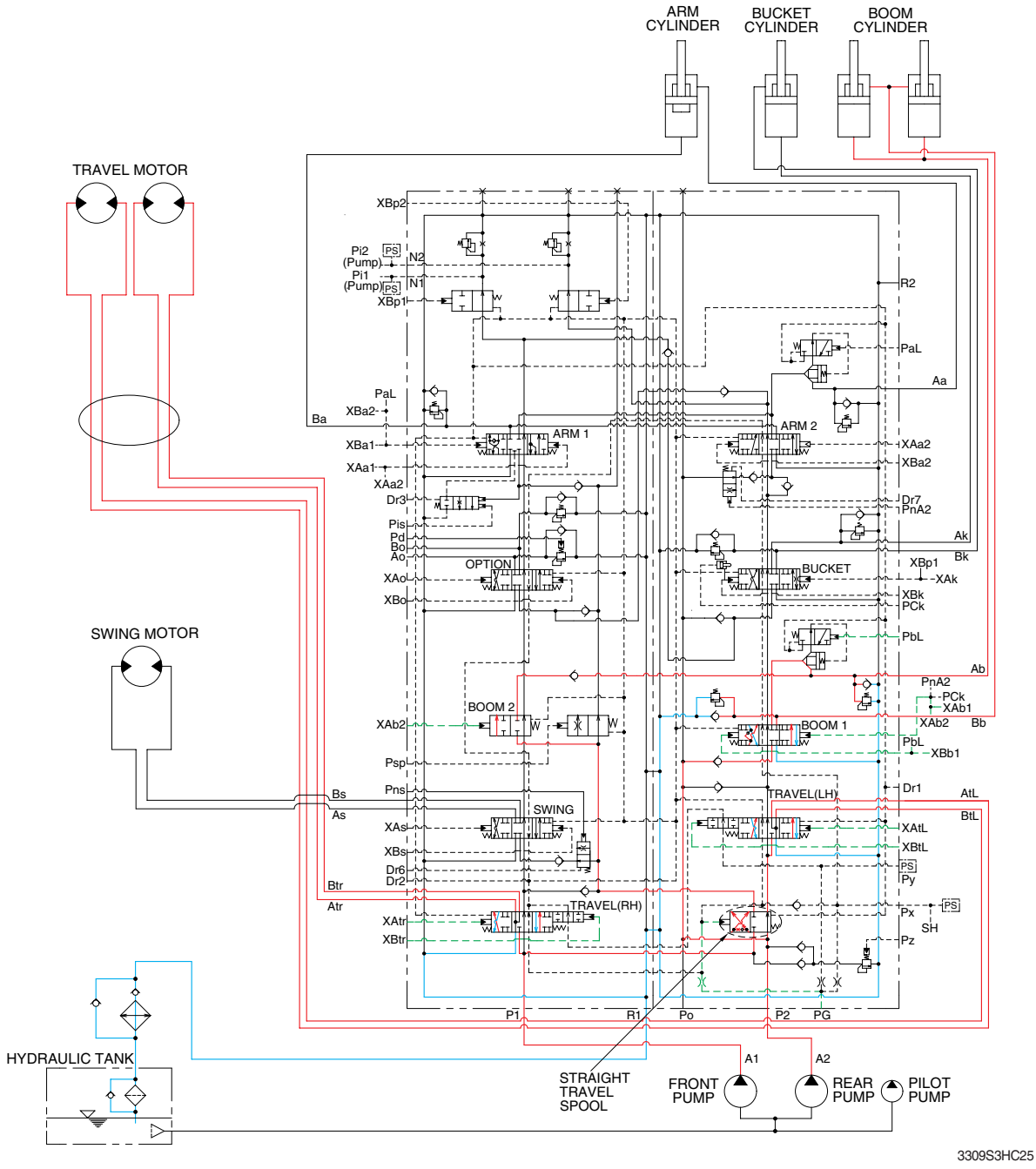
When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and straight travel spool is pushed to the right by the pilot oil pressure from the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

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

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

The upper structure swings and the machine travels straight.

6. COMBINED BOOM AND TRAVEL OPERATION



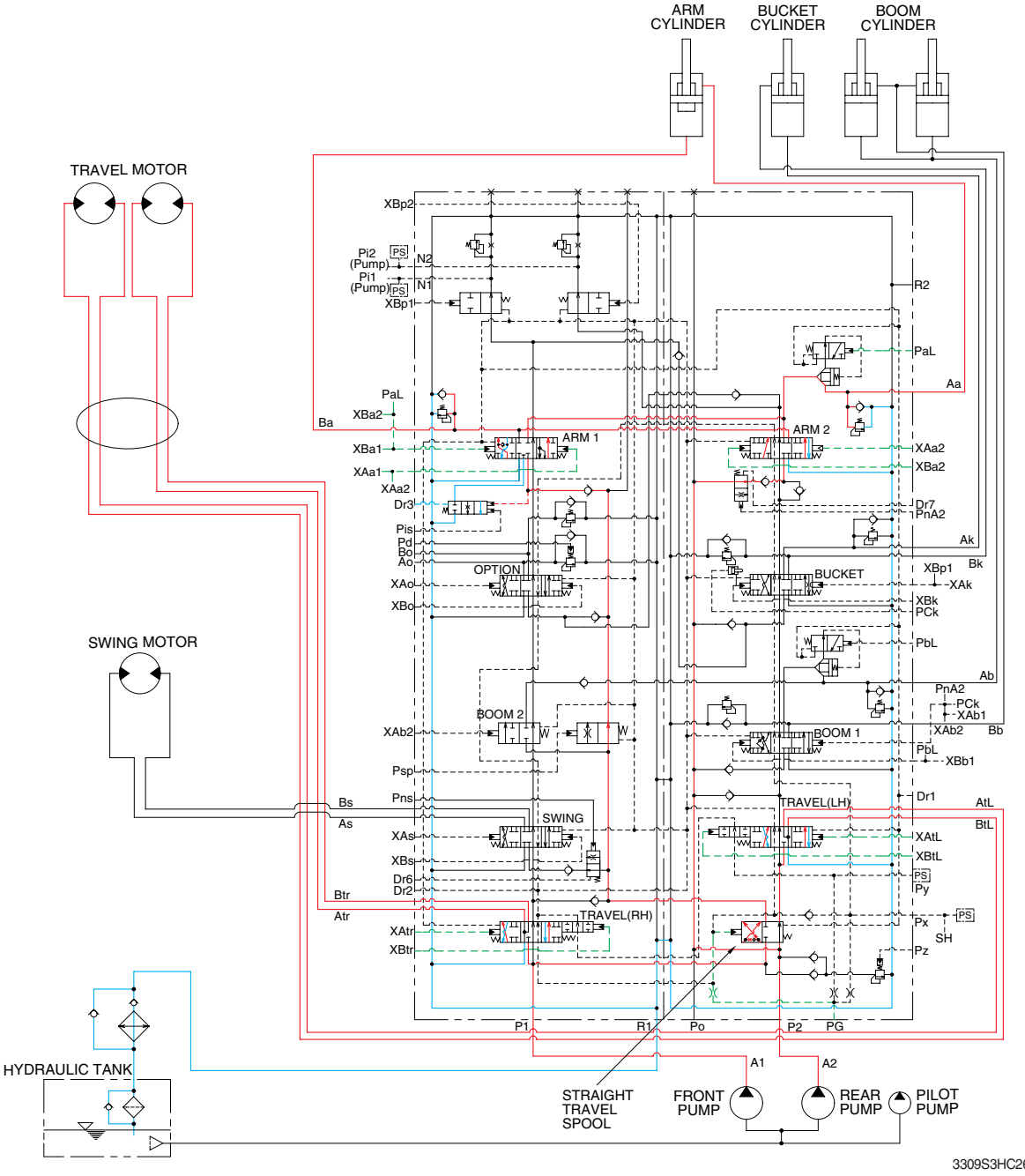
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot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

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

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

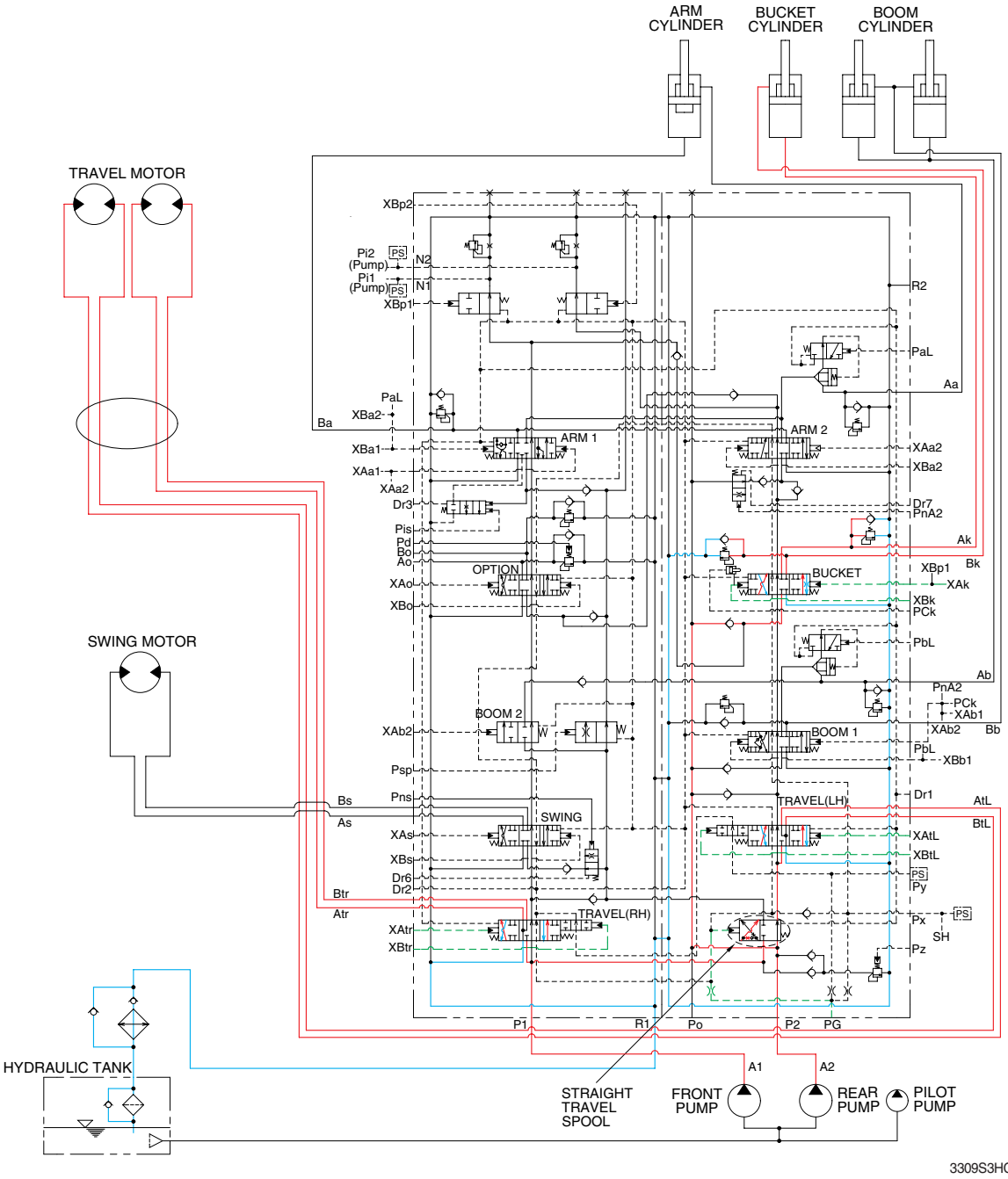
The boom is operated and the machine travels straight.

7. COMBINED ARM AND TRAVEL OPERATION



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 and the straight travel spool is pushed to the right by the oil pressure from pilot pump.
The oil from the front pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.
The oil from the rear pump flows into the arm cylinders through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage. Also, the oil from the rear pump flows into the travel motors through the LH travel spool via the check valve and orifice in the straight travel spool.
The arm is operated and the machine travels straight.

8. COMBINED BUCKET AND TRAVEL OPERATION

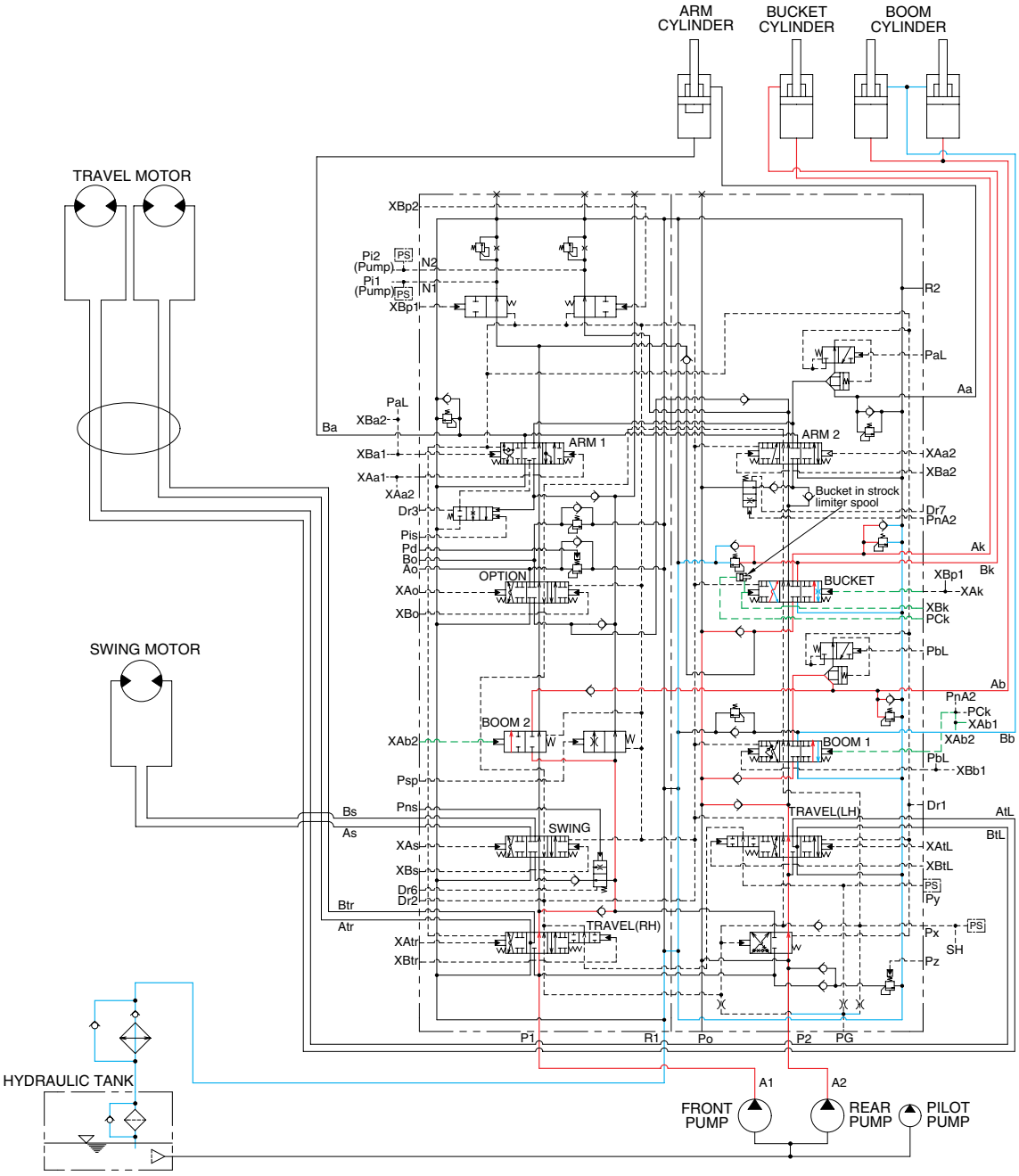


When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve, and the straight travel spool is pushed to the right by the oil pressure from pilot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

The oil from the rear pump flows into the bucket cylinder through the bucket spool via the confluence oil passage. Also, the oil from the rear pump flows into the travel motors through the LH travel spool via the check valve and orifice in the straight travel spool.

The bucket is operated and the machine travels straight.

9. COMBINED BOOM UP AND BUCKET OPERATION



3309S3HC28

When the boom up and bucket functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure from the remote control valve. Also, the boom up operation preference function is operated by the pilot pressure PCk (refer to page 2-33).

The oil from the front pump flows into the boom cylinders through the boom 2 spool in the left control valve. The oil from the rear pump flows into the boom cylinders and bucket cylinder through the boom 1 spool, bucket spool and the parallel and confluence oil passage in the right control valve.

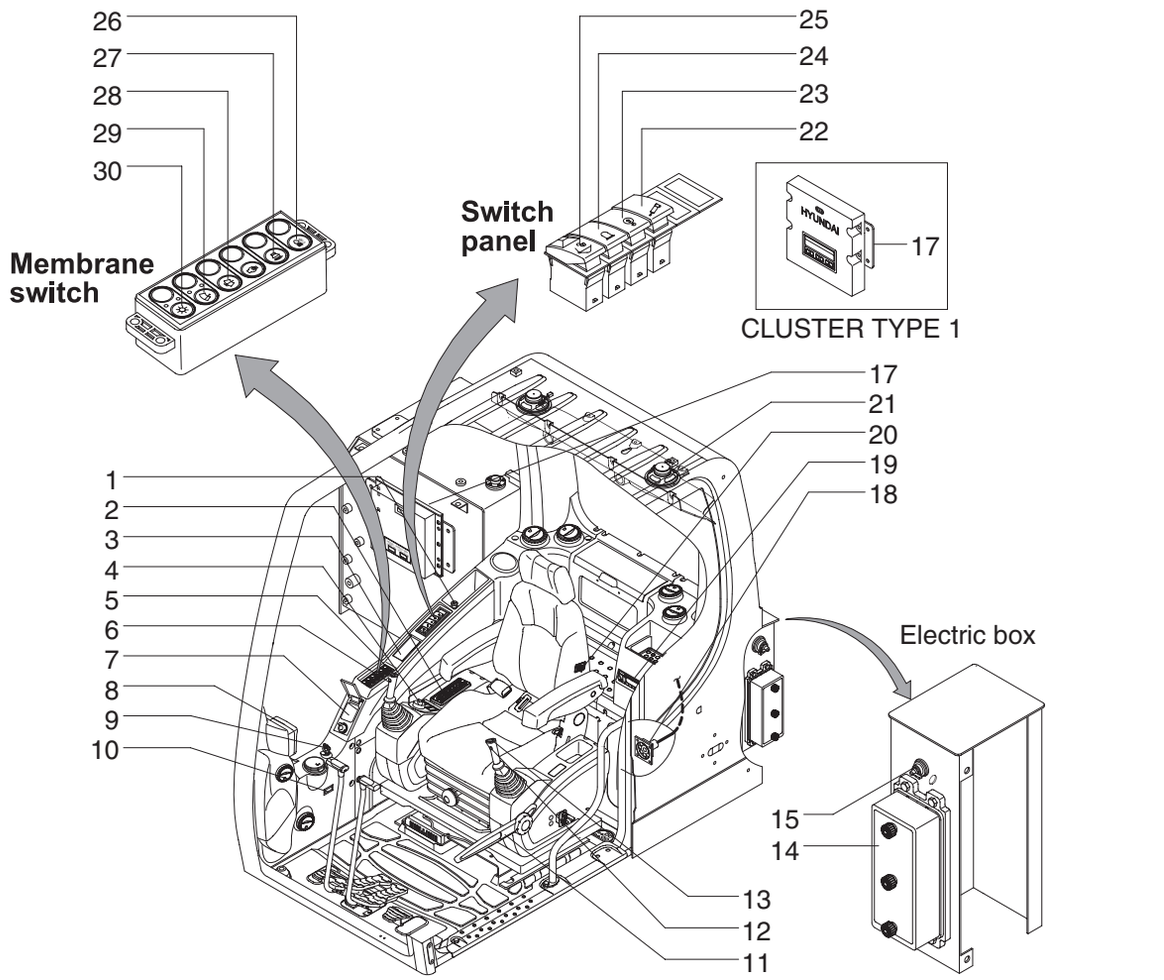
The boom and bucket are operated.

SECTION 4 ELECTRICAL SYSTEM

Group 1 Component Location 4-1
Group 2 Electrical Circuit 4-3
Group 3 Electrical Component Specification 4-38
Group 4 Connectors 4-46

GROUP 1 COMPONENT LOCATION

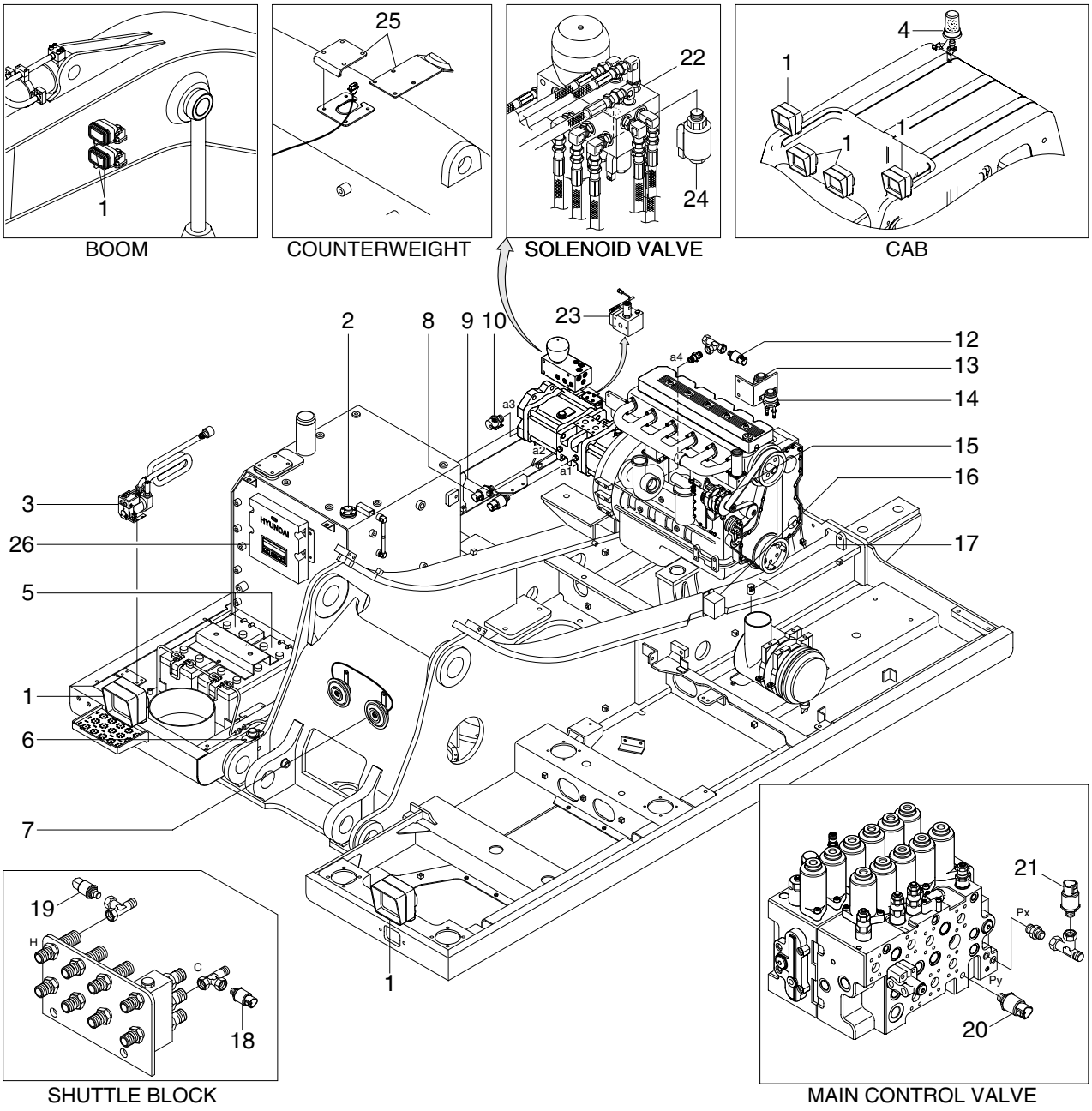
1. LOCATION 1



3309S4EL01

1	Cigar light	11	Power max switch	22	USB socket
2	Aircon & heater switch panel	12	Emergency engine stop switch	23	Overload switch
3	Accel dial switch	13	One touch decel switch	24	Beacon switch
4	Horn switch	14	Fuse box	25	Quick clamp switch
5	Breaker operation switch	15	Master switch	26	Cab light switch
6	Air compressor switch	17	RS232 service socket	27	Travel alarm switch
7	Starting switch	18	Radio & USB player	28	Washer switch
8	Cluster	19	Heated seat switch	29	Wiper switch
9	Service meter	20	Speaker	30	Main light switch
10	Safety lever	21	MCU		

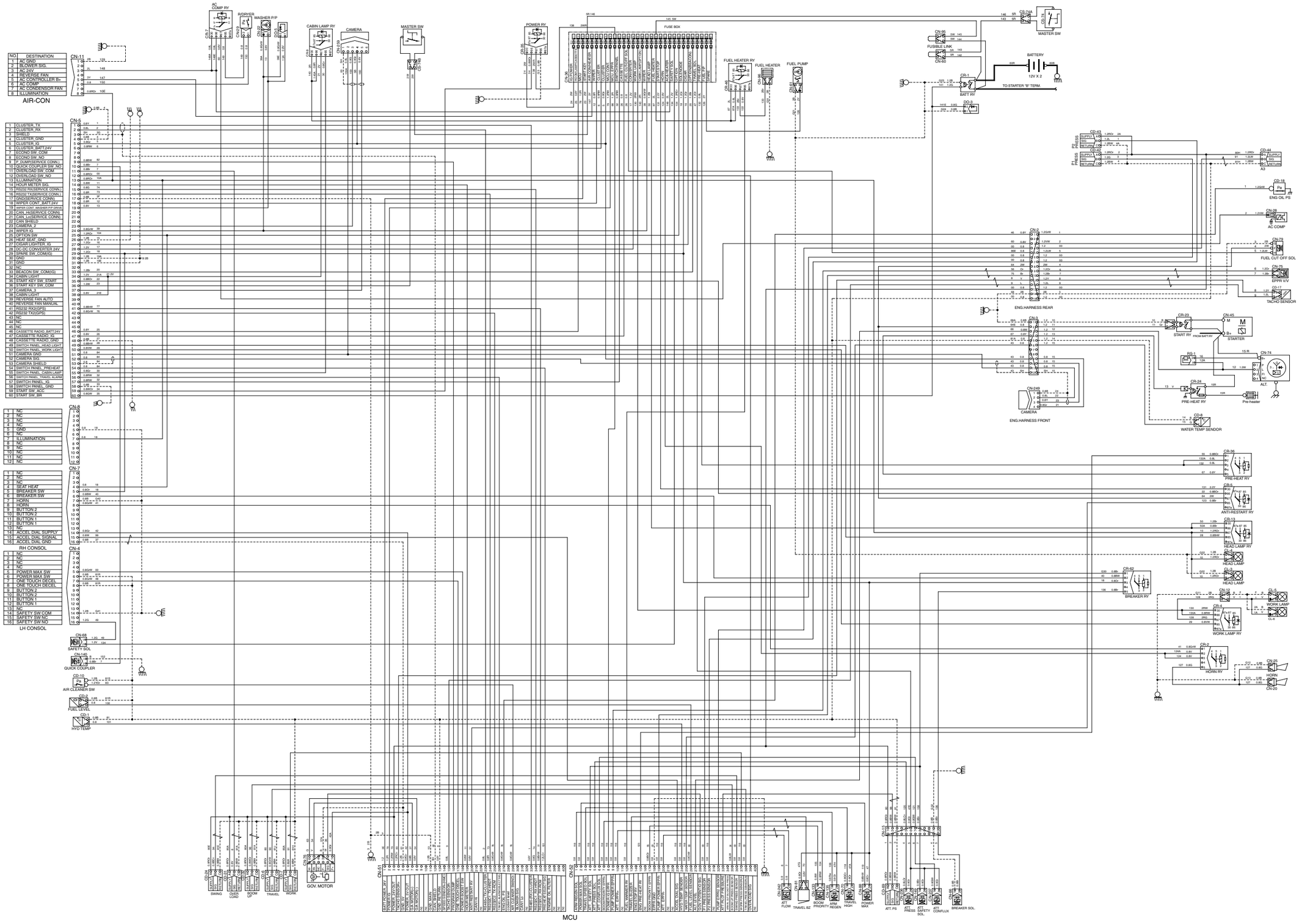
2. LOCATION 2



1	Lamp	10	P3 pressure sensor	20	Travel pressure sensor
2	Fuel sender	12	EPPR Pressure sensor	21	Attach pressure sensor
3	Fuel filler pump	13	Start relay	22	Solenoid valve
4	Beacon lamp	14	Heater relay	23	Pump EPPR valve
5	Battery	15	Alternator	24	Boom priority EPPR valve
6	Battery relay	16	Travel alarm buzzer	25	Rear view camera kit
7	Horn	17	Air cleaner switch	26	MCU(machine control unit)
8	P1 pressure sensor	18	Swing pressure sensor		
9	P2 pressure sensor	19	Boom up pressure sensor		

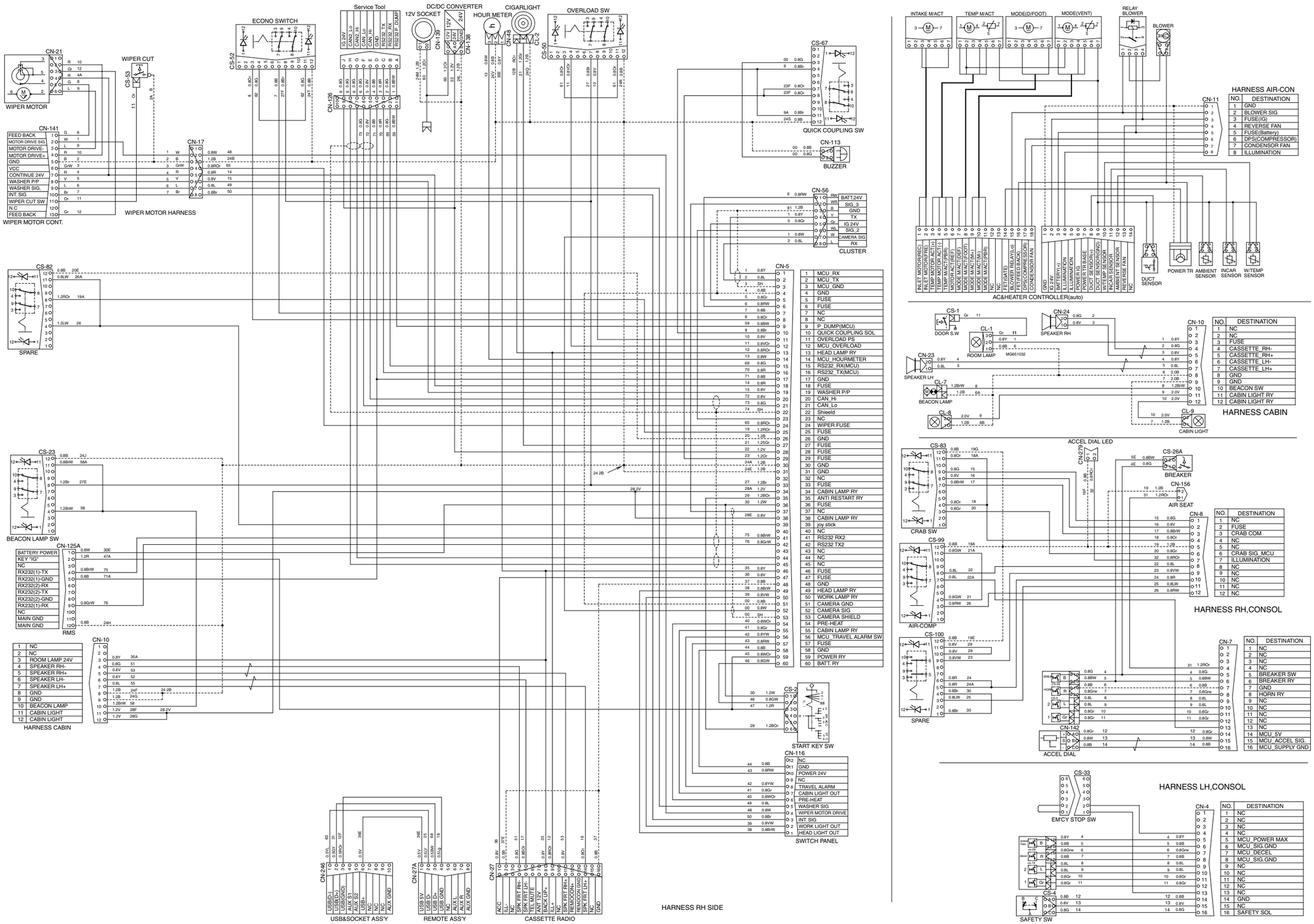
※ Cluster type 1 only : 10, 12, 18, 19

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



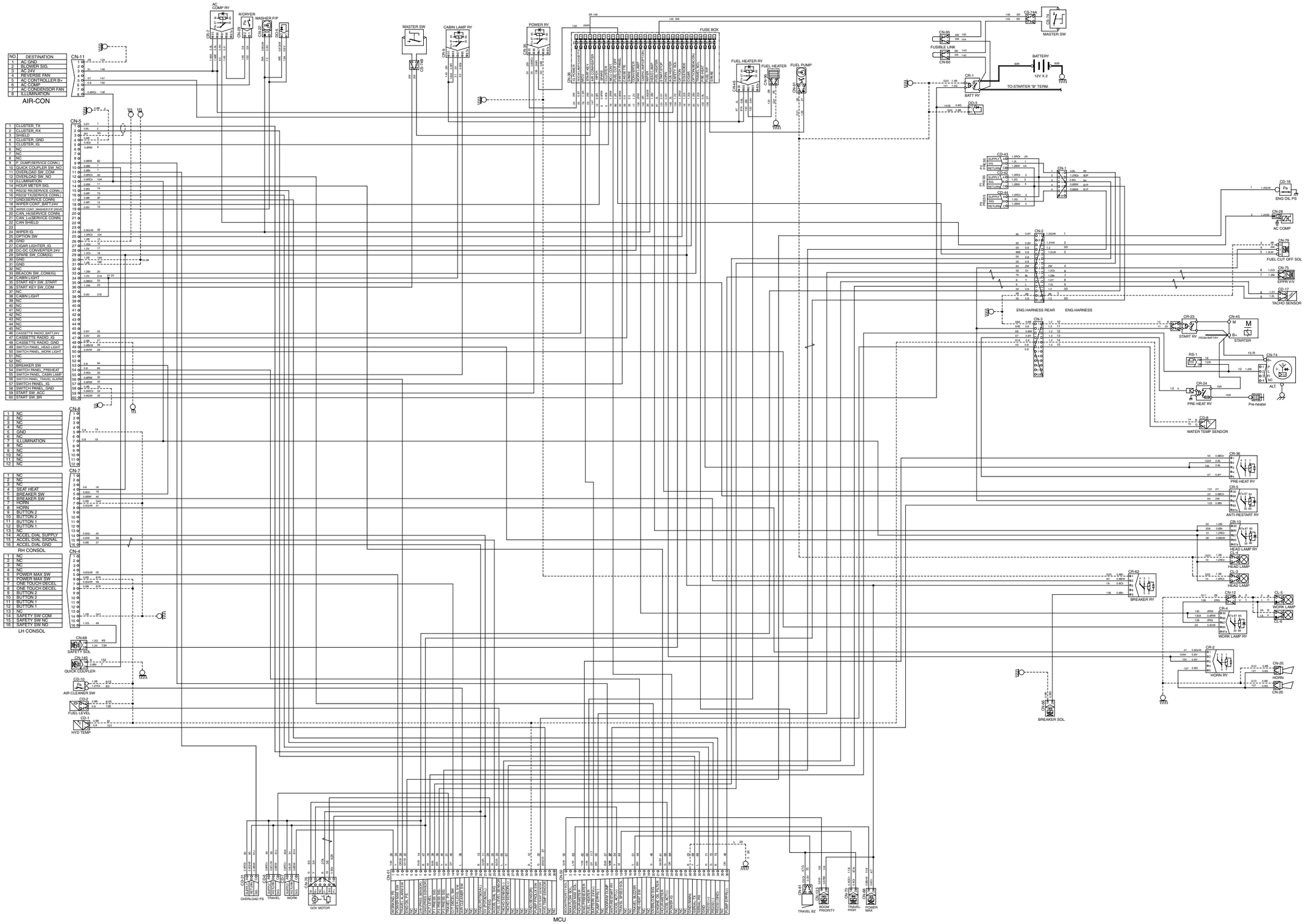
3309S4EL03

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



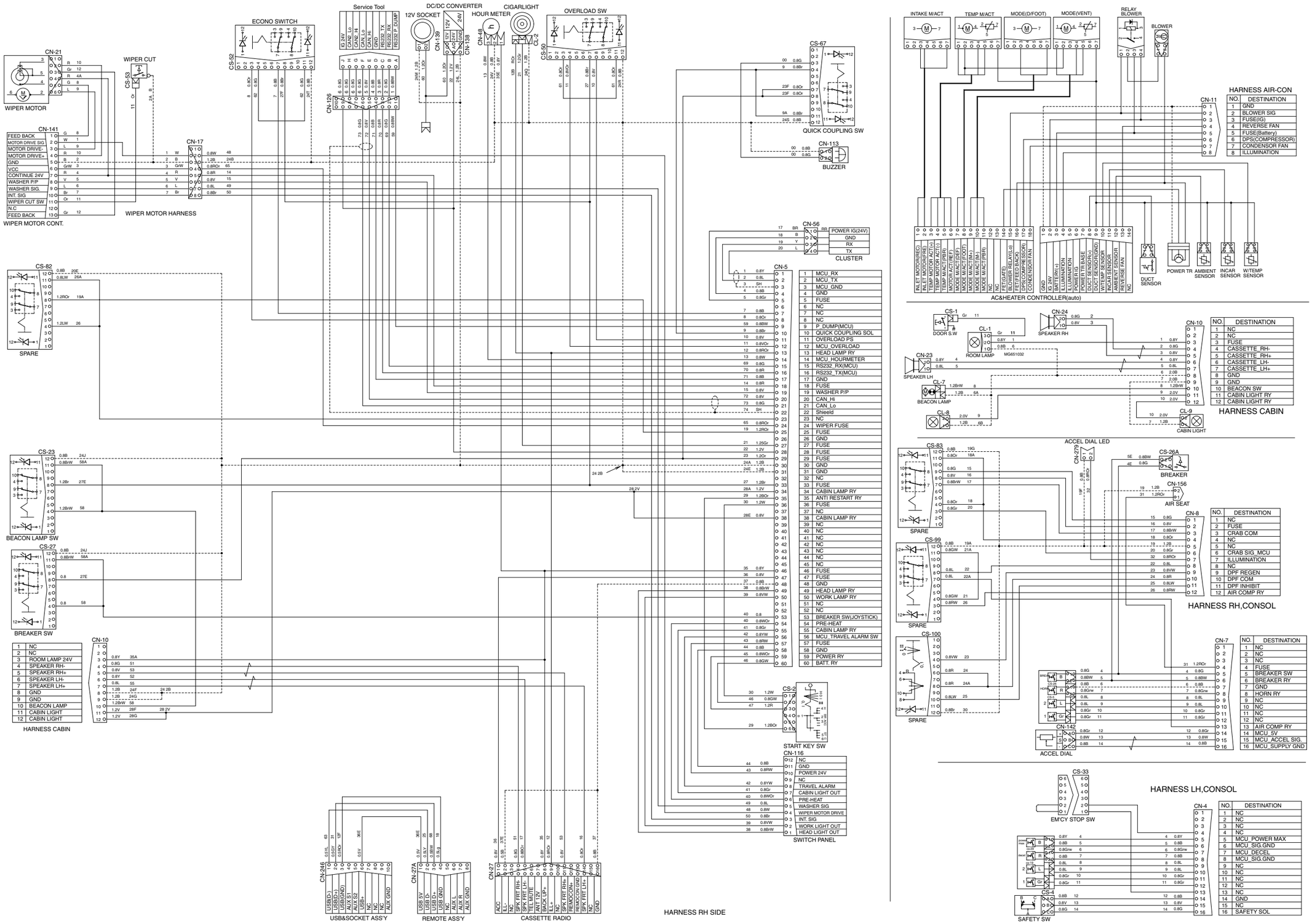
3309S4EL04

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



3309S4EL05

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



3309S4EL06

MEMORANDUM

HYUNDAI HEAVY INDUSTRIES CO., LTD
CONSTRUCTION EQUIPMENT DIV.

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]
  - → Cassette radio [CN-27 (8)]
  - → Hour meter [CN-48 (1)]
- → Fuse box [No.3] → MCU controller [CN-51 (1)]
- → Fuse box [No.4] → 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
  - → Blower relay
- → 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)] → I/conn [CN -56 (1)] → Cluster
- → Fuse box [No.8] → I/conn [CN - 5 (5)] → I/conn [CN -56 (5)] → Cluster

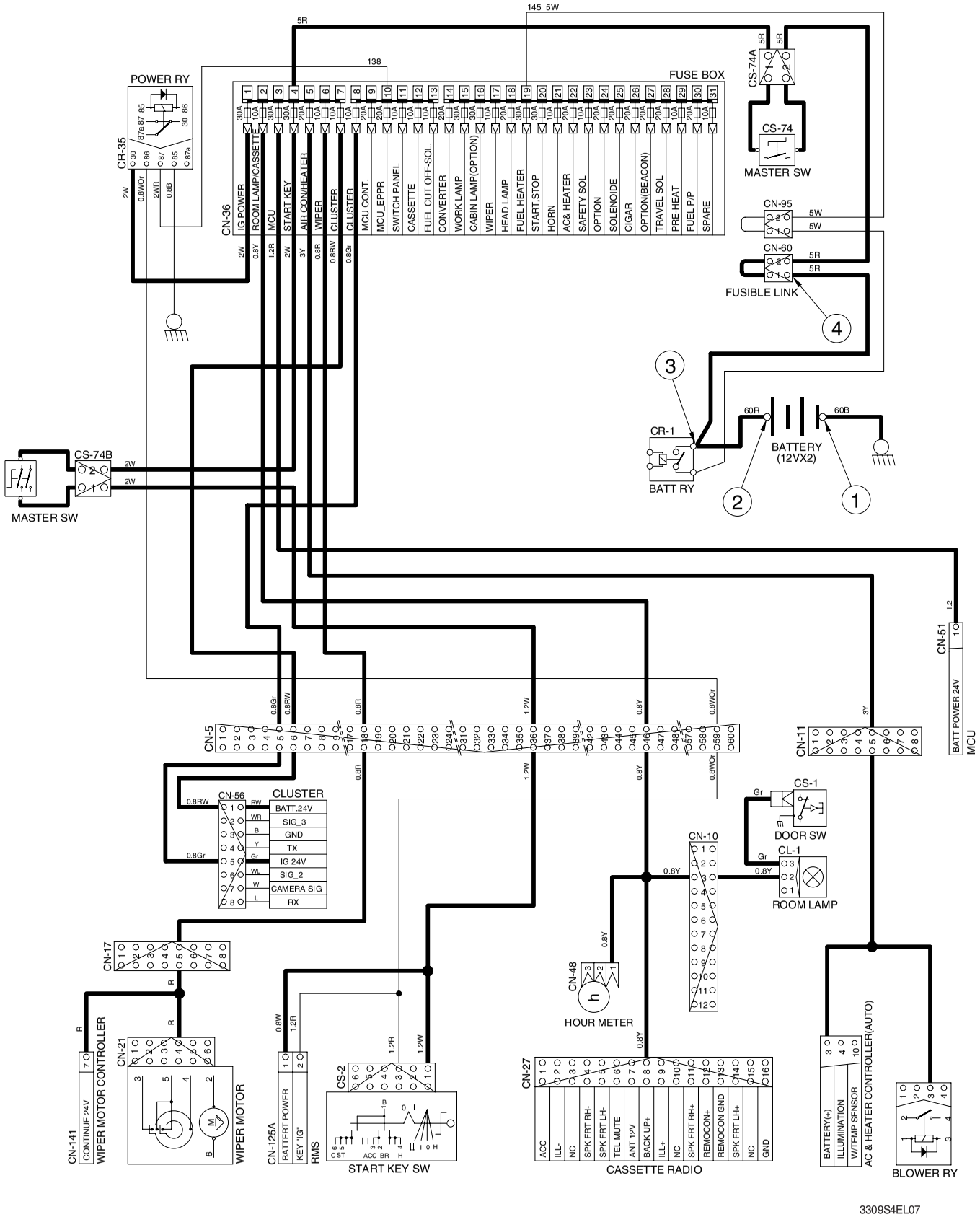
※ I/conn : Intermediate connector

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)



■ 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-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]
  - → Cassette radio [CN-27 (8)]
  - → Hour meter [CN-48 (1)]
- → Fuse box [No.3] → MCU controller [CN-50 (7)]
- → Fuse box [No.4] → I/conn [CN-5 (36)] → Start switch [CS-2 (1)]
- → Fuse box [No.5] → I/conn [CN-11 (5)]
  - → AC & Heater controller
  - → Blower relay
- → 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)] → I/conn [CN -56 (1)] → Cluster

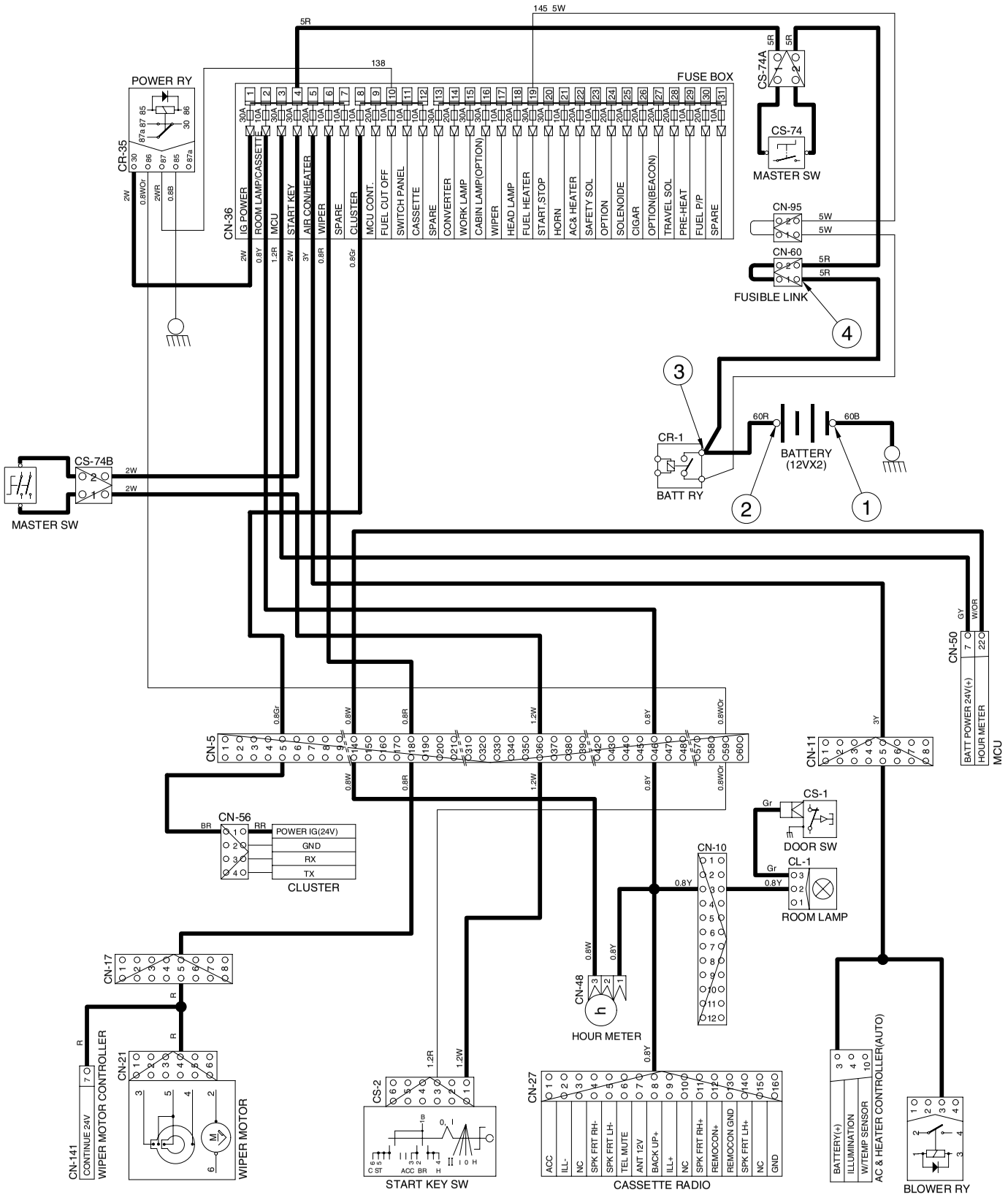
※ I/conn : Intermediate connector

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)



2. 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.10]
  - GPS [CN-125A (2)]

(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)]

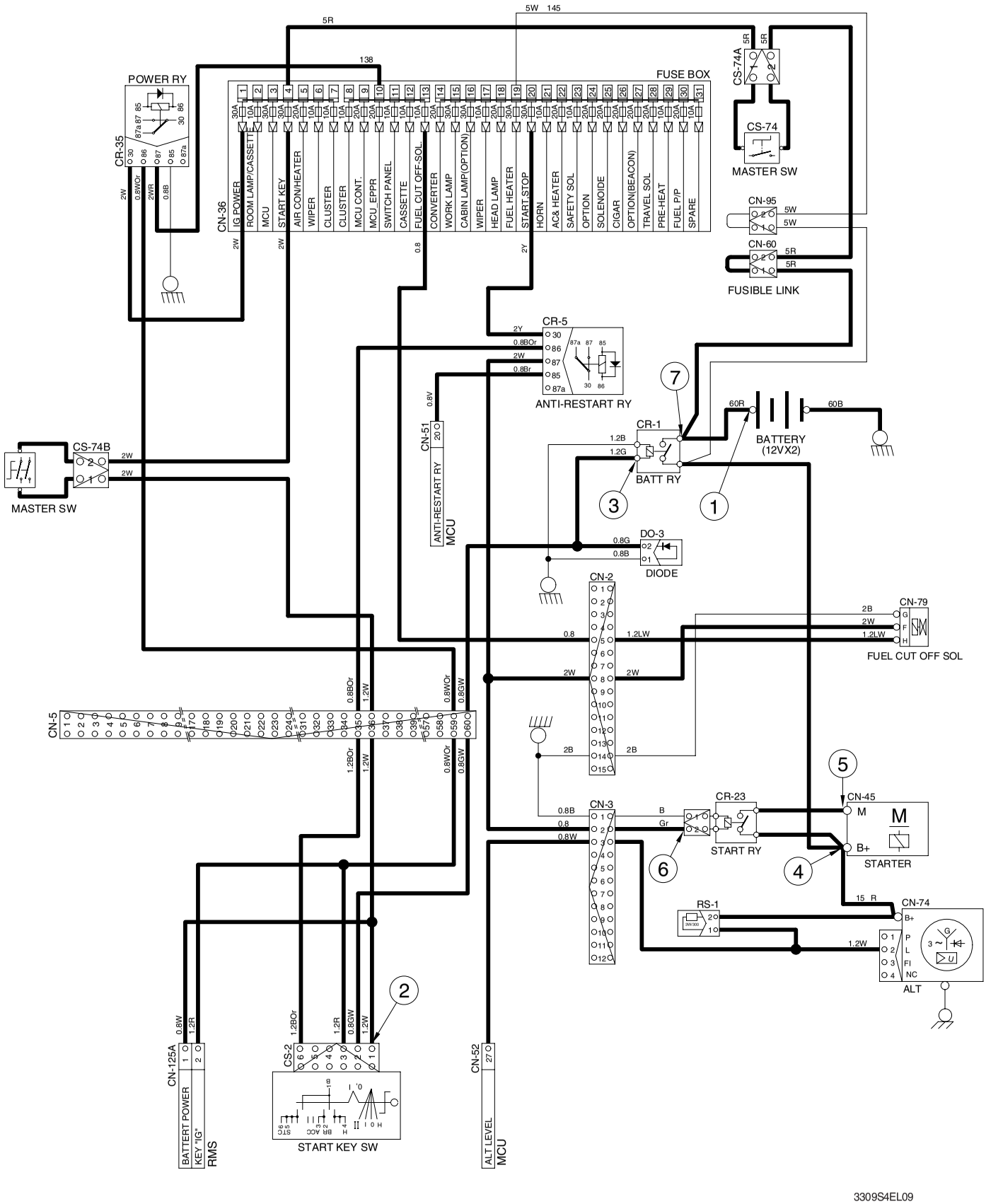
- I/conn [CN-3 (2)] → Start relay [CR-23]
- I/conn [CN-2 (8)] → Fuel cut off solenoid

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)



3309S4EL09

■ 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]

(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)]

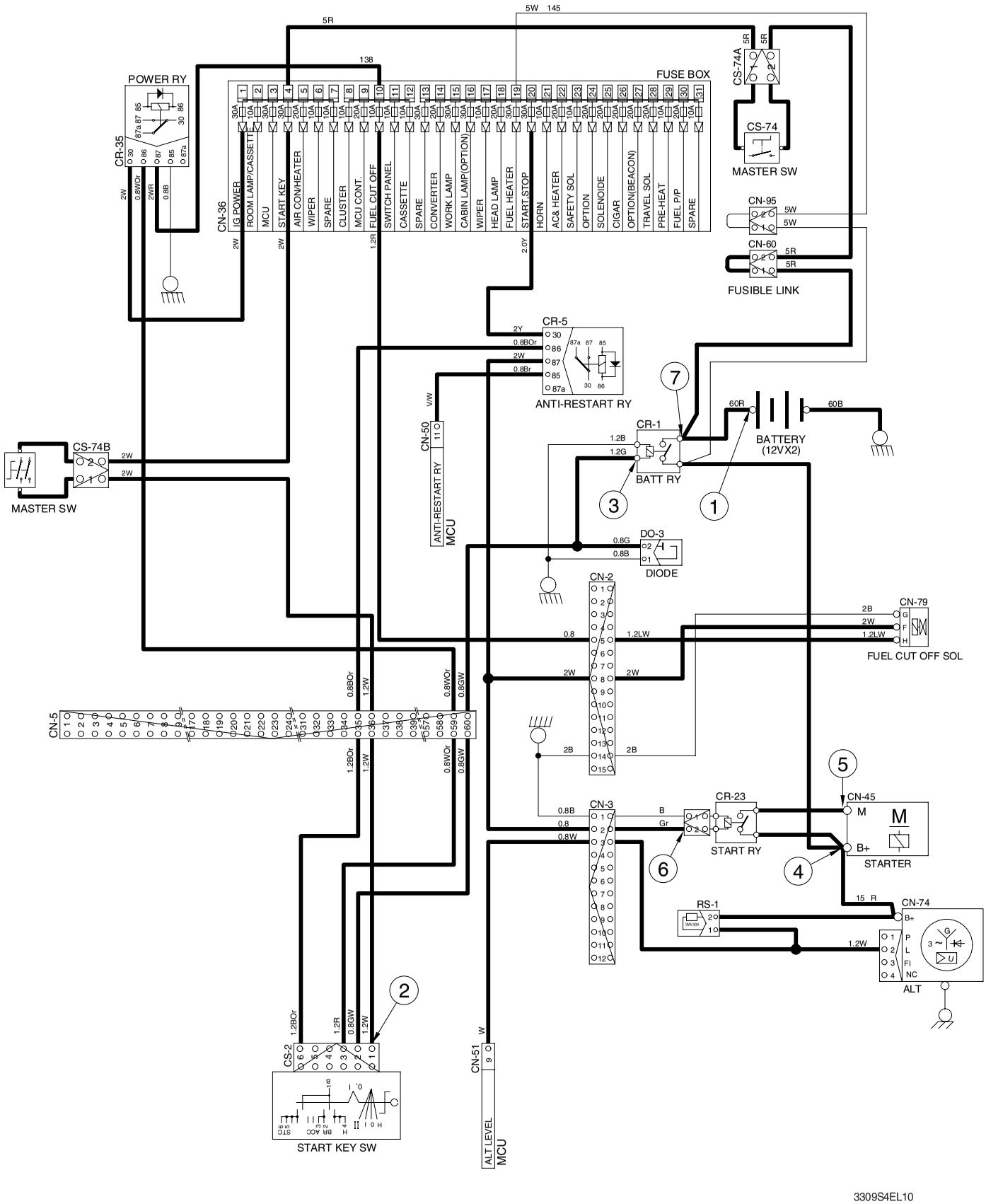
- I/conn [CN-3 (2)] → Start relay [CR-23]
- I/conn [CN-2 (8)] → Fuel cut off solenoid

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)



3. 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 "I" 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

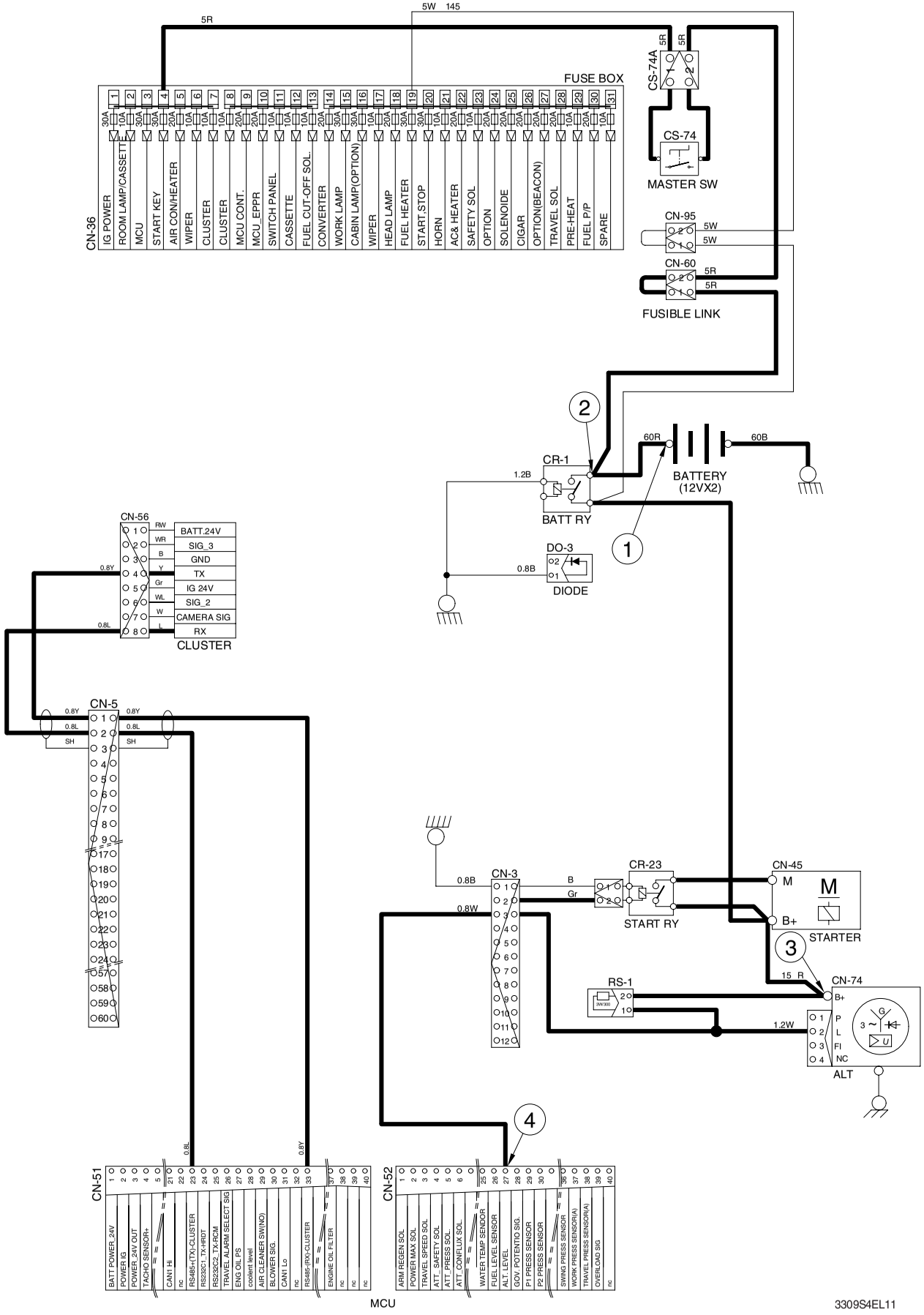
Battery relay(M8) → Fusible link [CN-60] → Master switch [CS-74] → Fuse box

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 I terminal) ⑤ - GND (MCU)	20~30V

※ GND : Ground

CHARGING CIRCUIT (CLUSTER TYPE 1)



■ 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 "I" 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

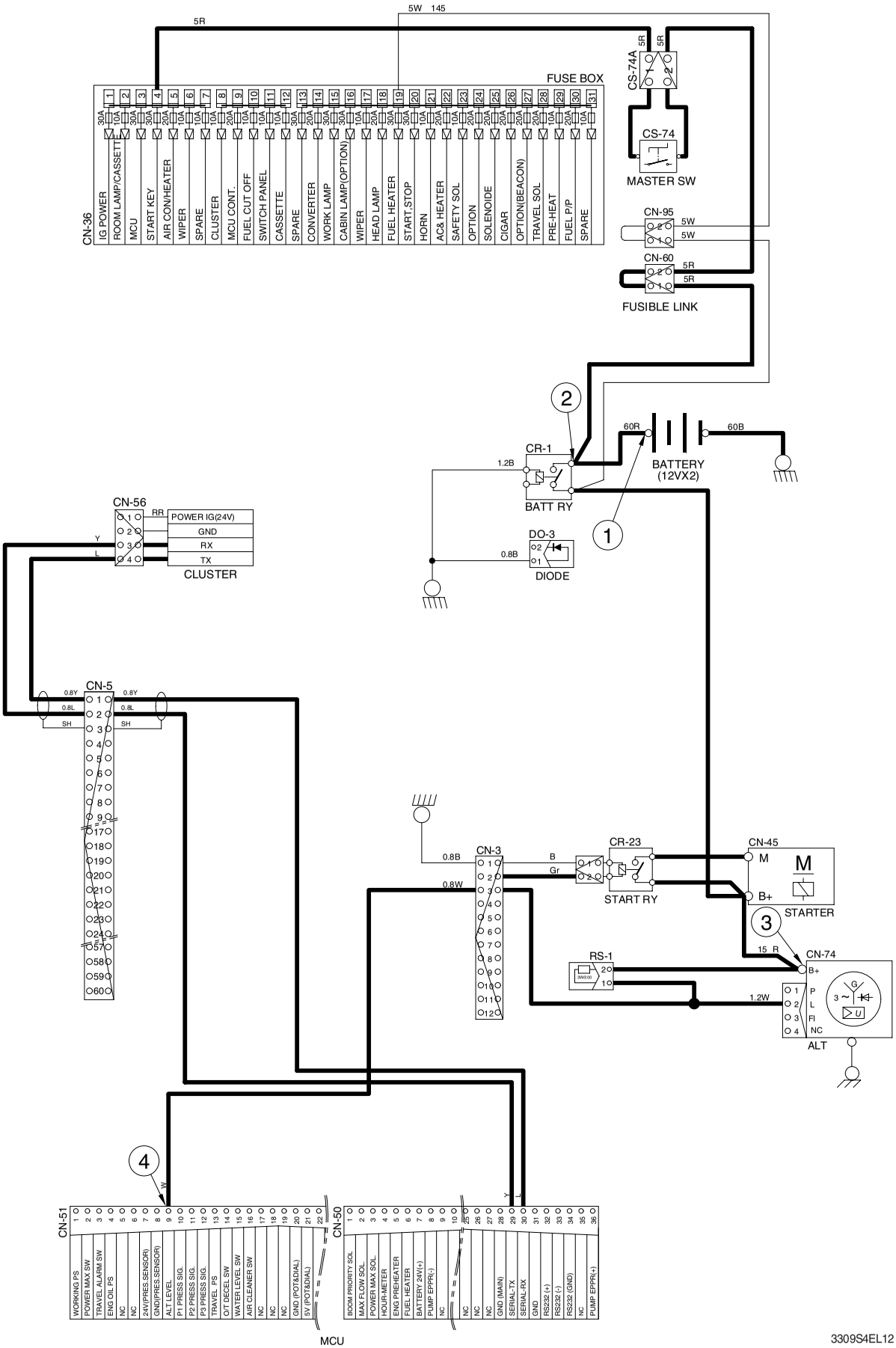
Battery relay(M8) → Fusible link [CN-60] → Master switch [CS-74] → Fuse box

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 I terminal) ⑤ - GND (MCU)	20~30V

※ GND : Ground

CHARGING CIRCUIT (CLUSTER TYPE 2)



4. HEAD AND WORK LIGHT CIRCUIT (CLUSTER TYPE 1)

1) OPERATING FLOW

Fuse box (No.15) → Work light relay [CR-4 (30, 86)]
Fuse box (No.18) → Head light relay [CR-13 (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)]
  - → Cassette radio illumination ON [CN-27 (9)]
  - → Cigar light [CL-2]
- → I/conn [CN-8 (7)] → Accel dial LED ON

(2) Work light switch ON

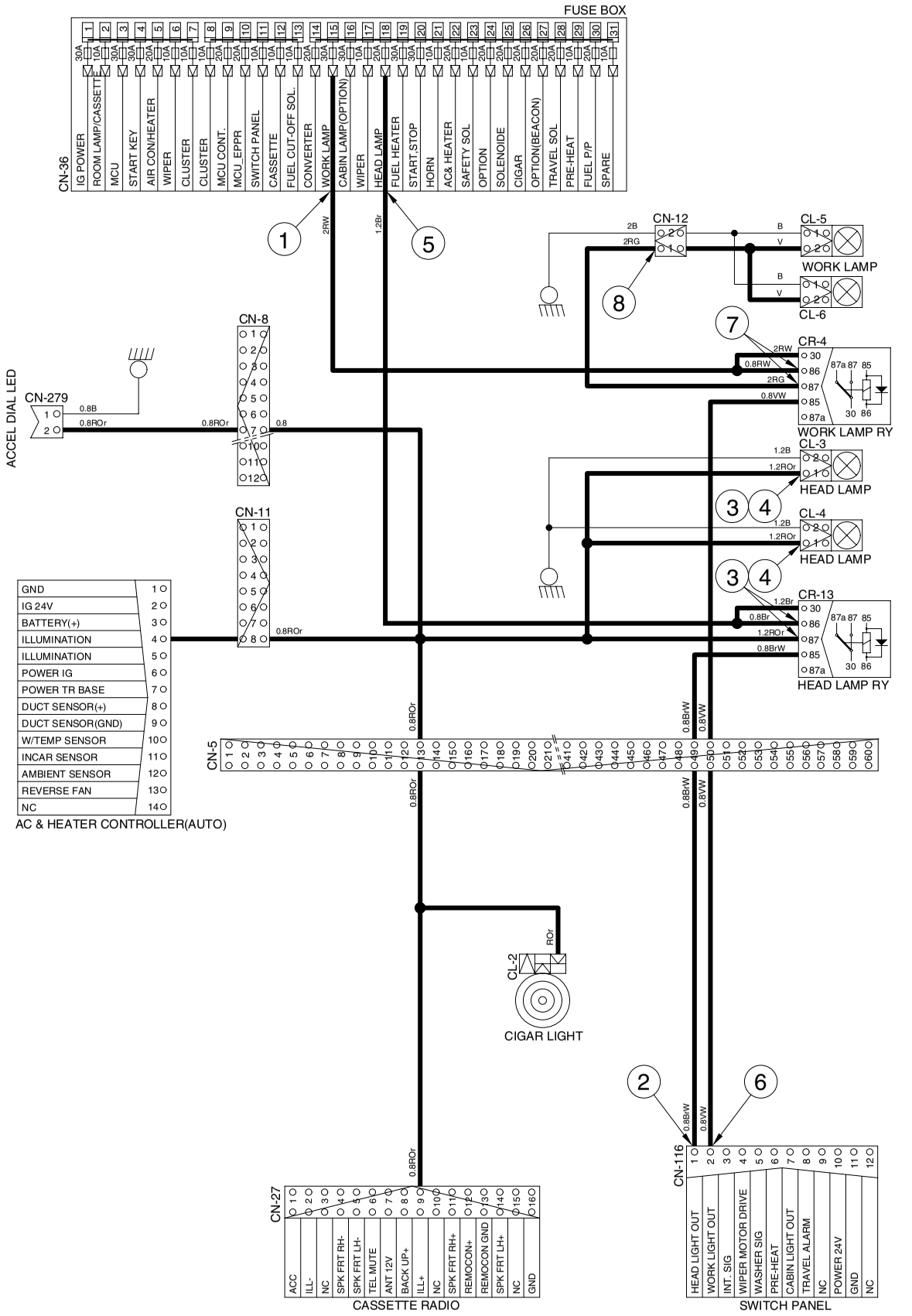
Work light switch ON [CN-116 (2)] → I/conn [CN-5 (50)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

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 (CLUSTER TYPE 1)



3309S4EL13

■ HEAD AND WORK LIGHT CIRCUIT (CLUSTER TYPE 2)

1) OPERATING FLOW

Fuse box (No.15) → Work light relay [CR-4 (30, 86)]
Fuse box (No.18) → Head light relay [CR-13 (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)]
  - → Cassette radio illumination ON [CN-27 (9)]
  - → Cigar light [CL-2]
- → I/conn [CN-8 (7)] → Accel dial LED ON

(2) Work light switch ON

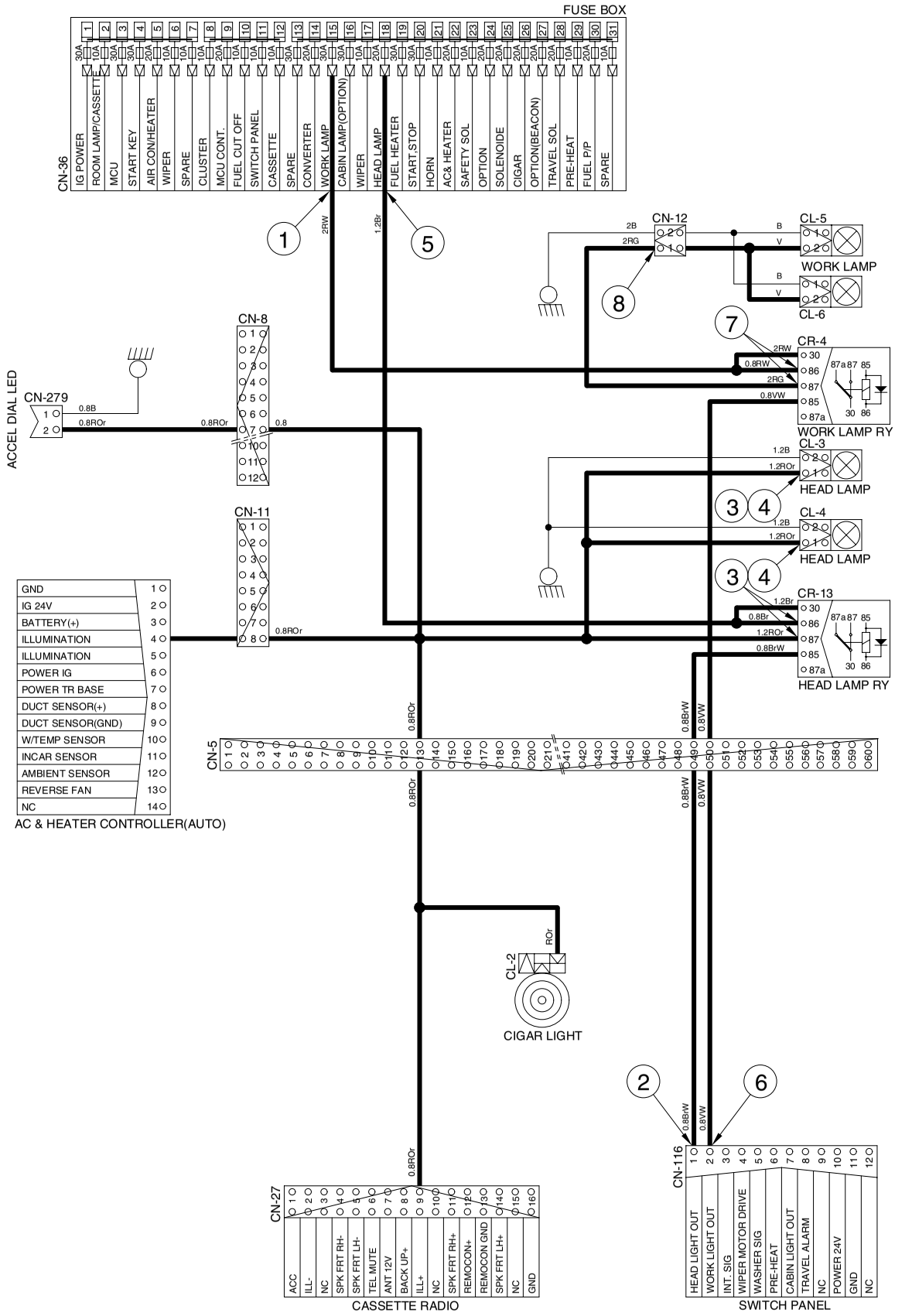
Work light switch ON [CN-116 (2)] → I/conn [CN-5 (50)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

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 (CLUSTER TYPE 2)



3309S4EL14

5. BEACON LAMP AND CAB LIGHT CIRCUIT (CLUSTER TYPE 1)

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

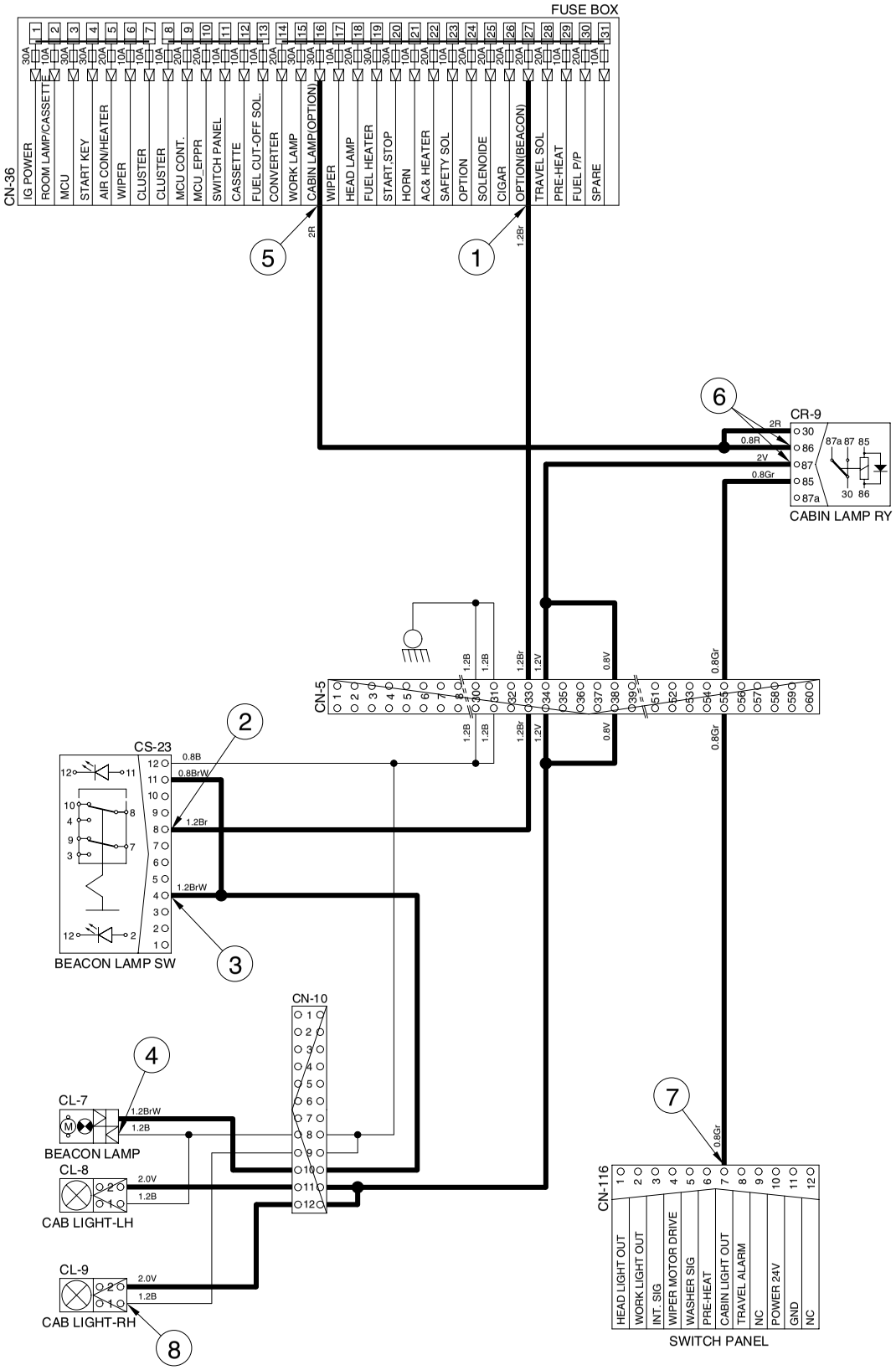
Cab light switch ON [CN-116 (7)] → I/conn [CN-5 (55)] → Cabin light relay [CR-9 (85) → (87)]
→ I/conn [CN-5 (34)] → I/conn [CN-10 (11, 12)] → Cab light ON [CL-8 (2), CL-9 (2)]

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 (cab light relay) ⑦ - GND (switch power output) ⑧ - GND (cab light)	20~25V

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT (CLUSTER TYPE 1)



3309S4EL15

■ BEACON LAMP AND CAB LIGHT CIRCUIT (CLUSTER TYPE 2)

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

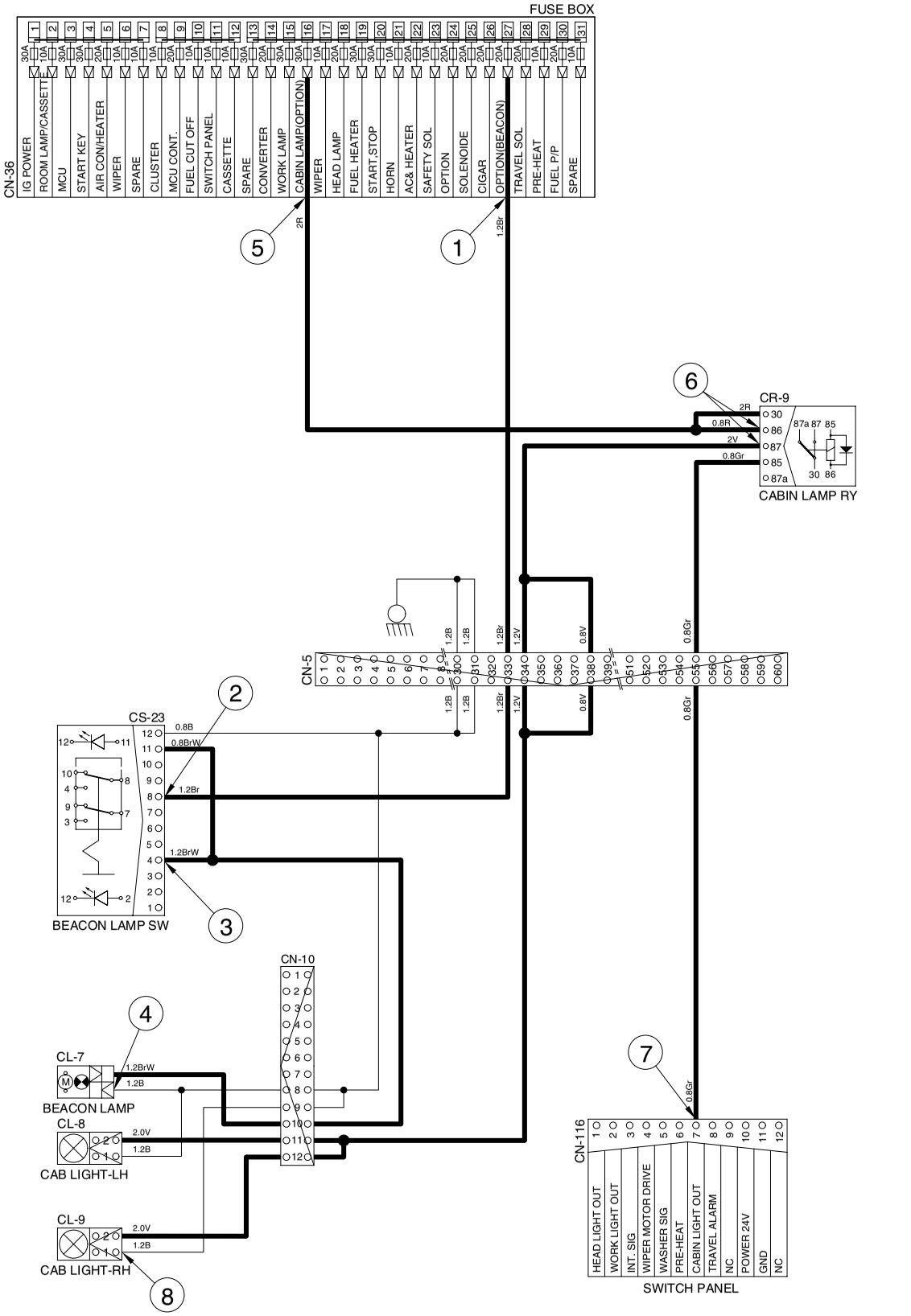
Cab light switch ON [CN-116 (7)] → I/conn [CN-5 (55)] → Cabin light relay [CR-9 (85) → (87)]
→ I/conn [CN-5 (34)] → I/conn [CN-10 (11, 12)] → Cab light ON [CL-8 (2), CL-9 (2)]

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 (cab light relay) ⑦ - GND (switch power output) ⑧ - GND (cab light)	20~25V

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT (CLUSTER TYPE 2)



3309S4EL16

6. WIPER AND WASHER CIRCUIT (CLUSTER TYPE 1)

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)

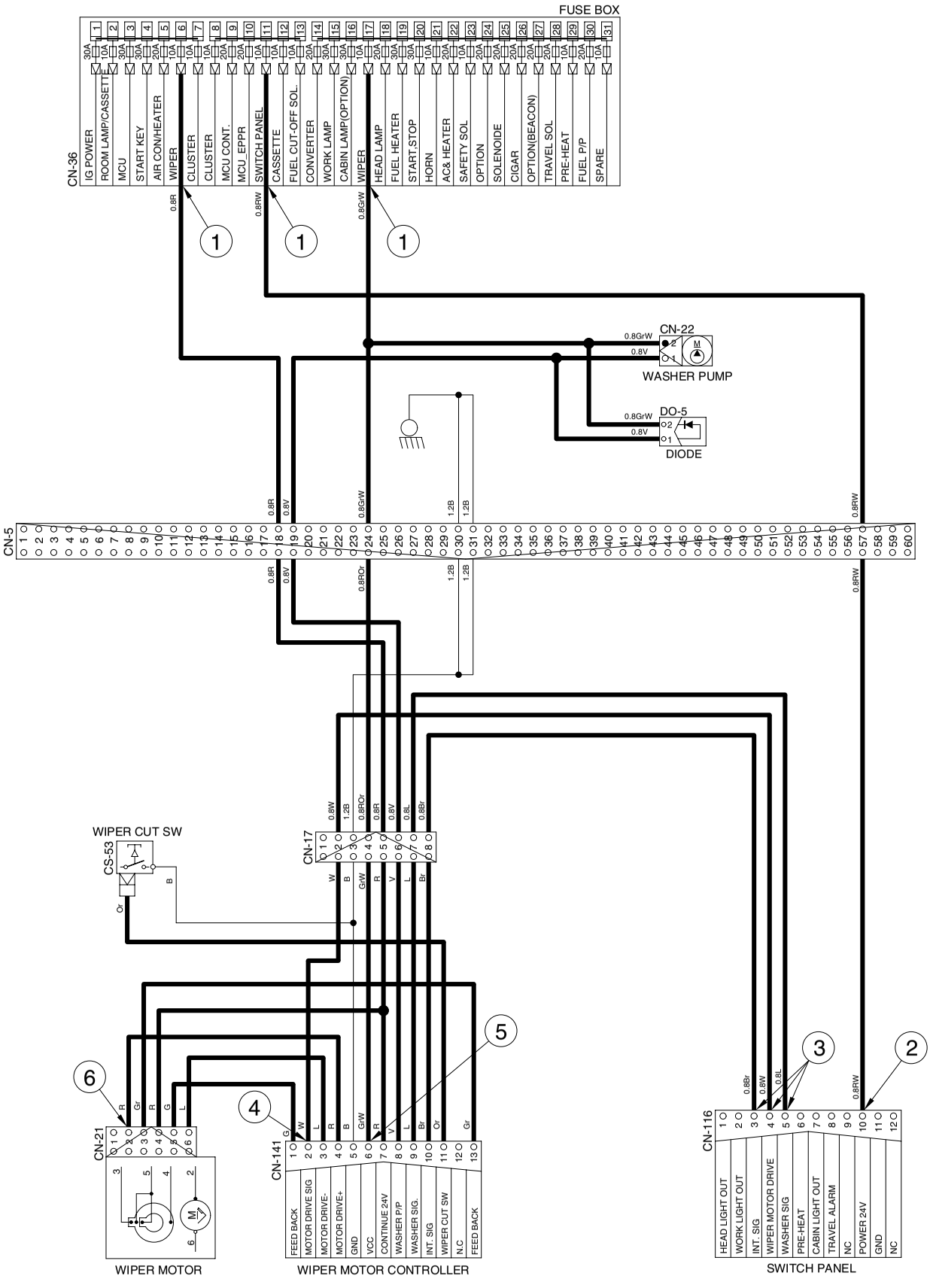
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

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 (CLUSTER TYPE 1)



3309S4EL17

■ WIPER AND WASHER CIRCUIT (CLUSTER TYPE 2)

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)

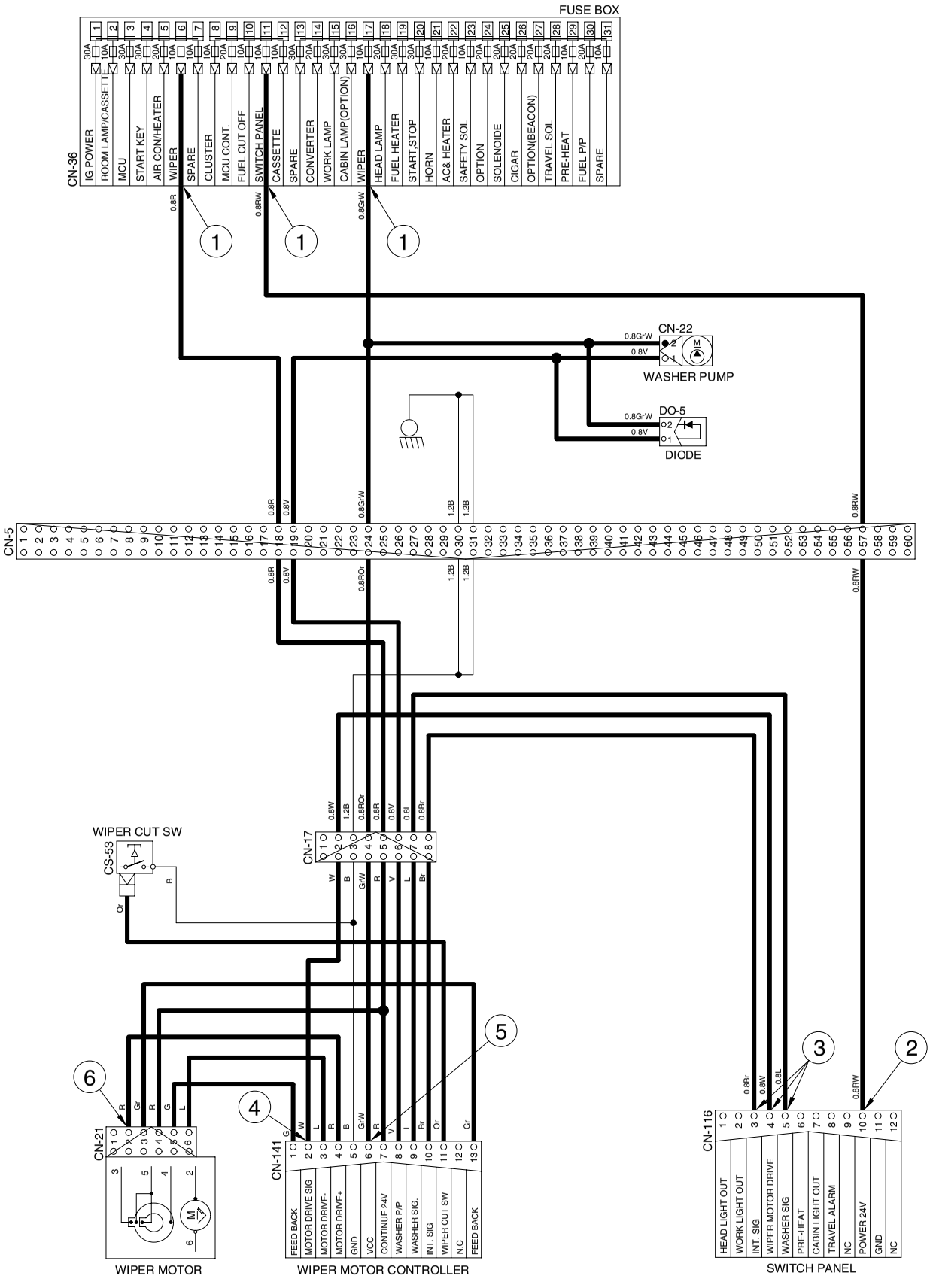
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

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

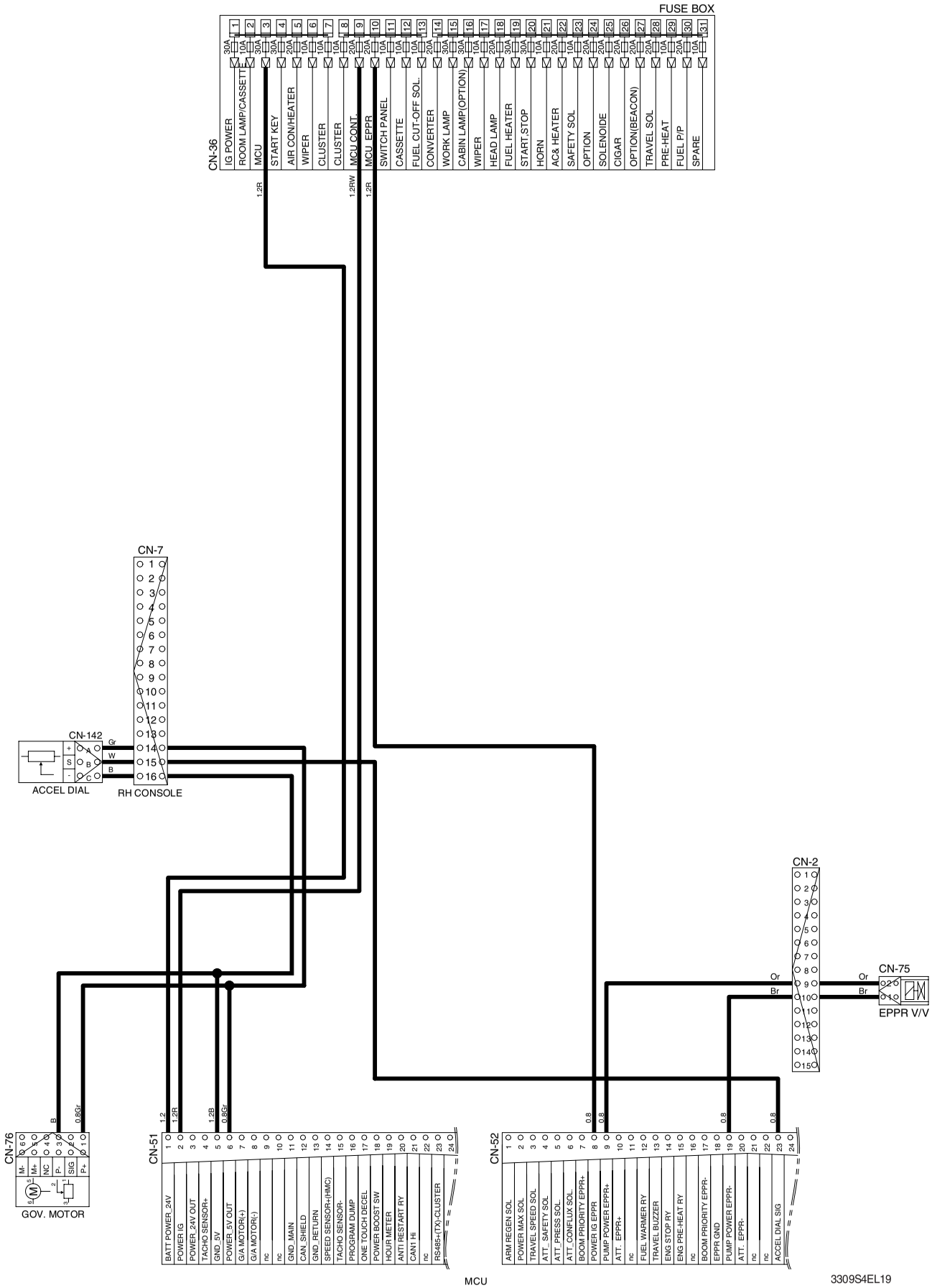
※ GND : Ground

WIPER AND WASHER CIRCUIT (CLUSTER TYPE 2)

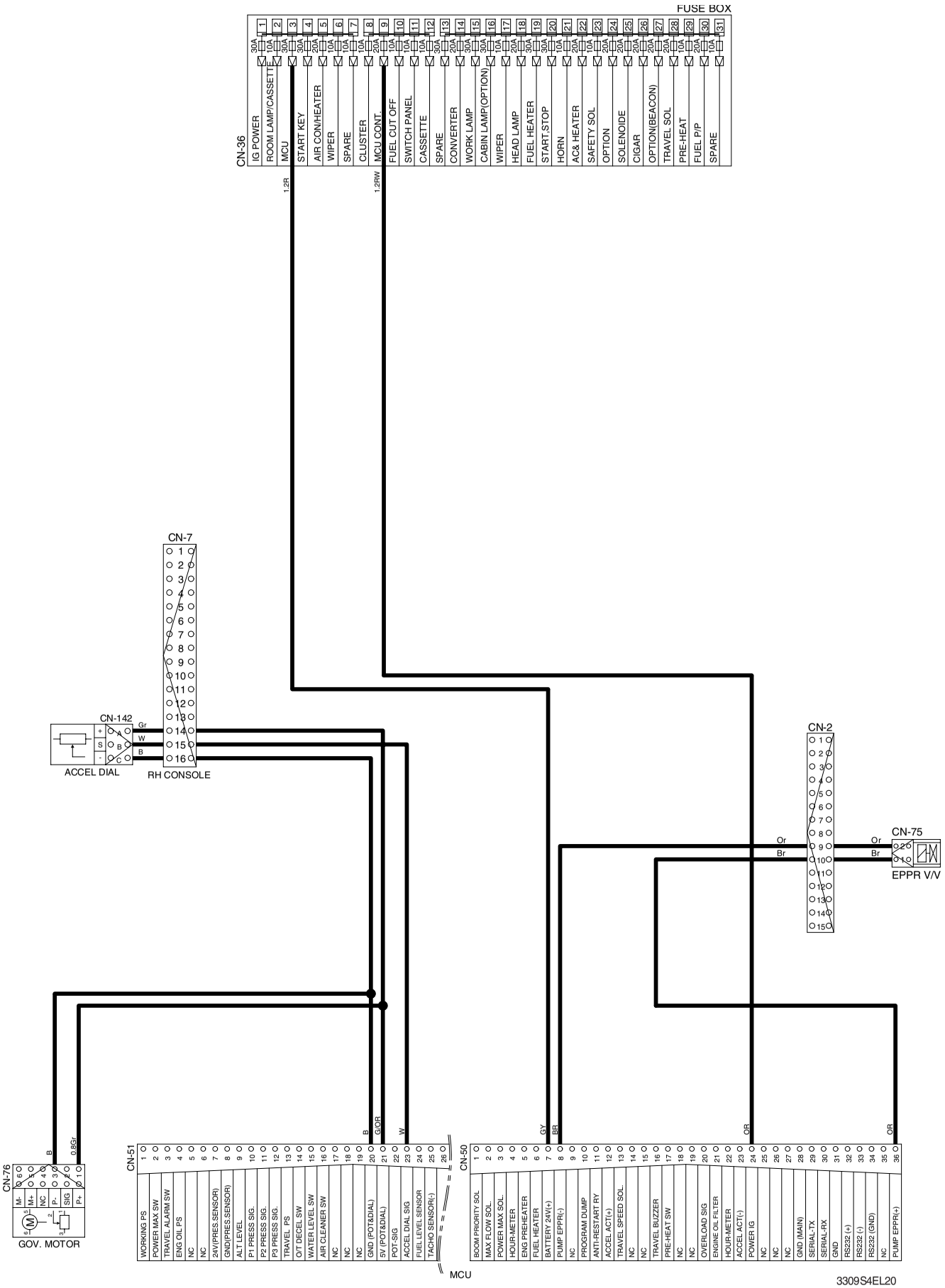


3309S4EL18

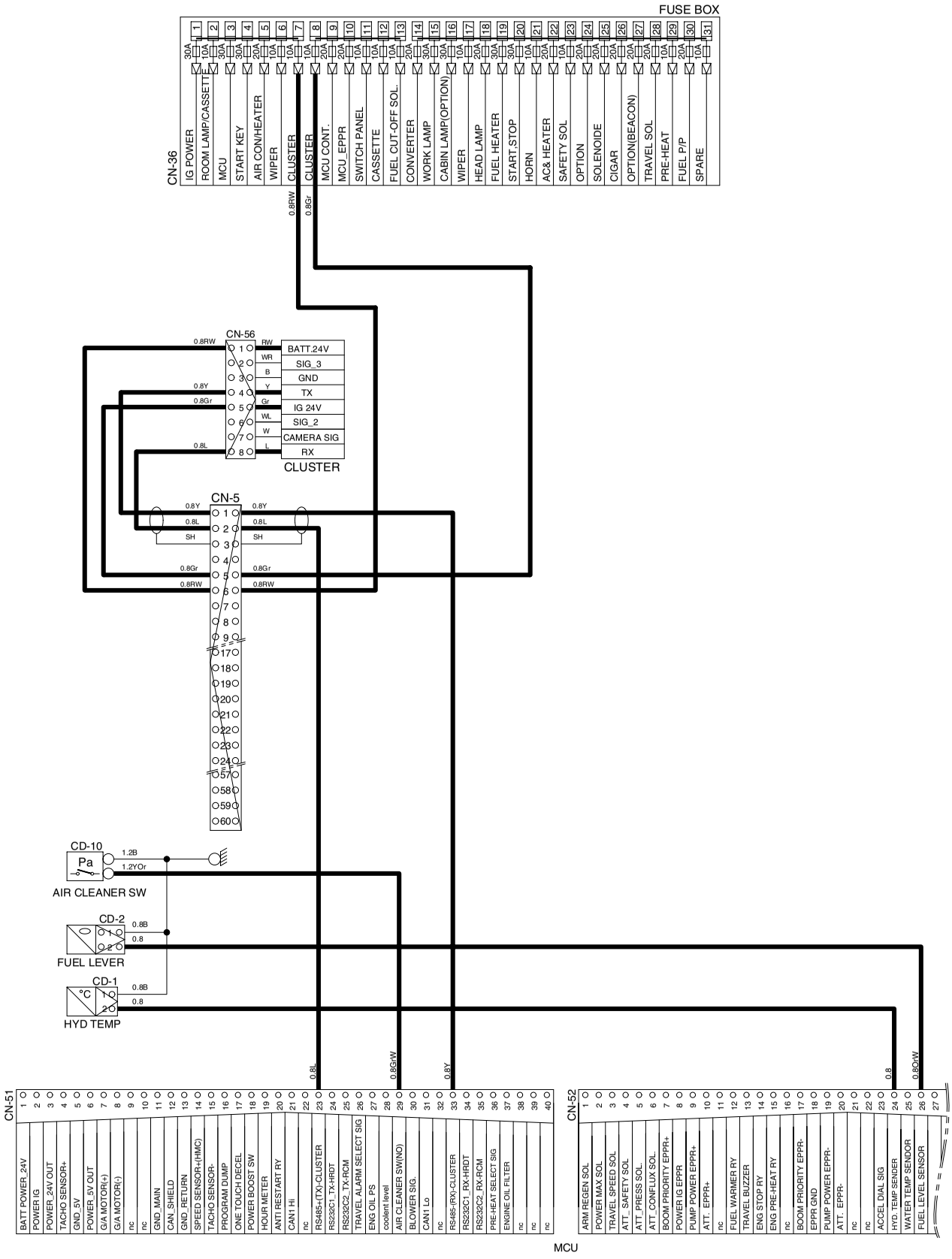
CONTROLLER CIRCUIT (CLUSTER TYPE 1)



CONTROLLER CIRCUIT (CLUSTER TYPE 2)

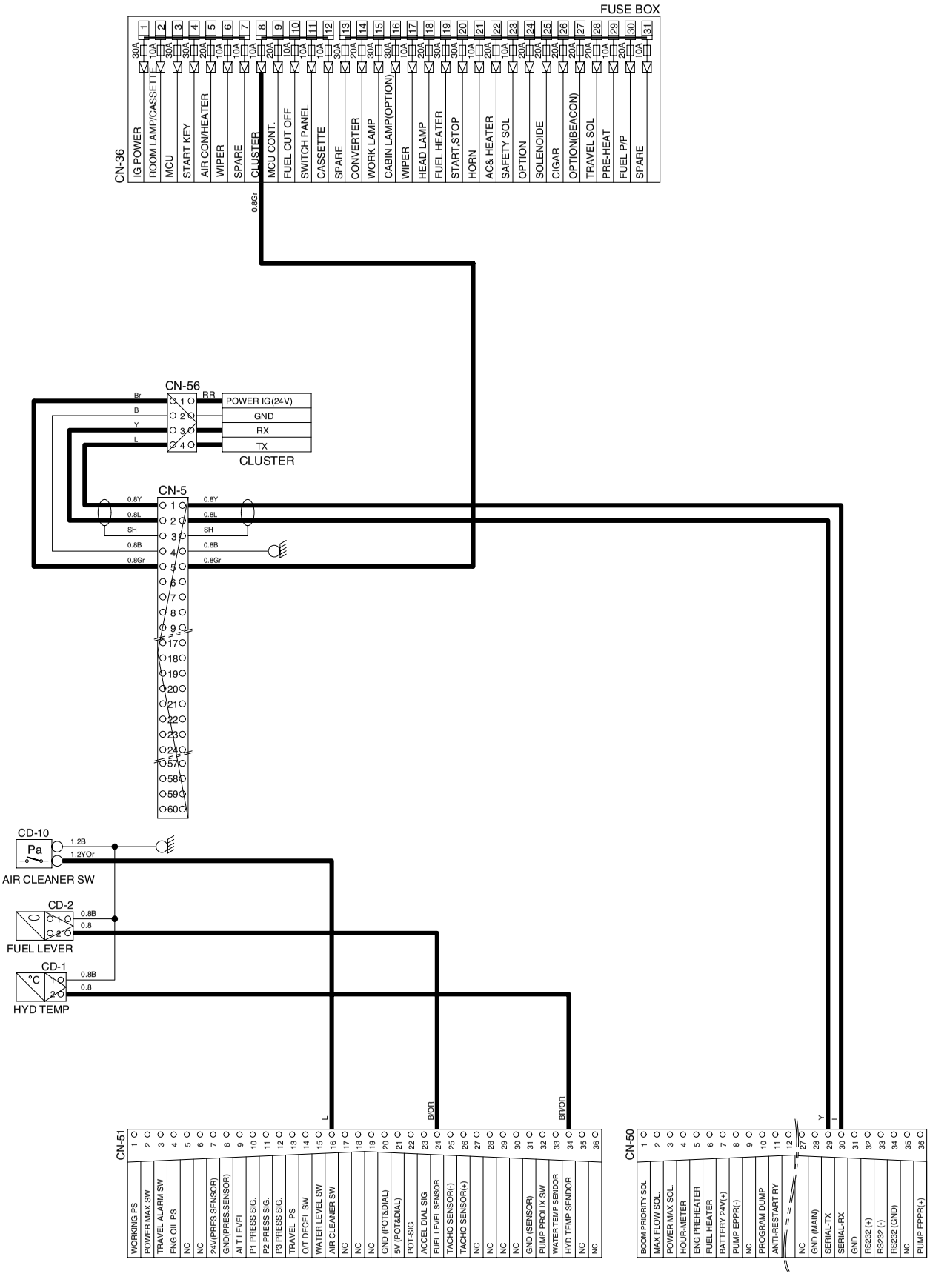


MONITORING CIRCUIT (CLUSTER TYPE 1)



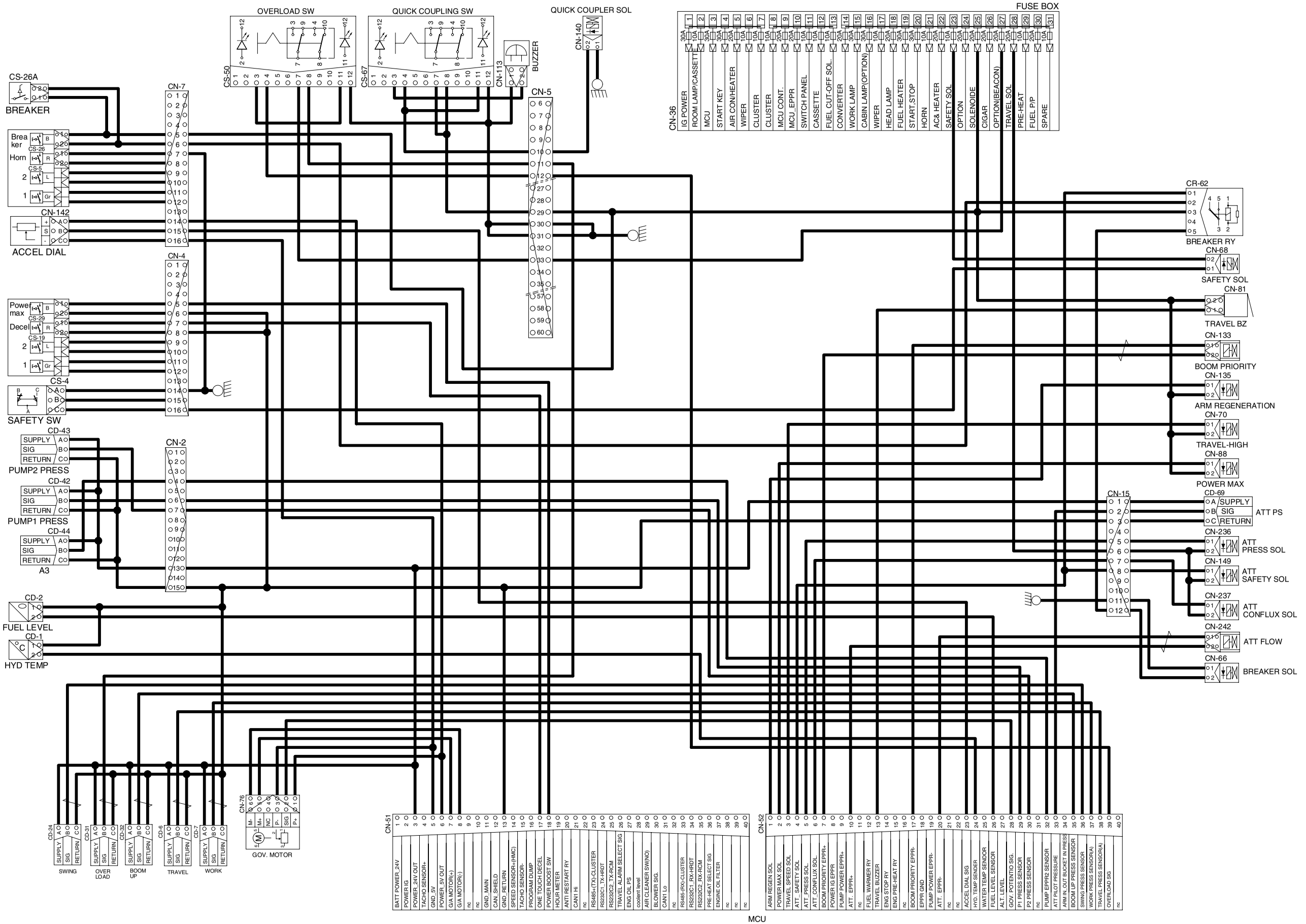
3309S4EL21

MONITORING CIRCUIT (CLUSTER TYPE 2)

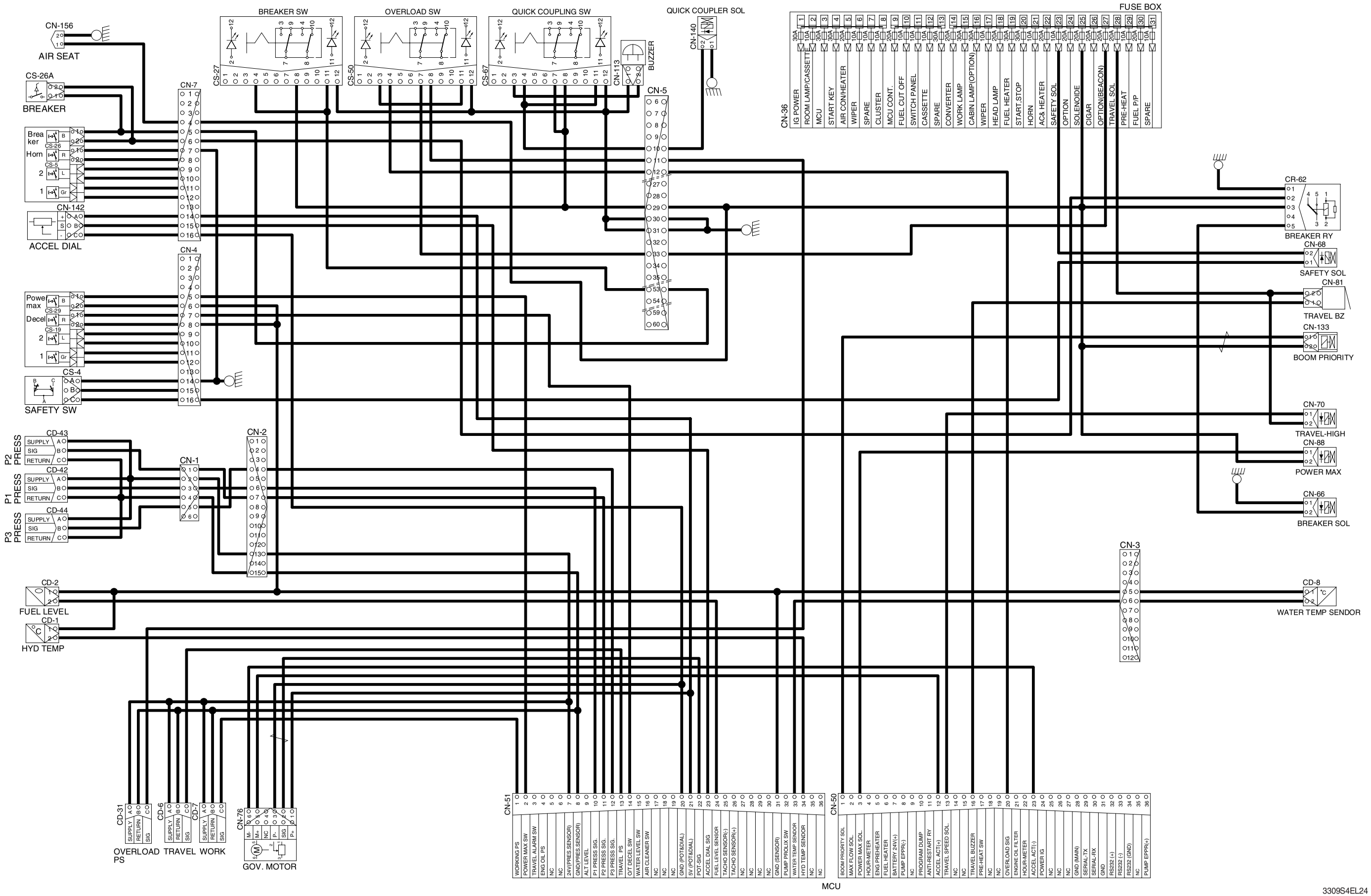


3309S4EL22

ELECTRIC CIRCUIT FOR HYDRAULIC (CLUSTER TYPE 1)

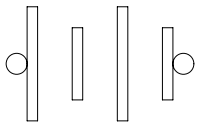
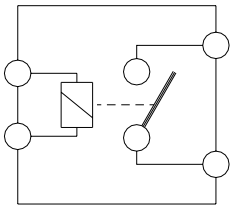
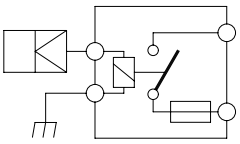
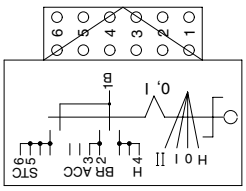
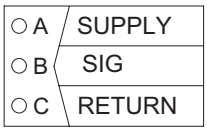
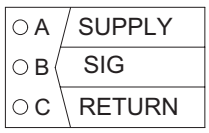


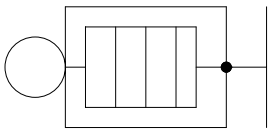
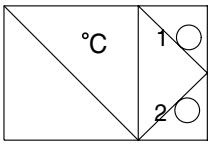
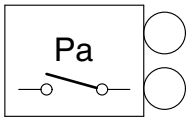
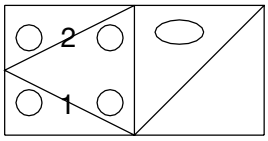
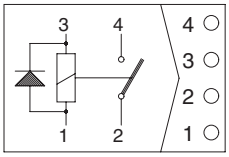
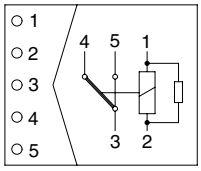
ELECTRIC CIRCUIT FOR HYDRAULIC (CLUSTER TYPE 2)

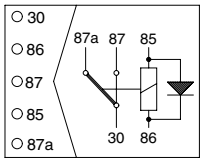
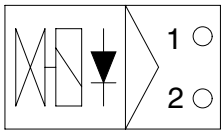
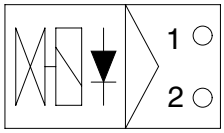
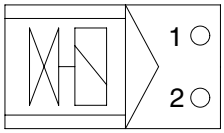
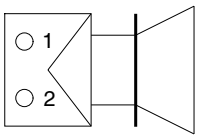
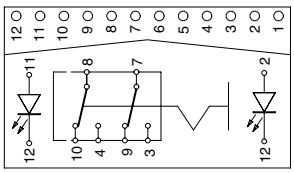
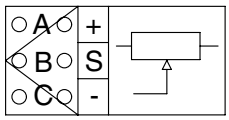


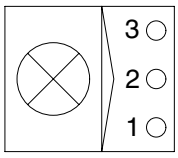
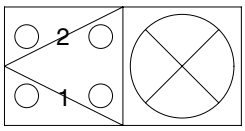
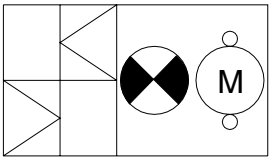
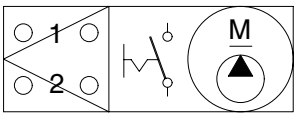
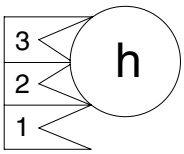
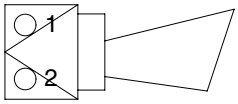
3309S4EL24

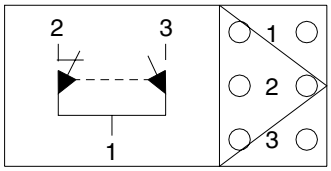
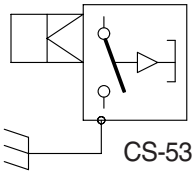
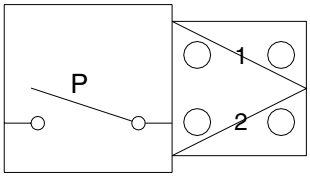
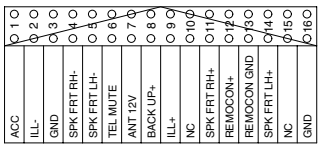
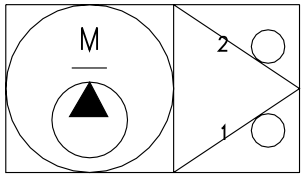
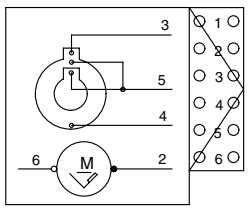
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

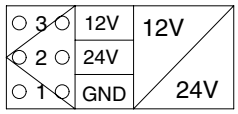
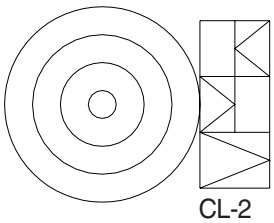
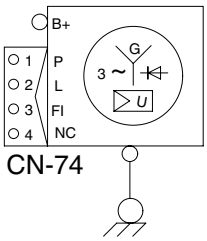
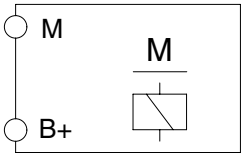
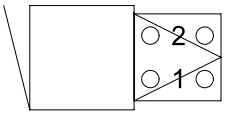
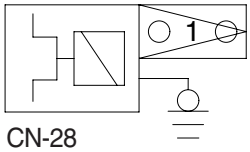
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Pre-heat relay	 CR-24	24V 200A	※ Check contact Normal : 0.942Ω (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 : 0Ω (for terminal 1-3 and 1-2) START : 0Ω (for terminal 1-5)
Pressure sensor (cluster type 1)	 CD-6 CD-7 CD-24 CD-31 CD-32 CD-42 CD-43 CD-44 CD-69	8~30V	※ Check contact Normal : 0.1Ω
Pressure sensor (cluster type 2)	 CD-6 CD-7 CD-31 CD-42 CD-43 CD-44	8~30V	※ Check contact Normal : 0.1Ω

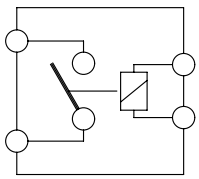
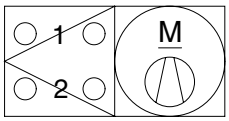
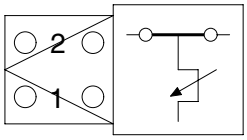
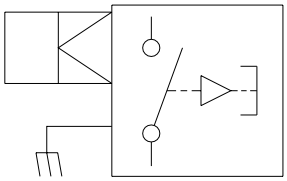
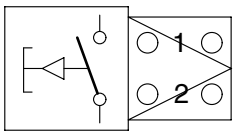
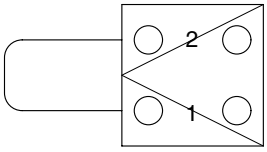
Part name	Symbol	Specifications	Check
Pre-heat plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12Ω
Temperature sensor (hydraulic, coolant)	 CD-1 CD-8	-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω
Air cleaner pressure switch	 CD-10	(N.O TYPE)	※ Check contact High level : ∞Ω Low level : 0Ω
Fuel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

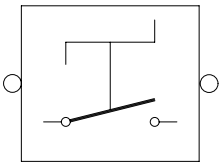
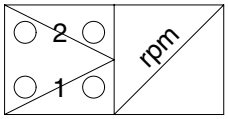
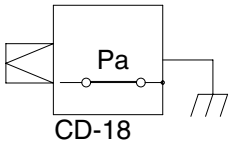
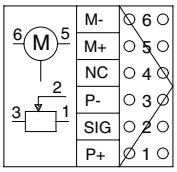
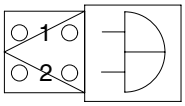
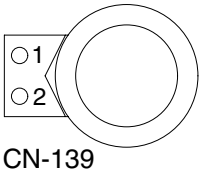
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve (cluster type 1)	 CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-236 CN-237	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Solenoid valve (cluster type 2)	 CN-66 CN-68 CN-70 CN-88 CN-140 CN-133	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve (cluster type 1)	 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 : 1.0Ω ON : 0Ω(For terminal 1-2) ∞Ω(For terminal 1-3) OFF : ∞Ω(For terminal 1-2) 0Ω(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 : 1.2Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35ℓ /min	※Check resistance Normal : 1.0Ω
Hour meter	 CN-48	16~32V	※Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※Check operation Supply power(24V) to each terminal and connect ground.

Part name	Symbol	Specifications	Check
Safety switch	 CS-4	24V 15A (N.C TYPE)	※Check contact Normal : 0Ω (for terminal 1-2) ∞Ω (for terminal 1-3) Operating : ∞Ω (for terminal 1-2) 0Ω (for terminal 1-3)
Wiper cut switch	 CS-53	24V (N.O TYPE)	※Check contact Normal : 0Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※Check contact Normal : ∞Ω
Radio & USB 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 : 10.7Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※Check disconnection Normal : 7Ω (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	Delco Remy 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 : 0.94Ω(for terminal 1-2)
Blower motor		24V 9.5A	※Check resistance Normal : 2.5Ω(for terminal 1-2)
Duct sensor (switch)		1˚C OFF 4˚C ON	※Check resistance Normal : 0Ω(for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※Check resistance Normal : About 5MΩ
Switch (power max, one touch decel, horn, breaker)	 CS-5 CS-19 CS-26 CS-26A CS-29	24V 6A	※Check resistance Normal : ∞Ω
Fusible link	 CN-60 CN-95	60A	※Check disconnection normal : 0Ω (connect ring terminal and check resist between terminal 1 and 2)

Part name	Symbol	Specifications	Check
Master switch	 CS-74 CS-74B	6-36V	※Check disconnection Normal : 0.1Ω
Speed sensor	 CD-17	-	※Check resistance Normal : 300Ω (for terminal 1.2)
Pressure switch (engine oil)	 CD-18	0.5 kgf·m² (N.C TYPE)	※Check resistance Normal : ∞Ω(CLOSE)
Accel actuator	 CN-76	-	※Check resistance Normal : 10Ω(for terminal 5-6) 5KΩ (for terminal 1-3)
Travel alarm	 CN-113	24V 200mA 107 ± 4dB	-
Socket	 CN-139	12V 10A	-

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 cluster type 2)	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	S816-112002
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB12-60PAE-L018
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	S816-116002
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-EP06	-
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-Breaker solenoid)	S816-012002	S816-112002
CN-17	AMP	8	I/conn (Wiper harness-Side harness RH)	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 & USB player	PK145-16017	-
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	-
CN-48	KET	1	Hour meter	2-520193-2	-
CN-51	AMP	36	MCU	341111-1	-
CN-52	AMP	36	MCU	341111-1	-
CN-56	AMP	8	Cluster (type 1)	-	S816-108002
CN-56	DEUTSCH	4	Cluster (type 2)	-	DT04-4P
CN-60	AMP	2	Fusible link	-	S813-130201
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	DT04-2P-E005
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-
CN-74	AMP	4	Alternator "I" terminal	12186568	-

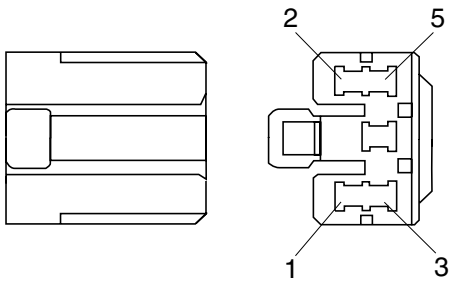
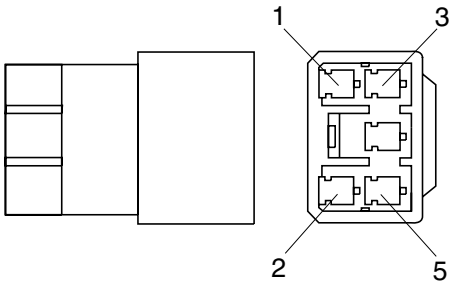
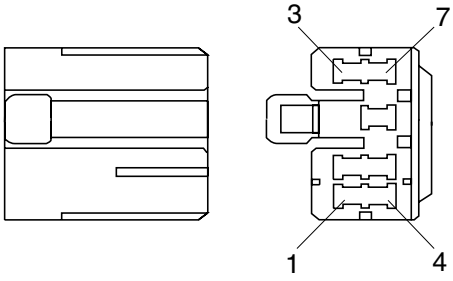
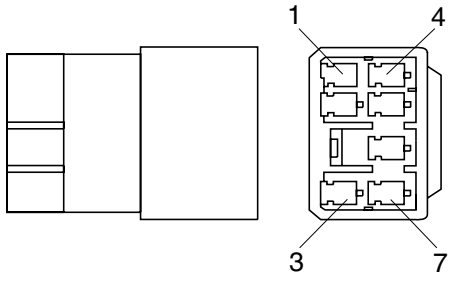
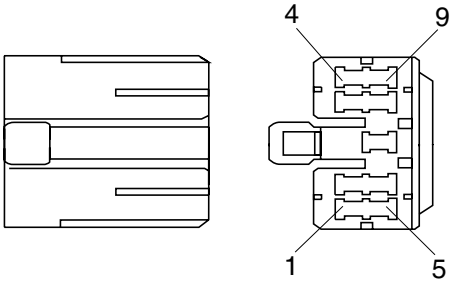
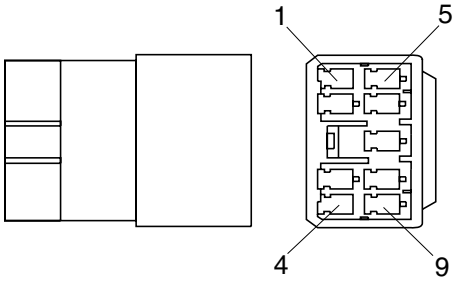
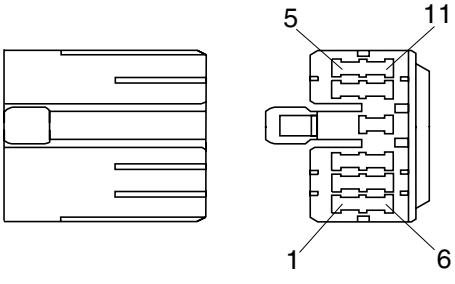
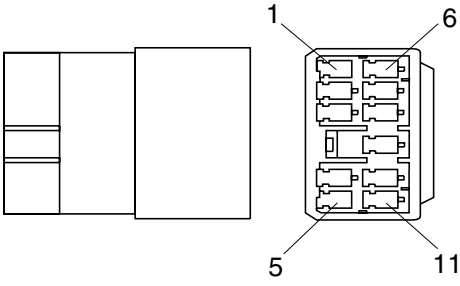
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-76	DEUTSCH	6	Accel actuator	DT06-6S-EP06	-
CN-79	AMP	3	Fuel cut off solenoid	12124685	
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-95	AMP	2	Fusible link	-	S813-130201
CN-96	AMP	4	Fuel warmer	2-967325-3	-
CN-113	KET	2	Buzzer	MG651205-5	-
CN-116	AMP	12	Switch panel	176116	-
CN-125A	Econoseal J	4	GPS connector (cluster type 1)	DT06-12S	-
CN-126	AMP	8	Service tool	S816-010002	-
CN-133	DEUTSCH	2	Boom priority solenoid	DT06-2S-EP06	-
CN-135	DEUTSCH	2	Arm regeneration solenoid (cluster type 1)	DT06-2S-EP06	-
CN-138	DEUTSCH	3	DC/DC Converter	DT06-3S	-
CN-139	FASTEN	2	12V socket	170434-2	-
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-147	AMP	4	Fuel-heater	2-967325-3	-
CN-149	DEUTSCH	2	Attach safety solenoid (cluster type 1)	DT06-2S-EP06	-
CN-156	DEUTSCH	2	Air seat	DT04-2P-E005	-
CN-157	AMP	1	Antena power	S822-014002	-
CN-170	AMP	2	Heated seat	12052641	12162000
CN-236	DEUTSCH	2	Attach pressure solenoid (cluster type 1)	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid (cluster type 1)	DT06-2S-EP06	-
CN-242	AMP	2	Attach flow solenoid (cluster type 1)	DT06-2S-EP06	DT04-2P-E005
CN-246	AMP	10	USB	316988-6	-
CN-249	AMP	4	Rear view camera (cluster type 1)	S816-004002	S816-104002
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710285-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Head lamp relay	-	-
CR-13	-	5	Cabin lamp relay	-	-
CR-23	AMP	2	Start relay	-	814-102001
CR-24	RING TERM	1	Preheat relay	S822-014000	-

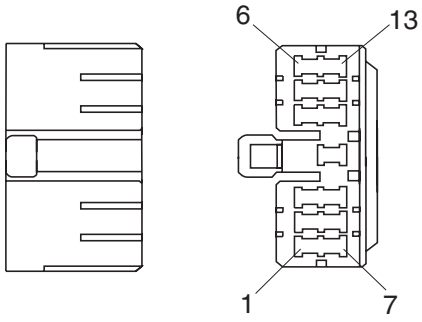
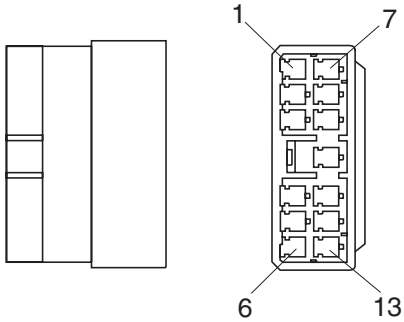
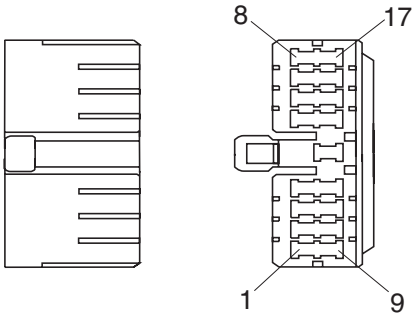
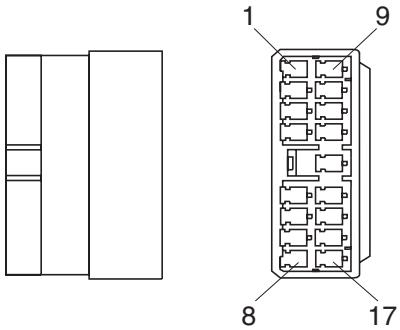
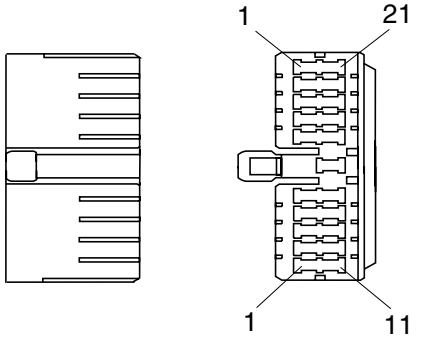
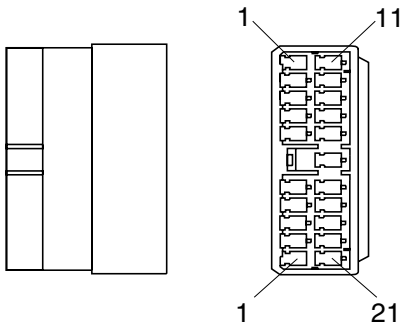
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	WP	6	Start key switch	S814-006100	-
CS-4	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	10	Breaker switch (cluster type 2)	SWF 593757	-
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
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-73	SWF	12	Spare switch	SWF 589790	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-82	SWF	12	Spare switch	SWF 589790	-
CS-83	SWF	12	Spare switch	SWF 589790	-
CS-99	SWF	12	Spare switch	SWF 589790	-
CS-100	SWF	12	Spare switch	SWF 589790	-
CS-142	DEUTSCH	3	Accel dial LED	DT06-3S-EP06	-
· 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	-
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-5	DEUTSCH	2	Work lamp-LH	-	DT04-2P
CL-6	DEUTSCH	2	Work lamp-RH	-	DT04-2P
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT04-2P-E005
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P-E005

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	-
CD-8	AMP	2	Coolant temp sender	85202-1	-
CD-10	RING TERM	-	Air cleaner switch	ST730135-2	S820-104000
CD-17	AMP	2	Speed sensor	-	S818-120221
CD-18	RING TERM	-	Engine oil pressure switch	S820-104000	-
CD-24	DEUTSCH	3	Swing sensor (cluster type 1)	DT06-3S-EP06	-
CD-31	AMP	3	Overload sensor	S816-003002	S816-103002
CD-32	DEUTSCH	3	Boom up sensor (cluster type 1)	DT06-3S-EP06	-
CD-42	AMP	3	Pump pressure 1	S816-004002	-
CD-43	AMP	3	Pump pressure 2	S816-004002	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-69	DEUTSCH	3	Attach pressure sensor (cluster type 1)	DT06-3S-EP06	-

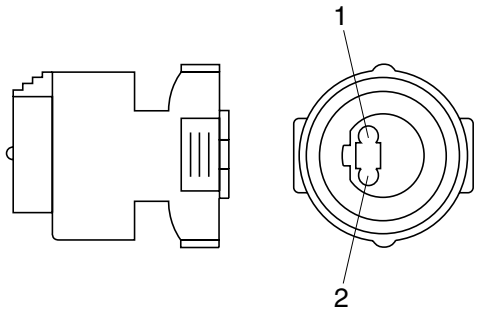
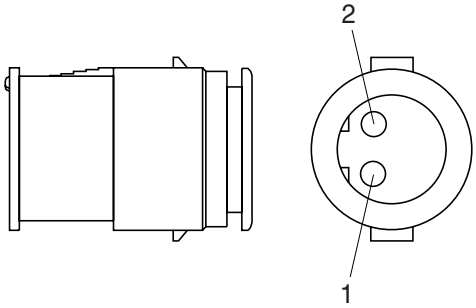
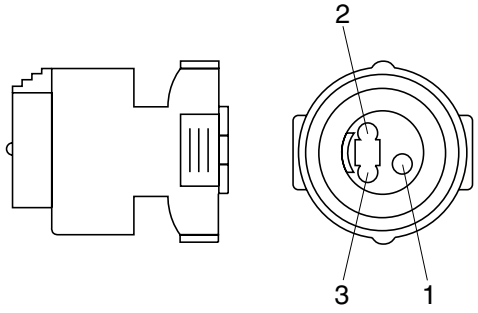
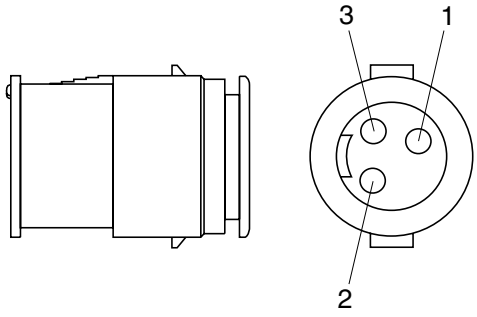
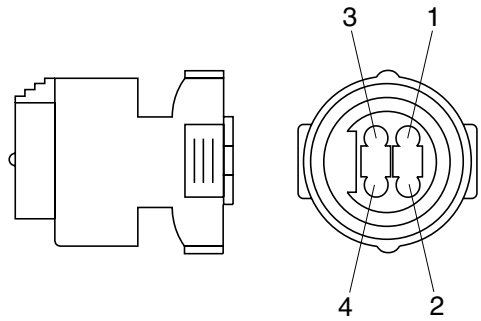
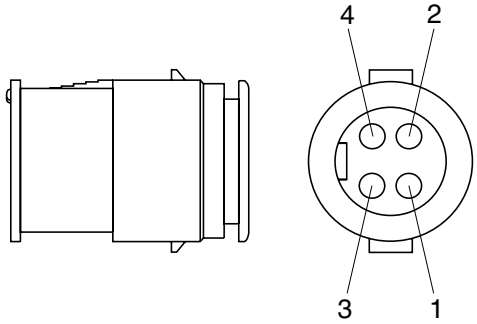
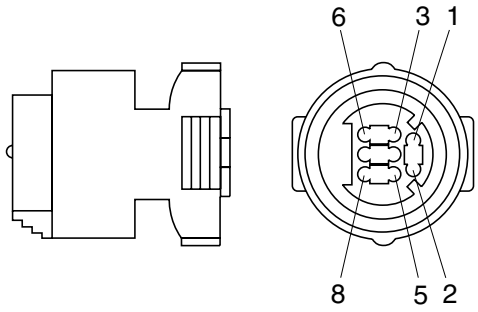
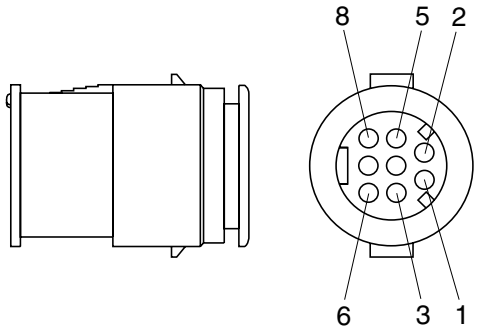
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

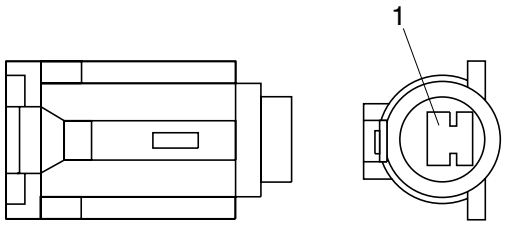
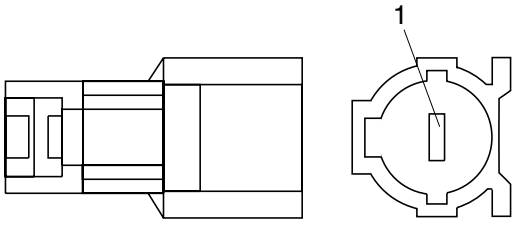
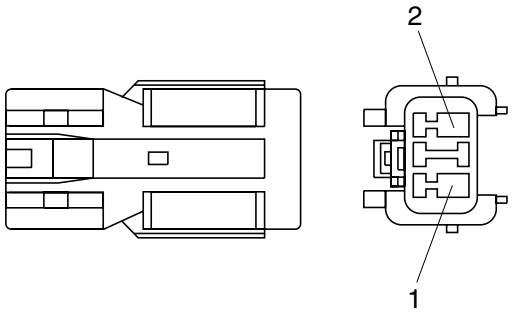
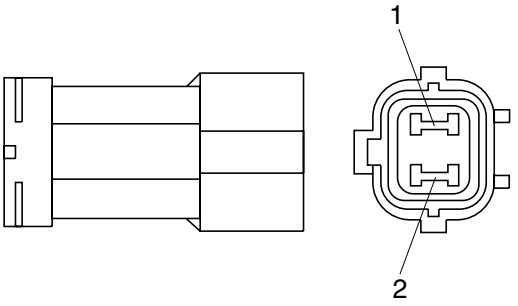
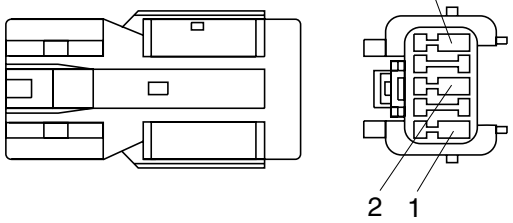
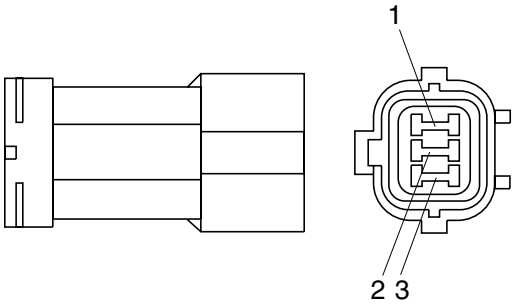
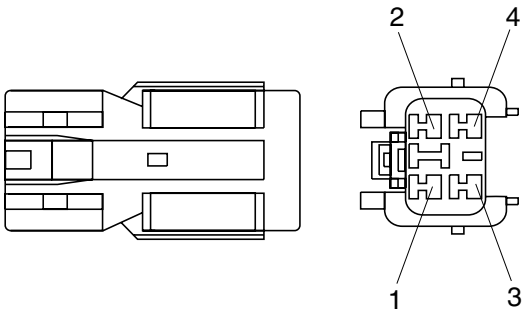
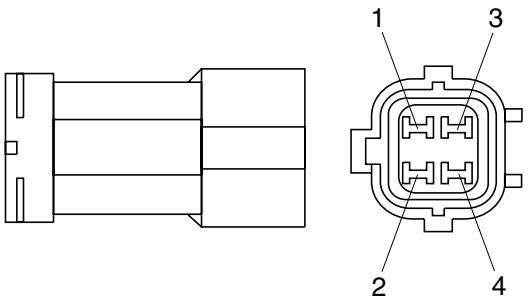
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

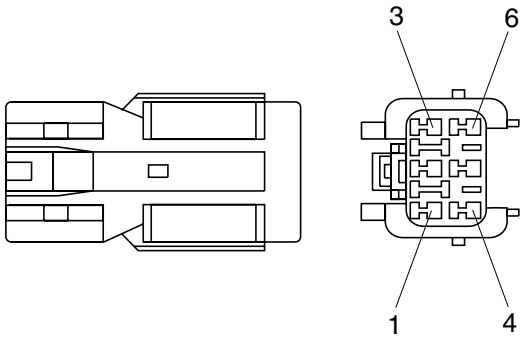
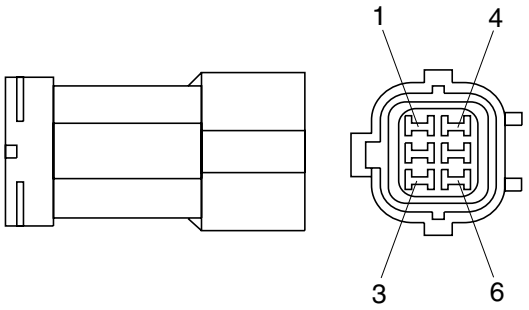
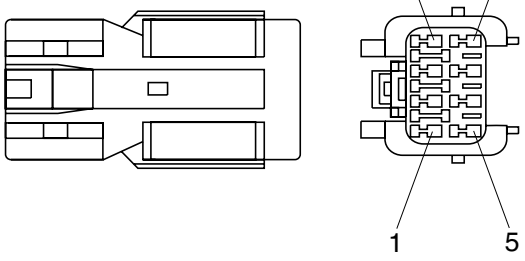
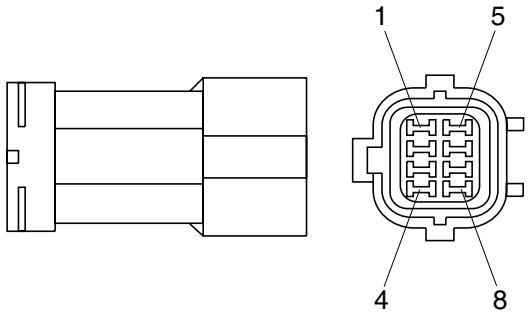
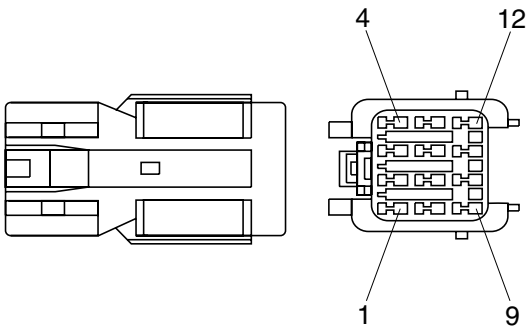
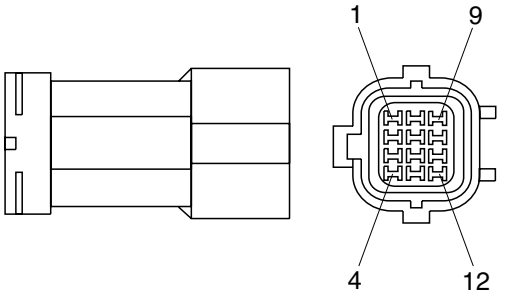
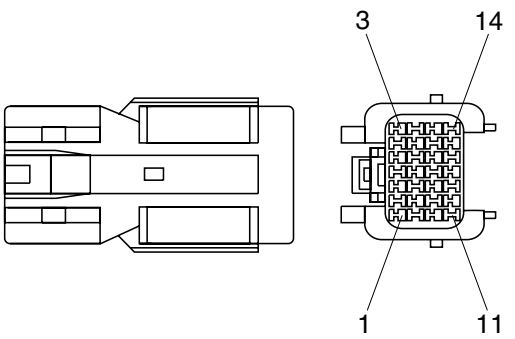
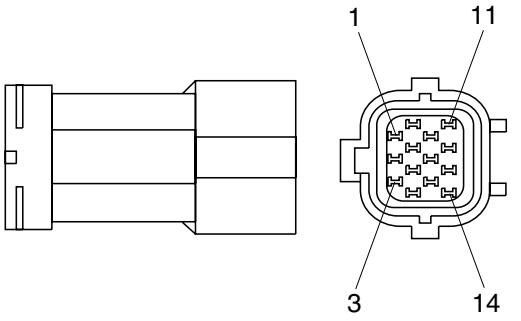
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

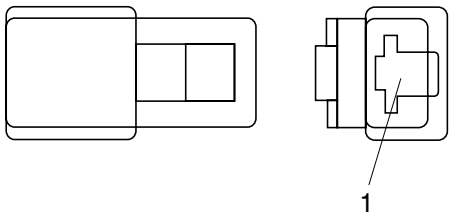
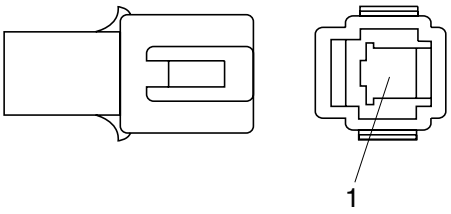
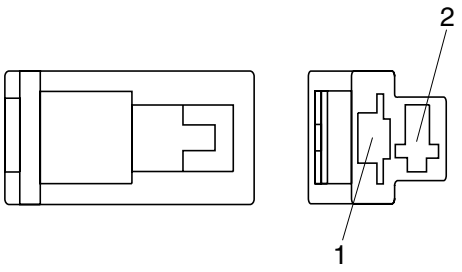
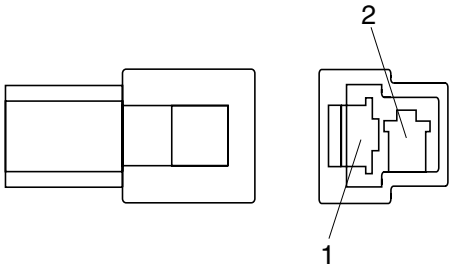
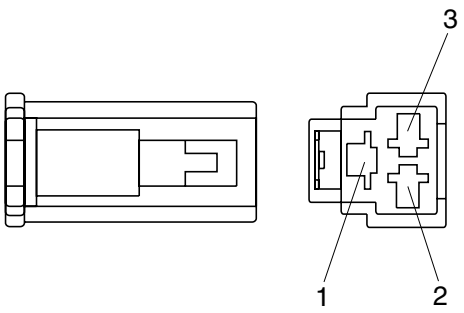
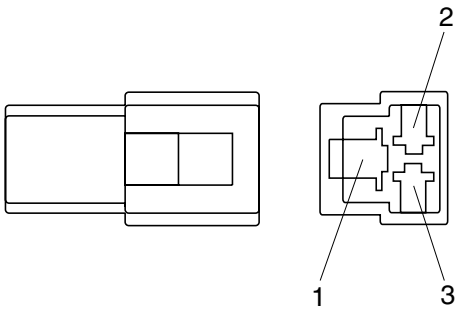
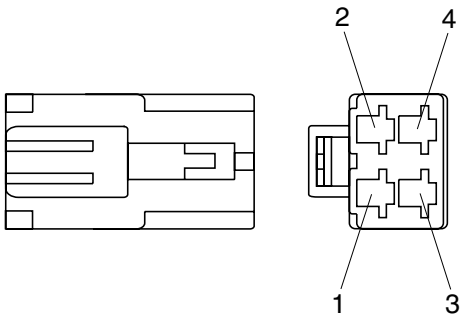
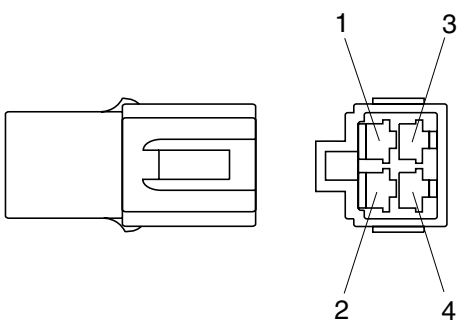
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

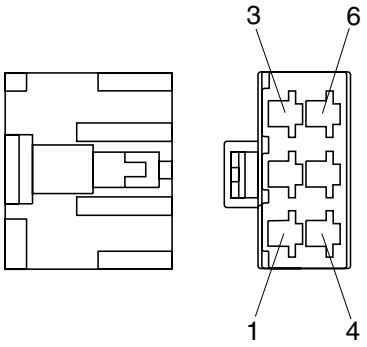
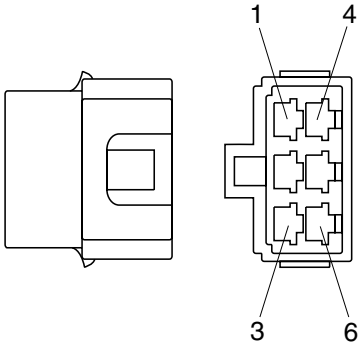
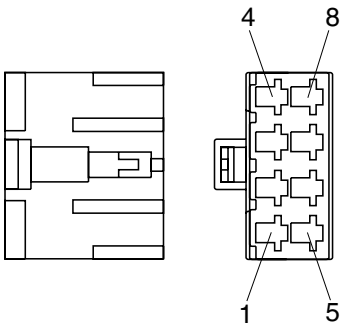
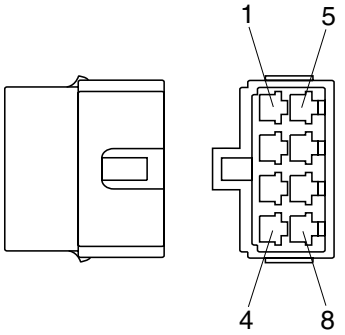
3) SWP TYPE CONNECTOR

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

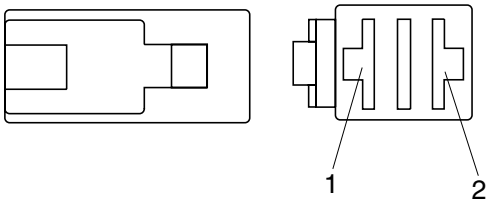
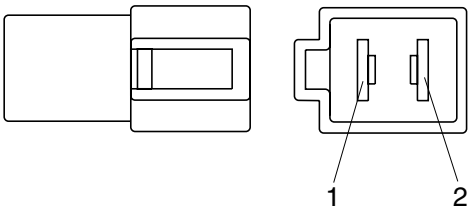
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

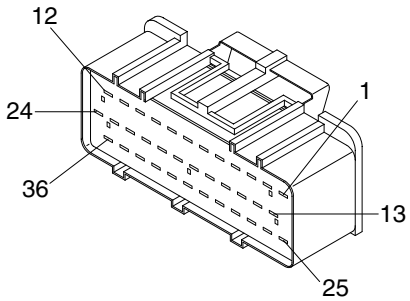
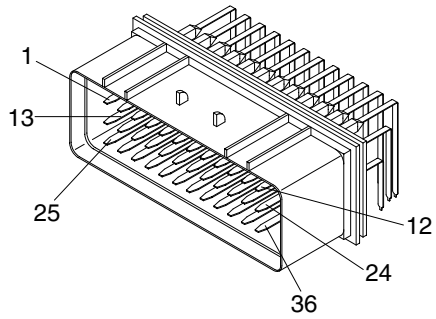
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

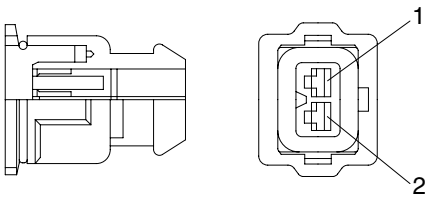
5) 375 FASTEN TYPE CONNECTOR

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

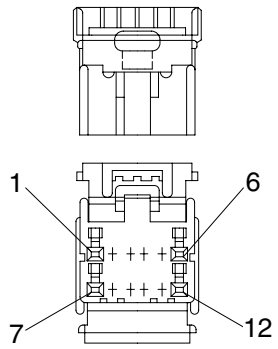
6) AMP ECONOSEAL CONNECTOR

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

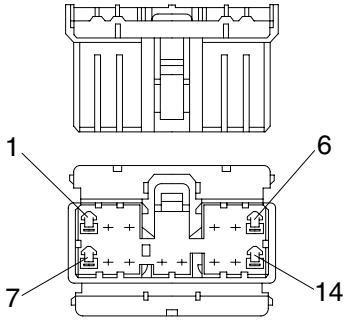
7) AMP TIMER CONNECTOR

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

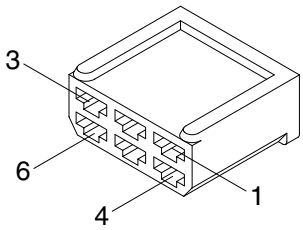
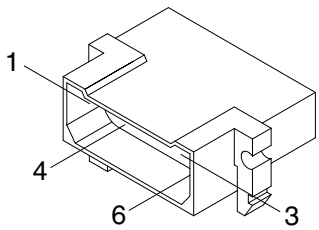
8) AMP 040 MULTILOCK CONNECTOR

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

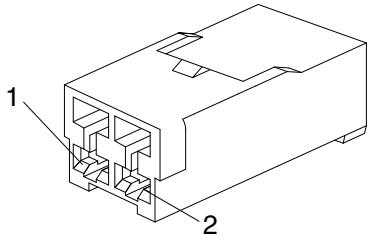
9) AMP 070 MULTILOCK CONNECTOR

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

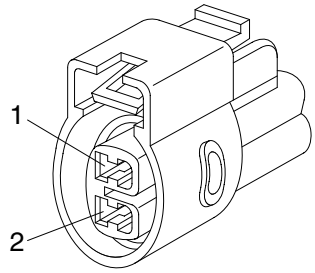
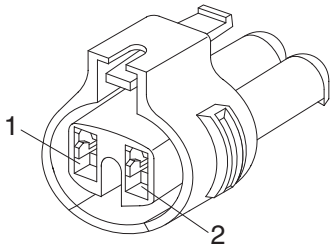
10) AMP FASTIN - FASTON CONNECTOR

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

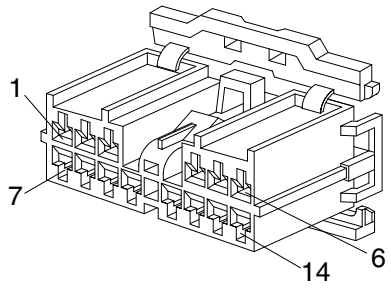
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

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

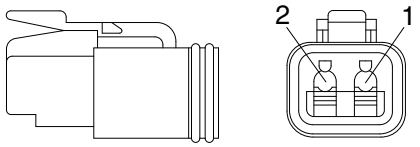
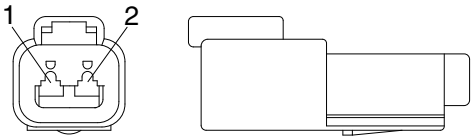
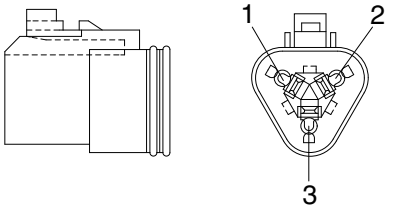
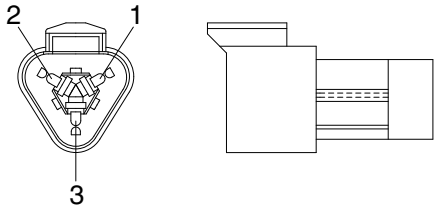
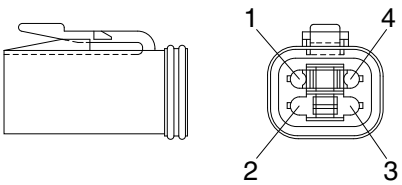
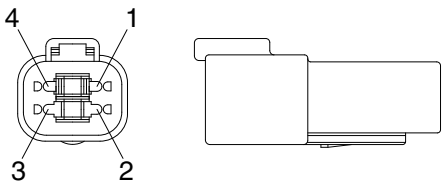
14) DEUTSCH DT CONNECTORS

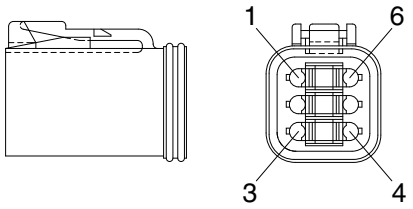
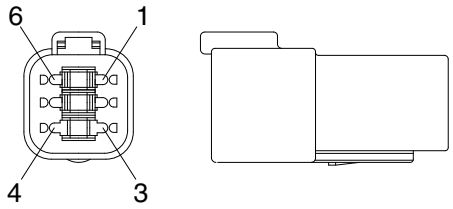
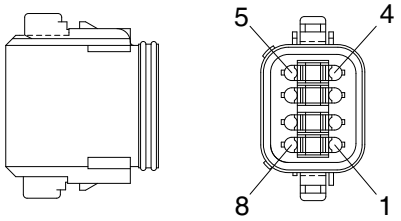
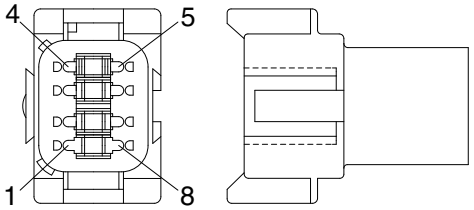
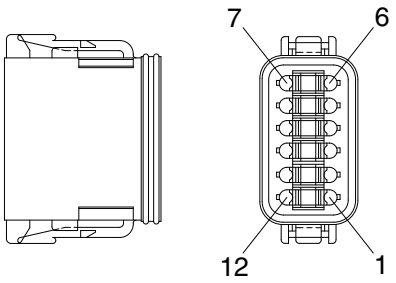
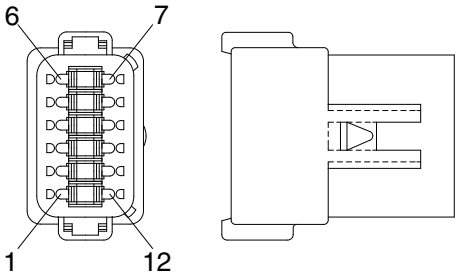
DT 06 - 3S - ★★★★

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

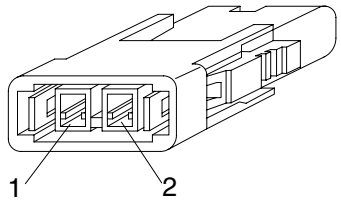
※ Modification

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

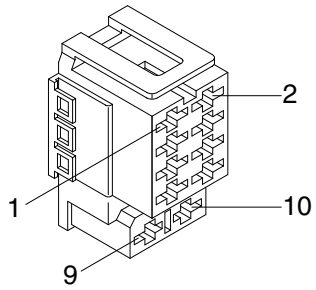
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

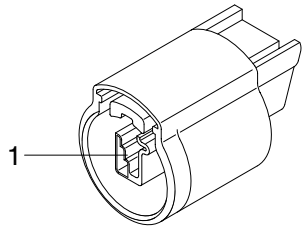
15) MOLEX 2CKTS CONNECTOR

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

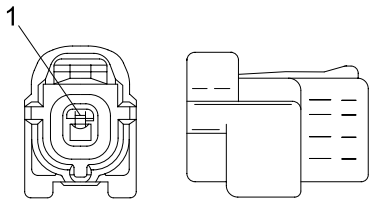
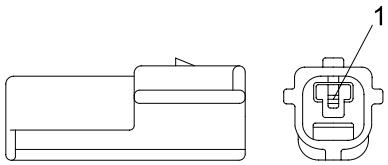
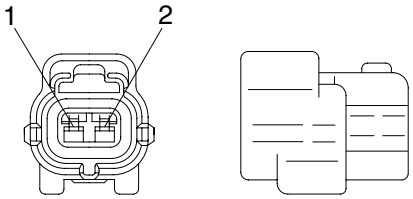
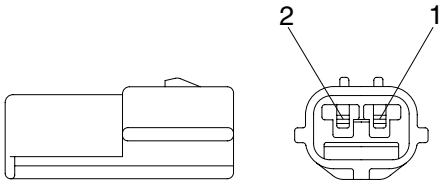
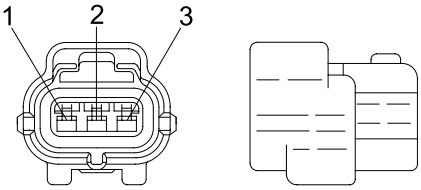
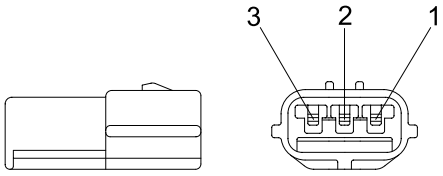
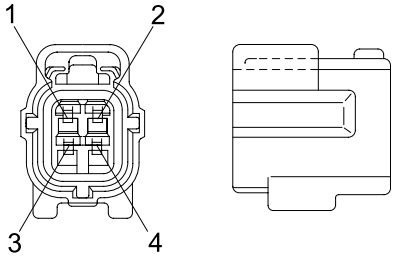
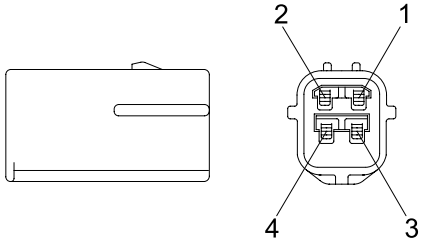
16) ITT SWF CONNECTOR

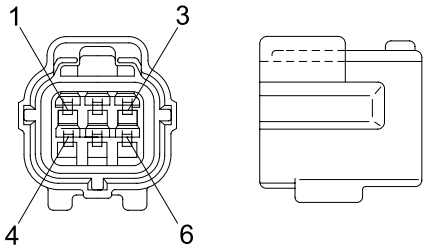
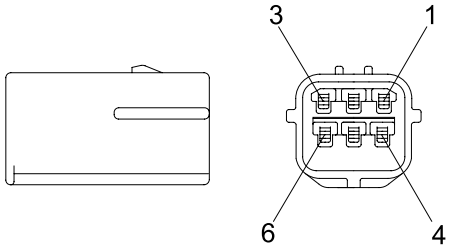
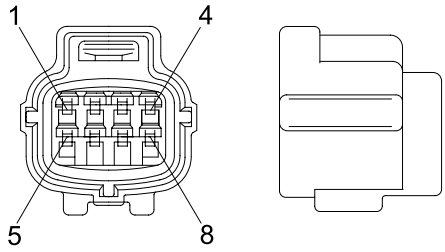
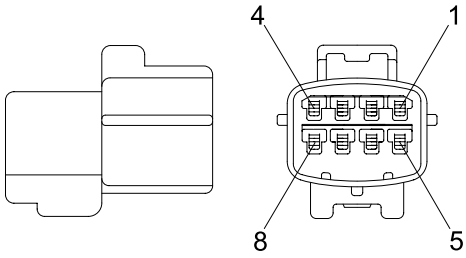
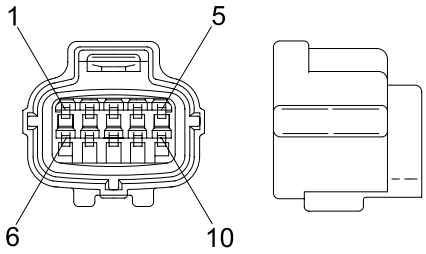
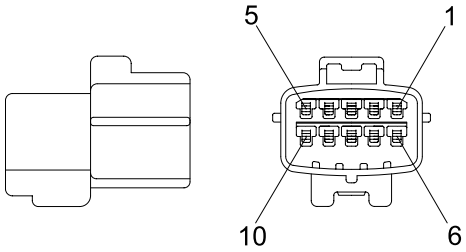
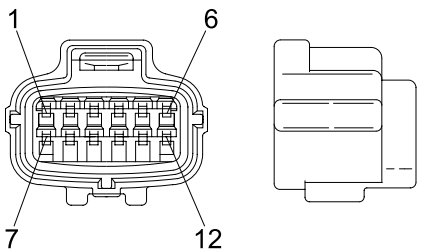
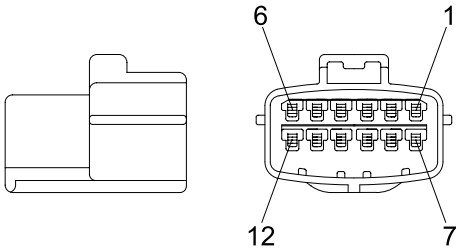
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

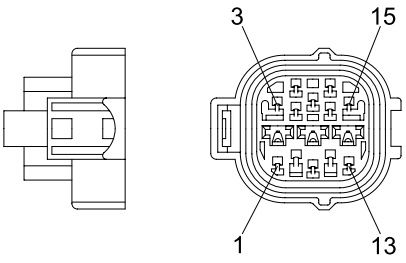
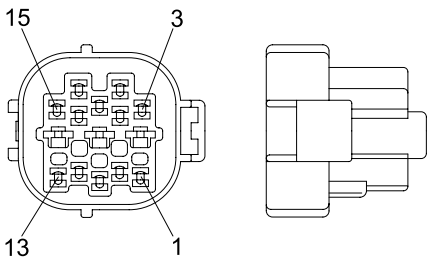
17) MWP NMWP CONNECTOR

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

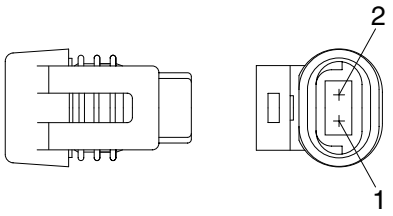
18) ECONOSEAL J TYPE CONNECTORS

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

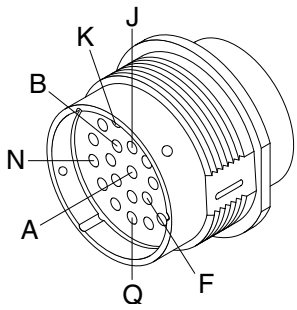
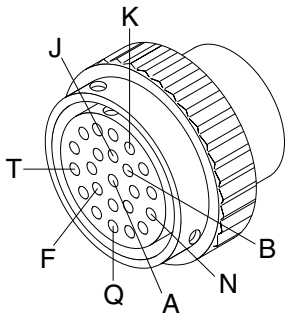
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

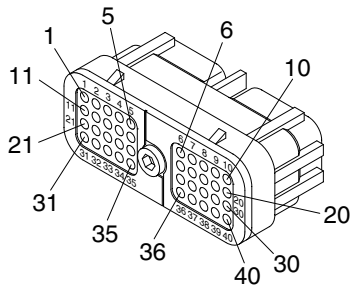
19) METRI-PACK TYPE CONNECTOR

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

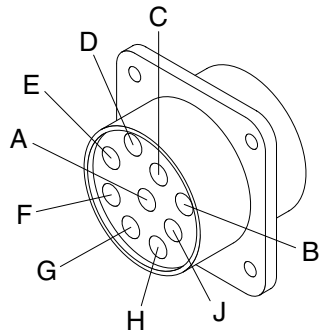
20) DEUTSCH HD30 CONNECTOR

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

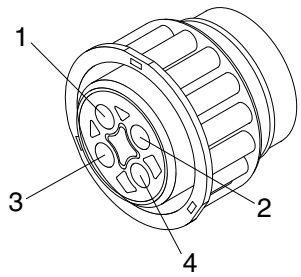
21) DEUTSCH MCU CONNECTOR

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

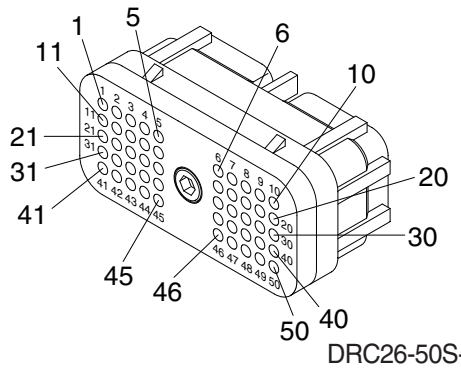
22) DEUTSCH SERVICE TOOL CONNECTOR

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

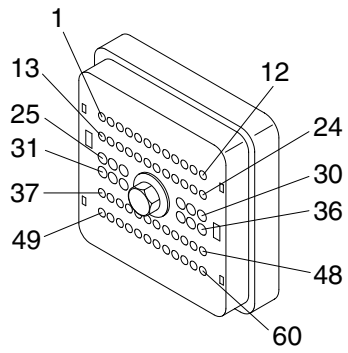
23) AMP FUEL WARMER CONNECTOR

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

24) DEUTSCH ENGINE ECM CONNECTOR

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

25) DEUTSCH INTERMEDIATE CONNECTOR

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

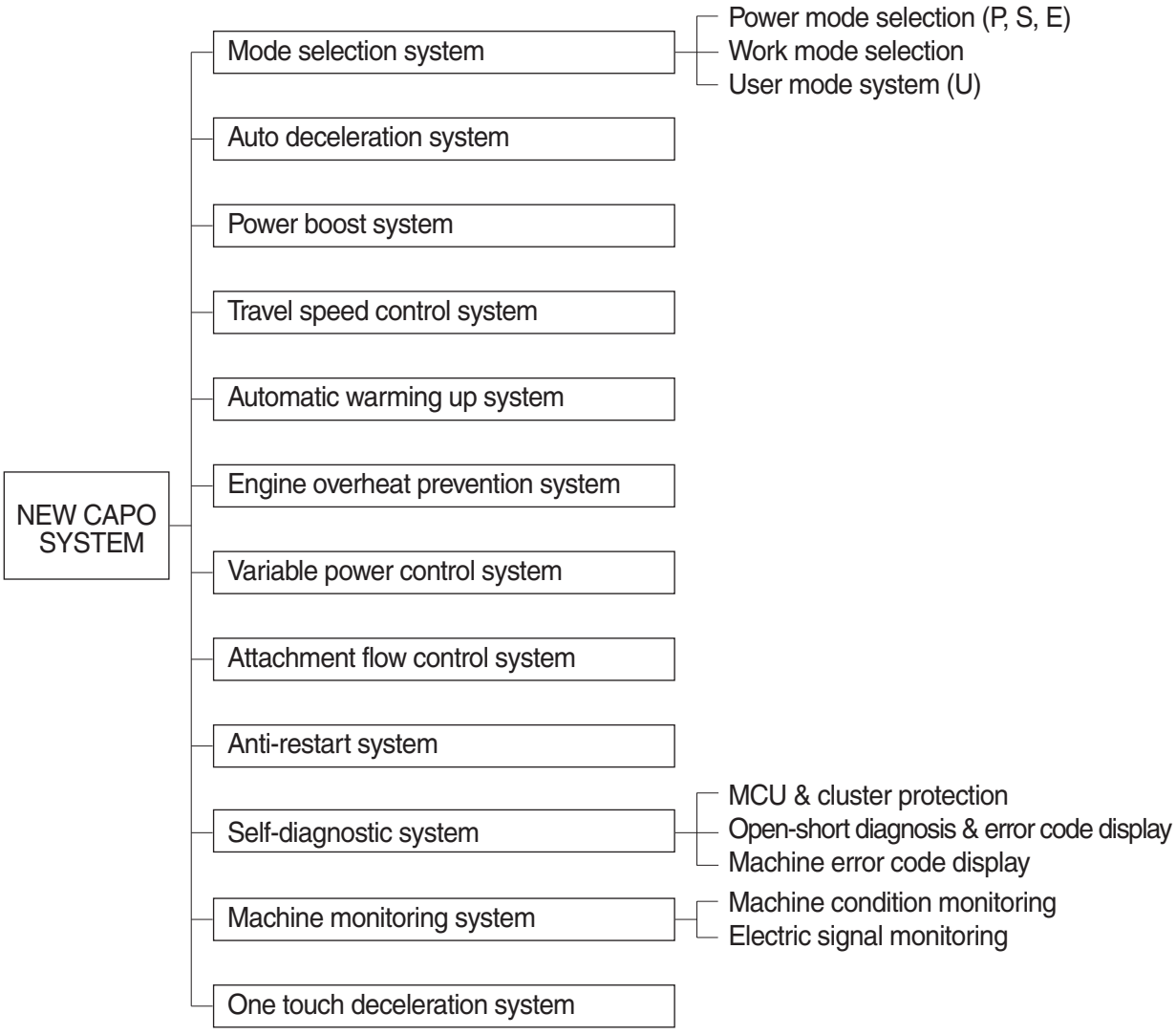
SECTION 5 MECHATRONICS SYSTEM

Group 1 Outline 5-1
Group 2 Mode Selection System 5-5
Group 3 Automatic Deceleration System 5-11
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Group 5 Travel Speed Control System 5-15
Group 6 Automatic Warming Up System 5-17
Group 7 Engine Overheat Prevention System 5-19
Group 8 Variable Power Control System 5-21
Group 9 Attachment Flow Control System 5-22
Group 10 Anti-Restart System 5-23
Group 11 Self-Diagnostic System 5-24
Group 12 Engine Control System 5-31
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Group 14 Monitoring System 5-39
Group 15 Fuel Warmer System 5-71

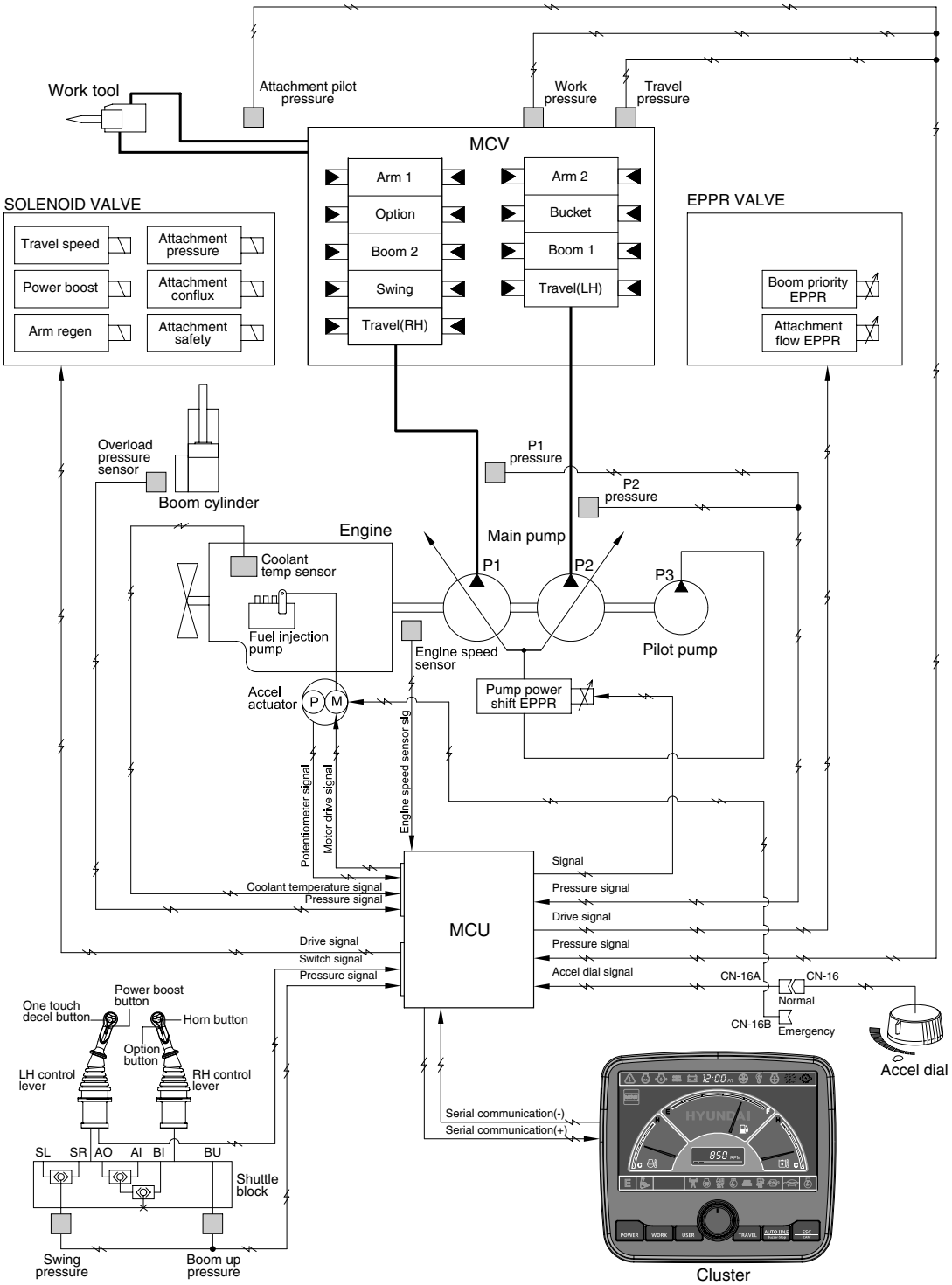
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE (CLUSTER TYPE 1)

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.



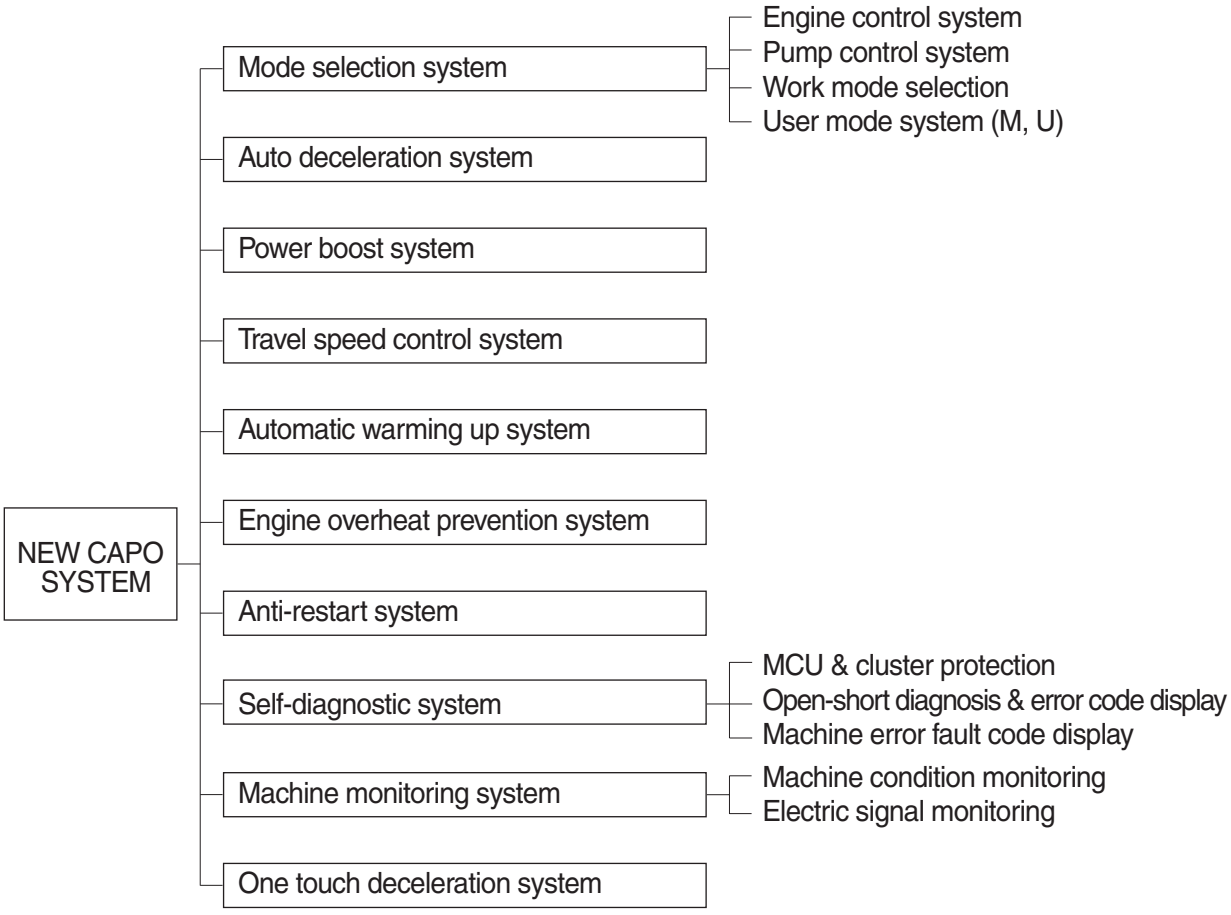
SYSTEM DIAGRAM (CLUSTER TYPE 1)



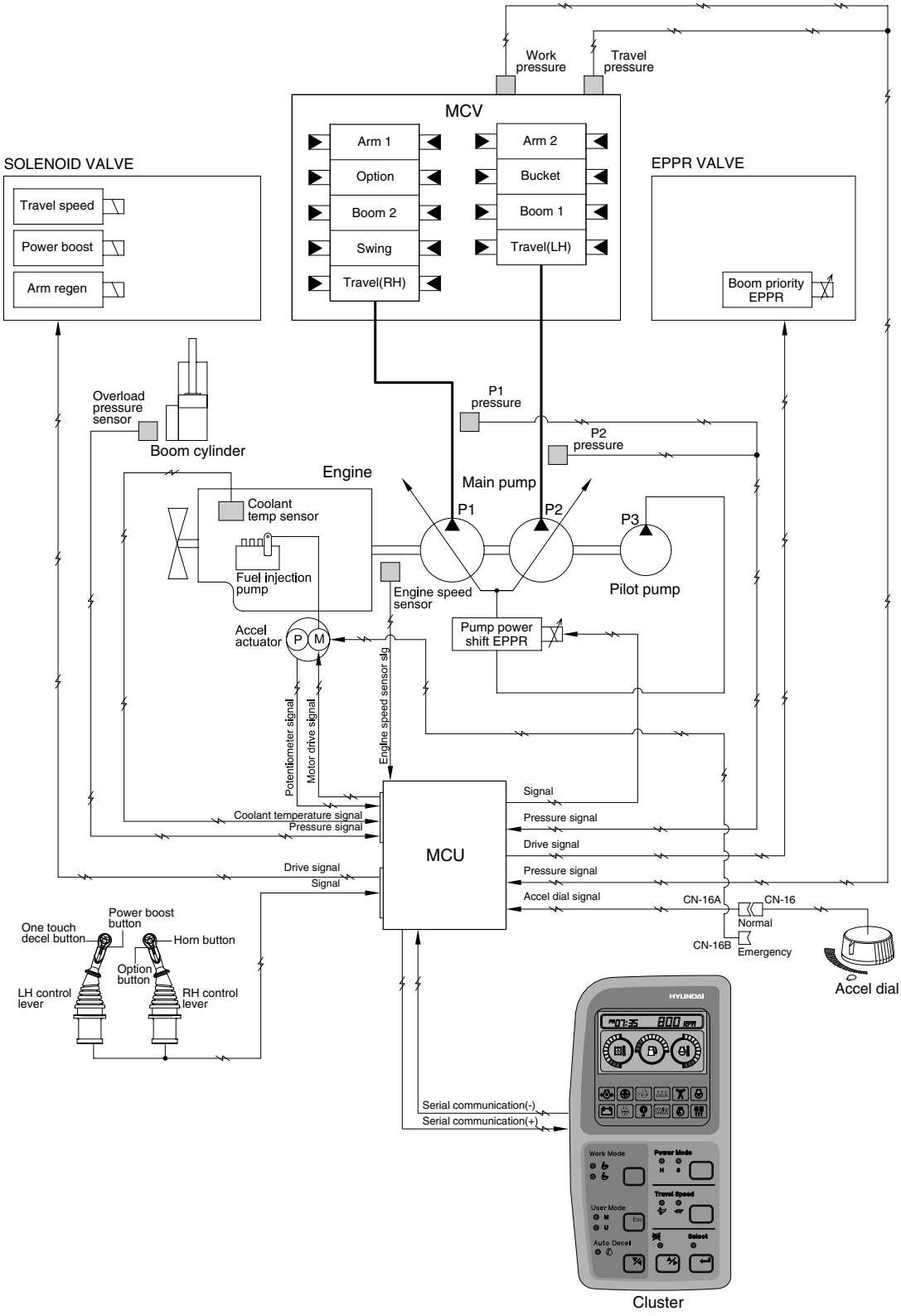
3309S5MS01

■ OUTLINE (CLUSTER TYPE 2)

The NEW 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.



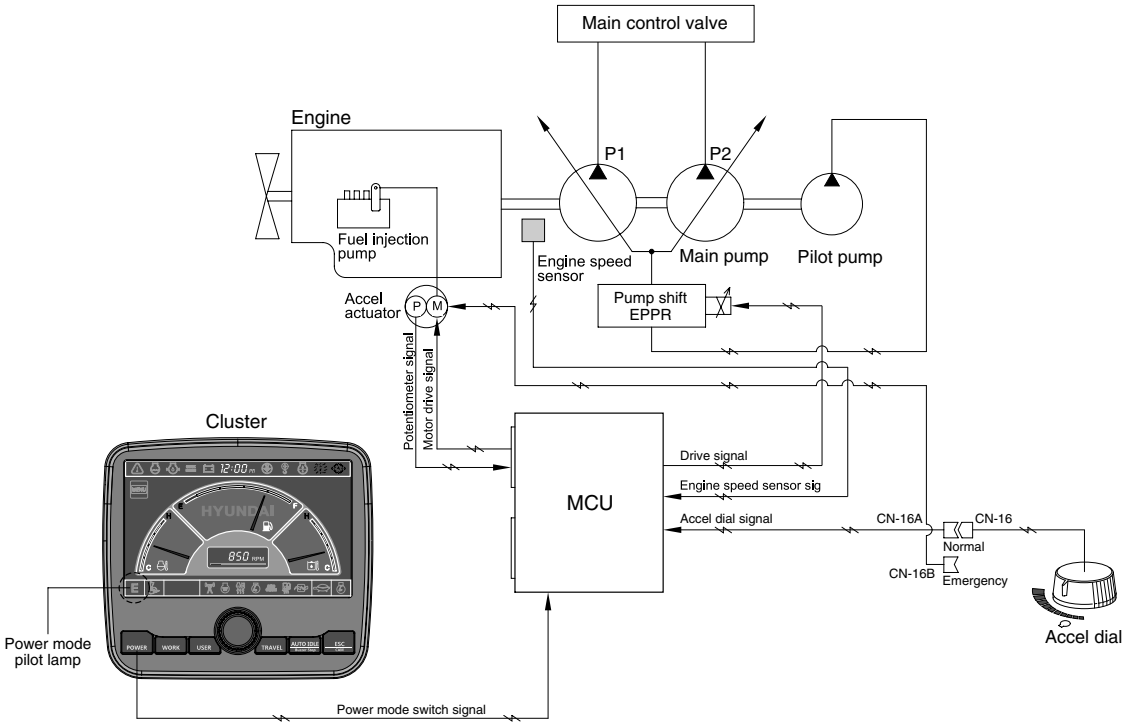
SYSTEM DIAGRAM (CLUSTER TYPE 2)



3309S5MS20A

GROUP 2 MODE SELECTION SYSTEM (CLUSTER TYPE 1)

1. POWER MODE SELECTION SYSTEM



3009SH5MS02

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

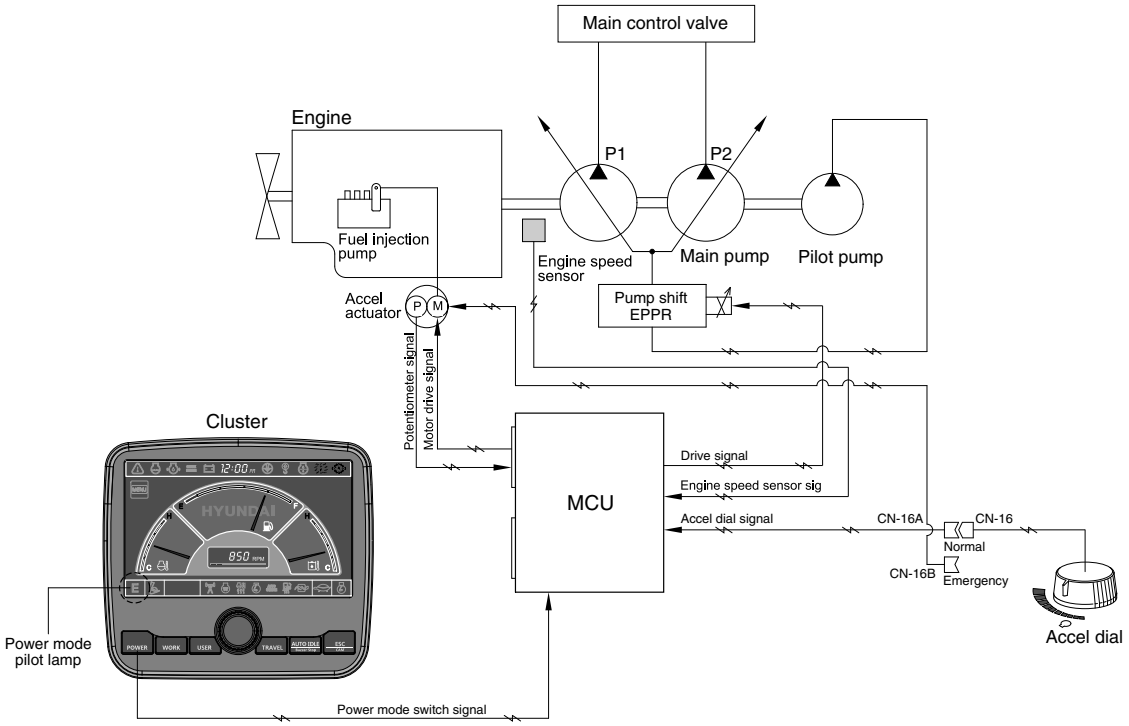
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm²)	Current (mA)	Pressure (kgf/cm²)
P	Heavy duty power	2100±50	1900±50	2100±50	1900±50	360±30	12±3	280±30	7
S	Standard power	2000±50	1800±50	2050±50	1850±50	360±30	12±3	280±30	7
E	Economy operation	1900±50	1700±50	1950±50	1750±50	360±30	12±3	360±30	12±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.

GROUP 2 MODE SELECTION SYSTEM (CLUSTER TYPE 1, HCEC ENGINE)

1. POWER MODE SELECTION SYSTEM



3009SH5MS02

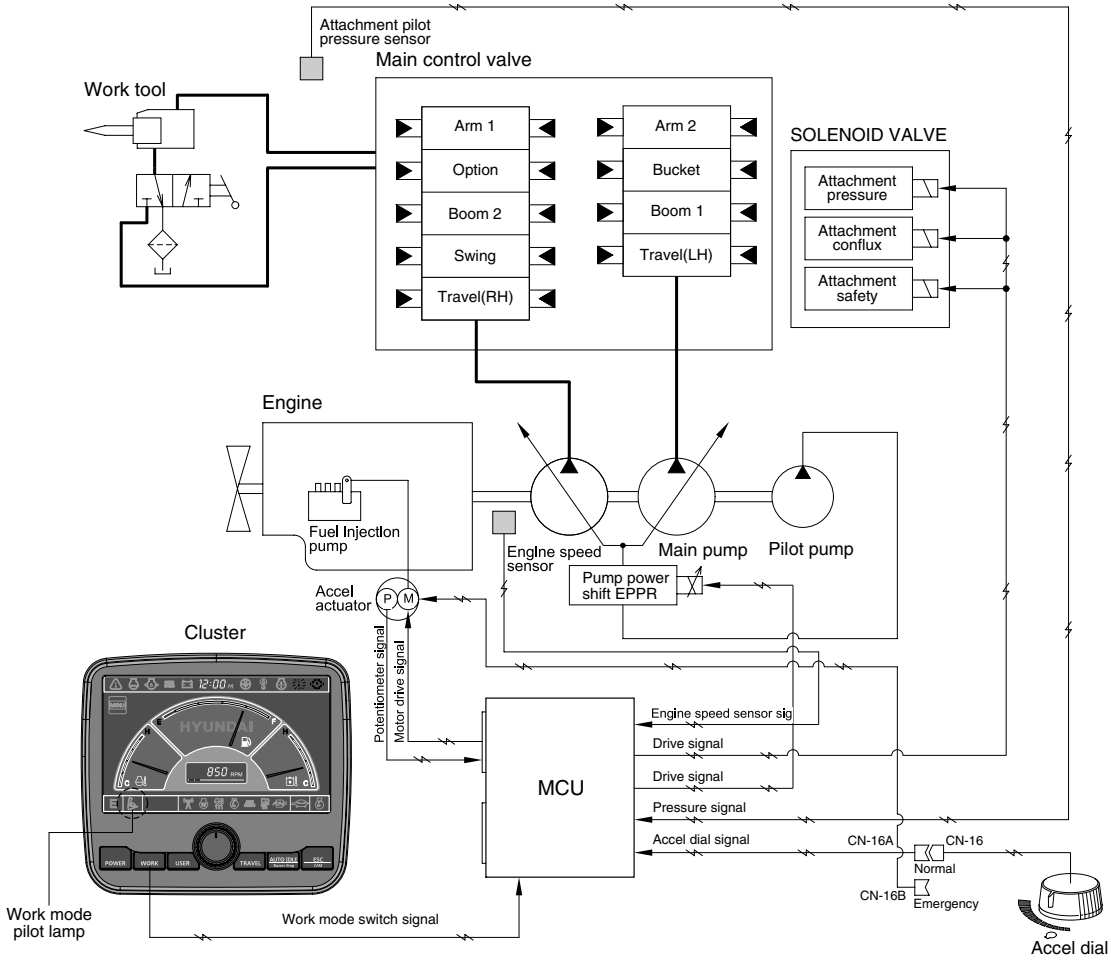
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding 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/cm²)	Current (mA)	Pressure (kgf/cm²)
P	Heavy duty power	1950±50	1750±50	1950±50	1750±50	360±30	12±3	280±30	7
S	Standard power	1850±50	1650±50	1900±50	1700±50	360±30	12±3	280±30	7
E	Economy operation	1750±50	1550±50	1800±50	1600±50	360±30	12±3	360±30	12±3
AUTO DECEL	Engine deceleration	1050±100	-	1050±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	950±100	-	950±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	950±100	-	950±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).



3309S5MS03

1) GENERAL WORK MODE (bucket)

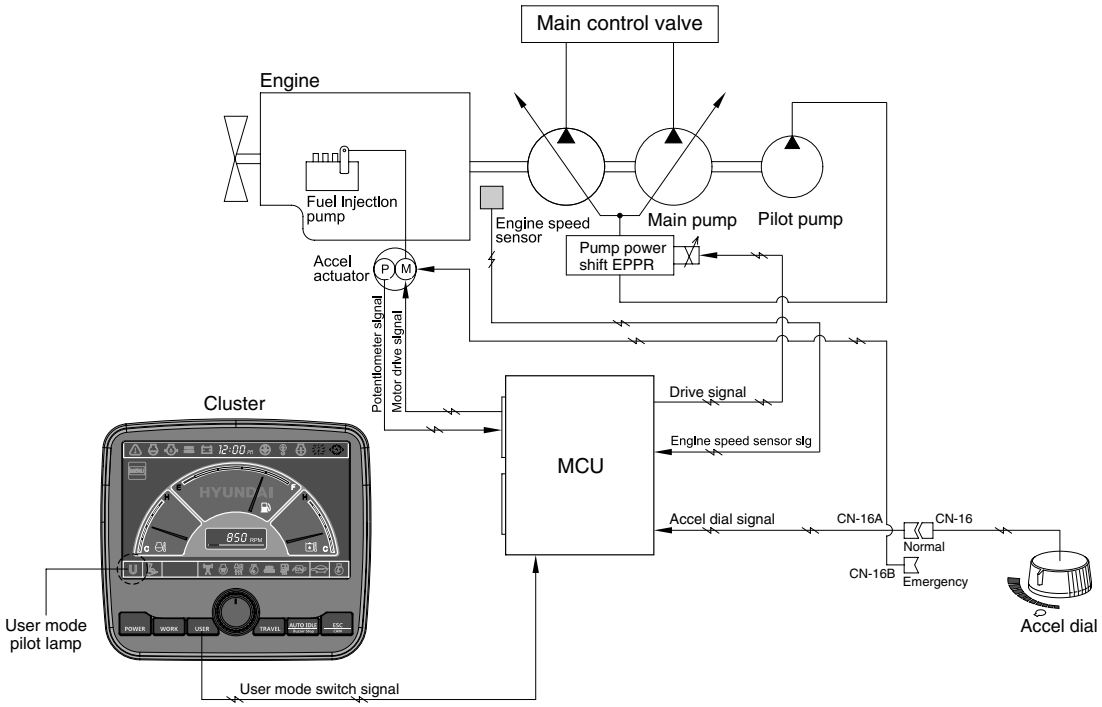
This mode is used to general digging work.

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	0~700 mA

3. USER MODE SELECTION SYSTEM



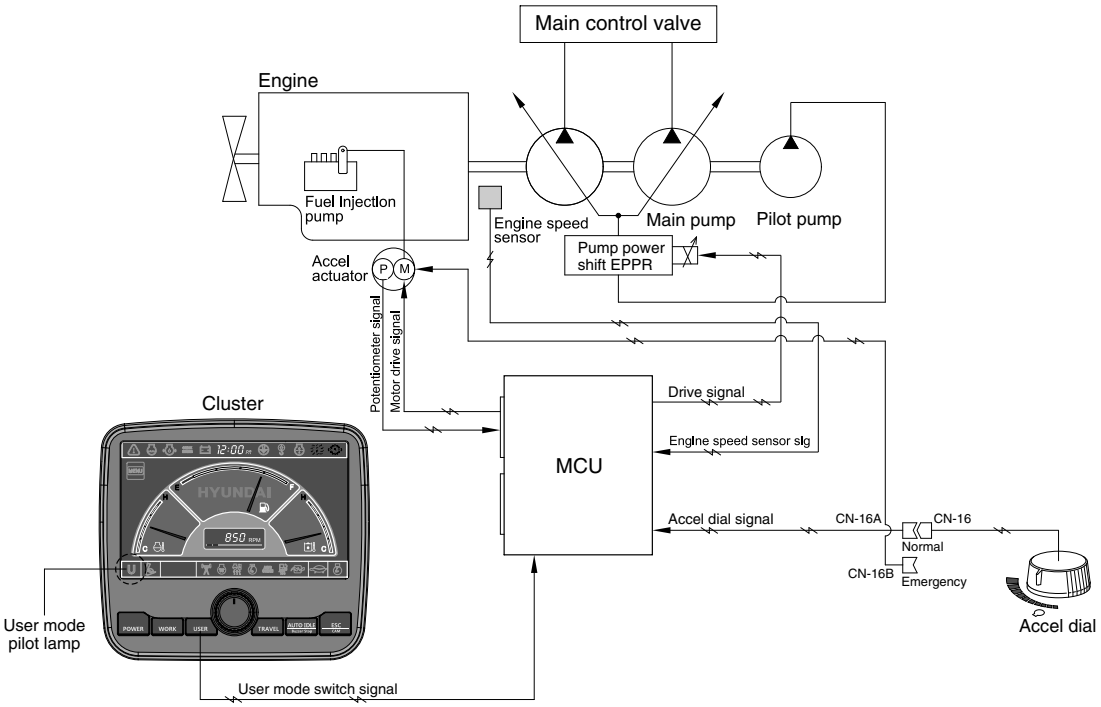
3009SH5MS04

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	1850	1200	12
6	1900	1250	16
7	1950	1300	20
8	2000	1350	26
9	2050	1400	32
10	2100	1450	38

3. USER MODE SELECTION SYSTEM (HCEC ENGINE)



3009SH5MS04

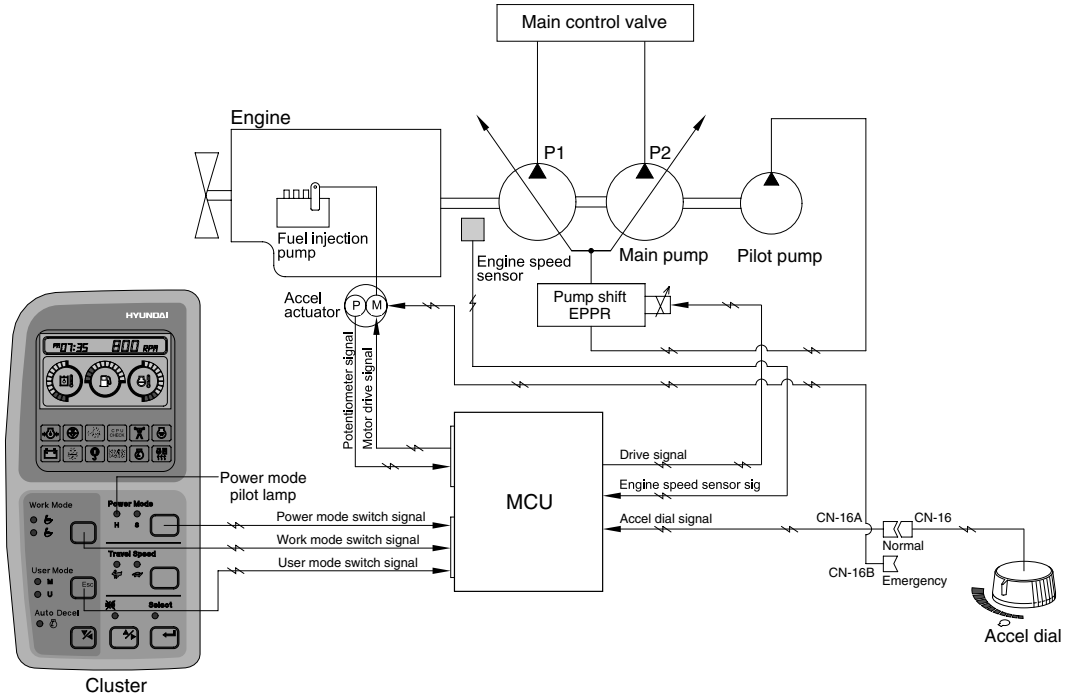
1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1400	1000	0
2	1500	1050 (auto decel)	3
3	1550	1100	6
4	1650	1150	9
5	1700	1200	12
6	1750	1250	16
7	1800	1300	20
8	1850	1350	26
9	1900	1400	32
10	1950	1450	38

■ MODE SELECTION SYSTEM (CLUSTER TYPE 2)

1. POWER MODE SELECTION SYSTEM



3009SH5MS21

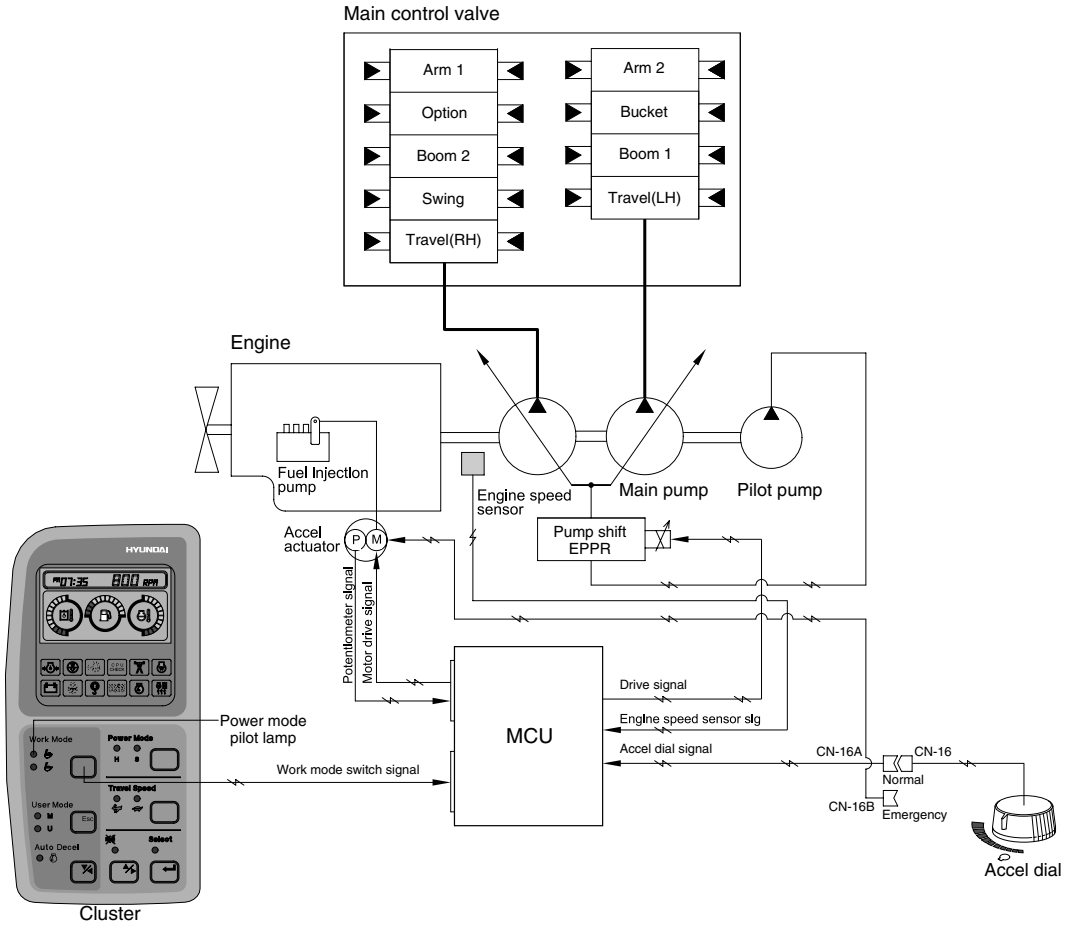
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

The combination of 2 power modes (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	2100±50	1900±50	330±30	10±3	280±30	7
H	High power	2000±50	1800±50	2050±50	1850±50	330±30	10±3	280±30	7
S	Standard power	1900±50	1700±50	1950±50	1750±50	330±30	10±3	330±30	10±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

2. WORK MODE SELECTION SYSTEM

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



3309S5MS22

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	Heavy duty work 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 power and memorize it for his preference.

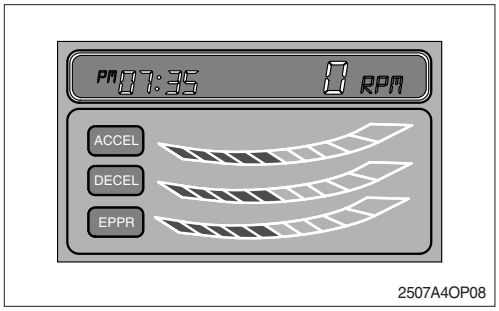
Mode	Operation
U	High idle rpm, auto decel rpm EPPR pressure can be modulated and memorized separately

HOW TO MPDULATE 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.

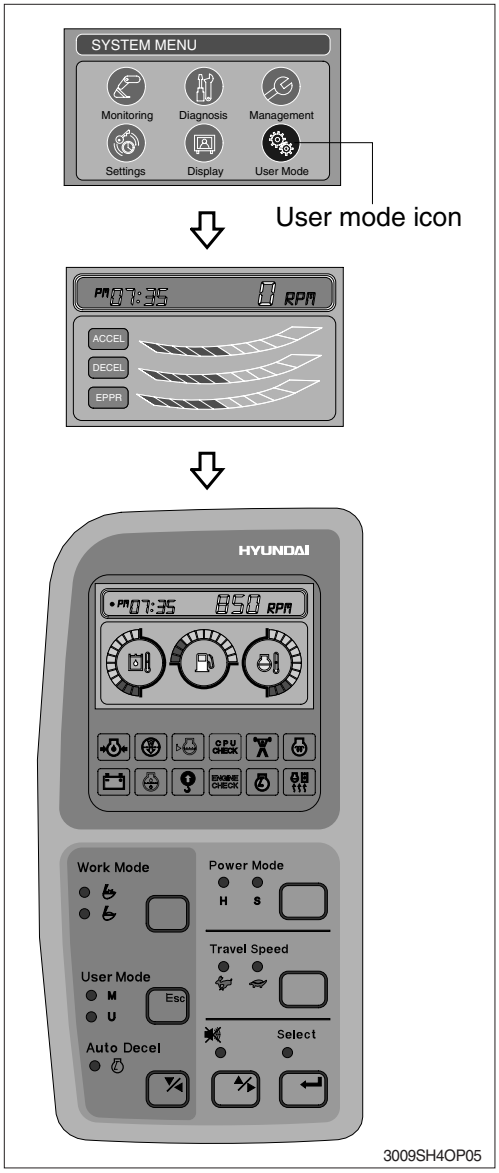
※ Refer to the page 5-68 for set of use mode.



2507A4OP08

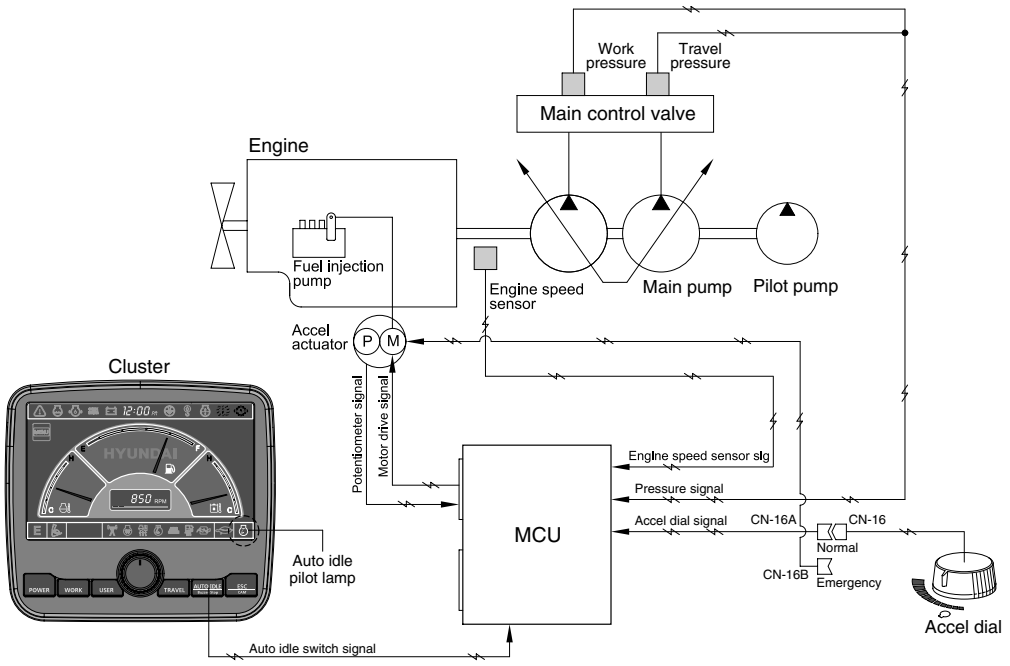
· LCD segment vs parameter setting

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	1850	1200	350
6	1900	1250	400
7	1950	1300	450
8	2000	1350	500
9	2050	1400	550
10	2100	1450	600



3009SH4OP05

GROUP 3 AUTOMATIC DECELERATION SYSTEM (CLUSTER TYPE 1)

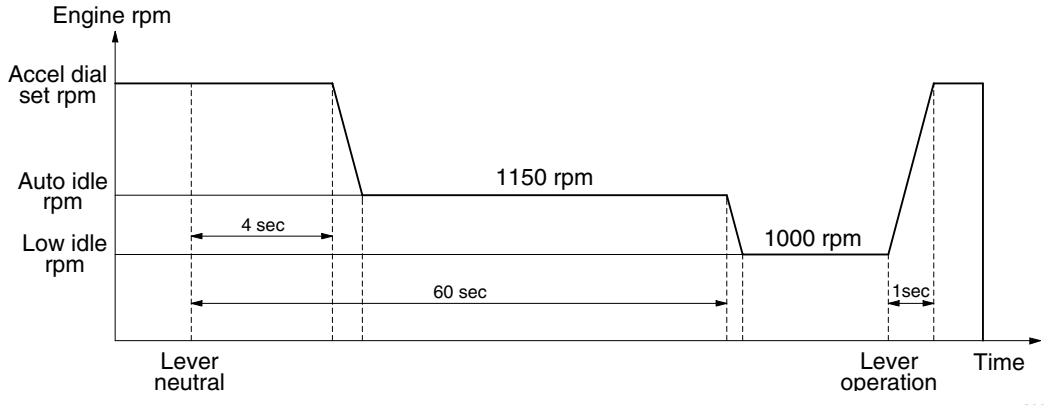


3009SH5MS05

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.



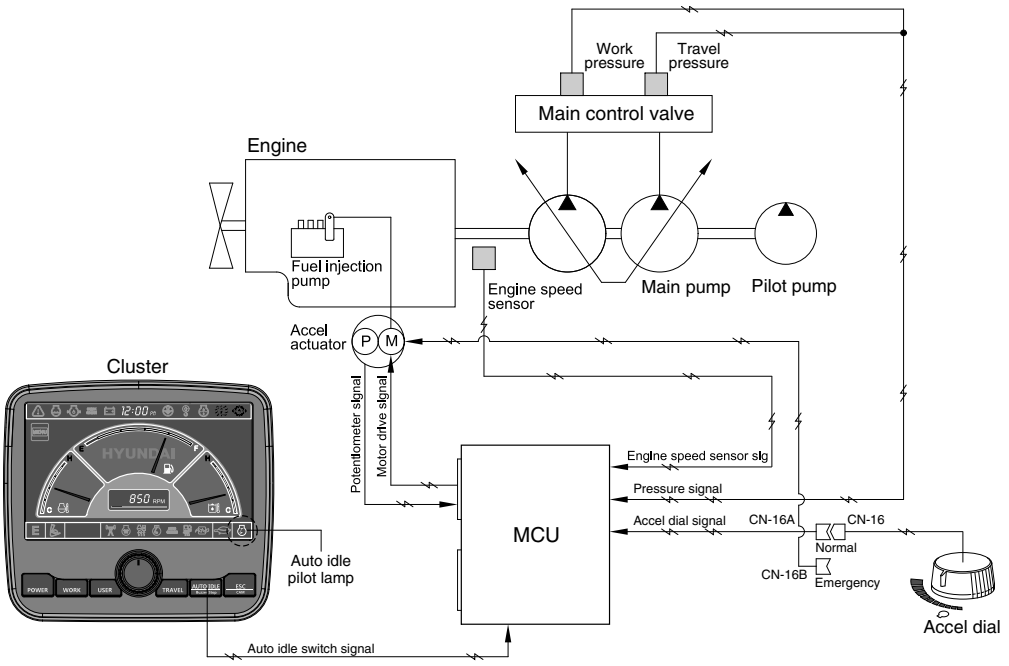
3009SH5MS06

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 3 AUTOMATIC DECELERATION SYSTEM (CLUSTER TYPE 1, HCEC ENGINE)

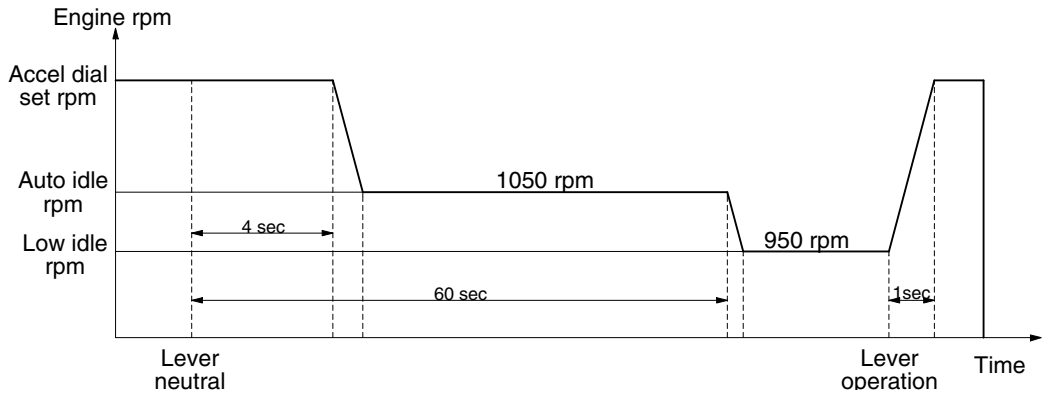


3009SH5MS05

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 1050 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 950 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.



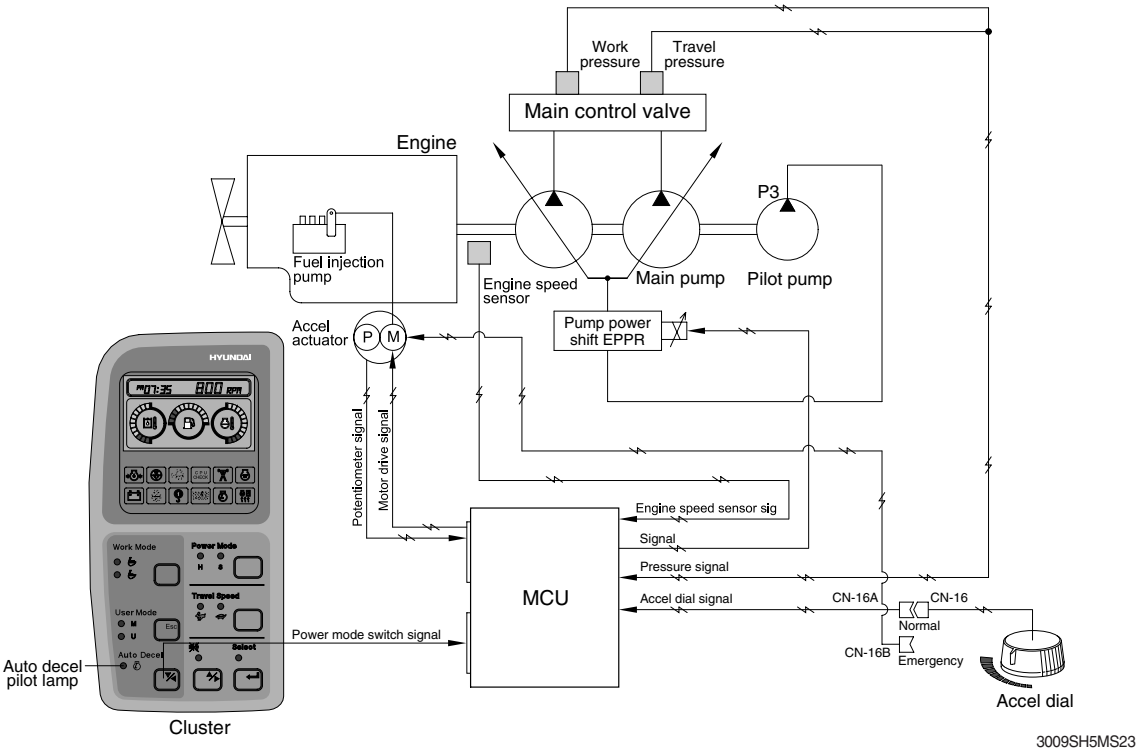
3009SH5MS40

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)

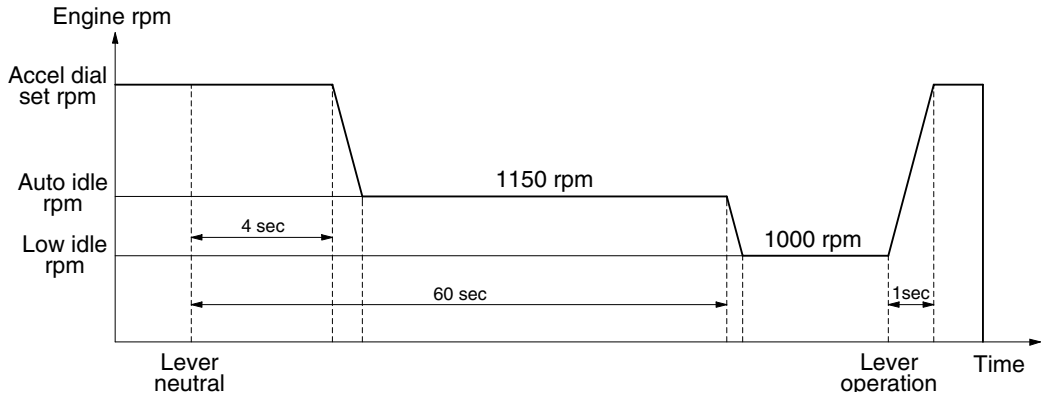


3009SH5MS23

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.



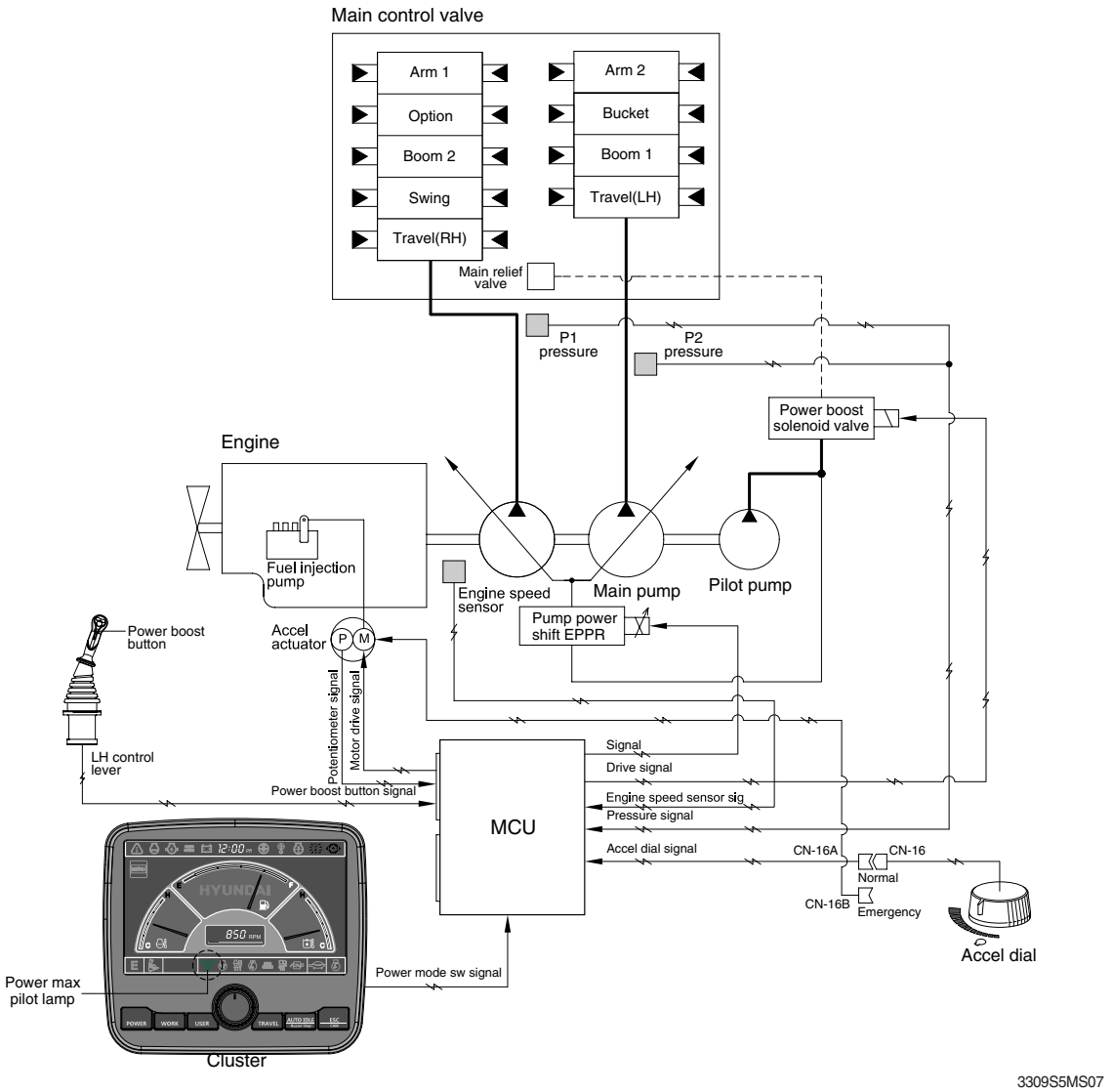
3009SH5MS06

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)



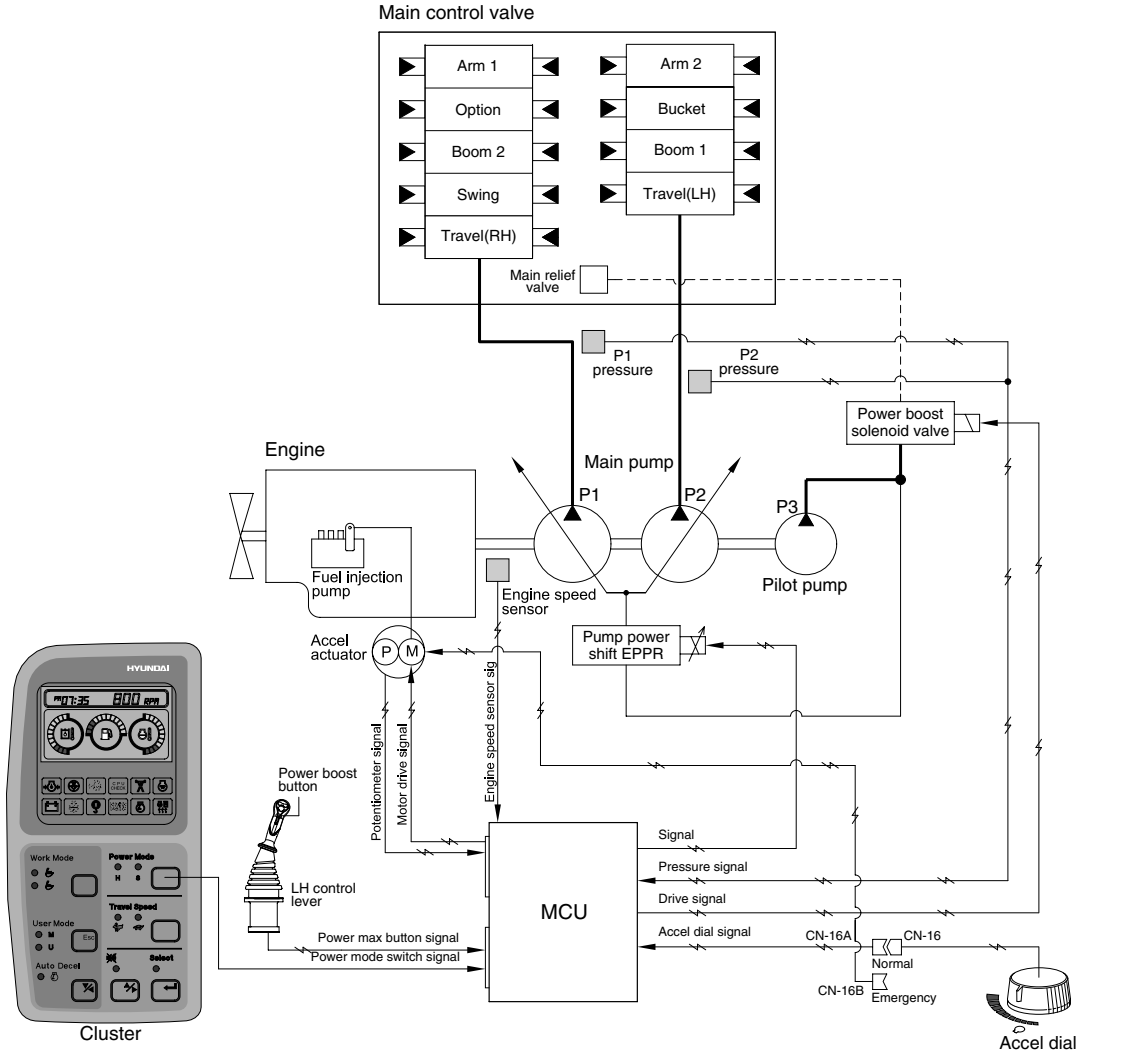
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

· 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 lamp : 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)



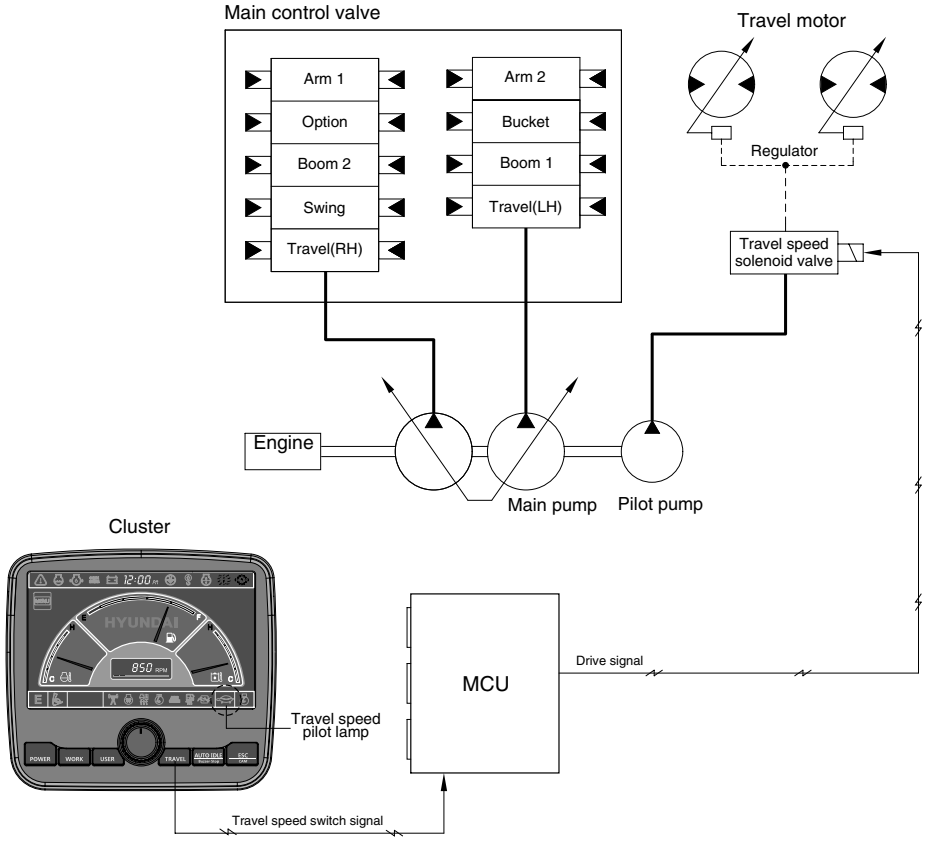
· When the power boost switch on the left control lever knob is pushed ON, the maximum digging power is increased by 10 %.

· When the power set is at M, H or S and the power boost function is activated, the power 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 continuousty, it is canceled after 8 sec.

※ Default - Power boost solenoid valve : OFF

GROUP 5 TRAVEL SPEED CONTROL SYSTEM (CLUSTER TYPE 1)



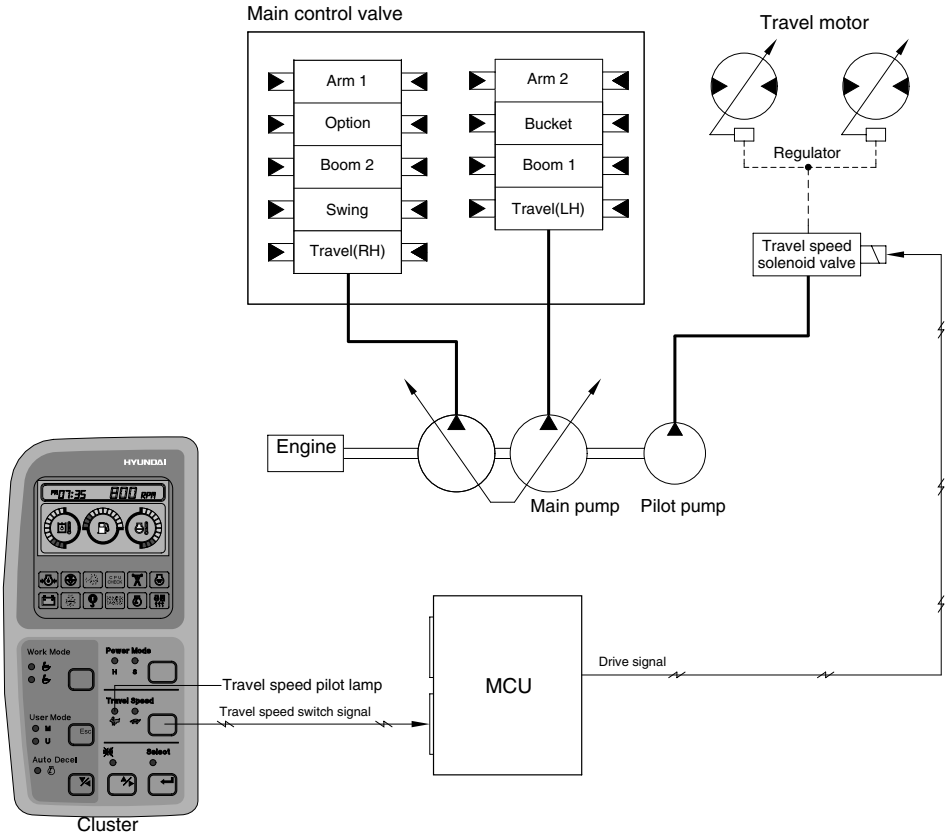
3309S5MS06

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)



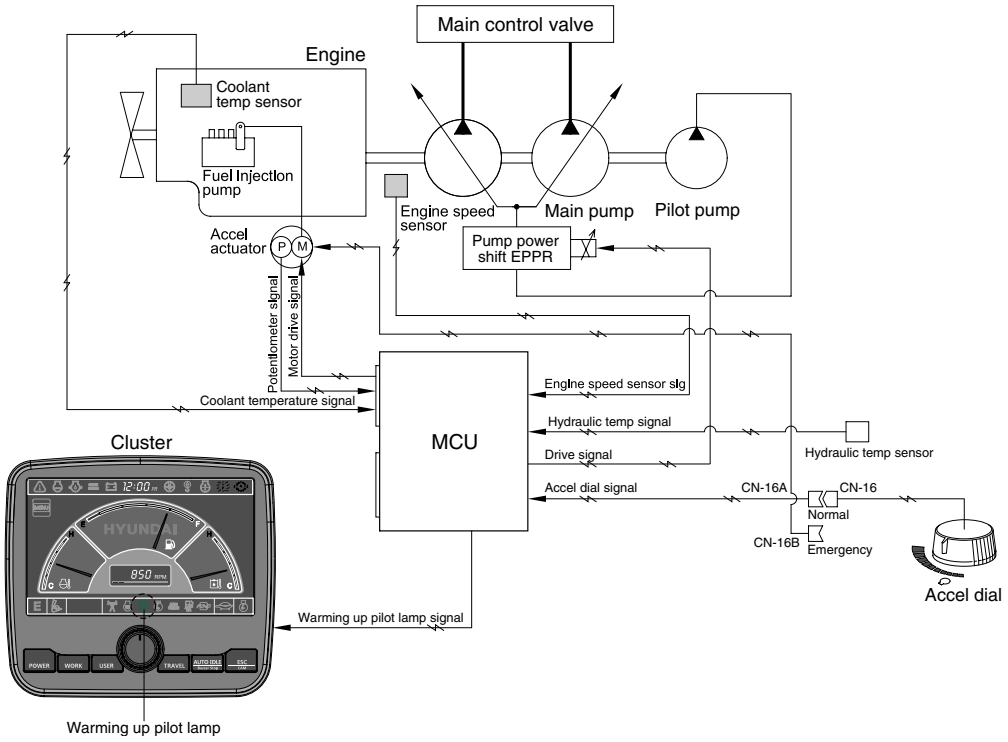
3309S5MS25

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)



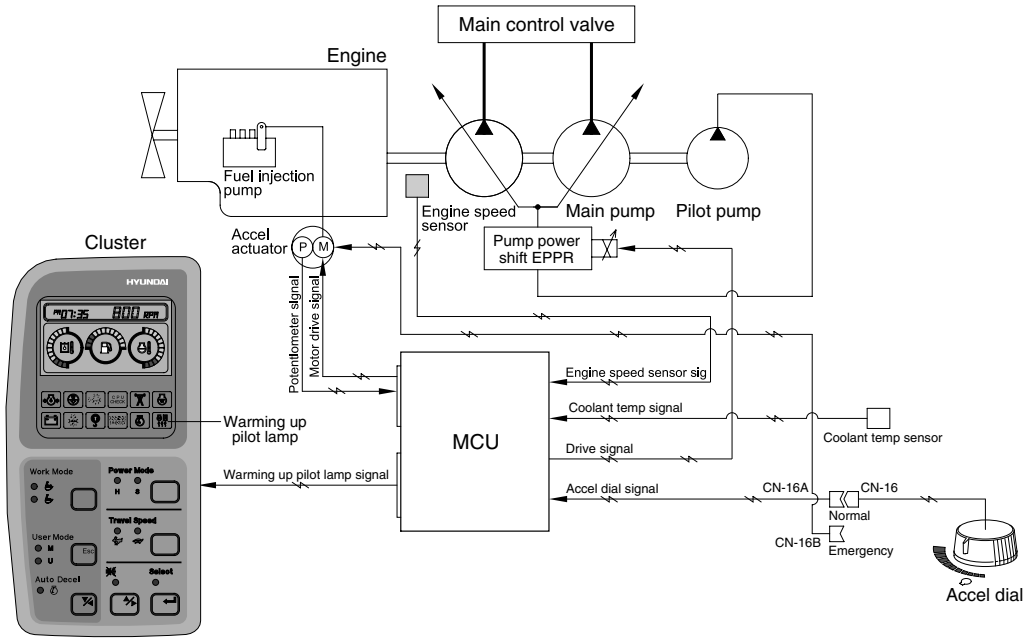
3009SH5MS08

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 (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)



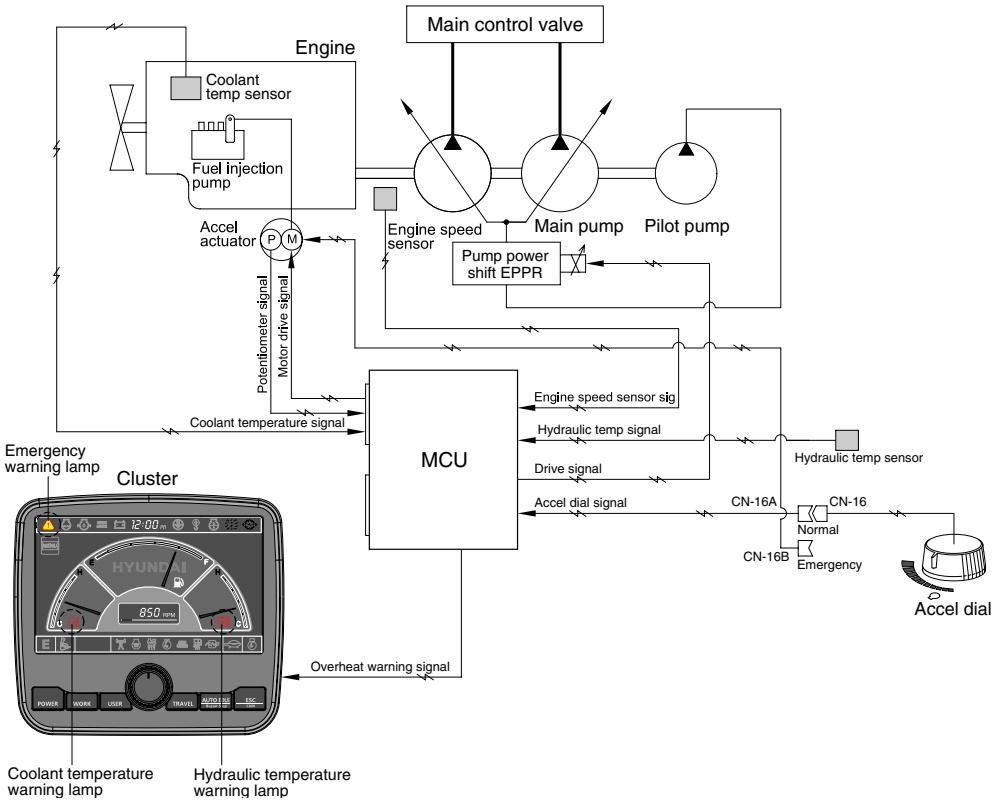
3009SH5MS26

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.
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 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) - Accel dial poisition is under 30˚C	- Power mode : Default (S mode) - Warming up time : 10 minutes (max) - Warming up lamp : ON
Canceled	- Coolant temperature : Above 30˚C - Warming up time : Above 10 minutes - Changed mode set by operator - Increase engine speed by rotating accel dial clockwise ※ If any of the above conditions is applicable, the automatic warming up function is canceled	- Power mode : set mode - Warming up pilot lamp : OFF
Warming up lamp	- Coolant temperature : Above 30˚C	- Warming up lamp : OFF

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM (CLUSTER TYPE 1)



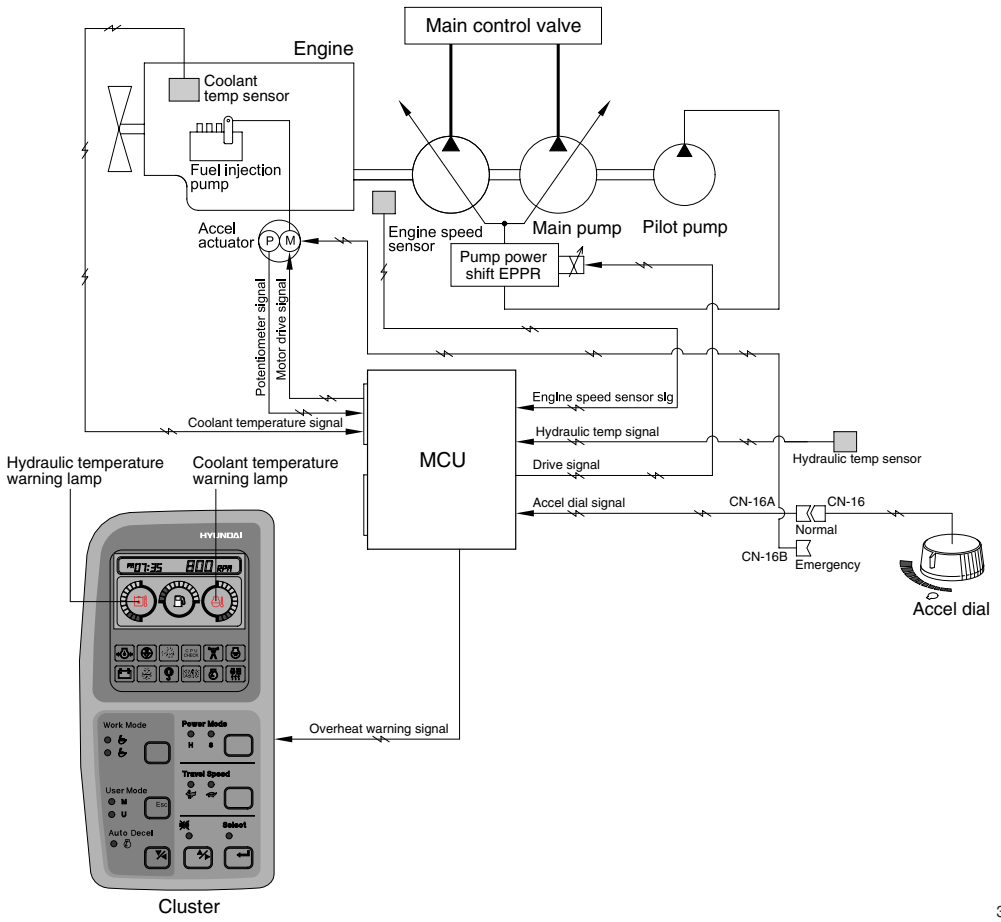
3009SH5MS09A

1. 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 & buzzer : ON - Pump input torque is reduced.
	Canceled	- Coolant or hydraulic oil temperature : Less than 95˚C	- Return to pre-set the pump input 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 input torque on the first step warning.

■ ENGINE OVERHEAT PREVENTION SYSTEM (CLUSTER TYPE 2)



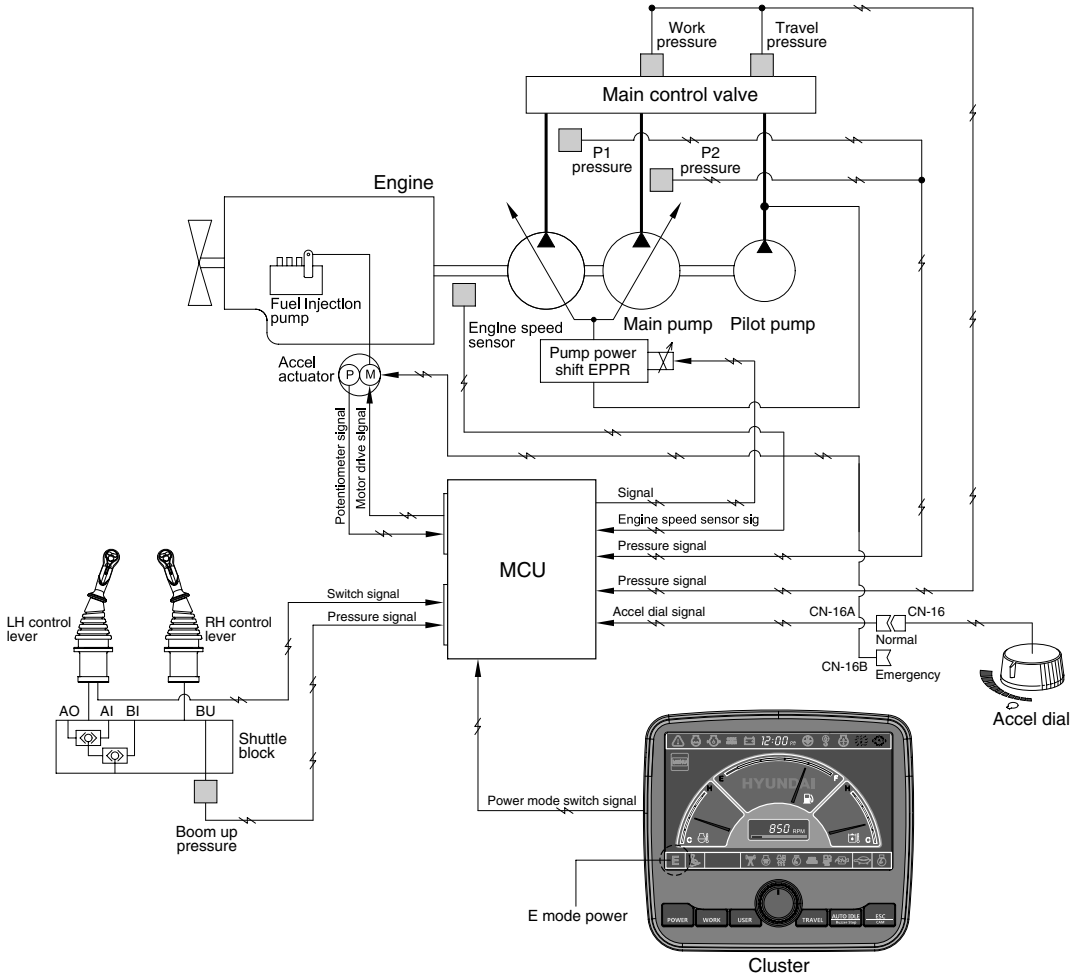
1. MCU receives engine coolant temperature through the temperature sensor and when the engine coolant boils up to 110˚C, it sends overheat warning signal to the cluster and decrease the engine speed same as accel dial 7 position.

2. If the coolant temperature drops less than 100˚C, the MCU returns the mode to the mode set before. And if mode set is changed during the function, the MCU cancels the function.
   Even if the overheat prevention function is canceled by mode change, the overheat warning lamp turns OFF only when the coolant temperature is less than 100˚C.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : Above 110˚C - Accel dial set : Above 8	- Engine rpm drop to accel dial 7 position - Overheat warning lamp & buzzer : ON
Canceled	- Coolant temperature : Less than 100˚C - Changed mode set by operator ※ If any of the above conditions is applicable, engine overheat prevention function is canceled	- Return to the mode and accel dial set before - Hold on the changed set
Overheat warning lamp	- Coolant temperature : Less than 100˚C	- Overheat warning lamp : OFF

GROUP 8 VARIABLE POWER CONTROL SYSTEM (CLUSTER TYPE 1)

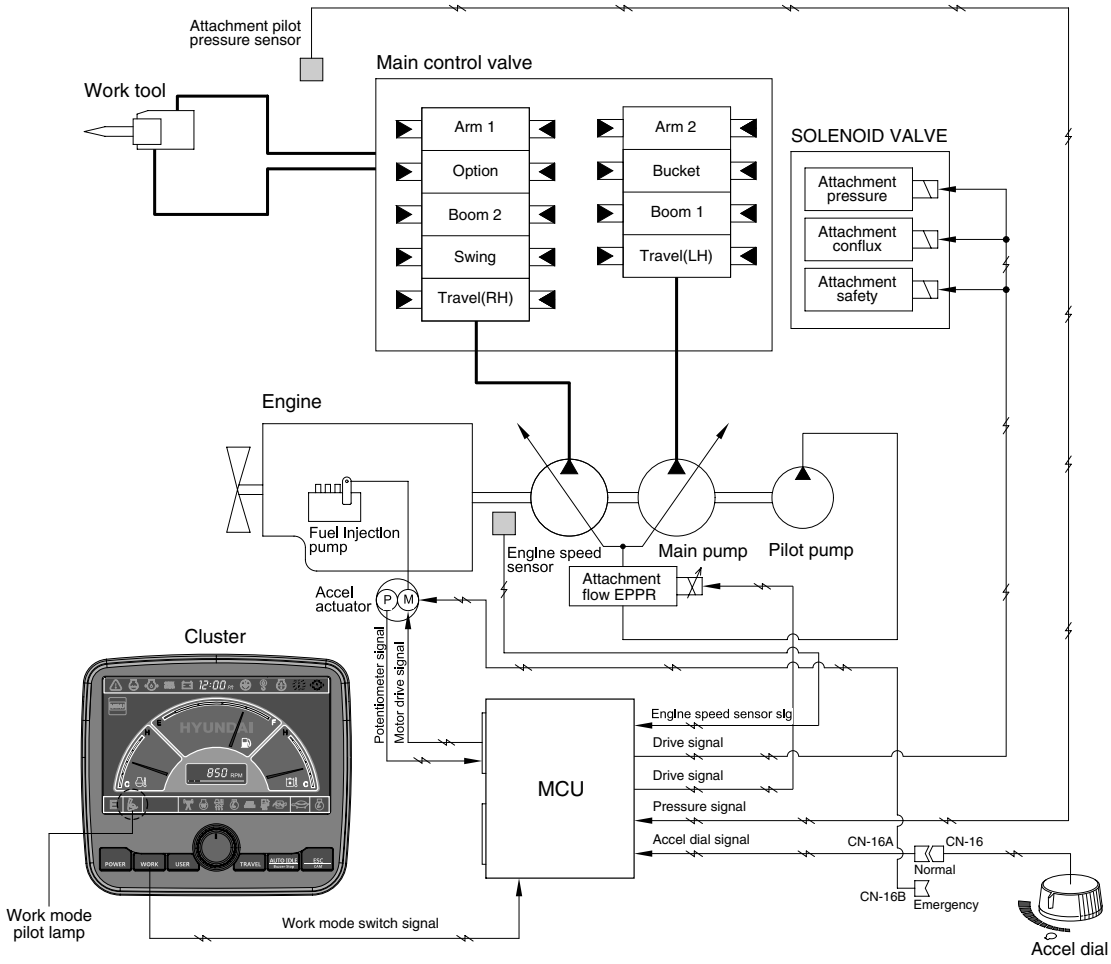


· The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.
It makes fuel saving and smooth control at precise work.

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)



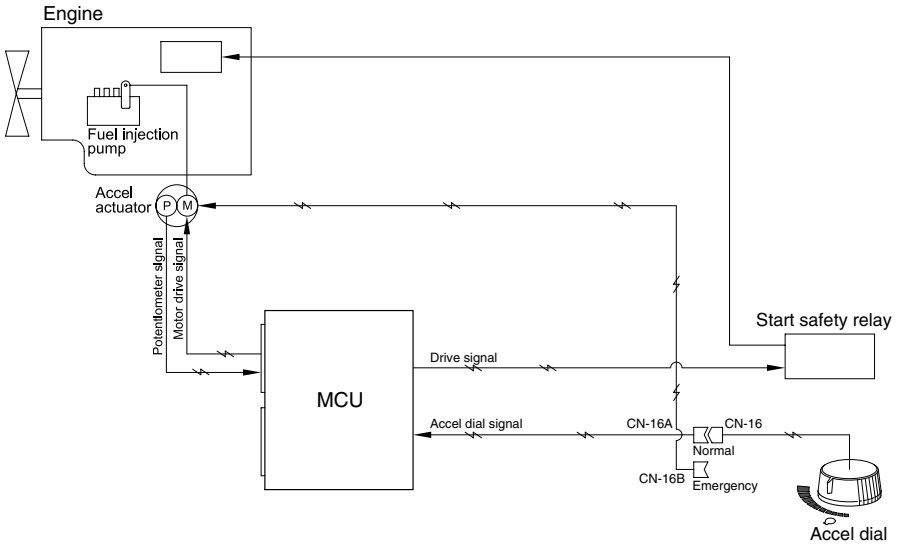
3309S5MS11

· 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 5-51 for the attachment kinds and max flow.

GROUP 10 ANTI-RESTART SYSTEM



3009SH5MS12

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.

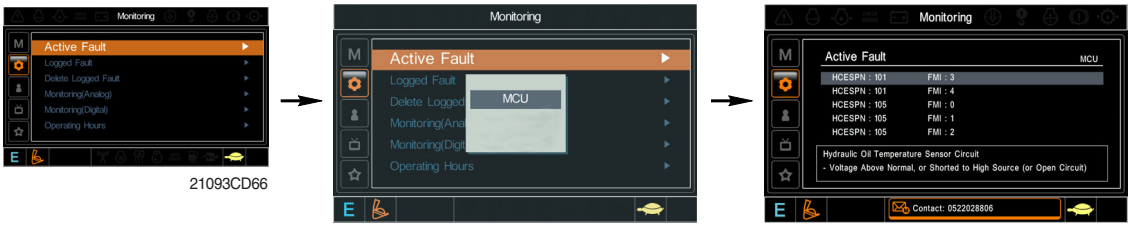
GROUP 11 SELF-DIAGNOSTIC SYSTEM (CLUSTER TYPE 1)

1. OUTLINE

When any abnormality occurs in the ADVENCED 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

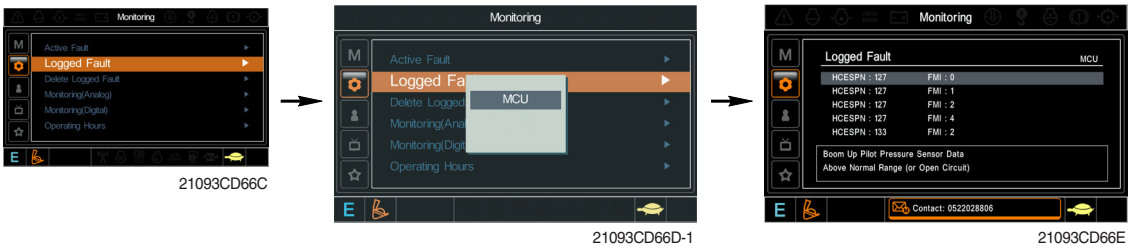
1) Active fault



21093CD66 21093CD66A-1 21093CD66B

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

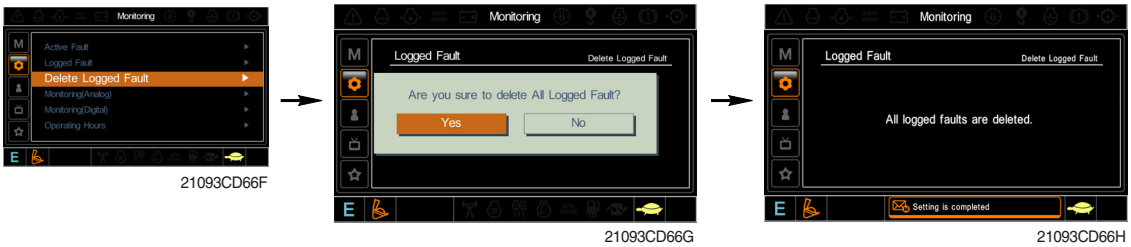
2) Logged fault



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	Overhead pressure sensor data above normal range.
	1	Overhead pressure sensor data below normal range.
	2	Overhead pressure sensor data error.
	4	Overhead 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 model.

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.
200	0	Pump EPPR 2nd pressure sensor data above normal range.
	1	Pump EPPR 2nd pressure sensor data below normal range.
	2	Pump EPPR 2nd pressure sensor data error.
	4	Pump EPPR 2nd pressure sensor circuit - Voltage below normal, or shorted to low source.
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 model.

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	RCM communication data error.

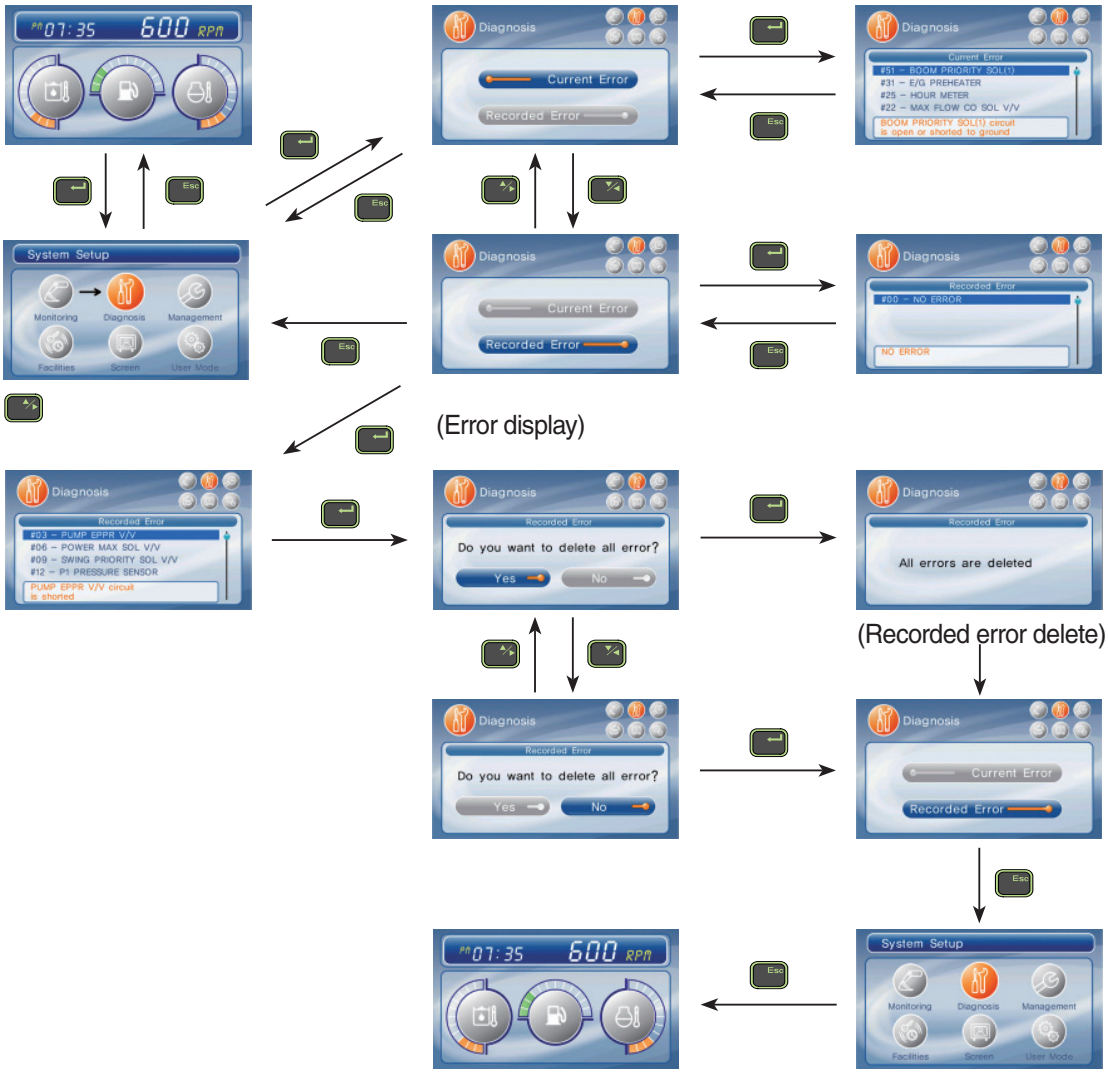
※ Some error codes are not applied to this model.

■ 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

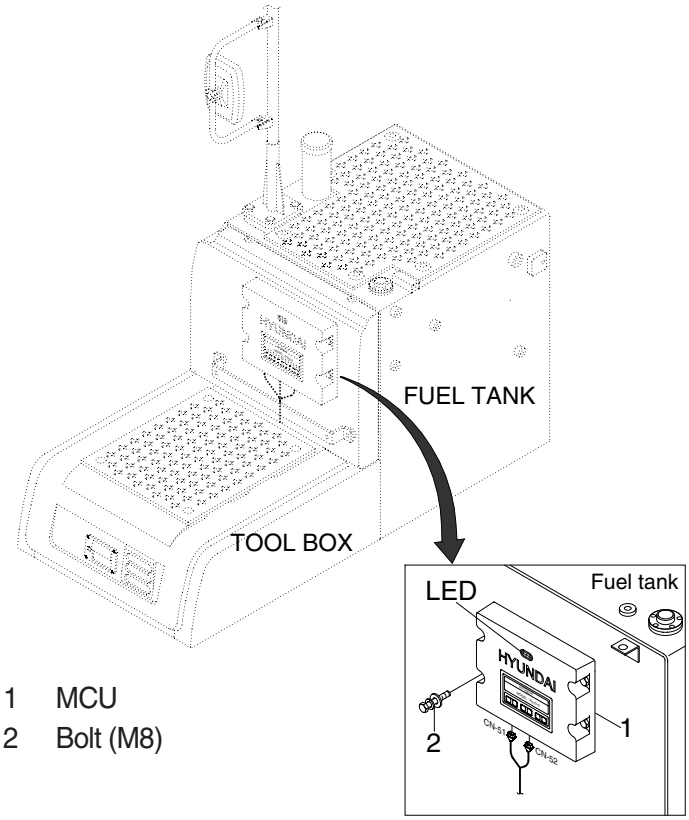


3. ERROR CODES TABLE

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 (5 V) 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 (24V) 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	Altemator circuit is open or shorted to ground
34	Controller input voltage is below 18V

Error code No.	Description
35	Controller input voltage is below 38V
36	Communication error with cluster
37	Engine speed sensor circuit is open or shorted to ground
38	Aati-restart relay circuit is open or shorted to ground
39	Accel actuator does not stop at a target position
40	There is more than 500 rpm difference between target speed and actual speed
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	Heavy duty work solenoid circuit is open or shorted to battery +
56	Travel alarm buzzer circuit is shorted to battery +
58	Heavy duty work solenoid circuit is shorted to battery +

1. MCU (Machine Control Unit)



1 MCU
2 Bolt (M8)

3009SH5MS13

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.

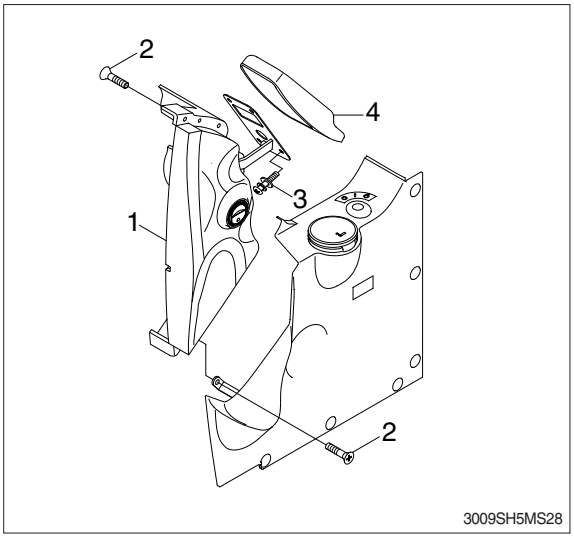
LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on MCU	- Change the MCU
G and Y are turned ON	Trouble on serial communication line	- Check if serial communication lines between controller and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	- Check 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)

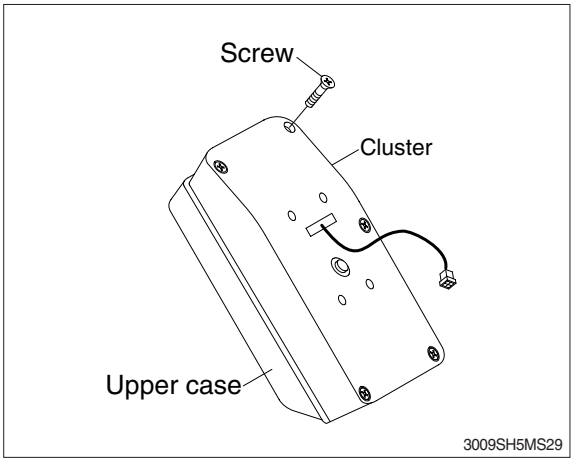
1) Disassemble screws (2) and wiper motor cover (1).

2) Disassemble hexgon socket bolts (3) and cluster (4).

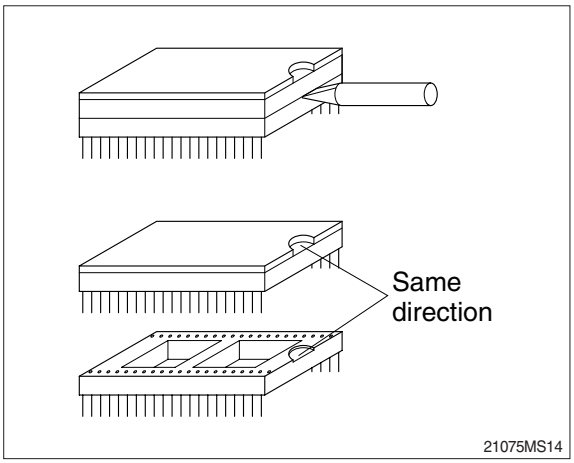


4) Loosen the screws (6EA) located back of the cluster.

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



6) Install the new ROM. (Be careful of direction and assemlbe 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.

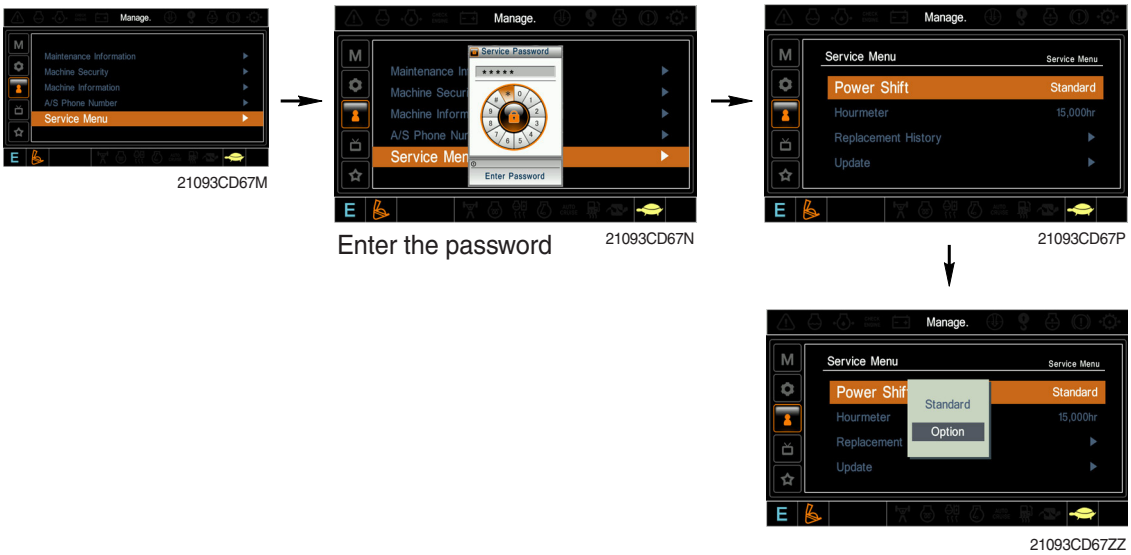
(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm²	psi		
Standard (Stage : 1.0)	P	12 ± 3	171 ± 40	360 ± 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 ± 3	100 ± 40	280 ± 30	2100 ± 50
	S	7 ± 3	100 ± 40	280 ± 30	2050 ± 50
	E	12 ± 3	171 ± 40	360 ± 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.

■ 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 hydraulic pump flow.
When the electro magnet valve is activated, pilot pressure enters into flow regulator of hydraulic pump.
So, pump flow decreases to prevent engine stall.

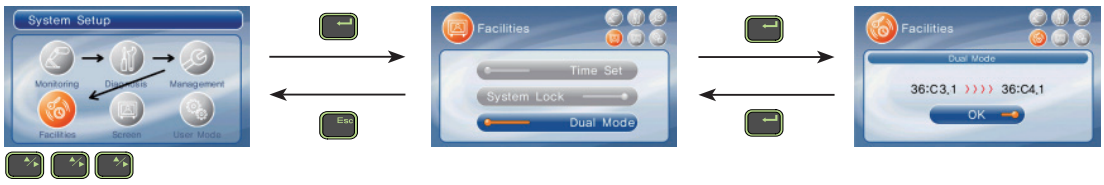
(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm²	psi		
Standard (Stage : 1.0)	M	10 ± 3	142 ± 40	330 ± 30	2100 ± 50
	H	10 ± 3	142 ± 40	330 ± 30	2000 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1900 ± 50
Option (Stage : 2.0)	M	7 ± 3	100 ± 40	280 ± 30	2100 ± 50
	H	7 ± 3	100 ± 40	280 ± 30	2050 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1950 ± 50

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

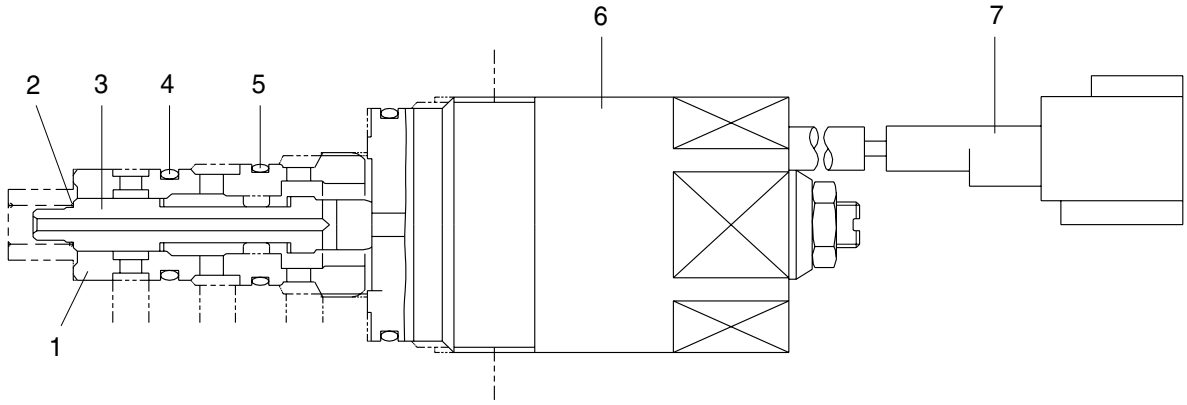
You can switch the EPPR valve pressure set by selecting the version (3.1 ↔ 4.1).

- Dual mode
  · Changing the MCU mode



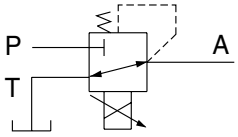
3) OPERATING PRINCIPLE (pump EPPR valve, cluster type 1,2)

(1) Structure



5-22(1)

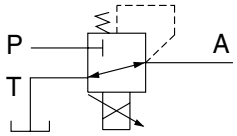
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

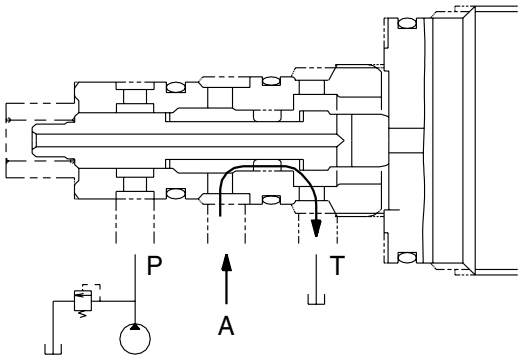


P	Pilot oil supply line (pilot pressure)
T	Return to tank
A	Secondary pressure to flow regulator at main pump

(2) Neutral

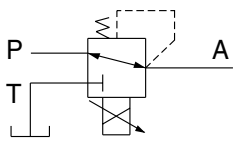
Pressure line is blocked and A oil returns to tank.

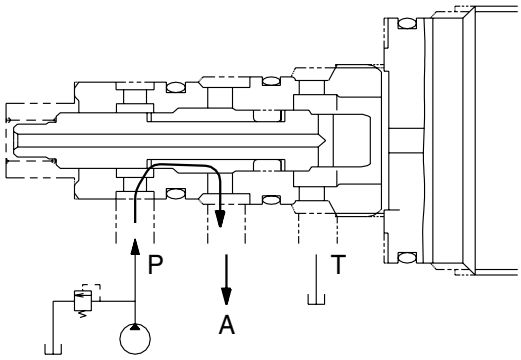




(3) Operating

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.

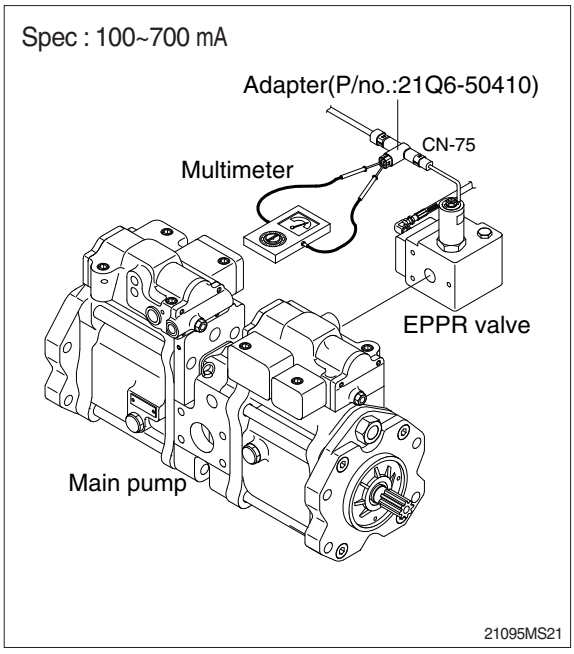
③ Start engine.

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 (HCEC engine:1850±50 rpm) check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.



(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.

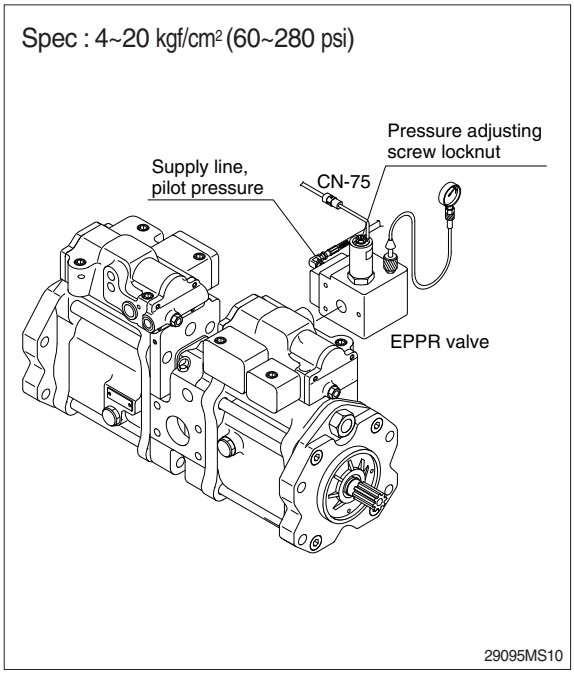
③ Set power-mode and cancel auto decel mode.
: cluster type 1 : S mode
cluster type 2 : H mode

④ Position the accel dial at 10.

⑤ If tachometer show approx 2000±50 rpm (HCEC engine:1850±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. BOOM PRIORITY EPPR VALVE (Cluster type 1,2)

1) COMPOSITION

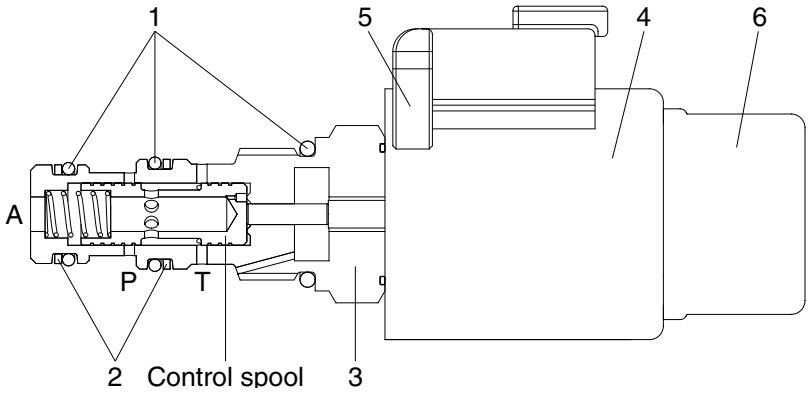
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

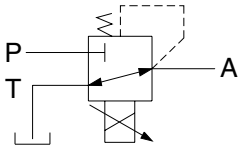
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

3) OPERATING PRINCIPLE

(1) Structure



21095MS14



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

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

(2) Operation

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

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

(3) Maximum pressure relief

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

2) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

① Disconnect connector CN-133 from EPPR valve.

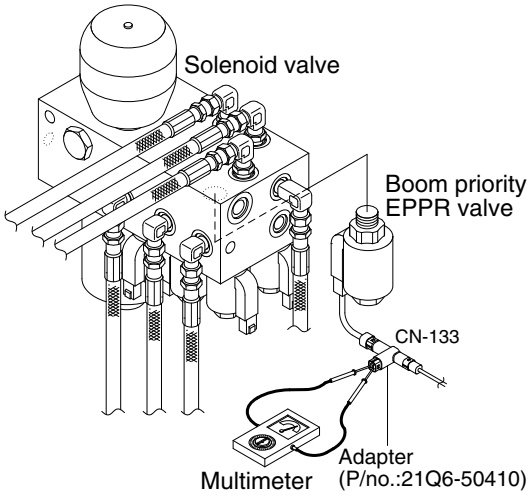
② Insert the adapter to CN-133 and install multimeter as figure.

③ Start engine.

④ If rpm display approx 2000±50 rpm (HCEC engine:1850±50 rpm) disconnect one wire harness from EPPR valve.

⑤ 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)

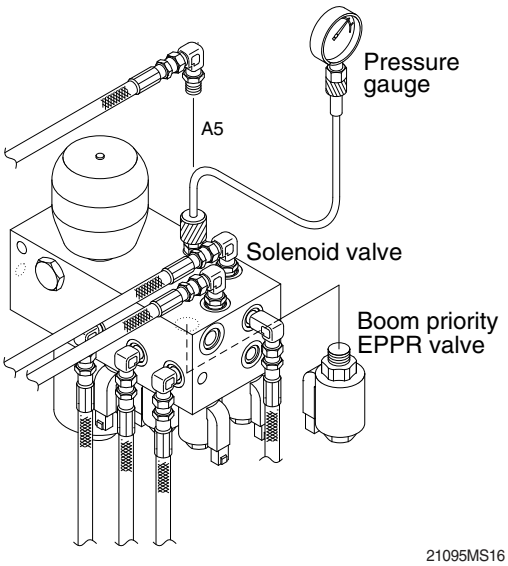
② Start engine.

③ If rpm display approx 2000±50 rpm (HCEC engine:1850±50 rpm) disconnect 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

GROUP 14 MONITORING SYSTEM (CLUSTER TYPE 1)

1. OUTLINE

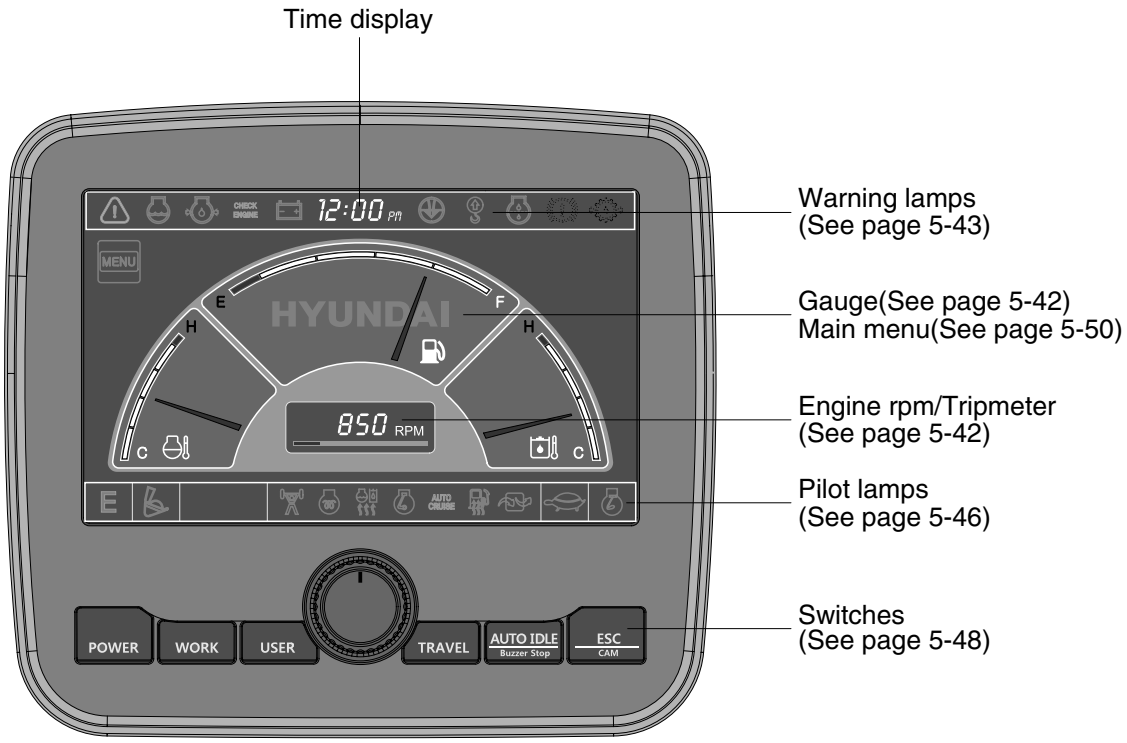
Monitoring system consists of the monitor part and switch part.

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



3009SH5MS31

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

※ When engine coolant temperature below 30˚C, the warming up pilot lamp lights up.

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 1200 rpm.

※ Others same as above.

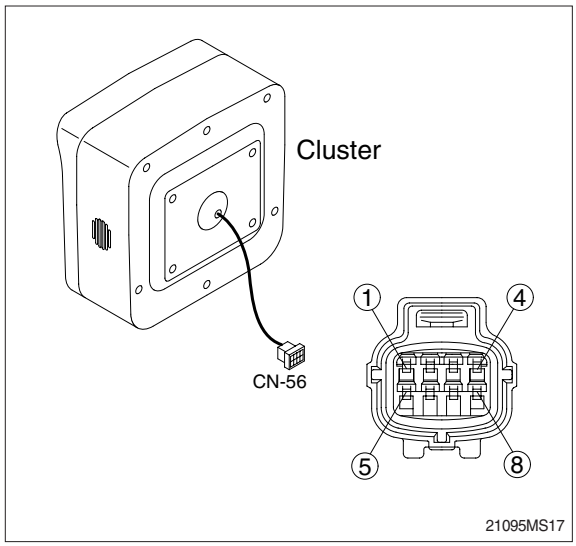
③ When abnormal condition

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.

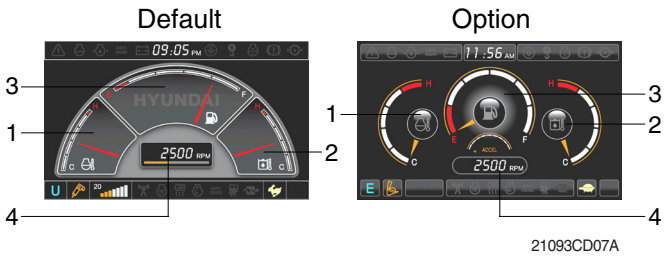
3. CLUSTER CONNECTOR

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



2) GAUGE

(1) Operation screen

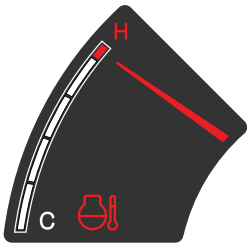


21093CD07A

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 5-60 for details.**

(2) Engine coolant temperature gauge



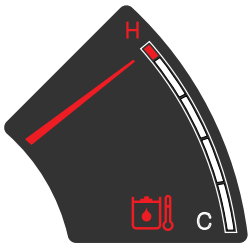
21093CD07G

① This gauge indicates the temperature of coolant.
- 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 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



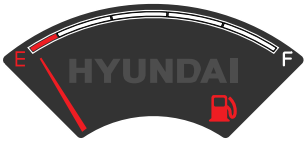
21093CD07E

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

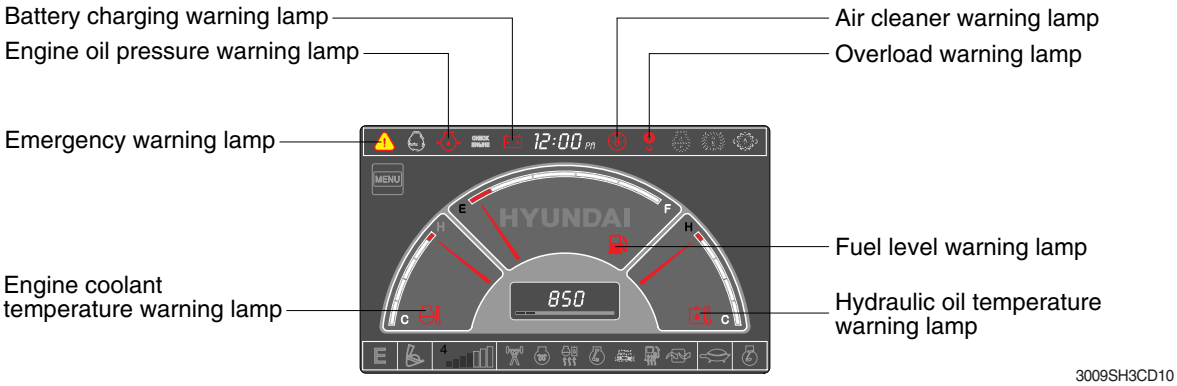


21093CD02D

① This displays the engine rpm or the tripmeter.

※ **Refer to page 5-60 for details.**

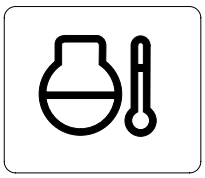
3) WARNING LAMPS



3009SH3CD10

※ **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 5-49 for the select switch.

(1) Engine coolant temperature



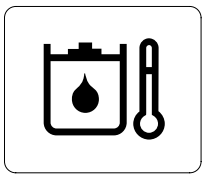
21093CD08A

① Engine coolant 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 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 69 ℓ (18.2 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp



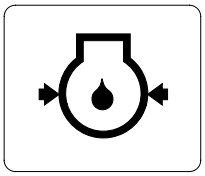
21093CD30

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

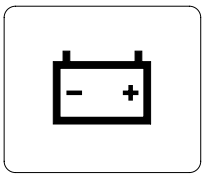


21093CD32

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

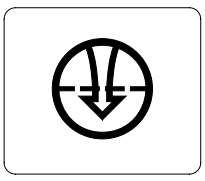


21093CD34

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

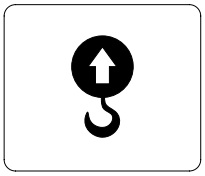


21093CD35

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)

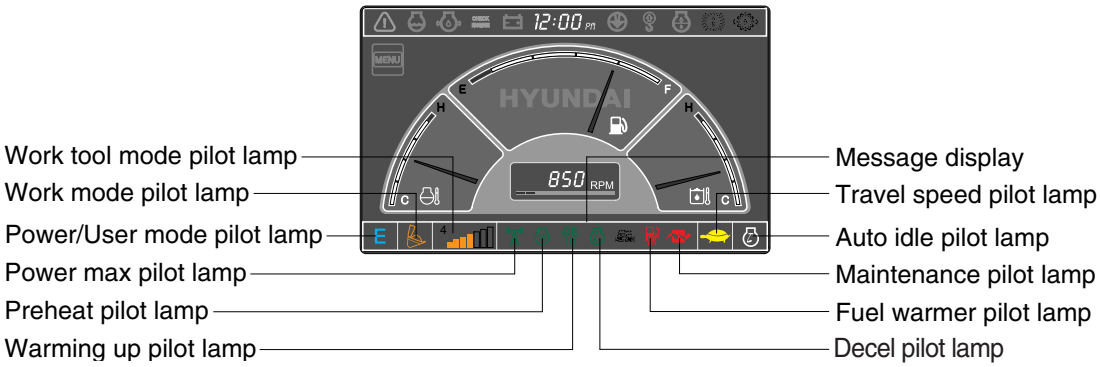


21093CD36

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



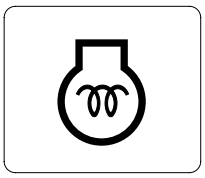
21093CD38

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 3-38 for power max function.**

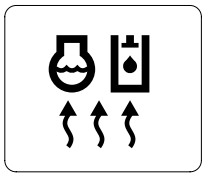
(3) Preheat pilot lamp



21093CD39

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

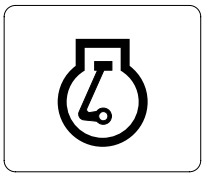
(4) Warming up pilot lamp



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



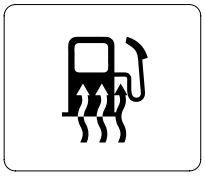
21093CD41

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 3-38.

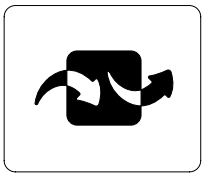
(6) Fuel warmer pilot lamp



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.

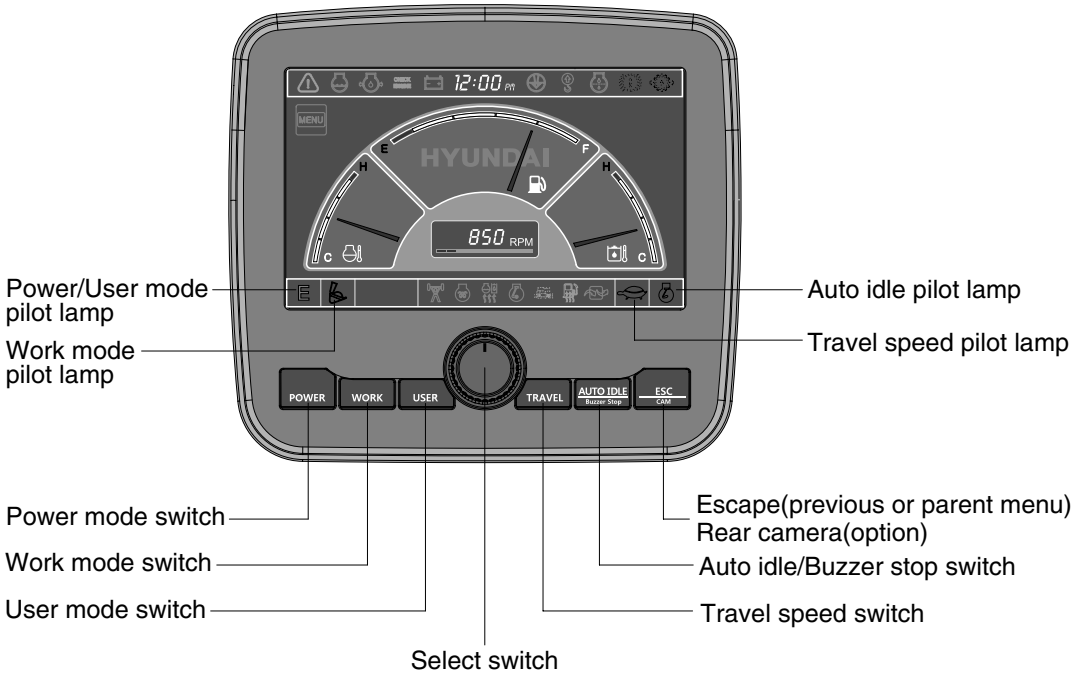
(7) Maintenance pilot lamp



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.

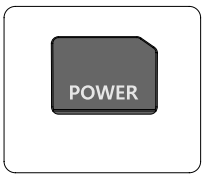
5) SWITCHES



21093CD45

※ **When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-46 for details.**

(1) Power mode switch

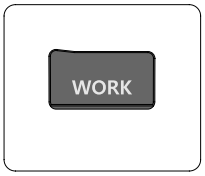


21093CD45A

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

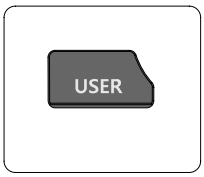


21093CD45C

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 4-6 for details.**

(3) User mode switch

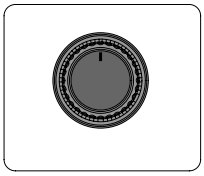


21093CD45D

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 5-51 for another set of user mode.

(4) Select switch



21093CD45E

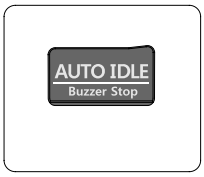
① This switch is used to select or change the menu and input value.

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

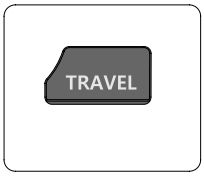


21093CD45F

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.

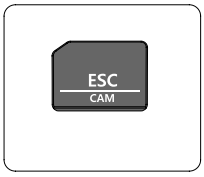
(6) Travel speed control switch



21093CD45G

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

(7) Escape/Camera switch



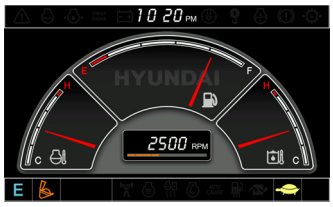
21093CD45H

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 5-61 for the camera.

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

6) MAIN MENU



21093CD64



21093CD64A

Press



21093CD64B

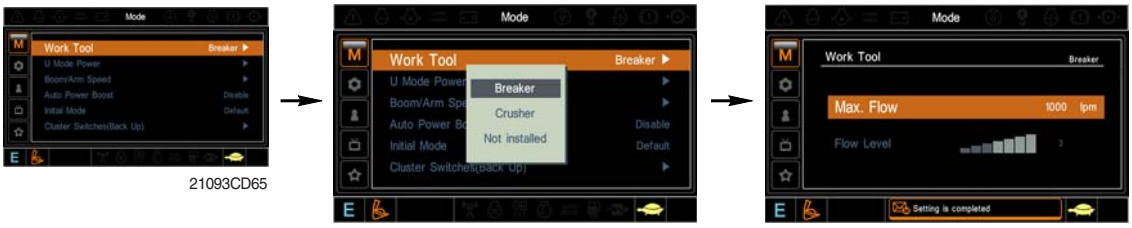
※ **Please refer to select switch, page 5-49 for selection and change of menu and input value.**

(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 start, 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



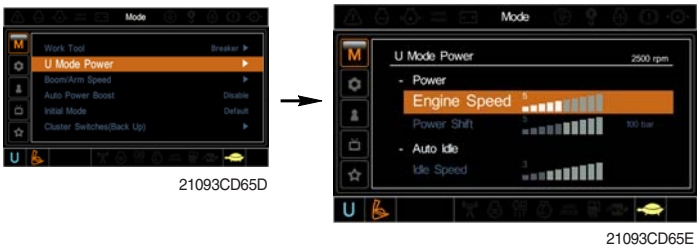
21093CD65 21093CD65A 21093CD65B

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

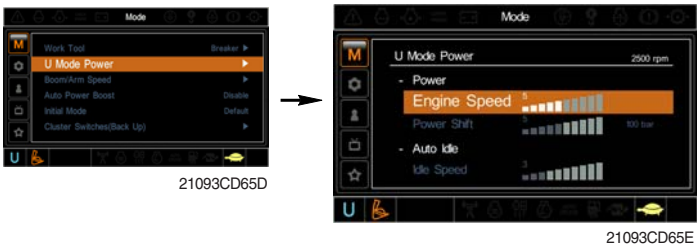


21093CD65D 21093CD65E

- 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	1850	1200	12
6	1900	1250	16
7	1950	1300	20
8	2000	1350	26
9	2050	1400	32
10	2100	1450	38

② U mode power (HCEC engine)

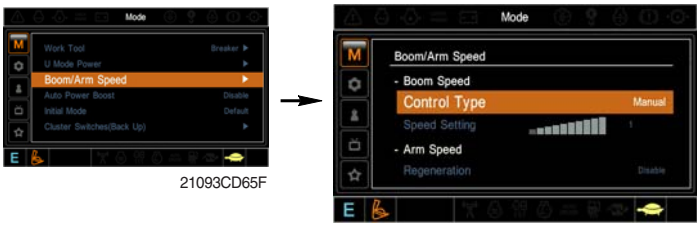


21093CD65D 21093CD65E

- 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	1400	1000	0
2	1500	1050 (auto decel)	3
3	1550	1100	6
4	1650	1150	9
5	1700	1200	12
6	1750	1250	16
7	1800	1300	20
8	1850	1350	26
9	1900	1400	32
10	1950	1450	38

③ Boom/Arm speed

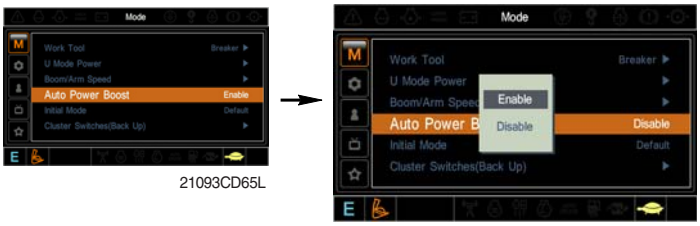


21093CD65F 21093CD65G

· **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.

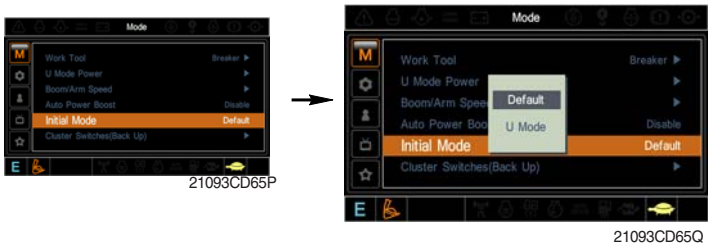
④ Auto power boost



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.

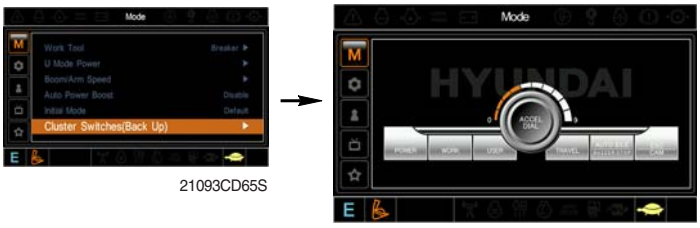
⑤ Initial mode



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**



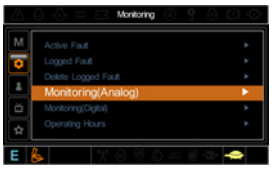
21093CD66F

21093CD66G

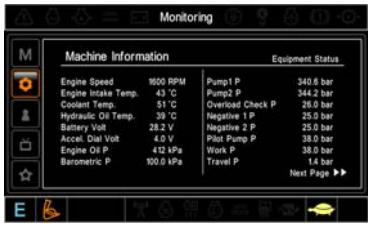
21093CD66H

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

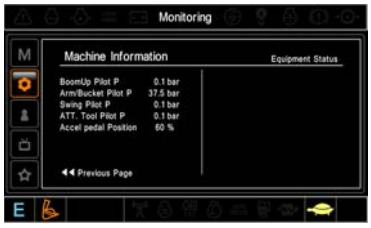
④ **Monitoring**(Analog)



21093CD66J



21093CD66K



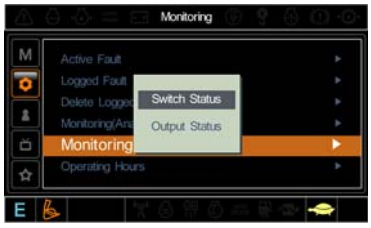
21093CD66L

· 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



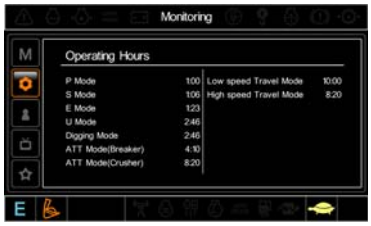
21093CD66P

· 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

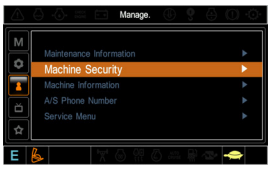


21093CD67 21093CD67A 21093CD67Q 21093CD67R 21093CD67S 21093CD67T

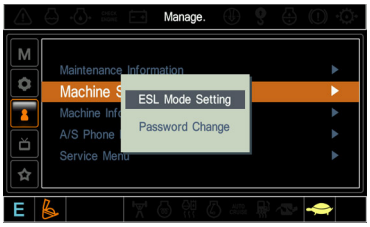
- Alarm(☼ ✹ ✹) : Gray ☼ - Normal
  Yellow ✹ - First warning
  Red ✹ - Second warning
- Replacement : The elapsed time will be reset to zero (0).
- Change interval : The change or replace interval can be changed in the unit of 50 hours.
- OK : Return to the item list screen.
- **Change or relpace interval**

No	Item	Interval
1	Engine oil	250
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	250
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

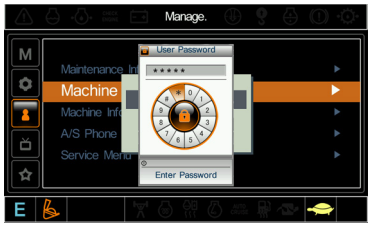
② Machine security



21093CD67C



21093CD67D



21093CD67E



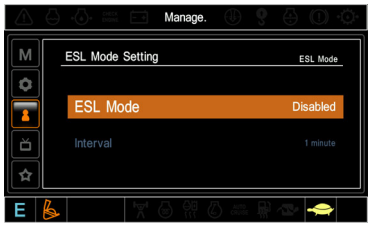
· **ESL mode**

- ESL : Engine Starting Limit
- ESL mode is desingned 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

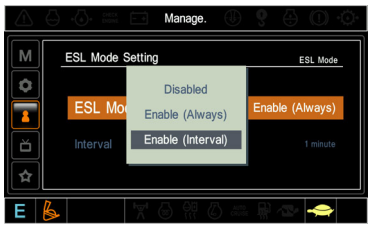
  Enable (always) : The password is required whenever the operator start engine.

  Enable (interval) : The password is required when the operator start engine first. But the operator restarts the engine within the interval time, the password is not required.

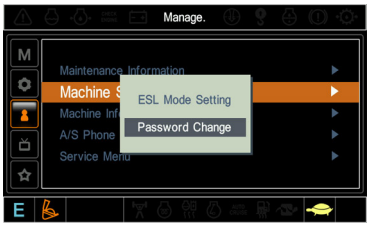
  The interval time can be set maximum 4 hours.



21093CD67EE



21093CD67H



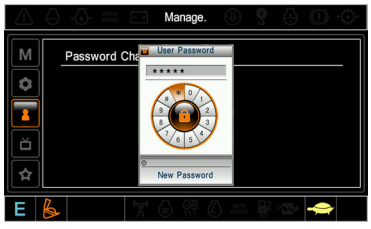
21093CD67U



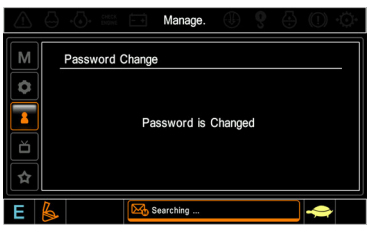
Enter the current password 21093CD67V

· **Password change**

- The password is 5~10 digits.



Enter the new password 21093CD67VV



21093CD67X

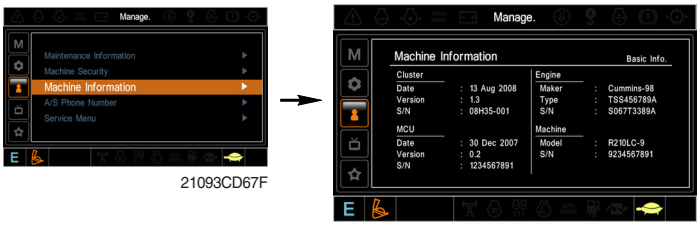
The new password is stored in the MCU.



21093CD67XX

Enter the new password again

③ Machine Information



21093CD67F 21093CD67G

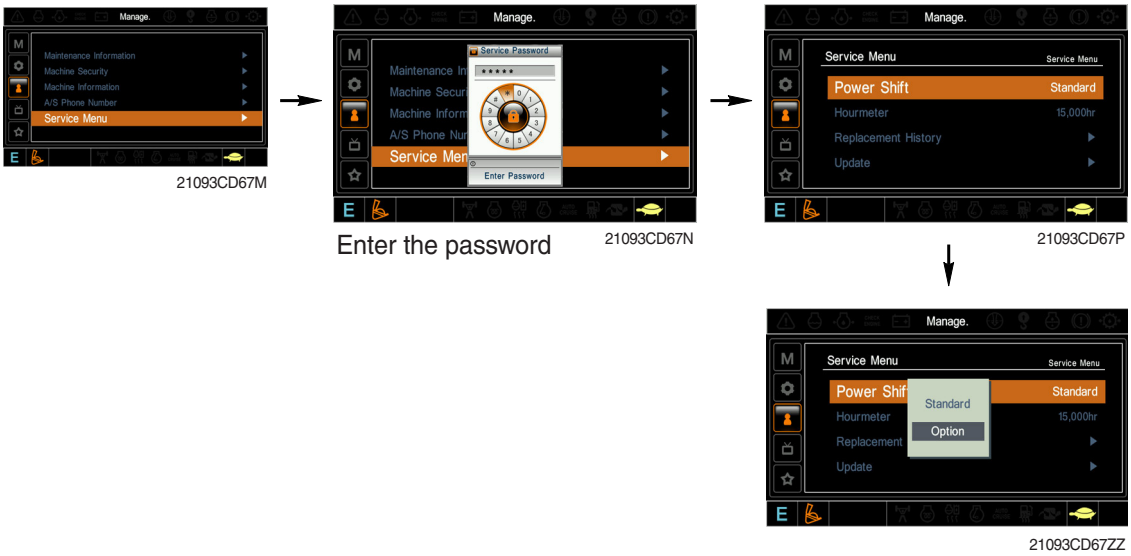
· This can confirm the identification of the cluster, MCU, engine and machine.

④ A/S phone number



21093CD67J 21093CD67K 21093CD67L 21093CD67Z 21093CD67Y

⑤ Service menu

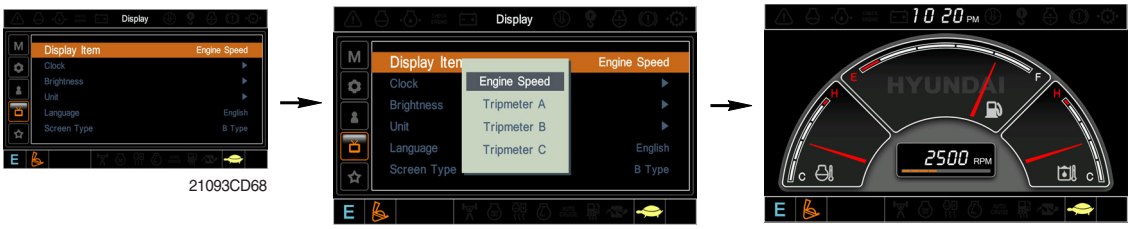


21093CD67M Enter the password 21093CD67N 21093CD67P 21093CD67ZZ

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



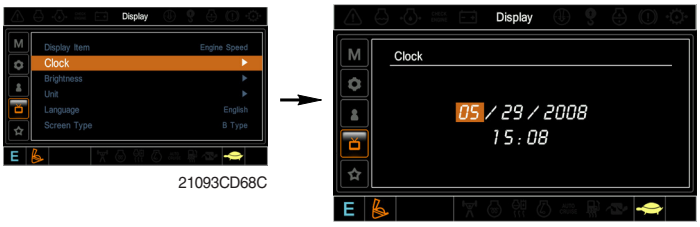
21093CD68 21093CD68A 21093CD68W

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.

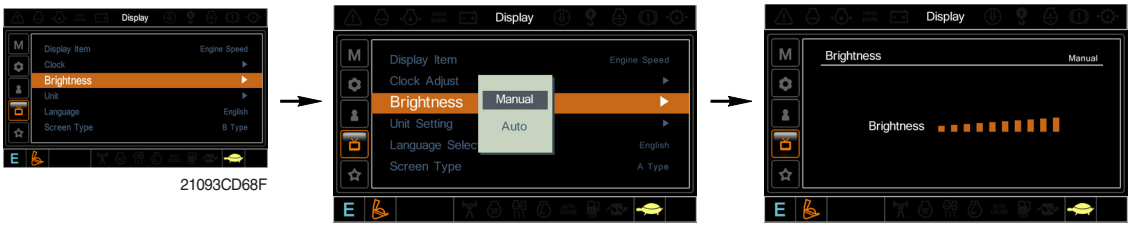
② Clock



21093CD68C 21093CD68D

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

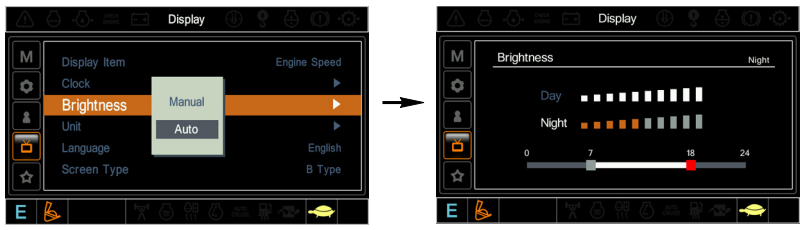
③ Brightness



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



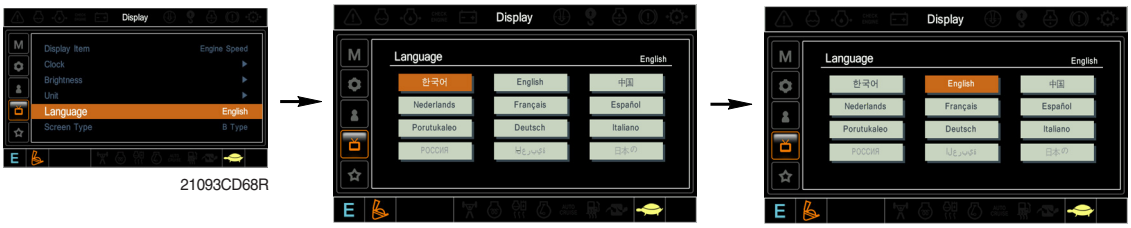
21093CD68L

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



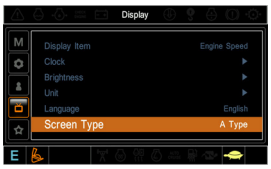
21093CD68R

21093CD68S

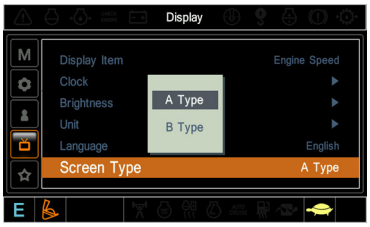
21093CD68T

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

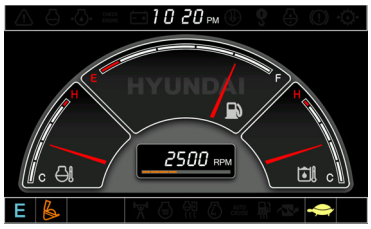
⑥ Screen type



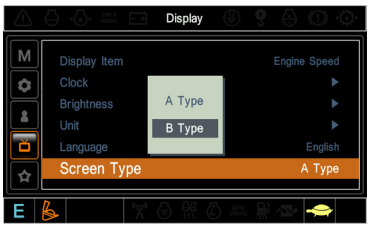
21093CD68U



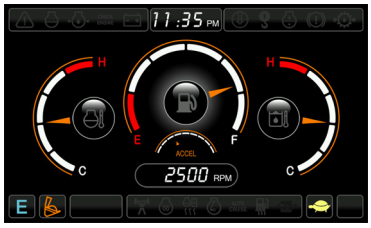
A Type 21093CD68V



Standard 21093CD68W



B Type 21093CD68X



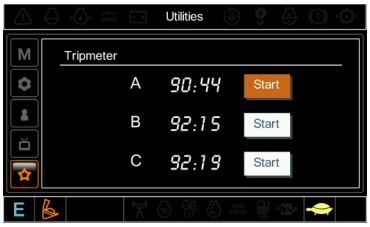
Option 21093CD68Y

(6) Utilities

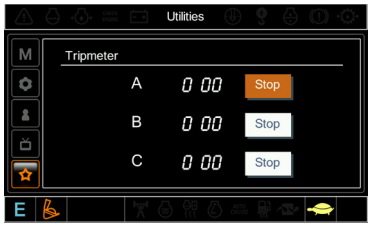
① Tripmeter



21093CD69



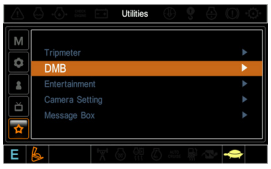
21093CD69A



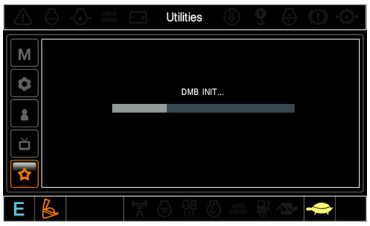
21093CD69B

- 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.

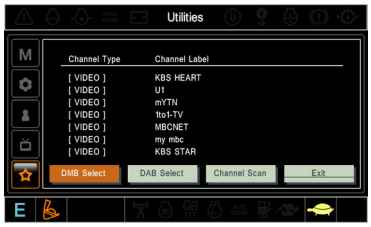
② DMB



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

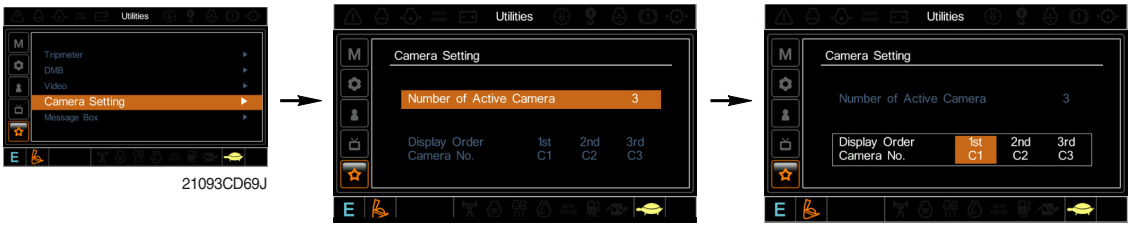
③ Entertainment

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



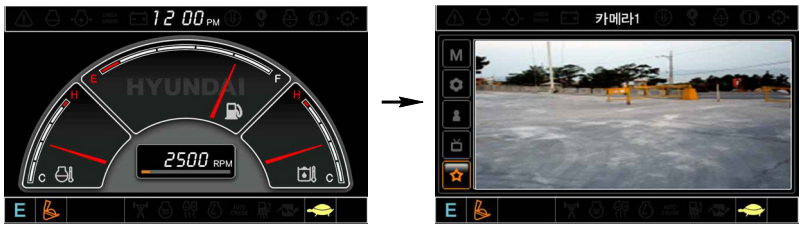
21093CD69F 21093CD69G

④ Camera setting



21093CD69J 21093CD69K 21093CD69L

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

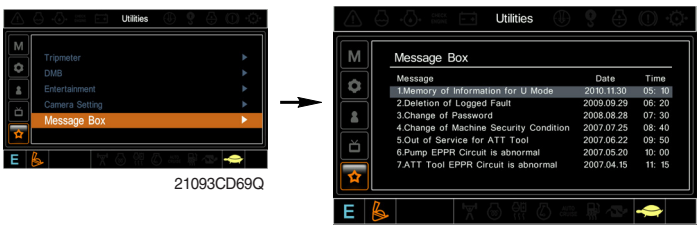


21093CD69M 21093CD69N

· 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

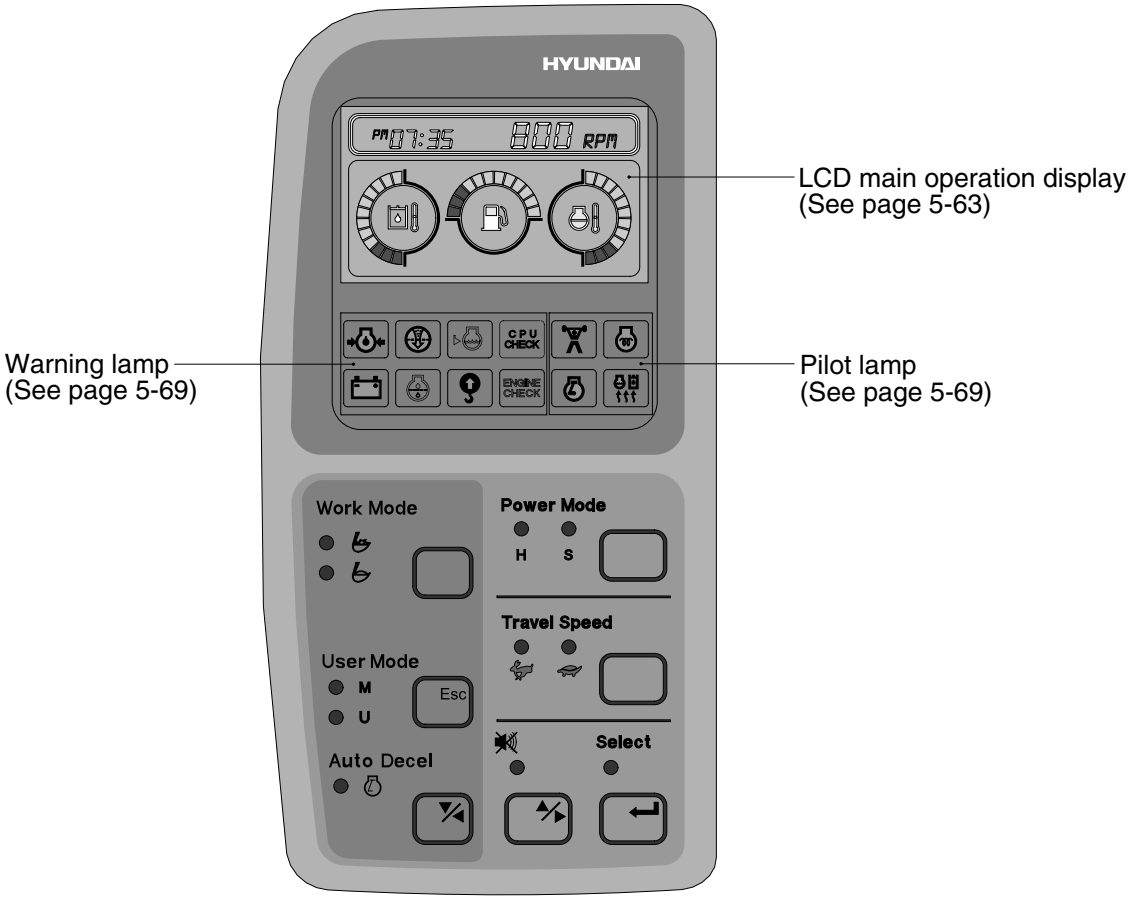
■ MONITORING SYSTEM (CLUSTER TYPE 2)

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.

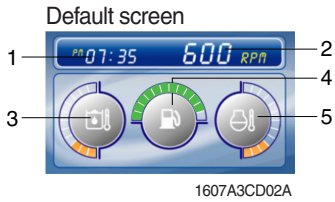
2. CLUSTER

1) MONITOR PANEL

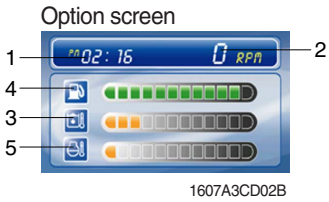


3009SH5MS30

2) LCD main operation display



1607A3CD02A



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 5-67 to set time for details.**

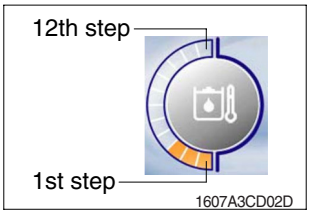
(2) RPM display



1607A3CD02C

① This displays the engine rpm.

(3) Hydraulic oil temperature gauge



1607A3CD02D

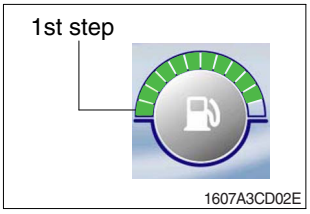
① This gauge indicates the temperature of hydraulic oil in 12 step gauge.
- ·1st step : Below 30˚C (86˚F)
- ·2nd~10th step : 30-105˚C (86-221˚F)
- ·11th~12th step : Above 105˚C (221˚F)

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



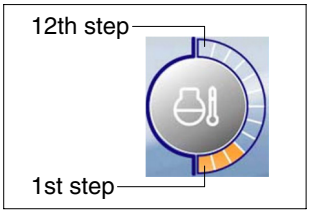
1607A3CD02E

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 69 ℓ (18.2 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



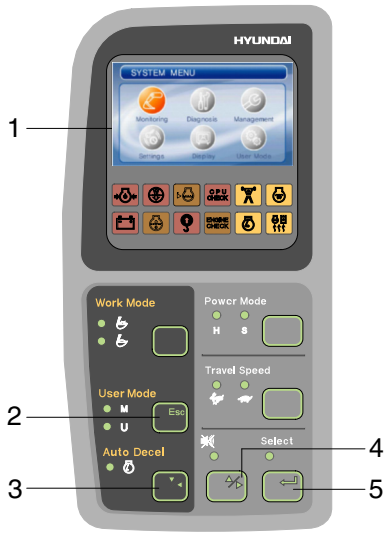
- Communication problem between MCU and cluster makes the lamp blinks and the buzzer sounds.
- Check if any fuse for MCU burnt off.
  If not check the communication line between them.

(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

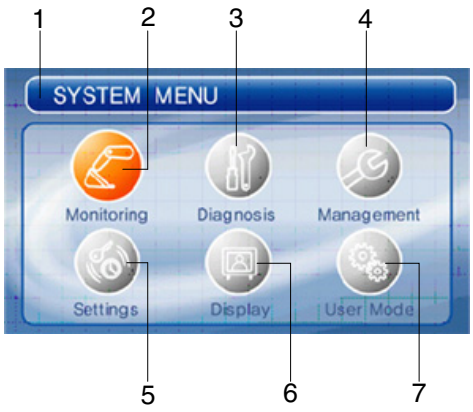
2 : Esc, Return to the previous menu

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

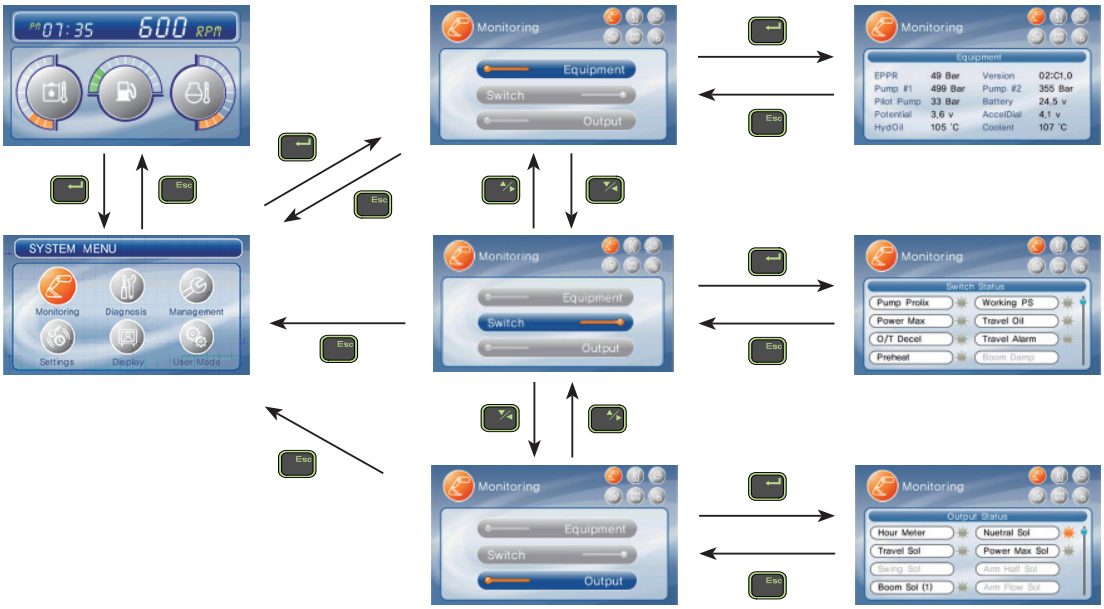
5 : Settings
- Time set, Dual mode
- System lock (reserved)

6 : Display
- Operation skin, Brightness, Language

7 : User mode

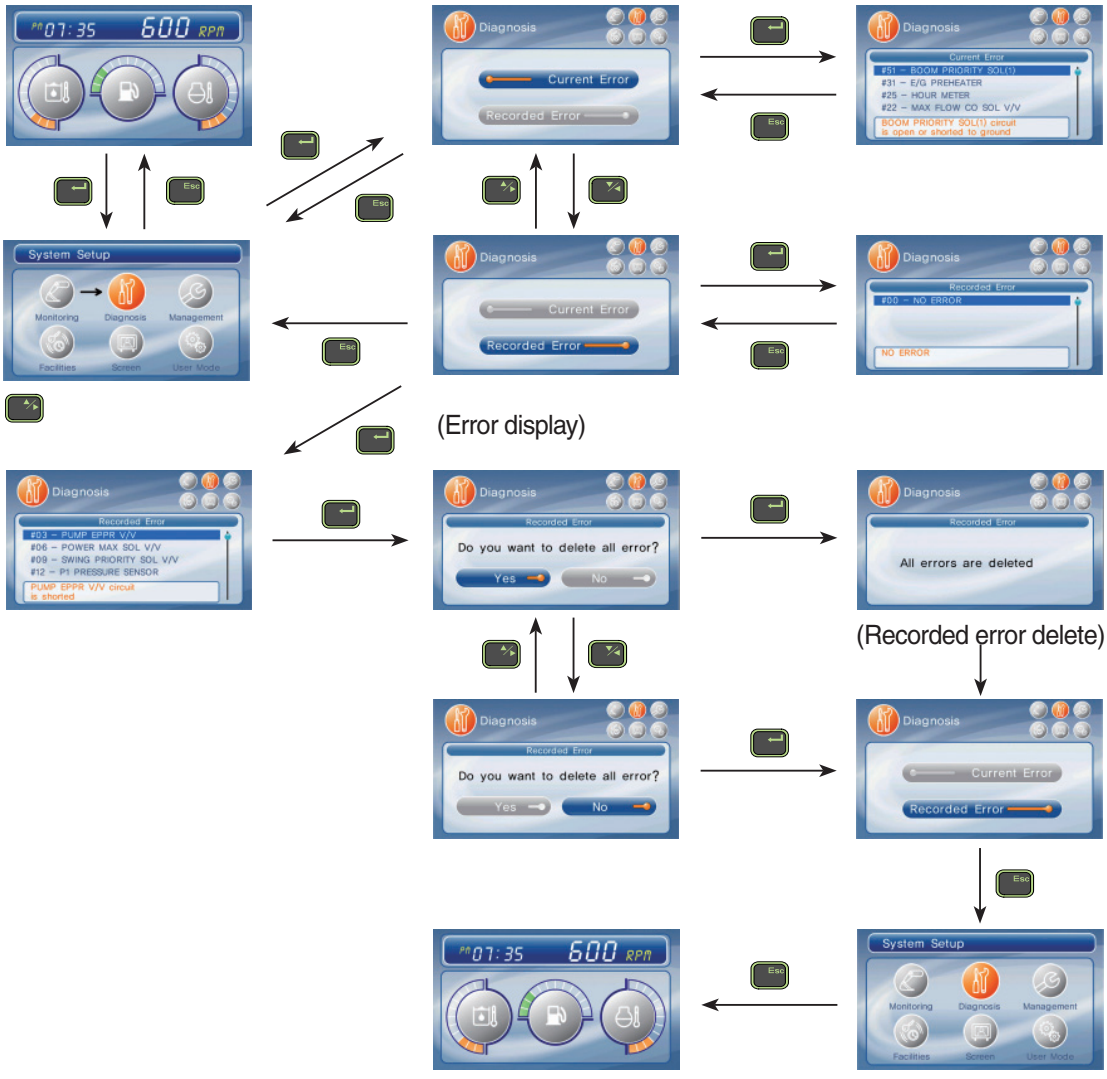
(2) Display map

① Monitoring



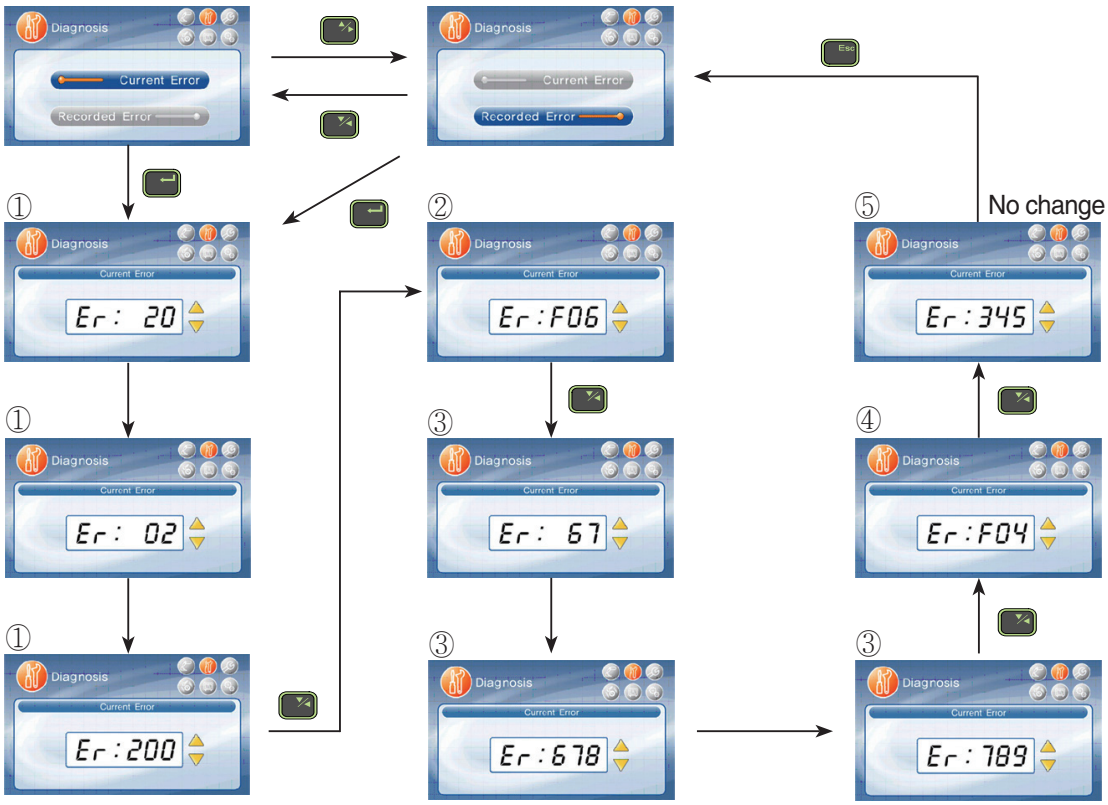
② Diagnosis

a. Protocol type 1

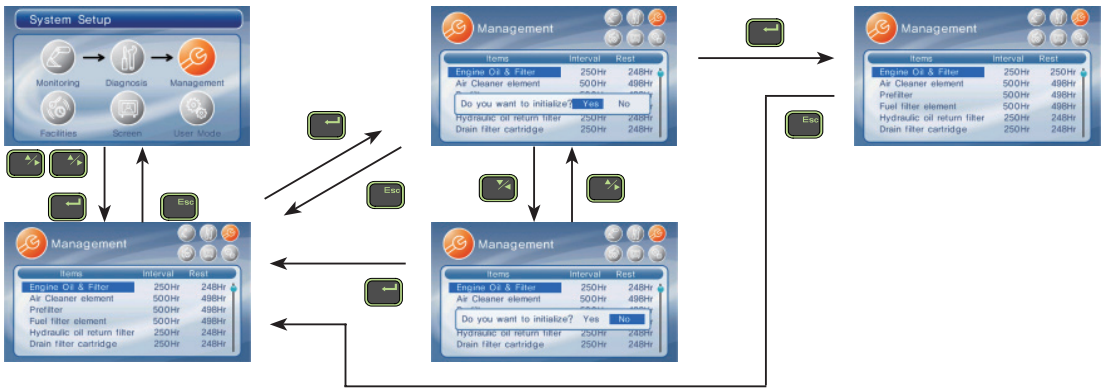


b. Protocol type 2

- 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.

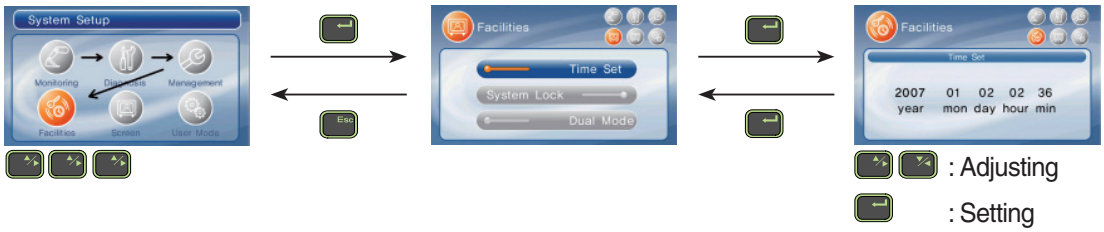


③ Maintenance



④ Setting

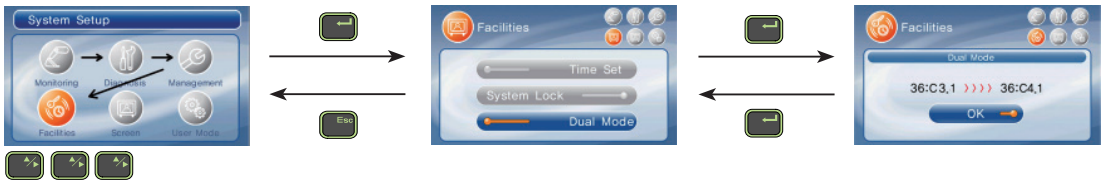
a. Time set



b. System lock - Reserved

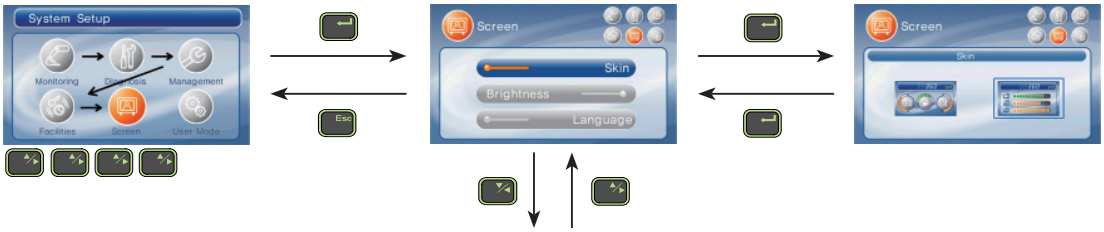
c. Dual mode

- Changing the MCU mode

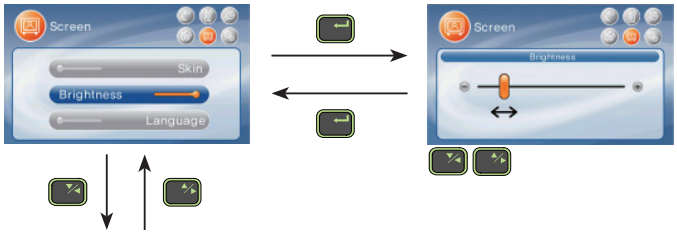


⑤ Display

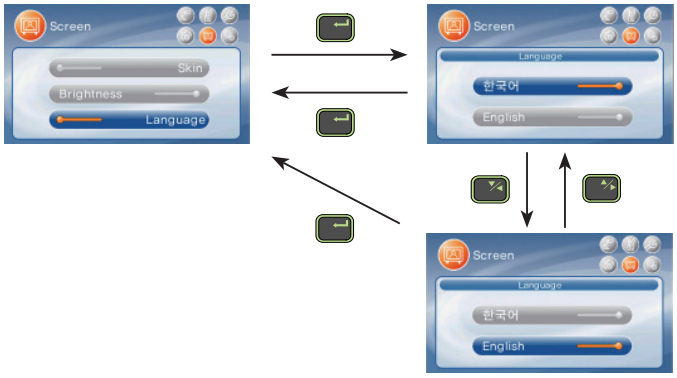
a. Operation skin



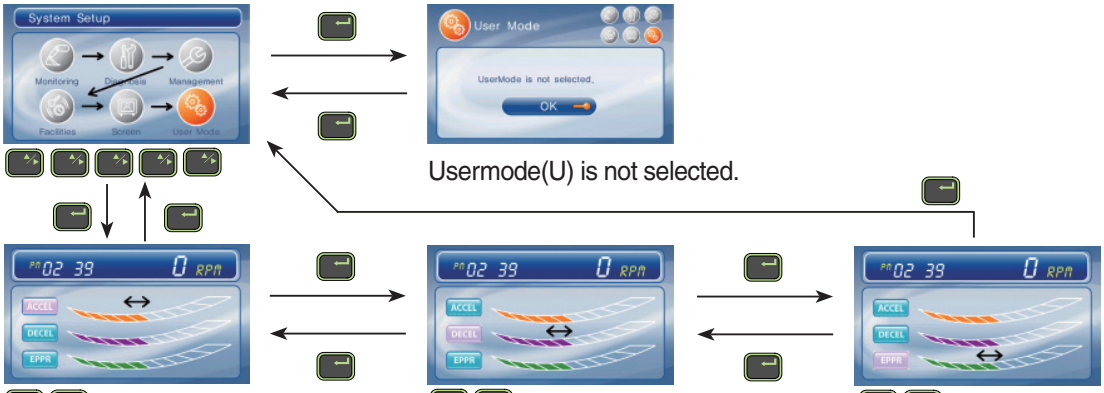
b. Brightness



c. Language

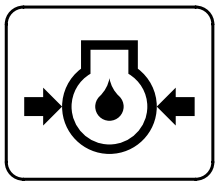


⑥ User mode



5) Warning and pilot lamp

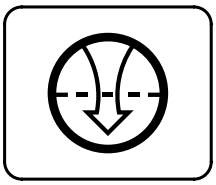
(1) Engine oil pressure warning lamp



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.

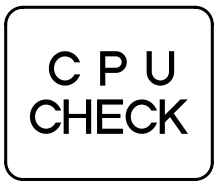
(2) Air cleaner warning lamp



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.

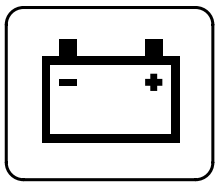
(3) CPU controller check warning lamp



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.

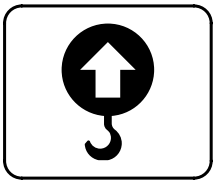
(4) Battery charging warning lamp



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.

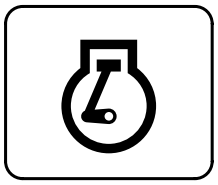
(6) Power max pilot lamp



21073CD11

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

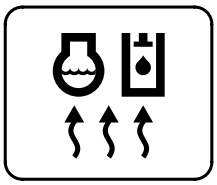
(7) Decel pilot lamp



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.

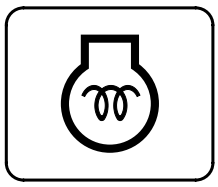
(8) Warming up pilot lamp



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



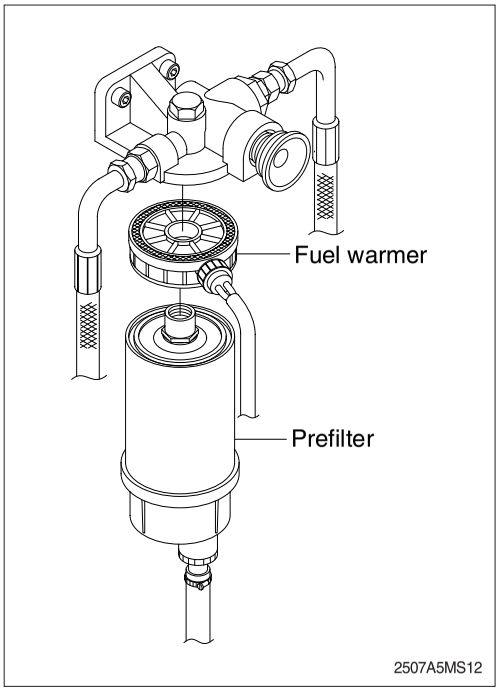
21073CD12

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

GROUP 15 FUEL WARMER SYSTEM

1. SPECIFICATION

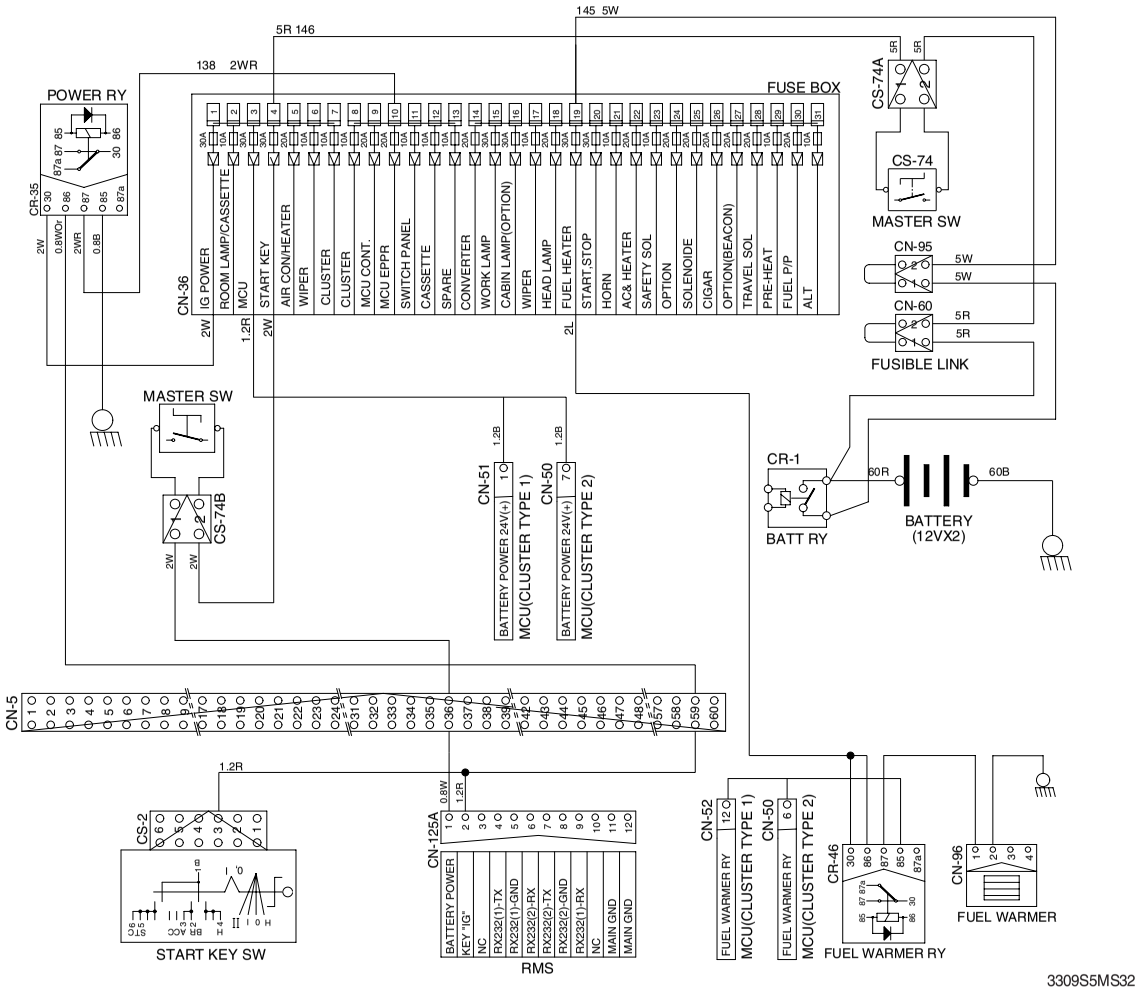
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A



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

Group 1 Before Troubleshooting ····· 6-1
Group 2 Hydraulic and Mechanical System ····· 6-4
Group 3 Electrical System ····· 6-24
Group 4 Mechatronics System ····· 6-56

SECTION 6 TROUBLESHOOTING

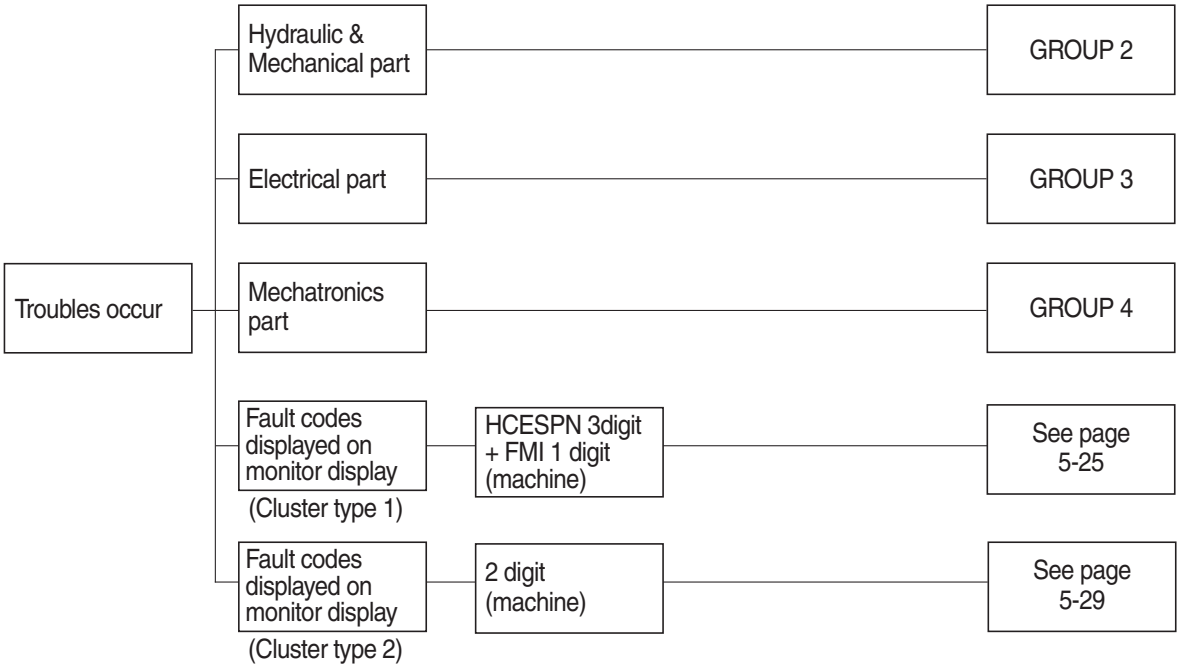
GROUP 1 BEFORE TROUBLESHOOTING

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.**

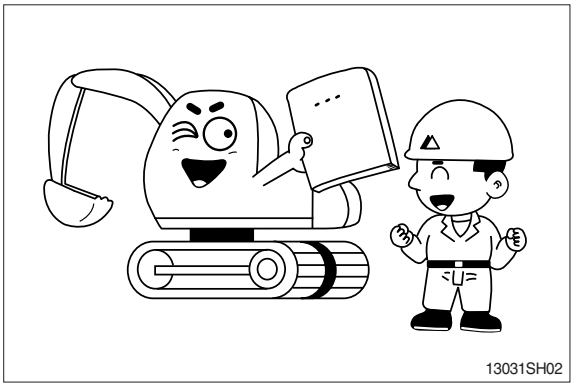


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

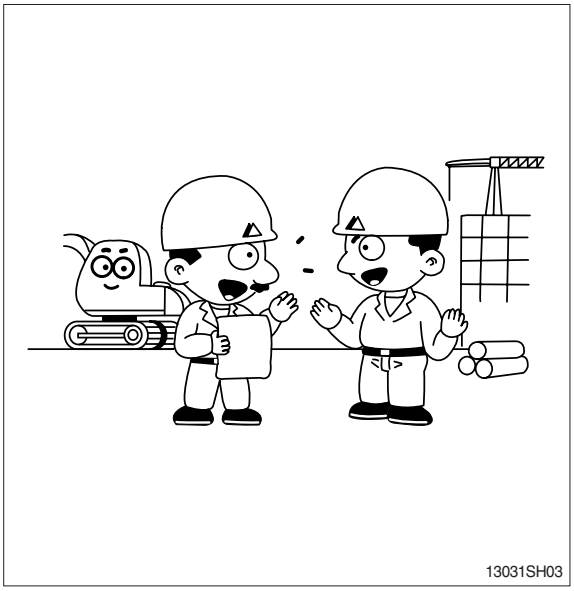
Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.
Especially, deepen the knowledge for the related parts of the trouble.



STEP 2. Ask the operator

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

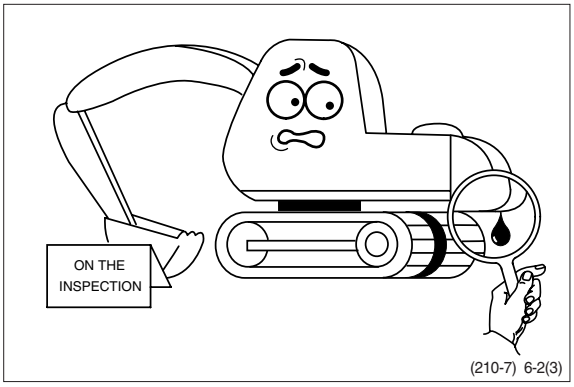
1) How the machine is used and when it is serviced?
2) When the trouble was noticed and what work the machine was doing at that time?
3) What is the phenomenon of the trouble? Was the trouble getting worse, or did it come out suddenly for the first time?
4) Did the machine have any troubles previously?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



STEP 3. Inspect the machine

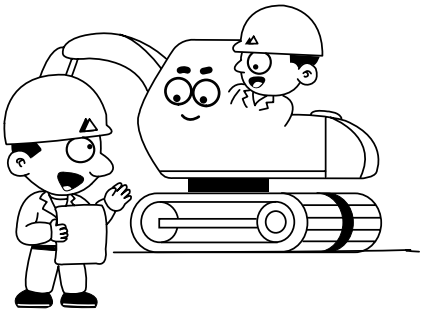
Before starting troubleshooting, check the machine for the daily maintenance points as shown in the operator's manual.

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



STEP 4. Inspect the trouble actually on the machine

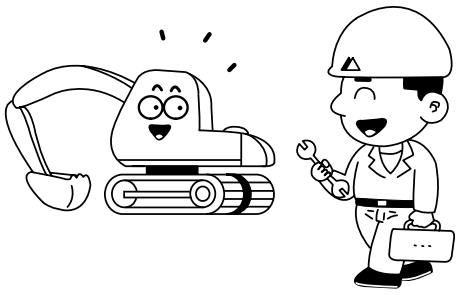
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 6-3(1)

STEP 5. Perform troubleshooting

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

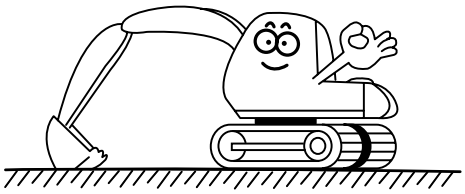


13031SH05

STEP 6. Trace a cause

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

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



(210-7) 6-3(3)

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

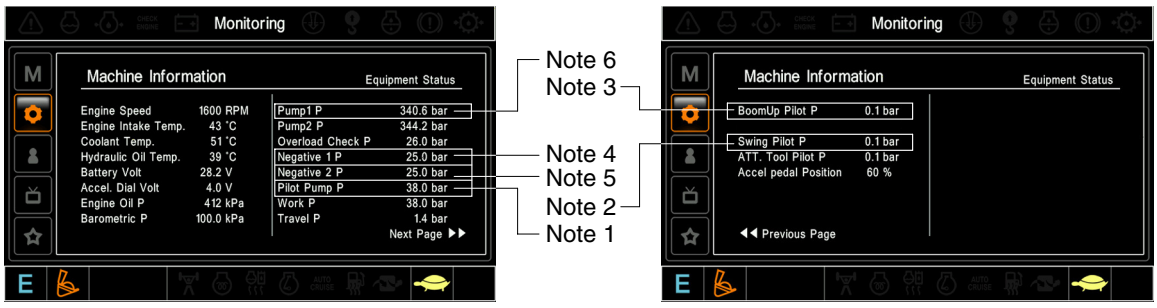
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

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

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

2) MACHINE STATUS MONITORING ON THE CLUSTER (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

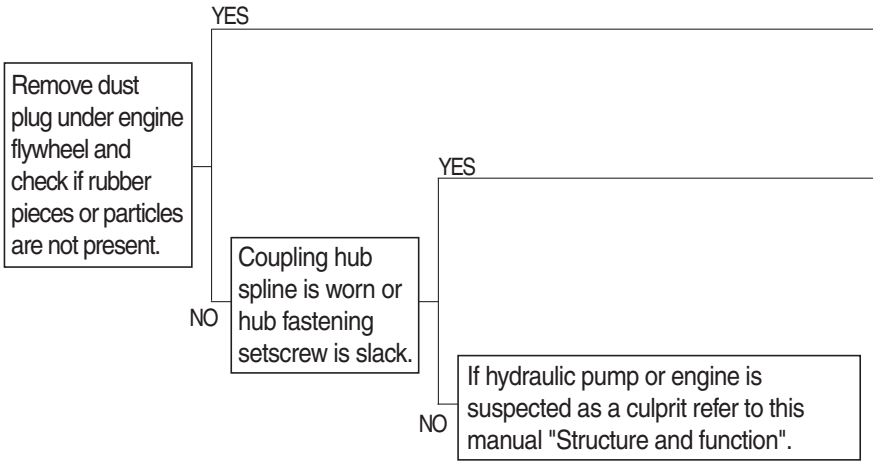
3009SH6HS01

(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 4	P1 pump control pressure	0~25 bar
Note 5	P2 pump control pressure	0~25 bar
Note 6	Pump 1 pressure	350 bar

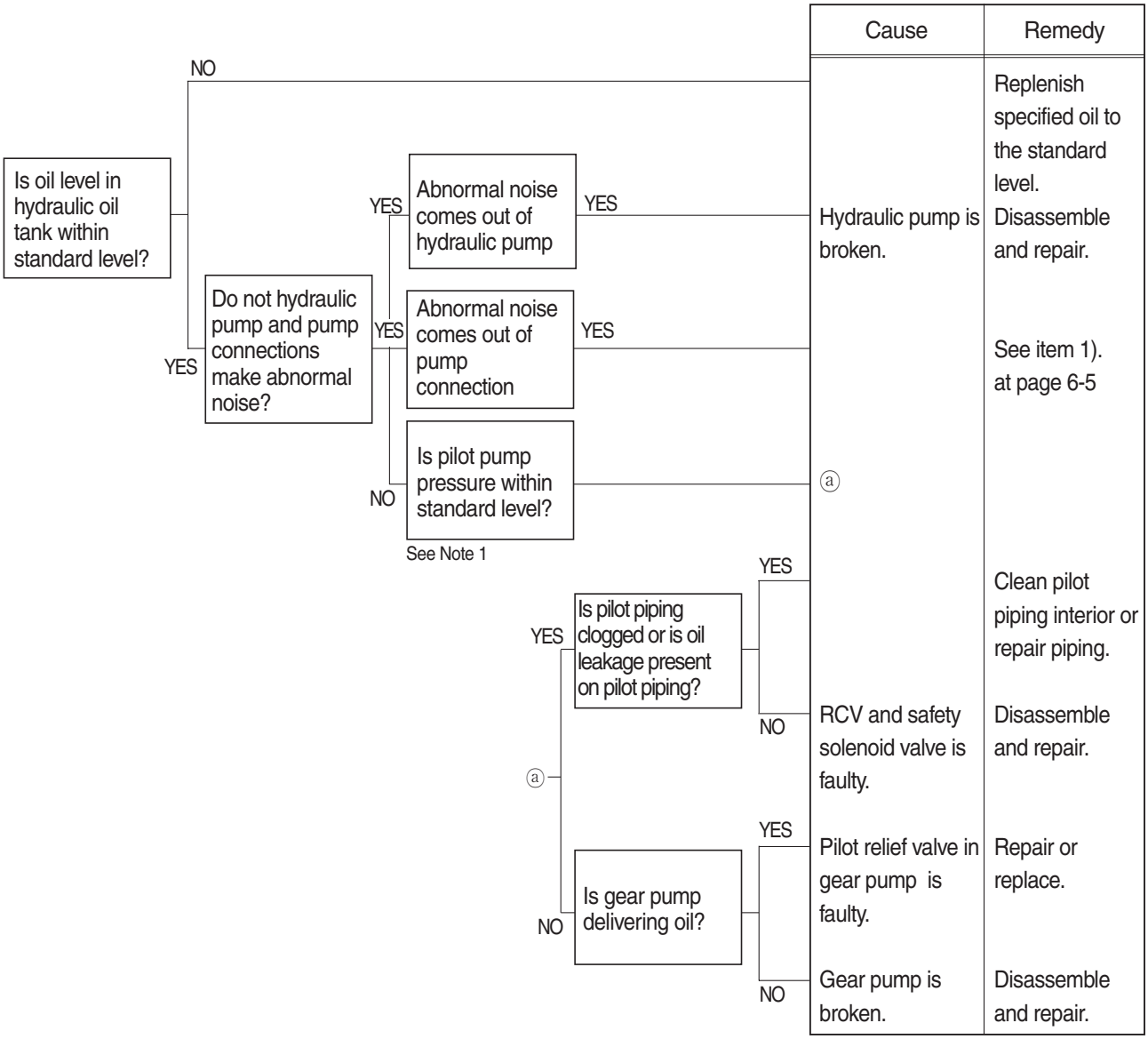
2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



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

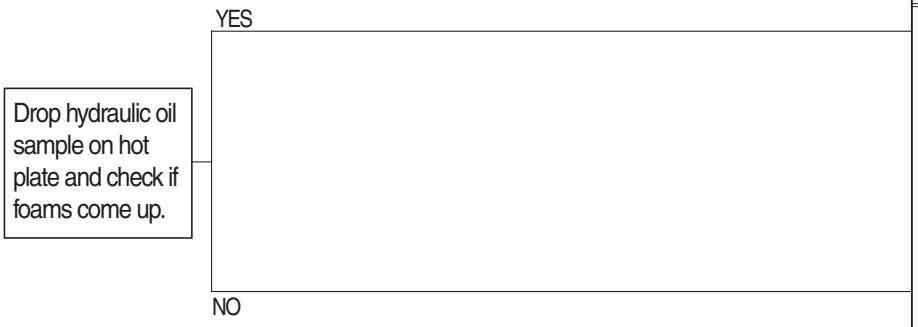
2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL



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

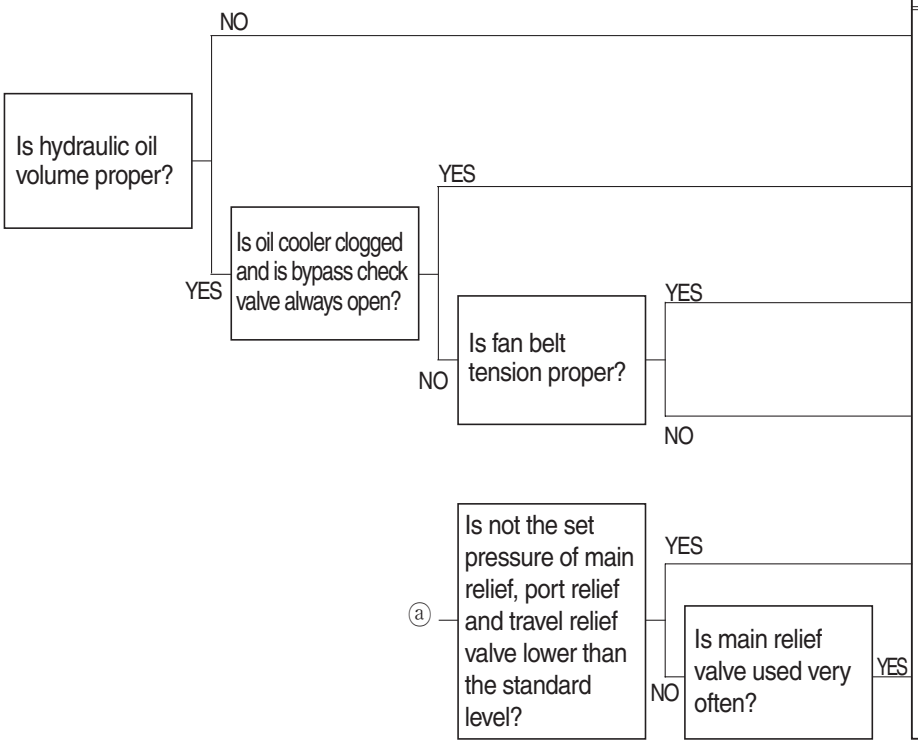
3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY



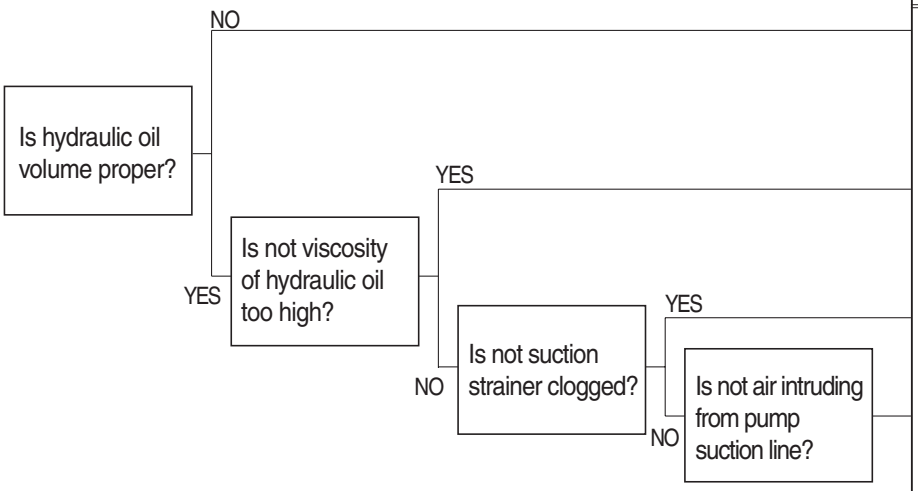
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



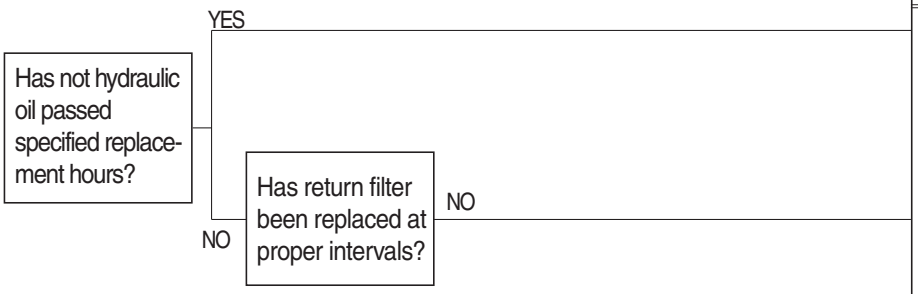
Cause	Remedy
Oil cooler clogged. Bypass check valve is defective. ⓐ	Replenish specified oil to the standard level. Clean oil cooler. Replace
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

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.

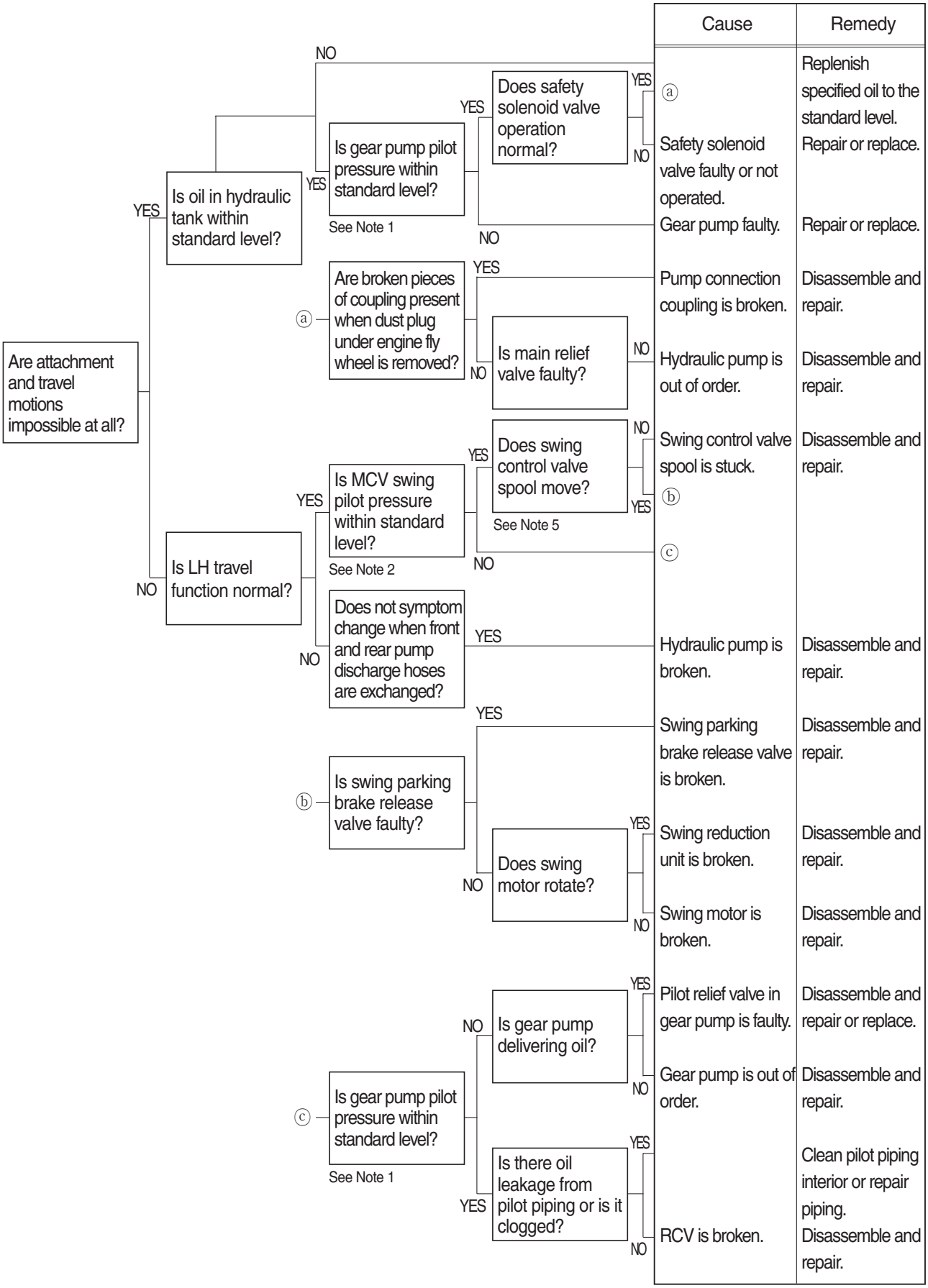
4) HYDRAULIC OIL IS CONTAMINATED



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

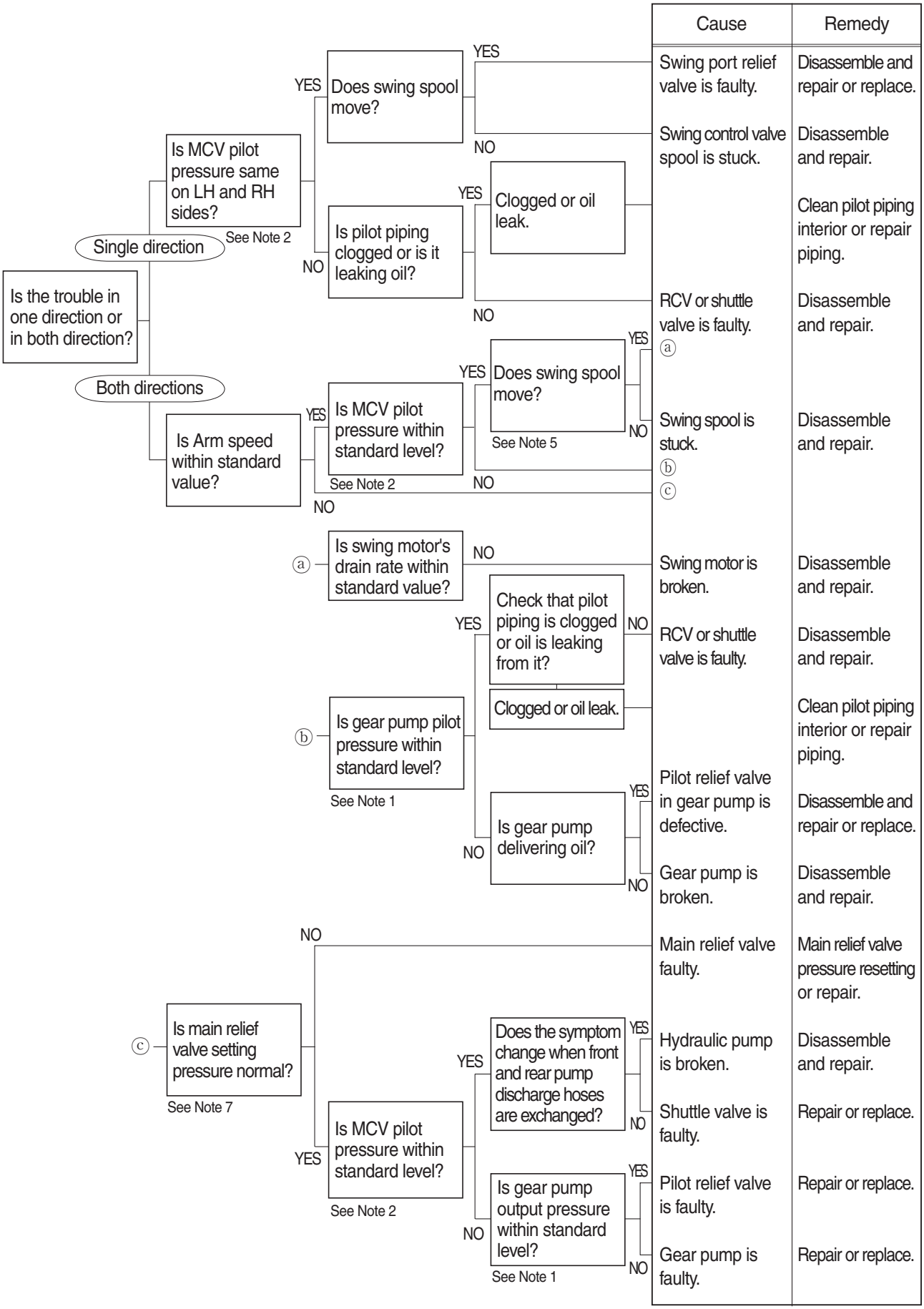
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE

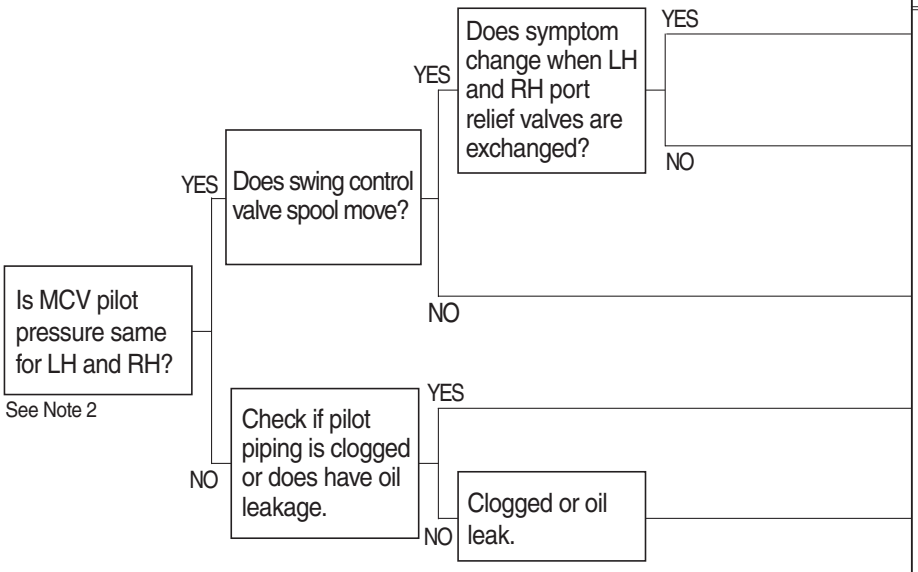


Cause	Remedy
ⓐ	Replenish specified oil to the standard level.
Safety solenoid valve faulty or not operated.	Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool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

2) SWING SPEED IS LOW

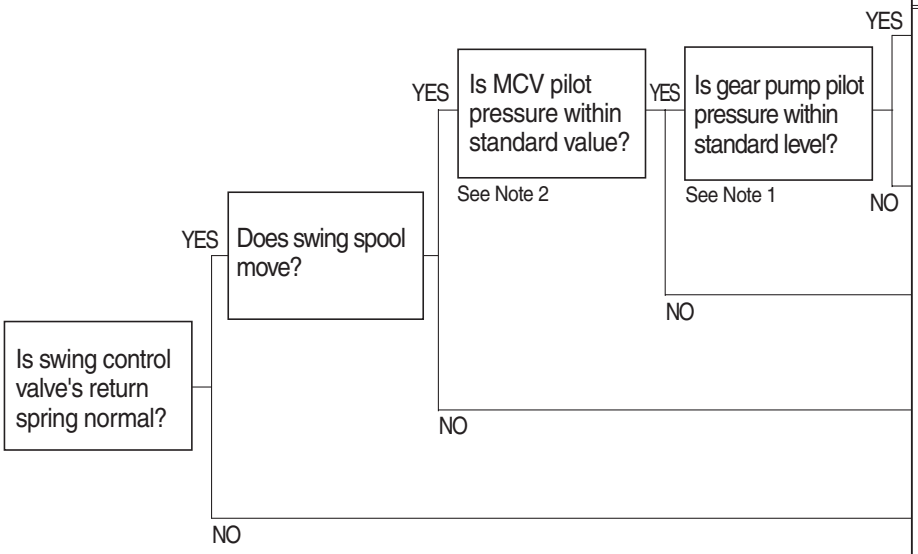


3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



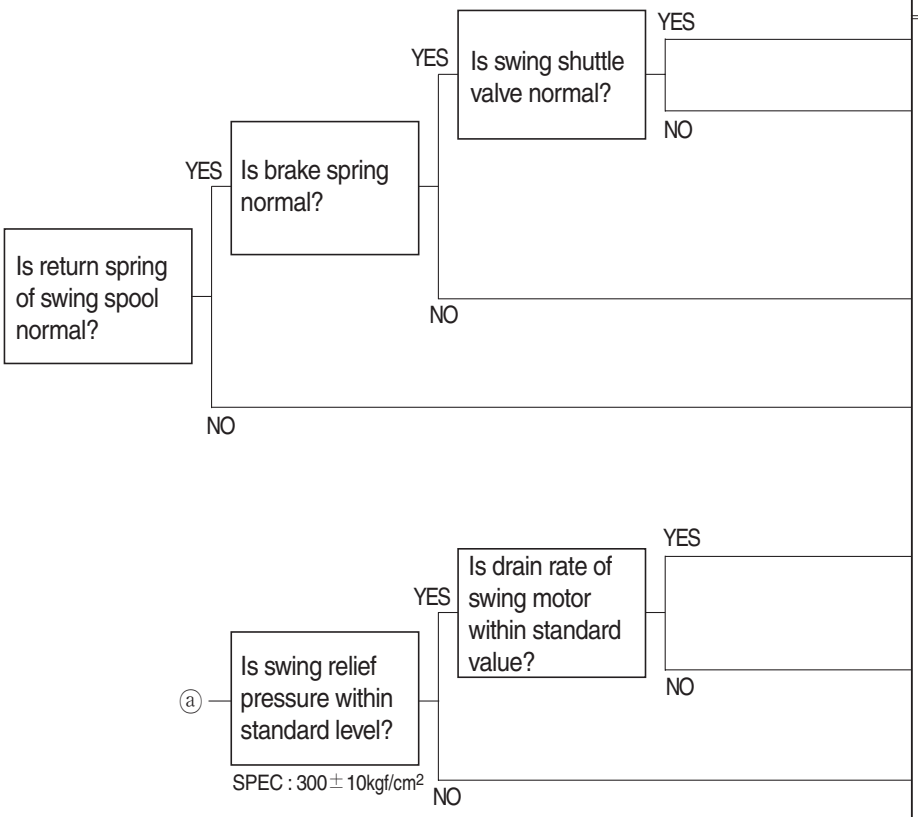
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
RCV is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

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.

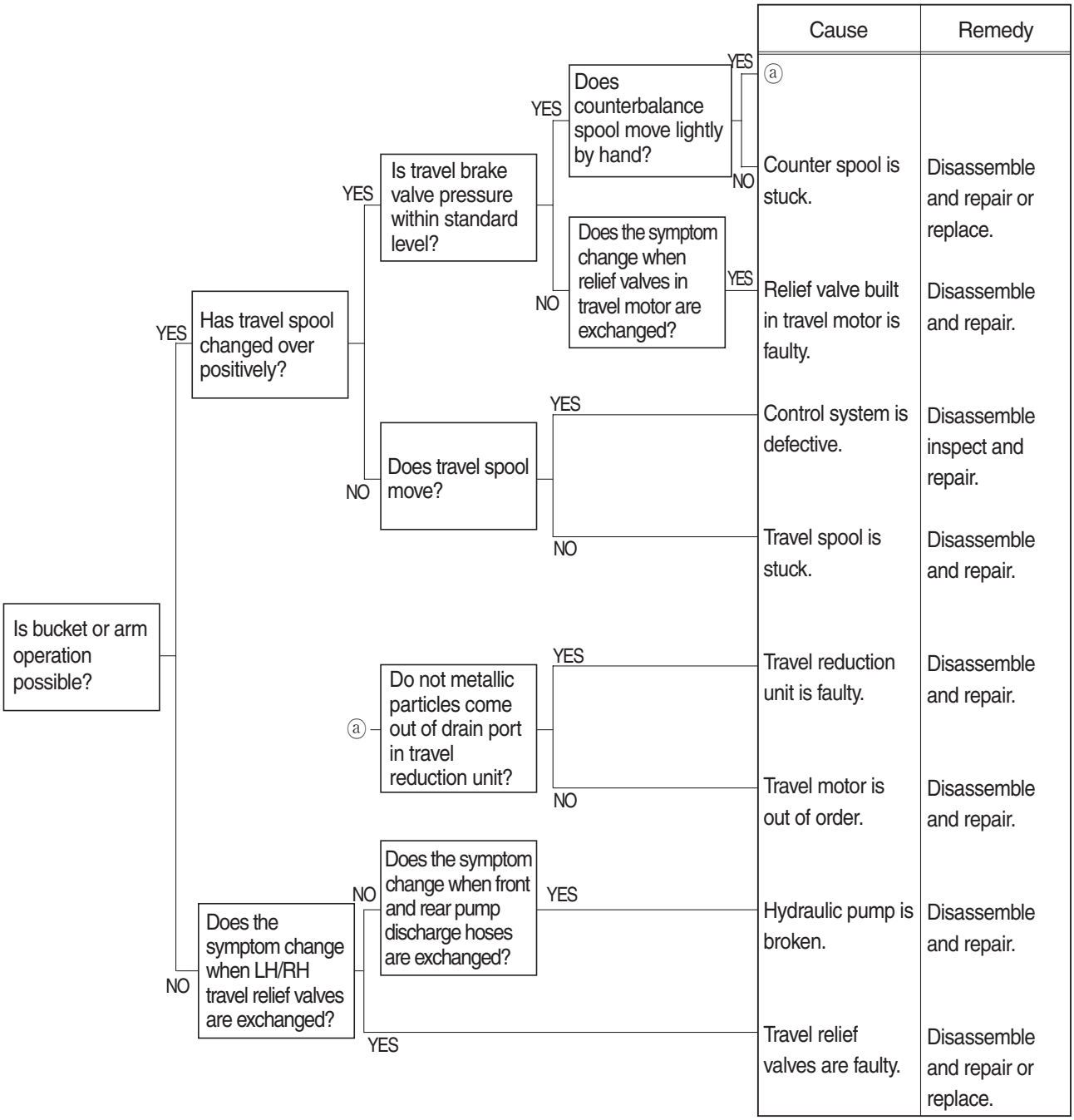
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



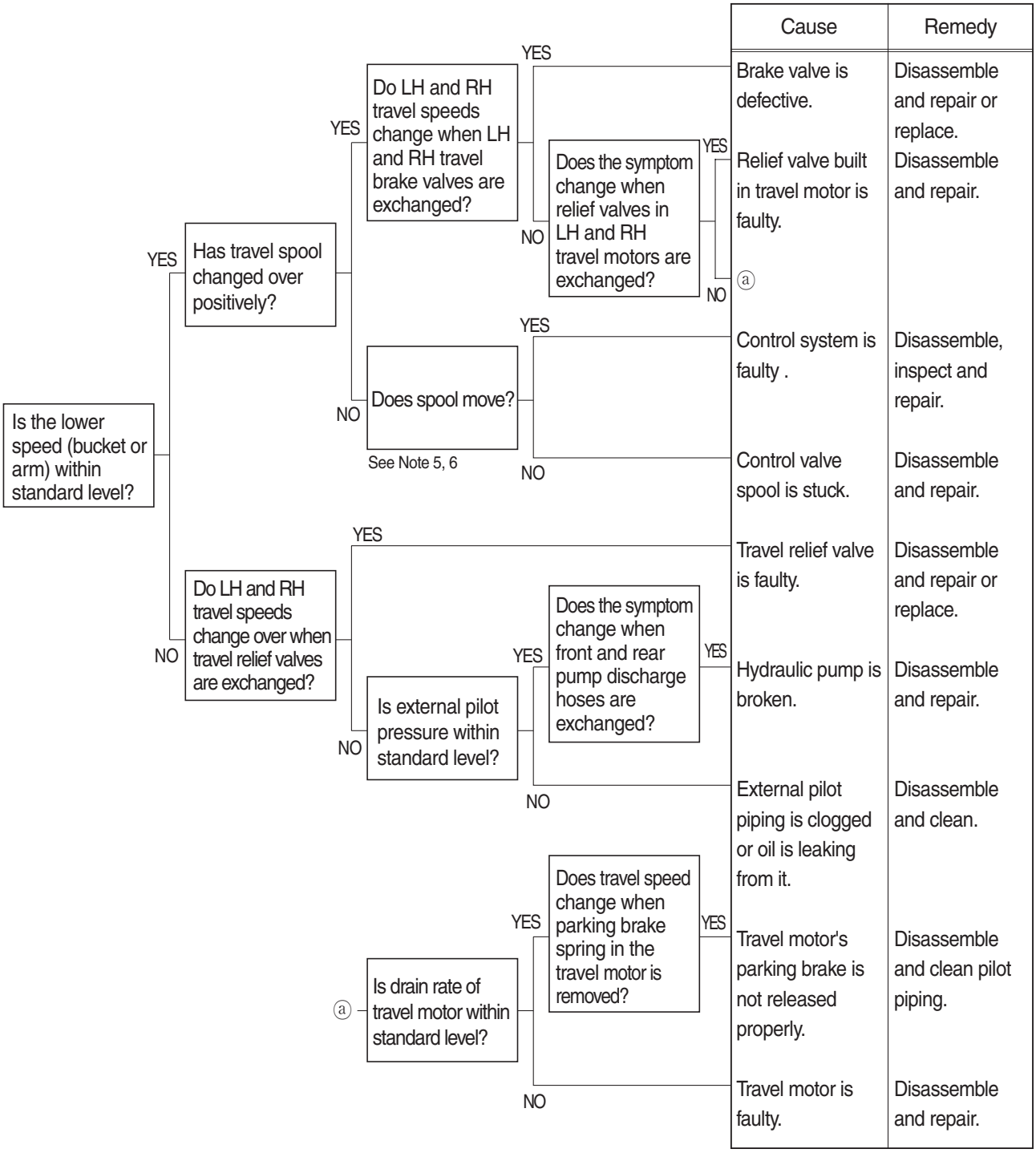
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.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

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



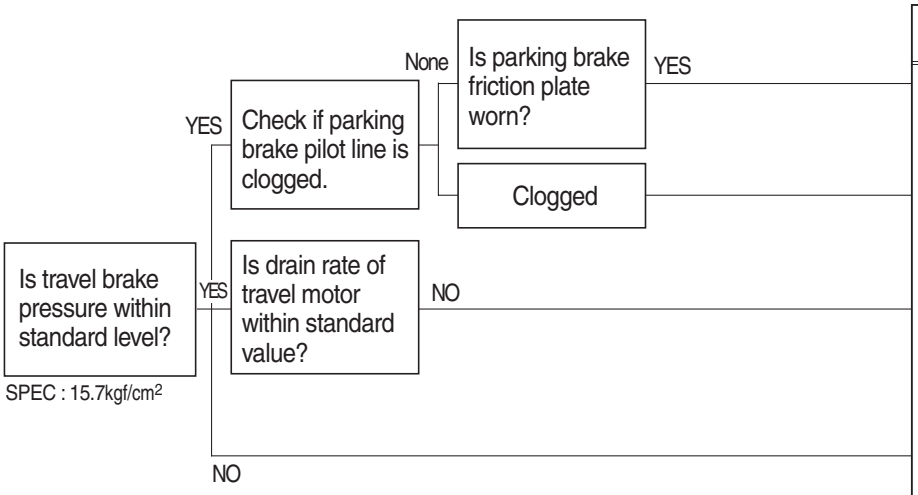
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



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.

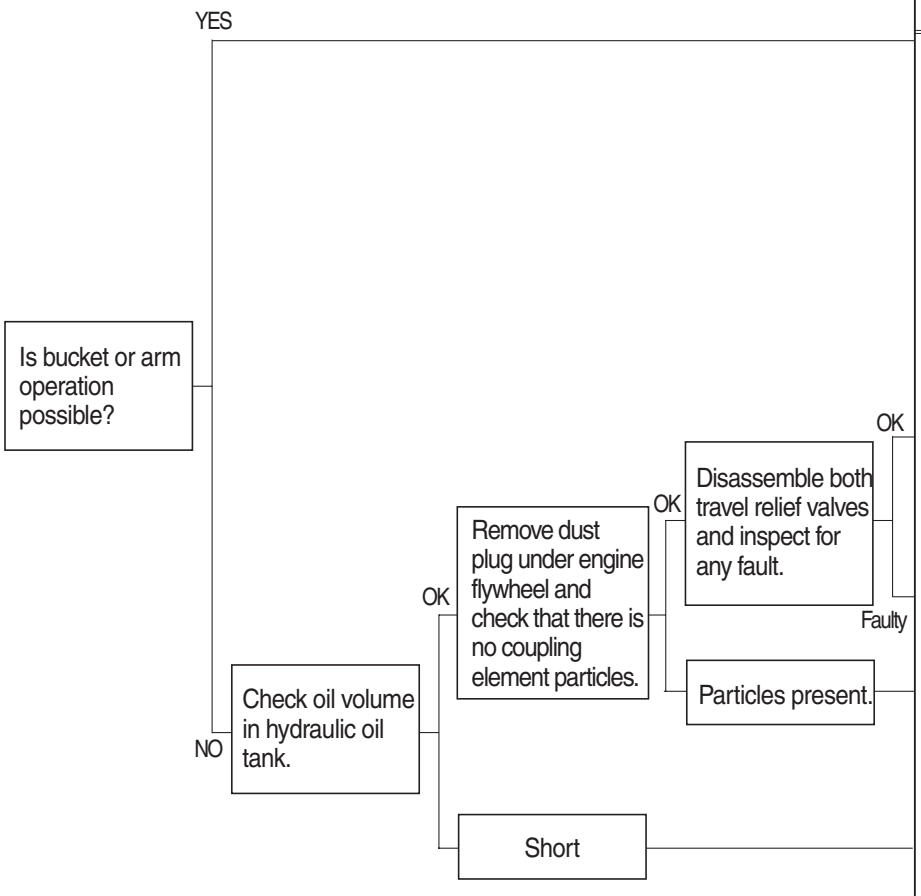
3) MACHINE DOES NOT STOP ON A SLOPE

Machine is pulled forward as sprocket rotates during digging operation.



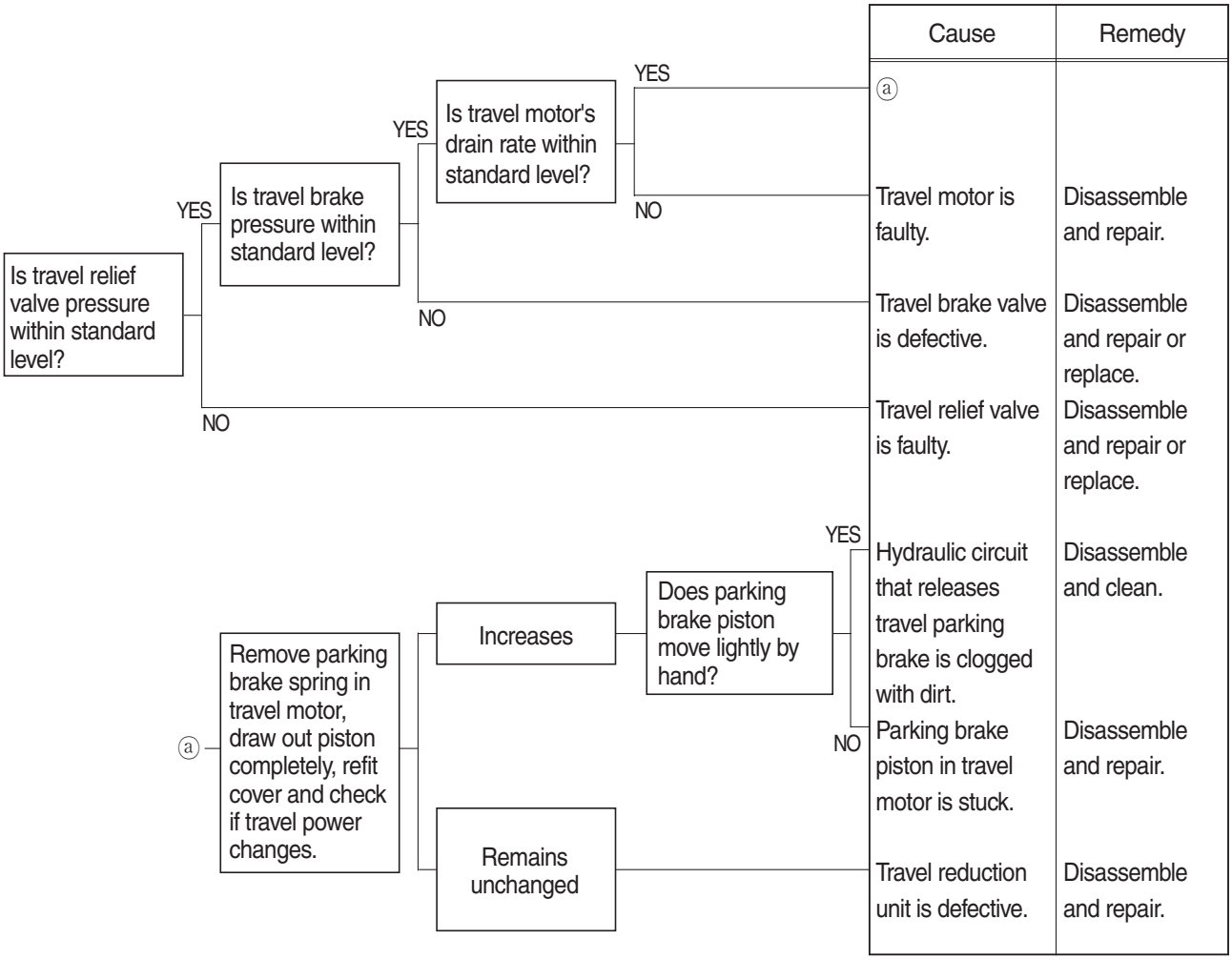
Cause	Remedy
Friction plate is faulty.	Disassemble and repair.
Clogged	Disassemble and clean pilot piping.
Travel motor is defective.	Disassemble and repair.
Brake valve is faulty.	Disassemble and repair or replace.

4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



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

5) TRAVEL ACTION IS POWERLESS (travel only)



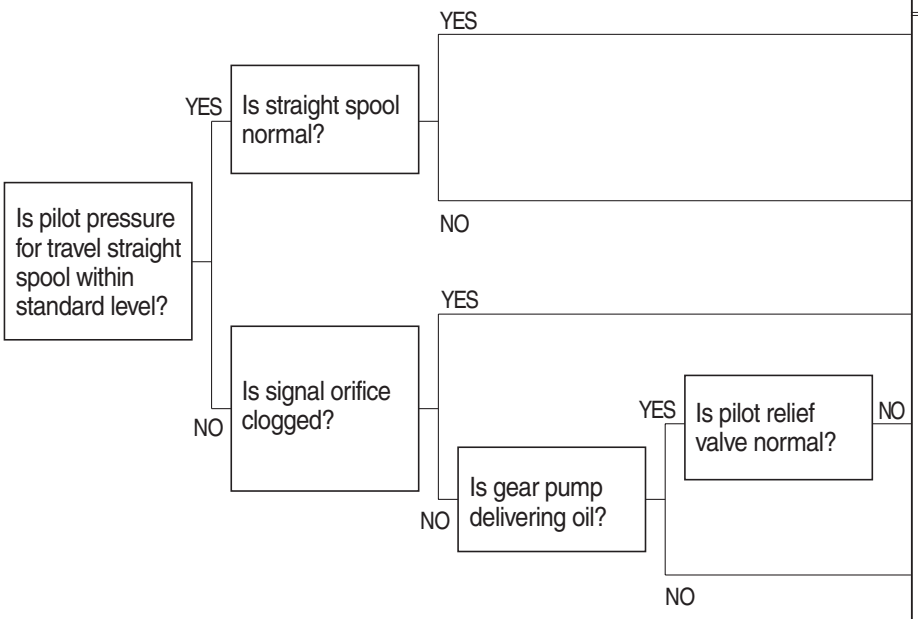
Cause	Remedy
ⓐ	
Travel motor is faulty.	Disassemble and repair.
Travel brake valve is defective.	Disassemble and repair or replace.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic circuit that releases travel parking brake is clogged with dirt.	Disassemble and clean.
Parking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

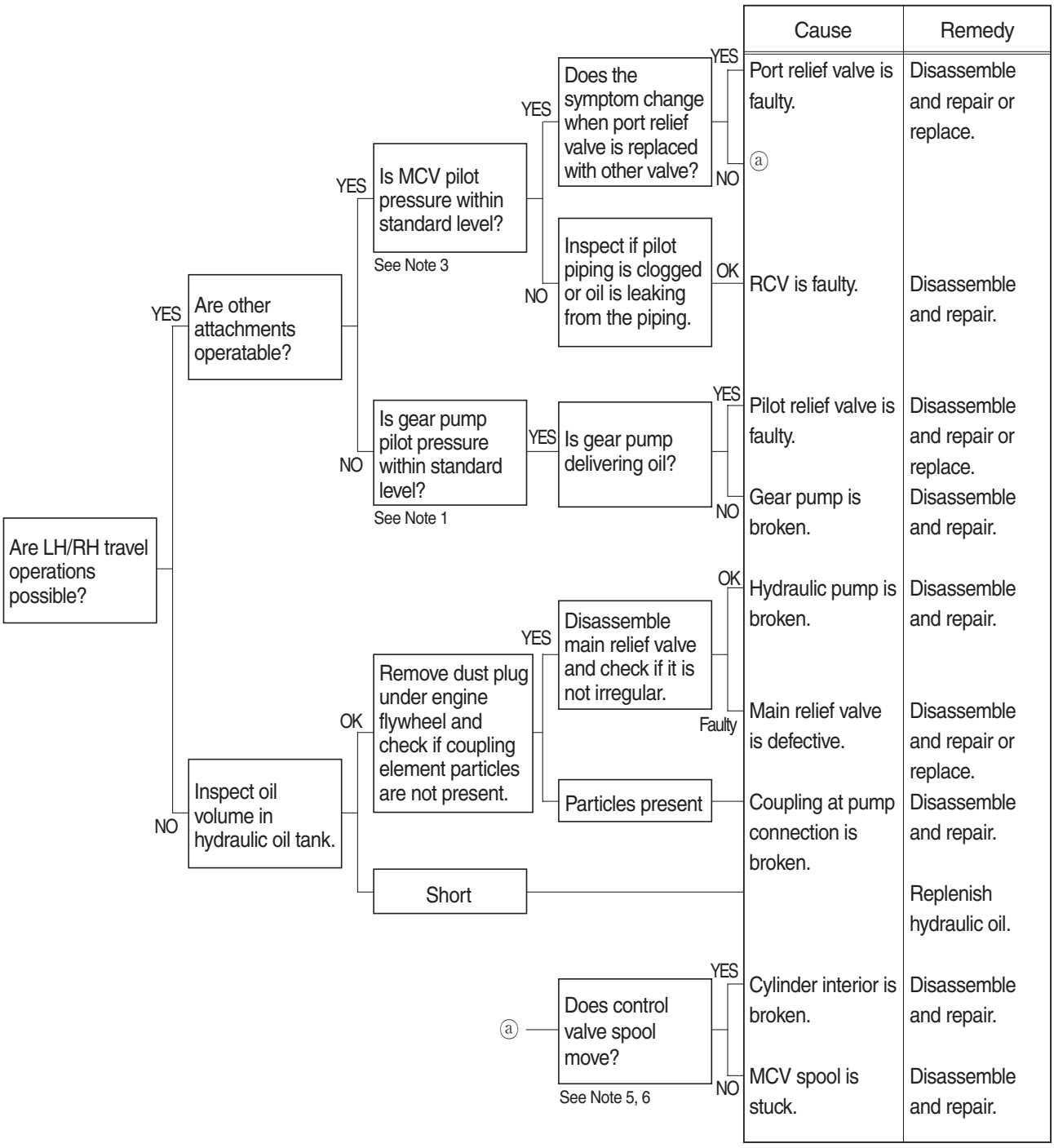
7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME



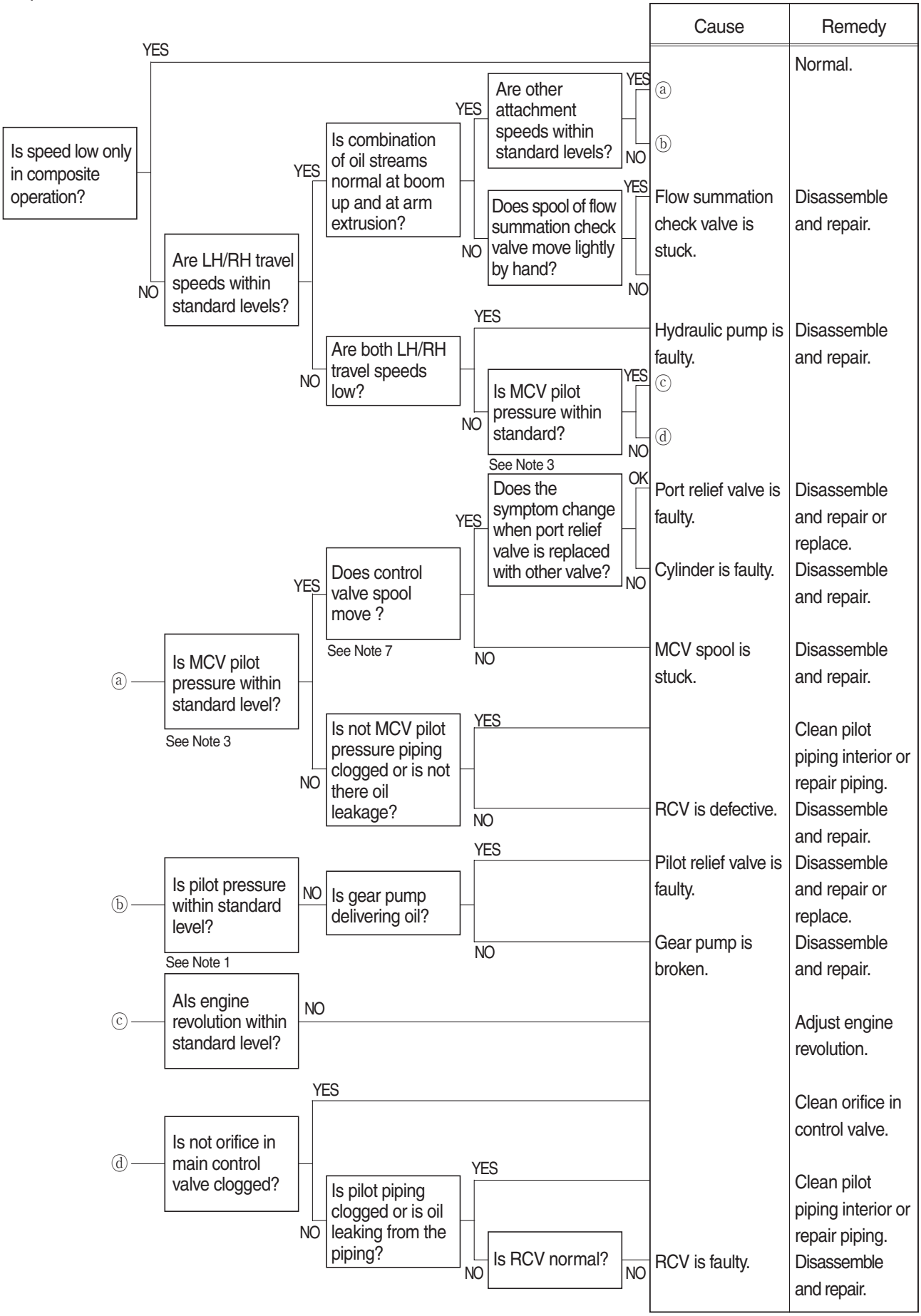
Cause	Remedy
	Normal.
Straight spool is faulty.	Repair or replace.
	Remove dirt on signal orifice.
Pilot relief valve is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.

6. ATTACHMENT SYSTEM

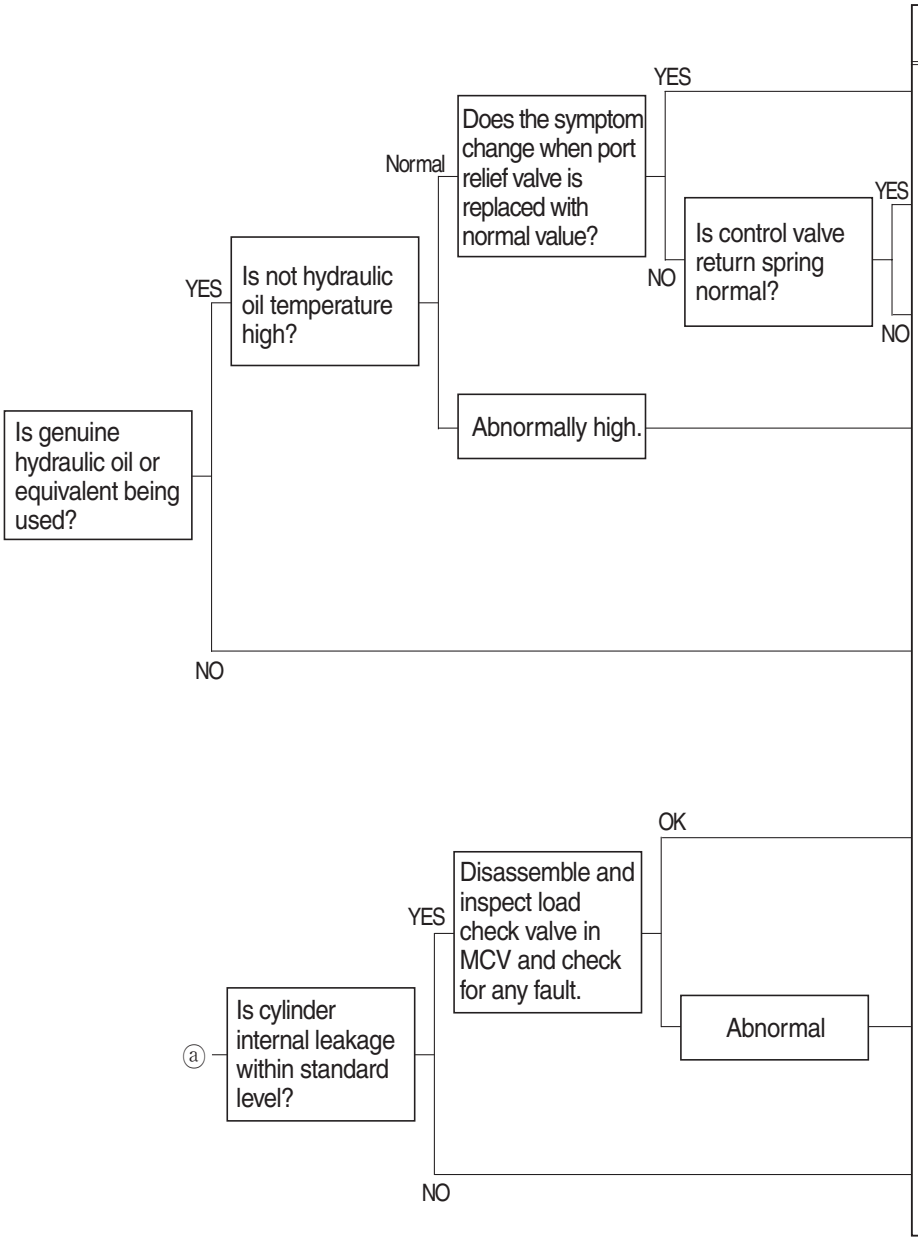
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

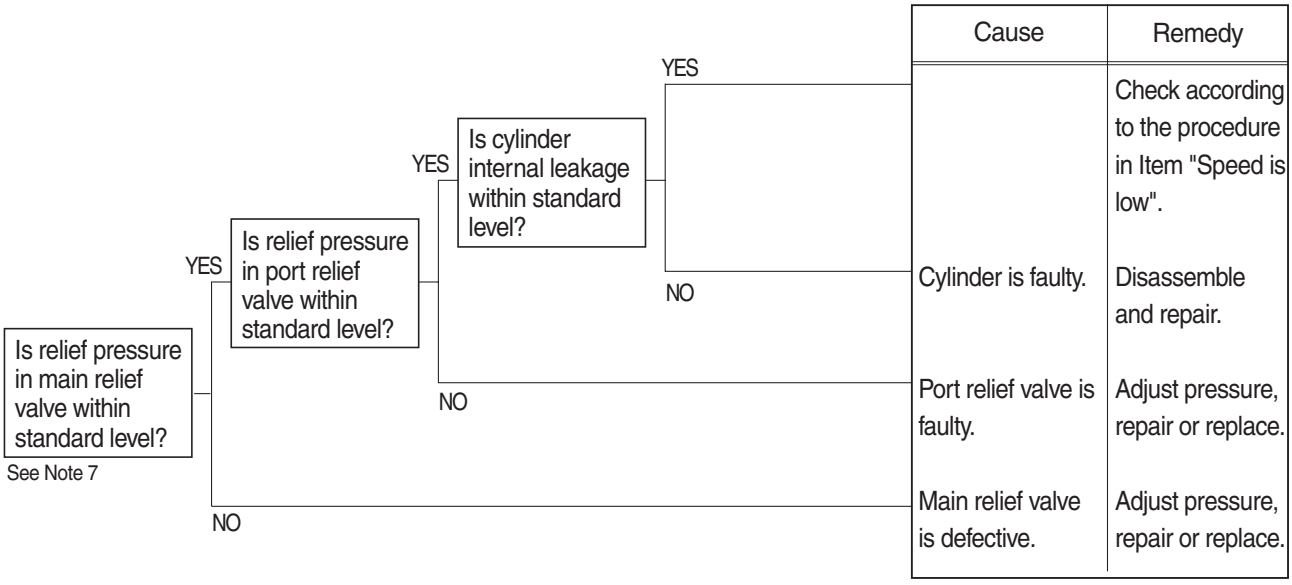


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



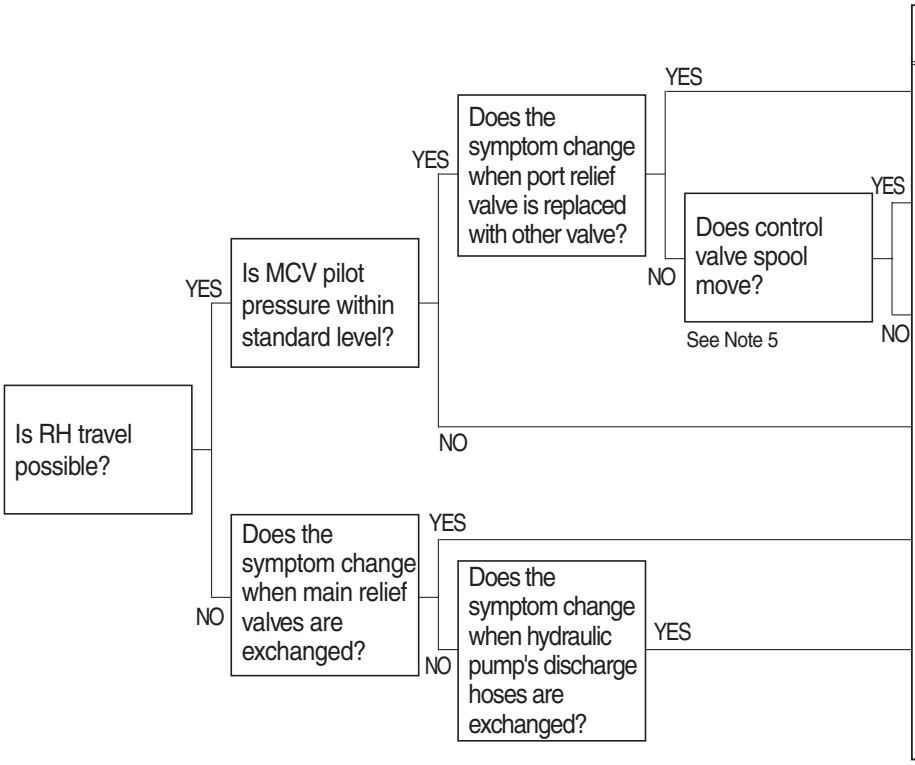
Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level. Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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



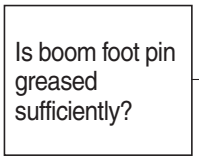
Cause	Remedy
Cylinder is faulty.	Check according to the procedure in Item "Speed is low". Disassemble and repair.
Port relief valve is faulty.	Adjust pressure, repair or replace.
Main relief valve is defective.	Adjust pressure, repair or replace.

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



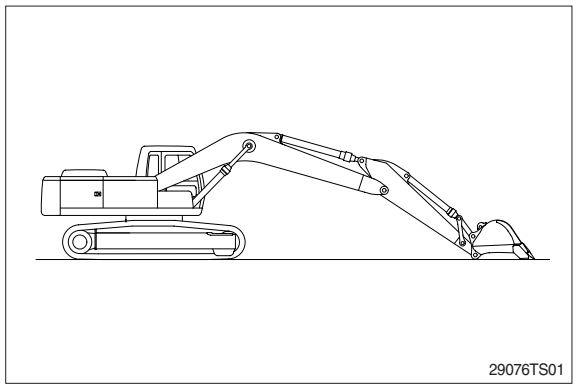
YES

NO

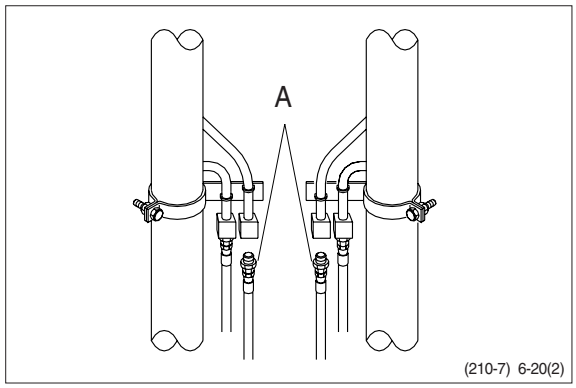
Cause	Remedy
	Frictional noise occurs between the sliding faces of boom cylinder's oil seal and boom proper. ※ Frictional noise will disappear if they are kept used.
Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in an initial stage, supply sufficient grease. If seizure is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

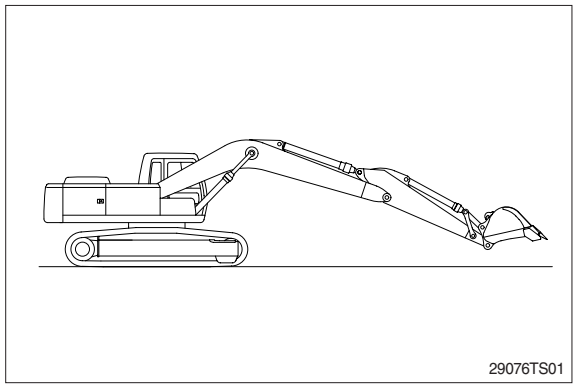


2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



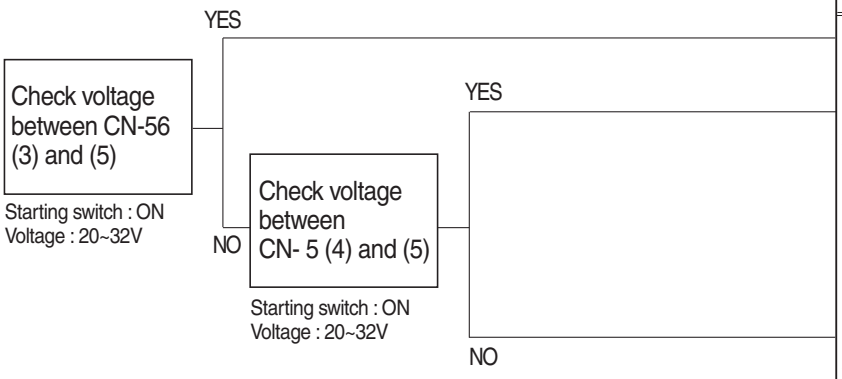
3. Raise bucket OFF the ground by retracting the arm cylinder rod.

   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.



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

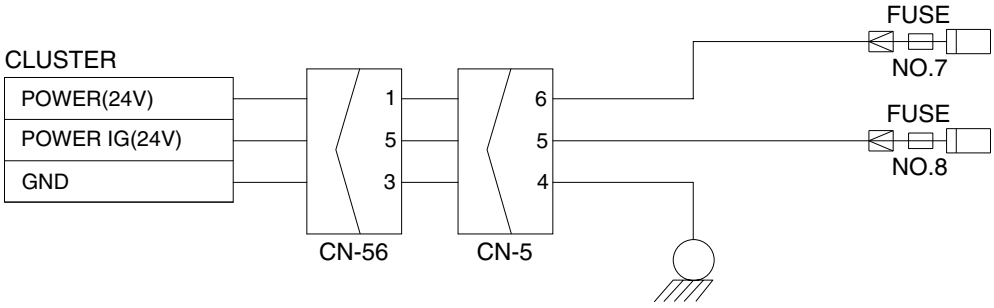
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.7, 8.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



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

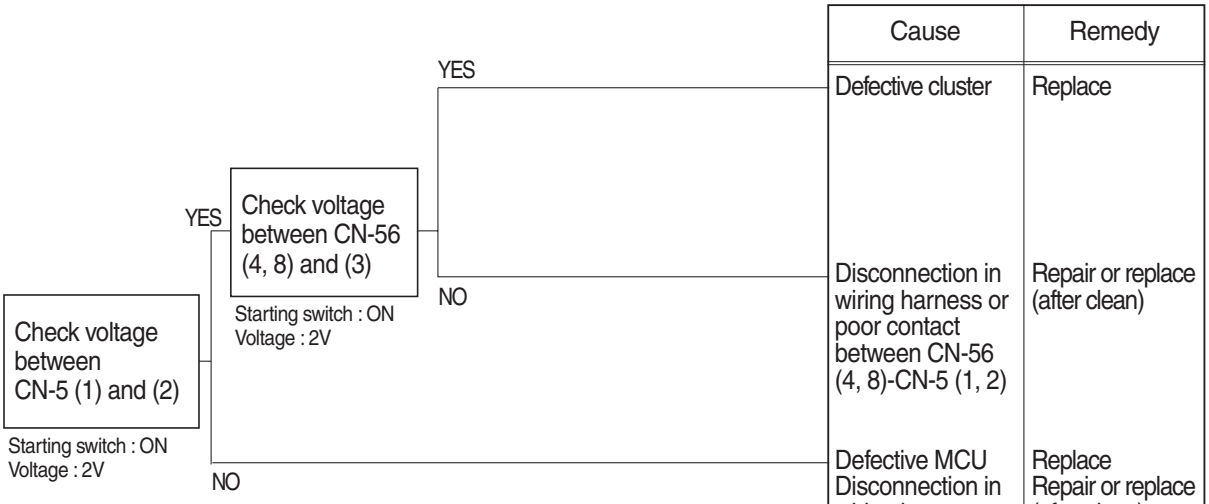
YES	20~32V
NO	0V



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

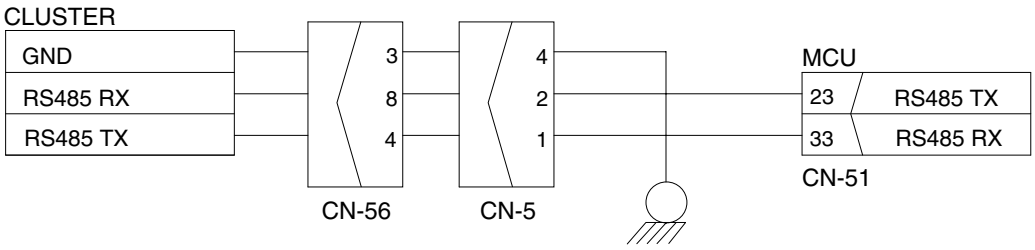
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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

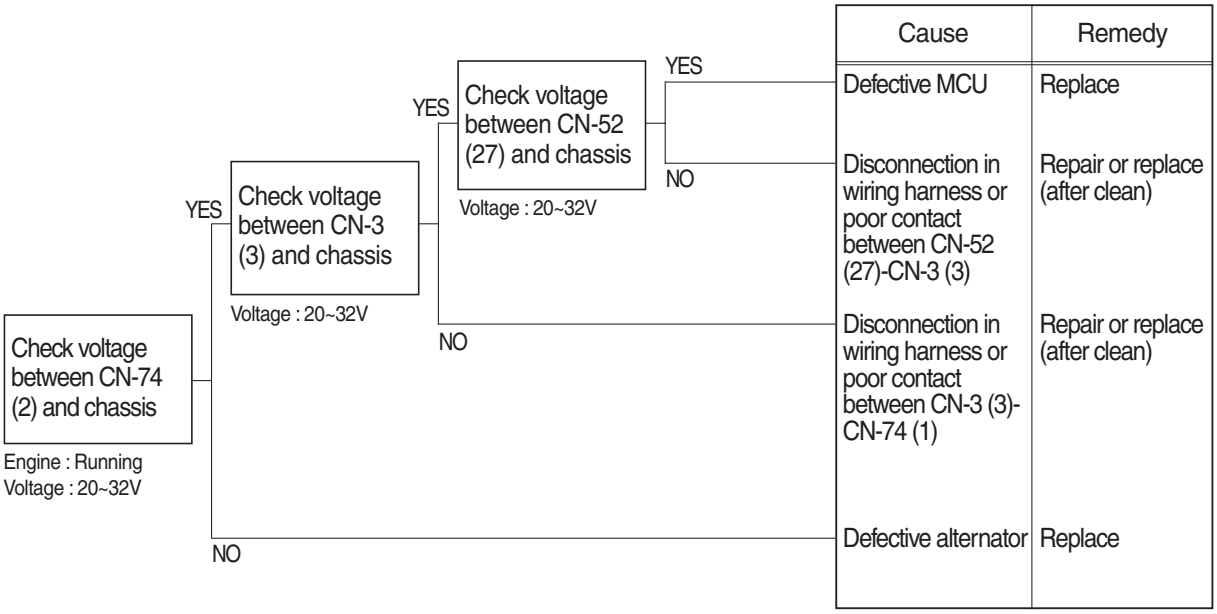
YES	2V
NO	0V



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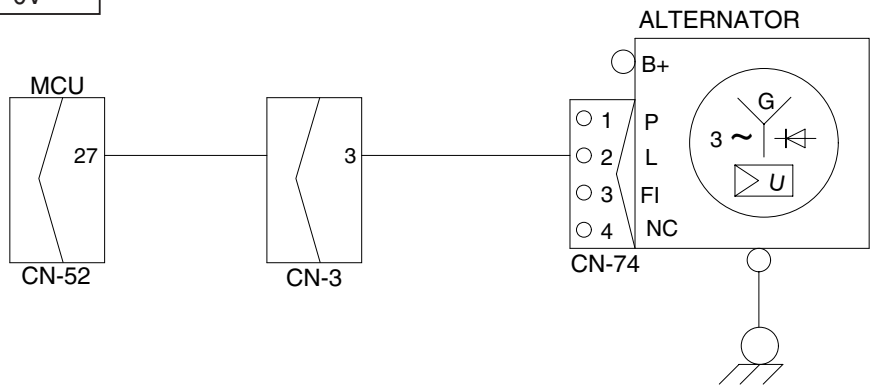
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

· 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

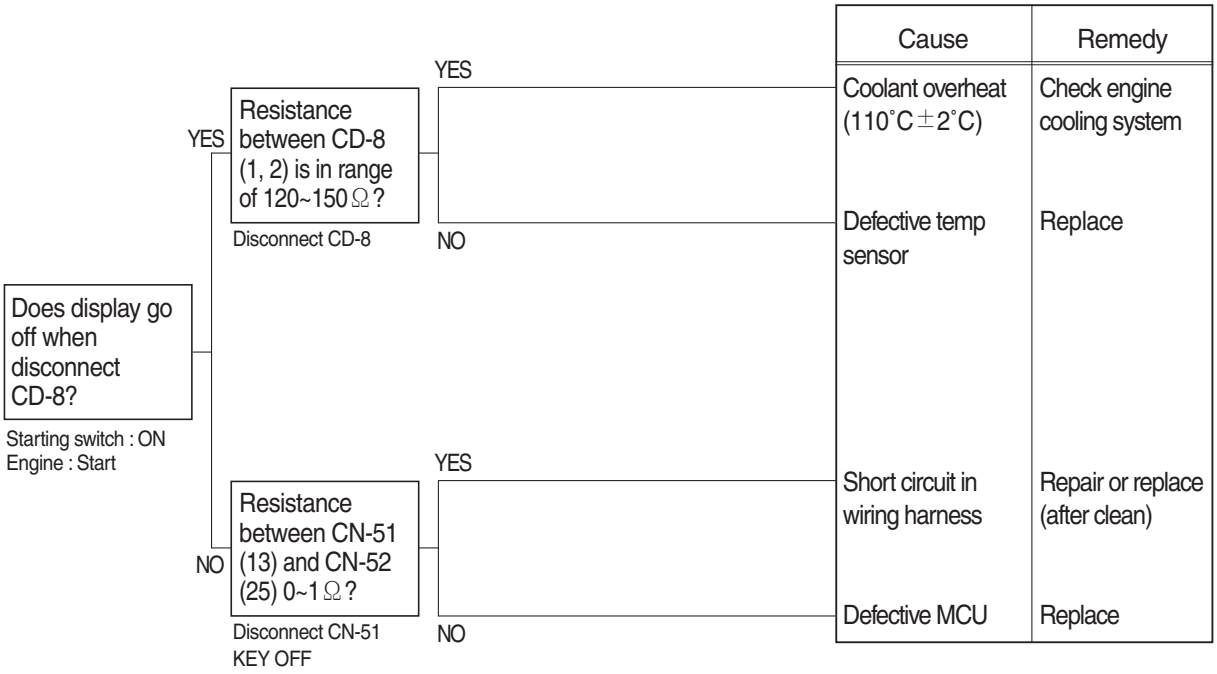
YES	20~32V
NO	0V

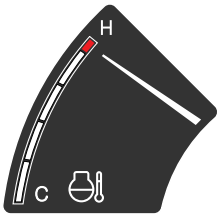


3009S6ES01

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

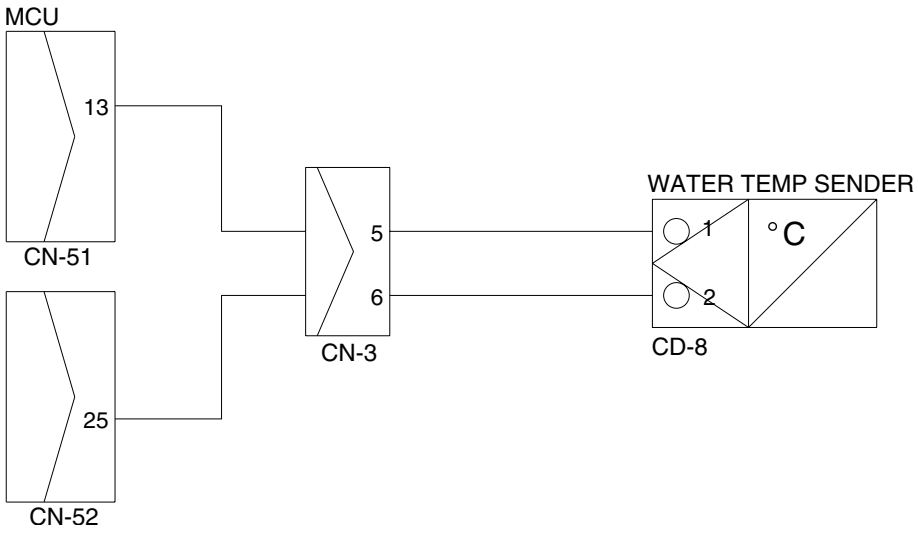
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

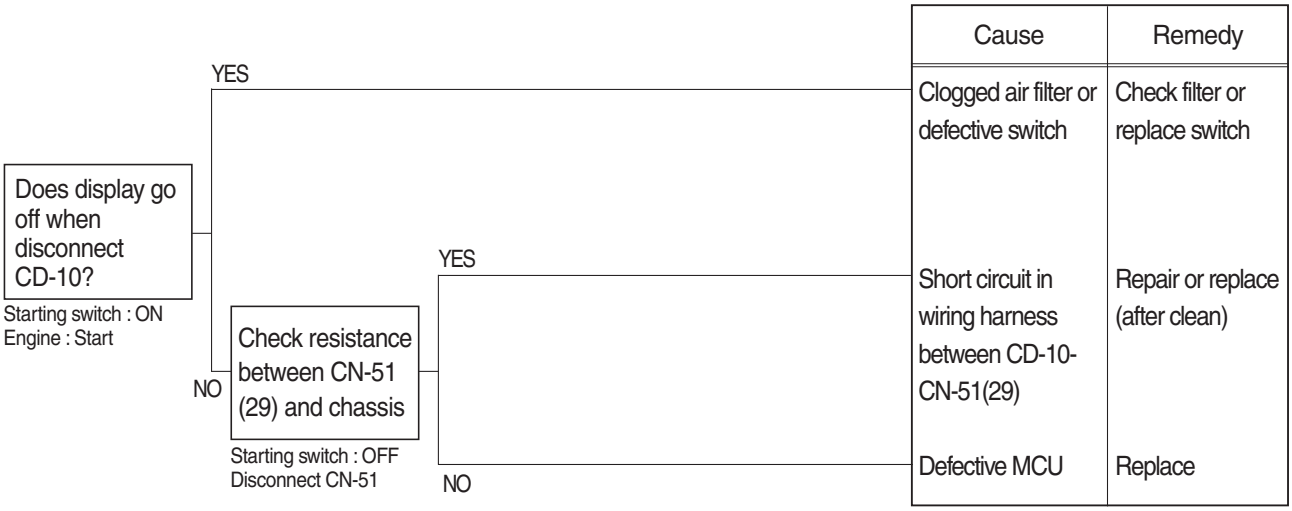
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



3009SH6ES04

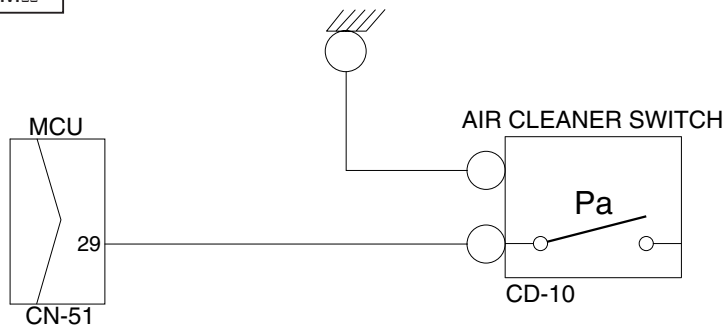
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

· 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

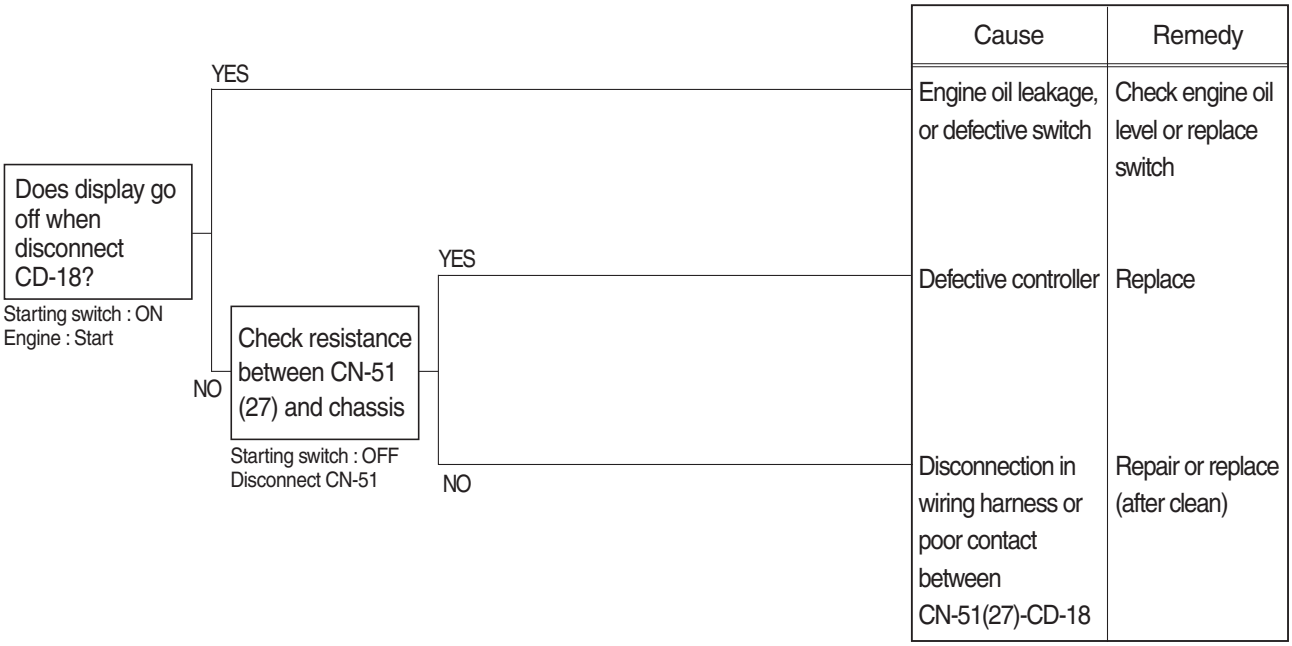
YES	MAX 1Ω
NO	MIN 1MΩ

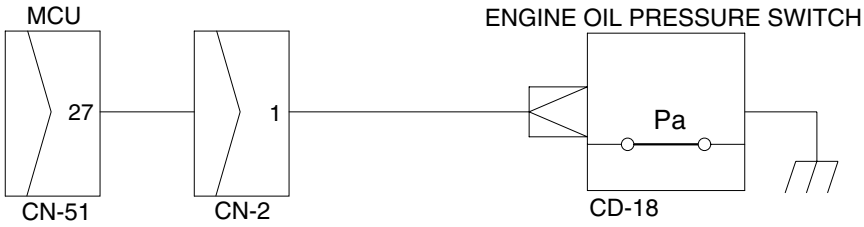


3009SH6ES05

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.

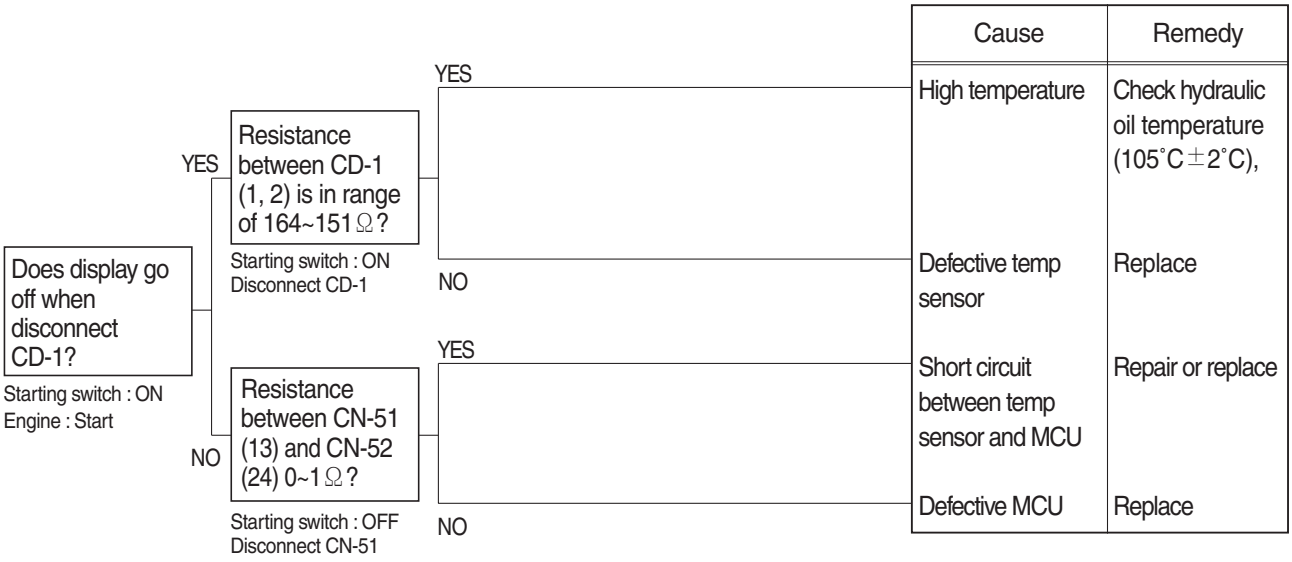




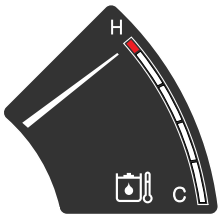
3009SH6ES06

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.

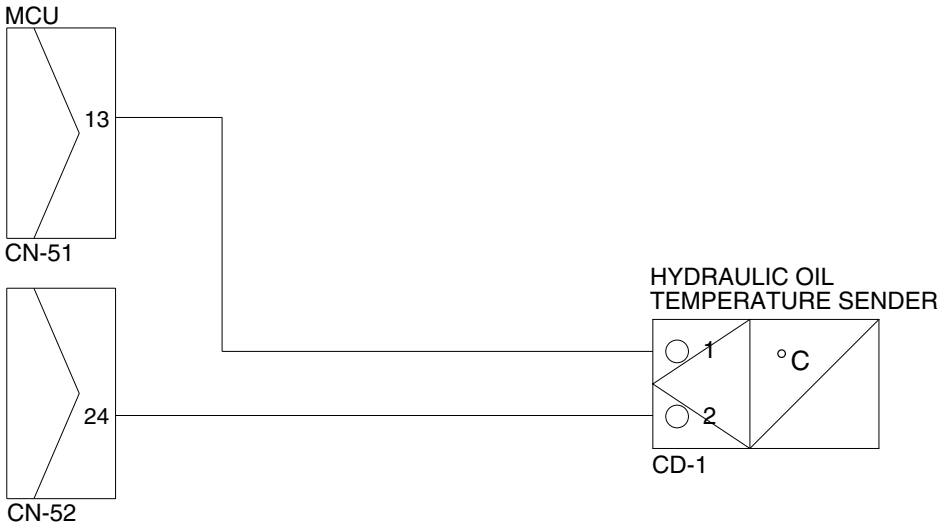


Cause	Remedy
High temperature	Check hydraulic oil temperature (105˚C±2˚C),
Defective temp sensor	Replace
Short circuit between temp sensor and MCU	Repair or replace
Defective MCU	Replace



Check Table

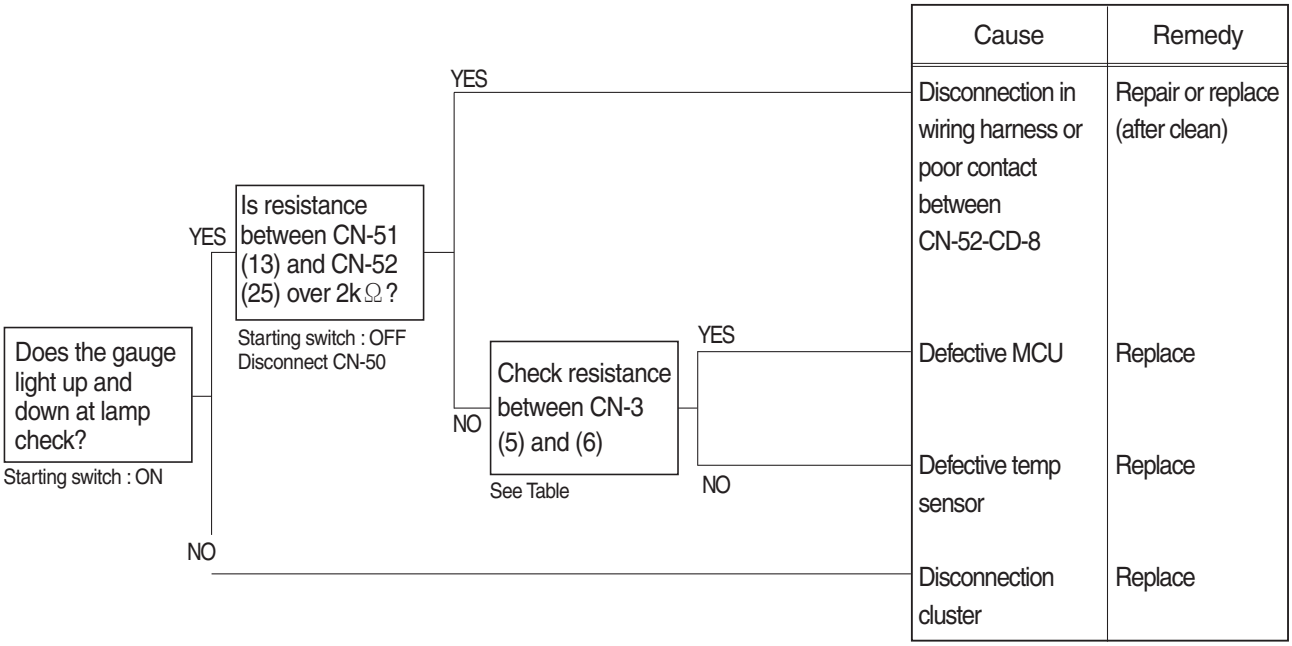
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



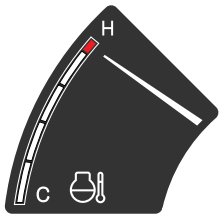
3009SH6ES07

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.

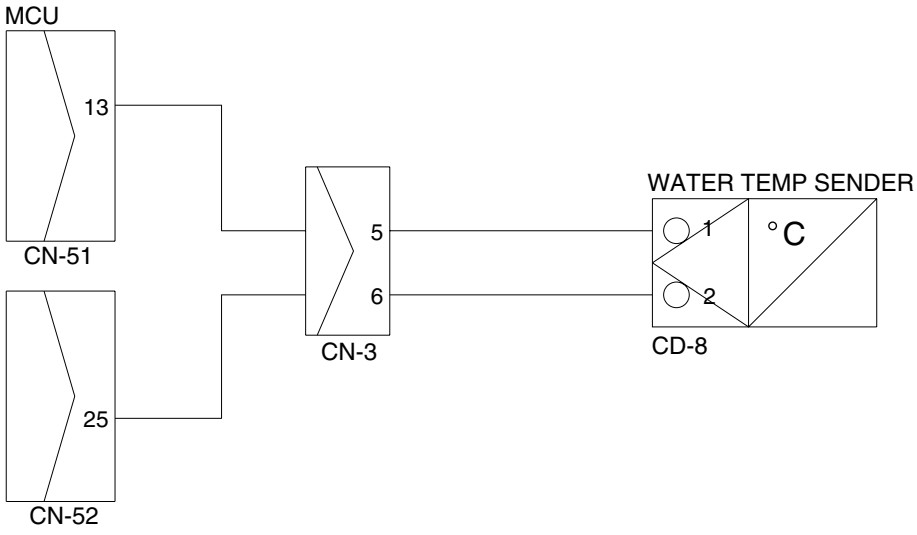


Cause	Remedy
Disconnection in wiring harness or poor contact between CN-52-CD-8	Repair or replace (after clean)
Defective MCU	Replace
Defective temp sensor	Replace
Disconnection cluster	Replace



Check Table

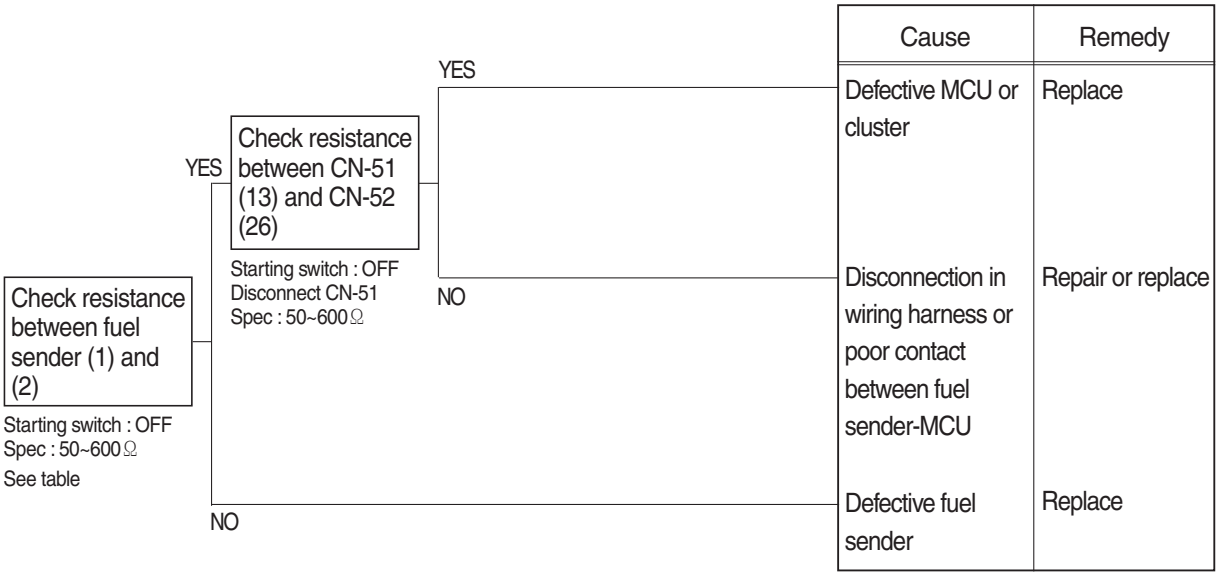
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



3009SH6ES04

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

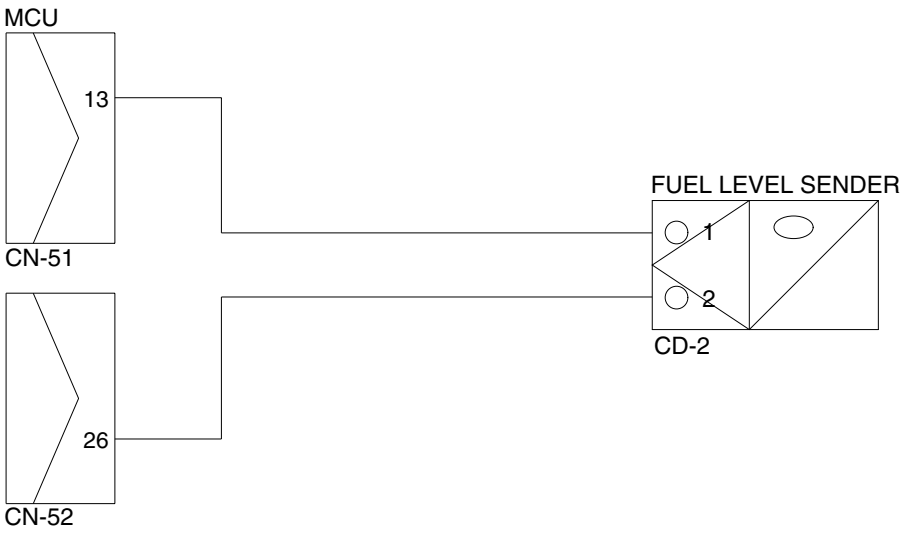
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

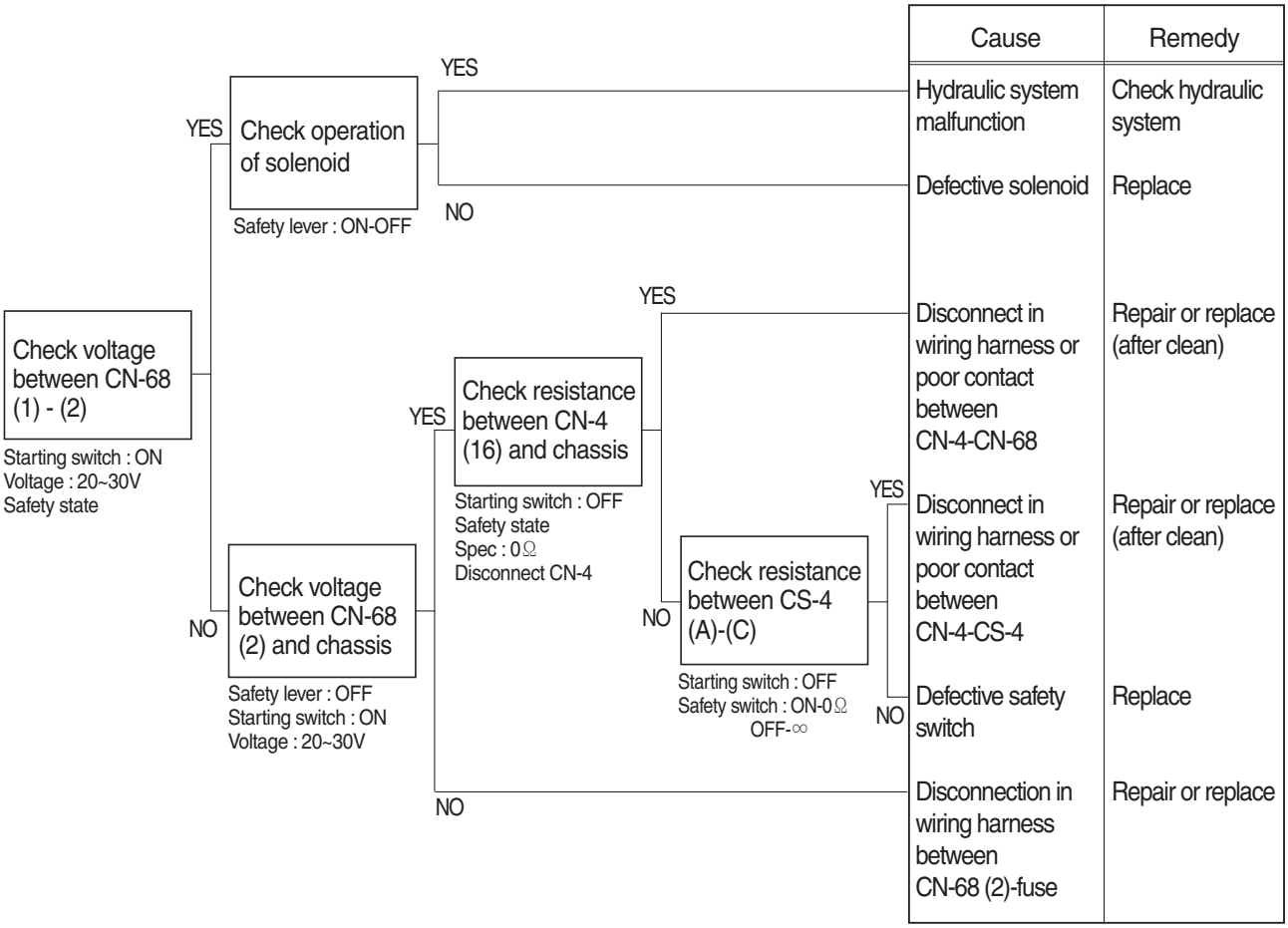
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

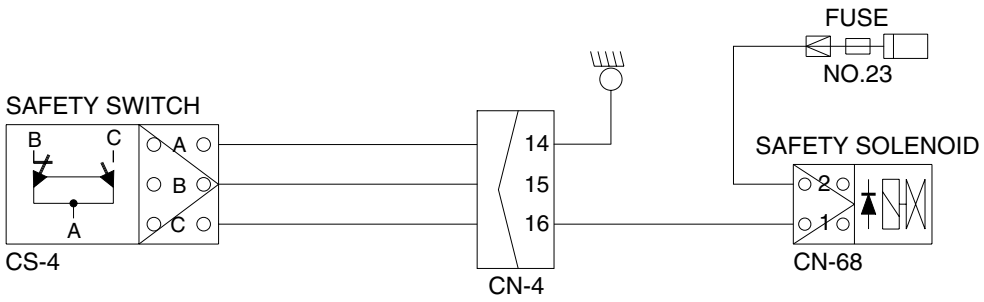


3009SH6ES08

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

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

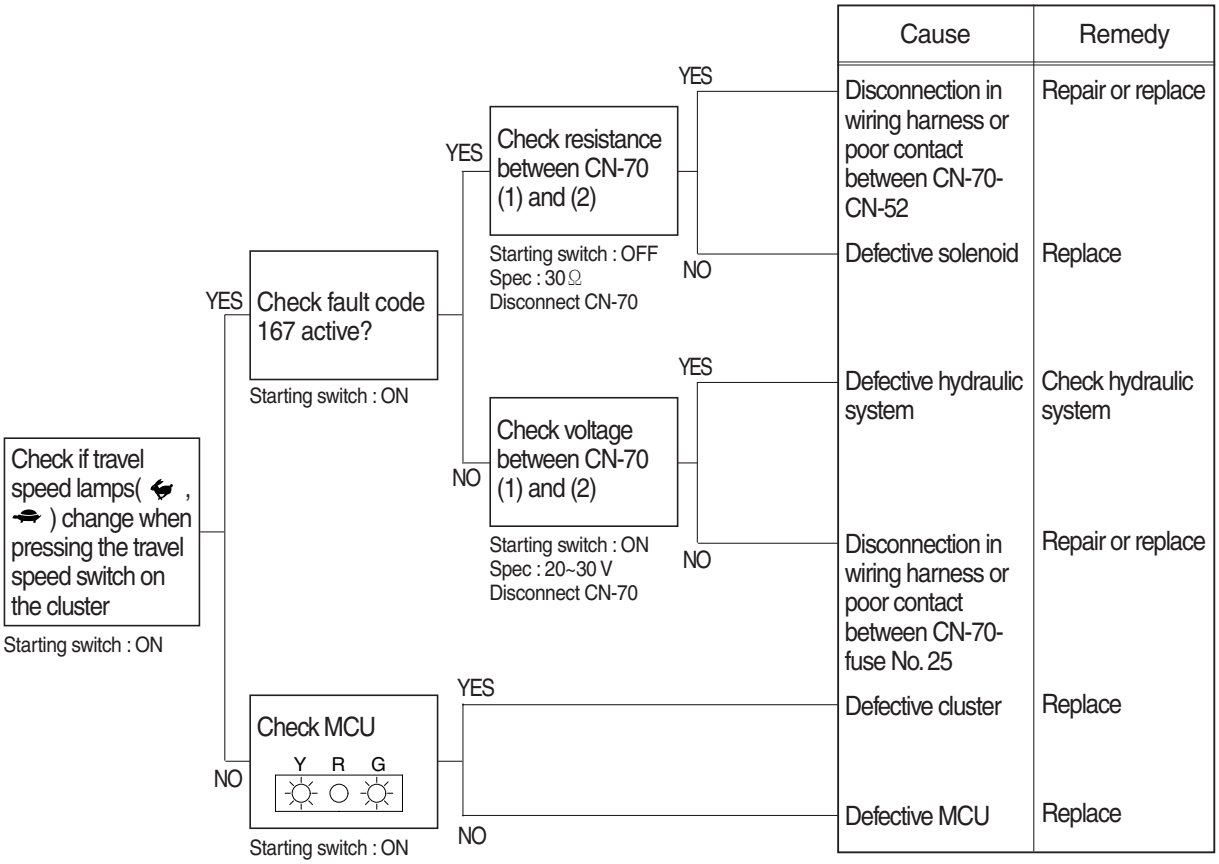


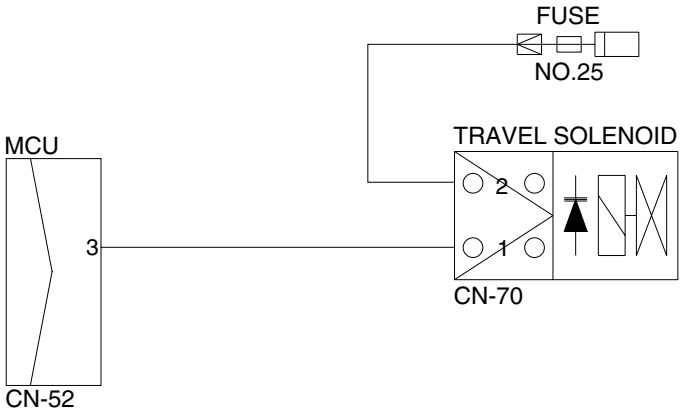


21096ES10

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 short of fuse No.25.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

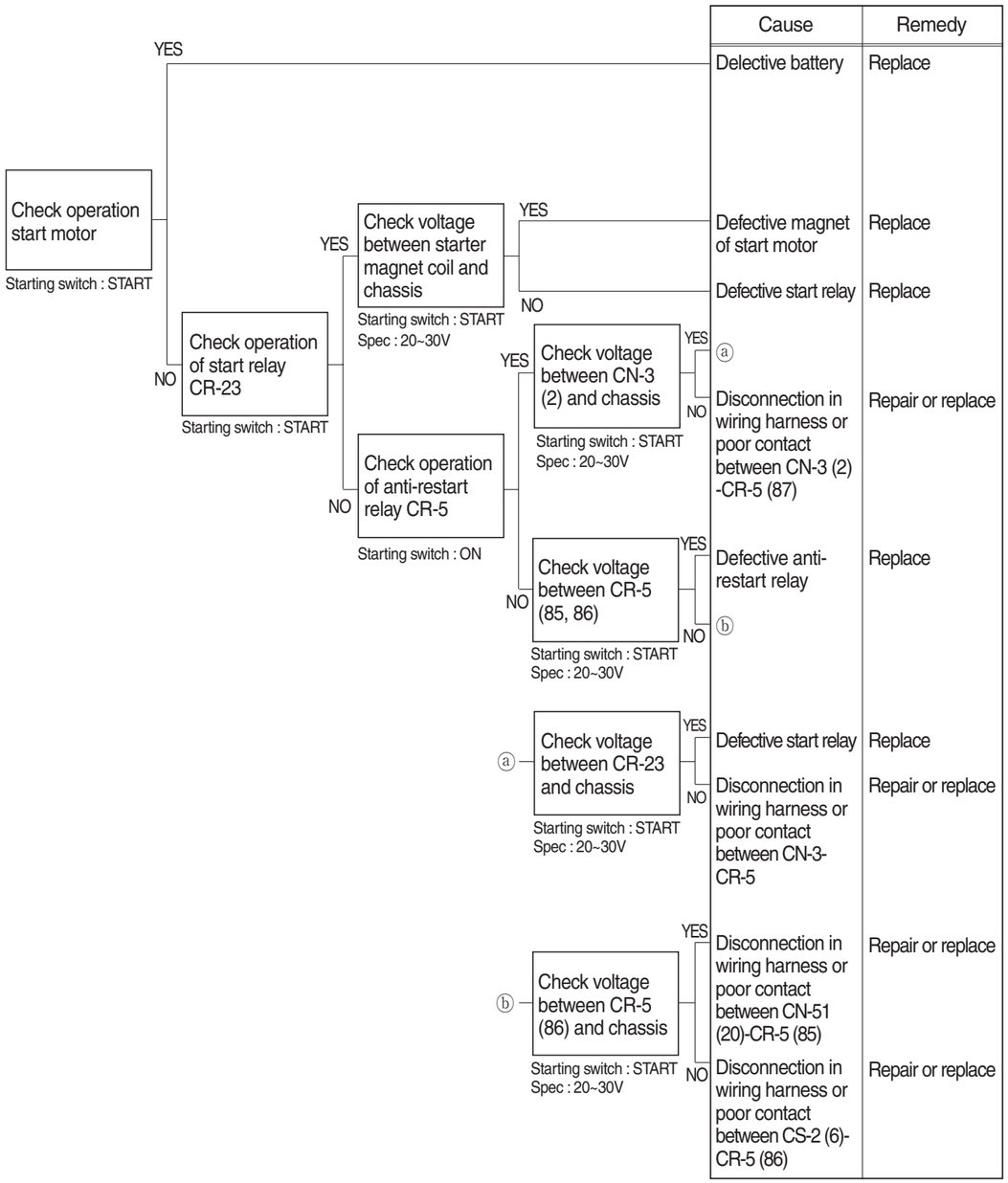


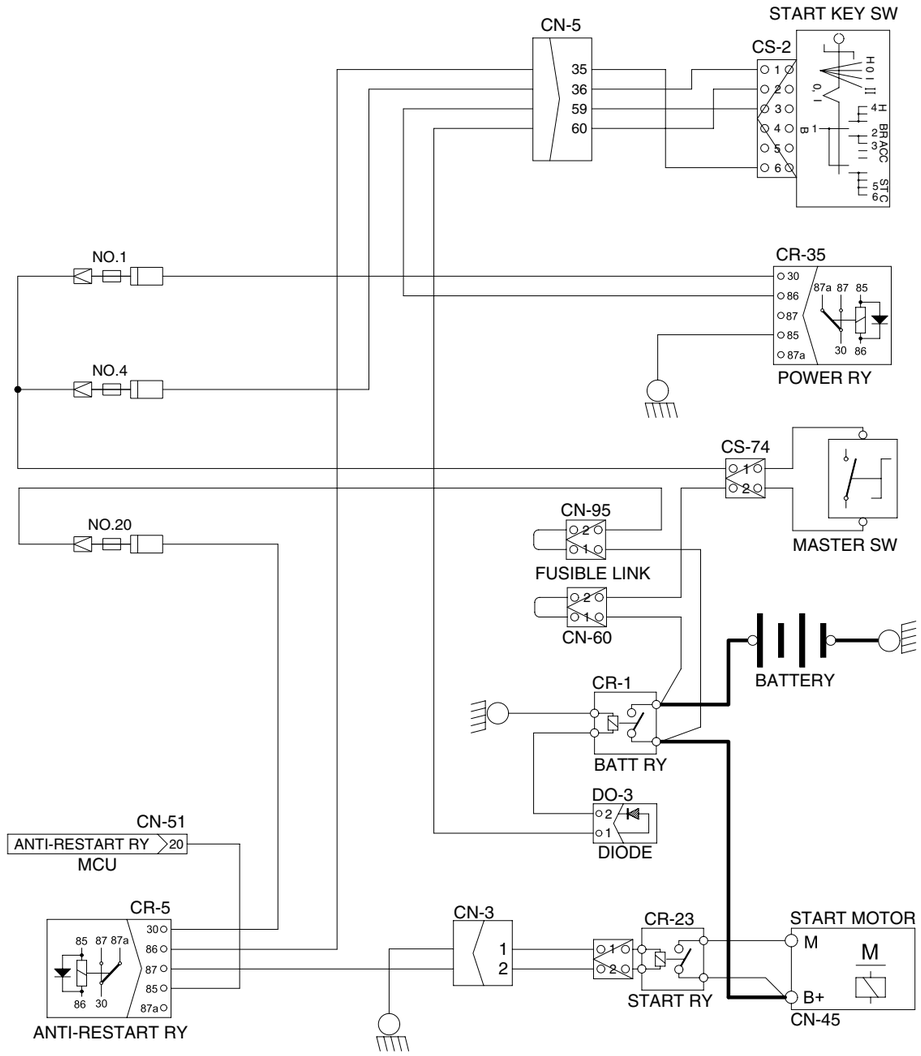


3009SH6ES09

12. WHEN ENGINE DOES NOT START ([- +] lights up condition)

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 1, 4, 20.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

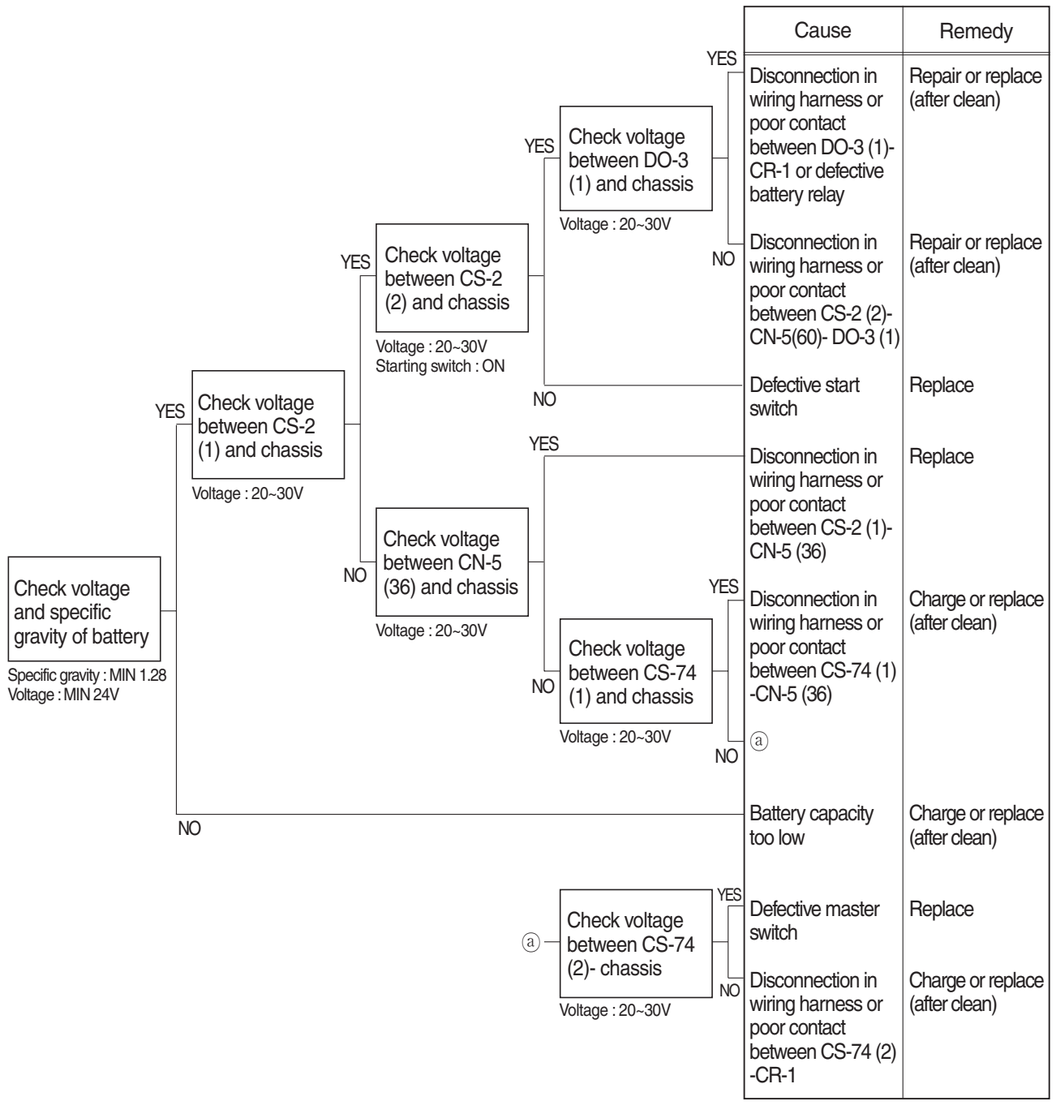


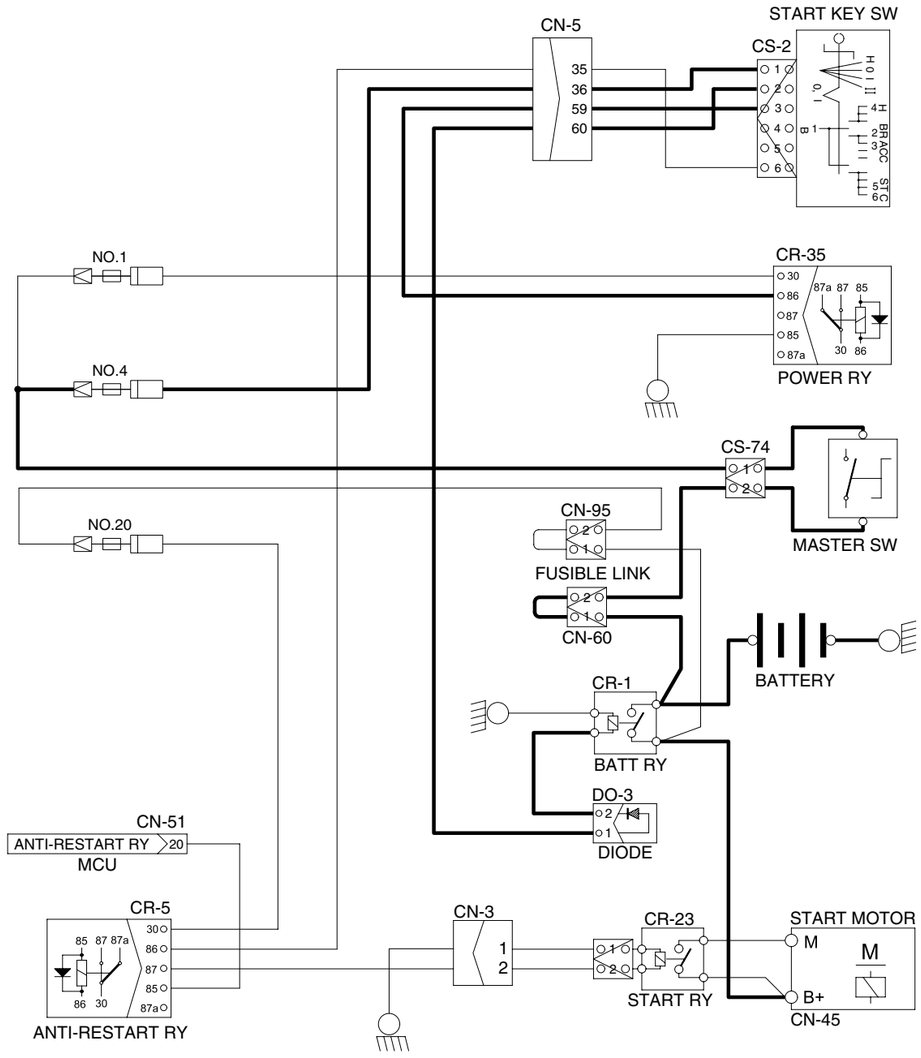


3009SH6ES10

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.

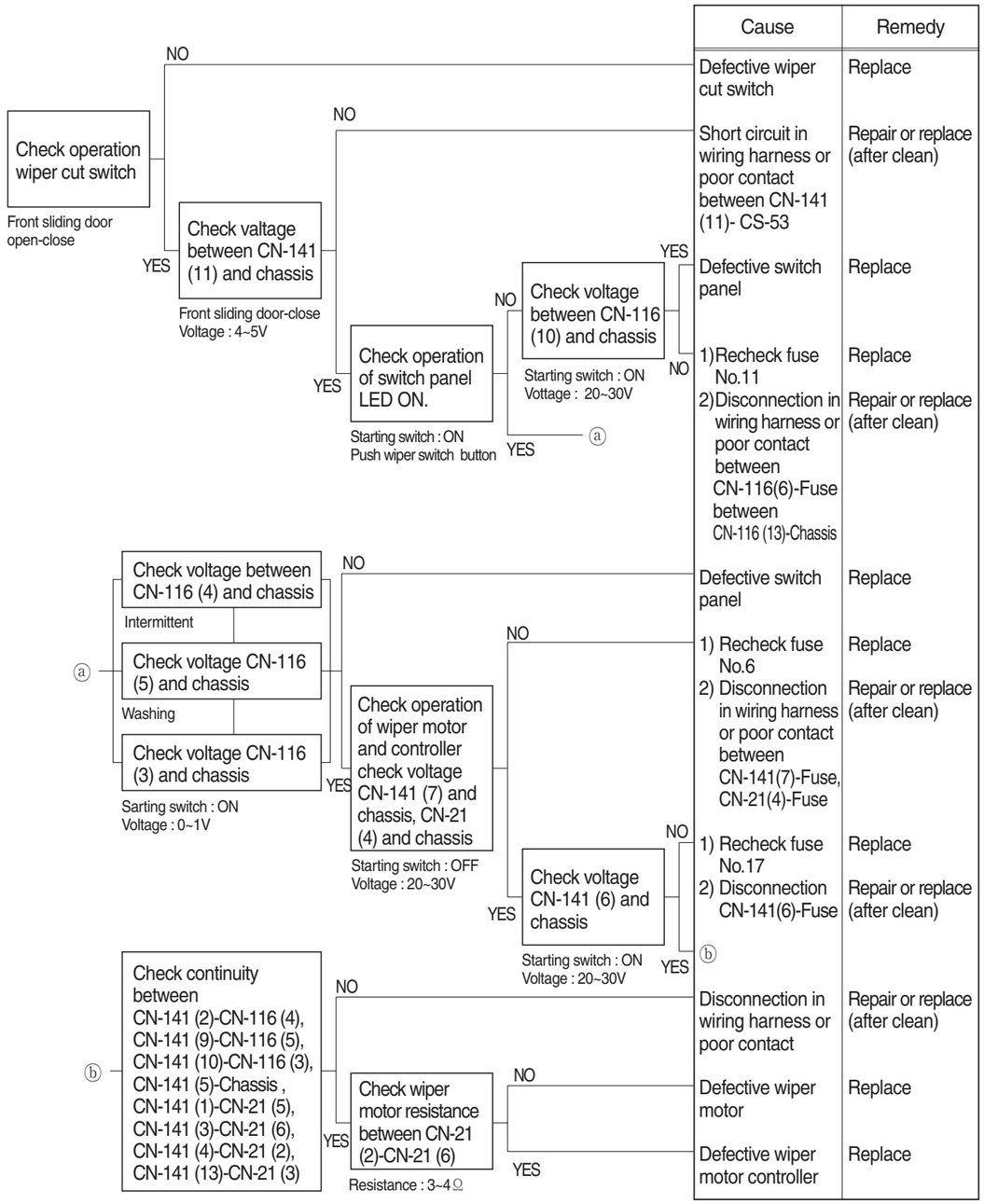




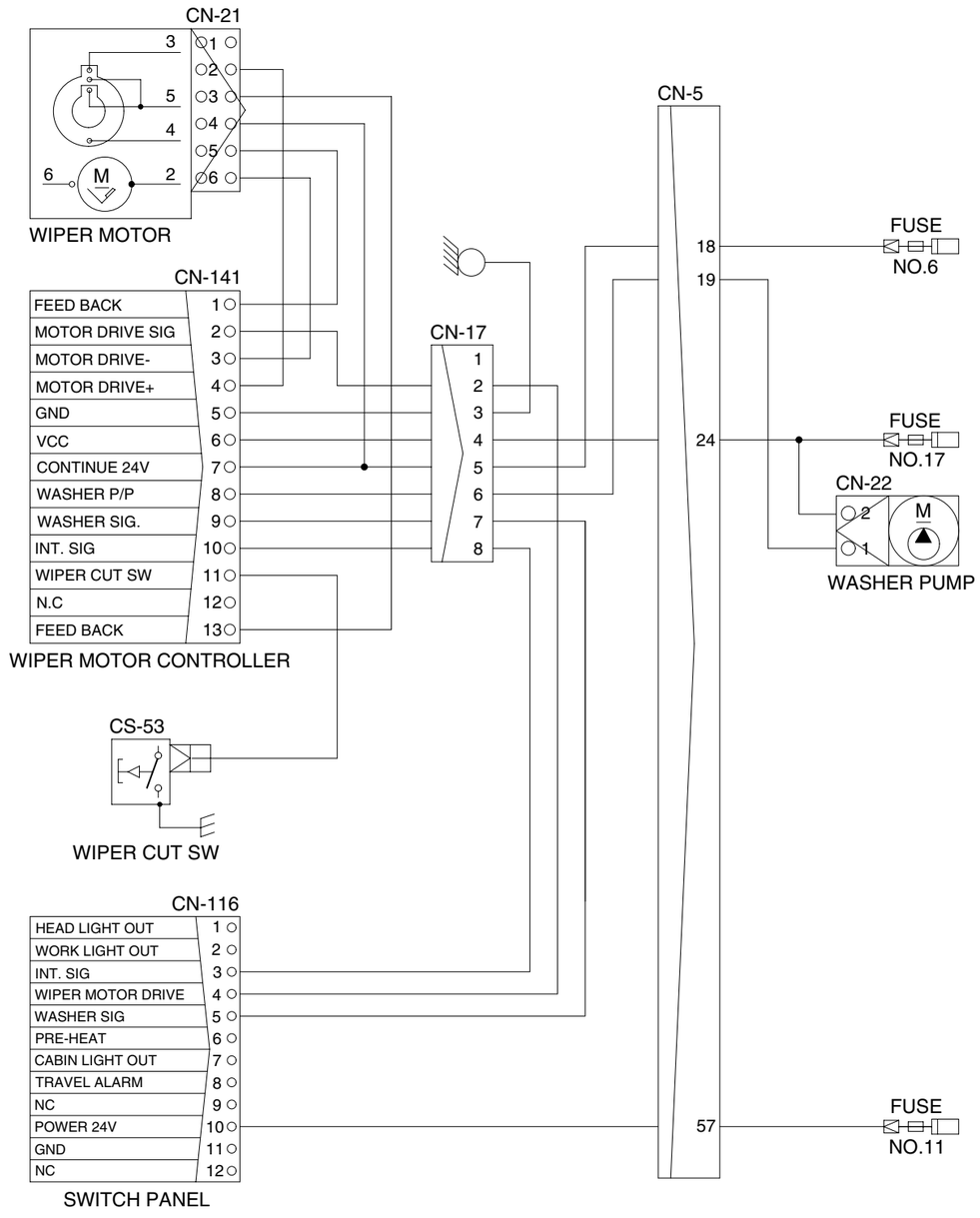
3009SH6ES11

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 the fuse No. 6, 11 and 17 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



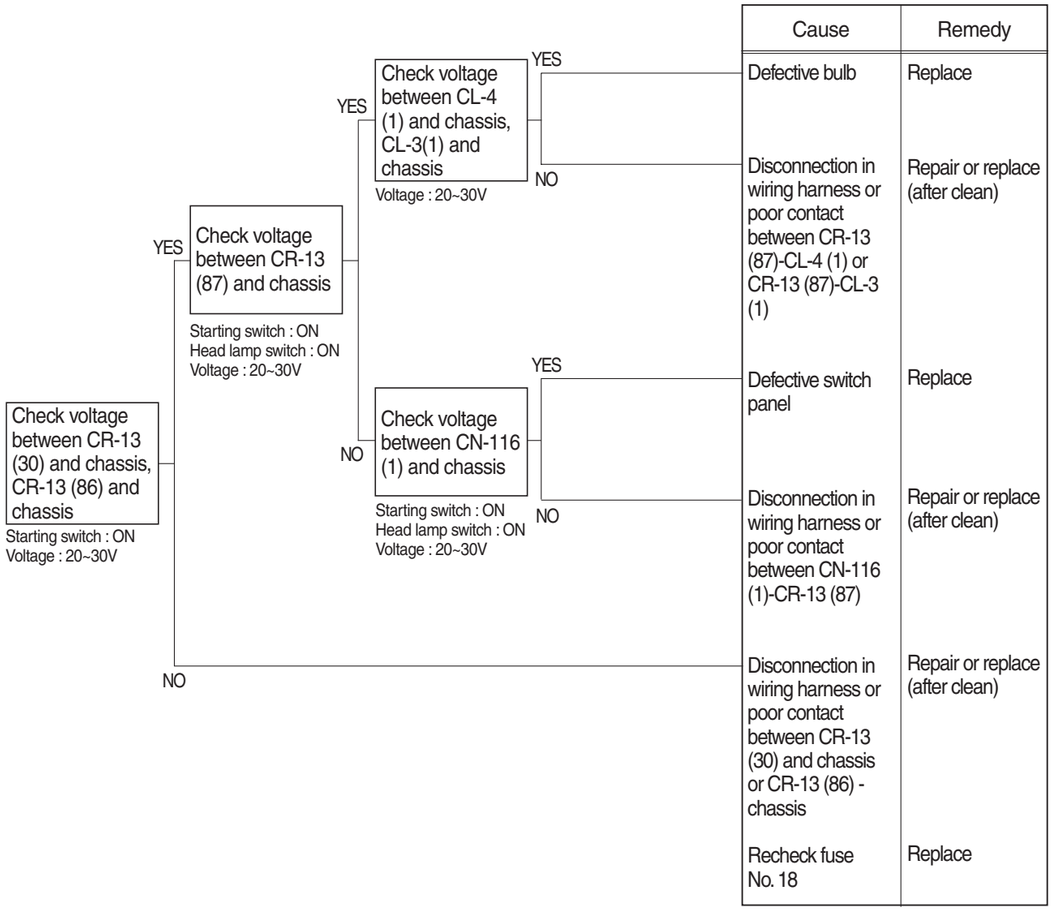
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective switch panel	Replace
1)Recheck fuse No.11	Replace
2)Disconnection in wiring harness or poor contact between CN-116(6)-Fuse between CN-116 (13)-Chassis	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



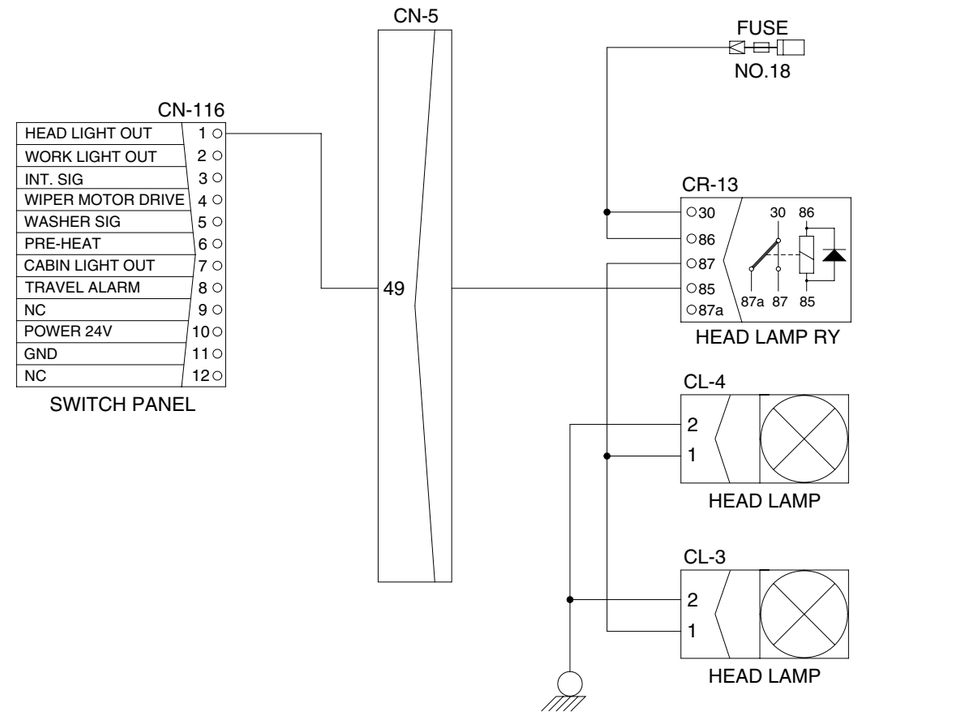
21096ES14

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 short of fuse No.18.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



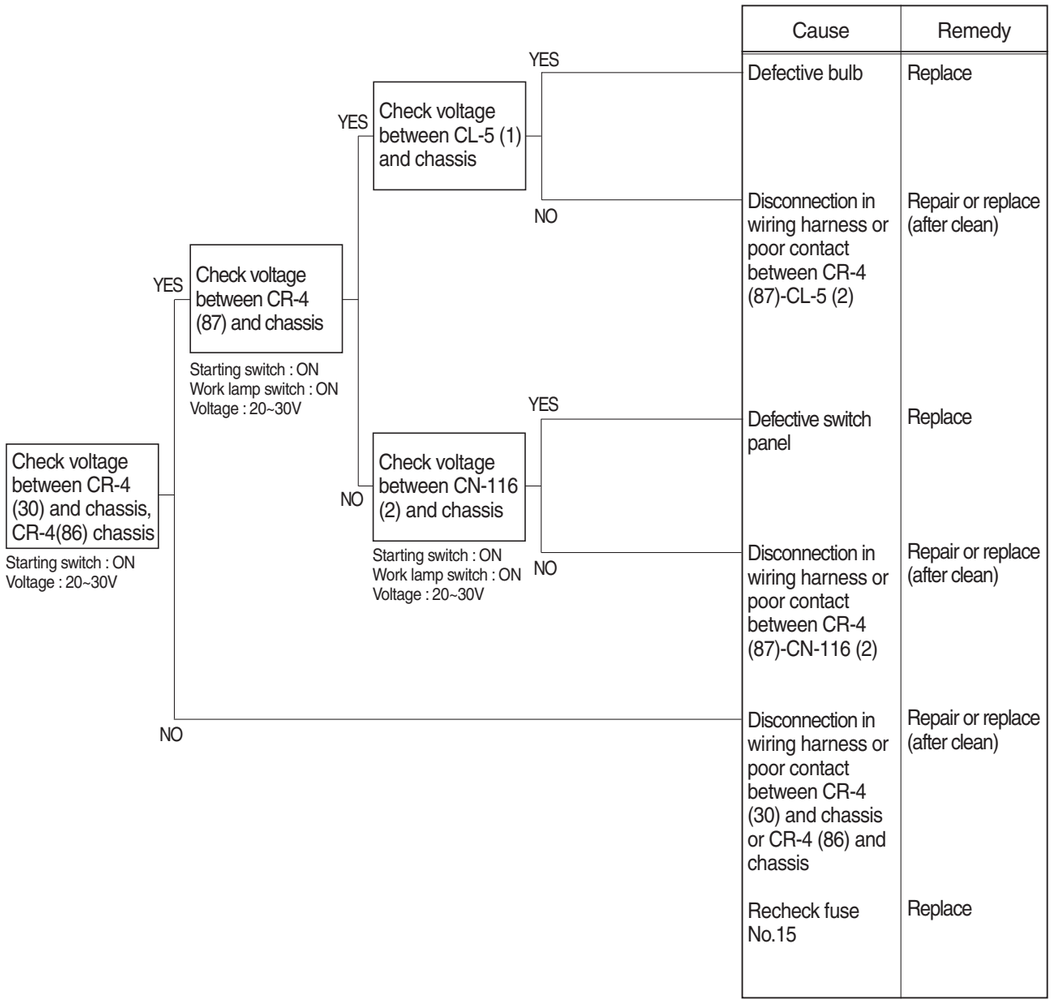
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13 (87)-CL-3 (1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (87)	Repair or replace (after 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

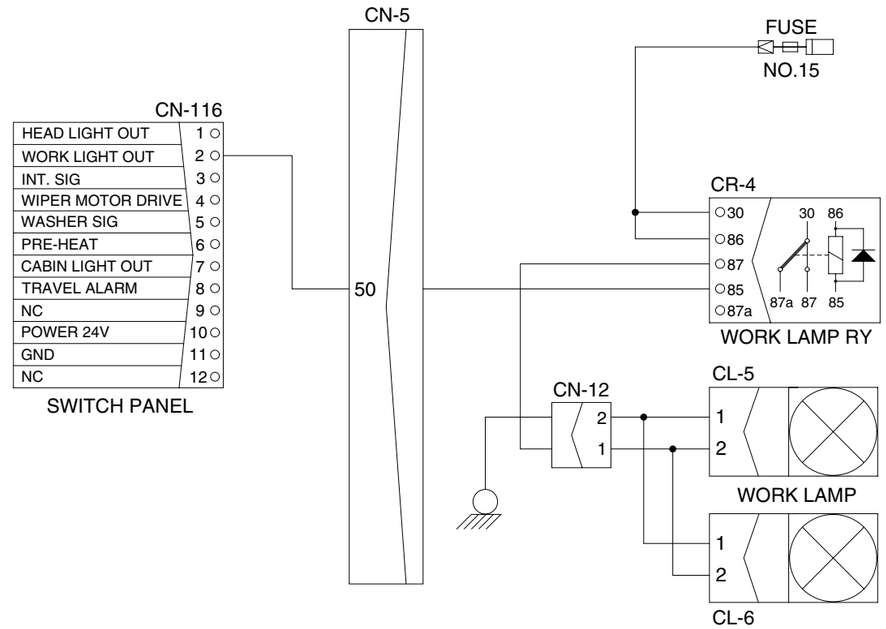


3009SH6ES12

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 short of fuse No.15.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

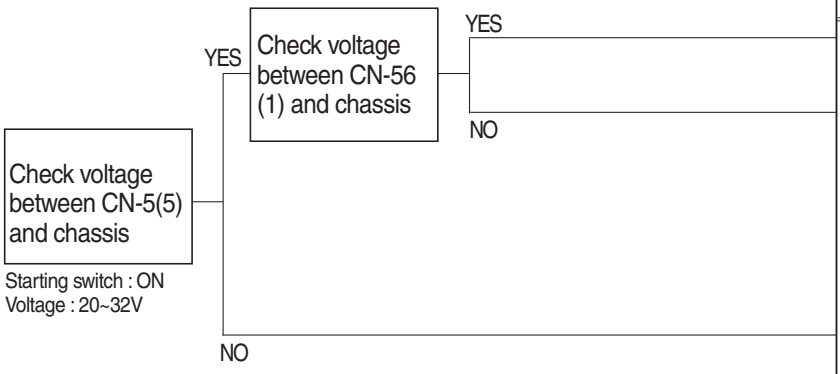




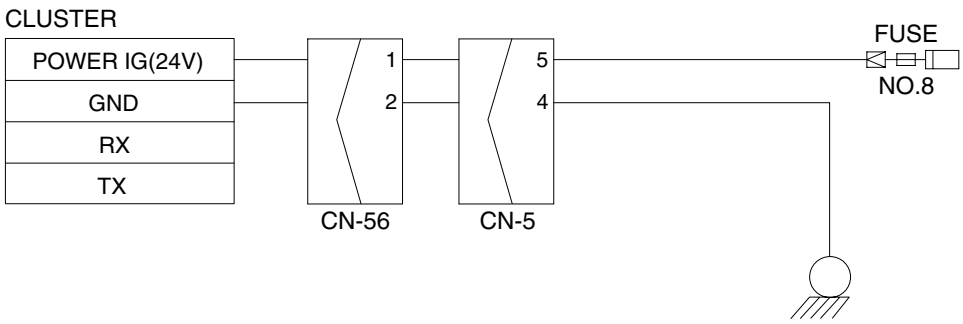
21096ES16

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

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.8.
· 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-56(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)



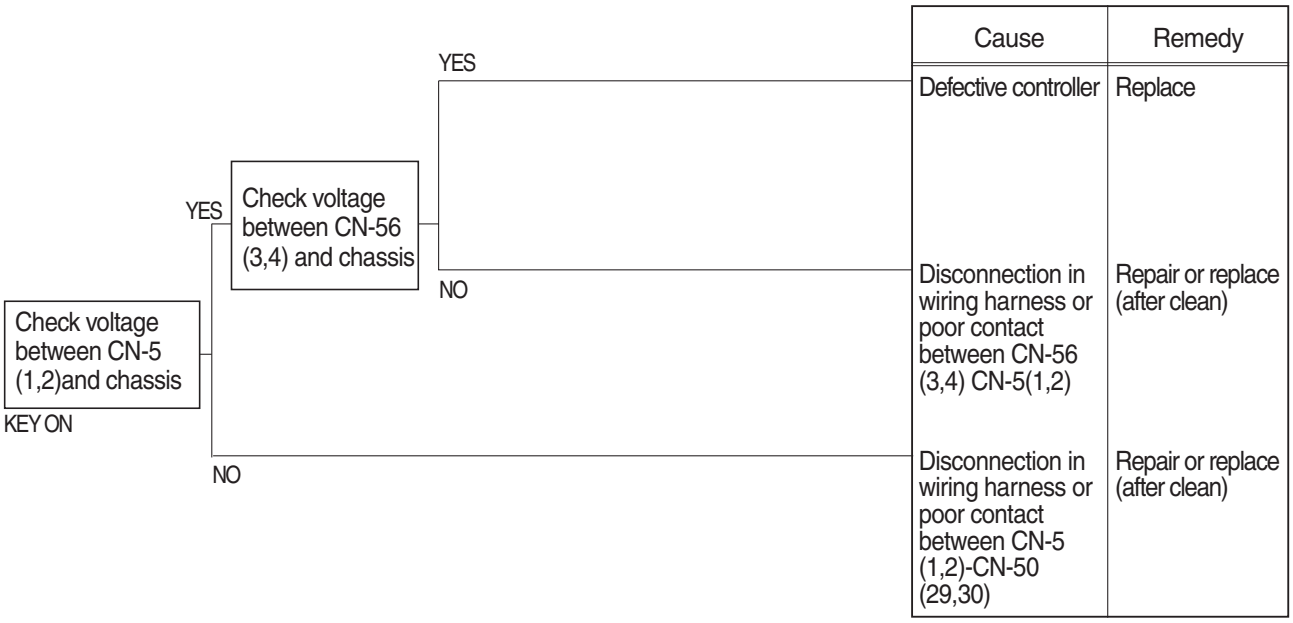
Check voltage

YES	20 ~ 32V
NO	0V

3009SH6ES20

2. COMMUNICATION ERROR FLASHES ON THE CLUSTER

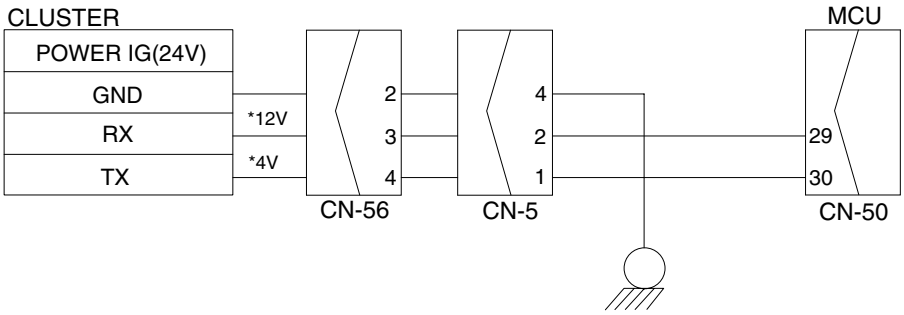
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective controller	Replace
Disconnection in wiring harness or poor contact between CN-56 (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

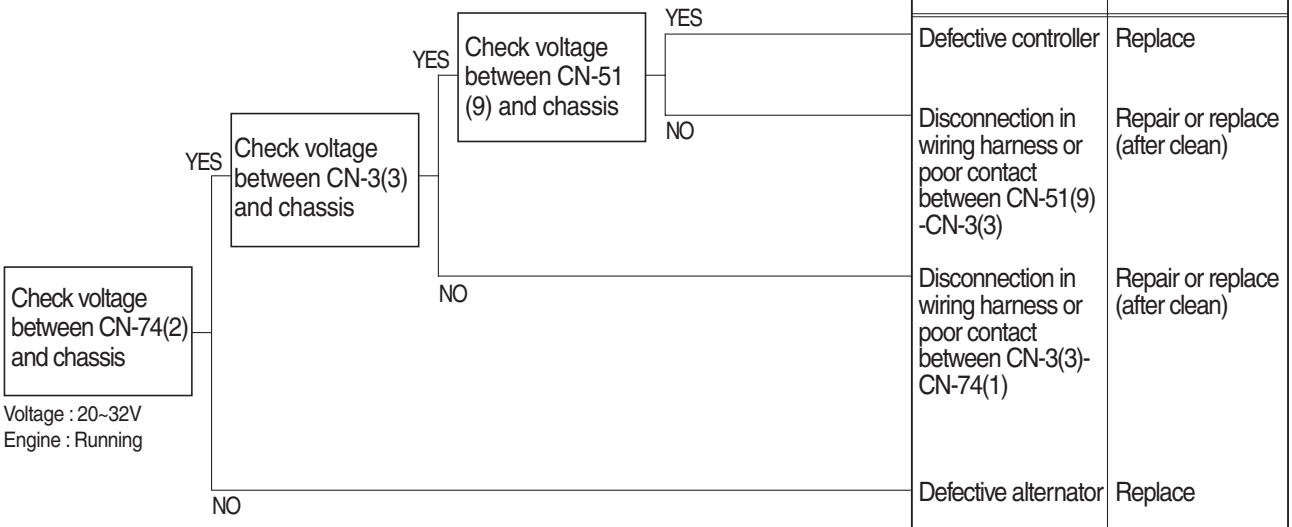
YES	*4V	*12V
NO	0V	0V



3009SH6ES21

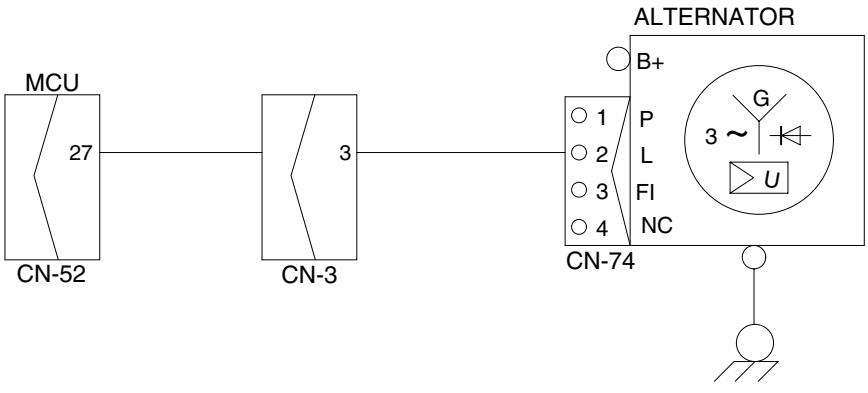
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

· 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

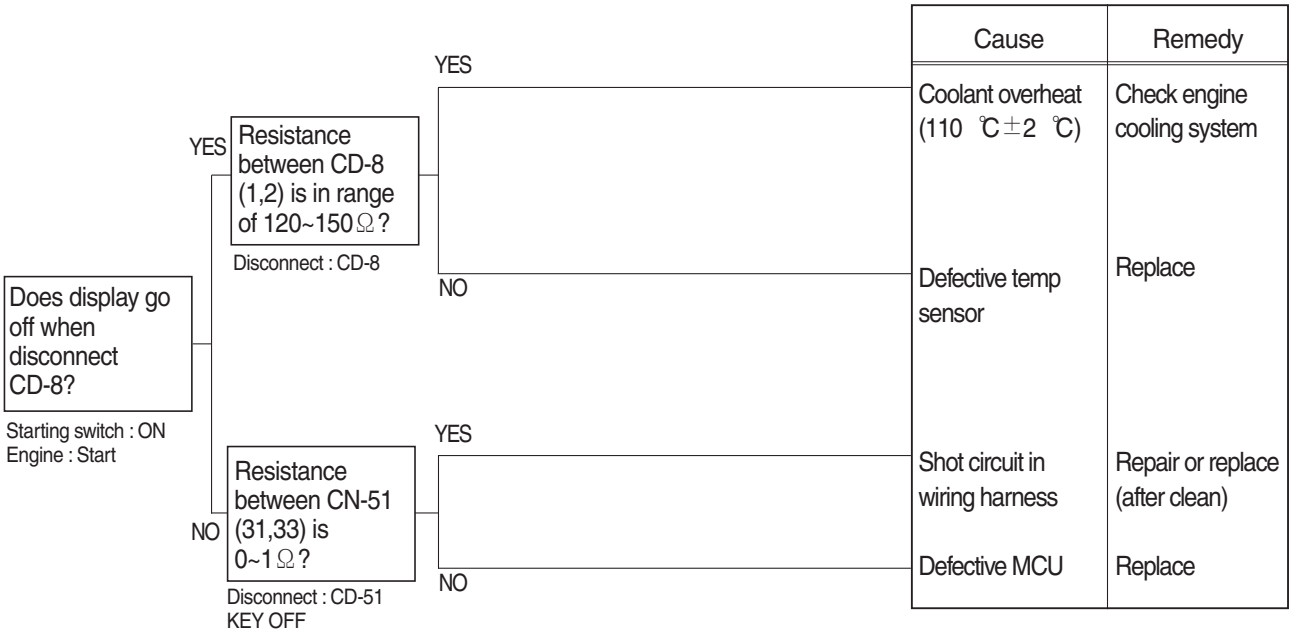
YES	20 ~ 32V
NO	0V

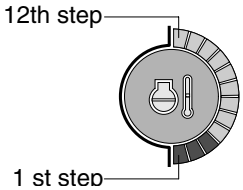


3009S6ES01

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

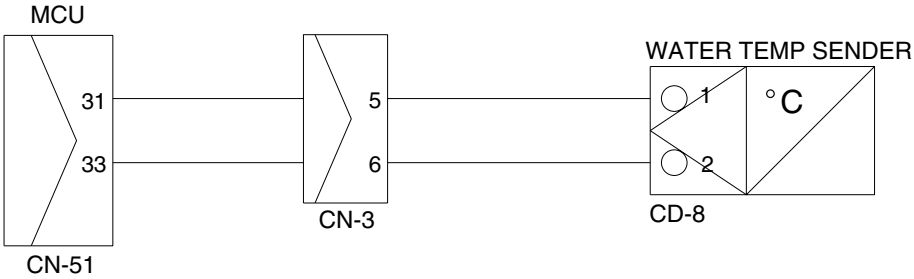
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

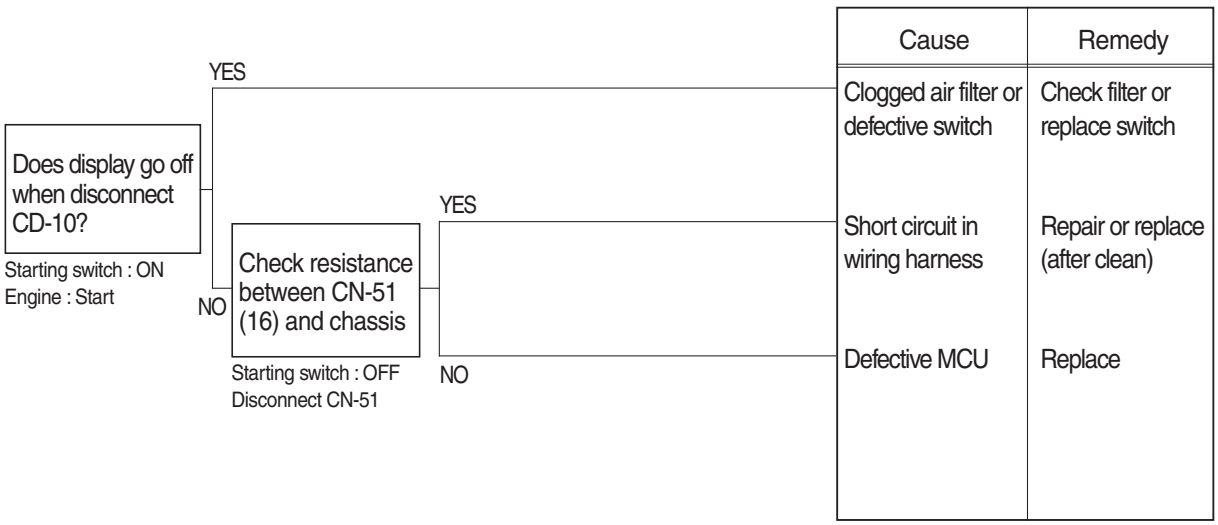
Range	1st step	2nd~10th step	11th~12th step
Temperature	~29 ℃	30~105 ℃	105 ℃ ~



3009SH6ES23

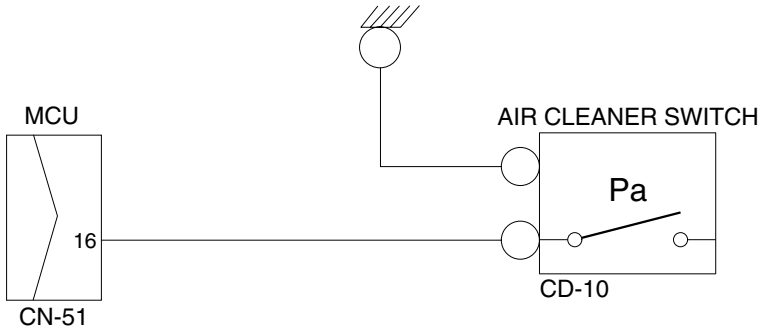
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP(Engine is started)

· 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

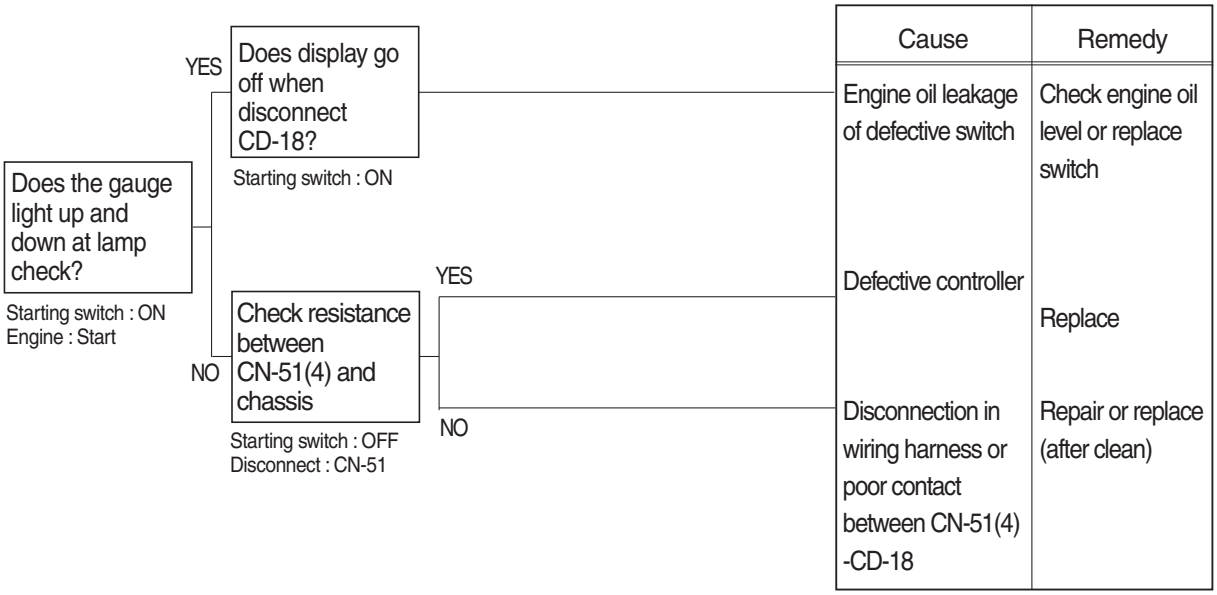
YES	MAX 1Ω
NO	MIN 1MΩ



3009SH6ES24

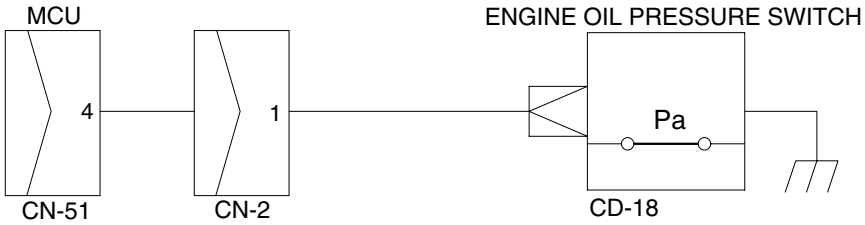
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP(Engine is started)

- 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.



Check resistance

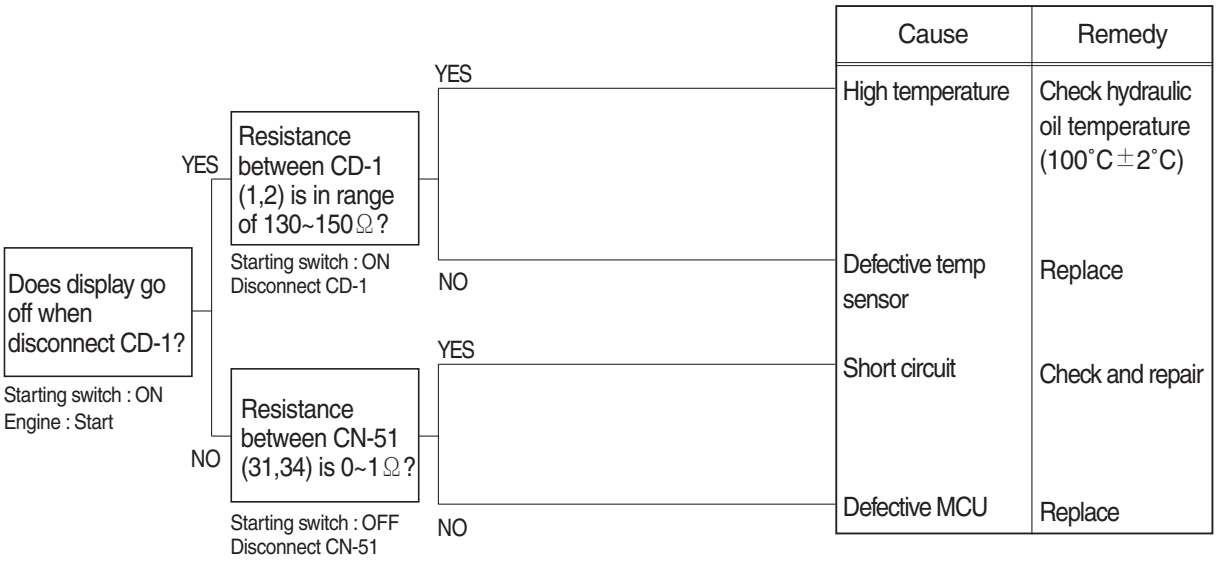
YES	MAX 1Ω
NO	MIN 1MΩ



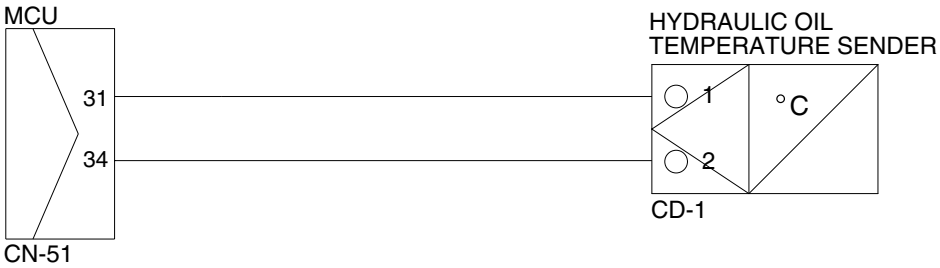
3009SH6ES25

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.



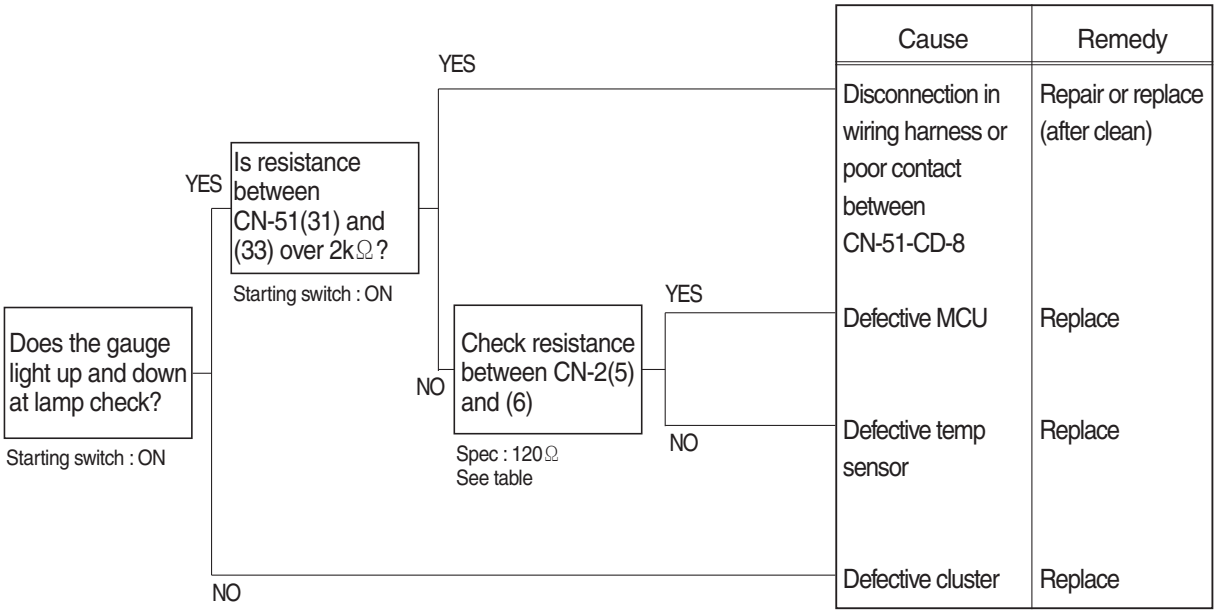
Cause	Remedy
High temperature	Check hydraulic oil temperature (100˚C±2˚C)
Defective temp sensor	Replace
Short circuit	Check and repair
Defective MCU	Replace

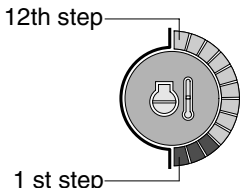


3009SH6ES26

8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

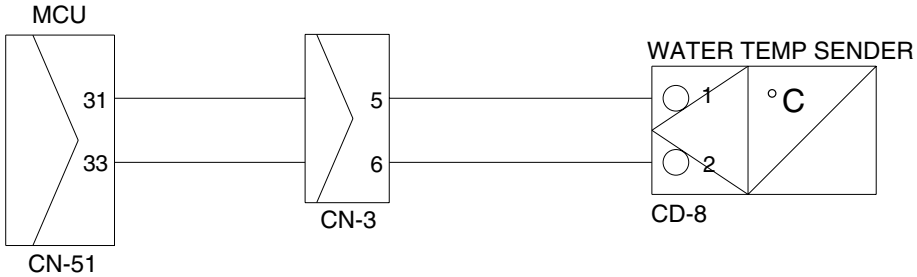
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

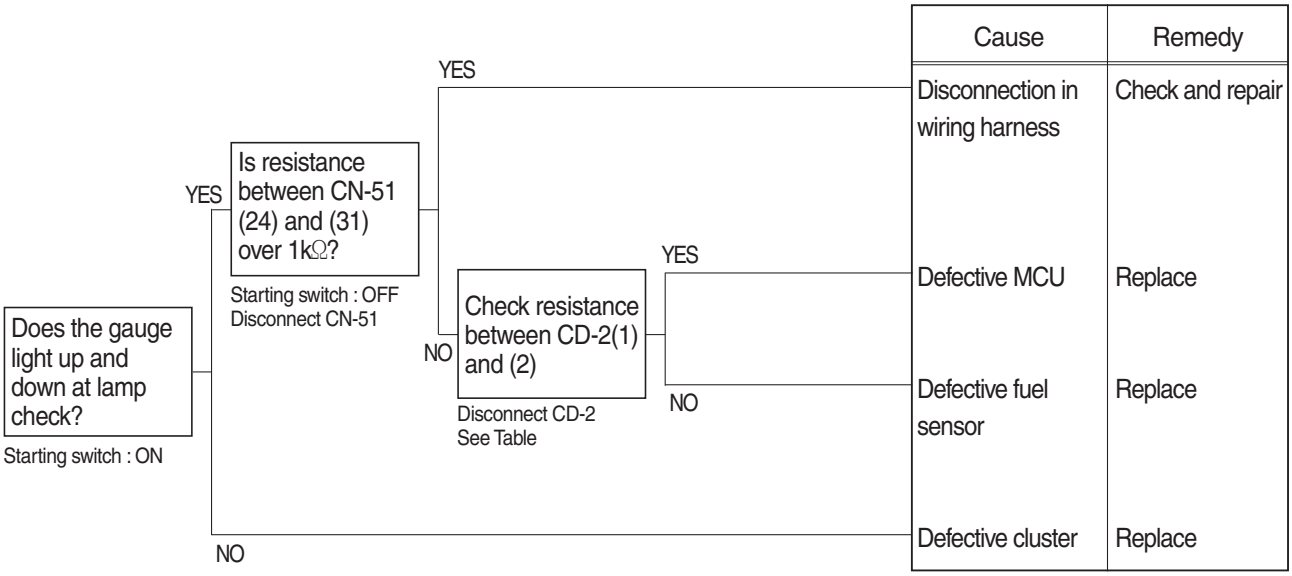
Range	1st step	2nd~10th step	11th~12th step
Temperature	~29 ℃	30~105 ℃	105 ℃ ~

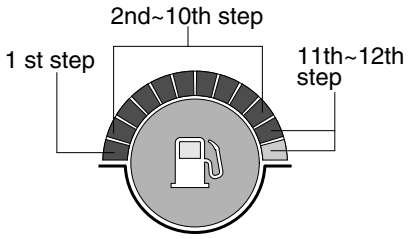


3009SH6ES23

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

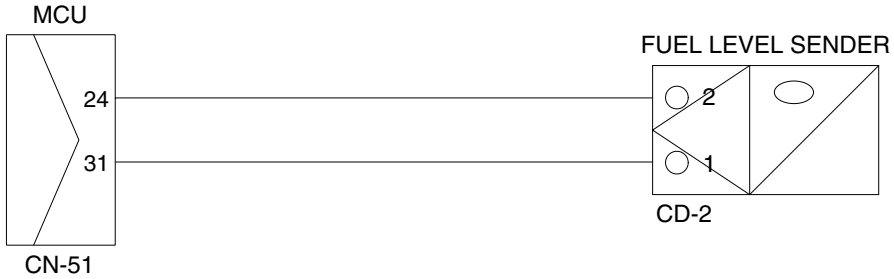
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

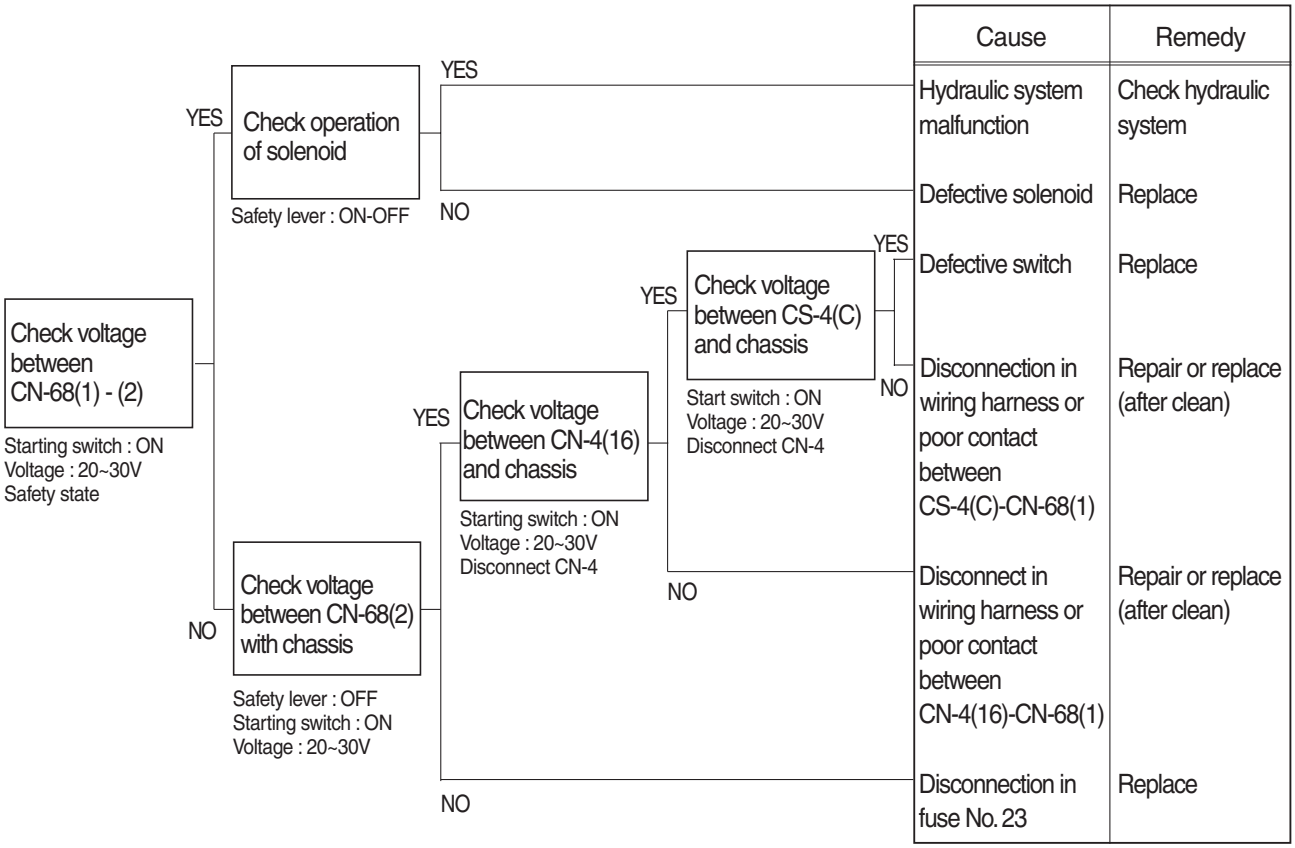
Item \ Range	1st step	2nd~10th step	11th~12th step
Unit Resistance(Ω)	700~601	600~101	~100
Tolerance(%)	±5	±5	±5

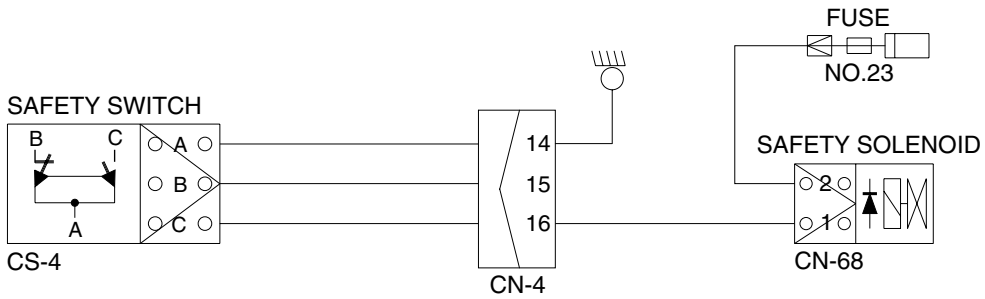


3009SH6ES27

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

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

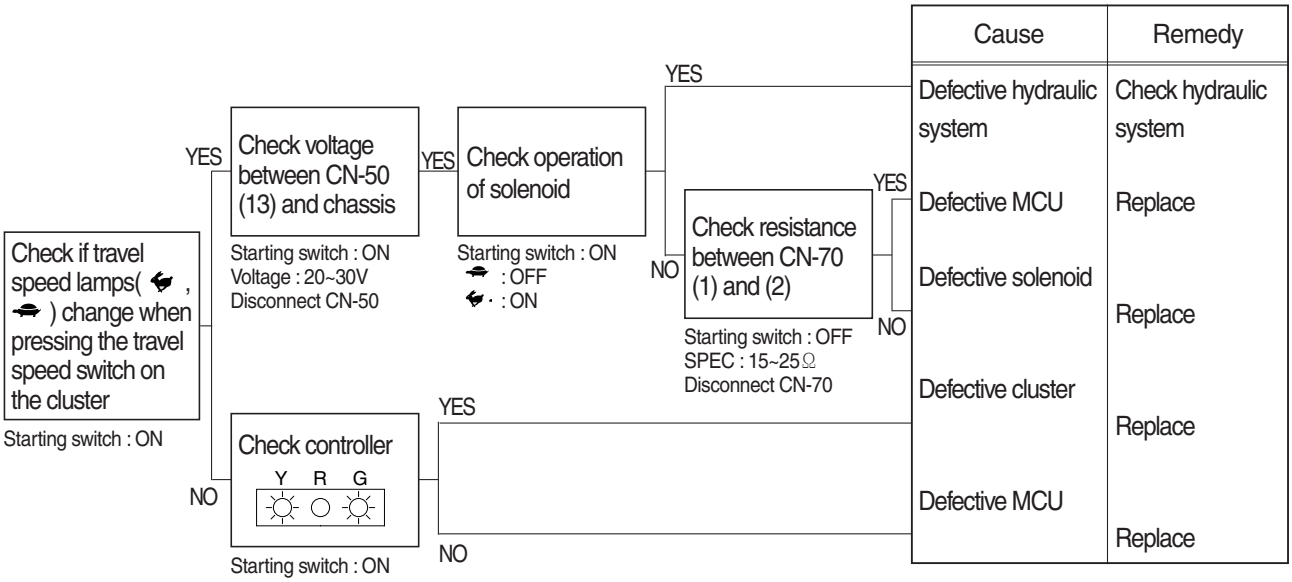


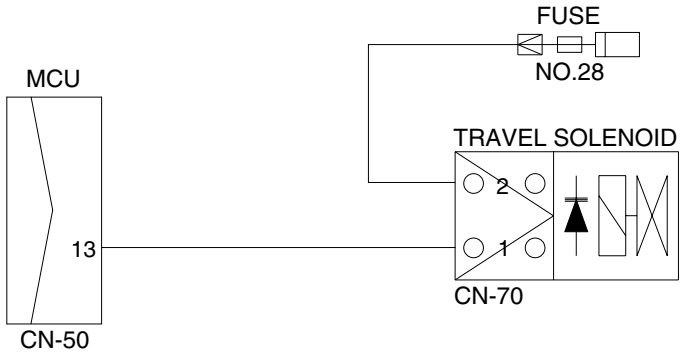


21096ES10

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.

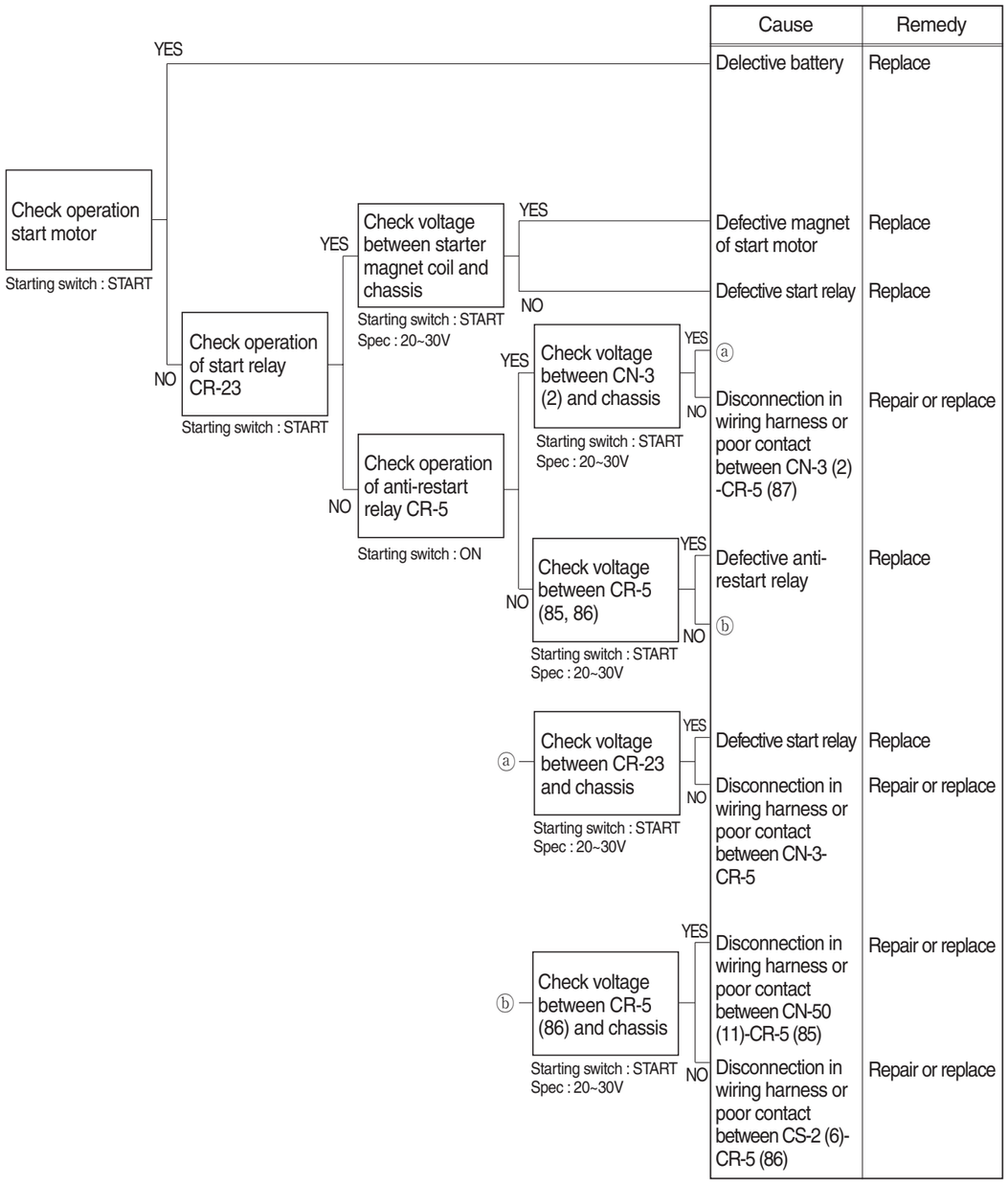


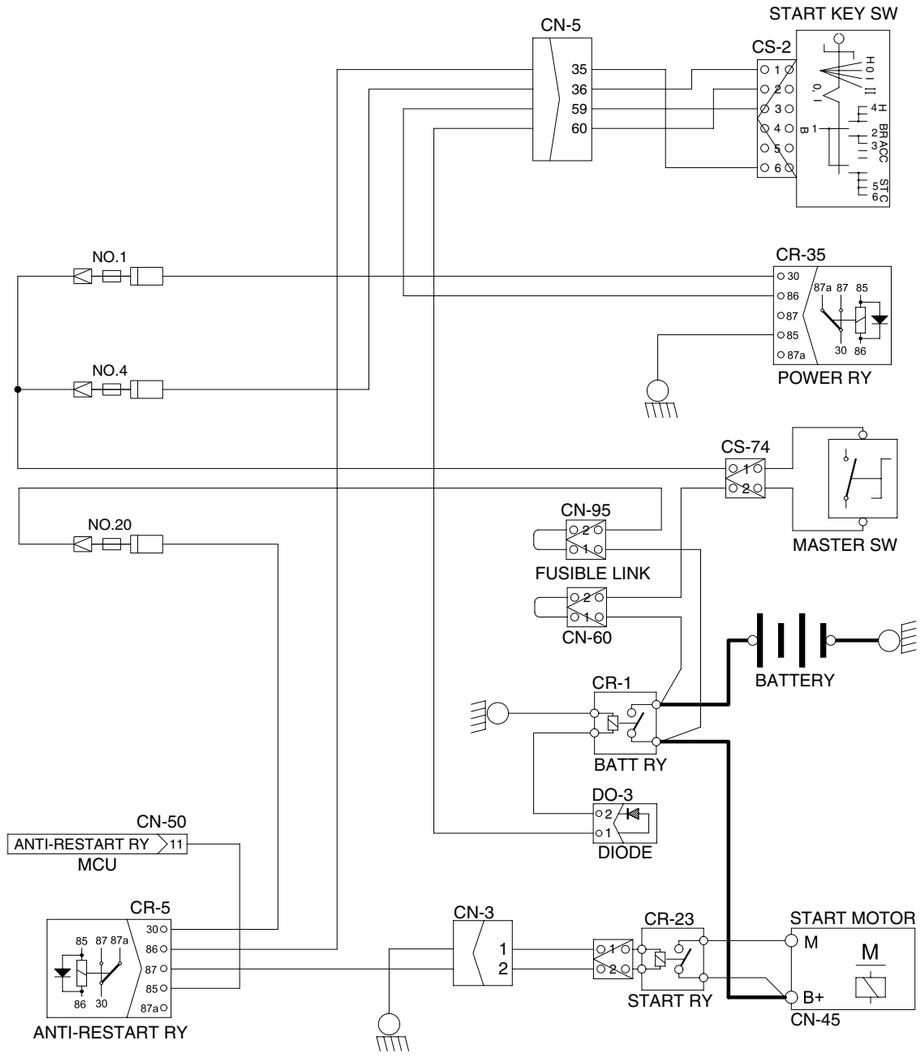


3009SH6ES28

12. WHEN ENGINE DOES NOT START ([- +] lights up condition)

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 1, 4, 20.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

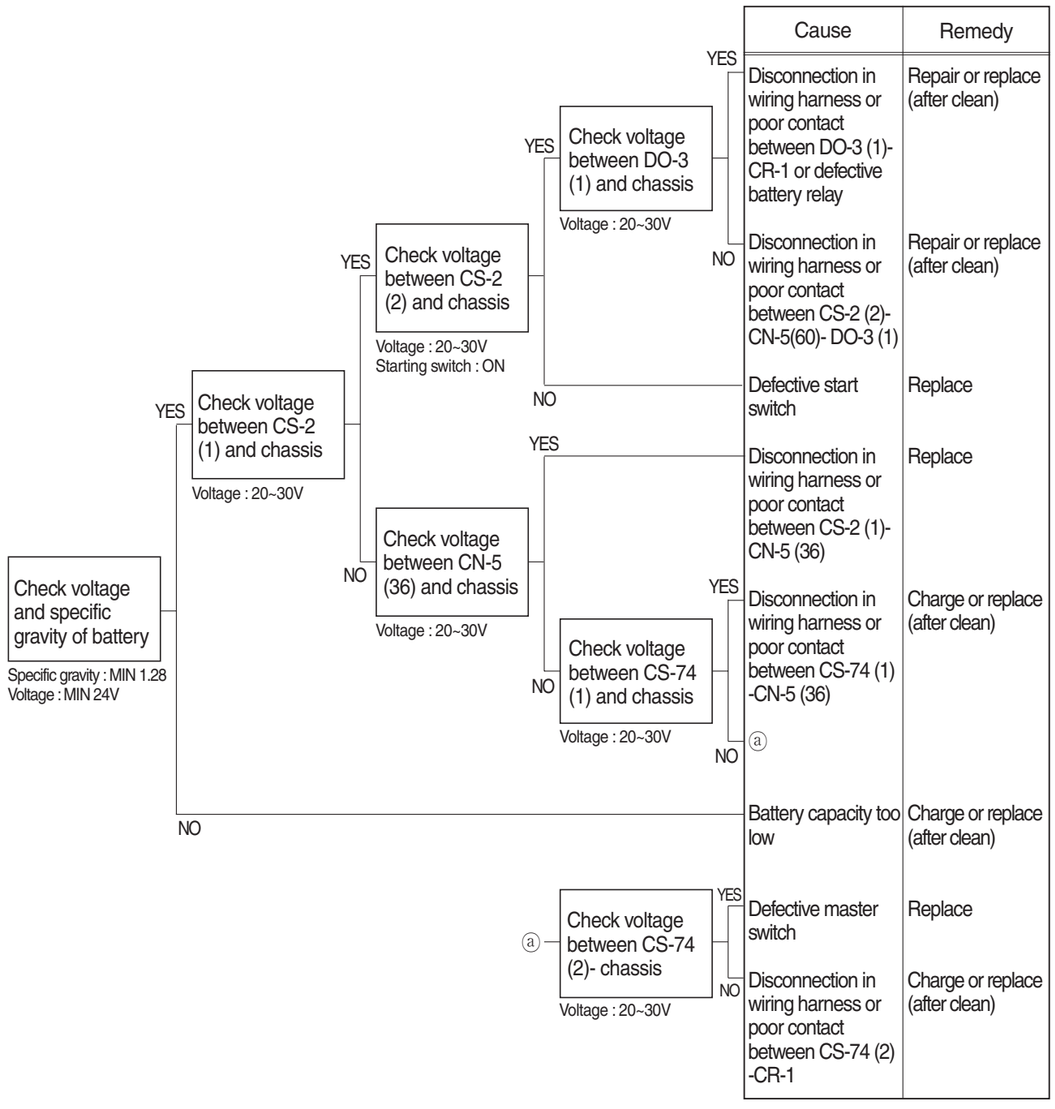


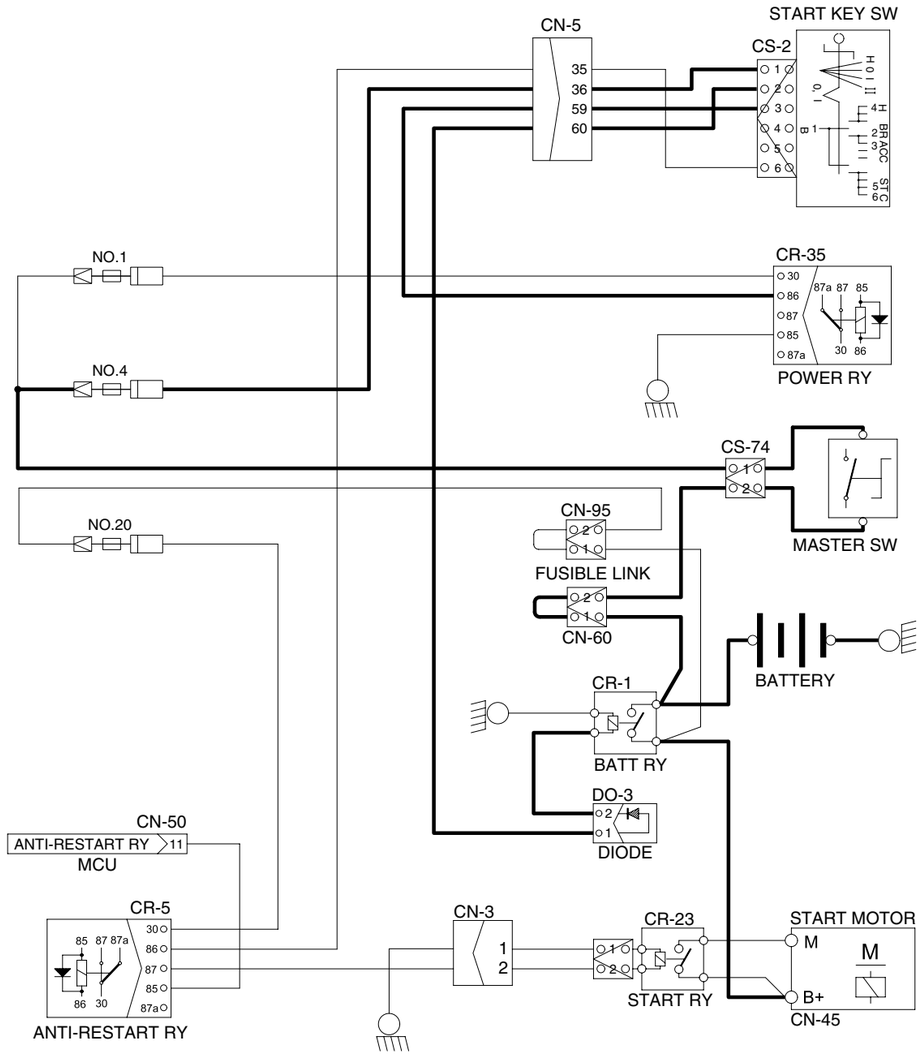


3009SH6ES29

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.

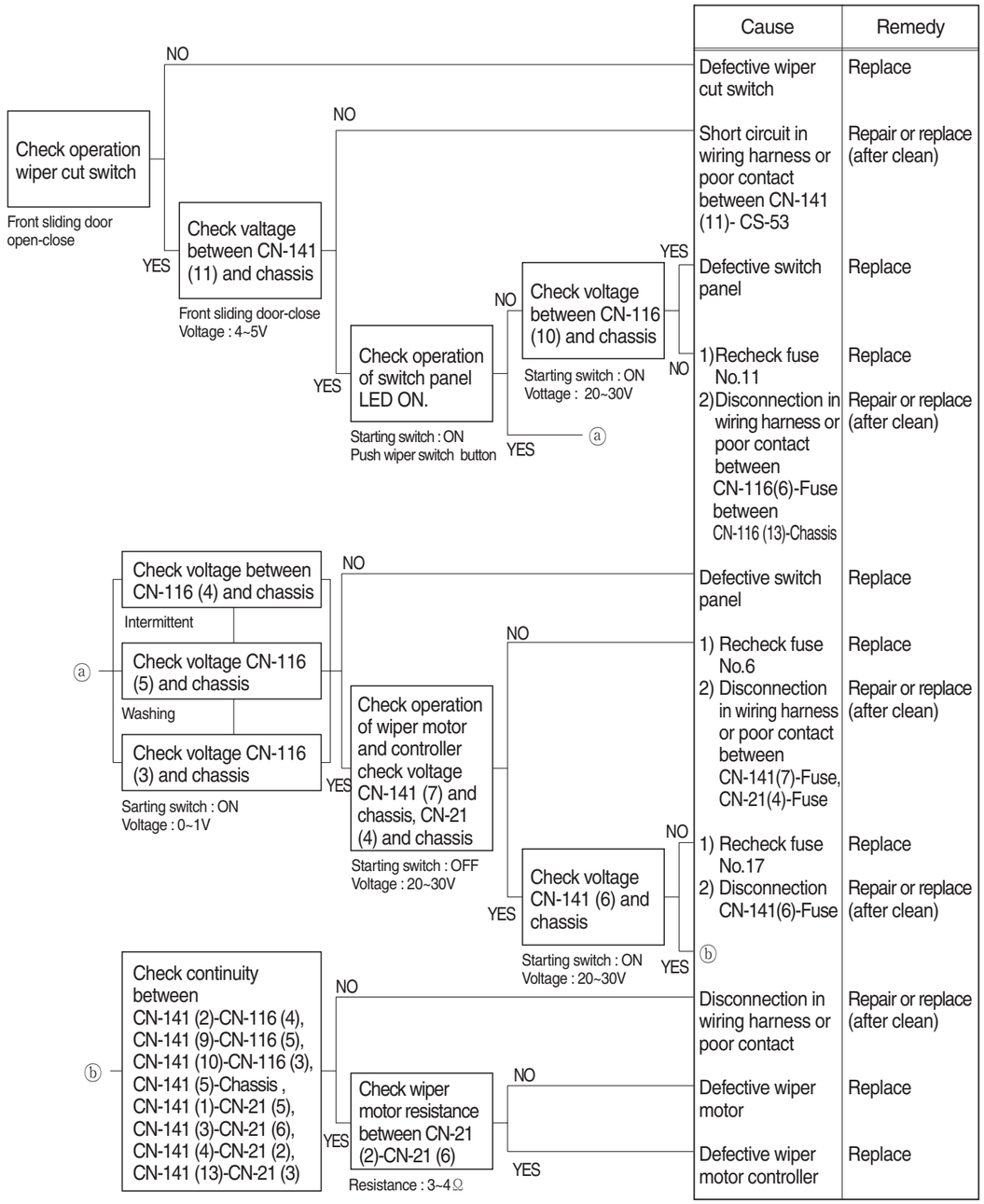




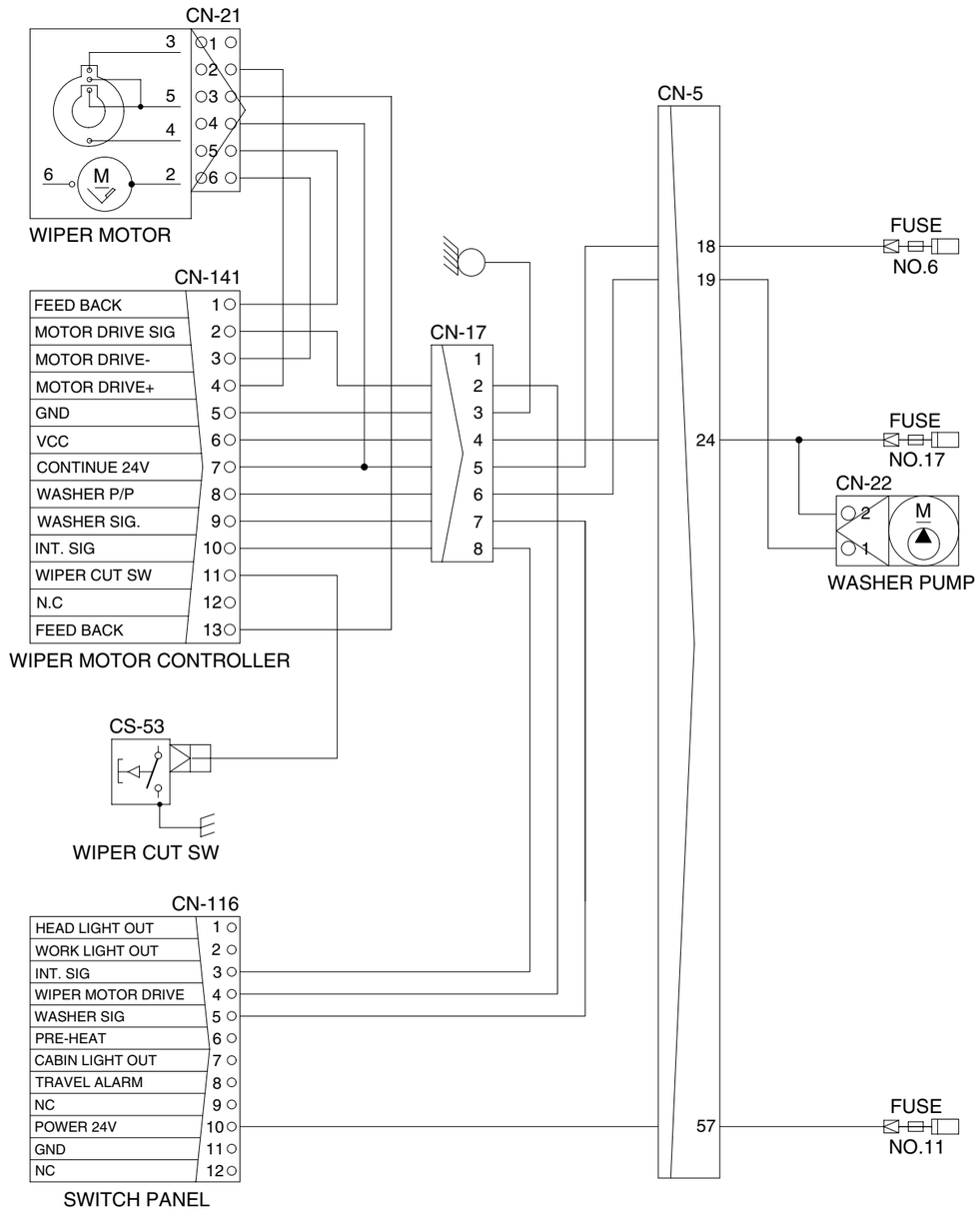
3009SH6ES30

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 the fuse No. 6, 11 and 17 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



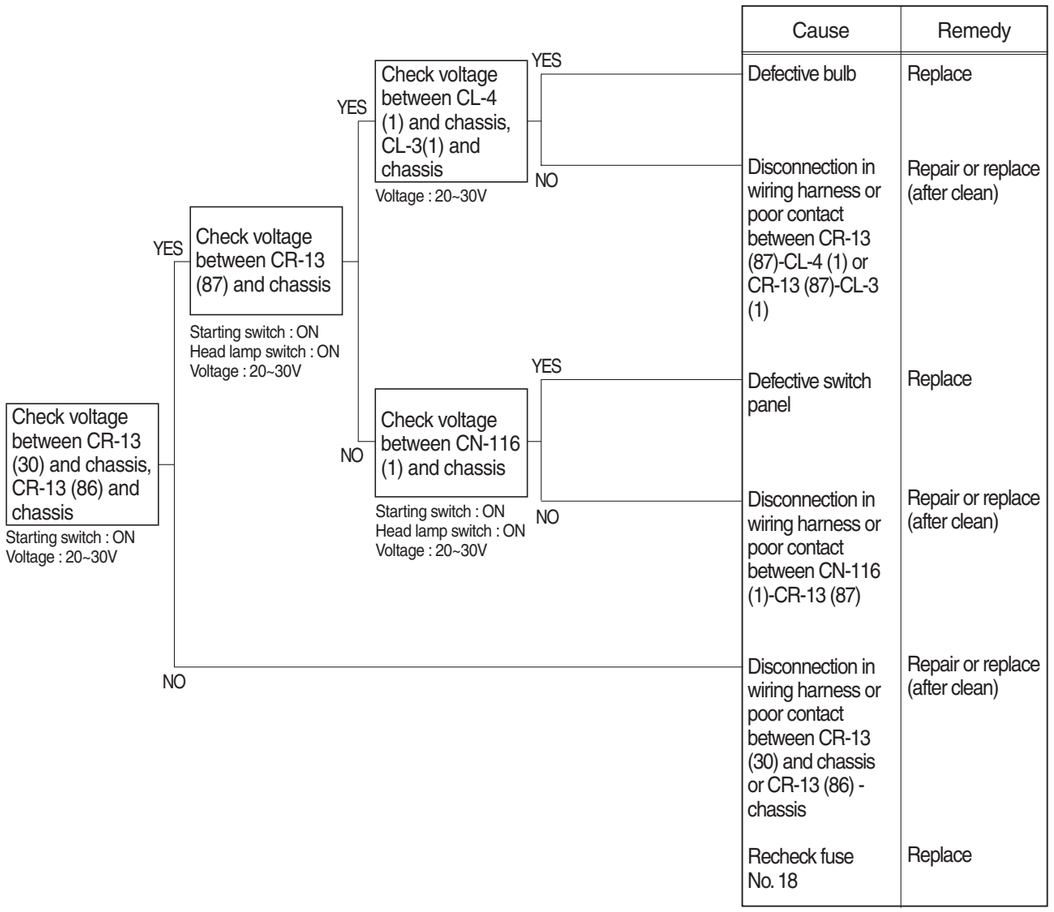
Cause	Remedy
Defective wiper cut switch	Replace
Short circuit in wiring harness or poor contact between CN-141 (11)- CS-53	Repair or replace (after clean)
Defective switch panel	Replace
1)Recheck fuse No.11	Replace
2)Disconnection in wiring harness or poor contact between CN-116(6)-Fuse between CN-116 (13)-Chassis	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



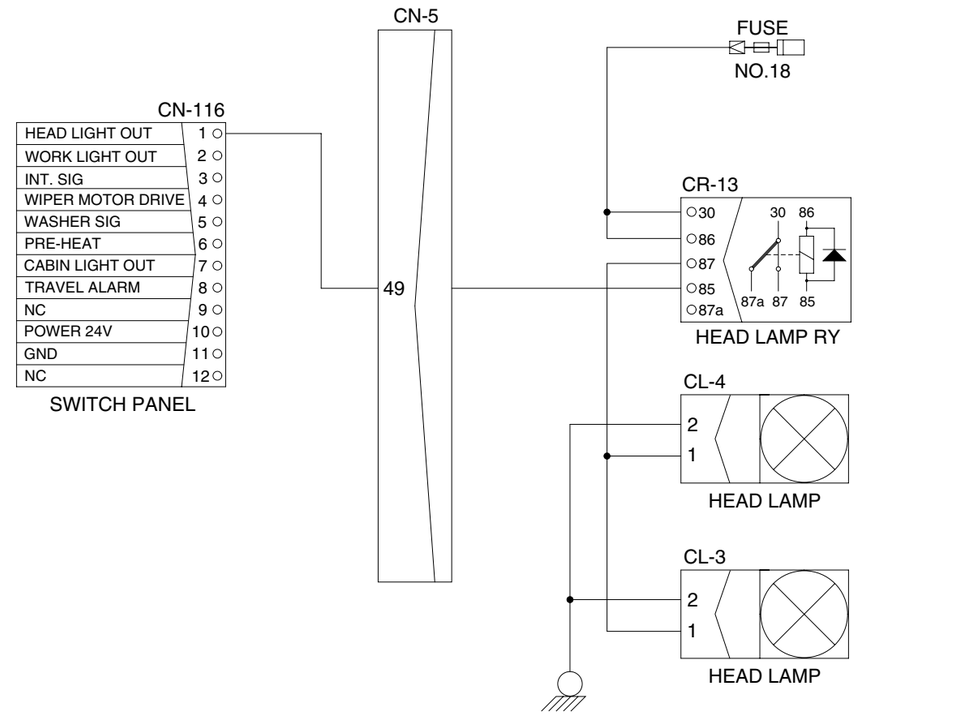
21096ES14

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 short of fuse No.18.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



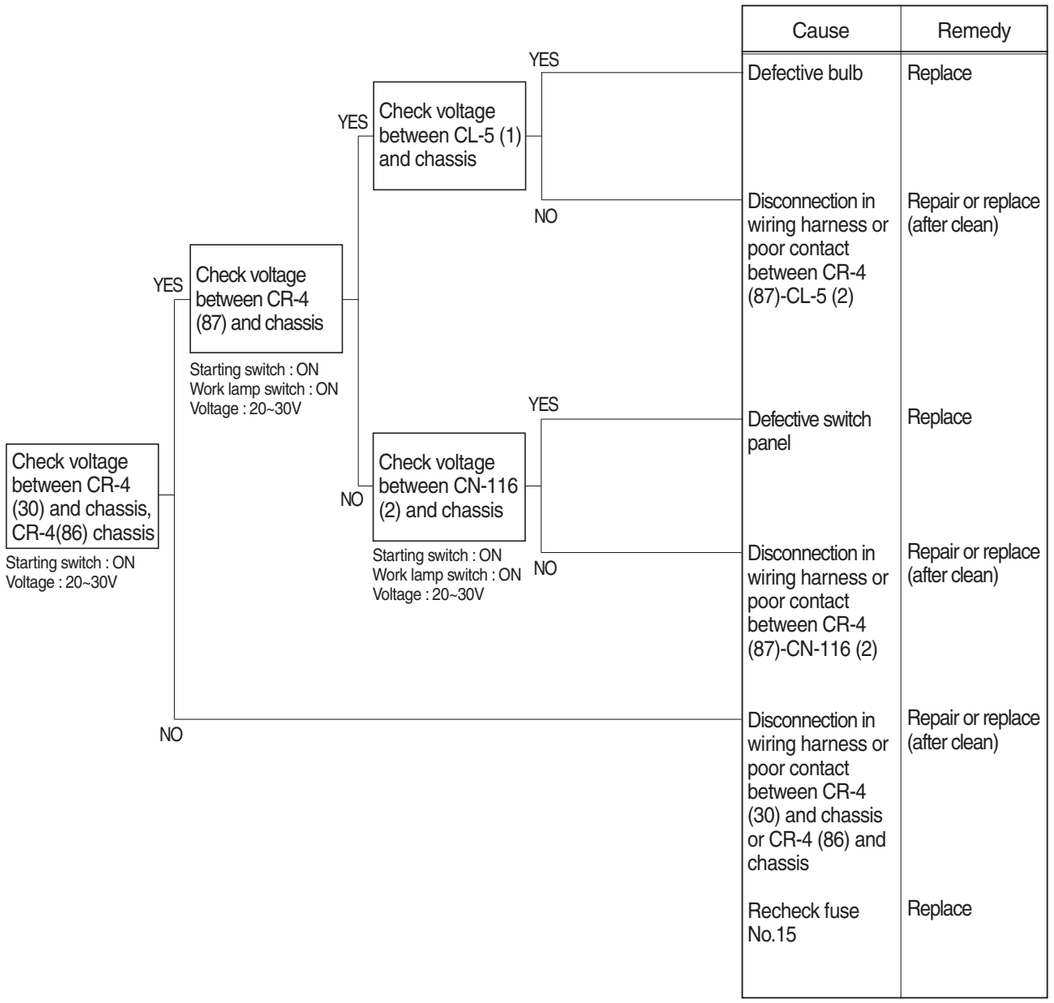
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13 (87)-CL-3 (1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (87)	Repair or replace (after 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

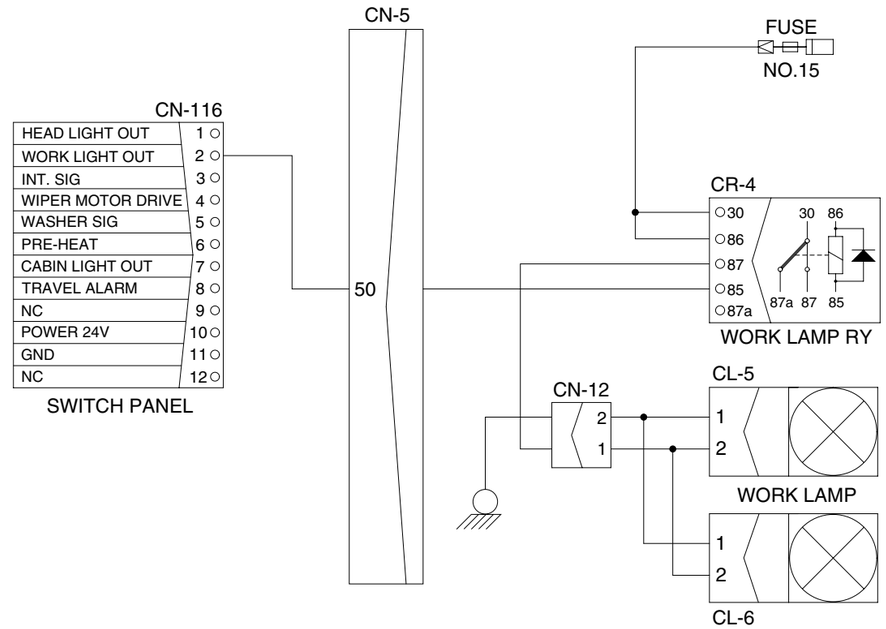


3009SH6ES12

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 short of fuse No.15.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



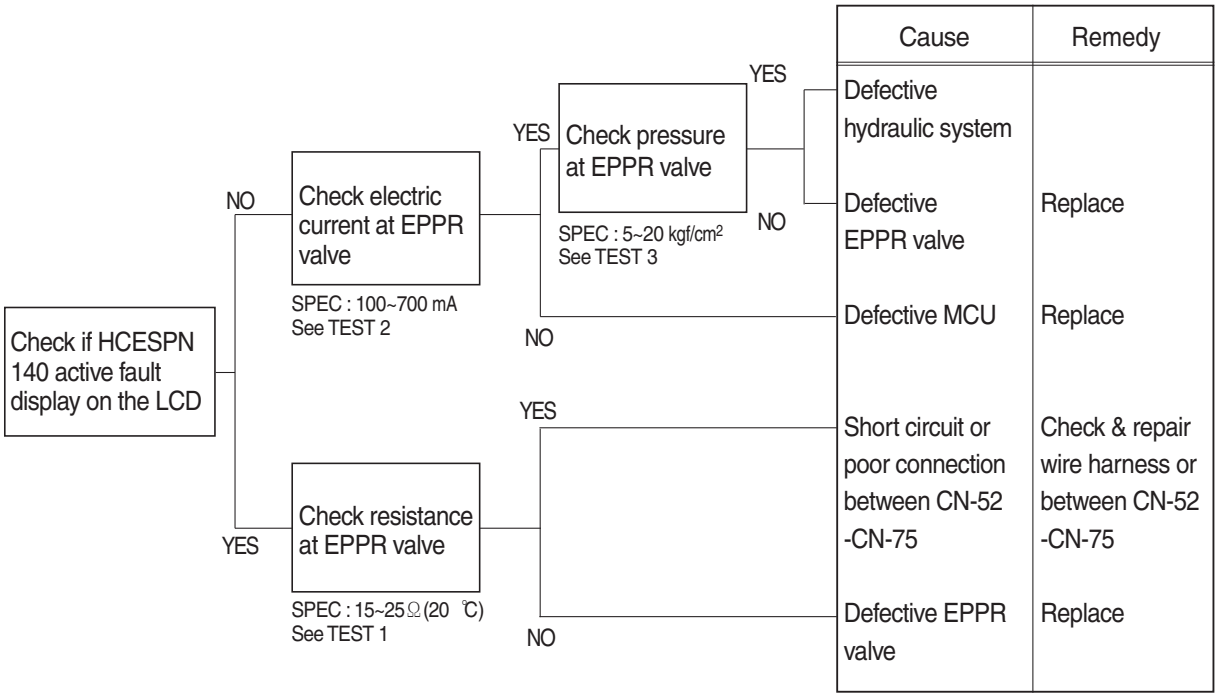


21096ES16

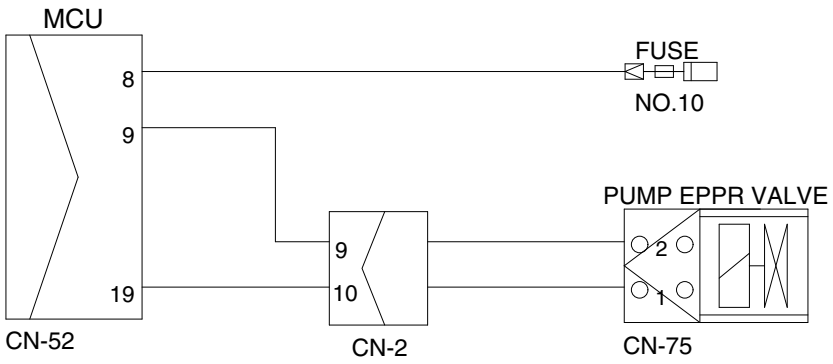
1. ALL ACTUATORS SPEED ARE SLOW

※ 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
(HCEC engine : P-mode 1950 ± 50 rpm S-mode 1850 ± 50 rpm E-mode 1750 ± 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



3309S6MS01

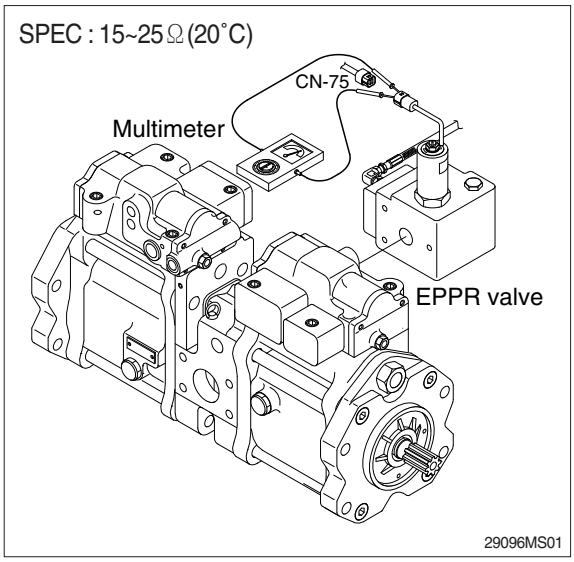
2) TEST PROCEDURE

(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.

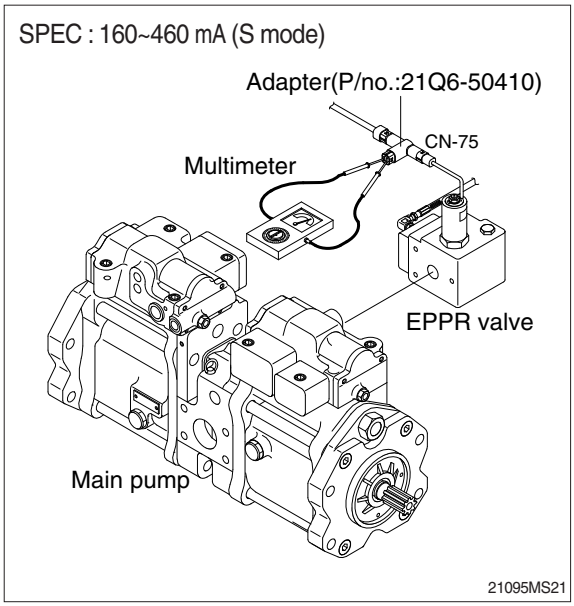
① Install multimeter as figure.

② Start engine.

③ Set the accel dial at "10" (MAX)

④ Set S-mode and cancel auto decel mode.

⑤ If tachometer show approx 2000±50 rpm (HCEC engine : 1850±50 rpm), check electric current.



(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.

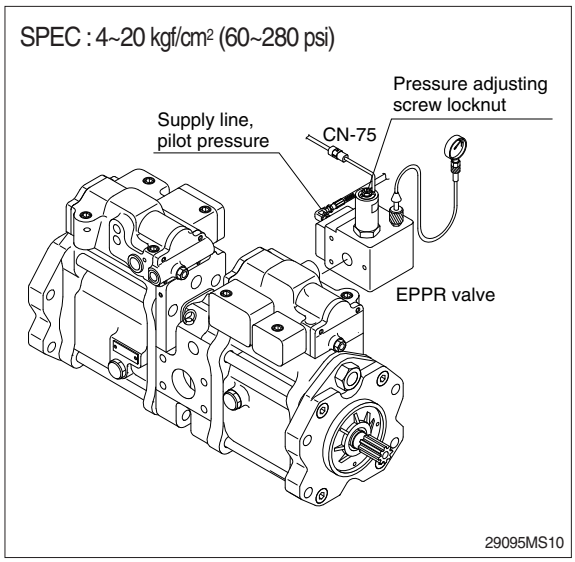
③ Set the accel dial at "10" (Max).

④ Set S-mode and cancel auto decel mode.

⑤ If tachometer show approx 2000±50 rpm (HCEC engine : 1850±50 rpm), check pressure.

⑥ If pressure is not correct, adjust it.

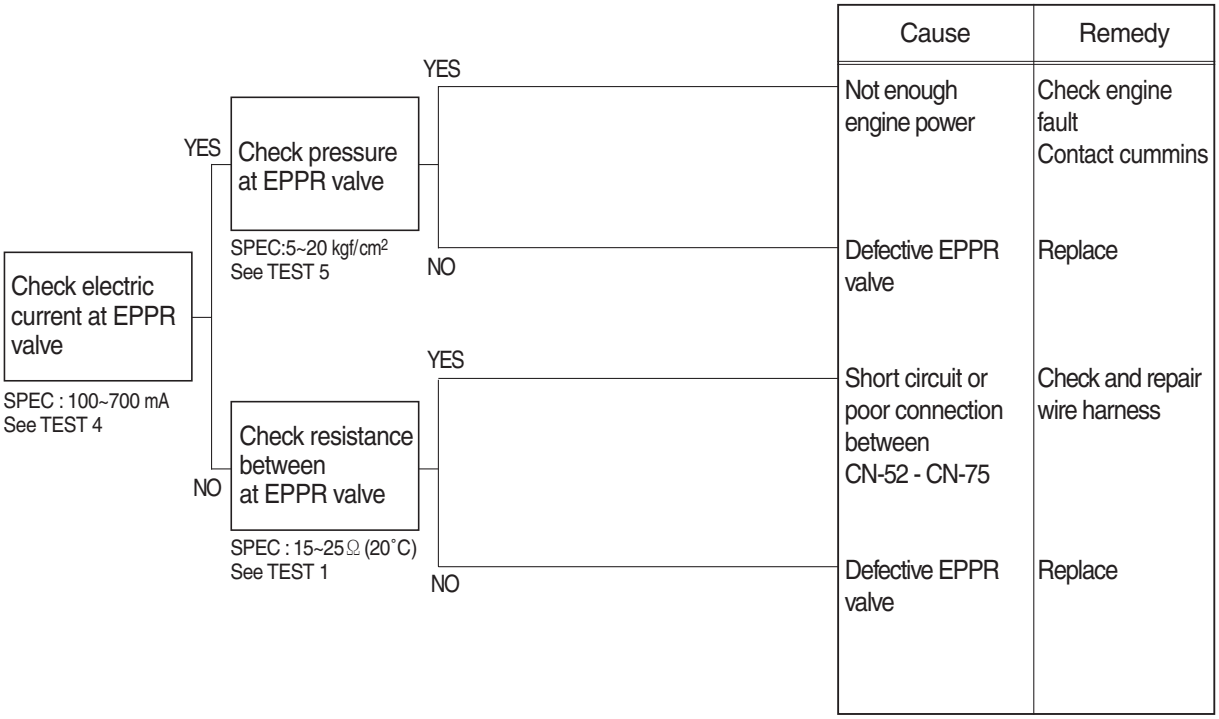
⑦ After adjust, test the machine.



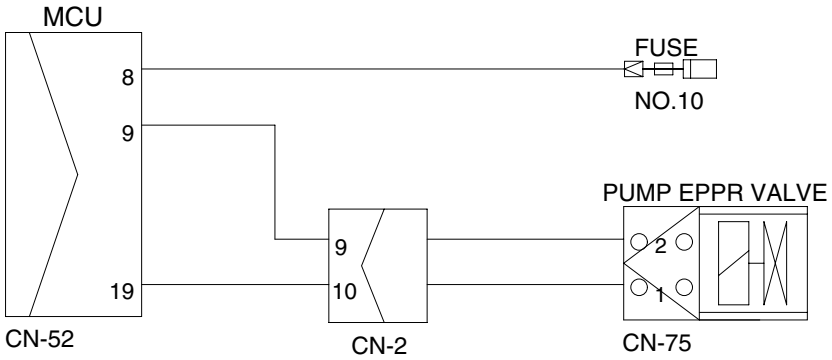
2. ENGINE STALL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



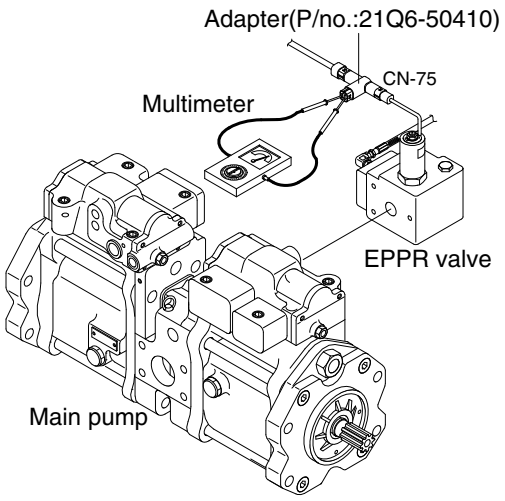
3309S6MS01

2) TEST PROCEDURE

(1) Test 4 : Check electric current at EPPR valve at S-mode

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at "10" (max)
④ Set S-mode with 2000±50 rpm (HCEC engine : 1850±50 rpm).
⑤ Check electric current.

SPEC : 100~700 mA

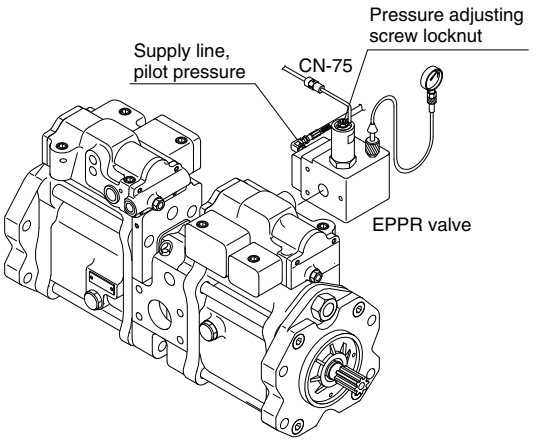


21095MS21

(2) Test 5 : Check pressure at EPPR valve at S-mode

① Connect pressure gauge at EPPR valve.
② Start engine.
③ Set the accel dial at "10" (max)
④ Set S-mode with 2000±50 rpm (HCEC engine : 1850±50 rpm).
⑤ Operate bucket lever completely push or pull.
⑥ Hold arm lever at the end of stroke.
⑦ Check pressure at relief position.

SPEC : 4~20 kgf/cm² (60~280 psi)

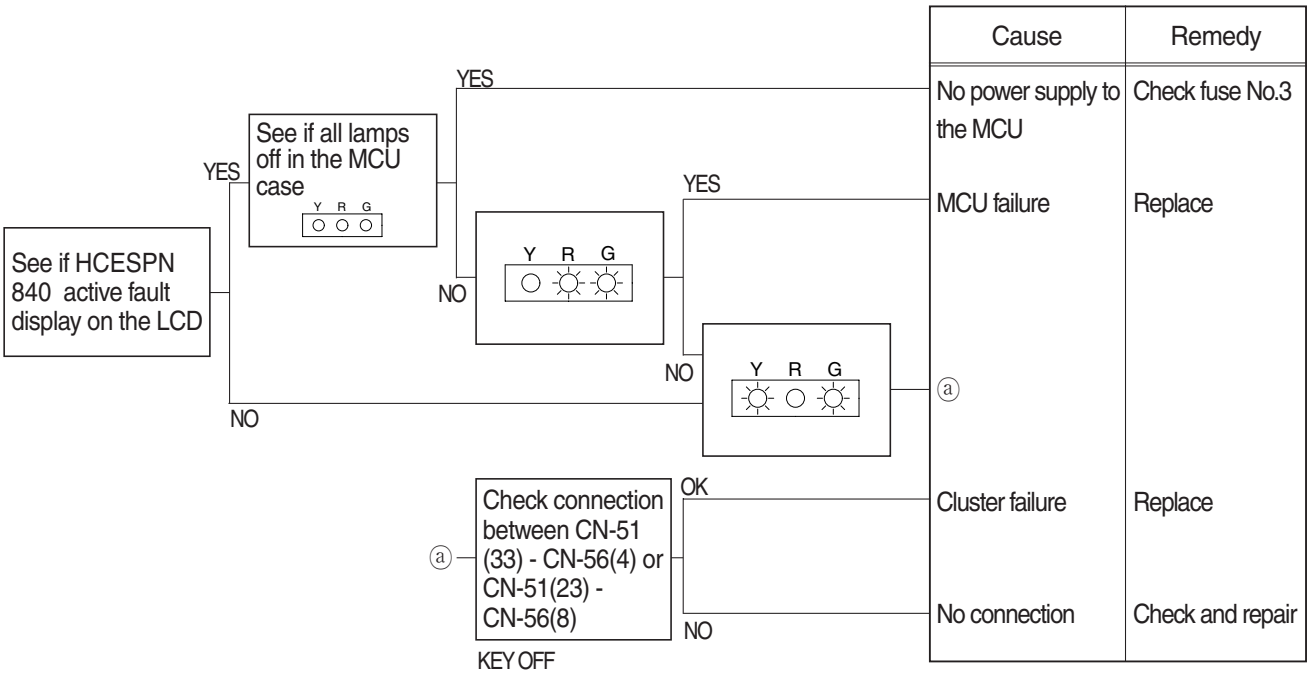


29095MS10

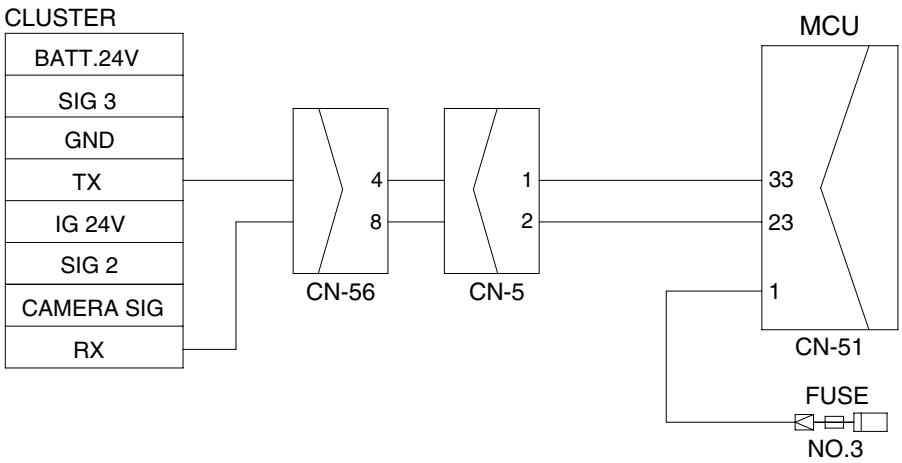
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

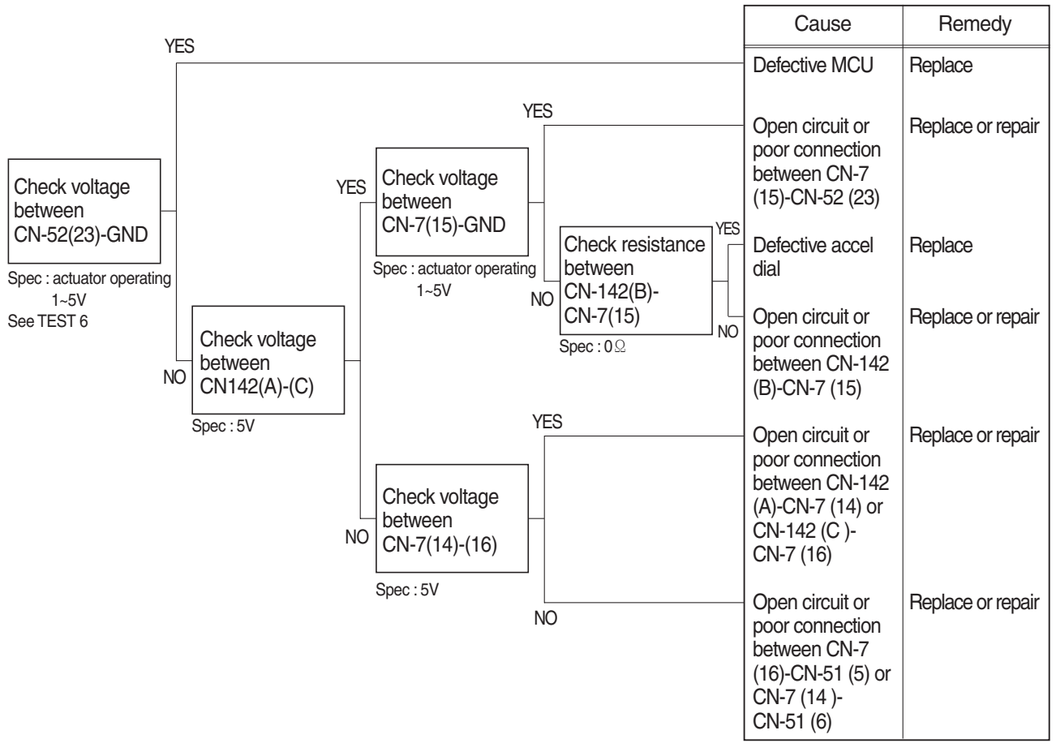


3009SH6MS02

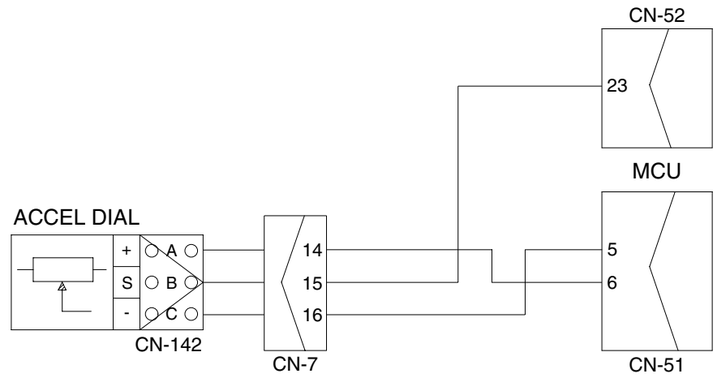
4. MALFUNCTION OF ACCEL DIAL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Open circuit or poor connection between CN-7 (15)-CN-52 (23)	Replace or repair
Defective accel dial	Replace
Open circuit or poor connection between CN-142 (B)-CN-7 (15)	Replace or repair
Open circuit or poor connection between CN-142 (A)-CN-7 (14) or CN-142 (C)-CN-7 (16)	Replace or repair
Open circuit or poor connection between CN-7 (16)-CN-51 (5) or CN-7 (14)-CN-51 (6)	Replace or repair



3009SH6MS03

2) TEST PROCEDURE

(1) Test 6 : Check voltage at CN-52(23) and ground.

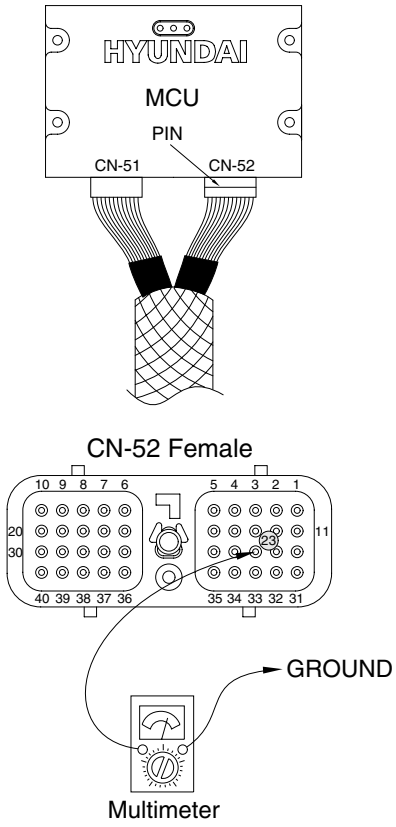
① Prepare 1 piece of thin sharp pin, steel or copper.

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



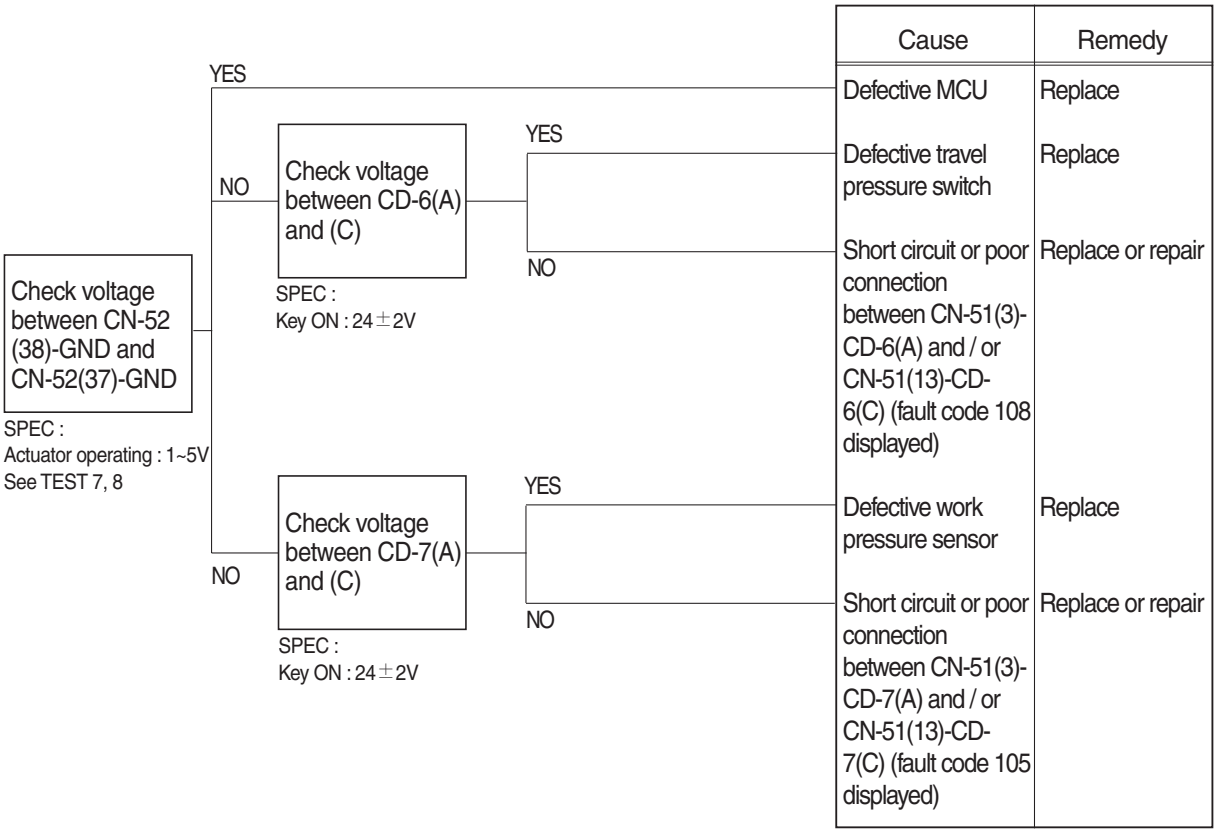
3009SH6MS04

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)

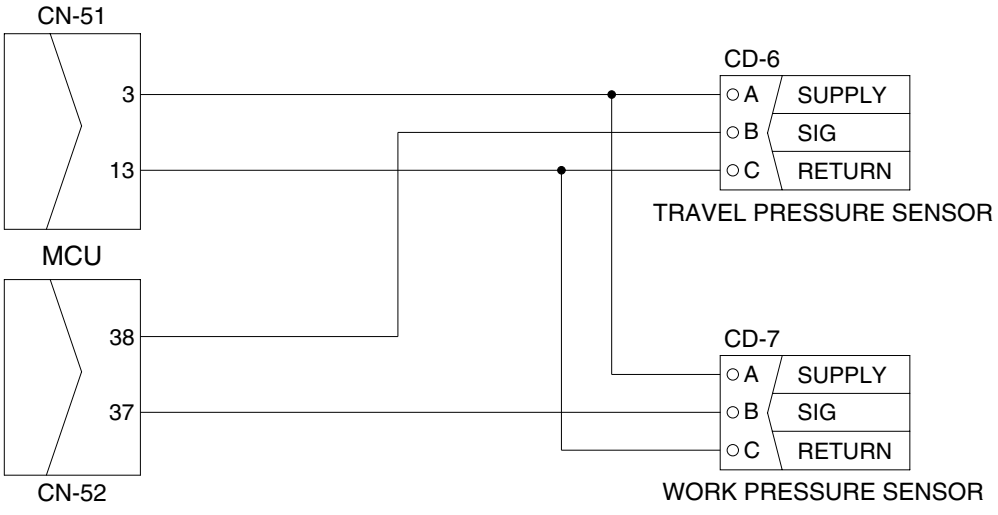
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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



3009SH6MS05

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.

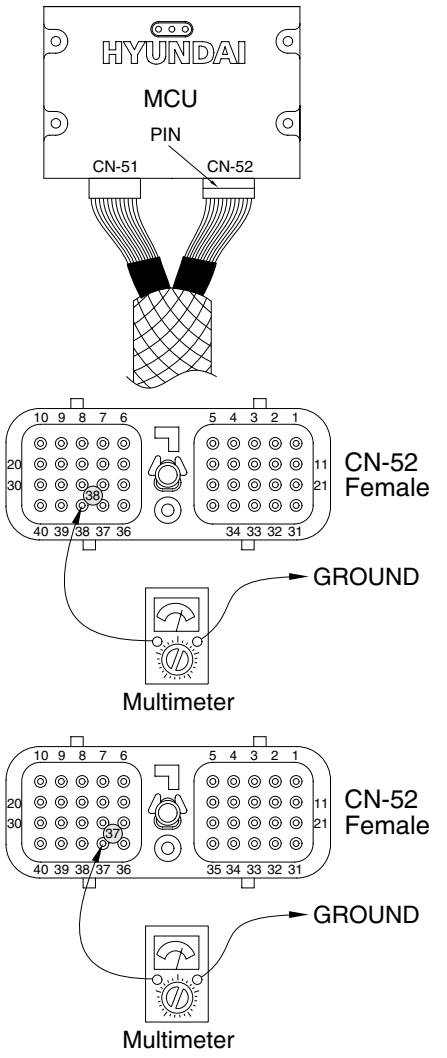
① Prepare 1 piece of thin sharp pin, steel or copper

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



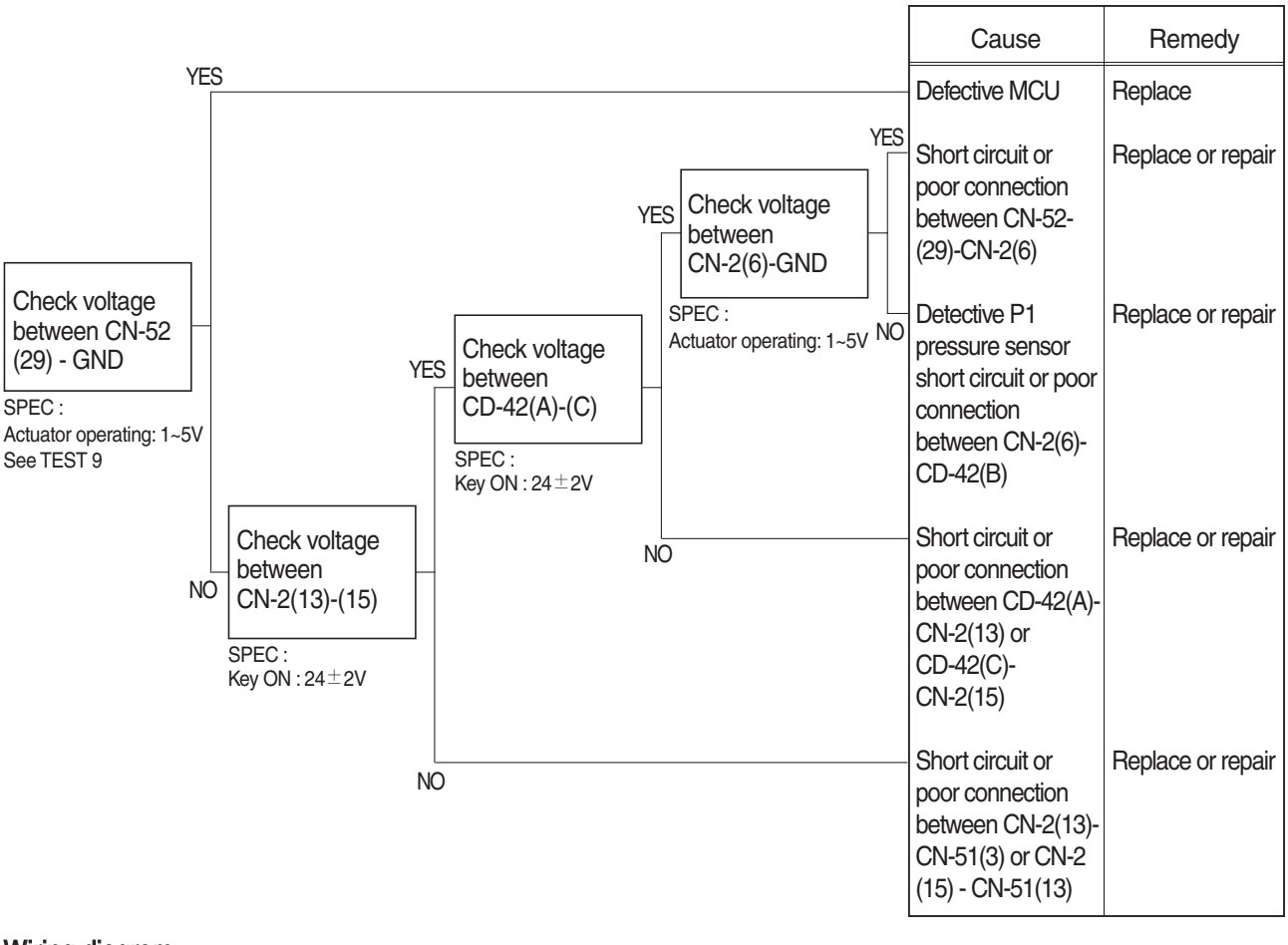
3009SH6MS06

6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

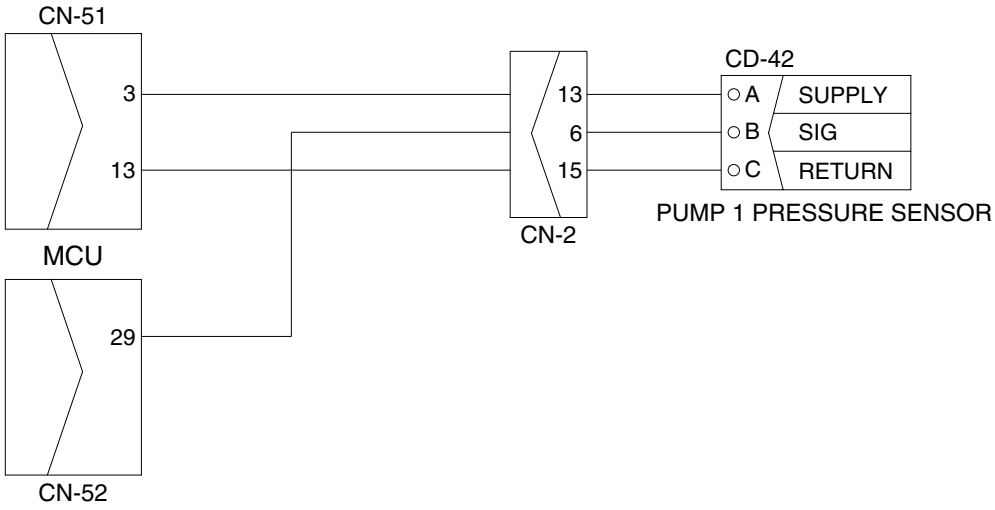
· Fault code : HCESPN 120, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS07

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-52(29) and ground.

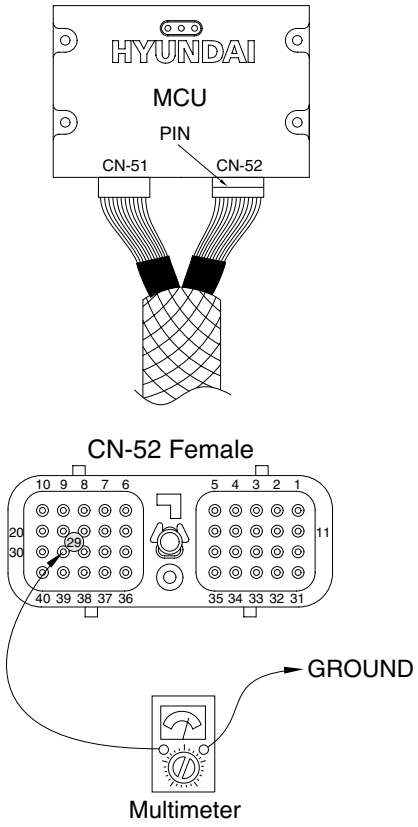
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (29) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



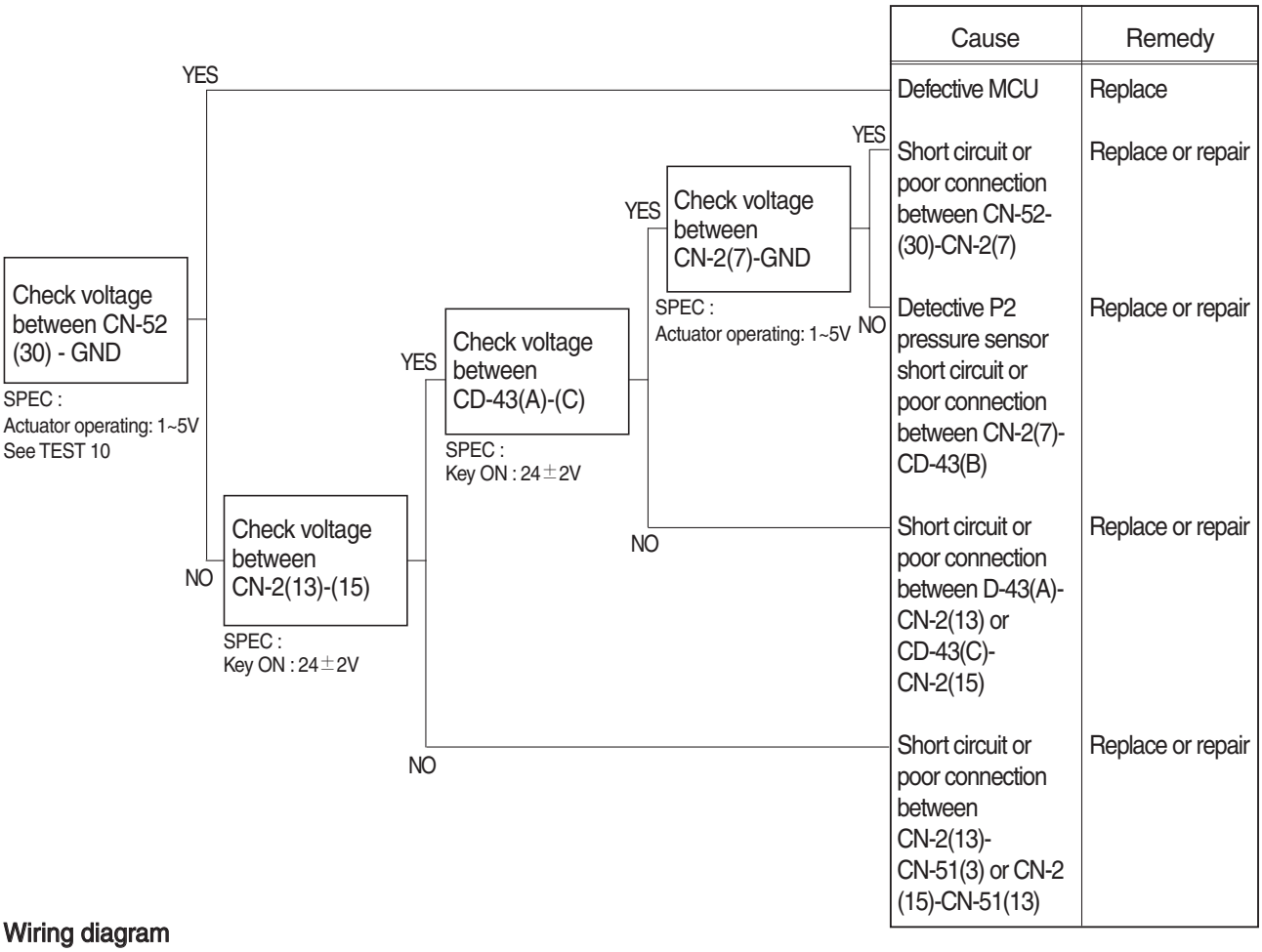
3009SH6MS08

7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

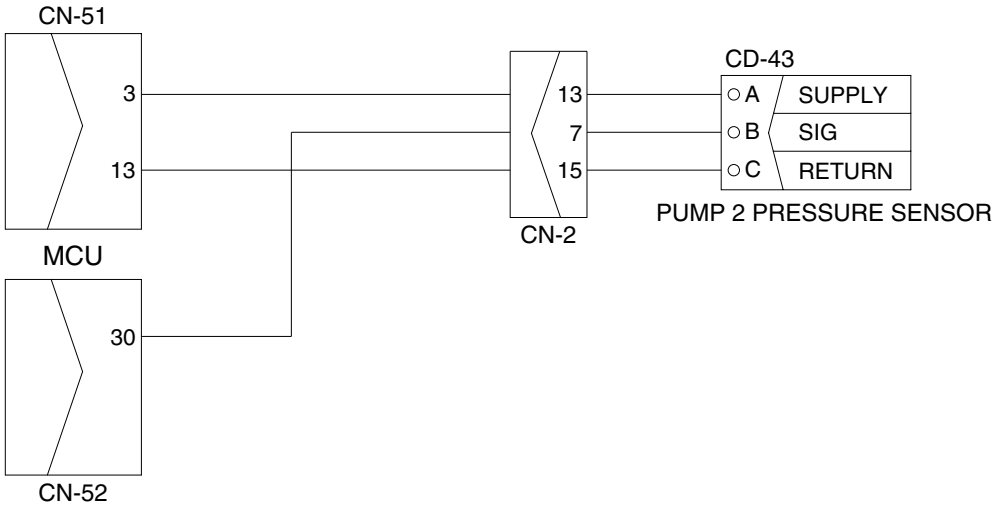
· Fault code : HCESPN 121, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS09

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52(30) and ground.

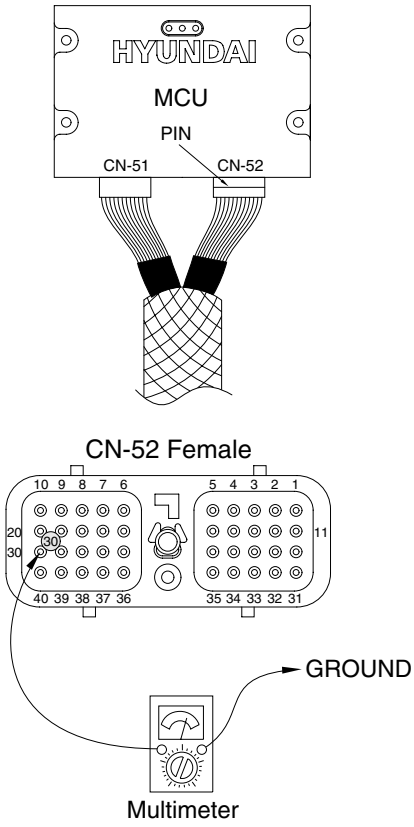
① Prepare 1 piece of thin sharp pin, steel or copper.

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



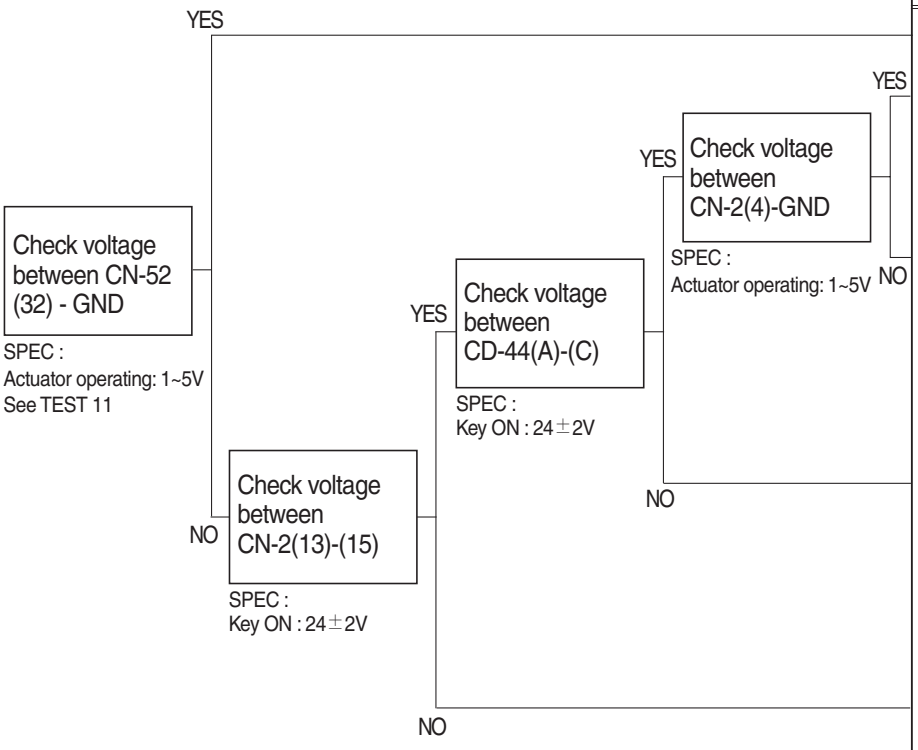
3009SH6MS10

8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

· Fault code : HCESPN 125, FMI 0~4

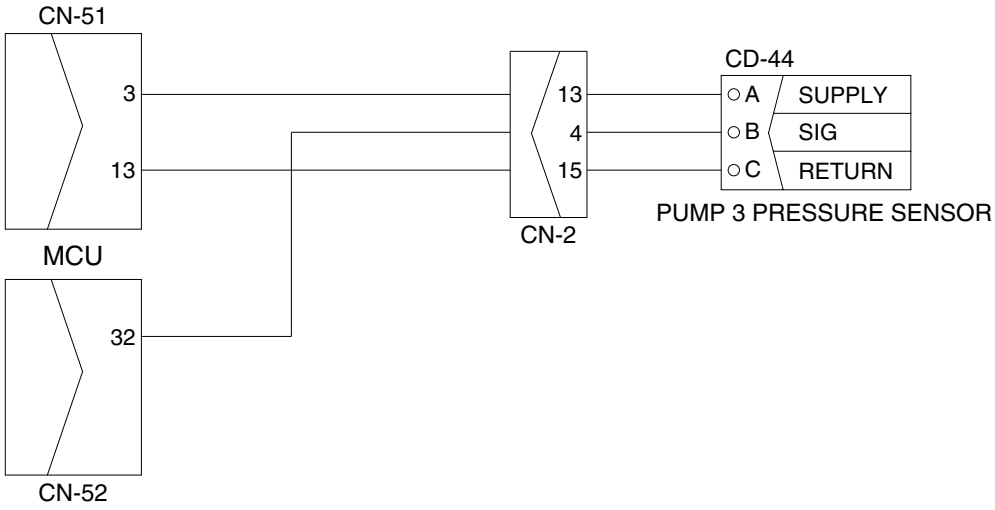
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(32)-CN-2(4)	Replace or repair
Detective P3 pressure sensor short circuit or poor connection between CN-2(4)-CD-44(B)	Replace or repair
Short circuit or poor connection between D-44(A)-CN-2(13) or CD-44(C)-CN-2(15)	Replace or repair
Short circuit or poor connection between CN-2(13)-CN-51(4) or CN-2 (15) - CN-51(5)	Replace or repair

Wiring diagram



3009SH6MS11

2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-52(32) and ground.

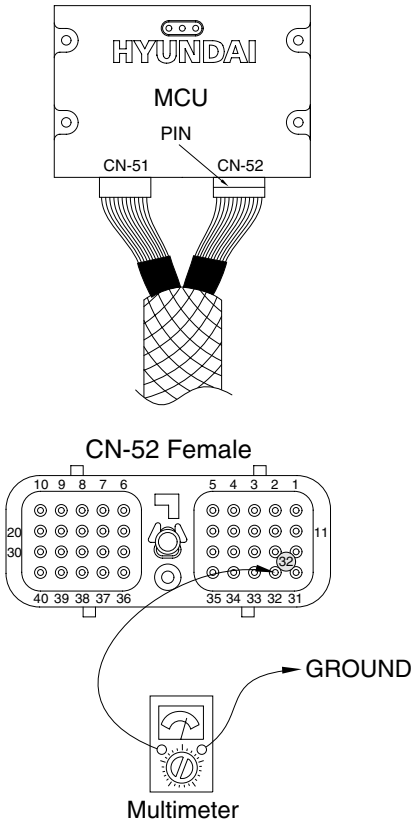
① Prepare 1 piece of thin sharp pin, steel or copper.

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



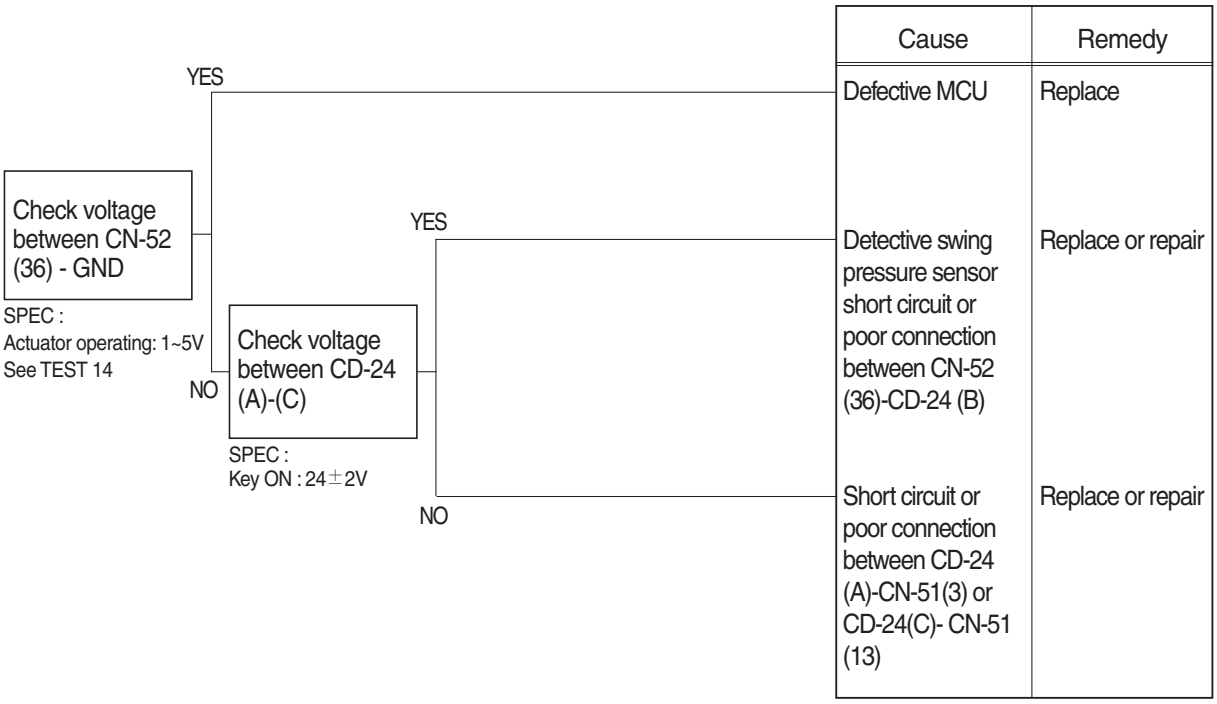
3009SH6MS12

9. MALFUNCTION OF SWING PRESSURE SENSOR

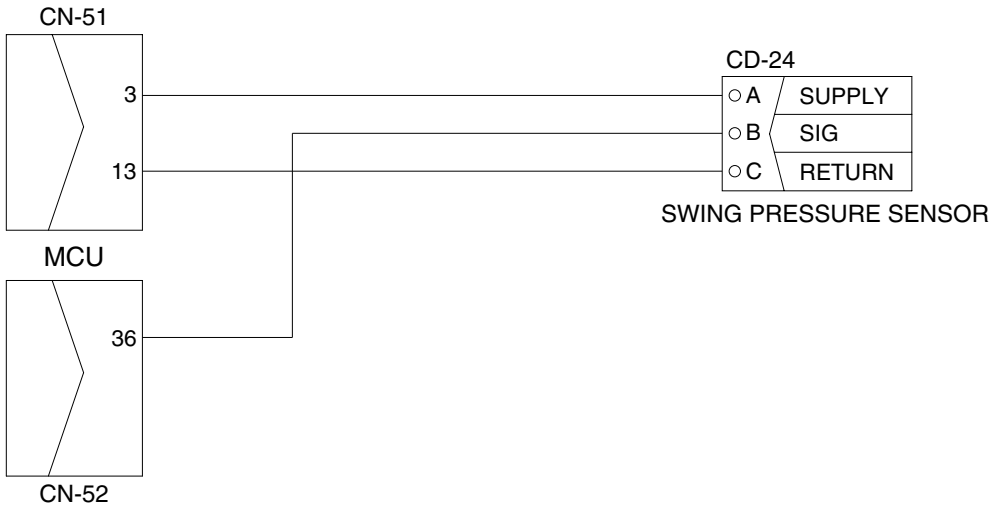
· Fault code : HCESPN 135, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS13

2) TEST PROCEDURE

(1) Test 14 : Check voltage at CN-52(36) and ground.

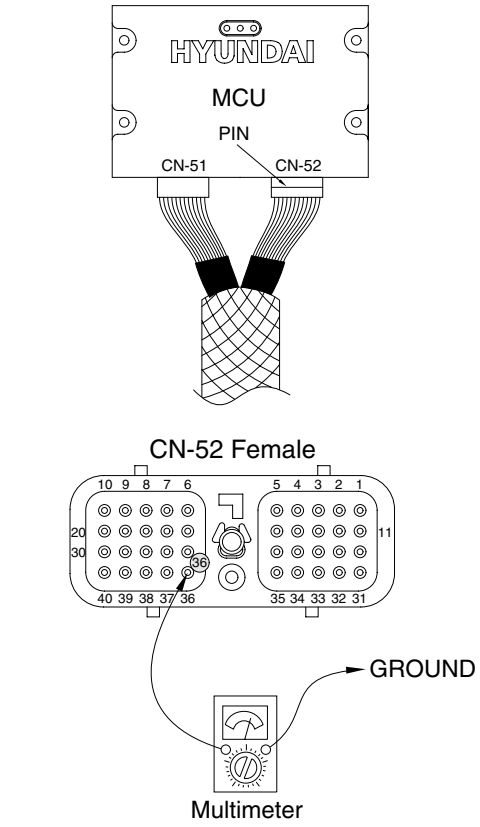
① Prepare 1 piece of thin sharp pin, steel or copper.

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



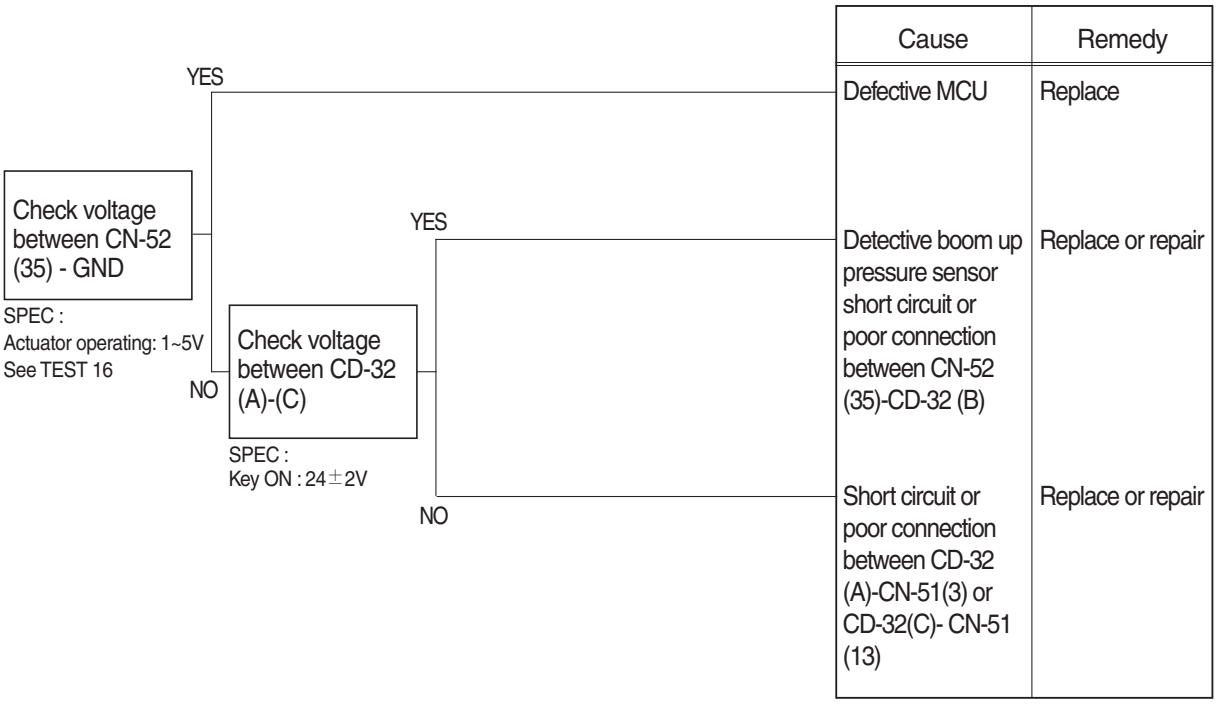
3009SH6MS14

10. MALFUNCTION OF BOOM UP PRESSURE SENSOR

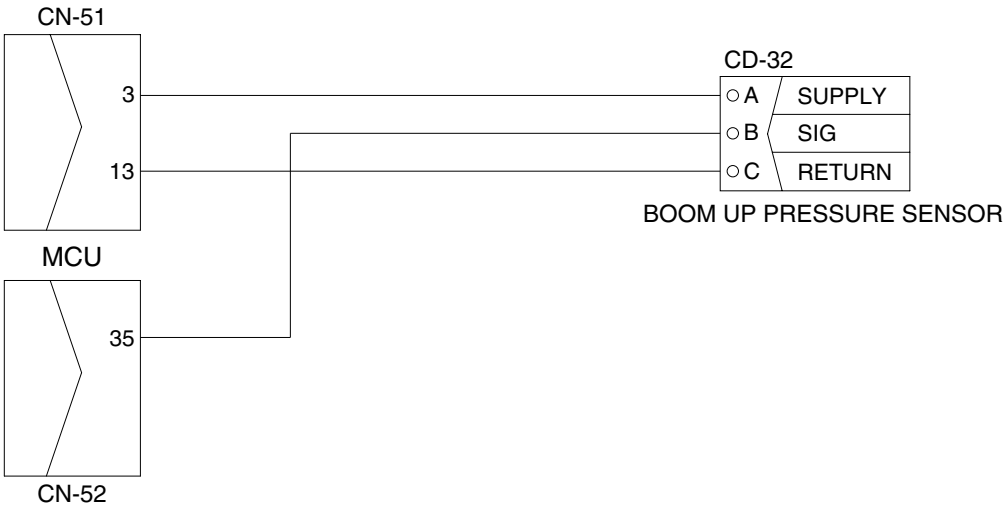
· Fault code : HCESPN 127, FMI 0~4

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS15

2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52(35) and ground.

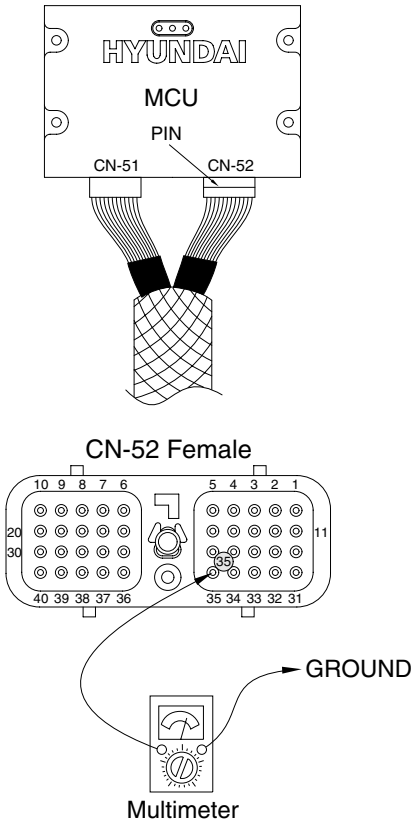
① Prepare 1 piece of thin sharp pin, steel or copper.

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



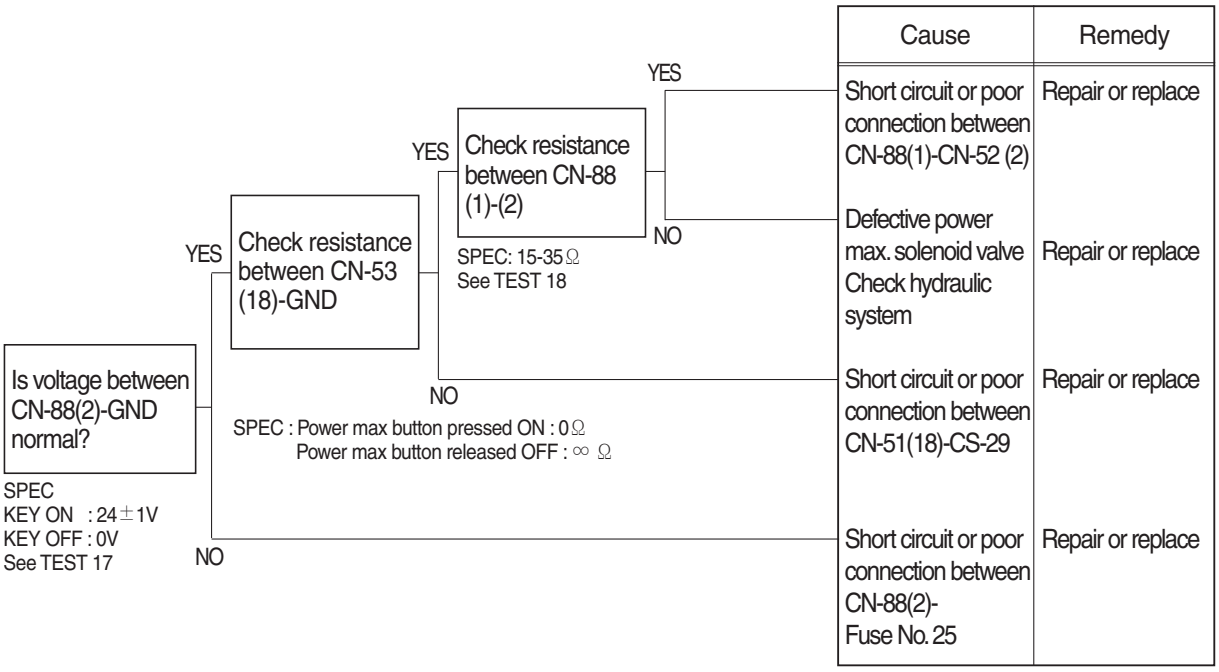
3009SH6MS16

11. MALFUNCTION OF POWER MAX

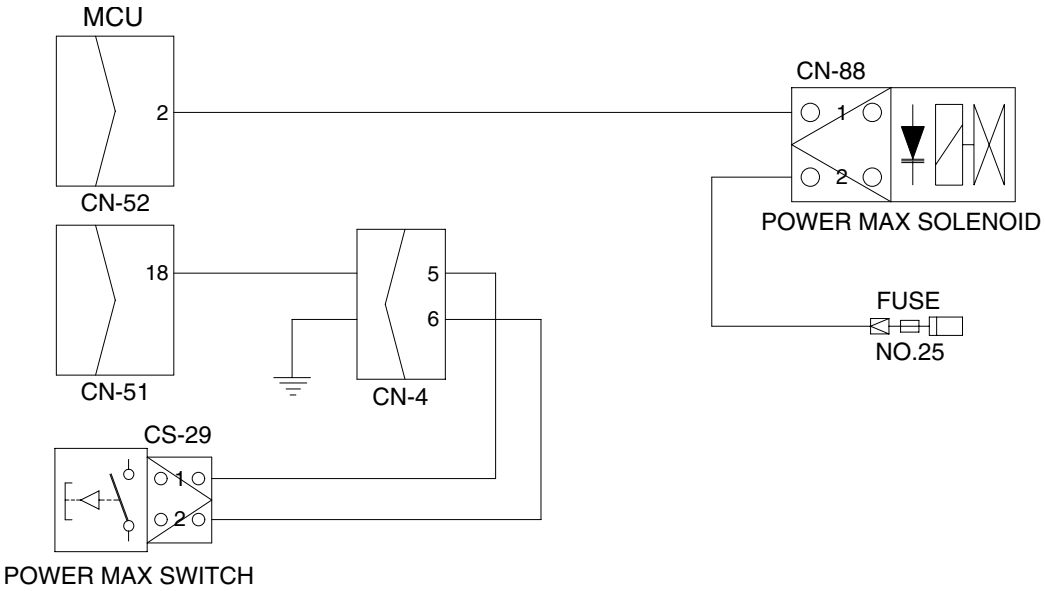
· Fault code : HCESPN 166, FMI 4 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS17

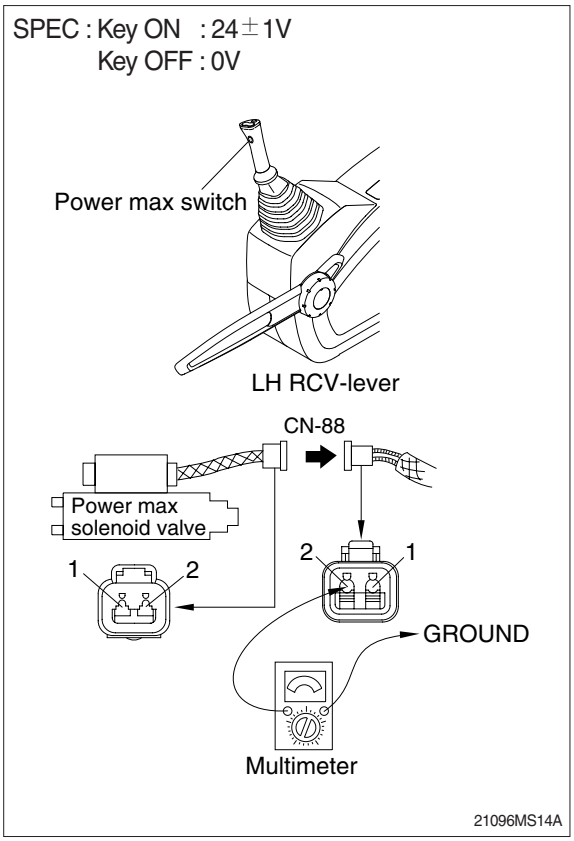
2) TEST PROCEDURE

(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.

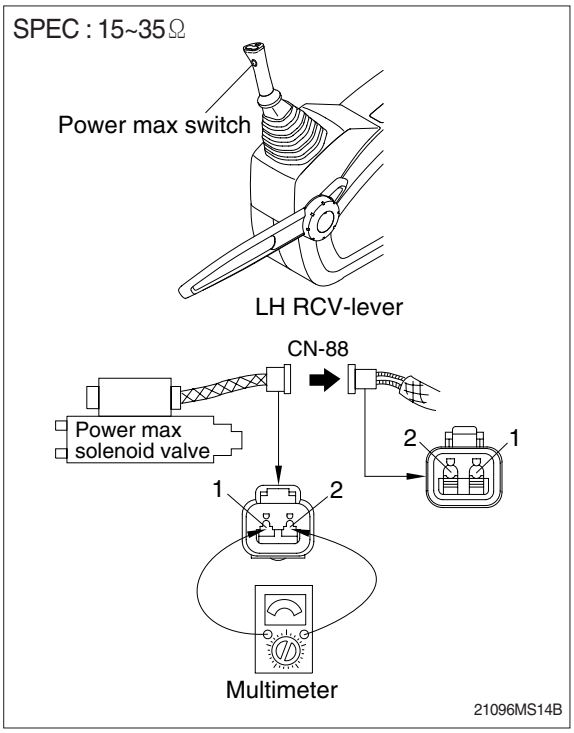


(2) Test 18: Check resistance of the solenoid valve between CN-88(1)-(2).

① Starting key OFF.

② Disconnect connector CN-88 from power max solenoid valve.

③ Check resistance as figure.

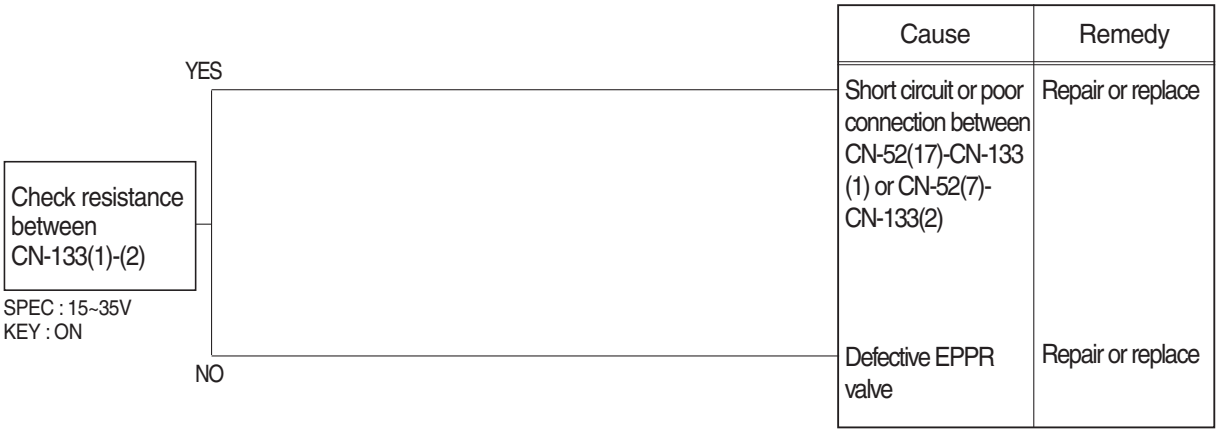


12. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

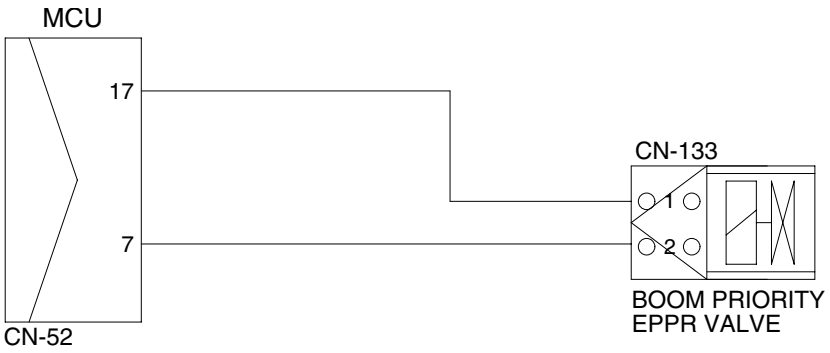
· Fault code : HCESPN 141, FMI 5 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



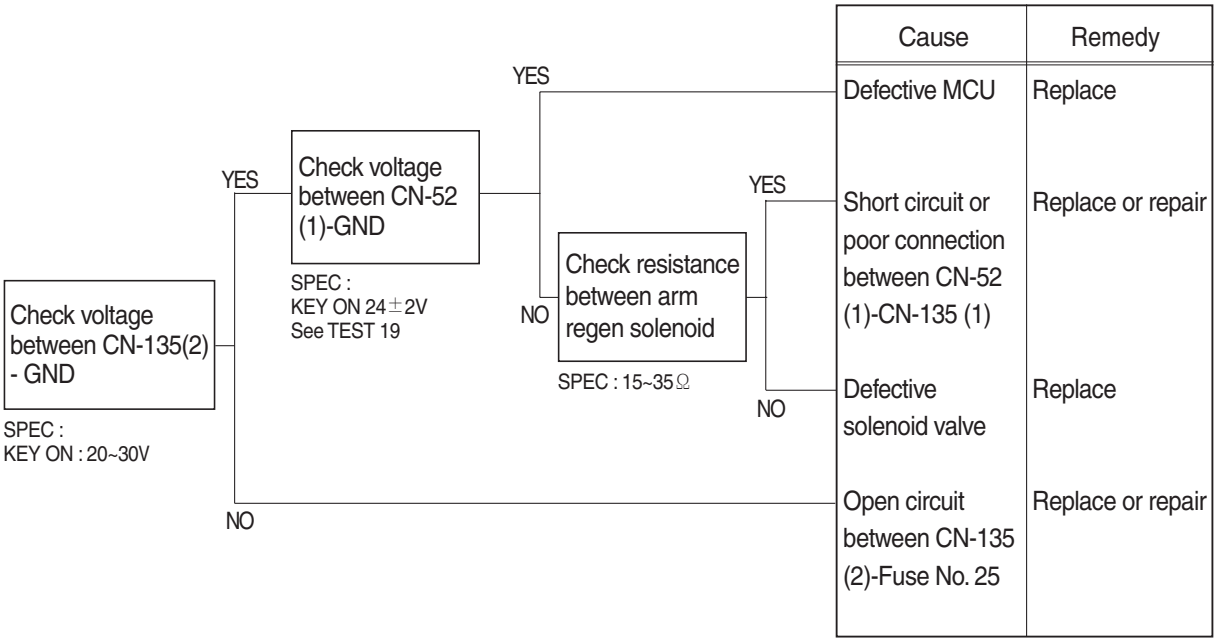
3009SH6MS18

13. MALFUNCTION OF ARM REGENERATION SOLENOID

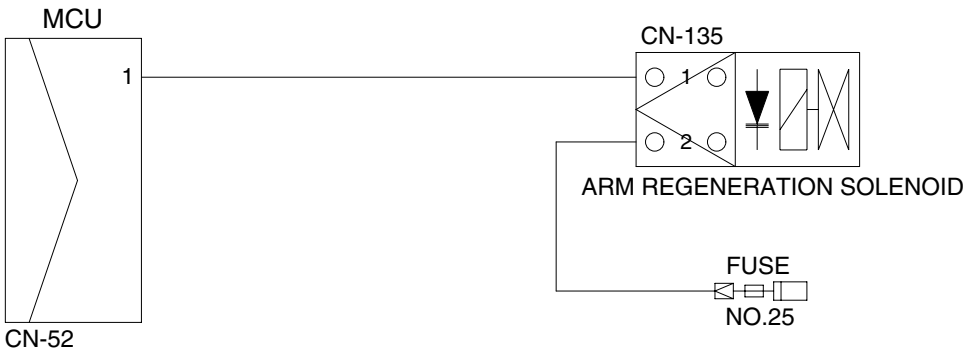
· Fault code : HCESPN 170, FMI 4 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS19

2) TEST PROCEDURE

(1) Test 19 : Check voltage at CN-52(1) and ground.

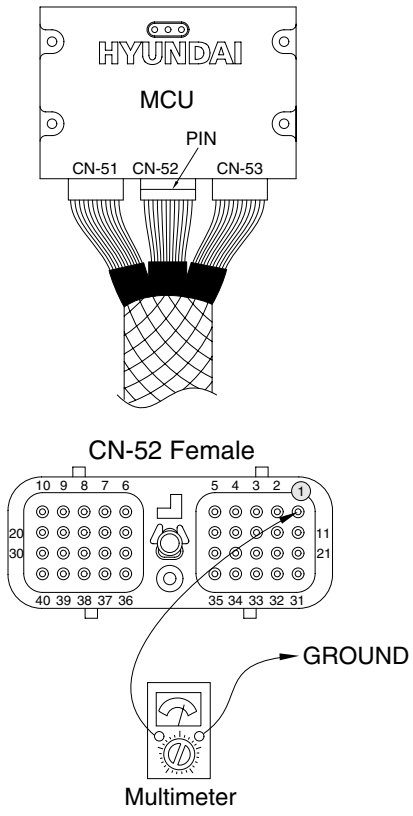
① Prepare 1 piece of thin sharp pin, steel or copper.

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



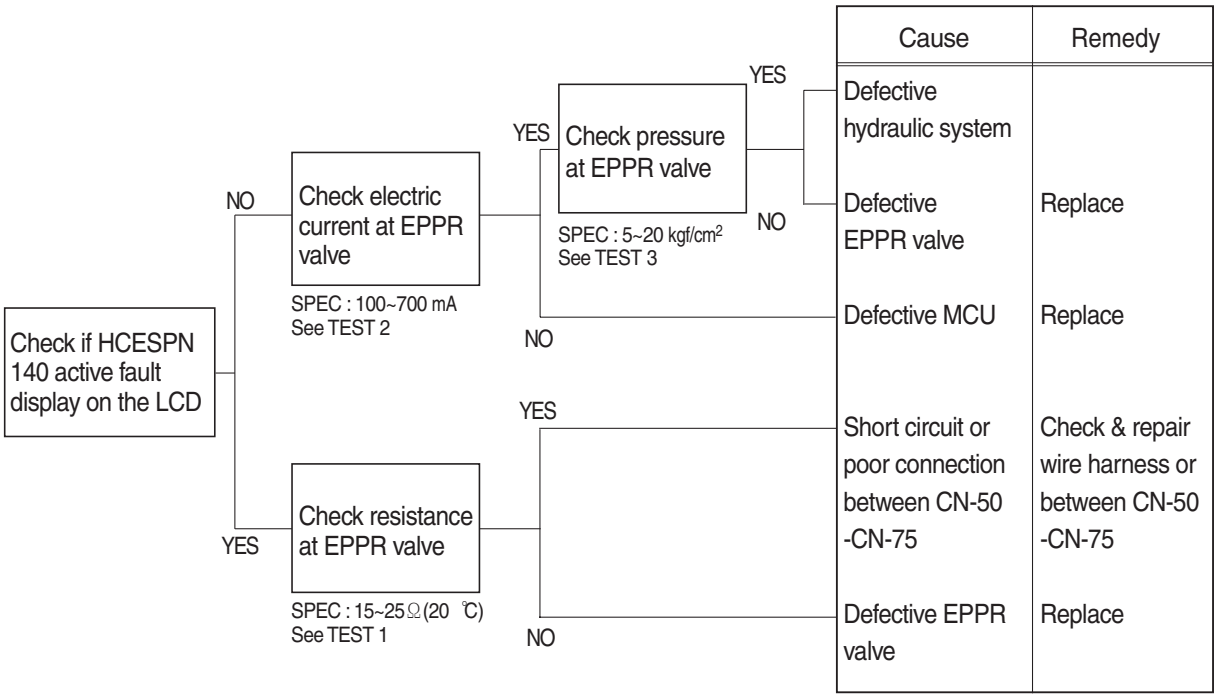
21096MS16A

■ MECHATRONICS SYSTEM (CLUSTER TYPE 2)

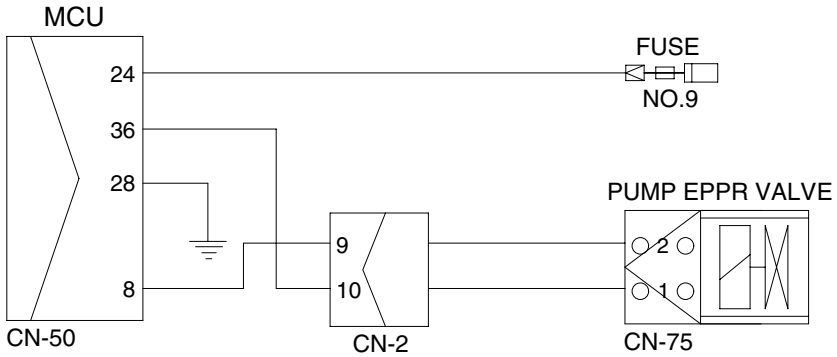
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : 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



3009SH6MS30

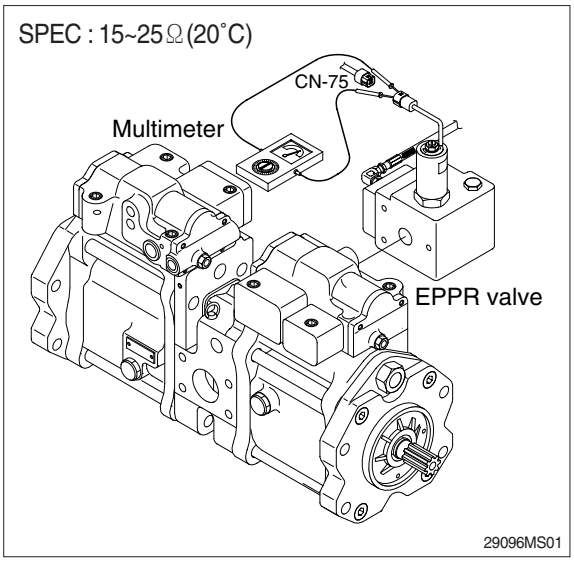
2) TEST PROCEDURE

(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.

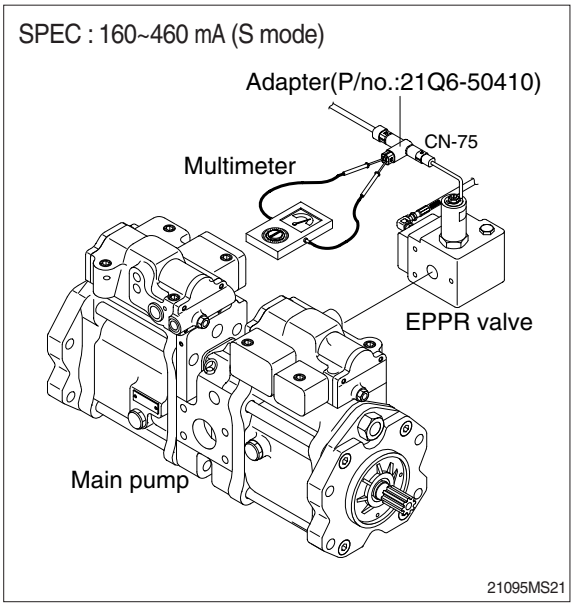
① Install multimeter as figure.

② Start engine.

③ Set the accel dial at "10" (MAX)

④ Set H-mode and cancel auto decel mode.

⑤ If tachometer show approx 2000±50 rpm, check electric current.



(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.

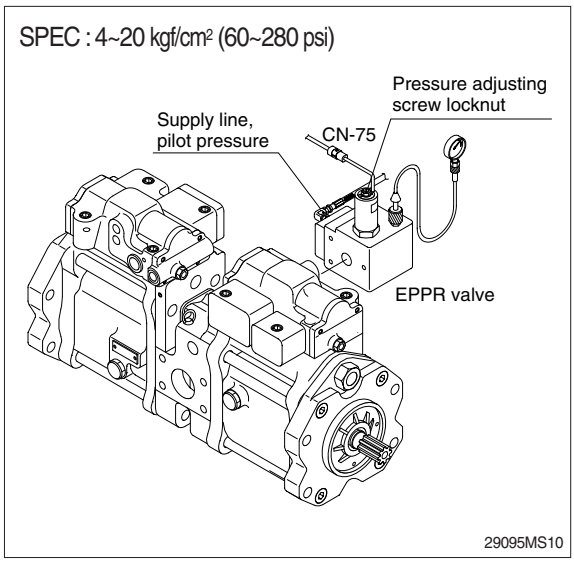
③ Set the accel dial at "10" (Max).

④ Set H-mode and cancel auto decel mode.

⑤ If tachometer show approx 2000±50 rpm, check pressure.

⑥ If pressure is not correct, adjust it.

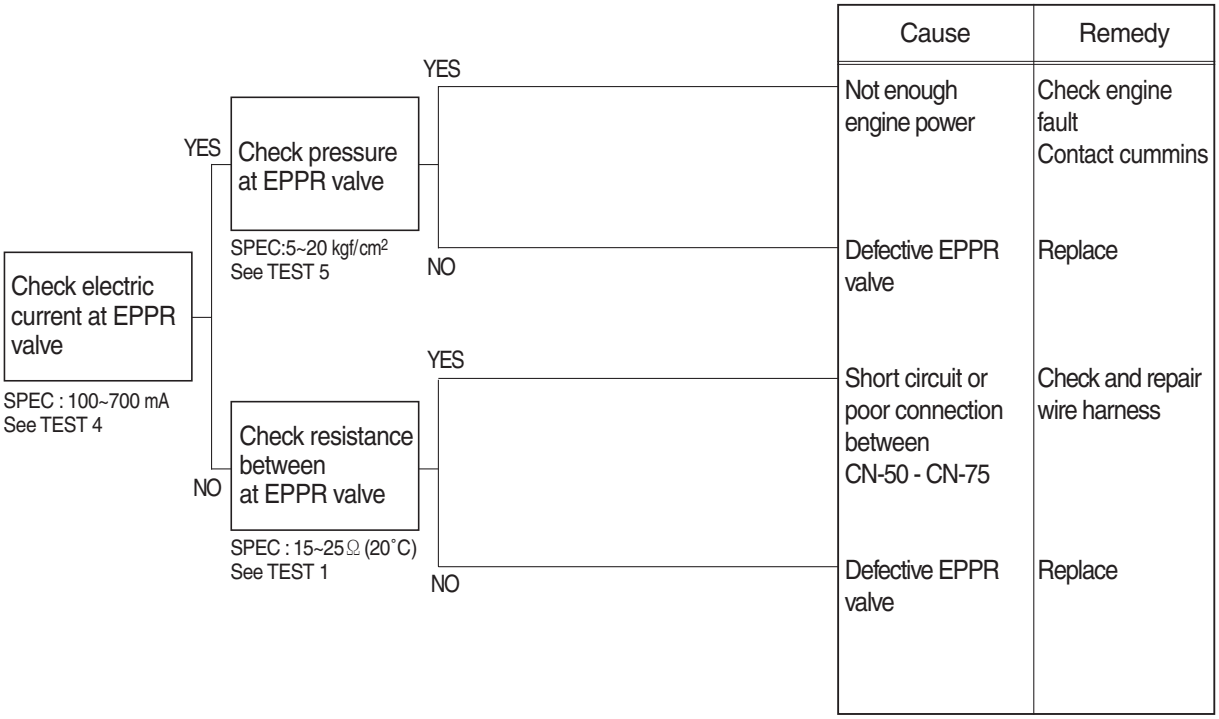
⑦ After adjust, test the machine.



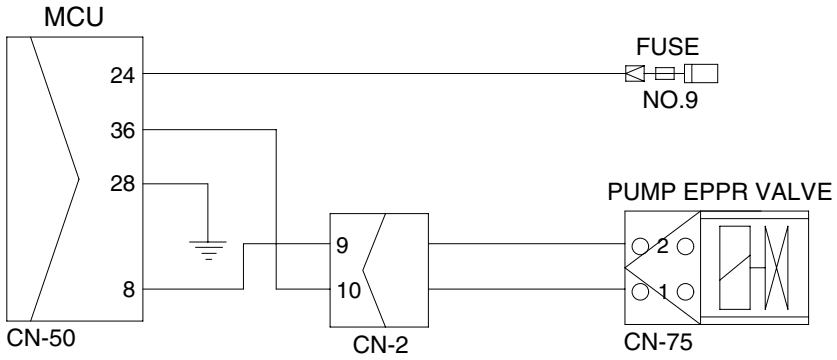
2. ENGINE STALL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

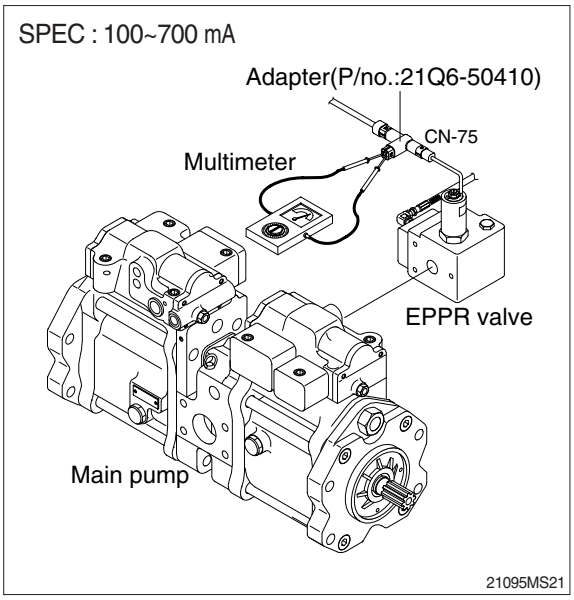


3009SH6MS30

2) TEST PROCEDURE

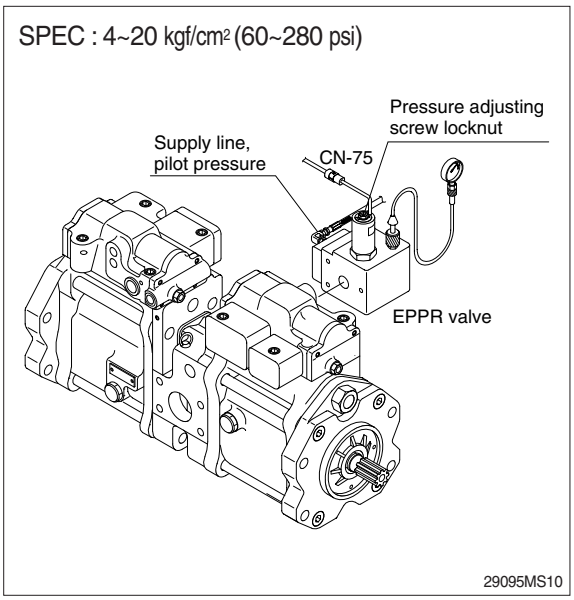
(1) Test 4 : Check electric current at EPPR valve at S-mode

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at "10" (max)
④ Set H-mode with 2000±50 rpm.
⑤ Check electric current.



(2) Test 5 : Check pressure at EPPR valve at S-mode

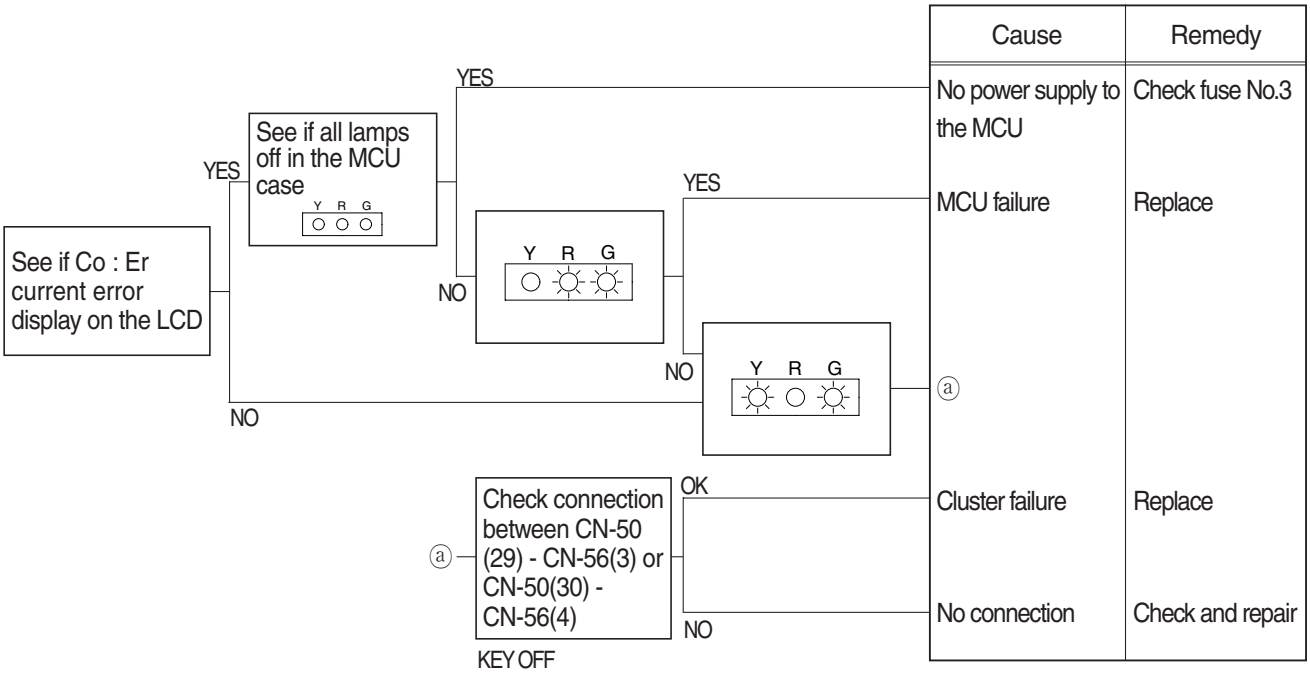
① Connect pressure gauge at EPPR valve.
② Start engine.
③ Set the accel dial at "10" (max)
④ Set H-mode with 2000±50 rpm.
⑤ Operate bucket lever completely push or pull.
⑥ Hold arm lever at the end of stroke.
⑦ Check pressure at relief position.



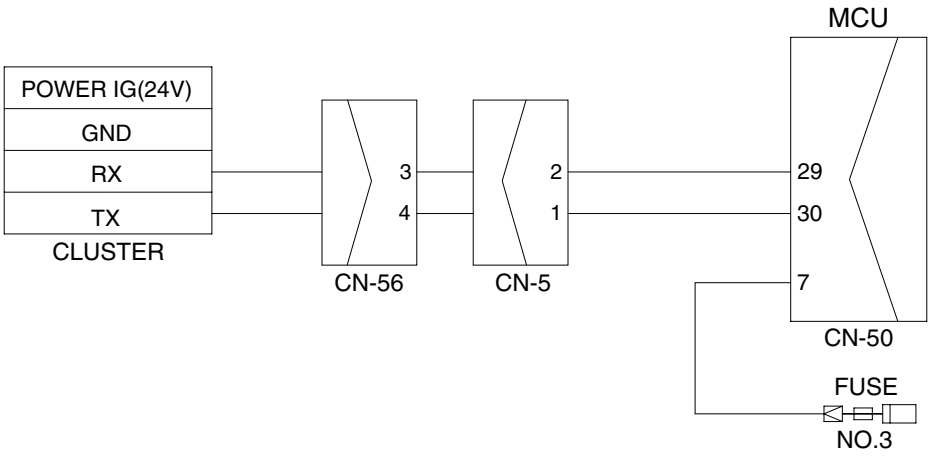
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

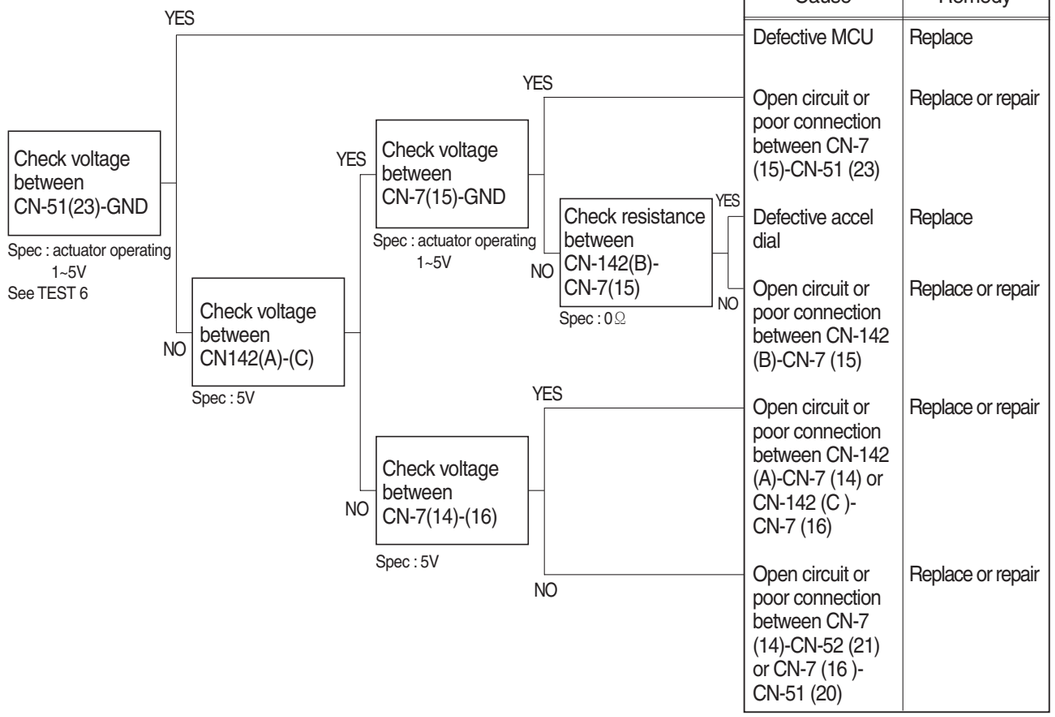


3009SH6MS31

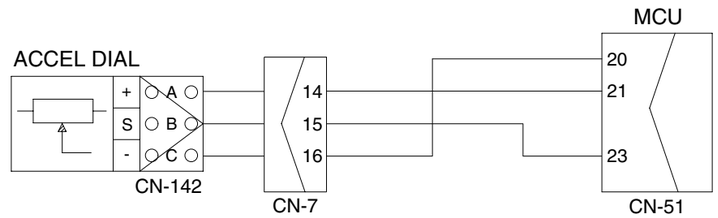
4. MALFUNCTION OF ACCEL DIAL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Open circuit or poor connection between CN-7 (15)-CN-51 (23)	Replace or repair
Defective accel dial	Replace
Open circuit or poor connection between CN-142 (B)-CN-7 (15)	Replace or repair
Open circuit or poor connection between CN-142 (A)-CN-7 (14) or CN-142 (C)-CN-7 (16)	Replace or repair
Open circuit or poor connection between CN-7 (14)-CN-52 (21) or CN-7 (16)-CN-51 (20)	Replace or repair



3009SH6MS32

2) TEST PROCEDURE

(1) Test 6 : Check voltage at CN-51(23) and ground.

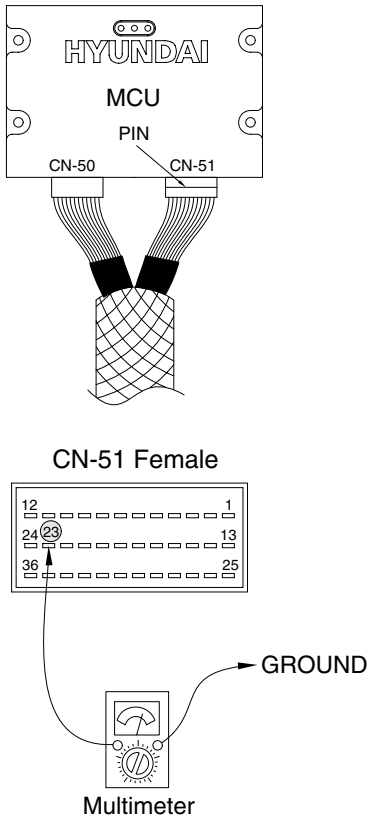
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (21) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

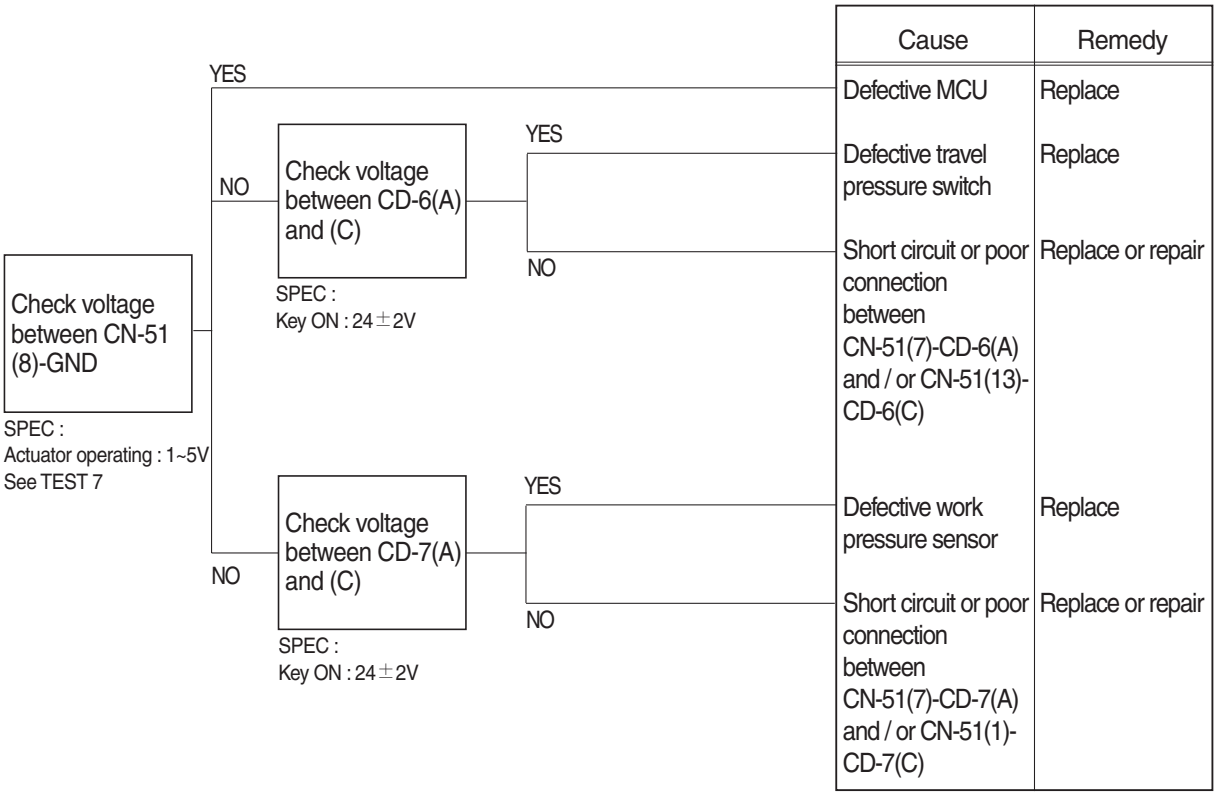


3009SH6MS33

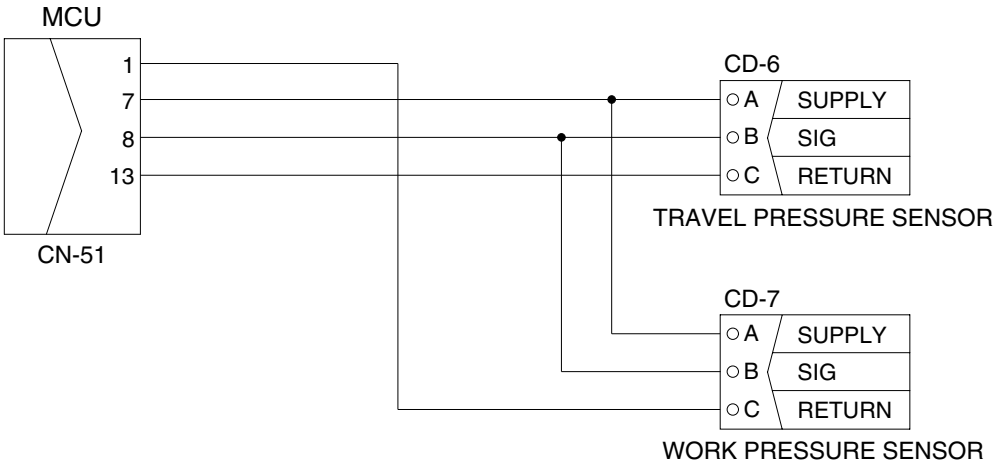
5. AUTO DECEL SYSTEM DOES NOT WORK

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS34

2) TEST PROCEDURE

(1) Test 7 : Check voltage at CN-51(8) and ground.

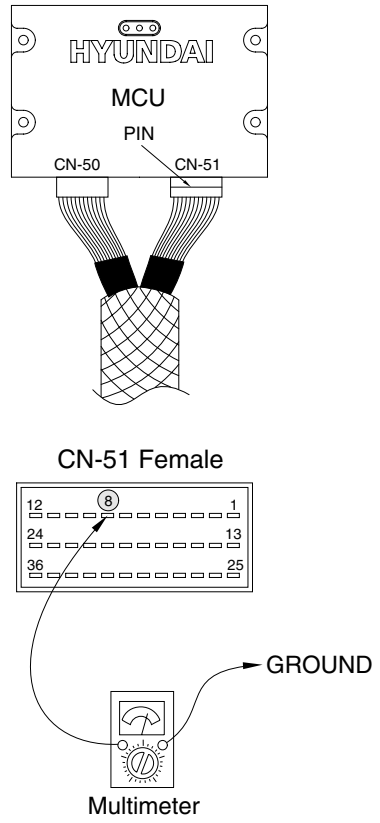
① Prepare 1 piece of thin sharp pin, steel or copper.

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

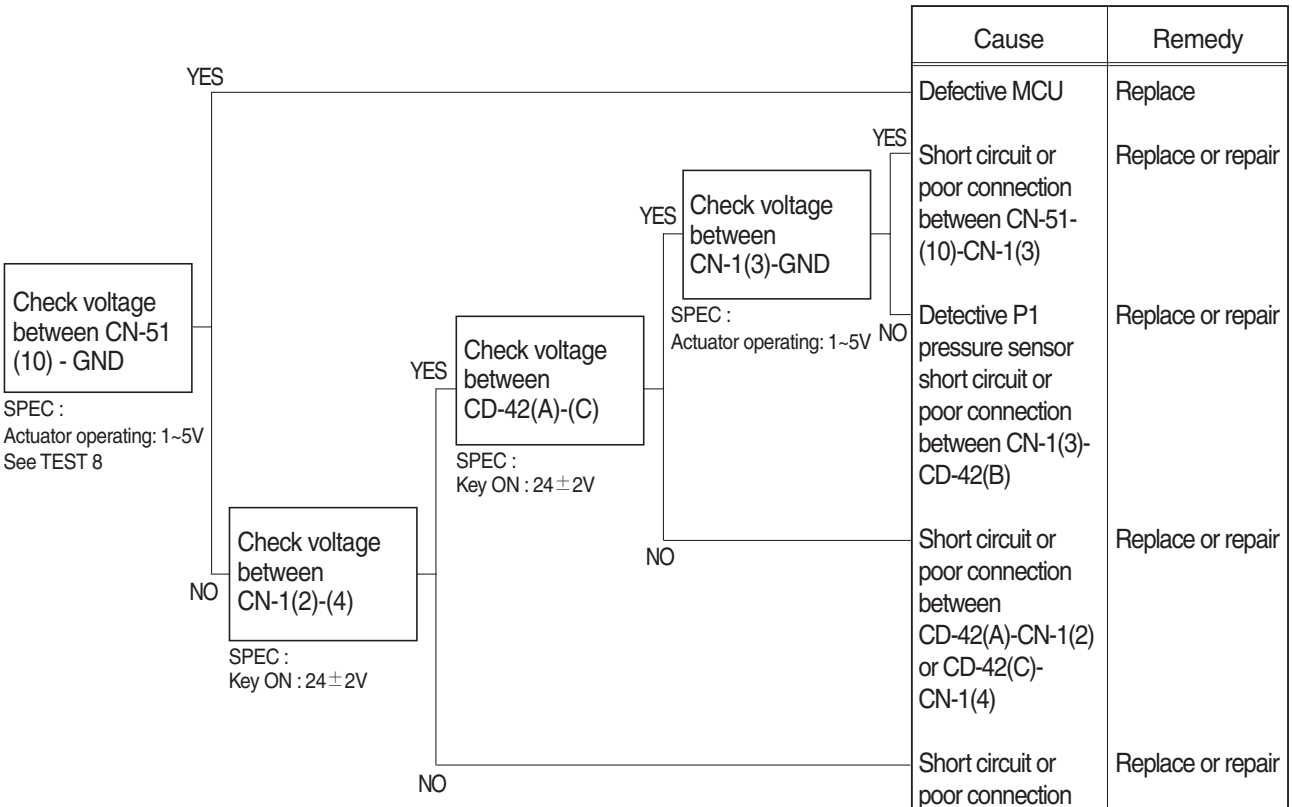


3009SH6MS35

6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

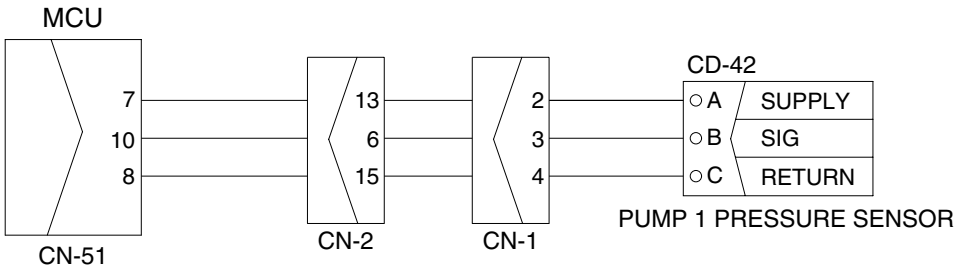
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-51-(10)-CN-1(3)	Replace or repair
Detective P1 pressure sensor short circuit or poor connection between CN-1(3)-CD-42(B)	Replace or repair
Short circuit or poor connection between CD-42(A)-CN-1(2) or CD-42(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(7) or CN-1 (4) - CN-51(8)	Replace or repair

Wiring diagram



3009SH6MS36

2) TEST PROCEDURE

(1) Test 8 : Check voltage at CN-51(10) and ground.

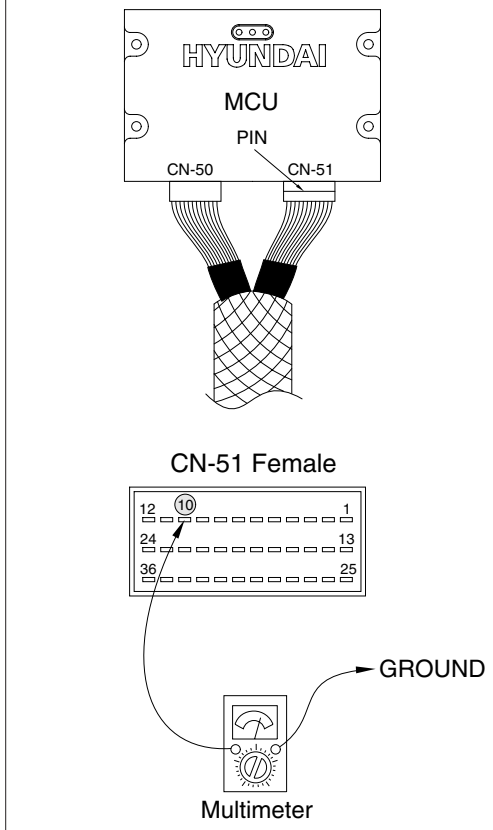
① Prepare 1 piece of thin sharp pin, steel or copper.

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

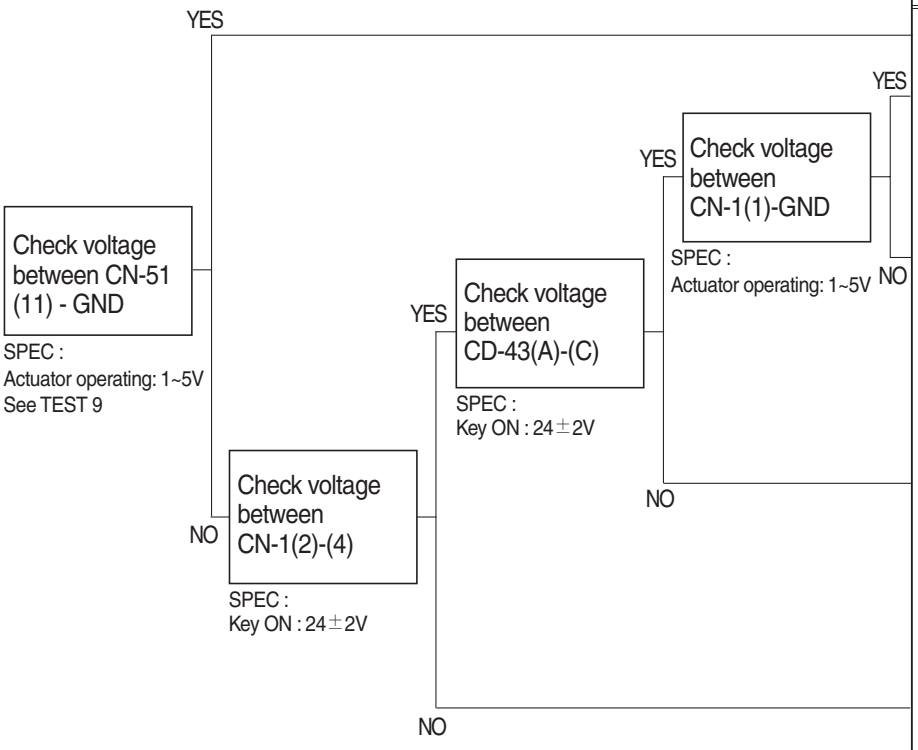


3009SH6MS37

7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

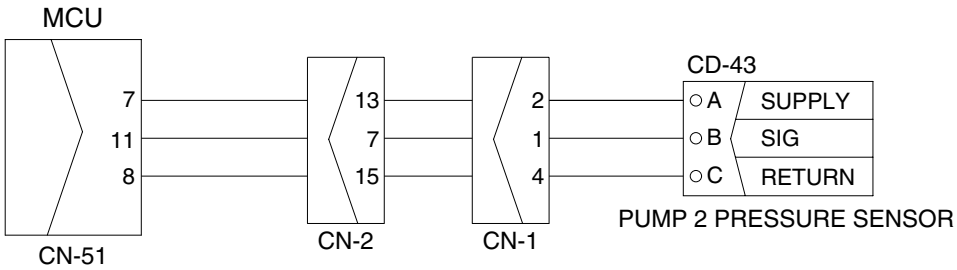
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-51-(11)-CN-1(1)	Replace or repair
Detective P2 pressure sensor short circuit or poor connection between CN-1(1)-CD-43(B)	Replace or repair
Short circuit or poor connection between CD-43(A)-CN-1(2) or CD-43(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(7) or CN-1 (4) - CN-51(8)	Replace or repair

Wiring diagram



3009SH6MS38

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-51(11) and ground.

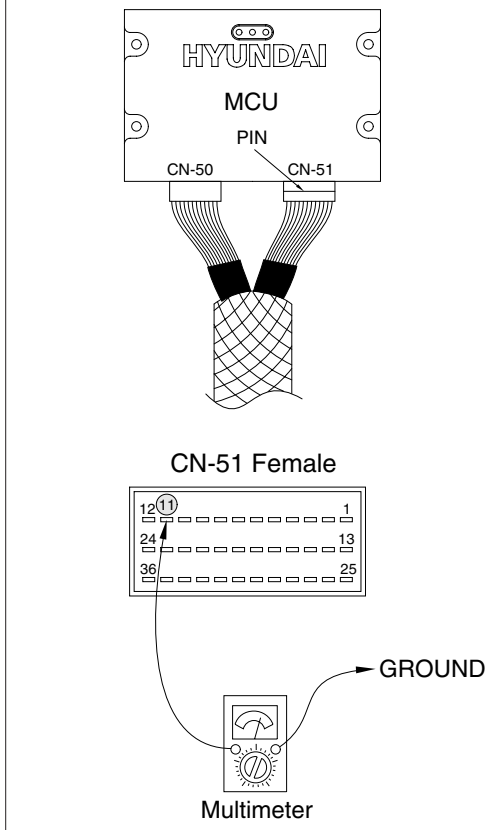
① Prepare 1 piece of thin sharp pin, steel or copper.

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

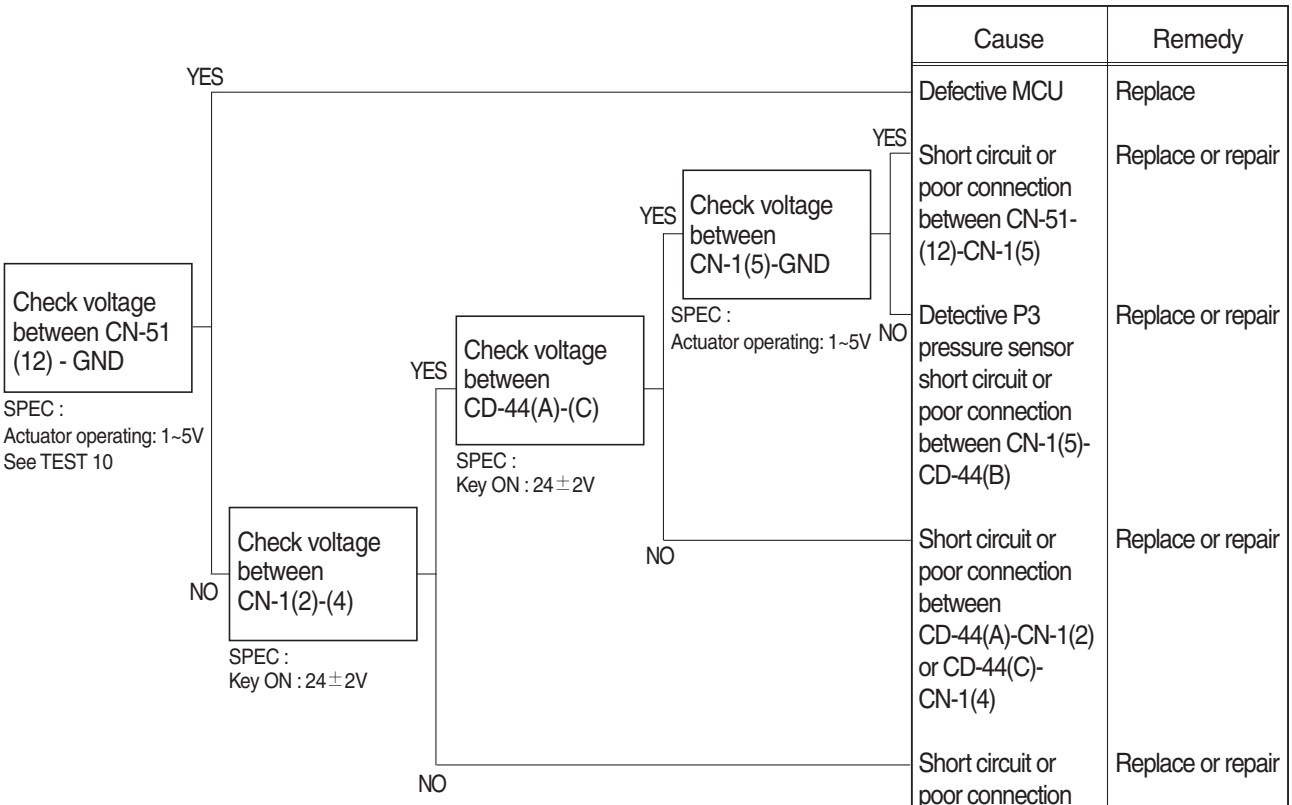


3009SH6MS39

8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

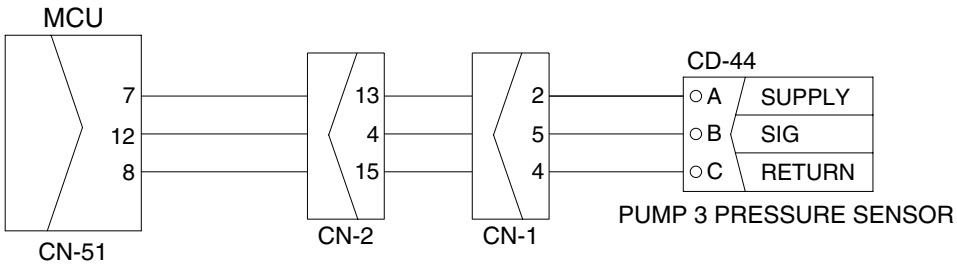
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-51-(12)-CN-1(5)	Replace or repair
Detective P3 pressure sensor short circuit or poor connection between CN-1(5)-CD-44(B)	Replace or repair
Short circuit or poor connection between CD-44(A)-CN-1(2) or CD-44(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(7) or CN-1 (4) - CN-7(8)	Replace or repair

Wiring diagram



3009SH6MS40

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-51(12) and ground.

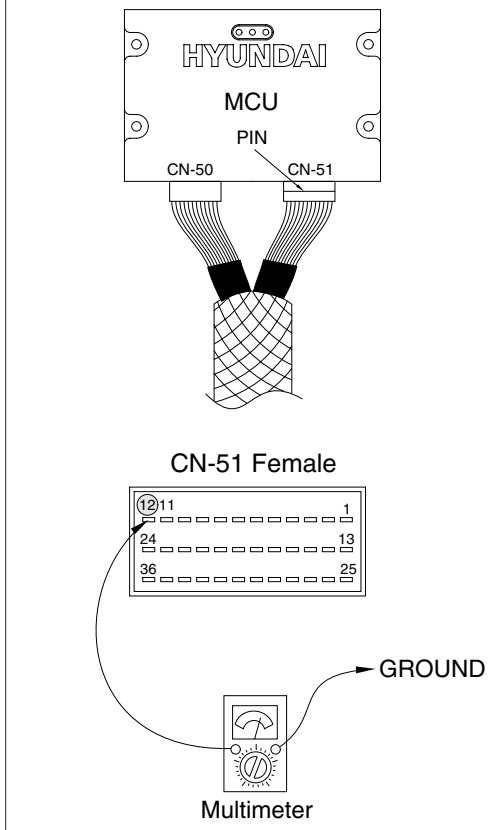
① Prepare 1 piece of thin sharp pin, steel or copper.

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

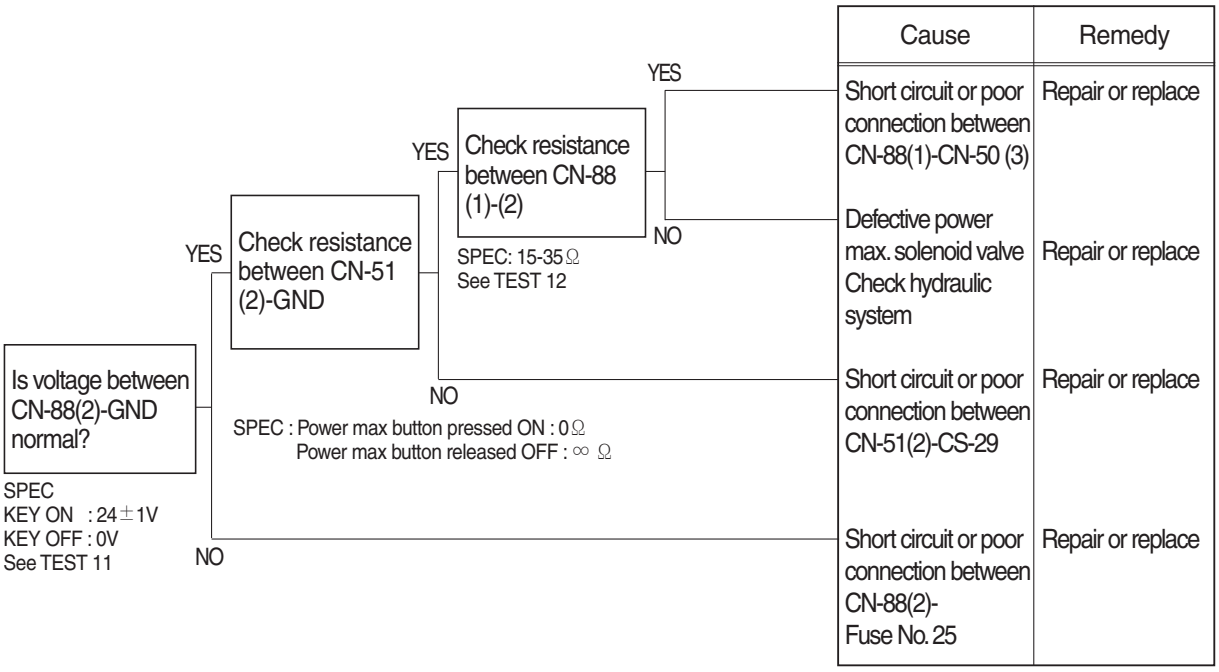


3009SH6MS41

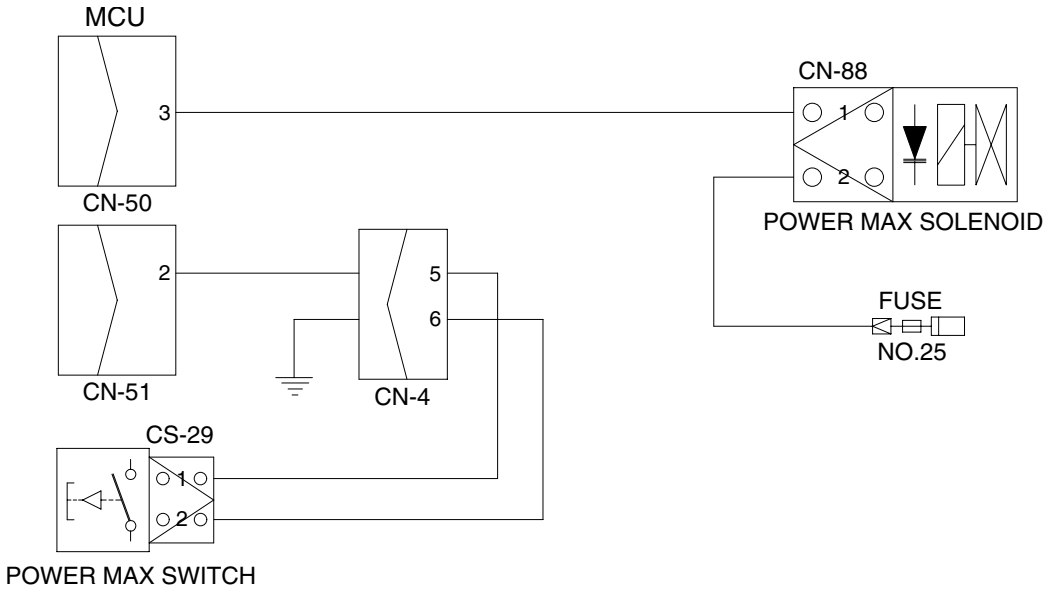
9. MALFUNCTION OF POWER MAX

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS42

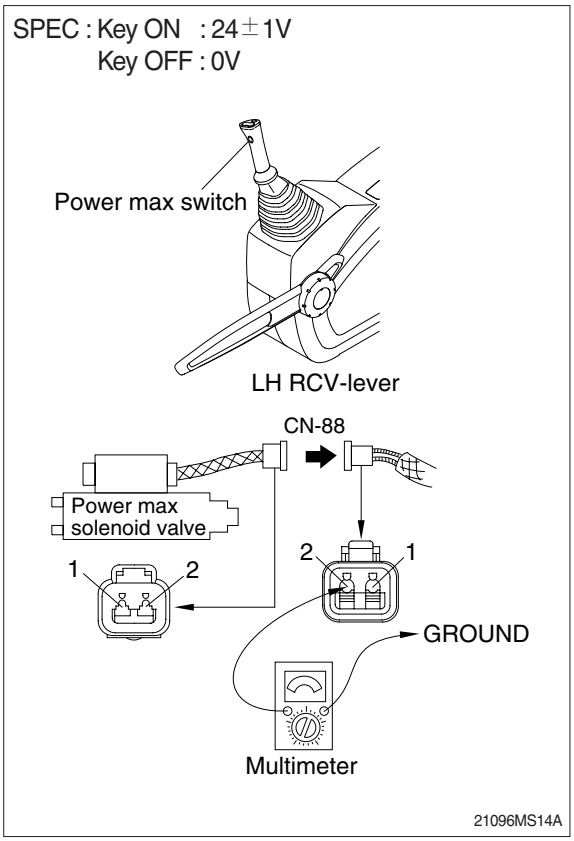
2) TEST PROCEDURE

(1) Test 11: 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.

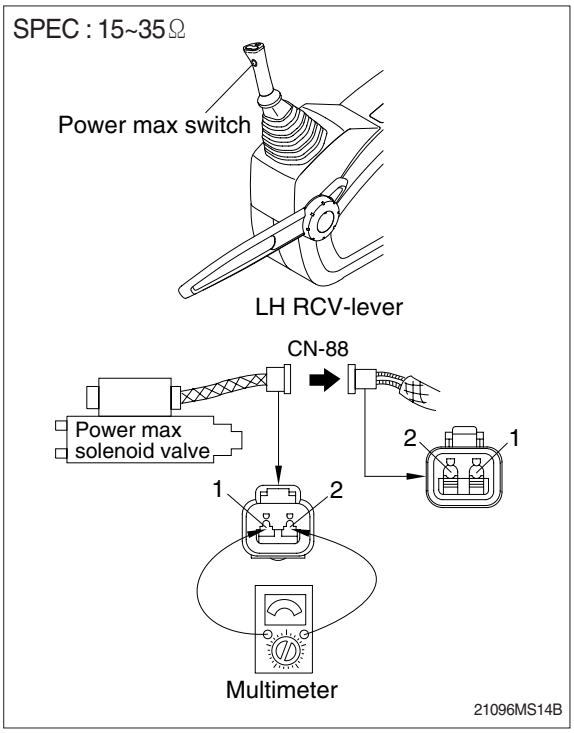


(2) Test 12: Check resistance of the solenoid valve between CN-88(1)-(2).

① Starting key OFF.

② Disconnect connector CN-88 from power max solenoid valve.

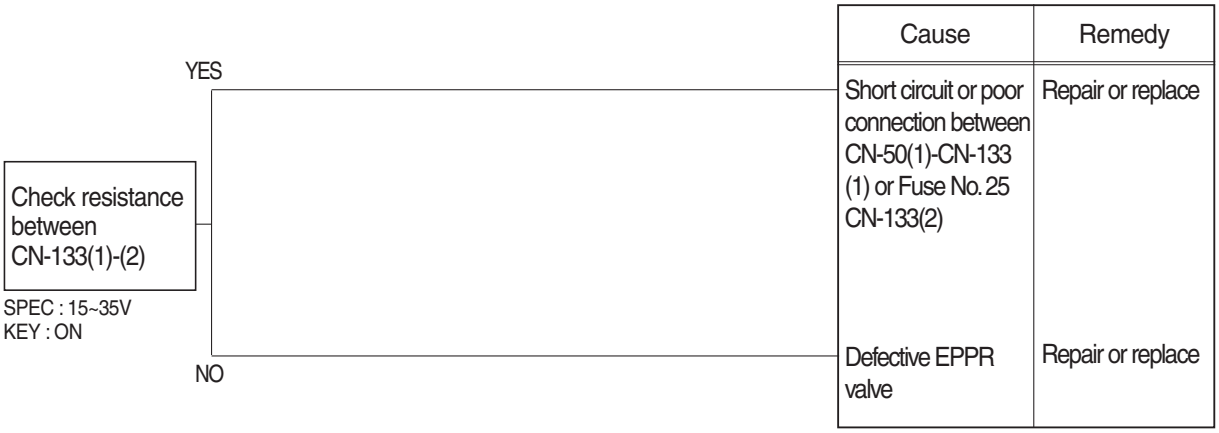
③ Check resistance as figure.



10. MALFUNCTION OF BOOM PRIORITY EPPR VALVE

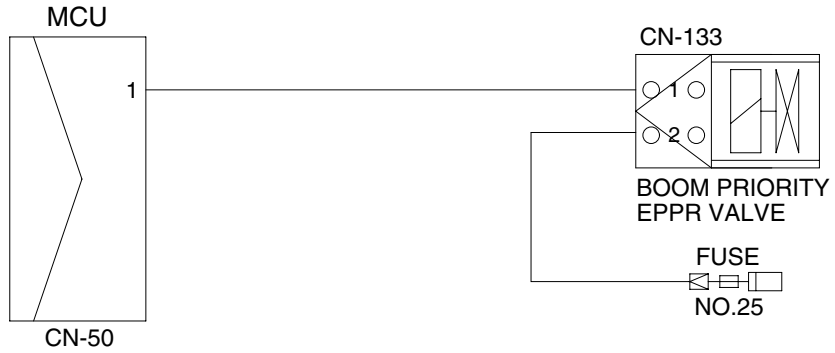
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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



3009SH6MS43

SECTION 7 MAINTENANCE STANDARD

Group 1 Operational Performance Test ····· 7-1
Group 2 Major Components ····· 7-23
Group 3 Track and Work Equipment ····· 7-32

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.

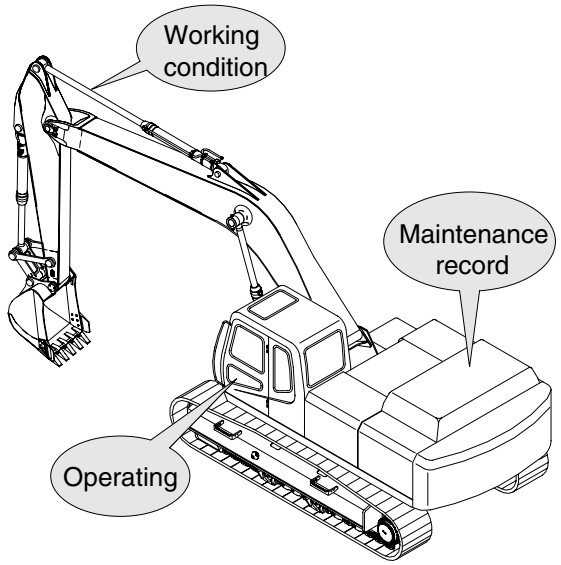
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

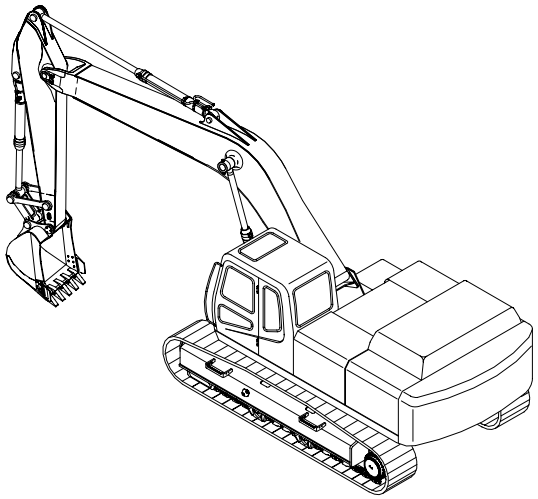


21077MS01

2. TERMINOLOGY

1) STANDARD

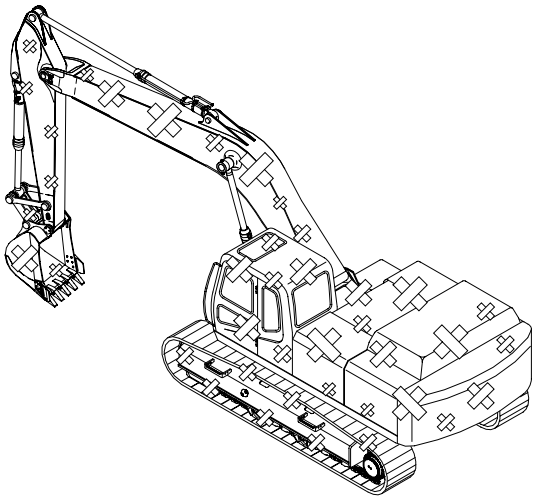
Specifications applied to the brand-new machine, components and parts.



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.

(1) The machine

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

(2) Test area

① Select a hard, flat surface.

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

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

(3) Precautions

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

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

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

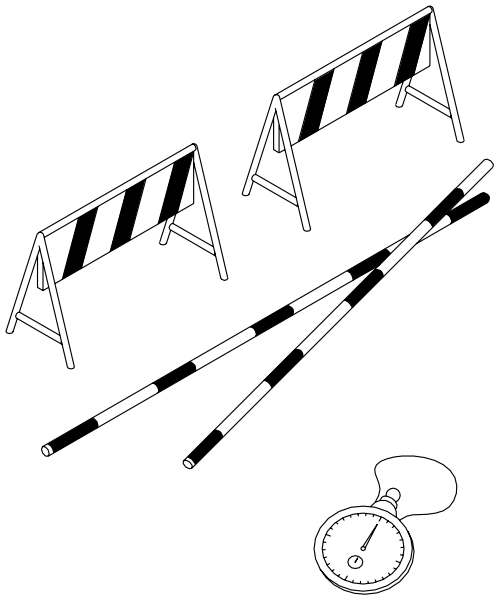
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

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

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

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



7-3

2) ENGINE SPEED (CLUSTER TYPE 1)

(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 Push the H-mode switch and confirm that the fuel injection pump governor lever comes into contact with the high-idle stopper.

④ Measure the engine RPM.

(3) Measurement

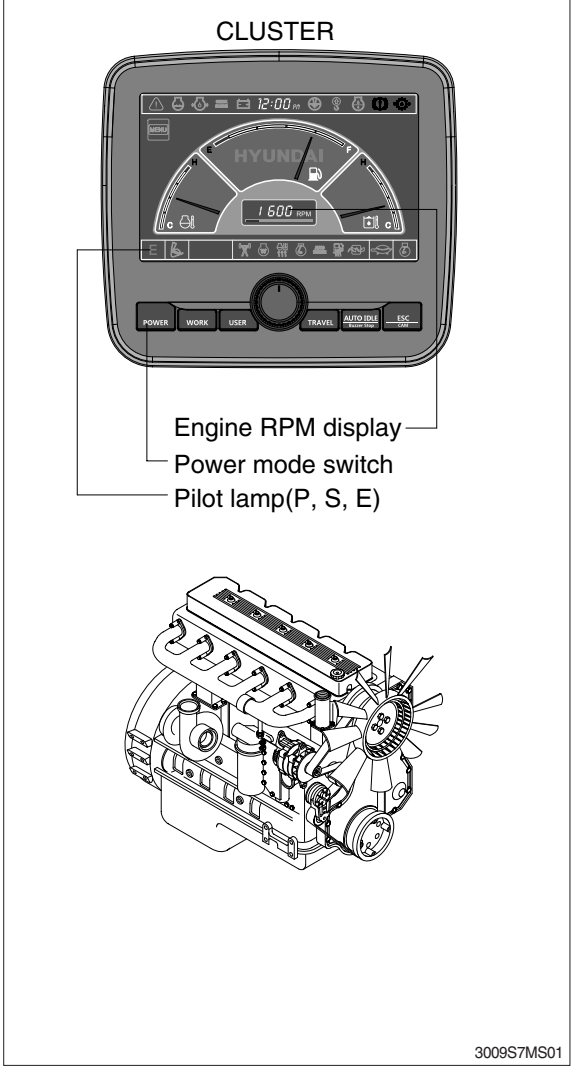
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

② Measure and record the engine speed at each mode (P, S, E).

③ Select the P-mode.

④ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.

⑤ Measure and record the auto deceleration speed.



(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R330LC-9S	Start idle	1000±100	
	P mode	2100±50	
	S mode	2000±50	
	E mode	1900±50	
	Auto decel	1150±100	
	One touch decel	1000±100	

Condition : Set the accel dial at 10 (max) position.

■ ENGINE SPEED (CLUSTER TYPE 2)

(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 Push the H-mode switch and confirm that the fuel injection pump governor lever comes into contact with the high-idle stopper.

④ Measure the engine RPM.

(3) Measurement

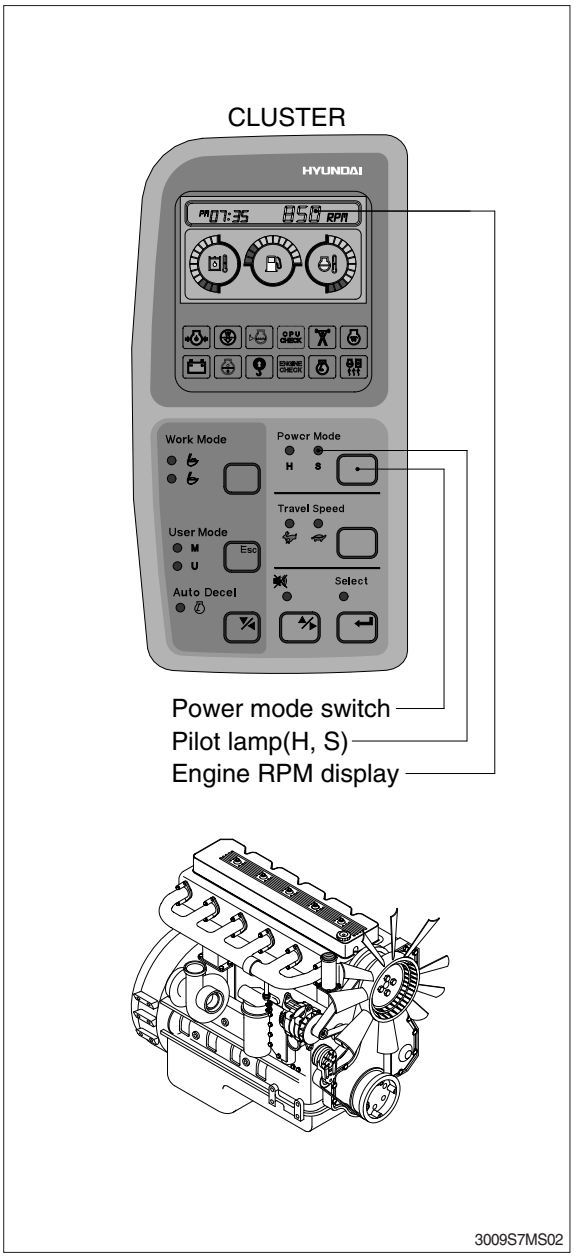
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

② Measure and record the engine speed at each mode (M, H, S).

③ Select the M-mode.

④ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.

⑤ Measure and record the auto deceleration speed.



(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R330LC-9S	Start idle	1000±100	
	M mode	2100±50	
	H mode	2000±50	
	S mode	1900±50	
	Auto decel	1150±50	
	One touch decel	1000±50	

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.

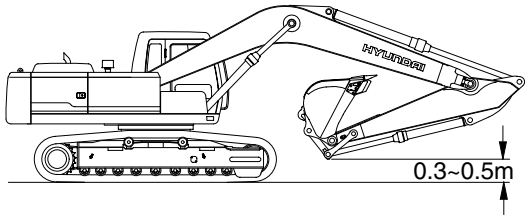
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Prepare a flat and solid test track 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.



290LC7MS01

(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.

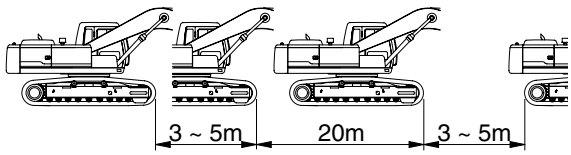
· Power mode switch :
P mode(Cluster type 1)
M mode(Cluster type 2)

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.



290LC7MS02

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
R330LC-9S	1 Speed	21.8±2.0	29.0	
	2 Speed	12.4±1.0	17.1	

4) TRACK REVOLUTION SPEED

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

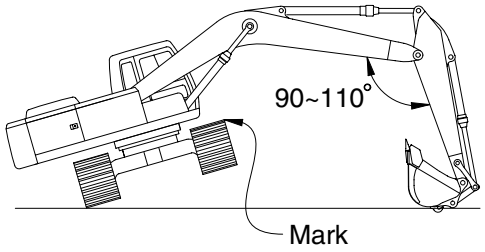
(2) Preparation

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 decel 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
R330LC-9S	1 Speed	33.5±2.0	41.8
	2 Speed	19.2±2.0	24.0

5) TRAVEL DEVIATION

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

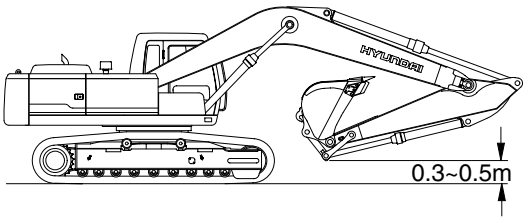
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



290LC7MS01

(3) Measurement

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

② Before beginning each test, select the following switch positions.

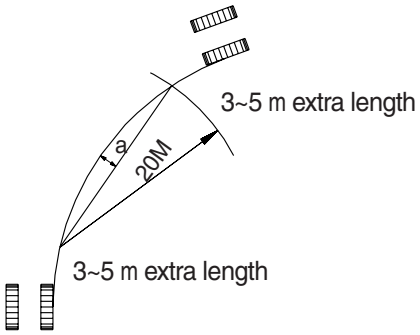
· Power mode switch :
P mode(Cluster type 1)
M mode(Cluster type2)

③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.

④ Measure the distance between a straight 20m 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.



7-7(2)

(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
R330LC-9S	200 below	250	

6) SWING SPEED

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

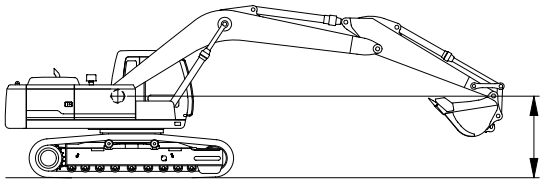
(2) Preparation

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

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

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

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



290LC7MS03

(3) Measurement

① Select the following switch positions.

· Power mode switch: Each mode

② Operate swing control lever fully.

③ Swing 1 turn and measure time taken to swing next 3 revolutions.

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

(4) Evaluation

The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
R330LC-9S	P mode (Cluster type 1)	18.8±1.5	23.5
	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.

(2) Preparation

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

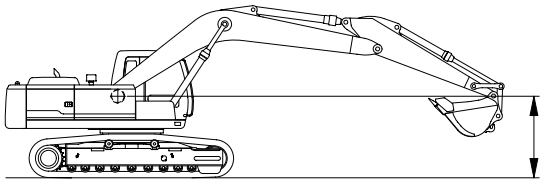
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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.



290LC7MS03

(3) Measurement

① Conduct this test in the P mode.(M mode)

② Select the following switch positions.

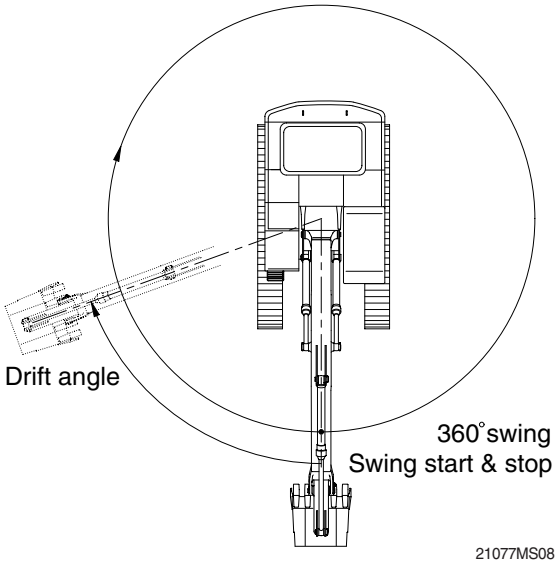
· Power mode switch :
P mode(Cluster type 1)
M mode(Cluster type 2)

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

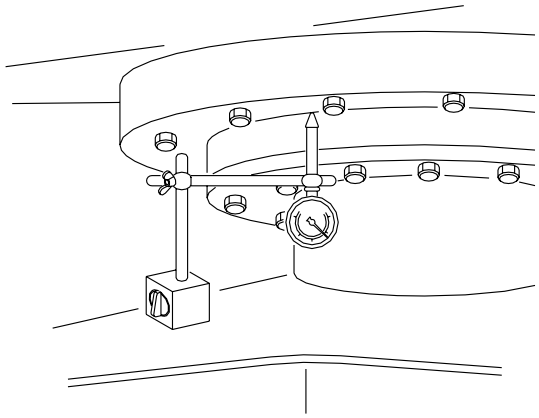
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R330LC-9S	P mode	90 below	112.5	
	M mode			

8) SWING BEARING PLAY

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



7-10(1)

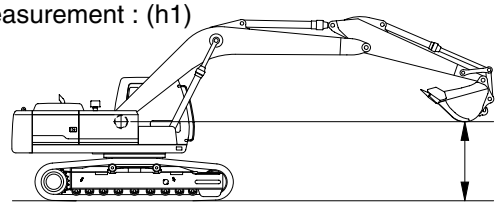
(2) Preparation

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.

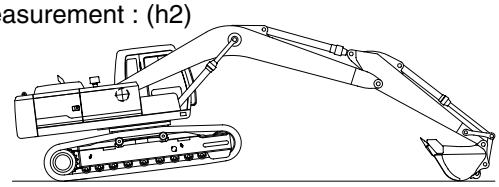
(3) Measurement

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)



290LC7MS04

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R330LC-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.

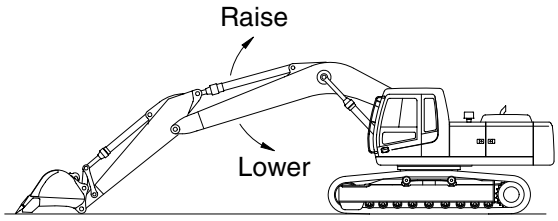
· Power mode switch :
P mode(Cluster type 1)
M mode(Cluster type 2)

② To measure cylinder cycle times.

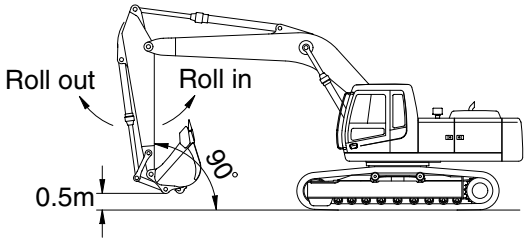
- Boom cylinders.
Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.

- 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.

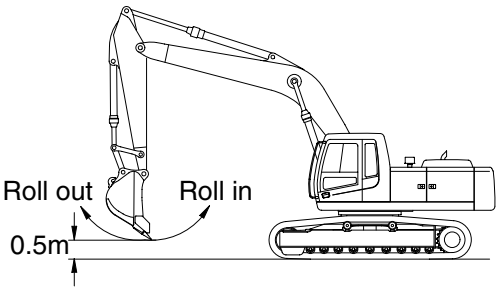
Boom cylinder



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
R330LC-9S	Boom raise	4.0±0.4	5.0	
	Boom lower	3.4±0.4	4.4	
	Arm in (Regen ON)	3.5±0.4	4.6	
	Arm out	3.3±0.3	4.1	
	Bucket load	2.8±0.4	3.4	
	Bucket dump	2.5±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.

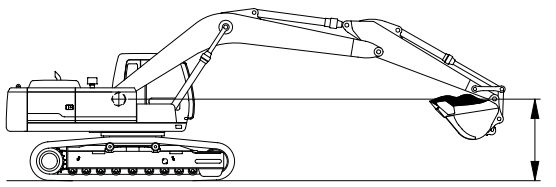
· $W=M^3 \times 1.5$
Where :
M^3 = Bucket heaped capacity (m^3)
1.5 = Soil specific gravity

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.



290LC7MS05

(3) Measurement

① Stop the engine.

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

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

(4) The measured drift should be within the following specifications.

Unit : mm / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
R330LC-9S	Boom cylinder	10 below	20	
	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	50	

11) CONTROL LEVER OPERATING FORCE

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

(2) Preparation

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

(3) Measurement

① Start the engine.

② Select the following switch positions.

· Power mode switch :
P mode(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
R330LC-9S	Boom lever	1.6 or below	2.0	
	Arm lever	1.6 or below	2.0	
	Bucket lever	1.6 or below	2.0	
	Swing lever	1.6 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
R330LC-9S	Boom lever	102±10	128	
	Arm lever	102±10	128	
	Bucket lever	90±10	113	
	Swing lever	90±10	113	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE (CLUSTER TYPE 1)

(1) Preparation

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

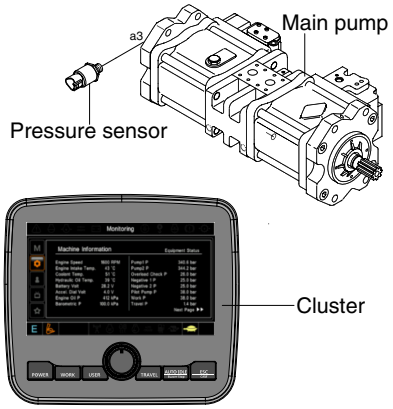
(2) Measurement

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.



29097MS13

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R330LC-9S	P mode	40^{+2}_{0}	-	

■ PILOT PRIMARY PRESSURE (CLUSTER TYPE 2)

(1) Preparation

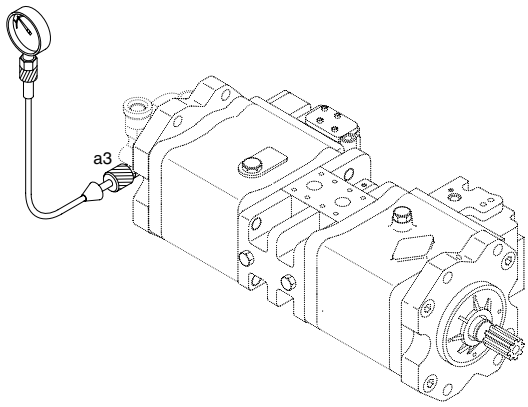
① Stop the engine.

② Push the pressure release button to bleed air.

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.



2507A7MS02A

(2) Measurement

① Select the following switch positions.

· Power mode switch : M mode

· Auto decel switch : OFF

② Measure the primary pilot pressure in the M mode.

(3) Evaluation

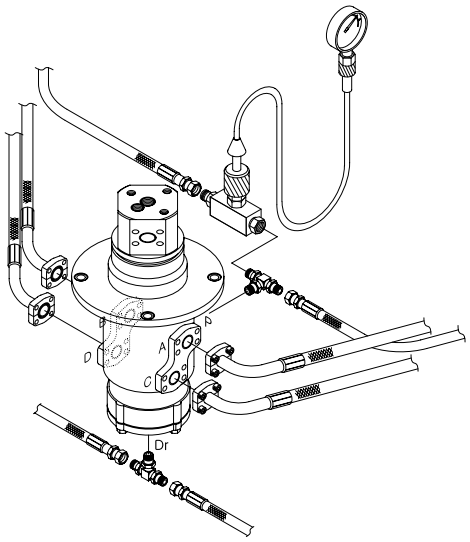
The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R330LC-9S	M mode	40^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE

(1) Preparation



① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ Push the pressure release button to bleed air.
④ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.
⑤ Start the engine and check for on leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5˚C.

(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.

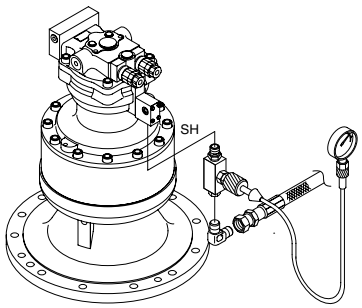
Unit : kgf / cm²

Model	Travel speed	Standard	Maximum allowable	Remarks
R330LC-9S	1 Speed	0	-	
	2 Speed	40±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
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.



29097MS03

(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
R330LC-9S	Brake disengaged	40	Over 9	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE (CLUSTER TYPE 1)

(1) Preparation

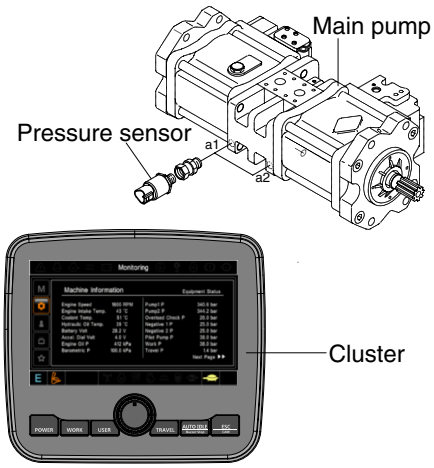
① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Measure the main pump delivery pressure by the monitoring menu of the cluster.



29097MS14

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R330LC-9S	High ilde	40±5	-	

■ MAIN PUMP DELIVERY PRESSURE (CLUSTER TYPE 2)

(1) Preparation

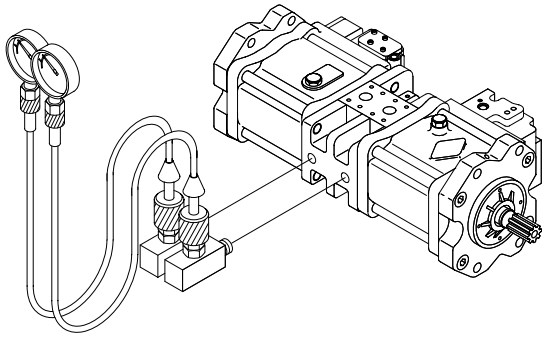
① Stop the engine.

② Push the pressure release button to bleed air.

③ Loosen and remove pump pressure. Install a connector and pressure gauge assembly main pump gauge port as shown.

④ Start the engine and check for oil leakage from the port.

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



290LC7MS07

(2) Measurement

① Select the following switch positions.

· Mode selector : M mode

② Measure the main pump delivery pressure in the M mode (high idle).

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R330LC-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

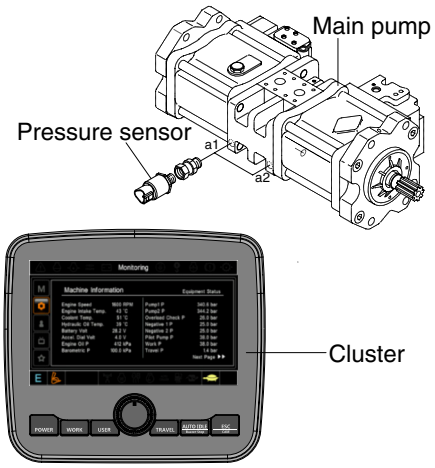
① Select the following switch positions.

· 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.



29097MS14

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

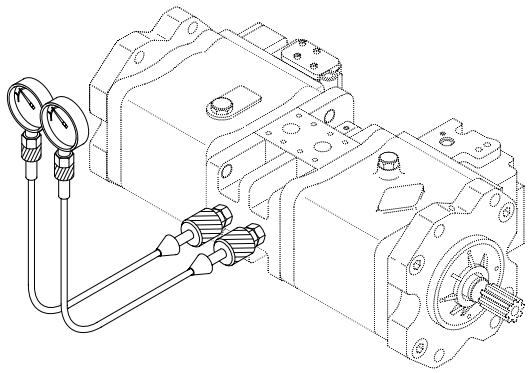
Model	Function to be tested	Standard	Remark
R330LC-9S	Boom, Arm, Bucket	350(380)±10	400±10 (Port relief)
	Travel	350±10	-
	Swing	300±10	-

( ) : Power boost

■ SYSTEM PRESSURE REGULATOR RELIEF SETTING (CLUSTER TYPE 2)

(1) Preparation

① Stop the engine.
② Push the pressure release button to bleed air.
③ To measure the system relief pressure. Install a connector and pressure gauge assembly main pump gauge port, as shown.
④ Start the engine and check for oil leakage from the port.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



2507A7MS03A

(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

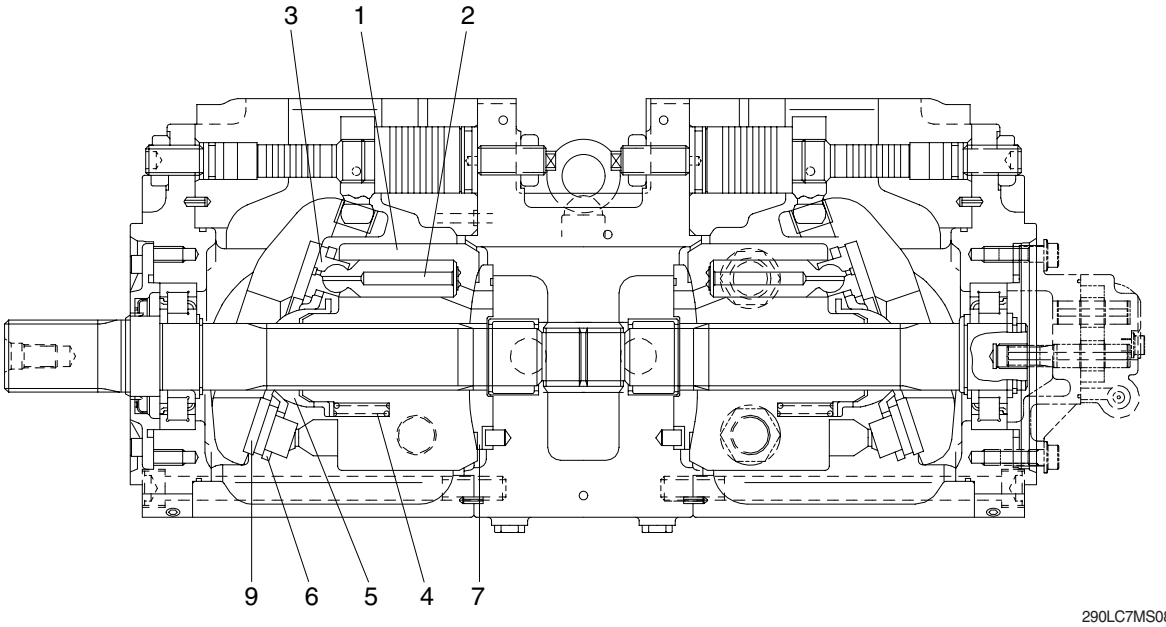
The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

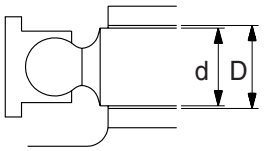
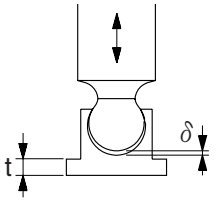
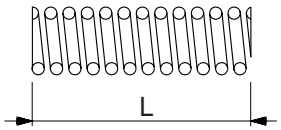
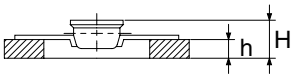
Model	Function to be tested	Standard	Remark
R330LC-9S	Boom, Arm, Bucket	350(380)±10	400±10 (Port relief)
	Travel	350±10	-
	Swing	300±10	-

( ) : Power boost

1. MAIN PUMP



290LC7MS08

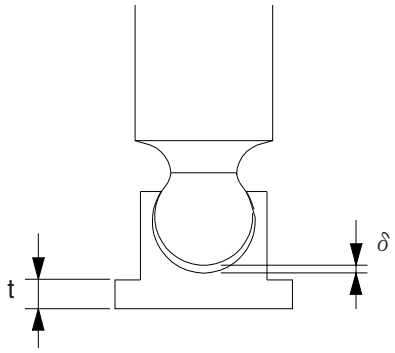
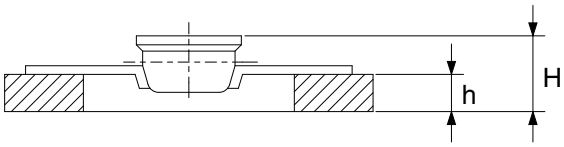
Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston(1) & cylinder bore(2) (D-d)		0.043	0.070	Replace piston or cylinder.
Play between piston(1) & shoe caulking section(3) (δ)		0-0.1	0.3	Replace assembly of piston & shoe.
Thickness of shoe (t)		5.4	5.0	
Free height of cylinder spring(4) (L)		47.9	47.1	Replace cylinder spring.
Combined height of set plate(5) & spherical bushing(6) (H-h)		23.8	22.8	Replace retainer or set plate.
Surface roughness for valve plate (sliding face) (7,8), swash plate (shoe plate area) (9), & cylinder(2) (sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (corrected value)	0.4z or lower		

2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part - Sliding sections of casing fore and spool, especially land sections applied with holding pressure - Seal pocket section where spool is inserted - Seal section of port where O-ring contacts - Seal section of each relief valve for main, travel, and port - Other damages that may damage normal functions
Spool	· Existence of scratch, gnawing, rusting or corrosion. · Insert spool in casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals contacting section) · Correction or replacement when O-ring is damaged or when spool does not move smoothly
Load check valve	· Damage of load check valve or spring	· Repair or replace of improper seat contact
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage
Around seal for spool	· External oil leakage.	· Replacement
Main relief valve, Over relief valve	· External rusting or damage. · Contacting face of valve seat.	· Replacement · Replacement when damaged

3. SWING DEVICE

1) WEARING PARTS

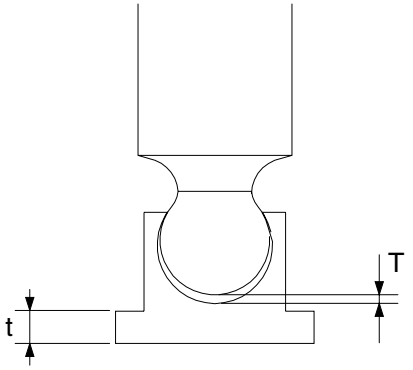
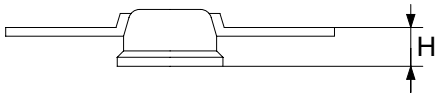
Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section (δ)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	5.5	5.3	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	6.5	6.0	Replace set of retainer plate and sperical bushing
Thickness of friction plate	4.0	3.6	Replace
			

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	0.028	0.058	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)	5.5	5.3	Replace assembly of piston and shoe
Combined height of set plate and ball guide(H-h)	6.5	6.0	Replace set of set plate and ball guide
Thickness of friction plate	4.0	3.6	Replace
			

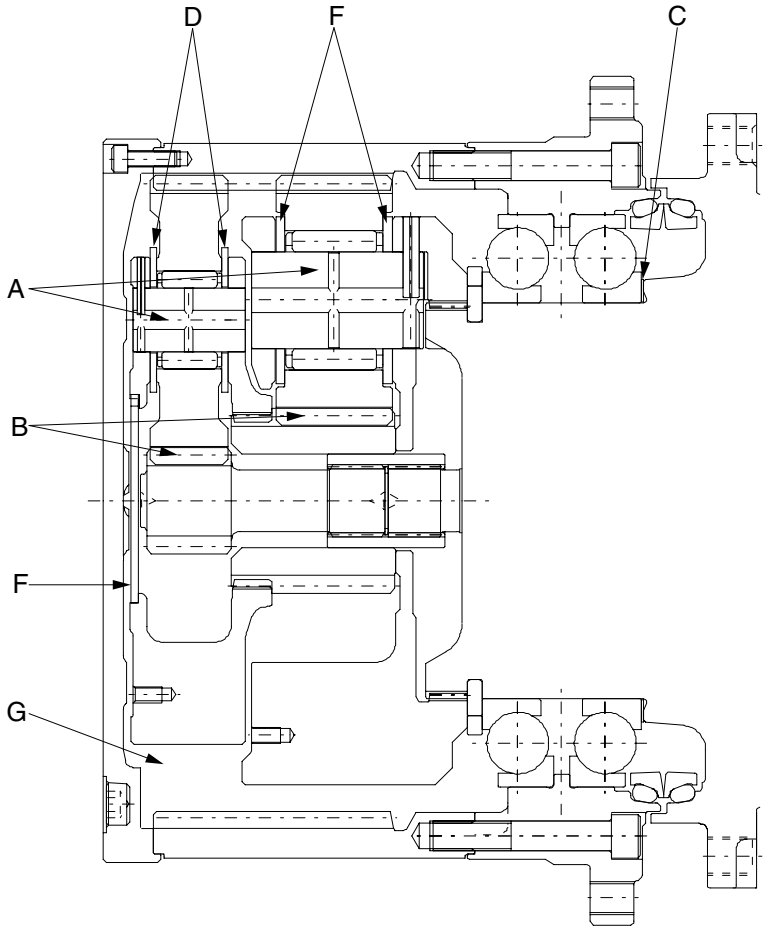
2) SLIDING PARTS

Part name	Standard roughness	Remark
Shoe	0.8S	-
Shoe plate	0.4S	-
Cylinder	1.6S	-
Valve plate	0.8S	-

5. TRAVEL REDUCTION GEAR

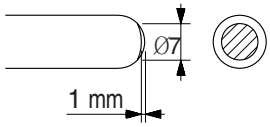
The followings are the general maintenance standards. However, it is most important to determine which parts should be replaced, depending on the characteristics shown before disassembling, damages or discoloration of exterior view, the purpose of disassembling, the expected remaining service life etc..

Item	Part name	Criteria	Allowable limit	Remedy
A	Wear of planetary shaft	Smooth, without abnormal wear or seizure	←	Replace 3 pieces as a set
B	Condition of tooth surface	Smooth, without abnormal wear or seizure	Not over 1.6 of pitching, no cracks at root	Replace 3 pieces as a set for planetary pinion
C	Thrust clearance of angular bearings (2)	-0.08~0.02 mm	←	Adjust shim thickness Refer to 8-101 (5)
D	Thickness of thrust washer 1 (18)	3.3~3.7 mm	Wear 0.1 mm	Replace
E	Thickness of thrust washer 2 (11)	5.3~5.7 mm	Wear 0.1 mm	Replace
F	Thickness of thrust plate (23)	4.34~4.66 mm	Wear 0.15 mm	Replace
G	Lubrication oil	2000 working hours (machine hour meter)		Replace



29097MS11

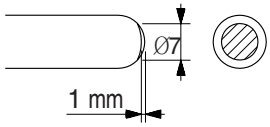
6. RCV LEVER

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 : 30 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

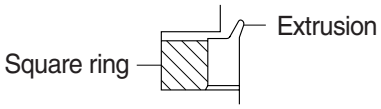
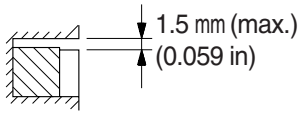
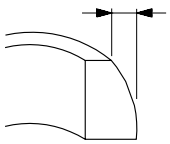
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

7. 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 : 30 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

8. TURNING JOINT

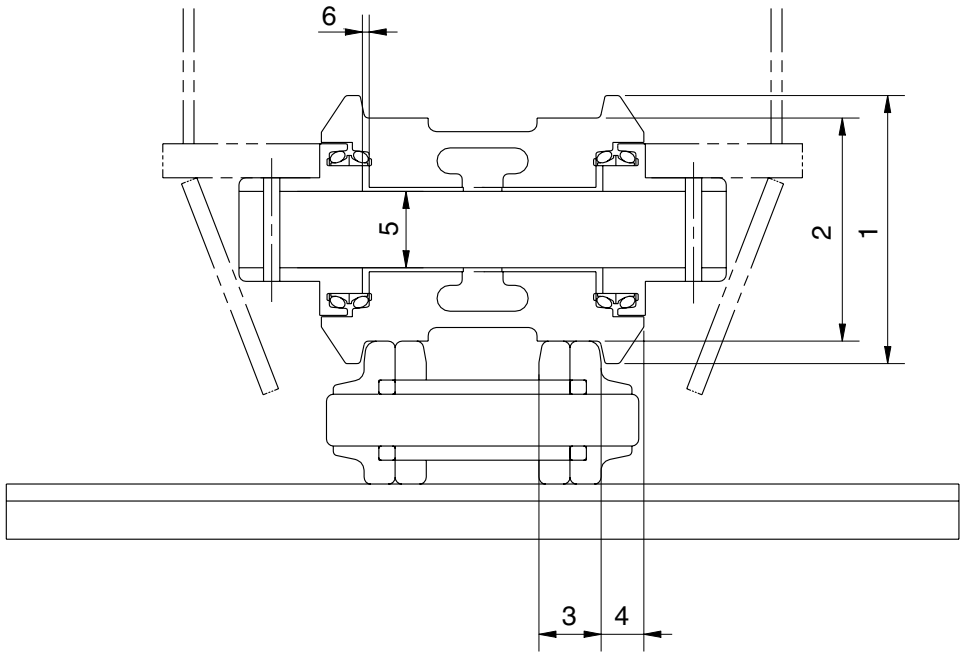
Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure 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

9. 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

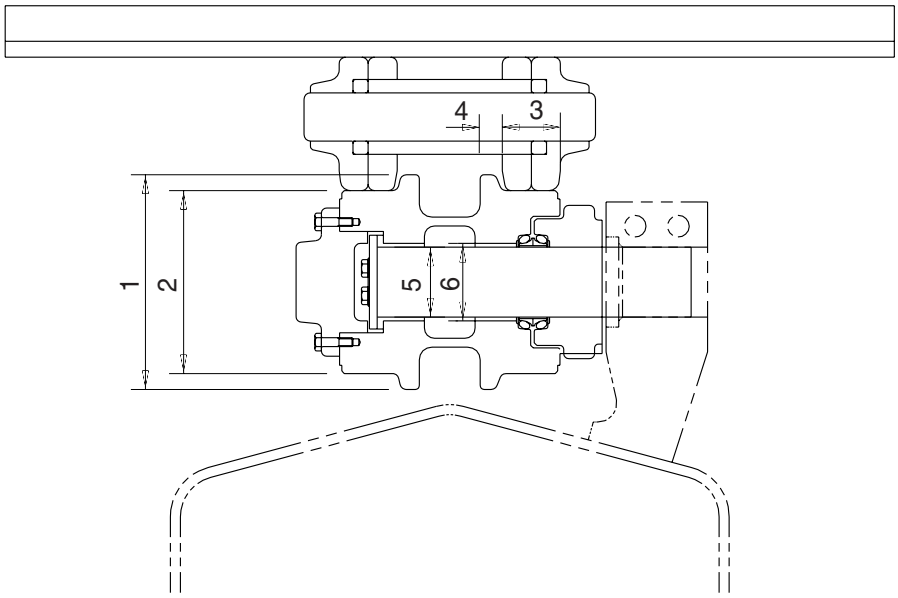


21037MS01

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø216		–		
2	Outside diameter of tread	Ø180		Ø168		
3	Width of tread	50		56		
4	Width of flange	57		21		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø75 $^{0}_{-0.03}$	Ø75.35 $^{+0.05}_{0}$	0.35 to 0.40	2.0	
6	Side clearance of roller (both side)	Standard clearance		Clearance limit		Replace
		0.16~1.24		2.0		

2) CARRIER ROLLER

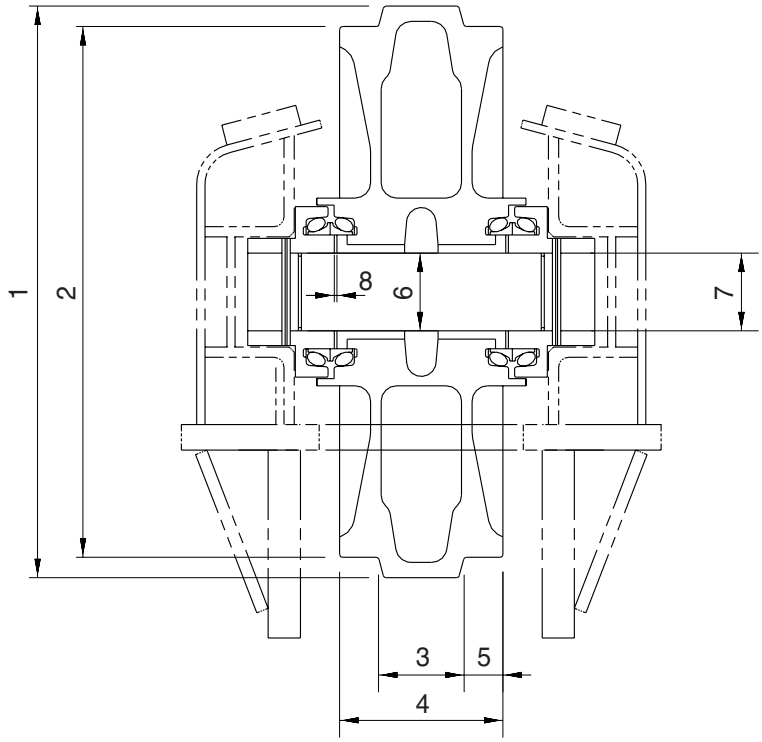


32037MA37

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø200		–		
2	Outside diameter of tread	Ø168		Ø158		
3	Width of tread	54		59		
4	Width of flange	19		–		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø55 +0.085 +0.066	Ø55 +0.37 +0.33	0.245 to 0.304	2.0	
6	Clearance between shaft and support	Ø58 0 -0.1	Ø58 +0.5 +0.3	0.3 to 0.6	1.2	Replace

3) IDLER

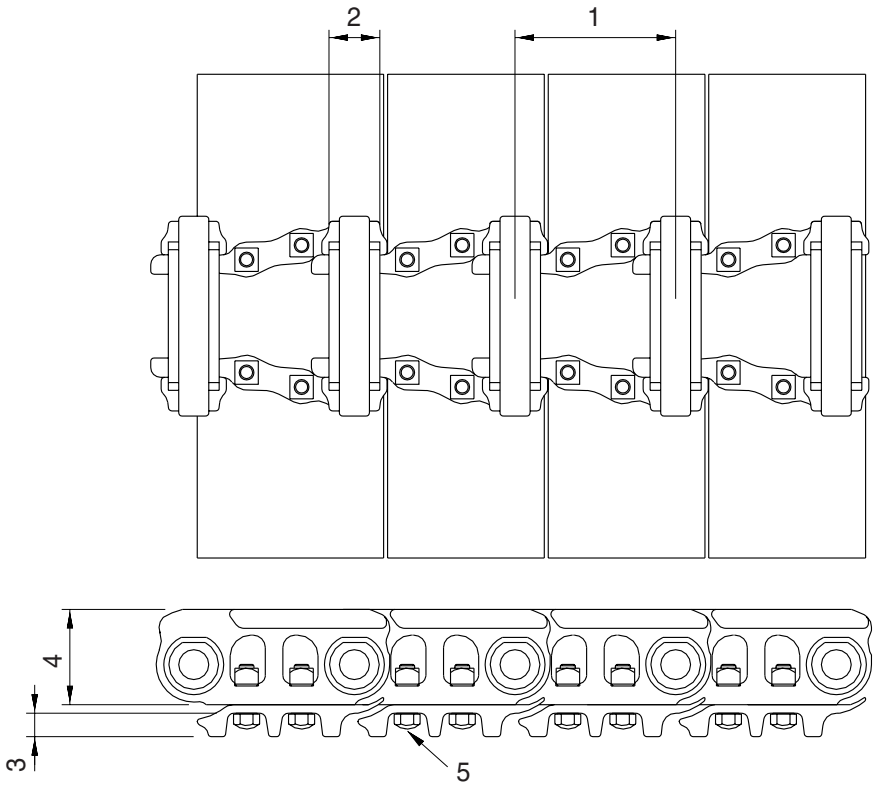


21037MS03

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of protrusion	Standard size		Repair limit		Rebuild or replace
		Ø646		Ø636		
2	Outside diameter of tread	Ø594		Ø588		
3	Width of protrusion	102		92		
4	Total width	203		–		
5	Width of tread	50.5		56.5		
6	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø90 $^{0}_{-0.035}$	Ø90.35 $^{+0.05}_{0}$	0.35 to 0.435	2.0	
7	Clearance between shaft and support	Ø90 $^{0}_{-0.035}$	Ø90 $^{+0.09}_{+0.036}$	0.036 to 0.125	1.2	Replace
8	Side clearance of idler (both side)	Standard clearance 0.4 to 1.2		Clearance limit 2.0		Replace

4) TRACK

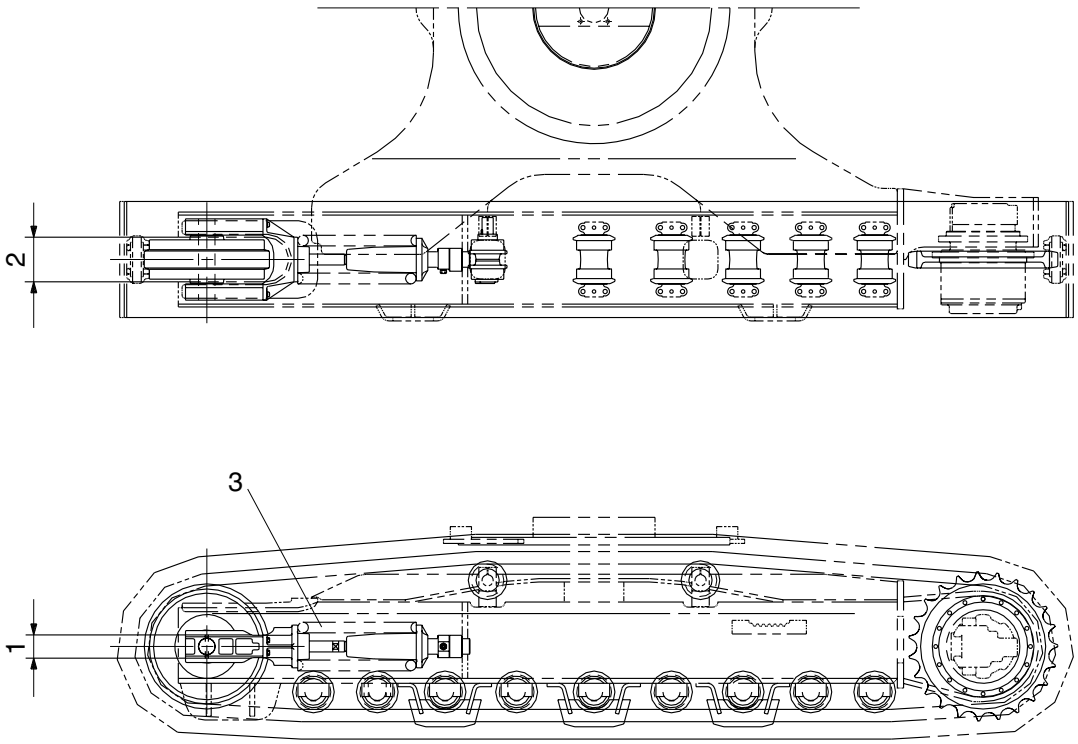


21037MS04

Unit : mm

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		216	223	
2	Outside diameter of bushing	Ø66.5	Ø58.5	Rebuild or replace
3	Height of grouser	30	21	
4	Height of link	116	104	
5	Tightening torque	Initial tightening torque : 115±5 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING

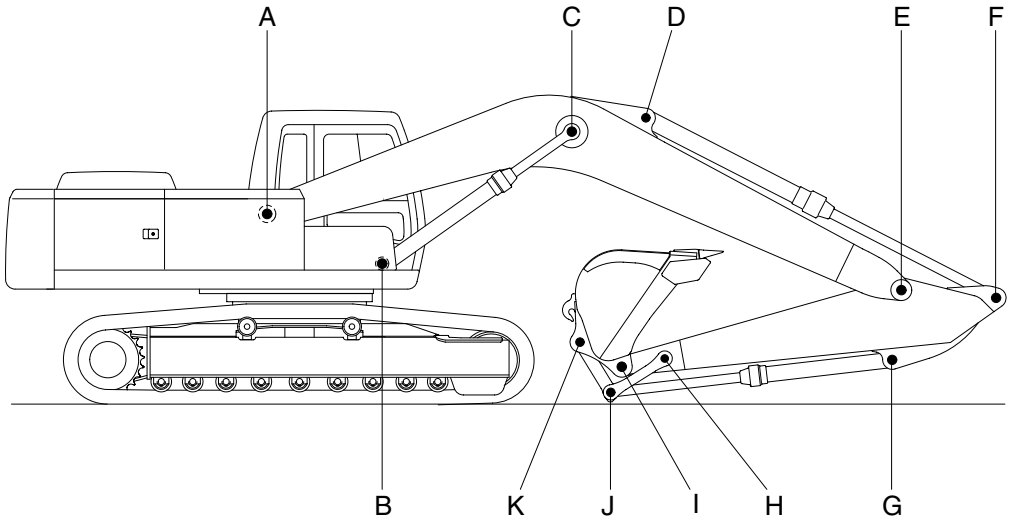


21037MS05

Unit : mm

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide		Standard size	Tolerance	Repair limit		Rebuild or replace
		Track frame	132	+2 0	138		
		Idler support	130	0 - 1.5	124		
2	Horizontal width of idler guide	Track frame	292	+2 0	298		
		Idler support	290	-	286		
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		Ø253×710	580	19012 kg	–	15210 kg	

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	110	109	108.5	110.5	111	Replace
B	Boom Cylinder Head	100	99	98.5	100.5	101	〃
C	Boom Cylinder Rod	100	99	98.5	100.5	101	〃
D	Arm Cylinder Head	100	99	98.5	100.5	101	〃
E	Boom Front	100	99	98.5	100.5	101	〃
F	Arm Cylinder Rod	100	99	98.5	100.5	101	〃
G	Bucket Cylinder Head	90	89	88.5	90.5	91	〃
H	Arm Link	90	89	88.5	90.5	91	〃
I	Bucket and Arm Link	100	99	98.5	100.5	101	〃
J	Bucket Cylinder Rod	90	89	88.5	90.5	91	〃
K	Bucket Link	100	99	98	100.5	101	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

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Group 2 Tightening Torque ····· 8-4
Group 3 Pump Device ····· 8-7
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Group 8 Turning Joint ····· 8-126
Group 9 Boom, Arm and Bucket Cylinder ····· 8-131
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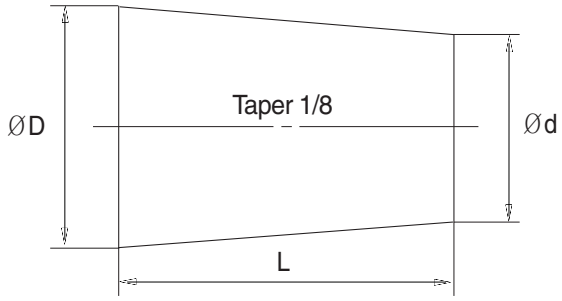
SECTION 8 DISASSEMBLY AND ASSEMBLY

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	10 ± 1.0	72.3 ± 7.2
2		Engine mounting bolt (bracket-frame)	M24 × 3.0	90 ± 7.0	651 ± 51
3		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
4		Coupling mounting socket bolt	M20 × 2.5	46.5 ±2.5	336 ±18.1
5		Fuel tank mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
6	Hydraulic system	Main pump housing mounting bolt	M10 × 1.5	6.9 ± 0.3	49.9 ± 2.2
7		Main pump mounting socket bolt	M20 × 2.5	42 ± 4.5	304 ± 32.5
8		Main control valve mounting nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
9		Hydraulic oil tank mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
10		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
11	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
12		Swing bearing upper part mounting bolt	M24 × 3.0	97.8 ± 10	707 ± 72.3
13		Swing bearing lower part mounting bolt	M24 × 3.0	97.8 ± 10	707 ± 72.3
14		Travel motor mounting bolt	M24 × 3.0	84 ± 8.0	608 ± 57.8
15		Sprocket mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
16	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7± 3.0	215 ± 21.7
17		Track roller mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
18		Track tension cylinder mounting bolt	M12 × 1.25	15 ± 5.0	108 ± 36
19		Track shoe mounting bolt, nut	M22 × 1.5	115 ± 5.0	831 ± 36
20		Track guard mounting bolt	M20 × 2.5	46 ± 5	333 ± 36
21	Others	Counterweight mounting bolt	M36 × 3.0	337 ± 33	2440 ± 72.3
22		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
23		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8

※ For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.7 ~ 4.1	19.5 ~ 29.7
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60.0
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.0	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36 × 4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.2 ~ 3.4	15.9 ~ 24.6	3.0 ~ 4.4	21.7 ~ 31.8
M10 × 1.2	4.5 ~ 6.7	32.5 ~ 48.5	5.9 ~ 8.9	42.7 ~ 64.4
M12 × 1.25	7.8 ~ 11.6	56.4 ~ 83.9	10.6 ~ 16.0	76.7 ~ 116
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 131	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 195	26.6 ~ 36.0	192 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 391	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 516	70.7 ~ 95.7	511 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 665	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1339	182 ~ 248	1314 ~ 1796
M36 × 3.0	192 ~ 260	1390 ~ 1880	262 ~ 354	1894 ~ 2562

2) PIPE AND HOSE (FLARE TYPE)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS TYPE)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

(4) Remove the wirings for the pressure sensors and so on.

(5) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 190 ℓ

(6) Remove bolts (13) and disconnect pipe (1,2).

(7) Disconnect pilot line hoses (4, 5, 6, 7, 8, 9, 10).

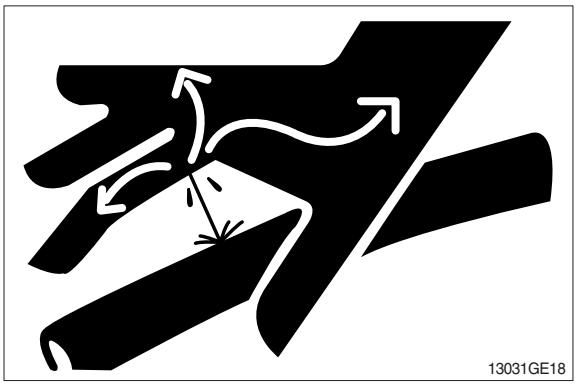
(8) Remove bolts(12) and disconnect pump suction tube (3).

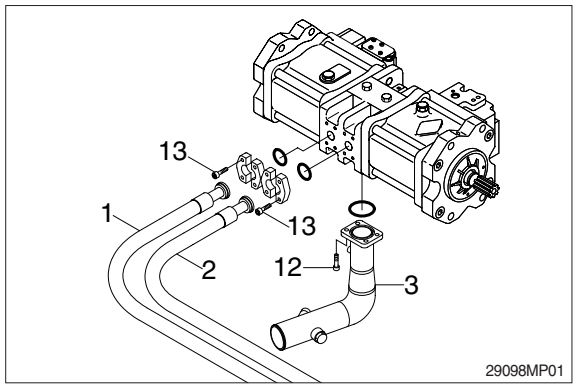
※ **When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.**

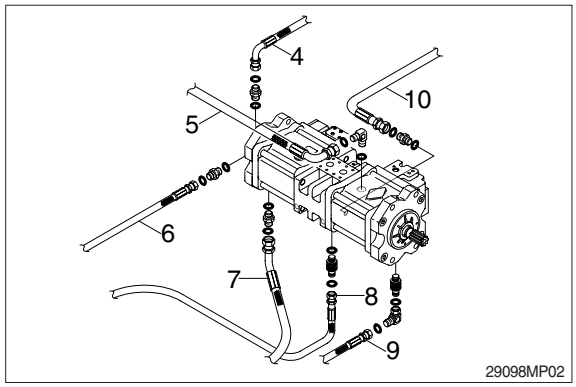
(9) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 140 ㎏ (310 ㏪)

※ **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 the return filter with a new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

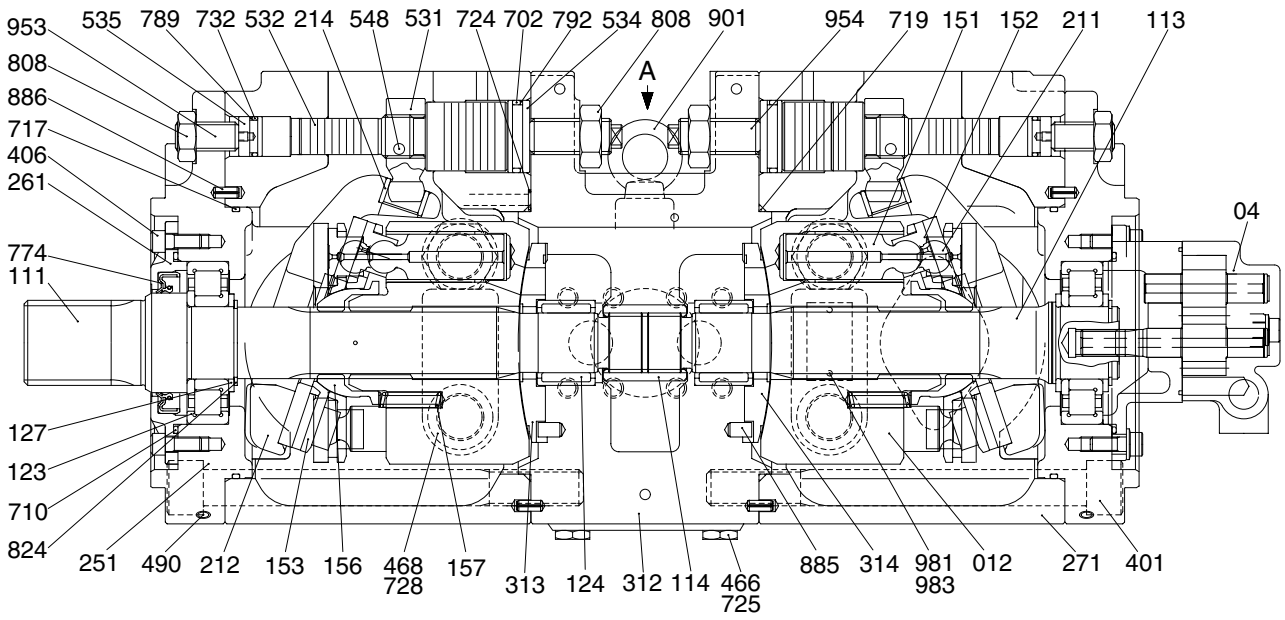
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA)
② Tighten plug lightly
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

(8) Confirmed the hydraulic oil level and check the hydraulic oil leaks or not.

2. MAIN PUMP (1/2)

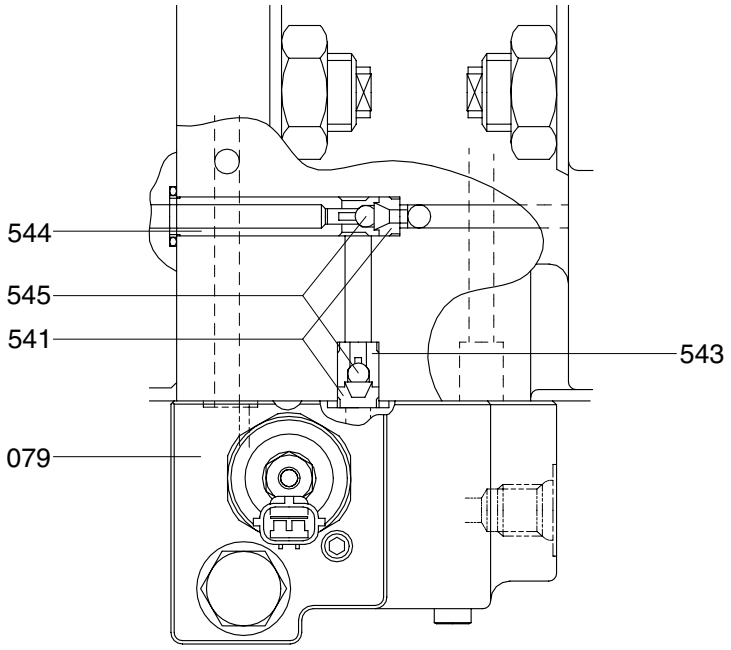
1) STRUCTURE



33092MP02A

04	Gear pump	271	Pump casing	719	O-ring
111	Drive shaft (F)	312	Valve block	724	O-ring
113	Drive shaft (R)	313	Valve plate (R)	725	O-ring
114	Gear	314	Valve plate (L)	728	O-ring
123	Roller bearing	401	Hexagon socket bolt	732	O-ring
124	Needle bearing	406	Hexagon socket bolt	774	Oil seal
127	Bearing spacer	466	VP plug	789	Back up ring
151	Piston	468	VP plug	792	Back up ring
152	Shoe	490	VP 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	Swash plate support	710	O-ring	981	Name plate
261	Seal cover (F)	717	O-ring	983	Pin

MAIN PUMP (2/2)



VIEW A

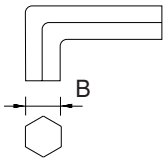
32092MP03

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

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 rowspan="6">Allen wrench
 
</td><td>B</td><td>Hexagon socket head bolt</td><td>PT plug (PT thread)</td><td>PO plug (PF thread)</td><td>Hexagon socket head setscrew</td></tr>
<tr><td>4</td><td>M 5</td><td>BP-1/16</td><td>-</td><td>M 8</td></tr>
<tr><td>5</td><td>M 6</td><td>BP1/ 8</td><td>-</td><td>M10</td></tr>
<tr><td>6</td><td>M 8</td><td>BP-1/ 4</td><td>PO-1/4</td><td>M12, M14</td></tr>
<tr><td>8</td><td>M10</td><td>BP-3/ 8</td><td>PO-3/8</td><td>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>-</td></tr>
<tr><td rowspan="6">Double ring spanner, socket wrench, double (single) open end spanner
 
</td><td>-</td><td colspan="2">Hexagon head bolt</td><td colspan="2">Hexagon head bolt</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	115.7	0.47	12
	M16	24.0	173.6	0.55	14
	M18	34.0	245.9	0.55	14
	M20	44.0	318.3	0.67	17
PT plug (material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/16	0.7	5.1	0.16	4
	PT 1/ 8	1.05	7.59	0.20	5
	PT 1/ 4	1.75	12.66	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	108.5	0.55	14
	PF 1	19.0	137.4	0.67	17
	PF 1 1/4	27.0	195.3	0.67	17
	PF 1 1/2	28.0	202.5	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

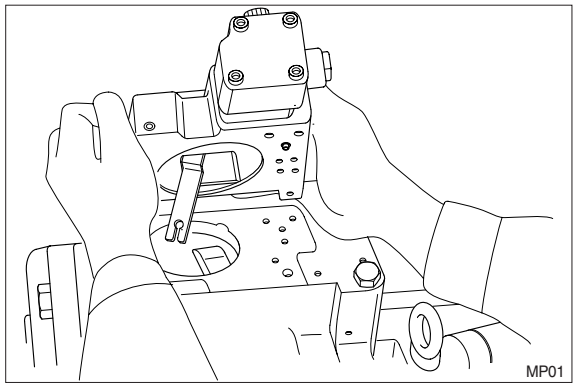
※ Select clean place.

※ 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).

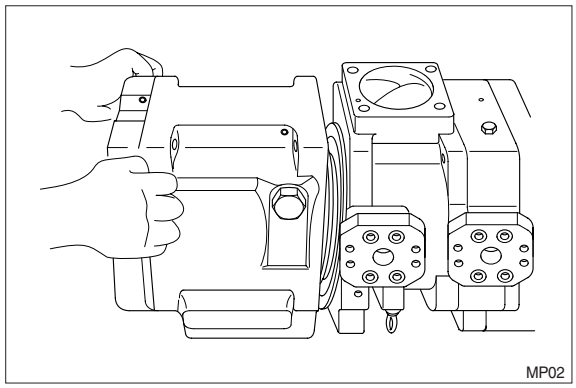
(4) Remove hexagon socket head bolts (412, 413) and remove regulator.
Remove hexagon socket head bolts (416) and remove gear pump.


MP01

(5) Loosen hexagon socket head bolts (401) fixing swash plate support (251), pump casing (271) and valve block (312).

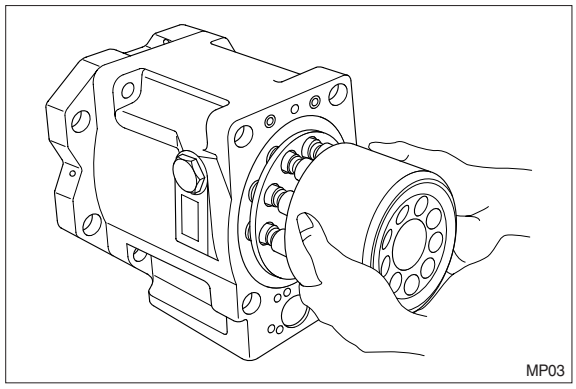
(6) Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve block (312).

※ Before bringing this surface down, spread rubber sheet on workbench without failing to prevent this surface from being damaged.


MP02

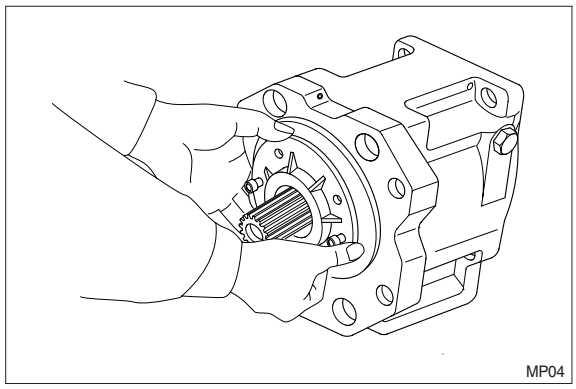
(7) Pull cylinder (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.


MP03

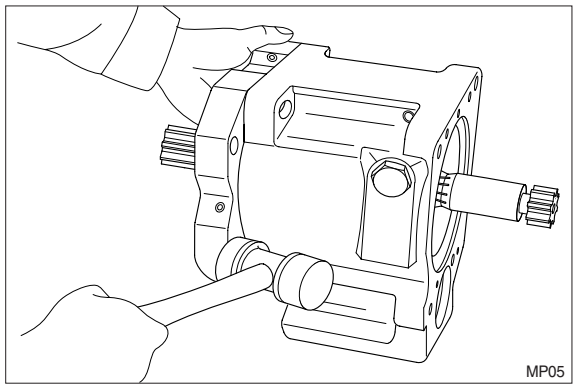
(8) Remove hexagon socket head bolts (406) and then seal cover (F) (261).
Fit bolt into pulling out tapped hole of seal cover (F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover (F), take care not to damage it when removing cover.

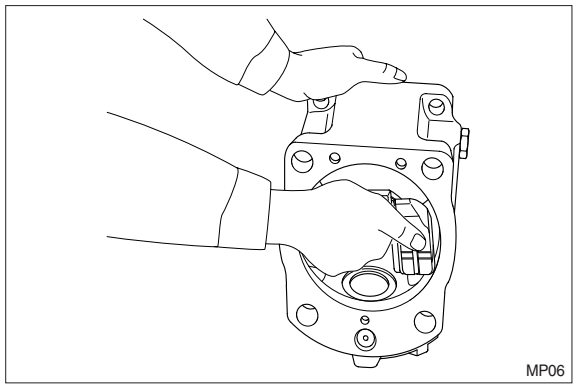

MP04

(9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).
In case of fitting a gear pump, first, remove gear pump.

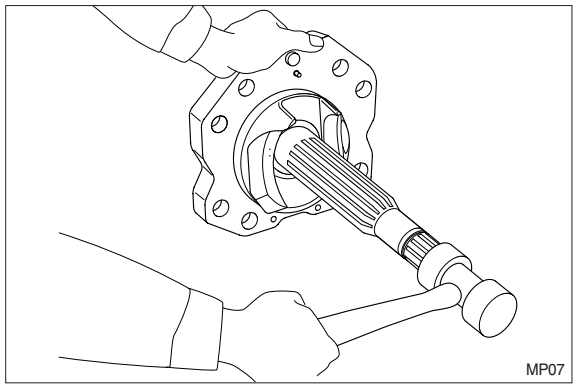
(10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.


MP05

(11) Remove shoe plate (211)and swash plate (212) from pump casing (271).

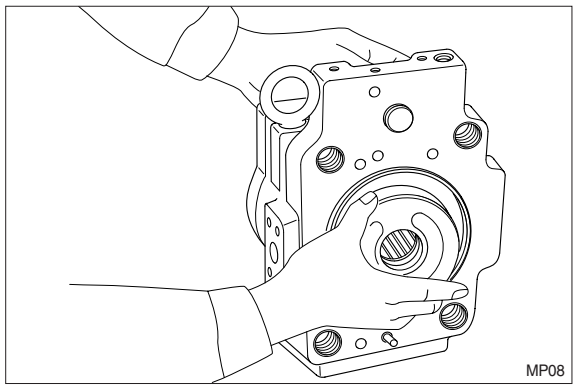

MP06

(12) Tapping lightly shaft's end of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



(13) Remove valve plates (313, 314) from valve block (312).

※ These may be removed in work 6.



(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 gear (116) 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.
Once 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 Section 2-3.

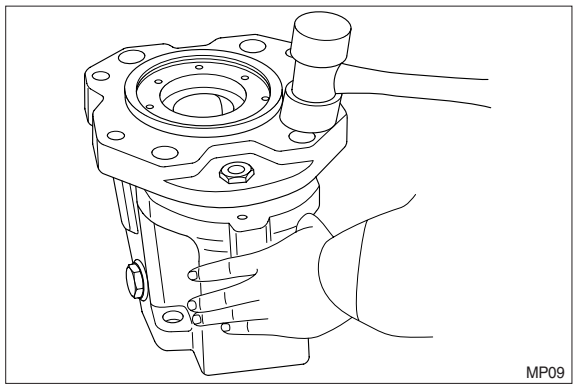
⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(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.

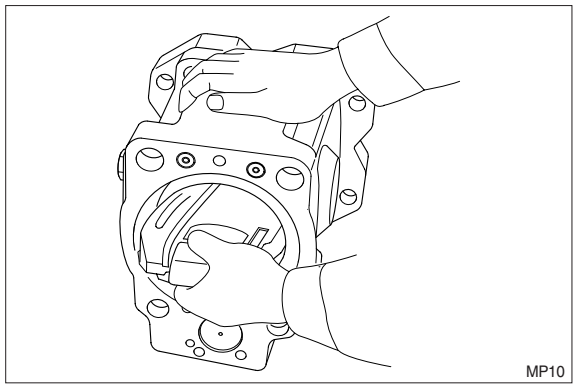
In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply lock-tight (medium strength) to their threaded sections.


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.


MP10

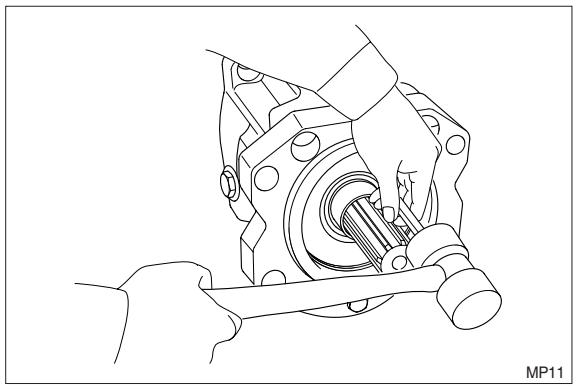
(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).

※ 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.

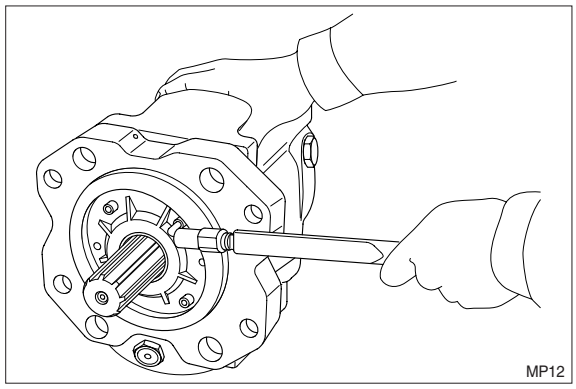

MP11

(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.

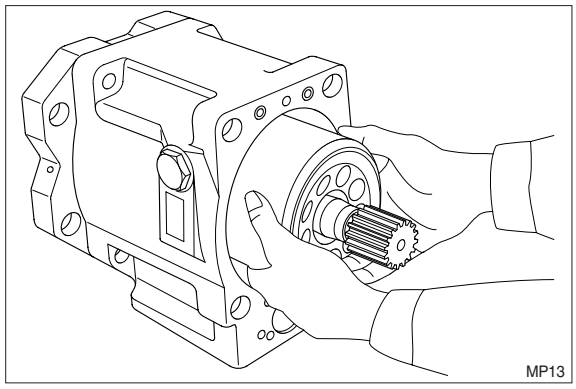
※ For tandem type pump, fit rear cover (263) and seal cover (262).


MP12

(6) Assemble piston cylinder subassembly [Cylinder (141), piston subassembly (151, 152), set plate (153), spherical bush (156), spacer (158) and cylinder spring (157).]

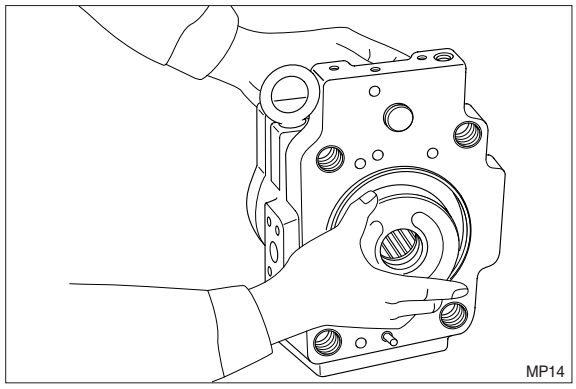
Fit spline phases of retainer and cylinder.

Then, insert piston cylinder subassembly into pump casing.


MP13

(7) Fit valve plate (313) to valve block (312), entering pin into pin hole.

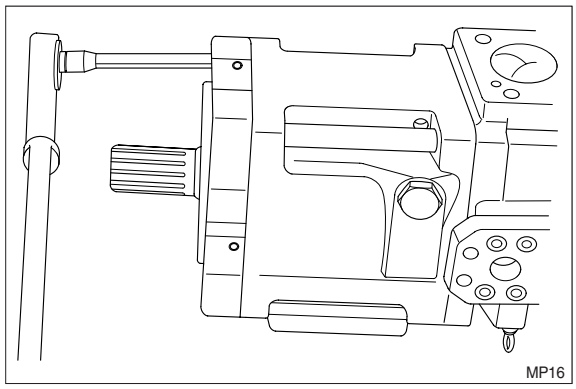
※ Take care not to mistake suction / delivery directions of valve plate.



(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.

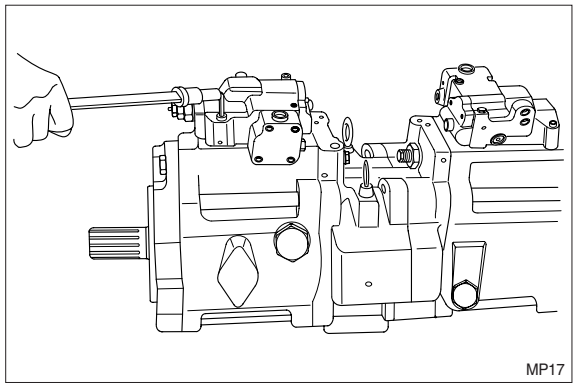


※ Clockwise rotation (viewed from input shaft side)

※ Fit block with regulator up and with delivery flange left, viewed from front side.

(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.

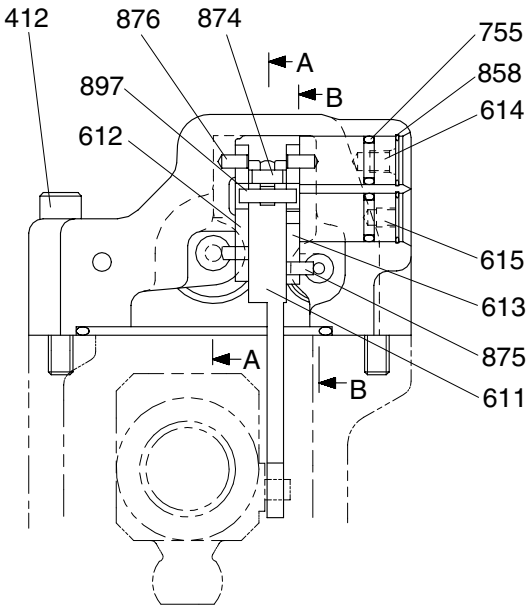


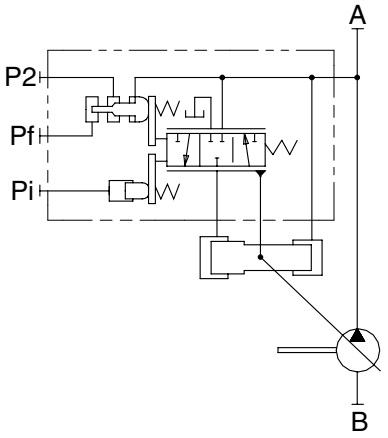
(10) Fit drain port plug (468).

This is the end of reassembling procedures.

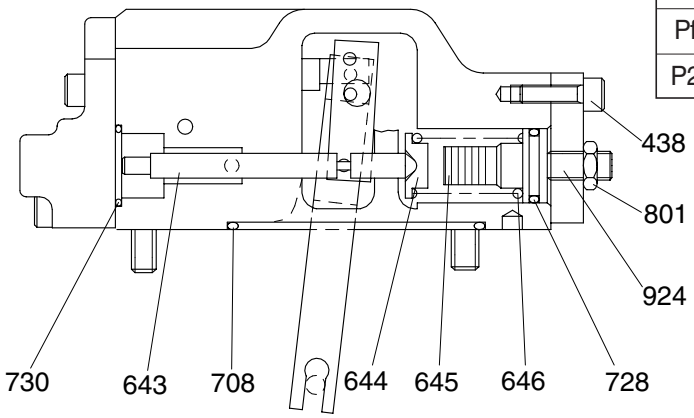
3. REGULATOR

1) STRUCTURE(1/2)

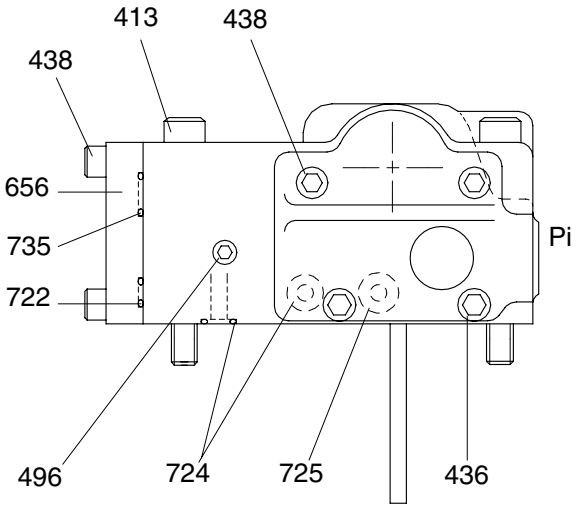




Port	Port name	Port size
A	Delivery port	1"
B	Suction port	3"
Pi	Pilot port	PF 1/4-15
Pf	Power shift pressure	-
P2	Companion delivery pressure	-



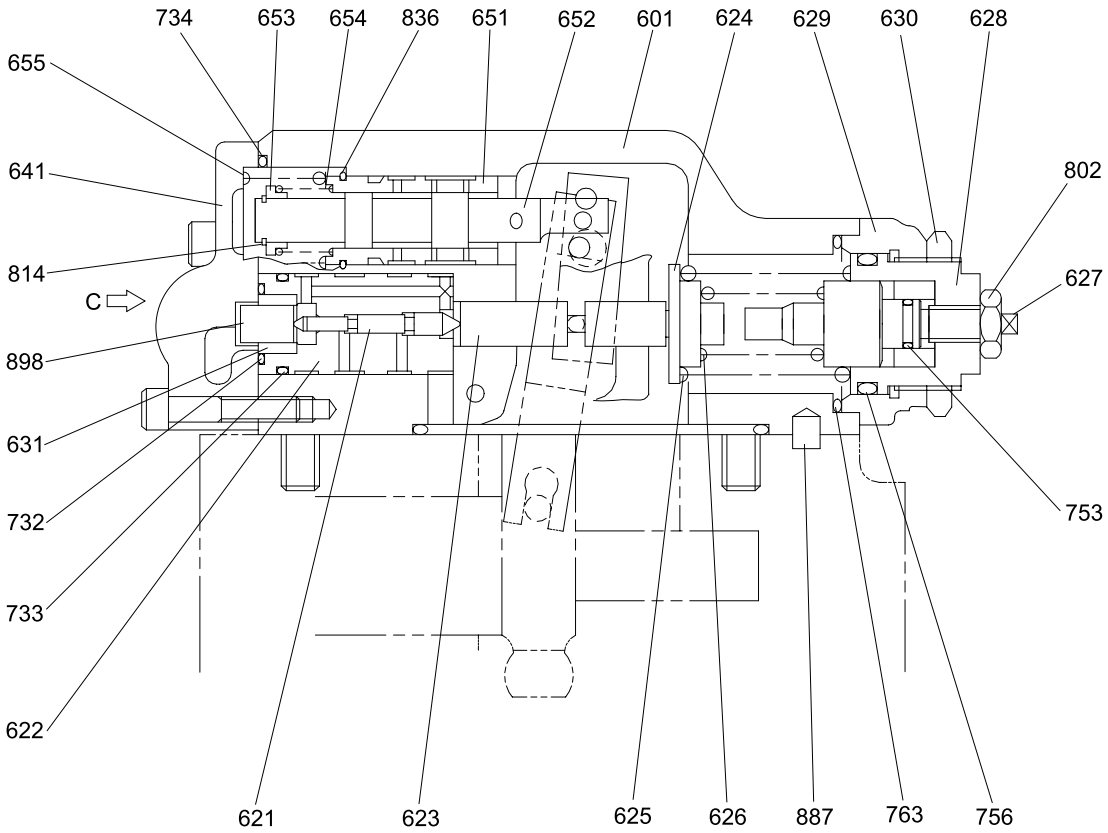
SECTION B-B



VIEW C

32092MP04

REGULATOR (2/2)



SECTION A-A

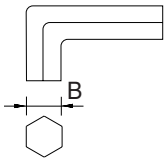
29092MP04A

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 rowspan="4">Allen wrench  </td><td>B</td><td>Hexagon socket head bolt</td><td>PT plug (PT thread)</td><td>PO plug (PF thread)</td><td>Hexagon socket head setscrew</td></tr>
<tr><td>4</td><td>M 5</td><td>BP-1/16</td><td>-</td><td>M 8</td></tr>
<tr><td>5</td><td>M 6</td><td>BP1/ 8</td><td>-</td><td>M10</td></tr>
<tr><td>6</td><td>M 8</td><td>BP-1/ 4</td><td>PO-1/4</td><td>M12, M14</td></tr>
<tr><td rowspan="2">Socket wrench, double (single) open end  </td><td>-</td><td colspan="2">Hexagon head bolt</td><td>Hexagon nut</td><td>VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="2">M 8</td><td>M 8</td><td>-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="5">Small size, Max 36 mm</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>
<tr><td colspan="2">Pincers</td><td colspan="5">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="5">M4, Length : 50 mm</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	115.7	0.47	12
PT plug (material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/16	0.7	5.1	0.16	4
	PT 1/ 8	1.05	7.59	0.20	5
	PT 1/ 4	1.75	12.66	0.24	6
PF plug (material : S45C)	PT 1/ 4	3.0	21.7	0.24	6

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 not 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.

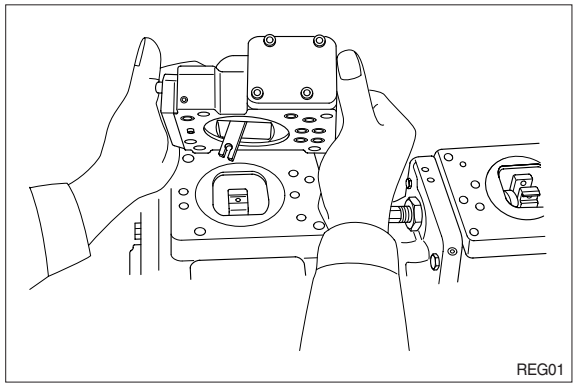
※ Choose a clean place.

※ 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.

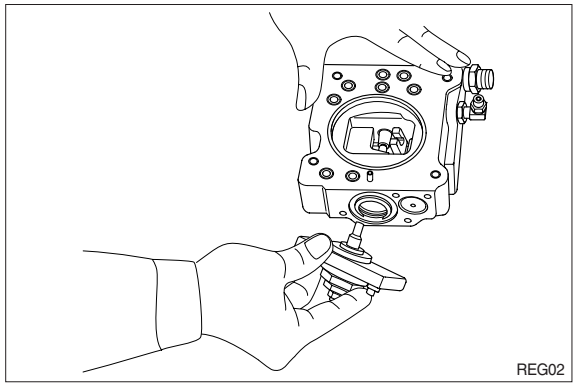

REG01

(4) Remove hexagon socket head screw (438) and remove cover (C, 629).

※ Cover (C) is fitted with adjusting screw (C, 628), adjusting stem (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

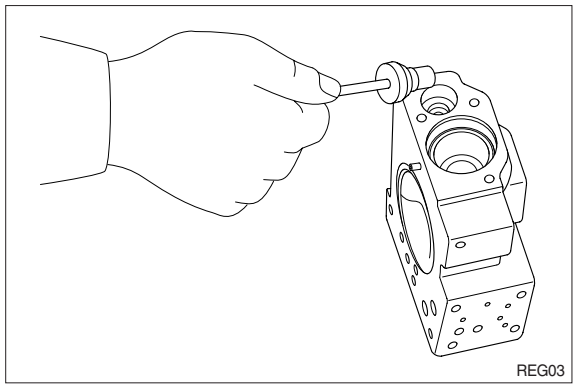
Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.

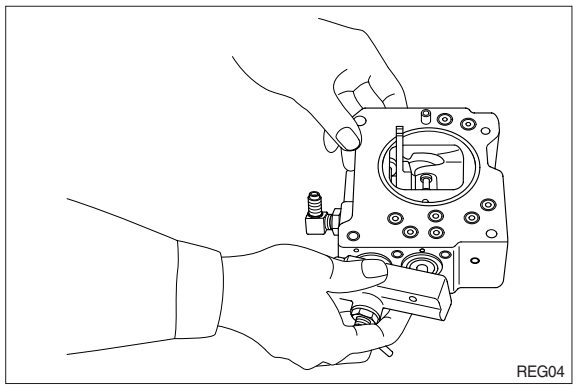

REG02

(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 stem (Q, 645), pilot spring (646) and spring seat (644) from pilot section.

※ Adjusting stem (Q, 645) can easily be drawn out with M4 bolt.


REG03

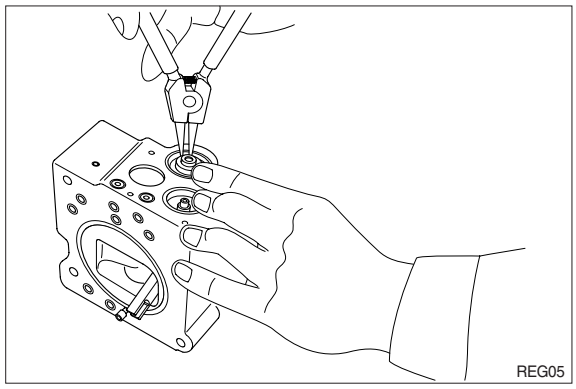
(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.


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).

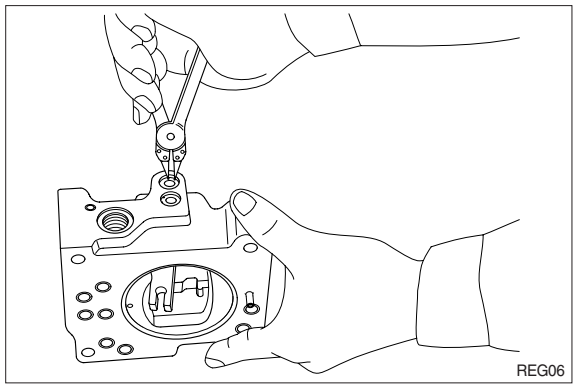
※ When removing snap ring (814), return spring (654) may pop out.

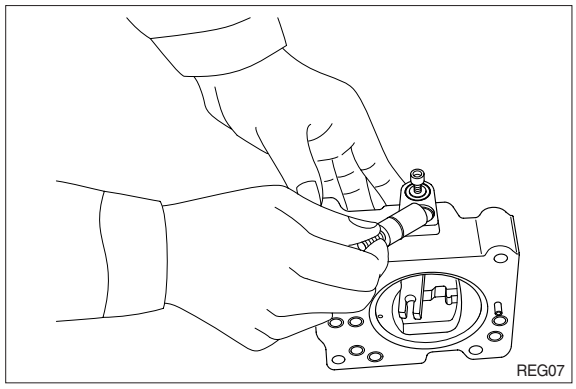
※ Take care not to lose it.


REG05

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).

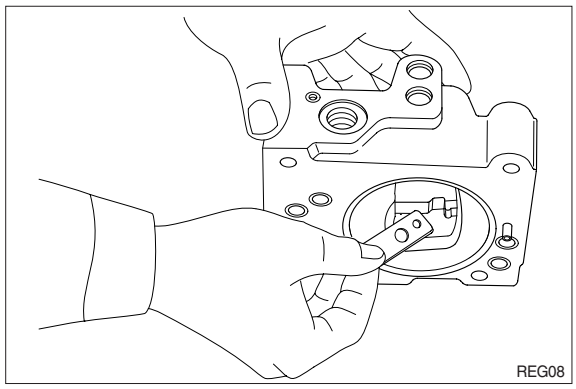
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.


REG06



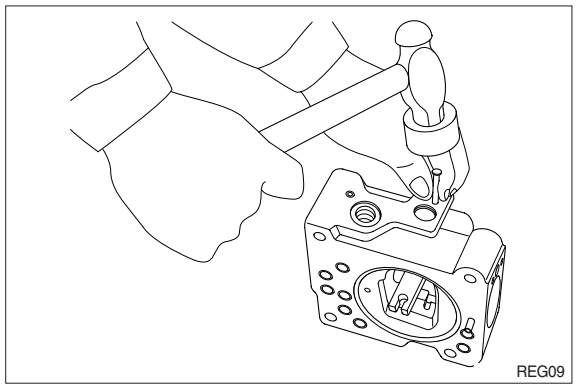
(9) Remove lever (2, 613). Do not draw out pin (875).

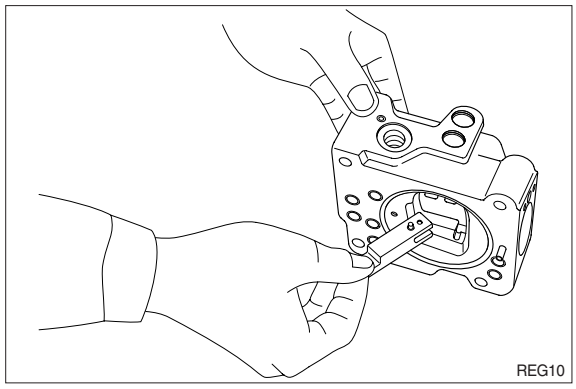
※ Work will be promoted by using pincers or so on.



(10) Draw out pin (874) and remove feedback lever (611).

※ Push out pin (874, 4 ㎜ in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).





(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 operation.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.
Get replacement parts ready beforehand.

② 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.

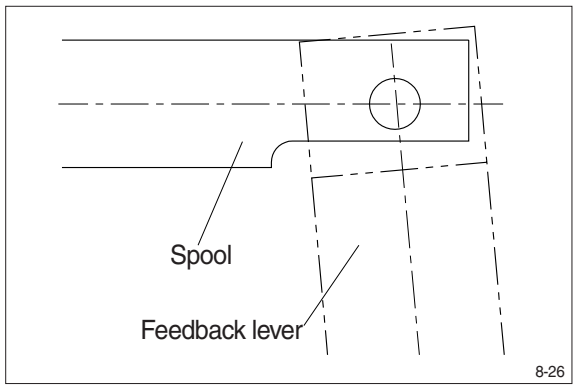
(2) Put compensating rod (623) into compensating hole of casing (601).

(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.

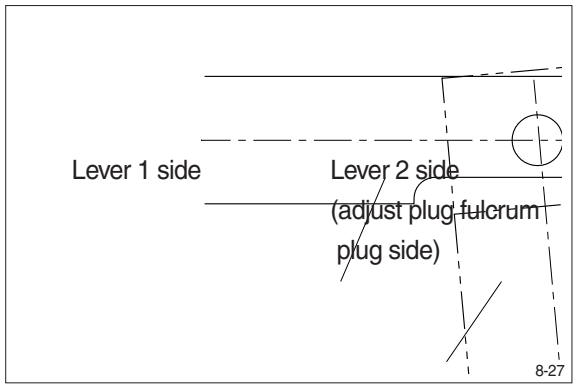
※ Pay attention to orientation of spool.



(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.

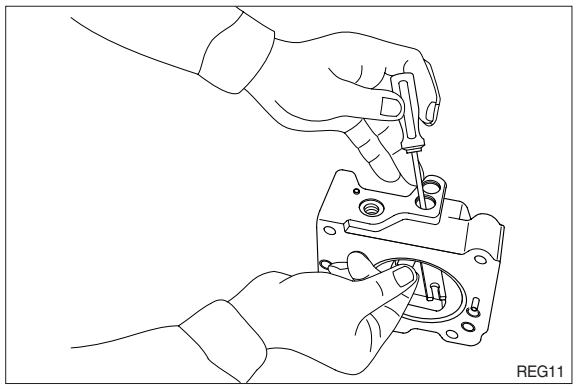
※ Take care not to mistake direction of feedback lever.



(6) Put pilot piston (643) into pilot hole of casing.

※ Confirm that pilot piston slides smoothly without binding.

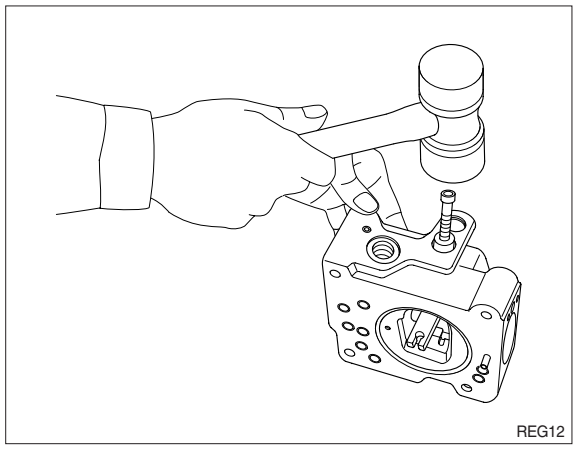
(7) Put pin force-fitted in lever (2, 613) into groove of pilot piston.
Then fix lever (2).



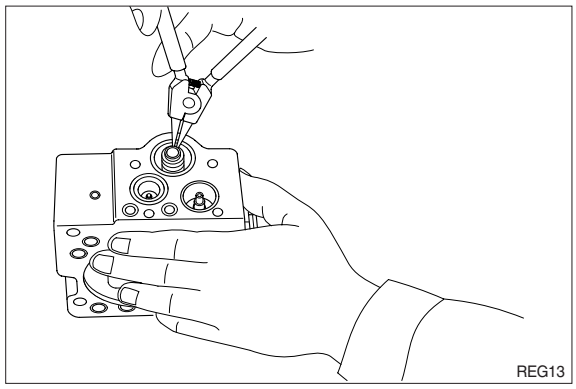
(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug(614) can be put into pin hole of lever (2).
Then fix locking ring (858).

(9) Insert adjusting plug (615) and fit locking ring.

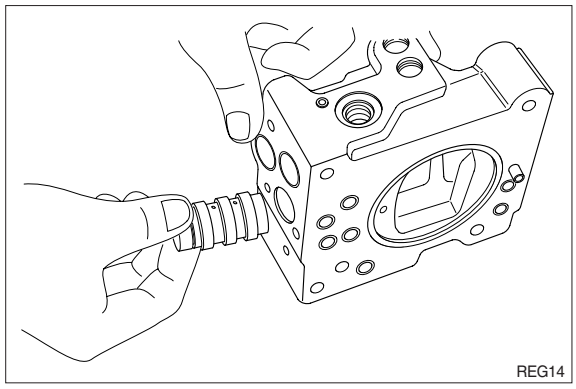
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.



(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).

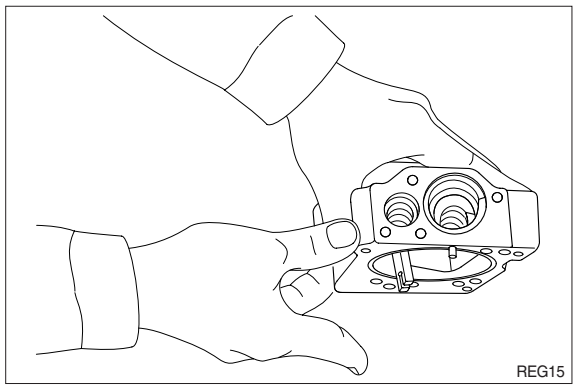


(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).

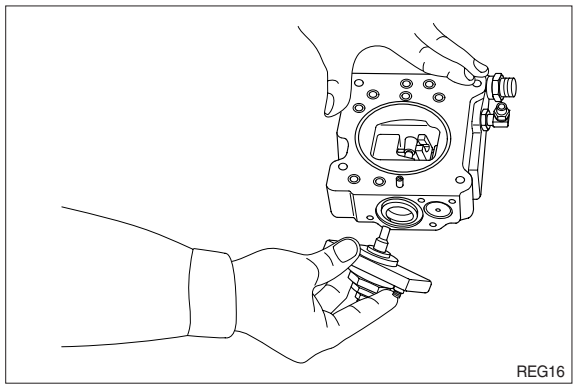

REG14

(12) Put spring seat (644), pilot spring (646) and adjusting stem (Q, 645) into pilot hole. Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

※ When fitting spring seat, take care not to mistake direction of spring seat.


REG15

(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting stem (C, 627), lock nut (630), hexagon nut (802) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).
This completes assembly.


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.

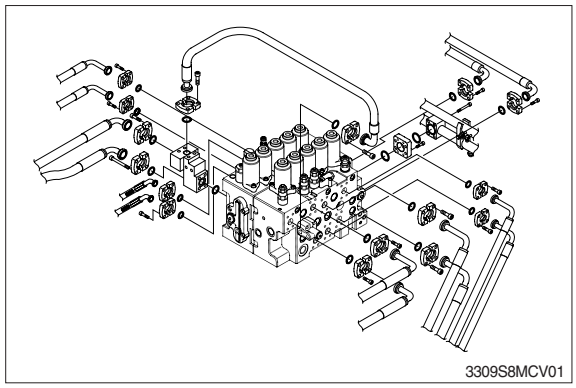
(6) Disconnect pilot line hoses.

(7) Disconnect pilot piping.

(8) Sling the control valve assembly and remove the control valve mounting bolt.
· Weight : 200 kg (441lb)

(9) Remove the control valve assembly.
When removing the control valve assembly, check that all the piping have been disconnected.



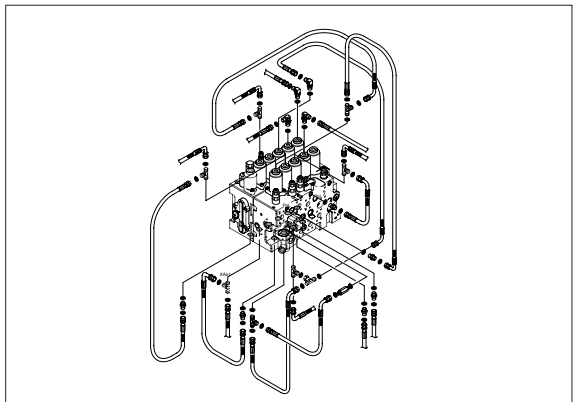


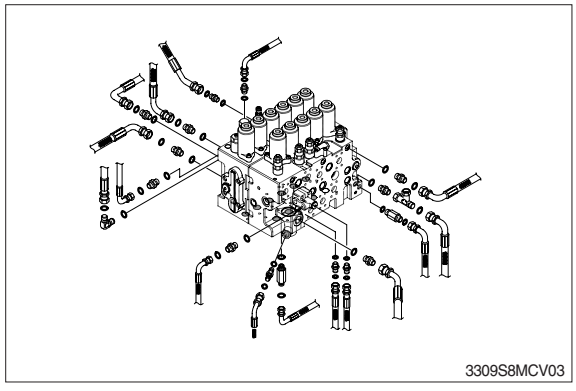
2) INSTALL

(1) Carry out installation in the reverse order to removal.

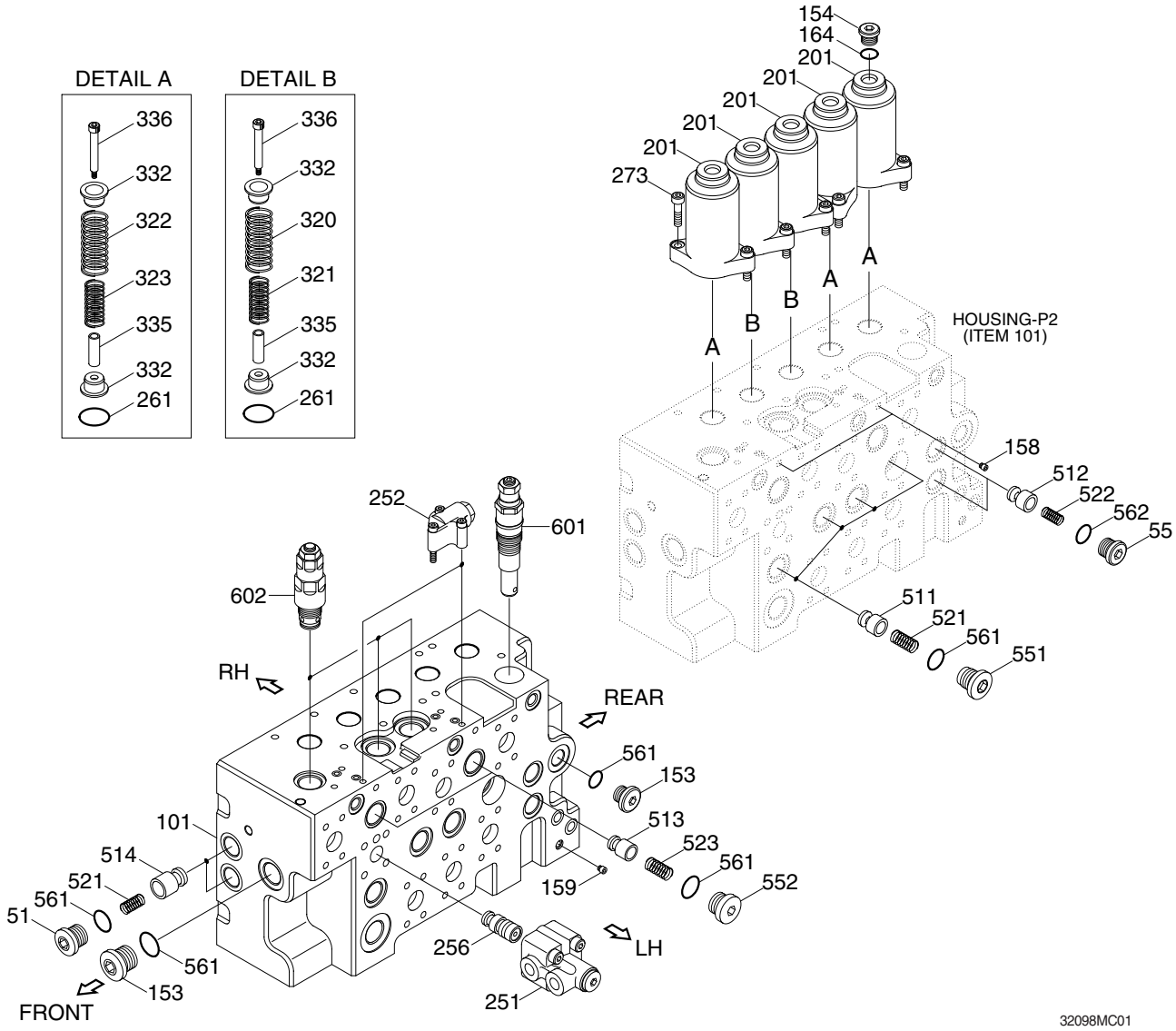
(2) Bleed the air from below items.
① Cylinder (boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.



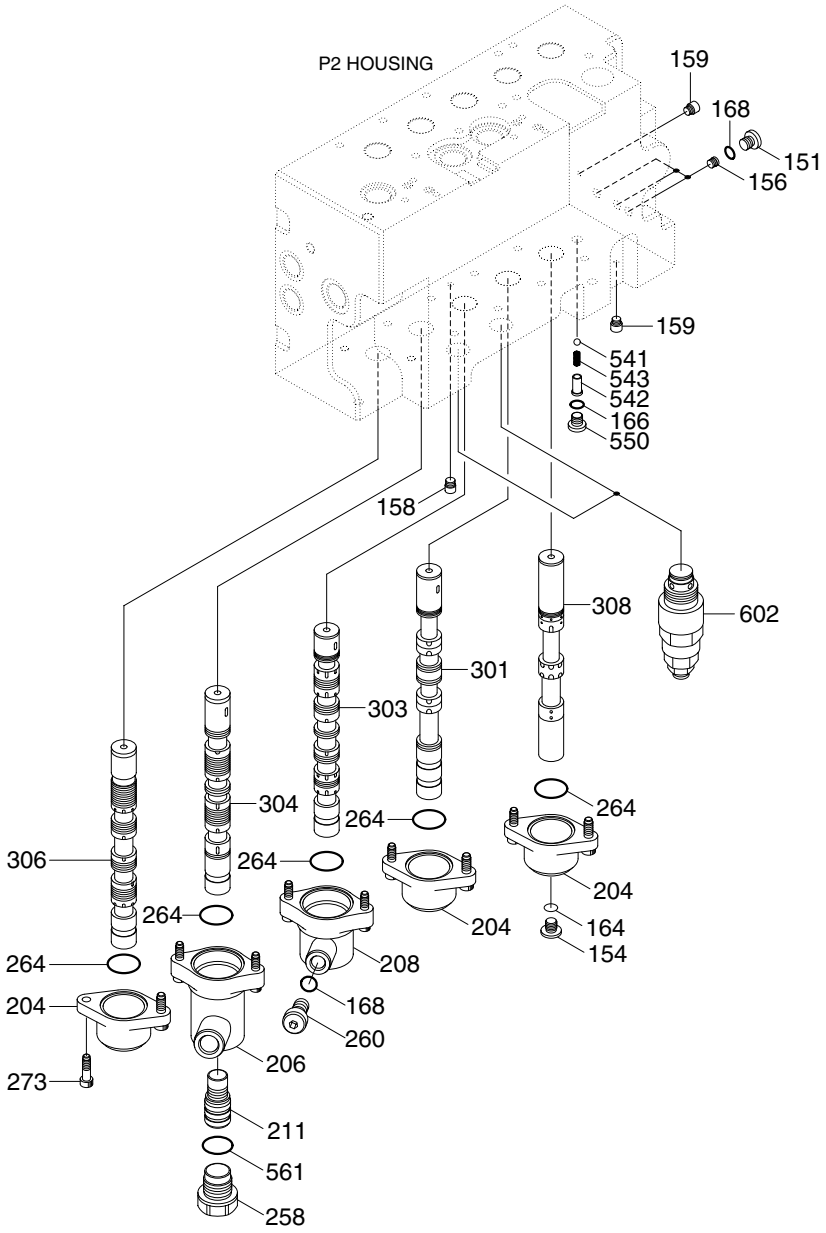


2. STRUCTURE (1/4)



101	P2 housing (casing A)	273	Socket screw	514	Poppet
153	Plug	320	Spring	521	Spring
154	Plug	321	Spring	522	Spring
158	Plug	322	Spring	523	Spring
159	Plug	323	Spring	551	Plug
164	O-ring	332	Seat	552	Plug
201	Spring cover	335	Stopper	553	Plug
251	Logic control valve	336	Bolt	561	O-ring
252	Selector lock valve	511	Poppet	562	O-ring
256	Logic poppet	512	Poppet	601	Main relief valve
261	O-ring	513	Poppet	602	Port relief valve

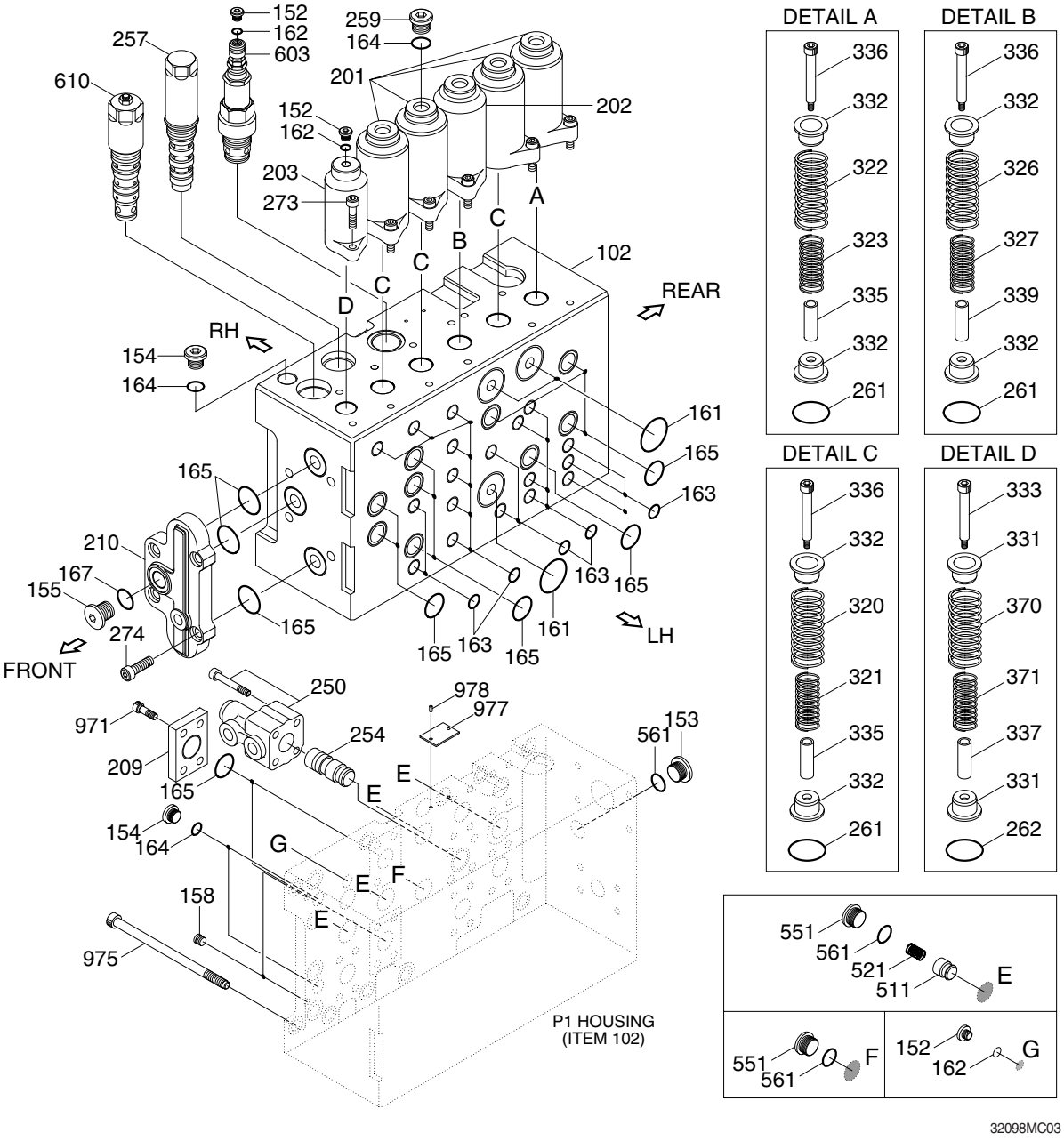
STRUCTURE (2/4)



32098MC02

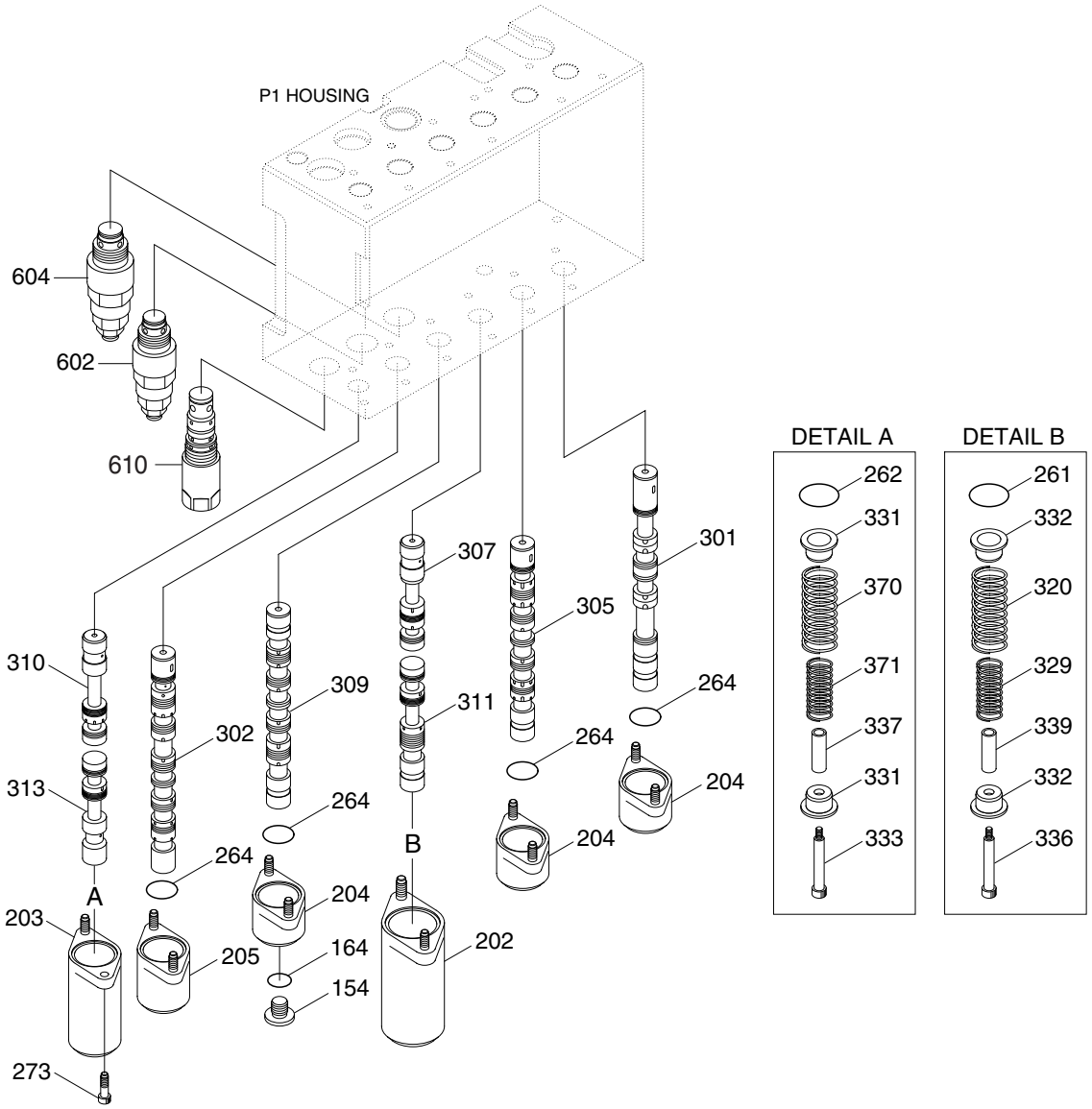
151	Plug	206	Cover	304	Bucket spool
154	Plug	208	Cover-spool	306	Arm 2 spool
156	Orifice	211	Piston	308	Straight travel spool
158	Plug	258	Plug	541	Steel ball
159	Plug	260	Plug	542	Spring seat
164	O-ring	264	O-ring	543	Spring
166	O-ring	273	Socket screw	550	Plug
168	O-ring	301	Travel, LH spool	561	O-ring
204	Cover	303	Boom 1 spool	602	Port relief valve

STRUCTURE (3/4)



102	P1 housing (casing B)	201	Spring cover	274	Socket screw	337	Stopper
152	Plug	202	Spring cover	320	Spring	339	Stopper
153	Plug	203	Spring cover	321	Spring	370	Spring
154	Plug	209	Flange	322	Spring	371	Spring
155	Plug	210	Plate	323	Spring	511	Poppet
158	Plug	250	Logic control valve	326	Spring	521	Spring
161	O-ring	254	Logic poppet	327	Spring	551	Plug
162	O-ring	257	Arm regen cut sub	331	Seat	561	O-ring
163	O-ring	259	Plug	332	Seat	603	Port relief valve
164	O-ring	261	O-ring	333	Spacer bolt	610	Nega control relief valve
165	O-ring	262	O-ring	335	Stopper	971	Screw
167	O-ring	273	Socket screw	336	Bolt	975	Socket screw

STRUCTURE(4/4)



21098MC07

154	Plug	302	Arm 1 spool	333	Spacer bolt
164	O-ring	305	Swing spool	336	Bolt
202	Spring cover	307	Boom 2 spool	337	Stopper
203	Spring cover	309	Option spool	339	Stopper
204	Cover	310	Bypass cut spool	370	Spring
205	Cover	311	Swing priority spool	371	Spring
261	O-ring	313	Bypass cut spool	602	Port relief valve
262	O-ring	320	Spring	604	Port relief valve assembly
264	O-ring	329	Spring	610	Nega control relief valve
273	Socket screw	331	Seat		
301	Travel, LH spool	332	Seat		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components must be worked with precision working. Then, before disassembling and assembling them, it is essential to select an especially-clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working, spread a paper or rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying, transferring and so on of the control valve. Do not support the lever, exposed spool, end cover section or so on without fail.

(5) After disassembling and assembling of the component, it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but the hydraulic test equipment is necessary to these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Besides, prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

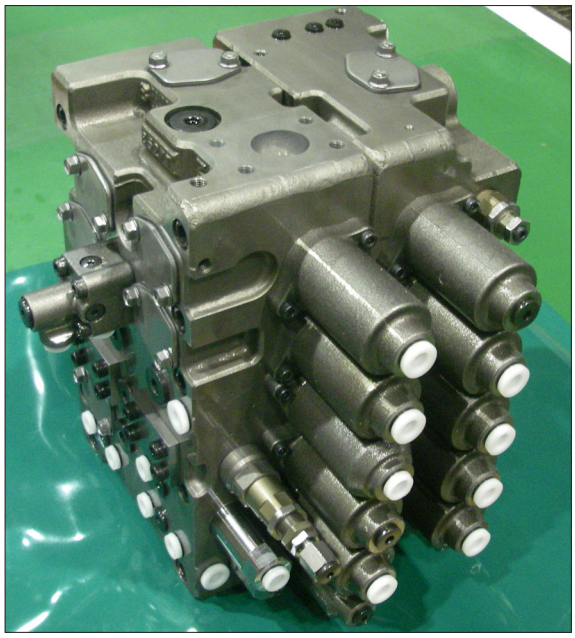
Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Box wrench	Each 1 piece	24, 32, 36
Hexagon key wrench	Each 1 piece	4, 5, 6, 8, 10 and 12
Loctite #262	1 piece	-
Spanner	Each 1 piece	32 (main relief valve, 601) 36 (port relief valve, 603)

3) DISASSEMBLY

The figure in ( ) shown after the part name in the explanation sentence shows its number in the structure figures (8-31~34).

(1) Place control valve on working bench.

※ Disassemble it in clean place and pay attention not to damage flange faces and plate faces.



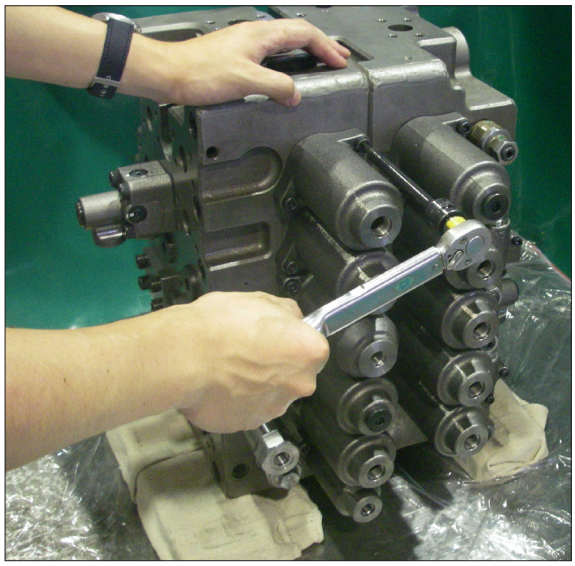
21098MC37

(2) Disassembling of main spools

· Travel (301), bucket (304), swing (305), option (308), arm 2 (306), boom 2 (307), swing priority (311).

① Loosen the hexagon the socket head bolts (273) and remove the spring cover (201, 202) and the O-ring (261).

· Hexagon key wrench : 6 ㎜



21098MC38

② Pull out the spool, spring, spring seats (322), stopper (335 or 339) and spacer bolt (336) in the spool assembly condition from the casing.

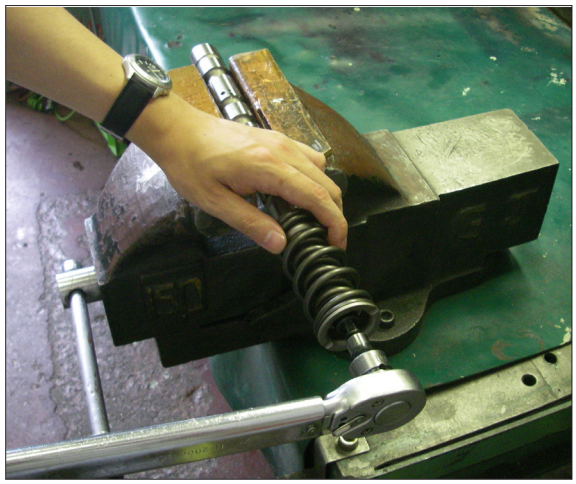
※ When pulling out the spool assembly from housing, pay attention not to damage the housing.



21078MC11

③ Hold the spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336) and disassemble the stopper (335 or 339) and spring seats (332).

· Hexagon key wrench : 10 mm



21098MC40

(3) Disassembling of boom 1 spool (303):

① Loosen the hexagon socket head bolts (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 mm

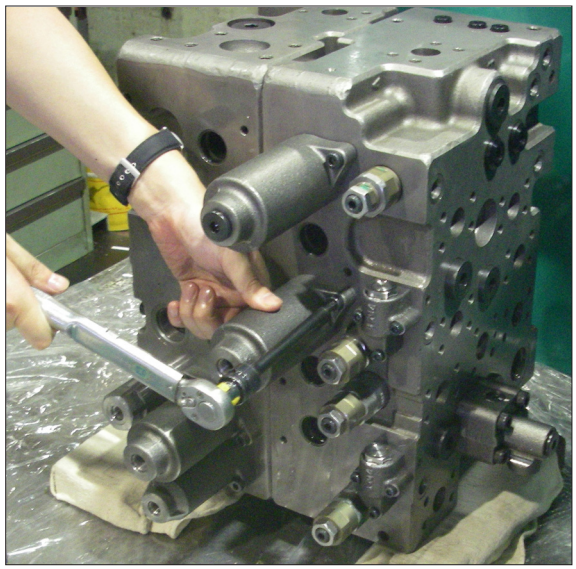
② Pull out the boom 1 spool (303), spring (320, 321), spring seats (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the P2 housing (101).

※ When pulling out the spool assembly from P2 housing (101), pay attention not to damage housing.

③ Hold the boom1 spool (303) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336), and disassemble the spring (320, 321), spring seats (332) and stopper (335).

· Hexagon key wrench : 10 mm

④ Do not disassemble the boom1 spool (303) more than these conditions.



21098MC41

(4) Disassembling of arm 1 spool (302):

① Loosen the hexagon socket head bolts (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 ㎜

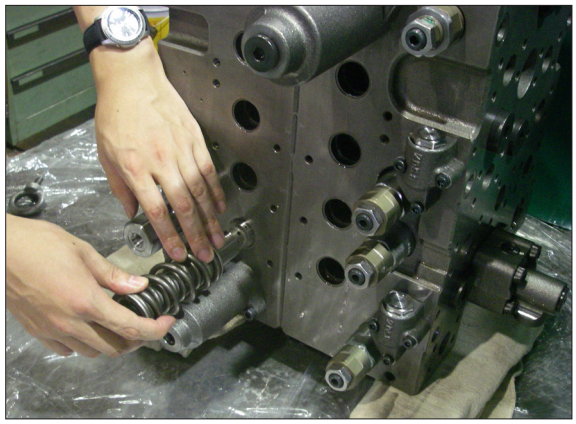
② Pull out the arm 1 spool (302), spring (320, 321), spring seats (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the P1 housing (102).

※ When pulling out the spool assembly from P1 housing(102), pay attention not to damage housing.

③ Hold the arm 1 spool (302) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336), and disassemble the spring (320, 321), spring seats (332) and stopper (335).

· Hexagon key wrench : 10 ㎜

④ Do not disassemble the arm 1 spool (302) more than these conditions.



21098MC42

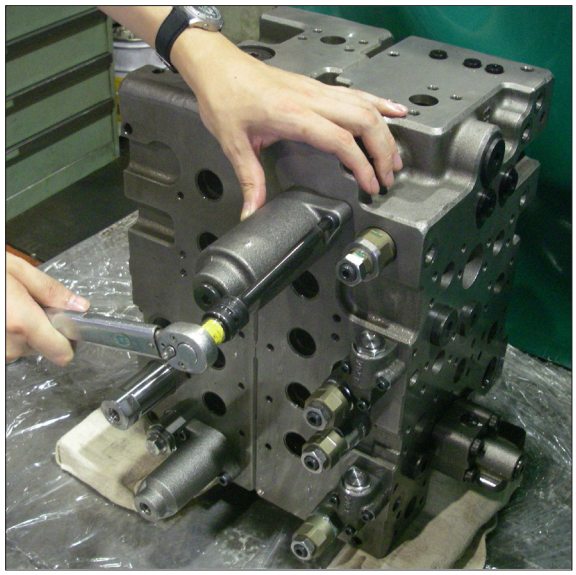
(5) Disassembling of travel straight spool (308):

① Loosen the hexagon socket head bolts (273), and remove the spring cover (201) and the O-ring (261).

· Hexagon key wrench : 6 ㎜

② Pull out the travel straight spool (308), spring (322, 323), spring seat (332), stopper (335) and spacer bolt (336) in the spool assembly condition from the P2 housing (101).

※ When pulling out the spool assembly from P2 housing (101), pay attention not to damage housing.



21098MC43

③ Hold the travel straight spool (308) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (336) and disassemble the spring(322, 323), spring seats(332) and stopper (335).
・Hexagon key wrench : 10 ㎜

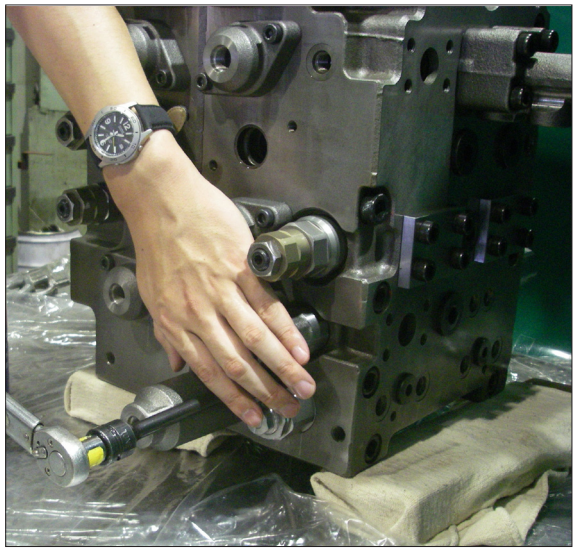
④ Do not disassemble the travel straight spool (308) more than these conditions.

(6) Disassembling of bypass cut spool (310, 313):

① Loosen the hexagon socket head bolts (273), and remove the spring cover (203) and the O-ring (262).
・Hexagon key wrench : 6 ㎜

② Pull out the bypass cut spool (310, 313), spring (370, 371), spring seats (331), stopper (337) and spacer bolt (333) in the spool assembly condition from the P1 housing (102).

※ When pulling out the spool assembly from P1 housing (102), pay attention not to damage housing.



21098MC44

③ Hold the bypass cut spool (310,313) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Remove the spacer bolt (333) and disassemble the spring (370, 371), spring seats (331) and stopper (337).
・Hexagon key wrench : 10 ㎜

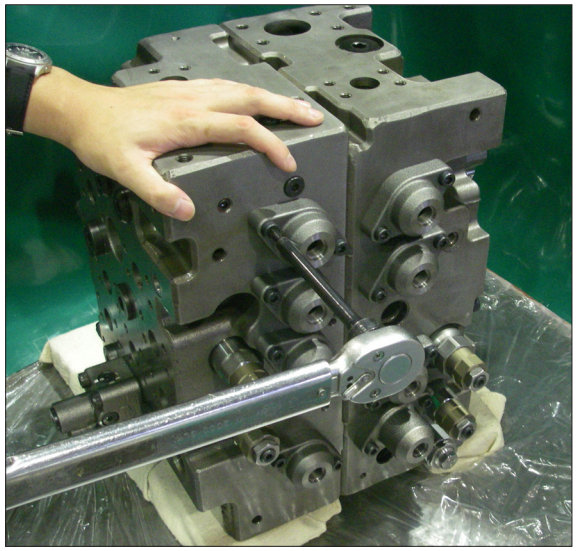


21098MC45

(7) Disassembling of spool covers (204, 205, 206, 208):

① Remove the hexagon socket head bolts (273), and remove the spool cover (204, 205, 206, 208) and the O-ring (264).
- Hexagon key wrench : 6 mm

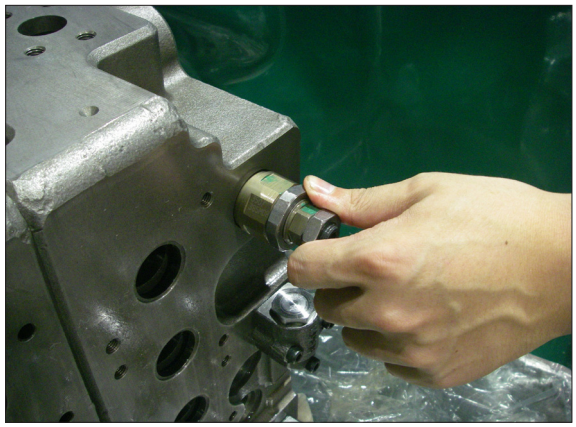
② In removing the bucket spool cover (206), at first loosen the plug (258) before it is removed from the P1 housing (102). After removing the bucket spring cover (206) remove the plug (551), and take out the piston (211).
- Box wrench : 32 mm



21098MC46

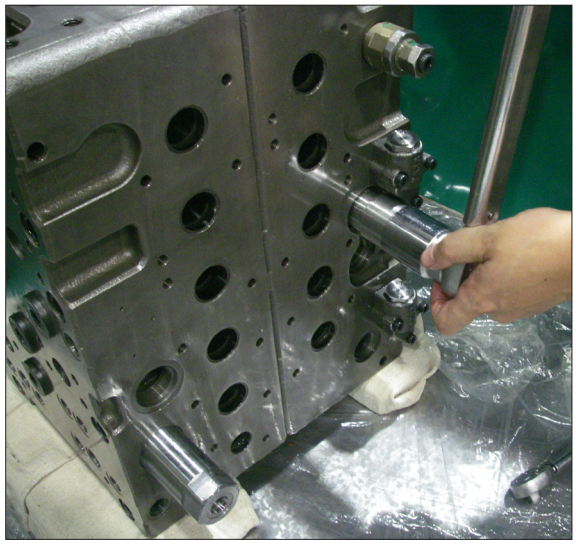
(8) Removal of main relief valve (601) port relief valves (602, 603, 604) :

① Remove the main relief valve (601) and the port relief valves (602, 603, 604) from the housing.
Main relief valve (601) : spanner 32mm
Port relief valve (602) : spanner or box wrench 32mm
Port relief valve (603) : spanner 36mm
Port relief valve (604) : spanner or box wrench 36mm

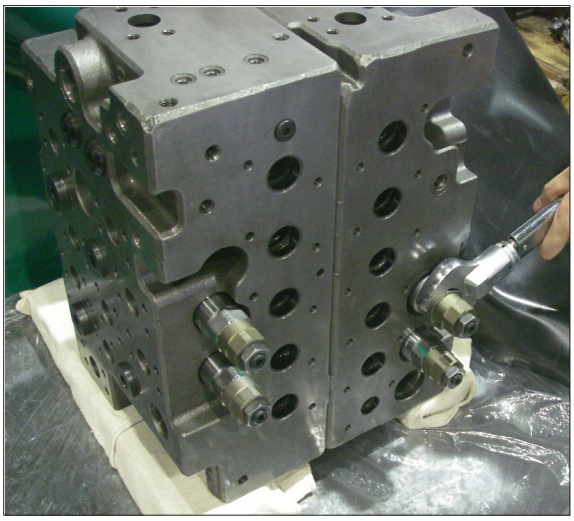


21098MC47

② Do not disassemble the relief valves more than these conditions.



21098MC48



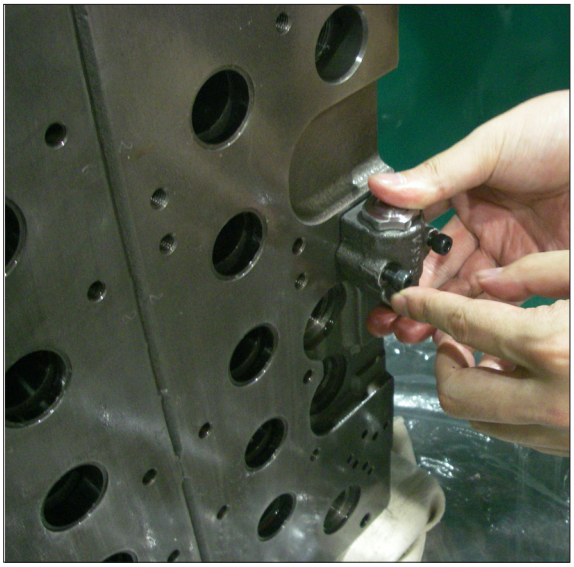
21098MC49

(9) Removal of lock valve selector (252):

① Loosen the hexagon socket head bolts (252-171) and remove the lock valve selector (252) and the O-rings (252-161).

· Hexagon key wrench : 5 mm

② Do not disassemble the lock valve selector (252) more than these conditions.



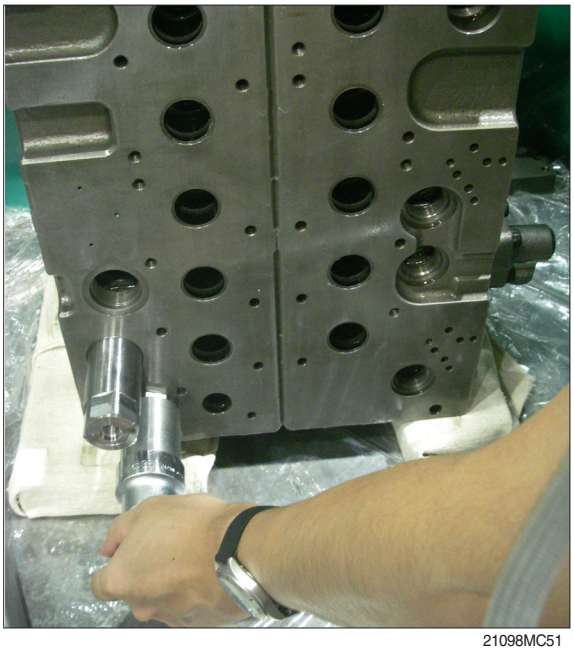
21098MC50

(10) Removal of negative control relief valve (610):

① Remove the negative control relief valve (610) from the P1 housing (102).

· Box wrench : 36 mm

② Do not disassemble the negative control relief valve (610) more than these conditions.

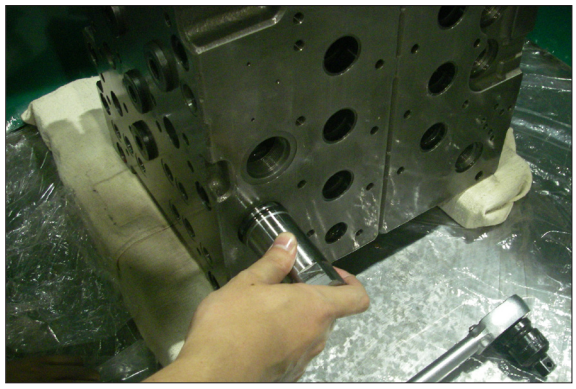


21098MC51

(11) Removal of arm regeneration cut valve (257):

Remove the plug (253), spring (331), spool (211), and sleeve (392) from the P1 housing (102).

· Box wrench : 36 mm



21098MC52

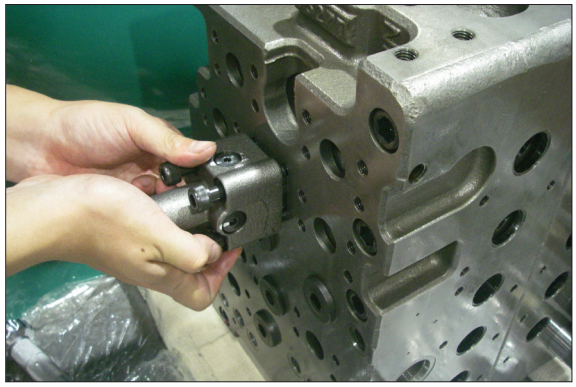
(12) Disassembly of logic control valve (250, 251) and logic poppet (254, 256):

① Loosen the hexagon socket head bolts (250-120, 251-120) and remove the logic control valve (250, 251) and the O-rings (250-112 and 113, 251-112 and 113).

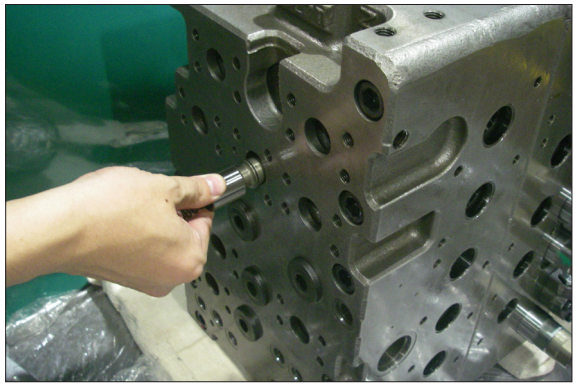
· Hexagon key wrench : 8 mm

② Pull out the logic poppet (254, 256), spring (254-106, 256-106) and spring seat (254-103, 256-103) from the housing.

③ Do not disassemble the logic control valve and the logic poppet more than these condition.



21098MC53



21098MC54

(13) Disassembly of check valve :

① CP1, C2, CCb, LCb, LCo, LCk, LCa, LCAT2

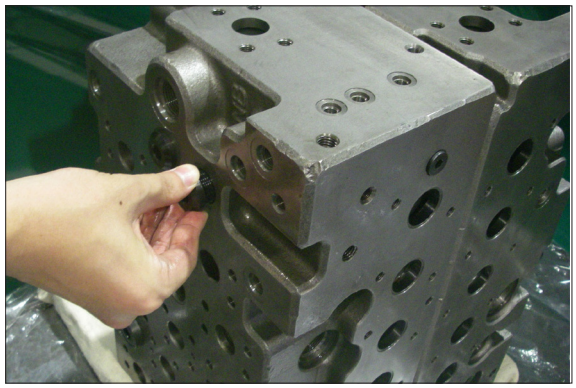
Remove the plug (551) and take out the poppet (511) and the spring (521).

· Hexagon key wrench : 12 mm

② CMR1, CMR2

Remove the plug (553) and take out the poppet (512) and the spring (522).

· Hexagon key wrench : 10 mm

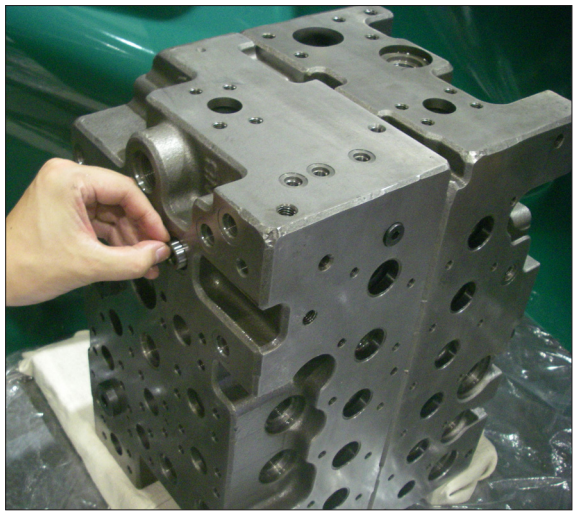


21098MC55

③ CRa, CRb

Remove the plug (552) and take out the poppet (513) and the spring (523).

· Hexagon key wrench : 12 mm



21098MC56

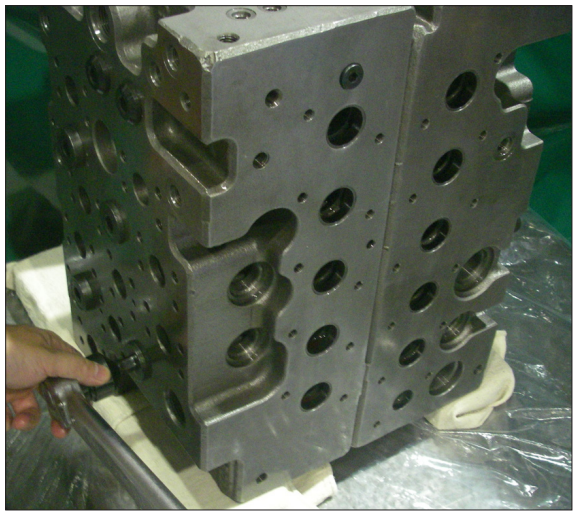
④ CCk, CCo

Remove the plug (551) and take out poppet (514) and the spring (521).

· Hexagon key wrench : 12 mm

⑤ Remove the plug (550) and take out the ball (541), spring (543) and spring seat (542).

· Hexagon key wrench : 6 mm



21098MC57

(14) Disassembly of flanges (209) :

Loosen the hexagon socket head bolts (971) and remove the flange (209) and the O-ring (165).

· Hexagon key wrench : 8 mm

(15) Disassembly of plate (210) :

Loosen the hexagon socket head bolts (274) and remove the plate (210) and the O-rings (165).

· Hexagon key wrench : 10 mm

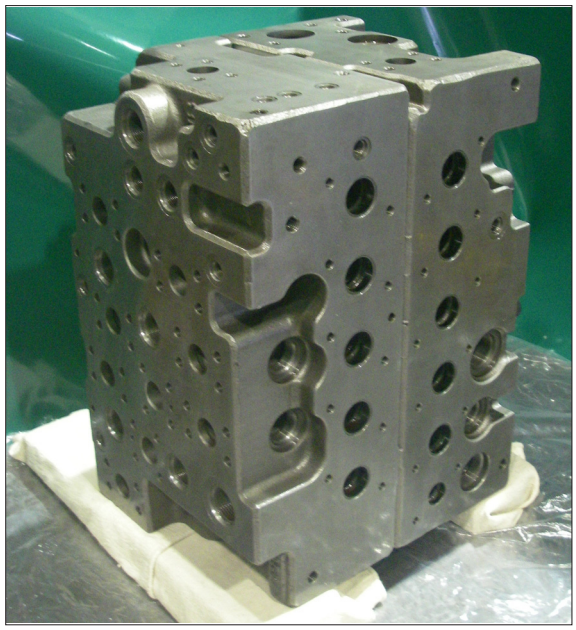
(16) Disassembly of orifices for signal line :

Do not disassemble the plug (151) and orifice (156) unless required specifically.

(17) Disassembly of casing :

① Except when required specially, do not disassemble the tie bolts of the P1 housing.

② Since the plugs not described in above disassembling procedures are the blind plugs for sacrifice holes and the blind plugs for the housing sanitation, do not disassemble them as far as not required specially.



21098MC58

(18) Inspection after disassembling

Clean all the disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that the seal groove faces of the housing and the covers are smooth and free of dust, dent, rust etc.
c. Correct dents and damages on check seat faces of housing, if any, by lapping.
※ Pay attention not to leave lapping agent in the housing.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following its inspection procedures.
g. Replace all the O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and are uniform contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that orifices of the main poppet and seat section are not clogged with foreign matter.
e. Replace all O-rings with new ones.
f. When any light damage is found in above inspections, correct it by lapping.
g. When any abnormal part is found, replace it with a relief valve assembly.

4) ASSEMBLY

① In this assembling section, explanation only is shown. Refer to figures and photographs shown in disassembling section.

② Figure in ( ) shown after part name in explanation sentence shows number in structure figure.

③ Cautions in assembling O-rings

a. Pay attention to keep O-rings free from defects in its forming and damages in its handling.

b. Apply grease, hydraulic oil or so on to O-rings and seal-fitting sections for full lubrication.

c. Do not stretch O-rings so much to deform them permanently.

d. In fitting O-ring, pay attention not to roll it into its position. In addition, twisted O-ring cannot remove its twisting naturally with ease after being fitted, and causes oil leakage.

e. Tighten fixing the bolts for all sections with a torque wrench to their respective tightening torque.

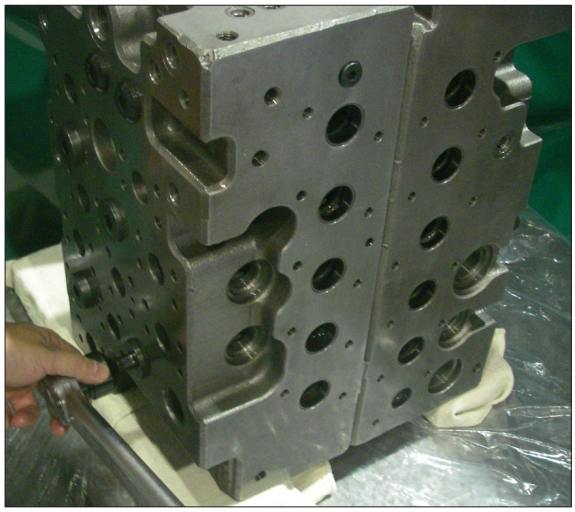
(1) Assembly of check valve :

① Assemble the poppets (511, 512, 513, 514) and the springs (521, 522, 523) : Put the O-rings (561) onto the plugs (551, 552). Put the O-rings (562) onto the plugs (553). Tighten the plugs (551, 552, 553) with their specified torques.

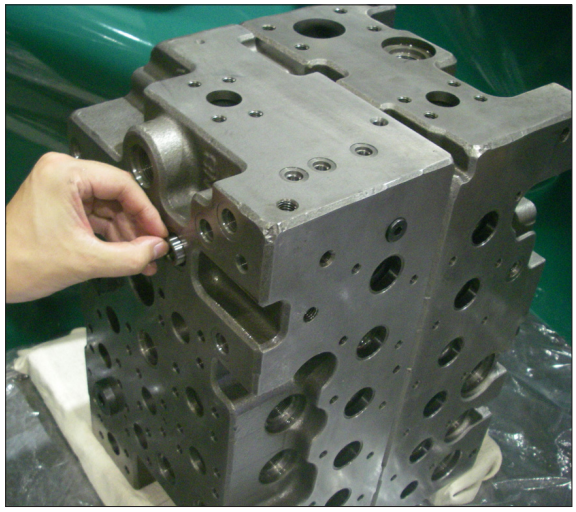
※ Use the poppets, springs and plugs in following groups.

Poppet	Spring	Plug	Remember that
511	521	551	511 in 8 positions
512	522	553	512 in 2 positions
513	523	552	513 in 2 positions
514	521	551	514 in 2 positions

Plug No.	Hexagon key wrench (mm)	Tightening torque (kgf·m)
551	12	23.5 ~ 26.5
552	12	23.5 ~ 26.5
553	10	13.3 ~ 15.3



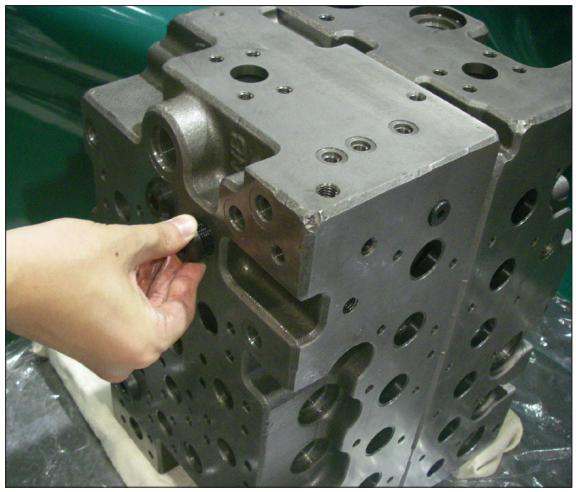
21098MC57



21098MC56

② Assemble of ball (541), spring Seat (542) and spring (543) : Put the O-ring (166) onto the plug (550), and tighten the plug (550) with specified torque.

- Hexagon key wrench : 6 mm
- Tightening torque : 2.55 ~ 2.96 kgf·m (18.4~21.4 lbf·ft)



21098MC55

(2) Assembly of plate (210) :

Fit the O-rings (165) to the P1 housing (102), and tighten the hexagon socket head bolts (274) with specified torque.

- Hexagon key wrench : 10 mm
- Tightening torque : 10.0 ~ 12.2 kgf·m (72.3~88.2 lbf·ft)

So turn the control valve that the plate face may be directed downward.

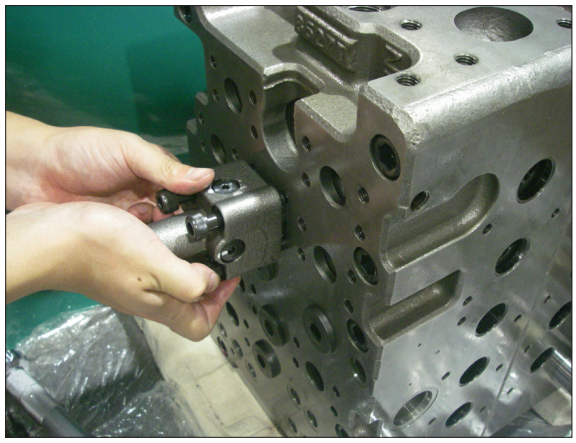
(3) Assembly of flange (209) :

Fit the O-rings (165) to the flange (209), and tighten the hexagon socket head bolts (971) with specified torque.

- Hexagon key wrench : 8 mm
- Tightening torque : 5.0 ~ 6.6 kgf·m (36.2~47.7 lbf·ft)

(4) Assemble of logic control valve (250, 251):

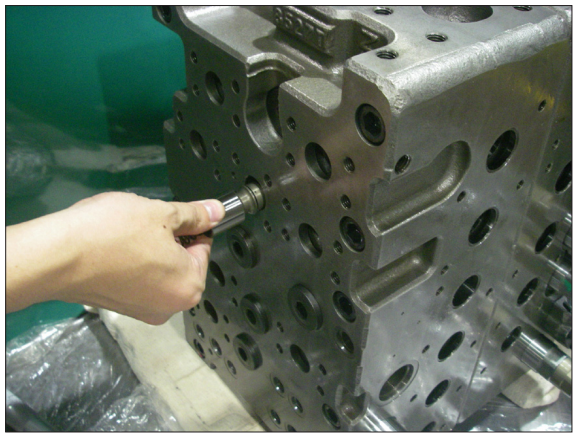
① Put the O-ring (250-115, 251-115) onto the plug (250-111, 251-111).



21098MC53

② Assemble the spool (250-102, 251-102), spring seat (250-104, 251-104) and spring (251-105, 251-105) into the casing (250-101, 251-101) of the logic control valve, and tighten the plug (250-111, 251-111) with specified torque.

- Hexagon key wrench : 8 mm
- Tightening torque : 7.0 ~ 8.1 kgf·m (50.6~58.6 lbf·ft)



21098MC54

③ Assemble the logic poppet (254; poppet, spring, spring seat) into the housing of the control valve.

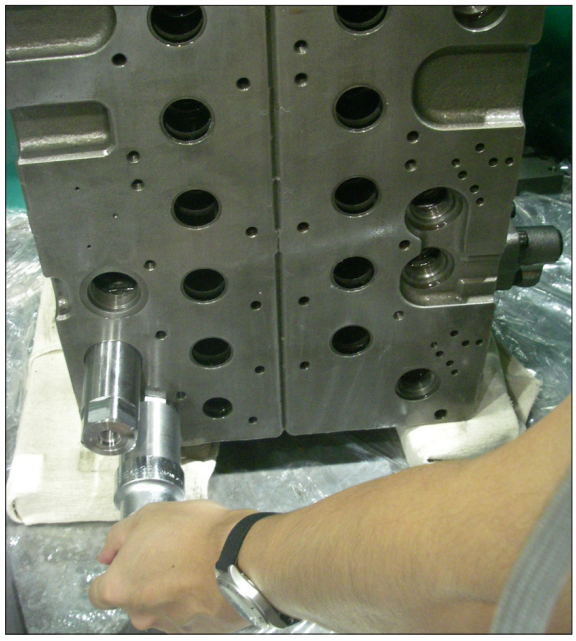
④ Fit the O-rings (250-112 and 113, 251-112 and 113) to the casing (250-101, 251-101) of the logic control valve, and tighten the hexagon socket head bolts (250-120, 251-120) with specified torque.

- Hexagon key wrench : 8 mm
- Tightening torque : 5.0 ~ 6.6 kgf·m (36.2~47.7 lbf·ft)

(5) Assembling of negative control relief valve (610) :

Assemble the negative control relief valve (610) into the P2 housing (101), and tighten it with specified torque.

- Box wrench : 36 mm
- Tightening torque : 7.0 ~ 8.0 kgf·m (50.6~57.9 lbf·ft)

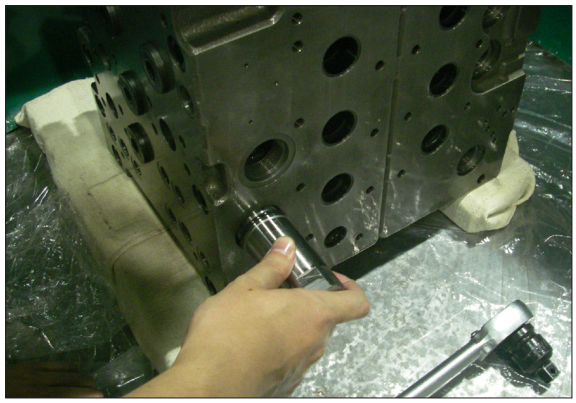


21098MC51

(6) Assembly of arm regeneration cut valve (257) :

Assemble the sleeve (257-212), spool (257-211), and spring (257-231) into the P1 housing (102). Put the O-ring (265) onto the plug (257-253), and tighten with specified torque.

- Box wrench : 36 mm
- Tightening torque : 7.0 ~ 8.0 kgf·m (50.6~57.9 lbf·ft)

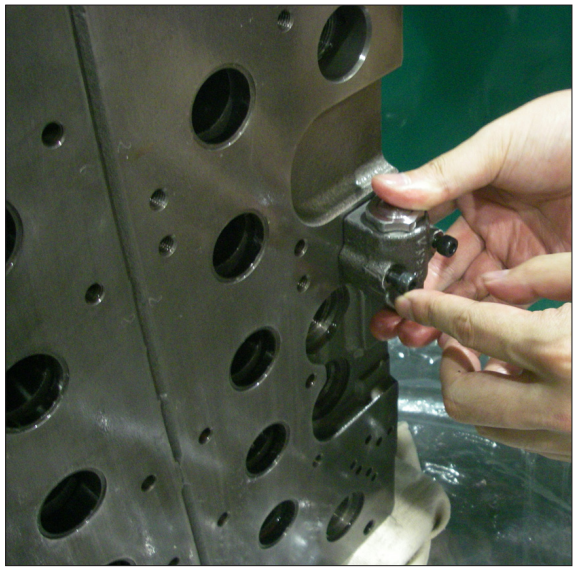


21098MC52

(7) Assembling of lock valve selector (252) :

Fit the O-rings (252-161) to the lock valve selector (252) and tighten the hexagon socket head bolts (252-171) with specified torque.

- Hexagon key wrench : 5 mm
- Tightening torque : 1.0 ~ 1.4 kgf·m (7.2~10.1 lbf·ft)

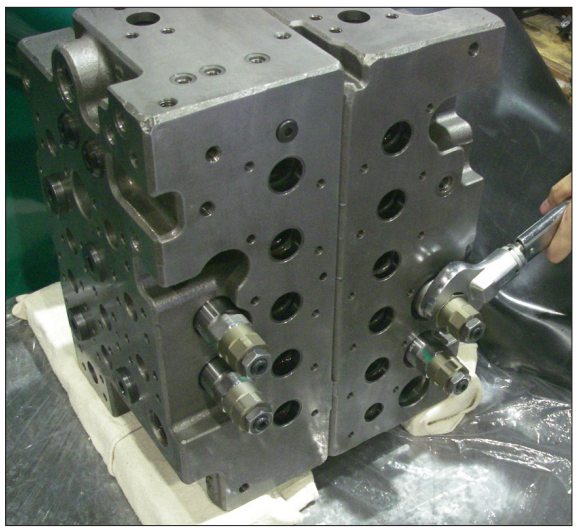


21098MC50

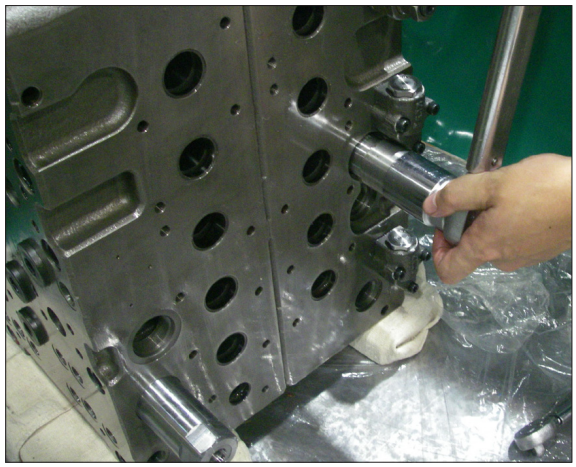
(8) Assembling of main relief valve (601) and port relief valve (602, 603, 604) :

Assemble the main relief valve (601) and the port relief valves (602, 603, 604) to the housing, and tighten them with specified torque.

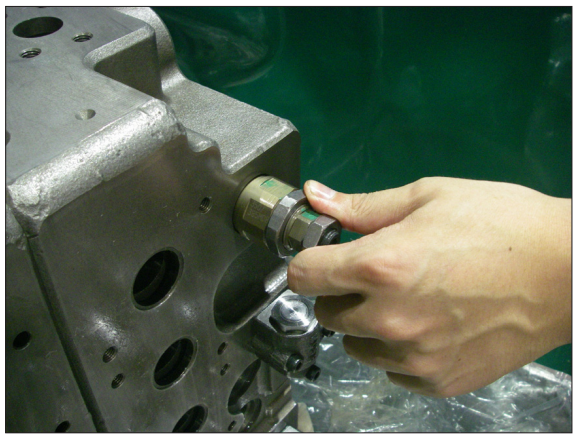
Item	Tool	Tightening torque (kgf·m)
Main relief valve (601)	Spanner 32	7.0 ~ 8.1
Port relief valve (602)	Spanner 32 or box wrench 32	7.0 ~ 8.1
Port relief valve (603)	Spanner 36	12.2 ~14.3
Port relief valve (604)	Spanner 36 or box wrench 36	12.2 ~14.3



21098MC49



21098MC48



21098MC47

(9) Assemble of travel straight spool (308) :

① Hold the middle of the travel straight spool (308) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (332), springs (322, 323) and stopper (335), and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

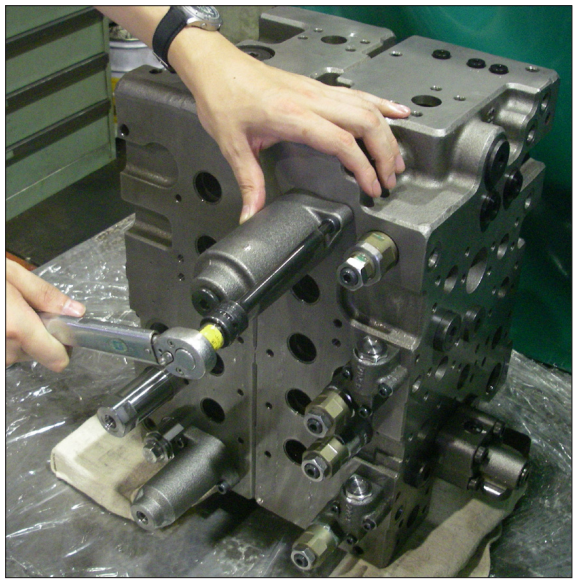
- Hexagon key wrench : 10 mm
- Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the travel straight spool (308) is deformed.

② Insert the spool assemblies of ① items above into the P2 housing (101).

※ Fit spool assemblies into P2 housing (101) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC43

(10) Assembling of boom 1 spool (303) :

① Hold the middle of the boom1 spool (303) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (332), springs (320, 321) and stopper (335), and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

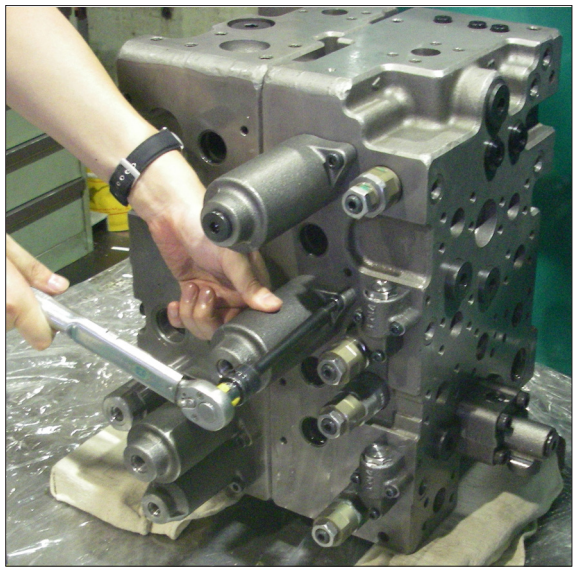
- Hexagon key wrench : 10 mm
- Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the boom 1 spool (303) is deformed.

② Insert the spool assemblies of items ① above into the P2 housing (101).

※ Fit spool assemblies into the P2 housing (101) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC41

(11) Assembling of arm 1 spool (302) :

① Hold the middle of the arm1 spool (302) in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (332), springs (320, 321) and stopper (335) and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

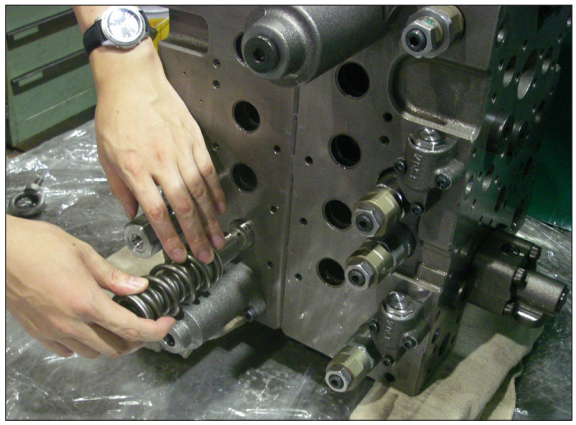
- Hexagon key wrench : 10 mm
- Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the arm 1 spool (302) is deformed.

② Insert the spool assemblies of items ① above into the P1 housing (102).

※ Fit spool assemblies into the P1 housing (102) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC42

(12) Assembling of main spool (travel (301), bucket (304), swing (305), option (309), arm2 (306), boom2 (307), swing priority (311)):

① Hold the middle of each spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (332), springs and stopper (335 or 339) and tighten the spacer bolt (336) with specified torque.

※ Before tightening the spacer bolt (336), apply loctite #262 to it.

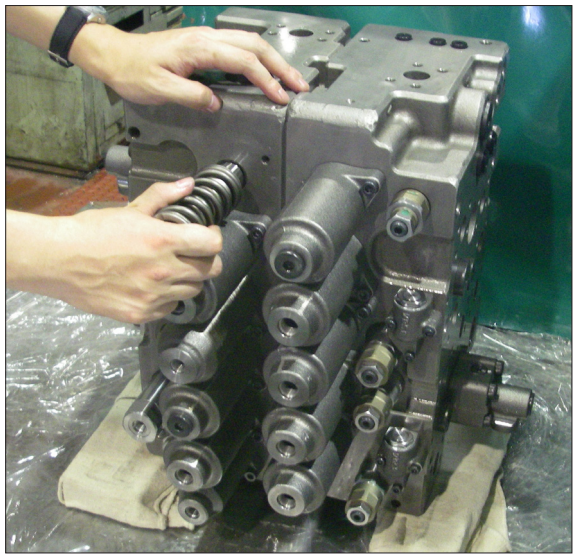
- Hexagon key wrench : 10 mm
- Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the spool is deformed.

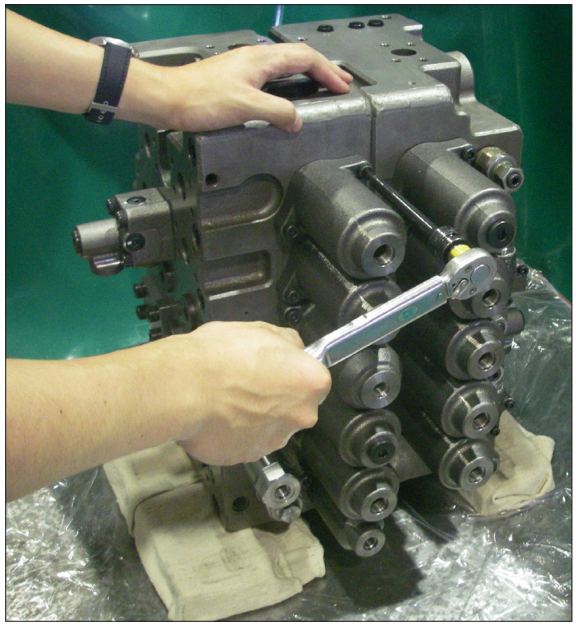
② Insert the spool assemblies of Items ① above into the P2 housing (101) and P1 housing (102).

※ Fit spool assemblies into P2 housing (101) and P1 housing (102) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC39



21098MC38

(13) Assembling of bypass cut spool (310, 313) :

① Hold the middle of each spool in the mouthpiece-attached vise applying a protection plate (aluminum plate and the like) in between. Attach the spring seats (331), springs (370, 371) and stopper (337) and tighten the spacer bolt (333) with specified torque.

※ Before tightening the spacer bolt (333), apply loctite #262 to it.

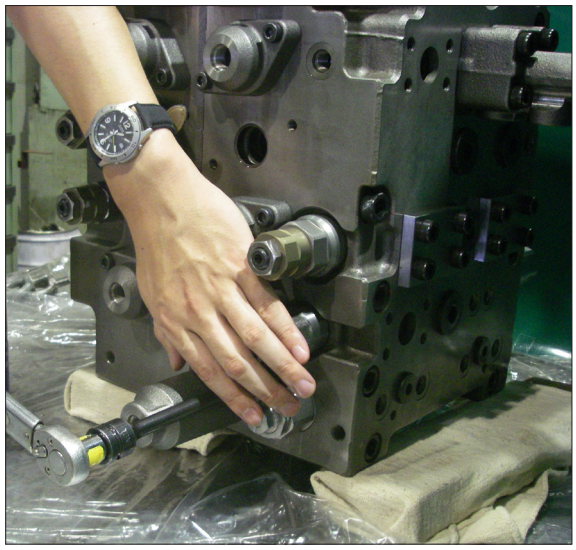
- Hexagon key wrench : 10 mm
- Tightening torque : 1.6 ~ 1.8 kgf·m (11.6~13.0 lbf·ft)

※ Pay attention not to fasten the vise excessively to the shape of the bypass cut spool (310, 313) is deformed.

② Insert the spool assemblies of Items ① above into the P1 housing (102).

※ Fit spool assemblies into the P1 housing (102) carefully and slowly.

※ Do not push them forcibly without fail.



21098MC44

(14) Assembling of covers :

① Fit the O-rings (264) to the spool covers (204, 205, 206, 208) to sides reverse to the spring sides of spools, and tighten the hexagon socket head bolts (273) with specified torque.

※ Confirm that O-rings (264) have been fitted to the spool covers (204, 205, 206, 208).

- Hexagon key wrench : 6 mm
- Tightening torque : 2.5 ~ 3.5 kgf·m (18.1~25.3 lbf·ft)

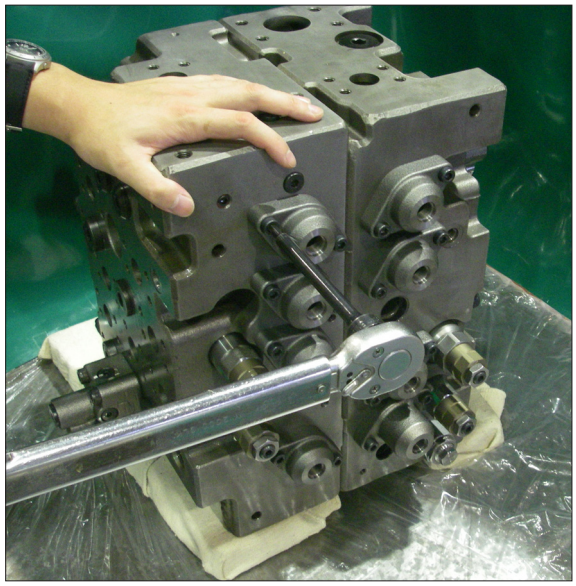
② Bucket spool cover (206) : Assemble piston (355) into bucket spool cover (206). Put O-ring (561) onto plug (258) and tighten it with specified torque.

- Box wrench : 32 mm
- Tightening torque : 15.3 ~ 18.4 kgf·m (111~133 lbf·ft)

③ Fit the O-rings (261, 262) to spring covers (201, 202, 203) to the spring sides of spools, and tighten the hexagon socket head bolts (273) with specified torque.

※ Confirm that O-rings (261,262) have been fitted to spring covers (204, 205, 206).

- Hexagon key wrench : 6 mm
- Tightening torque : 2.5 ~ 3.5 kgf·m (18.1~25.3 lbf·ft)



21098MC46

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(3) Disconnect pipe assy (2, 3).

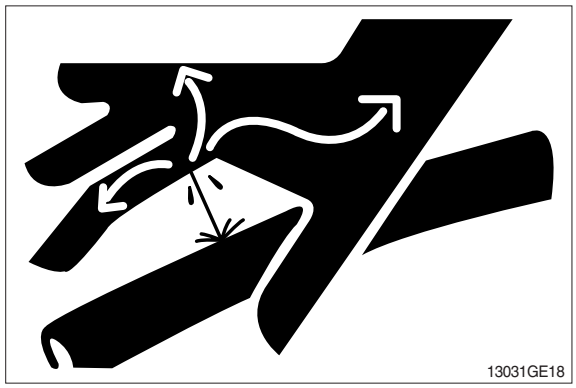
(4) Disconnect pilot line hoses (4, 5, 6, 7, 8, 9).

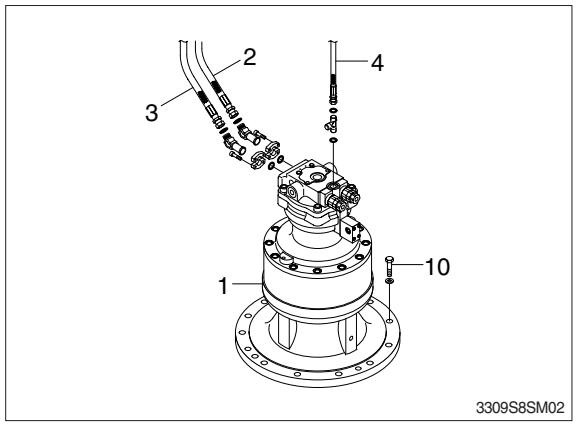
(5) Sling the swing motor assembly (1)and remove the swing motor mounting bolts (10).

- Motor device weight : 65 kg (140 lb)
- Tightening torque : 58.4 kgf · m (422.4lbf · ft)

(6) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.





2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.

① Remove the air vent plug.

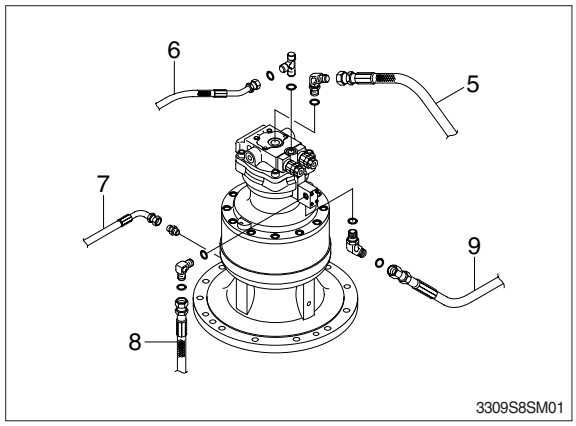
② Pour in hydraulic oil until it over flows from the port.

③ Tighten plug lightly.

④ Start the engine, run at low idling, and check oil come out from plug.

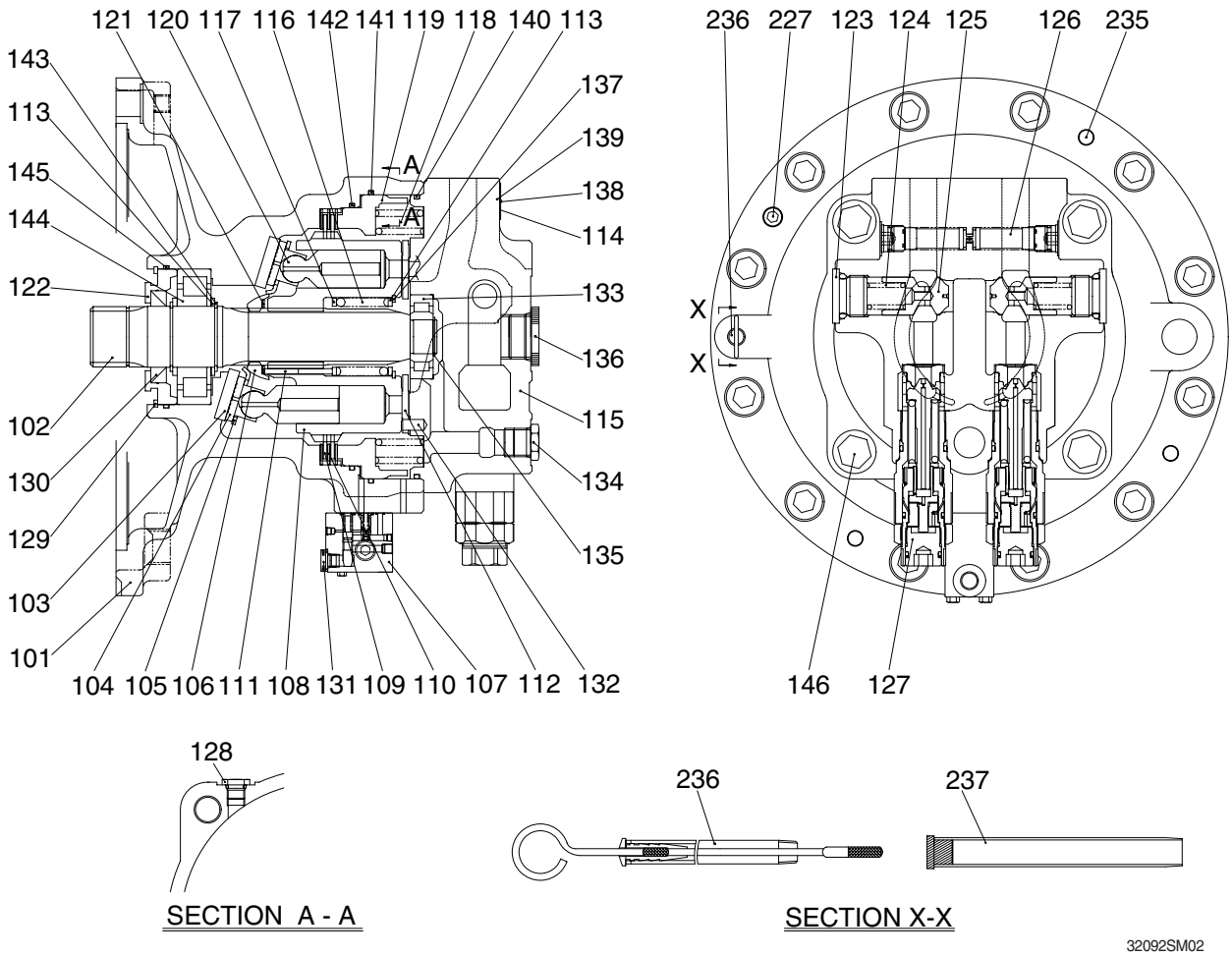
⑤ Tighten plug fully.

(3) Confirmed the hydraulic oil level and check the hydraulic oil leak or not.



2. SWING MOTOR

1) STRUCTURE

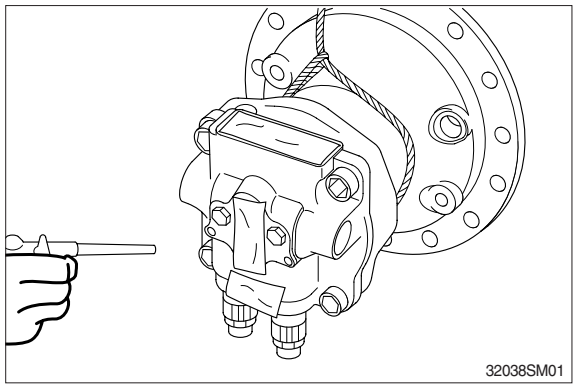


101	Casing A1	118	Brake spring	135	Ring snap
102	Drive shaft	119	Brake piston	136	Dust plug
103	Shoe plate	120	Piston	137	Ring snap
104	Shoe	121	Spacer F	138	Name plate
105	Retainer	122	Front cover	139	Rivet screw
106	Spherical bush	123	RO plug	140	O-ring
107	Brake valve	124	Spring	141	O-ring
108	Cylinder block	125	Plunger K	142	O-ring
109	Friction plate	126	S/reaction less valve	143	Ring snap
110	Separation pate	127	Relief valve	144	Roller bearing
111	Push rod	128	VP plug	145	O-ring
112	Valve plate	129	Ring snap	146	Socket bolt
113	Spacer	130	Oil seal	227	Socket bolt
114	VP plug	131	Dust plug	235	Pin
115	Valve casing	132	Pin spring	236	Level gauge
116	Cylinder spring	133	Roller bearing	237	Air breather assy
117	Spacer R	134	Dust plug		

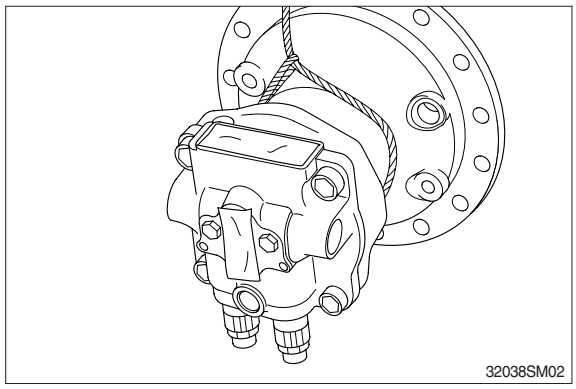
2) DISASSEMBLY

(1) Lift the motor out. Clean the motor in kerosene and dry with compressed air.

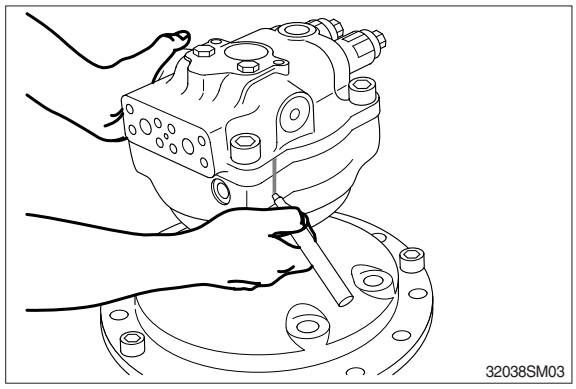
※ To avoid dust inside the motor, mask all the ports of the motor with tapes.



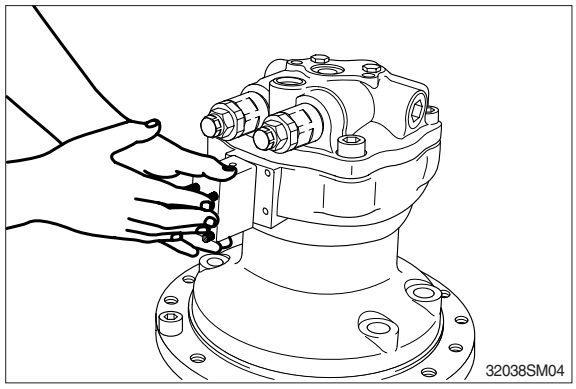
(2) Loosen the drain plug to discharge oil in the casing (101).



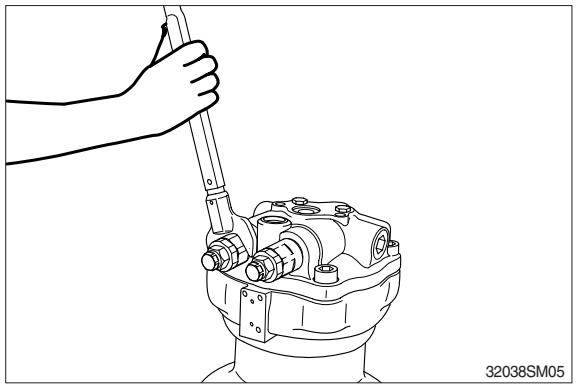
(3) Fix the drive shaft (102) on the workbench with the end of output shaft down. Put matching marks on casing (101) and valve casing (303) for easy reassembly.



(4) Remove the valve (107).

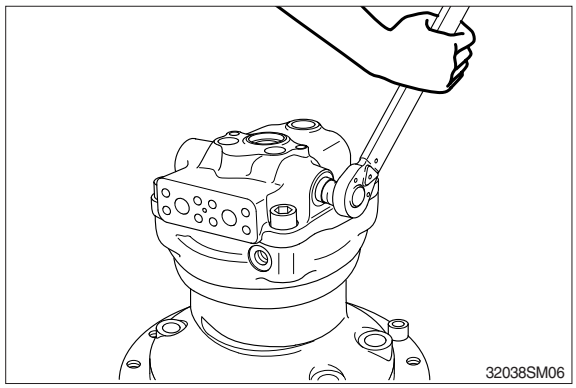


(5) Remove the relief valve (127) from valve casing (115).

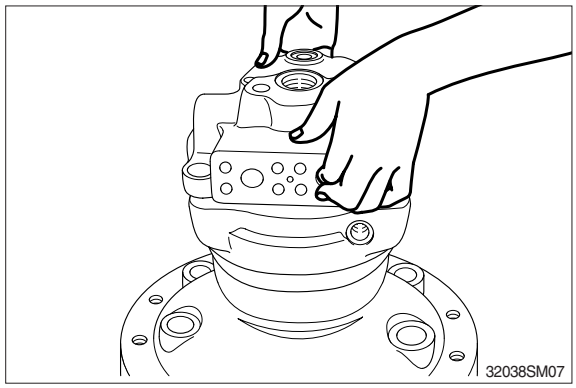


(6) Remove plug (123) from valve casing (115) and spring (124), plunger (125).

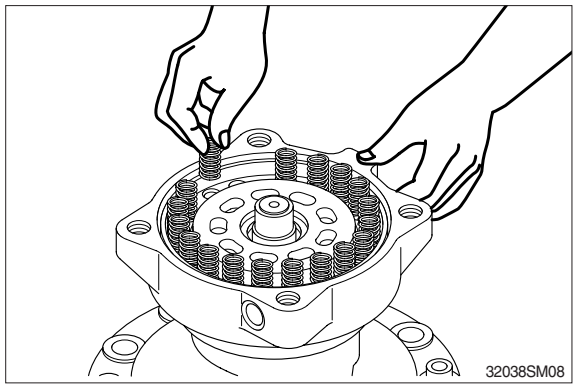
※ Be careful not to damage the plunger seat assembly.



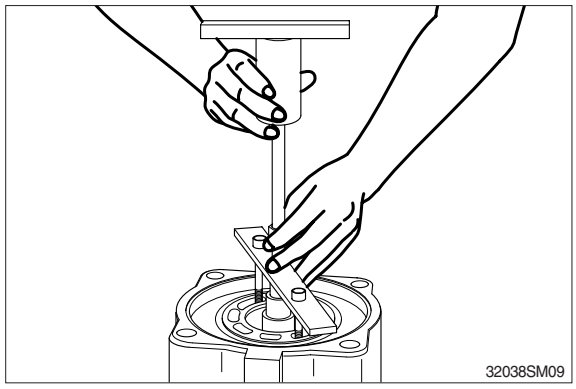
(7) Remove valve casing (115) from casing (101). Then, remove the valve plate (112) from valve casing (115) with care.



(8) Remove the brake spring (118) from brake piston (119).

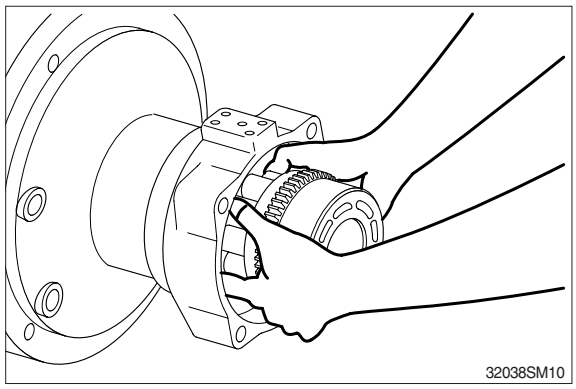


(9) Remove brake piston (119) from casing (101).

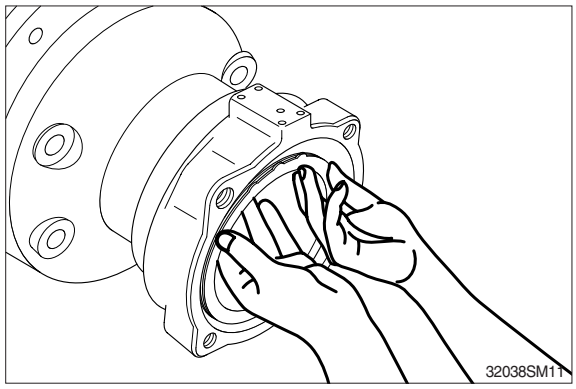


(10) Remove the cylinder (108) from the output shaft (102) with the motor positioned horizontally. Remove piston (104, 120), retainer (105), spherical bush (106), spacer (121) and shoe plate (103).

※ If shoe plate would not removed easily, try again after procedure (14).

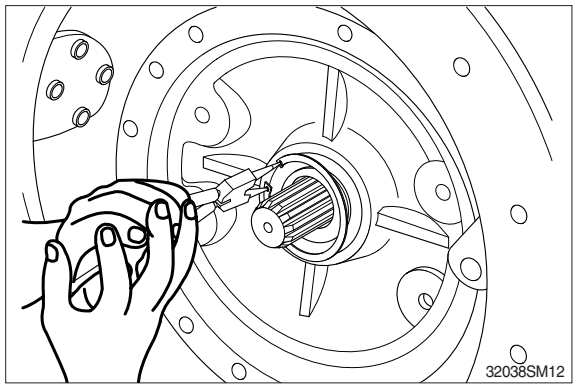


(11) Remove friction plate (109) and separate plate (110) from casing (101).

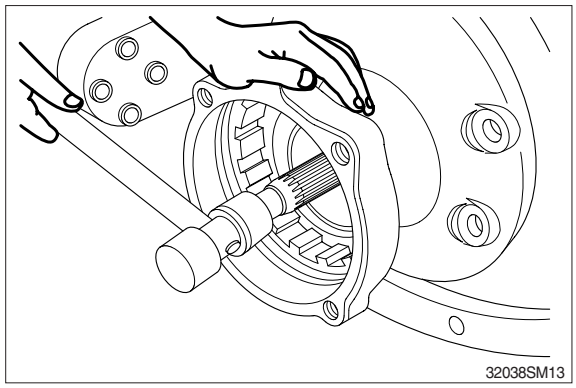


(12) Remove snap ring (129) with pillar and remove the front cover (122) from casing (101).

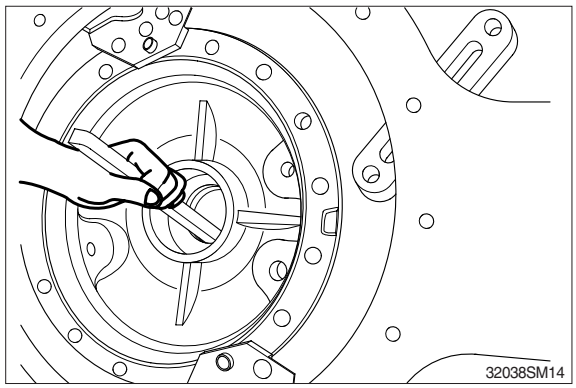
※ Front cover could be removed with sliding shaft if necessary.



(13) Remove drive shaft (102) from casing (101).



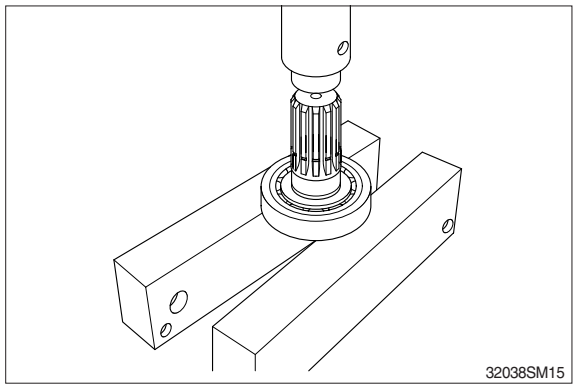
(14) Remove the shoe plate (103) from casing (101).

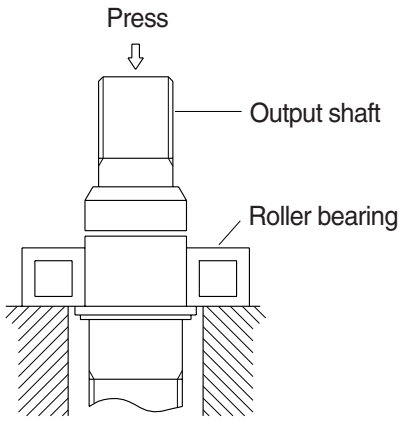


(15) Proceed with following job only when necessary.

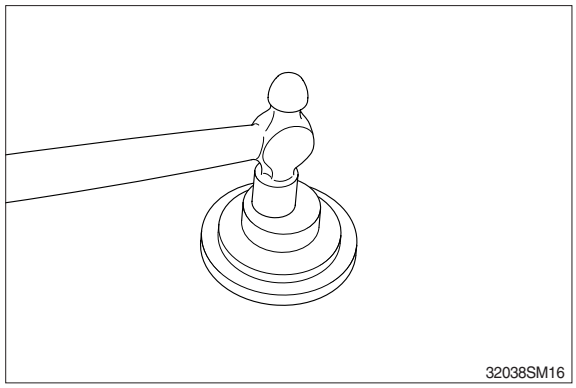
① Remove the snap ring (143), spacer (113) from drive shaft (102) and remove the cone of roller bearing (144) by press.

※ Do not reuse bearings.

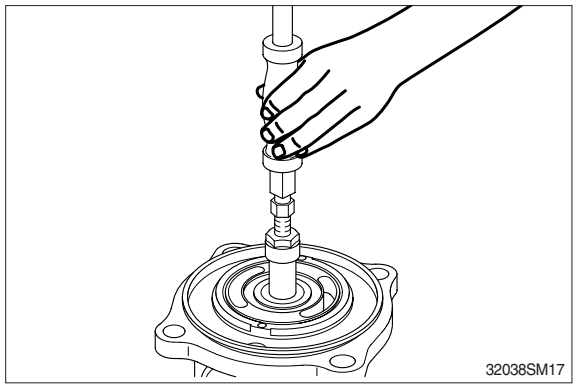




② Remove oil seal (130) from front cover (122).

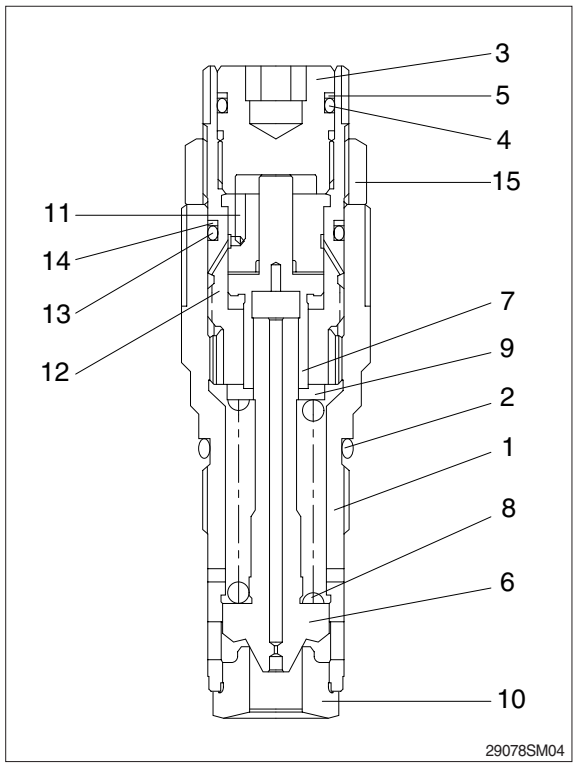


③ Remove the roller bearing (133) from the valve casing (101) by using slide hammer bearing puller.



④ When disassembling the relief valve, release the plug (3).
Remove the piston (7), spring seat (9), spring (8) and plunger (6) with the body (1) downwards.

※ Do not release the lock nut (15).

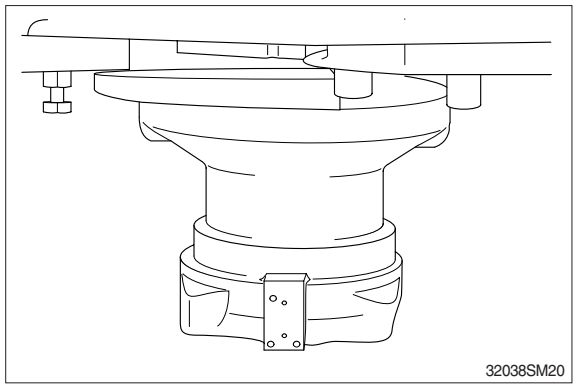


This completes disassembly.

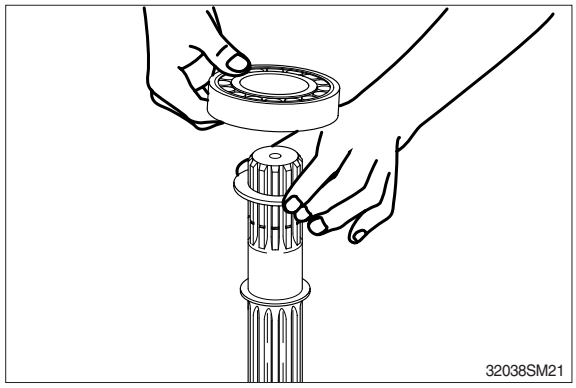
3) ASSEMBLY

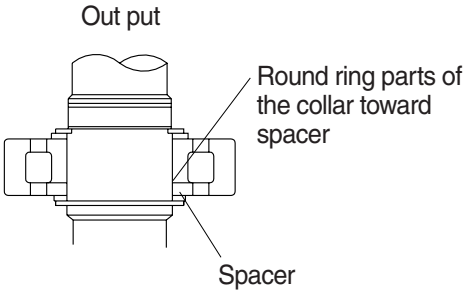
Do the reassembly in the reverse procedure of the disassembly.

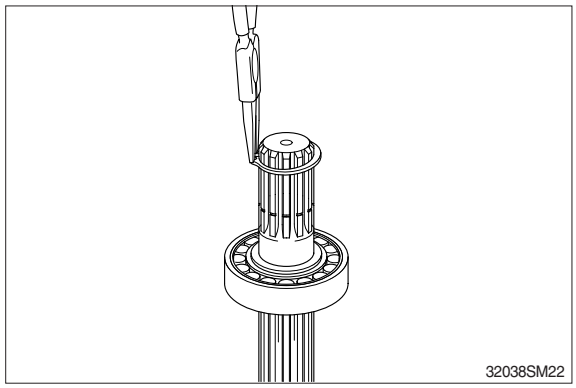
(1) Place the casing (101) on the workbench with the valve casing (115) downward.



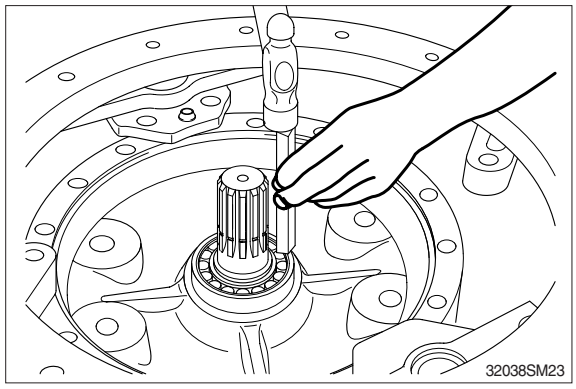
(2) When reassembling the roller bearing, install the snap ring (143), and spacer (113) to the drive shaft (102). Insert the collar and cone of the roller bearing (144). Install the spacer (113) and stop ring (143). Install stop ring (144) to the output shaft (102) by heating the cone of the roller bearing (133).



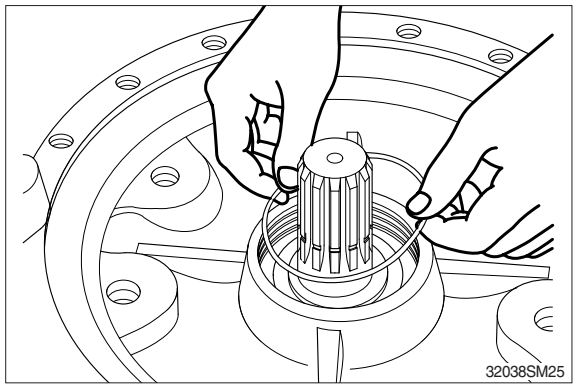




(3) Insert the drive shaft (102) into the casing (101) with the end of output shaft upward and tap the outer race of roller bearing with the hammer.

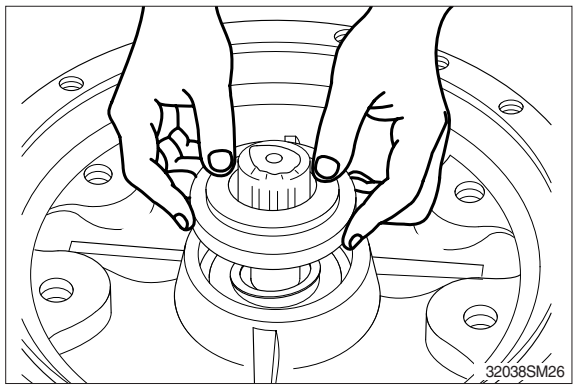


(4) Tack O-ring (145) to the casing (101).

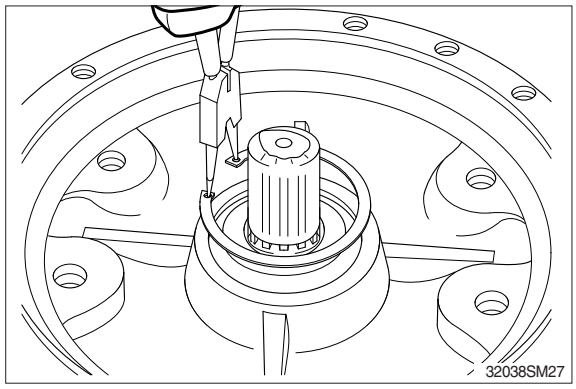


(5) Reassemble the front cover (122) to the casing (101).

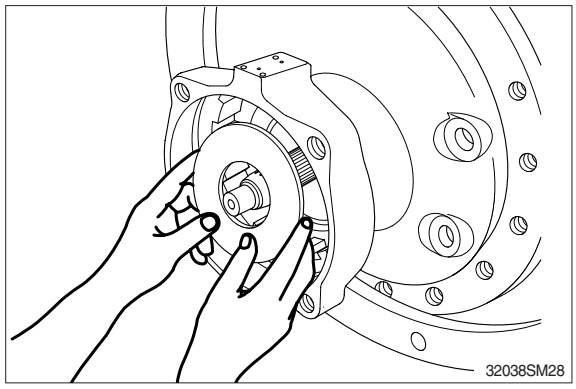
※ Apply grease to the rib of oil seal to avoid damage to the rib.



(6) Install the snap ring (129) to the casing (101).

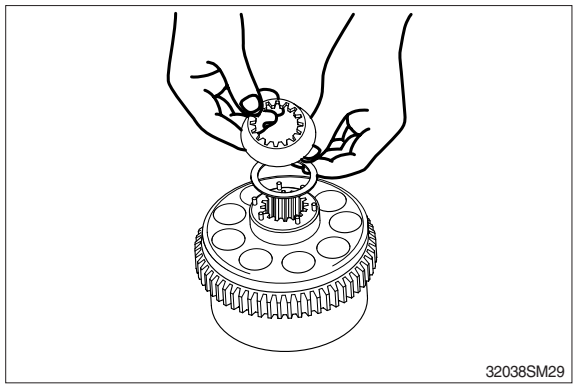


(7) Insert the shoe plate (103) with the casing (101) position horizontally.

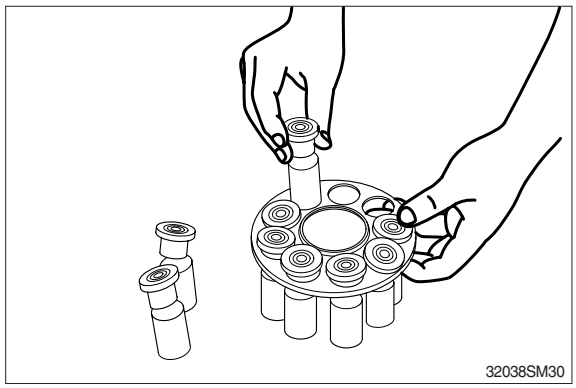


(8) Insert the spherical bush (106) into the cylinder (108). Place the retainer (105) assembled with spacer (121) onto the cylinder.

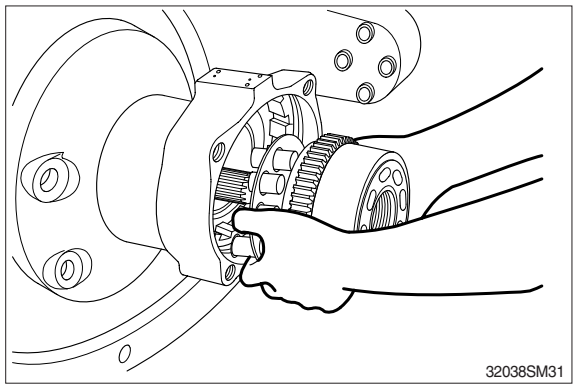
※ Insert two push rods in each hole.



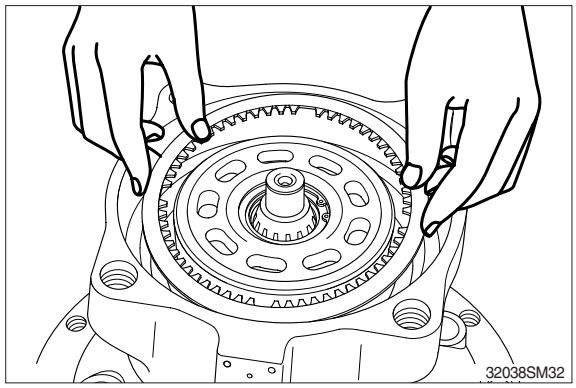
(9) Install the piston sub-assembly (120, 104) to the retainer (105).



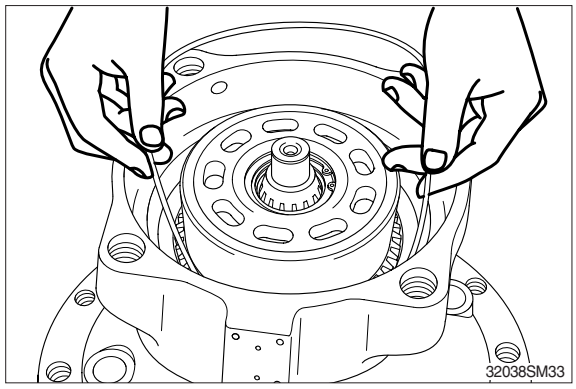
(10) Reassemble the piston assembly (120, 104) to the cylinder block (108).



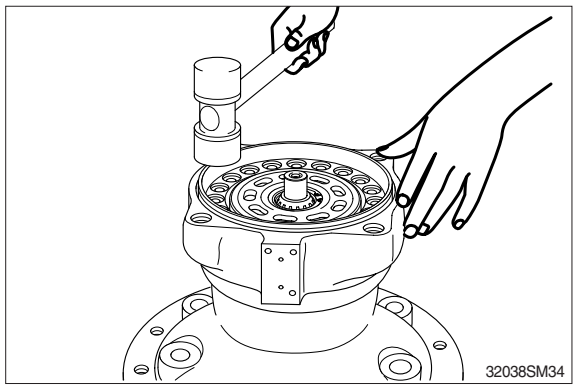
(11) Place the casing (101) under the front cover (122) and reassemble 3 sheets of separate plate (110) and then 2 sheets of friction plate (109) to the casing (101).



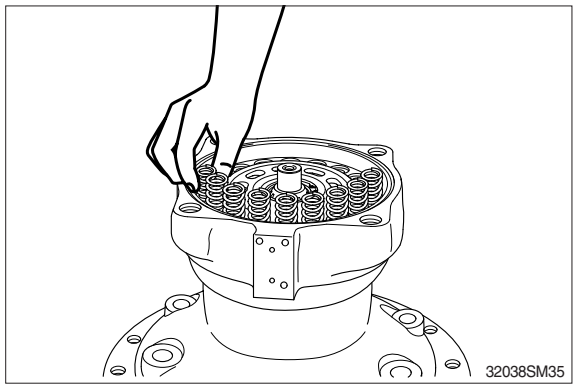
(12) Insert O-ring (141, 142) inside the casing (101).



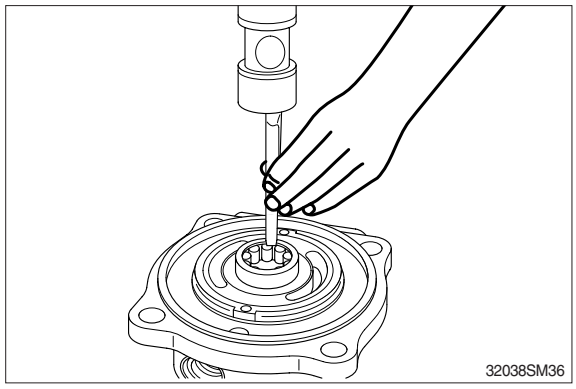
(13) Reassemble brake piston (119) to the casing (101).



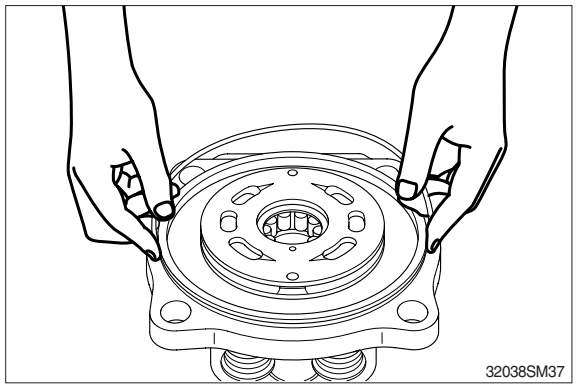
(14) Reassemble brake spring (118) to the brake piston (119).



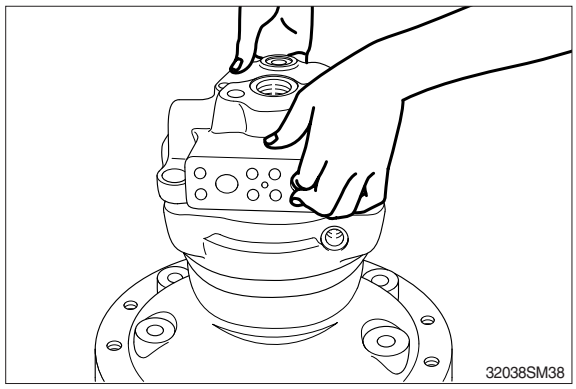
(15) When assembling the roller bearing (133), insert the roller bearing (444) into valve casing (115) by hammering.



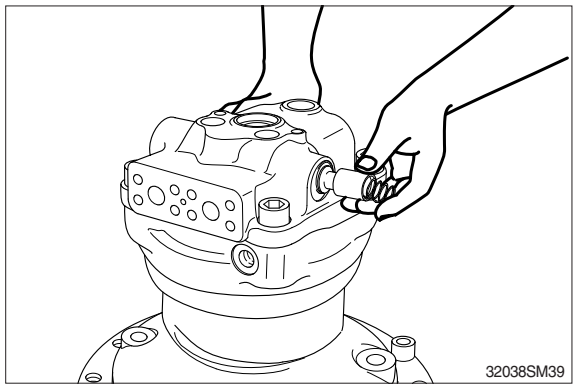
(16) Reassemble valve plate (112) to the valve casing (115) and reassemble O-ring (140).



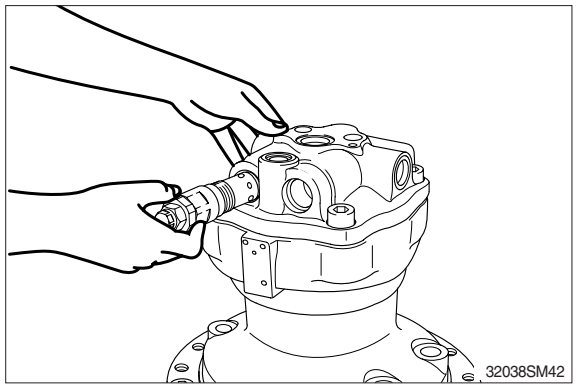
(17) Connect the valve casing (115) with the casing (101) and tighten the socket bolt (146).



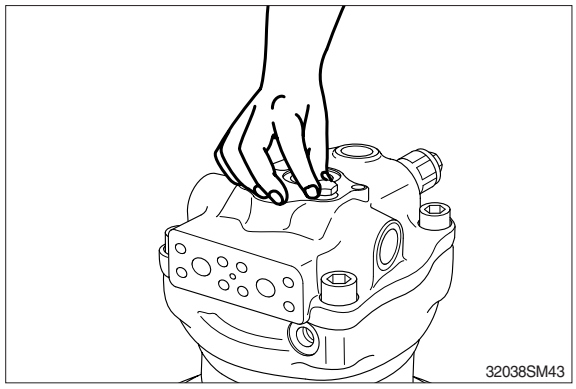
(18) Insert plunger (125) and spring (124) in the valve casing. Tighten plug (123) to the valve casing.



(19) Insert O-rings (127-1) to the relief valve (127) and reassemble them to valve casing (101).



(20) Tighten the plug (114) to valve casing (115) to casing (301).



(21) Connect the valve casing (115) with the casing (101).

This completes assembly.

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

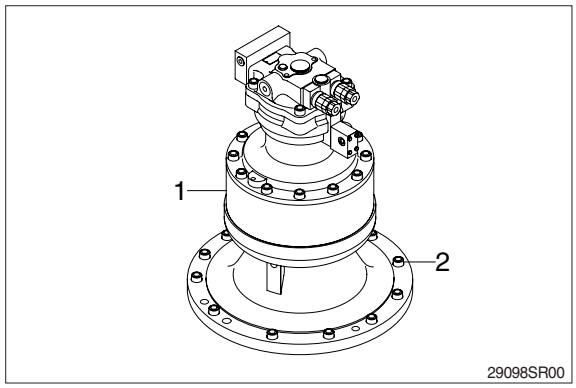
(2) Sling reduction gear assembly(1) and remove mounting bolts(2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 320 kg (705 lb)



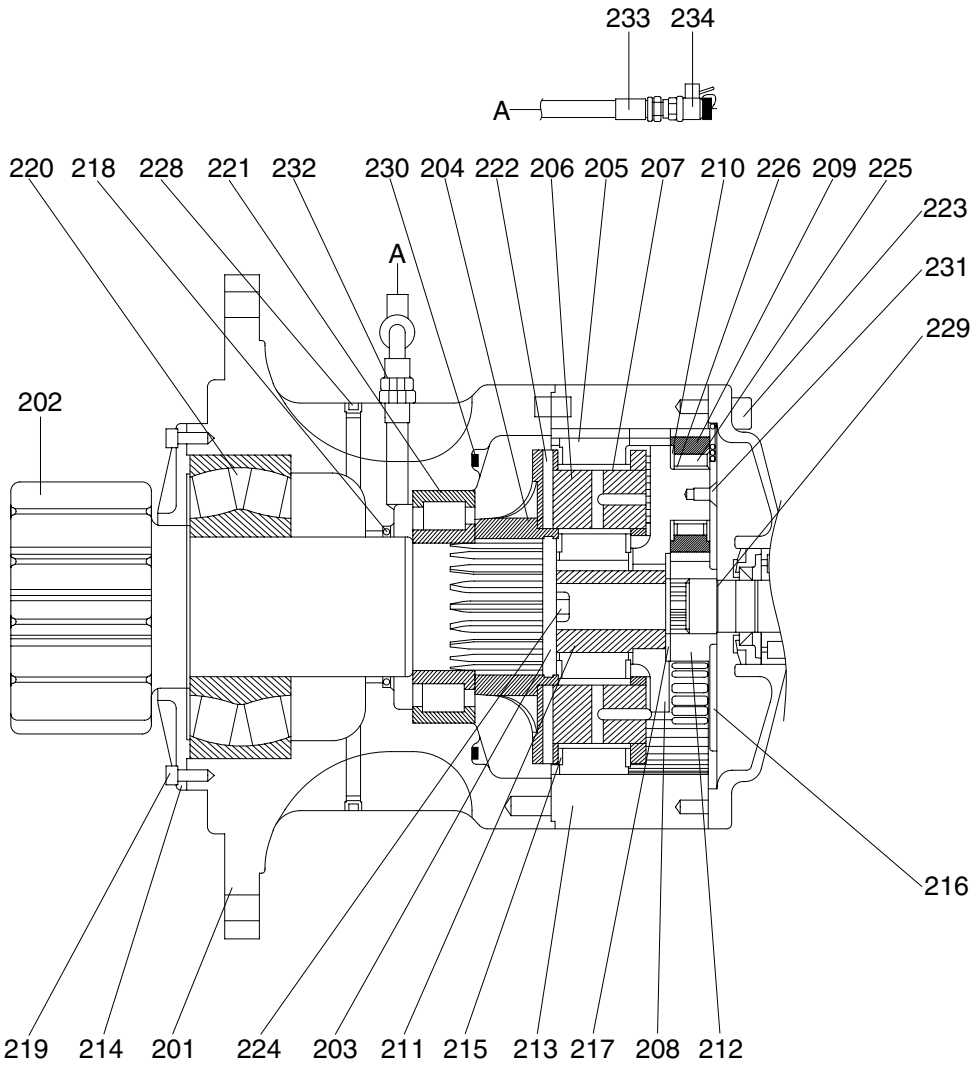
2) INSTALL

(1) Carry out installation in the reverse order to removal.
· Mounting bolt : 84±8.0 kgf · m (608±58 lbf · ft)



4. REDUCTION GEAR

1) STRUCTURE

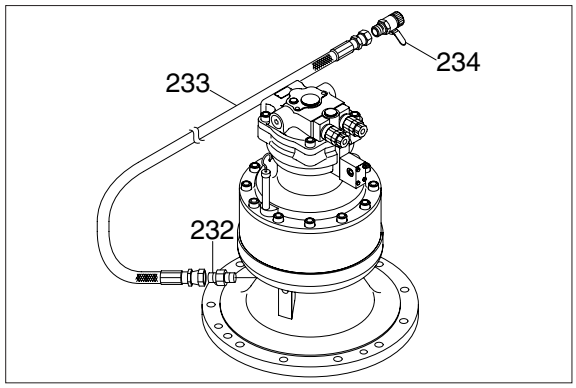


32092RG01

201	Casing	212	Sun gear 1	223	Socket bolt
202	Pinion shaft	213	Ring gear	224	Hex bolt
203	Preload plate	214	Cover	225	Needle bearing
204	Carrier 2	215	Thrust washer	226	Inner ring
205	Planet gear 2	216	Thrust plate	228	PT plug
206	Pin	217	Thrust washer	229	Snap ring
207	Bush	218	Oil seal	230	Magnet
208	Carrier 1	219	Socket bolt	231	Flat head screw
209	Planet gear 1	220	Spherical roller bearing	232	Connector (1/2 inch)
210	Thrust washer	221	Cylindrical roller bearing	233	Hose assembly
211	Sun gear 2	222	Spring pin	234	Drain valve assembly

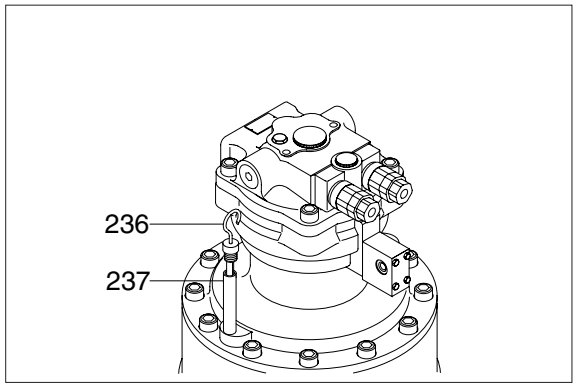
2) DISASSEMBLY

(1) Remove connector (232), hose assy (233) and drain valve (234).



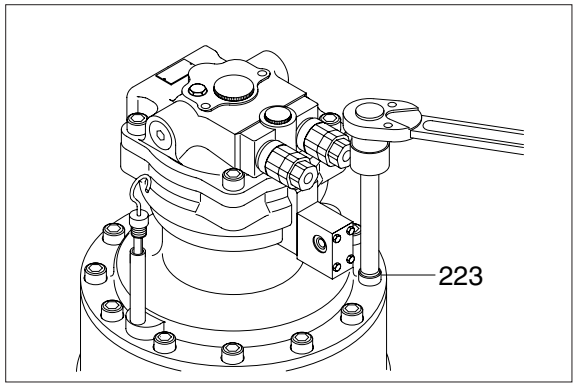
32098SR02

(2) Remove gauge bar(236) and gauge pipe (237) from the swing motor casing.
Pour the gear oil out of reduction gear into the clean bow1 to check out the friction decrease.



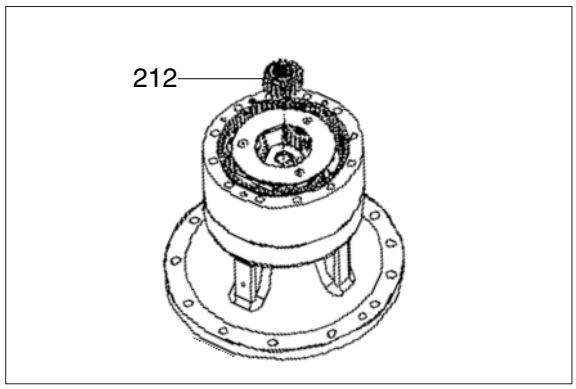
32098SR03

(3) Loosen the socket bolt (223) to separate swing motor from reduction gear.



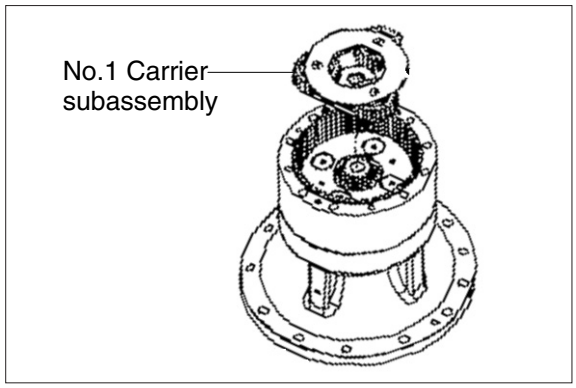
32098SR04

(4) Full out No.1 sun gear (212).



32098SR05

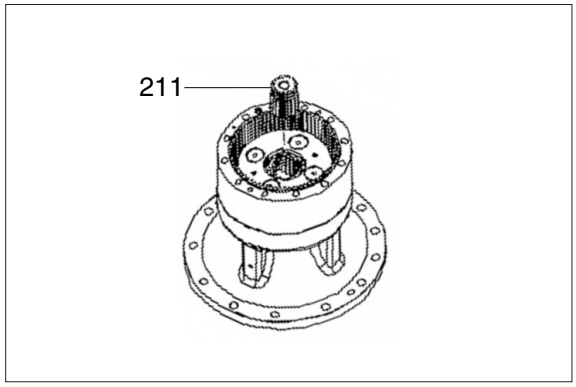
(5) Full out No.1 carrier subassembly.



32098SR06

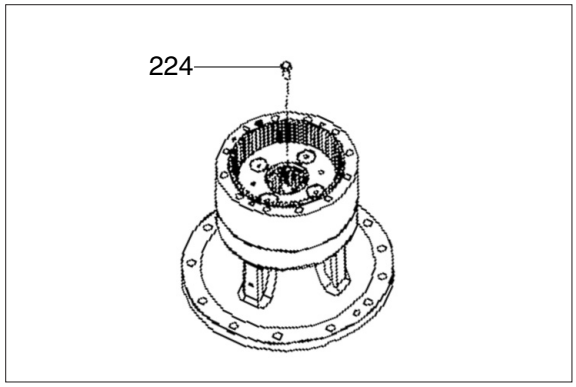
(6) Full out No.2 sun gear (211).

※ Pay attention to ensure gear is not damaged during disassembling.



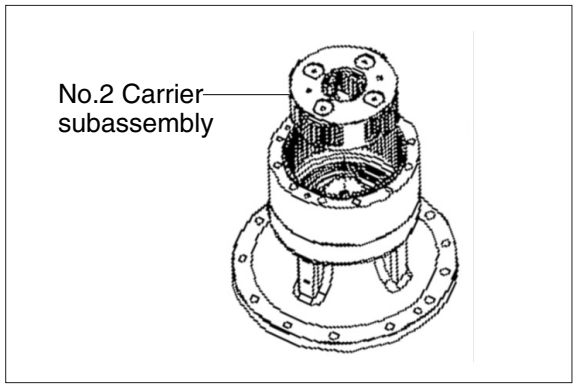
32098SR07

(7) Loosen the hexagon bolt (224).



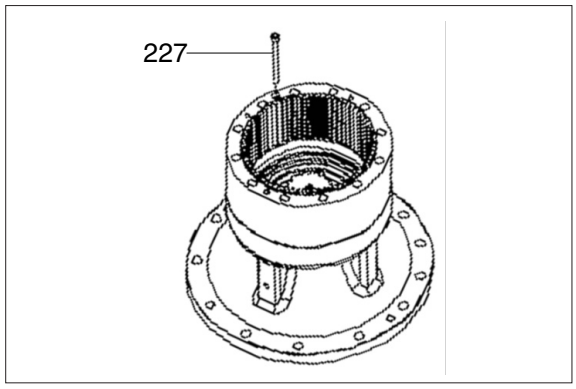
32098SR08

(8) Full out No.2 carrier subassembly.



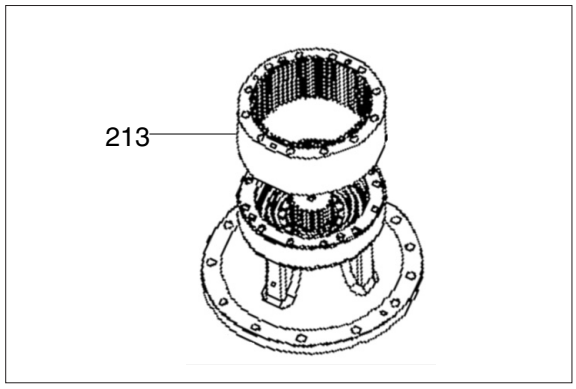
32098SR09A

(9) Loosen the hexagon socket bolt (227).



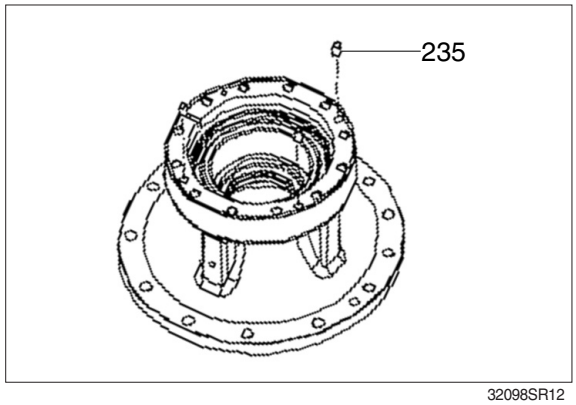
32098SR10

(10) Tighten two M10 eye bolts to ring gear (213) and lift up and remove ring gear (213).



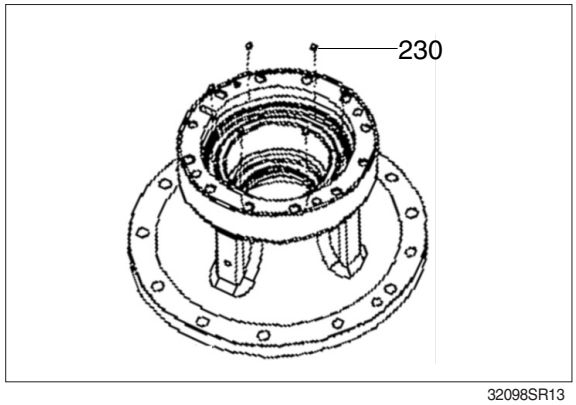
32098SR11

(11) Full out pin (235).



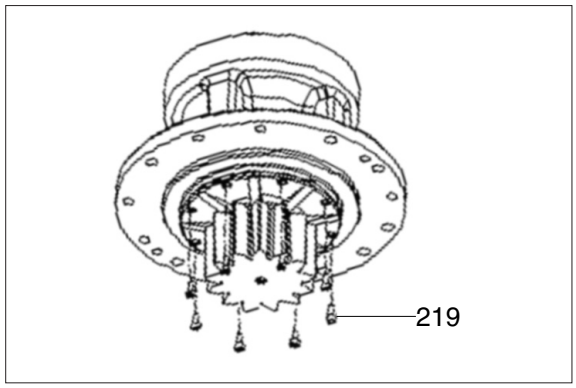
32098SR12

(12) Full out magnet (230).



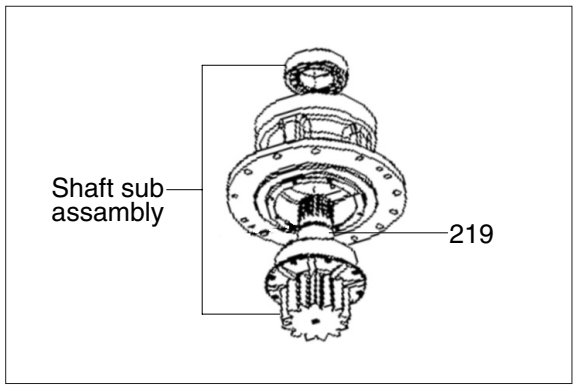
32098SR13

(13) Loosen the hexagon socket bolt (219).



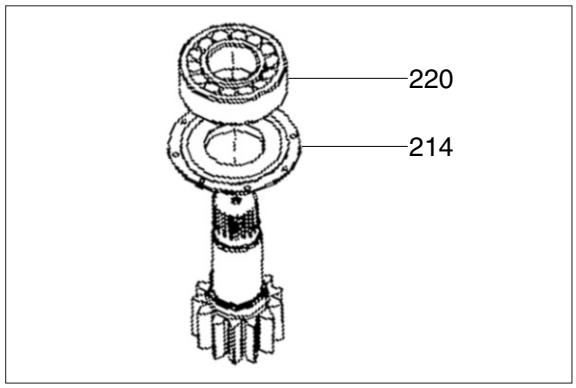
32098SR14

(14) Remove the shaft sub assembly with pinion shaft (202).



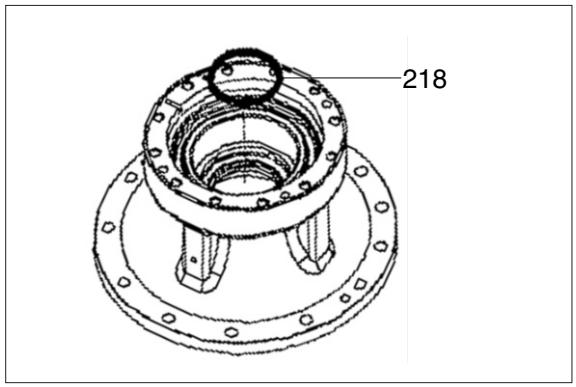
32098SR15

(15) Press drive shaft by using jig to remove spherical roller bearing (220) and cover (214).



32098SR16

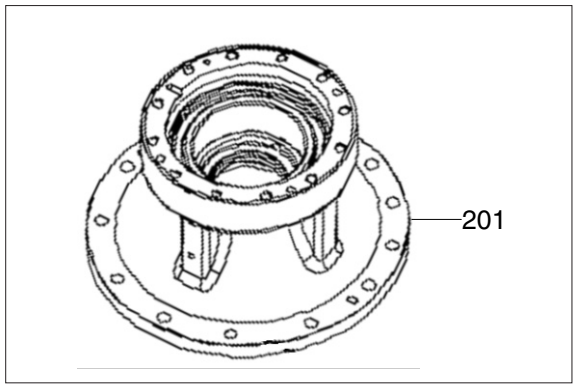
(16) Full out oil gear (218).



32098SR17

2) ASSEMBLY

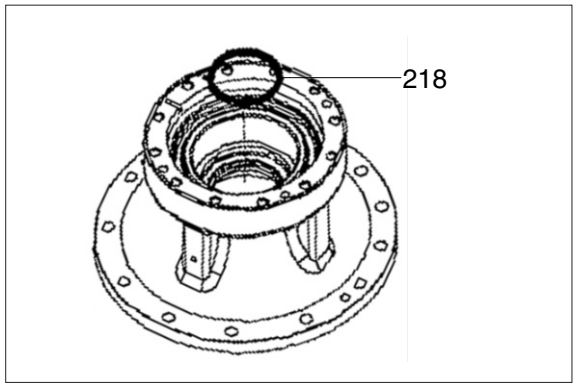
(1) Place the casing (201) on the reversing machine having the flange sid of the casedown.



32098SR18

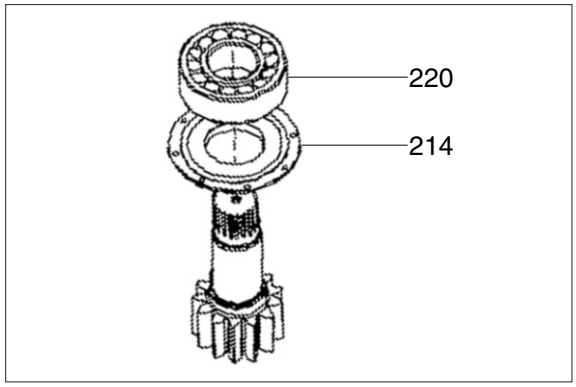
(2) Press the insert oil seal (218) by using pressure jig after spreading grease oil around the out side ring of the seal.
Coat grease oil slightly on the lip surface to prevent any scratch when installing.

※ Be sure to check by eye that the oil seal is seated completely after being installed.



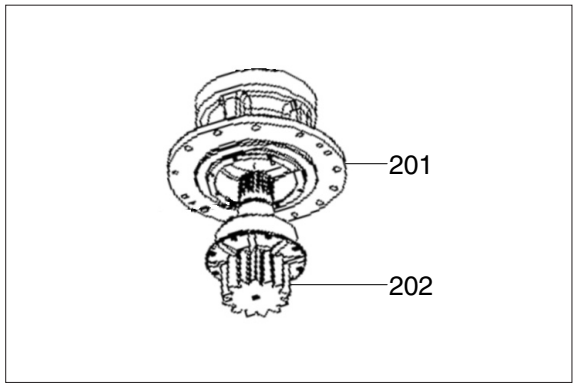
32098SR17

(3) Insert cover (214) to pinion shaft (202) and insert spherical roller bearing (220) by using a pressing jig.



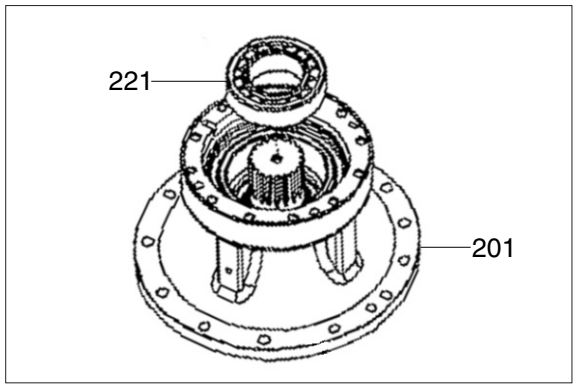
32098SR16

(4) Install pinion shaft (202) sub assembly into casing by using a pressing jig.



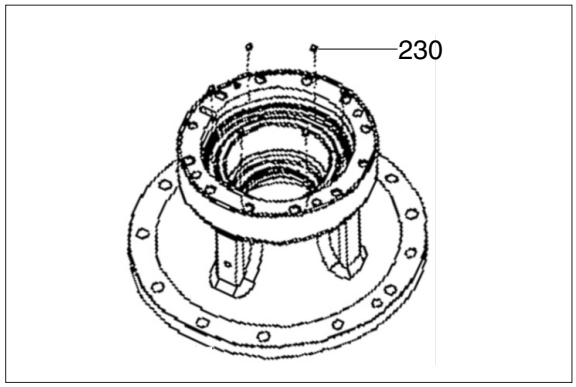
32098SR19

(5) Install roller bearing (221) into casing by using a pressing jig.



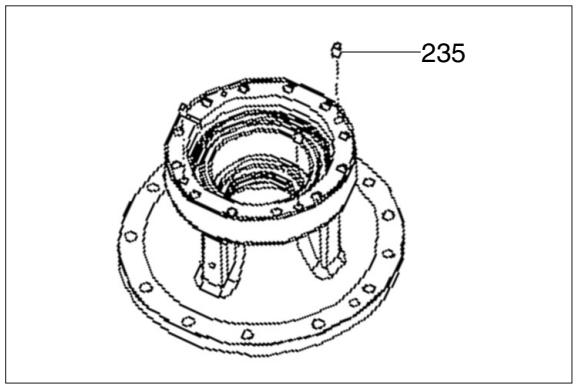
32098SR20

(6) Insert magnet (230).



32098SR13

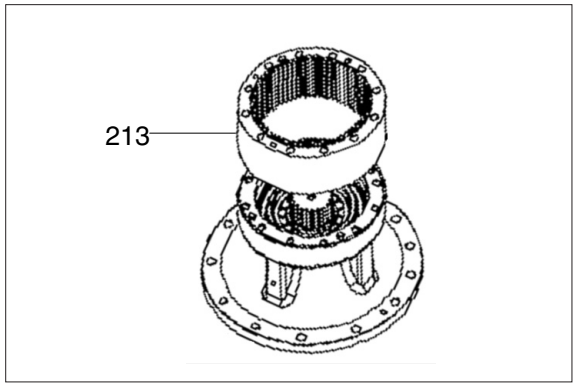
(7) Insert pin (235).



32098SR12

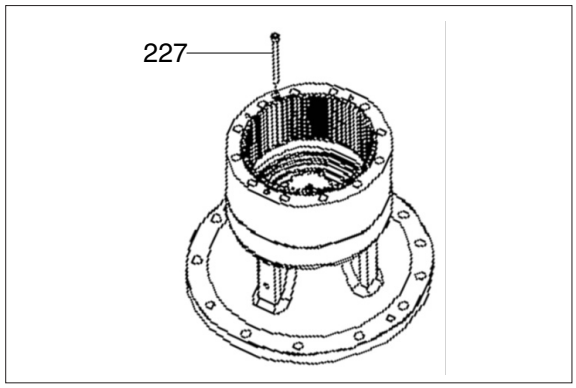
(8) Place ring gear on the case by matching it with pin hole.

※ Be sure to check the hole location of oil gage before inserting.



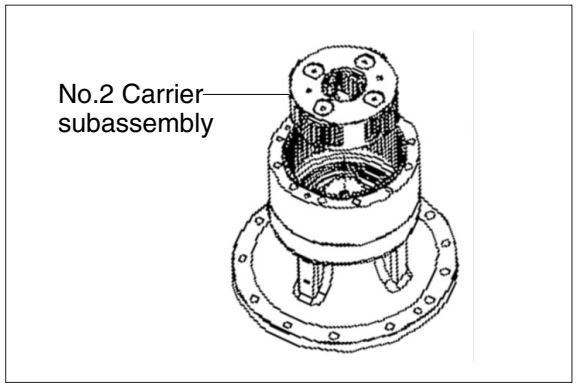
32098SR11

(9) Assemble ring gear with case by screwing socket bolt (227).



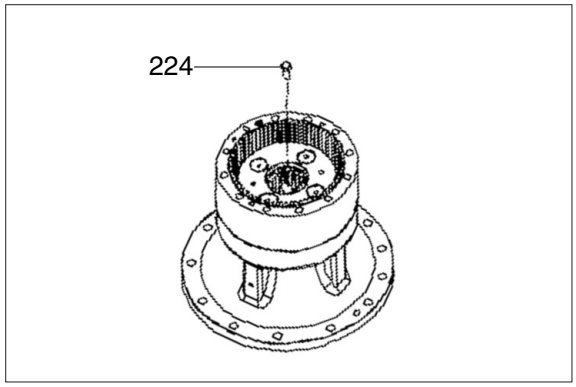
32098SR10

(10) Mount No.2 carrier subassembly in the casing.



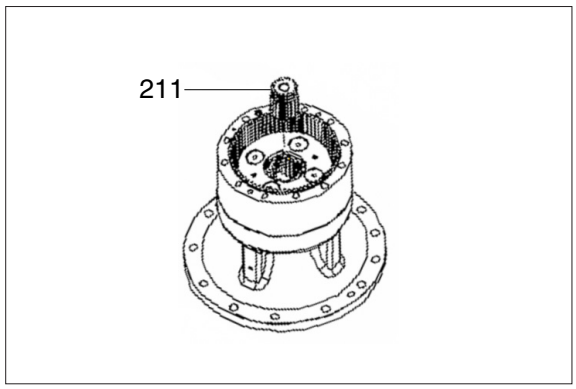
32098SR09A

(11) Tighten hexagon bolt (224).



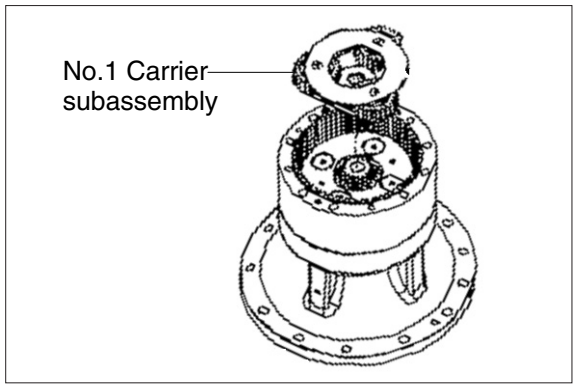
32098SR08

(12) Install No.2 sun gear (211).



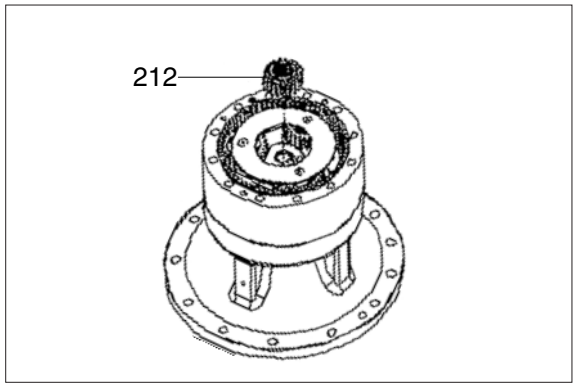
32098SR07

(13) Mount No.1 carrier subassembly.



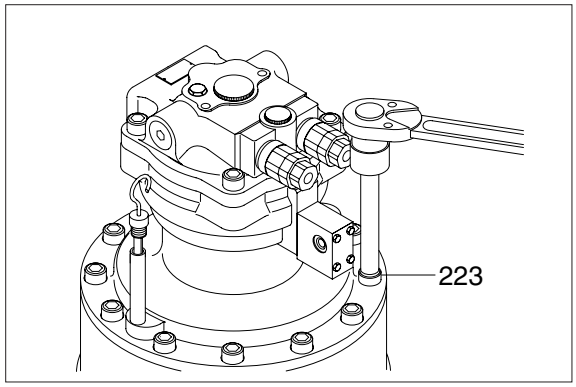
32098SR06

(14) Install No.1 sun gear (212).



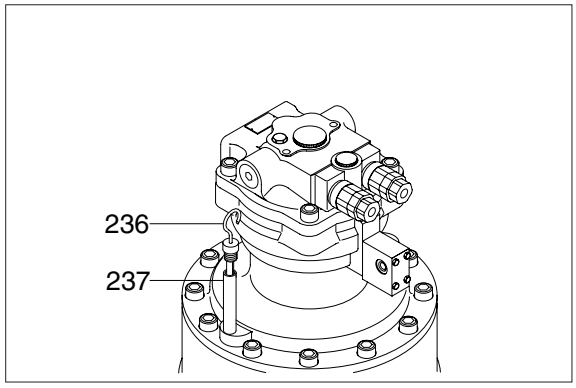
32098SR05

(15) Tighten socket bolt (223) around the swing motor assembly.



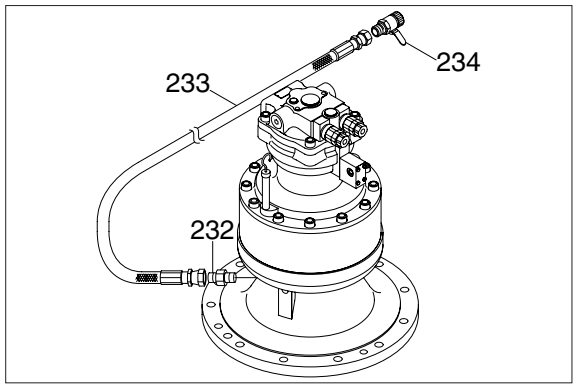
32098SR04

(16) Assemble gauge bar (236) and gauge pipe (237).



32098SR03

(17) Assemble connector (232).
Hose assy (233) and drain valve (234).



32098SR02

GROUP 6 TRAVEL DEVICE (TYPE 1)

1. REMOVAL AND INSTALL



1) REMOVAL

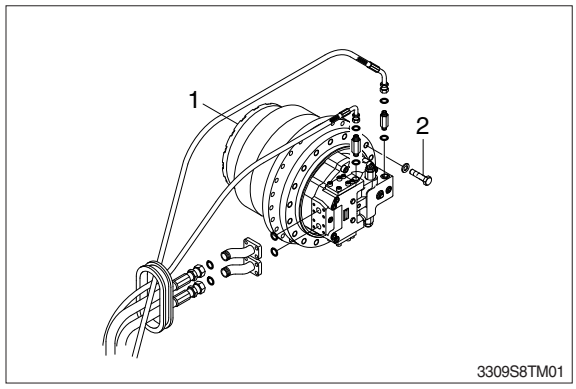
(1) Swing the work equipment 90 °and lower it completely to the ground.

(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 : 305 kg (670 lb)

2) INSTALL

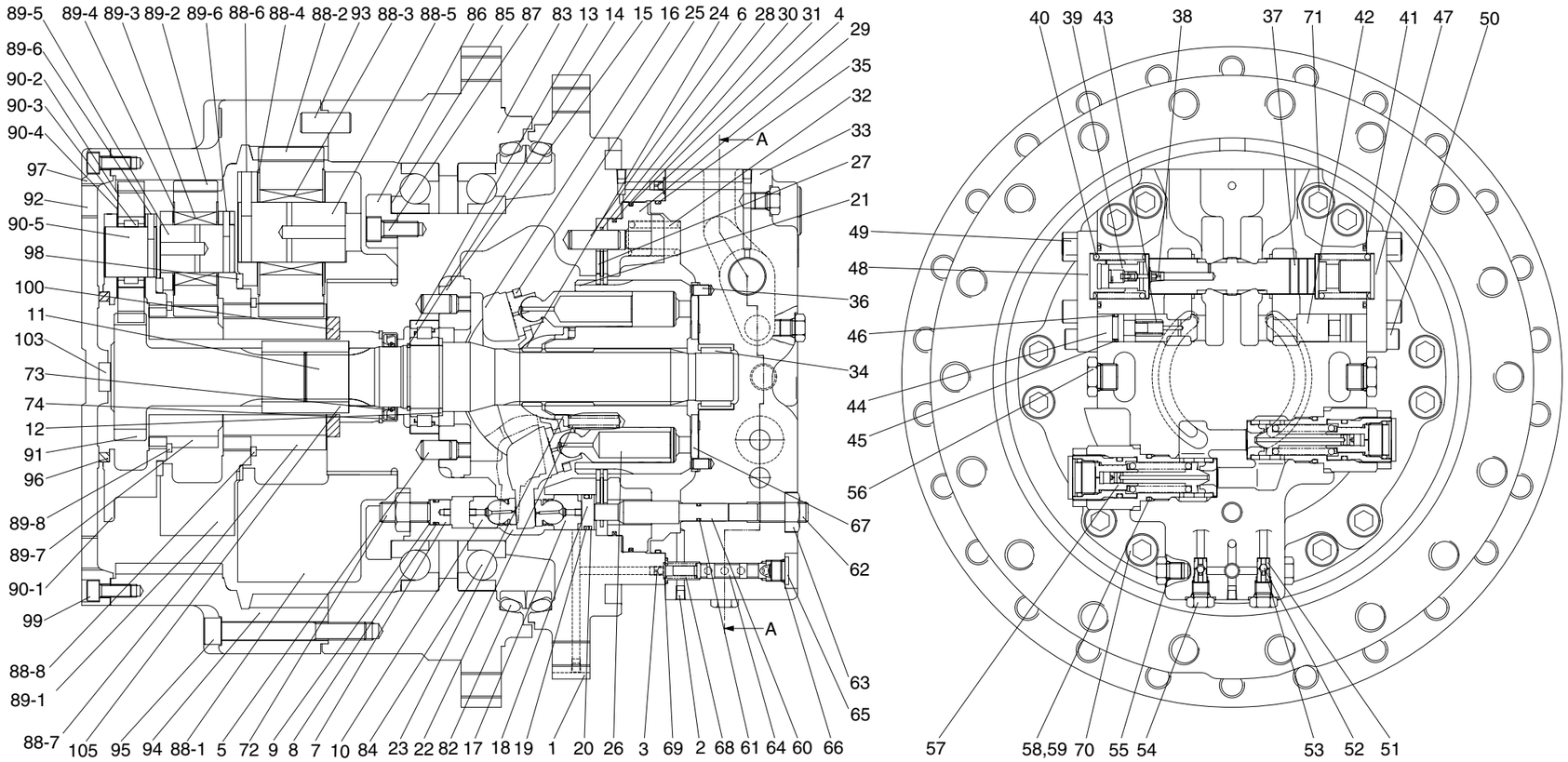
(1) Carry out installation in the reverse order to removal.

(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



SECTION A-A

32092TM01

1	Casing	16	Plate	31	Ring	46	Back up ring	61	O-ring	83	Housing	89-1	Carrier No.2	92	Plug
2	Plug	17	Piston	32	Spring	47	Cap	62	Lock screw	84	Bearing	89-2	Planetary gear No.2	93	Lock pin
3	Screw	18	Stopper	33	Valve casing	48	Cap	63	Nut	85	Shim	89-3	Needle No.2	94	Ring gear
4	Screw	19	O-ring	34	Needle bearing	49	Socket bolt	64	Spool	86	Retainer	89-4	Thrust washer No.2	95	Bolt
5	Pin	20	Back up ring	35	O-ring	50	Socket bolt	65	Plug	87	Bolt	89-5	Pin No.2	96	Thrust ring No.1
6	Pin	21	Cylinder block	36	Pin	51	Seat	66	O-ring	88	Carrier No.3	89-6	Spring pin No.2	97	Cover
7	Stopper	22	Cylinder spring	37	Spool	52	Steel ball	67	Valve plate	88-1	Carrier No.3	89-7	Sun gear No.2	98	Thrust ring No.2
8	O-ring	23	Spacer	38	Screw	53	Stopper	68	Spring	88-2	Planetary gear No.3	89-8	Snap ring No.2	99	Bolt
9	Back up ring	24	Guide	39	Damping check	54	Plug	69	O-ring	88-3	Needle No.3	90	Carrier No.1	100	Motor ring
10	Piston	25	Plate	40	Spring	55	O-ring	70	Socket bolt	88-4	Thrust washer No.3	90-1	Carrier No.1	101	Thrust ring No.3
11	Shaft	26	Piston & Shoe assy	41	O-ring	56	Plug	71	Socket bolt	88-5	Pin No.3	90-2	Planetary gear No.1	103	Pad
12	Spacer	27	Plate	42	Plunger	57	Relief valve	72	Lock screw	88-6	Spring pin No.3	90-3	Needle bearing No.1	105	Coupling
13	Roller bearing	28	Plate	43	Spring	58	O-ring	73	Oil seal	88-7	Sun gear No.3	90-4	Thrust washer No.1		
14	Stop ring	29	Brake	44	Stopper	59	Back up ring	74	Lock ring	88-8	Snap ring No.3	90-5	Pin No.1		
15	Support	30	Ring	45	O-ring	60	Rod	82	Floating Seal	89	Carrier No.2	91	Sun gear No.1		

2) TOOL AND TIGHTENING TORQUE

(1) Tools

Name of tools	B-size	Name of part applied
Hexagonal L-Wrench	4	Plug(2), Orifice screw(3, 4, 38)
	8	Hex socket bolt(50), Lock screw(62, 72), Plug(65)
	10	Hex socket bolt(49)
	46	Hex(57)
Socket wrench/ spanner	19	Hp plug(54)
	24	Hex nut(63)
	27	Hp plug(56)
Snap-ring plier(for holes, axis)		Ring stop(14), Ring lock(74)
Solder hammer		Needle bearing(34), Pin(5, 6, 36)
Torque wrench		Size : 500, 3000
Jig for assembling oil seal		Oil seal(73)

(2) Tightening torque

NO.	Part name	Standard	Size	Torque	
				kgf · m	lbf · ft
2	Plug	NPTF 1/16	4	7~11	50.63~79.5
3, 4, 38	Orifice screw	NPTF 1/16	4	7	50.63
49	Hex socket bolt	M12	10	100	723.3
50	Hex socket bolt	M10	8	67	484.6
54	Plug	PF 1/4	19	37	267.6
56	Plug	PF 1/2	27	110	795.6
57	Relief valve	HEX 46	46	170~190	1230~1374
63	Nut	M16	24	240	1736
65	Plug	PF 3/8	8	75	542.4
70, 72	Hex socket bolt	M16	14	240	1736
71	Hex socket bolt	M16	14	240	1736

2. DISASSEMBLING

1) GENERAL INSTRUCTIONS

(1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.

(2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.

(3) Before disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

(4) The piston can be inserted to whichever cylinder block for the initial assembling.
However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.

⚠ **Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.**

2) DISASSEMBLEING TRAVEL MOTOR

(1) Fix a hydraulic motor on jig with four pieces of bolts (M16 × 60L).

※ When rotating jig up to 90˚ in disassembling and assembling, fix a motor making drain plug (56) faced to the bottom.



300072TM20

(2) After disassembling drain plug (56), let an oil in a case of a motor discharged.

※ Check whether manufactured chips or metal dust are added in a drain oil.



300072TM21



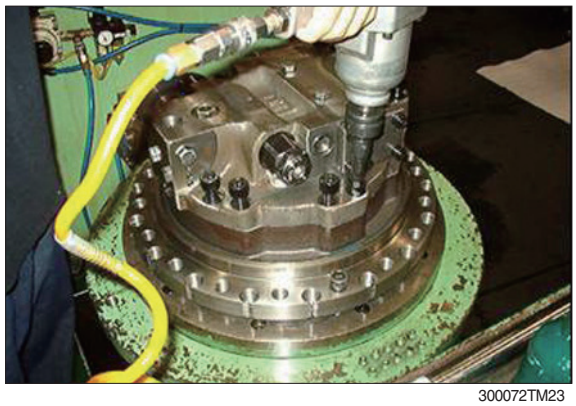
300072TM21A

(3) In order to making the out-put axis of a hydraulic motor faced upward, disassemble ring lock (74) with a plier after rotating jig up to 90˚ in disassembling and assembling.



300072TM22

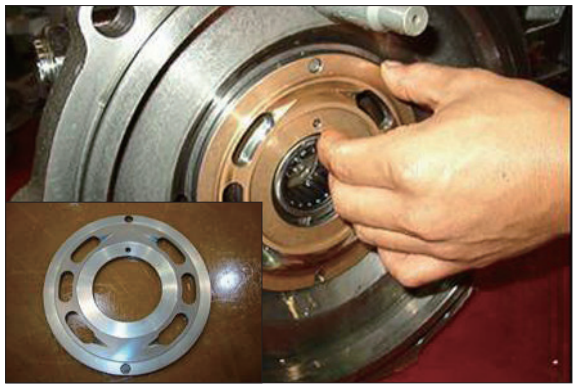
(4) Disassemble hexgon socket bolts (70, 71) holding valve casing.



300072TM23

(5) After detaching valve casing sub, disassemble valve plate (67).

※ In case of serious abrasion of valve plate, exchange it to a new one.



300072TM24A 300072TM24

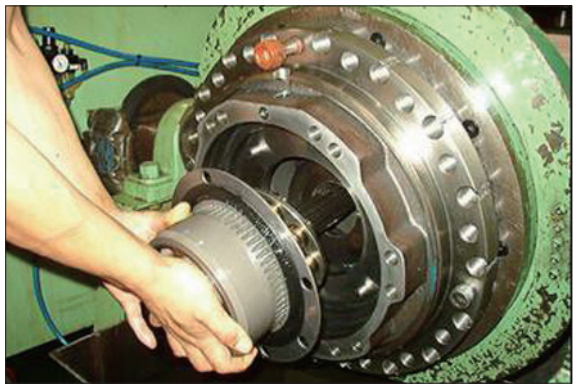
(6) After taking brake spring (32) and then bonding two pieces of M16 bolts to brake piston (29), disassemble it pulling it upward.

※ There are 10 pieces of brake spring.



300072TM25
300072TM25A
300072TM25B

(7) First, rotate jig in disassembling and assembling up to 90˚, then let a motor faced toward the horizon. then disassemble a cylinder and piston sub.a



300072TM26

(8) Disassemble stopper L (18) and piston swash (17).

※ Piston swash : Use M5 bolt



300072TM27

(9) Disassemble swash plate (16).



300072TM28

(10) After put M12 into support (15), disassemble support.



300072TM29

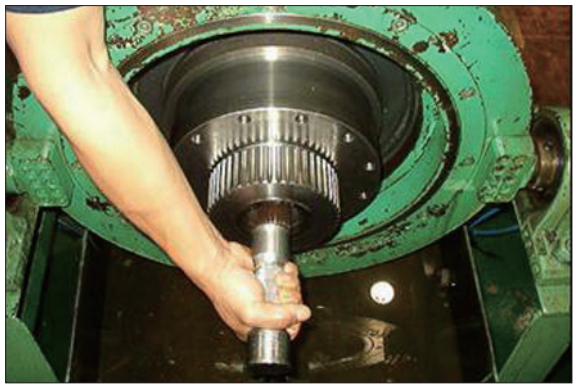
(11) Disassemble piston swash (10) and stopper (7).



300072TM30

(12) In order to making the turning axis (11) faced upward, put it way from shaft casing tapping the bottom of the turning axis with hammer, after rotating jig up to 90˚ in disassembling and assembling.

※ Try to deal with roller bearing (13) without any damage.



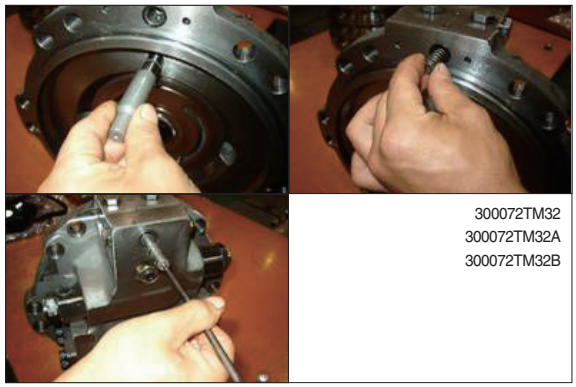
300072TM31

(13) Disassemble valve casing sub.

※ Try to deal with needle bearing (3) without any damage.

① Disassemble plowing road (60), automatic changeover spring (68), and automatic changeover spool (64).

※ Do not touch hexagon nut (63) for controlling the amount of an oil and lock screw (62).
If there is any abnormality on plowing spool and spring, exchange them to new ones.



300072TM32
300072TM32A
300072TM32B

② After unloading hexagon socket bolts (49, 50) and taking caps (47,48) away, disassemble parts of counter balance valve (37~46).

※ In disassembling counter balance valve, be careful of figuring out the directions such as the right or the left of finger.
If there is any abnormality in spool spring check, exchange it to new one.



300072TM33
300072TM33A
300072TM33B
300072TM33C
300072TM33D

(14) Disassemble cylinder sub.

① Disassemble set plate (25) and piston (26) sub.



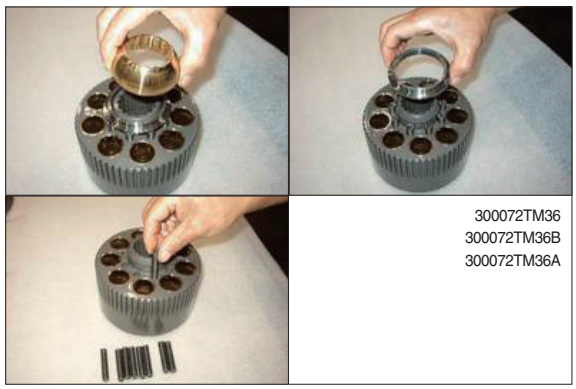
300072TM34

② Disassemble friction plate (27) and lee plate (28) in cylinder block (21).



300072TM35

③ Dismantle ball guide (24), spacer (23), and cylinder spring (22).



300072TM36
300072TM36B
300072TM36A

3) ASSEMBLING TRAVEL MOTOR

(1) Assemble the sub of a turning axis.

① After assembling bearing spacer (12) into a turning axis (11), have cylinder roller bearing (13) thermal-reacted.

a. In the thermal reaction of cylinder roller bearing, use and induction heating apparatus and adjust the temperature as about 100˚C.

b. Deal moisturized copper part oil seal in a turning axis without any damage of it.



300072TM51
300072TM51A
300072TM51B

(2) Assemble ring stop (14) with a plier.

※ Be careful of the direction of ring stop. (The direction of round is the side of bearing)



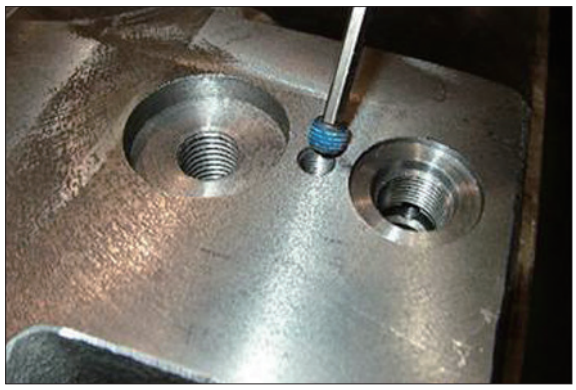
300072TM52

(3) Assemble valve casing sub.

① Bond seven pieces of plug (2) in valve casing (33) with standard torque.

② After taping plug with seal taper and spread rock tight, assemble it.

· Tightening torque : 7~11 kgf · m
(50.63~79.5 lbf · ft)



300072TM53

(4) Compress pin (36) into.

※ Using a hammer, make the height of pin 5 ㎜ from the a contact surface of valve plate.



300072TM54

(5) Assemble needle bearing (34).



300072TM55

(6) Assemble seat (51), ball (52), stopper (53), and hp plug (54) with O-ring (55), respectively.

① Be careful of the procedure and direction of assembling seat and stopper.

· Tightening torque : 37 ㎏f · ㎝
(267.6 lbf · ft)



300072TM56

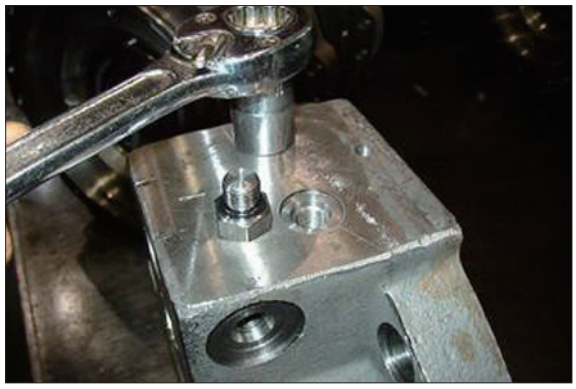


300072TM56A

(7) Assemble hp plug (54) set up with O-ring (55).

· 5sites

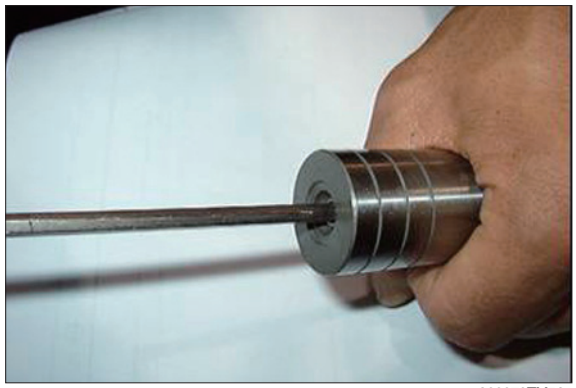
· Tightening torque : 37 ㎏f · ㎝
(267.6 lbf · ft)



300072TM57

(8) Bond orifice screw (38) on the right and left side of spool c.b (37) with a standard torque.

· Tightening torque : 7 kgf · m
(50.63 lbf · ft)



300072TM58

(9) Insert hold spool c.b (37) and damper check (39) into valve casing.



300072TM59 300072TM59A
300072TM59B 300072TM59C

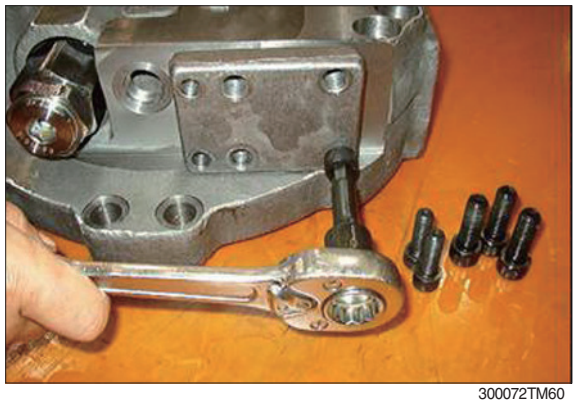
(10) Bond cap R (47) and cap L (48) with hexagon socket bolts (49, 50).

① Remember not to exchange cap R, L each other in assembling.

Tightening torque

· M12 : 100 kgf · m (item 49)

· M10 : 67 kgf · m (item 50)



300072TM60

(11) After fastening with torque, insert automatic plowing spool (04), spring (68) and O-ring (69).

· Tightening torque : 75 kgf · m
(542.4 lbf · ft)



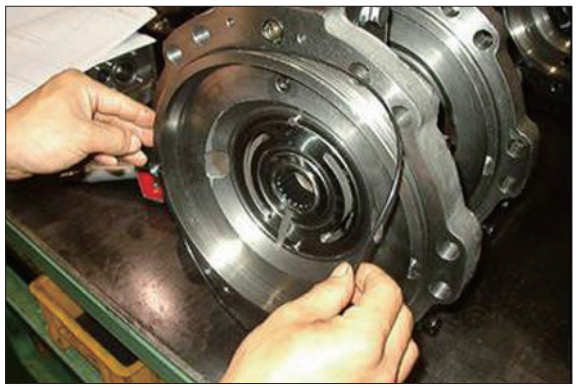
300072TM61 300072TM61A

(12)Assemble swash road (60) inserted by O-ring (61).



300072TM62

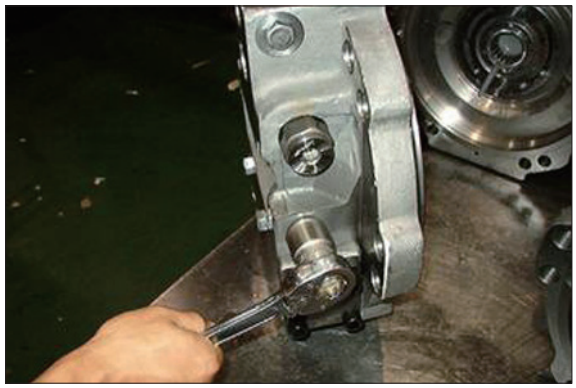
(13)Insert O-ring (32) into valve casing.



300072TM63

(14)Bond drain plug (30) inserted by O-ring (31) with standard torque.

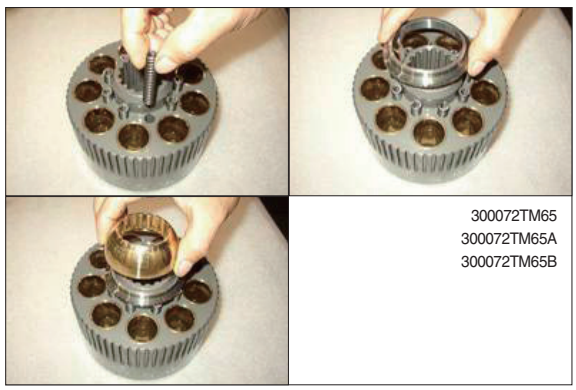
· Tightening torque : 100 kgf · m (723.3 lbf · ft)



300072TM64

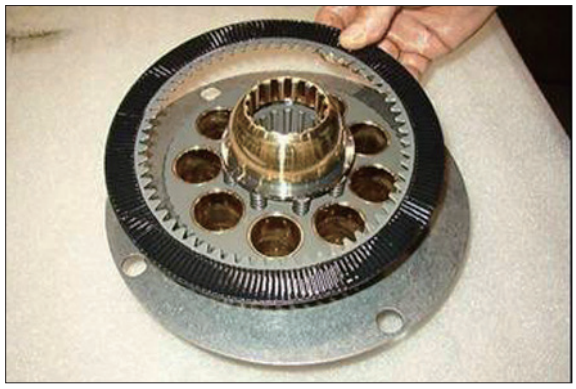
(15)Assemble cylinder sub.

① Assemble cylinder spring (22), spacer (23), and spherical surface bush (24) into cylinder (21).
Set the position of spline of spherical surface bush and cylinder.



300072TM65
300072TM65A
300072TM65B

(16) Assemble friction plate (27) and separated plate (28) into cylinder.



300072TM66

(17) After insert piston shoe (26) into set plate (25), assemble it into cylinder.



300072TM67



300072TM67A

(18) Using jig, compress oil seal (73) into shaft casing (01).



300072TM68

(19) Assemble the body of a motor.

① Bond seven piece of plug (02) in shaft casing plug with standard torque.

a. After taping plug with seal taper and spread rock tight, assemble it.
· Tightening torque : 7~11 kgf · m (50.63~79.5 lbf · ft)



300072TM69



300072TM69A

(20) Using a hammer and a handle, compress pin (5, 6).

① Pin (5) : Set the height as 10 mm from the contact surface of a plate supporter. - 2pieces.

Pin (6) : Set the height as 19 mm from the manufactured surface of shaft casing. - 4pieces.



300072TM70 300072TM70A

(21) Assemble sub of a turning axis.



300072TM71

(22) Assemble plate supporter (15) with M12 bolt.

※ Be careful of the direction of plate supporter driven.



300072TM72

(23) Assemble plate (16) into plate supporter.

① Spread grease in moisturized copper part of plate.

② Confirm the soft movement of plate.



300072TM73

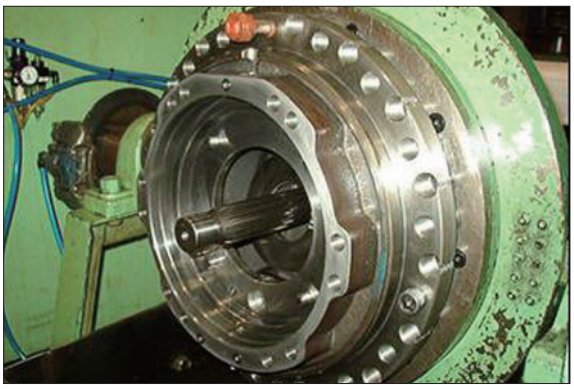
(24) Assemble stopper L (36) combined by plowing piston (35) and O-ring (42).



300072TM74 300072TM74A

(25) Rotating dismantling and assembling jig up to 90˚ make shaft from perpendicular to horizontal.

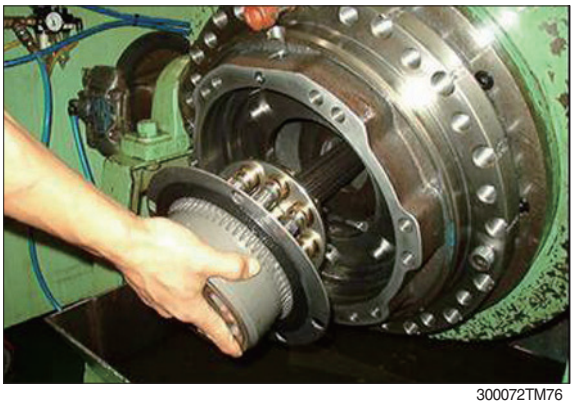
※ Be careful that plate is not segregated from plate supporter.



300072TM75

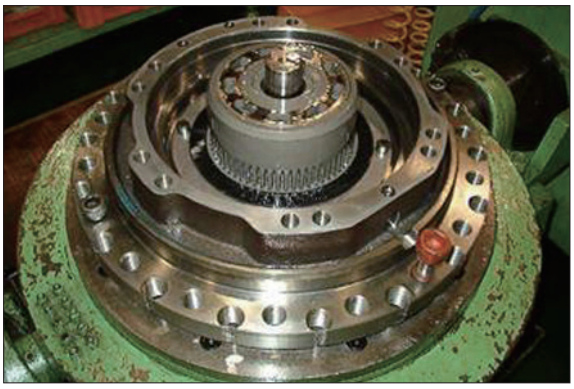
(26) Assemble cylinder sub.

※ Adjusting pin into holes of separated plate, assemble it.



300072TM76

(27) Rotating dismantling and assembling jig up to 90˚, make the direction of shaft from the horizon to the perpendicular.



300072TM77

(28) Assemble piston ring (30), piston ring 252 (30) and 278 (31) into brake piston (29).



300072TM78

(29) Assemble brake piston into shaft casing.

※ Be careful of the direction of assembling brake piston.

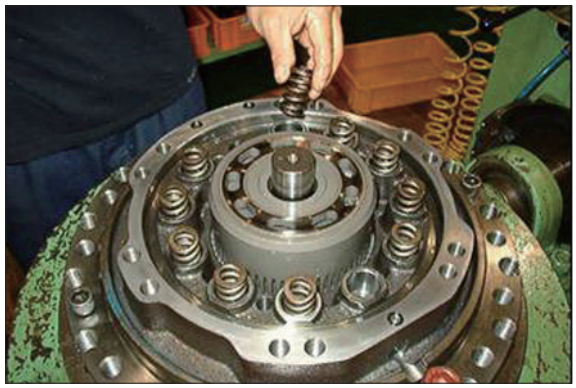


300072TM79

(30) Assemble brake spring (32).

※ Quantity : Spring-10pieces, Holes-11pieces

※ Do not assemble on the top of brake piston.



300072TM80

(31) Insert O-ring (69), after fastening orifice screw (4) with standard torque.

· Quantity and size : (4) 2 pieces- ø 1.0

(56)1pieces- ø 1.5

· Tightening torque : 7 kgf · m (50.63 lbf · ft)



300072TM81

(32) After inserting valve plate (67) into valve casing, bond it into shaft casing with hexagon socket bolt (70).

① Spread grease on the back side of valve plate, in order for valve plate to be adhered well.

② Use a crane in assembling it into valve plate shaft casing.

③ Set holes, ø5, of valve plate heading toward the port of the inlet and outlet of valve casing.

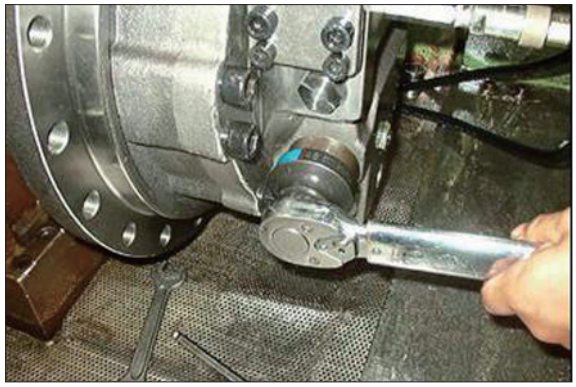
④ Spread grease in the side of plowing spool of plowing spring in order that plowing spring can not be detached.

- Tightening torque : 240 kgf · m (1736 lbf · ft)
- Tightening torque : 180±10 kgf · m (1302±72.3 lbf · ft)



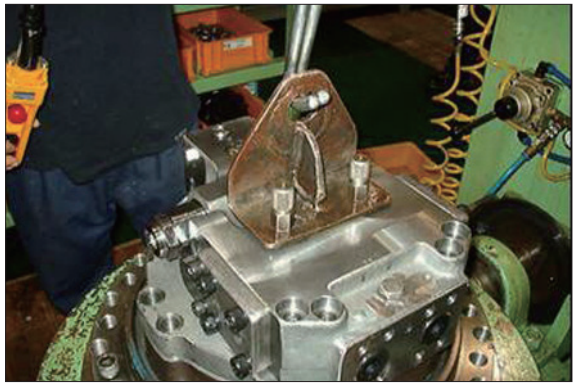
300072TM82

(33) Bond relief valve (57) with standard torque.



300072TM83

(34) Unloosen four pieces of bolts (M20×50L) fixing a motor and remove the motor away from jig.



300072TM84

3. 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.



300078RD01

2) Setting reduction unit (or whole propelling unit) on work stand for disassembling

(1) Remove hexagon socket head bolts (M10, 19) at 3 places from cover (17) almost equally each other, and then install eye bolts (M10).

Lift up the unit using them and place it on work stand with cover upward.

※ Take great care not th pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

3) Removing cover

(1) Remove the rest of hexagon socket head bolts(M10, 19) that secure ring gear.

Loosen all the socket bolts and then, disassemble cover.

(2) As the cover(17) is adhered to ring gear (14), dissemble ring gear (14) and cover (17) by lightly hammering slantwise upward using sharpen punch inserted between the cover and ring gear.

4) Removing No.1 carrier sub assy

(1) Remove No.1 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.



300078RD02

(2) Screw three eye bolt (M10, 15) in No.1 carrier and lift up and remove No.1 carrier assy.



300078RD03

5) Removing No. 2 carrier sub assy

(1) Remove No.2 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.2 sun gear.



300078RD04

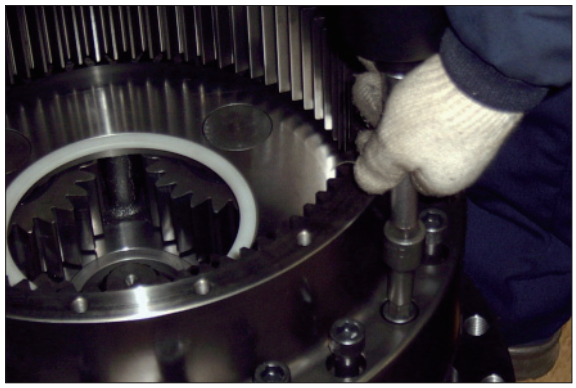
(2) Screw three M10 eye bolt in No.2 carrier and lift up and remove No.2 carrier assy.



300078RD05

6) Removing ring gear

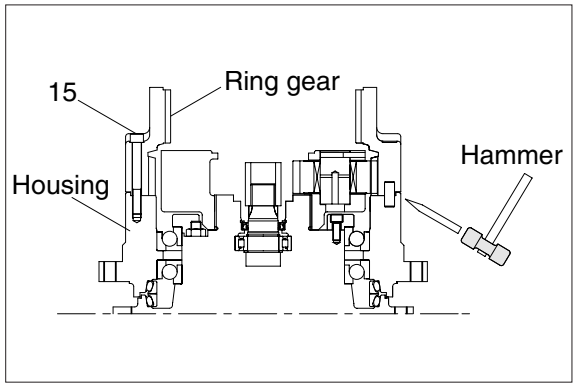
(1) Remove hexagon socket head bolts(M14, 15) that secure ring gear and housing.



300078RD06

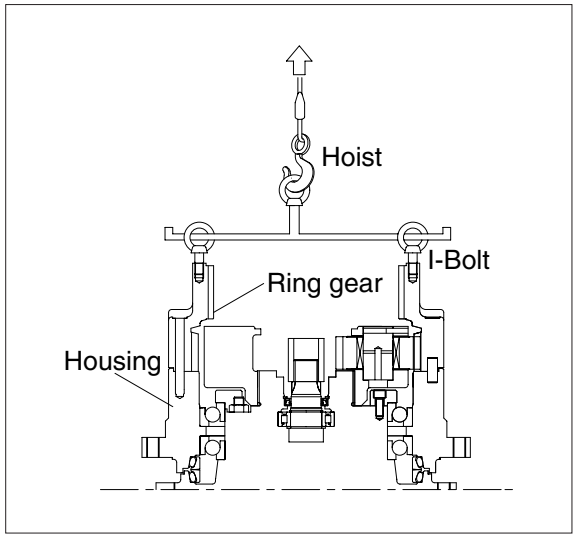
(2) As the ring gear (14) is adhered to housing (3), disassemble ring gear (14) and housing (3) by lightly hammering slantwise upward using sharpen punch inserted between the ring gear and housing.

※ Carefully disassembling ring gear not to make scratch on it.



2907A8RD01

(3) Screw three eye bolt (M10) in ring gear and lift up and remove it.



2907A8RD02

7) Remove No.3 carrier sub assy

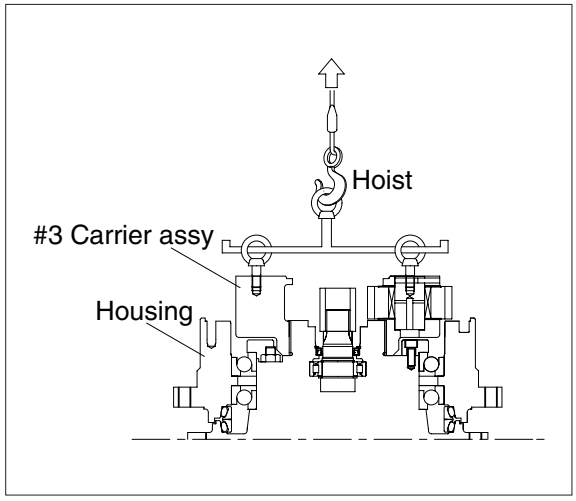
(1) Removing No.3 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.3 sun gear.



300078RD09

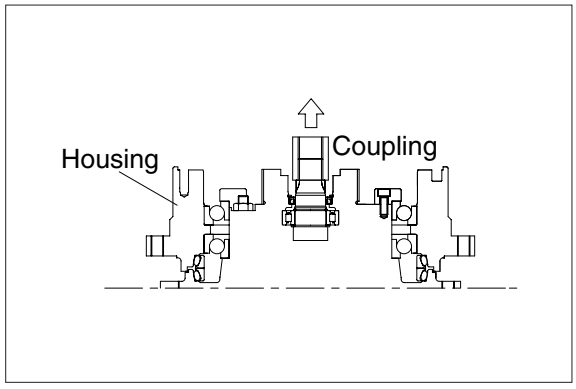
(2) Screw three eye bolt (M10) in No.3 carrier and lift up and remove No.3 carrier assy.



2907A8RD03

8) Remove coupling

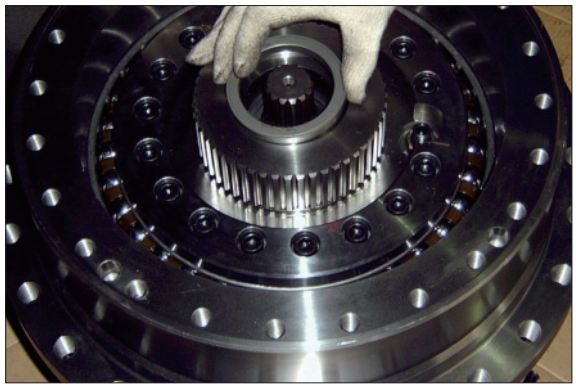
(1) Remove coupling



2907A8RD04

9) Remove motor ring

(1) Remove motor ring using hand.

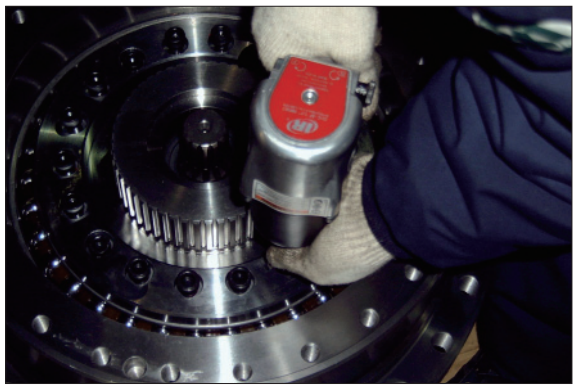


300078RD12

10) Removing retainer & shim

(1) Remove hexagon socket (M12) head bolts that retainer and motor.

(2) Remove retainer & shim.



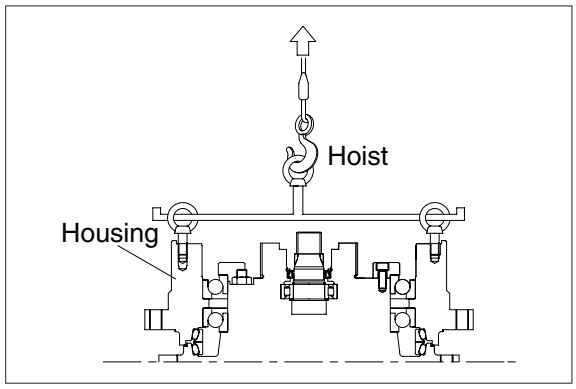
300078RD13

11) Removing housing sub assy

(1) Screw eye bolt (M14) in housing and lift up housing assembly including angular bearing and floating seal.

12) Removing floating seal

(1) Lift up a piece of floating seal of motor side.

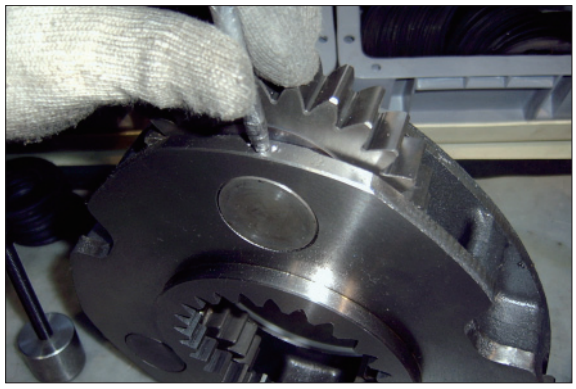


2907A8RD05

13) Dissembling housing assembly

(1) After turning housing, lift up a piece of floating seal from housing and then remove it.

※ Don't disassemble angular bearing.



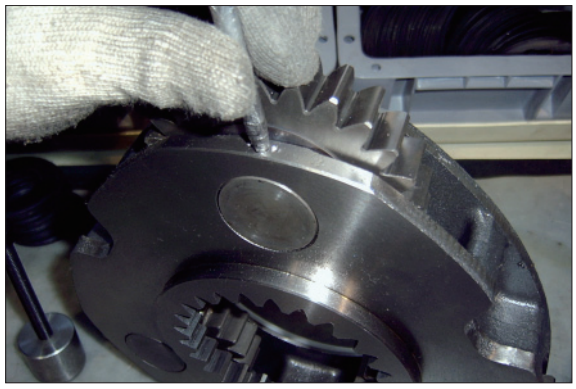
300078RD15

14) Dissembling No.1 carrier

(1) Remove thrust ring (16) from carrier.

(2) Knock spring pin (89-6) fully into No.1 pin (90-5).

(3) Remove planetary, thrust washer, No.1 pin, bearing from carrier.



300078RD15

15) Disassembling No.2,3 carrier

(1) Disassemble (14) carriers, using the same method for No.1 carrier assembly.

6. ASSEMBLING REDUCTION GEAR

- General precautions

  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. 242 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 surface or on O-rings.

1) Assembling No.1 carrier

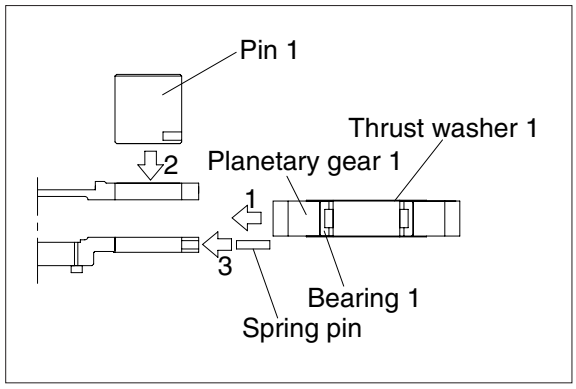
(1) Put No.1 carrier (90-1) on a flat place.

(2) Install No.1 needle bearing (90-3) into No.1 planetary gear (90-2), put 2 ea of No.1 thrust washer (90-4) on both sides of bearing, and then install it into carrier.

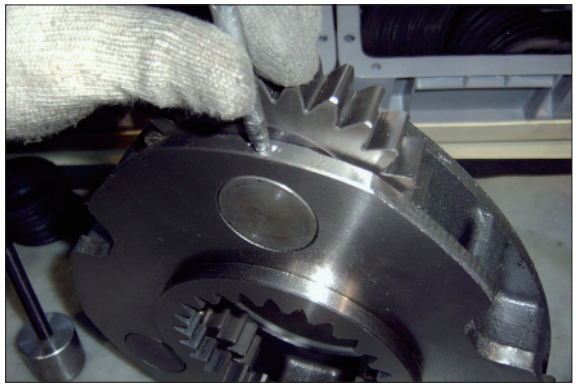
(3) Install No.1 pin (90-5) into No.1 carrier where the holes for No.1 pin (90-5) are to be in line with those of No.1 carrier, and then, install spring pins into the holes.

(4) Caulk carrier holes as shown on the picture.

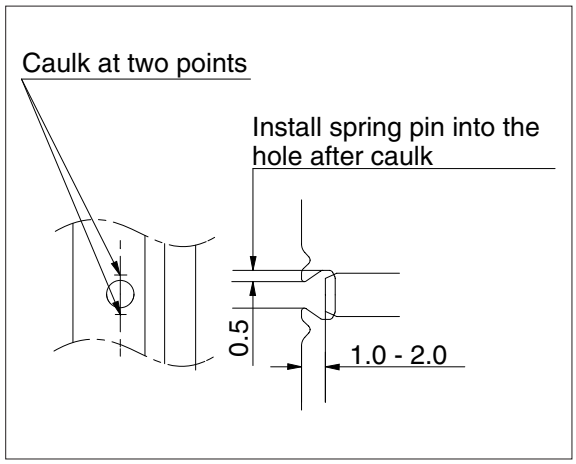
(5) Assembly ring thrust (96) into carrier.



2907A8RD06



300078RD15



2907A8RD19

2) Assembling No.2 carrier

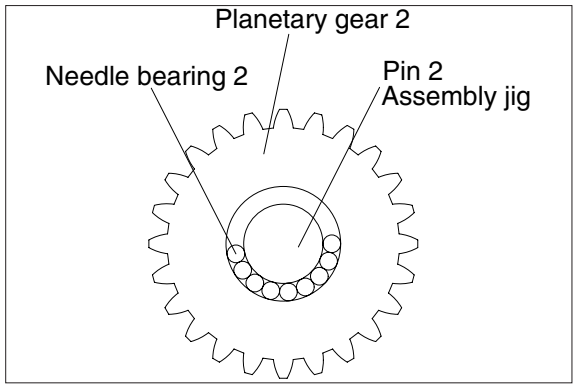
(1) Make No.2 planetary gear (89-2) vertical, assemble 8-9 ea of No.2 needle (89-3), and then, assemble the remaining No.2 needle by use of the assembly jig for No.2 pin (89-5).

(2) Remove out the assembly jig for No.2 pin and assemble 2 ea of No.2 thrust washer (89-4) into No.2 carrier (89-1).

(3) Insert No.2 pin (89-5) into carrier where the holes of No.2 pin (89-5) are in line with those of carrier.

(4) Hammer spring pin (89-6) to insert into carrier hole and No.2 pin hole, and then, caulk. Assemble 2 sets using the same method.

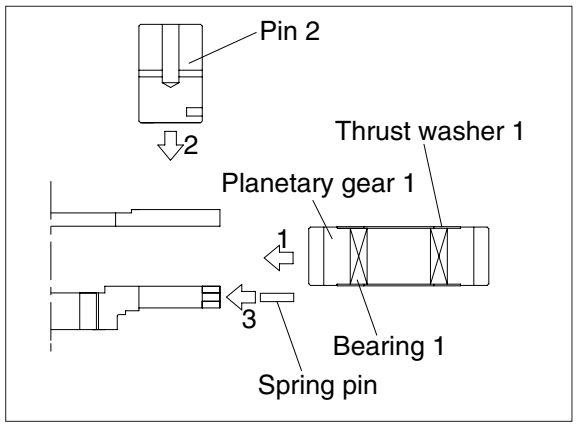
(5) Assemble ring thrust (98) into carrier.



2907A8RD07

3) Assembling No.3 carrier

(1) Assemble 4 sets, using the same method for assembly of No.2 carrier.

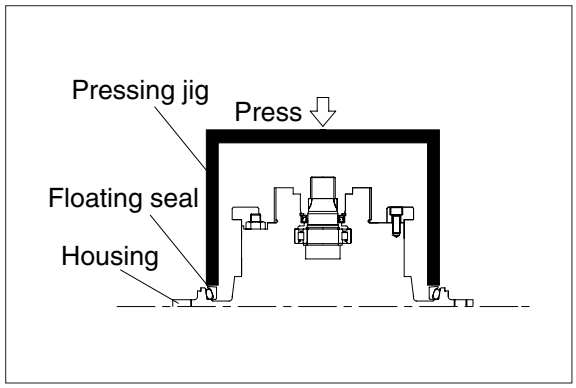


2907A8RD08

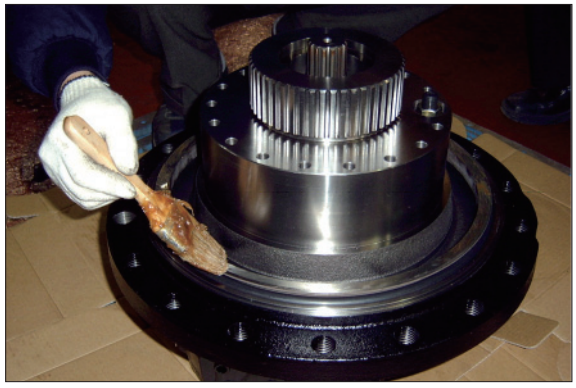
4) Installing floating seal

(1) Assemble floating seal into motor by use of pressing jig.

(2) Grease the contact parts for floating seal which is assembled into motor.



2907A8RD09



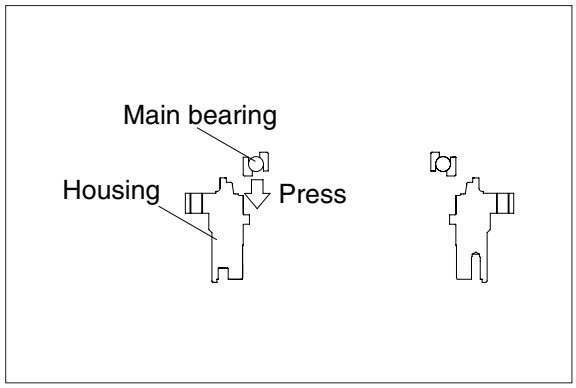
300078RD21

5) Assembling housing

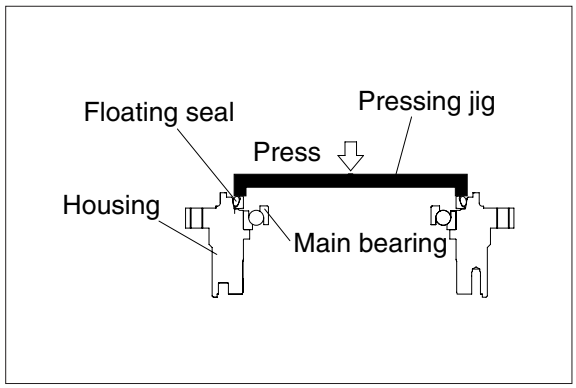
(1) Heat housing at 60~70˚C while clearing it out and then, assemble bearing.

(2) Assemble floating seal into housing by use of pressing jig as shown on the picture.

※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.



2907A8RD10



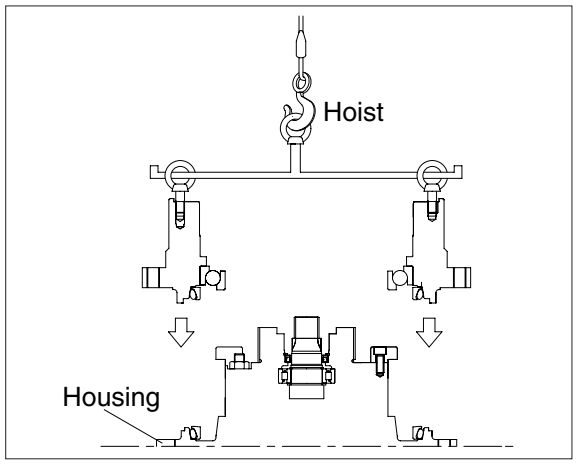
2907A8RD11

6) Installing housing assembly

(1) Install 2 ea of eye bolt (M14) into housing assembly.

(2) Assemble housing into motor by use of hoist and eye bolt.

※ Be sure to tighten eye bolt deep enough.

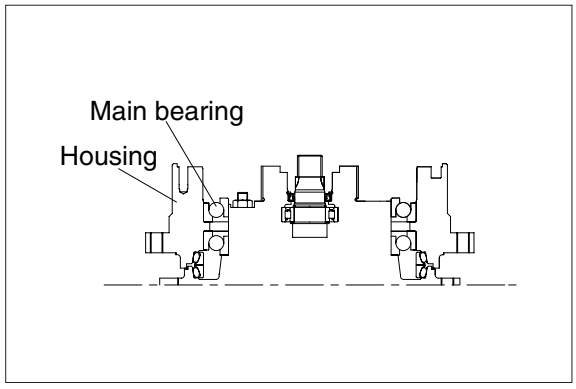


2907A8RD12

7) Installing main bearing

(1) Heat main bearing at 60~70˚C and then, install.

※ Be sure to maintain it vertical with the ground when assembling bearing.

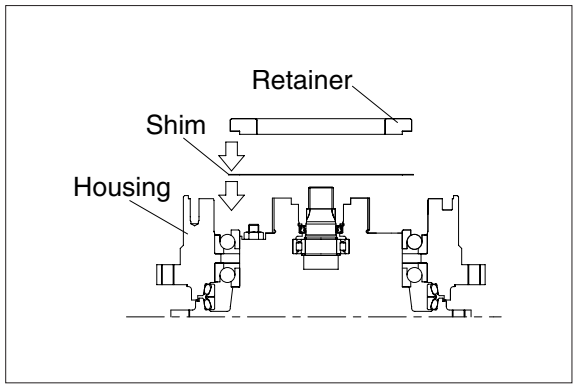


2907A8RD13

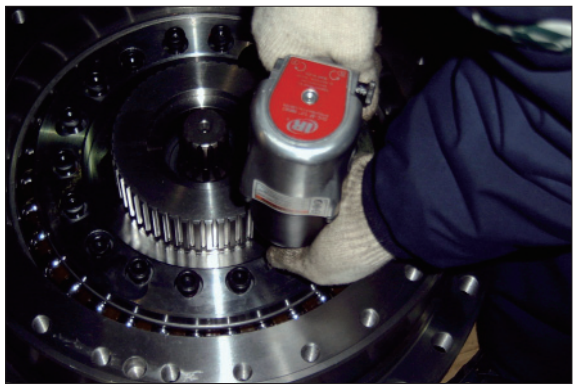
8) Installing retainer (86) and shim (85)

(1) Measure clearance between main bearing and retainer by use of jig to decide the thickness of shim and select and appropriate shim, and then, assemble retainer.

(2) Apply locktite (#242) on hexagon socket head bolt (M12), and then, bolt.



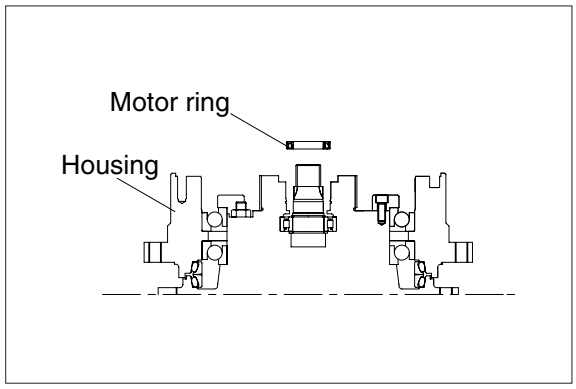
2907A8RD14



300078RD13

9) Installing motor ring

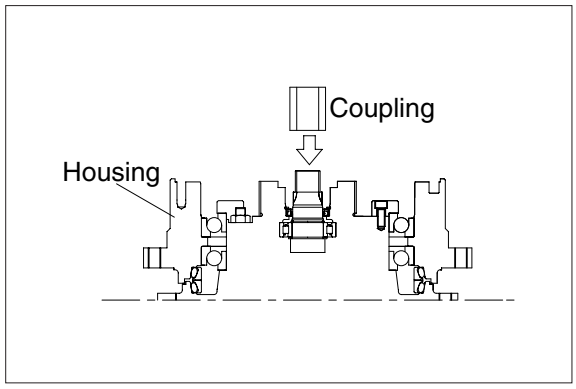
(1) Insert motor ring into motor to install.



2907A8RD15

10) Installing coupling

(1) Install coupling on spline of the motor.



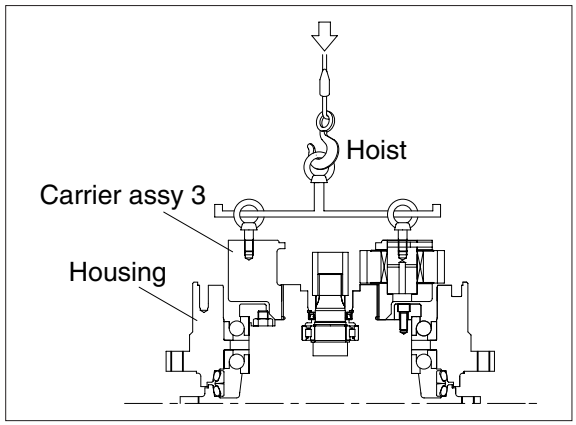
2907A8RD16

11) Installing No.3 carrier sub assy

(1) Install eye bolt(M10) on No.3 carrier assembly.

(2) Lift No.3 carrier assembly and then, assemble it into reducer.

※ Match it vertical with the spline of the motor and the, slowly lower.



2907A8RD17

12) Installing ring gear

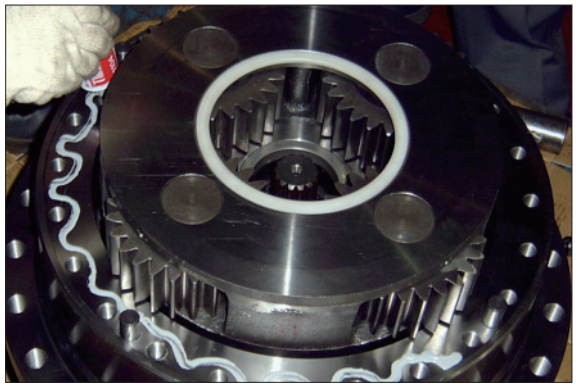
(1) Apply three bond #1104 (Locktite #515) on housing for ring gear without gap.

(2) Insert lock pin into housing hole.

(3) Install eye bolt (M12) on the tap for cover of ring gear.

(4) Lift ring gear and then, assemble into housing.

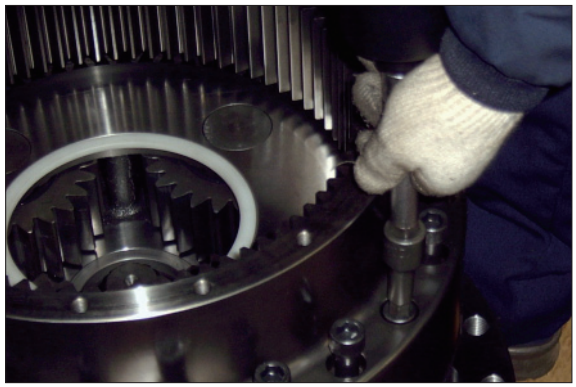
(5) Apply locktite to hexagon socket bolt (M14) and then, bolt, having appropriate torque.



300078RD30



300078RD31

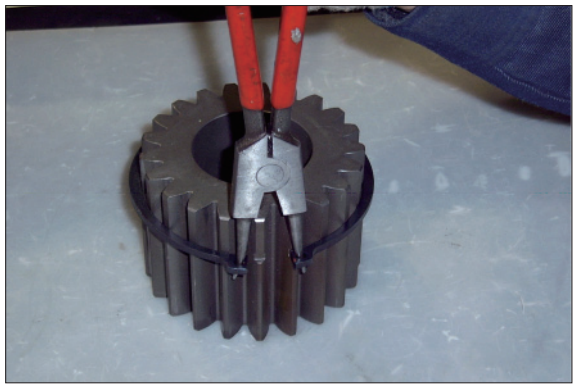


300078RD06

13) Installing No.3 sun gear (88-7)

(1) Install snap ring (88-8) in No.3 sun gear(88-7) by use if snap ring flier.

(2) Install No.3 sun gear on the spline of No.3 carrier, matching teeth of them.



300078RD32



300078RD09

14) Installing No.2 carrier sub assy

(1) Install eye bolt (M10) 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 in ring gear.

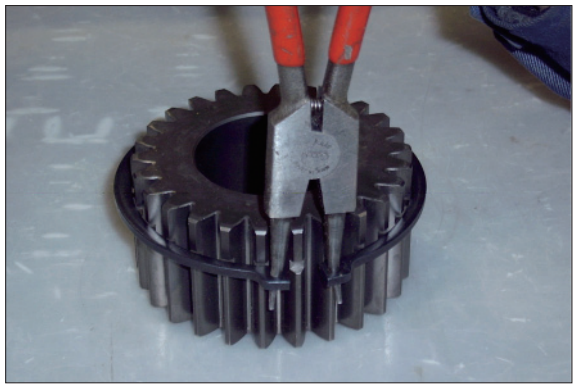


300078RD05

15) Installing No.2 sun gear (89-7)

(1) Install snap ring (89-8) on No.2 sun gear (89-7) by use of snap ring flier.

(2) Install No.2 sun gear on the spline of No.2 carrier and No.2 planetary gear, matching teeth of them.



300078RD33



300078RD04

16) Installing No.1 carrier sub assy

(1) Install eye bolt (M10) on No.1 carrier assembly.

(2) Lift No.1 carrier assembly and then, put it down on ring gear slowly.

(3) Rotate planetary gear by hands to install on ring gear, matching their teeth.



300078RD03

17) Installing No.1 sun gear (91)

(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.



300078RD02

18) Installing cover (97)

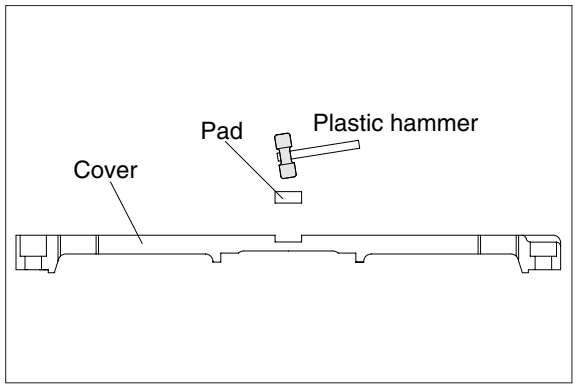
(1) Beat pad with plastic hammer, and press it into the center of cover.

(2) Apply three bond #104 (locktite #515) on the ring gear for without gap.

(3) Put cover on ring gear, apply locktite (#242) in hexagon socket head bolt (M10), and then, bolt.

(4) Fill gear oil (8L) into drain port.

(5) Apply sealing tape (teflon) on PT3/4 plug and then, bolt.



2908ARD18



300078RD35

GROUP 6 TRAVEL DEVICE (TYPE 2, 3)

1. REMOVAL AND INSTALL

1) REMOVAL


13031GE18

(1) Swing the work equipment 90° and lower it completely to the ground.

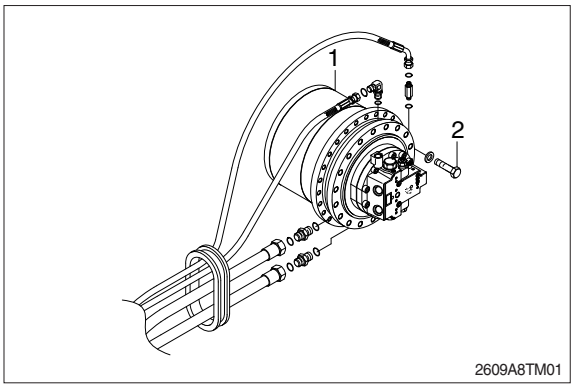
(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(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.**



2609A8TM01

(5) Remove the cover.

(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 430 kg (950 lb)

2) INSTALL

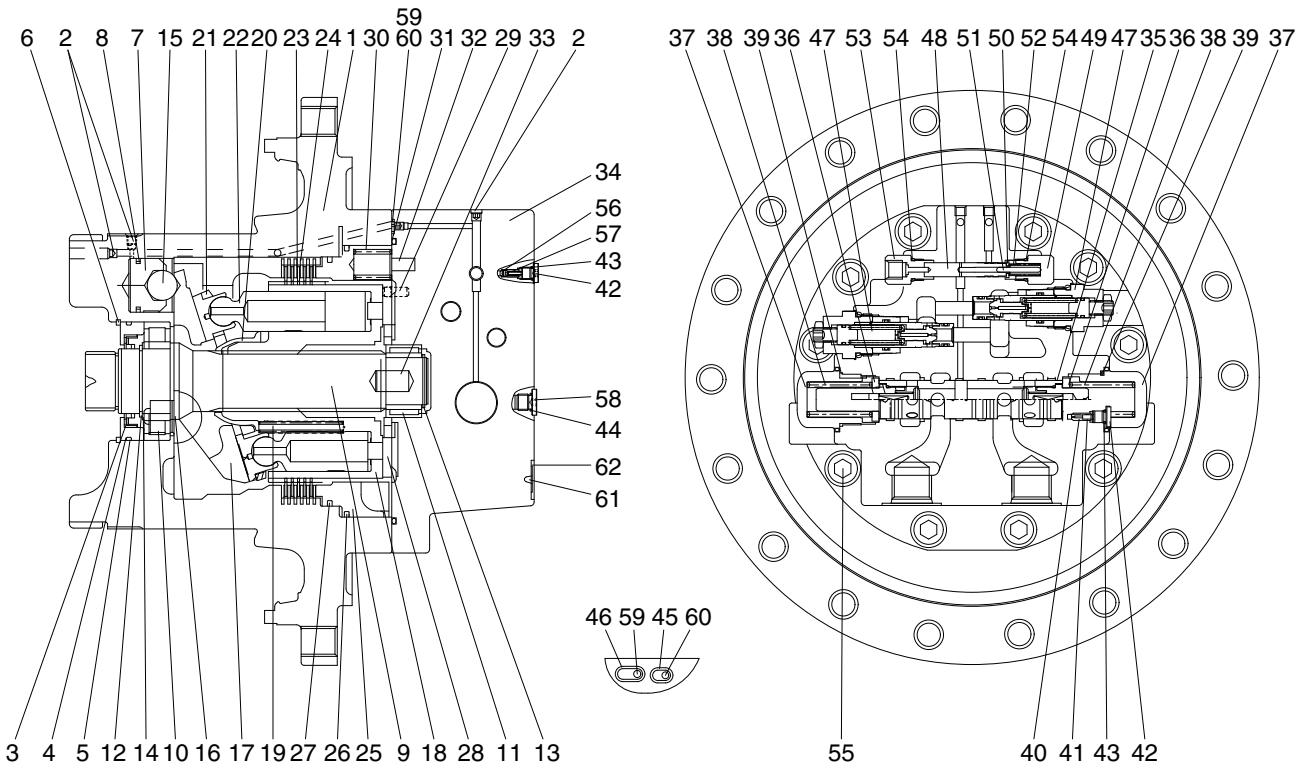
(1) Carry out installation in the reverse order to removal.

(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. SPECIFICATION

1) TRAVEL MOTOR



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

2) TOOL AND TIGHTENING TORQUE

(1) Tools

Name of tools	B-size	Name of part applied
Hexagonal L-Wrench	4	Plug (2), Orifice screw (3, 4, 38)
	8	Hex socket bolt (50), Lock screw (62, 72), Plug (65)
	10	Hex socket bolt (49)
	46	Hex (57)
Socket wrench/ spanner	19	Hp plug (54)
	24	Hex nut (63)
	27	Hp plug (56)
Snap-ring plier (for holes, axis)		Ring stop (14), Ring lock (74)
Solder hammer		Needle bearing (34), Pin (5, 6, 36)
Torque wrench		Size : 500, 3000
Jig for assembling oil seal		Oil seal (73)
Induction heating apparatus for bearing		Roller bearing (13)

(2) Tightening torque

NO.	Part name	Standard	Size	Torque	
				kgf · m	lbf · ft
2	Plug	NPTF 1/16	4	0.9±0.2	6.51±1.45
3, 4, 38	Orifice screw	NPTF 1/16	4	0.7	5.06
49	Hex socket bolt	M12	10	10	72.33
50	Hex socket bolt	M10	8	6.7	48.46
54	Plug	PF 1/4	19	3.7	26.76
56	Plug	PF 1/2	27	11	79.56
57	Relief valve	HEX 27	1 5/16	34±3.4	246±24.6
63	Nut	M16	24	24	173.59
65	Plug	PF 3/8	8	7.5	54.25
70, 72	Hex socket bolt	M16	14	24	173.59
71	Hex socket bolt	M16	14	24	173.59

3. DISASSEMBLING

1) GENERAL INSTRUCTIONS

⚠ **Combustibles such as white kerosene are used for washing parts.**
These combustibles are easily ignited, and could result in fire or injury.
Be very careful when using.

⚠ **Internal parts are coated with hydraulic fluid during disassembling and are slippery.**
If a part slips out of your hand and fails, it could result in bodily injury or could damage the park.
Be very careful when handling.

(1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.

(2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.

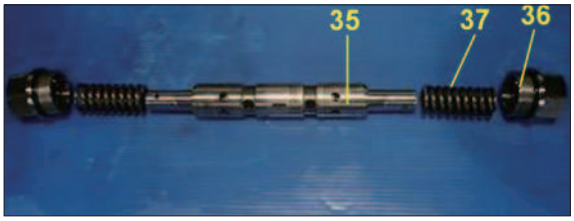
(3) Bofore disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

(4) The piston can be inserted to whichever cylinder block for the initial assembling.
However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.

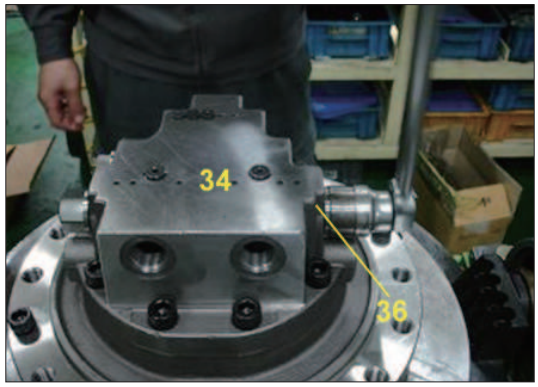
⚠ **Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.**

2) DISASSEMBLING TRAVEL MOTOR

(1) Disassemble main spool cover (36) into rear cover (34) using spanner and torque wrench and then disassemble spring (37), main spool assy (35).

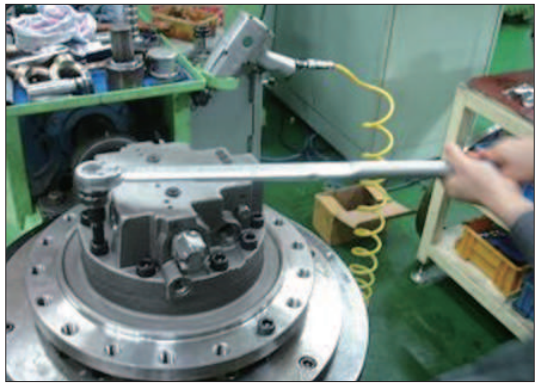


2609A8TM02



2609A8TM03

(2) Disassemble wrench bolt (54) using torque wrench.



2609A8TM04

(3) Take out rear cover (34) into casing (1).



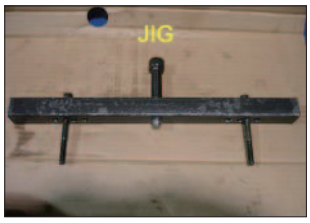
2609A8TM05

(4) Remove brake spring (30, 14EA)

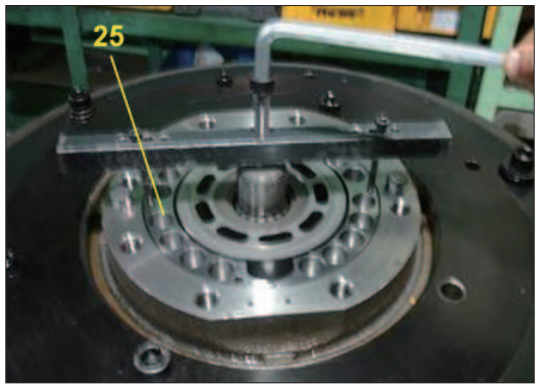


2609A8TM06

(5) Disassemble parking piston (25) using jig.

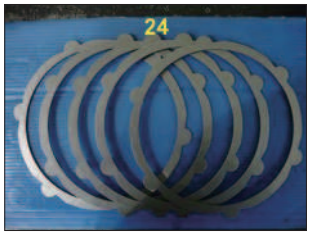


2609A8TM07

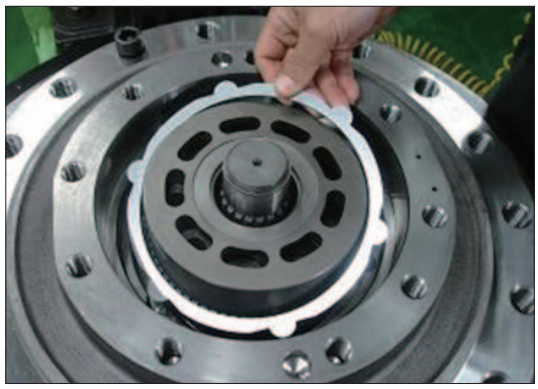


2609A8TM08

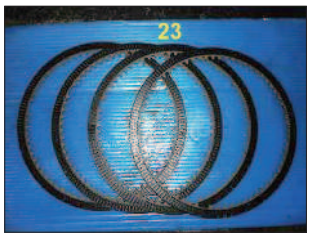
(6) Disassemble separate plate (24, 5EA) and friction plate (23, 4EA).



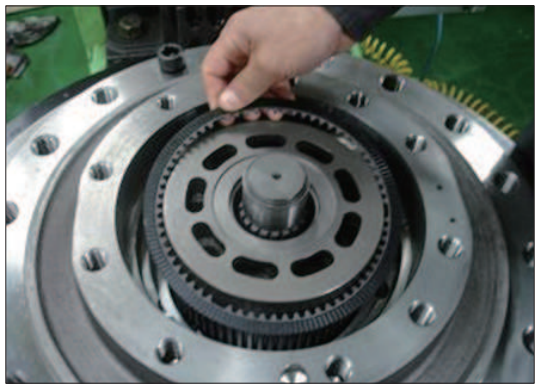
2609A8TM09



2609A8TM10

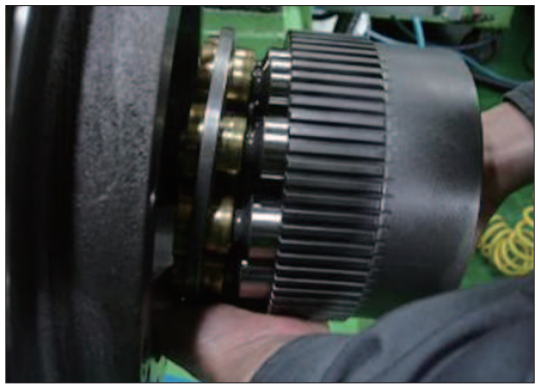


2609A8TM11



2609A8TM12

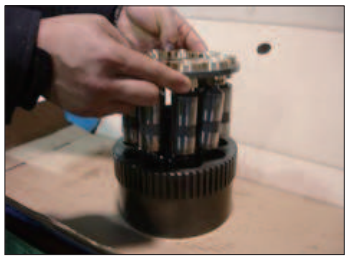
(7) Remove cylinder block kit.
It is easier to work by placing the casing (1) horizontal.

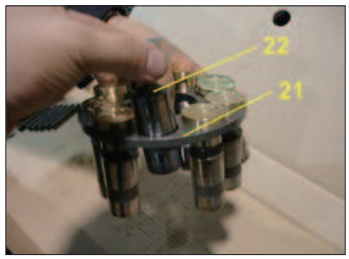


2609A8TM13

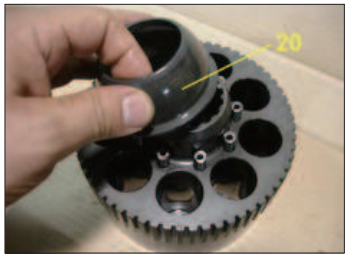
(8) Disassemble cylinder block (18), retainer plate (21), piston assy (22), ball guide (20) and spring (19) into cylinder block kit.


2609A8TM14

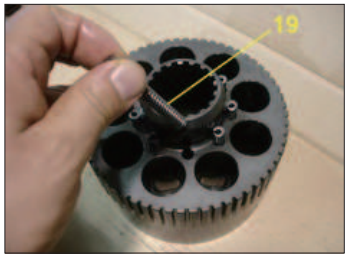

2609A8TM15



2609A8TM16



2609A8TM17



2609A8TM18

(9) Disassemble swash plate (17) into casing (1).



2609A8TM19

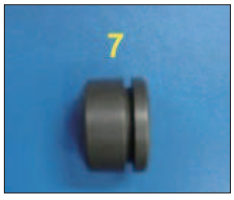

2609A8TM20

(10) Disassemble steel ball (15), swash piston (7) into casing (1).

※ **Hole in the Casing(1) of two speed line is decomposed by injecting air.**



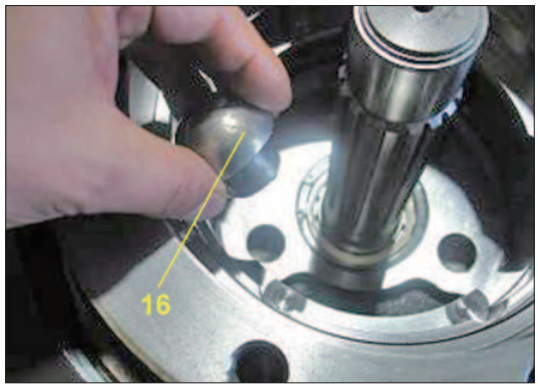
2609A8TM21



2609A8TM22


2609A8TM23

(11) Disassemble pivot (16, 2EA) into casing (1).



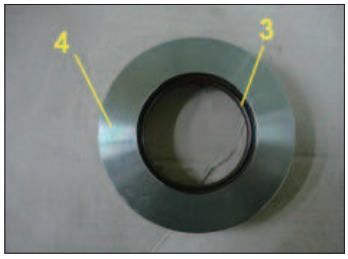
2609A8TM24

(12) Disassemble snap ring (6) using pliers.



2609A8TM25

(13) Disassemble trust block (4) and oil-seal (3) into casing (1).

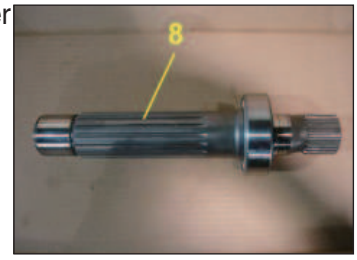


2609A8TM26

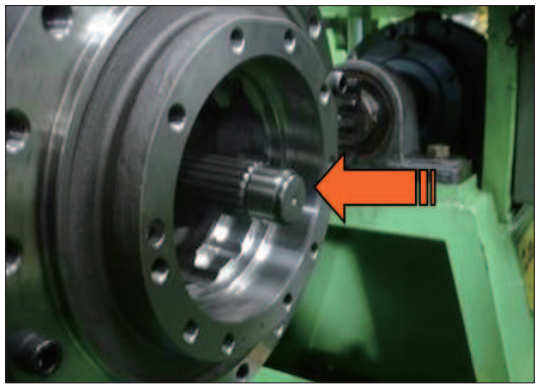


2609A8TM27

(14) In the casing (1), the arrow part of the shaft (8) using a rubber mallet taps and then disassemble the shaft (8) and bearing-roller (10) to the other side.

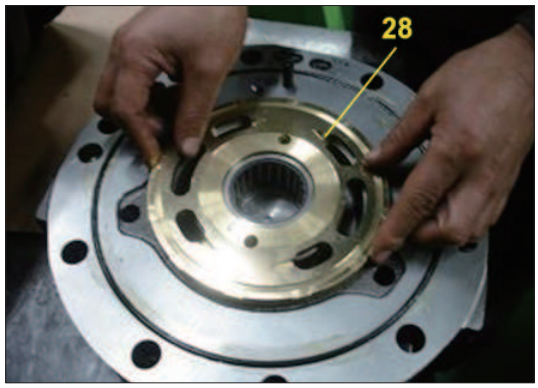


2609A8TM28



2609A8TM29

(15) Disassemble valve plate (28) into rear cover (34).

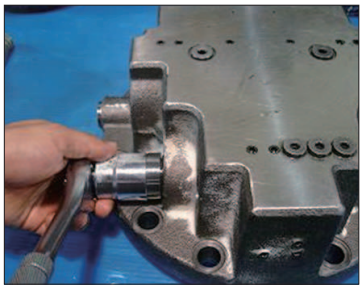


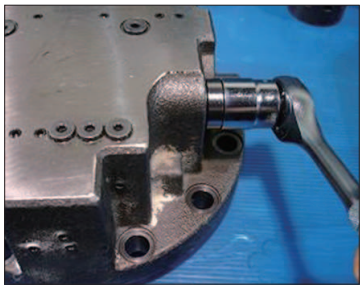
2609A8TM30

(16) Disassemble relief valve (46, 2EA) into rear cover (34) using the torque wrench.



2609A8TM31

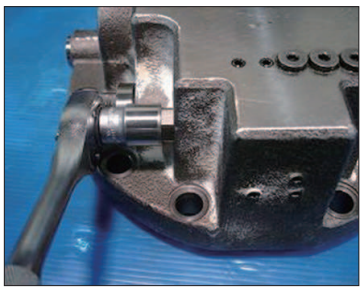

2609A8TM32

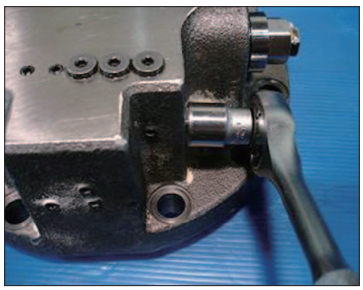

2609A8TM33

(17) Disassemble plug (48), connector (52) into rear cover (34) using the torque wrench and then disassemble spring (51), spring seat (49), parallel pin (50) and spool (47) in regular sequence.

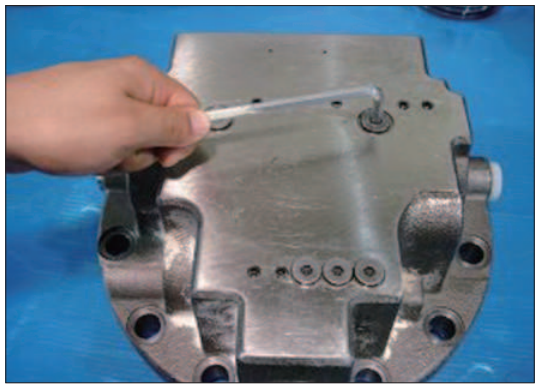


2609A8TM34


2609A8TM35

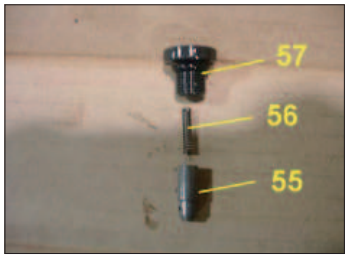

2609A8TM36

(18) Disassemble plug (57) into rear cover (34).

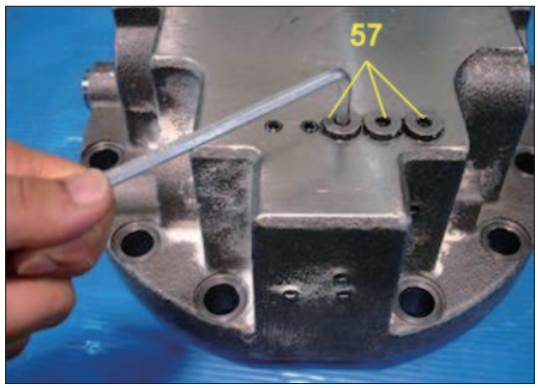


2609A8TM37

(19) Disassemble plug (57) into rear cover (34) and then disassemble spring (56), check valve (55) into rear cover (34) in regular sequence.



2609A8TM38



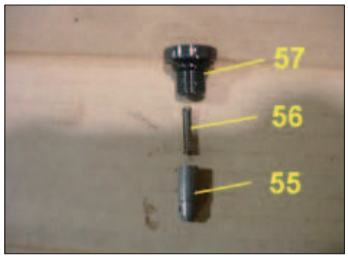
2609A8TM39

4. REASSEMBLING

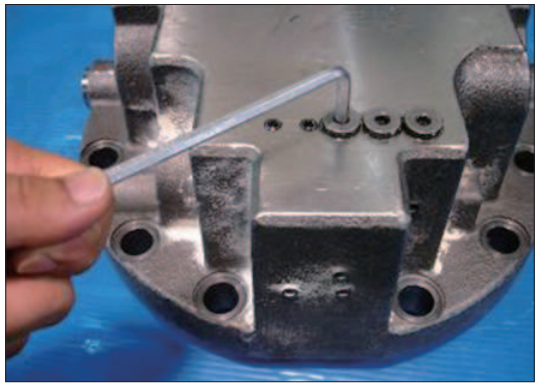
1) ASSEMBLING MOTOR

- REAR COVER ASSY

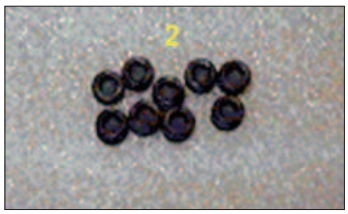
(1) Assemble check valve (55), spring (56) into rear cover (34) and then assemble plug (57) using L-wrench.



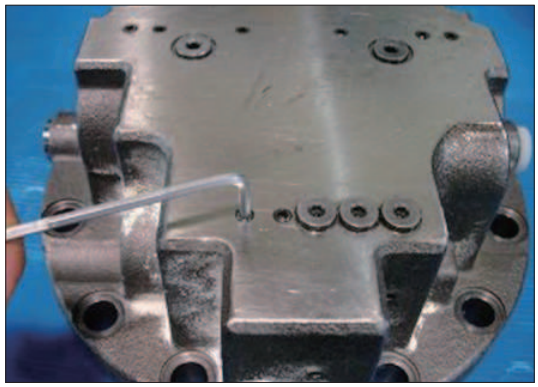
2609A8TM40


2609A8TM41

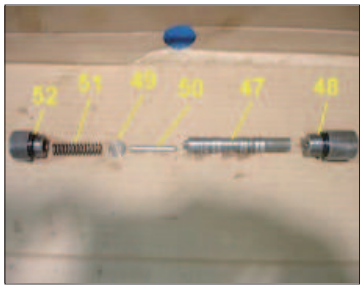
(2) Apply loctite #242 on the NPTF 1/16 plug (2) and then assemble 12-NPTF 1/16 Plug (2) into rear cover(34).



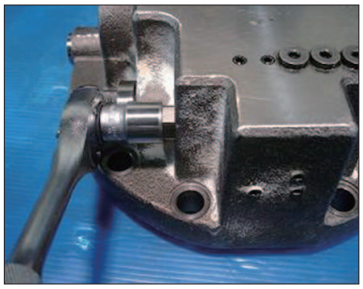
2609A8TM42

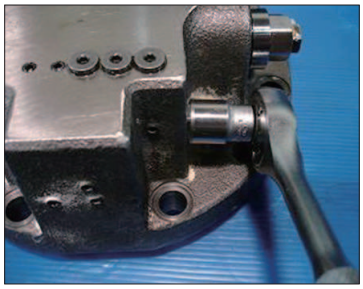

2609A8TM43

(3) Assemble spool (47), parallel pin (50), spring seat (49) and spring (51) into rear cover (34) in regular sequence and then assemble plug (48) and connector (52).



2609A8TM44

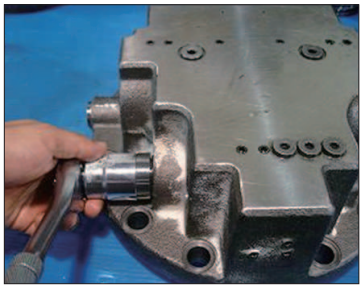

2609A8TM45

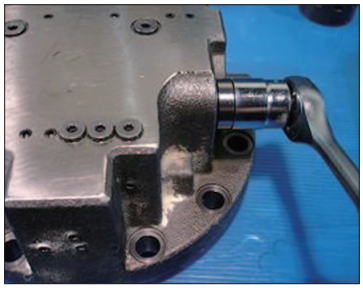

2609A8TM46

(4) Assemble relief valve (42, 2EA) into rear cover (34).

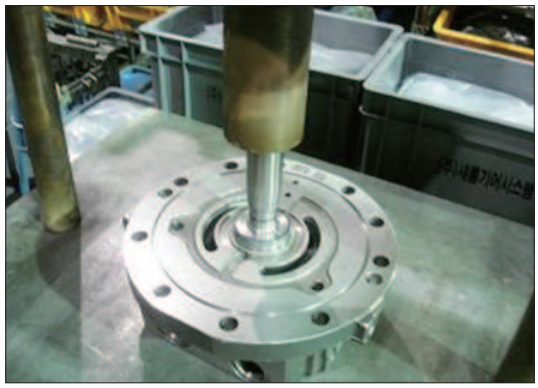


2609A8TM47


2609A8TM48


2609A8TM49

(5) Press needle bearing (11) into rear cover (34) using jig.



2609A8TM50

(6) Assemble spring pin (32) and parallel pin (29) using small hammer.



2609A8TM51

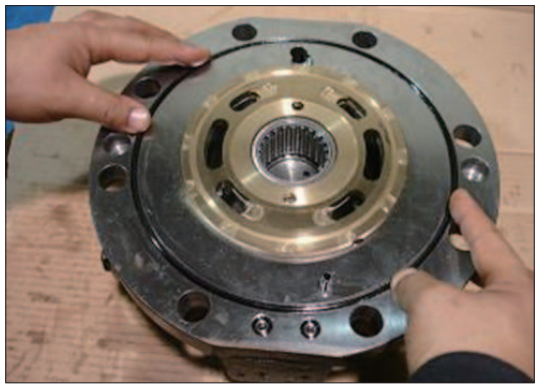
(7) Assemble valve plate (28) into rear cover (34).

※ **Apply grease to the valve plate contact and then assemble valve plate into rear cover (34).**



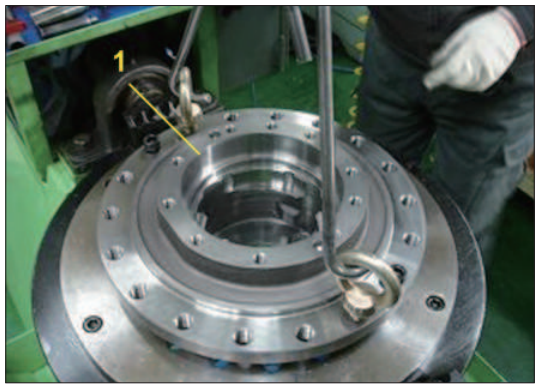
2609A8TM52

(8) Apply grease to the O-ring and then assemble O-ring into rear cover (34).



2609A8TM53

(9) Install casing (1) into assembling jig.



2609A8TM54

(10) Assemble the heated Roller Bearing(10) onto the Shaft(8).

① The temperature of the Roller Bearing : 100˚C.
Using tool : Heater.

※ **Be careful not to damage the sliding surface for the Oil seal on the shaft.**

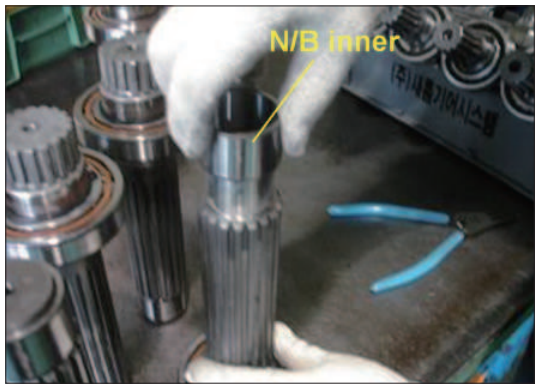

2609A8TM55


2609A8TM56


2609A8TM57

(11) Assemble the heated needle bearing inner ring on the shaft (8).


2609A8TM58

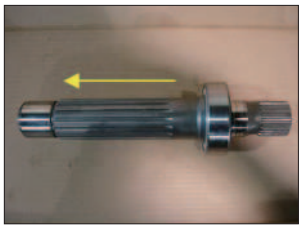


2609A8TM59

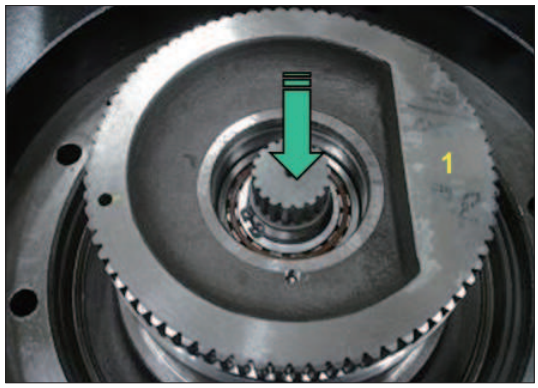
(12) Assemble snap ring (13) into Shaft (8) using pliers.


2609A8TM60

(13) Insert assembled shaft assy in the direction of the arrow into casing (1) using a rubber mallet.

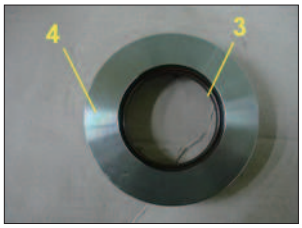


2609A8TM61

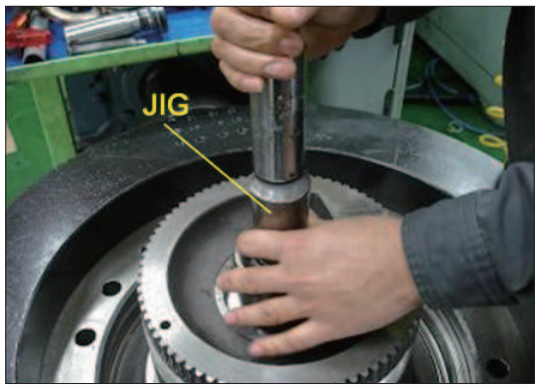


2609A8TM62

(14) Assemble oil seal(3) into trust block (4) with a assembling jig and press it into casing (1). Caution the direction of oil seal (3).



2609A8TM63



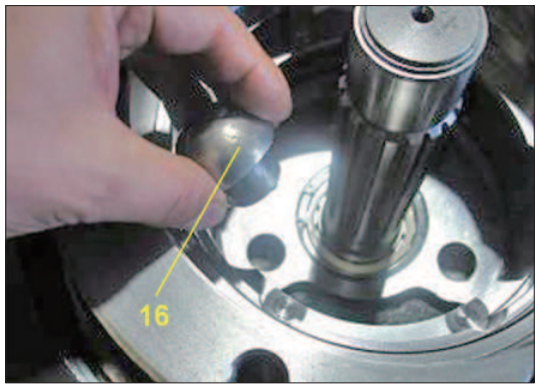
2609A8TM64

(15) Assemble snap ring(6) into casing(1) using pliers.



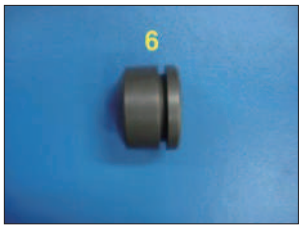
2609A8TM65

(16) Apply the grease to pivot (16, 2EA) and then assemble pivot (16) into casing(1).



2609A8TM66

(17) Warm piston seal (8) and assemble it on swash piston (7) and then bind the piston seal (8) with a bend for a minute.
Remove the bend and assemble it into casing (1).



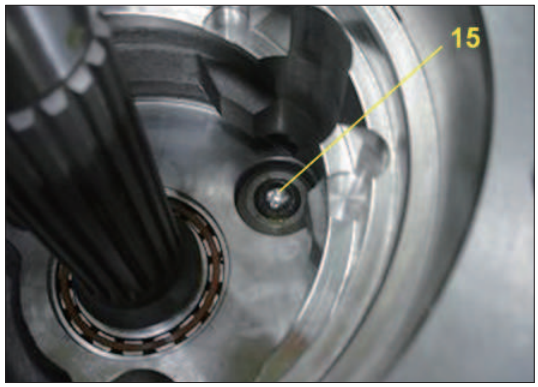
2609A8TM67


2609A8TM68

(18) Apply the grease to steel ball(15) and then assemble steel ball(15) into casing(1).



2609A8TM69



2609A8TM70

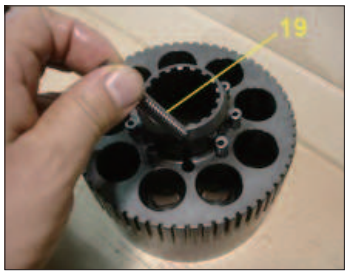
(19) Apply the grease to swash plate(17) and then assemble swash plate(17) into casing(1).



2609A8TM71


2609A8TM72

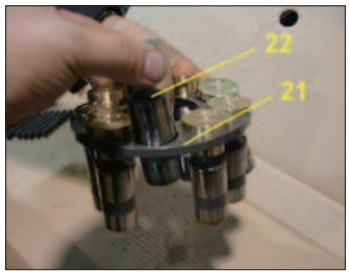
(20) Assemble spring (19), ball guide((20), retainer plate (21), piston assy (22) into cylinder block (18) in regular sequence.



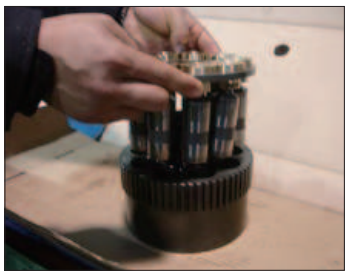
2609A8TM73



2609A8TM74



2609A8TM75

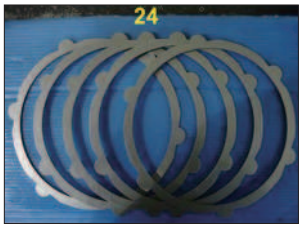

2609A8TM76


2609A8TM77

(21) Stant the casing (1) and then assemble cylinder block kit into casing (1).

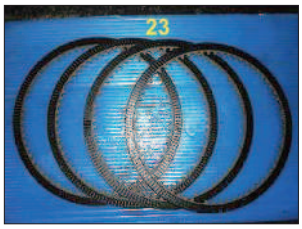

2609A8TM78

(22) Assemble separated plate (24), friction plate (23) into cylinder block in regular sequence.
Friction plate : 4EA
Separated plate : 5EA

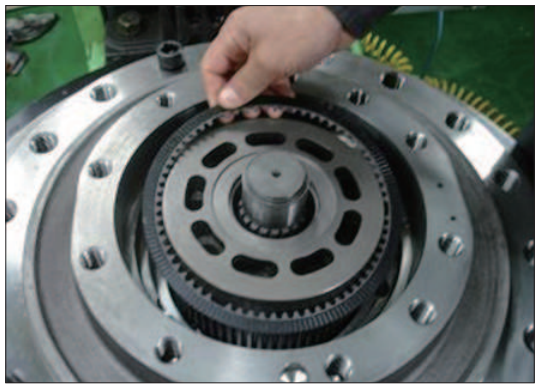


2609A8TM79


2609A8TM80

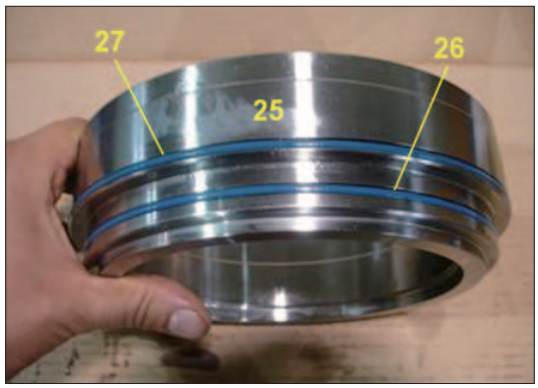


2609A8TM81



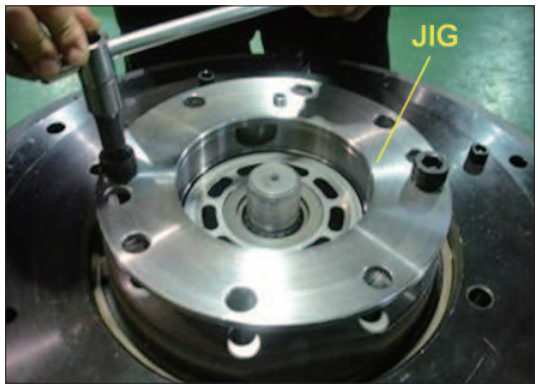
2609A8TM82

(23) Apply the grease to D-ring (26, 27) and then assemble D-ring (26, 27) into parking piston (25).



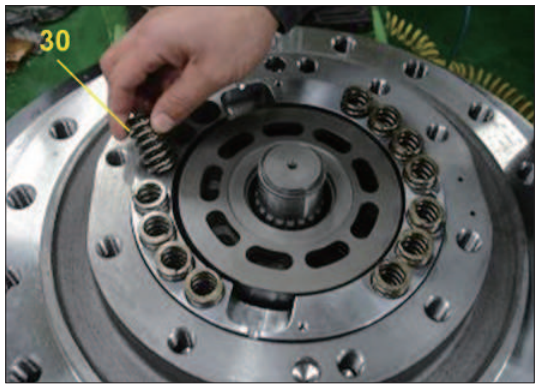
2609A8TM83

(24) Assemble parking piston into casing using jig.



2609A8TM84

(25) Assemble brake spring (30, 18EA).



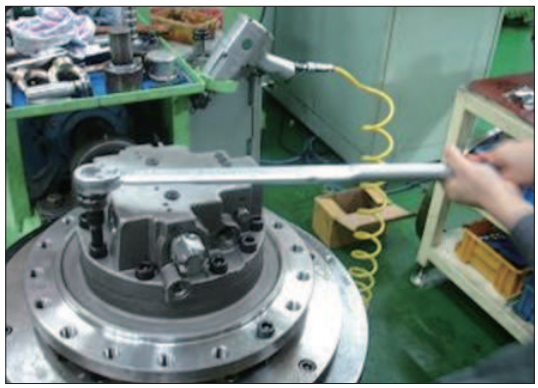
2609A8TM85

(26) Put on the rear cover (34) on the casing (1).



2609A8TM86

(27) Assemble rear cover (34) into casing (1) and then tighten the wrench bolt (54, 55) using torque wrench.

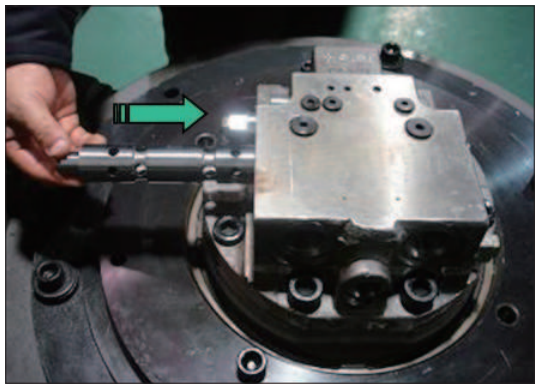


2609A8TM87

(28) Assemble main spool assy (35) into rear cover (34) after checking the direction to be correct.

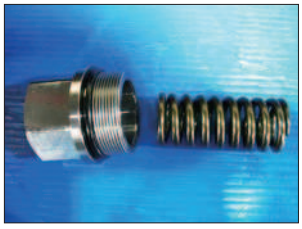


2609A8TM88

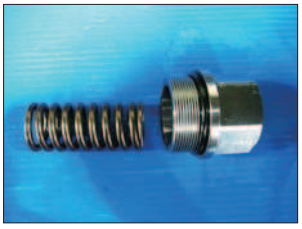


2609A8TM89

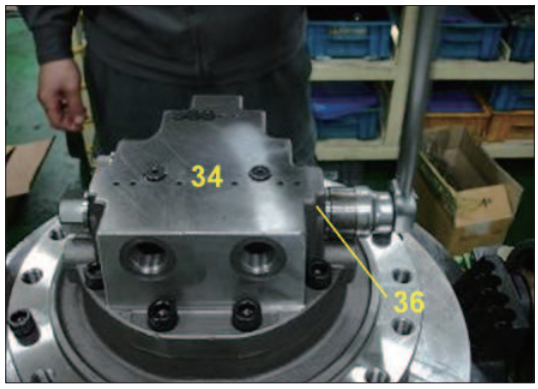
(29) Assemble spring (37), plug (36) into rear cover (34) in regular sequence and then plug (36) into rear cover (34) using torque wrench.



2609A8TM90

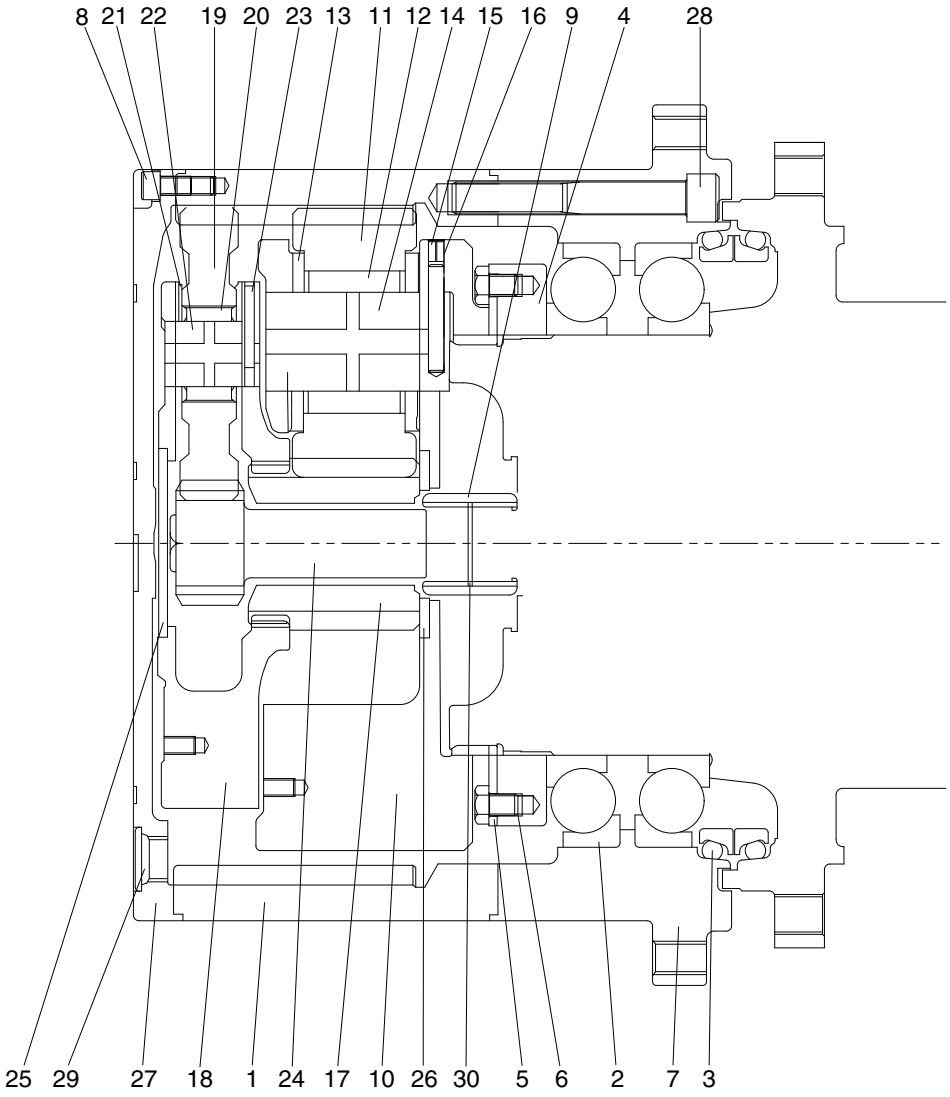


2609A8TM91



2609A8TM92

2) TRAVEL REDUCTION GEAR



2609A2TM03

1	Gear ring	11	Planetary gear 2	21	Thrust washer 1
2	Ball bearing	12	Needle bearing 2	22	Carrier pin 1
3	Floating seal assy	13	Thrust washer 2	23	Spring pin 1
4	Nut ring	14	Carrier pin 2	24	Sun gear 1
5	Lock plate	15	Spring pin 2	25	Thrust plate
6	Hexagon socket head bolt	16	Solid pin 2	26	Thrust plate
7	Housing	17	Sun gear 2	27	Cover
8	Hexagon socket head bolt	18	Carrier 1	28	Hexagon socket head bolt
9	Coupling	19	Planetary gear 1	29	Plug
10	Carrier 2	20	Needle bearing 1	30	Snap ring

6. DISASSEMBLING

1) GENERAL INSTRUCTIONS

⚠ **Combustibles such as white kerosene are used for washing parts.**
These combustibles are easily ignited, and could result in fire or injury.
Be very careful when using.

⚠ **Internal parts are coated with gear oil during disassembling and are slippery.**
If a part slips off from your hand and fails, it could result in bodily injury or could damage the park.
Be very careful when handling.

(1) Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather.
Tools and kerosene to wash parts should also be clean and handled with great care.

(2) Bofore disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

⚠ **Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.**

2) DISASSEMBLING TRAVEL REDUCTION GEAR

(1) Preparation for disassembling

① The reduction units removed from excavator are usually covered with mud. Wash outside of propelling unit and dry it.

② Locate reducer in order for drain port to be at the lowest level loosen taper screw plug of drain port, and drain oil from reduction gear.

※ While oil is still hot, inside of the unit may be pressurized.

⚠ Take care of the hot oil gushing out of the unit when loosening the plug.

③ **Mark for mating**

Put marks on each mating parts when disassembling so as to reassemble correctly as before.

(2) Set the reduction unit on table

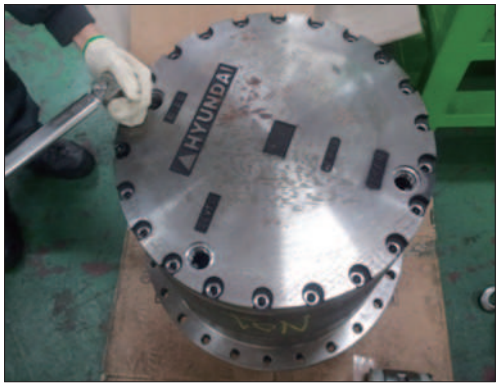
① Remove 7/16-14UNC hexagon socket head bolts at 3 places from cover almost equally apart each other, and then install 7/16-14UNC eye bolts.

⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

(3) Removing cover

① Remove 22 socket bolts (7/16-14UNC) those are attached to ring gear.

② Cover is stuck (27) to ring gear (1).
So use sharp chisel for removing cover (27) from ring gear (1).



2609A8TM02

(4) Removing sun gear No.1

Pull sun gear No.1 (24) vertically slow after removing thrust plate (25).



2609A8TM03

(5) Removing carrier No.1 sub assembly

Pull away carrier No.1 (18) with attached eye-bolt (M10) that is assembled to hole on carrier sub-assembly.



2609A8TM04

(6) Removing sun gear No.2

Pull away sun gear No.2 (17) for removing.

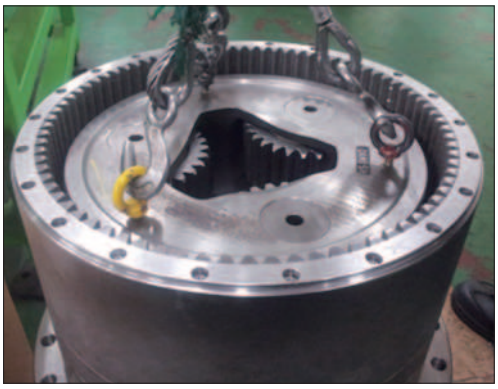


2609A8TM05

(7) Deassembleing carrier No.2 sub-assembly

Attach eye-bolt (M10) to the hole of carrier No.2 (10), and remove the carrier No.2 sub-assembly to lift up slowly.

※ **Keep horizontal to ground and make sure the eye-bolts to be safe operation.**



2609A8TM06

(8) Take away coupling

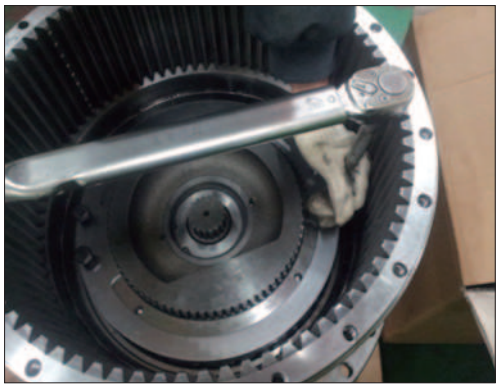
Take away the coupling (9) from casing (1).



2609A8TM07

(9) Lock plate

Release four hex head bolts (6, M12) and remove lock plate (5).



2609A8TM08

(10) Nut ring

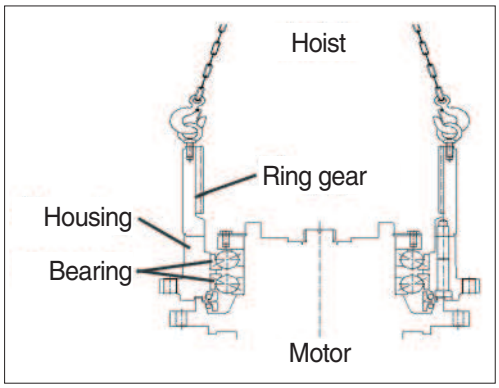
Release nut ring with removing jig.



2609A8TM09

(11) Housing sub-assembly

Lift up housing part slowly with hoist after attaching eye-bolt (7/16-14UNC) on it If you hit softly the center of motor with hammer and particular jig, you can remove the device easily.



2609A8TM10

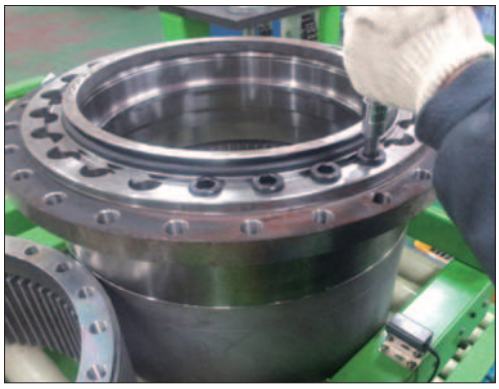
(12) Ring gear

① Reverse the housing sub-assembly part with machine, and remove floating seal (3) from the inside.



2609A8TM11

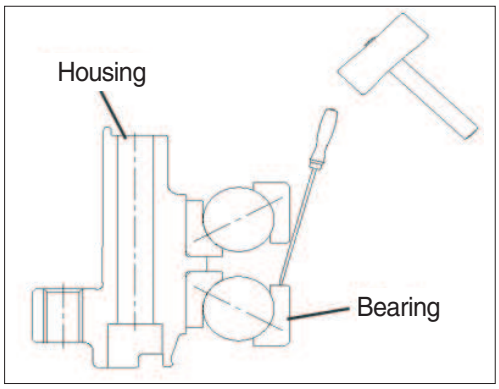
② Release 25 hex wrench bolts (28. M18) and remove ring gear (1) from housing (7).



2609A8TM12

(13) Angular Bearing

Put the housing sub-assembly (7) like this figure. And hit each opposite side of bearing with driver and hammer.



2609A8TM13

(14) Carrier No.1 sub-assembly

① Lay it on deassemblig jig. And remove pin No.1 (22) with press machine.



2609A8TM14

② Then remove planet gear No.1 (19) and thrust washer No.1 (21) from carrier No.1 (18).



2609A8TM15

(15) Carrier No.2 sub-assembly

Same as carrier No.1 (12) sub-asembly.



2609A8TM16

(16) Coupling

Remove snap ring (30) inside coupling (9) with nipper.



2609A8TM17

7. ASSEMBLY REDUTION UNIT

1) GENERAL NOTES

(1) Clean every part by kerosene and dry them by air blow.

(2) Surfaces to be applied by loctite must be decreased by solvent.

(3) Check every part for any abnormal.

(4) Each hexagon socket head bolt should be used with loctite No.242 applied on its threads.

(5) Apply gear oil slightly on each part before assembling.

⚠ **Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.**
Inspection before reassembling.

Thrust washer
- Check if there are seizure, abnormal wear or uneven wear.
- Check if wear is over the allowable limit.

Gear
- Check if there are pitting or seizure on the tooth surface.
- Check if there are cracks on the root of tooth by die check.

Bearing
- Rotate by hand to see if there are something unusual such as noise or uneven rotation.

Floating seal
- Check flaw or score on sliding surfaces or O-ring.

2) ASSEMBLING CARRIER 1 SUB-ASSY

(1) Put carrier No.1 (18) on the flat table.

(2) Insert needle bearing No.1 (20) in planet gear No.1 (20), and attach 2 thrust washers No.1 (21) on the both side of planet gear No.1. then assemble them in carrier No.1 (18).

※ **When assembling thrust washer, rounded edge-side should be facing casting side of carrier.**



2609A8TM18

(3) Insert pin No.1 (22) into pinhole of carrier correctly.

※ **Insert careful the pin not to scratch thrust washer and needle bearing.**



2609A8TM19

(4) Press spring pin No.1 (23) with jig and strike round spring pinhole (2 symmetrical point) with tool.

※ **After striking, draw the line by marker pen.**
※ **Check swinging conditon of planet gears.**

(5) Press two more pins and spring pins on the same way.



2609A8TM20

3) ASSEMBLING CARRIER 2 SUB-ASSY

(1) Put thrust plate (26) inside of carrier No.2 (10).



2609A8TM21

(2) Insert needle bearing No.2 (12) in planet gear No.2 (11) and attach 2 thrust washers No.2 (13) on the both side of planet gear No.2. Then assemble them in carrier No.2 (10).

※ **When assembling thrust washer, rounded edge-side should be facing casting side of carrier.**

(3) Insert pin No.2 (14) into pinhole of carrier No.2 correctly.

※ **Insert careful pin No.2 not to scratch thrust washer and needle bearing.**



2609A8TM22

(4) Insert solid pin No.2 (16) with pressing jig and insert spring pin No.2 (15) in the same position. When insertion is done, strike inner circle of spring pin (2 symmetrical point) with tool.

※ **After striking, draw the line by marker pen.**
※ **Check the spining condition of planet gear.**

(5) Insert two more pins and spring pins on the same way.

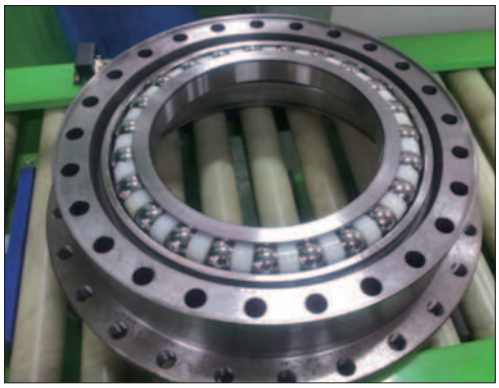


2609A8TM23

4) ANGULAR BEARING

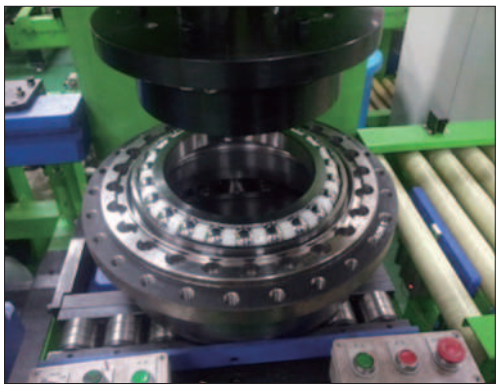
(1) Put the jig on housing (7) and insert angular bearing (2) into it with pressing machine, and turn down the upside of housing (7) by reversing machine.

※ **Check the direction of bearing when inserting it.**



2609A8TM24

(2) Insert angular bearing (2) into reversed housing (7) on the same way.



2609A8TM25

5) ASSEMBLING FLOATING SEAL

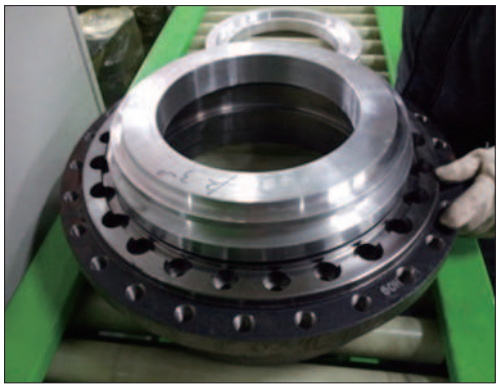
(1) Paint alchole on floating seal (3) and polish it.



2609A8TM26

(2) Put floating seal (3) on the right position of housing (3) and insert it by pressing jig.
After complete, check the condition by lifting with hand softly.

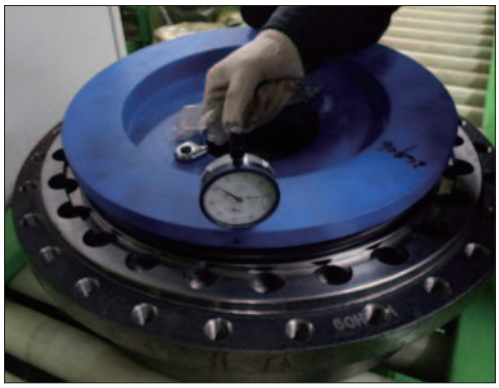
※ **Keep clean on surface of floating seal while assembling.**



2609A8TM27

(3) Put the gauge for seal measurement on floating seal (3) and check the horizontal angle by gauge scale.

※ **Two gauge scales should be same. (pass inspection)**



2609A8TM28

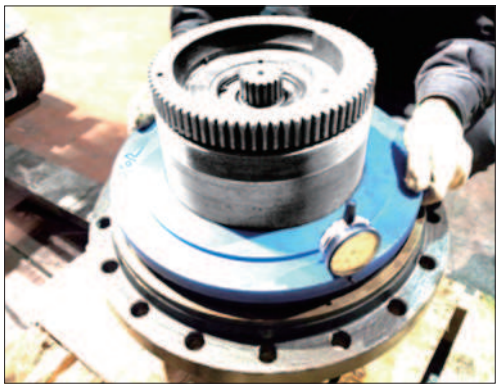
(4) Attach floating seal to motor that will be assembled with housing (on the same way to (1), (2))



2609A8TM29

(5) Put the measuring jig on floating seal (3) and check the horizontal angle condition with both gauge scale.

※ **Two gauge scales should be same. (pass inspection)**



2609A8TM30

6) ASSEMBLING RING GEAR

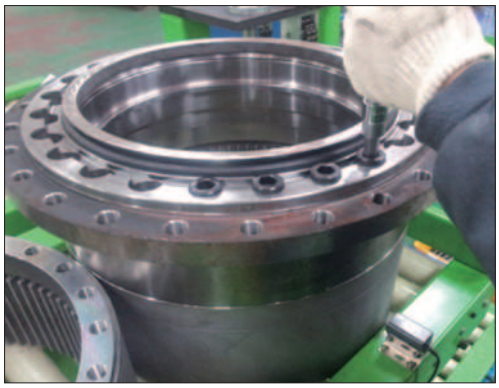
(1) Put ring gear (1) on contact surface (should be upside) of housing (7).

(2) Paint loctite #515 on ring gear (1) and put on housing (7). Then assemble 25 hexwrench bolts (28, M18)

※ **Paint loctite #262 on hex-wrench bolts (28) before assembling.**

※ **Tightening torque : 38.5±3.8 kgf · m (278.5±27.5 lbf · ft)**

※ **Bolts should be assembled with lust preventing oil.**



2609A8TM31

7) ASSEMBLING NUT RING

(1) Put housing (7) sub-assembly upside down (ring gear side is up), and attach it to motor by lifting with hoist. (shaking it lightly)

(2) When housing (7) sub-assembly is set, put nut ring (4) on it, and assemble with jig.

※ **Tightening torque for assembling nut ring : 66±6.0 kgf-m (477.3±43.3 lbf · ft)**

※ **Floating seal should not be damaged or separated while assembling.**



2609A8TM32

8) ASSEMBLING LOCK PLATE

(1) Put lock plate (5) on nut ring (4) to fit to M12 bolt hole. Then assemble 4 he head bolts (6, M12)

※ **Paint loctite #262 on hex-head bolts.**

※ **Tightening torque : 6.05±0.6 kgf · m (43.8±4.3 lbf · ft)**

※ **Bolts should be assembled with lust preventing oil.**



2609A8TM33

9) ASSEMBLING COUPLING

(1) Attach snap ring (3) into coupling (9) with nipper.



2609A8TM34

(2) Put coupling (9) on motor shaft to fit.

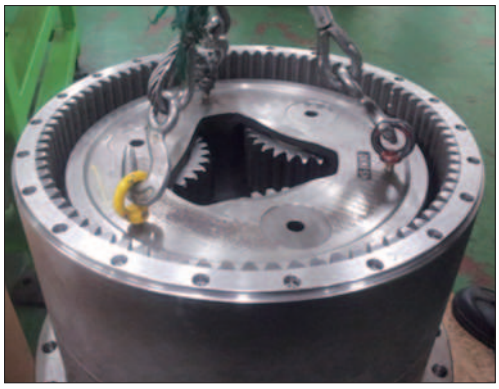


2609A8TM35

10) ASSEMBLING NO.2 CARRIER SUB-ASSY

(1) Lift carrier No.2 subassembly and put on ring gear (1), and fit it into internal side of ring gear (1). Then hit urethan hammer to fit.

※ **Check turning and cocking condition before assembling.**



2609A8TM36

11) ASSEMBLING NO.2 SUN GEAR

(1) Insert sun gear No.2 (17) in the middle of carrier No.2 sub assembly and make it fit in carrier No.2.



2609A8TM37

12) ASSEMBLING NO.1 CARRIER SUB-ASSY

(1) Lift carrier No.1 sub-assembly and put it into ring gear (1) and shake carrier No.1 to fit into ring gear.

※ **Check turning and cocking condition before assembling.**



2609A8TM38

13) SWINGING TORQUE INSPECTION

(1) Attach inspection jig before assembling sun gear No.1 (24).



2609A8TM39

(2) Attach torque wrench to the jig, check the torque when it swings.

※ **Swinging torque : below 3.0 kgf · m (21.7 lbf · ft)**



2609A8TM40

14) ASSEMBLING NO.1 SUN GEAR

(1) Remove the jig and wrench after torque inspection complete. And assemble sun gear No.1 (24) with pushing round to fix to the center of carrier No.1



2609A8TM41

15) ASSEMBLING THRUST PLATE

(1) Put thrust plate (25) on carrier No.1 sub assembly. And paint loctite #515 on flat side of ring gear (1).

※ **When assembling thrust washer, rounded edge-side should be facing casting side of carrier.**



2609A8TM42

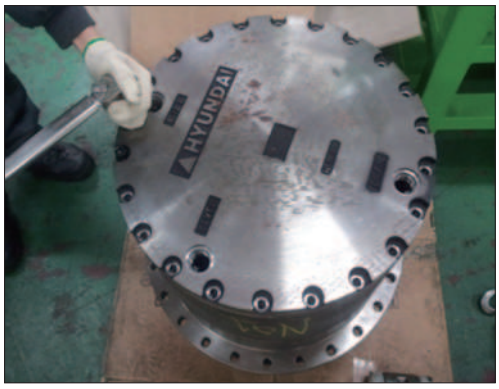
16) ASSEMBLING COVER

(1) Attach cover on ring gear (1) with assembling 22 hex-wrench bolts (8, 7/16-16UNC).

※ **Paint loctite #262 on screw of hex bolts.**

※ **Tightening torque : 8.1±0.8 kgf · m (58.6±5.8 lbf · ft)**

※ **Bolts should be assembled with lust preventing oil.**



2609A8TM43

17) ASSEMBLING OIL INJECTION

(1) Inject the oil (10 ℓ) through PF3/4 hole on cover (27).



2609A8TM44

18) ASSEMBLING PLUG

(1) Assemble 3 plugs (29, PF3/4) after oil injection complete.

※ **Tightening torque : 10±1.0 kgf · m (72.3±7.2 lbf · ft)**



2609A8TM45

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).

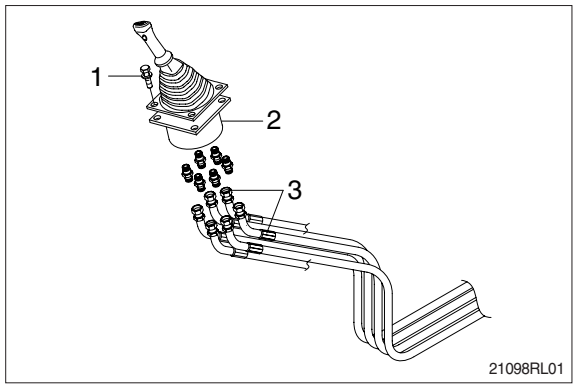
(5) Remove the cover of the console box.

(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.





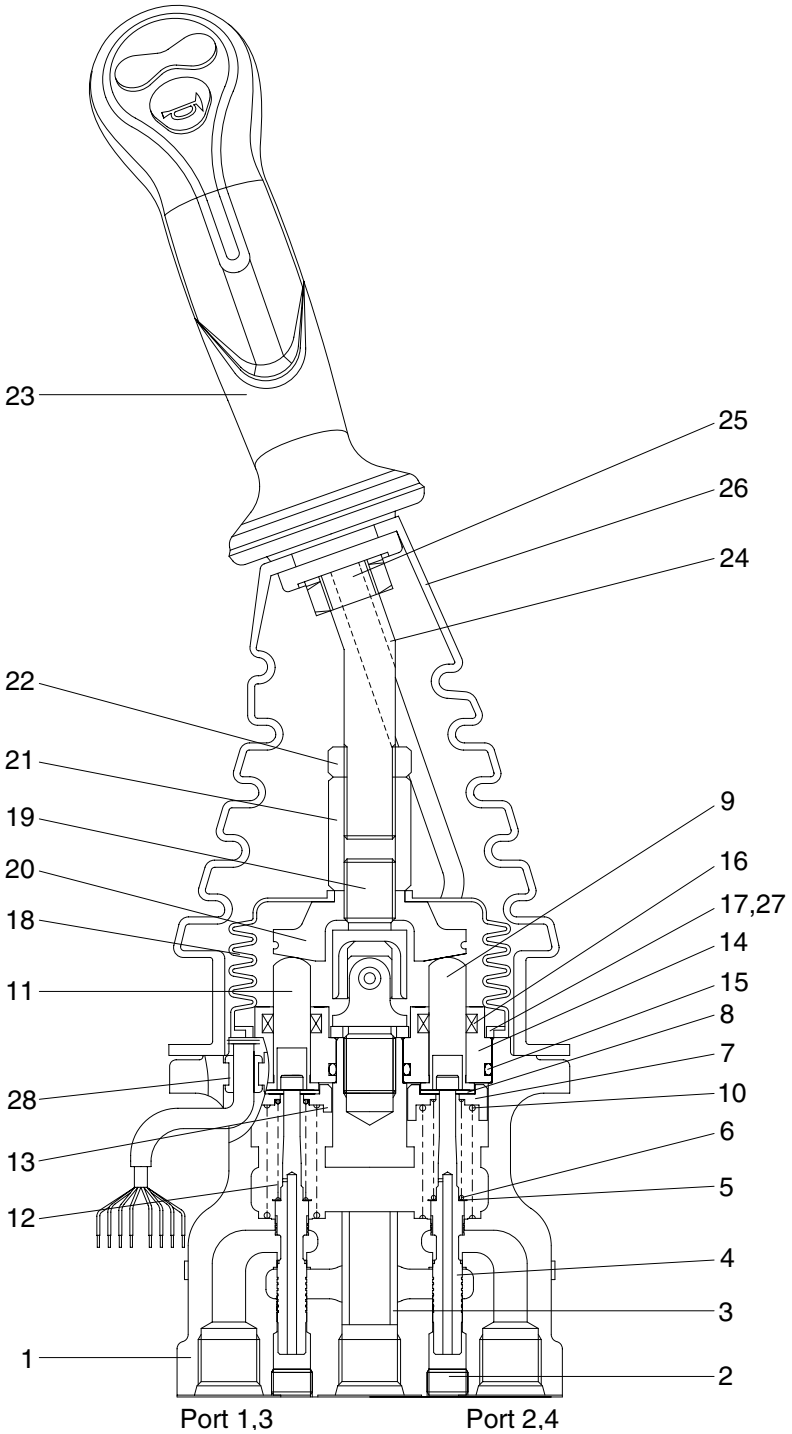
2) INSTALL

(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

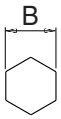


300E2RL02

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

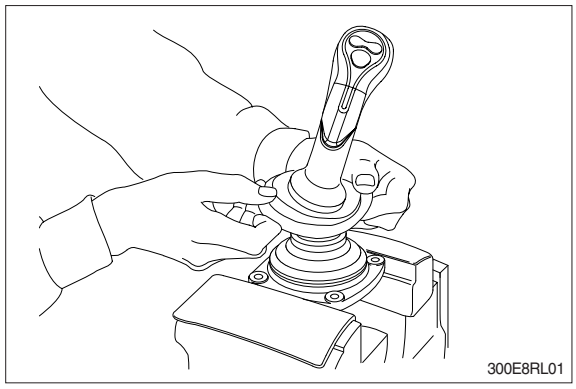
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

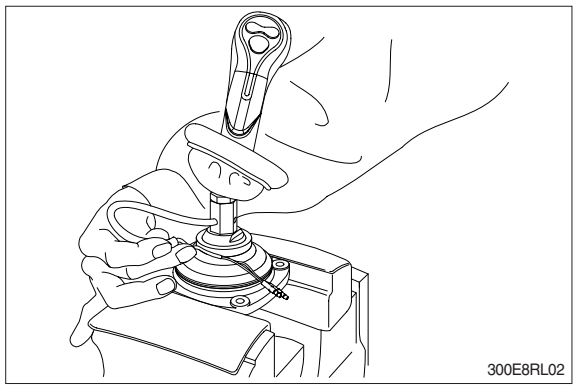
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper (or lead) sheets.

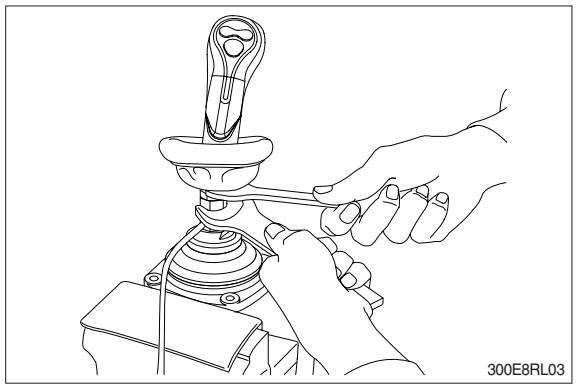
(3) Remove end of boot (26) from case (1) and take it out upwards.



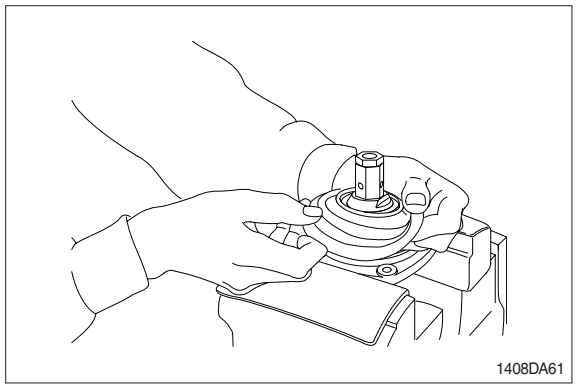
※ For valve with switch, remove cord also through hole of casing.



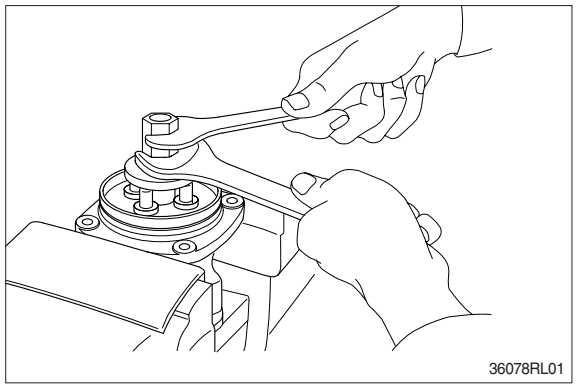
(4) Loosen lock nut (22) and adjusting nut (21) with spanners on them respectively, and take out handle section as one body.

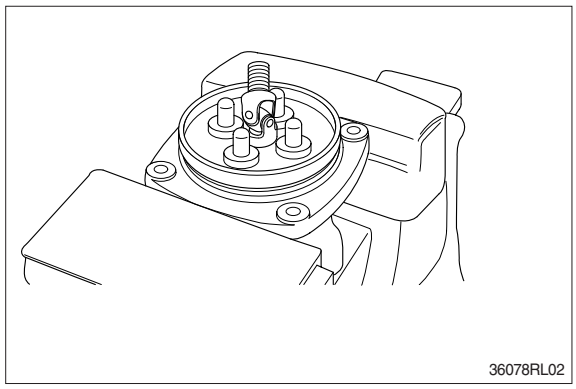


(5) Remove the boot (18).



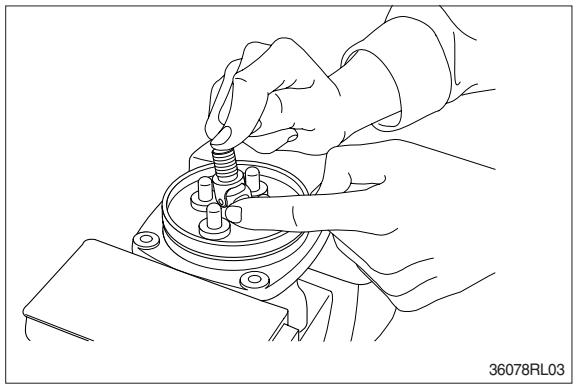
(6) Loosen adjusting nut (21) and swash plate (20) with spanners on them respectively, and remove them.

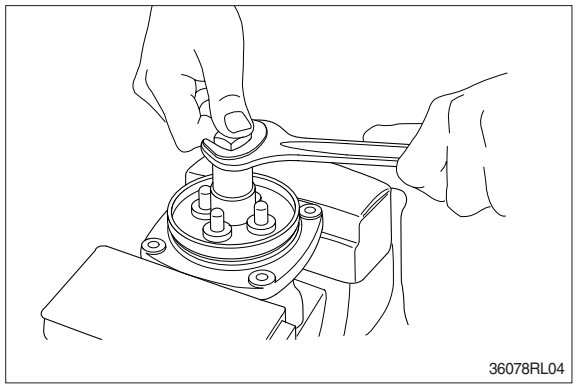




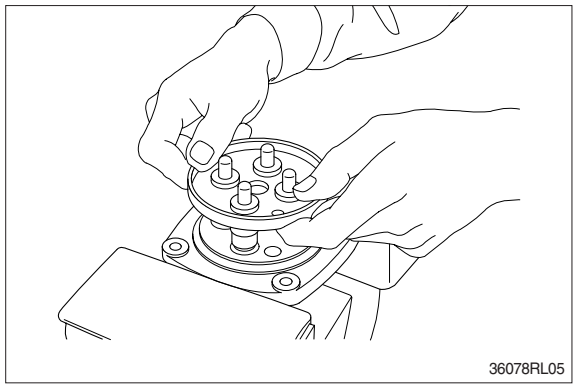
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ 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.





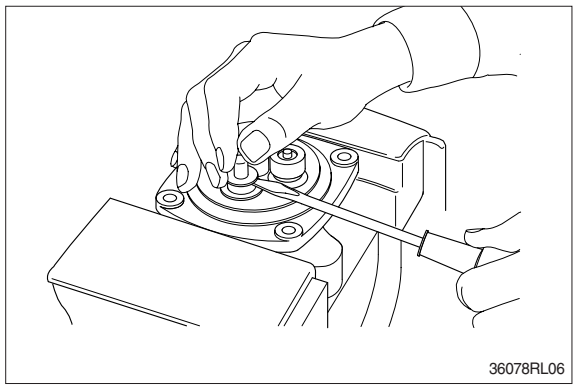
(8) Remove plate (17).



(9) When return spring (10) is weak in force, plug (14) stays in casing because of sliding resistance of O-ring.

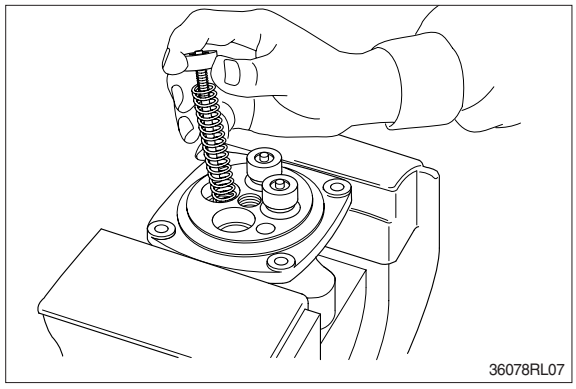
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (10) force.
Pay attention to this.

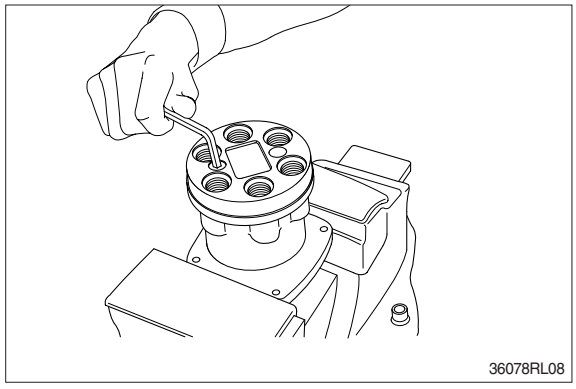


(10) Remove reducing valve subassembly and return spring (10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.

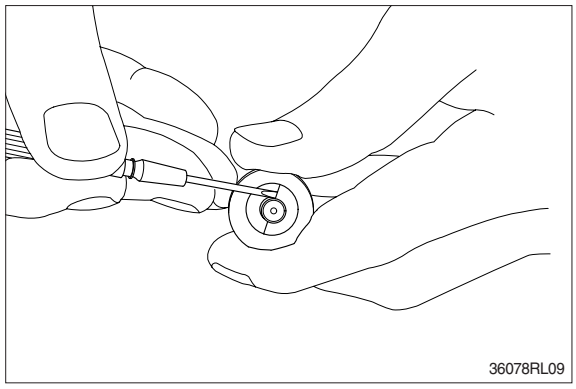


(12) For disassembling reducing valve section, stand it vertically with spool (4) bottom placed on flat workbench. Push down spring seat (7) and remove two pieces of semicircular stopper (8) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

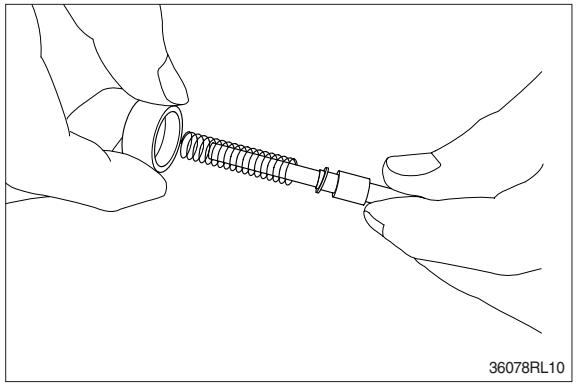
※ Record original position of spring seat (7).

※ Do not push down spring seat more than 6mm.

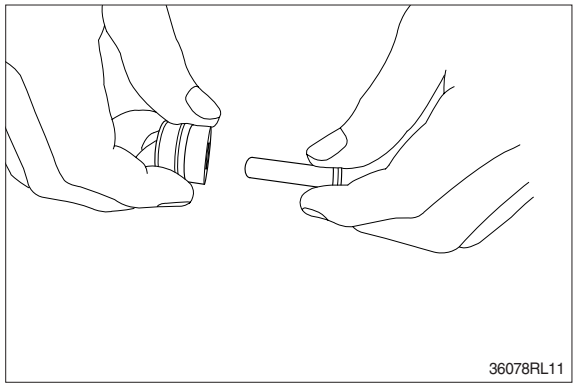


(13) Separate spool (4), spring seat (7), spring (6) and shim (5) individually.

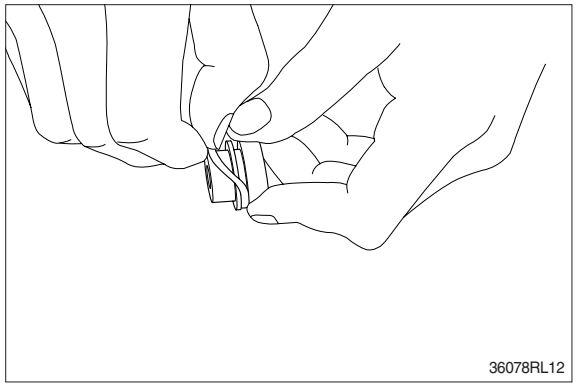
※ Until being assembled, they should be handled as one subassembly group.

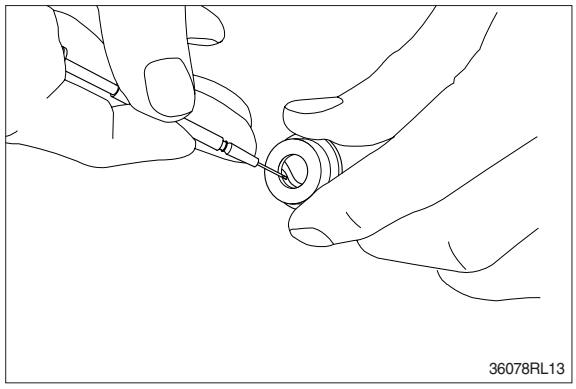


(14) Take push rod (11) out of plug (14).

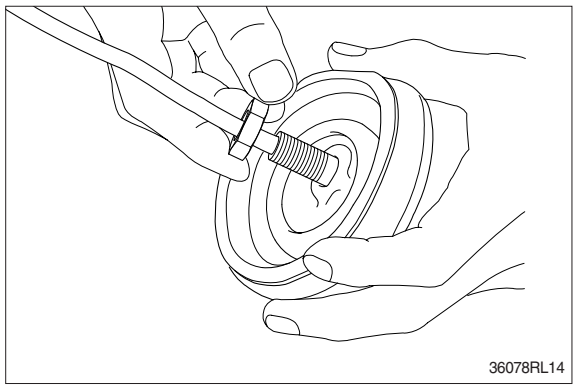


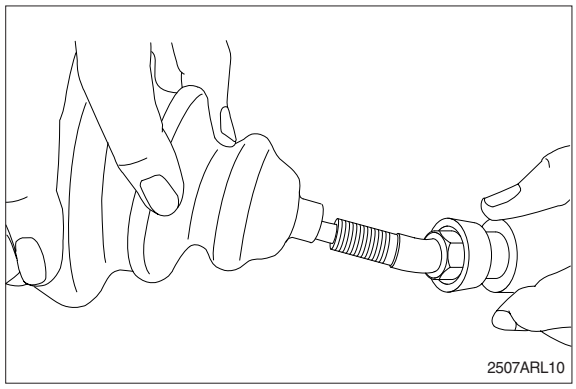
(15) Remove O-ring (15) and seal (16) from plug (14).
Use small minus screwdriver or so on to remove this seal.





(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

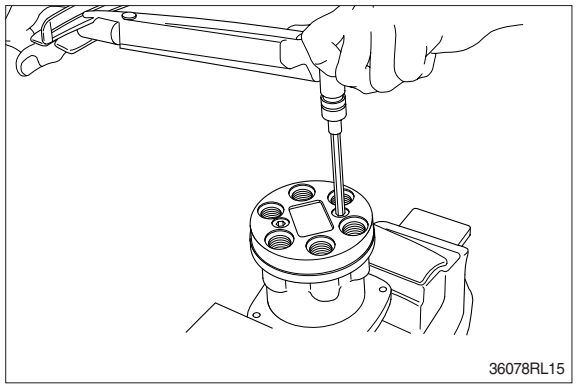
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

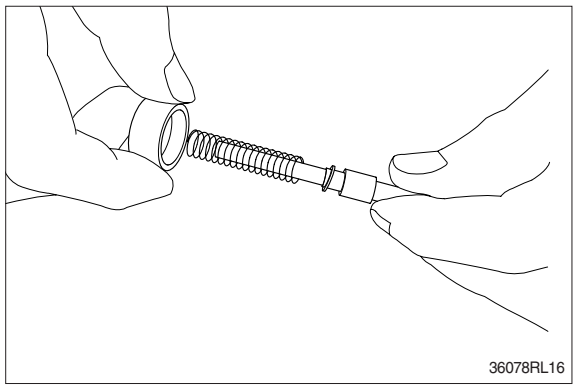
4) ASSEMBLY

(1) Tighten hexagon socket head plug (2) to the specified torque.

※ Tighten two bolts alternately and slowly.

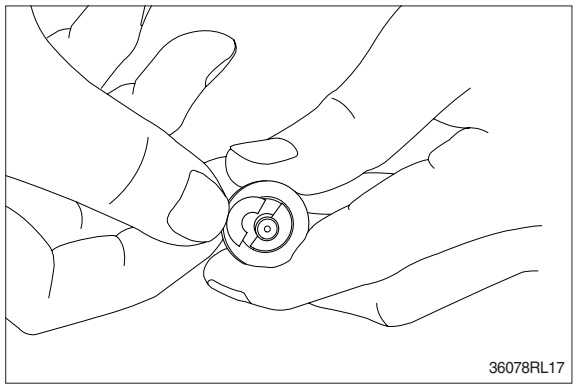


(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



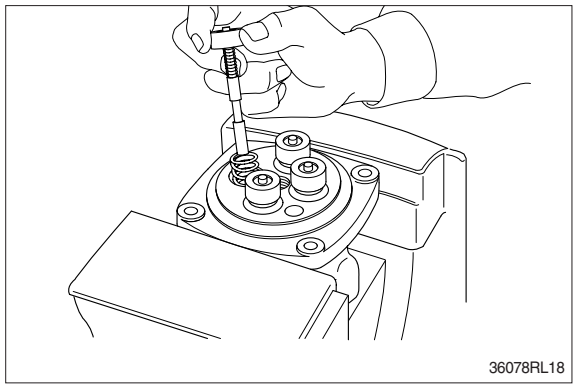
(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (8) on spring seat without piling them on.

※ 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.

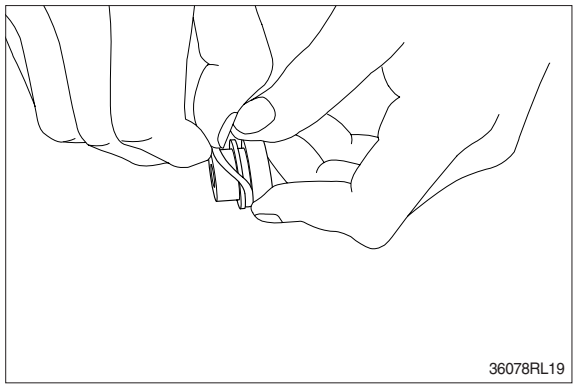


(4) Assemble spring (10) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

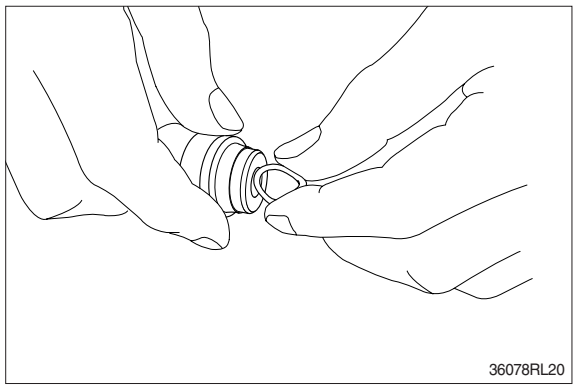


(5) Assemble O-ring (15) onto plug (14).



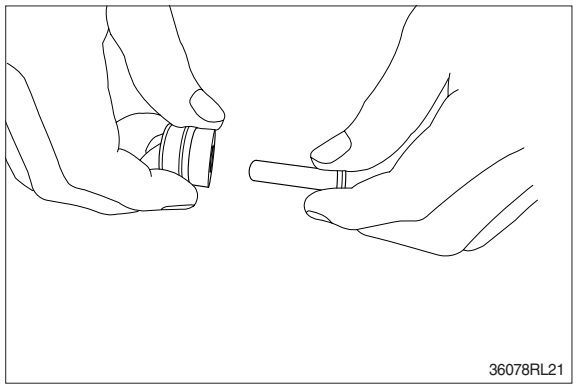
(6) Assemble seal (16) to plug (14).

※ Assemble seal in such lip direction as shown below.



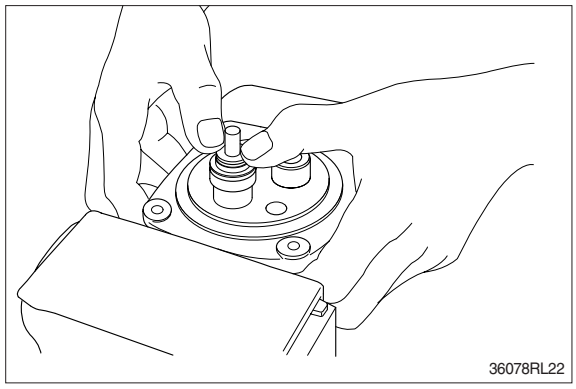
(7) Assemble push rod (11) to plug (14).

※ Apply working oil on push-rod surface.

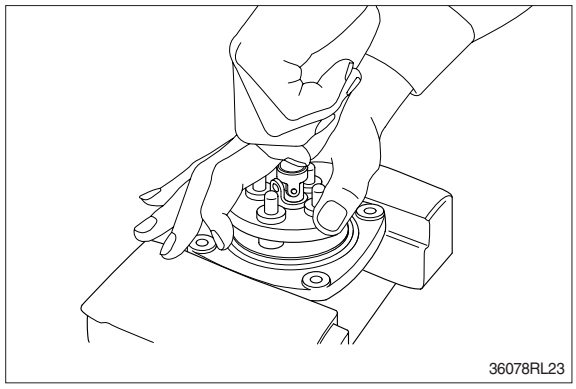


(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

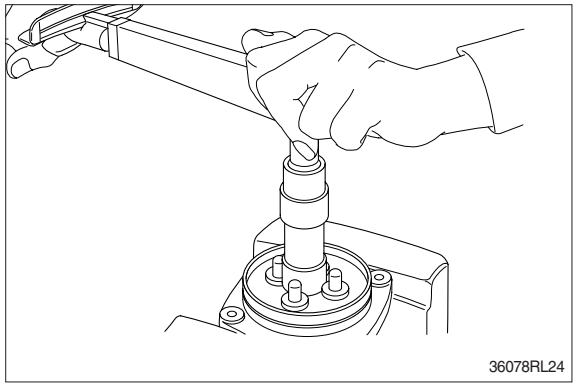


(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (17), and tighten joint (19) temporarily.



(10) Fit plate (17).

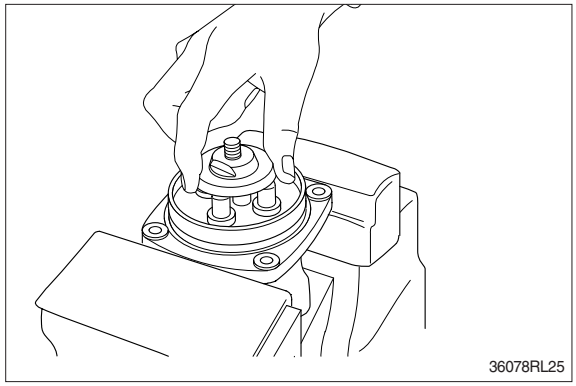
(11) Tighten joint (19) with the specified torque to casing, utilizing jig.



(12) Assemble swash plate (20) to joint (19).

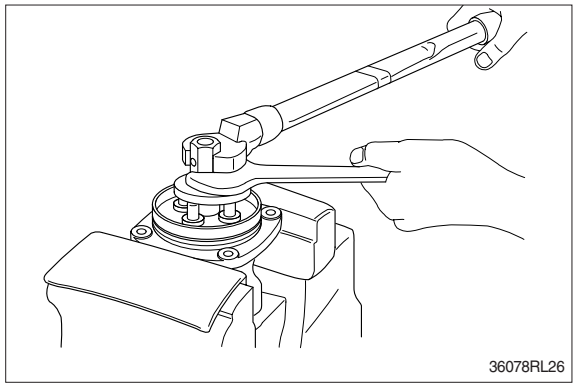
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

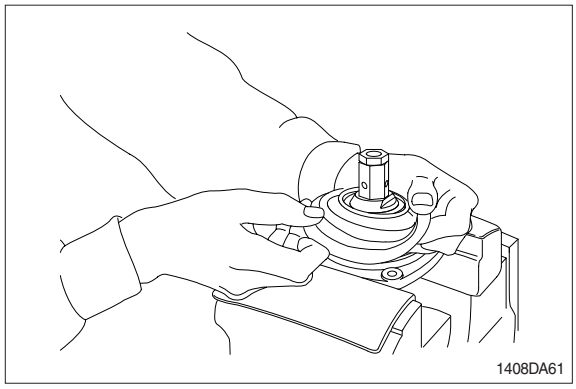


(13) Assemble adjusting nut (21), apply spanner to width across flat of plate (20) to fix it, and tighten adjusting nut to the specified torque.

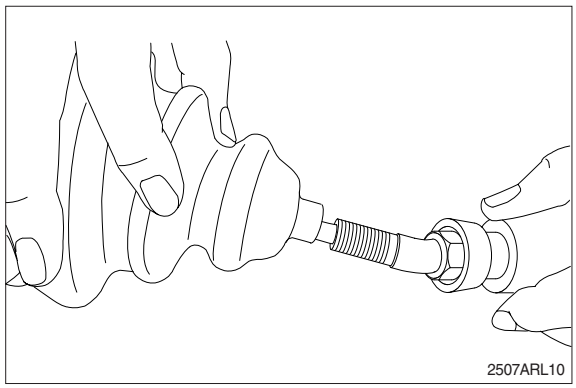
※ During tightening, do not change position of disk.

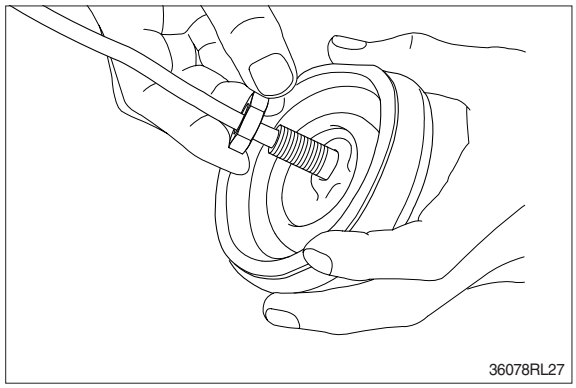


(14) Fit boot (18) to plate.

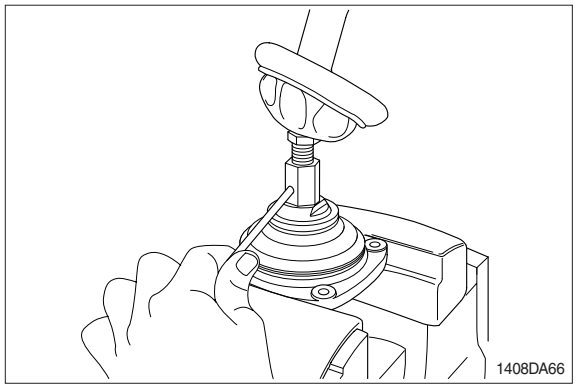


(15) Fit boot (26) and lock nut (22), and handle subassembly is assembled completely.



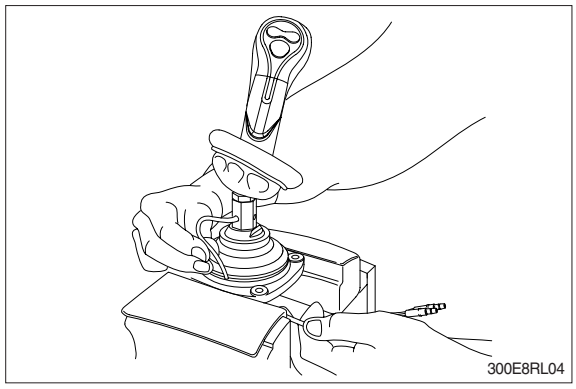


(16) Pull out cord and tube through adjusting nut hole provided in direction 60 ˚to 120 ˚from casing hole.

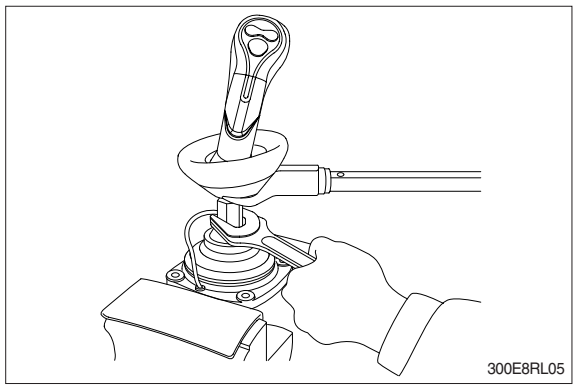


(17) Assemble bushing (27) to plate and pass cord and tube through it.

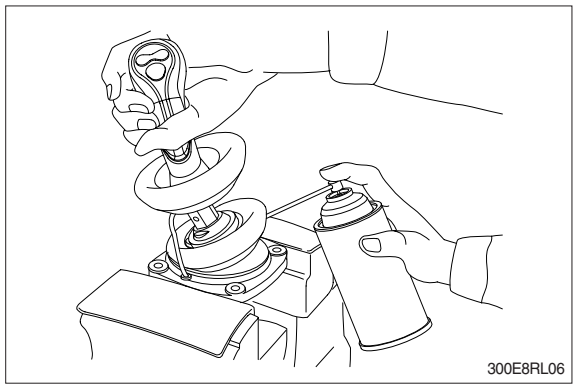
※ Provide margin necessary to operation.



(18) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

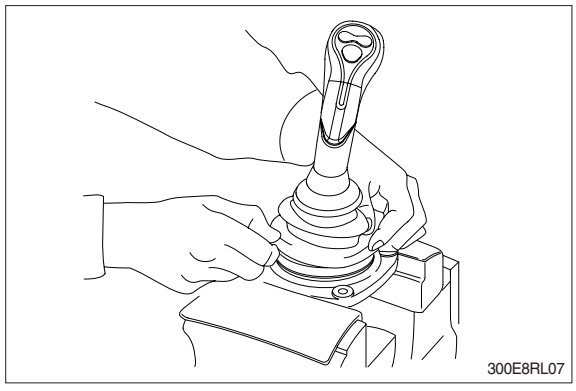


(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL



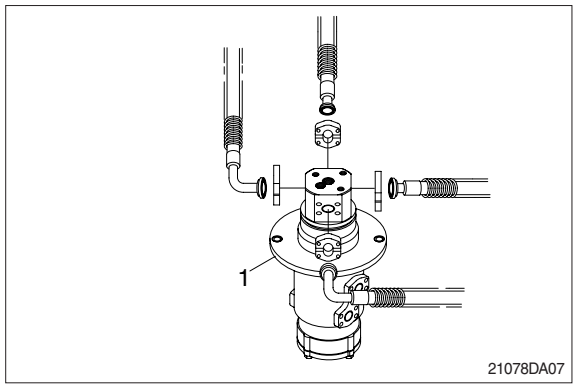
(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



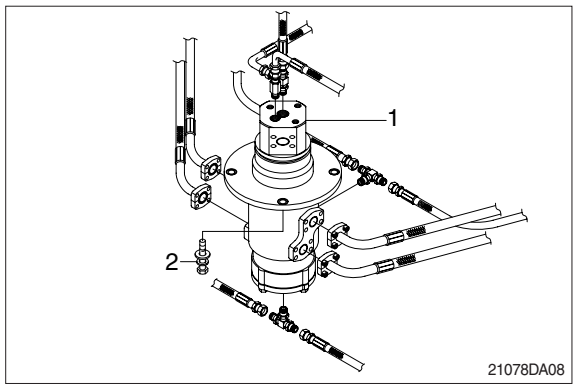
(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).
Weight : 55 kg (120 lb)
Tightening torque : 12.31.3 kgfm
(899.4 lbfft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

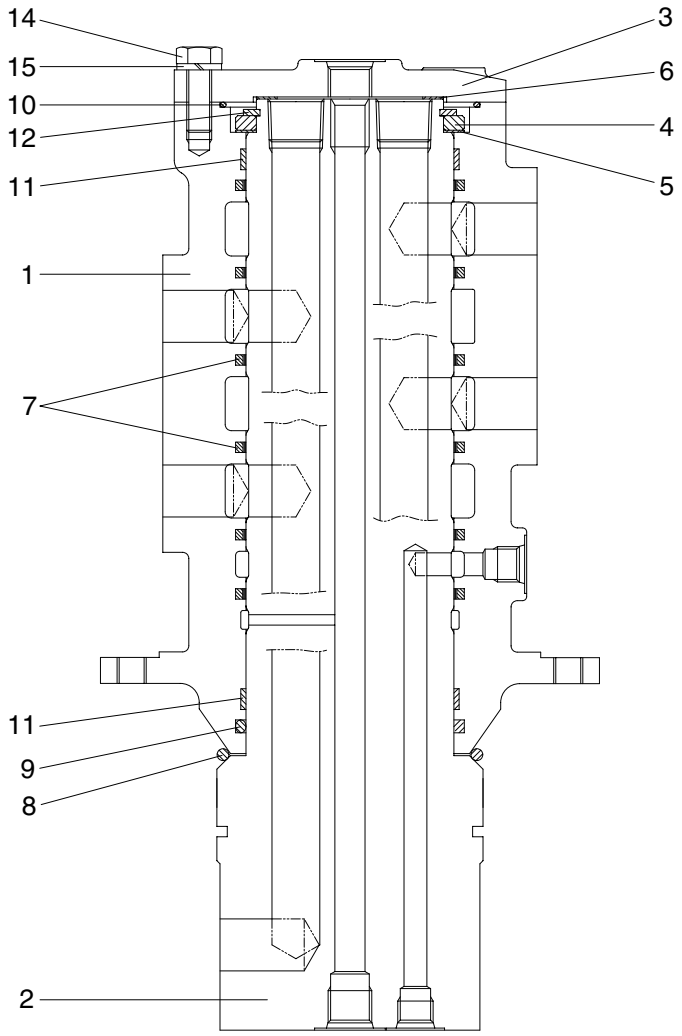
2) INSTALL



(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



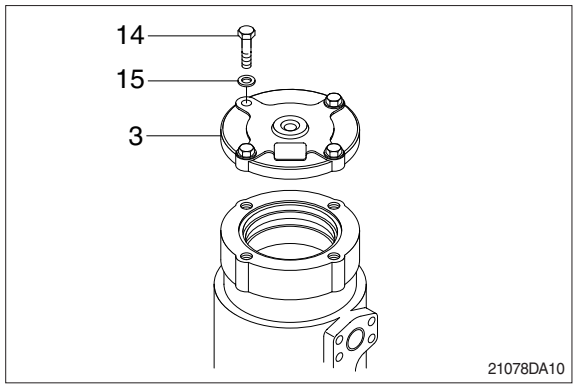
21098TJ01

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

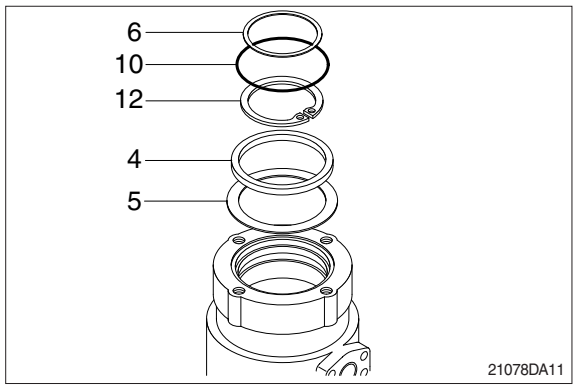
Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

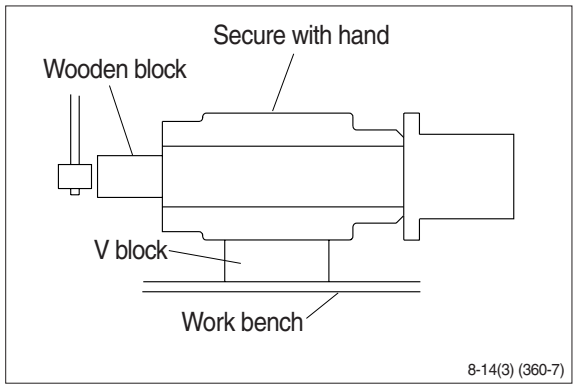
(3) Remove retainer ring (12), spacer (4) and shim (5).



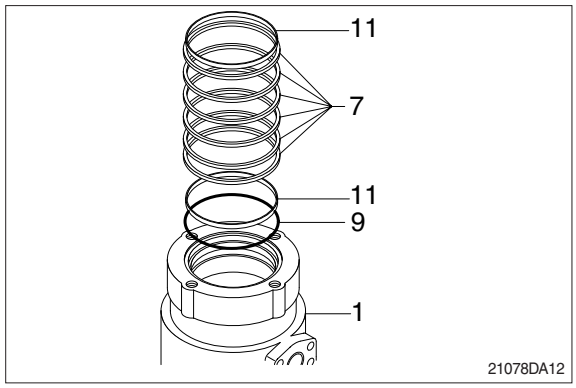
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ 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).

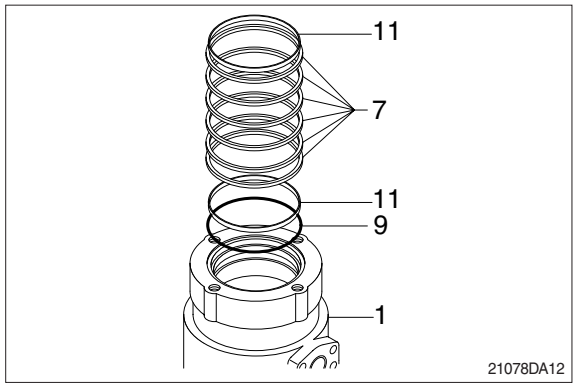


3) ASSEMBLY

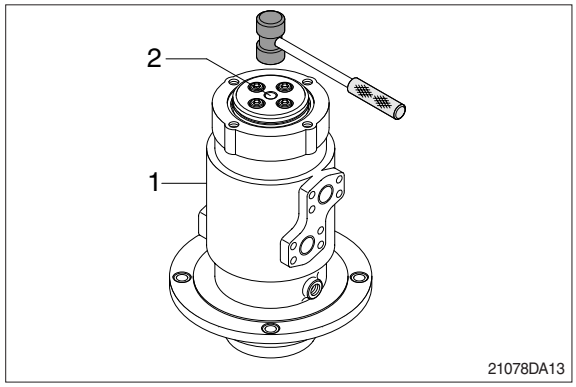
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(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).



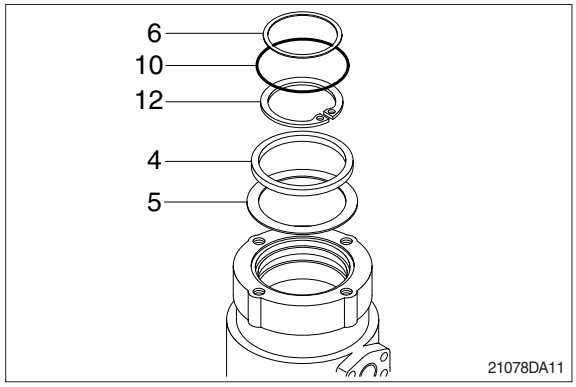
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



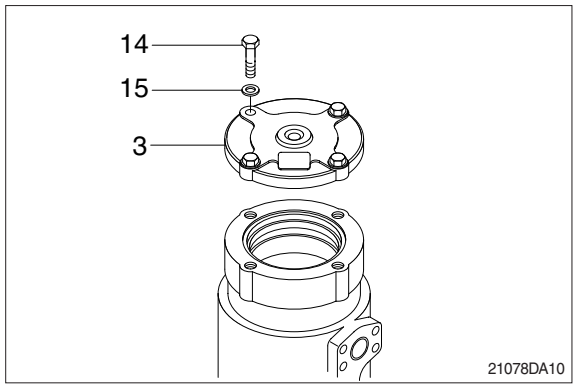
(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(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 kgfm
(72.3~90.4 lbfft)



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.

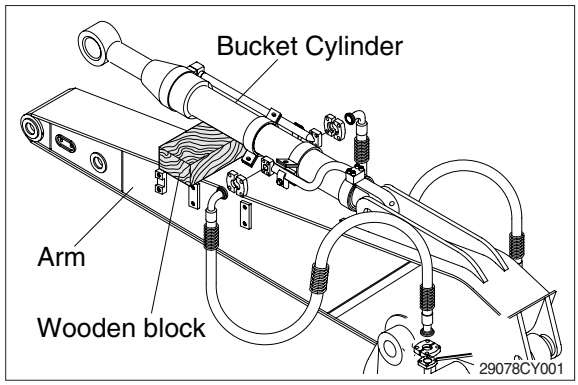
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ 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.

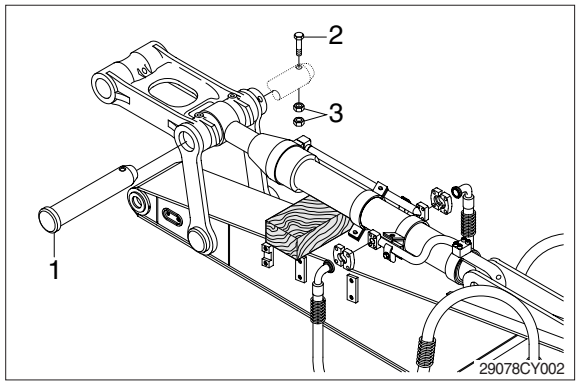


① Set block between bucket cylinder and arm.

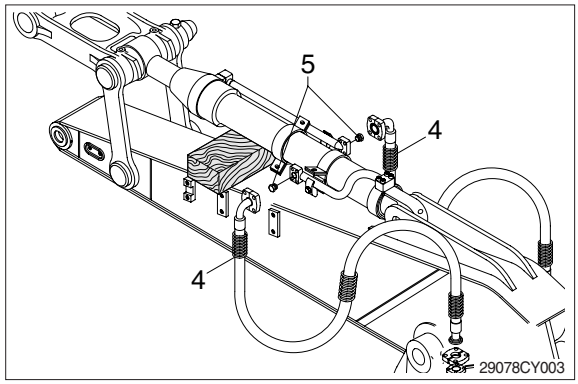


② Remove bolt (2), nut (3) and pull out pin (1).

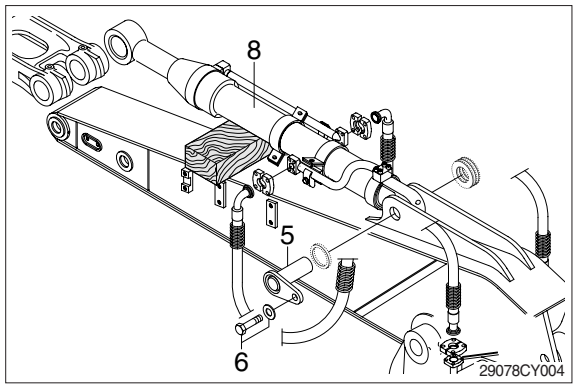
※ Tie the rod with wire to prevent it from coming out.



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 : 220 kg (485 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.

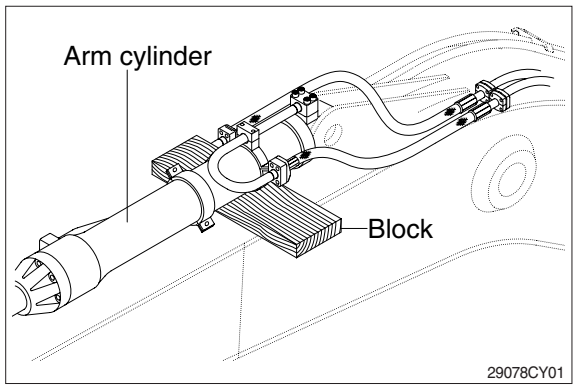
⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

※ 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.

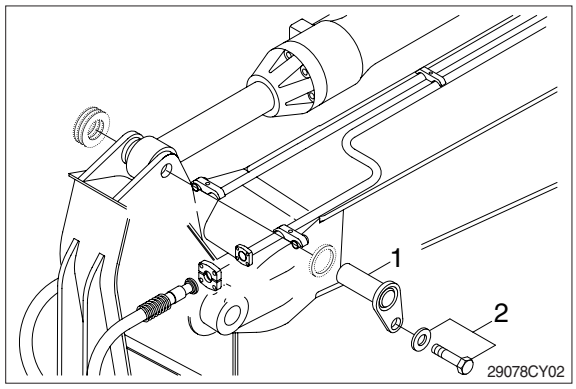
① Set block between arm cylinder and boom.





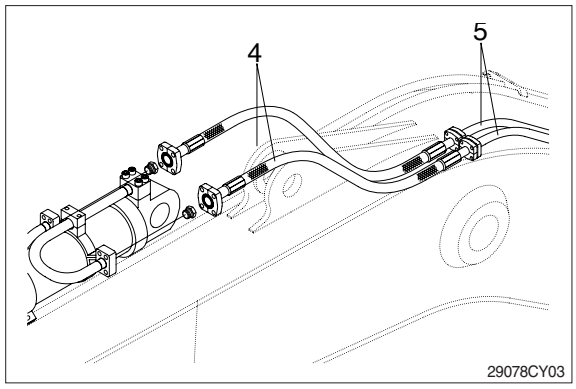
② Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

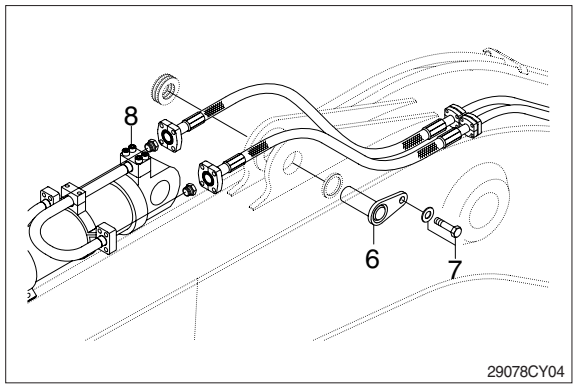
④ Disconnect greasing pipings (5).



⑤ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 360 kg (790 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.

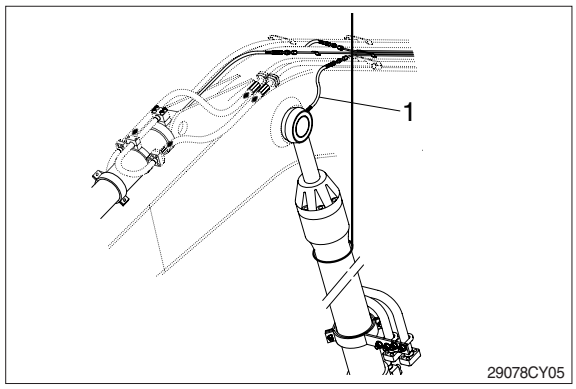
⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

※ 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).

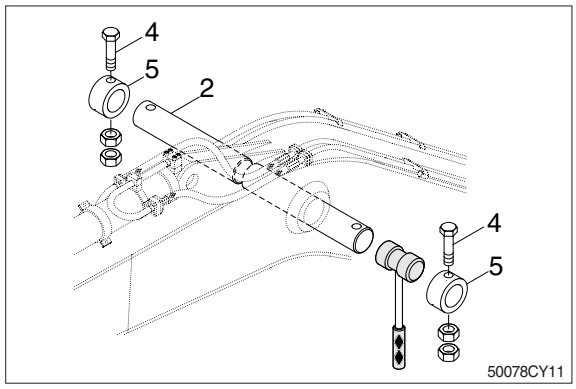
② Sling boom cylinder assembly.



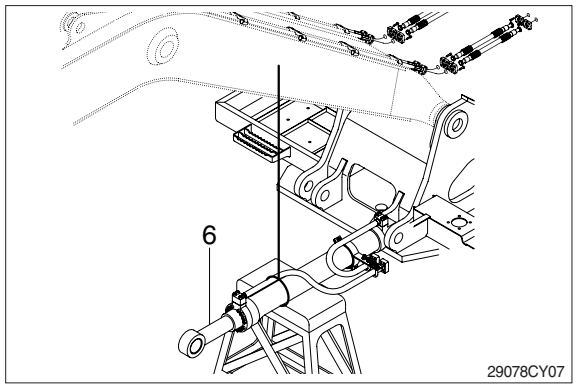


③ Remove bolt (4), pin stopper (5) and pull out pin (2).

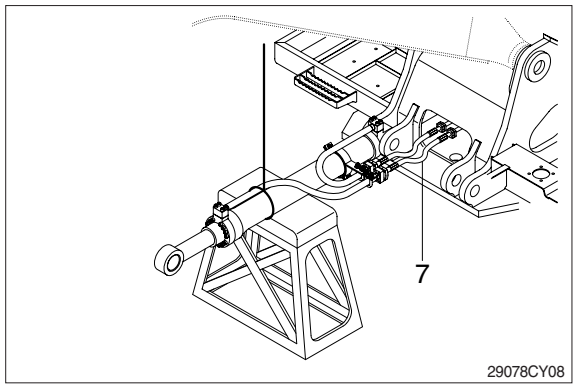
※ Tie the rod with wire to prevent it from coming out.



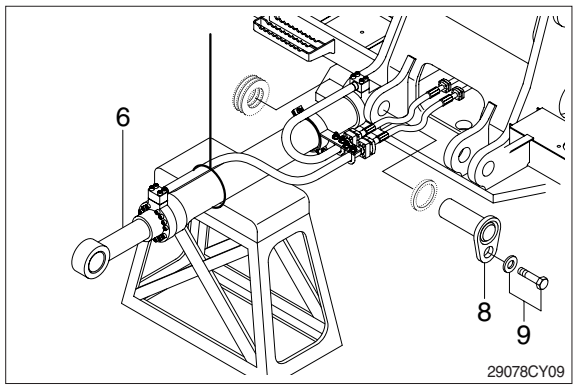
④ Lower the boom cylinder assembly (6) on a stand.



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 : 300 kg (660 lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

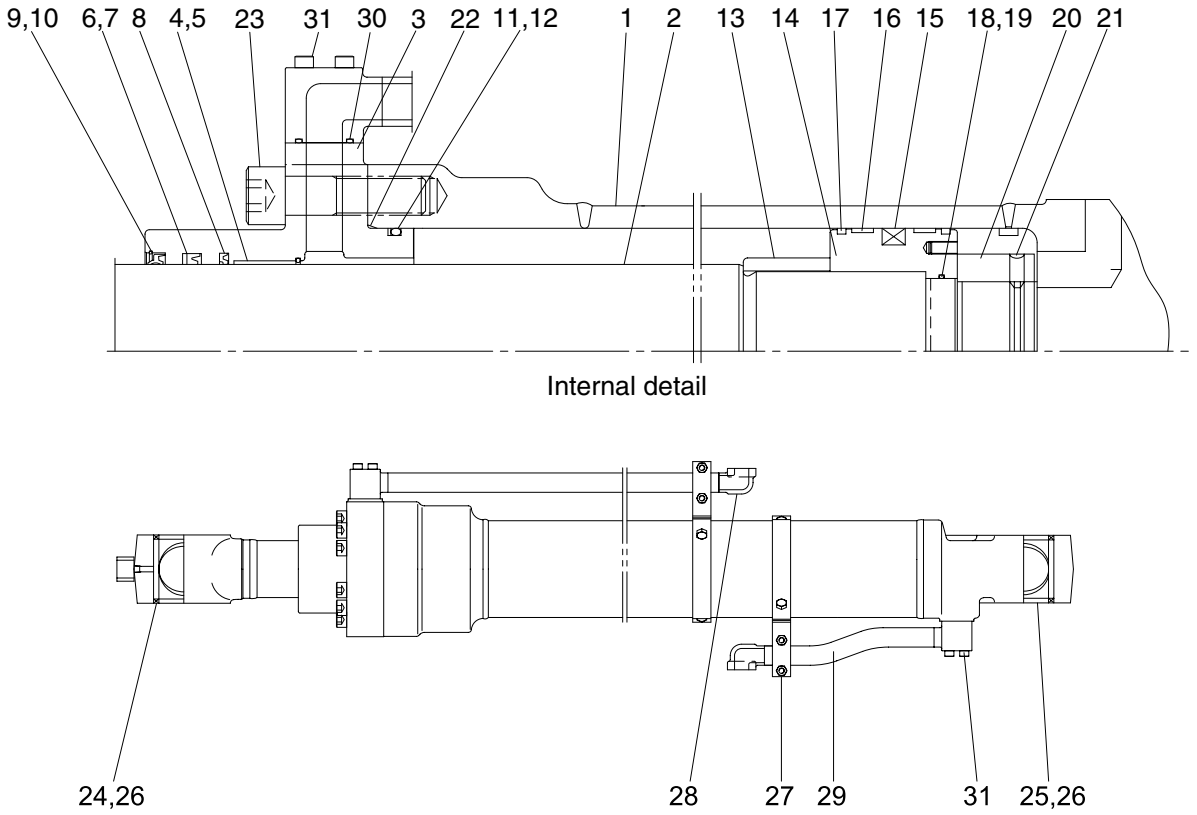
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

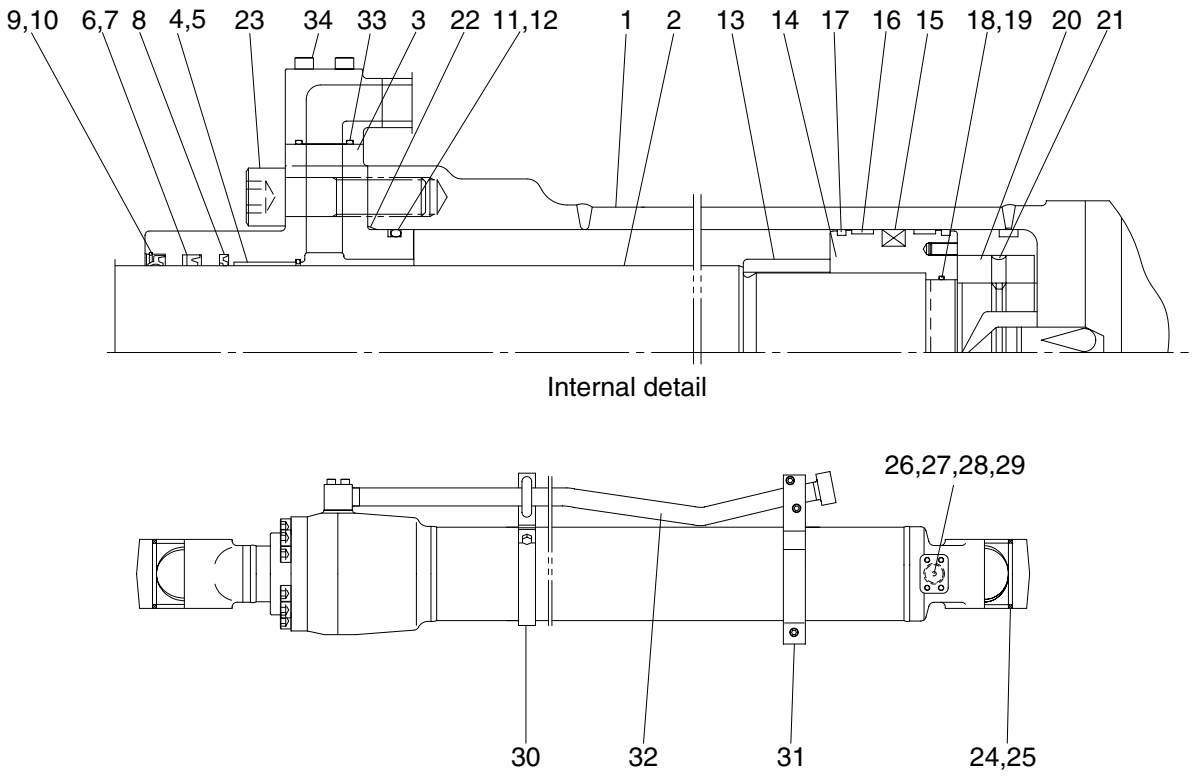
1) STRUCTURE

(1) Bucket cylinder



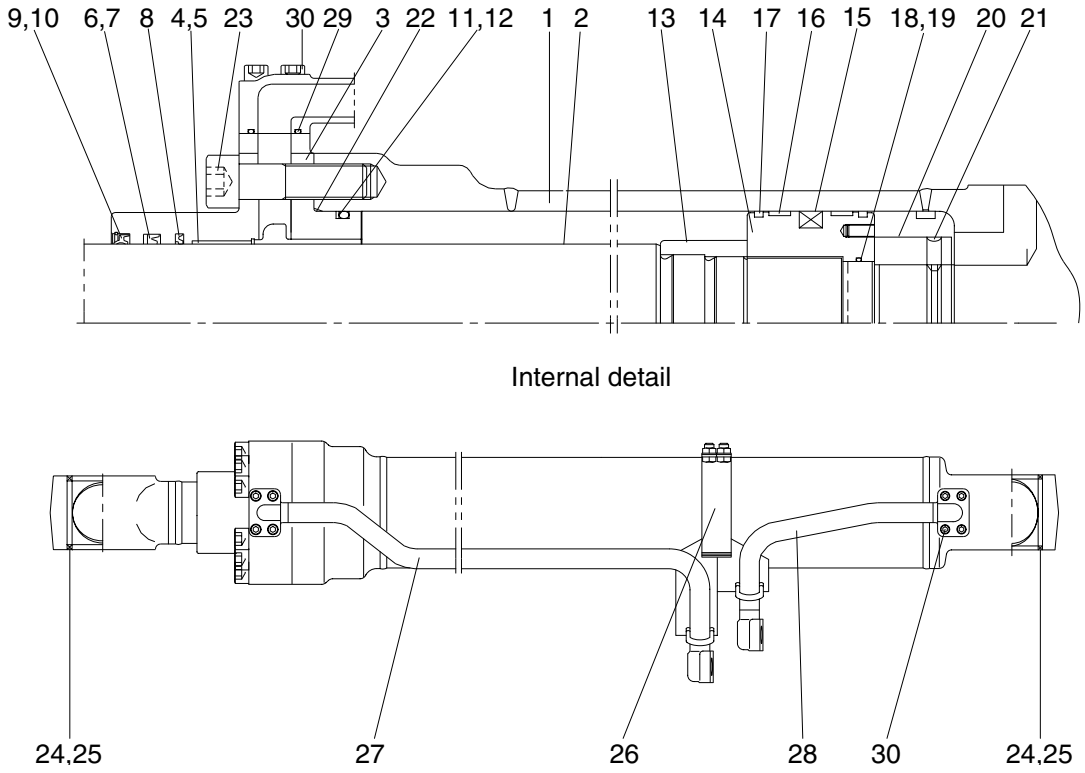
1	Tube assembly	12	Back up ring	23	Hexagon socket head bol
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly
7	Back up ring	18	O-ring	29	Pipe assembly
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



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
7	Back up ring	19	Back up ring	31	Band assembly
8	Buffer ring	20	Lock nut	32	Pipe assembly
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

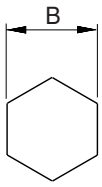


32098BO01

1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	O-ring
3	Gland	13	Cushion ring	23	Hexagon socket head bolt
4	DD2 bushing	14	Piston	24	Pin bushing
5	Snap ring	15	Piston seal	25	Dust seal
6	Rod seal	16	Wear ring	26	Band assembly
7	Back up ring	17	Dust ring	27	Pipe assembly
8	Buffer ring	18	O-ring	28	Pipe assembly
9	Dust wiper	19	Back up ring	29	O-ring
10	Snap ring	20	Lock nut	30	Hexagon socket head bolt

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	M18	32.0±3.0	232±21.7
	Boom cylinder	23	M12	46.0±5.0	333±7.2
	Arm cylinder	23	M22	63.0±6.0	457±43.4
Socket head bolt	Bucket cylinder	31	M12	9.4±1.0	68.0±7.2
	Boom cylinder	30	M12	9.4±1.0	68.0±7.2
	Arm cylinder	34	M12	9.4±1.0	68.0±7.2
Lock nut	Bucket cylinder	20	-	100±10.0	723±72.3
	Boom cylinder	20	-	100±10.0	723±72.3
	Arm cylinder	20	-	150±15.0	1085±108
Piston	Bucket cylinder	14	-	150±15.0	1085±108
	Boom cylinder	14	-	150±15.0	1085±108
	Arm cylinder	14	-	200±20.0	1447±145

3) DISASSEMBLY

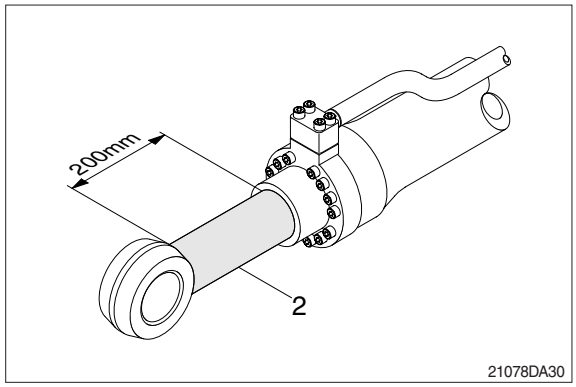
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

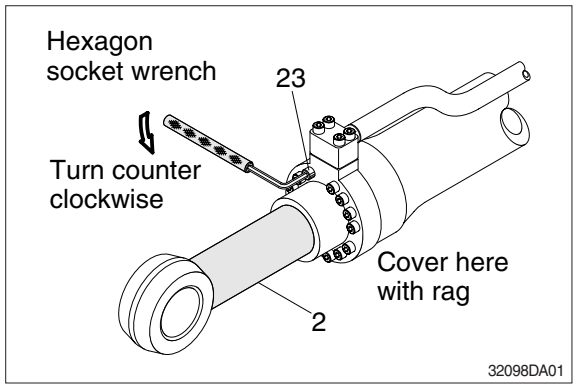
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 ㎜ (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



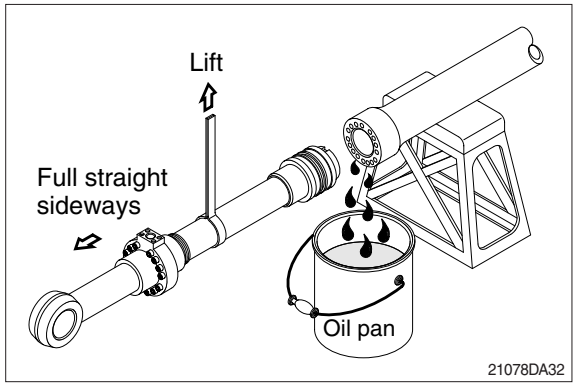
③ Loosen and remove socket bolts (23) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



④ Draw out cylinder head and rod assembly together from tube assembly (1).

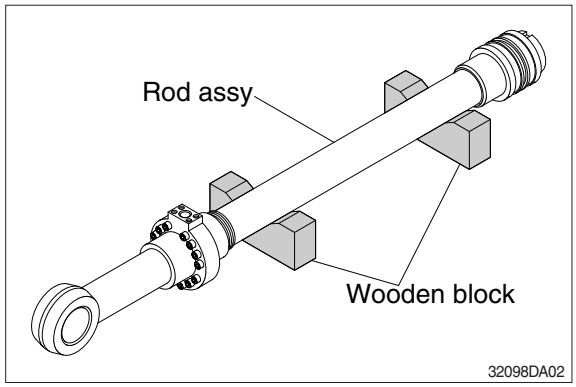
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

※ Cover a V-block with soft rag.

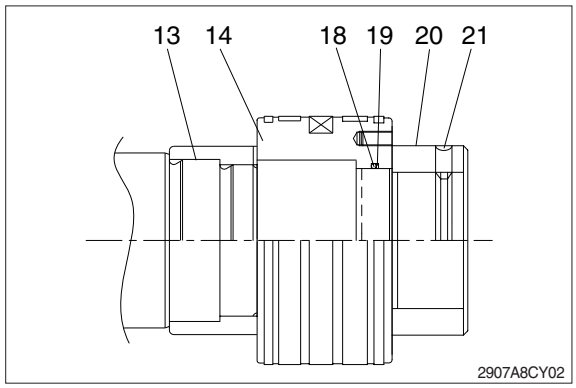


(2) Remove piston and cylinder head

① Loosen sochet set screw (21) and remove lock nut (20).

※ Since lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock nut (20).

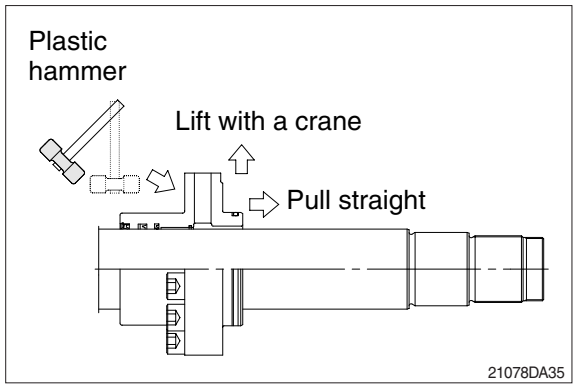
② Remove piston assembly (14), back up ring (19), and O-ring (18).



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).

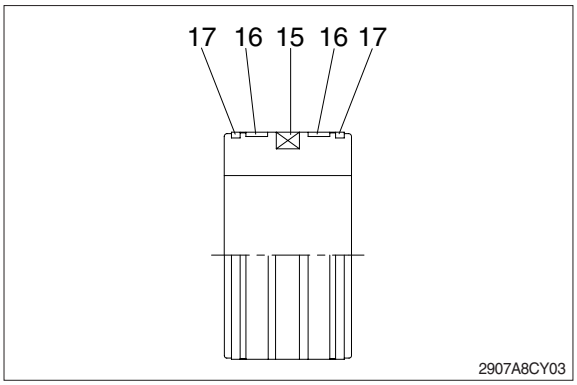


(3) Disassemble the piston assembly

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

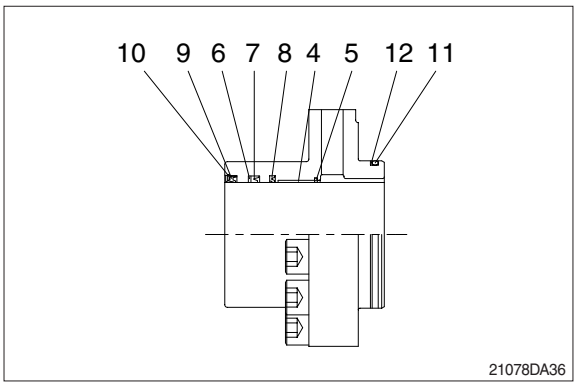
① Remove back up ring (12) and O-ring (11).

② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6), buffer ring (8) and snap sing (5).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

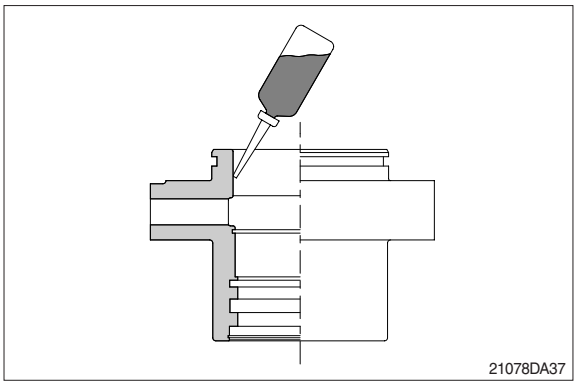


3) ASSEMBLY

(1) Assemble cylinder head assembly

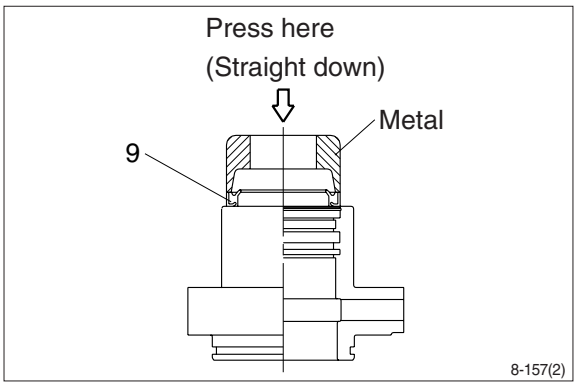
※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of gland (3) with hydraulic oil.



② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

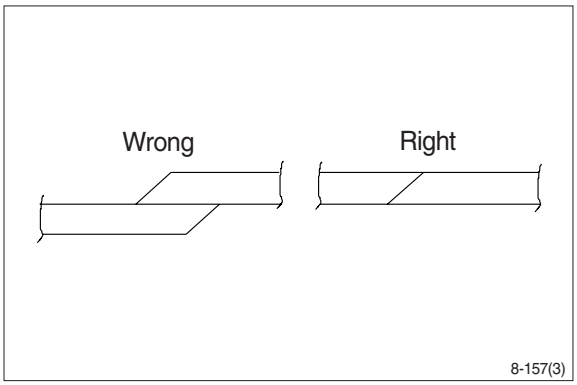
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

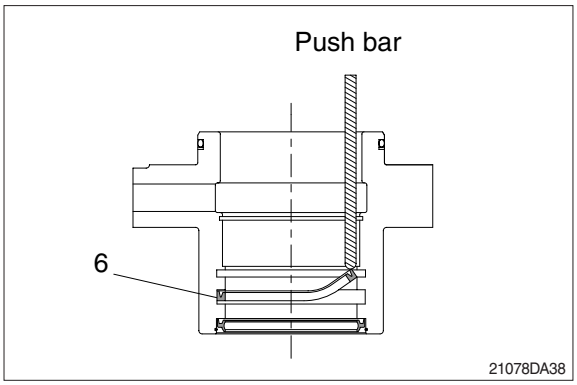
※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until one side of it is inserted into groove.



※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

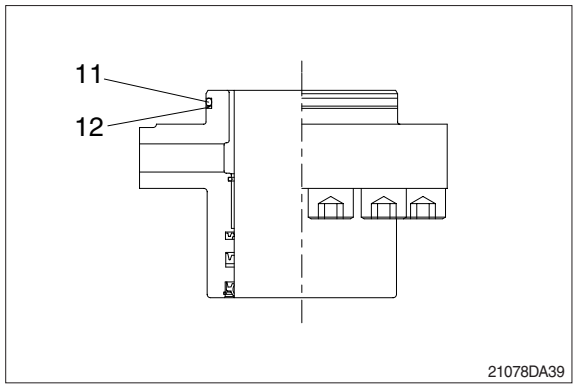
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

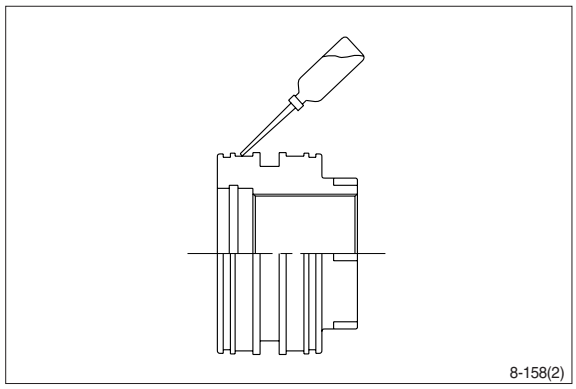
⑥ Fit O-ring (11) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

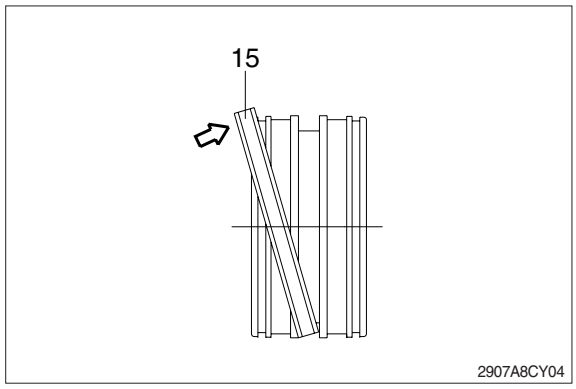
① Coat the outer face of piston (14) with hydraulic oil.



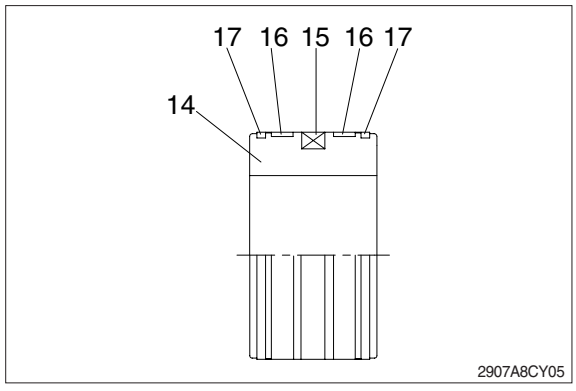
② Fit piston seal (15) to piston.

※ 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).

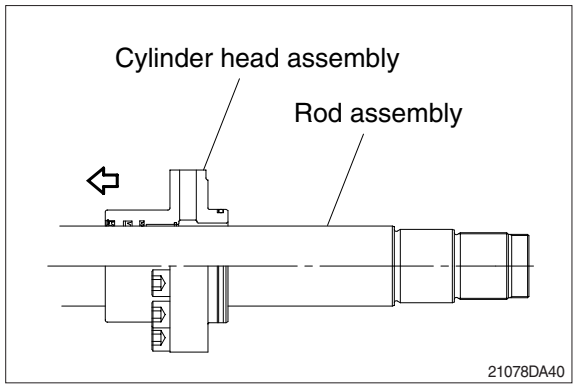


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

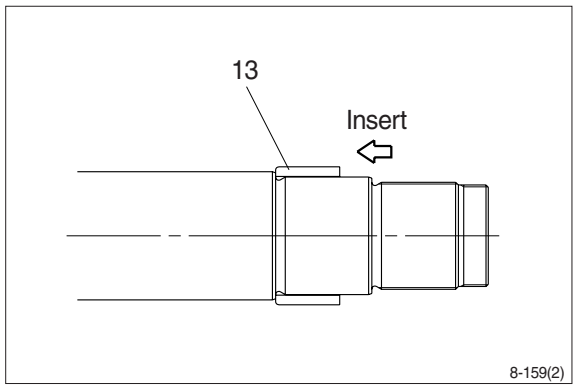
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



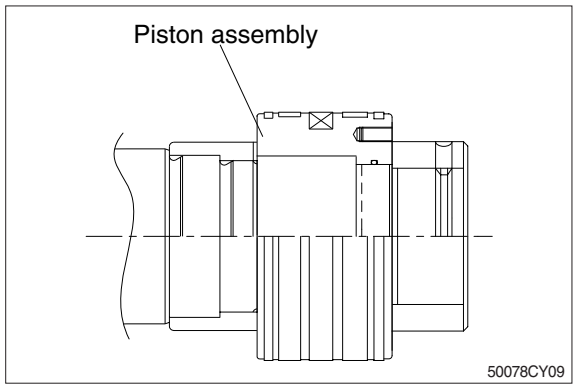
④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

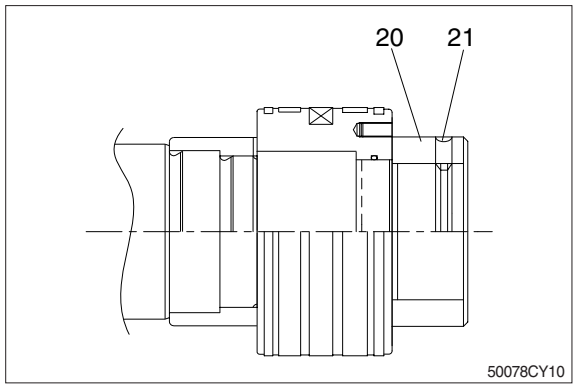
· Tightening torque : 100±10.0 kgf · m
(723±72.3 lbf · ft)



⑥ Fit lock nut (20) and tighten the set screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
Bucket	20	100±10	723.3±72.3
Boom	21	5.4±0.5	391±3.6
Arm	21	150±15	1085±108
	22	5.4±0.5	39.1±3.6



(3) Overall assemble

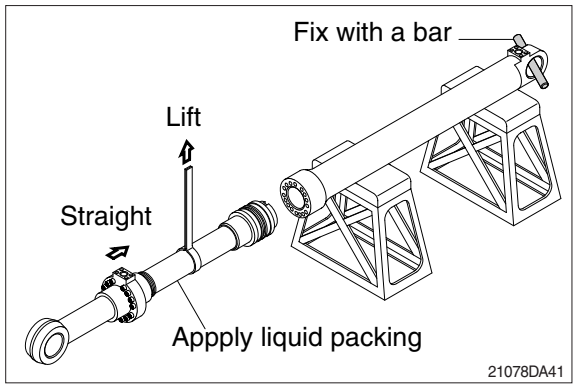
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

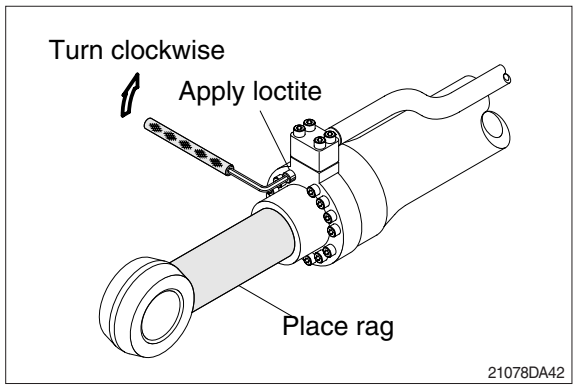
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ Be careful not to damage piston seal by thread of tube assembly.

③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.





1. TRACK LINK

1) REMOVAL

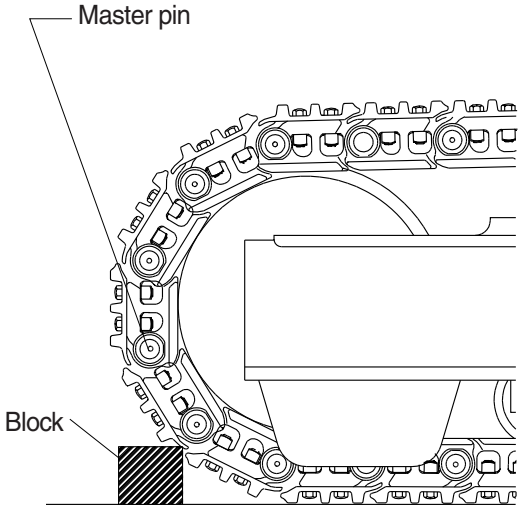
(1) Move track link until master pin is over front idler in the position put wooden block as shown.

(2) Loosen tension of the track link.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.

※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease nipple can be suddenly popped out by pressurized grease.

(3) Push out master pin by using a suitable tool.

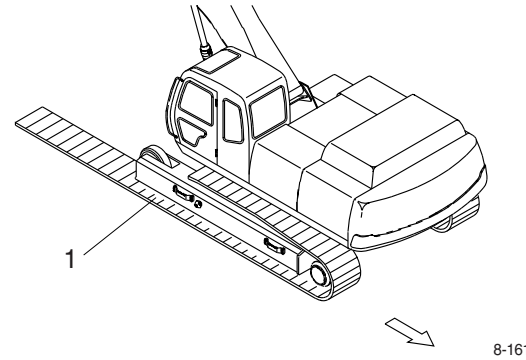


8-161(1)

(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.

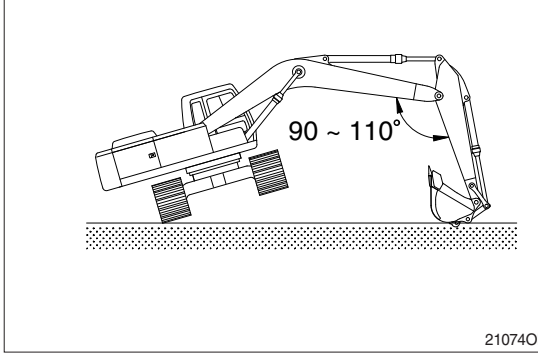
※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.



8-161(2)

2) INSTALL

(1) Carry out installation in the reverse order to removal.
Adjust the tension of the track link.

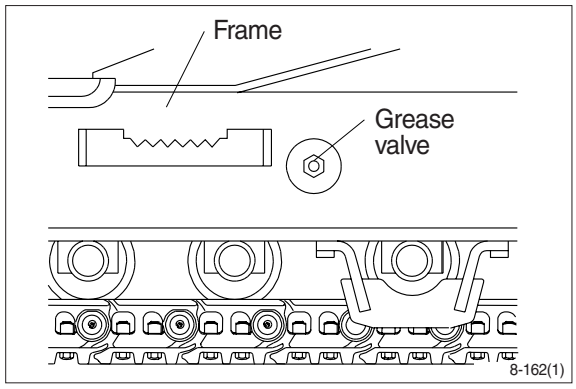


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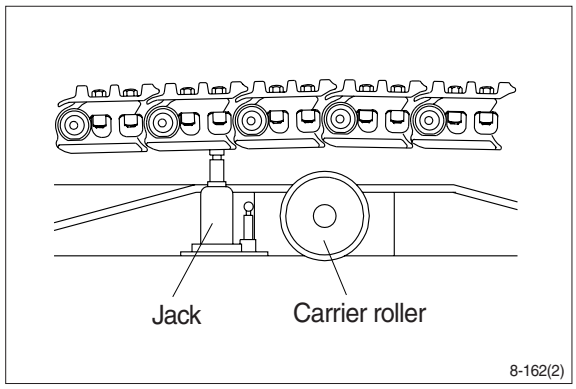
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.

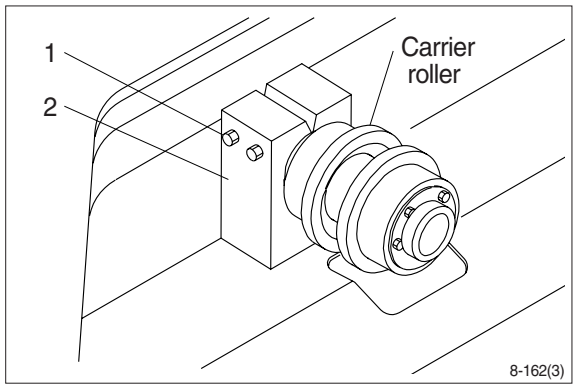


(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket (2) with a screwdriver, push out from inside, and remove carrier roller assembly.
Weight : 48 kg (88 lb)



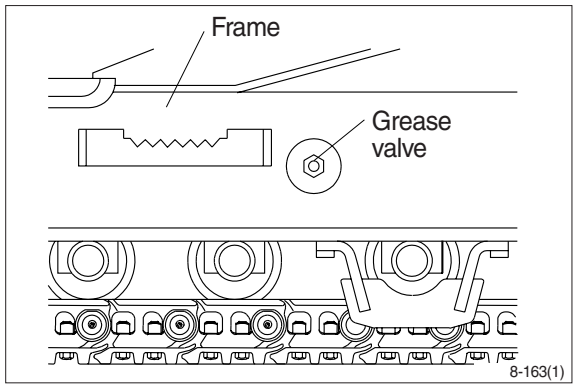
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

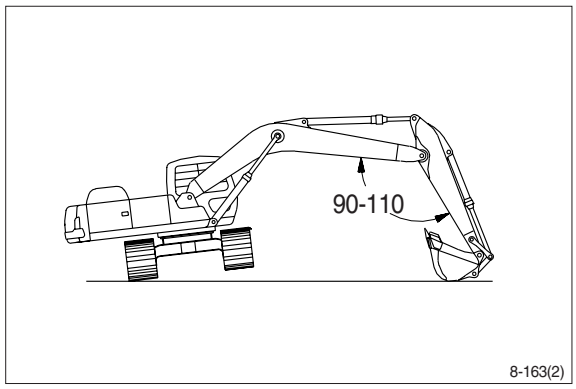
1) REMOVAL

(1) Loosen tension of the track link.



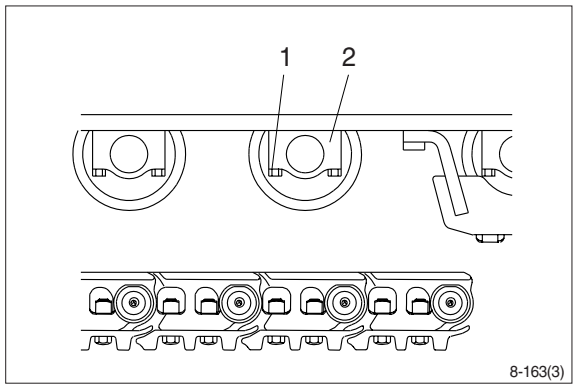
(2) Using the work equipment, push up track frame on side which is to be removed.

※ 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 : 54 kg (119lb)



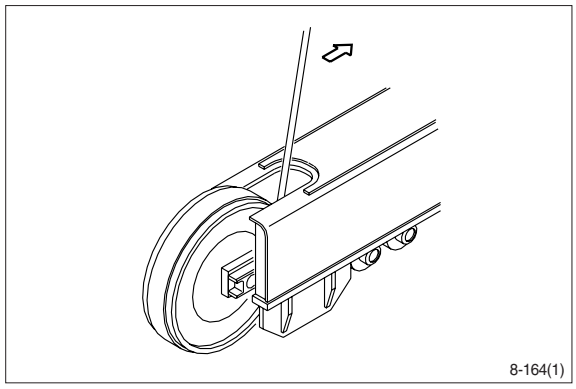
2) INSTALL

(1) Carry out installation in the reverse order to removal.

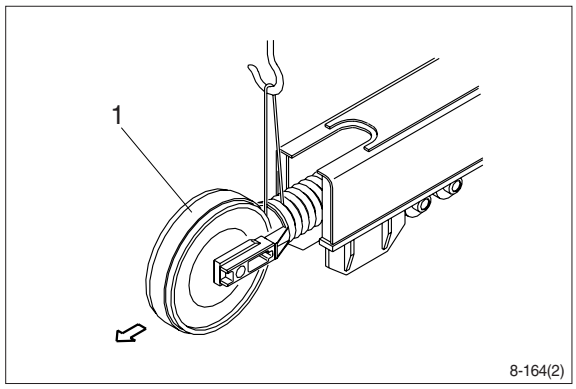
4. IDLER AND RECOIL SPRING

1) REMOVAL

(1) Remove the track link.
For detail, see **removal of track link.**

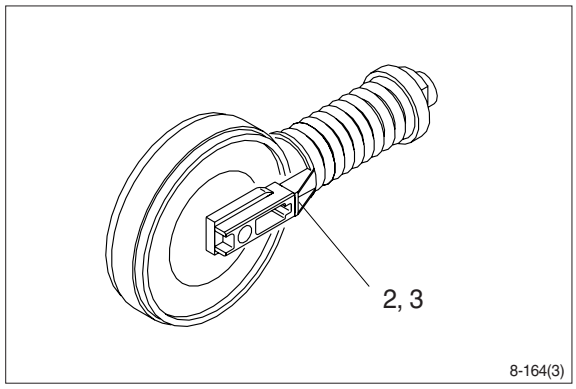

8-164(1)

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 457 kg (1010 lb)



8-164(2)

(3) Remove the bolts (2), washers (3) and separate idler from recoil spring.

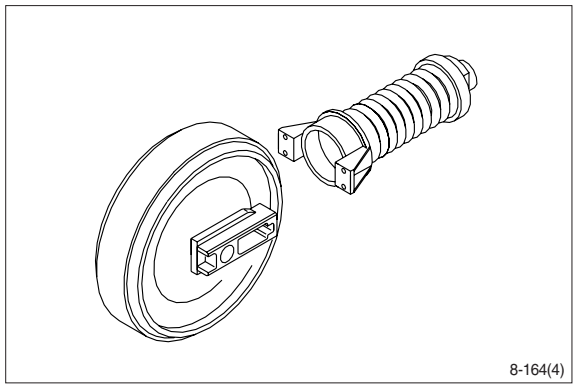


8-164(3)

2) INSTALL

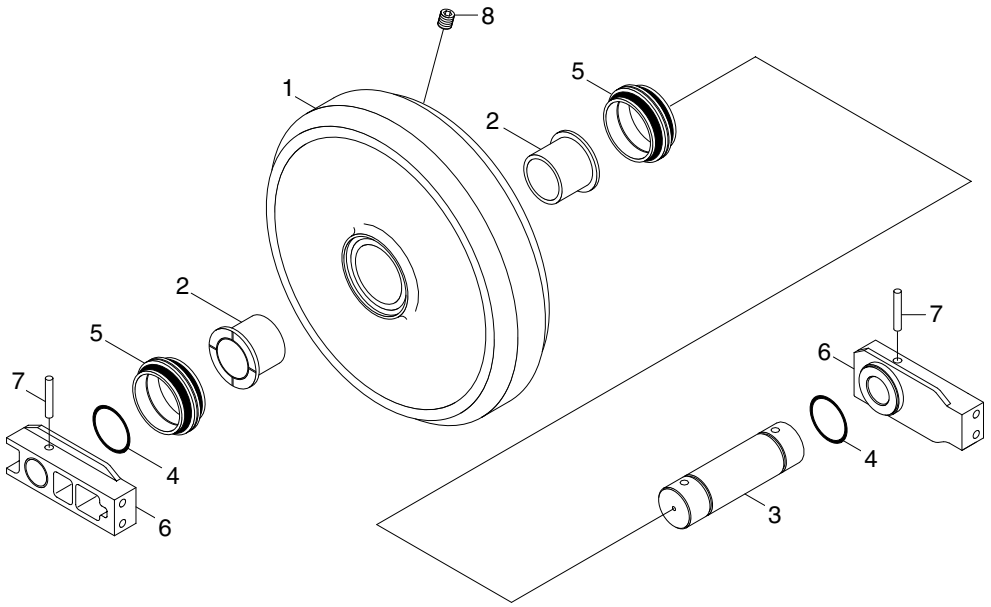
(1) Carry out installation in the reverse order to removal.

※ 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



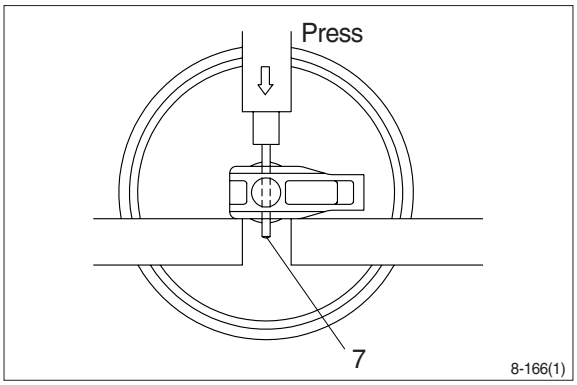
29078ID01

1	Shell	4	O-ring	7	Spring pin
2	Bushing	5	Seal assembly	8	Plug
3	Shaft	6	Bracket		

(2) Disassembly

① Remove plug and drain oil.

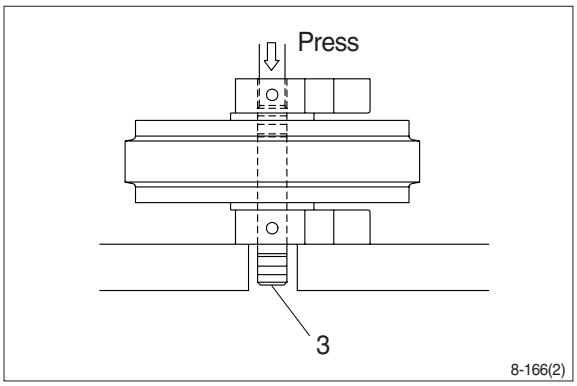
② Draw out the spring pin (7), using a press.



③ Pull out the shaft (2) with a press.

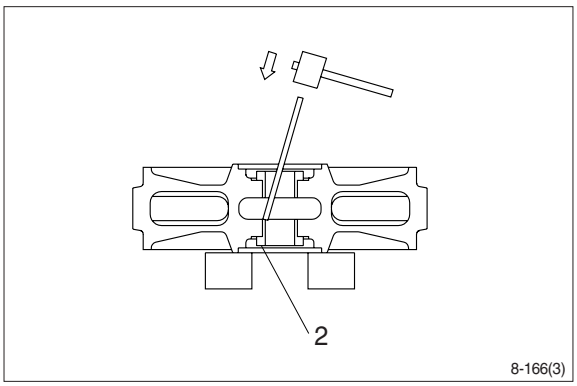
④ Remove seal (5) from shell (1) and bracket (6).

⑤ Remove O-ring (4) from shaft.



⑥ Remove the bushing (2) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.

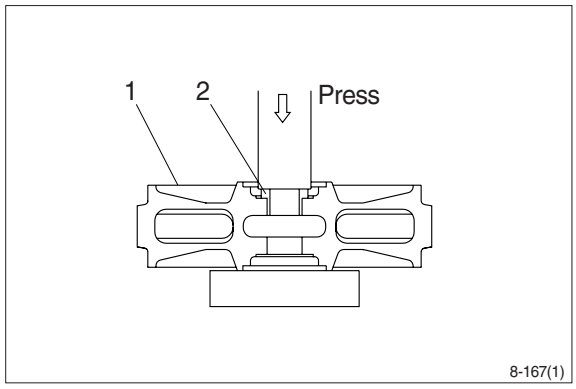


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

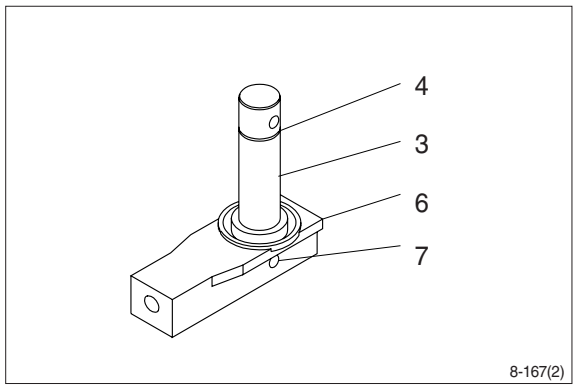
① Cool up bushing (2) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1)

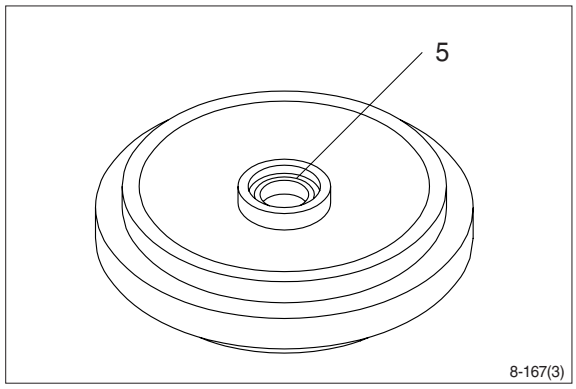
② Coat O-ring (4) with grease thinly, and install it to shaft (3).

③ Insert shaft (3) into bracket (6) and drive in the spring pin (7).



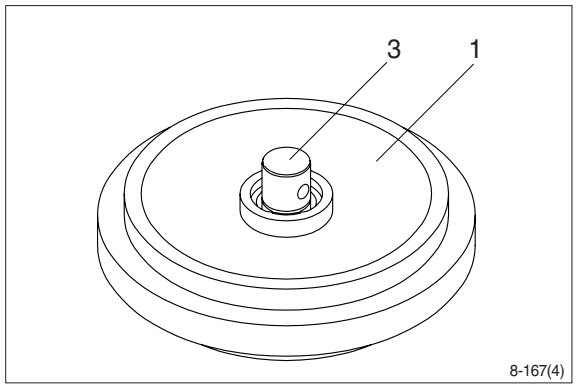
8-167(2)

④ Install seal (5) to shell (1) and bracket (6).



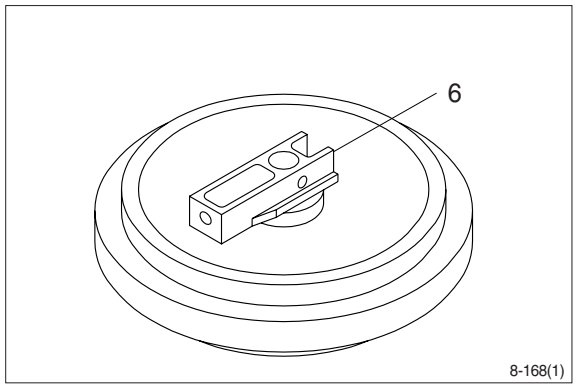
8-167(3)

⑤ Install shaft (3) to shell (1).

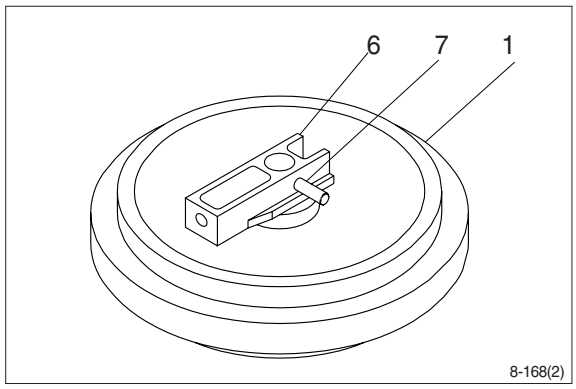


8-167(4)

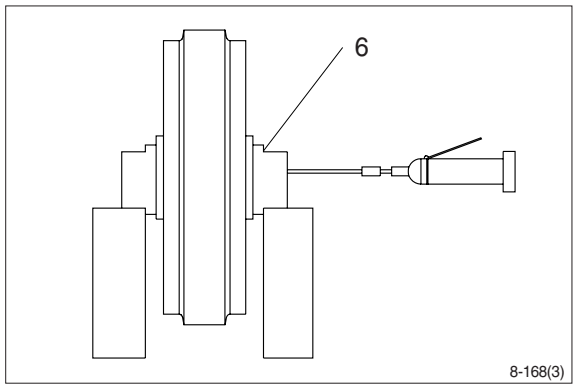
⑥ Install bracket (6) attached with seal (5).



⑦ Knock in the spring pin (7) with a hammer.

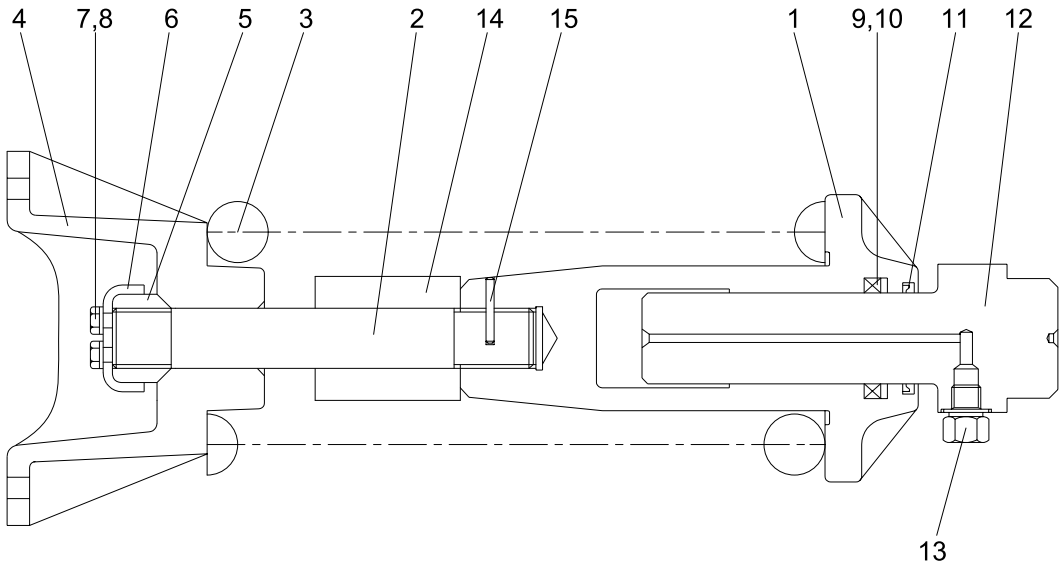


⑧ Lay bracket (6) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



36078UC02

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	14	Stopper tube
5	Lock nut	10	Back up ring	15	Spring pin

(2) Disassembly

① Apply pressure on spring (3) with a press.

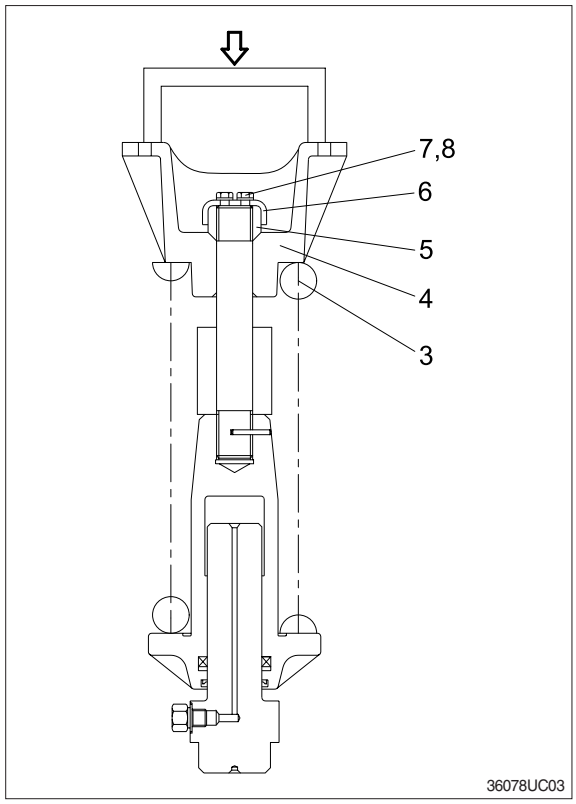
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

·Spring set load : 19012 kg (41826 lb)

② Remove bolt (7), spring washer (8) and lock plate (6).

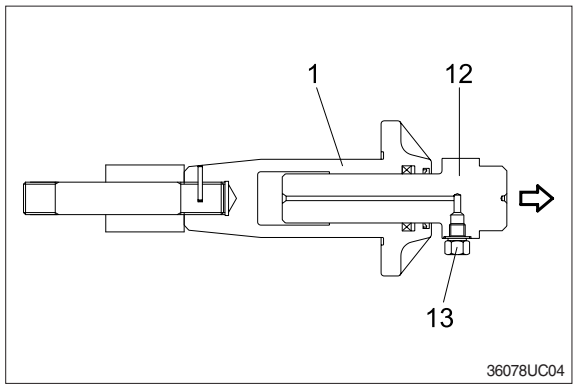
③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket (4) and spring (3).

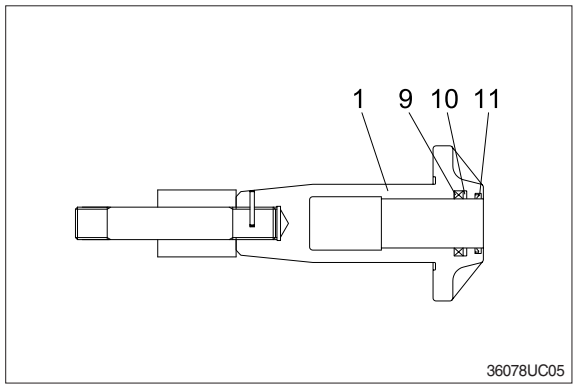


⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



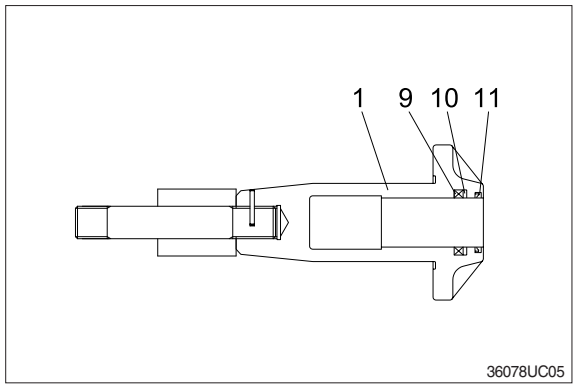
⑦ Remove rod seal (9), back up ring (10) and dust seal (11).



(3) Assembly

① Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

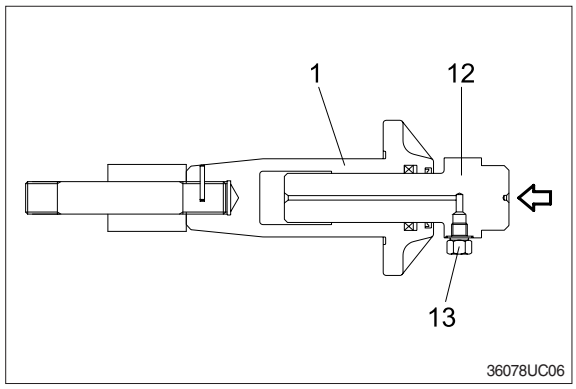
※ When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



② Pour grease into body (1), then push in rod (12) by hand.
After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (13) to rod (12).
·Tightening torque : 13.0±1.0 kgf · m
(94±7.2 lbf · ft)

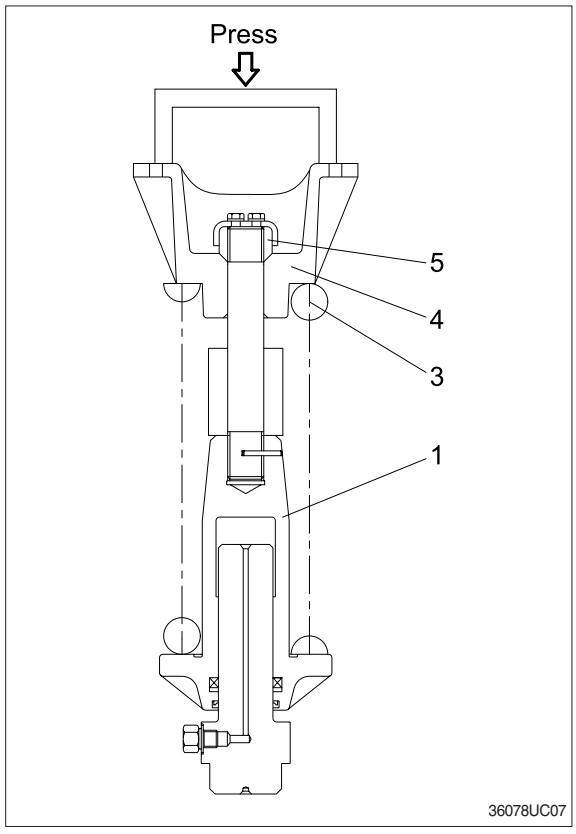


④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

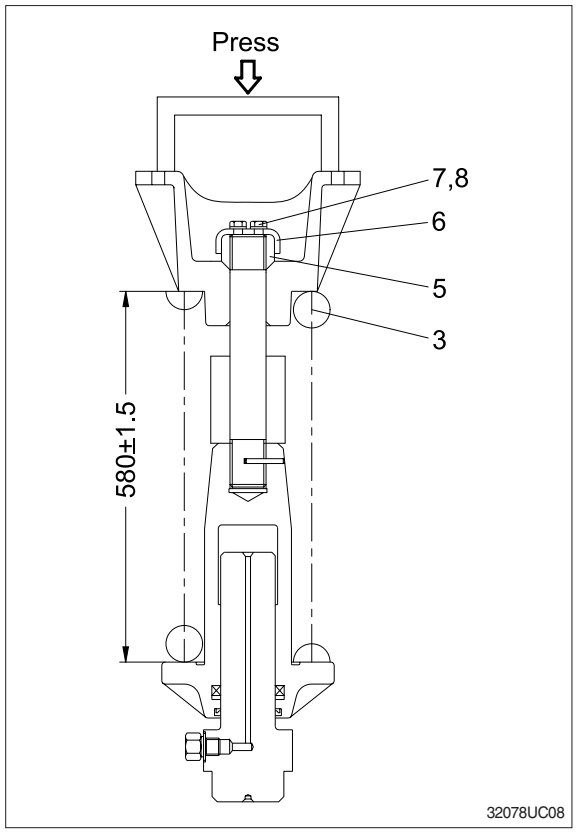
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.

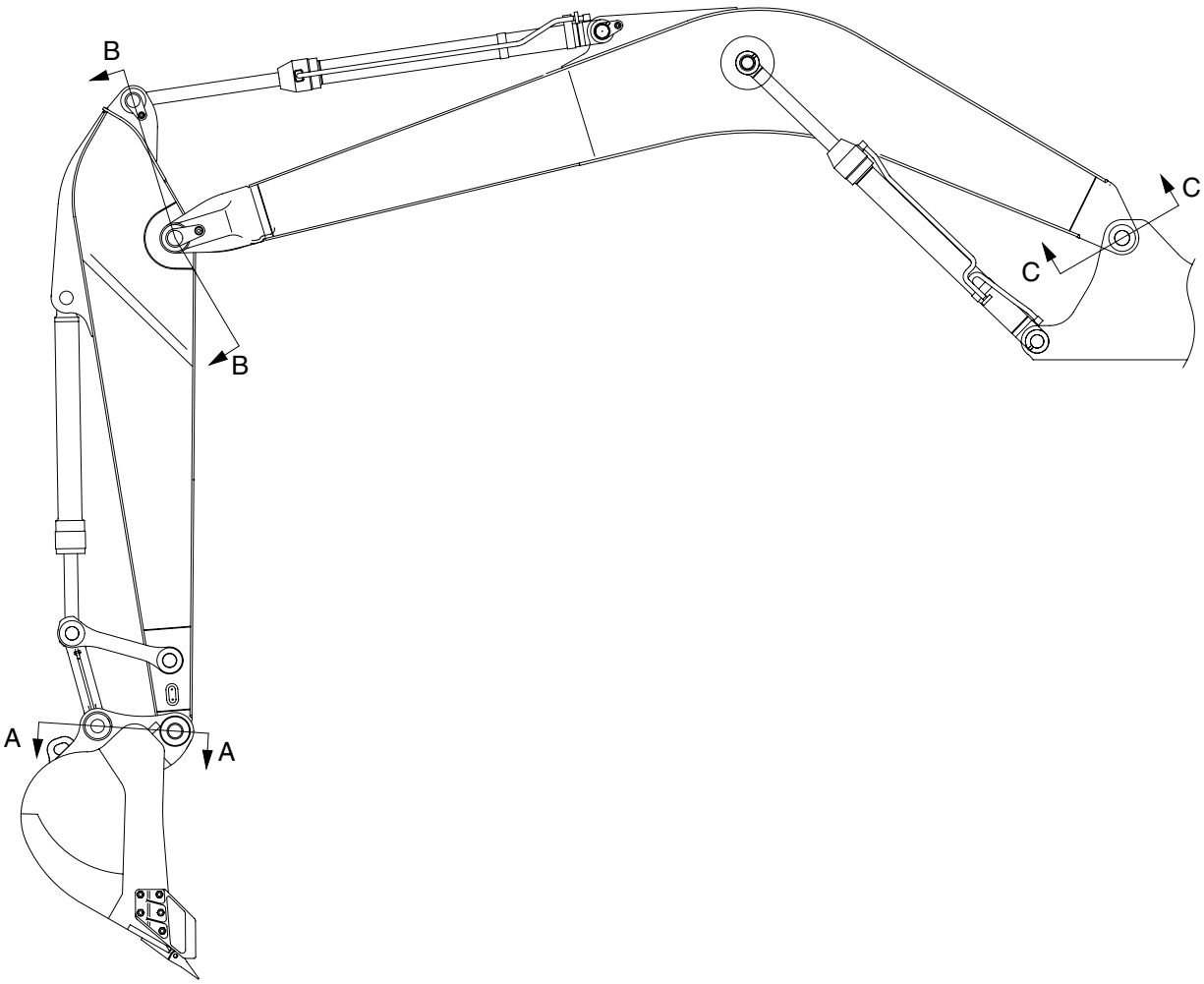


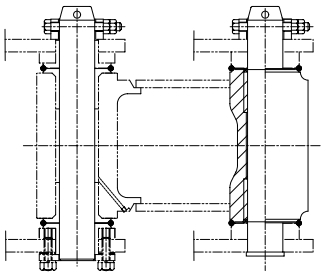
⑥ Lighten the press load and confirm the set length of spring (3).

⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).

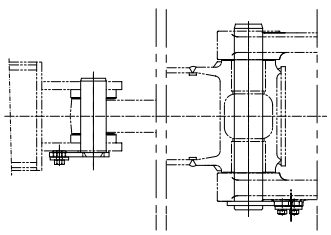


1. STRUCTURE

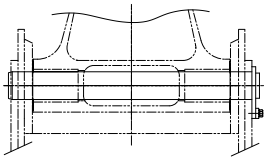




SECTION A



SECTION B



SECTION C

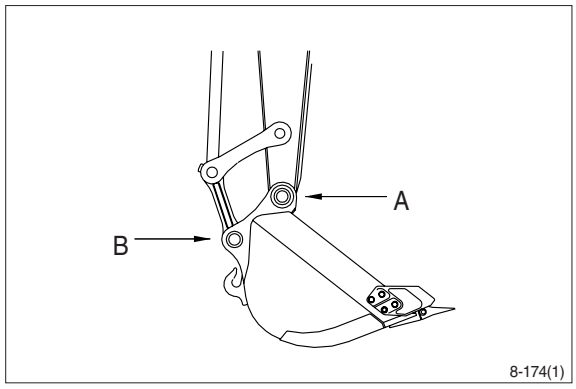
29078WE01

2. REMOVAL AND INSTALL

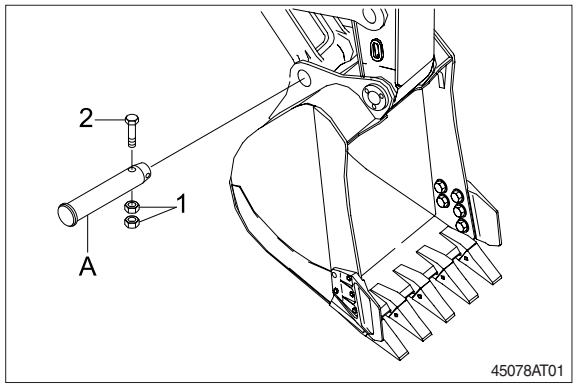
1) BUCKET ASSEMBLY

(1) Removal

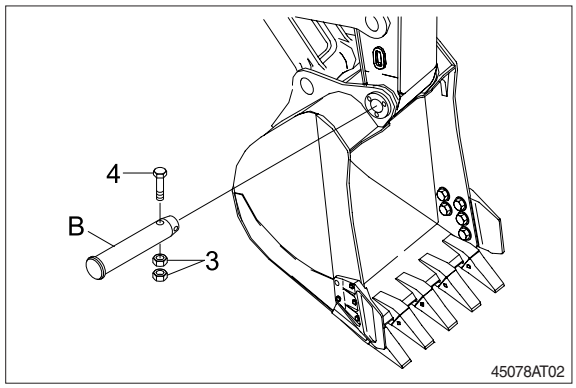
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut (1), bolt (2) and draw out the pin (A).



③ Remove nut (3), bolt (4) and draw out the pin (B).

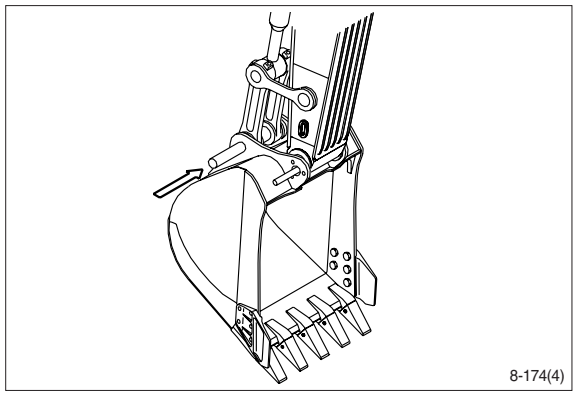


(2) Install

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 in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

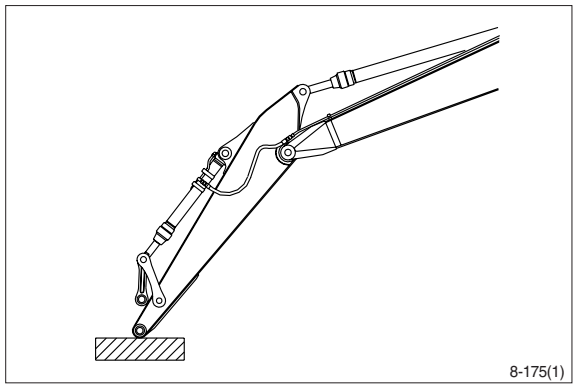
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

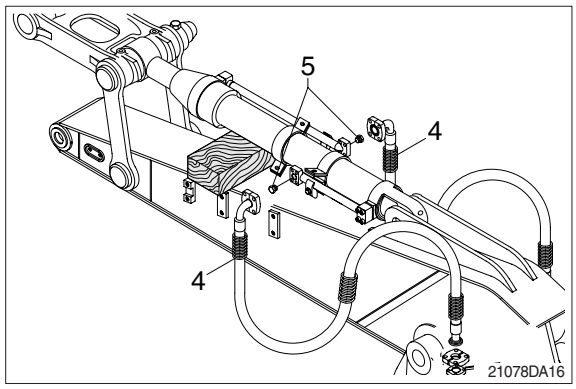
※ Tie the rod with wire to prevent it from coming out.

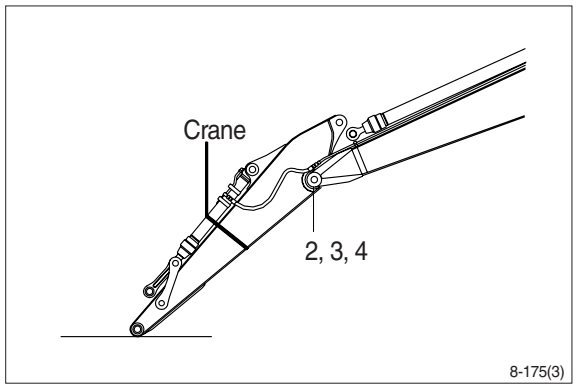
④ For details, see r**emoval of arm cylinder assembly.**
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.
· Weight : 1160 kg (2560 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.**

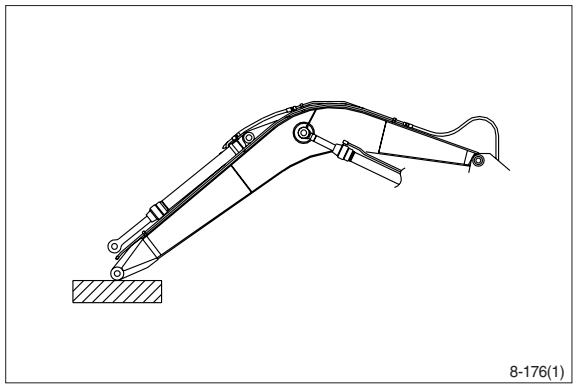
※ Bleed the air from the cylinder.

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.**

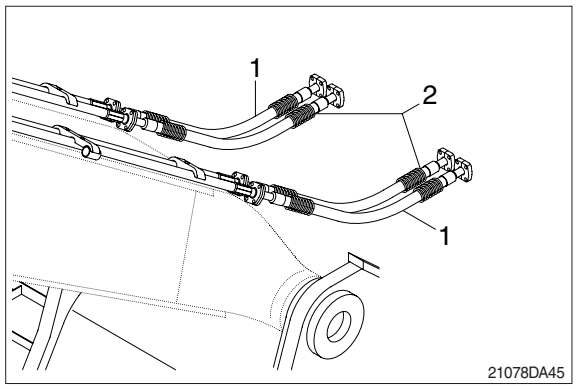


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

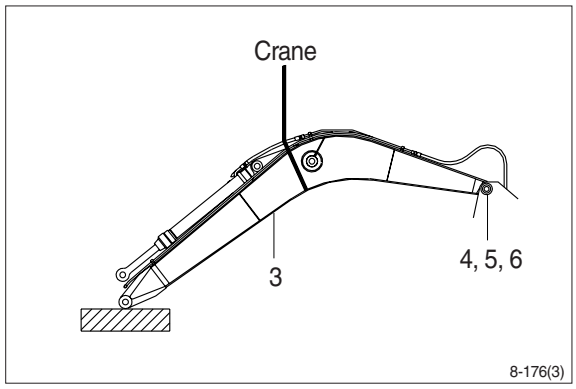
※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).



⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight : 2540 kg (5600 lb)

※ When lifting the boom assembly always lift the center of gravity.

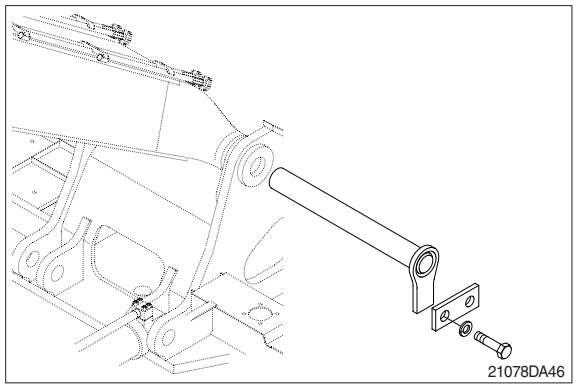


(2) Install

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

Group 1 Introduction guide 9-1
Group 2 Engine system 9-2
Group 3 Electric system 9-4
Group 4 Hydraulic system 9-6
Group 5 Undercarriage 9-9
Group 6 Structure 9-11
Group 7 Work equipment 9-15

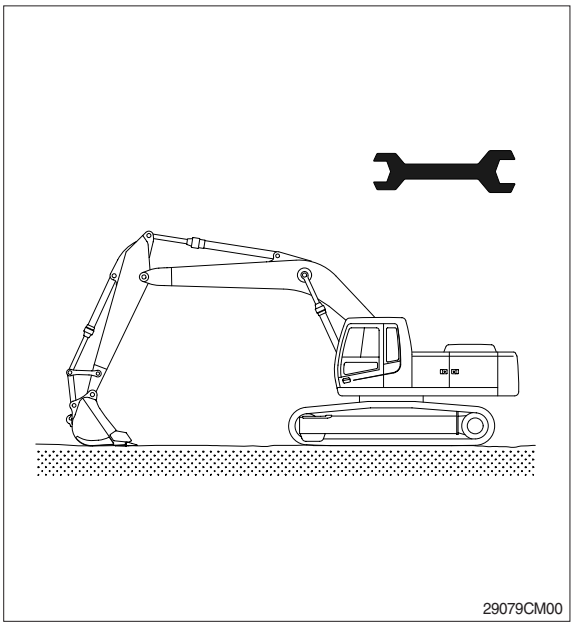
SECTION 9 COMPONENT MOUNTING TORQUE

GROUP 1 INTRODUCTION GUIDE

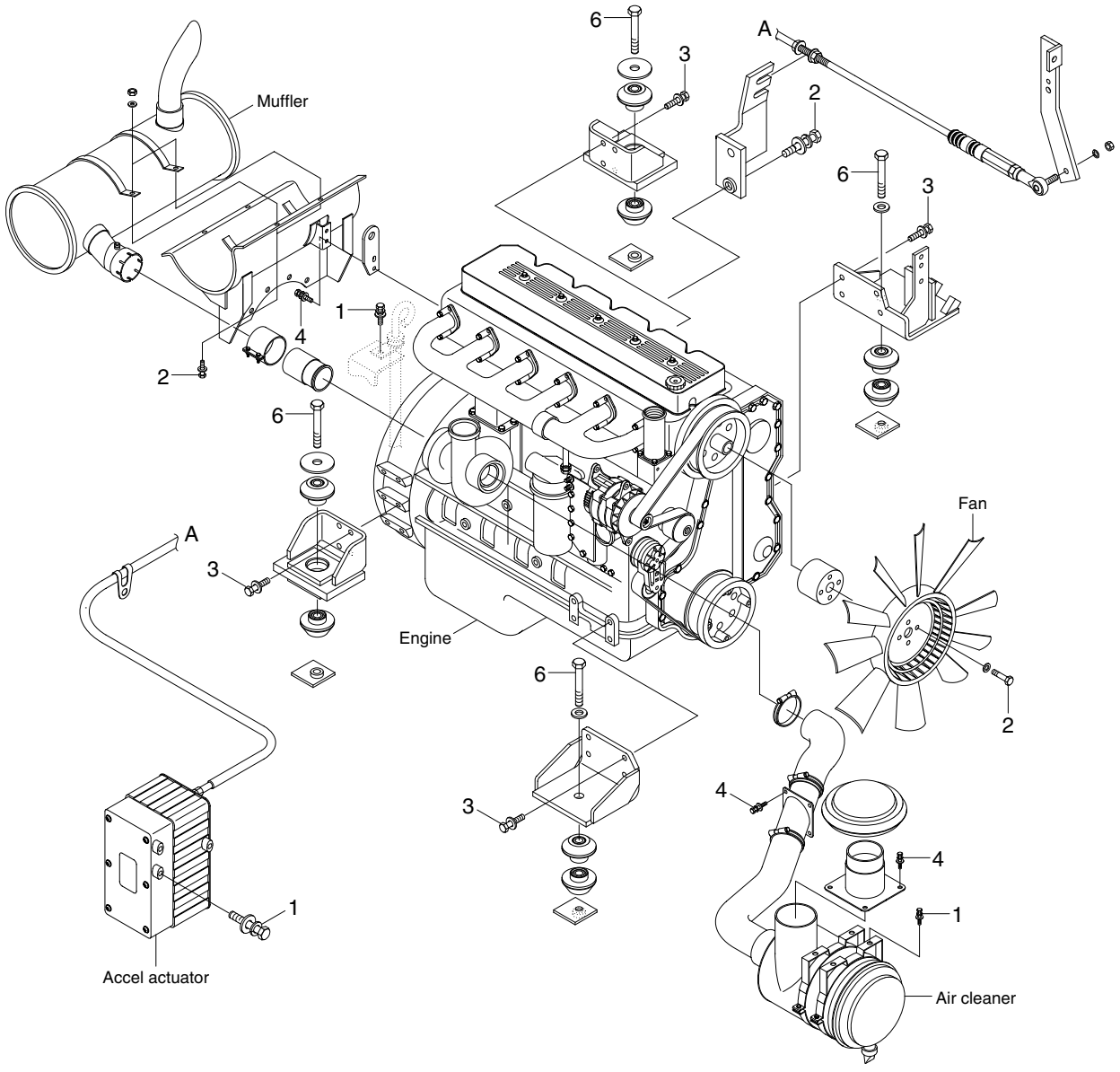
1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
2. Use genuine Hyundai spare parts.
   We expressly point out that Hyundai will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases Hyundai cannot 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.



ENGINE AND ACCESSORIES MOUNTING



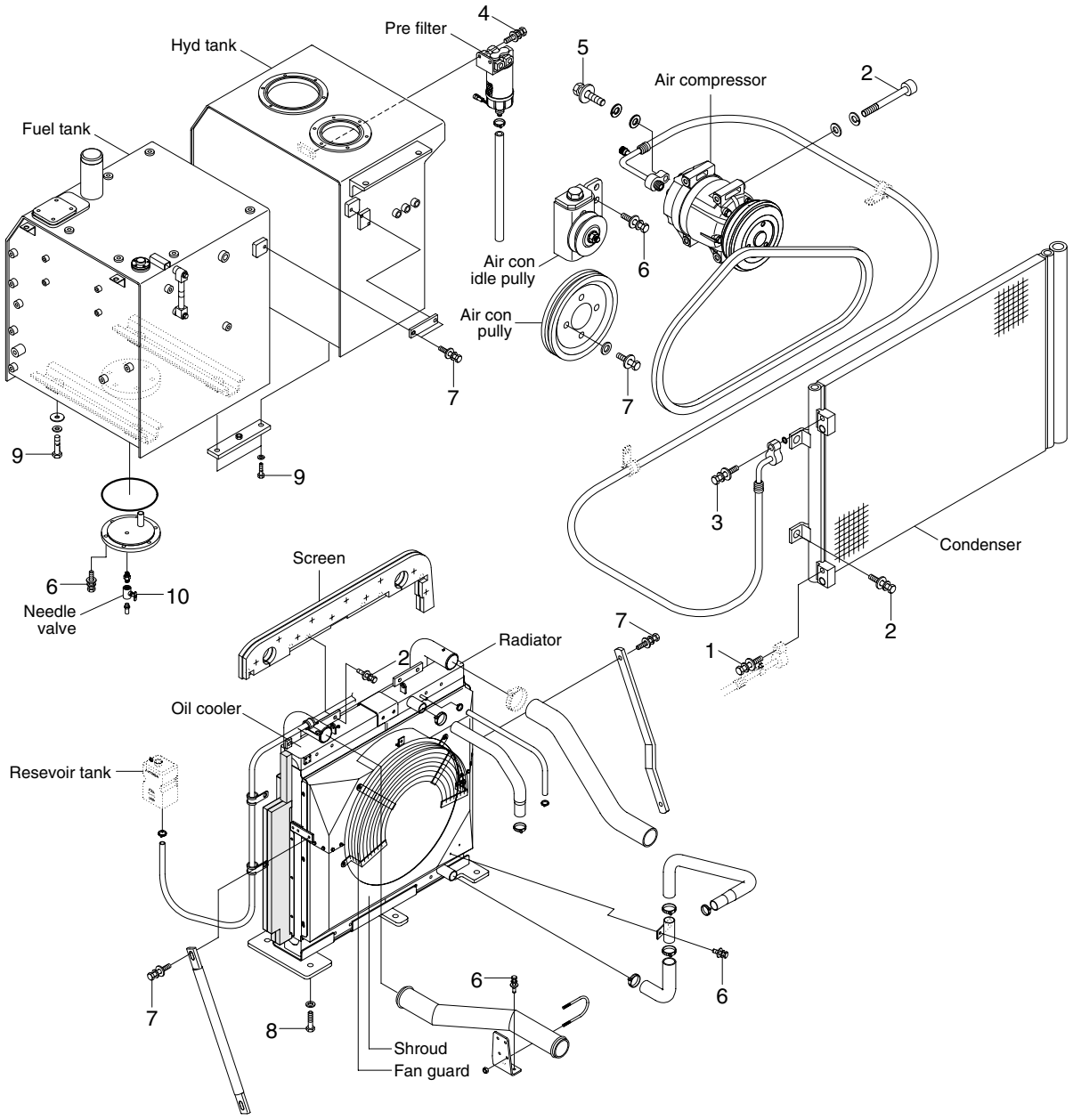
3309S9CM01

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	10.0±2.0	72.3±14.5

Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.8±3.0	92.6±21.7
5	M14×2.0	9.8±0.9	70.8±6.5
6	M24×3.0	90±7.0	651±51

COOLING SYSTEM AND FUEL TANK MOUNTING

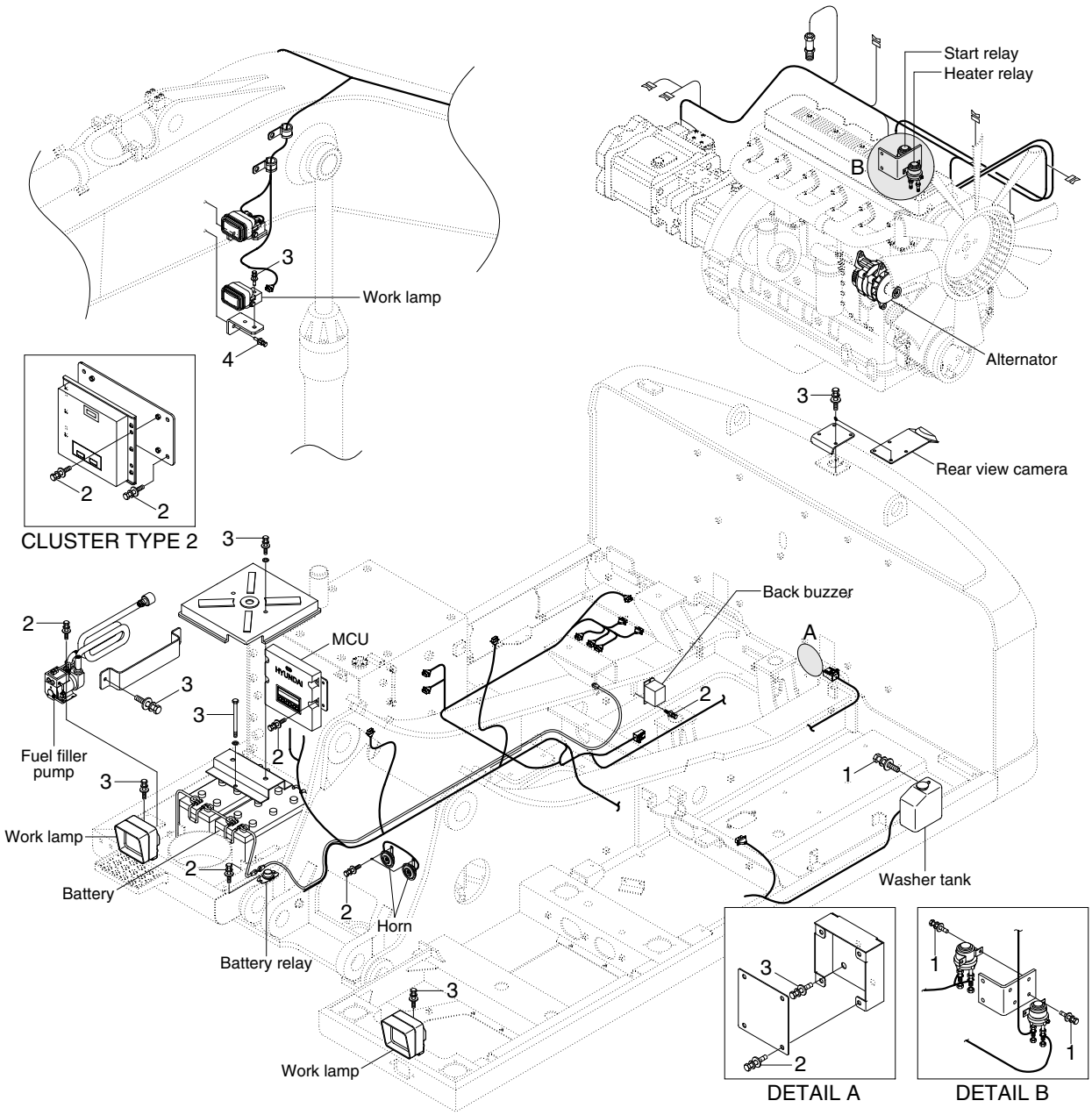


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	0.5±0.2	3.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M 8×1.25	1.3±0.2	9.4±1.45
4	M 8×1.25	4.3±0.2	31.1±1.45
5	M10×1.25	5.0±0.2	36.1±1.45

Item	Size	kgf · m	lbf · ft
6	M10×1.5	6.9±1.4	49.9±10.1
7	M12×1.75	12.8±3.0	92.6±21.7
8	M16×2.0	29.7±4.5	215±32.5
9	M20×2.5	57.9±8.7	419±62.9
10	-	1.8±0.1	13.0±0.7

ELECTRIC COMPONENTS MOUNTING 1 (CLUSTER TYPE 1)



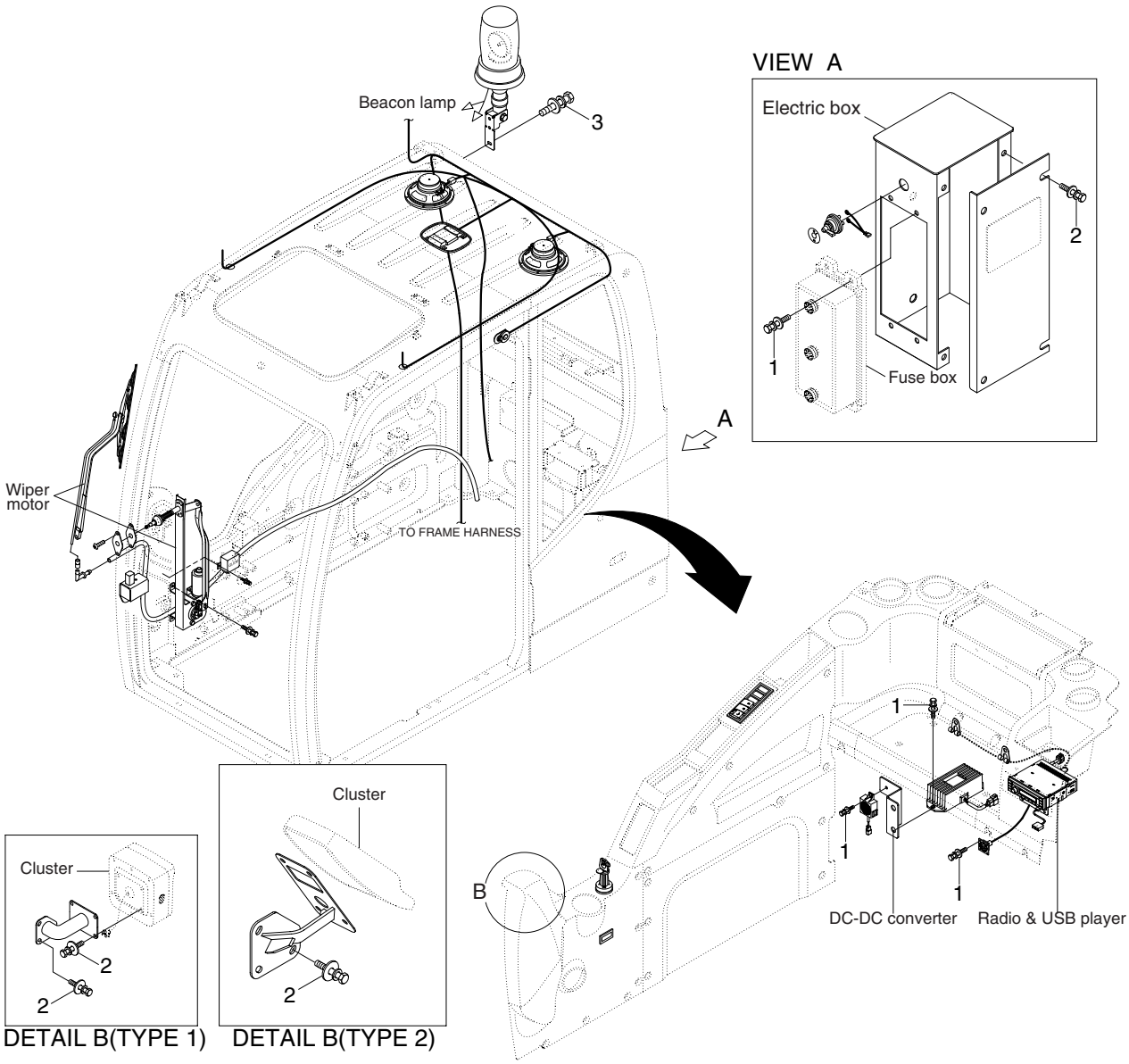
3309S9CM03

· 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
4	M12×1.75	12.8±3.0	92.6±21.7

ELECTRIC COMPONENTS MOUNTING 2



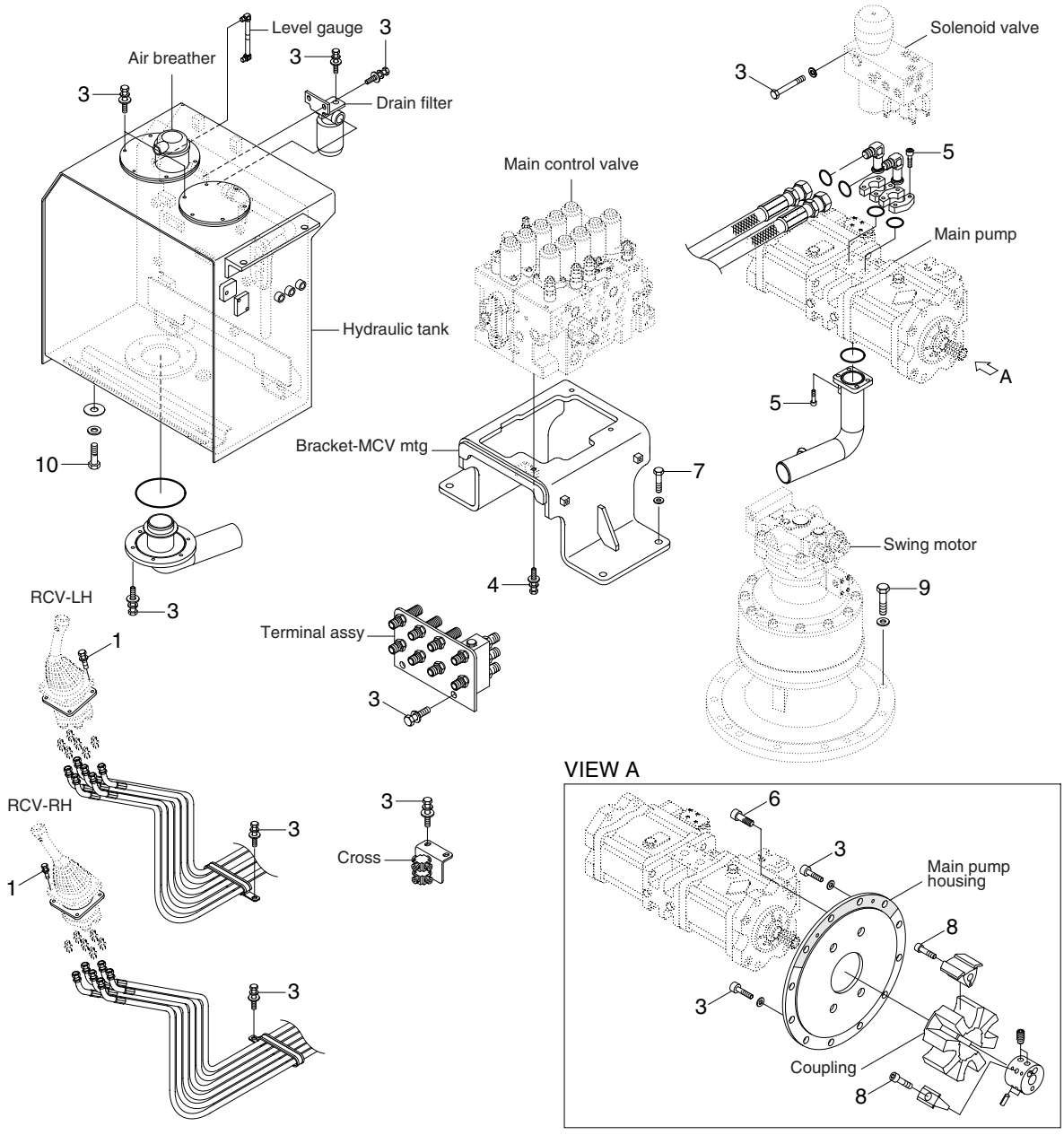
3309S9CM04

· 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

HYDRAULIC COMPONENTS MOUNTING 1



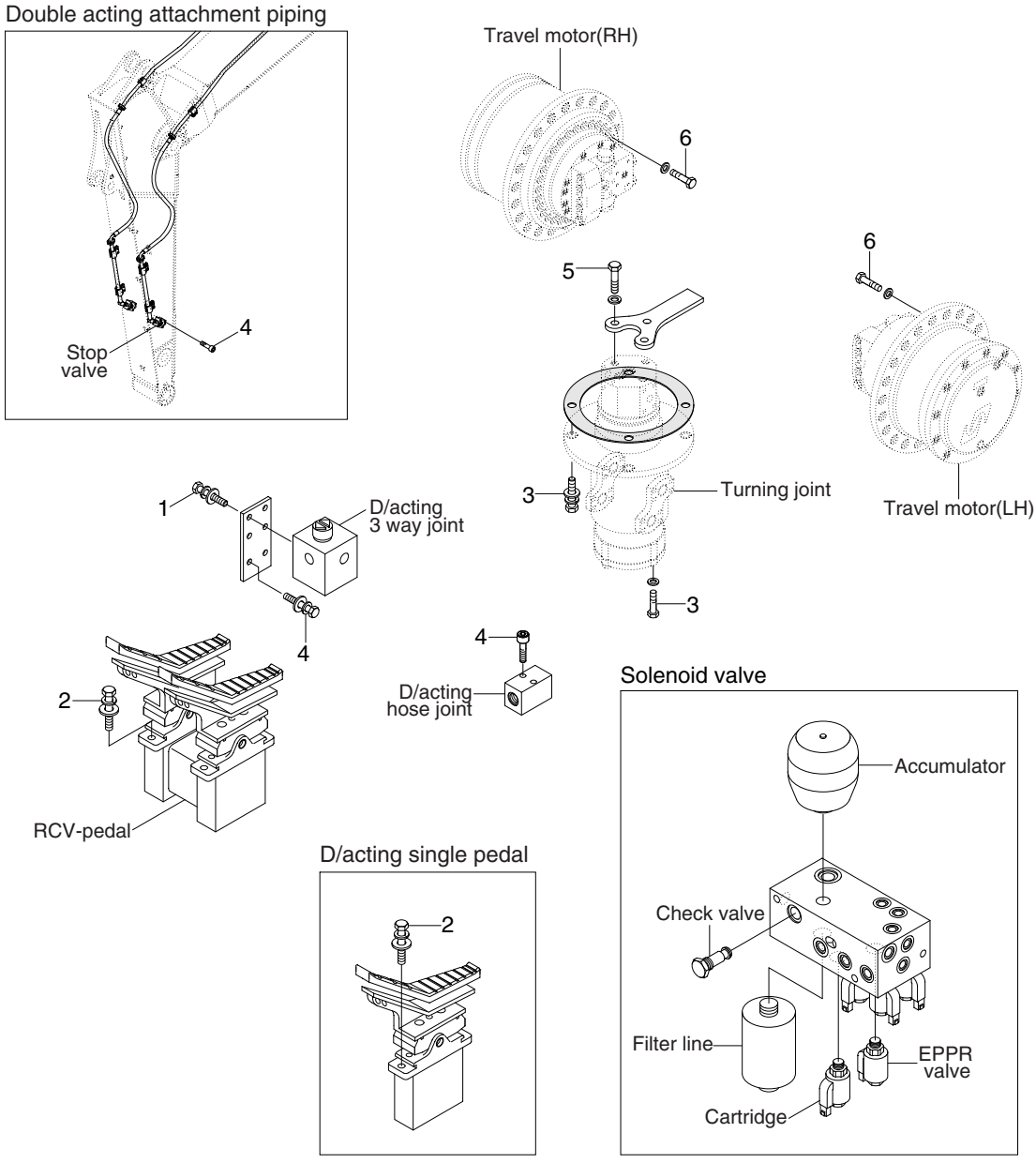
3309S9CM05

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M10×1.5	4.8±0.3	34.7±2.2
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.3±1.3	88.9±9.4
5	M12×1.75	12.8±3.0	92.5±21.6

Item	Size	kgf · m	lbf · ft
6	M20×2.5	42±4.5	304±32.5
7	M20×2.5	46±5.1	333±36.9
8	M20×2.5	46.5±2.5	336±18.1
9	M20×2.5	58.4±6.4	422±46.2
10	M20×2.5	57.9±8.7	419±62.9

HYDRAULIC COMPONENTS MOUNTING 2



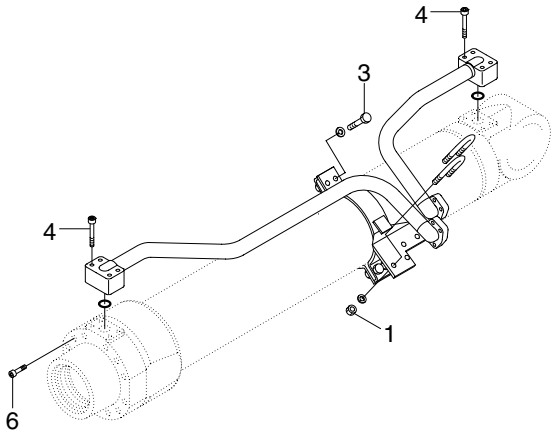
3009S9CM06

· Tightening torque

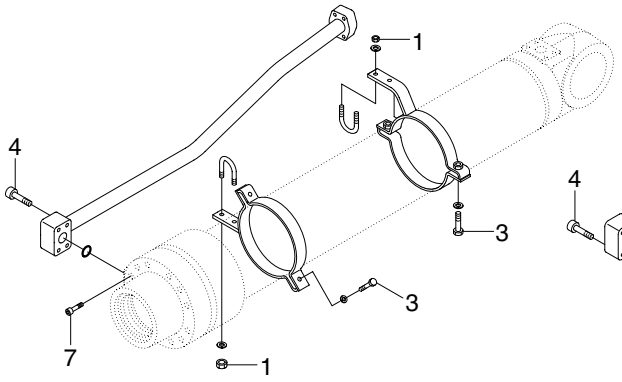
Item	Size	kgf · m	lbf · ft
1	M 8×1.25	4.05±0.8	29.3±5.8
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	12.3±1.3	88.9±9.4

Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.8±3.0	92.6±21.7
5	M14×2.0	19.6±2.9	142±20.9
6	M24×3.0	84±8.0	723±72.3

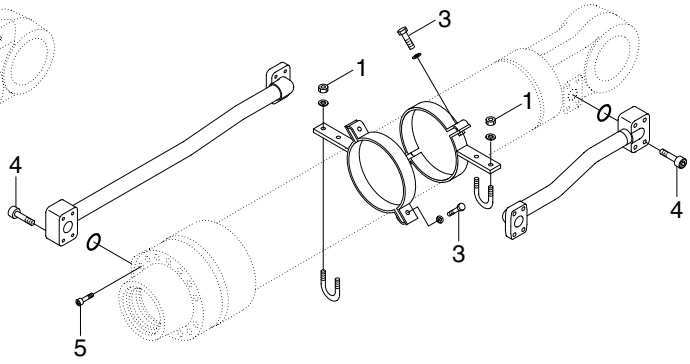
HYDRAULIC COMPONENTS MOUNTING 3



BOOM CYLINDER



ARM CYLINDER



BUCKET CYLINDER

3309S9CM07

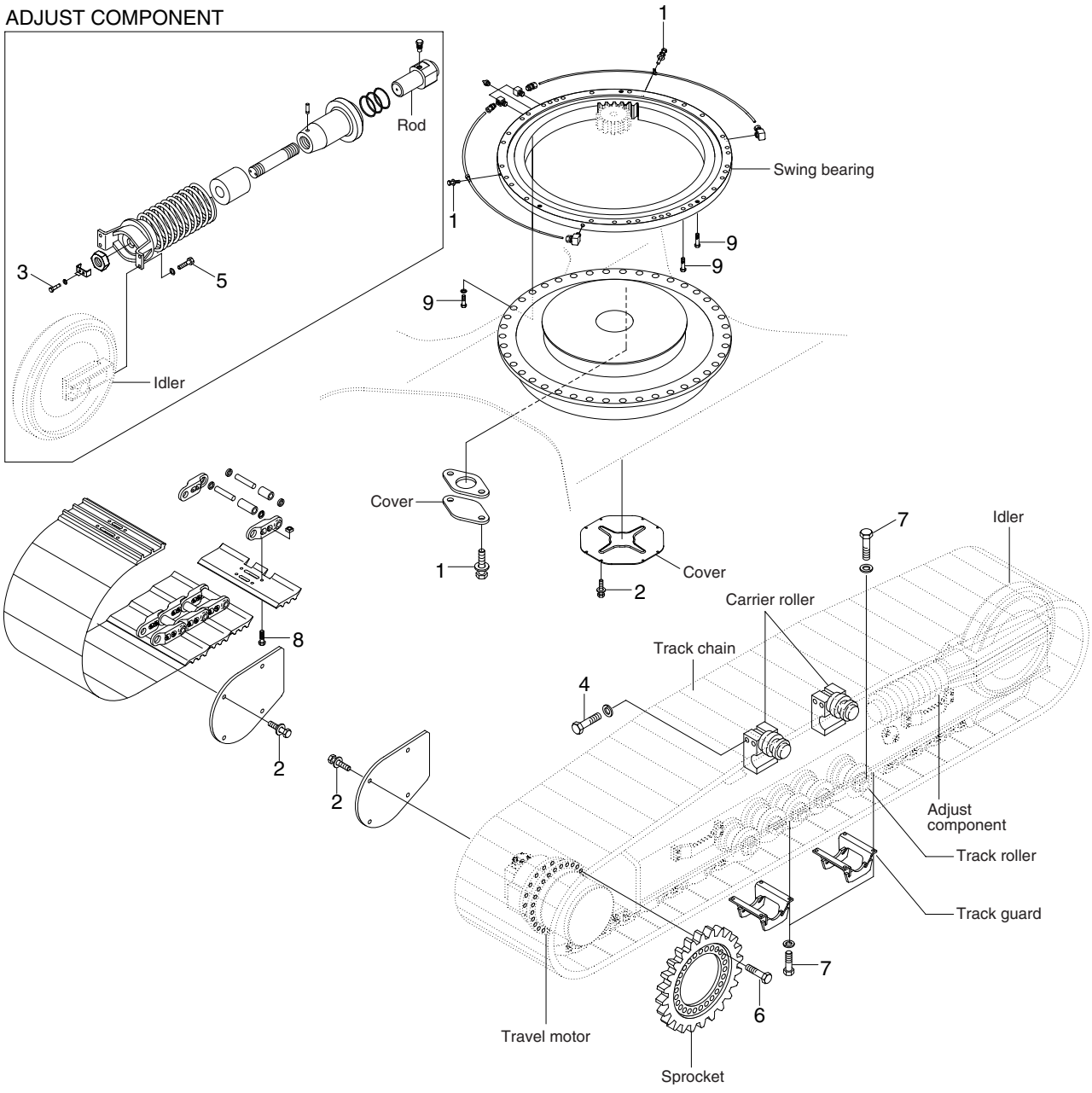
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	3.2±0.3	23.1±2.2
2	M 8×1.25	2.7±0.3	19.5±2.2
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	M20×2.5	46±5.0	333±36.2

GROUP 5 UNDERCARRIAGE

UNDERCARRIAGE MOUNTING



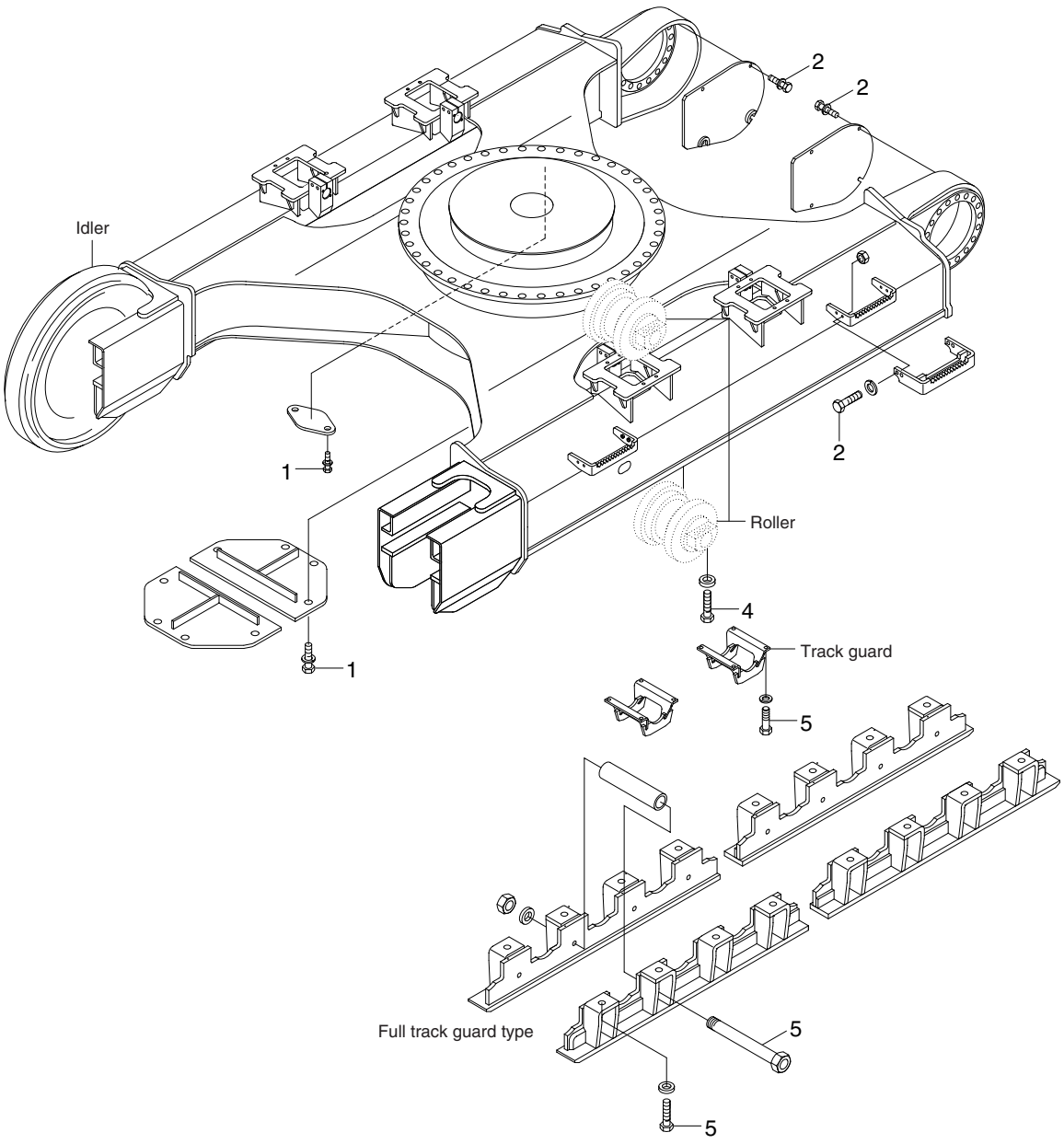
3309S9CM08

· 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	M12×1.75	15±0.5	108±3.6
4	M16×2.0	29.7±3.0	215±21.7

Item	Size	kgf · m	lbf · ft
5	M16×2.0	29.7±4.5	215±32.5
6	M20×2.5	57.9±6.0	419±43.4
7	M22×1.5	115±5.0	831±36
8	M24×3.0	100±10	723±72.3

UNDERCARRIAGE MOUNTING (HIGH WALKER)



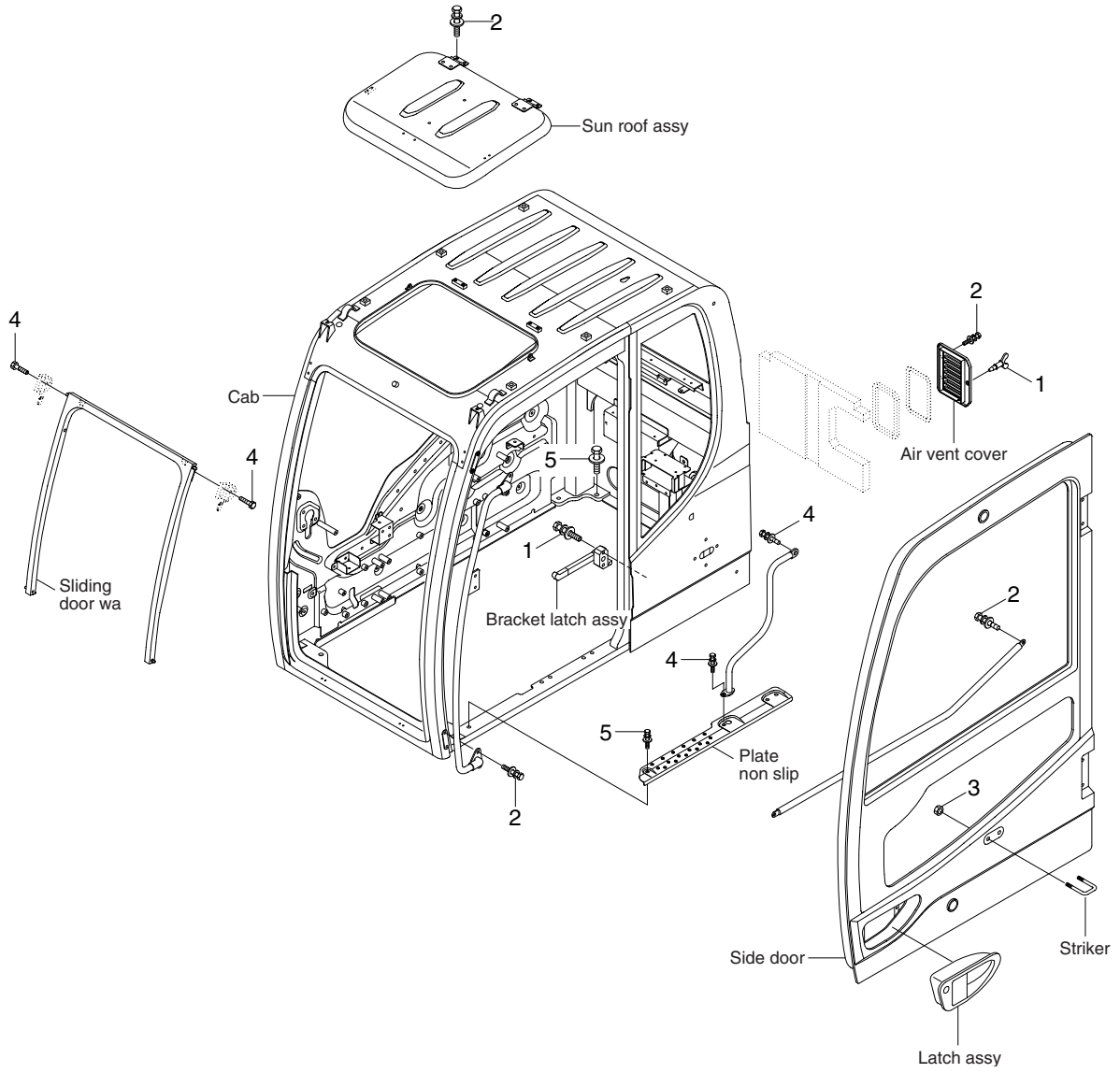
3309S9CM09

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.2±1.3	88.2±9.4
3	M20×2.5	51±4.0	369±28.9

Item	Size	kgf · m	lbf · ft
4	M20×2.5	57.9±8.6	419±62.2
5	M24×3.0	100±15	723±108
6	-	-	-

CAB AND ACCESSORIES MOUNTING



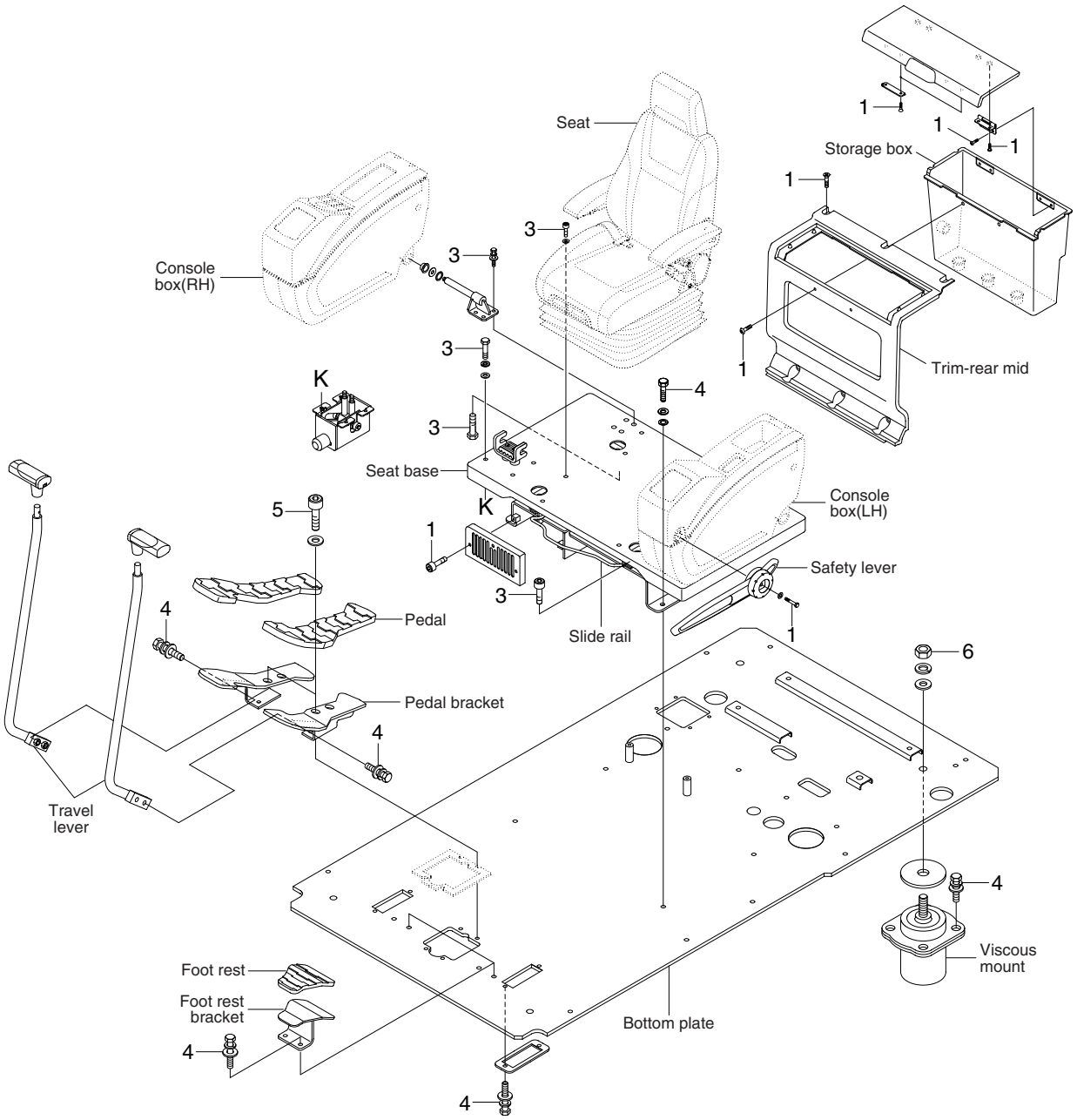
3309S9CM10

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	0.49±0.1	3.5±0.7
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	6.9±1.4	49.9±10.1
5	M12×1.75	12.8±3.0	92.6±21.7

CAB INTERIOR MOUNTING



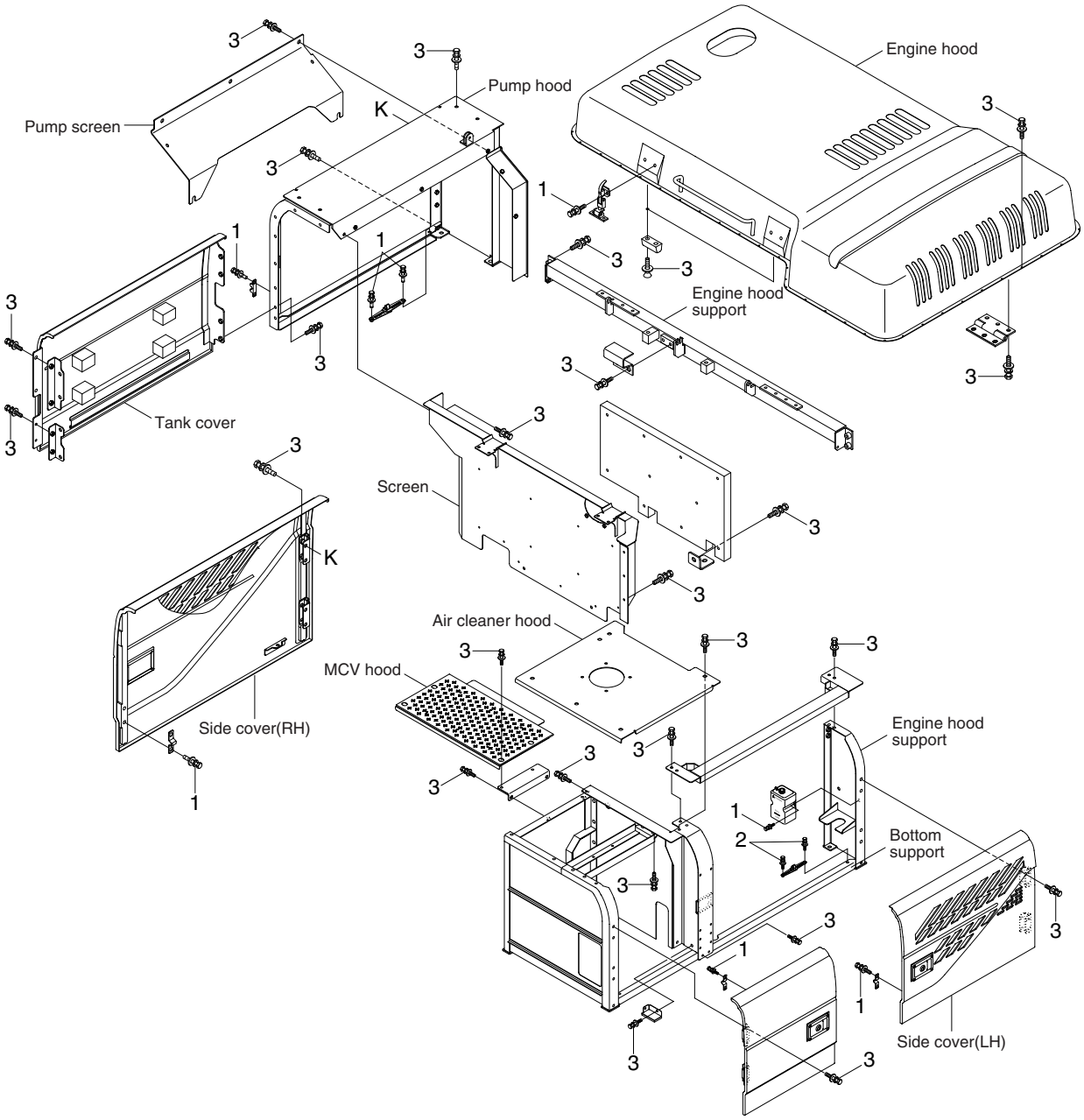
3309S9CM11

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	0.49±0.1	3.5±0.7
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
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	M16×2.0	29.7±4.5	215±32.5

COWLING MOUNTING

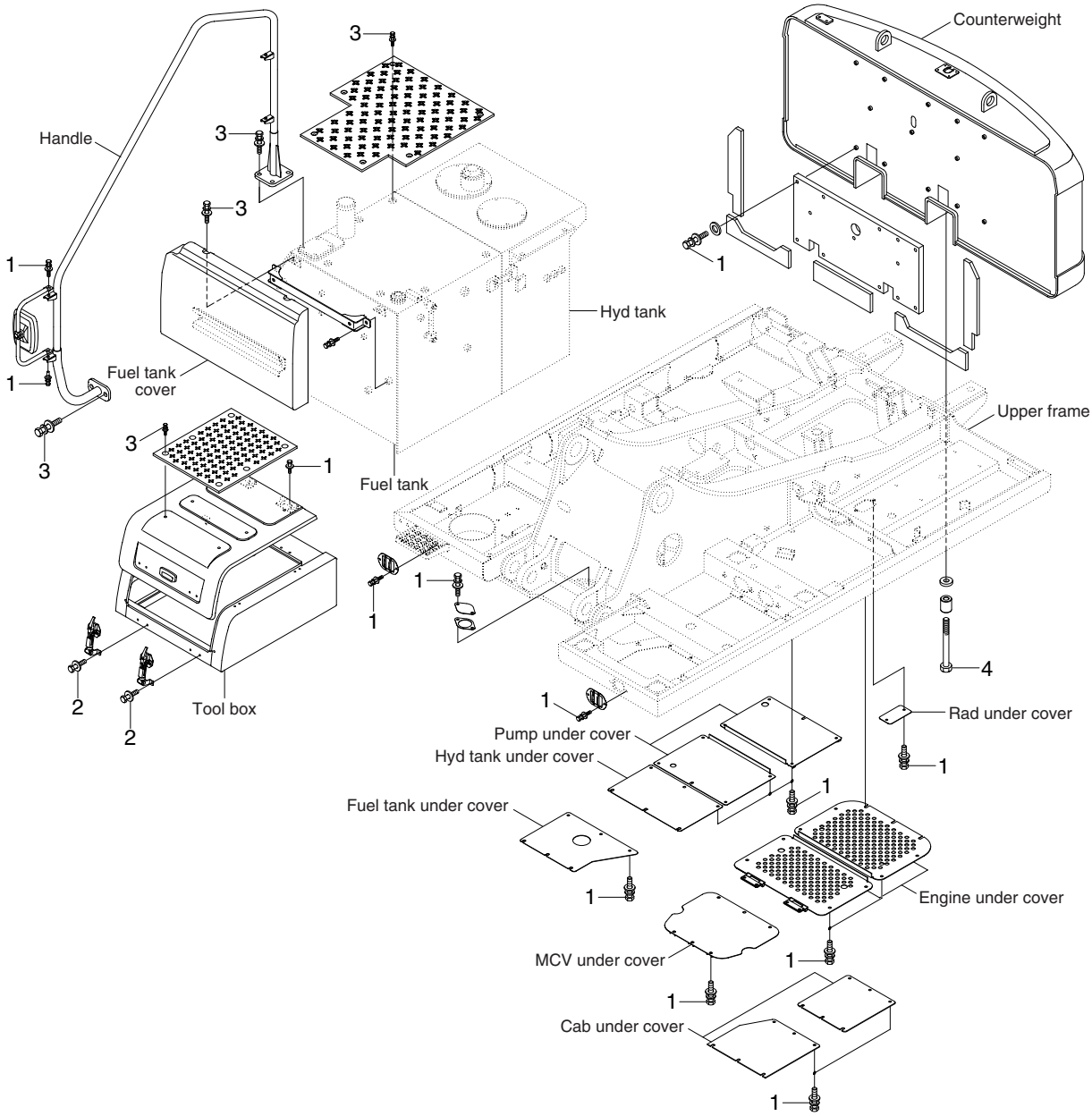


3309S9CM12

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	12.8±3.0	92.6±21.7

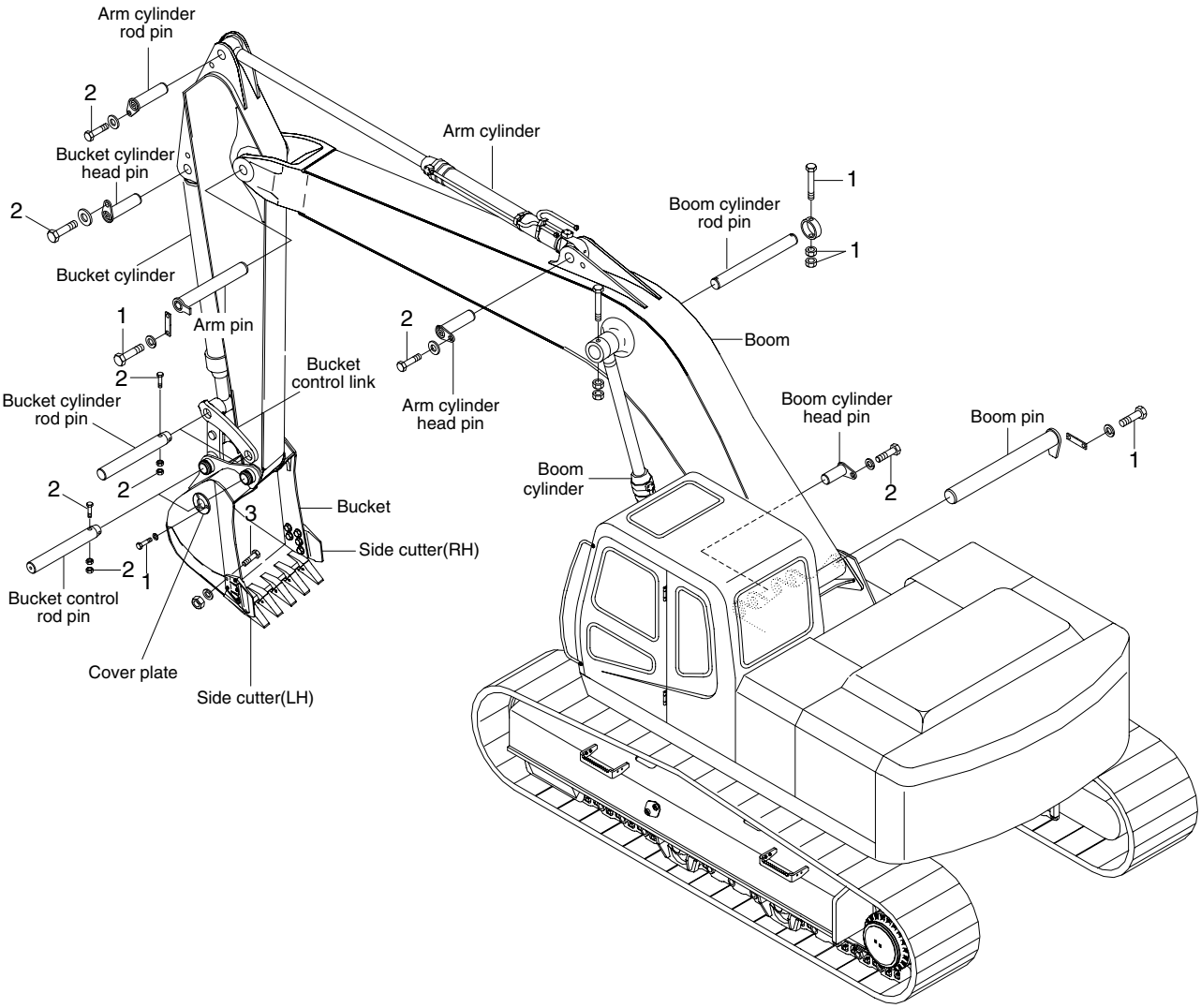
COUNTERWEIGHT AND COVERS MOUNTING



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
3	M12×1.75	12.8±3.0	92.6±21.7
4	M36×3.0	308±46	2228±333



3309S9CM14

· 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

Item	Size	kgf · m	lbf · ft
3	M22×2.5	81.9±16.1	592±116