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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
   - Item number(2. Structure and Function)
   - Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.

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

Revised edition mark(①②③···)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55mm into inches.

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

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

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

2. Convert 550mm into inches.

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

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

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

Millimeters to inches

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
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

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

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

SECTION 1 GENERAL

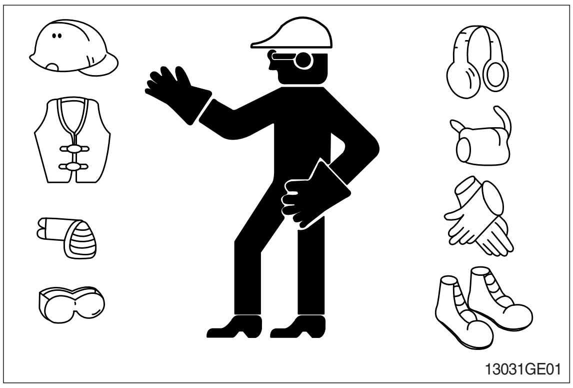
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

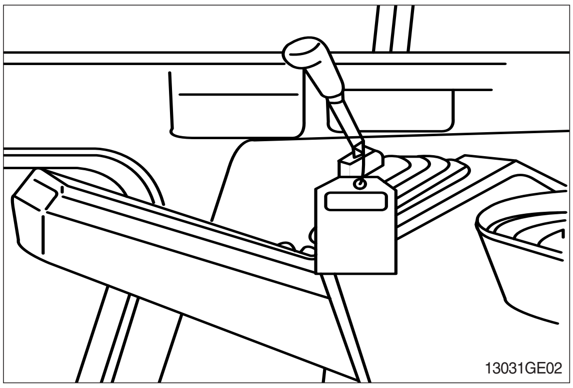
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

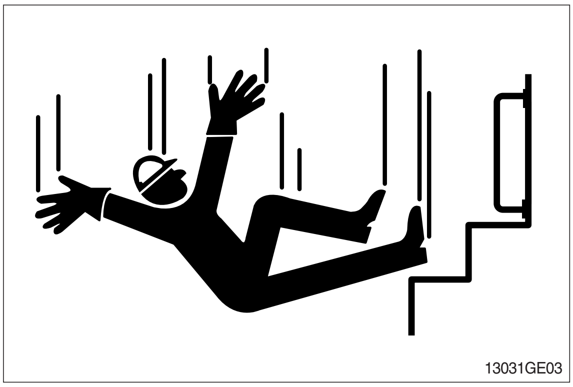
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「**Do Not Operate**」 tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



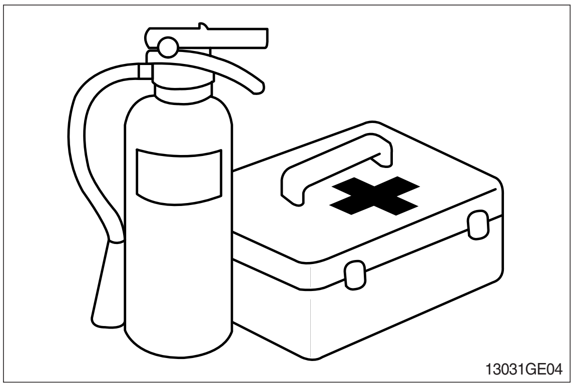
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

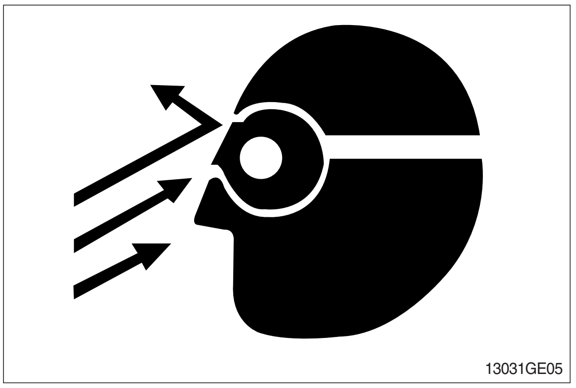
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

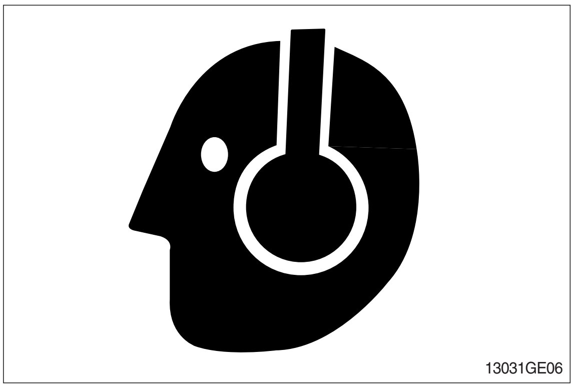


13031GE05

PROTECT AGAINST NOISE

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

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

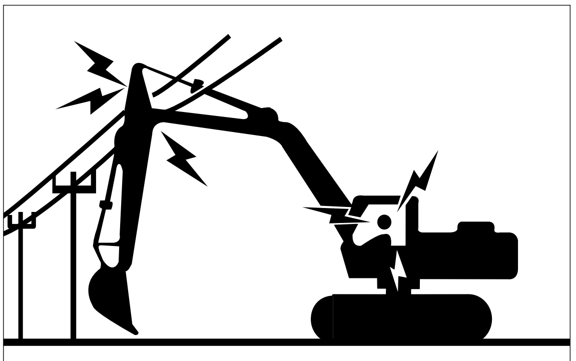


13031GE06

AVOID POWER LINES

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

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

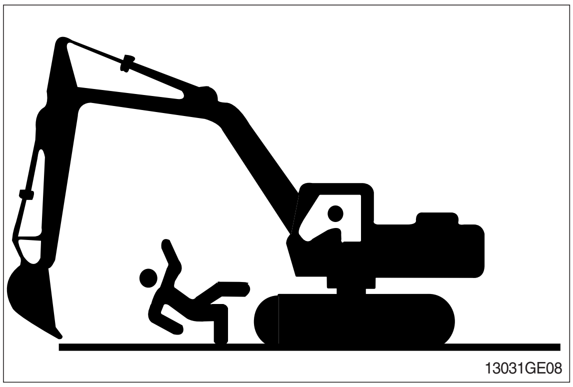


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



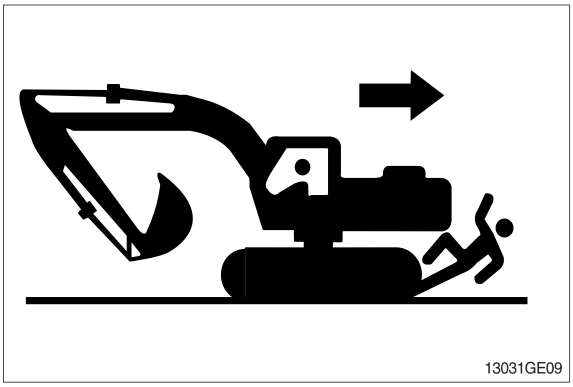
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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

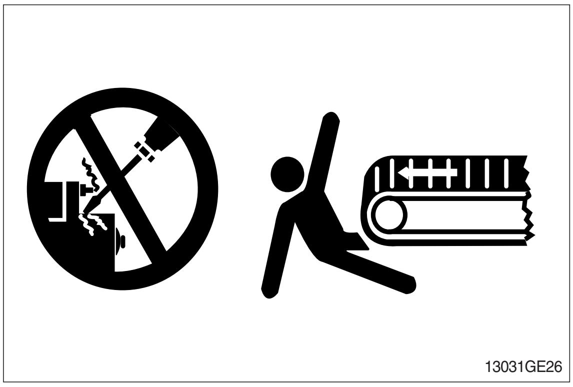


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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



13031GE26

PARK MACHINE SAFELY

Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

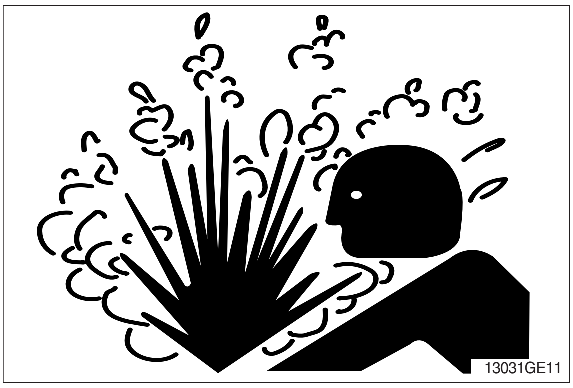
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

13031GE10

SERVICE COOLING SYSTEM SAFELY

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

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



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

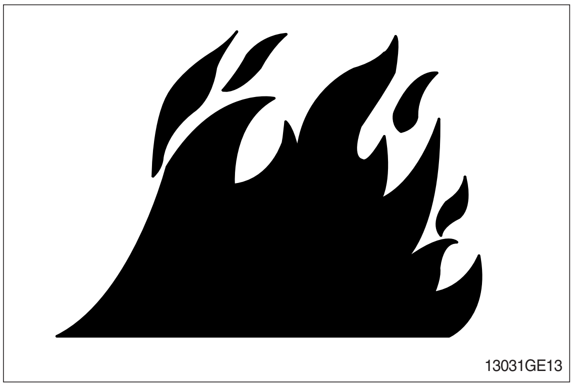
Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.

13031GE12

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

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

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

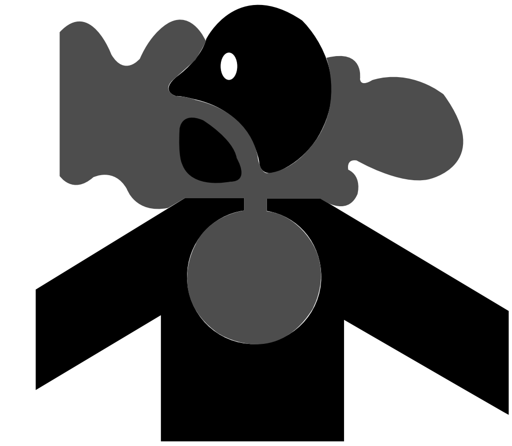


13031GE13

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

ILLUMINATE WORK AREA SAFELY

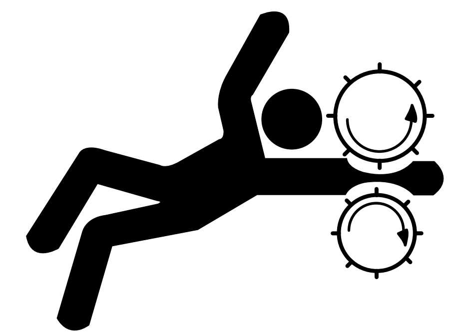
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

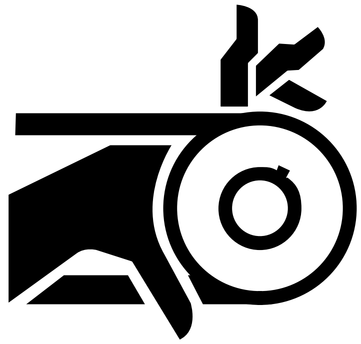


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

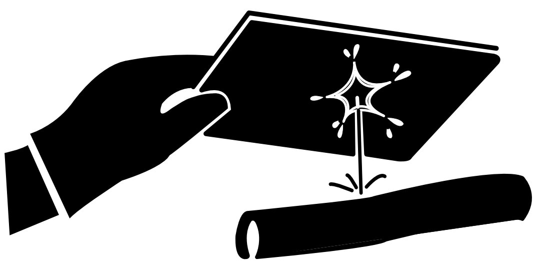
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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

13031GE20

PREVENT BATTERY EXPLOSIONS

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

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

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

13031GE21

PREVENT ACID BURNS

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

Avoid the hazard by:

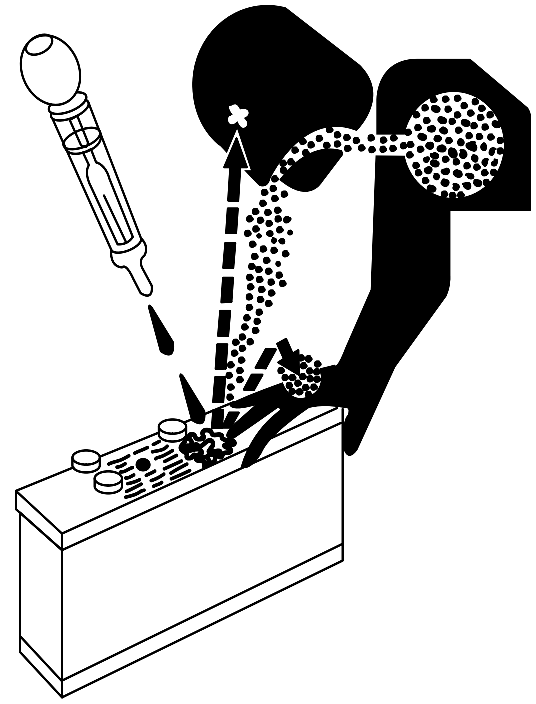
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

If you spill acid on yourself:

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

If acid is swallowed:

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



13031GE22

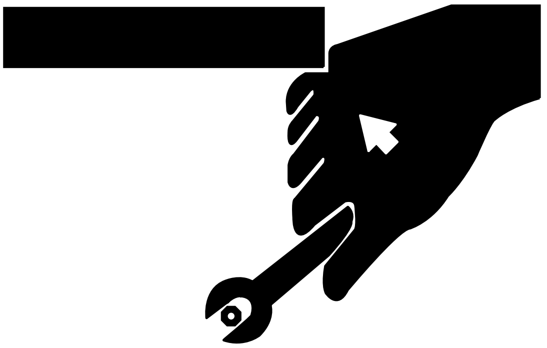
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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



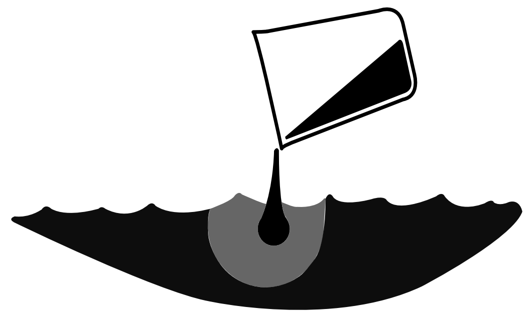
13031GE23

DISPOSE OF FLUIDS PROPERLY

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

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

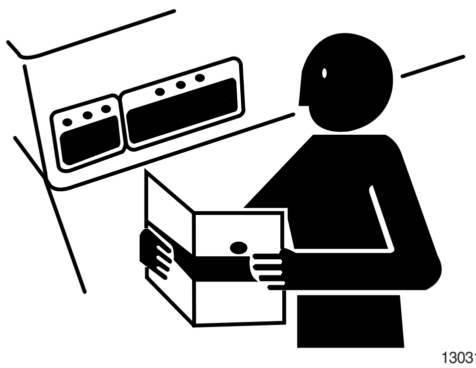
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



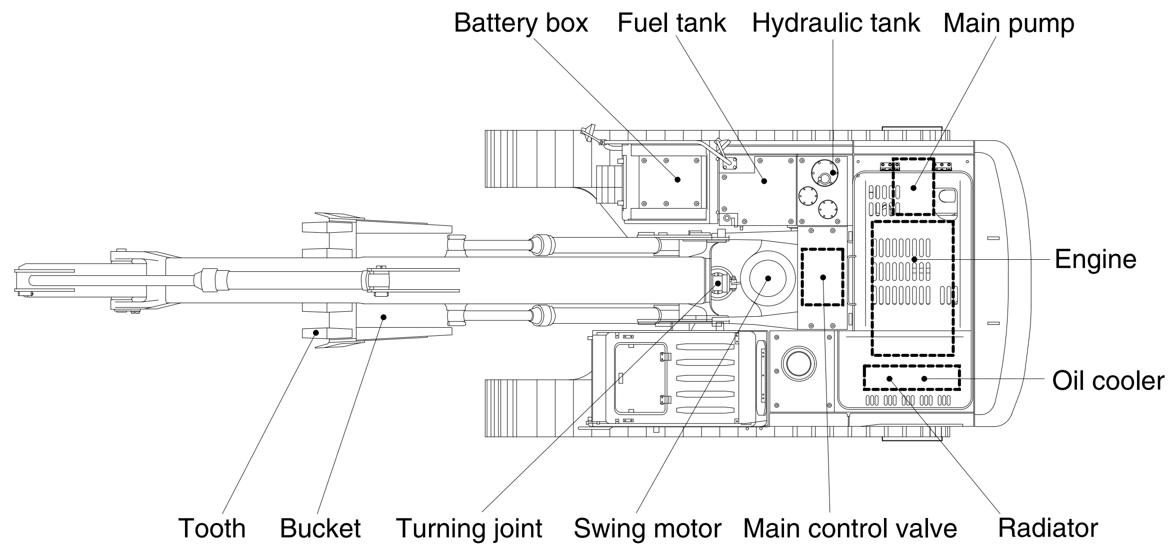
13031GE25

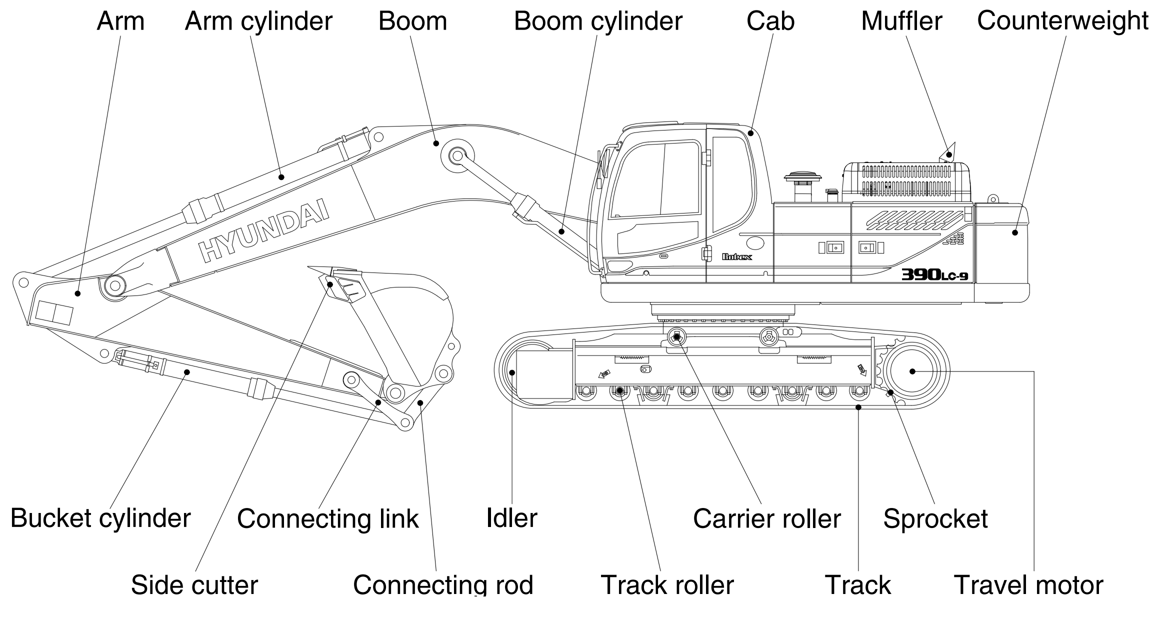
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

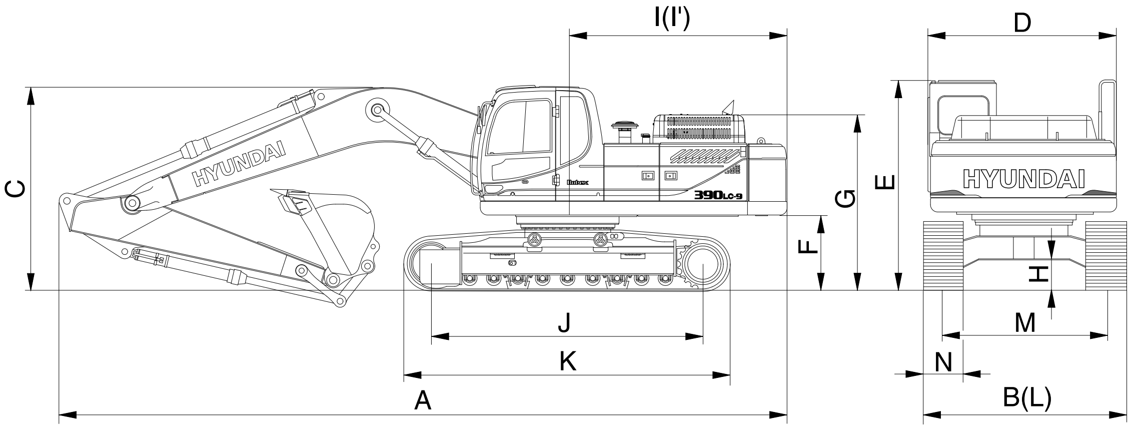
1. MAJOR COMPONENT





39092SP01

2. SPECIFICATIONS

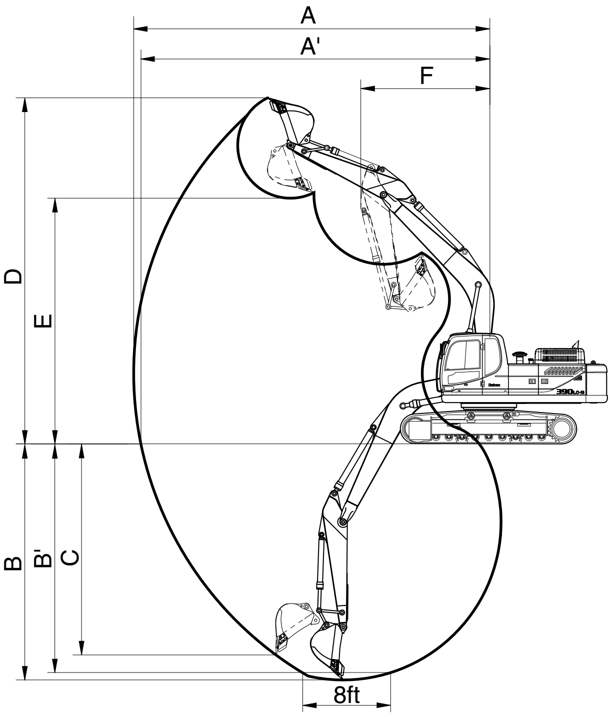


39092SP02

Description		Unit	Specification
Operating weight		kg (lb)	38400 (84660)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	1.62 (2.12)
Overall length	A	mm (ft-in)	11120 (36' 6")
Overall width, with 600 mm shoe	B		3340 (10'11")
Overall height	C		3450 (11' 4")
Superstructure width	D		2980 (9' 9")
Overall height of cab	E		3175 (10' 5")
Ground clearance of counterweight	F		1290 (4' 3")
Engine cover height	G		2790 (9' 2")
Minimum ground clearance	H		550 (1' 10")
Rear-end distance	I		3350 (11' 1")
Rear-end swing radius	I'		3415 (11' 2")
Distance between tumblers	J		4340 (14' 3")
Undercarriage length	K		5280 (17' 4")
Undercarriage width	L		3340 (11' 0")
Track gauge	M		2740 (9' 0")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.1/5.0 (1.9/3.1)
Swing speed		rpm	9.7
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2(psi)	0.69 (9.81)
Max traction force		kg (lb)	32000 (70550)

3. WORKING RANGE

· 6.5 m (21' 4") BOOM

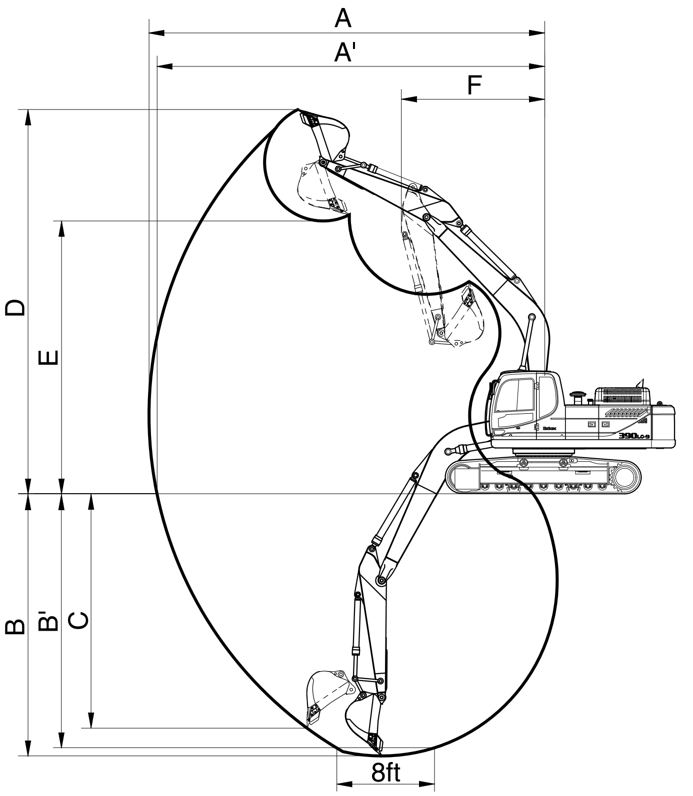


39092SP03

Description		2.5 m (8' 2") Arm	*3.2 m (10' 6") Arm	3.9 m (12' 10") Arm	4.3 m (14' 1") Arm
Max digging reach	A	10720 mm (35' 2")	11250 mm (36'11")	11870 mm (38'11")	12380 mm (40' 7")
Max digging reach on ground	A'	10490 mm (34' 5")	11040 mm (36' 3")	11670 mm (38' 3")	12180 mm (40' 0")
Max digging depth	B	6820 mm (22' 5")	7520 mm (24' 8")	8220 mm (27' 0")	8620 mm (28' 3")
Max digging depth (8ft level)	B'	6640 mm (21' 9")	7360 mm (24' 2")	8080 mm (26' 6")	8490 mm (27'10")
Max vertical wall digging depth	C	5930 mm (19' 5")	6330 mm (20' 9")	7040 mm (23' 1")	7540 mm (24' 9")
Max digging height	D	10590 mm (34' 9")	10570 mm (34' 8")	10800 mm (35' 5")	11360 mm (37' 3")
Max dumping height	E	7370 mm (24' 2")	7410 mm (24' 4")	7640 mm (25' 1")	8160 mm (26' 9")
Min swing radius	F	4530 mm (14'10")	4450 mm (14' 7")	4440 mm (14' 7")	4460 mm (14' 8")
Bucket digging force	SAE	201.0 [219.3] kN	201.0 [219.3] kN	201.0 [219.3] kN	201.0 [219.3] kN
		20500 [22360] kgf	20500 [22360] kgf	20500 [22360] kgf	20500 [22360] kgf
		45190 [49300] lbf	45190 [49300] lbf	45190 [49300] lbf	45190 [49300] lbf
	ISO	228.5 [249.3] kN	228.5 [249.3] kN	228.5 [249.3] kN	228.5 [249.3] kN
		23300 [25420] kgf	23300 [25420] kgf	23300 [25420] kgf	23300 [25420] kgf
		51370 [56040] lbf	51370 [56040] lbf	51370 [56040] lbf	51370 [56040] lbf
Arm crowd force	SAE	184.4 [201.1] kN	152.0 [165.8] kN	135.3 [147.6] kN	124.5 [135.9] kN
		18800 [20510] kgf	15500 [16910] kgf	13800 [15050] kgf	12700 [13850] kgf
		41450 [45220] lbf	34170 [37280] lbf	30420 [33190] lbf	28000 [30550] lbf
	ISO	192.2 [209.7] kN	156.9 [171.2] kN	139.3 [151.9] kN	128.5 [140.1] kN
		19600 [21380] kgf	16000 [17450] kgf	14200 [15490] kgf	13100 [14290] kgf
		43210 [47140] lbf	35270 [38480] lbf	31310 [34160] lbf	28880 [31510] lbf

[ ] : Power boost * : STD

· 6.15 ㎜ (20' 2") BOOM

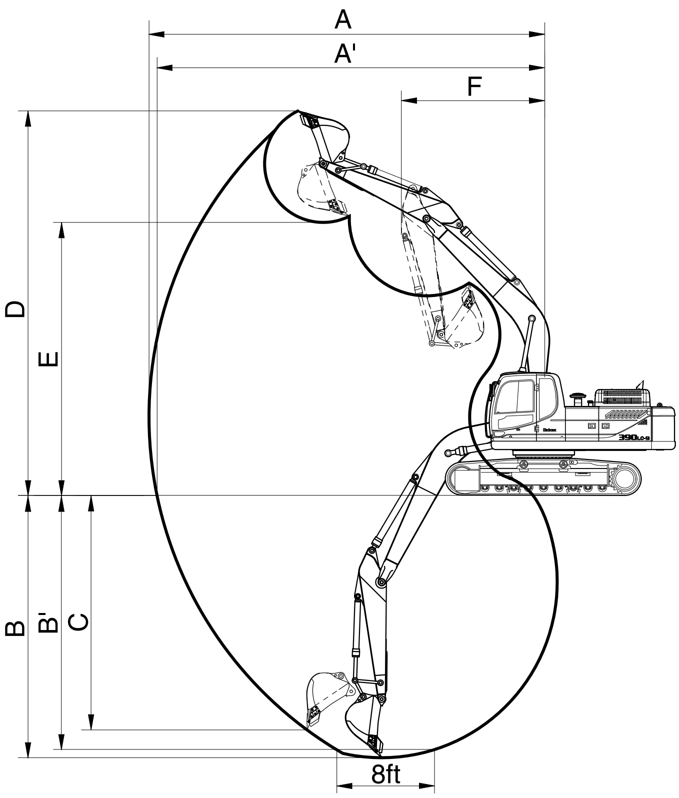


39092SP03

Description		2.5 ㎜ (8' 2") Arm
Max digging reach	A	10330 ㎜ (33'11")
Max digging reach on ground	A'	10100 ㎜ (33' 2")
Max digging depth	B	6450 ㎜ (21' 2")
Max digging depth (8ft level)	B'	6270 ㎜ (20' 7")
Max vertical wall digging depth	C	5490 ㎜ (18' 0")
Max digging height	D	10320 ㎜ (33'10")
Max dumping height	E	7120 ㎜ (23' 4")
Min swing radius	F	4220 ㎜ (13'10")
Bucket digging force	SAE	201.0 [219.3] kN
		20500 [22360] kgf
		45190 [49300] lbf
	ISO	228.5 [249.3] kN
		23300 [25420] kgf
		51370 [56040] lbf
Arm crowd force	SAE	184.4 [201.1] kN
		18800 [20510] kgf
		41450 [45220] lbf
	ISO	192.2 [209.7] kN
		19600 [21380] kgf
		43210 [47140] lbf

[ ] : Power boost

· 8.6 m (28' 3") BOOM



39092SP03

Description		5.1 m (16' 9") Arm
Max digging reach	A	15280 mm (50' 2")
Max digging reach on ground	A'	15120 mm (49' 7")
Max digging depth	B	11230 mm (36'10")
Max digging depth (8ft level)	B'	11120 mm (36' 6")
Max vertical wall digging depth	C	10060 mm (33' 0")
Max digging height	D	13350 mm (43'10")
Max dumping height	E	10150 mm (33' 4")
Min swing radius	F	5900 mm (19' 4")
Bucket digging force	SAE	201.0 [220.4] kN
		20500 [22360] kgf
		45190 [49550] lbf
	ISO	228.5 [250.3] kN
		23300 [25420] kgf
		51370 [56280] lbf
Arm crowd force	SAE	109.8 [119.8] kN
		11200 [12220] kgf
		24690 [26930] lbf
	ISO	112.8 [123.0] kN
		11500 [12550] kgf
		25350 [27650] lbf

[ ] : Power boost

4. WEIGHT

Item		R380LC-9SH	
		kg	lb
Upperstructure assembly		15040	33160
Main frame weld assembly		3090	6810
Engine assembly		920	2030
Main pump assembly		190	420
Main control valve assembly		340	750
Swing motor assembly		440	970
Hydraulic oil tank assembly		340	750
Fuel tank assembly		230	510
Counterweight	6.5, 6.15 m boom	6500	14330
	8.6 m boom	8100	17860
Cab assembly		490	1080
Lower chassis assembly		14310	31550
Track frame weld assembly		5415	11940
Swing bearing		560	1240
Travel motor assembly		380	840
Turning joint		65	140
Track recoil spring		210	460
Idler		260	570
Carrier roller		41	90
Track roller		80	180
Track-chain assembly (600 mm standard triple grouser shoe)		2380	5250
Front attachment assembly (6.5 m boom, 3.2 m arm, 1.62 m^3 SAE heaped bucket)		7720	17020
6.5 m boom assembly		2930	6460
3.2 m arm assembly		1340	2950
1.62 m^3 SAE heaped bucket		1330	2930
Boom cylinder assembly		370	820
Arm cylinder assembly		490	1080
Bucket cylinder assembly		320	710
Bucket control linkage assembly		370	820

5. LIFTING CAPACITIES

1) 6.5 m (21' 4") boom, 3.2 m (10' 6") arm equipped with 1.62 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 6500 kg (14330 lb counterweight.

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

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)
9.0 m	kg													*5950	*5950	7.97
(30 ft)	lb													*13120	*13120	(26.1)
7.5 m	kg									*4560	*4560			*6020	4890	9.12
(25.0 ft)	lb									*10050	*10050			*13270	10780	(29.9)
6.0 m	kg									*6620	*6620			*6110	4070	9.87
(20.0 ft)	lb									*14590	*14590			*13470	8970	(32.4)
4.5 m	kg							*8260	*8260	*7320	6610	*4450	*4450	*6190	3600	10.32
(15.0 ft)	lb							*18210	*18210	*16140	14570	*9810	*9810	*13650	7940	(33.9)
3.0 m	kg					*13520	*13520	*9960	9020	*8240	6240	*6360	4490	6010	3360	10.50
(10.0 ft)	lb					*29810	*29810	*21960	19890	*18170	13760	*14020	9900	13250	7410	(34.4)
1.5 m	kg					*16390	13030	*11570	8370	*9170	5880	*7510	4300	5960	3310	10.45
(5.0 ft)	lb					*36130	28730	*25510	18450	*20220	12960	*16560	9480	13140	7300	(34.3)
Ground	kg			*13090	*13090	*17880	12390	*12690	7930	*9880	5600	*7070	4150	6200	3430	10.14
Line	lb			*28860	*28860	*39420	27320	*27980	17480	*21780	12350	*15590	9150	13670	7560	(33.3)
-1.5 m	kg	*13720	*13720	*17520	*17520	*18150	12180	*13170	7710	9860	5450			6810	3800	9.57
(-5.0 ft)	lb	*30250	*30250	*38620	*38620	*40010	26850	*29030	17000	21740	12020			15010	8380	(31.4)
-3.0 m	kg	*17880	*17880	*22800	*22800	*17430	12250	*12880	7690	9860	5450			*7730	4560	8.65
(-10.0 ft)	lb	*39420	*39420	*50270	*50270	*38430	27010	*28400	16950	21740	12020			*17040	10050	(28.4)
-4.5 m	kg	*22600	*22600	*21880	*21880	*15520	12550	*11510	7890					*7690	6290	7.25
(-15.0 ft)	lb	*49820	*49820	*48240	*48240	*34220	27670	*25380	17390					*16950	13870	(23.8)
-6.0 m	kg					*11410	*11410									
(-20.0 ft)	lb					*25150	*25150									

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) 6.15 m (20' 2") boom, 2.5 m (8' 2") arm equipped with 1.62 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 6500 kg (14330 lb) counterweight.

Load point height		Load radius								At max. reach		
		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		7.5 m (25.0 ft)		Capacity		Reach
												m (ft)
9.0 m	kg									*7580	*7580	6.65
(30.0 ft)	lb									*16710	*16710	(21.8)
7.5 m	kg									*7420	6270	8.02
(25.0 ft)	lb									*16360	13820	(26.3)
6.0 m	kg					*8590	*8590	*6510	*6510	*7460	5050	8.88
(20.0 ft)	lb					*18940	*18940	*14350	*14350	*16450	11130	(29.1)
4.5 m	kg	*18270	*18270	*12170	*12170	*9790	*9790	*8620	6640	7560	4410	9.38
(15.0 ft)	lb	*40280	*40280	*26830	*26830	*21580	*21580	*19000	14640	16670	9720	(30.8)
3.0 m	kg			*15380	14360	*11300	9140	*9350	6330	7130	4100	9.58
(10.0 ft)	lb			*33910	31660	*24910	20150	*20610	13960	15720	9040	(31.4)
1.5 m	kg			*17740	13240	*12640	9140	*10060	6020	7090	4040	9.52
(5.0 ft)	lb			*39110	29190	*27870	20150	*22180	13270	15630	8910	(31.2)
Ground	kg	*13400	*13400	*18580	12720	*13410	8160	10230	5790	7450	4230	9.19
Line	lb	*29540	*29540	*40960	28040	*29560	17990	22550	12760	16420	9330	(30.2)
-1.5 m	kg	*21020	*21020	*18170	12580	*13400	7990	10120	5690	*8340	4780	8.53
(-5.0 ft)	lb	*46340	*46340	*40060	27730	*29540	17610	22310	12540	*18390	10540	(28.0)
-3.0 m	kg	*22960	*22960	*16580	12700	*12330	8040			*8180	6030	7.47
(-10 ft)	lb	*50620	*50620	*36550	28000	*27180	17730			*18030	13290	(24.5)
-1.5 m	kg	*17870	*17870	*13110	*13110							
(-10 ft)	lb	*39400	*39400	*28900	*28900							

(3) 6.5 m (21' 4") boom, 2.5 m (8' 2") arm equipped with 1.62 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 6500 kg (14330 lb) counterweight.

Load point height		Load radius								At max. reach		
		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		7.5 m (25.0 ft)		Capacity		Reach
												m (ft)
9.0 m	kg									*6820	*6820	7.22
(30.0 ft)	lb									*15040	*15040	(23.7)
7.5 m	kg									*6770	5460	8.49
(25.0 ft)	lb									*14930	12040	(27.9)
6.0 m	kg					*7970	*7970	*7480	6680	*6850	4460	9.29
(20.0 ft)	lb					*17570	*17570	*16490	14730	*15100	9830	(30.5)
4.5 m	kg			*11870	*11870	*9290	*9290	*8060	6420	6880	3930	9.77
(15.0 ft)	lb			*26170	*26170	*20480	*20480	*17770	14150	15170	8660	(32.1)
3.0 m	kg			*15200	13580	*10870	8740	*8870	6090	6520	3670	9.97
(10.0 ft)	lb			*33510	29940	*23960	19270	*19550	13430	14370	8090	(32.7)
1.5 m	kg			*17480	12590	*12250	8170	*9650	5780	6500	3630	9.91
(5.0 ft)	lb			*38540	27760	*27010	18010	*21270	12740	14330	8000	(32.5)
Ground	kg			*18200	12240	*13060	7830	9980	5560	6820	3810	9.59
Line	lb			*40120	26980	*28790	17260	22000	12260	15040	8400	(31.5)
-1.5 m	kg	*17830	*17830	*17860	12220	*13180	7720	9900	5490	7630	4300	8.97
(-5.0 ft)	lb	*39310	*39310	*39370	26940	*29060	17020	21830	12100	16820	9480	(29.4)
-3.0 m	kg	*22850	*22850	*16580	12420	*12430	7810			*7850	5340	7.97
(-10 ft)	lb	*50380	*50380	*36550	27380	*27400	17220			*17310	11770	(26.1)
-1.5 m	kg	*18790	*18790	*13880	12880					*7110	*7110	6.39
(-10 ft)	lb	*41420	*41420	*30600	28400					*15670	*15670	(21.0)

(4) 6.5 m (21' 4") boom, 3.9 m (12' 10") arm equipped with 1.62 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 6500 kg (14330 lb) counterweight.

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)
9.0 m	kg													*5220	*5220	8.81
(30 ft)	lb													*11510	*11510	(28.9)
7.5 m	kg													*5320	4220	9.85
(25.0 ft)	lb													*11730	9300	(32.3)
6.0 m	kg									*5820	*5820	*3620	*3620	*5490	3550	10.54
(20.0 ft)	lb									*12830	*12830	*7980	*7980	*12100	7830	(34.6)
4.5 m	kg									*6570	*6570	*5410	4680	*5660	3160	10.95
(15.0 ft)	lb									*14480	*14480	*11930	10320	*12480	6970	(35.9)
3.0 m	kg			*19700	*19700	*11910	*11910	*9000	*9000	*7540	6240	*6730	4460	5390	2950	11.13
(10.0 ft)	lb			*43430	*43430	*26260	*26260	*19840	*19840	*16620	13760	*14840	9830	11880	6500	(36.5)
1.5 m	kg			*12690	*12690	*15110	13210	*10740	8390	*8560	5830	*7320	4230	5330	2890	11.07
(5.0 ft)	lb			*27980	*27980	*33310	29120	*23680	18500	*18870	12850	*16140	9330	11750	6370	(36.3)
Ground	kg			*13710	*13710	*17120	12340	*12090	7860	*9410	5500	7350	4040	5510	2970	10.79
Line	lb			*30230	*30230	*37740	27210	*26650	17330	*20750	12130	16200	8910	12150	6550	(35.4)
-1.5 m	kg	*12630	*12630	*16860	*16860	*17890	11970	*12830	7550	9710	5300	7220	3930	5970	3240	10.26
(-5.0 ft)	lb	*27840	*27840	*37170	*37170	*39440	26390	*28290	16640	21410	11680	15920	8660	13160	7140	(33.7)
-3.0 m	kg	*16240	*16240	*21070	*21070	*17610	11920	*12860	7450	9630	5230			6900	3810	9.42
(-10.0 ft)	lb	*35800	*35800	*46450	*46450	*38820	26280	*28350	16420	21230	11530			15210	8400	(30.9)
-4.5 m	kg	*20300	*20300	*23540	*23540	*16240	12130	*11980	7560	*8980	5360			*7360	4970	8.17
(-15.0 ft)	lb	*44750	*44750	*51900	*51900	*35800	26740	*26410	16670	*19800	11820			*16230	10960	(26.8)
-6.0 m	kg			*18730	*18730	*13200	12640									
(-20.0 ft)	lb			*41290	*41290	*29100	27870									

(5) 6.5 m (21' 4") boom, 4.3 m (14' 1") arm equipped with 1.62 m³ (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 6500 kg (14330 lb) counterweight.

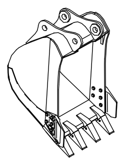
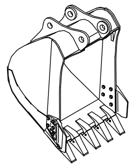
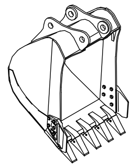
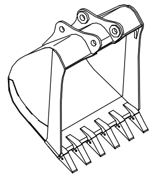
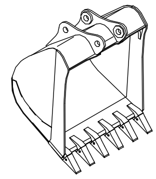
Load point height		Load radius														At max. reach		
		1.5 m (5.0 ft)		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		7.5 m (25.0 ft)		9.0 m (30.0 ft)		10.5 m (35.0 ft)		Capacity		Reach
																		m (ft)
9.0 m	kg															*4970	4590	9.45
(30 ft)	lb															*10960	10250	(31.0)
7.5 m	kg											*2710	*2710			*4770	3710	10.42
(25.0 ft)	lb											*5970	*5970			*10520	8180	(34.2)
6.0 m	kg											*4420	*4420			*4670	3150	11.07
(20.0 ft)	lb											*9740	*9740			*10300	6940	(36.3)
4.5 m	kg									*6030	*6030	*5580	4730			*4690	2820	11.46
(15.0 ft)	lb									*13290	*13290	*12300	10430			*10340	6220	(37.6)
3.0 m	kg			*16870	*16870	*10740	*10740	*8310	*8310	*7050	6310	*6340	4490	*2620	*2620	*4830	2640	11.63
(10.0 ft)	lb			*37190	*37190	*23680	*23680	*18320	*18320	*15540	13910	*13980	9900	*5780	*5780	*10650	5820	(38.2)
1.5 m	kg			*13700	*13700	*14150	13480	*10140	8500	*8130	5870	*6980	4230	*2950	*2950	4880	2580	11.58
(5.0 ft)	lb			*30200	*30200	*31200	29720	*22350	18740	*17920	12940	*15390	9330	*6500	*6500	10760	5690	(38.0)
Ground	kg			*13070	*13070	*16510	12440	*11640	7900	*9070	5510	7330	4010			5030	2660	11.31
Line	lb			*28810	*28810	*36400	27430	*25660	17420	*20000	12150	16160	8840			11090	5860	(37.1)
-1.5 m	kg	*11110	*11110	*15450	*15450	*17630	11930	*12570	7520	9670	5260	7170	3860			5420	2890	10.81
(-5.0 ft)	lb	*24490	*24490	*34060	*34060	*38870	26300	*27710	16580	21320	11600	15810	8510			11950	6370	(35.5)
-3.0 m	kg	*14410	*14410	*19090	*19090	*17690	11790	*12820	7360	9550	5150	*6600	3830			6180	3350	10.02
(-10.0 ft)	lb	*31770	*31770	*42090	*42090	*39000	25990	*28260	16230	21050	11350	*14550	8440			13620	7390	(32.9)
-4.5 m	kg	*18210	*18210	*24070	*24070	*16690	11930	*12250	7420	*9310	5120					*6710	4250	8.87
(-15.0 ft)	lb	*40150	*40150	*53070	*53070	*36800	26300	*27010	16360	*20530	11490					*14790	9370	(29.1)
-6.0 m	kg	*22860	*22860	*20530	*20530	*14250	12340	*10350	7720							*6520	6360	7.15
(-20.0 ft)	lb	*50400	*50400	*45260	*45260	*31420	27210	*22820	17020							*14370	14020	(23.5)

(6) 8.6 m (28' 3") boom, 5.1 m (16' 9") arm equipped with 1.46 m^3 (SAE heaped) bucket and 600 mm (24") triple grouser shoe and 8100 kg (17860 lb) counterweight.

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)		10.5 m (35.0 ft)		12.0 m (40.0 ft)		13.5 m (45.0 ft)		Capacity		Reach
																						m (ft)
9.0 m	kg													*3010	*3010					*3030	2560	12.91
(30 ft)	lb													*6640	*6640					*6680	5640	(42.4)
7.5 m	kg													*3110	*3110	*2630	*2630			*3100	2140	13.61
(25.0 ft)	lb													*6860	*6860	*5800	*5800			*6830	4720	(44.7)
6.0 m	kg													*3360	*3360	*3300	2870			*3180	1860	14.10
(20.0 ft)	lb													*7410	*7410	*7280	6330			*7010	4100	(46.3)
4.5 m	kg											*4100	*4100	*3730	3730	*3520	2730			*3290	1680	14.40
(15.0 ft)	lb											*9040	*9040	*8220	8220	*7760	6020			*7250	3700	(47.2)
3.0 m	kg					*10920	*10920	*7400	*7400	*5710	*5710	*4750	4690	*4160	3460	*3790	2560	*1720	*1720	3360	1560	14.53
(10.0 ft)	lb					*24070	*24070	*16310	*16310	*12590	*12590	*10470	10340	*9170	7630	*8360	5640	*3790	*3790	7410	3440	(47.7)
1.5 m	kg					*10890	*10890	*8990	8230	*6710	5840	*5420	4300	*4610	3210	*4090	2400	*1900	1770	3310	1520	14.49
(5.0 ft)	lb					*24010	*24010	*19820	18140	*14790	12870	*11950	9480	*10160	7080	*9020	5290	*4190	3900	7300	3350	(47.5)
Ground	kg					*10400	*10400	*10190	7550	*7560	5370	*6010	3970	*5030	2990	*4370	2260			3370	1540	14.28
Line	lb					*22930	*22930	*22470	16640	*16670	11840	*13250	8750	*11090	6590	*9630	4980			7430	3400	(46.9)
-1.5 m	kg			*7990	*7990	*11720	11360	*10930	7170	*8180	5050	*6480	3730	*5370	2820	4450	2150			3520	1630	13.90
(-5.0 ft)	lb			*17610	*17610	*25840	25040	*24100	15810	*18030	11130	*14290	8220	*11840	6220	9810	4740			7760	3590	(45.6)
-3.0 m	kg	*8910	*8910	*10270	*10270	*13880	11320	*11250	7010	*8540	4880	*6780	3600	5490	2730	4410	2110			3820	1810	13.31
(-10.0 ft)	lb	*19640	*19640	*22640	*22640	*30600	24960	*24800	15450	*18830	10760	*14950	7940	12100	6020	9720	4650			8420	3990	(43.7)
-4.5 m	kg	*11090	*11090	*12810	*12810	*15320	11460	*11200	7020	*8610	4840	*6850	3560	5480	2710					*4230	2130	12.50
(-15.0 ft)	lb	*24450	*24450	*28240	*28240	*33770	25260	*24690	15480	*18980	10670	*15100	7850	12080	5970					*9330	4700	(41.0)
-6.0 m	kg	*13540	*13540	*15800	*15800	*14460	11750	*10750	7160	*8340	4930	*6630	3630	*5260	2820					*4390	2660	11.41
(-20.0 ft)	lb	*29850	*29850	*34830	*34830	*31880	25900	*23700	15790	*18390	10870	*14620	8000	*11600	6220					*9680	5860	(37.4)
-7.5 m	kg	*16440	*16440	*18490	*18490	*12970	12210	*9770	7460	*7580	5160	*5850	3860							*4450	3630	9.94
(-25.0 ft)	lb	*36240	*36240	*40760	*40760	*28590	26920	*21540	16450	*16710	11380	*12900	8510							*9810	8000	(32.6)
-9.0 m	kg			*14620	*14620	*10500	*10500	*7900	*7900	*5800	5630											
(-30.0 ft)	lb			*32230	*32230	*23150	*23150	*17420	*17420	*12790	12410											

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

				
1.46 m^3 SAE heaped bucket	※1.62 m^3 SAE heaped bucket	1.86 m^3 SAE heaped bucket	2.10 m^3 SAE heaped bucket	2.32 m^3 SAE heaped bucket

Capacity		Width		Weight	Recommendation					
					6.5 m (21' 4") boom				6.15 m (20' 2") boom	8.6 m (28' 3") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.5 m arm (8' 2")	3.2 m arm (10' 6")	3.9 m arm (12' 10")	4.3 m arm (14' 1")	2.5 m arm (8' 2")	5.1 m arm (16' 9")
1.46 m^3 (1.91 yd^3)	1.27 m^3 (1.66 yd^3)	1380 mm (54.3")	1510 mm (59.4")	1170 kg (2580 lb)						
※1.62 m^3 (2.12 yd^3)	1.40 m^3 (1.83 yd^3)	1440 mm (56.7")	1570 mm (61.8")	1280 kg (2820 lb)						
1.86 m^3 (2.43 yd^3)	1.60 m^3 (2.1 yd^3)	1620 mm (63.8")	1750 mm (68.9")	1390 kg (3060 lb)						
2.10 m^3 (2.75 yd^3)	1.80 m^3 (2.4 yd^3)	1810 mm (71.3")	1940 mm (76.4")	1520 kg (3350 lb)						
2.32 m^3 (3.03 yd^3)	2.00 m^3 (2.62 yd^3)	1990 mm (78.3")	2120 mm (83.5")	1760 kg (3880 lb)						

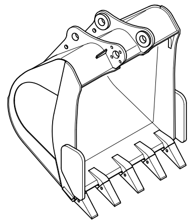
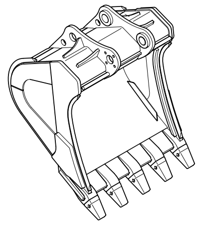
※ : Standard bucket

Applicable for materials with density of 2000 kg/m^3 (3370 lb/yd^3) or less

Applicable for materials with density of 1600 kg/m^3 (2700 lb/yd^3) or less

Applicable for materials with density of 1100 kg/m^3 (1850 lb/yd^3) or less

2) HEAVY DUTY AND ROCK-HEAVY DUTY BUCKET

	
◈1.62 m³ SAE heaped bucket	⊙1.44 m³, 1.62 m³, 1.86 m³ SAE heaped bucket

Capacity		Width		Weight	Recommendation				
					6.5 m (21' 4") boom				6.15 m (20' 2") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.5 m arm (8' 2")	3.2 m arm (10' 6")	3.9 m arm (12' 10")	4.3 m arm (14' 1")	2.5 m arm (8' 2")
◈1.62 m³ (2.12 yd³)	1.40 m³ (1.83 yd³)	1540 mm (60.6")	-	1570 kg (3460 lb)					
⊙1.44 m³ (1.88 yd³)	1.27 m³ (1.66 yd³)	1280 mm (50.4")	-	1565 kg (3450 lb)					
⊙1.62 m³ (2.12 yd³)	1.40 m³ (1.83 yd³)	1545 mm (60.8")	-	1610 kg (3550 lb)					
⊙1.86 m³ (2.43 yd³)	1.60 m³ (2.1 yd³)	1725 mm (67.9")	-	1710 kg (3770 lb)					

◈ : Heavy duty bucket

⊙ : Rock-heavy duty bucket

Applicable for materials with density of 2000 kg/m³ (3370 lb/yd³) or less

Applicable for materials with density of 1600 kg/m³ (2700 lb/yd³) or less

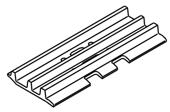
Applicable for materials with density of 1100 kg/m³ (1850 lb/yd³) or less

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				
							
R390LC-9	Shoe width	mm (in)	600 (24)	700 (28)	750 (30)	800 (32)	900 (36)
	Operating weight	kg (lb)	38400 (84660)	38850 (85650)	39075 (86140)	39300 (86640)	39750 (87630)
	Ground pressure	kgf/cm^2 (psi)	0.69 (9.81)	0.60 (8.53)	0.56 (7.96)	0.53 (7.54)	0.47 (6.68)
	Overall width	mm (ft-in)	3340 (10' 11")	3440 (11' 3")	3490 (11' 5")	3540 (11' 7")	3640 (11' 11")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2 EA
Track rollers	9 EA
Track shoes	51 EA

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

Confirm the category from the list of applications in table 2, then use table 1 to select the shoe.

Wide shoes (categories B and C) have limitations on applications. Before using wide shoes, check the precautions, then investigate and study the operating conditions to confirm if these shoes are suitable.

Select the narrowest shoe possible to meet the required flotation and ground pressure.

Application of wider shoes than recommendations will cause unexpected problem such as bending of shoes, crack of link, breakage of pin, loosening of shoe bolts and the other various problems.

※ Table 1

Track shoe	Specification	Category
600 mm triple grouser	Standard	A
700 mm triple grouser	Option	B
750 mm triple 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	HMC D6AC-C
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	130× 140 mm (5.12" × 5.51")
Piston displacement	11,149 cc (680 cu in)
Compression ratio	17 : 1
Rated gross horse power (SAE J1995)	276 Hp at 1900 rpm (206 kW at 1900 rpm)
Maximum torque	120.0 kgf · m (868 lbf · ft) at 1400 rpm
Engine oil quantity	27.3 l (7.2 U.S. gal)
Dry weight	920 kg (2028 lb)
Low idling speed	800± 100 rpm
High idling speed	2050+50 rpm
Rated fuel consumption	157.1 g/Hp · hr at 1900 rpm
Starting motor	24V-5.5 kW
Alternator	24V-70A
Battery	2 × 12V × 160Ah, *2× 12V× 200Ah

*: Artic machinery

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 175 cc/rev
Maximum pressure	330 kgf/cm² (4690 psi) [360 kgf/cm² (5120 psi)]
Rated oil flow	2 × 280 l /min (74.0 U.S. gpm/61.6 U.K. gpm)

[ ]: Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15cc/rev
Maximum pressure	40 kgf/cm² (570 psi)
Rated oil flow	24 ℓ/min (6.34 U.S. gpm/5.28 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	9 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	330 kgf/cm² (4690 psi) [360 kgf/cm² (5120 psi)]
Overload relief valve pressure	380 kgf/cm² (5400 psi)

[ ]: Power boost

5) SWING MOTOR

Item	Specification
Type	Axial piston motor
Capacity	233 cc/rev
Relief pressure	290 kgf/cm² (4120 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	107 kgf · m (773 lbf · ft)
Brake release pressure	30~50 kgf/cm² (427~711 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	360 kgf/cm² (5120 psi)
Capacity (max / min)	185.2/114.2 cc/rev
Reduction gear type	3-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	8.5 kgf/cm² (121 psi)
Braking torque	44.4 kgf · m (321 lbf · ft)

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Stroke	ø 160 × 1500 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Stroke	ø 170 × 1760 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Stroke	ø 150 × 1295 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.

8) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
R390LC-9	Standard	600 mm (24")	0.69 kgf/cm^2 (9.81 psi)	51	3340 mm (10' 11")
	Option	700 mm (28")	0.60 kgf/cm^2 (8.53 psi)	51	3440 mm (11' 3")
		750 mm (30")	0.56 kgf/cm^2 (7.96 psi)	51	3490 mm (11' 5")
		800 mm (32")	0.53 kgf/cm^2 (7.54 psi)	51	3540 mm (11' 7")
		900 mm (36")	0.47 kgf/cm^2 (6.68 psi)	51	3640 mm (11' 11")

9) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
R390LC-9	Standard	1.62 m^3 (2.12 yd^3)	1.40 m^3 (1.8 yd^3)	5	1440 mm (56.7")	1570 mm (61.8")
	Option	1.46 m^3 (1.91 yd^3)	1.27 m^3 (1.66 yd^3)	4	1380 mm (54.3")	1510 mm (59.4")
		◈1.62 m^3 (2.12 yd^3)	1.40 m^3 (1.83 yd^3)	5	1540 mm (60.6")	-
		◎1.44 m^3 (1.88 yd^3)	1.27 m^3 (1.66 yd^3)	5	1280 mm (50.4")	-
		◎1.62 m^3 (2.12 yd^3)	1.40 m^3 (1.83 yd^3)	5	1545 mm (60.8")	-
		◎1.86 m^3 (2.43 yd^3)	1.60 m^3 (2.1 yd^3)	5	1725 mm (67.9")	-
		1.86 m^3 (2.43 yd^3)	1.60 m^3 (2.1 yd^3)	5	1620 mm (63.8")	1750 mm (68.9")
		2.10 m^3 (2.75 yd^3)	1.80 m^3 (2.4 yd^3)	6	1810 mm (71.3")	1940 mm (76.4")
		2.32 m^3 (3.03 yd^3)	2.00 m^3 (2.62 yd^3)	6	1990 mm (78.3")	2120 mm (83.5")

◈ : Heavy duty bucket

◎ : Rock bucket (esco type)

9. RECOMMENDED OILS

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

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C(°F) -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	27.3 (7.2)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	8.0 (2.1)	★SAE 75W-90
Final drive	Gear oil	4.3×2 (1.1×2)	SAE 85W-140
Hydraulic tank	Hydraulic oil	Tank; 210 (55.5) System; 415 (110)	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	550 (145)	★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	45 (12.0)	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

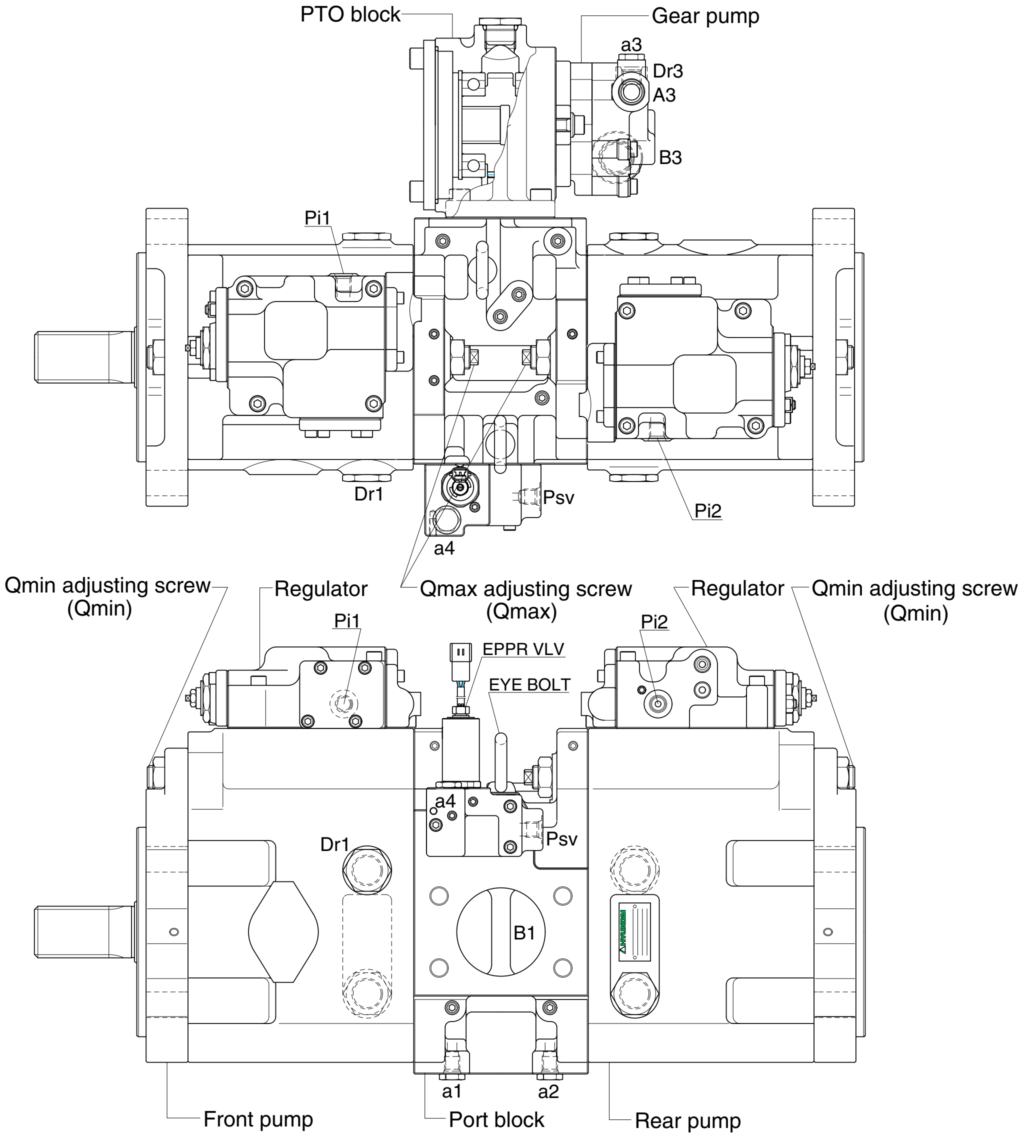
★ : Arctic machine

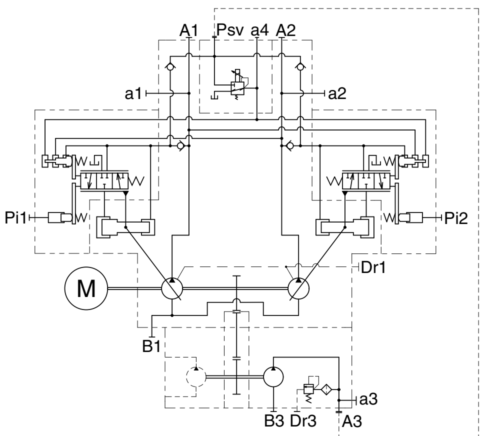
SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

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





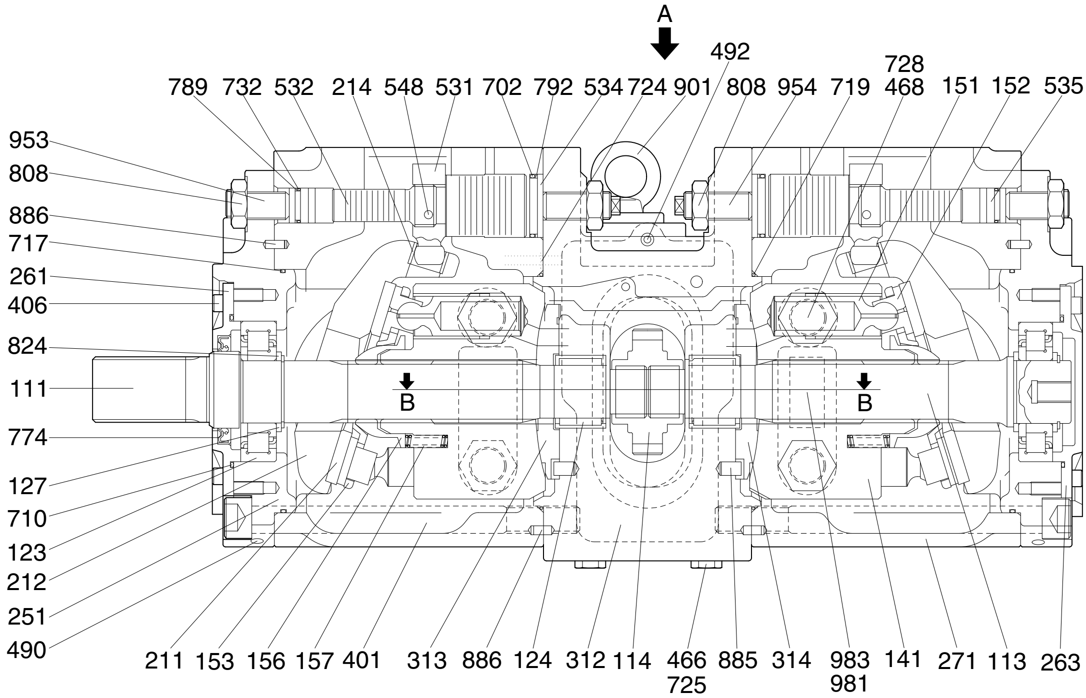
Hydraulic circuit

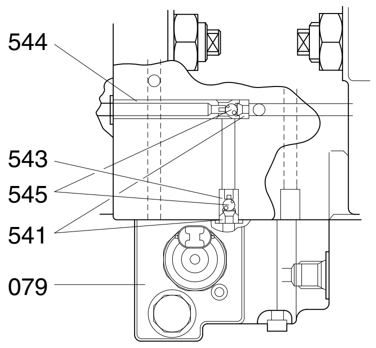
3809SH2MP01

Port	Port name	Port size
A1, 2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2000psi 3"
Dr1	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	Drain port	PF 3/8 - 15

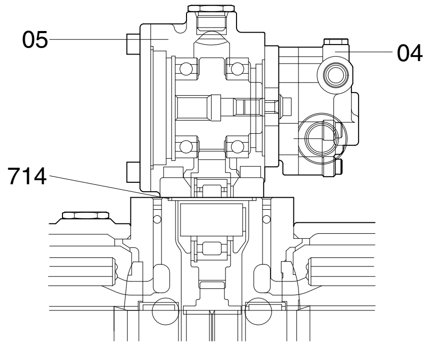
1) MAIN PUMP(1/2)

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





VIEW A

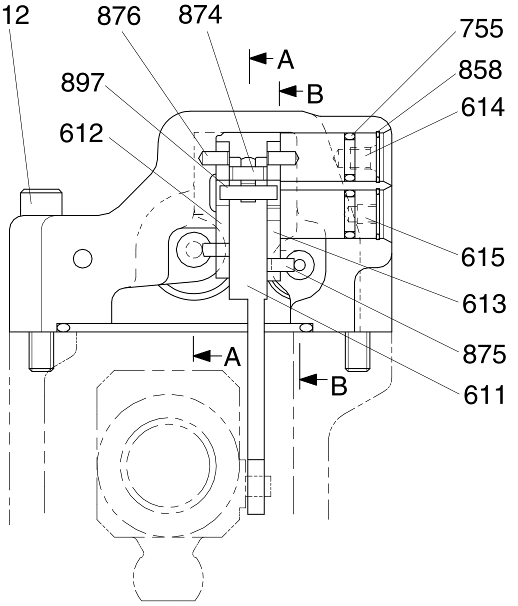


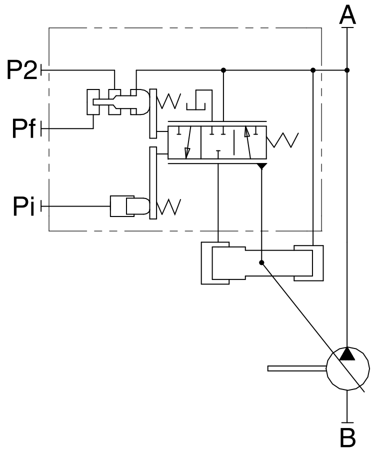
SECTION B-B

3809SH2MP02

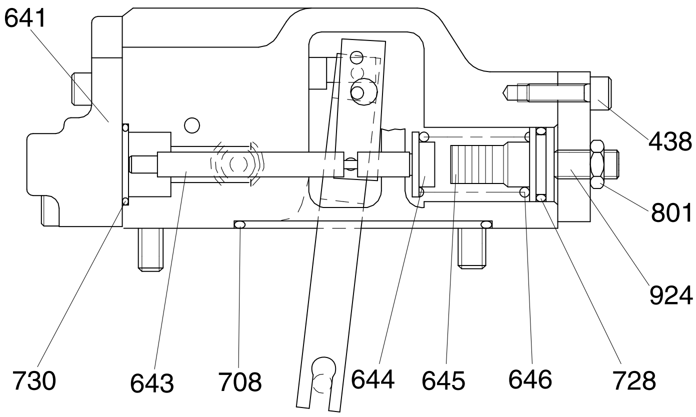
04	Gear pump	212	Swash plate	531	Tilting pin	725	O-ring
05	PTO unit	214	Bushing	532	Servo piston	728	O-ring
079	Proportional reducing valve	251	Support plate	534	Stopper (L)	732	O-ring
111	Drive shaft (F)	261	Seal cover (F)	535	Stopper (S)	774	Oil seal
113	Drive shaft (R)	263	Seal cover (R)	541	Seat	789	Back up ring
114	Spline coupling	271	Pump casing	543	Stopper	792	Back up ring
123	Roller bearing	312	Valve cover	544	Stopper	808	Hexagon head nut
124	Needle bearing	313	Valve plate (R)	545	Steel ball	824	Snap ring
127	Bearing spacer	314	Valve plate (L)	548	Feedback pin	885	Pin
141	Cylinder block	401	Hexagon screw	702	O-ring	886	Spring pin
151	Piston	406	Hexagon screw	710	O-ring	901	Eye bolt
152	Shoe	466	Plug	714	O-ring	953	Set screw
153	Set plate	468	Plug	717	O-ring	954	Adjust screw
156	Bushing	490	Plug	719	O-ring	981	Name plate
157	Cylinder spring	492	Plug	724	O-ring	983	Pin
211	Shoe plate						

2) FRONT REGULATOR (1/2)

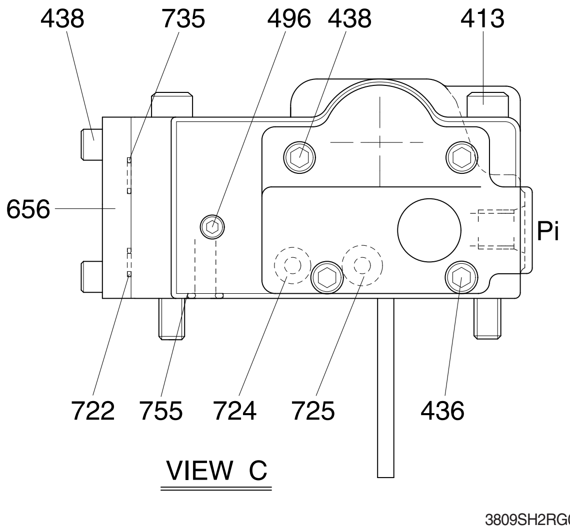




Hydraulic circuit



SECTION B-B

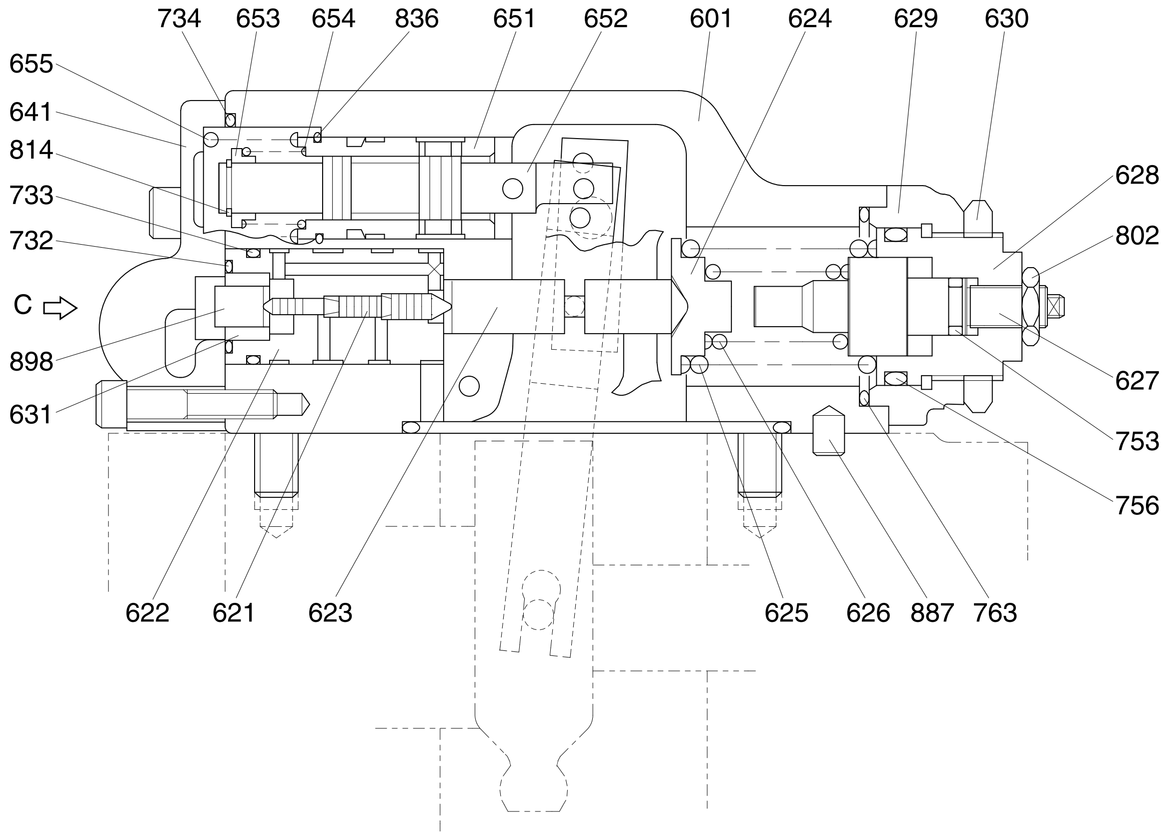


VIEW C

Port	Port name	Port size
Pi1,Pi2	Pilot port	PF 1/4-15
Psv1,Psv2	Servo assist port	PF 1/4-15

3809SH2RG01

REGULATOR (2/2)

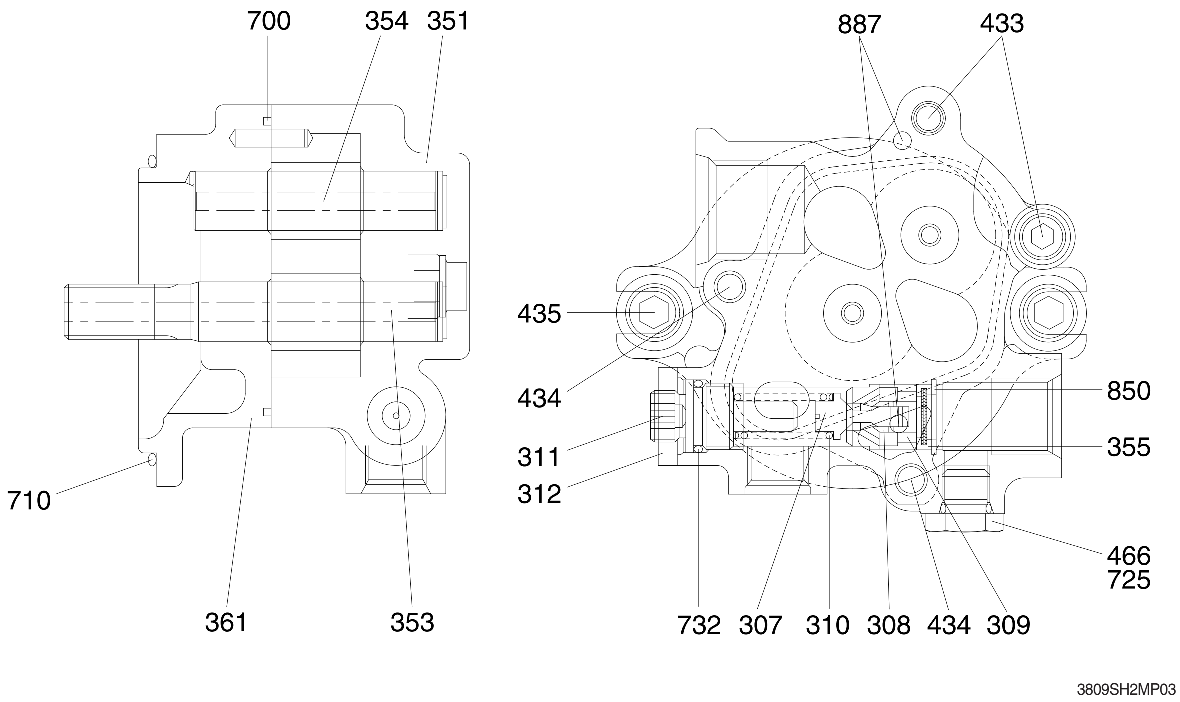


SECTION A-A

3809SH2RG02

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

4) GEAR PUMP



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

2. FUNCTION

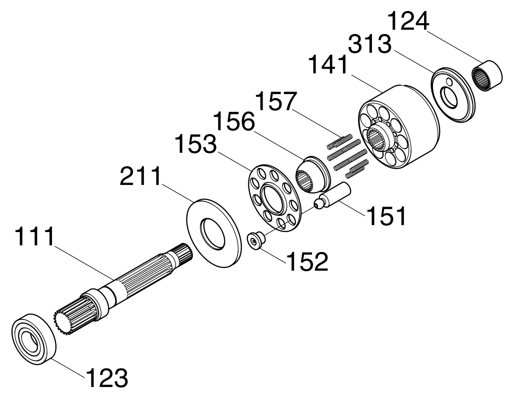
1) MAIN PUMP

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.



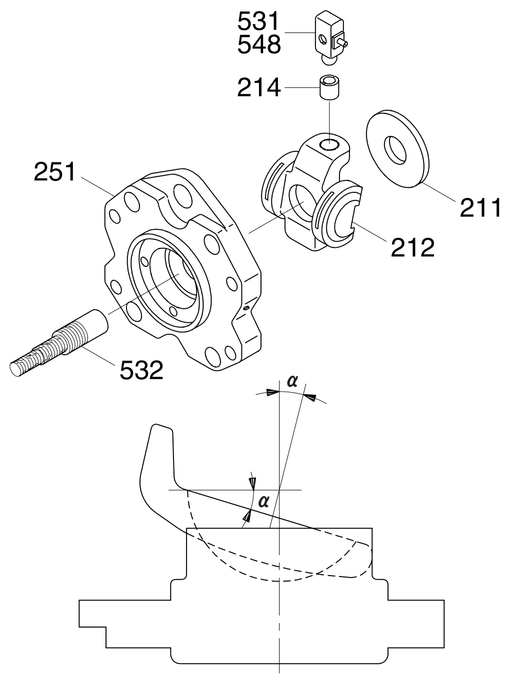
380H2MP04

(2) Swash plate group

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

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

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



3607A2MP10

(3) Valve block group

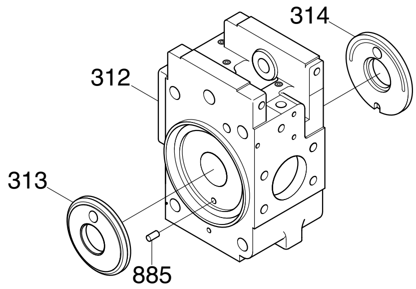
The valve block group consists of valve block (312), valve plate (313, 314) and valve plate pin (885).

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.



380H2MP05

2) REGULATOR

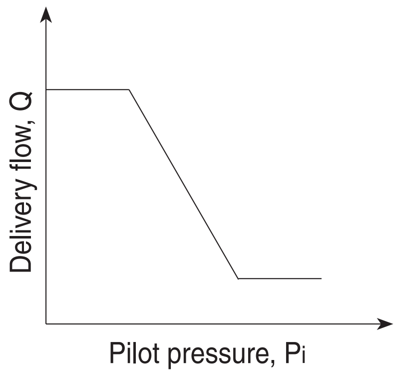
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

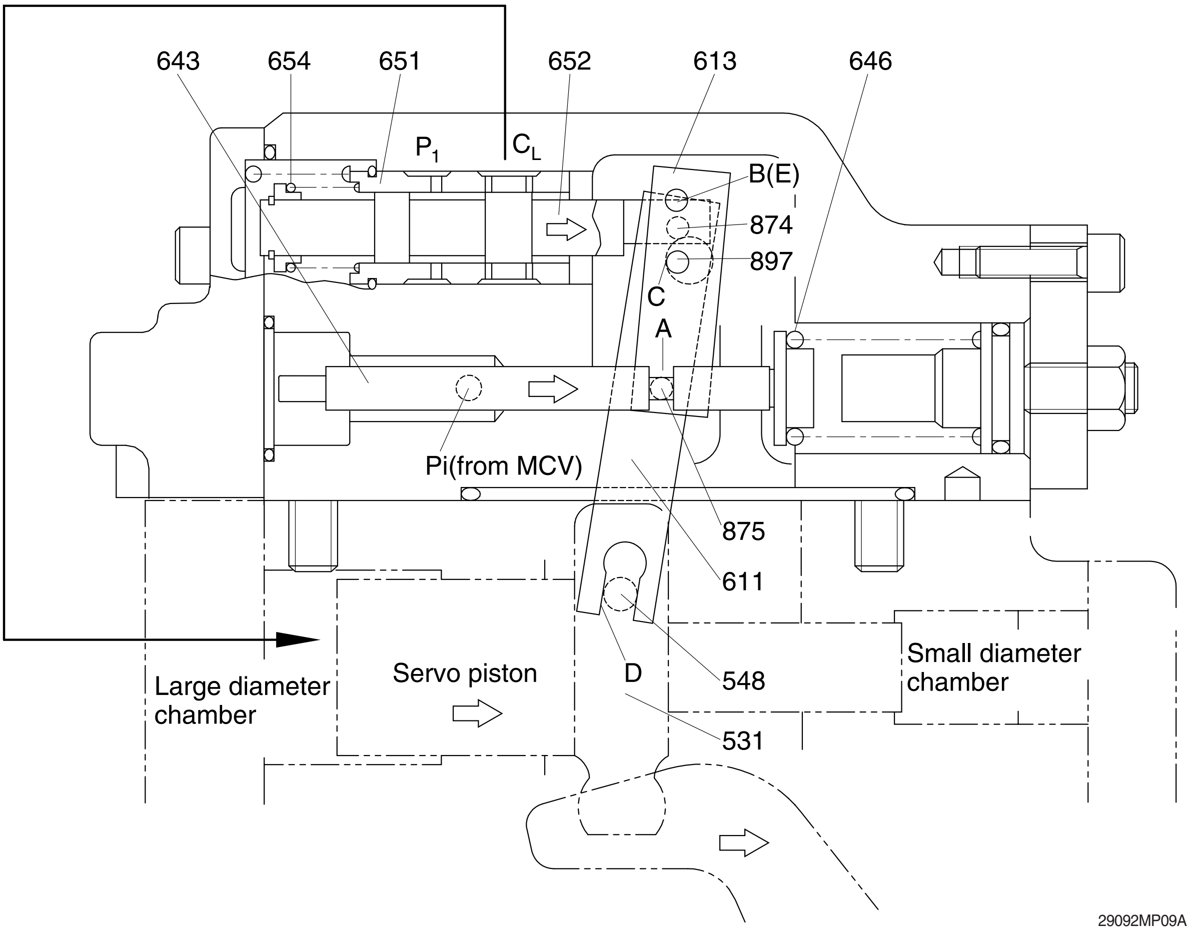
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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

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



① Flow reducing function



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

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

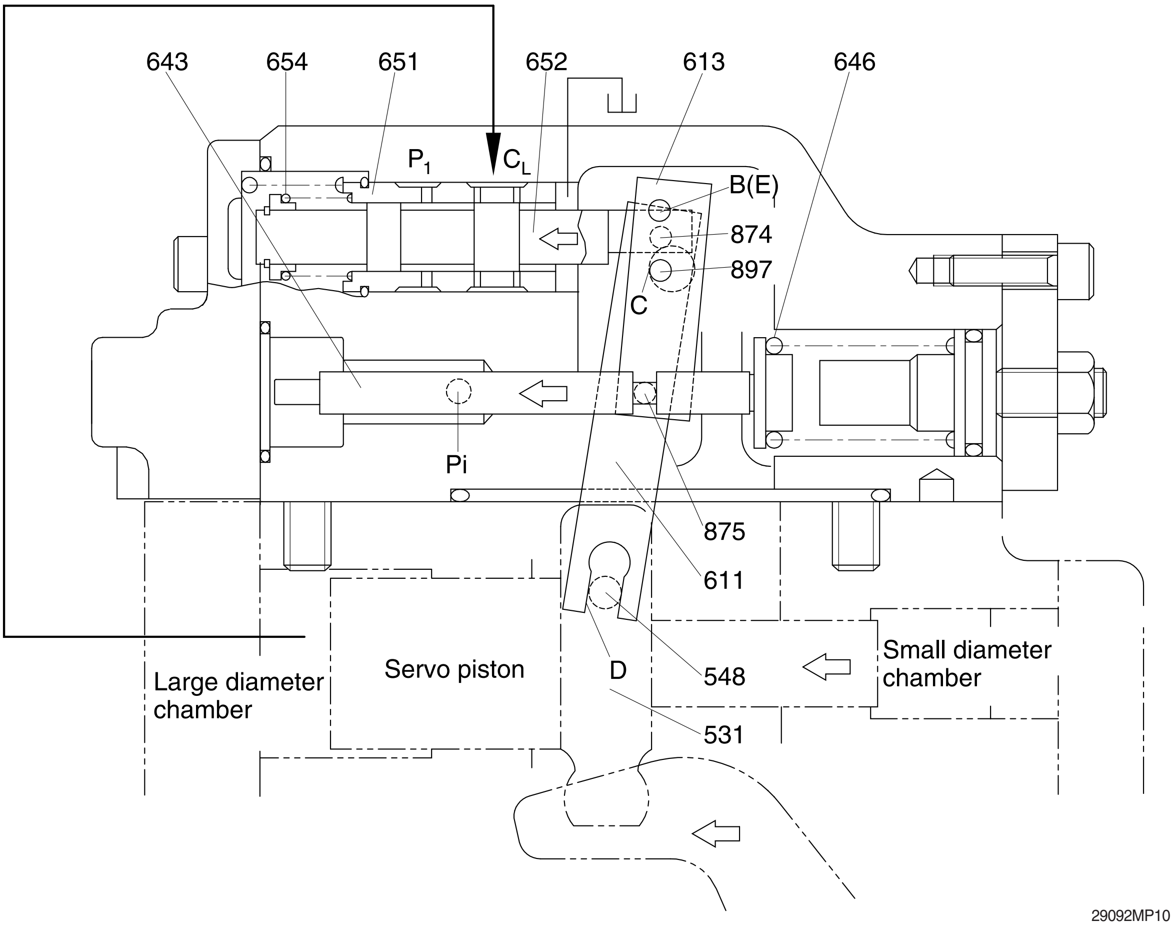
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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

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

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

② Flow increasing function



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

③ **Adjustment of flow control characteristic**

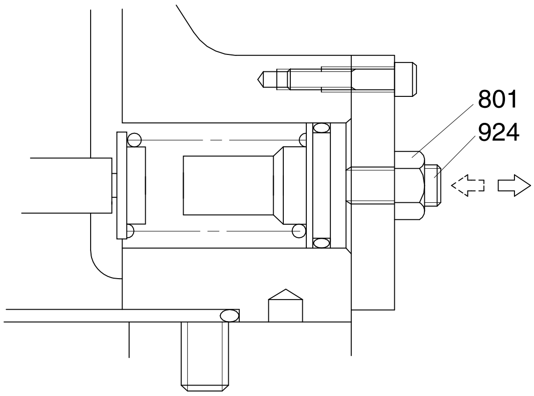
The flow control characteristic can be adjusted with the adjusting screw.

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

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

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

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(l /min)
1750	+1/4	+1.6	+18.4



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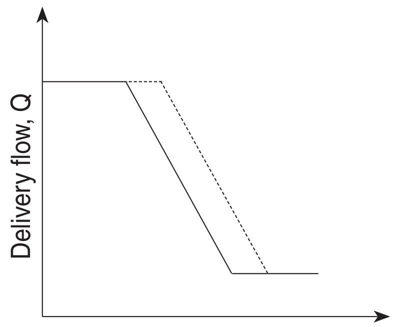


(2) Total horsepower control

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

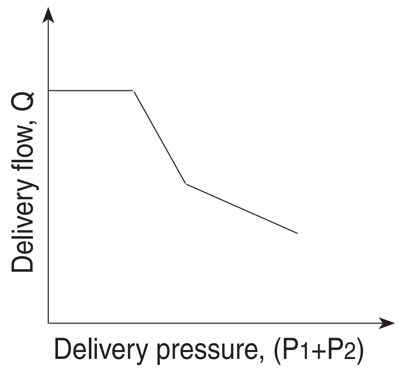
(The input horsepower is constant when the speed is constant.)

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

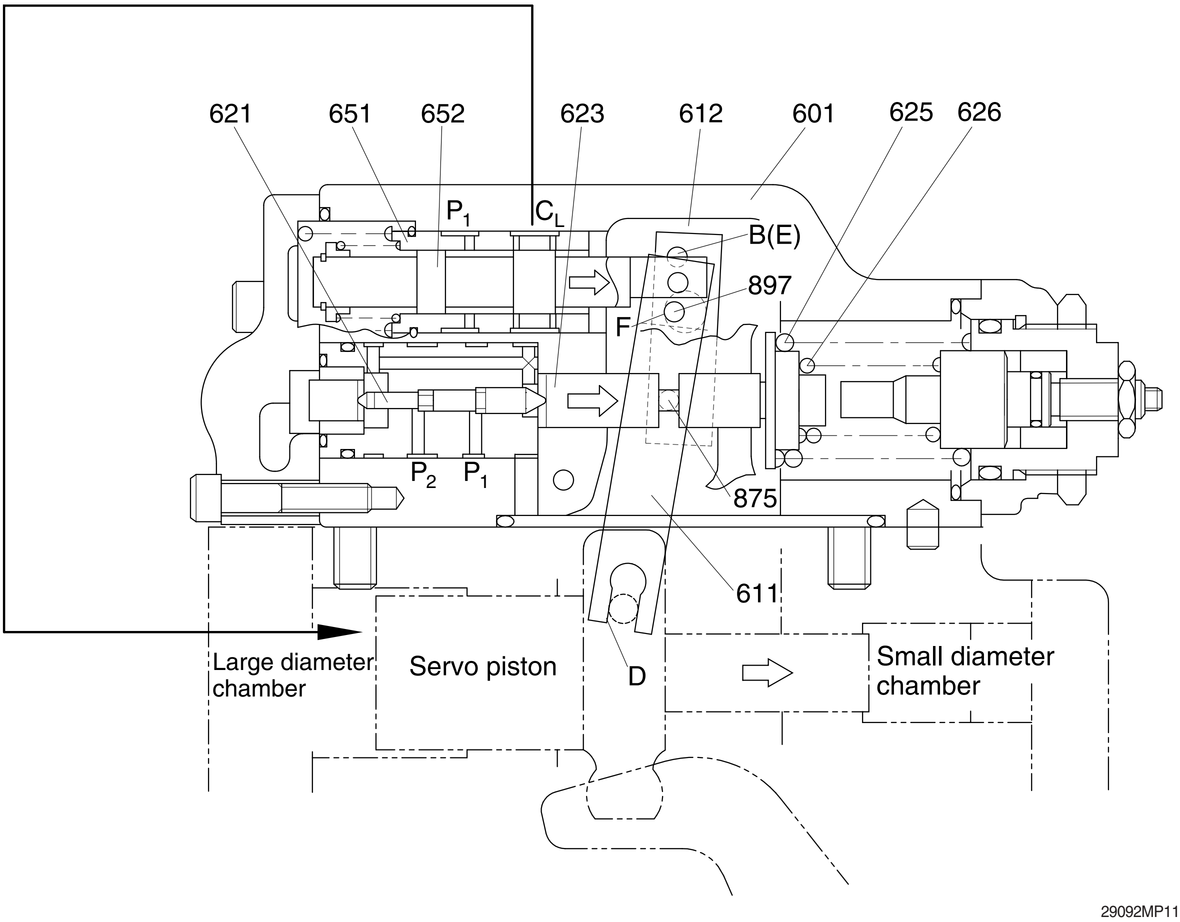
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation :

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

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

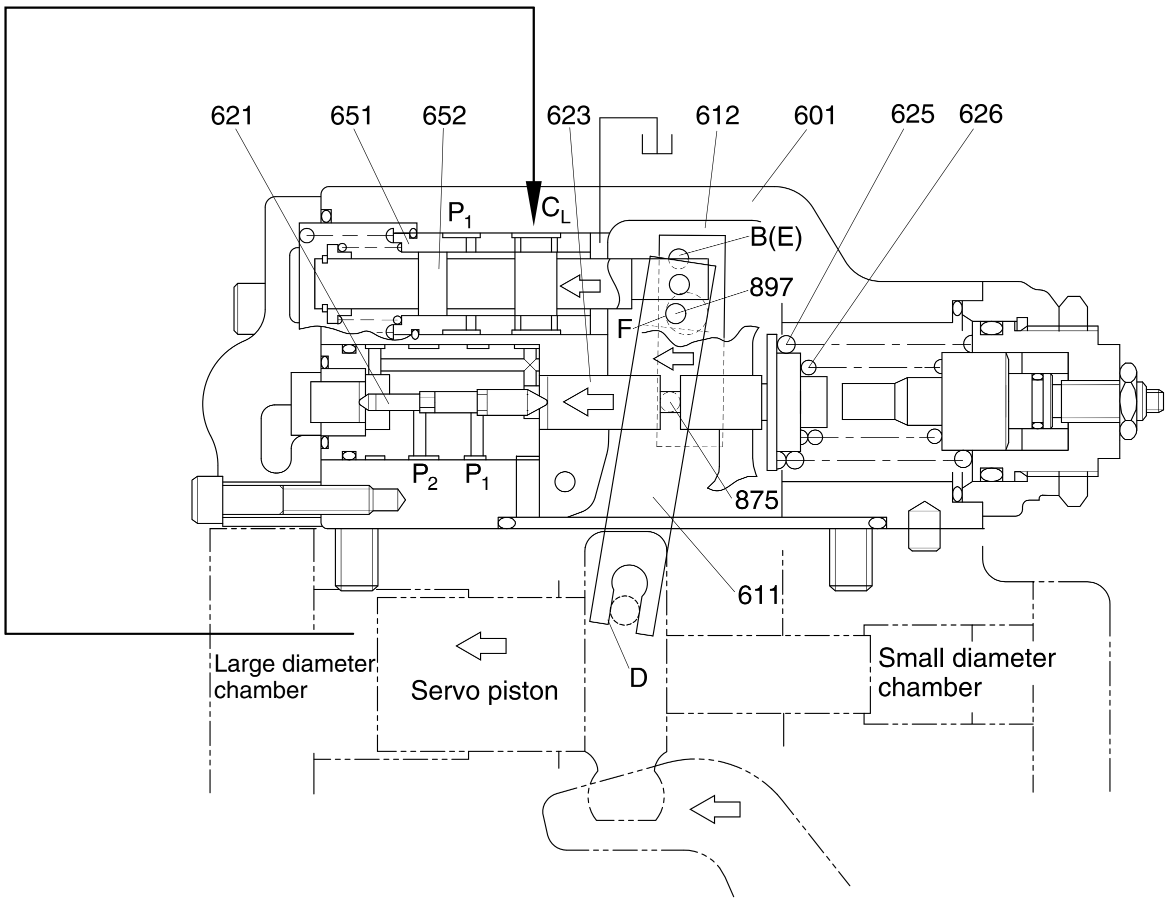


① Overload preventive function



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

② Flow reset function



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**

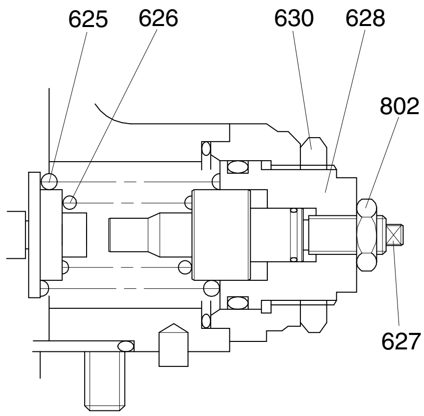
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (ø4) protruding from the large hole (ø8), only the lever lessening the tilting 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**

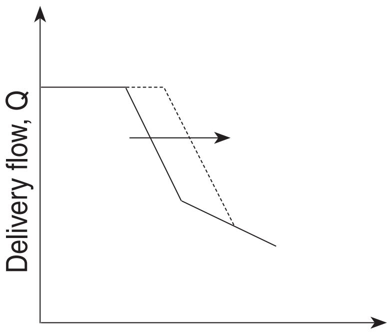
Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting screw QI (627) by N×A turns at first. (A=1.85)



8007A2MP03

※ **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	+19.2	+8.9



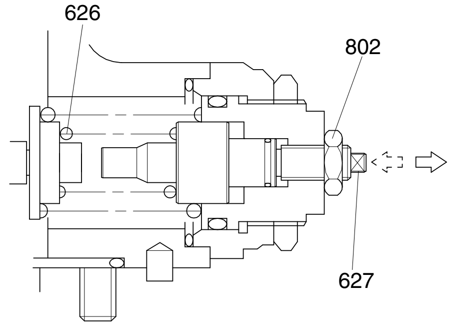
b. Adjustment of inner spring

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

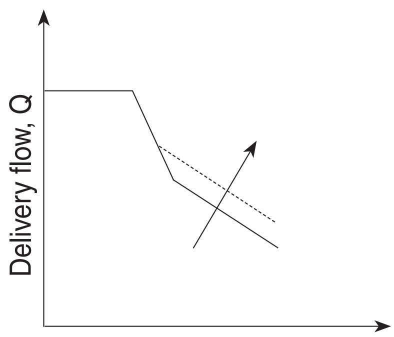
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valves are shown in table.

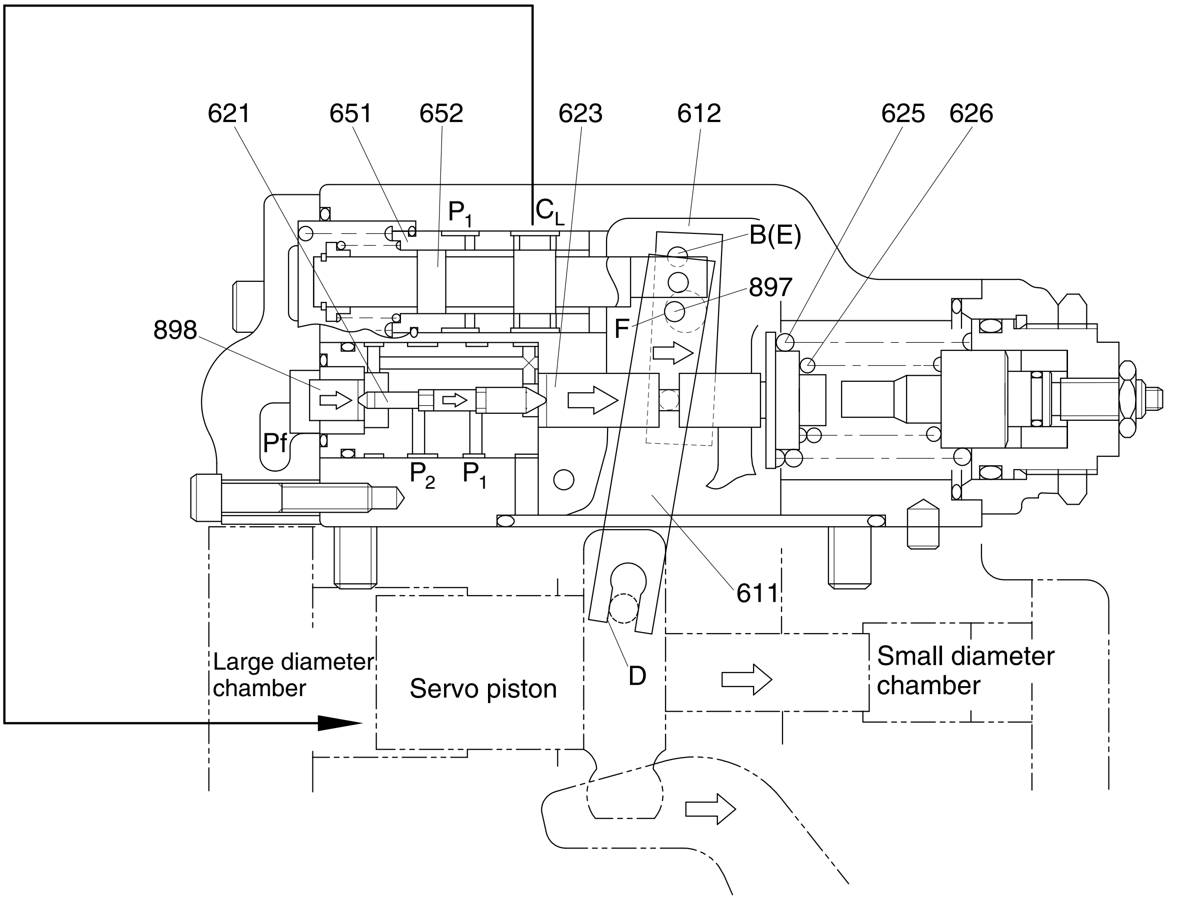
Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw (QI) (627)	Flow change amount (lpm)	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
1750	+1/4	+15.9	+9.1



8007A2MP04



(3) Power shift control

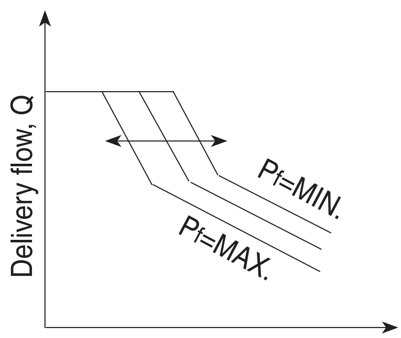


29092MP13

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).

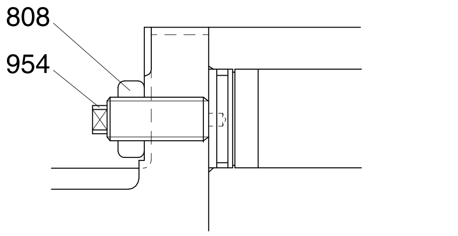
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

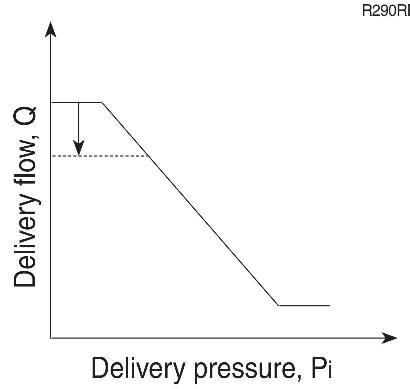
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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



R290RE08(5)

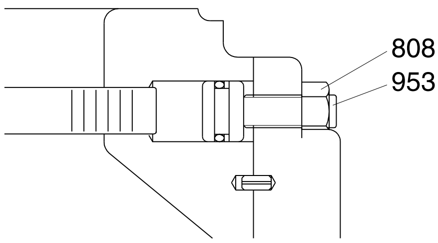
Speed	Adjustment of max flow spring	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(l /min)
1750	+1/4	-6.7



② Adjustment of minimum flow

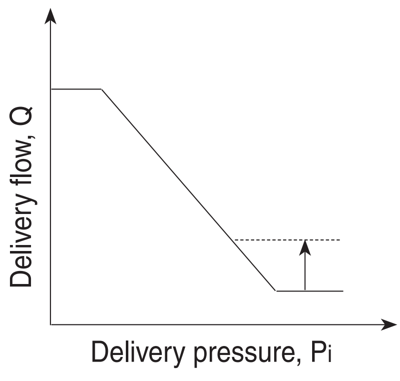
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

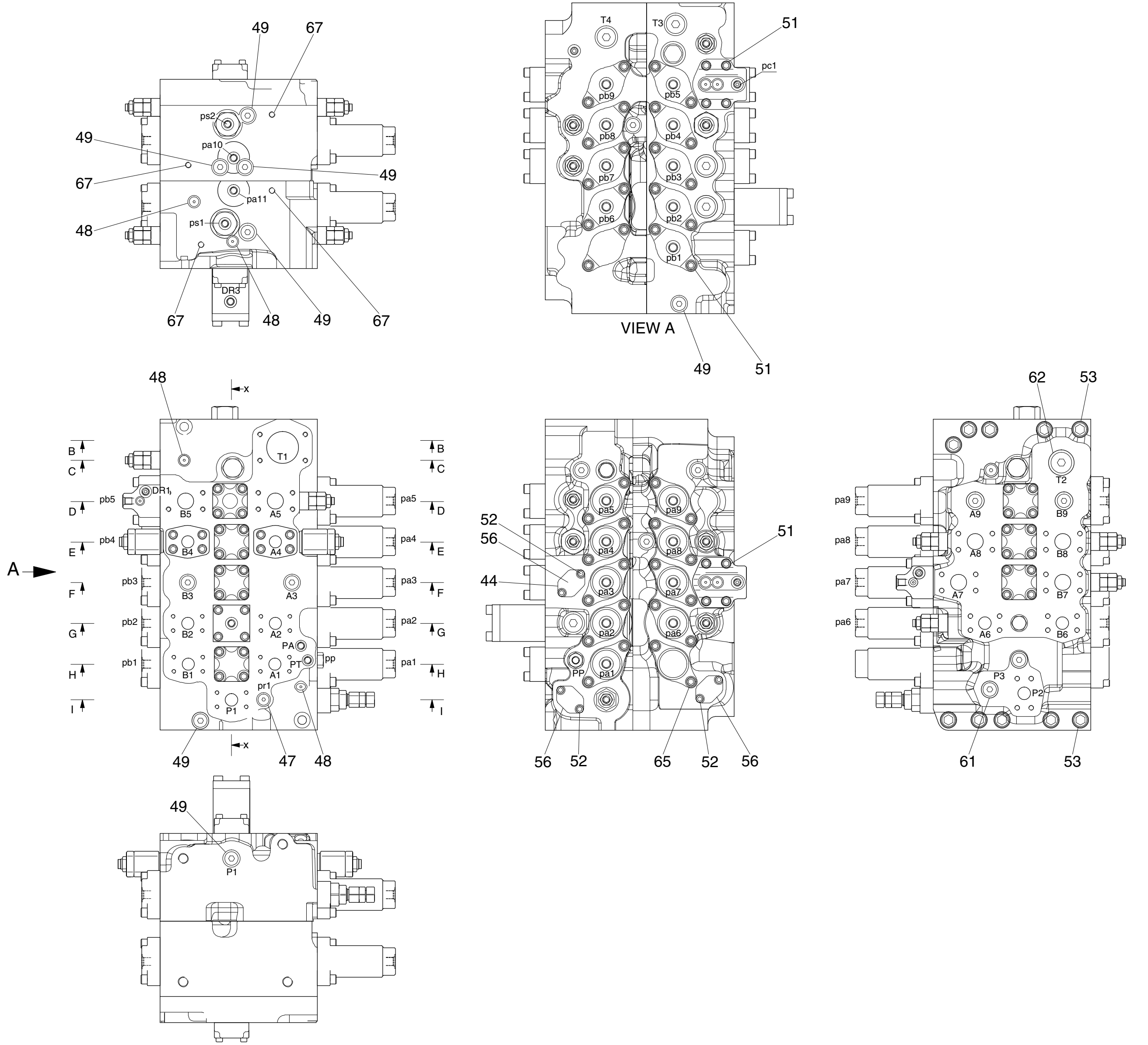


3607A2MP02

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



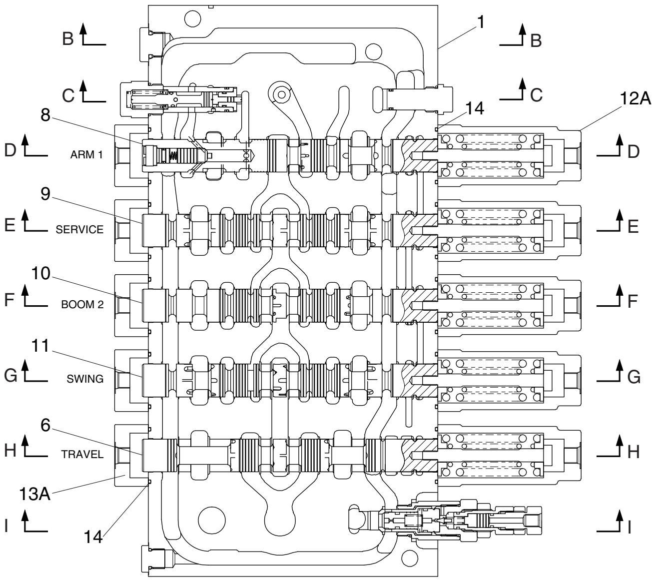
1. STRUCTURE



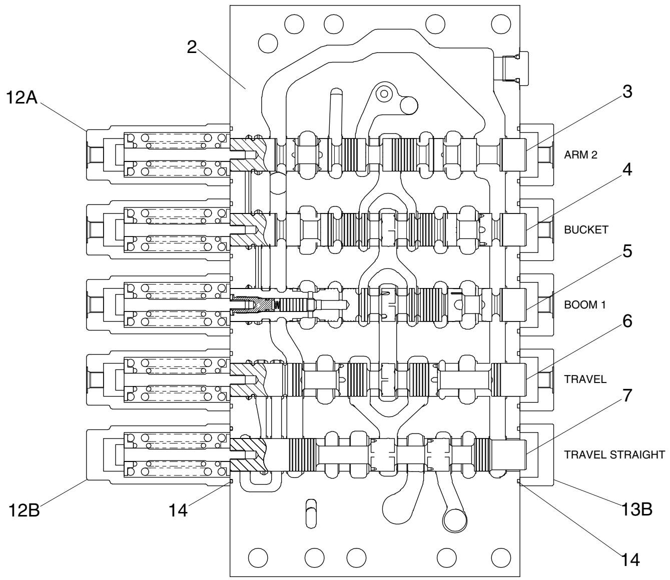
3809SH2MC01

Mark	Port size	Thread depth (mm)
DR1, DR2, DR3, pr1, ps1, ps2, pc1, pc2, pc6, pa10, pa11, PA, PT, PP, PH	PF 1/4	12
pa1~pa9, pb1~pb9	PF 3/8	14
A3, A9, B3, B9, P1, P3	PF 1/2	16
T3, T4	PF 3/4	17
T2	PF 1	21
T1	SAE 2 1/2"	-
A5, B5, A7, B7, A8, B8	SAE 1 1/4"	-
P1, P2, A1, A2, A4, B1, B2, B4, A6, B6	SAE 1"	-

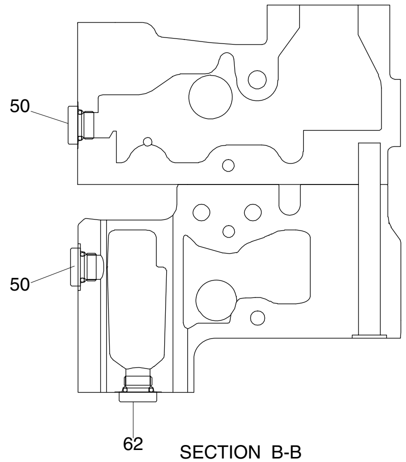
1 Valve housing (P1)
2 Valve housing (P2)
3 Arm 2 spool assy
4 Bucket spool assy
5 Boom 1 spool assy
6 Travel spool assy
7 TS spool assy
8 Arm 1 spool assy
9 Service spool assy
10 Boom 2 spool assy
11 Swing spool assy
12A Spool cap-A
12B Spool cap-B
13A Spool flange-A
13B Spool flange-B
14 O-ring
15 Popet
16 Spring
17 Spacer
18 O-ring
19 Back up ring
20 Spool assy
21 Spring seat
22 Spool assy
23 Spring
24 O-ring
25 Plug
26 Poppet
27 Spring
28 Poppet
29 Poppet
30 Poppet
31 Spring
32 Flange
33 O-ring
34 Swing priority assy
35 Holding valve assy
36 Main relief valve assy
37A Overload relief valve assy
37B Overload relief valve assy
38 Negacon valve assy
39 Plug assy
40 Poppet
41 Spring
42 Plug
43 O-ring
44 Flange
45 O-ring
46 Plug assy
47 Plug assy
48 Plug assy
49 Plug assy
50 Plug assy
51 Socket head bolt
52 Socket head bolt
53 Socket head bolt
54 Name plate
55 Screw
56 Socket head bolt
57 Poppet
58A Service relief valve assy
58B Service relief valve assy
59 O-ring
60 O-ring
61 O-ring
62 Plug
63 Plug
64 Flange
65 Socket head bolt
66 O-ring
67 Socket head bolt
68 Socket head bolt



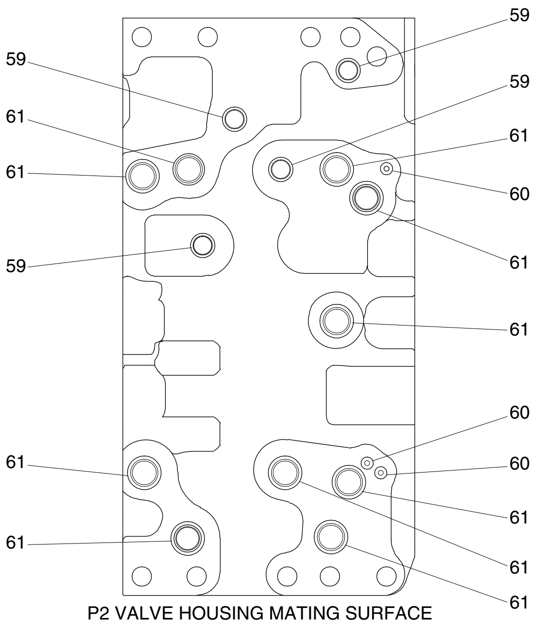
SECTION Z-Z



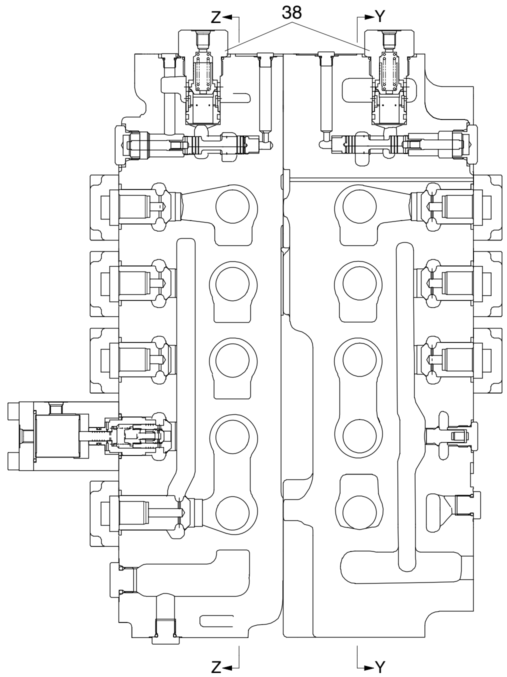
SECTION Y-Y

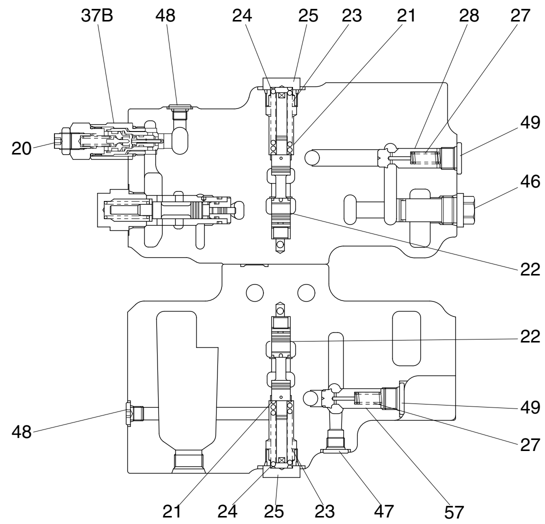


SECTION B-B



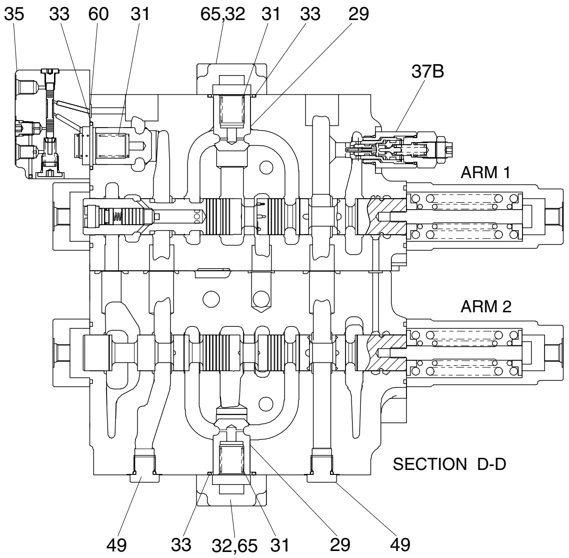
P2 VALVE HOUSING MATING SURFACE

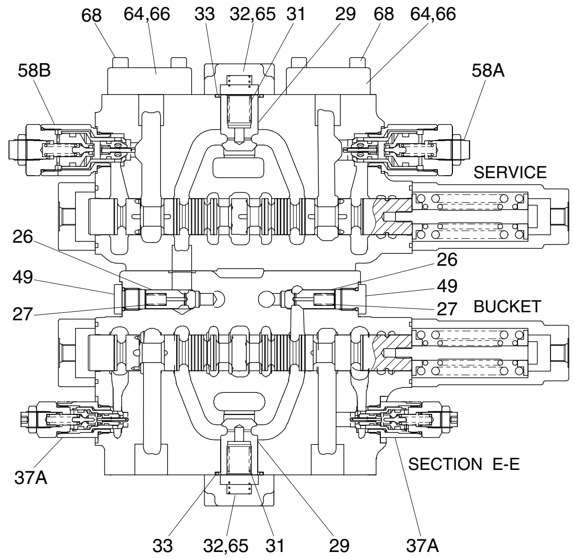


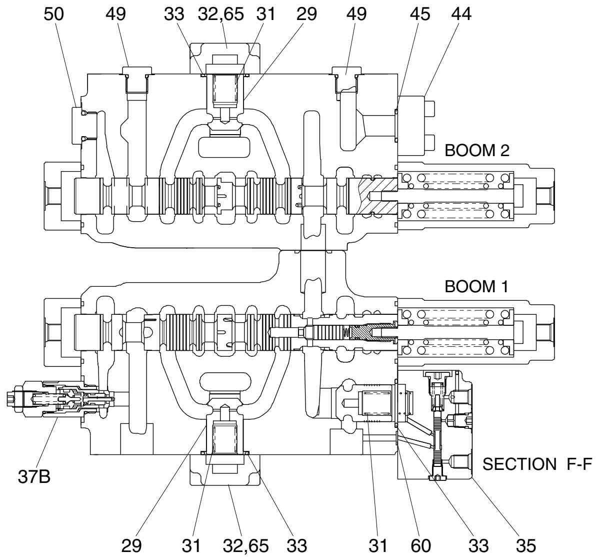


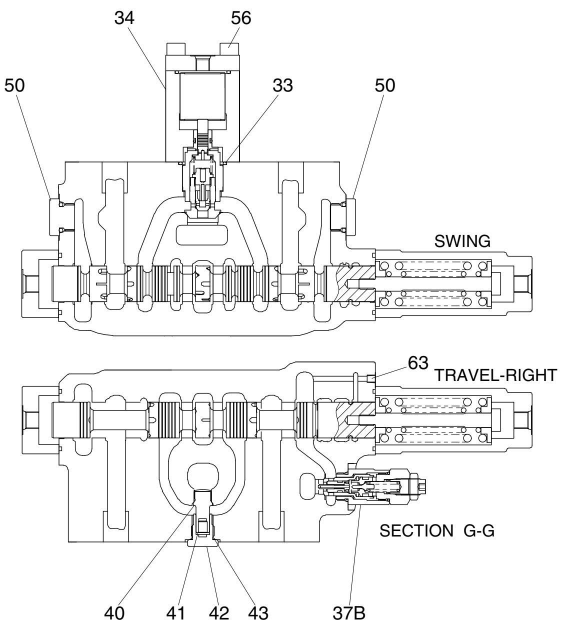
SECTION C-C

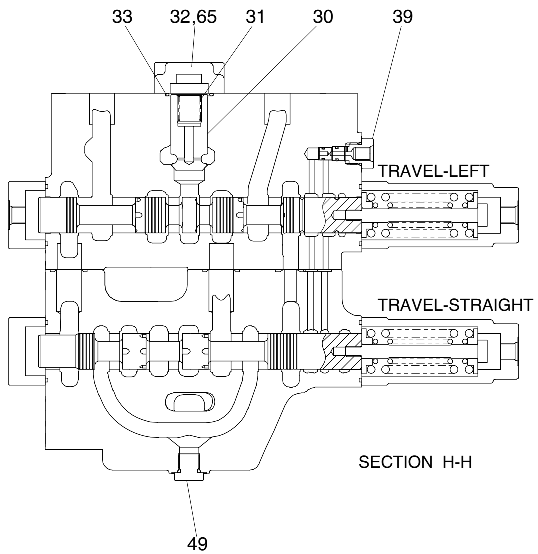
48092MC04

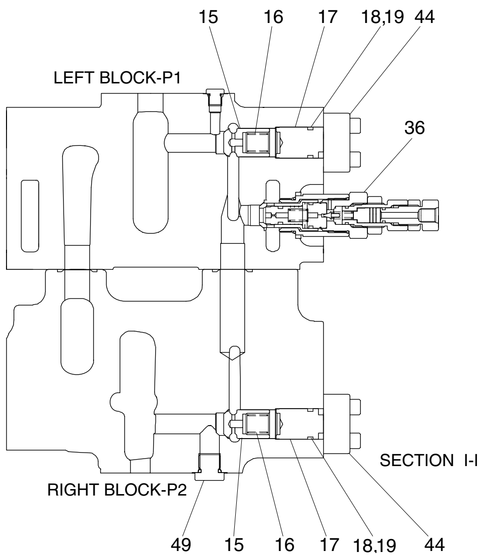

35 33 60 31 65,32 31 33 29
37B
ARM 1
ARM 2
SECTION D-D
49 33 32,65 31 29 49


68 64,66 33 32,65 31 29 68 64,66
58B
58A
SERVICE
26
49
27
26
49
27
BUCKET
37A
SECTION E-E
33 32,65 31 29 37A


50 49 33 32,65 31 29 49 45 44
BOOM 2
BOOM 1
37B
SECTION F-F
29 31 32,65 33 31 60 33 35

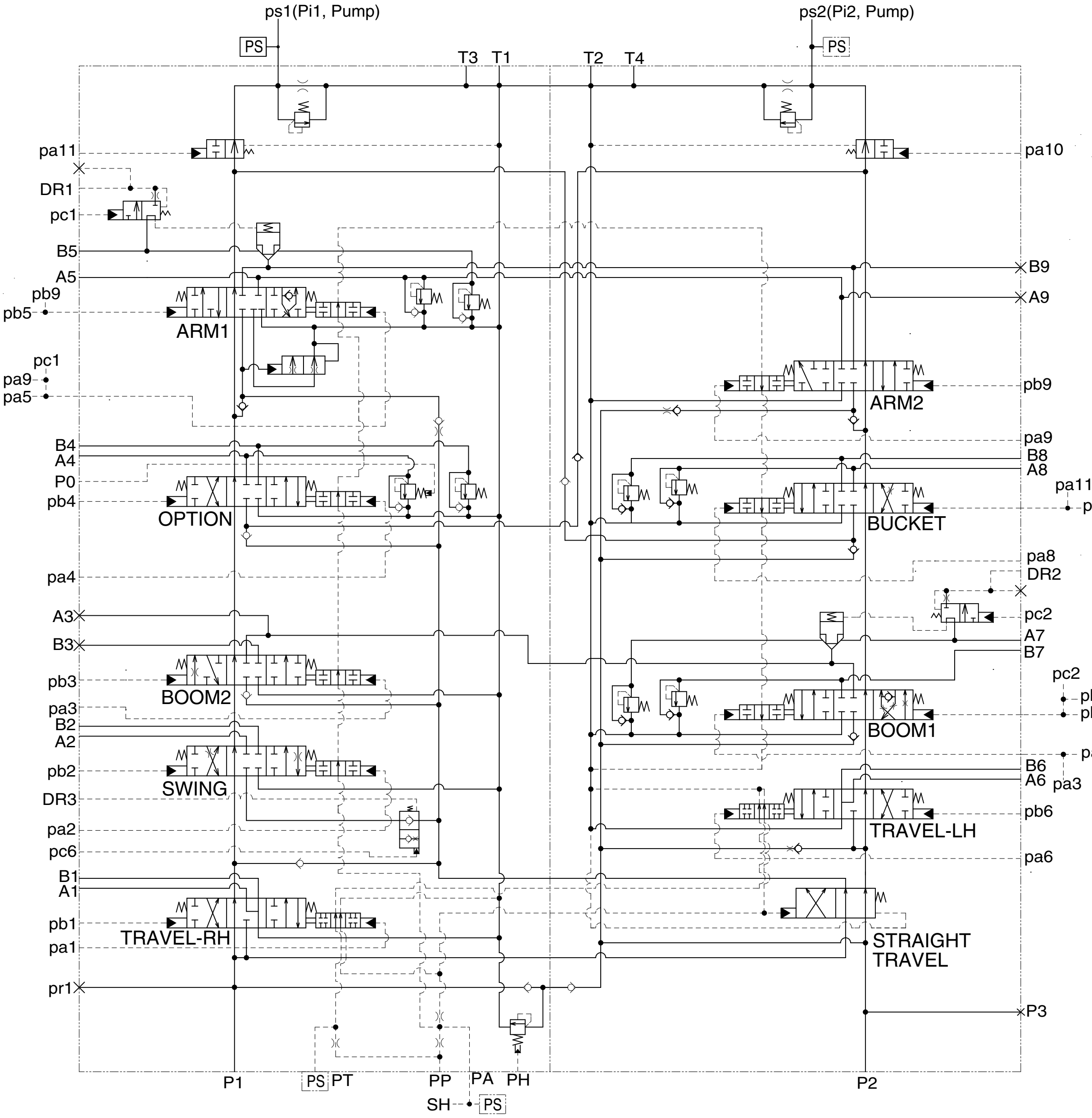

34 56
50 33 50
SWING
63
TRAVEL-RIGHT
SECTION G-G
40 41 42 43 37B


33 32,65 31 30 39
TRAVEL-LEFT
TRAVEL-STRAIGHT
SECTION H-H
49


15 16 17 18,19 44
LEFT BLOCK-P1
36
SECTION I-I
RIGHT BLOCK-P2
49 15 16 17 18,19 44

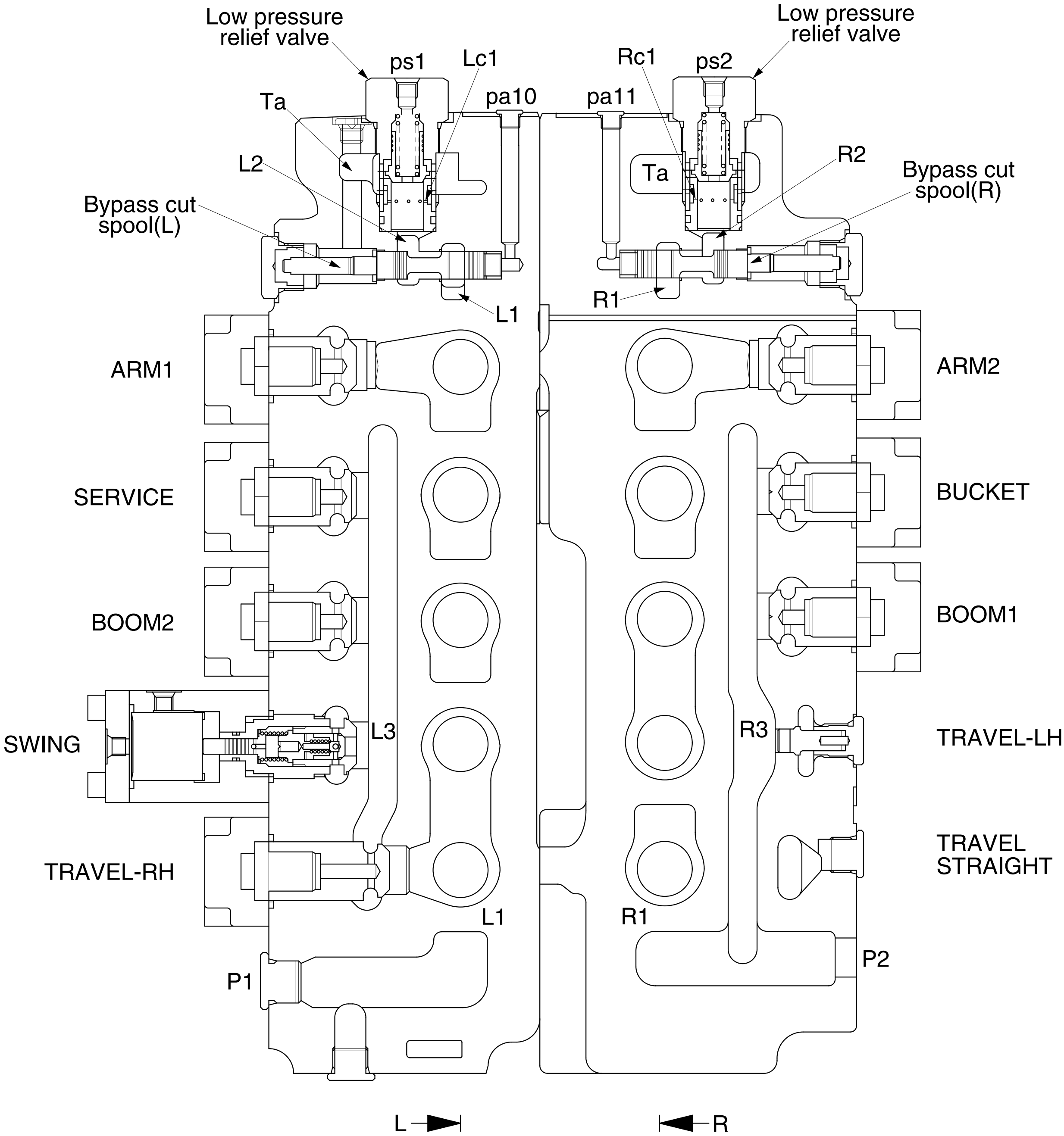
48092MC02

2. HYDRAULIC CIRCUIT



3809SH2MC02

3. OPERATION



48092MC05A

1) ALL SPOOL NEUTRAL

(1) Neutral passage

① Oil from pump P1 goes through neutral passage (L1) to the orifice (Lc1) of the low pressure relief valve and then oil returns to port T1 and T3 via tank passage (Ta).

② Oil from pump P2 goes through neutral passage (R1) to the orifice (Rc1) of the low pressure relief valve and then oil returns to port T1 and T3 via tank passage (Ta).

③ The pressure of upper chamber (L2), (R2) for the low pressure relief valve flow into pump through port ps1, ps2 and then controls the discharge of pump P1, P2.

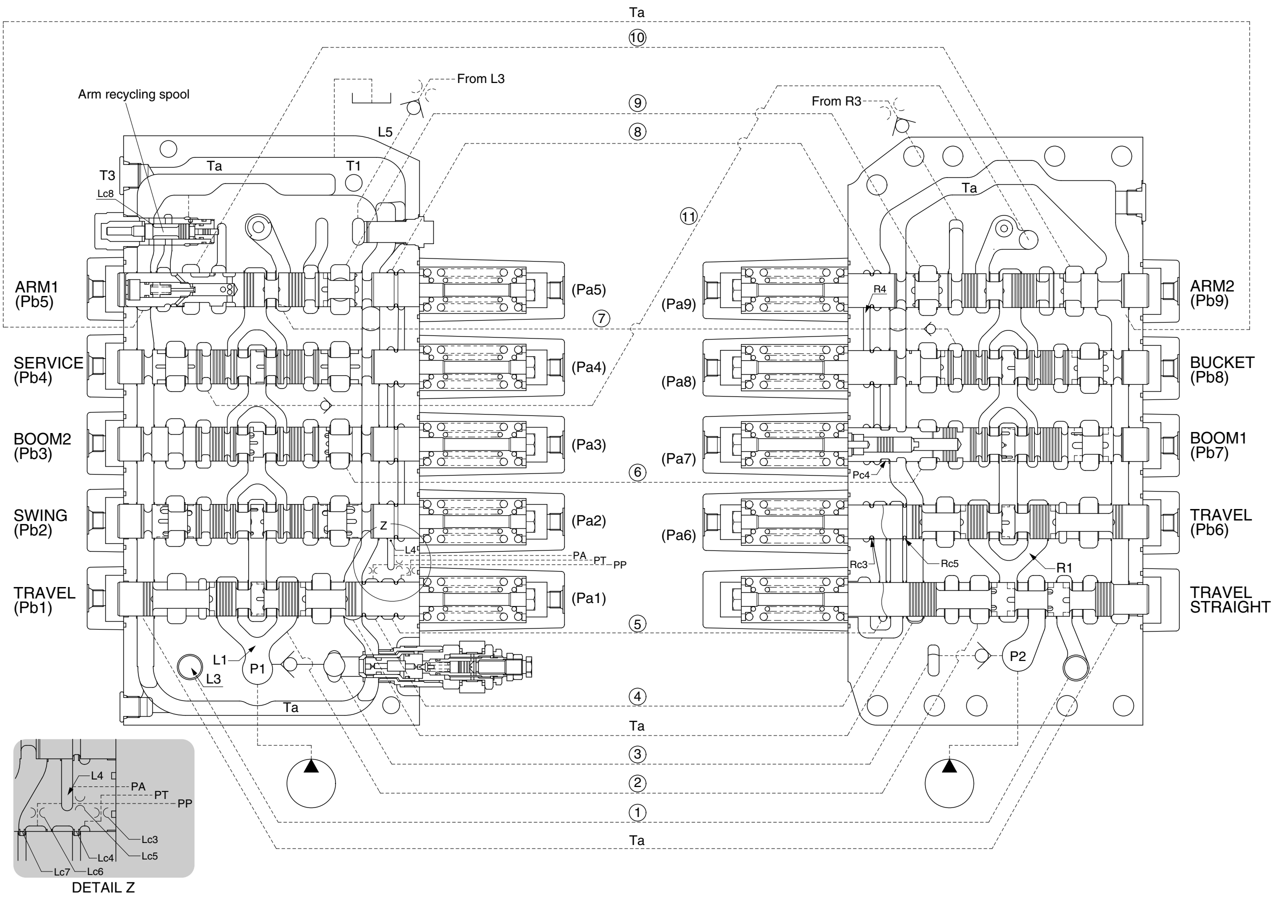
④ When a large amount of oil flows the neutral passage, the low pressure relief valves is operated. As a result, the shock pressure of port ps1, ps2 is prevented.

(2) Signal passage

① Oil from port PP flows into port PT via orifice (Lc3). At the same time, after passing through passage (⑤) via land (Lc4), oil returns to the tank passage (Ta) via land (Rc3).

② Meanwhile, some of oil from port PP flows into port PA via orifice (Lc5) and return to the tank passage (Ta) from boom 1 spool land (Rc4) via passage (L4, ⑧, R4).

③ Oil via orifice (Lc6) flows into the tank passage (Ta) from land (Lc7) and return to the tank passage (Ta) via travel spool land (Rc5) through the passage ④.



48092MC06

2) SINGLE OPERATION

(1) Travel spool

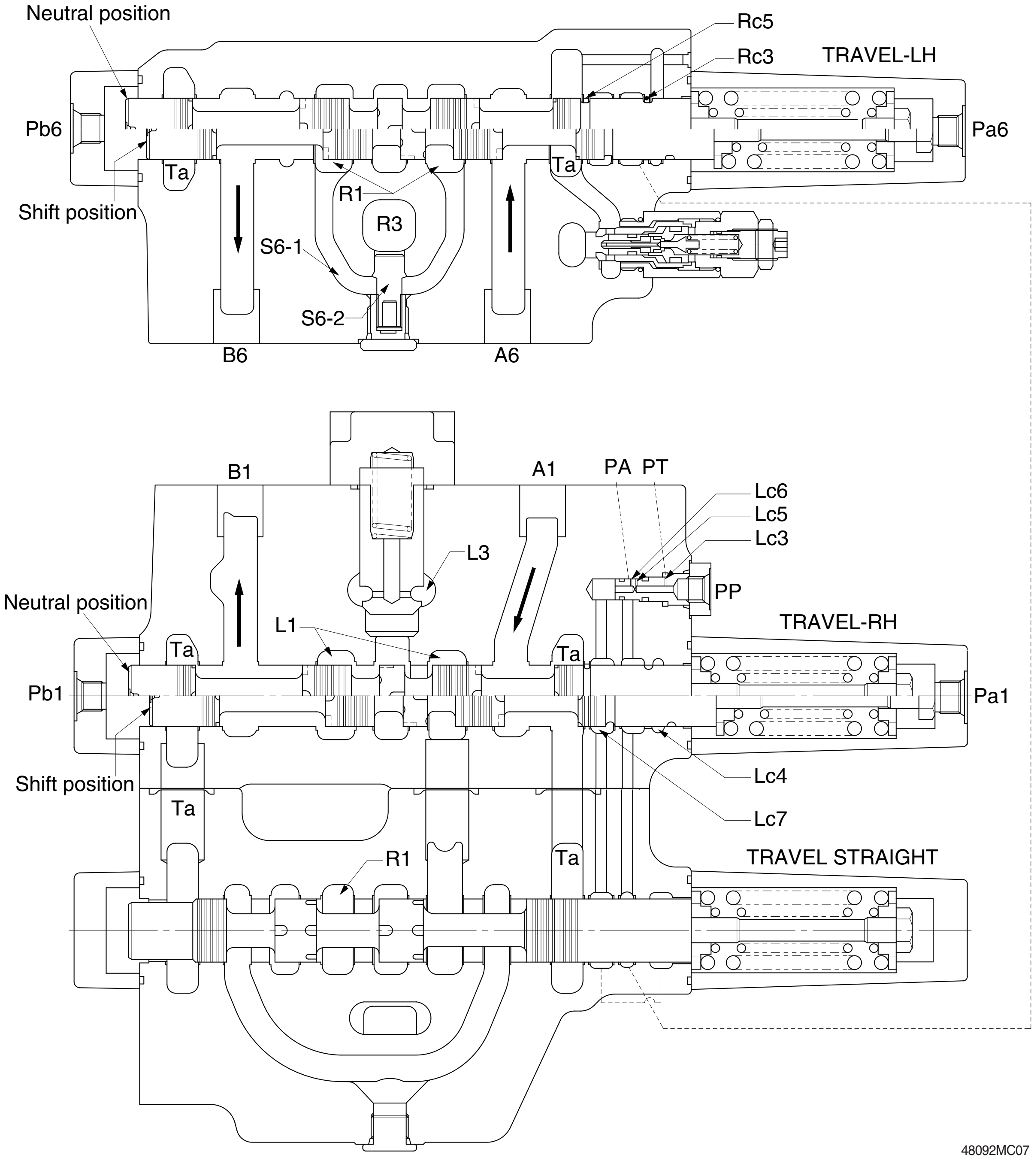
When the RH travel spool is pushed to right by the pilot pressure of port Pb1 the oil discharged from P1 port flows from the neutral passage (L1) to B1 port.

The oil from port A1 return to the tank via the tank passage (Ta).

When the LH travel spool is pushed to right by the pilot pressure of port Pb6 the oil discharged from P2 port flows from the neutral passage (R1) to B6 port through the passage S6-1.

At this time, the parallel passage (R3) and passage (S6-1) are to be maintained as same pressure as poppet (S6-2) is closed. The oil from A6 returns to the tank via the tank passage (Ta).

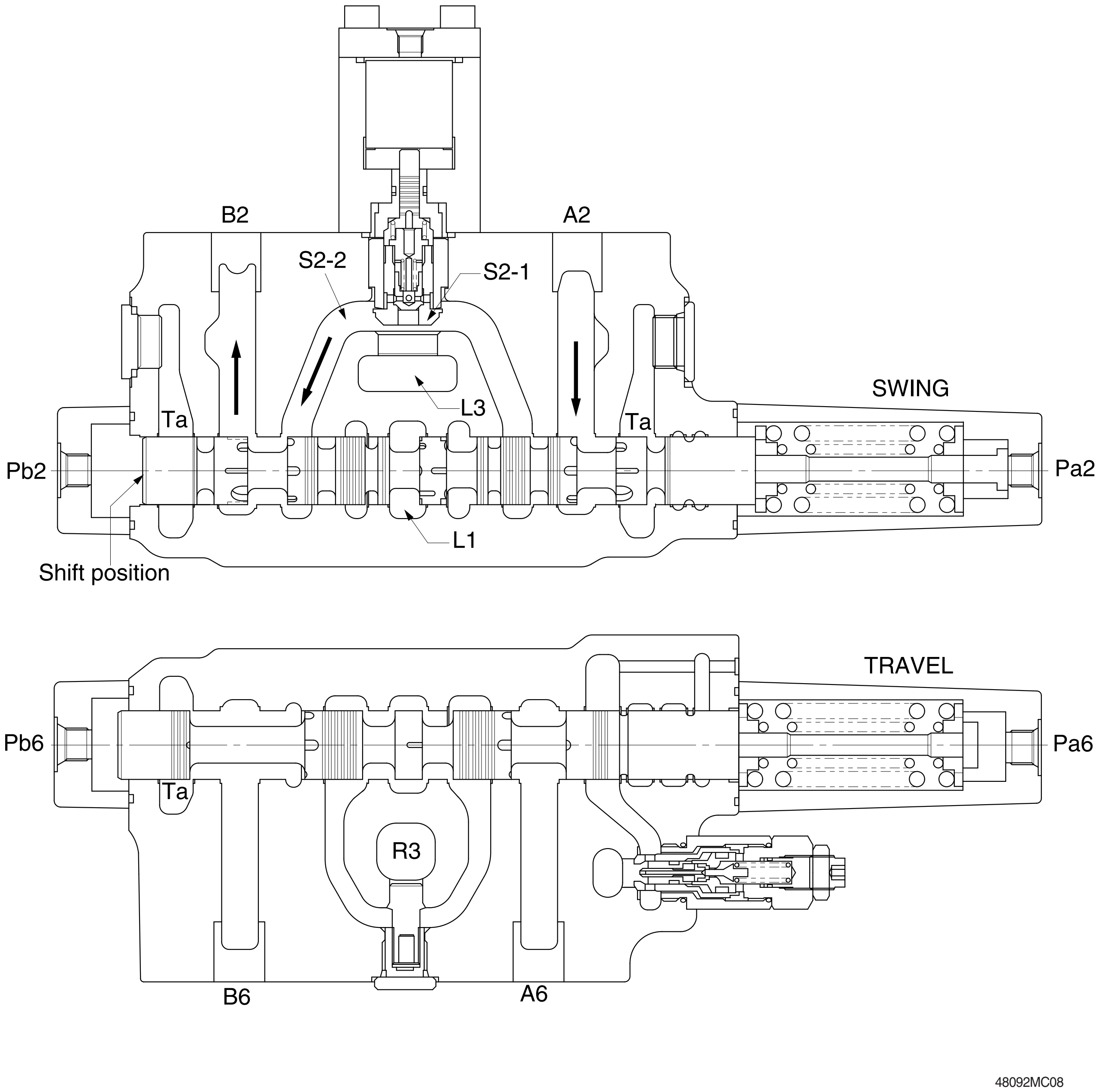
When the travel spool is pushed to the right by the pilot pressure, the land (Lc4, Rc3) is closed and the tank passage of the oil discharged from port PP is closed, and then the pressure of PT port is increased.



(2) Swing spool

When the swing spool is pushed to the right by the pilot pressure of port Pb2, the neutral passage (L1) is closed, the oil discharged from pump P1 pushes up the load check valve (S2-1), passage (S2-2) via parallel passage (L3) and then flows into port B2.

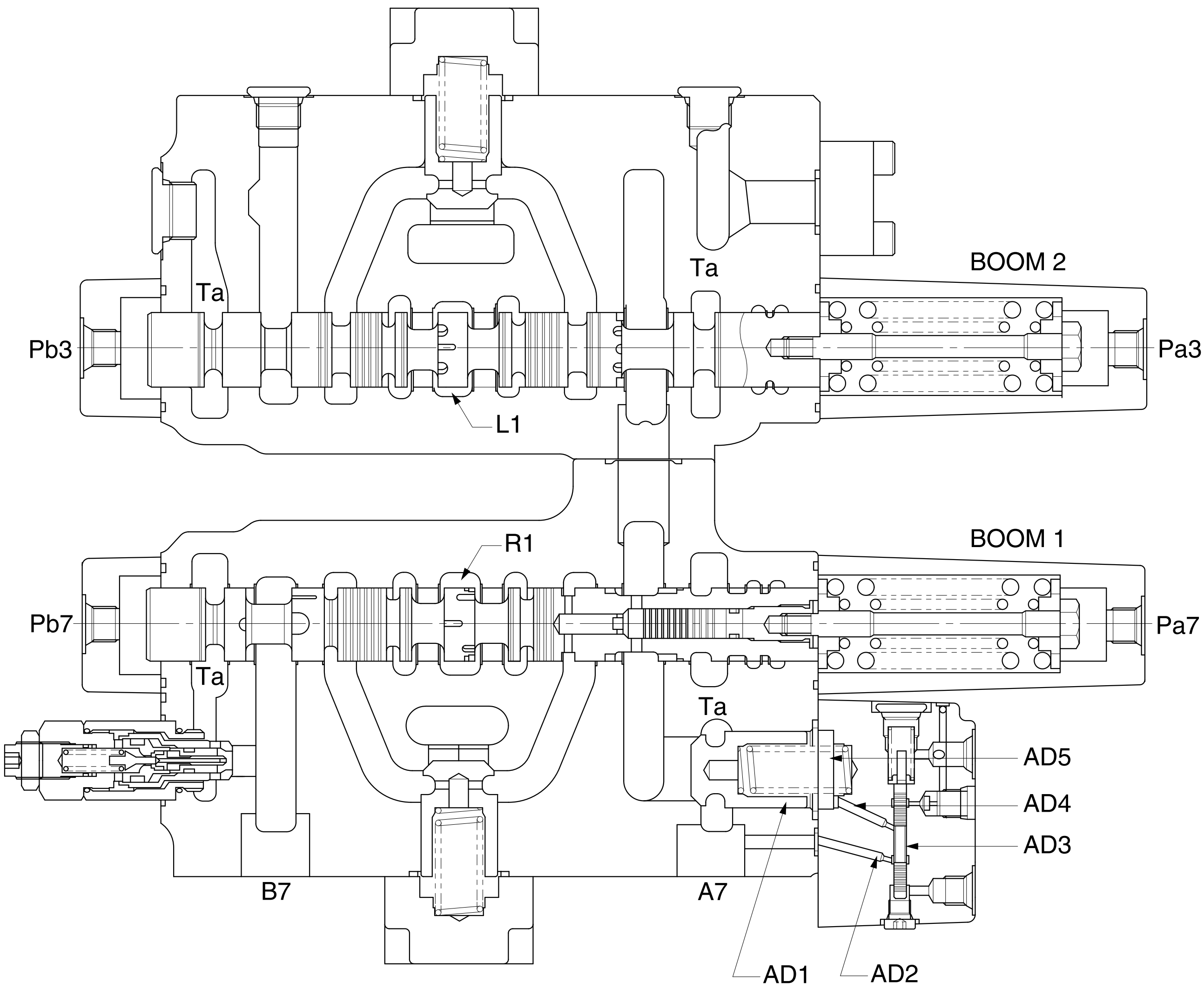
The oil from port A2 return to the tank via the tank passage (Ta).



3) BOOM SPOOL

(1) Neutral

This valve is providing the anti-drift valve on the cylinder bottom side of boom 1 section. In neutral, the poppet (AD1) is seated by the pressure of spring chamber (AD5) because the oil from the port A7 is connection with spring chamber (AD5) via passage (AD2), spool (AD3) and passage (AD4).

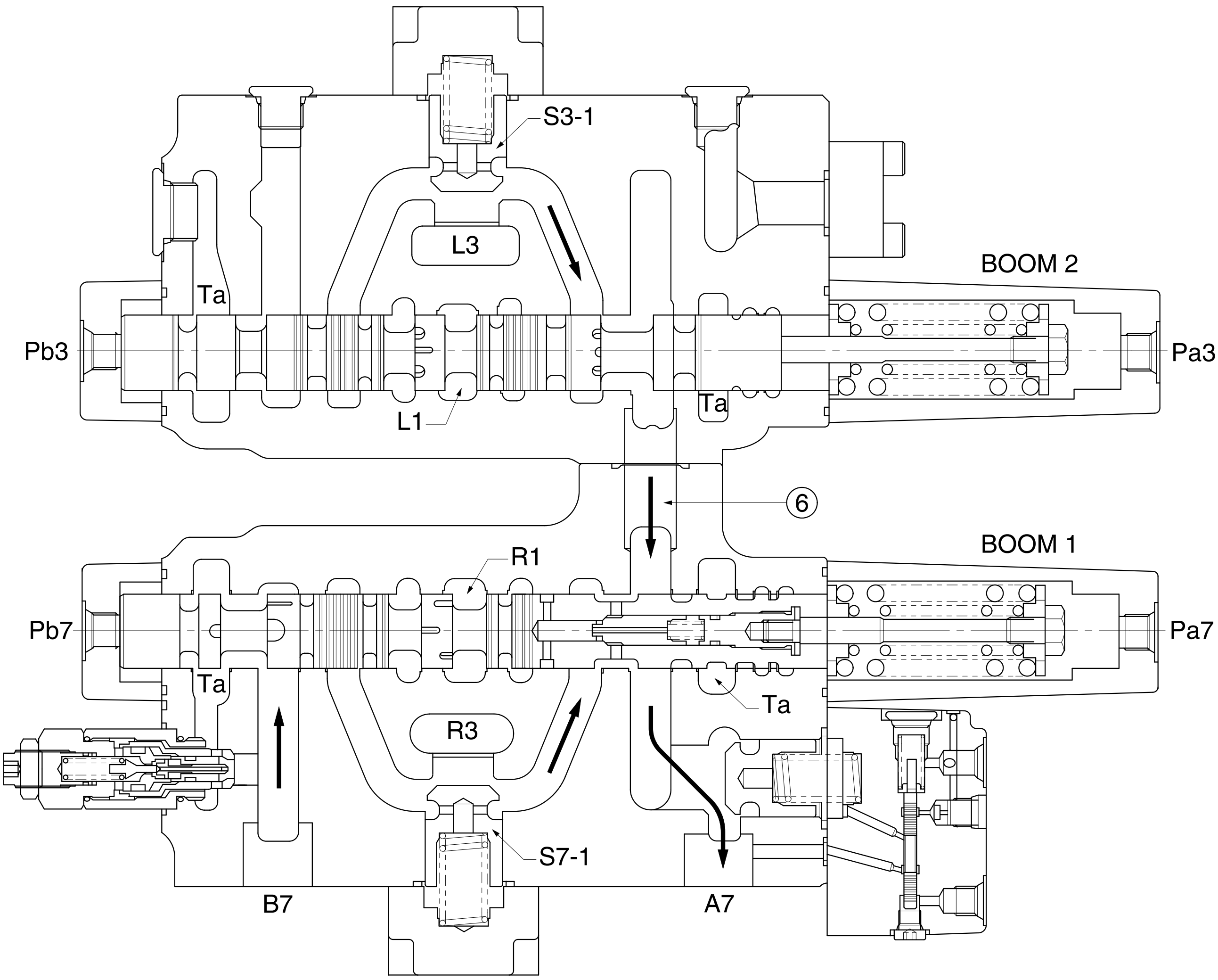


48092MC09

(2) Boom up (flow summation)

When the boom 1 spool is pushed to the left by the pilot pressure of port Pa7, the neutral passage (R1) is closed, the oil discharged from pump P2 flows into the port A7 via parallel passage (R3), the load check valve (S7-1). At the same time, the boom 2 spool is pushed to the left by the pilot pressure of port Pa3, the neutral passage (L1) is closed, the oil discharged from pump P1 flows into the port A7 via parallel passage (L3), the load check valve (S3-1) and then joins to the passage (⑥).

The return oil from port B7 flows into the tank via the tank passage (Ta).

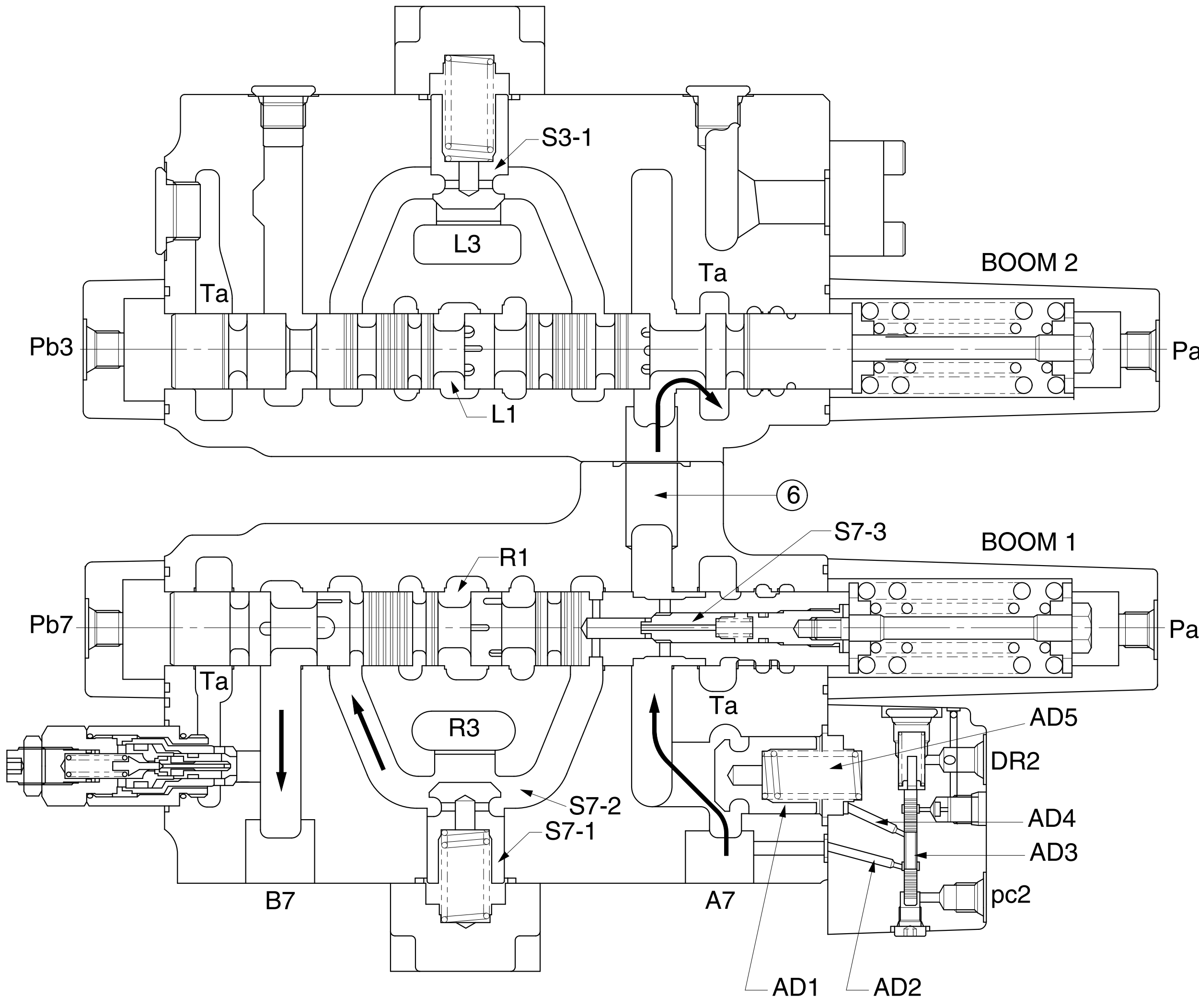


48092MC10

(3) Boom down (recycling)

When the boom 1 spool is pushed to the right by the pilot pressure of port Pb7, the neutral passage (R1) is closed, the oil discharged from pump P2 flows into the port B7 via parallel passage (R3) and the load check valve (S7-1). At the same time, as the port pc2 is pressurizing, the spool (AD3) of anti-drift valve is pushed up, the pressure of spring chamber (AD5) is released and the poppet (AD1) is opened and then the oil from port A7 flows into the tank passage (Ta). Some of returned oil makes the poppet (S7-3) inside boom 1 spool to open and is connected to the passage (S7-2) and flows together into the port B7.

This prevents the cavitation of cylinder rod side.



48092MC11

4) SERVICE SPOOL

When the service spool is pushed to the left by the pilot pressure of port Pb4, the neutral passage (L1) is closed, the oil discharged from pump P1 flows into the port B4 via parallel passage (L3), the load check valve (S4-1) and passage (S4-2).

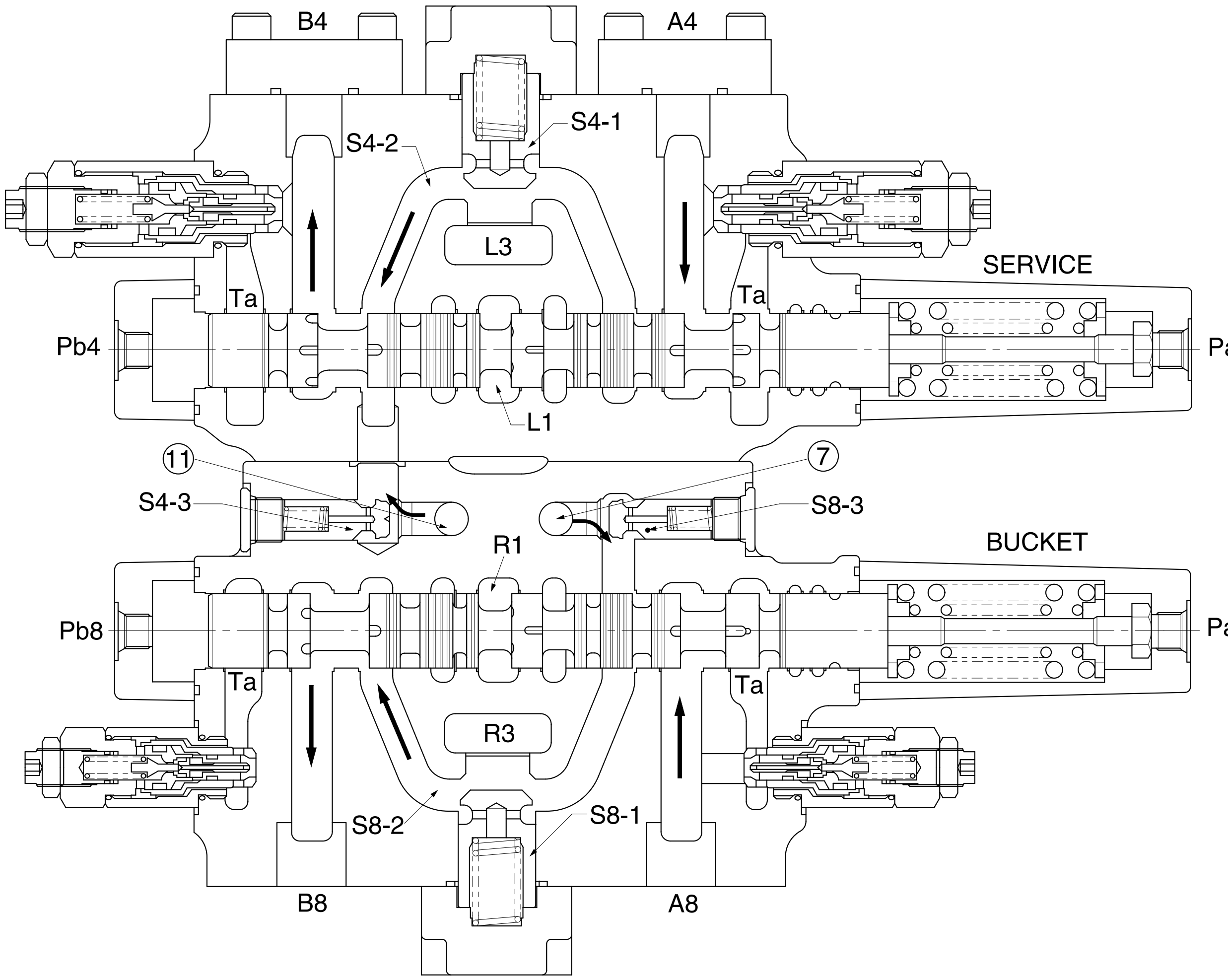
At the same time, as the port pa10 (see 2-25 page) is pressurizing and the bypass cut spool (R) is pushed, the oil discharged from pump P2 flows together into the port B7 via passage (11), poppet (S4-3). The oil returned from port A4 flows into the tank via the tank passage (Ta).

5) BUCKET SPOOL

When the bucket spool is pushed to the left by the pilot pressure of port Pb8, the neutral passage (R1) is closed, the oil discharged from pump P2 flows into the port B8 via parallel passage (R3), the load check valve (S8-1) and passage (S8-2).

At the same time, as the port pa11 is pressurizing and the bypass cut spool (R) is pushed, the oil discharged from pump P1 flows together the passage (S8-2) via passage (7), poppet (S8-3).

The return oil from port A8 flows into the tank via the tank passage (Ta).



48092MC12A

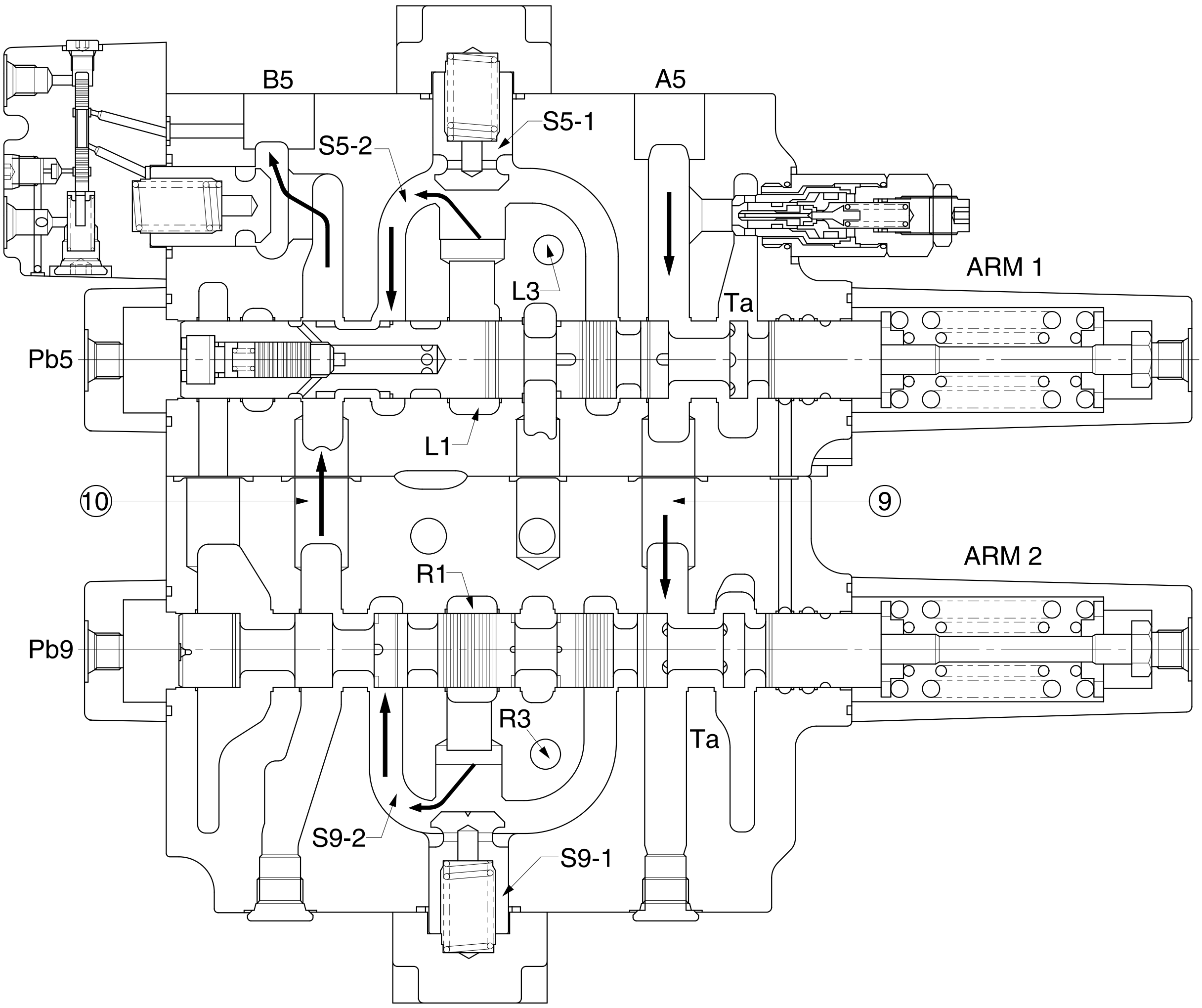
6) ARM SPOOL

(1) Arm out (flow summation)

When the arm 1 spool is pushed to the right by the pilot pressure of port Pb5, the oil discharged from pump P1 flows into the port B5 via neutral passage (L1), the load check valve (S5-1) and passage (S5-2).

When the arm 2 spool is pushed to the right by the pilot pressure of port Pb9, the oil discharged from pump P2 flows together the port B5 the passage (⑪) via the neutral passage (R1), the load check valve (S9-1) and passage (S9-2).

The return oil from port A5 flows into the tank via the tank passage (Ta).



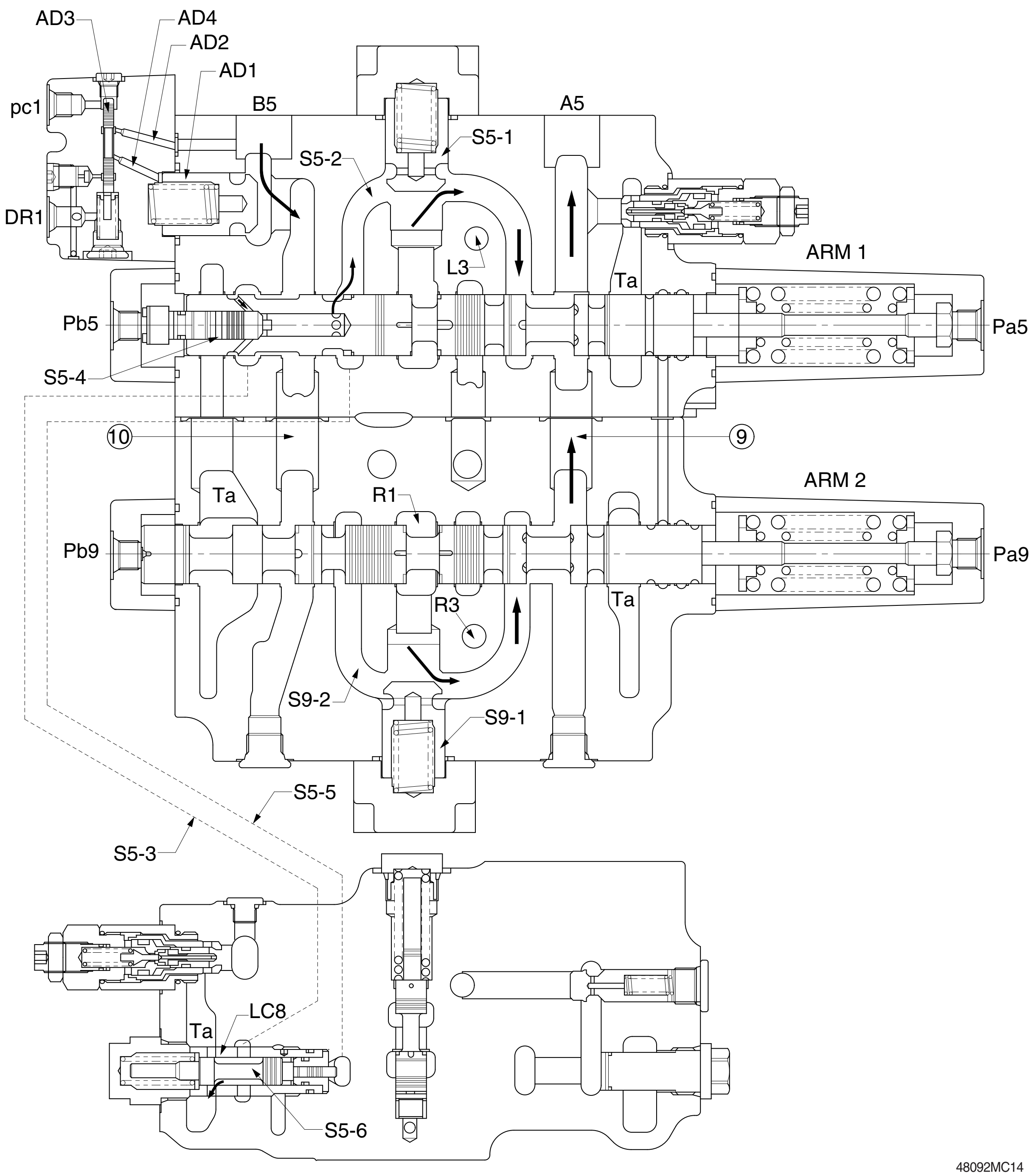
48092MC13

(2) Arm in (flow summation)

When the arm 1 spool is pushed to the left by the pilot pressure of port Pa5, the oil discharged from pump P1 flow into the port A5 via neutral passage (L1), the load check valve (S5-1) and passage (S5-2).

When the arm 2 spool is pushed to the left by the pilot pressure of port Pa9, the oil discharged from pump P2 flows together into the port A5 via neutral passage (R1), the load check valve (S9-1) and passage (S9-2).

At the same time, as the port pc1 is pressurizing and the spool (AD3) of anti-drift valve is pushed down, the pressure of spring chamber (AD5) is released and the poppet (AD1) is opened and then the oil returned from port B5 flows into the tank passage (Ta) through the passage (S5-4) inside arm 1 spool to open and is connected to the passage (S5-2) and flows together into the port A5, the cylinder speed is raised and also is prevents the cavitation of bottom side.

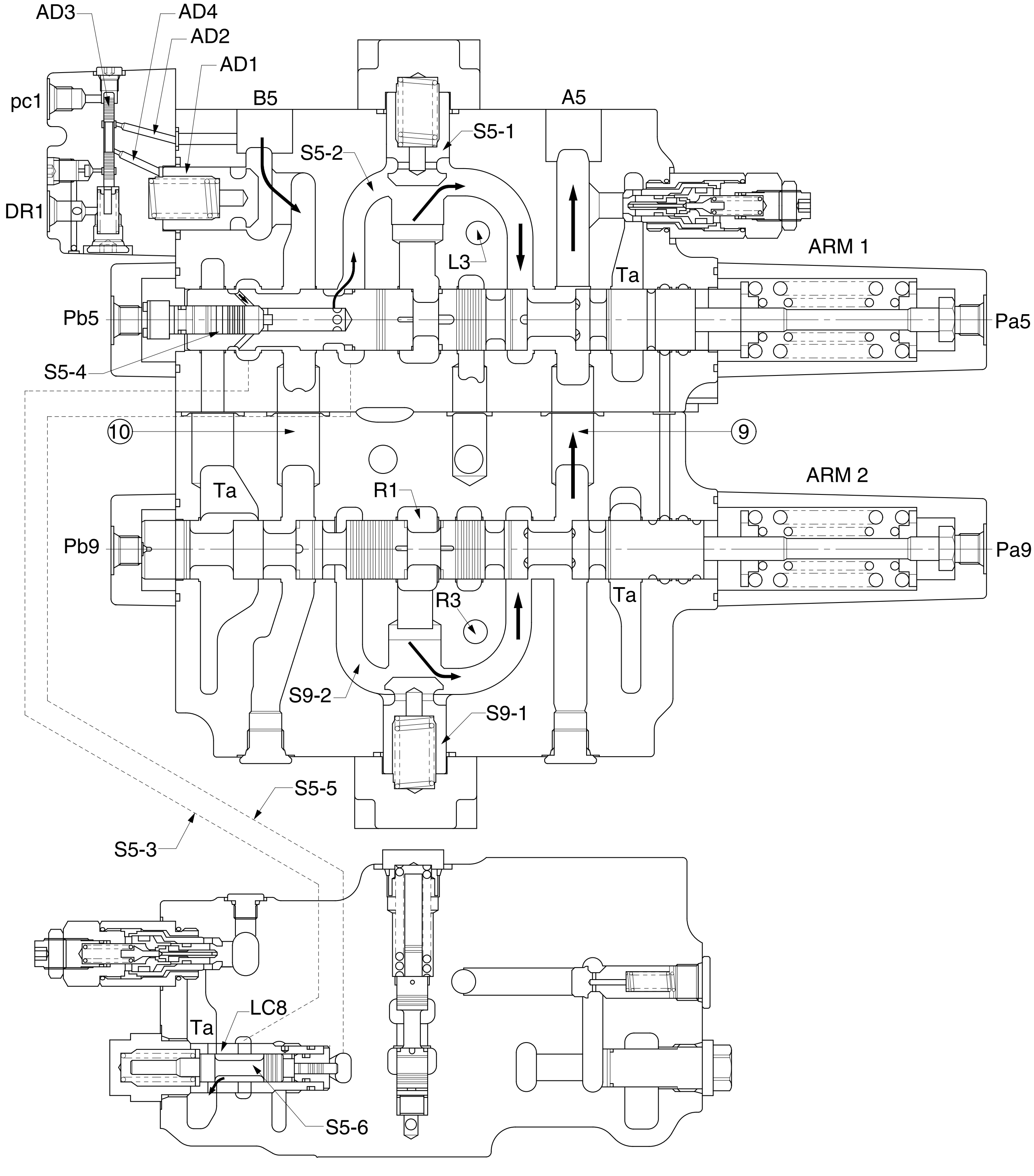


(3) Arm recycling (arm in)

When the arm is at in position, the spool (S5-6) stroke against the passage (S5-2) pressure guided from the passage (S5-5) is changed according to the opening angle of arm recycling orifice (Lc8).

When the pressure of the passage (S5-2) is high and this stroke is increased, the opening angle of orifice (Lc8) become large. On the contrary, when the pressure of passage (S5-2) is low, this stroke is decreased, the opening angle of orifice (Lc8) become small.

Therefore, the flow rate for arm recycling is changed by the pressure in bottom side of arm cylinder.



7) BYPASS CUT SPOOL

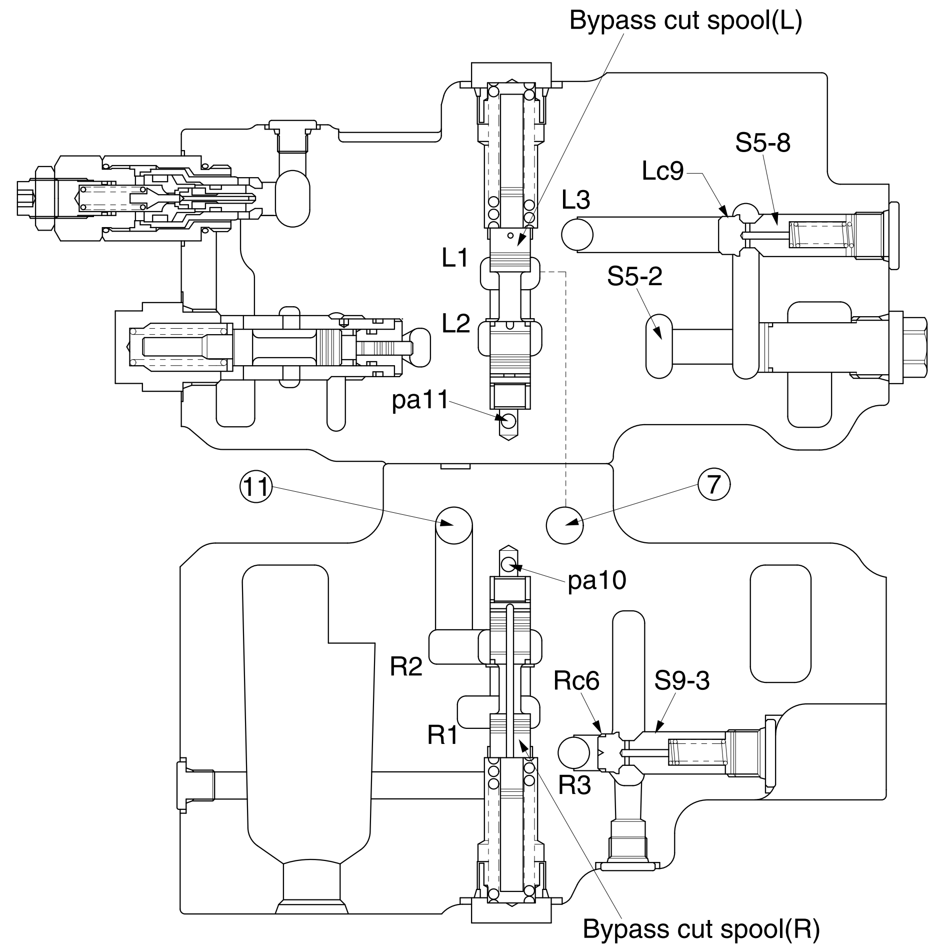
This valve is providing the bypass cut spool at the lowest stream of (upper stream of the low pressure relief valve) the neutral passage (L1, R1).

As the port pa10 (pa11) is pressurizing and the bypass cut spool (L, R) is pushed, the neutral passage (L1, R1) is closed. The oil discharged from port P1 flows together into the passage (S8-2, see 2-33 page) of bucket section via passage (⑦), poppet (S8-3) and the oil discharged from P2 port flows together into the passage (S4-2) of service section via the passage (⑪) and poppet (S4-3, see 2-33 page).

8) PARALLEL ORIFICE FOR ARM

The arm 1 and arm 2 section of this valve has orifices in the parallel circuit for arm. These orifices controls the speed of arm at combined operation.

The parallel circuit of arm 2 section is connected to the passage (S9-2, see 2-35) through orifice (Rc6) in the edge of the poppet (S9-3) from the parallel passage (R3), the parallel circuit of arm 1 section is connected to the passage (S5-2, see 2-35) through orifice (Lc9) in the edge of the poppet (S5-8) from the parallel passage (L3).



48092MC15

9) RELIEF VALVE

(1) Main relief valve

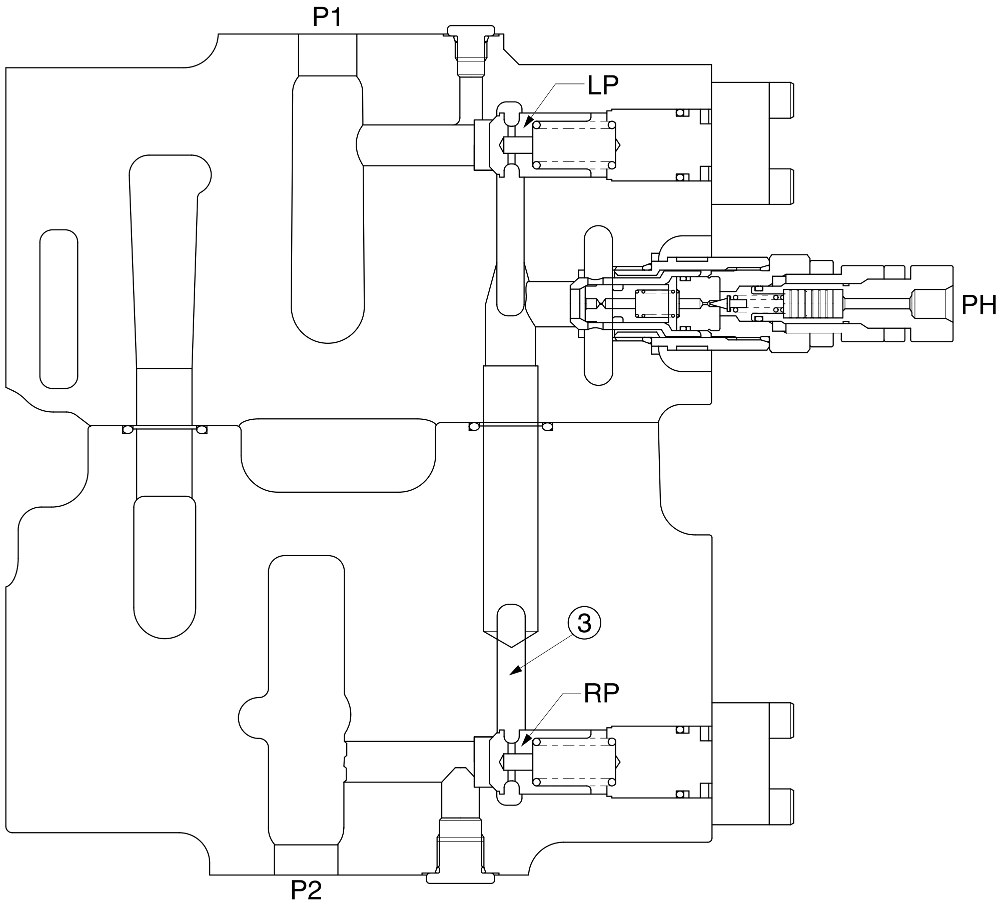
The oil discharged from P1 port via the poppet (LP) and the oil discharged from P2 port via the poppet (RP) flow into the main relief valve through the passage (3).

When the main relief valve is operating, the maximum pressure of pump P1, P2 is controlled.

(2) Overload relief valve

Overload relief valves are provided each cylinder ports of boom1, arm1 and bucket. These prevents the abnormal high pressure of actuators by external force.

Also, when the pressure of cylinder ports create back pressure, this valve opens allowing oil from tank to cylinder port; and then prevents cavitation.

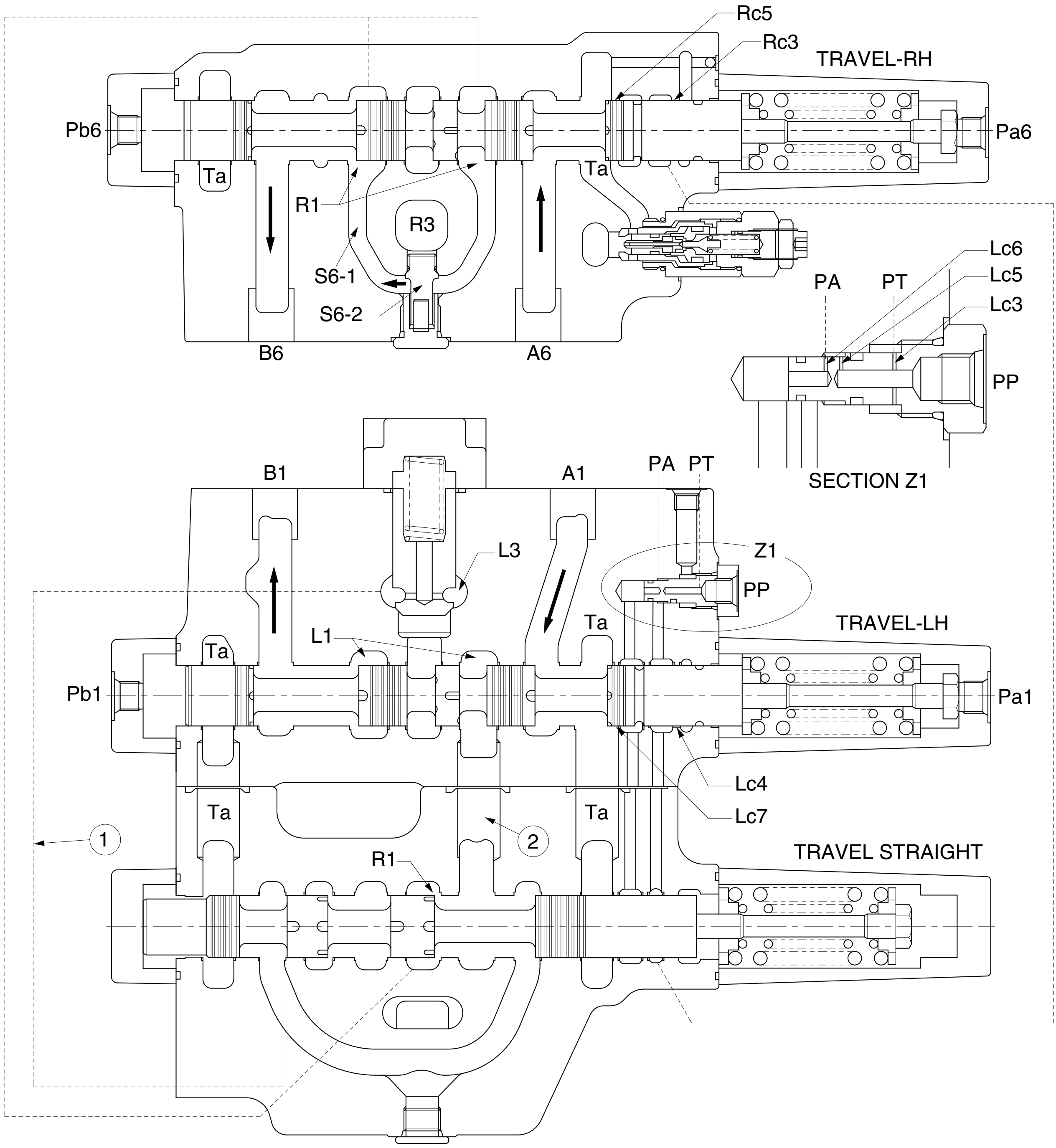


48092MC16

4. COMBINED OPERATION

1) TRAVEL COMBINED OPERATION

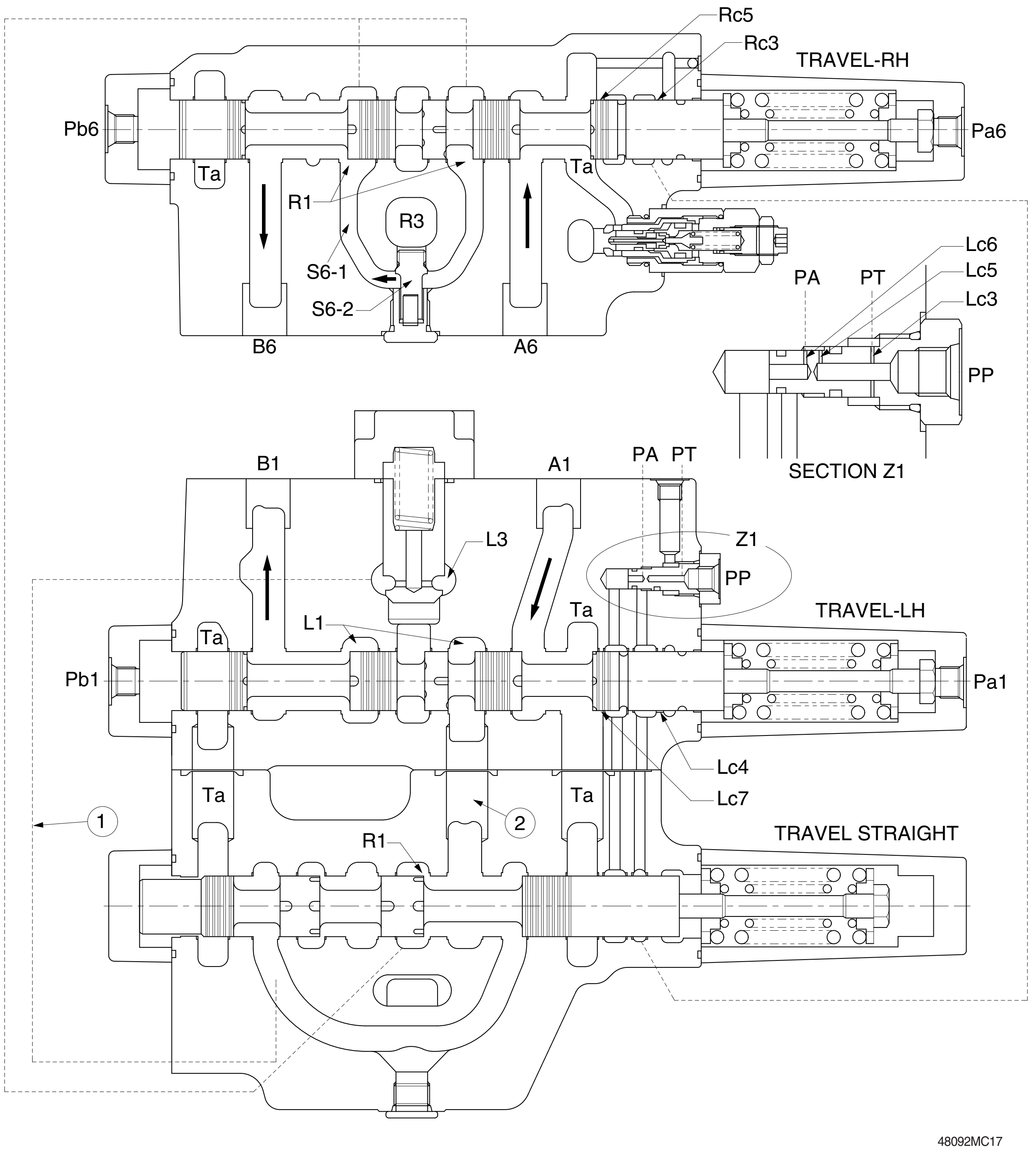
① While travel (forward, reverse and pivot turn) and front attachment (except travel section) functions are operated, the oil discharged from port PP is cut via land (Lc4, Lc7, Rc3, Rc5) and blocked from signal land except travel section to tank passage (Ta), the pressure of signal passage rises to the relief setting pressure of pilot pump and the straight travel spool is pushed to the left by raising of signal pressure and also, the pressure of port PT, PA port rises.



48092MC17

② When the straight travel spool is operated, the oil discharged from port P1 flows into RH travel section through the neutral passage (L1) and also flows into LH travel section via the neutral passage (R1) and passage (②). The oil discharged from port P2 flows into the parallel passage (L3) via passage (①).

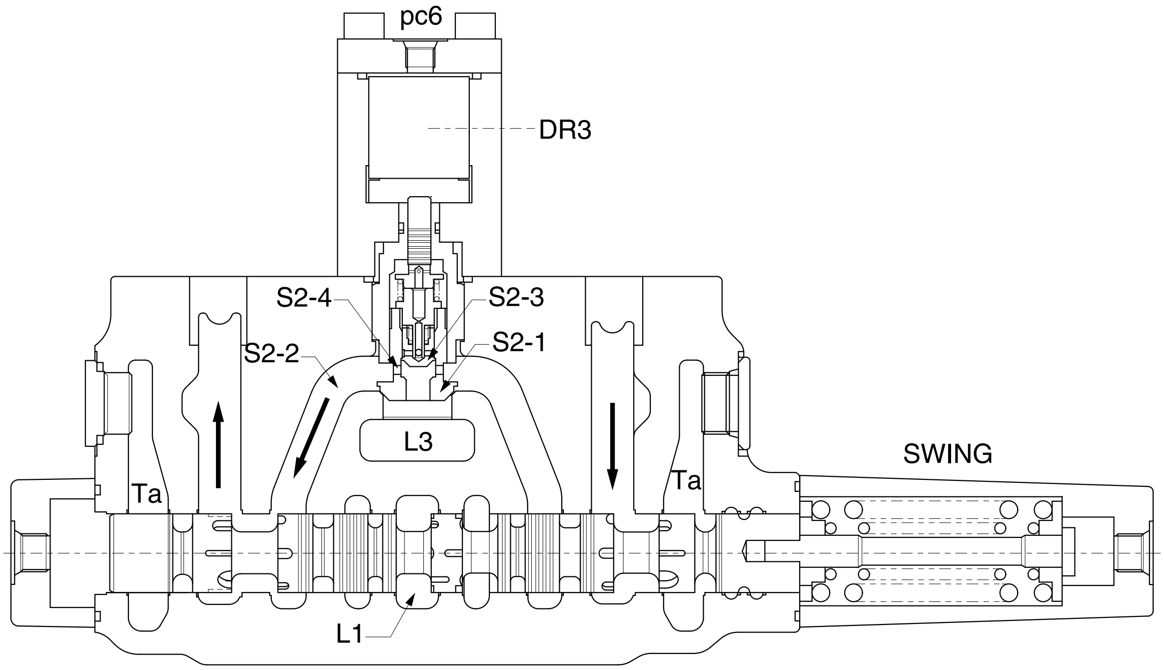
③ In case the load pressure of the section except travel is higher than that of the RH travel section, the partial oil of discharged from port P2 pushes open the poppet (S6-2) and flows together into the passage (S6-1) through the orifice at the edge of poppet. The travel (LH, RH) is operated by the discharged oil from port P1 and the other actuators are operated by the discharged oil from port P2. Thus, when travel and front attachment functions are operated simultaneously, keeps the straight travel.



2) SWING COMBINED OPERATION

When swing and boom up functions are operated, the poppet (S2-1) is seated by pressure of port pc6 and the poppet (S2-3) only opened and the supply pressure of the parallel passage (L3) is rises by orifice (S2-4).

As a result, boom and swing simultaneous operation is ensured even if lower load of swing section.



48092MC18

5. ANTI-DRIFT VALVE

The anti-drift valve is provided the boom bottom and arm rod side of cylinder port for prevention of self drifting by boom weight or bucket loads.

1) WHEN NEUTRAL

The oil from cylinder port flows into spring chamber (AD5) via passage (AD2), the around of spool (AD3) and passage (AD4).

Because of the difference of poppet area and spring force, the poppet (AD1) is seated certainly.

2) WHEN BOOM UP OR ARM OUT

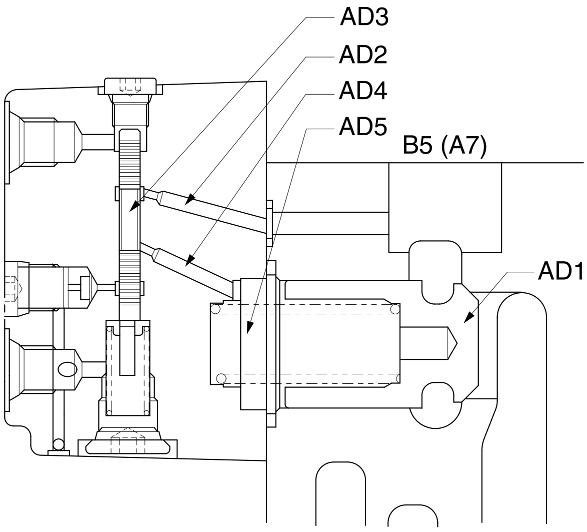
The oil from pump flows into cylinder by pushes open the poppet (AD1).

3) WHEN BOOM DOWN OR ARM IN

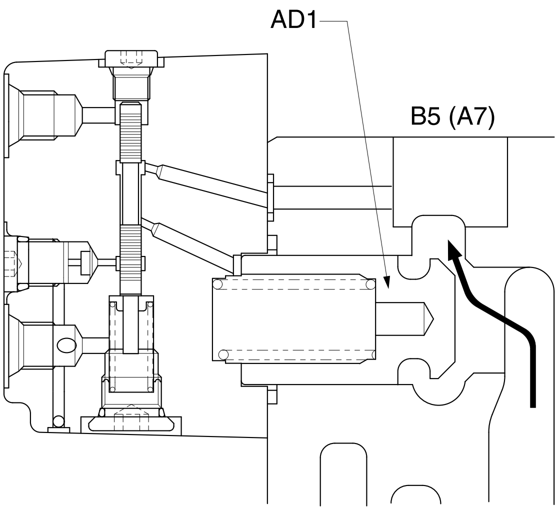
The spool (AD3) is pushed down by the pressure of pc1 (pc2).

Then the oil of spring chamber (AD5) flows into the drain port DR1 (DR2) and pushes open the poppet (AD1).

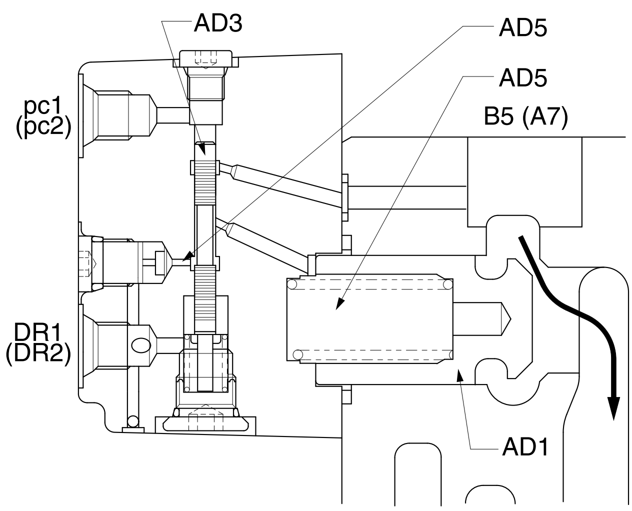
As a result, the oil from the cylinder port returns to tank passage (Ta).



NEUTRAL



ARM OUT
(BOOM UP)



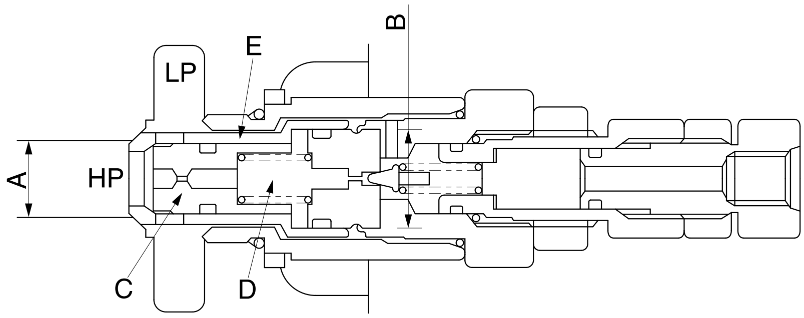
ARM IN
(BOOM DOWN)

48092MC19

6. RELIEF VALVE OPERATION

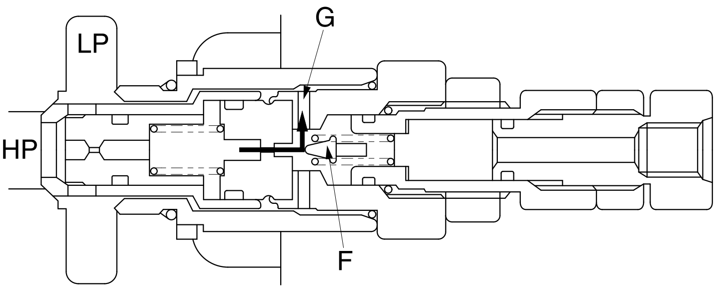
1) MAIN RELIEF VALVE

(1) This relief valve is built-in between the neutral passage (HP) and low pressure passage (LP), and the pressure oil fills up chamber (D) inside via orifice of main poppet (C).
Thus the sleeve (E) and the main poppet (C) are securely seated by difference area of A an B.



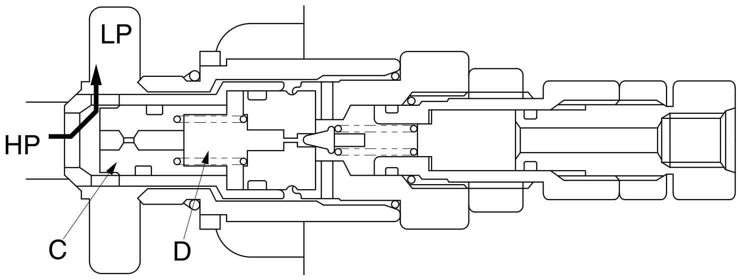
48092MC20

(2) When the pressure in neutral passage(HP) reaches the setting force of spring, pilot poppet(F) is opened.
The oil flows around poppet and into the low pressure passage(LP) via hole(G).



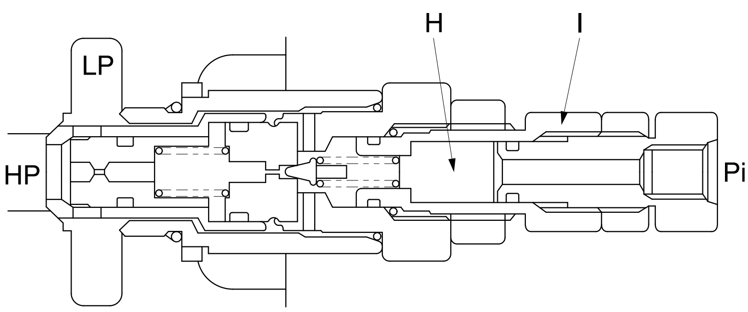
48092MC21

(3) When above flow is formed, the pilot poppet is opened; the pressure of chamber(D) drops, the main poppet(C) is opened and then the oil directly flows into the low pressure passage(LP).



48092MC22

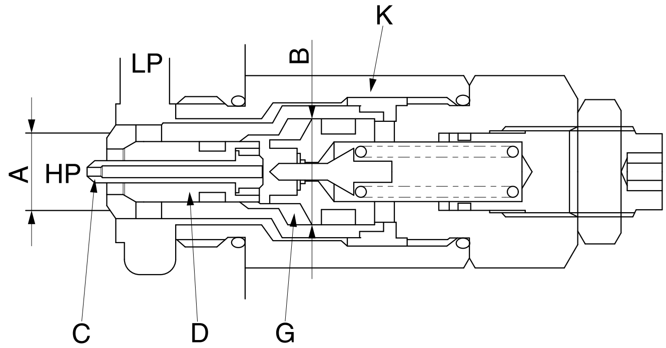
(4) High pressure setting pilot signal(Pi) : ON
The piston(H) moves to left by pilot pressure(Pi); set pressure of spring rises, making high pressure setting.



48092MC23

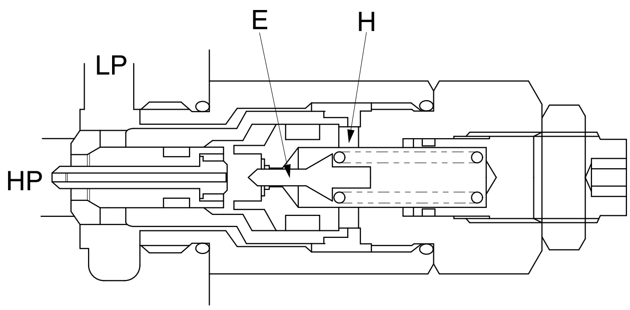
2) OVERLOAD RELIEF VALVE

(1) This relief valve is built-in the cylinder port (HP) and the low pressure (LP), and the pressure oil fills up chamber (G) inside via hole of piston (C).
Thus the sleeve (K) and the main poppet (D) are securely seated by difference area of A and B.



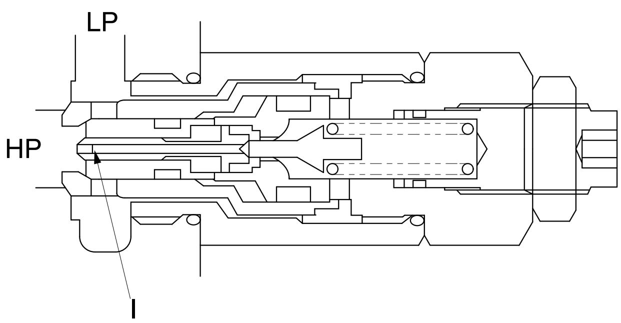
48092MC24

(2) When the pressure in cylinder port (HP) reaches the setting force of spring, the pilot poppet (E) is opened.
The oil flows around poppet and into the low pressure passage (LP) via hole (H).



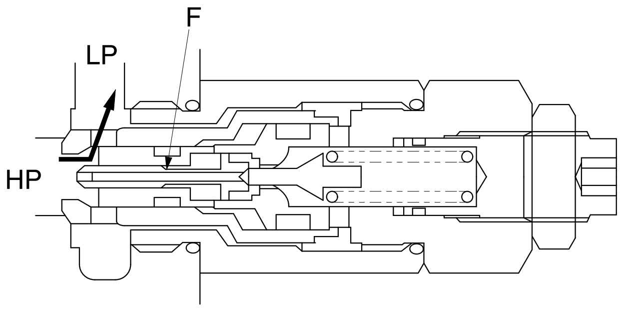
48092MC25

(3) When above flow is formed, the pilot poppet (E) is opened.
The pressure drops before and behind orifice (I); piston (C) moves to right and the piston (C) is seated at the tip of poppet (E).



48092MC26

(4) The oil flow from the high pressure passage (HP) to the poppet (D) behind is only around poppet and orifice (F); then the high pressure passage (HP) is higher than the poppet (D) behind pressure. Thus the poppet (D) is pushed open and the oil directly flows into low pressure passage(LP).

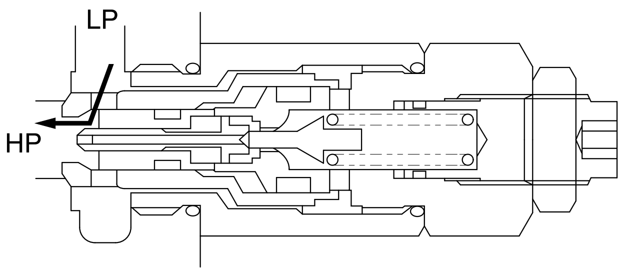


48092MC27

(5) Make up operation

This relief valve is built-in the cylinder port (HP) and the low pressure passage (LP), and the pressure oil fills up chamber (G) inside via hole of piston (C).

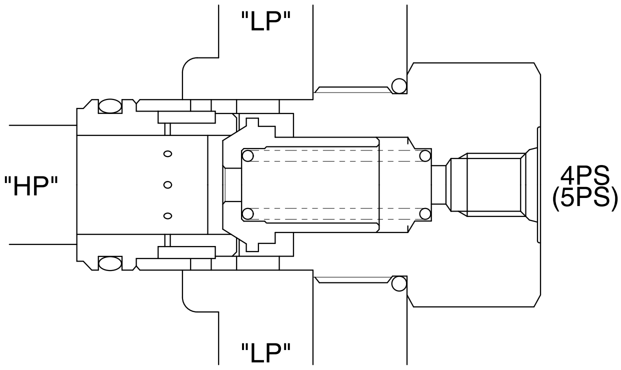
Thus the sleeve (K) and the main poppet (D) are securely seated by difference area of A and B.



48092MC28

3) LOW PRESSURE RELIEF VALVE

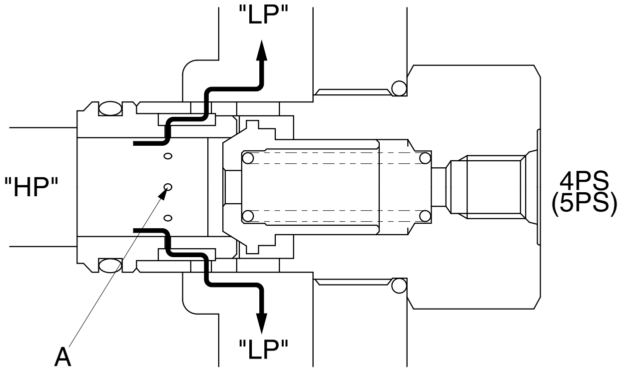
(1) When pump does not operational



48092MC29

(2) When spool neutral

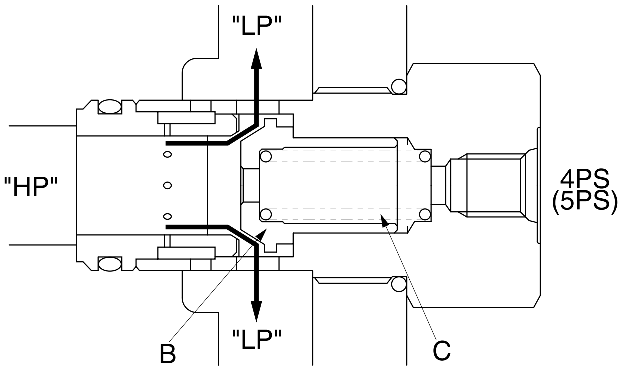
The neutral passage (HP) oil flows into the low pressure passage (LP) via signal orifice (S).
The signal port 4Ps (5Ps) pressure is raise by negative control orifice (A).



48092MC30

(3) Operation of low pressure relief

When the oil pressure neutral passage (HP) reaches the setting force of spring, the poppet is pushes open; the oil directly flows through passage (HP) to passage (LP) in order to prevent abnormal pressure.

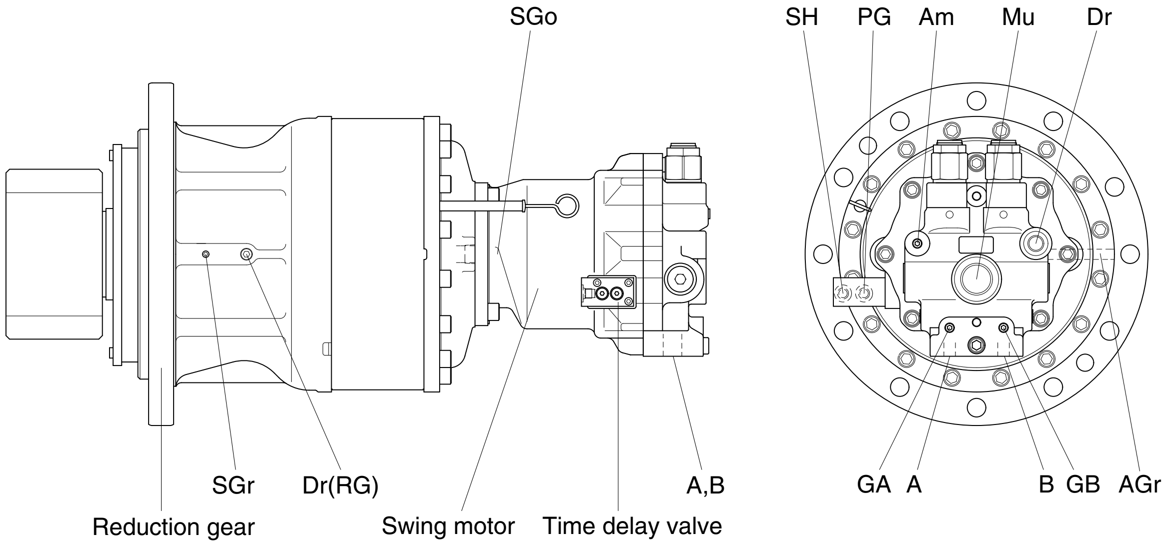


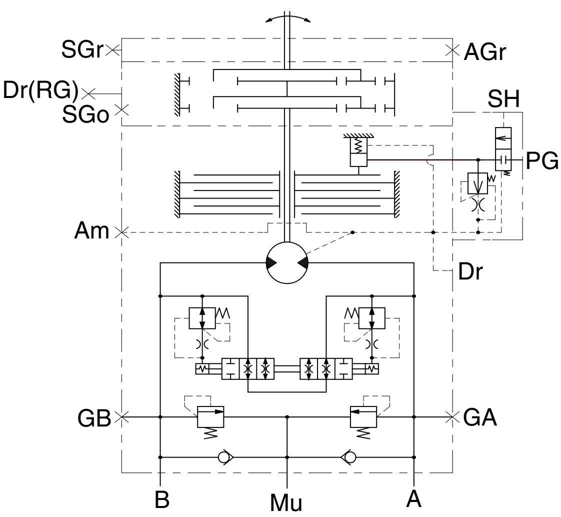
48092MC31

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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



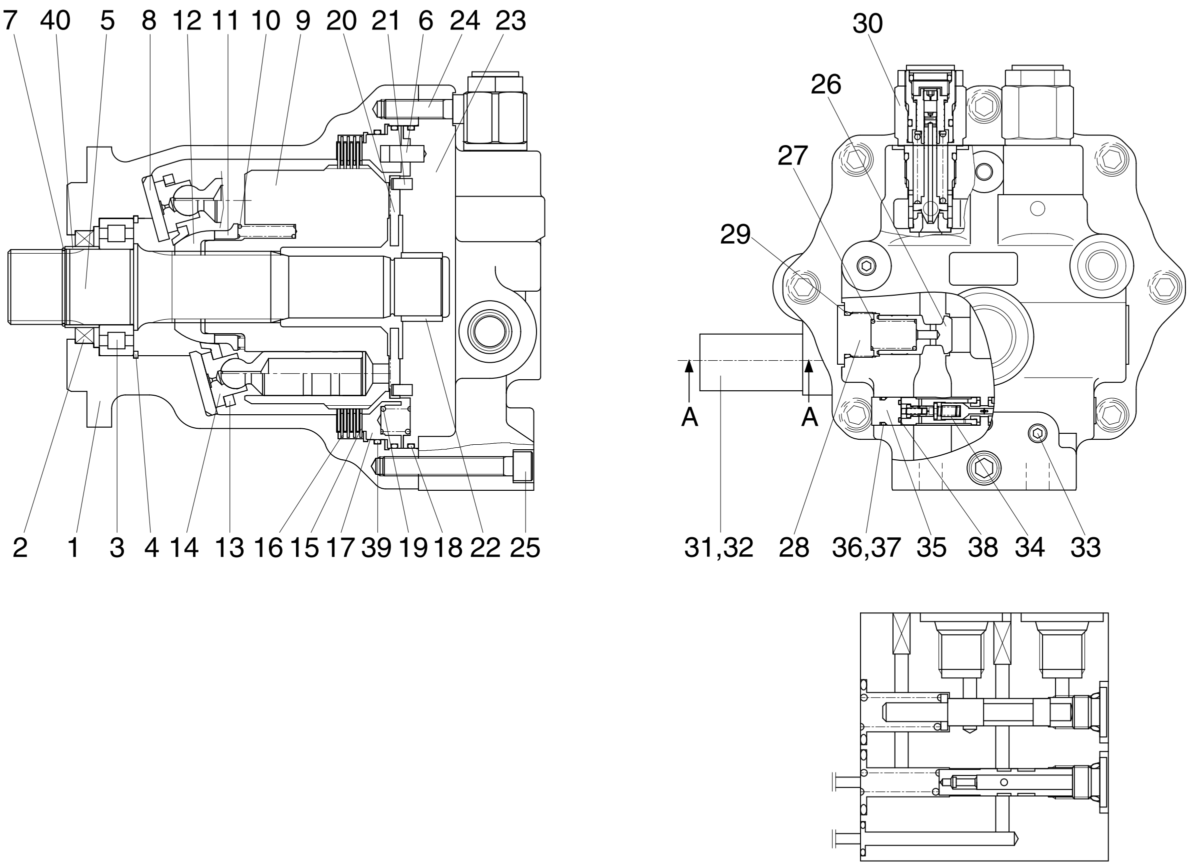


Hydraulic circuit

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

38092SM01A

1) SWING MOTOR

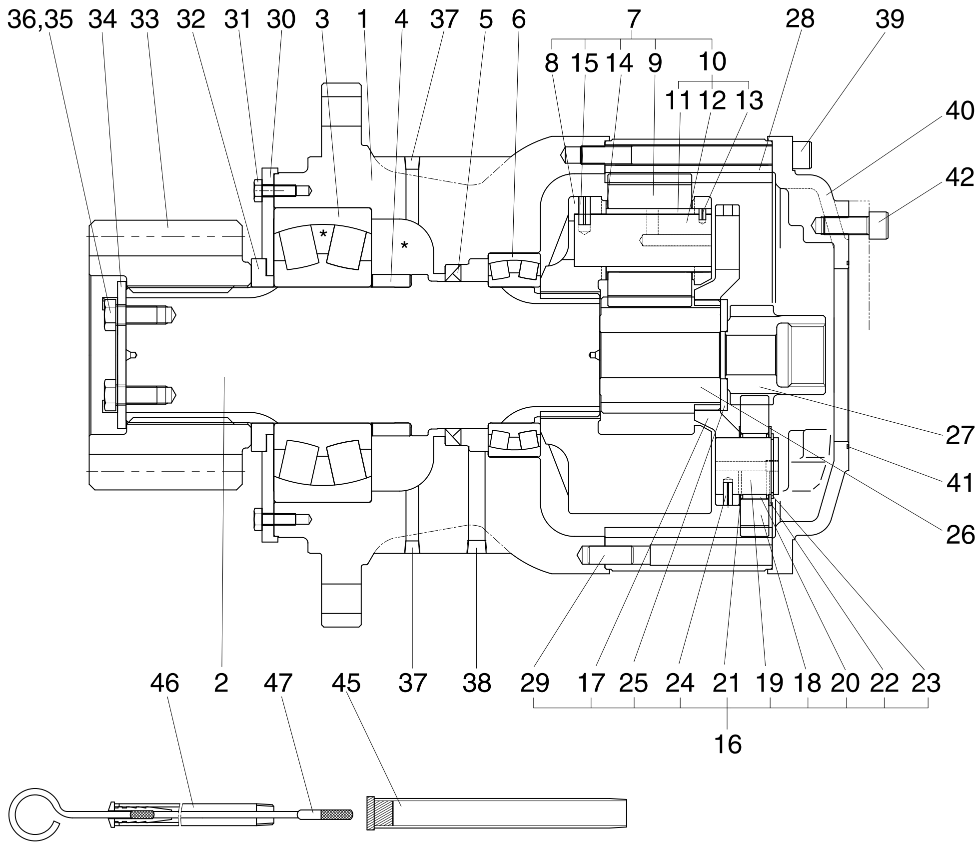


SECTION A-A

38092SM02

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

2) REDUCTION GEAR



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

2. FUNCTION

1) ROTARY PART

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

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

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

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

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

q : Displacement (cc/rev)

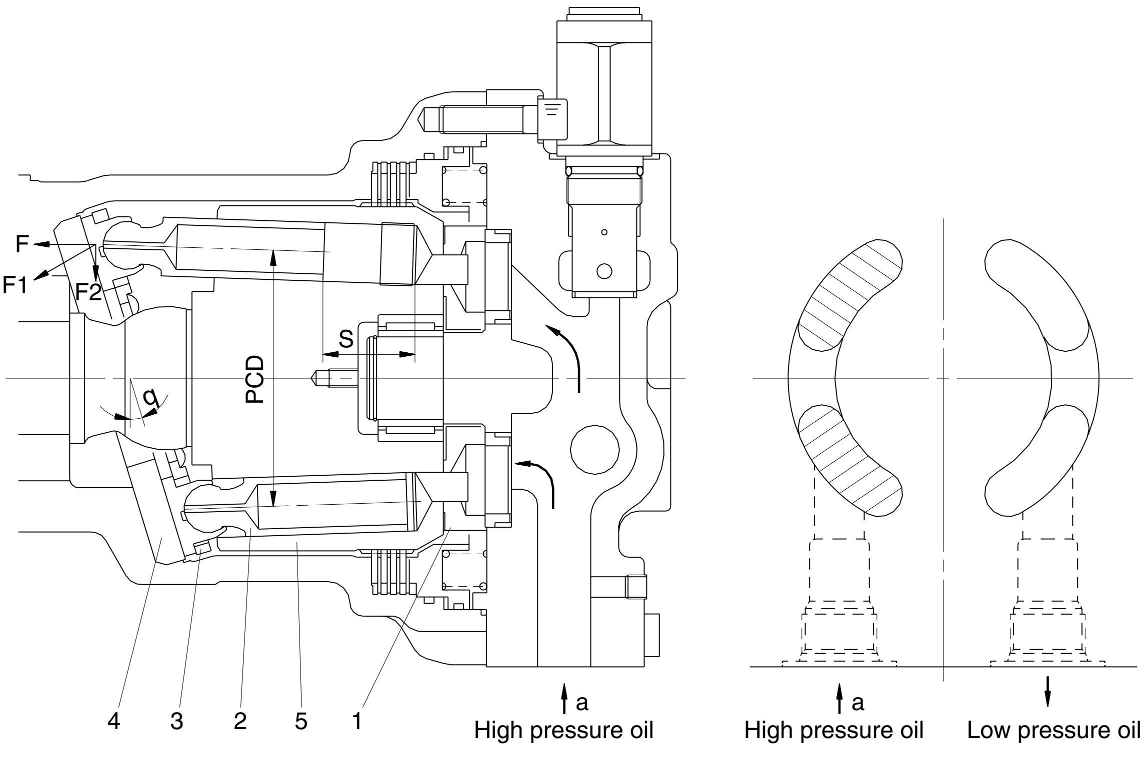
T : Output torque (kgf · cm)

Z : Piston number

A : Piston area (cm^2)

θ : Tilting angle of swash plate (degree)

S : Piston stroke (cm)



36072SM04A

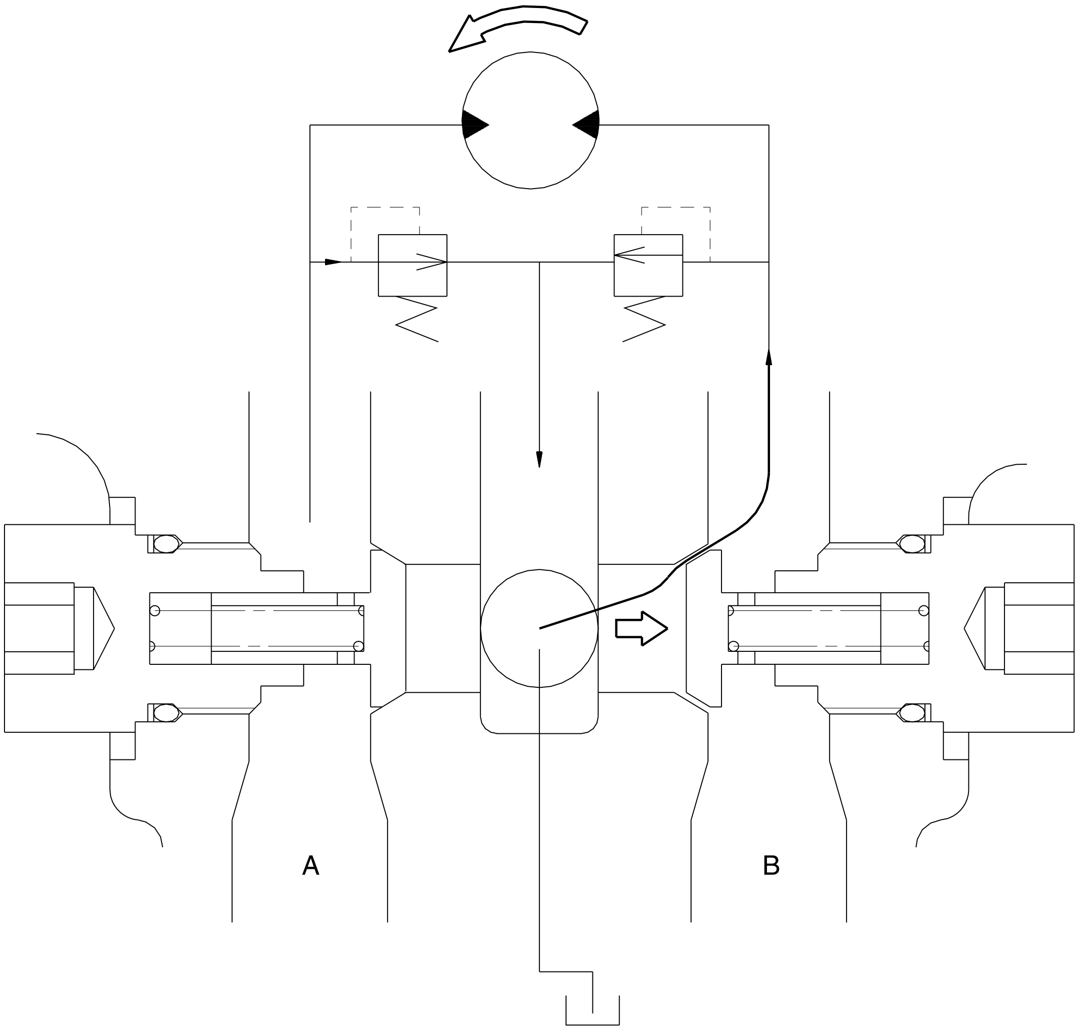
2) MAKE UP VALVE

In the system using this type of motor, there is no counter balance functioning valve and there happens the case of revolution exceeding hydraulic supply of motor. To prevent the cavitation caused by insufficient oil flow there is a make up valve to fill up the oil insufficiency.

A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

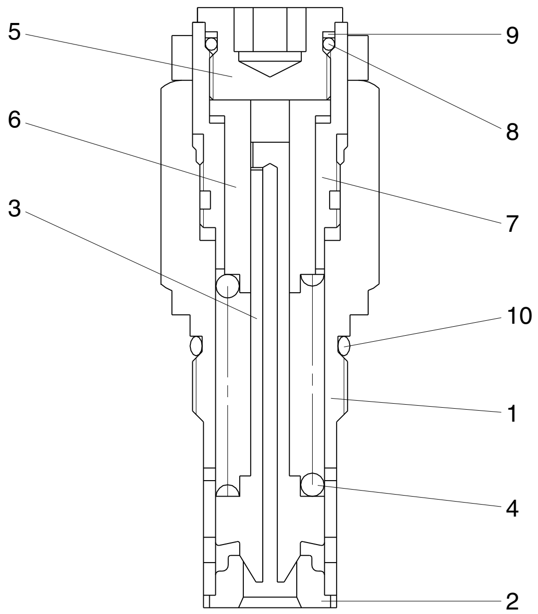
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, the drain oil from Mu port run into motor via right make up valve, which prevent the cavitation of motor.



36072SM05

3) RELIEF VALVE



36072SM06

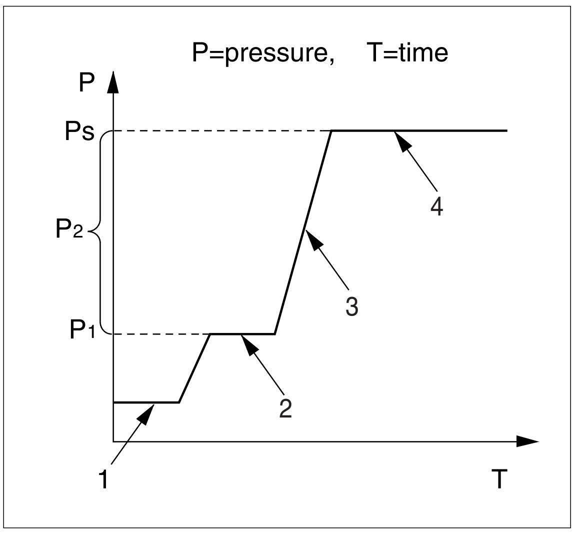
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Sleeve
8	O-ring
9	Back up ring
10	O-ring

(1) Construction of relief valve

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

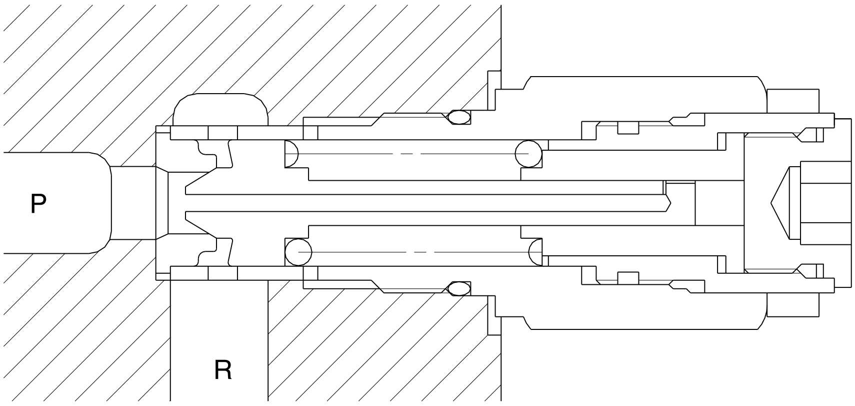
(2) Function of relief valve

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



2-51(2) [360-7]

① Ports (P, R) at tank pressure.

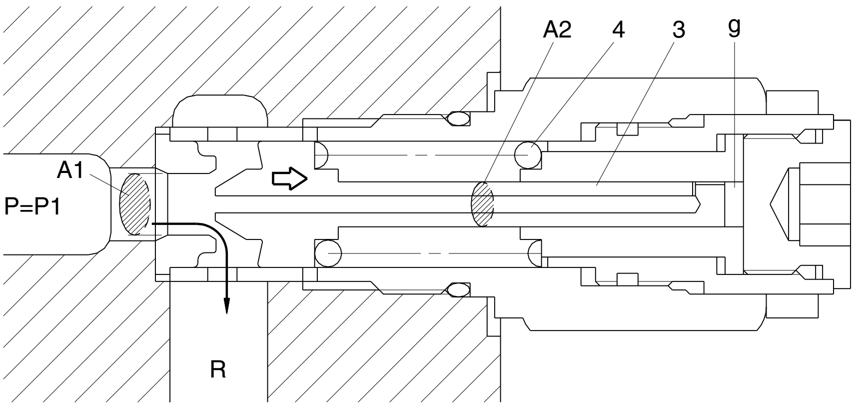


36072SM07

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

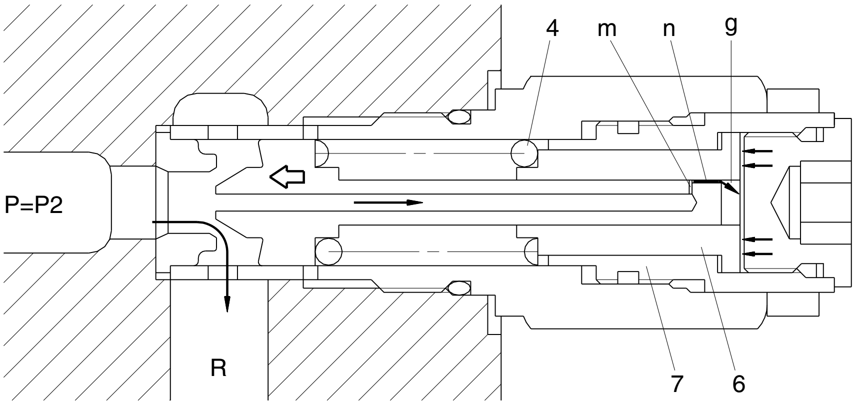
$P_1 \times A_1 = F_{SP} + P_g \times A_2$

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



36072SM08

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

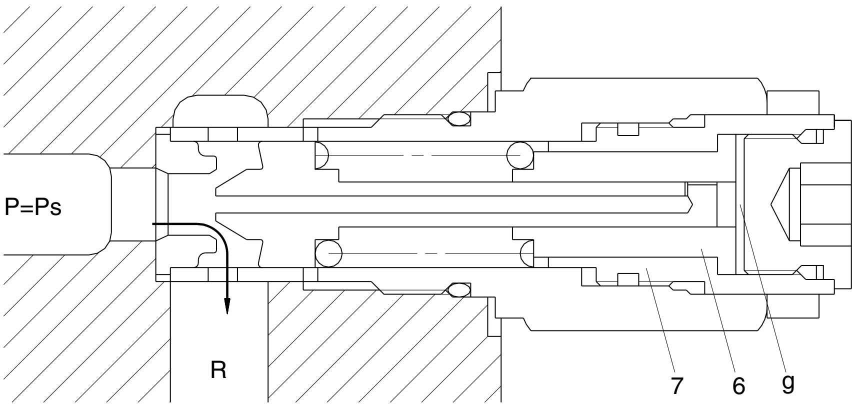


36072SM09

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

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

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



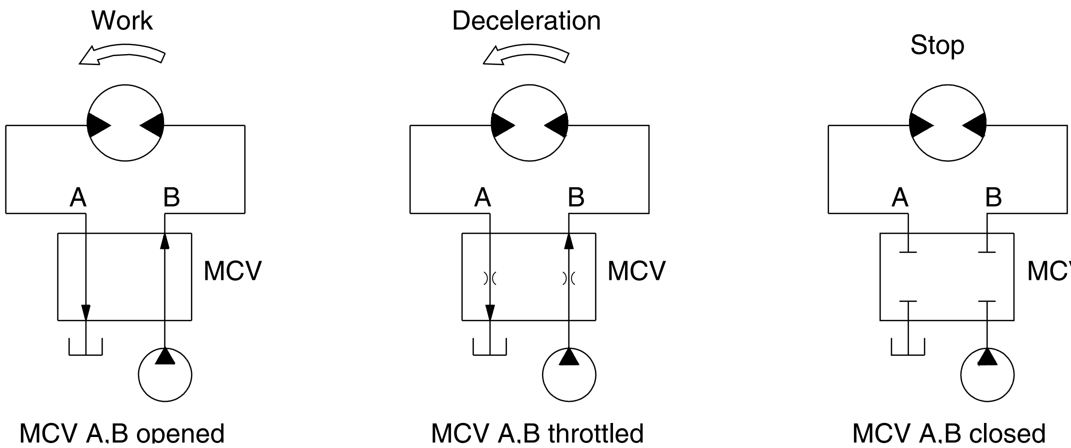
36072SM10

4) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



R130SM05

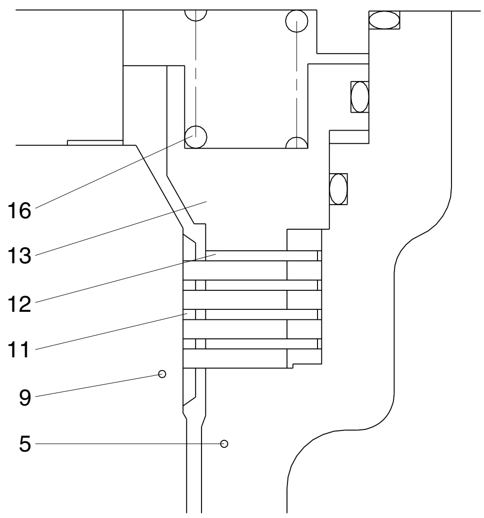
(2) Mechanical swing parking brake system

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

① Brake assembly

Circumferential rotation of separate plate (12) is constrained by the groove located at housing (5). When housing is pressed down by brake spring (16) through friction plate (11), separate plate (12) and brake piston (13), friction force occurs there.

Cylinder block (9) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

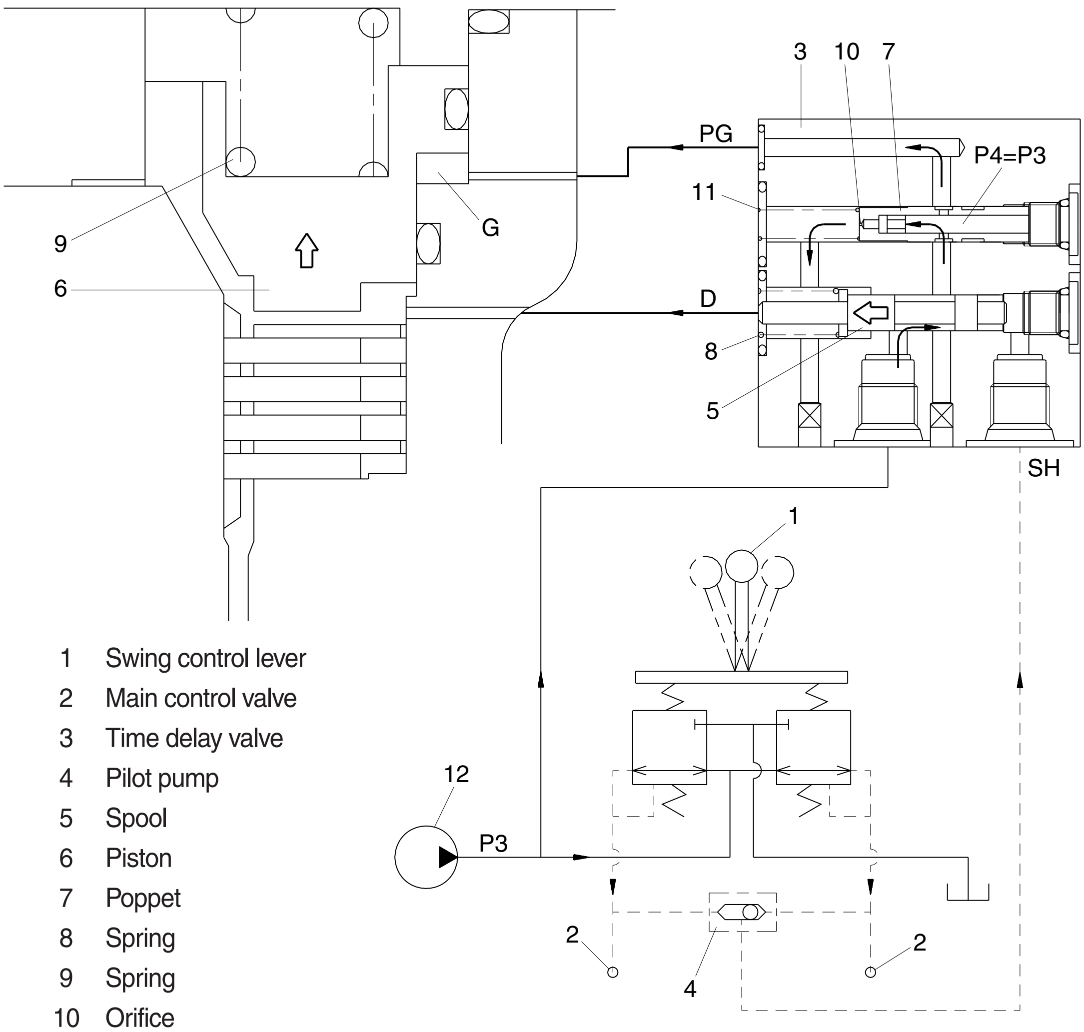


36072SM11

5	Housing	12	Separate plate
9	Cylinder block	13	Brake piston
11	Friction plate	16	Brake spring

② Operating principle

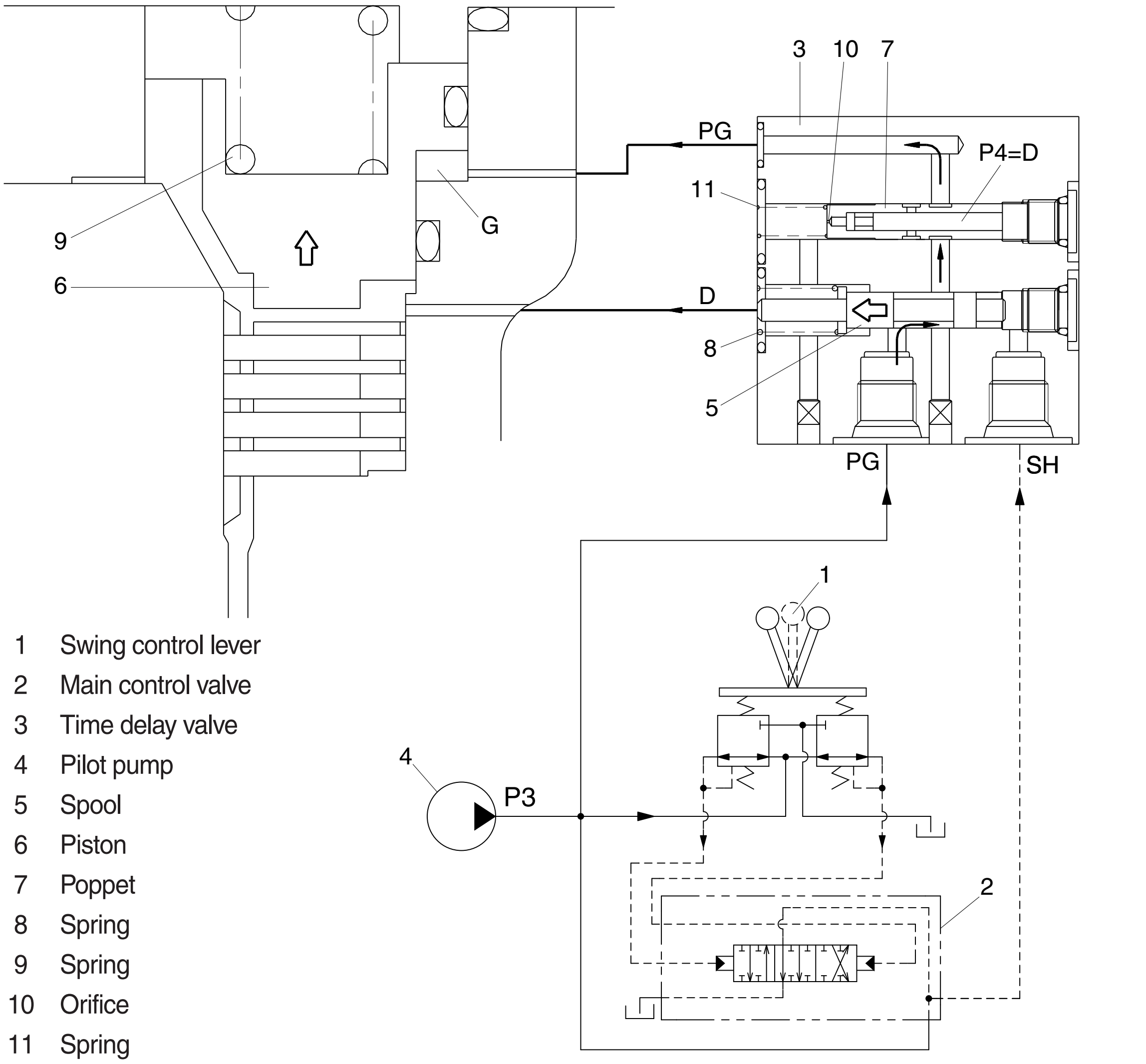
a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (3). This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged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



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

36072SM12

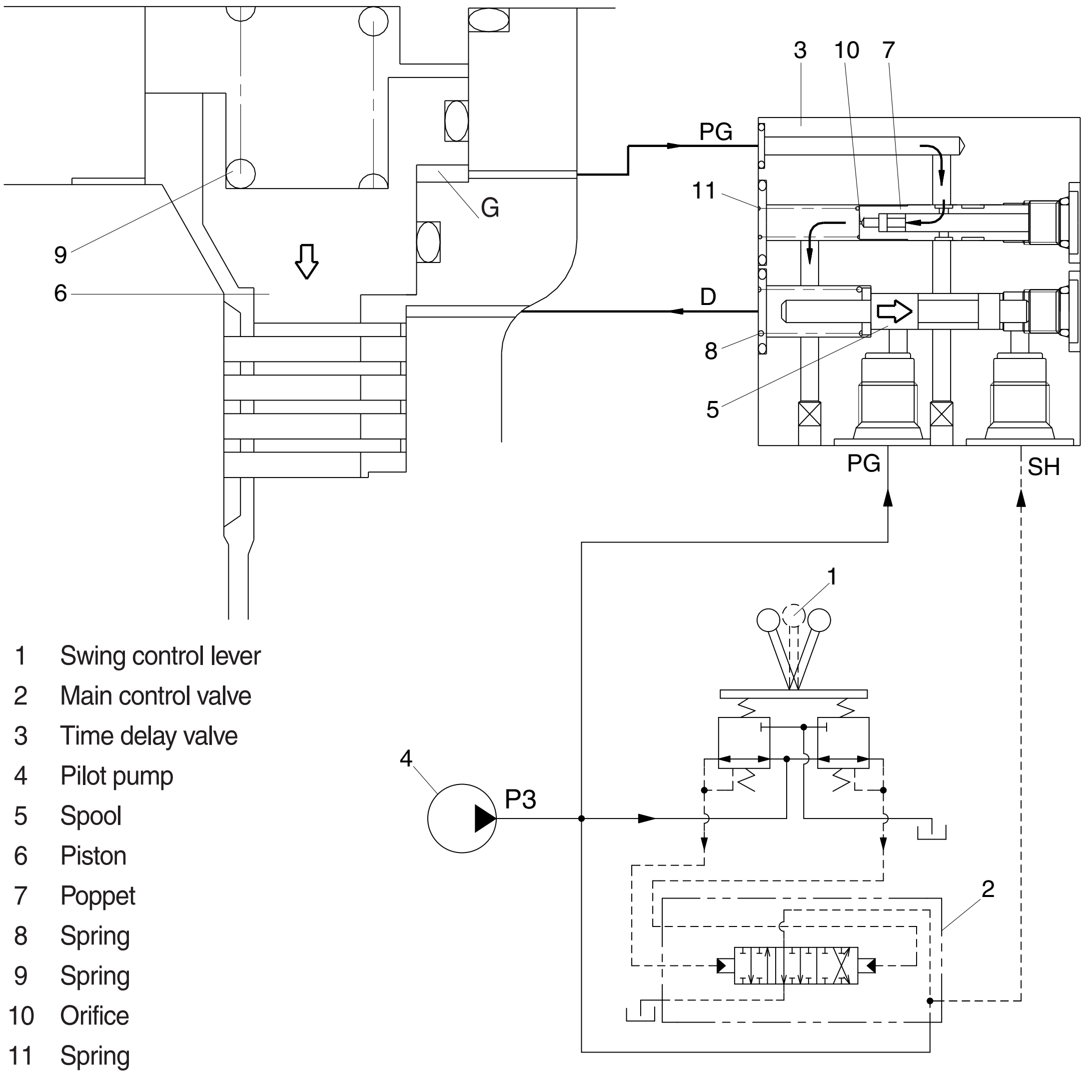
b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
   Then, the piston (6) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
   At this time, the brake works.



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

36072SM13A

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



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

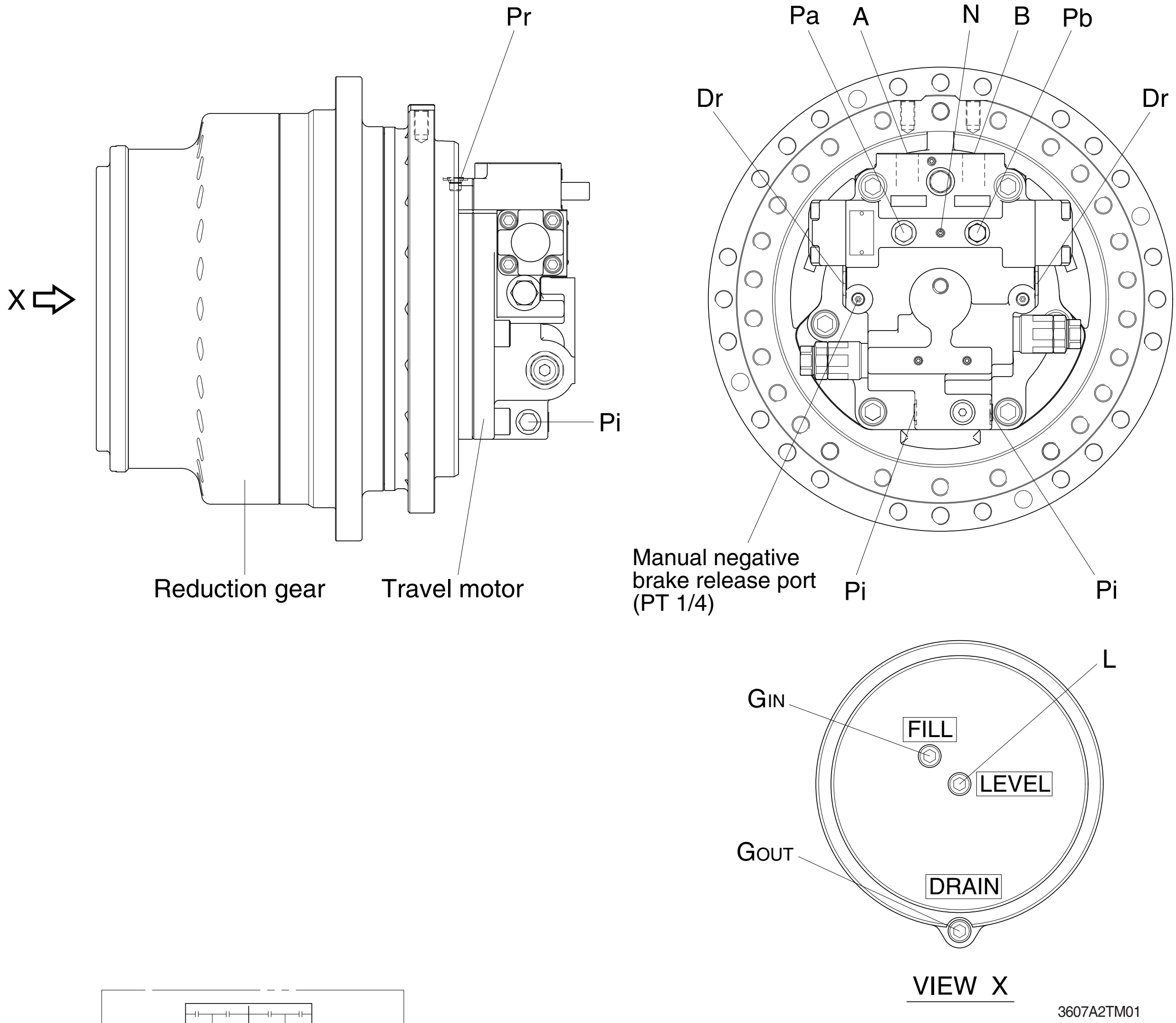
38092SM04

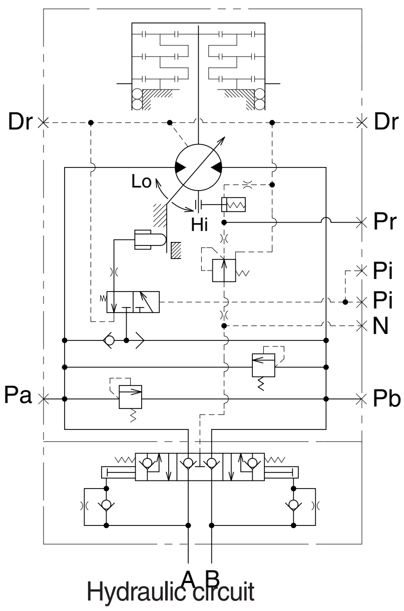
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION (TYPE 1)

Travel device consists travel motor and gear box.

Travel motor include counter balance valve, cross over relief valve.

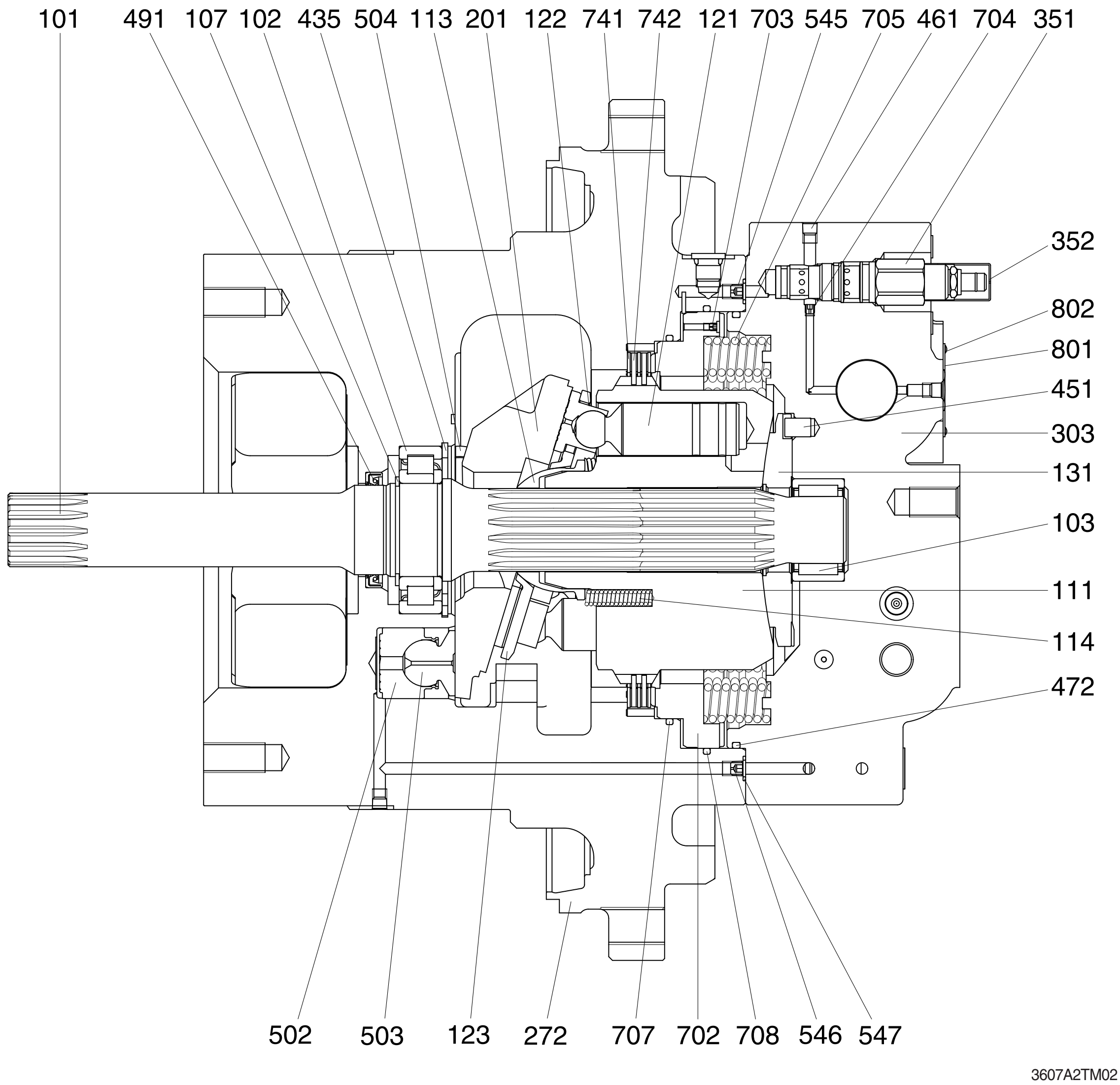




Hydraulic circuit

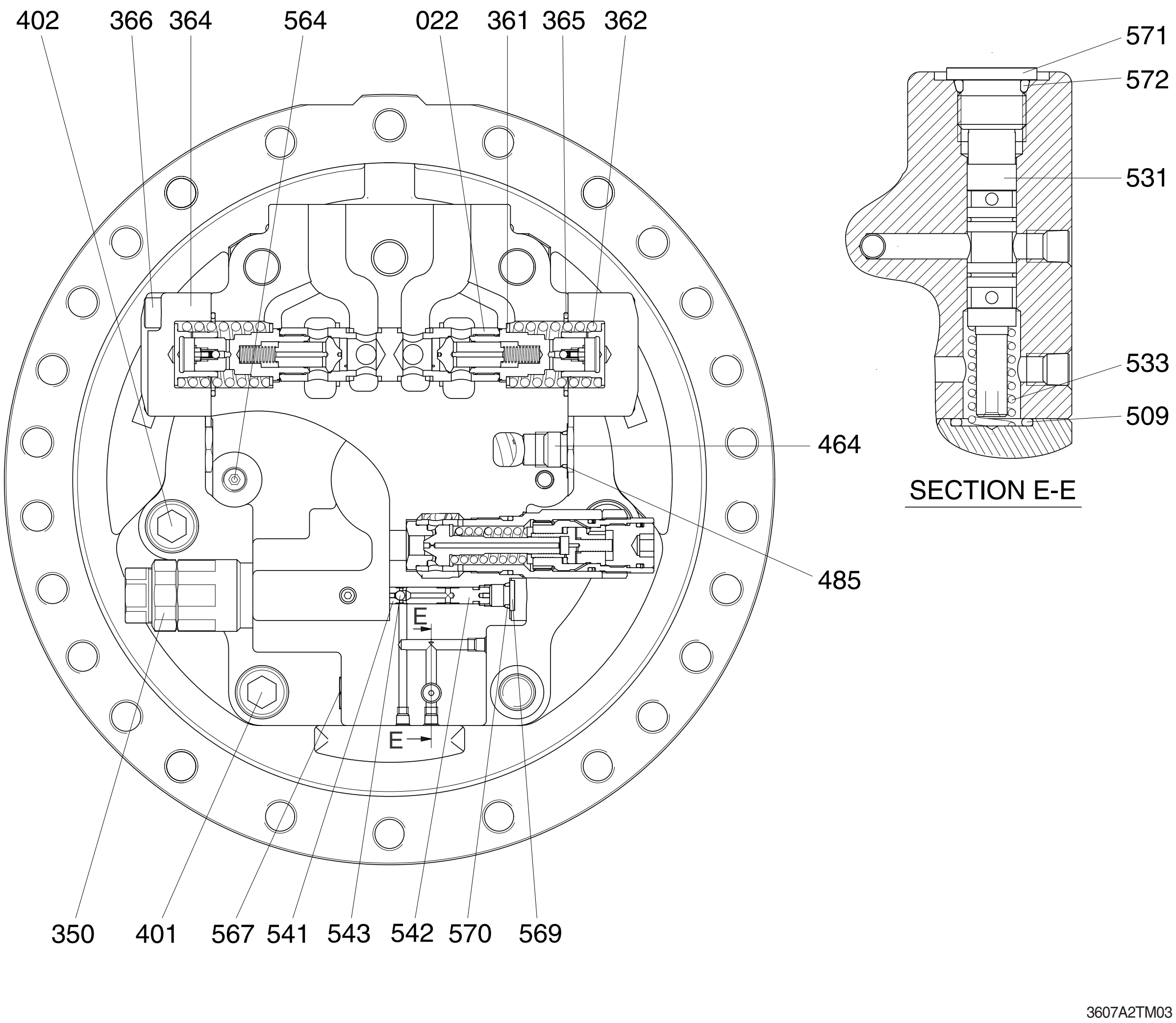
Port	Port name	Port size
A	Main port	SAE 6000 psi 1"
B	Main port	SAE 6000 psi 1"
Pi	Pilot port	PF 1/4
Dr	Drain port	PF 1/2
N	Negative brake release port	NPTF 1/16
Pa, Pb	Pressure gauge port	PF 1/4
Pr	Brake release pressure gauge port	PF 1/4
L	Level gauge	PF 1/2
GIN	Gear oil inlet port	PF 1/2
GOUT	Gear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

1) TRAVEL MOTOR (1/2)



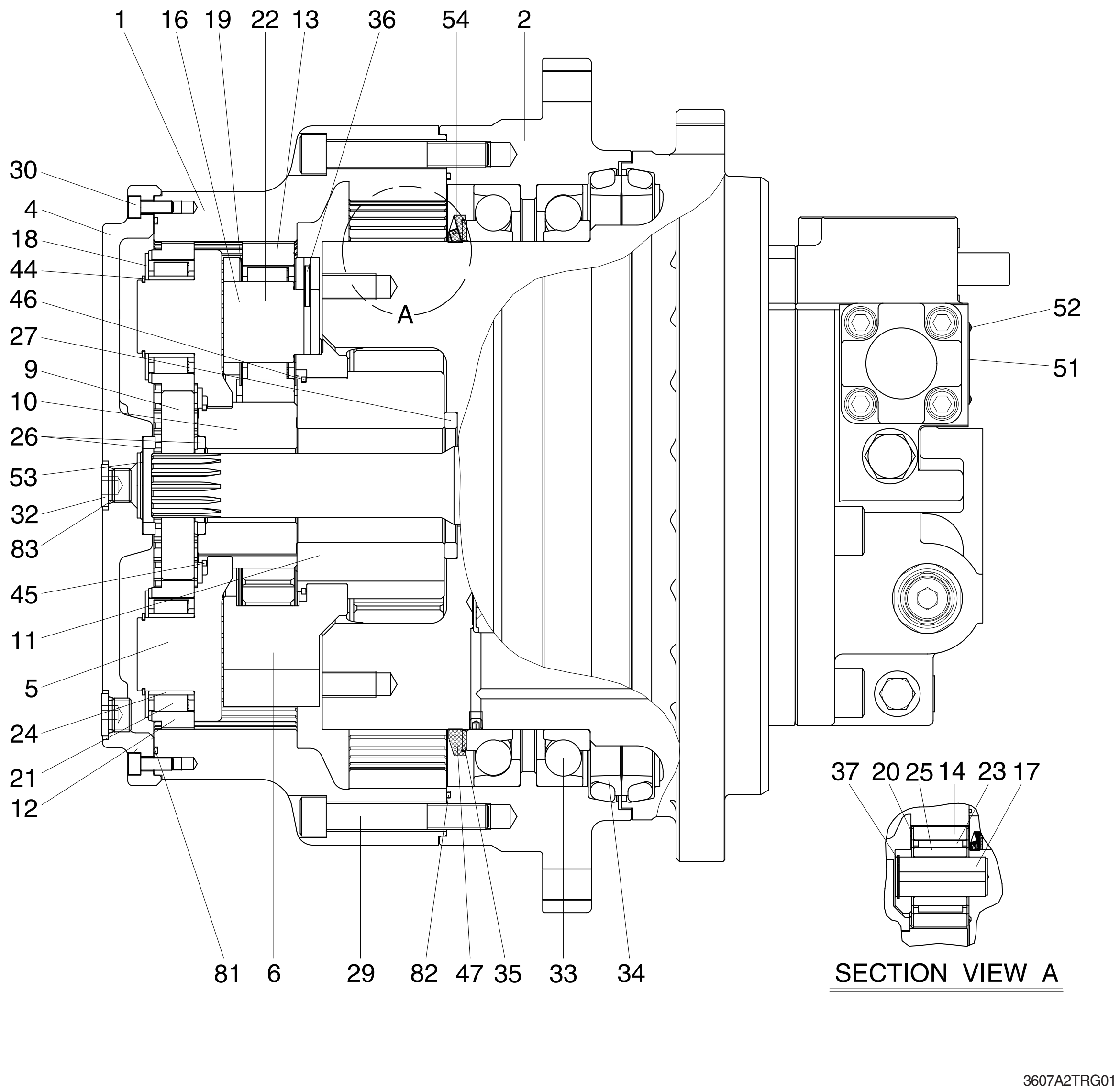
101	Drive shaft	303	Valve casing	547	O-ring
102	Roller bearing	351	Reducing valve	702	Brake piston
103	Needle bearing	352	Cover	703	Orifice
107	Snap ring	435	Snap ring	704	Orifice
111	Cylinder block	451	Pin	705	Brake spring
113	Spherical bushing	461	Plug	707	O-ring
114	Cylinder spring	472	O-ring	708	O-ring
121	Piston	491	Oil seal	741	Separation plate
122	Shoe	502	Piston	742	Friction plate
123	Set plate	503	Shoe	801	Name plate
131	Valve plate	504	Pivot ball	802	Rivet
201	Swash plate	545	Orifice		
272	Shaft casing	546	Orifice		

TRAVEL MOTOR (2/2)



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

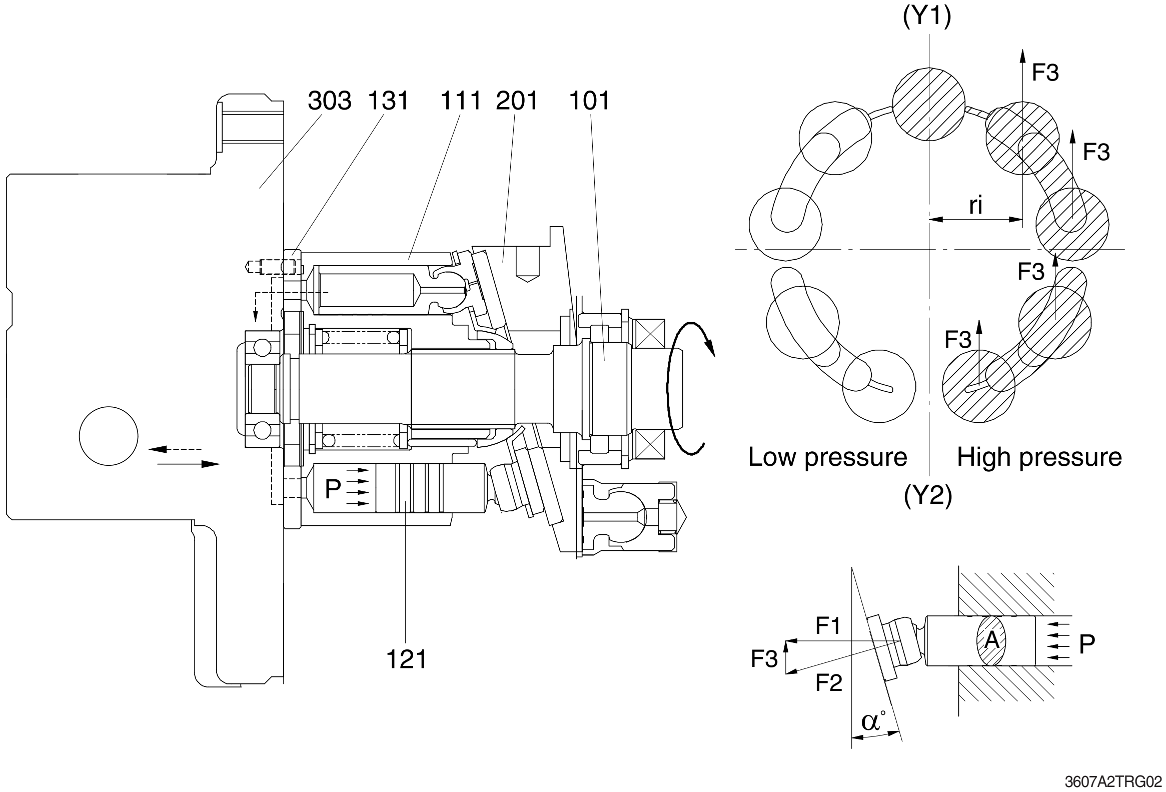
2) REDUCTION GEAR



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

2. FUNCTION

1) GENERATION OF TORQUE



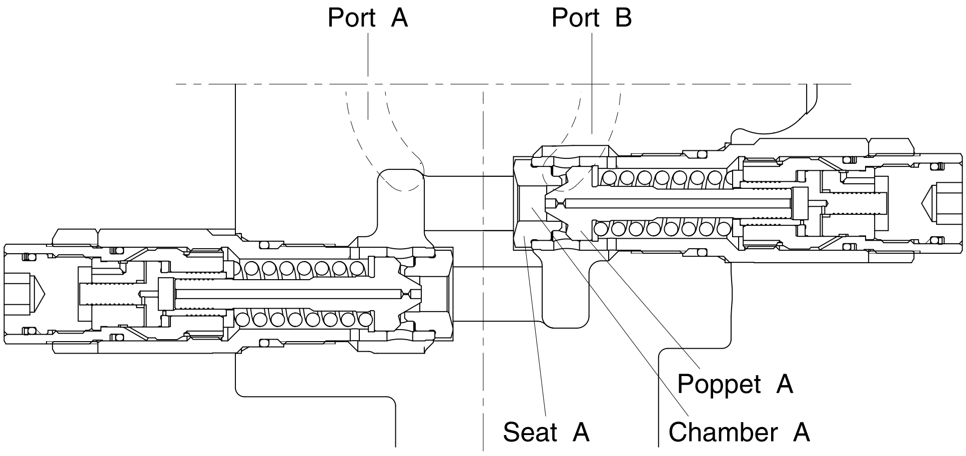
The pressurized oil delivered from the hydraulic pump flows to valve casing (303) of the motor, passes through the brake valve mechanism, and is introduced into cylinder block (111) via valve plate (131). This oil constructively introduced only to one side of (Y1)- (Y2) connecting the upper and lower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

2) RELIEF VALVE

The relief valve mainly has the following two functions :

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

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

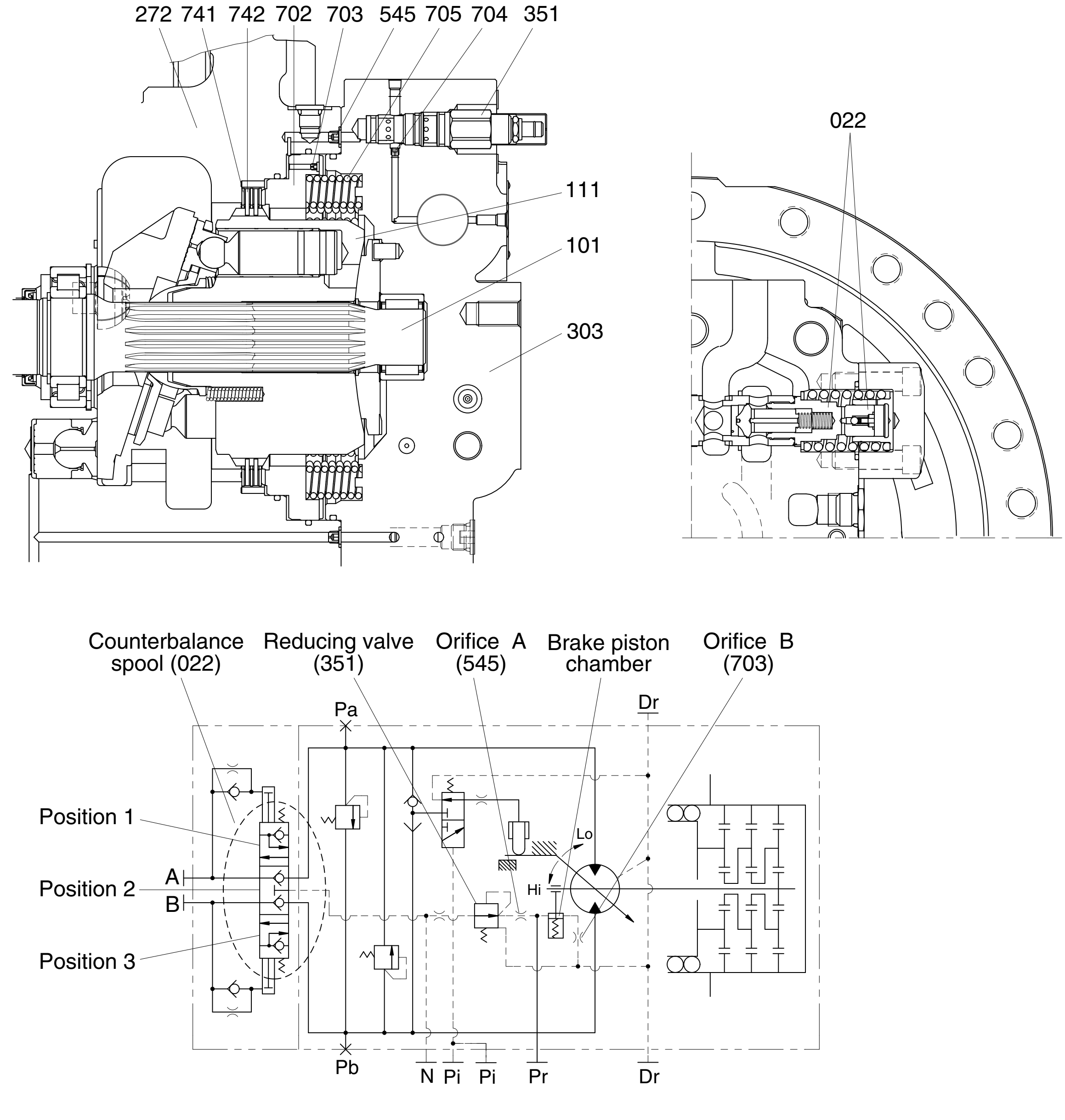


3607A2TM06

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

3) NEGATIVE BRAKE

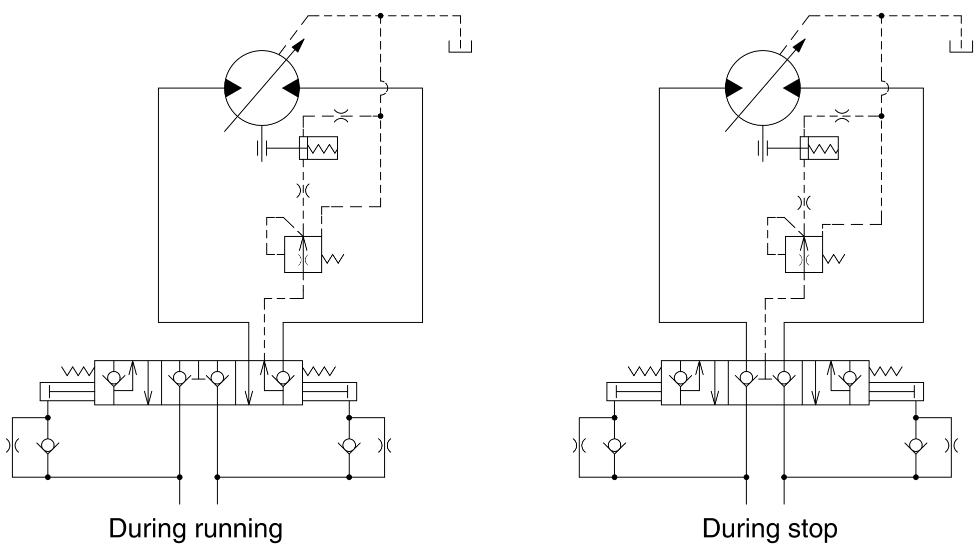
The negative brake is released applying to the brake piston (702) the pressure led through the built-in counterbalance spool sub-assembly (022).
With no pressure working, the brake force is always ensured.



3607A2TM07

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

4) PRESSURE RELEASE VALVE (Flow control valve)



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

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

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

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

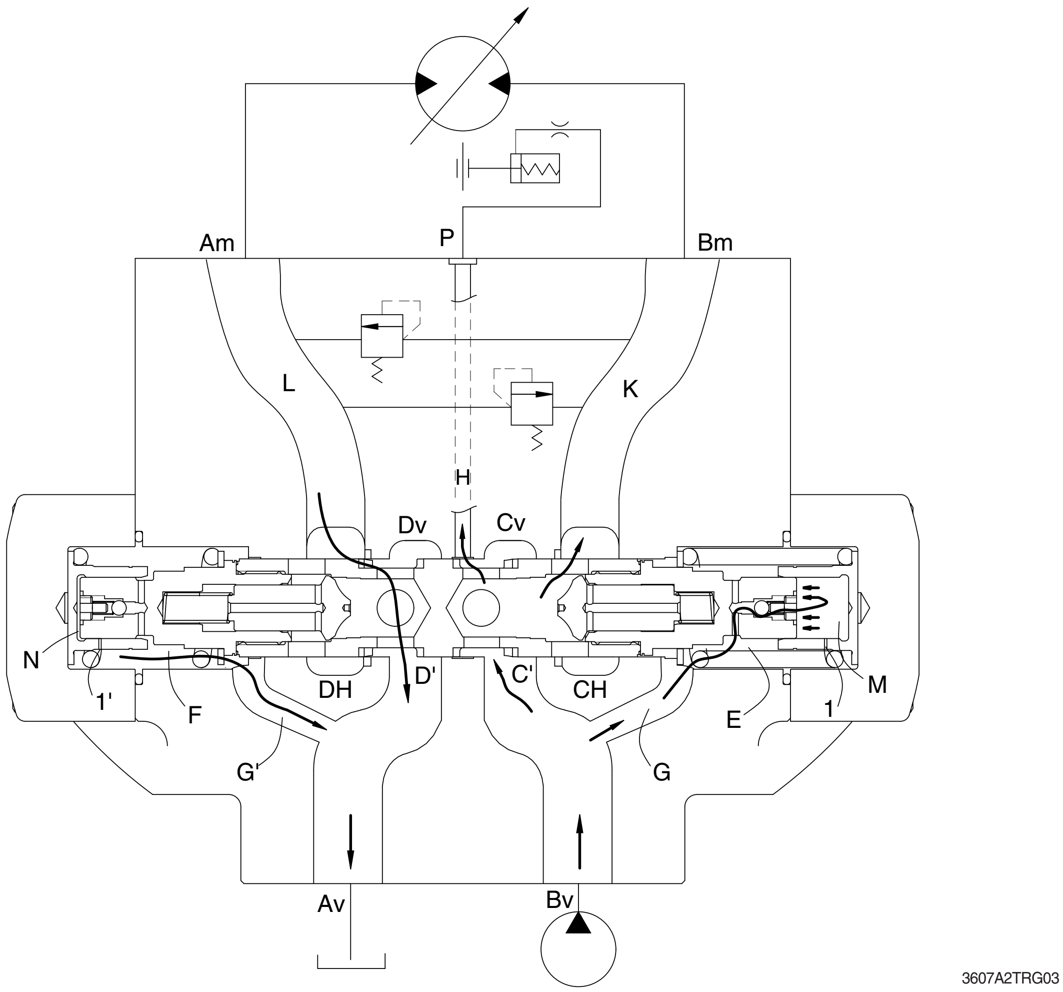
5) RELEASING METHOD OF NEGATIVE BRAKE

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

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

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

6) COUNTERBALANCE VALVE



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

Therefore, the pump discharge oil pressure increases, and the pressure is led via passage G to spring room E and via the ball check valve to dumping room M. When the pressure in rooms E and M exceeds the value equivalent to the force of the spring which holds the spool at its neutral position, the spool begins to move left. Since the working oil in room N flows into room F via throttle 1' or clearance 2' and that in room F is discharged via passage G' through port Av to the tank, the spool moves left to have passage L-Dm-D'-Dv composed. In addition, passage Cv-H-P is also composed, and the pump discharge pressure in port Bv is led to port P.

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

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

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

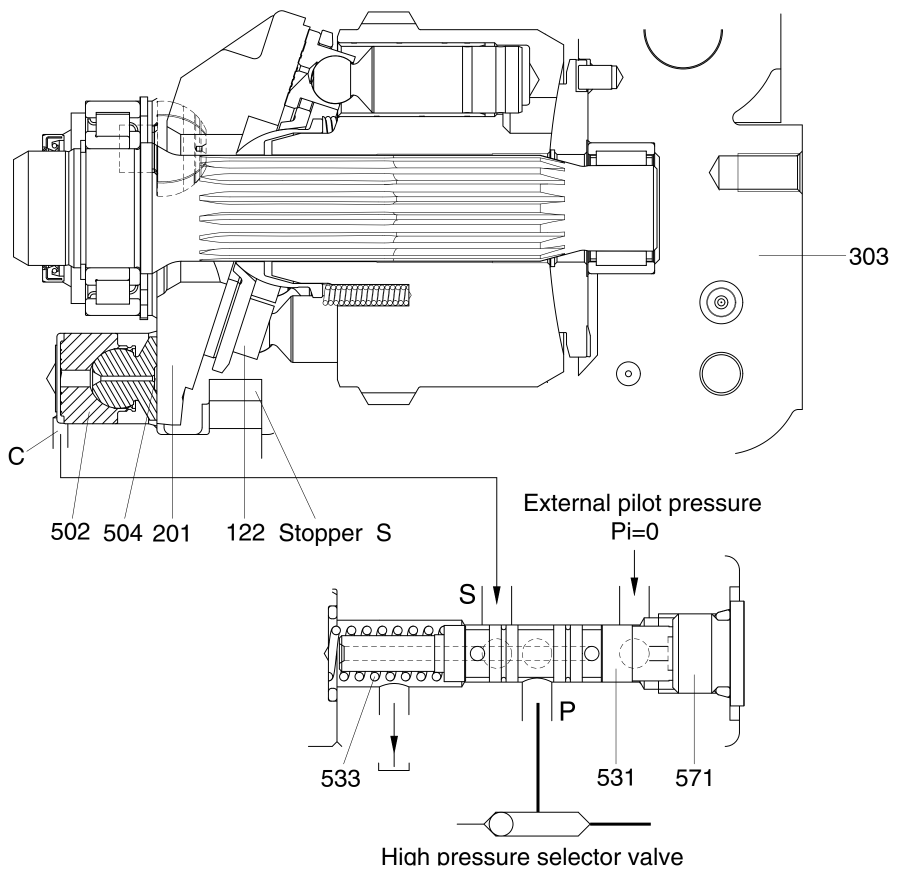
Since working oil in room M flows to room E via throttle 1 and that in room E, to port Bv via passage G, the spool moves right.

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

7) DISPLACEMENT CHANGEOVER SECTION

As a supporting mechanism for the swash plate (201) on which the shoes (122) slide, the pillar system is adopted to support the load with semi-cylindrical sliding bearings provided at both ends of the mechanism.
The capacity is changed by changing the tilting angle of this swash plate.
This is a mechanism that swash plate was pushed by tilting position, and the tilting angle of the swash plate is decided in two positions (large and small) by controlling the flows to and from these piston rooms with the displacement changeover valve section.

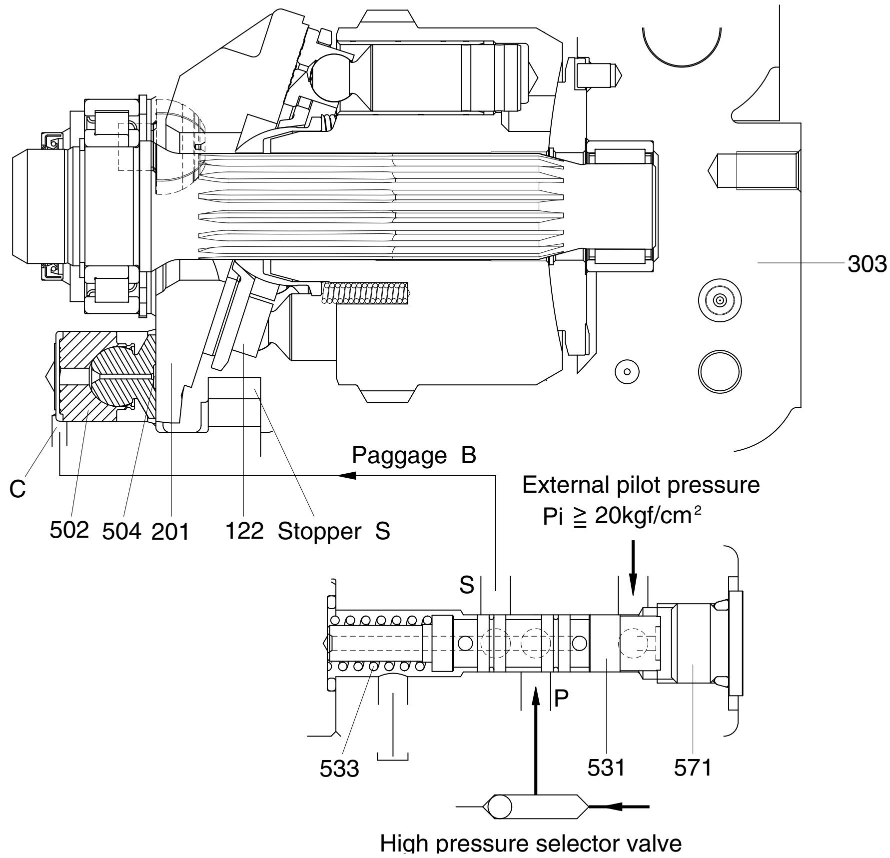
(1) External pilot pressure : $P_i = 0$ ······ Large displacement



3607A2TM04

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

(2) **External pilot pressure** : Pi $20 kgf/cm^2$ ——— small displacement



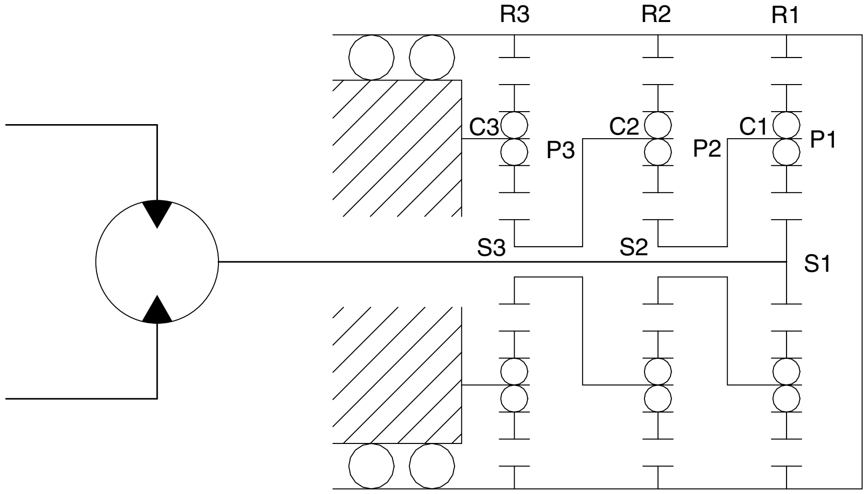
3607A2TM05

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

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

8) REDUCTION GEAR

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



3607A2TRG04

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

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

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

This reduction ratio is expressed as shown below:

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

where Z : Number of teeth of each gear

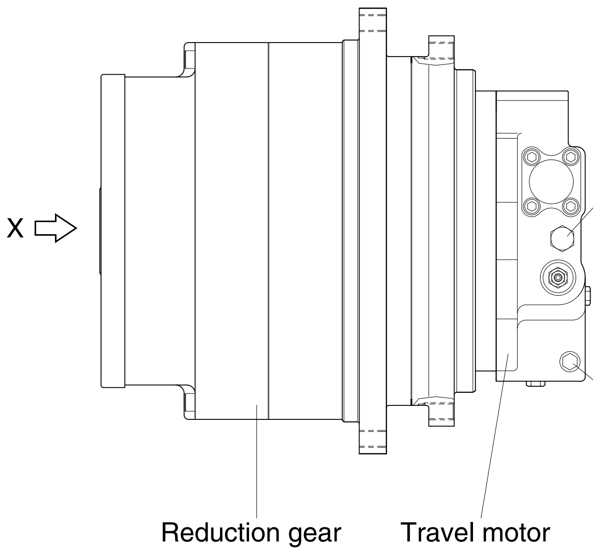
The direction of rotation is reverse to that of the input shaft.

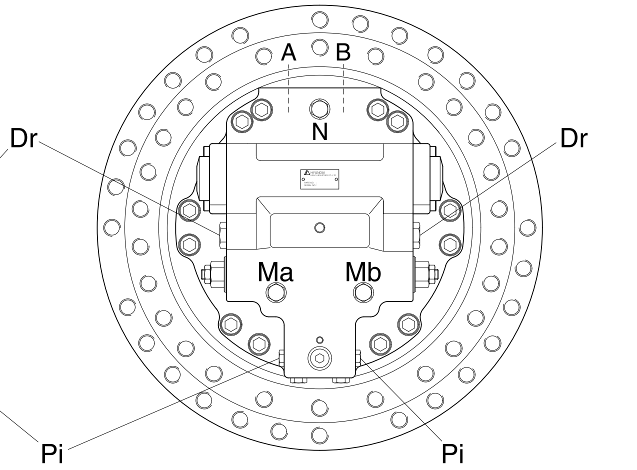
■ TRAVEL MOTOR (TYPE 2)

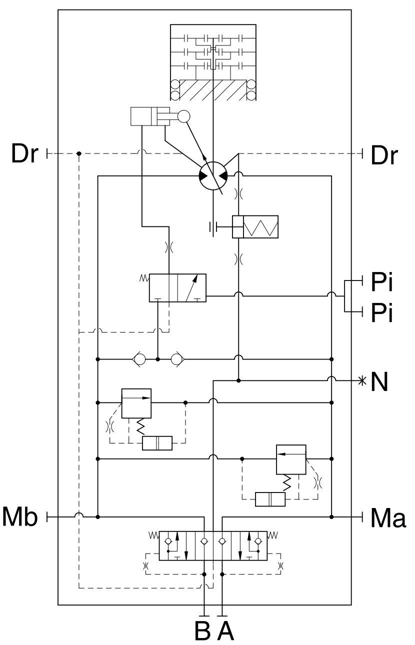
1. CONSTRUCTION

Travel device consists travel motor and gear box.

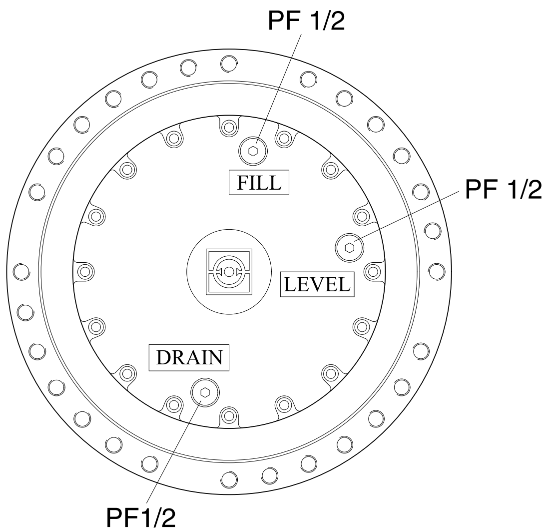
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







Hydraulic circuit



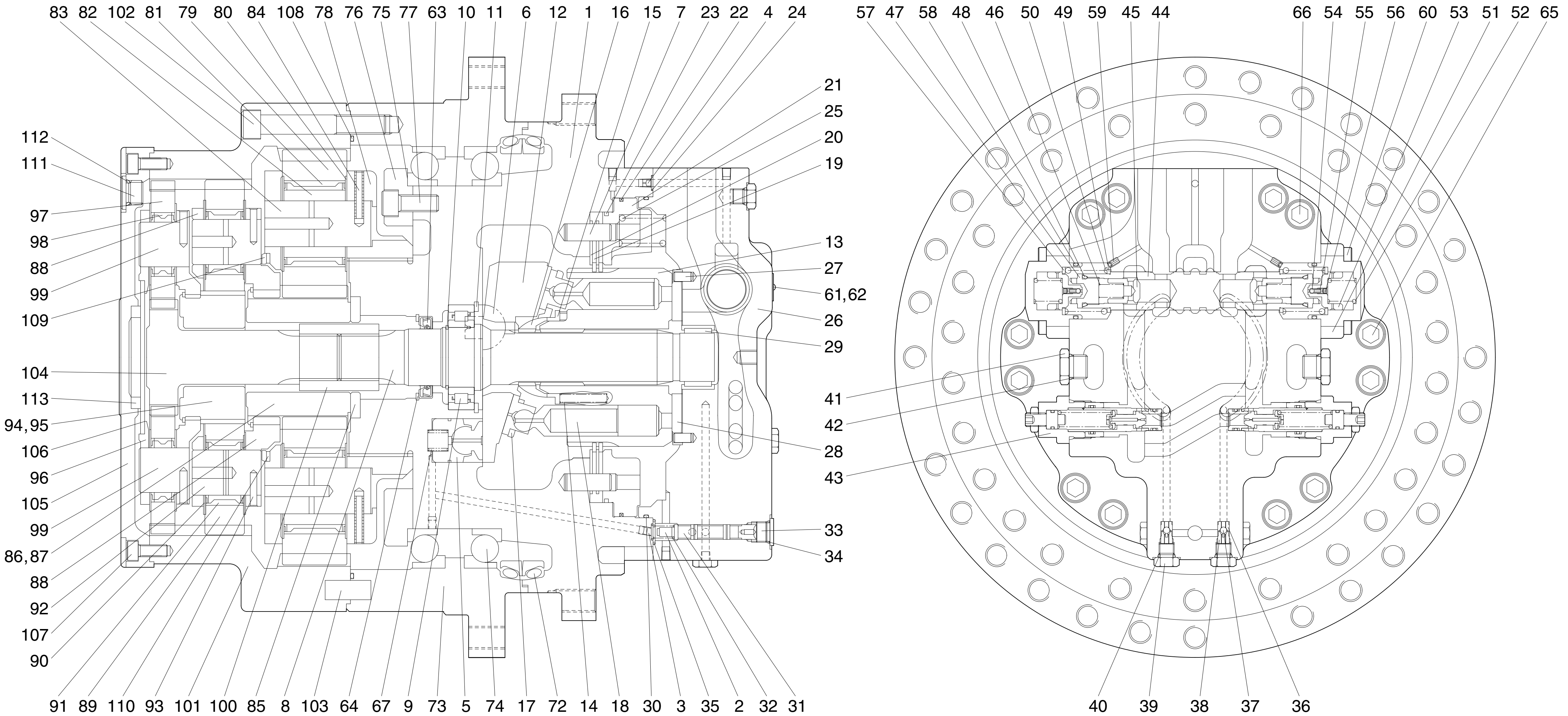
VIEW X

3809A2TM21

Port	Port name	Port size
A, B	Main port	SAE 6000 psi ø 25
Pi	Two speed control port	PF 1/4
Dr	Drain port	PF 1/2
Ma, Mb	Gage port	PF 1/4
N	Brake release port	PF 1/4

2. SPECIFICATION

1) TRAVEL MOTOR



3809A2TM22

1	Shaft casing	15	Spacer	29	Needle bearing	43	Relief valve assy	57	Spring seat	75	Shim	89	Planetary gear	103	Planetary pin
2	Plug	16	Ball guide	30	O-ring	44	Main spool	58	O-ring	76	Bearing guide	90	Plate	104	Drive gear
3	Orifice	17	Set plate	31	Swash spool	45	Check	59	Orifice	77	Wrench bolt	91	Needle bearing	105	End cover
4	Orifice screw	18	Piston & Shoe assy	32	Swash spring	46	Spring	60	Wrench bolt	78	Carrier	92	Pin	106	Plate
5	Swash piston	19	Friction plate	33	Plug	47	Plug	61	Name plate	79	Planetary gear	93	Spring pin	107	Wrench bolt
6	Swash ball	20	Separator plate	34	O-ring	48	O-ring	62	Rivet	80	Plate	94	Sun gear	108	O-ring
7	Brake pin	21	Brake piston	35	O-ring	49	Spring seat	63	Oil seal	81	Needle bearing	95	Snap ring	109	Ring
8	Shaft	22	Piston ring	36	Seat	50	Spring	64	Snap ring	82	Bearing bushing	96	Carrier	110	Ring
9	Roller bearing	23	Piston ring	37	Steel ball	51	Cover	65	Wrench bolt	83	Pin	97	Planetary gear	111	Plug
10	Stop ring	24	O-ring	38	Stopper	52	Spring	66	Wrench bolt	84	Spring pin	98	Needle bearing	112	O-ring
11	Lock ring	25	Brake spring	39	Plug	53	Spool	67	Spring pin	85	Thrust plate	99	Pin	113	Bushing
12	Swash plate	26	Valve casing	40	O-ring	54	Steel ball	72	Floating seal	86	Sun gear	100	Coupling		
13	Cylinder block	27	Valve plate pin	41	Plug	55	Spring	73	Hub	87	Snap ring	101	Ring gear		
14	Cylinder spring	28	Valve plate	42	O-ring	56	Plug	74	Bearing	88	Carrier	102	Wrench bolt		

3. PRINCIPLE OF DRIVING

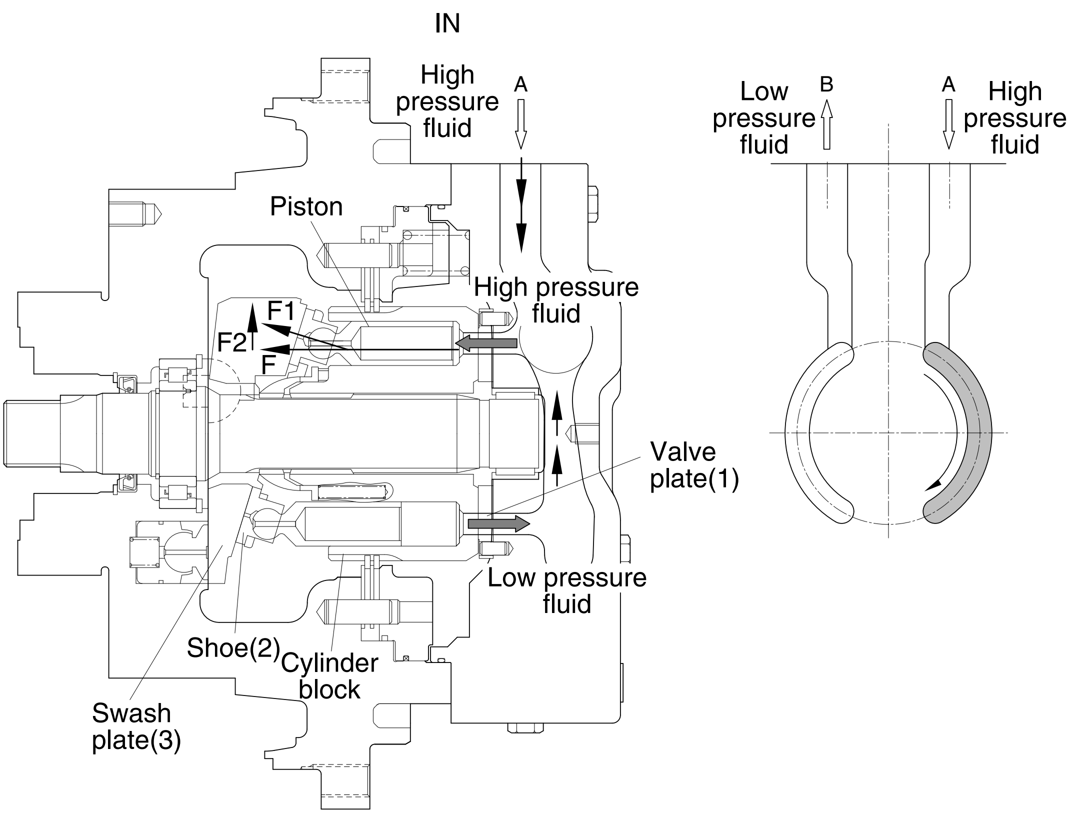
Travel motor comprises with rotary, relief valve, parking brake, counterbalance valve and 2-speed control.

1) WORKING OF ROTARY PART

In the figure below, axis direction power F occurs, when the high pressure oil flows in the cylinder block through to the valve plate (1) port, and the piston moves to the left hand side.

This power F, which takes shoe (2) as a medium, split into F1 power vertical to swash plate (3), and F2 power perpendicular from an axis. Through F2 power, cylinder block rotate with piston and shoe, while shoe (2) moves on the swash plate with piston. There are 9 pistons inserted into the cylinder block and they rotate with the cylinder block by taking high pressure gas in order at the entrance.

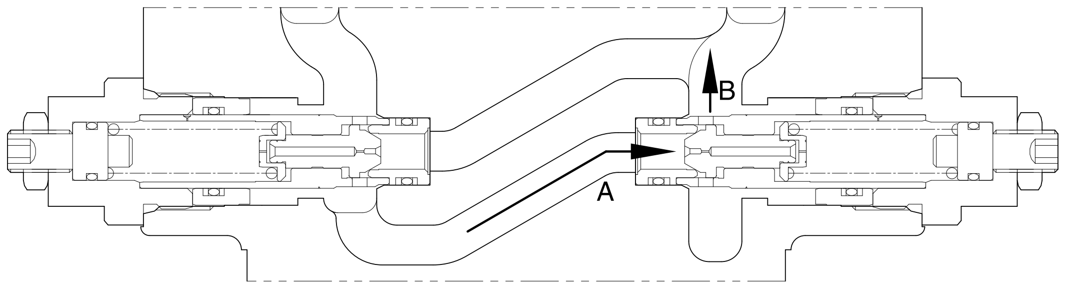
When you reverse the flow of the high pressure oil, piston and cylinder block rotate in the opposite direction above the shoe plate.



3809A2TM23

2) WORKING OF RELIEF VALVE

When the port from control valve to motor is closed, traveling movement stops.
However, motor continues rotating because of the traveling inertia of the machine's upper body.
By doing so, motor is damaged by the gradual rising of the pressure at the exit.
To prevent this damage, relief valve discharge the gradual rising pressure from the exit to the entrance which has lower pressure.



3809A2TM24

- Setting pressure : 360 kgf/cm^2
- Back pressure : 5 kgf/cm^2
- Cracking pressure : 330 kgf/cm^2 over

- AT THE BEGINNING OF TRAVELING

RELIEF VALVE A

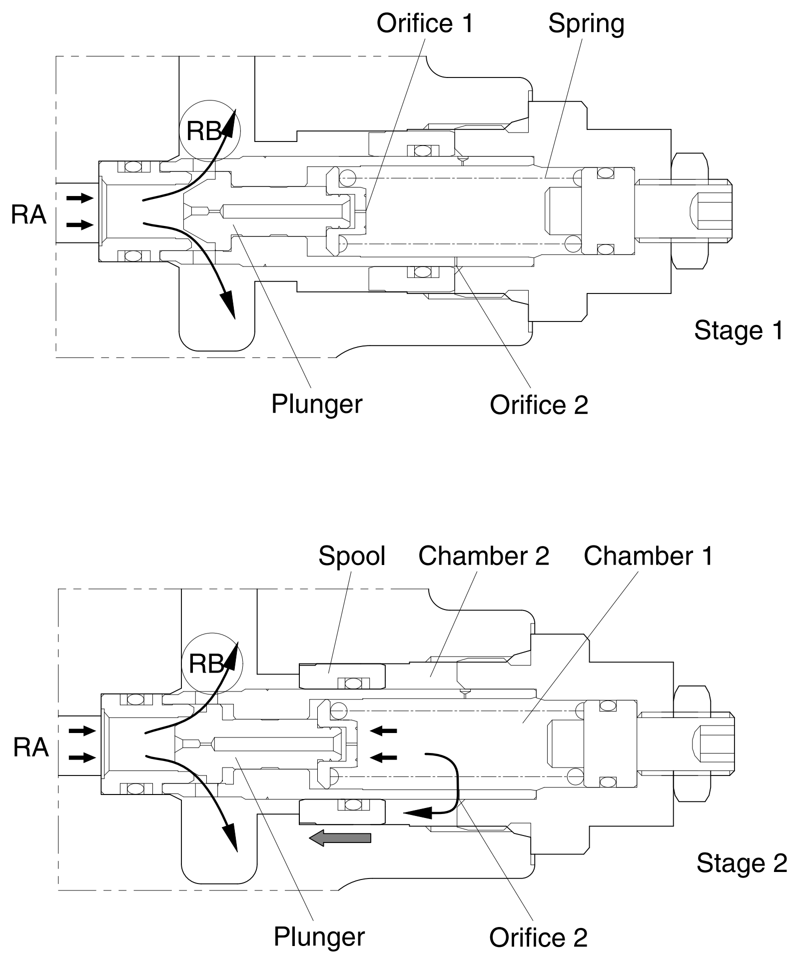
Traveling manipulation lever works to rise the pressure of RA port up. When this pressure oil press plunger to the right, and then sustain the power of the spring, the plunger moves to the right and release the pressure oil of RA port to RB port (stage 1).

The plunger moves slowly by the pressure oil which flows into chamber 1 through orifice 1.

The pressure oil flowed into chamber 1 flows into chamber 2 through orifice 2, and at this point, the plunger moves to the left again, when the spring is compressed by the flowed pressure oil which press the spool to the left. (stage 2).

When the RA port pressure goes up much more and the set pressure overcome the power of the compressed spring again, the plunger moves to the right and the pressure has of RA port is released to RB port.

Thus, at the early stage of the relief-valve operation, it works primarily at lower pressure, after then, shock is reduced during rotating at the set pressure as the secondary operation.



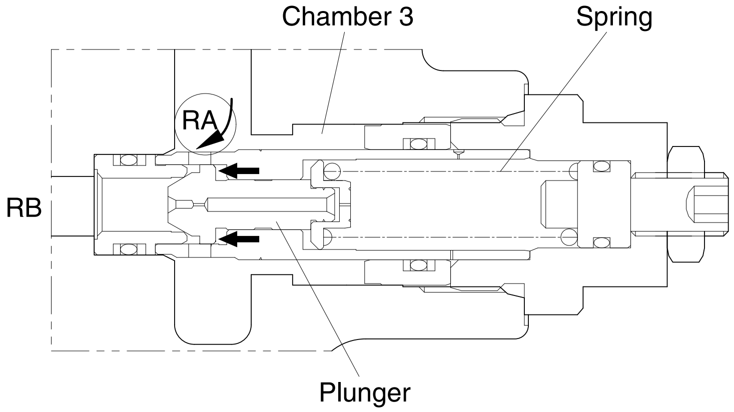
RELIEF VALVE A

3809A2TM25

- DURING TRAVELING OPERATION

RELIEF VALVE B

During traveling operation, RA port pressure goes up and RB port pressure goes down. Thus RA port pressure oil flows into chamber 3, and pushes plunger to the left with a high pressure and the power of the spring.



RELIEF VALVE B

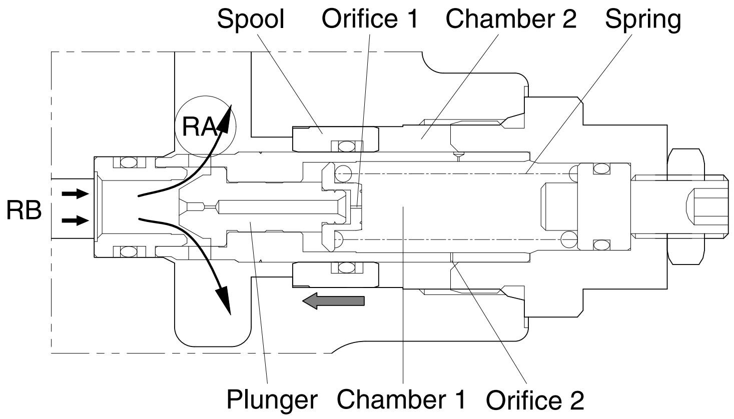
3809A2TM26

- WHEN IT STOP

RELIEF VALVE B

When it stops or operates reversely, RA port pressure is extremely lowered and RB port pressure gradually goes up because of the swing inertia from the upper swing part of machine.

Consequently, relief valve B operates as the same order as relief valve A, and maintains the set pressure by releasing the high pressure of RB port to RA port.



RELIEF VALVE B

3809A2TM27

3) WORKING OF PARKING BRAKE

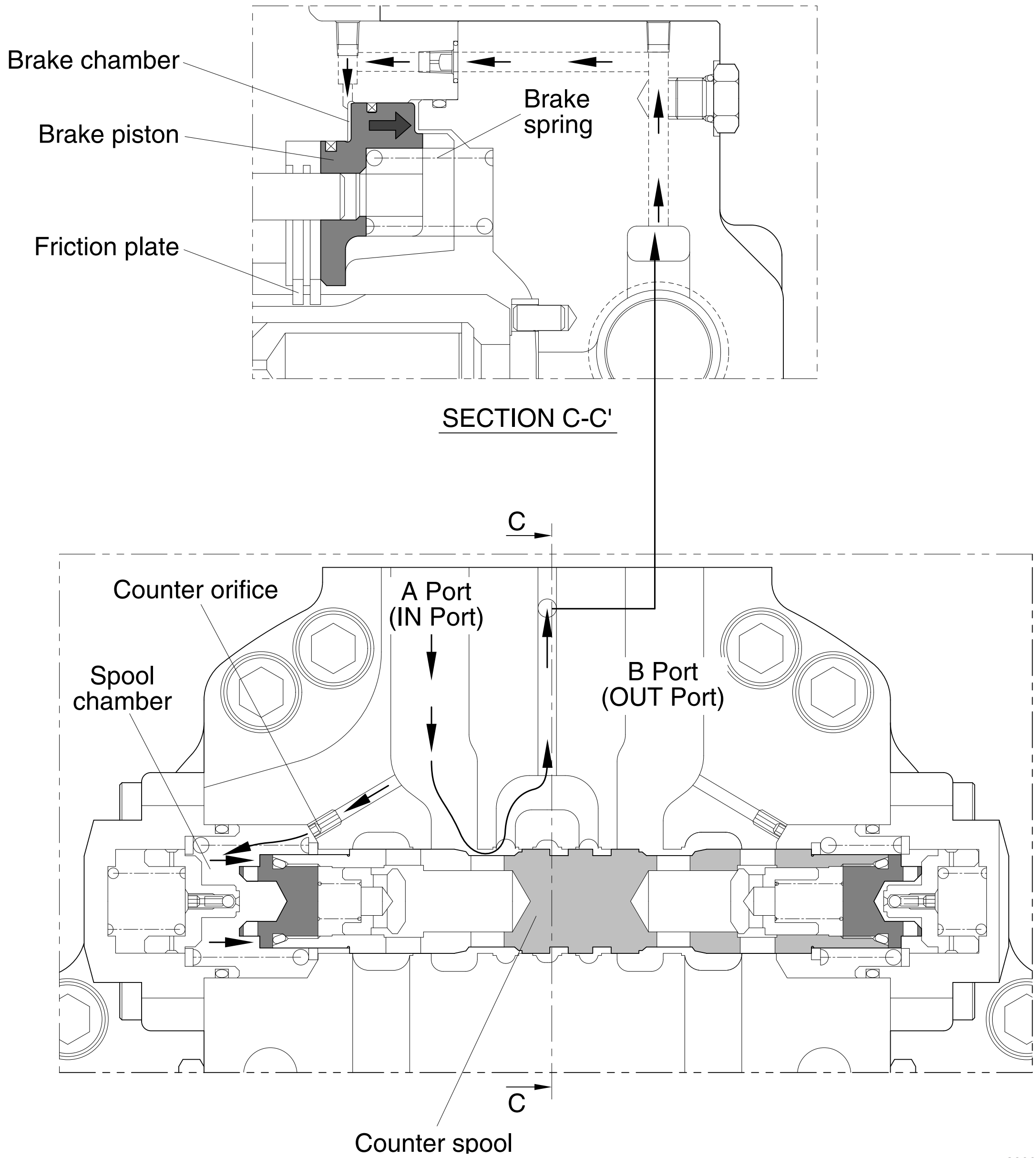
Parking brake consists of many wet friction plate. The brake is usually held with the power of spring, and it only removed by traveling pressure of motor.

- Parking brake OFF

  If worker operates the traveling control lever, traveling working pressurized oil into IN PORT flows from spool chamber through counter orifice.

  Pressurized oil pushes counter balance spool to right.

  Then notch of spool opens the brake line. At the same time, pressurized oil flow to brake chamber of motor from brake line. Brake piston to force of brake spring moves to right and brake lift.



3809A2TM28

- Parking brake ON

  If worker leave lever in neutral, pressurized oil supply to in port of motor stop.

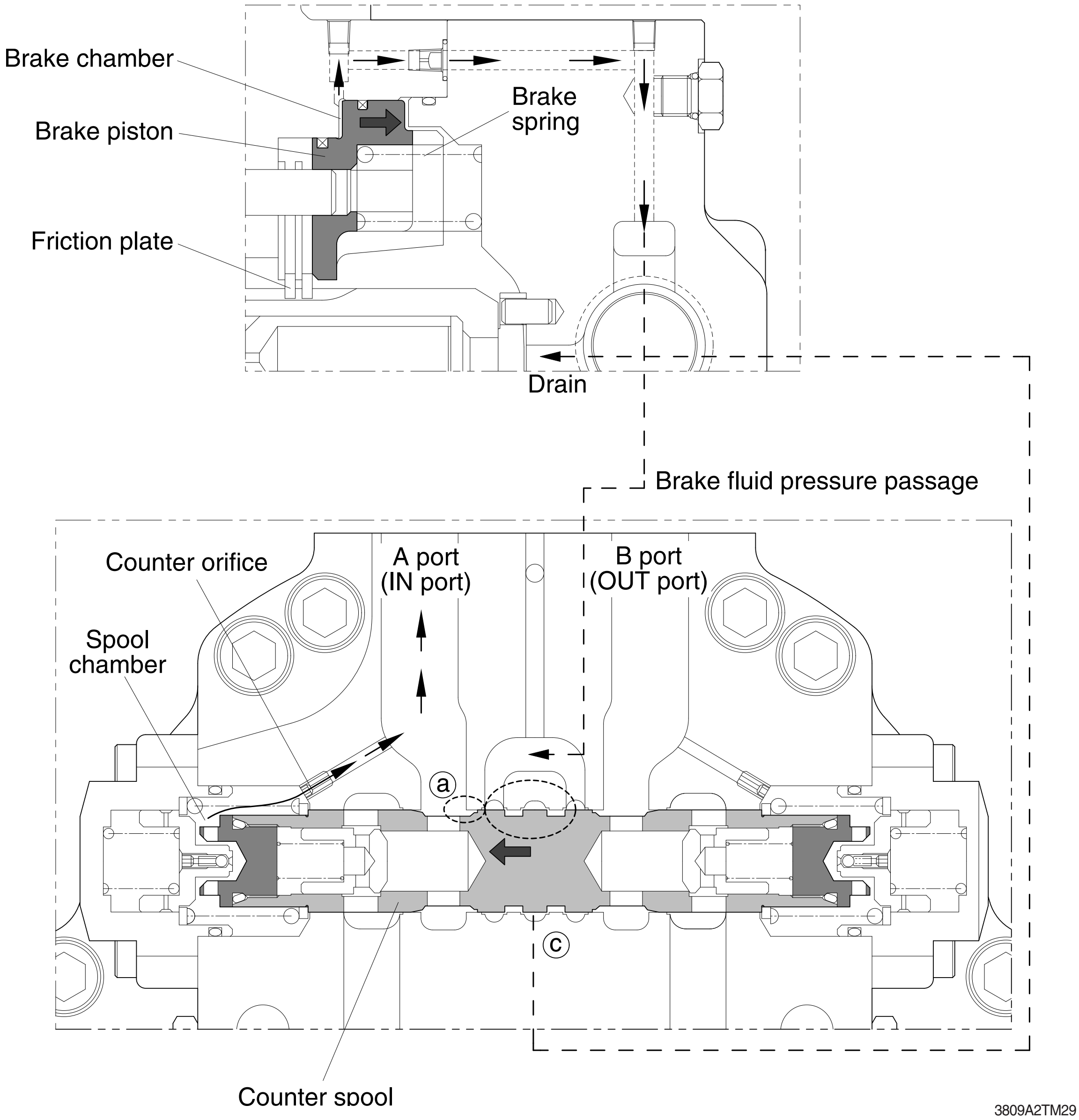
  If pressurized oil supply stop, in port pressure decline and pressurized oil of spool chamber moves to oil tank through counter orifice. Therefore counter balance spool return in neutral.

  If spool leave in neutral, notch ⓐ part of spool obstructed and brake pressurized oil obstructed.

  Brake pressurized oil line obstructed. So pressurized oil supply to brake chamber obstructed.

  Therefore if pressure of brake chamber decline, brake piston to force of brake spring moves to left and push friction plate.

  If brake force happens, brake stop. And pressurized oil to brake chamber drain to motor casing internal through line ⓒ to counter spool center.

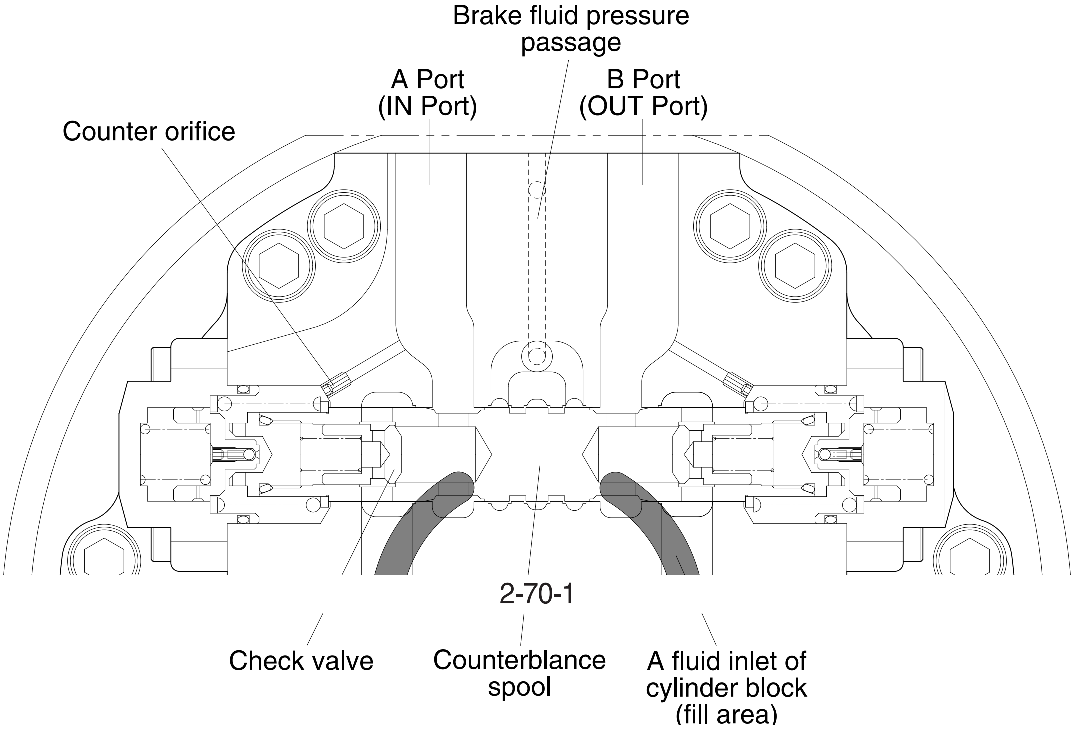


4) COUNTERBALANCE VALVE

- Function of counterbalance valve

(1) Parking brake off and operation of motor
(2) When motor descend in slope, traveling velocity control.
(3) After motor stop in slope, slip prevention.
(4) When motor stop, supplement the flow.

- NEUTRAL



3809A2TM30

5) HOW TO WORK

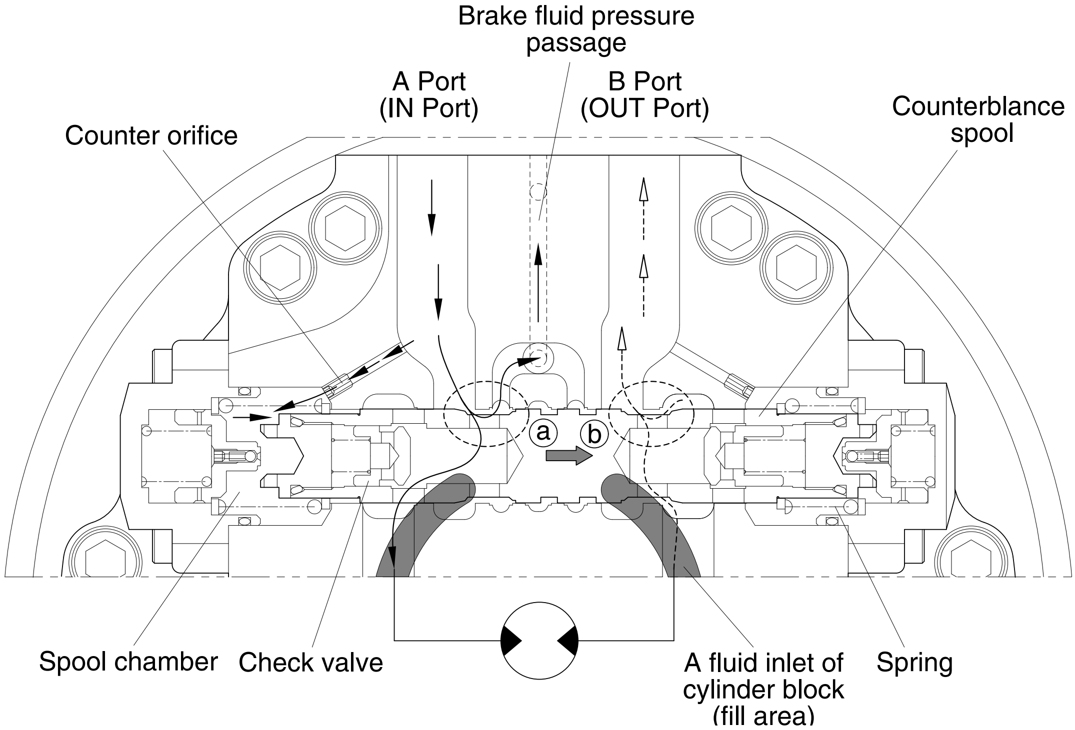
(1) When motor travel

If worker operates the traveling control lever, traveling working pressurized oil into IN PORT flows from spool chamber through counter orifice.

If spool moves to right, notch of spool open line ⓐ of brake pressurized oil.

Then pressurized oil lift the brake. At the same time, notch of counterbalance spool opens the line ⓑ.

Flowed pressurized oil to A port opens check valve and cylinder block of motor rotate.



3809A2TM31

(2) When motor stop

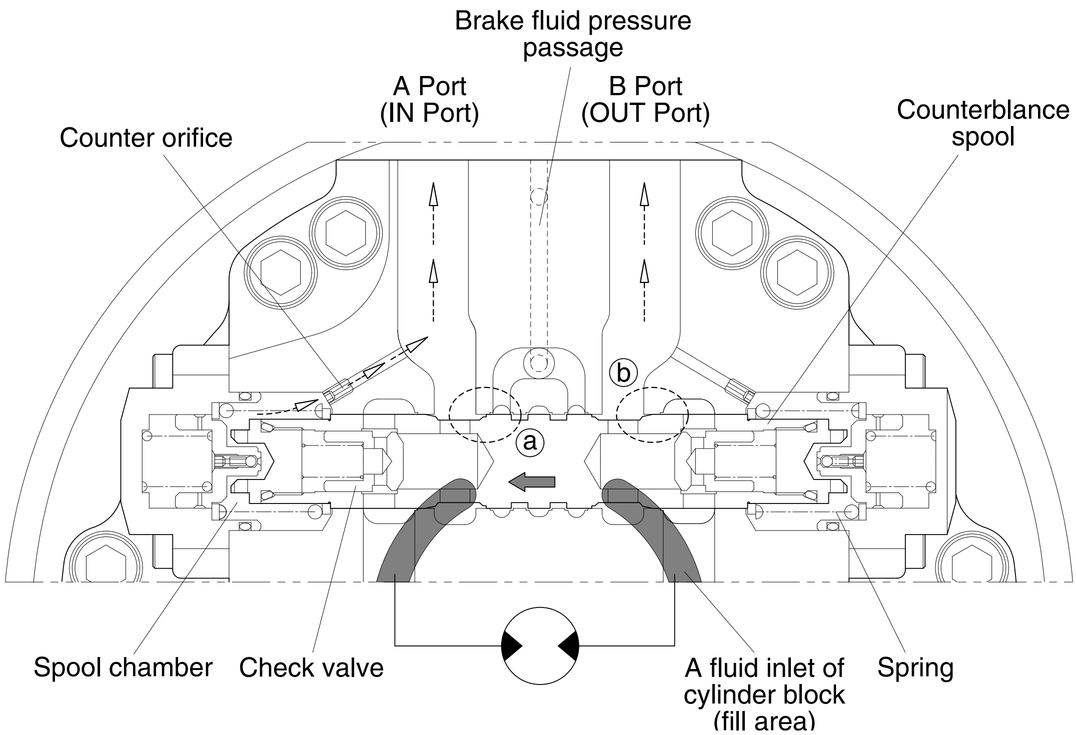
If worker leave lever in neutral, pressurized oil supply to in port of motor stop.

If pressurized oil supply stop, A port pressure decline and pressurized oil of spool chamber moves to oil tank through counter orifice. Therefore counterbalance spool return in neutral.

If counterbalance spool moves to left, line ⓑ by notch of counterbalance spool obstructed and brake pressurized oil obstructed.

At the same time, line ⓐ by notch of counterbalance valve obstructed. Therefore brake obstructed.

If brake force happens, brake stop.

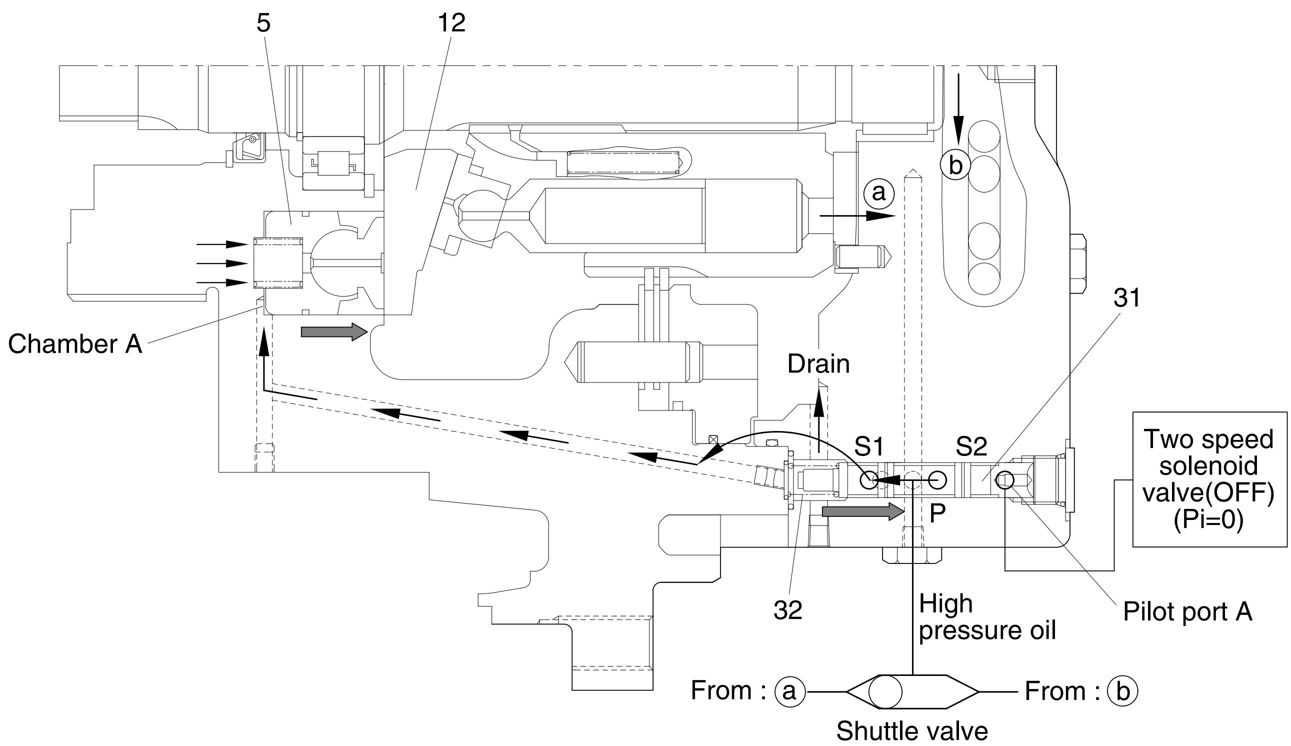


3809A2TM32

6) TWO SPEED (LOW SPEED - HIGH SPEED) CHANGEOVER EQUIPMENT

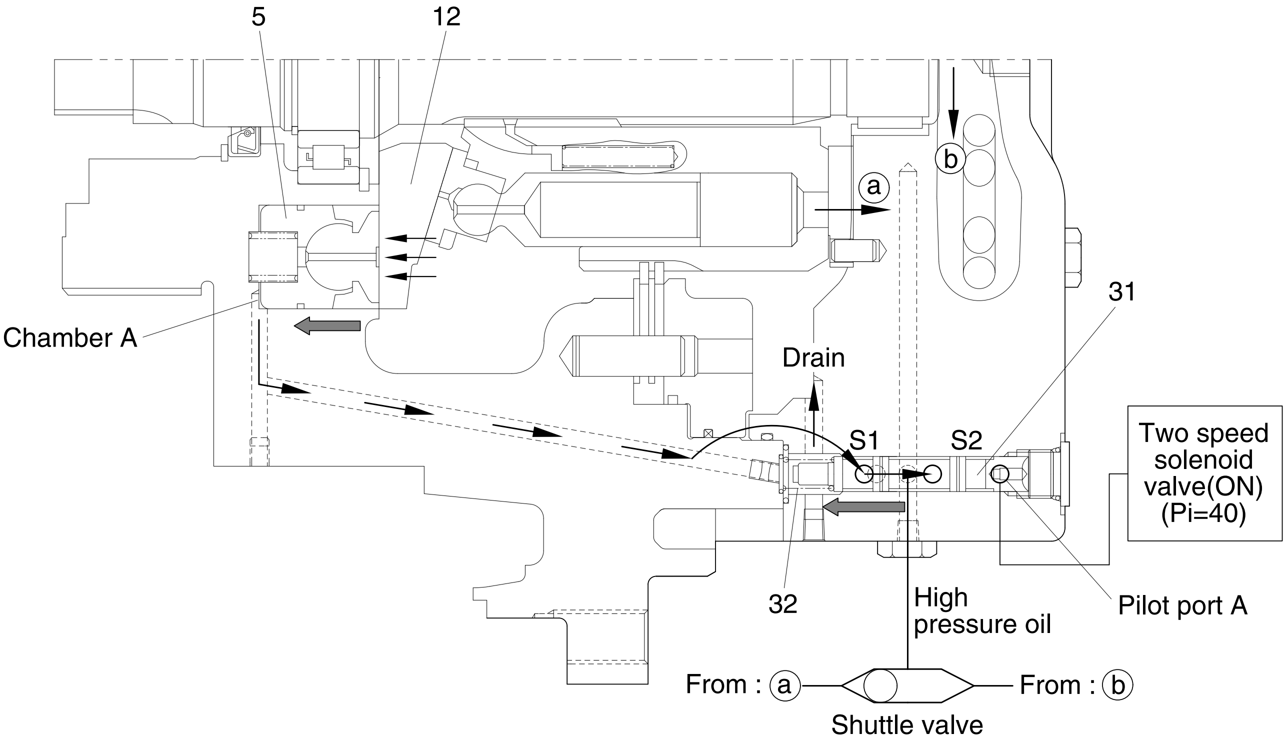
Rotation speed of track motor is depended on slope angle of swash plate (12).
When swash plate angle is Max, the motor rotates at low speed.
When swash plate angle is Min, the motor rotates at high speed.

• Low speed
- When the pilot pressure on spool (31) is disconnected, pilot pressure does not pass to pilot port A. Two speed changeover spool (31) moves right by the spring (32) force.
- High pressure oil of ⓐ port (or ⓑ port) of cylinder block flow to P port of two speed changeover spool (31) through shuttle valve.
  Pressurized oil of two speed changeover spool flow to chamber A of swash piston (5) through S2 port.
- Swash plate moves to increase swash angle, so the motor rotates at low speed.



3809A2TM33

- High speed
  - The pilot pressure on spool (31) of the displacement changeover valve overcomes the force of spring (32), and the spool moves left.
  - High pressure oil of ⓐ port (or ⓑ port) of cylinder block flow to P port of two speed changeover spool (31) through shuttle valve.
  - Swash plate moves to decrease swash angle, so the motor rotates at high speed.



3809A2TM34

4. REDUCTION GEAR

1) PLANETARY GEAR MECHANISM

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

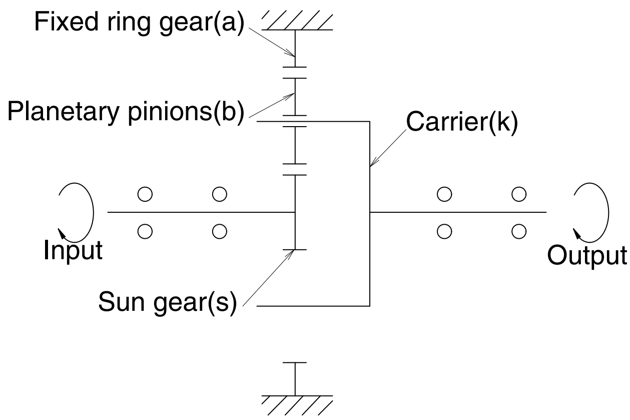
This reduction unit utilizes two stages, planetary reduction system.

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

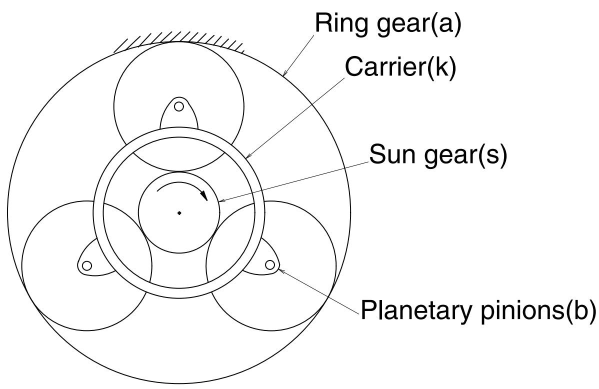
When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gears (s).

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

This mechanism is called planetary gear mechanism.



29072TM10

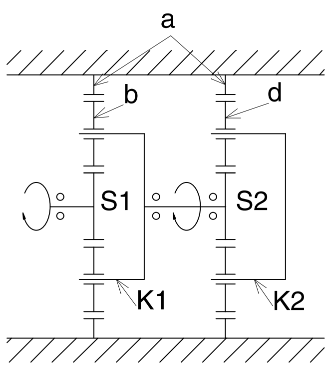


29072TM11

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.

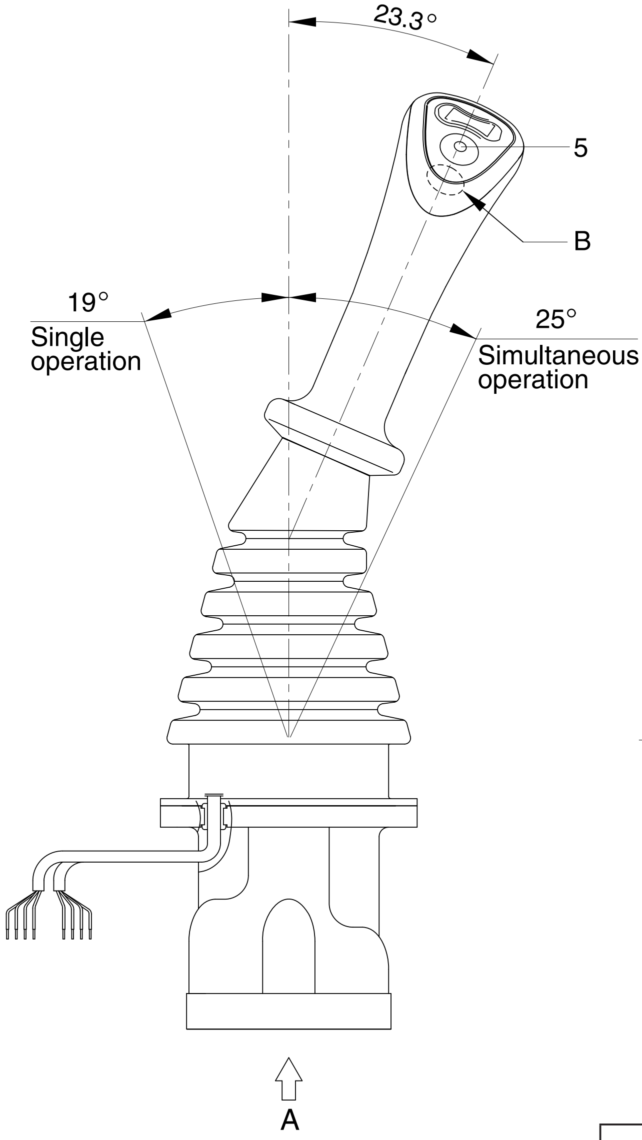


29072TM12

GROUP 5 RCV LEVER

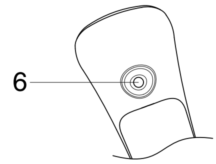
1. STRUCTURE

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

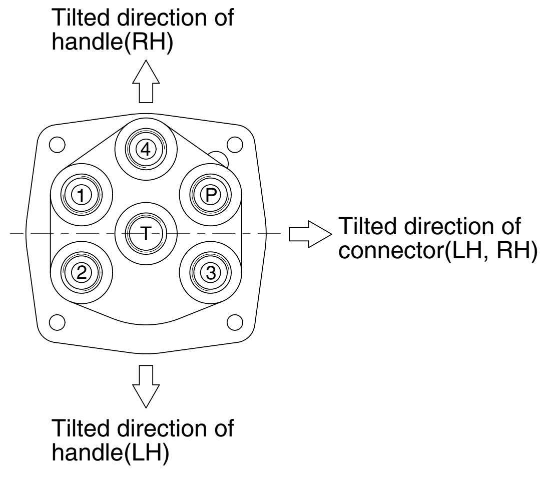


Switches

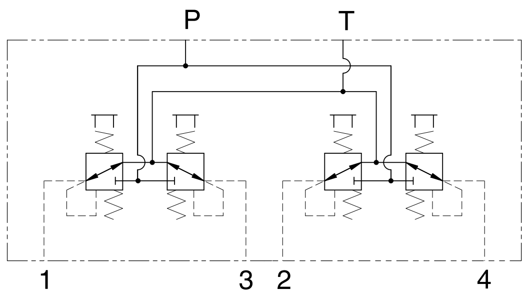
No.	LH	RH
5	One touch decel	Horn
6	Power boost	Breaker



DETAIL B



VIEW A



Hydraulic circuit

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 1/4
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	

21092RL01

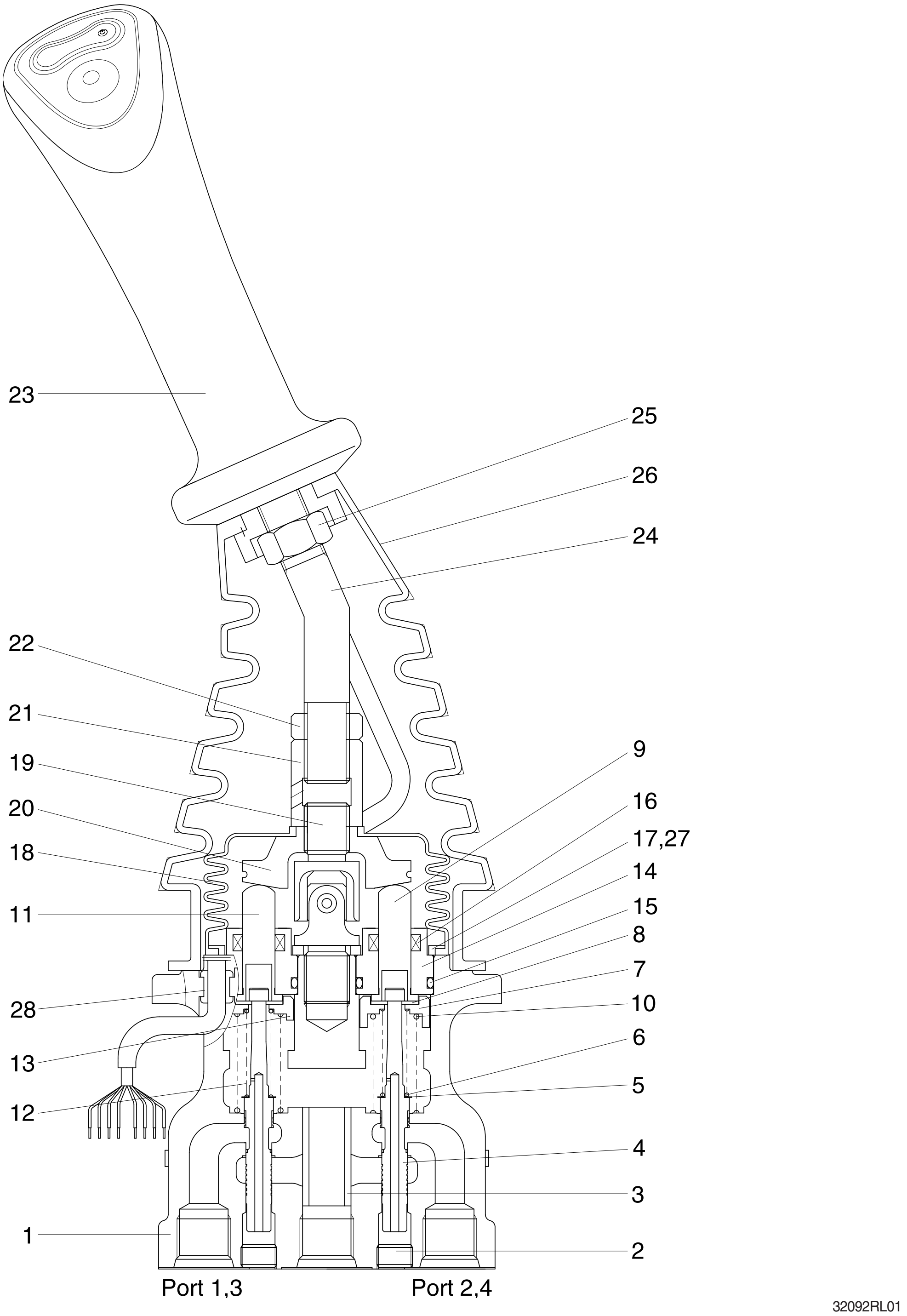
CROSS SECTION

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



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.

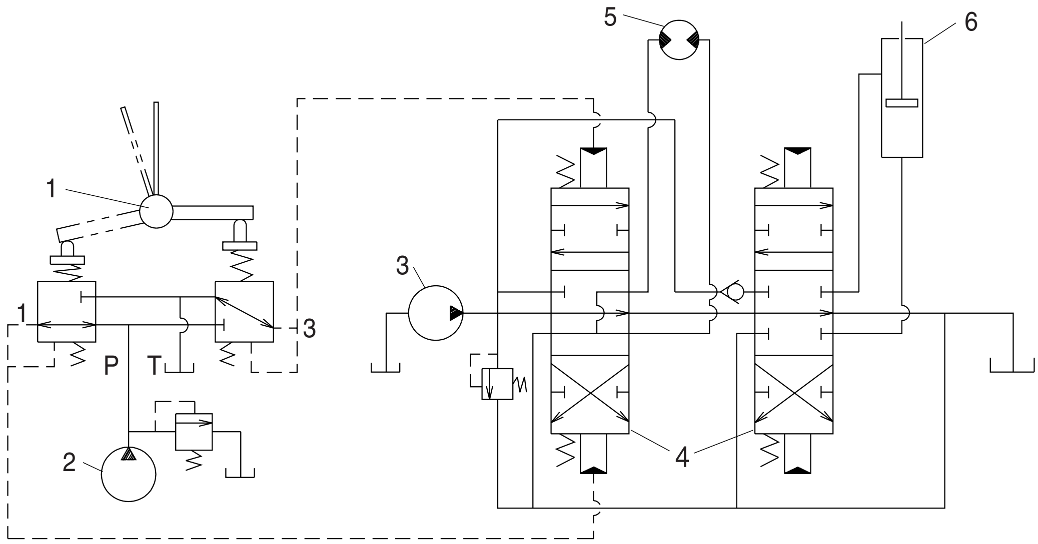
The spring (10) works on the case (1) and spring seat (7, 13) and tries to return the push rod (9,11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

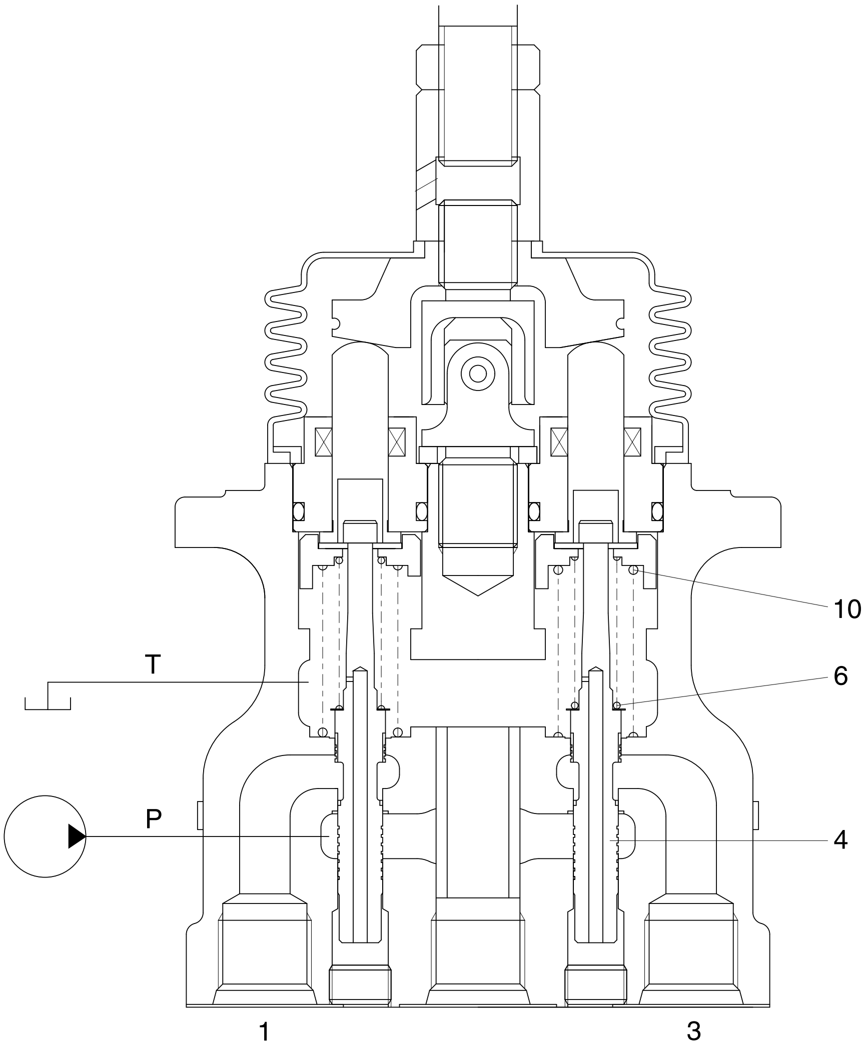
The diagram shown below is the typical application example of the pilot valve.



2-70

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

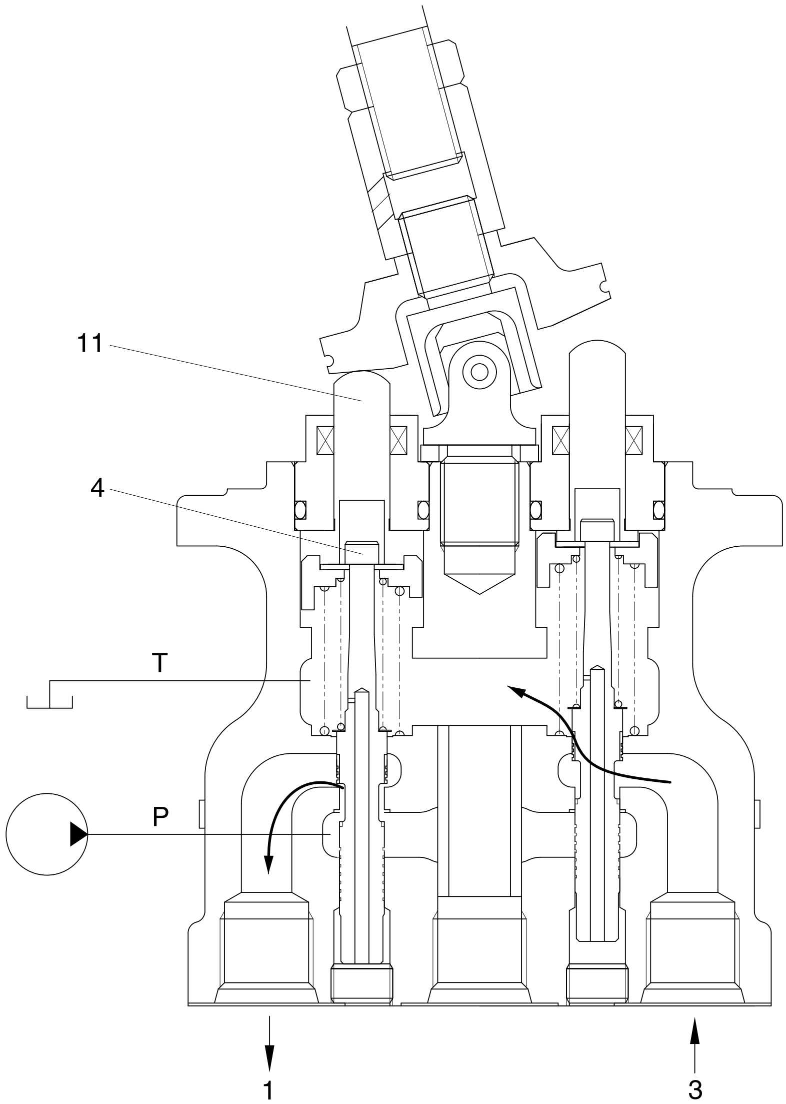
(1) Case where handle is in neutral position



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



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.

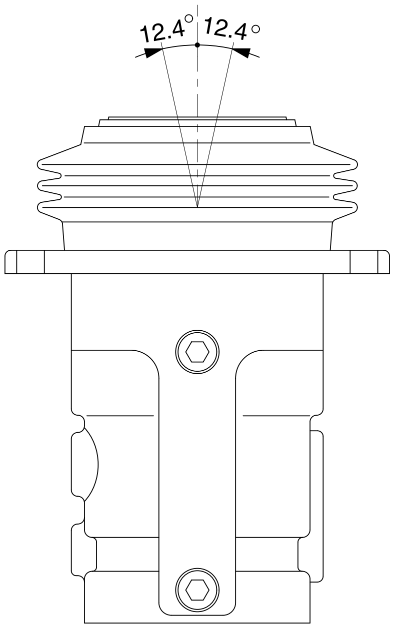
In this manner the secondary pressure is kept at the constant value.

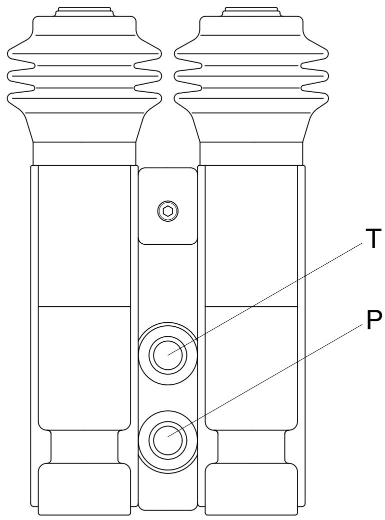
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

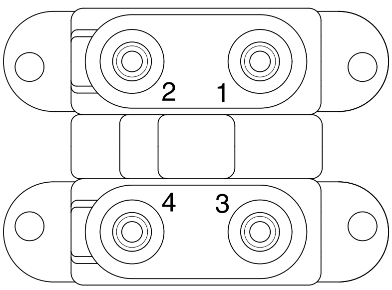
GROUP 6 RCV PEDAL

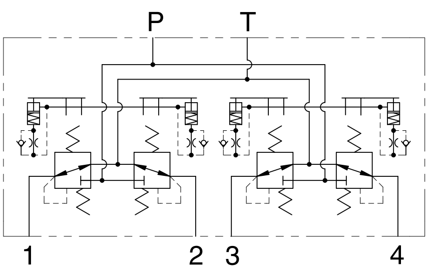
1. STRUCTURE

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)	

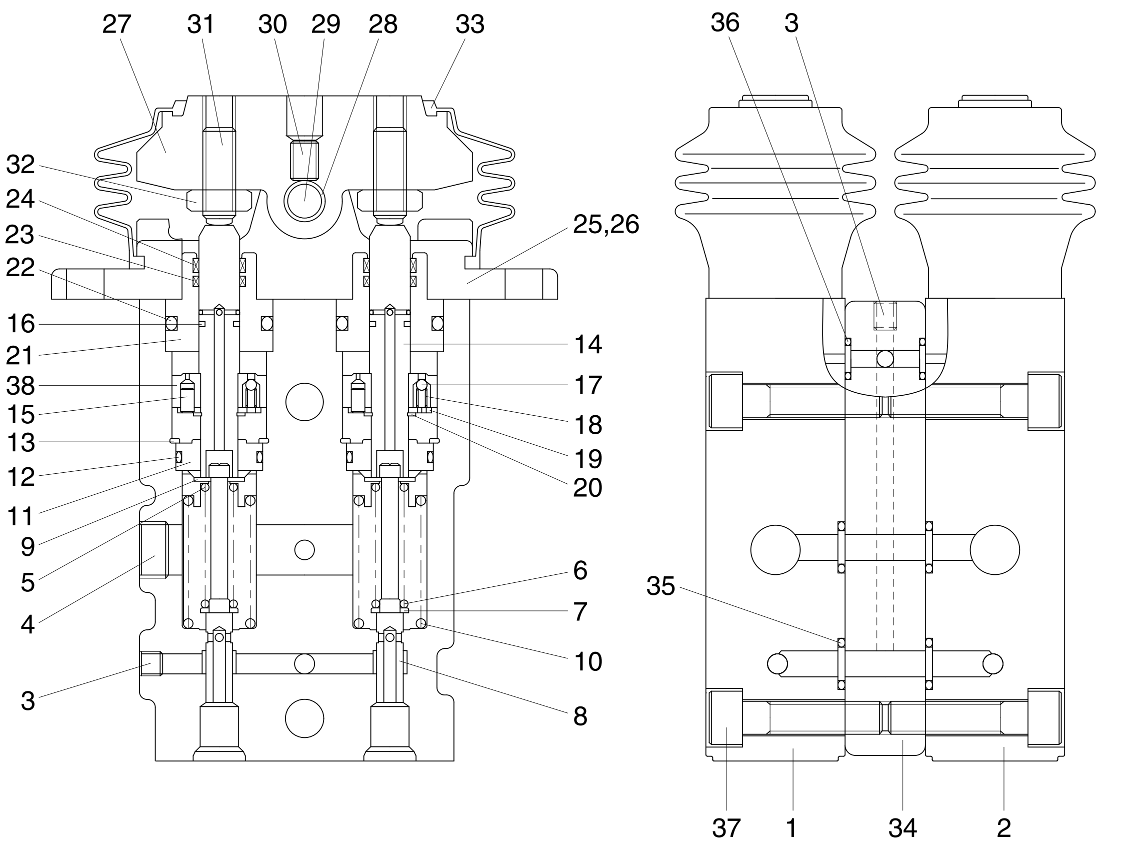
21092RP01

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.



21092RP02

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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (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.

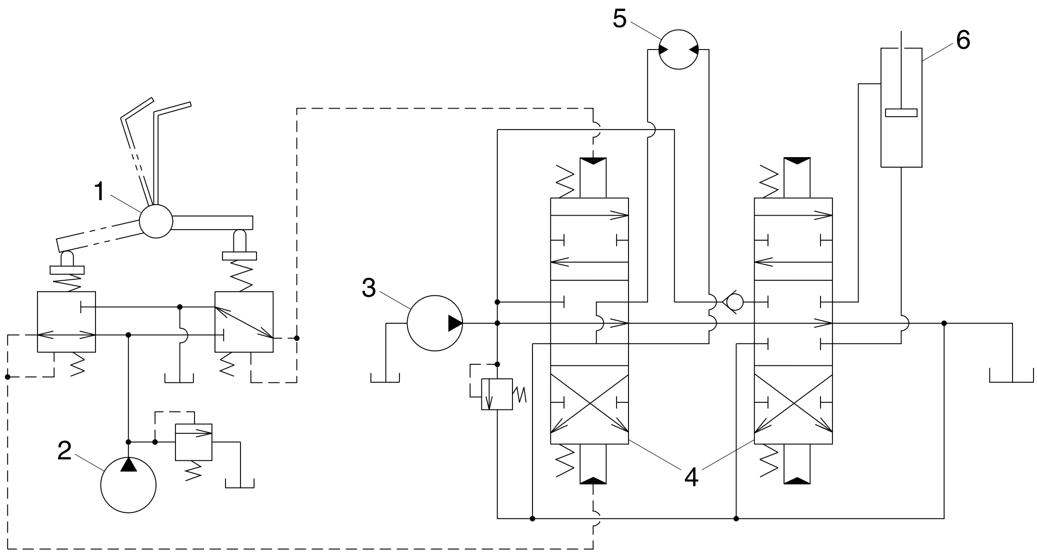
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

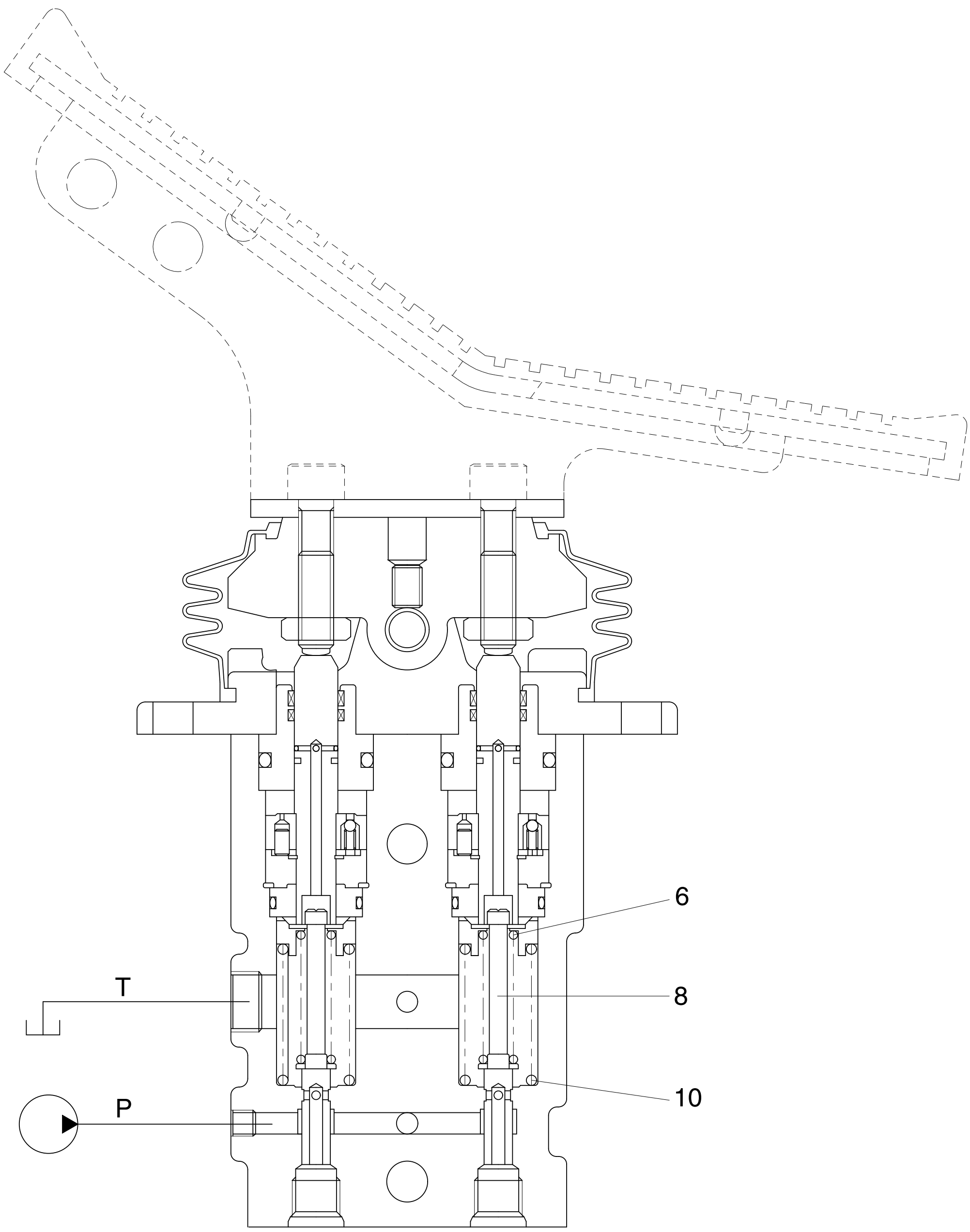
The diagram shown below is the typical application example of the pilot valve.



36072SF01

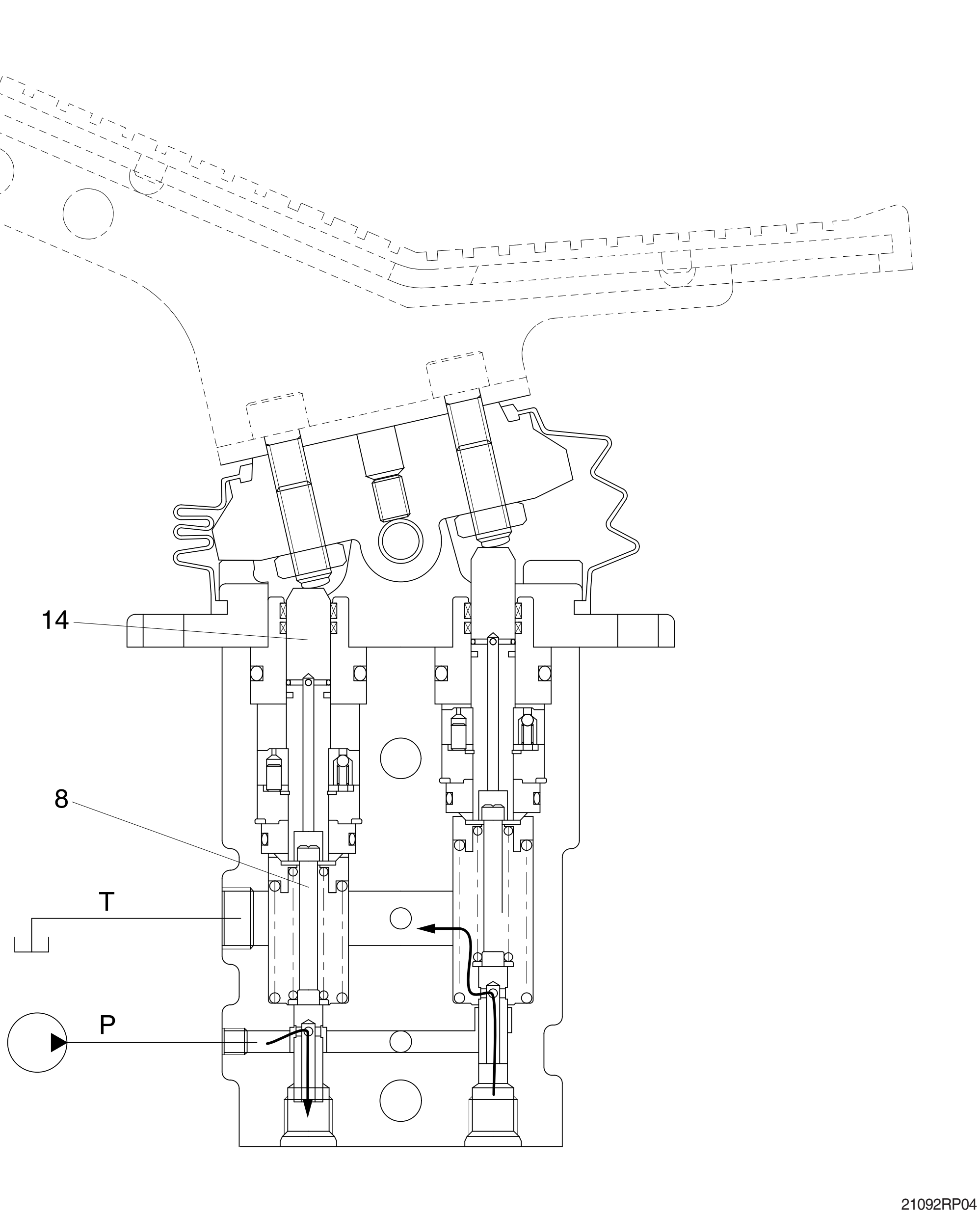
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



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.

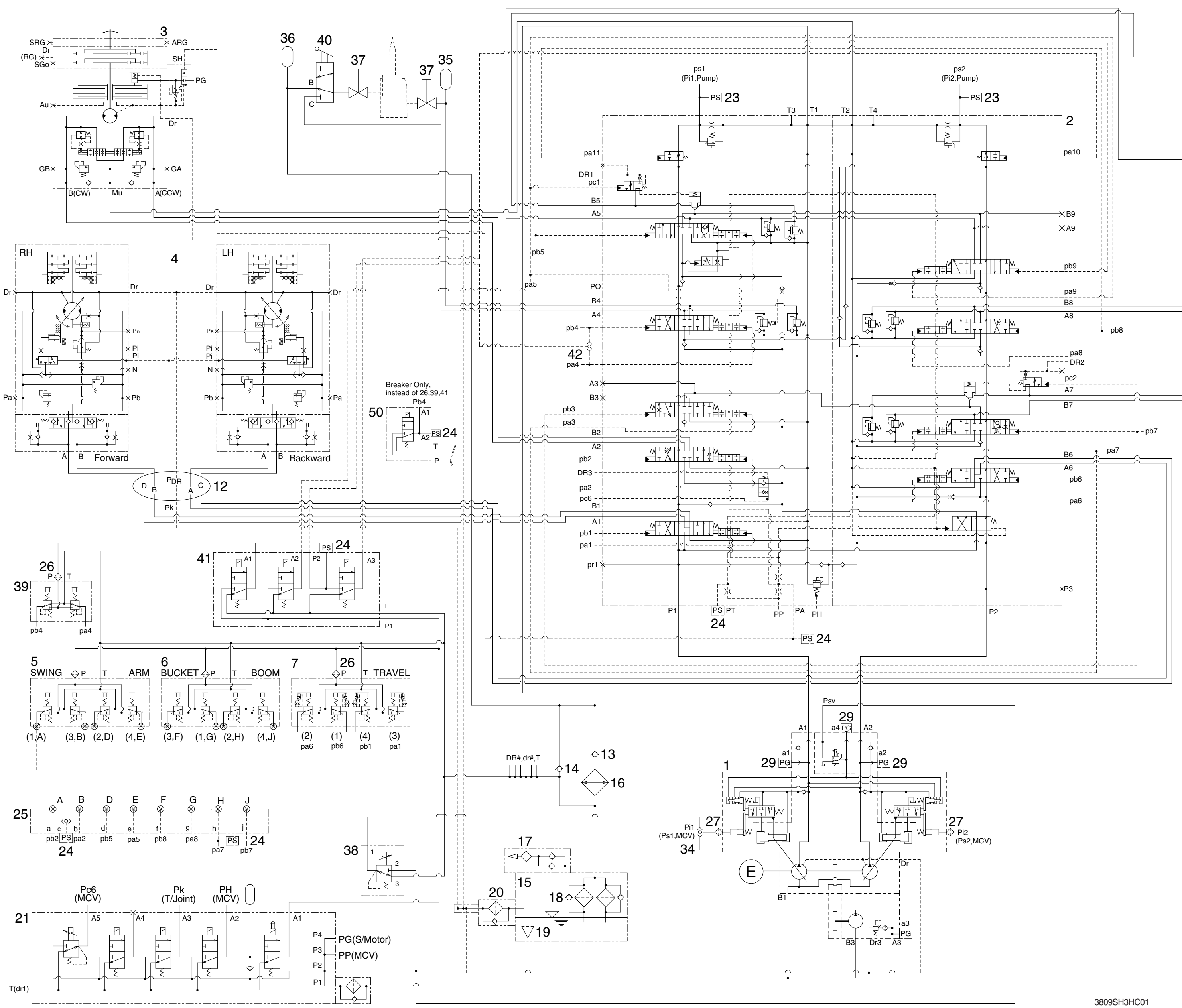
(2) Case where pedal is tilted



When the push rod (14) is stroked, the spool (8) moves downwards.
Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

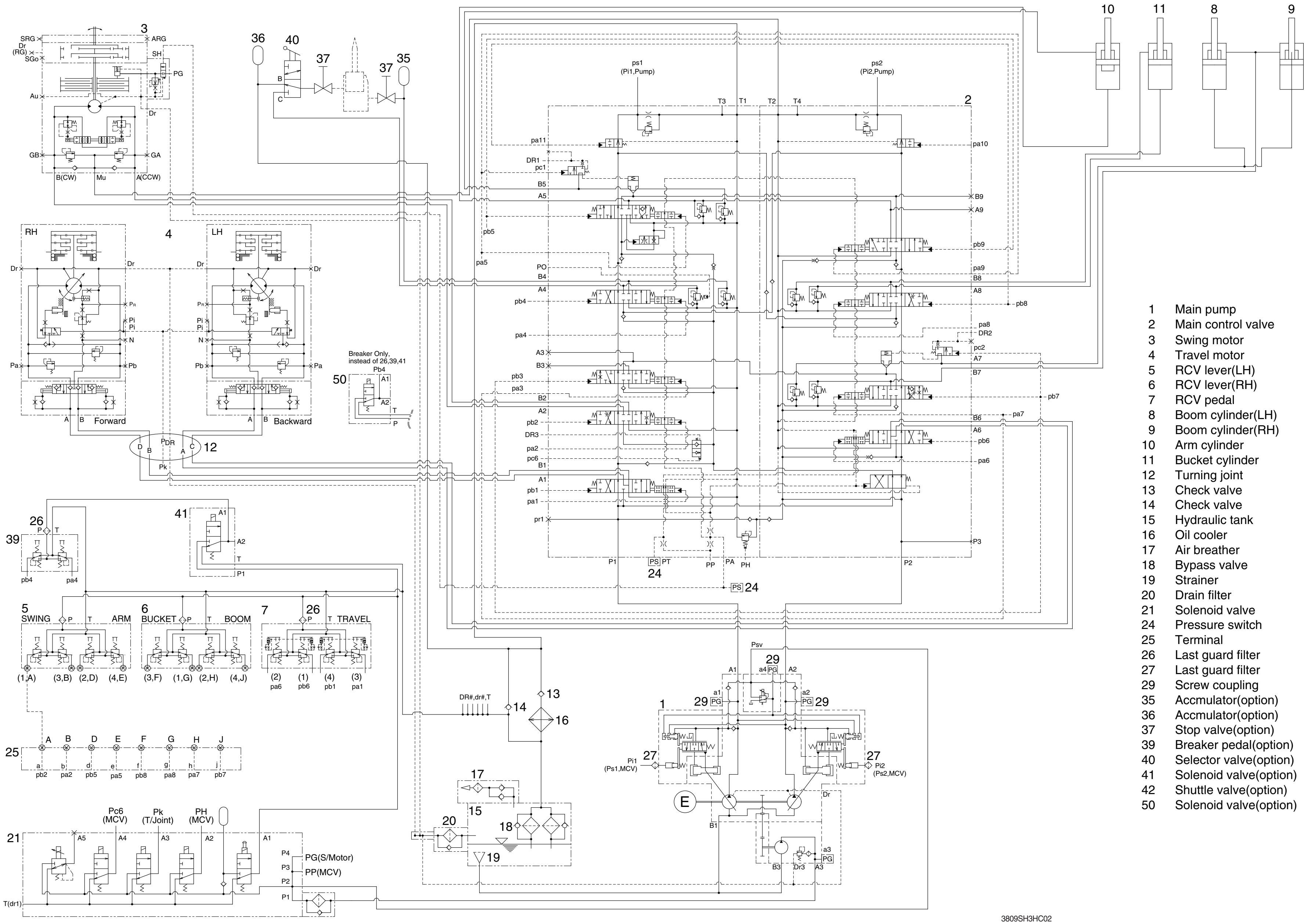
SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT (CLUSTER TYPE 1)



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 switch
23 Pressure switch
24 Pressure switch
25 Terminal
26 Last guard filter
27 Last guard filter
34 Shuttle valve
35 Accmulator(option)
36 Accmulator(option)
37 Stop valve(option)
38 EPPR valve(option)
39 Breaker pedal(option)
40 Selector valve(option)
41 Solenoid valve(option)
42 Shuttle valve(option)
50 Solenoid valve(option)

■ HYDRAULIC CIRCUIT (CLUSTER TYPE 2)



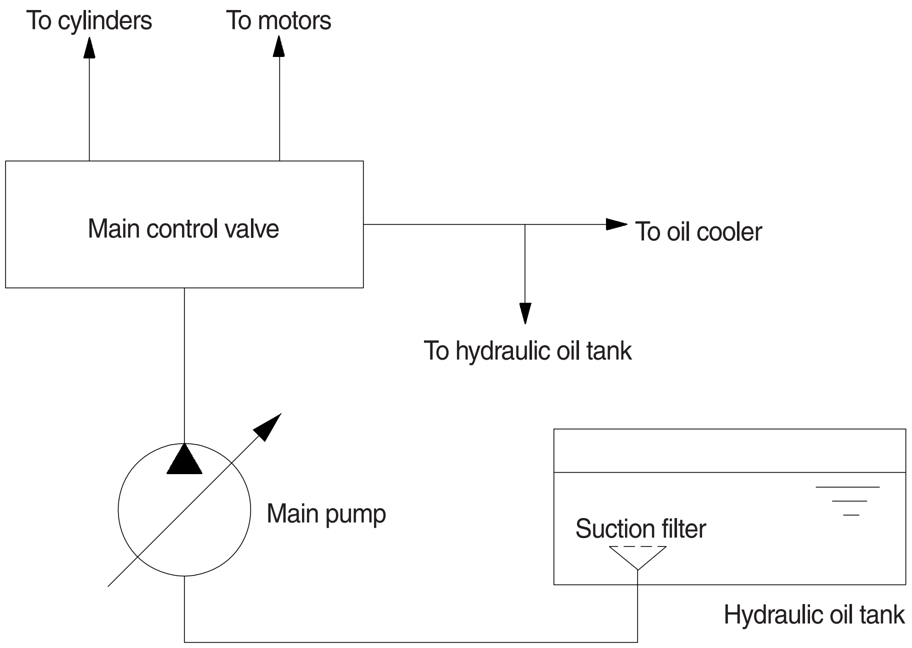
1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Bypass valve
19 Strainer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

3809SH3HC02

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.

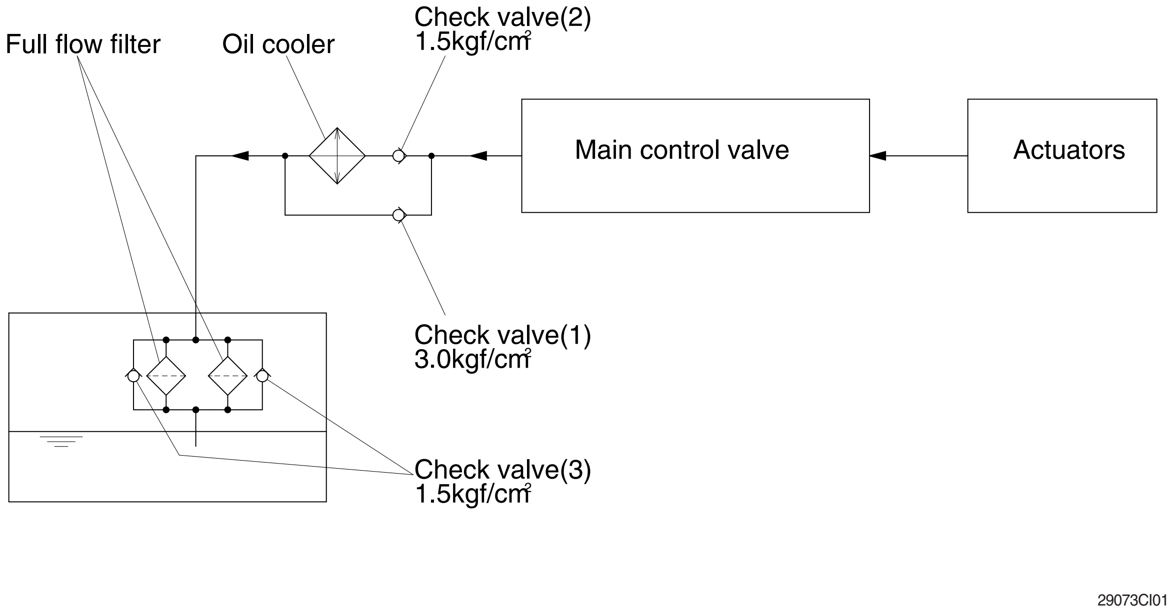
1. SUCTION AND DELIVERY CIRCUIT



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



All oil from each actuator returns to the hydraulic tank through the control valve.

The bypass check valves are provided in the return circuit.

The setting pressure of bypass check valves are 1.5 kgf/cm^2 (21psi) and 3.0 kgf/cm^2 (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/cm^2 (43psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

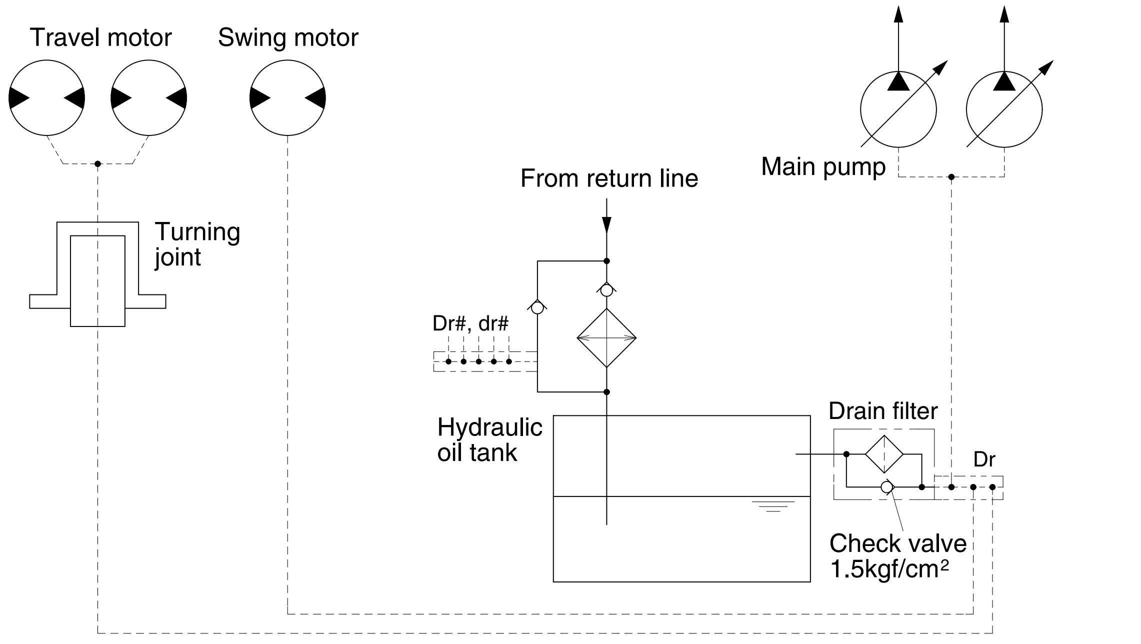
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

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/cm^2 (21psi) differential pressure.

3. DRAIN CIRCUIT



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

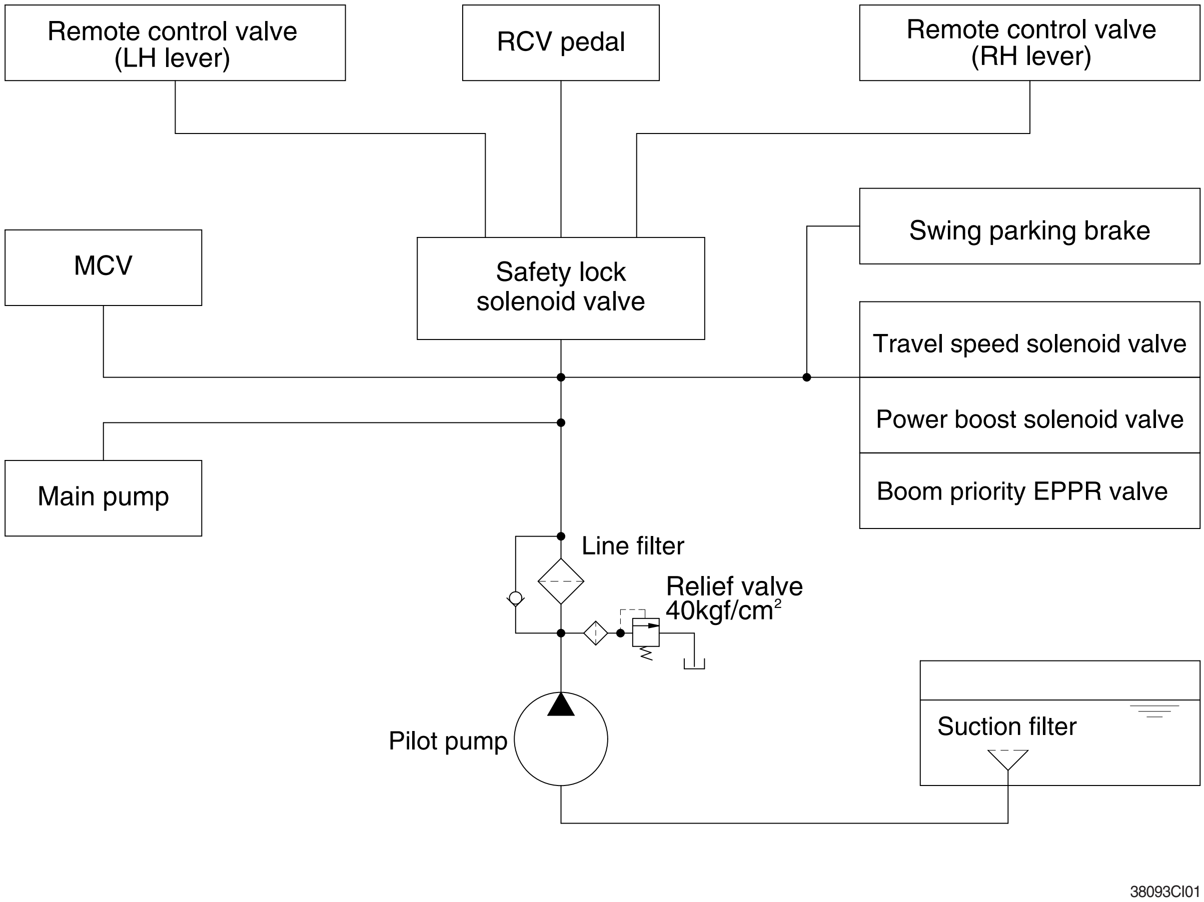
2) SWING MOTOR DRAIN CIRCUIT

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

3) MAIN PUMP DRAIN CIRCUIT

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

GROUP 3 PILOT CIRCUIT

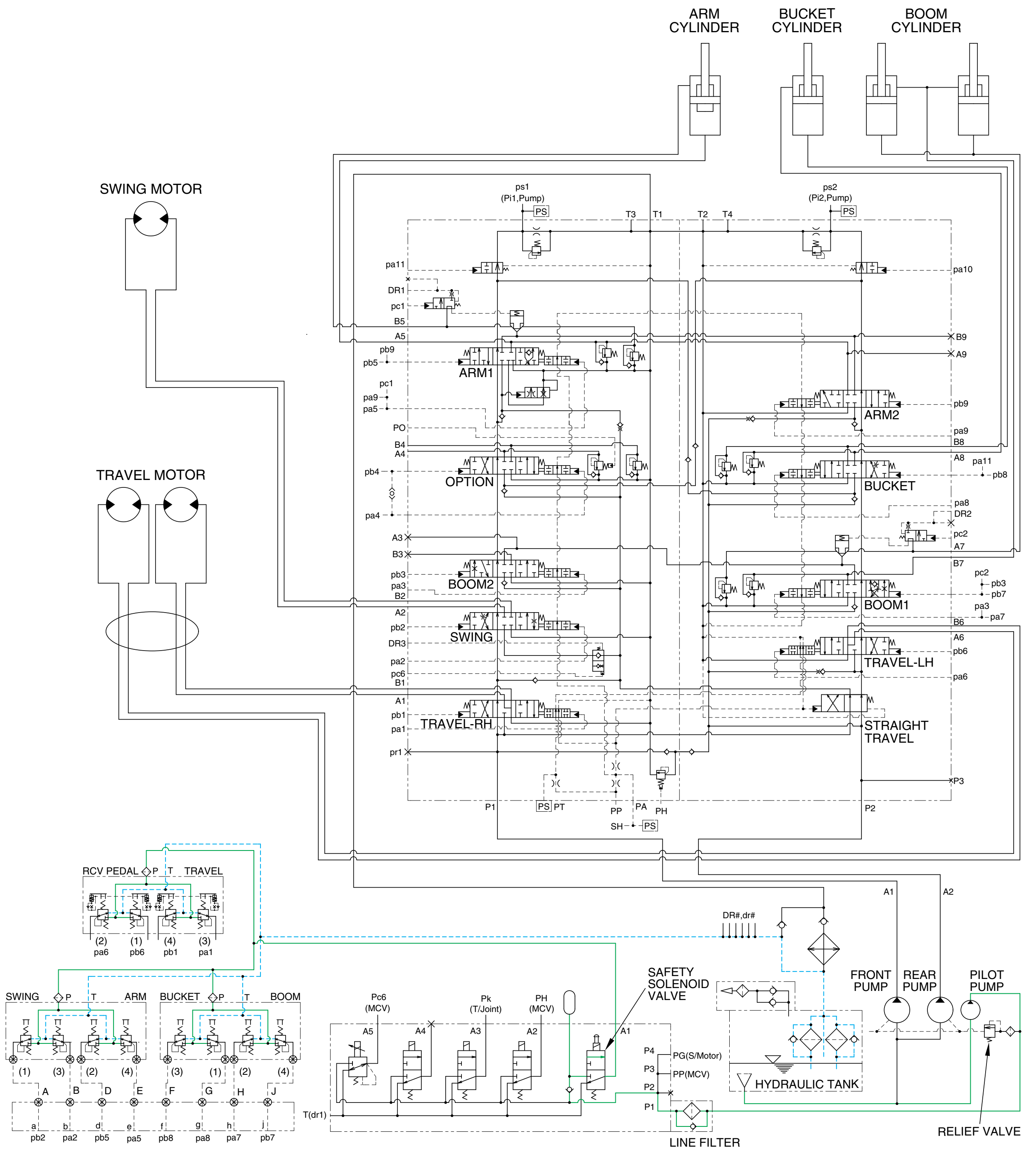


The pilot circuit consists of suction circuit, delivery circuit and return circuit.

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



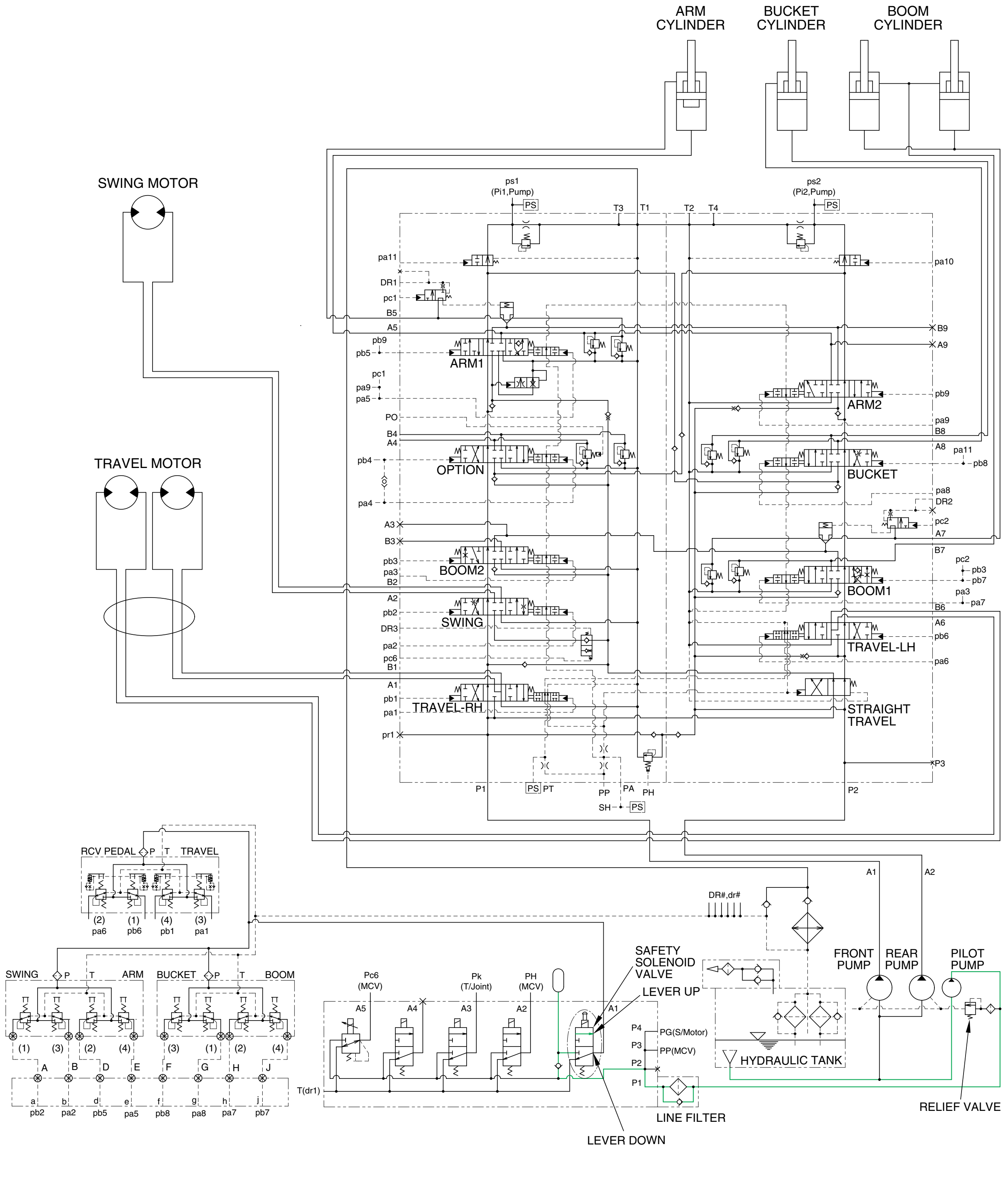
3809SH3HC04

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

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

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

2. SAFETY SOLENOID VALVE (SAFETY LEVER)



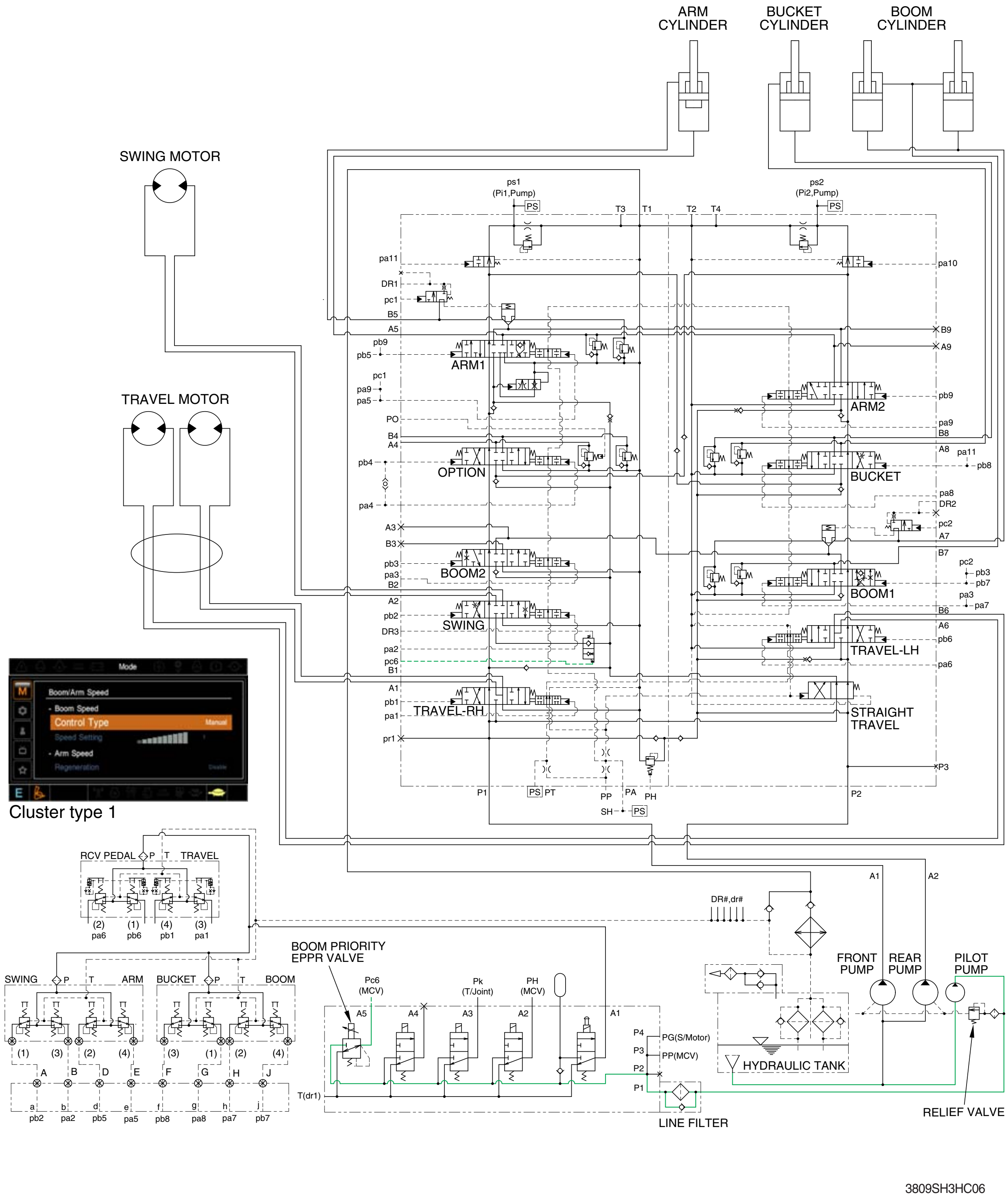
3809SH3HC05

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

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

The boom up speed can be adjusted by the cluster. Refer to page 3-12 of the operator's manual. (cluster type 1)

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.

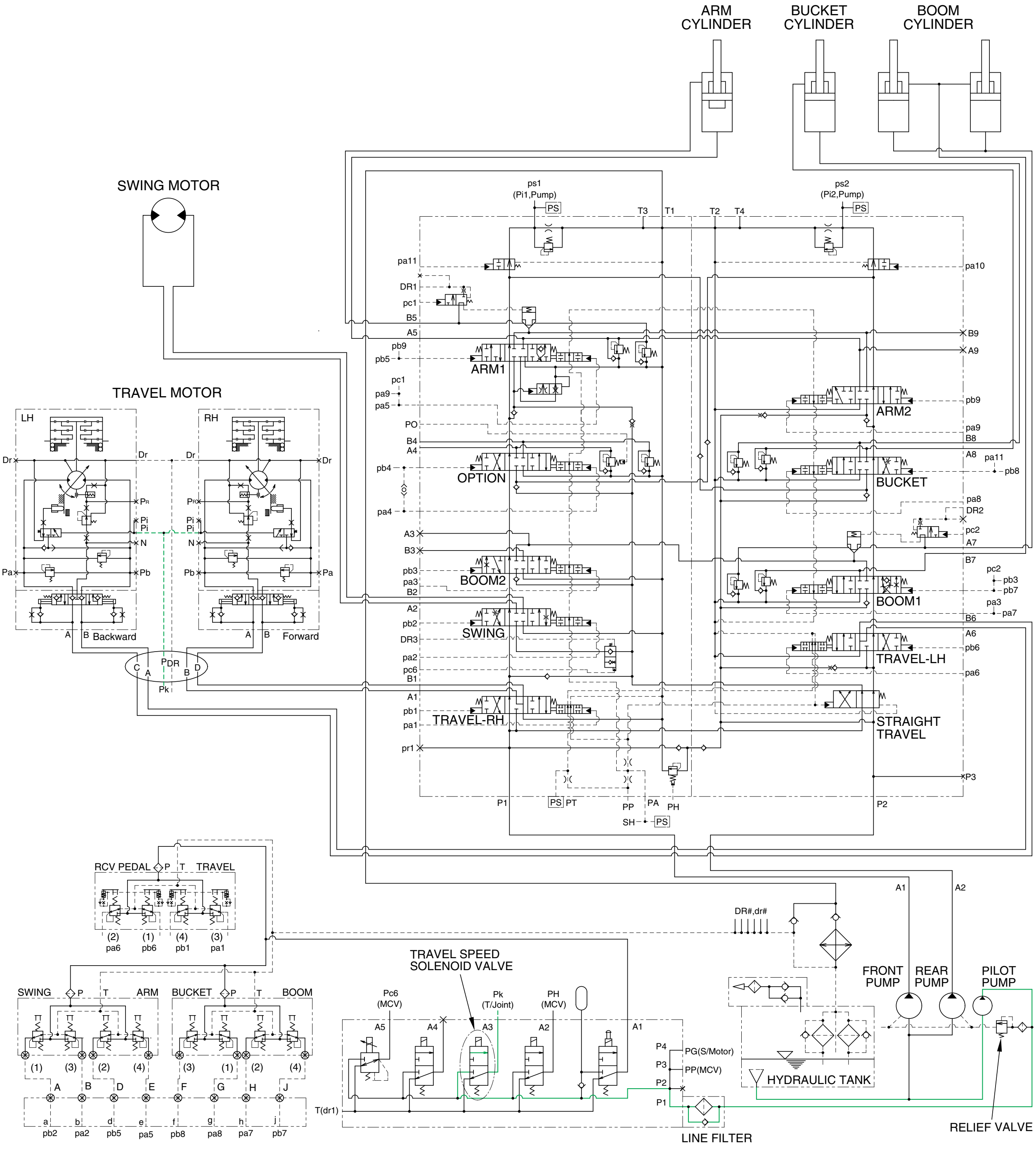
The pilot oil from pilot pump flow into Pc6 port in main control valve through boom EPPR valve.

Pc6 oil pressure moves swing reducing spool to right direction 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 the 3-12 of the operator's manual. (cluster type 1)

4. TRAVEL SPEED CONTROL SYSTEM



3809SH3HC07

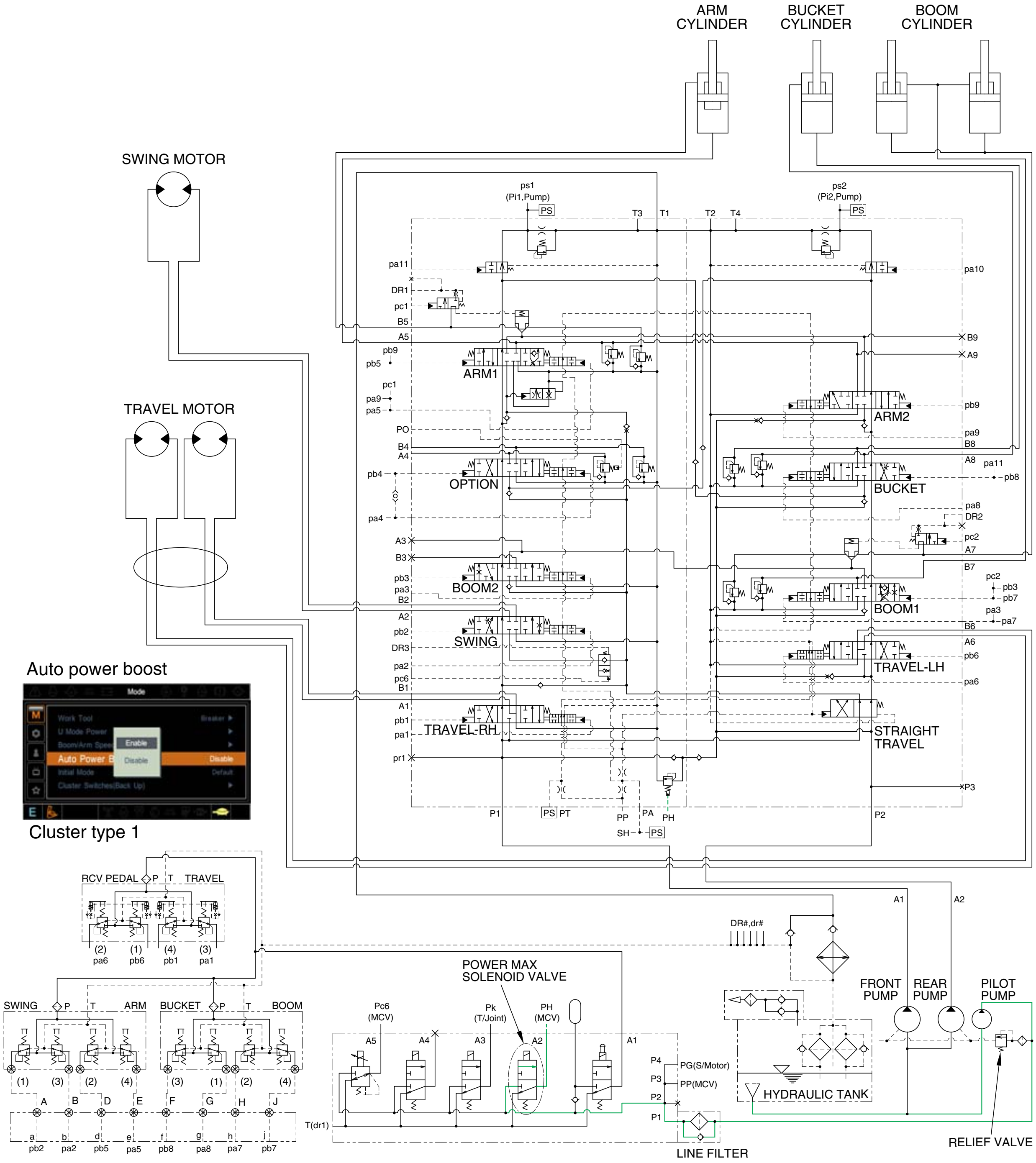
When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the **Pi** port of pilot valve in the travel motors.

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 **Pi** port returns to the hydraulic tank.

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

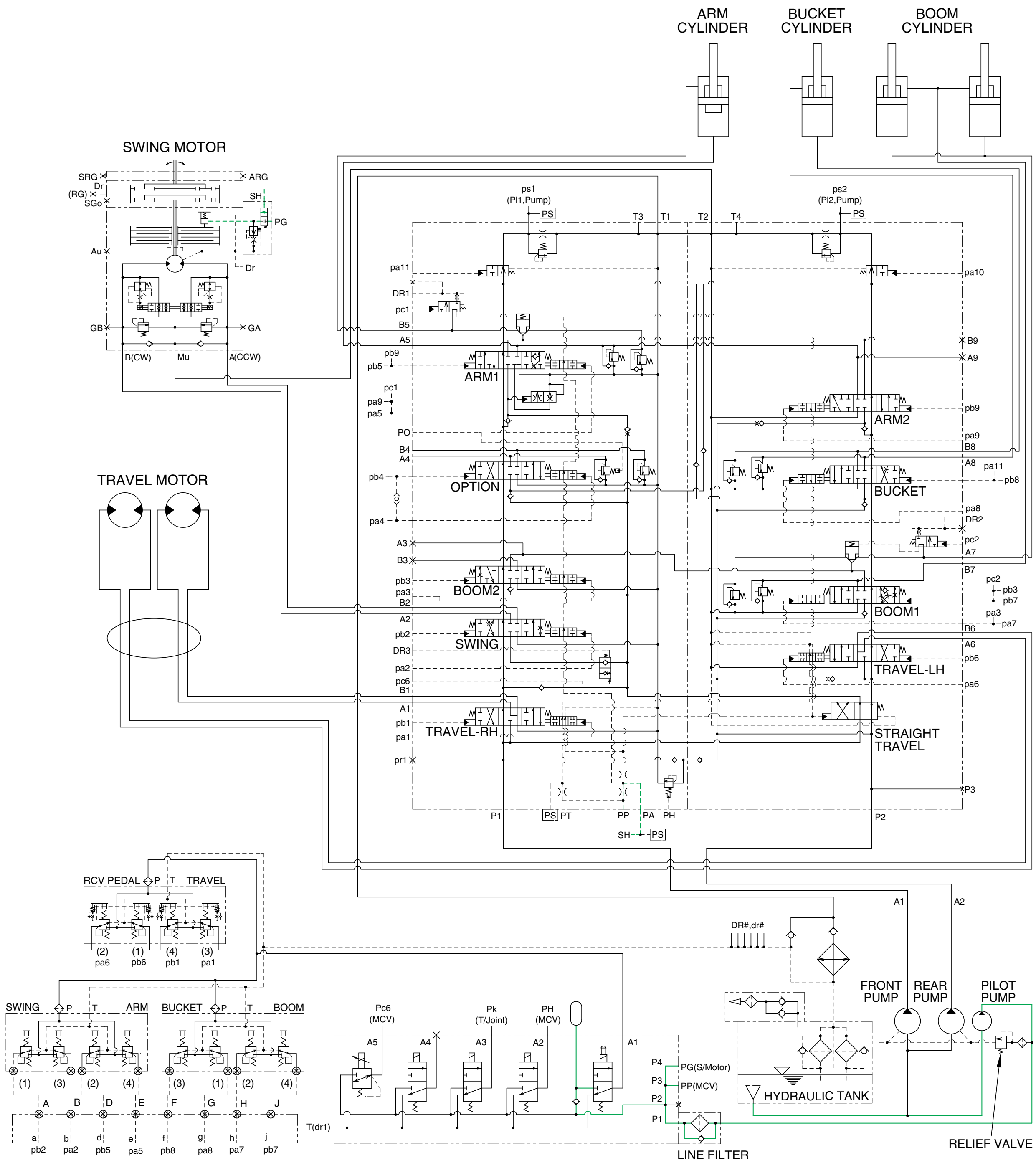
5. MAIN RELIEF PRESSURE CHANGE CIRCUIT



3809SH3HC08

When the power max switch on the left control lever is pushed ON, the power max solenoid valve is actuated, the discharged oil from the pilot pump flow into PH port of the main relief valve of main control valve ; Then the setting pressure of the main control valve is raises from 330 kgf/cm^2 to 360 kgf/cm^2 for increasing the digging power. And even when press 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. (cluster type 1)

6. SWING PARKING BRAKE RELEASE



3809SH3HC09

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

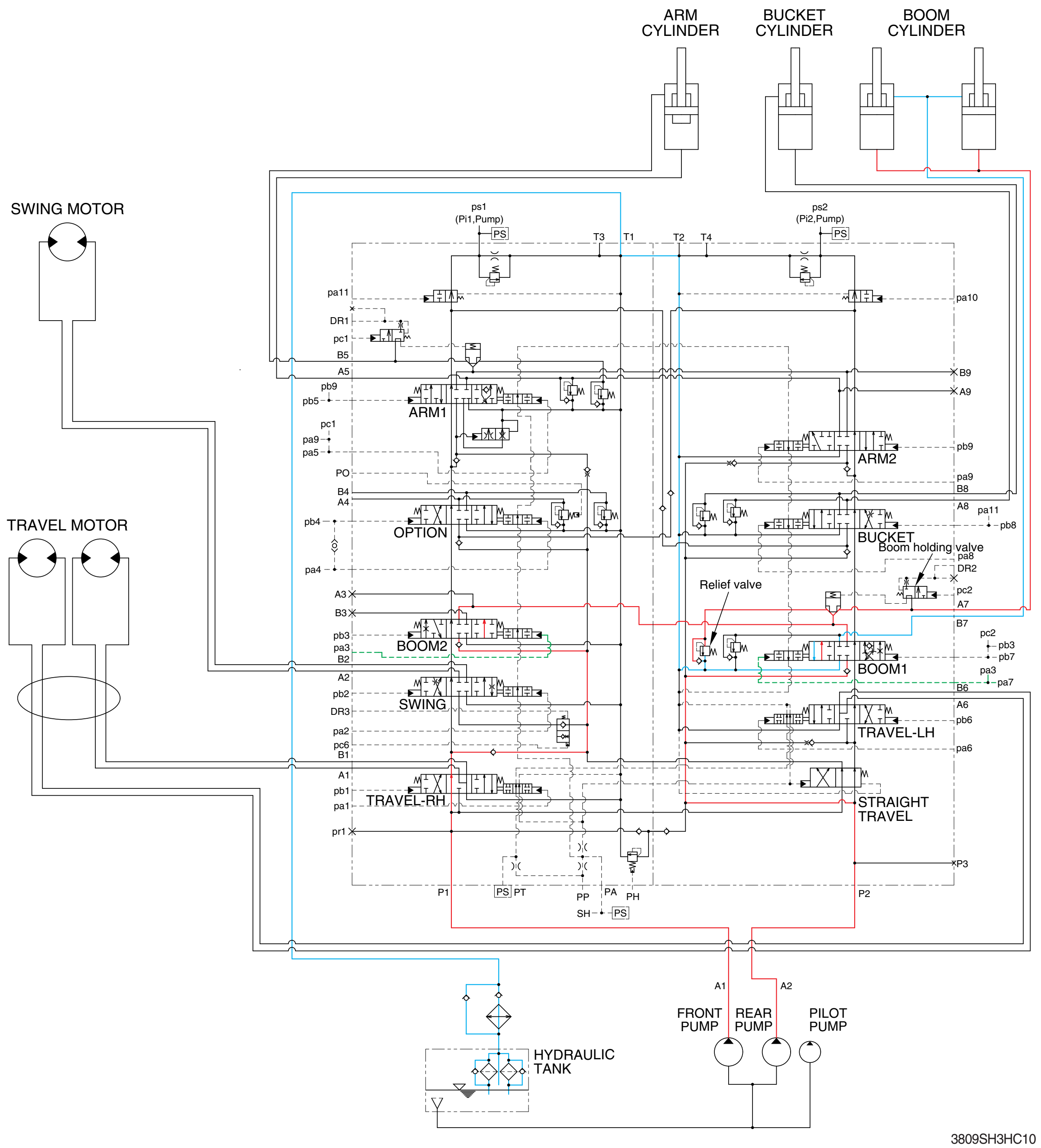
This pressure moves spool so, discharged oil from pilot valve flows to swing motor PG port.

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.

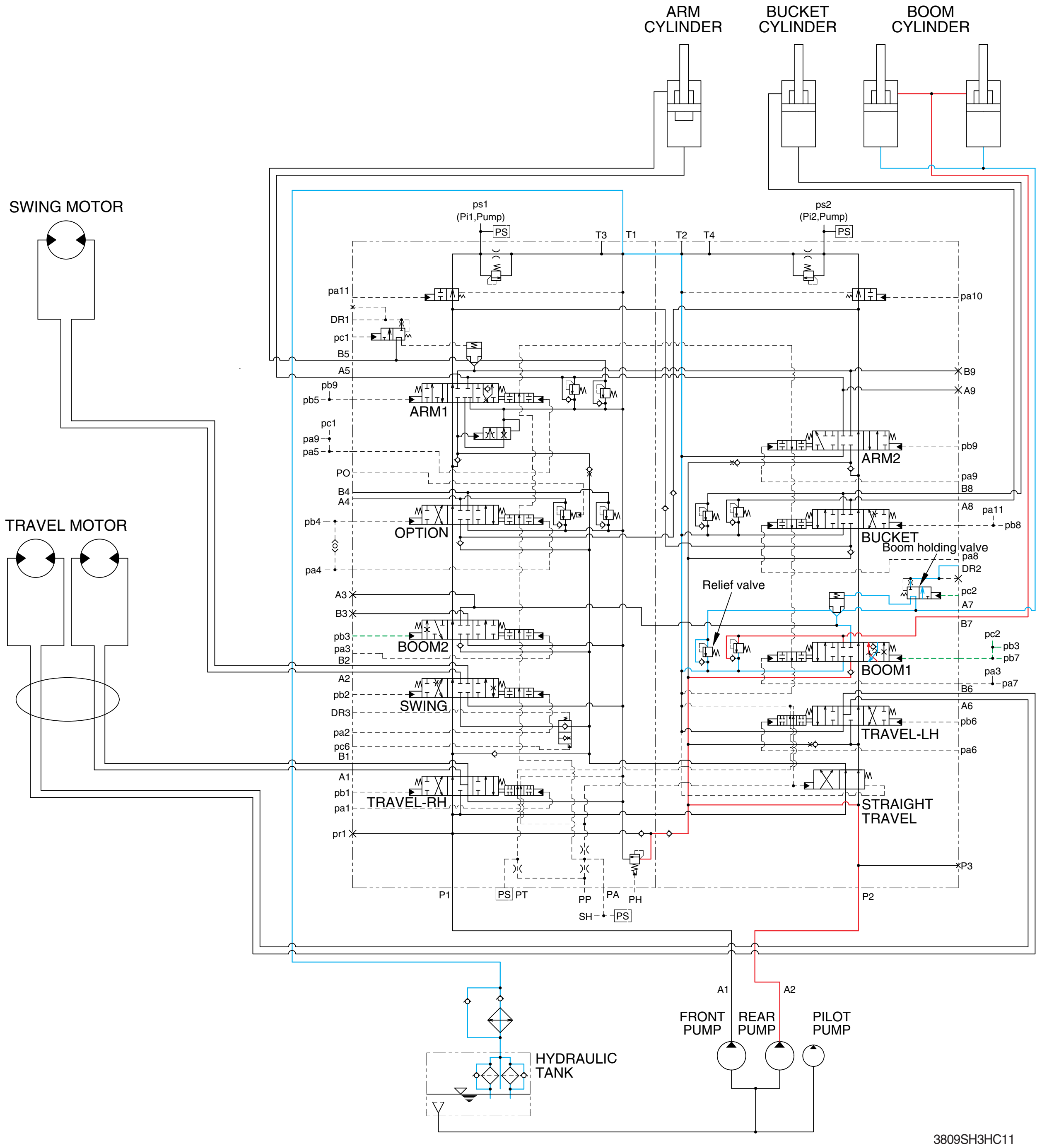
GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



When the RH control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure from the remote control valve.
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinders.
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up.
The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve.
When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the bottom end of the boom cylinder is closed by the boom holding valve.
This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



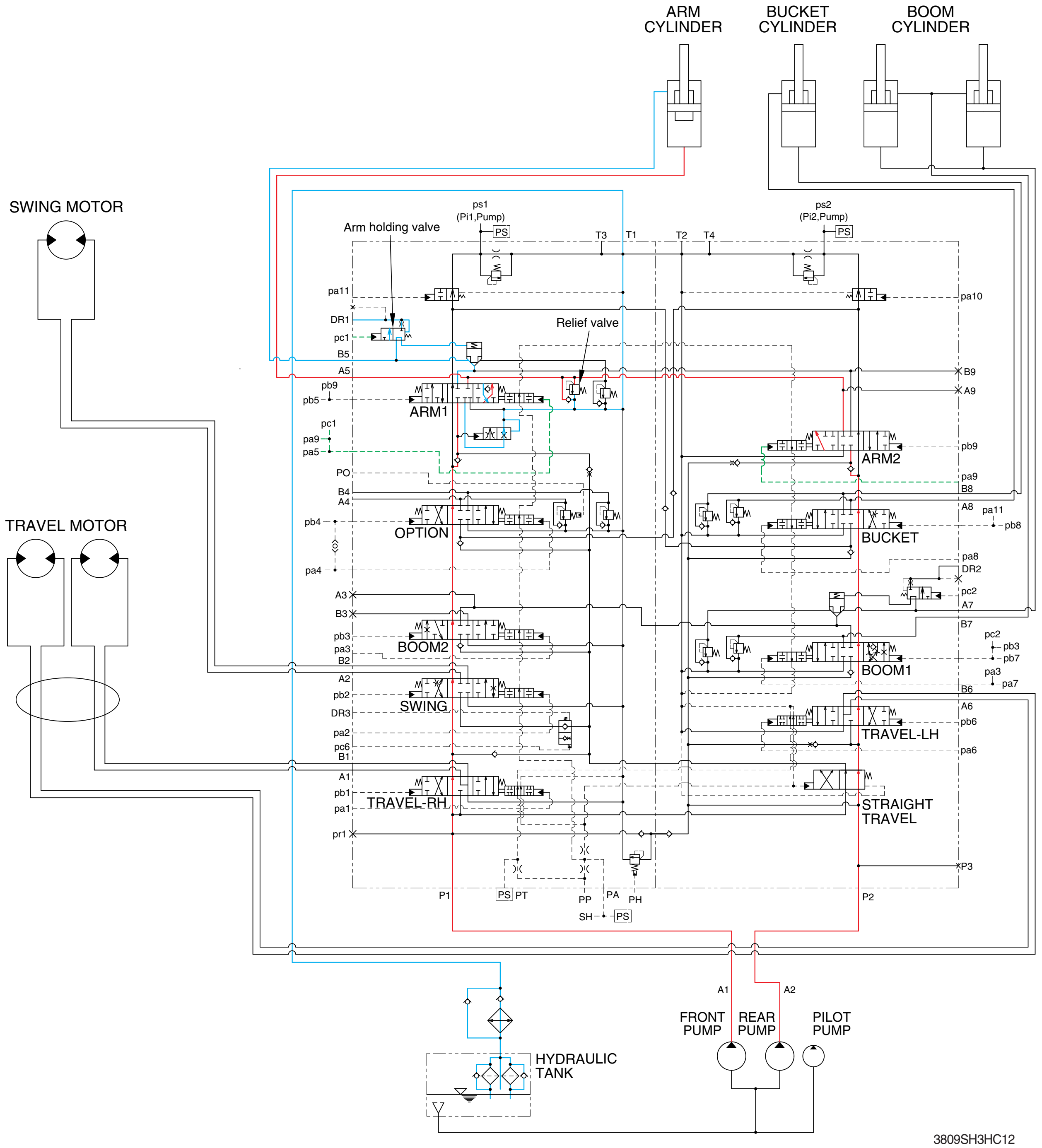
When the RH control lever is pushed forward, the boom 1 spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.

The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1 spool in the main control valve.

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

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

3. ARM IN OPERATION



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

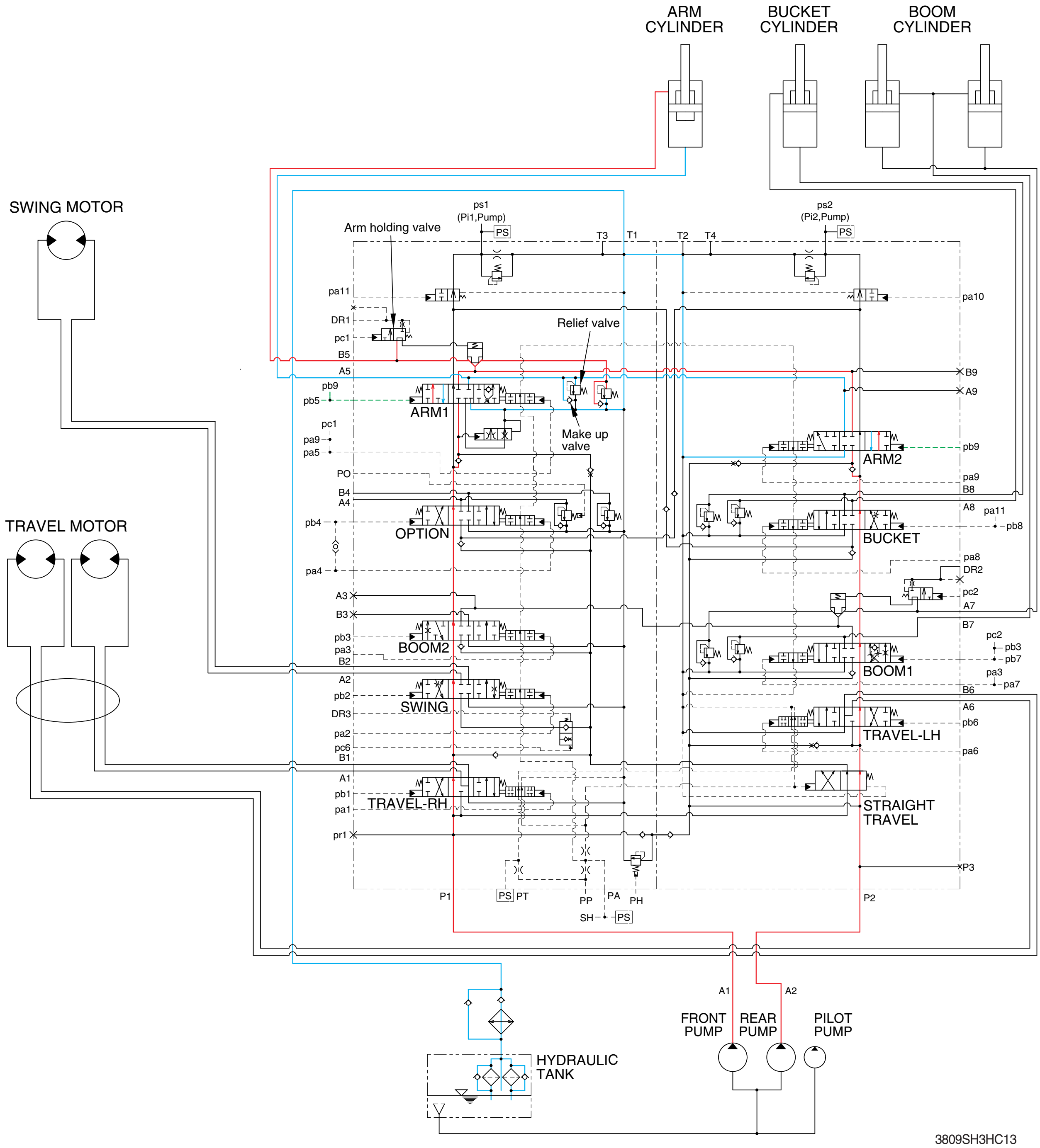
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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

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

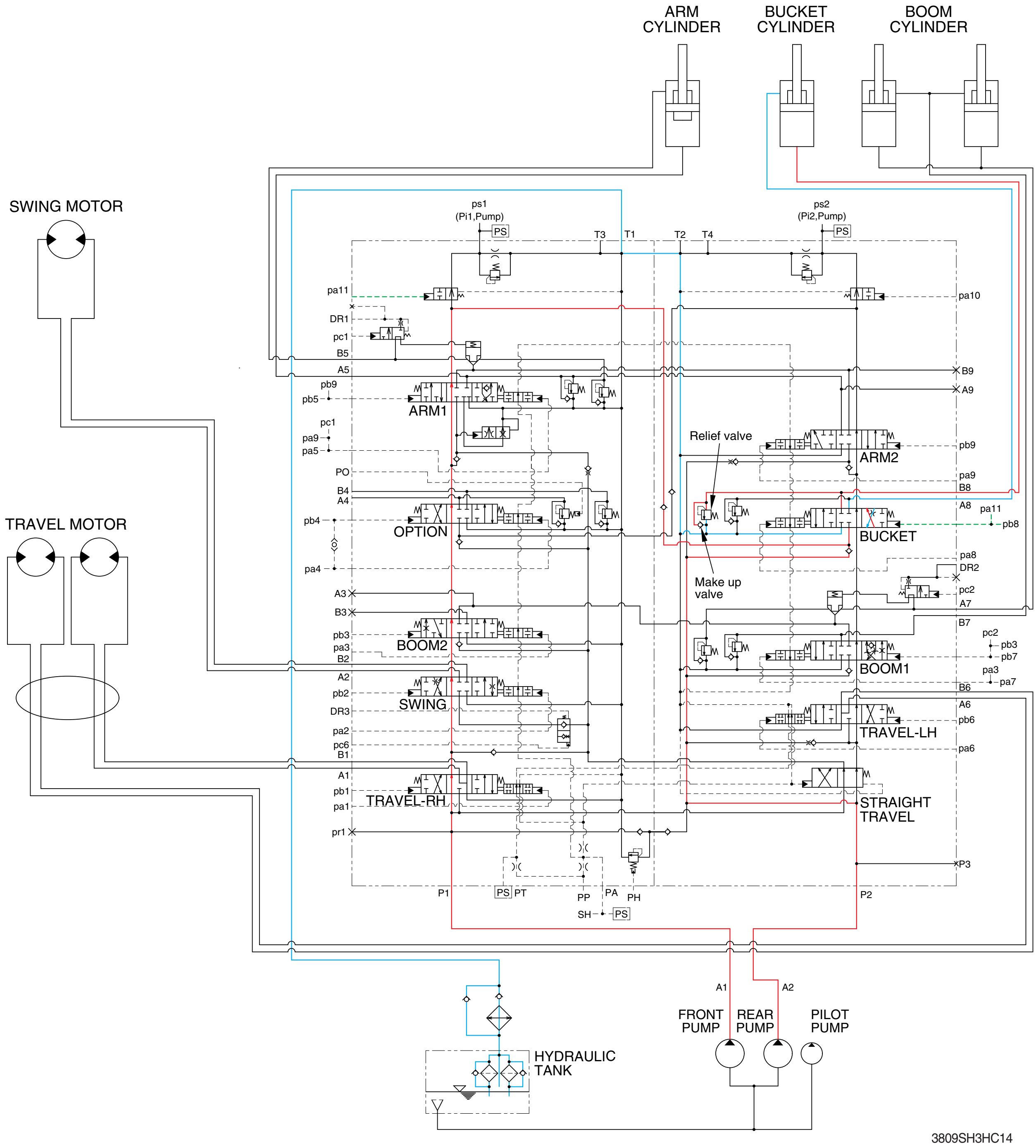
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spools in the main control valve. When this happens, the arm rolls out.

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

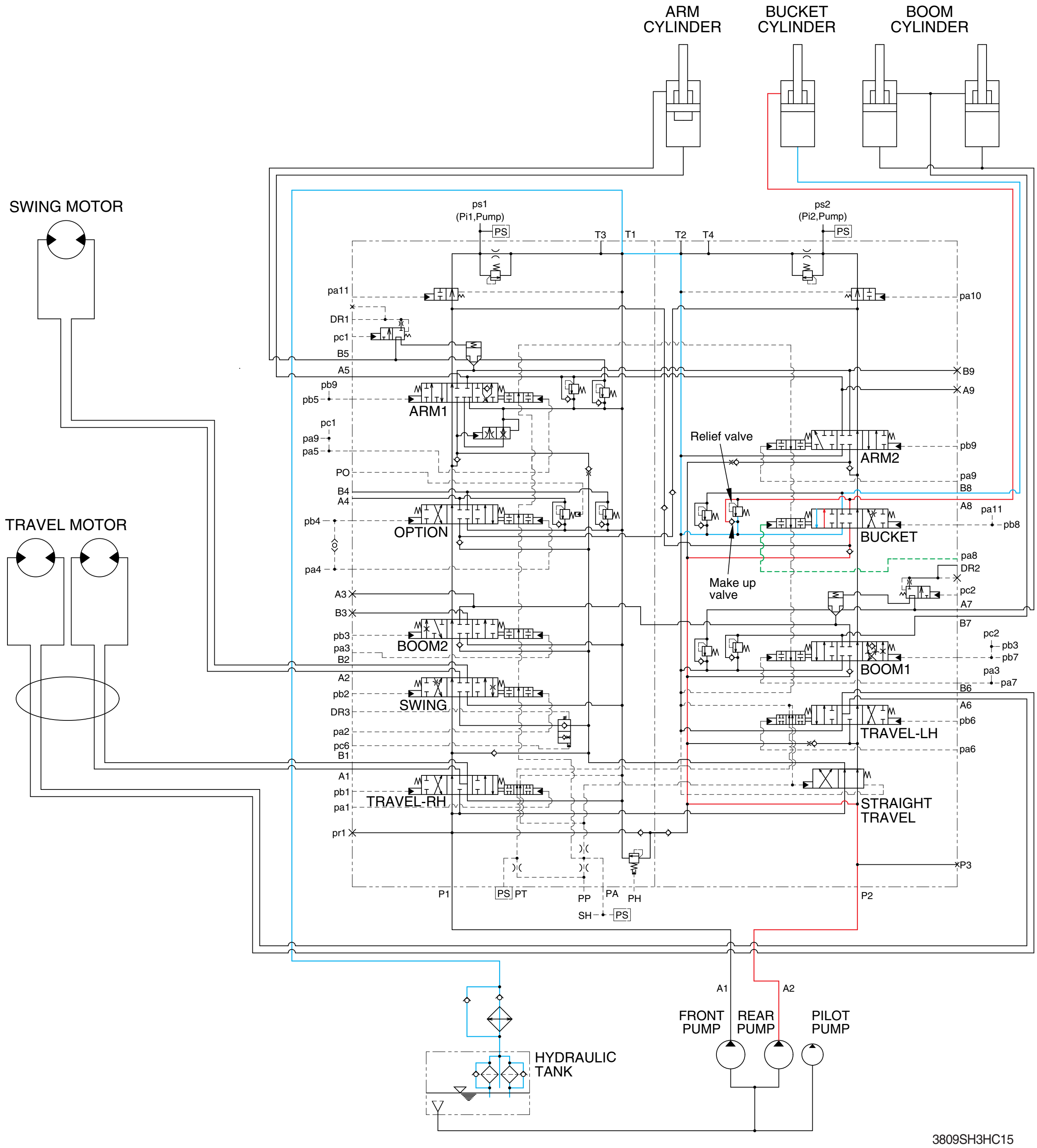
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder. The oil form the A1 pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (pa11).

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



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

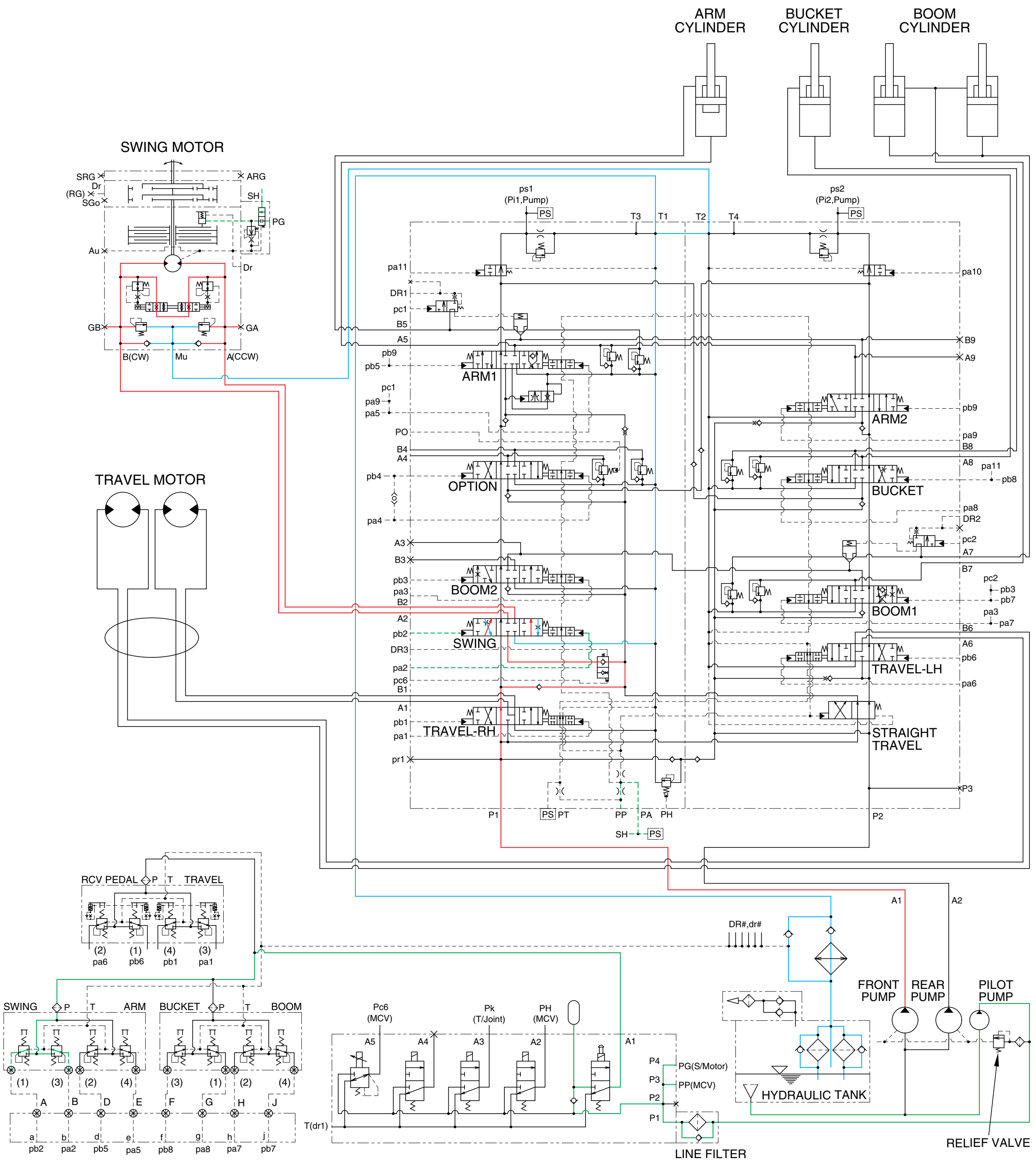
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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



3809SH3HC16

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

The oil from the A1 pump flows into the main control valve and then goes to the swing motor.

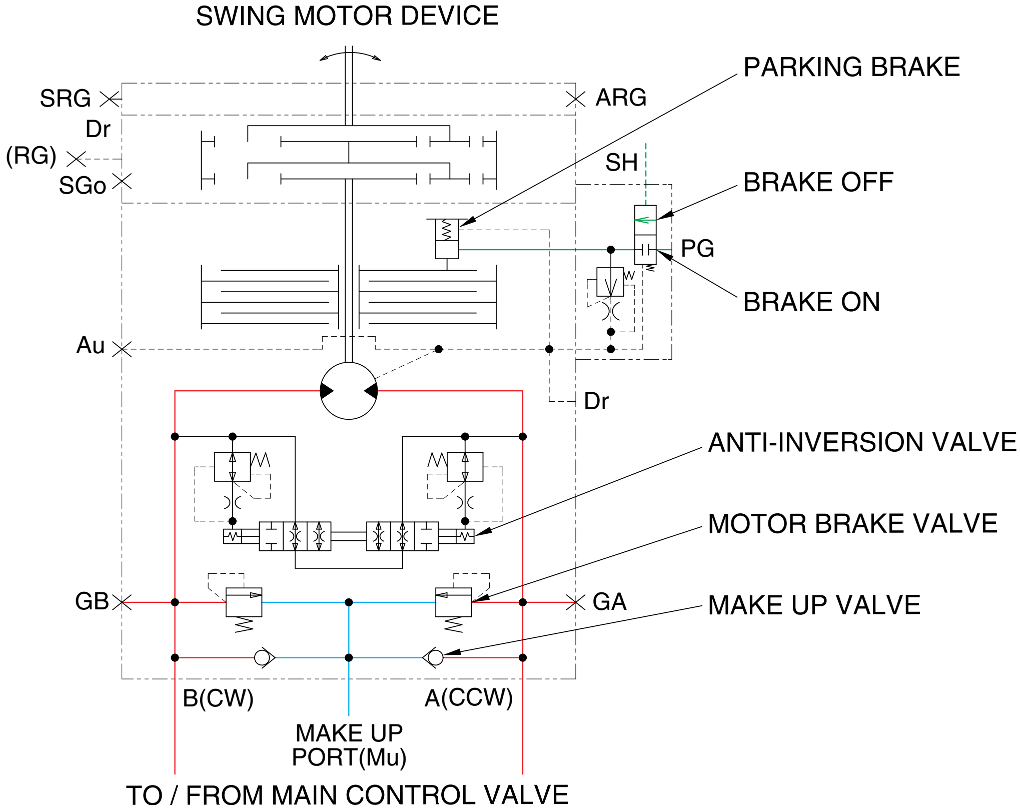
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

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

The swing parking brake, make up valve and the motor brake valve are provided in the swing motor.

The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



3809SH3HC17

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.

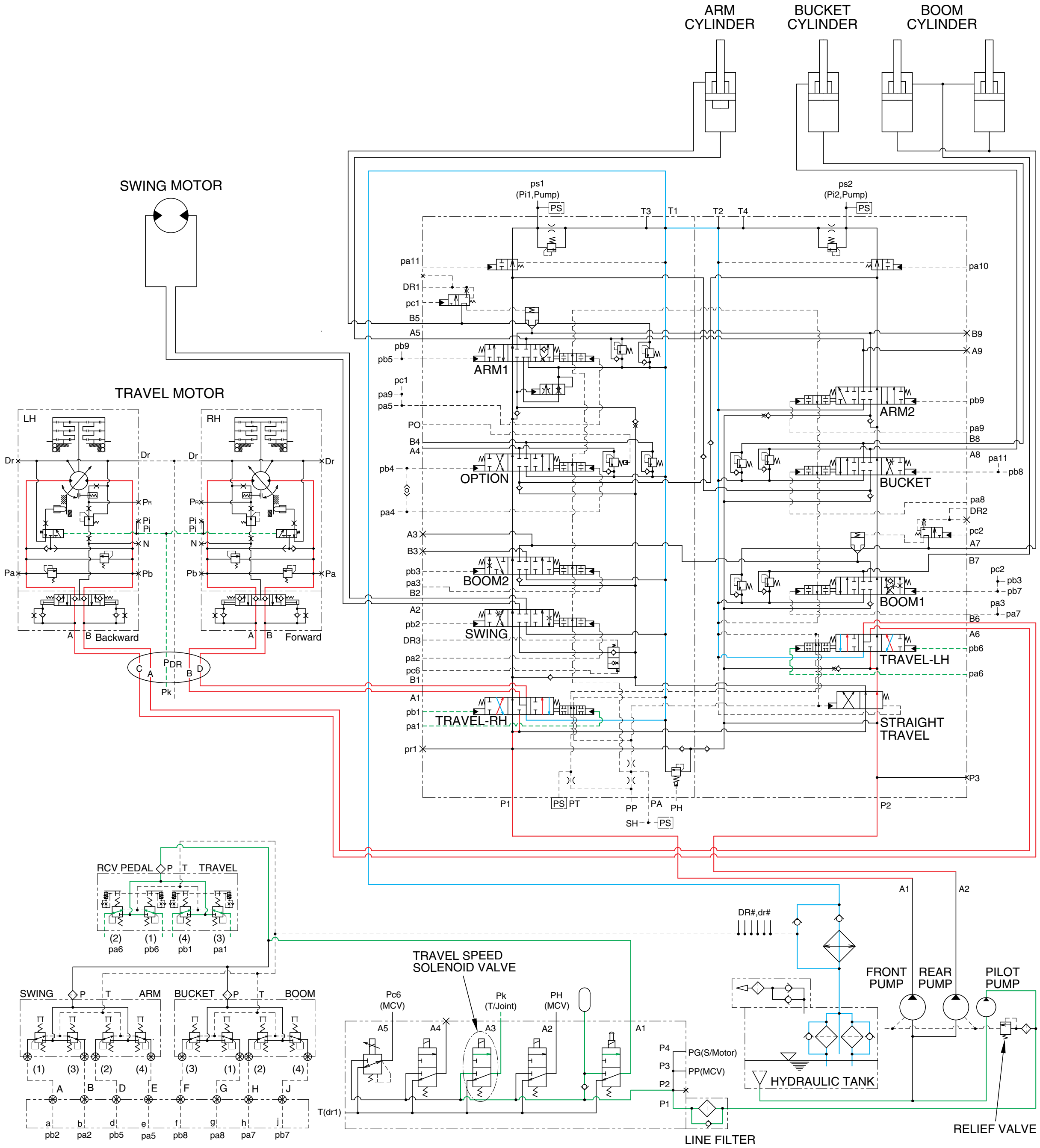
PARKING BRAKE "ON" OPERATION

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



3809SH3HC18

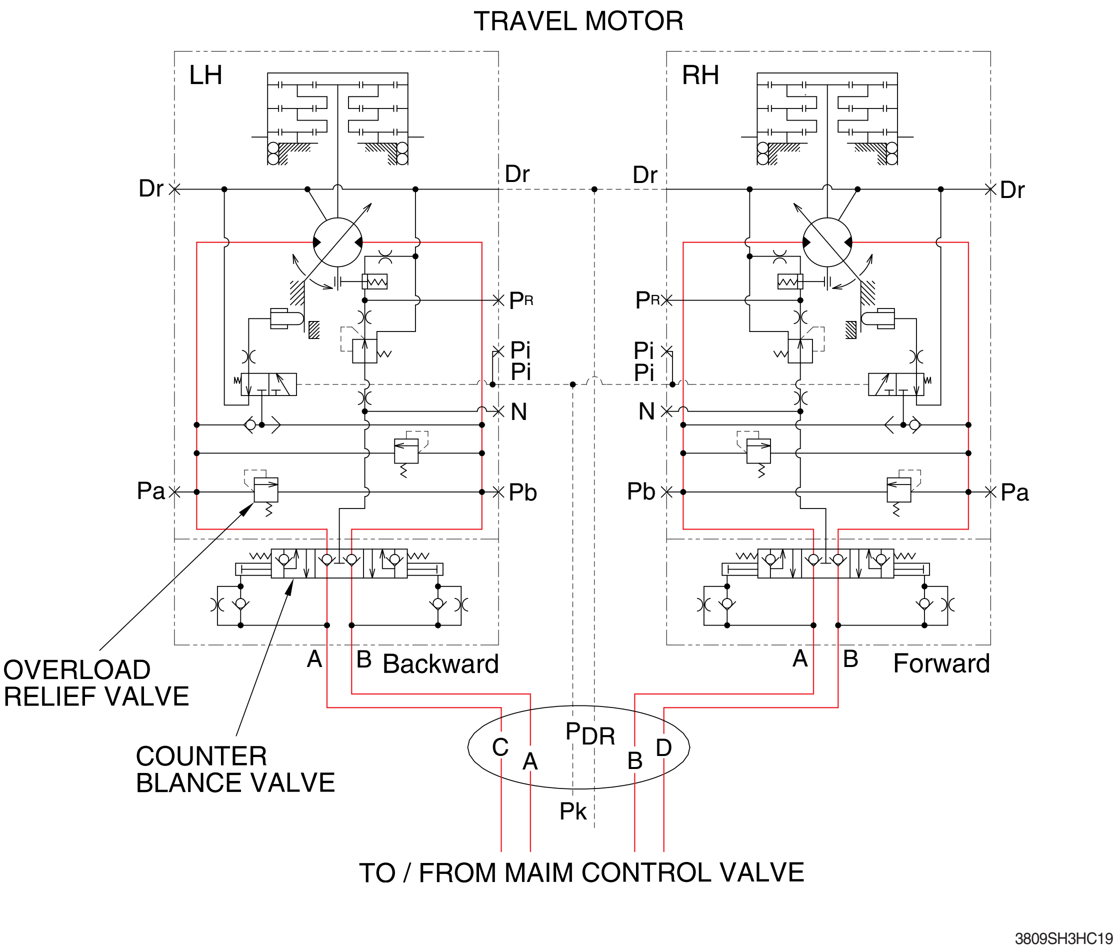
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

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



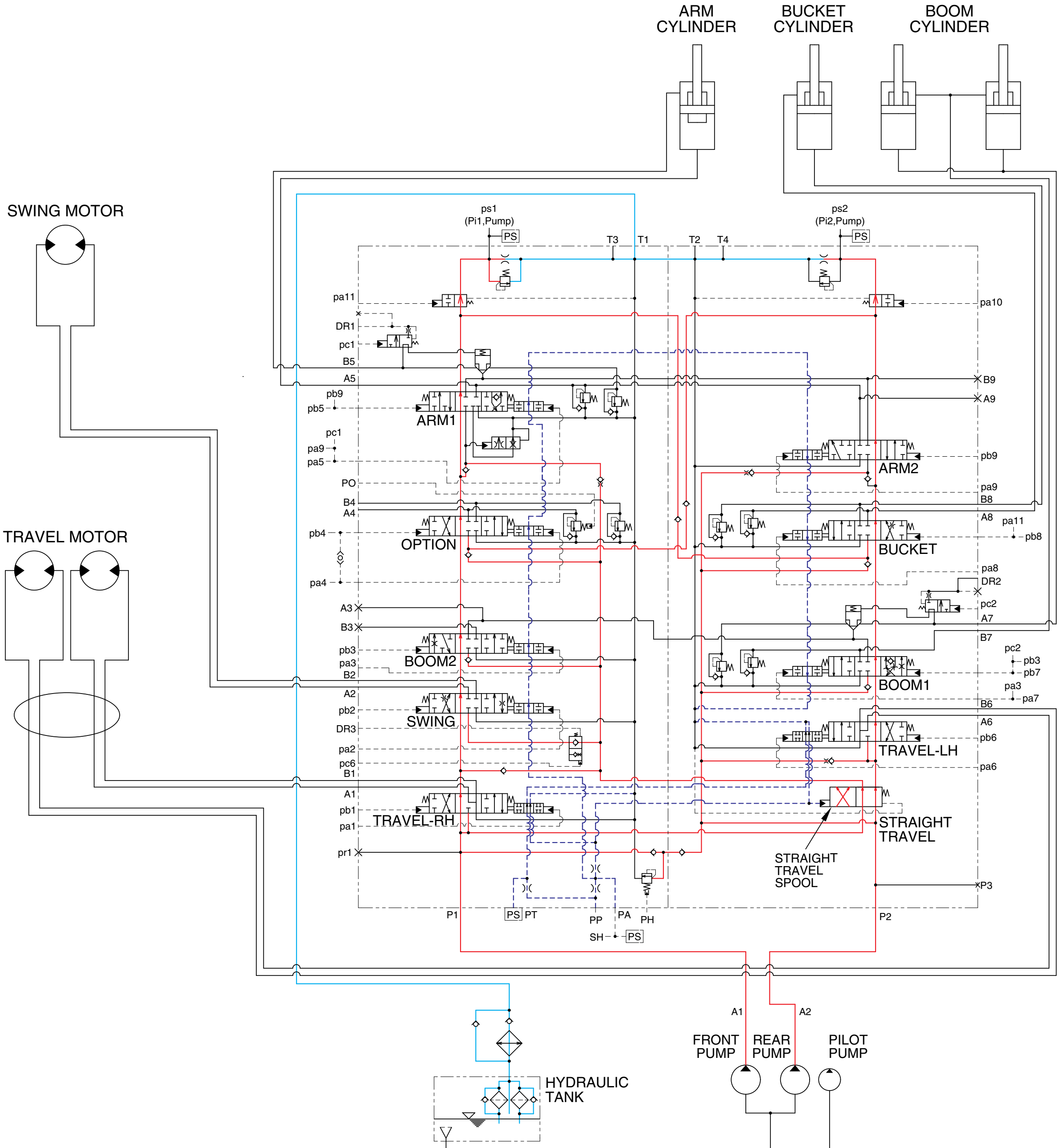
Valves are provided on travel motors to offer the following functions.

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 360 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



3809SH3HC20

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

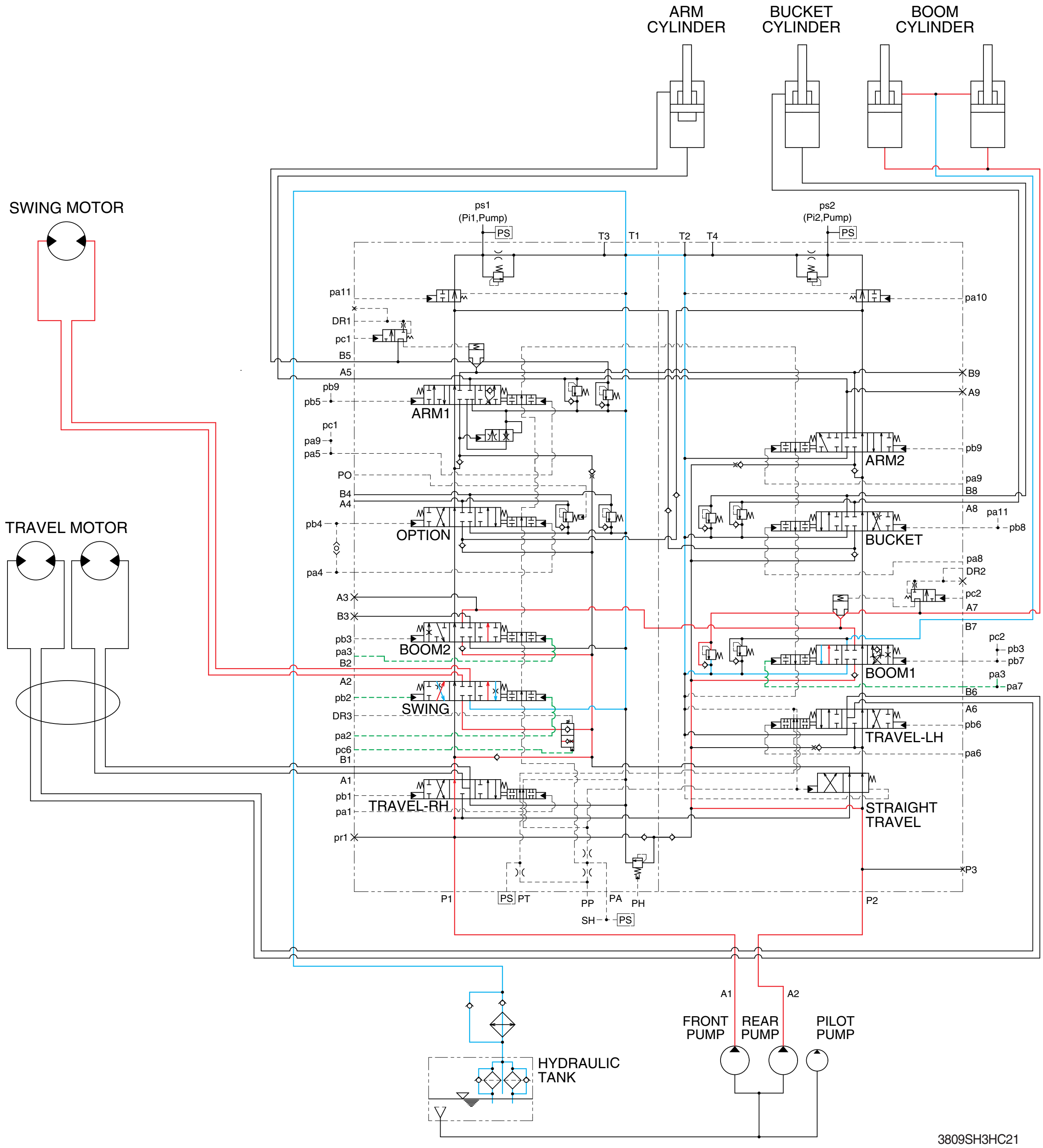
STRAIGHT TRAVEL SPOOL

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

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

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

2. COMBINED SWING AND BOOM UP OPERATION



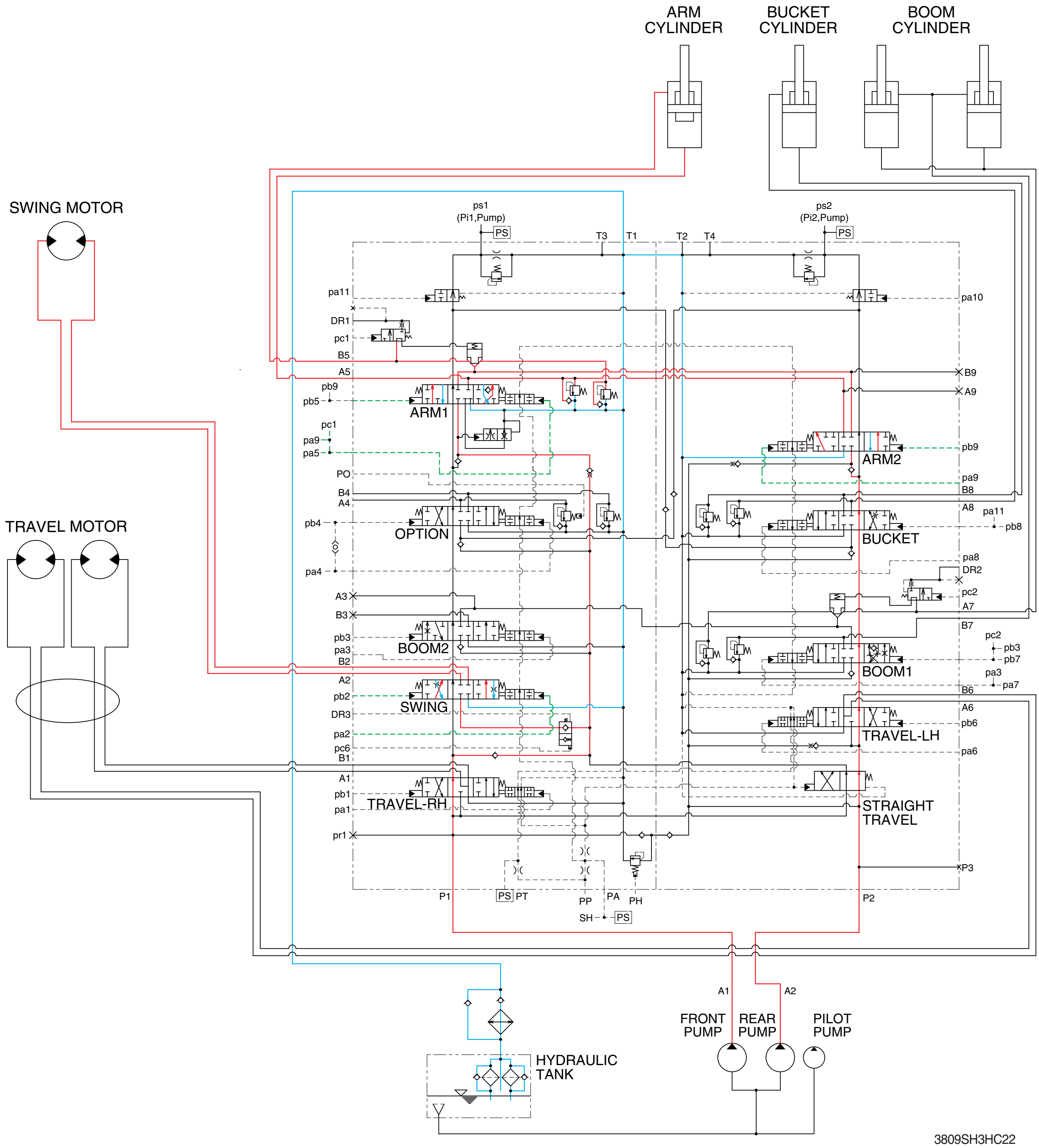
When the swing and boom up functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

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

3. COMBINED SWING AND ARM OPERATION



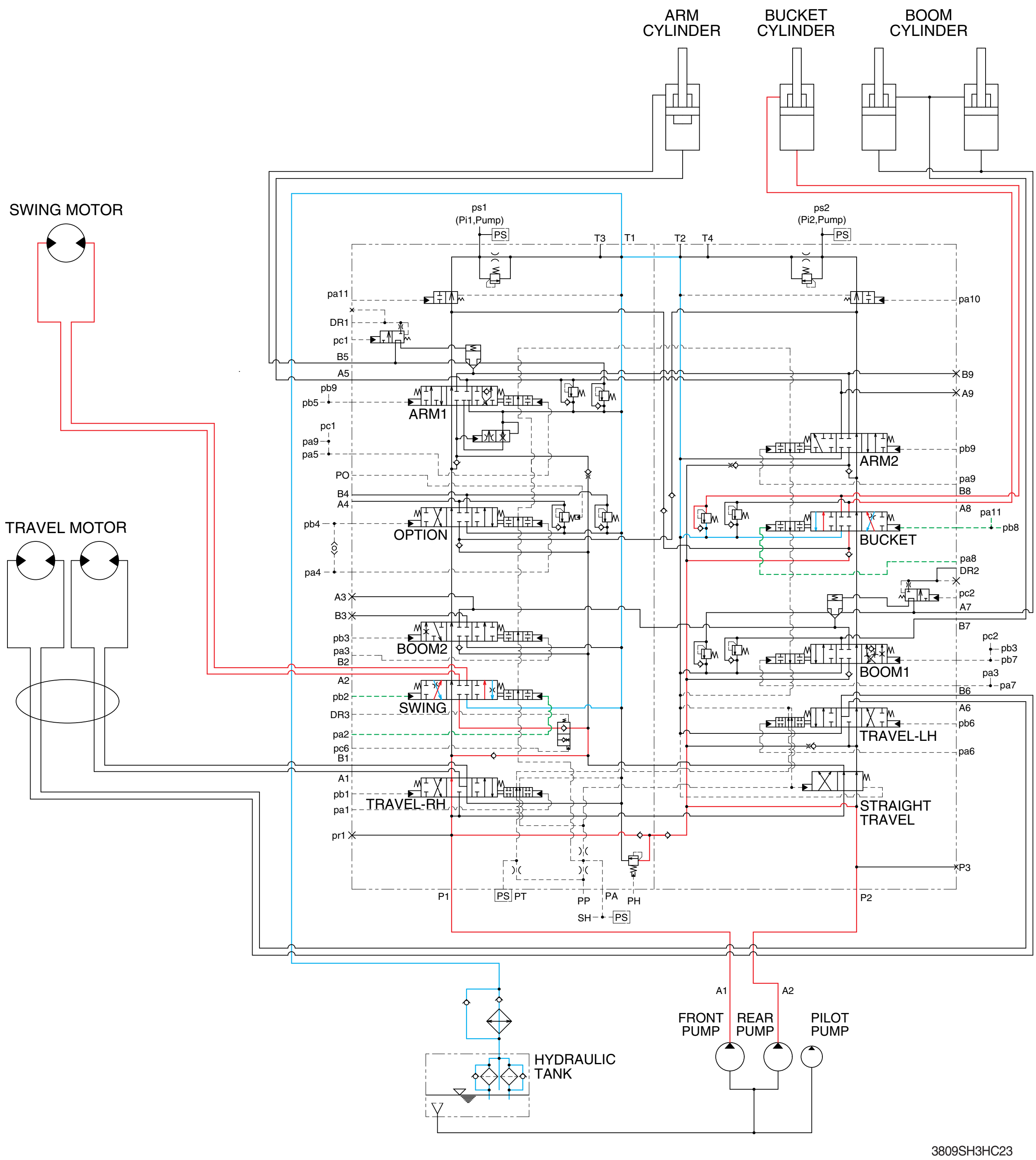
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

Refer to page 2-38 for the swing operation preference function.

4. COMBINED SWING AND BUCKET OPERATION



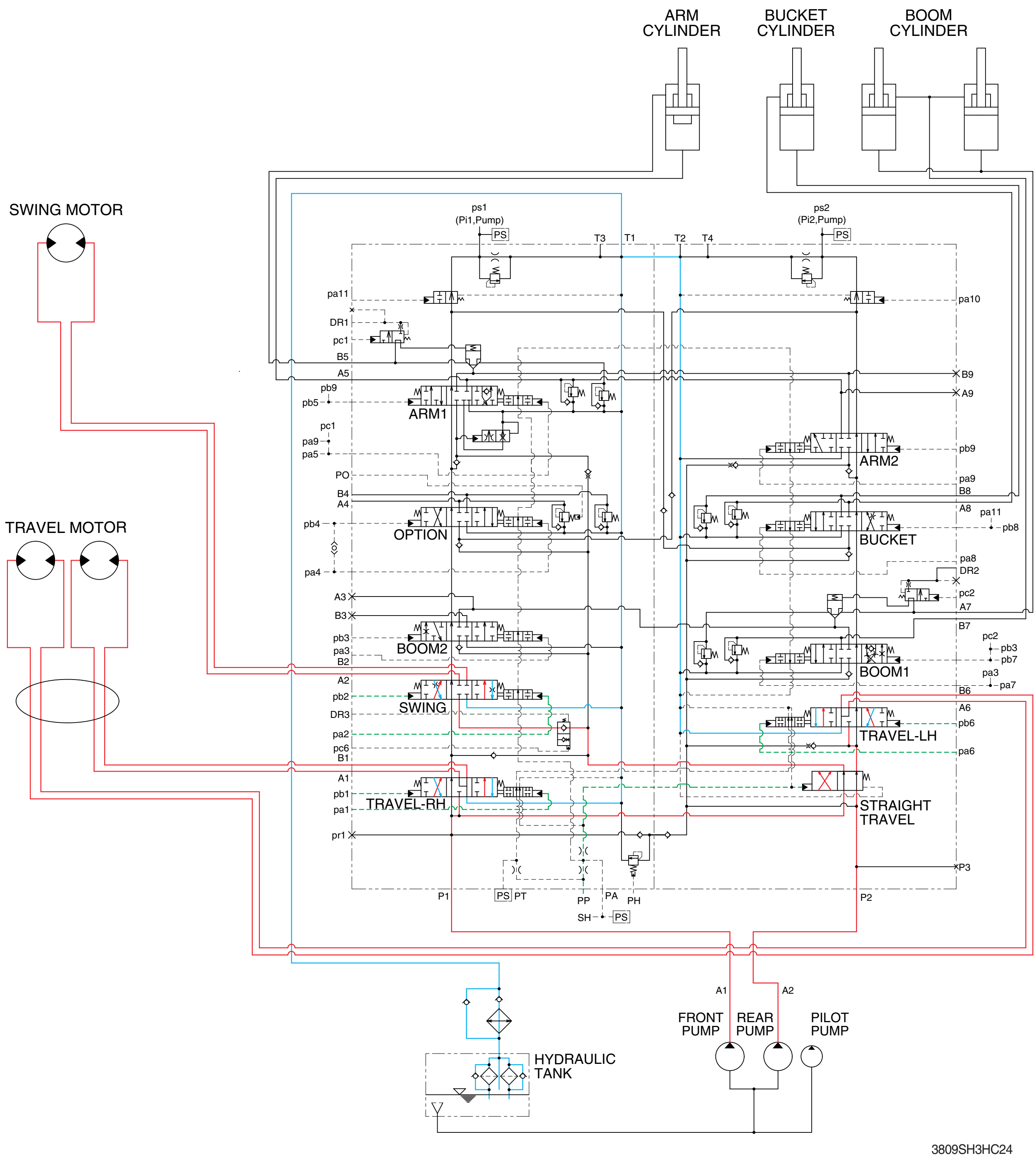
When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

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

The upper structure swings and the bucket is operated.

5. COMBINED SWING AND TRAVEL OPERATION



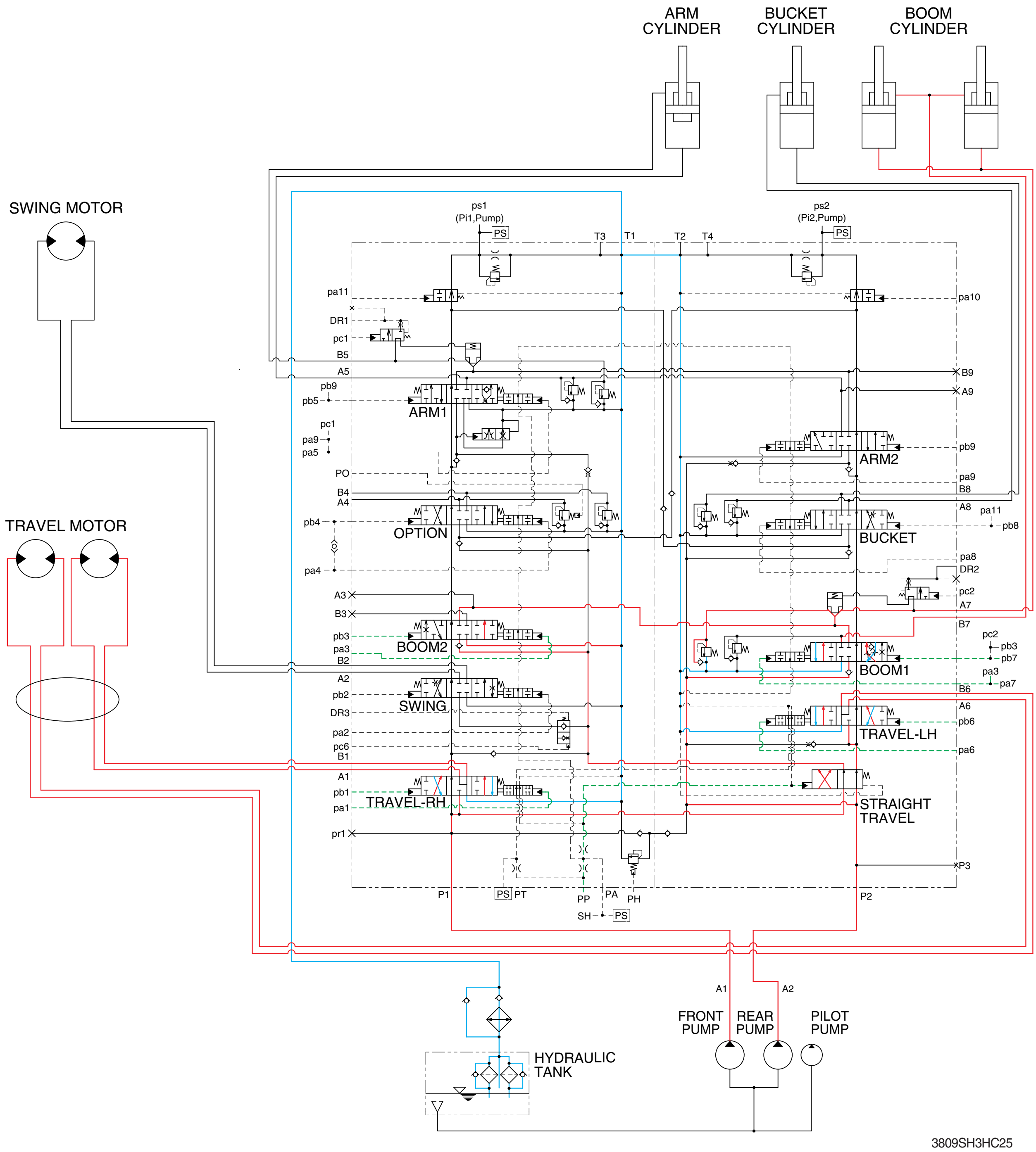
When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and straight travel spool is pushed to the right by the pilot oil pressure from the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

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

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

The upper structure swings and the machine travels straight.

6. COMBINED BOOM AND TRAVEL OPERATION



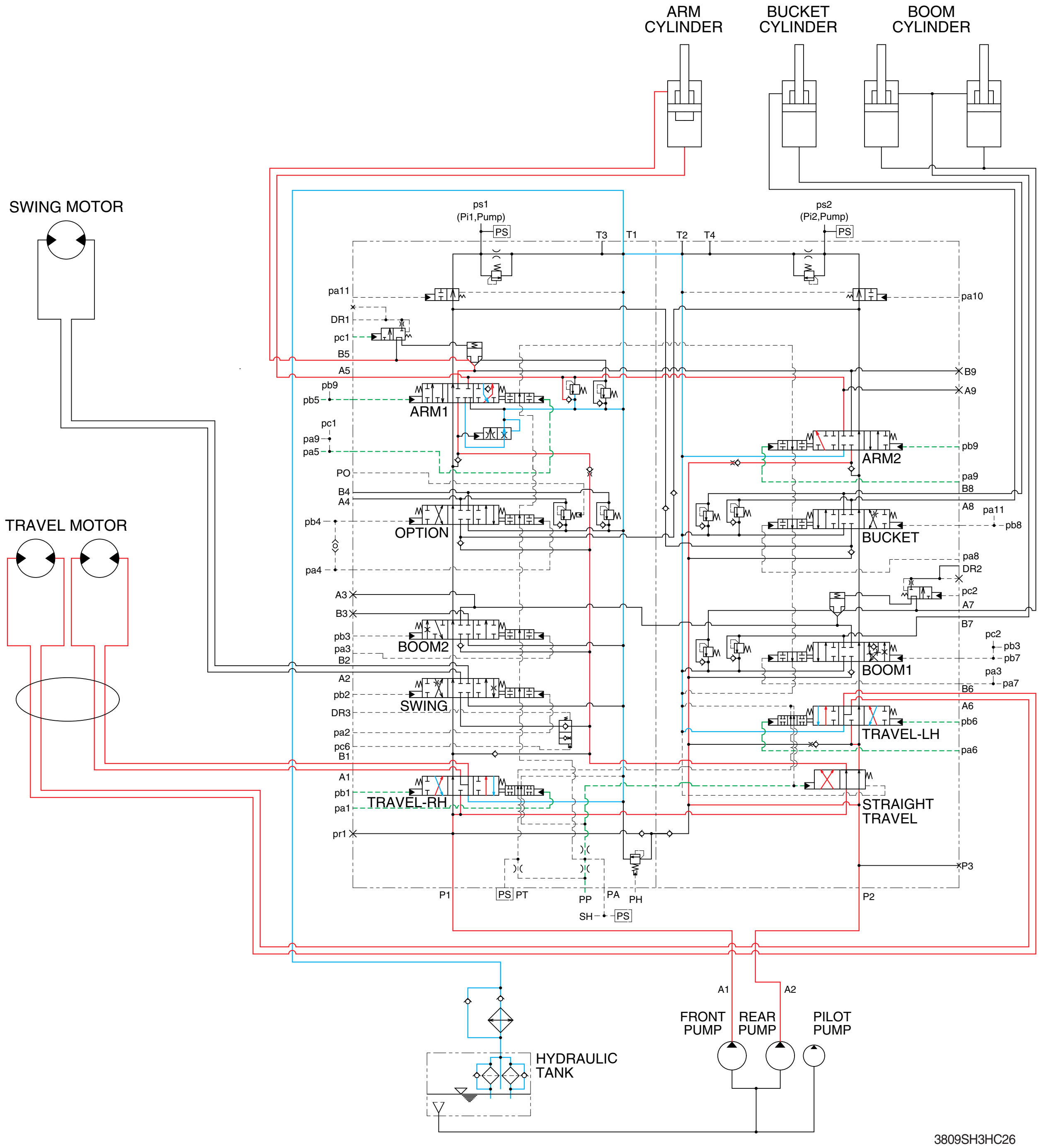
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot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

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

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

The boom is operated and the machine travels straight.

7. COMBINED ARM AND TRAVEL OPERATION



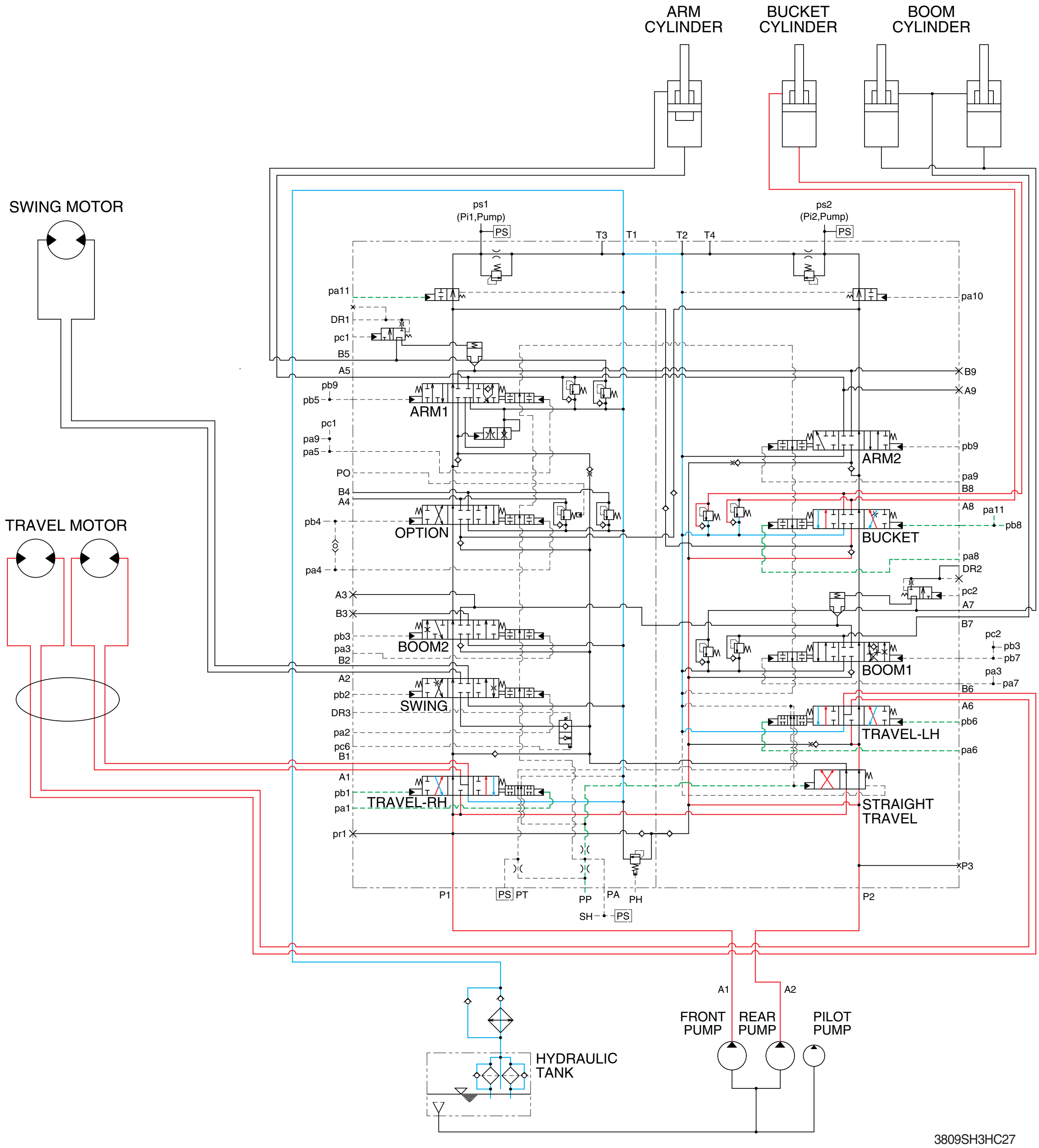
When the arm and travel functions are operated, simultaneously the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

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

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

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

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

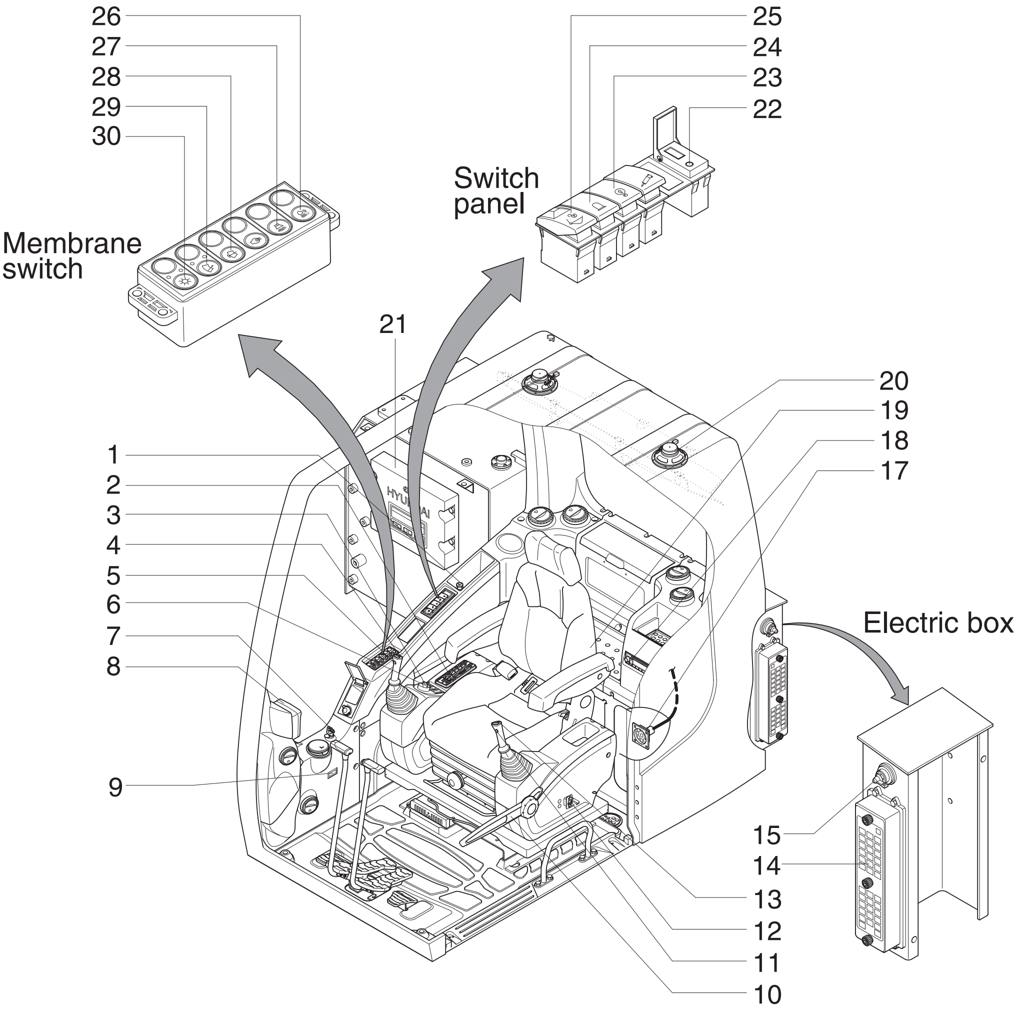
The bucket is operated and the machine travels straight.

SECTION 4 ELECTRICAL SYSTEM

SECTION 4 ELECTRICAL SYSTEM

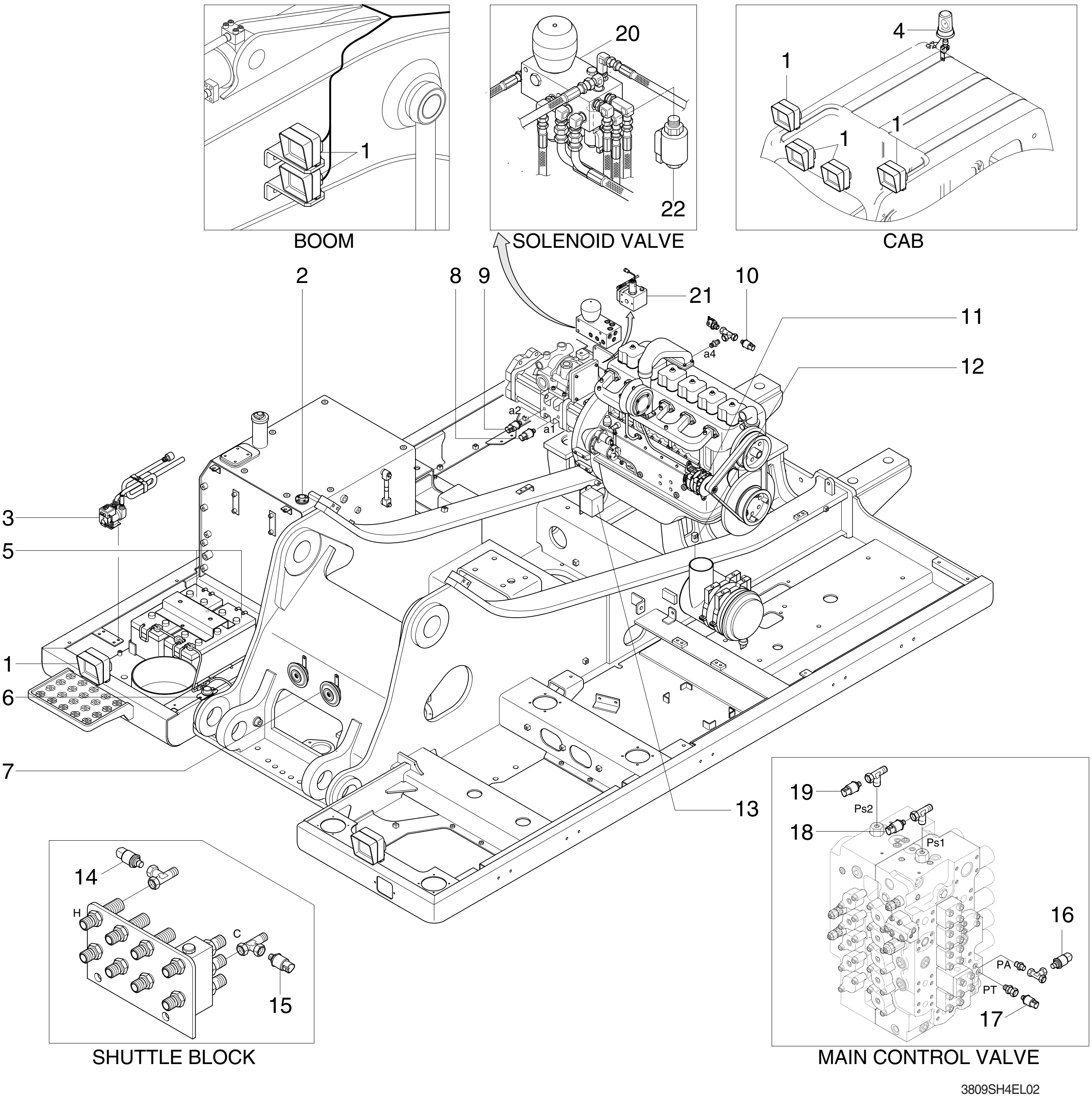
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



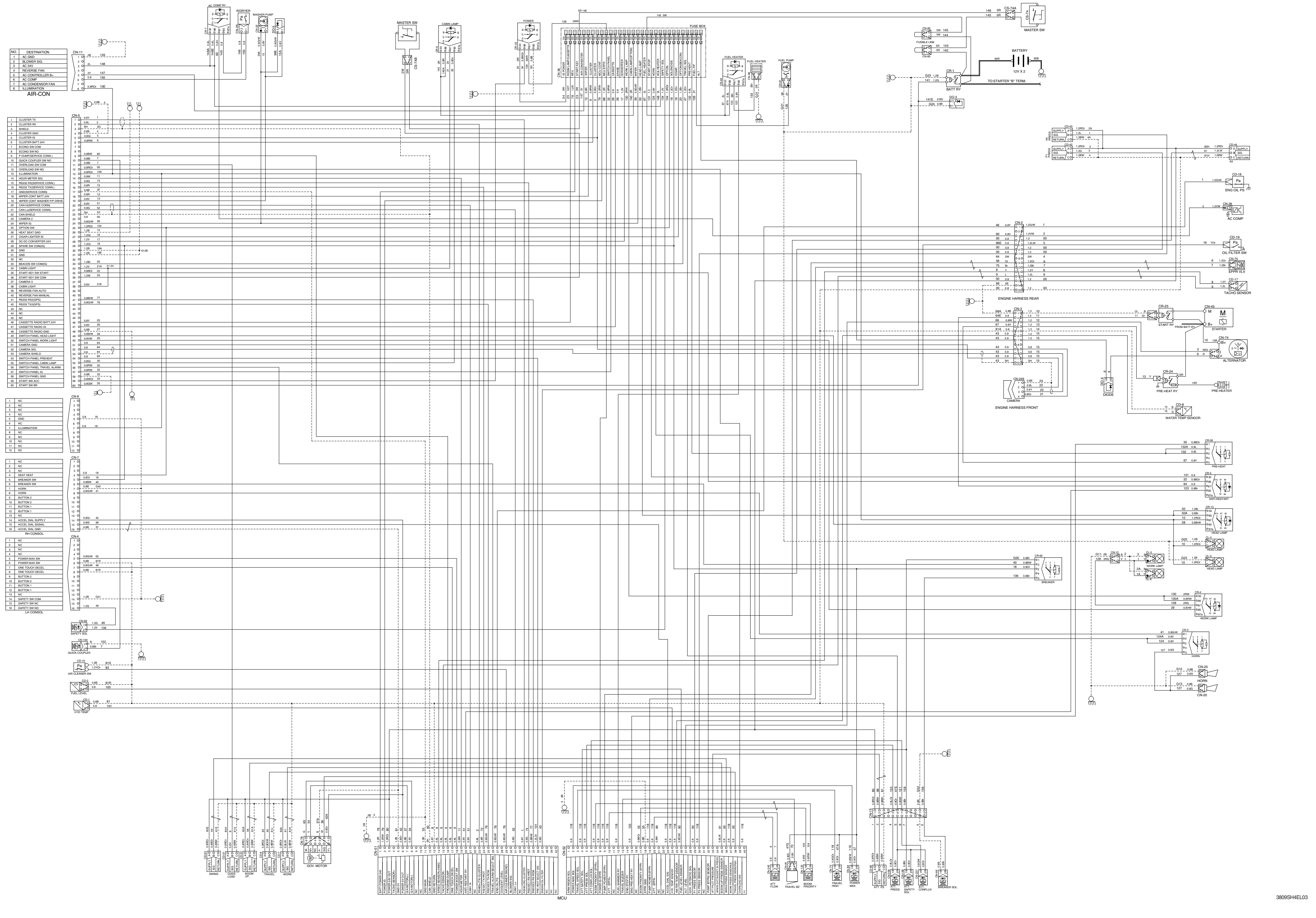
1	Cigar light	11	Power max switch	22	USB socket
2	Aircon & heater switch panel	12	Emergency engine stop switch	23	Overload switch
3	Accel dial switch	13	One touch decel switch	24	Beacon switch
4	Horn switch	14	Fuse box	25	Quick clamp switch
5	Breaker operation switch	15	Master switch	26	Cab light switch
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



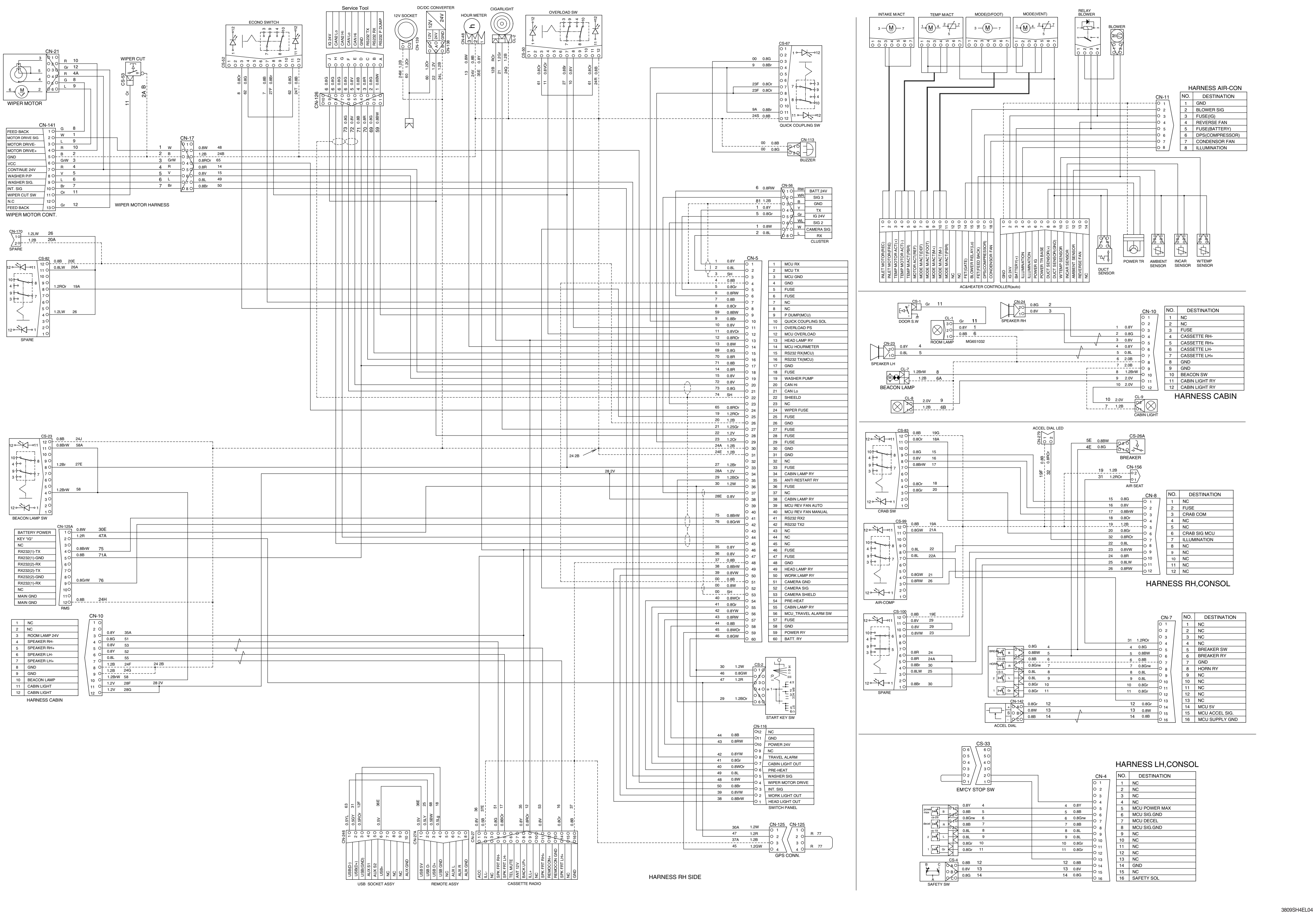
1	Lamp	9	P2 pressure sensor	16	Attach pressure sensor
2	Fuel sender	10	EPPR pressure sensor	17	Travel pressure sensor
3	Fuel filler pump	11	Alternator	18	P1 nega pressure sensor
4	Beacon lamp	12	Air cleaner switch	19	P2 nega pressure sensor
5	Battery	13	Travel alarm buzzer	20	Solenoid valve
6	Battery relay	14	Boom up pressure sensor	21	Pump EPPR valve
7	Horn	15	Swing pressure sensor	22	Boom priority EPPR valve
8	P1 pressure sensor				

※ Cluster type 1 only : 10, 14, 15, 18, 19

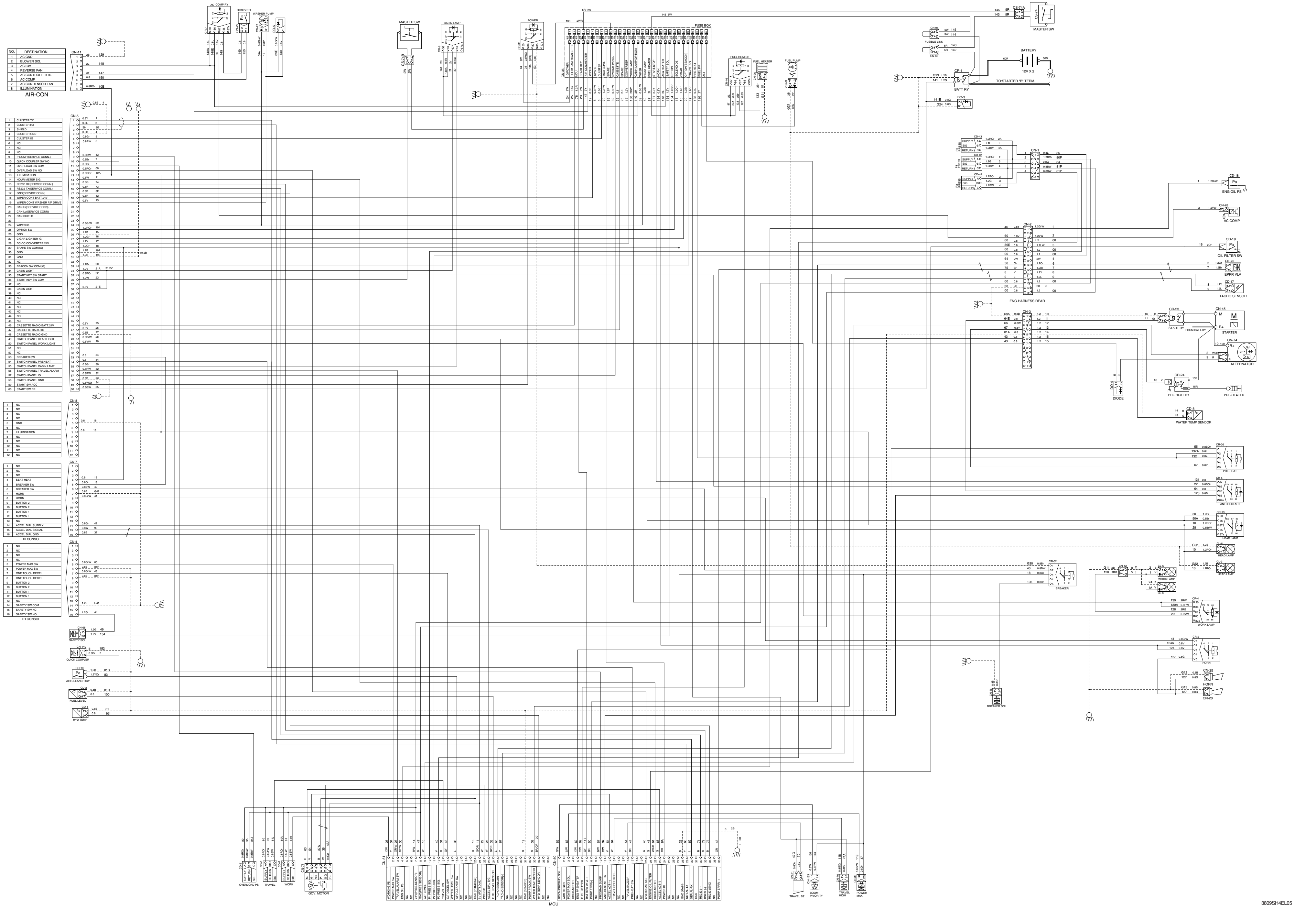


3809SH4EL03

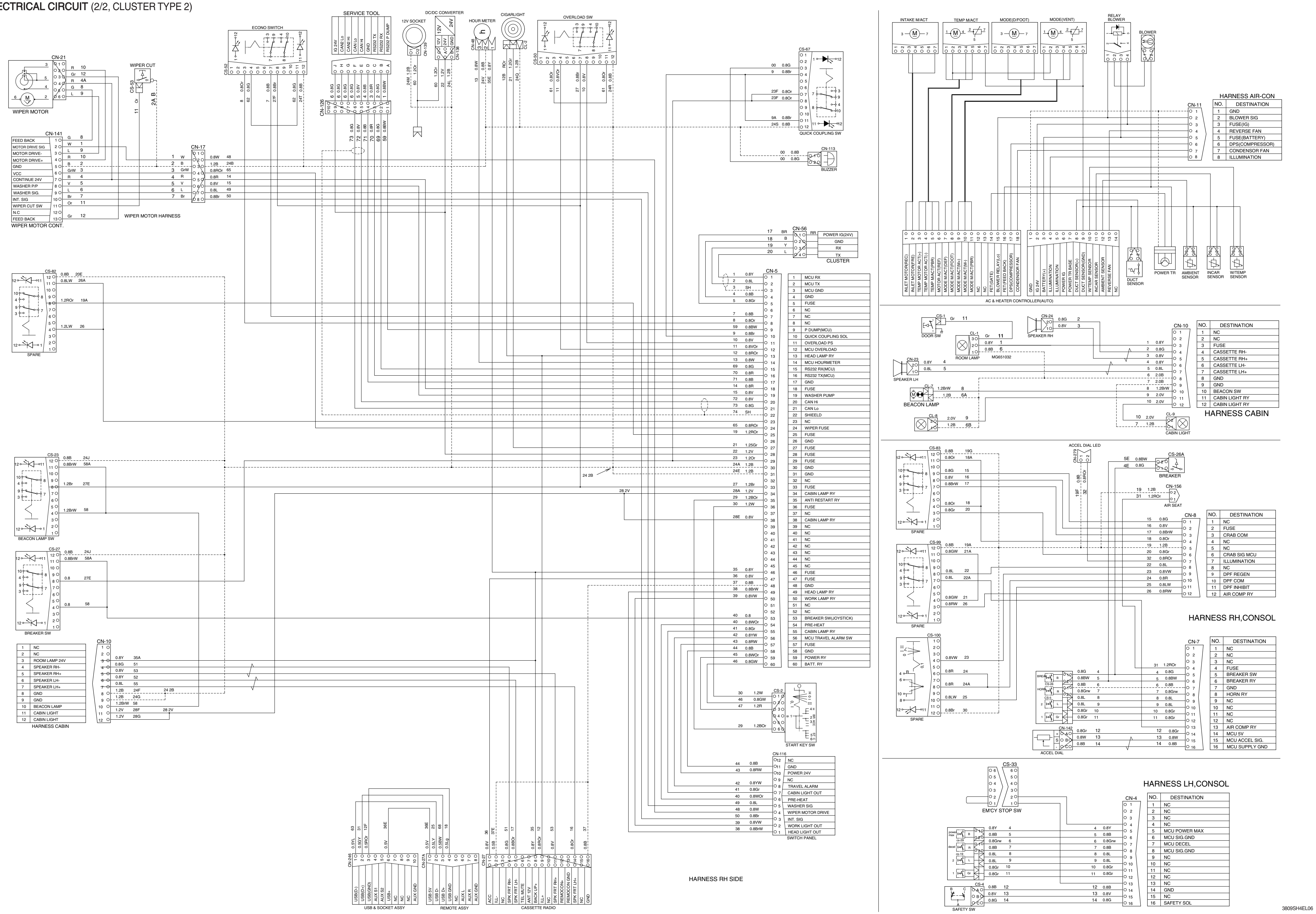
· **ELECTRICAL CIRCUIT** (2/2, CLUSTER TYPE 1)



ELECTRICAL CIRCUIT (1/2, CLUSTER TYPE 2)



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



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)]
  - → GPS connector [CN-125 (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

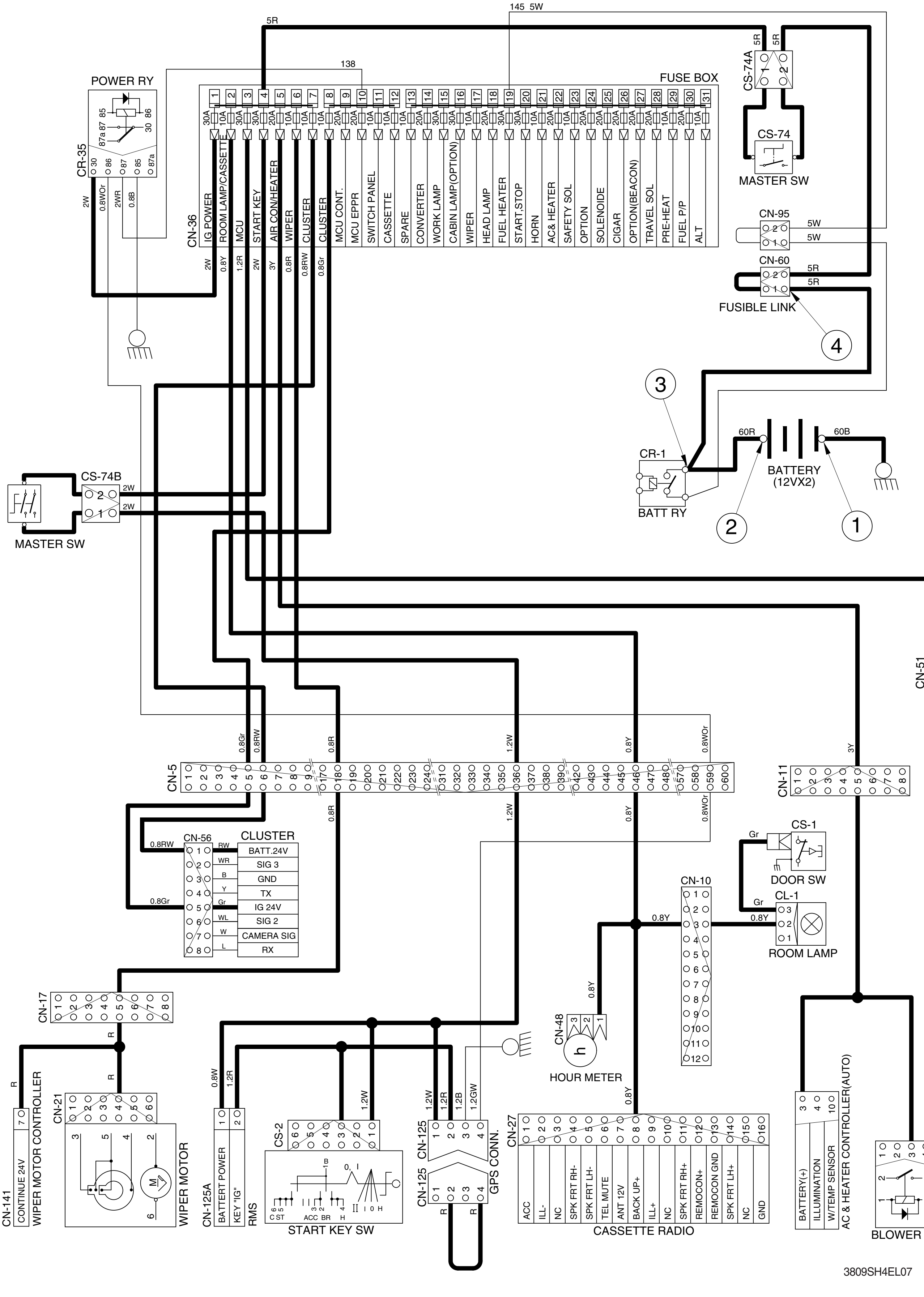
※ I/conn : Intermediate connector

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

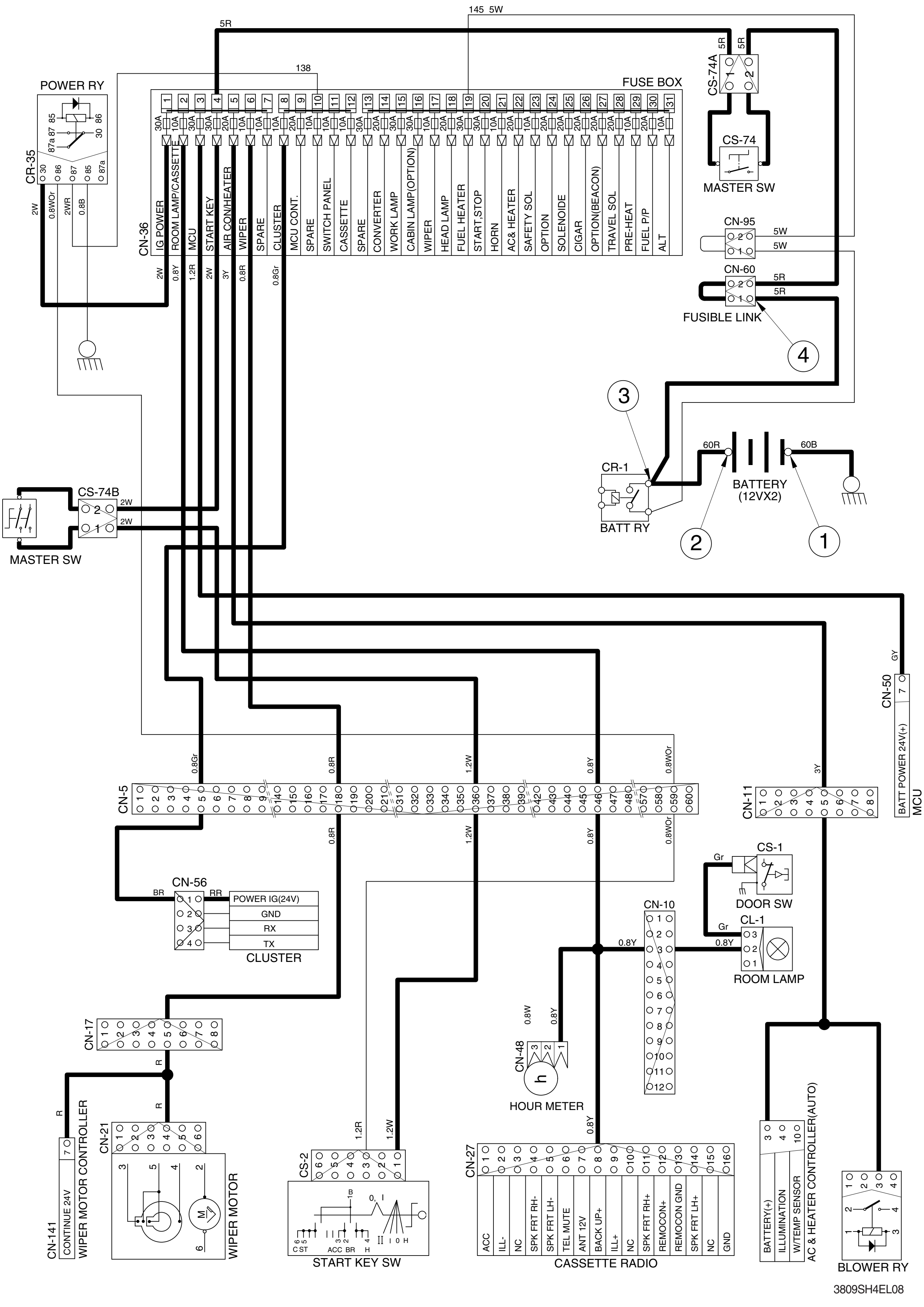
※ I/conn : Intermediate connector

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)] → GPS connector [CN-125 (2) → (4)] → 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

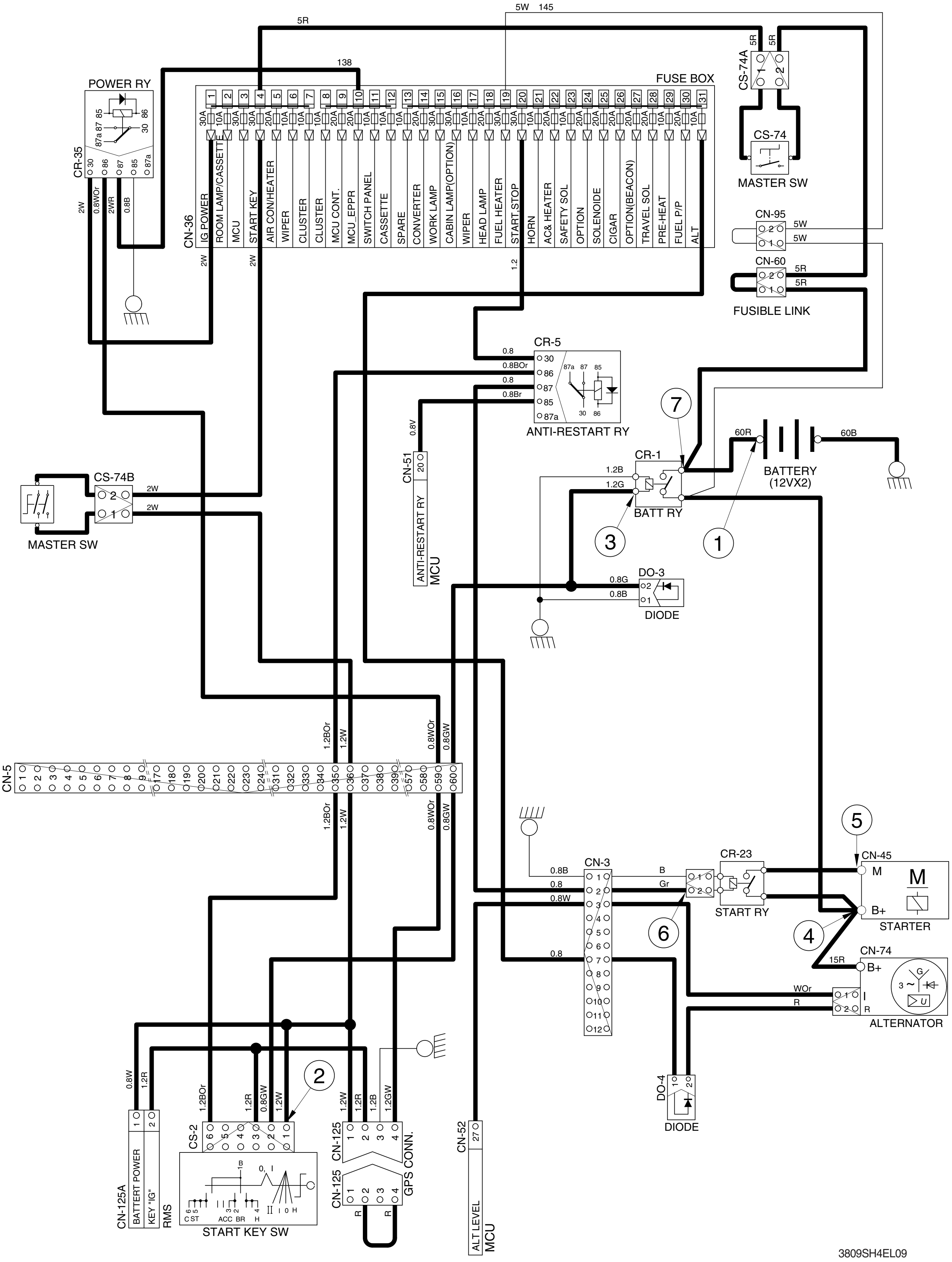
Start switch START [CS-2 (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (86) → (87)] → I/conn [CN-3 (2)] → Start relay [CR-23]

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)



■ 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

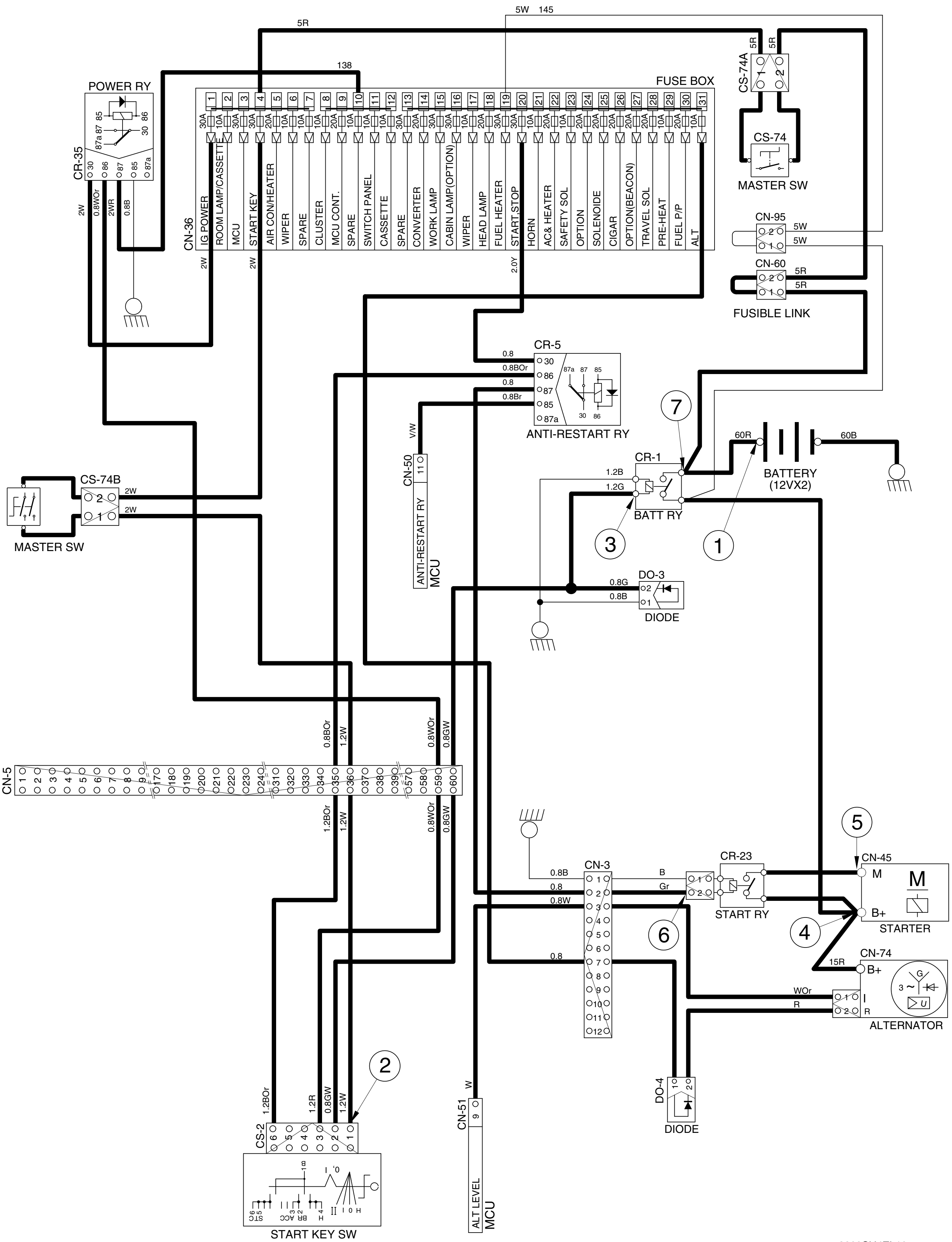
Start switch START [CS-2 (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (86) → (87)] → I/conn [CN-3 (2)] → Start relay [CR-23]

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

→ Fusible link [CN-60] → Master switch [CS-74]

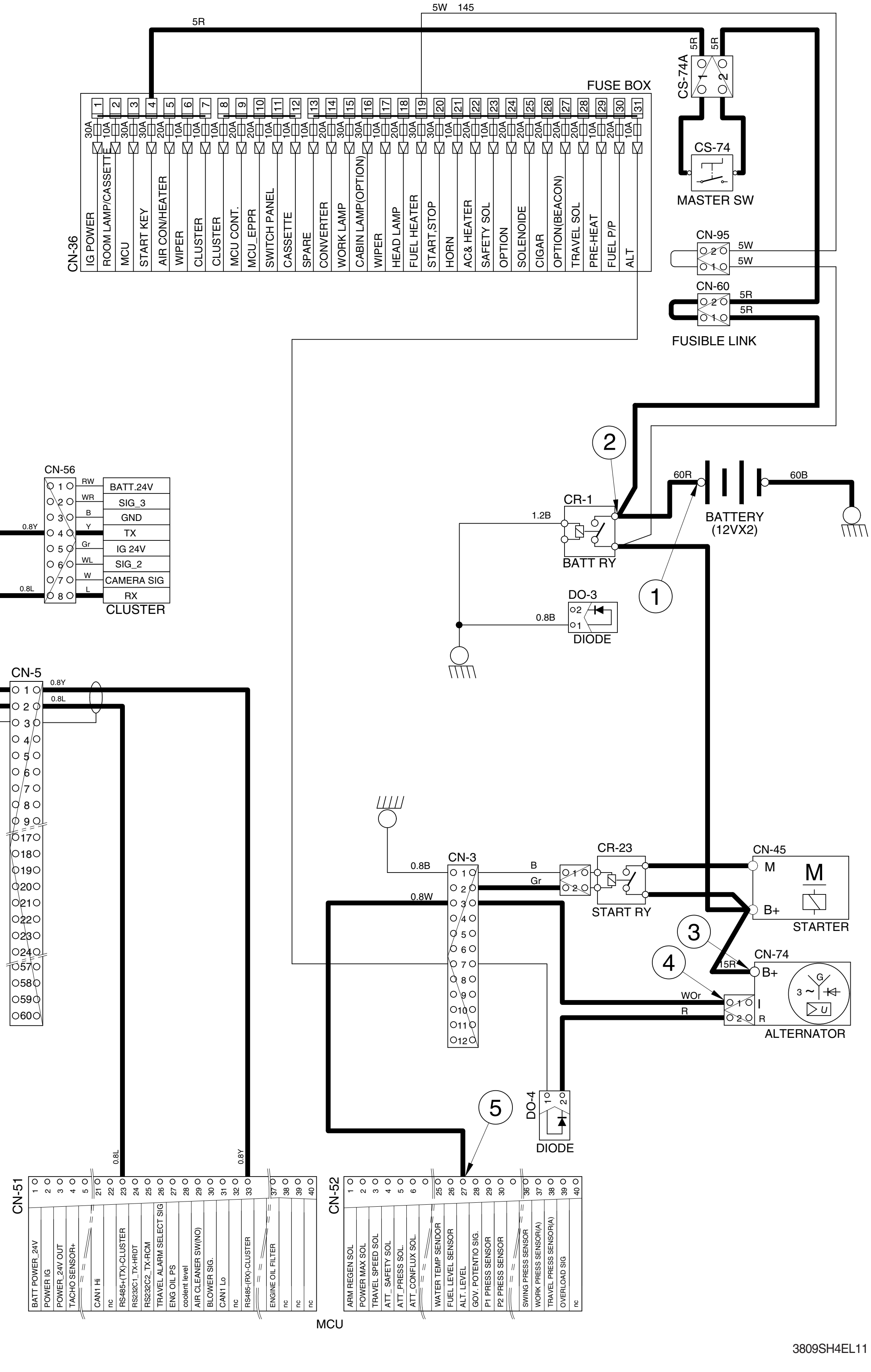
→ Fuse box

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

→ Fusible link [CN-60] → Master switch [CS-74]

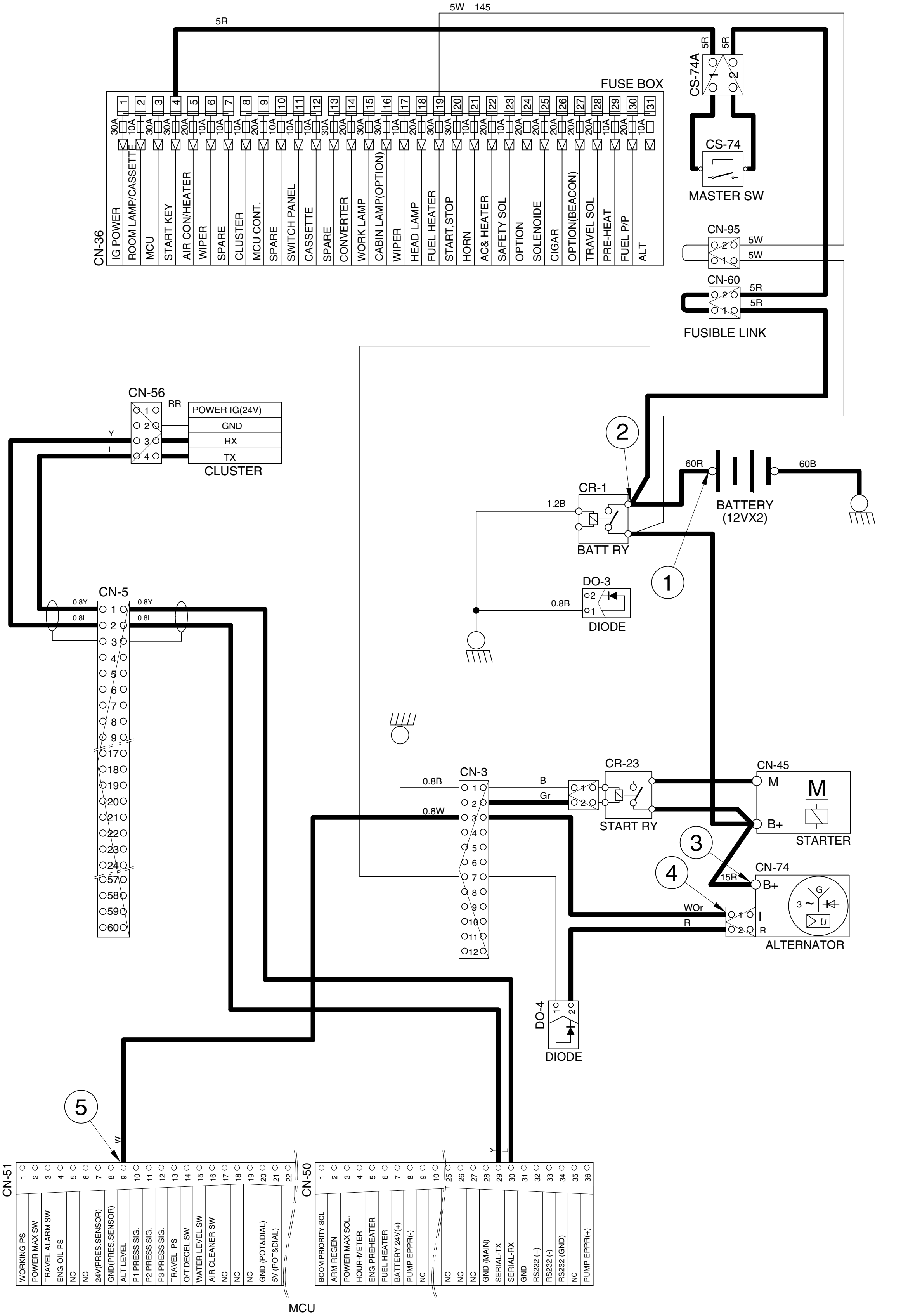
→ Fuse box

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)



3809SH4EL12

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

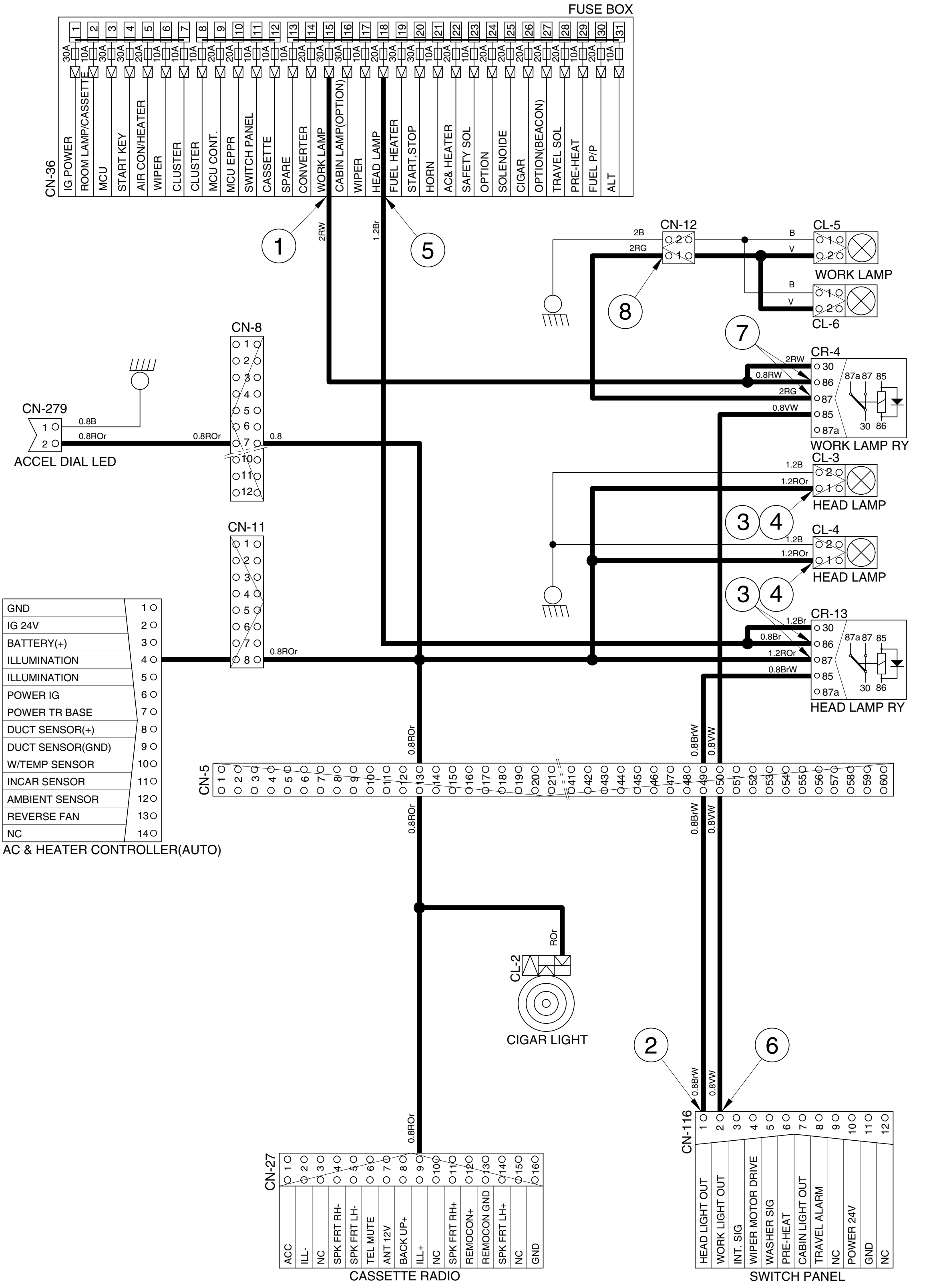
Work light switch ON [CN-116 (2)] → I/conn [CN-5 (50)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

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)



3809SH4EL13

■ 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

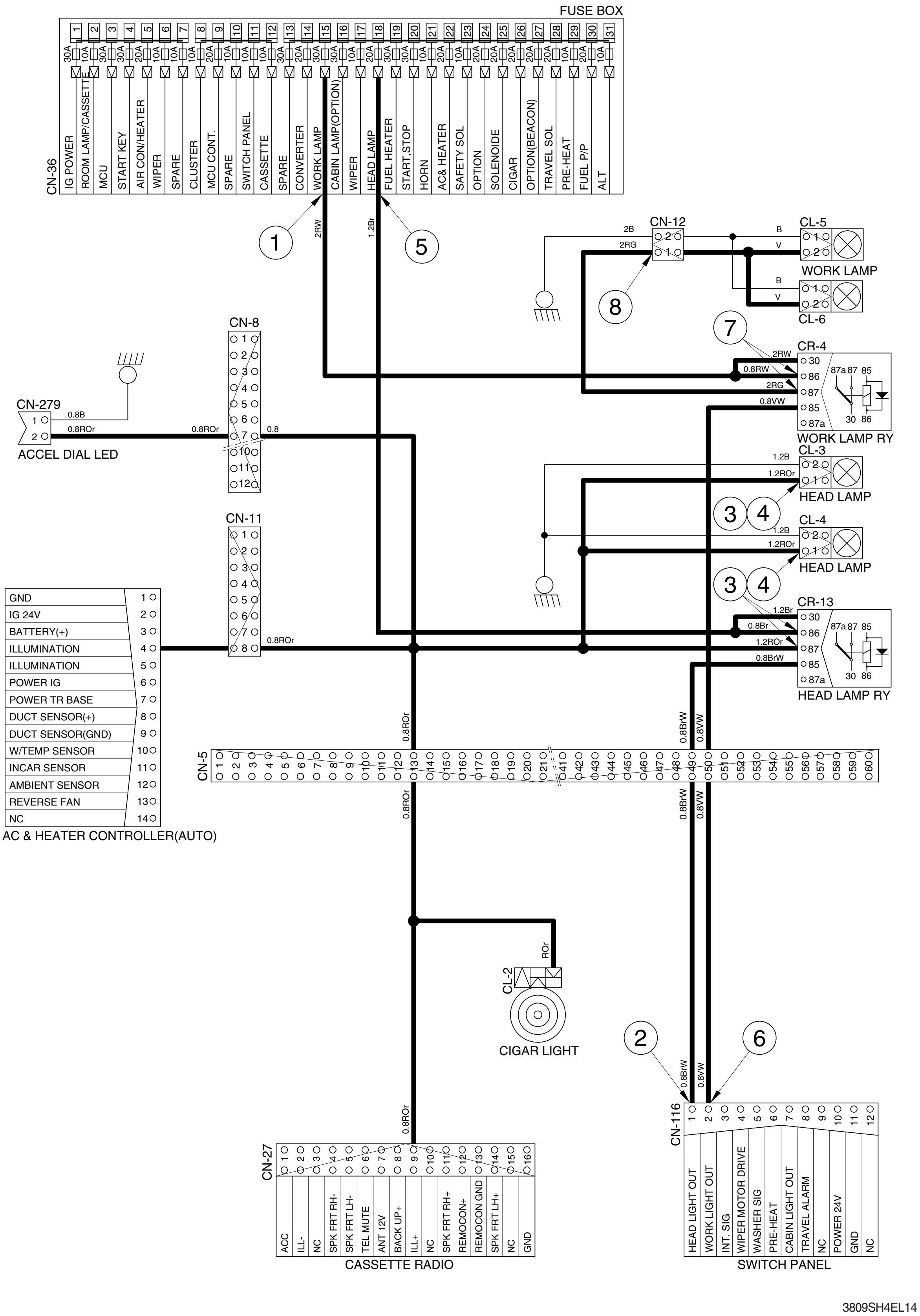
Work light switch ON [CN-116 (2)] → I/conn [CN-5 (50)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

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)



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

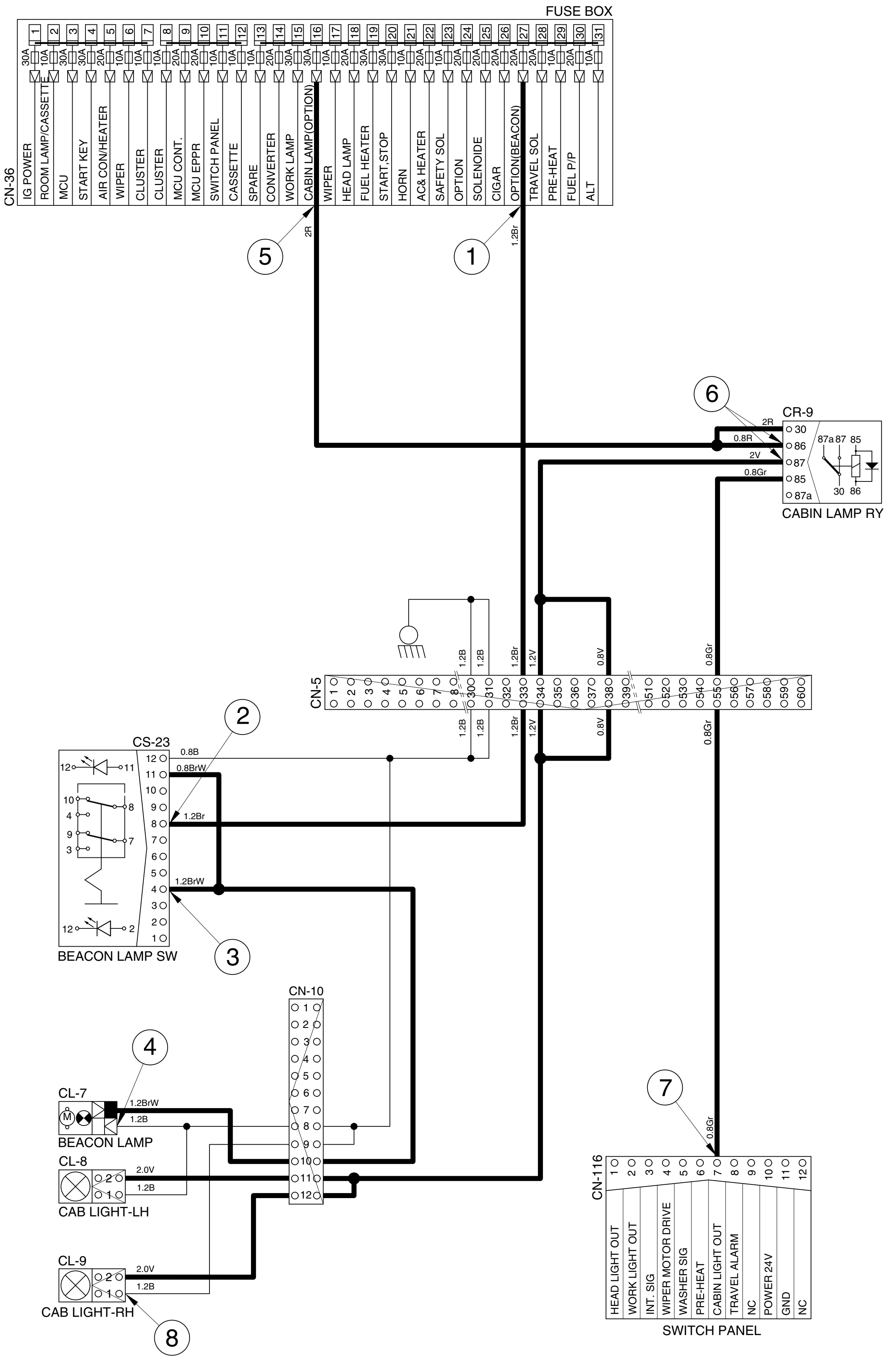
Cab light switch ON [CN-116 (7)] → I/conn [CN-5 (55)] → Cabin light relay [CR-9 (85) → (87)]
→ I/conn [CN-5 (34)] → I/conn [CN-10 (11, 12)] → Cab light ON [CL-8 (2), CL-9 (2)]

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)



3809SH4EL15

■ 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

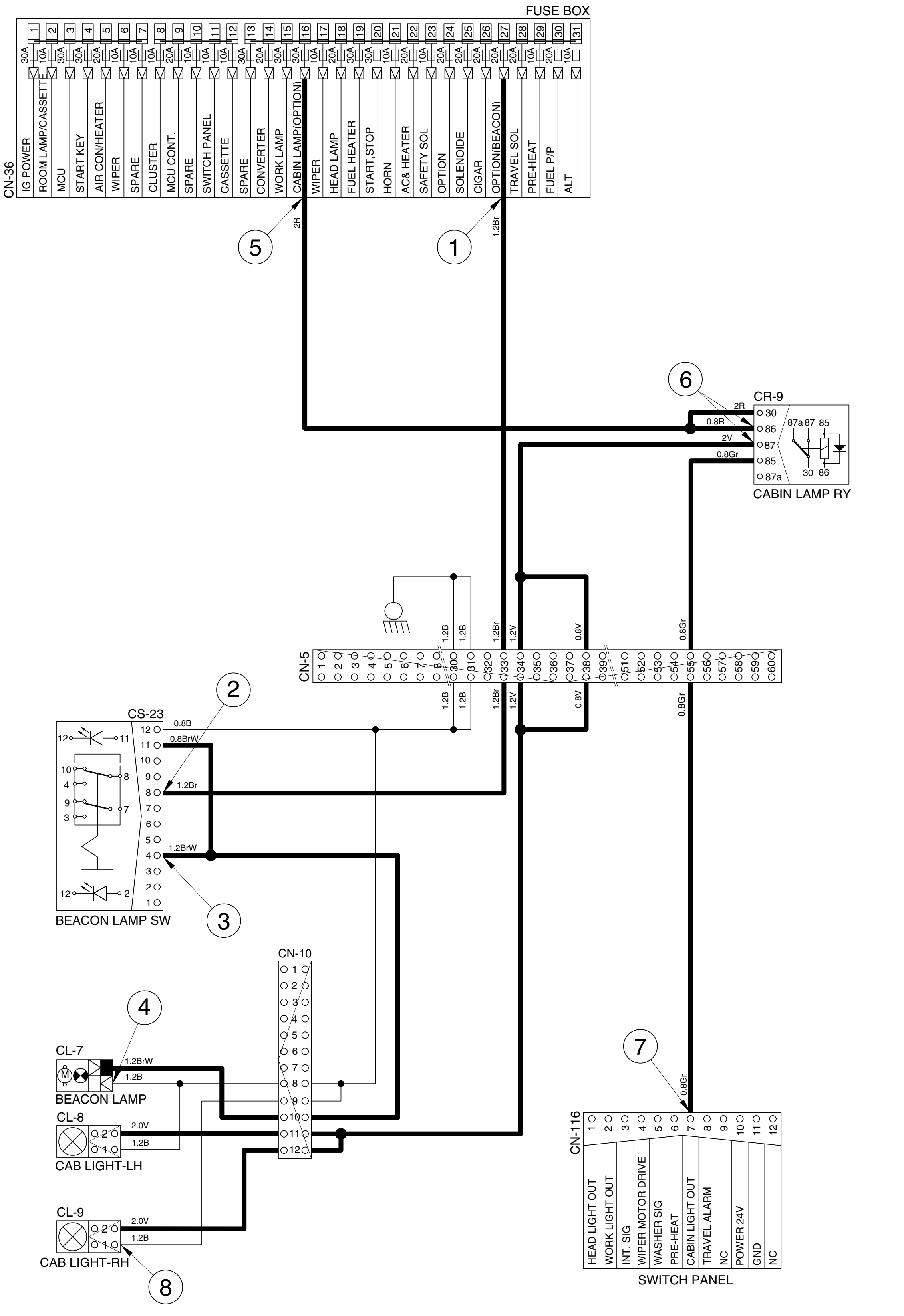
Cab light switch ON [CN-116 (7)] → I/conn [CN-5 (55)] → Cabin light relay [CR-9 (85) → (87)]
→ I/conn [CN-5 (34)] → I/conn [CN-10 (11, 12)] → Cab light ON [CL-8 (2), CL-9 (2)]

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)



3809SH4EL16

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)

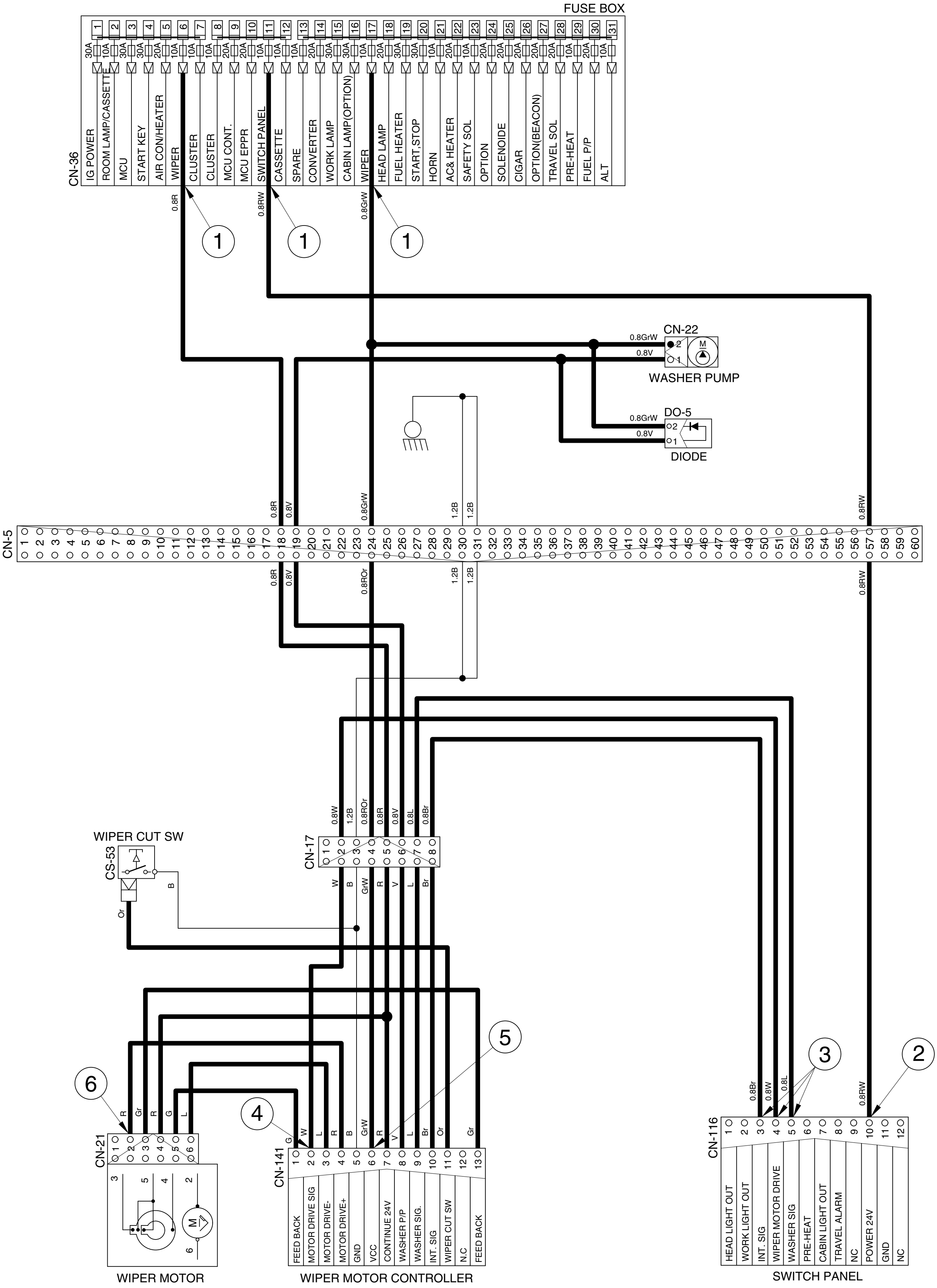
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

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)



3809SH4EL17

■ 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)

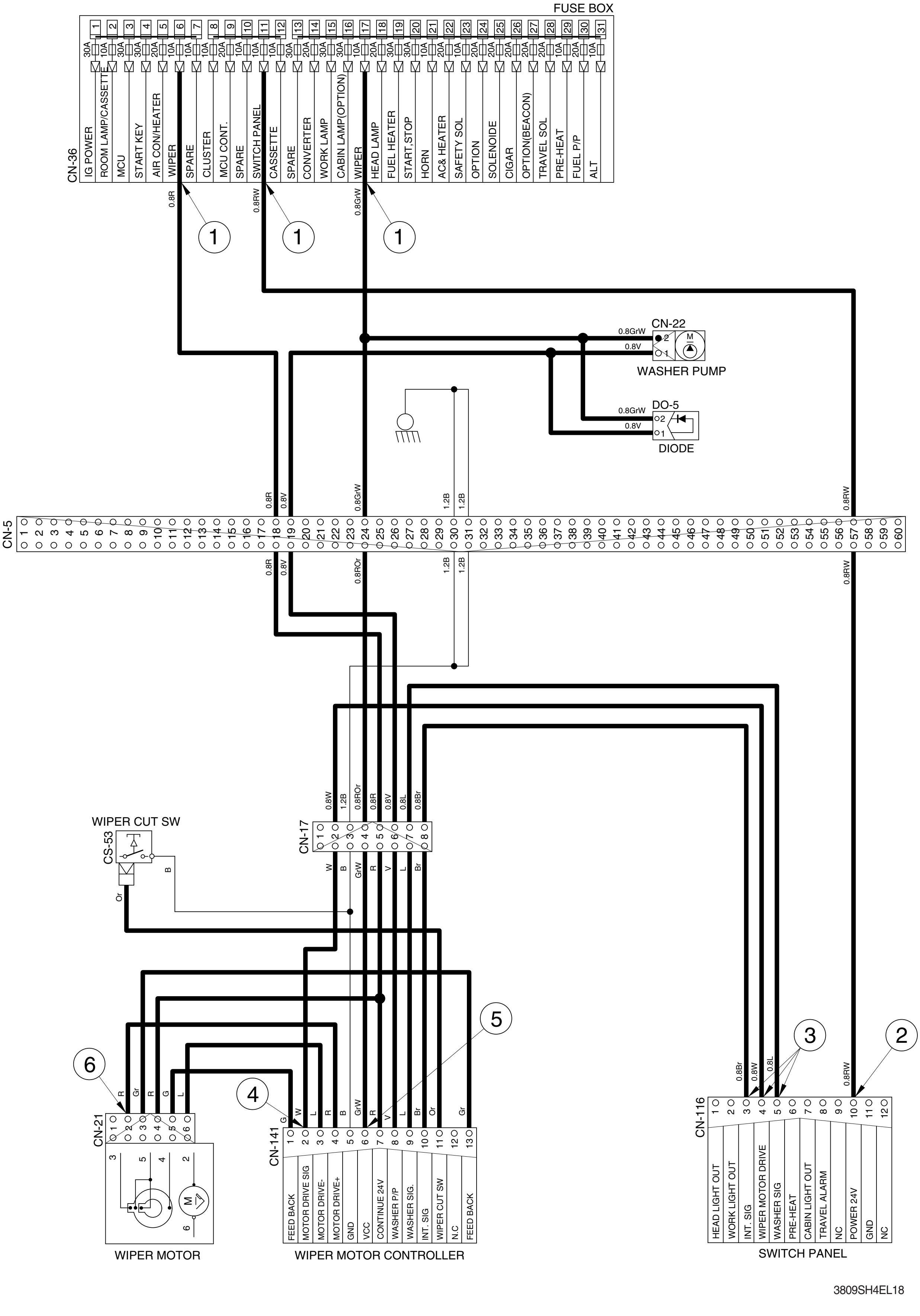
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

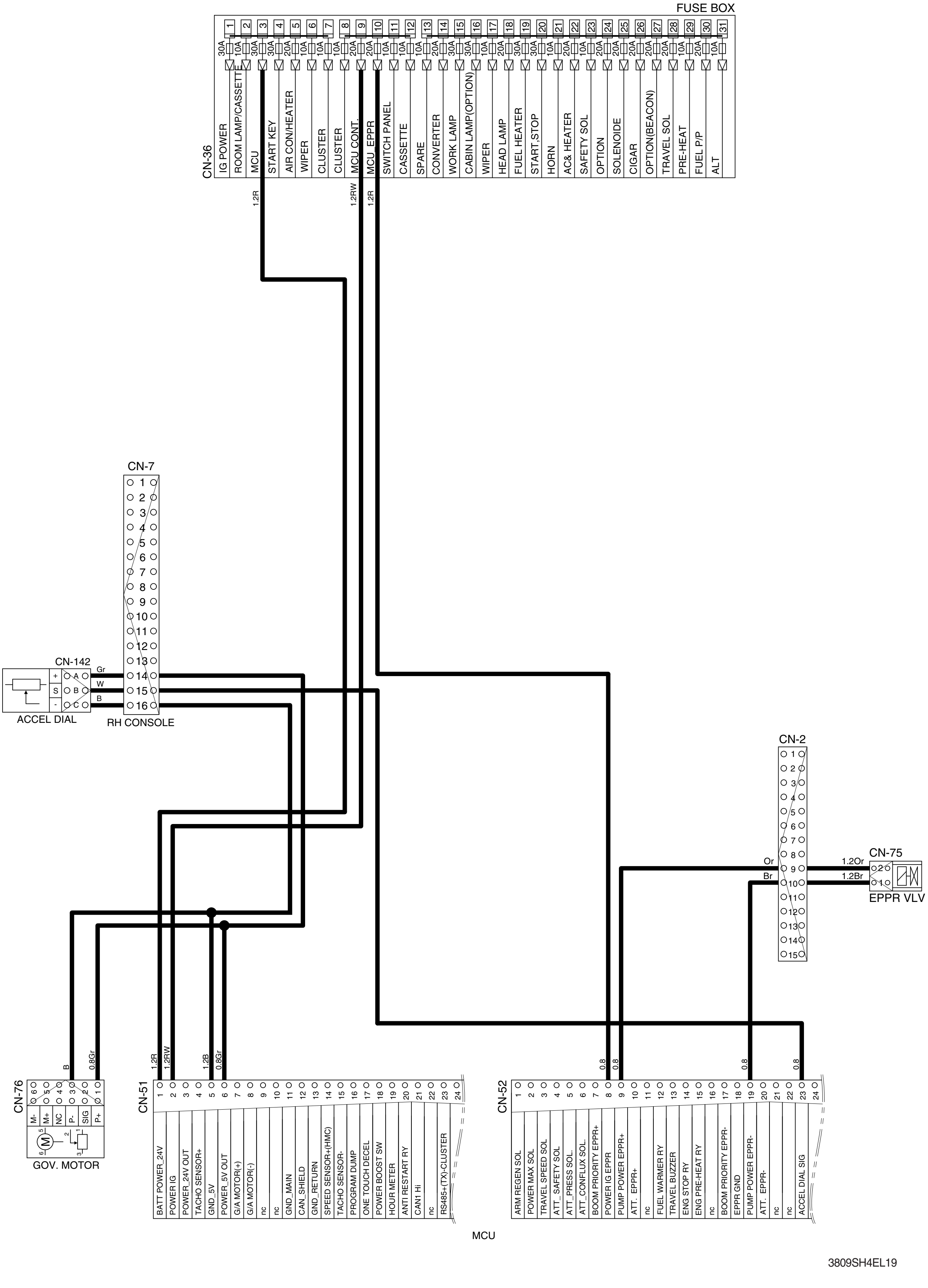
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	24V
		③ - GND (switch power output) ④ - GND (wiper power input)	0 ~ 5V
		⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

※ GND : Ground

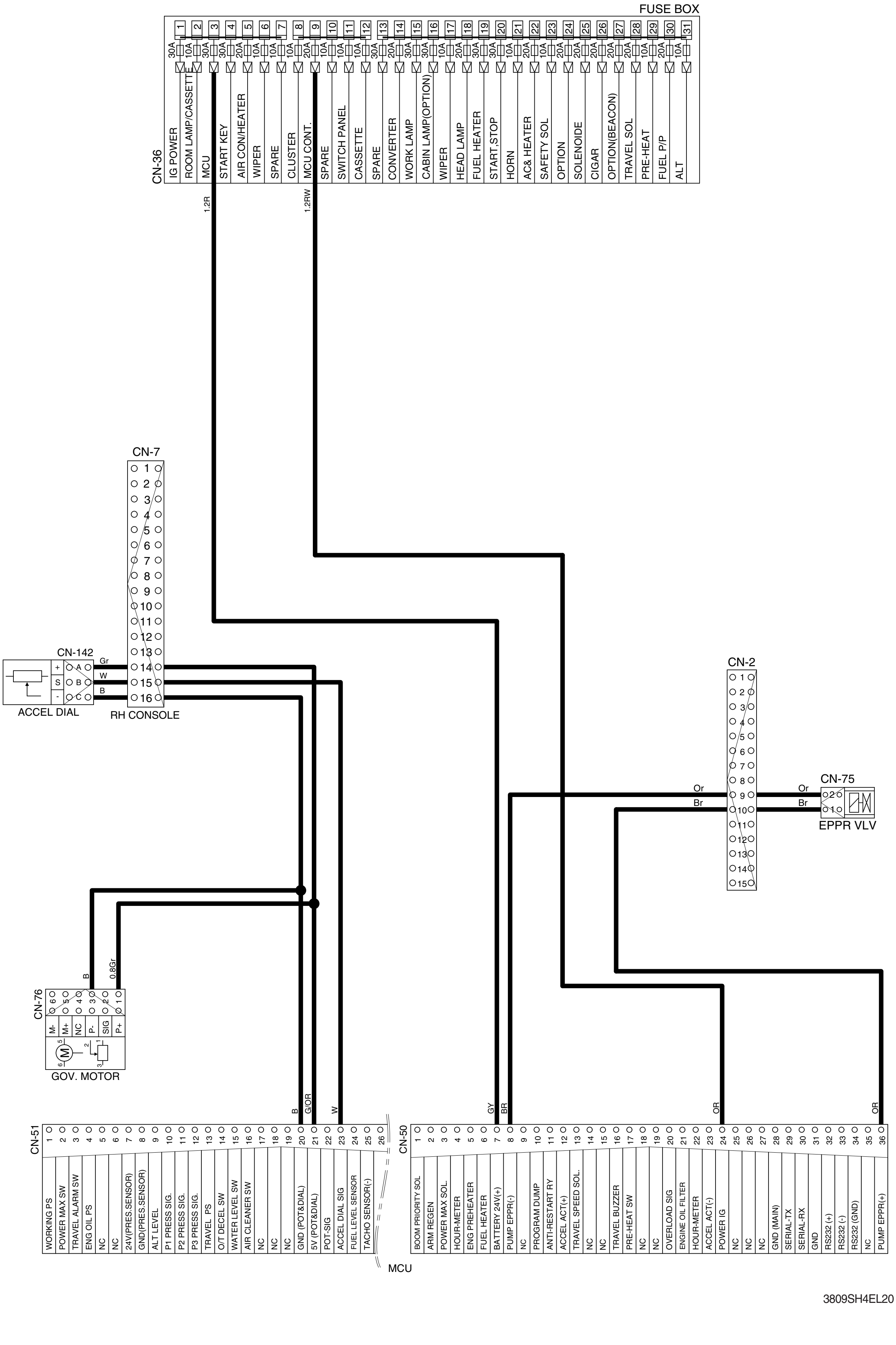
WIPER AND WASHER CIRCUIT (CLUSTER TYPE 2)



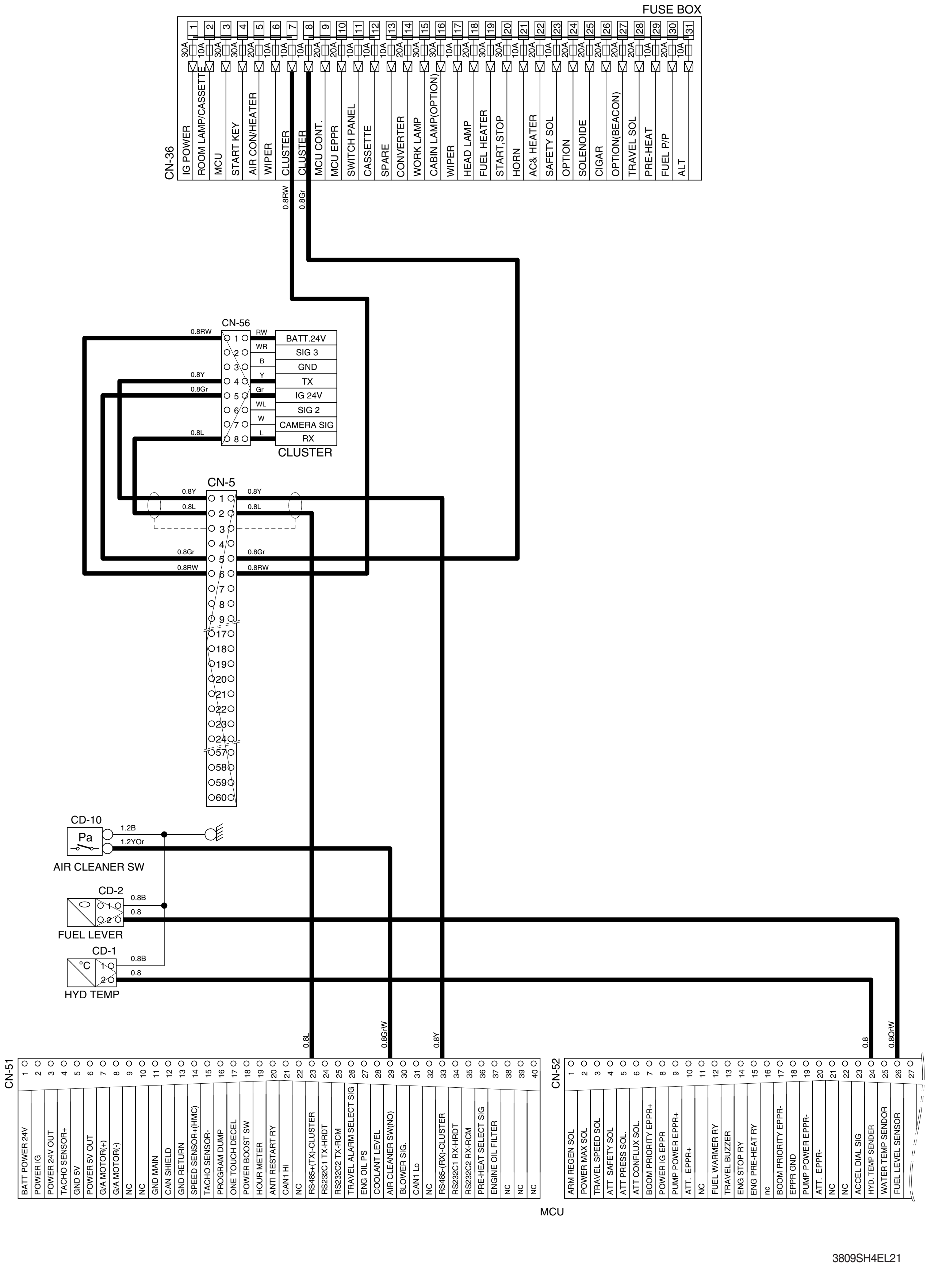
CONTROLLER CIRCUIT (CLUSTER TYPE 1)



CONTROLLER CIRCUIT (CLUSTER TYPE 2)

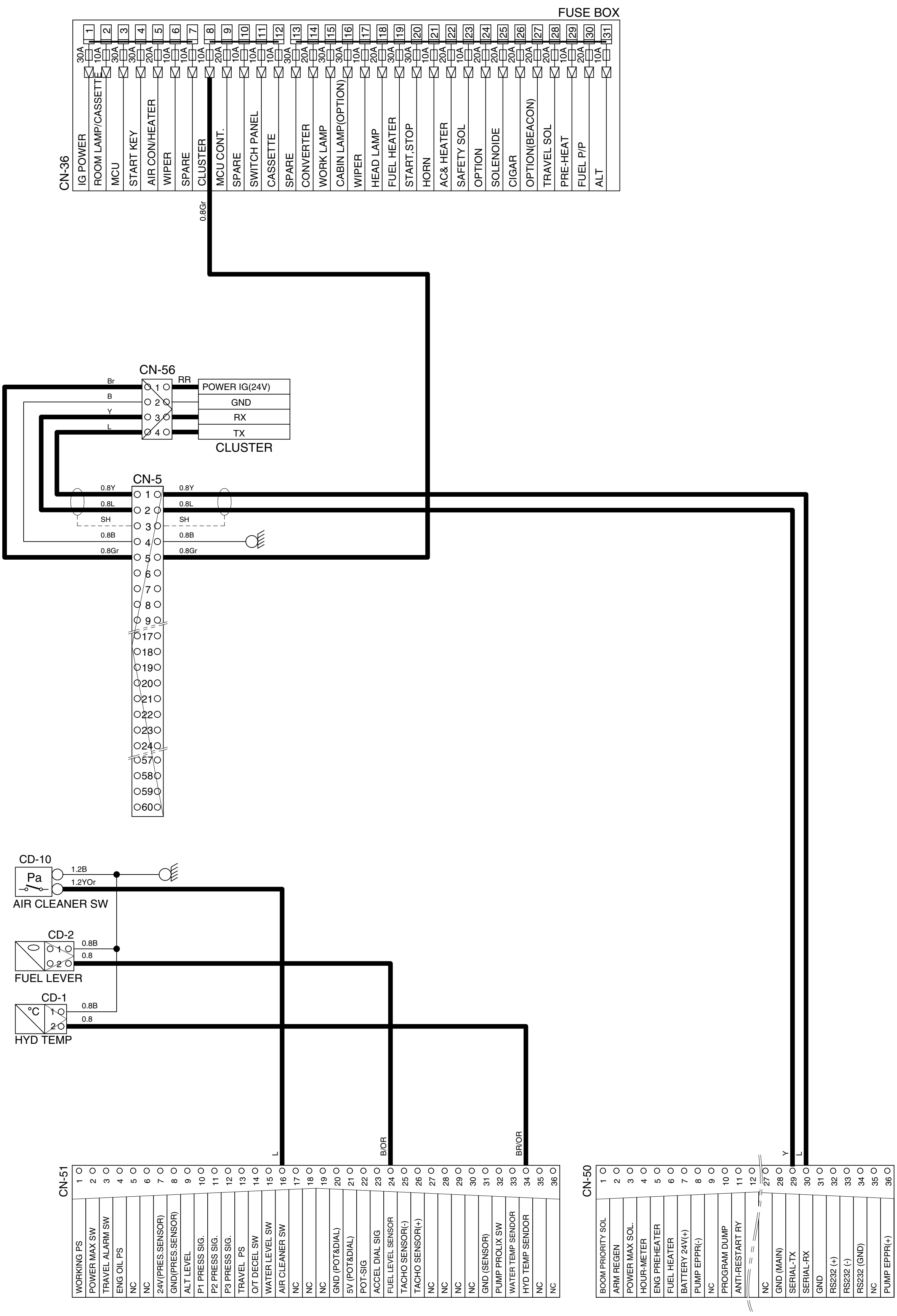


MONITORING CIRCUIT (CLUSTER TYPE 1)



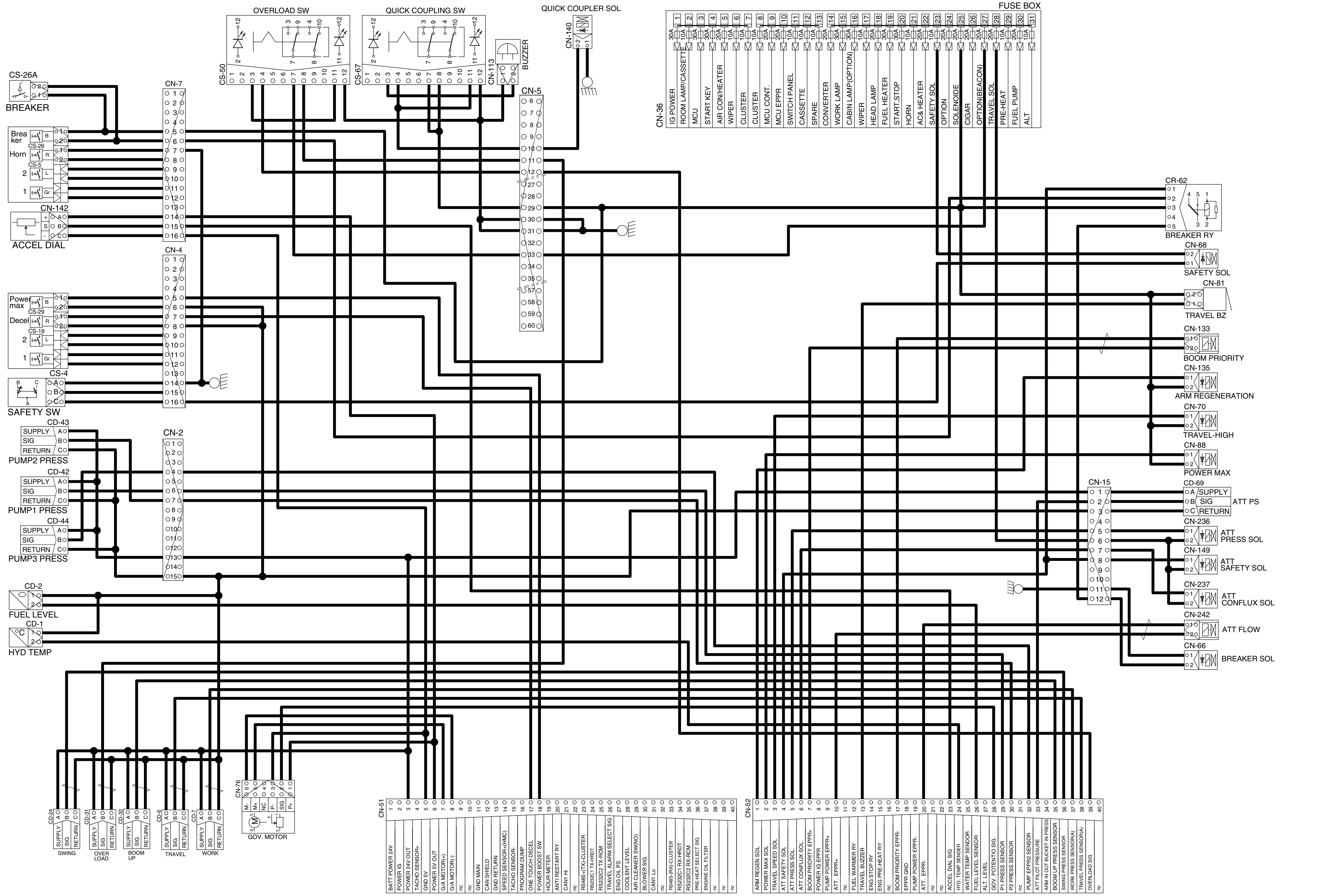
3809SH4EL21

MONITORING CIRCUIT (CLUSTER TYPE 2)



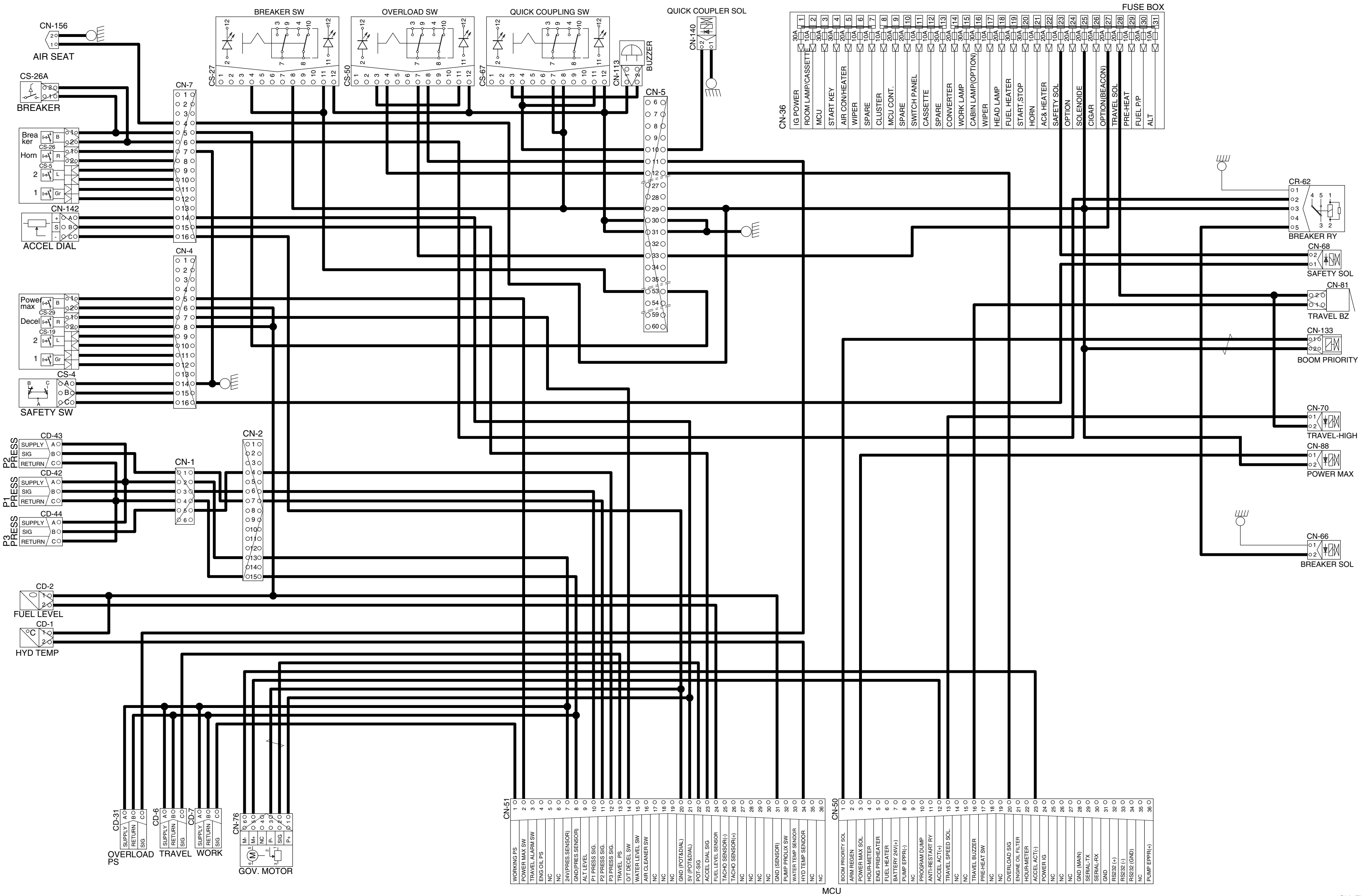
3809SH4EL22

ELECTRIC CIRCUIT FOR HYDRAULIC (CLUSTER TYPE 1)



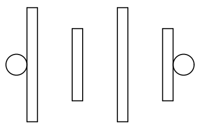
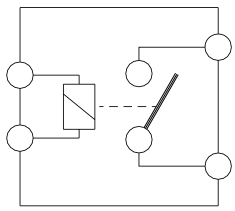
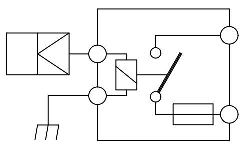
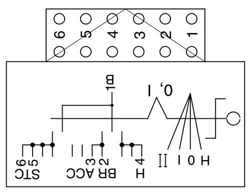
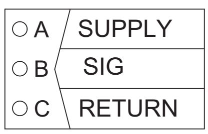
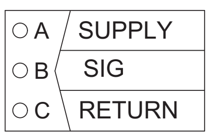
3009SH4EL23

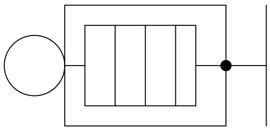
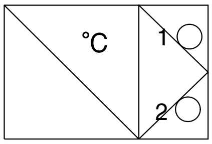
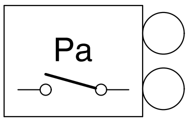
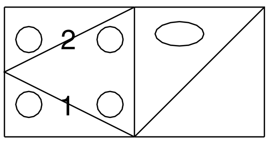
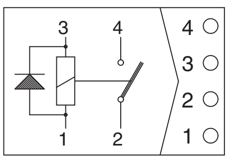
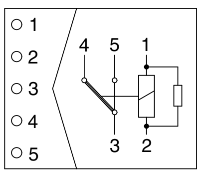
ELECTRIC CIRCUIT FOR HYDRAULIC (CLUSTER TYPE 2)

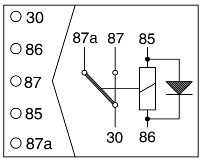
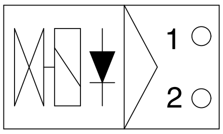
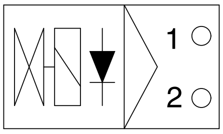
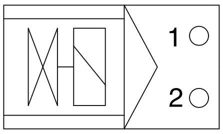
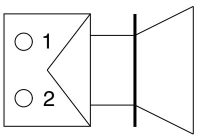
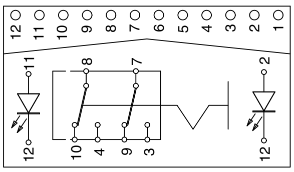
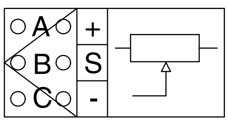


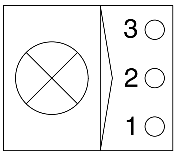
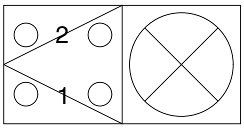
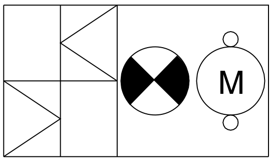
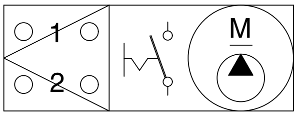
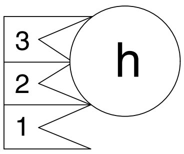
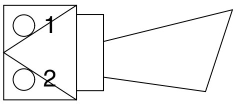
3009SH4EL24

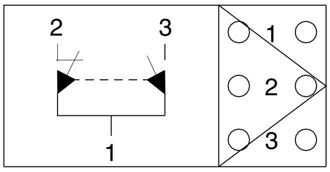
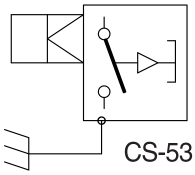
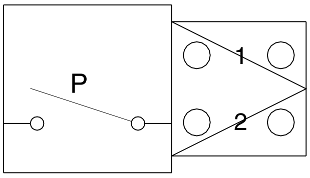
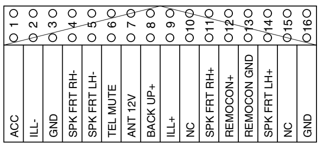
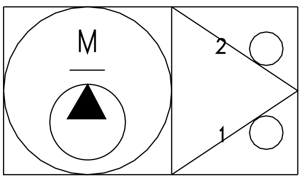
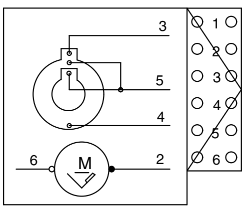
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

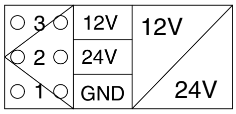
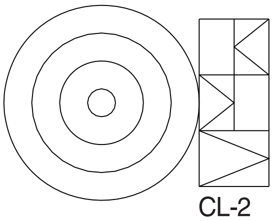
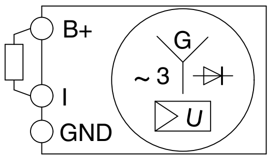
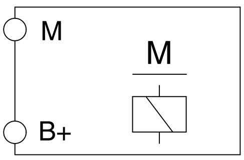
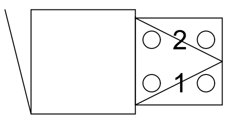
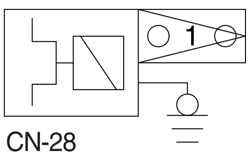
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact 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

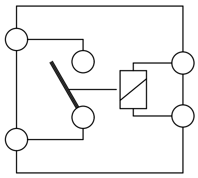
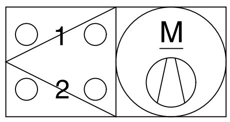
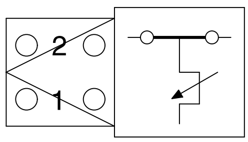
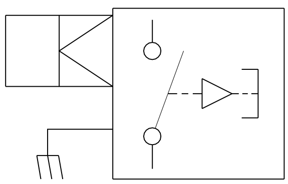
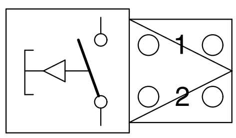
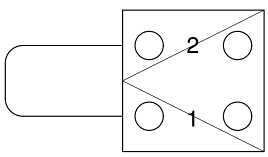
Part name	Symbol	Specifications	Check
Pre-heat plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12Ω
Temperature sensor (hydraulic, coolant)	 CD-1 CD-8	-	※ Check resistance 50˚C : 804Ω 80˚C : 310Ω 100˚C : 180Ω
Air cleaner pressure switch	 CD-10	(N.O TYPE)	※ Check contact High level : ∞Ω Low level : 0Ω
Fuel 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)

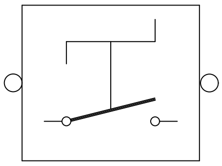
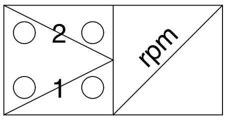
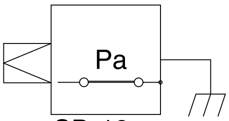
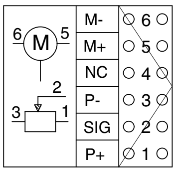
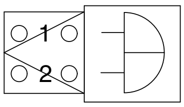
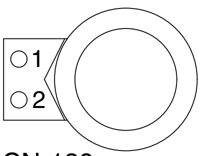
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-5 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0Ω (for terminal 30-87a) ∞Ω (for terminal 30-87)
Solenoid valve (cluster type 1)	 CN-66 CN-68 CN-70 CN-88 CN-135 CN-140 CN-149 CN-236 CN-237	24V 1A	※ Check resistance Normal : 15~25Ω (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 : 15~25Ω (for terminal 1-2)
EPPR valve (cluster type 1)	 CN-75 CN-133 CN-242	700mA	※ Check resistance Normal : 15~25Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-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 5kΩ (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) $\infty\Omega$(For terminal 1-3) OFF : $\infty\Omega$(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 fewΩ
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※Check resistance Normal : 1.0Ω
Hour meter	 CN-48	16~32V	※Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※Check operation Supply power(24V) to each terminal and connect ground.

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 playler	 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·m^2 (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	12	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-3	AMP	15	I/conn (Frame harness-Engine harness)	S816-012002	S816-102002
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-8	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12P-BE02
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-15	AMP	12	I/conn (F/harness-Breaker solenoid, cluster type 1)	S816-012002	S816-112002
CN-15	DEUTSCH	2	I/conn (F/harness-Breaker solenoid, cluster type 2)	DT04-2P-E005	DT06-2S-EP06
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	21Q7-10901	-
CN-45	RING-TERM	-	Starter motor B^+	S820-308000	-
CN-48	KET	1	Hour meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU (cluster type 1)	DRC26-40SA	-
CN-51	AMP	36	MCU (cluster type 2)	341111-1	-
CN-52	DEUTSCH	40	MCU (cluster type 1)	DRC26-40SB	-
CN-52	AMP	36	MCU (cluster type 2)	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 (cluster type 2)	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S	-

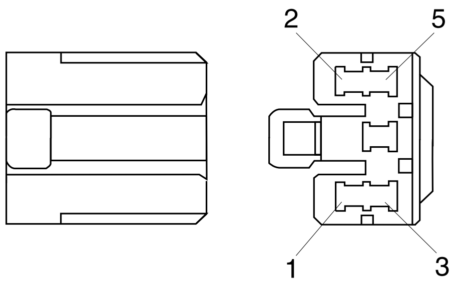
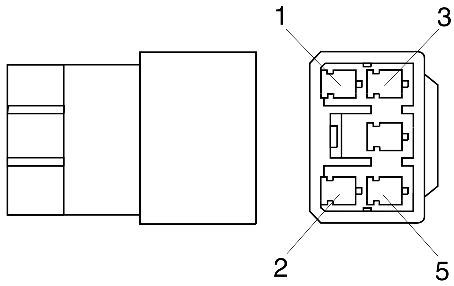
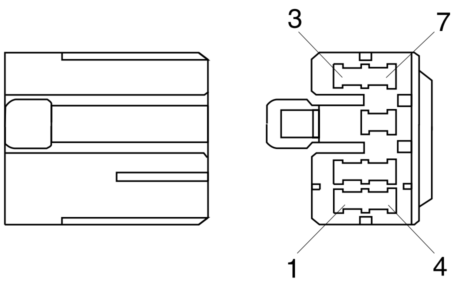
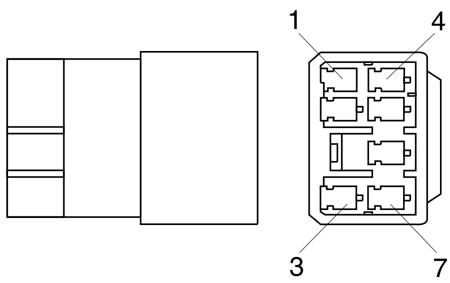
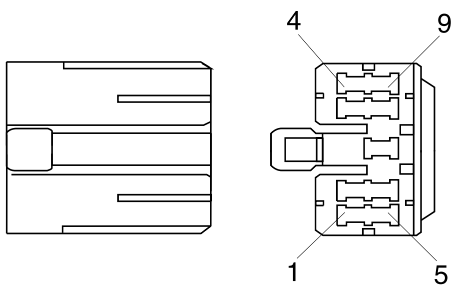
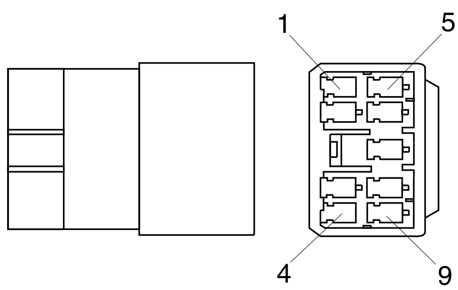
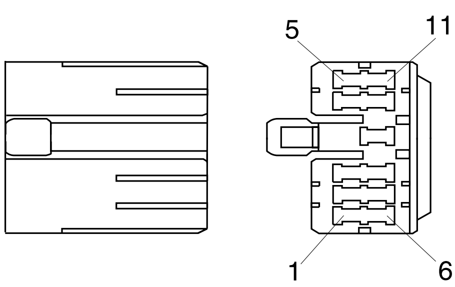
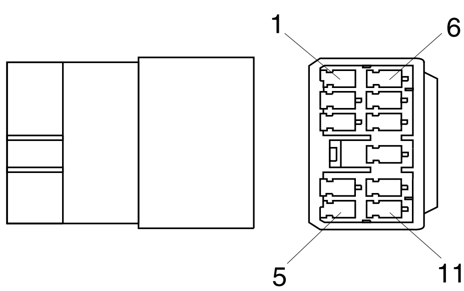
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-74	RING-TERM	2	Alternator "I" terminal	MG640188-4	-
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-76	DEUTSCH	6	Accel actuator	DT06-6S-EP06	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S	-
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	-
CN-135	DEUTSCH	2	Arm regeneration solenoid (cluster type 1)	DT06-2S	-
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
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	15300027	-
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)	S816-002002	S816-102002
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	-	S816-002003
CR-24	RING TERM	1	Preheat relay	S822-014000	-

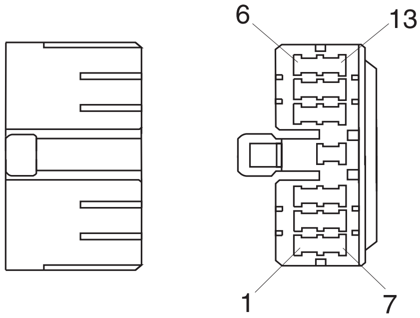
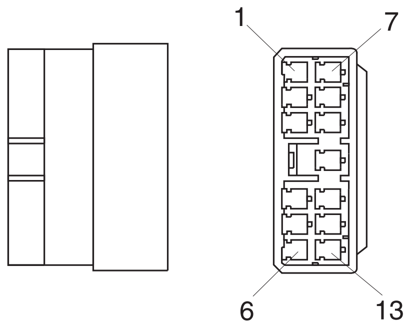
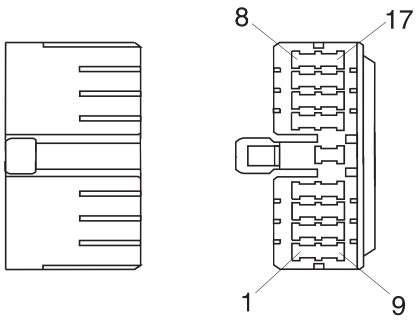
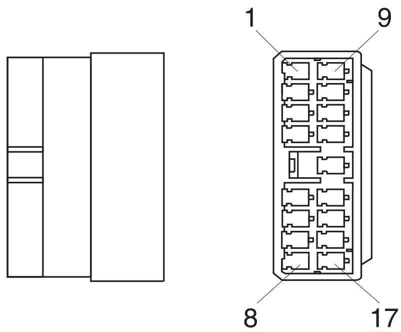
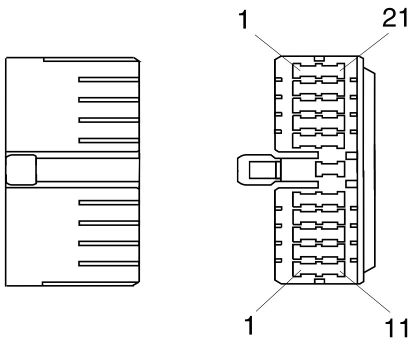
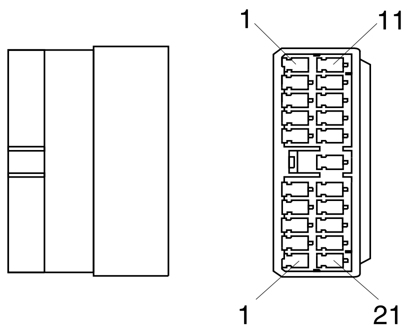
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	WP	6	Start key switch	S814-006100	-
CS-4	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	-
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	827551-2	-
CD-10	RING TERM	-	Air cleaner switch	ST730135-2	-
CD-17	AMP	2	Speed sensor	S814-002002	-
CD-18	RING TERM	-	Engine oil pressure switch	S822-014000	-
CD-19	AMP	1	Engine oil filter	S819-010122	-
CD-24	DEUTSCH	3	Swing sensor (cluster type 1)	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload sensor (cluster type 1)	DT06-3S-EP05	DT04-3P
CD-31	AMP	3	Overload sensor (cluster type 2)	S861-003002	S861-103002
CD-32	DEUTSCH	3	Boom up sensor (cluster type 1)	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-69	DEUTSCH	3	Attach pressure sensor (cluster type 1)	DT06-3S-EP06	-

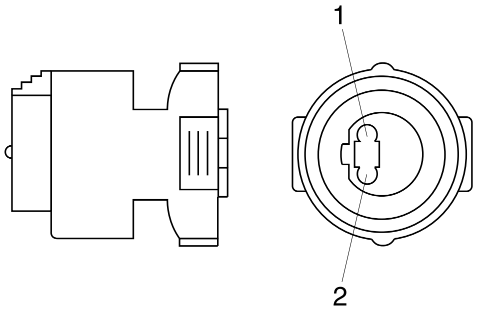
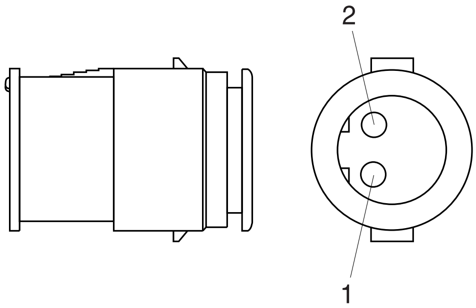
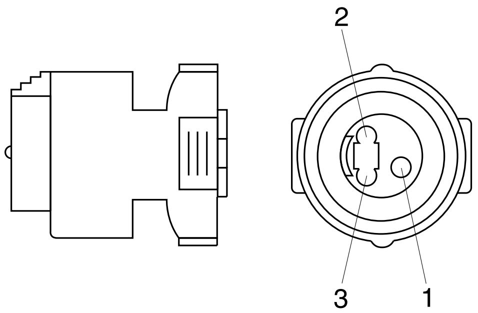
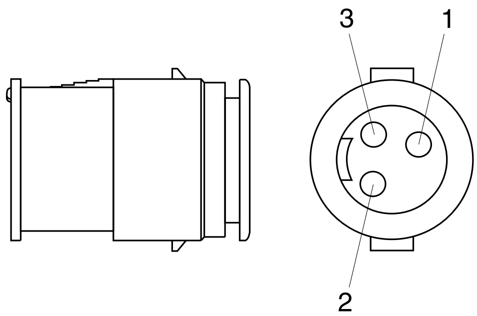
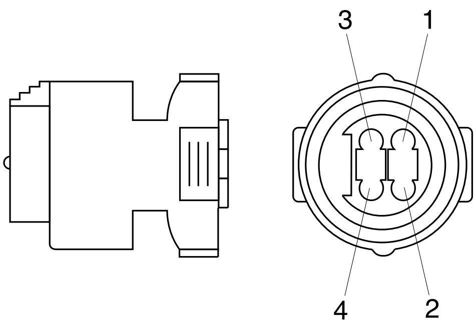
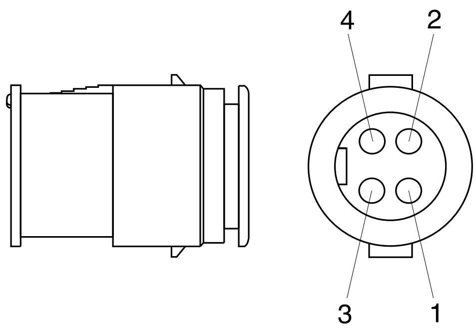
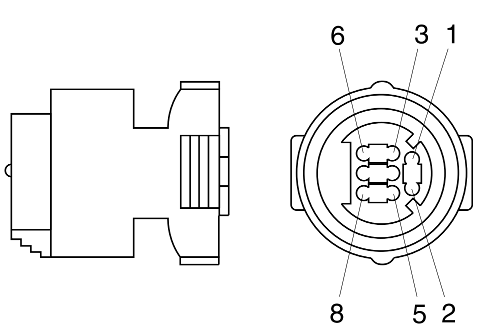
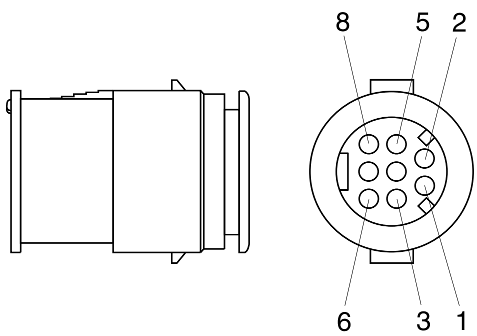
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

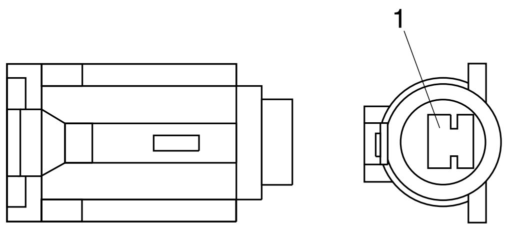
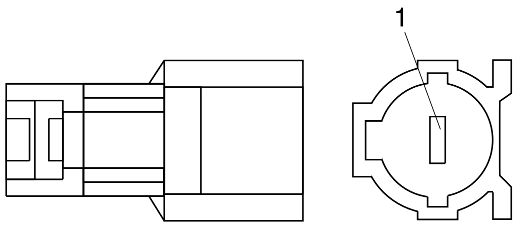
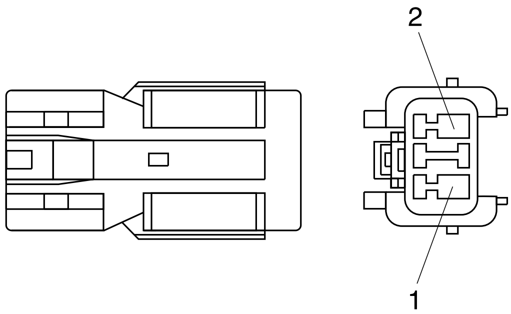
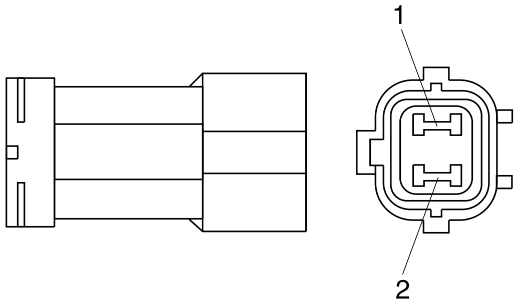
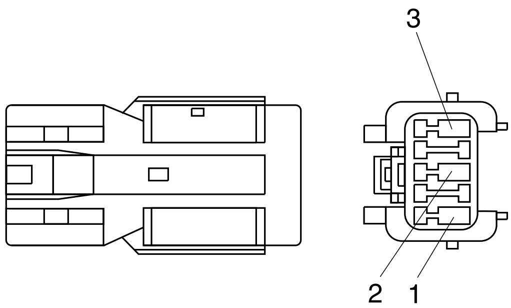
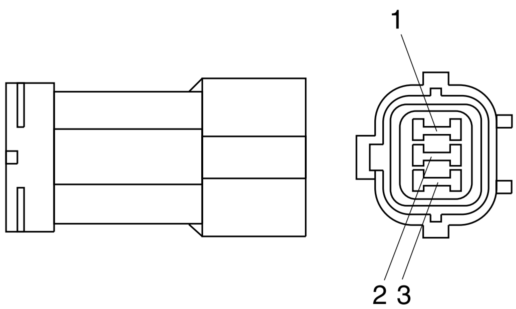
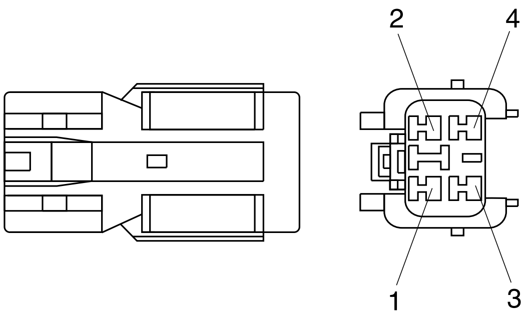
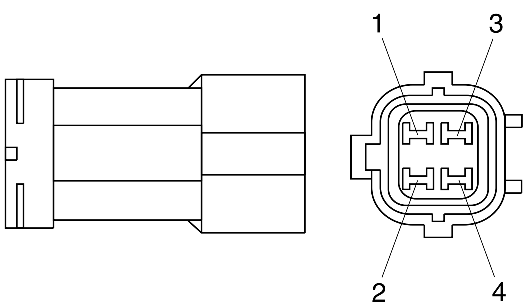
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

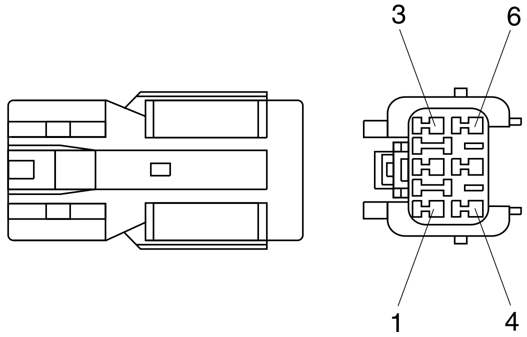
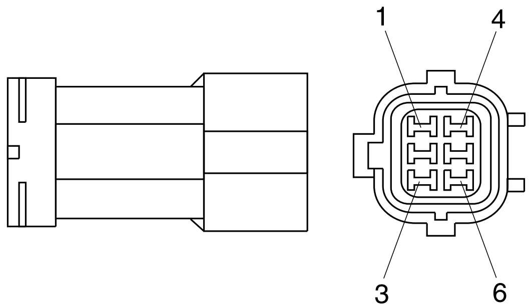
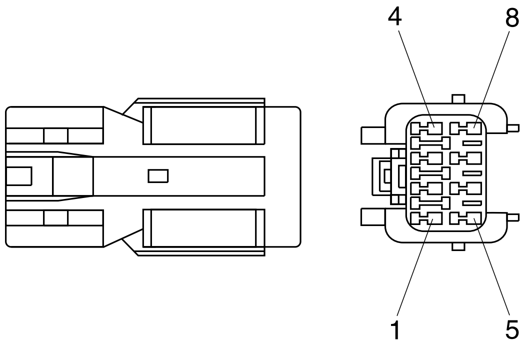
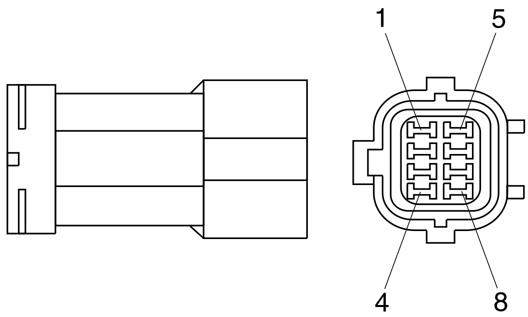
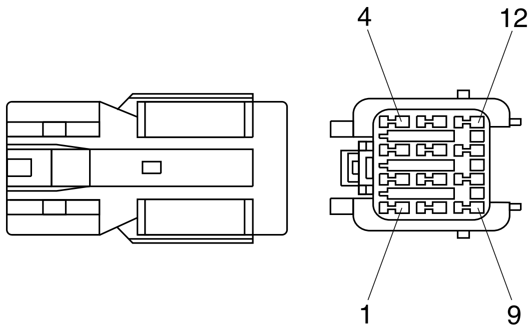
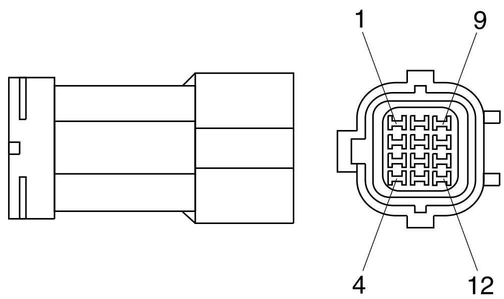
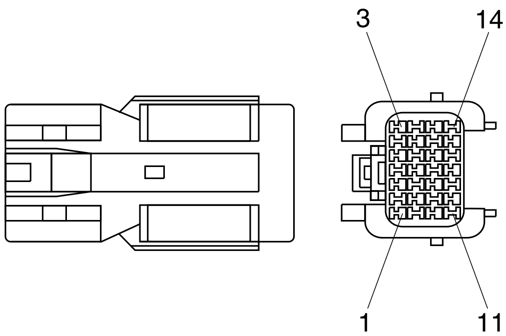
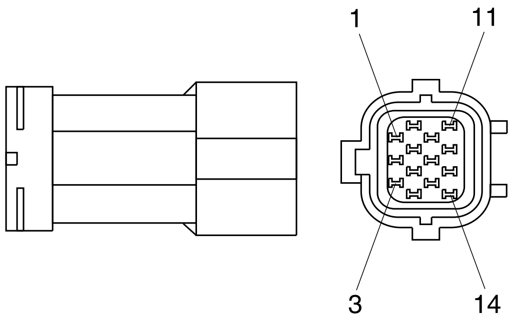
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

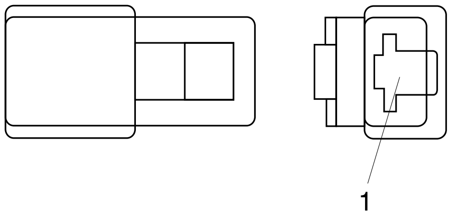
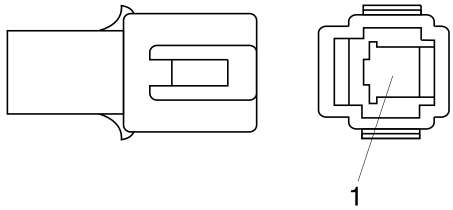
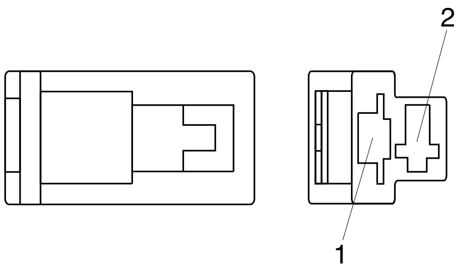
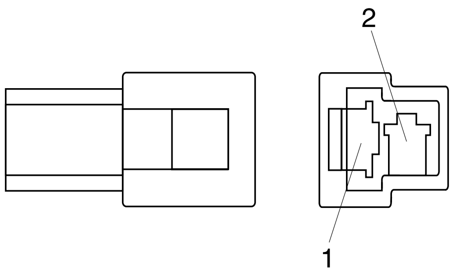
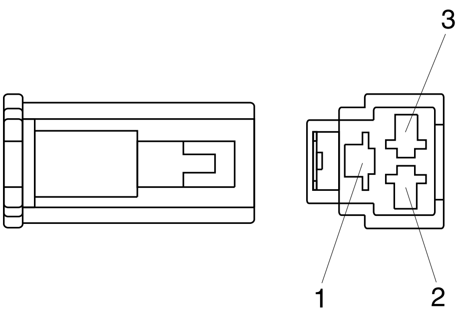
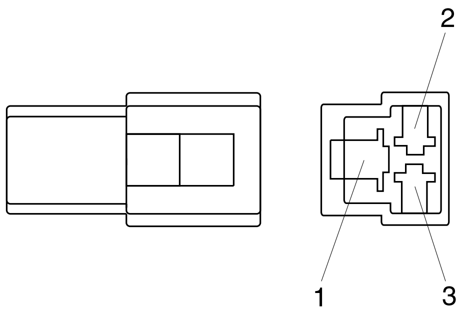
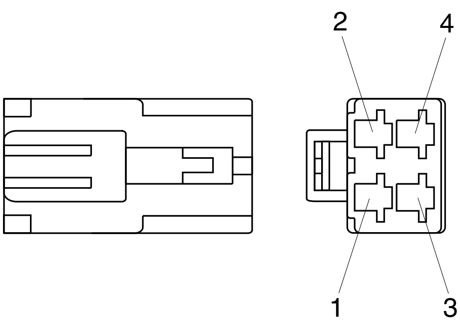
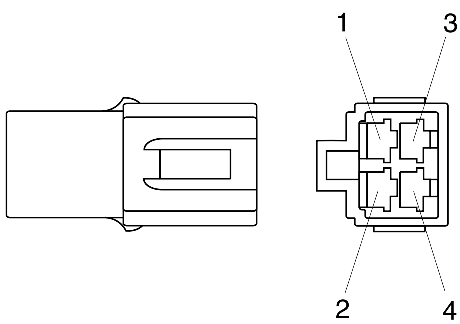
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

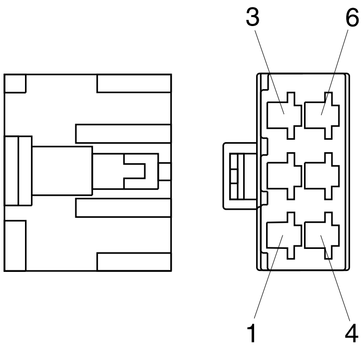
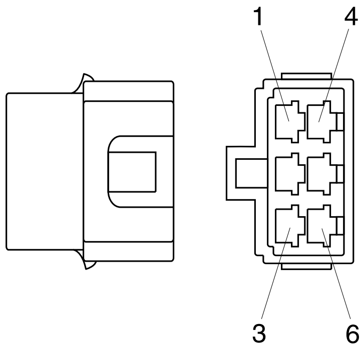
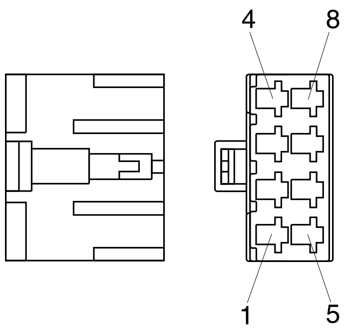
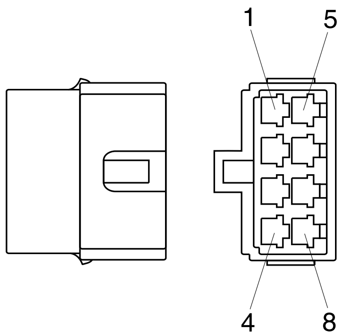
3) SWP TYPE CONNECTOR

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

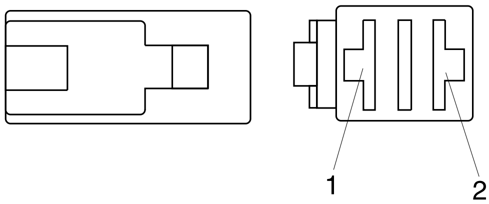
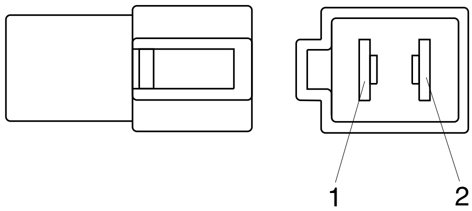
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

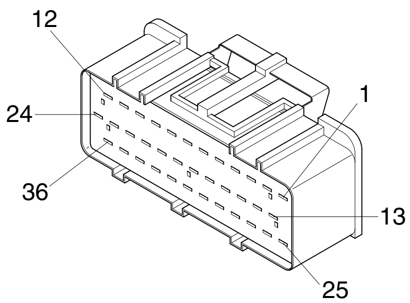
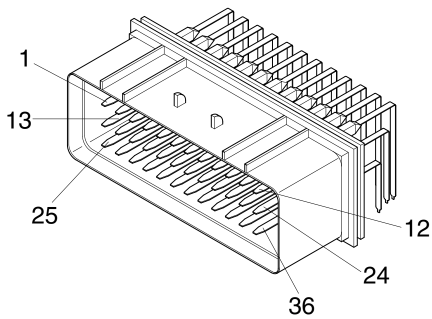
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

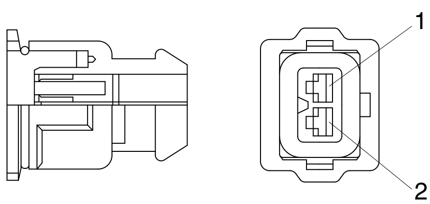
5) 375 FASTEN TYPE CONNECTOR

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

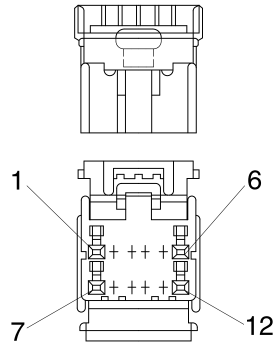
6) AMP ECONOSEAL CONNECTOR

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

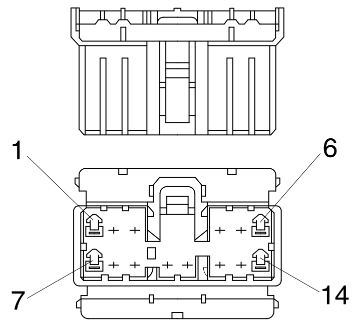
7) AMP TIMER CONNECTOR

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

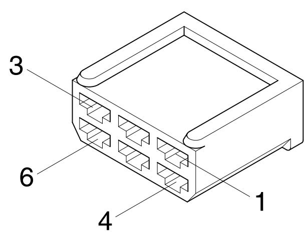
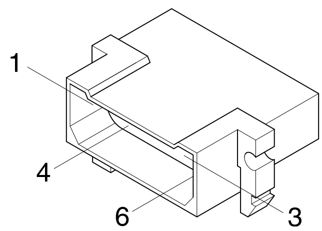
8) AMP 040 MULTILOCK CONNECTOR

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

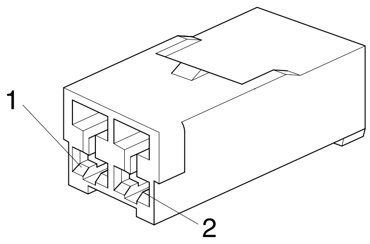
9) AMP 070 MULTILOCK CONNECTOR

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

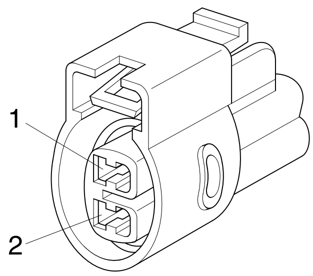
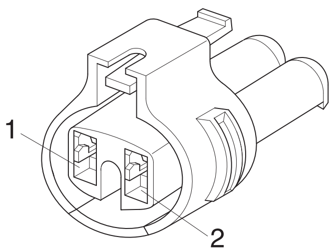
10) AMP FASTIN - FASTON CONNECTOR

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

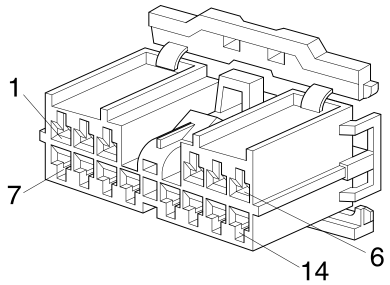
11) KET 090 CONNECTOR

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	

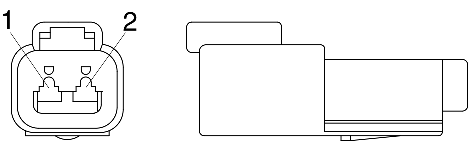
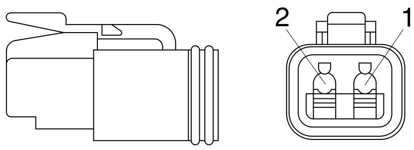
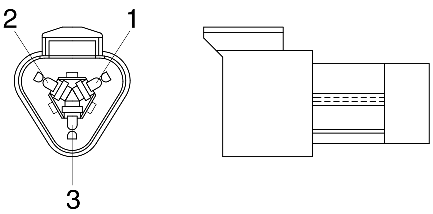
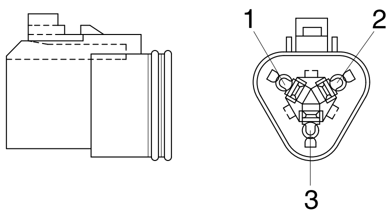
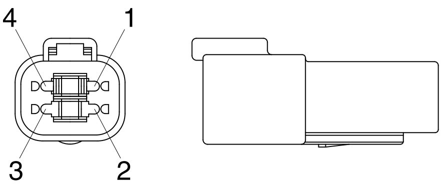
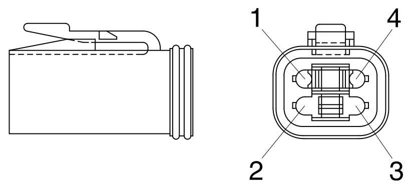
14) DEUTSCH DT CONNECTORS

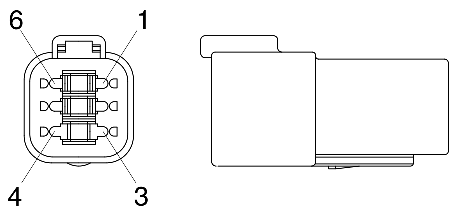
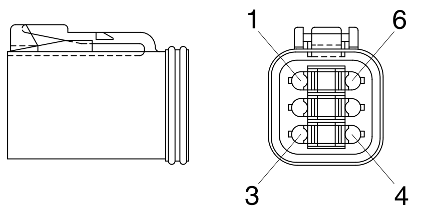
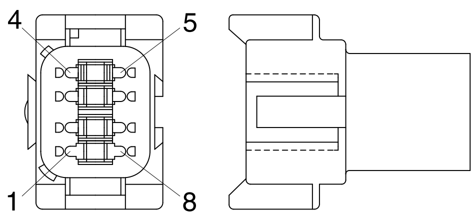
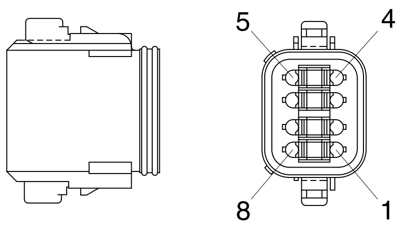
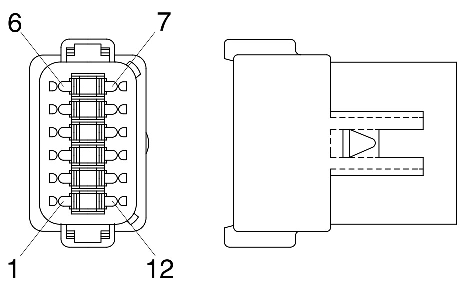
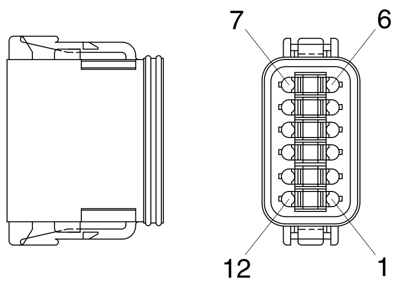
DT 06 - 3S - ★★★★

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

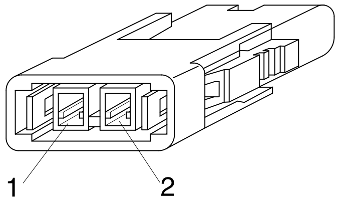
※ Modification

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

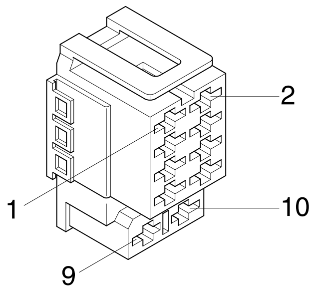
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

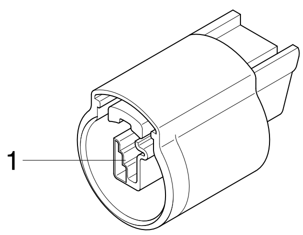
15) MOLEX 2CKTS CONNECTOR

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

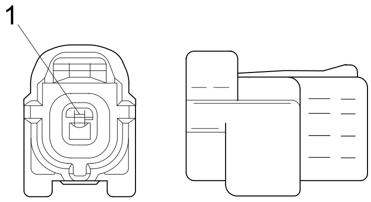
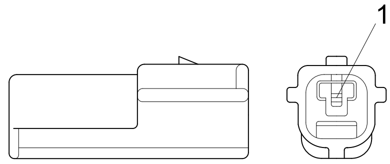
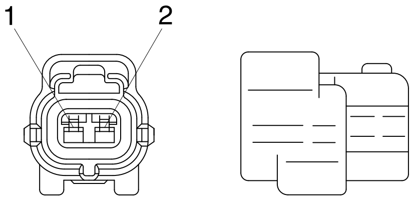
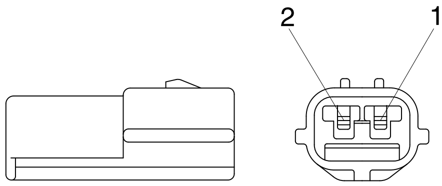
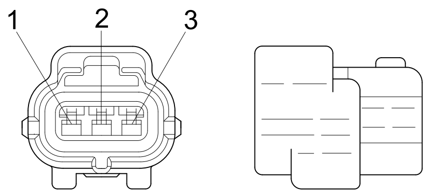
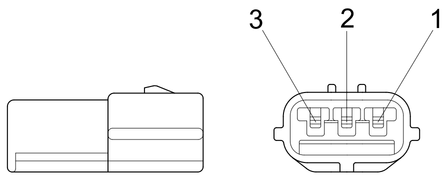
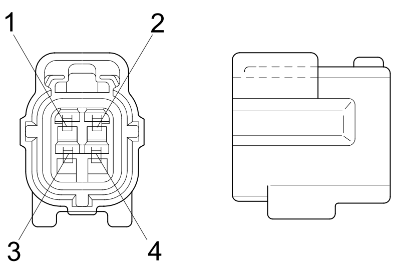
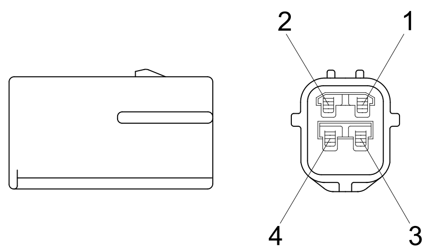
16) ITT SWF CONNECTOR

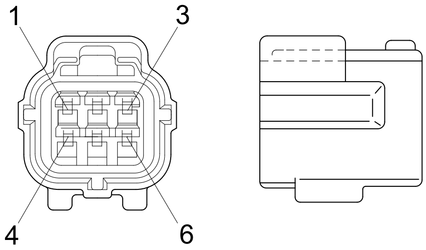
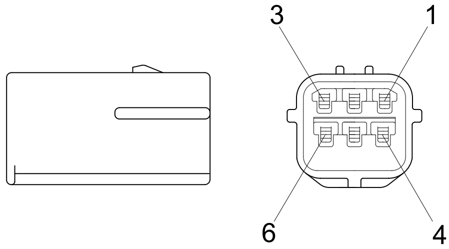
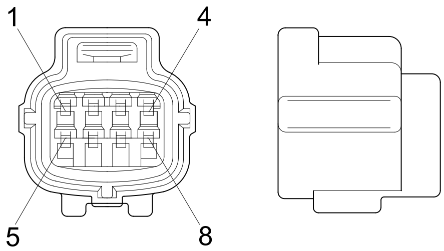
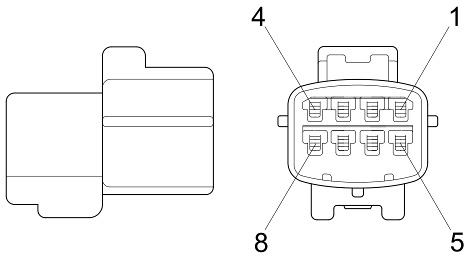
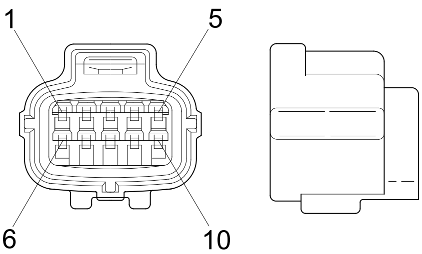
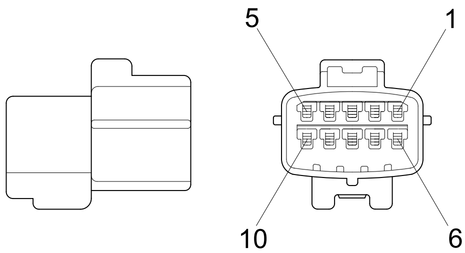
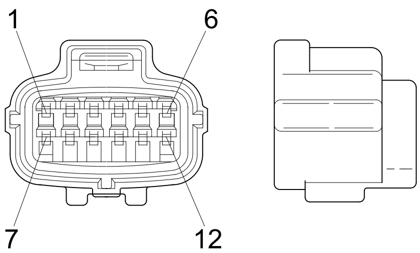
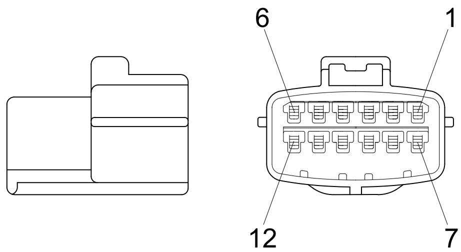
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

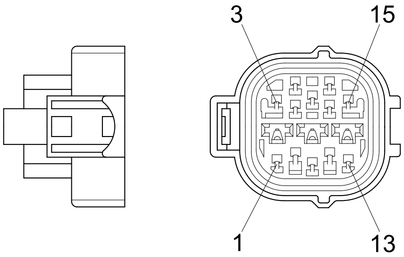
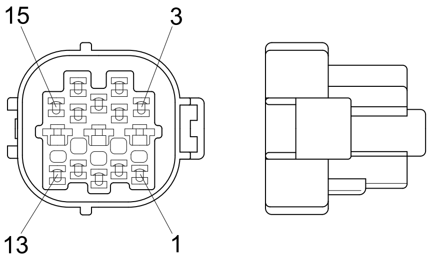
17) MWP NMWP CONNECTOR

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

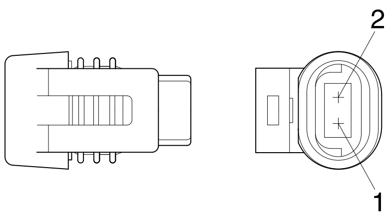
18) ECONOSEAL J TYPE CONNECTORS

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

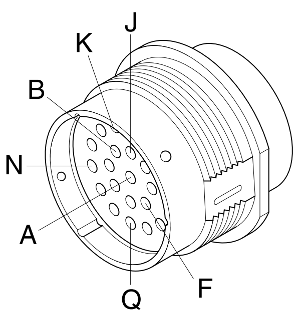
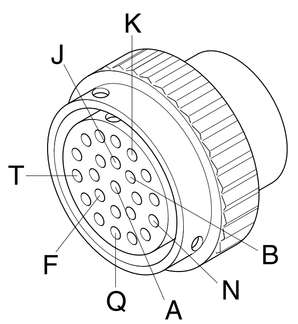
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

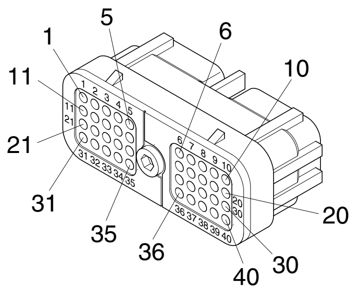
19) METRI-PACK TYPE CONNECTOR

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

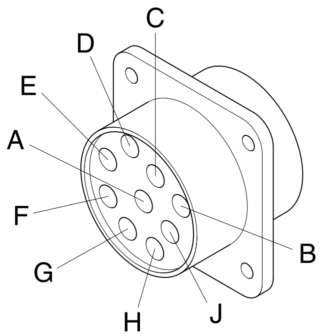
20) DEUTSCH HD30 CONNECTOR

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

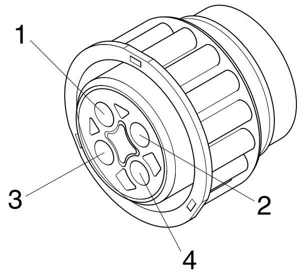
21) DEUTSCH MCU CONNECTOR

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

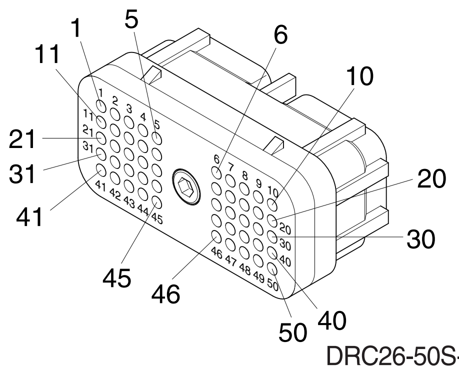
22) DEUTSCH SERVICE TOOL CONNECTOR

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

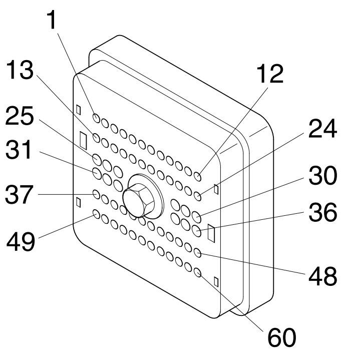
23) AMP FUEL WARMER CONNECTOR

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

SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE (CLUSTER TYPE 1)

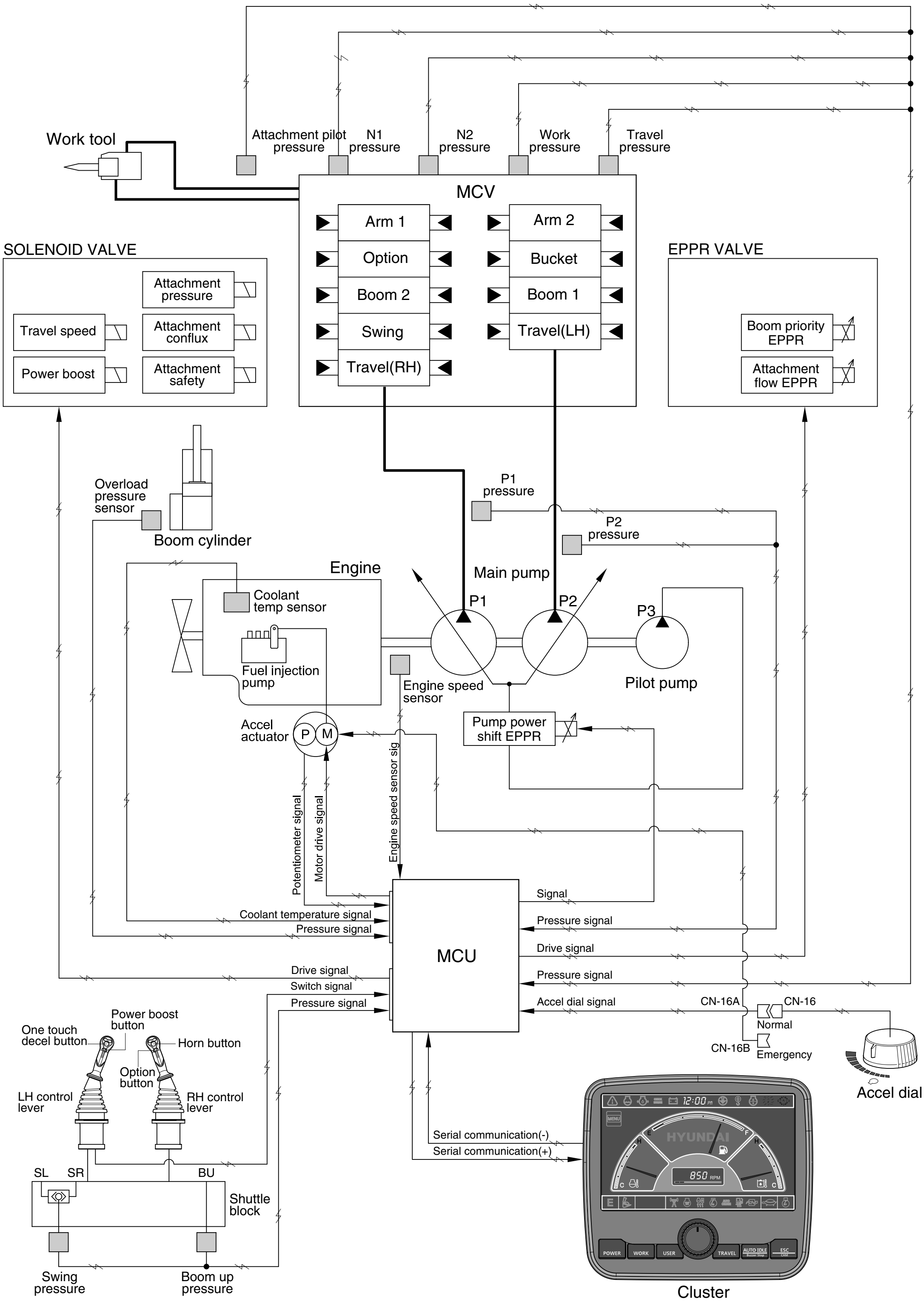
The CAPO (Computer Aided Power Optimization) system controls engine and pump mutual power at an optimum and less fuel consuming state for the selected work by mode selection, auto-deceleration, power boost function, etc. It monitors machine conditions, for instance, engine speed, coolant temperature,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

NEW CAPO SYSTEM

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

SYSTEM DIAGRAM (CLUSTER TYPE 1)



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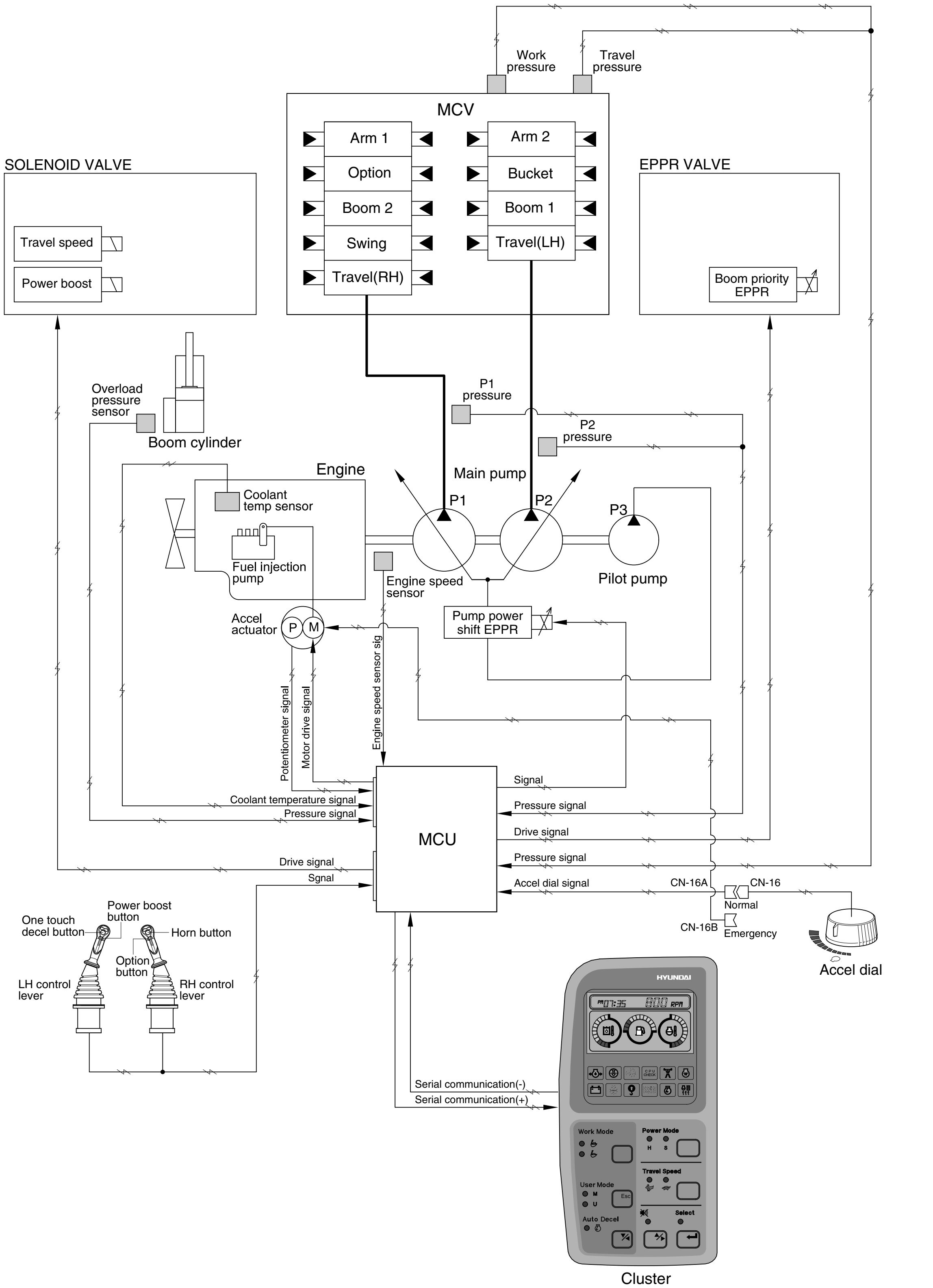
■ OUTLINE (CLUSTER TYPE 2)

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.

- NEW CAPO SYSTEM
  - Mode selection system
    - Engine control system
    - Pump control system
    - Work mode selection
    - User mode system (M, U)
  - Auto deceleration system
  - Power boost system
  - Travel speed control system
  - Automatic warming up system
  - Engine overheat prevention system
  - Anti-restart system
  - Self-diagnostic system
    - MCU & cluster protection
    - Open-short diagnosis & error code display
    - Machine error fault code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system

SYSTEM DIAGRAM (CLUSTER TYPE 2)



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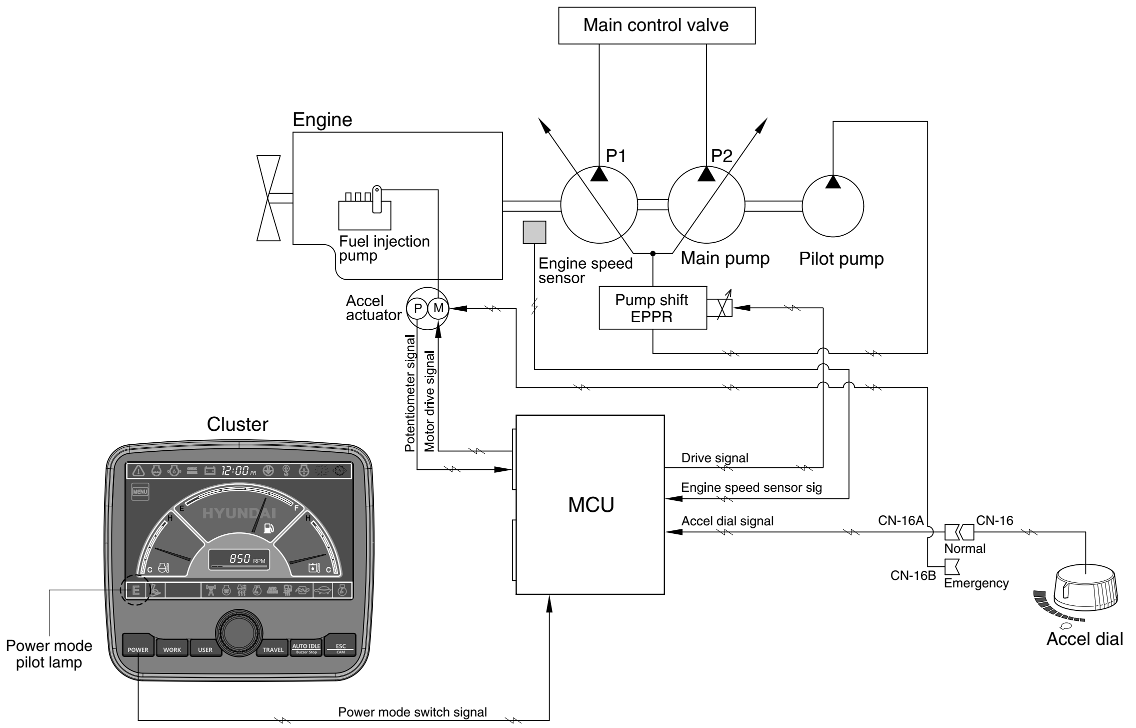
GROUP 2 MODE SELECTION SYSTEM (CLUSTER TYPE 1)

1. POWER MODE SELECTION SYSTEM



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

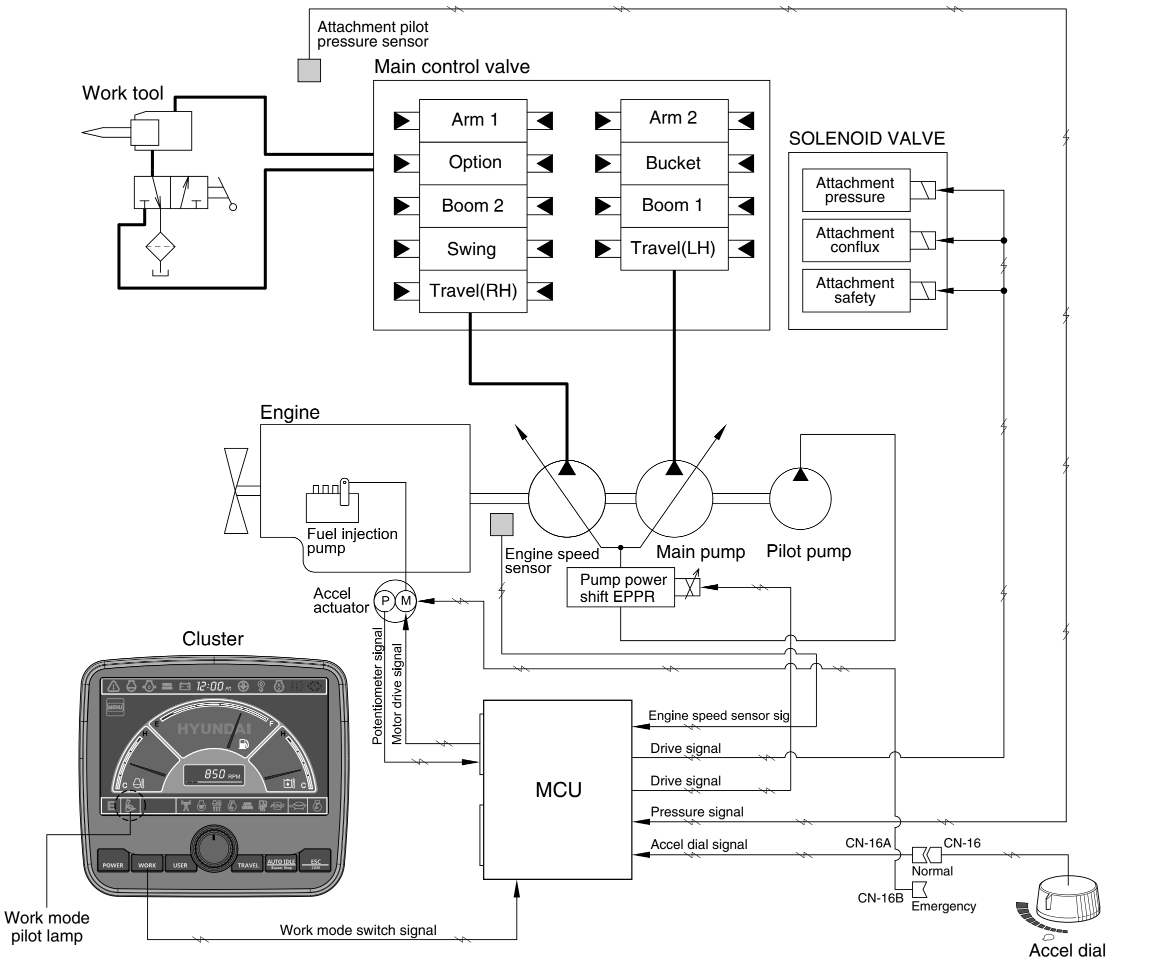
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

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	1800±50	1600±50	1900±50	1700±50	360±30	12	250±30	5
S	Standard power	1700±50	1500±50	1800±50	1600±50	400±30	15±3	290±30	8±3
E	Economy operation	1600±50	1400±50	1700±50	1500±50	400±30	15±3	450±30	13±3
AUTO DECEL	Engine deceleration	1150±100	-	1150±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).



3809SH5MS03

1) GENERAL WORK MODE (bucket)

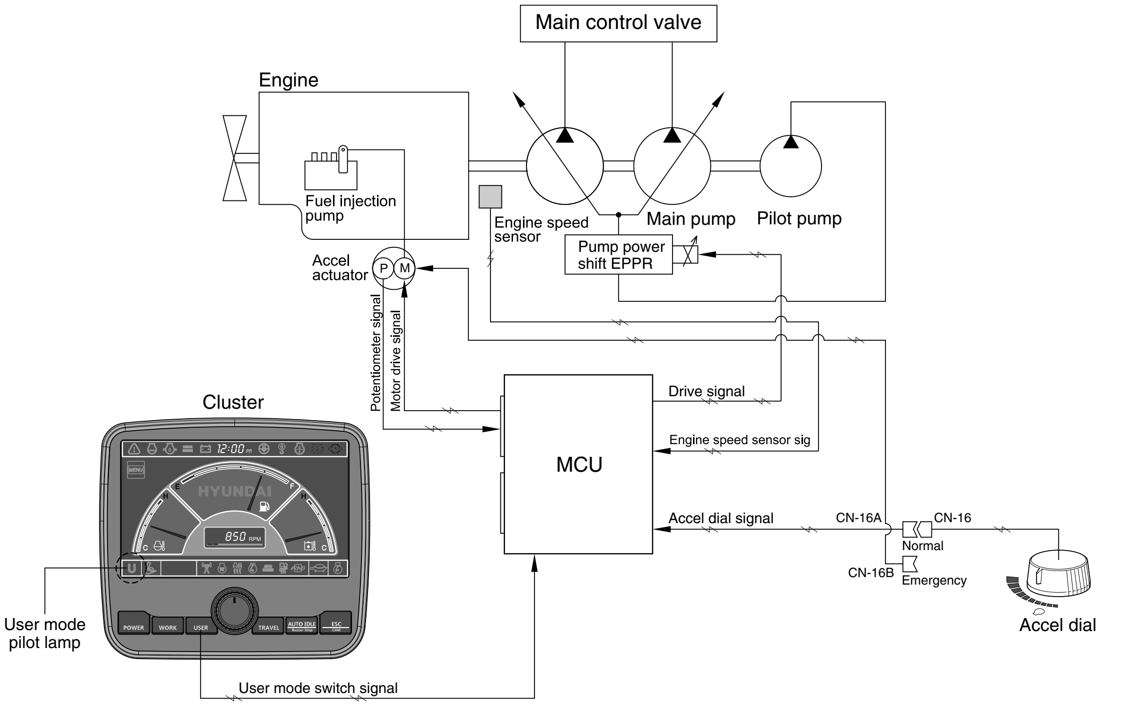
This mode is used to general digging work.

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

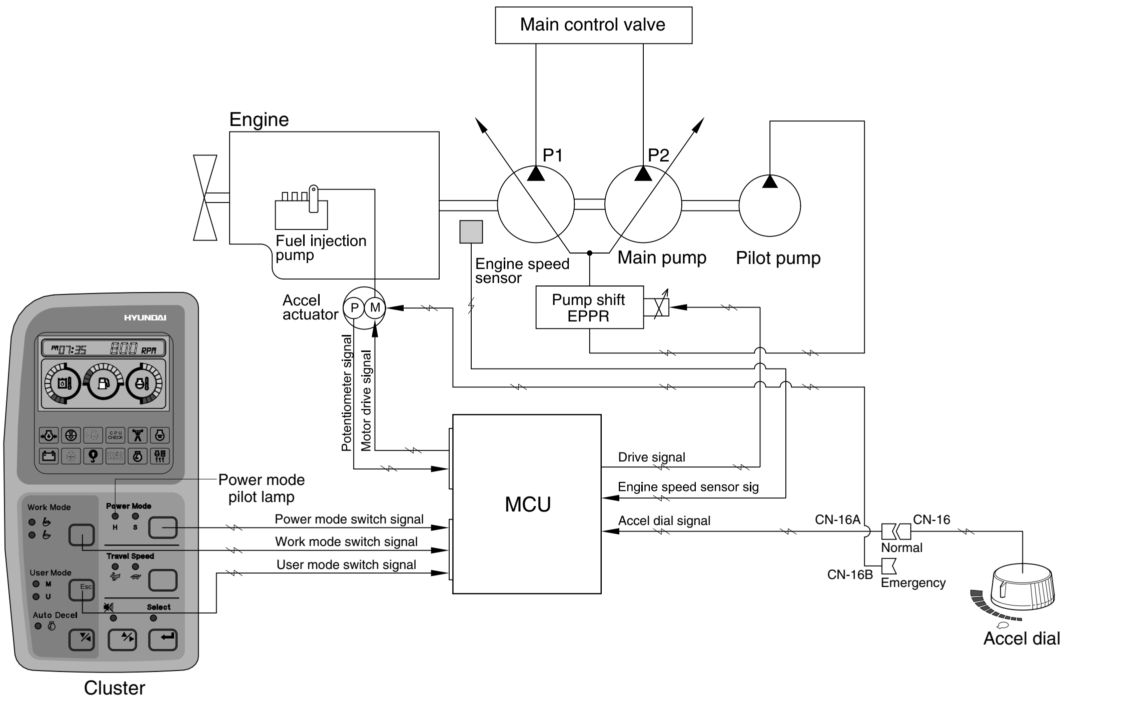
1) High idle rpm, auto idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1450	900	0
2	1500	950 (low idle)	3
3	1550	1000	6
4	1600	1050	9
5	1650	1100	12
6	1700	1150(decel rpm)	16
7	1750	1200	20
8	1800	1250	26
9	1850	1300	32
10	1900	1350	38

■ MODE SELECTION SYSTEM (CLUSTER TYPE 2)

1. POWER MODE SELECTION SYSTEM



3009SH5MS21

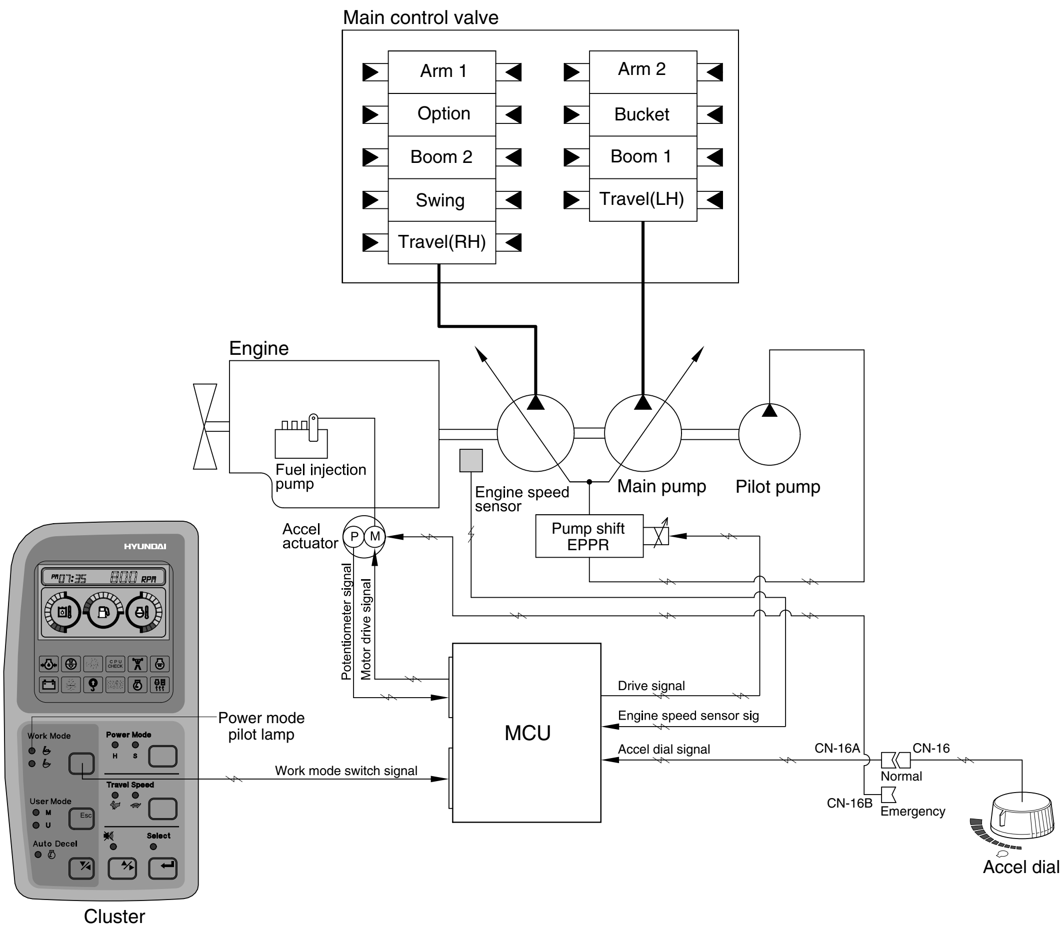
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

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/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1800±50	1600±50	1900±50	1700±50	330±30	10	250±30	5
S	Standard power	1700±50	1500±50	1800±50	1600±50	365±30	13±3	290±30	8±3
E	Economy operation	1600±50	1400±50	1700±50	1500±50	365±30	13±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	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

2. WORK MODE SELECTION SYSTEM

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



3809SH5MS22

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

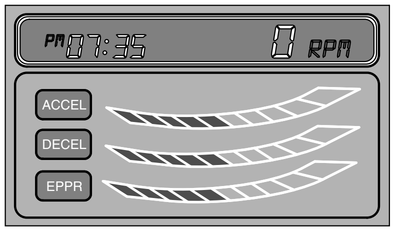
An operator can change the engine and pump power and memorize it for his preference.

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.

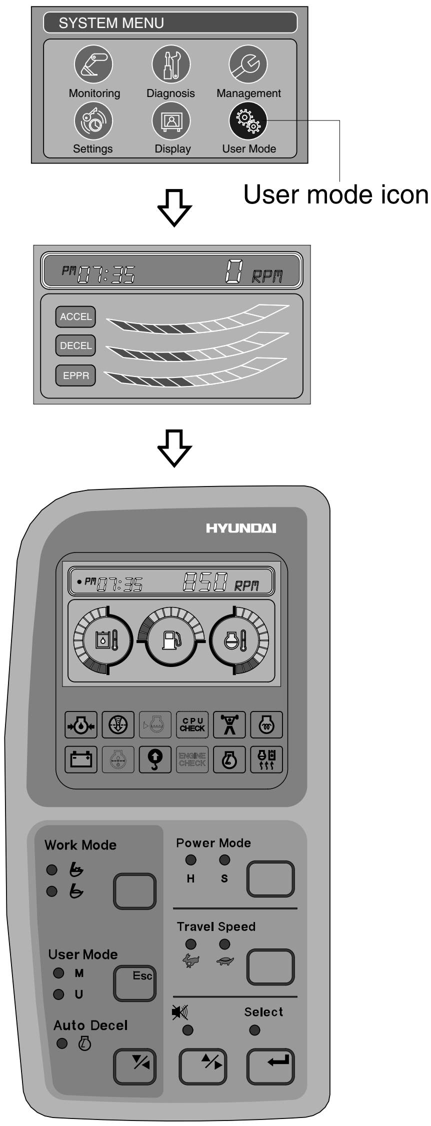


2507A4OP08

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

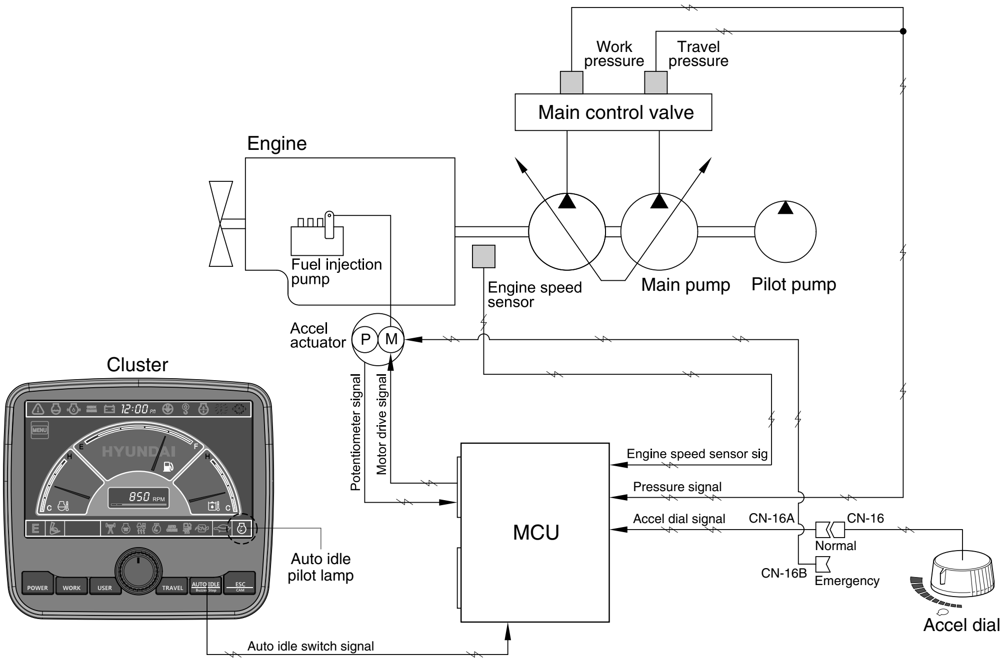
· LCD segment vs parameter setting

Segment (▮)	ACCEL (rpm)	DECEL (rpm)	EPPR (mA)
1	1450	900	150
2	1500	950 (low idle)	200
3	1550	1000	250
4	1600	1050	300
5	1650	1100	350
6	1700	1150	400
7	1750	1200	450
8	1800	1250	500
9	1850	1300	550
10	1900	1350	600



3009SH4OP05

GROUP 3 AUTOMATIC DECELERATION SYSTEM (CLUSTER TYPE 1)

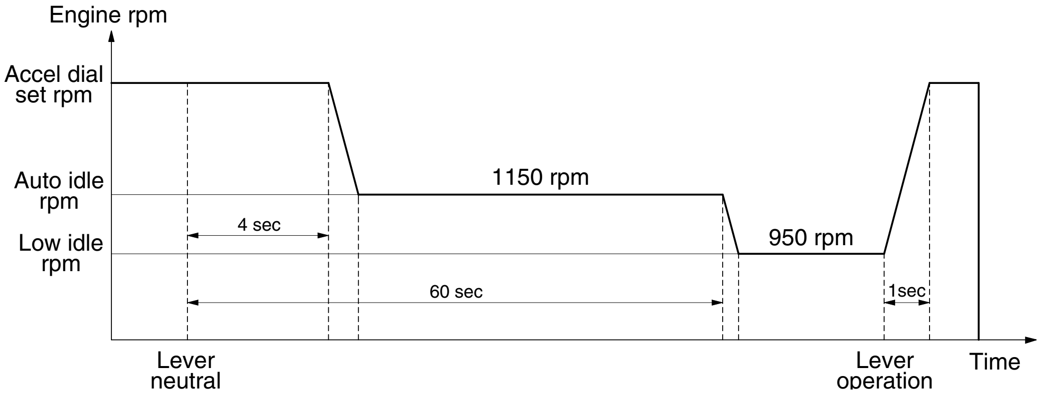


3009SH5MS05

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 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.



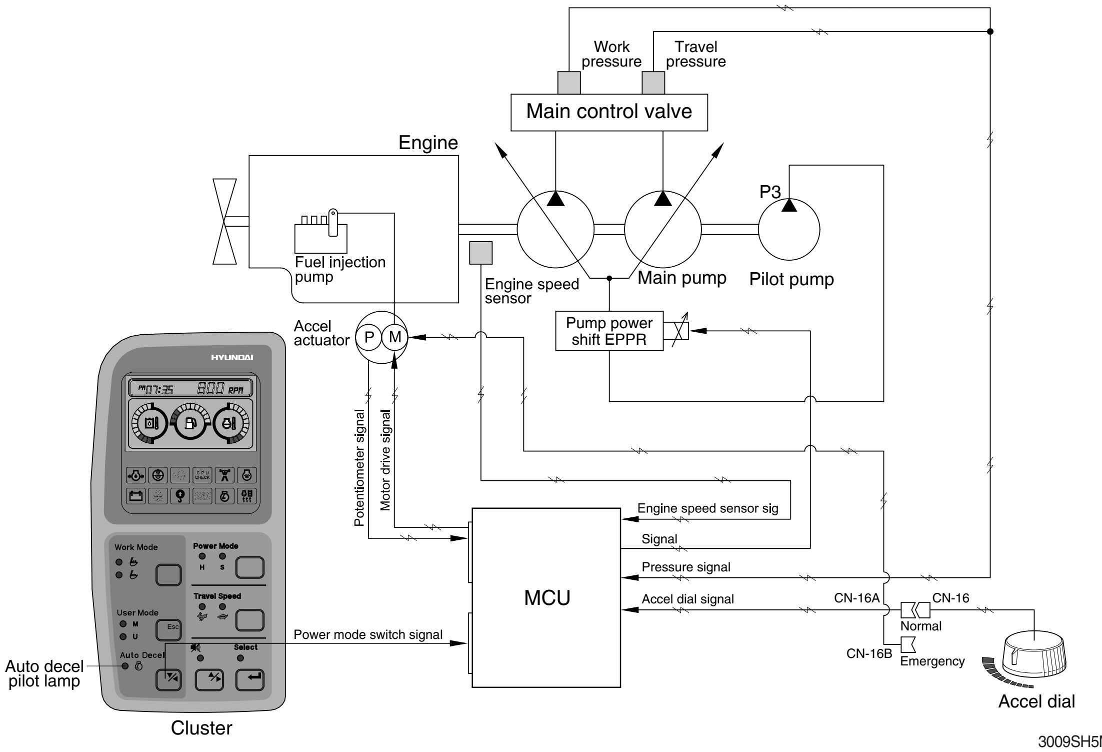
3809SH5MS21

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)

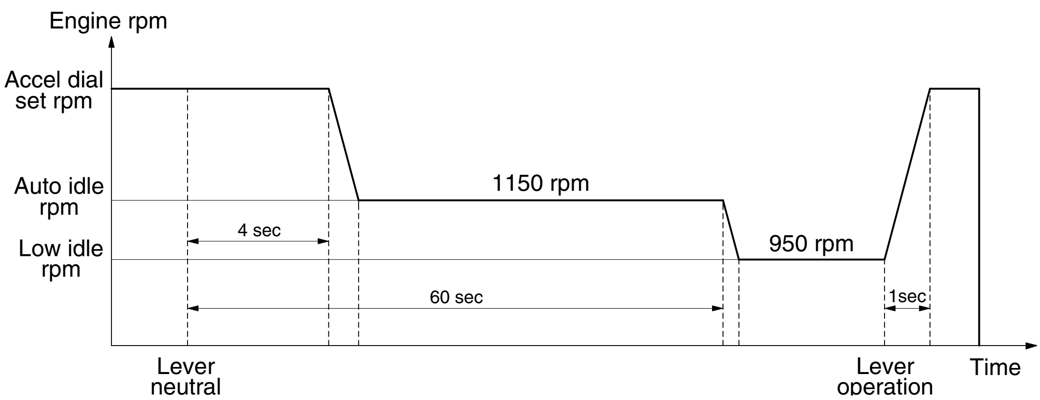


3009SH5MS23

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 1100 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.



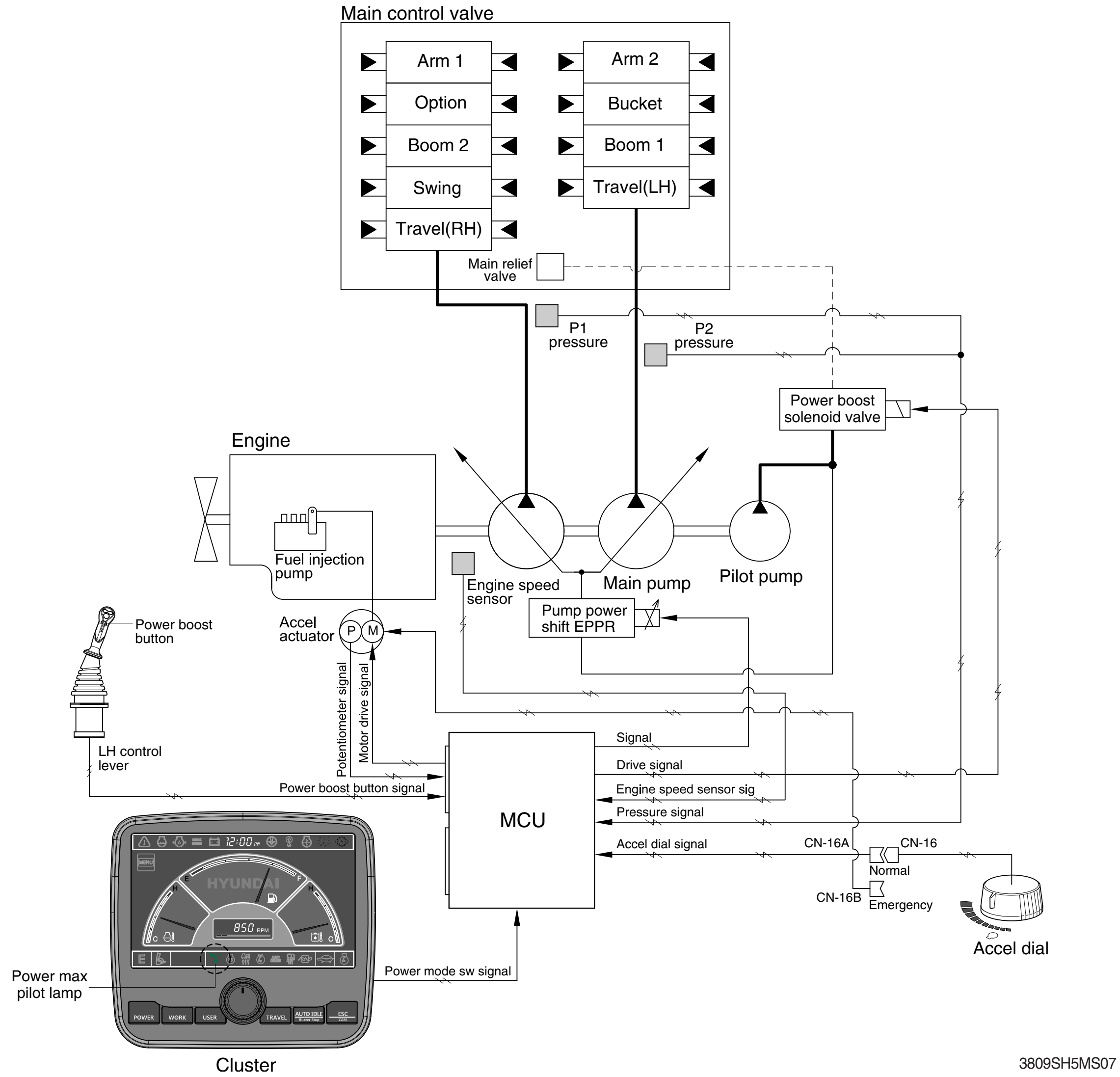
3809SH5MS21

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)



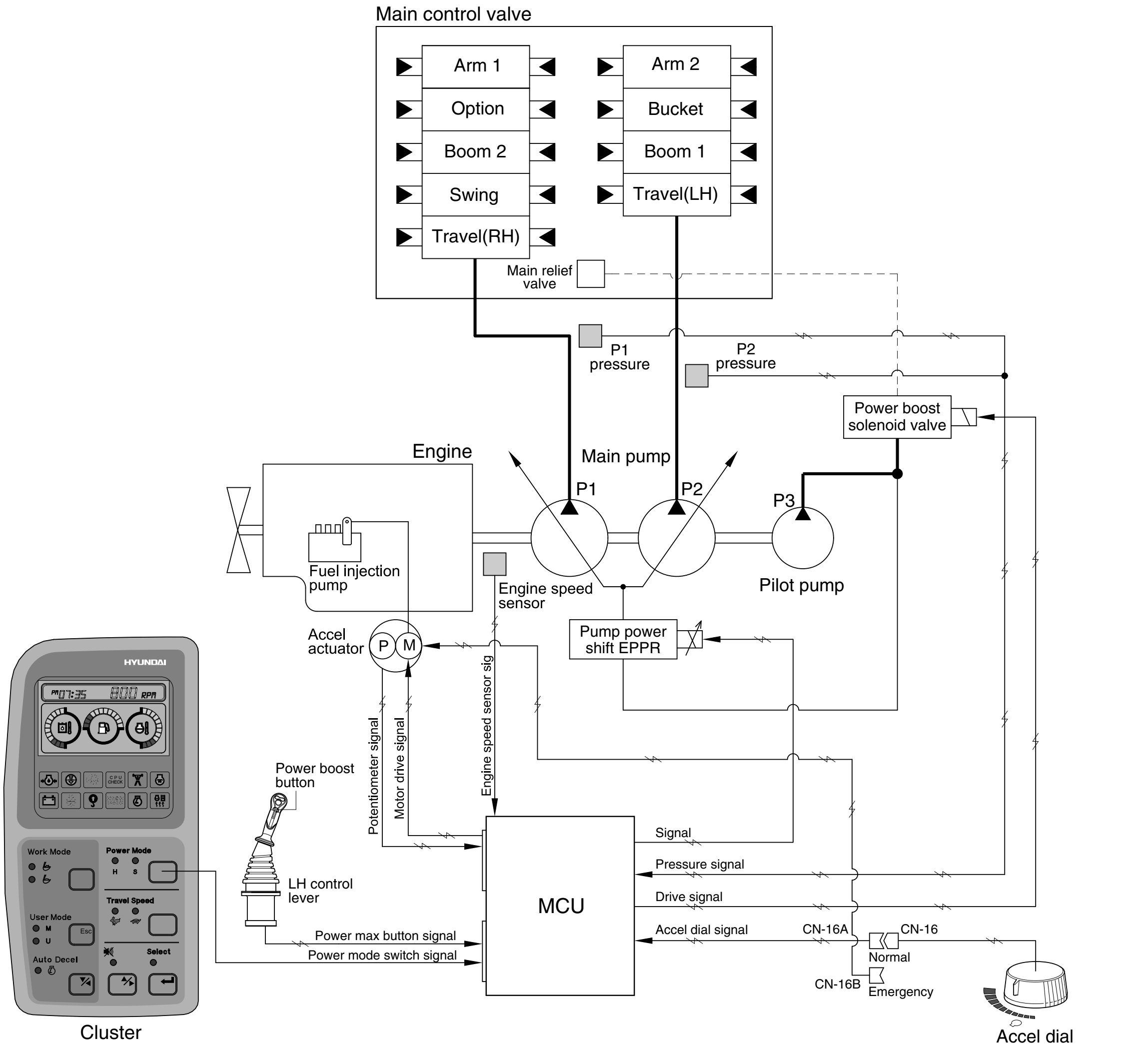
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

· 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)



3809SH5MS24

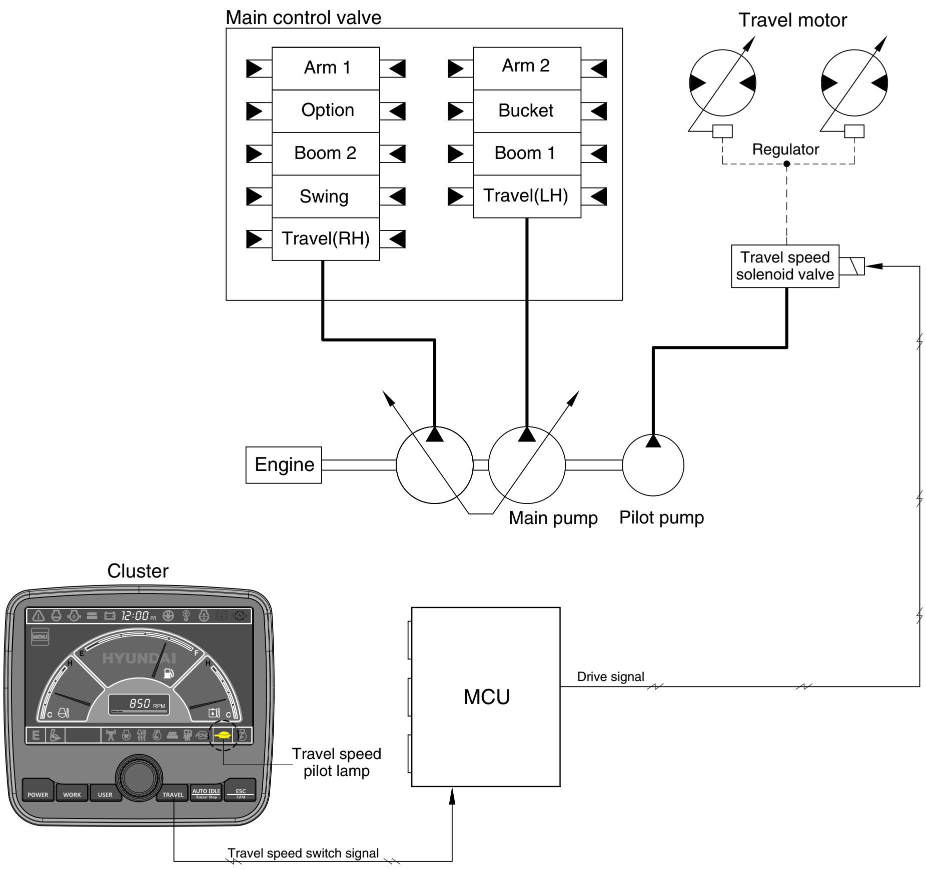
· When the power boost switch on the left control lever knob is pushed ON, the maximum digging power is increased by 10 %.

· 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)



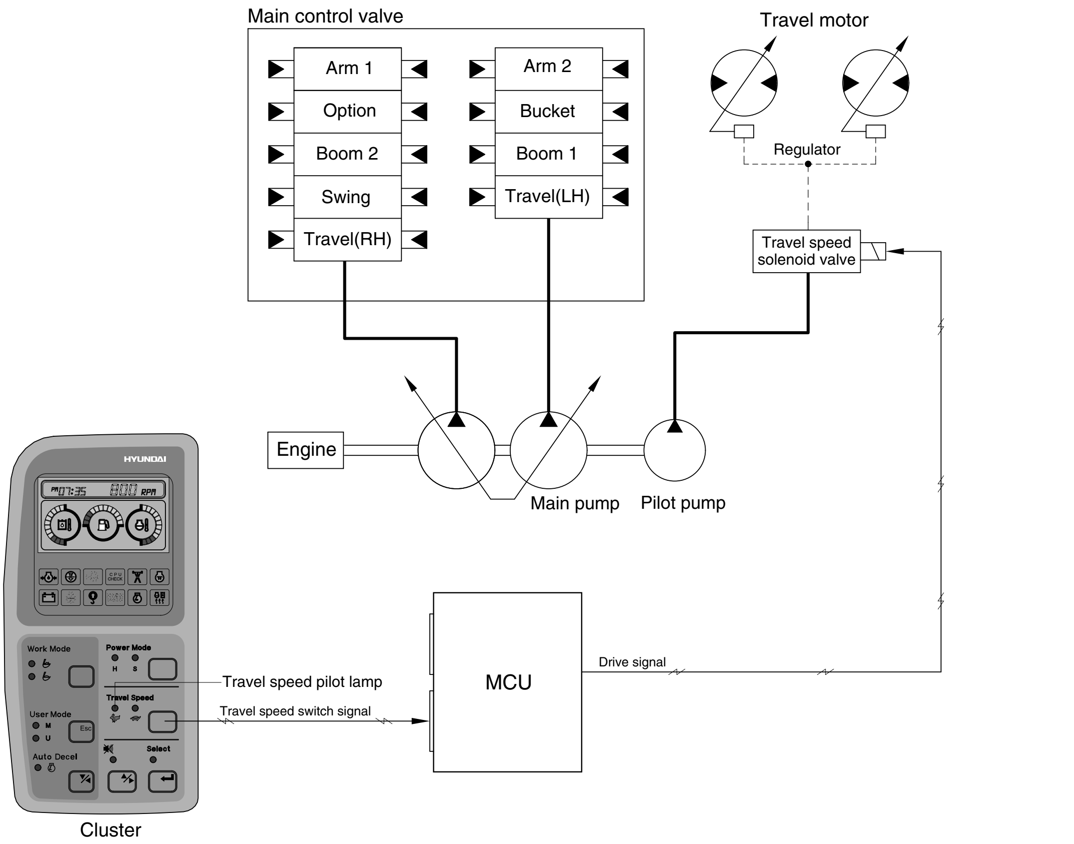
3809SH5MS05

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)



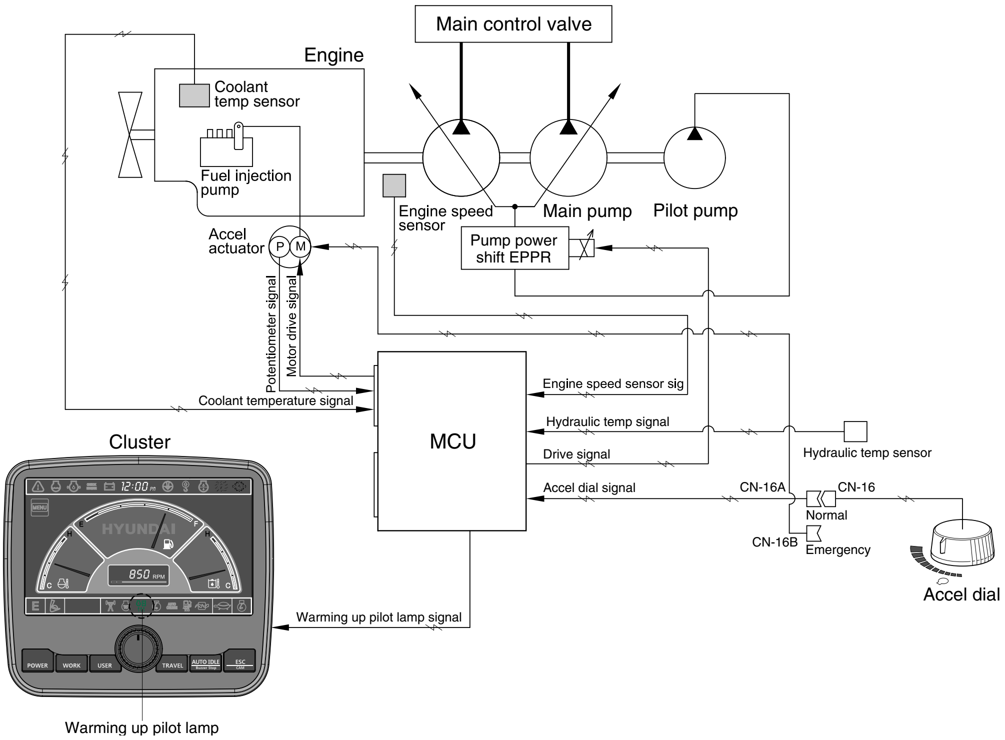
3809SH5MS25

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

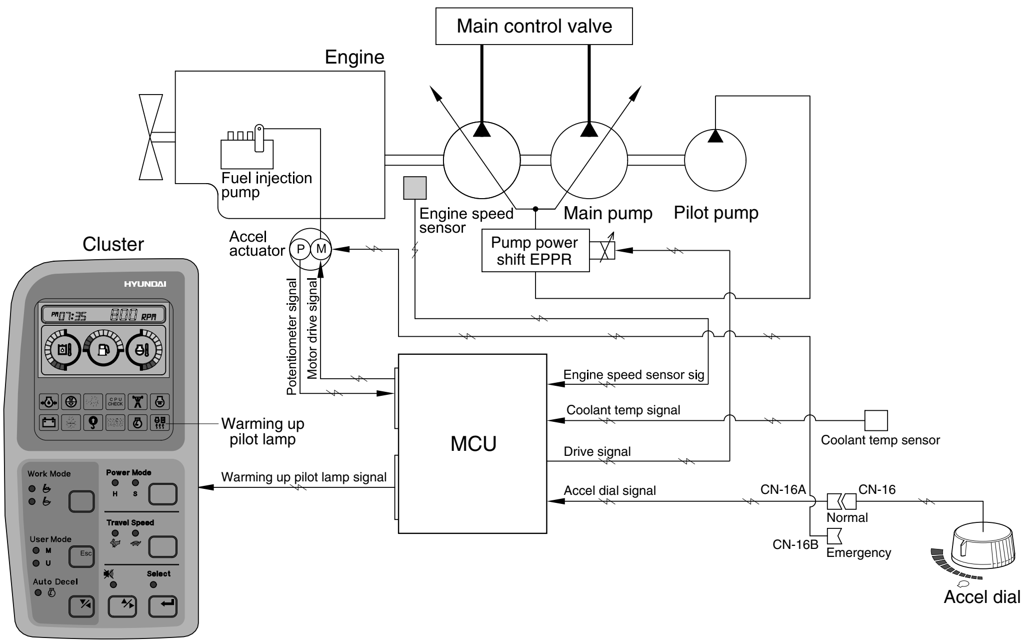
1. The MCU reads engine coolant temperature through the temperature sensor, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1150rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal 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)

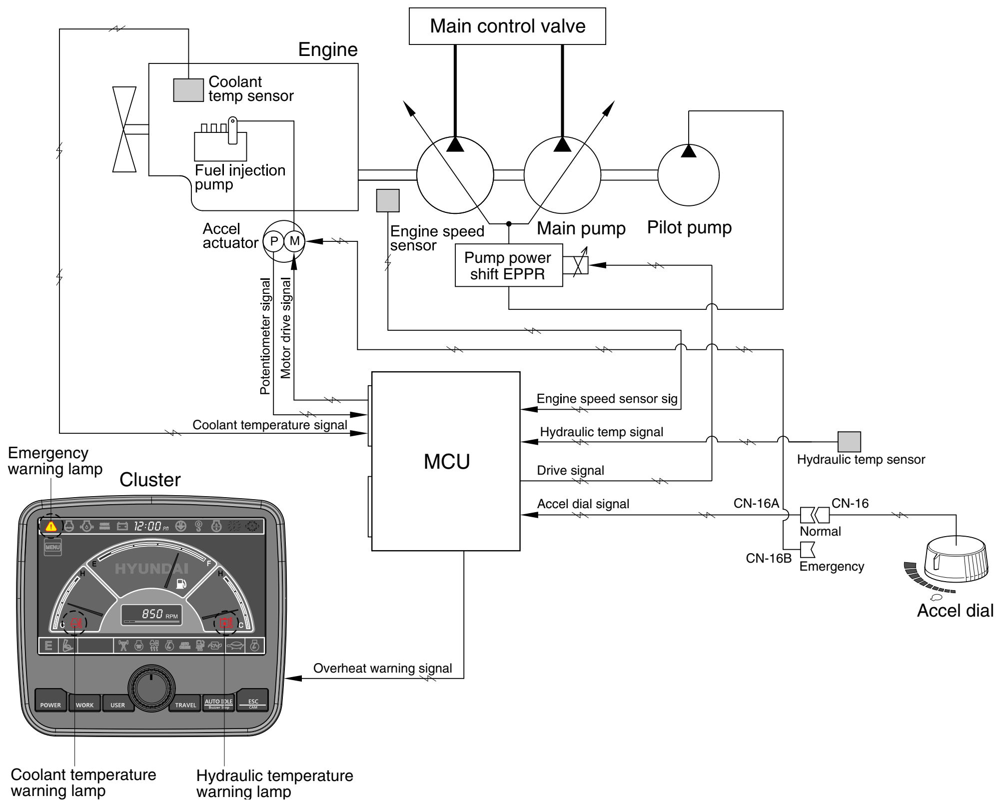


3009SH5MS26

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)



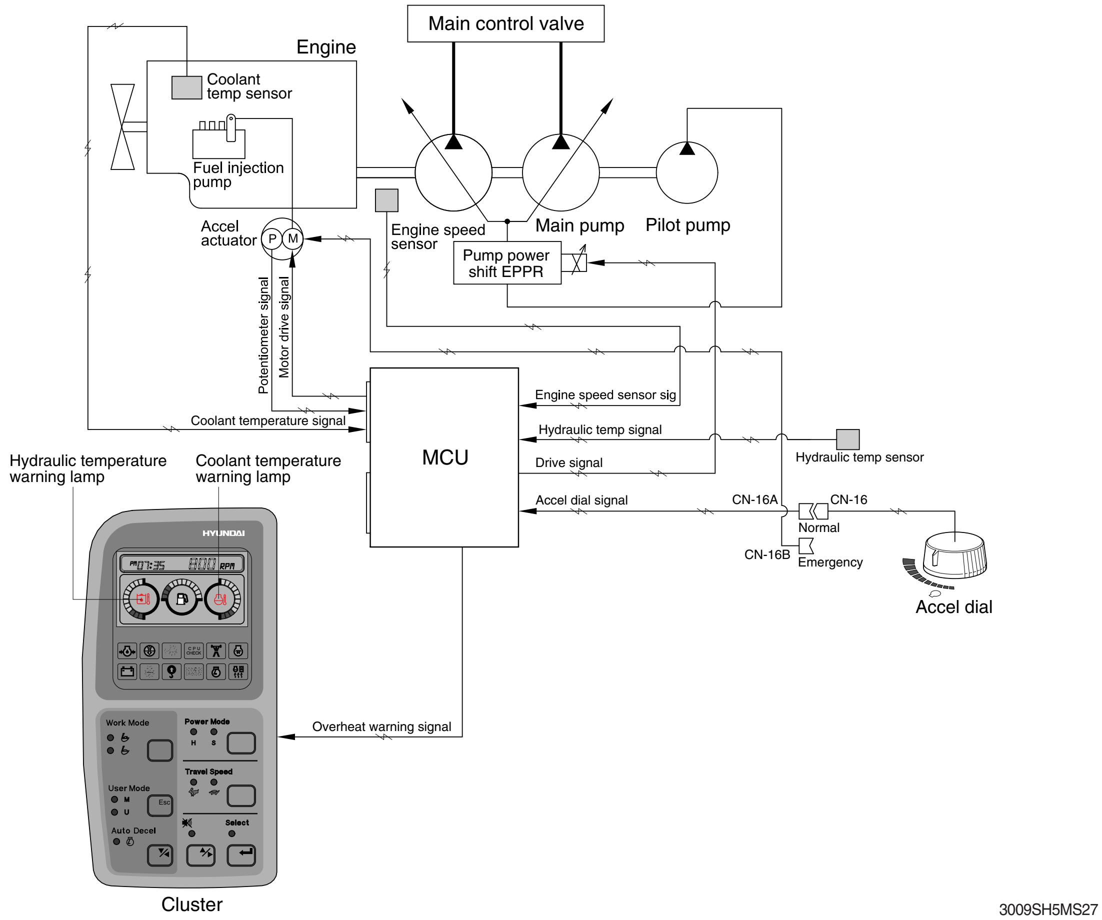
3009SH5MS09A

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)



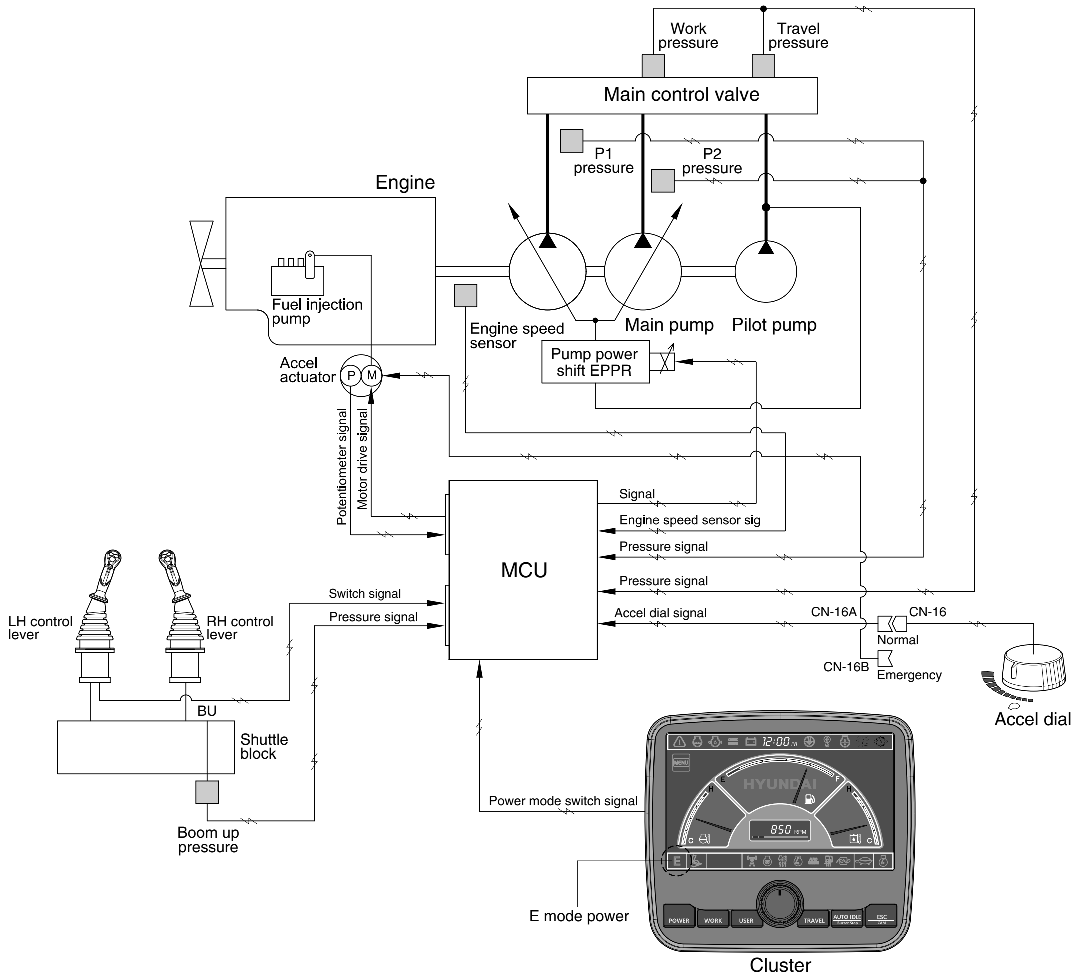
1. MCU receives engine coolant temperature through the temperature sensor and when the engine coolant boils up to 110˚C, it sends overheat warning signal to the cluster and decrease the engine speed same as accel dial 7 position.

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)



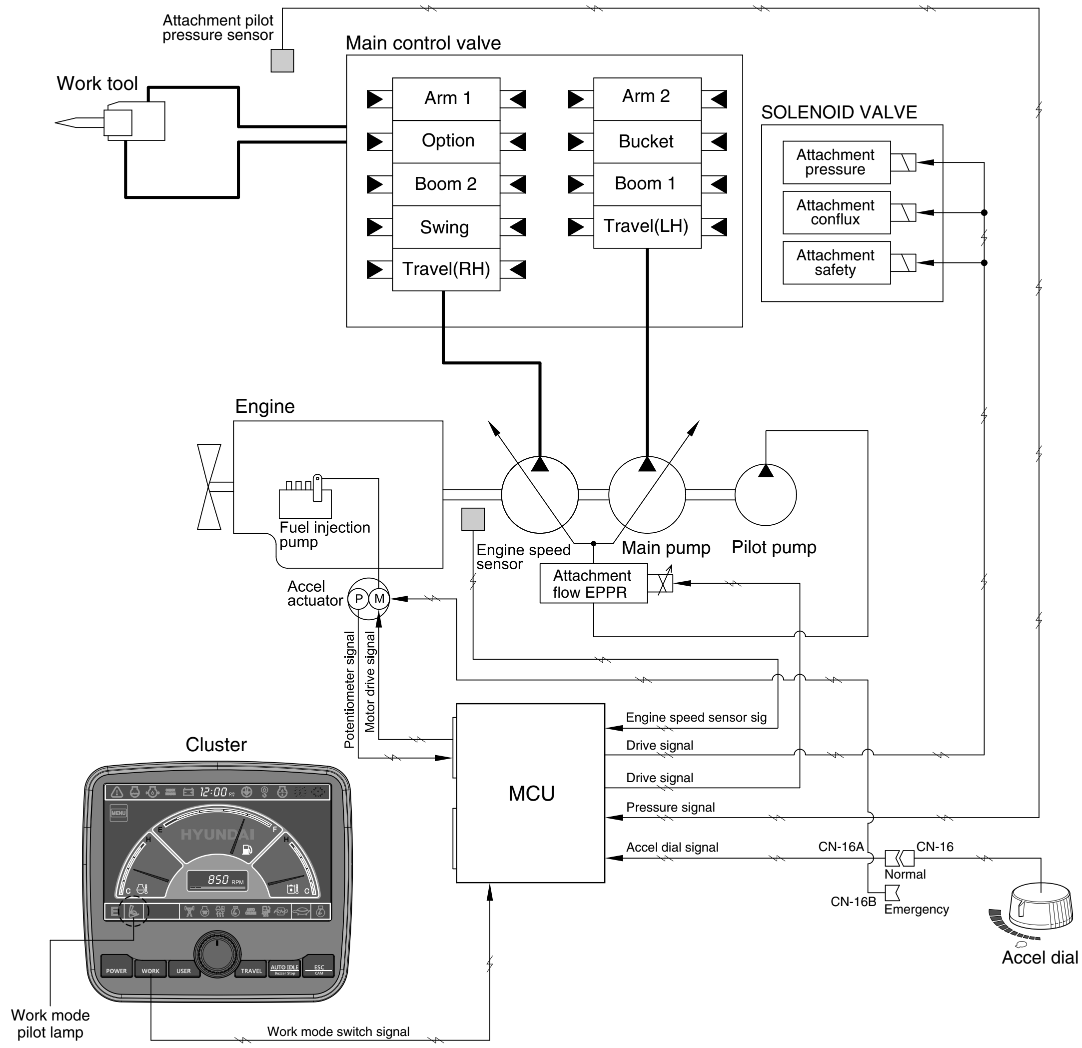
3809SH5MS08

· 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)



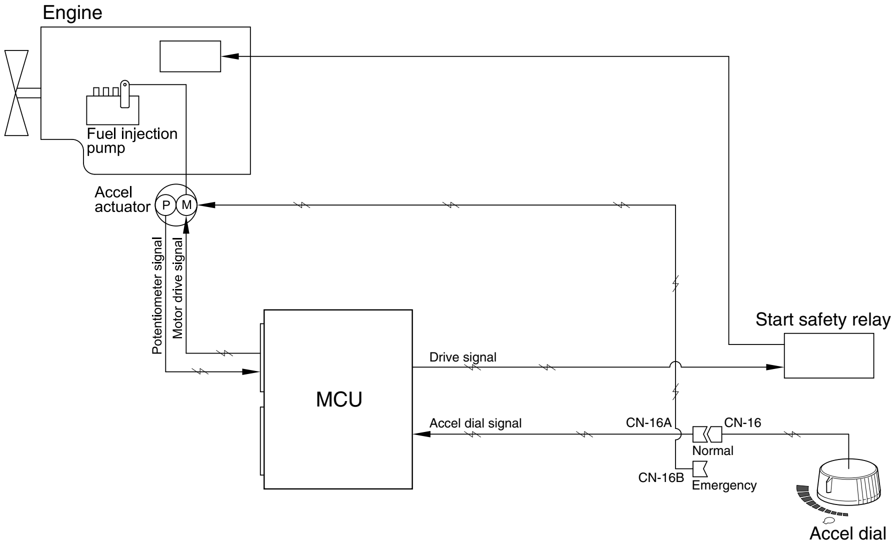
3809SH5MS11

· 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)

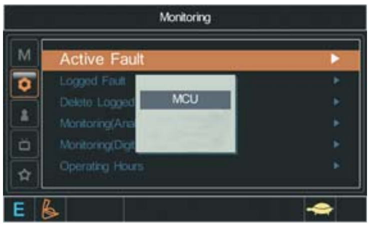
1. OUTLINE

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.

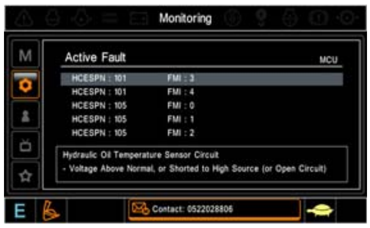
2. MONITORING

1) Active fault

21093CD66



21093CD66A-1

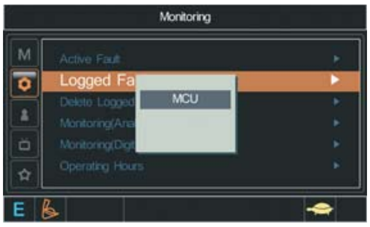


21093CD66B

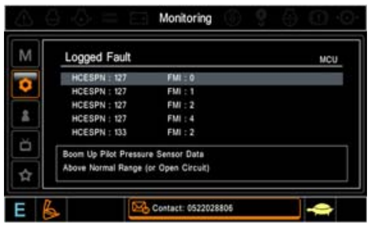
· The active faults of the MCU can be checked by this menu.

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.

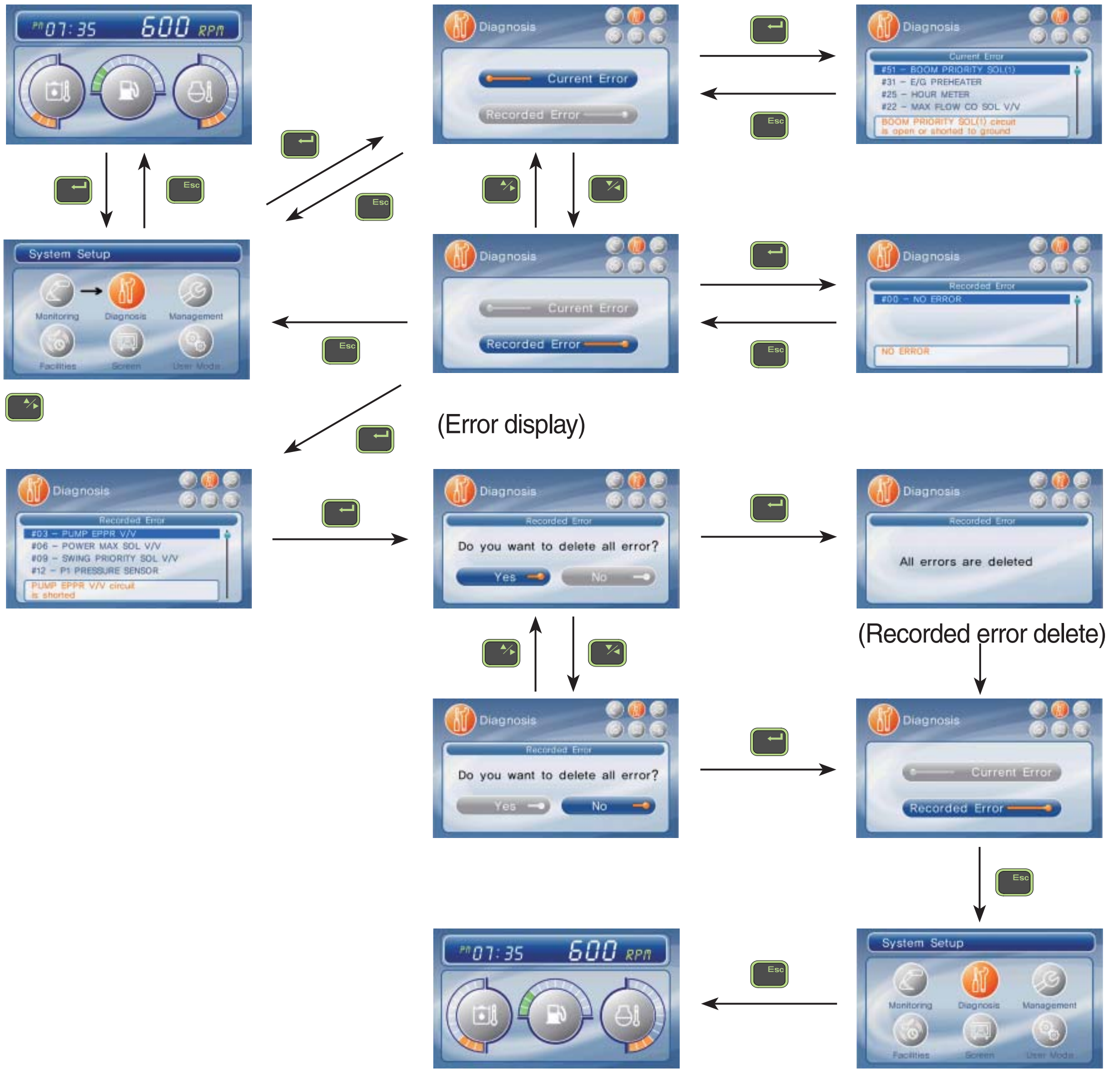
※ Some error codes are not applied to this model.

■ 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



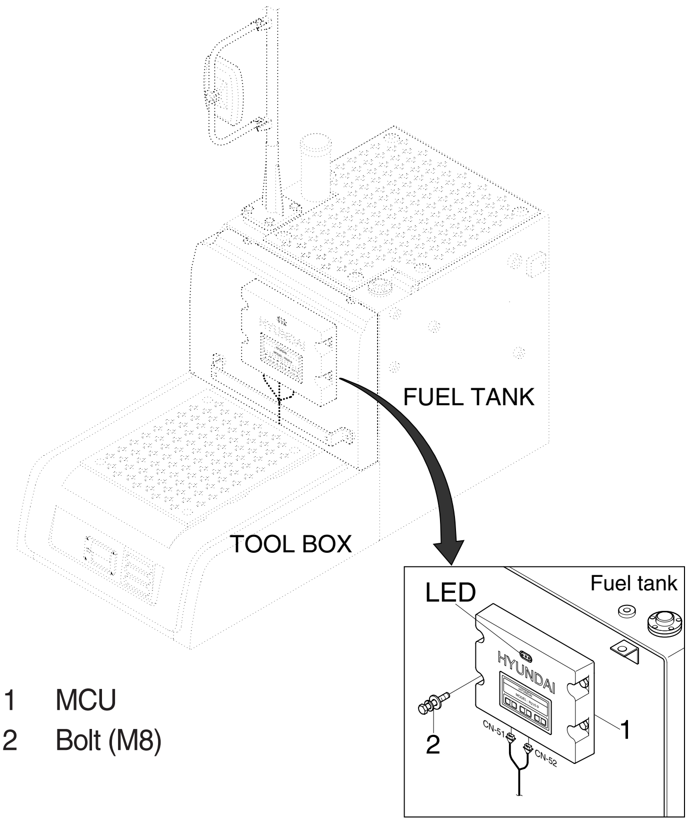
3. ERROR CODES TABLE

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 +

GROUP 12 ENGINE CONTROL SYSTEM

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.

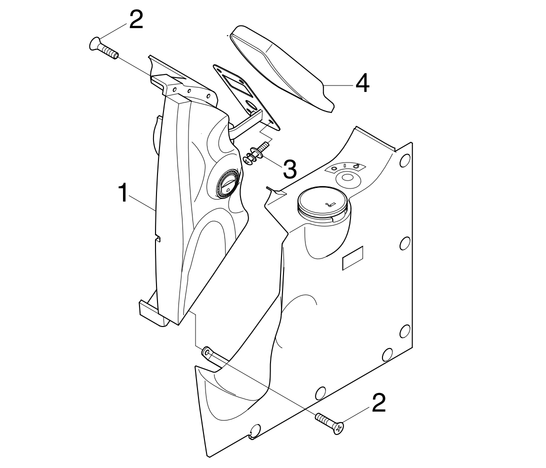
LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on MCU	· Change the MCU
G and Y are turned ON	Trouble on serial communication line	· Check if serial communication lines between controller and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	· Check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

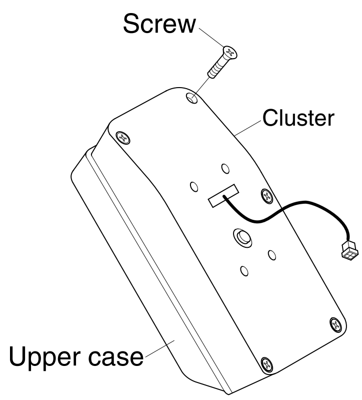
2) Disassemble hexgon socket bolts (3) and cluster (4).



3009SH5MS28

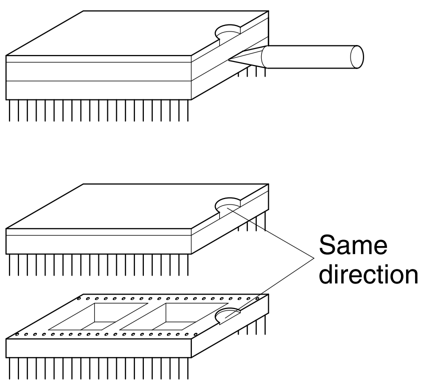
4) Loosen the screws (6EA) located back of the cluster.

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



3009SH5MS29

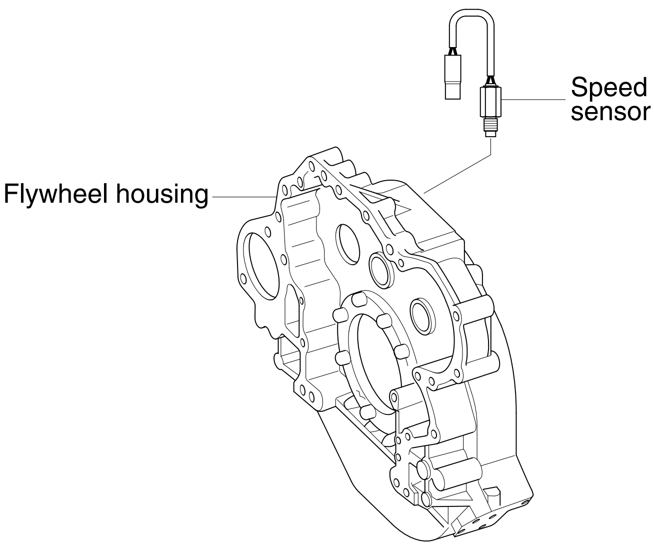
6) Install the new ROM. (Be careful of direction and assemlbe the cluster in the reverse order to removal).



21075MS14

4. ENGINE SPEED SENSOR

1) DETECT ACTUAL ENGINE RPM AND SEND SIGNAL TO TACHOMETER



21H75MS10

2) INSTALLATION

(1) Clean contacting point of sensor.

(2) Screw speed sensor into flywheel housing.

3) INSPECTION

(1) Check resistance
- SPEC : $2.3 \pm 0.2\ \Omega$

(2) Tightening torque
- 3.75 ± 0.75 kgf · m

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/cm^2	psi		
Standard (Stage : 1.0)	P	12 ± 3	171 ± 40	360 ± 30	1800 ± 50
	S	15 ± 3	213 ± 40	400 ± 30	1700 ± 50
	E	15 ± 3	213 ± 40	400 ± 30	1600 ± 50
Option (Stage : 2.0)	P	5 ± 3	71 ± 40	250 ± 30	1900 ± 50
	S	8 ± 3	114 ± 40	290 ± 30	1800 ± 50
	E	13 ± 3	185 ± 40	450 ± 30	1700 ± 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).

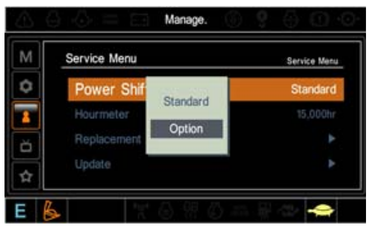
- Management
  · Service menu

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/cm^2	psi		
Standard (Stage : 1.0)	M	10 ± 3	142 ± 40	330 ± 30	1800 ± 50
	H	13 ± 3	185 ± 40	360 ± 30	1700 ± 50
	S	13 ± 3	185 ± 40	365 ± 30	1600 ± 50
Option (Stage : 2.0)	M	5 ± 3	71 ± 40	250 ± 30	1900 ± 50
	H	8 ± 3	114 ± 40	290 ± 30	1800 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1700 ± 50

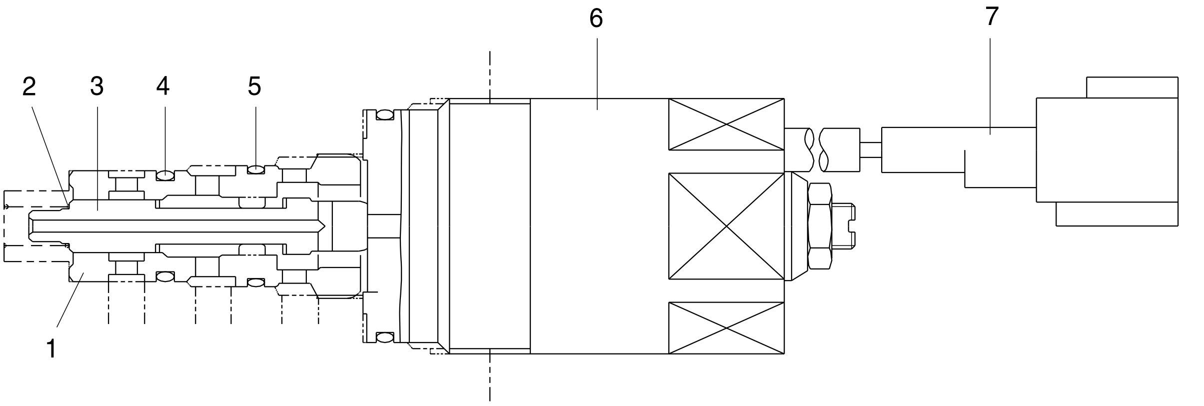
2) HOW TO SWITCH VERSION (3.1 ↔ 4.1) ON THE CLUSTER

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

- Dual mode
  · Changing the MCU mode

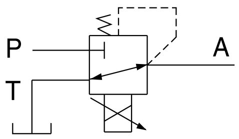
3) OPERATING PRINCIPLE (pump EPPR valve, cluster type 1,2)

(1) Structure



5-22(1)

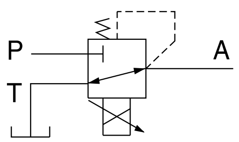
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

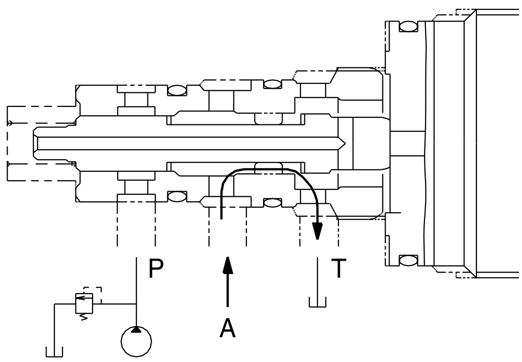


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

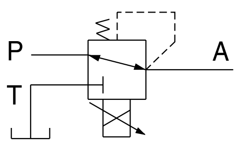
Pressure line is blocked and A oil returns to tank.

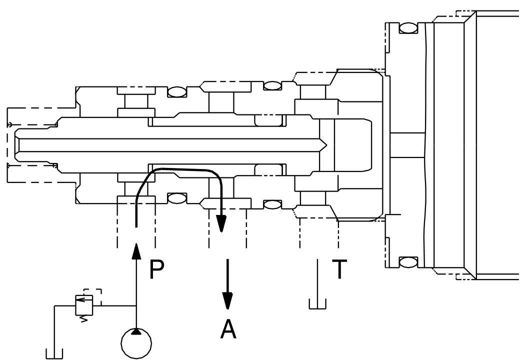




(3) Operating

Secondary pressure enters into A.



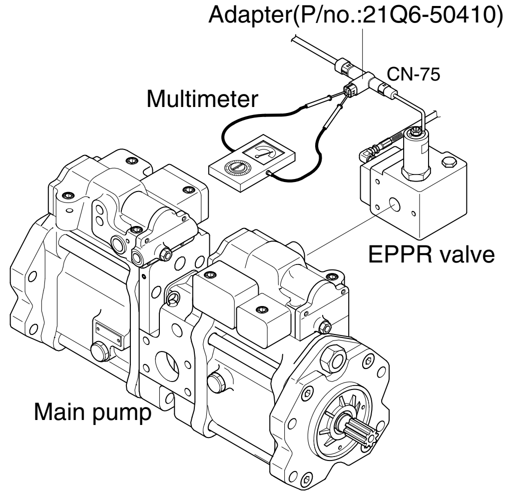


5-22(2)

4) EPPR VALVE CHECK PROCEDURE
(Cluster type 1,2)

(1) Check electric current value at EPPR valve

Spec : 100~700 mA



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

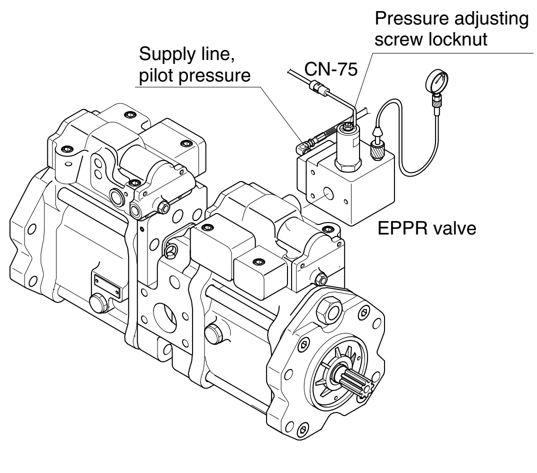
⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1700±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

Spec : 4~20 kgf/cm² (60~280 psi)



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 1700±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

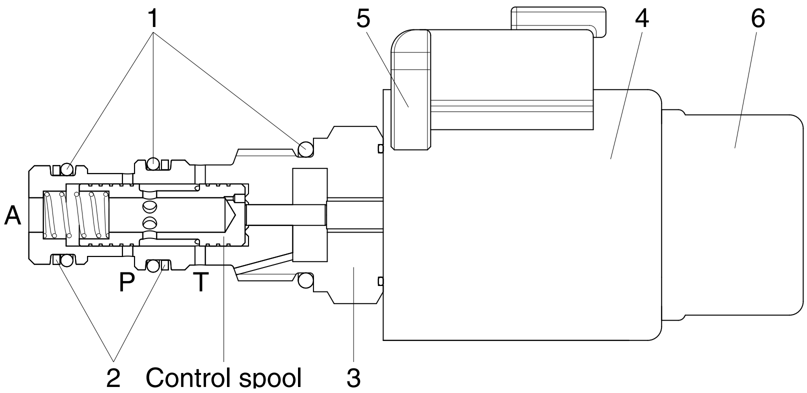
The boom priority EPPR valve is built in a manifold and mainly consisting of valve body and coil. This EPPR valve installed under the solenoid valve.

2) CONTROL

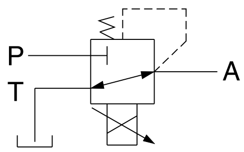
The boom priority EPPR valve has to be controlled by a specific electronic amplifier card, which is supplying the coil with a current 580 mA at 30Ω and 24 V.

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.

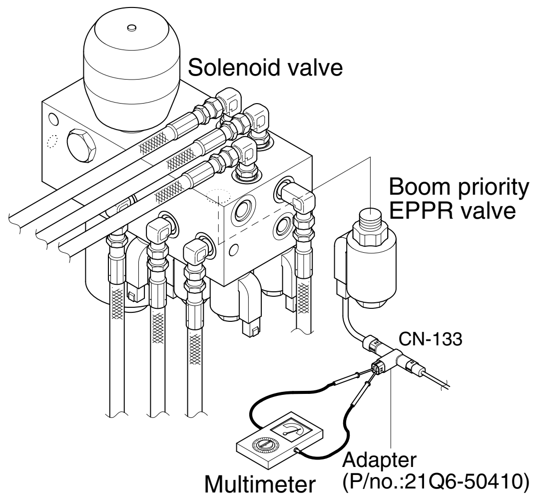
② Insert the adapter to CN-133 and install multimeter as figure.

③ Start engine.

④ If rpm display approx 1700±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/cm^2 (0 to 725 psi)

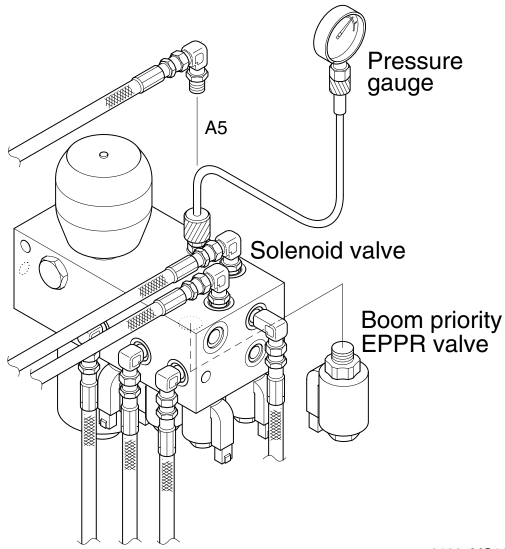
② Start engine.

③ If rpm display approx 1700±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

④ If pressure is not correct, adjust it.

⑤ After adjust, test the machine.

Spec : 12~37 kgf/cm^2 (170~530 psi)
(bucket relief operation)



21095MS16

GROUP 14 MONITORING SYSTEM (CLUSTER TYPE 1)

1. OUTLINE

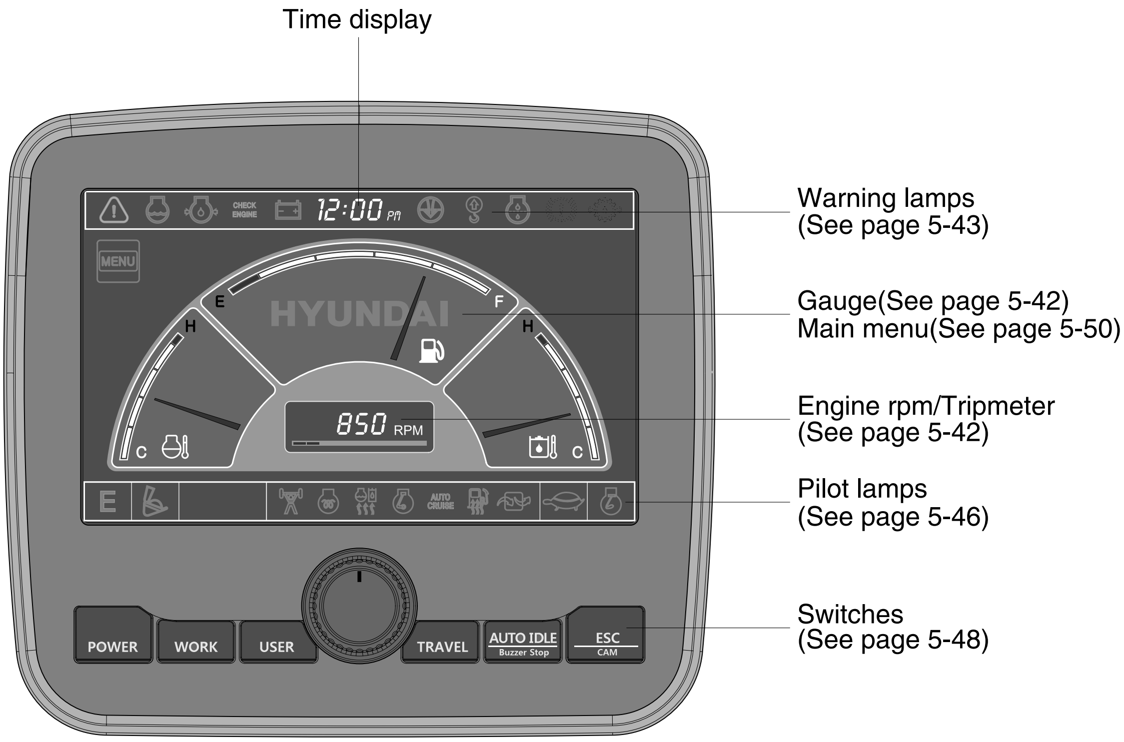
Monitoring system consists of the monitor part and switch part.

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

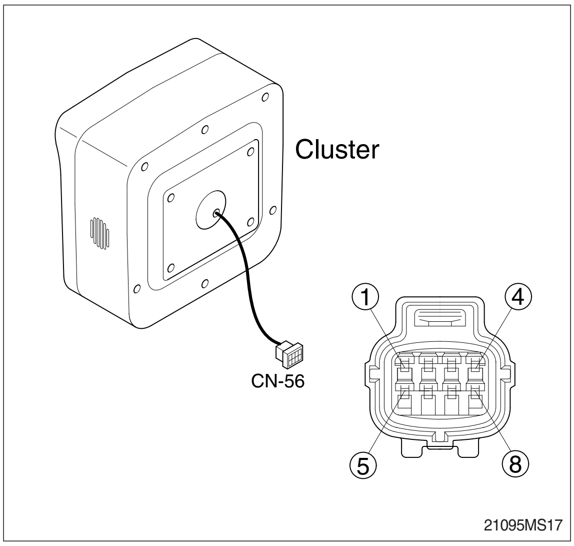
a. The warning lamp lights up and the buzzer sounds.

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

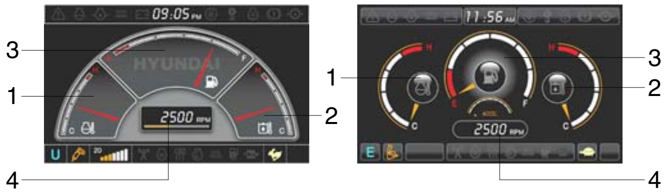
No.	Name	Signal
1	Battery 24V	20~32V
2	Signal 3	NTSC
3	GND	-
4	Serial + (TX)	0~5V
5	Power IG (24V)	20~32V
6	Signal 2	NTSC
7	Camera signal	NTSC
8	Serial - (RX)	0~5V



2) GAUGE

(1) Operation screen

Default Option

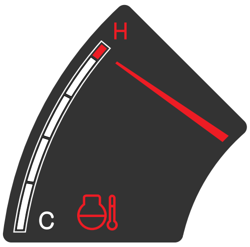


21093CD07A

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



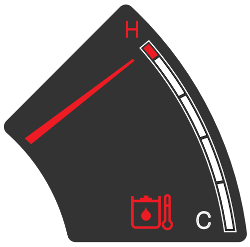
21093CD07G

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



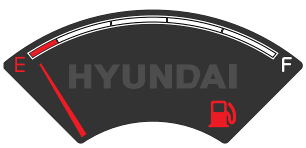
21093CD07E

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.

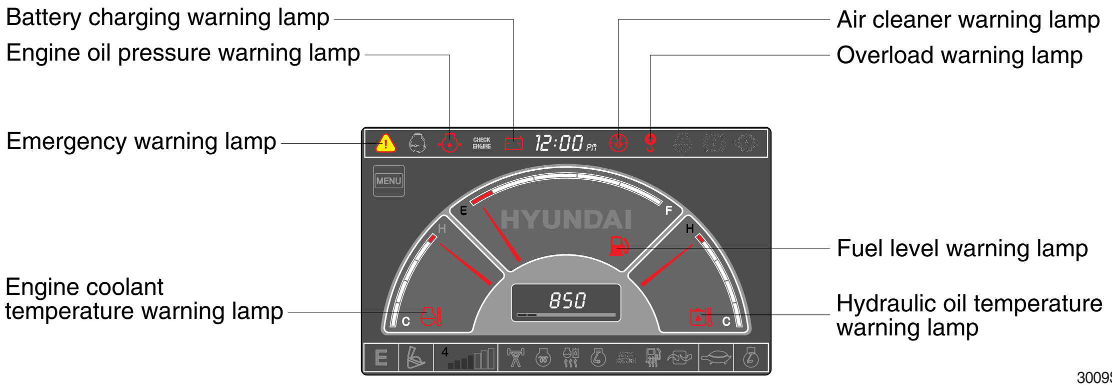
(5) RPM / Tripmeter display

21093CD02D

① This displays the engine rpm or the tripmeter.

※ Refer to page 5-60 for details.

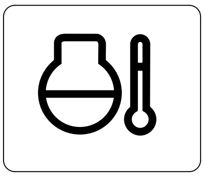
3) WARNING LAMPS



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



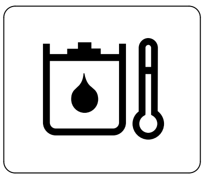
21093CD08A

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 75 ℓ (19.8 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

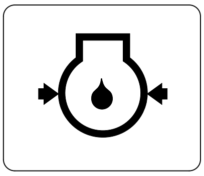
21093CD30

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.

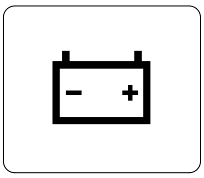
(5) Engine oil pressure warning lamp



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.

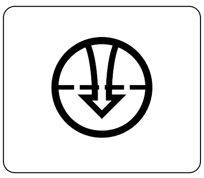
(6) Battery charging warning lamp



21093CD34

① This lamp blinks when the battery charging voltage is low.
② Check the battery charging circuit when this lamp blinks.

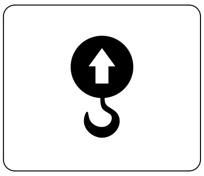
(7) Air cleaner warning lamp



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)

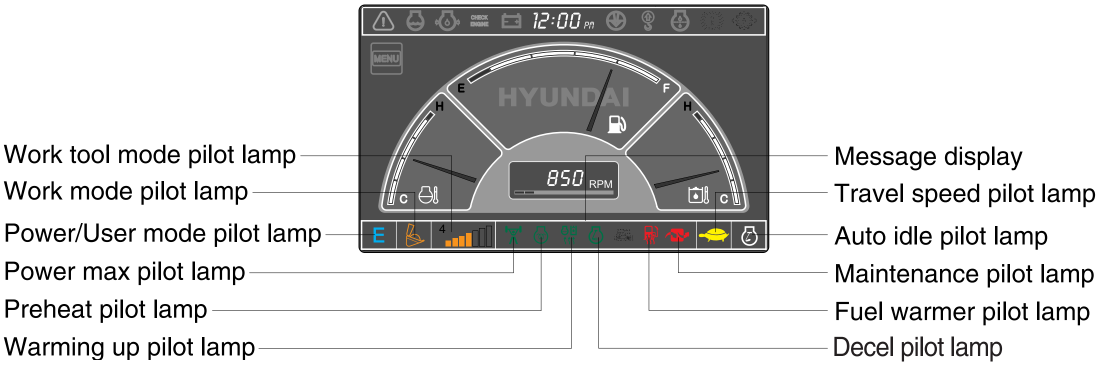


21093CD36

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

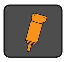
② Reduce the machine load.

4) PILOT LAMPS

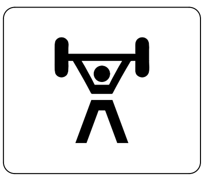


21093CD09

(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

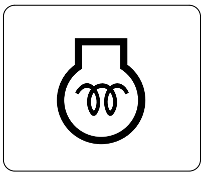
(2) Power max pilot lamp



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.**

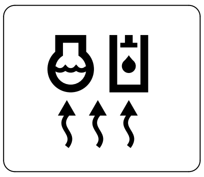
(3) Preheat pilot lamp



21093CD39

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

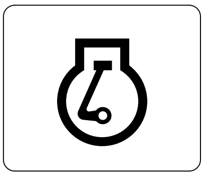
(4) Warming up pilot lamp



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.

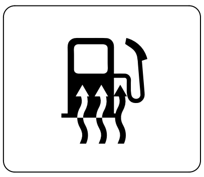
(5) Decel pilot lamp



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.

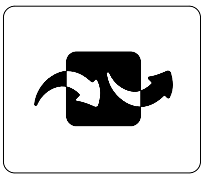
(6) Fuel warmer pilot lamp



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.

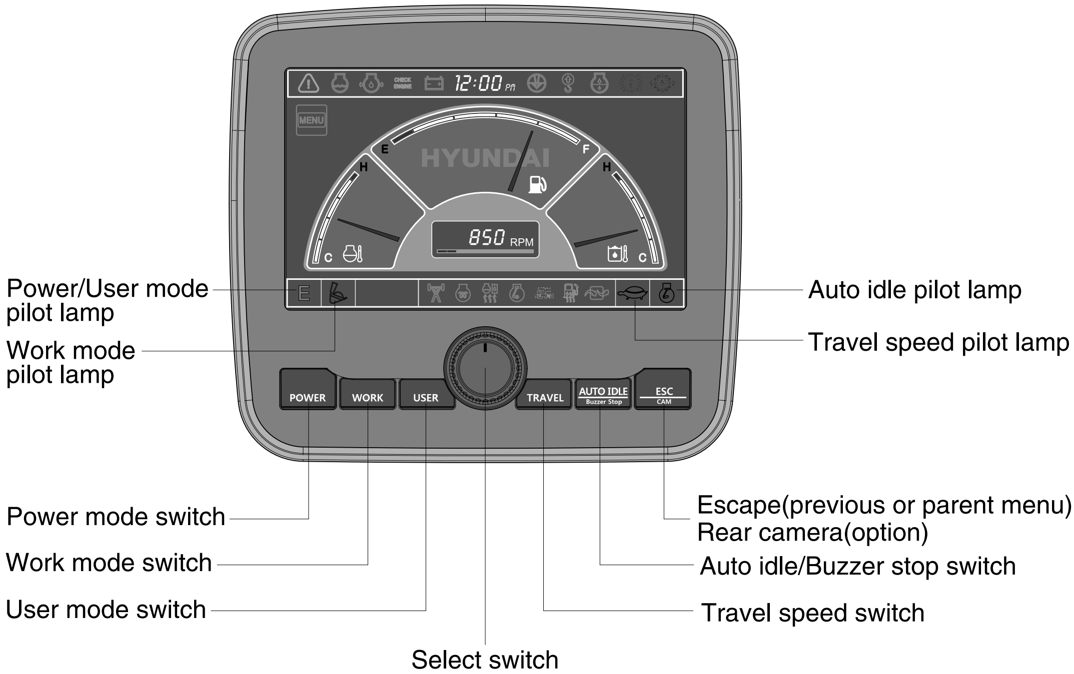
(7) Maintenance pilot lamp



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.

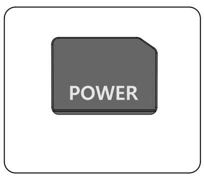
5) SWITCHES



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

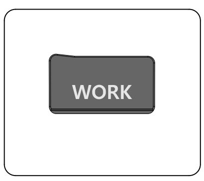


21093CD45A

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

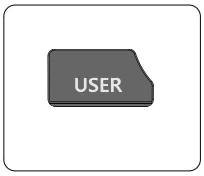


21093CD45C

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

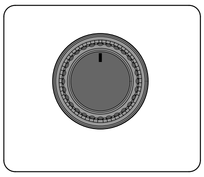


21093CD45D

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



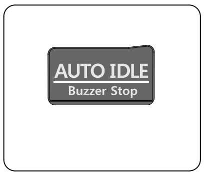
21093CD45E

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

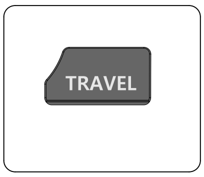


21093CD45F

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.

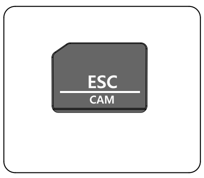
(6) Travel speed control switch



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.

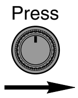
② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-61 for the camera.

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

6) MAIN MENU

21093CD64

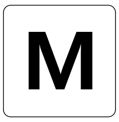
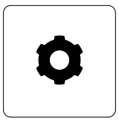
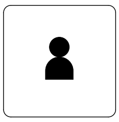
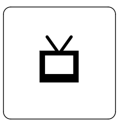
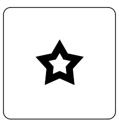
21093CD64A



21093CD64B

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

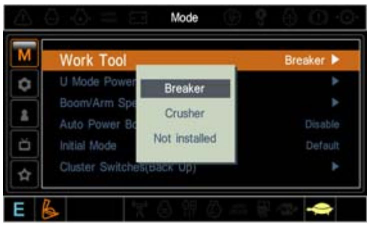
(1) Structure

No	Main menu	Sub menu	Description
1	 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

A

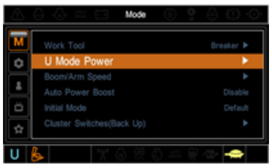
21093CD65B

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



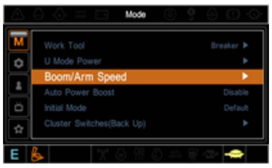
21093CD65D

21093CD65E

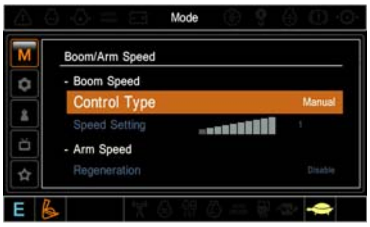
- Engine high idle rpm, auto idle rpm and pump torque (power shift) can be modulated and memorized separately in U-mode.
- U-mode can be activated by user mode switch.

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1450	900	0
2	1500	950 (low idle)	3
3	1550	1000	6
4	1600	1050	9
5	1650	1100	12
6	1700	1150 (decel rpm)	16
7	1750	1200	20
8	1800	1250	26
9	1850	1300	32
10	1900	1350	38

③ Boom/Arm speed



21093CD65F

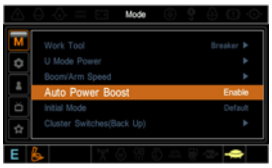


21093CD65G

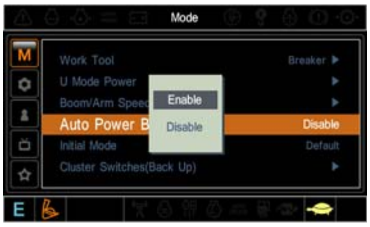
- Boom speed
  - Control type
    Manual - Boom up speed is fixed as set steps.
    Auto - Boom up speed is automatically adjusted as working conditions by the MCU.
  - Speed setting - Boom up speed is increased as much as activated steps.

- Arm speed
  - Regeneration - Arm regeneration function can be activated or cancelled.
    Enable - Arm in speed is up.
    Disable - Fine operation.

④ Auto power boost



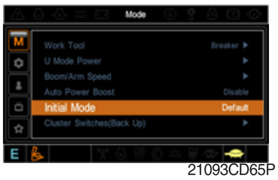
21093CD65L



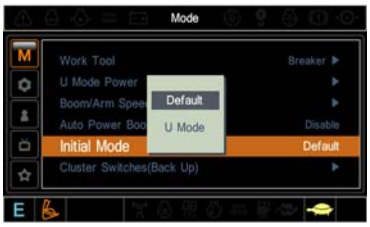
21093CD65M

· 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

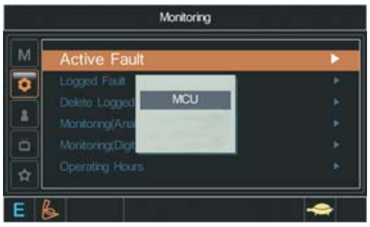
21093CD65T

- 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.

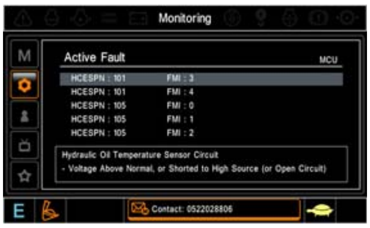
(3) Monitoring

① Active fault

21093CD66



21093CD66A-1

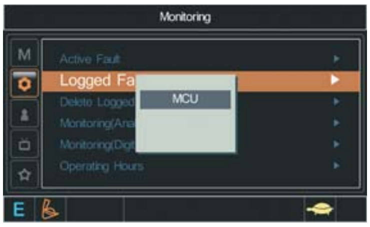


21093CD66B

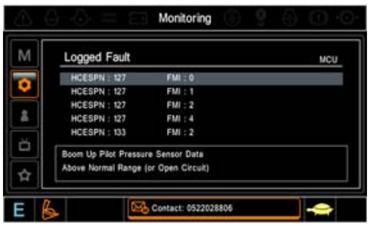
· The active faults of the MCU can be checked by this menu.

② Logged fault

21093CD66C



21093CD66D-1



21093CD66E

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

③ Delete logged fault

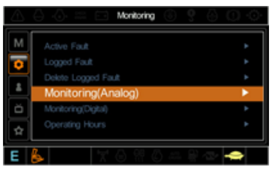
21093CD66F

21093CD66G

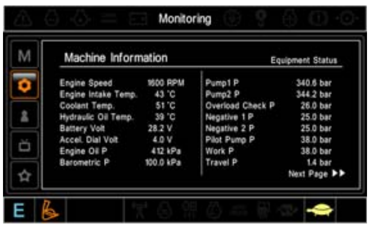
21093CD66H

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

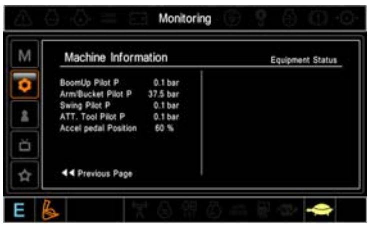
④ Monitoring(Analog)



21093CD66J



21093CD66K

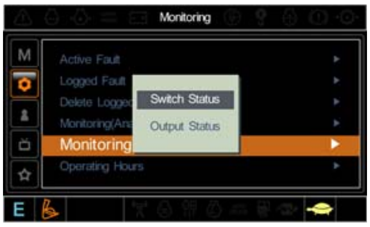


21093CD66L

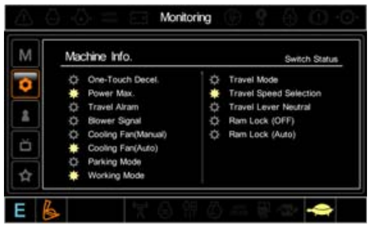
· The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu.

⑤ Monitoring (digital)

21093CD66M



21093CD66N

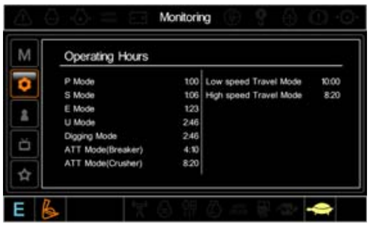


21093CD66P

· 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

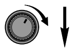
No	Item	Interval
1	Engine oil	250
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	5000
5	Pilot line filter	1000
6	Drain filter	1000
7	Hydraulic oil return filter	1000
8	Engine oil filter	250
9	Fuel filter	500
10	Pre-filter	500
11	Hydraulic tank breather	250
12	Air cleaner (inner)	500
13	Radiator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

② Machine security

21093CD67C

21093CD67D

21093CD67E



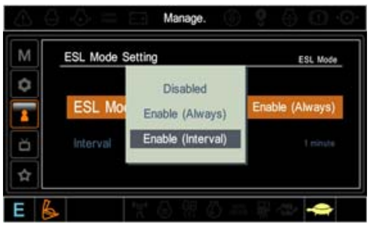
· ESL mode

- 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

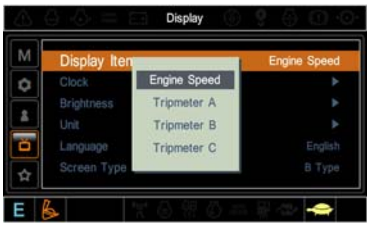
21093CD67ZZ

· 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

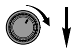
① Display item

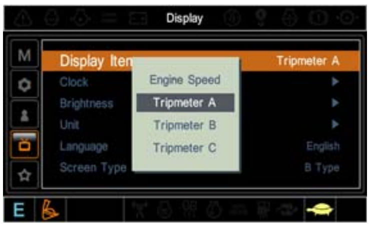
21093CD68



21093CD68A

21093CD68W





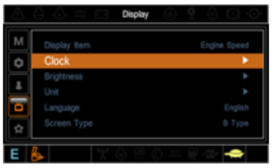
21093CD68B

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



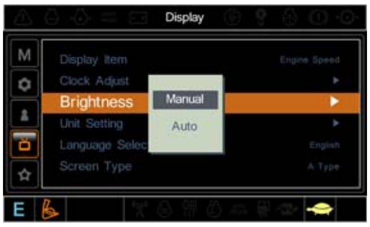
21093CD68C

21093CD68D

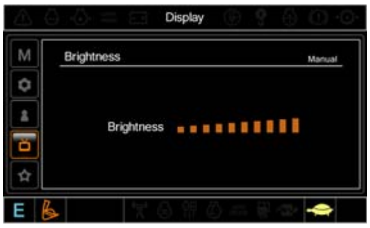
- The first line's three spots "**/**/****" represent Month/Day/Year each.
- The second line shows the current time. (0:00~23:59)

③ Brightness

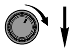

21093CD68F

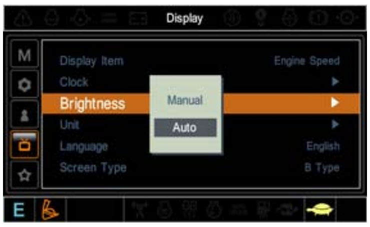


Manual (1st~10th step) 21093CD68G



21093CD68H





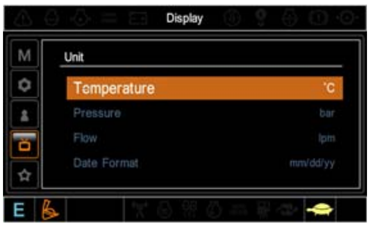
Auto (day/night) 21093CD68J

21093CD68K

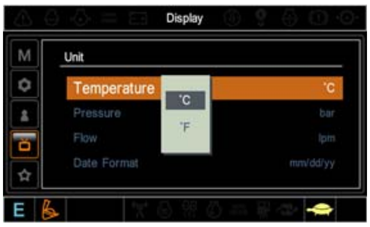
※ If "Auto" is chosen, brightness for day and night can be differently set up. Also by using the bar in lower side, users can define which time interval belongs to day and night.
(in bar figure, gray area represents night time while white shows day time)

④ Unit


21093CD68L



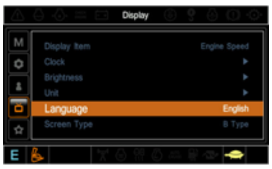
21093CD68M



21093CD68N

· Temperature : ˚C ↔ ˚F
· Pressure : bar ↔ MPa ↔ kgf/cm^2
· Flow : lpm ↔ gpm
· Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-Mar-yy

⑤ Language

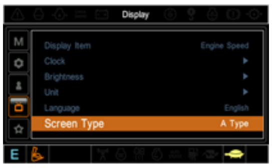

21093CD68R

21093CD68S

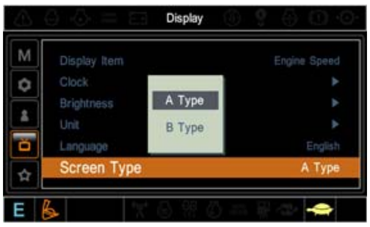
21093CD68T

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

⑥ Screen type

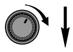


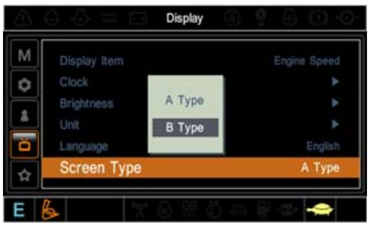
21093CD68U



A Type 21093CD68V

Standard 21093CD68W





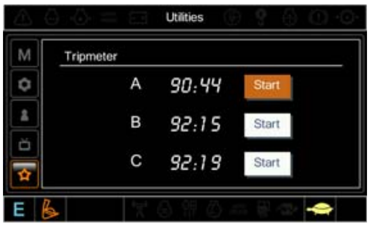
B Type 21093CD68X

Option 21093CD68Y

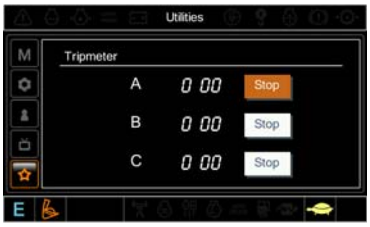
(6) Utilities

① Tripmeter

21093CD69



21093CD69A

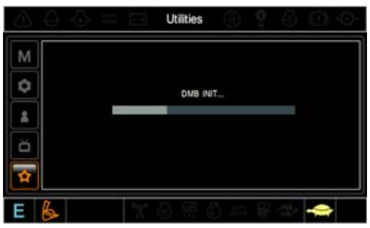


21093CD69B

- 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.

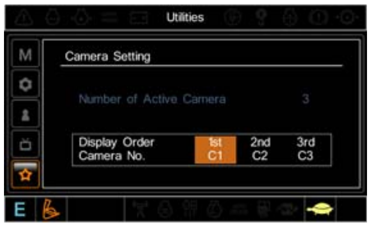
21093CD69F

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

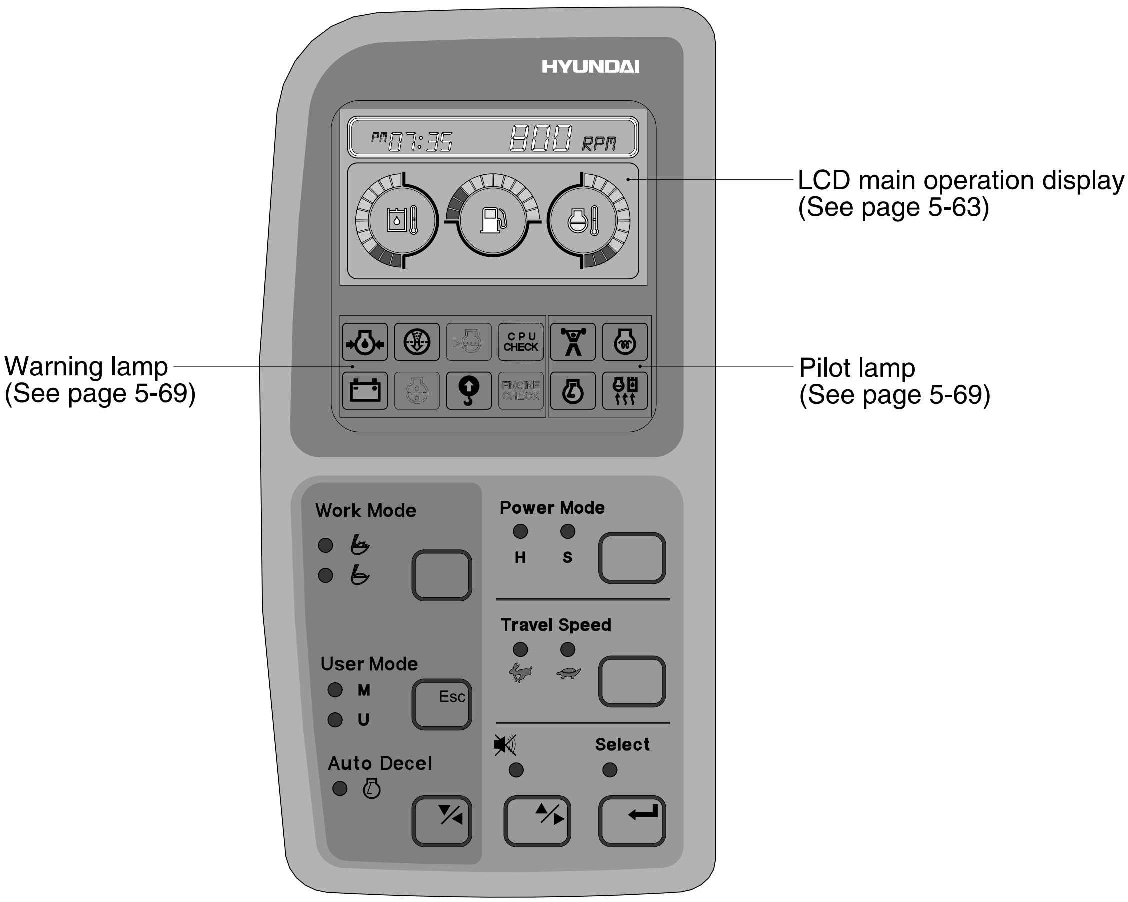
■ MONITORING SYSTEM (CLUSTER TYPE 2)

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

Default screen

1607A3CD02A

Option screen

1607A3CD02B

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

(1) Time display

1607A3CD02C

① This displays the current time.

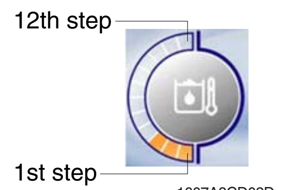
※ Refer to the page 5-67 to set time for details.

(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

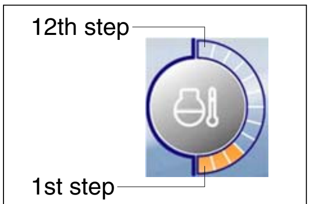
1607A3CD02E

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 75 ℓ (19.8 U.S. gal).
- Fill the fuel immediately when the lamp blinks.

③ Hydraulic oil temperature

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

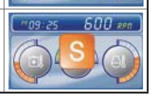
④ All gauge

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

⑤ Communication error

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

(2) Pop-up icon display

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

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

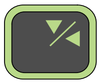
4) LCD

2209S3CD05

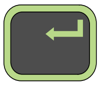
1  : LCD

2 

: Escape,
Return to the previous menu

3  : Down / Left Direction

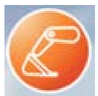
4  : Up/Right Direction

5  : Select (enter)
Activate the currently chosen item

(1) Main menu

2507A4OP94

1  : Menu information

2  : Monitoring
- Equipment, Switch, Output

3  : Diagnosis
- Current error, Recorded error

4  : Maintenance

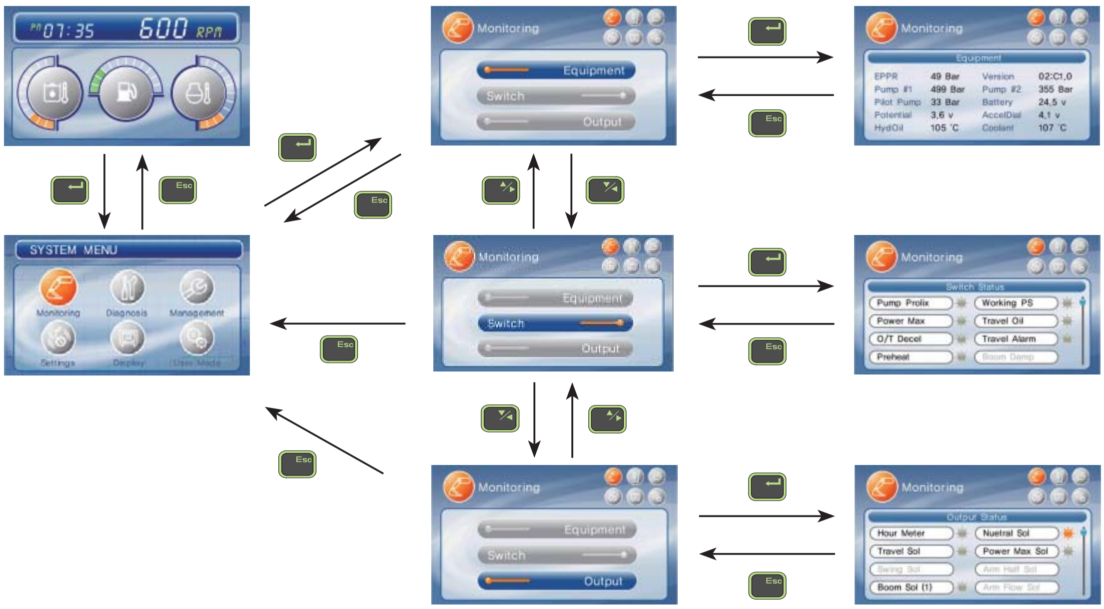
5  : Settings
- Time set, Dual mode
- System lock (reserved)

6  : Display
- Operation skin, Brightness, Language

7  : User mode

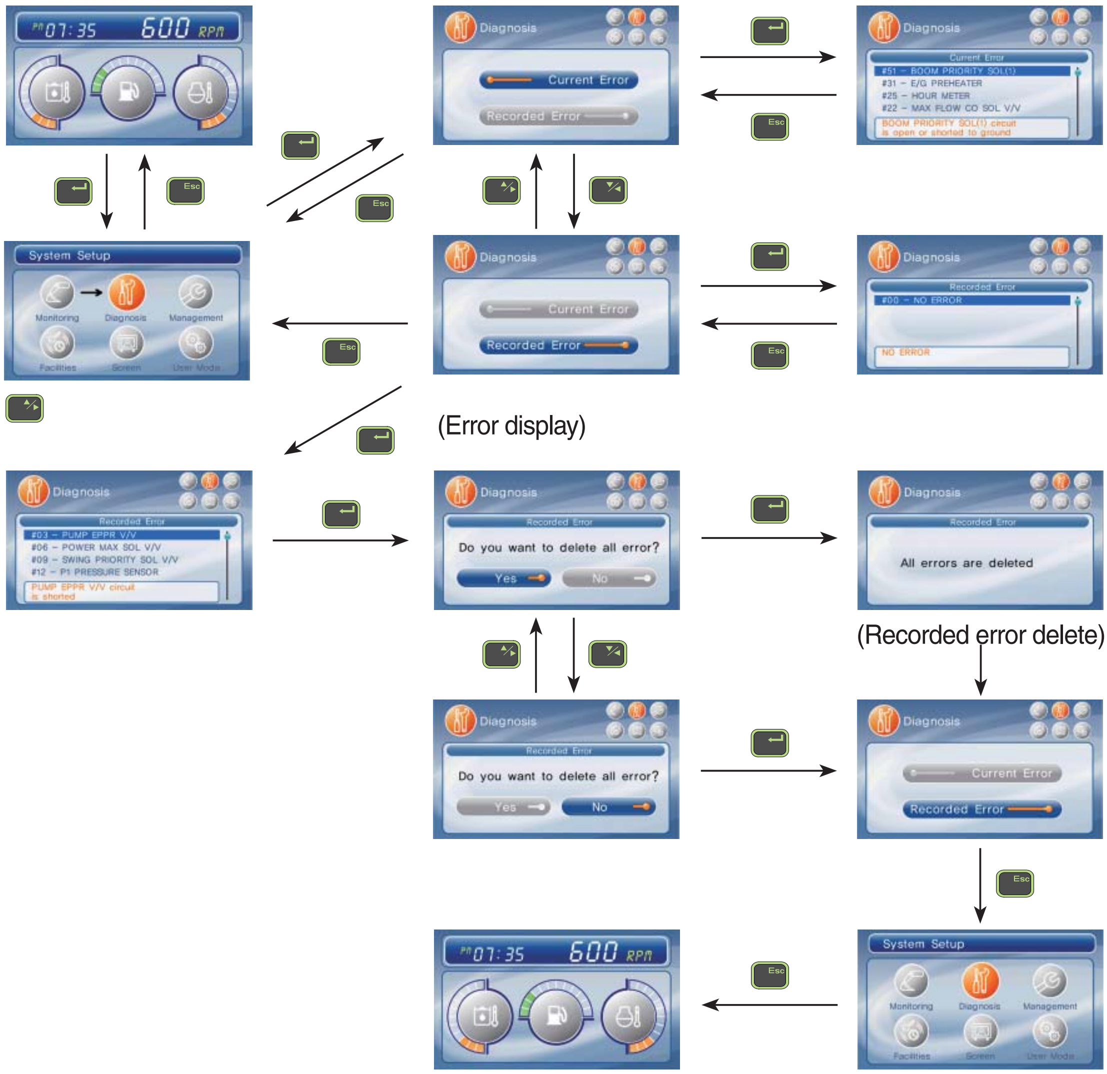
(2) Display map

① Monitoring



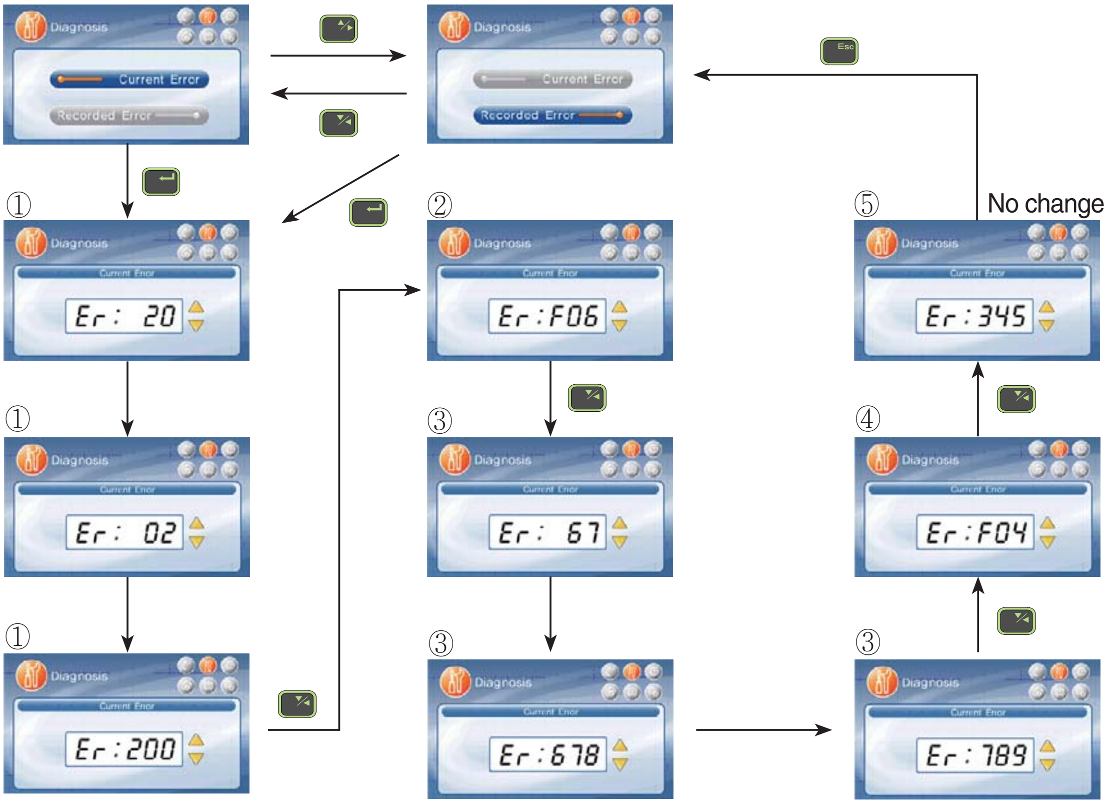
② Diagnosis

a. Protocol type 1

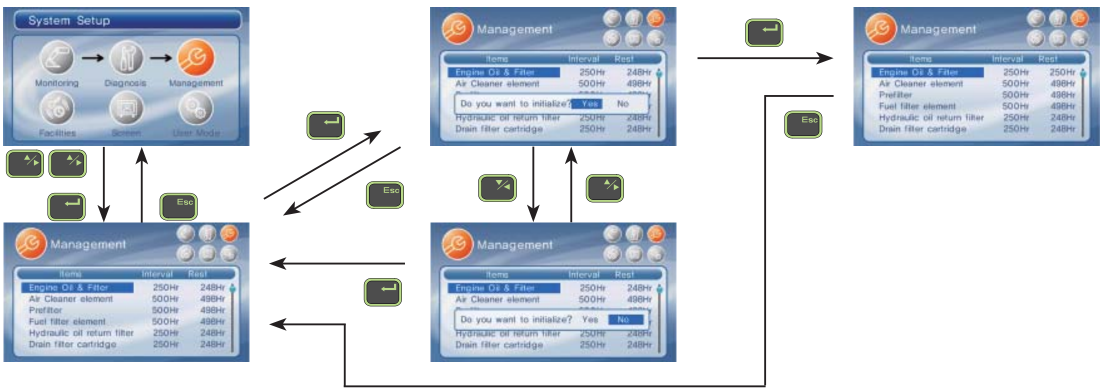


b. Protocol type 2

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



③ Maintenance



④ Setting

a. Time set

: Adjusting

: Setting

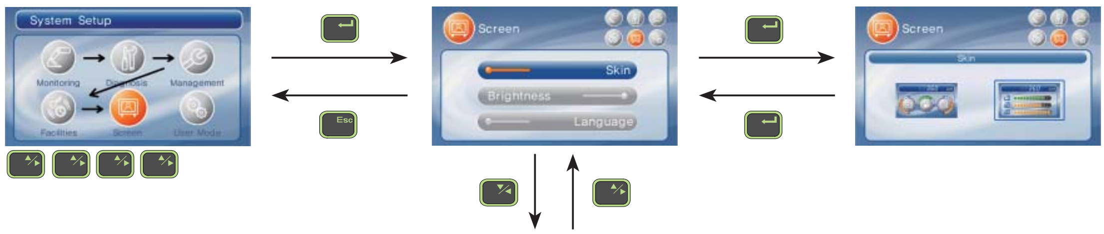
b. System lock - Reserved

c. Dual mode

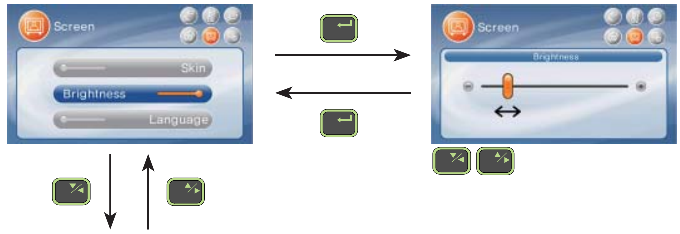
- Changing the MCU mode

⑤ Display

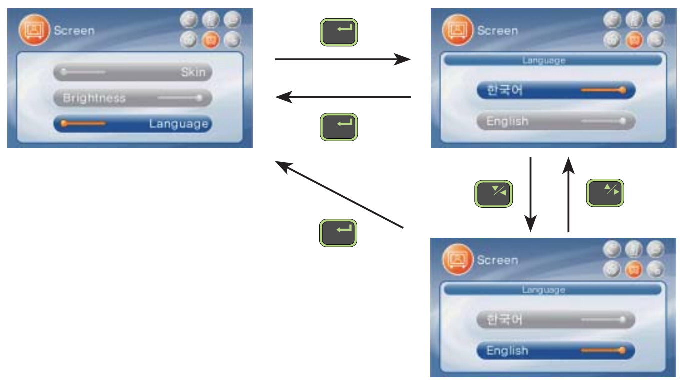
a. Operation skin



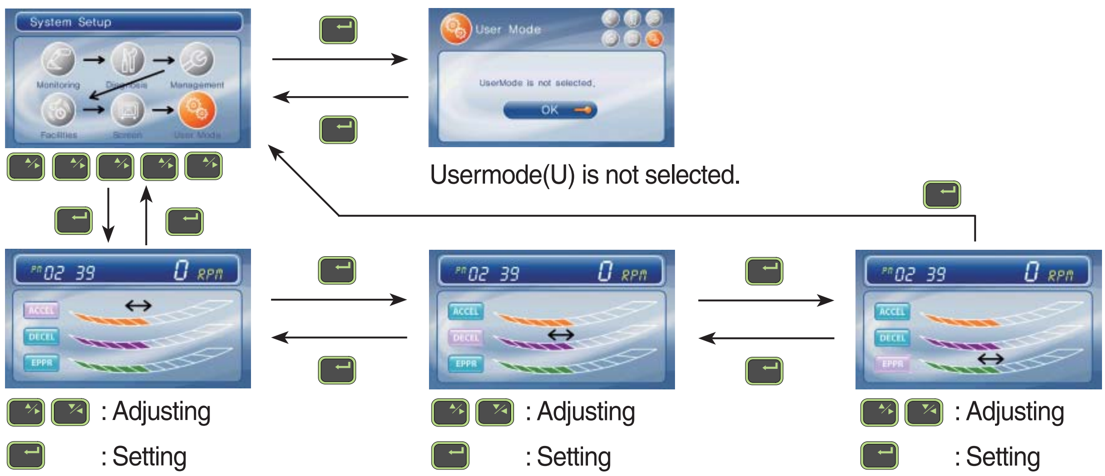
b. Brightness



c. Language

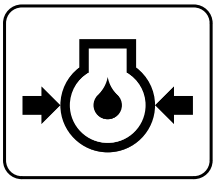


⑥ User mode



5) Warning and pilot lamp

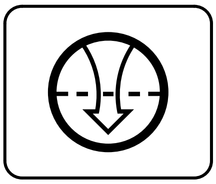
(1) Engine oil pressure warning lamp



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.

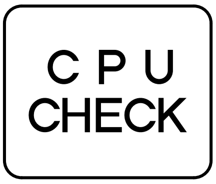
(2) Air cleaner warning lamp



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.

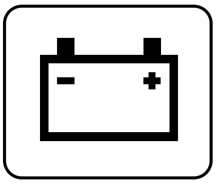
(3) CPU controller check warning lamp



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.

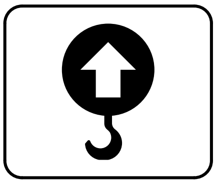
(4) Battery charging warning lamp



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.

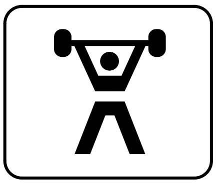
(5) Overload warning lamp



21073CD15

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

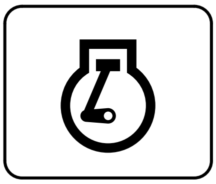
(6) Power max pilot lamp



21073CD11

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

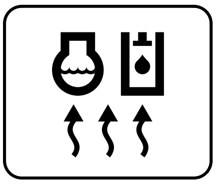
(7) Decel pilot lamp



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.

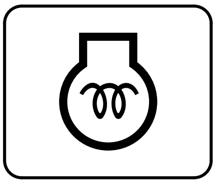
(8) Warming up pilot lamp



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.

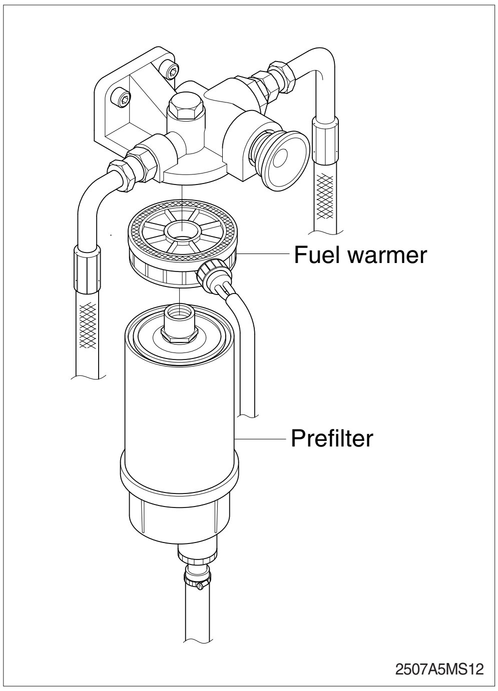
GROUP 15 FUEL WARMER SYSTEM

1. SPECIFICATION

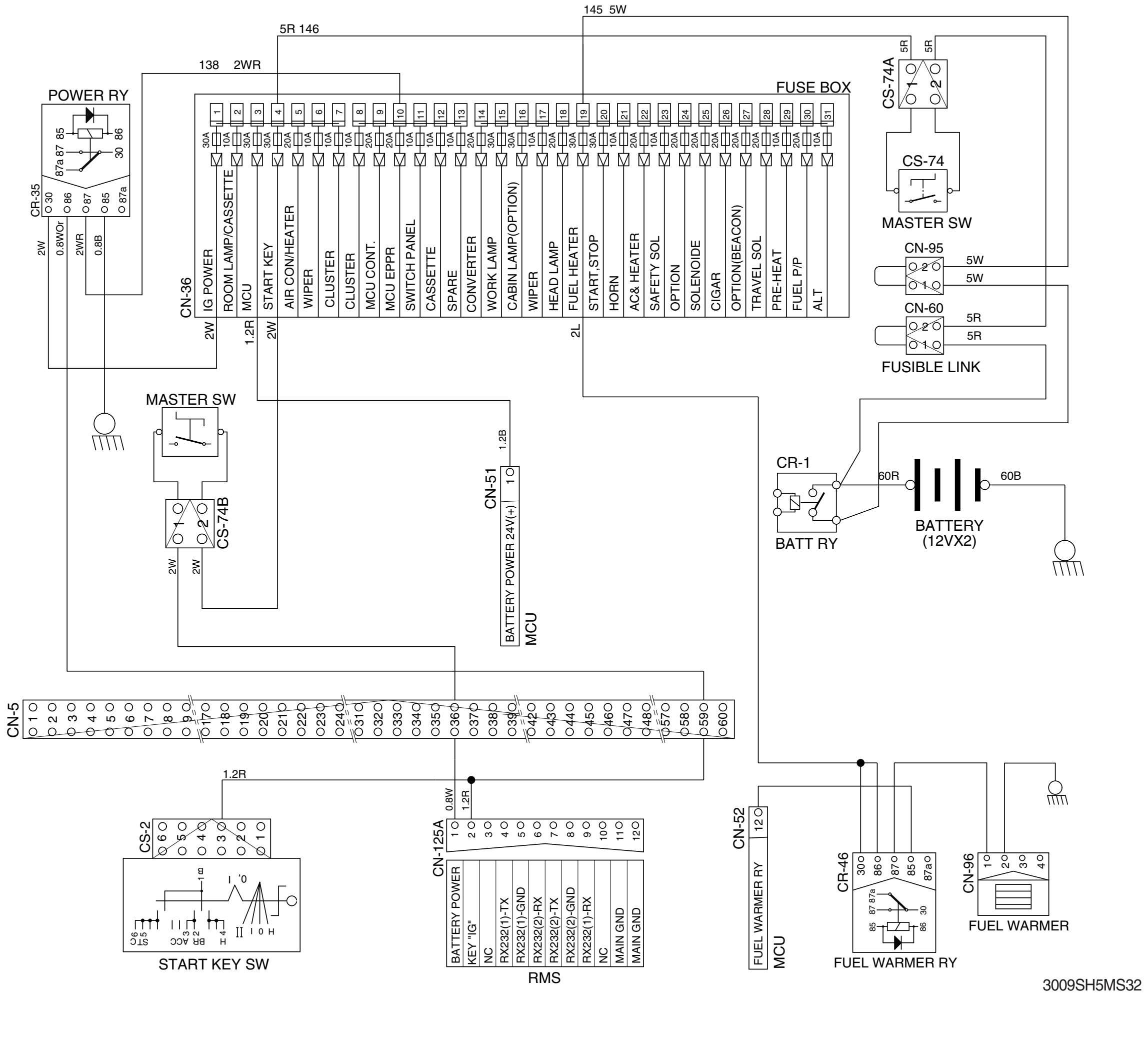
1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A

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

SECTION 6 TROUBLESHOOTING

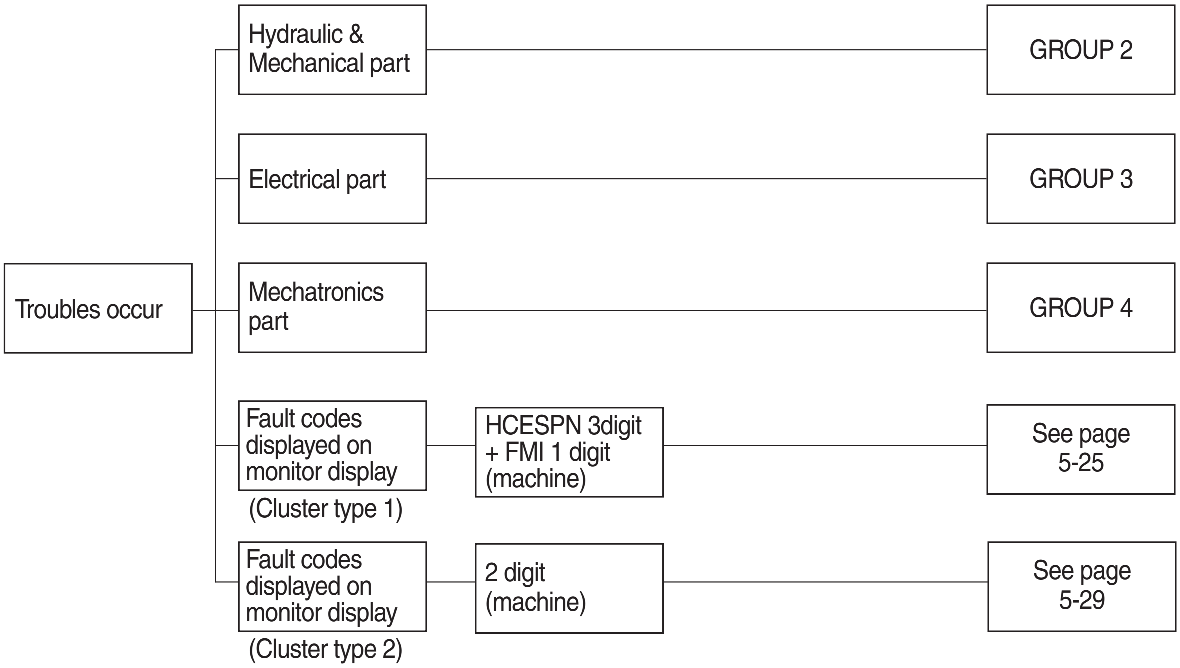
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

When a trouble is occurred in the machine, this section will help an operator to maintain the machine with easy.

The trouble of machine is parted Hydraulic & Mechanical system, Electrical system and Mechatronics system. At each system part, an operator can check the machine according to the troubleshooting process diagram.

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

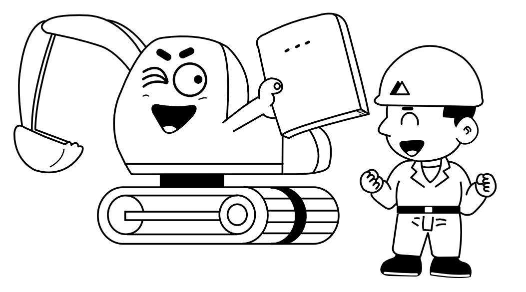


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

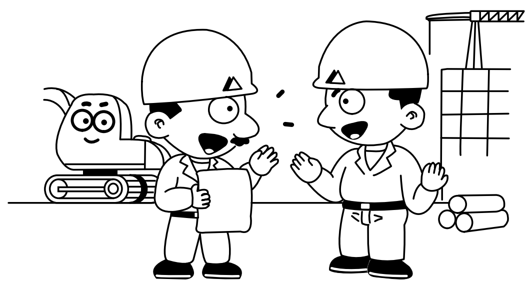


13031SH02

STEP 2. Ask the operator

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

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

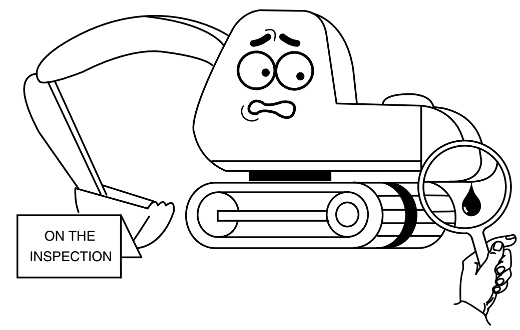


13031SH03

STEP 3. Inspect the machine

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

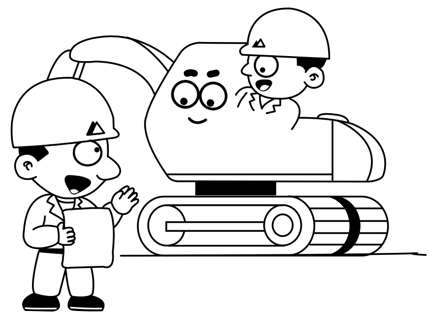
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

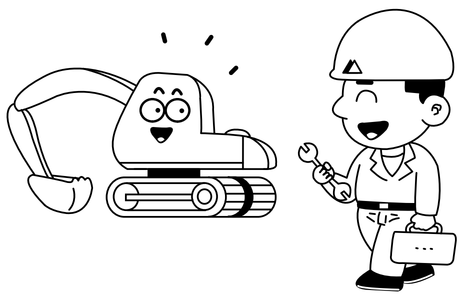
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 6-3(1)

STEP 5. Perform troubleshooting

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

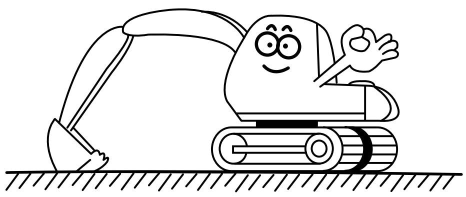


13031SH05

STEP 6. Trace a cause

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

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



(210-7) 6-3(3)

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

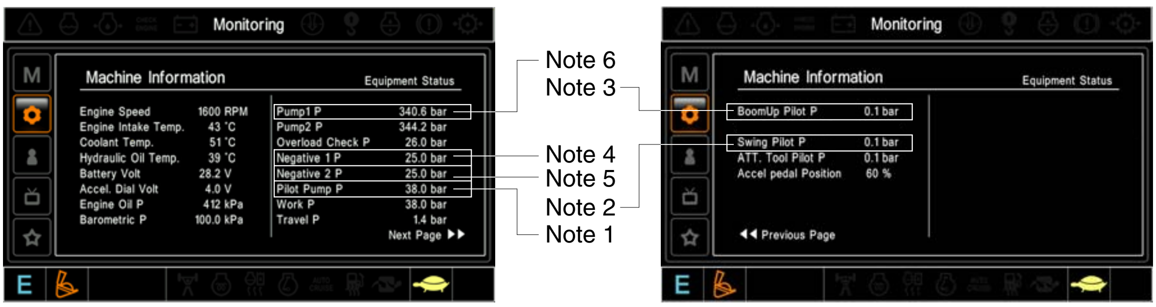
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

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

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

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

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



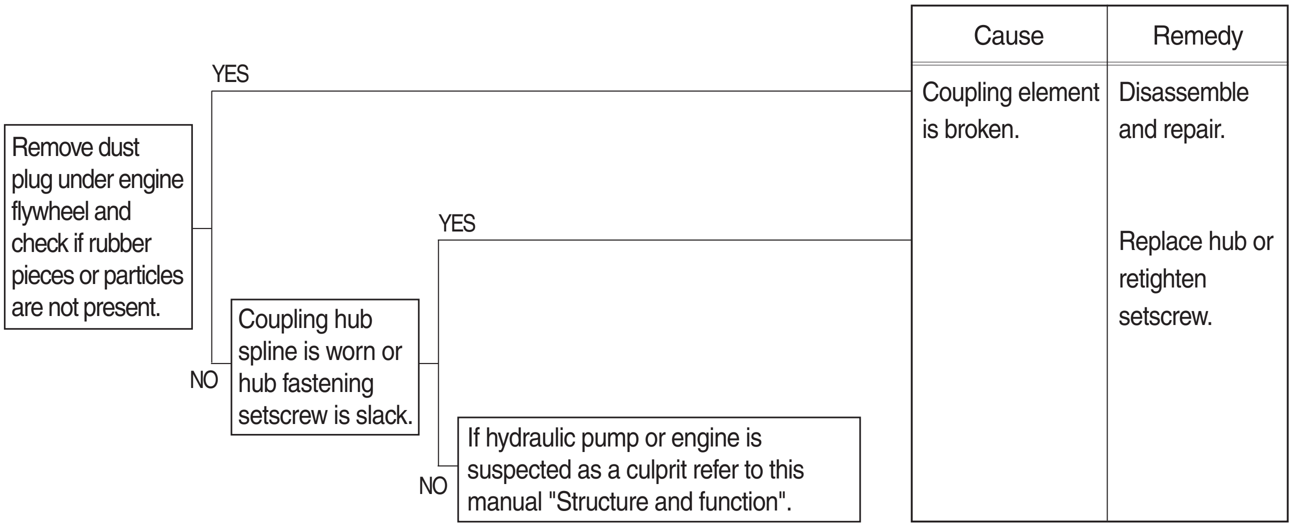
Analog 1 Analog 2 3009SH6HS01

(2) Specification

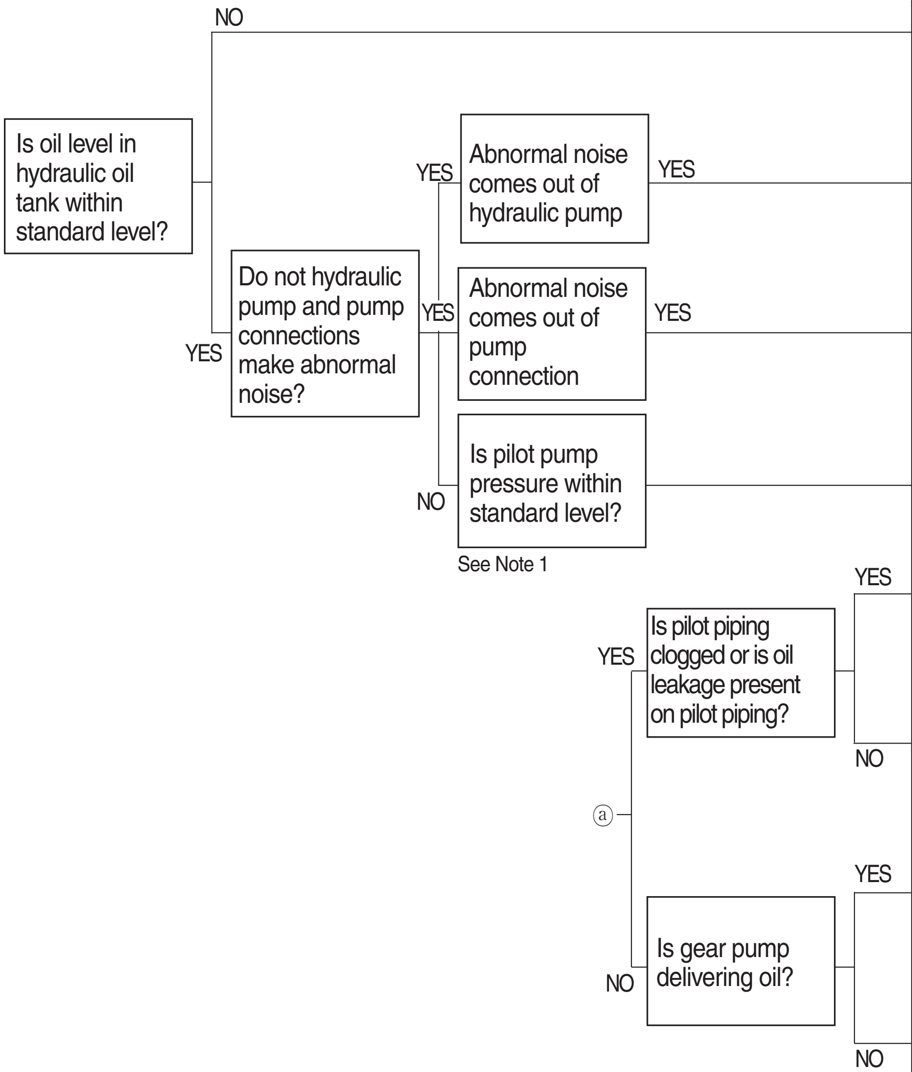
No.	Description	Specification
Note 1	Pilot pump pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	P1 pump control pressure	0~25 bar
Note 5	P2 pump control pressure	0~25 bar
Note 6	Pump 1 pressure	350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



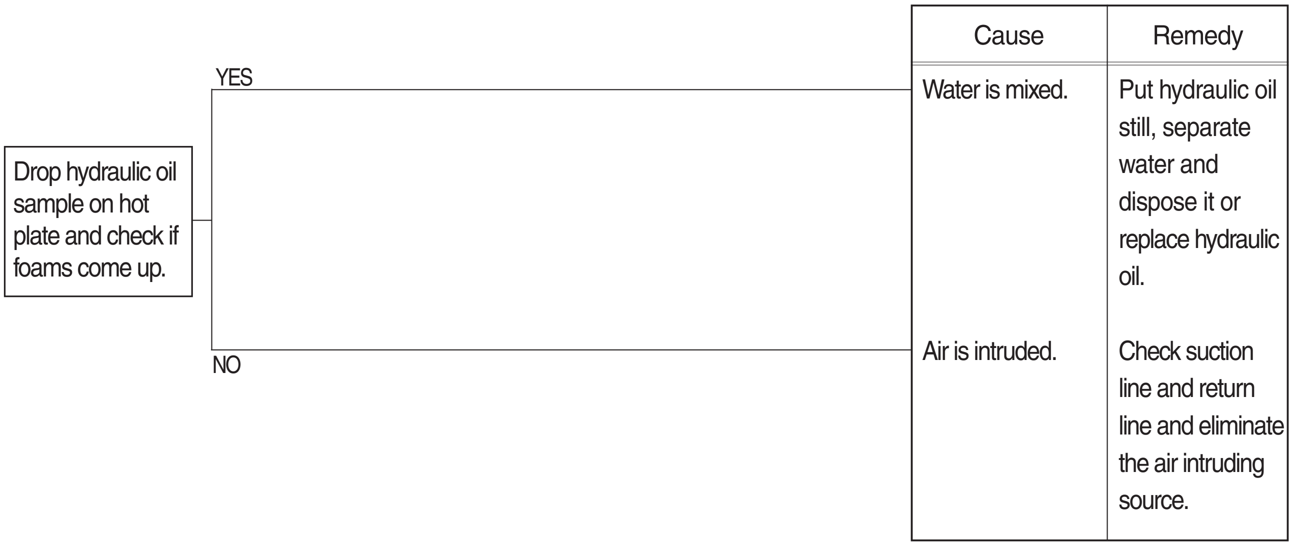
2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL



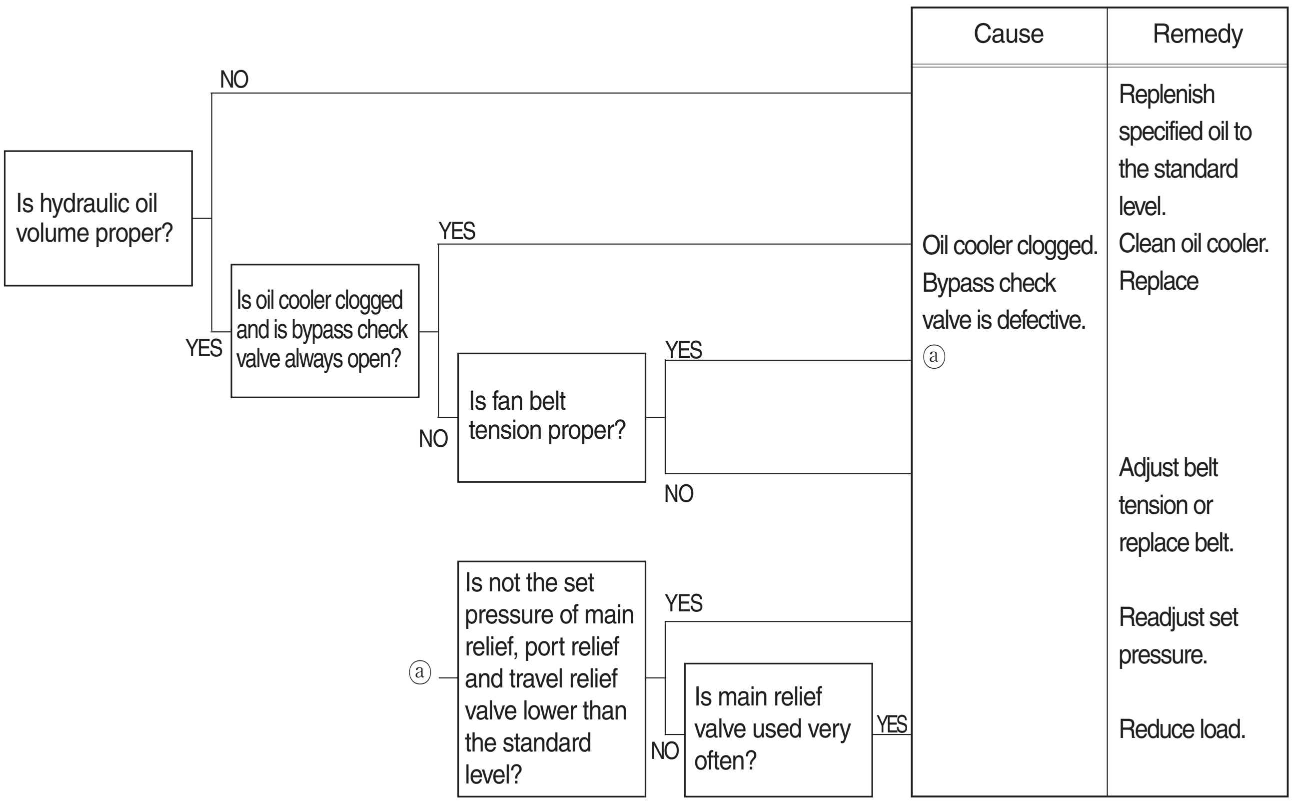
Cause	Remedy
	Replenish specified oil to the standard level.
Hydraulic pump is broken.	Disassemble and repair.
	See item 1). at page 6-5
ⓐ	
	Clean pilot piping interior or repair piping.
RCV and safety solenoid valve is faulty.	Disassemble and repair.
Pilot relief valve in gear pump is faulty.	Repair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

3. HYDRAULIC SYSTEM

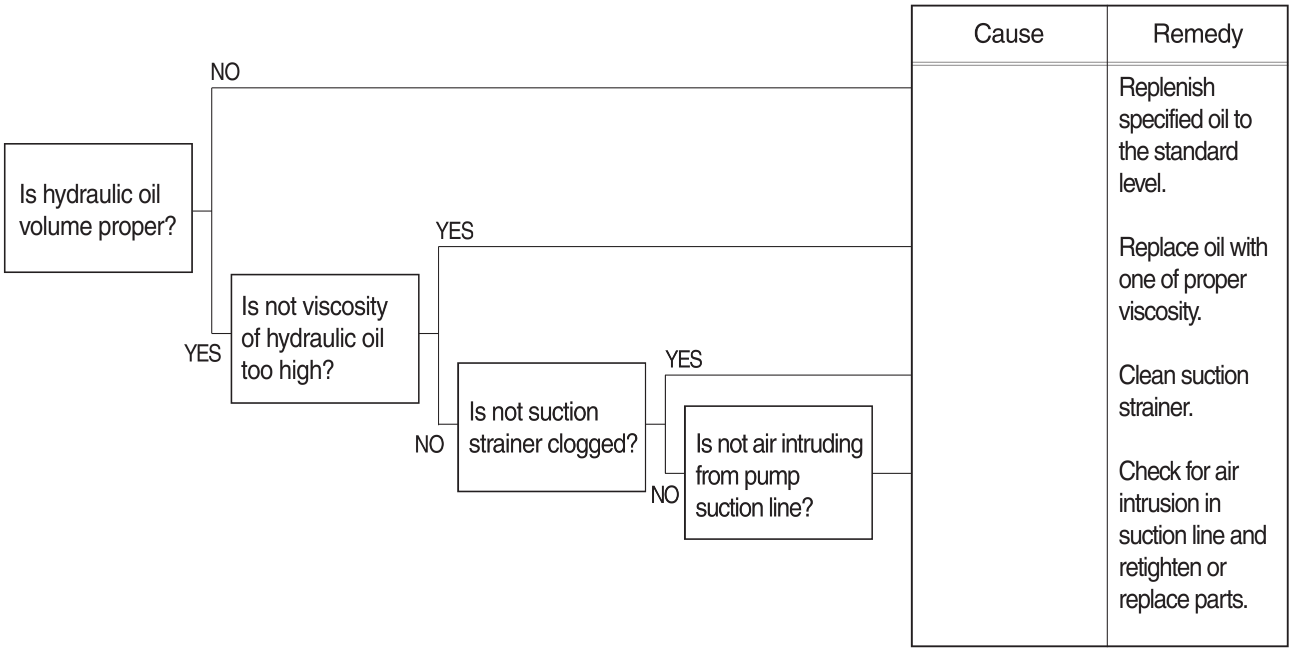
1) HYDRAULIC OIL IS CLOUDY



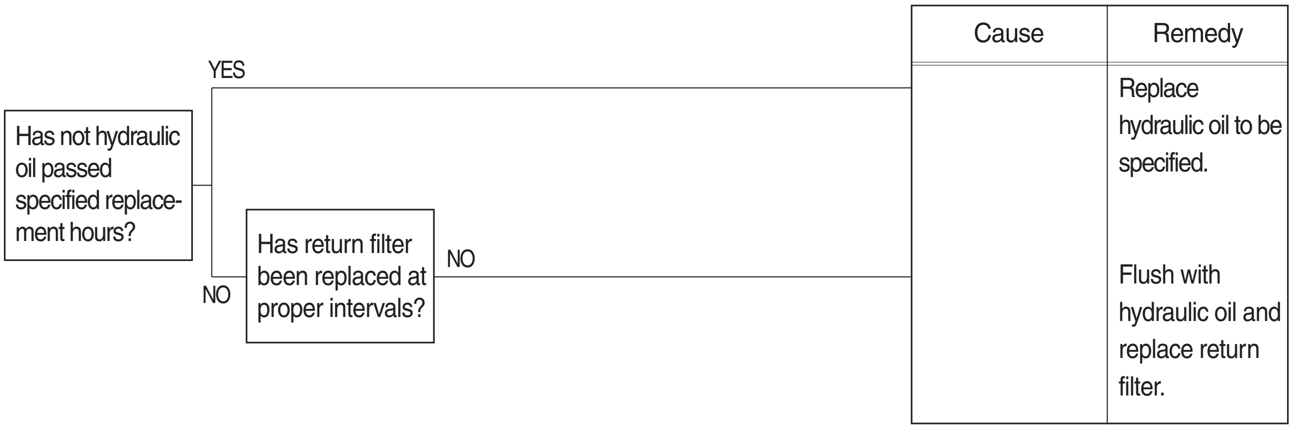
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

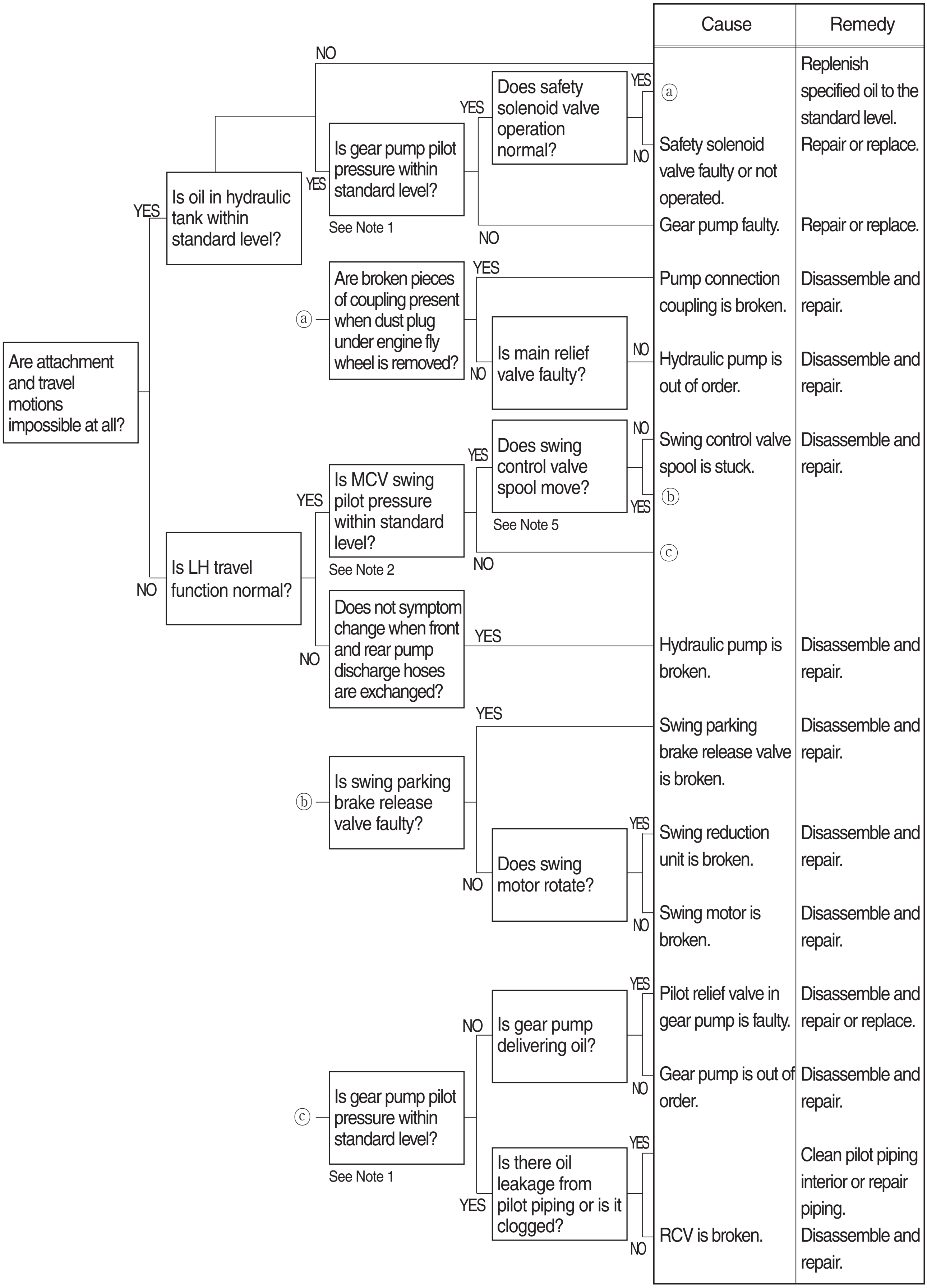


4) HYDRAULIC OIL IS CONTAMINATED

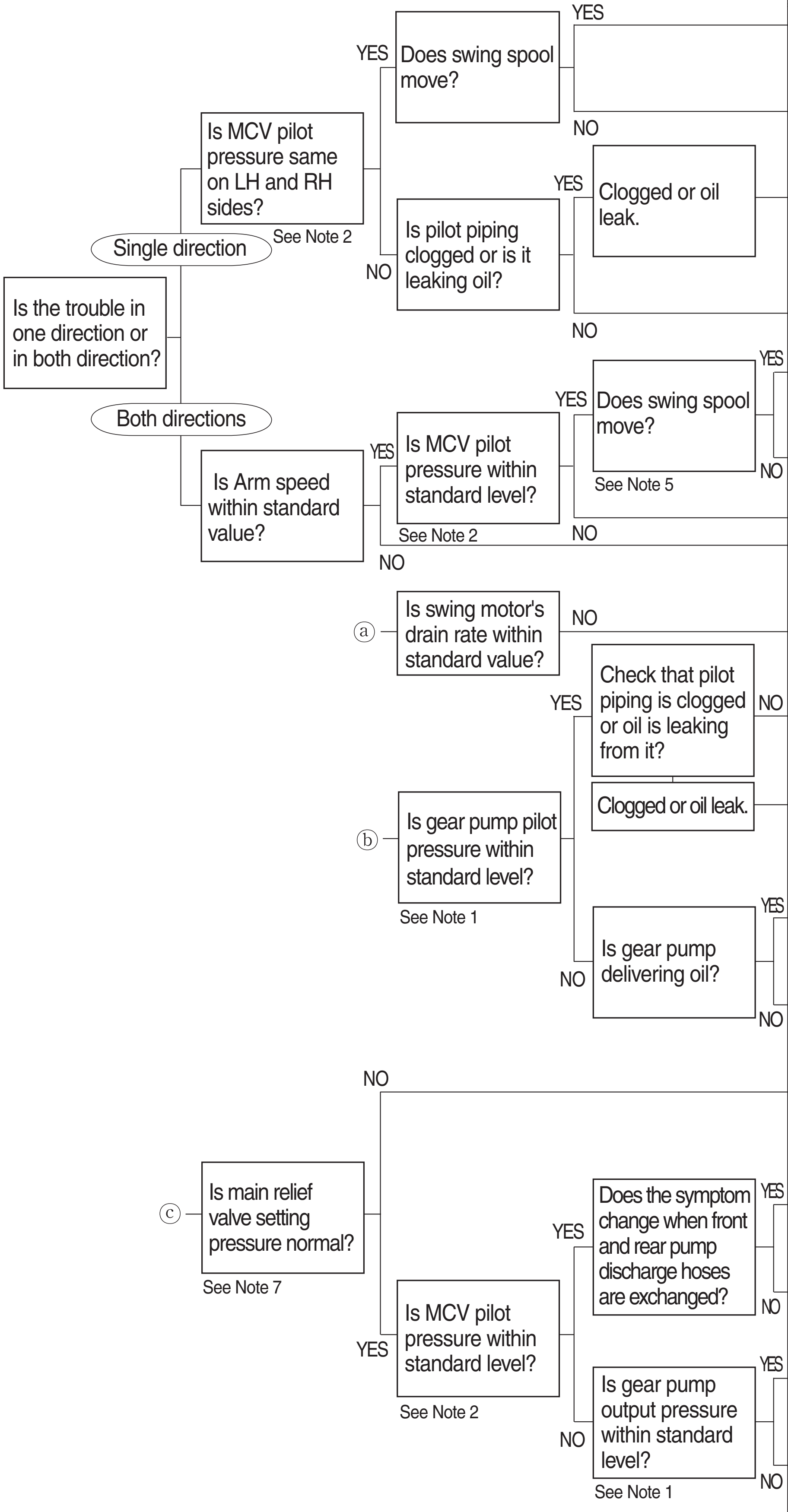


4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE

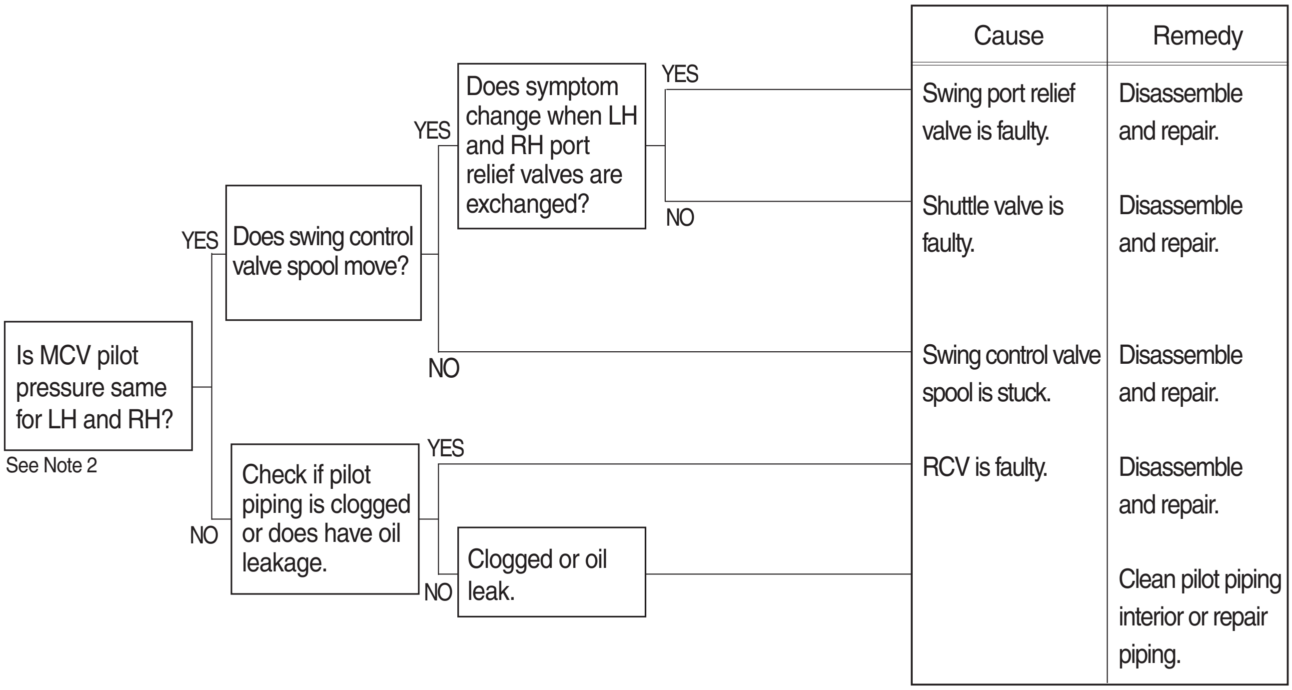


2) SWING SPEED IS LOW

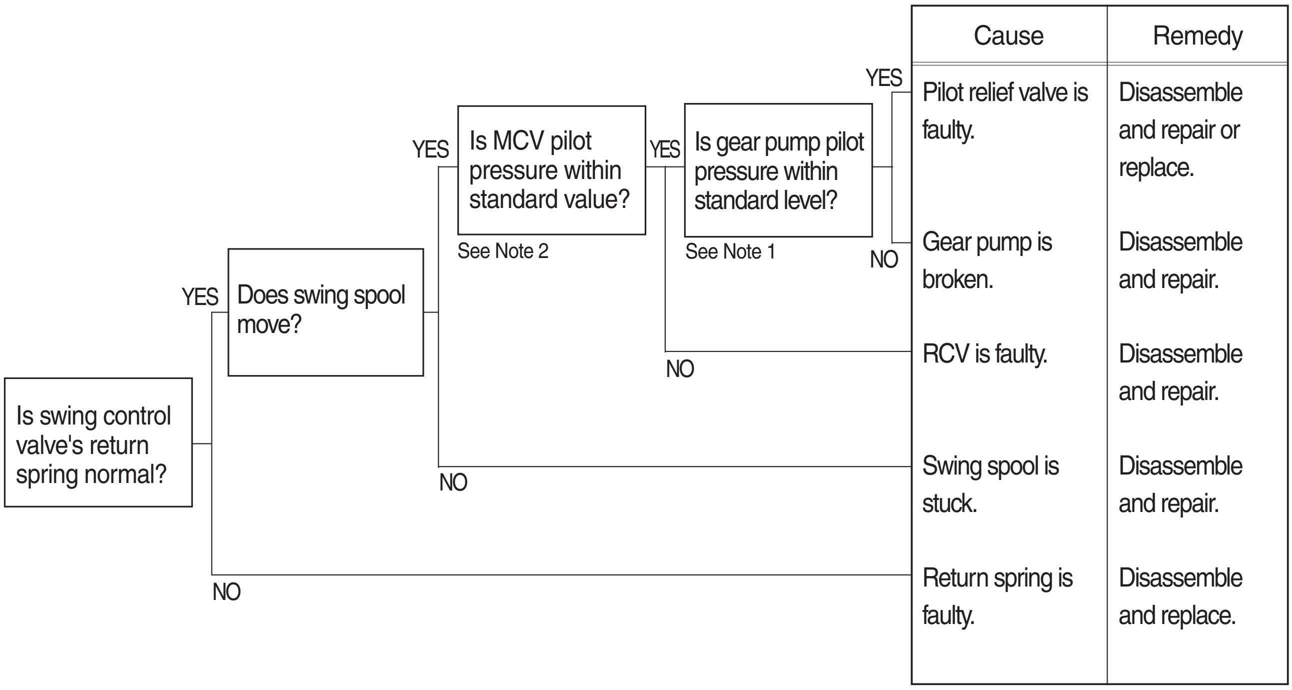


Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing control valve spool is stuck.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
RCV or shuttle valve is faulty.	Disassemble and repair.
Swing spool is stuck.	Disassemble and repair.
Swing motor is broken.	Disassemble and repair.
RCV or shuttle valve is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
Pilot relief valve in gear pump is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
Main relief valve faulty.	Main relief valve pressure resetting or repair.
Hydraulic pump is broken.	Disassemble and repair.
Shuttle valve is faulty.	Repair or replace.
Pilot relief valve is faulty.	Repair or replace.
Gear pump is faulty.	Repair or replace.

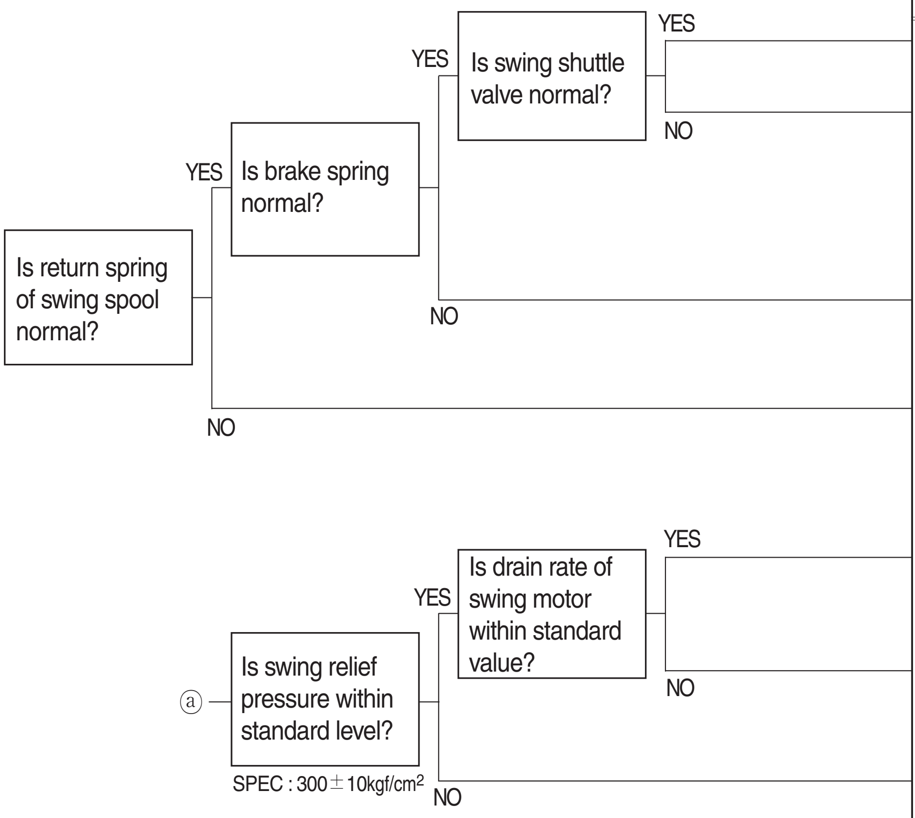
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP



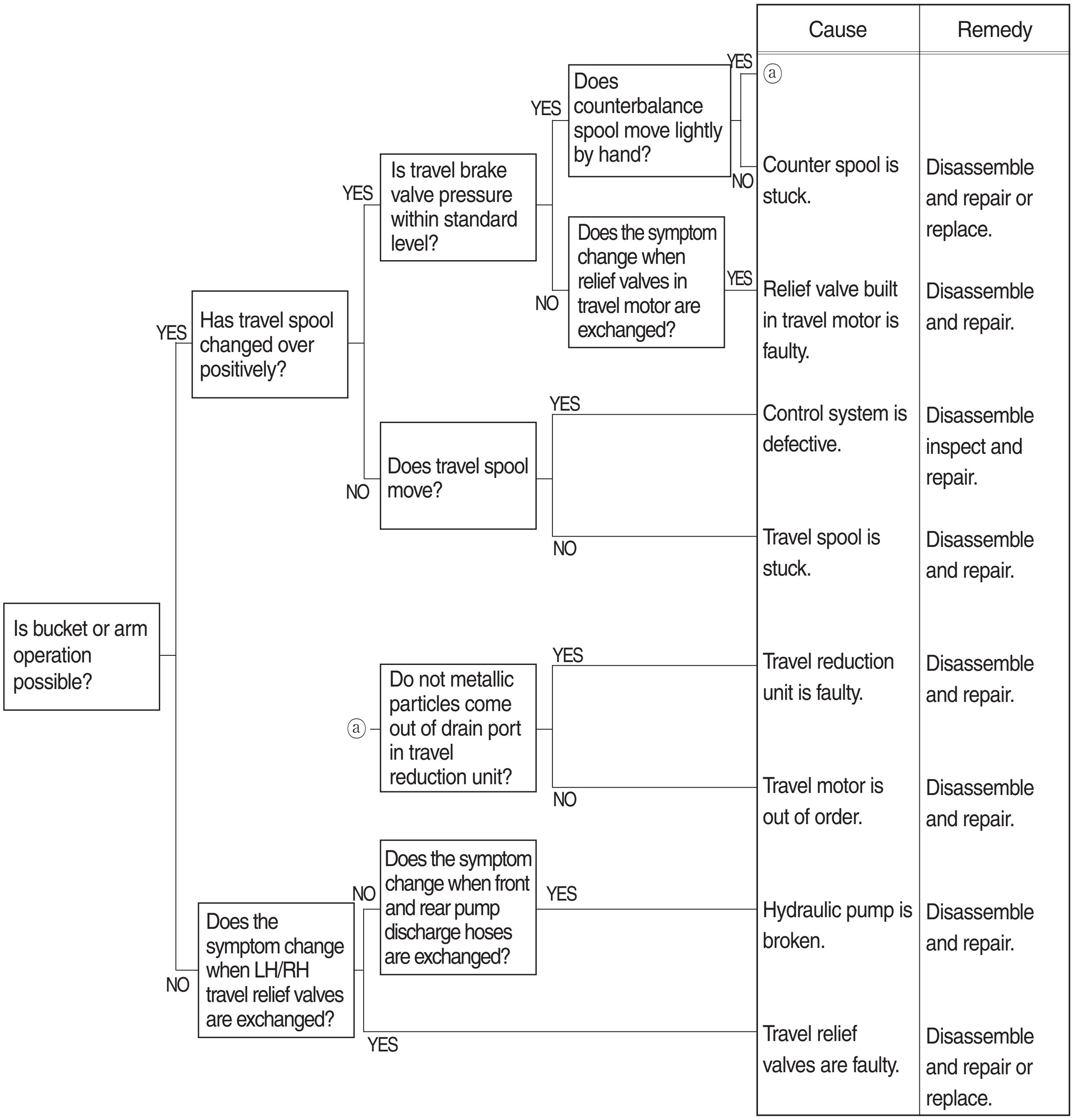
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



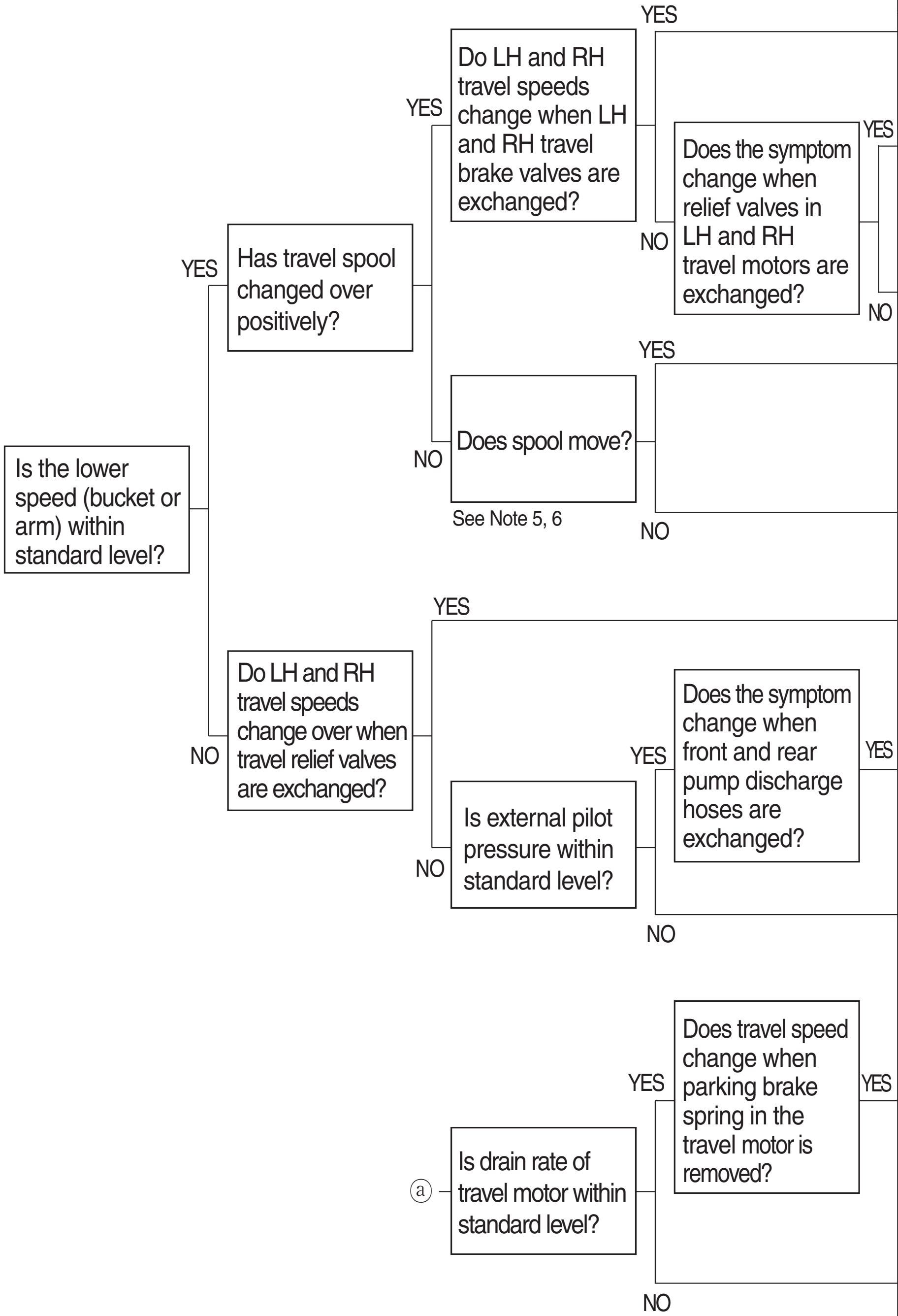
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.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

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



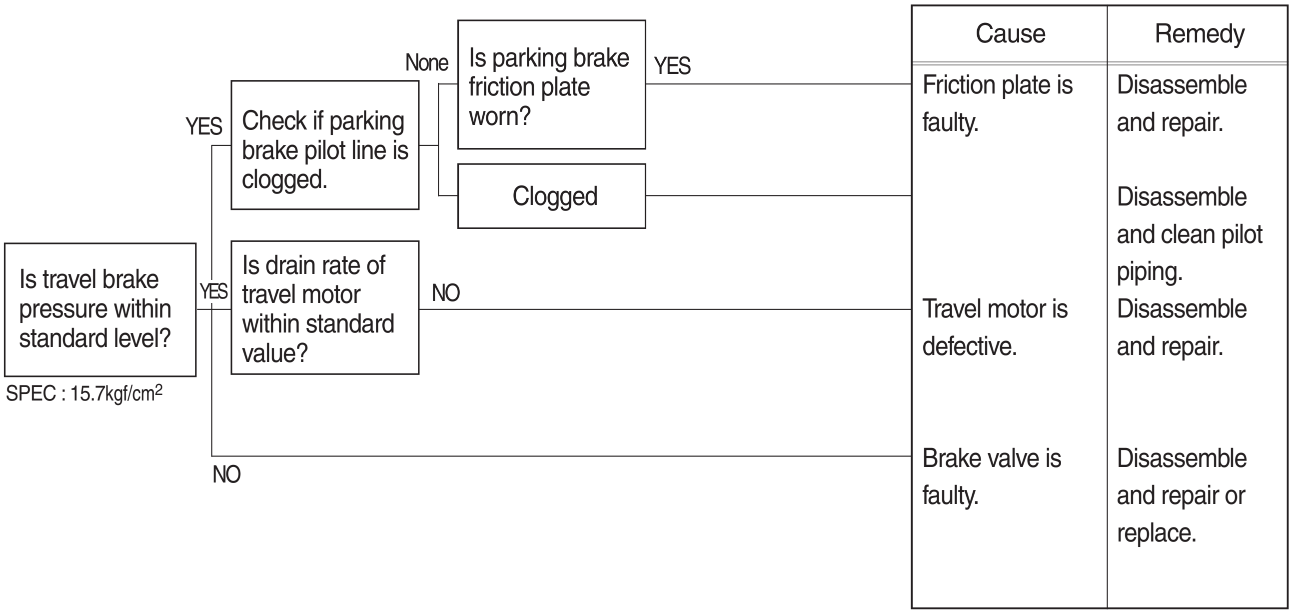
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



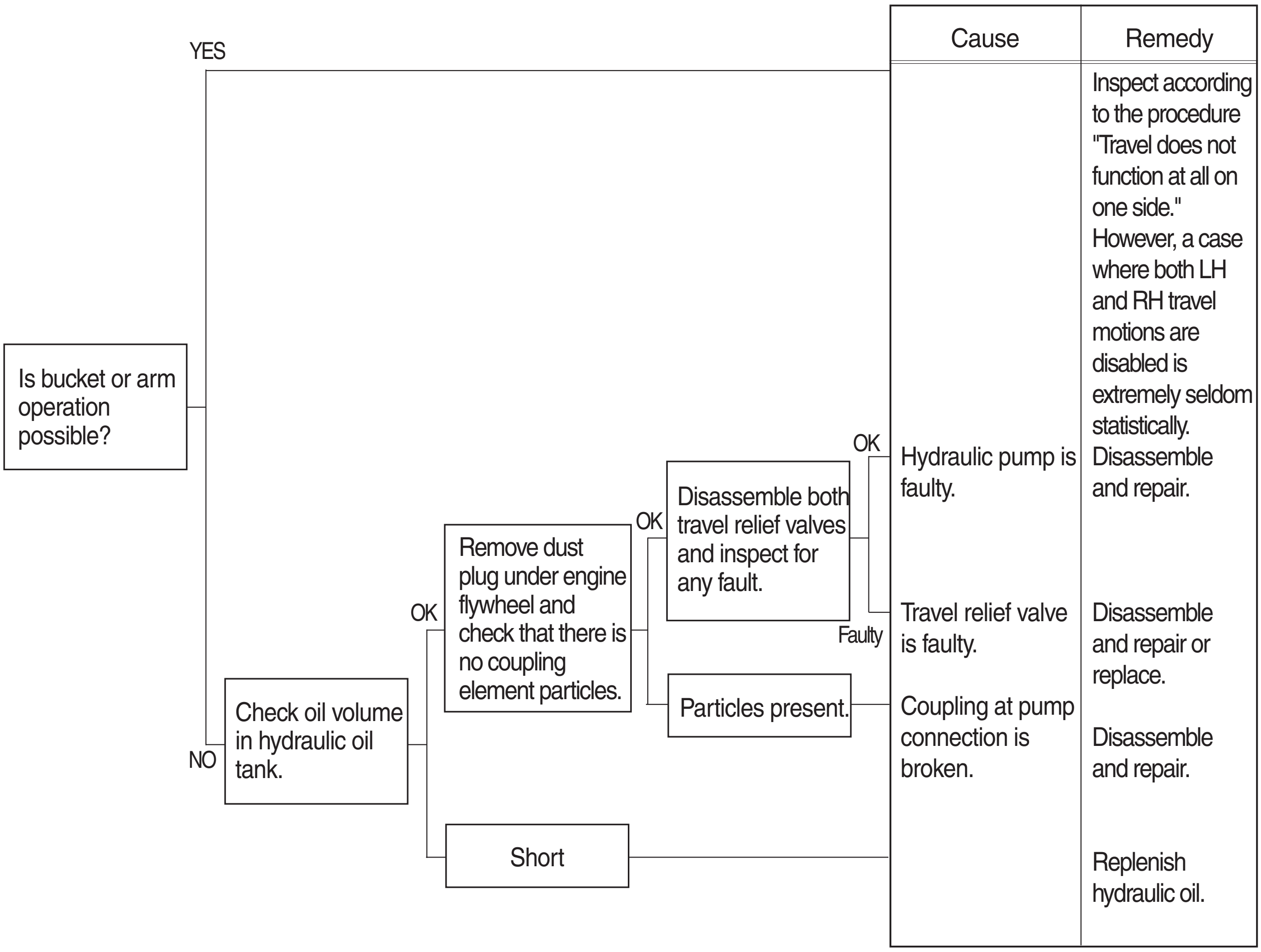
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble 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

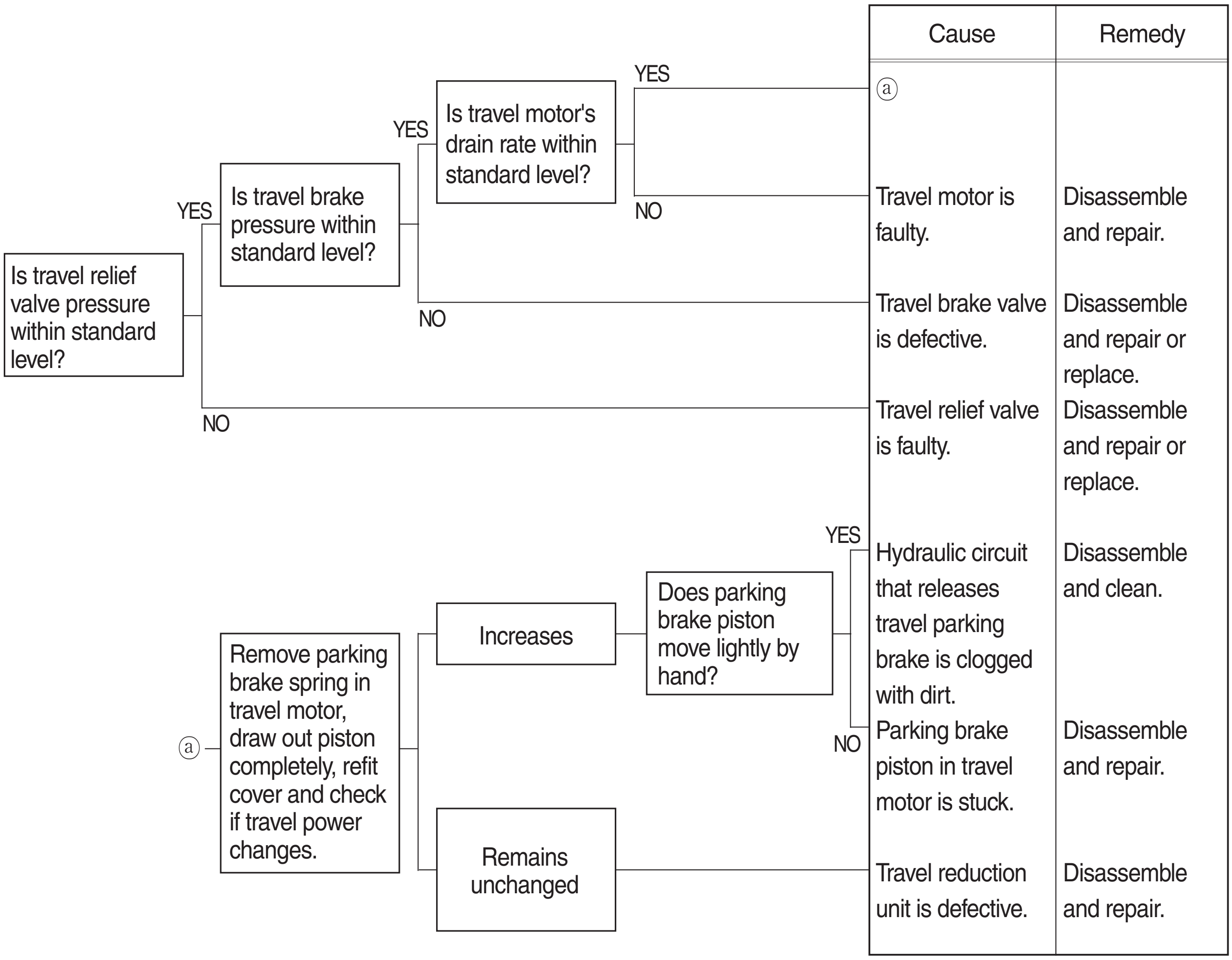
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

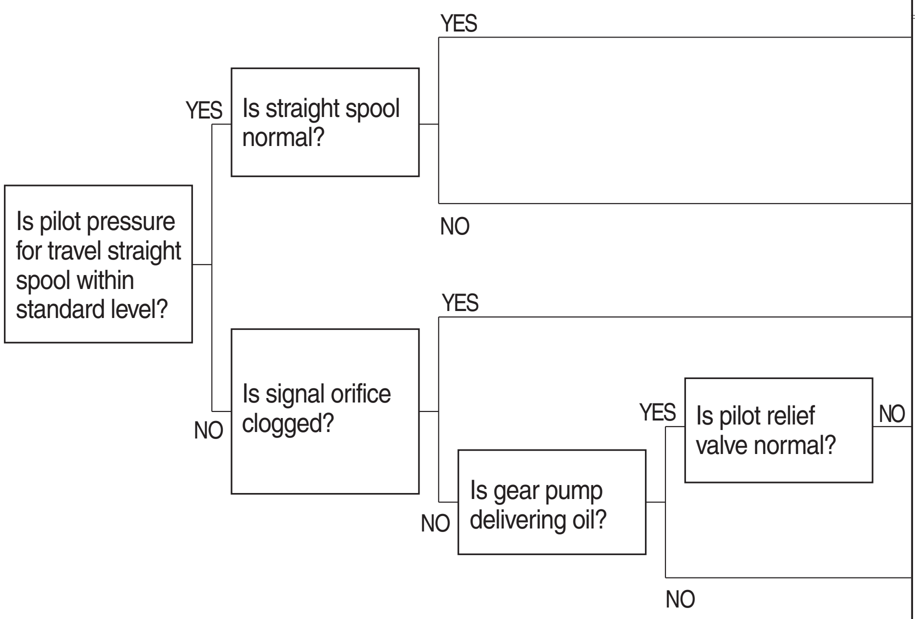


5) TRAVEL ACTION IS POWERLESS (travel only)



6) MACHINE RUNS RECKLESSLY ON A SLOPE

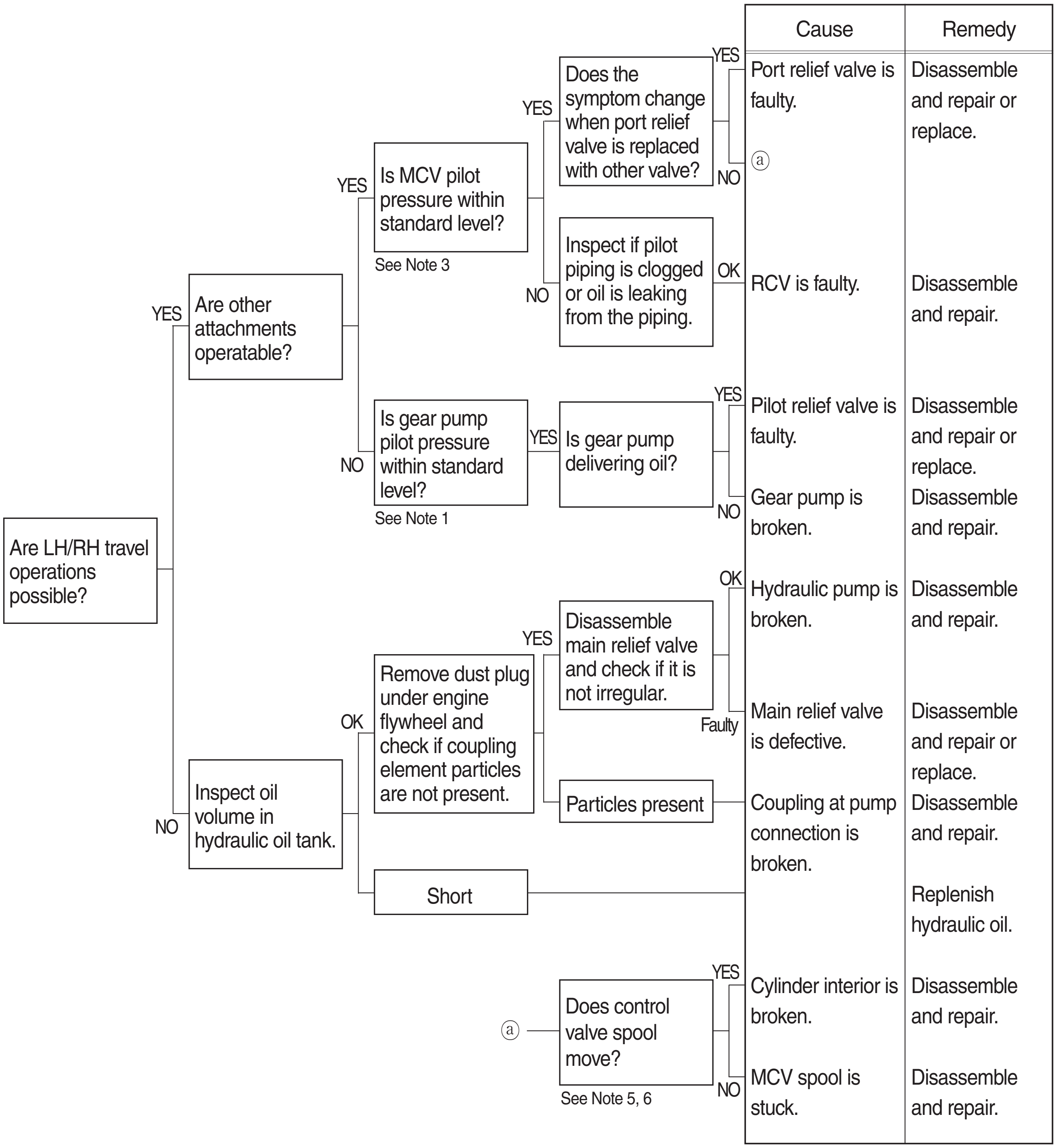
7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME



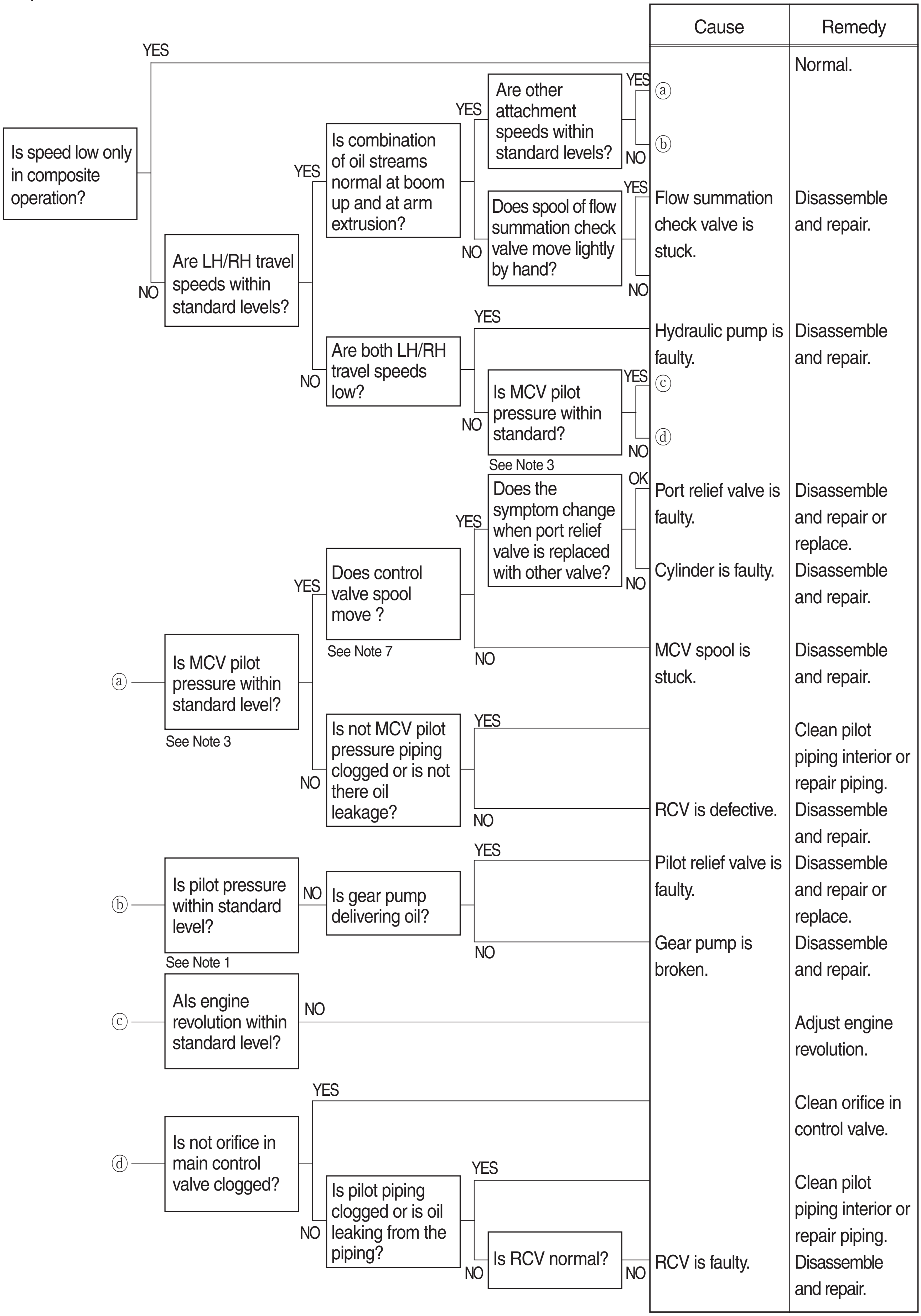
Cause	Remedy
	Normal.
Straight spool is faulty.	Repair or replace.
	Remove dirt on signal orifice.
Pilot relief valve is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.

6. ATTACHMENT SYSTEM

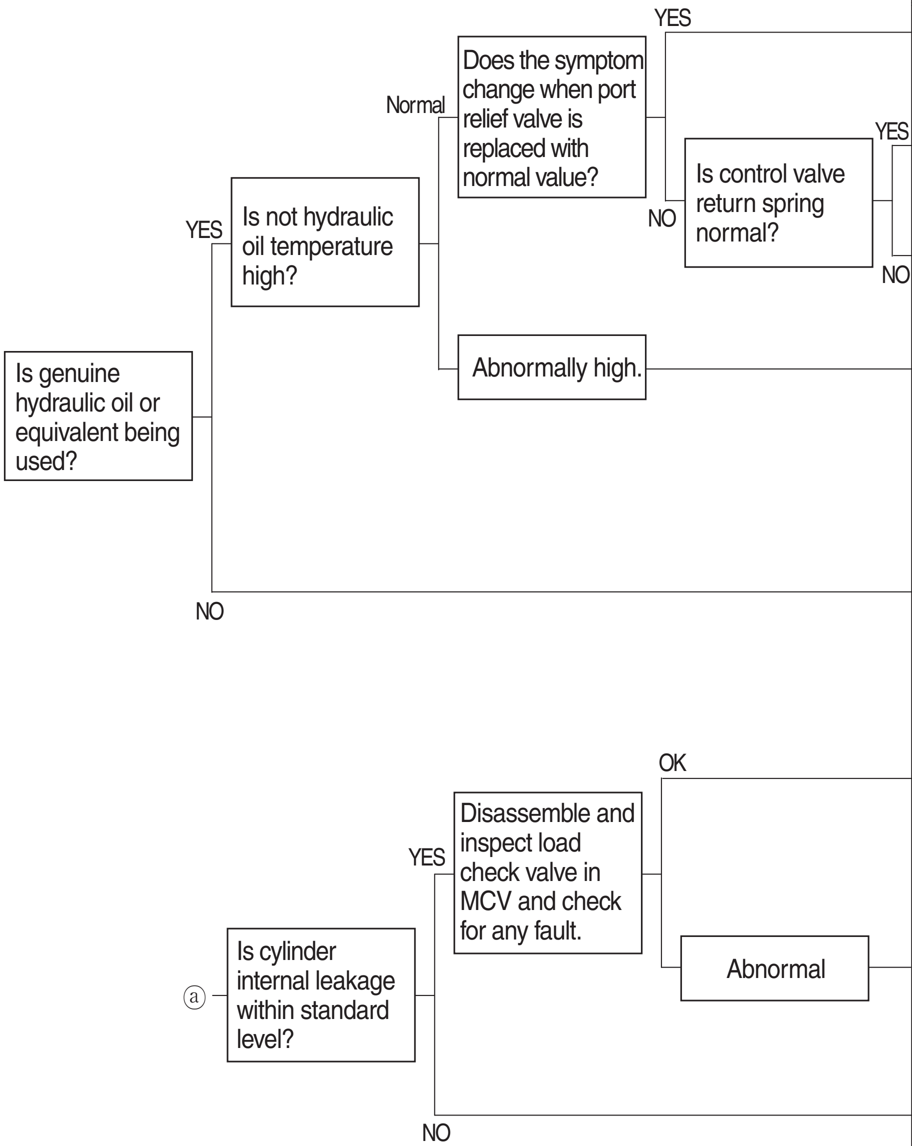
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

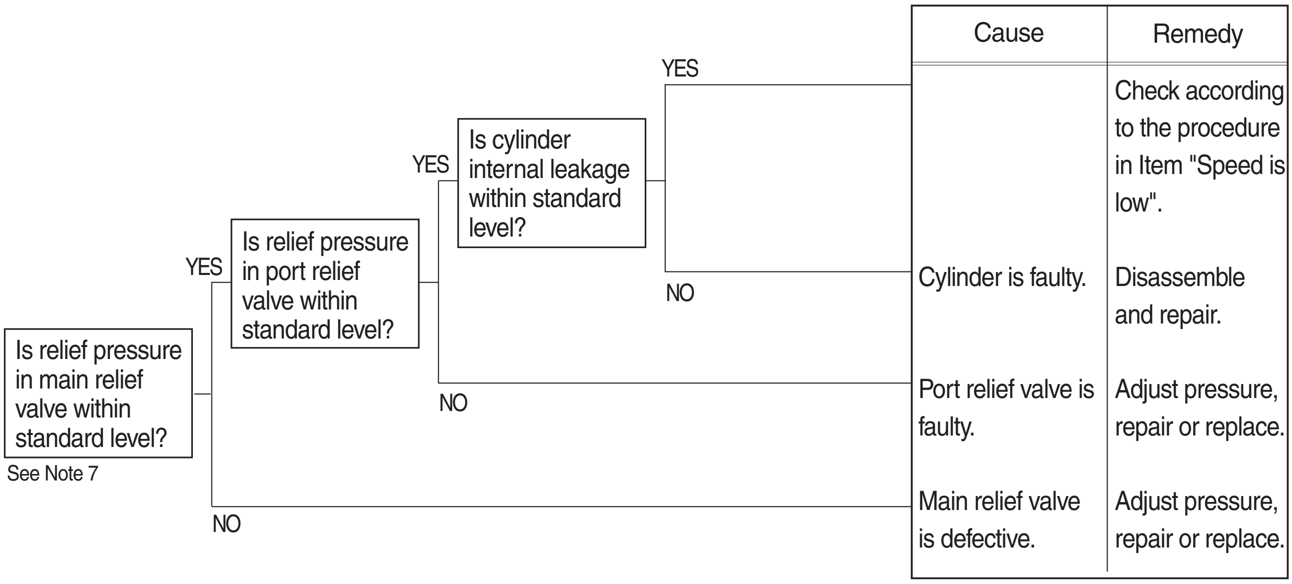


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

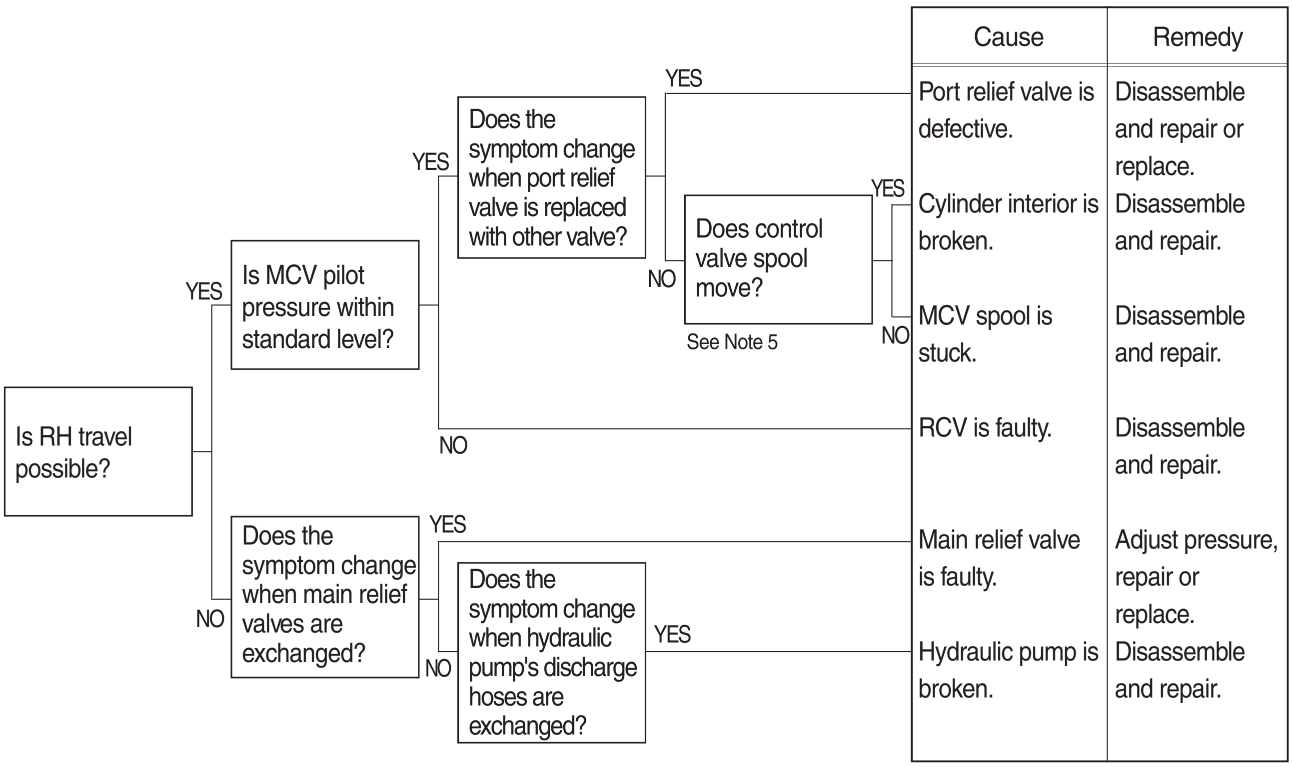


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



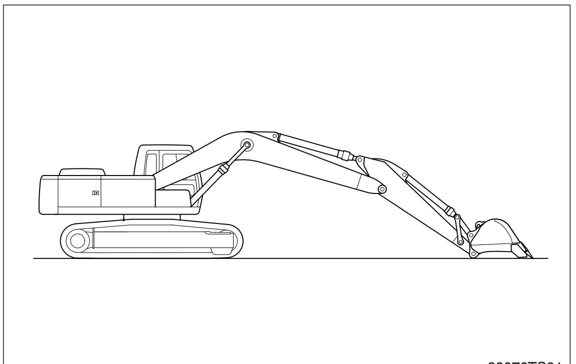
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

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

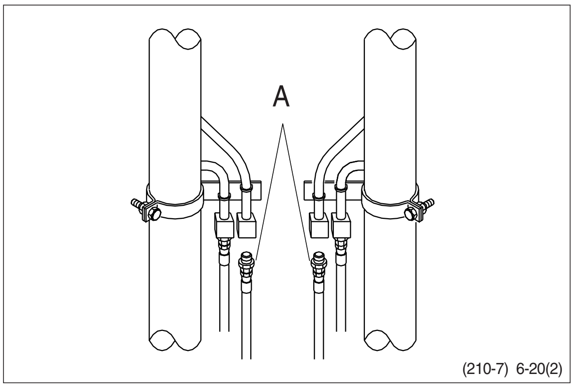
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



29076TS01

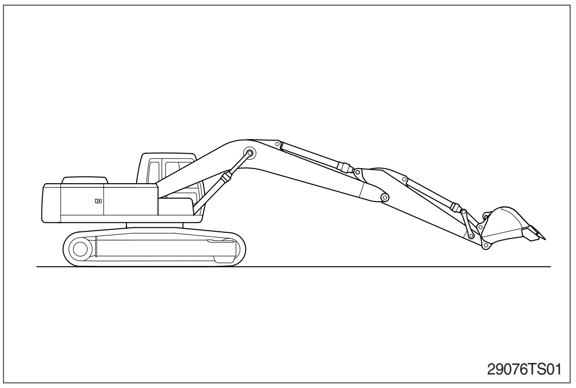
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



(210-7) 6-20(2)

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

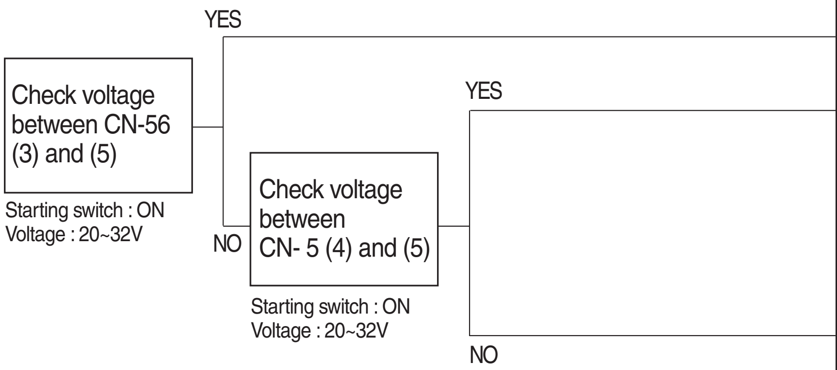
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



29076TS01

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

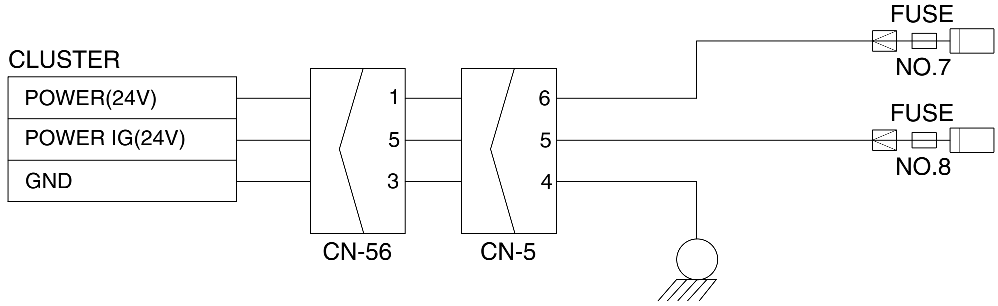
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.7, 8.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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

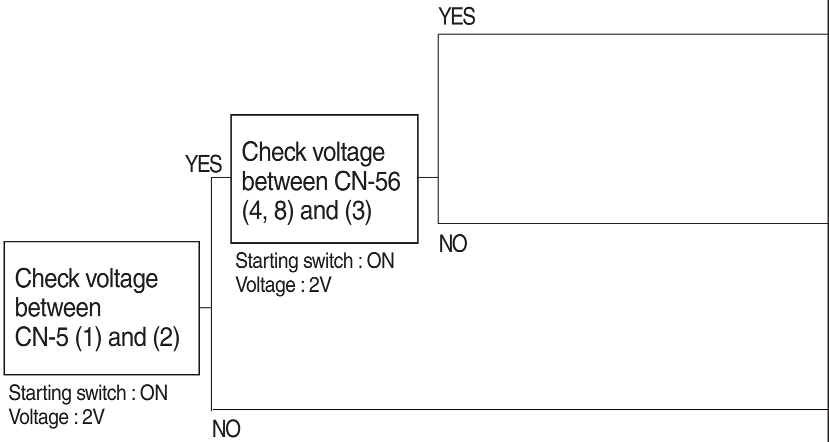
YES	20~32V
NO	0V



3009SH6ES01

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

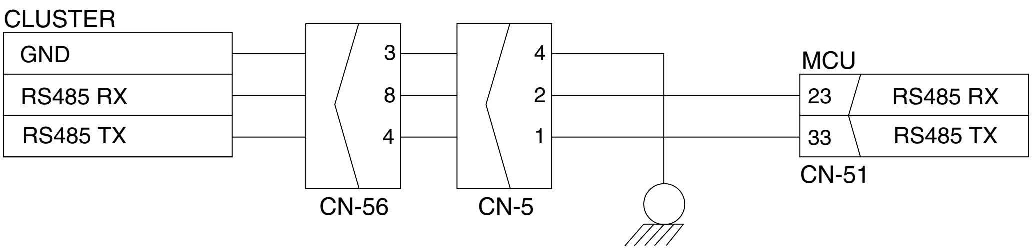
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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

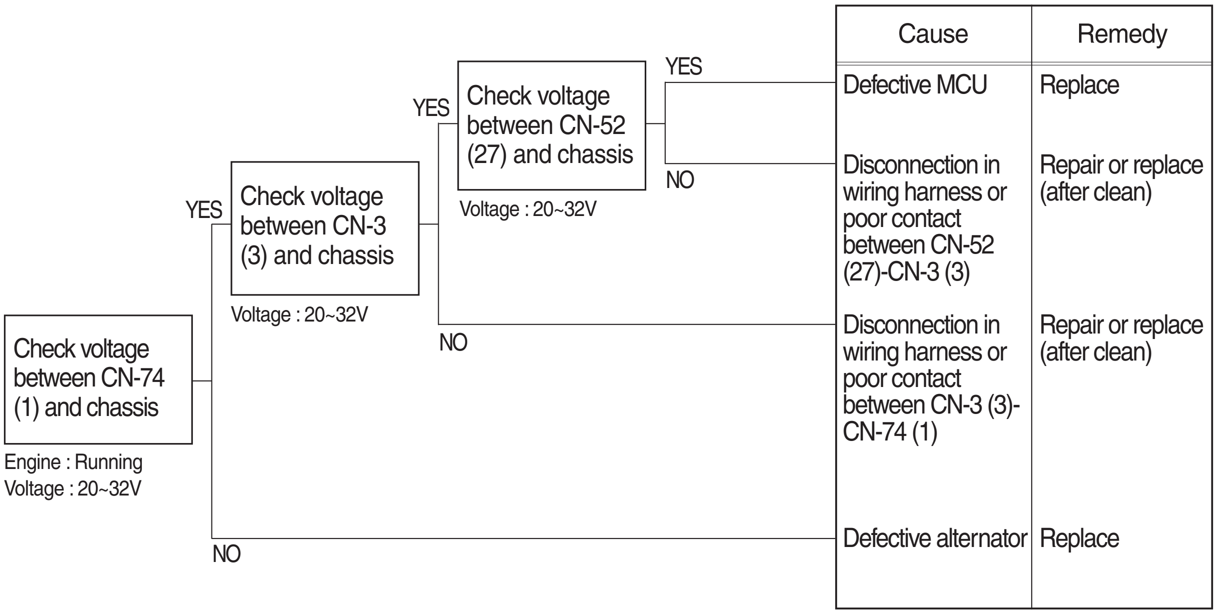
YES	2V
NO	0V



3009SH6ES02

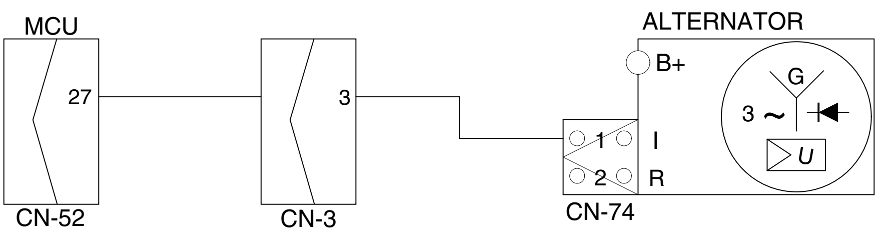
3. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

· 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

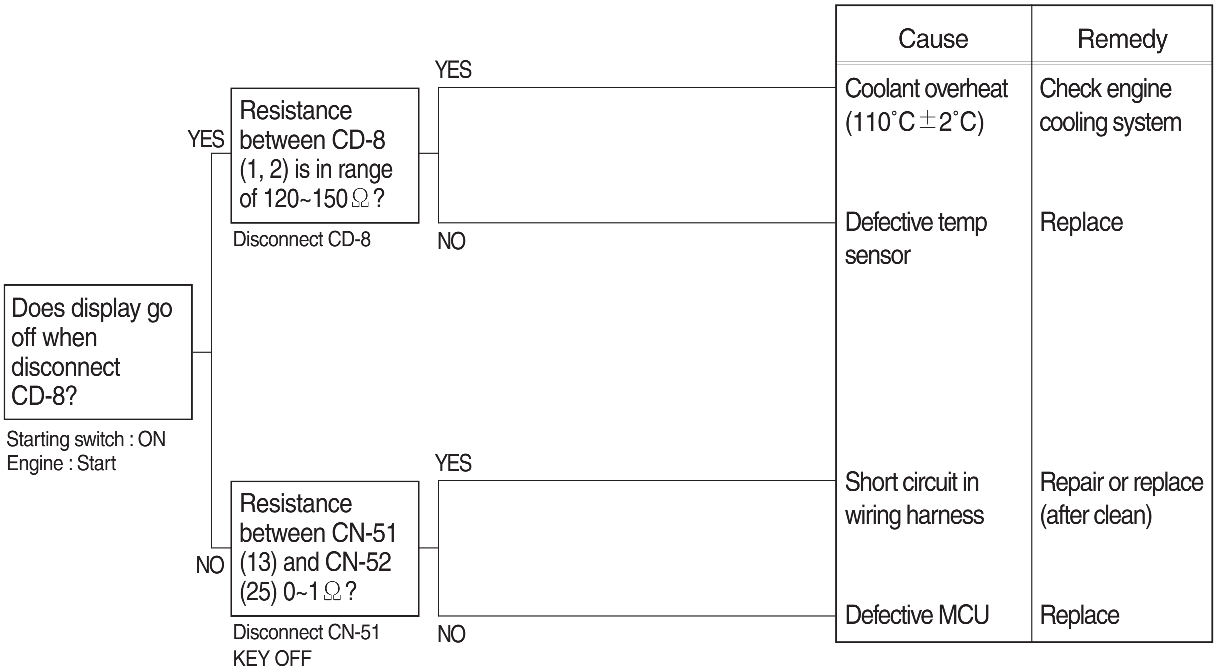
YES	20~32V
NO	0V

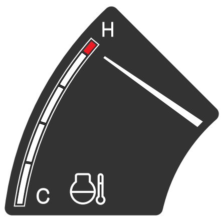


3009SH6ES03

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

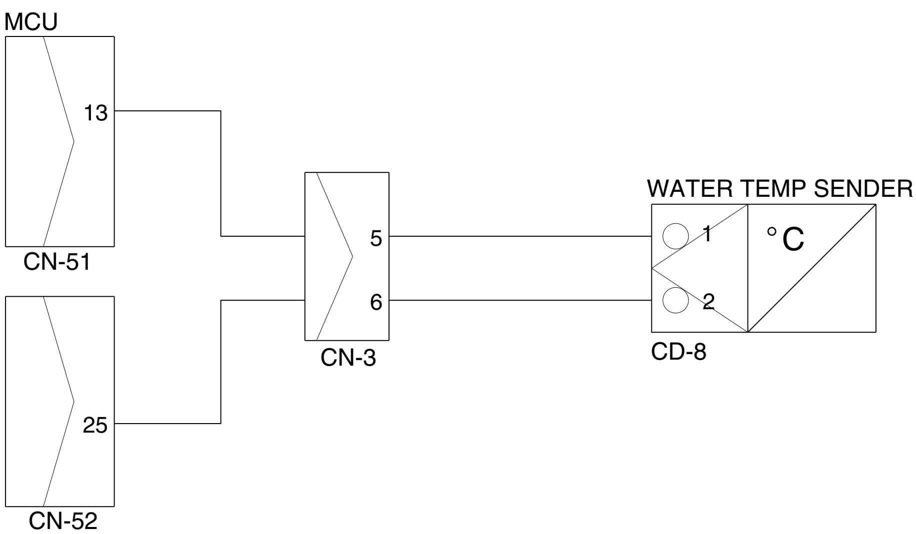
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

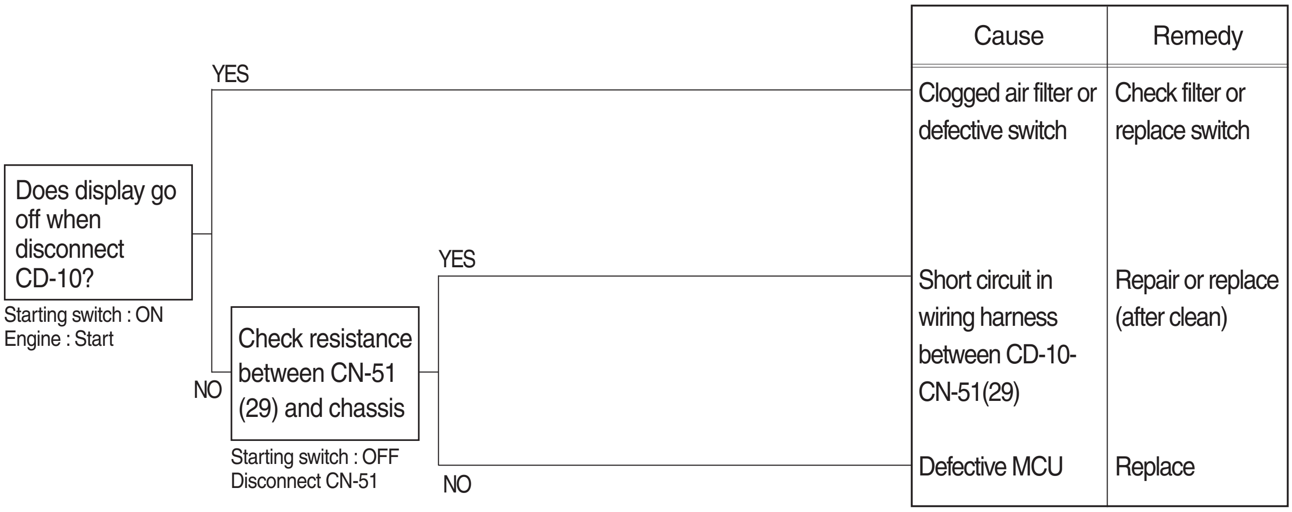
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



3009SH6ES04

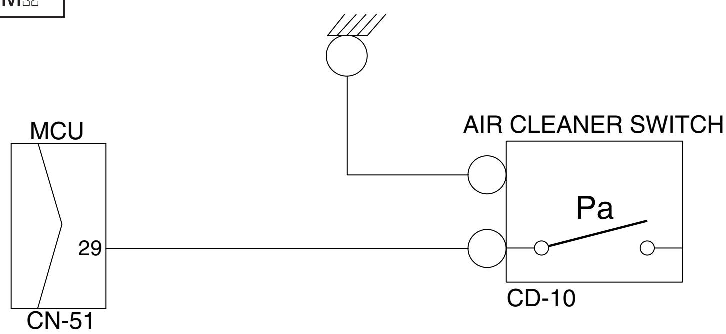
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

· 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

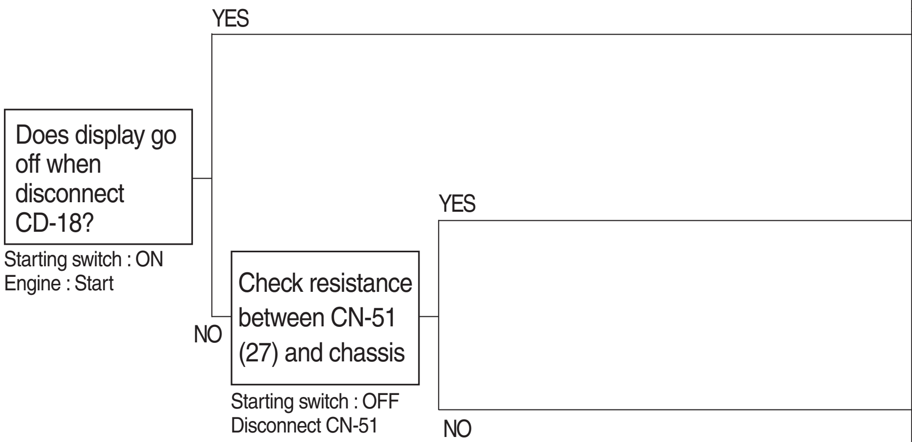
YES	MAX 1Ω
NO	MIN 1MΩ



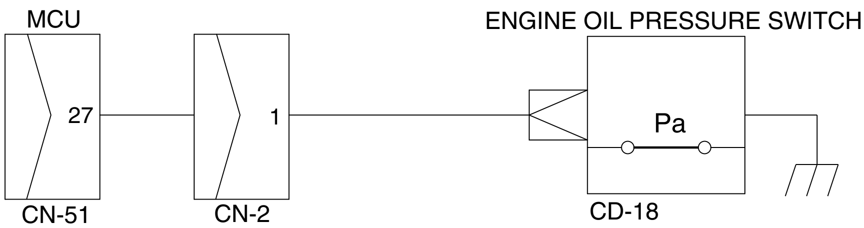
3009SH6ES05

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.



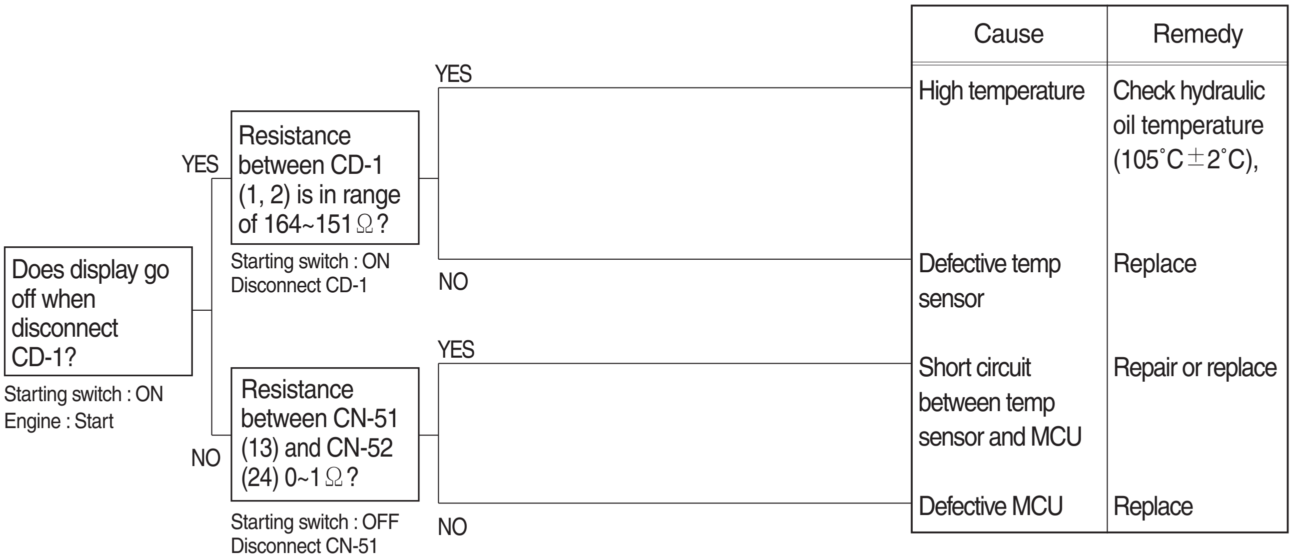
Cause	Remedy
Engine oil leakage, or defective switch	Check engine oil level or replace switch
Defective controller	Replace
Disconnection in wiring harness or poor contact between CN-51(27)-CD-18	Repair or replace (after clean)

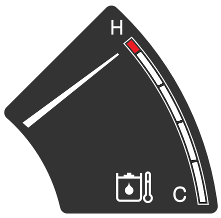


3009SH6ES06

7. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP (engine is started)

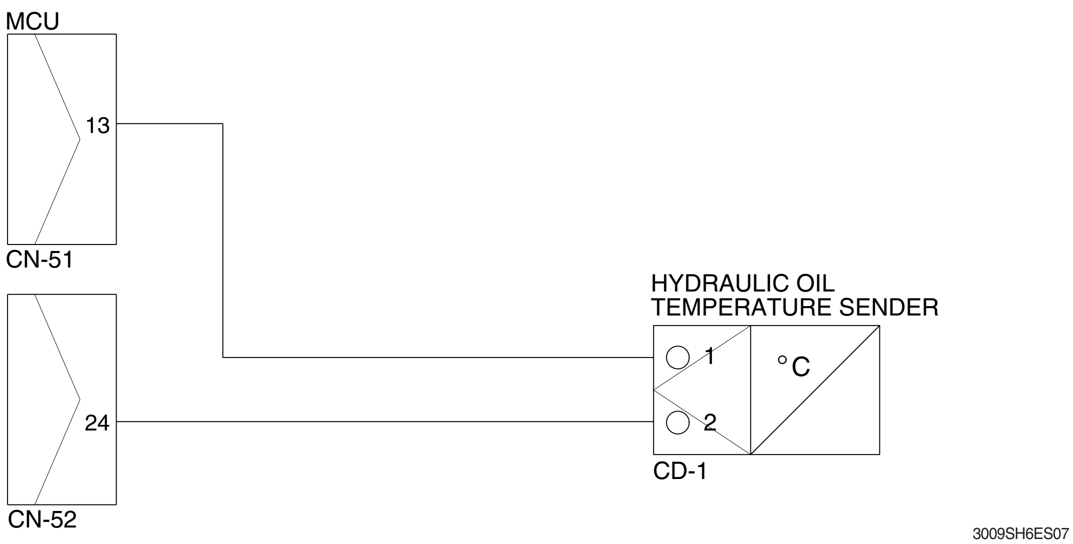
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





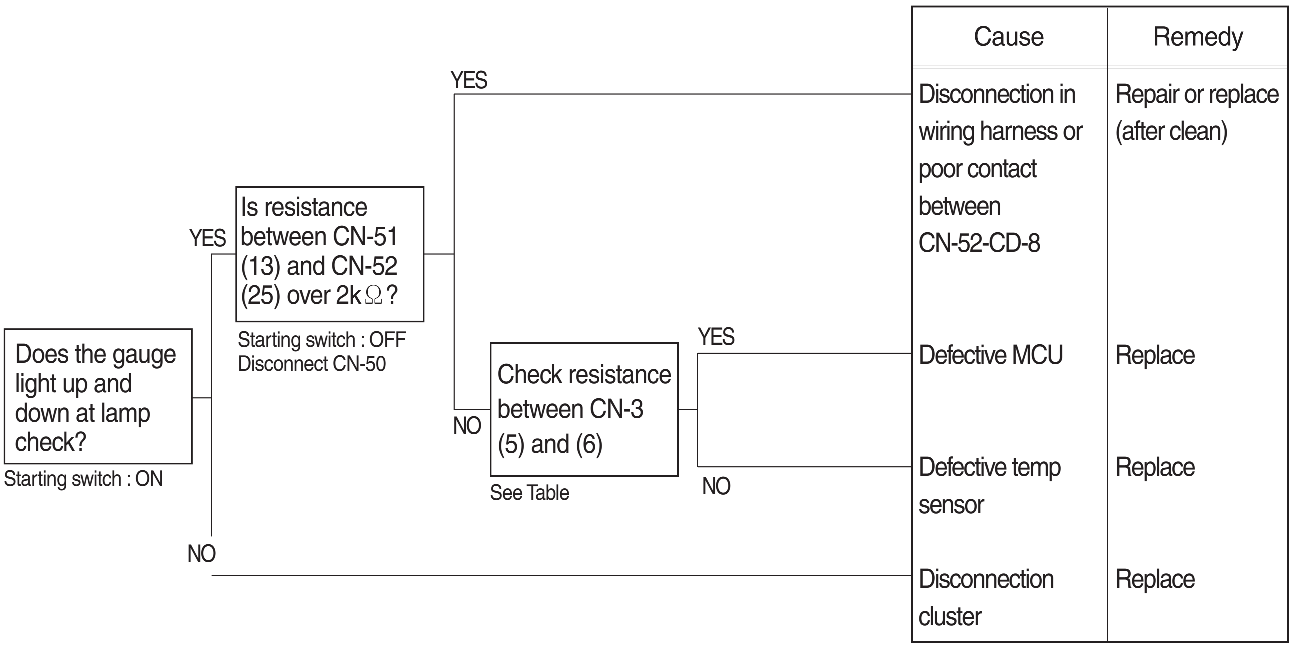
Check Table

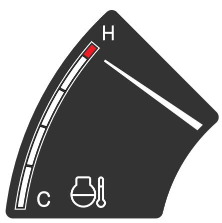
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



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

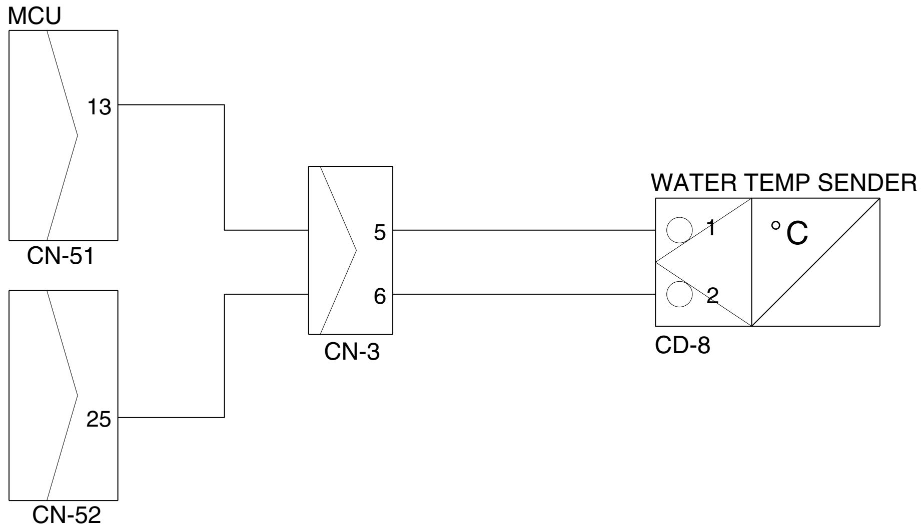
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

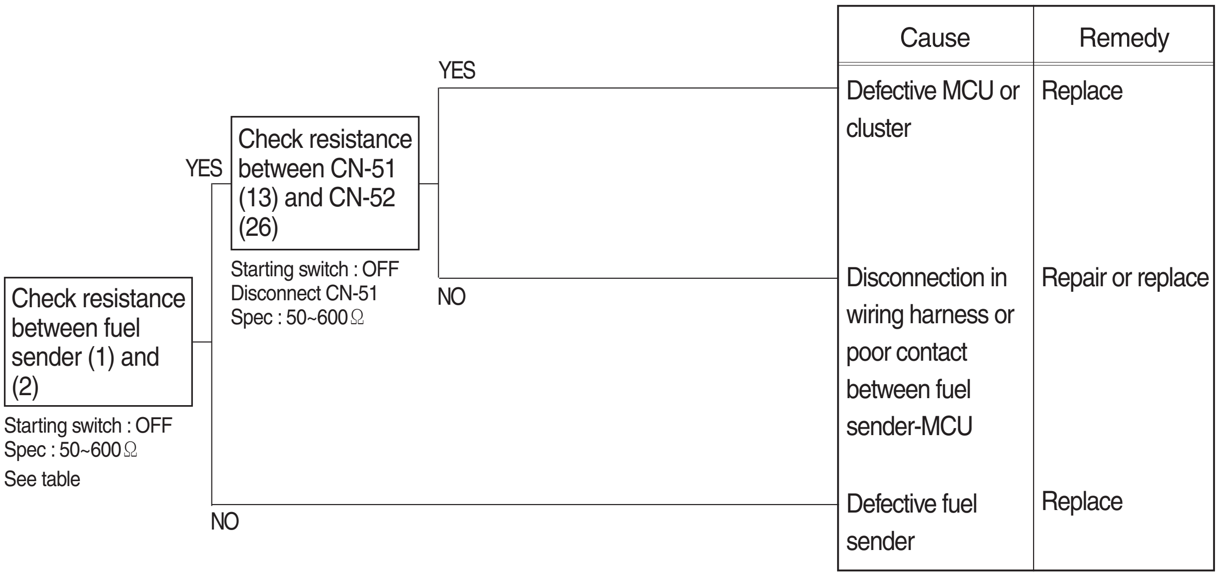
Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8

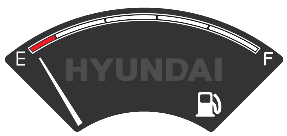


3009SH6ES04

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

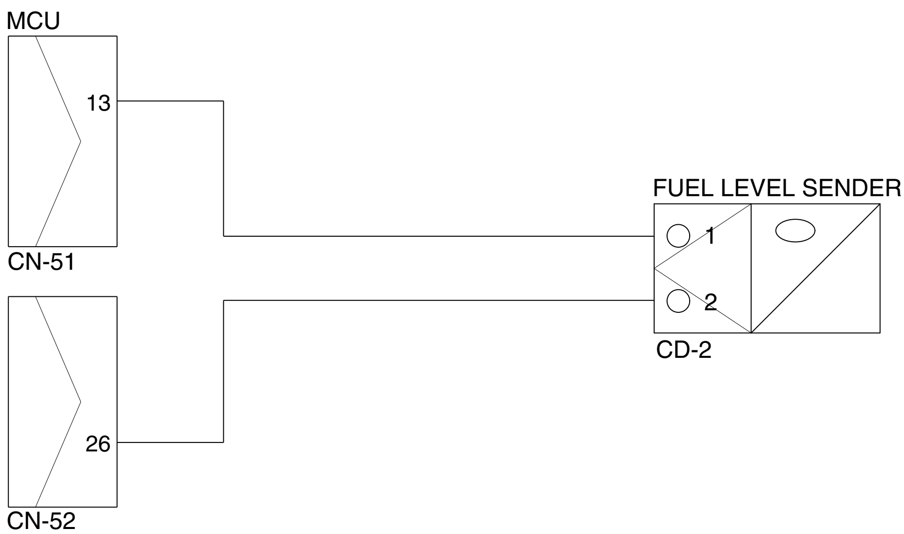
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

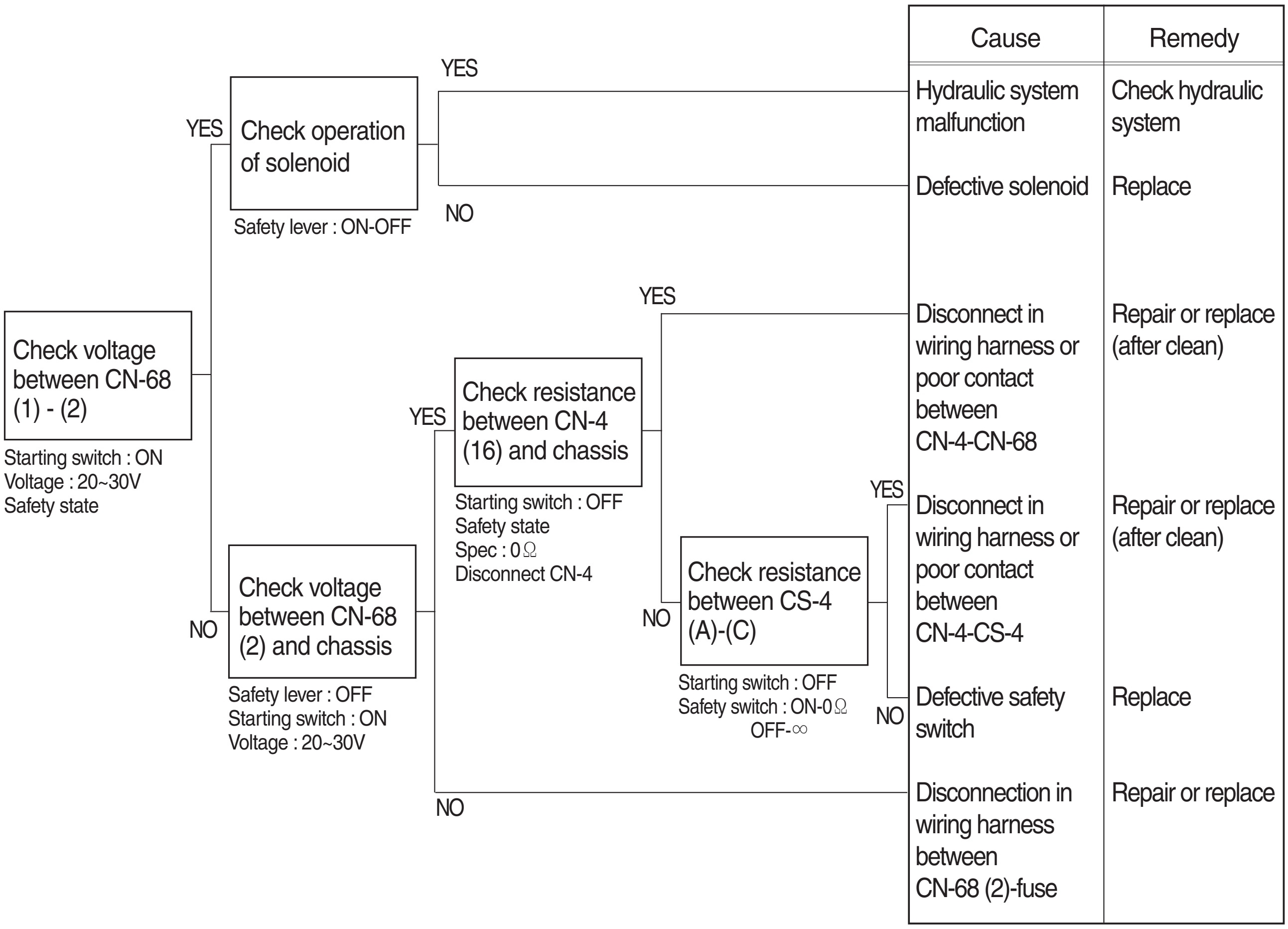
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

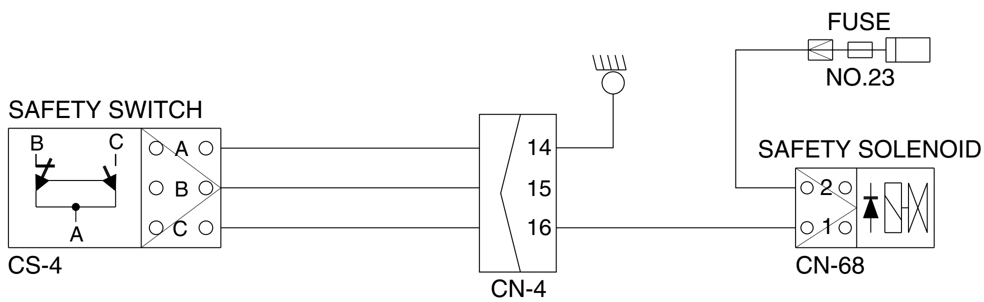


3009SH6ES08

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.

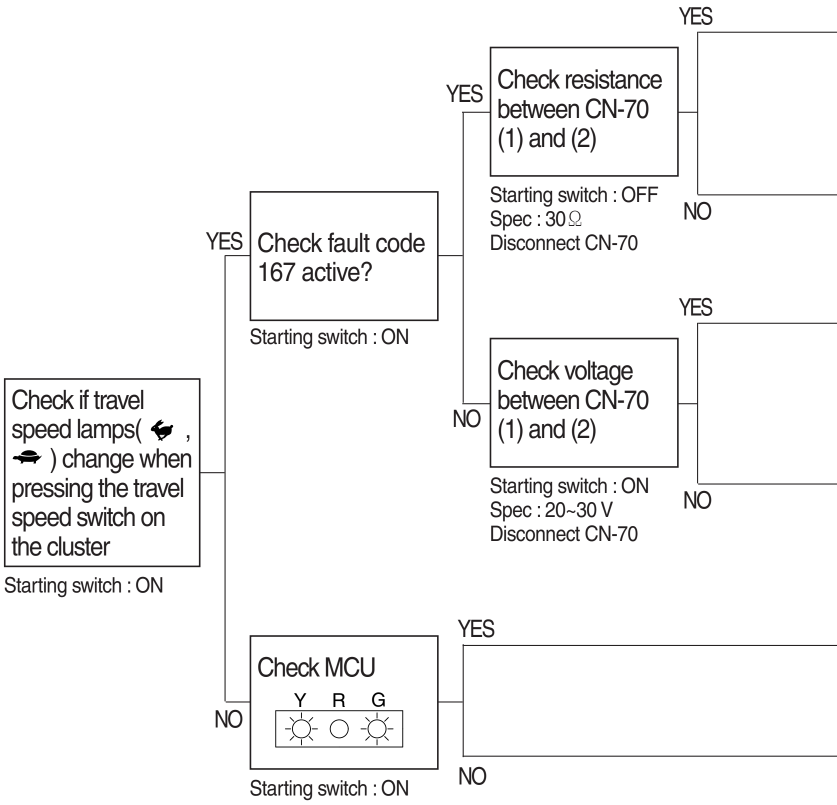




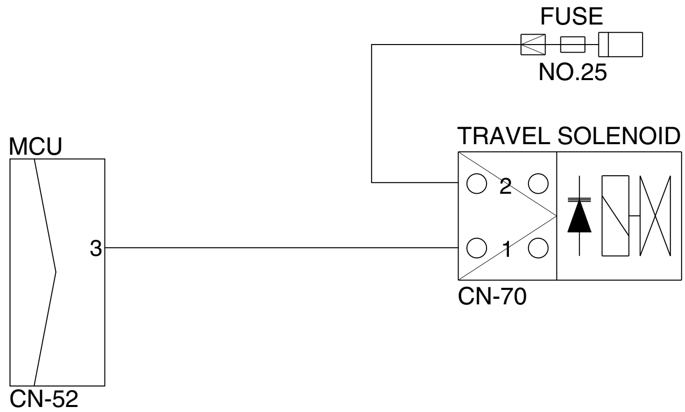
21096ES10

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.



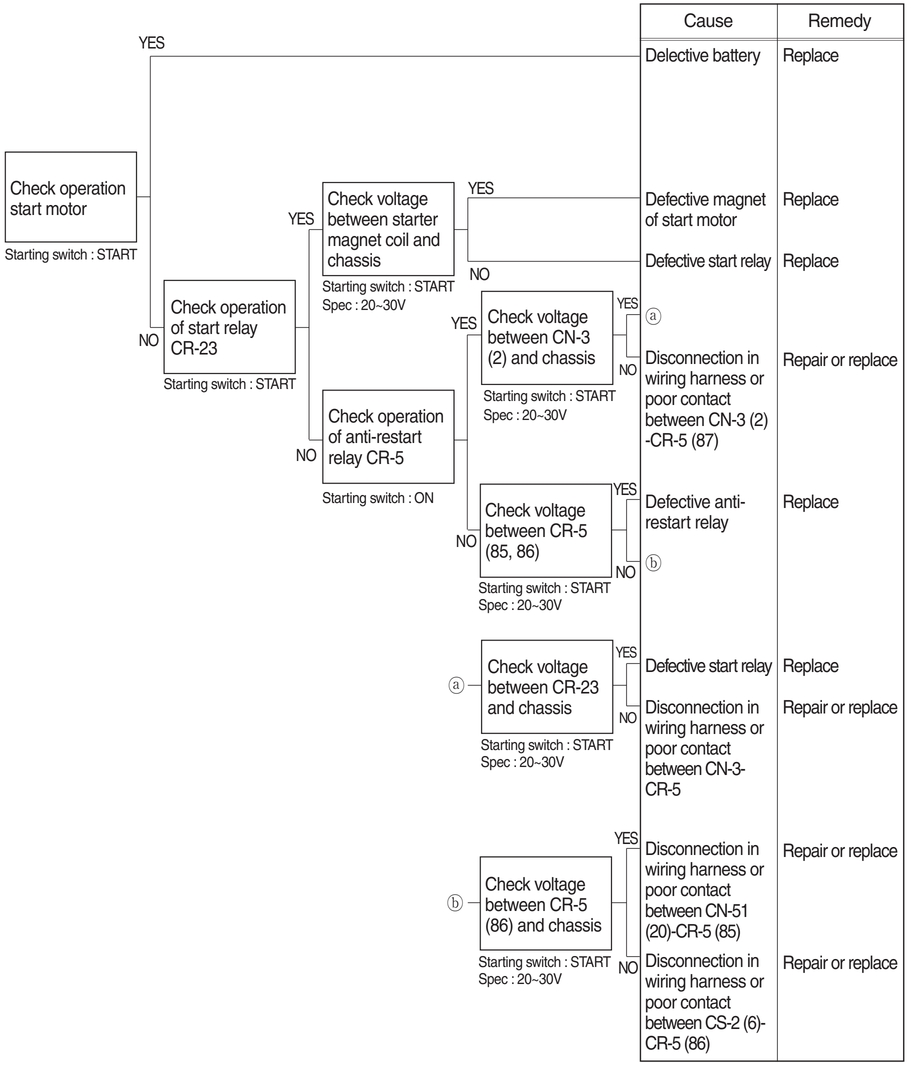
Cause	Remedy
Disconnection in wiring harness or poor contact between CN-70-CN-52	Repair or replace
Defective solenoid	Replace
Defective hydraulic system	Check hydraulic system
Disconnection in wiring harness or poor contact between CN-70-fuse No. 25	Repair or replace
Defective cluster	Replace
Defective MCU	Replace

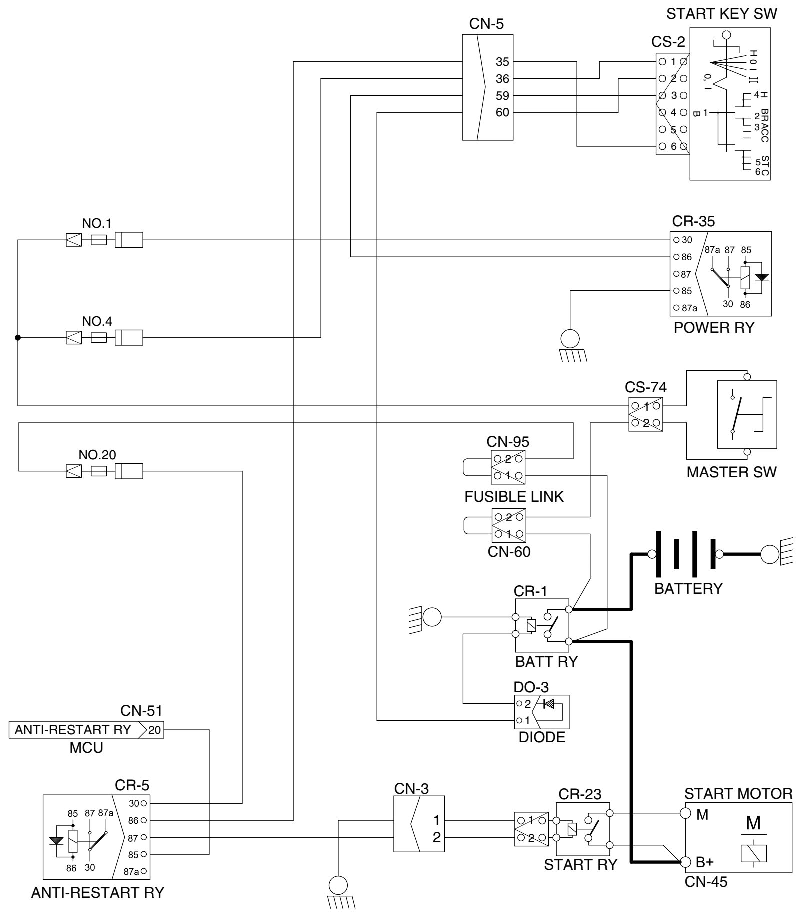


3009SH6ES09

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.

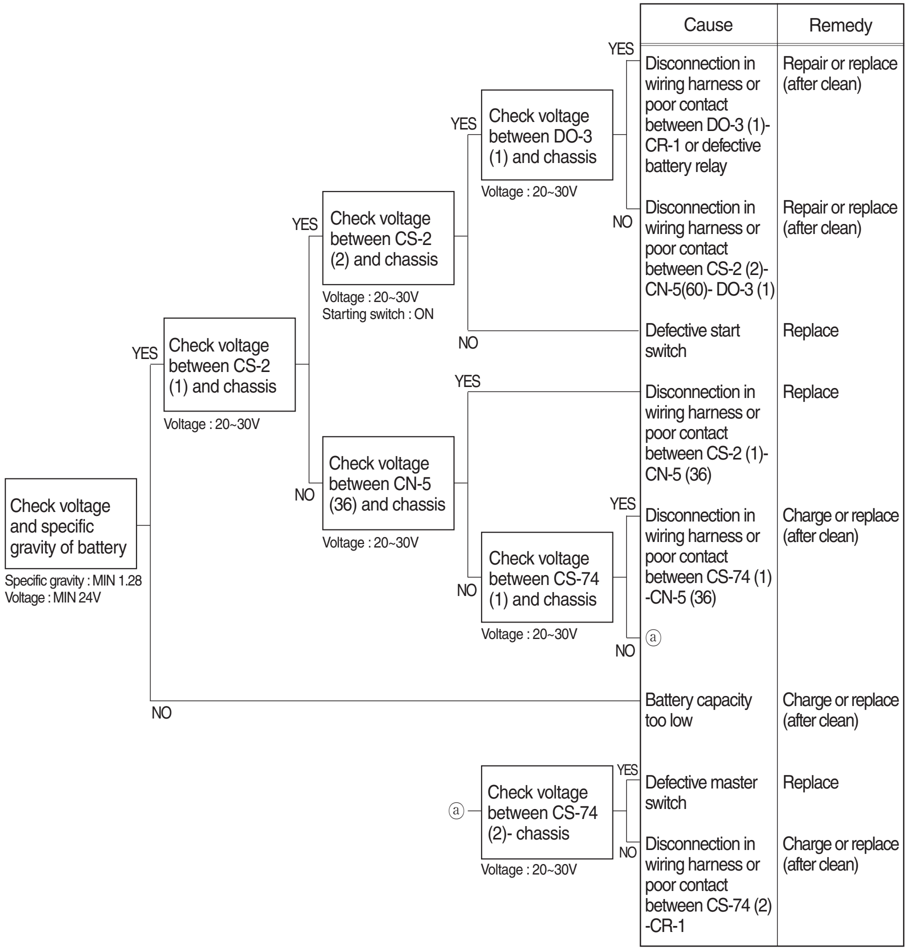


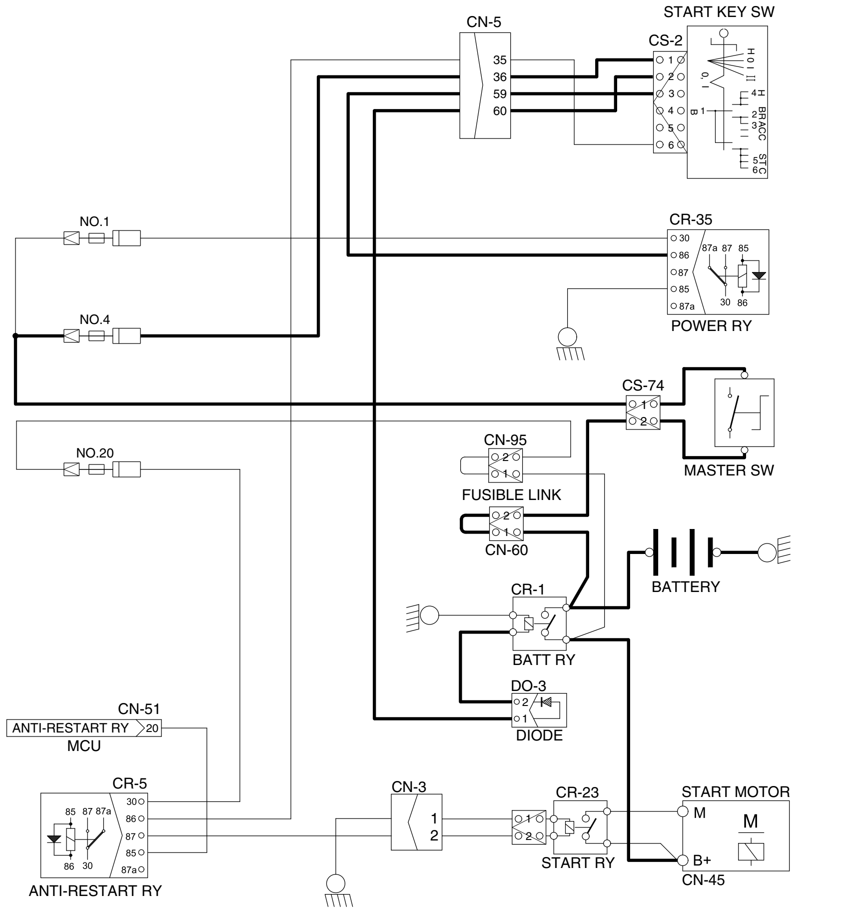


3009SH6ES10

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.

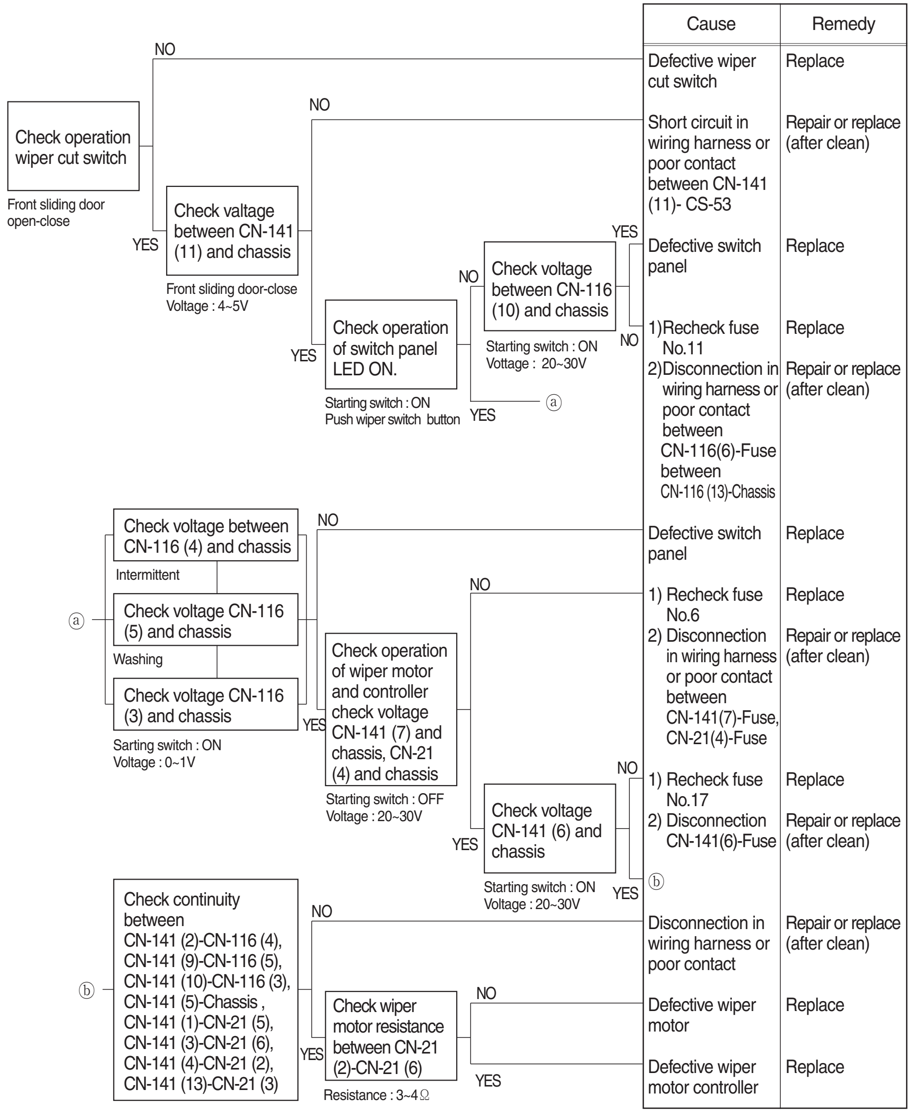


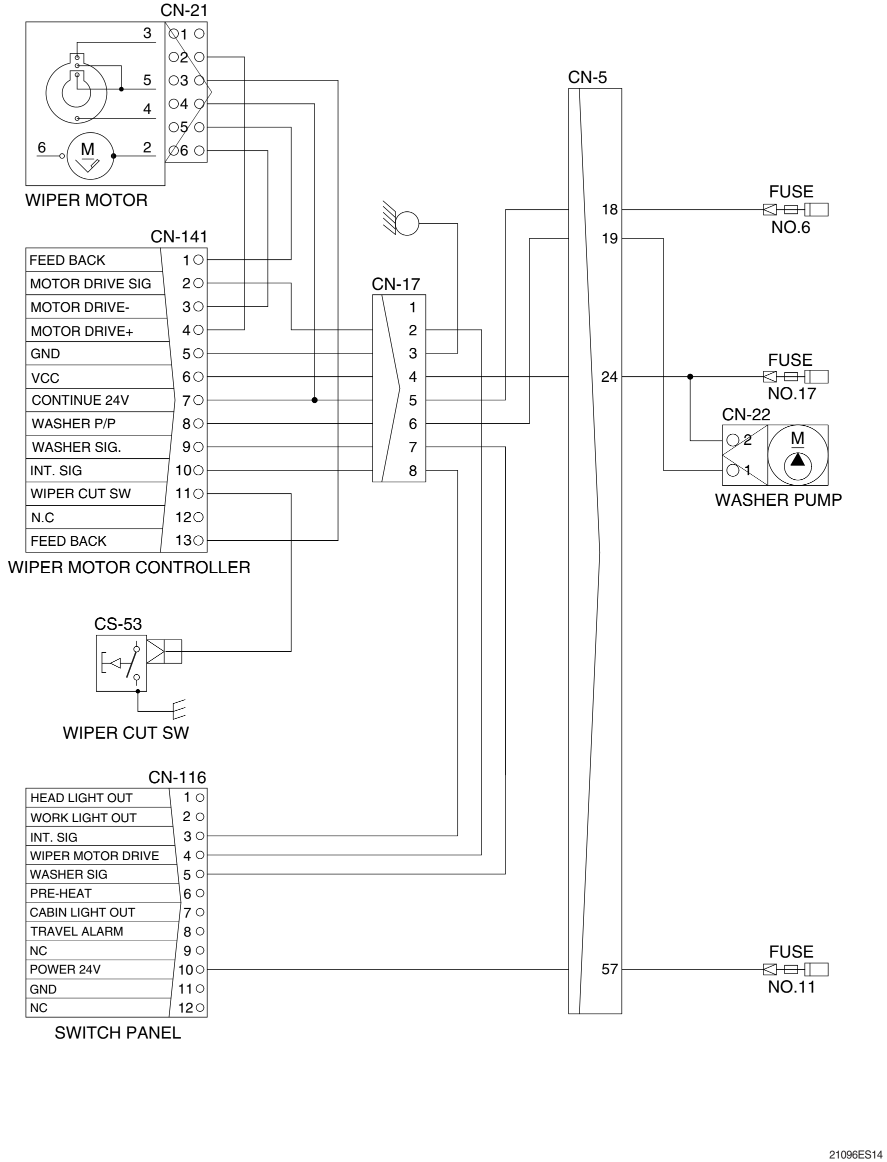


3009SH6ES11

14. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

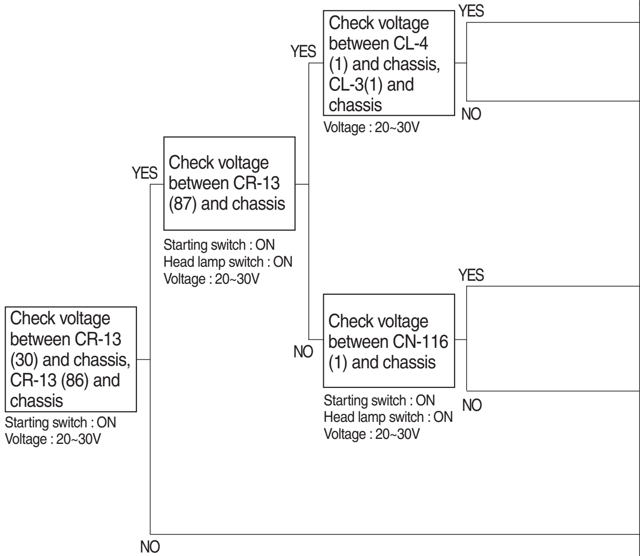
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No. 6, 11 and 17 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



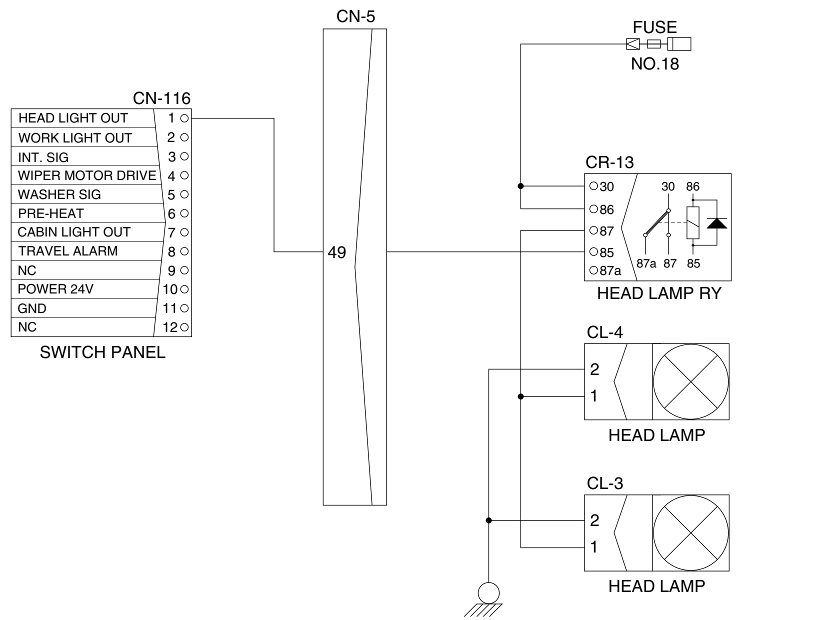


15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

· 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.



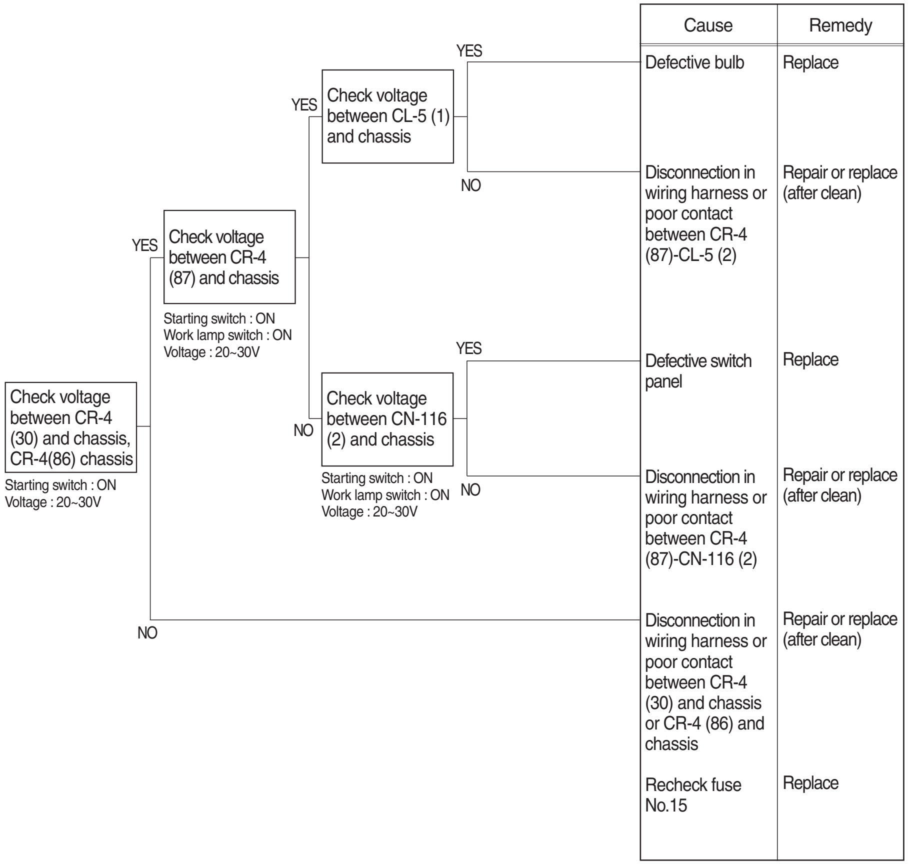
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13 (87)-CL-3 (1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (87)	Repair or replace (after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

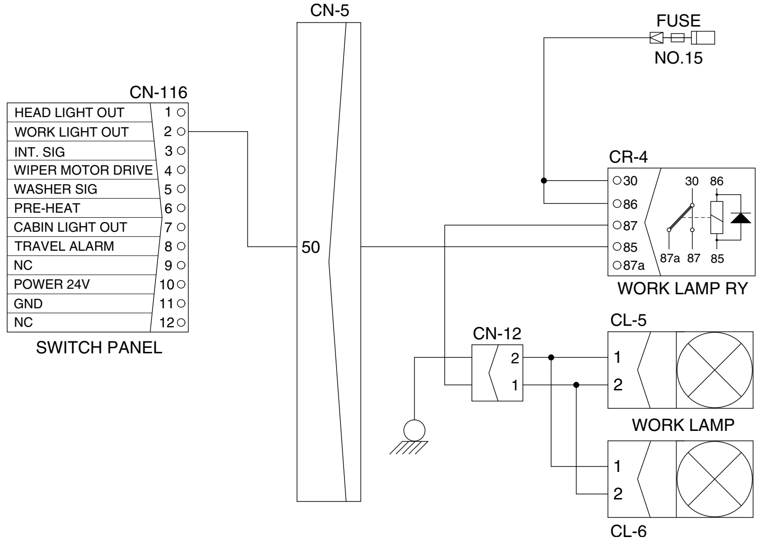


3009SH6ES12

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.

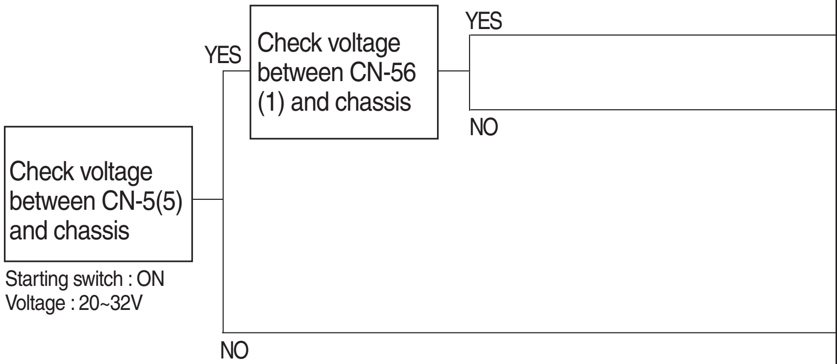




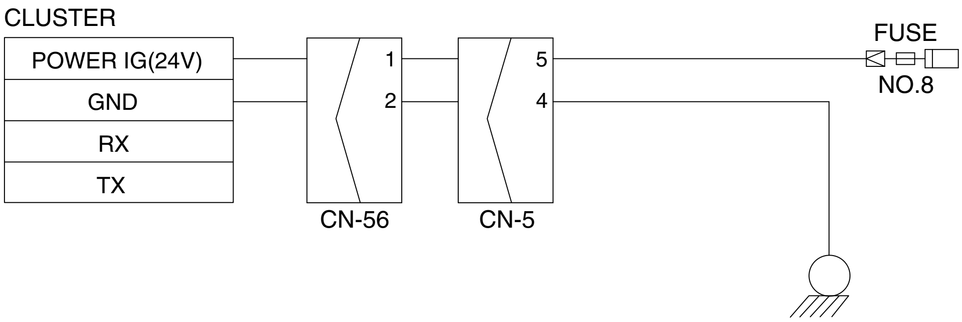
21096ES16

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)



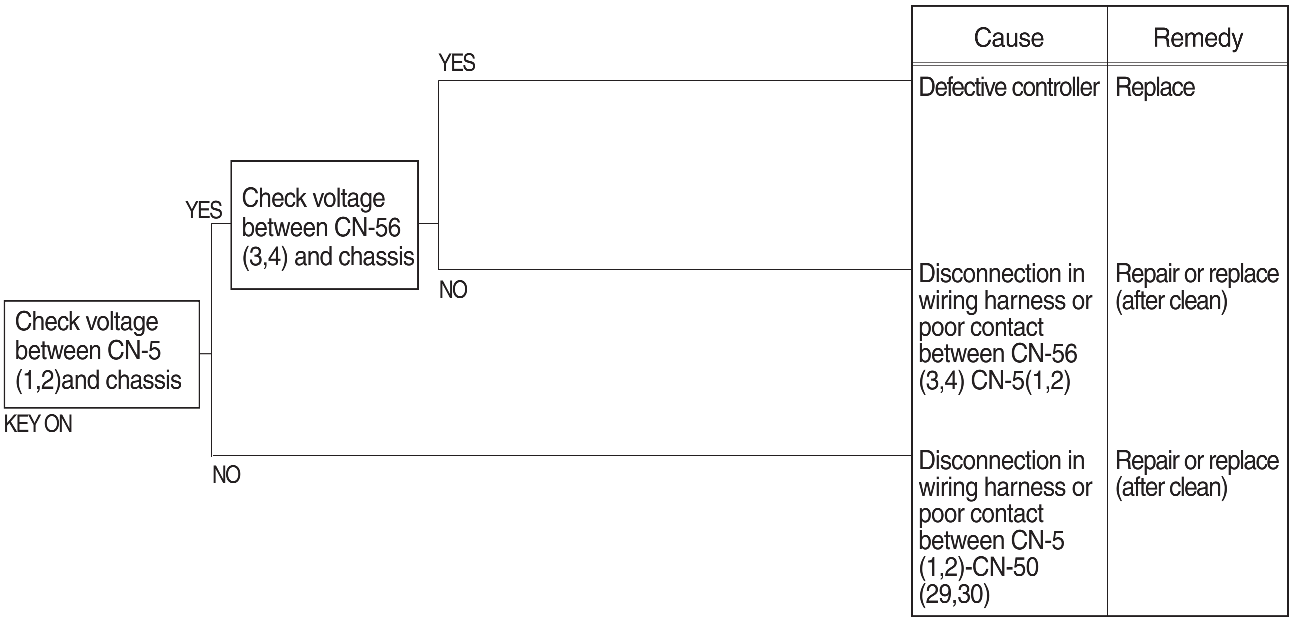
Check voltage

YES	20 ~ 32V
NO	0V

3009SH6ES20

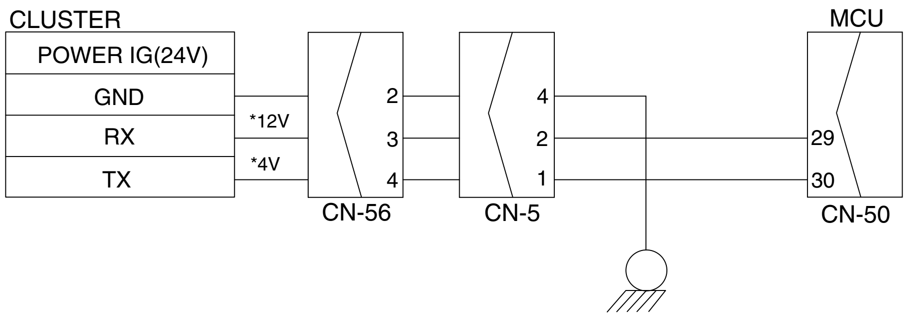
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER

· 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.



Check voltage

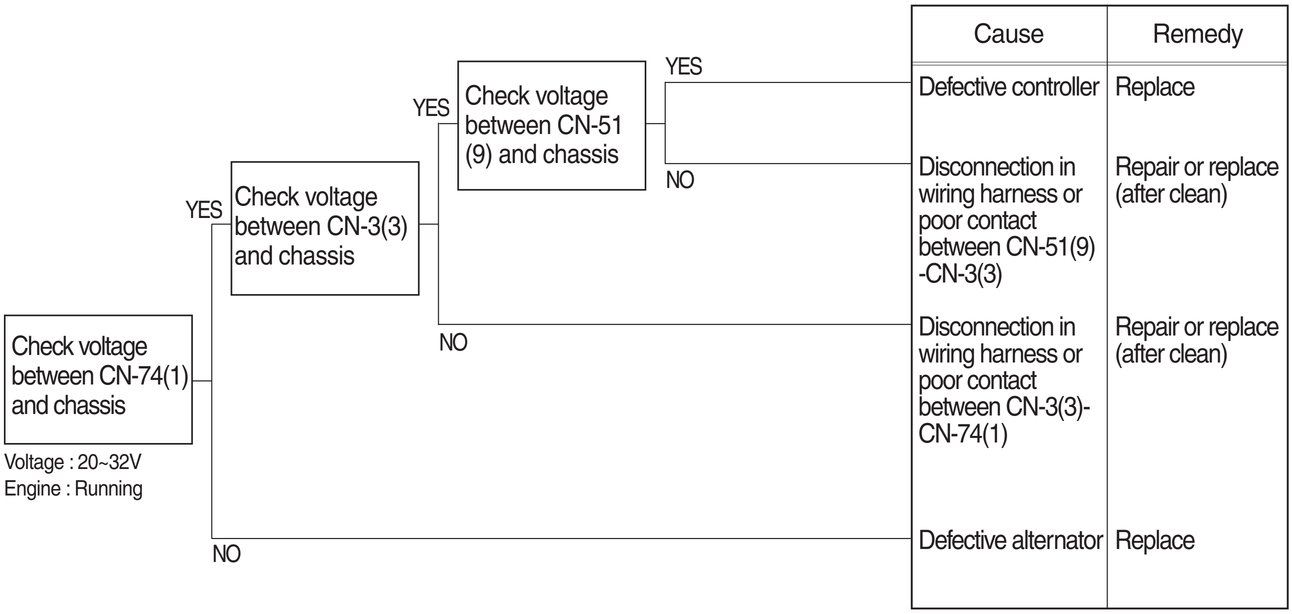
YES	*4V	*12V
NO	0V	0V



3009SH6ES21

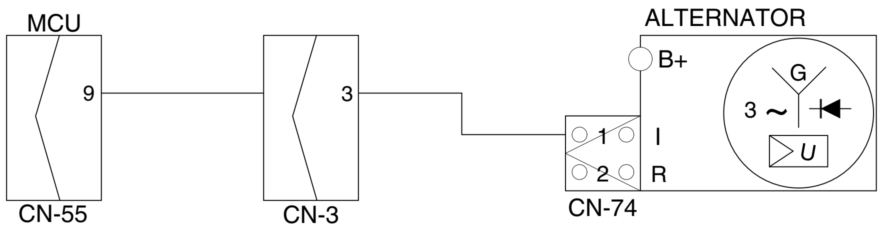
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

· 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

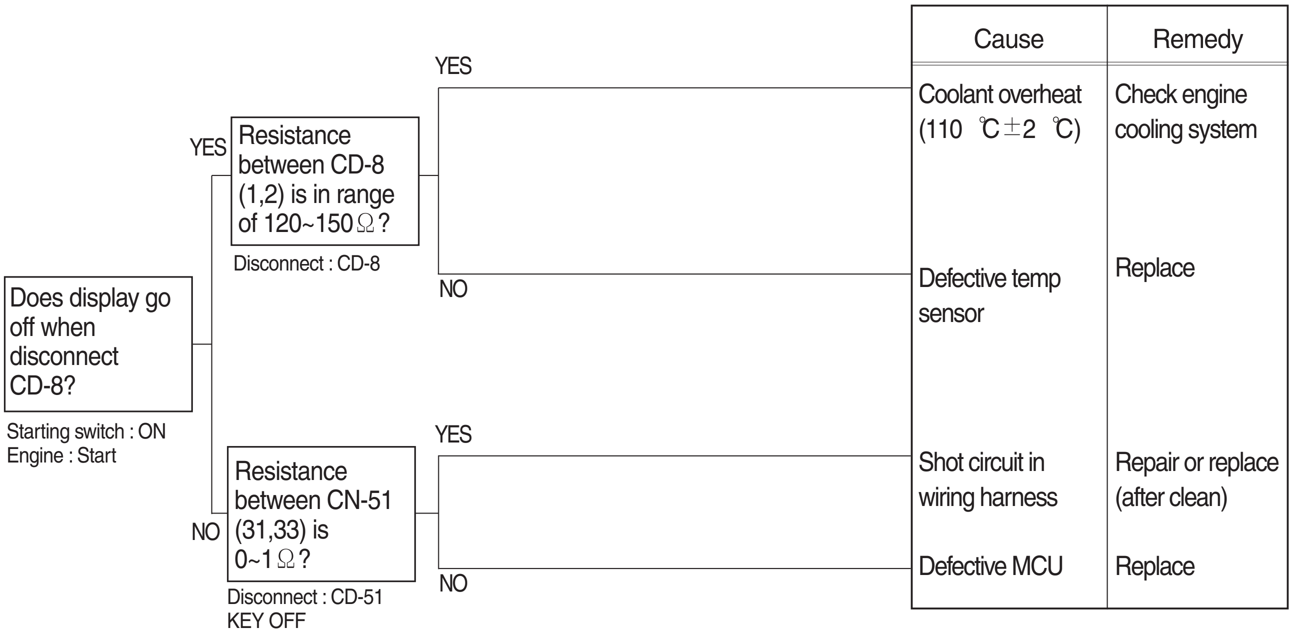
YES	20 ~ 32V
NO	0V

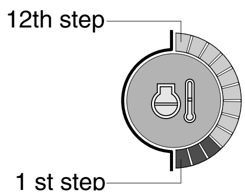


3009SH6ES22

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

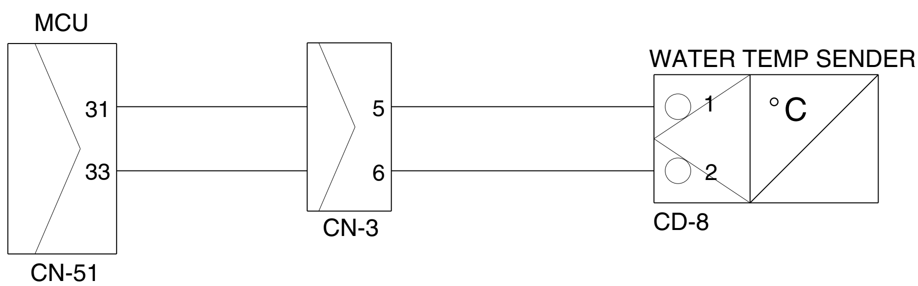
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

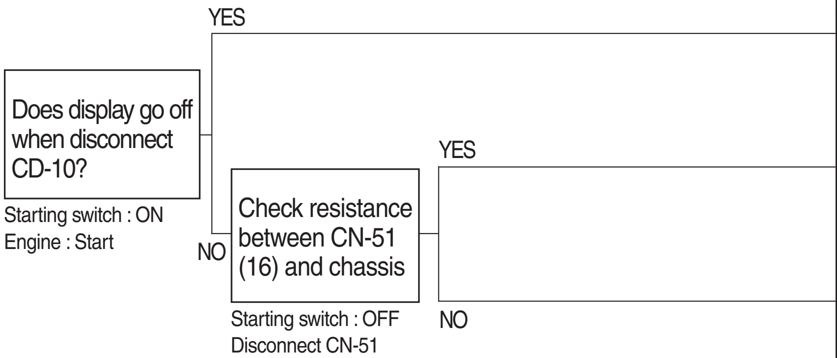
Range	1st step	2nd~10th step	11th~12th step
Temperature	~29 ℃	30~105 ℃	105 ℃ ~



3009SH6ES23

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

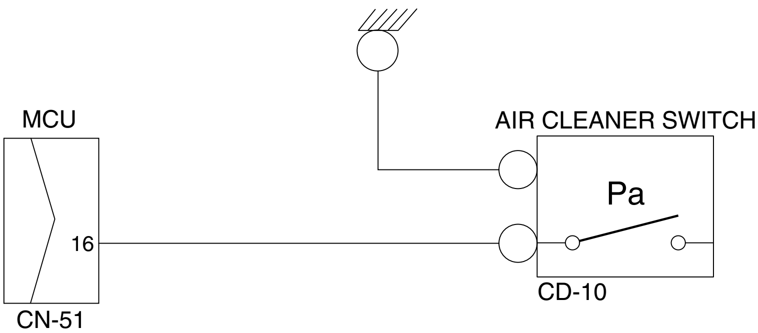
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Clogged air filter or defective switch	Check filter or replace switch
Short circuit in wiring harness	Repair or replace (after clean)
Defective MCU	Replace

Check resistance

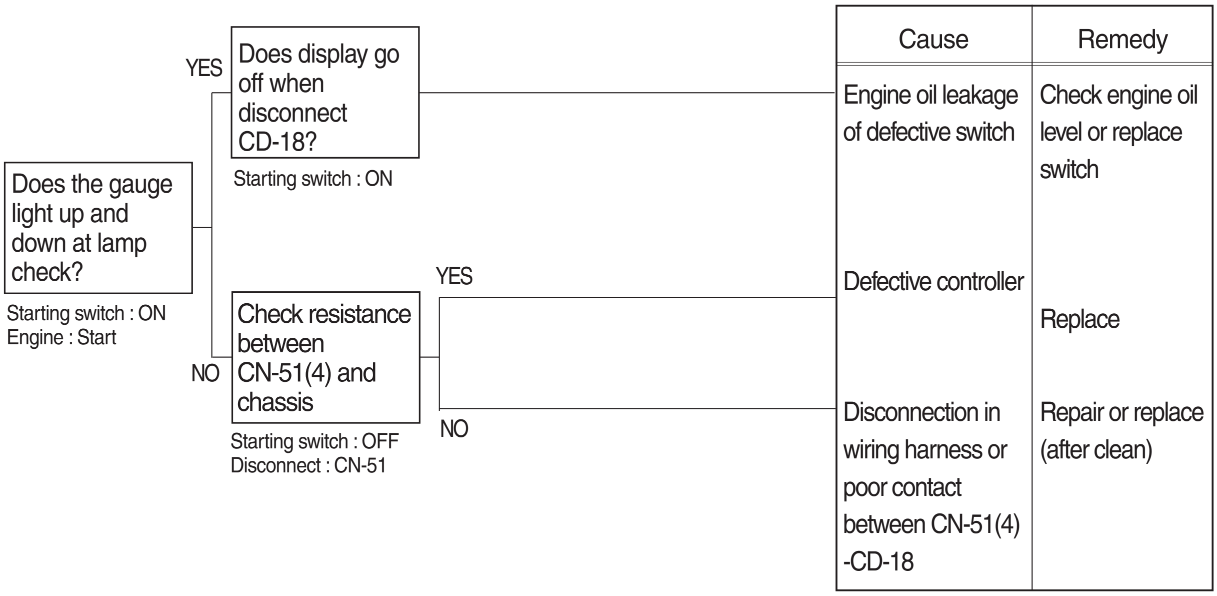
YES	MAX 1Ω
NO	MIN 1MΩ



3009SH6ES24

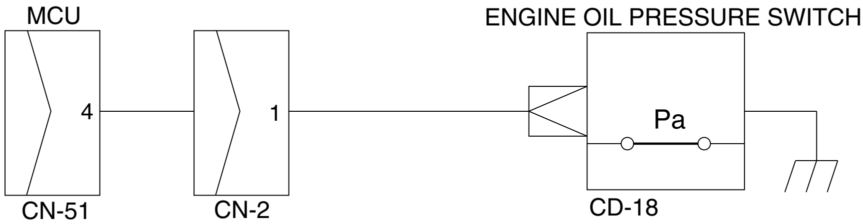
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP(Engine is started)

· 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

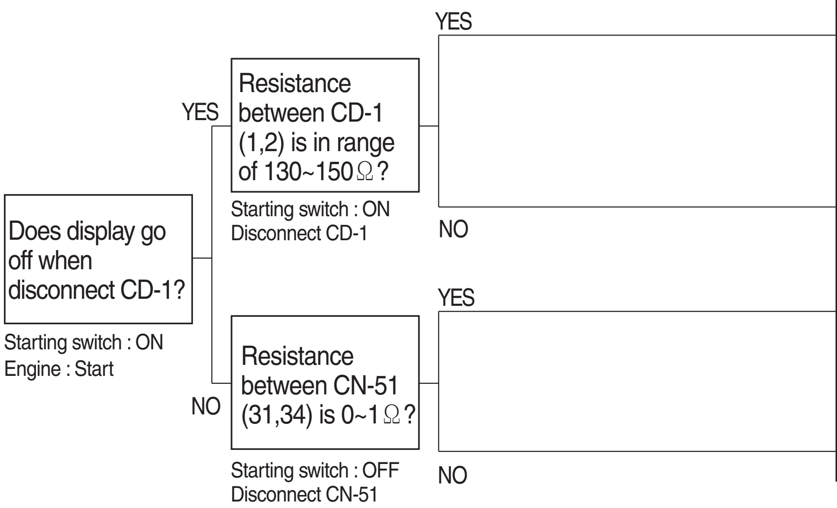
YES	MAX 1Ω
NO	MIN 1MΩ



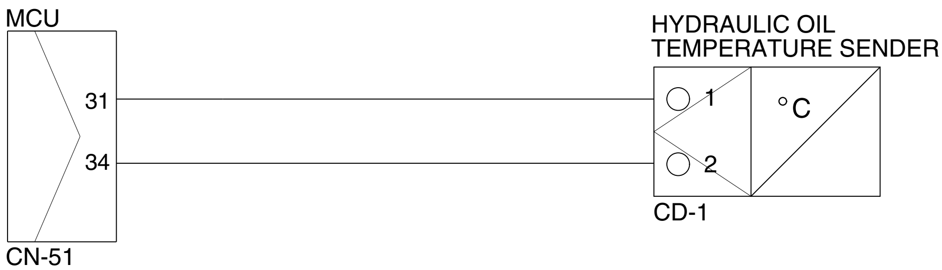
3009SH6ES25

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.



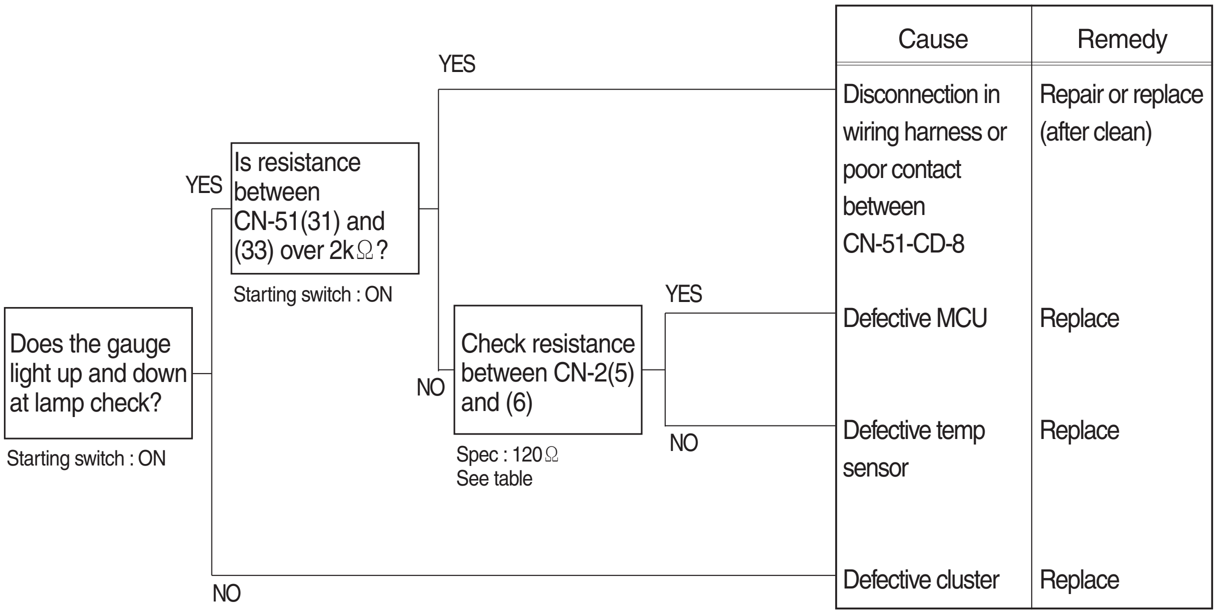
Cause	Remedy
High temperature	Check hydraulic oil temperature (100˚C±2˚C)
Defective temp sensor	Replace
Short circuit	Check and repair
Defective MCU	Replace

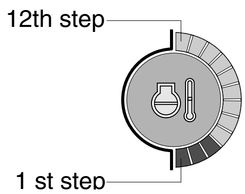


3009SH6ES26

8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

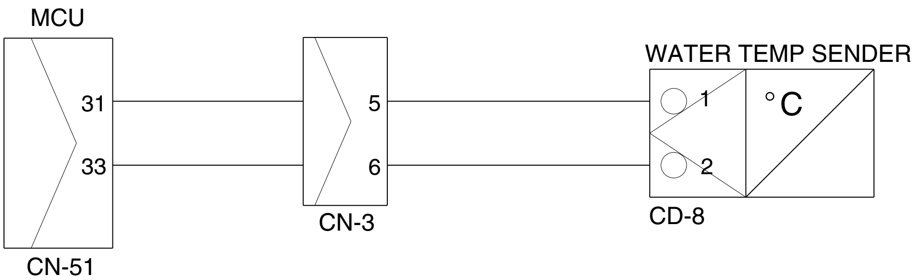
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

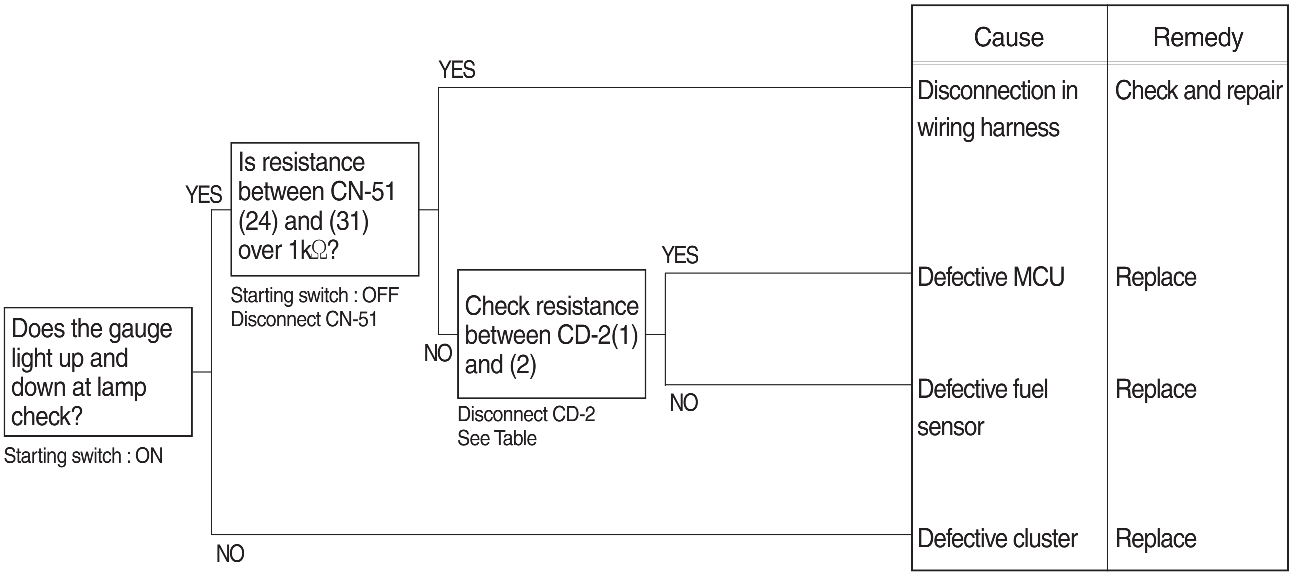
Range	1st step	2nd~10th step	11th~12th step
Temperature	~29 °C	30~105 °C	105 °C ~

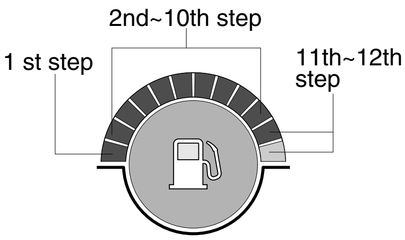


3009SH6ES23

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

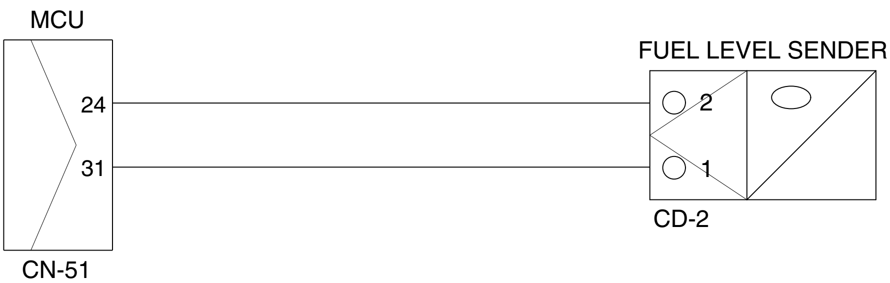
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

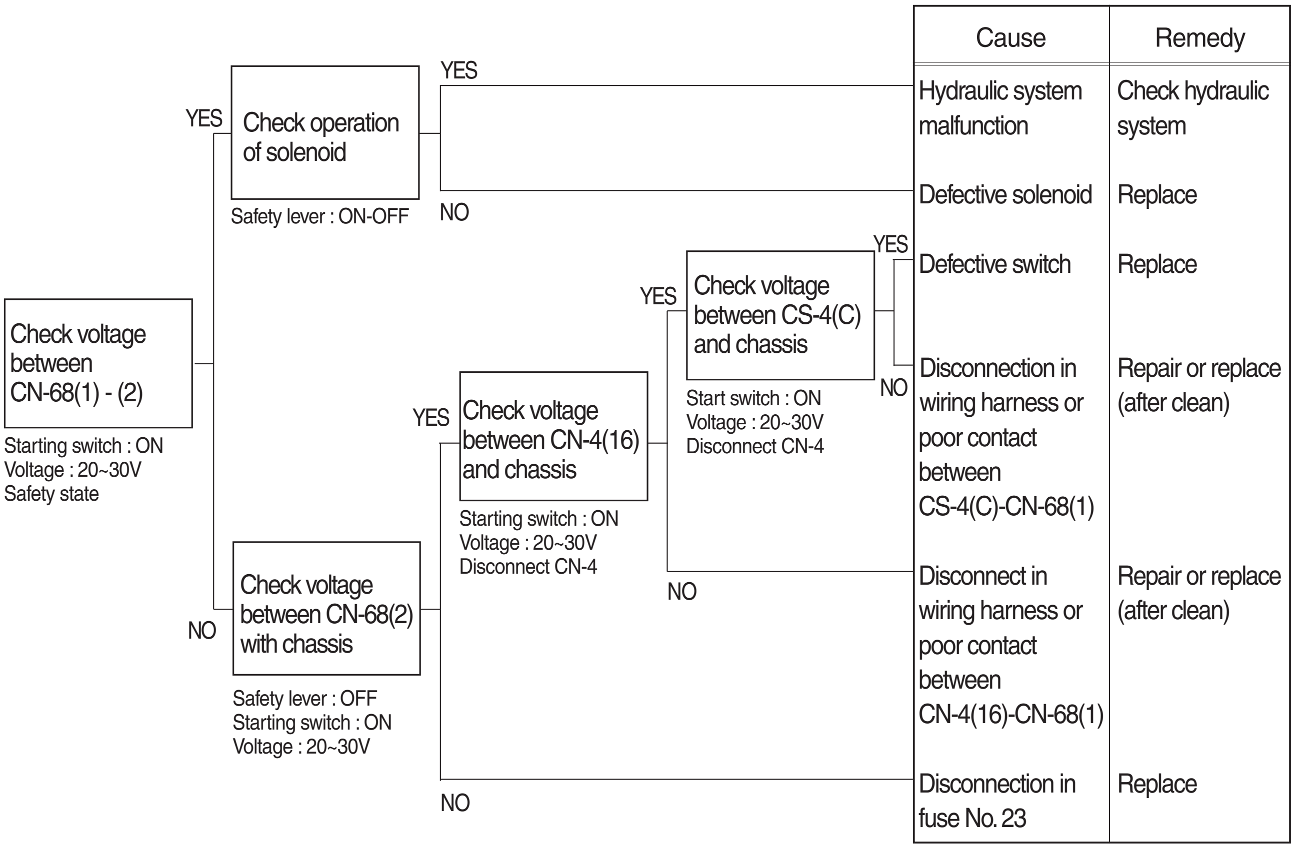
Item \ Range	1st step	2nd~10th step	11th~12th step
Unit Resistance(Ω)	700~601	600~101	~100
Tolerance(%)	±5	±5	±5

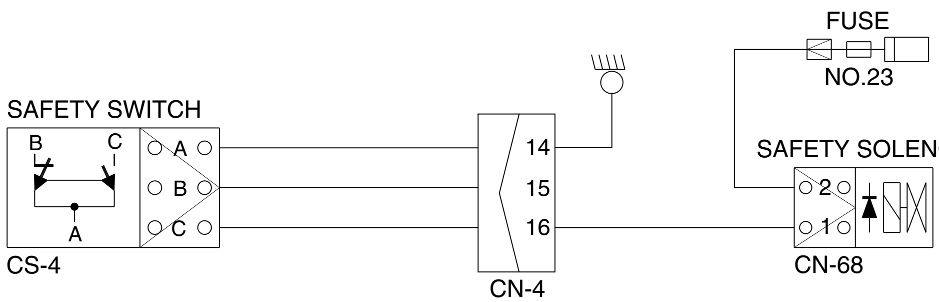


3009SH6ES27

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.

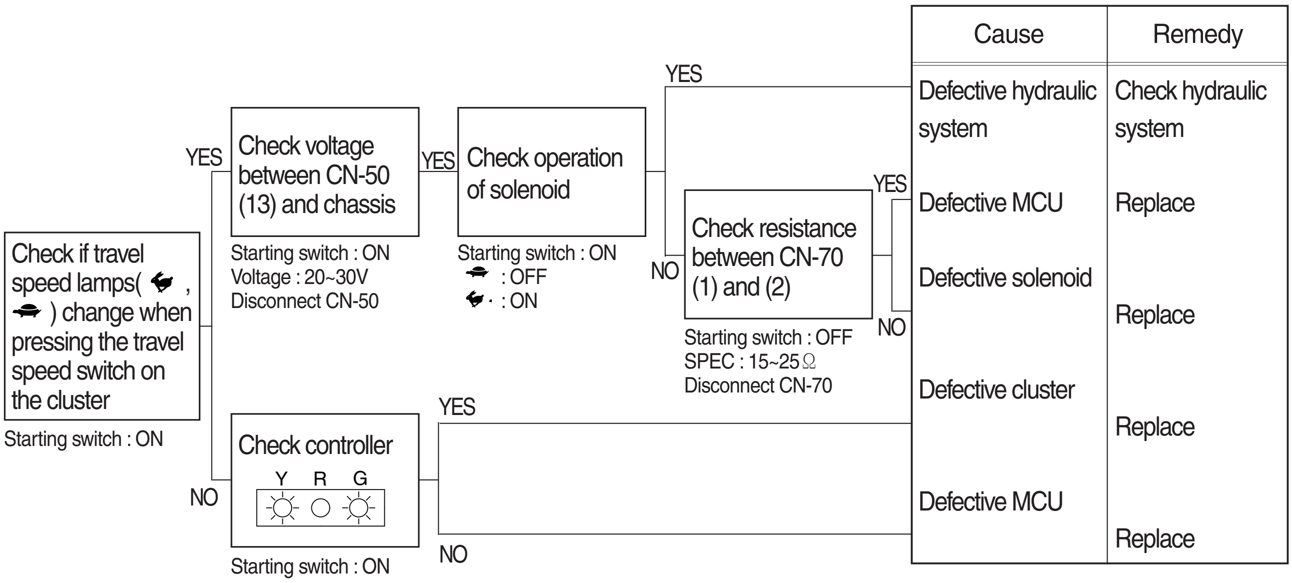


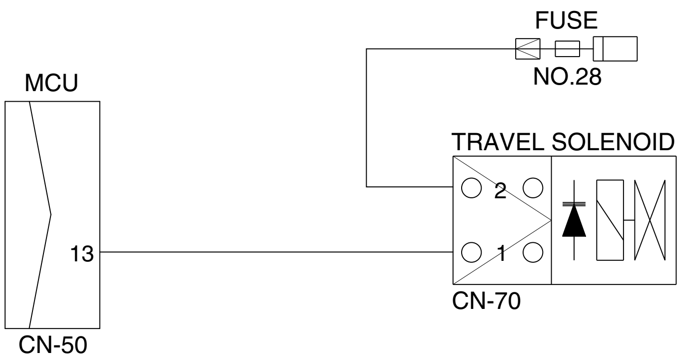


21096ES10

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.

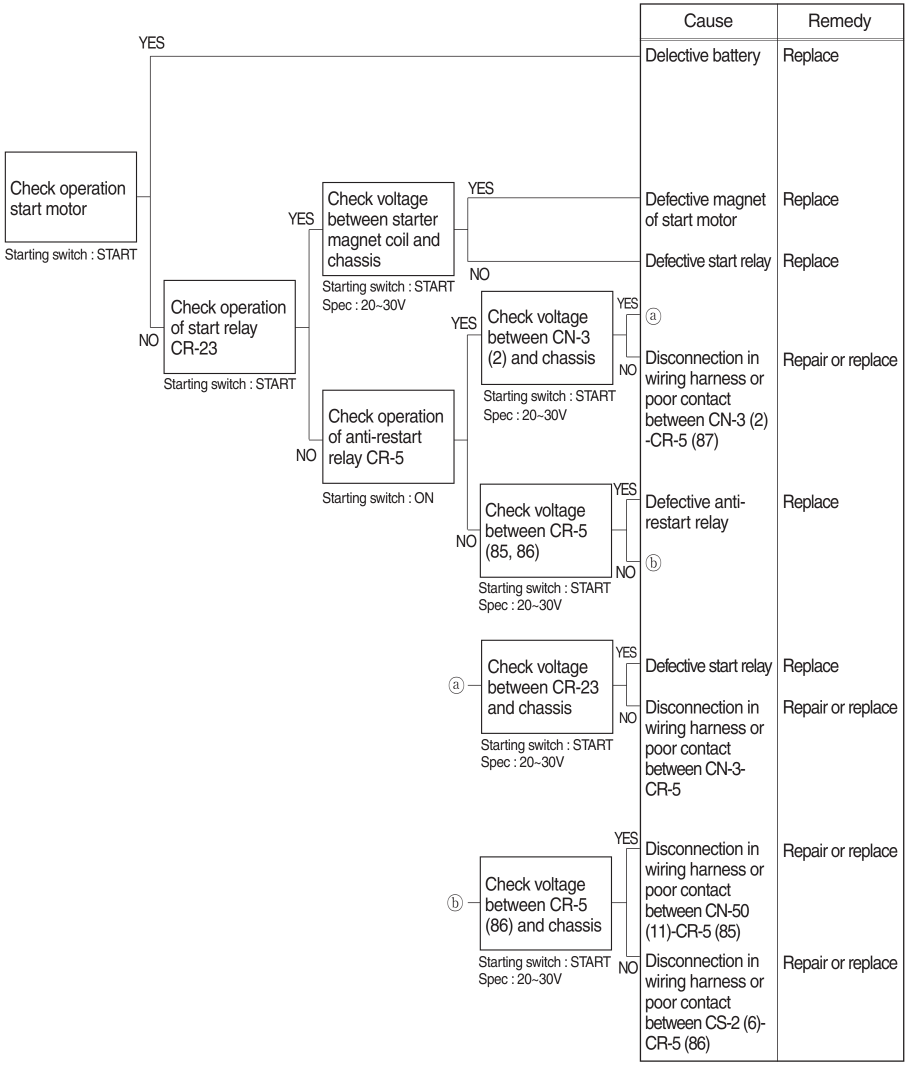


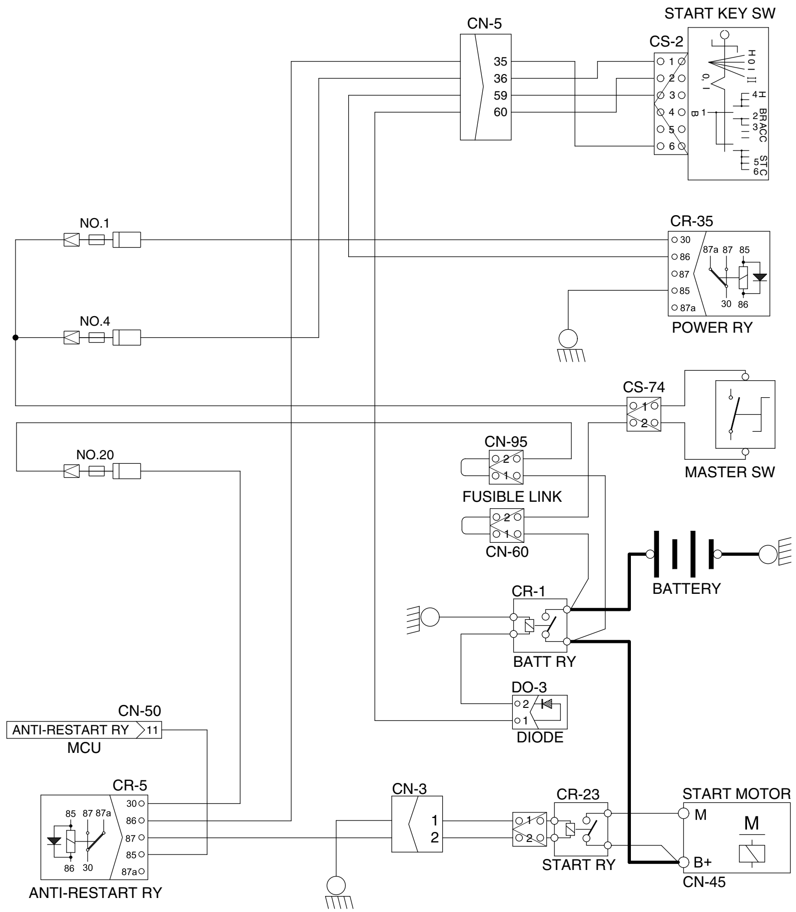


3009SH6ES28

12. WHEN ENGINE DOES NOT START ([battery warning symbol] 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.

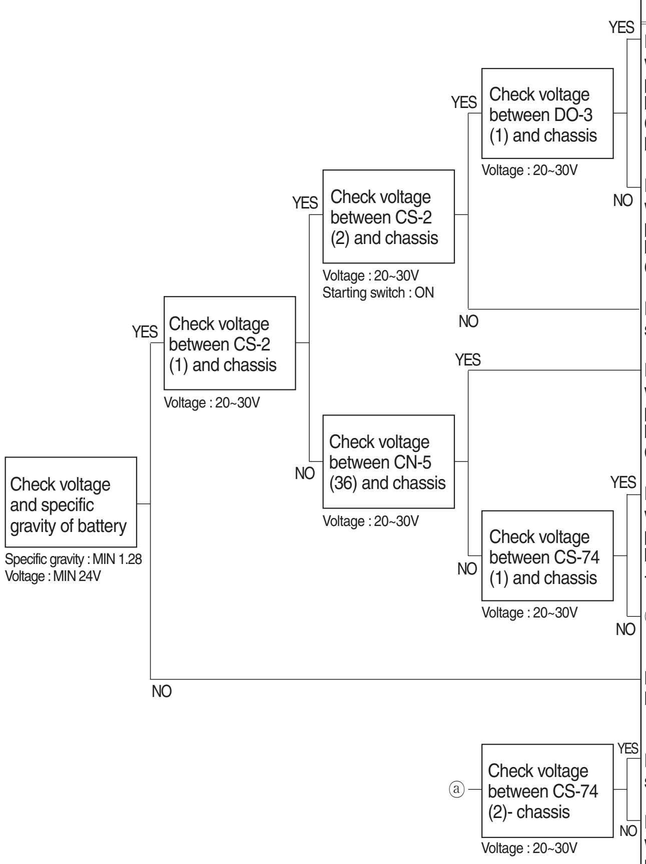




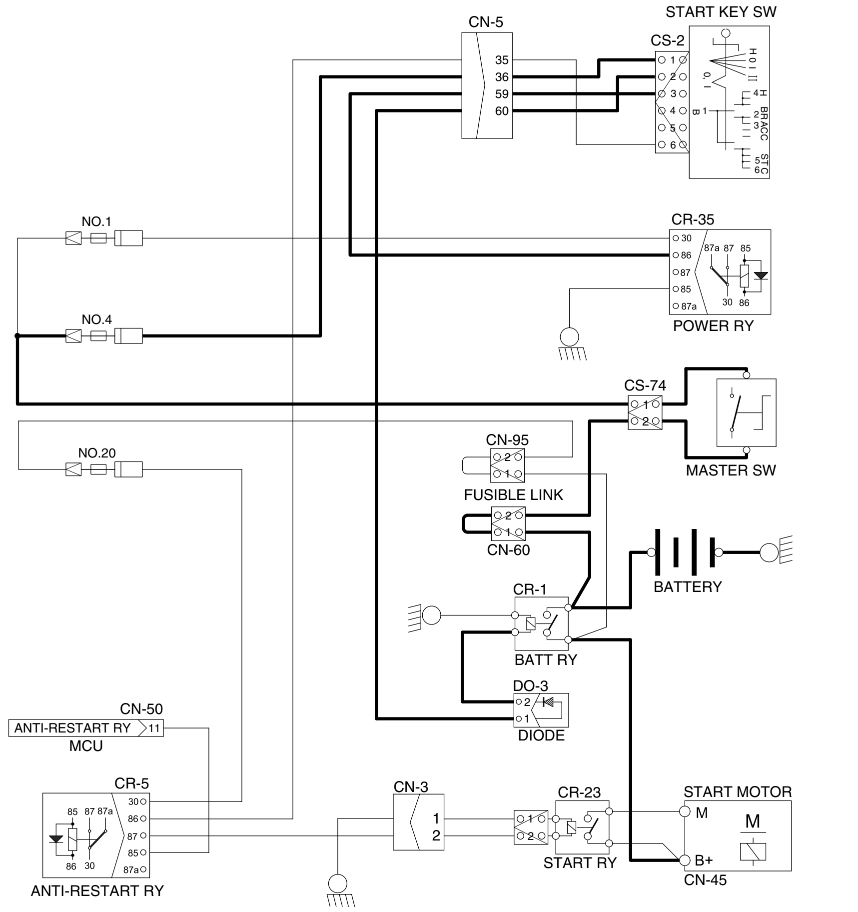
3009SH6ES29

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.



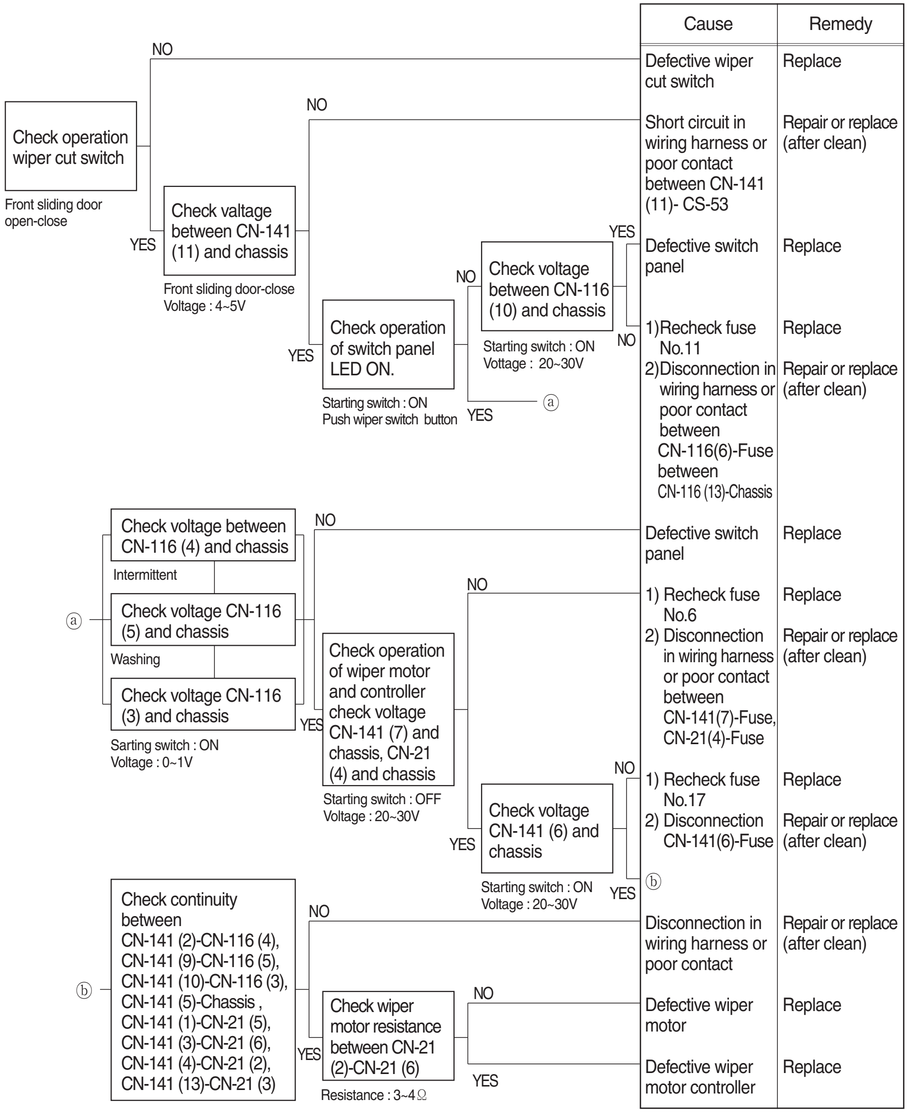
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-3 (1)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2 (2)-CN-5(60)- DO-3 (1)	Repair or replace (after clean)
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74 (1) -CN-5 (36)	Charge or replace (after clean)
Battery capacity too low	Charge or replace (after clean)
Defective master switch	Replace
Disconnection in wiring harness or poor contact between CS-74 (2) -CR-1	Charge or replace (after clean)

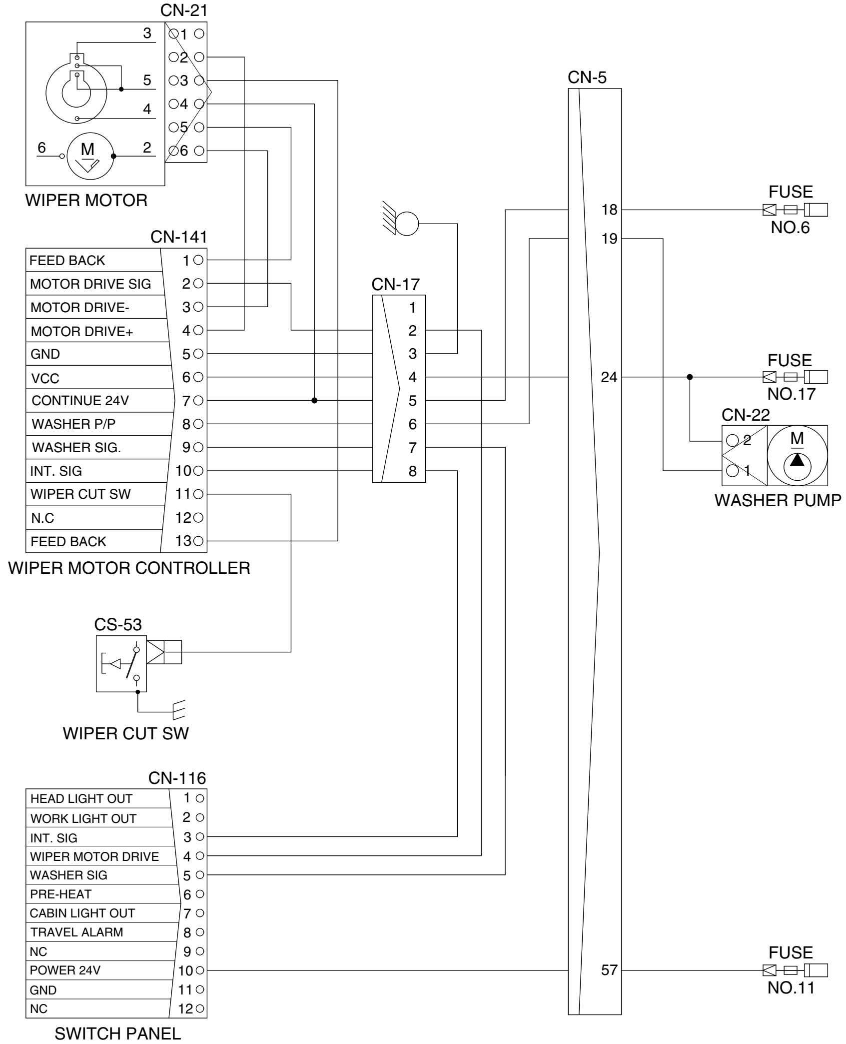


3009SH6ES30

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.





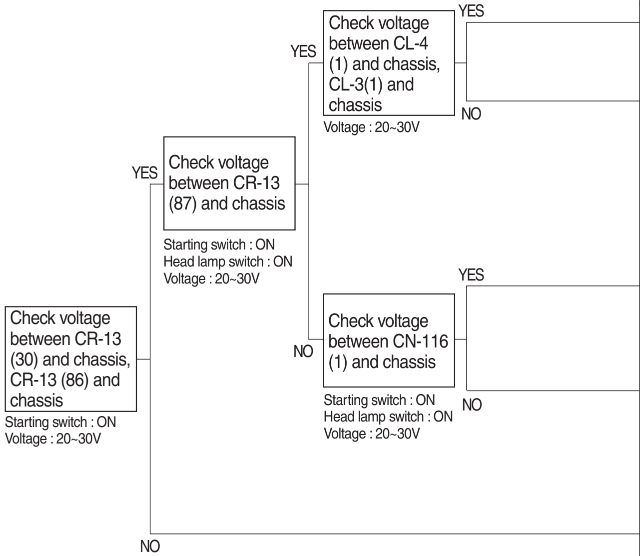
21096ES14

15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

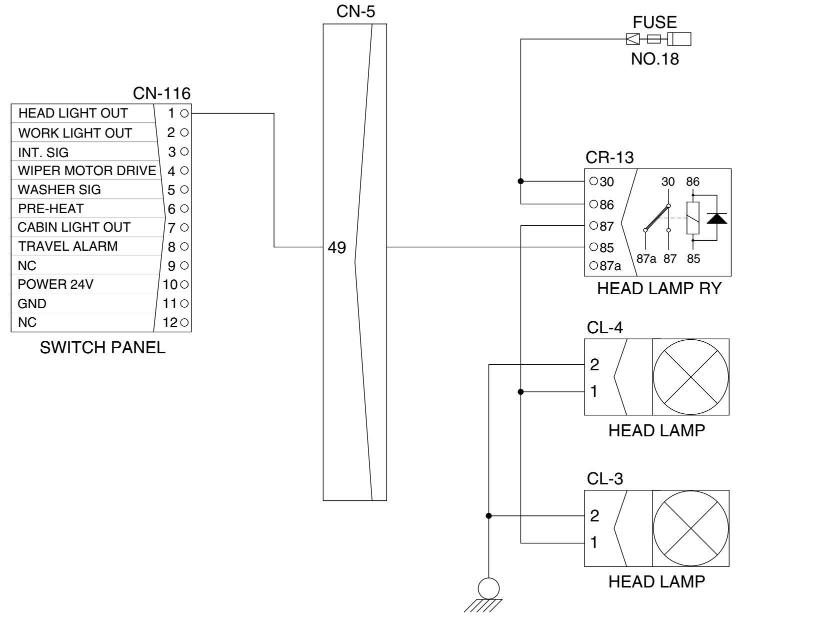
· Before disconnecting the connector, always turn the starting switch OFF.

· 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.



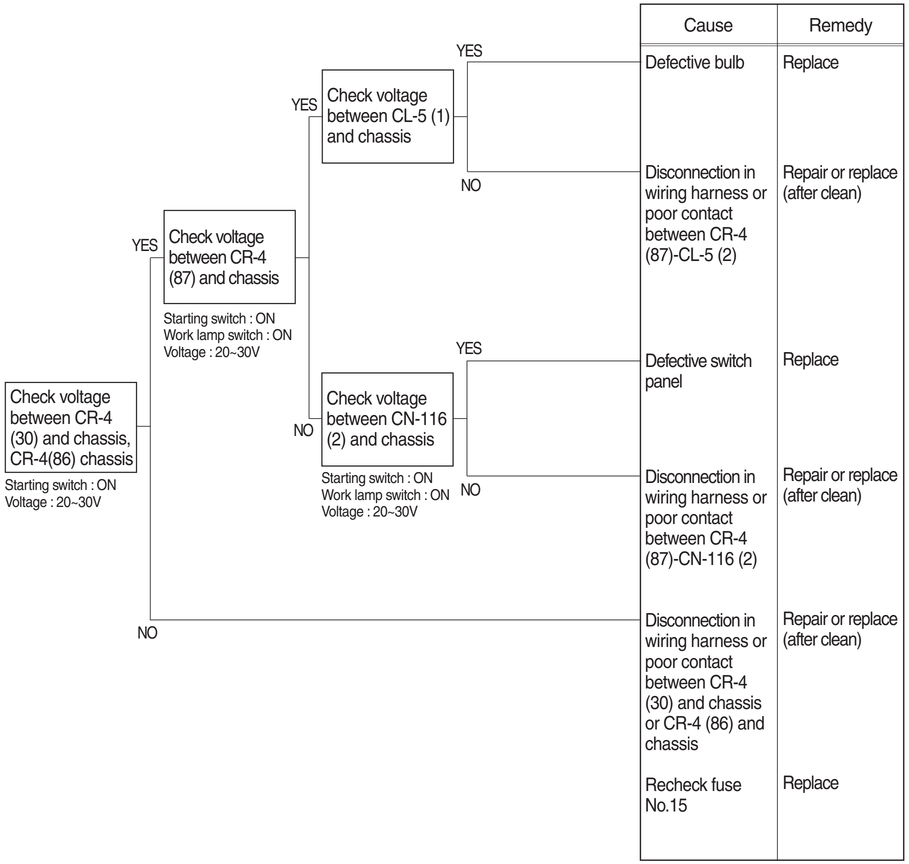
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1) or CR-13 (87)-CL-3 (1)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (87)	Repair or replace (after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

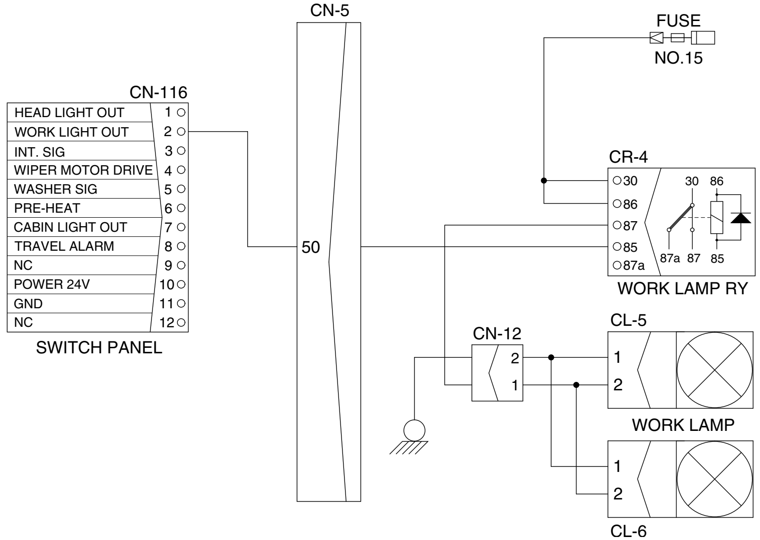


3009SH6ES12

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

GROUP 4 MECHATRONICS SYSTEM (CLUSTER TYPE 1)

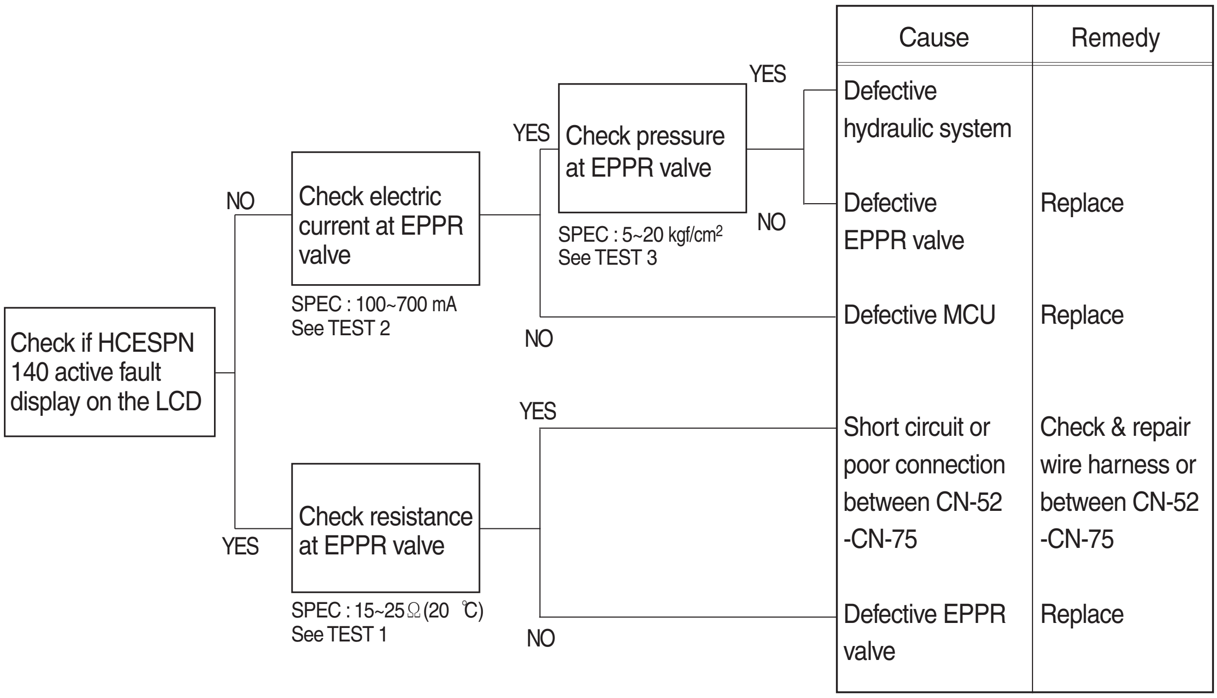
1. ALL ACTUATORS SPEED ARE SLOW

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

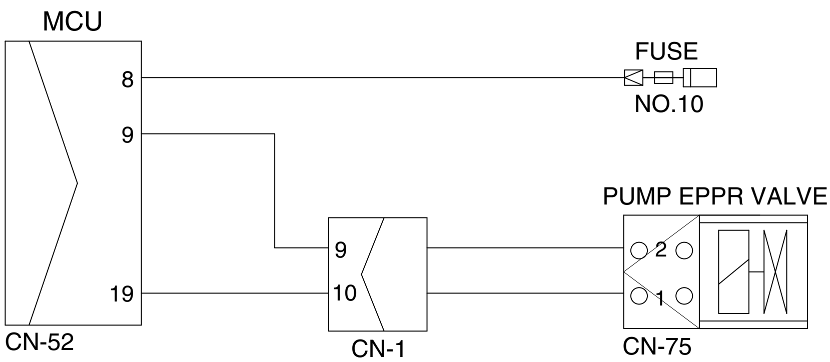
※ Spec : P-mode 1800 ± 50 rpm S -mode 1700 ± 50 rpm E-mode 1600 ± 50 rpm

※ Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS01

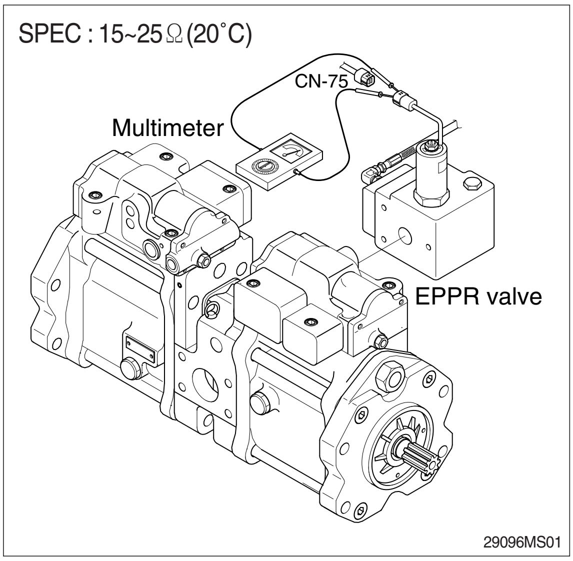
2) TEST PROCEDURE

(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.

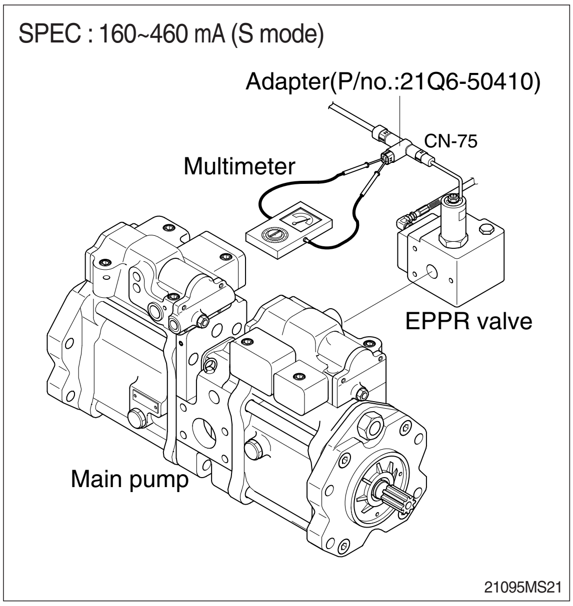
① Install multimeter as figure.

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 1700±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/cm^2 (0 to 710 psi)

② Start engine.

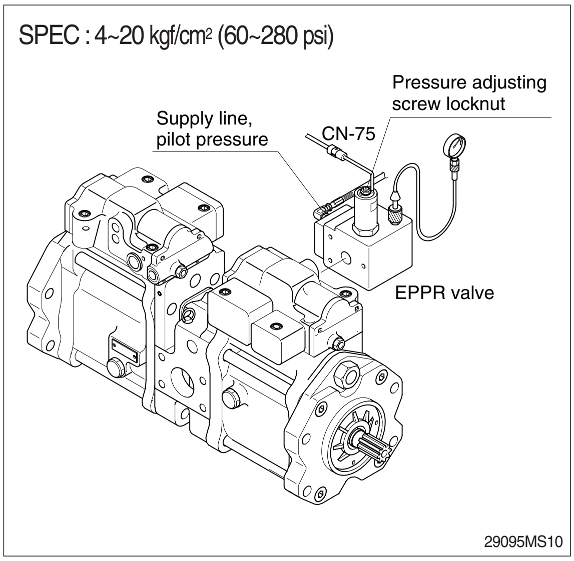
③ Set the accel dial at "10" (Max).

④ Set S-mode and cancel auto decel mode.

⑤ If tachometer show approx 1700±50 rpm, check pressure.

⑥ If pressure is not correct, adjust it.

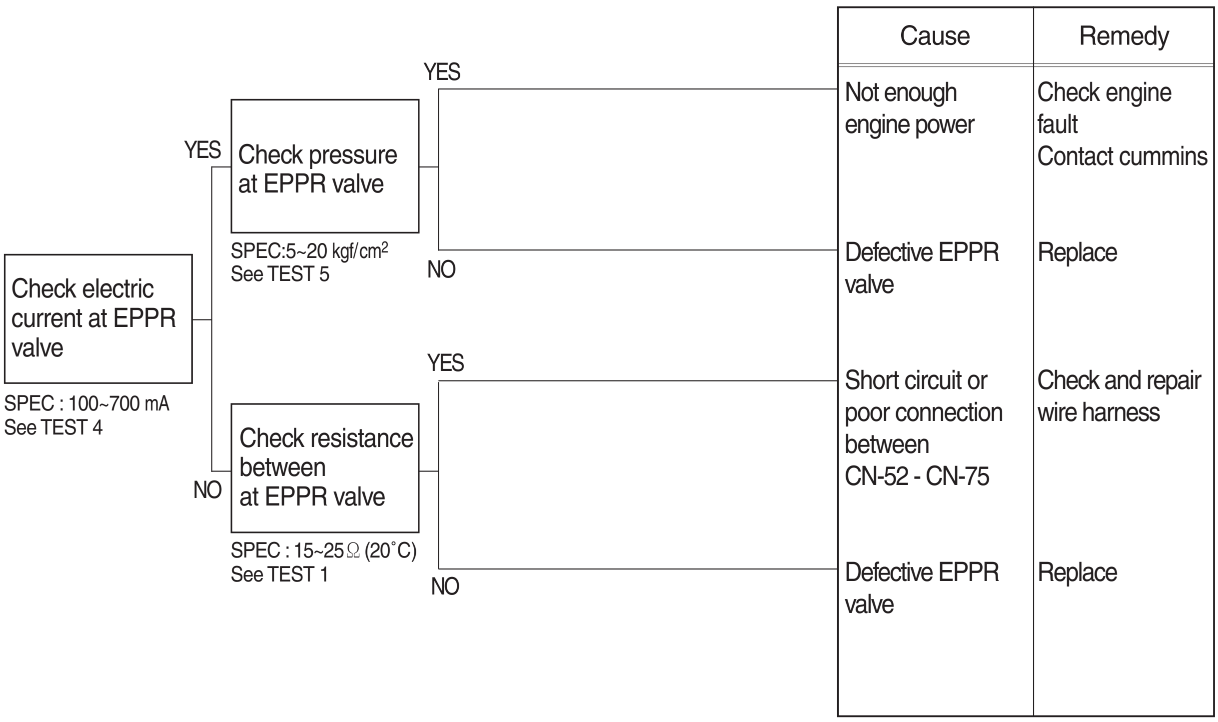
⑦ After adjust, test the machine.



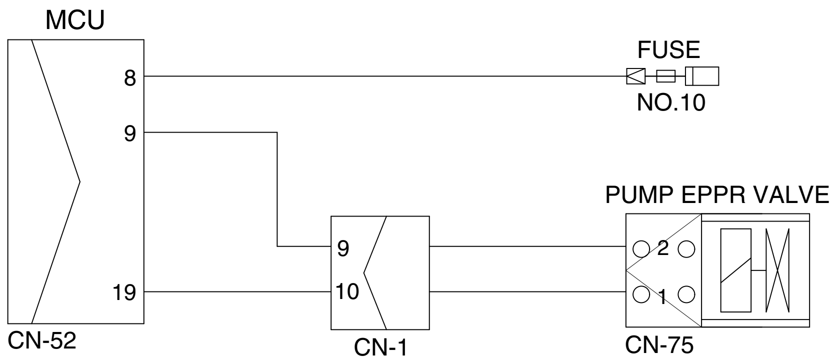
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram



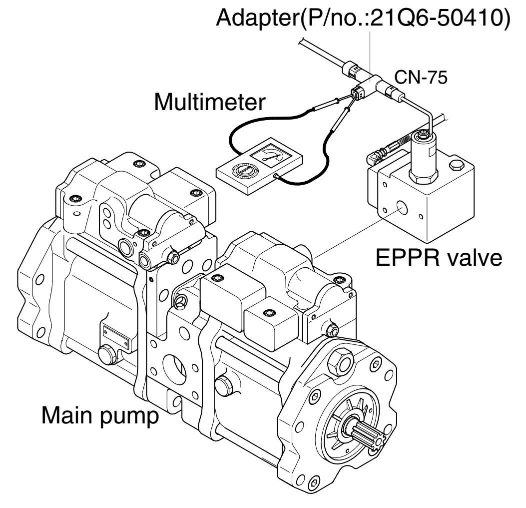
3009SH6MS01

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 1700±50 rpm.
⑤ Check electric current.

SPEC : 100~700 mA

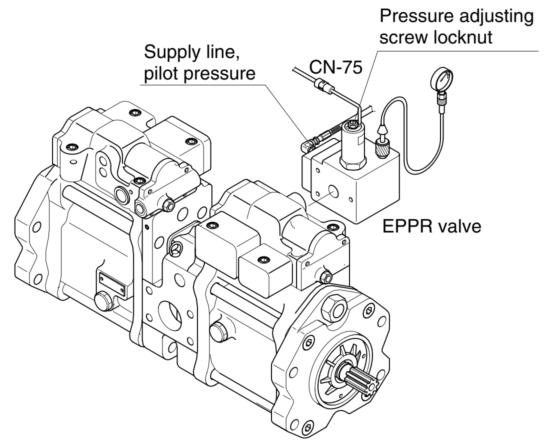


21095MS21

(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 1700±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/cm^2 (60~280 psi)

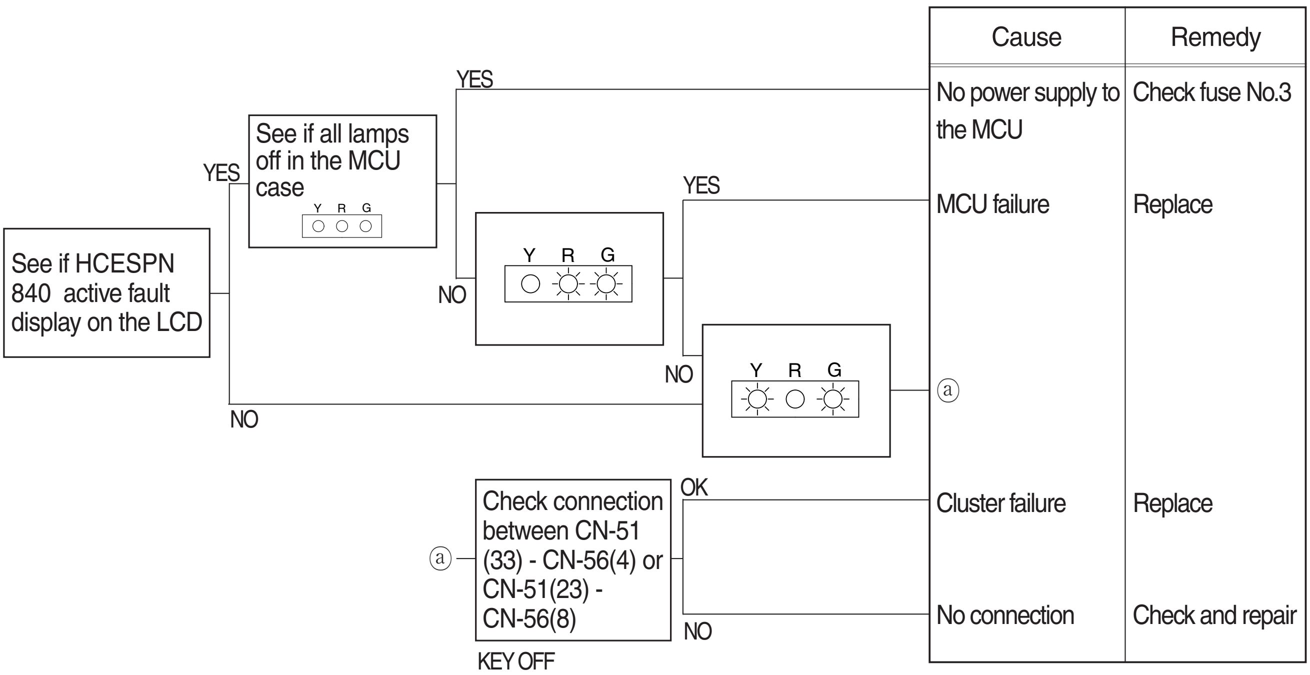


29095MS10

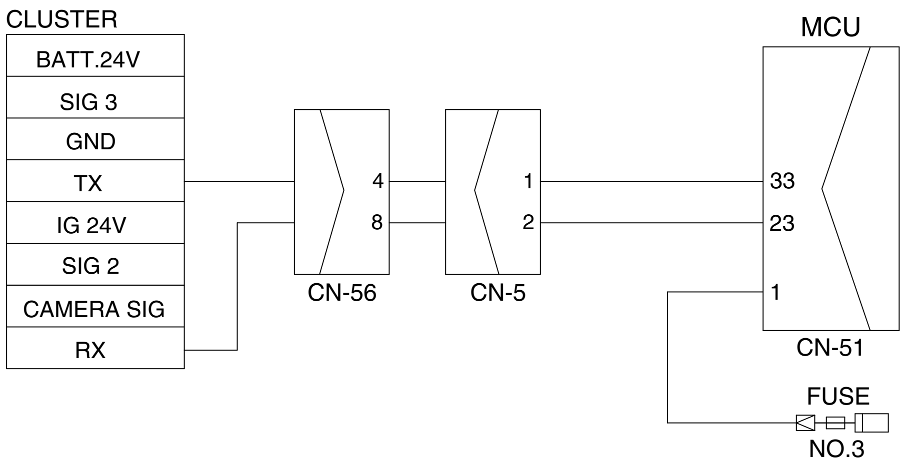
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram

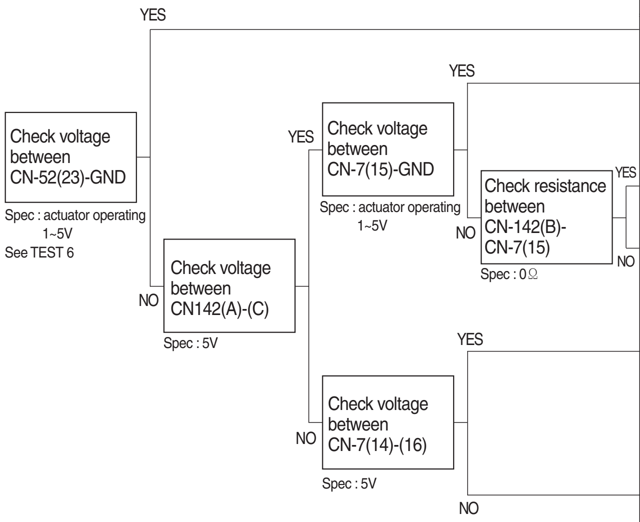


3009SH6MS02

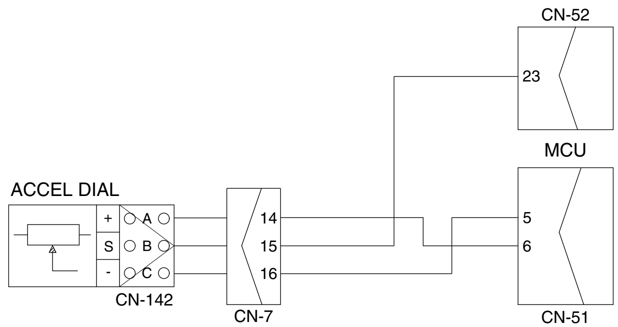
4. MALFUNCTION OF ACCEL DIAL

※ 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.

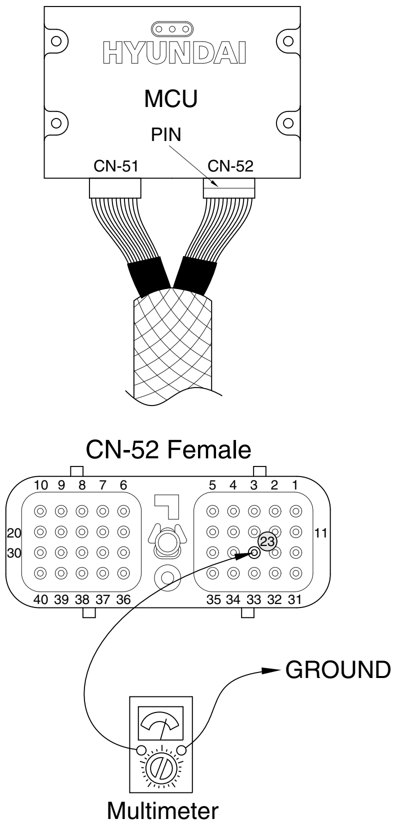
① Prepare 1 piece of thin sharp pin, steel or copper.

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



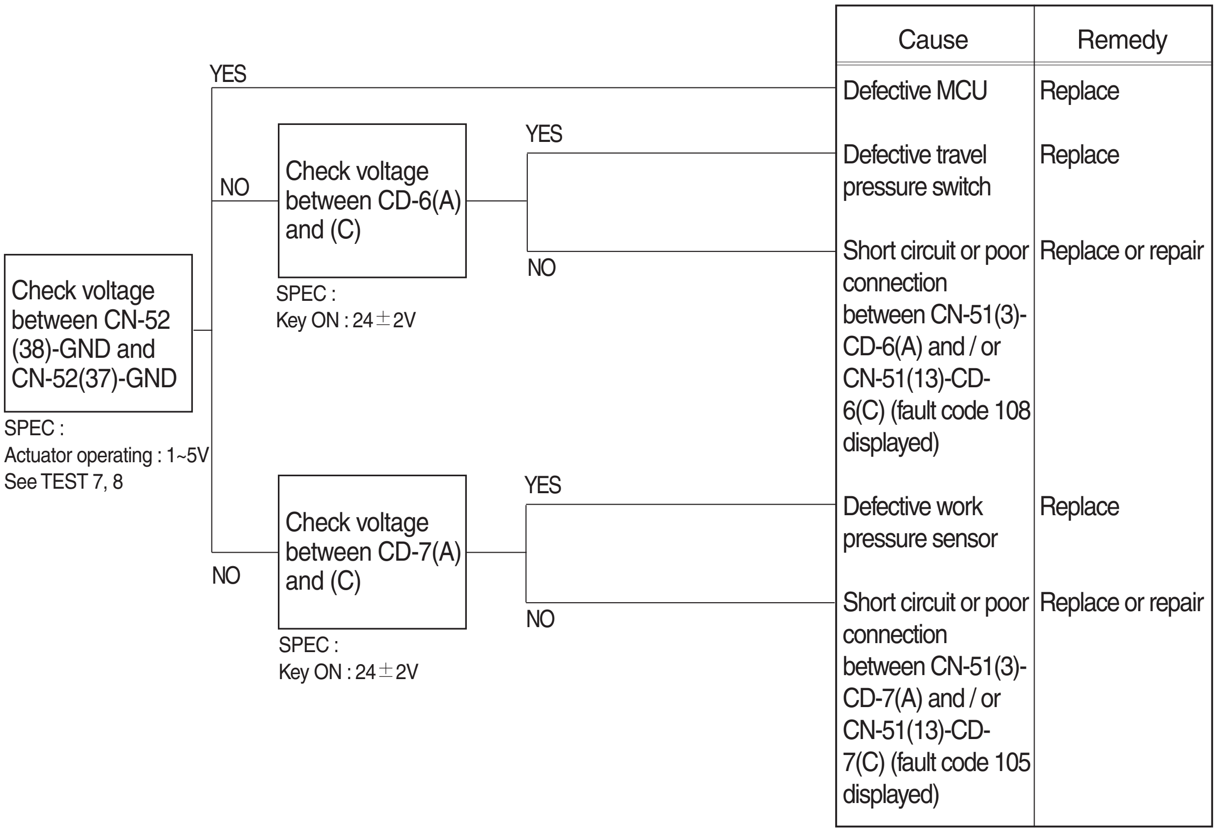
3009SH6MS04

5. AUTO DECEL SYSTEM DOES NOT WORK

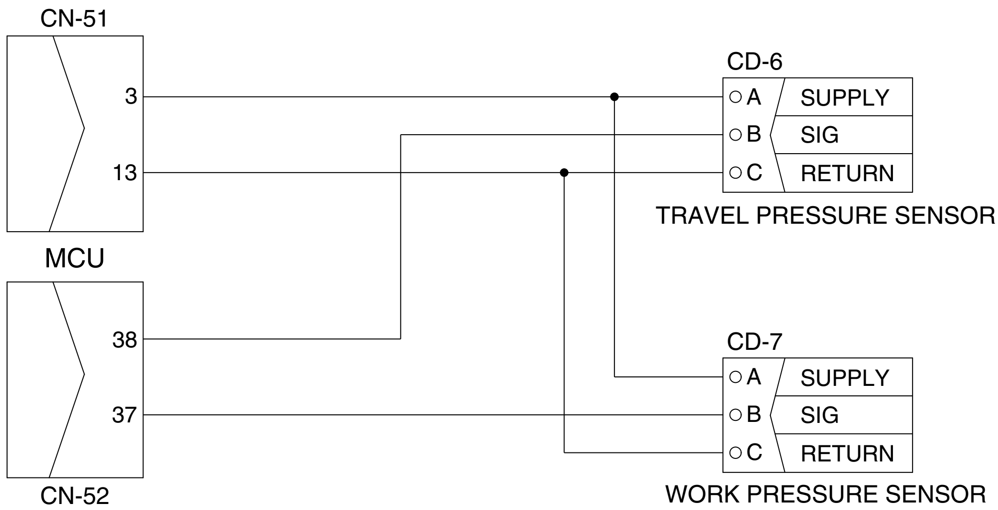
· Fault code : HCESPN 105, FMI 0~4 (work pressure sensor)
HCESPN 108, FMI 0~4 (travel oil pressure sensor)

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

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS05

2) TEST PROCEDURE

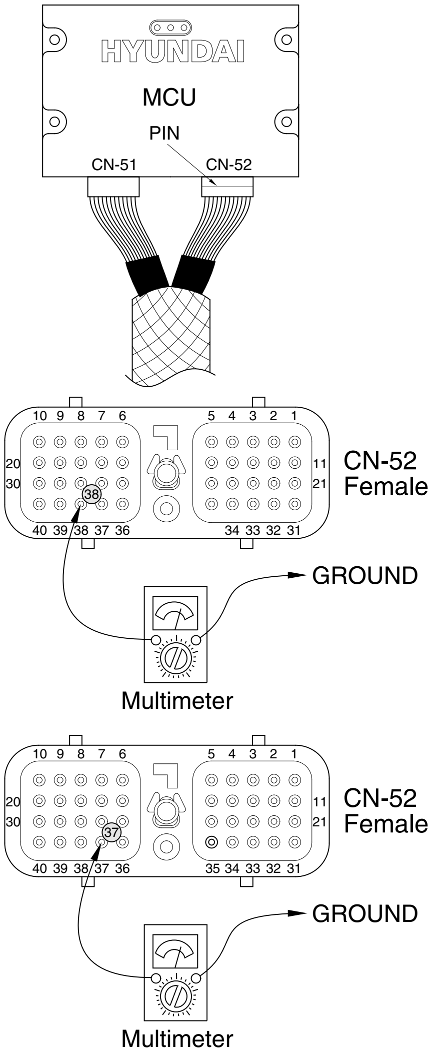
(1) Test 7 : Check voltage at CN-52(38) and ground.

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



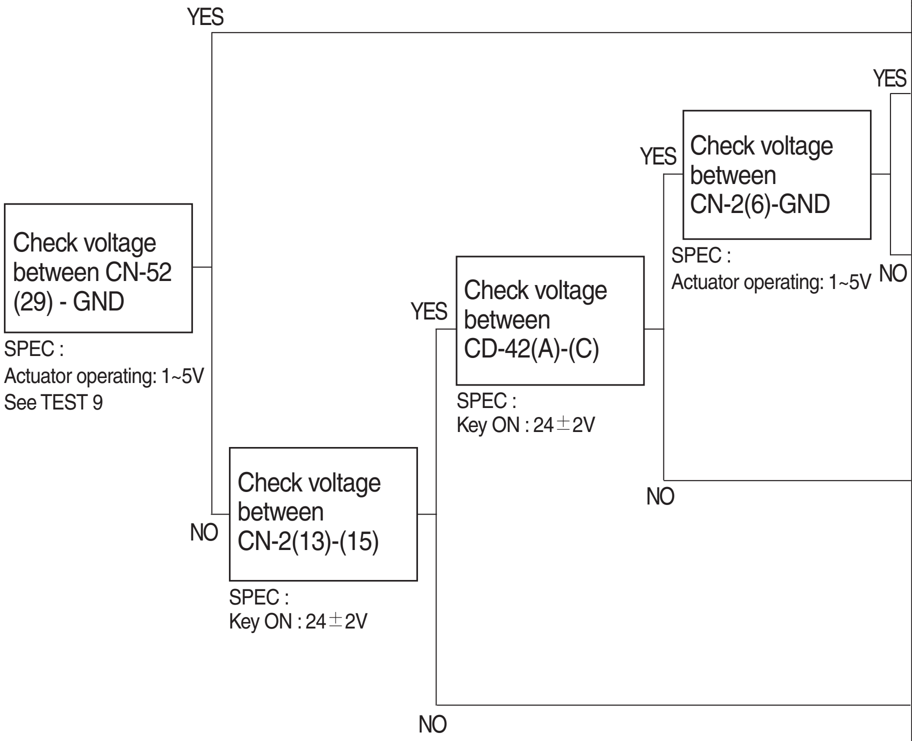
3009SH6MS06

6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

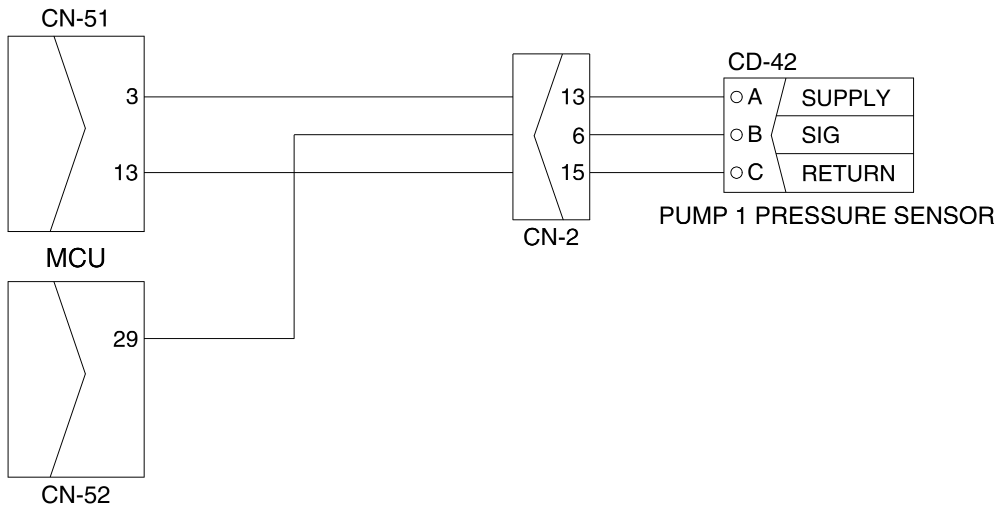
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(29)-CN-2(6)	Replace or repair
Detective P1 pressure sensor short circuit or poor connection between CN-2(6)-CD-42(B)	Replace or repair
Short circuit or poor connection between CD-42(A)-CN-2(13) or CD-42(C)-CN-2(15)	Replace or repair
Short circuit or poor connection between CN-2(13)-CN-51(3) or CN-2 (15) - CN-51(13)	Replace or repair

Wiring diagram



3009SH6MS07

2) TEST PROCEDURE

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

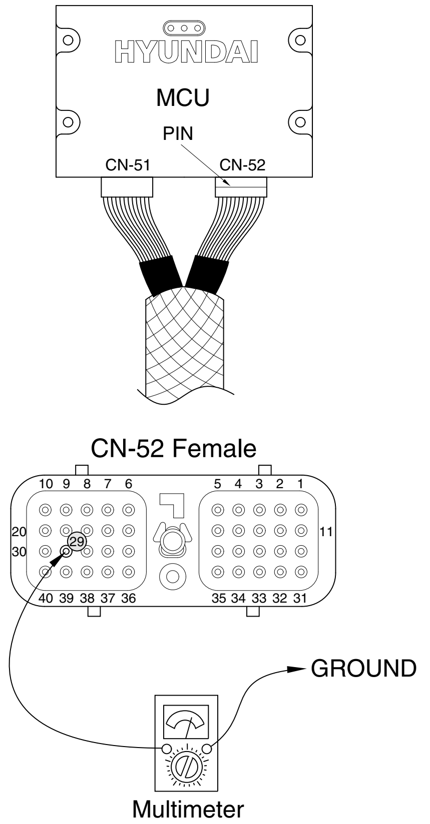
① Prepare 1 piece of thin sharp pin, steel or copper.

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



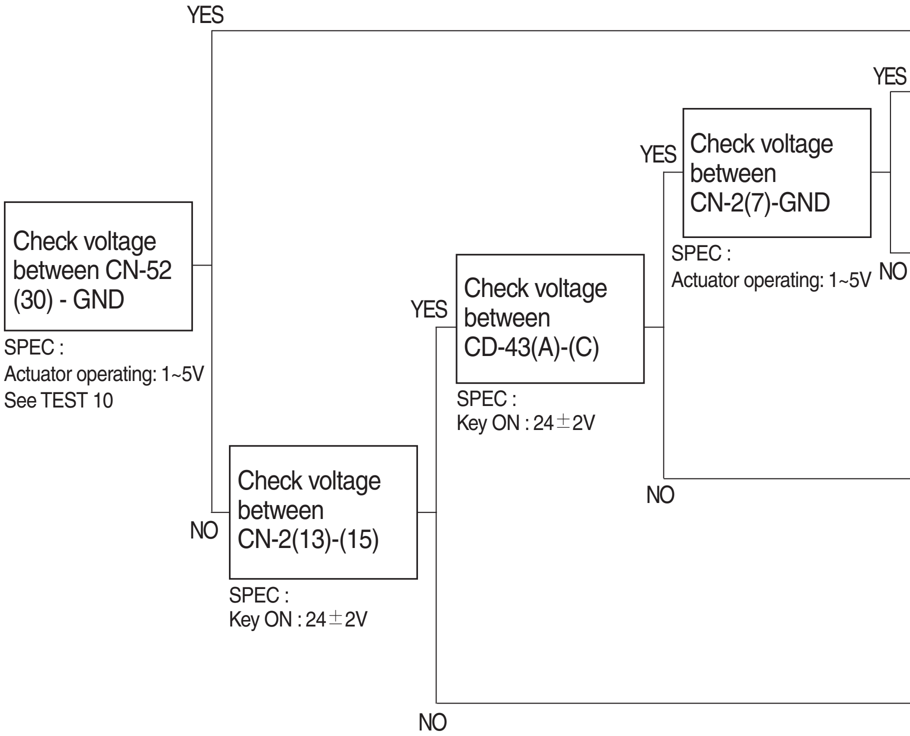
3009SH6MS08

7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

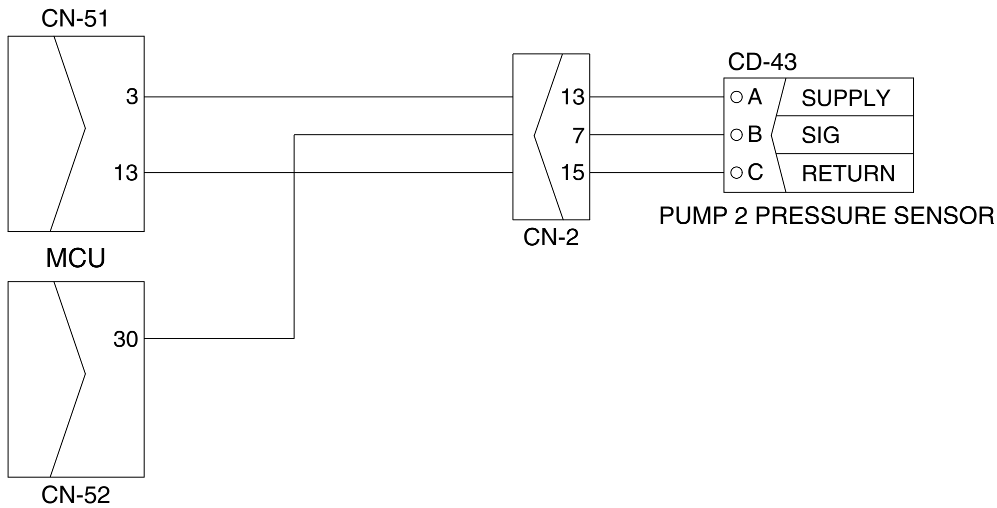
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(30)-CN-2(7)	Replace or repair
Detective P2 pressure sensor short circuit or poor connection between CN-2(7)-CD-43(B)	Replace or repair
Short circuit or poor connection between D-43(A)-CN-2(13) or CD-43(C)-CN-2(15)	Replace or repair
Short circuit or poor connection between CN-2(13)-CN-51(3) or CN-2(15)-CN-51(13)	Replace or repair

Wiring diagram



3009SH6MS09

2) TEST PROCEDURE

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

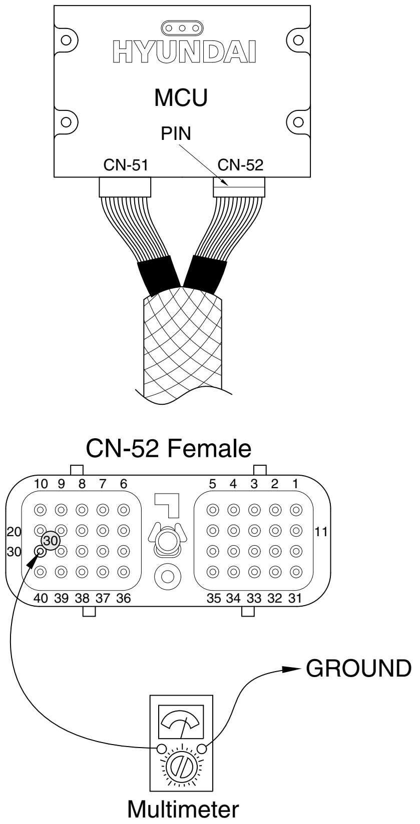
① Prepare 1 piece of thin sharp pin, steel or copper.

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



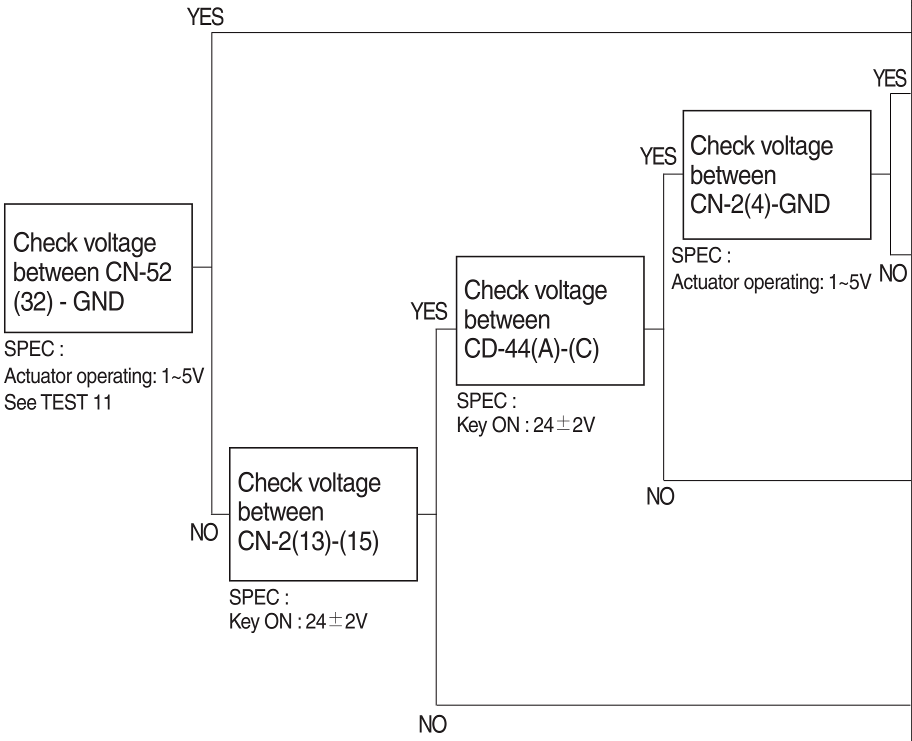
3009SH6MS10

8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

· Fault code : HCESPN 125, FMI 0~4

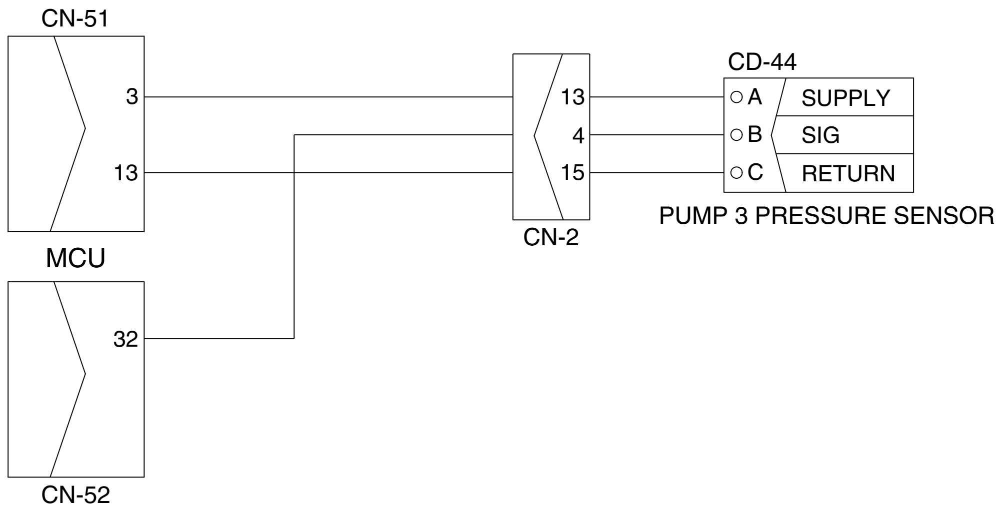
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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.

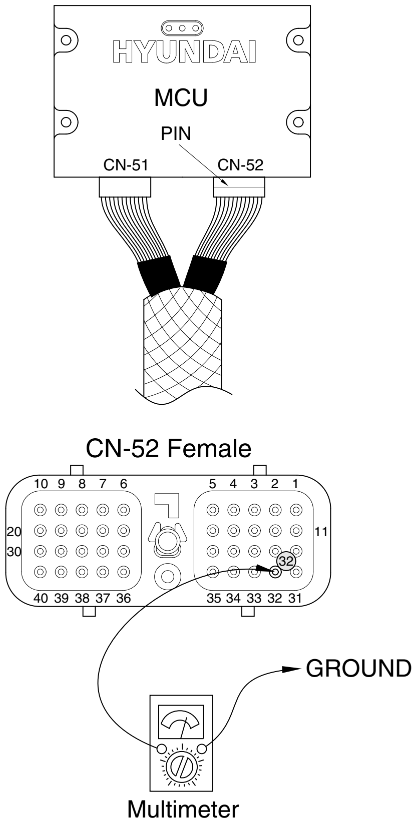
① Prepare 1 piece of thin sharp pin, steel or copper.

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



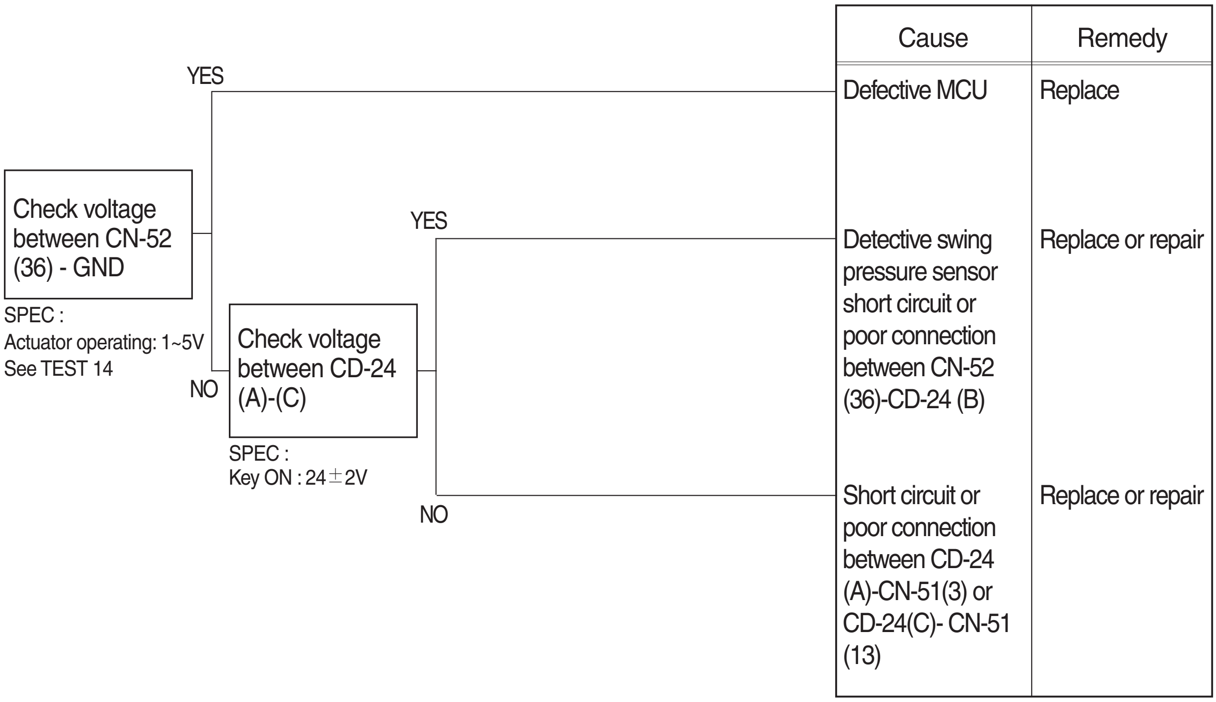
3009SH6MS12

9. MALFUNCTION OF SWING PRESSURE SENSOR

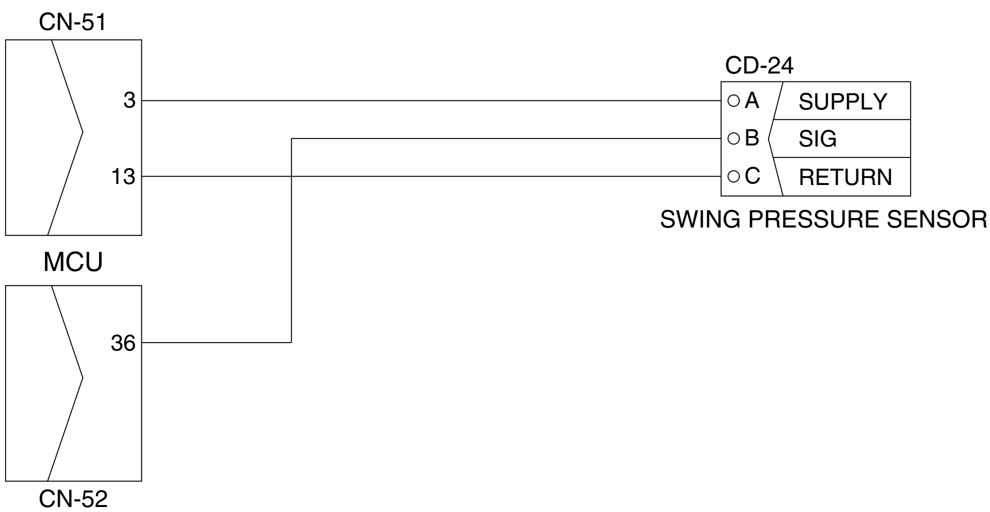
· Fault code : HCESPN 135, FMI 0~4

※ 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.

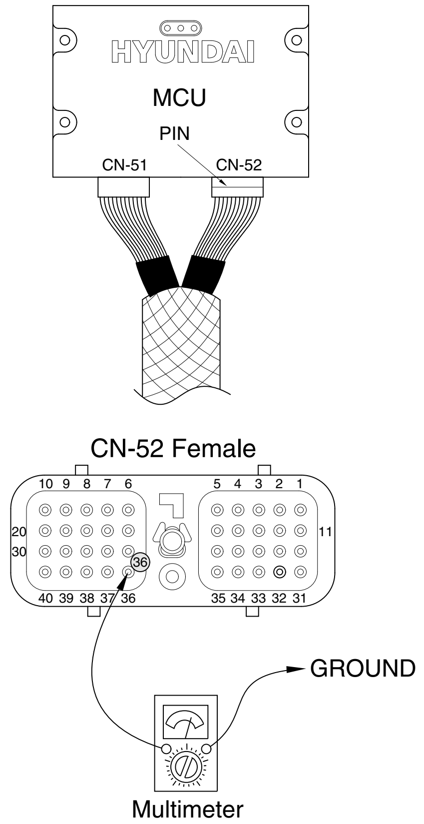
① Prepare 1 piece of thin sharp pin, steel or copper.

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



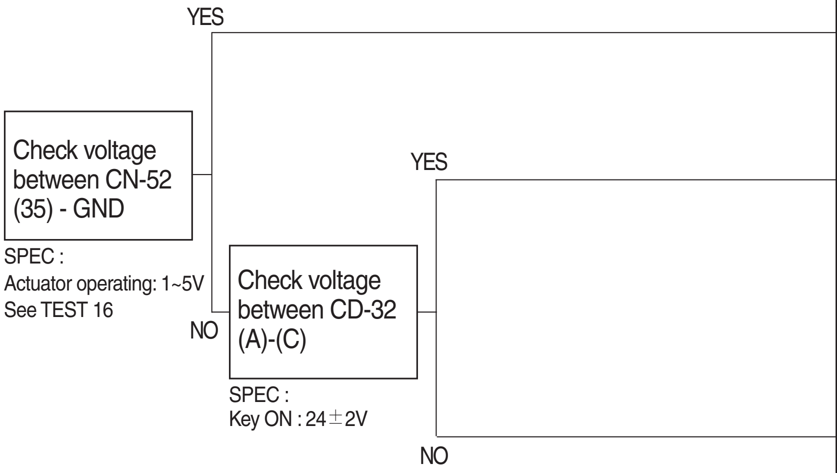
3009SH6MS14

10. MALFUNCTION OF BOOM UP PRESSURE SENSOR

· Fault code : HCESPN 127, FMI 0~4

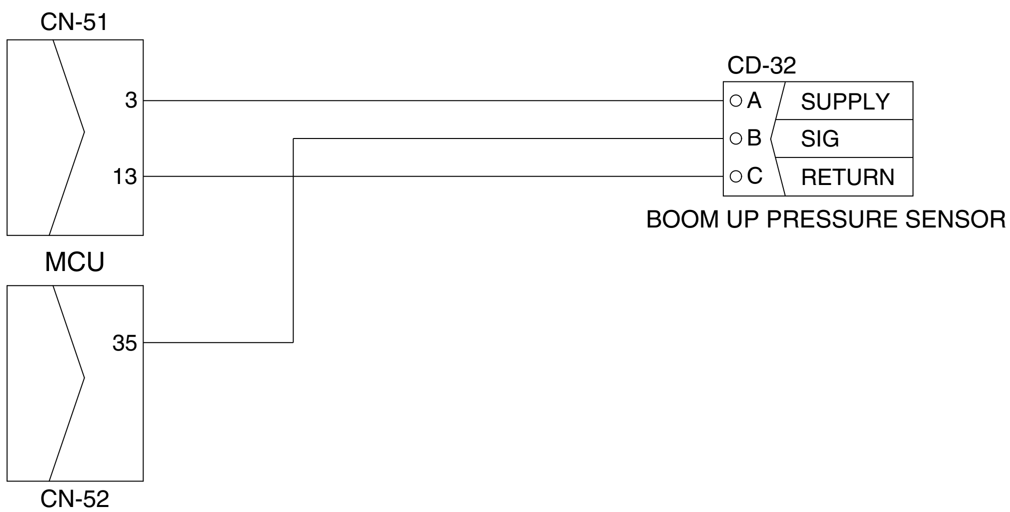
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor short circuit or poor connection between CN-52 (35)-CD-32 (B)	Replace or repair
Short circuit or poor connection between CD-32 (A)-CN-51(3) or CD-32(C)- CN-51 (13)	Replace or repair

Wiring diagram



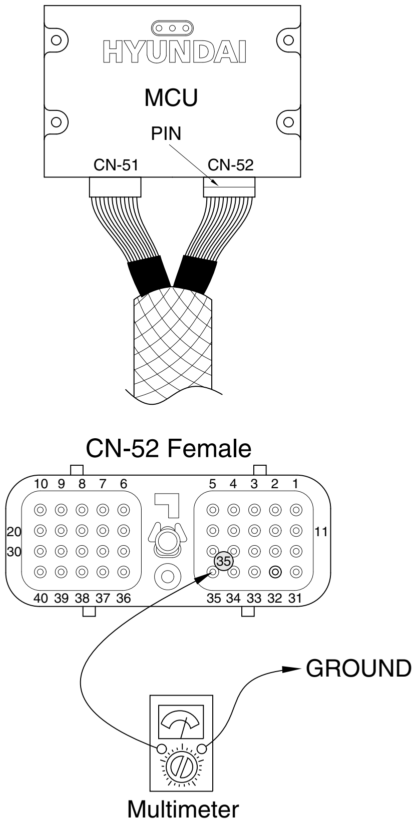
3009SH6MS15

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



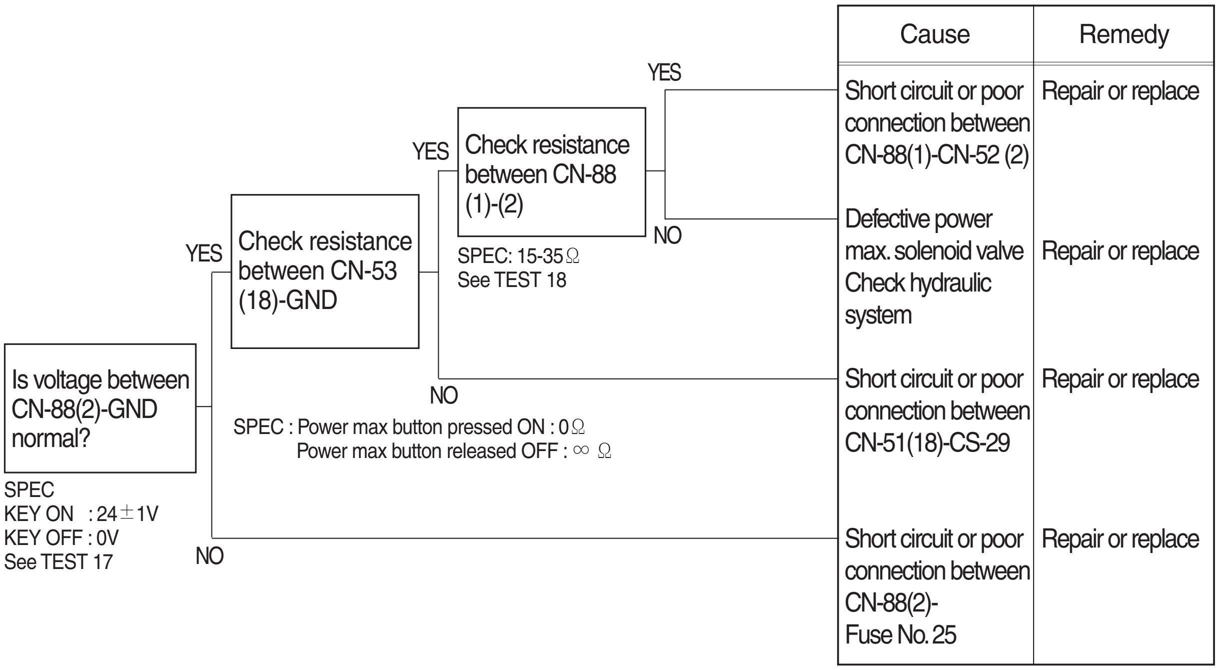
3009SH6MS16

11. MALFUNCTION OF POWER MAX

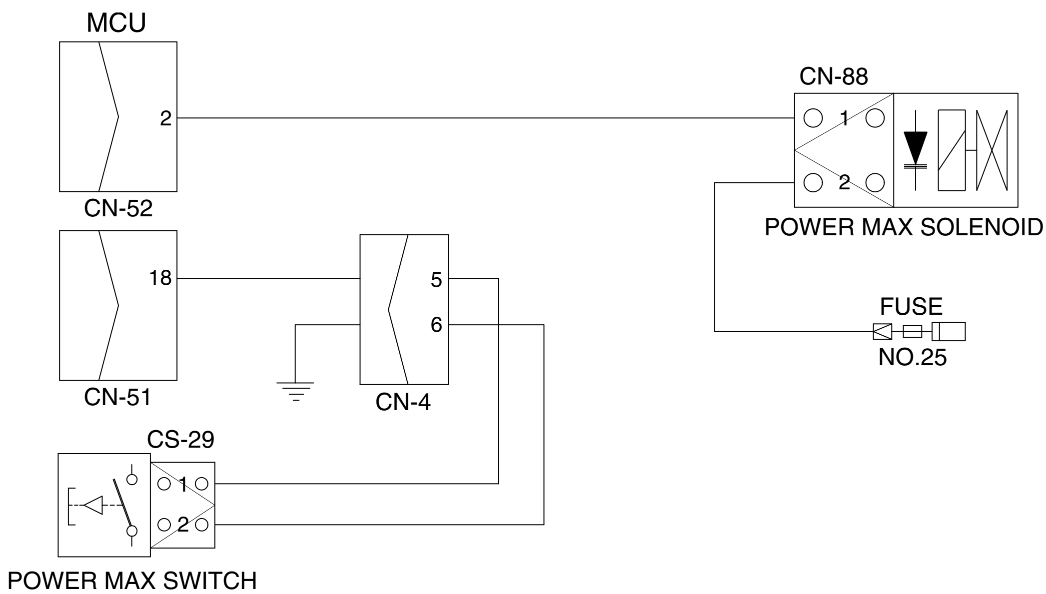
· Fault code : HCESPN 166, FMI 4 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram

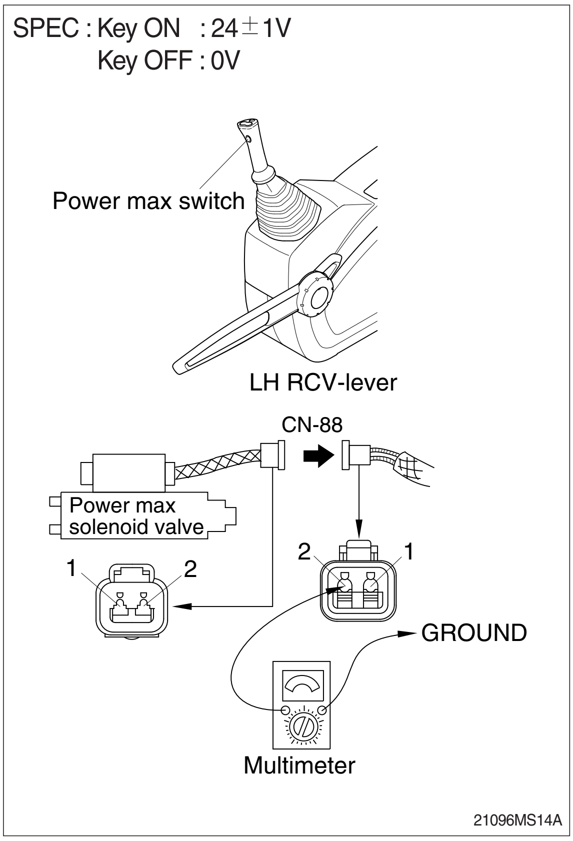


3009SH6MS17

2) TEST PROCEDURE

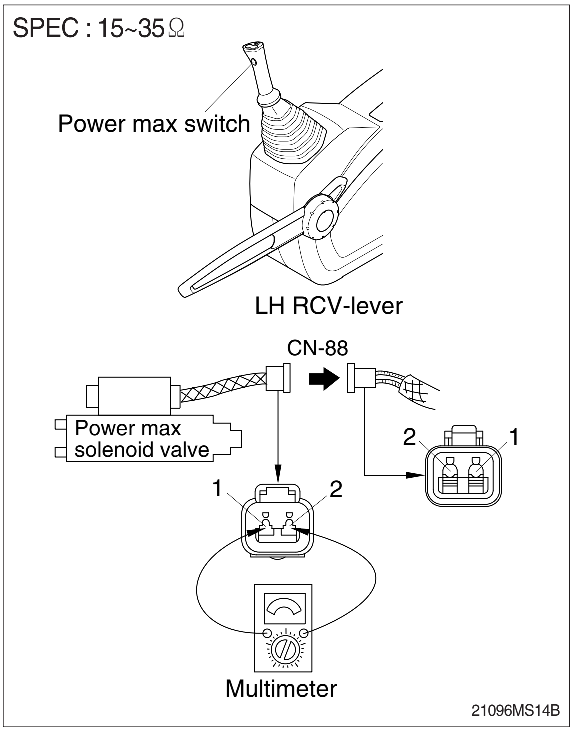
(1) Test 17: Check voltage between connector CN-88(2) - GND.

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.

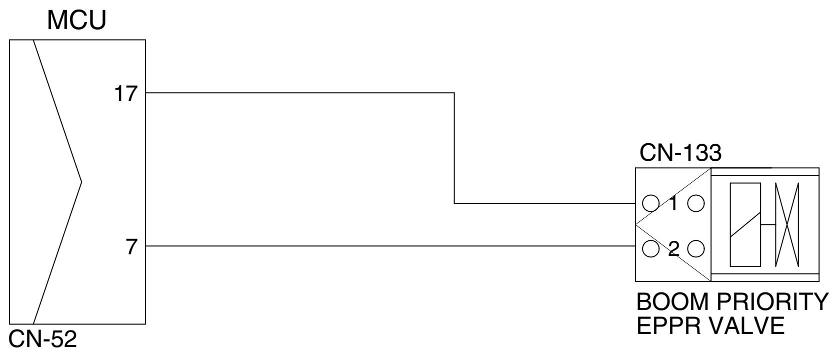
1) INSPECTION PROCEDURE

Check resistance between CN-133(1)-(2)

SPEC : 15~35V
KEY : ON

	Cause	Remedy
YES	Short circuit or poor connection between CN-52(17)-CN-133 (1) or CN-52(7)-CN-133(2)	Repair or replace
NO	Defective EPPR valve	Repair or replace

Wiring diagram



3009SH6MS18

■ MECHATRONICS SYSTEM (CLUSTER TYPE 2)

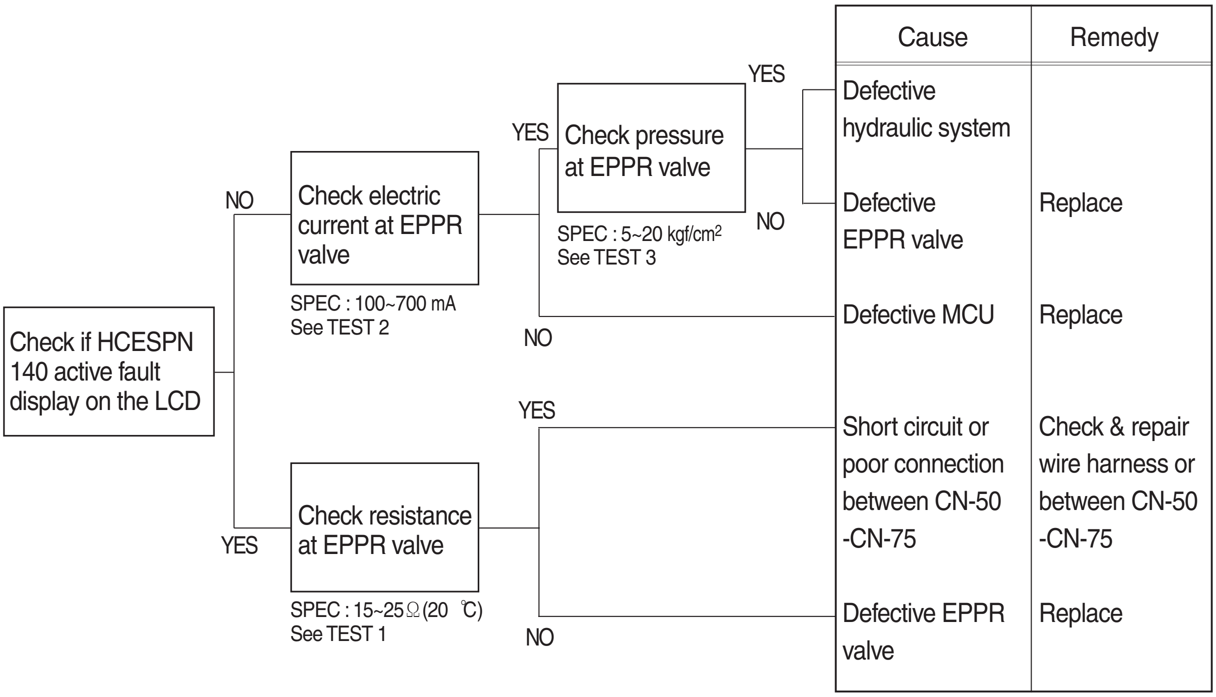
1. ALL ACTUATORS SPEED ARE SLOW

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

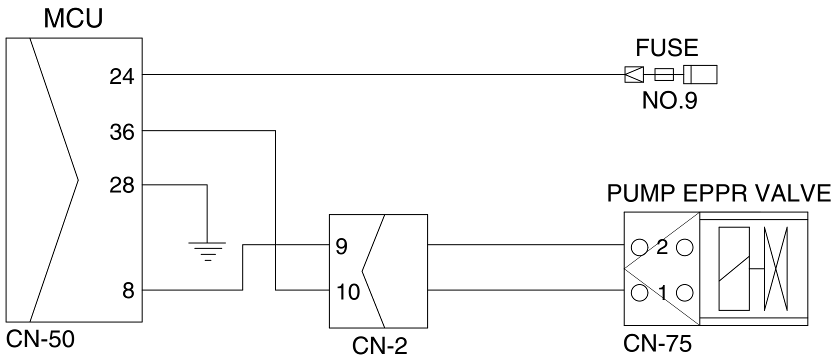
※ Spec : P-mode 1800 ± 50 rpm S -mode 1700± 50 rpm E-mode 1600 ± 50 rpm

※ Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE



Wiring diagram



3009SH6MS30

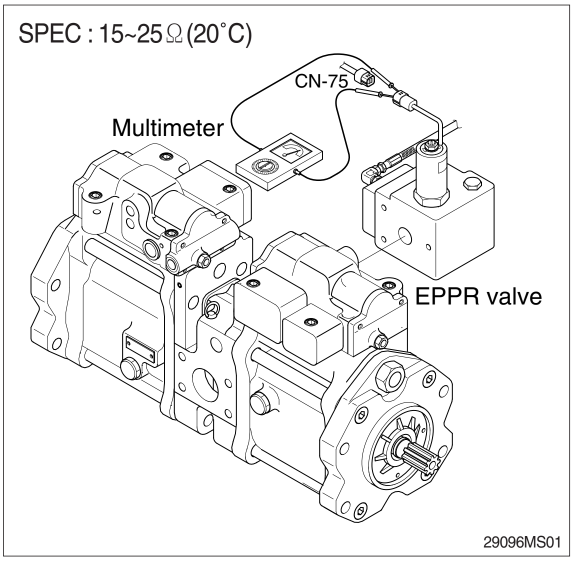
2) TEST PROCEDURE

(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.

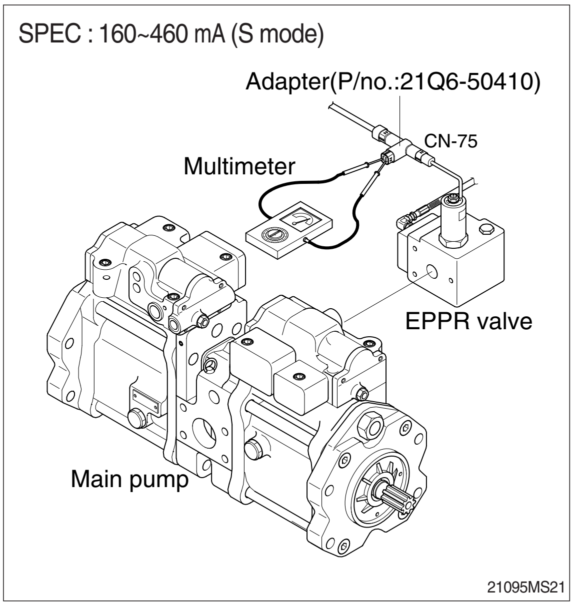
① Install multimeter as figure.

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 1700±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/cm^2 (0 to 710 psi)

② Start engine.

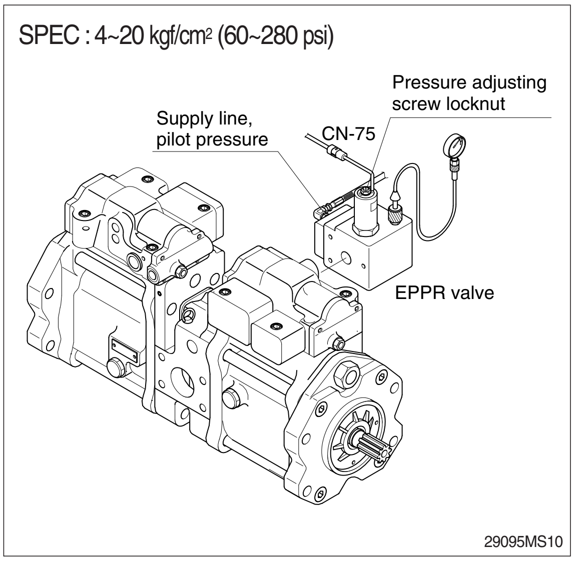
③ Set the accel dial at "10" (Max).

④ Set H-mode and cancel auto decel mode.

⑤ If tachometer show approx 1700±50 rpm, check pressure.

⑥ If pressure is not correct, adjust it.

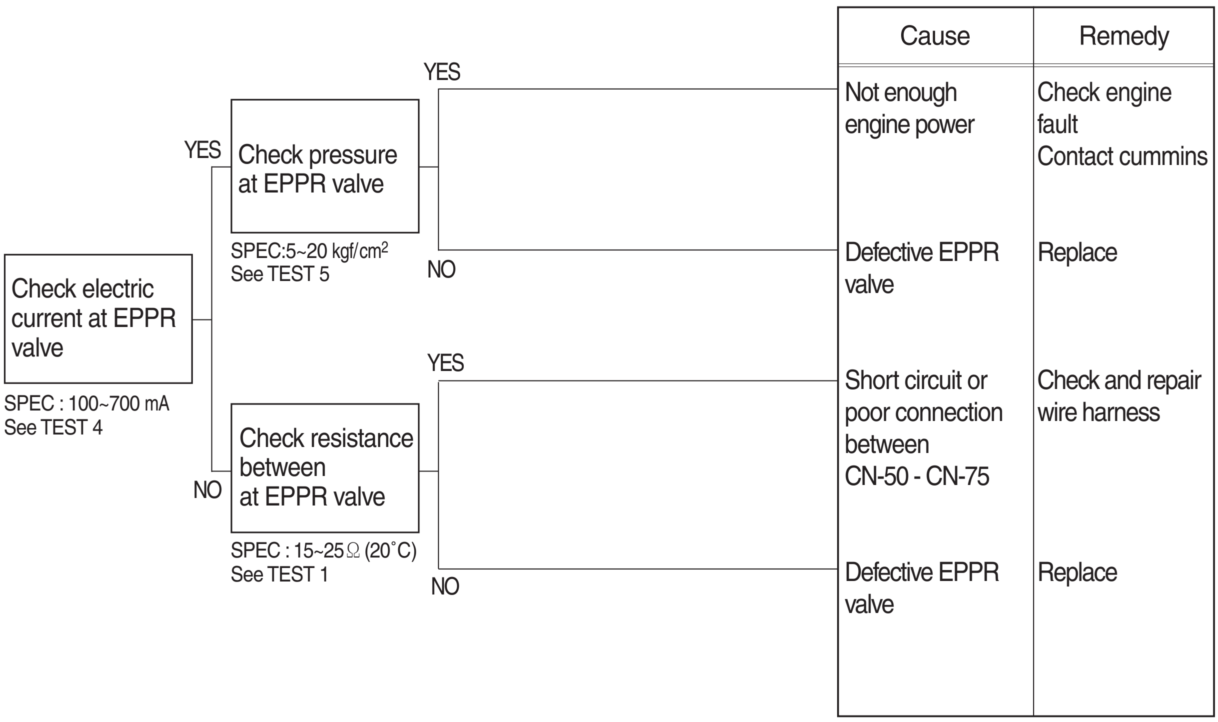
⑦ After adjust, test the machine.



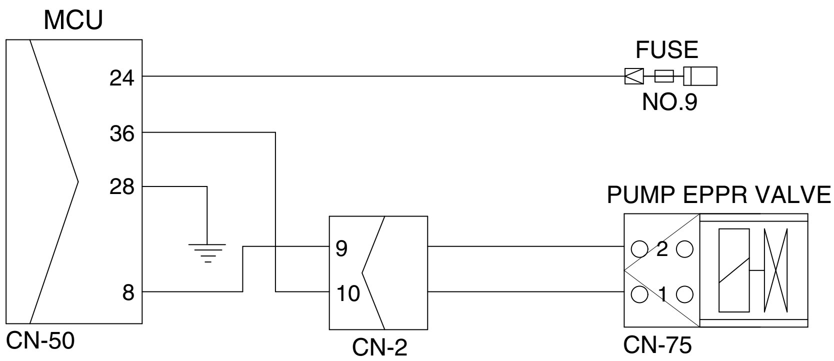
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

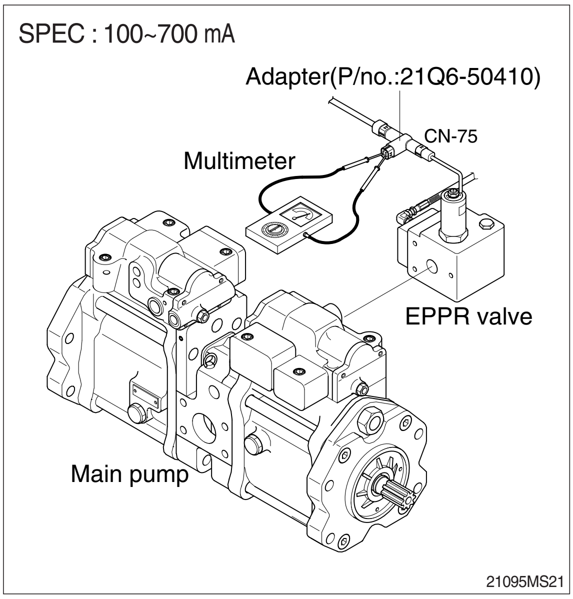


3009SH6MS30

2) TEST PROCEDURE

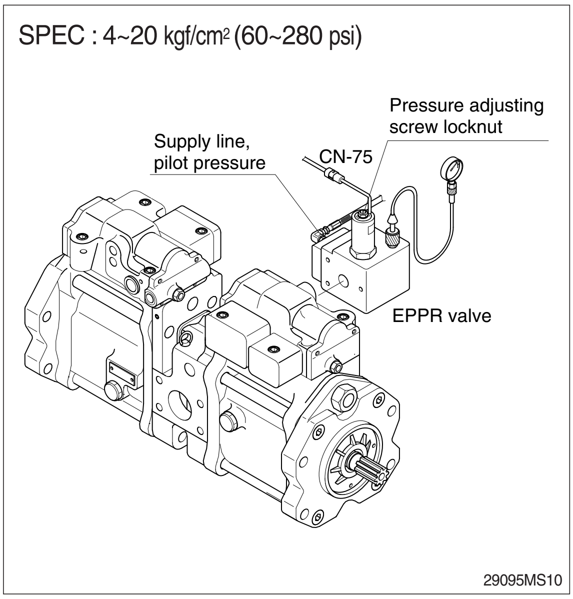
(1) Test 4 : Check electric current at EPPR valve at S-mode

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at "10" (max)
④ Set H-mode with 1700±50 rpm.
⑤ Check electric current.



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

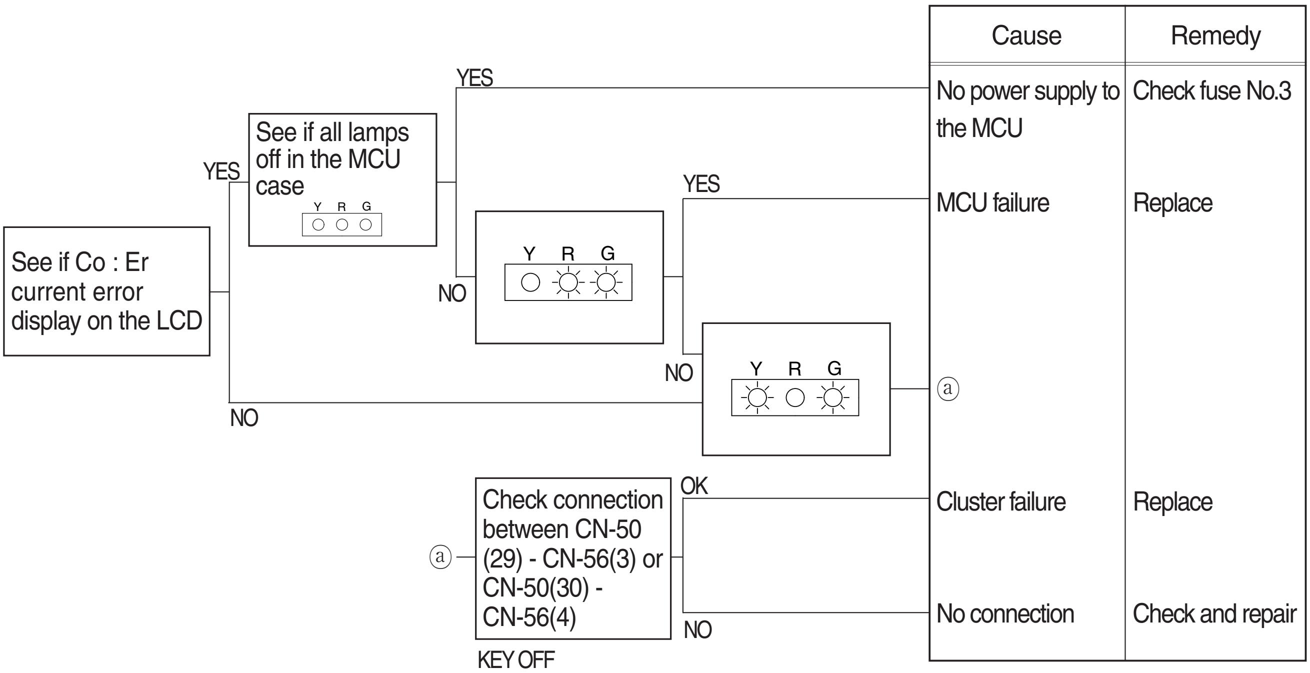
① Connect pressure gauge at EPPR valve.
② Start engine.
③ Set the accel dial at "10" (max)
④ Set H-mode with 1700±50 rpm.
⑤ Operate bucket lever completely push or pull.
⑥ Hold arm lever at the end of stroke.
⑦ Check pressure at relief position.



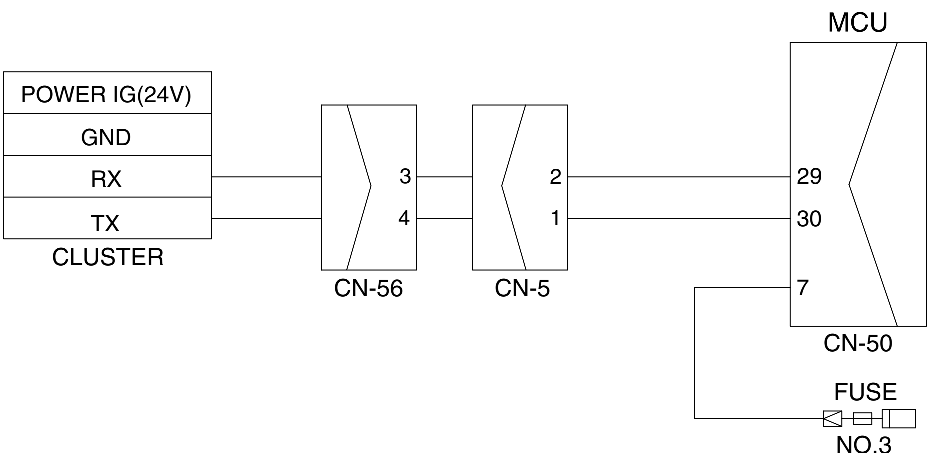
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram

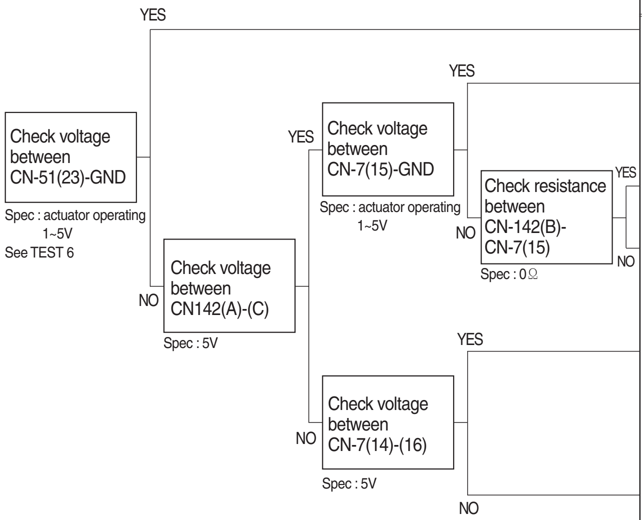


3009SH6MS31

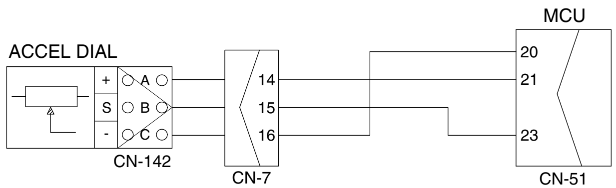
4. MALFUNCTION OF ACCEL DIAL

※ 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.

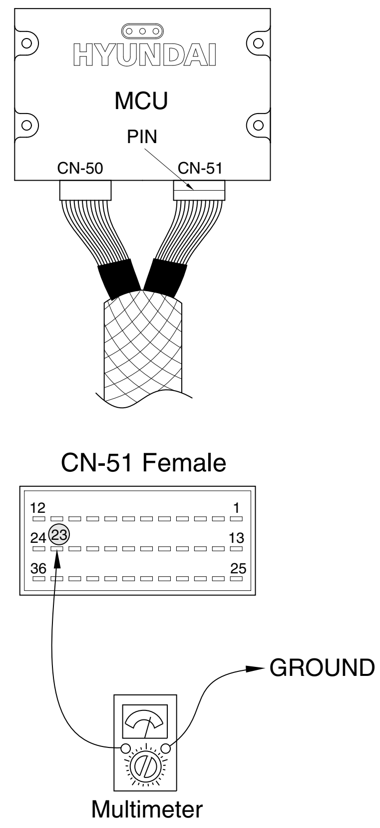
① Prepare 1 piece of thin sharp pin, steel or copper.

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

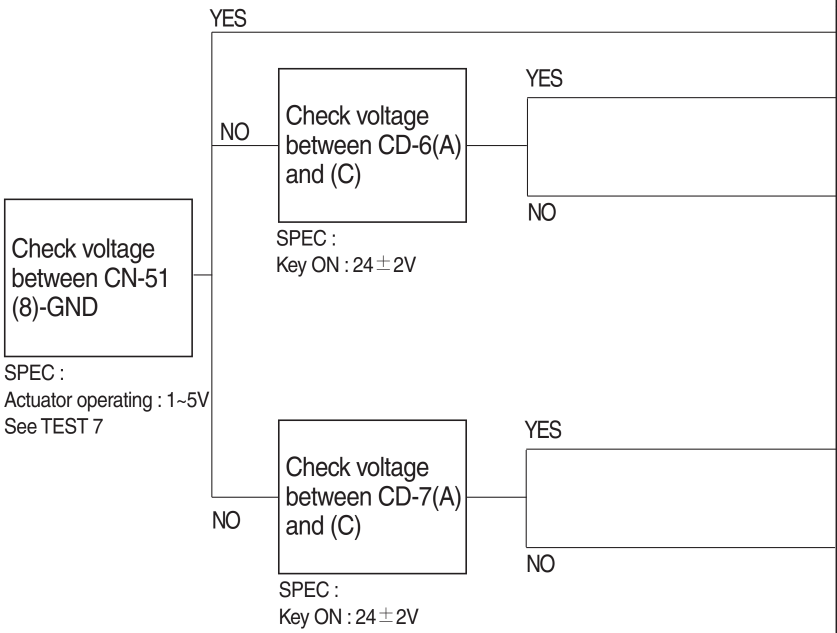


3009SH6MS33

5. AUTO DECEL SYSTEM DOES NOT WORK

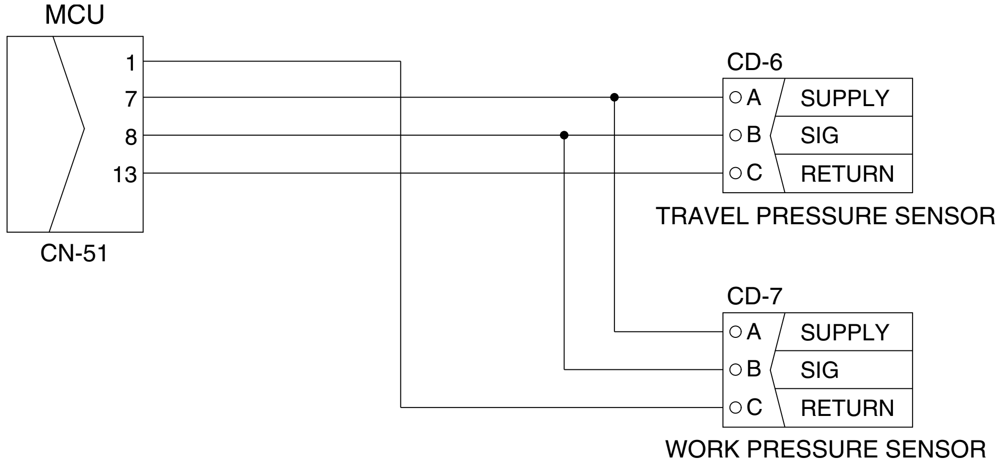
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51(7)-CD-6(A) and / or CN-51(13)-CD-6(C)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51(7)-CD-7(A) and / or CN-51(1)-CD-7(C)	Replace or repair

Wiring diagram



3009SH6MS34

2) TEST PROCEDURE

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

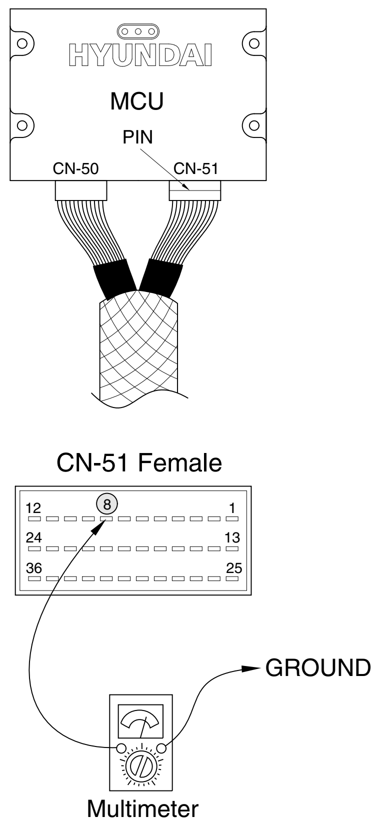
① Prepare 1 piece of thin sharp pin, steel or copper.

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

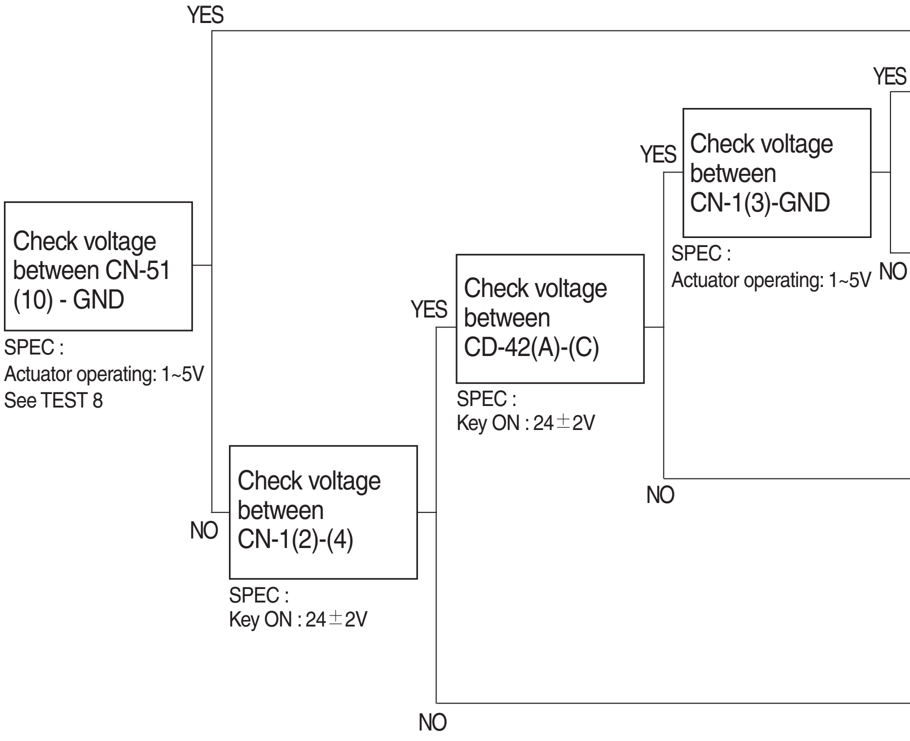


3009SH6MS35

6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

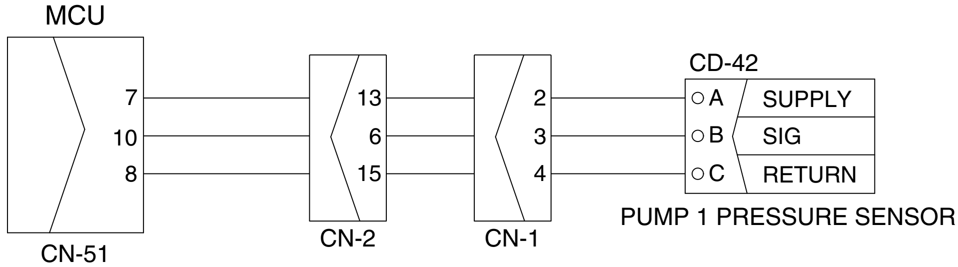
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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.

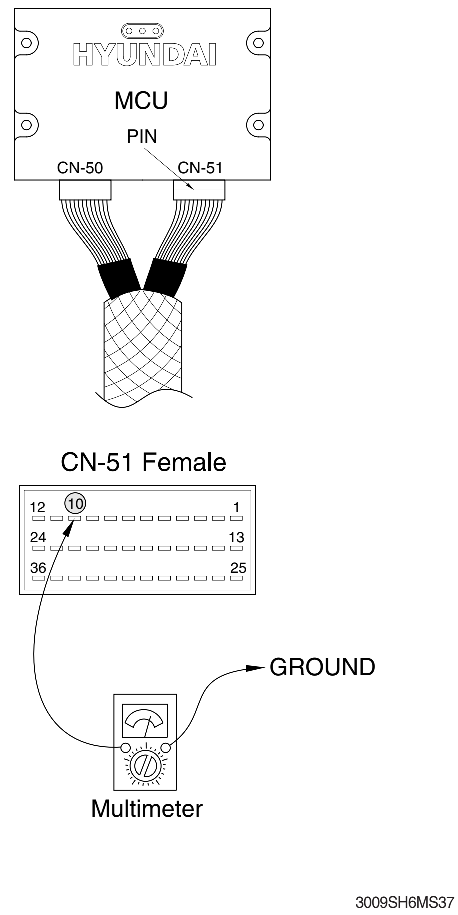
① Prepare 1 piece of thin sharp pin, steel or copper.

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.

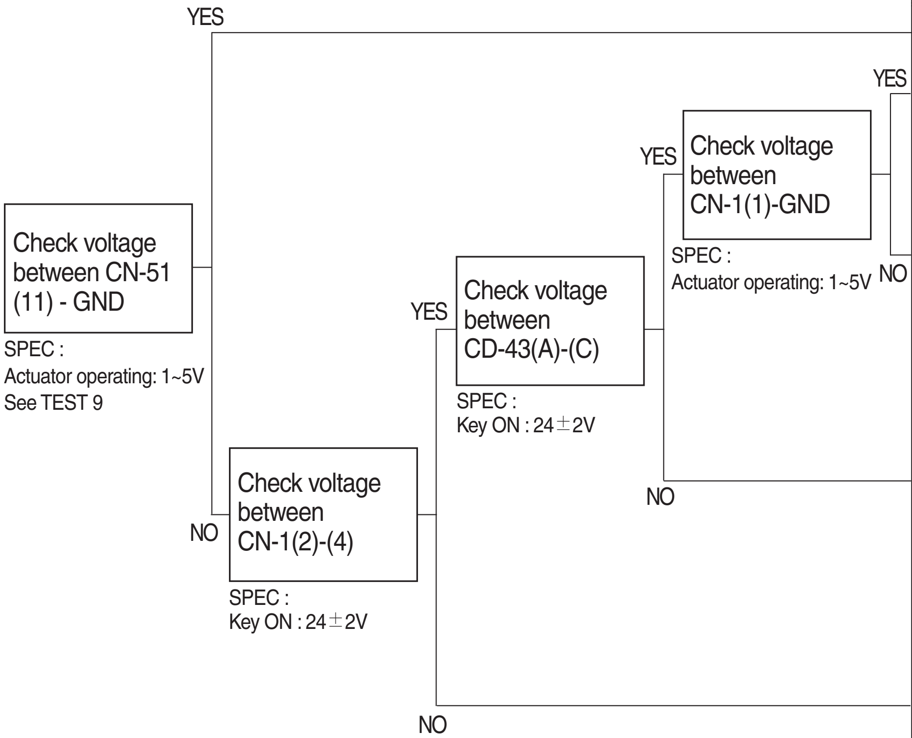
SPEC : Actuator operating : 1~5 V



7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

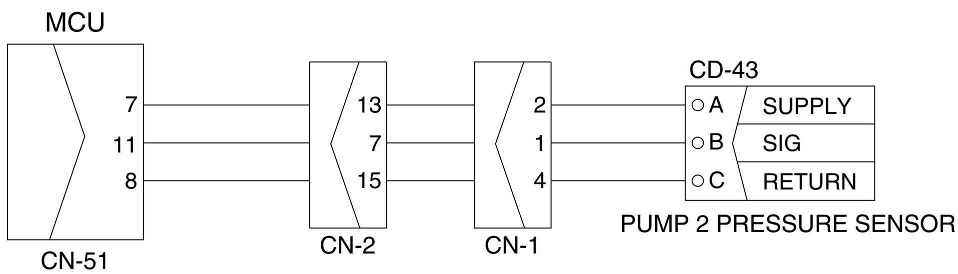
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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



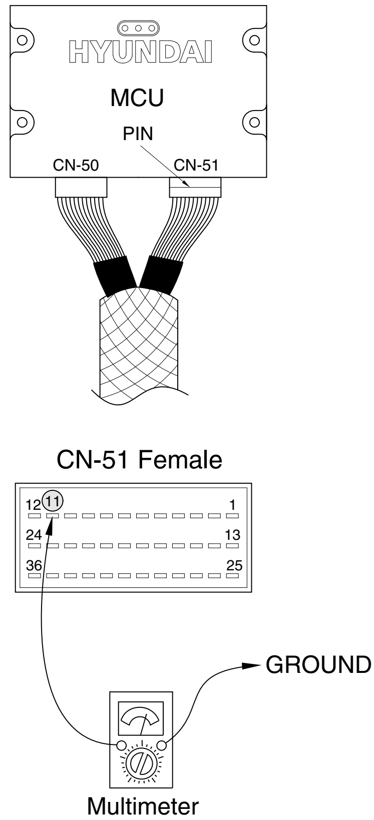
3009SH6MS38

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

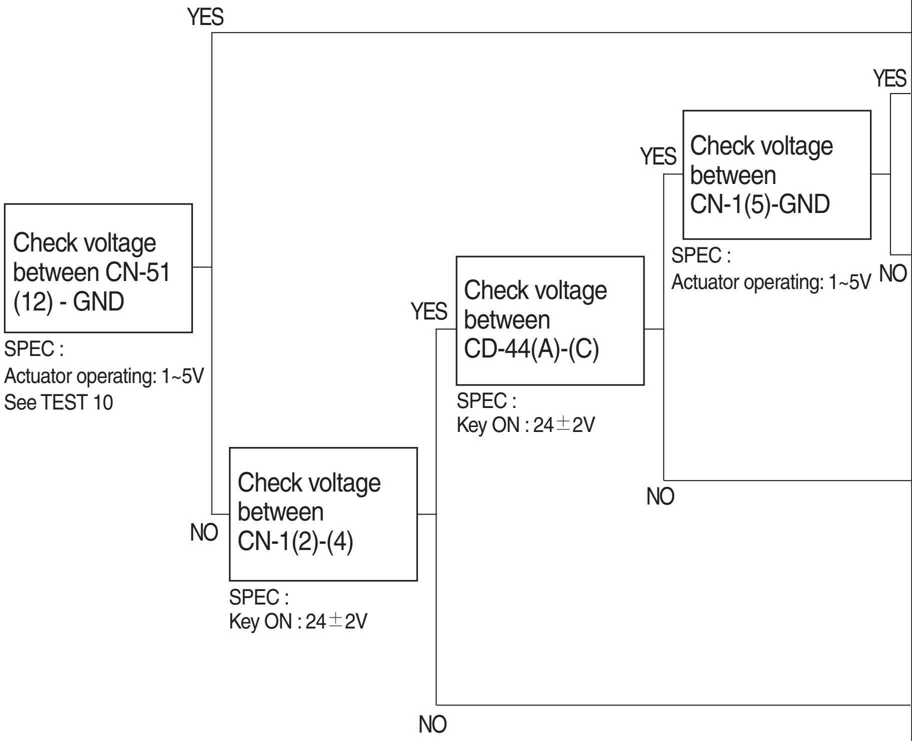


3009SH6MS39

8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

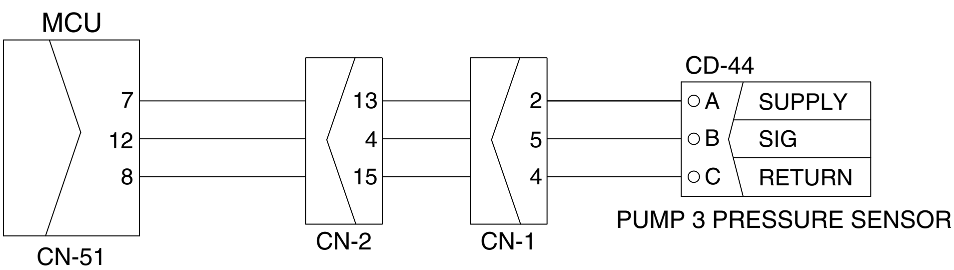
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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.

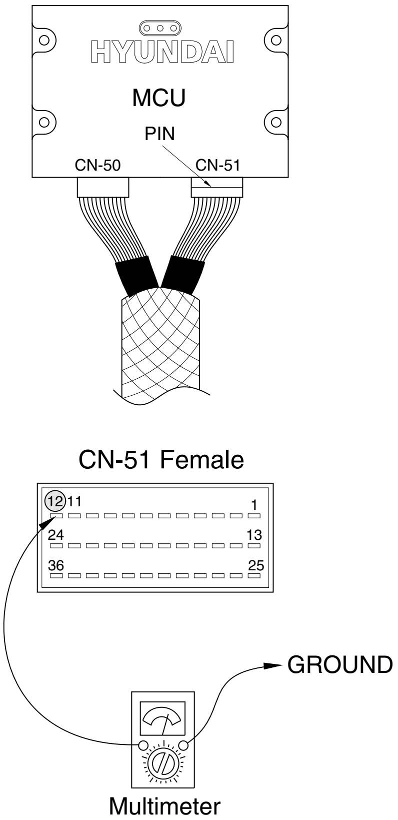
① Prepare 1 piece of thin sharp pin, steel or copper.

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

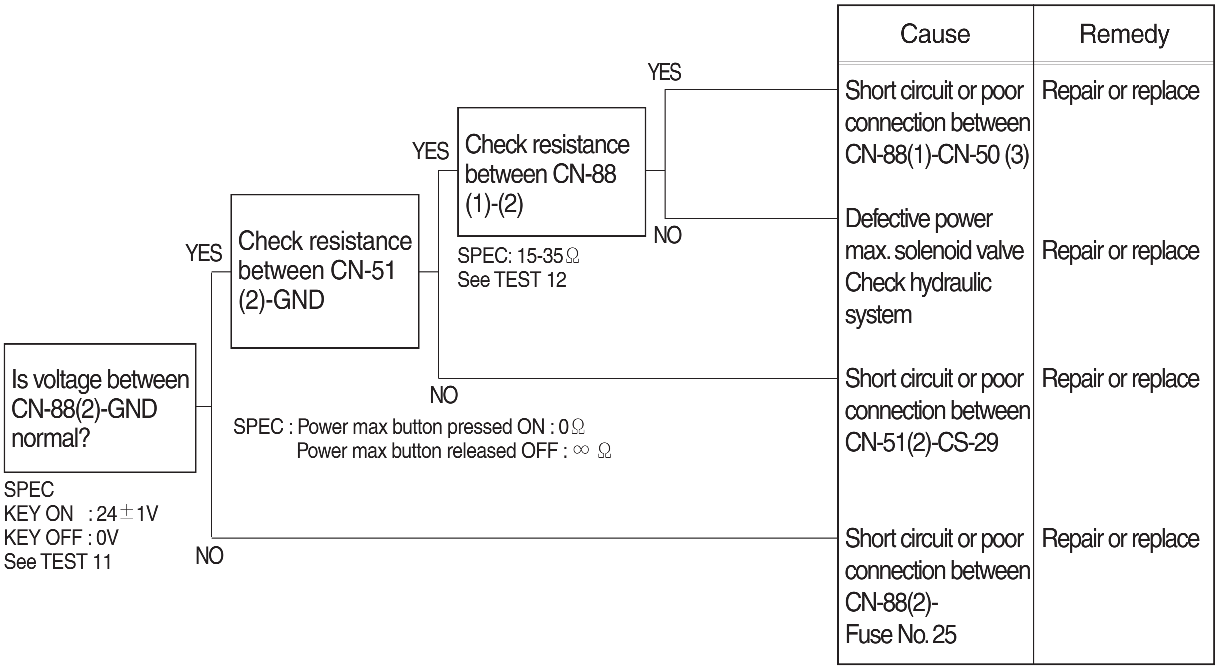


3009SH6MS41

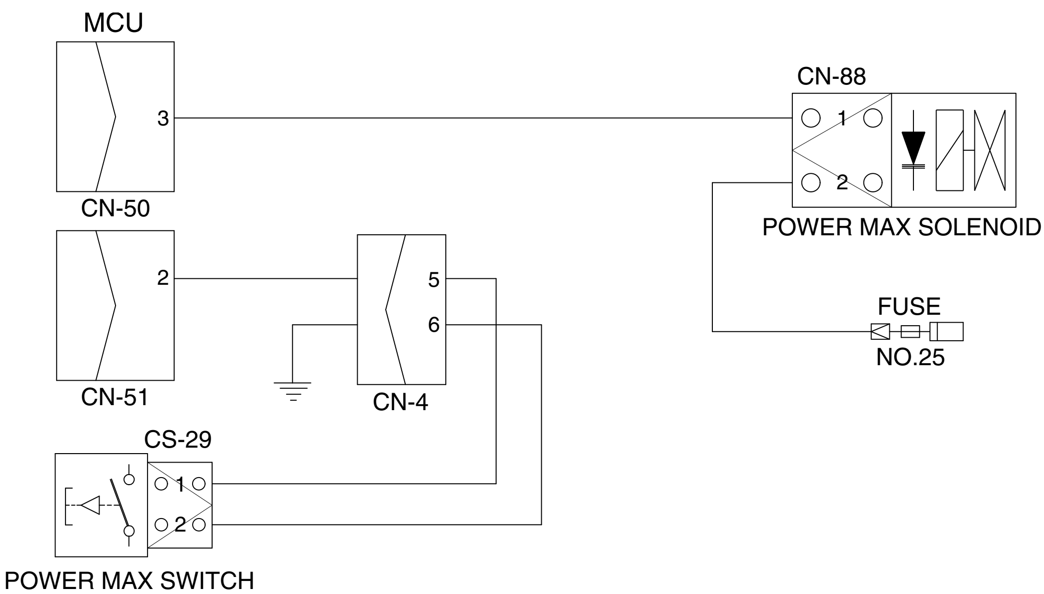
9. MALFUNCTION OF POWER MAX

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

1) INSPECTION PROCEDURE



Wiring diagram

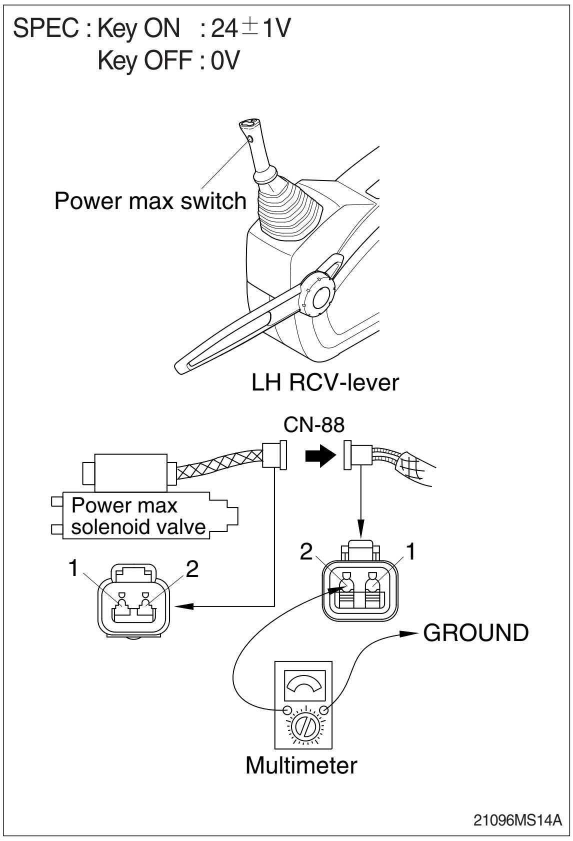


3009SH6MS42

2) TEST PROCEDURE

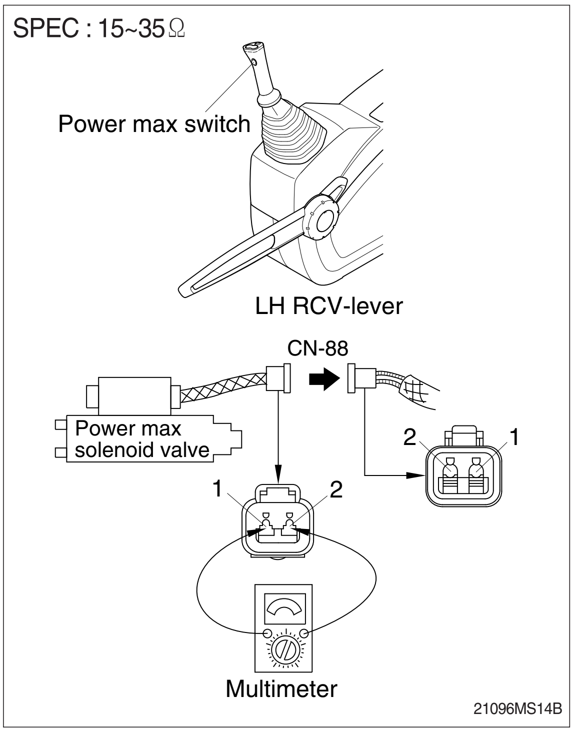
(1) Test 11: Check voltage between connector CN-88(2) - GND.

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.

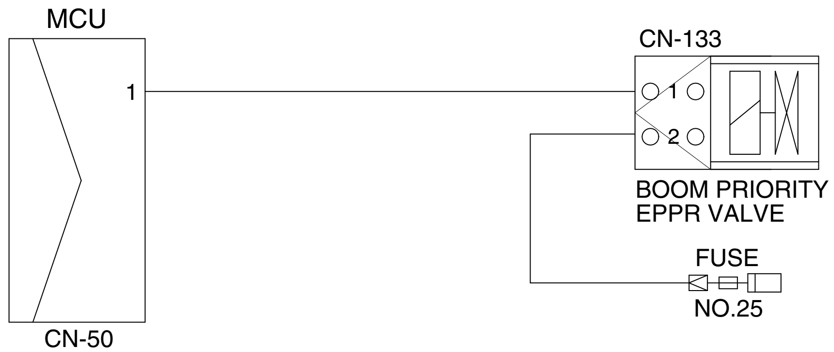
1) INSPECTION PROCEDURE

Check resistance between CN-133(1)-(2)

SPEC : 15~35V
KEY : ON

	Cause	Remedy
YES	Short circuit or poor connection between CN-50(1)-CN-133 (1) or Fuse No. 25 CN-133(2)	Repair or replace
NO	Defective EPPR valve	Repair or replace

Wiring diagram



3009SH6MS43

SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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

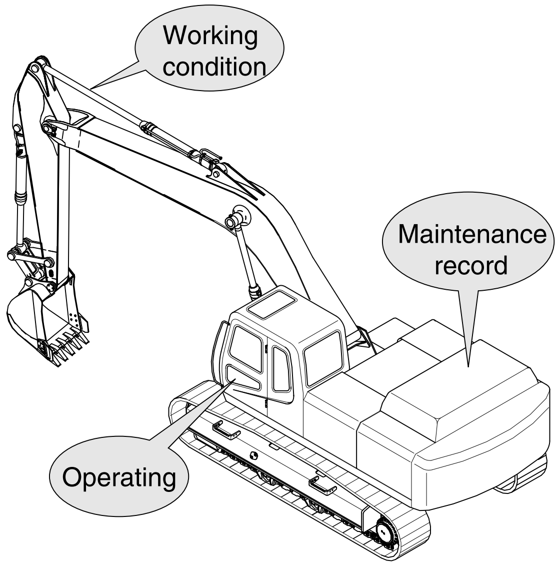
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

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

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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

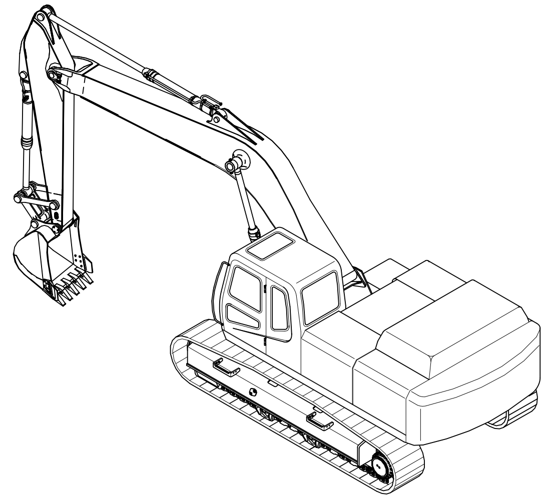


21077MS01

2. TERMINOLOGY

1) STANDARD

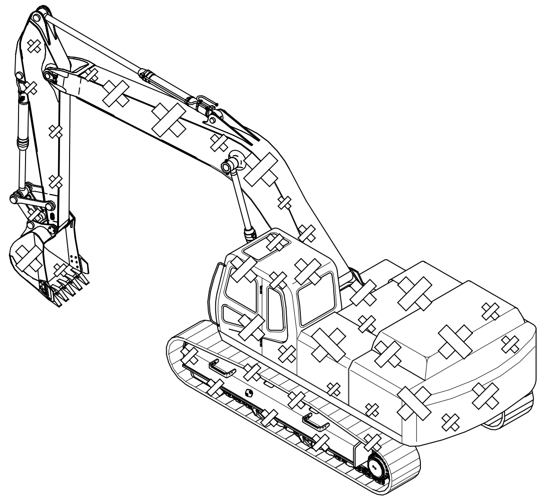
Specifications applied to the brand-new machine, components and parts.



21077MS02

2) SERVICE LIMIT

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



21077MS03

3. OPERATION FOR PERFORMANCE TESTS

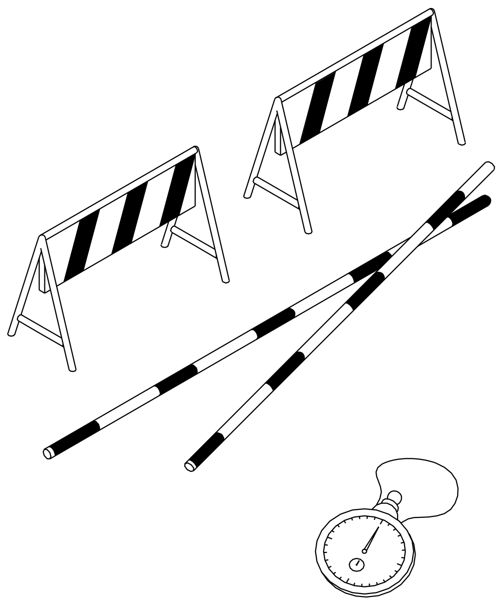
1) Observe the following rules in order to carry out performance tests accurately and safely.

(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.

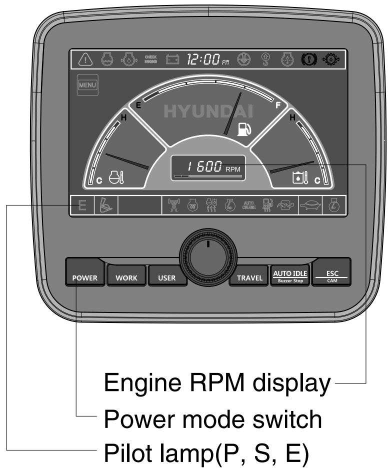
② Measure and record the engine speed at each mode (P, S, E).

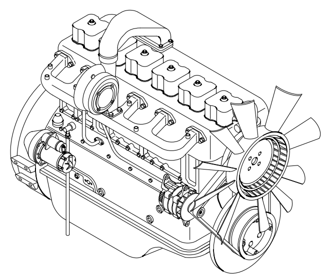
③ Select the P-mode.

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.

CLUSTER





3809SH7MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R390LC-9	Start idle	950±100	
	P mode	1800±50	
	S mode	1700±50	
	E mode	1600±50	
	Auto decel	1150±50	
	One touch decel	950±50	

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

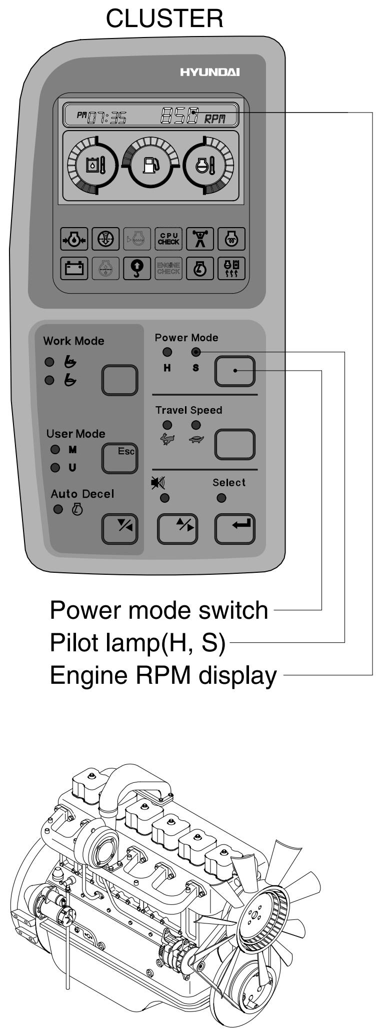
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

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.



3809SH7MS02

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R390LC-9	Start idle	950±100	
	M mode	1800±50	
	H mode	1700±50	
	S mode	1600±50	
	Auto decel	1100±50	
	One touch decel	950±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.

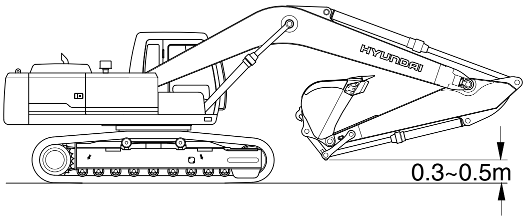
(2) Preparation

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.

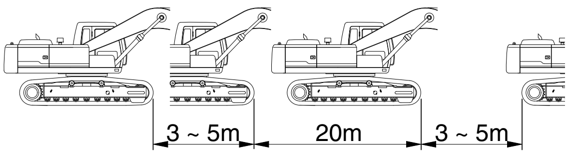
· Power mode switch :
P mode(Cluster type 1)
M mode(Cluster type 2)

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
R390LC-9	1 Speed	22.6±2.0	30	
	2 Speed	14.3±1.0	19.6	

4) TRACK REVOLUTION SPEED

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

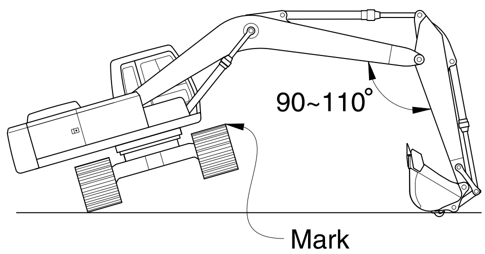
(2) Preparation

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

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

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

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



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
R390LC-9	1 Speed	38.2±2.0	47.7
	2 Speed	23.5±2.0	29.4

5) TRAVEL DEVIATION

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

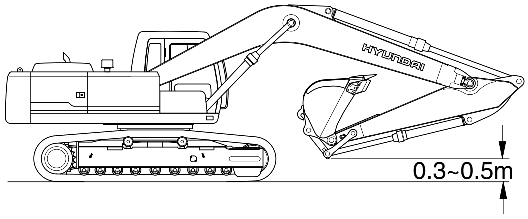
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

③ Hold the bucket 0.3 to 0.5 ㎧ 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.

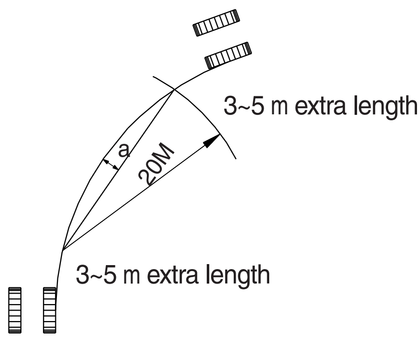
· Power mode switch :
P mode(Cluster type 1)
M mode(Cluster type2)

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

④ Measure the distance between a straight 20㎧ 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 : ㎜ / 20 ㎧

Model	Standard	Maximum allowable	Remarks
R380LC-9SH	200 below	250	

6) SWING SPEED

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

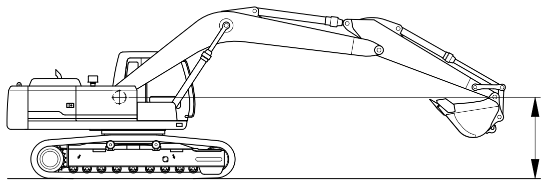
(2) Preparation

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
R380LC-9SH	P mode (Cluster type 1)	18±1.5	22.5
	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.

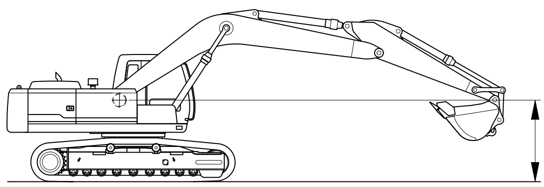
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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.

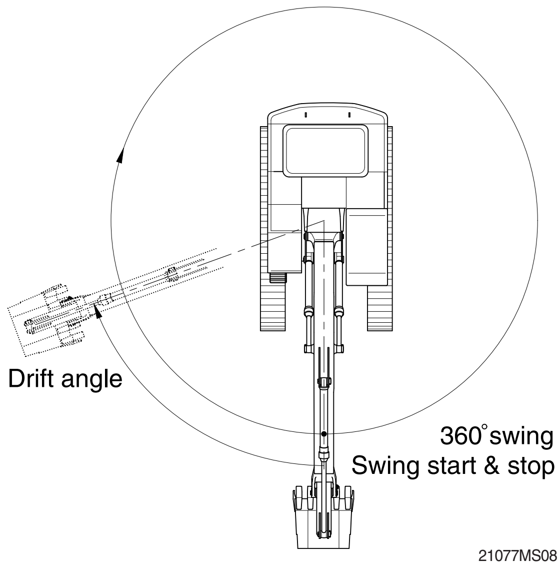
· Power mode switch :
P mode(Cluster type 1)
M mode(Cluster type 2)

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

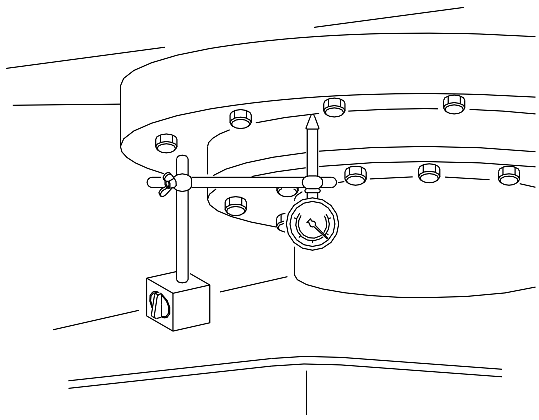
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R390LC-9	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.

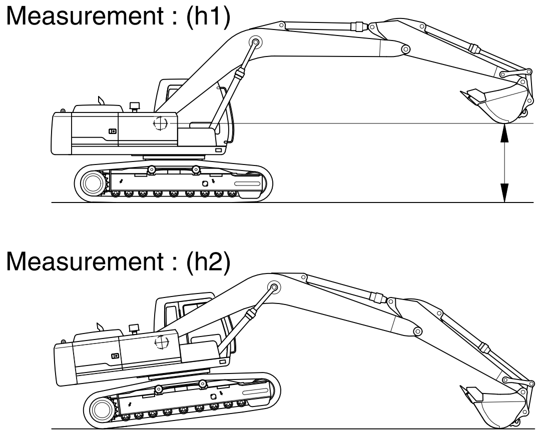
③ Install a dial gauge on the track frame as shown, using a magnetic base.

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



290LC7MS04

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

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R390LC-9	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.

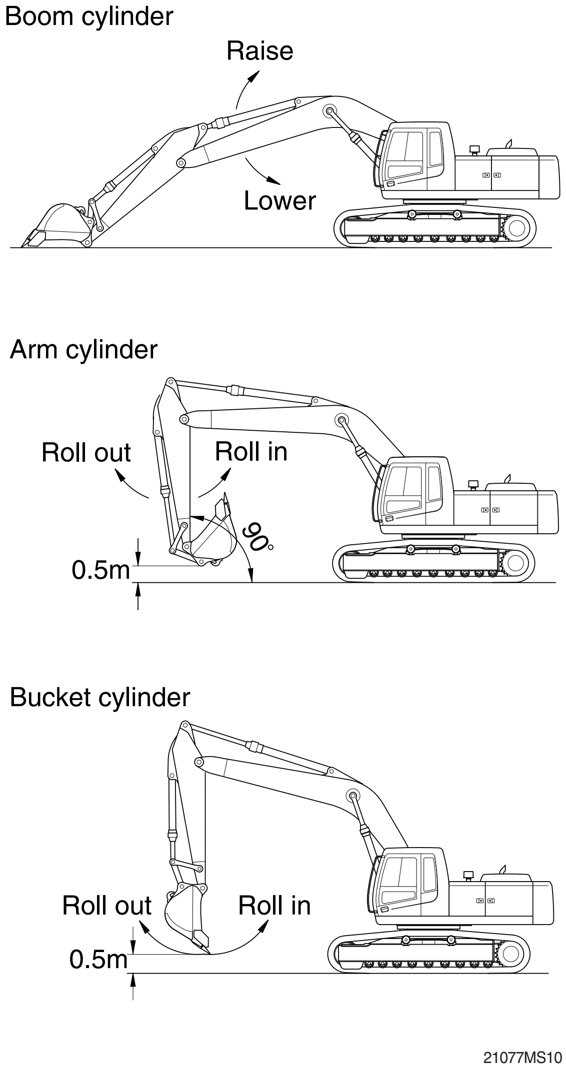
(2) Preparation

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.

- 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
R390LC-9	Boom raise	3.7±0.4	4.6	
	Boom lower	2.7±0.4	3.4	
	Arm in	3.3±0.4	4.1	
	Arm out	2.7±0.3	3.4	
	Bucket load	2.6±0.4	3.1	
	Bucket dump	2.6±0.3	3.1	

10) DIG FUNCTION DRIFT CHECK

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

(2) Preparation

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

· $W = M^3 \times 1.5$

Where :

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

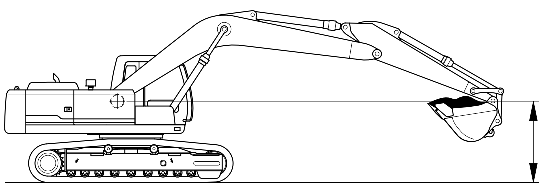
1.5 = Soil specific gravity

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

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

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

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



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
R390LC-9	Boom cylinder	10 below	15	
	Arm cylinder	10 below	15	
	Bucket cylinder	40 below	50	

11) CONTROL LEVER OPERATING FORCE

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

(2) Preparation

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

(3) Measurement

① Start the engine.

② Select the following switch positions.

· Power mode switch :
P mode(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
R390LC-9	Boom lever	1.6 or below	2.0	
	Arm lever	1.6 or below	2.0	
	Bucket lever	1.3 or below	1.7	
	Swing lever	1.3 or below	1.7	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

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

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

(2) Preparation

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

(3) Measurement

① Stop the engine.

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

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

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
R390LC-9	Boom lever	101±10	125	
	Arm lever	101±10	125	
	Bucket lever	90±10	115	
	Swing lever	90±10	115	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE (CLUSTER TYPE 1)

(1) Preparation

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

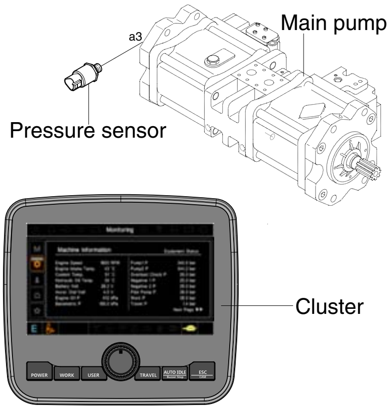
(2) Measurement

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.



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(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R390LC-9	P mode	40^{+2}_{0}	-	

■ PILOT PRIMARY PRESSURE (CLUSTER TYPE 2)

(1) Preparation

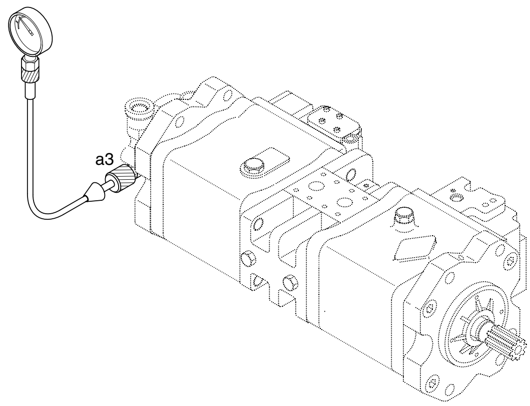
① Stop the engine.

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.



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(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

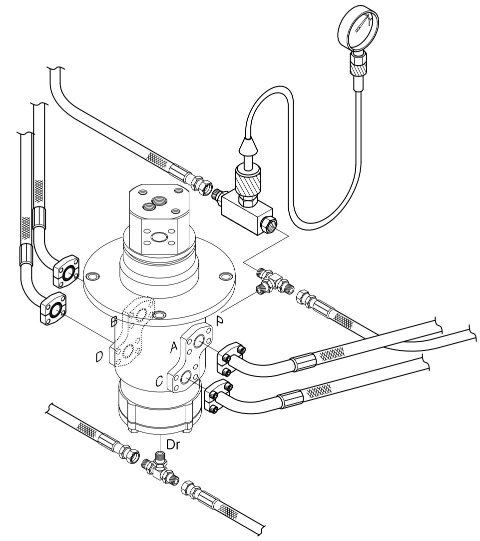
The average measured pressure should meet the following specifications:

Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R390LC-9	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.

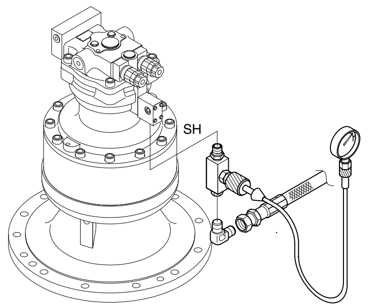
Unit : kgf / cm^2

Model	Travel speed	Standard	Maximum allowable	Remarks
R390LC-9	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
R390LC-9	Brake disengaged	40	31~49	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE (CLUSTER TYPE 1)

(1) Preparation

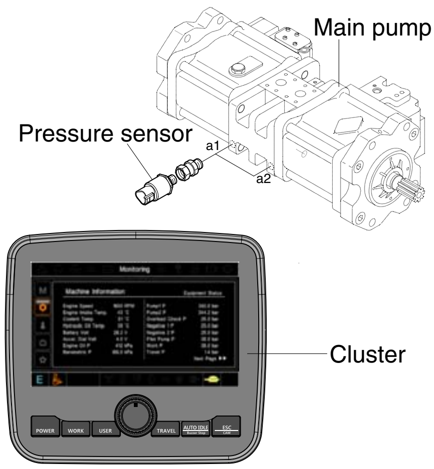
① Keep the hydraulic oil temperature at 50±5˚C.

(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 / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R390LC-9	High ilde	40±5	-	

■ MAIN PUMP DELIVERY PRESSURE (CLUSTER TYPE 2)

(1) Preparation

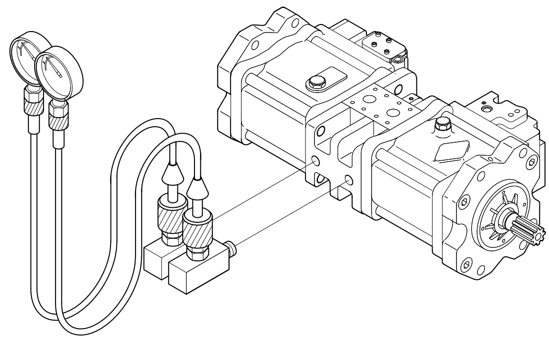
① Stop the engine.

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 / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R390LC-9	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

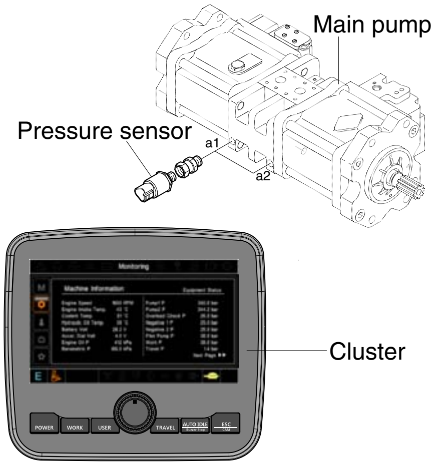
① Select the following switch positions.

· 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

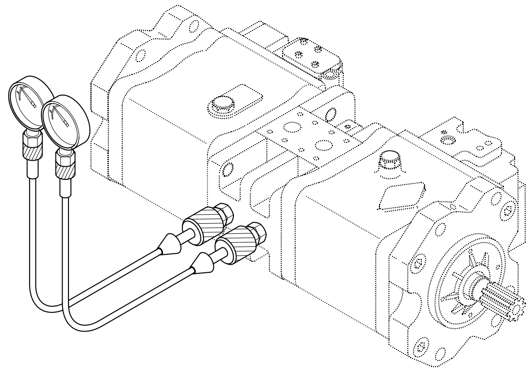
Model	Function to be tested	Standard	Remark
R390LC-9	Boom, Arm, Bucket	330(360)±10	380±10
	Travel	350±10	-
	Swing	290±10	-

(　) : 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

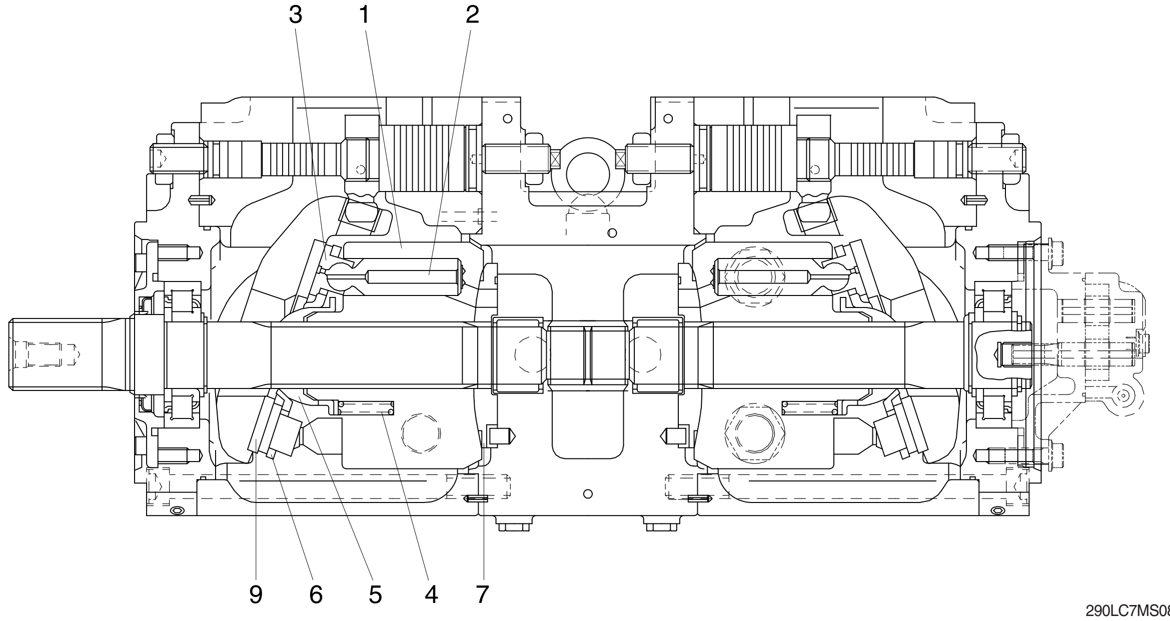
The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

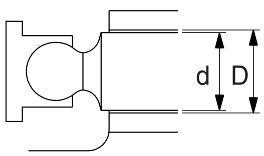
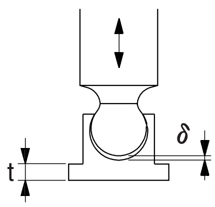
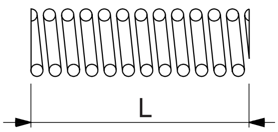
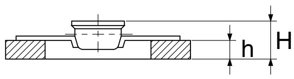
Model	Function to be tested	Standard	Remark
R390LC-9	Boom, Arm, Bucket	330(360)±10	380±10
	Travel	350±10	-
	Swing	270±10	-

( ) : 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		

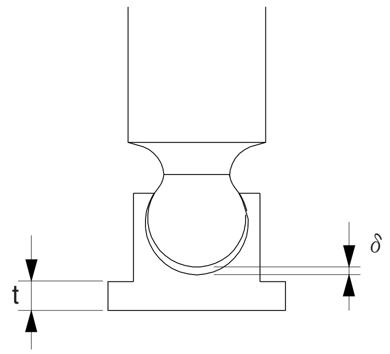
2. MAIN CONTROL VALVE

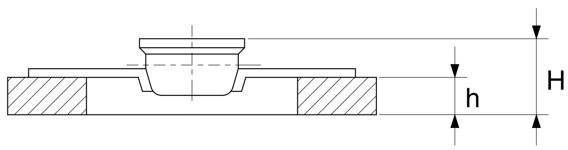
Part name	Inspection item	Criteria & measure
Casing	· Existence of scratches, rust or corrosion.	· In case of damage in following section, replace casing. - Sliding sections of casing hole and spool, especially land sections applied with held pressure. - Seal pocket section where spool is inserted. - Sealing section of port where O-ring contacts. - Sealing section of each relief valve for main and port. - Sealing section of plug. - Other damages that may damage normal function.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool into casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of spring · Damage of poppet · Insert poppet into casing and function it.	· Replacement. · Correction or replacement when sealing is incomplete. · Normal when it can function lightly and smoothly without sticking.
Spring and related parts	· Rusting, corrosion, deformation or breakage of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & control relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · O-rings and back up rings.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement in principle.

3. SWING DEVICE

1) WEARING PARTS

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

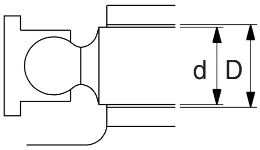
4. TRAVEL MOTOR

Replace parts in accordance with the following standards. However, if a part is damaged significantly in terms of its appearance, replace it irrespective of the standards.

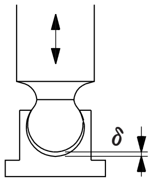
1) HYDRAULIC MOTOR

Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Clearance between piston & cylinder bore (D-d)	0.052 mm	0.077 mm	Replacement
Clearance caulked part between piston and shoe (δ)	0.1 mm	0.3 mm	Replacement
Thickness of shoe	5.5 mm	5.3 mm	Replacement
Assembled height of spherical bush and set plate (H-h)	23.8 mm	23.3 mm	Replacement as a set
Free length of cylinder spring	40.9 mm	40.3 mm	Replacement
Shaft over pin dia. Output spline Cylinder spline	43.91 (ø 5) 49.06 (ø 5)	43.31 mm 48.46 mm	Replacement if either one reaches replacement value.
Spline over dia. Spline in cylinder Spline in spherical bushing	35.25 (ø 5)	35.75 mm	Replacement
Thickness of separation plate Thickness of friction plate	1.5 mm 3.9 mm	1.3 mm 3.7 mm	Replacement
Free length of brake spring	42.4 mm	41.4 mm	Replacement
Displacement over teeth Over pin dia. of friction plate internal teeth	50.02 (7teeth) 152.97 (ø 5)	49.42 mm 153.57 mm	Replacement Replacement
Roughness of sliding surfaces Swash plate/shoe Cylinder block/valve plate	0.4 - z 0.4 - z	3 - z 3 - z	Each independent lapping Mutual lapping
Roller bearing Needle bearing	-	-	Replacement if flaking is found on rolling surface.
O-ring Oil seal	-	-	Replacement at every disassembly, in principle.

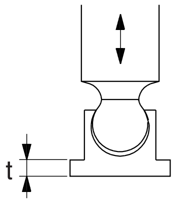
Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Bolt	-	-	Replacement if elongation is found.



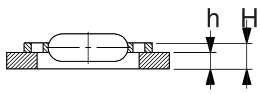
clearance between piston
and cylinder bore : D-d



Play at caulking between piston and shoe : δ



Thickness of shoe : t



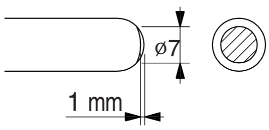
Assembled height of set plate
and spherical bushing : H-h

2) REDUCTION GEAR

Part name & inspection item		Standard dimension	Recommended value for replacement	Remedy
Pitting or crack of gear		-	Pitting area rate : 10%	Replacement pitting or crack is found
Motor driving gear external spline		Overpin 43.91 (ø 5)	43.31 mm	(Z=14)
No. 1 sun gar internal spline		Overpin 30.25 (ø 5)	30.85 mm	Replacement (Z=14)
Reduction ratio i = 70.145	No. 1 sun gear	Displacement 42.22 (4teeth)	41.92 mm	Do. (Z=23)
	No. 1 planetary gear	Displacement 43.98 (4teeth)	43.68 mm	Do. (Z=26)
No. 1 carrier internal spline		Overpin 81.562 (ø 5)	82.162 mm	Do. (Z=23)
No. 2 sun gear		Displacement 31.40 (3teeth)	31.10 mm	Do. (Z=23)
No. 2 planetary gear		Displacement 43.67 (4teeth)	43.37 mm	Do. (Z=26)
No. 2 carrier internal spline		Overpin 112.24 (ø 10)	112.84 mm	Do. (Z=25)
No. 3 sun gear		Displacement 54.92 (4teeth)	54.62 mm	Do. (Z=25)
No. 3 planetary gear		Displacement 54.93 (3teeth)	54.63 mm	Do. (Z=22)
Ring gear (3rd stages)		Overpin 348.74 (ø 8.5)	349.34 mm	Do. (Z=71)
Crack and flaking of bearing inner/outer races and rollers		-	-	Replacement if crack or flaking is found.
Crack and flaking of 1st/2nd/3rd planetary gears and pins		-	-	Replacement if crack or flaking is found.

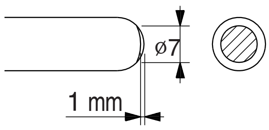
Part name & inspection item	Standard dimension	Recommended value for replacement	Remedy
Radial clearance of needle bearing	0.01-0.04 mm	0.07 mm	Replacement of abnormal parts as a set.
Crack of spline contact part	-	-	Replacement if such damage as crack, crevice of chipping is found.
Backlash of spline contact part	0.1-0.3 mm	0.5 mm	Dimension check and replacement according to following standards.
Thrust ring (026)	7 mm thick	6.6 mm	Replacement if severe wear or seizure is found on sliding surface.
Thrust ring (027)	8 mm thick	7.6 mm	
Floating seal	-	-	Replacement of scratch or rust is found in sliding surface. Replacement if O-ring is deformed of damaged.
Gear oil	SAE 85W-140 (API GL-5)	-	1st time : 500hr 2nd time and later : Every 2000hr After disassembling, fill with new oil without fail. The above times are measured with engine hour meter.

5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000 cc/m at neutral handle position, or more than 2000 cc/m during operation.	Conditions : Primary pressure : 40 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μ m, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

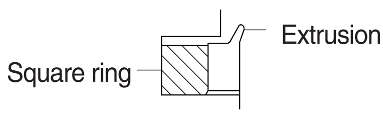
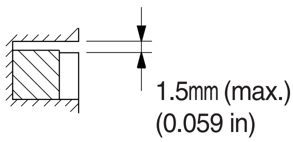
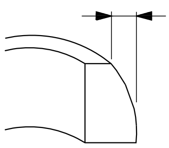
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

6. RCV PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	Conditions : Primary pressure : 40 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10μ m, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

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

7. TURNING JOINT

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

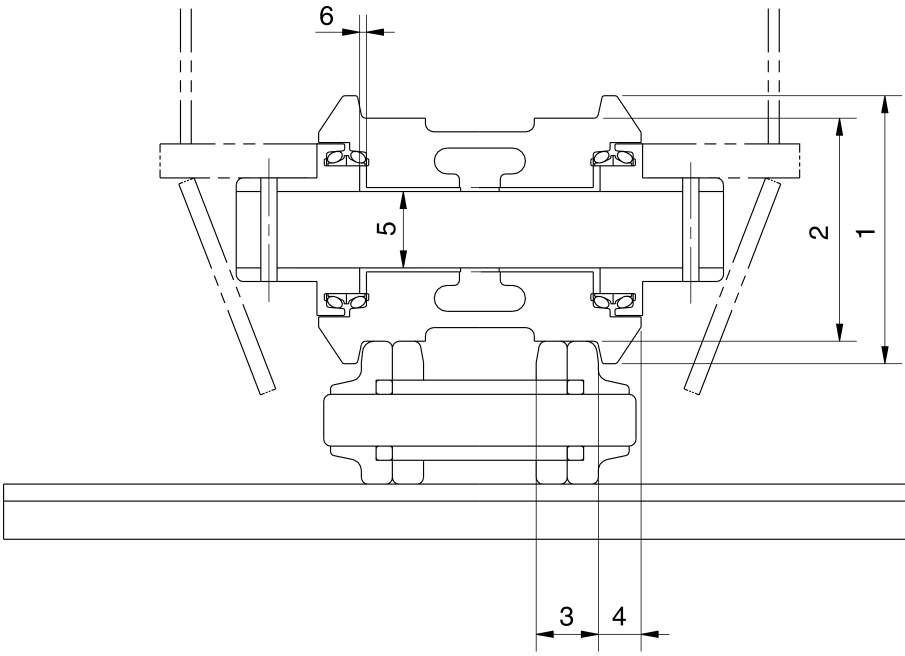
8. CYLINDER

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

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER

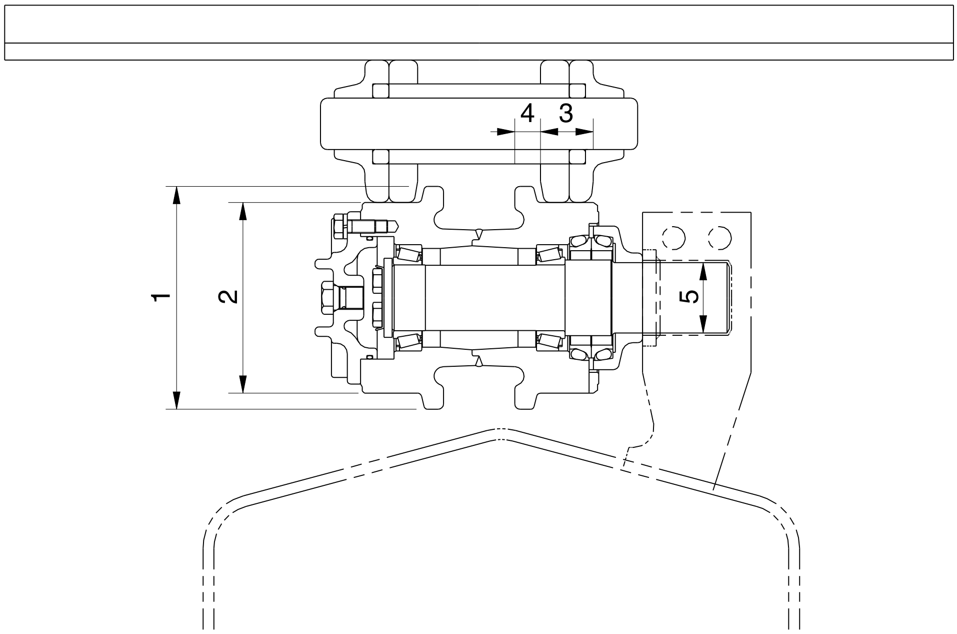


21037MS01

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		ø 250		-		
2	Outside diameter of tread	ø 200		ø 188		
3	Width of tread	54.6		60.6		
4	Width of flange	34.4		-		
5	Clearance between shaft and bushin	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		ø 85 $^{-0.25}_{-0.35}$	ø 85 $^{+0.176}_{+0.029}$	0.279 to 0.526	2.0	
6	Side clearance of roller (Both side)	Standard clearance		Clearance limit		Replace
		0.12~1.3		2.0		

2) CARRIER ROLLER



21037MS02

Unit : ㎜

<table>
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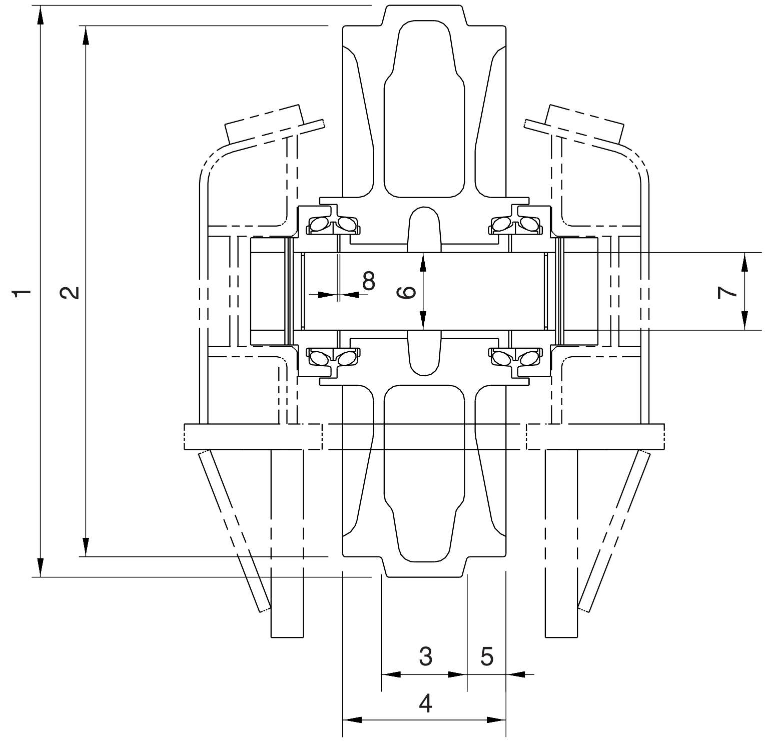
<tr><td colspan="2">ø 200</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 191</td><td colspan="2">ø 181</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">51</td><td colspan="2">56</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">20</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and support</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>ø 57.15 $^{0}_{-0.1}$</td><td>ø 57.15 $^{+0.3}_{+0.1}$</td><td>0.1 to 0.4</td><td>1.2</td></tr>
</table>

3) IDLER

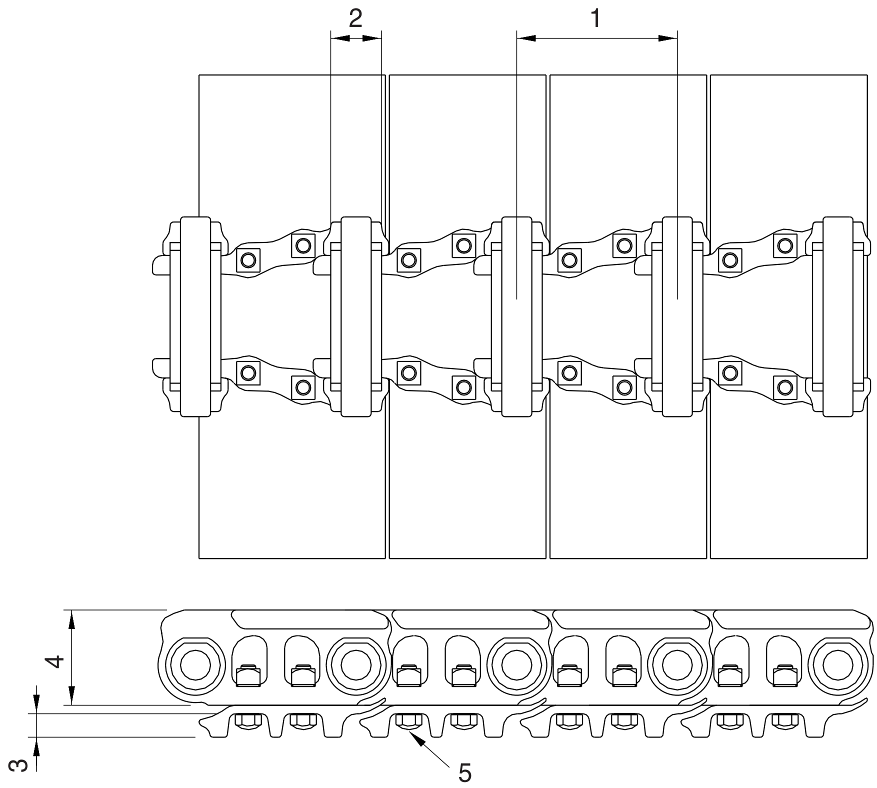


21037MS03

Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protrusion</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">ø 646</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 594</td><td colspan="2">ø 580</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">102</td><td colspan="2">-</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">203</td><td colspan="2">-</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">50.5</td><td colspan="2">57.5</td><td></td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and support</td><td colspan="2">Standard size & tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>ø 85 $^{0}_{-0.035}$</td><td>ø 85.35 $^{+0.05}_{0}$</td><td>0.35 to 0.435</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>ø 85 $^{0}_{-0.035}$</td><td>ø 85 $^{+0.09}_{+0.036}$</td><td>0.036 to 0.125</td><td>1.2</td><td>Replace</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Side clearance of idler (Both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">0.25 to 1.2</td><td colspan="2">2.0</td></tr>
</table>

4) TRACK

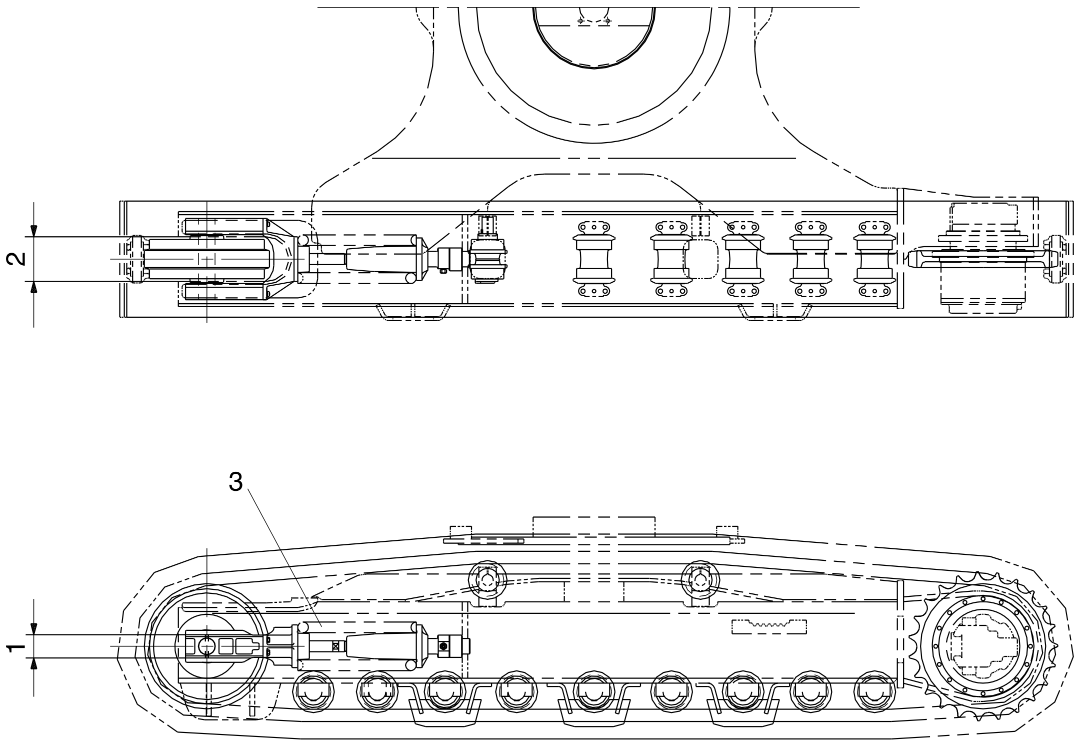


21037MS04

Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		215.9	220.9	
2	Outside diameter of bushing	ø 71	ø 60.4	Rebuild or replace
3	Height of grouser	36	21	
4	Height of link	129	115	
5	Tightening torque	Initial tightening torque : 140 ± 14 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING



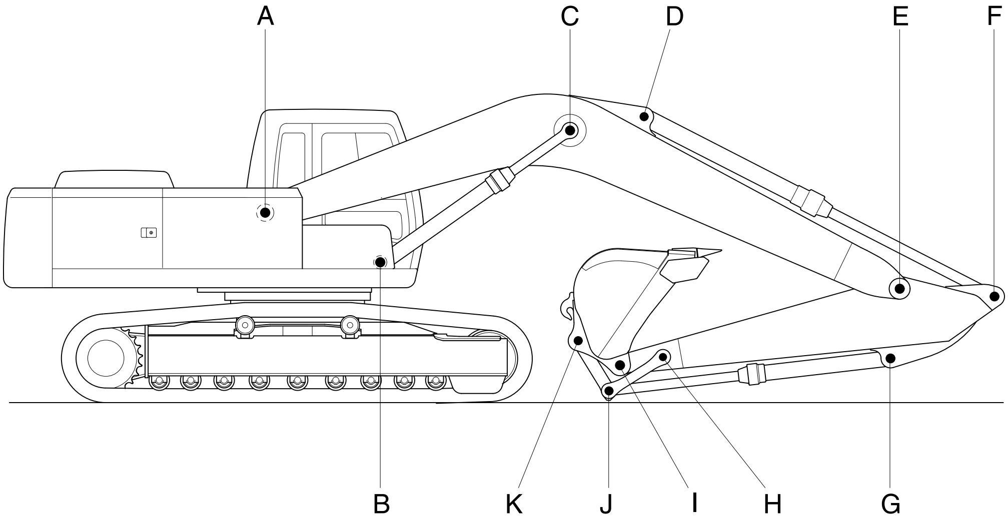
21037MS05

Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width of idler guide</td><td></td><td>Standard size</td><td>Tolerance</td><td>Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td>Track frame</td><td>123</td><td>+2
-1</td><td>127</td></tr>
<tr><td>Idler support</td><td>120</td><td>0
- 1.5</td><td>116</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td>292</td><td>+2
-1</td><td>296</td></tr>
<tr><td>Idler support</td><td>290</td><td>-</td><td>287</td></tr>
</table>

<table>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>ø 254 × 740</td><td>595</td><td>24500 kg</td><td>-</td><td>19600 kg</td></tr>
</table>

2. WORK EQUIPMENT



21077MS20

Unit : ㎜

Mark	Measuring point (Pin and Bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom Rear	120	119	118.5	120.5	121	Replacement
B	Boom Cylinder Head	100	99	98.5	100.5	101	〃
C	Boom Cylinder Rod	110	109	108.5	110.5	111	〃
D	Arm Cylinder Head	110	109	108.5	110.5	111	〃
E	Boom Front	110	109	108.5	110.5	111	〃
F	Arm Cylinder Rod	110	109	108.5	110.5	111	〃
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	98.5	100.5	101	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

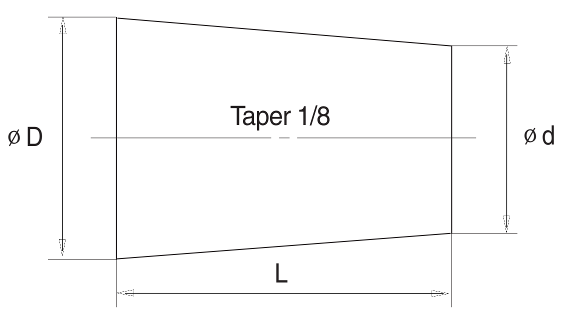
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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



2. INSTALL WORK

1) Tighten all bolts and nuts(Sleeve nuts) to the specified torque.

2) Install the hoses without twisting or interference.

3) Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.

4) Bend the cotter pin or lock plate securely.

5) When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.

6) When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.

7) Clean all parts, and correct any damage, dents, burrs, or rust.

8) Coat rotating parts and sliding parts with engine oil.

9) When press fitting parts, coat the surface with antifriction compound(LM-P).

10) After installing snap rings, check that the snap ring is fitted securely in the ring groove(Check that the snap ring moves in the direction of rotation).

11) When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.

12) When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.

13) When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

14) When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:

(1) Start the engine and run at low idling.

(2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100mm before the end of the stroke.

(3) Next, operate the piston rod to the end of its stroke to relieve the circuit. (The air bleed valve is actuated to bleed the air.)

(4) After completing this operation, raise the engine speed to the normal operating condition.

※ If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to the work equipment.

※ Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

3. COMPLETING WORK

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

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

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

4) Add the specified amount of grease (molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket)	M14 × 2.0	14.5 ± 2.5	10.5 ± 18.1
2		Engine mounting bolt (bracket-frame)	M22 × 2.5	4.8 ± 2.0	34.7 ± 14
3		Radiator mounting bolt	M16 × 2.0	22 ± 1.0	159 ± 7.2
4		Coupling mounting socket bolt	M20 × 2.5	46.5 ±2.5	336 ±18.1
5		Main pump housing mounting bolt	M10 × 1.5	4.8 ± 0.3	24.7 ± 2.2
5	Hydraulic system	Main pump mounting socket bolt	M20 × 2.5	42 ± 4.5	304 ± 32.5
6		Main control valve mounting nut	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
7		Fuel tank mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
8		Hydraulic oil tank mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
9		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
10	Power train system	Swing motor mounting bolt	M24 × 3.0	97.8 ± 15	707 ± 108
11		Swing bearing upper part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
12		Swing bearing lower part mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
13		Travel motor mounting bolt	M20 × 2.5	58 ± 6.0	420 ± 43.4
14		Sprocket mounting bolt	M20 × 2.5	57.9 ± 6.0	419 ± 43.4
15	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7± 3.0	215 ± 21.7
16		Track roller mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
17		Track tension cylinder mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1
18		Track shoe mounting bolt, nut	M24 × 1.5	140 ± 5.0	1010 ± 36.2
19		Track guard mounting bolt	M24 × 3.0	77.4 ± 11	560 ± 79.6
21	Others	Counterweight mounting bolt	M36 × 3.0	308 ± 46	2228 ± 333
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 each component disassembly and assembly.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.73 ~ 4.12	19.7 ~ 29.8
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 79.5	9.8 ~ 15.8	71 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 167
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 343
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	350 ~ 457	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.5	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1655
M36 × 4.0	174 ~ 236	1261 ~ 1703	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 8 × 1.0	2.17 ~ 3.37	15.7 ~ 24.3	3.04 ~ 4.44	22.0 ~ 32.0
M10 × 1.25	4.46 ~ 6.66	32.3 ~ 48.2	5.93 ~ 8.93	42.9 ~ 64.6
M12 × 1.25	7.78 ~ 11.58	76.3 ~ 83.7	10.6 ~ 16.0	76.6 ~ 115
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 130	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 194	26.6 ~ 36.0	193 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 390	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 515	70.7 ~ 95.7	512 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 664	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1338	182 ~ 248	1314 ~ 1795
M36 × 3.0	192 ~ 260	1389 ~ 1879	262 ~ 354	1893 ~ 2561
M36 × 4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

2) PIPE AND HOSE (FLARE TYPE)

Thread size (PF)	Width across flat (mm)	kgf·m	lbf·ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS TYPE)

Thread size (UNF)	Width across flat (mm)	kgf·m	lbf·ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat(mm)	kgf·m	lbf·ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

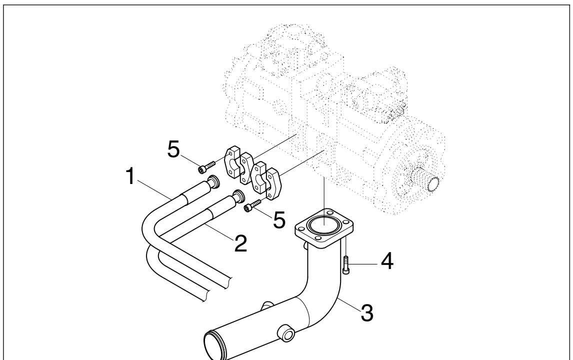
⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**


13031GE18

(4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 230 ℓ

(5) Remove socket bolts (5) and disconnect pipes (1, 2).

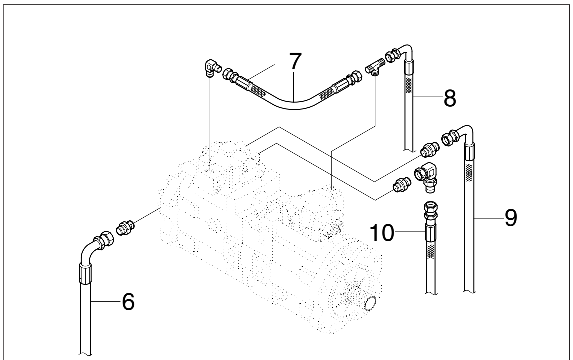


38098MP01

(6) Disconnect pilot line hoses (6, 7, 8, 9, 10, 11, 12, 13).

(7) Remove socket bolts (4) and disconnect pump suction tube (3).

※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

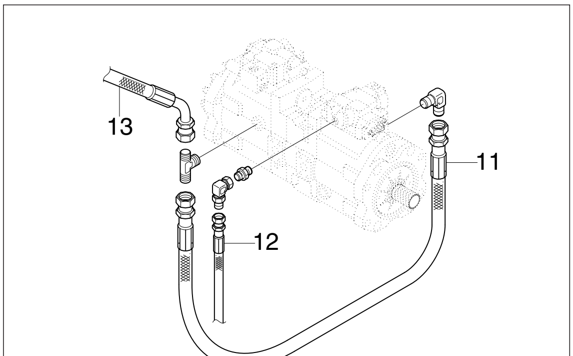


38098MP02

(8) Sling the pump assembly and remove the pump mounting bolts.

· Weight : 190 kg (420 lb)

※ Pull out the pump assembly from housing. When removing the pump assembly, check that all the hoses have been disconnected.



38098MP03

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

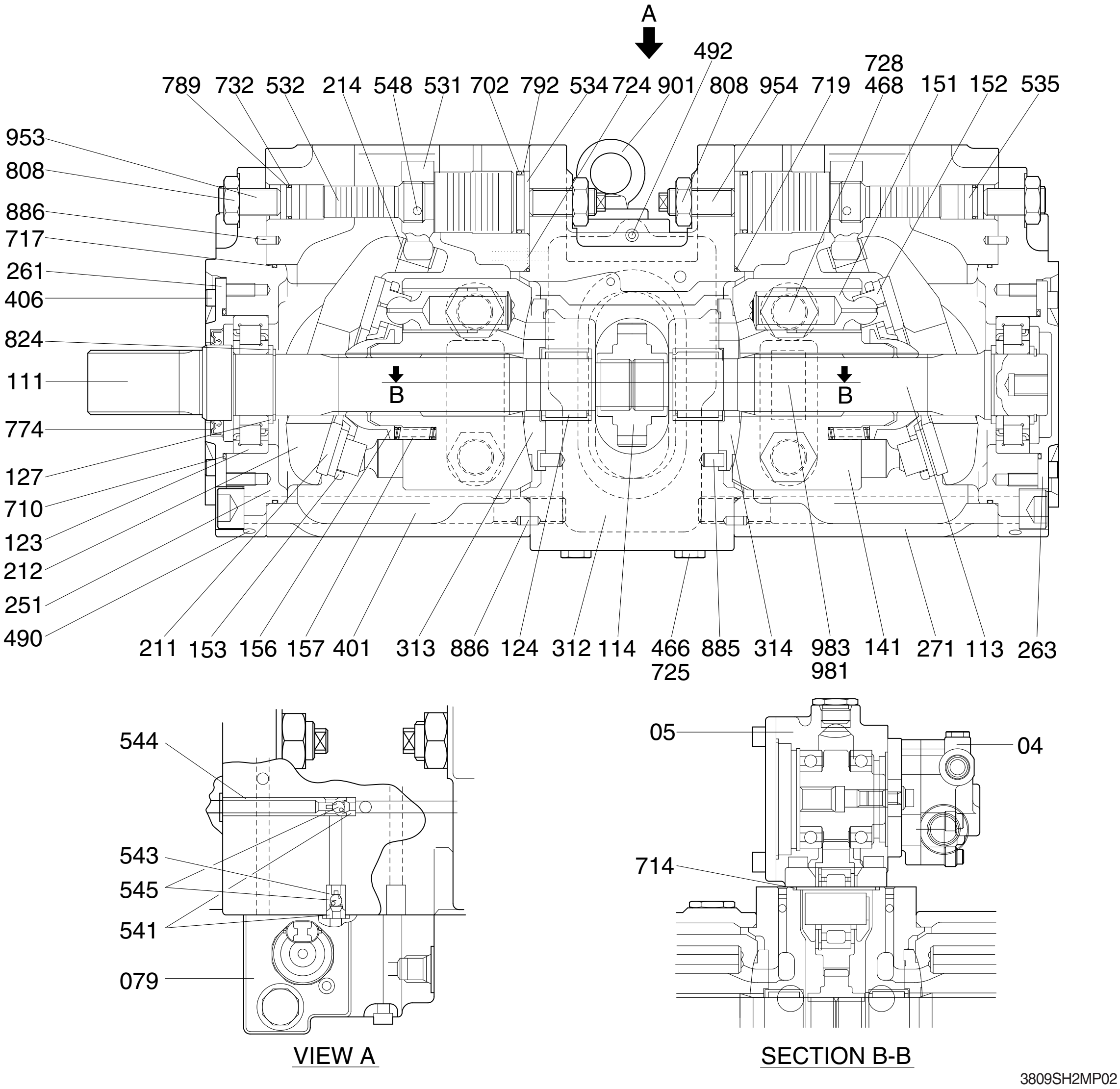
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

(8) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. MAIN PUMP (1/2)

1) STRUCTURE

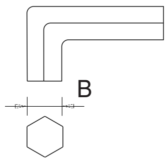


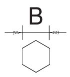
04	Gear pump	212	Swash plate	531	Tilting pin	725	O-ring
05	PTO unit	214	Bushing	532	Servo piston	728	O-ring
079	Proportional reducing valve	251	Support plate	534	Stopper (L)	732	O-ring
111	Drive shaft (F)	261	Seal cover (F)	535	Stopper (S)	774	Oil seal
113	Drive shaft (R)	263	Seal cover (R)	541	Seat	789	Back up ring
114	Spline coupling	271	Pump casing	543	Stopper	792	Back up ring
123	Roller bearing	312	Valve cover	544	Stopper	808	Hexagon head nut
124	Needle bearing	313	Valve plate (R)	545	Steel ball	824	Snap ring
127	Bearing spacer	314	Valve plate (L)	548	Feedback pin	885	Pin
141	Cylinder block	401	Hexagon screw	702	O-ring	886	Spring pin
151	Piston	406	Hexagon screw	710	O-ring	901	Eye bolt
152	Shoe	466	Plug	714	O-ring	953	Set screw
153	Set plate	468	Plug	717	O-ring	954	Adjust screw
156	Bushing	490	Plug	719	O-ring	981	Name plate
157	Cylinder spring	492	Plug	724	O-ring	983	Pin
211	Shoe plate						

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Tool name & size	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
Allen wrench 	4	M 5	BP-1/16	-	M 8
	5	M 6	BP1/ 8	-	M10
	6	M 8	BP-1/ 4	PO-1/4	M12, M14
	8	M10	BP-3/ 8	PO-3/8	M16, M18
	17	M20, M22	BP-1	PO-1, 1 1/4, 1 1/2	-

Tool name & size	B	Hexagon head bolt	Hexagon head bolt	VP plug (PF thread)
Double ring spanner, socket wrench, double (single) open end spanner 	19	M12	M12	VP-1/4
	24	M16	M16	-
	27	M18	M18	VP-1/2
	30	M20	M20	-
	36	-	-	VP-3/4

Tool name & size	Part name
Adjustable angle wrench	Medium size, 1 set
Screw driver	Minus type screw driver, Medium size, 2 sets
Hammer	Plastic hammer, 1 set
Pliers	For snap ring, TSR-160
Steel bar	Steel bar of key material approx. 10×8×200
Torque wrench	Capable of tightening with the specified torques

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT plug (material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF plug (material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

※ Select clean place.

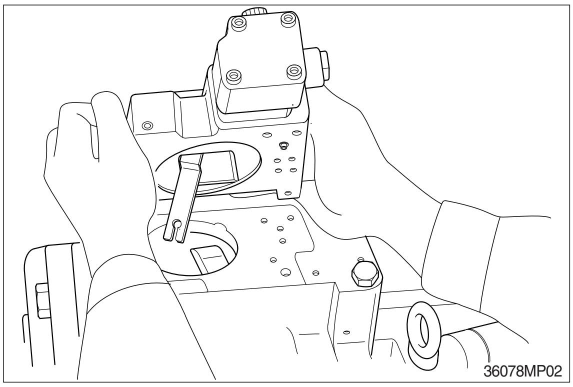
※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing (front and rear pump).

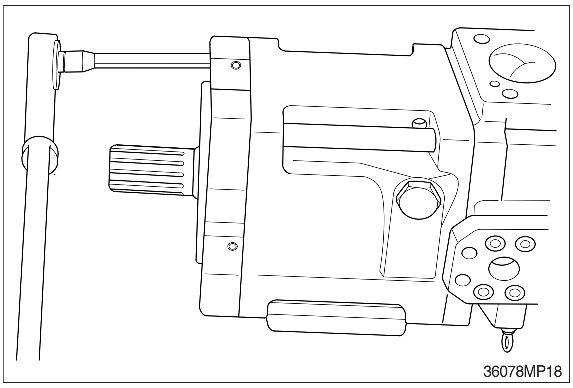
(4) Remove hexagon socket head bolts (412, 413) and remove regulator.

① Remove hexagon socket head bolt (435) and remove gear pump.



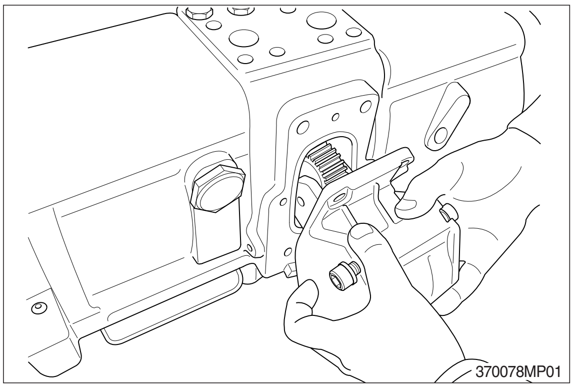
36078MP02

(5) Loosen hexagon screw (401) which tighten swash plate support (251), pump casing (271) and valve block (312).



36078MP18

② Remove flange socket bolt (435) and remove PTO unit.



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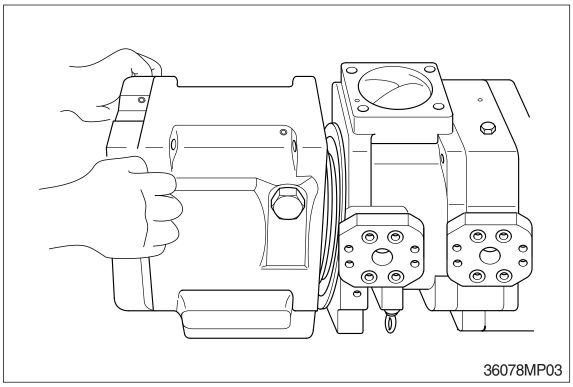
(7) Place pump horizontally on workbench with its regulator-fitting surface down, and separate pump casing (271) from valve cover (F, 312).

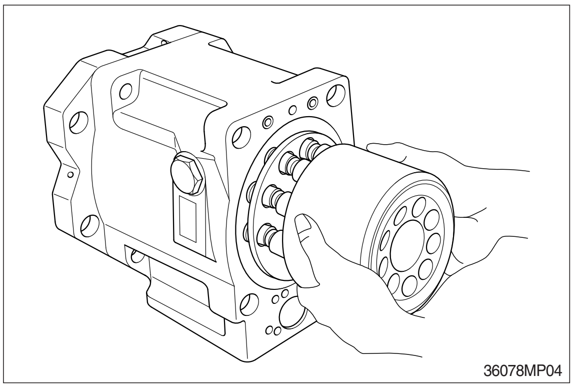
※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.



36078MP03

(8) Separate valve cover (R, 312) from pump casing and then pull out the cylinder block (141) of pump casing (271) straightly over drive shaft(R, 113). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.

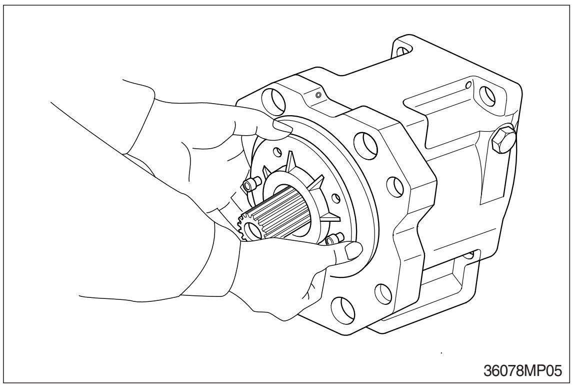


36078MP04

(9) Remove hexagon screw (406) and then seal cover (F, 261).

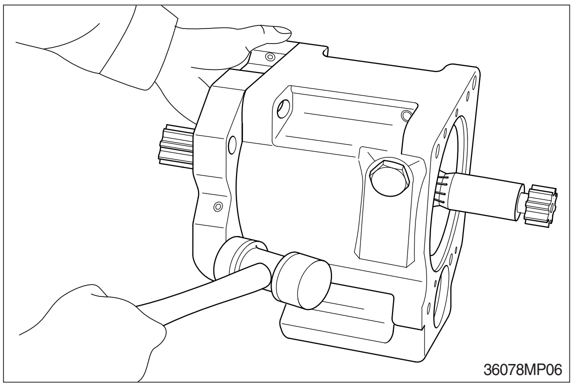
※ Fit bolt into pulling-out tapped hole of seal cover (F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover (F), take care not to damage it when removing cover.



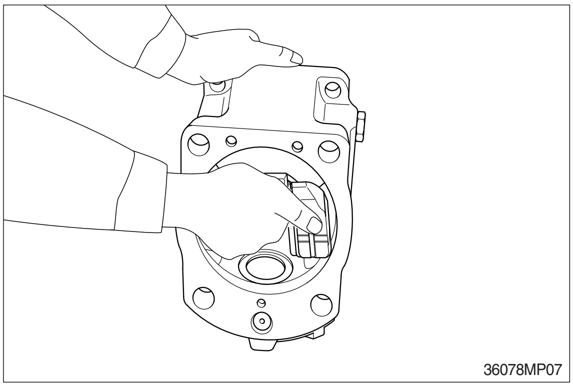
36078MP05

(10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



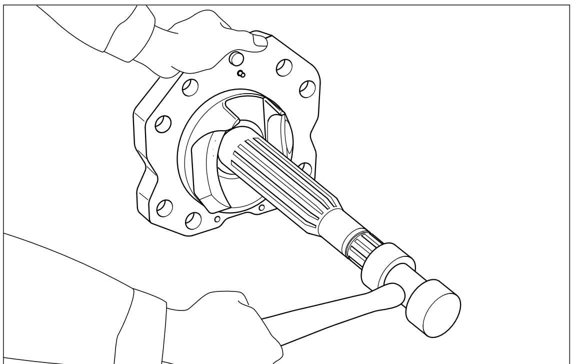
36078MP06

(11) Remove shoe plate (211) and swash plate (212) from pump casing (271).



36078MP07

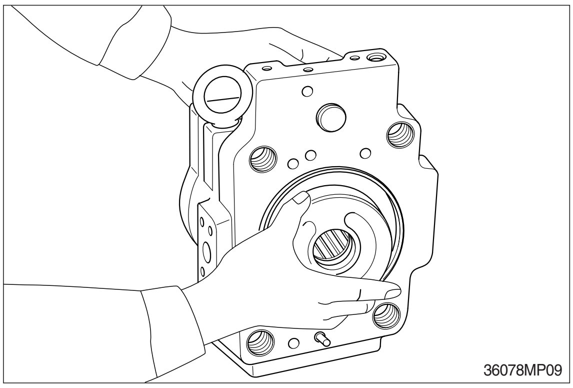
(12) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



36078MP08

(13) Remove valve plates (313, 314) from valve cover (312).

※ These may be removed in work 7, 9.



36078MP09

(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) from valve cover (312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve cover and swash plate support.
If loosened, flow setting will be changed.

(15) This is the end of disassembling procedures.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

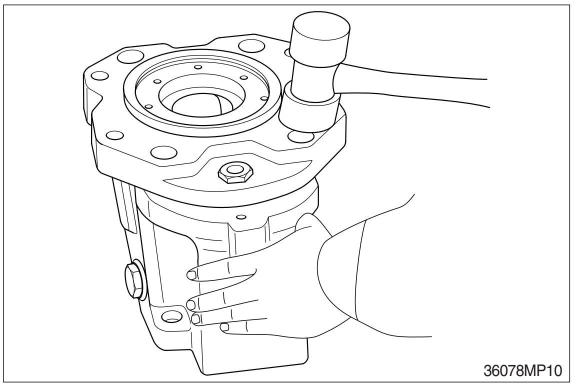
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-10, 11.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

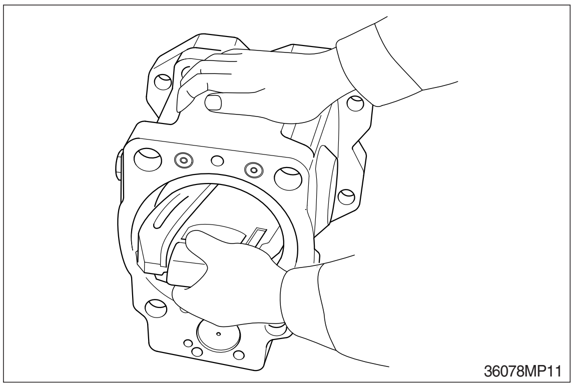
(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.

※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (medium strength) to their threaded sections.

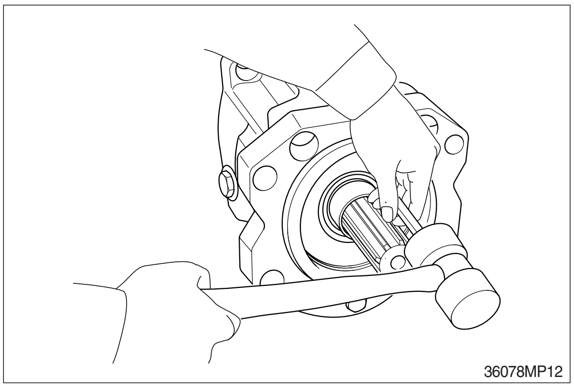

36078MP10

(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.
※ Confirm with fingers of both hands that swash plate can be removed smoothly.
※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.



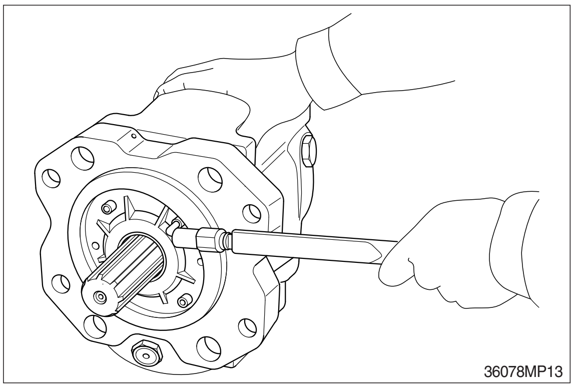
36078MP11

(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).
※ Do not tap drive shaft with hammer or so on.
※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.
Fit them fully, using steel bar or so on.



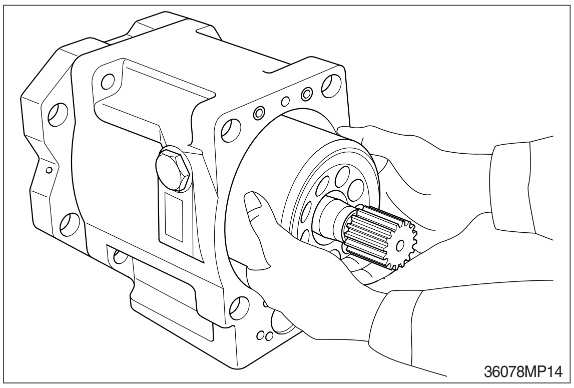
36078MP12

(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon screw (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 (261) similarly.



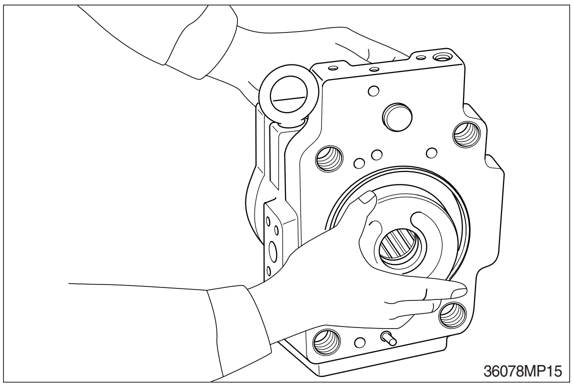
36078MP13

(6) Assemble piston cylinder subassembly [cylinder block (141), piston subassembly (151, 152), set plate (153), spherical bushing (156) and cylinder spring (157)].
Fit spline phases of retainer and cylinder.
Then, insert piston cylinder subassembly into pump casing (271).

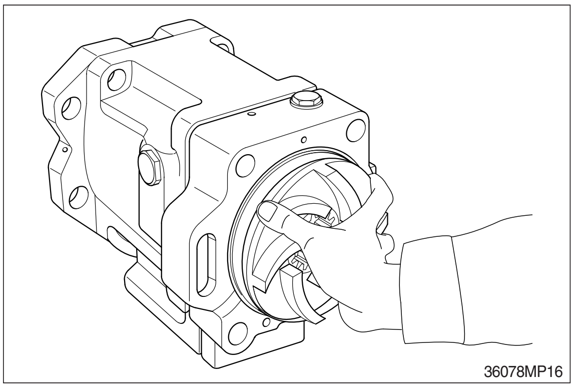


36078MP14

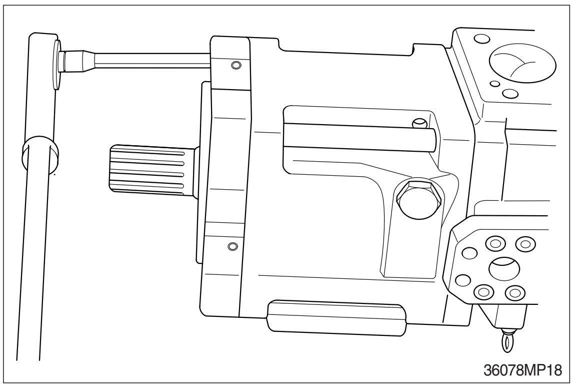
(7) Fit valve plate (313) to valve cover (F, 312), and fit valve plate (314) to valve cover (R, 312), entering pin into pin hole.
※ Take care not to mistake suction / delivery directions of valve plate.


36078MP15

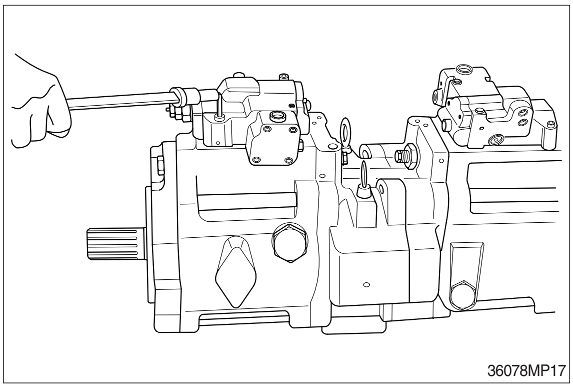
(8) Fit valve block (R, 312) to pump casing (271) and fit spline coupling (114) to shaft (R, 113).
※ Take care not to mistake direction of valve cover (312).
※ Fit valve cover with regulator up and with delivery flange left, viewed from front side.


36078MP16

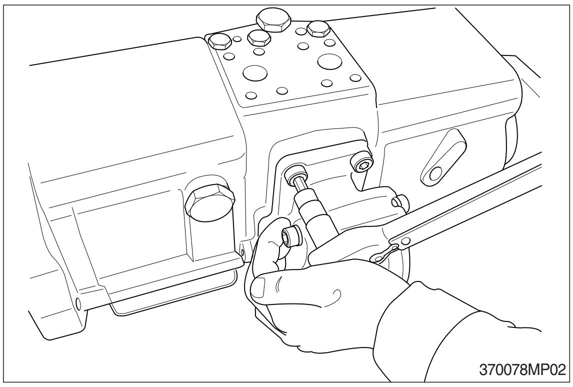
(9) Fit pump casing (271) with shaft (F, 111) to valve cover (F, 312) and tighten hexagon screw (401).
※ Mate spline phases of shaft (F) and spline coupling, with shaft (F) been rotating.


36078MP18

(10) 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.


36078MP17

(11) Attach the PTO unit by fastening the flange socket bolt (435) to the valve block (312).

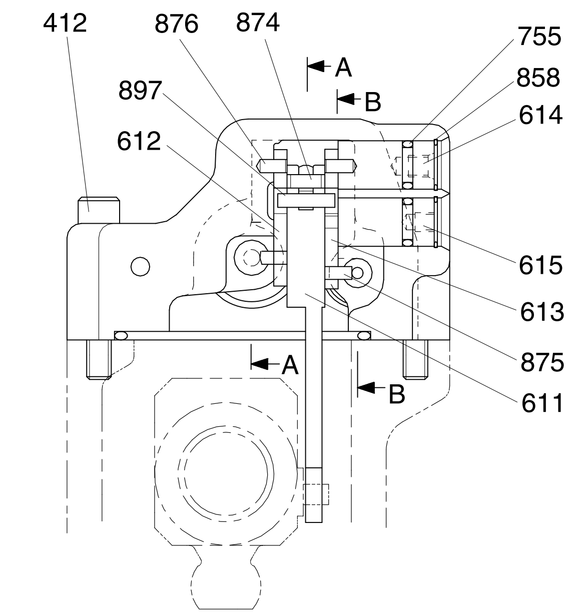


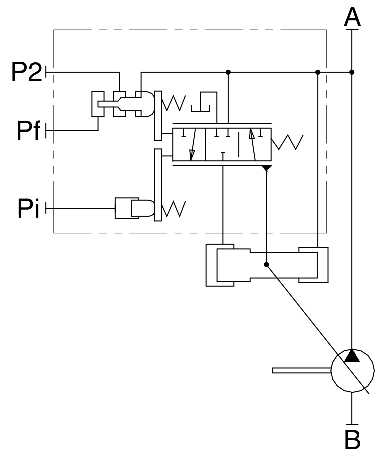
(12) Fit drain port plug (468).

This is the end of reassembling procedures.

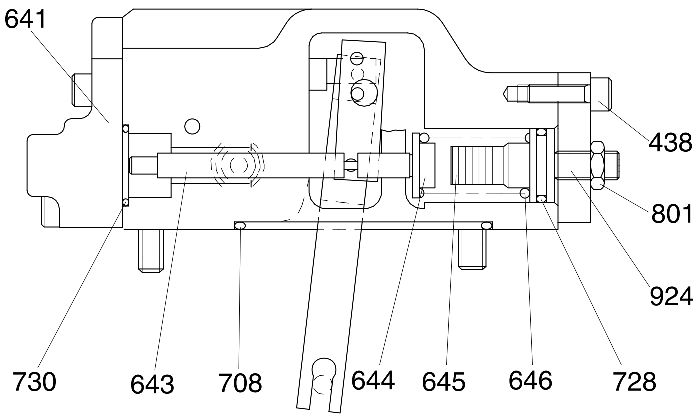
3. REGULATOR

1) STRUCTURE(1/2)

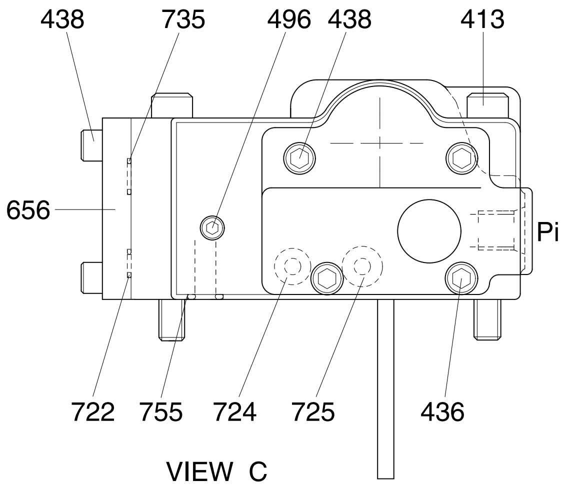




Hydraulic circuit



SECTION B-B

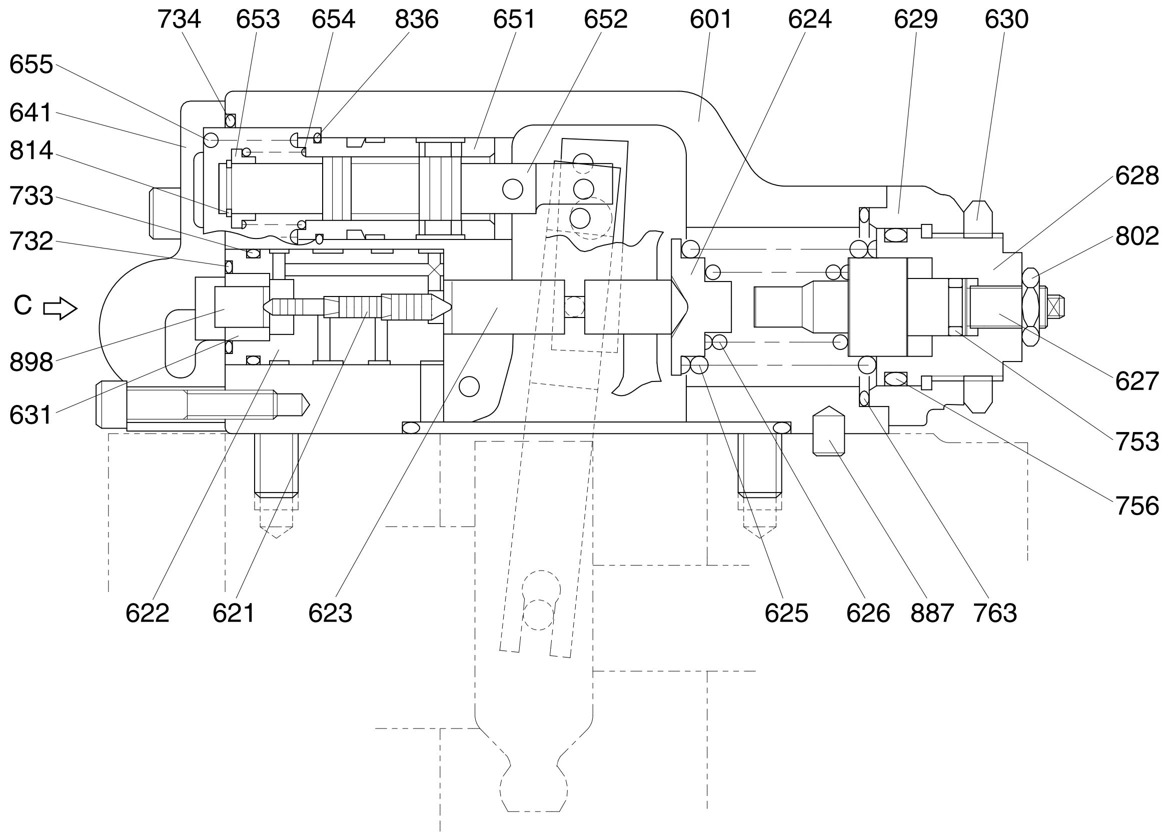


VIEW C

Port	Port name	Port size
Pi1,Pi2	Pilot port	PF 1/4-15
Psv1,Psv2	Servo assist port	PF 1/4-15

3809SH2RG01

2) STRUCTURE (2/2)



SECTION A-A

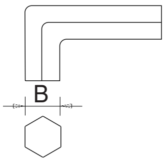
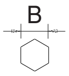
3809SH2RG02

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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><th colspan="2">Tool name & size</th><th colspan="12">Part name</th></tr>
<tr><td rowspan="4">Allen wrench
</td><td>B</td><td colspan="3">Hexagon socket head bolt</td><td colspan="3">PT plug (PT thread)</td><td colspan="3">PO plug (PF thread)</td><td colspan="3">Hexagon socket head setscrew</td></tr>
<tr><td>4</td><td colspan="3">M 5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M 6</td><td colspan="3">BP1/ 8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M 8</td><td colspan="3">BP-1/ 4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double (single) open end spanner
</td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon head nut</td><td colspan="4">VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="4">M8</td><td colspan="4">M8</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Small size, Max 36 mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="12">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="12">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="12">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="12">4×100 mm</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="12">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="12">M4, Length : 50mm</td></tr>
</table>

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT plug (material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF plug (material : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

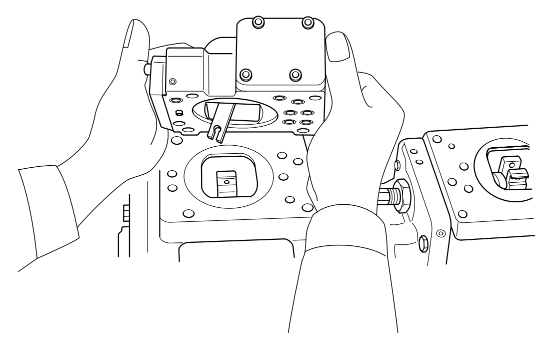
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.



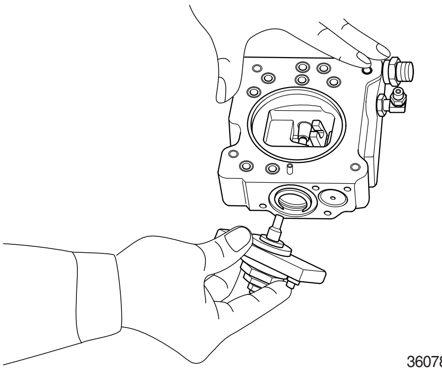
36078RE01

(4) Remove hexagon socket head screw (438) and remove cover (C,629)

※ Cover (C) is fitted with adjusting screw (C,QI) (628), adjusting stem (C, 627), lock nut (630), hexagon nut (801) and set screw (924).

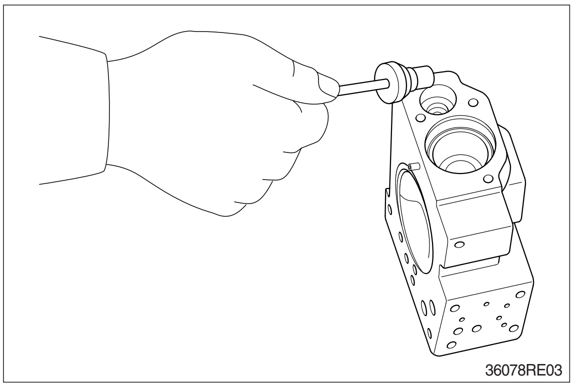
Do not loosen these screws and nuts.

If they are loosened, adjusted pressure-flow setting will vary.

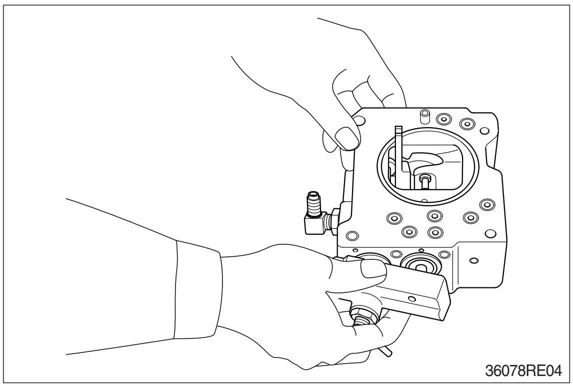


36078RE02

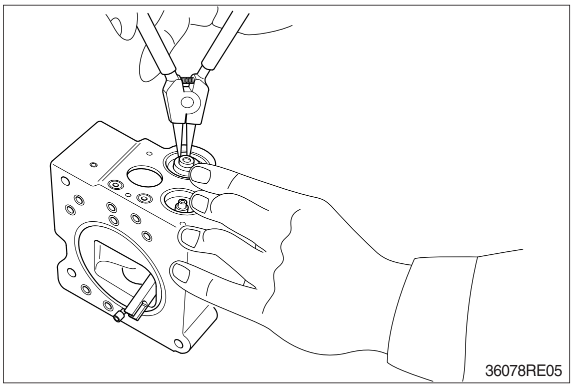
(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting stem (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
※ Adjusting stem (Q,645) can easily be drawn out with M4 bolt.


36078RE03

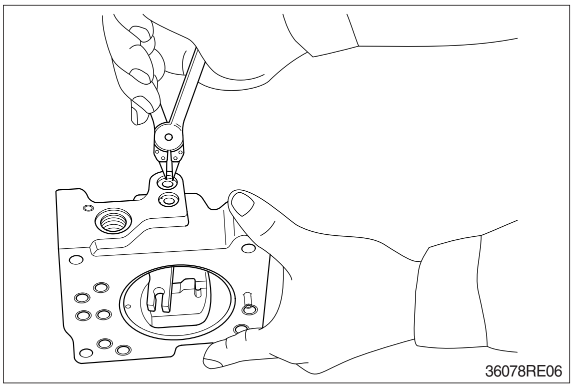
(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.

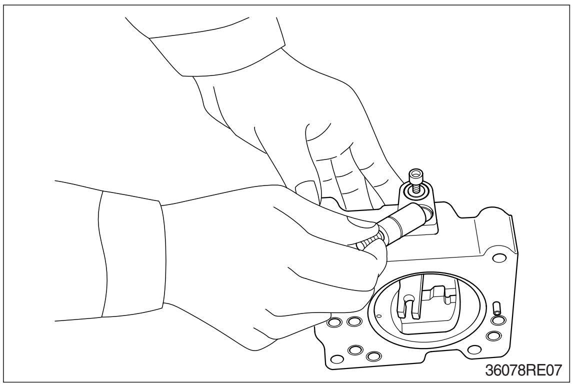

36078RE04

(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
Sleeve (651) is fitted with snap ring (836).
※ When removing snap ring (814), return spring (654) may pop out.
※ Take care not to lose it.

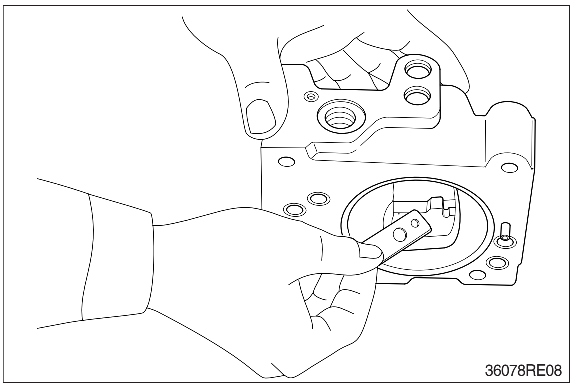

36078RE05

(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.

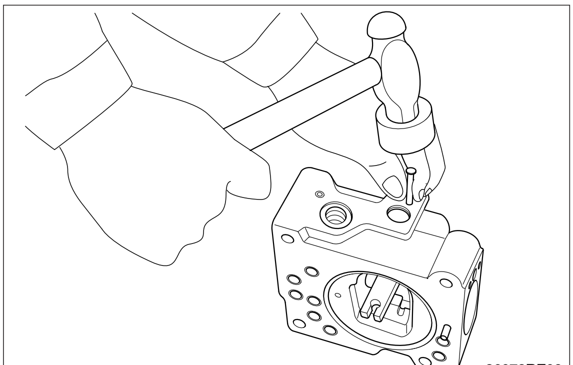

36078RE06

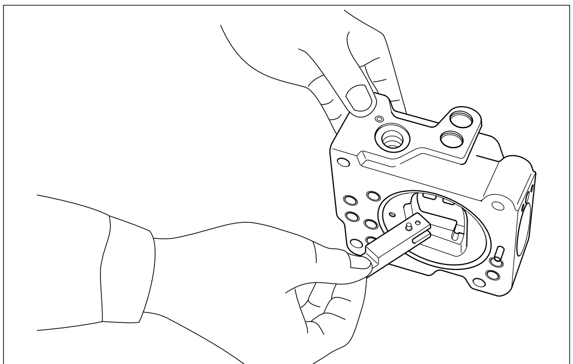

36078RE07

(9) Remove lever2 (613). Do not draw out pin (875).
※ Work will be promoted by using pincers or so on.


36078RE08

(10) Draw out pin (874) and remove feedback lever (611).
※ Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever1 (612).


36078RE09


36078RE10

(11) Remove lever1 (612). Do not draw out pin (875).

(12) Draw out pilot piston (643) and spool (652).

(13) Draw out piston case (622), compensating piston (621) and compensating rod (623).

※ Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand.
Mixing of foreign matter will cause malfunction.

③ Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

④ Always tighten bolts, plugs, etc. to their specified torques.

⑤ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.
Replace seals such as O-ring with new ones as a rule.

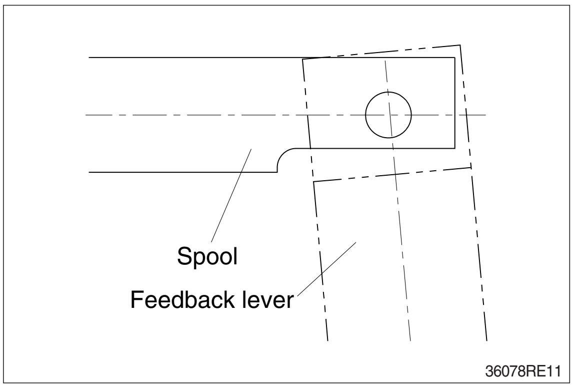
(2) Put compensating rod (623) into compensating hole of casing(601).

(3) Put pin force-fitted in lever1 (612) into groove of compensating rod and fit lever 1 to pin force-fitted in casing.

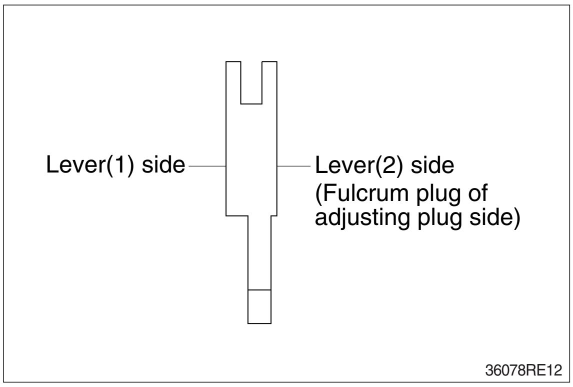
(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.

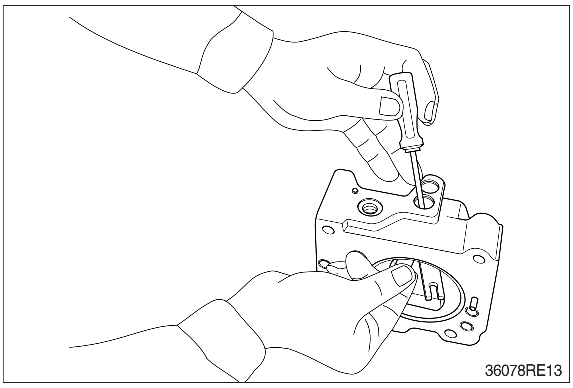


(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



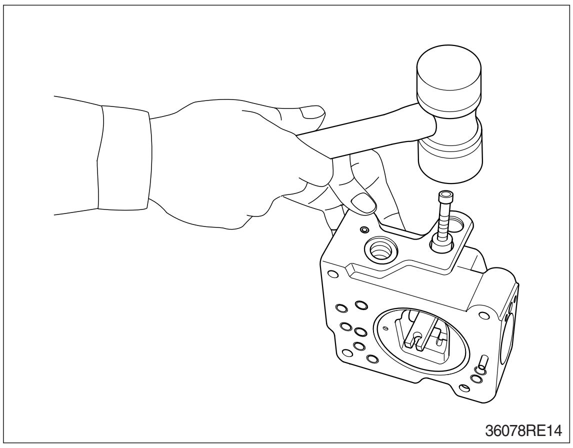
(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

(7) Put pin force-fitted in lever2 (613) into groove of pilot piston.
Then fix lever (2).

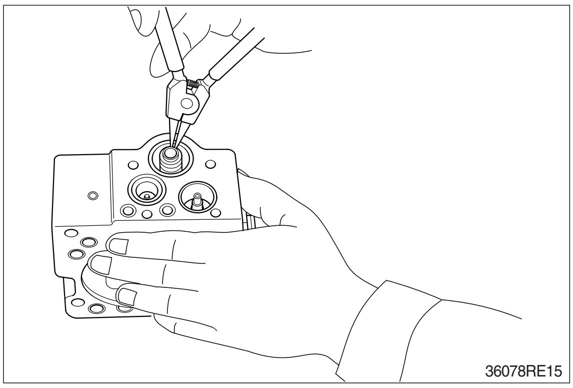


(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever (2).
Then fix locking ring (858).

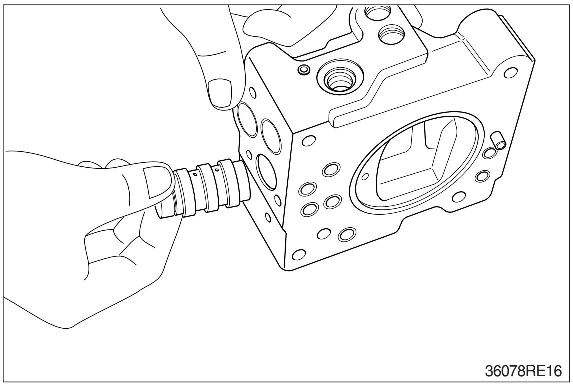
(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.



(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).



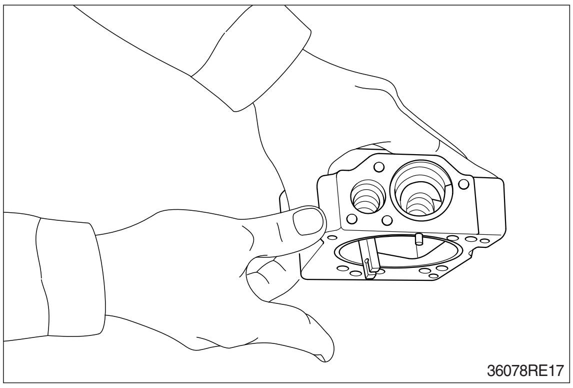
(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).



36078RE16

(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.

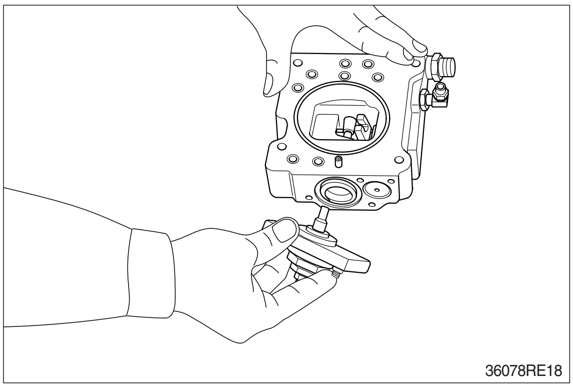
※ When fitting spring seat, take care not to mistake direction of spring seat.



36078RE17

(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting stem (C, 627), lock nut (630), hexagon nut (802) and set screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.



36078RE18

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

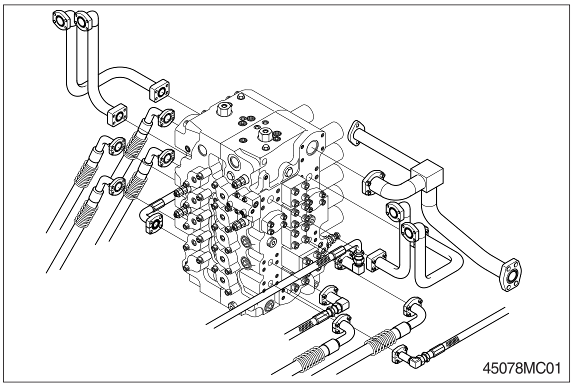
13031GE18

(4) Remove the wirings for the pressure sensor and so on.

(5) Remove bolts and disconnect pipe.

(6) Disconnect pilot line hoses.

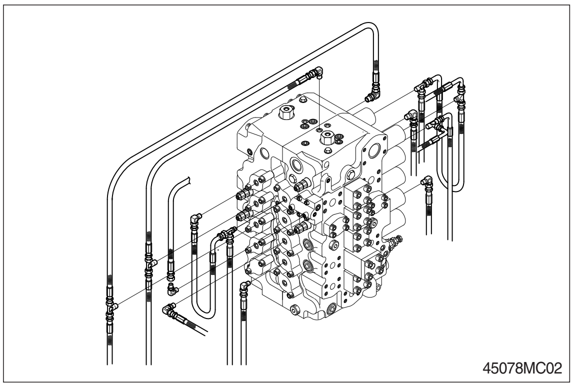
(7) Disconnect pilot piping.



45078MC01

(8) Sling the control valve assembly and remove the control valve mounting bolt.
  · Weight : 420 ㎏ (930 ㏈)

(9) Remove the control valve assembly.
When removing the control valve assembly, check that all the piping have been disconnected.



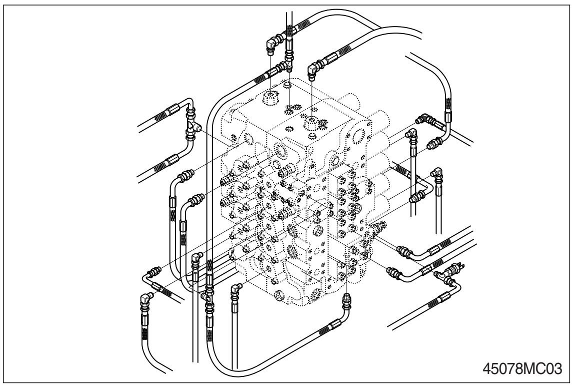
45078MC02

2) INSTALL

(1) Carry out installation in the reverse order to removal.

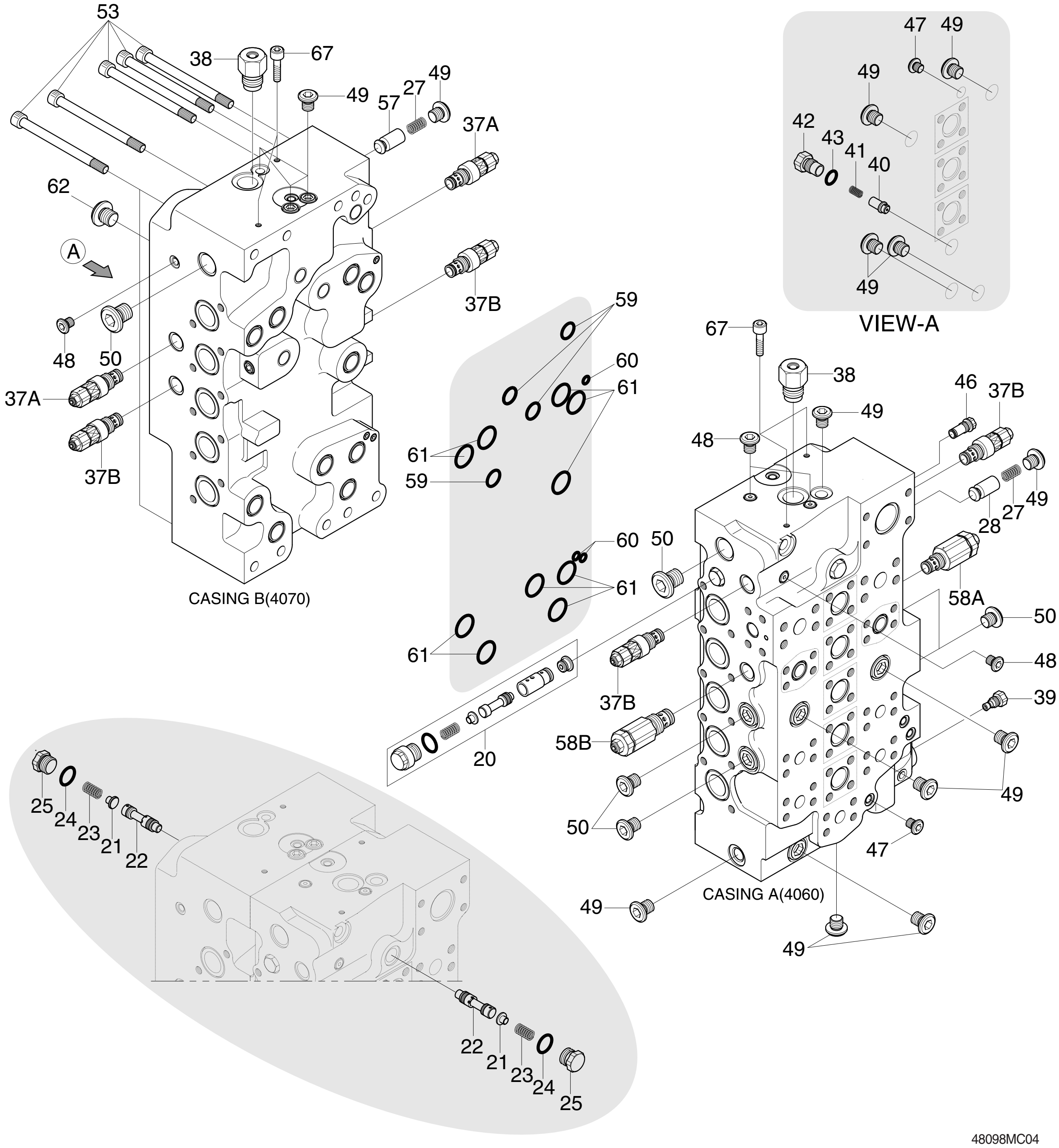
(2) Bleed the air from below items.
  ① Cylinder (boom, arm, bucket)
  ② Swing motor
  ③ Travel motor
  ※ See each item removal and install.

(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.



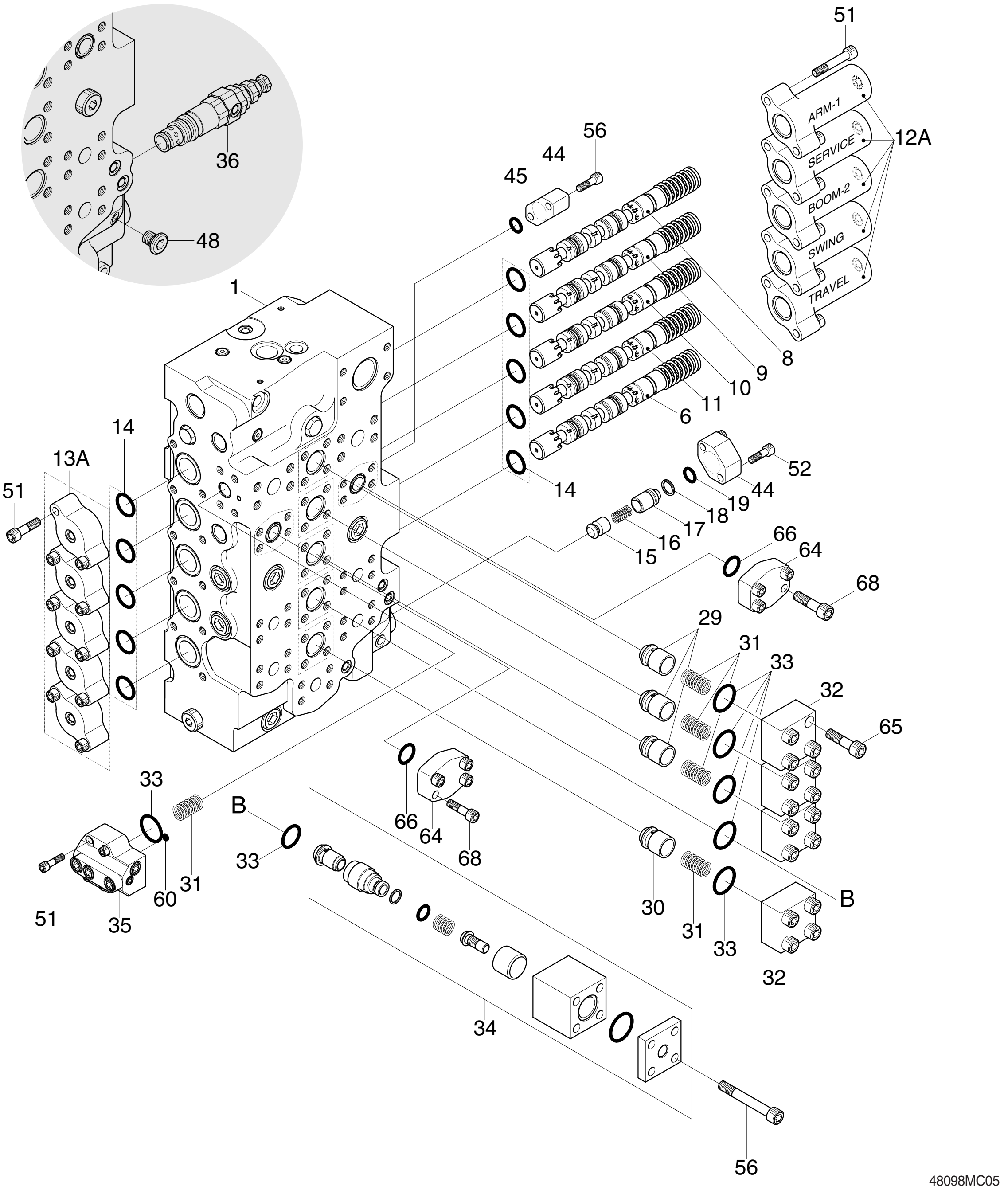
45078MC03

2. STRUCTURE (1/3)



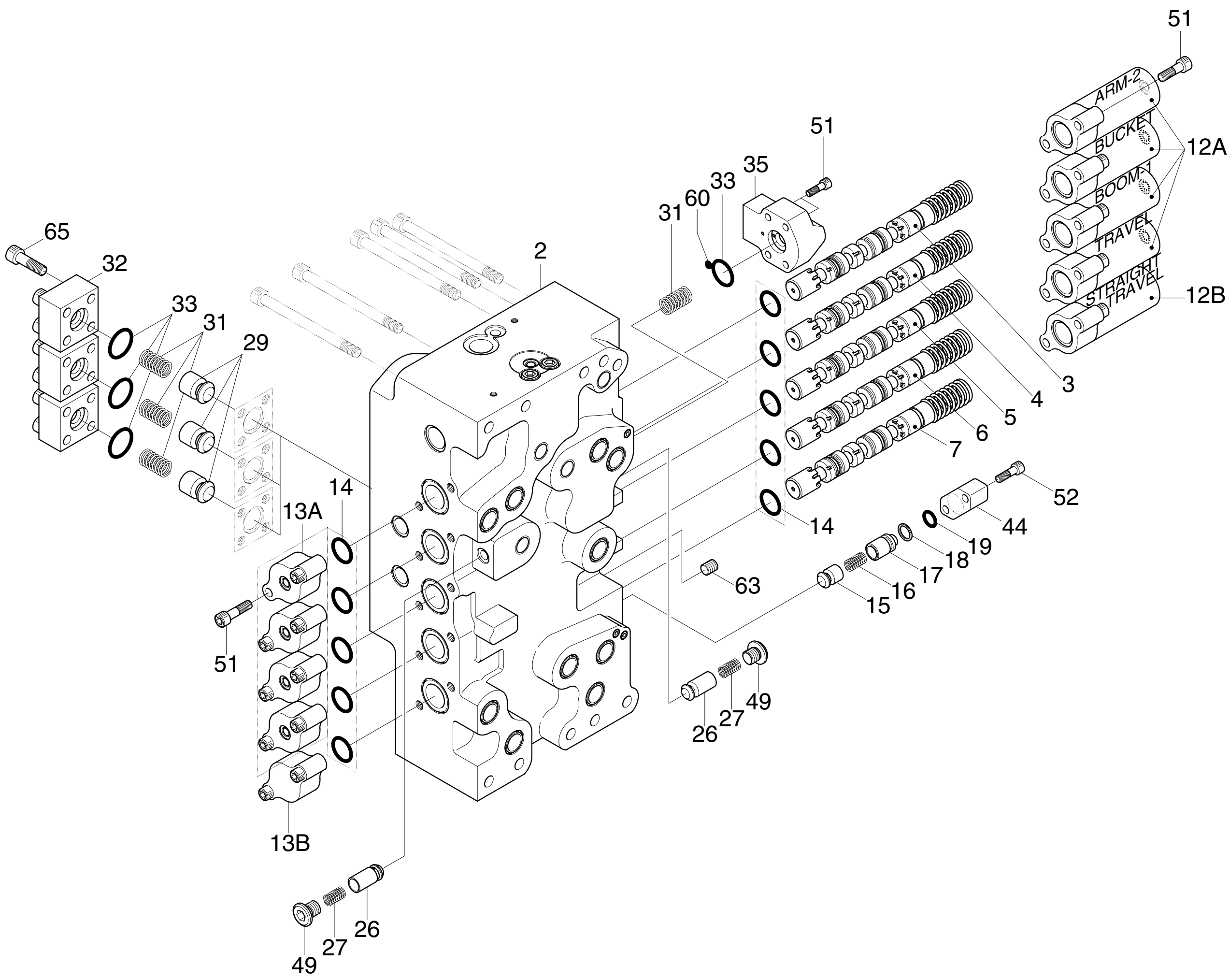
20	Spool assy	38	Negacon valve assy	50	Plug assy
21	Spring seat	39	Plug assy	53	Socket head bolt
22	Spool assy	40	Poppet	57	Poppet
23	Spring	41	Spring	58A	Service relief valve
24	O-ring	42	Plug	58B	Service relief valve
25	Plug	43	O-ring	59	O-ring
27	Spring	46	Plug assy	60	O-ring
28	Poppet	47	Plug assy	61	O-ring
37A	Overload valve	48	Plug assy	62	Plug
37B	Overload valve	49	Plug assy	67	Socket head bolt

STRUCTURE (2/3)



1	Housing	17	Spacer	44	Flange
6	Spool assy	18	O-ring	45	O-ring
8	Spool assy	19	Back up ring	48	Plug assy
9	Spool assy	29	Poppet	51	Socket head bolt
10	Spool assy	30	Poppet	52	Socket head bolt
11	Spool assy	31	Spring	56	Socket head bolt
12A	Cap	32	Flange	60	O-ring
13A	Flange	33	O-ring	64	Flange
14	O-ring	34	Swing priority assy	65	Socket head bolt
15	Poppet	35	H/D valve assy	66	O-ring
16	Spring	36	M/R valve assy	68	Socket head bolt

STRUCTURE (3/3)

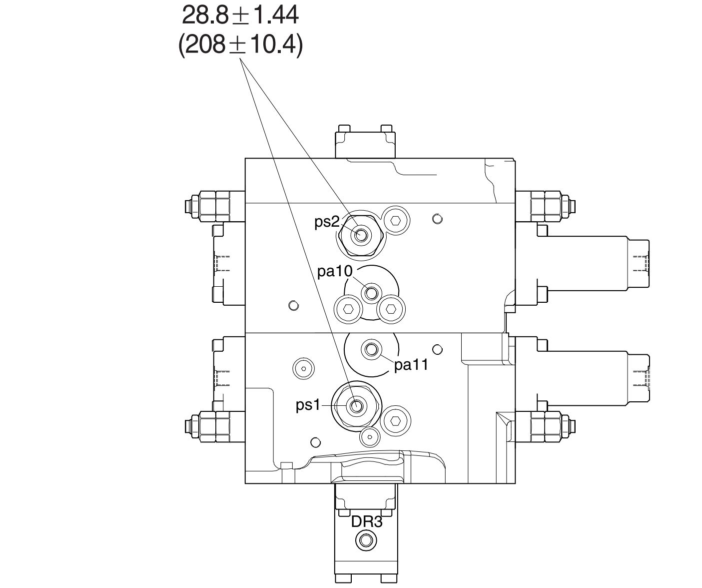


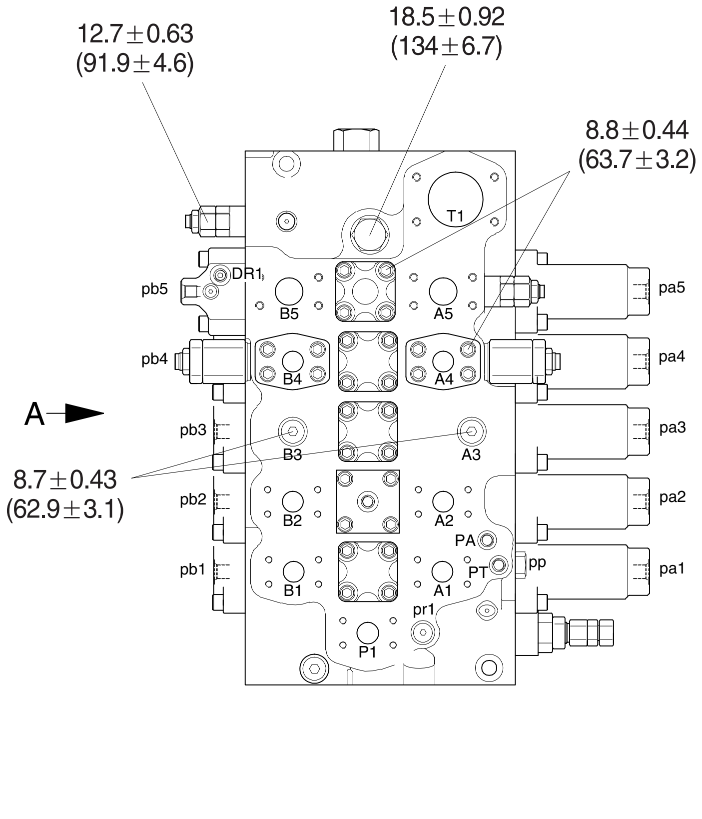
48098MC06

2	Housing	14	O-ring	32	Flange
3	Spool assy	15	Poppet	33	O-ring
4	Spool assy	16	Spring	35	H/D valve assy
5	Spool assy	17	Spacer	44	Flange
6	Spool assy	18	O-ring	49	Plug assy
7	Spool assy	19	Back up ring	51	Socket head bolt
12A	Spool cap-A	26	Poppet	52	Bolt
12B	Spool cap-B	27	Spring	60	O-ring
13A	Spool flange-A	29	Poppet	63	Plug
13B	Spool flange-B	31	Spring	65	Socket head bolt

3. TIGHTENING TORQUE (1/2)

※ Unit : kgf · m (lbf · ft)

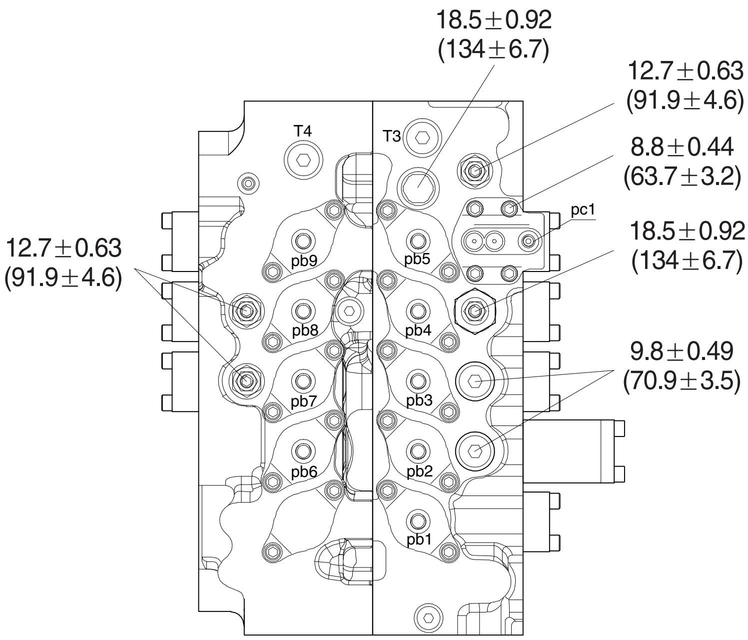




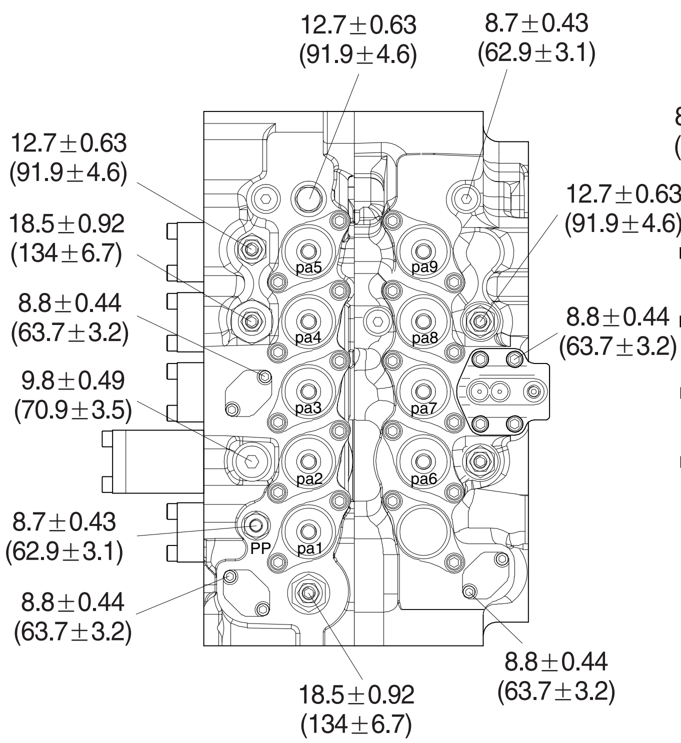
48098MC01

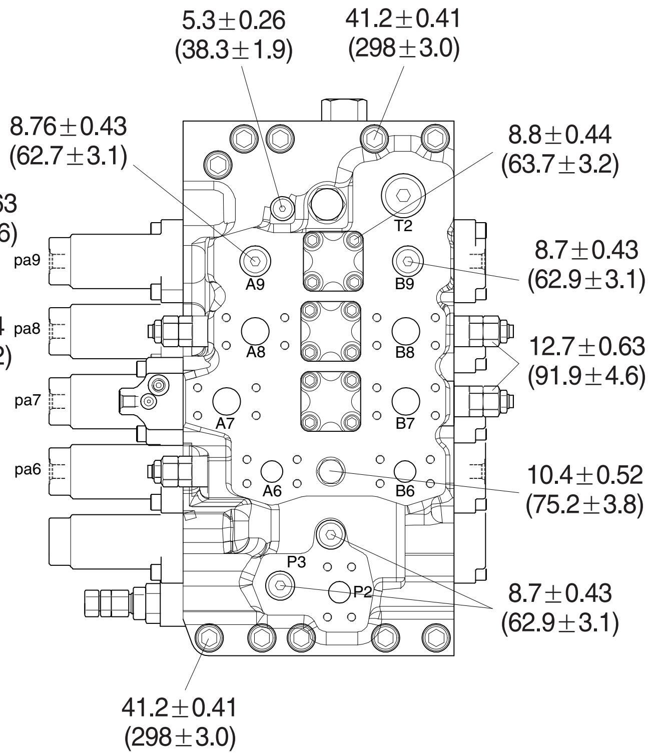
TIGHTENING TORQUE (2/2)

※ Unit : kgf · m (lbf · ft)



VIEW A





48098MC02

4. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but the hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) DISASSEMBLY

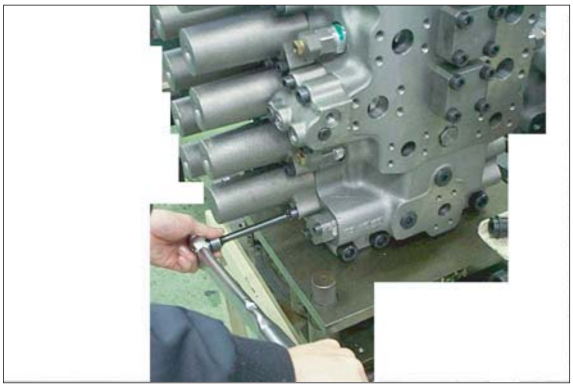
The figure in ( ) shown after the part name in explanation sentence shows its number in the construction figures.

(1) Place control valve on working bench

※ Disassemble the valve in a clean and dry environment and pay careful attention not to damage the sealing flange faces.

(2) Main spool

① Loosen socket head bolts (65) and remove the lock cap (12A, 12B).
Pull out O-ring (14) from valve housing.



45078MC07

② Remove all spool (3~11) of subassembly itself from valve housing.

※ Be careful not to be damaged while pulling out spools. Identify them with a tag to prevent from being mistaken at disassembly.

45078MC08

③ Spools sub assy (3, 4, 6, 7, 9, 10, 11).

45078MC10

④ Spool sub assy (5).

45078MC11

⑤ Spool sub assy (8).

※ When disassemble the spool assembly, fix the spool with vise. On this occasion attach wood between vise blades to prevent the spool from damaging.

※ Heat the outer race of spool with industrial drier and then loosen easily. (Temperature : 200~250˚C)

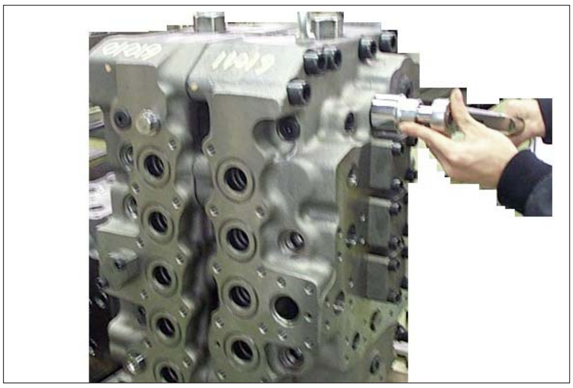
45078MC12

⑥ Loosen the socket head bolt (65) and remove the short cap (13A, 13B).
Pull out O-ring (14) from valve housing.

45078MC09

(3) Center bypass cut spool assy (22)

① Loosen the plug (25) and remove spring (23), spring seat (21) and the spool (22).

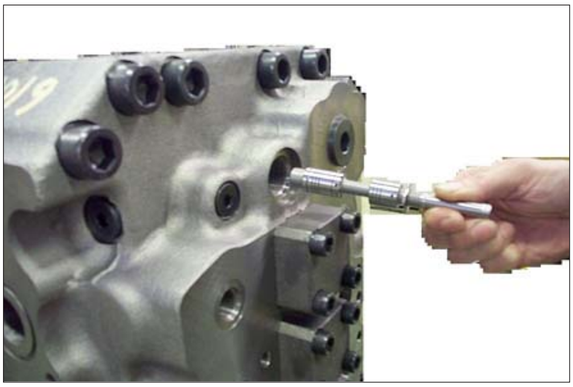


45078MC13

② Pull out O-ring (24).

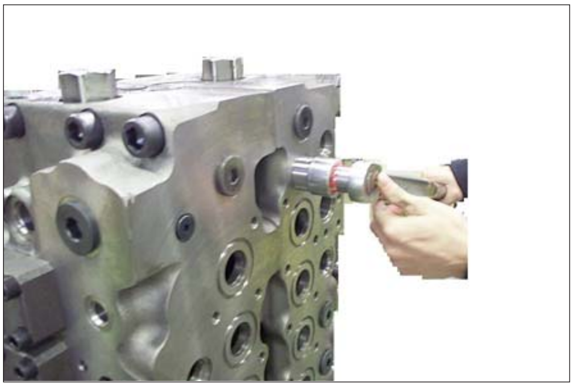
※ When disassemble the spool assembly, fix the spool with vise. On this occasion attach wood between vise blades to prevent the spool from damaging.

※ Heat the outer race of spool with industrial drier and then loosen easily. (Temperature : 200~250˚C)

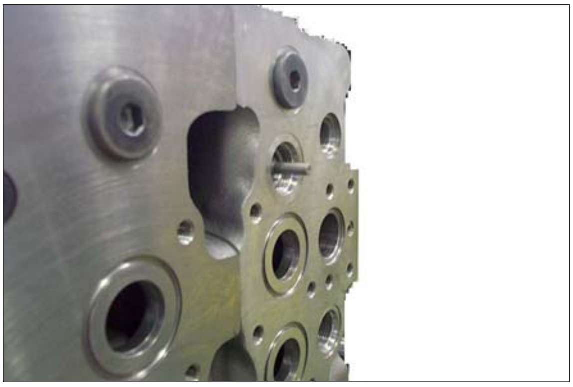

45078MC14

(4) Arm1 regeneration spool assy (20)

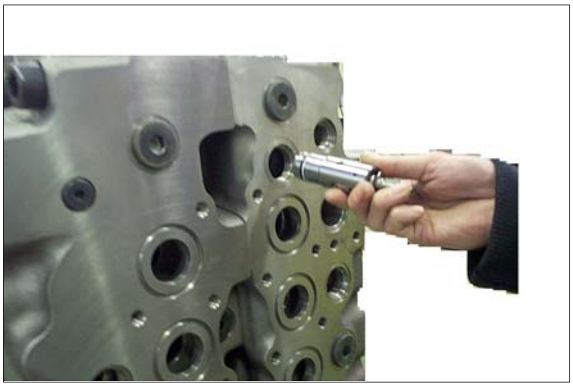
① Loosen the plug and pull out O-ring.


45078MC15

② Disassemble spring, spring seat and spool.


45078MC16

③ Pull out sleeve of hole inside at same time, disassemble sleeve and piston.


45078MC18

(5) General precautions

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.

b. Confirm that seal groove faces of casing and block are smooth and free of dust, dent, rust etc.

c. Correct dents and damages and check seat faces within the casing, if any, by lapping.

※ Pay careful attention not to leave any lapping agent within the casing.

d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from foreign matter.

e. If any spring is broken or deformed, replace it with new one.

f. When a relief valve does not function properly, repair it, following the prescribed disassembly and assembly procedures.

g. Replace all seals and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.

b. Confirm manually that main poppet and seat can slide lightly and smoothly.

c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.

d. Confirm that springs are free from breakage, deformation, and wear.

e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.

f. Replace all O-rings with new ones.

g. When any light damage is found in above inspections, correct it by lapping.

h. When any abnormal part is found, replace it with a completely new relief valve assembly.

3) ASSEMBLY

(1) General comments

① In this assembly section, explanation only is shown.
For further understanding, please refer to the figures and photographs shown in the previous disassembly section.

② Figure in ( ) shown after the part name in the explanation refers to the reference identity number shown on the construction figure shown in the spares section.

③ Cautions in assembling seal

a. Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.

b. Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly.

c. Do not stretch seals so much as to deform them permanently.

d. In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.

e. Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque as shown on the corss section drawings of the spares section.

(2) Main spool

① Apply loctite to thread of spools (3, 4, 6, 7, 9, 10, 11) and assemble spring seat, spring and spool end. Assemble spool end to spool after fixing spool with a vise attached wood.

※ Be careful not to applying loctite too much.

· Tightening torque : 2.4 ~ 2.6 kgf · m (17.4 ~ 18.8 lbf · ft)

Fit O-ring into housing and assemble spools (3, 4, 6, 7, 9, 10, 11) into housing.

Assemble lock cap on housing and tighten hex socket bolt.

· Tightening torque : 11±0.5 kgf · m (79.7±3.7 lbf · ft)

② Insert poppet, spring into spool (5) and then apply loctite to thread of spool.

Fit O-ring and backup ring on the plug and then tighten plug.

Assemble spring seat, spring, and spool end and then assemble spool end sub assy to spool after fixing spool with a vise attached wood.

· Tightening torque : 2.4 ~ 2.6 kgf · m (17.4 ~ 18.8 lbf · ft)

Fit O-ring into housing and assemble spool (5) into housing.

Assemble lock cap on housing and tighten hex socket bolt.

· Tightening torque : 11±0.5 kgf · m (79.7±3.7 lbf · ft)

③ Insert poppet, spring into spool (8) and then apply loctite to thread for spool.

Fit O-ring and backup ring on the plug and then tighten plug.

Assemble spring seat, spring, and spool end and then assemble spool end sub assy to spool after fixing spool with a vise attached wood.

· Tightening torque : 2.4 ~ 2.6 kgf · m (17.4 ~ 18.8 lbf · ft)

Fit O-ring into housing and assemble spool (8) into housing.

Assemble lock cap on housing and tighten hex socket bolt.

· Tightening torque : 11±0.5 kgf · m (79.7±3.7 lbf · ft)

④ Assemble short cap on housing and tighten hex socket bolt.

· Tightening torque : 11±0.5 kgf · m(79.7±3.7 lbf · ft)

(3) Center bypass cut spool assy (22)

① Apply loctite to thread of spool, assemble spool end to spool.
※ Be careful not to appling loctite too much.
② Assemble spool assy, spring seat, spring and tighten plug with O-ring.
· Tightening torque : 9.5 ~ 11.0 kgf · m (68.6 ~ 79.7 lbf · ft)

(4) Arm1 regeneration spool assy (20)

① Assemble backup rings and O-rings to sleeve respectively.
② Assemble piston to sleeve which seal is assemble, and insert spool into sleeve.
③ Assemble spool assy, spring seat, spring and tighten plug with O-ring.
· Tightening torque : 9.5 ~ 11.0 kgf · m (68.6 ~ 79.7 lbf · ft)

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

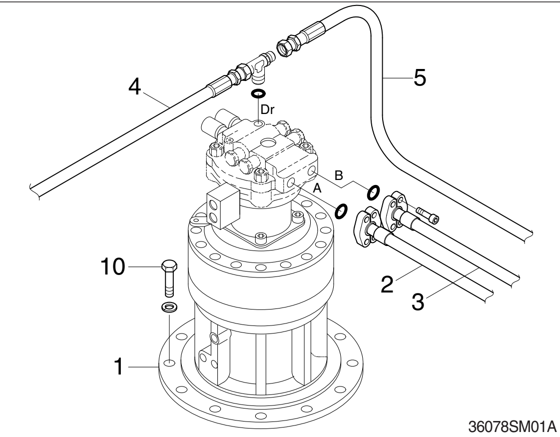
13031GE18

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect hoses (2, 3, 4, 5, 6, 7, 8, 9).

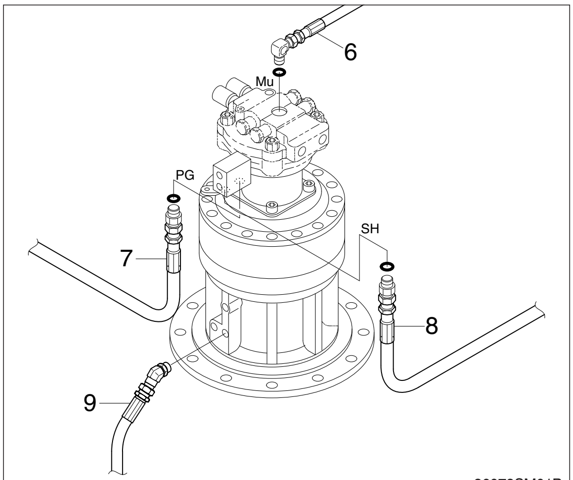
(5) Sling the swing motor assembly (1) and remove the swing motor mounting bolts (10).
·Motor device weight : 75 kg(165 lb)
·Tightening torque :97.8±15 kgf·m
(707±108 lbf·ft)



36078SM01A

(6) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.



36078SM01B

2) INSTALL

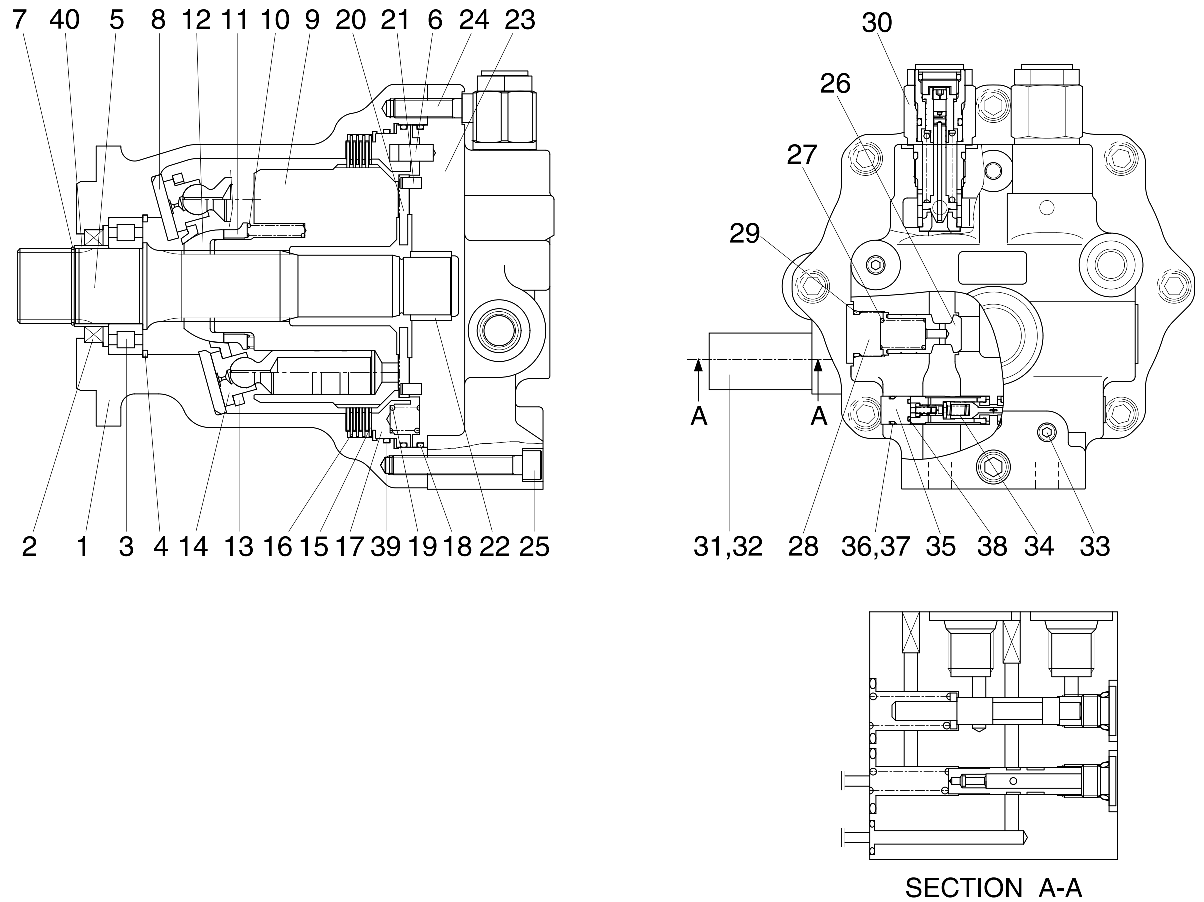
(1) Carry out installation in the reverse order to removal.

(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

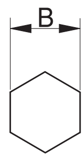


38092SM02

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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

<table>
<tr><th>Tool name</th><th colspan="2">Remark</th></tr>
<tr><td rowspan="4">Allen wrench</td><td>5</td><td rowspan="5">
</td></tr>
<tr><td>6</td></tr>
<tr><td>12</td></tr>
<tr><td>17</td></tr>
<tr><td>Socket for socket wrench, spanner</td><td>36</td></tr>
<tr><td>Torque wrench</td><td colspan="2">Capable of tightening with the specified torques</td></tr>
<tr><td>Snap ring plier(for holes, axis)</td><td colspan="2">Snap ring(4)</td></tr>
<tr><td>Solder hammer</td><td colspan="2">Needle bearing(22), pin(6, 21)</td></tr>
<tr><td>Oil seal inserting jig</td><td colspan="2">Oil seal(2)</td></tr>
<tr><td>Induction heating apparatus for bearing</td><td colspan="2">Roller bearing(3)</td></tr>
</table>

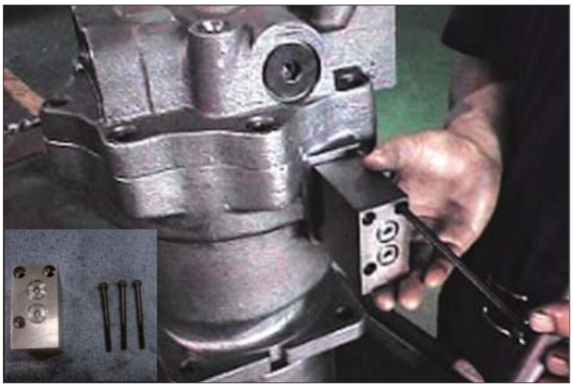
(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	in	mm
Wrench bolt	24	M14	20.9	151.2	0.47	12
Wrench bolt	25	M14	20.9	151.2	0.47	12
Relief valve	30	M33	18.0	130.2	1.42	36
Wrench bolt	32	PF 1/4	6.9	49.9	0.20	5
Plug	33	PF 1/4	20.9	151.2	0.24	6

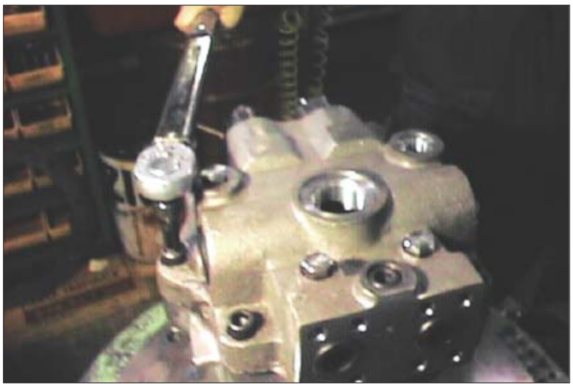
2) DISASSEMBLING

(1) Disassemble the sub of a TURNING AXIS

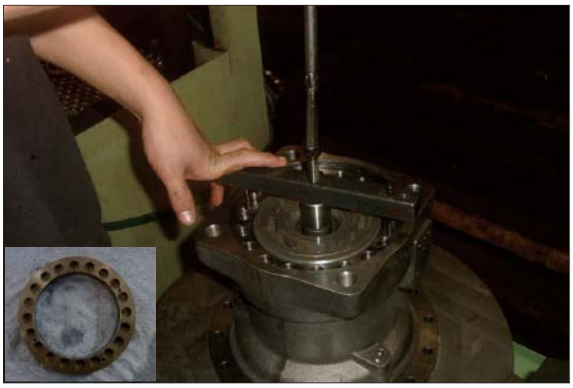
① Unloosing wrench bolt (32) and disassemble time delay valve assy (31) from rear cover (23)


3607A8SM01/01A

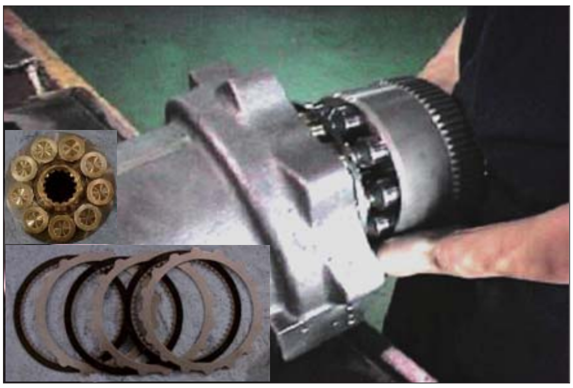
② Hang rear cover (23) on hoist, unloose wrench bolt (24, 25) and disassemble from body (1).


3607A8SM02

③ Using a jig, disassemble break piston (17) from body (1).


3607A8SM03

④ Disassemble respectively cylinder block assy, fricktion plate (15), plate (16) from body (1).


3607A8SM04

⑤ Disassemble shoe plate (8) from body (1).

3607A8SM05

⑥ Using a plier jig, disassemble snap ring (4) and shaft assy (5).

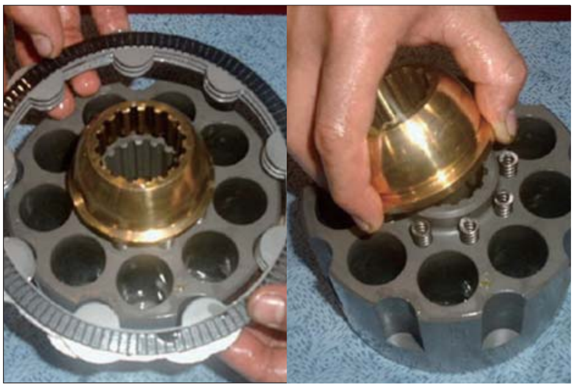
3607A8SM06/06A

(2) Disassemble cylinder block assy sub

① Disassemble pistion assy (14), set plate (13) from cylinder block assy.

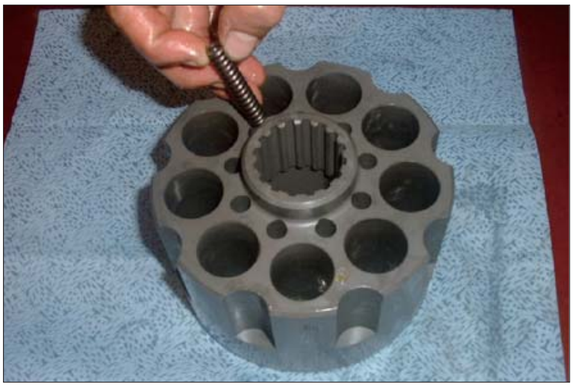
3607A8SM07

② Disassemble ball guide (12), friction plate (15), plate (16) and ball guide seat (11) from cylinder block (9).



3607A8SM08A/08B

③ Disassemble spring (10) from cylinder block (9).



3607A8SM09

(3) Disassemble rear cover assy sub

① Disassemble pin (6, 21) and valve plate (20) from rear cover (23).

3607A8SM10/10A

② Using a torque wrench, disassemble relief valve assy (30) 2 set from rear cover (23).

3607A8SM11/11A

③ Disassemble make up check valve assy with a torque wrench from rear cover (23).

3607A8SM12/12A

4) ASSEMBLING

(1) Assemble the sub of a turning axls

① Put roller bearing (3) on preheater and provide heat to inner wheel (compress ing temp : 290˚C for 2 minutes)

  · Roller bearing ×1EA

3607A8SM21

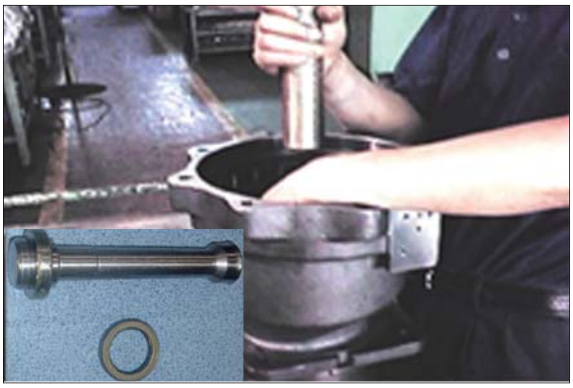
② After assembling and compressing pre-heated roller bearing (3), stop ring (7) into shaft (5).

  · Stop ring ×1EA
  · Shaft× 1EA

3607A8SM22/22A

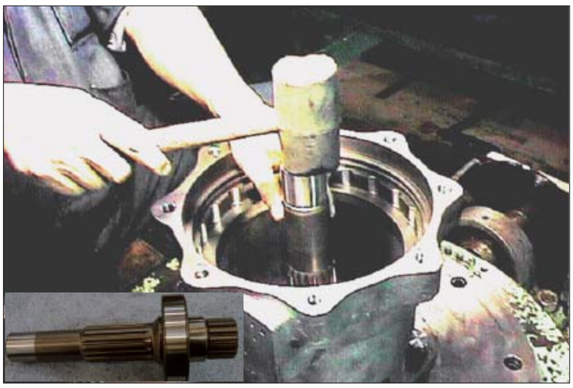
③ Using a compressing tool and steel stick, assemble oil seal (2) into body (1).

  · Oil seal ×1EA



3607A8SM23/23A

④ Insert above shaft sub into body (1) and assemble it with a hammer.



3607A8SM24

⑤ Fix snap ring (4) to shaft with a plier jig.
  · Snap ring × 1EA

3607A8SM06

⑥ Spread grease on shoe plate (8) and assemble on the body.
  · Shoe plate × 1EA

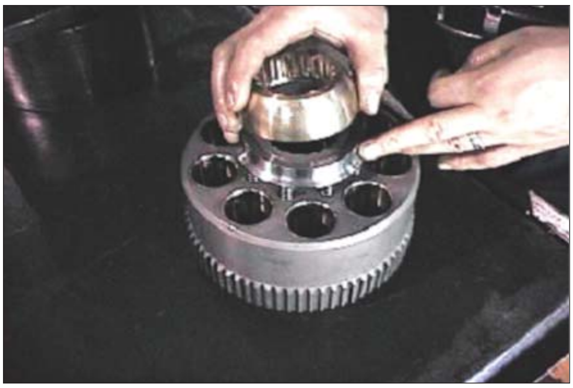
3607A8SM05

(2) Assemble the sub of cylinder block assy

① Assemble spring (10) 9 set into cylinder block (9).
  · Spring × 9EA

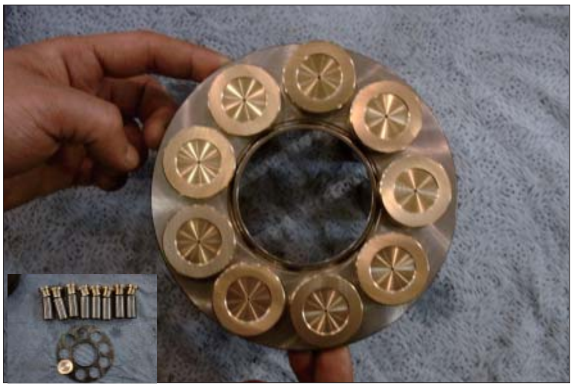
3607A8SM25

② Assemble ball guide (12) and ball guide seat (11) into cylinder block (9).
  · Ball guide × 1EA



3607A8SM26

③ Assemble piston assy (14) 9 set into set plate (13).
- Piston assy ×9EA
- Set plate ×1EA



3607A8SM27

④ Assemble above item ② and ③.

3607A8SM28

⑤ Assemble cylinder block assy into body (1).

3607A8SM04

⑥ Assemble 4 set of lining plate (16), friction plate (15) respectively into body.
- Lining plate ×4EA
- Friction plate ×4EA

3607A8SM29

⑦ Assemble O-ring (18) into break piston (17).
· O-ring ×2EA

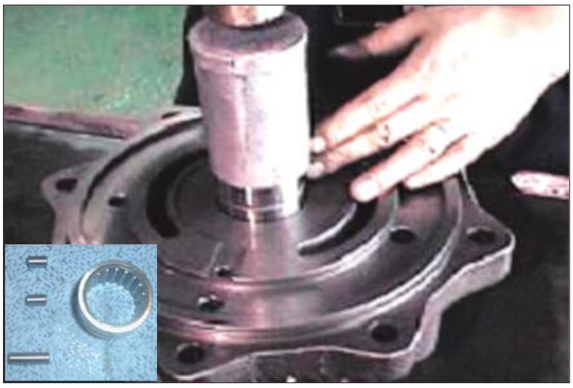
3607A8SM30

⑧ Insert break piston assy into body (1) and assemble spring (19) into break piston (17).
· Spring×19EA

3607A8SM31/31A

(3) Assemble the sub of rear cover assy sub

① After assembling needle bearing (22) into rear cover (23), with a hammer assemble pin (6, 21).



3607A8SM32/32A

② Assemble respectively make up check valve assy spring (27), poppet (26), plug (28) into rear cover (23) after then screw it torque wrench.
· Make up check sub ×2set
· Spring ×2EA
· Check ×3EA

3607A8SM33/12A

③ Assemble relief valve assy (30) 2set into rear cover (23) with a torque wrench.

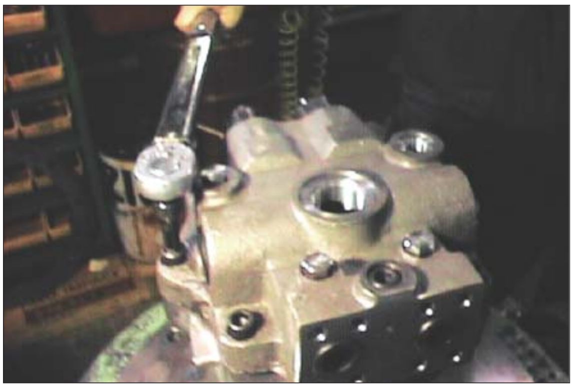
3607A8SM34/11A

④ Spreading grease on valve plate (20), assemble into rear cover (23).

· Valve plate × 1EA

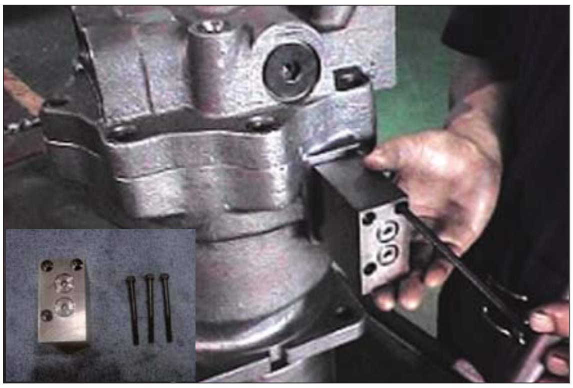
3607A8SM10/10A

⑤ Lift up rear cover assy on body (1) by a crane and assemble it with a wrench bolt (24, 25).



3607A8SM02

⑥ Assemble time delay valve assy (31) into rear cover (23) with a wrench bolt (32).



3607A8SM01/01A

(4) Air pressing test

Be sure of leakage, after press air into assembled motor.

14078SM232

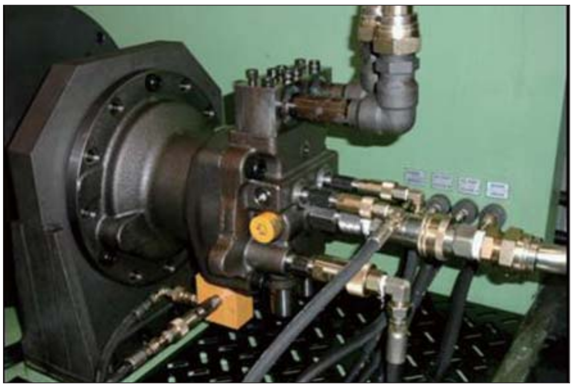
(5) Leakage check

After cleaning motor by color check No.1, paint No.3 and be sure of leakage.

14078SM233/233A

(6) Mount test bench

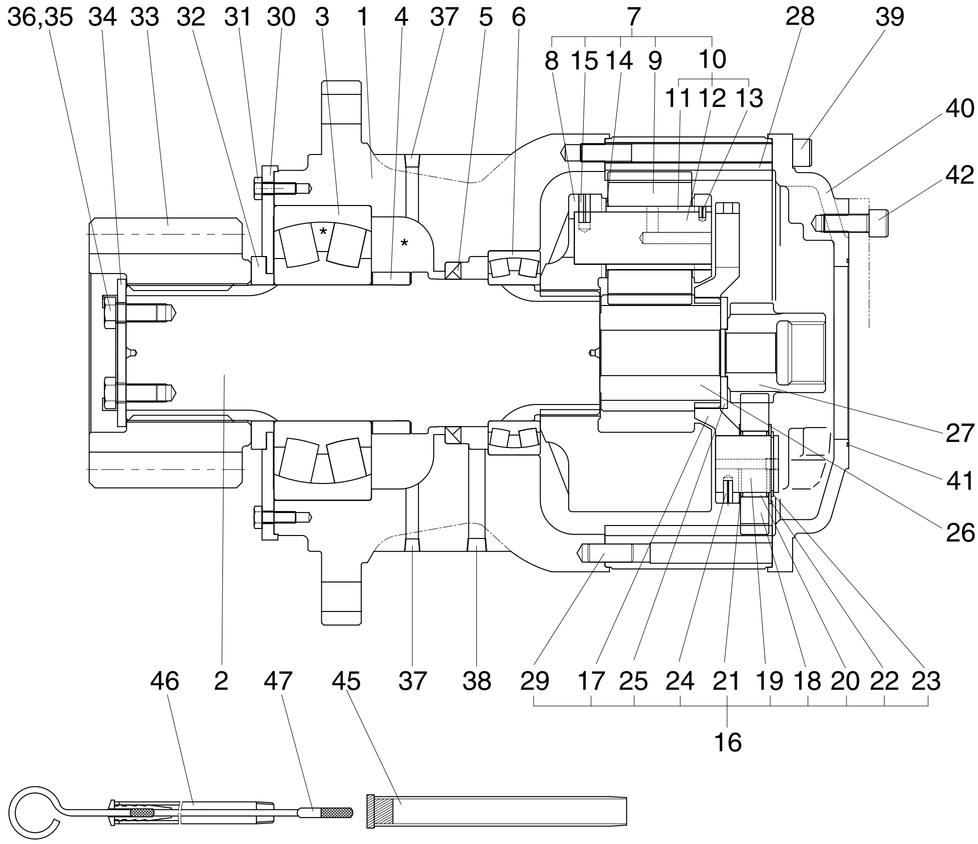
Mounting motor test bench, test the availability of each part.



220078SM14

3. REDUCTION GEAR

1) STRUCTURE



38092SM03

1	Casing	17	Carrier 1	33	Pinion gear
2	Drive shaft	18	Planetary gear 1	34	Lock plate
3	Roller bearing	19	Pin 1	35	Hexagon bolt
4	Spacer ring	20	Needle cage	36	Lock washer
5	Oil seal	21	Side plate 1	37	Plug
6	Roller bearing	22	Side plate 2	38	Plug
7	Carrier 2	23	Stop ring	39	Socket bolt
8	Carrier 2	24	Spring pin	40	Cover
9	Planetary gear 2	25	Thrust ring	41	O-ring
10	Pin 2	26	Sun gear 2	42	Hexagon socket bolt
11	Pin 2	27	Sun gear 1	43	Plug
12	Bushing 2	28	Ring gear	45	Air breather assy
13	Spring pin	29	Knock pin	46	Gauge pipe
14	Thrust washer	30	Cover plate	47	Gauge bar
15	Spring pin	31	Hexagon bolt		
16	Carrier 1	32	Spacer		

2) DISASSEMBLY

(1) Removal of cover

※ Loosen the socket bolt (24) with 16mm hexagonal socket and remove the cover (37).

(2) Removal of sun gear 1 and thrust ring assembly

Remove carrier 1(16), install eye bolt to tap hole (M10) and remove carrier 1 assembly itself.

3607A8SR03

(3) Removal of sun gear 2

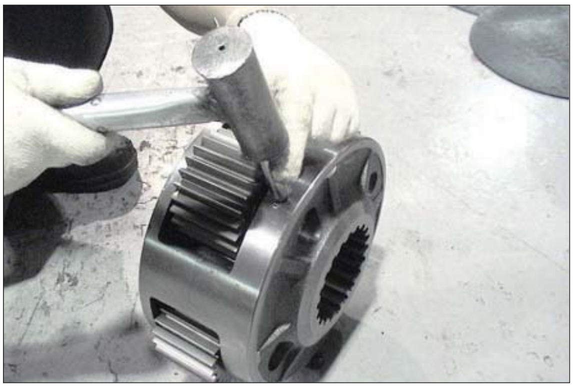
Remove sun gear 2 (26), install eye bolt to tap (M10) of carrier 2 (8) and remove carrier 2 assembly itself.

3607A8SR04

(4) Disassembly of 2nd carrier assembly

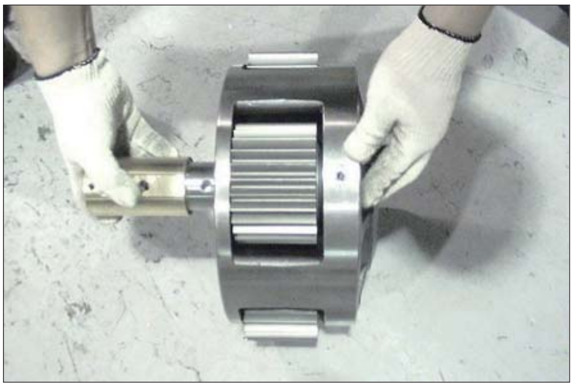
① Insert spring pin (15) into pin assy 2(11) by hammering.

※ Do not reuse spring pin after removal.



3607A8SR05

② Remove pin assy 2 (11) from carrier 2 (7), planetary gear 2 (9) and thrust washer (14) with hands.



3607A8SR06

(5) Removal of ring gear

Remove ring gear (28) from casing (1).

※ Fluid packing is applied on contacting face of ring gear and gear casing. Therefore, remove ring gear from casing by minus screw driver.

3607A8SR07

(6) Removal of drive shaft (2) assembly

① Spread off the corners of spacer (32), cover plate (30) and hex bolt (31) with a tool.

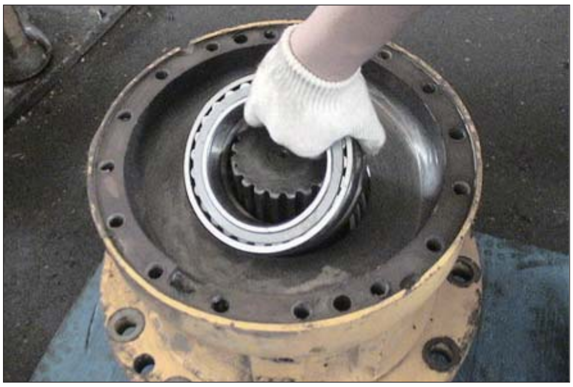
3607A8SR08

② Install hydraulic press at the end face of shaft, and remove drive shaft(2), spacer ring (4), and roller bearing (3) as assembly.

※ Do not reuse oil seal after removal.

3607A8SR09

③ Remove roller bearing (6) from gear casing (1).



3607A8SR10

④ Remove oil seal (5) from gear casing (1).

3607A8SR11

(7) Disassembly of shaft assembly

Insert motor side of shaft (2) into steel tube (inner dia : ø 145 mm) and push the end of output shaft side with hydraulic press and then remove roller bearing (3), and spacer ring (4) as assembly from drive shaft (2).

3607A8SR12

3) ASSEMBLY

(1) Assembly of drive shaft assembly

① After assembly drive shaft (2), heat roller bearing (3) up to 50˚C plus surrounding temperature and assemble it to shaft with hydraulic press and then assemble spacer ring (4) in this order.

※ Pay attention to the assembling direction of cover plate (30).

3607A8SR13

(2) Installation of oil seal

Remove oil from assembled face of oil seal of gear casing (1) and oil seal (5).

Apply fluid packing (three bond of white color) on outer face of oil seal and assemble at pressing jig of gear casing.

After inserting with press, lubricate oil seal with grease.

3607A8SR14

(3) Assembly of drive shaft assembly

① Be careful lest oil seal lip damage by spline of drive shaft (2).
Assemble drive shaft assembly by using seal guide.

② Put drive shaft of gear casing (1) upward.
Assemble drive shaft assembly to gear casing by tightening eye bolt into tap hole (M16) of output side of drive shaft (2).

※ Place support (approx 150 mm) below of gear case (1) for seal protector contact with work table.

3607A8SR15

(4) Install of roller bearing

Put gear casing under output shaft and heat roller bearing (6) up to 50˚C plus surrounding temperature and then assemble it to the shaft.

3607A8SR16

(5) Assembly of ring gear

① Remove oil from mating faces between gear casing (1) and ring gear (28), and knock pin (29). Assemble collar of gear casing and apply fluid packing (three bond of grey color).

3607A8SR17

② Assemble ring gear (28).

36078SR18

(6) Assembly of carrier 2 assembly

① Assemble planetary gear 2 (9) to carrier 2 (8) with thrust washer (14) and insert pin assy 2 (11).

※ Lubricate gear oil to inside of gear and outside of shaft.

3607A8SR19

② Insert spring pin (15) by hammering.
※ Insert as the clearance between spring pins toward planetary gear 2 (9).

3607A8SR20

(7) **Assembly of carrier 2 assembly and sun gear 2**

① Mount eye bolt into tap hole (M10) of carrier 2 (8) and lift carrier assembly and then insert carrier assembly being engaged with internal teeth of ring gear (28). Rotate carrier assembly lightly so that splines of drive shaft (2) are engaged.

3607A8SR21

② Insert sun gear 2 (26) to planetary gear 2 (9).

3607A8SR22

(8) **Assembly of sun gear 1, carrier 1 assembly**

① Mount eye bolt into tap hole (M10) of lift carrier assembly and then insert carrier assembly being engaged with internal teeth of ring gear (28).
Rotate holder assembly lightly so that sun gear 2 (26) is engaged with teeth of carrier 1 (17).

3607A8SR23

② Insert sun gear 1 (27) to planetary gear 1 (18).

3607A8SR24

(9) Check rotation of sun gear by turning plunge part of gear casing with hands.

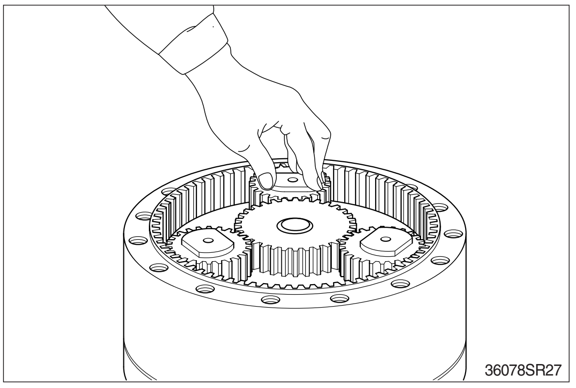
(10) Assembly of cover

Remove oil from mating faces between ring gear (28) and cover (40) and apply fluid packing.

Assemble cover (40) and tighten socket bolt (39) with 16mm hexagonal socket.

Tightening torque : 28.5±3.0 kgf · m
(206±21.7lbf · ft)

This completes assembly



36078SR27

GROUP 6 TRAVEL DEVICE

■ TRAVEL MOTOR (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.

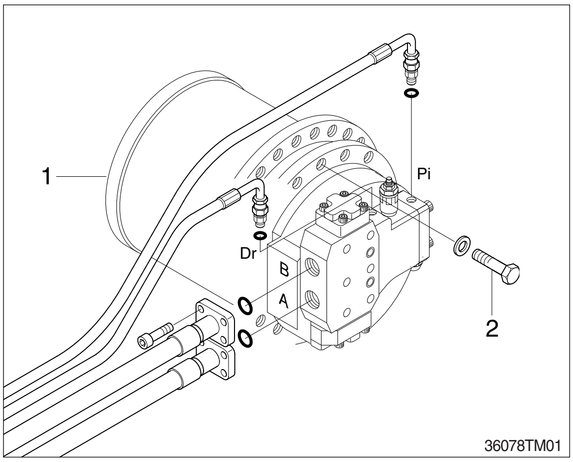
(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **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.

13031GE18

(4) Remove the track shoe assembly.
For details, see removal of track shoe assembly.



36078TM01

(5) Remove the cover.

(6) Remove the hoses.
※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

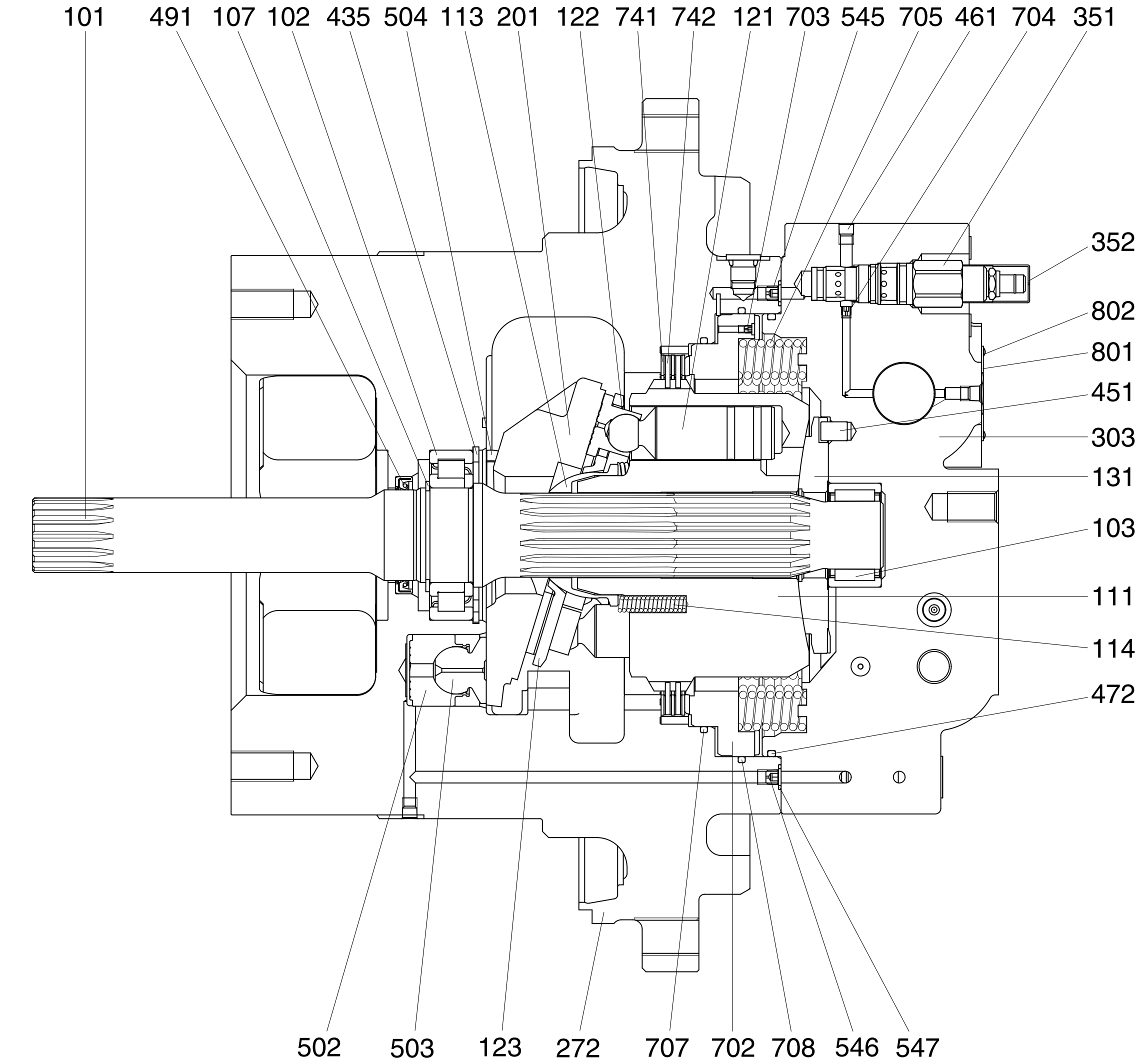
(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 380 kg(840 lb)

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.

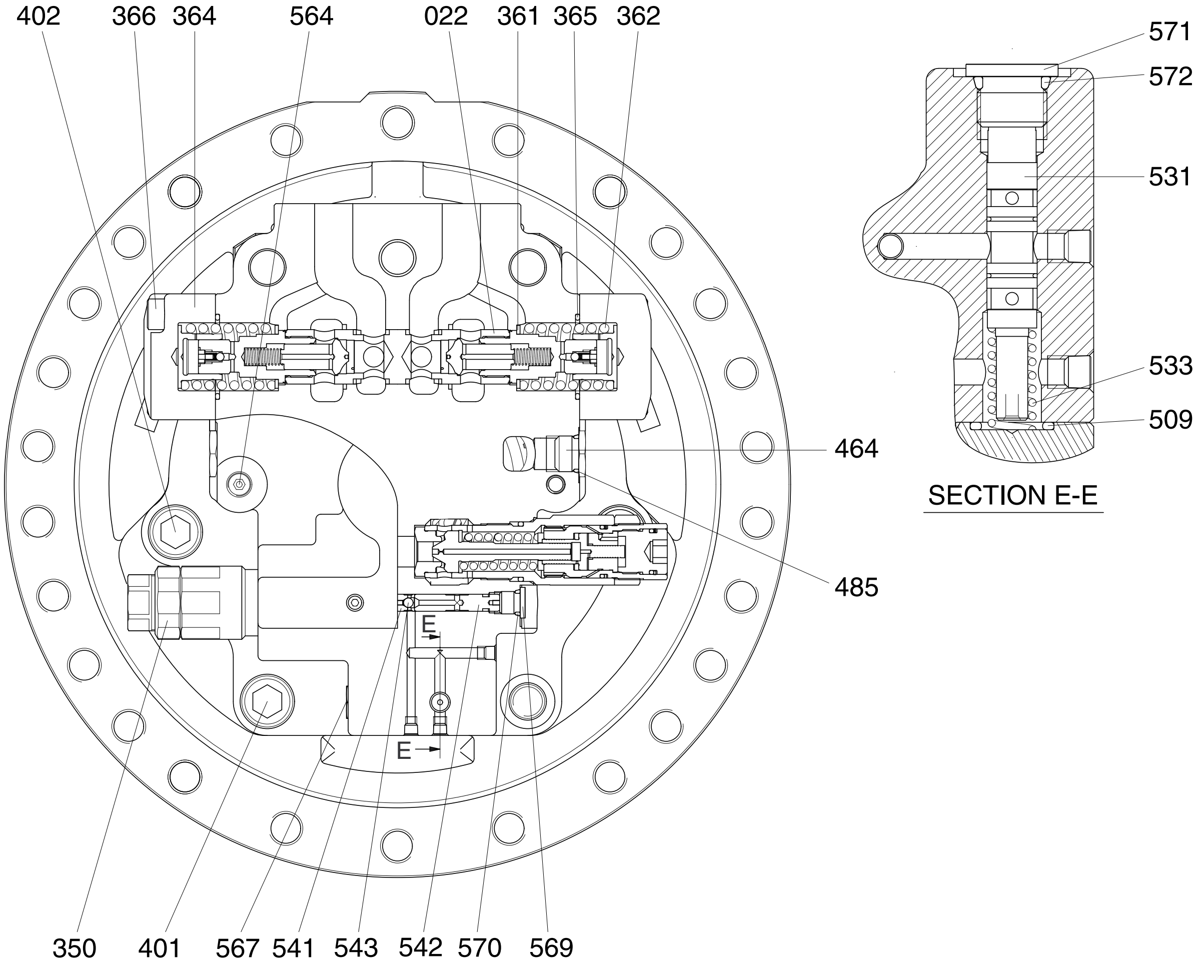
2. TRAVEL MOTOR (TYPE 1)

1) STRUCTURE (1/2)



101	Drive shaft	303	Valve casing	547	O-ring
102	Roller bearing	351	Reducing valve	702	Brake piston
103	Needle bearing	352	Cover	703	Orifice
107	Snap ring	435	Snap ring	704	Orifice
111	Cylinder block	451	Pin	705	Brake spring
113	Spherical bushing	461	Plug	707	O-ring
114	Cylinder spring	472	O-ring	708	O-ring
121	Piston	491	Oil seal	741	Separation plate
122	Shoe	502	Piston	742	Friction plate
123	Set plate	503	Shoe	801	Name plate
131	Valve plate	504	Pivot ball	802	Rivet
201	Swash plate	545	Orifice		
272	Shaft casing	546	Orifice		

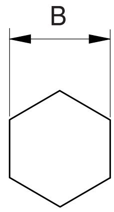
STRUCTURE (2/2)



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

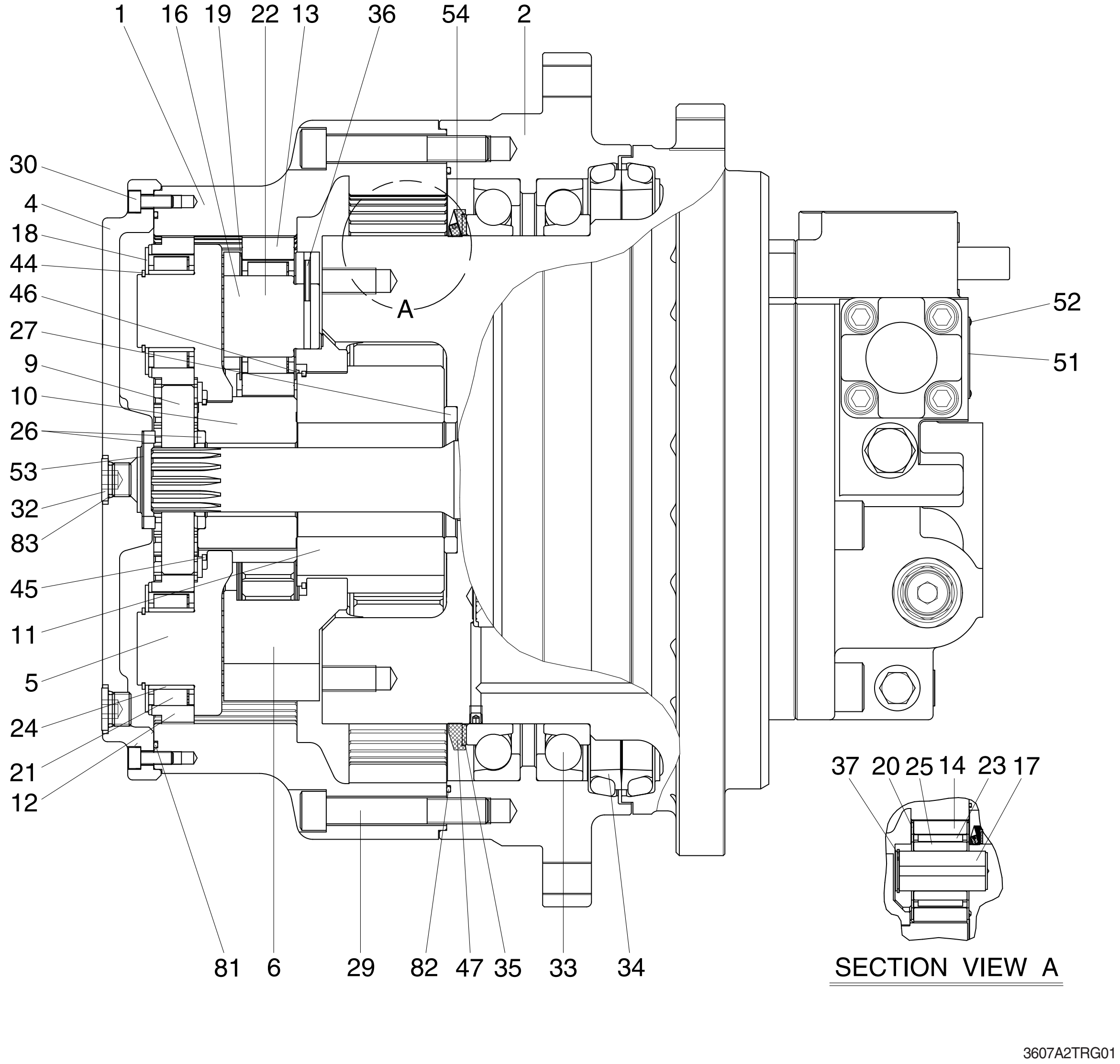
Tool name	Remark	
Allen wrench	2	
	2.5	
	4	
	6	
	8	
	10	
	17	
Socket for socket wrench, spanner	19	
	22.4	
	27	
	42	
Torque wrench	Capable of tightening with the specified torques.	
Plier(For hole, TPR-90)	For snap ring(435)	
Plier(For shaft)	For snap ring(107)	
(-) Driver	-	
Plastic hammer	Wooden hammer allowed. Nominal 1 or so	
Steel rod approx	7×7×200mm, Bearing(102, 103)	
Monkey wrench	-	
Oil seal inserting jig	-	
Bearing plier	-	
Seal tape	-	

(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	in	mm
Socket bolt	366	M12×45	10	72.3	0.39	10
Socket bolt	401	M20×100	44	318	0.67	17
Socket bolt	402	M20×50	44	318	0.67	17
Plug	461	NPTF 1/16	0.9	6.5	0.16	4
VP Plug	464	PF 1/4	11	79.6	1.06	27
Orifice	545, 546	NPTF 1/16	0.7	5.1	0.16	4
Plug	564	PT 1/2	2.2	15.9	0.24	6
VP Plug	567	PF 1/4	3.7	26.8	0.75	19
Plug	569	PF 1/4	3.7	26.8	0.24	6
Plug	571	PF 3/8	7.5	54.2	0.31	8
Orifice	703	M4×0.7	0.35	2.5	0.08	2
Orifice	704	M5×0.8	0.7	5.1	0.1	2.5

3. TRAVEL REDUCTION GEAR (TYPE 1)

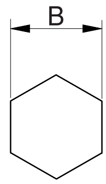
1) STRUCTURE



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	4	
	8	
	10	
	14	
Spanner	27	
Torque wrench	Capable of tightening with the specified torques.	
Plier (for shaft)	Snap ring (037, 044)	
(-) Driver	For removing floating seal	
Plastic hammer	Wooden hammer allowed	
Eye bolt	M8, M10, M16, M20, For lifting-up	
Press (1 ton)	Angular bearing (033)	
Depth gauge straight edge	100mm depth, for adjusting shins (053)	
Tap M16	For removing screw lock in tapped holes	
Oil stone	For finishing mating faces	
Punch	For preventing spring pin from coming out	
Loctite (three bond 1373B)	Set screw (054)	
Loctite	Socket bolt (029)	
Nut ring inserting jig Nut ring (047)		

(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	in	mm
Socket bolt	29	M16×100	30	217	0.55	14
	30	M8×20	3.5	25.3	0.24	6
Plug	32	PF 1/2	11	79.6	0.39	10
Set screw	54	M8×16	1.0	7.2	0.24	6

4. DISASSEMBLING

1) GENERAL PRECAUTIONS

(1) Pay attention to not damaging contact surfaces for O-rings, oil seals, etc. and contact/sliding surfaces for gears, pins, bearings, etc.

(2) This motor can be disassembled even in a state on the reduction gear.
However, in that case, pay full attention to preventing mud, dust, etc. from entering in it.

(3) The numerical in parentheses following each part name indicates its part number shown in the attached **assembly drawings.**

(4) The piping side of the motor is referred to as the rear side, and the output side as the front side.

2) DISASSEMBLY OF REDUCTION GEAR

(1) Select a disassembling place.
※ Select a clean place.
※ Spread rubber sheet or cloth on work bench to prevent parts from being damaged.

(2) Remove dust, mud, etc. from reduction gear surfaces with washing oil or so.

(3) Place reduction gear with its gear oil drain port or level gauge at the lowest position, and drain reduction gear oil.
※ Receive gear oil with clean vessel and check it for abnormalities.
Renew gear oil.

(4) Place reduction gear with its side cover (4) upward, and remove socket bolt (30), and remove side cover (4) and O-ring (81).

370078TM01

(5) Remove sun gear 1 (9).

370078TM02

(6) Remove carrier 1 (5), together with planetary gears 1 (12), sun gear 2 (10), etc. fitted.

370078TM03

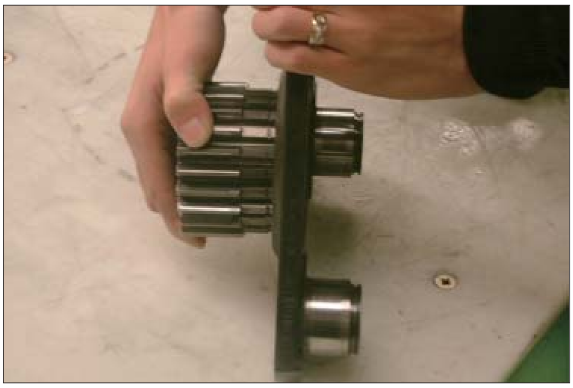
(7) Disassembling of carrier 1 sub-assembly

① Remove snap ring (44), and then remove side plate (18), planetary gear 1 (12), needle cage (21) and side plate (18).

※ If flaking is observed on the inner ring surface replace inner ring. In this case, replace planetary gear 1 and needle cage simultaneously.

370078TM04

② Remove circlip (45), and then remove carrier 1 (5) from sun gear 2 (10).



370078TM05

③ Remove thrust ring (26).

370078TM06

(8) Remove carrier 2 (6), with planetary gears 2 (13), sun gear 3 (11), etc. fitted.

※ Use M10 eyebolt. In this case, thrust ring (26) is removed simultaneously.

370078TM07

(9) Disassembling of carrier 2 sub-assembly

① Push in spring pin (36), and remove pin 2 (16), from carrier 2.

※ Carry out the following check in advance. If any abnormality should be found, carry out disassembling.
- Is there any crevice, crack or pitting on tooth surface of planetary gear?
- When turning planetary gear lightly, is there any abnormal noise or eccentric clearance? Carry out check similarly to the above for carrier 3.

370078TM08

② Remove side plate (20), planetary gear 2 (13), and needle bearing (22) from carrier 2.

③ Remove thrust ring (26).

370078TM09

④ Remove snap ring (46), and remove carrier 2 (6) from sun gear 3 (11).

⑤ Remove thrust ring (27) from sun gear 3 (11).

370078TM10

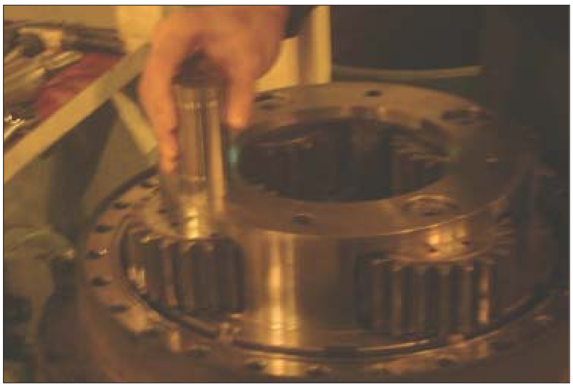
(10) Remove socket bolt (29), and then screw two M8 eyebolts on front side of ring gear (1), lift up ring gear with crane, and remove O-ring (82) from housing (2).

※ It is difficult to separate them, because it is assembled by LOCTITE.
In this case, if you can use wrench and pipe, it is easy to separate them.


370078TM11

(11) Remove snap ring (37) and then remove pin 3 (17) from shaft casing (272).


370078TM12


370078TM13

(12) Remove side plate (20), planetary gear 3 (14), needle cage (23), floating bushing (25) from shaft casing (272).


370078TM14

(13) Remove set screw (54) from nut ring (47), and then remove nut ring (47) from shaft casing (272).

※ When disassembling nut ring, remove dust, mud, etc. from set screw hole by blasting compressed air.
And remove the nut ring by using the special tool for removing the nut ring.


370078TM15

(14) Remove housing (2), angular bearing (33), floating seal (34) from shaft casing (272).

※ Screw two M16 eye bolts on front side of housing (2).
Lift up housing (2) with crane.


370078TM17

(15) Remove floating seal (34) from housing (2), paying attention to not damaging it.

※ Pay attention to O-ring and sheet faces.


370078TM18

(16) Remove floating seal (34) from casing (272), pay attention to not damaging it.

※ Pay attention to O-ring and sheet faces.


370078TM19

(17) Remove angular bearing (33) from housing (2).

※ Bearing should be renewed once it is removed.

370078TM20

3) DISASSEMBLY OF MOTOR

(1) Disassembling of motor main body

① Place hydraulic motor on bench with its output shaft down.

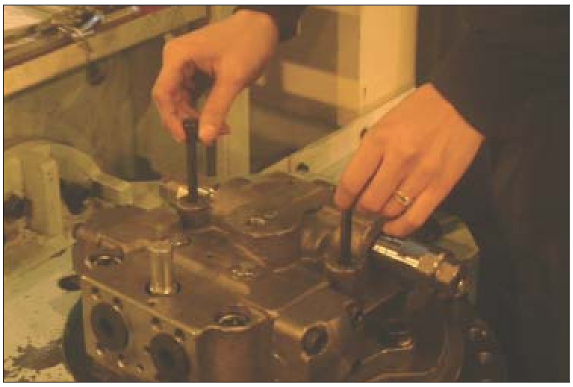
370078TM21

② Loosen relief valve (350), reducing valve (351), cover (352), plug, etc.
They are fitted to valve casing (303).

370078TM22

370078TM23

③ Remove plug (564) from valve casing (303). And then screw two M10×135 bolts on the holes of compelent brake release. Sub assembly (valve casing & brake piston)



370078TM24

④ Remove socket bolts (401, 402) that assemble valve casing (303).

370078TM25

⑤ Remove the above socket bolt, and then separate valve casing sub-assembly and remove valve plate (131).

370078TM26

⑥ Pull out friction plate (742) and separation plate (741) from cylinder block (111).

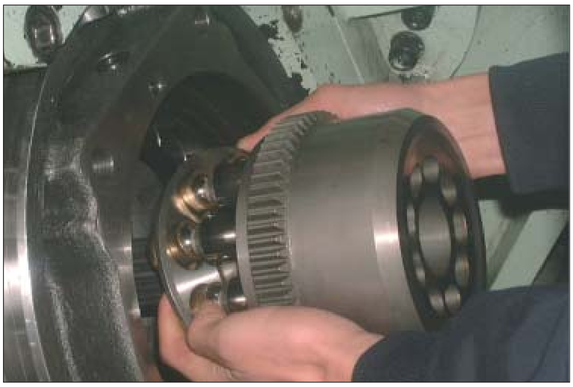
※ In this case, motor should be located in horizontally.

370078TM27

⑦ Pull out cylinder block and piston sub-assembly.

※ After placing the motor horizontally, take out cylinder block from casing.

※ Be careful not to damage the sliding parts of the cylinder block, spherical bushing and shoe.



370078TM28

⑧ Remove swash plate (201).

370078TM29

⑨ Remove pivot ball (504) and tilting piston sub assembly.

370078TM30

⑩ Take out snap ring (435), and then hit front side end face of shaft (101) lightly with plastic hammer or so to remove from casing (272).

※ Do not remove cylinderical roller bearing (102) as far as it remains normal.

370078TM31

⑪ Take out oil seal (491) from shaft casing (272).

※ Do not reuse the disassembling oil seal (491).

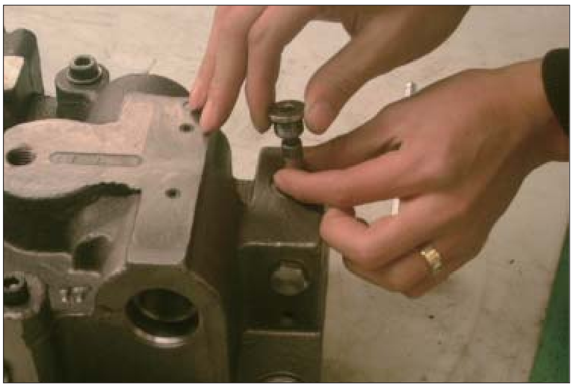

370078TM32

(2) Disassembling of valve casing sub-assembly

① Remove two M10×135 bolts for compelling brake release. Disassemble brake piston from valve casing.

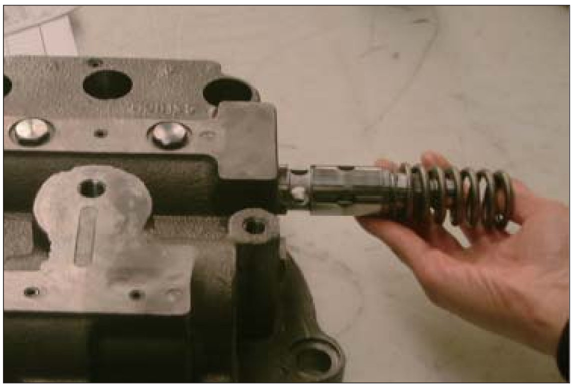

370078TM33

② Remove plug (571), tilting spring (533), and tilting spool (531) from valve casing.


370078TM34

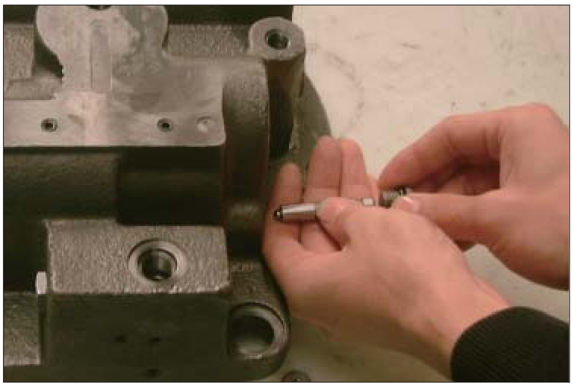
③ Remove socket bolts (366), counterbalance cover (364), and counterbalance spool assembly.

※ When any abnormality is found in counterbalance spool, counterbalance spring, etc. replace with the counter balance spool sub assembly as a set.


370078TM35

④ Remove plug (569), stopper (542), steel ball (543) and seat (541).

※ When no abnormality is found in displacement changeover, it is not necessary to overhaul it specifically.
And don't remove needle bearing (103) as far as it remains normal.


370078TM36

(3) Disassembling of cylinder sub-assembly

① Pull out set plate (123), piston (121), and shoe (122) sub-assembly.


370078TM37

② Remove spherical bush (113) and cylinder spring (114).
That is all of the disassembling work.
The pins (451) force-fitted to the valve casing cannot be removed.


370078TM38

5. ASSEMBLING

1) GENERAL CAUTIONS

(1) Clean each part fully with washing oil and dry it by blasting compressed air. It is better not to use waste cloths as much as possible.
However, if they are to be used, use clean ones, and pay attention to not leaving lint and so on.
Don't clean the friction plate with washing oil without fail.

(2) Use the torque wrench in tightening fitting screws and plugs to their respective torque shown in page 8-75, 8-77.

(3) When hammering is required, use the plastic hammer and try to hit parts lightly.

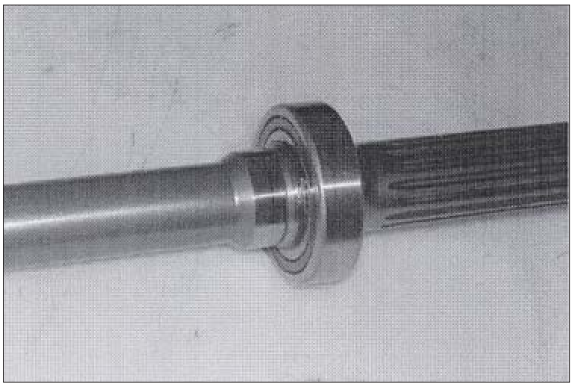
(4) Similarly to the disassembling procedures, the numeral in parentheses following each part name indicates its item number shown in the attached assembly drawings.

2) ASSEMBLY OF MOTOR

(1) Assembling driving shaft sub-assembly

① Put roller bearing (102) on drive shaft (101), and assemble snap ring (107) by using the plier.

※ Roller bearing is press fit by the heat to drive shaft.
※ Pay attention to not damaging oil seal sliding area of driving shaft.
※ Pay attention to not fitting snap ring the other way around.



370078TM39

(2) Assembling of valve casing sub-assembly

① Tighten plugs (461, 564) into valve casing (303) with specified torque.
- Plug(461) : 0.9 kgf · m (6.5 lbf · ft)
- Plug(564) : 2.2 kgf · m (15.9 lbf · ft)

370078TM40

② Interference-fit pin (451).

370078TM41

③ Interference-fit needle bearing (103).

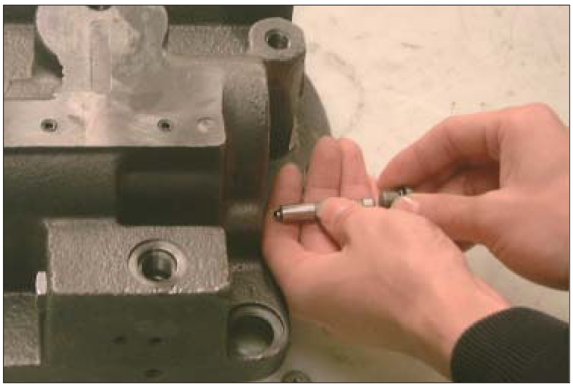
※ It is necessary when needle bearing was disassembled from the valve casing.

370078TM42

④ Assemble seat (541), steel ball (543), stopper (542) and RO plug (569) in the order named.

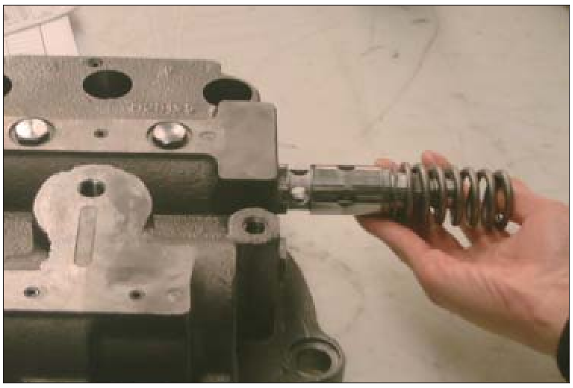
· Tightening torque : 3.7 kgf · m (26.8 lbf · ft)

※ Pay attention to not assembling seat and stopper the other way around.



370078TM43

⑤ Assemble counterbalance spool (360), washer (361), spring (362) in the order named.

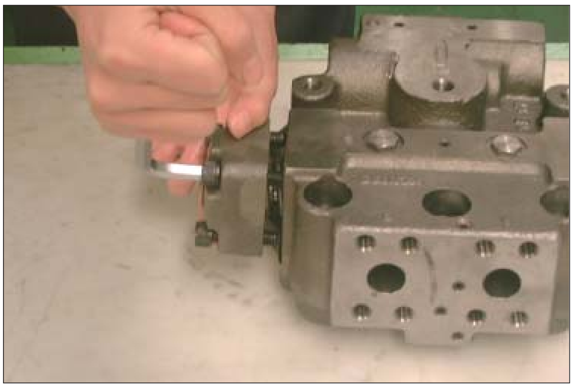


370078TM44

⑥ Fit counterbalance cover (364) by tightening socket bolt (366).

· Tightening torque : 10 kgf · m (72.3 lbf · ft)

※ Confirm that O-ring (365) has been inserted in cover.



370078TM45

⑦ Assemble tilting spool (531), tilting spring (533) and plug (571) in the order named.

- Tightening torque : 7.5 kgf · m (54.2 lbf · ft)

370078TM46

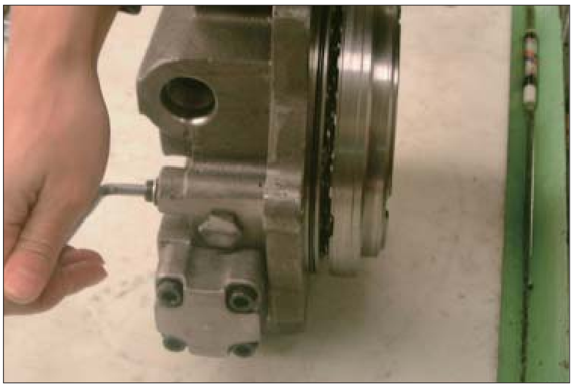
⑧ Assemble orifice (703) and tighten them into brake piston (702) to specified torque.

- Tightening torque : 0.35 kgf · m (2.5 lbf · ft)

370078TM47

⑨ Assemble brake spring (705) in brake piston (702). And then screw two M10×135 bolts on the holes for compelent brake release.
Sub-assembly (valve casing & brake piston)

※ After finishing assembly, two M10×135 bolts will be removed.



370078TM48

(3) Assembling of cylinder sub-assembly

① Fit cylinder spring (114) and spherical bush (113) to cylinder block (111).

※ Match spline phase of cylinder block (111) to that of spherical bush.

370078TM49

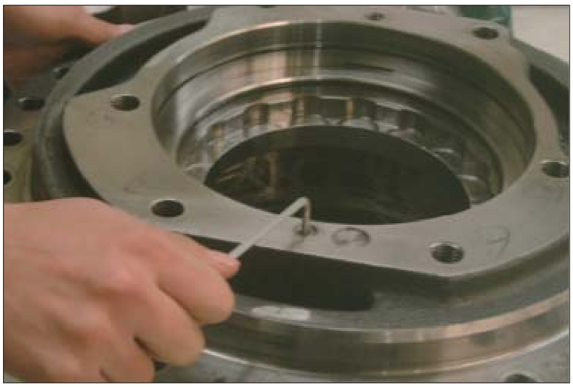
② Put piston (121), shoe (122) sub-assembly in set plate (123) and then assemble them to cylinder block (111).


370078TM50

(4) Assembling of motor main body

① Tighten plug (461) and orifice (545, 546) into shaft casing (272) to specified torque.
  · Plug (461) : 0.9 kgf · m (6.5 lbf · ft)
  · Plug (545, 546) : 0.7 kgf · m (5.1 lbf · ft)


370078TM51


370078TM51A

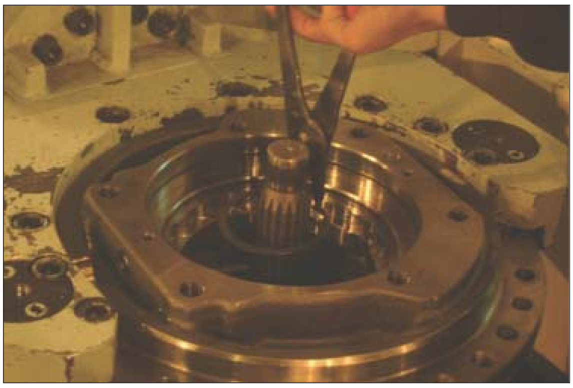
② Interference-fit oil seal (491) into shaft casing (272) by special tool.


370078TM52

③ Interference-fit the shaft sub-assembly. And then assemble snap ring (435).

※ Interference-fit outer race of cylindrical roller bearing (102) by hitting lightly with hammer, utilizing key.

370078TM53



370078TM54A

④ Assemble tilting piston sub-assembly and pivot ball (504) into shaft casing (272).

370078TM54

370078TM54A

⑤ Assemble swash plate (201) onto pivot ball (504).

※ Apply grease on sliding area of swash plate rear surface.

※ Confirm with finger tips of both hands if swash plate moves smoothly.

370078TM55

⑥ Change position of shaft casing (272) from vertical one to horizontal one. And then mount cylinder block sub-assembly.

※ Pay attention to not dropping swash plate.

370078TM56

⑦ Change position of shaft casing (272) from horizontal one to vertical one.

370078TM57

⑧ Fit separation plate (741) and friction plate (742) into cylinder block (111).

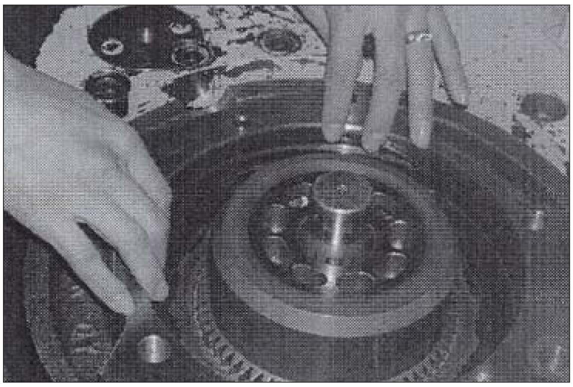
※ Mate hole of separation plate each other.

370078TM27

⑨ Assemble O-ring (707, 708) into shaft casing (272).

※ Do not reuse the disassembling O-ring (707, 708).

※ Coat the O-ring with grease.
(O-ring can be protected by grease)



370078TM59

⑩ Fit valve plate (131) to valve casing (303) sub-assembly. Assemble them to casing, and then tighten them with socket bolt (401, 402).

· Socket bolt (401, 402) Tightening torque : 44 kgf · m (318 lbf · ft)

※ Apply grease on valve plate rear surface and pay attention to not dropping valve plate.

※ Use guide bolt.

※ Apply grease on roller of needle bearing and pay attention to easy to assemble with driving shaft.

※ Use crane in assembling valve casing to shaft casing.

370078TM60

370078TM60A

⑪ Tighten to specified torque plugs, relief valve (350), reducing valve (351), etc. fitted to valve casing sub-assembly.

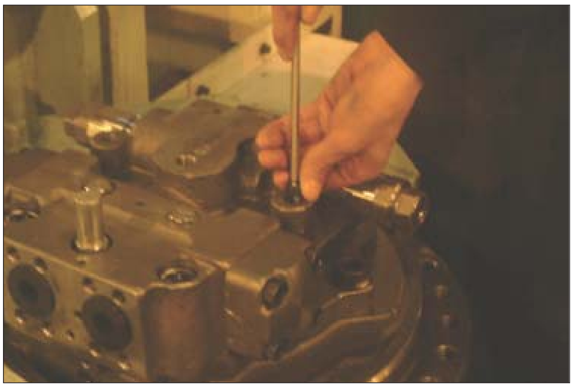
· Tightening torque :

- Relief valve (350) : 18 kgf · m (130 lbf · ft)
- Reducing valve (351) : 4.5 kgf · m (32.5 lbf · ft)

370078TM61

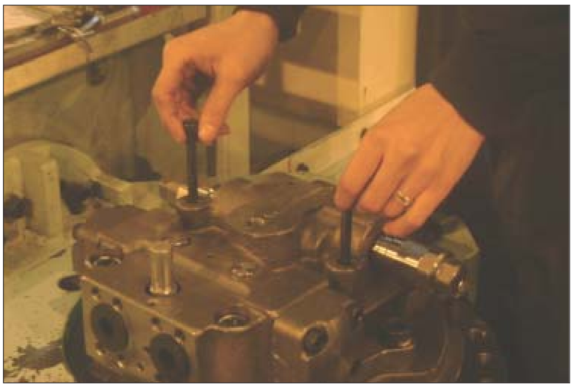
370078TM61A

⑫ Mount cover (352).



370078TM63

⑬ Disassemble two M10×135 bolts on the holes for compelent brake release.
And then assemble plug (564).
· Tightening torque : 2.2 kgf · m (15.9 lbf · ft)



370078TM24

3) ASSEMBLY OF REDUCTION GEAR

(1) Place housing (2) with its front side up, and fit angular bearings (33) with their back faces mated.

※ Fit angular bearings one by one with press or key hammer.
※ When housing is to be reused, remove screw lock of its tapped holes with M16 tap.

370078TM64

(2) Fit O-ring to floating seal (34) without twisting it, and then to housing (2).

※ Apply grease to O-ring thinly.
※ Do not reuse the disassembling O-ring.

370078TM65

(3) Similarly, fit floating seal to shaft casing (272) of hydraulic motor.

※ Do not reuse the disassembling O-ring.

370078TM66

(4) Lift up housing sub-assembly with its floating seal side down, and put inner diameter of angular bearing on outer diameter of shaft casing.

※ Pay attention to not damaging sliding faces of floating seal.

370078TM67

(5) Assemble shim (35) to nut ring (47).

※ Apply grease between shim and nut ring.

370078TM68

(6) Insert nut ring assembled shim to shaft casing, and then tighten it to specified torque, utilizing special tool.

※ After tighten it to maximum torque and then disassemble, and then tighten it to specified torque.

· Tightening torque : 60 kgf · m (434 lbf · ft)

370078TM70

(7) After assemble set screw (54) affixed LOCTITE, and punch at hole to lock it. Pay attention to not be lifted nut ring (47).

※ Screw the set screw, until upper side of set screw is lower than tilting side of nut ring.

· Loctite specifications : Three bond 1373B

· Tightening torque : 1 kgf · m (7.2 lbf · ft)

370078TM71

(8) Assemble thrust ring (27) into shaft casing (272).

※ Pay attention to not assembling thrust ring (27) the other way around. (Oil groove is located upside.)

370078TM72

(9) Put needle cage (23) into inside of planetary gears 3 (14), and insert them into shaft casing, holding them between side plates (20).

※ Mate pin hole of shaft casing with center of planetary gear.

370078TM73

(10) Insert pin 3 (17) into shaft casing, and then assemble snap ring (37).


370078TM74


370078TM74A

(11) Assemble O-ring (82) to housing (2), and then assemble ring gear (1).
Pay attention to its meshing planetary gear 3 (14) and ring gear (1), utilizing crane.

※ Applying grease to O-ring thinly.
※ Do not reuse the disassembling O-ring.


370078TM75

(12) Assemble ring gear (1) and housing (29).
(Screw socket bolt (29), and tighten it to specified torque, with torque wrench.)
· Tightening torque : 30 kgf · m (217 lbf · ft)
· Loctite specifications : #636


370078TM76

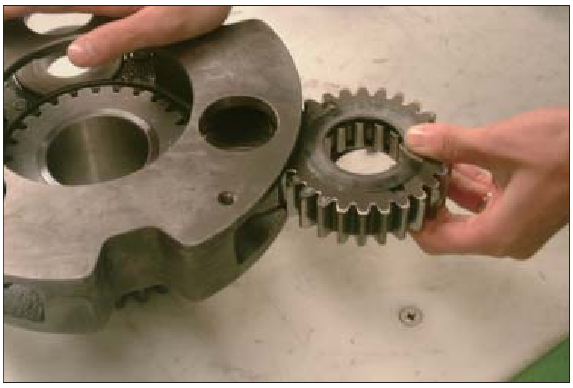
(13) Assembling carrier 2 sub-assembly

① Assemble carrier 2 (6) to sun gear 3 (11), and fit clip (46).

② Place carrier 2 with sun gear 3 up.

370078TM77

③ Put needle cage (22) into inside of planetary gear 2 (13), and insert them into carrier 2, holding them between side plates (19).



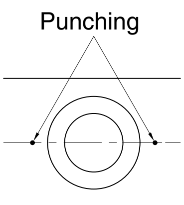
370078TM78

④ Insert pins 2 (16) into carrier 2.

370078TM78A

⑤ Insert spring pin (36) into pin holes of carrier 2 and pin 2, and punch at two points as figure to lock it.

※ Mate pin hole of carrier 2 with center of planetary gear.



370078TM79

(14) Screw two M10 eyebolts into carrier 2 sub-assembly, and assemble it with crane, paying attention to its meshing with planetary gear 2 and ring gear.

370078TM80

(15) Assembling of carrier 1 sub-assembly

① Interference-fit inner ring (24) to carrier 1 (5).

※ Inner ring is press-fit by the heat to carrier 1 (5).

370078TM81

② Assemble carrier 1 (5) to sun gear 2 (10), and fit clip (45).

370078TM82

③ Assemble thrust ring (26) to sun gear 2 (10).

※ Pay attention to not assembling thrust ring (26) the other way around.
(Oil groove is located upside.)

370078TM83

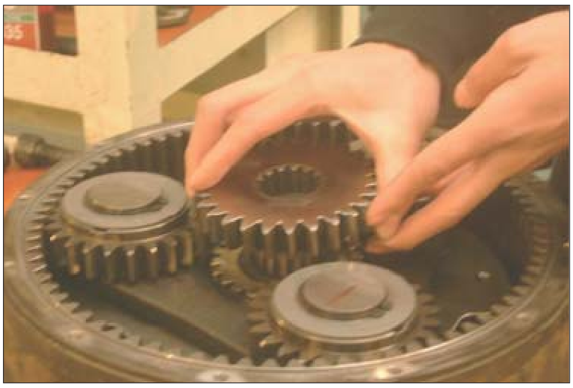
④ Put needle cage (21) into inside of planetary gear 1 (12), and assemble them, holding them between side plates (18). Then fit snap ring (44) on them.

370078TM84

(16) Assemble carrier 1 (5) sub-assembly to ring gear (1).
Paying attention to its meshing with carrier 1 sub-assembly and ring gear (1).

370078TM85

(17) Assemble sun gear 1 (9) to drive shaft (101) paying attention to its meshing with sungear and drive shaft (101).



(18) Measure height "A" from sun gear 1 end face to ring gear (1) mating face with straight edge and depth gage.

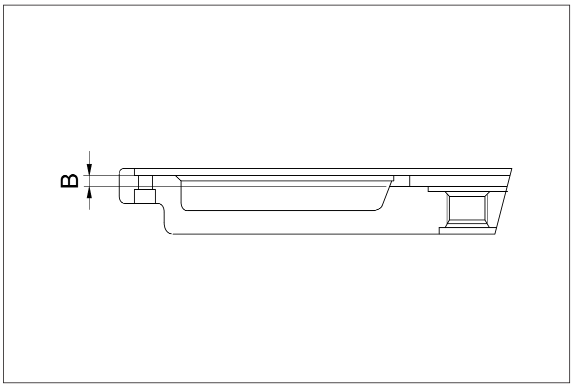
370078TM87

(19) Measure height "B" from side cover (4) mating face to center hold bottom with straight edge and depth gage.

370078TM88

(20) Obtain optimum thickness with the following formula.
1.5~2.0 = (B+A)
- (Thickness of thrust ring + thickness of washer)

※ Keep axial clearance between sun gear and washer 1.5~2.0 mm.



370078TM89

(21) Place washer (53) of above-selected thickness and thrust ring (26) to center of side cover (4).

※ Pay attention to not assembling thrust ring (26) the other way around and punch it (Oil groove is located upside)

370078TM90

(22) Assemble O-ring (81) into ring gear.
And degrease and dry mating faces of side cover & ring gear. Then lift side cover(4) up, and place it on ring gear.
And tighten socket bolt (30) to specified torque to fix side cover.
· Tightening torque : 3.5 kgf · m (25.3 lbf · ft)

370078TM91

(23) Tighten plug (32) to specified torque at side cover (4).
· Tightening torque : 11.0 kgf · m (79.6 lbf · ft)

That is all of the assembling work. After fitting the motor this reduction gear, supply oil until overflows from the level gauge.

370078TM92

4) CHECKING FACTS AFTER ASSEMBLY

(1) Air test of reduction gear
Disassemble plug (32) of reduction gear part.
When compressed air(0.3 kgf/cm^2) is inserted that in water during the 2 minutes, it should be not happened air bubble.
· Gear oil : 5.5 liter (SAE 85W-140, API GL-5 or better)

(2) Air test of hydraulic motor
One port should be opened, the others port should be closed.
When compressed air (3 kgf/cm^2) is inserted opened port in water during the 2 minutes, it should be not happened air bubble.
· Working fluid : 1.5 liter

■ TRAVEL MOTOR (TYPE 2)

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90˚ and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.


13031GE18

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**

(5) Remove the cover.

(6) Remove the hose.

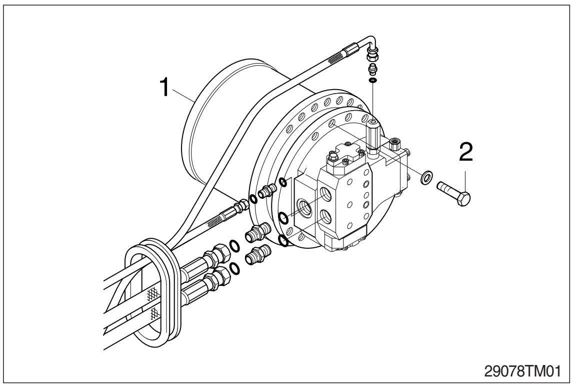
※ Fit blind plugs to the disconnected hoses.

(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 : 425 ㎏ (940 ℔)



29078TM01

2) INSTALL

(1) Carry out installation in the reverse order to removal.

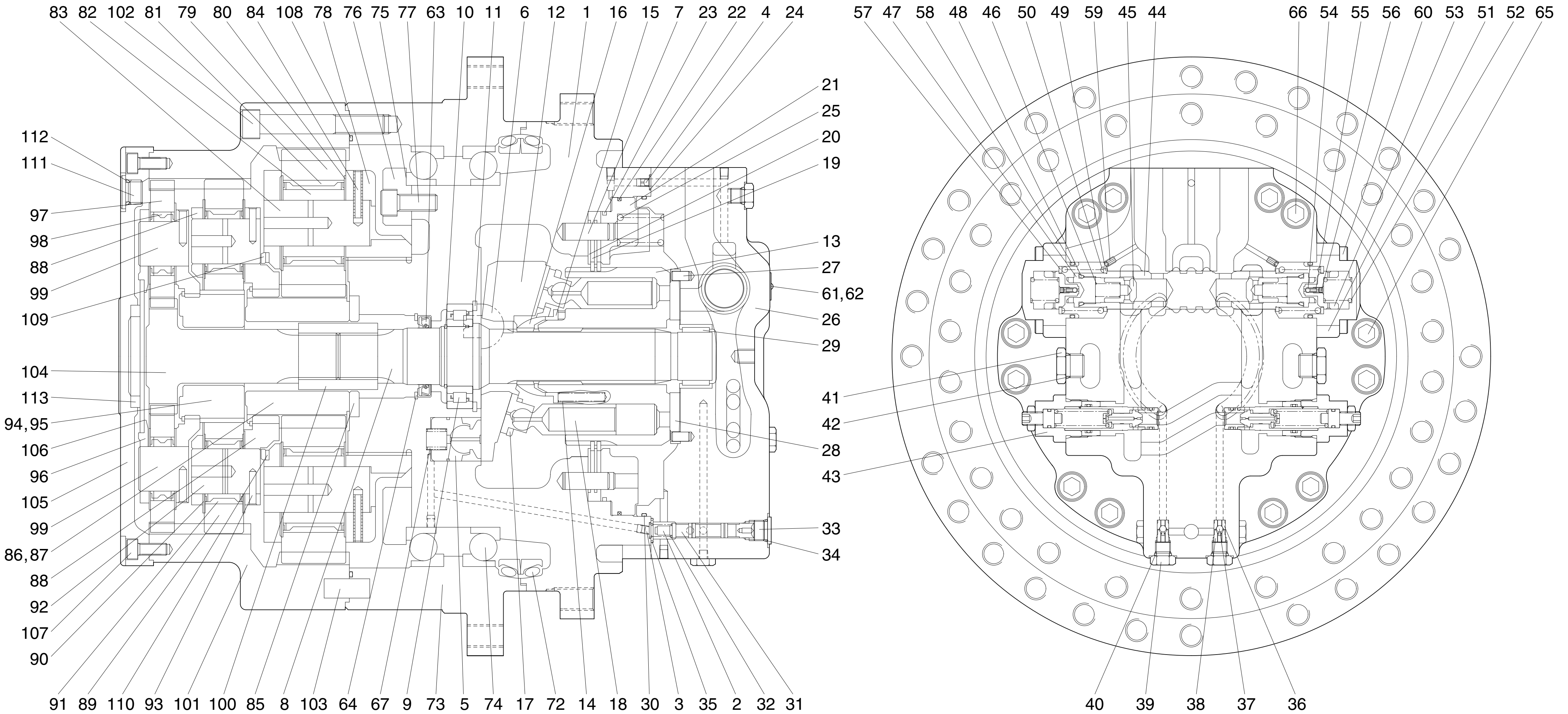
(2) Bleed the air from the travel motor.

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



3809A2TM22

1	Shaft casing	15	Spacer	29	Needle bearing	43	Relief valve assy	57	Spring seat	75	Shim	89	Planetary gear	103	Planetary pin
2	Plug	16	Ball guide	30	O-ring	44	Main spool	58	O-ring	76	Bearing guide	90	Plate	104	Drive gear
3	Orifice	17	Set plate	31	Swash spool	45	Check	59	Orifice	77	Wrench bolt	91	Needle bearing	105	End cover
4	Orifice screw	18	Piston & Shoe assy	32	Swash spring	46	Spring	60	Wrench bolt	78	Carrier	92	Pin	106	Plate
5	Swash piston	19	Friction plate	33	Plug	47	Plug	61	Name plate	79	Planetary gear	93	Spring pin	107	Wrench bolt
6	Swash ball	20	Separator plate	34	O-ring	48	O-ring	62	Rivet	80	Plate	94	Sun gear	108	O-ring
7	Brake pin	21	Brake piston	35	O-ring	49	Spring seat	63	Oil seal	81	Needle bearing	95	Snap ring	109	Ring
8	Shaft	22	Piston ring	36	Seat	50	Spring	64	Snap ring	82	Bearing bushing	96	Carrier	110	Ring
9	Roller bearing	23	Piston ring	37	Steel ball	51	Cover	65	Wrench bolt	83	Pin	97	Planetary gear	111	Plug
10	Stop ring	24	O-ring	38	Stopper	52	Spring	66	Wrench bolt	84	Spring pin	98	Needle bearing	112	O-ring
11	Lock ring	25	Brake spring	39	Plug	53	Spool	67	Spring pin	85	Thrust plate	99	Pin	113	Bushing
12	Swash plate	26	Valve casing	40	O-ring	54	Steel ball	72	Floating seal	86	Sun gear	100	Coupling		
13	Cylinder block	27	Valve plate pin	41	Plug	55	Spring	73	Hub	87	Snap ring	101	Ring gear		
14	Cylinder spring	28	Valve plate	42	O-ring	56	Plug	74	Bearing	88	Carrier	102	Wrench bolt		

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)
	8	Plug (33)
	10	Wrench bolt (60)
	27	Hex (43)
Socket wrench/ spanner	19	Hp plug (39)
	27	Hp plug (41)
Snap-ring plier (for holes, axis)		Ring stop (10), Snap ring (64)
Hammer		Needle bearing (29), Pin (7, 27)
Torque wrench		Size : 500 kgf · m, 3000 kgf · m
Jig for oil seal assembling		Oil seal (63)
Heating tool for bearing		Roller bearing (11)

(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	Orifice screw	NPTF 1/16	4	0.7	5.06
33	Plug	PF 3/8	8	7.5	54.25
39	HP plug	PF 1/4	19	3.7	26.76
41	HP plug	PF 1/2	27	11	79.56
43	Relief valve	HEX 27	27	18±1.0	130±7.0
60	Wrench bolt	M12×35L	10	13	94.03
65	Wrench bolt	M16×50L	14	13	94.03
66	Wrench bolt	M16×100L	14	6.7	48.46

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

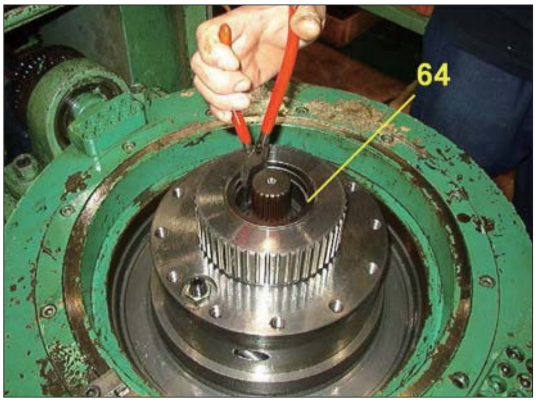
(1) Set up the motor assembly on the workbench for disassembly.
※ When you spin the disassembly-assembly jig at 90˚, please fix the motor drain plug (56) to the bottom.


3809A2TM040

(2) Please emit the oil in the motor case with dismantlement for the drain plug (56).
※ Please inspect whether there are some kinds of foreign substance (metal powders, processed chips and others) during drain oil.

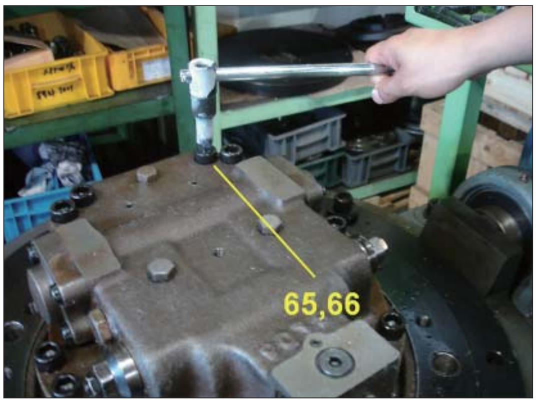

3809A2TM041

(3) Disassemble the snap-ring (64) using pliers.



3809A2TM042

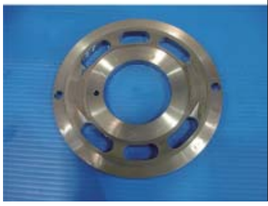
(4) Please disassemble the hexagonal socket bolt (65, 66) fixing the valve casing.



3809A2TM043

(5) Disassemble the valve plate (28) after the valve casing sub.

※ If abrasion on the valve plate, please change to new product.



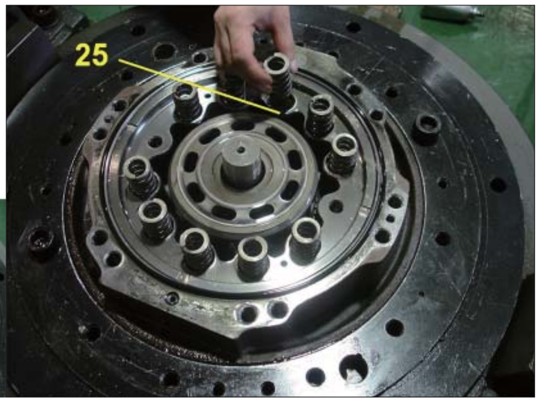
3809A2TM044A

3809A2TM044

(6) Remove brake springs (25) and take the brake piston out by screwing a M16 screw into the brake piston.

※ Number of brake springs is 10.

3809A2TM045A



3809A2TM045

(7) Remove the cylinder and piston assembly.

※ It is easer to work by placing the motor shaft horizontal.

3809A2TM046

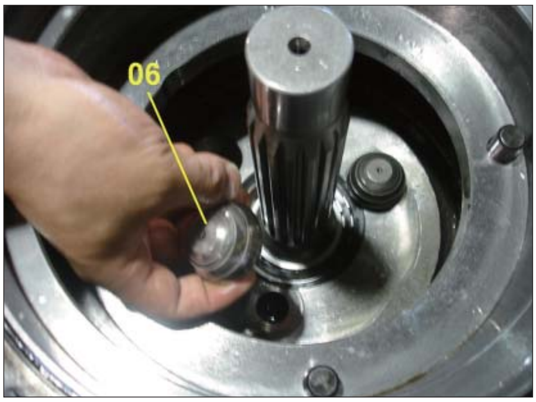
(8) Take swash plate (12) out.

3809A2TM047

(9) Take swash piston kit out.

3809A2TM048

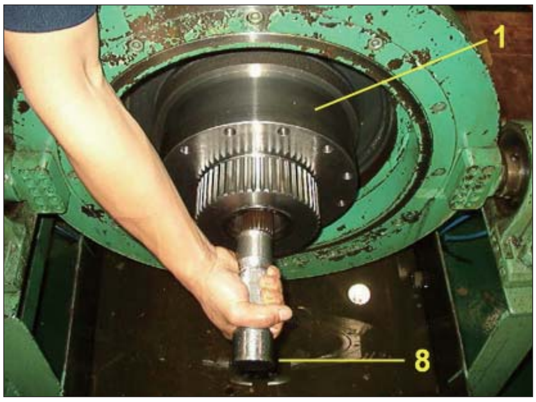
(10) Take swash ball (06) out.



3809A2TM049

(11) Take out shaft (8) from shaft casing (1) by striking the bottom part lightly with a hammer.

※ Be careful not to damage the roller bearing (9).

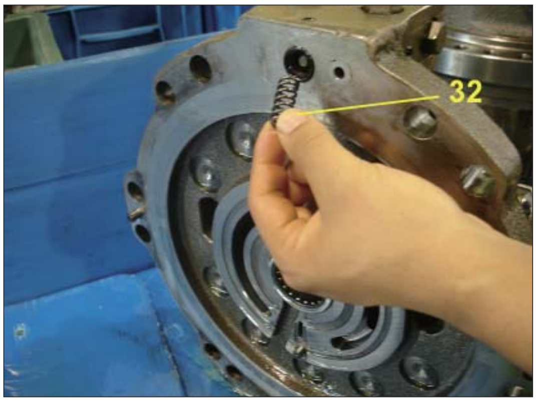


3809A2TM050

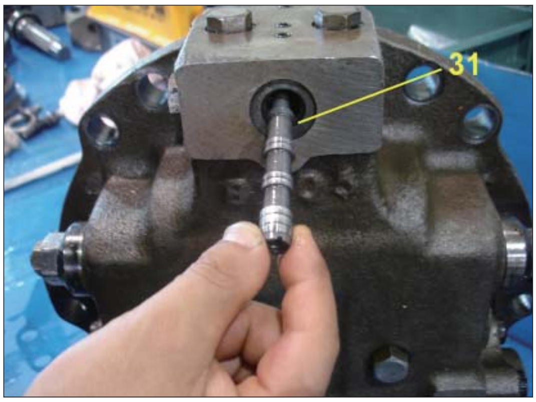
(12) Take valve casing sub out.

※ Be careful not to damage the needle bearing (29).

① Remove automatic control spring (32), automatic control spool (31).

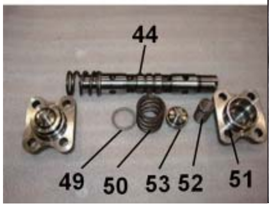


3809A2TM051

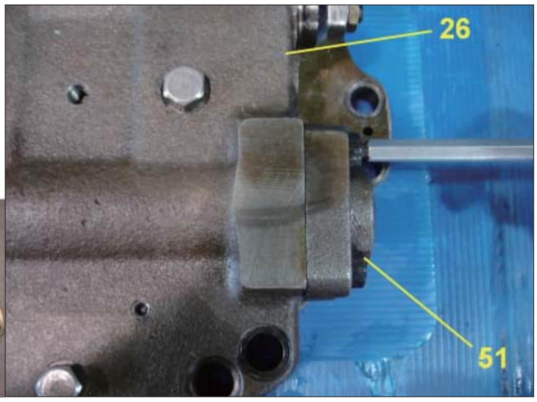


3809A2TM052

② Take out main spool cover (51) from valve casing (26). Remove spring (52), spool (53), spring seat (49), spring (50) and main spool (44) in sequence.

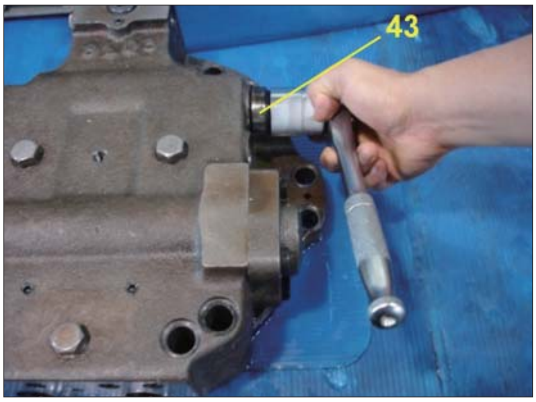


3809A2TM053A



3809A2TM053

③ Remove relief valve assembly (43).



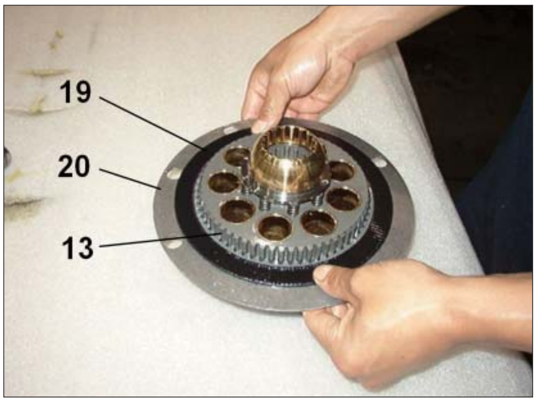
3809A2TM054

(13) Take cylinder sub out.

① Remove set plate (17) and piston (18) sub.

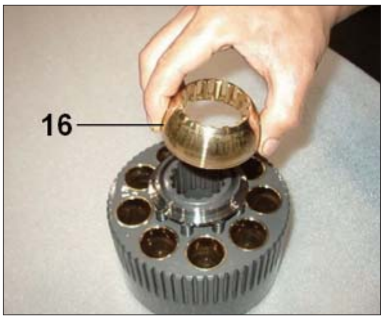
3809A2TM055

② Remove friction plates (19) and separate plates (20) from cylinder block (13).

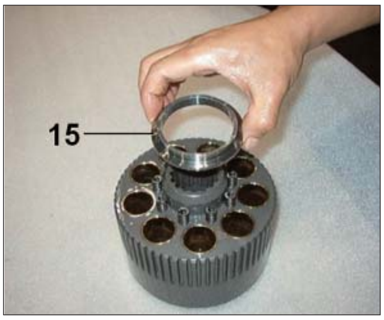


3809A2TM056

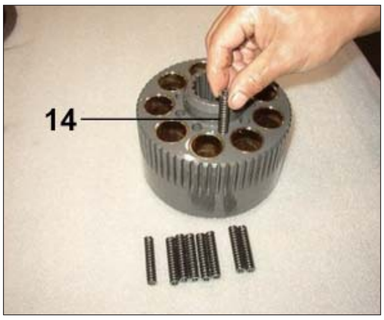
③ Remove ball guide (16), spacer (15), cylinder spring (14).



3809A2TM057



3809A2TM058



3809A2TM059

※ Disassembly has completed.
Check that the motor parts are broken or not.

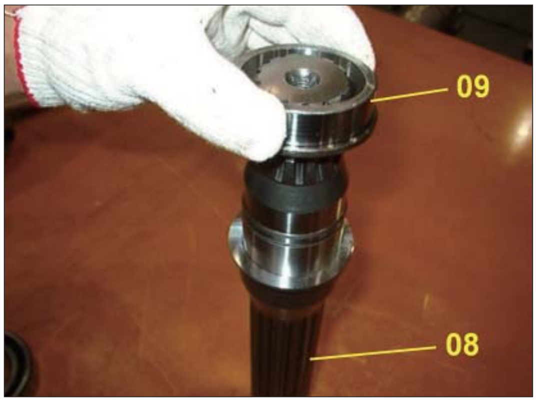
3) ASSEMBLING TRAVEL MOTOR

(1) Shaft sub assembly

① Fit bearing spacer to shaft (08) and press-fit roller bearing (09).

※ Press the roller bearing after preheating.

3809A2TM060



3809A2TM061

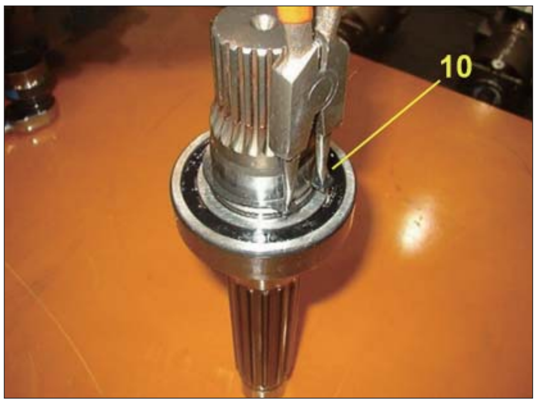
a. Induction heating apparatus temperature : 100˚C

b. Be careful not to damage the sliding surface for the seal on the shaft.

3809A2TM062

② Insert stop ring (10) with snap ring pliers.

※ Pay attention to the direction of the stop ring. (round direction is bearing direction.)



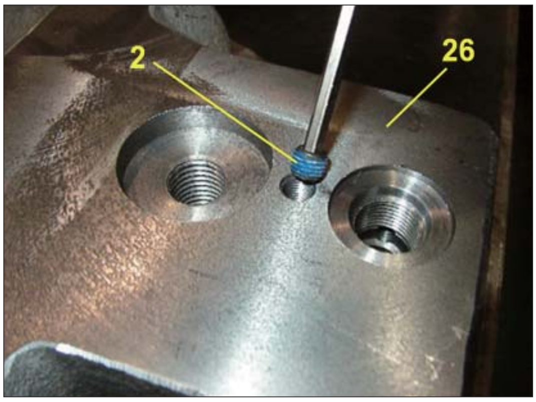
3809A2TM063

(2) Assemble valve casing sub assembly

① Tighten plugs (2) to valve casing (26) to the specified torque.

a. Apply loctite to the plug, and tighten them to the specified torque.

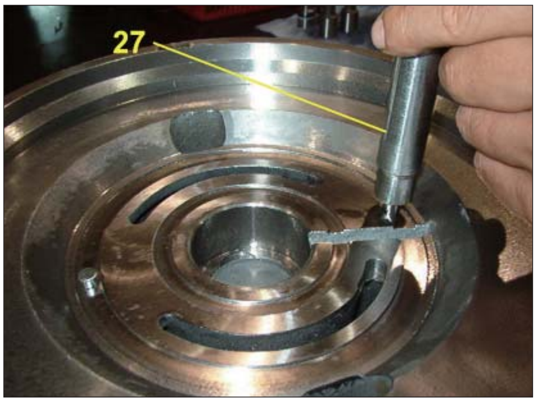
· Tightening torque : 70~110 kgf · cm



3809A2TM064

② Press-fit pin (27).

The pin's length will be 5 mm from valve plate with contacted area using a hammer.



3809A2TM065

③ Assemble needle bearing (29).

- Tools : Press-fit jig and hammer.

3809A2TM066

④ Assemble seat (36), ball (37), stopper (38), O-ring (40) and HP plug (39) in sequence.

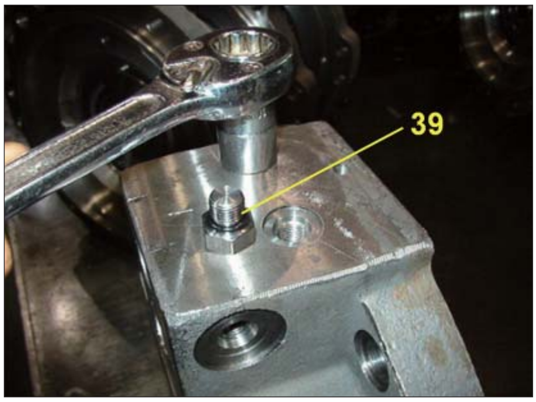
3809A2TM067


3809A2TM068

※ Pay attention to the direction of the seat and stopper.
· Tightening torque : 370 kgf · cm

⑤ Assemble HP plug (39) to the specified torque.

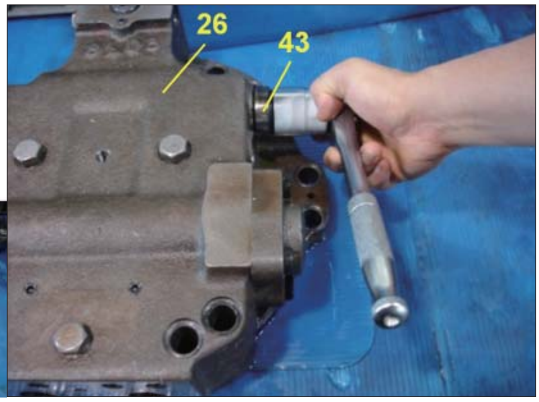
· 5 places
· Tightening torque : 370 kgf · cm



3809A2TM069

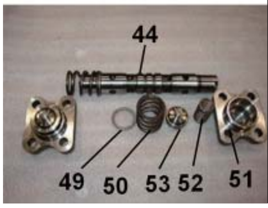
⑥ Mount relief valve (43) to the specified torque.
· Tightening torque : 2200 kgf · cm

3809A2TM070A

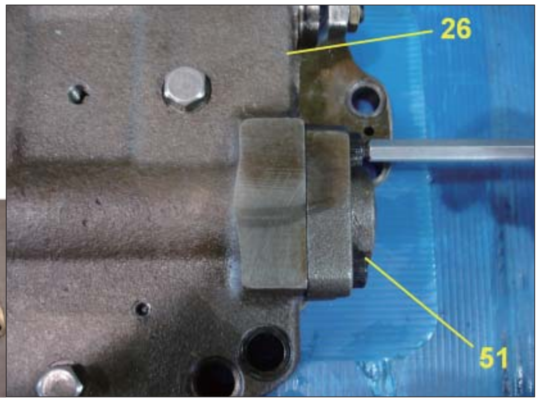


3809A2TM070

⑦ Assemble main spool cover (51), spring (52), spool (53), spring seat (49), spring (50), and main spool (44) in sequence.



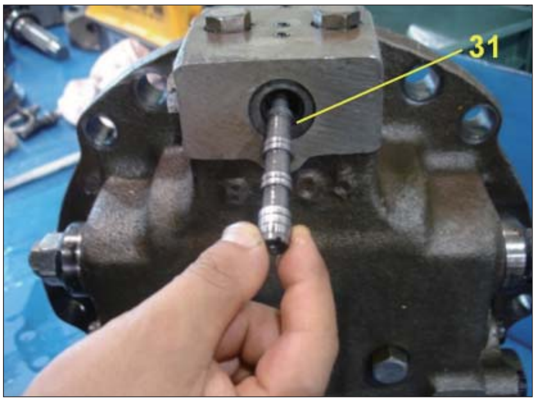
3809A2TM071A



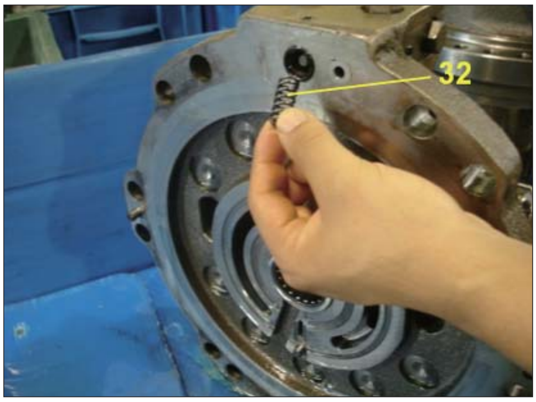
3809A2TM071

⑧ Assemble automatic control spool (31), spring (32), O-ring (35).

· Tightening torque : 750 kgf · cm



3809A2TM072



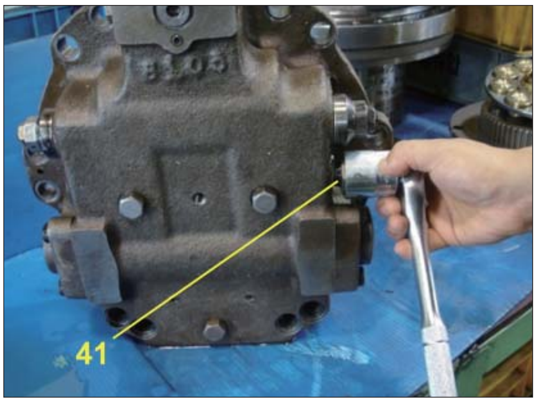
3809A2TM073

⑨ Insert O-ring (30) to valve casing. Apply grease to the O-ring.

3809A2TM074

⑩ Assemble drain plug (41) to the specified torque.

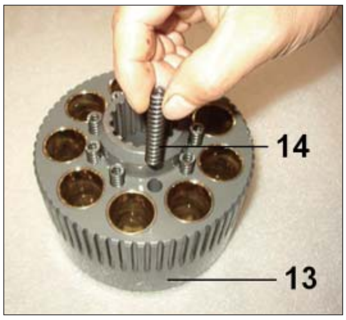
· Tightening torque : 1100 kgf · cm



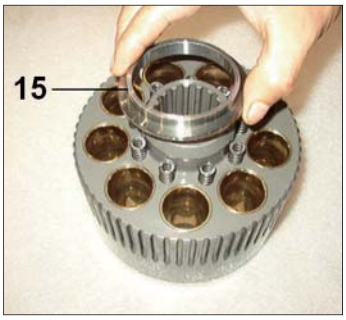
3809A2TM075

(3) Assemble cylinder sub assembly

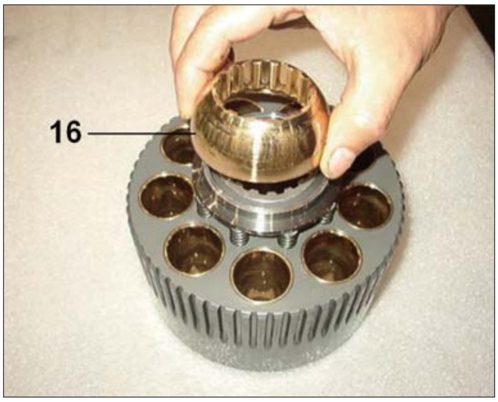
① Fit cylinder spring (14), spacer (15) and ball guide (16) to cylinder block (13).
Align the phase of the cylinder and the splineof the ball guide.



3809A2TM076A

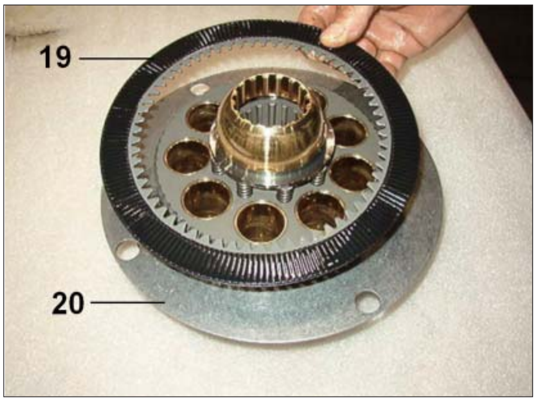


3809A2TM076B



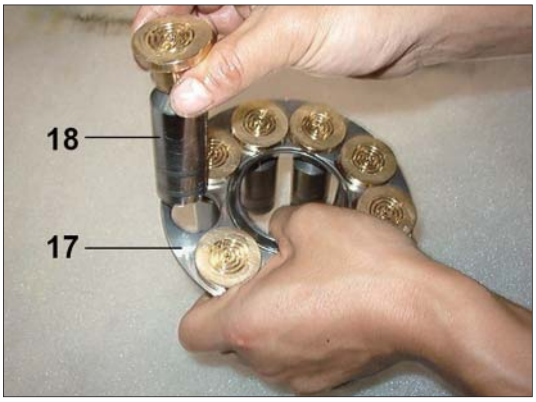
3809A2TM076

② Assemble friction plates (19) and separate plates (20).



3809A2TM077

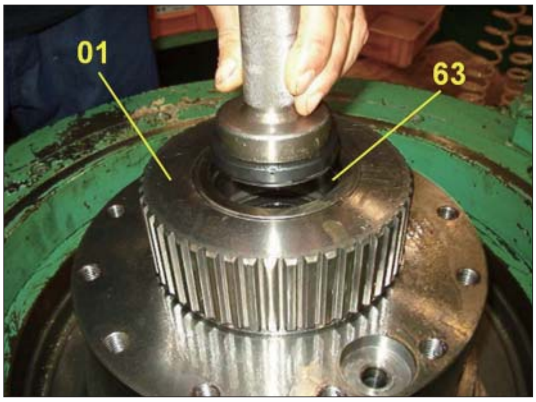
③ Insert the assembly of piston shoe (18) to retainer set plate (17) and fit it to the cylinder block (13).



3809A2TM078

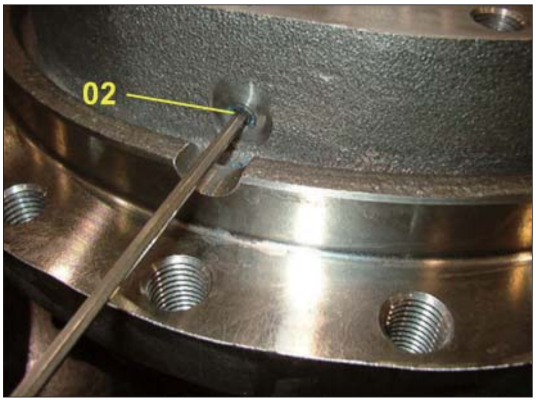
3809A2TM079

(4) Fit oil-seal (63).
※ Be careful not to damage the lip of the seal.

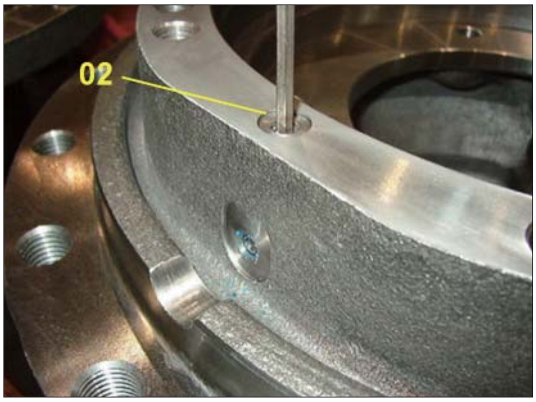


3809A2TM080

(5) Assemble plug (02) to the specified torque.



3809A2TM081



3809A2TM082

① Apply loctite to the plug and assemble.
② Tightening torque : 70~110 kgf · cm

(6) Fit pins (7).
- Tools : Hammer
Pin (7) : Please keep the length at 19 mm from surface of the shaft casing.
Pin (7) numbers - 4 EA


3809A2TM083

(7) Assemble the shaft sub assembly.

3809A2TM084

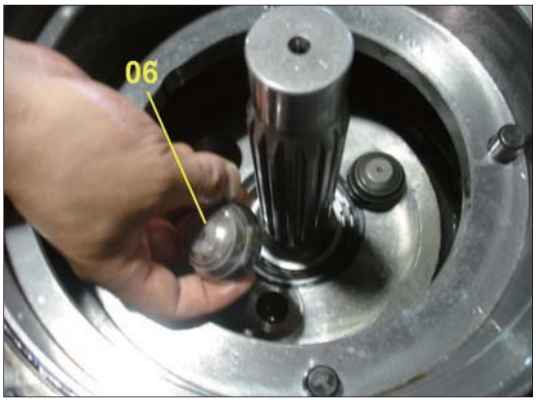
(8) Assemble swash plate (12).

3809A2TM085

(9) Assemble swash piston kit assembly.

3809A2TM086

(10) Assemble swash ball (06).

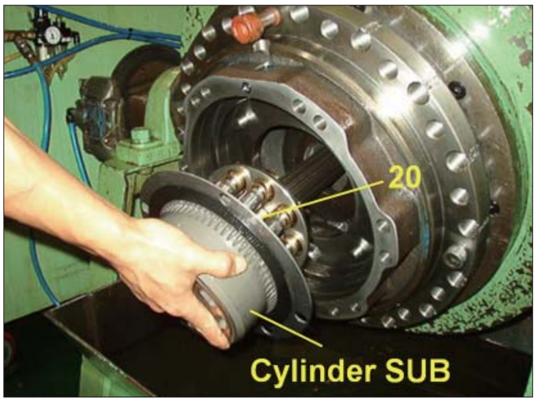


3809A2TM087

(11) Work when the shaft casing is at the vertical direction.
※ Be careful not to drop the swash plate.


3809A2TM088

(12) Fit the cylinder sub assembly.
※ Align the separate plates (20) to the pin.

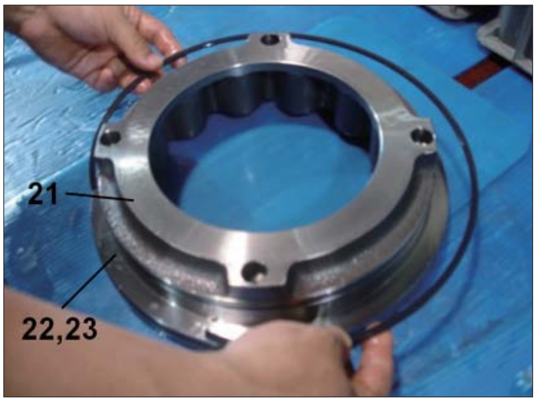


3809A2TM089

(13) Place the motor vertical again.


3809A2TM090

(14) Fit piston ring (22), piston ring (23) to brake piston (21).



3809A2TM091

(15) Fit the brake piston (21) to the shaft casing (01).

※ Pay attention to the direction of the brake piston.

3809A2TM092

(16) Mount brake springs (25).

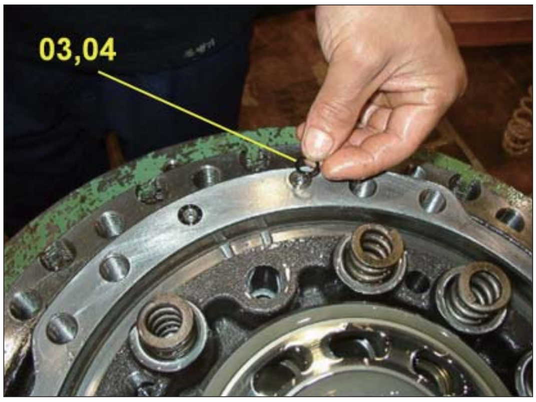
① Numbers : Springs - 10EA , Holes - 10EA

3809A2TM093

(17) Tighten orifice (03, 04) to the specified torque.

① Numbers and size : (03) 1 EA - ø 0.6
(04) 1 EA - ø 0.8

② Tightening torque : 70 kgf · cm



3809A2TM094

(18) Mount valve plate (26) to valve casing and tighten it with hexagonal socket bolt (66).

① Apply grease to the valve plate back and be careful not to drop the valve plate.

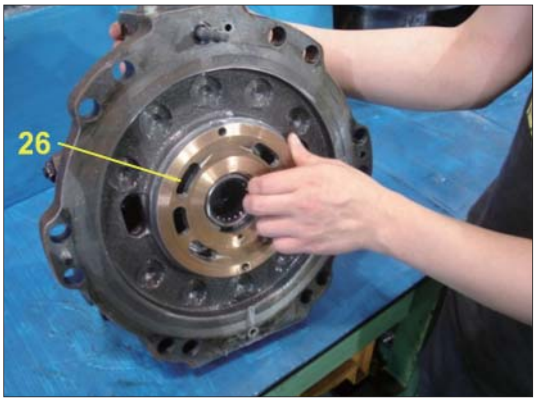
② When you assemble the valve casing to shaft casing, please use a crane.

③ The hole (ø 5) of valve plate will be located for inlet and outlet port of valve casing.

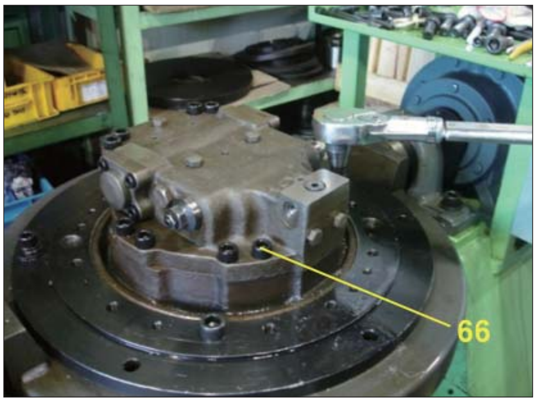
④ Coat grease to swash spool of swash spring.

· Tightening torque : 2400 kgf · cm

- Bolt tightening torque : 1800±100 kgf · cm



3809A2TM095



3809A2TM096

(19) Tighten relief valves (43) to the specified torque.

3809A2TM097

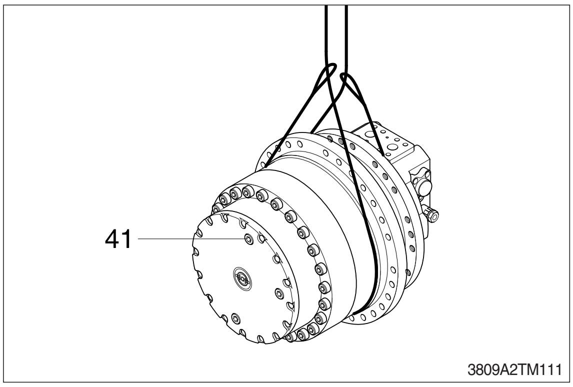
※ Assembly has completed.

3. DISASSEMBLING REDUCTION GEAR

1) DISASSEMBLY

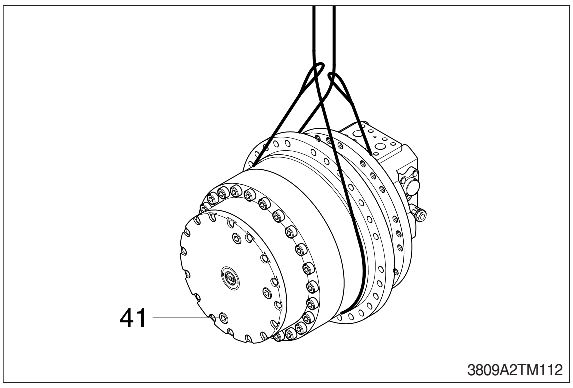
(1) Loosen drain plug (41).

- Do not remove drain plug (41) at once.
- Because gear oil was compressed, plug and oil protrude suddenly.



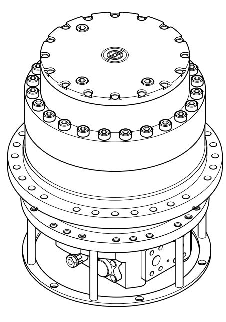
3809A2TM111

(2) After loosening drain plug (41), drain gear oil.



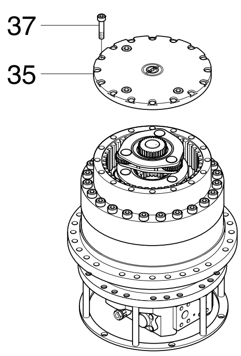
3809A2TM112

(3) Overturn the traveling device.



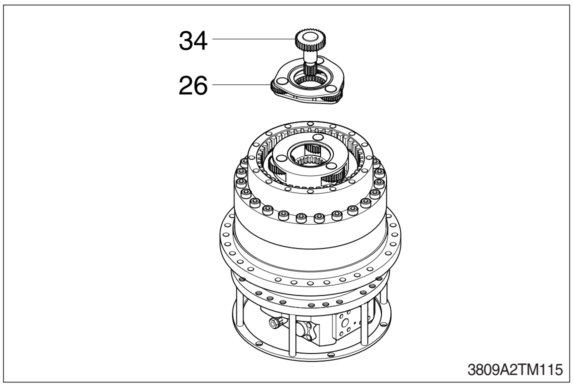
3809A2TM113

(4) After loosening bolt (37), take cover (35) off.

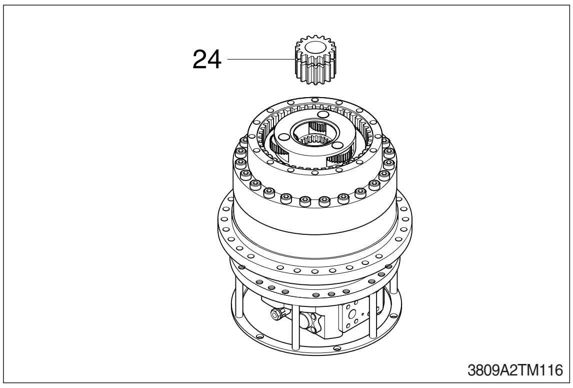


3809A2TM114

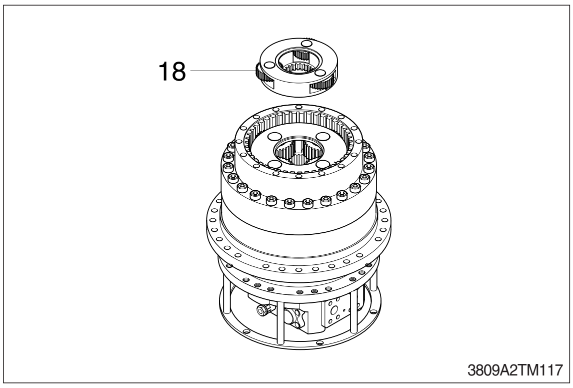
(5) Remove drive gear (34) and No.3 carrier (26).



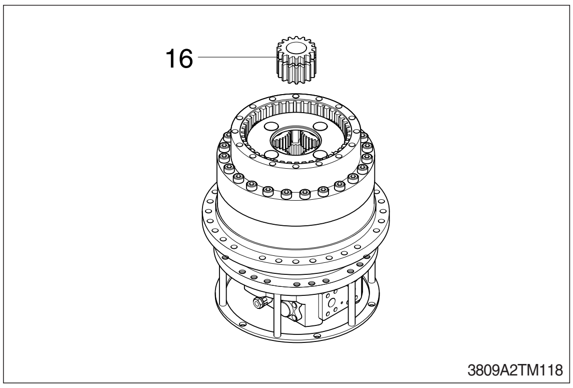
(6) Remove No.2 sun gear B (24).



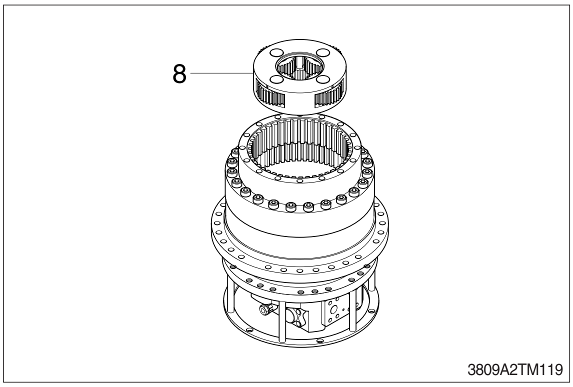
(7) Remove No.2 carrier B (18).



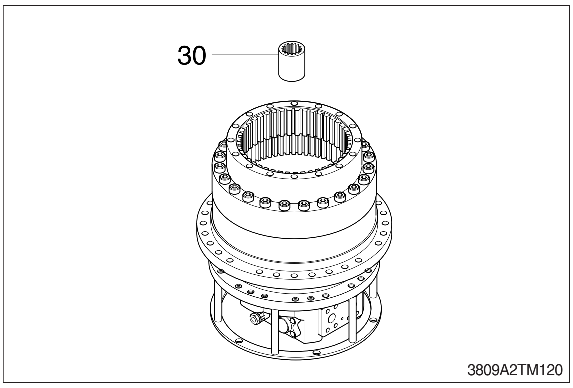
(8) Remove No.1 sun gear A (16).



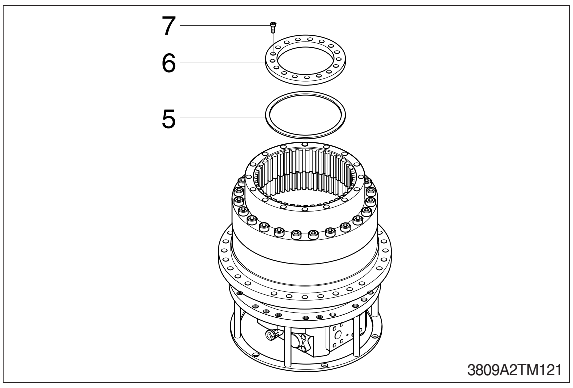
(9) Remove No.1 carrier A (8).



(10) Remove coupling (30).

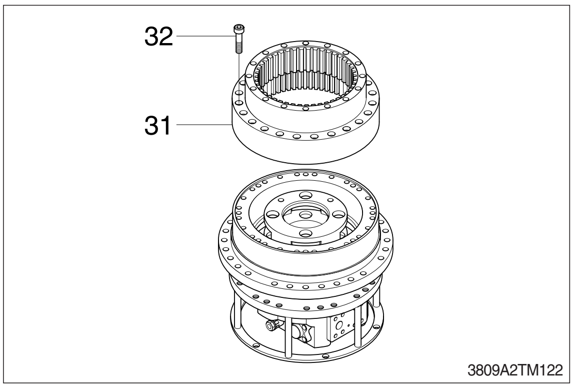


(11) After loosening bolt (7), remove bearing guide (6) and shim (5).

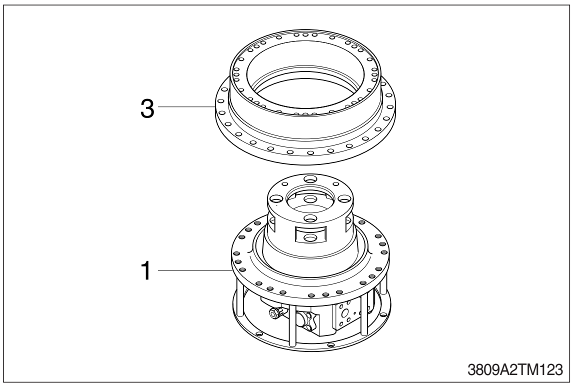


(12) After loosening bolt (32), remove ring gear (31).

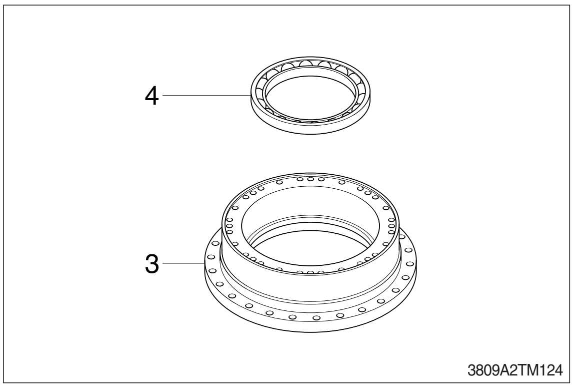
- Tools : I-bolt, Hoist



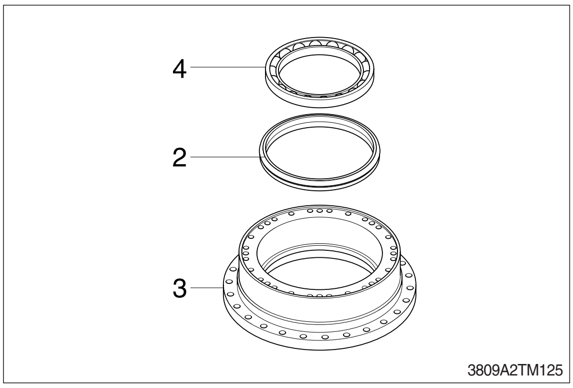
(13)Remove hub (3) from assembly (1).
- Tools : I-bolt, Hoist



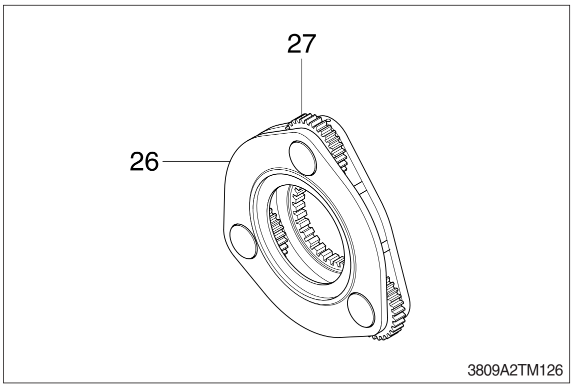
(14)Remove angular bearing (4) from hub (3).



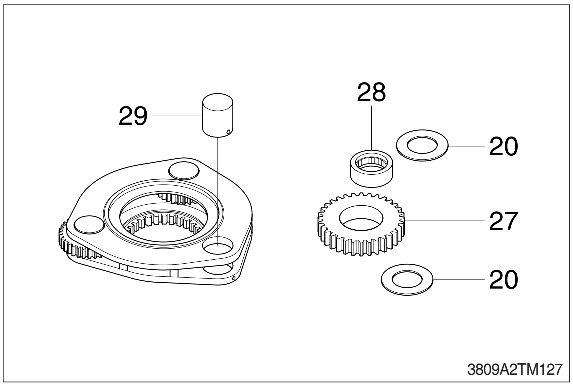
(15)Remove floating seal (2) and angular bearing (4) at opposite of hub (3).



(16)Remove planetary gear C (27) from No.3 carrier C (26).



(17)After removing pin (29), remove No.3 planetary gear C (27), needle bearing (11) and plate C (20).



(18)Remove No.2 carrier B (18) assy.

(19)Remove No.1 carrier A (8) assy.

※ Disassembly has completed.

4. ASSEMBLING REDUCTION GEAR

- General precautions

  Clean every part by kerosene and dry them by air blow.

  Surfaces to be applied by loctite must be decreased by solvent.

  Check every part for any abnormals.

  Each hexagon socket head bolt should be used with loctite 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) Track gearbox, assembly

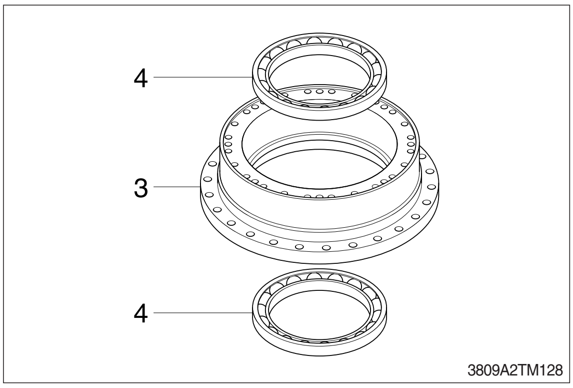
Before assembly track gearbox

Please observe following item.

- Wash all parts cleanly using solvent and dry all parts perfectly using compressed air.
- Check metal dust in casing and cleansing solution.
- Before application packing, please remove oil certainly.
- Before insert needle bearing, apply grease to bearing inlet enough.
- Apply lubricant to rotation part and sliding part.
- Damaged part or discolored part exchanges by new parts.

(1) Assemble hub

① Press fit angular bearing (4) to hub (3).



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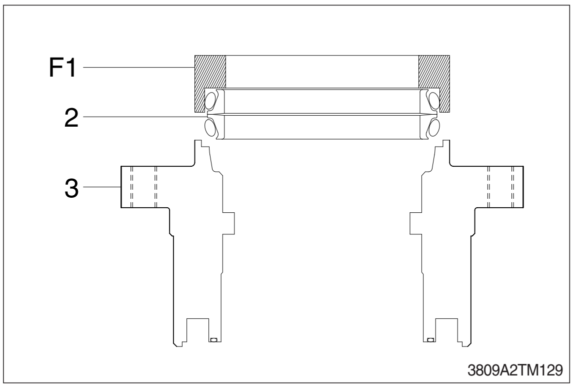
② Assemble floating seal (2) to hub (3) using press jig (F1).

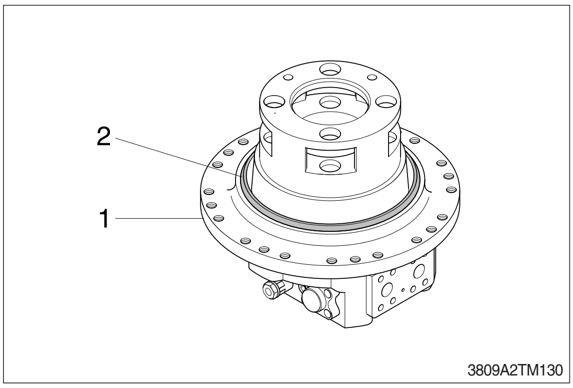
- Remove completely the oil of surface that O-ring and O-ring contact.
- Dry completely the floating seal.
- After assembling the floating seal, check floating seal angle (within 1 mm).
- After assembling the floating seal, coat lubricant to the sliding surface of the floating seal.



3809A2TM129

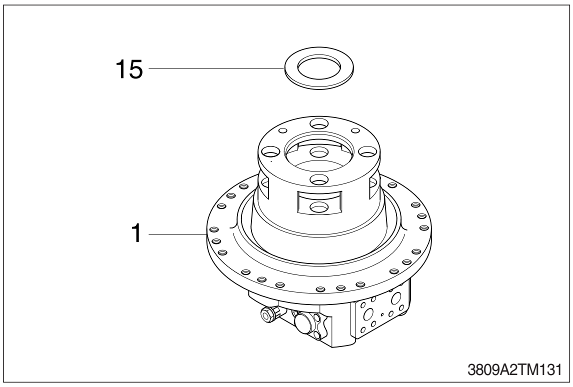
③ Assemble floating seal (2) to track motor (1) using press jig (F1).
Assembling sequence is same with sequence (②).

- Remove completely the oil of surface that O-ring and O-ring contact.
- Dry completely the floating seal.
- After assembling floating seal, coat lubricant to the sliding surface of the floating seal.

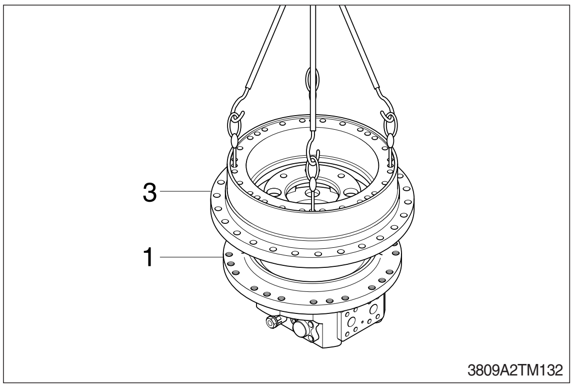


3809A2TM130

(2) Assemble thrust plate (15) to spline surface of track motor (1).

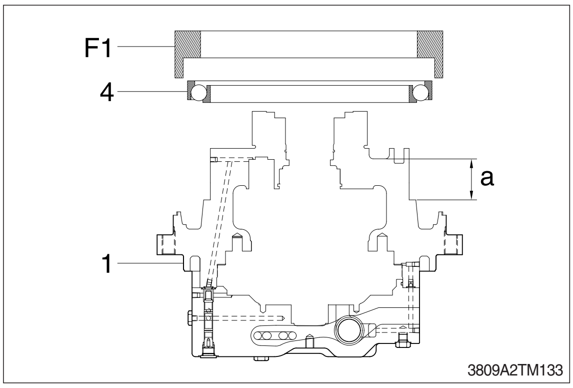


(3) Insert the assembly of hub (3) to track motor (1).



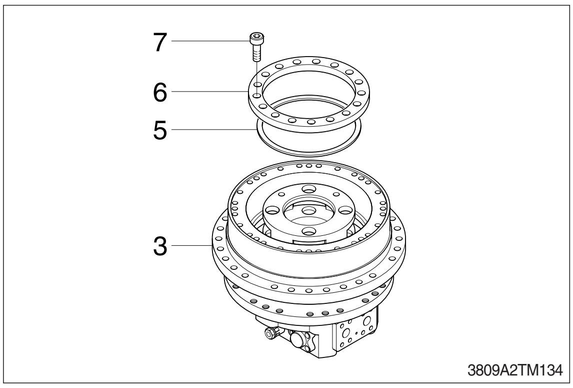
(4) Stick bearing (4) to track motor (1) using press jig (F1).

- Don't heat the bearing.
- Don't hit the bearing retainer.
- Spin the hub. (two times ~ three times)
- Measure "a" size of figure.

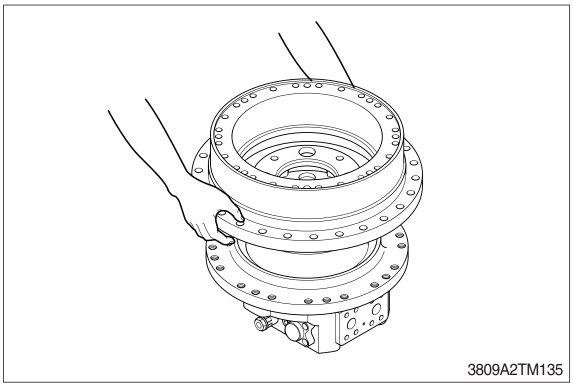


(5) After assembling shim (5), assemble bearing guide (6) using bolt (7).

- Select thickness of shim (5) and assembly.
- Apply loctite #262 to bolt (7).
  · Tightening torque : 1300 kgf · cm



(6) Assemble bearing guide.
According to the hub turn, we can check it goes on smoothly or not.

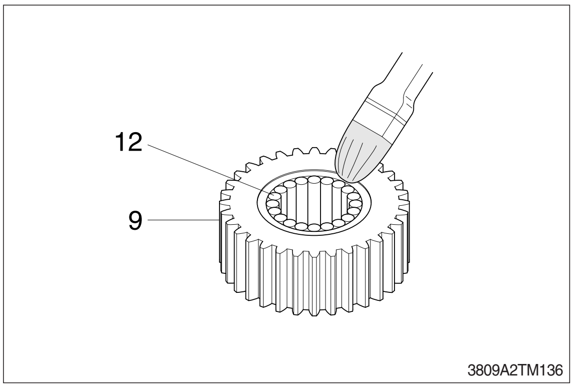


(7) Assemble No.1 carrier A (8) sub.

① Mount bearing bushing (12) to No.1 planetary gear A (9).

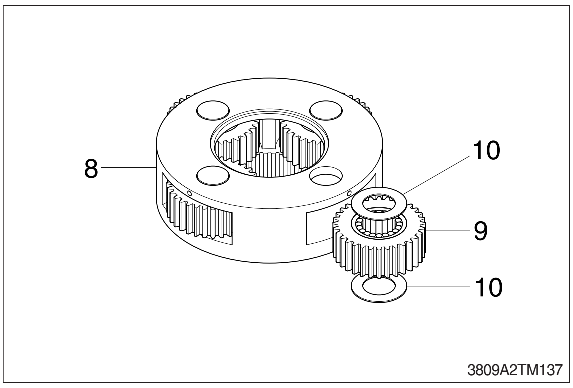
- Bearing bushing numbers : 18EA

Insert needle and coat grease.



② Mount No.1 planetary gear A (9) and plate A (10) to No.1 carrier A (8).

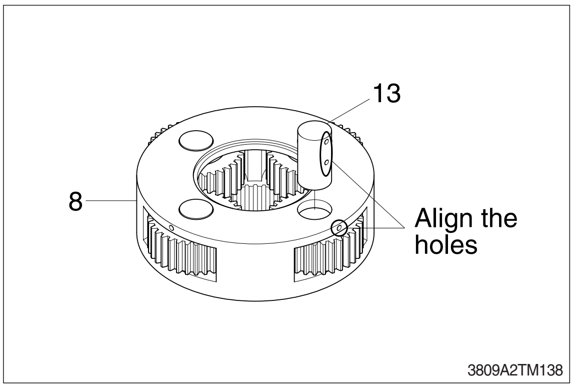
- Align the hole of carrier and needle inside diameter.



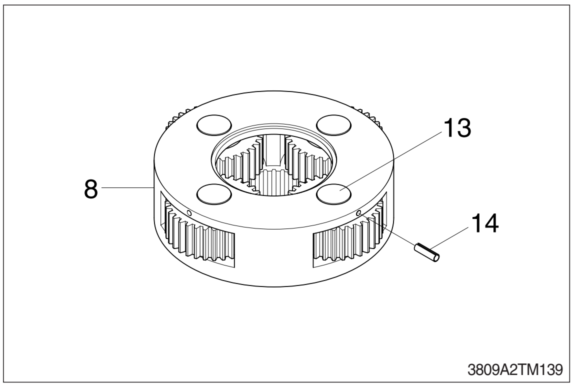
③ Put pin (13) on holes of No.1 carrier A (8).

※ Align the holes of the carrier and pin holes.

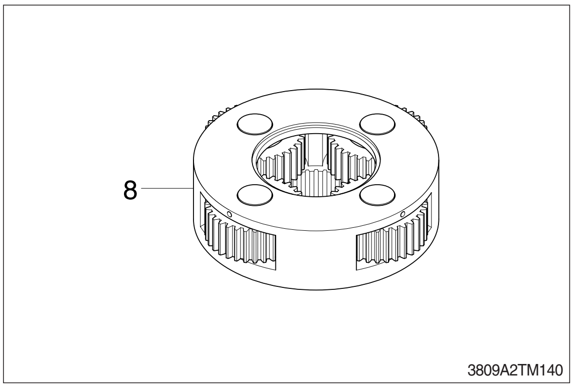
※ Beat on it lightly with hammer and put in.



④ Assemble carrier (8) and pin (13) striking pin (14) by hammer.
After assembly pin (14), caulking.



⑤ Complete remainder by equal method.

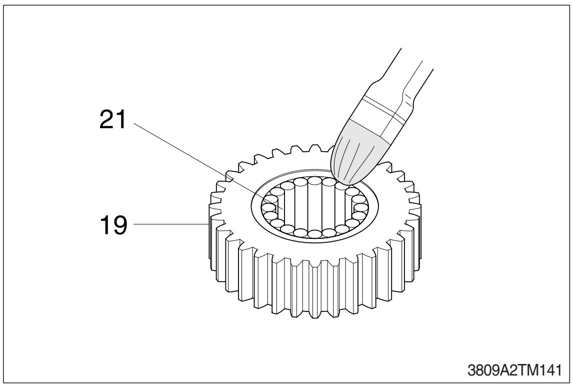


(8) Assemble No.2 carrier B (18) sub.

① Mount needle (21) to No.2 planetary gear B (19).

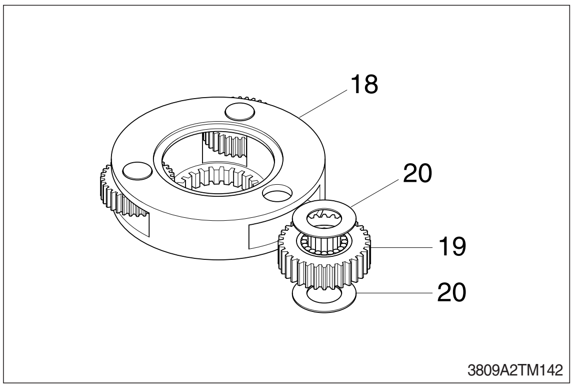
- Needle numbers : 15 EA

Insert needle and coat grease.



② Insert No.2 planetary gear B (19) and plate B (20) to No.2 carrier B (18).

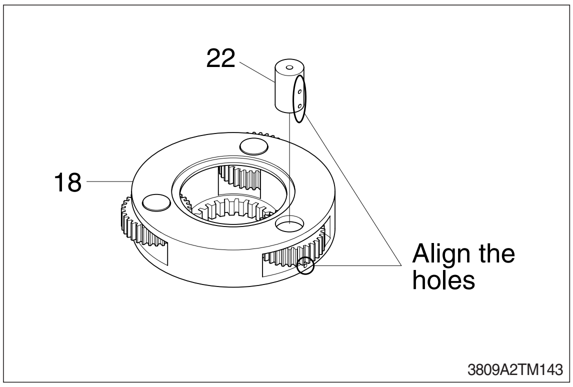
- Align the holes of the carrier and pin holes.



③ Put pin (22) on holes of No.2 carrier B (18).

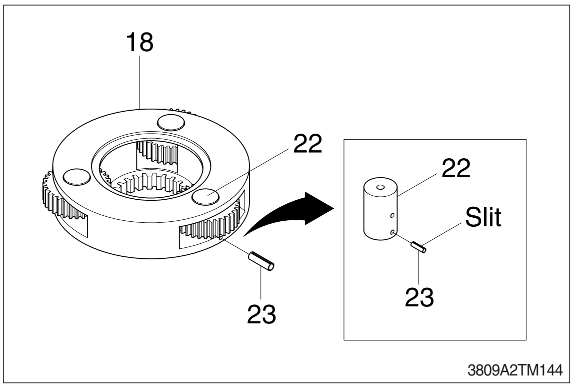
※ Align the holes of the carrier and pin holes.

※ Beat on it lightly with hammer and put in.

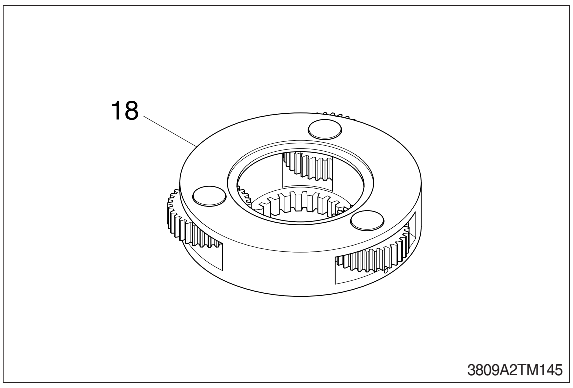


④ Assemble carrier (18) and pin (22), striking pin (23) by hammer.

- If the pin's divided side is not located in the above,it will be damaged during operation.
- After assembly pin, caulking.

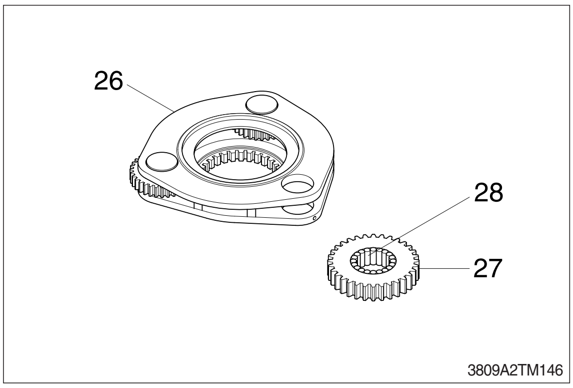


⑤ Complete remainder by equal method.



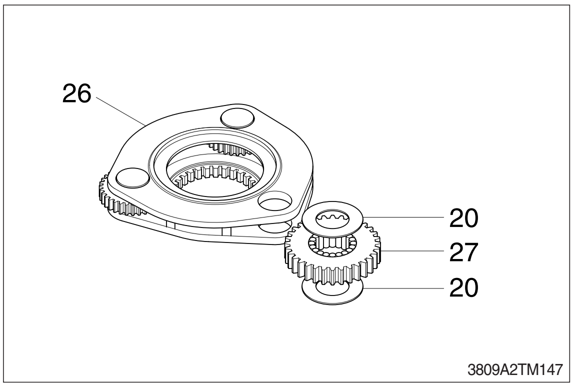
(9) Assemble No.3 carrier C (26) sub.

① Insert needle bearing (28) to No.3 planetary gear C (27).
Insert needle and coat grease.



② Insert No.3 planetary gear C (27) and plate C (20) to No.3 carrier C (26).

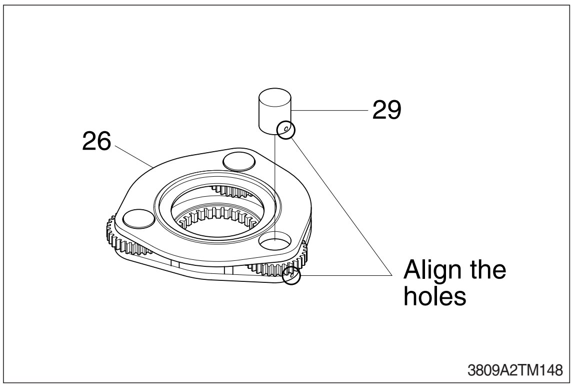
- Align the holes of the carrier and inside diameter of needle bearing.



③ Put pin (29) on holes of No.3 carrier C (26).

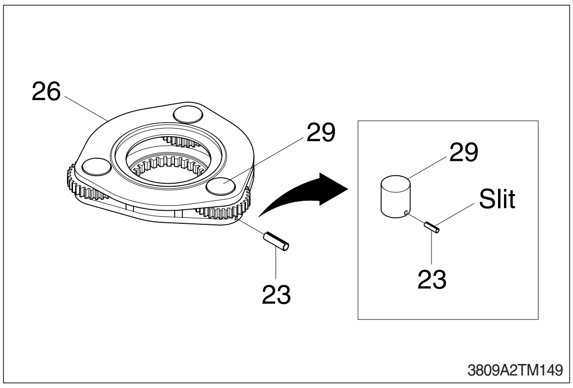
※ Align the holes of the carrier and pin holes.

※ Beat on it lightly with hammer and put in.

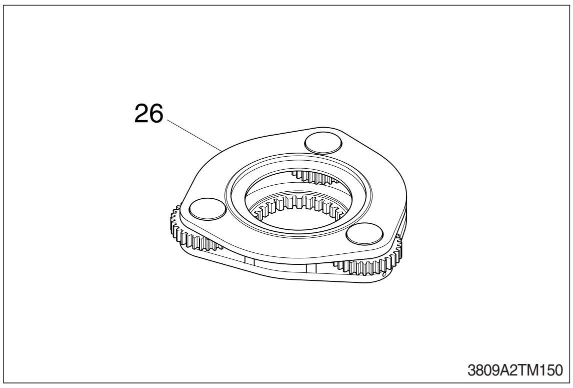


④ Assemble carrier (26) and pin (29) striking pin (23) by hammer.

- If the pin's divided side is not located in the above, it will be damaged during operation.
- After assembly pin, caulking.

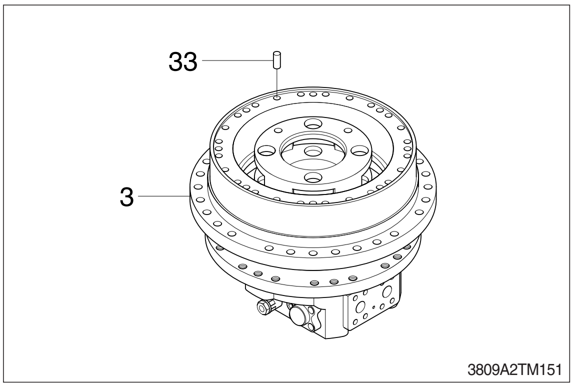


⑤ Complete remainder by equal method.

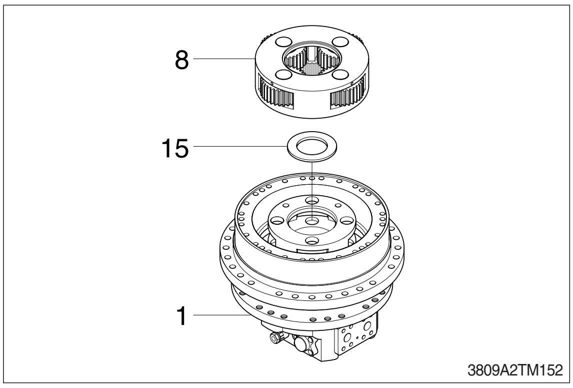


(10)Press-fit parallel pin (33) to the surface of hub (3).

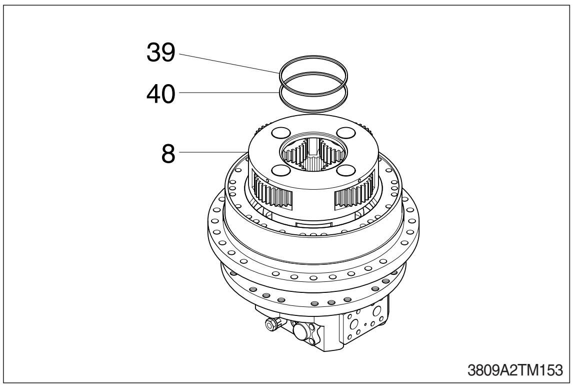
- Parallel pin numbers : 8EA



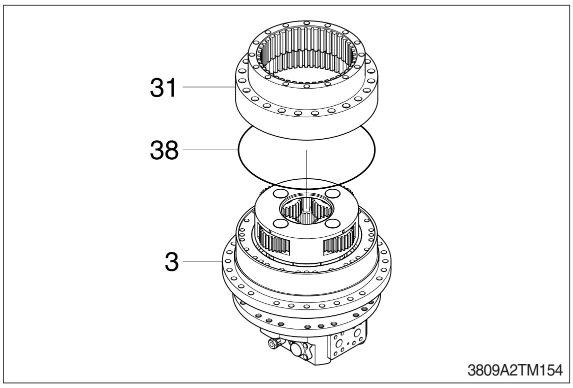
(11)Insert thrust plate (15) to shaft casing of track motor (1).
Press-fit No.1 carrier A (8) assy to shaft casing spline using hoist.



(12)Press-fit ring (39, 40) to the No.1 carrier A (8) assy.

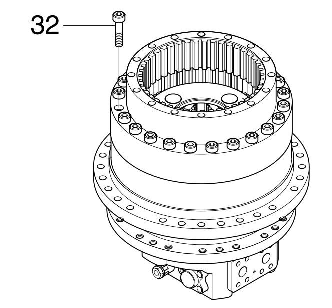


(13)Mounting O-ring (38) into hub (3), and assemble ring gear (31) to hub (3).



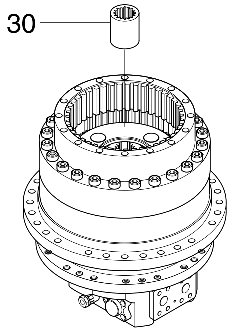
(14) Tighten hub and ring gear.

- Bolt numbers : 24 EA
- Tightening torque : 1800 kgf · cm



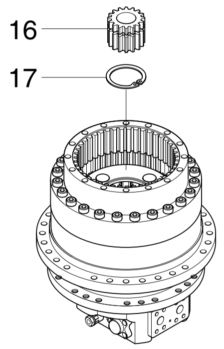
3809A2TM155

(15) Insert coupling (30) to splineof shaft.



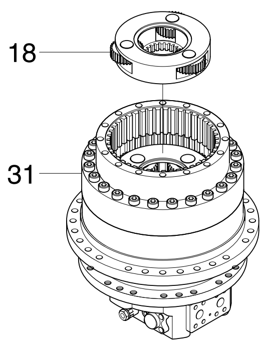
3809A2TM156

(16) Assemble snap ring (17) to sun gear A (16).
Insert sun gear A (16) to carrier A.



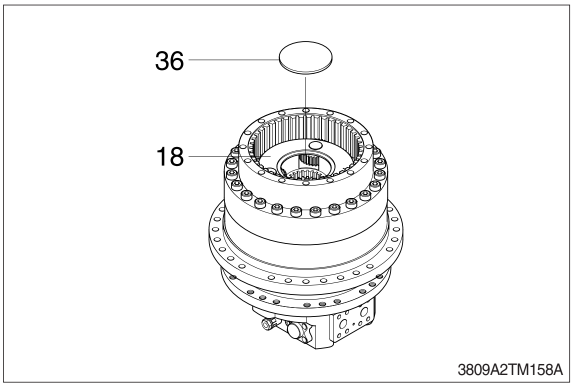
3809A2TM157

(17) Assemble carrier B (18) to ring gear (31).

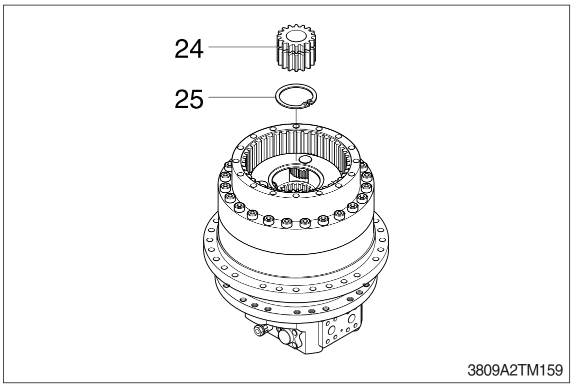


3809A2TM158

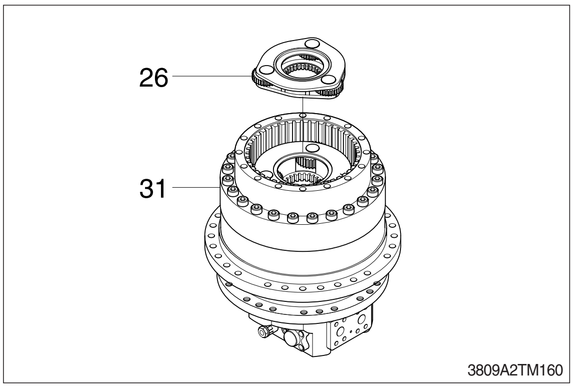
(18) Assemble plate (36) to carrier B (18).



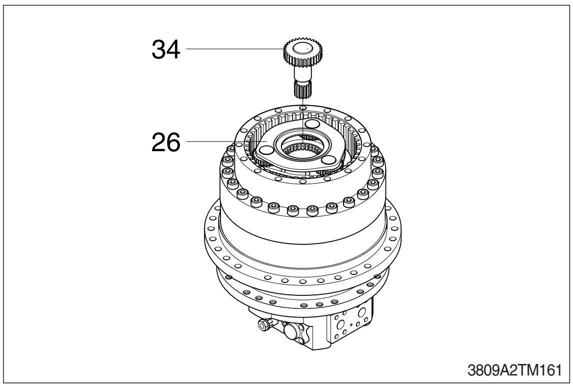
(19) Assemble snap ring (25) to sun gear B (24).
Insert carrier B to sun gear B (24).



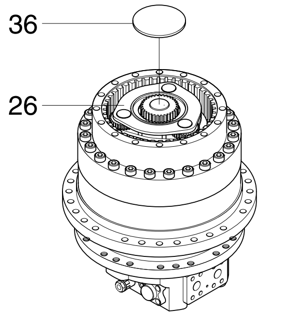
(20) Assemble carrier C (26) assy to ring gear (31).
After assembling, check whether gear rotate or not.



(21) Assemble carrier C (26) to drive gear (34).

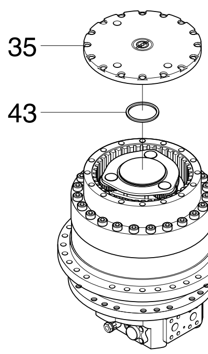


(22) Assemble plate (36) to carrier C (26).



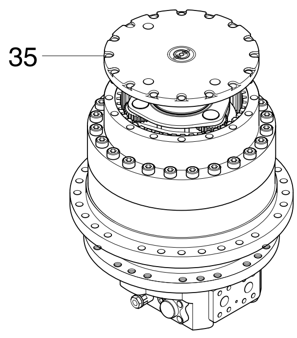
3809A2TM162

(23) Press-fit bushing (43) to cover (35).



3809A2TM163

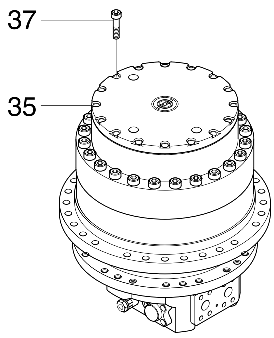
(24) Assemble cover (35).



3809A2TM164

(25) Assemble cover (35) and tighten them to the specified torque.

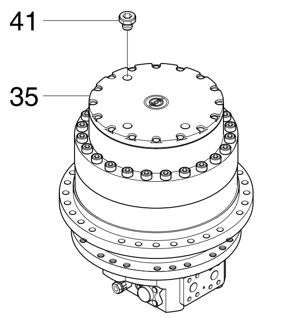
· Tightening torque : 750 kgf · cm



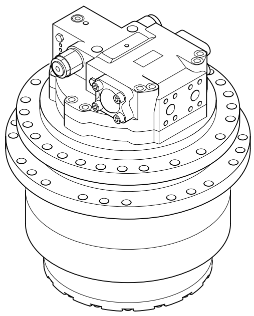
3809A2TM165

(26) Inject gear oil and assemble plug (41) of cover (35).

- Volume of gear oil : 4.5 liter



3809A2TM166


3809A2TM167

※ Assembly has completed.

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

13031GE18

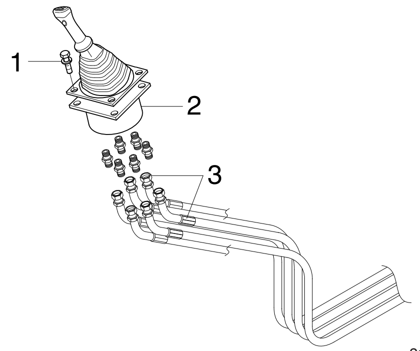
(4) Loosen the socket bolt (1).

(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.



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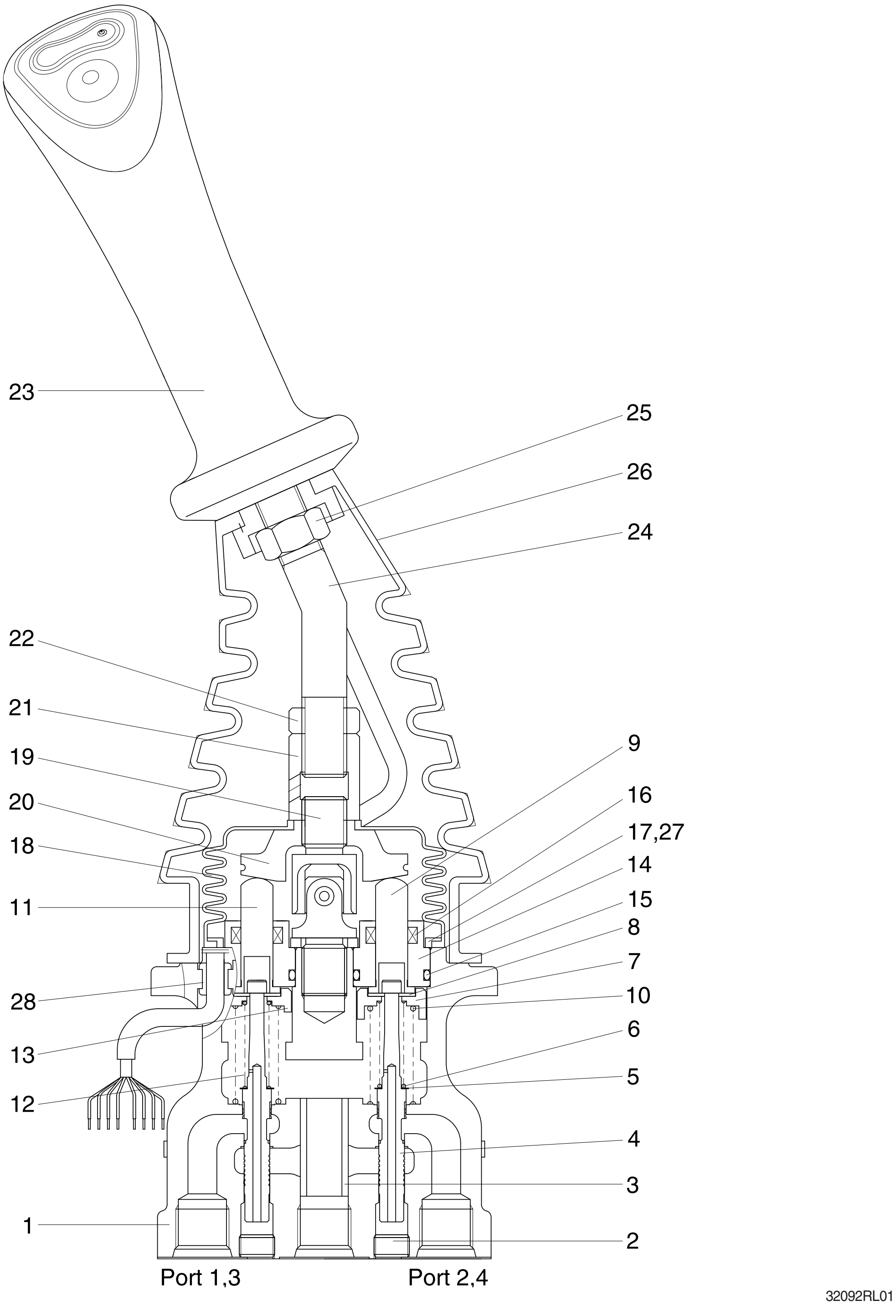
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

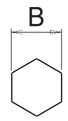
1) STRUCTURE



1	Case	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

<table>
<tr><th>Tool name</th><th colspan="2">Remark</th></tr>
<tr><td>Allen wrench</td><td>6</td><td rowspan="3">
</td></tr>
<tr><td rowspan="2">Spanne</td><td>22</td></tr>
<tr><td>27</td></tr>
<tr><td>(+) Driver</td><td colspan="2">Length 150</td></tr>
<tr><td>(-) Driver</td><td colspan="2">Width 4~5</td></tr>
<tr><td>Torque wrench</td><td colspan="2">Capable of tightening with the specified torques</td></tr>
</table>

(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

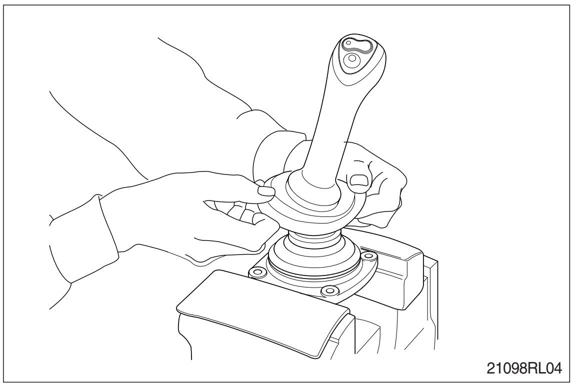
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

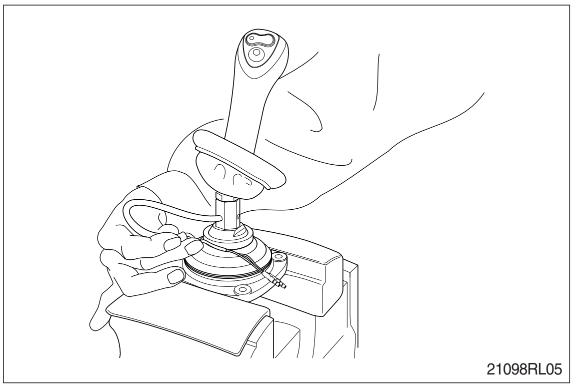
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper (or lead) sheets.

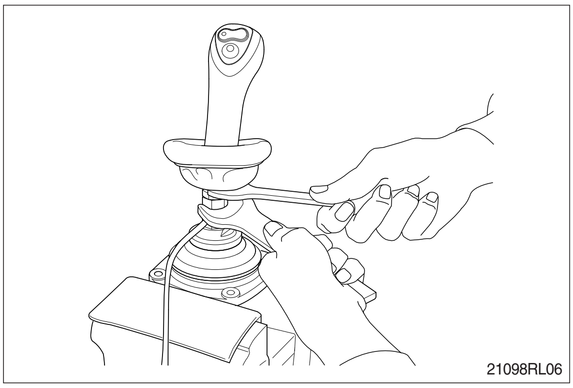
(3) Remove end of boot (26) from case (1) and take it out upwards.



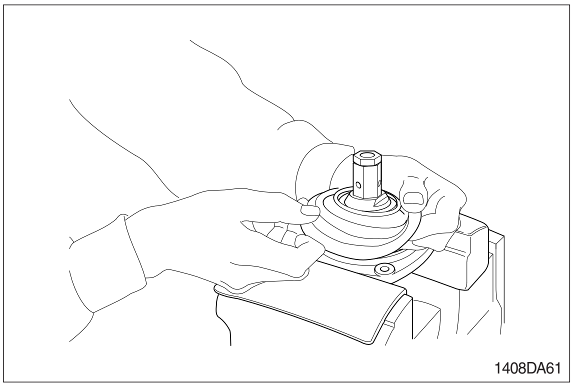
※ For valve with switch, remove cord also through hole of casing.



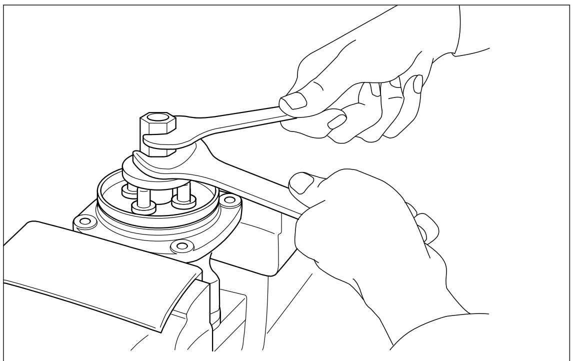
(4) Loosen lock nut (22) and adjusting nut (21) with spanners on them respectively, and take out handle section as one body.



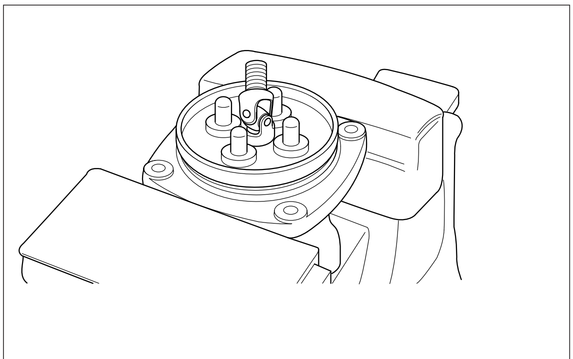
(5) Remove the boot (18).



(6) Loosen adjusting nut (21) and swash plate (20) with spanners on them respectively, and remove them.



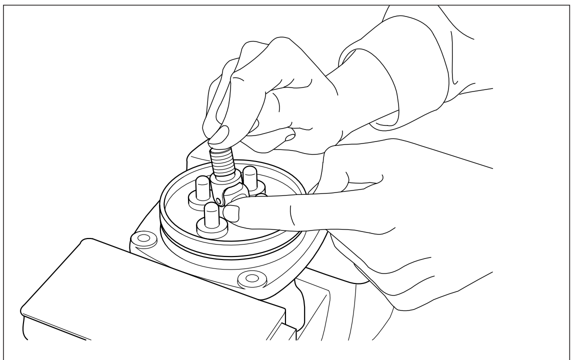
36078RL01



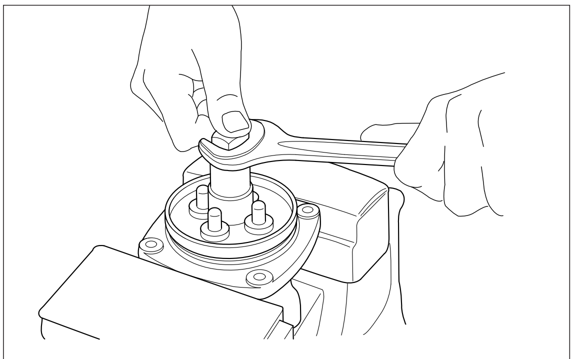
36078RL02

(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.

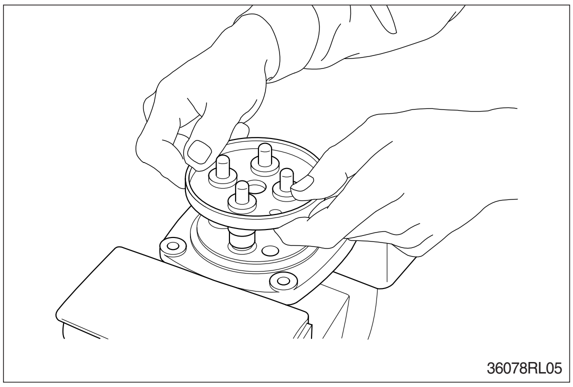


36078RL03



36078RL04

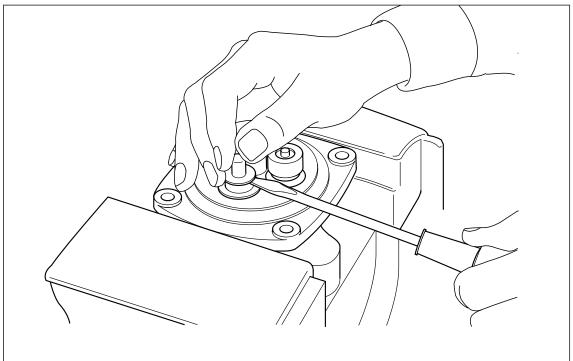
(8) Remove plate (17).


36078RL05

(9) When return spring (10) is weak in force, plug (14) stays in casing because of sliding resistance of O-ring.

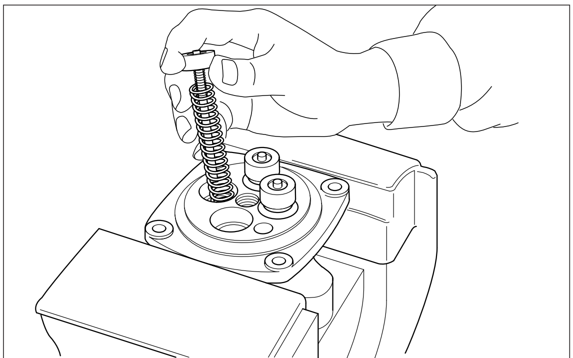
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (10) force.
Pay attention to this.

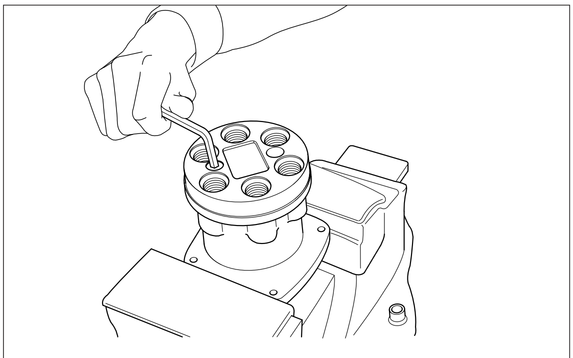

36078RL06

(10) Remove reducing valve subassembly and return spring (10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.


36078RL07

(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.

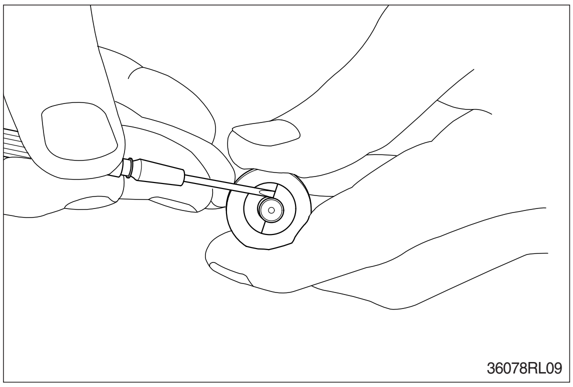

36078RL08

(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.

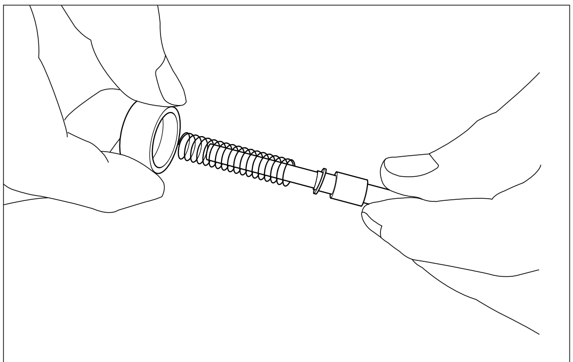
※ Record original position of spring seat (7).

※ Do not push down spring seat more than 6mm.

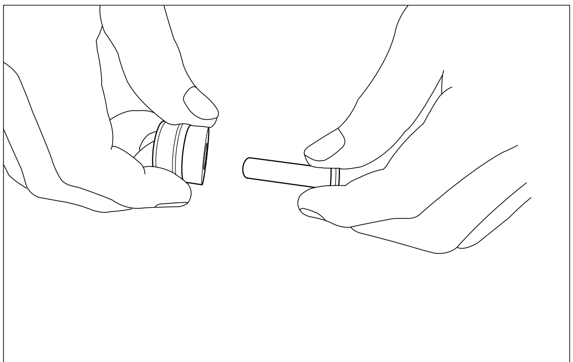

36078RL09

(13) Separate spool (4), spring seat (7), spring (6) and shim (5) individually.

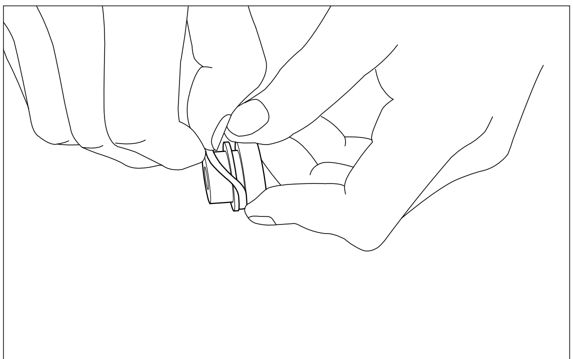
※ Until being assembled, they should be handled as one subassembly group.

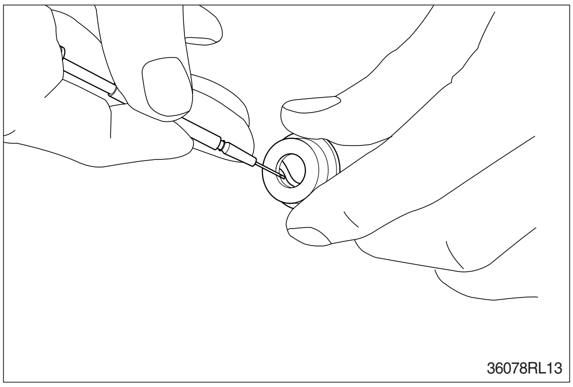

36078RL10

(14) Take push rod (11) out of plug (14).

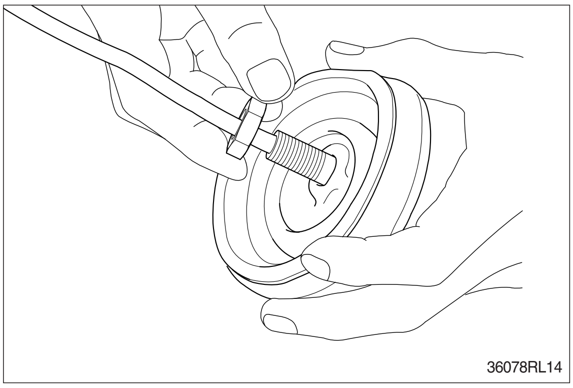

36078RL11

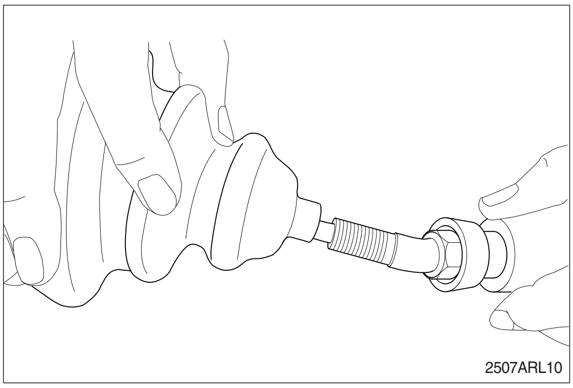
(15) Remove O-ring (15) and seal (16) from plug (14).
Use small minus screwdriver or so on to remove this seal.


36078RL12



(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

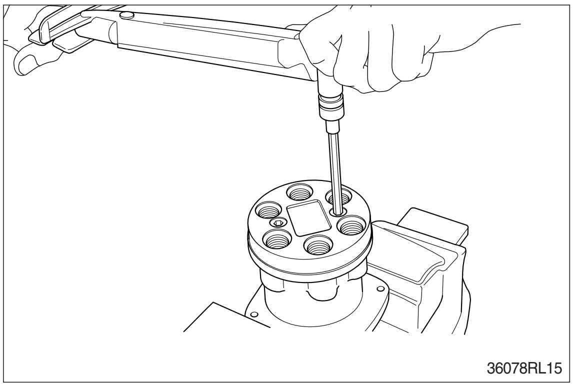
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

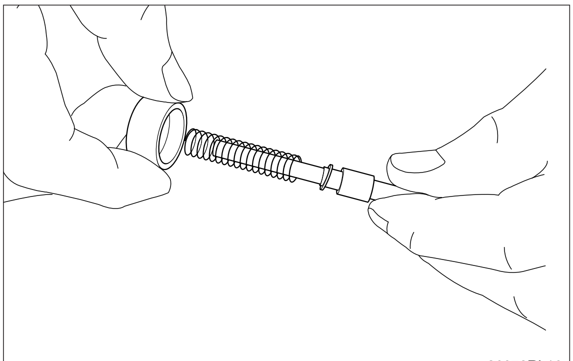
(1) Tighten hexagon socket head plug (2) to the specified torque.

※ Tighten two bolts alternately and slowly.



36078RL15

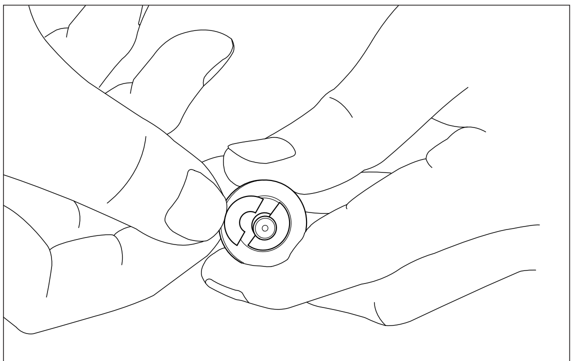
(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



36078RL16

(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.

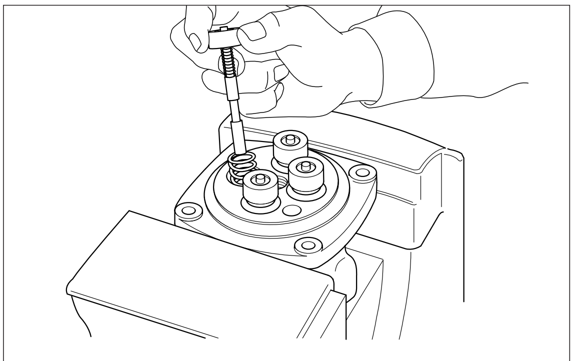
※ Assemble stopper (8) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.



36078RL17

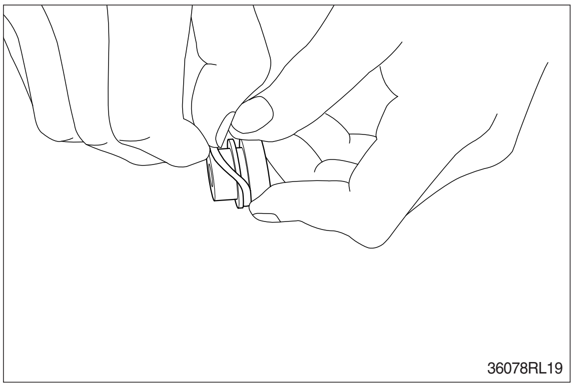
(4) Assemble spring (10) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

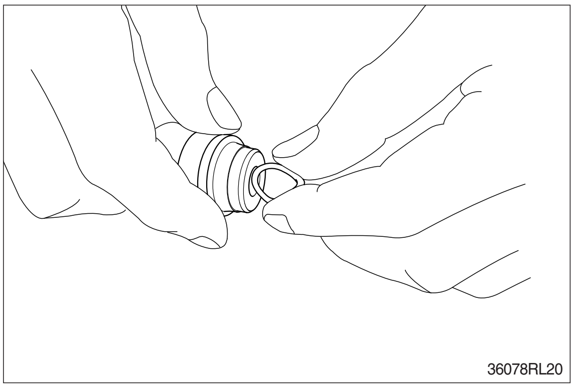


36078RL18

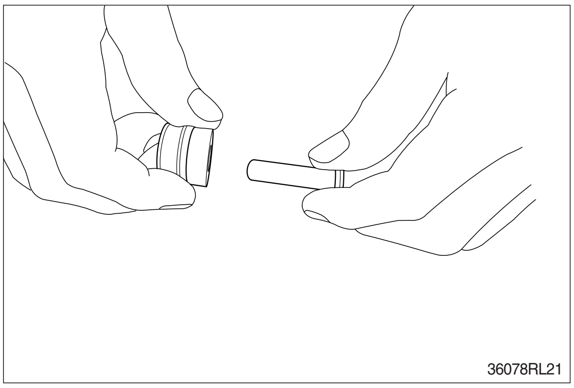
(5) Assemble O-ring (15) onto plug (14).



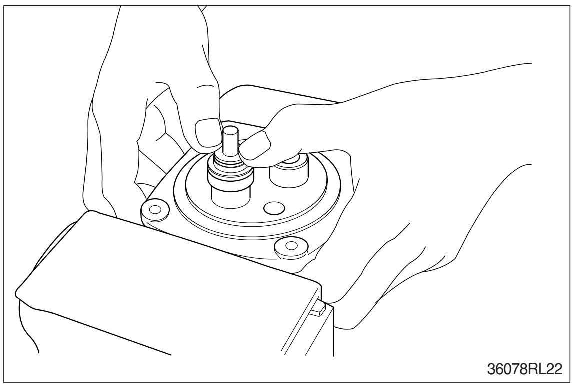
(6) Assemble seal (16) to plug (14).
※ Assemble seal in such lip direction as shown below.



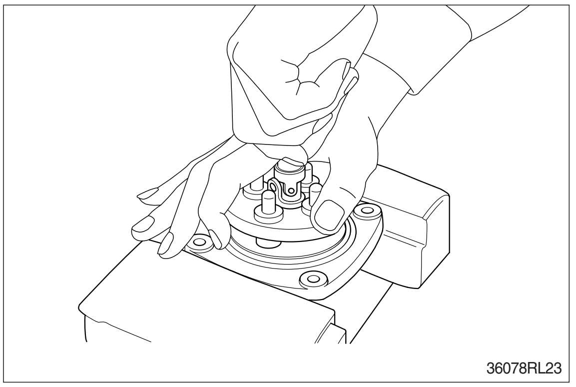
(7) Assemble push rod (11) to plug (14).
※ Apply working oil on push-rod surface.



(8) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

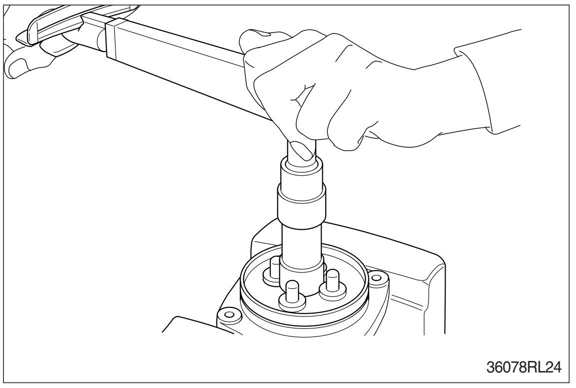


(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (17), and tighten joint (19) temporarily.



(10) Fit plate (17).

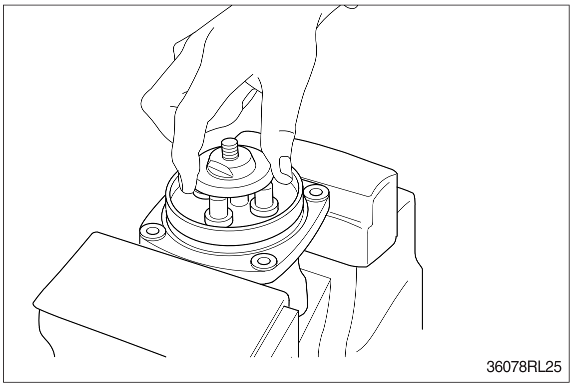
(11) Tighten joint (19) with the specified torque to casing, utilizing jig.



(12) Assemble swash plate (20) to joint (19).

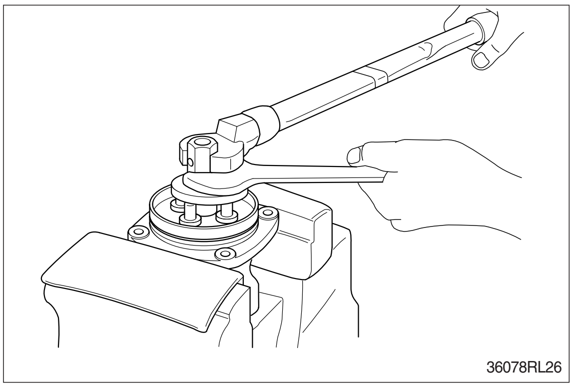
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

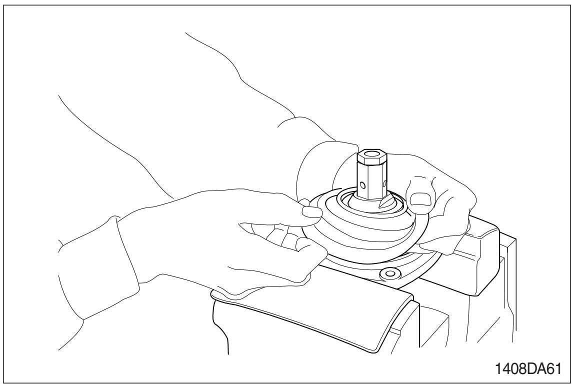


(13) Assemble adjusting nut (21), apply spanner to width across flat of plate (20) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.

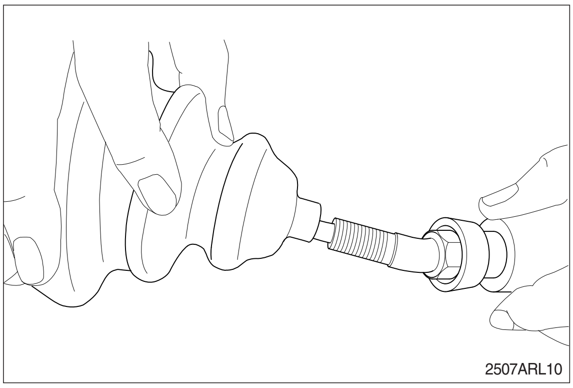


(14) Fit boot (18) to plate.



1408DA61

(15) Fit boot (26) and lock nut (22), and handle subassembly is assembled completely.



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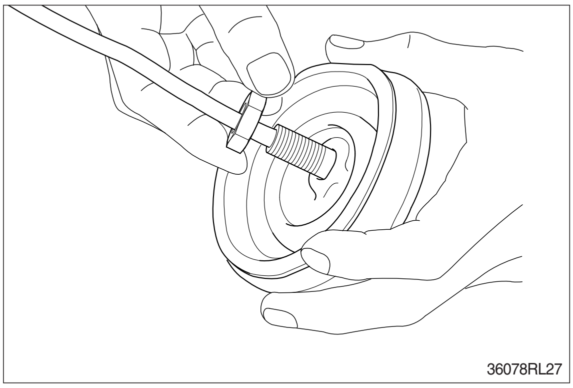
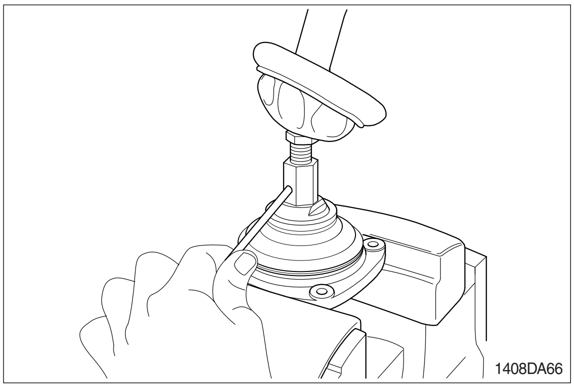


36078RL27

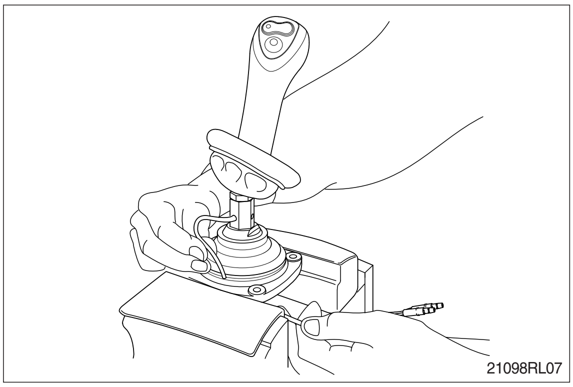
(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



1408DA66

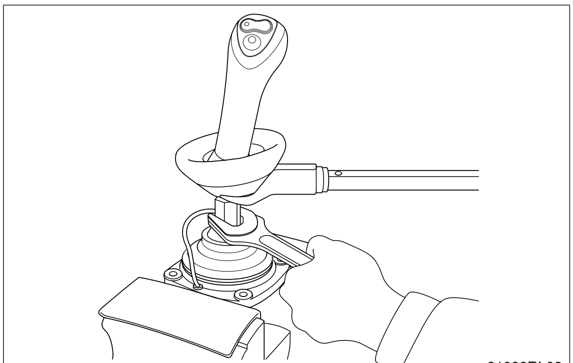
(17) Assemble bushing (27) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.



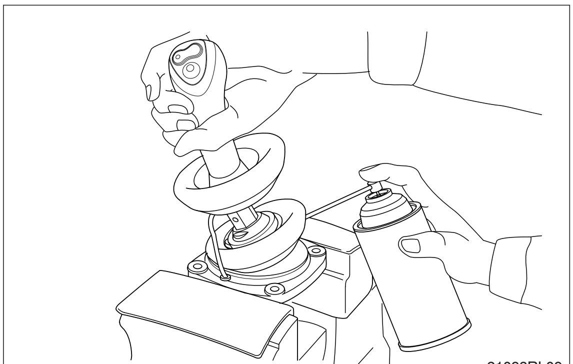
21098RL07

(18) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.



21098RL08

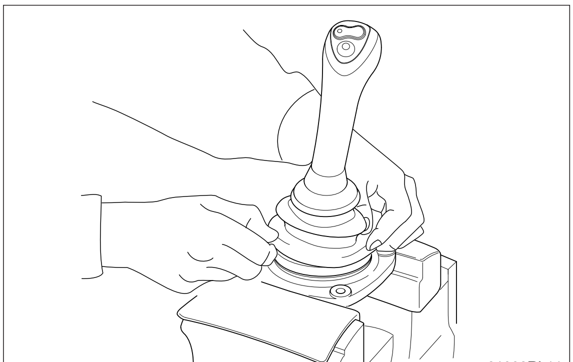
(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



21098RL09

(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



21098RL11

GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

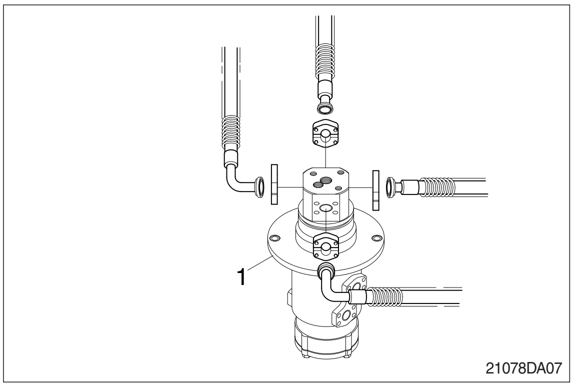
(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(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.

13031GE18



21078DA07

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

· Weight : 55 kg (120 lb)

· Tightening torque : 12.3± 1.3 kgf · m (89± 9.4 lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

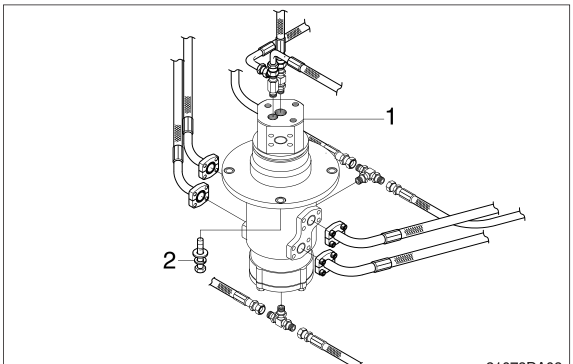
2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

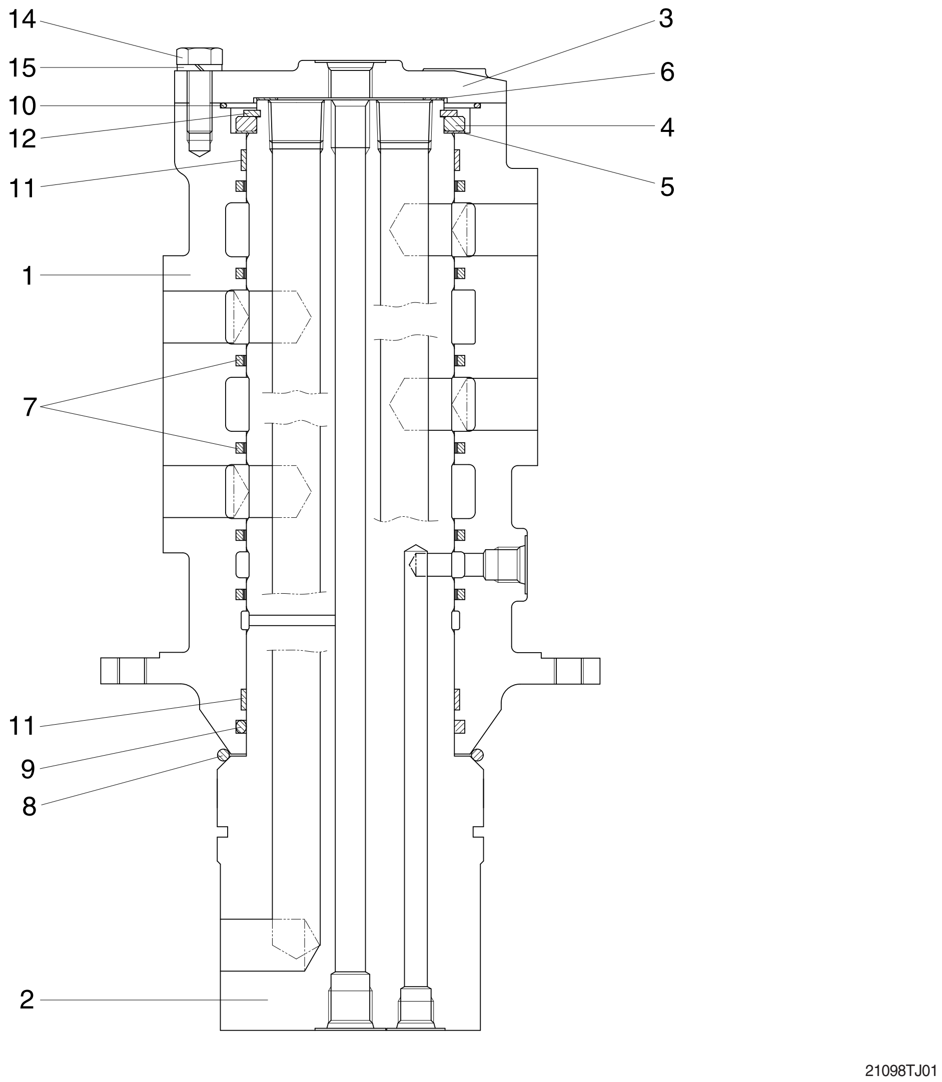
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



21078DA08

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

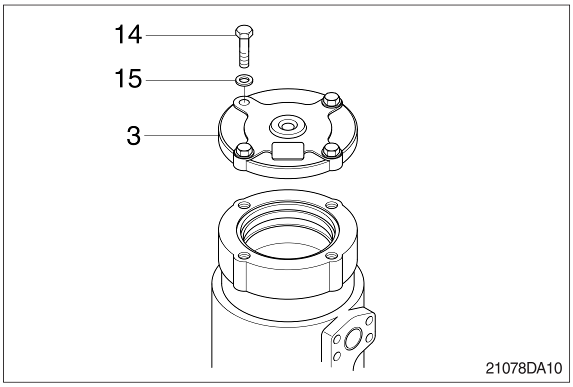


1	Hub	6	Shim	11	Wear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

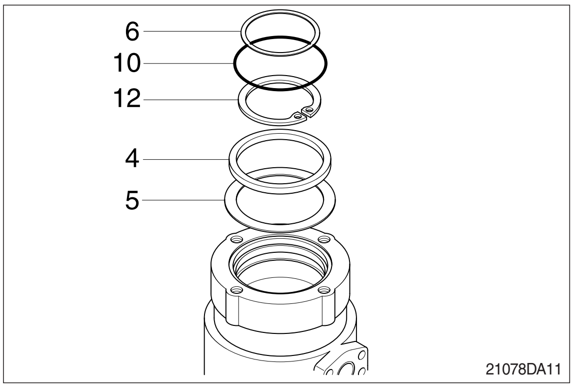
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

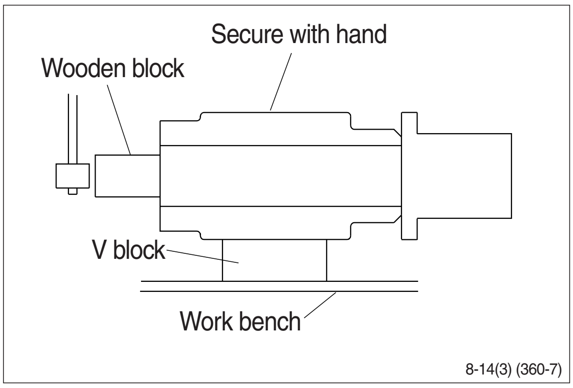
(3) Remove retainer ring (12), spacer (4) and shim (5).



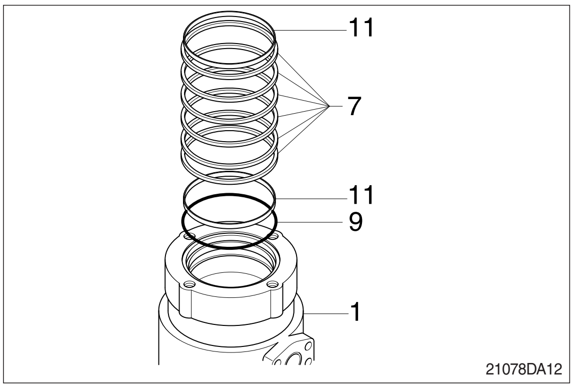
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ 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

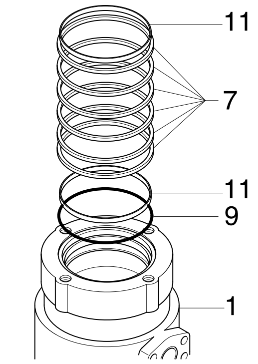
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

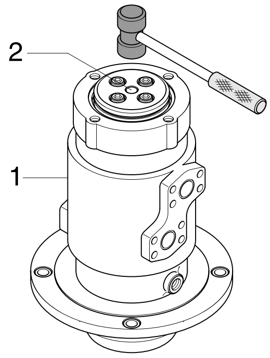
(1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).

(2) Fit O-ring (8) to shaft (2).



21078DA12

(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.

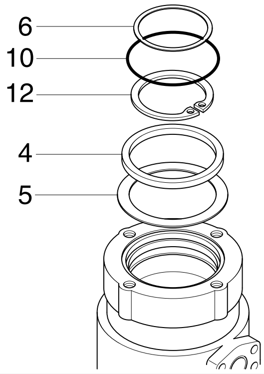


21078DA13

(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(5) Fit O-ring (10) to hub (1).

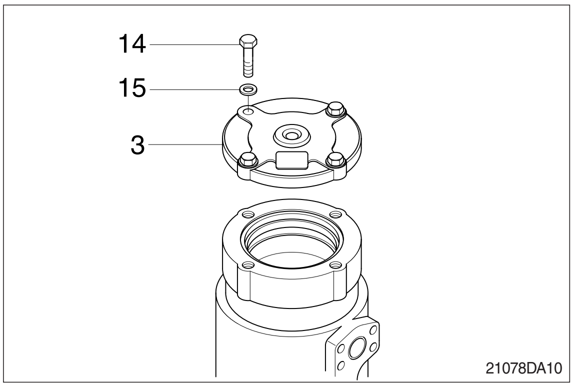
(6) Fit shim (6) to shaft (2).



21078DA11

(7) Install cover (3) to body (1) and tighten bolts (14).

· Torque : 10~12.5 kgf · m
(72.3~90.4 lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

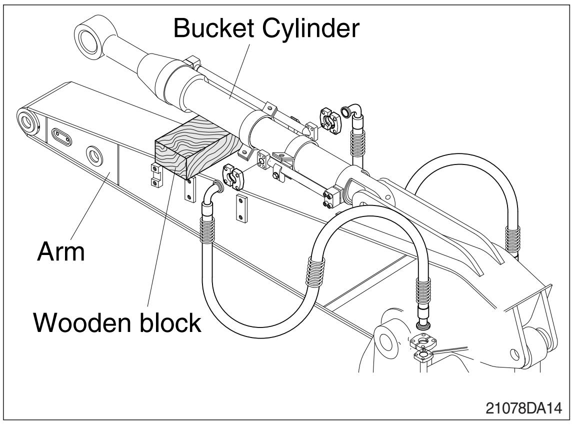
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

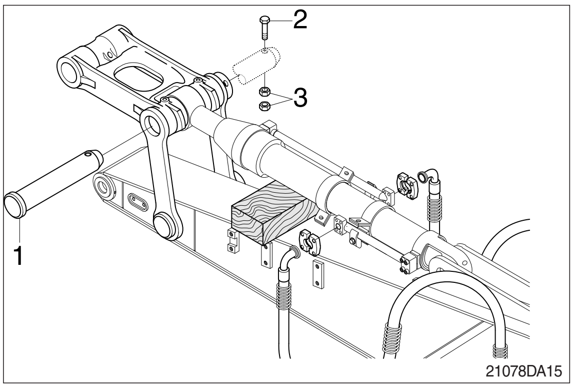
※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between bucket cylinder and arm.

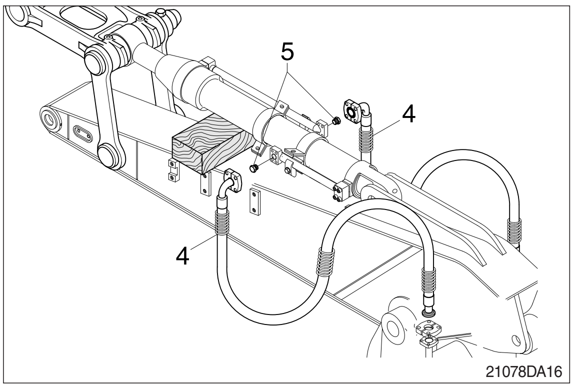


② Remove nuts (3), bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



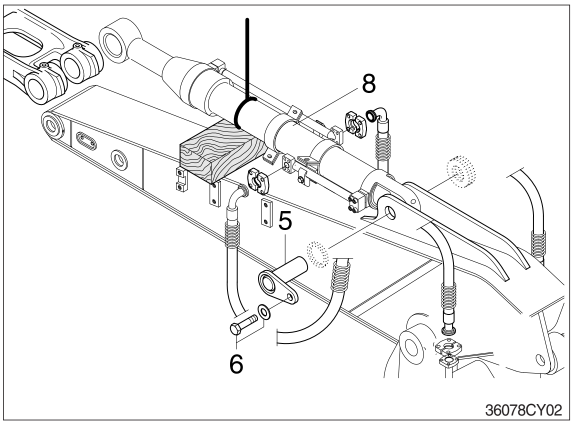
③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



④ Sling bucket cylinder assembly, and remove bolt (6), plate (7) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 320 ㎏ (710 ℔)



(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.

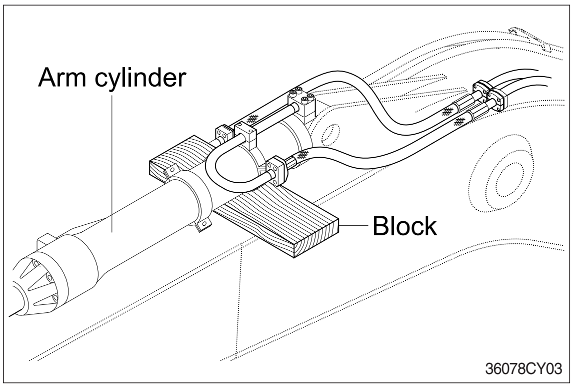
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.


13031GL18

※ 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.

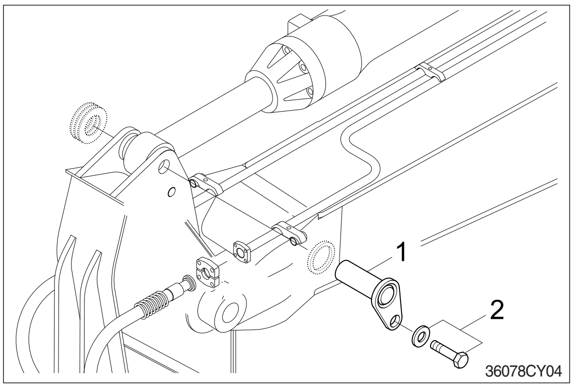
① Set block between arm cylinder and boom.



36078CY03

② Remove bolt (2) and pull out pin (1).

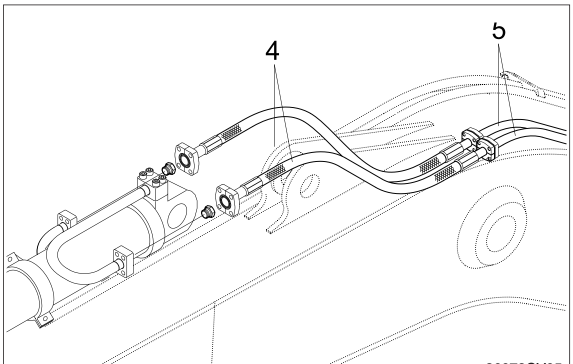
※ Tie the rod with wire to prevent it from coming out.



36078CY04

③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings (5).

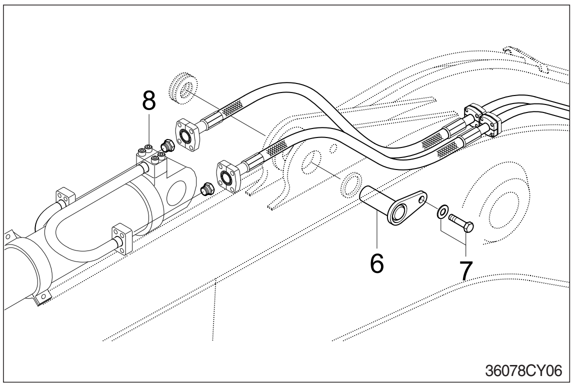


36078CY05

⑤ Sling arm assembly (9), and remove bolt (7), plate (8) then pull out pin (6).

⑥ Remove arm cylinder assembly (9).

· Weight : 490 ㎏ (1080 ℔)



(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.

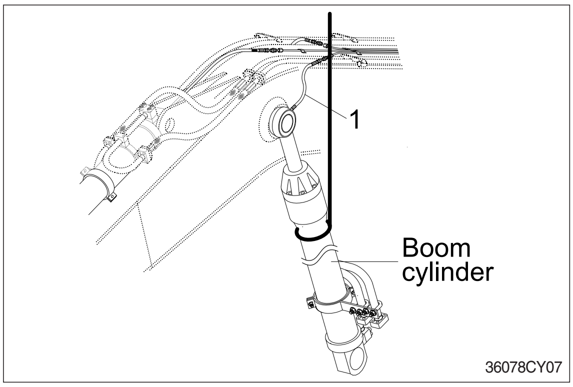
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ 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.

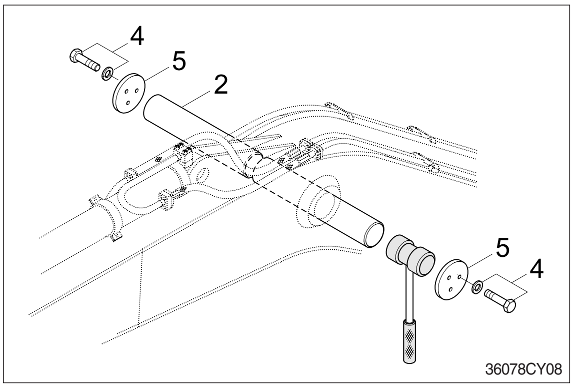
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

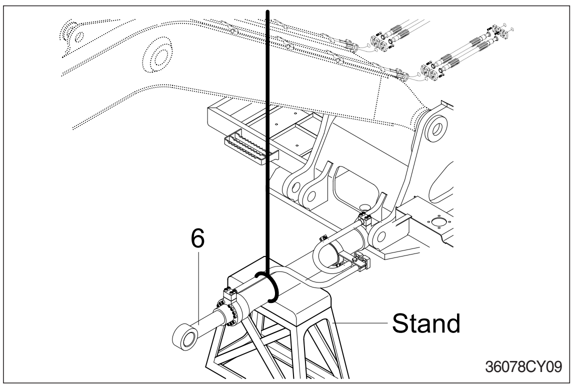


③ Remove bolt (4), stop plate (5) and pull out pin (2).

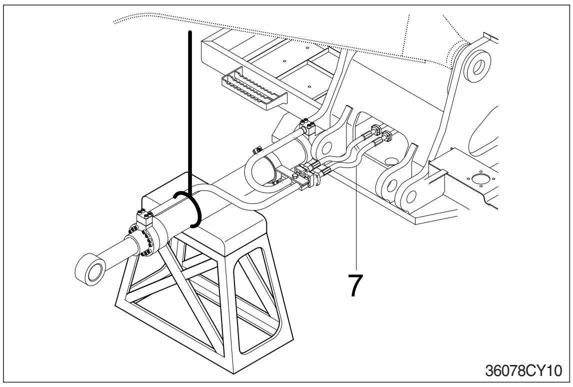
※ Tie the rod with wire to prevent it from coming out.



④ Lower the boom cylinder assembly (6) on a stand.



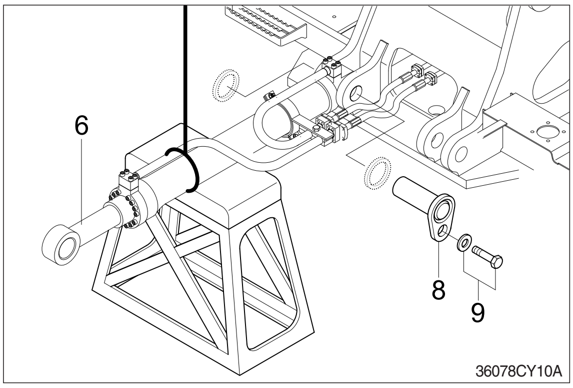
⑤ Disconnect boom cylinder hoses (7), and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 370 ㎏ (820 ℔)



(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.**

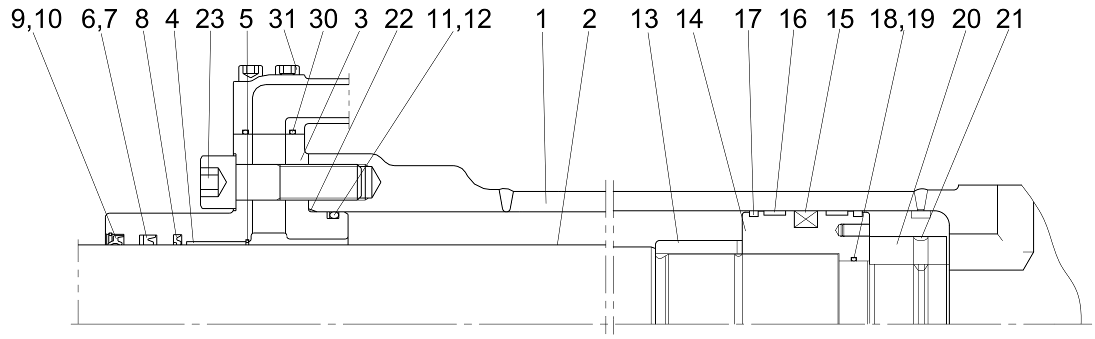
※ Bleed the air from the boom cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

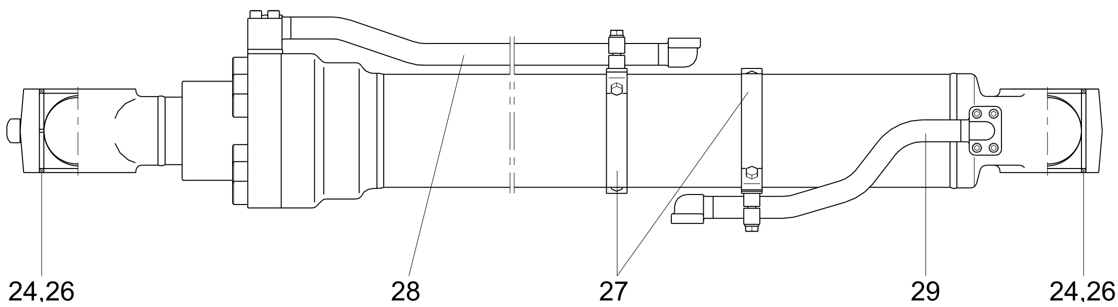
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder



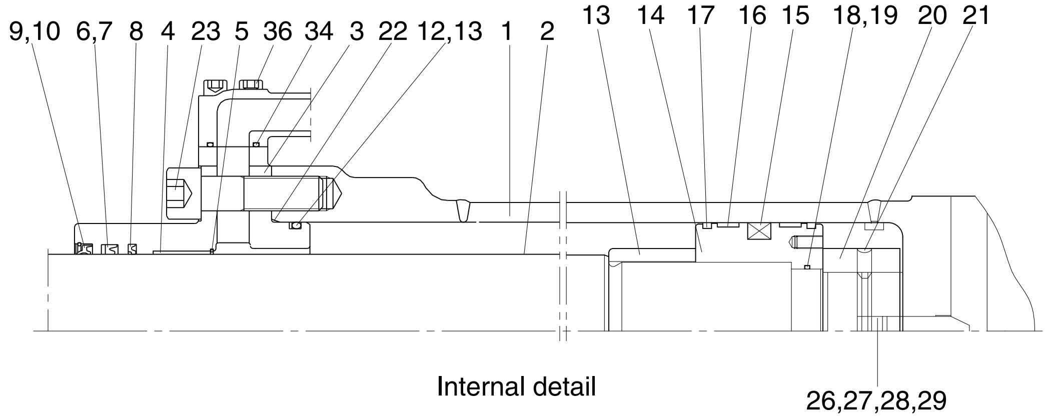
Internal detail



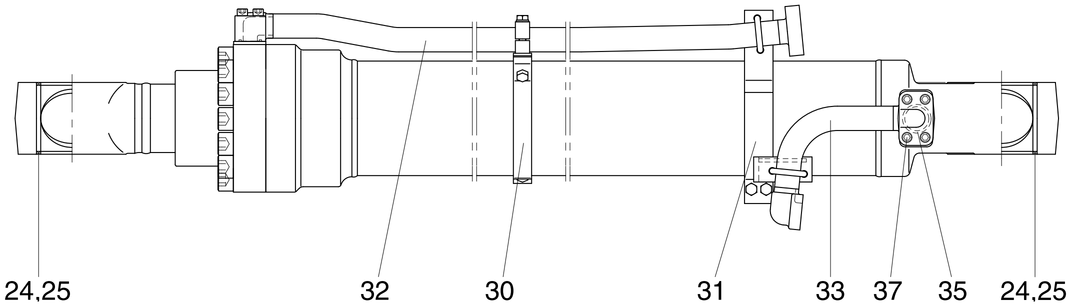
38098CY01A

1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	Du bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly (R)
7	Back up ring	18	O-ring	29	Pipe assembly (B)
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket screw		
11	O-ring	22	O-ring		

(2) Arm cylinder



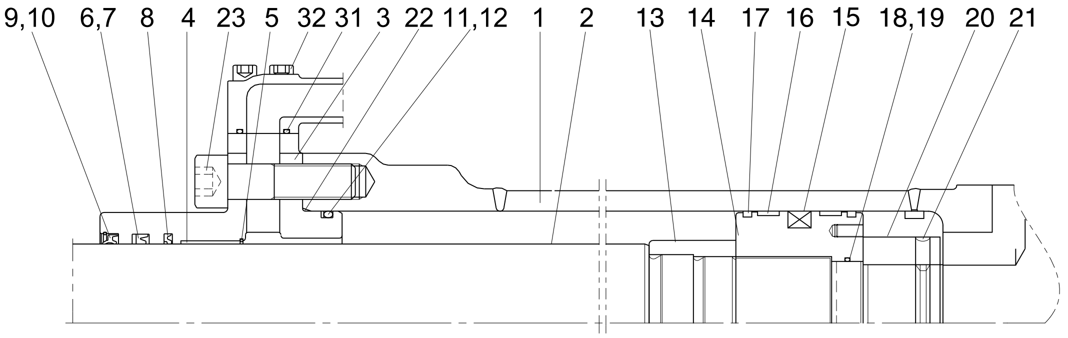
Internal detail



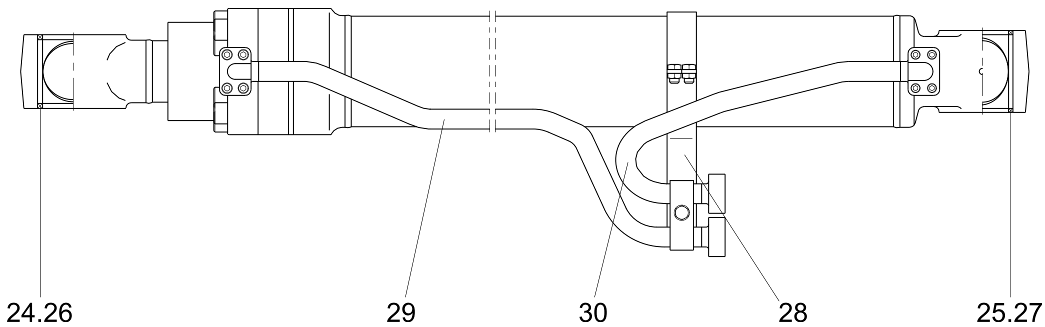
38098CY02

1 Tube assembly
2 Rod assembly
3 Gland
4 Du bushing
5 Snap ring
6 Rod seal
7 Back up ring
8 Buffer ring
9 Dust wiper
10 Snap ring
11 O-ring
12 Back up ring
13 Cushion ring
14 Piston
15 Piston seal
16 Wear ring
17 Dust ring
18 O-ring
19 Back up ring
20 Lock nut
21 Hexagon socket screw
22 O-ring
23 Hexagon socket head bolt
24 Pin bushing
25 Dust seal
26 Check valve
27 Coil spring
28 O-ring
29 Plug
30 Band assembly (R)
31 Band assembly (B)
32 Pipe assembly (R)
33 Pipe assembly (B)
34 O-ring
35 O-ring
36 Hexagon socket head bolt
37 Hexagon socket head bolt

(3) Boom cylinder



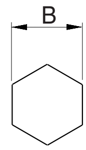
Internal detail



1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing (R)
3	Gland	14	Piston	25	Pin bushing (B)
4	Du bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Dust seal
6	Rod seal	17	Dust ring	28	Band assembly
7	Back up ring	18	O-ring	29	Pipe assembly (R)
8	Buffer ring	19	Back up ring	30	Pipe assembly (B)
9	Dust wiper	20	Lock washer	31	O-ring
10	Snap ring	21	Hexagon socket screw	32	Hexagon socket head bolt
11	O-ring	22	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Allen wrench	10	
	19	
Spanner	19	
(-) 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	M20	46±5	333±36.1
	Boom cylinder	23	M22	63±6	456±43.4
	Arm cylinder	23	M22	63±6	456±43.4
Socket head bolt	Bucket cylinder	31	M12	9.4±1	68.0±7.2
	Boom cylinder	32	M12	9.4±1	68.0±7.2
	Arm cylinder	36	M12	9.4±1	68.0±7.2
		37	M12	9.4±1	68.0±7.2
Lock nut	Bucket cylinder	20	M76	100±10	723±72.3
	Boom cylinder	20	M80	150±15	1085±108
	Arm cylinder	20	M90	150±15	1085±108
Piston	Bucket cylinder	14	-	150±15	1085±109
	Boom cylinder	14	-	200±20	1447±145
	Arm cylinder	14	-	200±20	1447±145

3) DISASSEMBLY

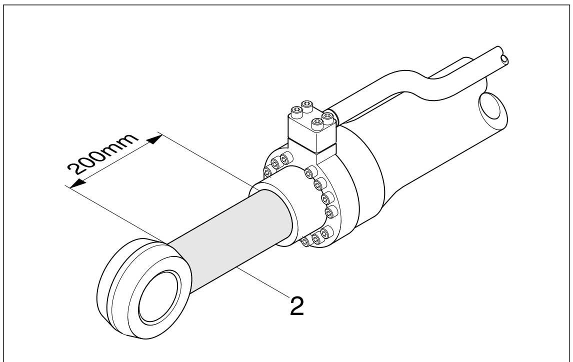
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200mm (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



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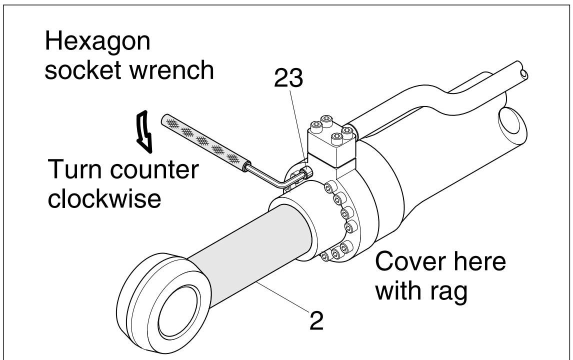
③ Loosen and remove socket bolts (23) of the gland in sequence.

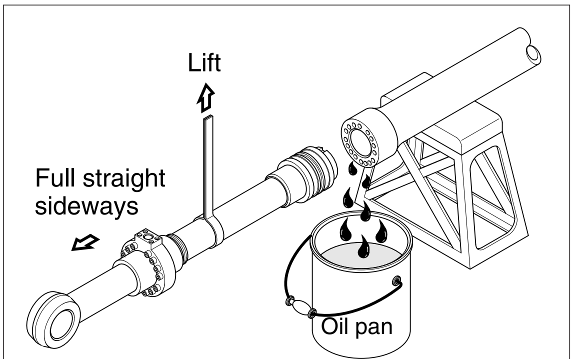
※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



38098CY04

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.



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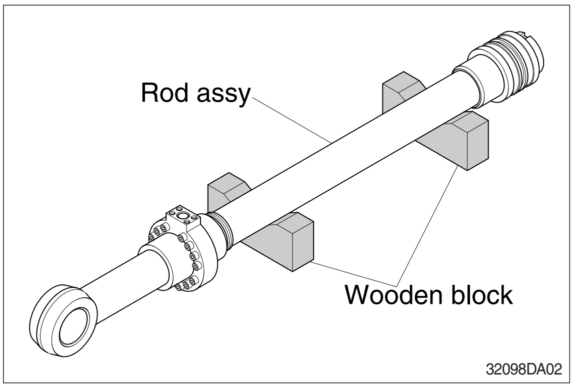
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.

※ Cover a V-block with soft rag.

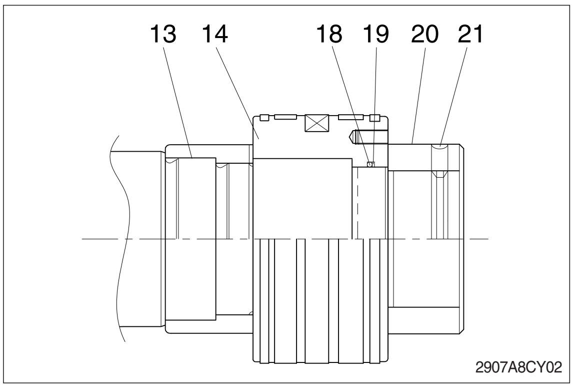


(2) Remove piston and cylinder head

① Loosen socket set screw (21) and remove set screw (21).

※ Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock set screw (21) and lock nut (20).

② Remove piston assembly (14), back up ring (19), and O-ring (18).

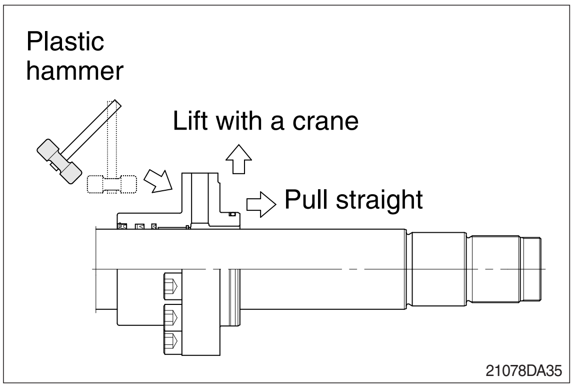


③ Remove the cylinder head assembly from rod assembly (2).

※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.

※ Pull it straight with cylinder head assembly lifted with a crane.

Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

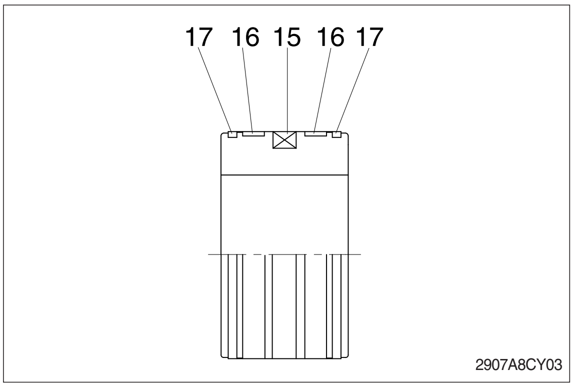


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

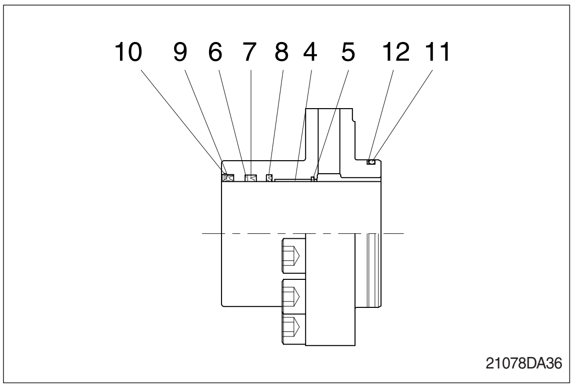
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6), buffer ring (8) and snap ring (5).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove bushing (4).

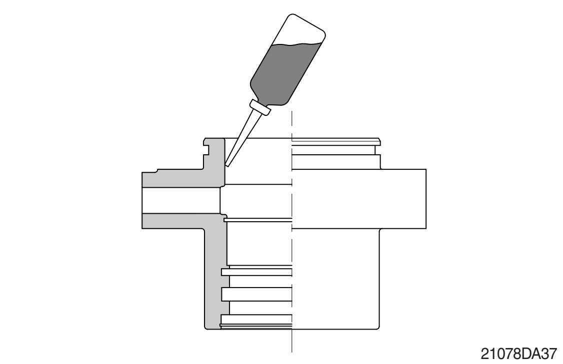


3) ASSEMBLY

(1) Assemble cylinder head assembly

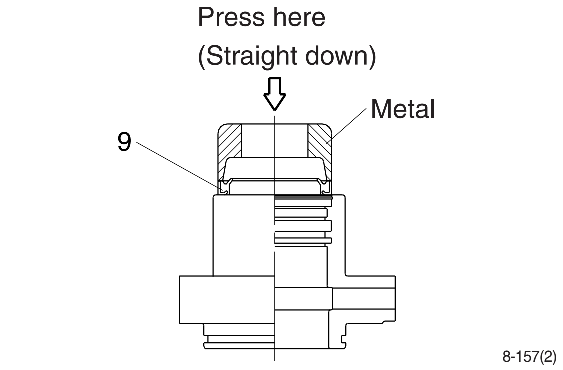
※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of gland (3) with hydraulic oil.


21078DA37

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.

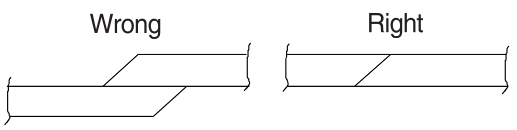


8-157(2)

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.

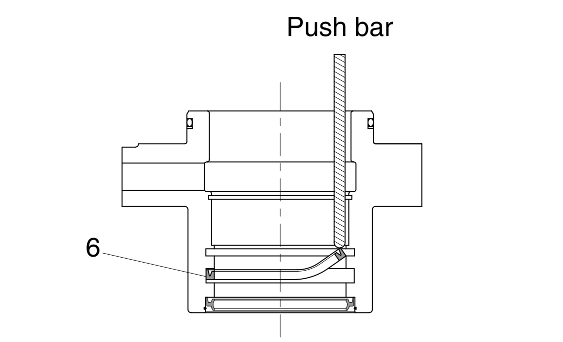
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3)

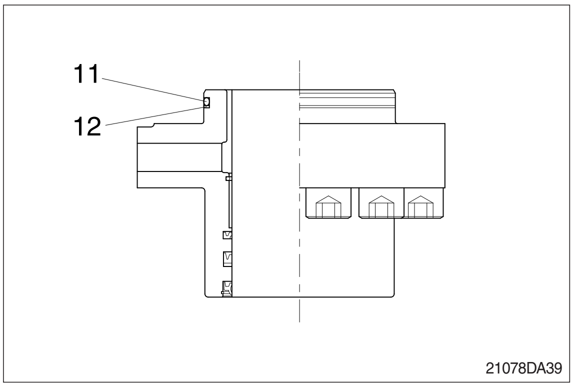
※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

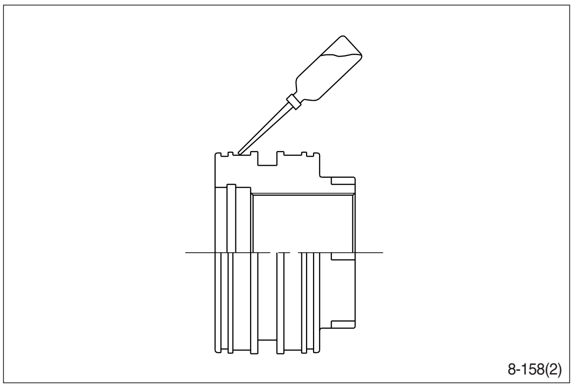


21078DA38

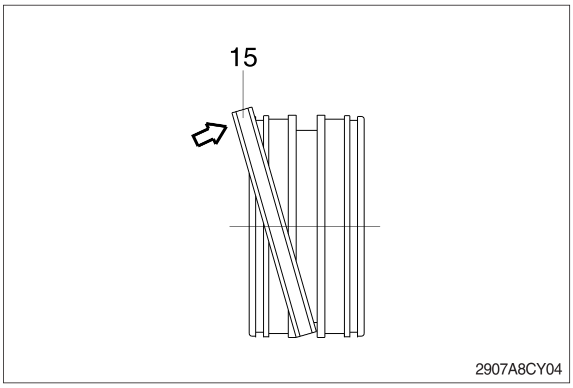
⑤ Fit back up ring (12) to gland (3).
※ Put the backup ring in the warm water of 30~50˚C.
⑥ Fit O-ring (11) to gland (3).



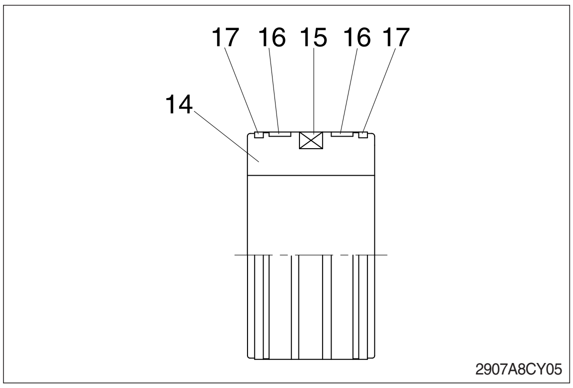
(2) Assemble piston assembly
※ Check for scratches or rough surfaces. If found smooth with an oil stone.
① Coat the outer face of piston (14) with hydraulic oil.



② Fit piston seal (15) to piston.
※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.
※ After assembling the piston seal, press its outer diameter to fit in.



③ Fit wear ring (16) and dust ring (17) to piston (14).

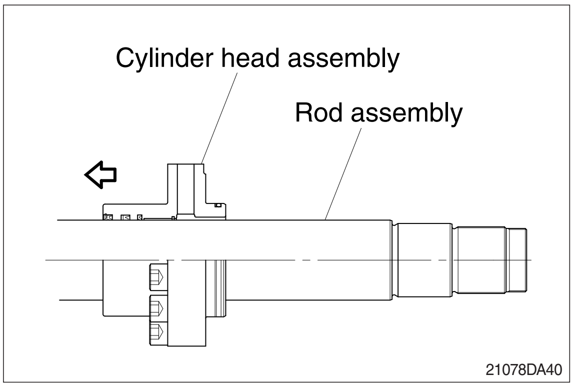


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

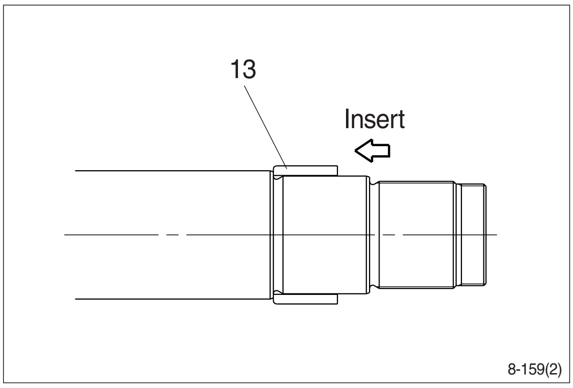
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



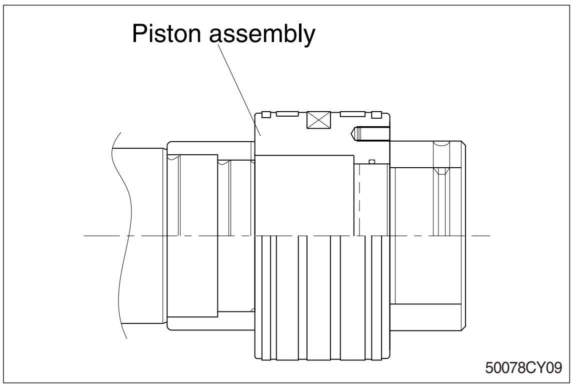
④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

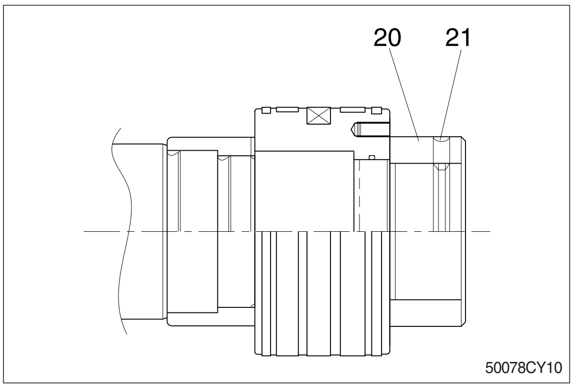
· Tightening torque : 150±15 kgf · m (1085±108 lbf · ft)



⑥ Fit lock nut (20) and tighten the set screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
Bucket	20	100±10	723±72.3
	21	5.4±0.5	391±3.6
Boom Arm	21	150±15	1085±108
	22	5.4±0.5	39.1±3.6



(3) Overall assemble

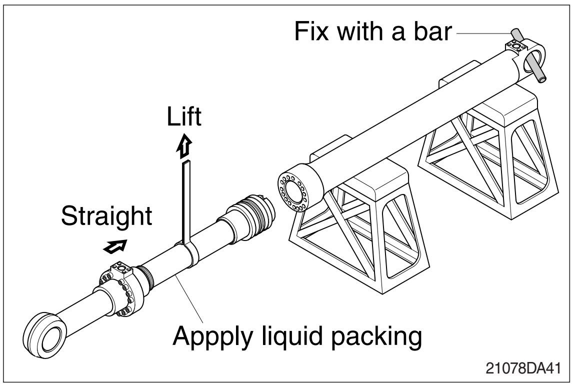
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

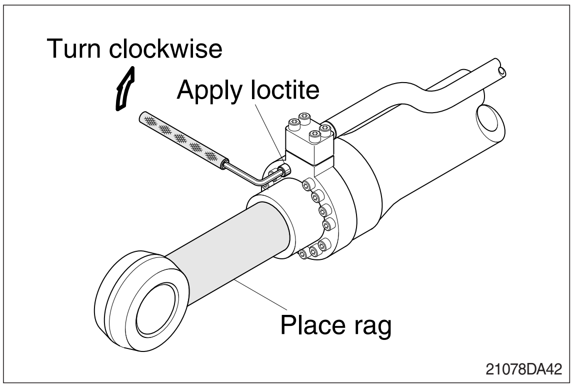
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ 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.

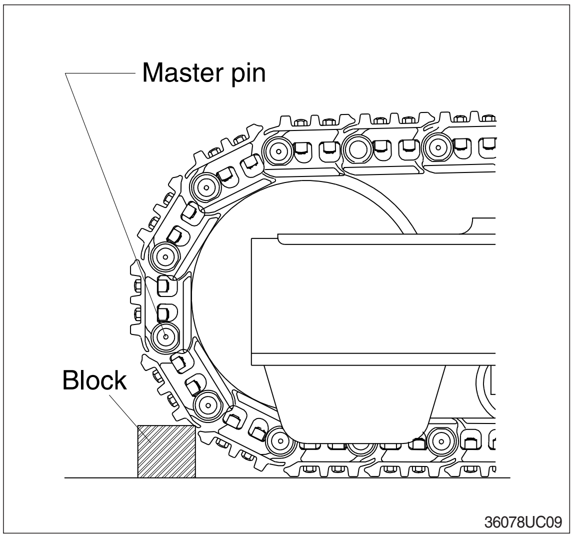




GROUP 10 UNDERCARRIAGE

1. TRACK LINK

1) REMOVAL



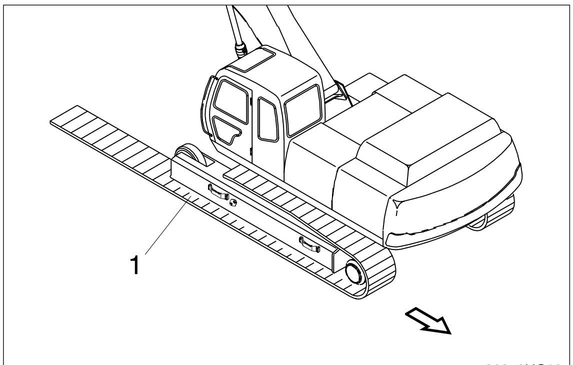
36078UC09

(1) Move track link until master pin is over front idler in the position put wooden block as shown.

(2) Loosen tension of the track link.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.

(3) Push out master pin by using a suitable tool.



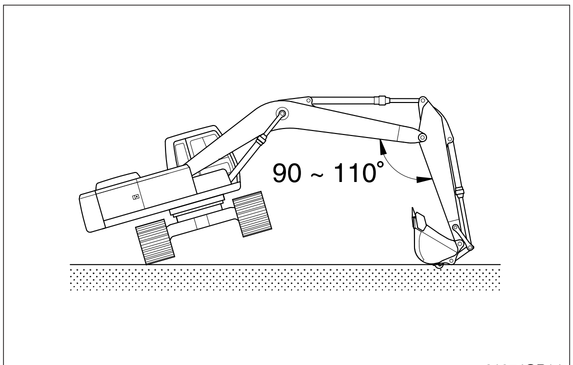
36078UC10

(4) Move the machine slowly in reverse, and lay out track link assembly (1).

※ Jack up the machine and put wooden block under the machine.

※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.

2) INSTALL



21074OP14

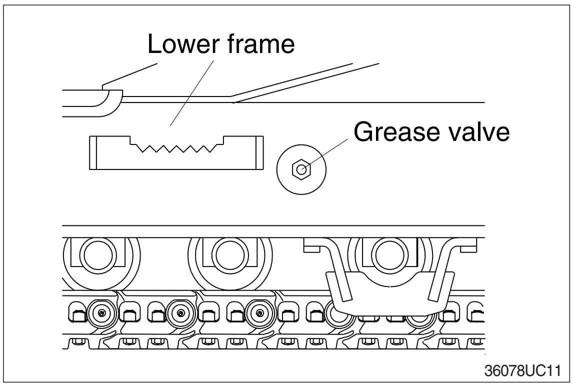
(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.

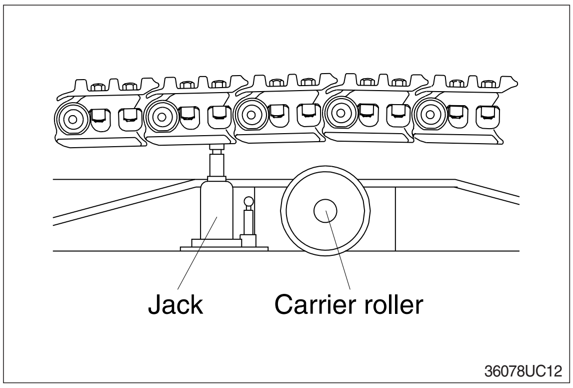
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



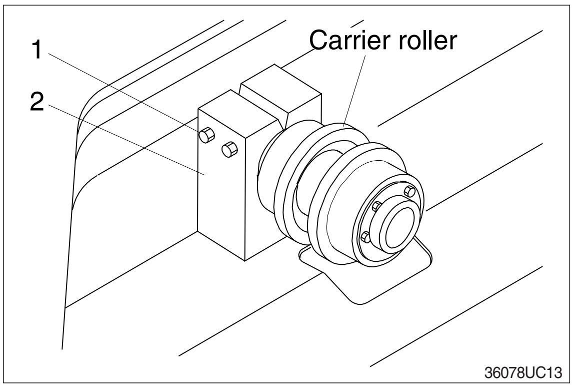
(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket (2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight : 40 ㎏ (88 ℔)



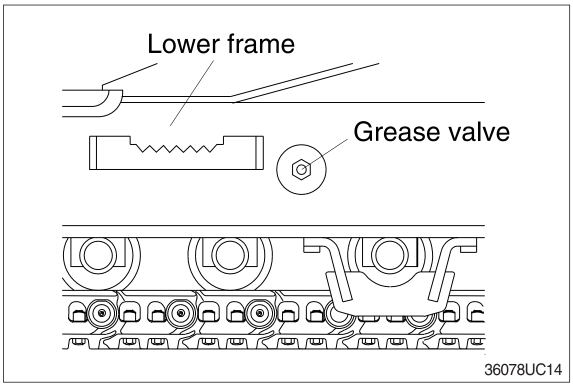
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

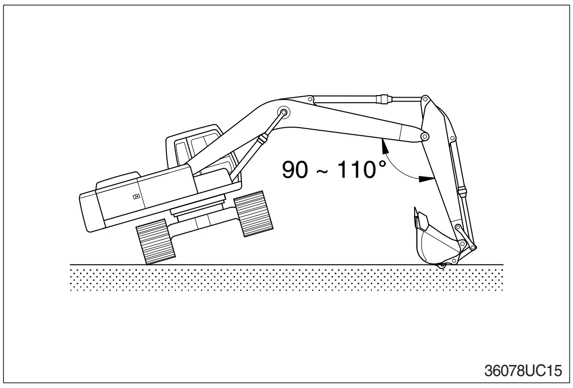
1) REMOVAL

(1) Loosen tension of the track link.



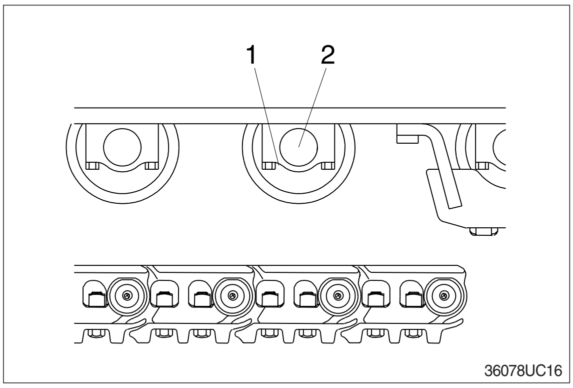
(2) Using the work equipment, push up track frame on side which is to be removed.

※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolts (1) and draw out the track roller (2).

· Weight : 80 kg (176.4 lb)



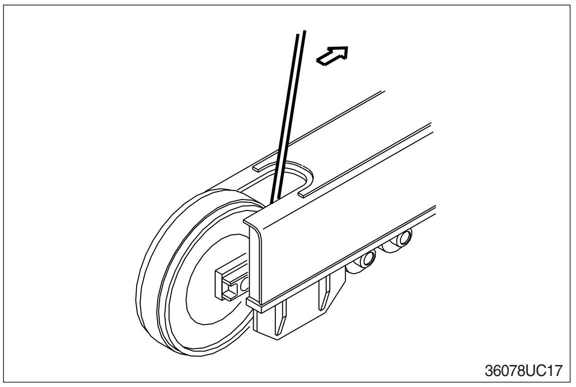
2) INSTALL

(1) Carry out installation in the reverse order to removal.

4. IDLER AND RECOIL SPRING

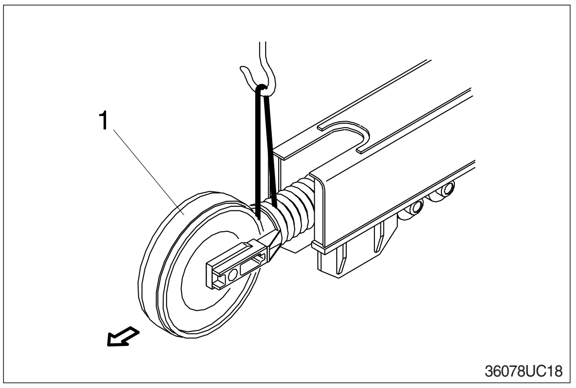
1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.



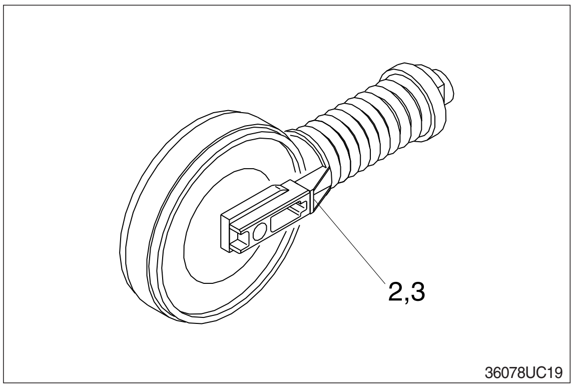
36078UC17

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 420 kg (930 lb)



36078UC18

(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.

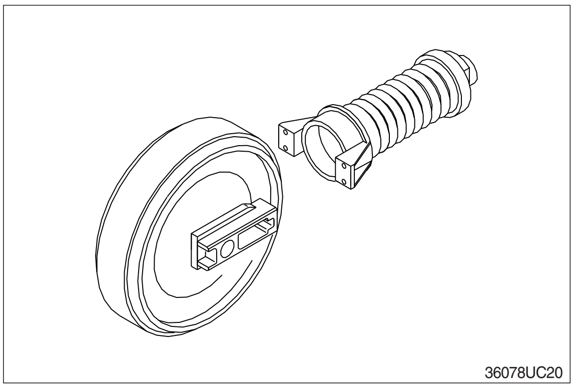


36078UC19

2) INSTALL

(1) Carry out installation in the reverse order to removal.

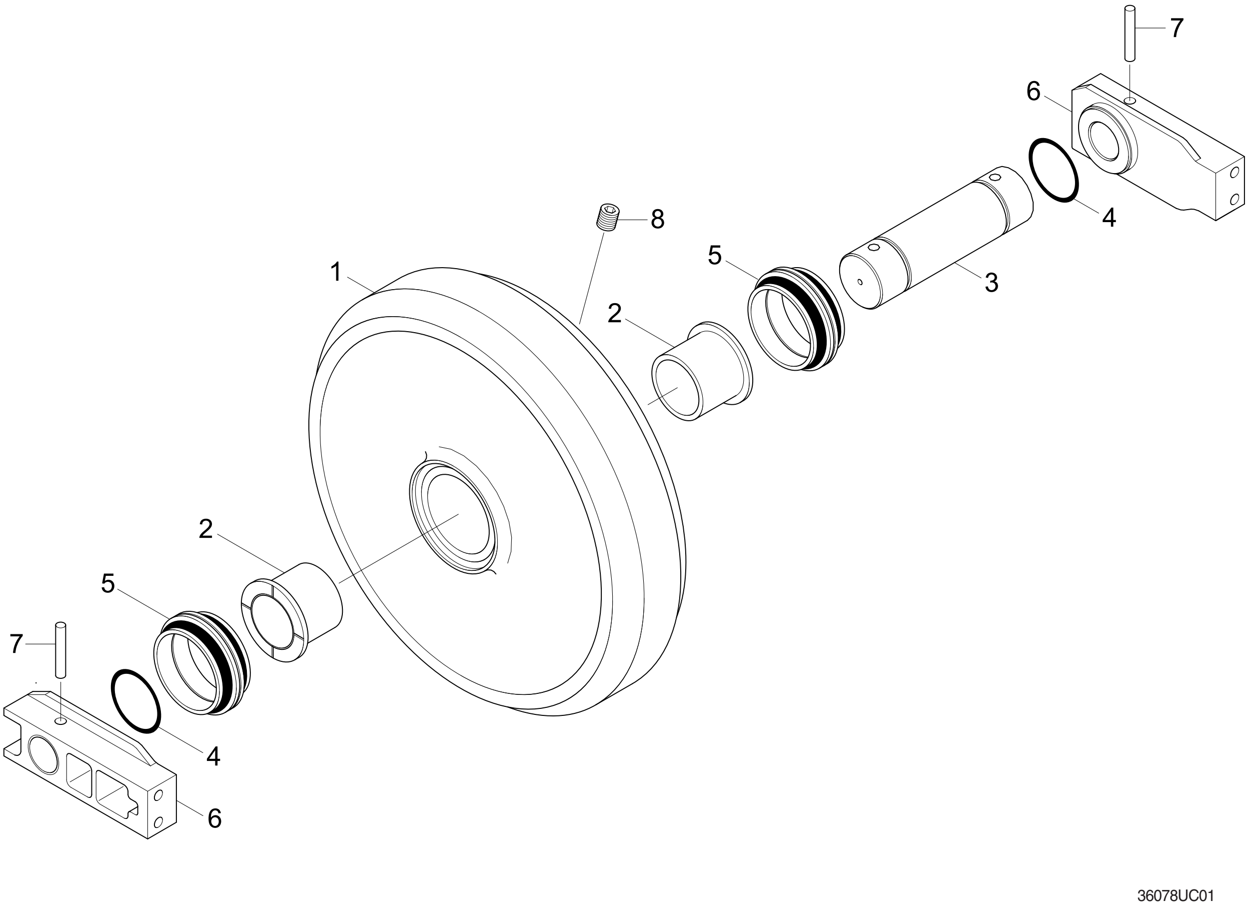
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



36078UC20

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

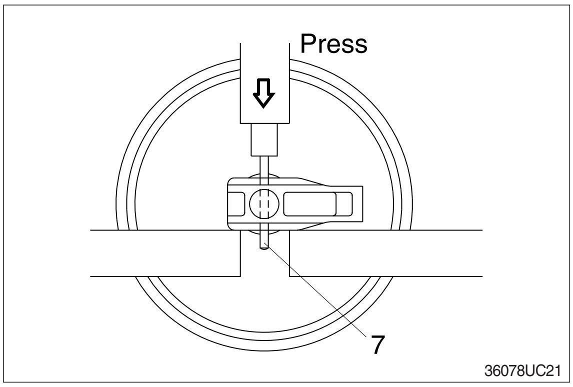


1	Shell	4	O-ring	7	Spring pin
2	Bushing	5	Seal assembly	8	Plug
3	Shaft	6	Bracket		

(2) Disassembly

① Remove plug and drain oil.

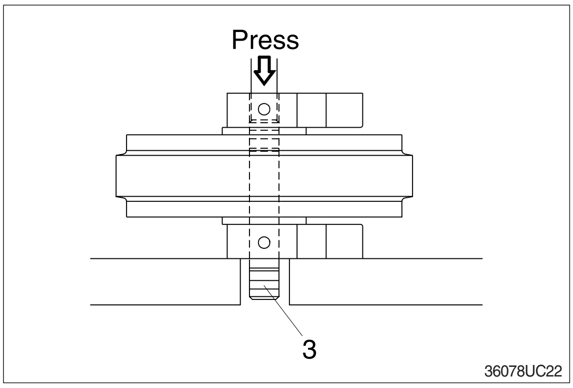
② Draw out the spring pin (7), using a press.



③ Pull out the shaft (3) with a press.

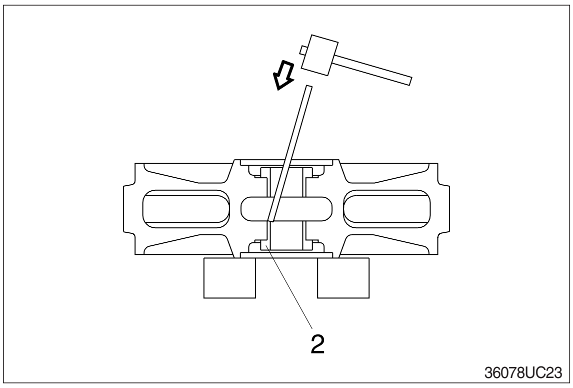
④ Remove seal (5) from shell (1) and bracket (6).

⑤ Remove O-ring (4) from shaft.



⑥ Remove the bushing (2) from shell, using a special tool.

※ Only remove bushing if replacement is necessity.

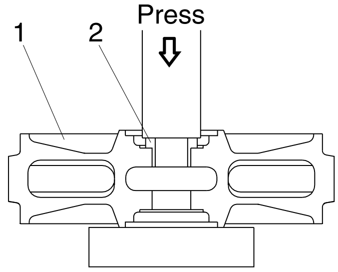


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

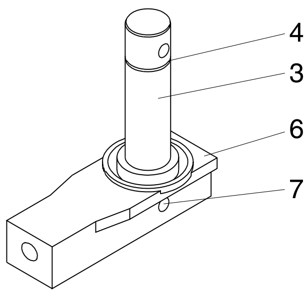
① Cool up bushing (2) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



36078UC24

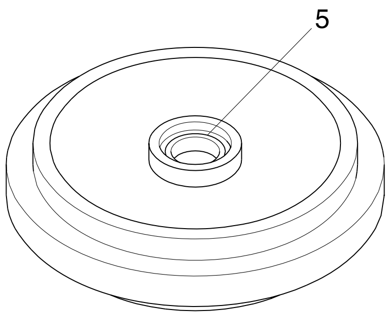
② Coat O-ring (4) with grease thinly, and install it to shaft (3).

③ Insert shaft (3) into bracket (6) and drive in the spring pin (7).



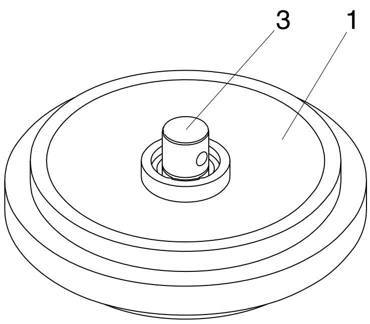
36078UC25

④ Install seal (5) to shell (1) and bracket (6).



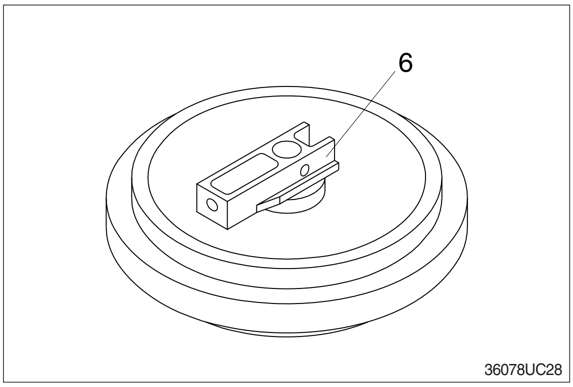
36078UC26

⑤ Install shaft (3) to shell (1).

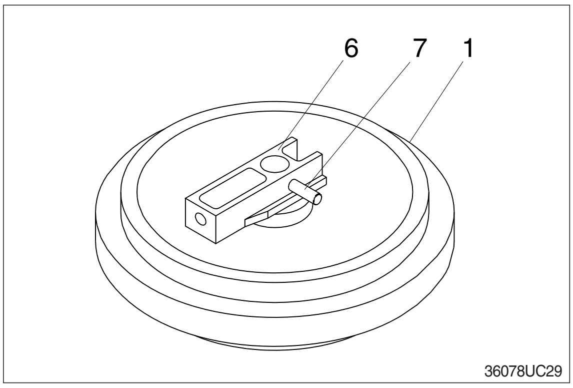


36078UC27

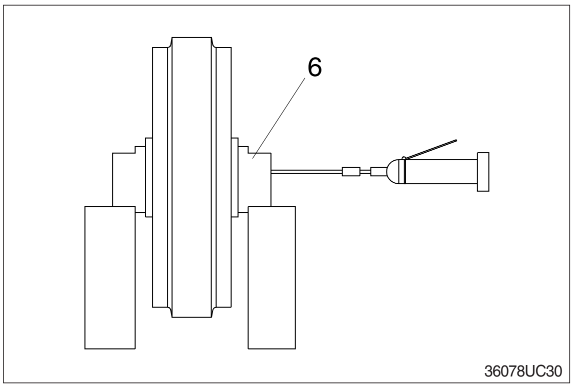
⑥ Install bracket (6) attached with seal (5).



⑦ Knock in the spring pin (7) with a hammer.

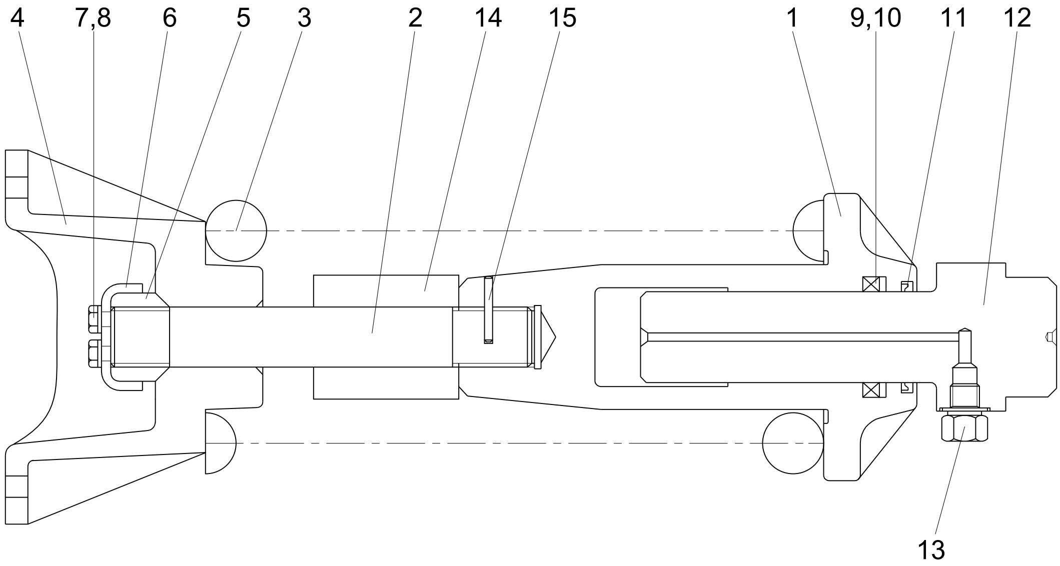


⑧ Lay bracket (6) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



36078UC02

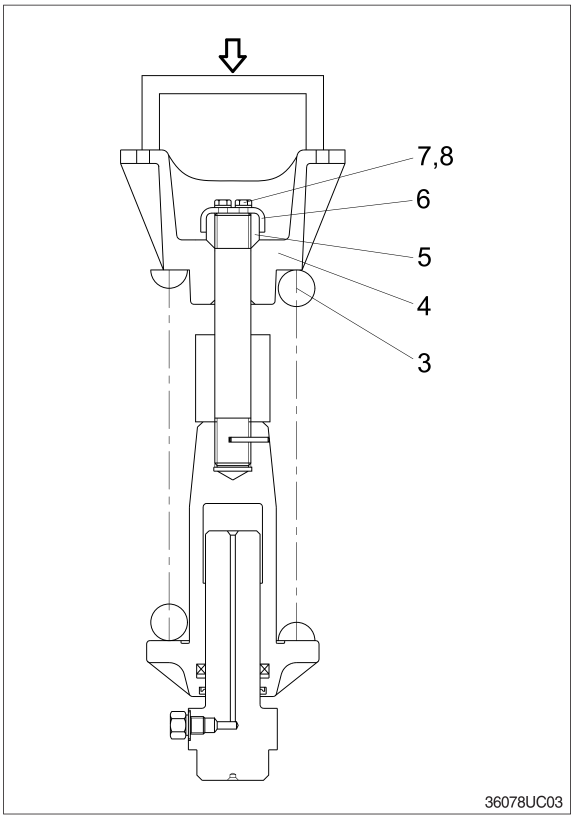
1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Hexagon bolt	12	Rod
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod packing	14	Tube stopper
5	Lock nut	10	Back up ring	15	Spring pin

(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 : 21100 ± 1688 kg
(46517 ± 3721 lb)



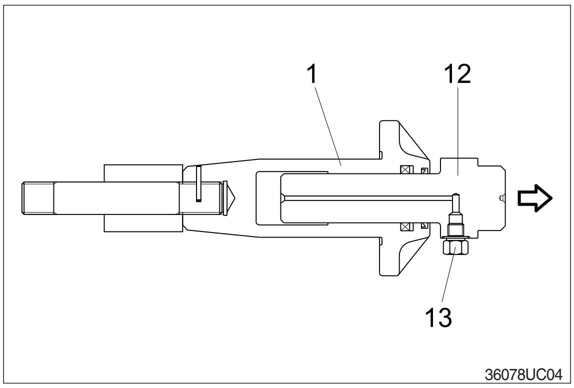
② Remove bolt (7), spring washer (8) and lock plate (6).

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.

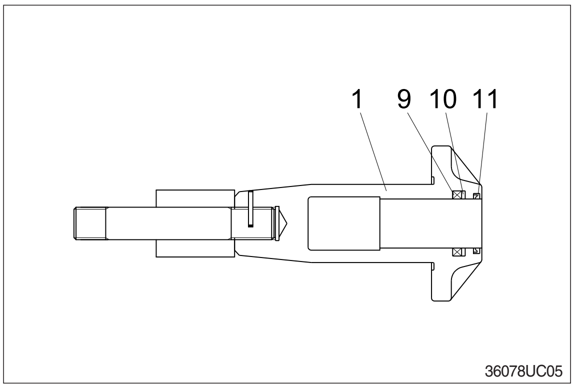
④ Lighten the press load slowly and remove bracket (4) and spring (3).

⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



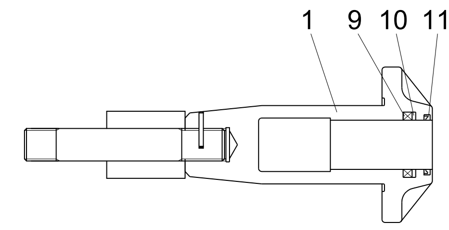
⑦ Remove rod packing (9), back up ring (10) and dust seal (11).



(3) Assembly

① Install dust seal (11), back up ring (10) and rod packing (9) to body (1).

※ When installing dust seal (11) and rod packing (9), take full care so as not to damage the lip.



36078UC05

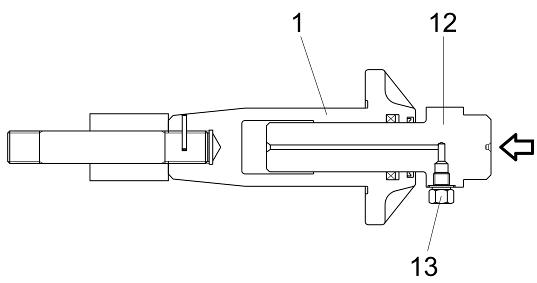
② Pour grease into body (1), then push in rod (12) by hand.

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±1.0 kgf · m (94±7.2 lbf · ft)



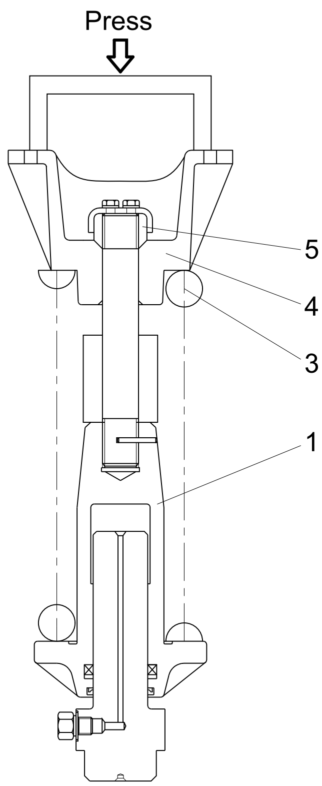
36078UC06

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.

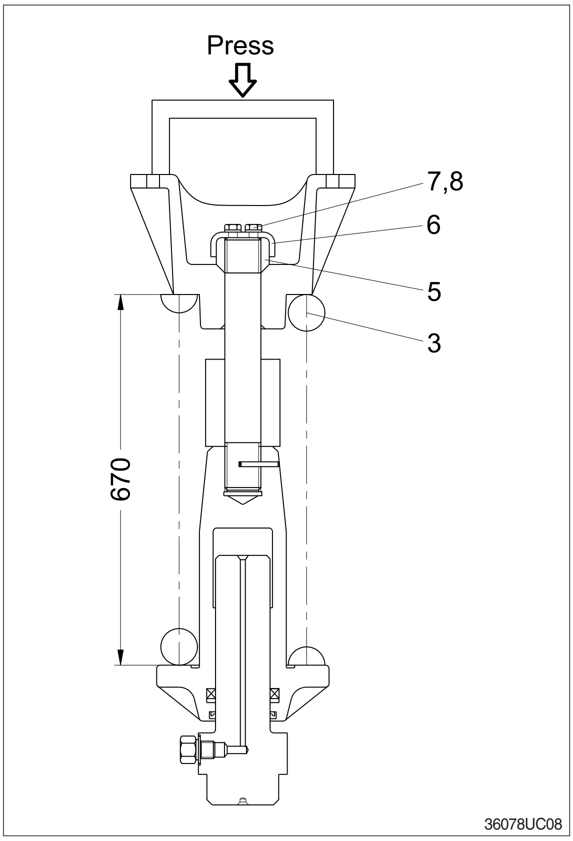
※ During the operation, pay attention specially to prevent the press from slipping out.



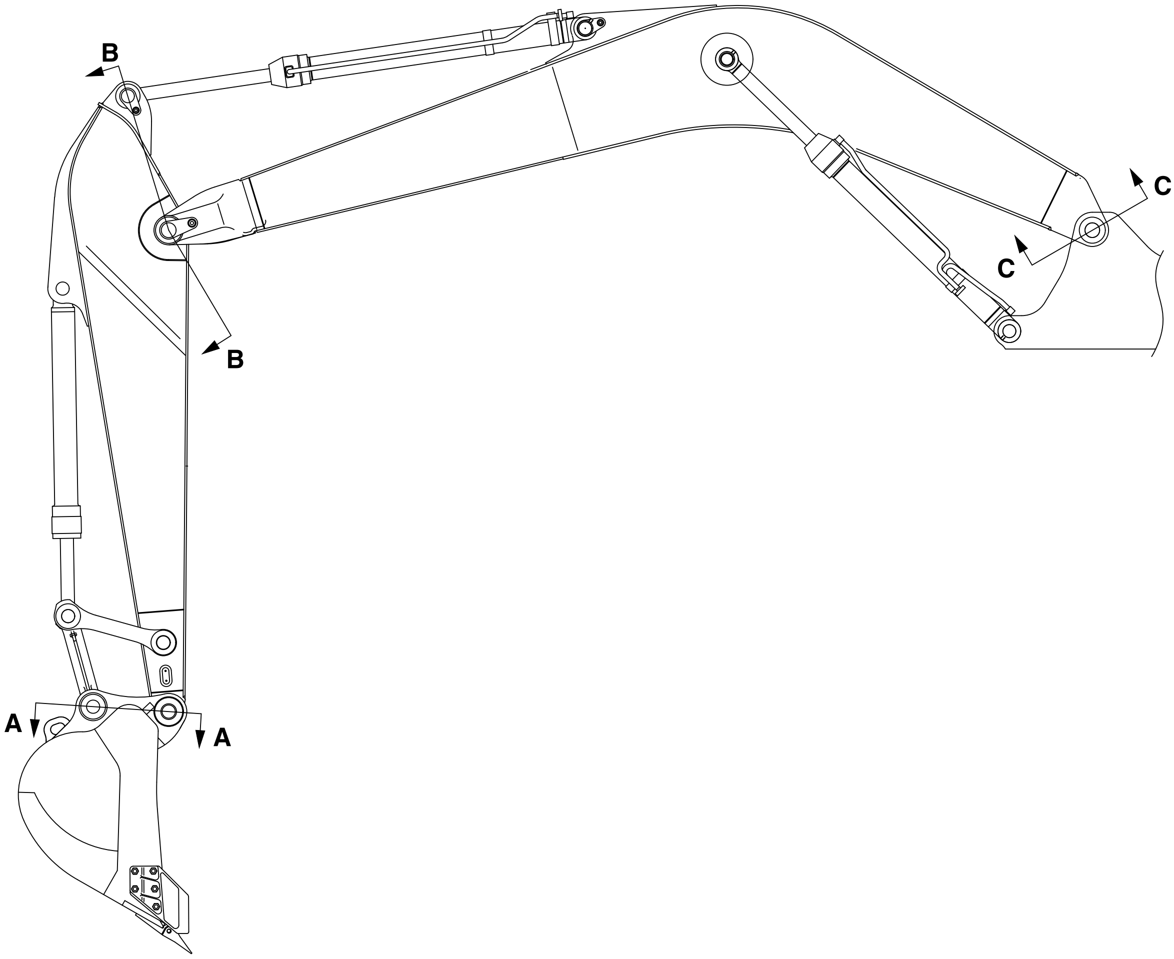
36078UC07

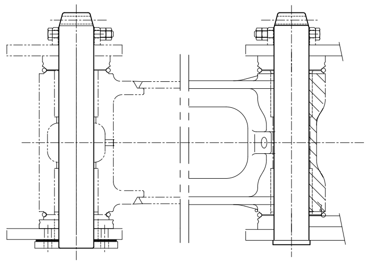
⑥ Lighten the press load and confirm the set length of spring (3).

⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).

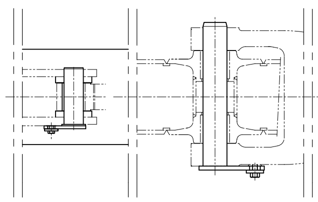


1. STRUCTURE

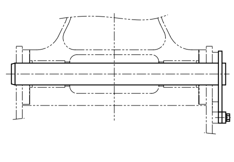




SECTION



SECTION



SECTION C

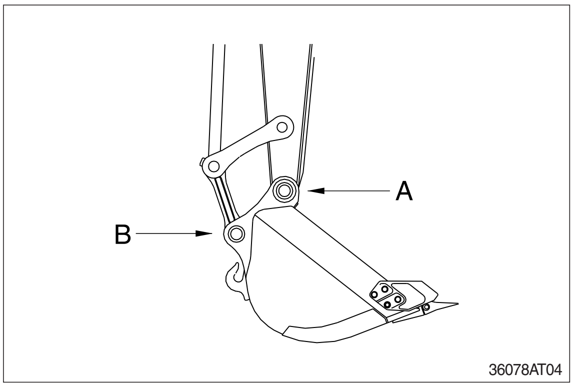
21078DA44

2. REMOVAL AND INSTALL

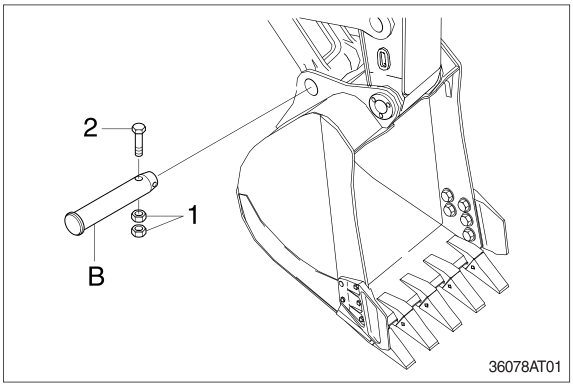
1) BUCKET ASSEMBLY

(1) Removal

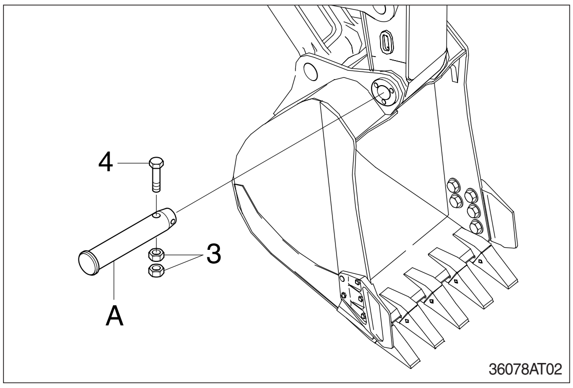
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nuts (1), bolt (2) and draw out the pin (B).



③ Remove nuts (3), bolt (4) and draw out the pin (A).

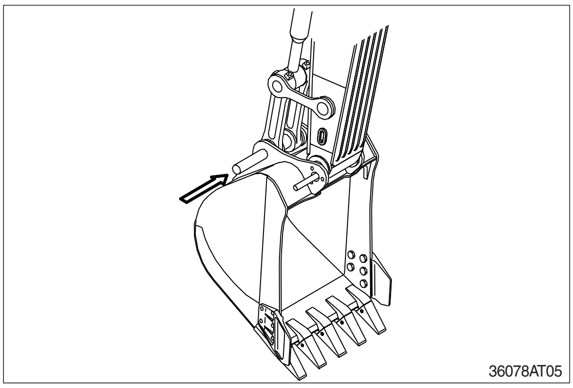


(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Adjust the bucket clearance.
For detail, see operator's manual.



2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**

① Remove bucket assembly.
For details, see removal of bucket assembly.

② Disconnect bucket cylinder hose(1).

⚠ **Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

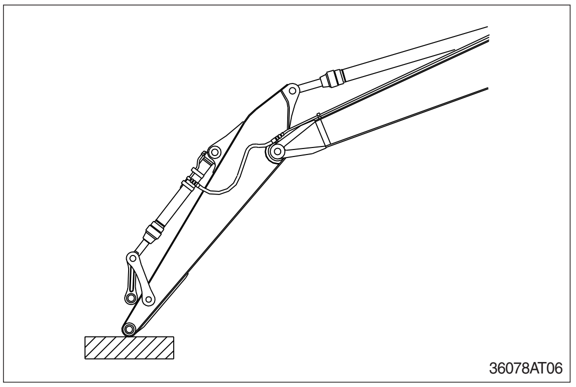
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

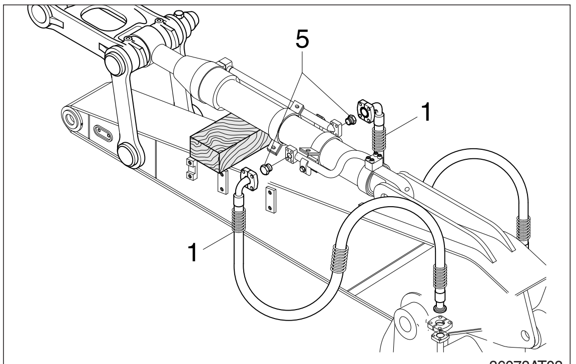
※ Tie the rod with wire to prevent it from coming out.
For details, see removal of arm cylinder assembly.

④ Place a wooden block under the cylinder and bring the cylinder down to it.

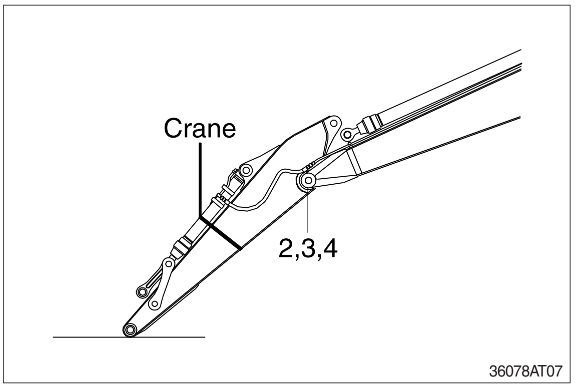
⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.
· Weight : 1243 ㎏(2740 ℔)

※ When lifting the arm assembly, always lift the center of gravity.


36078AT06



36078AT03



36078AT07

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

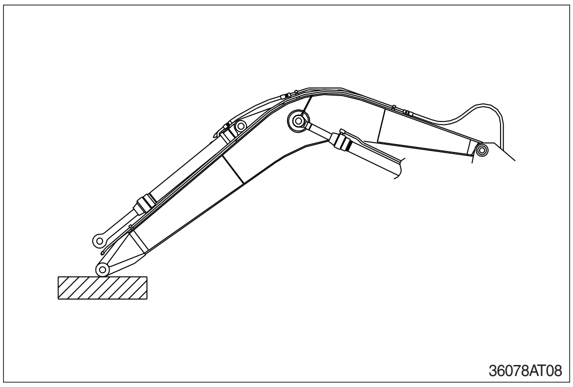
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(1) Removal

① Remove arm and bucket assembly.

② For details, see removal of arm and bucket assembly.
Remove boom cylinder assembly from boom.
For details, see removal of arm cylinder assembly.

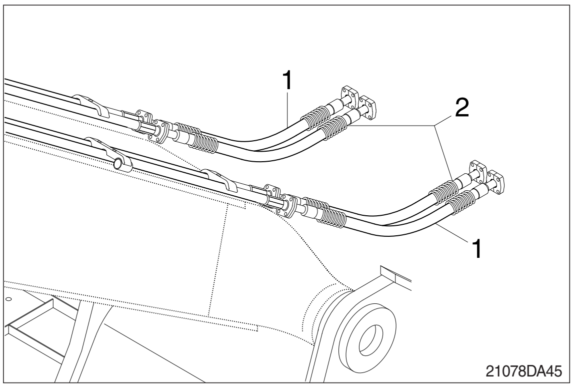


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hoses (2) and arm cylinder hoses (1).

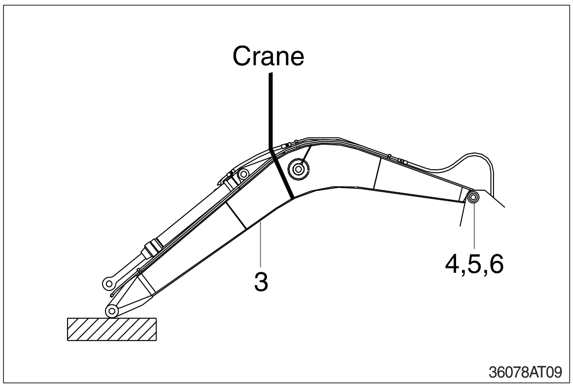
※ When the hoses are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).



⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight : 2600 ㎏ (5730 ℔)

※ When lifting the boom assembly always lift the center of gravity.

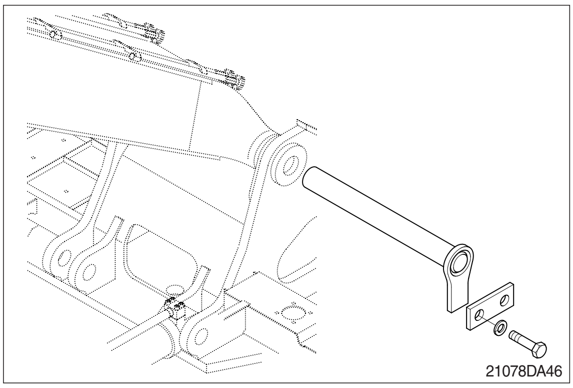


(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.



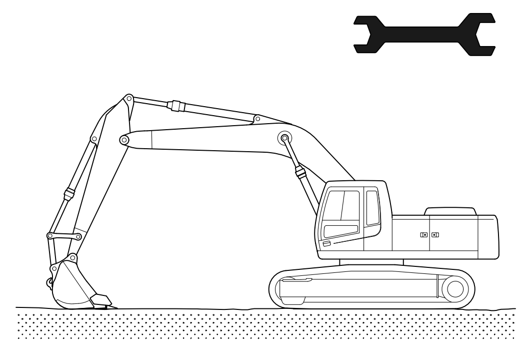
SECTION 9 COMPONENT MOUNTING TORQUE

SECTION 9 COMPONENT MOUNTING TORQUE

GROUP 1 INTRODUCTION GUIDE

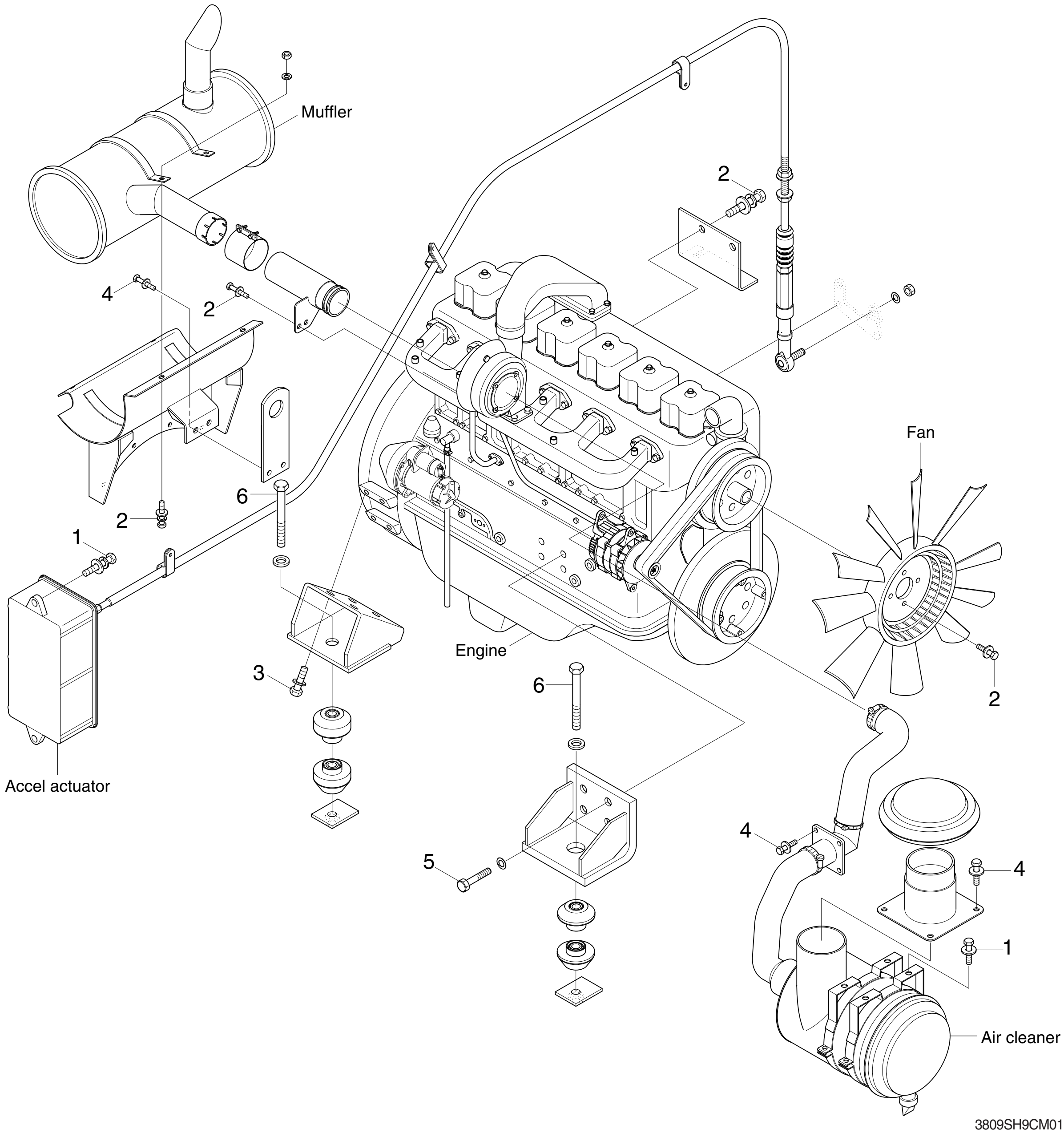
1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
2. Use genuine Hyundai spare parts.
   We expressly point out that Hyundai will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases Hyundai cannot assume liability for any damage.

※ Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.
※ Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.


29079CM00

GROUP 2 ENGINE SYSTEM

ENGINE AND ACCESSORIES MOUNTING

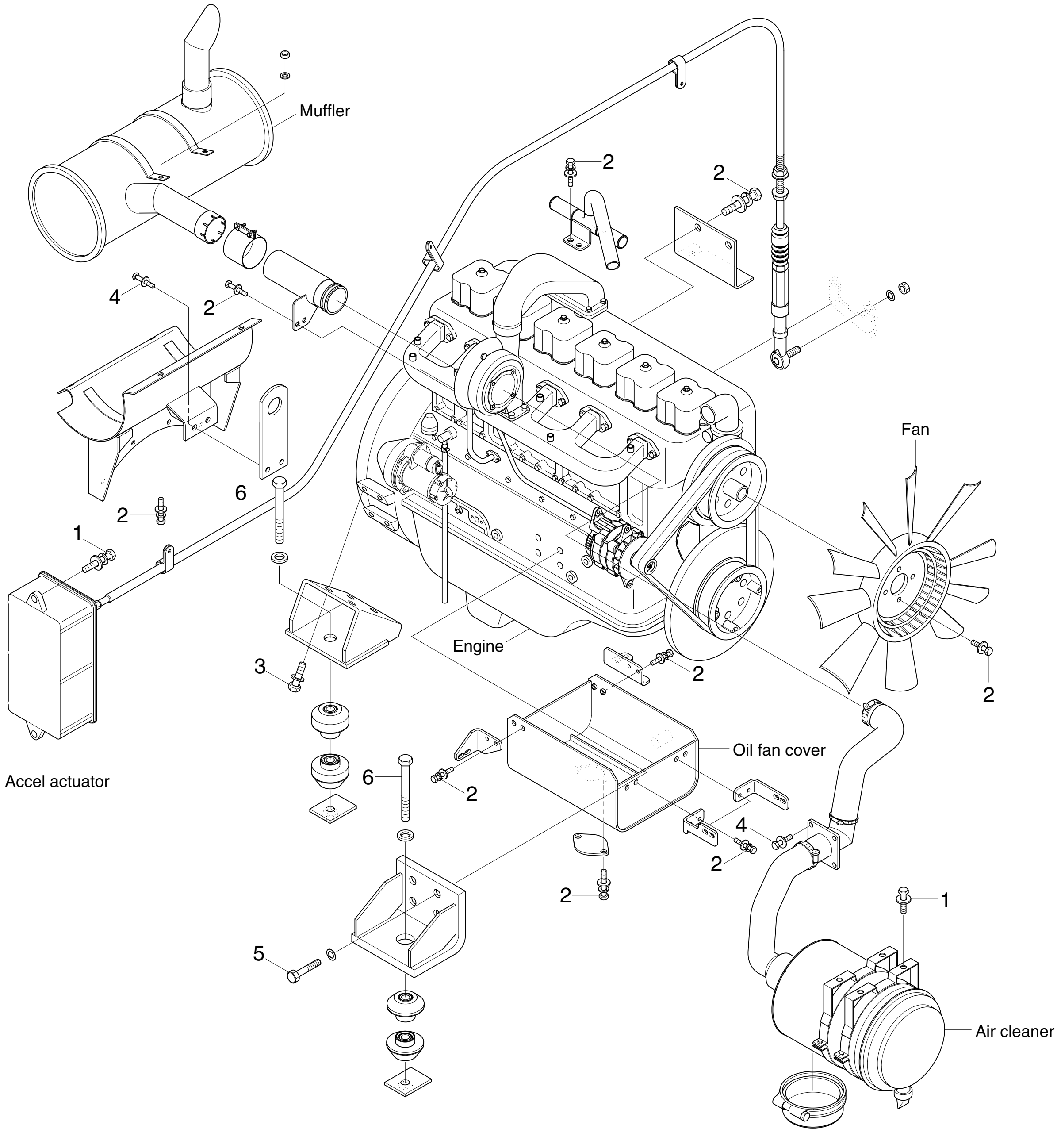


· Tightening torque

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	7.5±1.0	54.2±7.2

Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.8±3.0	92.6±21.7
5	M14×2.0	14.5±2.5	105±18.1
6	M22×2.5	48±2.0	347±14.4

ENGINE AND ACCESSORIES MOUNTING (ARCTIC MACHINE)

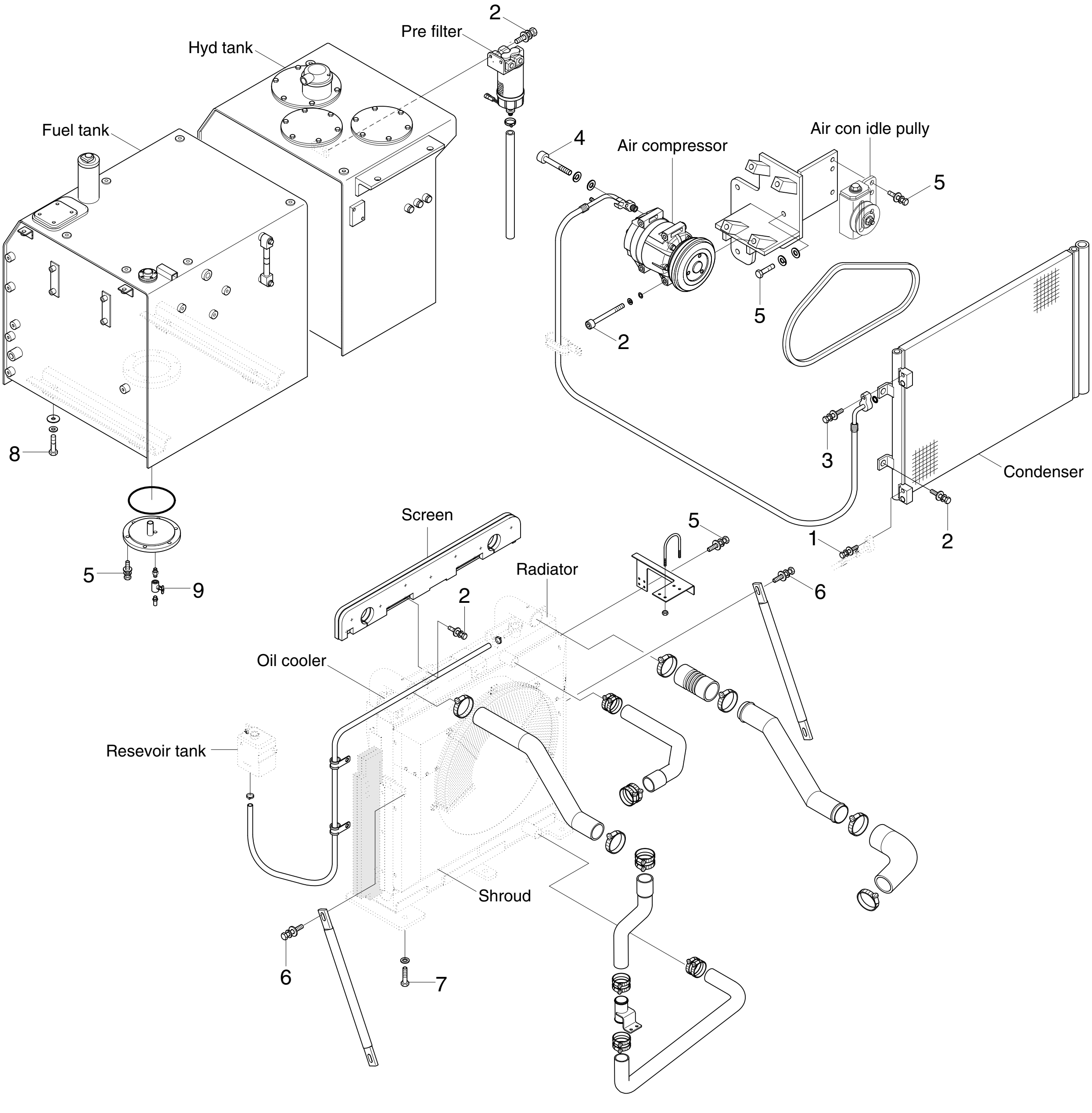


· Tightening torque

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	7.5±1.0	54.2±7.2

Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.8±3.0	92.6±21.7
5	M14×2.0	14.5±2.5	105±18.1
6	M22×2.5	48±2.0	347±14.4

COOLING SYSTEM AND FUEL TANK MOUNTING

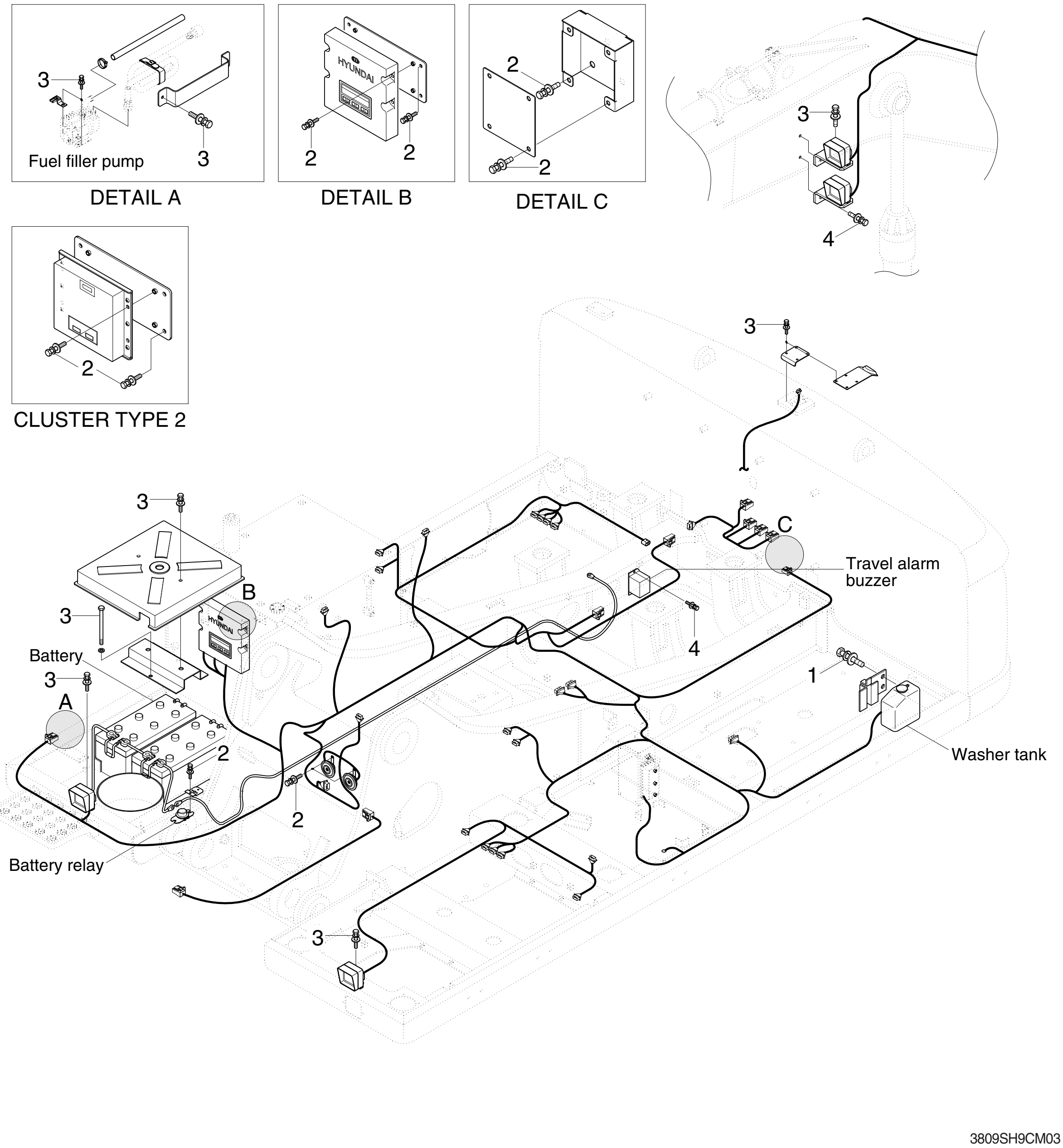


· Tightening torque

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	M10×1.25	5.0±0.2	36.1±1.45
5	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
6	M12×1.75	12.8±3.0	92.6±21.7
7	M16×2.0	29.7±4.5	215±32.5
8	M20×2.5	57.9±8.7	419±62.9
9	-	2.3±0.6	16.6±4.3

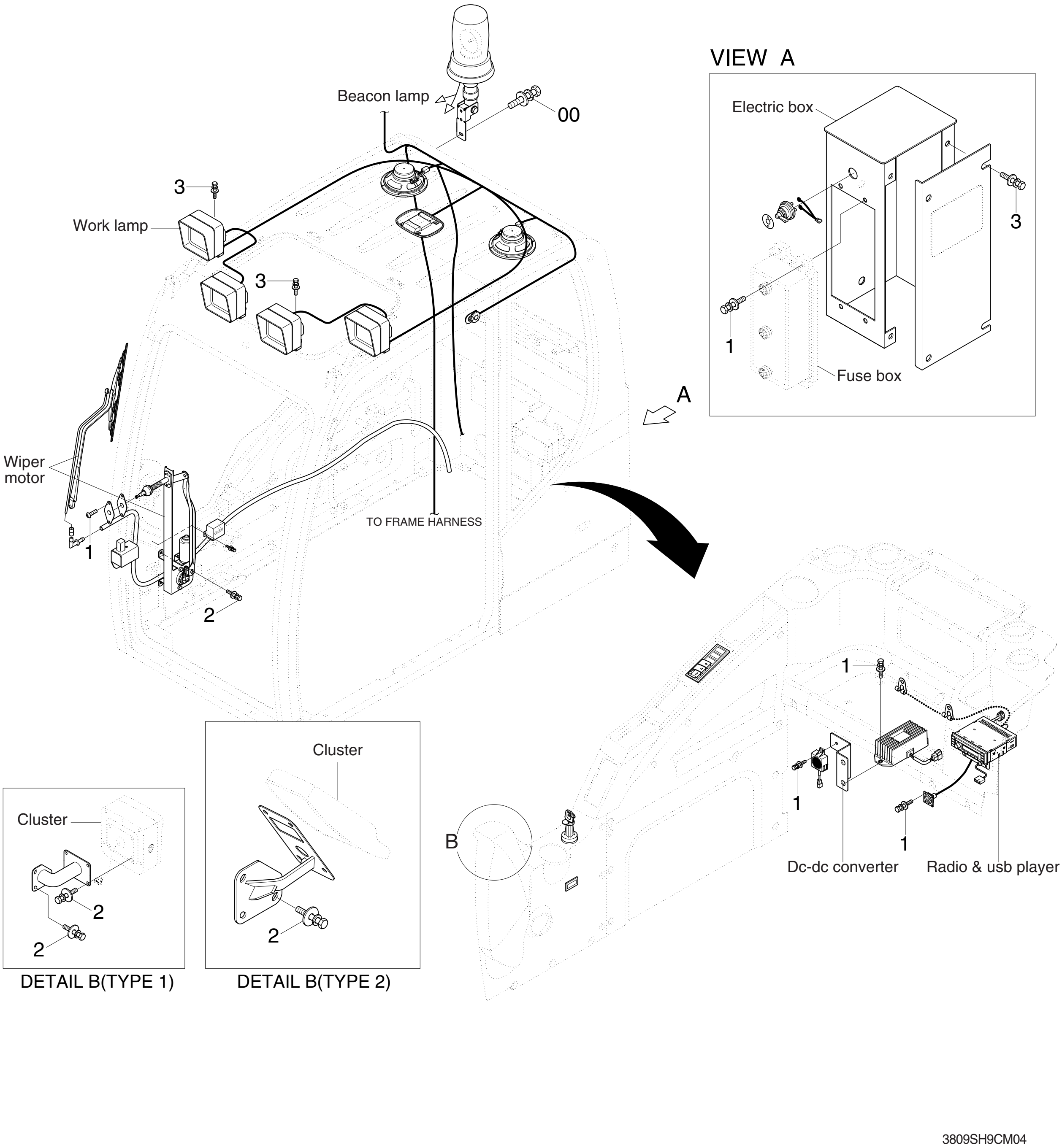
ELECTRIC COMPONENTS MOUNTING 1



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
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

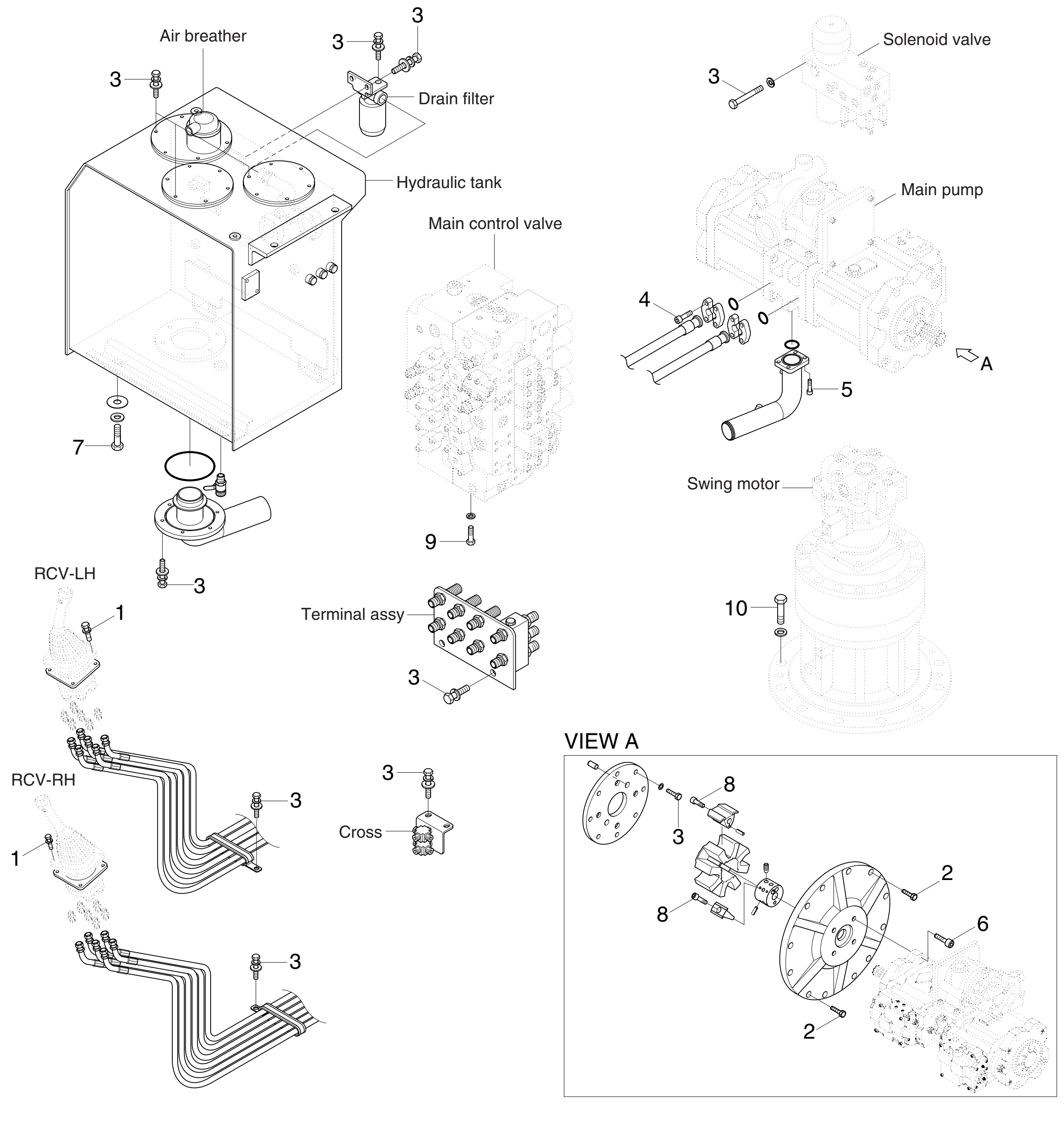


· Tightening torque

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

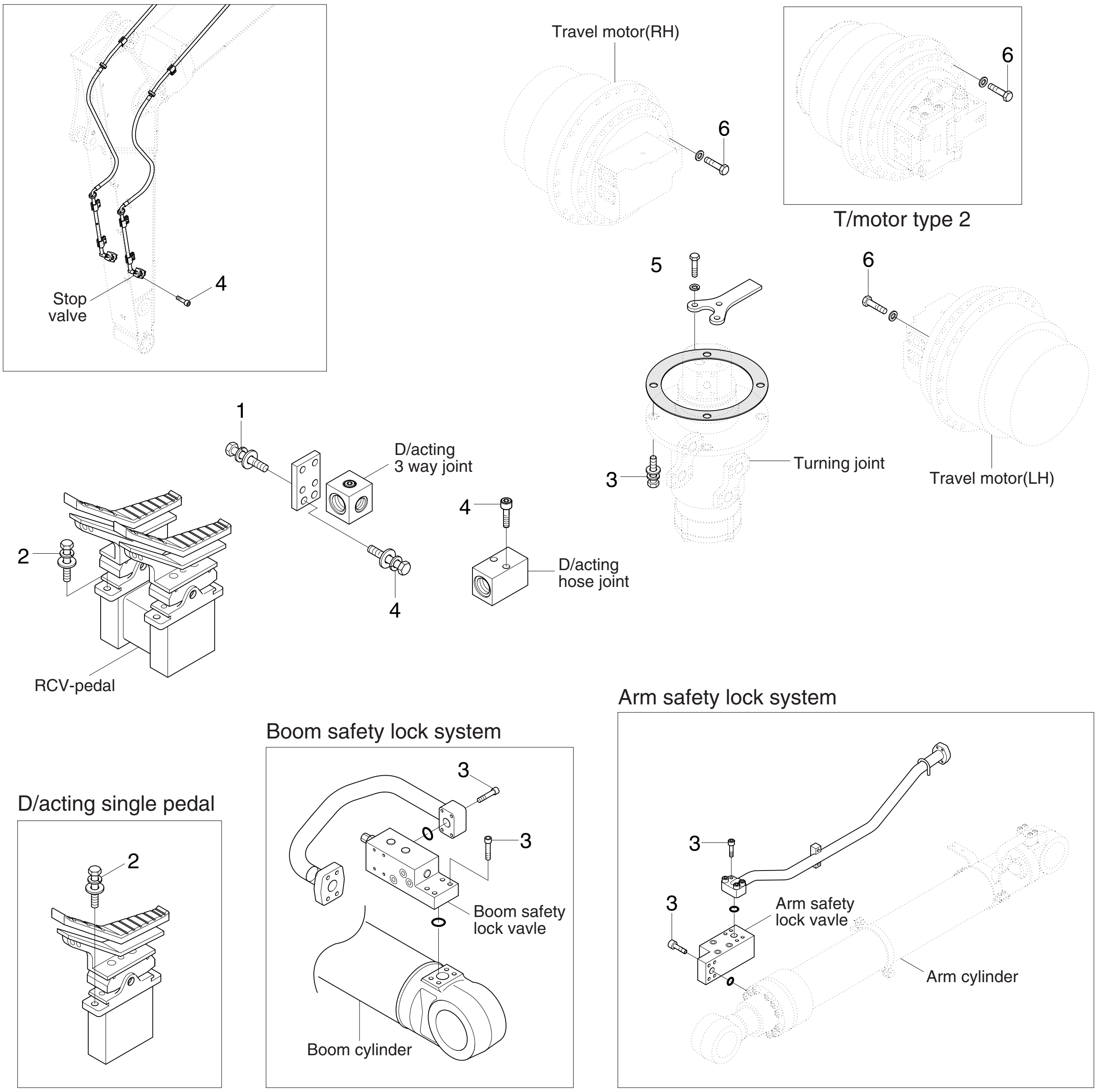


· Tightening torque

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	M16×2.0	29.7±4.5	215±32.5

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
9	M20×2.5	57.9±8.7	419±62.9
10	M24×3.0	97.8±15	707±108

HYDRAULIC COMPONENTS MOUNTING 2

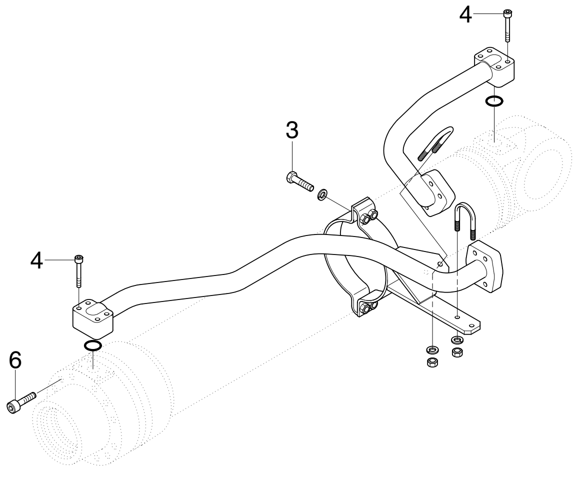


· Tightening torque

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

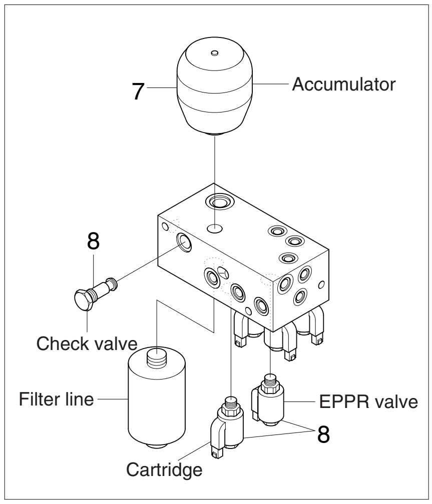
Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.8±3.0	92.6±21.7
5	M14×2.0	19.6±2.9	142±20.9
6	M20×2.0	58±6.0	420±43.4

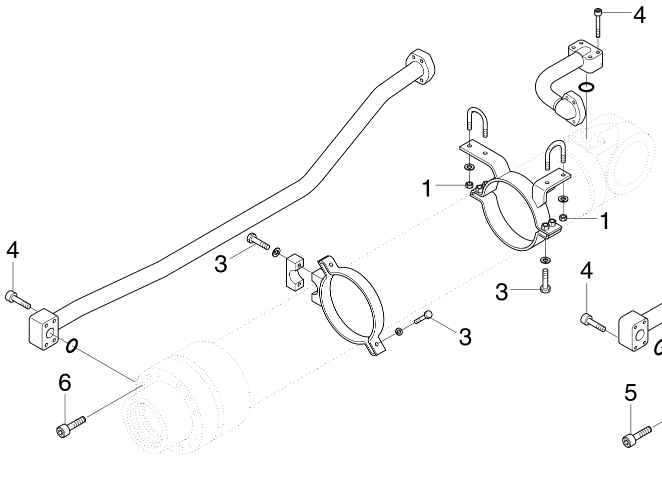
HYDRAULIC COMPONENTS MOUNTING 3



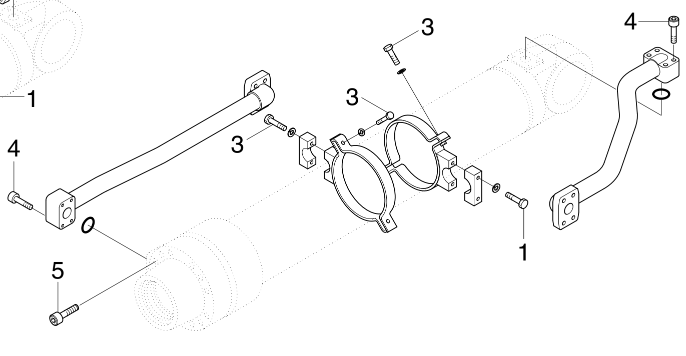
BOOM CYLINDER

Solenoid valve





ARM CYLINDER



BUCKET CYLINDER

3809SH9CM07

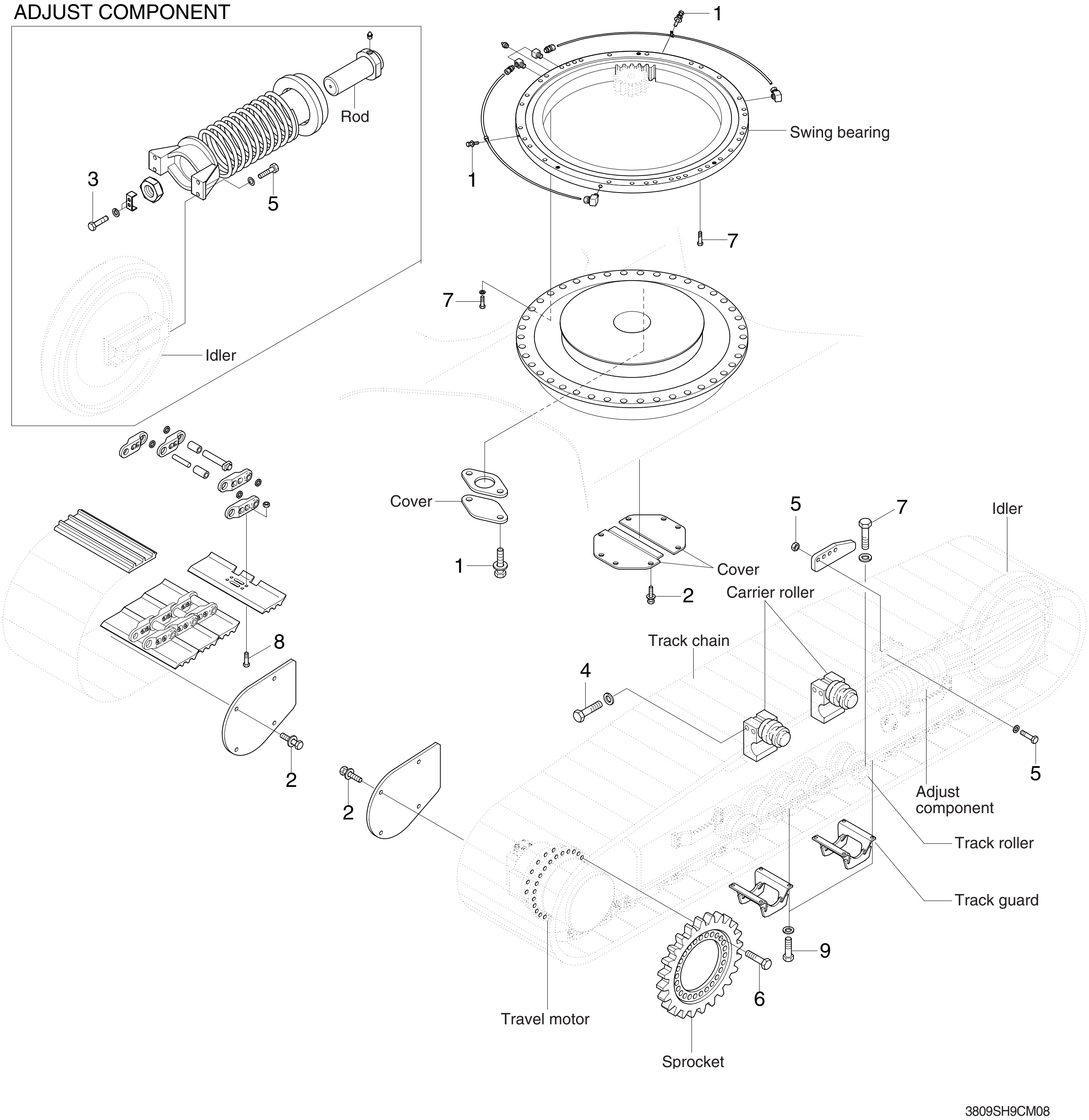
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	3.2±0.3	23.1±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
5	M20×2.5	46±5.0	333±36.2

Item	Size	kgf · m	lbf · ft
6	M22×2.5	63±6.0	456±43.4
7	M22×2.5	4.1	29.6
8	M27×3.0	5.1	36.9
-	-	-	-

GROUP 5 UNDERCARRIAGE

UNDERCARRIAGE MOUNTING



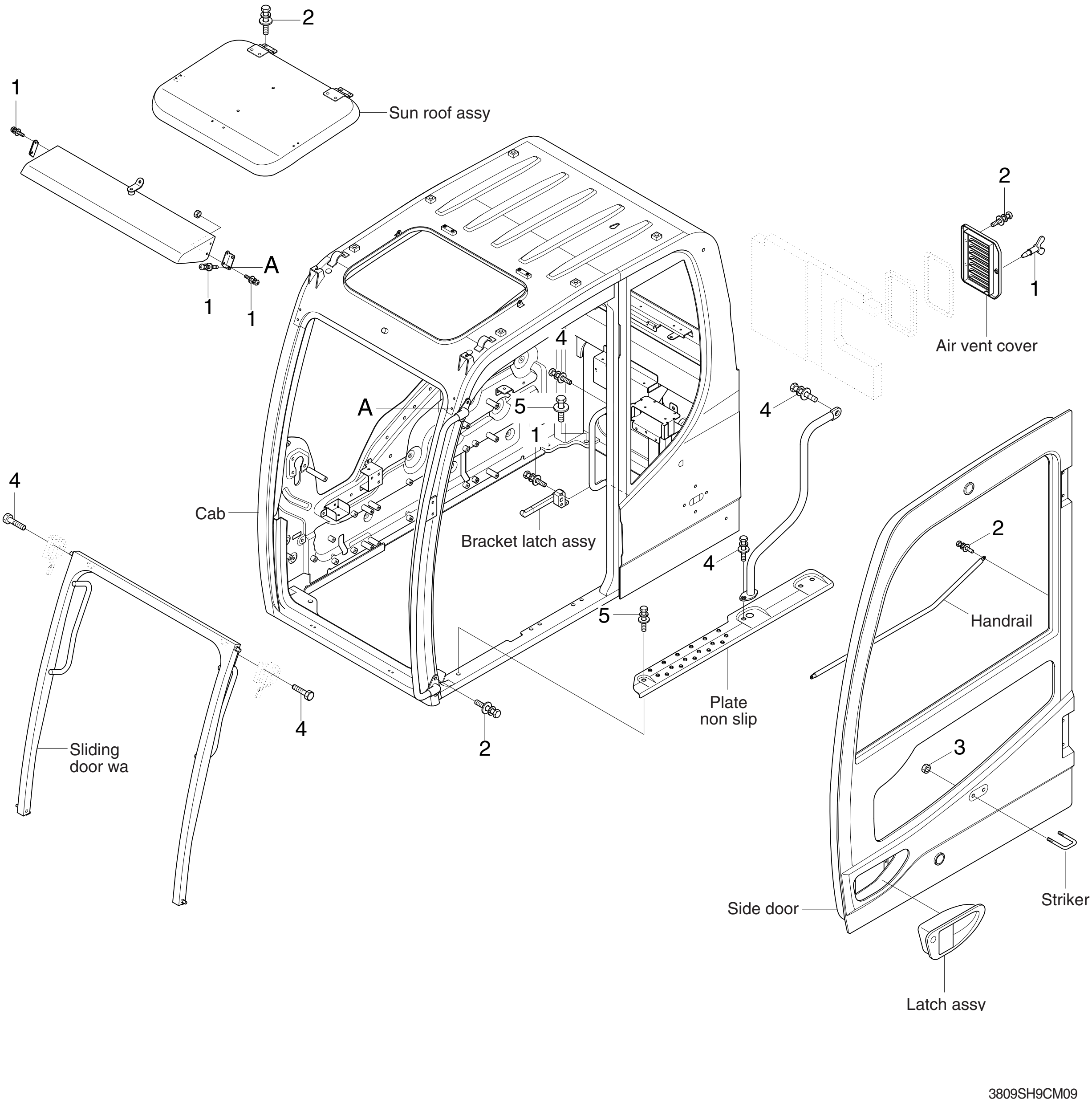
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M12×1.75	15±0.5	108±3.6
4	M16×2.0	29.7±3.0	215±21.7
5	M16×2.0	29.7±4.5	215±32.5

Item	Size	kgf · m	lbf · ft
6	M20×2.5	57.9±6.0	419±43.4
7	M24×3.0	100±10	723±72.3
8	M24×1.5	140±5.0	1010±36.2
9	M24×3.0	77.4±11	560±79.6
-	-	-	-

GROUP 6 STRUCTURE

CAB AND ACCESSORIES MOUNTING

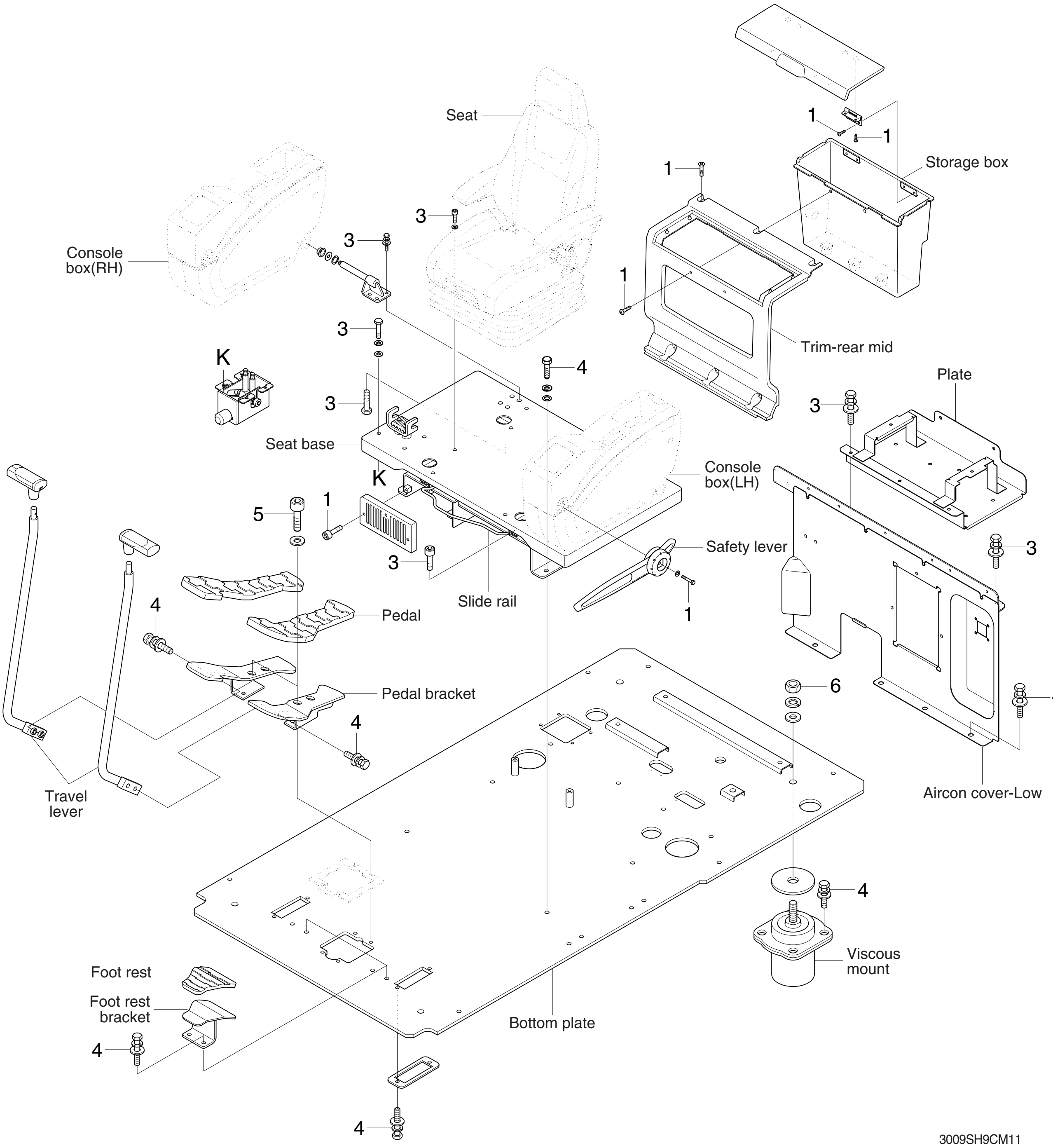


· Tightening torque

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

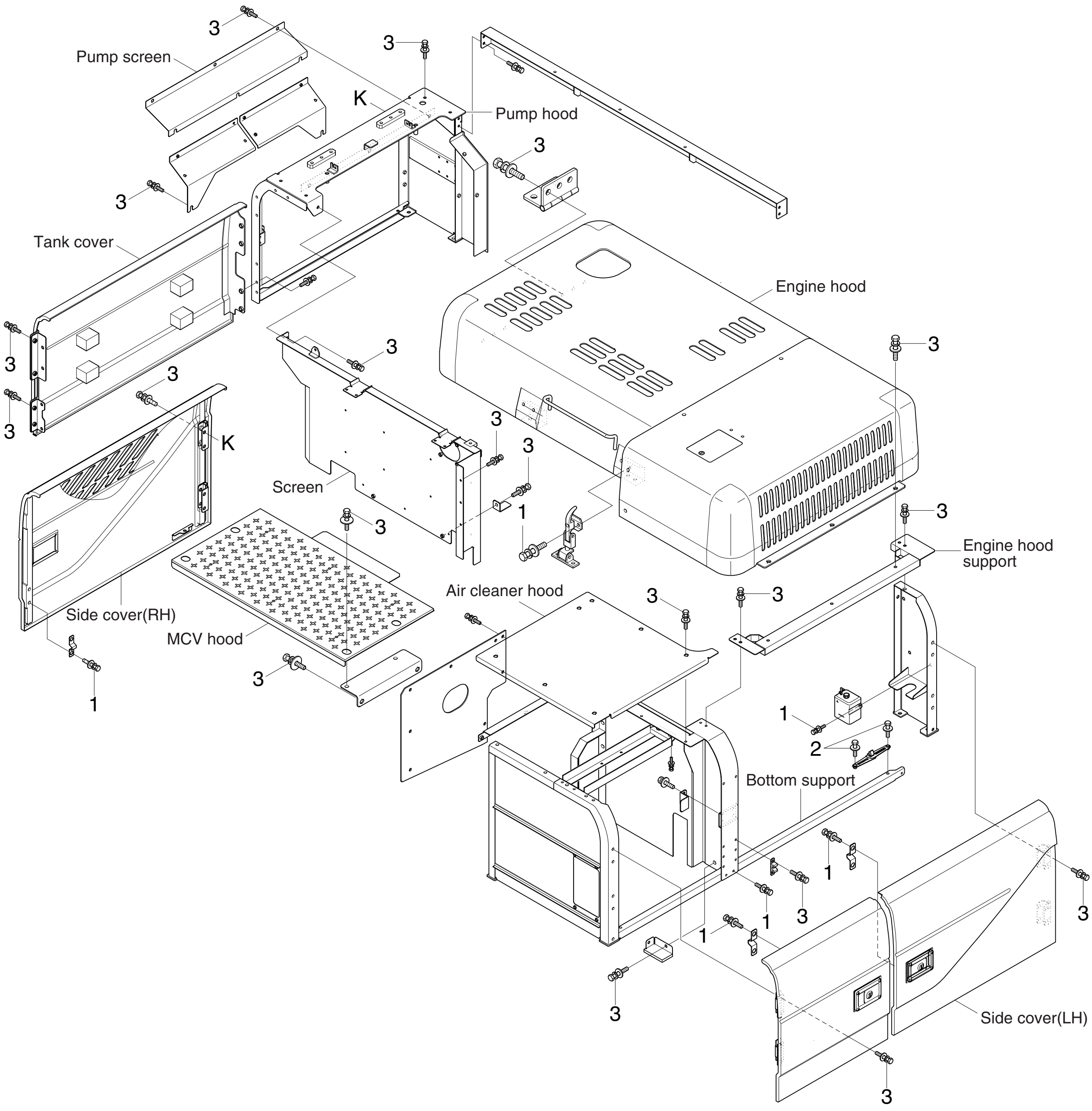


· Tightening torque

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



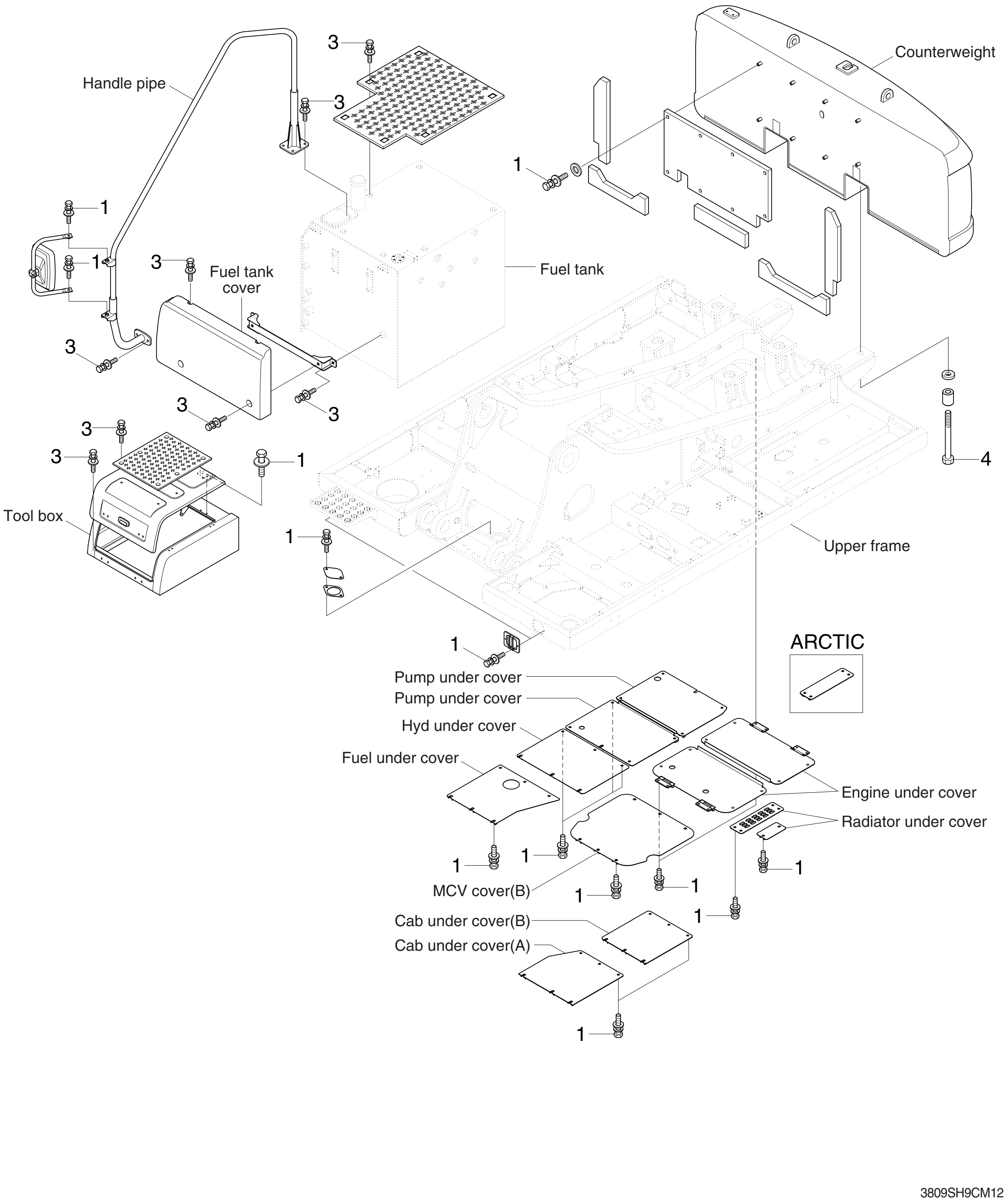
3809SH9CM21

· 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

Item	Size	kgf · m	lbf · ft
3	M12×1.75	12.8±3.0	92.6±21.7
-	-	-	-

COUNTERWEIGHT AND COVERS MOUNTING

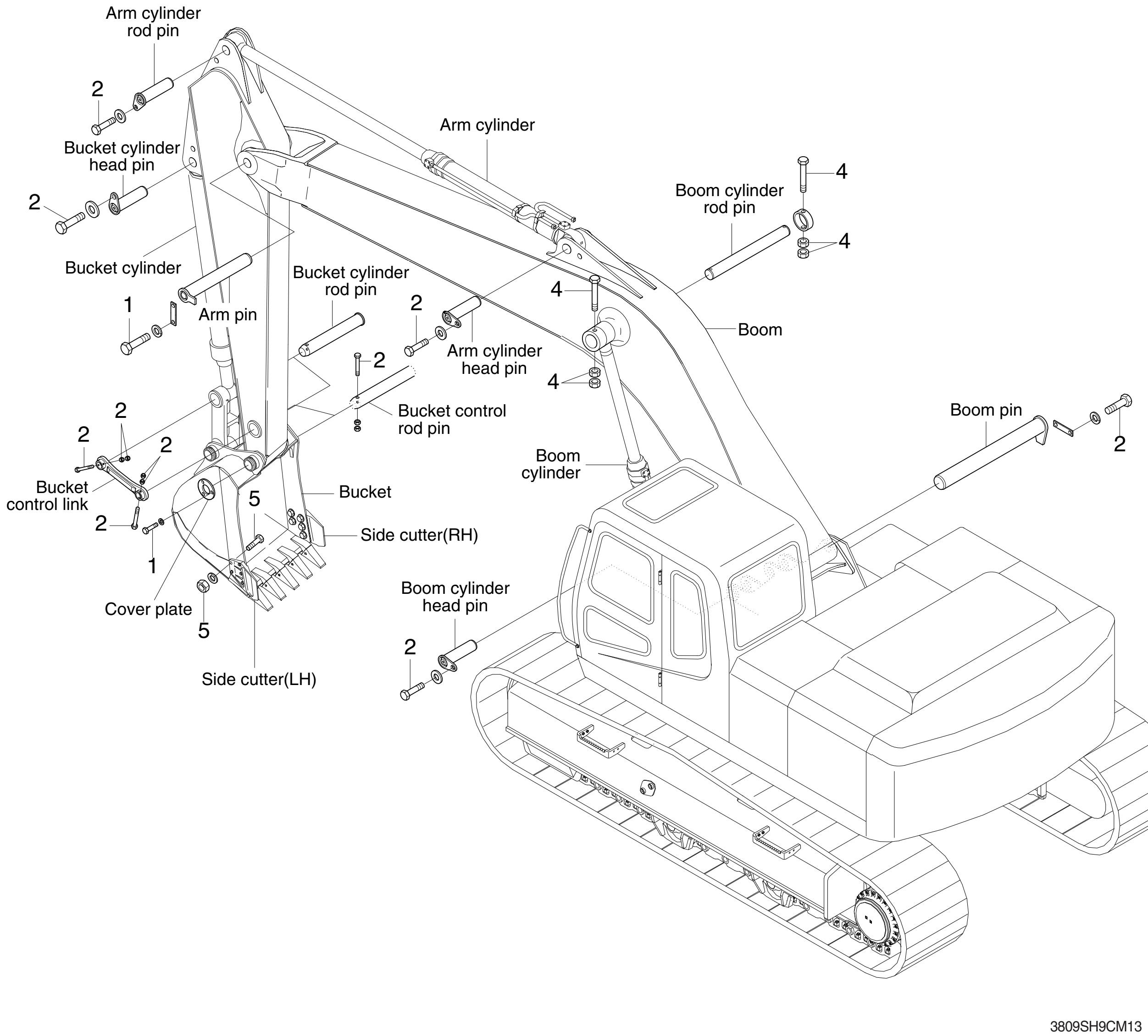


· Tightening torque

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

GROUP 7 WORK EQUIPMENT



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M16×2.0	29.7±4.5	215±32.5
2	M20×2.5	57.9±8.7	419±62.9
3	M22×2.5	81.9±16.1	592±116

Item	Size	kgf · m	lbf · ft
4	M24×3.0	100±15	723±108
5	M30×3.5	199±30	1439±217
-	-	-	-